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Approved Organisation, Leader of Approved Research Program	Approved Research Program	Estimated and Approved Expenditure ($)			Indicative Funding ($)			Total ($)
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Australian Capital Territory

The Australian National University

DP220100050	**Public Interest Advocacy in Australian Policymaking**	35,105.50	87,615.00	104,031.00	51,521.50	0.00	0.00	278,273.00
Halpin, Prof Darren	The project aims to evaluate the impact and effectiveness of public interest advocacy, via the media, in elevating the responsiveness of elected political elites. The project expects to generate new knowledge about how the advocacy and media agendas are set, examine the way elected elites access and ingest news media, and conditions under which advocacy groups access to news changes political priorities. It is expected that the project will provide an evidence base for citizens and policy makers to assess the effectiveness of public interest advocacy, and deliver benefits such as strengthening the quality of Australia's representative democracy, and offer scholars new theories on the role of public interest advocacy on policy priorities.							

National Interest Test Statement

Governing in the public interest is a cornerstone of Australia's representative democracy. It encourages public trust in both government and our democratic institutions. Yet these vital outcomes rely on a well-developed system of genuine public interest advocacy that can convey citizen concerns about policy problems to elected officials who will in turn, act on these. However, the filtering of citizen voices is poorly understood in Australia. This project will produce new knowledge of how public interest advocates identify policy issues, communicate these through the media, and the way that policy makers engage with and respond to them. It will provide the evidence base needed to build the capacities of policy makers and citizens alike on how policy action is translated via the public advocacy system and media. It will also support policy makers to be more responsive to citizen advocacy. This research will illuminate ways in which the media can be made more transparent to citizens and improve the overall quality of our democracy.

DP220100111	**Programmable Organometallics for Spatiotemporal Light Control**	87,000.00	174,000.00	174,000.00	87,000.00	0.00	0.00	522,000.00
Humphrey, Prof Mark G	This Project aims to develop new materials that control and modify light. The new organometallics from this Project are anticipated to display world record light intensity-dependent absorption and other phenomena. These new programmable molecules are expected to respond to environmental stimuli with precise spatial control. Anticipated outcomes of this Project include environmental sensors and a technology platform for targeted medical imaging and light-responsive therapies. This Project should provide significant benefits including possible commercialisation of the new materials, enhanced research capacity, training students and a postdoctoral fellow with unique skills, and the strengthening of research linkages with strategic partners.							

National Interest Test Statement

Replacing electronics with photonics (light-based technologies) will result in enormous improvements in data processing speeds and a myriad of new devices, of crucial importance to a globally connected Australia. However, the uptake of photonics has been slow because of the lack of high-performance materials that can modify the properties of light. The Project will provide these materials, some of which can be used in 3D data storage and micromachining. The Project will also generate a platform technology for the development of materials that can be used in medical diagnosis and targeted therapies, with vastly improved bio-imaging and photodynamic therapy outcomes compared to those from the current modalities. In addition, the Project will provide sensors that will respond to environmental pollutants with exceptional precision. Australia will gain leadership in this technology of the future. The launch of companies to commercialise these products has clear potential for economic benefits, creating jobs and generating a high-quality workforce.

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DP220100173	**Earth's Dynamic Topography Through Space and Time**	101,000.00	183,500.00	102,500.00	20,000.00	0.00	0.00	407,000.00
Davies, Dr Rhodri	A key component of Earth’s topography remains enigmatic. This so-called dynamic topography is transient, varying in response to convection within Earth’s mantle. This project aims to use a data-driven computational approach to: (i) reconstruct the evolution of dynamic topography over the recent geological history of our planet (Cenozoic Era, 0-66 million years ago); and (ii) uncover the mechanisms controlling its spatial and temporal evolution. This transformational new understanding will connect the evolution of our planet's surface environments to its deep interior, revealing the impact of dynamic topography on sea level change, flooding, river networks, groundwater systems, habitat development and the distribution of economic resources.							
	National Interest Test Statement							
	This project will facilitate a quantum leap in our understanding of how processes deep beneath our feet shape the surface of our planet, with implications for continental flooding, river networks and habitat development: as Earth is going into a period of major environmental change, it is imperative to interrogate the geological record effectively to predict how our planet responds to disruptive change far beyond human lifetimes. The project will fundamentally increase our knowledge of the structure and evolution of the Australian continent, with implications for our understanding of the distribution and preservation of natural resources that underpin the Australian economy (e.g., groundwater, some critical minerals). Finally, the project will train researchers and students in multiple disciplines, specifically in connecting a diverse set of datasets to cutting-edge modelling tools. These advanced skillsets represent a distributed knowledge base that is highly sought-after, but seldom taught, helping to fill a void in national expertise, which will be of tremendous societal benefit.							
DP220100211	**Suharto's enablers? Social complicity in the Indonesian killings of 1965-66**	103,245.00	209,794.50	173,622.00	67,072.50	0.00	0.00	553,734.00
Cribb, Prof Robert B	This projects aims to revolutionise understandings of civilian involvement in the most critical and bloody turning point in modern Indonesian history, the 1965-66 killings, and to transform the evidence base for Indonesian history-writing. By accessing critically endangered and never before used survivor community archives, the project will examine the complicity of civilians in the killings and how the violence shaped modern Indonesian national identity and moral consciousness. It will further generate a new, centralised archive of these preserved materials and compile new oral history interviews with the remaining witnesses to these pivotal events.							
	National Interest Test Statement							
	The Australian Government, in its 2020 Defence White Paper, characterises its decision to prioritise ‘engagement and defence relationships in the region’ including with Indonesia—Australia’s closest Asian neighbour— as ‘vital to regional security and stability.’ However, Australia’s current defence relationship with Indonesia is based on only a partial understanding of how the Indonesian Armed Forces has mobilised its citizens to participate in national defence campaigns since the time of the 1965-66 Indonesian genocide. This project seeks to undertake the urgent task of preserving critically endangered survivor accounts from this period, in order to break through Indonesia’s continued official denial of state involvement in the violence. The project will establish the first centralised survivor-centred human rights archive on the 1965-66 Indonesian genocide. The preservation and analysis of this new archive will provide Australia with a solid, evidence-based, foundation upon which to build its defence relationship with Indonesia into the future.							
DP220100289	**Deciphering strategies polar phytoplankton employ to lessen iron limitation**	59,053.00	144,612.00	176,118.00	90,559.00	0.00	0.00	470,342.00
Ellwood, Prof Michael J	The Southern Ocean is of global importance. It comprises one-third of the global ocean by area and disproportionately absorbs two-thirds of anthropogenic ocean heat and half of anthropogenic carbon dioxide (CO_2) emissions even though phytoplankton in this region are chronically iron-limited. This project aims to understand why copper uptake by phytoplankton lessens the effects of iron limitation and how copper substitutes for iron. This knowledge is critical for evaluating the impacts and feedbacks between iron and copper in regulating Southern Ocean productivity and ultimately its ability to drawdown atmospheric CO_2. The results from this project will facilitate the development of improved ecosystem models and conservation tools.							

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	National Interest Test Statement The Southern Ocean covers approximately 4000 km of coastline across southern Australia, thus it exerts significant control on Australia's climate. Understanding the health and vitality of the Southern Ocean ecosystem as ocean temperature rises is important as this region is a large sink for atmospheric carbon dioxide. This project will determine how Southern Ocean phytoplankton respond to chemical changes in their environment and how this manifests at a cellular level. This research addresses Federal Governmental Science and Research Priorities in 'Environmental Change' by helping us to measure and predict the impact of environmental change caused by climate is having on the Southern Ocean. This research will help develop options for responding and adapting to the impacts of environmental change on biological systems. This knowledge is critical for the management of Australia biological resources along its southern shores.							
DP220100800 Li, Prof Hongdong	**Two-way Auslan: Automatic Machine Translation of Australian Sign Language** This project aims to develop an automatic two-way machine-translation system between Auslan (Australian Sign Language) and English by researching and leveraging advanced computer vision and machine learning technology. The project expects to advance research in AI technology on topics including visual recognition, language processing and deep learning. This will boost Australia's national research capacity and global competitiveness. Expected outcomes of this project will help to break the communication barriers between the Deaf and hearing population. This should provide significant benefits to Deaf communities through enhanced communication and improved quality-of-life, leading to a fair, more inclusive and resilient Australian society.	20,000.00	97,500.00	155,000.00	77,500.00	0.00	0.00	350,000.00
	National Interest Test Statement Auslan is the official language used by the Australian Deaf community, and is used uniquely within Australia. This project will develop a two-way (i.e. bi-directional) Auslan and English machine translation system to facilitate natural and easy inter-person communications between the deaf and hearing communities in Australia. The resulting automatic translation system will provide an inclusive education platform for deaf children to learn both Auslan and English, as well as provide deaf adults more social engagement and employment opportunities. This will benefit the public health sector by reducing communication disparities for vulnerable social groups by assisting deaf Australians in their everyday interactions with the proposed two-way Auslan communication tool. This project will help to improve social inclusion, to address social equity, diversity, and to promote a fair, and more resilient Australia Society. This project will also elevate Australia's research capacity and global leadership in AI research and applications.							
DP220100828 Schneider, Dr Larissa	**Long range toxic metal pollution in Australia and the Southern Ocean** This project aims to investigate how environmental change and human activities since industrialisation have impacted toxic metal transport and deposition on the south coast of Australia, Tasmania and Southern Ocean islands. This project expects to fill gaps in understanding of the global mercury cycle using a state-of-the-art multidisciplinary methodology including the role of sea salt aerosols and hemispheric-scale wind patterns . Anticipated outcomes involve a novel palaeo-atmospheric model that can be applied in other parts of the world. This should provide significant benefits, such as science-based evidence to ratify the Minamata Convention on Mercury and guide new regulations to reduce environmental/health risks from metal pollution.	61,836.50	162,510.00	142,760.00	42,086.50	0.00	0.00	409,193.00
	National Interest Test Statement Little is known about how increases in global mercury emissions have affected the Australia-Pacific region, yet mercury is a potent neurotoxin causing serious environmental and health issues. Australia has signed but not ratified the Minamata Convention on Mercury, an international treaty to protect human health and the environment from anthropogenic mercury emissions. This is in part due to a lack of quantitative data. This project seeks to quantify toxic metal sources and contamination in lake sediment records spanning the industrial and pre-industrial era from southern Australia, Tasmania and Southern Ocean islands. The project will deliver new evidence-based knowledge to inform effective measures, allowing better decision-making on metal emission control. Findings will be applicable globally, taking Australia to the forefront of metal contamination research, while benefiting the Australian population by providing the best available scientific knowledge to reduce the environmental, health and economic costs associated with inadequate policies, and evidence needed for ratifying the Minamata Convention.							

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DP220100880	**Governance for Gender Inclusion: Levelling the Field in Australian Sport**	85,194.00	181,905.00	163,148.50	66,437.50	0.00	0.00	496,685.00
Henne, Prof Kathryn E	This project aims to understand why, despite gains in women's sport participation, gender inclusion efforts in Australian sport have not yet led to gender parity in leadership roles or broad accessibility for marginalised groups. It seeks to generate new knowledge about the regulatory mechanisms and social conditions that facilitate change through the development of a new interdisciplinary conceptual framework. Expected outcomes include enhanced analytic guidelines and robust recommendations for governance strategies, which can be applied to study other domains. This should provide significant theoretical and policy benefits by supporting equity in professional settings and health promotion through wider inclusion.							
	National Interest Test Statement							
	The documented social benefits of better health and stronger community relations enabled through sport have served as strong grounds for government-backed initiatives, yet the goal of fully inclusive sport remains elusive. By analysing the successes and struggles of gender inclusion in sport, this project has the potential to contribute social, health and economic benefits to the Australian community. It will provide an important baseline understanding of the limitations of earlier gender inclusion efforts and identify strategies to increase sport participation, particularly among marginalised groups. The project will facilitate the development of new approaches to gender inclusion, contributing positively to rebuilding the post-pandemic sector. Findings will aid health promotion and community-building efforts and will support economic benefits by (1) identifying ways to increase the number of women in professional roles, which are higher-wage opportunities dominated by men; and (2) helping to expand involvement in—and in turn, the value of—the Australian sport sector, which was last valued at $12.8 billion.							
DP220100971	**Body, Language and Socialisation across Cultures**	122,351.50	217,405.00	205,075.00	110,021.50	0.00	0.00	654,853.00
Rumsey, Em/Prof Alan	This project aims to advance the understanding of how people learn languages, and in the process become socialized into particular cultures and communities. To that end, it will bring together an international team of leading experts in the field, and focus in new ways on the interplay of speech and sign with other bodily forms of communication in a wide variety of cultures. Expected outcomes include improved understanding of multimodal communication and language socialization, and enhancement of Australian research capacity in these fields. This should lead to significant practical benefits, improving Australia's ability to adapt to cultural diversity and to counteract its disadvantages in schools and everyday life.							
	National Interest Test Statement							
	Australia prides itself on being a multicultural nation, where everyone gets a fair go. But many Australians including children continue to be disadvantaged by their diverse cultural backgrounds, and communication problems that result from them. Language difference plays a part in this, but so does a less widely recognized factor: bodily forms of communication other than speech, such as gesture, gaze and touch, which vary widely across cultures, and shape people's learning experiences. If we could understand how these communicative modalities are differently combined and deployed in social interaction, we would have a framework for understanding and accommodating cultural differences. No such framework currently exists. We will develop one through systematic cross-cultural investigation of children's multimodal language socialisation, involving collaboration with world-leading experts in the field. This will advance the scientific understanding of that process, with practical applications for accommodating cultural diversity and overcoming its disadvantages in Australian schools and everyday life.							
DP220101318	**Physical Layer Security for Wireless Machine-Type Communications**	76,500.00	156,500.00	160,000.00	80,000.00	0.00	0.00	473,000.00
Zhou, A/Prof Xiangyun	This project aims to provide new understanding and design guidelines to secure wireless communications among low-cost resource-constrained devices. This is achieved by advancing the fundamental theory of an emerging security paradigm named physical layer security. Expected outcomes of this project include a communication-theoretic framework to characterise the secrecy performance of communications over wireless networks, followed by novel signal processing and transmission designs. The research outcomes should provide innovative solutions to safeguard commercial and industry Internet of Things networks, benefiting Australia's digital transformation.							

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	National Interest Test Statement							
	With the recent advancement in communications technology and network infrastructure in Australia, hundreds of millions of wireless devices can now be deployed in major cities and regional areas to realise numerous Internet of Things (IoT) applications. These IoT applications are expected to generate a total economic benefit of 200 to 300 billion dollars per annum in Australia. But, such an expectation will be far out of reach if Australian people and businesses do not have the confidence to embrace such a technology due to security concerns. In fact, the communication security of wireless IoT devices is often easy to be compromised, because their limited battery capacity, memory storage and computing power do not support the operations of many current security solutions. This project addresses this challenge by providing novel design guidelines for a new technological approach, named physical layer security. It is a low-complexity solution, which is well suited for adoption by wireless IoT devices to guarantee highly secure communications, benefiting Australia's digital transformation.							
DP220101352 Eyras, Prof Eduardo	**How novel ribosomal RNA gene repeat variants drive cellular function** The hundreds of ribosomal RNA gene repeat copies are a remarkable part of our genomes, as they encode the machinery responsible for all cellular protein synthesis and shape the structure of the nucleus. However, due to their high degree of sequence similarity, they still have not been assembled into the human genome reference. This project will resolve this impasse and furthermore uncover the functional impacts of a newly identified molecular diversity in the ribosomal RNA gene repeats. Outcomes include new paradigms for how the ribosomal RNA gene repeats drive protein synthesis and genome structure, and a blueprint to develop novel genomics applications for human health, biotechnology, and agriculture.	109,867.50	214,860.00	209,110.00	104,117.50	0.00	0.00	637,955.00
	National Interest Test Statement							
	The human genome reference remains incomplete. It is missing a remarkable array of repeats that play fundamental dual roles in the cell. These repeats drive protein synthesis and shape the structure of the cell nucleus. The current inability to distinguish individual repeats limits our understanding of major physiological processes, including development, stress response, and ageing. This project will characterise a newly identified diversity of these repeats to complete the human genome reference and to determine how this diversity impacts cellular function. These discoveries will improve our understanding of the mechanisms underpinning fundamental processes in health and disease, and will enable the application of genome editing approaches to modulate these processes. This project will generate a skilled workforce in new genomics technologies and will unlock new knowledge applicable to species of economic importance in Australia’s agriculture and their pathogens. These outputs can drive commercial development and invigorate the fields of genomics and biotechnology in Australia.							
DP220101388 Wen, Dr Jiayu	**RNA-binding proteins rewire transcriptomes in immune cell differentiation** This project aims to combine advanced computational and experimental techniques to investigate a new layer of gene regulation by novel RNA binding proteins (RBP) which control messenger RNA length in immune cells. This project expects to demonstrate that these RBPs have a profound effect on immune cell differentiation and response to infection. Expected outcomes include the discovery of new RBPs regulating immunity, with mechanism and function determined by novel CRISPR editing of a transgenic mouse model. The significant benefit will be a more complete understanding of RNA mechanisms of immune response, which will be critical in informing future advances in the rapidly developing areas of RNA-based biotechnologies and synthetic immunology.	76,000.00	156,000.00	161,000.00	81,000.00	0.00	0.00	474,000.00
	National Interest Test Statement							
	Harnessing the full potential of rapidly advancing RNA-based biotechnologies and synthetic biology, as most recently demonstrated by RNA-based Covid-19 vaccines, requires precise understanding of RNA-based gene regulatory mechanisms. This project will investigate a new layer of gene regulation by RNA binding proteins (RBP) which control alternate messenger RNA lengths in immune cells. We hypothesise that these RBPs will have a profound effect on immune cell differentiation and response to infection. We will develop advanced computational methods to discover these RBP targets genome-wide, and experimentally investigate their mechanism of action. Understanding these new mechanisms is a prerequisite to their future exploitation as targets for RNA-based biotechnologies and synthetic immunology, mRNA therapeutics, and gene therapy, with broad economic implications in agriculture and health. This project will contribute to Australia's traditional research strengths in RNA biology and immunology, and provide long-term benefits in the education of young scientists in these areas and advanced computational biology.							

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DP220101542	**An Empirical Study of Agenda Setting in the High Court of Australia**	105,116.50	184,365.50	150,311.00	71,062.00	0.00	0.00	510,855.00
Robinson, Prof Zoe R	This project aims to undertake the first comprehensive study of institutional and individual factors that facilitate and constrain access to judicial power via the High Court's agenda setting process, special leave. Using quantitative methods, the project expects to generate new and advanced knowledge about the High Court's role as the gatekeeper of judicial power. Expected outcomes include foundational knowledge on the nature and scope of access to judicial power in Australia via policy reports, scholarly articles and datasets. This should provide significant benefits such as important insights on the impact and influence of justices, litigants, lawyers, and governments on High Court's decisions to grant or deny special leave to appeal.							
	National Interest Test Statement							
	The High Court of Australia is a key policymaker in national and subnational politics in Australia. Yet we know very little about what drives decision making in the discretionary process ('special leave') by which the High Court selects the subset of cases it will decide from the multitude of applications it receives. This project provides a comprehensive study of the High Court's agenda setting process by mounting the first large-scale empirical study of all applications for special leave between 1986 and 2020. The project will identify the impact of justices, litigants, and lawyers on the Court's decision to grant or deny special leave, in order to address key barriers to accessing judicial power in Australia and direct effective measures and strategies to overcome entrenched inequalities in the Australian judicial system. The project will benefit policymakers, litigants, and the Australian community by highlighting systemic barriers to accessing judicial power in Australia, while providing clear guidelines for strategic decision-making to maximise equality of access to the High Court for all Australians.							
DP220101558	**Magnetic fields and atomic gas flows in the Milky Way and Magellanic Clouds**	85,000.00	160,000.00	145,000.00	70,000.00	0.00	0.00	460,000.00
McClure-Griffiths, Prof Naomi M	This project aims to understand how gas and magnetic fields interact to set the fate of galaxies. Magnetism, alongside gravity, is one of the most influential forces in determining the structure and evolution of the Universe, and yet one of the least understood. Using Australia's newest astronomy investment, the Australian Square Kilometre Array Pathfinder, this project hopes to reveal the linkage of magnetism and atomic gas flows in our own Milky Way and between its galactic neighbours, the Magellanic Clouds. The expected outcomes of this project include the delivery of one of the Australian Square Kilometre Array Pathfinder key science projects, improved understanding of how galaxies evolve and training students in scientific skills.							
	National Interest Test Statement							
	For nearly 70 years Australia has led the world in radio astronomy research with outstanding radio technology and radio quiet spaces. Through investments in radio astronomy infrastructure of nearly $300 million over the last 15 years, Australia has secured the co-hosting of the world's next great radio telescope, the Square Kilometre Array (SKA). With the SKA Australia will maintain its world leadership in radio astronomy throughout the next decades. In this Discovery Project we will use the new Australian SKA Pathfinder telescope, and capitalise on our natural advantage through the Southern hemisphere view of our own Galaxy and nearest galactic neighbours to reveal how galaxies work. We will set the foundations for new scientific ventures and international leadership with the SKA. This Discovery Project will add benefit to Australia's infrastructure investment in radio astronomy by investing in jobs and the development of knowledge to ensure that we not only host the SKA, but also lead many of its future scientific insights.							
DP220101584	**Reconceiving Engagement with International Law in a Populist Era**	26,850.00	115,850.00	178,500.00	170,500.00	104,500.00	23,500.00	619,700.00
Farrall, Prof Jeremy M	This project seeks to address the fundamental problem of how to reconceive engagement by states with the international legal order, in the face of a sustained populist backlash. It proposes to develop a new analytical framework to evaluate the origins and impact of populist concerns about international law. Expected outcomes include detailed empirical studies of the extent to which countries with populist leaders have disengaged from the international legal order, and evidence-based recommendations to increase committed engagement by states with that order. Anticipated benefits include expanding national research and policy capacity in reinforcing the rules and institutions that support Australia's security and prosperity.							

* Note - Indicative funding for approved projects will be made available through a funding variation under section 54 of the ARC Act

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	National Interest Test Statement							
	As a trade-dependent regional power with global interests, Australia gains national benefit from an effective rules-based international order. This project contributes to this benefit by diagnosing how rising domestic populism in key trade partner states affects their engagement in the international institutions that manage global threats to peace, trade, public health and human rights. The project will identify steps Australia can take to promote more committed state engagement with these institutions, contributing economic, social and cultural benefits in three ways. First, a peaceful international order that promotes human rights boosts Australia's security, decreasing conflict and migratory pressure, while advancing Australian freedoms. Second, a robust, rules-based trade system is vital to secure trade certainty, thus delivering economic benefits to the Australian community. Third, the project contributes economic and social benefits by strengthening collective responses to global public health threats, thereby decreasing the vulnerability of Australia and international communities to future pandemics.							
DP220101882	**A step change in modeling leaf respiration-photosynthesis relationships**	94,137.00	181,541.50	171,469.50	84,065.00	0.00	0.00	531,213.00
Atkin, Prof Owen K	This project aims to use innovative, high-throughput technologies to develop a novel framework that links daytime photosynthesis and starch/amino acid mobilisation to variations in night-time leaf respiration. Variations in leaf respiration can have large impacts on ecosystem functioning and the Earth's climate. Although advances have been made in respiration modelling, current models are unable to predict dynamic, day-to-day variations in respiratory rates. Expected outcomes include equations that predict daily variations in night-time leaf respiration for environments across Australia and overseas. Benefits to planners include the ability to more accurately model vegetation-atmosphere carbon exchange and future changes in climate.							
	National Interest Test Statement							
	Across Australia, plant growth is crucial for the functioning of our natural ecosystems and productivity of our agricultural sector. To aid socio-environmental-economic planning, it is vital that we develop models that can predict how future changes in climate affect plant growth across Australia. While we have a range of tools to model photosynthesis – a key part of plant growth – our ability to model plant respiration remains limited. This is a problem, as half of the carbon taken up by photosynthesis each day is respired back into the atmosphere. The proposed research will use recent advances in robotics and sensors to develop new, large datasets – combined with a conceptual framework that links the mobilization of starch and amino acids to leaf respiration – to improve modelling of day-to-day variations in respiration. In doing so, the research will provide new ways for modellers to predict how future changes in Australia's climate will affect the growth of plants in some of our most iconic ecosystems, ranging from the dry regions of inland Australia to the wet ecosystems of Queensland and Tasmania.							
DP220102071	**The impact of COVID-19 economic stimulus measures on corporate stakeholders**	32,438.00	64,876.00	64,876.00	32,438.00	0.00	0.00	194,628.00
Berndt, Prof Antje	Australia's economic response to COVID-19 saw cash injections to companies and bailouts of some insolvent firms. This project aims to quantify the market value of these government subsidies and how it was shared across corporate stakeholders. The project expects to generate new knowledge for the design of financial stability regimes by developing the world-first dynamic structural model of firm assets that allows for government interventions both prior to and at default. Expected outcomes include a novel public dataset that tracks expected future subsidies and how they are shared by stakeholders. These forecasts should provide significant benefits to taxpayers as they fund the subsidies and gain from them as claimants to Australian firms.							
	National Interest Test Statement							
	In response to the COVID-19 outbreak, governments worldwide implemented emergency relief measures to stabilise their economies. In Australia, struggling businesses received cash injections through wage subsidies and firms considered too important to fail were kept from bankruptcy. To date, it is unknown how the net benefits derived from these subsidies are shared among different types of corporate stakeholders. This project proposes to develop the world-first dynamic structural model of firm assets that allows for government interventions both prior to and at insolvency, and to calibrate this model to financial reporting and securities market data. A novel database will be created to track, firm by firm, the market value stakeholders derive from future potential government interventions, and how it is split across equity owners, creditors and taxpayers. While taxpayers fund these interventions they may also gain from them as claimants to the cash flows generated by Australian firms. Australia will benefit from this research through the advancement of crucial cost-benefit analysis and crisis management tools.							

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DP220102167	**Understanding the Geodynamo: Putting Australia on the Map**	80,000.00	175,000.00	155,000.00	60,000.00	0.00	0.00	470,000.00
Heslop, A/Prof David C	This Project aims to construct high-quality Australian palaeomagnetic records from lake sediments for incorporation into models of Earth's magnetic field history. Earth's magnetic field is generated by a dynamo within our planet's outer core, it underpins modern navigation and forms a shield against space radiation. International efforts to understand ancient geodynamo evolution lack Australian palaeomagnetic data, a shortcoming referred to as the "Australian data wasteland". This Project aims to address this data deficiency and is expected to reinvigorate Australia's role in understanding the geodynamo. Furthermore, models of Earth's ancient magnetic field are anticipated to provide ages for Australian archaeological and climate records.							
	National Interest Test Statement Earth's magnetic plays an under-appreciated role in our day-to-day lives. It is used in a broad range of navigation tasks spanning aerospace technologies through to personal smartphone apps. One restriction on these technologies, however, is that Earth's magnetic field changes through time. This field evolution is poorly understood, particularly in the Australian region. This project aims to produce high-resolution records of changes in Earth's magnetic field direction and strength through recent geological time. These records will be incorporated into computer models that describe the evolution of Earth's magnetic field both globally and in the Australian region. Such models will contribute to the scientific community's understanding of changes in Earth's magnetic field and potential consequences for technological development. In a cultural and environmental context, models of Earth's ancient magnetic field can provide ages for Australian archaeological and climate records where other dating techniques may not be feasible.							
DP220102219	**Generating Highly Entangled Photons from Nonlinear Monolayer Domes**	82,500.00	165,000.00	165,000.00	82,500.00	0.00	0.00	495,000.00
Lu, A/Prof Yuerui	This project aims to investigate novel monolayer domes for the development of high-performance quantum photon sources. This research expects to expand our understanding of fundamental physics of photon pair generation in nonlinear optical materials. Such monolayer domes have ultra-high optical nonlinearity, which gives rise to strong light-matter interactions and enables high-efficiency photon pair generation. The expected outcome is demonstration of a prototype light-weight and intense quantum photon source based on novel materials, which can be readily integrated with photonic circuits for quantum communication technologies. This research could strengthen the development of new industries and lead to job creation.							
	National Interest Test Statement Materials research is a proven pathway to the development of new technologies. Our research focuses on the recently emerged atomically thin monolayer domes and aims to understand and harness their unique physical properties for building quantum photon source devices. Our research will deliver novel light-weight quantum photon sources with broad spectral and angular widths, which are important for many quantum technologies and applications, such as quantum imaging, quantum communication and future quantum computation. These devices are expected to play an enabling role in the future developments of light weight portable devices, such as mobile phones, displays, distributed sensors, and wearable photonics. This research could strengthen the development of new industries and lead to job creation. The outputs of this project will enhance the international competitiveness of Australian research and foster national and international collaborations on novel materials and devices.							
DP220102232	**Novel statistical methods for data with non-Euclidean geometric structure**	65,000.00	130,000.00	130,000.00	65,000.00	0.00	0.00	390,000.00
Wood, Prof Andrew	This project aims to develop new flexible regression models and classification algorithms, along with robust and efficient inference methods, applicable to a wide range of non-Euclidean data types which arise in many fields of science, business and technology. There are serious flaws with currently available methods of analysis for non-Euclidean data. This project expects to transform such analyses by providing new quantitative tools within a unifying framework. The anticipated project outcomes will be of mathematical interest and valuable in applications such as finance (predicting Australian stock returns); modelling electroencephalography data; Australian geochemical data, relating to sediments; and Australian X-ray tumour image data.							

* Note - Indicative funding for approved projects will be made available through a funding variation under section 54 of the ARC Act

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	National Interest Test Statement							
	The research outcomes of the project will support two Australian Government Science and Research priorities: (i) Resources, through the analysis of geochemical data from the National Geochemical Survey of Australia; and (ii) Health, through the analysis of X-ray data from a Brisbane hospital and an analysis of electroencephalography data. For (i), it is anticipated that this project will lead to a completely new way of analysing sediment or rock samples collected from geographically dispersed sites in Australia and it will help to identify many relevant underlying geological processes, thus aiding mineral exploration and recovery of resources. For (ii), the impact of the project is expected to be enormous, through a large improvement in the diagnosis of epilepsy and saving lives by providing new algorithms to help detect cancers more quickly from X-ray image data. A further expected major benefit is substantially improved portfolio allocation based on analysis of the Securities Industry Research Centre of Asia-Pacific database which contains stock return data of particular relevance to Australia and NZ.							
DP220102549	**A new platform technology for gene therapy**	110,926.50	209,403.00	199,981.00	101,504.50	0.00	0.00	621,815.00
Nisbet, Prof David R	The project aims to make a landmark contribution to biological science by enabling programmed delivery of therapeutic payloads from biocompatible materials. It will employ a novel synthetic biology approach to form two distinct peptide-enabled molecular architectures in a single system. This is expected to deliver a platform technology that will allow successful programmed delivery of viral vectors. The project is likely to deliver significant societal benefit as a fundamental scientific platform, improving Australia's capacity and impact in the agriculture and the healthcare sectors. The platform technology has the potential to increase the quality of life for patients and their carers, while also produce fitter, healthier livestock.							
	National Interest Test Statement							
	Australia’s livestock industry faces significant climate variability, drought, increased competition, and resource scarcity. How Australia supports the sector to respond to these challenges will determine the industry’s future prosperity. New gene therapy technologies, which allow defective genes to be replaced by superior ones, have been shown to improve animal health and hold the potential to transform the sector’s ability to respond to climate, resource and market challenges. While gene therapy holds enormous potential for the sector, solutions to its current limitations are needed – particularly in cost, precision, and efficacy. This project will engineer programmable materials to improve gene therapy’s overall efficacy by allowing precise control over the location and timing of genetic material delivery. It will produce a robust and efficient platform technology for the livestock industry. By accessing and exploiting these advanced engineering technological capabilities, the research will be of widespread benefit to the Australian agricultural sector and its future market sustainability and growth.							
DP220102755	**Quantum optical methods for entangled devices**	87,500.00	180,000.00	178,000.00	85,500.00	0.00	0.00	531,000.00
Ward, Dr Robert L	This project aims to develop experimental quantum optics methods and techniques for enhancing the performance of sensitive devices. Entangled photons will be used to probe separate devices, yielding an improved detection of correlated signals. This new technique will benefit laboratory searches for new fundamental physics effects such as space-time fluctuations due to quantum gravity and exotic dark matter candidates. The project is expected to train scientists and students in advanced quantum methods, promoting and securing Australia's position as a leader in the development of quantum technologies.							
	National Interest Test Statement							
	Quantum physics underpins key components of many modern technologies that Australians rely on for their entertainment, livelihood, and security, including mobile phones, computers, and the internet. Yet we are only at the beginning of exploiting further advances in these areas - which will be the basis of entirely new economies for Australia. This project will produce the experimental techniques and cutting edge theories in quantum optical methods that will drive the development of future real world technology applications in Australia and internationally. By driving new technology development within Australia's quantum communication industry (which is projected to reach $4B by 2040), the project will contribute longer term economic and commercial benefits to Australia, as well as to Australian consumers of those next-generation communication technologies.							

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DP220102815	**A new Journey to the Earth's Inner Core: a Planet Within a Planet**	75,000.00	155,000.00	140,000.00	60,000.00	0.00	0.00	430,000.00
Tkalcic, Prof Hrvoje	This project aims to address critical unsolved problems in global geophysics by probing the structure and dynamics of the inner core, the Earth's time capsule. It focuses on elucidating the inner core's nature with the improved tomographic images, critically testing our current understanding of how the inner core is assembled and grows, its thermodynamic state, crystallographic structure, and connection with the Earth's upper layers and geomagnetic field. Answering these questions can have far-reaching consequences for the current knowledge of fundamental geophysics. Expected benefits include training students and researchers in geophysics and data processing, contributing to a skilled STEM workforce and creating leadership for Australia.							
	National Interest Test Statement							
	Australia's socio-economic future depends on the Earth System. The Earth's inner core is the deepest shell considered the key to understanding the Earth as a system that involves both past, present, and future states, and impacts as critical for the life-existence issues as protecting magnetic field and climate. If the inner core is thermally convecting and if the convection is in its final stages, it is critical to determine this effect on the magnetic field that protects us from cosmic radiation. A better understanding of the Earth's deep interior and its relation to its surface has direct implications on the formation of the Australian crust and distribution of mineral resources. This project employs a novel methodology that we pioneered and developed in recent years and has the potential to discover new structures and phenomena that contribute to the scientific and cultural wealth of Australian society. We aim to see Australia recognized as a global observational seismology leader, train the next generation of Australians, and promote Earth physics as a primary gateway to STEM fields.							
DP220103155	**The effect of unconventional advocates on public support for climate policy**	74,055.00	145,820.50	142,178.50	70,413.00	0.00	0.00	432,467.00
Colvin, Dr Rebecca M	This project aims to discover whether the presence of unconventional climate advocates in public debate can foster broad-based support for climate policy in Australia. Unconventional advocates include political conservatives, farmers, resource industry workers, and businesspeople. The project expects to generate new knowledge about the role of intersectional social identities in contentious policy debates. Expected outcomes of this project include evidence-based insights on how to reduce social division about climate policy. This should provide significant benefits such as guidance for policy actors for how to overcome social cleavages to implement climate policy, with relevance to other contentious policy domains.							
	National Interest Test Statement							
	When longstanding advocates speak, their messages can be dismissed as being that of "the usual suspects" – but is there another pool of advocates, outside the mainstream, who are more engaging to the public? Our project will provide the first investigation of the potential for unconventional advocates in the public debate to foster broad-based support for climate policy in Australia. This will include insight on strategies, relationships between conventional and unconventional advocates, and the impacts on public opinion, particularly including key social constituencies that currently tend toward strong support or opposition to climate policy. Our findings will inform how a range of policy advocates can work independently or in cooperation to foster a public debate that favours successful implementation of effective and enduring policy. These findings will be of particular value to policy actors, including governments, think tanks, advocacy groups, peak business groups, and community organisations.							
DP220103228	**Ultrathin III-V Solar Cells via Crack-Assisted Layer Exfoliation**	80,000.00	160,000.00	160,000.00	80,000.00	0.00	0.00	480,000.00
Jagadish, Prof Chennupati	III-V semiconductors are excellent photovoltaic materials with highest demonstrated solar-to-electricity conversion efficiencies, but find limited usage in terrestrial applications due to high material and fabrication costs. This project aims to improve the cost-effectiveness of III-V solar cells by developing ultrathin III-V semiconductors via crack-assisted layer transfer approach and epitaxy-free fabrication via heterojunction architectures, paving the way for cost-effective, high-efficiency, flexible solar cells. The expected outcomes include a disruptive technology for integrated photovoltaics, novel contact and passivation materials, as well as new knowledge generated in materials science and optoelectronics disciplines.							

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	National Interest Test Statement							
	Development of low-cost flexible solar cells with high efficiency is critical to unlock the true potential of solar cells for integration with a multitude of indoor and outdoor applications including building infrastructure, automobiles, self-powered electronics, spacecraft and marine vessels, and further accelerate the much needed renewable energy transition. Traditional thick wafer-based solar cells suffer from rigidness, making them unusable where flexibility and light-weight are necessary. This project expects to develop a new technology for flexible solar cells by utilizing excellent photovoltaic properties of III-V materials and developing ultrathin III-V heterojunction devices. Successful achievement of the outcomes will enable cost-effective solar cells for integrated photovoltaics, placing Australia at the forefront of exploiting advanced photovoltaics technologies. The availability of flexible solar cells intensifies the utilization of solar cells in decentralized energy generation, contributing to an increased usage of Australia's abundant renewable energy resources and enhanced grid stability.							
DP220103640 Pogson, Prof Barry J	**Regulators of protein translation reveal new pathways to plant productivity** This proposal aims to make transformative insights into the control of photosynthetic protein production. Photosynthesis is a key target for crop improvement that can address global food security. Improving photosynthesis requires precision control of photosynthetic proteins. It was unknown how this is achieved at the level of protein production. Excitingly, the team discovered how cellular protein production changes in response to photosynthetic demand. The project strives to uncover how clusters of RNAs are decayed or translated into new proteins based on RNA features and linked binding proteins. This will allow manipulation of the accumulation of target proteins towards the goal of revealing unexplored ways to improve photosynthesis.	73,500.00	147,000.00	147,000.00	73,500.00	0.00	0.00	441,000.00
	National Interest Test Statement							
	Australia's $34B crop industry peaked in 2017. Stress caused by swift light changes and drought has drastically reduced yield. Making proteins is the most costly process within a living cell, and the photosynthetic proteins are the most abundant in a plant. Photosynthesis is globally a key limiter for crop yield improvement. Optimisation of photosynthetic protein production is critical for energy efficiency and plant productivity. However, no approaches to control this process have been done so far. This proposal will discover how and by what means photosynthetic protein production changes under stressful conditions. Consequently, discovering how to regulate the efficient production of proteins and building tools to control this system will reveal innovative strategies for long term goals of better plant productivity. Potential benefactor is the Australian agricultural market, as a 5% increase in wheat yield in a single season across Australia equates to $391 million in gross value production. The immediate benefit will be a fuller understanding of the most important energy capture mechanism for the world.							
DP220103714 Sherburn, Prof Michael S	**Enhanced Synthetic Efficiency For Molecular Complexity and Diversity** This project aims to introduce new, broad-spectrum strategies that permit more efficient and selective ways to access complex organic molecules. The approach involves maximising the molecule-building potential of some of the smallest accessible molecular building blocks. Significant outcomes expected from this work include much shorter chemical syntheses of important organic substances and much improved, broad scope synthetic methods. The concepts introduced by this work aims to benefit industry and manufacturing by introducing more efficient methods for fine chemical manufacture, while simultaneously lowering energy use and producing less waste.	74,343.50	148,687.00	148,687.00	74,343.50	0.00	0.00	446,061.00
	National Interest Test Statement							
	This project aims to devise better ways to make organic molecules by inventing innovative new strategies for chemical synthesis. The approach introduces new concepts for the manipulation of feedstock precursors to drive significant efficiency improvements in the chemical synthesis of complex molecules. Efficiency gains in chemical synthesis leads to lower energy use and less waste, hence a lower environmental impact. Other significant outcomes and benefits include enhanced capacity in chemical synthesis, which will be of value in the invention of new medicines, agrochemicals and other materials. While contributing to Australia's Advanced Manufacturing Science and Research Priority, this work will advance fundamental science through the introduction of new cutting-edge methods, and through training the next generation of Australian scientists.							

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DP220103811	**Inequality, Prosperity and the Australian Welfare State**	83,110.50	166,221.00	166,226.00	83,115.50	0.00	0.00	498,673.00
Whiteford, Prof Peter	This project aims to clarify contested understandings of Australian inequality and the role of economic and social policies in addressing policy challenges going forward. The objective of the project is to generate significantly improved knowledge of inequality in Australia using innovative approaches of data splicing, decomposition, simulation and backcasting to fill research gaps and resolve contested interpretations. We aim to provide a benchmark and robust framework against which policy development after the current crisis can be evaluated. This project aims to provide significant benefits, keeping Australia at the forefront of research on inequality and public policy, strengthening links between researchers and policy makers.							
	National Interest Test Statement							
	This project has the potential to deliver economic and social benefits by analysing trends in Australian economic inequality, and identifying the most effective ways to reduce inequalities going forward. A distinctive feature of Australian history and politics is our belief in providing a "fair go" for all. This has been expressed through our wage setting, social security and taxation systems. This shared understanding of the importance of restraining inequalities has been a distinctive “Australian way”. This view precedes Federation but was revised from the 1980s on. Since the GFC, concern with inequality has become prominent again. But not everyone agrees we need to be worried. These conflicting accounts may reflect differing value positions or a selective approach to evidence. Alternatively, this divergence of views result from actual changes in income inequality. Was there a critical juncture between the 1960s and the 1980s when inequality started to increase? Has there subsequently been another break with inequality stabilising at a new level? Answering these questions will show new ways forward.							
DP220103815	**AI Planning: The Next Generation**	80,000.00	160,000.00	160,000.00	80,000.00	0.00	0.00	480,000.00
Thiebaux, Prof Sylvie	This is a project in Artificial Intelligence. It aims at extending and integrating automated planning (and other forms of reasoning) with learning to produce a new generation of planning systems that are robust, safe, scalable, and trusted. These are some of the most significant issues to address to accelerate the adoption of planning systems in industry. Expected outcomes include a pipeline to learn rich symbolic planning models from narrated demonstration videos, new ways to represent, learn, and search for generalised policies that are scalable and robust, and approaches to verify and explain generalised policies. The new systems should benefit the aerospace industry by assisting humans in assembling and delivering aerospace products.							
	National Interest Test Statement							
	The ability to plan ahead is one of the cornerstones of human intelligence. Humans routinely make sequences of decisions (or plans) to achieve their objectives, are capable of explaining the rationale behind these decisions, and excel at generalising and adapting plans to address new and more complex situations. In contrast, these capabilities remain very challenging for artificial intelligence (AI). This project will build AI agents displaying these capabilities in a safe, scalable, robust and trustworthy manner. The research will be validated by demonstrating the potential for collaborative robots and virtual assistants equipped with these capabilities working alongside humans in assembly and delivery of aerospace products. This project is at the leading edge of AI research. It will help Australia lead the race in an area of paramount social and economic importance. The project outcomes have the potential to help Australian businesses adapt and become more efficient, in industries ranging from manufacturing to warehousing, via the pharmaceutical to luxury food preparation industries.							
	The Australian National University	2,246,630.00	4,634,966.00	4,528,593.50	2,221,257.50	104,500.00	23,500.00	13,759,447.00

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University of Canberra								
DP220100406	**Just add noise: the benefits of neural and stimulus noise for perception**	23,726.50	80,393.00	119,025.50	62,359.00	0.00	0.00	285,504.00
van Boxtel, Dr Jeroen J	This project aims to improve visual perception by maximising the beneficial effects of neural and stimulus noise, i.e. stochastic resonance (SR). SR challenges conventional thinking that noise decreases performance. We expect to reveal the underlying mechanisms using experimental and computational approaches. This project is expected to generate unprecedented insights into how noise influences brain processing, leading to a possible re-evaluation of the function of noise in the brain. Expected outcomes include protocols to optimise human performance through SR, and an augmented reality set-up to apply SR to real-world settings. Economic and social benefits include the ability to individually optimise performance in visual tasks using noise.							
	National Interest Test Statement							
	Noise shapes the functioning of the nervous system and impacts every aspect of brain processing. The popular believe is that noise only has negatively impacts in human performance. However, using our advanced noise measurement technology, we will investigate and optimise how noise improves brain processing and resultant human decision making and task performance. We aim to maximise these beneficial effects in a personalised manner. As such, this work will contribute to social and economic benefits, by improving performance of tasks that require perceptual decision-making e.g., detecting blips on a radar, or tumours in x-rays. The approaches we develop enable dissection of the beneficial impact of noise into different components, that could each be optimised in the future. Our approach will lead to an augmented reality set-up, facilitating transfer to future real-world applications, such as night-vision goggles, and personalised treatments to improve vision in clinical populations, such as glaucoma and age-related macular degeneration, the leading cause of blindness in Australia.							
DP220101429	**The Epigenetics of Sex in the Dragon**	101,230.00	290,380.00	365,372.00	338,130.50	161,908.50	0.00	1,257,021.00
Georges, Prof Arthur	Genetic codes do not directly translate to phenotypes -- environment acts through epigenetics to modify development. We use advanced molecular techniques to examine how epigenetics responds to temperature to reverse sex in our novel animal model, the dragon lizard. How does the cell sense temperature? Once the extrinsic signal is captured, how does it influence chromatin modification to release or suppress key genes in the sex differentiation pathway? Which sex genes are targets? Epigenetic enzymes are astonishingly conserved, providing exciting opportunities to draw from human systems to unravel novel signatures of temperature-induced sex switching in reptiles. This project will advance knowledge of developmental programming generally.							
	National Interest Test Statement							
	This project addresses the National Science Research Priority of addressing the challenges of environmental change, in that it identifies the options we have assessing the impact of climate change on a key element of our native fauna, namely, reptiles subject to sex reversal under the influence of temperature. Species with temperature-dependent sex determination are particularly vulnerable to climate change. Sex reversal under a changing thermal environment unexpectedly also renders species with genetic sex determination vulnerable to climate change. Although not a medical project per se, this project will also increase our understanding of the epigenetic processes of developmental programming generally, and so is of strategic value to the national priority of health and well-being and may have downstream implications for managing human disease.							
	University of Canberra	124,956.50	370,773.00	484,397.50	400,489.50	161,908.50	0.00	1,542,525.00
	Australian Capital Territory	2,371,586.50	5,005,739.00	5,012,991.00	2,621,747.00	266,408.50	23,500.00	15,301,972.00

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New South Wales								
Australian Catholic University								
DP220101015	**Enabling students' critical mathematical thinking**	70,758.50	131,750.00	120,599.00	59,607.50	0.00	0.00	382,715.00
Geiger, Prof Vince S	The capacity to use mathematics critically is essential for making prudent decisions and forming balanced judgements about economic, health, environmental and other challenges facing society. Developing Critical Mathematical Thinking (CMT) in the classroom provides students with the necessary skills to address complex real-world problems. Fostering CMT, however, is difficult and teaching practices around its development are under-researched and under-theorised. This study aims to generate new insight into teaching practices that can promote or inhibit students' CMT development. To address this aim, we use an innovative video-based methodology that integrates researcher and teacher perspectives on students' CMT development.							
	National Interest Test Statement							
	This project aims to build teachers' capacity to promote students' critical mathematical thinking (CMT). CMT includes the ability to use mathematics to make prudent decisions and form balanced judgements when responding to real-world problems. CMT is key to finding solutions to many existing and emerging national and international challenges, including how to respond to technological, environmental, economic and social change. Thus, this study seeks to promote excellence in education, a national priority identified in the Gonski report, to prepare students for a complex and rapidly changing world. CMT is the basis for active citizenship as well as a STEM capable workforce. Citizens who are CMT capable can fully engage with initiatives aimed at enhancing social cohesion, economic prosperity and care for the environment. Despite the importance of CMT, the results of international assessment programs, such as PISA, indicate that Australian students find mathematical reasoning difficult. This highlights the urgent need to address teaching practices that promote students' CMT within Australian education.							
DP220103700	**Metabolite regulation of mitochondrial fission**	90,000.00	183,500.00	187,000.00	93,500.00	0.00	0.00	554,000.00
Oakhill, A/Prof Jonathan S	This project aims to understand how the function and health of mitochondria – the energy producing structures in cells - are controlled by fat molecules. The project expects to integrate cutting edge techniques and instrumentation to generate new knowledge of how fat molecules interact with, and influence, enzymes that control how cells maintain their mitochondria in response to nutrient state. An anticipated goal is to define a fingerprint for enzymes regulated by fat molecules that will be of great interest to researchers across many branches of life sciences. Expected outcomes and benefits will be deeper understanding of fat molecules as nutrient signalling metabolites, and how they influence cell metabolism, growth and development.							
	National Interest Test Statement							
	This project will generate knowledge related to how fat regulates function of mitochondria - the energy producing units of the cell. Mitochondrial function is important for cell development and growth, immunity, metabolism and aging but declines with chronic over-nutrition and sedentary lifestyle, factors underpinning current societal trends that are driving the spiralling rates of obesity in the Australian population. Understanding the biological processes involved in maintaining mitochondrial function will contribute to policies promoting healthy lifestyle that may have important social benefits. This project will also generate publications in high impact, open access journals that will further establish Australia as a world leader in metabolism research, incentivise collaboration and industrial investment, and maintain Australian Universities as destination centres of research and learning for domestic and international students.							
	Australian Catholic University	160,758.50	315,250.00	307,599.00	153,107.50	0.00	0.00	936,715.00

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Macquarie University								
DP220100196	**Social Resilience, Migrant Integration and Informal Sport in Public Space**	48,507.00	112,343.50	103,214.00	39,377.50	0.00	0.00	303,442.00
Wise, Prof Amanda Y	The COVID-19 pandemic has highlighted the importance of public space and leisure in strengthening individual and community well-being. This project investigates the potential of informal sport in fostering social resilience and cohesion in new migrant communities by analysing how social outcomes are shaped by public spaces and built environments of Australia and Singapore. Expected outcomes and benefits include qualitative evidence of the dynamics that contribute to the formation of successful neighbourhoods and communities, related policy and urban planning recommendations and an enhanced capacity to build urban citizenship among Australia's growing and vulnerable multicultural migrant populations.							
	National Interest Test Statement							
	Studies have shown that active participation in formal sport has immense public health benefits and builds community. Little, however, is known about the role that informal sporting cultures play in building social cohesion and intercultural relations amongst migrants in Australia. This is incredibly significant in the current COVID-19 pandemic era. By providing the first comprehensive analysis of migrant participation in informal sports teams in Australia, which has now overtaken participation in formal amateur clubs, this study will generate new knowledge of the neighbourhood level dynamics that can contribute to social cohesion. Findings delivered through stakeholder workshops, policy briefings and media engagement will provide government, community workers, city planners and sporting bodies with new insights into the social implications of informal sport in our major cities. The findings will have the potential to contribute to policy and public space planning that fosters inclusive participation in sport and leisure and enhances community building among diverse urban residents.							
DP220100285	**Harmonic analysis of Laplacians in curved spaces**	78,500.00	162,500.00	109,000.00	25,000.00	0.00	0.00	375,000.00
Li, Dr Ji	Harmonic Analysis is a branch of mathematics which is interrelated to other fields of mathematics like complex analysis, number theory and partial differential equations (pdes) with many applications in engineering and technology. This project aims to solve a number of difficult fundamental problems at the frontier of harmonic analysis in understanding Laplacians in curved spaces. Such Laplacians control the propagation of heat and waves on manifolds and Lie groups, arising in mathematical physics and quantum mechanics. Expected outcomes are the solutions of dispersive equations and the framework of singular integrals in curved spaces; new ideas and techniques in harmonic analysis developed; and training of Australian future mathematicians.							
	National Interest Test Statement							
	Harmonic analysis has provided powerful tools to solve linear and non-linear differential equations that arise in complex analysis, mathematical physics, engineering (e.g., signal processing), medical science (e.g., image processing) and financial mathematics. The Laplacian concerning the sum of second derivatives is the fundamental operator for the heat equation and the wave equation in different settings. The proposed project will develop four significant interconnected open problems on the Laplacians on curved spaces. The specific proposed problems will contribute to the scientific discoveries in the frontiers of many important branches of mathematics and mathematical physics. By developing state-of-the-art solutions to these problems, the outcomes of this project will contribute to Australia's future success in advancing science and technology and boost national research capacity in pure mathematics via directly enabling world-class research training opportunities for the postdocs and PhD students. Some new techniques in this project could lay the foundation for further developments in image processing.							

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(Columns 1 and 2)	(Column 3)	2021-22 (Column 4)	2022-23 (Column 5)	2023-24 (Column 6)	2024-25* (Column 7)	2025-26* (Column 8)	2026-27* (Column 9)	(Column 10)
DP220100474	**From trash to treasure: engineering waste carbon utilisation in yeast**	80,275.00	159,325.00	167,000.00	87,950.00	0.00	0.00	494,550.00
Williams, Dr Thomas C	This project aims to engineer yeast to convert carbon dioxide- and methane-derived methanol into sustainable chemicals, foods, and pharmaceuticals. This project expects to generate new design principles for methanol metabolism by using the innovative approach of laboratory evolution along with state-of-the-art bio-engineering capabilities at Macquarie University and The University of Queensland. Expected outcomes of this project include new manufacturing processes for chemicals and foods, discovery of novel metabolism in yeast, and enhanced collaboration between Australia, Denmark, and the United States. This Project will provide benefits through sustainable bio-manufacturing, new economic activity, and reduced greenhouse gas emissions.							
	National Interest Test Statement This project will benefit the Australian economy and environment by enabling sustainable resource production from organic waste, biomass, and natural gas. Australian natural gas and agricultural industries will benefit from a mechanism to add value to their products and waste streams. At the same time, environmental benefits will be realised in the form of a reduction in carbon emissions by directing natural gas towards high-value yeast products as an alternative to combustion for electricity. Existing yeast products in Australia can be generated using methanol instead of sugar, making more of Australia's arable land available for food production. A long term benefit of the project is that the commercialisation of novel yeast strains will create new job opportunities in biotechnology.							
DP220101067	**Understanding and improving sustained attention under vigilance conditions**	56,109.00	138,436.00	146,853.00	64,526.00	0.00	0.00	405,924.00
Rich, Prof Anina N	This project aims to address a major global challenge caused by technological advances: human operators have to monitor computer-control (e.g., in autonomous vehicles, rail and airtraffic control) but sustaining attention is very difficult under these conditions. Developing innovative behavioural and neural methods, this internationally collaborative project bridges basic and applied science to understand lapses of attention under monitoring conditions. It creates a novel intervention, based on brain activity patterns, to improve performance. Outcomes will increase our neural understanding of attention and lay a foundation for a novel system to detect lapses of attention in high-risk environments, preventing errors before they occur.							
	National Interest Test Statement A major problem with modern automation of high-risk industries such as transport is the change in the role of the operator from active control to one of surveillance for rare computer errors. Humans are very poor at monitoring for rare events: we are likely to miss them, resulting in significant safety concerns for autonomous (self-driving) vehicles, and train or aircraft control. This project develops new brain imaging methods to predict lapses of attention and intervene when a lapse occurs. It combines basic and applied science to develop proof-of-concept in tightly-controlled experiments through to driving simulation. These innovative methods will advance interventions to prevent errors due to lapses in attention, benefitting the transport industry and society through improved safety: saving money and saving lives. It will also advance commercial potential of such technology. The social benefits to the Australian community will be a better understanding of attention and a foundation for a new system to detect lapses of attention in high-risk environments, preventing errors before they occur.							
DP220101435	**Using assisted evolution to win the war against invasive species**	83,500.00	124,000.00	78,250.00	37,750.00	0.00	0.00	323,500.00
Le Roux, A/Prof Johannes J	Invasive species disrupt ecosystem functioning, causing severe economic costs. This project investigates the use of native insects, alongside assisted evolution, as a novel approach to control invasive plants. Combining experimental and observational data we aim to accelerate adaptation already underway and entrained by selection from interactions between invasive plants and Australian insects. These data will not only address unresolved questions in evolutionary biology but will also provide knowledge on the role native insects can play in the biocontrol of invasive weeds. This will be crucial for conservation managers and agricultural practitioners dealing with plant movement and/or crop development under ongoing environmental change.							

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	National Interest Test Statement This research will inform novel methods to manage invasive plants, resulting in better outcomes for national biosecurity, risk assessment and biodiversity conservation. Between 2011–2012, Australia spent AUD$3.77 billion, or 0.29% of GDP, on the control of invasive species, demonstrating the urgent need for innovative approaches to better understand, prevent and manage biological invasions. Harnessing the evolutionary lability of biotic interactions between native and invasive species, via assisted evolution, provides a novel and cost-effective way to aid invasive species control. Through artificial selection, assisted evolution will enhance traits in native species of biocontrol value to suppress invasive populations. Assisted evolution is not only of relevance to the management of invasive species, but also provide solutions to agricultural and other biodiversity problems stemming from changing environmental conditions, e.g., ensuring sustainable crop production using novel pollinator services. Another major national benefit of this project is the training of postgraduate students in scarce skills areas.							
DP220101793 Gilchrist, A/Prof Alexei	**Quantum measurement as a resource** Advanced quantum computers will use modular measurements significantly enhancing their capabilities. However, due to the noisy environment, the measurements may have nontrivial effects on the computation. Making best use of realistic (hence imperfect) measurements is a challenging problem that hinders the development of these technologies. This project, using modern tools of resource theory, aims to design optimal realistic measurement procedures for near-term noisy quantum devices. The expected outcomes of the project are refined methods to optimise quantum measurements in today's rudimentary quantum machines. This will provide a significant benefit to the Australian community, advancing the development of disruptive quantum technologies.	45,000.00	90,000.00	90,000.00	45,000.00	0.00	0.00	270,000.00
	National Interest Test Statement Australia is investing in quantum technologies in a significant way, entirely justified by the influence those technologies are expected to have. Emerging applications such as quantum cryptography, quantum computation, enhanced sensing, and quantum simulation are set to have a profound impact that will be felt in all sectors of the economy. Furthermore, these impacts likely do not include the truly unpredictable and disruptive technologies that will emerge when we harness the full power of quantum mechanics. Practical implementations of quantum technologies will require realistic measurement devices which can only perform imperfect quantum measurements. These imperfections jeopardise the promised quantum enhancements in computing, security in communication, and precision in sensing that were developed on the assumption of perfect measurements. This project will enable and ease the development of quantum technologies by understanding and making optimal use of these imperfect measurements. The project will pave the way for the development of these disruptive quantum technologies.							
DP220102086 Wang, A/Prof Yuling	**Next-generation epigenetic analysis: direct reading of DNA methylation** This project aims to develop a new molecular tool to directly and dynamically read chemical modifications on genomic DNA (epigenetics) by utilizing advanced nanomaterials with the unique features of Raman spectroscopy. Epigenetics affects cellular processes and controls genetic programs by turning them “on” and “off" but there is currently no direct method to measure modifications on DNA. A new technology will be designed to avoid complicated procedures/chemistry for DNA epigenetic analysis providing a specific molecular fingerprint. The anticipated outcomes include a new technique and advanced knowledge in nanomaterials and DNA functions, thus strengthening the economic viability of Australian manufacturing and biotechnology sectors.	65,000.00	130,000.00	130,000.00	65,000.00	0.00	0.00	390,000.00
	National Interest Test Statement Chemical changes to DNA modulate gene function during the development and progression of disease in animals and plants. To understand disease progression we therefore need accurate and fast methods to detect and quantify DNA modifications during cell development. Current procedures for directly reading chemical modifications on DNA are complex and blind to the differences between methyl group derivatives. This project will design a new platform technology that can directly read chemical modifications on DNA without complicated procedures, by using a new molecular tool and advanced nanomaterials. This new technology will lead to economic and social benefit by providing a manufacturing opportunity and finding application in areas of national and international significance. It will enable the detection of unique DNA biomarkers that are indicators of the well-being of humans, animals and plants, thus reducing health care costs and increasing productivity in animal husbandry and other areas of agriculture.							

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DP220102152	**All-on-chip twisted light modulator for ultrahigh-capacity data processing**	35,000.00	105,000.00	140,000.00	70,000.00	0.00	0.00	350,000.00
Ren, Dr Haoran	The project aims to develop a conceptually new all-on-chip twisted light modulator via photonic integration of a customised twisted-light metasurface with on-chip optical waveguides. The goal is to replace current bulky, slow, and costly spatial light modulators by a compact nanophotonic chip for the generation and detection of multiple twisted-light modes. Project outcomes include new knowledge in photonic integration and 3D meta-optics, and novel nanophotonic devices for twisted light, which will expand applications of twisted light for all-on-chip fibre-optic communications and holographic displays. The ultra-compact, high-capacity, efficient twisted-light modulators are expected to have a practical impact on many photonic applications.							
	National Interest Test Statement							
	A new way to boost the data capacity of optical information systems is by using twisted light, where the light beam can encode information based on the tightness and direction of its helix. Different twisted light modes can carry information in different channels. However, this idea is currently hindered by the bulky, slow, and expensive modulators required to create the twisted light modes. This project will create the world's first integrated twisted light modulator combining a customised nano-scale light interface and light guide. The resulting compact optical chip will enable fast, efficient generation and detection of multiple twisted light modes, enabling ultrahigh-capacity data processing. This project will support new optical fibre applications for the telecommunications, security and healthcare sectors, and will boost Australia's competitive advantage in advanced manufacturing, nanofabrication and quantum communications. This project offers early economic benefits to Australia by translating a new optical chip manufacturing platform to local photonics companies, with potential for global markets.							
DP220102223	**Will rivers be smaller when the climate is hotter?**	91,000.00	186,000.00	130,500.00	35,500.00	0.00	0.00	443,000.00
Hesse, A/Prof Paul	This project aims to investigate how large rivers are affected by changing atmospheric temperature. Large inland rivers are the main source of water supporting ecological functions, economies and societies. This project will quantify the size and age of abandoned river channels in the Murray-Darling Basin (MDB) of southeast Australia and the Atuel/Diamante basin of Argentina. We will use this to reconstruct a history of changes in river discharge and relate this to climate. Novel climate and hydrological modelling will then be used to simulate the impact of temperature changes on catchment runoff and river discharge. Such information is vital for decision-making, planning and water resource allocation in the MDB and elsewhere.							
	National Interest Test Statement							
	This research will aid policy-makers and managers in decision-making about the sustainable limits of river flows. Understanding the influence of temperature change on river behaviour, and therefore water security, is the key aim of this project. This knowledge will inform high-level decision-making for environmental management, agricultural and water resource planning. This project will fill a significant gap at the national and international level in explaining how large rivers respond and develop during periods of global climate change. Quantifying the discharge of Murray-Darling Basin rivers formed under a wide range of climates will discriminate the response of river flood discharge to temperature range. The results will provide a framework for anticipating future climate impacts which, in turn, can be used to test the environmental and socioeconomic costs and benefits of existing or proposed water resource infrastructure and management strategies.							
DP220102243	**Advanced Bayesian Inversion Algorithms for Wave Propagation**	65,000.00	140,000.00	145,000.00	70,000.00	0.00	0.00	420,000.00
Hawkins, Dr Stuart C	This project aims to improve algorithms for detecting hidden items by developing new computational mathematical techniques capable of reconstructing the shape and location of objects using electromagnetic waves. This project expects to generate new knowledge in the areas of Bayesian Inversion and computational wave propagation. Expected outcomes of this project are algorithms that can be developed for use in nonintrusive radio wave security scanners. This should provide benefits such as the capability to scan a crowd without a checkpoint, which will have the potential to improve security in public places.							

* Note - Indicative funding for approved projects will be made available through a funding variation under section 54 of the ARC Act

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	National Interest Test Statement This project aims to develop new mathematical techniques for processing data obtained using nonintrusive waves (such as radio waves) for detecting and identifying hidden objects. The technology, in the form of advanced computational algorithms, will facilitate the development of new kinds of nonintrusive scanner that can detect dangerous objects in public places, without requiring people to pass through security checkpoints. Such scanners will reduce the cost and inconvenience of scanning large crowds of people and improve the safety of people in public places such as airports. By training a PhD student and research assistant in the associated computational mathematics techniques this project will expand Australia's skills base in this area.							
DP220102254 Zucker, A/Prof Daniel B	**Seeing Dark with Light: Revealing the Milky Way with Stellar Streams** This project aims to reveal the dark matter that envelops the Milky Way, deconstructing its mass through observations of cannibalised smaller galaxies. Uniting ground- and space-based observations, this project expects to uncover the detailed size and shape of the Galaxy's dark matter halo through dynamical modelling of dwarf galaxies as they are disrupted by Galactic tidal forces. As well as determining this dominant mass, the expected outcomes of this project include a unique snapshot of the evolution of our Milky Way. Leveraging major international collaborations and producing high-impact scientific results, this project will address the primal question of origins, yielding important societal and cultural benefits.	135,000.00	270,000.00	215,000.00	80,000.00	0.00	0.00	700,000.00
	National Interest Test Statement This project will result in significant social, cultural and economic gains for Australia, by engaging with fundamental questions about our cosmic origins through advanced modelling techniques and data science approaches. With novel methods that bridge two major fields of astrophysics, it will create new opportunities for cutting-edge research and international collaboration led by Australian researchers, while engaging top researchers from around the globe. This project builds on sophisticated approaches to statistical analysis and machine learning, applied to large datasets; these have both commercial and noncommercial applications across science and data-intensive industries. Together with its scientific and methodological results, the project will provide a unique training ground for HDR students and early career researchers in STEM fields, combining innovative astrophysical research with computational and data analysis skills that will drive Australia’s growth across the knowledge-based industries that will underpin its economic future.							
DP220102323 Herberstein, Prof Marie E	**Why are warning colours in animals so rare?** Toxic insects display warning colours as protection from predators who learn to associate them with an unpleasant taste. Theoretically, there is no limit to the number of species that could show warning colours but only about 5% are estimated to have them. This presents a fundamental and unresolved biological problem - what limits warning colours? This project aims to address this significant biological question by testing three hypotheses predicting warning signal limitations. Projected outcomes are an improved understanding of the ecological niche of these colourful insects, which may inform conservation and biodiversity management and raise awareness of these flamboyant creatures.	67,398.50	138,664.00	134,317.00	63,051.50	0.00	0.00	403,431.00
	National Interest Test Statement This project will deliver environmental and social benefits to Australia. The environmental benefits of this study include improving our knowledge of Australian butterfly biodiversity for monitoring the impact of environmental change on insects and the discovery of yet undiscovered butterfly species. We will deposit butterfly specimen with Australian museums and record butterfly sightings into online biodiversity databases, which may contribute to butterfly conservation efforts. The social benefits include building scientific capacity by training young scientists, educating the public about charismatic colourful insects by adding our data to publicly available databases (Living Atlas of Australia). Further benefits are research collaborations with Germany (Max Planck Institut and Universtiy of Bielefeld) and Finland (Helsinki University), and reserach outputs of high quality publications contributing to science globally.							

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DP220102547	**Leaf and wood physiology and biomass allocation as drivers of plant growth**	109,096.50	216,443.50	183,401.00	76,054.00	0.00	0.00	584,995.00
Wright, Prof Ian J	This project will build new understanding of how physiological and morphological traits of plants drive growth rates and reflect evolutionary adaptation to different environments. This is significant because growth rates are pivotal in vegetation ecology and a core element of plant ecological strategies. Expected outcomes include new cost-benefit theory for plant form and function considered at whole-canopy scale, with empirical tests from Australian and Chinese ecosystems and via global trait datasets. Benefits include new approaches for predicting plant physiological properties and growth rates, and new knowledge crucial for understanding links between species traits, plant strategies and, ultimately, ecosystem productivity.							
	National Interest Test Statement							
	Plant growth underpins ecosystem productivity, timber production and crop yields. This project will deliver new understanding of what factors drive field growth rates, and how processes fundamental to growth, like photosynthesis and respiration, are coordinated. New theory will be developed, and predictions confirmed with data collected across Australia: from tropical savanna and rainforest, to arid desert shrublands, to coastal forests and woodlands in the south-east. Analysis of global datasets will build broad-scale generality. This knowledge will have clear potential to improve management of Australia's forest estate and to guide crop improvement programs. Theory and data from the project will be used to refine the "P model", our "next generation" ecosystem productivity model used for predicting shifts in vegetation distribution under future climates, and associated changes to ecosystem carbon, nutrient and water cycles. This project clearly articulates with the National Priority area "Build Australia's capacity to respond to environmental change".							
DP220102637	**Crisis as Opportunity: Societal Change in Early Middle Kingdom Egypt**	71,986.00	137,981.00	132,454.50	66,459.50	0.00	0.00	408,881.00
Bommas, Prof Dr Martin	The project aims to address political and social shifts in the ancient Egyptian early Middle Kingdom c. 4000 years ago. For the first time, and with exclusive study concessions from the government of Egypt, material data of the two most significant cemeteries of the period will be investigated. The project not only expects to generate new knowledge about human interaction during crisis but will utilise interdisciplinary research strategies to investigate the emerging opportunities, such as social mobility, for individuals from all strata of society. It will provide significant benefits such as understanding the mechanics of post-crisis political leadership and the cultural impact that enabled the classical period of ancient Egypt to emerge.							
	National Interest Test Statement							
	Actively responding to socio-economic change on individual and societal levels is a significant aspect of human experience, especially at times of crisis. This project investigates the impacts of a disintegrating administration and downward social mobility in ancient Egypt, c. 4600 years ago. New opportunities emerged with a reunified government in c. 2055 BC, enabling sustainable political solutions to turn a period of crisis into a significant success. Crisis has the potential to create durable impact on society, which is relevant for present-day leadership in democratic societies such as Australia. Ancient Egypt provides an exemplary opportunity for assessing the long-term impacts of crisis and the strategies of leaders. Our museum exhibition will make ancient responses to crisis visible and relevant to the national general public, including school children in NSW, stage 6: Human Society and its Environment. The ancient experience can develop an appreciation of diversity, informed citizenship and intercultural understanding, preparing Australians to be informed and responsible participants in the world.							
DP220102732	**Reducing Cyberbullying: Turning Bystanders into Constructive Defenders**	65,158.00	132,827.00	137,962.50	70,293.50	0.00	0.00	406,241.00
Bussey, A/Prof Kay	This project aims to develop a theoretically driven internet-based training program to reduce cyberbullying among adolescents. It expects to discover how to turn passive bystanders (onlookers) into active constructive defenders who help to stop cyberbullying and assist those being cyberbullied. Expected outcomes include developing the first theoretical model of bystanders in the cyberbullying context and practical evidenced-based methods to increase constructive bystanding. The provision of an accessible training program for use in schools will produce significant benefits for the well-being of Australian youth by reducing cyberbullying and increasing the civility of Australian youth.							

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	National Interest Test Statement Australia has one of the highest bullying rates in the world and it is imperative that more effective and sustainable methods for reducing bullying are found than are currently available in existing anti-bullying programs. This project builds on new research showing that bystanders have a crucial role in reducing cyberbullying. It aims to encourage bystanders, through an accessible internet training program, to respond constructively rather than aggressively to cyberbullying they witness. This research will enable bystanders to be a part of the solution in preventing cyberbullying rather than responding aggressively or ignoring it, thereby contributing to the problem. Evidence shows that the scars of being bullied during adolescence remain with many across their lifetime. The project will deliver economic and social benefits by improving the wellbeing of Australians who have been a target of cyberbullying. This in turn will reduce the burden on services, community programs and other supports for Australians impacted by cyberbullying, as well as improving Australian society's resilience to cyberbullying.							
DP220102836 Narendra, Dr Ajay	**Overcoming limits of miniaturisation to enhance spatial memory capacities** Ensuring optimal efficiency at the smallest possible physical limit is a challenge for technical systems, which has been elegantly solved by biological systems. This project aims to identify how insects with miniature brains enhance their memory capacities. It will leverage previous ARC funded research on navigation of Australian ants and apply sophisticated analytical tools to quantify the neural connectivity in the brain in the context of spatial memory. Expected outcomes include understanding how expensive neural tissue can be miniaturised for efficient spatial navigation, identifying the consequences of miniaturisation for developing miniature and autonomous agents, enhancing research capacity and institutional collaborations.	128,739.50	251,001.00	241,053.50	118,792.00	0.00	0.00	739,586.00
	National Interest Test Statement Spatial memory is one of the most important cognitive functions for all animals as it informs animals where they are relative to home. While we rely on the 86 billion neurons in our brain to carry out spatial tasks, a humble ant achieves it with just 1 million neurons. This project will discover how animals with miniature brains increase memory capacities by investigating how ants overcome the physical limits imposed by miniaturisation to enhance information processing. The study will reveal how to achieve optimal cognitive efficiency at the smallest physical limit. Outcomes of this research will provide clear designs to develop miniature nanometer transistors and computer chips with large memory, and hence will make significant contributions towards the National Research Priority of Advanced Manufacturing. This project has enormous potential to generate valuable intellectual property and patents in the fields of engineering and robotics, bringing economic and commercial benefits to Australia's technology industry.							
DP220102985 Smith, Prof Tom	**Political connections and the cleantech transition in China and Australia** Estimates show that the transition to clean technology will likely create $20 trillion in wealth worldwide. This project aims to analyse how corporate investment and government strategies are deployed in China and Australia to maximise wealth capture. Taking into consideration the critical role of government policy in the cleantech transition, the project attempts to determine how carbon-intensive and cleantech firms use political connections as a mechanism for mitigating risks and taking advantage of opportunities. This project focuses on the relation between politically connected boards and the cleantech transition, and seeks to empirically show the economic importance and value effects of political connections in two countries.	65,118.00	129,190.00	130,723.00	66,651.00	0.00	0.00	391,682.00
	National Interest Test Statement A transition to clean technology is forecast to lead to $20 trillion in wealth creation. This project will examine how political connections help fossil-fuel intensive firms and cleantech firms to secure favourable government action to mitigate the risks of investment in the cleantech transition and increase cleantech uptake. This research will assess public interest in the transition to cleantech, the role that a firm's political connections have on accessing government contracts, resources and influencing policies, and how the importance of those connections may change as the legal and business cases for action on climate change become more evident. The project will examine the economic importance of political connections in Australia and China in maintaining the fossil-fuel sector while transitioning to cleantech. The findings will benefit the Australian community by providing investors, companies, policymakers and decision-makers with a comprehensive understanding of the economic and political factors that will act as barriers and enablers during Australia's transition to clean energy technology.							
	Macquarie University	1,290,387.50	2,623,711.00	2,414,728.50	1,081,405.00	0.00	0.00	7,410,232.00

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Southern Cross University								
DP220100195	**Decoding the geochemical record of early human fossils**	61,333.00	130,266.00	122,726.00	53,793.00	0.00	0.00	368,118.00
Joannes-Boyau, A/Prof Renaud	This project aims to reconstruct the infanthood records of early hominin species in South Africa, using cutting-edge geochemical imaging of fossil teeth. The research is at the forefront of human evolution and will transform our understanding of hominin adaptations to their ecological niches. The project will shine light on adaptive strategies of early Homo which allowed our genus to outcompete other hominin species at a time of climate variability. The results will pioneer new analytical approaches to extract early-childhood geochemical archives such as breastfeeding behaviour, diet, seasonality and physiological adaptations of each species and thereby gain novel perspectives on the environmental conditions of our ancestors.							
	National Interest Test Statement							
	Some two million years ago under severe climatic pressure, our earliest ancestors made unknown physiological and behavioural adaptations that led to them outcompeting all other human-like species in the landscape. By observing the distribution of trace-element and isotopes archived in fossil teeth of three early human species using novel onsite micro-scale geochemical imaging techniques, the project will shed light on nursing behaviour, health conditions, diet, environmental pressure and migration pattern of these prehistoric populations. The results will provide key insights into our origins, our unique adaptations and our unmatched evolutionary success. This project will pioneer the use of micro-scale geochemical imaging in the field and also increase the stock of high-quality skilled researchers, by training a PhD candidate and a postdoctoral researcher in this transdisciplinary project spanning geoscience, anthropology, health and evolutionary biology.							
DP220100918	**Resolving the role of dryland flooding in the global carbon cycle**	85,500.00	166,000.00	142,500.00	62,000.00	0.00	0.00	456,000.00
Eyre, Prof Bradley D	Aquatic sources of carbon dioxide and methane are globally significant, but unknown for flooded drylands. The aim of this project is to use an innovative combination of well-integrated methodologies to determine if flooded drylands release large amounts of carbon dioxide and methane. This project is significant because this release of carbon dioxide and methane has not previously been accounted for and may change the magnitude of the global terrestrial carbon dioxide sink and account of some of the planet's missing sources of methane. The outcomes of this project will make a significant contribution to our understanding of the global carbon cycle and earth climate system, and inform future management of these systems.							
	National Interest Test Statement							
	Drylands, where evaporation exceeds rainfall, cover about 78% of Australia. In addition to extended dry periods these areas also flood periodically. The breakdown of plant organic matter during flooding, that was stored during dry periods, releases carbon dioxide and methane. Carbon dioxide and methane are well-known, potent greenhouse gases, contributing to global warming and its environmental (e.g. more extreme flooding and droughts), financial (e.g. disaster recovery costs, tourism impacts) and social effects. In a world first, this project will estimate the amount of carbon dioxide and methane emitted from flooded drylands. The data from this project will result in better global models and more accurate forecasts of climate change. These models are vital for scientists, governments, and the community to understand how land use and other variables in drylands can be better managed to reduce emissions and slow global warming for the benefit of all Australians and the international community.							

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DP220101263	**Shallow water carbonate sediment dissolution in the global carbon cycle**	86,500.00	165,500.00	132,000.00	53,000.00	0.00	0.00	437,000.00
Eyre, Prof Bradley D	Carbonate sediment dissolution is a globally significant process, but poorly understood in shallow marine waters. This project will determine whether the combined effect of organic matter, ocean acidification and pore water flow in shallow water carbonate sediments increases the release of calcium and alkalinity to the ocean. This project is significant because this release has not previously been accounted for and may lead to an additional uptake of atmospheric carbon dioxide into the global ocean, maybe some additional buffering against ocean acidification, but unfortunately, maybe also a loss of carbonate ecosystems. The outcomes of this project will make a significant contribution to our understanding of the global carbon cycle.							
	National Interest Test Statement							
	Carbonate sediments, made of skeletons of sea life (e.g. coral), are the Earth's largest store of carbon, and form carbonate ecosystems, such as coral reefs, low lying Pacific islands, and beaches. Australia has stewardship of many such ecosystems, including the Great Barrier Reef (GBR), which has an estimated value in excess of $50 billion. The ocean has become increasingly acidic due to the uptake of human made carbon dioxide from the atmosphere. In the shallow ocean (less than 200m) acidification is poorly understood, yet those regions contain more than 50% of ocean carbonate. This project will create the first shallow water carbonate dissolution model, based on measurements in the GBR, that can be integrated into global carbon models resulting in more accurate forecasts of climate change and ocean acidification. Understanding the impact of climate change and ocean acidification is critical to inform policies and decision-making to secure the health of the GBR, and other carbonate ecosystems, for the ongoing benefit of the Australian community.							
	Southern Cross University	233,333.00	461,766.00	397,226.00	168,793.00	0.00	0.00	1,261,118.00
The University of New England								
DP220101820	**Nonlinear partial differential equations and propagation phenomena**	67,500.00	135,000.00	134,500.00	67,000.00	0.00	0.00	404,000.00
Du, Prof Yihong	This project of strategic basic research aims to develop new mathematics in nonlinear partial differential equations to better understand the propagation phenomena arising in a variety of applications, such as the spreading of infectious diseases or cancerous cells, or the invasion of alien species. New models of partial differential equations over spatial regions with moving boundaries will be introduced and systematically studied to provide deep understanding of the mechanisms of important new phenomena in propagation, including accelerated spreading and the onset of such spreading. The mathematical questions are concerned with the long-time dynamics of equations with free boundary, and the asymptotic profiles of their solutions.							
	National Interest Test Statement							
	Propagation arises in many different areas and forms, such as the spreading of infectious diseases, the invasion of alien species, or the progression of the healing front of a wound. This project develops new mathematics in nonlinear partial differential equations to provide a deep understanding of these propagation processes. It creates new mathematics tailored to applications, which will be of lasting value in mathematics. The mathematical theory developed in the project provides invaluable insights to many propagation problems of great concern to society, and therefore the research is of significant national interest. Moreover, the research also enhances expertise and training in areas of science and mathematics with increasing national importance.							

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DP220102976	**Intergenerational Transmission of Inequality**	68,943.50	143,899.00	121,118.50	46,163.00	0.00	0.00	380,124.00
Maxwell-Stewart, Prof Hamish J	There is a growing interest in the ways in which biological and socioeconomic heritage can shape vulnerabilities to disease. Once viewed as primarily a product of recent conditions such as lifestyle choices, it is now evident that health outcomes can also be shaped by intergenerational mechanisms. Analysis of these in current populations is impractical given the considerable time it would take for a prospective study to unfold. The analysis of historical populations, however, presents an opportunity to circumvent this obstacle. Using data for male and female convicts and their descendants, this project seeks to determine the extent to which disadvantage experienced by one generation impacted on the life expectancy of those that followed.							
	National Interest Test Statement This application aims to contribute to the national interest by creating the longest Australian series of continuous digitised death certificates. This resource will enable the measurement of longevity and disability of men and women across three generations leading to the creation of the necessary base line data to analyse the impact of past policy interventions on long-term outcomes. This will in turn provide the opportunity to better inform and evaluate current and future policy planning. The project findings have the potential to be of particular use to Aboriginal Australians through an exploration of the complex pathways responsible for the intergenerational transmission of inequality. This could lead to more effective targeting of interventions aimed at 'closing the gap'. Finally, the project will bring new methodologies to bear on the digitisation and analysis of complex archival series, leading to better access to Australia's past for researchers, administrators and the general public at large.							
	The University of New England	136,443.50	278,899.00	255,618.50	113,163.00	0.00	0.00	784,124.00
The University of New South Wales								
DP220100040	**Punishment learning: from cells to circuits to behaviour**	97,843.00	194,641.00	192,733.50	95,935.50	0.00	0.00	581,153.00
McNally, Prof Gavan P	This project aims to ask and answer fundamental questions about how risk and danger guide our learning and behaviour. It combines theoretically driven approaches from associative learning and experimental psychology with a state of the art technology platform for mapping and manipulating brain function. This project expects to provide new mechanistic knowledge, from cells to circuits to behaviour, about how punishment shapes our learning and behaviour. This should provide significant benefits including a new knowledge base advancing theories of associative learning as well as laying a new basic science platform for understanding how punishment contributes to learning and emotional deficits.							
	National Interest Test Statement Reward and punishment are among the most fundamental building blocks of our behaviour. They are essential to normal, adaptive learning and emotional resilience. They allow us to cope with a changing world, assess risk, and avoid harm. They are also critical contributors to the cognitive deficits observed in ageing, dementia, depression, and addictions - problems affecting more than one in three Australians and imposing significant social, health, and economic burdens that will only increase in the future. Our research takes advantage of recent theoretical and technological advances to deliver a new, detailed understanding of how these fundamental building blocks are organised in our brains as well as how they guide our behaviour, learning and choices. This basic science platform has the potential to guide better approaches to supporting behaviour change in parental, educational, workplace, and judicial settings as well as open new paths towards next-generation understanding learning and decision making in ageing, dementia, depression, and addictions.							

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DP220100088	**Manufacturing Nanostructured Polymer Thin Films using Visible Light**	80,000.00	160,000.00	155,000.00	75,000.00	0.00	0.00	470,000.00
Boyer, Prof Cyrille A	This research aims the development of selective photochemical tools driven by different colours of light for the fabrication of nanostructured polymer brush thin films. By using different wavelengths to selectively activate specific chemical reactions, this will enable multiple reactions to be performed simultaneously, significantly streamlining fabrication. Additionally, the increased selectivity offers pathways to more sophisticated nanoarchitectures in comparison to existing methods. This research will lead to the fabrication of 3D polymer brush architectures with unparalleled precision, which will be of high scientific and industrial value for a diverse range of applications, such as optoelectronics, nanoactuation, and sensing.							
	National Interest Test Statement							
	The global nanocoatings market is expected to reach a value of almost AUD$17B in 2022. Polymer brushes are a highly promising nanocoating that can be configured for applications ranging from self-cleaning surfaces to LEDs to biomimetic actuators. However, their complex fabrication processes have hindered the realisation of this potential. This project aims to streamline polymer brush manufacture through the development of synthetic tools mediated by different colours of light, allowing multiple chemical processes to be conducted simultaneously. This paradigm shifting technology will open avenues to complex, multilayered architectures that will find applications in the realms of nanotechnology, advanced materials and electronics. In addition, by promoting a technology based on the use of visible light, this project will develop energy-efficient process. This project addresses the National Research Priority of Advanced Manufacturing and will place Australia in a strong position to lead the rollout of next-generation technologies driven by multiple wavelengths of light.							
DP220100090	**Quantitative Analysis of Systemic Risk in Insurance**	19,298.50	105,793.50	169,847.50	83,352.50	0.00	0.00	378,292.00
Tang, Prof Qihe	This project aims to achieve a contemporary and comprehensive quantitative analysis of systemic risk in insurance. The significance lies in narrowing the gap between the studies of systemic risk in banking and insurance. Expected outcomes include the construction of insurance/reinsurance networks to formalise systemic risk, the analysis of the role of network integration, and the development of pricing frameworks to entail a systemic risk premium. The project will benefit insurers and regulators by providing a forward-looking approach to monitoring and assessing insurance risk during a systemic crisis. These important original contributions to insurance risk management will help establish Australia’s global leadership in systemic risk.							
	National Interest Test Statement							
	Australia is highly vulnerable to natural disasters, climate change, and pandemics which, through the increasing integration of the Australian economy, may become systemic shocks. Australia should be at the forefront of the research in related fields. This project will offer a forward-looking approach to managing systemic risk in insurance, which is of utmost importance to the security of Australia in this rapidly changing environment. Its completion represents important original contributions to insurance risk management, which will help establish Australia’s global leadership. The two fundamental objectives of APRA are the financial safety of institutions and the stability of the Australian financial system. This project will contribute to APRA from an insurance perspective by providing profound insights into the development of regulatory frameworks designed to proactively identify, assess, and manage insurance systemic risk. The project relates directly to the National Research Priority “Environmental Change”. It touches COVID-19 and climate change, two typical systemic shocks faced by Australia.							

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DP220100183	**Understanding visual working memory: a cognitive strategy framework**	55,749.00	164,621.00	166,115.00	57,243.00	0.00	0.00	443,728.00
Pearson, Prof Joel	This project will assess the role cognitive strategies play in visual working memory with the aim of unifying theories in the field. Specifically, this work will investigate whether variations in cognitive memory strategies result in the use of different sensory stores and neural regions to hold visual information in mind. This work aspires to use innovative perceptual psychophysics and modelling techniques along with brain imaging and non-invasive brain stimulation to elucidate the exact neural regions responsible for different memory strategies. This work has the potential to solve many of the current debates in the field and lead to a unified theory and model of visual working memory, opening the door to optimise human memory.							
	National Interest Test Statement							
	Our lack of understanding cognitive function and methods to boost it, costs Australia dearly not just at the national level, but also at the individual level where personal aspirations and prospects remain unfulfilled. Cognitive function can decline due to age, injury, stress and disease, without understanding the underlying mechanisms this will continue to cost Australia greatly. This DP is a comprehensive project to support high-quality basic research in Australia by providing a new framework and methods to investigate visual working memory, through including cognitive strategy as a key variable, such as the use of mental imagery as a cognitive tool. It will expand the knowledge base, research capability and international competitiveness of Australia and provide high-quality research training. The novel methods will uncover individual differences in cognitive strategy and the underlying brain structures and networks used. Understanding these limitations, where and why they arise in the brain, is the first step to improve cognitive function and its capacity for all Australians.							
DP220100306	**Modelling of polydisperse particle-fluid reacting flows**	65,000.00	130,000.00	130,000.00	65,000.00	0.00	0.00	390,000.00
Shen, A/Prof Yansong	Complex polydisperse particle-fluid reacting flows are widely practised in many industries where particle size distribution is wide and particle number is huge, yet the process design and optimisation are hindered by the lack of fundamental understanding of the complex reacting flows, particularly polydispersity and interactions. The project will tackle this specific challenge by developing a novel particle-scale mathematical model by incorporating new numerical techniques of interphase heat/mass transfers, polydispersity and computation speed-up; and applying it to two typical industry processes for demonstration. The outcomes will be applied across a range of industries of vital importance to Australian economic and technological future.							
	National Interest Test Statement							
	Polydisperse reacting flows are encountered in many energy-intensive industries where particle size distribution is wide and particle numbers are huge, including mineral, metallurgical, chemical and recycling processes. However, design and optimisation of these flows are hindered by difficulties in quantifying complex flow behaviour. The project will develop a novel mathematical model that incorporates new numerical techniques for efficiently describing the behaviour of reacting flows. The model will be applied to two reacting flow processes in conventional and emerging sectors – ironmaking and end-of-life solar panel recycling, offering a cost-effective advanced tool for design in industrial processes involving polydisperse reacting flows, leading to improved development of cleaner and low-cost technologies in traditional and emerging sectors. The outcomes will inform a range of Australian manufacturing industries addressing optimal operation and control, particularly wastes recycling and renewable energy like solar energy, ultimately enhancing the competitiveness of Australian technologies in these areas.							

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DP220100318	**Fluorescent daytime radiative cooling for urban heat mitigation**	95,000.00	190,000.00	190,000.00	95,000.00	0.00	0.00	570,000.00
Santamouris, Prof Matthaios	This project aims to develop a fluorescent daytime radiative cooling technology suitable for the mitigation of urban overheating in the built environment and for the reduction of future cooling energy demands in buildings. The project expects to generate new knowledge in this area to enable the exploitation of fluorescent materials for urban heat mitigation and cooling of buildings. Expected project outcomes consist of the establishment of the new cooling technology for application on coloured surfaces, typically used in the urban built environment, and on white surfaces for boosting the cooling power of current daytime radiative coolers. This should lead to significant benefits for the Australian building and construction industry.							
	National Interest Test Statement Australian cities are experiencing increasing magnitudes of urban overheating. One of main causes is solar radiation that is absorbed by built surfaces such walls and roofs. This study will develop new coatings that can be applied to walls and roofs to reduce urban overheating, through the use of fluorescent materials. This will benefit society by enabling architects, planners and builders to use more effective materials to reduce overheating. It will develop the first coloured 'super cool materials' of this type, which are suitable for use on walls in dense urban areas. The development of these new cooling materials will also contribute to the reduction of the negative effects of urban overheating in Australia, including the potential to reduce building cooling energy needs and costs, urban pollution during heatwaves, heat related illness and discomfort.							
DP220100355	**Data-based Control of Process Feature Dynamics through Latent Behaviours**	67,500.00	135,000.00	135,000.00	67,500.00	0.00	0.00	405,000.00
Bao, Prof Jie	This project aims to develop a novel data-based approach to control the feature dynamics of complex industrial processes. The dynamic features of desired process operations (leading to high energy and material efficiencies and good product quality) are often not directly measured but can be distilled from high-dimensional big process data. However, little effort has been made to develop process control approaches to achieve desired dynamic features. This project aims to develop such a data-based approach by controlling latent variable dynamics, using the behavioural systems framework integrated with big data analytics and artificial neural networks. The outcomes are expected to help build a cornerstone for future smart manufacturing.							
	National Interest Test Statement Australia has very strong process/manufacturing industries representing over $873bn turnovers and $350bn value added per annum. In these industries, many processes have complex nonlinear dynamics but are still controlled by simple logic controllers that deliver inadequate performance. The project will harness the large amount of process operation data collected during operations to develop a novel big data-based approach to improve the efficiency of process operations (including reducing energy/materials consumption and improving product quality). Data-based process control is fast becoming a cornerstone of future manufacturing and the outcomes of this research have potential to assist Australian process/manufacturing industries (e.g., refinery, sugar, fertiliser, gas, metal production and mineral processing) improve their competitiveness in the global market while reducing their environmental footprint.							
DP220100412	**Novel dopamine pathways underlying motivated behaviours**	60,715.50	136,361.00	156,435.00	80,789.50	0.00	0.00	434,301.00
Prasad, Dr Asheeta	Rewards such as food, sex and social media are seeked on daily basis. Neurological and psychological basis of learning and memory of reward processing behaviour. This project maps real time neural activity during reward processing in two novel brain regions. It has the potential to revolutionize the understanding of the brain mechanisms in reward processing. The biological data obtained can be directly integrated into computational modelling approaches to benefit reward processing algorithms for learning behaviours in humans or artificial intelligence. This project will fuel the understanding of algorithms driving social media platforms and consumer consumption, hence driving economic and technological progress in Australia.							

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	National Interest Test Statement The ever-expanding nature of rewarding seeking acts on the brains systems regulating how we learn about rewards; forming the basis of motivated behaviours. This project will identify and characterise novel neural pathways in reward seeking behaviour, extending our neurobiological understanding of motivated behaviours. We apply cutting edge technology to obtain real time biological data during reward learning process. This is a timely project, as the data derived can be combined with behavioural data from current consumer markets. Examining these understudied neural pathways will provide knowledge required for better understanding the neural processes underlying consumer consumption, advertising, decision making; essential factors driving Australian and global markets. The outcomes have the potential to have economic, commercial, social benefits to the Australian community.							
DP220100585 Hunter, Prof Jill B	**Judges' work, place and psychological health - a national view** This project aims to address the human, juridical and financial costs of judicial officers' work-related psychological harm. This harm is implicated in early retirement, sick leave and suicide. It threatens appropriate courtroom conduct, procedural fairness and impartial adjudication. The project seeks to generate new knowledge of the stress judicial officers experience and the individual and institutional mechanisms for managing stressors, combining socio-legal and psychological approaches. Expected outcomes include evidence-based understandings to inform recruitment and retention strategies specific to this highly specialized workforce. This should provide significant benefits for judges' work capacities and courts' delivery of justice.	84,500.00	180,500.00	185,500.00	89,500.00	0.00	0.00	540,000.00
	National Interest Test Statement This project's national focus is directed at the administration of justice and public trust in courts as institutions of national governance. It addresses judicial officers' exposure to extreme work-related psychological harm, implicated in early retirement, sick leave and suicide. It is directed to reducing the threat such harm causes to fair and impartial adjudication and through judges' courtroom conduct, causing delays, unnecessary appeals and additional stress on court users. This project goes behind Law's objectivity to unmask detail of stressors on judges' work and on the delivery of justice to generate new evidence-based understanding informing recruitment and retention strategies specific to this highly specialized workforce. This understanding will reduce the human and economic tolls of this harm, some of incalculable impact. It will benefit judicial officers, court users and the community, particularly in remote and regional areas and where judicial officers adjudicate cases rife with legal or social complexity, and cases that expose judicial officers to vicarious trauma through graphic evidence.							
DP220100747 Goddard, Dr Erin	**Making sense of ambiguity: brain system interactions and visual uncertainty** This project aims to identify and characterise the interactions between brain regions underlying a fundamental process in visual perception: interpreting sensory input that is unclear or ambiguous. It will use two complementary neuroimaging techniques and cutting-edge analysis methods. The intended outcomes include new insights into a fundamental but poorly characterised aspect of brain function: how brain regions interact, and advanced analysis methods with wide application. Expected benefits include important advances in knowledge that lay foundations for future study of neural disorders, international collaboration, and new methods placing Australia at the forefront of the international effort to understand the human brain.	56,684.50	115,157.00	137,560.00	162,074.50	82,987.00	0.00	554,463.00
	National Interest Test Statement This project addresses a fundamental question in neuroscience: how does the human brain integrate sensory input with expectations and memories when generating our perceptual experience? We will extend analysis methods that we recently developed, to gain new insights by measuring how stimulus information is exchanged between different areas of the brain over time. Understanding these brain network interactions is a crucial first step towards identifying how these interactions are disrupted in disorders or disease, for example, in autistic spectrum disorder. Identifying how the brain resolves ambiguity in images could also lead to improvement of computer vision systems and brain-inspired artificial intelligence. Our project will also develop and refine cutting-edge research tools with broad applicability in neuroscience: future applications of these tools include identifying brain network interactions in memory, reward evaluation, language, social cognition, and their disorders. Collaboration between investigators will strengthen ties between Australia and a world-leading brain research group in Cambridge, UK.							

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DP220100841	**Connections for hybrid steel-timber-concrete structures**	55,000.00	111,000.00	104,000.00	48,000.00	0.00	0.00	318,000.00
Valipour, Dr Hamid	Connections play a vital role in overall performance, reliability, and adaptability of civil structures. This project aims to develop innovative, easy to fabricate and efficient connections for hybrid structural systems that fully exploit advantages of steel, concrete and engineered timber to reduce the self-weight, cost and negative environmental impact and enhance opportunities for deconstruction, reusing and upgrading of the structures. Structural performance of the connections will be assessed by laboratory testing and advanced numerical modelling. Comprehensive knowledge on stiffness, strength, and ductility and world-first provisions for safe and cost-effective design of the hybrid steel-timber-concrete structures are generated.							
	National Interest Test Statement							
	The construction industry has negative impact on the environment, but it also plays a vital role in Australia's economy, being the largest non-service-related contributor to the nation's economy and one of the biggest employers. Moreover, Australia's steady population growth and rapid urbanisation has dramatically increased demand for new cost-effective residential and commercial buildings. This Project will deliver substantial environmental, social and economic benefits by developing innovative connections for hybrid structural systems that takes advantage of lightweight environmentally friendly timber panels in conjunction with steel and reinforced concrete. In a rapidly evolving world driven by efficiency, innovation and impacts of climate change, the outcome of this Project will improve sustainability, resilience, and productivity of the building industry by increasing speed of construction, facilitating deconstruction and providing more opportunities for reducing, recycling, and reusing the carbon and energy intensive construction materials with overall reduced costs.							
DP220100891	**The long-term impact of short-lived, fluorinated pollutants.**	79,706.00	117,737.00	78,487.00	40,456.00	0.00	0.00	316,386.00
Hansen, Dr Christopher S	In 1987, the Montreal Protocol has regulated the manufacture and use of compounds that deplete the ozone layer. Industry has innovated to produce new compounds that do not affect ozone levels, for use in refrigeration and other applications for modern society. We have discovered that the current generation of compounds called hydrofluoroolefins decompose in the atmosphere to produce the worst global warming gas known. We hypothesise that other HFOs will also decay into global warming compounds. In this project we will determine the atmospheric consequences of modern refrigerants. Expected benefits include determination the best and worst compounds for environmental impact, and data to guide industry and legislators.							
	National Interest Test Statement							
	Since the 1980s, the Montreal Protocol has regulated the manufacture and use of compounds that deplete the ozone layer and form the Antarctic ozone hole. Since then, industry has innovated to produce new compounds for use in refrigeration, fire fighting, and other important applications for modern society. The latest generation of refrigerant gases has no impact on ozone levels. However we hypothesize that they partially decompose into strong global warming gases, i.e. one environmental hazard has been exchanged for another. In this project we will determine the environmental fate of this new class of gases and determine which of them present the greatest and least hazard to both ozone and climate change. This work will provide important benchmarks for both industry and regulators to minimise the environmental impact of these crucial industrial gases.							
DP220101023	**How inequalities affect attitudes and behaviours concerning sex and gender**	70,019.00	154,822.50	163,771.50	78,968.00	0.00	0.00	467,581.00
Brooks, Prof Robert C	This project addresses how economic inequalities—between and within the sexes—shape behaviour, gender sentiment, and violence both online and 'in real life'. The research brings evolutionary understandings of sexual marketplaces together with the psychology of social behaviour, to shed new light on the origins of sexual conflict and harmful gender ideologies. This project integrates within-individual variation, careful experimental dissection of the sources of inequality, and the study of large-scale (among cities, among countries) patterns of behaviour on social media. A fuller understanding of how and why inequalities affect behaviour presents opportunities for improved social policy and responses to gendered violence and cyberhate.							

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	National Interest Test Statement Large inequalities between individuals and between groups tend to hinder economic growth, impede well-being, and polarize societies. Inequalities are balmed for recent surges in right-wing populism, home-grown terrorism, and online hate. We will combine the strengths of social psychology and evolutionary theory to understand the complex ways in which gender inequality and within-sex income inequality influence behaviour in Australia and worldwide. The research will provide novel insights in raising women's labour force participation, improving wellbeing for both sexes, and reducing domestic abuse. Such insights will ultimately improve economic productivity and growth, and domestic peace. The project will also demonstrate the usefulness of using publicly available, anonymous social media data to predict real-world imminent violence and right-wing terrorism. This approach may provide a cost-effective means for prospectively predicting violence outbreaks, allowing the Australian government to divert resources to prevent and counteract future violence or anti-democratic behaviour.							
DP220101038 Valipour, Dr Hamid	**Torsion in innovative timber composite floors** Application of lightweight sustainably sourced timber panels combined with steel beams or reinforced concrete slabs in composite floors has the potential to significantly improve the speed and efficiency and reduce the carbon and energy footprint of the construction industry. This project aims to produce world first benchmark experimental data and advanced numerical and simple analytical models required for efficient, yet safe and reliable analysis and design of timber-concrete and steel-timber composite floors subjected to complex 3-dimensional loading scenarios that involve combinations of torsion, bending and shear. The outcomes of this project are expected to promote innovation and advance knowledge in the field of structural mechanics.	55,000.00	120,000.00	115,000.00	50,000.00	0.00	0.00	340,000.00
	National Interest Test Statement Due to effects of climate change and rapid urbanisation, the construction sector as one of the largest contributors to Australia's gross domestic product has been under pressure to reduce its carbon and energy footprint and meet the increasing demand for sustainable buildings and infrastructures. This project will deliver substantial environmental and societal benefits by promoting greater, and more efficient and reliable use of locally manufactured and sustainably sourced timber panels in structures. The lightweight attribute of timber composite floors and decks is conducive to prefabrication that in turn increases speed and efficiency of construction and reduces noise, dust and interference with the surrounding environment, particularly in busy urban areas where most of the large commercial, residential, and institutional construction typically take place. Additionally, the efficient use of timber in construction is expected to bring benefits such as reduced embodied energy and carbon, and a route to sustainable forest management which are all key tenets of the United Nations Sustainable Development Goals.							
DP220101043 Panchenko, Prof Valentyn	**Understanding macroeconomic fluctuations with unobserved networks** Whilst empirical evidence suggests that firm-level shocks can have large aggregate effects, via network connections, macroeconomic policies have mostly an aggregate nature. This project aims to build a new framework to disentangle aggregate shocks from shocks to individual units. The major innovations are i) to infer the network from the data and ii) to jointly estimate aggregate factors and network effects. Expected outcomes are i) measures of systemic risk and ii) a theoretical framework to study the optimality of aggregate versus sectoral stabilization policies. Benefits include a better understanding of macroeconomic fluctuations in Australia and proposed economic policies to mitigate large and persistent declines in employment and GDP.	33,812.50	67,570.50	66,012.00	32,254.00	0.00	0.00	199,649.00
	National Interest Test Statement This research aims to shed light on the stability of Australia's financial and economic systems and on the underlying mechanisms through which future economic downturns may arise. In particular, we aim to establish the relative importance of economic shocks to individual units (e.g. firms, banks, industries) versus aggregate shocks to the economy as a whole, the sources of these shocks (e.g. from large overseas financial institutions), and how they propagate through the economy. Our findings would be used to evaluate the relative merits of unit-specific and aggregate stabilisation policies, yielding policy recommendations for improving economic stability in Australia. Ultimately, this research could improve macroeconomic stability and resilience to global economic downturns.							

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DP220101187	**A mmWave Sensor Network for Hand Gesture Monitoring**	68,500.00	133,500.00	134,000.00	69,000.00	0.00	0.00	405,000.00
Hu, A/Prof Wen	This project aims to realise a world-first mmWave radar-based sensor network for device-free ubiquitous hand gesture monitoring. By harnessing recent radar technology breakthrough in mmWave, hand gesture may be monitored in a non-privacy intrusive manner. Pilot studies show different handrub gestures can be sensed and recognised by analysing the radio signal variations in the receiver. Given the many social, economic and health advantages of low-cost and non-privacy intrusive hand gesture sensing --- including enabling interactions and communications with smart environments (e.g., homes and offices) in a natural way --- the proposed research promises multiple benefits while positioning Australia as smart buildings innovator.							
	National Interest Test Statement							
	The proposed mmWave radar-based device-free hand gesture sensor network technology enable us to interact with smart home and office systems in one of the most natural ways. By adding value to existing smart home and office systems, the proposed research is expected to bring major commercial benefits to this rising $40 billion industry. The proposed hand gesture sensor network technology can also be used to monitor handrub gestures to improve hand hygiene. This ubiquitous handrub/hand hygiene monitoring could be integrated into care and health systems, as one of the most effective ways to prevent the spread of deadly viruses and cross-infection, to deliver associated-cost savings. Therefore, this project aligns with both the "Advanced Manufacturing" and "Health" national Science and Research priority areas.							
DP220101339	**How hormones help to overcome fear: from rats to humans**	71,673.00	145,144.00	148,738.00	75,267.00	0.00	0.00	440,822.00
Graham, A/Prof Bronwyn M	This project aims to identify how sex hormones regulate the ability to overcome fear in male and female rats, and test the translation of these mechanisms in humans. Current theories of how we overcome fear are severely limited because they were derived from studies that overwhelmingly focused on males, and the impact of sex hormones has been relatively ignored in both sexes. This project is significant because it will lead to the development of ecologically valid, sex-specific models of how we overcome fear. The outcomes will illustrate how underlying mechanisms of fear regulation differ between males and females, and will provide a foundation from which future research can develop sex-specific means of optimising treatments for anxiety.							
	National Interest Test Statement							
	Anxiety disorders are the most common class of mental illness in Australia and cost $5 billion annually in treatment costs and productivity loss. Women are twice more likely than men to develop anxiety disorders, yet laboratory research on fear regulation, which informs the development of anxiety treatments, has focused almost exclusively on males. This project will address this critical knowledge gap by combining innovative methodologies from diverse disciplines, including endocrinology and psychology, to map the impact of female-unique hormonal factors, like the menstrual cycle, on fear regulation in females. The project will also elucidate a novel role for sex hormonal signaling in fear regulation in males. Outcomes will provide foundational knowledge that can be used in future research to tailor treatments for anxiety disorders according to the unique hormonal profiles of men and women, and improve the health and well-being of the 2.3 million Australians suffering from anxiety, thus reducing the considerable associated economic costs of anxiety, in line with our national Science and Research Priorities.							
DP220101427	**Engineered interlayers of bio-retardant and nano-reinforcement on polymers**	51,649.00	108,011.00	114,520.00	58,158.00	0.00	0.00	332,338.00
Yeoh, Prof Guan H	This project will address the important need for a highly effective lightweight coating. Different interlayers of bio-retardants derive from organic compounds and two-dimensional sheet-like nanomaterials are fabricated to enhance the charring, thermal barrier and flammability resistance. Molecular dynamics are adopted to deliver more targeted fabrication to achieve increased efficacy of the engineered interlayers and provide important insights on the combustibility of polymers undergoing mass diffusivity, thermal diffusion and oxidation process at high temperatures. Expected outcomes of the project are lightweight coated polymers possessing elevated resistance to fire with a significant reduction of toxic gas emissions and smoke releases.							

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	National Interest Test Statement The pervasive fire threat to human life, property, assets and the environment continues as many synthetic materials are made from flammable polymers. Polymers have clearly shown to burn very rapidly when ignited and produce immense heat, dense smoke and gases that are irritating, flammable and toxic products comprising harmful asphyxiant gases such as carbon monoxide and hydrogen cyanide. During a fire outbreak, flames from these flammable materials may engulf entire domestic dwellings or commercial premises within a short time, resulting in significant structural damage and possible human casualties. This study will overcome the flammability and toxicity of polymers by developing a unique lightweight coating comprising heterogenous interlayers of non-toxic, eco-friendly bio-retardants and two-dimensional sheet-like nanomaterials that will be highly effective in flameproofing polymers. As such, it will not only provide enhanced mechanical and thermal stabilities but also limit the combustible gas volatiles and harmful asphyxiant gases being emitted as a result of the flames meeting the flammable polymers.							
DP220101436 Bonduriansky, Prof Russell	**Uncovering the transgenerational dimension of ageing** Despite over a century of research on the biology of ageing, one intriguing aspect of ageing – the widely observed tendency for older parents to produce offspring with reduced lifespan and fitness – remains poorly understood. Such effects could be a major source of variation in individual fitness, could play a role in the evolution of ageing, and could impact human health. Building on recent discoveries by CI Bonduriansky's research group and others, this project's aims will address significant questions about the mechanisms mediating these effects, the roles of mothers vs. fathers, and the role of the ambient environment. This project will also contribute new theory on the evolutionary implications of such effects.	65,500.00	147,000.00	153,000.00	71,500.00	0.00	0.00	437,000.00
	National Interest Test Statement Australians are choosing to have children later in life, and it is therefore imperative to understand how the mother's and father's ages at reproduction affect children's health. Studies on human cohorts as well as other organisms suggest that children of older parents tend to have compromised health and reduced longevity, but the physiological and environmental factors shaping these effects remain poorly understood. Because many physiological processes are shared by all complex animals including humans, experimental investigations on small, rapidly breeding animals offer powerful and cost-effective tools for fundamental research on these effects. This project will build on ground-breaking discoveries to address key questions about the physiological and genetic mechanisms mediating effects of parental age on offspring longevity and fitness, the roles of parental diet and stress, and the interaction of maternal and paternal ages. This research will substantially enhance basic knowledge of this poorly understood transgenerational dimension of the ageing process.							
DP220101489 Quinlan, A/Prof Kate G	**Transcription factors find their targets by reading the epigenetic code** This project aims to elucidate how transcription factors, proteins that regulate gene expression, find their target genes. The hypothesis is that non-DNA binding domains play an essential role in this process. This project expects to transform our understanding of transcription factor families, and how factors in families with the same DNA-binding domain manage to regulate different genes. Expected outcomes of this project include revealing how accessory proteins help transcription factors identify their targets in the genome by reading epigenetic marks. This should provide significant benefits including improved design of artificial transcription factors to up- or down-regulate specific genes in research and agriculture.	85,079.00	175,995.50	180,210.50	89,294.00	0.00	0.00	530,579.00
	National Interest Test Statement The amount of protein or enzyme produced in a cell is largely regulated by the amount that its corresponding gene is expressed. The regulation of this process is fundamental to normal development and function of plants and animals and its perturbation can lead to disease. This project seeks to generate new knowledge of how this fundamental biological process is controlled. Understanding of the regulation of gene expression is critical for efforts to artificially alter the production of specific proteins. This is important for the advancement of bioengineering and bioproduction industries that aim to grow synthetic food, artificial organs, and medicines, and for enhancing food production, improving animal health, reducing environmental impacts, and increasing sustainability. Each of these has potential to benefit Australia through supporting these industries and securing sovereign capabilities in these important areas.							

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DP220101532 Ekins-Daukes, A/Prof Nicholas J	**Energy resolving photodetection through extracting hot carrier photocurrent** The project will develop infrared metallic hot-electron photodetectors for energy and wavelength resolving photodetection. With the varied applications of infrared photodetectors in Australia, the project aims to establish a novel photodiode architecture that harnesses thermal energy through hot-electrons for high speed and broadband photodetection. By enabling energy resolving photodetection, the photodiode will combine research laboratory scale capabilities into a single optical element. Advanced hot-electron absorber materials will be studied. The research outcomes have applications from telecommunications to biotechnology where photodetectors are a critical sensing component, and for metallic hot electrons utilised in photocatalysis.	70,000.00	140,000.00	135,000.00	65,000.00	0.00	0.00	410,000.00
	National Interest Test Statement Photodetectors are crucial for sensing light in a variety of fields with applications in telecommunications, biotechnology and defence, with expanding remote sensing opportunities in wearable consumer electronics, manufacturing process control and environmental monitoring for infrared detectors. By realising a novel photodetector architecture that harnesses thermal energy through hot-electrons, we will demonstrate the capacity for high speed and broadband photodetection extending into the infrared. Furthermore, we will demonstrate energy resolving photodetection, a paradigm shifting technological innovation which combines research laboratory scale capabilities into a single optical element, giving rise to commercialisation opportunities for the Australian technology industry. The creation of advanced fast infrared photodetectors has the strategic benefit of enabling future defence R&D partnerships. The development of the high-performance metallic absorber alloys for hot electron generation will contribute towards advanced manufacturing in Australia for optoelectronic and photocatalytic applications.							
DP220101592 Hayes, Prof Brett K	**Exploration, Generalisation and the Development of Learning Traps** This project addresses three fundamental questions about human decision-making; 1) how does exploratory choice lead to “learning traps”, persistent patterns of poor decision-making that cause us to miss rewards and experience losses? 2) how does susceptibility to traps change with age? 3) what strategies prevent traps or facilitate escape? The project will advance our understanding of the cognitive processes underlying adult and child decision-making, using innovative experimental paradigms and computational modeling. Expected outcomes include a novel computational model that explains developmental change in trap formation. The results will guide strategies for improved decision-making in educational, financial, and social settings.	67,720.50	131,418.00	129,401.50	65,704.00	0.00	0.00	394,244.00
	National Interest Test Statement Learning traps are patterns of poor decision-making that commonly occur in financial, social, medical and educational settings. They can lead for example, to a consumer repeatedly purchasing products that perform less well than other options, or in the formation of false negative impressions of other individuals or groups. This project aims to determine how and why such traps form, and to develop strategies for trap prevention or escape. Project results will expand our understanding of how problematic decision-making arises. Our results are likely to be of significant benefit to the Australian financial and medical sectors by guiding strategies for training decision-makers in these fields. The project findings will also offer guidance for public policy makers for developing effective, evidence-based approaches for reducing social stereotyping and prejudice against minority groups. Because the project addresses age-related changes in learning traps, our results will also provide a guide for developing educational approaches that enhance learning and critical thinking in pre-school and school-age children.							

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DP220101598	**Assessing Architectural Aesthetic Character: An 'Intelligent' Approach**	60,000.00	120,000.00	120,000.00	130,000.00	70,000.00	0.00	500,000.00
Ostwald, Prof Michael J	This project aims to develop ground-breaking insights and software to improve the assessment of architectural aesthetic character by Australia's designers, councils and courts. Combining empirical, neurophysiological and machine-learning approaches, this project expects to provide a new level of robustness and repeatability in administrative and legal assessments of building aesthetics. Planned outcomes include: (i) a unique quantitative understanding of aesthetic assessment and (ii) a world-first method for measuring and comparing the character of buildings. This research has the potential to reduce the substantial cost of disputes and provide more certainty and efficiency in the architectural design, approval and appeal processes.							
	National Interest Test Statement In Australia, uncertainty and disputes about the assessment of architectural aesthetic character result in substantial inefficiencies and loss of productivity costing in the order of $400 M per year. One reason for this costly situation is that the building design, council approval and legal appeal processes in Australia do not have access to an objective and repeatable system for measuring and comparing the character of a building and its surrounding context (a property called 'contextual fit' in legislation). In response, this project uses a unique combination of empirical, neurophysiological and artificial intelligence methods to develop a new architectural aesthetic assessment method. This world-first method will provide an objective and repeatable approach for measuring and comparing contextual fit. This method has the potential to be used in Australia's architectural practices, councils and the courts to reduce the cost of aesthetic assessment, which in turn will diminish the economic burden of legal appeals on taxpayers.							
DP220101632	**China's Belt and Road Initiative: A New Model of Economic Governance?**	41,625.00	106,625.00	100,000.00	35,000.00	0.00	0.00	283,250.00
Wang, Prof Heng	China's Belt and Road Initiative (BRI) involves thousands of projects in the world, with a combined value over USD 1 trillion. Under the BRI, China is constructing new norms and legal institutions to govern international economic activity. But the opacity of the BRI means that little is known about the details of these arrangements or their operation in practice. This socio-legal project will examine how the BRI is changing the way that cross-border economic interactions are governed, and explore the implications of these changes for how power and authority are exercised in the global economy. The project's findings will equip Australian policymakers, businesses and publics to navigate more astutely the changes that the BRI is advancing.							
	National Interest Test Statement China's Belt and Road Initiative (BRI) poses major economic and foreign policy challenges to Australia, as illustrated by China's recent agreement with Papua New Guinea to build a new port 200km from Australia and the wider controversy around Victoria's participation in the BRI. In particular, Australian policymakers and businesses need insight into how the BRI is changing the way that cross-border economic interactions are governed. DFAT Secretary Adamson highlighted the urgency of this challenge in 2017: "The Australian Government is mindful that major economic initiatives can have profound geopolitical effects. This is all the more reason for the Australian Government to think constructively yet clearly about the principles, rules and institutions that underpin an initiative such as Belt and Road given its scale, ambition and complexity." This project contributes to Australia's national interest by directly answering this challenge. It will uncover the principles, rules and institutions that underpin the BRI, including recent developments, and clarify the implications of these governance arrangements.							
DP220101649	**Evolutionary computation for expensive bilevel multiobjective problems**	65,000.00	130,000.00	130,000.00	65,000.00	0.00	0.00	390,000.00
Singh, Dr Hemant K	This project aims to develop an evolutionary computation framework to solve computationally expensive bilevel multiobjective problems. The research is fundamental in nature and will address key open challenges in solving such problems, including hierarchical decision-making, multiple performance criteria, uncertainties and computational expense. The proposed research has applications in diverse domains such as environmental policy formulation, network design, engineering, defence and cybersecurity; offering significant benefits to the researchers and practitioners in these fields. In addition to research outputs, it will strengthen international collaboration and build research capacity to put Australia at the forefront of this research.							

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	National Interest Test Statement Real-world problems often involve hierarchical decision-making, where entities at two levels want to maximize their own objective interests. As an example, consider a taxation policy design problem that involves two stake holders: a government regulator with a goal of minimizing environmental impact, and a mining company with a goal of maximizing profits. Such "bilevel" problems pose certain characteristic challenges such as presence of multiple conflicting objectives, operational uncertainties, and expensive design evaluations, which the existing solution methods are unequipped to handle. This project aims to overcome this research gap by developing computationally efficient methods to solve bilevel problems. The research is fundamental in nature, has the potential to contribute to areas of strategic importance to Australia, such as management of environmental resources, resilient design of infrastructure networks, defence and cybersecurity. The main beneficiaries of the technology developed would be researchers and practitioners involved in optimizing designs and processes in these areas.							
DP220101811 Dick, Prof Josef	**Novel Mathematics and Efficient Computational Techniques for Human Vision** This project aims to develop a new mathematical framework to understand elastic properties of human corneas. The project expects to generate new knowledge in understanding bio-mechanical models for human corneas, as well as other engineering applications involving materials with random fluctuations of elasticity. Expected outcomes of this project include new mathematics and computational algorithms for solving complex mathematical equations which describe elastic and hyper-elastic materials such as human corneas. This project will benefit Australia by enhancing the standing in cutting edge research trends in computational mathematics such as uncertainty quantification and machine learning.	67,500.00	136,000.00	138,500.00	70,000.00	0.00	0.00	412,000.00
	National Interest Test Statement The project will contribute to research innovation in computational methods and algorithms for solving linear and non-linear elasticity equations that arise from bio-mechanical models of human corneas and other related models. The outcomes of the project are expected to be new mathematics and computer algorithms that enable a better understanding of the elasticity properties of the human cornea. These outcomes are expected to benefit health professionals such as optometrists and ophthalmologists to gain a better understanding of human eyes. The project also enhances Australia's standing in the international research community in the important areas of computational mathematics, including uncertainty quantification, and machine learning, through impactful research publications and high profile visitors.							
DP220101847 Beves, A/Prof Jonathon E	**Go with the flow! Using diffusion to direct the transport of molecules** This project aims to understand the mechanisms behind the directed bulk transport of molecules by controlled diffusion and flow linked by chemical reactions and chemical concentration gradients. The significance of this project is it will provide the first detailed experimental data to test proposed theories and produce a fundamental understanding of how molecules can undergo controlled transport in dilute solutions. Expected outcomes include a new understanding of how molecules can be guided toward their desired targets, which could have applications in waste collection or sensing by concentrating analytes, and for understanding biological processes.	91,000.00	194,500.00	141,500.00	38,000.00	0.00	0.00	465,000.00
	National Interest Test Statement The main goal this project is to address: How can we guide chemicals towards their target? By addressing the fundamental question of how to control the transport of molecules in solution, the outcomes of this project will underpin better understanding of the transport of fuels and signals within cells which has implications for how we sense, collect and dispose of chemical waste, and for our methods for chemical production. The project aligns with the Science and Research Priority of Australia in Advanced Manufacturing and the Practical Research Challenge, ‘Cross-cutting technologies'. The interdisciplinary and collaborative project will generate fundamentally new knowledge and develop new technologies. The international linkages with world leaders developed in this project are a strong benefit to Australian science and will contribute strongly to Australia’s innovation capability. This multidisciplinary research will lead to the training of Australia’s future highly-skilled scientists required for Australia’s important future nanotechnology, chemical and biotech industries.							

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DP220101883	**Efficient strategies for visually guided flight: from insects to drones**	65,936.50	134,120.50	139,675.50	71,491.50	0.00	0.00	411,224.00
Garratt, Prof Matthew A	Flying in real environments, that are densely cluttered with obstacles, is a major challenge limiting the proliferation of aerial robotic technology yet flying insects such as honeybees accomplish this task with ease. This project will seek to uncover the salient vision-based flight-control strategies implemented by insects to deal with clutter. These will be used to develop sensory and information processing frameworks for implementation in miniature robotic systems which will allow them to navigate autonomously in complex environments even when GPS positioning is denied. Such capabilities will expand the operational domain and potential applications for small autonomous vehicles while improving our knowledge of insect locomotion.							
	National Interest Test Statement							
	The intended research outcomes will benefit Australia scientifically, technologically, socially and economically. Scientifically, this project will unravel the sensory and computational processing strategies underpinning the remarkable flying abilities of insects. The project will also lead to the development of innovative scientific approaches for enabling flying robots to perform autonomously even in complex environments thus placing Australia in the forefront of this field. Technologically and socially, results obtained will have direct application to bio-inspired miniature air vehicles and other unmanned aerial robotic platforms that are increasingly becoming part of our society. Increased autonomy in realistic environments will enhance safety of operations of these robots allowing an even greater range of utility and operating conditions. Economically, the research capability developed has the potential to increase the global competitiveness of intelligent drone technology in Australia.							
DP220101938	**Decoding regulatory RNA function in bacteria**	102,500.00	205,000.00	185,000.00	82,500.00	0.00	0.00	575,000.00
Tree, Dr Jai J	All complex biological processes in bacterial cells appear to utilise regulatory small RNAs to control gene expression, but we lack a systems-level understanding of their functions and mechanisms of control. This proposal aims to address this fundamental knowledge gap using machine learning and cutting-edge, systems-level techniques to determine how small RNA sequence and structure determines function. Small RNAs have been found to control a broad range of traits including metabolism, biofilm formation, antibiotic tolerance, and virulence. The work proposed here will enhance our ability to predict and control bacterial gene expression with potential future impacts on bioproduction, synthetic biology, and veterinary and medical microbiology.							
	National Interest Test Statement							
	Microorganisms and microbially-driven processes permeate almost every aspect of our lives. From food microbiology, to bioproduction of vaccines and vitamins, to human and animal disease - bacteria use regulatory small RNAs to sense and respond to their environment. Hundreds of these gene regulatory elements have been uncovered in industrially and medically significant bacterial species, but we lack a comprehensive understanding of how this fundamental layer of gene regulation controls functions. This knowledge gap will be addressed in this proposal using cutting-edge sequencing technologies and machine learning that will allow precise predictions of regulatory RNA function in a broad range of bacterial species. The project outcomes will improve our ability to control microbially-driven processes including the bioproduction of recombinant proteins, vaccines, primary and secondary metabolites, and biopharmaceuticals from bacteria.							
DP220101999	**Future stories: creating virtual worlds with young people in hospital**	45,000.00	95,000.00	105,000.00	55,000.00	0.00	0.00	300,000.00
Balfour, Prof Michael S	The project will address the ways in which participation in the arts impacts on the wellbeing of young people in hospital. It acknowledges the circumstances of the young people and the conditions of the location, and examines the potential of supporting young people during their stay in hospital through creativity and new technologies. It will explore the affordances of combining arts approaches with virtual reality (VR) technology to provide a positive experience for young people in hospital. The project aims to develop opportunities for creativity in hospital and pioneer the use of secure cloud-based peer-to-peer virtual reality interaction that facilitate communication and interaction across hospital and home environments.							

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	National Interest Test Statement Hospitalisation can be a challenging and dislocating experience for young people. The double burden of illness and disconnection from normal social networks can have long-term consequences, including delays in developmental skills, attention and concentration problems, and increased vulnerability to other life stressors. The project aims to provide evidence of the ways in which the arts and co-designed virtual reality experiences can contribute to meeting a young person's social needs in hospital beyond the clinical treatment. The outcome of the project addresses the Action Plan for the Health of Children and Young People (2019) priority to develop best practice approaches to support young people to continue engaging in learning and social connection when in health service settings. The use of virtual reality also connects to the Government's (2019) priority for the innovative application of technology within health care contexts.							
DP220102159 Solo, Prof Victor	**Estimation and Control of Noisy Riemannian Systems** Many application areas such as satellite control, computer vision, coordination of rigid bodies, require the estimation and control of systems subject to geometric constraints. Most current algorithms for doing this are deterministic and can fail catastrophically in the presence of noise. This project aims to provide: (i) Methods for analysing and then redesigning deterministic algorithms to ensure stability in the presence of noise; (ii) New design methods that deal with noise in an optimal way; (iii) Noise resistant methods for distributed consensus seeking systems and cooperative control systems. The outcomes will advance and benefit spatio-temporal data analysis and coordination in areas such as transport, health and video-security.	80,000.00	160,000.00	160,000.00	80,000.00	0.00	0.00	480,000.00
	National Interest Test Statement Tracking of moving rigid objects such as robot arms in a manufacturing environment, mobile robots on land, satellites in space, is a challenging problem with numerous commercial, industrial and security applications. The sensors that deliver the data used for tracking are noisy and when that noise is ignored, as with many current algorithms, large errors or even failure can result. Further the motions of these rigid objects are partially constrained and these geometric constraints must be taken into account to enable safe and efficient operation. This project aims to develop new statistical signal processing and control engineering algorithms and tools that will enable such tracking tasks for partially constrained moving rigid bodies when the sensor data is noisy. Given the application areas listed above this could provide benefits across a range of commercial, industrial and health sectors both locally and internationally.							
DP220102231 Faasse, Dr Kate	**Living down to expectations: generic medicines and the nocebo effect** This project aims to generate new knowledge of how the awareness of taking a generic medicine can lead to increased nocebo effects (side effects caused by negative expectations). The project is expected to deepen scientific understanding of how generics can trigger nocebo effects by using an innovative experimental approach to tease out contributing key features, explore the role of conscious and nonconscious negative expectations, and test novel strategies to reduce these nocebo effects. Expected outcomes of this project include theory development and enhanced understanding of nocebo effect causes and mechanisms. This should provide significant benefits, including potential strategies for mitigating nocebo effects of generic medicines.	54,875.00	111,750.00	123,400.00	66,525.00	0.00	0.00	356,550.00
	National Interest Test Statement Generic medicines are a crucial part of the Australian healthcare system, providing safe, effective, and affordable medicines. However, negative expectations about generics are common, and generics are often associated with increased side effects. These side effects are likely to be caused by the nocebo effect, whereby unpleasant sides effects are caused by negative expectations. Nocebo effects from generic medicines lead to substantial healthcare costs caused by treatment discontinuation and unnecessary switches to costly branded drugs. Little is known about how the key features of generics contribute to nocebo effects, or whether these features trigger negative expectations within or outside of conscious awareness. The current project involves important new fundamental research that will uncover how generics trigger nocebo effects and test novel strategies to reduce these effects. This will provide substantial benefit to Australia, setting the stage for translational research that will allow us to reduce nocebo effects from generic medicines, improving patient outcomes and reducing healthcare costs.							

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DP220102278	**Why do neutrophils swarm?**	91,104.50	184,456.50	188,949.00	95,597.00	0.00	0.00	560,107.00
Chtanova, Dr Tatyana	This project aims to combine novel immunology, microscopy and computational approaches to investigate how immune cells called neutrophils cooperate to protect the host against microbes. Neutrophils are rapidly recruited to sites of inflammation and then utilise a type of highly coordinated collective behaviour termed swarming. However, the role of neutrophil swarms in fighting off infection is poorly understood. The project is poised to generate new knowledge on the importance of immune cell cooperation by developing in silico models of the immune response. The project will provide benefit through enhanced understanding of fundamental principles of immunity and develop new computational tools to model complex immune function in silico.							
	National Interest Test Statement							
	The immune system (white blood cells) employs multiple strategies to protect the host from the spread of infection. Since bacterial infection is a fundamental issue affecting the livestock industry and Australian fauna, improving our understanding of anti-microbial immunity will provide an important contribution to Australia's national interest. This research project will study how immune cells work together to respond to pathogens. The immune system uses unique, but poorly understood strategies to guard against infection and this project will generate new knowledge in the areas of immunity and uncover the broad evolutionary significance of immune cooperation. In addition, by combining state-of-the-art microscopy approaches with sophisticated mathematical models, the tools developed here will provide a new technological platform to study cell cooperation. The development of these new cross-disciplinary sciences will contribute to Australia's future technological capacity. This project will also promote the exchange of knowledge and build a strong international multidisciplinary collaborative network.							
DP220102317	**Brain circuits for parsing aversion**	53,957.50	107,901.00	116,054.00	62,110.50	0.00	0.00	340,023.00
Jean-Richard-dit-Bressel, Dr Philip	This project aims to map the brain mechanisms by which adverse events shape our decisions and behaviour. It combines cutting-edge neuroscience techniques with advanced approaches from experimental psychology. This project expects to provide new knowledge about how we learn about avoidable and unavoidable danger to guide behaviour, from critical neurotransmitter systems to specific brain circuits. Expected outcomes include significant advancements in our understanding of aversive learning processes, motivation and decision-making. Alongside theory development, the outcomes of this project can be used to benefit the development of treatments for depression and anxiety disorders, of which dysfunctions in aversion are a defining feature.							
	National Interest Test Statement							
	Learning about adverse events is fundamental to adaptive and healthy decision-making and behaviour change. We need to respond to danger to make choices that minimise harm. However, how the brain produces adaptive (and maladaptive) choices in response to aversive events remains poorly understood. This basic science project will provide new insights into how the brain supports learning about avoidable and unavoidable danger and how this guides behaviour. The work will highlight critical neurotransmitter systems and specific brain circuits underpinning behavioural choices driven by aversive events. Understanding the mechanisms of decision-making and choice driven by adverse events will provide a framework for our better understanding of functional and dysfunctional aversively-motivated learning. This knowledge can also provide principles of learning that promote better choices and decision-making in the context of risk, including educational and workplace settings and where dysfunctional risk-based decision-making is present such as addiction, depression and suicide.							

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DP220102338	**The effect of methylation and phosphorylation on ribosome function**	74,350.00	149,740.00	156,515.00	164,045.00	82,920.00	0.00	627,570.00
Wilkins, Prof Marc R	This project aims to discover how cells regulate ribosome function and selectivity, by modifying their ribosomal proteins. This affects protein synthesis, a process which is central to the growth of all living things. Expected outcomes include new knowledge on the regulation of protein synthesis, improved techniques for the study of this process and an enhanced capacity for international collaboration. New avenues for the artificial regulation of the ribosome may also emerge, relevant to synthetic biology and the engineering of industrial yeasts. The project should provide significant new findings for the research community, generate research citations and contribute to a highly skilled workforce by the training of staff and students.							
	National Interest Test Statement							
	This project will generate significant new knowledge concerning how cells regulate protein synthesis. This universal process, conserved across all animals and plants, ultimately affects the growth of all living things. A deeper understanding of how this fundamental process is regulated at the cellular level will generate important insights for synthetic biology, which in turn will grow Australia's biotechnology industry. Bioengineering of the protein synthesis process could underpin increased efficiency and thus cell biomass, construction of synthetic polymers or exploitation of mRNA selectivity. In the near- to mid-term, the regulatory processes and principles discovered here could have potential applicability across a number of sectors, including the manipulation of industrial yeasts and crops to enhance food production, the development of novel plant and animal antifungals and human chemotherapeutics.							
DP220102378	**Slavery, Sugar, Race: Australia’s South Sea Islander Labourers**	32,702.50	102,199.50	133,370.00	63,873.00	0.00	0.00	332,145.00
Christopher, A/Prof Emma L	This project aims to recover and make usable the history of Caribbean sugar as a labour migration model, cultural repertoire and source of investment for the early Australian sugar industry. Working with international slave studies centres and Australian South Sea Islander organisations, we will use methodologies from four disciplines to explore the question of Pacific labour from every perspective. The latest digital humanities techniques will be utilised to create a database of Pacific Voyages. This will further understandings of Australia’s place in global labour and race history, create new resources for research and teaching in history, literature and sociology, and further Islander community initiatives.							
	National Interest Test Statement							
	Australia is today a top sugar exporter, but Australian South Sea Islanders, whose ancestors were imported by early sugar producers to cultivate the crop, remain largely alienated from academic retellings of the industry’s history. Uniting Australian scholars, prominent international slavery research centres, and the Australian South Sea Islander community, this project will explore the story of Australia’s early sugar industry through the people, investments, ideas of labour migration, and cultural norms that linked it to sugar production in the Atlantic. Creating an online, searchable database of Pacific Labour voyages, and an archive of Pacific Literature, it will build new, global understanding of Australia’s place in the history of sugar and aid Pacific Islander community initiatives.							
DP220102382	**Rethinking walking infrastructure: AI-assisted footpath network modelling**	72,500.00	137,500.00	130,000.00	65,000.00	0.00	0.00	405,000.00
Saberi, Dr Meead	The project aims to develop new macroscopic and network wide transport modelling and optimisation methodologies specific to walking suitable for large scale footpath network planning applications. The expected outcomes of this project are a novel Artificial Intelligence (AI) assisted tool for automated generation of footpath network attributes, and a set of equilibrium and non-equilibrium seeking walking route choice models driven by real-world individual walking trajectory data. This project will deliver a step-change in transport planning for walking infrastructure that will lead to increased active transport and improved urban infrastructure planning, thereby resulting in significant gains in population and environmental health.							

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	National Interest Test Statement							
	Walking is an indication of a city's liveability, economic vibrancy and health. Despite its potential to deliver significant benefits to society, walking is often overlooked in planning and investment decisions. Improved understanding of walking behaviour is critical to unlocking economic savings and can provide benefits for the community, environment, and economic prosperity with relatively low-cost infrastructure. The growing interest and need for investment in active transport across state governments in Australia (e.g. NSW government to invest $710m in walking and cycling as part of the 2020-21 NSW State Budget) calls for timely and appropriate tools and frameworks for reliable appraisal of walking infrastructure that is expected to reduce traffic congestion and create jobs. This project supports the development of new strategic planning tools for walking infrastructure.							
DP220102392 Zhang, Prof Jianqiang	**Corrosion of heat resisting alloys in steam/hydrogen-rich environment** Hydrogen is a clean fuel for energy future. Its production and utilisation unavoidably involve water vapour and hydrogen at high temperature which is however corrosive to materials used in the system. This project aims to investigate corrosion behaviour of heat resistant alloys in the presence of both hydrogen and water vapour, mechanisms of water transport in oxide scale, and the effect of hydrogen on water vapour corrosion. Alloying effects on corrosion rates will be defined and methods of slowing or preventing water vapour corrosion in the presence of hydrogen will be devised. The results will provide a basis for improved design/selection of heat resisting alloys for hydrogen production and hydrogen utilisation industries.	75,000.00	150,000.00	150,000.00	75,000.00	0.00	0.00	450,000.00
	National Interest Test Statement							
	Conventional fossil energy generates carbon emission. Development of new clean energy is a current direction to reduce this emission. As a clean energy source, hydrogen is an important part of our clean and secure energy future. Hydrogen production in electrolysis cells, and subsequent use in generating power or for direct reduction of iron ore is under development, but inevitably involve handling hot water vapour and hydrogen gases. Water vapour acceleration of oxidation is a widespread phenomenon, but the mechanism is still unclear, in particular in the presence of hydrogen. This project represents a comprehensive understanding of the problem of water vapour corrosion, the form of corrosion responsible for high temperature failures in several important industries. This understanding will lead to alloy improvement to resist corrosion in industries related to hydrogen production and utilisation.							
DP220102412 Martire, A/Prof Kristy A	**Misinformation: Evidence evaluation in an alternate fact reality** This project aims to understand why people believe misinformation. Misinformation causes some people to adopt implausible beliefs. These beliefs pose a significant challenge for society because they can result in behaviours that negatively impact personal and public safety. By combining surveys, qualitative analysis, and systematic experimentation, this project will identify differences in evidence evaluation and persuasiveness between people who believe misinformation and those who do not. It is anticipated that our novel approach will build knowledge about misinformation effects and will reduce associated harms by expanding our understanding of how to communicate effectively with people who are persuaded by misinformation.	52,346.00	125,299.50	152,667.50	79,714.00	0.00	0.00	410,027.00
	National Interest Test Statement							
	Misinformation undermines the social, economic, commercial and environmental security of Australia. Misinformation can create prejudice, conflict and discord. In doing so it has the potential to limit the success of public health initiatives, slow the implementation of sustainable environmental policies, and exacerbate social and economic inequalities. By expanding our understanding of what makes misinformation persuasive, this project will provide new information about how misinformation is believed and how is spreads. These insights will form the basis of evidence-based strategies for disseminating accurate, reliable and persuasive information to the Australian public, thereby minimising the social and individual harms caused by misinformation in Australia.							

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DP220102436	**Solar powered water splitting/flow cell system for hydrogen and electricity**	72,500.00	145,000.00	145,000.00	72,500.00	0.00	0.00	435,000.00
Pan, Dr Jian	This project aims to develop an advanced solar energy conversion system for converting solar energy to hydrogen fuel and electric power. It aims to achieve unprecedented conversion efficiency by Integrating solar water splitting with the rechargeable battery. The solar-powered system without external bias assisted can split water and charge the battery. The significance of this project is to propose an innovative concept of efficient energy conversion and establish a promising research area of solar energy utilization. The project's success will bring game-changing breakthroughs, push the frontier of solar energy and accelerate its practical application in the hydrogen industry, which is crucial to Australia National Hydrogen Strategy.							
	National Interest Test Statement							
	This project aims to provide a new solution to push the solar-powered PEC water splitting towards its practical application and boost the hydrogen generation, which will significantly contribute to Australia's National Hydrogen Strategy. The technology will alleviate the urgent energy and environment issues, optimise the national energy structure and create enormous economic benefits since Australia has abundant solar energy. The success of this project will boost the related sciences and technologies in solar energy conversion and application, semiconducting materials and clean energy storage. The outcomes will significantly promote economy and bring profound social impact. By adding hydrogen production to our economy, it could create jobs, especially in regional areas, and increase prosperity. It could help integrate renewable energy into our electricity grid and lower bills in the long term. It can reduce dependence on imported fuel and reduce carbon emissions in Australia and around the world.							
DP220102437	**Making New Readers: The Australasian Book Society and the Cold War**	22,500.00	52,500.00	85,000.00	55,000.00	0.00	0.00	215,000.00
Moore, Prof Nicole R	This project aims to produce the first full history of one of the boldest ventures in Australian publishing. The Australasian Book Society sought to develop new readers and writers in mid-century Cold War Australia. Using a rich web of archival sources, this project shows whether and how the Society met those ambitious aims. New knowledge about the unique business model of a grassroots nationalist publisher will lead to deeper understanding of the development of Australian working-class writing and reading. This will afford new insights into Australian literary identity for a nation still committed to reading, an archive preserved for future generations and, for the determining global history of the Cold War, a revealing Australian case.							
	National Interest Test Statement							
	This project offers numerous benefits to the Australian community. Even after the digital revolution, Australia remains a reading nation. Australians value reading as a leisure activity and they care deeply about Australian books and the Australian book industry. This research sheds new light on one of the most interesting chapters in the history of publishing in Australia: the bold, grassroots activities of the Australasian Book Society, with its cooperative, subscription-based model. The project secures the publisher's archive for future generations and makes its findings accessible to the wider public through a digital exhibition and several podcasts. Policy-makers, publishing industry professionals and the education sector will be engaged by the lessons that can be learned from the publisher’s efforts to make literature more relevant to lower socio-economic groups. To the global community of scholars, increasingly interested in the activities of non-superpower players in the Cultural Cold War, this project reveals an enlightening case that will vividly illuminate the Australian experience.							

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DP220102466 Kable, Prof Scott H	**Atmospheric Photothermal Oxidation as a New Reaction in the Atmosphere** Atmospheric models provide crucial advice on the current and future impacts of human activity on the atmosphere. This project hypothesizes the presence of a new class of chemical reactions that are unknown in atmospheric science and therefore missing from the best existing models. The reactions require both sunlight and air, and they behave differently to all other types of atmospheric reactions. This project aims to characterise these reactions in the lab, understand them with theory, and quantify their global impact through modelling. Expected benefits include new understanding of atmospheric chemistry, more accurate model predictions, and—as a result—better strategies for managing the impacts of human activity on the environment.	102,908.00	194,689.50	151,253.00	59,471.50	0.00	0.00	508,322.00
	National Interest Test Statement Humankind has the ability to put almost anything into the atmosphere. Throughout history, this has had adverse impacts, including "killer smog", the ozone hole, long-lasting toxins, and climate change. In Australia, we continue to feel the devastating effects of the ozone hole, bushfire pollution, and climate change. Atmospheric models play a crucial role in recommending abatement strategies for existing problems and in predicting the effects of new pollutants. But atmospheric models are only as good as the underlying chemistry and physics that is coded into them. In this project, we hypothesise a completely new chemical reaction that is completely missing from the current generation of state-of-the-art models. The new reaction requires sunlight and air, both of which are found in abundance in the atmosphere, and could fundamentally change model predictions. Our work to understand this reaction and implement it in models will provide national environmental and social benefit by improving the accuracy of the models used to guide policymakers on abatement strategies and the effects of new pollutants.							
DP220102520 Seneviratne, Prof Aruna P	**Betrayed by Apps: Automated, Scalable Detection of Mobile App Malpractices** This project aims to develop a novel framework to detect content and privacy malpractices perpetrated by thousands of mobile apps. It will use innovative models and algorithms to achieve unprecedented levels of automation and scalability, making it possible for the first time to identify compliance violations across the global app ecosystem. Outcomes will include a knowledge base of prevalent app malpractices, detection algorithms, and a software framework for scalable app analysis. New evidence and tools will benefit both Australian and global policymakers and regulators in combating malpractices, users in identifying safe mobile apps for themselves, and local and global app market stakeholders in being more diligent about compliance.	67,500.00	135,000.00	135,000.00	67,500.00	0.00	0.00	405,000.00
	National Interest Test Statement The goal of this project is to design and develop technological solutions to ensure that mobile apps available in Australia comply with local content ratings and privacy regulations. As Australian society moves increasingly towards mobile-based internet access, and as more and more children start to use smartphones, it is essential to ensure that content presented in mobile apps is appropriate and that user privacy is respected. Currently, we rely on app market operators to enforce content and privacy policies. Nonetheless, apps with dubious data collection practises and questionable content (e.g. hate speech, explicit material) are commonplace. This project will create models and algorithms capable of automatically detecting content and privacy policy violations at scale, eliminating dependence on app market operators. These will help Australian policymakers and regulators to combat malpractices, the Australian public to identify safe mobile apps for themselves, and local and global app market stakeholders to be more diligent about compliance, ultimately contributing to a safer mobile internet.							

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DP220102526 Balint, A/Prof Ruth A	**Russian Immigrants and Anti-Communism in Cold War Australia, 1946-1966** The project explores the experience of Russian immigrants in Australia during the Cold War. It examines the ambiguity and complexity of what it meant to be Russian at a time of heightened anti-Soviet and anti-Communist sentiment, when 'Red' and 'Russian' were often equated, and when ASIO took a keen interest in the Russian migrant community. The project will generate new knowledge in the fields of immigration and politics, by exploring the factors that influence political activism for newly arrived migrants and diasporas. Expected outcomes of the project include a deepened knowledge of Australia's Cold War and immigrant politics, and important benefits for Australian understanding of migrants who carried significant political baggage.	45,639.00	75,890.00	61,978.50	31,727.50	0.00	0.00	215,235.00
	National Interest Test Statement Immigration is a fundamental national security concern, particularly in the case of immigrants from a country to which Australia is hostile. Russia (the Soviet Union) was such a country during the Cold War, and despite the professed anti-communism of the Russian post-war immigrants, their presence worried ASIO and the Australian government. During the Cold War, Soviet communism seemed a threat to the Western world and to Australia. The benefits of this project to Australia's national security lie in contributing to a deeper understanding of migrant community allegiances and the global reach of Australia's migrant communities. It will also provide insights into the internal dynamics of an immigrant community with links to a diaspora whose historical experiences may predispose some members and their children to right-wing radicalisation. The benefit to Australia's social and cultural fabric is realised in making known the unrecognised impact and significance of this migrant community in the public life of post-war Australia.							
DP220102756 Freestone, Prof Robert	**An Intellectual History of Modern Australian Planning 1900-2000** Urban planning is forward-looking but is constantly leveraging knowledge from the past. This original project will investigate the key ideas which have shaped modern planning thought in Australia, concentrating on the 20th century. It will focus on leading practitioners, advocates, public intellectuals, and community critics in an ideas-centred intellectual history that fills a major knowledge gap. The critical transition away from post-consensus planning in the last 3 decades of the 20th century will be an important focus and linked to a national oral history exercise before the opportunity is lost forever. Development of an open access biographical website sharing data will bedrock the project.	67,500.00	142,500.00	145,000.00	70,000.00	0.00	0.00	425,000.00
	National Interest Test Statement In 2019 the History Councils of Australia introduced their joint declaration on the value of history by stating: 'the study of the past and telling its stories are critical to our sense of belonging, to our communities and to our shared future.' This project as the first of its kind nationally creates a richer understanding of the specific role of urban planning ideas and their proponents in shaping modern Australian urbanism through the 20th century. A biographical approach offers a progressive new lens for planning history in acknowledging contributions of women, immigrants, minority groups, and other lost voices. The findings will provide a more inclusive, informed and nuanced appreciation of the development of modern planning thought. Focused on ideas and the individuals who promoted them, the project will reposition understandings of the genesis, maturation and societal contributions of planning in making modern Australia.							
DP220102790 Valanoor, Prof Nagarajan	**Ferroelectric bilayer composites with giant electromechanical properties.** This project aims to create a novel bilayer ferroelectric material structure that provides giant electromechanical response at the nano-scale. Traditional electromechanical devices based on ferroelectric materials including position sensors, mechanical actuators, and ultrasonic transducers rely on bulk form. As technology moves toward integrated functionalities, future electro-mechanical materials need to be scaled down to thin film form. Currently, doing this induces mechanical constraints that dramatically suppress the electromechanical response. Using this approach one layer relieves this mechanical constraint while the other gives a giant electromechanical response, providing a pathway for future functional devices.	77,500.00	155,000.00	155,000.00	77,500.00	0.00	0.00	465,000.00

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	National Interest Test Statement The outcomes achieved will advance the fundamental knowledge base of functional nano materials and provide new device opportunities in sensors, electronics, actuators etc. The proposal aims to realize superior functional performance by precise engineering of thin films. These will be made using advanced functional materials synthesis techniques, which fits within the National Research Priorities of Energy and Advanced Manufacturing. It demands cutting-edge analysis tools, which provide state-of-the-art training to Australian scientists arming them with critical skills for the new digital economy. These skills will not only build Australia's research capacity but also advance STEM career opportunities, and hence bring social benefit. Finally, the project involves significant collaboration with world-leading international groups. Fostering such collaborations by strengthening the ties provides a two-fold benefit to Australia: i) attracts world-renowned experts to Australia to conduct research, and ii) improves the reputation of Australia as a growing force in advanced materials.							
DP220102856 Lanicek, Dr Jan	**The Holocaust as an Australian Story, 1933-1954: An Intimate History** This project intends to explore the connections between Australian and the Holocaust between 1933 and 1954. In doing so, the project will generate new ways of understanding how Jewish families and the community responded to, and actively resisted, Nazi genocide in Europe. Through detailed and micro-historical archival analysis, it will argue that the Holocaust was an event that both touched and changed Australia during a period of immense local transformation. The expected outcomes include a deeper understanding of the personal connections that have existed between parts of Australia's society and victims of genocides worldwide, and a new migrant and family-centred Australian history of the Holocaust.	17,587.00	36,858.00	51,771.00	32,500.00	0.00	0.00	138,716.00
	National Interest Test Statement At a time of rising anti-Semitism across the western world, Holocaust education has become a recognised strategy for combatting racial prejudice. This was recognized in June 2019 in the General Assembly of the United Nations, where the Australian delegation announced the government’s commitment to support Holocaust education and commemoration. But as the last survivors pass away, Australia faces a unique challenge in how to make the Holocaust relevant. This project seeks to undertake a new history of the Holocaust from an Australian perspective, as one way of responding to this challenge. It will: 1) bring historical awareness of the direct relevance to Australia of cataclysmic world events; 2) offer new, insightful avenues of commemorating the Holocaust as an integral part of Australian history; 3) address rising anti-Semitism by showing the historical connections between the Holocaust and Australian society; 4) provide new vantage points from which Australia’s multicultural society can understand global crises as affairs intimately linked to the Australia's multicultural population.							
DP220102861 Chan, A/Prof Daniel S	**New frontiers in the theory of noncommutative surfaces** In the 90s, Artin launched his school of noncommutative algebraic geometry, where novel geometric methods were used to profoundly deepen our understanding of the classical subject of noncommutative algebra. This project aims to advance this theory by establishing several new frontiers in the theory of noncommutative surfaces. This project expects to develop new methods involving sheaf theory, Mori's minimal model program and moduli stacks, to study in particular, Artin's classification problem for noncommutative surfaces. Expected outcomes include a much richer geometric understanding of noncommutative algebra. This project should help ensure Australia plays a leading role in important developments in both algebra and algebraic geometry.	69,000.00	141,000.00	144,000.00	72,000.00	0.00	0.00	426,000.00
	National Interest Test Statement Noncommutative algebra is an age old discipline which is still very much of great research interest, in part because of its applications to a variety of fields, from physics (quantum mechanics, string theory) to symmetry to computer graphics. In the last few decades however, geometric methods such as those initiated by Artin's school of noncommutative algebraic geometry have brought fascinating new ways of studying noncommutative algebra sparking a flurry of research in the area. This project will form an important part of these exciting and fundamental new developments, reinforcing Australia's traditional strength in algebra as well as building on the nation's emerging strength in algebraic geometry. The project being inter-disciplinary, involving both algebra and geometry, will do much to raise the mathematical competency of the nation, a necessary pre-requisite for advances in physics and cyber-security.							

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DP220102893	**Designing Efficient and Equitable Voting Mechanisms**	50,310.50	104,217.50	112,029.50	58,122.50	0.00	0.00	324,680.00
Goeree, Prof Dr Jacob K	The most commonly used method for collective decision making, majority voting, is generally not efficient as it does not allow voters to express the intensity of their preferences. In addition, majority voting suffers from the tyranny of the majority, i.e. the risk of repeatedly excluding minority groups from representation. A final downside of majority voting is its winner-take-all nature, i.e. it provides no compensation for losing voters. This project concerns the design of alternative mechanisms that avoid these shortcomings and robustly deliver efficient and equitable outcomes. The project develops the theory underlying these novel mechanisms, tests them in a range of environments, and delivers an implementation for practical use.							
	National Interest Test Statement							
	Designing robust systems that improve on majority voting has important benefits for collective decision making in practice. The proposed bidding mechanisms allow voters to express their preference intensities for the issue on ballot. By designing the mechanism such that voters bid proportionally to their values, the outcome will be efficient and maximize the electorate's welfare. Moreover, by allowing voters to submit any positive bid, minorities can escape the tyranny of the majority. Finally, the proposed mechanisms have a redistributive element built in -- the bids are transferred back to the voters with a higher share going to those that lose. While equal representation (one-man-one-vote) is an immutable right in some settings, e.g. national elections, bidding mechanisms are needed when losing voters need compensation. E.g., if there is a proposition on the ballot to repurpose land for the development of publicly accessible infrastructure, it is overly harsh not to compensate those who gave up their land or whose house was demolished. Bidding mechanisms can resolve such issues fairly and efficiently.							
DP220103024	**How electric fields can facilitate reversible protein binding to surfaces**	49,398.00	141,496.00	166,795.00	74,697.00	0.00	0.00	432,386.00
Gooding, Prof John J	The aim of this project is to develop the first biosensors that prevent nonspecific protein adsorption and allow reversible protein binding. The project expects to achieve this using a combination of novel surface chemistry and pulsed electric fields that dynamically change a sensing interface. The impact of electric fields on the binding of proteins to this interface will be followed using a novel single molecule fluorescence microscope previously developed that can locate the position of proteins with 2 nanometer resolution. The expected outcomes of this project is a class of biosensor that can continuously monitor protein biomarkers for wearable sensors that provide information on a user’s wellness and nutrition.							
	National Interest Test Statement							
	This research will revolutionise wearable sensors for health and well-being by developing the first methods that allow continuous monitoring of protein biomarkers. It will allow Australia to become a major beneficiary in the wearable sensor industry, predicted to be $30 billion dollar by 2023. It will lead to high impact publications and an understanding of how dynamically changing an interface with electric fields will allow proteins to reversibly bind. The research will produce valuable intellectual property related to continuous use sensors. The research will contribute to the broader societal need for preventative health. The research aligns with the Science and Research Priority in Health and the Practical Research Challenge, ‘effective technologies for individuals to manage their own health care’.							
DP220103128	**Towards High-Order Structure Search on Large-Scale Graphs**	85,000.00	170,000.00	170,000.00	85,000.00	0.00	0.00	510,000.00
Lin, Prof Xuemin	High-order structure search over large-scale graphs has many applications including cybersecurity, crime detection, social media, marketing recommendation, and public health. The project aims to lay the scientific foundations and develop novel computing techniques for efficiently conducting structure search. The outcomes include novel computing paradigms, algorithms, indexing, incremental computation, and distributed solutions. The success of the project will directly contribute to the scientific foundation of Big Data computation. It will also contribute to the development of local industry involving cybersecurity, social media based recommendation, network management, and E-business.							

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	National Interest Test Statement While higher order structure information, such as protein structure, organisational structure or social structures has been shown to be very effective for modeling the intricate relationships among objects, it is often hidden within the voluminous information being generated. Uncovering such structures is emerging as a key area in a wide spectrum of applications including cybersecurity, crime detection, social media, marketing recommendation, e-business, and public health. Efficiently conducting structure searches remains a major gap that this project with address with novel graph-based searches. The success of the project will bring a number of technological breakthroughs and lay the scientific foundation for efficient structure identification. This provides a great opportunity to place Australia at the forefront of Big Data research worldwide. The success of the project may also guide and help boost the growth of local industry in the aforementioned sectors.							
DP220103229 Li, Prof Sean S	**Beyond the Ferroelectric Field Effect Transistors** The von Neumann paradigm is the foundation of modern computing systems, which are based on the data exchange between central processing unit (CPU) and memory. The physical separation between the CPU and memory will cause von Neumann bottleneck – a memory wall to limit the data processing speed for contextually intelligent applications. This project aims to develop a novel ferroelectric field effect transistor that integrates a ferroelectric material into a semiconductor transistor structure to merge logic and memory functionalities in a single-device level. This will solve the memory wall problem while provide low power, high speed, high density and long data retention time for future logic-in-memory and data centric computing paradigms.	85,000.00	170,000.00	170,000.00	85,000.00	0.00	0.00	510,000.00
	National Interest Test Statement It is believed that high performance microelectronic devices will revolutionize telecommunications, computing, artificial intelligence and daily life. Key attributes, such as high efficiency, faster switching and small size are expected to boost the demand for new generation microelectronics. Success of this project will provide new insights to the fundamental science of ferroelectric field effect transistors that exhibit low power, high speed and long data retention time for the new logic-in-memory computing paradigm. It will overturn the existing semiconductor technology and push the boundaries of microelectronic technology to atomic scale with elimination of the memory wall in von Neumann architecture, demonstrating the viability of nanoelectronic devices to support the upcoming computing paradigm effectively. This will place Australia in the leading position of the technology that will have a global market toward an over-a-trillion-dollar business.							
DP220103269 Sisson, Prof Scott A	**New methods for modelling real-world extremes** This project aims to develop new theory and methods for analysing and predicting extreme values observed in real-world processes. Many existing techniques are limited by convenient mathematical assumptions that commonly do not hold in practice: dependence at asymptotic levels, process stationarity, and that the observed data are direct measurements of the process of interest. As a result, using these techniques may produce undesirable results. Expected outcomes of this project include theoretically justified data analysis techniques that can accurately model extreme values seen in the real world. Project benefits include more realistic analyses of nationally important applications in climate, bushfire insurance risk, and anomaly detection.	65,000.00	132,500.00	137,500.00	70,000.00	0.00	0.00	405,000.00
	National Interest Test Statement The ability to accurately and flexibly model real world extreme values is highly beneficial in a number of nationally important areas. These include: environmental and economic benefits arising from accurately understanding and modelling future spatial-temporal trends in environmental and climate extremes (such as e.g. extreme temperature, precipitation, droughts etc.); economic and commercial benefits arising from improved risk assessment in the insurance sector through more realistic accounting for interdependence between simultaneously occurring extreme events, in particular for bushfire insurance claims; commercial and national security benefits arising from improved techniques for anomaly detection with direct benefits in the financial sector (e.g. fraud), and potential applications in defence (e.g. detecting deviations in measurements on ship hulls, or on the sea bed in strategic waterways); and social benefits arising through improved public understanding of the nature and changes within extremes in the Australian context, as part of this Project's outreach plan.							

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DP220103294 Zhao, Prof Chuan	**Anion Exchange Membrane Water Electrolysis for Clean Hydrogen Production** Low-cost and robust water electrolysis technology is a cornerstone towards the success of the hydrogen economy. This project aims to develop next generation anion exchange membrane water electrolyser technologies for low-cost and high-efficiency clean hydrogen production and renewable energy storage. Novel non-precious transition metal-based catalysts with high intrinsic activity, large surface area and super-hydrophilic surfaces will be developed, and their mechanism and stability within membrane electrode assemblies understood by using operando spectroscopy, electrochemistry and 3D X-ray imaging characterisations. An efficient anion exchange membrane water electrolyser prototype made entirely of non-precious materials is to be devised. **National Interest Test Statement** Australian economy is heavily dependent on fossil-fuels, which generate significant environmental concerns. Developing innovative water electrolyser technologies that are low cost and efficient will lead to industrial-scale hydrogen fuel production, and provide affordable hydrogen feedstocks to Australia’s chemical industry, reducing Australia's dependence on fossil fuels and the environmental impact of CO2 emissions. The technology also can be used for storing renewable energies such as solar and wind which are abundant in Australia. By smart catalyst design and architecture on the nanoscale and using start-of-the-art characterisation techniques, a low cost and efficient water electrolyser will be constructed in this project. The knowledge learned in this project will advance Australia's science and technology. The advanced technologies and methods developed in this project will extend the Australia’s track record in innovative research in hydrogen fuel production, accelerating Australia's shift to a renewable energy future.	135,000.00	205,000.00	140,000.00	70,000.00	0.00	0.00	550,000.00
DP220103309 Baker, Dr Kathryn D	**Dissecting the Brain Circuitry Shaping Fear Regulation Across Development** Adolescence is an important time when individuals learn to manage stress-related emotions like fear. This project aims to understand how maturational changes in the prefrontal cortex of the brain hinder adolescents when learning to reduce reactivity to threats. It aims to do so by dissecting the brain circuitry shaping learning, memory, and emotional regulation across pre-adolescence, adolescence, and adulthood. The project expects to generate new knowledge about why developmental changes in the brain are necessary for mature forms of learning and memory. The expected outcomes of this project include a significantly richer knowledge of the developing brain, which will ultimately inform approaches for improving emotion regulation in youth. **National Interest Test Statement** Adolescence is an important time when individuals learn to manage stress-related emotions like fear. Yet, one in three adolescents experiences moderate to high levels of psychological distress. Excessive fear and worry lead to psychological distress, stress within relationships, and impairments in educational and work functioning. This project aims to study how brain development shapes learning, memory, and emotional regulation across preadolescence, adolescence, and adulthood. The project may help understand why adolescents struggle to inhibit fear and how they “grow out” of this behavioural risk. The expected outcomes of this project include a significantly richer knowledge of the developing brain as well as new fundamental knowledge about the brain mechanisms of fear inhibition across development. Such knowledge should inform strategies to increase the quality of life and reduce psychological distress in adolescents. Ultimately, this knowledge may help ease economic burden due to days off school and lost work productivity arising from emotional distress.	61,174.50	124,180.50	118,675.00	55,669.00	0.00	0.00	359,699.00

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DP220103430	**The rare biosphere; discovering how soil bacteria live on air**	82,111.50	164,900.50	163,213.00	80,424.00	0.00	0.00	490,649.00
Ferrari, A/Prof Belinda C	In Antarctic deserts where photosynthetic potential is low, we discovered that soil microbiomes sustain their energy and carbon budgets through a novel process reliant on trace gases we coined 'atmospheric chemosynthesis'. But how do soil bacteria literally live on air? This project aims to reveal functional chemoautotrophic pathways in cultured soil bacteria that use trace gases as a source of energy and carbon acquisition. We will perform biogeochamistry, transcriptomics and proteomics on the first model bacterial strains genetically capable of this overlooked process. Outcomes will advance knowledge on microbial metabolism, extending the repertoire of hydrogen-oxidising bacteria to soil ecosystem services, primarily primary production.							
	National Interest Test Statement							
	This project will advance new knowledge to the fields of soil ecology and cell biology. We will define the significance of atmospheric chemosynthesis, a novel primary production process where bacteria are reliant on trace gases for energy and growth. Quantifying the contribution of this overlooked process to energy and carbon inputs in dry desert ecosystems has serious implications for predictions of soil carbon footprints which rely on carbon use efficiency metrics, as such metrics do not include the ability of soil bacteria to store organic carbon. In addition to clarifying processes fundamental to biology, ultimate benefits from this investment extend to agriculture and future climate predictions that rely on accurate soil carbon models. Economic benefits from this cost-effective investment will be capacity building through future potential for the discovery of new natural products and integration of our Antarctic research into policy, by making recommendations for the conservation of Antarctic soil biodiversity, with a focus on protecting soil microbiomes that contribute to critical ecosystem services.							
DP220103462	**Impacts of diet on the brain, body, and microbiome**	66,000.00	133,500.00	127,500.00	60,000.00	0.00	0.00	387,000.00
Kendig, Dr Michael D	Dietary habits determine cognitive function, metabolism and the composition of the gut microbiome. This project seeks to clarify the role of the gut microbiome in diet-induced changes to cognition. It aims to do so through longitudinal studies of cognitive function in which dietary patterns are systematically varied, and intervention studies where cognition is tested after experimentally manipulating the gut microbiome. Expected outcomes include new interdisciplinary knowledge spanning psychology, neuroscience, nutrition and metabolism. This project is timely given the enormous shifts in Australian dietary choices. The knowledge to be gained should provide benefits to individual and public health, agriculture, and food systems.							
	National Interest Test Statement							
	Australian dietary habits have shifted dramatically in recent years. Over a third of energy intake now comes from energy-dense foods rich in fat and sugar, and 95% of adults do not meet fruit and vegetable intake guidelines. As well as contributing to high rates of overweight and obesity, this dietary pattern is associated with poorer cognitive function and altered composition of the gut microbiome. However, the role of the gut microbiome in the cognitive effects produced by diet remains poorly understood. We need to identify whether the links between cognition and the microbiome are correlational or causal; model dietary effects in longitudinal studies; understand the role of specific nutrients; and isolate the effects of diets from their metabolic consequences. By addressing these knowledge gaps, this project seeks to provide new insights into the underlying mechanisms by which nutritional patterns alter brain function. Knowledge gained will advance our fundamental understanding of issues highly relevant to Australia's future, including optimal nutrition and maintaining cognitive and physical health.							
DP220103526	**Improving novice drivers' speed and hazard management.**	53,401.00	81,906.50	81,051.00	52,545.50	0.00	0.00	268,904.00
Molesworth, A/Prof Brett R	The aim of the study is to extend the evidence-based approach we have developed for speed management (cognitive integration speed management training) to hazard management, thereby developing cognitive integration hazard management training for young drivers. Hence, this study is specifically designed to curb the alarming trend in young driver fatalities on Australian roads. The results of the research will provide clear direction to road authorities and driver training providers as to effective training strategies to improve young driver training, and ultimately improve road safety with this vulnerable population.							

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	National Interest Test Statement On average, three people die on Australian roads everyday. This number has largely remained unchanged since 2011. One in three people killed on Australian roads each day are aged between 17 and 25 years. These young Australian have their whole working life ahead of them. BITRE, (2018) estimate the economic cost of road crashes to be a staggering $27 billion per annum. As little as a 1% reduction in road fatalities could save $18 million. The saving to families involved in this trauma would be immeasurable. Central to the proposed research is to develop a training programme to improve young drivers' speed and hazard management. The success of this training programme will not only lead to a reduction in road fatalities, but also improve our understanding about effective training methods in high hazard industries, leading to the development of new theories and practices. These can be applied in other domains such as aviation, rail and even medicine. Hence, there is commercial potential for the development of such a training programme.							
DP220103596 Yuan, Prof Jinhong	**Orthogonal Time Frequency Space Modulation for Future Mobile Communications** Future wireless systems need to support high-mobility services, including self-driving autonomous cars, in-vehicle infotainment, and communications onboard aircraft. This project proposes to develop novel orthogonal time frequency space (OTFS) communications theories and pragmatic transceiver techniques, aiming to substantially improve data rates, reliability, and robustness of future high-mobility communications. Innovative transceiver techniques, signal processing algorithms for channel estimation and detection, and efficient coding approaches will be devised for OTFS systems. The project outcomes are expected to advance the capabilities of high-mobility communications and provide significant benefits for users and network providers.	80,000.00	167,500.00	165,000.00	77,500.00	0.00	0.00	490,000.00
	National Interest Test Statement Developing future mobile communications technology is critical for Australia's productivity and economic growth. Communications for self-driving autonomous vehicles and onboard aircraft are game-changing applications for the future telecommunications industry. It is expected that the mobile connectivity market for the Australian future transport industry will be over $9 Billion by 2025. This proposal will address key research challenges and develop innovative techniques for converting data into radio waves, in order to enable ultra-high speed and reliable communications in future transport systems. The innovations from the project will have great economic, productivity and social benefits, including real-time aerial and road traffic congestion control for passenger safety and stimulation of novel on-board entertainment applications. Outcomes will better equip Australian companies to seize the technology opportunity for creating new high-tech businesses and strengthen Australia's leadership in future wireless communications systems.							
DP220103650 Westbrook, Prof Reginald F	**Existing knowledge determines how new experiences are encoded in the brain.** The aim of this project is to identify how existing knowledge shapes the way that new fear memories are encoded and stored in the brain. It seeks to achieve this aim through the use of an animal model, Pavlovian fear conditioning in rats. It is significant in providing the first systematic assessment of fear memories that form when dangerous experiences are consistent versus inconsistent with existing knowledge. The expected outcomes include new information regarding the links between existing knowledge, fear memories and their neural substrates. This information is needed for the development of a comprehensive theory that explains how the conditions under which fear memories form determines their content and wiring in the brain.	62,843.00	140,291.00	140,099.00	62,651.00	0.00	0.00	405,884.00
	National Interest Test Statement This project examines how existing knowledge shapes the way that information about danger is encoded and stored in memory. Based on our recent findings (presented in this application), we propose that, when danger is inconsistent with existing knowledge, information about the danger is encoded and stored as a new fear memory via processes that are well described. In contrast, when danger is consistent with existing knowledge (e.g., repeated bullying/abuse), new experiences with danger are incorporated into existing memories; and the molecular processes by which this is achieved are distinct. This project uses an animal model to study the latter processes. The knowledge it provides will help us to develop a more comprehensive account of fear and how it is processed in the brain. This knowledge is needed for the development of better fear regulation strategies in people and has the potential to generate both societal and economic benefit by advancing our understanding of fear-related disorders.							

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DP220103708 Graham, A/Prof Bronwyn M	**How do females overcome fear? New insights from the maternal brain** This project aims to identify how the mechanisms underlying fear regulation shift as a function of pregnancy, a female-unique biological event that leads to profound and enduring changes within fear-relevant brain regions. The outcomes of this project will substantially advance current, male-based theories of fear regulation by generating new knowledge on fear regulation in females that is tailored to their reproductive status. This aligns with international priority calls to close the knowledge gap on fundamental processes in females. This new knowledge will provide a foundation to improve treatments for anxiety disorders in women, who are twice more prone to such conditions than men, particularly during the peripartum period. **National Interest Test Statement** Anxiety disorders are the most common class of mental illness in Australia and cost $5 billion annually in treatment costs and productivity loss. Women are twice more likely than men to develop anxiety disorders, and are highly susceptible during the peripartum period. Yet research on fear regulation, which informs the development of anxiety treatments, has focused almost exclusively on males. This project will close this critical gap by combining innovative methodologies from diverse disciplines, including endocrinology and psychology, to identify how the mechanisms of fear regulation shift as a function of pregnancy, a female-unique biological event that leads to profound and enduring changes within fear-relevant brain regions. Outcomes will provide foundational knowledge that can be used to tailor treatments for anxiety disorders in women as a function of their reproductive history, and improve the health and well-being of the 2.3 million Australians suffering from anxiety, thus reducing the considerable associated economic costs of anxiety, in line with our national Science and Research Priorities.	71,186.50	139,004.50	138,021.50	70,203.50	0.00	0.00	418,416.00
DP220103881 Hill, Prof David J	**Customer Centred Peer-to-Peer Energy Trading Framework for Future Grids** This project aims to develop a peer-to-peer (P2P) energy trading framework that facilitates cooperative and trustworthy energy trading directly among energy customers such as residents. By developing novel energy load monitoring and prediction techniques, a customer cooperation scheme and a privacy-preserving P2P energy market, this project expects to transform current energy networks to facilitate energy trading at the edge of the grid and contribute to achievement of Australia's net-zero emission target by 2050. The intended outcomes form this project include new science and knowledge of customer-side energy systems, new design philosophy and strategies for energy markets, and an open-source framework for prototype evaluation. **National Interest Test Statement** An efficient and low-emission power grid with high penetration of dispersed renewable energy sources can provide a sound basis for high quality life and underpin the Australian economy. Encouraging energy sharing and trading among the owners of the dispersed renewable energy sources can foster the energy economy in the energy demand side, increase the value of distributed energy assets, and lower the customer's energy cost. It can also enhance the grid's reliability and security through reduced power loss and deferred infrastructure construction. Thus, this project has substantial national economic, environment and social benefits. Integrating cutting-edged technologies including machine learning, load monitoring, and cryptosystems to develop a trustworthy environment where customers can trade energy is the innovative idea of this project which is aimed to reshape the future of a smart Australia as a leading technology knowledge generator. The proposed idea is envisioned to redefine energy services in a shared economy to amplify the benefits for energy customers, power utilities, and governments.	80,000.00	160,000.00	160,000.00	80,000.00	0.00	0.00	480,000.00

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DP220103933 Bogdanovic, A/Prof Ozren	**System-level characterisation of the siphonophore, Indo-Pacific man o' war** The Indo-Pacific man o' war (bluebottle), is a cnidarian from the siphonophore order. These animals frequent Australian beaches in swarms and cause thousands of stings every year. The project proposes to profile the genome, transcriptome, epigenome, and proteome of the bluebottle to gain insight into its life cycle, its behaviour, and toxins. Expected outcomes include the generation of novel information related to bluebottle gene regulation and its toxin repertoire, which will be highly beneficial for the design of future sting treatment strategies. Given that the bluebottle is a colony made of functionally specialised polyps, this study will also provide significant novel insight into the origins and evolution of animal multicellularity.	92,361.50	203,374.00	191,714.50	80,702.00	0.00	0.00	568,152.00
	National Interest Test Statement The bluebottles frequent Australian beaches every year resulting in tens of thousands of stings. For example, during a single week in January 2019, more than 13,000 people were treated for bluebottle stings in Queensland. Nevertheless, despite their frequent interactions with humans, surprisingly little is known about bluebottle behaviour, its life cycle, and its toxins. Through this project we aim to establish a framework to start understanding this iconic Australian species and identify a way to ultimately manage its interactions with beachgoers in Australia and globally. Most importantly, we will aim to provide a platform that will enable us to start tackling the composition of bluebottle toxins with potential future applications for sting treatment. Finally, this project will provide excellent opportunities for interdisciplinary PhD / early career researcher (ECR) training, establish strong long-lasting ties with world-renowned scientific institutions, and increase Australia's capacity for cutting edge genomics research.							
DP220104021 Khalili, Prof Nasser	**Non-differentiable Energy Minimisation For Modelling Fractured Porous Media** This project is aimed at advancing theoretical, computational and experimental bases for the fracturing of geomaterials, and providing scientists and engineers with much needed predictive tools for quantitative assessment of the responses. By incorporating previously neglected aspects such as energy minimisation, advanced constitutive modelling, and non-planar interacting fracture growth, confidence in the design and planning of engineering processes in fractured porous media will be increased to the point that costly over/under designs are avoided. Through the use of the tools developed, it will be possible to detect weaknesses in the design, assess the impact and implement effective measures to improve performance.	60,500.00	123,500.00	126,000.00	63,000.00	0.00	0.00	373,000.00
	National Interest Test Statement The national benefit of the proposed research cannot be overstated. Three major sectors will be the direct beneficiaries: Oil and Gas industry, Mining, and Geothermal Energy. Australian natural gas is the third-largest global energy source with an anticipated increasing consumption rate of 3.4% per year up to 2030. This project enables the economical extraction from unconventional hydrocarbon reservoirs while contributing to the sustainable development of conventional reservoirs. As the largest national export earner, mining contributes $180b a year to the national economy. Dynamic fracturing and fragmentation will provide engineers with much needed predictive tools for quantitative assessment of response in block caving projects. The government is investing ~$30b in ground investigations and design of infrastructures associated with energy supply, in which there is a critical knowledge gap in shallow geothermal systems in fractured porous media. The theories and advances in knowledge derived from this research will also find applications in geology, geotechnical engineering, and water resources engineering.							

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DP220104036	**Mapping networks governing cell state plasticity: how, where and when?**	103,500.00	202,000.00	202,000.00	103,500.00	0.00	0.00	611,000.00
Chaffer, A/Prof Christine L	Single cell organisms are the basic unit of life, yet, if they had not developed the ability to change cell states we would not exist today. Changing cell states lies at the core of almost every developmental and disease process in multicellular organisms. Building upon our fundamental discovery that stem cells and non-stem cells readily interconvert, we will now incorporate innovative cell systems and the development of our new multi-layered systems biology strategy to elucidate the first comprehensive understanding of the cell biology that underlies cell state changes. These studies are a major step toward understanding the fundamentals of life.							
	National Interest Test Statement							
	The ability of cells to change states lies at the core of almost every developmental and disease process in multicellular organisms. In fact, if cell state changes did not occur, we would not exist today. We discovered that the protein ZEB1 plays a fundamental role in cell state changes, yet the diversity of cellular programs it regulates remain poorly defined. Determining how ZEB1 drives cell state changes will unveil a key step in the fundamentals of life. This research further contributes to the national interest by deploying a new research technology, Proteomic Microscopy, in cell biology research for the first time in Australia. This truly next-generation technique resolves molecular data in space and time enabling researchers to see more than ever before. Proteomic microscopy is applicable across fundamental and translational research, and has commercial potential in drug discovery, diagnostics and precision medicine. Our research program facilitates new synergies, promotes research outcomes as well as providing major commercial and economic opportunities for Australia.							
	The University of New South Wales	4,406,767.00	9,056,172.00	9,094,563.50	4,681,065.50	235,907.00	0.00	27,474,475.00
The University of Newcastle								
DP220100098	**Mining voids and just transition: reimagining post-mining landscapes**	35,068.50	93,921.00	106,994.00	65,408.50	17,267.00	0.00	318,659.00
Askland, Dr Hedda H	This project aims to address the complex problem of how to deal with the long-term legacies of coal mining. Through a combination of ethnographic and Arts-Based Methods, the project will advance insight into how local communities in the Hunter Valley, NSW, experience socio-cultural impacts of environmental disturbance and mining legacies, particularly where final voids are present. It will generate new knowledge into potentials for reimagining post-mining landscapes and how such landscapes can support a just transition towards a post-mining future. Expected benefits include advancement of public discourses around mining legacies, research capacity building and theory development to support multi-stakeholder engagement and dialogue.							
	National Interest Test Statement							
	As Australia transitions away from coal, the question of how to address the long-term legacies of coal mining is becoming increasingly pertinent. Of particular concern is the question of how to deal with the ecological, social and cultural legacies of mining and the repurposing or rehabilitation of former mine sites. This project will offer an intergenerational and intercultural analysis that explores the possibilities of transforming past mining sites to support social cohesion, cooperation and dialogue in transition towards a post-mining future. Community input is recognised by industry and governments alike as an essential step in developing final land use objectives for closed mines yet alternative modes of knowing and understanding landscape are often ignored in policy and planning. This project will have social and cultural benefits for the Australian community by collecting and analysing diverse community voices and presenting recommendations for revisioning mining legacies and, specifically, final voids in a way that seeks to build community cohesion, dialogue and hope.							

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DP220100152	**Understanding selfie-editing apps in youth visual digital cultures**	27,289.00	65,720.50	60,459.00	22,027.50	0.00	0.00	175,496.00
Coffey, Dr Julia E	This project aims to investigate how young people navigate identity and body image concerns online through new digital editing tools provided by selfie-editing apps. The project expects to generate new knowledge about the literacies young people use in reading, evaluating and editing images of themselves, and the role of digital technologies in forming young people's embodied identities, using an innovative participatory methodology. Expected outcomes include a new evidence base and youth-centred conceptual framework on the connections between youth selfie-editing, body image, and wellbeing. This should provide significant benefits in helping young people to better navigate body image and wellbeing in online cultures.							
	National Interest Test Statement							
	Young people must navigate a rapidly changing digital landscape of self-presentation and appearance. Images of 'perfect' beauty are presented as normal and everyday in social media. New apps enabling professional-quality editing tools now enable a user to 'perfect' their own faces and bodies. The new capabilities provided by these apps emerge at a time when body and image-based appearance pressures are a pervasive and enduring issue of concern for Australian youth. This project employs a youth-centred methodology to create a new framework to address key issues of identity and wellbeing in digital visual cultures. This evidence will support the development of policies and resources to respond to young people's wellbeing needs in relation to body and image-based pressures and peer cultures online.							
DP220100199	**Investigating the direct and indirect effects of a student leader program**	69,350.00	140,850.00	126,350.00	54,850.00	0.00	0.00	391,400.00
Lubans, Prof David R	This innovative project aims to investigate the direct and indirect effects of a school-based leadership program for primary school-aged children. Schools are ideal settings for developing children's leadership effectiveness, but there are few examples of evidence-based programs guided by leadership theory. This project will generate new knowledge about the importance of leadership skills for students' self-efficacy, classroom behaviour, and teachers' well-being and work-related stress. Expected outcomes of this inter-disciplinary project include a framework for understanding how children's leadership behaviours shape school culture and an evidence-based program for dissemination in Australian schools.							
	National Interest Test Statement							
	The proposed project will have benefits for the Australian community across multiple domains. First, providing children with opportunities to develop their leadership skills may have short-term benefits for their confidence and classroom behaviour. It may also have medium- and long-term benefits for students' academic performance and employability, respectively. Second, providing teachers with innovative methods to manage student behaviour may help reduce the burden of teacher burnout. Australian teachers report high levels of work-related stress and nearly one in three consider leaving in their first five years of employment. Finally, the economic burden of physical inactivity in Australia is estimated to be $805 million per annum. The majority of young Australians are not sufficiently active and while schools are ideal venues to address this challenge, schools are not fulfilling their potential. This project will provide opportunities for children to be active at school and equip them with the movement skills needed to be active across their lifespan.							
DP220101621	**Investigating voluntary and involuntary intergroup contact**	46,134.00	135,586.00	151,289.00	130,551.50	68,714.50	0.00	532,275.00
Paolini, A/Prof Stefania	Extensive research suggests that interactions between people of opposing groups - intergroup contact - reduce prejudices and improve social cohesion. Yet these benefits may not be realised if intergroup contact is actively avoided, passively received, or mandated. Drawing from social psychology and human geography, this project aims to establish the conditions under which voluntary contact occurs and how voluntary (vs. involuntary) intergroup contact shapes diversity experiences and impacts social attitudes, trust, and civic participation. With data from multiple settings and participant populations, this project has the potential to inform interventions and policies that deliver harmonious, healthy and productive communities.							

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	National Interest Test Statement The mental health burden of discrimination is estimated to cost Australia $30M per year. This project is set to bring social, economic, and cultural benefits by informing the development of interventions and policies that reduce discrimination and increase social cohesion. Currently, many diversity programs revolve around involuntary intergroup contact. For example, some schools integrate students from diverse backgrounds and ability levels. Some workplaces require employees to undergo diversity training. And, some immigration policies mandate new arrivals to spend a period in regional communities. The project aims to identify the typical settings of voluntary versus involuntary contact and the social impacts of these different kinds of contact for individuals and communities. Using data from schools, the workplace and ordinary community settings, this research intends to clarify the kinds of contact that are best for different people and contexts. It will also engage with policy makers to help formulate policies and interventions that maximise benefits for Australia.							
DP220101629 Nyberg, Prof Bernt D	**About time: Climate change adaptation in Australian industries** This project aims to assist the most vulnerable industries in Australia as they adapt to climate change. By investigating the interplay between industry practices and climate impacts, the project proposes to develop a theoretical conceptualization of time. This is significant in addressing the temporal tension between financial short-termism and future climate commitments. The expected outcomes include advancing the scholarly discussion of time and the creation of a practical tool in the form of digital stories that will make sustainable futures actionable. This benefits Australian industries by strengthening their capacity to meet the future challenges of climate change.	64,500.00	131,000.00	117,500.00	51,000.00	0.00	0.00	364,000.00
	National Interest Test Statement This project will strengthen the capacity of Australian industries to respond to the economic and social challenges of climate change. In collaboration with some of Australia's most important sectors – agriculture, building and construction, mining, and tourism – this project will identify industry best practice in climate adaptation. By developing tools to understand the interplay between climate impacts and adaptation practices, the project will generate future scenarios to assist in recognising risks but also opportunities for Australian business. The project supports Australia's Science and Research Priority of Environmental Change by directly addressing the Practical Challenge of improving our ability to anticipate and adapt to the impacts of environmental change. The knowledge developed in this project will have broad applicability across the economy by translating industry best practice to business, government and local communities, generating improved economic, social and environmental resilience.							
DP220102101 Eshragh, Dr Ali	**Large Markov decision processes and combinatorial optimisation** Markov decision processes continue to gain in popularity for modelling a wide range of applications ranging from analysis of supply chains and queueing networks to cognitive science and control of autonomous vehicles. Nonetheless, they tend to become numerically intractable as the size of the model grows fast. Recent works use machine learning techniques to overcome this crucial issue, but with no convergence guarantee. This project aims to provide theoretically sound frameworks for solving large Markov decision processes, and exploit them to solve important combinatorial optimisation problems. This timely project can promote Australia's position in the development of such novel frameworks for many scientific and industrial applications.	60,000.00	126,500.00	131,500.00	65,000.00	0.00	0.00	383,000.00
	National Interest Test Statement The intellectual benefit underlying the proposed work will have a two-fold focus: first, it will develop new practical and theoretical methods to solve large Markov decision processes; and second, it will implement these results to develop efficient solution algorithms to solve a celebrated combinatorial optimisation problem, the so-called the traveling salesman problem. Since the development of approximate solution algorithms for large Markov decision processes is a subject of ongoing intense study in both Operations Research and Machine Learning communities, this timely project can promote Australia's position in the development of novel frameworks for large MDPs for many scientific and industrial applications. This project will enhance Australia's research profile in the areas of operations research and applied probability, while also offering training for one Research Associate and one PhD student. The results will have the potential to be exploited in several areas including (but not limited to) engineering, sustainability, health systems, economics, and military.							

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DP220102758	**Structural safety and reliability of unreinforced masonry shear walls**	82,500.00	180,000.00	173,000.00	75,500.00	0.00	0.00	511,000.00
Masia, Prof Mark J	This project aims to investigate and quantify the role of spatial variability of material properties in the failure behaviour and safety of unreinforced masonry shear walls. In masonry buildings, shear walls provide the primary means for safely resisting lateral loads due to wind and earthquake. Failure of the shear walls can result in building collapse causing injuries and death and significant economy losses. Through experimental testing and numerical modelling the project will enable improved techniques for the assessment and design of masonry walls which account, for the first time, for the influence that spatial variability of material properties has in determining the failure behaviour and capacity of masonry shear walls.							
	National Interest Test Statement							
	Reliability-based assessment of existing structures is increasingly being used to extend their useful service life. The ability to more accurately evaluate the safety of existing masonry structures will likely allow authorities to avoid unnecessary demolition or rehabilitation of such structures, or to correctly identify when such measures are essential. For new construction, a more efficient use of structural masonry will mean that less material will be used when compared to masonry structures designed to existing design specifications. This will result in lower construction costs and could help contribute to an increase in building approvals. Moreover, a 5% improvement in efficiency of use for masonry walls used by 10% of the market will produce ongoing savings to the Australian economy of over $20 million per annum. It can also reduce greenhouse gas emissions by 3-5% and enhance the sustainability of construction.							
DP220102969	**Enhancing marine bathymetry using new generation satellite sensors**	75,000.00	166,000.00	187,500.00	96,500.00	0.00	0.00	525,000.00
Deng, A/Prof Xiaoli	Highly accurate marine bathymetry are currently lacking in 72% of the global ocean including around Australia, particularly in shallow seas and near-shore coastal zones, contributing to various navigation and marine safety accidents. Ship surveys of the seafloor are time-consuming and expensive. Satellite altimetry data provide an alternative solution. This project will improve Australia's marine bathymetry by using spatially comprehensive and unprecedented data from new radar and laser satellite sensors. We aim to develop techniques for integration of the new data with other independent data sources, producing the most precise marine bathymetry for coastal terrain mapping, marine transport and safety management.							
	National Interest Test Statement							
	This project will contribute to the national interest in three ways. Firstly, through improved knowledge of the marine gravity and bathymetry with significantly improved accuracy and spatial resolution over the Australian waters, it will allow us to considerably reduce costs and needs of shipborne (or airborne) gravity and shipboard depth surveys for resource exploration and coastline bathymetry determination - bringing clear benefits to the Australian economy. Secondly, with improvement in Australia's marine bathymetry, it will enable identification of the largely unexplored frontiers and geomorphic features for offshore basins, such as paleo-submarine canyons, faults and seamounts - bringing new knowledge for better management of resources. It will also provide a safe navigation map for ocean transportation, both ships and submarines, and diverse engineering activities, including petroleum exploration. Thirdly, techniques developed for analysing the metadata from new satellite altimetry will enhance Australia's global position as a leader in innovative remote sensing technologies and marine geosciences.							
DP220103044	**Intelligent Incident Management for Software-Intensive Systems**	16,250.00	73,750.00	115,000.00	57,500.00	0.00	0.00	262,500.00
Zhang, A/Prof Hongyu	This project aims to develop intelligent incident management methods for software-intensive systems. Incidents are unplanned system interruptions or outages that could affect the normal operations of an organization and cause huge economic loss. This project expects to develop innovative, Artificial Intelligence (AI) based methods for automated incident management, including incident detection, incident identification, and incident triage. Expected outcomes of the project include a set of novel methods and tools that can facilitate incident diagnosis and resolution. This project will provide significant benefits, such as improving the availability of software-intensive systems and reducing the economic loss caused by the incidents.							

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	National Interest Test Statement A large number of Australian business and government organizations rely on services provided by software-intensive systems. Due to the complexity of these system, incidents are almost inevitable. Detecting and resolving incidents in a timely manner is important for reducing economic loss caused by the incidents. In this project, we aim to develop a set of novel, artificial intelligence based techniques for effective incident management. In particular, we will propose new techniques to automatically detect incidents, analyse the root cause of incidents, and assign teams to troubleshoot the incidents. These techniques can significantly benet a wide variety of software-intensive systems in Australia, and in turn benefit the entire society including government, business, defence, and emergency services.							
DP220103045 Yi, A/Prof Jiabao	**Cold catalysis for water splitting** This project aims to develop photocatalysts via AC magnetic field through nanoscale heating for efficient H2 generation. This project is to introduce cold catalysis concept, which heats catalysts only but not solution, thus called cold catalysis, in the area of production of renewable energy. Expected outcome is the creation of clean and low cost catalysts to effectively harvest the chemical energy from the sun via splitting of water into H2 and O2 without causing any environmental damage. This unique technology will also help to address clean energy generation, which is in line with H2 economy plan by Australia government, and provide opportunities for new industries that will benefit Australian economy.	60,000.00	120,000.00	110,000.00	50,000.00	0.00	0.00	340,000.00
	National Interest Test Statement Hydrogen technologies are possible non-polluting energy sources that represent a major opportunity for Australia's energy sector. Conversion of water into hydrogen using renewable solar energy has the potential to achieve the Australian government net zero emission target before 2050. However, the low efficiency and high cost of currently available solar conversion technologies limit the potential for commercialisation. If such technologies are developed with low cost and high efficiency, we can achieve the Australia government goal of producing hydrogen under two dollars per kilogram, with an anticipated contribution of $10 billion to the Australian economy every year until 2040. This project will develop highly efficient photocatalytic materials using nanoscale heating. Practical application of this technology will advance solar assisted hydrogen production technologies to address the Australia's net-emission strategies and energy challenges. The outcomes of this project will deliver industrial, economic, and environmental benefits to the Australian community.							
DP220103381 Huang, Prof Jinsong	**A novel quantitative risk assessment framework for fractured rock slopes** Rock slope instabilities present grave risks to life and to the serviceability of major Australian infrastructure such as mines, roads and railways, and to coastal recreation areas. This project aims at developing tools for the quantitative risk assessment of fractured rock slopes based on rigorous rock mechanics, numerical methods and probabilistic methods. The research outcomes will improve our understanding of natural and engineering rock slopes, reduce the uncertainties in the prediction of the safety of infrastructures, and thus minimize the loss and damage. The research outcomes can also be used to maintain workplace safety in mining environments and avoid disruptions to production.	81,500.00	153,500.00	145,000.00	73,000.00	0.00	0.00	453,000.00
	National Interest Test Statement Rock slope instabilities present grave risks to life and to the serviceability of major Australian infrastructure such as mines, roads and railways, and to coastal recreation areas. This project will develop a rigorous framework for the characterisation and the risk assessment of fractured rock slopes. Immediate benefits of this project include increasing the safety level of infrastructures, maintaining workplace safety in mining environments, and maximising the return on Australia's financial investment in natural resources. The research will have broader impacts in geotechnical science and engineering through improved understanding of the behavior of fractured rock mass, and development of more scientific methodologies for dealing with uncertainties and risks associated with fractured rock slope instabilities.							

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DP220103637	**Safe, Plug and Play, Multi Agent Dynamic Systems**	67,500.00	137,500.00	140,000.00	70,000.00	0.00	0.00	415,000.00
Middleton, Prof Richard H	From driverless cars, to networks of nano satellites, and complex biological networks, the modern world has many examples of multi agent dynamic systems that need careful coordination and control to perform correctly. In many cases, these systems are built up using designs based on intuition, computer simulations and empirical testing. However, there is a clear need to advance the fundamental understandings of such systems: (i) Verifiable overall dynamic system properties need to be derived to give assurance of performance in situations not previously envisaged; (ii) It is also critical to understand stable system behaviours not just with fixed configurations, but with agile configurations such as splitting, merging, and morphing							
	National Interest Test Statement							
	This research addresses important fundamental questions that underpin computerised systems of multiple interacting intelligent agents, or multi-agent systems. These multi-agent systems need careful coordination and control to perform correctly with a wide range of application areas, including (but not limited to): (i) Understanding of vehicle platoon system (eg cooperative adaptive cruise control between vehicles and autonomous driving); (ii) Distributed electric energy generation (with next generation grids incorporating widely distributed renewable generation); (iii) Swarms of autonomous vehicles (eg drones, unmanned ground/underwater vehicles, groups of nano satellites). The need for multi-agent systems is growing rapidly. This research will provide rigorous, high level guidance for the design of the algorithms needed to reliably and flexibly control such systems across many industries. In practice ensuring that these networks are safe, adaptive and scalable. This will have long term impacts to the reliability and security of advanced network system critical to Australia's economic future.							
DP220103928	**Advanced multivariable nonlinear control methodology for matrix converters**	82,500.00	165,000.00	165,000.00	82,500.00	0.00	0.00	495,000.00
Goodwin, Prof Graham C	The aim of this project is to explore a specific multivariable nonlinear control design problem. Motivation for the project arises from the control of Matrix Converters. Matrix Converters are considered one of the key enabling technologies for the electric transport of the future. However, their penetration into practice has fallen short of their promise. This is, in part, due to the associated control design problem which is extremely difficult involving coupled nonlinear dynamics and under-actuation. We plan to address these problems by using modern control system design methods. Our specific goal is to achieve a provably stable, closed loop control system whose performance is independent of unmeasured disturbances and model errors.							
	National Interest Test Statement							
	This project is aimed at making a major improvement to the control of direct alternating current (AC) to (AC) energy conversion equipment. These improvements have the potential to significantly increase reliability, reduce size, reduce weight and boost energy efficiency of such equipment. This, in turn, will lead to greater efficiency of electric motor drive technology. Since electric motor drive systems consume more than 50% of the world's electricity, the potential reduction of green house gas emission will be substantial. The ideas are likely to lead to "game changing" improvements in many related areas of national importance including wind power generation, electric vehicles of all types (land, water and air) and all variable speed drives used in manufacturing industries.							
	The University of Newcastle	767,591.50	1,689,327.50	1,729,592.00	893,837.50	85,981.50	0.00	5,166,330.00

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The University of Sydney								
DP220100101 Codd, Prof Rachel	**Enzyme-Mediated Machining of Chelators to Bind and Recover Valuable Metals** Metals are critical components of electronic devices and electrical products. Rapid disposal cycles create a major problem in managing e-waste metals and identifies an opportunity in the circular economy for recovery and re-use. Organic compounds that bind metal ions (chelators) are useful but could be improved to select a target metal from a mixture. This project aims to dissect a method used by bacteria to biosynthesize chelators and hijack this to bioengineer new classes of chelators. Outcomes include new chelators and advanced knowledge of metal selectivity, with potential environmental and economic benefits arising from recovery of valuable metals. The project will benefit chemical biology research training for real-world applications.	85,000.00	170,000.00	135,000.00	50,000.00	0.00	0.00	440,000.00
	National Interest Test Statement There is a looming global crisis in the management of waste generated from the short life cycles of electrical and electronic equipment, including mobile phones, computers, and televisions. This ‘e-waste’ is growing at an alarming rate, with 53.6 million tons generated globally in 2019 and predicted to reach 74.7 million tons by 2030. These products contain a range of metals as critical components which pose environmental concerns when present in landfill. Bacteria produce natural compounds called ‘chelators’ which leach iron from the environment to supply the cell with this essential element for growth. Bacteria have evolved a multistep biosynthetic pathway to produce chelators and this project aims to exploit this pathway in nature to promote the discovery of new chelators in the laboratory. High-performance chelators could be used to recover metal ions from e-waste streams for re-use as part of the circular economy. This could provide dual benefit to Australia by creating new technologies and employment in metal recovery and securing the safe environment of communities living close to unlined landfills.							
DP220100218 El-Zein, Prof Abbas H	**Microplastics in Landfills and Surrounding Environments** This project aims to build a risk-based framework for managing micro- and nano-plastic particles in landfills and surrounding environments. It expects to develop a new experimentally validated theory of micro/nano-plastic transport in soils, focussing on lining systems used in landfills worldwide to protect aquifers from contamination. The project will use state-of-the-art experimental, theoretical and computational approaches to generate new knowledge on micro/nano-plastic fate in lining systems and their effects on the mobility of heavy metals and organic pollutants. This should provide significant benefits including safe plastic containment and groundwater protection from landfill waste, a major reservoir of plastic in the environment.	75,000.00	150,000.00	150,000.00	127,250.00	52,250.00	0.00	554,500.00
	National Interest Test Statement Landfills are by far the most dominant form of waste disposal in Australia. Protecting aquifers from these concentrated contamination sources is critical for Australia’s ecological and economic futures. Microplastics and nanoplastics have emerged in the last few years as a serious threat to our health, food and water resources, with widespread presence in the environment recorded. Currently, landfills constitute a major sink of micro/nano-plastic, but we do not know whether our current best-practices are capable of preventing their migration to underlying aquifers. Of particular concern is evidence that micro/nano-plastic may enhance the mobility of heavy metals and organic contaminants in the waste. The project will benefit our national interest in two ways. It will help protect Australia’s water resources by developing a science-based, risk management framework that will allow landfills to safely contain micro/nano-plastic. It will also contribute to a national strategy of micro/nano-plastic management by developing safe disposal practices that will allow the diversion of plastics from other ecosystems.							

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DP220100231 Li, Dr Sinan	**Need for Speed: Towards Controller Design Automation for Power Electronics** This project aims to address the need for advanced controller design automation tools for power electronics systems by advocating a novel design paradigm. The project expects to seek breakthroughs in the modelling and optimisation aspects of power electronics systems and generate new automation tools for existing and emerging power electronics applications. Expected outcome include significant reduction of controller development cycle time and cost, minimisation of human oversight, and maximisation of system performance. Profound benefits include maintaining Australia's leadership in a wide range of sectors such as renewable energy and electric vehicles demanding rapid development cycles and realisation of Australia's zero-carbon vision.	82,500.00	165,000.00	165,000.00	82,500.00	0.00	0.00	495,000.00
	National Interest Test Statement Power electronics is one of the key technologies enabling a wider proliferation of renewable energies and realisation of Australia's zero-carbon vision. Power electronics has undergone rapid development in recent years to constantly produce new and better products, but the process of producing these improved systems takes much longer. Consequently, there is an urgent need for advanced design automation tools to expedite their design. This project will advocate a controller design automation paradigm for power electronics systems. It will bring the benefits of timeliness, consistency, quality, robustness and productivity that normally accrue with any automation process. The outcomes could potentially transform Australia's power electronics industry by significantly reducing development cycles and cost while improving reliability and productivity. This will significantly promote the uptake of green technologies, e.g. renewable energies and electric vehicles, creating ample job opportunities, but most importantly, it will provide a competitive pathway for Australian energy sector towards a sustainable future.							
DP220100241 Turpin, A/Prof Myfany M	**The role of song in Kaytetye and Warlpiri biocultural knowledge** This project aims to integrate Indigenous Ecological Knowledge with Indigenous ceremonial knowledge in two central Australian Aboriginal languages: Kaytetye and Warlpiri. With a multidisciplinary team and by building on existing lexical and musical corpora, the project expects to produce the first biocultural monographs. Identification of biota and human uses of them will be expanded with their song, site of origin and kinship affiliation; thus advancing knowledge of how societies interact with the natural world and the role of music in retaining knowledge. Expected benefits of this project are greater intergenerational transfer of Indigenous biocultural knowledge through working on country and enhanced Indigenous capacity.	68,500.00	148,500.00	152,500.00	72,500.00	0.00	0.00	442,000.00
	National Interest Test Statement Aboriginal ceremonial songs are a pinnacle of Aboriginal knowledge, yet their potential to inform broader understandings of Australian society, history and culture and transmit Indigenous knowledge is yet to be realised. Current land management programs struggle to integrate the cultural understandings embedded in song; similarly, national biological collections lack Indigenous cultural documentation. By building on existing large lexical and musical corpora combined with on-country fieldwork, this project will produce resources for future generations that integrate ecological and ceremonial knowledge contained in song to advance knowledge of Central Australian societies and environments. As the nation realises the importance of Indigenous biocultural knowledge, communities are struggling to maintain this highly localised and fragile knowledge. In bringing ceremonial songs to the fore this project strengthens the transmission of biocultural knowledge of our unique arid environments.							

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DP220100395 Roche, A/Prof Paul A	**The Vandal Renaissance: Latin Literature in Post-Roman Africa (435-534CE)** The project aims to investigate the Latin literature of the Vandal kingdom of North Africa. It expects to identify a vibrant literary culture that celebrated multicultural diversity, embraced the Classical tradition, and contributed to Christian theology, while helping form a distinct Vandal identity. Expected outcomes include a more detailed understanding of the intellectual influences on Vandal African authors, the mechanics of Vandal court patronage, and the breadth of these authors' contribution to the history of Latin literature. The project will benefit Australian culture by providing a detailed historical example of the benefits and challenges of a multicultural society.	55,000.00	125,000.00	96,000.00	26,000.00	0.00	0.00	302,000.00
	National Interest Test Statement Multicultural societies like Australia face challenges in times of uncertainty and stress, but also enjoy great benefits, as differing religious, ethnic and language groups are enriched by each other's culture. This project will provide a detailed historical study of a society which celebrated multicultural diversity, and produced a vibrant culture that embraced different literary and religious traditions, while also forming its own, overarching distinct cultural identity. This research will deliver social and cultural benefits to Australia by developing a rich, historically informed understanding of how a nation can embrace diversity and create a strong sense of cultural identity from a wide range of religious, ethnic and linguistic groups. It will uncover links between literary creativity and multicultural diversity, which are crucial for sustaining social cohesion and freedom of expression. Examining both Christian and Classical traditions, which remain important sources for Australian culture today, this project will deepen our understanding of the challenges and value of social and cultural diversity.							
DP220100452 Muellner, Dr Markus	**Biomimetic hydrogels** Hydrogels are promising materials to repair and regenerate damaged tissues, but their weak mechanical properties limit their applications. This project aims to develop hydrogels with better mechanical properties by mimicking the way natural tissues, such as cartilage, work. Specifically, we aim to develop a new class of hydrogels by adding molecular polymer brushes to traditional materials. We will design the hydrogels with long-term stability and render them suitable as viable hosts for chondrocytes. Through this project, we will grow fundamental knowledge in polymer chemistry and tissue engineering, and pave the way for new technologies to repair damaged joints and tissues.	51,000.00	136,500.00	173,500.00	88,000.00	0.00	0.00	449,000.00
	National Interest Test Statement One key application of hydrogels is the replacement or regeneration of load-bearing tissues in the joints, such as cartilage. Cartilage is a highly hydrated natural tissue with extraordinary mechanical properties. Cartilage damage often leads to osteoarthritis, a leading cause of disability in Australia, costing billions of dollars annually. This project aims to address the persistent problem that mimicking cartilage properties and function in the lab is extremely challenging and thereby limits the development of hydrogels with superior mechanical and biological performance. The project outcomes grant significant progress in polymer synthesis control and are expected to aid the development of new and more effective polymer hydrogels to improve their use in load-bearing applications. The developed materials will have direct benefit for the tissue engineering and biomedical fields, with future applications including cartilage repair, replacement and regeneration. This cutting-edge research will also strengthen Australia's position as a leader in polymer science, nanomaterials, and biomedical research.							
DP220100584 Soutphommasane, Prof Thinethavone E	**The ideologies and practices of anti-racism in Australia** This project aims to advance understanding of what anti-racism work looks like in Australia and how it has developed. Drawing upon approaches within politics and cultural studies, this project expects to map the history of thinking about anti-racism in Australia, evaluate the impact of anti-racist work within Australian society, and theorise the effect of anti-racist efforts on liberal democratic institutions and ideology. The project's benefits include the identification of best practices in anti-racist policies and approaches. This would make a significant contribution to Australia's social cohesion and the combatting of racial discrimination, both of which relate to official Australian government policy objectives.	71,000.00	154,000.00	107,500.00	24,500.00	0.00	0.00	357,000.00

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	National Interest Test Statement							
	This project will make a significant and ground-breaking contribution to the public understanding of anti-racism. It will contribute to enabling Australia to meet its national goals regarding cultural harmony, social cohesion and racial discrimination. Australia has a long-standing commitment to racial equality and multiculturalism. It is widely recognised that racial discrimination inflicts substantial damage to Australians' physical health, mental wellbeing and economic productivity – and to national social cohesion. This project will identify ways for improving the effectiveness of anti-racism interventions including through legislation, policy, education and awareness-raising. Our evaluation of anti-racism work will address the current limited examination of the efficacy of anti-racism programs in social and organisational settings.							
DP220100589	**Valuing News: Aligning Individual, Institutional and Societal Perspectives**	67,557.50	141,375.50	144,327.00	70,509.00	0.00	0.00	423,769.00
Flew, Prof Terry F	This project aims to identify the links between the preparedness of individuals to pay for news, the value of news brands and organisational cultures of news publishers, and the social value of news in promoting a democratic public sphere. Its significance arises with the ongoing crisis of news media business models, which is raising new questions about the future of journalism, and the changing role of governments worldwide in financing news production. Its expected outcomes include advancing debates about how to support public interest journalism, and the value of news as both a commodity and a public good. It will be of benefit to industry, policymakers and the community in addressing the prospects for Australian journalism.							
	National Interest Test Statement							
	News and journalism are central to the democratic public sphere and civic life in Australia, but the ongoing shift of digital advertising away from commercial news publishers has generated a crisis around sustainable future business models. The ACCC Digital Platform Inquiry identified a need for digital platforms to contribute to the funding of news, but this is contested by those global tech companies, and the direct and indirect value of news remains subject to debate. This project is timely as it addresses the economic and social value of news, aligning to individual preparedness to pay (micro), the value of news brands (meso), and the social and public value of news production and public interest journalism (macro). The project will generate important insights for policy makers as they grapple with 21st century issues of who pays for news, and what are appropriate levels of government and other forms of support, such as contributions from tech companies, as the advertiser-financed model that dominated 20th century mass media comes under sustained challenge in a age of digital platforms and social news.							
DP220100624	**Planetary Health Histories: Developing Concepts**	96,667.50	217,392.00	236,781.00	116,056.50	0.00	0.00	666,897.00
Anderson, Prof Warwick H	This historical research project aims to explain the conceptual development of the new planetary health, the principal means of assessing impacts of climate change and global environmental degradation on human health. Using a novel combination of history of science and medicine, environmental history, international history and Indigenous studies, this research is expected to show how environmental health and disease ecology have been re-framed and scaled up in the past century to address the effects of global warming. The project will examine critically this intellectual formation, exploring its potential in global health and revealing its blind spots and omissions, especially in relation to Indigenous knowledge and structural inequalities.							
	National Interest Test Statement							
	Climate change and environmental degradation are among the greatest challenges to health and life we currently face. The more we learn from history about how we perceive and attempt to tackle such challenges, the better placed we are to survive as a species. This research gives the first comprehensive historical account of the relationship between environment and human health across the past 150 years. Using the history of science and medicine, environmental and international history and Indigenous studies, it will show how environmental health and disease ecology evolve to address emerging challenges, such as global warming. This will provide a usable history of global environmental health for medical researchers and policymakers, showing how to translate insights from environmental health and epidemiology into national policy settings. It will also explore how Indigenous knowledge of environment and sustainability can be incorporated into planetary health. This research will enhance our understanding of effects of climate change and environmental degradation on the health and well-being of all Australians.							

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DP220100657	**Understanding gender inequality in the post-pandemic future of work**	59,298.00	118,758.00	81,315.50	21,855.50	0.00	0.00	281,227.00
Hill, A/Prof Elizabeth	This project examines the impact of the COVID-19 pandemic and economic crisis on the working futures of young women and men in three advanced market economies where the pandemic hit with varying degrees of severity. Young people have experienced the greatest upheaval of all workers, and the impact has been gendered. Recovery strategies will have lasting consequences for women's and men's working futures. The project will produce macro-level mapping of post-pandemic national work/care regimes, and micro-level survey data on young people's experience of and attitudes to the future of work in Australia, the UK and Japan, to deliver insights on the gendered economic and social impact of the pandemic and inform a more inclusive global recovery.							
	National Interest Test Statement							
	This project advances Australia's national interest by delivering economic and social benefits for the post-pandemic recovery. It will produce knowledge about the critical role work and care regimes play in shaping gender equality in the future of work at a time of significant economic and social instability. Data collected in the project will provide a unique evidence base to inform policy makers and labour market stakeholders with evidence and insights to construct a post-pandemic gender equitable future of work. Outputs will benefit Australian engagement in the global dialogue about gender and the future of work and will support Australia's efforts to meet Global Sustainable Development Goal 5 on Gender Equality and 8 on Decent Work and Economic Growth. Undertaken at a pivotal moment of heightened concern about the scarring effects of economic crisis on young people, women's economic security, declining fertility and rapid aging of the population, project outputs will support long term productivity, growth and wellbeing in Australia and two of its major trading partners, Japan and the United Kingdom.							
DP220100663	**Charting age-related changes in the quality of episodic memory**	79,220.50	175,378.50	174,904.50	78,746.50	0.00	0.00	508,250.00
Irish, Prof Muireann	As we get older, our capacity to remember events in rich detail becomes less efficient. The mechanisms driving these changes remain unclear, severely limiting our capacity to accurately assess and optimise memory function in later years. This project aims to determine how memory accuracy and memory quality change across the adult lifespan using cutting-edge experimental and neuroimaging techniques. It will deliver new insights into the relationship between confidence, memory success and memory quality, and the underlying neural substrates of these processes. This work will provide the essential empirical foundation to augment memory function, ensuring that older adults can continue to participate as active members of society.							
	National Interest Test Statement							
	The Australian population is rapidly ageing with 15% of Australians over 65 years old. Age-related changes in memory are common and often herald the withdrawal of older adults from the workforce. For older adults to thrive, they must be supported to remain active and engaged members of society. The proposed research will use novel experimental and brain imaging approaches to establish trajectories of memory function across the adult lifespan and their underlying brain mechanisms. The resulting knowledge will benefit Australian society via improved understanding of the neurobiology of memory across the entire adult lifespan as well as providing the necessary foundation to optimise memory function in older age. Our proposal emerges at an opportune time to elevate Australian research capacity in a rapidly growing area, and place Australian science at the forefront of supporting older adults, enabling us to retain the wealth of experience of these citizens.							
DP220100706	**Dynamics of Suppressed Mixing Regimes in Australian Rivers**	72,500.00	152,500.00	162,000.00	82,000.00	0.00	0.00	469,000.00
Armfield, Prof Steven W	This study aims to further the fundamental science of turbulent mixing in the context of flow in Australian rivers. The focus is on prolonged low flow conditions which when coupled with warm surface temperatures cause the water column to become thermally stratified which then suppresses turbulent mixing. The extreme scale of the river systems has made investigating the true dynamics of the strongly stratified mixing regimes particularly challenging. By taking world first in-situ measurements of turbulent mixing and undertaking high resolution numerical simulations this study will provide definitive data which will allow correct characterization of the mixing regimes and how they are associated with river flow conditions.							

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	National Interest Test Statement Australia's inland rivers regularly experience periods of low flow and strong thermal stratification as a result of our unique climate. These conditions are associated with environmental catastrophes such as fish kills and toxic algal blooms. A major contributor to these events is the suppression of turbulent mixing within the water column by the stable stratification. This mixing is required to maintain dissolved oxygen transport for example. The impacts of these events can be very far reaching for the environment itself and the inland communities and industries. These rivers provide the main source of drinking water in regional Australia and are a primary factor determining economic output in the agricultural sector. This study will improve our understanding of and ability to model turbulent mixing in these scenarios. The knowledge obtained will lead to more accurate flow modelling and thereby support more sophisticated management of our waterways. It will also provide freshwater scientists with the means to quantify the influence of flow conditions on river ecology.							
DP220100709 Rey, A/Prof Patrice F	**Mapping mineral systems of deep Australia** We aim at enabling mineral resource discoveries by calibrating geophysical surveys using geochemical and petrophysical properties measured on mantle samples brought to the surface by recent volcanoes. National geophysical surveys deliver images of geophysical gradients in the deeper part of the Australian continent. The interpretation of these gradients in geological terms and in terms of economic mineral systems is the key to unlock deep exploration success. This project will turn Australia's investment in National geophysical surveys into new discoveries of base metals. The benefit stems from enabling the transition to a clean economy which requires a much broader range of critical minerals and a larger quantity of base metals.	45,000.00	150,000.00	200,000.00	95,000.00	0.00	0.00	490,000.00
	National Interest Test Statement To enable the discovery of deep deposits of base metals such as copper, we need improved methods for interpreting the data from national geophysical surveys. A central goal of this project is to develop a workflow to map mineral systems and increase our ability to predict the regions in which base metals are located. Focused on southeast Australia, the research will integrate geophysical, geological and rock properties to build a model of the region down to the base of the uppermost solid mantle of the Earth. The results will transform our knowledge of ore mineralisation and provide tools that can be applied to mineral exploration throughout Australia. This will bring substantial economic and environmental benefits by reducing the cost of mineral exploration and improving capacity to supply essential resources for the clean-energy economy.							
DP220100764 Chan, Prof Hak-Kim	**Unravelling the mechanics of particle deposition at the micro-scale** This project aims to discover the mechanisms responsible for the interactions between aerosol particles and surfaces in a range of air flow conditions. The project expects to transform our understanding of particle deposition through a combination of novel laser-based diagnostic techniques, optical coherence tomography, and state of the art particle formulation methodologies. Expected outcomes of the project include delivery of new methods to optimise particle deposition, development of tunable powder formulations, as well as definition of particle-surface interaction mechanisms in flows. The project should provide significant benefits to particle systems for applications ranging from additive manufacturing to aerosol delivery.	82,500.00	165,000.00	165,000.00	82,500.00	0.00	0.00	495,000.00
	National Interest Test Statement This project will develop the science necessary to lead to aerosol delivery technology that can more efficiently control the deposition of particles onto a surface. Effectively depositing particles onto a surface is critical for a multitude of Australia's industries from coating processes in additive manufacturing, to agricultural pesticide sprays, and pharmaceutical powder delivery. The investigatory team will apply a combination of unique advanced experimental tools to develop new engineering capability which will help to ascertain how particle deposition can be optimized for a range of closely controlled conditions. The project will ultimately lead to economic/commercial benefits through i) providing the scientific foundations and new IP for new particle delivery technologies which can optimize deposition ii) a new non-destructive measurement technology specifically tuned for characterization of aerosols (optical coherence tomography) and iii) development of a data set that can be used to improve guidelines related to aerosol deposition.							

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DP220100882	**Design of micro-decisions in automated transport**	74,750.00	157,750.00	171,500.00	88,500.00	0.00	0.00	492,500.00
Levinson, Prof David M	This project aims to design methods and market algorithms for vehicle control to tackle traffic congestion with interactive micro-auctions, micro-tolling and cooperative games. Specifically, this project develops and designs incentives, auctions and behavioural and pricing rules to manipulate micro traffic dynamics such as lane-changing, merging, energy-efficient driving, and driving at intersections, in roads without defined lanes and shared spaces to achieve collective macro benefits. The project targets mixed traffic where AVs and conventional human-driven vehicles interact and share the road. The project expects to generate new knowledge of transport science to lessen social, economic and environmental impacts of private cars.							
	National Interest Test Statement							
	Australia is the most rapidly growing developed economy, and the physical size of its transport networks are expected to grow with population (with Sydney and Melbourne growing from about 5 million to 8 million in the next four decades). Developing safe, efficient, reliable, resilient, and fair transport networks for Australia is critical to a growing nation. The deployment of autonomous vehicles provides an opportunity to use technology to achieve those aims. This research will establish the design features for autonomous vehicles that increase traffic safety and reduce traffic congestion. The findings and tools will be open sourced to help practitioners in planning and transport agencies, and students, test AV policies for their resulting changes in safety and congestion.							
DP220100931	**A dynamical systems theory approach to machine learning**	70,000.00	141,500.00	108,000.00	36,500.00	0.00	0.00	356,000.00
Gottwald, Prof Georg	Forecasting the future state of a high-dimensional complex multi-scale system is a challenge we face in areas ranging from climate science to epidemiology. Even when basic physical mechanisms have been identified, the actual evolution equations are often unknown. This project will develop a computationally cheap machine learning framework for forecasting. The proposed mathematical framework provides a forecast together with a quantification of its uncertainty. We will develop sophisticated mathematical theory underpinning the novel methodology, as well as applying it to the perennial problem of subgrid-scale parametrisation of tropical convection, a missing key element in current climate models.							
	National Interest Test Statement							
	Machine learning algorithms have recently had spectacular success in vision and language recognition, propelling forward medical diagnosis, drug discovery, self-driven cars and security scanning. This project will leverage the success of machine learning to tackle the more challenging problem of forecasting dynamical systems such as our climate system. Equally important to issuing an actual forecast is to estimate the degree of uncertainty associated with the forecast. This is particularly important for policy makers who have to base their decisions on the outcome of an algorithm. This project develops new methodology to do so. It further develops sophisticated mathematics to put machine learning algorithms, which otherwise are mere black boxes, on a sound footing.							
DP220101031	**Employment Relations in Indonesia’s Commercial Fishing Industry**	32,500.00	92,500.00	95,000.00	35,000.00	0.00	0.00	255,000.00
Ford, Prof Michele T	This project aims to investigate the role of the state, supply chain actors and activists in protecting commercial fishers' labour rights in Indonesia, the world’s third-largest source of marine catches and its largest archipelagic state. This multi-scalar study will generate new knowledge about employment relations at sea. Expected outcomes include a conceptualisation of employment relations that better accommodates fishers and workers in other non-standard occupations. The project’s findings will benefit governments, global supply chain actors and labour activists by helping them to identify and overcome impediments to more effective regulation of employment relations and work to reduce labour exploitation in commercial fishing globally.							

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	National Interest Test Statement This study of employment relations in Indonesia's commercial fishing industry will improve our understanding of labour relations in seafood supply chains, and of possible institutional responses to labour exploitation involving governments in our region. It will help Australian companies meet their requirements under the 2018 Modern Slavery Act. In addition, the project supports the priorities of the Department of Foreign Affairs and Trade (DFAT), which funds the ASEAN–Australia Counter-Trafficking Initiative, a 10-year $80 million program that focuses on victim inclusion and rights protection in Indonesia and seven other countries in the region. Much like the Act, an overarching purpose of this regional program is to prevent forced labour situations within Australia's borders. In addition, DFAT provides $300 million in aid to Indonesia to support the achievement of 11 of the 17 Sustainable Development goals. This project supports progress towards Goal 8 on Decent Work and Economic Growth; Goal 10 on Reduced Inequalities; and Goal 16 on Peace, Justice and Strong Institutions.							
DP220101037 Payne, Prof Richard J	**Expanding access to modified proteins via a novel semi-synthetic platform** This project aims to address a critical knowledge gap in understanding how post-translational modifications modulate the structure and activity of proteins. By developing an innovative semi-synthetic platform to produce pure proteins inaccessible by existing methods, the project will reveal how natural protein modifications influence structure and function. Expected outcomes include the delivery of breakthrough technologies for accessing modified proteins for a range of applications in academia and industry, as well as the generation of new knowledge in the fields of chemistry and biology. The project will lead to the training of interdisciplinary early career researchers and has the potential to benefit Australia's biotechnology sector.	53,500.00	139,500.00	194,000.00	108,000.00	0.00	0.00	495,000.00
	National Interest Test Statement This project will develop detailed and unprecedented knowledge on how chemical modifications that occur naturally on proteins can be used to control structure and biological activity. This will be achieved through the development of a novel technology platform that will enable rapid and efficient access to pure modified proteins that are inaccessible with currently available techniques. This project has the potential to provide numerous benefits to Australia in the following ways: 1) By delivering new methods for accessing valuable protein molecules with defined modifications for the burgeoning Australian biotechnology and pharmaceutical sectors, thus contributing to the advanced manufacturing science and research priority; 2) By providing knowledge on how to modulate biological activity of proteins which may lead to new intellectual property; and 3) by building critical capacity and advanced interdisciplinary skills in the rapidly growing fields of chemical biology and protein science in Australia by training early career scientists.							
DP220101125 Vila Concejo, A/Prof Ana	**The Great Barrier Reef in 2100** Our research aims to answer fundamental geomorphic questions about the future of coral reefs, focusing on the Great Barrier Reef (GBR). We will develop cutting-edge, fully open-source numerical models to quantify the eco-morphodynamic evolution of the GBR under IPCC climate-change scenarios. Our geomorphic numerical models will consider biotic/abiotic feedbacks including synergistic effects of multiple stressors such as waves, temperature, acidification and sediment transport, at individual reef scales. We will model the future of the GBR's ecosystem-services, allowing for a quantum leap in the geomorphic knowledge and understanding of coral reef ecosystems. Expected outcomes include a gamechanger tool for future management of the GBR.	100,000.00	191,000.00	162,000.00	71,000.00	0.00	0.00	524,000.00
	National Interest Test Statement The Great Barrier Reef (GBR) is one of the most iconic places in Australia, and in recent years it has received ample public attention because of its ecological decline, which has been linked to climate change, including global warming and acidification, and other factors such as biological invasions or water run-off from mainland Australia. Recent scientific and technological developments have given us a great understanding of the processes that drive change in coral reefs both at the geological, event, and short time-scales. For the first time, we are now in a position of developing numerical forward models that will analyse the most likely forecasts of evolution for the GBR, considering biotic/abiotic feedbacks and the combined interactions of multiple environmental stressors. The objectives and outcomes of this project include new numerical models and tools, as well as extensive datasets that will be essential for the future management of the GBR, thus offering social, commercial and economic benefits on top of the obvious environmental value. Undertaking this project is in Australia's best interest.							

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DP220101164	**Physics-informed hydrodynamic model for clay across scales**	80,500.00	159,500.00	164,000.00	85,000.00	0.00	0.00	489,000.00
Einav, Prof Itai	This project aims to develop a predictive model for the macroscopic behaviour of clay by combining direct observations of microscopic and mesoscopic mechanisms with rigorous physical principles. The project expects to track clay aggregates as they expand or shrink under variable loads and moistures using novel X-ray and optical methods. A key anticipated result is the development of a robust hydrodynamic model for clay that rationalises the observed phenomena. Expected outcomes include the accurate predictions of clay dynamics, either fast during landslides or slow under drying and wetting. As much of Australia experiences droughts and floods, this project should benefit the longevity and safety of critical infrastructure situated on clay.							
	National Interest Test Statement							
	Much of Australia's buildings and infrastructure, such as pipelines, roads and railways, are built on clays. Clays are highly problematic soils in engineering because their volume alters dramatically and unpredictably with changing water content during wet and dry seasons. They can swell up to the point of destroying infrastructure or shrink away to leave foundations exposed. This project will develop a predictive model for the deformation of clay, tracking clay aggregates as they expand or shrink under variable loads and moistures using novel X-ray and optical methods. The knowledge gained will significantly improve our ability to reliably predict the behaviour of clay in different conditions, allowing engineers to more effectively design structures built on clay. This research will benefit urban and rural Australia by lowering installation and maintenance costs and increasing the longevity of buildings and vital infrastructure. It will also help mitigate against the costly damage caused to buildings and infrastructure by increasingly frequent floods and droughts.							
DP220101258	**Narrative Ecologies of Warragamba Dam**	48,500.00	101,500.00	122,000.00	112,000.00	43,000.00	0.00	427,000.00
van Dooren, A/Prof Thom	We are living in a period of significant environmental and land use challenges, many of them accompanied by conflicting understandings and values. This interdisciplinary environmental humanities project focuses on the proposed raising of the Warragamba Dam wall to explore the role of narrative in analysing and responding to socio-environmental controversies: narratives of connection to place, of livelihood and economic prosperity, of deep cultural relationships to Country. Ultimately, this project aims to develop new resources for enhancing community understanding and involvement in these complex issues, utilising narrative to enable responses that are creative, inclusive, and just.							
	National Interest Test Statement							
	Socio-environmental controversies are often highly divisive, pitting different community priorities against one another, while also having major implications for the economy and the environment. Stories play a central role in shaping how environmental issues are framed and negotiated: stories of risk, development, cultural difference and uncertainty. This interdisciplinary environmental humanities project will focus on the controversy over the raising of the Warragamba Dam wall, NSW, to explore the role of narrative in understanding and addressing complex socio-environmental controversies. Using public-facing research, it will develop a narrative-centred approach that will both enhance our understanding of community perspectives and enrich community understandings through collaborative and inclusive dialogue, making a major contribution to the way such controversies are understood and addressed. This project will develop new narrative resources for enhancing community understanding and involvement in these complex issues, and enable responses that are creative, inclusive, and just.							
DP220101342	**Epigenetic effects of environmental thyroid disruption**	75,500.00	148,329.50	146,021.50	73,192.00	0.00	0.00	443,043.00
Seebacher, Prof Frank	Anthropogenic impacts increasingly disrupt hormone-mediated responses to environmental change. The project aims to determine the interactive effects of climate warming, light-at-night, and plastic pollution on thyroid hormone signalling, and test whether these effects are passed between generations epigenetically. Epigenetic effects of endocrine disruption are one of the most important emerging conservation threats. Mathematical modelling of experimental data will help to predict how animals respond to anthropogenic impacts, and to acquire the tools necessary to maintain ecosystem function and services. The project will therefore have environmental benefits, as well as social benefits stemming from international collaborations and training.							

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	National Interest Test Statement							
	Human-induced environmental drivers, such as climate warming, plastic pollution, and artificial light-at-night have unprecedented impacts on natural systems. We therefore have to re-learn responses of animals to changing environments to acquire the tools necessary to maintain ecosystem function and the services these provide for human societies. The proposed research will benefit environmental management by introducing a mechanistic, physiological dimension in assessing the impacts of human modifications. This approach will result in more effective decision-making to increase sustainability of human activities, and conservation of natural resources. The ensuing social and economic benefits will manifest in the continued uses of natural habitats for recreational activities and tourism. The use of a model organisms can translate to benefits for human wellbeing, particularly concerning exposure to endocrine disrupting compounds from plastic waste. The project will comprise international collaboration, and training of students and staff, which will be of social and economic benefits to Australia.							
DP220101405	**Data breaches: A study of organisational disclosures**	36,731.50	94,177.00	102,875.50	45,430.00	0.00	0.00	279,214.00
Andrew, Dr Jane L	This project aims to study data breach disclosure rules and practices in Australia. Organisations are under growing pressure to inform individuals, regulators and the public of data breaches and this project will explore how these responsibilities are conceptualised within organisations, and how they are discharged in practice. We expect to yield rich empirical insights into both the voluntary and mandatory reporting of data related breaches, the scope and form of disclosures, the organisational framing of data related accountability, and we expect to provide insights into best practice. The project will lead to refereed research publications and policy relevant research reports.							
	National Interest Test Statement							
	Given the importance of data security to the nation, the organisation and the individual, this project will assist stakeholders to navigate data related risks by shedding light on current data disclosure practices surrounding data breaches. The research will support the development of more uniform disclosures of data breaches that are comprehensive, timely and actionable in order to help mitigate data related risks. The benefits of this project will be seen in improved data breach related disclosure rules and practices, and in an informed public debate about data related accountabilities. Given that the future competitive advantage of Australia will be reliant on our knowledge and data, this project will help ensure that organisations and individuals provide, and are provided with, sufficient information so as to mitigate the organisational and personal risks associated with data breaches. Beyond this, the project will also help scope best practice strategies to ensure stakeholders are sufficiently informed and resourced to improve the overall effectiveness of data protection strategies.							
DP220101412	**Extinction and response inhibition**	66,479.50	143,835.00	156,209.50	78,854.00	0.00	0.00	445,378.00
Harris, Prof Justin A	Humans and other animals readily learn to perform an action if it is “reinforced” by a reward and will extinguish the action if it stops being reinforced. Popular models of learning describe extinction as the automatic outcome of a prediction-error correction process that gradually weakens, and eventually eliminates, the response-reward association. But there is much evidence that conditioned responses are not eliminated and can be quickly restored. Other evidence suggests that extinction might involve more specific inhibitory processes that suppress the response without eliminating the original learning. The current project investigates the role of response inhibition in the extinction of learned responses in humans.							
	National Interest Test Statement							
	Our understanding of how people develop certain behavioural disorders (such as the excessive consummatory behaviours that characterise drug dependence, gambling, and obesity) is rooted in our knowledge of the principles of associative learning. These principles describe how we learn to perform actions that are rewarded and how we learn to extinguish those actions when they stop being rewarded. Indeed, our understanding of extinction has been central to the development of behaviour therapies aimed at treating many disorders. But effective and enduring treatment remains a challenge because many disorders can be resistant to extinction or prone to relapse. These failures highlight the importance of continued research into the basic processes of extinction. The current project takes a novel approach to investigate the mechanisms of extinction, stemming from our recent discoveries about the neurophysiological substrates of response inhibition in the brain. It aims to test whether differences in these inhibitory mechanisms are responsible for differences between people in how readily they can extinguish a response							

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DP220101431	**Catching the fast waves: high speed RF sensing using Brillouin scattering**	75,000.00	165,000.00	165,000.00	75,000.00	0.00	0.00	480,000.00
Eggleton, Prof Benjamin J	This project aims to develop a room temperature approach to fast sensing of microwave electromagnetic waves by harnessing stimulated Brillouin Scattering (SBS), simultaneously achieving high frequency range, high resolution and high-speed performance. This project expects to generate new knowledge in microwave photonics and SBS, specifically elucidating the transient temporal response of SBS. Expected outcomes of this project include a proof of concept RF sensor that has multi-Gigahertz real-rime instantaneous bandwidth with high-resolution that can be miniaturized on to a chip. This compact RF sensor, will play a vital role for situational awareness in space, defence and communications applications.							
	National Interest Test Statement							
	Traditional radio frequency (RF) sensors relying on digital electronic processors have a slow response, so they cannot detect rapidly fluctuating time-varying microwave electromagnetic waves, leaving gaps in time or frequency, which limits situational awareness. The project will create critical sovereign capabilities in high-speed RF sensors to achieve 100% probability-of-intercept over Gigahertz of bandwidth with high spectral resolution and high frequency range. These novel RF sensors are essential for increasing situational awareness in an increasingly crowded and dynamic microwave spectrum and for reducing threats, which increases the lifetime of hardware and personnel. The size, weight, and power benefits of the photonics approach will ultimately be compatible with the requirements for mobile platforms, such as drones and CubeSats, with benefits flowing to the communications, mining, agriculture, and defence sectors. Future partnerships with defence end-users and SMEs will allow for the created intellectual property to translate to sovereign industry and attract overseas investment to Australia.							
DP220101454	**Space, time and boundary conditions: Mathematics for evolving plaques.**	65,500.00	137,000.00	145,000.00	73,500.00	0.00	0.00	421,000.00
Myerscough, Prof Mary R	This project aims to create new mathematical theory to model the morphology of atherosclerotic plaques, which cause heart attacks and strokes, as plaques grow or regress. The project expects to devise new mathematical tools for formulating novel spatial models for cellular processes inside the plaque. These should give a new window into plaque growth and spatial structures . Expected outcomes include powerful and reliable mathematical models, new tools to understand plaque evolution, and national and international collaborations with scientists and mathematicians. This should provide significant benefits including increased capacity to use mathematical models in vascular biology and training young researchers in interdisciplinary methods.							
	National Interest Test Statement							
	This project will contribute to Australia through the knowledge that it produces and the training in interdisciplinary mathematical modelling that it provides. Heart attacks and strokes have a profound economic and societal impact in the Australian community. This research will provide foundational mathematical models, formulated as differential equations, for the cellular mechanisms and processes that lead to heart attacks and strokes. Although it is beyond the immediate scope of this project, these models will contribute to Australia's capacity to develop personalised medical treatment for vascular disease. This project will also train graduate students and an early career researcher in interdisciplinary research at the boundary of mathematics and the life sciences. Australia needs workers with this deep level of skills and cross-disciplinary experience to work, for example, in epidemiological modelling and disease control, designing medical technology, and agricultural and water supply planning.							
DP220101511	**Electrocatalytic Generation of Ammonia from Air and Water**	75,000.00	184,000.00	171,000.00	62,000.00	0.00	0.00	492,000.00
Maschmeyer, Prof Dr Thomas	The aim is to directly convert nitrogen under mild conditions, using renewable power, to form ammonia for fertilisers and fuels, enabled by new, nanostructured, electrocatalysts based on single-sheet and composite materials. Unlike nitrogen fixation using a three-electrode system, the project will use a novel mixed gas- and liquid-phase electrocatalytic nitrogen reduction two-electrode reactor. Based on fuel cells, it is designed to accelerate the naturally sluggish nitrogen reduction reaction, NRR, significantly improving the reaction rate and selectivity. The project will also gain atomic-level understanding of the mechanism of NRR, based on in-situ spectroscopies used under operando conditions, e.g., Raman or X-ray absorption.							

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	National Interest Test Statement							
	Our combination of two fuel cells operating synergistically to drive the generation of ammonia from just water, air (i.e., nitrogen), and electrical power, will be a paradigm shift and form a foundation for significant economic, environmental and social benefits. The anticipated scientific breakthroughs in catalyst design and preparation, coupled to the technical implementation of these advanced materials in our novel ammonia generator, will lead to a new and exciting low-temperature, low-pressure, and (if using renewable energy) zero-carbon synthesis route for producing ammonia – the world's single-greatest CO2-emitting process for chemicals at about 2% of global emissions. Our in-depth, fundamental study of the reaction mechanism will generate the knowledge base for applied success. The project will help to position Australia at the leading edge of research into carbon-neutral ammonia production that can be used as inputs for key Australian industries such as agriculture (fertiliser production), mining (explosive manufacture) and energy (hydrogen transport vector).							
DP220101528 Wickham, Dr Shelley F	**Synthetic leukocytes: bio-inspired DNA nanorobots powered by flow** Inspired by the way white blood cells roll along blood vessel walls, our goal is to build DNA nanorobots that roll along surfaces in flow. We take a synthetic biology approach to using biomolecules, such as DNA and proteins, to build functional particles and surfaces. To achieve this, we will combine our teams' technological advances in DNA nanotechnology, plasma-activation for biomolecule immobilisation, and microfluidic devices. This project will contribute new methods for synthetic particle motion in flow and provide new insights into biomolecule interactions and motion. Ultimately, this will allow us to harness rolling for the delivery of synthetic nanorobots for detection and remediation in flow systems, such as the body.	92,118.50	187,884.50	196,970.50	101,204.50	0.00	0.00	578,178.00
	National Interest Test Statement							
	Our advances in the field of bio-nanotechnology to build nanorobots with the complexity of living cells will contribute to Australia's national interest by providing an enabling new technology platform for: precision fabrication of nano and microparticles for detection and remediation of defects in flow systems; microfluidic 'organ-on-a-chip' models for high-throughput screening of molecular interactions in flow; integrated computational fluid dynamic simulations of biochemical systems. These outcomes will build capacity in advanced manufacturing techniques in Australia and improve our intellectual capital in this field. These advances have potential future applications in diverse areas including: diagnosing disease; targeted drug delivery; surface cleaning in biomedical and semi-conductor industry; waste remediation in water systems; preventing fine particle damage in mining equipment; and colloid deposition in nuclear waste storage. Overall this technology promises significant economic, commercial and quality of life benefits to Australia.							
DP220101537 Logan, A/Prof Cameron J	**Locating Giurgola: From Philadelphia School to Global Practice** This project aims to conduct the first major systematic assessment of the architectural career of Romaldo Giurgola (1920-2016), the principal architect of Australian Parliament House. It will review all known archives relating to his life and works, including significant collections in North America and Australia, and it will survey the full range of his architectural projects. The project expects to result in a new and complete assessment of Giurgola's architecture, figuring important Australian buildings into an international landscape of professional practice. The primary outcome of this project will be a large critical catalogue, presenting the full extent of his career for the first time and locating APH in that career in new terms.	40,450.00	81,750.00	77,800.00	36,500.00	0.00	0.00	236,500.00
	National Interest Test Statement							
	Australian Parliament House is one of Australia's most iconic and significant buildings. This project will offer new ways of understanding that complex informed by the long and important career of its principal architect, Romaldo Giurgola. This will not only enrich the public understanding of this building, but will inform publicly funded efforts to adapt its fabric to the evolving needs of a modern constitutional democracy. It will locate Parliament House in new terms within the history of late twentieth century architecture globally, providing new impetus to consider Giurgola's Australian work alongside his experience throughout the United States and in Italy, Brazil, Colombia, Singapore and Sweden. This research will add value to a major public asset, placing Giurgola's work into conversation with major figures in the history of American architecture, and moving beyond national collections to enhance our appreciation of his Australian buildings. It will foster public literacy of architectural works of clear national significance and build a corp of expertise in connection with those works.							

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DP220101596	**The shock of the old: Rediscovering the sounds of bel canto 1700-1900**	84,000.00	170,500.00	193,000.00	106,500.00	0.00	0.00	554,000.00
Peres Da Costa, Prof Neal S	Bel canto—beautiful singing—describes a forgotten tradition (1700–1900), epitomising clear communication of expression and meaning of text. This project aims to generate new research-based knowledge of bel canto sound vocabulary, music, and history through implementation of a multi-modal method—working with an international community of singers—to produce multi-faceted outputs that inform future scholarship and creativity in singing. Modern classical singing fails to communicate the meaning of the text in bel canto repertory. Expected outcomes are revitalisation of global practices to produce classical singers better equipped to convey the text, increasing audience engagement, and the sustainability of the classical music industry.							
	National Interest Test Statement							
	Bel canto—an admired style of singing operas and songs (1700-1900)—piqued the interest of crowds through its compelling communication of story lines, providing high levels of cultural and economic stimulation. While bel canto music remains the staple of industry programming in Australia, its unique performance style is forgotten; its powers to communicate text severely tarnished; its relevance to modern Australian life continually in question. We will undertake vital research with a community of singers in Australia and internationally to rediscover the communicative sounds of bel canto, which will illuminate this significant era of cultural history. It will influence revision of Australian singing pedagogy, providing new tools to increase the capability of its singers. This will attract excellent national and international students. The project will re-ignite interest in classical singing to expand Australian audiences and the music economy. It will position Australia as world leading in classical music performance research, and render its musicians and outputs more competitive on the world market.							
DP220101620	**The critical role of rhizosheath biophysics in plant water availability**	83,303.50	166,653.50	163,850.00	80,500.00	0.00	0.00	494,307.00
Warren, A/Prof Charles W	This project aims to determine how plants can increase their water availability by altering the small volume of soil, rhizosheath that adheres to roots. This project expects to integrate root exudates metabolomics, biophysics and microbial ecology to determine for the first time which of a suite of interconnected factors increase water availability in the root zone. Expected outcomes include better understanding of the direct and indirect roles of soil pore geometry, root exudates and microbial communities play in shaping plant's ability to take up water from soil. This knowledge may ultimately pave the way for engineering the rhizosheath of crops to cope with increased drought conditions.							
	National Interest Test Statement							
	Over the past 50 years, Australia's real gross farm product has declined by 27.5 per cent during droughts; including 8% decrease in wheat production, 35% below the 10-year average to 2018–19. In 2019, east coast production of the five core grains — wheat, barley, canola, chickpeas and sorghum — was down 53.9 per cent to 7.7 million metric tonnes. For vast regions of the eastern states, there was no 2019 harvest. The heat stress that crops suffer during a drought may also exacerbate the yield loss. For the past 1000 years we have selected crop varieties based on aboveground traits of the plant. Our focus will be on the hidden half of the plant, the plant roots, which take up the water and nutrients that drive plant growth. Our new, multidisciplinary approach will enable us to integrate and understand the plant, soil and microbiome, will provide opportunities to select plants with desirable soil-root interface, better able to cope with the increasing drought and heat stress conditions in Australia.							
DP220101644	**Tuning mesenchymal stem cell lifespan, performance, and differentiation**	96,500.00	195,500.00	188,500.00	89,500.00	0.00	0.00	570,000.00
Yeo, Dr Giselle	This project aims to fully characterise a unique molecular process that strongly modulates mesenchymal stem cell lifespan and behaviour. This work is significant, as it is expected to reveal new concepts underpinning the mechanistic actions of classical structural proteins. It will also shape a more nuanced understanding of the context-dependent mechanical and biochemical signals that regulate stem cell fate and function. Expected outcomes include new knowledge surrounding native extracellular matrix and stem cell biology, and the development of strategies to define and tailor stem cell properties. This work is anticipated to drive new technologies that can efficiently and robustly manipulate stem cells for diverse functional applications.							

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	National Interest Test Statement Mesenchymal stem cells (MSC) possess regenerative and protective capabilities that make them potentially valuable therapeutics for a wide array of diseases and disorders, and avoid the ethical and safety concerns of other types of stem cells. This project aims to uncover new mechanisms to regulate MSC behaviour using tropoelastin that can potentially prolong cell lifespan, enhance the properties of these stem cells, and direct their function. This research will lead to strategies for MSC production and manipulation that directly enhance the feasibility, efficacy, robustness and cost-effectiveness of fundamental and translational stem cell work. Outcomes of this research will unlock innovative technologies to address the emerging global demand for functionally defined MSCs and derivative cells. This project will in the longer-term deliver economic benefits to Australia's medical industry and better health outcomes for Australians.							
DP220101688 Prokopenko, Prof Mikhail	**High-resolution multiscale modelling of pandemics: COVID-19 and beyond** The project aims to develop high-resolution computational models for pandemic mitigation and control, focussing on the novel coronavirus and its emerging variants, and leveraging demographic, genomic and epidemiological data. It expects to rigorously compare multi-scale effects of complex vaccination and social distancing strategies and quantify optimal responses under the COVID-19 induced uncertainty. The intended outcomes include computational models of how the most infectious viral variants emerge and spread in presence of interventions, how to predict the outbreaks, and which are the most vulnerable communities. This should make a significant economic and social impact, improving population health while maintaining a resilient economy.	65,000.00	133,500.00	141,000.00	72,500.00	0.00	0.00	412,000.00
	National Interest Test Statement The project results will increase resilience of the Australian society to disruptions caused by pandemic crises. The benefits will include increased vaccine adoption by the community, reduced frequency of super-spreading events, more efficient risk-based interventions during outbreaks, and lessened economic cost of local and regional lockdowns. The project will model feasible interventions across diverse demographics, hospital and aged care facilities, complex travel patterns, in presence of novel infections and their variants, reimportations and reinfections. This will make a significant economic and social impact by improving health of the population, including its most vulnerable parts, and significantly reducing disruptions to business and social activity. The project will also develop a leading position for the Australian research in the field of computational epidemiology. The novel computational models, verified across different epidemic scenarios, demographics, risk and genomic profiles, will form foundations for a comprehensive and rigorous pandemic crisis modelling framework.							
DP220101716 Mackay, Prof Joel P	**How does an essential histone variant effect changes in gene expression?** The mechanisms that determine how genes are switched on and off in different tissues and at different times are not clearly known. It is well established that gene expression patterns are determined in part by the molecular signals transmitted by variation in the proteins that package eukaryotic DNA. Our aim is to understand new aspects of these mechanisms that revolve around how our DNA is packaged. This foundational knowledge will deepen our understanding of gene regulation in all complex organisms and will inform future efforts to rationally modulate gene expression patterns in agriculture, research and other important areas.	70,000.00	142,500.00	147,500.00	75,000.00	0.00	0.00	435,000.00
	National Interest Test Statement This application investigates one of the most fundamental and long-standing questions in biology – how does an organism 'read' the right parts of its genome at the right times and in the right places to develop and thrive? The answers to this question are largely shared by all complex organisms, ranging from fungi to plants and animals. The delineation of the mechanisms by which the genome is interpreted will have significant implications across fields such as agriculture and biotechnology. As well as providing a deeper understanding of the world around us, determination of these mechanisms will potentially allow more efficient and higher-quality agricultural production and other biotechnological applications. A number of examples already exist of such applications and a stronger grasp of the underlying mechanisms will significantly expand our opportunities to have economic and agricultural impact.							

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DP220101721	**Scale invariance: A new paradigm for particle physics and cosmology**	35,000.00	105,000.00	145,000.00	75,000.00	0.00	0.00	360,000.00
Kobakhidze, A/Prof Archil	The origin of mass and mass hierarchies remains arguably the major unresolved problem in particle physics. This project aims to introduce and explore a conceptually new paradigm to address this problem by promoting scaling invariance as a fundamental symmetry of Nature. Namely, we will establish an entirely new realisation of quantum scale invariance within a theoretically consistent picture of the relativistic theory of gravitation and explore its phenomenological, cosmological and astrophysical implications. The anticipated results will likely lead to transformational advancements in particle physics and cosmology and serve as an important theoretical guide for new physics searches in ongoing and future experimental programs worldwide.							
	National Interest Test Statement							
	Particle physics seeks to answer some of the most fundamental questions about our universe and unravel its mysteries, such as dark matter and the Higgs boson particle's mass. This project aims to develop new theories of particle physics and the evolution of the universe based on the paradigm that physical laws at large distances and at microscopic distances are the same. From these theories, we will design experimental tests for new fundamental particles as well as advance our understanding of the early universe. With the considerable public interest and opportunities for educational programs fundamental physics discoveries inspire, this project brings benefits to the Australian community by promoting an innovation culture. It will enhance Australia's future workforce by developing the critical thinking, analytic and computational skills industry and policymaking demand. Finally, strong international exposure will reinforce Australia's standing among the leading scientific nations, and assist decisionmakers in government in formulating Australia's role in international scientific projects.							
DP220101731	**Cleaning of tough paints on advanced composites using laser technologies**	110,000.00	220,000.00	220,000.00	110,000.00	0.00	0.00	660,000.00
Ye, Prof Lin	This project researches fundamental knowledge and algorithms to underpin the deployment of a novel ablation technology using pulsed lasers to remove paints, in particular tough paints, from surfaces of advanced composite structures, e.g. airframes and turbine blades. It establishes thermal mechanical models to describe ablation mechanisms of pulsed laser removal of the paint using both IR and UV bands. Optimal processing protocols to clean paints with different properties, without damaging the underlying composites, will be determined and demonstrated. It meets a cleaning technology need for this paint-on-composites material system to support retrofitting and re-manufacturing in industry. These are crucial industry requirements.							
	National Interest Test Statement							
	The original protective coating on complex equipment or structural frames, such as aircraft, wind turbines, and high-speed rail, needs to be removed for maintenance or re-manufacturing. Traditional technologies based on mechanical tools or chemical solvents have been widely adopted by industry for metallic equipment and structures. Mechanical methods become less viable for advanced composites made of reinforcing fibres in polymer matrices, because of the potential to cause damage. Chemical solvents create environmental hazards by releasing harmful volatiles. In recent years, pulsed lasers have been used for removal of paint or graffiti from metallic and concrete structures. It has been applied in practice because of its advantages of low environmental pollution, high paint stripping efficiency, and automatic operation. This project develops fundamental engineering science that underpin the deployment of a novel ablation technology using pulsed lasers to remove paints, in particular tough paints, on advanced composite structures and equipment. It meets a need in advanced cleaning technologies for paints.							

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DP220101771	**Simulating and verifying quantum circuits**	68,631.50	144,294.50	148,914.50	73,251.50	0.00	0.00	435,092.00
Bartlett, Prof Stephen D	This project aims to develop new theoretical and numerical tools to simulate intermediate-scale quantum computer circuits using today's existing computers. Such simulation tools are critically important to verify the performance of the next generation of quantum computing devices. Expected outcomes of this project include efficient algorithms to predict the outcomes of intermediate-scale (50 to 1000 qubit) quantum processors, and a clear identification of the essential ingredients in a circuit that can allow for 'quantum advantage'. These tools will be used by quantum industries to benchmark quantum devices, certify their performance, and develop new efficient architectures for practical quantum computers.							
	National Interest Test Statement							
	This project will strengthen Australia's leadership in the research and development of commercialisable quantum technologies. As more complex quantum computer technology is developed, research labs will require new methods to check if a quantum circuit is operating correctly, and if it is capable of performing a uniquely 'quantum' computation. This project will produce these new tools to simulate intermediate-scale quantum circuits, and verify the results of such circuits. Such tools will be of immediate interest to Australian and international quantum industries, developing and commercialising quantum computer technology. It will also provide unique training of highly-qualified researchers who can contribute to, and lead, a burgeoning quantum economy in Australia.							
DP220101808	**Microlocal Analysis - A Unified Approach for Geometric Models in Biology**	67,500.00	135,000.00	135,000.00	67,500.00	0.00	0.00	405,000.00
Tzou, A/Prof Leo	This project will use microlocal analysis to create a unified approach for predicting the outcome of a broad class of diffusion and reaction-diffusion models. This will replace the traditional theory which is no longer adequate for the level of geometric complexity demanded of current models arising in biology/ecology. This project will address the urgent need for a systematic theoretical underpinning of diffusion/reaction-diffusion in geometric settings whose scope of application is broader than the the existing patchwork of methods.							
	National Interest Test Statement							
	Accurate mathematical models provide cost-effective ways to obtain valuable insights into the phenomena behind processes critical to our environment and our health. This Project will develop and sharpen the mathematical tools that are required to analyse these models of increasing complexity. By providing more detailed analyses of ecological models, this Project will yield insights into how climate change will impact our environment, and conversely, what the state of our environment tells us about how the climate has changed. The Project's new techniques will also provide accurate and efficient ways to model biological processes that underpin our understanding of diseases and ways to treat them. The tools developed by this Project will help unlock the information contained in such models, leading to better-informed policies on how best to tackle impending threats to our health and environment.							
DP220101816	**Singular solutions for nonlinear elliptic and parabolic equations**	80,000.00	163,000.00	133,500.00	50,500.00	0.00	0.00	427,000.00
Cirstea, A/Prof Florica C	The analysis of many models fundamental to physical and biological sciences is obstructed by singularities. This project aims to discover and classify the singular solutions for two important types of nonlinear equations: elliptic and parabolic. The project expects to generate novel methods to decipher singularities by using innovative approaches from geometric analysis and dynamical systems. Expected outcomes of this project include new and powerful tools to advance a more general theory of singularities. This should provide significant benefits, such as new mathematical knowledge on key issues on singularities lying at the forefront of international research and enhanced expertise in an area of worldwide recognition for Australia.							

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	National Interest Test Statement Mathematics is the backbone of our civilization. It underpins the great technological and scientific advances to date. Countless phenomena arising from physical and biological sciences are modeled by nonlinear equations. But their understanding is often hindered by singularities. This project will unveil the nature and type of singularities for many nonlinear equations stemming from applied mathematics and life sciences. The new methods originating from this project will help develop a more inclusive theory. The research outcomes will enrich other areas where singularities play a pivotal role such as geometry, probability theory and mathematical physics, with potential applications in other fields such as fluid dynamics, mathematical finance, population dynamics, and image processing. The project will train early career researchers and graduate students in cutting-edge research in an area for which Australia is widely acclaimed. The skills and expertise resulting from this project will be readily transferable and highly sought after by industry such as IT, financial, engineering and educational sectors.							
DP220101817 Wechselberger, Prof Martin	**A coordinate-independent theory for multi-time-scale dynamical systems** Biochemical reaction networks operate inherently on many disparate timescales, and identifying this temporal hierarchy is key to understanding biological behaviour. Currently, the existing dynamical systems theory is not able to rigorously analyse many important biological systems and networks due to this inherent non-standard multi-time-scale splitting. This project aims to remove these stumbling blocks and develop a coordinate-independent mathematical theory that weaves together results from geometric singular perturbation theory, differential and algebraic geometry and reaction network theory to decompose and explain the structure in the dynamic hierarchy of events in non-standard multi-time-scale systems and networks.	67,500.00	139,500.00	148,500.00	76,500.00	0.00	0.00	432,000.00
	National Interest Test Statement This research will develop a new geometric theory to analyse multi-time-scale models of biological systems and networks. The understanding of temporal hierarchy and the formation of temporal aggregates on different timescales has relevance in multiple areas ranging from metabolic engineering to understanding disease processes in humans. We will design diagnostic tools to identify the underlying multi-time-scale structure and key parameters that control and cause dynamic interactions and temporal organisation in such applications. As such, we will deliver powerful mathematics for detecting and understanding temporal hierarchy of multi-time-scale biological systems and networks. The mathematical insights thus gained will greatly support the cross-disciplinary flow of ideas leading to novel insights into biological systems behaviour and their failure.							
DP220101823 Bouguettaya, Prof Athman	**Adaptive and Ubiquitous Trust Framework for Internet of Things interactions** The aim of the project is to address the Trust challenges in Internet of Things (IoT) environments, thus enabling the wide deployment of potentially billions of IoT devices. This project will generate new knowledge in the area of IoT Trust by developing novel techniques to establish trust in highly dynamic crowdsourcing IoT environments. The project's main outcomes include the development of a ubiquitous and adaptive multi-component trust framework reflecting trust perspectives. The developed solutions will allow the establishment of trusted interactions among crowdsourced IoT devices and wider deployment of convenient and just-in-time services, thus enabling the development of novel applications, such as the crowdsourcing of green energy.	80,000.00	160,000.00	160,000.00	80,000.00	0.00	0.00	480,000.00
	National Interest Test Statement This research will provide an environment for the rapid uptake of the sharing economy , thus enabling the fast and wide deployment of crowdshared digital services. The Internet of Things (IoT) will be the backbone and enabling framework for the crowdsharing of digital services.Having a trusted framework is at the heart of any solution enabling the rapid and successful deployment and wide adoption of these emerging services. Examples of crowdsharing services will include the sharing of such services as WiFi, computing resources, wireless green energy generated by IoT powered smart devices and smart wearables. This project will contribute to the acceleration of and innovation in the digital sharing economy by providing a trusted framework for crowdsharing IoT-based digital services. Outcomes from this project have the potential of creating a new and vibrant market for IoT crowdsharing of digital services, allowing Australia to be the first to establish a novel framework for the free and trusted sharing of emerging digital services.							

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DP220102019	**Shared-space interactions between people and autonomous vehicles**	73,999.00	152,867.00	160,263.50	81,395.50	0.00	0.00	468,525.00
Tomitsch, Prof Martin	This project aims to understand how autonomous vehicles in urban environments need to interact with the people that they share those spaces with. Autonomous vehicles that are able to operate in shared spaces, such as campuses and pedestrian zones, promise to improve urban life. However, their uptake depends heavily on public acceptance as they operate in close proximity to people. The project investigates whether people are more likely to trust the technology and feel safe if they are able to understand how the system makes decisions and to directly influence its behaviour. Outcomes are expected to promote safe behaviour around urban robotic applications and accelerate the uptake of autonomous systems in Australia's cities.							
	National Interest Test Statement							
	The project delivers a key component for the success of robotic applications in cities: It develops critical understanding about how autonomous vehicles in urban environments need to interact with the people that they share those spaces with. Australia's world-leading position in mining robotics offers a unique first-mover advantage for Australia to lead the development of autonomous vehicle technology, a market estimated to increase to $348 billion globally within the next 10 years. Beyond the domain of driverless cars, autonomous vehicle technology enables new applications, such as transport pods, delivery droids and maintenance robots. The benefits of these kinds of vehicles, which can operate in spaces, such as pedestrian zones, include mobility for people with disabilities, delivery of goods in areas that are not accessible by cars and more efficient maintenance of urban infrastructure. The project contributes to Australia's Smart Cities Plan, which outlines the transformative impact of autonomous vehicles, and the Transport for NSW Future Transport 2056 Strategy, which prioritises "places for people".							
DP220102094	**The university and the city**	53,302.00	117,081.00	114,250.00	50,471.00	0.00	0.00	335,104.00
McNeill, Prof Donald	This project aims to investigate the changing relationship of the university with the contemporary city. This project expects to generate new knowledge on how the spatial management of the university interfaces with urban economic development, students, and business and philanthropy. Examining how prevailing concepts such as the neo-liberal and civic university apply on the ground, it will develop a framework and a qualitative dataset for analysing the development of university space that can be used by a range of stakeholders in Australia and internationally. This should benefit urban policy makers, university management, students and the general public in understanding the place of the university in the contemporary city.							
	National Interest Test Statement							
	Universities have become an important driver of the Australian economy, and their campuses are an important part of civic infrastructure. The project will discover the governance and financial arrangements behind campus masterplanning strategies. This is important because university campus space is expected to support a wide range of activities. This includes providing research infrastructure that is part of the national innovation economy, providing a productive workspace, and catering to both international and domestic student learning demands. These activities sometimes conflict, and the project will identify some of the key challenges facing university management and the higher education and urban policy community. It will also seek to explain how the mix of public funding and private investment drives specific campus development outcomes, researching Australian and international case studies as illustration.							
DP220102121	**Transfer Learning Handling Causally Bilateral Shift**	67,500.00	135,000.00	135,000.00	67,500.00	0.00	0.00	405,000.00
Liu, Dr Tongliang	Transfer learning is a core step for machines to transfer knowledge. This Project aims to equip machines with the ability to harness complex causal structures for transfer learning. The Project expects to produce the next great step for artificial intelligence – the potential to explore and exploit complex causal information to better understand, reason, and trust transfer learning. Expected outcomes of this Project include theoretical foundations for transfer learning utilising causality and the next generation of intelligent systems to accommodate data with complex causal structures. This should benefit science, society, and the economy nationally and internationally through the applications to analysing their corresponding complex data.							

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	National Interest Test Statement							
	The proposed research aligns with Australia's national research priorities for improved accuracy and precision in predicting and measuring the impact of environmental changes caused by climate and local factors in environmental change, building Australia's capacity and leadership to respond to environmental change. High-performance maintenance of this proposed classification system will enable us to quickly respond and adapt to variations of environment, e.g., species distribution changes. By applying the research results to social networks, we could discover the causal information within social networks and recommend potential friends and social communities to users with proper reasoning rather than simply fitting statistics. This will improve recommendation quality and contribute to the growth and development of social networks. Additionally, this project will provide a fertile environment for participants to gain advanced research experience, and therefore advance Australia's skill base.							
DP220102196	**Resurrecting Ancient Proteins to Unlock New Catalytic Activity**	85,000.00	175,000.00	180,000.00	90,000.00	0.00	0.00	530,000.00
Rutledge, Prof Peter J	This project aims to study the proteins that nature uses to make penicillin and related antibiotics, and their prehistoric ancestors. By doing so, the project expects to deepen understanding of these important processes, open up ways to make new antibiotics, and generate new knowledge about protein evolution. Intended outcomes include new biocatalysts based on the ancient ones, new antibiotic compounds active against resistant bacteria, and a richer understanding of how these proteins have evolved over the last 4 billion years. This promises significant benefits in the form of new ways to address the challenge posed by antimicrobial resistance to antibiotics, which is a serious threat to the continued effectiveness of current antibiotics.							
	National Interest Test Statement							
	Antimicrobial resistance to antibiotics is a threat to our way and quality of life. This project will study the proteins that are used to make antibiotics, and prehistoric ancestors of these proteins, to develop new ways of making new antibiotic compounds in the fight against resistant bacteria. This work promises significant economic and commercial benefit in the future, as we uncover new compounds for application as antibiotics and resistance inhibitors. This proposal focuses on the fundamental enabling science, but the longer term goals of the wider project have significant potential for commercial application and economic benefit, as well as the social benefits associated with improved health outcomes. This research sits at the interface of chemistry and biology. This project will provide valuable training opportunities for young researchers in this interdisciplinary space, and increase Australia's international research reputation in chemical biology.							
DP220102201	**A Stress-relax Model for Stellar Flares**	60,000.00	120,000.00	120,000.00	60,000.00	0.00	0.00	360,000.00
Wheatland, Prof Michael S	This project aims to improve our ability to predict solar and stellar flares by developing a theoretical model for the build-up and release of magnetic stress in stellar atmospheres. Solar flares are the most energetic events in the solar system, and together with associated coronal mass ejections can create hazardous conditions in our local space environment. Stellar flares are thousands of times more energetic and produce dangerous space weather for exoplanets orbiting flare stars. Expected outcomes include insight into the flare mechanism, and new approaches to flare prediction. The major potential benefit is improved solar and stellar space weather forecasting to protect human safety and infrastructure.							
	National Interest Test Statement							
	Large solar flares and coronal mass ejections cause dangerous space weather conditions, which pose radiation risks to astronauts and crew on polar flights, damage satellite electronics, interfere with short-wave radio communication, and trigger widespread electrical power outages. The Bureau of Meteorology's (BoM's) Space Weather Services deals with space weather monitoring and prediction. Results of the research, especially improved approaches to flare prediction, will be communicated to the BoM regularly. More accurate operational flare forecasts will save money and potentially lives. The project will train early career researchers in cutting-edge science, technology, engineering, and mathematics (STEM), strengthening Australia's knowledge economy and society.							

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DP220102246	**Plasma-catalytic bubbles for sustainable ammonia**	75,246.00	152,159.00	156,023.50	79,110.50	0.00	0.00	462,539.00
Cullen, Prof Patrick C	Ammonia is one of the world's most important chemicals directly sustaining over 50% of our food supply. But the current means of its production is highly eco-destructive and responsible for over 1% of global CO2 emissions, a similar value to global air travel. This project aims to produce ammonia from renewable sources of water, electricity and air, which can provide farmers with a zero-carbon fertilizer under a decentralized and even farm-level approach. Moreover, if driven by renewables, ammonia offers an effective means of exporting hydrogen from Australia. Hydrogen has been highlighted by the federal government as a priority technology in its Technology Investment Roadmap with ammonia seen as the best approach for its exportation.							
	National Interest Test Statement Ammonia is one of the world's most important industrial chemicals, directly sustaining over 50% of our food supply. However, the current means of producing ammonia is energy intensive and highly pollutant, responsible for a similar amount of CO2 emissions as air travel. This project aims to produce ammonia from water, renewable sources of energy and air using plasma-driven catalytic reactions. The proposed breakthrough technology for ammonia production is a key driver in creating a clean hydrogen industry with significant environmental and economic benefits to Australia's agricultural, energy and transport sectors. As well as providing farmers with a zero-carbon fertilizer, it would provide a means to reduce emissions from shipping and other diesel-powered heavy vehicles as a replacement fuel, and an efficient and economical means of transporting and exporting 'green' energy. The knowledge and innovative technologies this project will develop directly support Australia's commitment to sustainable agriculture and combating the industry's effects on climate change.							
DP220102249	**High Predictive Performance Models via Semi-Parametric Survival Regression**	67,500.00	135,000.00	135,000.00	67,500.00	0.00	0.00	405,000.00
Lo, A/Prof Serigne N	This project will develop novel statistical models for high prediction performance. When applied to help doctor to treat patients, these models allow the users to include gene or other biomarkers for predicting effectiveness of a treatment. When applied to risk management in finance, these models are capable to include an organization's or individual's ongoing finance status to predict, for example, the probability of or time to loan default. Innovative computational methods will be developed for fitting these models. Compared to traditional prediction method, this approach allows greater flexibility while being superior in terms of statistical accuracy and bias. Extensive analyses of healthcare data from diverse fields will be undertaken.							
	National Interest Test Statement This research will make strong contributions to our nation's research ability in biostatistics by proposing new and improved statistical methods for fitting multiplicative, additive and generalized hazard models. These methodology researches are extremely important for survival analysis. In fact, the idea of this MPL approach is more general than the cases examined in the context of this grant and could well be extended to semi-parametric models. Many research fields can benefit from the results of this project. Semi-parametric hazard models are widely used in many other areas, such as biology, insurance, economics, traffic and mechanics. Our research will contribute to the "Promoting population health and well being" Strategic Research Priority. We will contribute to this priority by making methodological advances in the interpretation of health data, particularly in relation to methods for identifying the determinants of longer survival. Finally, this research project will help to train junior researchers in theoretical and computational skills in statistics and in STEM in general.							

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DP220102497	**Elucidating the molecular basis of plant potyvirus resistance**	84,695.00	176,320.00	187,420.00	95,795.00	0.00	0.00	544,230.00
Christie, Dr Mary T	Plant viruses are responsible for a large proportion of crop losses, and genetic resistance is currently the most effective means to control viral spread. This project investigates, on a molecular and structural level, host factors that plant viruses hijack during infection, and in particular, the mutations in these factors that confer resistance. We further aim to elucidate the mechanisms by which plant viruses overcome resistance mediated by these host factors. A detailed understanding of the molecular interactions between plant viruses and their host will enable new, robust and more effective forms of resistance to be engineered. This work therefore has economic and environmental implications for agricultural productivity in Australia.							
	National Interest Test Statement Global food security is a critical issue, and the development of effective strategies to reduce crop losses are of immediate importance. Plant viruses are responsible for >$30 billion in annual crop losses globally. This study looks at a group of viruses called potyviruses, which account for more than 30% of all known plant viruses worldwide. In Australia, potyviruses cause significant damage across the agricultural sector including grains, vegetables and feedstock. In 2016, potyviruses were listed as a high priority group that cause significant economic impact to the Australian vegetable industry. This project investigates how key host factors in plants are hijacked by potyviruses during their infection cycle; variants of these host factors have been identified in naturally resistant crops. This project aims to understand the molecular basis of how potyvirus resistance is conferred by host factor variants. This understanding will expedite the identification and rational design of new and robust forms of potyvirus resistance in crops of agricultural importance to Australia.							
DP220102588	**Triangulations: linking geometry and topology with combinatorics**	65,500.00	138,000.00	149,000.00	76,500.00	0.00	0.00	429,000.00
Spreer, Dr Jonathan	Triangulations are the method of choice to represent geometric objects given by a finite sample of points. Prominent examples include the pictures produced by the finite element method, polytopes in optimisation, or surfaces in computer graphics. Knowledge about the triangulations of an object and how they relate to each other is essential for these applications. Seemingly canonical and straightforward methods perform well - or not at all, depending on intricate and highly involved mathematical properties. In this project we combine geometric and topological viewpoints to tackle high-profile questions about triangulations. This will unlock the full potential of combinatorial methods and practical algorithms in applications.							
	National Interest Test Statement Triangulations are a key tool in allowing for computational methods from geometry and topology to be applied to data sets, with applications in computer imaging and graphics, signal processing, and optimisation problems. This project will produce new knowledge in pure mathematics by bringing experts in Australia and Europe together to tackle computational challenges in geometry and topology using triangulations. The research will deliver practical computational tools to study geometric shapes and their more abstract topological counterparts that will benefit industrial applications across many sectors, such as imaging, signal processing, robotics, mining and manufacturing, data analysis, and genetics. These outcomes will boost Australia's research capacity in these important areas and provide exceptional opportunities for training the next generation of Australia's workforce in mathematics at the highest level.							
DP220102736	**Channel Coding for Beyond 5G**	77,500.00	157,500.00	162,500.00	82,500.00	0.00	0.00	480,000.00
Shirvanimoghaddam, Dr Mahyar	Significant improvements are required for ICT services if they are to meet the needs of rapid urbanization and industrial transformation while also addressing the current digital divide, which sees half of the world's population currently without sufficient access to the internet. The 6th-generation (6G) of mobile standards will be a key solution to the constantly increasing demands on our communications infrastructure. This project will develop novel communication strategies for 6G to service new applications with requirements way beyond what 5G can achieve. The outcomes of the project are expected to significantly improve users' data rate and enhance the reliability and coverage of mobile networks.							

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	National Interest Test Statement Significant improvements in ICT services are required to meet the needs of rapid urbanisation and industrial transformation and to address inequalities in access to digital infrastructure and communication technologies. Half the world's population does not currently have sufficient access to the internet, including more than 2.5 million people and nearly 1.3 million households in Australia. The 6th-generation (6G) of mobile standards will be a key solution to the constantly increasing demands on our communications infrastructure. This project will develop novel communication strategies and algorithms, including new coding and retransmission techniques, for wireless communications and future 6G. These advanced communication strategies will be critical for providing all Australians with the resilient, reliable and highly efficient wireless communications essential for critical infrastructure, business, industry and accessing services such as education. The technological advances will have substantial social and economic benefits for the Australian community, government and business.							
DP220102767 Thornber, A/Prof Ben J	**Advanced Combustion Modelling for Scramjets and Rotating Detonation Engines** This project will develop new fundamental knowledge and engineering models underpinning air-breathing high speed propulsion engines employing complex hydrocarbon fuels. Extensive data and new physical understanding will be garnered through analysis of direct numerical simulations of supersonic reacting mixing layers including impinging shock waves. That data will be employed to isolate, test and develop computationally efficient engineering models that are accurate and efficient for high speed combustion in rotating detonation engines and scramjets. Expected outcomes are knowledge and tools needed to develop practical and effective supersonic propulsion engines for access to space, defence and high speed point-to-point flight.	78,500.00	219,000.00	171,500.00	31,000.00	0.00	0.00	500,000.00
	National Interest Test Statement Current models for fluid mixing and reactions are unable to simulate mixing and reactions in high speed flows such as found in supersonic and hypersonic propulsion systems. This is especially critical when using complex fuels, needed to realise applications in responsive access to space and defence in particular. This knowledge gap impedes the design and optimisation of these propulsion systems and is an obstacle which must be overcome to realise this sovereign capability. Through a unique set of high-fidelity simulations, this project will produce fundamental knowledge and accurate engineering models suitable for design and analysis. This project supports the evolution of key sovereign defence and industry capabilities in responsive access to space and high speed weapons, and is aligned with major government strategic directions including the 2020 Defence Strategic Update, the Defence, Science and Technology Group StarShots, sovereign industry capability and the National Civil Space Strategy.							
DP220102851 Huang, Prof Dr Jun	**Tailoring metal-organic framework catalysts for carbon dioxide conversion** Reducing the greenhouse gas, CO2, into valuable fuels would be beneficial for relieving energy shortage and improving global sustainability. This project aims to synthesise high-performance heterogeneous catalysts for CO2 conversion by periodic ordering photo-redox metalloligand and thermal-catalytically active metal oxide clusters in metal-organic frameworks (MOFs). This approach is expected to deliver a unique single-site metal-organic framework catalyst with high reaction-activity and chemo-selectivity in converting CO2 into valuable chemicals. This advancement will provide significant benefits for Australia's emerging chemical manufacturing industry, and ultimately leading to a carbon-neutral energy economy and environment.	90,000.00	165,000.00	150,000.00	75,000.00	0.00	0.00	480,000.00
	National Interest Test Statement Transforming the greenhouse gas carbon dioxide (CO2) into valuable fuels, such as methanol and formic acid, would be beneficial for relieving energy shortage and improving global sustainability. This project advances the prospect of design and synthesis of high-efficient metal-organic framework (MOF) catalysts and environmentally-friendly approach for the CO2 conversion. The new knowledge gained from this project will advance our mechanistic understanding of this environmentally and industrially important reaction and provide a pathway towards the groundbreaking technologies that would benefit in a carbon-neutral energy cycle, whilst also maximising Australia's competitiveness in sustainable manufacturing as well as the growth of jobs, economic benefits, and sustainable society .							

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DP220102876	**An anti-senescence nanoplatform and its underlying mechanism**	82,500.00	167,500.00	170,000.00	85,000.00	0.00	0.00	505,000.00
Zreiqat, Prof Hala	The project will bring together complementary expertise and skills by combining biomaterials, cell and molecular biology, and engineering, to develop a novel nano-biomaterial platform for anti-senescence and gain an in-depth understanding of its underlying mechanisms. The underlying mechanisms of senescence remain elusive and bone substitutes with anti-senescence property have not been explored and becoming a growing field of interest in bone regeneration. The project will develop a well-defined and efficient nanomaterial platform with optimal combination of nano-surface features and chemistry for cell rejuvenation, and it will give unprecedented depth of interdisciplinary understanding of senescence rejuvenation mechanisms.							
	National Interest Test Statement							
	Globally the number of persons aged 80 years or over is projected to increase more than threefold between 2017 and 2050, rising from 137 million to 425 million, and the brittle bones of Australians aged 50 years+ had cost $3.1bn in 2017. The main goal of this study is to develop a nano-platform with optimal nanotopography/mechanical property/compositions capable of controlling cell ageing process, and gain an in-depth understanding of its mechanisms underlying. The results will provide a novel and smart biomaterial platform that specifically and efficiently enhance bone regeneration capacity in aged people, and the deciphered underlying mechanisms for cell rejuvenation by nanomaterial will add enormously to the knowledge base of geroscience. This will significantly benefit millions of elderly as well as alleviating national health care burden. This project will contribute to the goals of the ARC Discovery Programme and the Australian Government's Science and Research Priorities in health.							
DP220102933	**Developmental trajectory of tongue control for speech with real-time MRI**	98,125.00	152,275.00	110,633.00	56,483.00	0.00	0.00	417,516.00
Ballard, Prof Kirrie J	This project aims to evaluate the developmental trajectory of tongue control during speech, relating dynamic 3D vocal tract modelling to the acoustic signal. By optimising real-time MRI technology to capture and model articulatory movements, the project expects to accelerate understanding of how tongue control for speech is developed, mastered, and perturbed by factors such as rapid growth and foreign accent. Expected outcome is a new understanding of how different speakers' vocal tracts change and how speech is reshaped, informed by real physiological data. Significant benefits will be realised through refined methods and theory development for diverse fields e.g. linguistics, speech science, and automatic speech recognition/synthesis.							
	National Interest Test Statement							
	Evaluating the entire vocal tract during speech production has become possible only relatively recently. This has enabled the high sampling rates needed to capture articulatory movements across the length of the vocal tract in real-time. In international labs, this has been achieved through specialised hardware. Our group have worked with Siemens MRI to develop a no-cost software solution that will allow Australian researchers to rapidly accelerate research into this most fundamental of human traits. Applying our new methods for dynamic imaging and 3D vocal tract modelling, we will discover how the tongue controls vocal tract shape and resulting acoustic speech signal. We will document how this skill changes through adolescence, a period of dramatic physical growth, and with the expanded phonetic inventory of bilingual speakers. Outcomes will benefit research into speech variation in culturally and linguistically diverse populations, speech disorders in children and adults, and AI/machine learning to enhance performance of speech-controlled and speech-generating devices and for consumer electronics.							
DP220103026	**Unlocking the anchors of soil organic carbon to manage climate change**	74,000.00	162,500.00	166,000.00	77,500.00	0.00	0.00	480,000.00
Singh, Prof Balwant	Soil is the largest reservoir of terrestrial organic carbon. Most of the organic carbon in soils is preserved by association with minerals, however, the composition and stability of mineral-associated organic carbon remain poorly understood. The project will use novel and emerging techniques to discover the composition of organic carbon and stability of organic carbon present in mineral-organic associations in representative Australian soils. Expected outcomes include new knowledge necessary for emerging global carbon cycling models and improve future climate projections.							

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	National Interest Test Statement This project will generate novel results for soil organic carbon preservation and enhancement that will provide economic and environmental benefit to the $62 billion agricultural industry. The results from the project will help in achieving the UN initiative of increasing soil organic matter stocks by 0.4% per year to compensate for the global emissions of greenhouse gases by anthropogenic sources. Novel data from the research will help in formulating management strategies to increase organic carbon in crop- and pasture lands across Australia. The project will generate novel data for emerging carbon models for improved predictions of carbon cycle. These outcomes have the potential to inform government policies in relation to climate change and agriculture.							
DP220103174 Monds, Dr Lauren A	**Investigating memory reliability in intoxicated witnesses of crime** Eyewitness testimony is a crucial piece of evidence for solving a crime. Inaccurate testimony leads to miscarriages of justice such as failed prosecutions or false convictions. Many witnesses and victims are affected by alcohol or other drugs during the crime. This project brings together a multidisciplinary team aiming to improve understanding of how intoxication with different substances affects the reliability of victim and witness memory accuracy. Crucially, crimes are frequently distressing; therefore the interaction between intoxication and stress urgently requires exploration. This project will significantly advance our understanding of key mechanisms behind drug effects on memory, and support fairer judicial outcomes for all.	84,367.00	195,468.50	178,346.50	67,245.00	0.00	0.00	525,427.00
	National Interest Test Statement The majority of crimes involve a victim or witness and their testimony has the potential to help solve a crime or lead an investigation in the wrong direction, wasting time and resources. Crucially, substance use is a key factor in many violent crimes, with over 50% of assaults involving alcohol. Therefore, there is an urgent need to understand the degree to which intoxication impacts victim/witness memory reliability, especially for stressful events. Findings from our project will contribute to improved procedures for several aspects of the legal system: police interviewing and case development, trial strategy, and judicial instructions to jurors regarding substance use, trauma, and memory. Preventing false convictions and failed prosecutions due to erroneous testimony also contributes to a safer society where the true offender is held accountable for their actions. In these ways, the project will contribute to a more just society by ensuring policy and practice decisions about the collection and use of evidence from intoxicated and traumatised witnesses and victims is informed by sound scientific research.							
DP220103209 Armfield, Prof Steven W	**Large Scale Natural Convection Boundary Layers with Non-Boussinesq Effects** This proposal aims to understand and predict heat transfer by turbulent natural convection in two scenarios, firstly at very large environmental scales, such as occur on melting Antarctic ice sheets, and secondly convection involving very large temperature differences such as occur in solar thermal power plants and industrial processes. These natural convection flow regimes are incredibly difficult to investigate directly but by focusing on the fundamental dynamics of the turbulent flows using large scale numerical simulations and innovative experiments, the project is expected to develop better analytical and computational models which will underpin improvements in global ocean models and improve energy efficiency.	55,000.00	123,913.00	141,764.50	72,851.50	0.00	0.00	393,529.00
	National Interest Test Statement Natural convection boundary layers are intrinsically linked to heat transfer in fluids and so are unavoidable in our natural environment and in industrial processes. It is critical to accurately predict the cooling they provide. Our most complex physical systems are driven by them. They are the mechanisms by which Antarctic ice sheets melt and buildings are ventilated. Engineers and Scientists rely on accurate relationships to represent these flows within larger more complex models. As engineers seek to improve energy efficiency or expand the power density of telecommunications equipment they must be able to predict how these flows will behave and how much heat will be transferred. Scientists developing models for climate change require accurate models for ice melt rates in order to accurately represent ocean dynamics. The understanding gained through this project will support these activities and result better designed natural ventilation systems, improved safety of industrial process and more accurate modelling of the effects of climate change.							

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DP220103265	**Testing links between genomic and morphological evolutionary rates**	74,540.50	144,953.50	156,214.50	85,801.50	0.00	0.00	461,510.00
Ho, Prof Simon Y	This project aims to identify, understand, and characterise patterns of evolutionary rates across different levels of biological variation. The project expects to generate knowledge about the tempo and mode of evolution by using a phylogenetic approach to test fundamental models of evolutionary rates, including the link between rates of genomic and morphological evolution. Expected outcomes of this project include detailed insights into the tempo and mode of macroevolution, better modelling of genomic and phenotypic evolution, and improved design of studies in evolutionary genomics. Benefits of the project include greater understanding of the evolutionary processes that have generated the diversity of the Australian biota.							
	National Interest Test Statement							
	This project will address fundamental questions about how biological diversity is generated by the evolutionary process. The project will generate new genomic resources and will develop a strong framework for studying rates of evolution across the Tree of Life. By focussing on several important groups of organisms, the project will increase understanding of the tempo and mode of evolution in flowering plants, Australian marsupials, Australian cockroaches and termites, and songbirds. The project will build on collaborations with researchers across Australia, while also strengthening important international links with major genome consortia and researchers in three continents. The results of the study have the potential to improve our understanding of the evolutionary processes that produced the remarkable diversity of life and the present-day Australian biota.							
DP220103384	**Galactic seismology: a new window on Milky Way's evolution**	70,000.00	140,000.00	140,000.00	70,000.00	0.00	0.00	420,000.00
Bland-Hawthorn, Prof Jonathan	This project aims to investigate how the Milky Way responds to the passage of a small dwarf galaxy through its plane. This is motivated by the observational discovery of largescale waves crossing the Milky Way disc, and by new related supercomputer simulations. The project expects to generate new knowledge in this field, based on further supercomputer simulations and comparison of the predictions with new data from the Gaia space mission. Expected outcomes of the project include a demonstration of the diagnostic power of this new seismological approach to galaxy evolution. The project promises significant benefits in the form of establishing Australia as a leader in Galactic seismology, as it is in the field of Galactic archaeology.							
	National Interest Test Statement							
	Since 2018 the Gaia satellite has provided an extraordinary window into the inner workings of the Milky Way, including evidence of giant waves crossing the Milky Way disc and moving through our neighbourhood. This project will investigate how the Milky Way responds to the passage of a small dwarf galaxy through its plane, using a seismological approach that provides insights into the structure and dynamics of our Galaxy and its long-term evolution. It expects to generate new knowledge in Milky Way science, based on supercomputer simulations and comparison of these predictions with new data from the Gaia space mission. This project will also facilitate close engagement between the Australian, European and US research communities. In addition to advancing our knowledge of our Galaxy, this research offers a superb training field for young analysts to develop skills that are transportable to other fields of science, to high-tech industries and to the finance sector.							
DP220103393	**Biologically inert probes to unravel nutrient directed cellular processing**	43,482.50	159,851.50	232,923.00	116,554.00	0.00	0.00	552,811.00
Ryan, Prof Renae M	In this project we will develop novel compounds that can act as probes of the pathways present in cells for the uptake of nutrients and other essential molecules and show how to generate new agents for identifying and targeting specific populations of cells. The project will generate new tools for understanding biological processes including cell transport and processing. The insights gained from this work are expected to help guide the development of new agents for selectively delivering imaging and biologically active agents to cells.							

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	National Interest Test Statement							
	The primary focus of this project is to advance our knowledge of how cells collect and process nutrients. This knowledge is important because many compounds are being developed that are delivered by attaching them to nutrients, an approach that has potential application in developing tools for understanding biology and for developing imaging agents and treatments for a range of diseases. Work in these areas is already showing commercial promise with a number of new imaging and treatment agents undergoing development and testing. Providing a better understanding of the fundamental processes associated with nutrient uptake and how these processes are affected by the cargo will help to drive these developments and further boost the Australian economy.							
DP220103530	**Using venoms to map critical and evolutionary conserved vulnerabilities**	85,000.00	174,500.00	179,000.00	89,500.00	0.00	0.00	528,000.00
Neely, Prof Greg G	We have developed and applied new functional genomic approaches to study venom evolution. Using CRISPR screening, we find that unrelated venoms act on cells by exploiting the same vulnerabilities. By functionally mapping these vulnerabilities for all venom classes, we can begin to develop universal venom antidotes. Conversely, much of what we know about venom mechanisms comes from a small percentage of the biodiversity within a venom, and we have developed genomic tools to study the venom “dark matter”. This work will lead to the full molecular characterisation of venom biodiversity, and new venom components will be useful for research or as novel medicines.							
	National Interest Test Statement							
	The outcome of this work will be an understanding of conserved molecular vulnerabilities exploited by venomous animals, and a molecular profiling of venom components that modulate physiology. As our environment changes, we can anticipate new biological threats will similarly be constrained by the same target vulnerabilities exploited by venoms or other harmful biologics. By developing a basic understanding of animal vulnerabilities, we can more rapidly negate emerging threats as they are identified. Moreover, the tools we develop here will change how researchers access the biodiversity contained within animal venoms, and allow our field to rapidly isolate new venom components based on an expanding set of cellular responses. These efforts will generate IP and have significant I commercial potential, both via a future generation of effective universal venom antidotes, and through a new capacity to mine the venom “dark matter” for new bioactive tools or future medicines.							
DP220103573	**Analysis and design of midrise built-up cold-formed steel structures**	65,000.00	130,000.00	130,000.00	65,000.00	0.00	0.00	390,000.00
Rasmussen, Prof Kim J	The project will develop an analytical and computational basis for designing midrise buildings in cold-formed steel. It will enable solutions with high column capacities and high lateral load resistance to be realised by using built-up sections, thus overcoming the current barrier to constructing buildings up to 10 storeys from cold-formed steel and enabling green, fully recyclable and rapidly constructed buildings to be achieved. Experimental, analytical and computational studies will be undertaken and synthesised into efficient design guidelines for practising engineers, including structural reliability analyses at system level of midrise buildings featuring innovative built-up multi-section columns and integrated shear panels.							
	National Interest Test Statement							
	The project addresses the growing need for midrise residential buildings in Australian cities to meet the increasing demand for medium-density apartments in close proximity to services, workplace and entertainment. The project will develop a framework for designing midrise cold-formed steel buildings using multiple intermittently connected (built-up) sections to achieve buildings with sufficient load carrying capacity and stiffness. New solutions for the key structural elements, i.e. columns and shear panels, will be researched featuring built-up sections to greatly enhance the building’s resistance to wind and seismic loads. The project will develop advanced analytical solutions and efficient computational tools to aid the structural design of mid-rise cold-formed steel buildings. The design tools will benefit the end consumer and enable the Australian steel industry and structural engineering firms to enhance their preeminent record of producing innovative structural solutions and maintain their competitive edge nationally and internationally.							

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DP220103584	**Charge and energy transport in disordered functional materials**	68,000.00	140,500.00	122,500.00	50,000.00	0.00	0.00	381,000.00
Kassal, A/Prof Ivan	This project aims to understand how energy and electric charge move through disordered materials. Many next-generation materials—including organic semiconductors, hybrid perovskites, and conductive metal-organic frameworks—promise better solar cells, sensors, and electrocatalysts; however, they remain incompletely understood because they are disordered and noisy systems that are difficult to describe mathematically. This project expects to develop the first theoretical techniques that capture all essential features of transport in disordered materials. The resulting understanding of structure-function relationships should accelerate the rational design of cutting-edge devices for energy conversion and storage.							
	National Interest Test Statement							
	This project aims to provide Australia with world-leading capability in chemistry and materials science, with the potential to advance local manufacturing and energy industries. To do so, it aims to provide new computational tools to solve challenging problems in computational chemistry that form bottlenecks in the discovery of better disordered materials for energy conversion and storage. Devices such as organic and perovskite solar cells or electrocatalysts based on metal-organic frameworks promise energy that is both cheaper and cleaner than is used today. By developing the necessary computational techniques and expertise to accelerate the rational design of these types of next-generation, high-performance technologies, this project would advance Australia’s strategic vision of advanced manufacturing and energy sectors.							
DP220103611	**Lightly Loaded Energy Farm Foundations in Cracked Desiccated Soil**	60,000.00	92,500.00	65,000.00	32,500.00	0.00	0.00	250,000.00
Airey, Prof David W	This project aims are to understand the effects of seasonal changes in moisture on piles in clayey soils that develop desiccation cracks during dry times of the year. The project is significant because the economics of energy farms requires low cost foundations for their viability, but current methods of foundation design require long piles to overcome uncertainties in capacity and serviceability when soil shrinks in dry periods and swells in wetter periods. The main outcome of the project will be recommendations for the design of lightly loaded pile foundations in soils that shrink and swell significantly. The benefits will be the reduced risk and cost associated with the geotechnical aspects of foundation design.							
	National Interest Test Statement							
	Australia's arid climate can create an upper soil layer that is prone to expansion and contraction and desiccation cracking. These conditions lead to requirements for expensive foundation systems, often involving deep foundations. The proposed research will look at foundations on desiccated soil where vertical soil movements are less important to determine whether simple piled foundations can perform satisfactorily. Current design methods suggest that short piles can provide sufficient capacity provided that they are unaffected by the cracked soil, but the extent to which desiccated soil reduces capacity is unknown. The ultimate aim is to reduce the length of piles, or to demonstrate alternative screw piles can provide sufficient resistance and control movements. This will be of particular benefit to potential solar farm foundations which can involve 100,000 piles in a single project and for which foundation design is a significant part of the cost and a major risk factor.							
DP220103731	**Directionality-Aware Cohesive Subgraph Search over Directed Graphs**	80,000.00	160,000.00	158,172.00	78,172.00	0.00	0.00	476,344.00
Chang, Dr Lijun	Searching cohesive subgraphs around a set of user-specified seed vertices in big graphs has many applications including cybersecurity, crime detection, social marketing and public health. This project aims to investigate directionality-aware search of cohesive subgraphs over directed graphs by designing effective models and developing efficient and scalable algorithms. This project expects to address key challenges and lay scientific foundations for searching big directed graphs. The expected outcomes include novel models, computing paradigms, algorithms, indexing techniques, and distributed solutions. The success of the project will not only provide technological breakthroughs but also benefit the development of key industries in Australia							

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	National Interest Test Statement							
	Graphs are widely used to capture the relationship and information flow between entities in many applications such as social media, online communities, mobile communications, e-commerce, and financial transactions. Advances in these information technologies have generated huge, and rapidly growing, amounts of graph data. Managing and extracting knowledge and insights from large graphs poses great computational challenges, but also opens extraordinary opportunities across a vast range of sectors, including science, engineering, business and public health. This project aims to unlock these opportunities by developing effective, efficient and scalable big graph data processing techniques to enable individuals, business, and organisations to exploit the information contained in big graph data. The research will address key scientific challenges as well as key problems in real applications to the direct benefit of e-commerce, cybersecurity, risk management, social networks, and other applications, including online fraud detection and health management, in Australia.							
DP220103782	**Life among giants: Jovian exoplanets and the habitable zone**	80,000.00	160,000.00	130,000.00	50,000.00	0.00	0.00	420,000.00
Tuthill, Prof Peter G	How and where do gas giant planets like Jupiter form? The best answers would come from direct studies of the cradles of planetary birth themselves. This project takes direct aim at the forbidding technological challenge to recover the first images of planetary birth at the required scales of size (around Jupiter's orbit) and contrast. In revealing the architecture of formation of the giants, we simultaneously make an enormous stride in understanding the potential for habitable rocky worlds such as Earth, whose orbits will be dictated by the Jovians. Our program is driven by unique and innovative photonics technologies integrated within the best modern telescope facilities, allowing us to open a new window in exoplanetary science.							
	National Interest Test Statement							
	This project will map the formation pathways and evolution of planets and reveal the underlying physics that drives planetary formation within solar systems. To achieve this, the project will deliver a new observational capability, using novel fabrication technologies to build optical photonic chips with unique design and properties. This photonic chip technology will be translatable into the next generation of Extremely Large Telescopes, putting Australia at the forefront of delivering the technology required for the science of tomorrow. As well as building Australia's technical research capacity, the unique photonic architectures this project will develop will be able to be applied in optics and advanced imaging technologies. These developments will provide new capabilities and potential spin-offs that can be harnessed by Australian high-tech industries.							
	The University of Sydney	4,783,465.00	10,116,966.50	10,147,480.00	4,909,228.50	95,250.00	0.00	30,052,390.00
University of Technology Sydney								
DP220100369	**Gender-Lens Investing: Harnessing Social Innovation for Impact**	60,146.00	129,130.00	140,041.00	71,057.00	0.00	0.00	400,374.00
Logue, A/Prof Danielle	This project aims to investigate how the field of gender-lens investing can be harnessed to address gender inequality and generate social impact. It will generate novel scholarly knowledge that addresses how social innovations like GLI can emerge, grow and be sustained. The expected outcomes include improved theoretical understanding of the organisational and institutional infrastructure required to sustain social innovations by identifying obstacles and best-practice approaches for growth, organisation and governance. This should provide significant benefits in terms of national and international policies and systems supporting impact investing and addressing Sustainable Development Goals.							
	National Interest Test Statement							
	The project centrally contributes to Australia's national interest by conceptually informing how to harness gender-lens investing for social impact. As a social innovation and form of impact investing, it contributes directly to the Prime Minister's Women's Leadership and Development Program (Job Maker) and the National Taskforce on Social Impact Investing, and national and state efforts to address the Sustainable Development Goal 5, gender equality. The domain of applicability of findings will, at the same time, transcend this specific setting, as the problem of growing and sustaining social innovations and managing organizations towards social impact is salient in other settings in need of impact investing such as affordable housing, youth unemployment, and aged care.							

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DP220100662	**Wikipedia and the nation's story: Towards equity in knowledge production**	67,500.00	133,500.00	137,000.00	71,000.00	0.00	0.00	409,000.00
Ford, A/Prof Heather	As the world's largest source of public information, Wikipedia is a crucial site in which national stories are made. This project aims to institute a critical approach to understanding Wikipedia by investigating how it produces knowledge in its coverage of Australian historic events. The project expects to advance digital media studies, utilizing an innovative conceptual approach to undertake the first systematic examination of events from a national perspective. Expected outcomes include an expanded evaluation framework and an international research collaboration. This should provide significant benefits, building research capacity and creating tools to help generate more equitable coverage for millions of users in Australia and beyond.							
	National Interest Test Statement							
	It is in Australia's interest that its citizens are able to access information about themselves, their country and their culture. With over 200 million monthly page views, Wikipedia has become the most powerful and widely used source of public knowledge about the Australian past. But Wikipedia is a very limited resource. Not only does its content only partially reflect the national story, but no survey of its Australian coverage has ever been undertaken. By providing new tools to understand the coverage of Australian events in Wikipedia, this project will benefit millions of Australians by enabling them to better see themselves in Wikipedia's pages, and will also benefit the Australia in its international relationships, through expanding and improving Australian representation in one of the most globally used sources of information.							
DP220100768	**Robust Federated Learning for Imperfect Decentralised Data**	57,500.00	115,000.00	115,000.00	57,500.00	0.00	0.00	345,000.00
Zhang, Prof Chengqi	This project aims to develop a next-generation robust federated learning framework to tackle the challenging scenarios of imperfect decentralised data in real applications, e.g. mobile phones and the Internet of Things (IoT) devices. The outcomes will bring great benefits to a broad range of industry sectors by providing novel large-scale intelligent applications with privacy preservation. The proposed method will advance the development of a cutting-edge technique to develop new intelligent applications in a decentralised and privacy-sensitive scenario. This game-changing research will advance current data mining and artificial intelligence research from centralised intelligence to decentralised intelligence with a collaboration network.							
DP220100769	**Interpretable Behaviour Analysis with External Structured Knowledge**	57,500.00	115,000.00	115,000.00	57,500.00	0.00	0.00	345,000.00
Blumenstein, Prof Michael	This project aims to develop novel interpretable neural models for predictive analytics tasks on human behaviour, operating on sequence behaviour data associated with external supportive structured knowledge. It is expected to present theoretical foundations for robust representation learning on heterogeneous behaviour data and interpretable machine reasoning models, which can support a broad scope of intelligent systems. Expected outcomes will be a next-generation interpretable behaviour analysis system with versatile abilities to reason over various data structures and provide a high-level interpretability about its reasoning procedure. The benefits will span the research and industry sectors, e.g., retail, healthcare, service provider.							
	National Interest Test Statement							
	This project adopts a novel approach to deliver ground-breaking advances for augmenting artificial intelligence (AI) capabilities to drive an uplift in productivity for Australian businesses and organisations through predictive data analytics. The outcomes will embody the transparency and explainability principles in Australia's new AI Ethics framework. It will unlock next-generation predictive analytics that can provide enhanced automatic data processing, and more accurate and transparent predictions to support responsible data-driven decision making. The innovative outcomes will enhance the capacity of Australian organisations across different sectors to deliver significant economic and social benefits. The latter range from enabling small and medium-sized enterprises (SMEs) across social and healthcare services to deliver more accurate predictions for effective and timely support to vulnerable populations, all the way to enabling advanced manufacturing industries to gain better data-driven insights for client demands and new trends in product design.							

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DP220100803	**AI-Human Empowered Team Decision-Making**	83,000.00	164,500.00	162,000.00	80,500.00	0.00	0.00	490,000.00
Lin, Prof Chin-Teng	This project aims to introduce machine intelligence into human team decision-making using the brain-to-brain synchrony that arises when people cooperate toward achieving a goal. The expected outcomes are models and indicators of this synchrony, and methods to fuse individual human decisions with autonomous machine agents, into collective decisions. This new knowledge is expected to greatly increase our understanding of cooperative decision-making by humans and machine agents. The tools produced are expected to provide a computational basis for human-autonomy teaming, the core of Industry 5.0, that software developers and end-users in various industries could further build upon to optimise complex decision-making to benefit humanity.							
	National Interest Test Statement							
	Cooperative decision-making software used in various private and public sectors lack the engagement of intelligent machines as teammates. Enhancing the decision-making power of human-machine collaboration, which is the core of Industry 5.0, with the added perspective of machine intelligence, holds extraordinary potential for more accurate, better-informed and more timely collective decision-making in complex situations (e.g. healthcare, transport). The expected outcomes of this project are translation-ready AI-empowered tools to optimise human group planning and decision-making for Australian enterprises. The commercial potential of these tools is expected to (1) position Australia as a leader to exploit AI and cognitive science for collaborative decision support software; and (2) advance three of the Australian government's Strategies for the Future: Artificial Intelligence, Boosting Science and Innovation, and Increasing International Collaboration. The project also provides substantial training opportunities to add to Australia's capacity in AI where demand for skills is growing rapidly.							
DP220100964	**Journeys and Legacies of European Émigré Lawyers in Australia**	51,200.00	103,775.00	147,225.00	94,650.00	0.00	0.00	396,850.00
Biber, Prof Katherine	This project investigates the reception and contribution of legally-qualified European émigrés to Australian law, institutions and society. Examining the cohort who arrived in Australia before, during and immediately after the Second World War, we focus on three sites: the legal academy, the legal profession, and the role of international institutions and agencies. Using archival research, oral history, personal papers and case law, the project makes an Australian contribution to international research into the journeys and legacies of European émigré lawyers. The project provides important new knowledge about the role of migration in shaping Australian legal institutions.							
	National Interest Test Statement							
	In 2019, almost 30% of Australia's population was born overseas, with most being skilled migrants. Only a small fraction of these are represented in Australia's legal profession and legal academy. This project examines this lack of diversity, recovering evidence of the lives, journeys and careers of legally-qualified migrants. Focusing upon European émigrés arriving in the period before, during and immediately after the Second World War, this project investigations their reception in Australia and their contributions to the legal profession, legal academy and to Australia's engagement with international institutions and agencies. It generates important new knowledge about the contributions that have been made to Australian legal institutions by émigré lawyers.							
DP220101051	**Self-Healing Concrete for Mitigation of Chloride Induced Steel Corrosion**	37,500.00	75,000.00	72,500.00	35,000.00	0.00	0.00	220,000.00
Castel, Prof Arnaud	This project aims to develop an intrinsic self-healing concrete using crystalline admixtures for rapid healing of concrete cracking. In marine environments, concrete cracking provides a direct access for chlorides from sea water to the steel reinforcement, leading to early and severe steel corrosion. The self-healing concrete will be designed to address the two main causes of concrete structures deterioration in Australia: early age cracking due to restrained shrinkage and chloride induced steel reinforcement corrosion. The outcomes of this project will drive the advances in developing and applying crystalline admixture-based self-healing concrete to extend the service life of concrete structures and avoid costly repair.							

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	National Interest Test Statement Concrete is the most widely used construction material of choice for much of Australia's infrastructure. Moreover, most of Australia's critical infrastructure is located on or near the coast in high saline conditions, and is therefore exposed to a high risk of corrosion of reinforcing steel. Our ability to design or repair such structures with the full knowledge of their long-term performance is crucial, both economically and strategically, to the nation's wealth and security. This project will provide benefits for developing intrinsic self-healing concrete, aiming for mitigating chloride transport and preventing corrosion propagation of steel reinforcement. This novel crystalline admixtures-based self-healing technology will cater for the stringent requirements on smart concrete infrastructures, and will create new revenue streams, and bring this novel technology into cement and concrete industry to improve durability, serviceability and sustainability of structures, producing important economic, environmental and social benefits, enhancing workforce skills of engineers, builders and civil constructors.							
DP220101139 Ni, Prof Bing-Jie	**Overcoming microplastics induced inhibition on waste-to-energy conversion** This project aims to develop an innovative technology and the underpinning science to achieve stable and efficient mitigation of emerging microplastics induced inhibition that is becoming a key barrier hindering waste-to-energy conversion in anaerobic digestion. Anaerobic digestion is a low-cost technology widely used to divert sewage sludge to renewable energy production. However, the increasing levels of microplastics captured in sludge leads to low methane yield and process failure due to their small size and specific characteristics. The outcome of the project will remove the emerging barrier to enhance energy recovery that can be applied in existing anaerobic digestion infrastructure for addressing Australia's increasing energy demand.	55,000.00	110,000.00	105,000.00	50,000.00	0.00	0.00	320,000.00
	National Interest Test Statement Australia's energy consumption is growing at about 2% per year. As natural resources currently used are finite, alternative and renewable energy sources are urgently required. Large quantities of waste sewage sludge generated from wastewater treatment in Australia are posing an ever increasing threat to our societies and economies, which though represents a substantial renewable energy resource. Anaerobic digestion is a mature sludge treatment technology for energy recovery in the form of methane. However, the increasing levels of microplastics captured in sludge during wastewater treatment is seriously challenging this energy recovery technology by inducing microbial inhibition and limiting its sustainable application. This project will provide novel operating solutions that realise the effective mitigation of microplastics induced inhibition on waste-to-energy conversion and the significant enhancement of treatment performance, which will bring strong economic, social and environmental benefits to Australia to supports Australia's transition to a reliable, low-cost, low-emission and secure energy future.							
DP220101142 Ni, Prof Bing-Jie	**Contribution of Comammox Process to Sustainable Wastewater Treatment** This project aims to understand the versatility, activity and physiological features of comammox bacteria, the newly-discovered complete nitrifiers, in Australian wastewater treatment systems, and to model and evaluate their contributions to biological nitrogen removal process. Nitrogen transformations are crucial microbial processes in the wastewater treatment ecosystems, with nitrification largely responsible for ammonium oxidation but comammox previously overlooked. The expected outcomes will develop new knowledge on the comammox process and provide novel insight and technological solution to refine strategies to manipulate nitrification processes for achieving improved biological nitrogen removal and sustainable wastewater management.	63,138.00	125,301.00	113,526.00	51,363.00	0.00	0.00	353,328.00
	National Interest Test Statement This project will directly deal with critical issues related to water scarcity and global climate change, both of which have been imposing significant challenges on the natural environment of Australia and the well-being of human beings. This project will provide novel wastewater treatment solutions for carbon footprint mitigation and therefore align well with the aspirational goal of providing greenhouse gas neutral water services set by many Australian water utilities. This project will make a valuable contribution by providing novel solutions that enable cost- and energy-effective management of nitrogen-rich waters in engineered systems and potentially also in natural environments. The optimum plant designs and control strategies which should be of great interest to and could be adopted by water utilities will be patented and could bring direct economic benefits to Australian academia and industry. Through dissemination and public engagement activities, this project will raise public awareness in the carbon footprint issue and the importance of sustainable wastewater management.							

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DP220101143	**Creation of a super-resolution map of the bacterial cytokinesis machinery**	71,202.50	147,393.50	153,107.00	76,916.00	0.00	0.00	448,619.00
Söderström, Dr Bill	Cell division is a fundamental process essential for life. Yet our understanding of this process on a molecular level is limited, mostly hampered by the inability to visualize the different components of the division machinery inside these tiny cells with adequate resolution. To overcome this barrier, capitalizing on recent advancements in imaging and molecular technologies combined with innovative engineering, this project aims to create a spatial and temporal map of the division machinery inside bacterial cells at unprecedented resolution. The expected outcomes are new knowledge on the mechanism of bacterial division and technological advances in biological imaging, informing applications in a wide variety of sectors.							
	National Interest Test Statement							
	Knowledge generated in this project could form the foundation for the development of new tools to combat an increasing global health treat; antimicrobial resistance (AMR). The importance of basic research in this area cannot be overstated as the world is rapidly heading towards a post-antibiotic era where several million people are predicted to succumb to bacterial infections each year. Other future potential applications of this work include advances in manufacturing, wastewater management, agriculture and bioremediation. More immediately, this project is expected to generate knowledge that will be disseminated in high-quality scientific literature that will help Australia maintain its front-line position in interdisciplinary basic research that has proven vital for the sustainability of an advanced progressive society. The innovative technologies in engineering, molecular science and biological imaging we will develop will provide excellent training for our young Australian scientists, and contribute to maintaining our strong reputation in basic interdisciplinary research leading to translation.							
DP220101158	**Radio Frequency Camera for Low-Complexity and High-Resolution Radar Imaging**	77,500.00	157,500.00	160,000.00	80,000.00	0.00	0.00	475,000.00
Huang, Prof Xiaojing	This project aims to develop the theory and enabling techniques to realise a low-complexity and high-resolution radar imaging system with uncoordinated illumination. New scientific breakthroughs include fundamental radar imaging theory, advanced radio frequency frontend design and fast signal processing algorithms. These will lead to a paradigm shift in active and passive imaging technologies. A proof-of-concept prototype of the proposed imaging system with 77 GHz millimetre wave will be developed to demonstrate its feasibility and performance. The expected outcomes include Australia's scientific and technological leadership in radar imaging and enhanced capability in emergency response, defence, public safety, and healthcare industries.							
	National Interest Test Statement							
	The project will enhance Australia's leadership in advanced radar imaging technology, thus supporting industries such as emergency response, defence, public safety, and healthcare. With improved sensing capability, the developed radio frequency camera will enable many new applications which are not possible today, such as helicopter landing in poor visibility, illegal object detection in airports and public areas, and medical examination on the spot and at home, thus bringing economic and social benefits to Australian society. The project also targets technology transfer and commercialisation and hence will stimulate growth of the local industry and attract overseas investment to Australia. The benefits of the breakthrough imaging technology will contribute to maximising Australia's competitive advantage and meeting the emerging global and domestic public security and healthcare demands. The project is expected to generate intellectual property in the form of technical publications and patent disclosures, build research strength, and nurture critical mass of Australian talent for this emerging technology.							

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DP220101417	**Laser-free on-chip super-resolution microscopy**	82,500.00	165,000.00	165,000.00	82,500.00	0.00	0.00	495,000.00
Wang, Dr Fan	The project aims to develop a compact, cost-effective on-chip super-resolution microscope through an innovative combination of imaging algorithms, optics and integrated photonics. This project addresses limitations in imaging algorithms that increase laser system complexity and constrain imaging speed and applications, as well as nanostructure fabrication issues. Expected outcomes include the discovery of emitter self-interference microscopy, new knowledge in imaging, photonics and biophysics, the world's fastest super-resolution technology, compact on-chip nanoscopy that can be added to existing technology and proof of concept in three areas. Benefits are anticipated in commercialisation, improved photonics devices and usage in biophysics.							
	National Interest Test Statement							
	This project aims to uncover fundamental insights into chip-based super-resolution microscopy ('nanoscopy'). The unique technology that is developed will expand Australia's knowledge base, research capability and international standing in super-resolution imaging. By overcoming the limitations of traditional nanoscopy chips, the proposed optical technology is expected to revolutionise nanoscopy chip fabrication. This would fast-track commercial scale-up and give Australia a competitive advantage to meet the rising global demand for innovation in advanced nanoscopy technology for biomedical and a broad range of other imaging applications in life sciences, chemistry, optics and physics, including rapid virus detection and characterisation. Positioning Australia at the forefront of these areas would deliver significant economic, commercial and social benefit.							
DP220101819	**The Molecular Basis of Nanoparticle Resistance in Mixed-Species Biofilm**	65,000.00	127,500.00	122,500.00	60,000.00	0.00	0.00	375,000.00
Gunawan, Dr Cindy	The project aims to understand how the globally significant mixed-species growth of pathogens develop resistance to silver nanoparticle, currently one of the most important alternative antimicrobials to antibiotics. The integrated research is to elucidate, for the first time, the nanoparticle multi-targeting toxicity on mixed-species bacterial community and how, in turn, the bacteria activate their cell-to-cell signalling for a synergistic defence to adapt to the nanoparticle toxicity. The pioneering knowledge is the foundation for technologies targeting the interspecies metabolite cross-talking to overcome the resistance phenomena, ensuring a long-term efficacy of the alternative antimicrobial on the difficult-to-control pathogenic growth.							
	National Interest Test Statement							
	The world is fighting a serious crisis of antibiotic resistance with bacterial pathogens becoming increasingly resistant to almost all antibiotics. Nanosilver is now an important alternative to antibiotics and the project seeks to preserve the long-term efficacy of the nanoparticle on the clinically and environmentally significant mixed-species biofilm growth of pathogens. Mixed-species growth is the leading cause of stubborn and in many cases, untreatable infections in human and livestock. The generated knowledge of how pathogens in mixed-species consortium communicate to coordinate defence against the potent nanoparticle, can guide development of technologies that can switch off this biological signalling. With no discovery of new effective antibiotics over the last 30 years, the project ultimate purpose is to protect the efficacy of nanosilver as a valuable alternative antimicrobial, saving lives and the billions currently spent in healthcare, livestock industries, as well as environmental remediation to cope with the issue of antibiotic resistance.							
DP220102059	**Formal Verification of Quantum Logic Circuits**	70,000.00	142,500.00	147,500.00	75,000.00	0.00	0.00	435,000.00
Ying, Prof Mingsheng	The project aims to develop comprehensive theory and effective techniques for formal modelling, equivalence checking, and model checking of quantum circuits. The research is timely as the rapid growth of quantum computing hardware makes it an urgent task to develop verification techniques for quantum hardware design and quantum compilers. The successful development of the algorithms and software tools proposed in this project will significantly advance the knowledge on formal verification of quantum circuits and help Australian quantum start-ups build and maintain an internationally leading position in the rapidly emerging quantum electronic design automation (EDA) industry.							

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	National Interest Test Statement The outcomes of this project include theoretical results, algorithms and prototype software tools which could have a significant impact in quantum hardware verification and profound potential benefits for new and advanced knowledge and implications for the Australian economy. Its successful completion will complement Australia's strong research success in quantum hardware, consolidate our position in the global research community, and benefit Australian Information and Communication Technology industries. This project addresses the National Science & Research priority of advanced manufacturing by contributing essential theoretical support and prototype software tools for Australian quantum start-ups, helping them establish and maintain an internationally leading position in the rapidly emerging quantum electronic design automation (EDA) industry, which could better exploit Australia's advantages in attracting, training, and maintaining high-end human resources in quantum computing, while avoiding the common disadvantages of its being in an isolated geographic position.							
DP220102635 Zhang, A/Prof Guangquan	**Robust meta learning for risk-aware recommender systems** Recommender systems are the core of many online services but they are highly vulnerable to risks like shilling attacks, privacy leaks, and unexpected change. This project aims to develop new adversarial Bayesian-based, privacy-preserved and self-adaptive fuzzy meta learning methods and meta recommender systems that are robust to these risky, uncertain and dynamic environments. The anticipated outcomes should significantly improve the reliability of recommender systems with particular benefits for online personalised service systems, e.g., e-government, e-business and e-Learning. The outcomes will also advance machine learning knowledge with a new robust meta learning schema for general data analytics and applications.	81,250.00	169,250.00	166,000.00	78,000.00	0.00	0.00	494,500.00
DP220102862 Indraratna, Prof Buddhima N	**The Role of Energy Absorbing Rubber Grid on Ballast Track Performance** Breakage and excessive displacement of ballast lead to instability and regular maintenance of railways. The project aims to study the fundamental mechanics of ballast aggregates interacting with the apertures of recycled-Rubber Energy Absorbing Grids (REAG). The role of REAG on enhanced track performance by damping the cyclic wheel loading and impact will be quantified via rigorous mathematical methods complementing a computer-based numerical model and validated by laboratory & field data. When placed within the rail substructure REAG will enable reduced ballast movement and breakage while attenuating noise/vibration. The research outputs will facilitate improved rail track design enabling enhanced longevity and reduced cost of maintenance.	90,000.00	180,000.00	180,000.00	90,000.00	0.00	0.00	540,000.00
	National Interest Test Statement This project will deliver rigorous design tools and guidelines for adopting recycled-rubber energy absorbing grids (REAG) in rail ballast and to improve track stability using a sustainable solution. Utilising REAG in railways can potentially deliver wide economic, commercial, and environmental benefits. Ballast degradation accounts for the bulk of track maintenance costs for rail authorities, where replenishing ballast alone costs over $15 million/year in NSW. Meanwhile, there are limited incentives for industry to recycle the large volumes of end-of-life tyres and worn conveyor belts; at present these go to landfills, stockpiled in mine sites, or illegally dumped. Revisions to technical specifications and Australian standards to incorporate REAG will ensure that an environmentally responsible solution is implemented to upcycle rubber waste and lessen the carbon footprint of industry. Rail authorities can expect substantially reduced maintenance costs as well as enhanced track performance and longevity. New markets for recycled rubber will also generate employment and socio-economic benefits for Australia.							

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DP220103458 Huang, A/Prof Zhenguo	**Novel hydrogen-rich liquids for storing and transporting hydrogen at scale** Hydrogen is proposed as the best candidate to store large amounts of energy produced by intermittent sources such as wind and solar. This project aims to address challenges in storing and transporting large amounts of hydrogen in a safe and effective way by developing novel liquid-phase compounds that contain light elements including boron, carbon, nitrogen, and hydrogen. Expected outcomes of this project include new liquid compounds that can effectively and safely store hydrogen at scale using the exisiting liquid hydrocarbon fuel infrastructure. This should provide significant benefits in the establishment of renewable hydrogen for domestic consumption and more for exporting sustainable and clean fuel using hydrogen as the energy carrier. **National Interest Test Statement** Australia has access to limitless solar and wind energy resources. These renewable energy sources can be used to split water molecules to produce hydrogen, a potential carrier of these renewables. But effective hydrogen storage and transport methods are currently lacking. The new liquid chemical compounds this project aims to develop will overcome this challenge by enabling the safe, cost-effective and efficient storage and transport of hydrogen at scale using existing liquid hydrocarbon fuel infrastructure, facilitating fast market uptake for various applications. Implementation of the outcomes will deliver Australia significant environmental and economic benefits. By facilitating higher amounts of renewables in its energy mix, Australia can lower its overall energy consumption and carbon emissions, and generate new domestic and export markets for renewables, opening up commercial and employment opportunities for Australian chemical manufacturers and stimulating the renewables sector.	80,000.00	160,000.00	150,000.00	70,000.00	0.00	0.00	460,000.00
DP220103717 Xu, Prof Guandong	**Contextual Behabiour Predictions in Dynamic Mobile E-commerce** The project aims to address behaviour prediction and develop novel techniques and tools for modelling, predicting human behaviours and making effective recommendations based on ubiquitous user behaviour data in mobile e-commerce. The techniques enable multi-source data fusion, context learning and model adaptation, and dynamic recommendation with interpretability ability. Expected outcomes include advances in data analytics theory and informed decision-making. This provides significant benefits of not only placing Australia in the forefront of exploiting multimodal user behaviour big data in dynamic e-commerce but also transforming Australian government and businesses to intelligent and contextual services adaptive to complex situations. **National Interest Test Statement** Australians are increasingly relying on online shopping when purchasing goods and services. In one of the fastest-growing sectors, as much as 46% of e-commerce transactions are conducted on mobile devices. This project provides a valuable opportunity to not only better understand customers' shopping behaviour through advanced data analytics, but to further improve their shopping experience. Through technological advantages, such as better understanding mobile customer preferences and personalised recommendations, the project will deliver novel digital solutions to the Australian e-commerce sector. This will especially benefit Australian vendors such as grocery chains and local consumer electronics stores by promoting sales to mobile users, therefore gaining added profits at a lower cost. In return, Australian customers will benefit through more relevant product recommendations and a seamless cross-device shopping experience. In the long term, the outcomes will contribute to transforming Australia into a leading and efficient digital economy and society.	67,500.00	135,000.00	135,000.00	67,500.00	0.00	0.00	405,000.00
	University of Technology Sydney	1,217,436.50	2,455,349.50	2,486,399.00	1,248,486.00	0.00	0.00	7,407,671.00

University of Wollongong

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DP220100003 Susilo, Prof Willy	**Secure Crowdsourcing Classification with Privacy Protection against Servers** This project aims to enable comprehensive quality data classification via secure crowdsourcing. The quality of a data-intensive process, such as a Machine Learning algorithm, depends on the input data quality. By using a crowdsourcing classification, the project expects to overcome the painstaking and costly process of humans correctly annotating extensive input data from diverse real information. The expected outcomes are innovative technologies, guaranteeing accuracy and confidentiality of annotation results whilst protecting the privacy of data classification results. It enhances data-intensive outputs quality, which will benefit large data-intensive applications, such as cybersecurity protections via intrusion detection.	73,500.00	151,000.00	157,500.00	80,000.00	0.00	0.00	462,000.00
	National Interest Test Statement Machine Learning (ML) algorithms have proven to be successful in delivering cybersecurity services, such as intrusion detection. The key challenge in this area is obtaining large volumes of quality data that has been correctly classified for training ML algorithms. This project aims to deliver a breakthrough technology, namely secure crowdsourcing, which facilitates data classification by the crowd workers while protecting the results for the data owner. Reducing false negative outputs from ML algorithms will reduce the need for manual maintenance through human intervention, thus lowering expensive labour costs and increasing productivity for a more innovative economy. This will be of benefit to Australian and international communities. Through this project, we plan to make the outcomes of this available to influence changes to Australian standards via ASD, DST Group and Data61 to secure Australia's industries, thus enhancing their productivity. It will also enable research training for the best available Australian and international researchers through research collaboration.							
DP220100756 Gibson, Prof Christopher R	**Reassembling the pandemic city: shifting geographies of creative work** This project aims to address the critical knowledge gap around COVID-19 disruptions to city centre economic geographies. It will longitudinally document and analyse post-pandemic reassembling of these geographies, focused on a bellwether sector—creative work—hard hit by the pandemic yet central to urban economic recovery planning. Spatial ethnographies of creative work will reveal shifts in space use, work practices, economic diversification, networks, and on-the-ground adaptations. The project will generate essential new practical knowledge of city centre reconfigurations and networks of creative industries across metropolitan spaces. Its benefits will include vital insights for urban policy to support resilient and inclusive recovery.	53,019.00	116,940.50	125,348.50	61,427.00	0.00	0.00	356,735.00
	National Interest Test Statement Effective post-pandemic planning and policy are critical to the prosperity of Australian cities and their disrupted city centres. This requires in-depth knowledge of pandemic-induced change in the geography of metropolitan economic activity. Through a focus on the bellwether economic sector of the creative industries, this project will identify on-the-ground patterns as enterprises respond to pandemic constraints and opportunities. New methods integrating qualitative interviews with GIS mapping will reveal continuity and change in enterprise use of central city, inner industrial and outer suburban space. Crucial empirical data on shifting dynamics and motivations will enable practical policy measures that accurately respond to needs. Australian cities will benefit from leveraging disruptions to generate social, environmental, economic and cultural benefits: more resilient, inclusive city centres, and suburban jobs and enterprise growth. This is a once-in-a-generation opportunity to study disruptive dynamics in real-time, positioning Australia as a leader in innovative urban development and policy.							

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DP220101196	**Topological stability from spectral analysis**	15,000.00	90,000.00	151,000.00	76,000.00	0.00	0.00	332,000.00
Rennie, A/Prof Adam C	The aim is to use mathematical scattering theory to find and study new topological features of the spectra of linear transformations on Hilbert space. The significance derives from mathematical models of low temperature conducting quantum materials. These have revealed `topological phases of matter' that are stable with respect to a range of variations in the parameters that determine the system. The stability is desired for applications to quantum devices. Our results will give topological stability from the scattering spectrum, a feature not previously seen. The benefits stem from new results in mathematical scattering theory with a primary novelty being the analysis of ``zero energy resonances'' in mathematical models of graphene.							
	National Interest Test Statement							
	Newly discovered exotic phases of matter with tuneable electronic properties have potential applications across the quantum engineering revolution, most importantly to quantum computation. The theoretical work from our team, which advances the mathematical models describing a range of quantum materials, contributes predictive and computational tools for these quantum technologies. The development of these technologies is supported by a range of Government funding initiatives, including DST's Next Generation Technologies Fund. The highly skilled graduates from this project will be able to contribute to these development efforts, as well as the nascent Australian quantum engineering industry. These graduates will also be well positioned to work with commercial enterprises spun off from universities' investment in quantum computation hardware, by supporting further experimental developments and applications.							
DP220101290	**Ambient Electrochemical C-N Coupling via Co-electrolysis of N2 and CO2**	77,500.00	155,000.00	157,500.00	80,000.00	0.00	0.00	470,000.00
Chen, Prof Jun	To overcome the hurdles in N2 fixation (massive energy consumption and CO2 emission), investigators creatively hypothesize that the simultaneous electrocatalytic coupling of N2 and CO2 would enable the selective formation of N-products and thus realize their conversion into N--fertilizers and acetamides. Based on the CI's recent discoveries, this project will develop an innovative / sustainable system, which could promote the N2 fixation along with CO2 conversion process, a significant alternative approach to simplify the pathways of C-N bond formation. It will thereby contribute to mitigation of greenhouse emissions and create an ecofriendly protocol/technology for distributed production of C-N products under ambient conditions.							
	National Interest Test Statement							
	Nitrogen-containing C-N bonds based organic compounds possess the most important status in drug molecules and agricultural chemicals. The fixation of earth-abundant N2 along with CO2 reduction has significant benefits from both social and economic point of views. The use of N-fertilizers (consuming 80% of the global ammonia) has been estimated to have supported 27% of the world's population over the past century, while acetamides (C-N complexes) are commonly used in the pharmaceutical industries. However, the traditional approach for C-N bonds formation (such as urea, etc.) is challenging both scientifically and technologically due to the high inertness of N2 molecule, and consuming approximately 3-5% of world's energy and contributing ~2% CO2 emission annually. The project will thereby contribute to mitigation of greenhouse emissions and create a technology for distributed production of C-N based N-products via taking the advantages of the combination of N2 along with CO2 reduction process.							
DP220101631	**Noncommutative analysis for self-similar structure**	62,500.00	127,000.00	129,500.00	65,000.00	0.00	0.00	384,000.00
Sims, Prof Aidan D	This project in pure mathematics aims to develop novel mathematical techniques for understanding self-similar structures using operator algebras. Fractals and self-similarity have many applications both within and outside mathematics, but remain deeply mysterious, while operator algebras are the mathematical language of quantum mechanics. This project expects to provide new connections between self similarity and operator algebras advancing both fields. Expected outcomes include increased understanding of self-similar structures, and novel operator-algebraic phenomena and examples. Benefits include growing Australia's capacity in operator algebras and mathematics more generally, and enhanced international collaboration.							

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	National Interest Test Statement							
	Mathematics has long-term technological and commercial impact, but it is difficult to predict in detail: it arises through advances in other disciplines based on new mathematical concepts and techniques. For example, the operator algebras on which this project focusses underpin quantum mechanics: the science that led to the transistors and LEDs from which the electronic device on which you are most likely reading this is built. Mathematical research also has impact via mathematically skilled individuals who transition to industry, addressing Australia's critical and growing need for a mathematically-skilled workforce for a data-driven future. At least five recent UOW doctoral graduates in operator algebras are currently working in the Australial public service or Australian government agencies, where they are driving policy. This project supports world-leading research in operator algebras, fosters Australian international competitiveness, and will train individuals who will enhance Australia's ability to make informed, data-driven decisions to tackle the complex challenges of the future.							
DP220101784 Wang, A/Prof Lei	**Making Meta-learning Generalised** This project aims to develop novel machine learning techniques, termed generalised meta-learning, to make machines better utilise past experience to solve new tasks with few data. It expects to reduce the undesirable dependence of current machine learning on labelled data and significantly expand its application scope. Expected outcomes of the project consist of new theoretical results on meta-learning and a set of innovative algorithms that can support the building of next generation of computer vision systems to work in open and dynamic environments. This should be able to produce solid benefits to the science, society, and economy of Australian via the application of these advanced intelligent systems.	75,000.00	150,000.00	150,000.00	75,000.00	0.00	0.00	450,000.00
	National Interest Test Statement							
	Two major obstacles limiting the application of machine learning are its data-demanding nature and the lack of capability in transferring and utilising the knowledge gained from a set of task to another set. This project aims to address these two pressing issues by proposing a series of novel meta-learning models that can adapt to entirely new data domains and solve new tasks distinct from existing ones in a data-efficient manner. This expects to advance Australia's research excellence in Computer Vision and Machine Learning. The research outcomes produced from this project could bridge the gap between current machine learning techniques and the applications that require quick and adaptive decisions. In light of the envisaged impact of machine learning, the project anticipates to generate solid economic and social benefits. Potential application scenarios include, but far not limited to, self-driving to quickly identify safety issues in unforeseen circumstances, robots to swiftly learn to perform new tasks, computer-based diagnosis systems to identity rare diseases from novel imaging modalities, and so on.							
DP220103301 Chou, Prof Shulei	**Sodium-Metal-Free, Safe and Sustainable Sodium-Ion Sulfur Batteries** This project aims to develop sodium sulfide cathodes via effective single-atom catalysts and elaborately regulate the solid-electrolyte interphase on the anode by using a new class of electrolytes. Thus, the obtained low-cost, high-energy, safe sodium-ion sulfur batteries can serve as a novel technique for large-scale stationary energy storage, especially for intermittent solar and wind energy storage in Australia. Expected outcomes include a comprehensive understanding and a breakthrough in advances of innovative and affordable battery storage technology, leading to significant scientific, economic, environmental, and social benefits to Australia by integrating this battery system with renewable energy.	65,000.00	130,000.00	130,000.00	65,000.00	0.00	0.00	390,000.00
	National Interest Test Statement							
	Through the development of novel sodium sulfide cathodes, the thus developed room-temperature sodium-ion sulfur batteries can serve as safe and low-cost storage devices for renewable energy in Australia, especially our abundant solar, wind, and ocean energy. The outcomes from this research will provide an incentive for the Australian industry to develop new energy storage devices, thus establishing a leading national position in the development of new energy storage technology. The broader impacts of the proposed research are both educational and technological. Training graduate students through fundamental research will offer a broad range of career opportunities for the students in the current competitive job market. The development of new scientific knowledge related to this project will encourage more researchers and industries into these emerging and promising fields.							

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DP220103466	**Understanding chaperone function, one molecule at a time**	89,000.00	177,000.00	179,500.00	91,500.00	0.00	0.00	537,000.00
van Oijen, Prof Antoine M	This project aims to determine how molecular chaperones, a class of proteins represented in all phyla of life, work together to keep proteins folded and functional, particularly following cellular stress. This is important as proteins are involved in virtually all biological processes. This project will exploit innovative microscopy techniques to watch these molecular chaperones as they work. Expected outcomes of this project are the first definitive description of how molecular chaperones interact to refold proteins, and the development of novel methods to study dynamic biological processes. This should provide significant benefits including enhanced collaboration and scientific capacity in Australia.							
	National Interest Test Statement By elucidating how molecular chaperones work to keep proteins in a folded and functional state, this project will provide direct insights into the processes that keep cells and organisms viable during times of stress. As such, this knowledge has the potential for economic, commercial and environmental impact since cellular stress affects all living organisms - a failure in the molecular processes that ensure cells and organisms remain healthy following periods of stress can detrimentally influence agriculture, ecosystems and health. By developing new cutting-edge techniques to study dynamic biological processes, this project will boost the research capacity of scientists nationally and internationally. This project will also provide training for students and young researchers in cutting-edge techniques, putting them at the forefront of biophysical and biochemical research around the world.							
	University of Wollongong	510,519.00	1,096,940.50	1,180,348.50	593,927.00	0.00	0.00	3,381,735.00
Western Sydney University								
DP220100036	**Maximising the Use of Waste Glass in Sustainable Composite Columns**	71,500.00	146,500.00	136,500.00	61,500.00	0.00	0.00	416,000.00
Tao, Prof Zhong	This project aims to develop novel structural concrete made with over 80% waste glass for use in manufacturing sustainable concrete-filled steel tubular columns used in buildings. Because of limited established markets for recycled glass, significant stockpiling of recycled and recyclable waste glass currently exists across Australia. This study will provide a suite of novel solutions to maximise the use of waste glass in structural concrete by fully replacing sand and gravel with crushed glass and up to 72% cement with glass powder. This will provide practical solutions to address not only Australia's glass recycling crisis but also the worldwide issue of disposal of waste glass.							

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	National Interest Test Statement The innovations in developing sustainable concrete and associated construction are at the forefront of international trends and will address the need to promote sustainable construction and a circular economy. The research outcomes will solve Australia's glass recycling crisis, which will provide significant economic, commercial, environmental, and social benefits to the Australian community. The annual glass waste generated in Australia is 1.16 million tonnes, of which over 40% go directly to landfills. Because of limited established markets for waste glass, significant stockpiling of recycled and recyclable waste glass mixed with other combustible wastes exists across Australia, heightening the risk of fire and threatening the environment. At the same time, there is a shortage of quarry materials and natural sands in many places in Australia because of the tremendous demand for concrete and natural aggregates. This project will provide innovative solutions to maximise the use of waste glass in concrete and promote the use of this concrete in composite construction.							
DP220100795 Boer, A/Prof Matthias M	**Physics-aware machine learning for data-driven fire risk prediction** The 2019/20 Australian fire season was unprecedented in its extent, impact, and the response of fire agencies. In this project, we aim to answer the question: was the scale of these fires driven by known drivers of fire (drought, weather, fuels and ignitions), or were fundamentally new undescribed processes and phenomena involved? We will accomplish this by developing an innovative, physics-aware machine learning model of fire risk and spread, trained and validated on a two-decade satellite fire record. The predictive ability of the model will be tested on the 2019/20 fire season to determine if novel drivers of fire can be identified, and the model itself will be operationalised into a novel short-to-mid term fire risk prediction tool.	95,000.00	187,500.00	147,500.00	55,000.00	0.00	0.00	485,000.00
	National Interest Test Statement This project will strongly benefit Australian communities, ecosystems, emergency services and agriculture by improving our ability to prepare and respond to extreme bushfire seasons, by providing a new, innovative tool for fire risk forecasting, and by identifying and understanding novel drivers of the costly 2019/20 fire season. The development of this machine learning model will assist fire management agencies to identify areas at risk of fire and plan resource allocation more rapidly, and will allow communities and individuals to make more timely preparations and assessments of risk. In applying this model to a retrospective analysis of the 2019/20 fire season, this project aims to strengthen our understanding of fire behaviour in south-eastern Australian eucalyptus forests by identifying novel drivers of extreme fire seasons, information that will be vital for protecting populations and natural assets in a warmer, drier future.							
DP220101256 Etherington, Dr Ben	**Creole Voices in the Caribbean and Australia: Poetics and Decolonisation** Creole Voices will investigate the experiences of Caribbean people that have been repressed or lost in colonial archives. Its first theme introduces the methods of historical poetics to Caribbean literary studies in order to recover a forgotten archive of poems written in the region's hybrid creole languages and to reconstruct for the first time the history of Creole poetry between the end of slavery and formal decolonisation. Its second theme synthesises archival research and literary reconstruction to explore the lives of Caribbean people arriving in Australia over the same period. Creole Voices' discoveries will be made readily accessible to Australian and Caribbean communities through online digital archives, podcasts, and publications.	27,500.00	60,000.00	60,000.00	27,500.00	0.00	0.00	175,000.00
	National Interest Test Statement At a time when the number of Australians from Caribbean backgrounds is increasing, Creole Voices will confer great social and cultural benefits as the first comprehensive exploration of Caribbean people's role in Australia's cultural formation. It will contribute to social cohesion by giving a new perspective on how Caribbean people participated in key aspects of Australia's history like its convict period, its economic expansion through mining, its sporting achievements, the tribulations of the White Australia era, and the current context of multiculturalism. It will further the aims of DFAT's Caribbean Regional Program by establishing links to institutions and scholars across the Caribbean and by ensuring that all materials uncovered will be accessible to Caribbean and Australian communities. Outputs like the project's podcast series and digital anthology are designed to maximise public exposure. It will boost Australia's international research standing by producing elite publications and aid renewal in Caribbean studies following the retirements of several eminent Australian scholars in this area.							

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DP220101722	**Being a Transnational Muslim in Australia in an Era of Hyper-Security**	82,000.00	173,000.00	128,500.00	37,500.00	0.00	0.00	421,000.00
Possamai, Prof Adam M	Muslims have been the focus of significant policy articulations around security and integration in a hypersecuritised environment. This project aims to investigate how Australian Muslims are negotiating increased surveillance and public hostility and how this impacts on their sense of belonging. Working with members of four disparate Muslim communities in Brisbane, Melbourne, Perth and Sydney, the project will examine the varied manifestations of national and transnational belonging for conceptions of identity and social inclusion. In addition to generating new knowledge in the sociology of religion and migration studies, this project will also yield novel data for better policy and practice both locally and internationally.							
	National Interest Test Statement							
	Within the current context of the Australian government's emphasis on the security and counter-terrorism agenda, this project analyses and advances our understanding of the interrelationship between transnational connections and Muslim migrant integration. Western anxieties over the implications of certain transnational activities among Muslim migrants and the promulgation of anti-Western sentiment ensure this project is relevant. It will address a critical area of national and international study. Empirically, the project will generate novel data on how social inclusion among Muslim communities are affected by national and international terrorist events as well as transnational connections. By investigating perceptions of belonging, as well as transnational practices of Australian Muslims, this project directly addresses the issues of cultural citizenship, intercultural relations, and human rights, which are central to building resilient communities in Australia.							
DP220102039	**Rhizosphere mediation of soil greenhouse gas fluxes with climate change**	53,836.00	152,039.50	196,057.00	97,853.50	0.00	0.00	499,786.00
Pendall, Prof Elise	Increasingly extreme heat waves, droughts and floods contribute major uncertainties in predicting natural land-based climate change mitigation. This project will quantify current and future greenhouse gas absorption in a managed grassland ecosystem, and the new knowledge will contribute to carbon emissions offsets in climate change accounting schemes. We will conduct this research using a manipulative field experiment, controlled laboratory incubations, microbial gene analysis and mechanistic modelling to provide new insights into future potential climate change mitigation by soils.							
	National Interest Test Statement							
	This project will provide environmental benefits by improving our understanding of how soil processes can take carbon dioxide and other greenhouse gases out of the atmosphere. This project will bring societal and economic benefit to Australia's vast grazing lands by informing farmers how much carbon their soils can store. Economic benefits emerging from the project are also related to the data and model results necessary to calculate contributions to any carbon Emissions Reduction scheme. The new knowledge is urgently needed by Australia to inform reliable climate change mitigation strategies. The project builds on international collaborations with world leaders in soil carbon measurement and advanced computational methods, and leverages significant investment by NCRIS via the Terrestrial Ecosystem Research Network (TERN).							
DP220102925	**The building blocks of language: Words in Central Australian languages**	89,126.50	179,935.00	184,988.50	94,180.00	0.00	0.00	548,230.00
Mailhammer, A/Prof Robert S	This project seeks to model the structure of words and phrases in three indigenous languages of of central Australia: Anmatyerr, Kaytetye, and Warumungu. The project will advance our understanding of the different ways that words and phrases function as the building blocks of language: how words vary in complexity, and the different ways that they combine to generate higher levels of linguistc structure. The project will preserve Indigenous language heritage and contribute to Indigenous cultural maintenance, a significant factor in advancing Indigenous well-being. The project will generate new insights into language structure that will advance linguistic theory, and inform language teaching and speech processing technologies.							

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	National Interest Test Statement This research will provide social and cultural benefits by working with speakers of Anmatyerr, Kaytetye, and Warumungu -- three endangered languages of Central Australia -- to provide new knowledge about their structures. For Indigenous students, learning their heritage language is important for well-being and achievements. Descriptions of most indigenous languages do not adequately explain the richness and complexity of structure, knowledge of which are well understood by older speakers, but might not survive as the languages are spoken less by younger members of the community. The research team will work with speakers of Anmatyerr, Kaytetye, and Warumungu to provide good quality descriptions of complex structures, relating them to Indigenous learning practices. Good quality descriptions of complex structures in these languages will serve as models for improving descriptions in other Australian languages. The increase in knowledge of Australian languages and cultures with key implications for Indigenous wellbeing and health ares a National Priority area within the Indigenous Advancement Strategy.							
DP220103043 Zhang, A/Prof Yixia (Sarah)	**A Green and Fire-resistant Magnesium Oxychloride Cementitious Composite** This project aims to develop a novel and green fibre reinforced magnesium oxychloride cementitious composite with durability and resilience for buildings subject to fire/bushfire attack via well-integrated multiscale numerical and experimental studies. This enhances integrity and safety of buildings and increases the energy efficiency for buildings. The project will significantly advance the research and application of green cement, and find a solution for recycle and reuse a large amount of waste/industry by-products in construction towards circular economy. The research outcomes are innovative material, models, experiment technology and modelling methods, with significant impact and benefits to environment, economy and society.	68,500.00	139,000.00	107,500.00	37,000.00	0.00	0.00	352,000.00
	National Interest Test Statement Manufacturing of conventional cement and cement-based construction materials such as concrete emit a large amount of carbon dioxide, causing strong concern to environment. Australia is currently facing an immediate challenge of waste management, and bushfire poses risks to buildings and life. This project aims to develop an innovative light, green and fire-resistant construction material based on a green cement-magnesium oxychloride cement via rigorous and innovative scientific investigations to achieve durability, sustainability and resilience for buildings subject to fire/bushfire attack. This new material will consume a large amount of wastes and industry byproducts providing a solution to the waste issue along with significant environmental benefit contributing to a circular economy. The application of light, fire-resistance material with thermal insulation properties will enhance the structural safety and energy efficiency of buildings. The project brings commercial and economic benefits, advancing the products of Australia industries and enhancing the application of innovative construction technology.							
DP220103047 Varlet, Dr Manuel P	**Brain mechanisms for coordinating with others through sound** Distinguishing between sounds produced by self and others is critical for interpersonal coordination and communication through speech and music. This project employs a novel dual-brain electrophysiological technique with tagged audio signals to elucidate how the human brain achieves this distinction, and when and why it cannot. Expected outcomes include new knowledge on the neurophysiological mechanisms that support self-other processing, and the acoustic conditions and behavioural strategies that facilitate their operation. These outcomes should ultimately have applied benefits for improving interpersonal coordination and social interaction, especially in digital environments and clinical populations with atypical self-other processing.	99,624.00	200,654.00	206,631.50	105,601.50	0.00	0.00	612,511.00
	National Interest Test Statement The project will contribute to Australia's national interest by elucidating and enhancing the brain mechanisms that enable humans to communicate and coordinate through sounds including speech and music. Neuroimaging will be used to determine how the human brain optimally processes sounds produced by self and others during social interaction, and when and why it cannot. Expected outcomes are new knowledge in psychology and neuroscience, deepening the understanding of self-other auditory processing, and of the environmental conditions and behavioural strategies that influence it. These outcomes have potential applications for developing and commercialising better acoustic environments for human-human and human-machine teaming, especially for digital platforms used increasingly by the Australian and international community. Potential social and economic benefits to Australia include understanding and improving social interaction in individuals with mental disorders and clinical conditions characterised by atypical self-other processing, like schizophrenia and autism.							

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DP220103291	**Diet, gut microbiota and the evolution of lifespan and reproduction**	81,585.50	173,119.00	169,204.00	77,670.50	0.00	0.00	501,579.00
Hunt, Prof John C	Nutrition has pronounced effects on lifespan and reproduction across animal species, yet how these effects are mediated is poorly understood. This project aims to determine if the gut microbiota regulates these nutritional effects. This project expects to deliver key insights on the complex interplay between nutrition and the gut microbiota, as well as the potential to manipulate this relationship to extend lifespan and alter reproduction. The expected outcomes of this project include generating new knowledge, building multidisciplinary collaborations and the development of novel experimental approaches. This should provide significant benefits, fore-most in bolstering Australia's high international standing in evolutionary research.							
	National Interest Test Statement							
	This project aims to deliver breakthroughs in understanding the role of gut microbiota in mediating the effects of nutrition on lifespan and reproduction in an exotic insect host. There is the potential for our work to have important benefits for human health and pest management: topics that are well aligned with two of Australia's Science and Research Priorities (health and food). Faecal transplant of gut microbiota shows promise in the treatment of numerous human diseases (e.g. inflammatory bowel disease) and we use this approach extensively in our experiments. Therefore, testing how the effectiveness of this approach varies with diet, genotype and sex may help with the development of more effective human treatments in the future. Likewise, because we examine how faecal transplant influences lifespan and reproduction in an exotic insect, there is the potential to isolate the gut microbiota that reduce lifespan and inhibit reproduction and apply them to other orthopteroid pest species (e.g. locusts, cockroaches) that have substantial socio-economic and human health issues in Australia.							
DP220103325	**Are Secreted Proteins determinants of host range in ectomycorrhizal fungi?**	71,017.50	146,250.00	149,018.50	73,786.00	0.00	0.00	440,072.00
Anderson, Prof Ian C	This project aims to understand the role of small secreted proteins in governing symbiotic fungal-host compatibility and determine the impact of environmental change on the role of these proteins. Using innovative approaches, this project expects to achieve these goals using comparative genomics, transcriptomic analyses and functional characterisation of these proteins within a keystone Australian ectomycorrhizal fungus. It is anticipated that outcomes of this project will add a critical component to the global effort in understanding the role of soil microbes in supporting the health of plants experiencing a variety of climactic conditions. This could provide significant benefits to informing management practices of forest ecosystems.							
	National Interest Test Statement							
	The intended aim of this project is to identify the genetic traits of mutualistic fungi and their host trees that improve the efficiency of their symbiotic relationship under both normal and stressful conditions. The outcome of this work would result in enhanced tree health with fewer industrial inputs thereby improving the sustainability of our forestry practices both now and under future climactic extremes. Practically, this project will provide new tools to the forestry and bio-energy sectors that could be applied towards optimising inoculation strategies of forestry plantation seedlings with superior mutualistic fungal genotypes proven to enhanced tree productivity. The path to impact of this project will be promoted and measured through shared screening tools, regular policy briefings to stakeholders, via media releases as well as through informational seminars.							
DP220103371	**Mechanistic responses of phosphorus-limited forests to CO2 enrichment**	15,000.00	84,497.50	135,449.00	99,993.00	34,041.50	0.00	368,981.00
Smith, Prof Benjamin	Carbon dioxide continues to accumulate in the atmosphere, driven by human emissions. The future fate of the global forest carbon sink, which significantly slows CO2 increase in the atmosphere, helping to dampen climate change, remains poorly constrained, hindering mitigation and adaptation planning. A key gap concerns the role of phosphorus, crucial in limiting the productivity of Australian woodlands and tropical forests. Model-data fusion based on the results of a crossed CO2 x P experiment in Eucalyptus forest - EucFACE - will help close this vital knowledge gap, and leverage new mechanistic knowledge in a leading global model used for climate and emissions assessment.							

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	National Interest Test Statement Australia's eucalypt woodlands and forests are a vital part of our landscapes and national identity, providing economic, social and environmental benefits. Woodlands are impacted by ongoing environmental change, but there are surprising and important gaps in our understanding of how rising atmospheric CO2 concentrations in combination with climate affect their productivity, carbon storage and biodiversity. Interactions with soil nutrients in Australia's phosphorus-deficient soils are a key knowledge gap. This project will advance knowledge and develop predictive tools targeted to providing key evidence to inform adaptive management and land-based carbon abatement measures. The project capitalises on past Commonwealth investment in a globally unique elevated CO2 experiment at WSU to provide new understanding of how rising CO2 concentrations and phosphorus availability interact in a representative Australian native woodland ecosystem. Knowledge gained will inform enhancements in a state-of-the-art ecosystem model suitable for large-scale analysis, assessment and policy support.							
DP220103440 Choat, A/Prof Brendan	**Understanding the survival of forests under drought** Droughts are predicted to become more extreme in the near future, with potentially devastating impacts on Australian forest ecosystems. This project aims to address key knowledge gaps in our understanding of how plants tolerate extreme drought stress and utilise this new knowledge to improve vegetation models suitable for assessing ecosystem vulnerability. We will use innovative experimental methodology to determine the processes by which water transport breaks down in roots, stems and leaves and the mechanisms governing recovery from severe drought stress. The project will provide a deeper understanding of drought tolerance in trees, improved forecasting of risks to native vegetation, and enhanced management of native forest resources.	72,828.50	142,786.00	142,740.00	72,782.50	0.00	0.00	431,137.00
	National Interest Test Statement Extreme drought events are expected to become more frequent in Australia's future climate. While much of Australia's flora is adapted to drought, the predicted increase in drought intensity, combined with heatwaves, may outstrip the capacity of plants to adapt or acclimate to new conditions. A detailed understanding of plant hydraulic function is essential to accurately model vegetation response to water stress and predict plant survival under extreme drought. This project will provide new knowledge on the mechanisms by which plants tolerate severe drought stress. Direct collaboration between plant biologists and modellers will ensure that this knowledge is incorporated into models suitable for large-scale analysis of ecosystem vulnerability. This will provide economic and environmental benefits associated with evidence based decision making in the management of forest and woodland ecosystems. The new understanding of drought tolerance in plants will also be translatable to the horticultural and forestry industries, helping to drought-proof Australia's agricultural sector.							
	Western Sydney University	827,518.00	1,785,281.00	1,764,088.50	840,367.00	34,041.50	0.00	5,251,296.00
	New South Wales	14,334,219.50	29,879,663.00	29,777,643.50	14,683,380.00	451,180.00	0.00	89,126,086.00

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Northern Territory								
Charles Darwin University								
DP220100823	**Linking terrestrial–aquatic fluxes to rectify the Australian carbon balance**	110,420.50	187,863.00	144,067.50	66,625.00	0.00	0.00	508,976.00
Duvert, Dr Clement	This project aims to rectify the Australian carbon balance by determining the amount of terrestrial carbon that is lost to streams and rivers across the country. Through a novel integration of high-resolution hydrochemical and gas measurements, remote sensing and machine learning algorithms, the project intends to generate new knowledge about the links between terrestrial carbon sequestration and aquatic carbon export. Expected outcomes include a refined estimate of the net carbon sequestration potential across Australian biomes and seasons. This should provide significant benefits such as avoiding misalignment of greenhouse gas abatement policies and advancing carbon cycling models and predictions.							
	National Interest Test Statement							
	The potential of terrestrial ecosystems to store atmospheric carbon dioxide is likely to be overestimated in Australia. This is because soils tend to leak some of the stored carbon into streams and rivers, where it is eventually returned to the atmosphere – a process that is not integrated into current models. This means that initiatives like the Emissions Reduction Fund, which supports projects based on their potential to store carbon dioxide in biomass and soils, are likely to overestimate offsets. By quantifying the amount of carbon that leaks out of soils and is exported by streams, this project will improve estimates of carbon storage on land, which will ensure that publicly funded greenhouse gas offset projects provide maximal return on investment.							
DP220101781	**Developing Ecosystem Services Economies for northern Australia**	29,942.50	59,885.00	59,260.00	29,317.50	0.00	0.00	178,405.00
Sangha, Dr Kamaljit K	The project aims to advance economic opportunities for Indigenous communities across Northern Australia by developing culturally appropriate ecosystem services economies. The project will offer new alternatives for collectively addressing chronic Indigenous socio-economic issues and pressing environmental issues. Expected outcomes include a co-developed ecosystem services economies business model with a toolkit, involving Indigenous and business stakeholders, for establishing innovative enterprises across northern Australia. Key benefits include new ecosystem services-based enterprises; sustainable land sector development; jobs in remote locations; improved well-being of Indigenous peoples; and better environmental management.							
	National Interest Test Statement							
	The Australian Government spends >$30 billion per year (2015-16) on Indigenous welfare, with little success to date. This project offers feasible alternatives to improve Indigenous well-being and address pressing environmental issues by developing a culturally appropriate Ecosystem Services business model that will provide Indigenous peoples with innovative economic opportunities on their lands. Such opportunities will advance Australia's national interests for mitigating and adapting to environment change, and protecting biodiversity & natural resources. The key benefits of this project include: enhancing Indigenous well-being by creating jobs on-country, enabling people to build their capabilities, and supporting cultural learning; protecting biodiversity and natural resources; and saving substantial government welfare costs on entrenched social and judicial Indigenous affairs by engaging remote Indigenous population in on-country opportunities. The multi-dimensional impact will include improved socio-economic outcomes for remote communities and better environmental outcomes for the Australian public.							
	Charles Darwin University	140,363.00	247,748.00	203,327.50	95,942.50	0.00	0.00	687,381.00
	Northern Territory	140,363.00	247,748.00	203,327.50	95,942.50	0.00	0.00	687,381.00

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Queensland								
Griffith University								
DP220100079	**Lifting the burden of imprisonment: Creating safer and stronger communities**	22,595.50	54,809.50	65,369.00	59,705.00	26,550.00	0.00	229,029.00
Besemer, Dr Kirsten L	This project aims to identify how a reduction in imprisonment rates could benefit Australian communities and enhance their safety and wellbeing. It will link a range of statistical data sources on imprisonment, crime and community wellbeing. We will, for the first time, comprehensively demonstrate the impact of imprisonment on individuals and communities in Australia and beyond. Expected outcomes of this project include expansion and innovation of coercive mobility theory, novel integration of data, and a forecasting tool to assess the impact of imprisonment reduction on communities. This evidence will assist advocacy groups and policy makers seeking to address Australia's burgeoning imprisonment rate.							
	National Interest Test Statement							
	Australia imprisons twice as many people as it did 30 years ago, placing it well above average imprisonment rates in comparable OECD countries. Australia has one of the most expensive prison systems in the world. Policy makers, professionals and advocacy groups agree on the urgent need to downsize imprisonment. They call for a reduction of imprisonment's economic and human costs, which are paid by vulnerable families and communities and hidden from public view. These costs are disproportionately paid by Indigenous people. This project will provide highly relevant information and robust evidence for policymaking in four key areas. We will (1) weigh the crime-preventing benefits of imprisonment against the burden of harmful consequences for communities; (2) demonstrate that considerable gains in community safety and wellbeing can be achieved solely by a reduction of members circulating in and out of prison; (3) identify conditions that break cycles of reoffending; and (4) identify communities severely affected by imprisonment for selective and targeted intervention.							
DP220100250	**The genetics of four ancient 'Kings' of Sahul and Sunda**	67,825.00	136,725.50	147,266.00	78,365.50	0.00	0.00	430,182.00
Lambert, Prof David M	This project aims to recover all the genetic information from four ancient humans. Two of these iconic specimens come from Australia and two from Malaysia. We will sequence the entire DNA (genomes) and proteins (proteome) of Mungo Man (Willandra), the Yidinji King (Cairns), the Deep Skull (Borneo) and the Bewah specimen (Malaysian Peninsula). This will provide a better understanding of the settlement of Australia and new knowledge about the ancient people of Australasia and their relationship to other human populations worldwide. The research will use cutting-edge methods of DNA and protein sequencing of ancient human material and will provide critical reference genomes / proteomes that will anchor future research.							
	National Interest Test Statement							
	The history of our part of the world has been dominated by two giant continents that are now long gone: Sunda and Sahul. Sunda was an ancient extension of continental Asia that included Borneo, Sumatra and the Philippines. Sahul was the other ancient continent that gave rise to mainland Australia, Tasmania and New Guinea. Our understanding of the ancient people from these two continents has been hindered by a lack of comprehensive DNA and protein sequences from them. We propose to sequence the nuclear genomes, (the DNA from both parents) and the proteomes (the expressed proteins) of four of the ancient 'Kings' from Sahul and Sunda. These are the oldest Australian, Mungo Man; the mummified Yidinji King from the Cairns region; Bewah specimen, the oldest human remains unearthed from the Malay Peninsular and the "Deep Skull", the oldest modern human that has been discovered in island South-East Asia. These genetic sequences will provide the necessary baseline information and will anchor future evolutionary and forensic studies of the early people of our region.							

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DP220100261	**Microfluidics with core-shell beads: handling liquids like solids**	82,500.00	165,000.00	165,000.00	82,500.00	0.00	0.00	495,000.00
Nguyen, Prof Nam-Trung	Reducing waste of consumables in chemical reactions promises to solve environmental problems as well as enable novel applications in space. This project aims to establish a revolutionary fluid handling technology that lowers waste in the labs and in satellites. The project deciphers the fundamental physics behind our recent discovery of encapsulating a tiny liquid content in a solid shell, allowing for handling liquid samples like solid particles. Examples of the benefit of this project are more precise detection of bacteria on earth and compact reactors in space. The research outcomes are instrumental for promoting a clean environment, good health, and creating new business opportunities, particularly in space industry, for Australians.							
	National Interest Test Statement							
	The fluid handling technology developed from this project will have direct commercial application to Australian industry while providing environmental and health benefits for Australians. Successful project outcomes will advance discussions with an Australian biotechnology company to further develop this intellectual property and implement the technology within their laboratory instrumentation to improve the detection of viral infections. The technology can also be utilised within water quality monitoring tools for the rapid determination of the microbiological quality of water and specifically the origin of faecal pollution. In addition to the environmental benefit of reducing plastic waste from laboratories, the technology is expected to enable the emerging sector of space chemistry. Thus, this project has significant potential to create economic benefit through the commercialisation of enhanced Australian products in the health and space industries, and environmental benefit by reducing the costs associated with managing water resources and reducing plastic waste.							
DP220100462	**Early art, culture and occupation along the northern route to Australia**	72,320.00	137,400.00	171,468.00	212,658.00	180,270.00	74,000.00	848,116.00
Aubert, Prof Maxime	This project aims to uncover archaeological evidence for early humans in Indonesia's northern island chain (from Borneo to West Papua). This poorly known region harbours the world's earliest known figurative cave art (>45,500 years old), and it is also the most likely maritime route used by modern humans during the initial peopling of Australia ~65,000 years ago. The project aims to use cave excavations and rock art dating to fill the 20,000 year gap between the earliest known archaeological evidence from these islands and the oldest human site in Australia. Expected outcomes include new insight into the ancient past of Indonesia and a greatly improved understanding of the art and cultural lifeways of the ancestors of the First Australians.							
	National Interest Test Statement							
	This project, set in Indonesia, aims to uncover archaeological evidence for the initial movements of people from the edge of 'ice age' Asia (present-day Borneo) to Australia's northern coastline as early as 65,000 years ago. Our team of Australian and Indonesian researchers will use modern science to trace the pathways of these first seafaring colonists and reveal new insight into how the human story in Australia began. Knowledge generated by this research will benefit Australia in two ways. First, our project will increase awareness and recognition within Australian society of the deeply ancient historical connection between Australia's Indigenous people and our most important northern neighbour: Indonesia. Second, cutting-edge dating technology developed for this project will highlight the global significance of Indonesia's early cave art (already under consideration for UNESCO World Heritage status); in so doing it will provide new opportunities for local communities to develop business enterprises focused on cultural heritage tourism, thus contributing to the long-term stability of Indonesian society.							
DP220100587	**The politics of expertise during COVID-19**	31,156.00	81,885.00	84,008.50	33,279.50	0.00	0.00	230,329.00
Davies, Prof Sara E	Experts play a crucial role during crises. This project aims to examine how four governments (Australia, Sweden, United Kingdom and United States) have incorporated public health expertise into their decision making during COVID-19. These countries have similar economic resources, liberal democratic institutions, health system capacities and pandemic preparedness. Yet, their governments responded differently to COVID-19. We will conduct a comparative study of how governments managed disagreements between experts and how they integrated diverse expert views into pandemic decision making processes. The research will advance our understanding of the role of experts during crises and help inform governments response to future pandemics.							

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	National Interest Test Statement							
	This project serves Australia's national interest in ensuring domestic health security and promoting international cooperation in crisis response. COVID-19 has highlighted the extraordinary costs of pandemics for public health, the domestic economy, international trade, travel and public trust in institutions. It has also exposed Australia's vulnerability to external health threats. The Australian Government has expressed an ongoing political and financial commitment to international collaboration in health emergency response. This project will enhance Australia's preparedness for future health emergencies and build Australian research and expertise in the areas of health security, global health and crisis management. It will deliver a publicly accessible evidence-base for the optimal design of expert advisory systems during health crises to increase health emergency preparedness activities at global, national and community levels.							
DP220101087 Zimmer-Gembeck, Prof Melanie J	**Parenting in an unsteady world across nations** Overinvolved and overcontrolling parenting seems to be on the rise as families are confronted with an unsteady world. This project aims to investigate how overparenting affects youth's achievements and well-being as they transition out of secondary school, and will isolate societal and cultural determinants of overparenting. This project will generate new knowledge on family influences on youth's progress, and will substantially contribute to an existing multinational study to identify macro social-cultural determinants of overcontrolling parenting. Expected outcomes are the generation of new knowledge relevant to family policy and practice within Australia, growth in cross-national collaborations, and new theories and methods.	54,120.50	106,585.00	106,199.00	53,734.50	0.00	0.00	320,639.00
	National Interest Test Statement							
	This research identifies how societal pressures can influence parenting practices, producing parental worries, overcontrolling behaviours and burnout, and in turn, how parents' behaviours affect youth's educational, vocational, relationship, and mental health progress post-secondary school. This knowledge can be translated into policies and practices for parents and youth in an unsteady world. When families are strong, the benefits extend across all sectors - economic, social, commercial, and cultural. Families also provide support for the next generation of active, engaged, healthy, and productive members of society. Yet, parents are not immune to the impact of stressors faced within their homes, their communities, their nation, and around the world. One outcome is parent worries and overprotection of children, which can be counterproductive to youth's optimal development, even when parents have the best intentions. We must keep pace to understand the contemporary pressures on parents and their impacts on parenting and youth to provide updated science-based information to support parents and families.							
DP220101252 Dao, A/Prof Dzung V	**Nano optoelectronic coupling: towards an ultrasensitive sensing technology** This project aims to elucidate ultrasensitive mechanical and thermal sensing effects that are tens of thousands of times better than conventional sensing technologies. This is achieved through controlling interactions between photons and electrons at the interface of two semiconductors. Outcomes of this project include scientific breakthroughs that are expected to revolutionise and disrupt the established sensing technologies. Microscopic low power mechanical and thermal sensors with ultra-high sensitivity have great value to enhance safety, security, and productivity of industry and society. The project is expected to generate new knowledge and place Australia as the world leader in physical sensing and create a new industry.	97,500.00	195,000.00	195,000.00	97,500.00	0.00	0.00	585,000.00
	National Interest Test Statement							
	Mechanical and thermal sensors are pivotal for safety, security and productivity of Australian industry and society. However, even state-of-the-art sensing technologies still face key obstacles in achieving sufficient sensitivity for high precision applications with reasonable cost, small size, light weight and low power consumption. The current limit of sensing performance is attributed to the conventional design approach, which is based on the inherent properties of sensor materials. This project aims to develop an unprecedented highly sensitive, low power and low-cost sensing technology, which is capable of measuring mechanical and thermal variables with accuracies thousands of times better than conventional sensors. The project will deliver an Australian made competitive sensing platform technology for applications including smart cities, natural disaster mitigation, and defense. The commercial translation of this technology will create new jobs and provide Australia with great economic benefits and international reputation.							

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DP220101460	**The impact of immigrant theatre artists on Australian culture 1919-1949**	25,000.00	60,000.00	57,500.00	22,500.00	0.00	0.00	165,000.00
Meyrick, Prof Julian J	Using an innovative mixed-methods research design, this project aims to investigate the lives and impact of immigrant theatre artists working in Australia from 1919 to 1949, focusing on the influential Latvian "power couple" Dolia and Rosa Ribush. After 1918, increased migration flows led numbers of foreign artists to come to Australia. These have been studied individually but never as a network, so their contribution to Australian culture has been greatly undervalued. Benefits of the project include better understanding of the way Australian theatre has been creatively shaped by diverse patterns of immigration. Expected outcomes include new knowledge of a major period of development in the place, operation and value of Australian culture.							
	National Interest Test Statement							
	The years 1919-1949 were a crucial time in the development of Australian political, intellectual and artistic life, and the role and contribution of immigrant artists was a key reason for this. This project will enhance Australian national identity, social cohesion and community well-being by improving understanding of how Australian culture was (and still is) influenced by diverse creative arts practices and values. It will enrich the relationship with Australian artists of diverse backgrounds today by showing how mutually respectful and fruitful ties existed between immigrant artists and local Australian artists in the interwar, war and reconstruction period, facilitating better cross-cultural collaboration in contemporary arts projects. It will fill an important gap in the national narrative that can be drawn on for educational and policy purposes by those responsible for managing arts events, programs and institutions in the socially and culturally diverse country that is Australia now.							
DP220101462	**Uncovering Antarctica’s Secret Chemical Voyagers for Expedited Regulation**	87,987.50	218,987.50	244,000.00	143,237.50	30,237.50	0.00	724,450.00
Bengtson Nash, A/Prof Susan	This project aims to strengthen global chemical policy by rapidly identifying chemicals that demonstrate environmental persistence and mobility, two requisite risk criteria for regulatory action. It will take the novel approach of applying powerful non-target chemical screening approaches to Antarctic environmental media, leveraging the remoteness of Antarctica to derive unambiguous evidence against the key risk criteria. Research will uncover a new catalogue of proven persistent and mobile chemicals, and further assess their ubiquity and biomagnification potential in the Antarctic system. Project findings will be directly disseminated to policymakers, facilitating expedited regulatory decision-making for improved Planetary Health outcomes.							
	National Interest Test Statement							
	Globally, 136 million new chemicals were registered between 2002-2019. Major adverse public health outcomes have been linked to the complex chemical mixtures that now fill our environment. Policies that limit or prevent emissions of hazardous chemicals are society’s main defense against harmful chemical exposure. A a lack of information regarding individual chemical risk is the greatest impediment to generating an effective chemical policy framework. This project seeks to rapidly expand the catalogue of known chemicals exhibiting the risk criteria of environmental persistence and mobility. Environmental transport of chemicals to Antarctica is conditional on these chemical properties. As such, confident detection in Antarctic environmental media provides the unambiguous evidence required for regulatory decision-making. This is a policy-relevant project that will equip regulators with the scientific basis for expedited policy action, with specific reference to the Stockholm Convention on POPs, the Australian Industrial Chemicals Introduction Scheme, and The Madrid Protocol of the Antarctic Treaty System.							

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DP220101602	**Heisenberg-limited lasers: building the revolution**	69,713.00	141,721.00	146,357.00	114,696.50	40,347.50	0.00	512,835.00
Wiseman, Prof Howard M	The project aims to design and build a revolutionary new type of laser based on the ground-breaking 2020 Nature Physics paper by the two Chief Investigators. The significance of this work is that it overturns 60 years of theory about the limits to laser coherence, by applying 21st century quantum theory and quantum technology to the problem. This project expects to greatly advance the theory and, by instigating a collaboration with world-leading experimentalists working with superconducting quantum devices, to demonstrate a laser with coherence beyond what was thought possible. Benefits of the project should flow from the manifold applications for highly coherent radiation, including scaling up superconducting quantum computing.							
	National Interest Test Statement							
	Laser have countless applications in science, medicine, and every day technologies, with a market in excess of 15 billion AUD per year. For many of these applications, the crucial difference between lasers and traditional sources of light is the coherence of the light beam. Since even before lasers were created, scientists thought they knew the limit to how coherent a laser could be. But research published in 2020 by the two Principal Investigators showed that by using quantum technology it should be possible to make the coherence much greater than was previously thought possible. This grant will build on that revolution to move the theory towards reality. In conjunction with world-leading quantum experimentalists, we aim to realise a laser with coherence beyond what was thought possible. The work will make use of the same technology that has already realised a quantum computer more powerful than any conventional computer. Our new class of lasers will have applications in scaling up such quantum computers, to the benefit of Australia's economy.							
DP220101911	**Understanding the Antipodean 'Fair Go'**	20,738.00	101,261.00	96,150.50	15,627.50	0.00	0.00	233,777.00
Howard, Dr Cosmo W	There is bipartisan support for the 'fair go' in Australia and New Zealand, but what does the fair go actually mean? This project aims to generate new knowledge about the role of the fair go in political debate and policy making. It will examine the values that have been historically connected to the fair go. It will assess how the public and politicians currently understand the fair go and will investigate how the fair go has influenced public policies. Expected outcomes include the first systematic analysis of one of the most pervasive and enduring social and political ideas in Australia and New Zealand. This will give policymakers a better understanding of citizens' values and will build knowledge about how values shape public policies.							
	National Interest Test Statement							
	The 'fair go' is a recurring theme in Australia and New Zealand, but what does it actually mean to Australians, New Zealanders and their elected representatives? Has the meaning of the fair go changed throughout history? What does the fair go mean in specific policy areas? This project will be the first to systemically investigate how Australians, New Zealanders and their national parliamentarians have understood the concept of the fair go, as well as how the notion has been used in public policy debates. The study will make a substantial contribution to knowledge about how values and ideas shape public policy in our region. It will also reveal the degree to which our values have shifted as a result of the changes wrought by COVID-19. Given the pervasiveness of the fair go in Antipodean political and social discourse, this project will help to clarify key values that make up our culture and identity.							
DP220102172	**Innovation in police gender equity management: Looking back, moving forward**	45,516.50	100,426.00	102,848.50	47,939.00	0.00	0.00	296,730.00
Drew, Dr Jacqueline	This project aims to investigate gender equity recruitment and career support policies in all nine Australian and New Zealand policing agencies. A wide range of equity initiatives that have been implemented across police agencies will be examined, along with affirmative action measures including recent 50/50 male/female recruitment targets. The project expects to generate an advanced best practice model that can be used by domestic and international police agencies. This will allow police organisations to better manage equity issues and support a more inclusive and representative workforce. The benefits of this project are significant, they range from stronger police-community relations through to better service delivery by police.							

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	National Interest Test Statement This study is unique in advancing knowledge of and evaluating contemporary efforts to significantly enhance the involvement of women in Australian and New Zealand policing through recruitment targets, targeted advertising and associated organisational inclusion strategies. The study also has a forward focus, it will produce valuable practical, best practice lessons to drive future management of equity issues in policing in Australia and internationally, and other occupations with strong traditions of gender discrimination. Police organisations should be representative of the communities that they serve and gender representation is associated with a number of critical organisational performance indicators. Research demonstrates that greater representation of women police has a transformative effect on police agencies, it improves service delivery, victim support, and reduces corruption and excessive force. Beyond domestic policing, gender representativeness is a key pillar in Australia's police policies in providing a more gender inclusive service in international peacemaking and capacity building missions.							
DP220102236 Rehm, Prof Bernd H	**Bioengineering self-assembly of innovative core-shell nanomaterials** This project aims to generate new knowledge in nanoscale bioengineering. It expects to develop a disruptive platform technology for design and manufacture of advanced nanomaterials to provide solutions for unmet needs in industry. It will explore an innovative bioengineering concept that merges biopolymer synthesis with virus-like particle self-assembly to produce innovative tunable core-shell nanomaterials. Expected outcomes are the development of advanced techniques for design and manufacture of innovate nanomaterials with enhanced stability and performance. This innovative platform technology for precision engineering of high-performance nanomaterials should provide significant benefits for biotechnological and agricultural industries.	70,000.00	140,000.00	140,000.00	140,000.00	70,000.00	0.00	560,000.00
	National Interest Test Statement This project will generate innovative high-performance hybrid materials with enormous potential for commercial translation in Australian advanced manufacturing and biotechnology sectors. Merging two cutting-edge technologies through advanced bioengineering will lead to new smart materials with enhanced properties. The broad applications of these cost-effective materials will be demonstrated as veterinary vaccines and nanoreactors (enabling precise, efficient control of chemical reactions) for use by chemical and pharmaceutical industries. In addition, we will harness this capability to study structure and function of biological molecules entrapped within these smart materials to create innovative biomedical research tools. The project will build multidisciplinary sovereign capability and capacity in bioengineering, bioprocess development and materials science. These outcomes align with the needs of Australia’s growing life sciences industry ($8.67 billion projected revenue in 2021), in particular the biomanufacturing and animal health sectors, contributing significant economic and health benefits.							
DP220102618 Poulsen, Prof Sally-Ann	**Chemical probes to dissect the cell cycle of globally important parasites** This project aims to develop new reagents, called chemical probes, to visualise key biological events in globally important pathogens. We will use innovative chemistry to modify the building blocks of DNA and provide researchers with essential tools to 'see' DNA synthesis in order to study growth and replication of pathogens in combination with microscopy. This project expects to support a major technical advance that will address important gaps in our understanding of many pathogens (e.g. those that cause malaria and tuberculosis), at both the cellular and molecular levels. This should provide significant benefits by enabling researchers worldwide to identify new intervention opportunities that target unique aspects of pathogen biology.	67,425.00	138,247.50	140,322.50	69,500.00	0.00	0.00	415,495.00
	National Interest Test Statement This project strengthens the important interface between chemistry and biology, vital for development of new chemical probes to tackle global problems, extend our understanding of the living world, improve the quality of biological research data and more rapidly advance translational projects. New chemical probes will be developed for imaging, manipulating, and tracking key molecules in important human pathogens (e.g. those that cause malaria and tuberculosis), so that researchers can better understand their replication, life cycle and impact on humans and the environment. The project outcomes will provide a unique resource for collaborative knowledge creation in the biotechnology sector, with potential for enabling future economic growth. Specifically, the project will generate IP with potential for development into commercial products (e.g. chemical probe reagent kits to be used by researchers worldwide), building beyond the opportunity of Australian research investment to create and supply knowledge for commercialisation elsewhere.							

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DP220102749	**China’s Law-Based Governance Revolution under Xi Jinping**	38,000.00	76,000.00	76,000.00	38,000.00	0.00	0.00	228,000.00
Trevaskes, Prof Sue	To sustain its unmitigated power, the Chinese Communist Party is transforming its legal ideology and governance focus to make politico-legal institutions more capable of supervising and moulding people’s behaviour and beliefs. This project aims to examine how this transformation is constructed by key institutions and digested into public policy and legal decision-making guidelines. It expects to generate new knowledge on how Xi Jinping-era legal ideology guides policy and decision-making in China. The expected outcomes include an enhanced conceptual and empirical understanding of politico-legal change in China. This project has significant implications for Australia given China’s increasingly assertive role in international governance.							
	National Interest Test Statement							
	Australia’s national interests are served by better understanding changes to China’s governance system. Understanding changes in law-based governance is a major challenge and policy concern with broad-ranging social, economic and security implications. This project examines how China’s new ‘Xi Jinping Thought on the Rule of Law’ ideology is being built into legal propaganda, scholarly thought and judicial guidelines, shaping the parameters of decision-making in the legal system. China says that it intends to promote this new governance system worldwide to compete with conventional liberal ideas on the rule of law. Australia’s economic and geo-strategic position in the contemporary world make maintaining deep knowledge of China strategically crucial, as China transitions towards great power status in the 21st century. This project contributes to national interest as it can help inform Australian government policy makers on how to best respond to the Chinese government’s new governance system underpinned by ideology that challenges western-liberal approaches to law and governance.							
DP220102820	**Glycan-based prebiotic approaches to increase food safety in Australia**	78,000.00	166,500.00	183,500.00	95,000.00	0.00	0.00	523,000.00
Haselhorst, A/Prof Thomas E	Since the launch of the first Australian Animal Sector National Antimicrobial Resistance Plan (2018) several approaches have been suggested to reduce the use antibiotics in agriculture, however no alternatives to antibiotics have been suggested or trialled. In this proposal we aim to develop a novel glycan-based prebiotic strategy to reduce Campylobacter jejuni colonisation in chicken and poultry by disrupting important glycan-glycan interactions. Outcomes of this proposal is a cost-effective antibiotic- and vaccine-independent animal feed supplement strategy that will decrease the risk of human food-borne illness and therefore promoting food safety and public health in Australia.							
	National Interest Test Statement							
	This project aims to reduce contamination of chicken meat with Campylobacter jejuni, a human pathogen that causes approximately 4.0 million food-borne illness each year costing the Australian society $1.25 billion. We suggest disrupting an emerging class of biomolecular interactions that are responsible for the colonisation of chicken meat with this C. jejuni. Our research project will not only pave the way to significantly decrease food borne illness promoting better food safety practices within Australia but also forms the basis for an excellent multidisciplinary research environment providing high quality training to the next generation of structural chemists, microbiologists and glycoscientists that are necessary to drive Australia's emerging biotechnology and biomedical sectors; thus providing economic, commercial and societal benefits.							
DP220103214	**Agents of Disinformation: The Rise of Counterfeit Election Observers**	16,936.00	54,084.50	66,131.00	28,982.50	0.00	0.00	166,134.00
Morgenbesser, Dr Lee	This project investigates the rise of “counterfeit” election observers as agents of disinformation. Using four case studies and four qualitative methods, it identifies how autocratic regimes entice partisan individuals to imitate genuine international observers. The expected project outcome is an explanation for the origins, features and impact of counterfeit election observers that is practically applicable to our foreign affairs and national intelligence communities as well as genuine observation organisations. The knowledge gained from this project will not only help defend Australia from malign disinformation, but advance its interest in the promotion of good governance and stronger democratic institutions everywhere.							

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	National Interest Test Statement The emergence of “counterfeit” election observers threatens Australia’s foreign policy objectives and national security initiatives. A counterfeit election observer is a partisan individual who deceptively imitates a genuine election observer for the purpose of validating an election held by an autocratic regime. By producing and spreading disinformation, they reduce citizen awareness about the poor integrity of elections; undermine the validity of opposition complaints about the integrity of elections; and decrease the leverage that genuine observation organisations rely upon to improve the integrity of elections. Through an investigation of this novel strategy, the proposed project will equip Australia’s foreign affairs and national intelligence communities - and those of our overseas allies - with a critical new capability, while also deliver new information to the genuine election observation organisations advocating for clean elections around the world.							
	Griffith University	947,333.00	2,074,632.50	2,187,120.00	1,333,225.50	347,405.00	74,000.00	6,963,716.00
James Cook University								
DP220101480 White, Prof Ronald D	**Non-equilibrium presolvation electron processes at the gas-liquid interface** The interaction of low-temperature plasma electrons with liquids has served as a reducing agent in various technological applications in water treatment, agriculture, biofuels and medicine. Predictive control of the plasma-liquid interface is essential to unlocking the potential of these applications, and this has been limited by the absence of the relevant non-equilibrium transport theory describing electrons at the plasma-liquid interface together with fundamental data describing electron interactions with liquids. The project will develop a state of the art presolvation electron transport model informed by world first measurements of electron cross-sections for radicals and liquids and apply it to model plasma electrochemistry processes.	60,000.00	120,000.00	120,000.00	60,000.00	0.00	0.00	360,000.00
	National Interest Test Statement The interaction of low-temperature plasmas (ionised gases) with liquids is fundamental to a number of technological applications including water treatment, agriculture production, biofuel production and medicine (including apoptosis of cancer, sterilisation, cell-signalling). These applications have the potential to benefit Australian communities through improved health, energy and food security among others. This project will provide the fundamental information for improving predictive models for low-temperature plasma-liquid systems to enhance the efficiency and efficacy of these technologies. In addition it provides the opportunity to leverage Australia’s unique and leading capabilities in modelling non-equilibrium electron transport processes and measuring electron scattering properties to contribute to science underpinning these emerging technologies. It will also enable Australia to participate in, and derive benefits from an internationally important research program with significant international collaborations.							
DP220103921 Morrison, Prof Tiffany H	**Novel governance for marine ecosystems in rapid transition** This project will develop the governance knowledge required to manage rapidly changing marine ecosystems. Australia has the third largest marine estate globally, and its ecosystems support critical economic and sociocultural values. However, human pressures are tipping marine ecosystems into alternate states, inspiring new interventions to sustain industries and communities. New interventions necessitate transitions in governance. Expected outcomes include a comparative understanding of novel marine interventions now underway globally, and practical guidance on how to diagnose and implement responsible marine governance. Significant benefits include enhanced governance and sustainability of Australian and international marine ecosystems.	62,500.00	129,500.00	138,000.00	71,000.00	0.00	0.00	401,000.00
	National Interest Test Statement Australia has the third largest marine estate in the world, and its marine ecosystems support critical industries and sociocultural values. The rapid rate of marine change requires similar transitions in governance: to realise new opportunities, meet escalating demands, and manage risks and unintended consequences. This project aims to produce new knowledge about how to sustain marine ecosystems into the future, by developing guidance for new fit-for-purpose governance informed by evidence from novel marine management interventions. The guidance will assist government, policy-makers, industry and scientists to develop new laws, norms, policies and protocols that more effectively and responsibly sustain valuable marine resources and ecosystem services across Australia, and which can be adapted to diverse jurisdictions at international, national, and subnational scales.							

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	James Cook University	122,500.00	249,500.00	258,000.00	131,000.00	0.00	0.00	761,000.00
Queensland University of Technology								
DP220100136	**Experimental and empirical insight into melting of the early Earth's mantle**	81,500.00	156,500.00	125,000.00	50,000.00	0.00	0.00	413,000.00
Kamber, Prof Balz S	The early Earth's mantle produced melt at much higher temperature than today, creating rocks with unique chemistries and mineralogies. But pressing knowledge gaps about hot mantle melting remain. The aim of this project is to generate new experimental and empirical knowledge to help closing these gaps by: (i) conducting high pressure experiments to refine phase-composition relationships and element partitioning; (ii) quantifying mineral fabrics in cratonic peridotites to understand the movement of early continents; and (iii) constructing the first petrological deep time model for greenstone belt volcanic rocks. The expected outcomes are better models for the early Earth's melting and tectonic regimes and insight into the emergence of land.							
	National Interest Test Statement							
	Ancient continents (cratons) are disproportionately well-endowed in minerals (gold, nickel, iron, diamonds), significantly contributing to Australia's GDP, including during the economic crisis caused by COVID-19. The enrichment of the old continents in these minerals is attributed to hotter melting of the early Earth's deep mantle (nickel, diamonds), the tectonic regime of the early Earth (gold), and its anoxic surface (iron). If and how these unique attributes of the Earth relate is currently still poorly understood. This project will generate much-needed new knowledge from a unique Australian experimental laboratory about very high temperature melting of magnesium-rich mantle. It will combine this knowledge with novel analyses of the orientation of minerals in samples from the ancient mantle to understand how continents moved. For this, it will develop new methodologies that will also benefit nano-material science. Finally, the project will integrate the new experimental data with large empirical data from Western Australian gold- and nickel ore-hosting rocks for a new model of early continent formation.							
DP220100303	**Sustainable Mathematical Foundations: STEM-enriched Modelling**	54,007.50	109,451.50	112,310.50	56,866.50	0.00	0.00	332,636.00
English, Prof Lyn D	This longitudinal project aims to generate new knowledge on how sustainable, innovative mathematics learning can be fostered through STEM-enriched mathematical modelling across the early grades. Featuring interdisciplinary processes, including engineering and science, novel modelling sequences will prompt children to adapt their existing ways of mathematical thinking to develop conceptual innovations in solving future-oriented problems. New theoretical and empirical frameworks are expected to transform our outmoded problem experiences to ones that challenge all children to reach their mathematical potential. Professional learning, informed by international collaboration, is expected to transcend existing teacher development modes.							
	National Interest Test Statement							
	Preparing our young students for an increasingly challenging world requires sustainable and innovative learning, where students engage in future-oriented problems, generate sophisticated disciplinary concepts, and retain and apply their learning to unanticipated problems. This project introduces a new and timely approach to advancing the mathematics achievements of young learners through STEM-enriched mathematical modelling. Creating opportunities for all students to experience success irrespective of their school achievement levels, the project will target the national goal of excellence and equity in the education of young Australians. Substantial educational, social, and policy benefits will be produced. Outcomes will include curriculum resources that capitalise on young learners' talents, data that inform policy decisions on developing more equitable mathematics and STEM learning, and strong foundations for future success in the changing realm of work.							

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DP220100436	**Coach My Ride: Mentorable Interfaces to support Older Australians' Mobility**	75,000.00	150,000.00	150,000.00	75,000.00	0.00	0.00	450,000.00
Soro, Dr Alessandro	This project aims to co-design new interfaces to support older Australians to collaboratively learn the use of automated vehicles. We will seek to understand the needs, expectations, and challenges of urban and rural residents, and the peer support strategies they deploy to learn technology. Mobility is key to the wellbeing of older people, but automated vehicles that are too complex will fail to deliver their promise of independent ageing. Outcomes will be a new theory of collaborative learning and new mentorable interfaces to allow older adults to mentor each other to access and use new mobility solutions. This will contribute to narrow the digital and mobility gap improving the independence, safety and wellbeing of ageing Australians.							
	National Interest Test Statement							
	Automated vehicles are expected to support the mobility of older adults who cannot drive anymore, yet those technologies are currently not designed with older users in mind. This project will expand our capabilities to design and deploy new user interfaces for automated mobility, co-created with older drivers to meet their needs, and considering both urban and rural dwellers to fit the unique Australian context. Older Australians will benefit from this project with improved access to automated mobility, increasing their independence, safety, and wellbeing. The broader society will benefit by advancing Australia's infrastructure readiness and self-sufficiency towards future 'mobility as a service'. The project will achieve this by conducting co-design led research with older Australians to understand their needs and expectations for automated vehicles, and their strategies to learn and teach each other new technologies. With this new knowledge the project will create 'mentorable interfaces' for automated vehicles and novel theories on how to design more accessible automated systems.							
DP220100461	**Food System Shocks: Managing Transitions to Future Food Security**	43,450.00	89,275.00	85,383.00	39,558.00	0.00	0.00	257,666.00
Richards, A/Prof Carol A	Recent food system shocks such as bushfires, floods, drought, and the impact of Covid-19 on the harvesting and distribution of agricultural products, are having profound on-farm impacts. Farmers, as land managers, are on the front line of navigating these major disruptions whilst also maintaining continuity of supply that supports Australia's national and regional food security. Situating the farmer as the 'expert' of managing and accommodating shocks, this project will co-produce a range of evidence-based transition and innovation scenarios for the horticultural industry to enhance future preparedness for shocks and support rural livelihoods.							
	National Interest Test Statement							
	The Australian agriculture sector is not only the predominant source of sustenance and nutrition for the Australian population, but also generates 13% of national merchandise export earnings. As such, the security of Australia's food system is crucial. Food system shocks, such as drought, fires and the Covid-19 pandemic, have the potential to undermine Australia's food production. Disruption to the food system compromises export markets, access to food domestically and presents a threat to domestic harmony, as recently evidenced in panic buying. This research produces multiple benefits for Australia by working with horticulturalists experiencing food system shocks to develop practical, evidence-based knowledge that can guide sustainability transitions in the face of complex challenges. Research outputs can contribute to future policy development.							
DP220100556	**Trusted business processes**	75,000.00	152,500.00	157,500.00	80,000.00	0.00	0.00	465,000.00
Rosemann, Prof Dr Michael	This project aims to use conceptual design, process modelling and co-design approaches to create a structured approach for the management of trust. With a focus on business processes, it is intended to develop research- informed methods in order to (1) identify and specify trust concerns and opportunities, (2) model these within a common process modelling language and (3) propose patterns for how to mitigate trust concerns and how to benefit from opportunities. If successful, this would lead to an operational, and world first, detailed trust methodology for organisations in all sectors. As a result, Australian customers would engage with business processes with reduced trust concerns and experience increased integrity and benevolence.							

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	National Interest Test Statement							
	Advanced technologies, the provision of private data and an increased uptake of online transactions have amplified the role and importance of trust in our economy. However, right now the ability to design trusted business processes is limited due to the lack of a dedicated trust management discipline and trust design approaches. This is a severe concern as an absence of trust significantly constrains contemporary technologies. This research will develop research-informed methods to enable organisations to (1) identify trust concerns and opportunities (2) describe these in the context of their business processes and (3) provide guidance in the form of trust patterns to ensure that customer trust is secured and protected. Exemplary processes from the finance and retail sector will be used as case studies to create and validate the desired research outcomes. If successful, organisations deploying the outcomes will be able to 'compete on trust' and positively impact early customer engagement, loyalty, and advocacy.							
DP220100580	**Mitigating the risks of cyberattacks on cyber-physical power systems**	77,500.00	160,000.00	167,500.00	85,000.00	0.00	0.00	490,000.00
Tian, Prof Yu-Chu	Cyber threats are a pertinent issue facing power systems as part of national critical infrastructure. This project will develop a systematic theory to capture the dynamic risk propagation of cyberattacks on cyber-physical power systems. Focusing on the physical domain of cyber-physical power systems, the theory includes offline risk modelling with consideration of attack intentions for risk propagation of cyberattacks, an online risk assessment method to quantify the risk propagation of cyberattacks, and resilient control strategies to mitigate cyberattack risks. The outcomes will not only advance knowledge in cyber-physical security but also facilitate an accelerated adoption of the increasing renewable energy sources into the power grid.							
	National Interest Test Statement							
	Power systems are a significant part of national critical infrastructure. Australia's main power grid has recently hit a record of over 50% renewable energy including wind and solar photovoltaic generations. The increasing integration of renewable energy sources comes with more interactions with data communication networks, making power systems more vulnerable than ever to cyberattacks. But the design of the security of power systems against cyberattacks is challenging due to the lack of a clear understanding of cyberattack risk propagation in cyber-physical power systems. This project contributes to the cyber-physical security of power systems. A breakthrough from this project on the security of cyber-physical power systems will facilitate an accelerated adoption of increasing renewable energy sources into the main power grid, enabling Australian power industries to reach the national strategic target of integrating renewable energy sources worth $50bn by 2050.							
DP220100878	**The emotional face: What determines preferential expression processing**	65,707.50	131,939.00	136,632.50	70,401.00	0.00	0.00	404,680.00
Lipp, Prof Ottmar V	The processing of facial expressions of emotion is essential for successful social functioning. However, we still lack a good understanding of key factors that facilitate or impede the processing of these important social signals. The current project aims to address this knowledge gap by providing a) a more rigorous test of the currently dominant account of expression processing, the evaluative congruence account, and delineating how b) contextual factors and c) person knowledge affect expression processing. The research aims to advance our understanding of facial expression processing, to build international collaborations, and to train the next generation of emotion scientists.							
	National Interest Test Statement							
	This basic emotion science project aims to enhance our understanding of the factors that affect the manner in which facial expressions of emotion are processed. Facial expressions are important signals that regulate human interactions, however, our understanding of the factors that influence the recognition of these expressions and the social response to them is still lacking. The proposed research will address this knowledge gap by correcting limitations of past research and applying new methodologies to the field of expression processing. The present program of research will further the outstanding reputation of Australian-based psychology research and enhance contemporary psychological knowledge. It will contribute to Australian society and beyond by providing research training in emotion science, fostering national and international collaborations, and by enhancing our understanding of the processes that determine the quality of human social interactions.							

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DP220101255	**Responsible Urban Innovation with Local Government Artificial Intelligence**	77,315.00	159,815.00	172,500.00	90,000.00	0.00	0.00	499,630.00
Yigitcanlar, A/Prof Tan	Artificial intelligence (AI) is not only becoming an integral part of urban services, but also impacting and shaping the future of cities and societies. However, the current AI practice has shown that urban innovation without responsibility generates more problems than it solves. Especially, the absence of a deep understanding of the costs, benefits, risks and impacts of deploying government AI systems creates negative externalities and serious concerns in the society. This project will generate new knowledge on the most appropriate approaches for local governments to engage with AI to achieve responsible urban innovation. The project outcomes will include responsible AI adoption and implementation pathways for Australian local governments.							
	National Interest Test Statement							
	While innovative technologies—e.g., artificial intelligence (AI)—offer opportunities to alleviate urbanisation problems, if not utilised responsibly, they entail the risk of intensifying existing problems or creating new ones. This research will generate knowledge to assist local government authorities engaging with AI in a responsible way. This will contribute to the nation-wide deliberations on how local governments should adopt, deploy and manage AI systems to generate sustainable outcomes. The research will inform government policy, and influence industry to adopt responsible innovation focus. It will help in relieving the public concerns—e.g., privacy, bias, inequality, safety and security—on government AI systems. The results will propel Australian conditions and research to the forefront of academic and practice debates internationally. The research will feed into research-led teaching in an Australian university, and will contribute to the development of new early career and doctoral researchers to build a critical mass in responsible innovation, which is an in-demand skill of the Australian economy.							
DP220101516	**Embedding Enterprise Systems in IoT Fog Networks through Microservices**	80,000.00	160,000.00	160,000.00	80,000.00	0.00	0.00	480,000.00
Barros, Prof Alistair P	The project will enable automated re-engineering of enterprise systems, to allow them to reused in Internet-of-Things (IoT) applications. It will support efficient ways in which the core business logic of these large scale and monolithic systems can be extended into resource control and data sensing functions managed through the IoT. The project will develop a novel, fine-grained software architecture style suitable for localised IoT execution, through microservices executing autonomously on nodes of IoT fog networks. It will develop new techniques for automated discovery of microservices from enterprise systems and the verification of future-state system execution based on current-state behavioural and other properties such as security.							
	National Interest Test Statement							
	Enterprise systems are multi-million-dollar software solutions which manage business operations across all corporate sectors. However, the value of this software is being eroded rapidly by changes in computing technologies and disruptive digital solutions available on the Cloud and the Internet-of-Things. This project will help enterprises protect their investments, by providing automated support for reengineering and repurposing established systems, into the IoT, rather than developing new IoT enterprise systems from scratch. It will accelerate enterprise-grade solutions into the IoT. This will be critical for the key Australian sectors requiring that enterprise systems be embedded in IoT systems, according to a recent study by Australian Computer Society: mining, healthcare, agriculture manufacturing, supply chain resilience and construction. Not only will existing systems be reusable for new IoT microservices services through the new systems re-engineering approach and techniques produced by the project. New security vulnerabilities, including intrusions of customer privacy, will be detected and avoided.							

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DP220101853	**A more sound approach to the neurobiology of language**	82,588.00	166,051.50	141,717.00	58,253.50	0.00	0.00	448,610.00
de Zubicaray, Prof Greig I	How does the brain attain spoken language? Current neurobiological models assume either implicitly or explicitly that there is no relationship between a word's sound and its meaning. Yet considerable evidence shows this strong assumption about the arbitrariness of language is invalid. This project will use a combination of behavioural, neuroimaging and computational studies to characterise how the brain processes statistical regularities in sound-to-meaning correspondences as probabilistic cues to attain spoken language. The outcome will be a better neural account of language comprehension and production. The benefit of this new account will be a stronger basis for assessment and treatment of developmental and acquired language impairments.							
	National Interest Test Statement							
	This project will enhance Australia’s knowledge-base, capability and technical innovation in investigating, modelling and manipulating the brain mechanisms involved in acquiring and processing spoken language. It will increase Australia's research standing internationally by leading collaborative research with colleagues in the United States of America. It will offer high quality Australian postgraduate training in the increasingly competitive field of neuroscience that attracts dedicated funding internationally, conducted in a world-class intellectually stimulating environment. The findings will inform future clinical research and improve the advice given to clinicians, patients and the broader Australian community about the nature of speech acquisition and production and associated impairments. The potential benefits include knowledge gain that might be used to provide better assessments of language impairments and support more effective and economical treatments of speech problems following brain disorders such as stroke or dementia.							
DP220102045	**Next Generation Bridge Monitoring using Novel Synergic Identification**	56,500.00	125,500.00	145,000.00	76,000.00	0.00	0.00	403,000.00
Chan, Prof Tommy H	Over 70% of the bridges in Australia are made of prestressed concrete, yet many do not meet the requirements of current Australian Standards. This project aims to provide a cost-effective system for monitoring bridges in real time along with systems that track the prestressing force and rate of damage for ongoing health assessment and necessary repairs. The use of innovative engineering techniques, solving long standing problems of engineers, will enable the safe operation of bridges, which play a primary role in Australia’s national transport system. Improved methodology for turning tired infrastructure into ‘smart bridges’ will be developed and commissioned first in Australia and then applied internationally.							
	National Interest Test Statement							
	In the state of Queensland alone, bridge maintenance inspections cost approximately $20M per year. Traditional methods of inspection have proven to be ineffective as evidenced by recent bridge collapses in spite of regular inspections. Moreover, a large number of prestressed concrete bridge decks crossing stretches of water and valleys do not have any form of health monitoring system and hence the urgency of the proposed research. This project aims to develop an efficient and economical system for monitoring the structural health of prestressed concrete bridges – medium and long spans. It will effectively safeguard Australian transportation infrastructure and prevent bridge failures, and hence provide substantial socio-economic benefits. It will also provide valuable information on bridge loadings for future more economical, safer and smarter bridge designs. This project will update health monitoring of older bridges and ensure many more Structural Health Monitoring systems are installed in new bridges. It will also contribute to the restoration of public confidence in the engineering community.							

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DP220102398 Suenderhauf, A/Prof Niko	**Learning Robotic Navigation and Interaction from Object-based Semantic Maps** Our project aims to develop new learning algorithms that enable robots to perform high-complexity tasks that are currently impossible. Compared to existing methods that rely on low-level sensor data, we aim to achieve this by learning from a high-level graph representation of the environment that captures semantics, affordances, and geometry. The outcome would be robots capable of using human instructions to efficiently learn complex interaction and navigation behaviours that transfer to unseen environments. Our research should benefit new applications in domains of economic and societal importance that are currently too complex, unsafe, and uncertain for robot assistants, such as aged care, advanced manufacturing and domestic robotics.	82,500.00	170,000.00	175,000.00	87,500.00	0.00	0.00	515,000.00
	National Interest Test Statement This project will develop improved software algorithms and innovative mathematical models that will significantly advance robot learning from human instructions. Better, faster, more reliable, and more human centred robotic learning will unlock applications that are currently too hard, too complex, and too unsafe for robot assistants. This includes industries of economic and societal importance where robots collaborate closely with humans, such as manufacturing, mining, construction, logistics, retail, and also domestic aged care where smarter robots can drastically improve the likelihood of older people retaining their independent living for much longer. By advancing natural language-based teaching, we will make robotic technology more accessible to the Australian industry and lower the specialised knowledge required for a human to collaborate with a robot. This project will strengthen Australia's global reputation as a robotics powerhouse and provide an exciting training environment for the next generation of researchers and robotics engineers.							
DP220102598 Rakotonirainy, Prof Andry	**A human-centric eXplainable Automated Vehicle** The aim is to create a computational model to address the inability of Automated Vehicles (AV), powered by Artificial intelligence, to self explain their behaviours. This project applies novel multidisciplinary methodologies in a real-world self-driving setting to formalise the essence of driving explanations. It explores the when, why and how a driver is seeking an explanation and what type of automated explanation is truly human-interpretable. Expected outcomes include the discovery of an acceptable, transparent and ethical explanation system that helps humans to understand the AVs decision making. This field will continue to rise in prominence and produce much-needed work to improve the widespread adoption of AVs.	87,500.00	175,000.00	175,000.00	87,500.00	0.00	0.00	525,000.00
	National Interest Test Statement Australia has the opportunity to transform the transport landscape and benefit from improved road safety and network efficiency, decreased pollution and mobility for all. Automated Vehicles (AV) are key to this transformation, but road users need to be able to better understand the AV's decisions—based on Artificial Intelligence—to build trust and accept them. This multidisciplinary project investigates when, why and how AV's driver is seeking an explanation and what type of explanation from the Artificial Intelligence system would be easy to understand, safe and ethical. Providing good explanations will help AVs to proliferate, so that the Australian community can reap the economic and social benefits. This project will also benefit Australian transport regulators by enabling them to future proof transport policies and road safety initiative spending. More broadly, this project will provide a consistent framework for the future design of human-centric explanation of Artificial Intelligence.							
DP220102759 Challis, Dr Vivien J	**Optimisation of piezoelectric metamaterials: Towards robotic stress sensors** This project aims to design new piezoelectric material microstructures that can enhance the measurement of complex local stress states within robotic limbs. The project expects to generate new knowledge of the achievable properties of multi-poled piezoelectric materials and develop computational tools for the analysis and structural optimisation of such materials. The designed microstructures may revolutionise piezoelectric sensor technology. Expected outcomes include manufactured proof-of-concept sensors that enable measurement of local stress fields. This should provide significant benefits, such as improved future robot capability and reliability, and research training for next-generation Australian computational mathematicians.	75,000.00	145,000.00	112,500.00	42,500.00	0.00	0.00	375,000.00

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	National Interest Test Statement This project will develop the science to underpin the next-generation of piezoelectric transducers for sensing complex stress states within robotic limbs. Such sensors would allow more sensitive robotic control that prevents components from breaking under high stress. This will be particularly important for climbing robots, improving their reliability and therefore their utilisation in industry settings. To this end, we will explore the piezoelectric properties of a range of microstructures, and develop new computational tools for the structural optimisation of piezoelectric metamaterials that have piezoelectric properties not naturally achievable. We will develop proof-of-concept transducers and test them within climbing robots. The project will contribute to Australia's research priority in advanced manufacturing and will train the next generation of Australian computational mathematicians.							
DP220103233 Mahendran, Prof Mahen	**Averting Disaster: New Ways to Assess Bushfire Risk and Building Integrity** This project aims to develop a new method of assessing bushfire risk and building integrity using drone-based advanced technologies and computational fluid dynamics based heat transfer modelling for buildings located in bushfire prone areas. This coupled approach will enable the evaluation of bushfire effects on buildings and provide pre-bushfire condition/risk assessments, and site-specific cost-effective remedial actions to reduce or eliminate bushfire damage and mitigate the risks pre-bushfire season. The new method will be applied to three selected buildings through which further enhancements and validations can be achieved. This project will showcase how the selected buildings and their components can be made bushfire safe.	60,000.00	120,000.00	120,000.00	60,000.00	0.00	0.00	360,000.00
	National Interest Test Statement Black summer bushfire 2019/20 have shown the disastrous consequences of bushfires, resulting in significant loss of lives and properties. This project proposes an innovative and highly efficient approach of using advanced drone-based technologies and numerical modelling to conduct bushfire risk and building integrity assessments of buildings. By identifying vulnerable building elements and weaker building design features, it will provide retrofitting strategies and site-specific bushfire safe solutions pre-bushfire season. The developed assessment method can be used by building owners, local councils and state government agencies to undertake pre-bushfire assessments of buildings. When used widely, it will significantly increase the proportion of buildings in bushfire prone areas with enhanced bushfire resistance. Ultimately, this project will change our collective approach to bushfire preparedness – saving homes, lives and livelihoods and will contribute to the Australian government’s goal of increasing the building and community resilience against future extreme and more frequent bushfire events.							
DP220103234 Phillips, A/Prof Matthew J	**Ancestral state reconstruction and the evolution of Australian marsupials** This project aims to investigate the diversification and evolvability of Australian marsupials, by enabling genomes, ecology and 3D skeletal shape to synergistically inform evolutionary inference. This project expects to generate new knowledge of the processes that have promoted and maintained marsupial biodiversity, by tracing their evolution across a fossil gap that spans half of their history. Expected outcomes of this project include improved methods for merging fossils into the tree of life and for reconstructing the ecology and morphology of ancestors on phylogenetic trees. This should provide significant benefits, such as a coherent evolutionary context for informing research on marsupial biology, ecology and conservation.	77,500.00	157,500.00	160,000.00	80,000.00	0.00	0.00	475,000.00
	National Interest Test Statement Marsupials, such as kangaroos and koalas are an integral part of Australia’s national and international identity. This project aims to integrate genomes, ecology and 3D skeletal shape to identify mechanisms that have shaped marsupial biodiversity. The research falls within National Research Priority, Environmental Change, under the Practical Research Challenge: Options for responding and adapting to the impacts of environmental change on biological systems, urban and rural communities and industry. Methods we are developing connect evolvability among species to climate processes and biotic interactions, and can augment efforts to predict adaptive responses in natural, agricultural and epidemiological systems. Our research linking diet genomics and morphometrics realizes the interdisciplinary scope of the National Resource Infrastructure Roadmap focus area, Complex Biology, which seeks increased collaboration across genomics, proteomics, metabolomics and bioinformatics. Anticipated benefits include a more accurate evolutionary context for informing future research on marsupials and other native biota.							

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DP220103668	**A Concurrent Multiscale Model for Improved Prediction of Drying Process**	72,500.00	145,000.00	142,500.00	70,000.00	0.00	0.00	430,000.00
Karim, A/Prof Azharul	This project aims to develop an innovative multiscale model for food drying, which integrates spatial and temporal nonlinear behaviours at different scales. The proposed unifying theory will capture dynamic micro level features and upscale them to macro level features through a concurrent bridging scheme. As cellular elements critically govern the drying process, the fundamental understanding captured through this theory will lead to more accurate prediction of drying kinetics, deformation and quality changes, and hence the development of efficient drying systems. This project will overcome a longstanding research problem and position Australia at the forefront in world drying research to reap substantial economic benefits for Australia.							
	National Interest Test Statement							
	Food processing is the largest manufacturing industry in Australia with an annual turnover of A$131 billion. While drying is a major process used in the food industry, it is a lengthy highly energy-intensive process, and if not properly designed, results in significant quality deterioration. These problems have yet to be solved as the fundamental knowledge of the drying process is not well understood. This project aims to radically advance the body of food drying knowledge and resolve a long overdue food engineering problem by developing the first multiscale model for accurate prediction of transport, deformation and quality changes. The project also aims to provide food scientists with reliable predictive tools to supplement experiments, thereby increasing their understanding of cellular changes during food processing and enabling the exploration of new approaches to ensure better food quality at minimum energy and time expenses. This modelling framework can be extended to other important engineering processes such as biomedical engineering and pharmaceutical industries, timber drying and sludge drying.							
DP220103833	**Passive biofiltration processes for nitrogen removal from polluted waters**	75,000.00	150,000.00	150,000.00	75,000.00	0.00	0.00	450,000.00
Deletic, Prof Ana	Traditional urban wastewater treatment is energy and resource demanding. By combining principles of Water Sensitive Urban Design (WSUD) with advanced pollutant removal processes, we will create necessary knowledge to underpin development of novel sustainable urban water treatment systems. This project aims to understand and utilise Simultaneous Nitrification, Anammox and Denitrification (SNAD) processes within passive plant-soil-based biofilters for cost-effective removal of nitrogen from a range of polluted urban water sources. The project will open a potential for a new technological advancements in urban water management, while simultaneously providing benefits to the environment and community through greening and waterway protection.							
	National Interest Test Statement							
	The project will underpin development of the next generation of sustainable water technologies; we will deliver necessary knowledge for advancement of plant-soil-based water filters for cost-effective treatment of polluted waters in urban environments. The project will deliver benefit to Australia by providing evidence and tools to manage contamination in the environment before it reaches waterways, while simultaneously promoting urban greening and a healthier environment for our communities to enjoy. Through a better understanding of nitrogen pollution pathways in plant-soil-based water treatment systems, we will develop novel processes for contamination removal from urban polluted waters (sewage, greywater, and stormwater). The project will ultimately provide economic benefit via more efficient treatment systems, contributing to heathy communities, by creating pathways for adoption of low-cost and low-energy water treatment systems in urban environment, that can be used to partially replace the current high-energy-demand facilities.							
DP220104043	**Academic Entrepreneurship in Australian Universities**	34,814.00	63,915.00	66,910.00	37,809.00	0.00	0.00	203,448.00
Hutmacher, Prof Dietmar W. W	ITRHs & ITTCs are a major funding sources to mentor future graduates that drive growth and innovation in today's economy. However, changes based on evidence based research are needed to ensure that they are adapted to the task of creating entrepreneurial thinking, stimulating business creation and exploiting ideas in society. Multiple-case studies are generally regarded as more robust than single-case studies, providing the observation and analysis of a phenomenon in several settings. In order to satisfy the requirements of the replication strategy we analyze all funded ITRHs & ITTCs from 2012 to 2024.							

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	National Interest Test Statement A important governmental scheme designed to foster innovation through academic entrepreneurship is the Industrial Transformation Research Program (ITRP). To date, academic entrepreneurship outcomes associated with this major program have not been systematically analysed. Here we hypothesize that the ITRP which " supports university-based researchers and industry to work together to find solutions to a range of issues facing Australian industries" could be an excellent tool to stimulate entrepreneurship in Australian universities. The ITRP offers funds awarded through two schemes: Industrial Transformation Research Hubs (ITRH), and Industrial Transformation Training Centres (ITTC). These research hubs and training centres should foster collaborative research, bringing researchers and industry together to share their skills and expertise to solve problems and develop new products, processes and services that will transform Australian industries. We systematically evaluate all funded ITRPs and ITRHs with respect to facilitating academic entrepreneurship based on innovation and new scientific knowledge.							
	Queensland University of Technology	1,333,382.00	2,687,447.00	2,655,453.00	1,301,388.00	0.00	0.00	7,977,670.00
The University of Queensland								
DP220100167 Schoville, Dr Benjamin	**The Impact of Water Stress on Early Humans in the Kalahari Desert** This project aims to understand the impacts of water stressed environments for early modern human behaviour through state-of-the-art excavation techniques and palaeoenvironmental reconstruction at two new archaeological sites in the Kalahari. How humans mitigated water stress during a major technological transition is significant because adaptability to arid environments was crucial for humans expanding beyond Africa and into Australia. The expected outcome of this project is creation of new knowledge on the origins of human resilience to water stress. The benefit lies in the potential to gain insights into meeting future climate challenges by exploring the adaptive strategies developed by early modern humans in the southern Kalahari.	36,570.50	92,056.00	96,956.00	41,470.50	0.00	0.00	267,053.00
	National Interest Test Statement Water stress looms as a key concern for the future. The effects of climate change on water availability are first felt in arid regions, such as Australia. Humans evolved in areas with significant water variability. Adaptability to water stress may be part of what it means to be human. The context in which adaptability developed provides clues for meeting Australia's future water challenges. Yet the behavioural strategies for coping with past variability are poorly known. This project combines archaeology and geochronology to generate this knowledge. Detailed archaeological excavations from a key technological transition provide evidence of human adaptation. A record of climate change will be developed from previously unrecognised ancient lake sediments in the Kalahari. Insights for Australia's future water stress from our species' deep history provides a national benefit. International collaboration and domestic partnerships build Australia's research capacity and make this project possible. Arid regions help us understand past resilience and develop strategies for the future in the face of climate change.							
DP220100189 Sonter, Dr Laura J	**Ecologically responsible mining to fuel a green energy transition** An energy transition is key to tackling climate change. However, renewable energy is mineral intensive and boosting its supply may create new mining threats to biodiversity. This project aims to facilitate strategic development of ecologically responsible mining. It expects to reveal where new mines will be needed to meet future energy demand, and create innovative tools to predict and mitigate threats to plants and animals. Expected outcomes include an improved ability to inform sustainable climate and energy policies, leading to strategic investment decisions, cleaner mineral supply chains and conservation outcomes that capture valuable environmental and social benefits and create a competitive advantage for Australia's mining sector.	44,009.50	113,493.00	133,408.00	128,521.50	64,597.00	0.00	484,029.00

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	National Interest Test Statement							
	Australia is set to become a world leading supplier of the minerals needed to fuel an energy transition and address climate change. Careful strategic planning of new mines is essential to support a sustainable approach and avoid damage to our natural environment and its immense societal values. This research seeks to position Australia's mining sector at the cutting edge of responsibly sourced energy transition minerals. It intends to advance understanding of where new mines may threaten species and minimise the net biodiversity impacts of climate policies. In partnership with industry and government, this project plans to create tools that streamline investment decisions in mining and energy infrastructure, and enable effective conservation planning. Explicitly integrating biodiversity risks into energy transition plans will not only enhance environmental and social benefits to Australia but also ensure businesses can capitalise on a market increasingly focussed on sustainability. This should bring a competitive advantage to Australia's mining sector and a boost to our clean green economic future.							
DP220100359 Friesen, A/Prof Lana M	**Managing Carbon Offsets to Improve Australian Climate Policy Effectiveness** This project aims to evaluate the Emissions Reduction Fund-Australia's flagship climate policy-by using a combination of state-of-the-art theoretical and experimental economic methods. This project expects to generate new knowledge by investigating how the use of aggregators (intermediaries) and contract design impact the current regulation. Expected outcomes of this project include a clear scholarly understanding of how to redesign the regulatory system to deliver better environmental outcomes for less public funds. The insights gained should provide significant benefits to both Federal and State Australian policymakers (as well as policymakers worldwide) on the design and implementation of carbon offsetting mechanisms.	29,647.00	86,564.50	89,231.50	32,314.00	0.00	0.00	237,757.00
	National Interest Test Statement							
	The control of greenhouse gases is one of the most pressing public policies challenges we face in Australia and across the world. A key challenge is the ability to design innovative regulatory controls that limit greenhouse gases at the lowest possible cost while also providing environmental benefits to Australia. This project aims to investigate the effectiveness of carbon offsetting and, in particular, analyse the current issues related to the Emission Reduction Fund. Two major aspects play a pivotal role in the regulation: (i) the use of intermediaries to aggregate small-scale offsetting potential and (ii) the design of alternative carbon contracts. This project investigates how these two features impact the efficiency and environmental effectiveness of Australia's current climate policy. This will allow fresh design ideas to be generated in order to improve and develop Australia's flagship policy. The findings will position Australia as a leader in the design and implementation of innovative carbon mitigation policies that could be applied and adapted across the world.							
DP220100561 Westaway, A/Prof Michael C	**Testing the Dark Emu hypothesis** How we define traditional Aboriginal food production and settlement systems is a key challenge to Australian archaeology in light of the far reaching success of Bruce Pascoe's popular book Dark Emu. This project aims to undertake a new trans-disciplinary investigation, the first incorporating archaeological science, plant genetics and palynology through the lens of Niche Construction Theory to generate new empirical data in order to determine how we best define Aboriginal socio-economic systems. Investigating the intricacies of Mithaka economy and possible 'village sites' with a focus on the idea of plant domestication, the project will identify how we best define these sophisticated cultural and economic systems.	64,500.00	131,500.00	137,500.00	70,500.00	0.00	0.00	404,000.00
	National Interest Test Statement							
	A renewed interest by Australian audiences to the complexity of past Aboriginal food production and settlement systems has emerged through engaging and accessible histories that question basic assumptions relating to the Aboriginal hunter-gatherer past. This project aims to provide the first transdisciplinary test of these popular histories in Mithaka country which is documented in ethnohistory as an area where people lived in villages and cultivated plants. A diverse outreach program aims to provide Australian society with a clear statement of the cultural complexity of Aboriginal food production systems through the Mithaka example, using Niche Construction Theory as an interpretive framework to establish if we can define it as a form of agriculture. Aligned with a palaeoenvironmental research program it will generate important new understandings of one of the world's last unregulated desert channel systems. The project directly supports the Mithaka's National Heritage nomination for the region, aimed at bringing greater conservation, education and sustainable economic growth through cultural tourism							

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DP220100627	**Balance of Power vs. Empire in International Relations: A Global Study**	23,333.50	50,716.00	57,765.00	30,382.50	0.00	0.00	162,197.00
Phillips, A/Prof Andrew B	Why have some international systems seen power-balancing between competing Great Powers, while others have been dominated by a single empire? Drawing from European history, International Relations (IR) scholars have conventionally assumed that international systems tend towards a balance of power. Yet recent analyses of East Asia highlight the historical dominance of successive Chinese empires. Other, neglected regional systems vary between these extremes. IR scholars lack an explanation of when and why international systems tend towards balance of power or empire. This project aims to fill this knowledge gap. With US hegemony in doubt, and China rapidly rising, understanding what drives change in international systems is urgent.							
	National Interest Test Statement							
	Policy-makers, scholars and pundits in Australia and globally are divided over whether the United States is in decline as a superpower, and whether China will dominate Asian or world politics in the 21st century. Much if not most of this debate, which is crucial for Australia's national security and foreign policy, is based on an assumption that international politics naturally tends towards a balance of power. This assumption is based on bad history, and is often wrong. Looking at history beyond Europe shows that sometimes the international system tends to balance, but sometimes it is dominated by a single power as an empire or hegemon. Because a key assumption on which much of Australia's national security and foreign policy is faulty, the policy may be badly flawed. By finding out when and why international systems tend towards either a balance of power or domination by a single power we will provide a firmer and more accurate intellectual foundation from which to advance Australia's national interests in world politics.							
DP220100643	**Cosmological vacuum stability as a window on fundamental physics**	102,761.00	208,102.00	219,363.50	114,022.50	0.00	0.00	644,249.00
Scott, Dr Pat	Vacuum is not just the absence of matter: it is the lowest-energy state of our Universe. This project aims to investigate the existence of new particles via their impacts upon the vacuum of the Universe. It expects to develop methods required to extract information on the existence of new particles from the vacuum, using transitions between different vacua, resulting gravitational waves, and results from a broad range of other complementary experiments. Expected outcomes include comprehensive tests of four of the most compelling theoretical frameworks for new particles. Significant expected benefits include advanced training for Australian students in numerical methods, software development, statistical analysis and research computing.							
	National Interest Test Statement							
	This project aims to advance our fundamental knowledge of the world we live in by improving methods for identifying, tracing and predicting the lifetime of vacuum states. This will drive the technology of the future, by increasing Australian scientists' ability to discover new fundamental particles. New particles may provide the basis for novel materials, new energy sources and new modes of transport. The project will generate new techniques in high-performance computing, computer programming, advanced statistics, constrained optimisation and machine learning, providing new capabilities to the Australian information technology and manufacturing sectors. The project will provide Australian students and recent PhD graduates with advanced training in numerical and quantitative methods, leading to a higher-quality workforce who will produce a range of economic and social benefits to Australia in scientific, medical and industrial applications. The project will also generate cultural and educational benefits in the areas of space, physics and computing, through extensive outreach activities.							
DP220100845	**Self-reinforced biopolymer composites**	80,000.00	160,000.00	150,000.00	70,000.00	0.00	0.00	460,000.00
Halley, Prof Peter H	This project will pioneer high performance and biodegradable composites using self-reinforced biopolymer composites. Composites can have poor properties due to interfacial issues, and this reduces their performance. By producing a fully self-reinforced (where the fibre and the polymer are the same type of polymer) polymer composites, the project will develop a way to improve properties, increase the use of biobased materials, and improve recyclability and biodegradability. Outcomes include greater understanding of design of self-reinforced biopolymer composites structure, processing and properties. This will produce opportunities for high performance biobased composite manufacturing and a growing circular plastics economy for Australia.							

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	National Interest Test Statement Australia and the world are facing a plastic waste crisis. The solution will require a mix of technical, social and political change. This project focuses on the technical innovation of biobased and easily recyclable polymers that will be part of this solution. Biobased and biodegradable polymers are experiencing rapid growth (20% in 2016), but have not yet gained full market acceptance due, in part, to a lack of high performance properties, such as high impact strength and toughness. Conventional approaches through blending or fibre composites impair recyclability or degradability, causing a continuing waste burden on Australian society and environment. By developing high impact strength self-reinforced biocomposites, where both the fibre and matrix are made from biobased PHA and PGA, this project will unlock far broader applications for biopolymers and accelerate their widespread use as engineering products. This strongly supports Australia's transition to a biobased and circular economy, providing key environmental, social and economic benefits.							
DP220100896 Mark, Em/Prof Alan E	**Enhanced force fields for computational drug design and materials research.** This project aims to improve the atomic interaction functions used to calculate the structural, dynamic and thermodynamic properties of molecules that alter net charge or structure in different environments. Predicting the stability of alternative protonation and tautomeric states for molecules bound to therapeutic targets is a major challenge in computational drug design. It is key to identifying the therapeutically active chemical species as well as understanding drug transport and off-target effects. The work will expand the utility of modelling software used by over 13,000 researchers worldwide. In addition, the improved interaction functions will also help in the understanding of a wide range of other materials at an atomic level.	75,000.00	142,500.00	100,000.00	32,500.00	0.00	0.00	350,000.00
	National Interest Test Statement The development of new drugs and functional materials has wide ranging social and commercial benefits. Modern drug and materials design increasingly relies on the use of computational methods to obtain a detailed knowledge of the structure and thermodynamics of highly complex molecular systems at an atomic level. This project is focused on improving the description of the basic interatomic interactions on which these computational models rely. The work aims to directly impact research into drug and materials design by helping identify the precise chemical state of molecules in solution and when bound to a therapeutic target. Improving the description of atomic interactions will also be applicable to a wide range of other molecular systems. This includes the design of highly efficient organic lighting and solar cells. Preliminary work has attracted significant commercial interest suggesting widespread impact. Facilities are also in place to make advances accessible to the broader scientific community ensuring rapid uptake and an enduring legacy for Australian research.							
DP220100900 Hugenholtz, Prof Philip	**Changing the classification status quo with a global genome-based taxonomy** A grand challenge in biology is the reconstruction of the complete evolutionary history of life on our planet. A major hurdle to this goal has been the inability to culture most microbial species which comprise the bulk of evolutionary diversity. However, new molecular techniques have removed this hurdle and >1,000 new microbial species are being revealed each month through sequencing of environmental samples. This project aims to organise both cultured and uncultured microbial diversity into a systematic evolutionary framework to replace the current highly flawed and incomplete classification of microorganisms. The systematic classification of the microbial world is timely and will enable fundamental insights into ecology and evolution.	156,097.50	315,095.00	324,095.00	165,097.50	0.00	0.00	960,385.00
	National Interest Test Statement The proposed study will contribute to fundamental understanding of microbial diversity and evolution. It builds on the foundation of an already internationally recognised resource, the Genome Taxonomy Database (GTDB), which has the potential to significantly disrupt current taxonomic practices and to improve our ability to interpret sequence-based studies of microbial ecosystems such as the human gut. The study involves development and application of cutting edge genome analysis methods that will advance Australian science and publicise Australian research internationally. This will contribute to achieving Innovation and Science Australia's vision for 2030 which calls for advancing Australia's technology training and education, specifically identifying genomics as an important growth area.							

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DP220100960	**An integrated nano-bioengineered chip for enhanced molecular evolution**	76,617.00	153,048.50	156,676.50	80,245.00	0.00	0.00	466,587.00
Trau, Prof Matt	This project aims to develop a novel molecular evolution platform technology for the rapid selection of high value target binding molecules from diverse molecular libraries using an electrically activated nanofluidic chip coated with target. Significant outcomes from the project is the controlled selection of target binding molecules that is not possible with current methods and improved understanding of nanoforce driven molecular collisions on nano-bioengineered surfaces. This provides significant benefits, creating new knowledge in nanomaterials and advanced manufacturing of nanofabricated devices, creating commercial interest and positioning Australia at the forefront of molecular discovery technology, a highly valuable global market.							
	National Interest Test Statement							
	This project will develop a highly disruptive platform nanotechnology to enable rapid and enhanced selection of peptide and protein binders for high value industries (e.g., the monoclonal antibody market valued at US$115 billion annually). The technology will also benefit Australian researchers by speeding up research outputs for molecule discovery, diagnostics, biotechnological manufacturing, agriculture, and biosecurity, as well accelerating the fundamental understanding of biological systems. The diverse applications of the technology, such as environmental monitoring and pathogen detection provide commercial and environmental opportunities that benefit the Australian community. The research also has social benefits including the training of researchers in diverse research fields which leads to capacity building and triggers further technology discovery for Australia. The interdisciplinary nature of the research in biologics and nanotechnology, combined with the innovation of the technology, contributes to Australia's national interest providing commercial benefits to the expanding biotech sector.							
DP220100967	**Constituent power in federal constitutions**	56,000.00	123,500.00	151,000.00	83,500.00	0.00	0.00	414,000.00
Aroney, Prof Dr Nicholas T	The concept of constituent power is fundamental to public law. This project aims to provide the first systematic and theoretical examination of the concept as it manifests in federations. The idea of constituent power was first developed in unitary states. Consequently, its role in federations has rarely been explored. Expected outcomes include a systematic comparative analysis of constituent power in federations and the development of a theory of pluralised constituent power. Expected benefits include the generation of insights into the constitutional foundations of federal systems (including Australia), new approaches to the interpretation of federal constitutions and mapping of pathways for legitimate constitutional reform.							
	National Interest Test Statement							
	The Australian Constitution is notoriously difficult to amend. This is due largely to its federal nature. Much of the responsibility for updating the Constitution has fallen to the High Court. This is controversial because the Constitution should only be amended by the people. Lying behind this controversy is the concept of ‘constituent power’: who has the power to make, amend and interpret the Constitution? These are fundamental questions that arise in all federations. By seeking out answers to these questions, this project will clarify the pathways to legitimate constitutional change in Australia and beyond. This will benefit governments and members of parliament when questions of constitutional reform arise and it will provide tools that can be used by judges when problems of constitutional interpretation emerge, as they frequently do. Because the Constitution sets the framework within which the political system operates, the project will provide downstream benefits for development of federally-coordinated economic and social policies and responses to environmental and public health crises.							

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DP220100985	**Understanding the generation of hypothalamic sleep neurons**	91,135.50	183,427.00	185,762.50	93,471.00	0.00	0.00	553,796.00
Thor, Prof Stefan T	This Project aims to investigate the mechanisms controlling the formation of the sleep neurons in the hypothalamus. We all sleep, and normal sleep-wake cycles play a central role in our biology. The functional role of these sleep neurons in the mature brain are well established. However, how the neurons are generated during development is very poorly defined. This project aims to address this critical knowledge gap, and will greatly increase our understanding of how the development of this critical aspect of organismal function is orchestrated during development. This project will also develop bioinformatics tools with broad utility within the biosciences field and enhance the capacity for interdisciplinary international collaborations.							
	National Interest Test Statement							
	This project aims to understand the formation of the sleep neurons in the hypothalamus, cells that are critical for sleep-wake states. Despite their well-known adult function, how sleep neurons form during embryonic development is largely unknown. By using a combination of novel, cutting-edge, single cell analysis technologies, this project will decode the molecular pathways controlling sleep neuron development. This project will develop approaches with which to decode the development of any other tissue, and will develop sophisticated bioinformatics tools with broad utility within the biosciences field. Expected outcomes also include enhanced capacity to build interdisciplinary international collaborations. The successful elucidation of how sleep neurons form will have implications for understanding scenarios when sleep is disturbed, such as jet-lag and in shift workers, or in situations where sleep is abnormal, such as in patients with narcolepsy (these patients specifically lack these sleep neurons). These are all important issues for Australians, underlining the importance of our research program.							
DP220100988	**Digital Transaction Platforms in Asia**	47,898.50	137,796.00	171,936.00	108,558.00	26,519.50	0.00	492,708.00
Athique, A/Prof Adrian	This project seeks to provide a comprehensive and authoritative account of the rapid shift towards digital payments in Asian economies. The study examines the technical and commercial organisation of the leading Asian transaction platforms. Our approach seeks to emphasise the significance of cultural diversity in Asian markets through detailed studies of everyday norms and practices in India , Indonesia, China, Japan, Malaysia, Singapore, Vietnam and the Philippines. A large scale analysis of market and user data seeks to illustrate key trends at scale and provide a regional knowledge base for assessing the implications for Australia, fostering multilateral collaboration and developing robust policy recommendations on the digital economy.							
	National Interest Test Statement							
	The shift towards cashless payments has been central to the expansion of the digital economy and the growing influence of technology companies across the world. Asia, and China in particular, has been at the forefront of the switchover to digitally transactions. This transformation has been taking place across the entire region and is accelerating under the conditions of the pandemic. The rise of digital transaction platforms in Asia is highly significant for Australia, because these platforms are central to the economic development agendas of key trading partners, and because these platforms operate across national borders. This project aims to provide a robust account of digital transactions in Asia. Access to this knowledge will be of national benefit in trade as we seek to develop domestic policy and bilateral partnerships in Asia, notably in Fintech, social development, and governance. This project will also constitute an Australian presence in empowering local communities, delivering social benefits and developing norms for financial inclusion in the region.							

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DP220101063	**Some like it hot: invasive species, hybridisation, and a warming world**	87,430.50	150,004.50	107,614.00	70,581.00	25,541.00	0.00	441,171.00
Riginos, Prof Cynthia	Temperatures are rising and invasive species are becoming more prevalent. This project aims to understand how climate change and hybridisation between exotic and native marine species leads to rapid adaptation. Using integrative approaches from genomics and physiology and focusing on Australian blue mussels, this proposal will test leading hypotheses about how climate change and hybridisation can enable rapid adaptation and the spread of exotic species. Outcomes will include strategies for minimising impacts of invasive mussels and boosting warm-temperature adaptation in aquaculture mussels and restored shellfish reefs. This project will yield fundamental insights into how marine species can quickly adapt to warming seas.							
	National Interest Test Statement							
	Marine invasive species and warming temperatures threaten Australia's biodiversity and aquaculture food sources. This research contributes to Australia's national interests, aligning to research priorities for environmental change and food. It will enhance accuracy in predicting impacts of environmental change through new integrated knowledge of the genomics and physiology of invasive species, enabling predictions of how climate change affects exotic species spread. It will also provide new options for responding and adapting to environmental change: by mapping an invasive mussel's distribution on Australia's coasts and hybridisation with a native mussel species, we may identify new strategies to mitigate exotic species based on natural barriers to dispersal and hybridisation. Finally, this research will aid sustainable aquaculture production through improved broodstock selection by propagating the native species and selecting for increased thermal tolerance, thus matching the genetic composition of aquaculture and restored shellfish reef mussels to present and emerging conditions.							
DP220101391	**Light-driven biocatalytic cell factories**	76,278.50	156,957.00	158,857.00	78,178.50	0.00	0.00	470,271.00
Hankamer, Prof Benjamin D	This project aims to develop single-cell algae optimised for high-efficiency green hydrogen production from cheap, sustainable resources - sunlight and water. The success of this project would be a game changer for industry by dramatically improving light to fuel conversion efficiencies. The expected high-efficiency cells would be a valuable resource for a wide range of other light-driven advanced bio-manufacture applications from high-value biopharmaceuticals (e.g. <10 Hectare scale) through to renewable fuels (e.g. 10-1000 Hectare regional scale). The benefits would include advanced green chemical and biochemical manufacturing, diversified sources for green H2 production, regional development, industry growth, job security and exports.							
	National Interest Test Statement							
	This project directly contributes to the national interest by delivering economic, commercial, environmental and social benefits to the Australian community. Economic and commercial interests are directly addressed through the development of commercially valuable algae-based cell lines and systems to produce new high-value molecules, fine chemicals and fuels, all with potential to generate patents and commercial outcomes. It addresses industry needs by coupling Australia's natural advantage to expand international partnerships and investment (e.g., into Asia), and thus boosts Australian industry's competitive capacity. This project also directly contributes to Australia's environmental interests by developing solar biotechnology industry platforms to deliver cleaner greener chemistry. With this scope the project also delivers social benefits by placing Australia's research at the international forefront to attract investment, improve training, create high value jobs by enhancing global reputation and providing access to better resources and supporting regional development.							
DP220101395	**A Space Odyssey: Exploring the Universe with Gravitational-Wave Sirens**	70,000.00	140,000.00	130,000.00	60,000.00	0.00	0.00	400,000.00
Howlett, Dr Cullan M	How fast is the Universe expanding? This project aims to produce the most precise measurement to date of the present day expansion rate of the Universe using gravitational waves and thus resolve current tensions plaguing existing measurements. We plan to develop the most comprehensive catalogue of gravitational waves and their hosts using the largest galaxy surveys in the world and use innovative statistical techniques to extract cosmological measurements from them. Expected outcomes include new knowledge of what the Universe is made of and how it has evolved, and enhanced international collaboration between Australia and other survey member countries. Anticipated benefits include new software and methods for the analysis of big data.							

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	National Interest Test Statement							
	The expansion rate of the Universe is the key parameter under-pining our understanding of the cosmos. This project will obtain new measurements of this that could hence radically change our understanding of the Universe. It will significantly boost Australia's international recognition and influence in fundamental science and create new techniques for statistical analysis, supercomputing and data mining of big data. Economic benefits are expected to flow from applying these techniques in other fields and industries. This project will seed new technologies by tying into the development of future Australian facilities such as the Square Kilometer Array, a billion-dollar multinational radio telescope facility being constructed in Western Australia, and gravitational wave detectors, increasing their cost effectiveness and Australia's return on investment. This project will inspire the next generation of Australians in STEM-related subjects, provide training in innovative solutions to programming, problem solving and data analysis and prepare them for success in a range of commercial industries.							
DP220101406 Monteith, Prof Gregory R	**An active ion transport pathway exploited by coronaviruses** Cells have active transport "pumps" that are regulators of a variety of cellular processes. This project aims to understand how a specific ion pump is exploited by coronaviruses when they infect animal cells. These studies will provide new mechanistic insights into how coronaviruses alter calcium signalling in cells and how a specific ion pump regulates a variety of key processes during coronavirus infection. This work will greatly enhance our understanding of the intersection between ion pumps and viruses.	87,356.50	180,032.00	187,513.50	94,838.00	0.00	0.00	549,740.00
	National Interest Test Statement							
	Coronaviruses are a risk to livestock (e.g. pigs and chickens) and human health. A better understanding of key host events during viral infection will inform the future development of animals less susceptible to future pandemics and/or the design of agents that can be administered to reduce transmission in livestock which would protect the economy. Environmental changes brought about by climate change, deforestation and urban expansion are increasing the threat of new zoonotic coronaviruses. Australia stopping these global changes is unlikely due to pandemics starting anywhere in the world and due to virus diversity. This project focuses on understanding the fundamental biology of the intersection between events in the host and coronaviruses. This new knowledge can then be used to reduce the impact of zoonotic coronaviruses by protecting the host. This project will consolidate leadership knowledge in the advanced use of genetically encoded calcium sensors, particularly in the context of equipment used for high throughput screening which will benefit Australian pharmaceutical and biotech industries.							
DP220101478 Gildfind, Dr David E	**Magnetohydrodynamic Aerobraking for Spacecraft Entry to Earth's Atmosphere** A spaceship returning from Mars will undergo unprecedented aerodynamic heating as it enters Earth's atmosphere. Magnetohydroynamic aerobraking involves applying a strong magnetic field to the plasma which forms around the spacecraft at these speeds, theoretically protecting it by reducing structural heat loads and enabling less severe flight trajectories. This project aims to experimentally study this technology for Earth return from deep space. It is significant because it will evaluate a new mechanism for managing the tremendous heat loads of planetary entry. The expected outcome and benefit will be development of a new technology to reduce spacecraft heating, leading to safer, more efficient, and potentially reusable spacecraft.	85,000.00	150,000.00	110,000.00	45,000.00	0.00	0.00	390,000.00
	National Interest Test Statement							
	The Australian Government is aiming to triple the size of Australia's space sector to $12 billion by 2030, creating 20,000 new jobs. This, combined with the recent establishment of the Australian Space Agency and the Federal Government's $150 million commitment to NASA's upcoming missions to the Moon and Mars, signals a seismic shift in Australia's commitment to a future in outer space. This project is in Australia's national interest because it strongly supports our national objective to develop our space industry and play a significant role in ambitious future international missions. It will develop a new technology to deal with the most dangerous stage of interplanetary spaceflight - atmospheric entry - which will lead to lighter, safer, and potentially reusable spacecraft. The project will reinforce Australia's strength in spacecraft aerodynamics and fully capitalise on the competitive advantage we hold in this field due to our unique experimental ground testing capabilities. And it will train a cohort of world-class researchers which Australia needs to achieve its ambitious objectives in space.							

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DP220101512	**Incorporating the gains from healthy ageing in health system planning**	51,948.50	103,489.50	105,012.00	53,471.00	0.00	0.00	313,921.00
Birch, Prof Stephen B	This project aims to develop evidence-based fit-for-purpose economic models for planning future capacity for public health programmes by developing new methodological approaches incorporating dynamic changes in health and health risks over time. The project expects to generate new knowledge on the impact of improvements in physical and mental well-being on funding and capacity requirements for public programmes to meet tomorrow's needs for care instead of projecting yesterday's use of care. Expected outcomes include new economic models responsive to changes in population characteristics, conditions and contexts. The proposed research should provide significant benefits through improving efficiency of public investments in health.							
	National Interest Test Statement							
	This project aims to develop evidence-based fit-for-purpose economic models for planning future capacity for public health programmes. This will be achieved through developing new methodological approaches incorporating dynamic changes in health and health risks over time. The project expects to generate new knowledge on the impact of improvements in physical and mental well-being on reducing the cost of healthcare. Additional benefits include estimating capacity requirements for public programmes based on tomorrow's needs for care instead of projecting yesterday's use of care. Expected outcomes include new economic models responsive to changes in population characteristics, conditions and contexts. The proposed research should provide significant economic benefits through improving efficiency of public investments in health.							
DP220101526	**Novel disinfection to combat antibiotic resistance**	81,000.00	163,000.00	108,500.00	26,500.00	0.00	0.00	379,000.00
Guo, A/Prof Jianhua	Control of antimicrobial resistance in water is critical. Disinfection in water and wastewater treatment plants is a vital barrier against antibiotic resistant bacteria (ARB); however, it is less effective in controlling- and may even facilitate the spread of antibiotic resistance genes (ARGs). This project aims to comprehensively investigate the effectiveness of widely-used disinfection processes in controlling ARB/ARGs, determine the underlying mechanisms, and identify optimal treatment conditions. This project also aims to develop a novel, cost-effective and environmentally friendly disinfection process for efficient ARGs destruction, thus significantly strengthening Australia's capacity to prevent the spread of antibiotic resistance.							
	National Interest Test Statement							
	The presence of antibiotic resistant bacteria and antibiotic resistance genes in wastewater, reclaimed water, and drinking water poses a serious risk to public- and environmental health. Disinfection processes are designed to remove pathogens, and will also partially remove antibiotic resistant bacteria from water. However, emerging evidence shows that widely-used disinfection processes do not effectively destroy antibiotic resistance genes, and may in fact promote the spread of antibiotic resistance. Through comprehensive experimental studies, this project will determine the fate of antibiotic resistant bacteria and antibiotic resistance genes during disinfection, and the underlying mechanisms. We will develop a novel and environmentally friendly disinfection process for efficient destruction of antibiotic resistance genes. This project will provide significant support to water utilities in the endeavour to control the spread of antibiotic resistance in urban water systems and linked environments. The project will return significant social, economic and environmental benefits to Australia and the world.							
DP220101566	**The psychology of gridlock: Compromise, coalitions, and radicalisation**	62,512.50	135,980.00	141,445.00	67,977.50	0.00	0.00	407,915.00
Louis, Prof Winnifred R	This project aims to test an innovative psychological model of collective gridlock. Using interviews, surveys, experiments, small group research, and analysis of social media data, the project aims to examine critical pathways in gridlock psychology, where opponents are locked into mutually suboptimal outcomes, unable to move forward. These pathways include the exit or self-censorship of moderates; normative pressure towards purity and refusal to compromise; tactical choices to avoid coalitions; and radicalisation. The research aims to develop novel interventions to reduce polarisation and radicalisation, and to promote compromises, which together will help society respond more nimbly and effectively to social and environmental challenges.							

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	National Interest Test Statement Australian governments, firms, non-governmental organisations, and councils are often plagued by instances of gridlock - situations in which opponents mutually recognise that their current state is sub-optimal, and yet remain locked into stalemates of mutual recrimination and hostility, without positive change. Intractable problems at the national level have multiple causes. However, the psychological level variables studied here (individual attitudes of moral conviction and hostility, and social norms for group purity and fixed, unchanging tactics) are contributing processes that can block progress even when technical solutions permit positive change. Critically, recent theoretical advances in intergroup social psychology may allow us to unravel these processes. The present research tests the robustness of a new theoretical model explaining psychological gridlock, and develops interventions for overcoming it.							
DP220101645 Anggono, Dr Victor	**Regulation of activity-induced glutamate receptor trafficking in neurons** Neurons communicate via synapses, where chemicals (such as glutamate) are released to transmit neuronal signals. This proposal is aimed at understanding the molecular mechanisms of neuronal communication and adaptive plasticity, which are essential for normal brain function. The proposed research will combine biophysical, biochemical, molecular and cell biological assays to elucidate the role of a calcium binding protein in controlling glutamate receptor trafficking in neurons. The outcomes will enhance our understanding of how neural plasticity is generated and maintained, knowledge that is critical for our understanding of cellular correlates of information, sensory and motor processing, as well as learning, memory and cognition.	87,247.00	177,772.00	182,435.00	91,910.00	0.00	0.00	539,364.00
	National Interest Test Statement Understanding how learning and memory are regulated in the brain, from the molecular to system level is the major goal of modern neuroscience. This proposal will address fundamental biological questions in cellular neuroscience to understand how key receptors are targeted to the neuronal membrane and synapses to maintain neuronal communication and normal brain function. This basic research project is expected to fill a large gap in our understanding of the previously unexplored roles for a neuronal specific calcium and lipid binding protein in controlling neuronal trafficking. The findings will build research capacity and have the potential to identify cellular targets for enhancing cognitive performance, which may lead to substantial health and economic benefits for Australians. The ability to enhance learning and memory has major implications throughout life, as deficits can lead to poor educational outcomes, reduced productivity and social isolation. Moreover, this project will further strengthen Australia's research capacity through international collaboration and the training of early career scientists.							
DP220101681 Landsberg, A/Prof Michael J	**The mechanistic basis of tropism in an insecticidal pore-forming toxin** This project aims to answer a fundamental question regarding the mechanism of a recently discovered family of insecticidal protein complexes - how do these pore-forming proteins recognise and target specific hosts? The project will use an innovative, cross-disciplinary approach to determine the mechanisms of cellular recognition and uptake on a molecular scale. These outcomes have the potential to influence the use of ABC toxins in many areas of biotechnology, delivering benefits including the development of new bioinsecticides for pest control and crop protection as well as in the development of bespoke protein delivery devices which may find use in biotechnological and therapeutic applications.	82,291.50	168,536.50	168,682.50	82,437.50	0.00	0.00	501,948.00
	National Interest Test Statement ABC toxins have strong, demonstrated potential to be deployed as next generation biopesticides that overcome problems associated with resistance to existing pest control measures. Successful development and deployment of new pest control strategies based on ABC toxins will ultimately be of benefit in addressing threats to food and infrastructure security posed by insect pests, as well as threats to human health posed by some insect-borne diseases. Despite this proven capability, the next phase in developing and understanding the potential of this technology requires a number of significant questions to be answered, which are addressed in this proposal. Specifically, how do ABC toxins recognise and distinguish susceptible insects from non-susceptible ones, and how are ABC toxins taken up by cells? Thus, the proposal represents an absolutely crucial step in the process of developing ABC toxins to a point where the technology will appeal to industry and other co-investment partners. Australia has the potential to benefit economically, environmentally and commercially from these outcomes.							

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DP220101790	**Realistic assessment of biomarker transformation in the wastewater system**	71,296.00	139,310.00	138,833.50	70,819.50	0.00	0.00	420,259.00
Thai, Dr Phong K	Wastewater-based epidemiology is an internationally recognised cost-effective tool to monitor population exposure to chemicals and infectious diseases including Covid-19. However, in-sewer degradation of critical biomarkers can limit their wastewater-based epidemiology suitability. This project aims to systematically evaluate the stability of a new suite of potential biomarkers and conduct the first Australia-wide assessment on the impact of biomarker stability on wastewater-based epidemiology estimates using wastewater samples from ~65% of the Australian population. The project expects to generate knowledge to expand the application of wastewater-based epidemiology to reliably quantify exposure and status of well-being even in remote areas							
	National Interest Test Statement							
	The federal government's National Wastewater Drug Monitoring Program based on the wastewater-based epidemiology (WBE) approach has provided important intelligence for several institutions in Australia. WBE is a tool which provides objective, near-real time data on population chemical exposures, health, wellbeing, and was recently adapted for detecting COVID-19 outbreaks in Australia. WBE however relies on biomarkers meeting a range of criteria. Of utmost importance is the stability in sewers. As such extending applications of WBE for novel biomarkers in Australian communities requires research on their stability. Using unique, state-of-the-art facilities at UQ, this project expects to provide essential information to improve both the scope and reliability of WBE. This will allow the tool to provide cost effective mapping of novel biomarkers across Australia to identify emerging threats to communities including toxic chemicals, infectious diseases and other emerging risks. This information is critical for regulators and policy advisors to formulate timely actions and interventions.							
DP220101878	**Revealing the mechanobiology of neural tube formation**	75,000.00	155,000.00	155,000.00	75,000.00	0.00	0.00	460,000.00
White, Dr Melanie D	This project aims to understand the formation of the neural tube; a fundamental tissue structure that generates the brain and the spinal cord. Using interdisciplinary approaches and exploiting recent advances in transgenic and imaging technologies, we expect to reveal the complex interplay between cells and their environment that generates mechanical forces to direct neural tissue formation. Outcomes include knowledge of previously intractable developmental processes, training of future scientists and development of international collaborations. This should provide enhanced imaging capacity, a higher quality scientific workforce and position Australia at the forefront of cell and developmental biology.							
	National Interest Test Statement							
	This project will strengthen Australia's capacity to generate innovative and internationally competitive research through multiple avenues. It contributes to development and innovation of Australian-based imaging technology and cell and developmental biology. It will ensure future Australian scientists are trained at a globally competitive level in quantitative imaging and image analysis techniques. The work will elevate the transgenic quail as a tractable model for research and industry applications. Transgenic quails are a patented Australian innovation and their use provides a competitive advantage and commercial benefit to Australia. The research will drive our understanding of how cells interact with their environment to form the foundations of the nervous system. It will also reveal how mechanical forces are integrated at a cellular and tissue level with morphological processes common to many biological contexts beyond development. This knowledge will be valuable for work across biological fields and also future industry-related applications such as tissue engineering and cell replacement approaches.							

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DP220101939 Carroll, Prof Annemaree	**Towards a School-Community Based Approach to Addressing Student Absenteeism** This project aims to develop an integrated school-community approach to assist education systems to effectively address student absenteeism in marginalised communities. Excessive absenteeism is linked to low academic achievement and school dropout, which limits young people's life opportunities and perpetuates social disadvantage. This project will use interdisciplinary methods to bring the experiences of schools and communities, existing research evidence, and academics together to enable schools to work in new ways to improve attendance. Expected outcomes will be enhanced capacity of schools to address absenteeism with the benefit of assisting the government to alleviate the societal and economic costs of this enduring problem.	58,190.50	117,702.50	120,347.00	60,835.00	0.00	0.00	357,075.00
	National Interest Test Statement Student absenteeism is an intractable educational, social and economic problem in Australia and internationally that leads to reduced opportunities for young people throughout their lives. This project addresses educational and social inequities through advancing innovative policy and practice solutions to develop an integrated school-community approach that is sustainable, evidence-based, and informed by social justice. This will improve attendance and provide greater value for expenditure among marginalised communities. This directly advances the educational priorities of the Australian Government to promote excellence and equity and provide equality of opportunity and educational outcomes for all students at risk of educational disadvantage. By combining the knowledge and experience of schools and their local communities with the best contemporary research evidence across multiple disciplines, we will develop an effective school-community approach to improve student attendance in marginalised communities.							
DP220101947 Zeng, Dr Jian	**Genetic architecture and evolution of complex traits across populations** Most human traits have a genetic component and display substantial diversity within and among populations. How natural selection changes and maintains genetic variation in human traits is a long-standing question in evolution that the proposed project aims to answer. Using innovative statistical methods and largest genomic "big" datasets ever across populations of different ancestral backgrounds, this project expects to generate new knowledge on the roles of natural selection in shaping the genetic variation in traits and identify key factors that drive the differentiation of human populations. These outcomes will significantly improve our understanding on the evolution of human traits and adaptation of populations to changing environments.	69,017.00	148,303.00	162,543.50	83,257.50	0.00	0.00	463,121.00
	National Interest Test Statement Understanding trait evolution and population adaptation has a profound impact on Australia's ecology, agriculture, science and public health. This research will generate new knowledge on the mechanisms by which the genetic differences between individuals are preserved and populations adapt to new environments. The knowledge and methodology produced by this project inform the management of Australia's biodiversity in the context of climate change. The improved method for trait prediction, from a better understanding of trait evolution, will benefit Australia's agriculture by helping to select the best animals and plants for breeding. Since Australia has a great diversity in their ancestral origins, ultimately this research may also benefit public health by better understanding the genetic differences between individuals and between ethnicities in common disorders and their risk factors. Other benefits include training scientists with bioinformatics skillset, which is in demand in Australian industry, and the distribution of software tools available to Australian researchers in academia and industry.							

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DP220101960	**YhcB, a crucial player in the control of bacterial cell envelope biogenesis**	73,500.00	157,500.00	171,000.00	87,000.00	0.00	0.00	489,000.00
Henderson, Prof Ian R	All life depends on a cell envelope to enclose the chemical reactions that make life possible. But how do cell envelopes grow? How each component of the cell envelope is incorporated into the envelope at the right amount and in the right time to prevent cell death, has been a longstanding question in bacteriology. Using a unique combination of high through put genetic screens and biochemical approaches, this project will characterise a key regulator of cell envelope growth in Gram-negative bacteria. Knowledge arising from this research will provide insight into a fundamental process in bacteria, will develop new technology to probe protein interactions, and will provide novel avenues to solve infection in plants, humans and animals.							
	National Interest Test Statement							
	Cell envelopes define life. For bacteria they are essential for survival. Understanding how they are made has applications in biotechnology and the future development of medicines. We have identified the first protein to coordinate all aspects of cell envelope growth in bacteria. Inhibiting the function of this regulator ultimately leads to cell death. This project will use a unique combination of high throughput genetic screens and biochemical approaches to characterise this regulator at a molecular level. Insights from the proposed work will lead to improved treatments of bacterial infections, thereby protecting Australian livestock, crops and Australians; contributing to greater economic prosperity. Other benefits include the development of new technology such as increased production of lipids and proteins that are important for Australia’s industrial and biotech sectors. The project outcomes will eventually lead to increased employment for Australians, ensure sovereign capability through training the next generation of scientists, and showcase Australia’s research excellence globally.							
DP220102018	**Regulated muscle-based thermogenesis for body temperature regulation**	100,750.00	203,595.00	203,445.00	100,600.00	0.00	0.00	608,390.00
Launikonis, A/Prof Bradley S	Mammals maintain a constant core body temperature by generating heat in resting muscles in response to changes in the environmental temperatures. This project aims to show how the skeletal muscles that are closer to the body core contribute the majority of heat, how the muscles of the limbs have their heat generation curtailed as necessary, and how this is coordinated by the body in response to ambient temperature. Project outcomes include defining, for the first time, how heat generation in the muscles of the body is regulated. This should provide critical knowledge of mammalian evolution and ways to manipulate metabolism, which may provide ways to assist the production of meat by managing hypothermia and hyperthermia risk in agriculture.							
	National Interest Test Statement							
	This is a fundamental biology project that will have economic and cultural impact. All mammals maintain core body temperature within certain limits for the continuing function of vital internal organs. This project will provide insight into how mammals achieve internal regulation of body temperature. There will be multiple benefits to Australia. The results will provide the basis for new ways to manipulate metabolism in livestock, especially under very high or low ambient temperatures. Manipulation of animal metabolism will directly affect meat quality, providing economic benefit. This includes death of livestock due to exposure to extremes being reduced. Further, the basic knowledge to be gained in this project will assist in ways to improve quality of life in Australia's ageing population. The reduction of muscle mass in the elderly affects the capacity to maintain body temperature against the cold. The project may identify approaches that may have future benefits for helping Australia’s ageing population to maintain body temperature.							
DP220102040	**Rapid evolution, and the dynamics and stability of ecological communities**	78,000.00	164,600.00	130,937.50	44,337.50	0.00	0.00	417,875.00
Hart, Dr Simon P	Population sizes of species go up and down and often we do not know why. This is a problem because changes in population size underpin more complex ecological change, and understanding why population sizes change affects our ability to manage environmental impacts, and threatened, harvested and pest species. The aim of this project is to discover how rapid evolution – evolution occurring over just a few generations – drives changes in population sizes of plants in Australian freshwater ecosystems. By focusing on this fundamental yet poorly understood process, our results promise to rewrite our understanding of the causes of change in ecological communities, while highlighting a unique and little studied component of Australia’s biota.							

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	National Interest Test Statement Our ability to manage Australia's environment relies on understanding the causes of change in the population sizes of species. Most studies on the causes of these changes ignore the ability of species to rapidly evolve. This project will improve our understanding of the circumstances under which rapid evolution is important for driving changes in population sizes, and resisting the impacts of environmental change. This knowledge will improve Australia's ability to incorporate the effects of rapid evolution into the prediction and management of environmental change – a national research priority. This project will also generate new understanding about the biology of a poorly understood component of the Australian biota – subtropical freshwater plant communities. These plants are ecologically and economically important, and we will develop these plants into a powerful new system for understanding the drivers of ecological change. This project will expose national and international audiences to our unique Australian flora, while consolidating Australia's reputation for discovery in the biological sciences.							
DP220102042 Reutens, Prof David C	**Advancing the visualisation and quantification of nephrons with MRI.** This project aims to characterise key components of nephrons, the glomeruli and tubules, using magnetic resonance imaging without contrast agents, in combination with Deep Learning and super-resolution techniques. Nephrons, the basic functional unit of the kidney, are critical to the maintenance of the body's homeostasis. Their number and architecture are critical determinants of kidney function. The expected outcomes are innovative semi-automated nephron visualisation and quantitation tools that enable efficient renal phenotyping. Techniques tailored to widely accessible preclinical research scanners are expected to accelerate research into genetic and environmental factors affecting kidney microstructure in embryonic and post-natal life.	73,015.50	157,405.50	169,772.00	85,382.00	0.00	0.00	485,575.00
	National Interest Test Statement The project contributes to Australia's national interest through potential benefits to the Australian community gained from building scientific expertise and technical capacity in the high value-add biomedical technology sector. Successful outcomes are expected to accelerate research that creates new knowledge into the factors that control the development of key microscopic components of the kidney that are essential for its normal functioning, and the changes that occur through life and normal aging. Australia's scientific reputation and competitive advantage will be enhanced by novel cutting-edge magnetic resonance imaging and artificial intelligence techniques that will be of commercial interest to manufacturers of magnetic resonance imaging scanners. Furthermore, the new techniques are designed for use on preclinical research scanners that are widely accessible in Australia, enabling kidney researchers across the country to benefit from project outcomes. This is also expected to add significantly to the impact of previous Commonwealth Government investments in the research scanners.							
DP220102050 von Briel, Dr Frederik	**Turning crises into opportunities: Learning from high growth businesses** Being able to adapt and respond to crises such as the COVID-19 pandemic or bushfires is important for Australia's economic development. This project investigates how crises can be turned into opportunities. It analyses the strategic crises responses of business ventures that managed to defy the odds and to achieve high growth because of crises. The outcomes include an improved understanding of the opportunities crises present; and actionable, empirically grounded insights into successful crises responses. As such, the project will make significant contributions to core areas of entrepreneurship and management research. It will also help policymakers and entrepreneurs to improve economic resilience and to foster sustainable economic growth.	42,577.00	89,727.50	96,670.50	49,520.00	0.00	0.00	278,495.00
	National Interest Test Statement Adapting and responding to environmental change is one of Australia's Science and Research Priorities. COVID-19 same as the 2020 bushfires highlight that being able to respond to crises as a type of environmental change is of utmost importance for Australia to achieve its long-term goals of sustained economic growth, job creation and improved national well-being. This project will contribute to fostering economic resilience and growth in light of crises by providing evidence-based strategies to turn crises into economic opportunities. Specifically, the project will analyse the strategic crisis responses of business ventures that successfully defied the odds and managed to achieve high growth despite and because of crises. Knowledge from this project will provide policymakers and entrepreneurs in Australia insights about successful crises responses and about fostering high growth businesses, thereby helping Australia to take advantage of emerging economic opportunities and to ensure sustained economic growth.							

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DP220102124	**Validation of predicted solution processed organic semiconductor properties**	90,500.00	185,000.00	191,500.00	97,000.00	0.00	0.00	564,000.00
Burn, Prof Paul	Controlling organic semiconductor film morphology at a molecular level is key to advancing the performance of optoelectronic devices such as large area organic light-emitting diode lighting, solar cells and sensors. The project aims to move from an empirical design cycle of material synthesis, device fabrication and testing to a more predictive approach where morphologies from molecular simulations are used to rationalise differences in experimentally measured optoelectronic properties. Outcomes will include unique insight into atomic-level structural details that determine device efficiency and an understanding of whether atomic simulations can be applied to accelerate improvements in device performance and translation to industry.							
	National Interest Test Statement							
	The aim of this project is to validate a predictive approach to improving solution processed organic semiconductor technologies. The foundational nature of the program means that it will impact not just a single technology but span a range of important applications including organic light-emitting diodes (that can be used for large area lighting modules), solar cells and sensors. A key feature of solution processed organic semiconductors is their environmental benefit through enabling low embedded energy manufacturing and technologies that reduce carbon dioxide emissions. For example, efficient solar cells and lighting provide societal benefit through green electricity generation and more efficient use of the generated electricity (20% of electricity generated in Australia is used for lighting). Determination of the solution processed organic semiconductor film morphology at an atomic level will facilitate the translation of these revolutionary devices from basic science to industrial products, maximising the competitive economic advantage of Australia's rapidly growing organic semiconductor community.							
DP220102216	**What predictions can I trust? Stability of chaotic random dynamical systems**	61,500.00	122,500.00	109,000.00	48,000.00	0.00	0.00	341,000.00
Gonzalez Tokman, A/Prof Cecilia I	This project aims to make significant progress on the intricate question of global stability of non-autonomous chaotic dynamical systems. Using ergodic theory, this project expects to determine when and how errors in dynamical models that are small and frequent, or large and infrequent, can cause dramatic changes in meaningful mathematical model outputs. Expected outcomes include the discovery of mathematical mechanisms underlying large-scale (in)stability for time-dependent dynamical systems, and reliable numerical methods for detecting instabilities. This research is expected to lead to improved characterisations of shocks or collapse in externally driven dynamical systems and assist scientists to gauge which predictions they can trust.							
	National Interest Test Statement							
	Random dynamical systems are flexible mathematical models used to describe large-scale and complex phenomena, such as fluidic, atmospheric, oceanic, and granular flows. Because models typically only approximate the evolution of systems of interest, it is important to understand how and when modelling errors can lead to dramatic changes in meaningful model outputs. If instabilities are present, systems evolving under similar (but not identical) rules may exhibit completely different behaviours. This project will provide insights into the stability of random dynamical systems and the susceptibility of these systems to display shocks or collapse under perturbation. The outputs of this project have the potential to inform Australian scientists and policymakers on the reliability of dynamical models, and to assist them to gauge which predictions they can trust. This project will train a body of talent with advanced analytical and computational skills, benefiting the Australian society and economy. Furthermore, it will enhance Australia's international reputation in mathematics.							

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DP220102330	**Nuclear alarmins escalate tissue immune responses**	115,848.00	234,196.00	236,696.00	118,348.00	0.00	0.00	705,088.00
Schroder, Prof Kate	Humans and other animals are constantly exposed to potential threats, including microbes on and near the body. Animals can live with such dangers because these everyday encounters are made harmless by the immune system. It is unclear how cells distinguish low-danger threats from high-danger threats. This proposal seeks to reveal how immune cells identify increasing levels of threat and appropriately escalate their responses. Expected outcomes include new insights into how immune cells and tissues respond according to the posing threat. Project benefits include understanding how to manipulate danger responses for future basic research and commercial applications, and fundamental understanding of how animals flourish in a dangerous world.							
	National Interest Test Statement							
	This project will generate new foundational scientific knowledge about the immune system. It seeks to reveal how immune cells identify increasing levels of threat and appropriately escalate their responses. In doing so, this project will characterise novel features of immune cell death that allow the dying cell to signal from beyond the grave. Immediate economic benefit will result from the research itself, including investment in training the next generation of Australian scientists in cutting-edge microscopy techniques. In doing so, this project raises the competitiveness of Australia's biotechnology sector, stimulating future economic benefits. The project team is skilled at discovering fundamental molecular mechanisms of immune system function, and using this knowledge to develop new commercial products. In the long term, foundational scientific knowledge generated during this project may be used to generate new commercial products, such as diagnostics, anti-infective drugs and anti-inflammatory drugs.							
DP220102334	**Super-resolving neurotransmitter release machinery during priming**	90,667.50	188,805.00	196,275.00	98,137.50	0.00	0.00	573,885.00
Meunier, Prof Frederic A	Understanding how neurons communicate in the brain is one of the most challenging feats in neuroscience. The assembly of the molecular machinery involved in communication is unknown. This grant aims to understand how priming molecules Munc18 and Munc13, undergo a series of molecular steps leading to the release of neurotransmitter. Using innovative single-molecule super-resolution imaging we will uncover how Munc18 and Munc13 are spatially and temporally organised to mediate communication. By elucidating how nanoclustering of these essential proteins enables key steps, this grant will reveal how brain cells communicate. This may then provide new opportunities to optimise underlying functions such as cognition, sensory and motor processing.							
	National Interest Test Statement							
	This research in the emerging field of single molecule super-resolution microscopy is at the forefront of molecular neuroscience. This research will advance our understanding of the fundamental mechanisms underpinning brain cell communication at the single-molecule level and in living brain cells. This communication is essential for all aspects of nervous system function including, brain plasticity and learning and memory. This is especially important considering future development of artificial intelligence based on brain cell function within networks. In addition to the advancement of fundamental scientific knowledge, this project will contribute in to Australia's position in the field: by (1) establishing state-of-the-art single-molecule technologies, and (2) establishing the first framework of dynamic organisation of synaptic proteins. This could be use to establish new technologies to further study synaptic dysfunction in a commercial setting. This grant will strengthen Australia's emerging position as world-class university education hubs, thus attracting the best and brightest scientists to Australia.							
DP220102349	**Information support tools for the trauma patient pathway**	70,000.00	140,000.00	140,000.00	70,000.00	0.00	0.00	420,000.00
Sanderson, Prof Penelope M	Processes such as critical supply chain management, disaster management, and trauma patient pathways need people, resources, and information to be smoothly transferred between jurisdictions, but problems can occur at each handover. This project focuses on the prehospital to hospital patient pathway and aims to develop technologies, devices, and displays to support more effective handover of patients between jurisdictions. The project will conduct field research, design activities, and simulation-based evaluation of prototypes with healthcare professionals. Expected outcomes are designs, technologies, and guidelines that will generalise to other multi-jurisdictional processes. Benefits are safer and more efficient handover processes.							

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	National Interest Test Statement In advanced economies, goods and services are provided through multiple stages of processing, with organisations specialising in specific processing stages and then handing over to organisations specialising in further stages. Examples are critical supply chains for manufacturing or distribution of goods such as vaccines, movement of populations and resources during disaster response, and the prehospital to hospital transfer of patients. However there are risks at handover points that critical information may be lost or distorted, and new information overlooked, due to challenges of coordination, teamwork, technical support, and situational factors. This project investigates challenges associated with the handover of trauma patients that occur at multiple points in the prehospital to hospital transfer pathway, proposes technical and procedural solutions using different forms of information technology, and evaluates prototype solutions in simulation exercises with healthcare professionals. Our findings will generalise to other industries where people, goods, and services move through different jurisdictions.							
DP220102377 Sah, Prof Pankaj	**Network activity and the role of NMDA receptors in associative learning** The brain is the most complex machine we know, and its activity shapes every aspect our lives. Studies over decades using tools from molecular and cellular neuroscience and behavioural experiments have discovered the parts of the brain involved in learning and memory formation. Much is understood about the neural circuits that mediate learning but how memories are formed and stored are not understood. The aim of this project is to understand learning and memory formation using a simple Pavlovian learning paradigm, fear conditioning. Using cutting-edge molecular tools we will label the circuits in the amygdala that mediate this learning and the nature of the memory trace. In the long term, these results may drive novel storage devices.	94,217.50	196,040.00	205,445.00	191,990.00	88,367.50	0.00	776,060.00
	National Interest Test Statement The brain is the most complex machine we know, it drives behaviour and disorders of brain function account for nearly half the burden of disease in Australia. However, little is understood about how the brain processes information, stores and retrieves memories. Disorders of brain function such as anxiety disorders and post traumatic stress are little understood, and do not have many effective treatments. This project uses a simple learning paradigm to study information processing and the storage of memories in the mammalian brain. These studies will reveal how circuits in the brain work during learning and memory formation. In the long term these results will help to understand what happens during disorders of brain function. Moreover, it will drive the understanding of new computational architectures that may lead to the development of new ways to process information, store it with little energy and rapidly retrieve it. It will help recruit new scientists to Australia and support the development of novel methods to treat brain disorders.							
DP220102493 Ferro, A/Prof Vito	**Opening Up Access to L-Sugars through a Synergy of Experiment and Theory** This project aims to address a major bottleneck in the science of carbohydrates by developing the first broad-scope synthetic routes to L-sugars. L-sugars are critical components of many biologically and commercially significant molecules, but knowledge of their functional roles is impeded by the fact that most L-sugars are expensive or difficult to make. This project expects to develop expeditious routes to L-sugars via an innovative combination of synthetic and theoretical chemistry. Expected outcomes include a markedly increased capacity to access pure samples of L-sugar-based biomolecules, as needed for studying their biological functions. Significant benefits in the development of vaccines, diagnostics and biomaterials are anticipated.	70,000.00	138,000.00	113,000.00	45,000.00	0.00	0.00	366,000.00
	National Interest Test Statement L-Hexoses are rare but biologically widespread components of various biomolecules which are crucial mediators of many biological processes. However, they remain under-exploited because of a lack of commercial availability and lack of methods to prepare them in significant quantities for biological studies and subsequently for production. These compounds are of great current interest to biotechnology companies, particularly for the development of new products for biotechnological and materials applications. This project involves the development of new chemical methods for preparing these important compounds. Access to these compounds will also provide opportunities to develop advanced understanding of biological processes and provide a platform for the development of new biotechnological products. Exploitation of this new technology by Australian companies has the potential to result in significant economic benefits in the future through commercialization of these products.							

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DP220102525	**Is there a climatic tipping point for Antarctic Bottom Water formation?**	110,000.00	233,000.00	226,000.00	103,000.00	0.00	0.00	672,000.00
Bostock, A/Prof Helen C	Antarctic Bottom Water plays an important role in global ocean circulation and climate and yet its formation is also highly sensitive to climate change. This project will analyse new seafloor, core and water samples from the understudied Cape Darnley, East Antarctica, collected on a voyage in early 2022. This new data will be used in combination with an improved high resolution regional ocean model, to understand modern and past Antarctic Bottom Water formation under different climate states (warmer and colder than present), to determine if there are climate tipping points for the shut down of Antarctic Bottom Water formation. The anticipated benefits include a better understanding of future climate change on this important water mass.							
	National Interest Test Statement							
	This project will improve Australia's understanding of oceanography and environment of Cape Darnley, East Antarctica, a remote and understudied region of Australia's Antarctic Territory where the globally important Antarctic Bottom Waters are formed. This project will contribute to Australia's commitment to the Antarctic Treaty to undertake science in the region for improved management and scientific diplomacy. The project also aligns with Australia's Antarctic Science Strategic Plan and the National Marine Science Plan to improve our understanding of oceans and ice in the southern hemisphere and past climate change in Antarctica. The team for this voyage and project is led by a multi-institutional team of female CIs and PIs from various stages of their careers, early, mid and experienced. This project will champion the recommendations from the Women in STEM Decadal Plan by supporting opportunities for training women at all career stages and developing core leadership skills. We are also committed to training up the next generation of Australian Antarctic scientists.							
DP220102530	**Lie superalgebra representations: a geometric approach**	30,000.00	91,500.00	126,500.00	65,000.00	0.00	0.00	313,000.00
Pulemotov, A/Prof Artem	The concept of a Lie group provides a mathematical underpinning for the idea of symmetry in mathematics, physics and chemistry. The project aims to advance two fundamental problems related to this concept: classification of unitary representations of Lie superalgebras, and the prescribed Ricci curvature problem on Lie groups. The research builds on newly-discovered connections between these problems to achieve exciting progress in their resolution. Outcomes are expected to find applications across a range of fields, such as condensed matter physics, particle physics, quantum field theory and knot theory. Anticipated benefits include stronger links between different areas of science achieved through a deeper understanding of symmetry.							
	National Interest Test Statement							
	Symmetry is ubiquitous in science, engineering and technology, from large constructions in architecture, to plant structures in biology, to models of subatomic physics. The notion of a Lie group provides a precise and adaptable mathematical description of symmetry which underpins scientific research and has recently found a range of more industry-related applications. Our project aims to discover new fundamental properties of Lie groups through an innovative combination of methods from algebra and geometry. These discoveries will help explain phenomena in several areas of science (e.g., the modern field of supersymmetric particle physics) and lay the groundwork for new technological developments significant to a range of industries in Australia, such as image processing software and intelligent manufacturing. As the project addresses important challenges for the international scientific community, it will expand Australian researcher networks and facilitate interdisciplinary ties. It will help attract students to Australian universities, thus contributing to the Australian economy and intellectual capacity.							
DP220102533	**Voter behaviour and polarisation: The role of social preferences**	42,745.50	85,955.00	68,209.50	25,000.00	0.00	0.00	221,910.00
Faravelli, A/Prof Marco	This project aims to investigate how peer pressure and other social concerns affect voter participation, vote choice, and political polarisation. It will marry behavioural experimental economics with political economics and make use of complementary experimental methods that will allow for the study of carefully controlled elections, followed by a large-scale real-world test of the results. Expected outcomes include improved understanding of how social media and other social factors, and political institutions such as compulsory voting, distort election representation and outcomes. Major benefits include the ability to advise policies to reduce polarisation and improve political institutions to ensure they reflect true societal preferences.							

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	National Interest Test Statement							
	Australia has played a leading role in ensuring fair democratic processes since it became the first country to adopt the secret ballot and one of only a few to use compulsory voting. This research will help Australia maintain this important status by addressing the modern threat to fair elections posed by social media. Social media is dramatically changing the culture of how people associate with others and engage with political debate in their various peer groups, and this may interact with voting institutions to produce polarised voters and politicians, distorted outcomes, and political gridlock. This research will reveal the mechanisms of this process. The goal of Australian democracy is to measure and aggregate societal preferences, so it is in our strong national interest to consider policies, advised by research like this, that preserve the integrity of that process. The results will similarly benefit Australian corporations and other organizations that use elections, for example by boards of directors or stockholders, to make economically critical choices.							
DP220102579 Domínguez, A/Prof Begoña	**Supporting Entry and Growth of Australian Businesses via Tax and Transfers** This project aims to characterise the optimal tax treatment of business income for insurance and efficiency purposes. Using new data for Australia, the project expects to first identify key determinants of businesses creation, growth and exit, before and after COVID-19. In light of those determinants, the project expects to develop original macroeconomic models integrating firm dynamics into optimal taxation frameworks. Expected outcomes include formulating fiscal policies that provide adequate stimulus to businesses, by balancing public insurance and income inequality. This should deliver evidence-based inputs to promote Australia's post-pandemic recovery, through the design of a fairer and more efficient business tax and transfer system.	38,384.50	55,997.50	39,116.00	21,503.00	0.00	0.00	155,001.00
	National Interest Test Statement							
	Over the last two decades, the macroeconomic business climate in Australia has become significantly less dynamic. Fewer entrepreneurs are setting up new firms, which has raised concerns around potential negative consequences for Australian innovation, job creation, and productivity. These pressing concerns have been intensified by the COVID-19 pandemic. This project aims to first identify the ex-ante and ex-post drivers of the differences of business income and employment across firms in Australia, before and after COVID-19. Taking into account those drivers, this project will build state of the art theoretical methods to yield novel results on the interaction between firm heterogeneity, income insurance, and the design of business taxes before and after the pandemic. Such results would be essential to the economic recovery of Australia’s business community post COVID-19, and would not only advance disciplinary knowledge in economics, but produce social benefits to the broader national community by guiding tax debates, and by contributing to a fairer and more efficient distribution of resources in Australia.							
DP220102606 Barlow, A/Prof Fiona K	**The social psychology of minority experiences of interracial contact** Interracial contact is perhaps the most prominent social psychological approach to reducing racism. This project aims to test the novel proposition that there may be hidden costs to relying on contact, however. Generating new knowledge in the field of social psychology, this project plans to examine whether minority group members feel pressured to 'perform' during interracial contact, engaging in emotional labour, and experiencing psychological burnout as a result. Expected outcomes include substantive collaboration, theory development, and scientific progress leading to social change. Ultimately, the project aspires to benefit those who suffer most from discrimination and prejudice by improving techniques for targeting racism.	39,479.00	67,948.00	58,148.00	29,679.00	0.00	0.00	195,254.00
	National Interest Test Statement							
	Australia is increasingly multicultural, bringing the country many benefits but also a higher risk of group based conflict and racism. Interventions to reduce or prevent racism are vital in this context; intergroup contact - repeated positive interactions between minority and majority group members - has strong evidence showing it can reduce the prejudice carried by majorities toward minorities. However, this project proposes that minority group members often feel pressured to engage in emotional labour during intergroup contact to ensure a positive experience for the majority group member. This emotional labour is predicted to lead to psychological burnout, reduced wellbeing, and maladaptive coping strategies. Examining and combating this phenomenon benefits Australia by opening the path to new anti-racism interventions which can serve all Australians. In sum, this project will investigate potential downsides of current anti-racism interventions, and provide solutions. Improving intergroup relations will bring social, cultural, and economic benefits and improve Australia's appeal as a home for everybody.							

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DP220102748	**Transforming titanium component fabrication with free machining additives**	70,000.00	140,000.00	140,000.00	70,000.00	0.00	0.00	420,000.00
Bermingham, Dr Michael J	Australian manufacturers of titanium products face grand challenges in affordably machining precision components because titanium is expensive, inherently difficult to machine and most designed parts require significant machining, all of which exacerbates cost. This project aims to overcome these impediments by discovering new alloy additives that can be introduced locally during additive manufacturing of titanium products in order to make machining operations easier and faster without affecting the quality of the final product. The knowledge gained from this project seeks to create new capabilities and improve the productivity of Australian manufacturers while lowering the cost of products for consumers.							
	National Interest Test Statement							
	Australia is a leader in fabricating high value titanium products but low manufacturing productivity remains a key impediment during the production of precision titanium components. In particular, the difficulty of mechanically removing and shaping this material through machining operations is high and consequently these operations account for up to half of the final product cost. This project takes a new approach to address this issue by developing alloy additives that greatly improve titanium's machinability that, when combined with additive manufacturing, result in higher manufacturing productivity without sacrificing the quality of the end product. This will enable Australian manufacturers to produce high quality titanium products faster and more affordably, allowing them to more competitively participate in global supply chains (such as the F-35 Joint Strike Fighter program). As a material with many applications, including defence, this strengthens our sovereign advanced manufacturing capability and supports the growth of an important industry, while also boosting jobs and local economies.							
DP220102760	**Portfolio projection of biodiversity responses under climate change**	84,500.00	167,500.00	148,000.00	65,000.00	0.00	0.00	465,000.00
Pandolfi, Prof John M	Organisms need to adapt and/or migrate to avoid critical population loss under climate change. Despite the importance of both processes in biodiversity dynamics, most biodiversity predictions focus on the patterns of migration under climate change. The type and amount of adaptation required to escape climate-driven extinction in the future remain largely unknown. This project aims to quantify the type and extent of adaptation and migration required for ecologically and economically important marine species to avoid critical population loss under climate change. By quantifying adaptive and migration responses as vulnerability metrics, the project outcomes will provide resource managers novel tools to formulate flexible management strategies.							
	National Interest Test Statement							
	Marine ecosystems annually provide AUD $3.2 trillion-worth of ecosystem services to humans and support nearly three billion people with a source of protein. These socio-economic benefits are critically threatened as climate-driven loss of marine biodiversity and impairment of ecosystem services become commonplace. Management strategies to combat socio-economic losses are hampered by the current limited knowledge of species responses to climate change. This project will quantify environmental pressures that marine species will experience under climate change and identify climate change hotspots and vulnerable species. Such information is critical for formulating targeted management strategies to minimise ecological, evolutionary, and socio-economic losses in Australia.							
DP220102832	**Structural basis of plant immune receptor signaling**	80,708.00	164,626.50	169,418.50	85,500.00	0.00	0.00	500,253.00
Kobe, Prof Bostjan	Plants detect invading pathogens and trigger immune responses in a process called "effector-triggered immunity", in which pathogen effector (avirulence) proteins are recognized by plant resistance proteins, typically so-called "plant NLRs". Ongoing work in the applicants' laboratories has shown that oligomerization into "resistosomes" and NAD+ (nicotinamide adenine dinucleotide) cleavage play central roles in the process. Building on these data, the project aims to characterize the structures of the signaling molecules resulting from TIR (Toll/interleukin-1 receptor) domain-mediated NAD+ cleavage and the structural architecture of plant NLR resistosomes. This knowledge will support the long-term objective of protecting crops from pathogens.							

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	National Interest Test Statement Pathogens account for >15-30% loss of global crop production, representing a threat to food security. Fungicides, one key form of protection, represent environmental concerns. Plant resistance gene breeding can protect against a broad range of pathogens, but suffers from lengthy breeding processes, restricted choice of genes from sexually compatible species and short effective time spans in the field, as pathogens evolve to avoid detection. Incursion of new pathogens from other parts of the world represents further threat. Understanding how resistance proteins function and finding new sources of these proteins, the subject of the proposed research, are central objectives to achieve effective and durable resistance and reduce the economic and environmental implications of plant diseases, especially for grains industry and other crops relevant to Australia.							
DP220103028 Mobli, A/Prof Mehdi	**Autocyclases: A new class of self-cyclising proteins** The biotechnology sector is emerging as an important economic strength in Australia. While the improved efficacy and selectivity of biomolecules has seen them emerge as alternatives to existing chemicals in health and agriculture, the stability of biomolecules remains a major limiting factor. A general strategy for improving protein stability is by joining the ends of the peptide chain in a cyclisation reaction. While a wide range of cyclic peptides and proteins are being developed in Australia and around the world, the cyclisation reaction presents a significant challenge. In this proposal we detail a novel method for protein cyclisation as a general, low-cost and green production method for making a diverse range of biomolecules.	68,952.50	139,931.50	146,984.00	76,005.00	0.00	0.00	431,873.00
	National Interest Test Statement The use of biomolecules as novel reagents, catalysts and drugs is revolutionising chemical and pharmaceutical industries. A major limitation of biomolecules is their poor stability compared to traditional chemicals. A general strategy for improving the stability of biomolecules, such as peptides and proteins, is joining their ends to create a cyclic molecule using protein cyclisation. Existing protein cyclisation methods are inefficient and costly, hence unsuitable for industrial applications. In this proposal we outline innovations in protein engineering that will allow us to create a general, scalable, low-cost, and environmentally friendly protein cyclisation method. This will provide a rapid translational path for cyclised therapeutic and agricultural (bio)products being developed across Australia. The outcome of this research will strengthen Australia's position as an international leader in the field of biotechnology, a sector recognised as a nationally important economic strength. In addition, the proposed work will train future Australian scientists in an area of significant growth and skills demand.							
DP220103054 Wei, Prof Yongping	**Enhancing and evaluating stakeholder engagement for improved water outcomes** Stakeholder engagement, widely recognised as essential in successful water governance, remains ad hoc both in practice and as a research theme. Using a detailed analysis of a complex evolutionary case of stakeholder engagement in water management in the Murray-Darling Basin (1900- 2020), this project aims to develop new approaches to measure the structure and form of socio-culturally derived stakeholder engagement system, to improve socio-economic and environmental benefits from water. The expected output is a new diagnostic tool for evaluating stakeholder engagement that can be taken up by governing bodies. The expected benefit is more inclusive, equal, and adaptive water governance through more effective stakeholder engagement.	62,000.00	121,500.00	122,500.00	63,000.00	0.00	0.00	369,000.00
	National Interest Test Statement Australia's water crises stem from the complex interdependence of hydrological cycles complicated by intense conflict and competition of water use among stakeholders. To date, stakeholder engagement practices have failed to foster sustainable water management and use, and have led to clientelism and the marginalisation of groups such as indigenous communities. This project will offer government agencies and river basin authorities a tool for designing, implementing, monitoring, and evaluating stakeholder engagement in river basin governance by assessing the structure of stakeholder engagement networks and explicitly linking them to both stakeholders' values of water and their water uses at catchments. Application of the tool will lead to more inclusive, equal, and adaptive water governance, and in the long run, greater socio-economic and environmental benefits from increasingly scarce water.							

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DP220103222	**Ductile grinding mechanism and technology of brittle single crystals**	77,500.00	150,000.00	145,000.00	72,500.00	0.00	0.00	445,000.00
Huang, Prof Han	This project aims to develop a fundamental understanding of the removal mechanics of emerging brittle single crystals under grinding-induced loading. A successful outcome will not only develop a new theoretical model for predicting the ductile removal regime of this class of difficult-to-machine materials, but their cost-effective ductile grinding processes will also be generated. It will address a longstanding bottleneck productivity issue in advanced manufacturing. The breakthrough technology developed in the project is expected to significantly benefit a number of industrial sectors for the fabrication of more affordable high-performance devices including mobile phones, light-emitting diodes, solar cells, sensors, and laser systems.							
	National Interest Test Statement							
	Semiconductors are in all the modern technologies around us, such as mobile devices, computers, medical equipment and sensors. The most common semiconducting materials are brittle single crystals, which need to be carefully machined with high precision as machining induced faults can interfere with the performance of semiconductor based devices. This project aims to develop a new cost-effective process for machining brittle single crystals, thereby addressing the shortcomings of the current trial and error approach that significantly slows production. This new technology will enable Australia's manufacturing sectors to make higher quality, lower cost, and less energy-consuming electronics devices such as LEDs, cochlear implants, microphones, security sensors, and solar cells, thus enhancing Australia's manufacturing capacity to meet the high demand from domestic and global consumers. It will enable Australian manufacturing to engage with the multi-billion dollar semiconductor market.							
DP220103268	**Bioelectrochemical interconversion of the building blocks of life**	67,500.00	136,500.00	105,500.00	36,500.00	0.00	0.00	346,000.00
Bernhardt, Prof Paul V	This project aims to harness the efficiency of enzymes (Nature's catalysts) by coupling them with an electrode for the electrochemical interconversion of carbon dioxide, carbon monoxide and formate; the organic building blocks of life. The significance of this research is that the efficient capture and reduction of carbon dioxide is an important quest in the environment and energy sectors. The expected outcomes of this project will be an understanding of the reactivity of these enzymes and the conditions under which they may be utilised as part of a renewable electrochemical system. Benefits of this research should emerge in energy efficient technologies for generating fuels (formic acid) from waste products (carbon dioxide).							
	National Interest Test Statement							
	The current world focus on carbon capture and storage and the demands for new sources of energy intersect with the biological world where these synthetically challenging chemical reactions are carried out by enzymes routinely. Capturing carbon dioxide and efficiently converting it into energy sources (fuels) of the future is still a major challenge. This project will harness the power and versatility of two enzyme biocatalysts to develop rapid and efficient methods for interconverting carbon monoxide, carbon dioxide, and formic acid; the carbon-based, building blocks of life. This research entails coupling enzymes with electrodes to produce bio-electrochemical methods for turning carbon dioxide into formic acid; a waste product into a potential fuel. The innovation in this approach will be integration of these biological catalysts with an electrode so that these reactions can be driven efficiently with electricity rather than chemicals. Long term benefits to Australia include technological advances in utilising biological systems to address issues of renewable energy sources and carbon capture.							
DP220103330	**Advancing the Science of Giant Planet Atmospheric Entry**	97,500.00	195,000.00	195,000.00	97,500.00	0.00	0.00	585,000.00
Morgan, Prof Richard G	This project aims to improve models used to design the heat shields which protect probes entering the atmospheres of the giant planets - four gaseous planets out beyond Mars. Further giant planet exploration is a key planetary science goal of the coming decade. However, the environment which an entry probe would experience features many unknowns and large uncertainties, making a mission a risky undertaking. Using unique experimental capabilities and state-of-the-art modelling, the expected project outcome is experimentally validated giant planet entry flow and surface chemistry models. This will allow more efficient heat shields to be designed while also increasing the chance of mission success, furthering our understanding of the universe.							

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	National Interest Test Statement							
	Entering the atmosphere of an ice giant, Uranus or Neptune, is a key space science goal for the coming decade as these planets played a pivotal role in our solar system's formation and are common in the universe. Studying them is of great multi-disciplinary interest. Our goal is to advance the design of the heat shield that will protect the entry probe, allowing Australia to leverage our planetary entry expertise for this mission. These missions are high-profile, multi-decade endeavours. They provide prolonged international interactions that increase our value as strategic partners. This will raise the profile of Australian space capability and grow collaborations between our industry and NASA and ESA. For our space industry to reach its full scientific and economic potential, an appropriately qualified workforce and the related local knowledge base are required. This project will directly contribute by training the future workforce, greatly increasing sovereign capability in heat shield design. This will aid Australian companies developing heat shields for future Australian or international space missions.							
DP220103350	**The costs and consequences of resistance to stress in microbial systems**	62,945.00	104,920.00	88,068.50	46,093.50	0.00	0.00	302,027.00
Letten, Dr Andrew	The coexistence of antibiotic resistant and sensitive bacteria in microbial communities represents a paradox. Combining novel ecological models and competition experiments, this project aims to investigate how the pulsing of antibiotics and resources affects the coexistence of resistant and sensitive bacteria. This project expects to generate new knowledge into how the complex non-equilibrium dynamics of natural systems feeds back to regulate the spread of antibiotic resistance in microbial communities. This should advance our fundamental understanding of microbial competition, and provide a foundation for the development of new ecologically-aware strategies for managing resistance.							
	National Interest Test Statement							
	The adaptive evolution of resistance to antimicrobials and other biocides can have significant negative economic, environmental and health impacts. This project will take advantage of recent advances in ecological theory to better understand the evolution of resistance under pulsed exposure to stress in the form of antimicrobials. In addition to consolidating Australia's reputation as a hotspot for ecological and evolutionary research, the findings should ultimately inform ecologically-aware strategies for limiting resistance, and in doing so this project has the potential to provide beneficial economic, environmental and human health outcomes. More generally, the fundamental insights arising from this project should also apply to non-microbial communities, including floral and faunal systems subject to pulsed environmental stressors characteristic of Australian landscapes.							
DP220103352	**General systems modelling of hydrogen production network in Australia**	70,000.00	140,000.00	140,000.00	70,000.00	0.00	0.00	420,000.00
Klimenko, Dr Alexander Y	The project aims at further developing a general framework for systems modelling and applying the framework to investigate the feasibility and sustainability of large-scale hydrogen production in Australia. Two pathways proposed in this project are to be examined: 1) hybrid plants sourcing hydrogen from fossil fuels and solar thermal energy and 2) hydrogen production network producing hydrogen from 100% renewable energy. The project involves building systems models and using these models to determine optimal operational parameters and conditions with the goal of maintaining export of high-end energy resources to Japan and other countries as well as using hydrogen domestically while minimising the environment effects of hydrogen production.							
	National Interest Test Statement							
	Australia approaches a period of rapid technological changes and it is important that the country progresses towards a new generation of technologies while retaining its standing in the areas of national advantage. A rapid increase in the production of hydrogen can be instrumental in achieving both of these strategic goals (i.e. upholding leading positions in the resource area and introducing a new technological base). While hydrogen can easily be produced in small and moderate quantities, a large scale production from renewable or partially renewable sources can put significant pressure on the resources and environment. This project suggests and investigates two pathways, hybrid fossil/renewable and 100% renewable, that should allow us to produce hydrogen from (partially) renewable sources in quantities sufficient for the export of clean hydrogen energy and, at the same time, minimise the environmental effect of the production. The project is to be conducted in cooperation with our strategic partners in developing a hydrogen economy (Japan and Germany) and should assist in objective policy selections.							

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DP220103362	**Coupled effects of stress and temperature changes on concrete structures**	54,500.00	85,500.00	57,500.00	26,500.00	0.00	0.00	224,000.00
Dao, Dr Vinh T	The coupled effects of stress and temperature changes that concrete structures are commonly subject to are significant and need to be properly accounted for. However, existing engineering models accounting for these effects remain essentially empirical, necessarily limiting their predictive capability. This research aims to examine such coupled effects using an innovative approach combining original physical-based analytical study with novel tests and advanced numerical work. Expected outcomes include a robust yet simple engineering model, and guidelines for rational design of structures (incl. concrete spalling in fire) with due account for such coupled effects, thereby enabling to achieve more robust structures at substantial cost saving.							
	National Interest Test Statement							
	Concrete is the most common construction material in Australia and worldwide. The critical need to properly account for the combined effects of stress and temperature changes commonly encountered in concrete structures has long been recognised: e.g. tall buildings in fires; bridges subject to varying temperatures; or nuclear reactors accidentally overheated. Unfortunately, current approaches are mainly through the use of empirical correlations with lack of rational basis and possibly questionable reliability. In consequence, constructed structures may be unsafe or overly conservative, with the degree of safety or conservatism unable to be rationally determined. The more rational structural design with due account for such coupled effects, resulted from this study, will enable to achieve more robust structures at substantial cost savings – thereby offering significant benefits to the Australian and global community. Such benefits now become even more significant in the context of the recent increasingly extended heat waves with amplified intensities and frequencies.							
DP220103391	**Neuronal Control of Adaptive Walking**	71,157.50	154,865.00	163,415.00	79,707.50	0.00	0.00	469,145.00
Dickson, Prof Barry J	This project seeks to understand how signals from the brain control motor circuits so that an animal can adaptively walk across varying terrains in pursuit of its ever-changing goals. It will focus on the fruit fly, Drosophila, as a model. The fly is an agile walker, its nervous system has been almost fully mapped at the synaptic level, and genetic reagents are available to selectively measure or manipulate the activity of single neurons. This project specifically focuses on the circuits that generate forward and backward walking, and switch between the two. It will enhance Australia's capacity in connectome-driven neuroscience research, deliver fundamental insights into neuronal motor control, and inspire the design of more agile robots.							
	National Interest Test Statement							
	This research will elucidate how neural signals from the brain control motor circuits to produce coordinated yet flexible patterns of leg movements during walking. It will focus on the fruit fly, an agile walker whose neuronal connections have been almost fully mapped, and in which it is uniquely possible to measure or manipulate the activity of single neurons. The knowledge gained in the fly is expected to be directly applicable to the study of leg motor control in other species. This research will strengthen Australia’s capacity in important areas of neuroscience, in particular the application of connectomes and optogenetic methods to the analysis of neural circuit function. The fundamental insights gained by this work can be expected to seed novel approaches in the engineering of more agile robots. Insights from the fly might also ultimately help us to better understand how leg motor circuits in humans might fail as a result of injury or degeneration, and find ways to restore their function by repairing or augmenting them.							
DP220103549	**Making peptides orally bioavailable**	50,581.00	134,537.00	168,872.50	84,916.50	0.00	0.00	438,907.00
Clark, Dr Richard J	Bioactive peptides are exceptionally useful molecules, however to fully realise their exciting applications key limitations need to be overcome: they can't be delivered orally and they do not last long in the body. This project aims to develop a molecular tag that can dramatically enhance both the oral absorption and time in the body of a peptide. This will include identifying the key elements of the tag required for function, the breadth of peptide cargoes it can be applied to and the mechanisms underlying this technology. The outcomes of this project will facilitate the future development of peptides for biotechnology, pharmaceutical and veterinary applications.							

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	National Interest Test Statement The study of endogenous human peptide hormones and bioactive peptides from natural sources have led to the realisation that they have huge potential in biotechnology. Despite this potential, peptides are still difficult to deliver to the body and are also rapidly cleared, which substantially limits their range of applications. We have developed a molecular engineering approach that overcomes these two key limitations of peptides and in this project we propose to investigate breadth of applications and the mechanism of how this strategy works. The outcomes will result in advancements in methodologies and technologies for Australia's biotechnology sector, novel research tools to study human physiology, patentable ligands with future applications in human health. These will be of value to industry partners and entrepreneurial spin-offs, increase Australia's knowledge base with trained higher degree students and research staff, attract national and international scientific collaborations, and further enhance recognition and competitiveness for Australia in biotechnology innovation.							
DP220103812 Scott, A/Prof Ethan K	**The physics and biology of hearing in larval fish** Using the zebrafish model and an array of cutting-edge biophysics and neuroscience tools, this project aims to provide the first complete map of a functioning auditory system. This is significant because it has previously been impossible to study the brain at the levels of single cells, circuits, and brain-wide networks simultaneously. Expected outcomes include detailed descriptions of information flow through a simple brain and the ways that brain cells and circuits communicate to process information. Benefits include knowledge gained about sensory systems in nature, future biomimetic approaches for information processing, and the training of the next generation of Australian researchers in cutting edge optical physics and neuroscience.	79,375.00	163,657.00	168,843.00	84,561.00	0.00	0.00	496,436.00
	National Interest Test Statement The outcomes from this work will have three major benefits for Australia. The first is in the basic discoveries that it will provide about brain function. Discovering the circuit-level mechanisms of hearing will benefit fields as diverse as behavioural ecology and medicine. The second is in technology development. The CIs have been central to the development of new technologies in behavioural analysis, microscopy, neuroinformatics, and optical physics, and the current proposal aims to merge these new technologies in a novel way that will allow important biological questions to be addressed for the first time. Finally, this technically challenging work will be an excellent training ground for young researchers who are developing their skills in optical engineering, computer programming, big data analysis, and other fields that will be in great demand in the future.							
DP220103941 Robinson, Prof Gail A	**Fundamental neurocognitive mechanisms underpinning creative thought** The project aims to understand the neural and cognitive bases of creative thought by using a novel approach and recent framework that has emerged from the study of semantic cognition and executive control functions. Creative thought is fundamental to human advances throughout history and it is the foundation to all arts and sciences. Expected outcomes are a framework that can explain the source of knowledge and the evaluative mechanisms needed to generate new and useful ideas. Significant benefits will be to advance our understanding of the neurocognitive mechanisms of creative thought, which can enhance Australia's scientific capability through training and collaboration and broader society by enhancing capacity for innovative thinking.	70,906.50	166,013.00	190,213.00	138,433.00	43,326.50	0.00	608,892.00
	National Interest Test Statement The project aims to understand the behavioural and brain bases of creative thought by using a novel approach at the intersection between executive control operations and semantic cognition. Creative thought is fundamental to all human advances; it reflects what is unique about humans. It is essential to scientific discovery and every Australians' ability to maintain health and well-being into older age as it enables us to solve problems as they arise in daily life to remain living longer at home. This project will give an understanding of what knowledge sources and evaluation processes we need to generate new and useful ideas. The intention is to identify the optimal conditions for developing creative thought for educators of all Australians, including our children, youth and older adults. This will impact Australia's scientific capability through training and broader society by enhancing capacity for innovative thinking. This will benefit many Australians solving real world problems and innovating new technologies to address our national challenges, like renewable energy sources.							

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DP220103951	**Keeping forces local for epithelial homeostasis**	85,000.00	185,000.00	200,000.00	100,000.00	0.00	0.00	570,000.00
Yap, Prof Alpha S	This project probes how epithelial cells use mechanical forces to communicate with one another in biological life. It tests the novel concept that negative feedback is a critical, hitherto unappreciated dimension in mechanical communication, which acts to ensure proportionate responses for homeostasis. It will generate fundamental new knowledge in biology using an innovative combination of cellular and biophysical experiments and physical theory. The expected outcomes are fundamental new knowledge, interdisciplinary training for young scientists, new national research capacity and growing international collaborations. It will benefit Australia by enhancing its scientific world linkage, status in scientific leadership and research capacity.							
	National Interest Test Statement							
	Epithelia are membranous tissues composed of layers of cells that cover the surfaces of the body and its organs. This project will analyse how cells in epithelia use mechanical forces to communicate with one another, to preserve a state of tissue stability (homeostasis), while also adjusting to conditions that are best for their survival. The project will generate fundamental new knowledge in biology using an innovative combination of cellular and biophysical experiments and physical theory. Australian researchers are international leaders in this field and the project will further advance this position. This cutting-edge and multi-disciplinary research will promote Australia's national interest through: new tools that expand the research capability of the national science community; world-class training for Australia's next generation of scientists that enhances STEM capacity; increasing our attractiveness as a world-class training destination for national and international students; and creating new directions for bio- and nano-technology in Australia.							
DP220104008	**Understanding the neural dynamics of integrated perceptual decisions**	90,305.00	184,610.00	192,310.00	98,005.00	0.00	0.00	565,230.00
Mattingley, Prof Jason B	This project aims to characterise the brain processes involved in perceptual decision-making. While scientists have a good understanding of how people make decisions about the properties of individual sensory inputs, much less is known about how the brain integrates information across multiple sensory sources that differ in their salience and fidelity. The project expects to elucidate the neural mechanisms responsible for these integrative perceptual decisions, using a combination of brain imaging and behavioural measures, computational modelling and real-time neurofeedback. This should provide significant benefits for developing more effective approaches to training individuals in professions that rely on optimal decision-making skills.							
	National Interest Test Statement							
	The capacity to make adaptive and reliable decisions is fundamental to virtually all human behaviour. The brain processes that control basic perceptual decisions, such as judging the trajectory of a ball in flight, are well understood. Much less is known about how people integrate multiple sources of sensory information to make the kinds of complex decisions commonly encountered in daily life, such as when it is safe to cross a busy road. This project will make an important contribution to scientists' understanding of the brain processes responsible for complex perceptual decision-making. Many professionals rely on their perceptual decision-making skills, including baggage screeners, air-traffic controllers and military personnel. This project will yield economic and social benefits for Australia by providing the foundational knowledge needed to develop novel and potentially more effective training protocols for optimal decision-making in a range of professional contexts.							
	The University of Queensland	4,392,753.50	9,029,814.50	8,973,816.00	4,585,106.50	248,351.50	0.00	27,229,842.00

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University of Southern Queensland								
DP220100365	**Catch me if you can: The race to rescue the smallest planets**	99,500.00	118,000.00	37,000.00	18,500.00	0.00	0.00	273,000.00
Wittenmyer, Prof Robert A	This project will upgrade a unique Australian observatory to study the smallest planets around other stars, using an innovative new technique to provide high precision measurements capturing the tiny shadow of planets as they cross in front of their stars. The project aims to generate new knowledge on potentially Earth-like planets and contribute to the legacy of current and next-generation space telescopes. Expected outcomes include preserving a list of best planets for in-depth characterisations, and the first Australian facility to match the capability of space observatories: detecting planets as small as Earth. This project will benefit the international community by optimising the effort of future space telescopes.							
	National Interest Test Statement							
	The research supported by this Discovery Project is expected to bring Australia to the forefront of cutting-edge international scientific endeavours for decades to come by addressing a key question in astrophysics: "What is the nature of planetary systems in our Galaxy?" Using Australian technology and expertise, the project will directly measure the detailed properties of planets orbiting nearby stars. Results from this project will preserve the legacy of key NASA spacecraft missions and will benefit the international space science community. With Australia's recent commitment to a Space Agency, the Federal Government has signalled the key role Australia can play in space science and this project will contribute by fostering collaborations with internationally-recognised scientists and space agencies.							
DP220101360	**Privacy Preservation over 5G and IoT Smart Devices**	56,837.00	114,629.50	116,754.50	58,962.00	0.00	0.00	347,183.00
Yong, Prof Jianming	This project aims to investigate privacy preservation protocols in a 5G integrated IoT environment through an analysis of the depth of smart-device use in common smart domains. 5G’s addition to IoT-based smart devices will be effectively deployed and utilised by a large majority of individual and organisation-based users. The knowledge-based ontology and tools developed in the project will help form the new privacy preservation mechanisms that are required for the 5G enabled environment. The construction of new AI-based tools and testing facilities as well as the generation of new knowledge in the field of privacy preservation and collaboration between universities are expected outcomes of this project.							
	National Interest Test Statement							
	This research project will contribute to the preservation of Australian citizen’s privacy from privacy threat and attack. This in itself is a major contribution to the Australian community. However, the project’s major contribution to the national interests of Australia include many other benefits. The taxonomies and tools that will be developed within the project’s outcomes will allow for the Australian community to have new levels of privacy preservation within 5G integrated IoT infrastructure. The testing facilities that will be built in this project will allow for further testing of 5G enabled technology and benefit the technological growth of the nation. All aspects of the Australian community will benefit from the implementation of the developed privacy preservation protocols as federal, commercial and residential smart technologies will have unmatched privacy preservation. The national interest of this project is very high, due to the multitude of benefits improved privacy preservation will have for the Australian community.							
DP220101959	**Inorganic/organic Hybrids for flexible thermoelectric generators**	35,000.00	70,000.00	70,000.00	35,000.00	0.00	0.00	210,000.00
Shi, Dr Xiaolei	Flexible thermoelectric generators can directly harvest electricity from body heat, offering a new technology for wearable electronics, but their unsatisfied performance limits their applications. This project aims to design high-efficient and mechanically robust flexible thermoelectric devices based on novel hybrids with quantum dots and conducting polymers as key components. The key breakthrough is to establish unique devices with record-high thermoelectric efficiency and to illustrate the underlying mechanisms for searching new-type flexible thermoelectrics. The expected outcomes will lead to innovative technology for energy conversion and advanced manufacturing and place Australia at the forefront of energy and manufacturing fields.							

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	National Interest Test Statement							
	Flexible thermoelectric materials and generators are capable of high-efficiency energy conversion from body heat into useful electricity, which provides sustainable power supply for ever-growing portable electronics. This technology can also be used in personal heat management or local energy supply for miniature electronics. In this regard, the impact of this project will help to create new employment opportunities in the manufacturing, energy recovery, and power generation sectors, and generate tremendous economic and environmental benefits to society. The success of this project will provide novel technology for energy conversion and provide the technological solutions to enhance the sustainability and wellbeing of Australian Society. The project will significantly enhance the international impact and recognition of Australia in the development of renewable energy in addressing climate change and advanced manufacturing.							
DP220102751	**Dispersion of spacecraft components during re-entry**	86,000.00	178,500.00	189,500.00	97,000.00	0.00	0.00	551,000.00
Buttsworth, Prof David R	Destructive re-entry trajectories for used satellites are designed so debris remaining after re-entry falls harmlessly to the Earth. However, the dramatic increase in the mass of orbiting objects has outpaced improvements in predicting hazardous impact zones. This project aims to develop the experimental and theoretical methods needed to study separation of objects in hypersonic flow in order to better predict the dispersion of debris from re-entering space objects. New hypersonic wind tunnel experiments, modelling, and computational simulations will be performed to enhance our understanding and improve predictions of how spacecraft components are dispersed during re-entry.							
	National Interest Test Statement							
	Destructive re-entry trajectories for used satellites are designed so debris remaining after re-entry ideally falls onto the sparsely populated Indian or Pacific Oceans. However, an overshoot on the Indian-trajectory or an undershoot on the Pacific-trajectory may put Australia in the line of fire, as demonstrated by the 1979 Skylab incident. Since then, the dramatic increase in the mass of orbiting objects has outpaced improvements in predicting hazardous impact zones, so there is a far greater risk to life and property on Earth today. Maintaining the safety and security of Australia's population, property, and natural environment is paramount. Hypersonic wind tunnel experiments and computational simulations will be performed to enhance our understanding of how spacecraft components are dispersed during re-entry. Through this new knowledge, Australia will be positioned to meaningfully engage in the global management of destructive re-entries of spacecraft to achieve outcomes that respect our sovereign interests.							
	University of Southern Queensland	277,337.00	481,129.50	413,254.50	209,462.00	0.00	0.00	1,381,183.00
	Queensland	7,073,305.50	14,522,523.50	14,487,643.50	7,560,182.00	595,756.50	74,000.00	44,313,411.00

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South Australia								
Flinders University								
DP220100070 Spencer, Prof Nick J	**How Spinal Afferent Neurons Control Appetite and Thirst** This project aims to provide major new insights about how the gut communicates with the brain, to regulate how much food and fluids have been consumed. The proposal expects to generate new knowledge about gut-brain communication and how one of the major sensory nerves from the gut relays information about thirst and appetite sensations. The project addresses fundamental questions that rely on techniques only recently developed in our laboratory. We expect to demonstrate a major new sensory nerve pathway from the gut to the brain that plays a major role in appetite and thirst sensations. We will learn how gut to brain communication underlies the feeling of "fullness" when people consume food and drink.	48,255.00	114,902.50	117,442.00	104,407.00	53,612.50	0.00	438,619.00
	National Interest Test Statement There is a clear lack of understanding about how animals regulate how much they eat and drink. Understanding how and why animals (including humans) eat and drink as much as they do is of major relevance to Australia's national interest, because excessive consumption of food and drink has major detrimental effects on several key fields at a commercial, social, cultural and environmental level. By understanding the mechanisms that determine how animals regulate how much food and liquids they have consumed, we have the potential to selectively target the mechanisms that underlie appetite and thirst sensations. This could occur by developing new drugs, with the pharmaceutical industry, or via non-pharmaceutical techniques. Therefore, the new information obtained will likely lead to significantly improved economic, commercial, environmental and social benefits to the Australian community. This project will provide essential new insights about how a major sensory nerve pathway controls appetite and thirst sensations in animals. The proposal relies on new methodologies that only exist in our laboratory.							
DP220100825 Long, Prof John A	**The Devonian Gogo Fauna: Diversity, Palaeoecology and Global Significance** The late Devonian Gogo Formation (380 million years old) is undoubtedly one of the richest and best-preserved assemblages of fossil fishes and invertebrates from this age anywhere on Earth. This project will use CT scanning for stomach contents, plus use biomechanical and morphometric analyses to reconstruct tropic relationships of reef-dwelling organisms and test the resilience of the reef ecosystem. Several new species will be published and the heritage significance of the site will be assessed. Working with local indigenous stakeholders, the scientific findings will feed into developing a long-term management plan to protect and conserve the site for future research work and to grow tourism in the region.	87,879.00	180,932.00	165,651.00	72,598.00	0.00	0.00	507,060.00
	National Interest Test Statement The Gogo Fossil sites are known as the best preserved Devonian fossil fishes and crustaceans in the world. This project will provide the first detailed models of the complex ecology of the site, with several new unknown species described to be incorporated into the ecological modelling, plus new documentation of the sites faunal diversity. The site faces an uncertain future with current proposals to build a dam on the Fitzroy River, so there is an urgency to get research completed. The site is on Gooniyandi land, so we aim to work with local land-owners to combine the detailed scientific significance of the site with local indigenous knowledge to develop a long-term management plan for protection of the site and to conceptualise future tourism ideas. The national benefits are thus in building new cultural assets, managing our most significant heritage sites, input to future potential UNESCO World Heritage proposals, and developing tourism, jobs, educational programs through collaboration with local first nations peoples.							

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DP220101269	**Mapping sites of visceral convergence connecting the colon and bladder.**	72,084.50	148,289.00	156,040.00	79,835.50	0.00	0.00	456,249.00
Harrington, Dr Andrea M	This project aims to develop multiple neuroanatomical approaches to identify where in the central nervous system the sensory signalling from the colon and bladder merge. The combination of such technologies is novel to the study of the central circuits relaying colon/bladder convergence into the brain and will generate new and detailed knowledge of the central pathways in which pelvic organ sensory (discomfort) and motor (defecation/urination) functions are coordinated. The expected outcomes are predicted to aid future discovery of mechanisms of cross-organ sensitisation and are anticipated to provide significant benefit to therapy development for chronic visceral pain syndromes associated with bowel and bladder dysfunction.							
	National Interest Test Statement							
	This project will extend Australia's standing as world leaders in gastroenterology research.The autonomic nervous system is the link between the central nervous system and viscera (internal organs). This project will generate new knowledge on how the central nervous system controls bowel and bladder functions. Such knowledge is required to identify neural abnormalities underlying chronic pelvic pain and motor dysfunction syndromes that affect the bowel, bladder and reproductive organs. Syndromes associated with chronic pelvic dysfunction that involve the bowel and the bladder, such as Irritable Bowel Syndrome and overactive-bladder syndrome, are estimated to cost Australia more than $6 billion annually. Thus the outcomes from this research will have potential economic benefits as it will provide vital information required to direct future work on identifying targeted therapies to relieve chronic pelvic dysfunction, thus reducing economic burden and attracting potential commercial interest.							
DP220101522	**Warratyi: Cultural Innovation in the Indigenous Settlement of Australia**	155,000.00	310,000.00	300,000.00	145,000.00	0.00	0.00	910,000.00
Smith, Em/Prof Michael A	This project aims to determine the role of cultural innovation in the Indigenous settlement of Australia's arid zone 50,000 years ago. Using innovative methods, it will produce new data on key technologies, symbolic behaviours and human interactions with animals and environment to identify the cultural innovations needed to overcome the challenges of Australia's deserts. Expected outcomes include new understandings of the settlement of the arid zone to inform global debates relating to the dispersal, settlement and lifestyles of early humans in marginal environments. Expected benefits include new information for cultural tourism and education and to support South Australia’s World Heritage nomination for the Flinders Ranges.							
	National Interest Test Statement							
	This project will provide new insights into how cultural innovations, symbolic behaviours and technological sophistication brought about the Indigenous settlement and occupation of Australia's arid zone. It will document Indigenous responses to climatic and environmental changes at the site of Warratyi in the Northern Flinders Ranges, excavated and dated to 49,000 years ago, and assess how this relates to the early occupation of the arid zone. Working collaboratively with the Adnyamathanha, the research adopts the methodological innovation of braiding Western and Indigenous science to ensure that understandings of Warratyi’s exceptional archaeological record are as nuanced and wide ranging as possible. Bridging the sciences and the humanities, this low-risk research will enhance scholarly and public understandings of how Indigenous cultural and technological innovations shaped the human past in Australia, enable better decision-making around cultural heritage assessments, and contribute directly to Australia's plans for a World Heritage nomination of the area that includes Warratyi in South Australia.							
DP220101900	**Molecular control of memory traces**	110,000.00	200,000.00	190,000.00	160,000.00	60,000.00	0.00	720,000.00
Ittner, Dr Arne	This project aims to understand how particular molecules help encode memories in the brain for future retrieval. Individual memories are encoded in brain cells through an unknown physical process. This project uses innovative approaches to manipulate memory-containing cells and will provide a new detailed explanation of memory. Outcomes of this work will significantly advance the current understanding of how memories are physically generated and maintained, which is an essential component of human and animal life. This research provides significant benefits in understanding the biology behind memory and in maintaining memory capacity in ageing.							

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	National Interest Test Statement							
	Aging in a productive way is of utmost importance to individual and population health. Maintaining memory is crucial for healthy aging. This project will address a fundamental question – how memory traces are encoded and maintained in the brain at the molecular level. This work will provide a deeper understanding of mammalian memory and thus will result in improved knowledge to maintain cognitive capacity in ageing. Furthermore, these insights will impact on brain performance and will help increase social and economic contribution of ageing Australians. Most human activities are based on memory of previous experiences. Understanding such an essential brain function as memory has wider implications beyond health, for example in education and information technology.							
DP220102511 Chew, Dr Yee Lian	**How do protein quality control mechanisms maintain neuronal ageing?** This project aims to interrogate how mechanisms of protein quality control act in the brain - an organ that is particularly vulnerable to a high load of misfolded protein - to maintain normal physiology during ageing. This project expects to make advances in cellular biochemistry and neuroscience, using an innovative proximity labelling approach to identify quality control regulators in neurons that specifically engage with misfolded proteins during ageing, within the nervous system of a living animal. Expected outcomes of this project will generate new knowledge of brain physiology and ageing relevant to all animals. This should provide significant benefits, such as a greater understanding of long-term brain functions including memory.	81,500.00	177,500.00	195,500.00	99,500.00	0.00	0.00	554,000.00
	National Interest Test Statement							
	This Project addresses a fundamental question in biology – what is the basis of brain ageing at a molecular level? Research outcomes will provide a greater understanding of the natural process of ageing: specifically, how biochemical pathways in ageing brains fundamentally differ from other tissues. Australia's population has one of the highest life expectancies worldwide (#6 in 2015), and ageing in a productive way is of utmost importance to individual and population health. Insights into the molecular basis of protein quality control in the brain is essential to enhance the maintenance of brain functions and increase the social/economic contributions of ageing Australians. This research also creates the opportunity to place Australia at the cutting-edge of neuroscience research at its most exciting time, through the development of innovative technologies and providing training to the next generation of young scientists. Lastly, this work will promote the global standing of Australian basic research through collaborations, presentations at international scientific meetings and science outreach.							
DP220102900 Andersson, Prof Mats R	**Develop materials for stable and efficient printed polymer solar cells** The project aims to develop strategies to overcome current limitations of polymer solar cells by enhancing the thermal stability of these devices. This project expects to generate new knowledge in the area of stable and high-performance polymer solar cells, that can be manufactured by the printing industry in Australia. The expected outcome of this project includes new high performing materials, processing and additive strategies to overcome the key challenge to commercialising polymer solar cells. A significant benefit is their printability, providing the opportunity to establish a sovereign capability to manufacture low cost energy production systems in Australia.	80,000.00	160,000.00	160,000.00	80,000.00	0.00	0.00	480,000.00
	National Interest Test Statement							
	Polymer solar cells have the potential to provide an inexpensive and green complement to other types of solar cells. One particular advantage of polymer solar cells is that they are printable, which reduces the complexity and cost of manufacturing infrastructure, providing the opportunity to establish a sovereign capability to manufacture energy production systems in Australia. Solar cells that can be manufactured on equipment already used in the printing industry offer an enormous opportunity for advanced manufacturing in Australia. This project will develop new materials for stable active layers in organic solar cells to provide an environmentally friendly pathway to overcome the key challenge to commercialising what holds the potential for a very cost-efficient technological pathway.							

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DP220102915	**Quantitative Metagenomics**	90,526.50	185,867.00	193,002.00	97,661.50	0.00	0.00	567,057.00
Edwards, Prof Robert A	This project aims to revolutionize our view of the microbial world once more by transforming microbiome studies from relative counts of organisms to actual numbers of microbes. This project expects to impact all the microbiome studies that are being performed worldwide by unveiling the actual numbers of microbes. Expected outcomes of this project include new techniques to enumerate the number of bacteria in different environments and new approaches to measure gene expression within individual bacteria in any environment that will be demonstrated with complex microbial communities. This should provide significant benefits because microbes affect every aspect of our lives and those effects are driven by how many microbes are present.							
	National Interest Test Statement							
	As we have come to realize this year, Viruses, Bacteria, and Archaea (hereafter microbes) are all around us and, for better or worse, they affect our everyday lives. Antimicrobial-resistant bacterial infections are one of the biggest threats to human and animal health today and are already estimated to cost Australia ~$250 million per year. Some microbes cause food, beer, and wine spoilage, while others can be used to prevent it. There are fundamental gaps in our knowledge about how many microbes are in different environments and how they impact those environments. We know that the number of each species is important in understanding the whole community, but without this work, there is no accurate method for enumerating them. Solving these challenges will provide the foundation for exciting new therapeutics that have the best possible potential to positively transform health care, agriculture, food production, and bioindustrial processes. This DP will expand the knowledge base in Biological Sciences and enhance research capability across Australia.							
DP220102926	**Evolution. Morphodynamics and History of the Younghusband Peninsula**	81,000.00	140,000.00	108,000.00	49,000.00	0.00	0.00	378,000.00
Hesp, Prof Patrick A	This project will examine the history and evolution of the Sir Richard-Younghusband Peninsula (SRYP) complex barrier in SA. The aims are to derive a understanding of how the influences of relative sea-level changes, neotectonics, and sediment supply, can produce remarkably different responses in barrier development. No complex barrier (i.e. foredune ridges in one portion, transgressive dunefields in another) has ever been comprehensively drilled, dated, modelled, or examined in the context of indigenous occupation and oral histories in Australia. The study provides excellent analogues for barrier and dune response, and shoreline translation to varying rates of sea level rise, paralleling pressures facing all coastlines today.							
	National Interest Test Statement							
	This project will study the geology and history of the Sir Richard-Younghusband Peninsula, a coastal barrier that separates the Coorong Lagoon from the Southern Ocean and which includes the Murray River mouth. The study will use geophysical and drilling techniques, advanced modelling, and Indigenous knowledge to understand how the influences of relative sea-level changes, wave energy, tectonics, and sediment supply can produce different responses in barrier development. No Australian complex barrier (a barrier displaying different coastal dune types) has ever been comprehensively examined, so the benefit to Australia will be a foundational understanding of barrier response to sea level rise with implications for the management of the Murray mouth and adjacent Coorong lagoon and the Australian coast. The project will produce a better understanding of 7000 years of Aboriginal occupation of the peninsula and information on the evolution and geography of a significant Australian national park for the benefit of school students and tourists, whose visits play a vital role in sustaining rural communities.							

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DP220103531	**How do cells survive nutrient stress? Insight into mechanisms.**	86,902.00	163,932.00	153,380.00	76,350.00	0.00	0.00	480,564.00
Petersen, Prof Janni	This project studies cell survival under nutrient stress in eukaryotes. Building on extensive preliminary data that identifies novel TOR (Target of Rapamycin) Complex 2 (TORC2) control points it expects to generate new knowledge of critical and conserved features of stress control of macroautophagy that ensures cell survival. It uses interdisciplinary and innovative approaches to validate and characterize nutrient-stress dependent signaling. Expected outcomes include novel insights into environmental control of cell proliferation and forging cross institutional collaborations. This knowledge benefits basic and applied biology and is relevant to industries/projects utilizing living cells as nutrient supports cell survival and proliferation.							
	National Interest Test Statement The nutrient stress response in all eukaryotic cells promotes survival and sufficient nutrient availability in limiting nutrient conditions (nutrient stress). Macroautophagy is a fundamental process whereby cells scavenge nutrients to ensure survival. In this proposal advanced genetics and innovative molecular (mass spectrometry) techniques will be used to identify and characterize molecules in the cell that regulate Macroautophagy. The benefit to Australia derives from an improved understanding of nutrient control of cell growth and cell proliferation through elucidation of the strategies used by TORC2, the key molecular nutrient sensor molecule, to regulate macroautophagy and therefore the response to nutrient stress. This will benefit any industrial or research programme utilizing and propagating living organisms, because cell proliferation, survival, secretion and differentiation are universally dependent on nutrient availability. Thus, this project is likely to have far-reaching applications, including in agriculture, medicine and bio-manufacturing industries.							
	Flinders University	893,147.00	1,781,422.50	1,739,015.00	964,352.00	113,612.50	0.00	5,491,549.00
The University of Adelaide								
DP220100007	**New Techniques for New Physics Searches at the CERN Large Hadron Collider**	67,500.00	144,000.00	156,000.00	160,000.00	80,500.00	0.00	608,000.00
Jackson, Prof Paul D	This project aims to break new ground in the quest to discover the existence of new fundamental constituents of nature. In order to achieve this, the team will invent and deploy a suite of advanced machine learning and anomaly detection techniques, developed by the chief investigators, to mine the data processed and collected with the ATLAS experiment at the CERN Large Hadron Collider throughout the entirety of the next data taking run. Expected outcomes of this project include the first application of revolutionary anomaly detection methods to fundamental physics, probing unexplored space in the process, and enhancing the capacity and development of future leaders in Australian science and technology at the forefront of data analytics.							
	National Interest Test Statement This project will develop new electronics and machine learning methods to discover new particles at the Large Hadron Collider particle accelerator at CERN. The key benefits come from the technology; we will make an extremely sensitive system for detecting tiny anomalies, with immediate applications in telecommunications, financial services, data analytics, and the protection of key Australian assets through improved cybersecurity. We will disseminate our results to Australian industry through our collaborative networks, including DST. An additional benefit is cultural – we will position Australian science at the forefront of the international quest for Nobel-worthy physics discoveries and will disseminate this to the wider public using the media experience of our CIs. We will train a new generation of students in these techniques, enhancing Australia's nascent data science industry that the recent CSIRO artificial intelligence roadmap predicted will require 161,000 new specialized workers by 2030, contributing $315 billion to the Australian economy.							

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DP220100110	**Artisanal making and the future of small-scale local production**	54,263.00	129,971.00	141,226.50	65,518.50	0.00	0.00	390,979.00
Phillipov, Dr Michelle	Small-scale local production is essential to Australia's post-COVID social and economic recovery. Employing a mixed methods approach, this project aims to identify the consumer identities, decision-making and sustainable artisanal production models underpinning contemporary demand for locally made goods. Moving innovatively beyond binaries of production/consumption and individual production sectors, the project expects to generate vital new knowledge about how markets for small-scale Australian production can be expanded. Expected outcomes of this project include the generation of robust data to inform strategies that will benefit operators in remaining competitive and support the development of new and emerging artisanal businesses.							
	National Interest Test Statement							
	Successful local food and small-scale manufacturing industries are essential to Australia's COVID-19 recovery. This project will provide existing and emerging businesses, policymakers, and local and regional governments with robust data about the strategies required to assist existing operators to remain competitive, and to support the development of new businesses. This new knowledge will be especially beneficial for those Australian states and regions where a comparative lack of large industry and predominance of small-to-medium enterprises means that a refocusing on local production is crucial for economic growth. It will save money, time (individuals, business and government) and other resources by enabling more targeted initiatives based on the actual needs of, and markets for, Australian small-scale producers. With compelling stories of local making a key pillar of regional tourism efforts, it will also provide new knowledge about the role of the local turn in revitalising regional tourism.							
DP220100489	**Empowering terahertz sources with silicon antennas**	82,500.00	165,000.00	165,000.00	82,500.00	0.00	0.00	495,000.00
Withayachumnankul, A/Prof Withawat	This Project aims to create dielectric antennas for high-frequency terahertz sources, i.e., resonant tunnelling diodes. Motivated by their end-use, the Project expects to deliver high-efficiency, high-gain low-profile cavity antennas for free-space operation and Yagi-Uda couplers for guided-mode operation. Silicon will be a key material for both types of terahertz structures to achieve highest efficiency. Effective medium theory will enable performance, functionality, and integrability, while maintaining structural simplicity for cost benefits. The expected outcomes will replace decades-old costly hyper-hemispherical lenses for future terahertz systems in fixed wireless backbone beyond 5G and short-range see-through radar and imaging.							
	National Interest Test Statement							
	The terahertz region, situated between the microwave and optical regions, is the last underutilised part of the electromagnetic spectrum for sensing, imaging and communications purposes. This part of the spectrum underpins advanced applications and emerging industries including non-contact security screening, non-invasive medical diagnosis, non-destructive evaluation of a variety of materials, and high-speed beyond-5G communications. One hurdle towards wide adoption of terahertz technology is the need for decades-old bulky, inflexible, and costly lenses. Capitalising Australia's research strength in advanced electromagnetics, the project will deliver designs of mass-producible multifunction terahertz antennas to replace these decades-old lenses. The inventions will serve an emerging global demand in terahertz technology and contribute to Australia's high-tech industry sector. An estimated global market for these applications will reach AUD1.7 billion in 2024. Development of the proposed terahertz antennas at this early stage could potentially lead to generation of new intellectual property for Australia.							

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DP220101506 Zuo, A/Prof Alec Z	**Impacts of changing water ownership and reforms on Australian water markets** Water markets play a critical role in helping Australia's food bowl survive periods of severe drought. This project aims to evaluate how the Murray-Darling Basin water markets performed, in terms of the impact of water ownership, and investigate how water reforms have affected rural communities over the past two decades. Expected outcomes include a clearer understanding on how different water ownership structures impact price and price volatility of water, market power, economic welfare of water traders, and what social and economic impacts water reforms in the past decades have in the Basin. The findings will provide critical evidence for evaluating future water reforms, building resilient rural communities and safeguarding food security.	38,619.00	77,121.00	78,820.00	40,318.00	0.00	0.00	234,878.00
	National Interest Test Statement The complex nature of water as a commodity, and the need for collective action in reallocation, highlight the difficulty of policy development and implementation. Cost-effective and efficient water reallocation in the Murray-Darling Basin has been one of the most politically contentious questions in Australia in recent decades and will be one in the foreseeable future. When climate change increases water scarcity, water market may become even more important. This project's findings will provide valuable insights on if/how bargaining power is affected by participant characteristics, and assist policies in improving market mechanism and efficiency. Findings from this project will provide empirical evidence for successful cost-effective water reform policies. Enhancing the welfare of Murray-Darling Basin rural communities through investigating the water reform consequences is crucial, which safeguards Australia's food security. Lastly research insights of this project will have great relevance for many water practitioners, in Australia and internationally, generating considerable social benefits for the nation.							
DP220101774 Doonan, Prof Christian J	**Metal-organic Framework (MOF) Superstructure Catalysts** The development of new catalyst technology is crucial to uncovering energy-efficient strategies for valorising chemicals. Although the designable pore networks of Metal-organic Frameworks (MOFs) provide a highly favourable environment for heterogeneous catalysis, most stable MOF materials are microporous - possessing pores less than 2 nm - which hinders mass transport. This research will develop novel, hierarchically porous MOF superstructures that will overcome these limitations and serve as platform materials for the development of new catalysts. This research will address future challenges in industrial catalysis and realise an important step towards the commercial application of MOF catalysis for valoriation of chemical feedstocks.	75,000.00	163,000.00	163,000.00	75,000.00	0.00	0.00	476,000.00
	National Interest Test Statement Heterogenous catalysts, which are insoluble in the reaction mixture, are ubiquitously employed in large-scale industrial chemical processes as they are easily separated from the product. However, these materials are less active than alternatives that are soluble in the reaction mixture, can be less selective and are developed in a trial-and-error approach. This project will develop synthesis protocols for Metal-organic Framework (MOF) superstructure-based catalysts that combine the separation advantages of industrially preferred heterogenous catalysts with the designable, chemically mutable pore structures of MOFs. Critically, the project will overcome the mass transport limitations of MOFs by developing methodologies for forming MOF superstructures and new catalysts to utilise these hierarchically porous supports. The project will also collect the data to demonstrate the advantages of the new MOF superstructure catalysts. The knowledge and materials developed in this project will benefit Australia through future applications in sustainable chemical production and more broadly in a clean energy economy.							
DP220102303 Dholakia, Prof Kishan	**Levitated Quantum Optomechanics with Trapped, Rotating Microparticles** This project will develop techniques for trapping, rotating and cooling microscopic particles in vacuum for exquisitely accurate studies of sensors and of fundamental physics at the classical-quantum interface - namely quantum vacuum friction. It will result in the establishment of an internationally recognised activity in rotational levitated optomechanics and expand Australia's presence in the field of quantum photonics. It has the potential for commercial benefit in areas including photonics, sensors and advanced manufacturing	85,000.00	160,000.00	150,000.00	75,000.00	0.00	0.00	470,000.00

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	National Interest Test Statement							
	The proposed work will use quantum control of the center-of-mass motion of a levitated nanoparticle (a solid-state object of few hundred nanometers and upwards) in ultra-high vacuum by using optical forces. The work will build on the Chief investigator's cutting-edge expertise in photonics, nanotechnology, optoelectronics, and quantum technology. The ability to cool and couple such particles will also give rise to ultrahigh sensing accuracies, with applications in inertial force sensing and measurements of short-range interactions (quantum friction). The grant will enhance the skill set in ECRs in Australia in this field. A recent Industry Review (Lighting Economic Growth 2020) stated that the Australian photonics-based industry sector accounts for around A$4.3B of economic activity, similar in size to Australian dairy production, and the mining and construction equipment sector, and employs nearly 10,000 people in 465 companies. A vast range of instruments used in imaging and sensing depend on lasers, microscopy and optical detection systems. We can be significantly inspire a new cohort of researchers.							
DP220102516	**Paradigm Shift in Mid-IR Fibre Laser**	86,500.00	137,500.00	91,000.00	40,000.00	0.00	0.00	355,000.00
Ottaway, Prof David J	This project introduces a paradigm shift in 3.5µm mid-IR fibre lasers. A new laser process will be investigated to obtain high-power, simple and robust mid-IR fibre laser design. We will use advanced spectroscopy to characterize the fibre laser dynamics, computer modelling to optimize the laser design, and demonstrate the concept experimentally. The new design will enable agile, high precision polymer processing tailored to the unique absorption lines of carbon-hydrogen bonds in different polymers where there is currently a lack of high power, high brightness low-cost light sources. It will also open the door for very high-resolution laser assisted glass 3D-printing. The project will give Australia a new edge in advanced manufacturing.							
	National Interest Test Statement							
	This project outcome will be a new paradigm in the design of high-power fibre optic-based laser that operate in the mid-infrared. The new design will enable agile, high precision polymer processing and open the door for very high-resolution laser assisted glass 3D-printing. Novel laser techniques will be explored generating new scientific breakthroughs as well as enabling new methods for advanced manufacturing of plastics, polymers and glasses. Most importantly, the project will contribute to the training of future employees of the Space, Defence and Advanced Manufacturing sectors which are an increasingly important part of the Australian economy and the South Australian economy in particular, giving Australia a new edge in advanced manufacturing.							
DP220102596	**Safe and Reliable Solid-State Zinc Batteries**	87,500.00	175,000.00	175,000.00	175,000.00	87,500.00	0.00	700,000.00
Qiao, Prof Shizhang	The project aims to design and fabricate a new-type of flexible and durable solid-state zinc-based battery with satisfactory energy density and long-term lifespan for scalable energy storage. A variety of novel electrode materials and solid-state electrolytes with desirable crystallographic and thermodynamic properties will be developed to construct flexible solid-state zinc battery systems, by combining advanced material engineering, in-situ instrumental techniques, and atomic-level computation - an interdisciplinary approach. The successful completion of this project will be of great significance for low-cost, safe and reliable energy storage technology – the key energy and environmental challenges facing today’s Australia and the world.							
	National Interest Test Statement							
	This project will harness Australia’s abundant Zn, Fe and Mn resources to develop flexible solid-state zinc-based batteries (SSZBs) for safe and reliable energy storage. It will lead to opportunities for the utilization of SSZBs in the upcoming large-scale smart electricity grids, and thereby place Australia at the forefront of the safe solid-state battery industry and significantly spur Australia’s energy revolution from fossil fuels to renewable energy sources. The project will pursue innovations in clean energy techniques for electricity storage devices. Success will pave the way for advanced technological solutions to the conversion and storage of intermittent renewable energies with high energy density, that are low-cost, safe, easy to store and transport, and more socially acceptable. The project will also support increasingly the viability of Australia’s industry to create new markets and supply chains as an energy exporter, with expansion of Australian industries and employment.							

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DP220102772	**Evolutionary dynamics in deep time: faunal turnover during the Ediacaran**	97,000.00	177,000.00	147,000.00	67,000.00	0.00	0.00	488,000.00
García-Bellido, A/Prof Diego C	This project aims to investigate the world's oldest faunal succession in the fossil record by determining the presence and extent of a sedimentary gap and confirming the role of time in the control of fossil distribution. Significant breakthroughs and capacity building are expected in the areas of palaeontology, evolutionary biology and geology using a hitherto unrecognised hiatus in the rock succession. Project outcomes include enhanced understanding of the first animal communities on Earth – these should provide significant benefits, such as revealing Australia's unique record of oldest complex organisms, while bringing additional tourism to the region, and increasing the strength of the Flinders Ranges UNESCO World Heritage nomination.							
	National Interest Test Statement Fossils and the story of early animal evolution fascinate many, as does the raw beauty of the Flinders Ranges; a region responsible for contributing $460 million annually (2019 figures) to Australia's economy. This project will deepen understanding of the exceptionally important fossil heritage found in the Flinders Ranges, an area of which was recently acquired by the SA state government due to its unique scientific significance as one of the best places on Earth to demonstrate the world's earliest animal faunas. In the short term, advanced new knowledge gained in this project will inform conservation agencies and local leaders on the long-term care and preservation of the area. In the longer term, cementing the uniqueness of these sites is expected to support the growth of tourism (particularly the burgeoning geotourism sector) and drive regional development, resulting in economic benefit. Project outcomes will contribute to the case for the Flinders Ranges to be recognised as a UNESCO World Heritage site; a status that would only amplify the potential of that growth.							
DP220102785	**Finding the missing links in salt and water transport in plants**	75,000.00	159,818.00	169,618.00	84,800.00	0.00	0.00	489,236.00
Tyerman, Em/Prof Stephen D	Grain crops and horticultural plants use proteins called aquaporins to move water across cell membranes, but a group of these proteins can also transport some important nutrient ions as well as toxic sodium ions. This project aims to reveal the molecular pathways that regulate water and ion transport via aquaporins using advanced techniques in biophysics and molecular biology. These results will provide novel insights into how plants coordinate and adapt to changing water and salt conditions, addressing a missing link in how ions and water move in and out of plant vacuoles. Benefits include an expanded, innovative range of targets for plant breeding programs to improve plant productivity in our changing climate.							
	National Interest Test Statement In 2019–20 the value of farm production in Australia was $61 billion, and agricultural exports was worth $48 billion, however the effects of drought dominate the financial performance of grain and horticultural farms. Barley and wheat are Australia's largest cereal crops by area and barley underpins the Australian beer industry worth $16.5bn. Wine grapes underpin the Australian wine industry worth $45.5bn. For these crop and horticultural plants we have identified genes that function to alter plant water use and at the same time can contribute to nutrient uptake and salinity tolerance. This project will train new students and create new intellectual capital to understand this recently discovered mechanism. The dual water-salt transport mechanism will be manipulated in barley using the latest gene editing techniques to understand if it is possible to improve water uptake and salt balance important for drought and salinity tolerance. If successful, the technology will be transferred to other major crops, providing a new tool for improving Australian agricultural sustainability.							

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DP220102857 Santos, Dr Abel	**Bioinspired photo–iontronic membranes for smart neuron-mimicking systems** The project aims to address key fundamental questions about the development of bioinspired artificial nanochannels that can precisely mimic current signals and functionalities in neurons. This is expected to generate fundamental and applied knowledge in bioengineered photo–iontronic systems, harnessing a multidisciplinary approach to engineer materials with precisely tailored properties at the nanoscale for unprecedented dynamic control over ionic current through responsive, adaptable neuron-mimicking nanopores. Anticipated outcomes are advanced materials, integrated into smart architectures to overcome the limitations of solid-state systems for the next generation of integrated circuits, bio-interfacial sensors, and energy generators.	70,000.00	140,000.00	140,000.00	70,000.00	0.00	0.00	420,000.00
	National Interest Test Statement The project will produce significant advances in nanomanufacturing by developing new synthetic technologies—materials, molecules, and functional systems—that can operate as neurons do in the human brain. These systems will be able to replicate the electrical signals, functions and communication mechanisms of the brain's neurons. The resulting new knowledge and technological advances will provide advanced tools for replicating and harnessing the powerful ability of neurons for transferring and processing information, sensing, adapting, and responding to stimuli and generating energy. This will have a transformative impact on the next generation of bioinspired integrated circuits, novel brain–machine interfacial systems, bionic devices, green energy generators and provide the building blocks for artificial intelligence devices. Development of the proposed technologies could potentially lead to advanced manufacturing opportunities, and the generation of new intellectual property for Australia.							
DP220103037 Hand, Prof Martin P	**Garnet speed dating: Innovation for fast tectonic problem solving** This project aims to develop and apply a novel way to rapidly date the mineral garnet within rocks using the analytical technique of laser ablation mass spectrometry to calculate Lutetium-Hafnium ages. Garnet is the most important mineral we have to determine the depths of burial and the temperatures rocks experienced during the tectonic processes that shaped the continents. Our novel in situ laser ablation method will allow garnet to be rapidly and easily dated, permitting routine collection of large age datasets for tectonic problem solving. It will also offer a rapid means to determine ages of garnet-bearing rocks across prospective mineral exploration regions, providing explorers with key exploration data.	86,891.00	116,159.00	55,356.00	26,088.00	0.00	0.00	284,494.00
	National Interest Test Statement Understanding Australia's tectonic history is critically important to the national benefit. Tectonic activity is the primary control on the formation of mineral resources. One ingredient to improving mineral exploration success is development of new analytical methods that provide fast and cost effective information about the geological character of the crust. This project will develop "garnet speed dating", a method for lightning fast isotopic dating of garnet. Garnet is the most important mineral for determining how temperatures varied with depth as our continent evolved. These temperature and depth variations hold essential information about the tectonic environment in which rocks form. Determining the age of these rocks allows reconstruction of ancient tectonic environments, an essential step in predicting the location of mineral resources. The project will explore questions such as when and how the different parts of Australia came together, the answers to which are essential to better understand the nature of Australia's geology and its contained resource endowment.							
DP220103098 Young, A/Prof Ross D	**Imaging the spatial distribution of forces that bind quarks to a proton** This project will perform supercomputer simulations to resolve the distribution of forces acting on quarks inside the proton. New knowledge will be generated in the area of fundamental strong-interaction physics by developing innovative approaches to image novel features that have not been possible in the past. The outcomes will therefore open new research possibilities by expanding the capacity of the international community to study strong interaction physics—including direct relevance to experimental research at the recently-upgraded Jefferson Lab in the US. In analogy to Rutherford's atomic model, the results will have benefit to future generations of humanity with a deeper understanding of the structure of matter.	60,000.00	127,500.00	137,500.00	70,000.00	0.00	0.00	395,000.00

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	National Interest Test Statement							
	The results of this project will captivate the imagination of the Australian public about the fundamental character of the most dense form of matter in nature. The outcomes of the project will transform our understanding of the way the strongest force of Nature acts on quarks to bind them to the nuclear building blocks of the universe. The training provided to graduate students and postdoctoral fellows will deliver a significantly-improved intellectual capacity for Australia's future work force; and securing the nation's competetiveness in rapidly-emerging industries, including data science, machine learning, predictive analytics, data-driven business and exascale supercomputing. Importantly, this training is essential to meet the expanding intelligence and cyber capabilities of the Australian defence community, where there is a surge in demand for graduates possessing analytic, numerical and computational skills.							
DP220103156 Bunder, Dr Judith E	**Multiscale modelling of systems with complex microscale detail** In modern science and engineering many complex systems are described by distinctly different microscale physical models within different regions of space. This project is to develop systematic mathematical and computational methods for the compact and accurate macroscale modelling and computation of such systems for application in industrial research and development. Our sparse simulations, justified with mathematical analysis, use small bursts of particle/agent simulations, PDEs, or difference equations, to efficiently evaluate macroscale system-level behaviour. The objective is to accurately interface between disparate microscale models and establish provable predictions on how the microscale parameter spaces resolve at the macroscale.	60,000.00	122,500.00	127,500.00	65,000.00	0.00	0.00	375,000.00
	National Interest Test Statement							
	Computational experimentation is frequently used as a predictive tool in engineering and science. Compared to traditional experimentation, numerical simulations are extremely cost effective and access a far greater parameter range. However, detailed simulations are constrained by the overwhelming complexity of many modern microscale models and cannot permit a full solution within a realistic time frame. Multiscale modelling avoids ineffective simulations of the full microscale model and instead extracts only those features of the microscale model which manifest at the system-level scale relevant to engineers and scientists. This project focuses on equation-free multiscale modelling which differs from other multiscale techniques in that it is a purely computational scheme, requiring no prior algebraic manipulation or analysis of the microscale model. Because equation-free schemes do not require a substantial analysis of underlying mathematical processes, and are readily adaptable to different physical scenarios, they will prove to be practical and cost-effective tools for industrial research and development.							
DP220103181 Ebendorff-Heidepriem, Prof Heike	**Ytterbium fibre laser with diamond: new laser threshold magnetometry method** This project aims to create a novel class of hybrid optical fibres that open new vistas for magnetic field detection at ambient temperatures in noisy environments. The multidisciplinary project will develop the first fibre laser threshold magnetometry platform that breaks through diamond magnetometry sensitivity limits by cross-cutting established fibre laser technology with the new diamond-glass fibres and magnetometry concepts recently invented by the investigators. Envisaged significant benefits include non-invasive detection of magnetic fields in hard-to-access regions, an area of key interest for remote detection of submarines, early sensing of aircraft corrosion, deep brain imaging of neuronal activities and mineral exploration.	110,000.00	225,000.00	225,000.00	110,000.00	0.00	0.00	670,000.00
	National Interest Test Statement							
	An optical fibre platform for magnetic field sensing in typical hard-to-access and sensitive areas is expected to yield significant economic, strategic and social benefits in critical areas of Australia, including: *Mineral and energy resource exploration where magnetic field detection using thin and long fibres, which can be readily deployed down a hole, could help resource explorers detect smaller signals from valuable deeper targets. *Defence and Security where early detection of the weak magnetic fields during corrosion in a non-invasive way in hard-to-access region of aircrafts and ships would generate significant cost-savings. Other key applications are persistent seabed surveillance for threat mitigation of unmanned underwater vehicles and long-range undersea sensors for tracking submarines and ships in complex environments. *Biology where deep brain sensing of neuronal activities via detecting weak magnetic field signals could lead to advancing our understanding of the function of the nervous system and improve early diagnostics of neurological disorders and traumatic brain injury and epilepsy.							

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DP220103213	**Developing Resilient Housing for Low Socio-Economic Older People**	70,000.00	132,500.00	117,500.00	55,000.00	0.00	0.00	375,000.00
Soebarto, Prof Veronica I	The project aims to advance knowledge about housing design and indoor environment to improve the wellbeing of older people with low socio-economic status in South Australia, including those with culturally and linguistically diverse backgrounds. It will gather information about indoor living environment and relationships with wellbeing of the occupants, household energy use and operational costs, to explore affordable improvement strategies. The project is significant to address the problems faced by one-third of the population who are unable to afford proper housing and fuel-poor. Improved living conditions will lead to better quality of life and reduce public health costs while providing environmental benefits through reduced energy use.							
	National Interest Test Statement							
	This research will contribute to Australia's national interests through its potential economic, social, cultural and environmental benefits. The research will provide evidence in order to (1) advance knowledge about the relationships between housing design, indoor environment quality and well-being and to (2) formulate strategies that will assist policy makers, public and community housing providers and building designer in providing and designing housing that will improve the well-being of occupants who are the most vulnerable in the society: older people with low socio-economic status including those with culturally and linguistically diverse backgrounds. Improved housing conditions will lead to a better quality of life, reducing the need for institutional care thus reducing public health cost. At the same time, improved housing conditions will lead to less reliance on heating and cooling thus reducing energy costs and carbon emissions.							
DP220103487	**The immune response as a determinant of female reproductive investment**	120,053.50	215,459.50	194,904.50	99,498.50	0.00	0.00	629,916.00
Robertson, Prof Sarah A	Aims: This project will define how ‘cryptic female choice’ affects reproductive outcomes through immune recognition of embryo histocompatibility genes, to modulate maternal nutrient provision and fetal growth. Significance: The research will tackle an important knowledge gap in animal reproduction science, where poorly-understood male-female compatibility effects cause variation in breeding efficiency with major economic and environmental impact. Expected outcomes: We expect to generate new understanding of the genes, immune response elements, and vascular changes that explain compatibility effects. Benefits: The results will inform strategies to improve fertility in livestock animals, and in rare and threatened species.							
	National Interest Test Statement							
	Animal breeding programs, whether at farms or zoos, face a difficult problem – the common issue of unpredictable incompatibility between male and female breeding partners. A lack of understanding of the underlying factors and mechanisms of what makes a ‘good pair’ is a limitation with substantial impact on Australia’s economy and environmental sustainability. In this project we will define how certain genes in sperm affect the immune system responses of females, and how these in turn impact embryo implantation and fetal growth. Identifying the mechanisms that bias toward robust reproductive outcomes would be a paradigm shift in reproduction science, and would provide a foundation for future research to identify markers of compatibility for better matching breeding partners. Our long-term goal is to develop tailored interventions based on this research to improve offspring generation in economically-important livestock animals, and in rare and threatened species.							
DP220103624	**Quantum Nanostructure Positioning for Breakthrough Quantum Photonics**	80,000.00	155,000.00	150,000.00	75,000.00	0.00	0.00	460,000.00
Solomon, Prof Glenn	The integration of quantum nanostructures in optical devices has been proposed to improve the efficiencies of existing optical devices and create new classes of quantum photonics. Limiting progress is that many nanostructures are made through bottom-up processes with inherently randomly distributions, making integration into devices problematic. Lithographic nanostructure fabrication is rarely an option as it leads to diminishes performance. Here, we propose a new and unique nanostructure positioning technique incorporated directly into the growth process. It interfaces bottom-up technologies with device fabrication, facilitating incorporation of nanostructures in photonic devices, and may be transferrable to a variety of other systems.							

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	National Interest Test Statement							
	This Discovery Proposal supports two National Research Priorities: 1) Advanced Manufacturing, through the Specialised, high value-add Research Challenge; and 2) Cybersecurity, through the New technologies and approaches Research Challenge. The project will develop new semiconductor technologies that will improve the interfacing of semiconductor quantum nanostructures with optical devices, adding functionality to existing devices and creating new ones for fields like quantum information. Through research and training, these new semiconductor technologies will contribute to growing the semiconductor ecosystem in Australia. This ecosystem is vital to the broader Australian high-tech arena, including Defence and commercial industries. In addition, this project will aid in the development of emerging quantum technologies for ultra-secure communications, quantum computing and simulation, contributing to current efforts to be world-leaders in the nascent but fast-growing area of quantum information and the cybersecurity spaces.							
DP220103665 Smith, Prof Scott T	**Multifunctional Structural Panels for Next-generation Infrastructure** This project aims to develop a multifunctional prefabricated structural panel for current and future infrastructure applications for both land and offshore environments. Prefabrication enables enhanced product control as well as the ability to rapidly construct whole structures or their components. The panels utilise an inner lightweight foam and fibre-reinforced polymer (FRP) composite core with strong outer panels made from FRP sheets and high-strength concrete. The expected outcomes include experimental and numerical validation of the system, that will give designers and asset owners the confidence to adopt this new panel. The panel system presents an upward step change in construction technology and built infrastructure performance.	68,500.00	111,500.00	85,500.00	42,500.00	0.00	0.00	308,000.00
	National Interest Test Statement							
	The built environment importantly sustains our way of life and our ability to generate economic benefit for individuals and Australia. This project seeks to develop a new construction product, namely a structural panel system that can be tailored to suit a wide range of infrastructure types, such as permanent and temporary buildings and bridges, for land and off-shore environments. Economic benefit will be provided to asset owners and the construction industry via reduced construction times and long-life structures due to several key aspects of the panel system, namely being prefabricated, lightweight, strong, durable and energy efficient. There will also be environmental and social benefits to the Australian community by the respective efficient use of high-performing materials with high quality control in manufacture, as well as the safe and resilient nature of the panel system. The project directly addresses the Practical Research Challenge ‘Resilient Urban, Rural and Regional Infrastructure'.							
DP220103803 Lucey, Prof Simon M	**Geometric reasoning in computer vision with using only 2D supervision** The aim of the project is to build a geometric reasoning system that can exhibit human like performance. Advances in autonomous systems such as vehicles, robots, and drones will transform the Australian and global economy. Geometric reasoning is fundamental to advancement in such AI and is the focus of this project. The project will leverage a theoretical breakthrough in the field of structure from motion; which will allow an AI to learn the 3D pose and shape of an object solely through 2D supervision. The project will provide new insights into how AI should understand the 3D world.	70,000.00	142,500.00	147,500.00	75,000.00	0.00	0.00	435,000.00
	National Interest Test Statement							
	This project aims to build a geometric reasoning system that can exhibit human like performance. Geometric reasoning is fundamental to advancement in Artificial Intelligence (AI). This project will provide new insights into how AI should understand the 3D world and how to make it less dependent upon human supervision when learning. This will allow intelligent machines such as autonomous vehicles, robots, and drones to be deployed into complex environments and application domains previously thought impossible. Benefits include, for example, allowing biologists to study the 3D movement of animals solely through digital imagery, assisting the study of endangered species and use of autonomous vehicles to increase the mobility of elderly and disabled Australians. Benefits also lie in applying this AI reasoning system to Australia’s emerging and economically valuable space industry – in particular it will assist with docking, debris removal, and inter-spacecraft communications.							

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(Columns 1 and 2)	(Column 3)	2021-22 (Column 4)	2022-23 (Column 5)	2023-24 (Column 6)	2024-25* (Column 7)	2025-26* (Column 8)	2026-27* (Column 9)	(Column 10)
DP220103846	**Investing in ecological portfolios: retaining migratory strategies of fish**	86,250.00	166,750.00	168,250.00	87,750.00	0.00	0.00	509,000.00
Gillanders, Prof Bronwyn M	In finance, investors minimize risk and optimize long term returns by building stock portfolios with different attributes. This contingency strategy also occurs in ecological systems. We will use portfolio effects as a conceptual model to characterise the poorly known sub-population variations in migratory strategies of estuarine fish and their response to environmental conditions. In doing so, we will determine how environmental change drives variations in migratory strategies, impacts long-term growth and population trophic web dynamics. Outcomes will foster novel and dynamic management frameworks that enhance population stability despite the predicted volatility of environmental conditions.							
	National Interest Test Statement							
	The proposed research aims to understand migratory strategies of estuarine fishes and their response to environmental change across southern Australia. Two commercially and recreationally important fish species, black bream and mulloway, will be used to (1) examine population asynchrony based on fisheries catch data, (2) the portfolio of migratory strategies that allow populations to persist despite changing or unfavourable environmental conditions and (3) assess implications for growth of fish. Maintaining variation in life history characteristics such as migratory strategies drives long term population stability, and therefore is essential for sustainable and resilient fisheries management. Developing a portfolio approach will also create opportunities to safeguard estuarine populations and ascertain how climate change, habitat loss and fragmentation, along with overfishing may affect populations. These estuarine species are economically important to regional communities attracting people for fishing opportunities thereby providing additional social benefits including jobs.							
DP220103934	**Structure and metabolism of bioactive carbohydrates from brown algae**	116,300.00	231,350.00	194,300.00	79,250.00	0.00	0.00	621,200.00
Bulone, Prof Vincent	Brown algae produce a diversity of species-specific carbohydrates in their cell walls that exhibit a variety of biological activities that can be exploited for the development of functional food and biopharmaceutical formulations. However, the metabolic pathways responsible for the biosynthesis of these carbohydrates are poorly characterised. This multidisciplinary project aims to understand the molecular events that control the structure and metabolism of bioactive carbohydrates in the prominent Australian brown alga Ecklonia radiata, with particular focus on alginates and fucoidans. This knowledge will be used to produce in yeast bioactive oligosaccharides that are of high commercial interest to the biopharmaceutical industry.							
	National Interest Test Statement							
	This project aims to define an important fundamental process, specifically, the biosynthesis of bioactive polysaccharides from Ecklonia radiata, a prominent Australian brown alga of high industrial relevance. The multidisciplinary approaches used for genome analysis, cell wall characterisation, biochemical and functional characterisation of cell wall biosynthetic enzymes will generate new, ground-breaking knowledge on metabolic processes involved in carbohydrate formation in the cell wall of this species. The project will also deliver new tools for the production of structurally-defined oligosaccharides that have been shown to be efficient for the treatment of chronic obstructive pulmonary diseases (COPD) as well as diseases whose prognosis is negatively impacted by fungal and bacterial biofilms, such as chronic sinusitis. The target bioactive oligosaccharides are also inhibitors of fungal growth, which can be exploited for the treatment of various forms of invasive candidiasis.Thus, beyond the delivery of new fundamental knowledge, this research has high potential benefit to the biopharmaceutical sector.							
	The University of Adelaide	1,746,876.50	3,374,628.50	3,179,975.00	1,720,223.00	168,000.00	0.00	10,189,703.00

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University of South Australia								
DP220100583	**Solar-thermal desalination system for parallel water-electricity generation**	67,500.00	135,000.00	135,000.00	67,500.00	0.00	0.00	405,000.00
Xu, A/Prof Haolan	This project aims to develop a multi-functional solar-thermal desalination device to simultaneously produce clean water and electricity. Interfacial solar evaporation-based desalination technology has the unique advantage of using solar light as the sole energy source for affordable clean water production. However, its absolute evaporation rate is still too low for practical application and all of the latent heat released from vapor condensation during desalination is wasted. Solving these two critical issues by the study of energy nexus, design and fabrication of advanced photothermal materials and desalination devices could accelerate practical adoption of this technology and benefit millions of people who desperately need clean water.							
	National Interest Test Statement							
	The outcomes of this project promise to deliver an off-grid, low cost, easily deployable and maintained sustainable desalination technology for remote and rural areas benefiting outback farms and small towns throughout Australia. Interfacial solar evaporation-based solar-thermal desalination is an ideal complementary technology to the current reverse osmosis membrane desalination technology, which can ensure that all areas throughout Australia have access to a potable water supply. This is extremely important to Australian development, which as one of the driest inhabited continents in the world, has suffered economically from severe drought in recent years. The developed solar-thermal desalination system could alleviate water scarcity and simultaneously also generate electricity and hydrogen as beneficial by-products, contributing to the growth of Australia's renewable energy and environmental industry.							
DP220100651	**Culturally Responsive Schooling**	65,562.00	137,499.50	118,022.00	46,084.50	0.00	0.00	367,168.00
Rigney, Prof Lester	Australian schools are struggling to respond positively to the increasing cultural diversity of the student cohort. The aim of this study is to research how schools become culturally responsive and specifically explores how the affective environments of schools attend to the diverse cultural, academic and emotional needs of their communities. This this study brings together methods borrowed from educational ethnography, critical policy analysis, and educational action research. The study will inform curriculum and pedagogical reform in schools, changes to teacher education programs, and potentially ameliorate systemic inequality in Australian schooling.							
	National Interest Test Statement							
	Australian schools are struggling to respond positively to the increasing cultural diversity of the student cohort. Expected outcomes of the project include an innovative reconstruction of Australia's pedagogy in schools that service Aboriginal and other diverse communities, enduring international collaborations, and a massive open, interactive, and translated literature review data base. Research aims are to address the significant gap in our knowledge on how schools become culturally responsive by exploring how affective school environments meet the diverse cultural, academic, and emotional needs of their communities. The study will improve leadership to scale up whole of school strategic planning, professional learning, and curriculum linked to pedagogical change. This will provide significant national benefits, creating a new transdisciplinary Australian version of culturally responsive schooling to inform teaching interventions and policies in Australia and internationally.							

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DP220101595	**Parametric VR: An Interactive Virtual Reality System for Parametric Design**	72,500.00	147,500.00	155,000.00	80,000.00	0.00	0.00	455,000.00
Thomas, Prof Bruce H	This project aims to create a new and intuitive set of user interactions for Virtual Reality (VR) to support parametric designers in architecture and design. Parametric tools are an emerging design technology dominating contemporary practices, yet their interfaces are on traditional desktop computers while VR is only employed to visualise the geometric models produced by the end design. This project will generate Parametric VR, a system of VR tools to support parametric design. Key outcomes include software tools and demonstrators to support parametric algorithms and processes in VR. This will have significant benefits for design industries, allowing designers to directly edit parametric design entirely in VR across the project lifecycle.							
	National Interest Test Statement							
	This project will advance the Architecture, Engineering and Construction industries through the creation of new Virtual Reality (VR) design and visualisation tools. This new generation of tools will facilitate innovative design methods and interactions to support improving new design techniques and project workflows, ultimately leading to novel designs and improved building performances. The application of VR will enable architects, specialist building consultants and clients to 1) improve their understanding of designs by being immersed in it at the real scale, and 2) enhance their ability to virtually prototype new buildings and streamline the design process, improving design quality and creativity. The project will provide Australia with a clear technological advantage for creating state-of-the-art and high-performance building designs, leading to improved living environments and experiences. The technologies developed from the project will place Australia at the forefront of design innovation and will support the growth of the VR software industry in Australia.							
DP220102630	**Investigating Conversational AI: Development, Usage and Governance**	59,932.50	134,903.50	151,967.00	76,996.00	0.00	0.00	423,799.00
Elliott, Prof Anthony M	The project aims to provide new and powerful understandings of the consequences of chatbot technologies in terms of economy, society and governance. In doing so it will enable an integrated approach to understanding the ecosystem of developers, users and regulators of conversational AI in the retail and services sector. Expected outcomes and benefits include breakthrough theory, publications, and significant contributions to academic research and policy discussions across science, government, and industry. This should also place Australia at the forefront of the international scientific community and policy regulation in a fast-emerging area of technological development.							
	National Interest Test Statement							
	The National Science and Technology Council has identified the boosting of capacity in Artificial Intelligence (AI) responsibly as a key imperative for Australia. This interdisciplinary research investigates the multiple interconnected dimensions entailed in the development of conversational AI design and its embedding in everyday commercial, public sector and private interactions, and will yield new understandings of how it can assist specific sectors of economy, society and governance. Specific beneficiaries include designers and developers (deepening the evidence base for AI-enhanced human- machine interactions); business enterprises and public service providers (new models for integrating conversational agents productively and equitably into business and customer service); and, policy makers, industry professionals and civil society groups concerned about AI governance (new approaches to ethical AI and computational trust).							
DP220103275	**Fundamentals of Electrically Conductive Elastomer Composites**	35,000.00	70,000.00	70,000.00	35,000.00	0.00	0.00	210,000.00
Ma, Prof Jun	This project aims to address the performance instability of stretchable/flexible electronics and devices, by developing mechanically resilient, electrically conductive patterns of nanomaterials to be encased in elastomers. It expects to generate new knowledge in the field of composite processing, to provide fundamentals for composite industry to develop novel strain gauges and conductors. Expected outcomes include a methodology for stabilising the cyclic performance of electrically conductive elastomer composites. This project is anticipated to provide significant long-term benefits not only for underwater infrastructure condition monitoring but for remote and personalised health-monitoring.							

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	National Interest Test Statement							
	The evolution of rigid electronics into stretchable/flexible ones requires fundamental research into mechanically resilient, electrically conductive elastomer composites. The project will provide basic knowledge for industrial sectors to develop such elastomer composites for stretchable/flexible strain gauges and conductors towards different applications. The global market share of flexible electronics is expected to reach US$74B in 2030. It will likely result in a number of future applications and commercialisable products, such as (i) wearable, highly stretchable and sensitive and cost-effective sensors to be used in the healthcare community for health monitoring, diagnosis and early treatments and (ii) asset management for expanding the lifeline of underwater infrastructure network. This project falls within the Science and Research Priority in Advanced Manufacturing. The project will also provide interdisciplinary training for students, positioning them to take on leading roles in strengthening the manufacturing sector in Australia industry.							
DP220103289	**Opening and closing doors in the fetal circulation impacts brain metabolism**	122,721.50	232,911.50	220,410.00	110,220.00	0.00	0.00	686,263.00
Morrison, Prof Janna L	This project aims to measure blood flow from the umbilical cord through special shunts or doors to the fetal brain and to understand how changes in delivery of oxygen may impact fetal brain metabolism. This fundamental phenomenon will be measured with novel MRI protocols developed by a multidisciplinary, international team. Expected outcomes of this project include world-leading advances in measuring fetal blood flow and brain metabolism with exchange of expertise between leading researchers in Australia and Canada and their trainees. In the long-term, this should provide significant benefits in enhancing Australia's research capacity in fetal physiology and may lead to new tools for monitoring or supporting fetal development.							
	National Interest Test Statement							
	This project will initiate a paradigm shift to define fetal circulatory responses using novel and non-invasive imaging techniques that are as reliable as current invasive experimental techniques. Specifically, we will provide important insights into how the fetus regulates oxygen delivery to the brain through normal regulation of unique doors in the fetal circulation and how changes in oxygen delivery may impact fetal brain metabolism. Better understanding of this mechanism will lead to improved research methods for monitoring normal fetal growth and development in the future. This project builds on an international collaboration. It will enhance capacity of advanced imaging techniques for studying normal fetal development to Australia. This will build our capability and capacity in cardiovascular research with training in fetal cardiovascular and brain MRI. In the future, this knowledge may provide new insight on how to identify and manage high-risk animal or human pregnancies to ensure normal brain growth.							
DP220103543	**Nanoengineering of Biomaterial Surfaces to Tailor Innate Immune Responses**	84,476.00	173,535.50	180,447.00	91,387.50	0.00	0.00	529,846.00
Vasilev, Prof Krasimir A	The overarching aim of this project is to provide a mechanistic understanding of how surface nanotopography affects inflammatory responses. Recently, we showed that surface nanotopography induced conformational changes in adsorbed proteins can activate or deactivate immune cells. These exciting findings are important because they show that it may be possible to engineer the nanotopography of a biomedical device surface in a manner which leads to a desired and predictable level of inflammation. The outcomes of the project will create new fundamental knowledge that in the future can instruct the development of the next generation of biomaterials capable of controlling and directing the body's inflammatory responses.							
	National Interest Test Statement							
	Unpredictable inflammatory response generated by biomaterial surfaces is a longstanding and unresolved problem for patients, clinicians and the biomedical industry. This project will provide the missing fundamental knowledge of how biomaterial surface properties affect physiological processes, and how these properties can be tailored to modulate innate immune responses, the associated inflammatory pathways and the subsequent Foreign Body Reaction in a desired manner. The scientific breakthroughs delivered through this project will underpin the design of the next generation, innovative, high value-added products, such as implantable devices and tissue engineering constructs, which have manageable and predictable inflammatory consequences. Although focused on fundamental science, the project has the potential to develop innovative IP protected solutions that can be exploited by Australian companies to create new high added value manufacturing industries in Australia. In turn, this will create skilled employment, increase revenue and enhance the wellbeing of Australians.							
	University of South Australia	507,692.00	1,031,350.00	1,030,846.00	507,188.00	0.00	0.00	3,077,076.00
	South Australia	3,147,715.50	6,187,401.00	5,949,836.00	3,191,763.00	281,612.50	0.00	18,758,328.00

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Tasmania								
University of Tasmania								
DP220100100	**Old brain cells perform new tricks to allow life-long learning**	59,500.00	136,500.00	154,500.00	77,500.00	0.00	0.00	428,000.00
Young, A/Prof Kaylene M	In the brain, nerve cells transmit electrical signals more quickly and reliably when they are insulated. The insulating cells undergo small adaptive changes that speed up information transfer during learning, and the faster the electrical signal, the better the learning outcomes. This project aims to understand the signals that direct insulating cells to adapt and support life-long learning. In the longer term, this knowledge may be used to: develop interventions that improve learning and educational outcomes; counteract age-related memory decline and enable longer work force participation; develop strategies to circumvent the memory loss caused by brain diseases, or improve the design of computer hardware.							
	National Interest Test Statement							
	Understanding how the brain works is critical for economic, cultural and social well being in Australia. Internationally, the USA BRAIN and European ‘Human Brain' projects are supported by AUD$4.5B, and the Australian Academy of Sciences recommended that Australian scientists contribute to this international research effort by fostering the development of new technologies and creating new knowledge fundamental to understanding brain function. This project will do just that, by learning how brain circuits adapt and allow us to learn throughout life. In the longer term, this knowledge could be used to: develop interventions to boost learning in educational settings; maintain cognitive performance in an ageing workforce; identify new molecular targets for the pharmaceutical industry, and improve the design of computer hardware. This multidisciplinary project stems from key neuroscience discoveries made by Australian scientists, and will ensure that our country remains at the forefront of this field with early career researchers trained to be the next generation of scientific and technological innovators.							
DP220100240	**Governing during an ocean climate crisis: Building integrative capacity**	81,653.00	172,695.00	150,710.00	59,668.00	0.00	0.00	464,726.00
Vince, Dr Joanna Z	This project aims to investigate how strengthening institutional integrative capacity will lead to more effective integrated oceans management (IOM). Integration across sectors and jurisdictions will enhance cooperation, coordination and policy coherence. This project expects to identify new and innovative approaches to implement IOM by identifying which components of integrative capacity can be improved. Expected outcomes of this project include practical new directions for IOM in Australia and Canada that will increase collaboration between governments, industry, Indigenous groups and communities. This study will improve oceans governance and benefit countries' efforts to mitigate climate change impacts on the marine environment.							
	National Interest Test Statement							
	Climate change adaptation has been identified by the Australian government as one of the key threats to marine biodiversity. The value of Australia’s blue economy (activities and industries based in marine and coastal environments) is forecast to reach $100 billion per annum by 2025. If current sector-based approaches to oceans governance continue to be implemented, the result will have a detrimental impact on marine resources industries and Australia’s cultural connection to its oceans and coasts. This project will provide new directions and strategies for the Australian government to deliver integrated oceans management to help proactively mitigate cumulative effects of development and the impacts of climate change on the marine environment. The results will help establish Australia as an international leader in integrated oceans management while protecting its national economic interests and environmental security.							

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DP220100606	**Australia's variable rainfall - how dry or wet can it really get?**	47,500.00	109,500.00	129,000.00	67,000.00	0.00	0.00	353,000.00
Vance, Dr Tessa R	Australia’s rainfall is extremely variable, which means existing weather records are too short to calculate the true risk posed by droughts and floods. This project aims to quantify how naturally variable the rainfall coming from the Indo-Pacific mid-latitudes is, allowing recent rainfall extremes and future projections to be assessed in a long-term context. This project expects to produce new estimates of atmospheric moisture budgets between Australia and Antarctica based on a novel, 1000-year length reconstruction of moisture-bearing southern Indian Ocean storms. This new information is critically needed by water managers so that they can properly calculate (and ultimately prepare for) the worst of Australia’s rainfall-related risks.							
	National Interest Test Statement							
	Australia’s relatively short weather records mean that we do not know why rainfall varies so much from one decade to the next. As a result we do not know how bad droughts and floods can get, which means we cannot properly prepare for the worst events possible. This project will use an innovative new analysis of Antarctic ice cores to quantify changes in Australia’s rainfall variability from mid-latitude storms over the past 1000 years. This new data is critical to better understanding how much Australia’s rainfall can vary naturally and improving evaluation of drought and flood risk into the future. Water resources managers urgently need this information in order to quantify and adapt to current and future stresses on water supply systems. The results from this project will enable adaptation that ensures water critical industries can weather the worst of Australia’s variable climate.							
DP220100915	**Carbon in - carbon out: can carbon inputs keep up with losses in peatland?**	72,456.50	141,427.00	135,842.00	66,871.50	0.00	0.00	416,597.00
Hovenden, Prof Mark J	This project aims to quantify the current and predict the future carbon balance of a high altitude, carbon-dense ecosystem, namely sub-alpine grassy peatland, by measuring how environmental variables including experimental warming control the fluxes of carbon and water into and out of the system. In this way, this project will produce new knowledge on the susceptibility of high-altitude peaty soils to climate change. Expected outcomes include an enhanced ability to predict future carbon accumulation rates and the resilience of the vital water-storage and filtration services provided by these systems. This project will enhance outputs from new infrastructure and assist planning for future flood and drought management across SE Australia.							
	National Interest Test Statement							
	This project aims to produce information important to predicting and managing future climate change as well as understanding, mapping and managing Australia’s carbon emissions and storage. High-altitude systems provide essential ecosystem services, perhaps most importantly filtering and releasing vast quantities of water to supply our most densely populated, farmed and industrialised regions. Key to this water filtration and supply is the peaty nature of many high-altitude soils, which, while tiny in area, are also disproportionately important stores of carbon. Global warming threatens the peaty nature of these soils and the associated services they provide. Only by understanding what drives the fluxes of carbon into and out of these systems can we make informed decisions about managing these important areas. This research will directly fill important knowledge gaps surrounding the future of these ecosystems, also plugging an important knowledge gap in our understanding of Australia's carbon emissions and storage.							
DP220101658	**Using the last glacial cycle to understand carbon-climate feedbacks**	113,100.50	220,527.50	148,736.50	41,309.50	0.00	0.00	523,674.00
Chase, Prof Zanna	This project aims to investigate how the ocean’s carbon cycle will respond to anthropogenic climate change by examining its response to past climate variability. The project expects to generate new records of the dust feedback cycle and the microbial decomposition feedback cycle in the poorly studied Indian sector of the Southern Ocean. Expected outcomes include new datasets to test climate models, and a new method to detect temperature-driven changes in microbial decomposition. This should lead to significant benefits including more accurate estimates of how much carbon humanity can safely emit, and the science to inform whether Australia should adopt ocean fertilisation as a strategy to combat climate change.							

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	National Interest Test Statement							
	The ocean controls the carbon dioxide content of the atmosphere on the timescale of a human lifetime. How the ocean stores carbon will change as the climate continues to warm. This might accelerate the rate at which carbon dioxide accumulates in the atmosphere, and lead to further climate warming. This project will generate new knowledge about how the ocean's biological carbon cycle changed as the Earth warmed at the end of the last ice age. Expected benefits include the ability to evaluate how well ocean carbon feedback processes are represented in climate models and the effectiveness of ocean fertilisation as a carbon reduction strategy. This will benefit Australia, and the world, by enabling more accurate estimates of how much carbon humanity can emit before entering a dangerous climate.							
DP220101795 Sussmilch, Dr Frances C	**How plants open up: revealing the evolution of stomatal opening mechanisms** This project aims to identify novel and conserved mechanisms that drive the opening of stomata – plant pores that enable CO2 acquisition for photosynthesis. Stomatal movements strongly affect plant productivity and water use efficiency and have profoundly influenced the earth's climate and terrestrial ecology. This project will address critical gaps in our understanding of how plants open stomata in response to their environment and the evolutionary history of the genes controlling this fundamental process. A major expected outcome is knowledge of the diversity of stomatal opening pathways, which should ultimately lead to improved predictions of plant responses to environmental change and assist future targeted modification of plant growth.	54,845.00	127,905.50	119,060.50	46,000.00	0.00	0.00	347,811.00
	National Interest Test Statement Australian plant-based industries yield approximately $62 billion/year in income. There is an urgent need to improve plant productivity and water use efficiency in agricultural and forestry systems to meet the needs of a growing population under a drying climate. Stomata – pores that enable plants to acquire CO2 for photosynthesis and growth – have a major influence on both plant productivity and water usage. This project will address critical gaps in our knowledge of how plants open their stomata, targeting a national research priority: Environmental Change. A major expected outcome is valuable new knowledge of the gene pathways that drive stomatal opening, their diversity, and their evolution. Our chosen study species will ensure the direct relevance of findings for our natural Australian ecosystems and coniferous forestry systems, in addition to representing diverse plant lineages that offer 450 million years of evolutionary perspective. Our findings will provide insight into the constraints that limit stomatal movements and the potential for future targeted improvement of plant growth.							
DP220101809 Taylor, A/Prof Rebe T	**Extinction, Survival, Resurgence: Indigenous and colonial histories** This project aims to investigate the histories of Indigenous communities deemed extinct by Europeans in the wake of settler colonisation but who maintain they have survived with renewed cultures. With a focus on Tasmania and Newfoundland, Canada, the project examines archival material alongside the lived experiences of Indigenous communities to advance understandings of extinction and survival at a time of rapid environmental change. Outcomes include enhanced capacity to build collaborations with international first nation communities, institutions and researchers. New digital tools making historical materials accessible to Indigenous Australians and cultural institutions will significantly benefit cultural and language renewal.	53,486.50	109,592.00	111,487.50	55,382.00	0.00	0.00	329,948.00
	National Interest Test Statement This project will produce the first international history of people's extinction, survival and renewal in the face of European settlement. Focussing on Indigenous Tasmanian history, this project will situate Australia at the centre of growing international research into the meanings of extinction and survival at a time of rapid environmental change and increasing Indigenous self-determination. Building on my award-winning work, this proposal will result a high impact book and an accessible web resource that will help Australians understand the history behind urgent threat of human extinction, and what survival and renewal means for Indigenous peoples. This project will benefit Indigenous Australians by supporting the revitalisation of languages and cultures by providing access to historical materials using new digital tools. This digital development will directly benefit museums, libraries and archives in Australia and around the world. Further outcomes include connecting institutions and Indigenous communities in Australia and Canada in shared evidence of cultural survival.							

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DP220102125	**Optimising biodiversity conservation in managed forest landscapes**	58,000.00	162,500.00	186,500.00	82,000.00	0.00	0.00	489,000.00
Baker, Dr Susan C	How to meet human needs for timber while limiting harm to biodiversity is an urgent scientific goal. The project will address this challenge by quantifying the impacts of forestry systems and wildfire on mammal species. Novel network modelling of interactions among plants, animals, and environmental variables will establish cost-effective management improvements to maximise biodiversity values. A systematic conservation planning approach will deliver spatially and temporally explicit solutions to balancing trade-offs between production and conservation taking into account dynamic impacts from climate change and fire. Outcomes will provide a foundation for policy changes to put theoretical solutions into practice.							
	National Interest Test Statement							
	Most land-based biodiversity lives in forests, and demand for timber is leading to tension between conservation and production. The research will assess how the configuration and intensity of timber production in the context of reserve networks and wildfire regimes can best achieve ecologically sustainable forest management. Since animal and plant communities are intimately and dynamically connected in functioning ecosystems, we will quantify vital interactions and identify the species, structures, and processes that are keystones to sustainability. These will deliver recommendations to improve management systems and superior cost-effective monitoring indicators. We will resolve a question of fundamental national interest: how can Australia's forests concurrently support timber production and biodiversity in the face of widespread wildfire impacts? The advances will inform ecologically sustainable forest policy and management, reduce risks of species extinctions, and support a valuable industry with economic, environmental and social benefits to Australia.							
DP220102446	**Universal properties and application of species size distributions**	75,000.00	150,000.00	153,000.00	78,000.00	0.00	0.00	456,000.00
Audzijonyte, Dr Asta	This project aims to identify general properties of body size distributions for thousands of aquatic species by bringing together datasets enabled by global observation and citizen science programs, novel statistical methods and latest theoretical advances. By addressing temperature effects on body sizes, the project expects to generate new knowledge about species status globally, under the combined impacts of climate change and harvesting. Expected outcomes include new tools to integrate limited body size data into a consistent framework for significance advancement of models used in research and management. This should increase the capacity to assess human impacts on natural ecosystems and predict global warming driven changes.							
	National Interest Test Statement							
	Most nations wish to improve ecosystem status and sustainability of fisheries but have limited data collection capacity and rely on models that assume static species body size properties. This assumption contrasts with the latest findings that species sizes change rapidly due to global warming. Our project aims to develop empirically supported and ecologically realistic theories and models for better informed resource management and decision making in the face of rapid environmental change, helping to prevent species extinctions and future-proof productive fisheries. By integrating through new sources of data the project will contribute to ecosystem assessment and establishment of national marine baselines. Our findings will support the nutritional and economic security of fishers and have a direct bearing on harvest strategies in Australia and beyond. Direct economic benefits to Australia can be estimated from the commercial-value of its many data-poor fisheries, which generate several billion dollars per year and represent social and cultural assets deeply cared for by millions of Australians.							
DP220102744	**Talking Maths: Bridging the gap through talk in Early Years mathematics**	43,372.50	112,274.50	135,139.50	66,237.50	0.00	0.00	357,024.00
Murphy, Dr Carol	The study aims to address the gap in mathematical performance in Australia in relation to socioeconomic status (SES) by focusing on language and learning in mathematics. The study will design and evaluate a school-based intervention that positions language through talk as a key resource in teaching mathematics in Grades 1 and 2. Outcomes of the study will be empirical evidence of the effect of a language-based pedagogy on young students' achievement in mathematics and further understanding of the relationship between talk and learning. These outcomes will inform policy and teacher education and have a long lasting impact on low SES students' educational and work opportunities with ultimate impact on economic and cultural prosperity.							

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	National Interest Test Statement							
	The project addresses inequities of low SES in mathematics education in Australia by presenting an innovation focused on language as an aspect in learning mathematics. The project meets the STEM education focus of the National Innovations and Science Agenda (NISA) (2017) in two key areas. First, increasing student ability and engagement in STEM and second, increasing teacher capacity. By investing in university research, in collaboration with teachers and schools, the project evaluates an intervention that directly benefits Australia by encouraging young Australians, regardless of SES, to engage in mathematics (a building block in STEM), from an early age. Outcomes of the research include publications, teaching artifacts and practices that will inform end-users, including policy makers, schools, teachers and education researchers. Longterm benefits relate to the improved educational outcomes for students of low SES, development of STEM skills for future economic prosperity, the social and cultural well-being for students, and for communities and civic life.							
DP220102863	**The drowned: cultural and political geographies**	20,000.00	42,500.00	22,500.00	0.00	0.00	0.00	85,000.00
Stratford, Prof E. Elaine	This project aims to reveal and critically analyse the geographies of drowning and the drowned. Drowning is the third most common cause of death worldwide, and a subject of universal interest that is relatively limited in specifically cultural and political geographical research, policy, and debate. The project will be significant by rectifying that gap and investigating shared concerns about drowning's abiding, widespread, profound effects. The expected outcomes will include public debate about drowning and its cultural and political reach and management generated from a book, articles, and blog. Benefits will include new fundamental knowledge and practical insights about how to rethink risks and disasters in rapidly changing environments.							
	National Interest Test Statement							
	Drowning devastates individuals, families, and communities and affects wellbeing and productivity. It is the third most common cause of death worldwide and has occurred over centuries in many sites, Australia among them. It is linked to internationally traumatic events such as war, terrorism, and humanitarian crises, and activities such as slavery that uproot people from place and force them to move, often across water at great risk. Geography is concerned with place and movement and geographers should be concerned with drowning. But no investigation in geography has considered drowning's deep social and cultural significance. This research will address that gap; generate new ways to understand how drowning is so socially and culturally important and costly; and produce new ideas about drowning in terms of risk, disaster, and resilience in changing contexts and environments. Those efforts will draw on geography's strengths in the study of place, movement, and different scales of impact and will contribute to debates of national importance about people's wellbeing.							
DP220102872	**Micro-electrofluidic platforms for monitoring 3D human biological models**	90,106.00	183,212.00	161,825.00	68,719.00	0.00	0.00	503,862.00
Paull, Prof Brett	The ability to study living cells and human biological models (cell cultures) delivers greater understanding of basic biological function and response to applied (bio)chemical stimuli. Creating the physical environments to sustain biological models, and mimic natural conditions and fluidic pathways, is immensely challenging, yet essential to deliver meaningful observational data. This project will deliver this capability through the convergence of expertise and innovation in analytical chemistry, materials science and cellular biology, ultilising the latest technology and understanding of 3D micro/electrofluidics, to enable the study and stimulation of advanced biological models, sustained within precisely controlled 3D micro-environments.							
	National Interest Test Statement							
	The project will provide the next generation advanced analytical and observational microfluidic platforms and functional assemblies to enable the control and stimulation of human cell based biological models in 3D arrangements, such that greater fundamental understanding is gained of their function and dysfunction in response to applied physio- and chemical stimuli. The future impact of this research will be seen across aspects of human health, the future understanding and treatment of disease states, understanding of cellular malfunction, and the whole science of cell culturing, including tissue regeneration. The technical developments in the fluidic platforms being proposed represent the cutting edge of 3D microfabrication for the study of living systems, and will provide new capability upon which future lab-based models of human biological systems can be developed and studied.							

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DP220102928	**Unlocking telomere effects on life, death and fitness in a warming world**	76,000.00	159,000.00	158,000.00	75,000.00	0.00	0.00	468,000.00
Wapstra, A/Prof Erik	Few things in biology provoke such a strong desire for understanding as when adult death and fatal disease can be predicted early in life. A common factor linking early life stress, disease, ageing and time of death are telomeres, the protective regions at the end of each chromosome. This project aims to explicitly link telomere dynamics in free-living ectotherm populations with experimental approaches to advance our understanding of parental and environmental effects on offspring telomeres and their effects later in life. This project will take advantage of one of the world's longest datasets on ectotherm responses to climate to provide new knowledge of how telomeres affect fitness and the role that the environment plays.							
	National Interest Test Statement							
	Few things in biology provoke such a strong desire for understanding as being able to predict death and fatal disease. Telomeres (the protective regions at the end of chromosomes) place natural limits on health into older age and ultimately may determine mortality. Building on Australia's international contribution to telomere biology, this project takes a novel, sophisticated experimental approach grounded in ecology and evolution to advance our understanding of how and why animals (including humans) age in the way they do. This project takes advantage of one of the world's longest datasets on free-living animals to directly link environmental effects on telomeres to provide a conceptual link between ageing and fitness – thus bridging evolutionary ecology and biomedicine. Our project contributes to the Science and Research Priority of Environmental Change, addressing the challenge of providing improved accuracy and precision in predicting and measuring the impact of environmental changes on animals.							
DP220103005	**Creative Antarctica: Australian Artists and Writers in the Far South**	50,000.00	100,000.00	107,000.00	57,000.00	0.00	0.00	314,000.00
Leane, Prof Elizabeth M	The project aims to make the rich history of Australian artists' and writers' engagement with Antarctica visible through an innovative combination of critical, curatorial, and qualitative research. It expects to generate new interdisciplinary knowledge of creative responses to the South Polar region. Anticipated outcomes include the first comprehensive history and analysis of the Antarctic stories, sounds, and images produced by Australian artists and writers and recommendations for maximising Antarctic residency outcomes. At a time when Antarctica's future is threatened by warming temperatures and geopolitical tensions, the project provides significant benefits in the form of broader and deeper public engagement with the ice continent.							
	National Interest Test Statement							
	Australian writers and artists have travelled south for over a century, returning with stories, sounds, and images that have shaped our view of the continent, but these have never been comprehensively gathered, researched, or displayed. This project will produce the first comprehensive history and analysis of Australia's creative responses to Antarctica across the literary, visual, and performing arts. Key works, and insights from their creators, will be brought to our communities through exhibitions and performances in-person and online, and through an illustrated history. The project will also produce data to inform best practice in Antarctic arts residency schemes. It will complement scientific and logistical investment in its Antarctic sector by making creative arts engagement with the region visible to a broad audience. At a time when the precariousness of Antarctica's icescape is increasingly evident, this project will enable broader and deeper understanding of our cultural connections with the continent to our south.							
	University of Tasmania	895,020.00	1,927,633.50	1,873,301.00	840,687.50	0.00	0.00	5,536,642.00
	Tasmania	895,020.00	1,927,633.50	1,873,301.00	840,687.50	0.00	0.00	5,536,642.00

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Victoria								
Deakin University								
DP220100130	**A design-led approach for multifunctional composites**	55,507.00	107,114.00	103,214.00	51,607.00	0.00	0.00	317,442.00
Walsh, Prof Tiffany	This project aims to remove some of the limitations of carbon fibre composites by introducing novel functionality into the underlying carbon fibre. The project expects to modify carbon fibres, predict their functionality and develop new high-performance resins. The expected outcomes include enabling carbon composite materials to have high strength-to-weight ratio, durability, toughness, minimal maintenance, without compromising processability and the ability to manufacture at high volumes. The benefits should include a significant boost to Australia's ability to lead economically important manufacturing innovations across a range of sectors including defence, energy and construction.							
	National Interest Test Statement							
	This project will provide new technologies and insight into materials design and performance which will provide a competitive edge for the existing composites industry in Australi. Providing unique opportunities for start up and small business to establish a presence in a global supply chain worth more than $40 billion dollars. This project will develop truly next generation carbon fibre composites for us in the automotive, military, aerospace, renewable energy and building sectors as value added materials. Manufacturing has been identified as a key sector for economic recovery post COVID-19, and the creation of jobs and exportable materials based on Australian generated intellectual property will be key to the success of this recovery effort.							
DP220100300	**Unlocking the potential of multiphoton photoredox catalysis**	67,179.50	149,138.00	164,257.00	82,298.50	0.00	0.00	462,873.00
Francis, Prof Paul S	Photoredox catalysis promises sustainable alternatives to synthesise high-value chemicals using energy converted from visible light. The project aims to address the current lack of understanding about how these reactions operate at the molecular level, using innovative electrochemical and spectroscopic techniques. The expected outcomes include new catalytic systems containing multiple light-driven steps that provide reactivities beyond those attainable in single-photon cycles. These will be applied to challenging modifications of large biomolecules under mild aqueous conditions. Anticipated benefits include adding value to Australia's growing chemical industry through efficient green syntheses with reduced dependence on toxic solvents.							
	National Interest Test Statement							
	With natural resources diminishing around the world, it is critical that sustainable methods for manufacturing life-saving drugs and agrochemicals are created. This will enable society to meet both current and future demand. This project will deliver tangible economic and environmental benefits to Australia by expanding knowledge in the chemical sciences, particularly in catalytic systems that contain multiple light-driven steps. Many new therapeutics are protein and antibody-based; this project expects to develop new methods for modifying these using visible in water instead of toxic solvents. These advances will be achieved using innovative experimental techniques that also serve to strengthen Australia's research capability in both photochemistry and other solar-powered technologies including solar fuel generation, next-generation lighting and cellular imaging. Finally, this project provides a training program that will produce skilled research scientists highly attractive to Australia's expanding chemical manufacturing industry.							

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DP220100552	**Student mobility, risk and changing geopolitics of international education**	53,454.50	119,961.50	124,338.50	57,831.50	0.00	0.00	355,586.00
Tran, Prof Ly T	This project will investigate the impacts of changing geopolitics on student mobilities between Australia and China, India and Vietnam. The project uses a multi-method research design to generate new knowledge about how pre, during and post COVID-19 government policy responses and regional and global geopolitics affect inbound and outbound student mobilities. The expected outcomes include evidence-based recommendations for Australian government and university planning to build a resilient international education sector and co-designed resources to support international and domestic students and universities. Substantial benefits are expected as international education is vital to Australian higher education, society, culture, and economy.							
	National Interest Test Statement The goal of this project is to generate foundational knowledge about the effects of geopolitics on inbound and outbound student mobilities between Australia and China, India and Vietnam. Both international students studying in Australia and Australian students learning abroad in the Indo-Pacific have created long-lasting regional and global ties benefiting Australia's education, society, economics and politics. Both mobilities, however, are vulnerable to global and regional geopolitics. The project will address the urgent need for government and universities to have more evidence of immediate and long-term impacts of geopolitics on student mobilities, and to generate theoretically and empirically informed recommendations for building a sustainable international education sector. A key outcome will be recommendations for policymakers and universities to support Australia's international education, its largest services export (worth $40 billion, and vital to its society and economy), optimise Australian students' learning in the Indo-Pacific, and strengthen Australia's international standing within the region.							
DP220100736	**Anti-women online movements: Pathways and patterns of participation**	104,451.50	203,965.50	116,067.00	16,553.00	0.00	0.00	441,037.00
Roose, Dr Joshua M	This project aims to understand the influences shaping men's attraction to anti-women online movements and patterns of participation within them. The project intends to advance sociological research on the endemic problem of anti-women movements advocating violence against women in online environments. Expected outcomes of this project include practical strategies for preventing and reducing participation by men in online movements responsible for the harassment and abuse of women and girls. By providing an evidence base and identifying key intervention points to inform policy making, this project should benefit women and girls who experience detrimental impacts on their democratic online participation and negative economic impacts.							
	National Interest Test Statement Women in online environments, particularly those expressing opinions, are increasingly subjected to harassment, threats and sexual violence through electronic means, undermining their participation in democratic exchange and with significant detriment to the economy due to harms caused. This behaviour is encouraged in the 'manosphere', a broad coalition of online, largely anonymous anti-women actors who coalesce around their shared antipathy toward women. These actions stand in strong contrast to Australian values including respect for the freedom and dignity of the individual, and equality of men and women. Furthermore, a stated aim of the Federal Office for Women is to ensure that women and their children are safe from violence. This project will identify key pathways and patterns of participation in online anti-women movements, improving scholarly understanding and identifying key intervention points for policy makers and practitioners. This has both a social benefit, protecting democratic exchange for women and girls and economic benefit, given the significant cost of online violence against women.							

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DP220100829	**Religious Populism, Emotions and Political Mobilisation**	56,135.00	136,504.50	133,894.00	53,524.50	0.00	0.00	380,058.00
Yilmaz, Prof Ihsan	This project aims to investigate the main features of religious populism with a focus on emotions in Turkey, Indonesia and Pakistan. Through multiple analytical methods that examine populist statements and interviews with voters, it will advance theoretical and empirical knowledge on religious populism, particularly in relation to emotive political mobilisation and polarisation. The expected outcomes are benchmark data sets and conceptual frameworks that can be used in other contexts where religious populism poses a danger to democracy. This will help democratic governments better understand religious populism so that they can generate effective policies to deal with any potential negative effects.							
	National Interest Test Statement							
	Understanding the transmission of radical ideologies that undermine social cohesion and lack of trust in democratic institutions is central to the national interest of Australia and all democratic nations. This project aims to understand the role of emotions in populist ideologies and the ways in which populists mobilise their followers at home and abroad. By providing an understanding of how emotional appeals to religion are used to mobilise people to act against other groups, this project will provide us with new and improved tools to counter extremism. In the long term, understanding the complexities of populists' ideology, narrative constructions and use of religion and emotions in mobilising their followers will help Australia and the broader international community predict and prevent the spread of radical ideologies.							
DP220100884	**Communicating to promote engagement in using electronic medical records**	72,500.00	145,000.00	145,000.00	72,500.00	0.00	0.00	435,000.00
Manias, Prof Elizabeth M	This reflexive ethnographic and co-design project aims to examine how patient and family participation occurs with health professionals in using the electronic medical record within hospitals, especially for patients with complex needs. Its significance involves working with patients and families to consider how they could take part in decision making activities across transitions of care and influence health care activities. Outcomes are new knowledge and practices about how communication occurs with the electronic medical record and strategies adopted for effective engagement. Benefits are increased understanding of how and under what circumstances, engagement can take place in using the electronic medical record.							
	National Interest Test Statement							
	Australia's investment in the creation of electronic health records has led to significant health improvements. Further benefits will come from greater engagement with these records, particularly for patients who have complex care needs including those of non-English speaking backgrounds, those with many health conditions, or those who take many medicines. This project examines dynamics of communication between patients, family and health professionals. We will use these understandings of the actual ways in which communication occurs to develop and test new strategies to promote successful, shared engagement with electronic health records. Research shows communication problems affect up to 80% of adverse events that cause patient harm. This project addresses the practical research challenge of creating better models of health care and services by providing a model to reduce miscommunication and its negative impacts in health care. Improved communication should reduce adverse events in and out of hospitals and lower healthcare costs, providing significant economic, social and cultural benefits to Australia.							
DP220100983	**Blockchain-Enabled Federated Learning for Secure and Decentralised Learning**	75,000.00	150,000.00	152,500.00	77,500.00	0.00	0.00	455,000.00
Xiang, Prof Yong	This project aims to develop novel blockchain-enabled federated learning techniques for secure and decentralised learning. It addresses an important and urgent machine learning problem, that is, the data useful for training machine learning models are often held by different owners who are not willing to share their data due to privacy concerns, resulting in isolated data islands. The project will result in a set of innovative algorithms that provide solutions to the key challenges in blockchain-enabled federated learning. The expected outcomes of the project will dramatically advance the frontier of machine learning and blockchain research, and have massive social and economic benefits for Australia and international communities.							

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	National Interest Test Statement The blockchain-enabled federated learning techniques developed in this project will enable the building of secure and decentralised learning systems, which will have tremendous social and economic benefits to Australia society and thus greatly contribute to Australia's national interest. In particular, the proposed techniques will provide governments and industries with new tools to enhance their privacy preservation capabilities and curb cybercrime and other illegal activities caused by privacy infringements. They will also enable Australian businesses to better comply with the privacy laws in Australian and other countries. Moreover, given the vast market size of machine learning, the proposed solutions will create enormous commercial opportunities for Australian companies and bring them huge economic benefits. Furthermore, the proposed research will greatly advance the theory of machine learning and blockchain and enhance Australia's international competitiveness in these research areas.							
DP220101682 Marshall, A/Prof Daniel L	**Locating LGBTIQ+ youth in the archive: Telling new stories for belonging** This project aims to produce the first study of LGBTIQ+ youth in Australia's past and investigate what these histories mean to LGBTIQ+ youth today. We will generate new knowledge of Australian LGBTIQ+ history and links between historical knowledge and wellbeing in relation to LGBTIQ+ youth. Working with LGBTIQ+ youth we will also develop new archival storytelling techniques, theorising archives as 'laboratories of belonging'. In doing so, the project forges links between cultural studies of storytelling, LGBTIQ+ youth studies and Australian history. Benefits include innovations in reparative historical methodologies, new resources for the GLAM, youth and education sectors and improvements in LGBTIQ+ youth wellbeing.	64,729.50	139,719.00	147,122.00	72,132.50	0.00	0.00	423,703.00
	National Interest Test Statement Despite recent progress in LGBTIQ+ rights, research with LGBTIQ+ youth has shown starkly worsening indicators of health and wellbeing. Our study will investigate innovative interventions that combine LGBTIQ+ youth history with storytelling workshops to improve young people's sense of belonging and wellbeing. Australian LGBTIQ+ youth history remains as yet untold. This silence contributes to the sense of isolation that many LGBTIQ+ youth experience: knowledge of your community's past is important to your sense of belonging in the present, and your capacity to envision a future. Our study starts the important work of writing LGBTIQ+ youth into our national history by conducting new archival research into LGBTIQ+ youth in the past and connecting youth to this history by sharing these stories with them. By studying the impact of this knowledge on LGBTIQ+ youth wellbeing, social and cultural benefits of our study include: enabling LGBTIQ+ youth to see themselves in our history; promoting public awareness of these histories; and producing resources to inform work in youth services and public history settings.							
DP220101925 Yearwood, Prof John L	**An intelligent machine modelling assistant for combinatorial optimisation** This project aims to discover key fundamental technologies for automating assistance to non-expert users in the formulation of mathematical models. Through automating the modelling of combinatorial optimization problems, this research will generate new knowledge to address the fundamental challenges of automatic mathematical modelling. This intelligent assistant will enable synthesis of new mathematical models through the utilisation of pioneering natural language processing components and novel custom-made machine-readable knowledge bases. The outcome of this research will broaden access to high-quality models by non-expert workforce and alleviate the shortage of expert mathematicians, bringing significant social and economic benefits.	80,000.00	160,000.00	160,000.00	80,000.00	0.00	0.00	480,000.00
	National Interest Test Statement Mathematical modelling has an important role in science, business, civic services, and government operations and is traditionally conducted by expert mathematicians. However, there is a shortage of trained expert mathematicians in Australia that has a direct impact on quality and timely mathematical modelling. Optimisation modelling is a prime example of mathematical modelling that has improved business processes by saving resources or increasing efficiency for optimal outcomes. This research will make it possible for non-mathematician users to develop models tailored to their requirements through interacting with a computer. Our prototype will assist non-experts in formulating optimisation models for a range of planning, scheduling, resource allocation, timetabling problems and will benefit businesses and not-for-profit organisations. In doing so, this project will utilise a natural language processing-based agent with knowledge bases and Artificial Intelligence solutions to deliver economic and societal benefits according to Australia's Tech Future report 2018.							

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DP220102184	**Identifying how a non-stationary environment affects species persistence**	78,618.50	159,760.00	152,279.50	71,138.00	0.00	0.00	461,796.00
Lester, Prof Rebecca E	This project aims to achieve the first application of new ecological theory that accounts for environmental change and species' ability to respond to that change, using caddisflies that lay eggs on rocks in rivers as a case study. Long-term change in climate has always occurred but is often not accounted for when estimating future population sizes and extinction risk in species. Outcomes will include new knowledge on changing habitat availability, species' ability to move in the landscape and successfully lay and hatch eggs, while creating a general template for use in other species. This will lead to significant benefits for conservation efforts worldwide, via the template's inclusion in accepted extinction assessment protocols.							
	National Interest Test Statement							
	This research adds to Australia's national interest via its potential environmental benefits to the Australian community, specifically addressing the National Science and Research Priority of Environmental Change. The research will measure environmental change in climate and hydrology and develop new methods to predict associated changes in the physical landscape and the species that live there. By explicitly accounting for environmental change and the ability of species to respond to that change, we will directly improve our ability to estimate future population sizes and so also extinction risk, improving conservation outcomes. This work will benefit from direct input from leading international scientists in hydroclimatology, geomorphology and ecological theory, enhancing the capacity of established and emerging Australian scientists.							
DP220102729	**Boosting photosynthetic efficiency using a plant nanobionics approach**	67,500.00	135,000.00	135,000.00	67,500.00	0.00	0.00	405,000.00
Wang, Dr Yichao	The project aims to improve light capture and enhance electron transport rates using a plant nanobionics approach. Biocompatible plasmonic low-dimensional transition metal oxides with unique optical and electronics properties will be selected as the bioinspired materials. The investigation will focus on developing oxide compounds as artificial antenna, capturing extended optical wavelengths that are not normally available to natural plants. Energetic hot electrons excited from plasmonic materials injected into the plant system will further be explored, achieving unprecedented energy conversion from solar to chemical. The anticipated findings will provide a strong base to develop new plant systems with improved photosynthetic efficiency.							
	National Interest Test Statement							
	This project is designed to create new low-dimensional metal oxide materials with highly tunable optical and electronics properties, which will target applications in augmenting photosynthetic efficiency in plants and result in more sustainable biomass production. The knowledge that will be produced is of fundamental importance in realising viable and vibrant energy and environmental industries. The high yield of biomass production through improvement of photosynthesis in plants will reduce the dependence on non-sustainable fossil fuels. Australian industry will benefit through the intellectual property that will be generated. Any arising patents will be Australian owned and will be beneficial to the economy through licensing. Australian industry will benefit through the intellectual property that will be generated. Any intellectual property/patents arising from this project will be Australian owned and will be beneficial to the economy through licensing. The project outcomes will place Australian research at the forefront of current technological advancements.							
DP220103416	**Developing novel two-dimensional hybrid nanostructures for renewable energy**	62,500.00	125,000.00	127,500.00	65,000.00	0.00	0.00	380,000.00
Lei, A/Prof Weiwei	This project aims to develop novel two-dimensional (2D) hybrid nanostructures with new physical and chemical properties. This innovation intends to address the critical challenges of control functionalisation of 2D hybrid nanostructures: essential to understanding the potential of nanomaterials in key applications of energy generation. Expected outcomes include scalable technology to produce functional 2D nanomaterials and hybrid nanostructures to accelerate research to advanced materials and frontier material manufacturing technologies. This project will provide significant social and economic benefits to Australia in the growth of sectors in advanced materials, energy generation, and advanced manufacturing.							

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	National Interest Test Statement							
	Climate change demands new technology and materials to develop clean, renewable, and sustainable energy. This project addresses this need by developing functional nanomaterials and their advanced hybrid nanostructures with unprecedented physical and chemical capabilities. The new materials can be assembled into devices that feed into technologies and industries for energy harvesting, water purification and smart sensors. Importantly, this program will have far reaching implications across a range of research disciplines including physics, chemistry, and materials science and engineering, and ultimately sectors critical to Australia's environmental, social, and economic future. It is anticipated that these advances will facilitate new ideas in advanced nanomaterials, novel hybrid technology, renewable energy materials and technologies industries, addressing the need for increased renewable and sustainable energy and diversification of advanced manufacturing in Australia.							
	Deakin University	837,575.50	1,731,162.50	1,661,172.00	767,585.00	0.00	0.00	4,997,495.00
La Trobe University								
DP220100376	**Reclaiming Child Rights: Activism, Public Inquiries and Social Change**	55,512.50	109,553.00	104,064.50	50,024.00	0.00	0.00	319,154.00
Wright, A/Prof Katie J	This project aims to develop an historical sociology of activism against institutional child abuse from the 1990s to the present. It examines the reform strategies, actions and rationales of activists before, during and after the Child Abuse Royal Commission using media-rich methods, and it investigates the mobilisation of child rights discourse in Australia and internationally. The project expects to generate new insights into child rights and activism, new understandings of a globally significant Royal Commission, and new knowledge on research translation. Expected outcomes and benefits include an archive of activist stories, a digital memory project, and a new model for public engagement with sensitive topics.							
	National Interest Test Statement							
	This project contributes to Australia's national interest by generating new knowledge about how a diverse group of Australians fought against historical injustices and worked for social change to better protect children in the future. It investigates how activism against institutional child abuse contributed to a Royal Commission that is regarded globally as gold standard, which prompted sweeping reforms, and shaped the processes of inquiries internationally. The project will enrich sociological and historical scholarship of social action, and public understandings of an important chapter in Australian social, legal and political life. It will contribute to child protection efforts by exploring how difficult materials and research on the topic of child sexual abuse can be made available safely to the public and stakeholders, while respecting sensitivity and privacy. A lasting record of social change activism will be created for future generations through a public memory project and a digital archive, which will enhance public understanding of one of Australia's most important royal commissions.							
DP220100838	**Motoring On? A New History of the U.S. Car Industry since 1900**	41,393.00	74,226.00	73,530.00	40,697.00	0.00	0.00	229,846.00
Minchin, Prof Timothy J	This project aims to provide a new history of the U.S. car industry between 1900 and 2020. America was the industry's birthplace, and the car is integral to national identity and history. Throughout the twentieth century, the U.S. was the world's biggest auto market, and today it has almost as many cars as people. For decades, the auto sector was central to policy-making; today it is integral to Climate Change. The intended outcome is the first comprehensive history that blends the perspective of business and labor, rather than treating them separately, and the first history that covers the domestic and foreign-owned sectors. Its central question interrogates how this industry assumed - and maintained - a prominent place in American life.							
	National Interest Test Statement							
	This project has considerable benefit to Australia. The U.S. is Australia's closest and most important ally, and its second-biggest trading partner. The industry's development in the U.S. greatly influenced Australia, where American-owned Holden and Ford were the main players for almost a century. As the ABC has observed, Australia is a "car country," and few industries evoke such passion. Australians spend over $78 billion a year buying, fuelling, and servicing their cars, and few other consumer products are as emotive. In 2017, car production in Australia ceased, generating considerable public engagement. Radio National described Holden's shutdown as "a turning point in our history," while the axing of the "iconic" Holden brand has also attracted widespread commentary. This project will illuminate why car-making has survived in the U.S. but not in Australia, investigating the role of government support, labor costs, and the size of the market, among other factors. The Australian perspective will also be directly explored through a Ph.D. scholarship to study the history of Australian car-making.							

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DP220101634	**Low-cost Sensing Methods and Hybrid Learning Models**	72,500.00	147,500.00	152,500.00	77,500.00	0.00	0.00	450,000.00
Xiang, Prof Wei	This project aims to revolutionise the theory and practice of sensing and monitoring by developing novel Artificial Intelligence and Internet of Things technologies. This project expects to generate new knowledge in the area of Artificial Intelligence of Things by combining sensing, machine learning, and big data analytics. Expected outcomes of this project include novel low-cost sensing methods and new hybrid machine learning models for predictive sensory data analytics. This should provide significant benefits, such as substantially reduced operating and service costs and improved accuracy for real-time monitoring in the fields where cheap-to-implement and easy-to-service monitoring systems over large geographical areas are imperative.							
	National Interest Test Statement Improving water quality of inputs to the Great Barrier Reef is a major national priority, with $2 Billion committed by Australian Governments to protect the reef for the coming decade as stated in the Australian Government's Reef 2050 Plan. Current monitoring practices are laborious and costly, with many gaps in the available data. This project proposes innovative low-cost, low-maintenance, and high-accuracy monitoring solutions by developing cheap-to-implement and easy-to-service Internet-of-Things monitoring systems. The outcomes of this project will find widespread application for monitoring agricultural runoff nationally and internationally and thus promote best farming and irrigation practices. Further potential benefits include making accurate monitoring available to communities that previously could not afford traditional sensory systems, as well as making conservation and monitoring projects more accessible to smaller/poorer governments globally.							
DP220101680	**Random fields: non-Gaussian stochastic models and approximation schemes**	46,235.00	130,070.00	165,105.00	81,270.00	0.00	0.00	422,680.00
Olenko, A/Prof Andriy	The project aims to address important problems in the theory and statistics of stochastic processes and develop new methodology for their applications. This project expects to generate new knowledge about stochastic processes defined on multidimensional spaces and surfaces that are used in spatio-temporal data modelling. Main anticipated outcomes include - developing approximation schemes for new complex data and investigating their accuracy and reliability; - studying nonlinear statistics and transformations of these data; - providing new tools to investigate complex real data, in particular, in cosmology and embryology. The results should provide significant benefits for optimal modelling and analysis of high resolution big data.							
	National Interest Test Statement The research is important for most of National Science and Research Priority areas as recent advances in technology allowed collecting big data at high frequency rates that led to the ubiquity of complex data. 90% of the data available in the world today has been created in the previous 2 years. The majority of modern Soil and Water, Cybersecurity, Energy, and Environmental data have complex spatial or georeferenced structures. Most of traditional models and tools inadequately perform for new complex data. Often, there is no theoretical justification for using them for such data. The project proposes several new perspectives, tools and algorithms for optimal representation and advanced analysis of non-Gaussian non-stationary processes. The results can be applied to improve various traditional techniques and develop optimal modelling schemes for naturally occurring big data. In particular, the power of these new perspectives will be demonstrated by studies of cosmological and embryological data. Applications of these new optimal methods will result in more effective analysis and use of Australian resources.							
DP220101901	**Re-purposing shelved 'antibiotics' in the search for new herbicides**	85,864.50	168,399.50	137,319.50	54,784.50	0.00	0.00	446,368.00
Soares da Costa, Dr Tatiana P	This project aims to identify target-specific herbicidal compounds that inhibit amino acid biosynthesis pathways to tackle herbicide resistance. This project expects to validate a novel herbicide discovery strategy by exploiting the similarity between bacterial and plant enzymes in these pathways to re-purpose failed 'antibiotics'. Expected outcomes include advances in our knowledge of the structure, function and inhibition of novel herbicide targets, and the identification of compounds with herbicidal activity. This should lay the foundations for long-term benefits related to improving the quantity and quality of Australia's crops to ensure our food security.							

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	National Interest Test Statement							
	Australia's ability to provide food security for a growing population is being increasingly challenged by the emergence of weeds resistant to our current herbicides. Such weeds are destroying the natural diversity and balance of ecological communities, invading farmland and reducing our capacity to deliver the required quality and quantity of crops to sustain our food production and export industries. The impact of herbicide resistance is exacerbated by the lack of new herbicides entering the market in the past 30 years. This project will validate an innovative herbicide discovery strategy to allow for the identification of much needed new herbicide candidates. Furthermore, we will advance fundamental knowledge into new herbicide targets and strategies to minimise herbicide resistance. Consequently, we anticipate making significant long-term economic, commercial and environmental contributions by enhancing food production through increased crop yields to protect Australia's food sources, agricultural export industry and natural environment.							
DP220101967	**Lost Mines: The Troubled Legacies of Former Mining Landscapes**	31,137.00	151,712.00	184,254.50	63,679.50	0.00	0.00	430,783.00
Lawrence, Prof Susan E	This project aims to investigate how historical mining activities in Victoria have left a toxic legacy of heavy metals in soil and water. By integrating approaches from historical archaeology, environmental humanities, and the physical sciences the project seeks to generate novel datasets that document the spatial distribution of contaminants and novel ways of understanding mining heritage. Anticipated outcomes include new knowledge about pre-industrial background levels of heavy metals in the environment, more efficient and targeted remediation of former mine sites, and improved dialogue between heritage and environmental managers. This promises significant benefits for future land and water management and approaches to mining heritage.							
	National Interest Test Statement							
	The project aims to investigate the lasting effects of historical mining activity on soil and water assets in key agricultural regions of Gippsland and northern Victoria, part of the Southern Murray Darling Basin. Integrating approaches from historical archaeology and hydrology, the project seeks to develop novel data about what kinds of historic mining activities produced pollutants, what pollutants remain in the modern landscape, and how these pollutants may continue to affect people and environments. By expanding the historical record it seeks to fill a gap in the understanding of risks posed by abandoned mines and how they are managed and remediated into the future. Outcomes should benefit Australians by informing new approaches to addressing modern challenges concerning mine remediation, sustainable resource extraction and climate change. Outcomes should lead to better decision-making that meets the potentially conflicting demands of environmental management and heritage conservation.							
DP220102307	**The future of the Pacific: youth leadership and civic engagement**	65,000.00	130,000.00	125,000.00	120,000.00	60,000.00	0.00	500,000.00
Lee, Prof Helen M	This project aims to investigate how youth in the Pacific develop and demonstrate the forms of leadership and civic engagement needed for positive outcomes for their countries. New knowledge is expected to be generated about what influences Pacific youth to engage with the profound challenges facing their region, through Pacific-wide research and three case studies using participatory and collaborative methodologies. Expected outcomes include interdisciplinary contributions to Pacific and youth studies and applied outputs. This should provide significant benefits including enhanced capacity for governments, development agencies and donors to develop policy and programming measures to nurture the future leadership of the Pacific region.							
	National Interest Test Statement							
	In the context of the profound challenges facing Pacific island countries, from geopolitical tensions to climate change and most recently the COVID-19 pandemic, it is in Australia's national interest to have a firm understanding of the social, cultural and political factors that influence emerging leadership in the region. With two-thirds of Pacific populations aged under 35, Australia will benefit from deeper understanding of how youth are approaching the challenges they face. The Australian government has clearly signalled its intention to increase engagement with Pacific societies and this project, focusing on youth leadership and civic engagement, will provide useful insights into how Australia can best support and engage with efforts to promote pro-social activities in these countries. Further, this project will add to Australia's understanding of how leadership is conceived, supported and exercised in the Pacific region. The findings of this research will inform Australian foreign policy on the Pacific region, on youth as a global development issue, on aid delivery and on the exercise of soft power.							

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DP220102840	**How is the plant genome reactivated and controlled during seed germination?**	65,000.00	140,000.00	142,500.00	67,500.00	0.00	0.00	415,000.00
Lewsey, A/Prof Mathew G	This project aims to determine the mechanisms by which plant genomes are regulated during seed germination. The genomes of cells in mature, inactive seeds are repressed, but later must be rapidly reactivated to allow the gene expression that drives early seedling growth and development. This project will study proteins that turn genes on and off, and how these interact with the structure of DNA, in order to understand how spatial and temporal patterns of gene expression are controlled. It will advance our understanding of genome regulatory programs controlling germination and growth, and how they vary between Arabidopsis and barley. This can improve our ability to manipulate seed behaviour which would benefit growers and producers.							
	National Interest Test Statement							
	Our research will produce benefits to Australia through the generation of knowledge that informs the agri-food sector. The sector contributes ~20% of GDP to our economy and employs 1.6 M people, 57% rural-based. Germination is critical to field crop systems and the brewing and malting industry. Farmers require that seeds germinate predictably and appropriately. If the seeds fail to do so, farmers struggle to achieve the correct planting density in their fields or lose crops to preharvest sprouting at the end of the season. Both result in poor yields and reduced profitability. The challenges for farmers caused by inappropriate seed germination will continue to increase in the future as climate change alters weather patterns. However, the National Farmers Federation has set a target of growing Australian agriculture from a $60 B to a $100 B industry by 2030, to provide for our growing population and contribute to the economy. Our research will support this effort by providing knowledge and technology to develop crop cultivars with germination characteristics appropriate for future climate conditions and uses.							
DP220103679	**NanoMslide: plasmon-enhanced ptychographic phase microscopy**	48,862.50	117,134.00	88,474.00	20,202.50	0.00	0.00	274,673.00
Abbey, Prof Brian	This proposal aims to combine recent advances in metamaterials and quantitative phase imaging to probe the near-surface refractive index properties of cells and tissues. The proposed technique delivers orders of magnitude improvement in terms of sensitivity over conventional phase contrast microscopy and will be used to provide new insights into the molecular basis for disease. This project will result in a new approach to stain-free, label free, tissue characterisation that will benefit a diverse range of applications in biological imaging and aid in the development of this nanotechnology platform into a long-term, sustainable business for Australia.							
	National Interest Test Statement							
	Misdiagnosis, particularly of early-stage diseases, leads to either over treatment or false negatives, significantly impacting the lives of many Australians. This project combines fundamental research in the physical and biological sciences to develop an entirely new method for detecting disease. Diagnostic error represents a significant cost to the Australian economy. For example, over and under treatment costs for breast cancer are approximately $40,000 per patient per error and yet some studies claim over 80% of all diagnostic errors are preventable. The cutting-edge nanotechnology that will be developed in this proposal aims to address this problem by offering a superior detection of disease, unlike existing chemistry-based approaches which can have limited accuracy. We anticipate that the long-term impact of this research will be directly relevant for the pharmaceutical and diagnostics industries where the technology could be commercialised as a novel label-free diagnostic tool.							
	La Trobe University	511,504.50	1,168,594.50	1,172,747.50	575,657.50	60,000.00	0.00	3,488,504.00

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Monash University								
DP220100002	**Toward a Female Stoic Tradition: Women's Writings in England, 1600-1800**	25,000.00	85,000.00	112,500.00	52,500.00	0.00	0.00	275,000.00
Broad, A/Prof Jacqueline S	This project aims to investigate the neglected history of women's engagement with Stoic ideas in early modern England. It expects to generate new knowledge of a distinctive strand of women's Stoic thought by taking a novel interdisciplinary approach to different genres of early modern writing. The intended outcomes include a new understanding of women's valuable contributions to philosophy, literature, and politics in the period, as well as a greater appreciation of the gender-inclusivity of Stoic philosophy. This should provide significant benefits, such as the development of Stoic therapeutic techniques informed by women's experiences, and the promotion of gender equality through the recognition of women's intellectual history.							
	National Interest Test Statement							
	Experts have noted a rise in mental health problems in Australian society as a result of COVID-19 and especially an increase in women seeking help for anxiety, depression, and eating disorders. Through its public outreach efforts and promotion of Stoic therapeutic techniques for women, this project will contribute to Australia's collective efforts to address the mental health costs of the pandemic and other crises. The project should also reap cultural benefits for Australian society by demonstrating how women made valuable historical contributions to the development of political and philosophical ideas still in currency today. Recent global reports have shown that Australia is falling behind other countries in terms of the promotion of gender equality. Our project will help to further promote gender-equality and gender-inclusivity in Australia by bringing timely recognition to women's strong intellectual, literary, and political past.							
DP220100067	**Optimal shapes in geometry and physics: Isoperimetry in modern analysis**	15,000.00	80,000.00	132,500.00	67,500.00	0.00	0.00	295,000.00
Clutterbuck, Dr Julie C	This project will find the best isoperimetric shapes in curved spaces: shapes that optimise geometric or analytic quantities, such as the volume enclosed by a surface of a given area, or the resonant frequency of a drum of given area. The optimal shapes lead to tools that are widely used in differential equations, geometric analysis, statistical physics, probability theory, and quantum computing. Through this work, we will forge connections between the geometry of curved spaces, and the physics of operators therein. The significant benefits of this project include increasing fundamental mathematical knowledge, building capacity in Australia's world-class geometric analysis community, and strong links with international partners.							
	National Interest Test Statement							
	This proposal contributes to society and its culture by supporting internationally significant mathematical research. Australia is a world leader in the area of geometric partial differential equations, and this project will consolidate this reputation. This area is one of the most exciting research fields in modern pure mathematics, recognised with several recent Fields medals (the "Nobel prize of mathematics"). We investigate familiar quantities such as area and volume, but in the challenging setting of curved spaces. It has significant real-world applications because it studies equations arising from the laws of physics (for example, the heat equation). The results of this proposal have the potential to transfer into applications by modelling physical, environmental, engineering and economic processes, with specific applications including models of phase transitions, fire-front propagation, and image analysis; and theoretical applications in quantum computing. This project contributes to the research training of PhD students and postdocs, thus developing the nation's skilled workforce.							

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DP220100192	**Investigating non-canonical RNA processing in developing spermatids**	105,000.00	205,000.00	180,000.00	80,000.00	0.00	0.00	570,000.00
Beilharz, A/Prof Traude H	RNA combines the information content of DNA and the physical properties of proteins. These features mean it's emerging as a major player for new knowledge; for answers to fundamental questions in biology, and for applications in biotechnology. This project aims to understand how non-canonical RNA processing events control gene expression. How mRNA is processed post-transcriptionally for selective storage, translation, stabilisation or decay to control development. RNA-driven processes program morphogenesis and differentiation of spermatids, but via mechanisms only poorly understood. Uncovering the function of extensive cytoplasmic polyadenylation, which is essential for murine fertility, may fuel the next wave of RNA biotech applications.							
	National Interest Test Statement RNA biology is a critical molecule at the interface of biology and biotechnology. RNA has been relegated as 'too hard' for too long. Because it holds more complicated information encryption that DNA; and its structure is less easily accessible than Protein, classical biochemistry and biotechnology initiatives have been slow to fully capitalise on its potential. Yet, a has become clear in the rush to develop vaccines to COVID_19, and in the CRISPR gene editing revolution that is still unfolding, RNA biology is ripe for further breakthrough discoveries that can be leveraged for future therapeutics, biotechnologies and clean chemistry. This proposal is for the study of RNA in developing sperm, where the work has direct relevance for the control of animal fertility and an indirect knowledge base for the understanding of human reproductive health. Because sperm development in mammals occurs in a processed programmed exclusively by RNA, this area is ripe for new discoveries with the potential to feed into novel biotech applications.							
DP220100245	**Endocrine disruption in wildlife: a sexual selection perspective**	79,215.00	159,090.50	153,608.00	73,732.50	0.00	0.00	465,646.00
Wong, Prof Bob B	The Project aims to uncover how environmental pollution by hormone-mimicking chemicals affects wildlife behaviour, reproductive performance, and offspring viability. Through an integrative approach that combines multigenerational laboratory studies with an experimental evolution perspective, the Project expects to yield important insights into the pervasive influence of chemical contaminants on biological systems, and the capacity for animals to adapt to environments degraded by human activity. Findings will enable predictions of the ecological and evolutionary consequences of anthropogenic change, and contribute new knowledge relevant to the management of Australia's biodiversity and the security of its sensitive freshwater resources.							
	National Interest Test Statement Research into how chemical pollutants affect animal reproduction is crucial for understanding whether and how wildlife adapt to environments impacted by human activity. This Project offers benefits through new fundamental science concerning the effects of hormone-mimicking pollutants, known as endocrine disruptors. Such pollutants are now ubiquitous in the environment, and are a serious threat to wildlife and human health worldwide. By focussing on the long-term population health and reproductive impacts on fish, which play a central role in the functioning and stability of aquatic ecosystems, the Project is expected to yield important insights that are translatable for better management of Australia's biodiversity and freshwater assets. Given mounting pressures on our sensitive water resources and the unique organisms these systems support, it is strategically important to conduct research towards defining the impacts of endocrine disruptors in the environment – both in Australia and globally.							
DP220100316	**Medium temperature electrolysis for low-cost carbon dioxide utilization**	93,000.00	165,500.00	147,500.00	75,000.00	0.00	0.00	481,000.00
Zhang, A/Prof Jie	Carbon dioxide is a notorious greenhouse gas. Its capture, and subsequent storage or utilization, is a major focus not only for researchers, but also for governments trying to meet their obligations of the Paris Agreement on climate change and for industries managing their legal and social responsibilities. This project aims to develop commercially viable medium temperature electrolysers to convert carbon dioxide into value added chemicals using electricity from renewable sources. New design principles will be developed to generate highly active and selective catalysts with long-term stability. These electrolyzers will be integrated with carbon capture technologies to directly utilize captured carbon dioxide with high energy efficiency.							

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	National Interest Test Statement							
	Sustainable technologies focused on using carbon dioxide are essential for addressing the world's energy crisis and mitigating global warming. Those based on electrochemical solutions are highly attractive since valued added chemicals can be generated from carbon dioxide and water directly, using renewable electricity. However, current technologies are inefficient, expensive, or lack long-term stability, and hence are not suitable for large-scale commercial applications. In this project, world-leading expertise in the areas of electrocatalysis and thermal catalysis will be leveraged to develop medium temperature electrolysers that are efficient and stable. These electrolysers will be ultimately integrated with carbon dioxide capture processes for industrial scale applications. The expected long-term benefit is a reduction in dangerous levels of carbon dioxide emissions, leading to improved environmental health. This significant advance in the field is expected to result in benefits, both environmental and economic, for Australian and overseas chemical industry and renewable energy sectors.							
DP220100321 Koo, A/Prof Bonsoo	**High-frequency Estimation of Term Structure Models at the Zero Lower Bound** This project aims to quantify monetary policy shocks as shifts of the entire term structure of interest rates, when the central bank's policy rate is constrained at the near-zero level. The proposed method will use a high-dimensional panel of high frequency government bond data. The term structure and resultant policy shocks estimated at intra-day frequencies for major economies including Australia, will be made publicly available. This project expects to deepen our understanding of how monetary policy decisions affect the macroeconomy in a near-zero interest-rate environment. This should provide significant benefits to policymakers for implementing and monitoring monetary policy in achieving desired economic outcomes.	76,502.50	141,177.50	79,675.00	15,000.00	0.00	0.00	312,355.00
	National Interest Test Statement							
	The term structure of interest rates describes the relationship between interest rates and terms to maturity for government bonds. Given that short-term interest rates are constrained at the near-zero level in major economies, the shift of the entire term structure can play a vital role in macroeconomic and financial analyses, especially in assessing the efficacy of monetary policy. This project will provide high-frequency (e.g. hourly) term structure estimates for Australia, among other selected economies, freely available for public use. In a near-zero interest rate environment, changes in the long-end of the term structure contain critical information on the stance of monetary policy, as well as market's expectation on the future path of short-term interest rates. By examining how monetary policies interact with financial markets and real economic activity through the term structure models, this project offers a new set of tools to the Reserve Bank of Australia for implementing and monitoring monetary policy decisions in order to safeguard the Australian economy against recession and inflation risk.							
DP220100338 Lithgow, Prof Trevor J	**Investigation of the molecular machinery enabling phage to enter bacteria.** This project aims at a comprehensive understanding of the architecture of a biological nanomachine, called a phage, through broad-reaching investigation into how the component parts to work together to function in attacking bacteria. The discovery project takes the foundation knowledge of each of the component parts, builds a conceptual framework using breakthrough technology to address the precise architecture of the component parts within the nanomachine. The project aims to expand Australia's knowledge base and research capability in the research frontier of nanomachines. This ground-breaking research program provides unique training opportunities for research students and staff in projects driving frontier technology applications.	103,215.50	204,181.00	184,805.00	83,839.50	0.00	0.00	576,041.00
	National Interest Test Statement							
	In industries spanning from food processing to health, bacterial residues on machinery and devices causes both economic loss and disease leading companies to deploy phage (viruses that kill bacteria) to solve this problem. However, substantial gaps in our knowledge base about phage limit their effectiveness in industrial and health settings as well as the development of new applications. This project will isolate phages from local waterways in collaboration with Traditional Owners and deploy Australian national infrastructure for nanoscale imaging of phage to predict how stable they will be in industrial settings, and biological assays to determine how to maximize their potency in killing bacteria. The intellectual property and knowhow generated in the project will underpin the use of phage in biotechnological applications which could unlock substantial economic and commercial benefit for Australian and international companies.							

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DP220100492	**Computer-aided proofs for non-hyperbolic dynamics and blenders**	64,500.00	131,000.00	135,500.00	69,000.00	0.00	0.00	400,000.00
Tucker, Prof Warwick B	This project aims to develop methods to rigorously detect certain geometric structures in systems that are known to imply chaos and are robust under perturbation. Such structures include blenders and robust heterodimensional cycles and homoclinic tangencies. This project expects to generate new knowledge in the area of non hyperbolic dynamics utilising a novel combination of recent developments in Dynamical Systems and techniques from rigorous numerics. Expected outcomes of this project include an efficient computation platform aimed at detecting and verifying chaos-inducing objects in complex dynamical systems. This should provide significant benefits, such as an increased understanding of non-hyperbolic dynamical systems.							
	National Interest Test Statement							
	We expect the following benefits to Australia's national interest through this project. This project will make many of the recent advances in the abstract study Dynamical Systems theory more broadly applicable to the systems that arise in applications. In particular, the project will develop algorithms and software to identify and understand chaotic behaviour arising in real-world applications. This work will help us better understand the chaotic behaviour underlying chemical reactions, planetary dynamics, industrial mixing processes, fusion reactors, iterative computer algorithms, and many other processes. This project will have intensive collaboration both within Australia and internationally. It will build stronger links between the Dynamics, Topology, and Numerical Methods communities here in Australia and will also build and strengthen collaborations between Australian researchers and those overseas. It will raise the profile of Australia in the world-wide Dynamical Systems community, and will train promising researchers in this area.							
DP220100500	**In the Driver's seat: role of trace elements in enabling crustal fluid flow**	88,000.00	176,000.00	148,000.00	60,000.00	0.00	0.00	472,000.00
Brugger, Prof Joel	This proposal aims to systematically investigate the role of trace elements in controlling the kinetics, product composition, and feed-back between fluid flow and the reaction interface, in fluid-driven mineral reactions. This project expects to provide a framework for the integration of activator trace elements in models of crustal fluid flow and their application in the recovery of base, precious, and critical metals, using interdisciplinary approaches across geochemistry, mineral engineering and material sciences. Expected outcomes include improved prediction of the transport of metals and fluids in geo-systems. This should provide significant benefits towards integrating the mineral value chain from exploration to mining and metallurgy.							
	National Interest Test Statement							
	The resources industry is Australia’s largest export earner (40-50%), contributing ~8% of total GDP. Increasing future assimilation of green technologies such as electric vehicles and renewable energy increases the demand for both established metals (e.g., copper, gold) and emerging, so-called critical metals (e.g., rare earth elements, cobalt, tungsten, ...). Australia is richly endowed in metals, but needs to overcome significant challenges to benefit from these new opportunities: (i) sustainable and ethical sourcing are key requirements of new global players; (ii) demand for a particular critical metal may fluctuate rapidly due to evolving technologies; (iii) poor understanding of the geological processes that concentrate critical metals hinder mineral exploration; and (iv) the complex nature of the ores impedes economic recovery. This project will facilitate innovation and agility in the resource sector by providing fundamental knowledge and tools about the processes that dissolve or scavenge metals in geo- and processing systems, thus leveraging synergies between geosciences and mineral engineering.							
DP220100937	**A new numerical analysis for partial differential equations with noise**	63,500.00	129,000.00	133,500.00	68,000.00	0.00	0.00	394,000.00
Droniou, Prof Jerome	This project aims to design novel numerical methods, grounded in rigorous mathematical foundations, for partial differential equations with stochastic source terms, such as for instance those modelling fluid flows with random perturbations. To ensure the accuracy of numerical simulations, preserving certain quantities of importance (mass, flux) is critical. The project's goal is to develop finite volume and high-order numerical methods that are applicable in real-world settings, designed to achieve this preservation of essential quantities, and mathematically proven to be robust. The expected benefits are cost-efficient and reliable numerical tools for the scientific simulation of phenomena subjected to uncontrolled influence.							

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	National Interest Test Statement							
	This project seeks to develop and analyse mathematical algorithms for computing solutions to complex real-world problems. Many physical or biological phenomena, including turbulent flows or population dynamics, are subjected to random effects (due to ill-controlled environments, etc.). These phenomena are modelled by non-linear equations that are much too complex to be exactly solved. Where this occurs, numerical algorithms are built to predict the solutions of these equations. The project's goal is to design new and reliable numerical algorithms that preserve critical physical properties of the models, and so are applicable to real-world solutions. Our expected achievements include the mathematical foundations for these algorithms, and testing them in practical situations. The developed computational methods and code will benefit Australian science and engineering communities by helping them understand and predict, for example, highly complex models of fluid flows with an enhanced efficiency.							
DP220100973 Klebaner, Prof Fima C	**New universality in stochastic systems** This project aims to uncover new analyses and effects in the complex behaviour of non-linear systems with random noise. Many systems originate near an unstable equilibrium. This project will develop a new mathematical theory that establishes a universality in the way the long term effect of noise expresses itself as random initial conditions in the dynamics. It will fill gaps in Mathematics and make refinements to existing fundamental scientific laws by including random initial conditions as predicted by our theory. This will advance our understanding of complex systems subjected to noise and will provide significant benefits in the scientific discoveries in Biology, Ecology, Physics and other Sciences where such systems are frequently met.	77,500.00	157,500.00	127,500.00	47,500.00	0.00	0.00	410,000.00
	National Interest Test Statement							
	The project will develop a new universal paradigm that will yield considerable advances in the understanding of the complex behaviour of many biological and physical phenomena. Mathematically the project will break new grounds in establishing universality in the behaviour of many complex systems with noise and in explaining their development and evolution from their birth to their establishment after a long time. The new mathematical results are important across a broad range of disciplines, from computer science, to physics, to biology. Applications include growth of DNA, establishment of mutants, development of tumours, epidemic models, as well as many other models in science. This will lead to concrete practical benefits. The new universal paradigm will also lead to the development of new techniques for extracting information from the distant past and predicting the future developments of such complex systems.							
DP220101107 Hill, Dr Briony L	**Weight stigma in the preconception, pregnancy and postpartum periods** The overall aim of this project is to develop guidance for the translation of weight stigma evidence into preconception, pregnancy and postpartum obesity-related policy. It focuses on the socio-ecological factors that perpetuate weight stigma in women across the reproductive life phase, that is, in women planning a pregnancy, in women who are pregnant and in mothers who have given birth within a 24-month period.	38,224.50	118,982.00	127,459.00	84,024.50	37,323.00	0.00	406,013.00
	National Interest Test Statement							
	This project aims to investigate aspects of the issue of weight stigma during women's reproductive life. This knowledge essential will fuel development of guidance for evidence-based obesity-related policy in, especially in women's health. Specifically, this project will provide empirical evidence explaining the drivers of weight stigma for women across the preconception, pregnancy and postpartum periods, to inform maternal obesity prevention interventions. Working with key stakeholders to address the dearth of research on how to implement such policy, this project has the potential to drive significant health and population benefits through changes in policy agendas that assist women to optimise preconception and pregnancy weight gain and thus improve maternal and child health outcomes.							

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DP220101179	**Targeting TGF-beta proteins to control animal reproduction**	79,500.00	166,000.00	170,500.00	84,000.00	0.00	0.00	500,000.00
Walton, Dr Kelly L	This project aims to develop a suite of novel biologics to control fertility in female mammals. This project expects to demonstrate that targeting a single class of ovarian proteins will enhance or inhibit egg production. The expected outcomes of this project are to (1) transform the breeding of livestock animals, which should provide significant benefits to the agricultural industry, through increased herd/flock sizes, and (2) provide a non-surgical method of contraception in companion/feral species, which should address the large unmet need for fertility control in these animals.							
	National Interest Test Statement							
	There is an unmet need to better control animal reproduction. On the one hand, it is imperative that more efficient reproductive strategies are developed to increase herd/flock size in livestock animals, while, on the other hand, new means for fertility control in companion/feral animals are required. This project aims to develop a completely novel suite of patentable reagents to meet these diverse reproductive goals. Improving fertility in sheep and cows will advance the National Science and Research Priority of enhanced capacity in food production and ensure the livestock industry maintains its central role in powering the Australian economy. Conversely, developing a permanent, non-surgical method of contraception for companion and free-roaming animals will improve animal welfare and, potentially, help protect our native fauna.							
DP220101198	**Add mountains and shake: plate boundary fault and earthquake patterns**	48,000.00	133,000.00	170,000.00	85,000.00	0.00	0.00	436,000.00
Cruden, Prof Alexander R	This project aims to determine the fundamental physical processes that link topography, seismic shaking and volcanism to the evolution of seismogenic fault networks in obliquely convergent (transpressional) plate boundary settings. We will combine detailed field and remote sensing-based structural analyses in transpressional mountain belts with advanced laboratory analogue and numerical experiments to evaluate: 1) how bursts of strong seismic shaking perturb fault zone evolution through time; 2) the contribution of topography and gravitation loading to fault interactions and earthquake generation; and 3) feedbacks between fault network development, the spatial distribution of volcanic centres, seismic shaking and ore deposits.							
	National Interest Test Statement							
	The dissemination of the findings of our research through peer reviewed publications, conference presentations, web sites and social media will strengthen Australia's international standing in the fields of structural geology, tectonics and geodynamics. The project will contribute to Australia's international role in the prediction and mitigation of natural hazards such as earthquakes and volcanic activity. The proposed research will develop a predictive framework for patterns of deformation, fluid flow and mineralisation in plate boundary settings that will be used extensively by Australia mineral exploration companies in their global search for the resources of the future. The research project will contribute to the training of highly qualified Earth scientists (postdoctoral, PhD and Honours BSc), who will become leaders in the Australian mineral resources sector and/or in academic research. The project will strengthen research ties and collaborations between Australia, Germany and New Zealand.							
DP220101209	**Data analytics-based tools and methods to enhance self-regulated learning**	65,746.50	132,624.00	128,759.00	61,881.50	0.00	0.00	389,011.00
Gasevic, Prof Dragan	This project aims to develop student self-regulated learning skills by harnessing the potential of Big Data analytics. The project expects to generate new knowledge at the intersection of learning analytics, educational technology, learning sciences and teaching practice resulting from novel data collection and analysis tools and methods. The outputs are expected to include insights into metacognitive, motivational, and technical issues facing analytics-based personalised feedback. The outcomes are intended to offer benefits for developing pedagogical and the design of educational technology. The outcomes can result in improved student learning outcomes in higher education to ensure graduates are prepared for the digital economy.							

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	National Interest Test Statement							
	The project produced results will contribute to the national priorities in Australia on economic, commercial, and social levels. Economically, the project will maximise graduate employability opportunities and scaffold career transitions required for the future workforce in an era of increased digitalisation and automation of jobs. This will be achieved by unlocking the potential of 'big data' to provide personalised support for fostering self-regulated learning skills in higher education and beyond. Commercially, this project will enable the development of the next generation of artificial intelligence and data science-driven products to advance the education technology industry. The technology industry will benefit from the design principles, models, and blueprints to develop technologies that optimise development of self-regulated learning and other higher order employability skills. Socially, the project will also offer validated approaches that can inform policies and practices in higher education for promoting personalised learning and develop self-regulated learning skills at scale.							
DP220101221	**Accessible Data Exploration and Analysis for Blind People**	95,000.00	190,000.00	190,000.00	135,000.00	40,000.00	0.00	650,000.00
Marriott, Prof Kimbal G	This project aims to develop new assistive technologies that will enable blind people to explore and analyse data more readily. The project expects to generate new knowledge in the fields of assistive technology, multimodal interfaces, dialogue systems and natural language understanding and generation. The expected outcome of the project is an innovative conversational agent that uses a mix of speech and tactile graphics to communicate with a blind user and proactively assists with data analysis tasks. This should provide significant benefits, as it will overcome barriers to data analysis and exploration by blind people that currently restrict access to government, health and personal data, and limit employment opportunities.							
	National Interest Test Statement							
	The last two decades have witnessed a sharp rise in the amount of data available to business, government and science. As a consequence data exploration and analysis skills have become essential knowledge for everyone, not just data scientists. However, many current exploration and analysis tools utilise data visualisation, effectively disenfranchising people who are blind. We aim to develop an Artificial Intelligent agent that makes data analysis accessible for blind people, thereby alleviating this inequity. The agent will allow blind people to tactually and verbally explore data, including personal, government and workplace-related data; and it will enable blind people to interact with data analysis tools. Endowing blind people with these capabilities will increase participation in society and employment opportunities, not only benefitting blind people, but the entire society.							
DP220101223	**Explainable Artificial Creativity**	62,085.50	129,585.50	137,500.00	70,000.00	0.00	0.00	399,171.00
McCormack, Prof Jon P	This project aims to develop explainable models for creative AI systems which enable more productive and satisfying interactions between them and their human co-creators. This will boost both human and machine creativity through sustained, ongoing exchanges, leading to high-quality creative outcomes via automated ideation and more advanced human-machine collaborations. The proposed techniques will be validated with creative professionals, ensuring practical industry relevance. We expect the outcomes to include new methods that automatically generate persuasive explanations, new forms of communication including dialogues between creative AI systems and users, and new understanding of general aspects of explainability for creative AI systems.							
	National Interest Test Statement							
	The use of Machine Learning and Artificial Intelligence (AI) technologies are rapidly gaining momentum across all areas of the creative industries. These technology innovations are set to radically transform how creative industries operate in the coming decades. Prior to the pandemic, the creative industries contributed over $90 billion to Australia's economy annually in turnover, so leveraging AI technologies for creative purposes is paramount. To get the most out of creative AI systems, both users and developers will need to understand what, why and how they have done something: without this, creative practitioners risk missing opportunities, working with low efficiency and producing substandard results. This research project aims to develop new ways for people to effectively collaborate with creative AI technologies, by enabling generative AI systems to elucidate the reasoning behind their decisions, the workings of their processes and the value of their outputs. This will hugely benefit creative professionals and general users alike, by generating trust and leading to high-quality creative outcomes.							

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DP220101234 Liu, A/Prof Joseph	**Scalable & Accountable Privacy-Preserving Blockchain with Enhanced Security** This project aims to address the scalability and accountability of privacy-preserving blockchain by advancing cryptographic techniques. This project expects to develop scalable protocols for privacy-preserving blockchain while also adding accountability for authority to trace cyber crime activities, which is a missing piece in any state-of-the-art public blockchain system. Expected outcomes of this project include not only practical solutions for protecting sensitive data recorded in blockchain but also crucial techniques to make the blockchain accountable for practical applications with enhanced security. This project provides significant benefits, such as building a trusted environment for sensitive transactions in the digital economy.	45,000.00	120,000.00	120,000.00	45,000.00	0.00	0.00	330,000.00
	National Interest Test Statement The proposed project aims to remove the barrier for applications to adopt blockchain technologies, by providing highly scalable privacy preserving blockchains. This would help businesses, both nationally and globally, to get a share of the expected US$176 billion to be generated by industry by 2025. For example, recent reports show that blockchain technology could help the banking industry to reduce its central finance reporting costs by 70%, and cut the banks' infrastructure costs by AU$15–20 billion annually by 2022, via savings on cross-border payments, securities trading and regulatory compliance. Making available scalable and accountable privacy-preserving blockchains, with enhanced quantum-safe security, presents an enormous opportunity to create jobs and support the growth of Australian businesses, as evidenced by recent reports from CSIRO's Data61, the Australian Computer Society and the Australian National Blockchain Roadmap from the Australian Government Department of Industry, Science, Energy and Resources.							
DP220101468 Capitanio, Dr Fabio A	**The impact of India-Asia tectonics on climate** This interdisciplinary project aims to determine the controls of tectonics on global climate in the last 50 million years. A combination of tectonics, paleogeography, climate modelling and high-performance computing will be applied to test systematically outstanding issues in the reconstruction of the Indo-Asia region and their landmass/seaways configurations and topography, which have bedevilled previous models of paleoclimate evolution. The proposal expects to generate novel knowledge in the area at the boundary between tectonics, paleoclimate modelling and present-day climate. This provides significant benefits to the interpretation of tectonics–climate coupling as current drivers of climate evolution.	76,488.50	159,420.00	135,492.00	52,560.50	0.00	0.00	423,961.00
	National Interest Test Statement The tectonics of the Indo-Asian region is associated with the emergence of complex features of present-day climate. The closure of the Tethys ocean, the growth of the Himalaya and the expansion of the Tibetan Plateau in the last 50 million years, are known drivers of regional, as well as global, climate change. To date, the exact timing of these critical features' evolution remain largely uncertain, affecting the global paleogeography and its correlation to the climatic record. This project will leverage geodynamics constraints, climate modelling and high-performance computing to systematically test the impact of tectonic forcing on the climate of key stages in the Cenozoic and their evolution into the present-day climate. The project will answer outstanding questions in Cenozoic tectonics, constrain their role in climate forcing and provide methodological advance in paleoclimatology. These outcomes improve our ability to understand the current drivers of long-term climate change at the regional and global scale.							
DP220101660 Slim, Dr Anja	**The fluid dynamics of intrusions** This project aims to investigate intrusions, the primarily horizontal flows of well-mixed fluid into density-stratified surroundings. Such flows are fundamental in the atmosphere and oceans, but they are little understood because they are controlled by strong feedback between the intrusion and internal waves generated in the stratified ambient. Existing studies rely on computationally intensive simulations, analogue experiments or ad-hoc models of limited applicability. This project expects to develop and validate a new, broadly applicable and rigorous mathematical model for such flows. Expected benefits include improved volcanic ash dispersal modelling and improved understanding of climate-critical oceanic and atmospheric flows.	47,500.00	127,500.00	96,000.00	16,000.00	0.00	0.00	287,000.00

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	National Interest Test Statement							
	Intrusive flows are fundamental flows in the atmosphere and oceans and as such they have widespread societal relevance. Volcanic ash from explosive eruptions is initially dispersed via an intrusion. They regularly causes disruption to air traffic, periodically grounding aircraft in Australia and have the potential of causing more prolonged and extensive disruption as occurred in Europe after the 2010 eruption of Eyjafjallajökull. Improved understanding of such flows would contribute to more reliable forecasts. Intrusions directly contribute to the overturning circulation in the oceans and play an important role in storm feedbacks and hence moisture distribution in the atmosphere. Improved understanding and modelling of such flows would contribute to more detailed and accurate forecasting of climate change and thus enable more refined mitigation approaches.							
DP220101787	**Measuring the Commercial Real Estate Sector in Australia**	55,774.50	102,248.00	82,829.50	36,356.00	0.00	0.00	277,208.00
Melser, Dr Daniel	This project aims to address a significant gap in our understanding of the Australian commercial real estate sector. It will use detailed data to develop sophisticated models of the prices of commercial buildings. Expected outcomes include a suite of commercial real estate price indexes for Australia, by region and property type, and a comprehensive and transparent examination of the methods used to construct them. This will shed light on a hitherto poorly measured sector and provide significant benefits by better informing market participants, guiding statistical agencies in developing such measures and better-enabling policymakers, banks, superfunds and macroprudential authorities to understand the risk profile of the sector.							
	National Interest Test Statement							
	Commercial real estate in Australia is worth at least $1 trillion, is an integral part of the production process economy-wide, secures around $239 billion in lending, and holds around $151 billion in superannuation savings. Yet there is no reliable information on the price dynamics of the sector. Using administrative and industry data, we will carefully develop, document, and deliver a suite of price indexes for the country, by region and property type. The indexes will have wide-ranging and enduring benefits: they will assist policymakers, banks and macroprudential authorities in better understanding risks to financial stability; assist government in developing appropriate land use policy; provide insight to superannuation funds about the risk-return characteristics of this asset class; better inform the many industry stakeholders from investors, renters, owners, and developers, to building managers and brokers; and help us understand the impact of the COVID-19 pandemic on the sector. Our approach will also provide a template for statistical agencies, and others, to construct such measures into the future.							
DP220101952	**Large-scale and long-term storage of Hydrogen in underground reservoirs**	85,000.00	175,000.00	167,500.00	77,500.00	0.00	0.00	505,000.00
Ranjith, Prof Pathegama G	This project aims to test effective strategies to re-use Australia's depleted gas fields for large-scale, long-term, renewable energy storage. With Australia's energy system undergoing a radical hydrogen-based energy transformation, a critical challenge in the years ahead will be to effectively store massive volumes of hydrogen for long periods (months and years). The overall expected outcome of this research is to fully understand the performance and the geological and environmental implications of long-term storage of hydrogen in empty gas fields. Benefit: this foundational scientific knowledge is crucial if Australia is to effectively bring about this new, sustainable, affordable, long-term, hydrogen-storage solution.							
	National Interest Test Statement							
	To tackle the challenges of increasing energy demand, committed decarbonisation goals, and climate change, Australia must transform its energy system in a novel direction. Green hydrogen has become very well-positioned for this future energy transition, since Australia will soon generate hydrogen at the commercial scale using surplus energy from renewable sources. The proposed project addresses a critical yet overlooked element of that energy transformation: large-scale, long-term energy storage and management. As the very first study into using Australia's depleted gas fields to store hydrogen, this research will provide new geological insights for selecting suitable sites, as well as strategies to ensure the safe and secure operation of storage facilities in the long-run. This would significantly benefit the Australian economy by enabling a new, low-emission, domestic energy supply; opportunities for future export revenue; and new industries and jobs. It would also reuse Australia's empty gas fields, improving sustainability. Last, but certainly not least, it would contribute to climate change mitigation.							

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DP220102203	**Carbon Molecular Sieve Membranes for Organic Solvent Separation**	70,000.00	140,000.00	140,000.00	70,000.00	0.00	0.00	420,000.00
Zhang, Prof Xiwang	Directly addressing the pressing challenge of organic solvent separation faced by numerous industries, the project aims to develop molecular sieve membranes with outstanding selectivity and solvent tolerance by constructing zeolite-carbon mixed matrix membrane via incorporating zeolite nanosheets into carbon materials. The project expects to generate advanced knowledge of nanosheet synthesis, membrane fabrication and selective molecule transport. The membranes developed in the project have great potentials for improving the production capacity and sustainability of Australian industries, e.g., pharmaceutical manufacturing, bioethanol production and petroleum refining, providing significant economic and environmental benefits to Australia.							
	National Interest Test Statement Organic solvents are commonly used in Australian key industries (e.g., pharmaceutical manufacturing, bioethanol production and petroleum refining) as reaction media, raw materials or final products. Organic solvent separations are essential for product enrichment and purification, raw materials recycling, resource recovery and waste minimisation. Because of their small molecular sizes and subtle size difference, organic solvent separations still predominantly rely on energy-intensive separation technologies. To address the urgent need for energy-efficient organic solvent separation, the project aims to develop highly selective membranes with outstanding solvent tolerance. The membranes developed in the project have great potentials for improving the production capacity and sustainability of Australian industries, providing significant economic and environmental benefits to Australia. The new knowledge of membrane fabrication and application will improve Australia's research and innovation capability and train next generation of highly-skilled scientists and engineers.							
DP220102212	**The Zarankiewicz problem through linear hypergraphs and designs**	32,500.00	96,500.00	130,000.00	66,000.00	0.00	0.00	325,000.00
Horsley, A/Prof Daniel J	The Zarankiewicz problem is a famous open problem with deep connections to many different areas of mathematics. Despite continued attention from some of the world's most celebrated mathematicians, it has remained unsolved for over 70 years. This project aims to make major progress on the Zarankiewicz problem by utilising a novel approach based in the field of combinatorial design theory. This approach will leverage recent major breakthroughs in design theory concerning edge decompositions of dense hypergraphs.							
	National Interest Test Statement This project aims to make breakthroughs on the Zarankiewicz problem: a famous unsolved mathematical question that has deep connections to many important areas of mathematics. The results obtained and techniques developed will have a wide impact in the mathematical community and will add to Australia's already strong reputation for research excellence in pure mathematics. The Zarankiewicz problem has connections to many vital real-world applications, including to data transmission and compression, the efficient design of experiments, and traffic control in optical fibre networks. Through the training of two young researchers, the project will also contribute to creating a highly skilled workforce and nurturing Australia's future research leaders.							
DP220102362	**Predicting adaptation and range expansion under climate change**	76,959.00	173,987.50	166,198.50	69,170.00	0.00	0.00	486,315.00
Hodgins, Dr Kathryn A	This project investigates the repeatability and thereby the predictability of adaptation to climate change by leveraging 1000 genomes sampled over 150 years and multiple climatic gradients in the rapidly adapting, globally invasive, and highly allergenic ragweed. We expect to deepen our understanding of the genetic basis of adaptation and decipher the circumstances under which adaptive genetic change is repeatable, by integrating a novel evolutionary model with genomic data. We will develop the capacity to predict species' distributions and trait evolution under climate change using a powerful empirical dataset. This will provide us with the capacity to anticipate and manage the effects of climate change on noxious and threatened species.							

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	National Interest Test Statement							
	Ragweed is the single most allergenic weed, causing skin irritation in 34% of Australians tested. Its pollen is responsible for rhinitis and seasonal asthma in Queensland and New South Wales where it is naturalised and it is increasingly found in Western and South Australia. It is also an agricultural weed causing heavy yield losses in soybean across America. With climate change, there is a substantial risk that ragweed would expand its range in Australia and become extremely noxious. Our research will make an impact within the Science and Research Priority Environmental Change by providing enhanced models that incorporate adaptive potential using genomic information. Current models of invasion underestimate the adaptive potential of weeds by not considering the genetic variation present within each species or their ability to evolve. Our research will fill this gap using ragweed as a model and provide a framework generally applicable to weeds with environmental, agricultural, or health impacts.							
DP220102401 Rossjohn, Prof Jamie	**An investigation into T cell immunity towards metabolites** This project aims to investigate how the immune system responds to small molecule metabolites, an emerging area in the life sciences about which little is known. The project aims to combine innovative mass spectrometry, structural and biochemical approaches to learn how metabolites are presented to specific T lymphocytes by an antigen presenting molecule called MR1. Outcomes are expected to transform the current understanding of the molecular basis underpinning metabolite-mediated immunity. Significant benefits are anticipated to include fundamental new knowledge about immunity that may ultimately be used by the biotechnology industry.	121,000.00	242,000.00	242,000.00	121,000.00	0.00	0.00	726,000.00
	National Interest Test Statement							
	Metabolite-mediated T cell immunity is emerging as a key area in the life sciences, being implicated in protective and aberrant T cell reactivity. This proposal will explore the use of novel biochemical tools, combined with structural and mass spectrometry approaches to study how T cells of the immune system responds to small molecule metabolites presented by an antigen presenting molecule, termed MR1. The national interest of this proposal lies in a) an advancement of fundamental knowledge in the functioning of the immune system and b) the multi-disciplinary nature of the research proposal will increase Australia's research capacity within this area via the training of a new generation of scientists with these skills. Further, this project will have direct implications for the biotechnology industry, where immunotherapies have the potential to treat many conditions relating to the function of the immune system.							
DP220102402 Rossjohn, Prof Jamie	**An investigation into CD1a, a versatile antigen-presenting molecule** This project aims to investigate how T lymphocytes are activated by lipids presented by the skin-associated antigen-presenting molecule, CD1a. Using X-ray crystallography and cellular immunology, we will provide fundamental insight into this poorly understood immunological axis. We will determine the molecular basis for how CD1a presents diverse self and foreign lipids, and how such CD1a-lipid complexes are recognised by the responding T cells. This basic science discovery project will provide substantial new knowledge in the burgeoning field of lipid-mediated immunity, which should ultimately lead to new therapies targeting the CD1a lipid display molecule to either prevent immune mediated damage or promote protective immunity as required.	94,571.00	190,302.00	192,622.00	96,891.00	0.00	0.00	574,386.00
	National Interest Test Statement							
	This proposal will investigate how T lymphocytes of the cellular immune system specifically responds to lipids and how this can play important roles in homeostasis as well as microbial immunity. The proposal uses a broad range of methodologies, including X-ray crystallography, protein chemistry and cellular immunology techniques to understand how the cellular immune system senses danger signals originating from lipids. The national interest of this proposal is: a) discovery science in an emerging area of immunological research into lipids; b) enhancing Australia's research standing and capacity in the life sciences field. This project will ultimately be of interest to the biotechnology industry as lipids are emerging as key mediators in inflammatory skin-based diseases and immunomodulatory agents.							

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DP220102500	**Mapping and defining inter-organ cross talk during exercise**	101,803.50	217,063.00	195,212.50	79,953.00	0.00	0.00	594,032.00
Febbraio, Prof Mark A	This project aims to examine precisely how organs communicate and interact. These interactions are particularly important during exercise, when continued movement demands intricate organ communication, and have major ramifications for the whole organism as it ages. Precisely how this communication takes place is unclear, but we now know that the movement of cargo with extracellular vesicles (EVs) plays an integral role in organ to organ communication. This project expects to build upon unprecedented recent developments we have made in the biology of inter-organ communication via EVs. The expected outcomes will have broad impact across life science and biotechnology.							
	National Interest Test Statement							
	Humans have survived on this planet for thousands of years because of our ability to physiologically adapt to the environment and much of this adaptation is due to movement. This application will establish the precise mechanism by which exercise allows for vital organs to communicate with each other. It will build on the already established research program, where we have identified many so called "myokines" which has led to commercial outcomes such as the foundation of new biotechnology companies. This project will attract world-class researchers to collaborate within Australia and it will provide an excellent training and mentoring environment for young researchers. It will grow international collaboration and enhance Australia's Life Science knowledge base and international research reputation.							
DP220102523	**Investigating Hippo-regulated transcription at single molecule resolution**	84,000.00	168,000.00	168,000.00	84,000.00	0.00	0.00	504,000.00
Harvey, Prof Kieran F	Signalling pathways operate throughout life to relay signals from the extracellular world to the cellular nucleus, to control transcription and elicit a response. This project aims to understand how the Hippo growth control pathway regulates transcription. Using a combination of biology, biophysics and computational biology, this project aims to quantify behaviour of the Hippo pathway transcription factors at sub-micron resolution, and how Hippo signalling modulates their behaviour, interaction with the genome and function. We anticipate our discoveries will stimulate new research, e.g. testing of how other signaling pathways regulate transcription. Intended benefits are creation of jobs and new knowledge on fundamental principles of life.							
	National Interest Test Statement							
	This project aims to provide new fundamental insights into how a cellular signalling pathway (Hippo) controls organ size and development in animals. This research is a valuable foundation for regenerative medicine and for our understanding of some forms of cancer (both of which relate to regulating elements of controlled or uncontrolled cell growth). More broadly, the project will provide an essential intellectual framework and the key tools to study, and ultimately control, signalling pathways for gene transcription and cellular behaviour. Given that these signalling pathways operate in all species (e.g. mammals, plants, insects, bacteria) the framework has the potential to be of far reaching benefit to the biotechnology industry with commercial, economic and health benefits for the Australian community.							
DP220102562	**Exploiting microbial metabolites to understand fungal biology**	91,599.50	185,359.00	182,931.50	89,172.00	0.00	0.00	549,062.00
Traven, Prof Ana	The project aims to investigate the principles of hyphal growth in fungi, by studying the mechanisms of action of a bacteria-derived compound that inhibits hyphae. Changing cell shape between yeast and hyphae is a prototype developmental switch enabling fungi to escape stressful environments, while hyphal invasion promotes fungal infections of animals and plants that endanger food security and biodiversity. By using interdisciplinary approaches of microbiology and chemistry, the expected outcomes are to generate deep knowledge of an important microbial process and how it could be modulated, characterise a new bacterial compound and build research capacity at the nexus of biology and chemistry to benefit discoveries in academia and industry.							

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	National Interest Test Statement							
	Fungal infections of animals and plants threaten environments, biodiversity, health and food supply. Many such infections rely on invasive fungal hyphae to penetrate and destroy tissues, yet our knowledge of hyphal growth and how it could be stopped is incomplete. This project will combine biology and chemistry to characterise a microbial product that inhibits fungal hyphae. This approach was chosen because chemicals produced by microbes are a rich source of bioactive compounds for applications in agriculture, health and biotechnology. The intended outcomes are to advance knowledge of fungal hyphal growth, characterise a microbial product that inhibits this process and train researchers in frontier technologies of biology and chemistry. This sort of interdisciplinary training is rare, yet critical to solve current and future challenges in biology and biotechnology. These outcomes should lead to benefits for Australia by building knowledge of an important microbial process with economic, societal and environmental implications and by generating a future-ready workforce for biotechnology industries.							
DP220102567 Andrews, Prof Zane B	**Hunger flexibly modifies hypothalamic neural circuits responding to threat.** Animal and human behaviour frequently involves a choice between actions or goals with conflicting positive and negative outcomes. However, the appropriate action or goal in conflicting situations often depends on physiological pressures like hunger, stress and mating opportunities. For example, the need for resources within an environment, such as food, drives approach behaviour, whereas threats to survival, such as predator cues, enhance avoidance behaviour. This project will uncover the neural circuitry and endocrine mechanisms through which hunger influences hypothalamic threat-detecting circuits that suppress food intake. These studies provide a new hypothalamic model to understand risk/reward decision in the brain.	92,727.00	185,210.00	185,604.00	189,793.00	96,672.00	0.00	750,006.00
	National Interest Test Statement							
	This project examines how the brain balances the conflict between avoiding threats and maintaining appetite, particularly during hunger. The investigation into how fear of danger affects appetite is important for many industries in Australia, including agriculture, animal health and conservation, which rely on achieving optimal growth at minimal cost. Indeed, stress-induced suppression of feeding can significantly impair animal growth rates, health & well-being, and survival, all of which influence economic outcomes for the primary food production industries (agriculture, aquaculture and fisheries). More broadly, the research will make important contributions to our fundamental understanding of how the brain computes risk/reward decisions under different environmental contexts.							
DP220102812 Phillips, Dr Andrew J	**Circadian photoreceptor sensitivity and impacts of modern lighting on sleep** Light has powerful non-visual effects, including effects on sleep. These non-visual effects are mediated by cells in the eye that are most sensitive to blue light. There are large individual differences in sensitivity to non-visual effects of light that are not understood and that would give great insight into suboptimal sleep, which has become widespread in modern society. This study will be the first systematic examination of individual differences in the effect of blue light on sleep and will uncover how alterations in the gene responsible for the effects of blue light on sleep (OPN4) contribute to these differences. This will lead to scalable individualised solutions to the unmet problem of how modern light environments impact sleep.	72,915.50	161,051.50	142,577.50	54,441.50	0.00	0.00	430,986.00
	National Interest Test Statement							
	Light has powerful effects on sleep. The move to energy-efficient LED lighting is occurring world-wide, with little systematic study of its effect on human physiology, resulting in unwanted negative effects on sleep. Australia's transition to LEDs has resulted in national savings of an estimated $5.5 billion per year. Current LED systems, however, do not take human biology into account and contribute to inadequate sleep (costing the Australian economy $26 billion per year), workplace accidents (costing the Australian economy $61 billion per year), and incalculable costs to general health. Our recent research shows that some people are much more sensitive to the effects of light than others, but we do not know the biological reasons or the real-world impacts. Our team is ideally positioned to understand mechanisms for individual differences in the impact of modern lighting on sleep. Our project will provide a mechanistic understanding of light sensitivity and will lead to scalable solutions for measuring light sensitivity and ultimately improving the way we light our homes and businesses.							

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DP220102867	**Epigenetic regulation of immune memory**	101,802.50	204,622.00	203,121.00	100,301.50	0.00	0.00	609,847.00
Jacobson, A/Prof Kim	Immune memory cells emerge from the dynamic and transient immune response to deliver two critical abilities: to produce rapid recall responses upon reinfection but also to persist for decades. This project aims to define how the polycomb repressive complexes regulate immune cell fate, by utilising cutting-edge cell and chromatin biology techniques coupled with bioinformatic pipelines. Expected outcomes of the proposed research include key insights into epigenetic programming required for immune cell differentiation and longevity. This should provide significant benefits such as knowledge creation that may lead to development of technology that reprograms cell behaviour, and contribution to Australian research recognition and capacity.							
	National Interest Test Statement							
	The ability of the immune system to 'remember' foreign antigens and produce a rapid, effective response is the fundamental basis of immunity. Despite their importance to protection of humans, livestock and pets, we still do not know the critical molecules that induce and maintain immunological memory. This Proposal will advance our fundamental understanding of epigenetic molecules that ensure the endurance and effectiveness of immune memory. This project will also: (i) enhance Australia's international research standing, (ii) increase novel research capacity by providing high quality career development opportunities to students and early career researchers, (iii) provide research mentorship and environment that will impart cultural benefits to Australia through the fostering of science communication skills and opportunities. In the longer term (beyond the scope of this proposal), the fundamental knowledge of immune cell biology addressed by this proposal have future applications for developing improved practices to protect against new pathogenic strains and to inform research into immunotherapies.							
DP220102873	**A balancing act: Resolving coastal wetland water, carbon and solute fluxes**	52,500.00	116,500.00	115,000.00	51,000.00	0.00	0.00	335,000.00
Reef, Dr Ruth E	Coastal wetlands offer an impressive capacity to regulate the Earth's climate by altering the way carbon dioxide is extracted from the atmosphere and stored while simultaneously influencing the water cycle, thus providing ecosystem services such as carbon storage, abating flood waters, improving water quality and protecting the coastline from sea level rise. This project aims to address the current gaps in understanding the critical exchanges of water and greenhouse gases (GHGs) combining field methodologies and hydrological models, under different climatic conditions. The intended outcomes will benefit management of GHG emissions, coastal flooding and vulnerable groundwater dependent habitats.							
	National Interest Test Statement							
	The carbon and water cycles in coastal wetlands are critical exchanges among land, ocean, and atmosphere. They determine globally important processes, such as carbon sequestration, nutrient delivery, and coastal surface elevation, with coastal vegetation playing a key role in these dynamics. Combining field methodologies and numerical modelling, our project focusses on these delicate coastal ecosystems, which are beneficial in mitigating climate change impacts such as flooding and salinisation of coastal aquifers, thus providing a nature-based solution for economic damages measured in billions. This project will assess 1) the water balance of coastal wetlands, 2) the role of climate and groundwater flow in carbon, salt and nutrient exchange at the coast, and 3) how plant transpiration and groundwater extraction influence coastal subsidence. By quantifying and improving the understanding of the flows of water, nutrients, and carbon occurring at coastlines, these ecosystems can be better managed to reduce flood disaster risk, improve water quality and improve climate change adaptation.							
DP220102914	**Pursuing Public Health in The Preindustrial World, 1100-1800**	100,000.00	270,000.00	315,000.00	205,000.00	60,000.00	0.00	950,000.00
Geltner, Prof Dr Guy	This project aims to recover community-health practices in three world regions before the takeoff of European industrialization. It challenges a common chronology and geography in public health history by examining how especially non-urban societies in Europe, the Middle East and India adjusted their behaviors and environments to manage health risks, often relying on the principles of humoral (or Galenic) medicine. A multidisciplinary team will conduct spatial, material, pictorial and text-based analyses, which will collectively extricate public health from Eurocentric narratives of modernization and illuminate preventative-medical cultures often ignored or studied in isolation.							

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	National Interest Test Statement							
	How did past communities define and promote their health? The answer can help meet current threats and prepare for future ones. At present, much of the historical insight into public health focuses on responses to the Industrial Revolution in urban Europe, and on colonial and imperial programs abroad. Neither, however, offers a full account of communities' deeper hygienic pasts and their present implications, a situation this project seeks to amend. Global health crises have repeatedly highlighted the dangers involved in a preference for modern biomedical solutions, which ignores culturally-specific definitions of health and communities' experiences and memories of disease. Furthermore, in laying a foundation for a broad but culturally nuanced research framework, the project develops a robust, multidisciplinary platform that can be adapted to the study of different cases and admixtures of evidence. As such, it will set new quality standards and keep Australia at the forefront of medical-historical research.							
DP220102952 Sparrow, Prof Robert J	**Artificial Intelligence, Robots, and Agriculture: Social and ethical issues** This project aims to investigate the social and ethical issues raised by the use of artificial intelligence and robotics in agriculture. By combining social science research methods and philosophical analysis, the project aims to generate new knowledge in bioethics and applied ethics. Expected outcomes of this project include an account of the social and ethical issues farmers, rural communities, and consumers anticipate arising from these technologies, improved understanding of these issues, and an account of how these groups would like to see these issues addressed. This should help Australia benefit from the responsible use of artificial intelligence and robotics in agriculture.	95,000.00	205,000.00	220,000.00	110,000.00	0.00	0.00	630,000.00
	National Interest Test Statement							
	Australian agriculture currently faces a series of profound challenges arising from soil degradation, depletion of the water table, loss of biodiversity, climate change, and demographic change. Robotics and artificial intelligence have the potential to bring about a 4th agricultural revolution to meet these challenges. By identifying the social and ethical issues raised by the use of AI and robotics in agriculture, this research will help farmers, businesses, policymakers, and the broader Australian community make informed decisions about the development and use of these technologies. It will benefit Australia by promoting the responsible use of AI and robotics to increase food production, support rural communities, and protect Australia's unique natural environment. Through its use of citizens' juries, and other social research methods, this project also contribute to an informed public discussion of the future of agriculture.							
DP220102958 Sgro, Prof Carla M	**Genomic vulnerability** Aims: This project aims to validate genomic predictions of species' vulnerability to climate change. Significance: Species are already responding to climate change, and many face high predicted rates of extinction. Some species will be able to avoid extinction via evolutionary adaptation. Yet we currently lack the ability to accurately predict which species do and do not have the capacity to adapt and avoid extinction. Expected outcomes: Expected outcomes of this project include enhanced ability to predict species' vulnerability to ongoing climate change. Benefits: This project should significantly improve our capacity to manage threatened and keystone species by identifying those that will require targeted conservation management.	97,390.00	237,853.00	189,182.00	48,719.00	0.00	0.00	573,144.00
	National Interest Test Statement							
	Australia's biodiversity is facing an extinction crisis. Some species will be able to avoid extinction through evolutionary adaptation. Predicting which species will be able to evolve their way out of trouble, and which won't, will be key to securing Australia's biodiversity at a time of rapid environmental change. This project will assess the extent to which genomic data can be used to accurately predict species' extinction vulnerability. The outcomes will inform the use of genomic data in threatened species management. By validating the use of genomics to identify species at risk we will be better able to use targeted management, such as habitat restoration, captive breeding programs or genetic rescue to mitigate extinction risk. The project may lead to advances in the agricultural and health sectors by increasing our ability to predict pest and disease vector responses to environmental change. This work will contribute to Australia's capacity to manage biodiversity and safeguard our environment.							

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DP220102997	**Defining the antiviral effects of Wolbachia in Aedes aegypti mosquitoes**	75,000.00	150,000.00	155,000.00	80,000.00	0.00	0.00	460,000.00
Fraser, Dr Johanna E	Mosquitoes that carry a bacterium called Wolbachia do not transmit human pathogenic viruses. These mosquitoes are being developed as a biocontrol tool to prevent mosquito-borne diseases. This project aims to define the molecular basis for virus inhibition by Wolbachia. Using unique biological tools including mosquitoes carrying different strains of Wolbachia that do or do not inhibit dengue virus, the project will define how Wolbachia modifies its host to create an antiviral state. The findings will provide insight into how viral pathogens can be suppressed in insect hosts. This may guide future viral disease intervention strategies for diverse areas afflicted by insect-borne viral disease, including human health and agriculture.							
	National Interest Test Statement							
	This project will lead to a better understanding of how the bacterium Wolbachia is able to inhibit the transmission of certain viruses when artificially introduced into mosquito populations. This Australian-led biocontrol technology has successfully halted transmission of dengue virus in North Queensland and is now being tested in 10 countries around the globe. Defining how Wolbachia modifies its mosquito host to create this effect will fill a vital knowledge gap in endosymbiont research and help us understand the different ways in which bacteria are able to manipulate their host environment. Ultimately, these findings may be used to develop second generation Wolbachia-mosquito combinations to to facilitate the long term effectiveness of this intervention, and may identify novel applications such as controlling disease spread by agricultural pests.							
DP220103023	**How does temperature affect complex life histories? A Cost Theory approach**	30,000.00	143,000.00	233,000.00	120,000.00	0.00	0.00	526,000.00
Marshall, Prof Dustin J	This proposal seeks to understand how temperature affects the relative costs of early life history stages, from development, through to energy independence for a diverse array of taxa, from seaweeds, to plants to vertebrates. The proposed research seeks to test the predictions of a new framework, Developmental Cost Theory, and extend this theory to include germination (for plants) and metamorphosis for animals. The anticipated goals are to provide clear predictions regarding which species are likely to thrive or suffer under continued global warming, and a valuable framework for understanding how temperature shapes the life histories of organisms, including those that are important from an ecological or agricultural perspective.							
	National Interest Test Statement							
	This proposal seeks to understand how temperature shapes the costs of development for plants and ectotherms (such as fish, insects and marine invertebrates). The proposed research provides a predictive framework that anticipates those species that are to suffer lower development costs under rising temperatures (i.e. 'winners') and those likely to experience higher developmental costs ('Losers'). Identifying species that are winners and losers under climate change is essential in the groups explored here. Plants that provide our crops, insects that pollinate these crops or act as pests, and aquatic ectotherms that provide seafood. Understanding which species are likely to benefit from rising temperatures and which are likely to suffer is an urgent priority in Australia's national interest. In doing so, we can better identify future-proof crops and aquaculture species as well as provide early warnings about those species that are more likely to perform poorly under future thermal regimes.							
DP220103074	**Enumeration and random generation of contingency tables with given margins**	31,000.00	95,000.00	130,000.00	66,000.00	0.00	0.00	322,000.00
Wormald, Prof Nicholas C	This project aims to find algorithms to construct random tables of numbers having given totals across the rows and down the columns. The aim is also to study properties of such tables. A significant aspect of the project is that it is expected to cover scenarios where all existing methods fail, by deploying recently developed powerful techniques used for random networks in combinatorics. Expected outcomes of this project include the development of efficient algorithms that can be used in statistics for identifying relationships between variables in large data sets. This would help bring Australia to the forefront of research in an area that is significant both in data analysis and in discrete mathematics.							

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	National Interest Test Statement This research is in pure mathematics, but with potential applications in statistics. Pure mathematics research benefits Australia because keeping the nation's hand in fundamental research helps it to share in the fruits of such research. Training with strong mathematical background has advantages in many areas through its rigour and depth of analysis, and its universality: the pure concepts have logical foundations and thus apply in many different contexts. This project also has a well identifiable potential application in statistics to analysis of contingency tables arising in experimental data. Examples are wide-ranging, including genetic data being associated with illnesses in the presence of different environmental factors, and examination of effects of vaccinations or medicine to treat disease.							
DP220103106 Guo, Dr Ivan W	**Can green investors drive the transition to a low emissions economy?** The project aims to develop a game-theoretical approach to model the impact of climate change on financial markets by studying the interactions between the government, companies and investors. Expected outcomes include novel solution concepts for stochastic games with heterogeneous beliefs, asymmetric information, and model uncertainty, as well as optimal investment and production strategies under climate driven economic transitions. Results will be used to validate and improve the recently launched Australian based climate transition index. The project should yield significant benefits for the financial industry and investors by providing novel insights into financial risks during the transition to a low emissions economy.	65,000.00	130,000.00	130,000.00	65,000.00	0.00	0.00	390,000.00
	National Interest Test Statement This project aims to develop mathematical models based on game theory to analyse the impact of climate change on the economy and financial markets in Australia. There has been a growing demand from investors and the financial industry to quantify the risk of climate change and seek sustainable investments. The project studies the behaviours and interactions of the government, companies and investors in various transition scenarios to a low emissions economy. Agents may have asymmetric access to information and heterogeneous beliefs about the impact of greenhouse gas emissions, as well as contrasting objectives. By examining various equilibrium concepts and working with institutions such as ClimateWorks Australia, the project will produce sustainability scores for individual companies based on their business models, emission levels and technological innovations. Moreover, the project will validate and improved the recently launched Australian-based climate transition index index, which will help investors better manage the financial risks of climate change and the transition to a low emissions economy.							
DP220103160 Badia, Prof Santiago	**Towards predictive 4D computational models for the heart** This project aims to develop novel high-performance numerical algorithms for multiscale and multiphysics PDEs with dynamic interfaces, the development and analysis of a novel PDE system modelling the electromechanics of heart and torso, and the combination of these numerical techniques and models to deliver predictive tools for patient-specific simulations of the cardiac function. It involves the design and mathematical analysis of space-time variational discretisations on embedded meshes, 4D computational geometry algorithms for numerical integration and multilevel solvers. By combining scientific computing and machine learning, one anticipated outcome of this research is a new generation of nonlinear PDE approximations and solvers.	66,000.00	132,000.00	132,000.00	66,000.00	0.00	0.00	396,000.00
	National Interest Test Statement Modelling the cardiac function involves electrical, chemical, solid and fluid mechanics models coupled through free interfaces. This multiphysics system also exhibits a broad range of scales both in space and time. Unfortunately, such level of complexity cannot be accurately and efficiently handled with current numerical techniques. Research in computational science and machine learning, underpinned by a rigorous mathematical foundation, is the only way to generate predictive patient-specific tools that will eventually assist in medical prognosis and exploration of new treatments in personalised medicine. The economic and societal impact of such advancements are notorious, heart disease being the leading cause of death in Australia. The algorithms and software tools produced by this project will not only allow scientists to better understand and predict the cardiac function but also benefit other disciplines that might involve multiscale and multiphysics problems with free interfaces.							

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DP220103197	**The structural basis for MPEG1 mediated assembly of immune complexes**	89,635.50	181,464.00	185,843.50	94,015.00	0.00	0.00	550,958.00
Whisstock, Prof James C	Macrophage Expressed Gene-1 (MPEG1) is an ancient pore forming perforin-like immune effector that is found throughout multicellular life. In humans MPEG1 is found in Macrophages (a type of immune cell) and functions to eliminate a wide range of different infectious microbes. In this study we will study how different modifications and molecular interactions drive MPEG1 function. Crucially our work will provide a framework to understand how MPEG1 interacts with the interferon signalling pathway. These data will provide fundamental insight into how perforin-like proteins are controlled and will broadly inform new approaches to modify immune function and molecular signalling events.							
	National Interest Test Statement							
	Immunity related conditions have a massive impact on quality of life and represent a signifiant (multi-billion / year) financial burden on society. There is accordingly an urgent need to understand the fundamental basis of how the immune response is triggered to function and how it is controlled. This proposal focuses on a conserved immune weapon (MPEG1) that is deployed by an ancient part of the immune system (the Macrophage) in order to destroy microbial targets. By studying MPEG1 we will gain important insights into the checks and balances that are in place to control a fundamental part of the immune system. This information will furthermore yield new insights into how complex signalling pathways in embryonic development, growth and neural development are controlled. Collectively in addition to fundamental knowledge, the outcomes of the project will inform future approaches to control unwanted immune function, for example the hyper activation events associated with cytokine storm.							
DP220103306	**Physician Preferences for Medical Innovation**	36,234.50	72,523.50	74,066.50	37,777.50	0.00	0.00	220,602.00
Avdic, Dr Daniel L	This project aims to identify the causes and consequences of medical practice variations by providing new evidence on the process through which physicians adopt and use new medical technology. This project expects to generate new knowledge on how physicians' human and social capital determine their preferences for taking up new medical technology and the economic consequences of such decisions. Expected outcomes of this project include a greater understanding of the sources for and costs of inappropriate use of healthcare, such as low-value care. This should provide significant benefits, such as contributing to the construction of effective policies for improving efficiency and equity of the healthcare system.							
	National Interest Test Statement							
	This project will benefit the Australian community by generating significant new knowledge on the role of the physician in the diffusion of new medical technology. This is a relevant research topic since spending on healthcare goods and services constitute the largest expenditure category in the Australian economy. Increasing rates of costly medical innovations are likely to add further strains on future healthcare budgets, prompting an urgent need to reduce low-value care and to optimise value in healthcare. Expected outcomes from this project will provide benefits to the Australian community by building and developing research capacity to reduce inappropriate use of medical care. Results from this project will improve healthcare policy in Australia by providing knowledge and instruments to reduce low-value care and inappropriate medical practice variation in health service delivery.							
DP220103315	**Addressing the deficit in men's participation in paid care work**	50,000.00	100,000.00	50,000.00	0.00	0.00	0.00	200,000.00
Roberts, A/Prof Steven D	This project aims to address the chronic and ongoing underrepresentation of men in front line, low paid occupations in the Health Care and Social Assistance Sector by exploring how men already employed in the sector overcome the barriers to participating in such jobs. Utilising a qualitative methodology, this project expects to generate new theoretical and practical knowledge in the areas of critical studies of men and masculinity and labour market transitions. Expected outcomes include producing a better understanding of men in the low paid care work labour market. This should provide significant benefits in relation to tackling the serious current and projected shortages of personal and aged/disability carers in the coming years.							

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	National Interest Test Statement							
	This project aims to contribute both socially and economically to Australia's national interest by addressing the current and future employee shortages in Australia's Health Care and Social Assistance sector. This is the fastest growing sector in Australia, and it is projected to need an additional 252,600 jobs by 2024, with over one million workers needed by 2050. Key to tackling this issue is engaging more men in this sector. This project seeks to identify ways to increase men's participation in frontline work as 'Personal Carers and Assistants' and as 'Aged/Disability Carers' - the official occupational categories that will contribute most to the sector's jobs growth over the next five years. The research will produce important insights by considering men's willingness and capacity to engage in this type of employment in both regional and metropolitan Australian areas with pressing care workforce needs.							
DP220103421 White, Prof Craig R	**Manipulative tests of metabolic theory** This project aims to take a new interdisciplinary approach to understanding how energy flows through individuals, populations, communities, and ecosystems. The project expects to develop a new framework for understanding the function of biological systems, bringing together the fields of physiology, ecology, and evolutionary biology, generating research publications, and training students in interdisciplinary research. The proposed research is anticipated to provide a means for understanding how management interventions can alter energy flows in biological systems, bringing benefits across the areas of climate change adaptation, conservation science, agriculture and aquaculture, and fisheries management.	77,000.00	158,500.00	163,000.00	81,500.00	0.00	0.00	480,000.00
	National Interest Test Statement							
	This project aims to develop a new understanding of how energy flows from individuals to ecosystems. The project will achieve this by bringing together approaches from the fields of physiology, evolutionary biology, and ecology to test how the metabolic rate of animals affects the function and persistence of populations and communities. The research will help us understand how energy flows through agricultural and aquaculture systems and natural environments. Each of these systems face challenges related to energy flow, which can be addressed by understanding the way animals use energy to grow, reproduce, and stay alive – e.g. the conversion of energy from feed to market size in aquaculture, and the impact of harvesting practices on fishery yield. The project will offer an opportunity to understand and predict the effects of management or environmental changes on these basic biological parameters and design better management systems for natural environments.							
DP220103439 Hall, Prof Philip	**A Novel Approach To Flow Control By Topography** The project will resolve important questions concerning the influence of boundary topography on transition to turbulence and on the exact coherent structures forming the backbone of turbulence. The canonical topography known from previous work by one of the investigators is a wavy wall and, as well as resolving important issues in flow physics, the research is relevant to many flows of importance such roughness induced transition on aircraft wings, flows in heat transfer/mixing devices, blood flow and the influence of topography on the atmospheric boundary layer. Expected outcomes are an understanding of the interplay between transitional and turbulent flows with wall topography together with strategies to enhance mixing and drag reduction.	67,500.00	135,000.00	135,000.00	67,500.00	0.00	0.00	405,000.00
	National Interest Test Statement							
	This project fills a crucial gap in our understanding of how fluid flows interact with topography. This is a topic of worldwide interest and its resolution has diverse application in aerospace, transport, atmospheric forecasting, water, energy and medical device industries. For example, one-half or more of the energy consumed in long-distance transport of people, freight, and fluids typically results from wall drag which is a central focus of this work. The research is fundamental in nature, dealing with cutting edge analytical and computational techniques which are broadly applicable. The specific topic to be investigated is expected to impact aircraft design and the team is associated with major international efforts in this regard, including with global companies which rely on Australian expertise. Additional national benefit will accrue through the production of knowledge to underpin advances in the design of mixing devices in engineering, more energy-efficient pipelines, and new techniques to improve weather and climate forecasting.							

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DP220103444	**The control of cell signalling by membrane remodelling**	70,250.00	152,250.00	161,750.00	79,750.00	0.00	0.00	464,000.00
Johnson, Dr Travis K	Cells secrete signalling molecules called growth factors to drive critical developmental processes such as growth, differentiation and death. This project aims to understand a new mechanism that we have discovered for the control of growth factors by a protein family evolved to damage cell membranes. This is highly novel since the usual role of these proteins is to kill pathogens targeted by the immune system. By coupling innovative genetics, high-resolution imaging, and advanced biochemical analyses, this project intends to provide key molecular insights into how cell signalling can be regulated during animal development. We anticipate that this will impact our general understanding of membrane biology and its influence on cell signalling.							
	National Interest Test Statement							
	This project aims to expand our general knowledge of biological systems by understanding how the activity of growth factors and their receptors can be controlled. Growth factors are critical molecules for cell-to-cell communication that are released from cells to act on others for development and homeostasis. Their dysregulation in humans and other animals underlies developmental disorders and diseases such as cancer. Our work will therefore contribute vital new knowledge about cellular processes that may eventually, assist in the development of therapeutic treatments for animals including humans, and in developing the regeneration capacity of damaged tissues. We anticipate that the discoveries we make will also reveal how an important family of proteins, and the cell membranes on which they act, influence critical developmental processes. This is important for understanding the role of cell membrane in cell communication and other related cellular processes. This knowledge may lead to new commercial applications such as in the biomaterials industry.							
DP220103512	**Tackling the computational bottleneck in precision particle physics**	62,500.00	126,500.00	130,500.00	66,500.00	0.00	0.00	386,000.00
Skands, Prof Peter Z	This project aims to deliver a breakthrough technique in theoretical-computational particle physics, with significant potential for high-precision applications. The project targets some of the most advanced and resource-intensive calculations in particle physics, which are widely used but currently limited by extremely high computational resource requirements. This project expects to develop a novel approach that will vastly reduce the computational complexity while at the same time improving their accuracy relative to the current global state of the art. Expected outcomes include the new methodology itself as well as a full-fledged and open-access simulation code based on it, which should be highly efficient.							
	National Interest Test Statement							
	This fundamental project aims to achieve major breakthroughs that will be of profound importance to the field of high-energy physics, in partnership with major international efforts in this field. The project leverages Australian leadership of (among others) the Pythia project which is among the most widely used and highly cited theory efforts worldwide to probe new questions in particle physics. The project will develop advanced and widely applicable algorithms designed for high precision with a conscious effort to minimise computational resource usage. The outcomes will advance national benefit through downstream applications in computer programming and software development, including in large-scale data analysis and visualisation which are skills and tools needed in an advanced economy.							
DP220103548	**Adaptation by DNA download: Experimental evolution of a pangenome**	52,039.50	111,379.00	125,621.00	66,281.50	0.00	0.00	355,321.00
McDonald, Dr Michael J	This project aims to understand how microbes adapt when they can directly “download" new genes from their surrounding environment, or from other types of bacteria. Specifically, the proposed research will carry out the largest-scale measurements of the fitness effects of horizontally transferred genetic variation, to discover how each of these genes interacts with the environment, and with other genes. This project is expected to generate new knowledge in the fields of microbial evolution and microbiome science. The benefits of this cutting-edge research will be to strengthen Australia’s research capacity in these rapidly developing fields and to train a new generation of interdisciplinary scientists.							

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	National Interest Test Statement							
	This research proposal is in the national interest because it will increase our understanding of how microbes adapt in natural and clinical environments. Microbes impact our lives through health (infectious disease), agriculture (the nitrogen cycle), industry (fermented products), and the processes that support the global ecosystem. A fundamental goal of the scientific enterprise to mitigate and harness the potential of microbes. This project will advance this goal by combining powerful approaches – laboratory evolution, genome sequencing and bioinformatics - to study populations evolving with "horizontal gene transfer". Horizontal gene transfer is very common in pathogenic bacteria that have evolved antibiotic resistance and understanding this process could ultimately provide insights of medical significance. The results are highly likely to have a large scientific impact, given their scale and novelty. Importantly, this project will provide a launching pad for training interdisciplinary scientists.							
DP220103553 White, Prof Craig R	**A new model for animal growth** This project aims to test and further develop a new theory for how animals grow. The new growth theory brings together the fields of physiology, ecology, and evolutionary biology, generating research publications, and training students. The proposed research is anticipated to provide a fundamentally new means for understanding how animals divide energy among growth and reproduction, paving the way for organismal allocation to these processes to be optimised by selective breeding or genetic manipulation, yielding potential benefits for aquaculture (enhanced growth) or re-introduction (enhanced reproduction).	147,570.00	252,276.00	182,107.00	77,401.00	0.00	0.00	659,354.00
	National Interest Test Statement							
	The proposed project aims to develop a new understanding of how animals grow. The project will achieve this by bringing together approaches from the fields of physiology, evolutionary biology, and ecology, and will involve the training of a postdoctoral researcher as well as PhD students and honours students. The project has the potential to contribute to Australia's national interest through the development and validation of a novel framework to describe and predict how animals allocate energy to growth and reproduction. This framework could then contribute to the development of new strategies to maximise animal production in agriculture and aquaculture, and to maximise animal reproduction for stock replenishment, conservation, or re-introduction.							
DP220103555 Hobbs, A/Prof Robin M	**Regulatory roles of the RNA helicase DDX5 in male germline stem cells** This project aims to investigate the role of the RNA helicase DDX5 in regulating gene expression programs of male germline stem cells by utilising novel mouse models, stem cell culture and genome-wide analysis approaches. This project expects to generate new knowledge in the area of germline maintenance and adult stem cells using innovative in vivo and in vitro experimental systems. Expected outcomes of this project will include gain of substantial insight into molecular mechanisms underlying germline stem cell function and gene regulation within the male germline. This should provide significant benefits, including advancement of reproductive science and development of systems applicable for animal germline preservation and manipulation.	92,531.00	187,524.00	191,068.00	96,075.00	0.00	0.00	567,198.00
	National Interest Test Statement							
	Germline stem cells in the testis are essential for continuous sperm generation but mechanisms regulating activity of these cells are poorly understood. We aim to characterise the role of DDX5, an RNA helicase capable of controlling gene expression and cell function at multiple levels, in germline stem cells. This study promises insight into gene regulation in the male germline and can provide important advances in reproductive biology plus facilitate agricultural applications including assisted reproduction. Increasing our understanding of how germline stem cells are regulated can indicate approaches for conservation of species and aid in design of drugs that can modulate male fertility. As increased activity of DDX5 is associated with cancer, our studies on DDX5 in germline cells can have broad future health implications. This project brings together internationally-recognised experts in germline stem cell plus RNA biology fields and will provide training to junior researchers in these areas. Importantly, this project will help to maintain Australia's position at the forefront of male fertility research.							

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DP220103559	**Dynamics of mitochondrial cristae in life and death**	90,000.00	180,000.00	180,000.00	90,000.00	0.00	0.00	540,000.00
Ryan, Prof Michael T	This application seeks to use innovative approaches to address how massive structural arrangements in mitochondria are dealt with during normal cell function, and modulated during cell death. The study builds on discoveries made by a team with world-leading expertise in mitochondrial biology and cell death – and brings innovative, cutting-edge techniques in cell biology, proteomics and imaging. The findings will provide new fundamental insights into cellular organisation and uncover new principles of communication. Trainees will gain skills in technologies that are highly translatable and in demand in other areas of scientific endeavours. As such the expertise obtained will expand Australian research capabilities.							
	National Interest Test Statement							
	Mitochondria are found in almost all animal cells. This project aims to develop new insights into the organisation and regulation of the structural components in mitochondria. This fundamental knowledge is important for understanding, controlling and impacting cellular metabolism, mitochondrial disease, and programmed cell death in a host of species. New understanding in these areas, particularly the proteins and mechanisms involved, may underpin new technologies in agriculture (biogenesis and metabolism) or may open up new avenues for biological control and targeted drug design. One key outcome will be exploration of a recently discovered step in programmed cell death (called mitochondrial herniation), and unravelling the immune signalling here may have potential for future therapeutic application for a variety of autoimmune disorders.							
DP220103632	**Combating Antimicrobial Resistance with Bismuth, Gallium and Indium**	107,500.00	212,500.00	210,000.00	105,000.00	0.00	0.00	635,000.00
Andrews, Prof Philip C	This research project focuses on the design, development, and application of new bismuth, gallium and indium compounds as antimicrobial agents. These metals act as iron mimics in vivo and can exert antimicrobial activity while displaying low systemic toxicity in humans. The project aims to exploit this, and the inability of microbes to easily develop resistance towards metals, to combat bacteria for which modern drugs are rapidly becoming ineffective, as highlighted in the WHO and US Centre for Disease Control list of critical and priority pathogens. The intended outcome is that efficacy will be driven through advances in synthetic and structural chemistry, discovering the mode of action, and creating anti-infective coatings and hydrogels.							
	National Interest Test Statement							
	The World Health Organisation, the United Nations, and the US Centre for Disease Control have warned us of the dangers humanity faces as the 'antibiotic-era' draws to an end. Without the development of new antimicrobials and the ability to fight infection, humans across the globe face dramatic reductions in effective medical treatment and increasing mortality rates. There will be negative economic growth rates as GDP falls as a result of burgeoning costs associated with managing drug resistant microbes and their effect on health, food, and agriculture. Australia will be heavily impacted due to a economic reliance on agriculture, escalating healthcare costs, and the cost burden of implementing anti-infective strategies across both rural and more densely populated areas.							
DP220103638	**Systems-level characterization of scaffold protein signalling networks**	99,500.00	201,000.00	201,500.00	100,000.00	0.00	0.00	602,000.00
Daly, Prof Roger J	The PEAK family of cell signalling scaffolds regulate cellular responses critical for normal development and physiology. This project will adopt a ‘holistic’ approach to characterizing their mechanism and function, integrating experimental and mathematical approaches and developing predictive computational models. It aims to generate fundamental new knowledge in cell, computational and synthetic biology with broad relevance that will foster establishment of new international linkages. This research will also identify strategies for engineering novel scaffolds that re-program cellular behaviour towards specific, applied outcomes, with potential benefit for the fields of synthetic biology, bioengineering and biotechnology.							

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	National Interest Test Statement							
	The Project aims to generate fundamental new knowledge in cell, computational and synthetic biology, leading to major international recognition for Australian science. Its impact on areas as diverse as cell biology, mathematical modelling and regenerative medicine will foster establishment of major international linkages. The Project will also provide interdisciplinary training at the interface of cell and computational modelling, an emerging frontier. This will help develop a cutting-edge workforce and maintain Australia's international competitiveness. The work may ultimately benefit the biotechnology sector by identifying strategies for programming of cells so that they exhibit specific biological characteristics, such as increased proliferation, which could be exploited for large-scale cell production, or migration, with applications in immunotherapy, regenerative medicine or wound healing. Given the potential significance of the research findings in terms of fundamental knowledge, multidisciplinary training and applied synthetic biology, the project represents outstanding value for money.							
DP220103654 Whittaker, Dr Michael R	**Functional Materials to Hijack on Lipid Transport Pathways** This Project aims to provide new design rules for novel polymers with lipid elements that would allow them to interact with natural lipid trafficking pathways in precise ways. The anticipated goal is to generate a greater understanding on how these materials co-opt lipid transport pathways, serum albumins and lipoprotein nanoparticle assemblies, as a function of lipid component, molecular weight and macromolecular structure. Expected outcomes of this project may be novel lipid functional materials with tuneable pharmokinetics, plasma exposure, lymph exposure and biodistribution. These materials would have wide application in the pharmaceutical and veterinary industries.	71,310.50	146,889.00	147,143.50	71,565.00	0.00	0.00	436,908.00
	National Interest Test Statement							
	The development of new functional materials that give greater control of the delivery of therapeutic and imaging agents is of considerable importance to the advanced manufacturing sector, where new products with a high added value are constantly sought. Of particular benefit in the current proposal is the first-in-world investigation of lipid functional polymers designed to access natural lipid trafficking pathways in predicable ways. We can align the pharmacokinetic properties of the delivery system specifically with the delivery needs of a therapeutic or imaging agent. The project will provide a new platform technology for potential end use in the pharmaceutical and agricultural sectors. These materials will also find application in flotation technology, personal care and the food industries, as detergents, wetting agents, emulsifiers, foaming agents, and dispersants. This trans-disciplinary project will see Australian-trained researchers equipped with cross-disciplinary skills that are truly unique and enhance Australia's reputation as a leading country for polymer materials research.							
DP220103759 Rogers, A/Prof Briony C	**Change agents and sustainability transformations in the water sector** The pursuit of sustainable development is a major challenge for Australian communities. System transformations are urgently needed, not just incremental change. While we know much about how to incubate local innovation, how innovation can be scaled to transform systems is not well understood. This project aims to understand how change agents can influence system transformations and how their actions can be enabled and constrained by local conditions and governance arrangements. Its focus is on change agents working to promote urban water innovations and system change. We hope to develop new knowledge on the capabilities and resources that local governments and other actors must deploy to achieve sustainability transformations in Australia.	44,350.00	84,796.50	110,184.50	69,738.00	0.00	0.00	309,069.00
	National Interest Test Statement							
	Sustainable development is an urgent challenge for Australian communities due to climate change, resource depletion and population growth. System transformations are needed, not incremental change. But even where support for change is strong, knowledge is often lacking about how to achieve system transformations. Focused on innovations in the urban water sector, this project will explain how change agents can be most effective as they work to promote sustainability. The project will advance Australia's national interests in three ways. First, it will systematically identify and learn from success cases of local sustainability transformation in the water sector. Second, it will reveal the factors that serve to enable or impede change agents as they drive those transformations. Third, it will generate knowledge for change agents and communities about the capabilities and resources they need to drive broader transformations in policy and practice.							

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DP220103767	**Mapping the physics of planet formation**	60,000.00	120,000.00	90,000.00	30,000.00	0.00	0.00	300,000.00
Pinte, Dr Christophe	The 2019 Nobel prize in Physics was awarded for the discovery of the first extra-solar planet around a Sun-like star. But we do not know how these planets, or those in our solar system, formed. In the last two years our group at Monash pioneered a new technique for detecting `baby' planets --- observed still embedded in the disc of gas and dust from which they are born. The aim is to grow this new field of protoplanet detection and characterisation. The project aims to capture images of these planets, and to provide 3D modelling of the environment in which they form. The project will develop state of the art computer algorithms for simulating fluid flow that can be applied to problems here on Earth.							
	National Interest Test Statement							
	The project will bring: a) new knowledge - about how the planets in our solar system, and other solar systems, were formed b) new partnerships - bringing together both young and experienced researchers from the US, Europe and Australia; c) new research directions - detecting baby planets from the gas flow around stars is a new field we started just 2 years ago, combining innovative modelling with observations on the world biggest telescopes to answer "How do stars and planets form?" - one of the 10 `big questions' in the Decadal Plan for Australian Astronomy (2016-2025); d) research training of 2 PhD students and 4 honours students in advanced scientific computing techniques - skills readily transferable to the business world of `big data' e) social benefits in the form of an enhanced skill base in computing, visualisation and data analysis including public availability of all of our simulation codes and data f) economic benefits from the build-up of human capital, such as the recent graduates from our group now working in the Bureau of Meteorology and the Astronomy Data and Computing Service.							
DP220103783	**Metal Halide Perovskite Spin-Orbit Torque Devices**	45,500.00	147,000.00	166,000.00	64,500.00	0.00	0.00	423,000.00
Jasieniak, Prof Jacek J	This project aims to demonstrate a new, highly efficient spin-based electronic device by developing a fundamental understanding into the generation and transport of spin in metal halide perovskite based heterostructures. Using an interdisciplinary approach, this project expects to exploit the beneficial spin properties, low cost and scalable production methods of metal halide perovskites. It is expected that this project will deliver new functionality to these emerging materials to enable their application in highly efficient spintronic devices. These outcomes should provide significant benefits to the Australian advanced manufacturing sector by developing new knowledge, advanced technology and training skilled professionals.							
	National Interest Test Statement							
	Over the last six decades, the global semiconductor industry has made breathtaking advances in terms of developing new electronic technologies with ever increasing capabilities at reduced cost. However, to be able to continue this trend, new technologies and the supporting science for them need be developed. This project will deliver a fundamentally new and efficient electronic device based on low-cost and easily synthesised perovskite materials. By leading research on new advanced functional materials that play a key role in the development of such next-generation electronic technologies, this project aims to create new scientific and technological knowledge and generate foundational intellectual property. This project will also enable translation of the research to high-tech manufacturing value chains and train the future workforce with necessary skillsets. Each of these outcomes supports the needs of Australia's manufacturing industry sector, particularly in its transition to high-tech, value-added production, and in ensuring its international competitiveness.							
DP220103800	**Imaging Symmetry – A New Mechanism for Revealing the Structure of Matter**	67,500.00	137,500.00	142,500.00	117,500.00	45,000.00	0.00	510,000.00
Etheridge, Prof Joanne	This project aims to develop a revolutionary method for imaging atomic structures. In this method, the image contrast derives from the symmetry of the structure, measured at the picometre scale, using tiny electron probes. This new conceptual approach is expected to overcome some of the key limitations of existing electron microscopy methods by providing increased sensitivity and reduced radiation damage, thereby enabling complex structures in technologically important materials to be determined. This should provide new ways to understand the properties of these materials advanced materials and engineer them for applications in the energy, transport, health, communications and other sectors of society.							

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	National Interest Test Statement Almost everything you have touched today will, at some point in its design life, have been examined in an electron microscope; from toothpaste to mobile phones, from food, to clothes, to cars, to medicines, to the roof over your head. Electron microscopes are an essential and powerful way to image, understand and engineer the world around us. However, they are not always powerful enough! There are some classes of materials that have subtle structural details that we cannot see with existing microscope techniques, these include many functional materials, from next generation battery materials, solar cells, pharmaceuticals, transport alloys to catalysts. This project will develop an entirely new method that will enable us to examine these subtle structural details in important functional materials. It will provide Australia with a world-first technology for examining the structure of materials at the level of atoms, enabling new and better materials to be designed and engineered for a wide range of applications, from food, to minerals, to energy, to communications, to transport.							
DP220103810 Mitchell, Prof Christina A	**The role of phosphoinositides in endosomal maturation dynamics.** This project aims to investigate the regulation of an intracellular compartment within a cell called endosomes, which plays critical roles in cellular homeostasis, signalling and pathogen entry. New knowledge is expected to be generated in understanding endosome maturation and the signalling events that drive this process using a unique, multidisciplinary approach combining state of the art imaging techniques and high throughput protein analysis. The anticipated outcomes will be to define the molecular steps that govern the membrane-bound machinery on endosomes that directs endosomal maturation. This should provide significant benefits in delineating a process that is linked to almost all aspects of cell life.	95,000.00	190,000.00	195,000.00	100,000.00	0.00	0.00	580,000.00
	National Interest Test Statement This project will investigate the mechanisms of late endocytosis, a fundamental biological process that controls the degradation of cellular cargo inside the cell. Many aspects of this dynamic process are poorly understood as it has been difficult to fully capture each step in the process with current imaging technologies. Our study will take a unique, multidisciplinary approach using state of the art protein and imaging technologies to delineate late endocytosis in unprecedented detail and provide a detailed roadmap of each step in the pathway. This will keep Australia at the forefront of cell biology and subcellular imaging. Endocytosis is critical for uptake of nutrients, cell signalling and pathogen entry into cells and their destruction, and understanding this process will have the potential for long-term benefits towards agriculture, aquaculture and drug development. The project will provide training for postgraduate and postdoctoral STEM researchers and building national research capacity in biochemistry and cell biology.							
DP220103829 Doron, Dr Daniella	**Familial Separation, Emotions, and Jewish Child Refugees, 1933-1945** Drawing upon largely untapped wartime sources from refugee youth, this project aims to produce the first sustained study of the lived experiences and memories of Nazi era Jewish unaccompanied child refugees to the United States. It expects to generate new knowledge by tracing the links between children, emotions, and mobility; the role of ideas about the family in shaping immigration policies; and the emergence of Holocaust survivor identities. The expected benefit of this work includes advancing academic and public understanding of how age, emotions and mobility can broaden our understanding of the Holocaust experience, child migration, and familial separation.	41,028.00	81,631.00	57,628.00	17,025.00	0.00	0.00	197,312.00
	National Interest Test Statement The last few years have seen a troubling rise of antisemitism and Holocaust denial across the globe, including very recently in Australia. In this context, politicians, teachers and scholars have called for greater Holocaust education in the Australian curriculum in order to combat these disconcerting trends. In order to address these twin developments, this project will broaden Holocaust scholarship, to augment and enliven the lived experience of Holocaust survivors (particularly children) driven to migrate during and after the Second World War. A key project outcome will be an online exhibit aimed at the public that will feature a range of Holocaust child narratives and primary sources relating to refugees and migration, familial separation, and the Holocaust and its memory. The project therefore will have social and cultural benefits to enhance social cohesion and may inform migration policy through a new understanding of child agency. Ultimately, this project brings to light a history that carries multiple implications for our own era and nation.							

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DP220103857	**Pipeline backfill reimagined to provide in-line corrosion protection**	57,950.00	116,700.00	118,750.00	60,000.00	0.00	0.00	353,400.00
Kodikara, Prof Jayantha K	This project aims to innovate new resistive pipeline backfill materials, associated construction methods and numerical techniques to minimise corrosion at network level, considering interference effects among adjacent pipelines. In contrast to only providing mechanical support, this project will envision backfill for in-line corrosion protection by elucidating its role in pipeline corrosion. The expected outcomes are very effective and low-cost approach and tools to provide in-line protection, in contrast to other protection methods that are expensive and not always possible. The project will bring significant economic benefits by addressing corrosion-induced pipe failures for urban centres, where underground space is heavily congested.							
	National Interest Test Statement							
	Pipelines are efficient transport systems for essential commodities such as water and gas. Large funds are spent annually on new, maintenance and renewal of pipelines. For instance, Australia has around 260,000 km of pipelines valued at $200b used by water utilities, out of which 80% are buried and metallic. Corrosion induced pipeline failures is a massive problem, incurring costs as much as $1 billion annually. Corrosion can arise in a pipe's own pipe-soil environment and (or) exacerbated by stray currents from interfering with adjacent pipelines, as underground space has become very congested with rapid urbanisation. Currently, sandy backfills are used to fill the pipe trench, only to provide adequate mechanical support. In contrast to other expensive techniques, a cost-effective way to minimise corrosion would be to electrically isolate the pipeline by providing a resistive backfill. Combining geotechnical and corrosion sciences, this proposal will innovate resistive backfill materials, pipe installation methods and software tools to mitigate corrosion damage to pipelines resulting in large cost savings.							
DP220103873	**Elliptical nozzles: the shape of silence?**	65,500.00	139,015.00	148,030.00	74,515.00	0.00	0.00	427,060.00
Edgington-Mitchell, Dr Daniel M	This project aims to leverage the aeroacoustic properties of elliptical nozzle geometries to significantly reduce installed jet noise. This project expects to generate new knowledge regarding methods to reduce installed jet noise, a serious problem for the aerospace industry. Regulatory constraints inhibit the implementation of efficiency-increasing configurations but still fail to eliminate public health impacts. Expected outcomes include a set of tools for optimizing nozzle designs capable of significantly reducing installed jet noise. This will provide significant benefits, as jet noise is a serious health issue for the Australian public. This project represents an opportunity to reduce its impact while improving fuel efficiency.							
	National Interest Test Statement							
	Australia is dependent on air travel, given our geographic isolation from the rest of the world. The proximity of our airports to major population centres results in significant noise exposure with the attendant health and economic costs. Aircraft noise is also a significant issue for civil aviation, not only in terms of airport construction and management, and for the health of surrounding communities. This project will pinpoint the underlying noise-causing physics in modern jet engines, and develop models to guide development of new, noise-efficient aircraft engines. Success in this endeavour will enable significant fuel savings while still meeting strict noise regulatory constraints. The development of new design tools will allow the results obtained in the project to be transferred to industry applications, and thus could contribute to the Australian aerospace and energy industries.							
DP220103907	**Sustainable recovery of gas hydrate using carbondioxide**	70,000.00	121,000.00	94,000.00	43,000.00	0.00	0.00	328,000.00
Ranjith, Prof Pathegama G	This project aims to develop a gas exchange method to sustainably extract methane from gas hydrates – an abundant and far cleaner energy than coal – while simultaneously sequestering carbon dioxide in its place. This project expects to overcome existing methods' risk of contaminating the ocean and killing sea life with methane gas. Expected outcomes of this project include a framework of the mechanics of gas hydrates during gas exchange; experimental exploration of the new method; and strategies for efficient gas recovery. This should provide significant benefits in that swapping waste carbon dioxide for an ample low-carbon energy source caters to ever-growing global energy demands while still reducing greenhouse emissions.							

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	National Interest Test Statement							
	Exporting coal has played a major role in supporting Australia's economy for decades, but as nations across the planet transition their energy sectors away from coal in response to the challenge of climate change, Australia could greatly benefit from developing an alternative, greener energy resource to export. Evidence indicates there are significant gas hydrate deposits on the northwest margin of Australia facing Indonesia and in the Southern Fairway Basin on the Lord Howe Rise of the Tasman Sea. This project aims to deliver a new method for harnessing these deposits without damaging Australia's marine environment. Obstacles to safely and economically harvesting gas hydrate have caused it to be overlooked globally, which means Australia could be at the forefront of this new resource sector if we act quickly. Leading the way with this cleaner energy could also improve Australia's international reputation for acting on climate change.							
	Monash University	4,700,919.50	9,986,704.50	9,888,268.50	4,881,478.50	278,995.00	0.00	29,736,366.00
RMIT University								
DP220100020	**Scalable atom-thin materials for monolithic electronics & optoelectronics**	66,500.00	136,500.00	140,000.00	70,000.00	0.00	0.00	413,000.00
Walia, A/Prof Sumeet	This project aims to understand large-area growth mechanisms and create practical, controllable doping methodologies for developing manufacturing-compatible tunable materials to overcome technological challenges presented by silicon. The project expects to generate new understanding of physico-chemical mechanisms that govern the optical and electrical properties of an emerging class of materials only few-atoms thick that offer unprecedented opportunities. This is expected to establish a suite of atomically-thin materials that will be deployed in miniaturised, high-density electronics and optoelectronics of which proof-of-concept functional devices are proposed to be demonstrated. These will be leveraged to explore industry partnerships.							
	National Interest Test Statement							
	This project aims to establish an evolving group of quantum-confined materials with versatile properties for next-generation electronics and optoelectronics. Collectively, the fundamental advances are expected to result in pioneering technologies that are in sync with developments in other sectors such as the Internet of Things and artificial intelligence to create end-user products that make quality-of-life easier and better. This will be achieved using a combination of innovations in materials engineering and parallel industry engagement to create knowledge that directly addresses national priorities in advanced manufacturing. The importance of new fundamental knowledge will be showcased using a series of application demonstrations that will be leveraged to commence partnerships with industry to take innovations to the market. This is expected to generate economic, employment and commercialisable outcomes and put Australia at the cutting-edge of the technological revolution.							
DP220100178	**Quantum microscopy meets photovoltaics: new tools for solar cell research**	72,500.00	136,500.00	126,000.00	62,000.00	0.00	0.00	397,000.00
Tetienne, Dr Jean-Philippe R	This project aims to create an innovative platform to characterise solar cells, based on recently developed quantum diamond microscopy. It will enable direct imaging of the current flow in operating photovoltaic devices, providing a new window into key processes such as charge collection and recombination. The platform will be applied to a range of industry-relevant photovoltaic materials and devices. Anticipated outcomes include new insights into recombination processes and the effect of device degradation, which could facilitate optimisation of the power conversion efficiency and reliability of next-generation solar cells. Additional benefits include new instruments and methods that may find use in the solar cell manufacturing industry.							
	National Interest Test Statement							
	Capitalising on Australia's long-term investment in quantum technologies, this proposal seeks to deliver new instruments and methods to characterise solar cells by enabling direct visualisation of the current flow, providing insights into the operation of solar cells and the role and presence of imperfections. This new way of characterising solar cells tool may lead to commercial products that could be used to aid solar cell research and development, or for non-invasive diagnostics in solar cell production lines. In addition, by using these new tools the project will deliver new knowledge on solar cells. This new knowledge may lead to gains in the power conversion efficiency of next-generation solar cells. This could have significant commercial benefits for Australia's solar power industry. Additionally, these gains would have immediate environmental benefits, by reducing the use of fossil fuels.							

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DP220100215	**Privacy-aware Smart Access Control for Internet-of-Things on Blockchain**	65,000.00	130,000.00	130,000.00	65,000.00	0.00	0.00	390,000.00
Khalil, A/Prof Ibrahim	This project aims to address privacy and trust issues in Internet-of-Things (IoT) access control mechanism of smart critical infrastructure. This project expects to generate new knowledge in the area of IoT access control by leveraging privacy-preserving techniques, blockchain, and machine learning. Expected outcomes of this project include enhanced capability to build improved techniques for privacy aware tamperproof IoT access control with machine learning based anomaly detection. This should provide significant benefits, such as preventing cyber threats on security and privacy of IoT and improving trust in IoT-enabled smart critical infrastructure of Australia.							
	National Interest Test Statement							
	This project will innovate and develop a new Australian cybersecurity capacity by merging several influential technologies such as blockchain, smart contract, access control, IoT, and privacy-preserving techniques. The aforementioned technologies will help building a trustworthy framework for IoT access control and will eliminate the chance of unauthorized access to IoT data. The framework and its theoretical models will present a solid platform that will prevent any potential threat from advanced adversarial attacks on the IoT-based critical infrastructure. Hence, this research will contribute to Australia's economy by enabling secure smart IoT-enabled critical infrastructure which will improve the services offered by governmental and non-governmental agencies. Additionally, this research will increase the commercial values of several IoT-enabled services and products in critical infrastructure through improved trust. Moreover, the adaptation of new privacy-aware IoT-enabled critical infrastructure services will engage more people in using the system and improve the social life of Australia's citizens.							
DP220100488	**Pumping up the volume on sound-light interactions**	85,000.00	170,000.00	170,000.00	85,000.00	0.00	0.00	510,000.00
Boes, Dr Andreas	This project aims to create a new class of integrated microwave information processors on a single optical chip. Using electro-acoustic coupling in semiconductors, we expect to reduce optical power requirements hundredfold, enabling the emergence of practically deployable processors using ordinary telecom lasers. The expected project outcomes are inexpensive, compact, stable and energy efficient microwave photonic processors, a key requirement for reference standards and precision measurements of time and frequency. This technology has the potential to create a multitude of opportunities for commercial development in the fields of defence, information security, autonomous vehicles, sensing, and ultra-high bandwidth mobile communications.							
	National Interest Test Statement							
	This project will pioneer new photonic chip simulation, design and fabrication capabilities to bring together the worlds of radio frequency engineering and optoelectronics. These capabilities will enable rapid creation of precision microwave photonic circuit chips with a clear path to scale up manufacture in Australia. This mix of capabilities has high potential for commercialisation and the intellectual property will be protected, creating opportunities for licensing and start-up ventures. The rapid prototyping of such chips will be offered as an accessible service to Australian and international industries as part of a new Australian industry capability. The expected benefits will be a greater adoption of photonic technologies in Australian products and quicker innovation cycles, particularly for applications in sensing and spectroscopy, quantum technologies, and the next generation of microwave and wireless communications (5G & 6G).							
DP220100793	**Precarious Dwelling: Encounters with housing crisis**	58,481.50	125,696.00	136,861.00	69,646.50	0.00	0.00	390,685.00
Porter, Prof Libby	This project aims to investigate the hidden impact and lived experience of housing insecurity. Using an innovative ethnography and policy analysis, the project will generate new knowledge about how people practice dwelling under conditions of dispossession, forced relocation or homelessness and the policy settings that create and sustain those conditions. The intended outcome is a holistic understanding of the lived experience and impacts of precarity and the policy changes necessary to remedy its conditions. This should provide benefits to people experiencing precarity, support policy makers to understand the implications of different policy choices, and inform public understanding about contemporary housing and urban conditions.							

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	National Interest Test Statement Housing and home are the foundations of a good society. This project will provide new evidence about the impacts of living under housing insecurity. The project is focused on renters experiencing forced relocation due to eviction or public housing renewal, people experiencing homelessness, and Indigenous people dispossessed of their Country. This will contribute to Australia's national interest by improving public investment and policy decisions to support the right of all Australians to secure living conditions. Better evidence about the social and wellbeing impacts of dispossession, displacement and homelessness can provide economic benefits by informing policy choices that contribute to greater housing security. The project will contribute to a more socially inclusive Australia by enabling people faced with dispossession, displacement or homelessness to share their experience, enhancing understanding for all Australians. The project will contribute to Australia's community infrastructure and service sector by improving understanding of contemporary social issues facing a growing number of Australians.							
DP220100943 Crawford, Prof Robert A	**Shop Talk: Department Stores, Shoppers and Consumer Capitalism, 1945-2025** This project aims to provide a deeper understanding of shopping and its significance in everyday Australian life by using oral history interviews with shoppers, workers and managers who have engaged with department stores since 1945. This project expects to produce the first history of the country's post-war department stores. Expected outcomes include new, more nuanced perspectives of shopping and the challenges affecting the retail sector via a range of publications, international collaborations, and an archive of oral history recordings. This should provide significant benefits to researchers examining the retail sector, to Australians working in retail, and to ordinary Australians, whose stories will be placed on the historical record.	27,692.00	56,039.00	45,498.50	17,151.50	0.00	0.00	146,381.00
	National Interest Test Statement The retail sector accounts for 4.1% of Australia's GDP and is the country's second largest employing industry. Yet its future is uncertain. This research develops new, broader understandings of current challenges through long-term analysis of Australia's department stores. As major retailers, employers and innovators, department stores make a significant contribution to the nation's economic, social and cultural well-being. The project's historical study of the relationship between department stores and shoppers provides new insights into the business of department stores. It offers retailers an opportunity to reflect on past approaches to disruption and innovation and reconsider current strategies. The project gives voice to everyday Australian experiences, recording them for the historical record. Its engaging and innovative investigation of an essential part of everyday life will deepen Australians' understanding of their past at a critical moment in Australia's retail evolution.							
DP220100945 Caruso, Prof Rachel A	**Data-driven development of photocatalytic and optoelectronic perovskites** This project aims to use materials informatics to discover new, high efficiency perovskites for synthesis and testing in optoelectronic applications. This project expects to identify perovskite composition-property relationships to overcome current drawbacks of high performance perovskites (contain rare or toxic elements and low stability in oxidative and humid environments) by considered selection of elements and their properties. Expected outcomes from this project include new perovskites with commercial potential in critical areas such as energy conversion, photocatalysis and luminescence. This should provide significant benefits including approaches to materials discovery, novel materials and in renewable energy and environmental areas.	55,735.50	127,277.00	131,693.50	60,152.00	0.00	0.00	374,858.00
	National Interest Test Statement A key issue for the application of perovskites is that those with high efficiency are unstable and contain toxic or rare elements. This project aims to discover perovskites with commercially applicable composition for optoelectronic and photocatalytic applications, as well as establish an approach for the development of industrially relevant advanced materials. Therefore, this research contributes to Australia's national interest as it has potential to produce materials that will have an impact on renewable energy generation, energy consumption and environmental remediation. By contributing materials that have application in clean energy sources that are efficient, cost effective and reliable and in developing solutions for water based pollutant degradation there is potential for product development and increased competitiveness internationally, leading to job growth. The materials informatics approach developed in this project will provide academic and industrial researchers with a tool to advance their materials research, thereby adding to the economic, environmental and societal benefits to the country.							

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DP220101281	**Inclusive memories: tracing democratic practices in contemporary memorials**	50,000.00	100,000.00	100,000.00	50,000.00	0.00	0.00	300,000.00
Stevens, A/Prof Quentin T	This project aims to investigate the significant role of recent public memorials in reflecting and shaping democratic identity, memory, values and engagement in Australia and internationally. The project expects to advance knowledge through an innovative international comparison of the evolving diversity of democratic themes, designs and procurement approaches used for public memorials and public spaces. Expected outcomes include practical and scholarly insights into how these processes can improve social engagement and inclusion. The project's benefits include improving decision-making processes for public art, public space and heritage, and expanding scholarly and public awareness about Australian history, identity and democratic values.							
	National Interest Test Statement							
	This project will identify a range of ways that the themes, designs and management of public memorials can foster social inclusion and engagement, address historical injustices, and enrich collective memory. In these terms, the project will benchmark Australia's memorials and memorial policies against other democratic nations. The project's insights will guide the stated ambitions of Canberra's National Capital Authority, and other government agencies and memorial sponsor groups, to innovate and improve the quality of democratic representation and engagement in Australia's design and decision-making for public spaces, public art, architecture and heritage. The project's insights will enhance the value of government and private-sector investments in these fields. The project's impacts on practice will bring social and cultural benefits, including improving civic engagement and social inclusion, particularly for marginalised groups. The research findings will contribute to public awareness and discussion about Australian history, identity and democratic values.							
DP220101434	**Advancing Analytical Query Processing with Urban Trajectory Data**	58,694.50	119,361.50	123,453.00	62,786.00	0.00	0.00	364,295.00
Bao, A/Prof Zhifeng	This project aims to provide accurate, rapid, and comprehensive information to analyze transport and related infrastructure use in real time. This project expects to develop innovative solutions by exploiting massive urban trajectory data derived from public transport usage, route mapping, GPS tracking and road-side sensors. Expected outcomes include a new algorithmic framework to support complex trajectory-driven analytical tasks in public transport network planning, traffic congestion prevention, and facility deployment. This should significantly benefit both government and industry in data-driven decision makings and evaluations on the impact of decisions made, and ultimately materialize Australian government's Smart Cities Plan.							
	National Interest Test Statement							
	This project will provide government and businesses with the ability to use the massive transportation-based data collections, such as vehicle movement and public transport records, to solve urban planning problems more effectively. This improves data-driven policy and decision making and provides low cost, reliable, resilient and efficient business store site selection, transportation planning and management. Additionally, this will improve the ability of transportation specialists to continuously evaluate the impact of the decisions made and make changes in real time. Finally, the project provides essential new skill training for professionals working in the transportation sector. These outcomes will help keep Australia cities among the world's most liveable as they continue to grow over the next decade.							
DP220101501	**A new class of titanium alloys developed for additive manufacturing**	66,500.00	131,500.00	130,000.00	65,000.00	0.00	0.00	393,000.00
Qiu, Dr Dong	This project aims to develop a new class of (Ti-Cu)-based alloys featuring high strength, high toughness, and high hydrogen-embrittlement resistance specifically for additive manufacturing (AM). This project expects to generate new knowledge of grain refinement and phase transformations in dynamic temperature field of metal AM process and to solve the common weakness – strong mechanical anisotropy and poor fatigue life – of AM Ti components. The expected outcomes include a whole set of processing maps of AM (Ti-Cu)-based alloys tailored to demanding applications. This should provide significant benefits to aerospace, marine and biomedical industries by delivering better durability, sustainability, and cost-effectiveness.							

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	National Interest Test Statement							
	This project will develop a new class of titanium alloys for additive manufacturing (AM), in which vanadium (the current standard alloying metal) is replaced by the more abundant and cheaper copper, leading to alloys with excellent strength and toughness. The global market for titanium-based AM powders is predicted to be $518 million in 2022 with a 20% growth rate over the next five years; the new alloys will position the Australian industry to take full advantage of this growth. The manufacture of these powders will increase demand for copper ore, currently a $10 billion industry in Australia. Additive manufacturing is revolutionising the aerospace components industry. In 2016-17 the Australian aerospace industry contributed $2 billion to the economy and employed over 13,000 people. The development of high-performance, lower cost AM alloys will expand the local industry, leading to new jobs. Another use of these alloys will be in dental implants, currently a $2 billion market in Australia. They will be very attractive to this industry because of copper's antibacterial properties.							
DP220101923 Daeneke, Dr Torben J	**Liquid metal solvents and colloids – a new frontier in chemistry** This project aims to develop a holistic understanding of dynamic bond formation within molten metals to unlock the full potential of liquid metal chemistry. The project expects to develop new methodologies required to study the nanoscale chemistry of liquid metals, an emerging class of solvents that could revolutionise modern catalysis, metallurgy and inorganic synthesis. The expected outcomes are an in-depth theoretical understanding of liquid metal chemistry as well as new electron and atomic force microscopy techniques that will shed light on these extraordinary materials. This should benefit future studies of liquid metal chemistry and consequently the development of industrial applications of these unique liquids.	75,000.00	151,000.00	136,000.00	60,000.00	0.00	0.00	422,000.00
	National Interest Test Statement							
	This project will cement Australia's leading role in the emerging field of liquid metal chemistry. The fundamental scientific discoveries will catalyse further innovations in this emerging field, leading to valuable intellectual property in areas such as catalysis, metallurgy and biomedical technology that can be developed by Australian industry. The fundamental understanding will also facilitate the uptake of liquid metals as tailored solvents for advanced processing, opening new markets for metals that are mined in Australia. This project will develop new readily accessible analytical techniques that will be of tremendous benefit to the Australian metallurgy and mining industries, since these methodologies will be capable of providing insights into chemical processes that occur within liquid metals. This will aid the design of better alloys, improved materials for additive manufacturing and more efficient metal refining processes.							
DP220102518 Stacey, Dr Alastair D	**Dopant engineering of diamond for quantum sensing technologies** Doped diamonds are central to a growing range of quantum-sensing technologies for future industries, including medical and defence. These diamonds must be doped with both an electron donors and active 'quantum-defects' to operate. Within existing devices, the electronic donors also create parasitic magnetic noise, due to their magnetic-spin properties. In this project we aim to investigate the growth of diamond with new electronic donors, aiming for spin-free and thus noise-free dopant properties. This should provide significant benefits to defence capability, through enhanced magnetic anomaly detection in naval environments, and health outcomes, through neural sensing of brain signals at room temperature.	70,000.00	140,000.00	130,000.00	60,000.00	0.00	0.00	400,000.00
	National Interest Test Statement							
	Diamond-based magnetometry devices are already being commercialised and explored for a variety of advanced industrial applications, including defence and medical technologies. This project would leverage the significant expertise in diamond-materials within Australia's universities and create a breakthrough for the use of diamond, due to an increase in sensitivity up to 100x. This would create a system with unprecedented combination of ultra-sensitivity, room-temperature and extreme environment operation, and size-scalability. This would have a direct economic impact, through the creation of Australian high-tech industrial activity, strengthen Australia's defence capabilities and enable new medical technologies, benefiting the community and the national interest.							

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DP220102622	**Advanced chemical recycling of mixed plastics for monomer recovery**	90,000.00	165,000.00	125,000.00	50,000.00	0.00	0.00	430,000.00
Lee, Prof Adam F	This project aims to develop innovative catalytic routes to the chemical recycling of mixed plastics for recovery of their molecular building blocks. Plastic pollution poses a significant threat to the Australian ecosystem. Efficient recycling technologies are urgently needed as Australia only recycles ~4% of its 3.4 million tons of mixed waste plastics. This project expects to design highly efficient catalysts for the stepwise breakdown of mixed polyolefin plastics into monomers for the subsequent manufacturing of virgin plastics in a circular economy, and to elucidate fundamental underpinning reaction mechanisms. Outcomes will stimulate the Australian waste plastic recycling industry, and minimise plastic accumulation in the environment.							
	National Interest Test Statement							
	Plastic waste is composed of diverse chemical compounds that render its recycling costly and inefficient. Past practice of exporting plastic waste is now banned, and the majority of such waste is now sent to landfill resulting in significant costs and negative environmental impact to land and aquatic ecosystems. In this project, plastic waste will be recycled through chemical transformation to produce building blocks for new plastics production. This technology aims to enable Australia to transition towards a circular economy and the creation/expansion of a domestic waste plastic processing industry. As a result, a new supply chain for plastic waste will become available, opening up jobs in the advanced manufacturing sector, product distribution and application. Environmental benefits include controlled plastic recycling with significantly reduced carbon dioxide emissions, and a significant reduction in plastic waste leakage into remote Australian coastlines.							
DP220102706	**Eco-evolutionary drivers of niche dynamics in invasive weeds**	22,500.00	81,000.00	123,000.00	64,500.00	0.00	0.00	291,000.00
Uesugi, Dr Akane	The project aims to understand how and why invasive species become invasive. Many exotic species are known to expand their ecological niches in their novel range, exploiting habitats that ancestral populations never used. Using a unique approach that combines field transplant and quantitative genetics experiments, this study will identify the drivers of niche expansion in invasive Australian capeweed, and predict if the invasive populations are likely to further expand their niches. By delivering key insights into mechanisms of adaptive evolution in invasive species, this research should benefit efforts to effectively limit the spread of invasive plants that threaten the native environment.							
	National Interest Test Statement							
	Invasive weeds cause biodiversity declines of Australia’s unique flora and fauna, and economic losses from reduced agricultural yields. To effectively control weed invasions, we must first understand how and why invasive species spread. This project will identify major mechanisms driving the expansion of ecological niches in invasive capeweed, thereby producing important knowledge necessary for future weed management. This project will also identify the genetic basis of plant traits that are adaptive in arid environments. As Australia’s climate is increasingly becoming drier, understanding how plants adapt to drought can help mitigate impacts of climate change on natural and agricultural systems. This project should provide vital information to Australia’s policy makers, weed managers, and farming communities.							
DP220102803	**Privacy-Preserving Location Based Queries**	72,500.00	145,000.00	145,000.00	72,500.00	0.00	0.00	435,000.00
Yi, Prof Xun	This project aims to develop efficient solutions for mobile users to consume location-based services (LBS) without revealing their locations. The project expects to demonstrate the effectiveness of the solutions using theoretic analysis and practical experiments. The expected outcomes are a multiparty trust model, techniques to distribute user location information among multiple location-based services, and a practical system to protect privacy in mobile environments. This should protect the privacy of individuals and increase users’ trust in location-based systems.							

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	National Interest Test Statement							
	The techniques developed in this project will protect the location data derived from mobile device users using location-based services and apps. The Asia-Pacific region is projected to have the world's highest growth in located-based services in this decade. These new techniques will lead to commercial software products, such as privacy-preserving, location-based service mobile apps, specific for Australian geography, and therefore benefit the Australian mobile industry. A 2020 survey showed that privacy is a major concern for 70% of Australians, with almost 90% wanting more choice and control over their personal information. Australians who would never download the COVIDSafe app listed privacy as their top concern. The outcomes of this project will allay those concerns and improve the effectiveness of government initiatives to monitor disease outbreaks and protect public health. The technology is also aimed at highly secure data acquisition for defence. It will allow Australian Defence Force personnel deployed in the field to navigate without revealing their locations.							
DP220103407	**Ultrahigh strength maraging titanium alloys for additive manufacturing**	75,000.00	150,000.00	150,000.00	75,000.00	0.00	0.00	450,000.00
Ma, Prof Qian	This project aims to pioneer an unprecedented class of ultrahigh-strength titanium alloys for 3D printing by capitalising on both the alloy design theory of ultrahigh-strength steels and the unique capability of laser-based 3D printing. The planned research expects to significantly advance the knowledge base of advanced metallic materials and metal 3D printing via atomistic level characterisation and systematic mechanical property evaluation in relation to specifically tailored 3D printing conditions. Expected outcomes include a group of ultrahigh-strength novel titanium alloys for 3D printing and a new alloy design theory. This should provide significant benefits to the manufacturing industry to support the national economy and security.							
	National Interest Test Statement							
	Key engineering materials are the cornerstone of the manufacturing industry. They play a pivotal role in enhancing the strength of the industrial supply chain to support the national economy and security. The expected outcome of this proposal is an unprecedented class of ultrahigh-strength titanium alloys for 3D printing using a new concept initiated in Australia. These novel ultrahigh-strength and ductile lightweight materials are ideal and essential for critical applications in the defence, aerospace, ship building, energy generation, and automotive industries. In particular, they could immediately enhance the influence and uniqueness of our supply chain in the defence and aerospace sectors. The patents or new intellectual properties out of this project will be made immediately available to our manufacturing industry via existing and new partnerships with small to medium enterprises. Examples of new commercial products include light, ultra-strong, ductile, corrosion-resistant components in commercial and military aircraft, helicopters, defence air, road and sea vehicles, energy production facilities etc.							
DP220103550	**Unravelling the mechanisms of sodium-selectivity in biological ion channels**	58,054.00	119,470.50	124,352.50	62,936.00	0.00	0.00	364,813.00
Allen, Prof Toby W	The aim of this project is to determine the origins of protein-mediated sodium ion transport across cell membranes. The project expects to reveal the mechanisms of selective ion conduction in different sodium-selective ion channels using advanced computer simulations, in concert with non-canonical mutation experiments that target the roles of protein chemistry. The expected outcome is improved understanding of how proteins discriminate between ion species, challenging theories that have stood for decades. The results should provide benefits in the form of basic understanding relevant to ion transport phenomena in biology and novel materials, with atomic-level views of nervous system function to guide future directions in drug development.							
	National Interest Test Statement							
	This project aims to provide fundamental explanations for charge transport processes in the nervous system that are central to life. It will lead to new understanding of biological ion channels that will assist in the development of improved therapeutics to treat neurological, cardiac and muscular disorders, such as epilepsy, cardiac arrhythmias, chronic pain, neurodegenerative disease and stroke, each representing significant social and economic burdens on the Australian public. For example, chronic pain affects over 4 million Australians and is estimated to cost $30 billion per year; higher than cancer, heart disease and diabetes combined. This knowledge will also guide future developments in advanced materials, such as ion channel mimetic membranes for more efficient water desalination; being a high priority for Australian agriculture and its growing cities. This project represents cutting-edge interdisciplinary and international collaboration, employing the latest experimental and computational technologies, leading to improved Australian competitiveness in biotechnological research.							
	RMIT University	1,069,157.50	2,184,344.00	2,166,858.50	1,051,672.00	0.00	0.00	6,472,032.00

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(Columns 1 and 2)	(Column 3)	2021-22 (Column 4)	2022-23 (Column 5)	2023-24 (Column 6)	2024-25* (Column 7)	2025-26* (Column 8)	2026-27* (Column 9)	(Column 10)
Swinburne University of Technology								
DP220100603	**Monolithic Solar Thermal Photocatalytic Membrane for Hydrogen Production**	90,000.00	185,000.00	195,000.00	100,000.00	0.00	0.00	570,000.00
Ma, A/Prof Tianyi	This ambitious project aims to develop a new concept of monolithic membranes composed of photocatalysts embedded in highly efficient solar thermal graphene. Such a membrane will be first of its kind and is able to utilise full solar spectrum for scalable seawater desalination and direct splitting to produce hydrogen without the need to concentrate sunlight. Expected outcomes include chemically and structurally tailored membranes and 2D floating prototypes for real life hydrogen production, and in-depth understanding of working mechanism to facilitate up-scaled renewable hydrogen generation. Significant benefits in minimising fossil fuel consumption, increasing energy security, and expanding competitive clean energy industry are promised.							
	National Interest Test Statement This project has significant benefits for Australia's energy and environmental security, and economic growth. It will deliver highly efficient and monolithic solar thermal photocatalytic membranes and reaction prototypes for water and seawater desalination and splitting by making full-spectrum use of the natural solar energy, so as to accelerate development of large-scale hydrogen production and relieve greenhouse effect by fossil fuel combustion. The project will promote R&D of the new-generation "all-in-one" hydrogen production techniques, which are highly promising for commercialisation and industry-level application, and put Australia at the forefront of the utilisation of clean energy and seawater. Therefore, it will bring substantial environmental benefit to Australia and the world, as well as reap huge savings for the clean energy industry. This project will also generate new advanced knowledge in the fields of materials science, nanotechnology, catalysis, clean energy and relevant engineering, thereby strengthening Australia's national research capacity in energy materials and technology.							
DP220101420	**SenShaMart: A Trusted Internet of Things Marketplace for Sensor Sharing**	75,000.00	150,000.00	150,000.00	75,000.00	0.00	0.00	450,000.00
Georgakopoulos, Prof Dimitrios	This project aims to devise a novel Internet of Things (IoT) sensor sharing marketplace that permits IoT applications to discover, integrate, and pay for any IoT sensor data that is made available by other parties. The project will devise highly-scalable sensor classification, query processing, and transactions solutions and incorporate them in a pair of novel blockchains that work in tandem to securely manage all the information and contracts needed by IoT applications to discover, integrate, pay, and use sensors provided by another parties. These IoT advancements will provide significant economic, environmental, and social benefits via making low-cost and immediate sensing available across the world.							
	National Interest Test Statement The Internet of Things (IoT) offers incredible potential to address major societal and scientific challenges but the cost and time needed to deploy and maintain unique sensors for each IoT application outweighs its short-term benefits. This project will devise a ground-breaking sensor sharing marketplace to allow any IoT application to find, pay for, and use existing IoT sensors and their associated data. The discovery and re-use of data from billions of sensors deployed at ground-level will open up applications in climate, agriculture, industry and society. Examples of benefits include wholescale monitoring of supply chains; crop selection to mitigate climate change; optimised use of resources (water, pesticides, fertilisers); monitoring real-time traffic and public transport use; increased bushfire awareness from environmental sensors; and more. The research will have strong commercial benefit – supporting SMEs and larger organisations to access and provide data – and will position Australia as an international leader in IoT innovation.							

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DP220101609	**Uncovering the laws of gravity using the largest map of the cosmos**	60,000.00	120,000.00	120,000.00	60,000.00	0.00	0.00	360,000.00
Blake, Prof Christopher A	This project aims to map out the behaviour of gravity across the Universe. This research will address a key gap in our understanding of physics, with significant implications for fundamental theory: we cannot account for the fact that the expansion of the Universe appears to be speeding up. This project will use the largest 3D map of how galaxies are distributed across the Universe, together with complementary datasets tracing the deflections of light -- obtained through unique international partnerships -- to produce a novel description of how Universal gravitation depends on separation and time. This work will provide new limits on allowed deviations from General Relativity (with 2% accuracy), or map out new and unexpected phenomena.							
	National Interest Test Statement							
	This Project aims to solve one of the leading mysteries in astrophysics: the nature of the mysterious dark energy which fills the Universe. Australian scientists and students will work in a leading international collaboration of 600 researchers, using the world's best instrumentation and applying new analysis techniques to big data, enhancing Australia's reputation as a leader in astrophysics. This Project will provide outstanding training opportunities in cutting-edge statistical and computational techniques, and invaluable international exposure, for multiple researchers and STEM students. Development of these skills and techniques creates excellent opportunities for the interchange of technology and personnel between academia and industry. Moreover, by studying the origin and evolution of our Universe, this Project is a powerful tool for engaging the public, providing an inspiring example of applying science to some of the most fundamental questions we can consider.							
DP220101610	**Precision cosmic expansion in the era of gravitational-wave astronomy**	75,000.00	150,000.00	150,000.00	75,000.00	0.00	0.00	450,000.00
Blake, Prof Christopher A	The disagreement in the size of the cosmic expansion rate, between measurements from local galaxy indicators and predictions from the early Universe, is a crisis for cosmology. This Project aims to resolve this situation using recent scientific breakthroughs in both observations and theory. We will optimise expansion measurements from the standard sirens discovered by gravitational-wave astronomy by accurate modelling of the cosmic velocity field which limits this analysis. And we will use recent breakthoughs in numerical general relativity to explore the influence of space-time curvature variations on these measurements. We will hence improve our understanding of the most important parameter describing the Universe, and its physics.							
	National Interest Test Statement							
	This Project aims to solve one of the leading puzzles in astrophysics: the conflicted measurements of how fast the Universe is expanding, which determines the age of the Universe. Australian scientists and students will approach this measurement using breakthrough advances in gravitational-wave astronomy and supercomputing technologies, enhancing Australia's reputation as a leader in astrophysics. This Project will provide outstanding training opportunities in cutting-edge statistical and computational techniques, and invaluable international exposure, for multiple researchers and STEM students. Development of these skills and techniques creates excellent opportunities for the interchange of technology and personnel between academia and industry. Moreover, by studying the origin and evolution of our Universe, this Project is a powerful tool for engaging the public, providing an inspiring example of applying science to some of the most fundamental questions we can consider.							
DP220101863	**Ultra Diffuse Galaxies: Challenging the galaxy formation paradigm**	70,000.00	140,000.00	140,000.00	70,000.00	0.00	0.00	420,000.00
Brodie, Prof Jean	We aim to understand the origins of newly discovered Ultra Diffuse Galaxies. Their extreme properties challenge many assumptions underpinning the accepted cosmological framework within which galaxies form, especially the role of dark matter and its interaction with normal matter. Outcomes, enabled by the world's best telescopes, novel machine learning techniques and supercomputer simulations of galaxy formation, will be a large new sample with measurements of their key properties and a clarification of their formation pathways. Benefits are the development of machine learning galaxy detection techniques, essential for future large data volumes, and a firmer understanding of the role of dark matter in forming galaxies over cosmic time.							

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	National Interest Test Statement							
	This project questions current assumptions about how galaxies form by investigating the origins of the recently discovered Ultra Diffuse Galaxies. These galaxies exhibit extreme properties which warrant close investigation as they challenge the accepted cosmological framework. The knowledge produced from this project will enhance Australia's position as a world leader in the fields of astronomy, astrophysics and cosmology and leverage Australia's multi-million dollar investments in large telescopes. Machine learning and enhanced imaging techniques developed in the project will also have wide commercial application within Australia's data science and burgeoning space industries, for example, in remote sensing from satellites and in medical imaging. The planned vehicle for communicating the research findings (an animated film) will help to attract students into Science Technology Engineering and Mathematics subjects and careers, providing further long-term cultural, economic and social benefits for Australia and its commitment to its national space strategy.							
DP220102118 Vincs, Prof Kim	**Holobody: Advancing the Future of Mixed Reality Technologies** This project aims to advance our understanding and use of mixed reality technologies by pioneering a new approach to interaction in virtual systems that recognises, capitalises on, and expands the potential of the human body as a human-machine interface. The project expects to apply the unique, embodied methodologies of dance and movement technology, integrated with customised software, advanced visualisation and artificial intelligence, to develop next-generation principles of embodied interaction in virtual systems. Expected outcomes are improved assistive technology, new prototyping techniques for manufacturing, and improved productivity through interactive and immersive systems, benefiting Australian businesses, healthcare and the arts.	71,000.00	147,000.00	161,000.00	85,000.00	0.00	0.00	464,000.00
	National Interest Test Statement							
	This project will place Australian research at the forefront of technology development by providing a unique and powerful creative approach to mixed reality design. New interactive systems will be developed enabling hands-free capabilities to access unique assistive technologies for Australians with disabilities, enhancing the lives of differently abled Australians. The new interactive systems this project will develop will also enhance the productivity and usability of mixed reality in Australian manufacturing, information and communication technology, social media and health care and the arts. These systems will expand Industry 4.0 capabilities across all of Australia's priority growth sectors; manufacturing, cyber security, food and agribusiness, medical technologies and pharmaceuticals, mining and energy, delivering economic and social benefits across Australian society, and enhancing the global competitiveness Australian businesses and technology start-ups.							
DP220102191 Liu, Prof Chengfei	**Modelling and Searching Cohesive Groups over Heterogeneous Graphs** Heterogeneous information networks (HINs) contain richer structural and semantic information represented as different types of objects and links. Searching cohesive groups from HINs finds many applications and also brings challenges at both conceptual and technical levels. This project aims to investigate the effective modelling of cohesive groups that take both homogeneous and heterogeneous information into account for different applications and devise efficient algorithms for searching and monitoring those cohesive groups based on different models. The methods, techniques, and evaluation systems developed in this project can be deployed to facilitate the smart use of heterogeneous information networks across the nation.	65,000.00	135,000.00	142,500.00	72,500.00	0.00	0.00	415,000.00
	National Interest Test Statement							
	Real network systems (social media, biological networks, collaboration networks, hidden terrorist networks and computer network systems) consist of many different and varied components. These systems can be thought of as heterogeneous information networks (HINs). Current methods of searching these networks to yield knowledge are inefficient, do not take into account the varying components, and do not cope with system changes, thus restricting their usefulness. Using big data analytics, this project will develop a complete framework for modelling and searching within these networks. The techniques, algorithms, and prototype systems developed can be deployed to facilitate the smart use of big data for many advanced real applications, including cybersecurity and better decision-making, for business, society and government.							

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DP220102305	**Illuminating the cosmic web with Fast Radio Bursts**	150,000.00	300,000.00	300,000.00	150,000.00	0.00	0.00	900,000.00
Shannon, A/Prof Ryan M	This project aims to establish the use of millisecond-duration Fast Radio Bursts as a wholly new means to map out the distribution of matter in the Universe. This project expects to localise 100s of bursts using novel infrastructure deployed on Australia's largest radio telescopes. Expected outcomes include an understanding of the processes that shape both the large-scale structures of the Universe, and the extreme conditions that exist at the sites of Fast Radio Bursts. This should provide significant benefits to our fundamental knowledge of the Universe, inspire students into careers in science, technology, engineering and mathematics, and develop signal processing techniques of application to both the Square Kilometre Array and industry.							
	National Interest Test Statement							
	Australia has a long and proud history in the discovery of Fast Radio Bursts, one of the most exciting developments in modern astronomy. The first discovery of a Fast Radio Burst was made with the iconic Parkes 64 metre radio telescope, and Australia's most recent array at the Square Kilometre Array site (ASKAP) produced the most convincing discovery of the so called missing baryons (normal matter). These prize-winning discoveries have been published in high impact journals and inspired young Australians to pursue careers in STEM. This project pushes the limits of energy-efficient advanced computing and signal processing, skills of relevance to the construction of the Square Kilometre Array and easily transferable to industry. This project will take common signal processing elements and deploy them at three major Australian radio facilities to maximise their scientific yield.							
DP220102784	**MemberGuard: Protecting Machine Learning Privacy from Membership Inference**	75,000.00	150,000.00	150,000.00	75,000.00	0.00	0.00	450,000.00
Wen, Dr Sheng	Machine Learning has become a core part of many real-world applications. However, machine learning models are vulnerable to membership inference attacks. In these attacks, an adversary can infer if a given data record has been part of the model's training data. In this project, the team aims to develop new techniques that can be used to counter these attacks, such as 1) new analytical models for membership leakage, 2) new methods for susceptibility diagnosis, 3) new defences that leverage privacy and utility. Data-oriented services are estimated to be valuable assets in the future. These techniques can help Australia gain cutting edge advantage in machine learning security and privacy and protect its intellectual property on these services.							
	National Interest Test Statement							
	Australia is a remarkably cyber-dependent country and securing its cyberspace is a national priority. There is an increasing number of Australian enterprises that use data-oriented machine learning services every day. Billions of dollars could be lost and people's privacy be breached if membership inference attacks are realised. Therefore, the capability that is gained through this project is essential to the Australian cyberspace security and stability. The developed new techniques safeguard the Australian digital infrastructure and its publicly accessible machine learning services by mitigating membership inference attacks. This project contributes to stopping membership inference attacks on machine learning models, and prevents leakage of confidential/sensitive information from people, companies, organisations, and governments.							
	Swinburne University of Technology	731,000.00	1,477,000.00	1,508,500.00	762,500.00	0.00	0.00	4,479,000.00

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The University of Melbourne								
DP220100124	**Advancing investor action on energy transition**	51,000.00	114,950.00	128,200.00	64,250.00	0.00	0.00	358,400.00
Peel, Prof Jacqueline	This project aims to advance action by investors (debt and equity) to increase finance for low-carbon energy sources that reduce fundamental climate risks. The project applies interdisciplinary approaches to generate new knowledge about the business case for investor leadership on energy transition and supportive climate law and financial regulatory frameworks. Collaborative legal and business analysis by leading Australian and US scholars, coupled with interviews and focus groups with investors, will examine contemporary engagement practices and investors' management of climate-related financial risks. Expected outcomes are targeted reform proposals to benefit policymakers and the environment by fostering private financing of clean energy.							
	National Interest Test Statement							
	This project will generate significant environmental and social benefits for the Australian community by developing new knowledge and reform recommendations to advance enhanced private sector financing of clean energy, thus helping to transition to lower carbon energy systems and reducing associated climate risks. The project recognises the untapped potential for changes in the funding practices of investors (debt and equity financiers) in Australia and other leading markets such as the United States, to foster enhanced uptake of low-carbon energy sources and technologies. It aims to fill a gap in existing research about the supporting business case and regulatory settings necessary to enable this shift. The project will triangulate analysis from business scholarship, financial regulation and energy/climate law in Australia and the closely-related US context to identify and develop reform proposals that are economically sound, environmentally beneficial and politically feasible, supplying solutions tailored to the need for a rapid transition in energy systems in order to mitigate urgent climate change risks.							
DP220100398	**Molecular Spin Switching with Earth Abundant Metals**	75,000.00	150,000.00	130,000.00	55,000.00	0.00	0.00	410,000.00
Boskovic, A/Prof Colette	This project aims to develop molecular materials based on non-precious metals that respond to stimuli, including heat or light, by switching between forms with different properties, such as colour and electrical conductivity. The project expects to deliver enhanced control over the switching characteristics and incorporation of the materials into responsive thin films, ready for integration into devices. These molecular switches are promising for molecular electronics, spintronics and colour-based sensing and display devices. Their fast response time and small component size imply less heat to dissipate and therefore less electricity required for cooling upon implementation in information communications and other technologies.							
	National Interest Test Statement							
	Production of molecular switches will revolutionize electronics, making them cheaper, smaller and more energy efficient. The spin switchable materials targeted in this project represent an exciting frontier in progressing new energy-efficient materials for Australia's high-end manufacturing and technology industries. A key benefit of electronic components based on responsive molecular systems is faster response times and decreased energy required to dissipate heat. The nanoscale materials developed will be based on inexpensive metals that are abundant in Australia and ultimately this project may contribute to the generation of new markets for Australian mineral commodities. This research facilitates local development of emerging information communications and other technologies to utilise the new materials, and thus underpins ensuing economic and social benefits. The multi-faceted research training will equip early career researchers with transferable problem-solving, project management, and communication skills which will be invaluable for Australia's shift towards a knowledge economy.							

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DP220100713	**Elucidating the determinants of cation import across the kingdoms of life**	92,171.50	170,542.00	157,419.50	79,049.00	0.00	0.00	499,182.00
McDevitt, Prof Christopher A	The metal ion manganese is essential to all forms of life. This project aims to investigate how this poorly abundant cation is selectively acquired from the chemical complexity of the environment for import into cells by using state-of-the-art biochemical and microbiological techniques. This project expects to define the fundamental basis for how bacterial, archaeal and eukaryotic plastid cation-selective importers can discriminate manganese from chemical similar cations to achieve selective uptake. The expected outcomes of this work will be an understanding of the fundamental basis for selective metal import in biological systems. This should provide benefits for industry through synthetic biological applications of this knowledge.							
	National Interest Test Statement							
	Metal ions play pivotal roles in the cellular chemistry of every cell in all forms of life. This Project will deliver knowledge that will define the mechanistic basis of a metal ion transporting system that is conserved throughout the kingdoms of life. This knowledge will lead to future economic, commercial, and environmental benefits for the Australian community. Applications of this knowledge will be to improve or tailor how this transporter works into industrially relevant microorganisms to enhance bioprocess activities. Applications that are currently limited by a lack of understanding in how to improve microbial metal uptake include the mining industry, where applications to enhance microbial bioleaching of rare metals are needed, and in environmental reclamation, where there is a need to improve capture and removal of toxic metals from waterways and soil. This knowledge will underpin improvements in these applications and advance Australia's Nation Interest through the development of new technologies and intellectual property, while also supporting local communities and industry.							
DP220100844	**Whole-body analysis of human tissue-resident memory T cells**	125,293.00	222,281.00	194,489.00	97,501.00	0.00	0.00	639,564.00
Gordon, Dr Claire L	T cells provide critical immune protection against infection and cancer, and dysfunctional T cells cause autoimmune disease. Much of our understanding of T cells comes from studies of mice and how these immune cells work in humans is not fully understood. This project aims to determine how human T cells persist and function using a unique organ donor tissue resource. The expected outcomes are to generate fundamental new knowledge about the regulation of the human immune response. This knowledge is critical for the development of vaccines and immunotherapies designed to harness T cell immunity.							
	National Interest Test Statement							
	This project will generate fundamental new knowledge on how the immune system is regulated. Knowledge generated through this effort will lead to new insights for innovative strategies for vaccination and immune therapies against disease, with the ultimate goal of improving veterinary and human health. These advances will impact a wide range of common diseases including infection, cancer and autoimmune disease, therefore improving the health and social outlook of many Australians. We expect to develop new collaborations to build commercial products and patent applications for improved vaccination strategies, encouraging multi-disciplinary research that will foster Australian research capacity and economic growth. In parallel with this project, the human organ donor tissue resource used in the project will be expanded and provide much-needed samples to other Australian biomedical scientists. We expect that this improved access to human tissues will greatly advance scientific discovery in Australia and will contribute to Australia's economic, commercial and social interests for the benefit of all Australians.							
DP220100851	**Proppant transport in non-Darcy fracture flow for reservoir integrity/yield**	67,500.00	94,020.50	67,520.50	41,000.00	0.00	0.00	270,041.00
Perera, Dr Samintha	Hydro-fracking of a typical gas well in Australia consumes around 3000 tonnes of proppants to keep open the created fractures, costing over $1.5 million. This project investigates proppant transport behaviour in non-Darcy turbulent flow during fracking of underground reservoir rock by combining Hele-Shaw-cell experiments with Particle Image Velocimetry and conceptual/numeric modelling. The generating advanced proppant transport knowledge is expected to be more accurate than laminar flow-based theories currently relied on. Expected outcomes include more efficient/safer proppant-assisted fracking strategies to reduce wasteful proppant disposition and inform industry/government management of fracking based on the reservoir geological features.							

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	National Interest Test Statement							
	Moving away from a reliance on coal to a renewable energy future is a National priority, which will take several decades to achieve. Natural gas represents an ideal transition fuel, but Australia requires effective low-carbon emission methods such as unconventional gas extraction and CO2 geosequestration, relying on reservoir stimulation techniques like hydro-fracking. This proposal aims to overcome significant issues with current fracking practices by revealing true transport behaviour of proppants (tiny particles that keep fractures open) in fractures, a critical factor in productivity and leakage risk. The proposed strategies to appropriately target suitable reservoirs for fracking will help industry and government decision-making on fracking. The project's outcomes will reduce wasteful disposition of proppants and hydrocarbon leakage risks, reducing the environmental impact of hydraulic fracturing. This will reduce public opposition, deliver significant economic benefits to Australia; and reduce carbon emissions by 50-60% while giving industry and consumers affordable and acceptable energy options.							
DP220100905	**Lessons From Nature: Late Stage Oxidation in Total Synthesis**	93,309.50	183,856.50	183,414.50	92,867.50	0.00	0.00	553,448.00
Rizzacasa, Prof Mark A	This project aims to achieve the chemical synthesis of a number of biologically active novel natural products. The key aspect is the application of chemistry inspired by Nature to deliver molecular complexity in a rapid fashion which would allow for the production of molecules otherwise unavailable in sufficient quantities from the natural sources. This research will utilize late stage oxidation of intermediates to provide ready access to complex molecules. The main goal is the development of new chemical and biological catalysts for further application in organic synthesis with a view to the production of new medicinal agents and important materials.							
	National Interest Test Statement							
	This proposal aims to achieve the total chemical synthesis of a number of bioactive natural products in which key steps are inspired by their production in Nature. Most significantly, this challenging research should deliver methods for the production of molecules that have applications in both basic and applied research. This research could lead to new compounds for applications in biology and medicine that will expand Australia's knowledge base and support the high-quality education and training of students to increase Australia's research capability in the pharmaceutical and biotechnology industries. In addition, this research will provide methods for complex molecule production and the synthesis of analogues that will be superior to known standard approaches.							
DP220101005	**Phylodynamics for Single Cell Genomics**	65,000.00	130,000.00	130,000.00	65,000.00	0.00	0.00	390,000.00
Stumpf, Prof Michael P	This project generates the mathematical framework required to look at single cell data in developmental systems and tissues. All cells in a multi-cellular organism derive from a single ancestral cell, generally the fertilised egg cell. Phylodynamics provides a framework to analyse and model this data, by connecting the shared ancestry of cells in an organism to the cell population and tissue dynamics. By developing the mathematical and statistical foundations for the analysis of single cell data in a phylodynamic framework we will establish a powerful new computational tools for the analysis of tissues and developmental processes.							
	National Interest Test Statement							
	This project is in Australia's national interest as its sets out the mathematical foundations required to understand developmental processes and the mechanisms underlying the generation and maintenance of healthy tissues. We will develop mathematical models of these fundamental processes and provide a computational platform to understand the normal operation of these important biological systems. The outcomes of this project will enable future studies to explore dysfunction and treatment of developmental disorders and cancer. In particular, the mathematical and statistical models will support Australia's life and biomedical sciences communities and will give new insight into fundamental biological processes. The outcomes of this project will thus have societal and economic impact, informing research into tissue engineering and the treatment of cancers. Both of these problems are best understood in a phylodynamic context, and the methods at the core of this project will deliver biomedical and therapeutic benefits to the Australian population.							

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DP220101012	**In for the count: Maximising trust and reliability in Australian elections**	67,500.00	135,000.00	135,000.00	67,500.00	0.00	0.00	405,000.00
Vukcevic, Dr Damjan	This project aims to develop innovative approaches to identifying, measuring, and evaluating errors and purposeful intervention in the uniquely complex elections at the basis of Australian democracy. Such methods can underpin a world-class election auditing system, which contends with the risks that are emerging at the intersection of election digitisation, cybersecurity and foreign interference. The project's expected outcomes are new auditing methods, tested on real Australian election data, with their benefits quantified against global best practice. The research outputs should help reinforce the community's trust in Australian elections, which are a foundation for our security, social cohesion, and political resilience.							
	National Interest Test Statement							
	Election outcomes must be accompanied by evidence that they accurately reflect the will of the voters. Post-election audits provide this evidence. This project develops methods to verify reported Australian election outcomes, detecting those that are incorrect as a result of software errors or purposeful manipulation. This adds a substantial layer of security to our electoral processes. Our methods involve inspecting cast ballots and applying innovative, rigorous statistical methodologies to ensure confidence in the outcome. Such 'risk-limiting' audit methods have been developed for simple elections, but none exist for highly complex election processes such as the single transferable vote used for our Senate. The project is well aligned with the Science and Research Priority of Cybersecurity, providing techniques to discover, understand, and respond to the vulnerabilities in our electoral processes. It will enhance trust in, and the reliability of, reported election outcomes and help in countering misinformation and external interference in fundamental democratic processes.							
DP220101035	**Democratisation of Deep Learning: Neural Architecture Search at Low Cost**	65,000.00	130,000.00	130,000.00	65,000.00	0.00	0.00	390,000.00
Halgamuge, Prof Saman K	The need to manually design Deep Learning-based Neural Networks (DNNs) limits their usage to AI experts and hinders the exploitation of their true potential more broadly, e.g., in farming, humanities. We aim to replace this tedious process through novel AI methods capable of generating DNNs that can perform significantly better and at a lower computational cost than manually designed DNNs. We further expand this idea to solve complex real-world problems with both labelled and unlabelled data found in various applications including energy and climate change. The expected outcomes include the novel AI methods, highly trained AI researchers and a number of critical applications that will bring significant benefits to Australia and the world.							
	National Interest Test Statement							
	Deep Learning uses data to make decisions or predictions. This project will make sophisticated AI tools, Deep Learning-based Neural Networks (DNN), available to non-experts at lower cost to solve complex real-world problems. As well as increasing usage, these more versatile new methods will be applicable to a broad range of fields. In energy demand forecasting, DNN could predict customer behaviour in electric vehicles, providing efficient modelling of the grid electricity usage with cost savings and environmental benefits for both commuters and the energy sector. Using data analysis of satellite images, DNN can investigate climate change and emergency events. It can enhance accuracy and precision in predicting and measuring environmental change impacts, and improve response and adaption to gradual changes in climate and catastrophic natural disasters. With many broad applications for DNN, this project has the potential to deliver significant economic, commercial, environmental, social and cultural benefits to Australia and globally.							
DP220101078	**A night shift: planning for night time economies and workers in Australia**	67,429.00	139,951.50	157,013.00	84,490.50	0.00	0.00	448,884.00
Acuto, Prof Michele	We need to talk about the night. If cities are now increasingly recognised as '24/7' places, little attention is paid to their nights and even less so to those workers who keep cities functioning afterhours by supporting a $134bn night-time economy. This project aims to deliver this needed shift to night-time thinking in urban planning and policy. It offers detailed assessments of the role of night-time work in 14 Australian capital and regional cities. It investigates conditions, contributions, voices and spaces that characterise night-time work. Partnering directly with local councils, it experiments with transferrable action-oriented and policy-ready methods, seeking to build capacity for 'night literacy' in cities and urban research.							

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	National Interest Test Statement The night-time economy is a key driver of growth. It employs 1.17m people across Australia and generates a $134bn turnover. Yet a 'night' focus is often lacking from local, state and national policy. Further, limited attention is typically centred on the 'consumption' side of Australia's night-time economy. Those hundreds of thousands who work to keep our 24/7 cities functioning, whether in the entertainment and hospitality sectors or as maintenance, environmental and healthcare workers, are rarely in the spotlight. It is imperative to better understand and develop the night-time economy sustainably, without leaving those who uphold it behind. Night equality challenges are pressing. Around 1-in-9 of all Australian employees work night shifts, most in low pay and in precarious health conditions. This project provides tangible evidence to tackle how night shift work can be better recognised, planned for and supported, working directly with capital cities and major regional centres to enhance their engagement with this critical workforce.							
DP220101100 Day, Dr Jennifer E	**Communities, Kava, Court Orders: The Ways of Possessing the Pacific City** This project aims to understand how urban tenure security is negotiated, claimed and/or recognised amid increasing stress on urban resources and competing potential sources of value for urban land. Through small-scale community-facing research, it intends to produce evidence of how residential tenure works on customary lands around Port Vila, Vanuatu. Expected outcomes include case studies and typologies showing the types of tenure relationships in place. This should have significant benefits for government and donors working to prevent displacement and developing plans for inclusive urbanisation into the future. Local populations should also benefit through increased awareness of the value and standing of customary tenure arrangements.	52,500.00	105,000.00	52,500.00	0.00	0.00	0.00	210,000.00
	National Interest Test Statement Project findings intend to improve understanding of how customary tenure operates in Pacific cities. This evidence base has the potential to increase the reach and effectiveness of Australian aid funds targeting Pacific cities through DFAT's Pacific Step-Up. How tenure is established and maintained has been a stumbling block for effective urban development and infrastructural strengthening in Vanuatu and our other Pacific neighbours. As such, the project addresses the Government's Science and Research Priority: Environmental Change; specifically, the Practical Challenge to build resilient urban, rural and regional infrastructure. Improved understanding in this area will contribute to inclusive development planning, due to recognition of stakeholders beyond landowners and those with formal title or tenure rights in the urban Pacific. This will enable Australia to further its goals to work in equitable development partnerships and help maintain stability and security across the region.							
DP220101166 Burkitt, Prof Anthony N	**The neural dynamics of real-time processing in the brain** The aim of this project is to investigate a new model for predictive coding of sensory processing in the brain in which the brain compensates for the time delays in neural transmission by maintaining a real-time temporal alignment of the neural activity. This results in a representation of sensory information that is aligned in time across the cortex, offering a new fundamental principle for how the brain functions in a highly dynamic world whose outcomes would provide a deeper understanding of brain function. It could also have profound significance for artificial intelligence and brain-inspired technologies, as well as benefit neural sensory prostheses and brain-machine interfaces.	80,000.00	160,000.00	160,000.00	80,000.00	0.00	0.00	480,000.00
	National Interest Test Statement When hitting a tennis ball, our brains manage rapid perception and response faster than our nervous system can transmit. How we do this remains a mystery. Unlocking this knowledge will improve the complexity of cognitive tasks in artificial intelligence, computing systems and brain-inspired technologies. This project will create new algorithms to mimic the brain by describing how the brain functions in real time. It will lead to new generations of AI and novel medical technologies able to handle rapidly changing stimuli. Such commercial applications of AI are far-ranging, including remote sensors, autonomous systems and wearable devices. In health, outcomes will greatly enhance neural prostheses, such as cochlear, and brain machine interfaces. This will have economic and social benefits for Australia, strengthen our world-leading reputation in bionics, foster skilled people for academic research and create unique opportunities for industries in neuro-technology and AI in Australia.							

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DP220101254	**Is SPINT1 a key regulator of placental development?**	89,000.00	193,000.00	179,000.00	75,000.00	0.00	0.00	536,000.00
Kaitu'u-Lino, A/Prof Tu'uhevaha J	The placenta is an essential organ required for reproduction in placental species. This project aims to elucidate the fundamental biology of SPINT1 in placental development. It will generate new knowledge about whether the spatial and temporal expression of SPINT1 is conserved across several species; cow, sheep, lizard, mouse and human. It will also define the molecular mechanisms by which SPINT1 directs formation, maturation and expansion of the placental exchange interface which is critical for offspring survival. The project will increase understanding of placental development, enhance collaboration and research knowhow, and promote future applied projects in all species that reproduce via placental support.							
	National Interest Test Statement							
	This project seeks to understand the function of a key protein, SPINT1, involved in the development of the placenta and the placenta is critical to healthy fetal development in placental animals. The project will provide a knowledge base that could be widely applied to improve reproductive outcomes in any placental animal. Improved understanding of this serves the Australian national interest, particularly the potential of these findings to aid livestock production and conservation breeding programs for threatened species and therefore have significant commercial, economic and environmental benefits for Australia. This project will also provide outstanding training opportunities, whereby we will mentor future leaders within the area of placental biology.							
DP220101306	**Neural circuitry of maternal behaviour**	81,987.00	142,159.50	123,212.50	63,040.00	0.00	0.00	410,399.00
Lawrence, Prof Andrew	Elaborate maternal care is a defining characteristic of mammalian species, suggesting conserved brain pathways evolved to orchestrate these responses. The neural substrates underscoring maternal behaviour have not been fully elucidated. This project aims to investigate the brain circuitry underpinning maternal care using a multidisciplinary approach combining behavioural assays and pharmacogenetic manipulations in mice alongside sophisticated molecular and functional analyses. The outcomes of this project are expected to improve our understanding of how specific brain pathways govern maternal behaviour. The novel insight gained is expected to advance theories regarding the organisation of maternal care and enable their practical testing.							
	National Interest Test Statement							
	This project seeks to improve understanding of how specific pathways in the brain control maternal behaviour, an area of research that remains underexplored, yet is of great social and economic importance. For example, appropriate maternal behaviour is critical to livestock production and our findings could lead to the ability to control aberrant maternal behaviour. This project builds capacity for Australia by the adoption of novel technology to ensure a critical mass of expertise within Australian universities, and by developing the next generation of scientists, who will be trained at the cutting edge of neuroscience research. This research will also advance Australia's profile as a leader at the forefront of basic scientific research. Research findings will likely spawn new collaborations around the world that will promote opportunities for Australia to lead international projects, and bring national benefits via joint international research programs and exchanges of expertise, personnel, technology, and reagents.							
DP220101336	**Historical frontier violence: drivers, legacy and the role of truth-telling**	59,475.00	151,906.00	184,596.00	92,165.00	0.00	0.00	488,142.00
Moschion, A/Prof Julie	This project aims to build data to identify the historical factors that incited frontier violence; quantify the legacy on communities today and conduct fieldwork to understand how historical trauma is transmitted across generations. This project expects to develop new knowledge on the circumstances and legacy of settlement and the origins of gaps in life prospects between Indigenous and non-Indigenous Australians. Our expectation is that this will increase public acceptance of the circumstances of settlement and the need to make amends. This project should help increase public support for truth-telling and better relations between Indigenous and non-Indigenous Australians, a vital step towards reconciliation and healing the nation.							

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	National Interest Test Statement							
	This project will build new knowledge about the circumstances of settlement, the impacts that frontier violence continues to have today and the role of truth-telling in healing. By engaging the public in the research through a project website, a data visualisation tool and other plain language dissemination material, this project aims to educate the public about the legacy of frontier violence on Indigenous communities today and motivate the need for truth-telling. In meeting this aim, this project will help progress Indigenous peoples' hope for Makarrata, a Yolngu word for coming together and facing the wrongs of the past, as expressed in the 2017 Uluru Statement from the Heart, and will help build stronger and more respectful relationships between Indigenous and non-Indigenous Australians. In progressing relations, this study promises to support current efforts to progress reconciliation and promote a more collaborative and community-wide effort to close the gap in life prospects between Indigenous and non-Indigenous Australians.							
DP220101361	**Using RNA interference to combat the worst emerging disease of wildlife**	68,227.00	153,774.00	158,414.00	72,867.00	0.00	0.00	453,282.00
Berger, A/Prof Lee	This project aims to develop a novel method of disease control in wildlife. It will use recent advances in RNA interference technology to knockdown virulence genes in an emerging pathogen that threatens biodiversity. Pathogens such as the amphibian chytrid fungus continue to cause widespread extinction and urgently require better control methods. RNA interference has been used to increase disease resistance to fungi in plants but adapting this approach for animals will have wide relevance in combatting fungi and other pathogens. The specific outcomes of this method will be to increase survival rates in a broad range of frog species to improve the success of captive release programs worldwide and hence save frogs from extinction.							
	National Interest Test Statement							
	This multidisciplinary project aims to provide social, cultural, environmental and economic benefits by conserving Australia's frogs including the iconic Australian corroboree frogs. It will restore frogs and hence improve ecosystem health in Australia's wetlands and save millions of dollars spent on maintaining captive assurance colonies of wildlife. Subsequently it could lead to effective, streamlined and inexpensive methods for fighting fungal and other emerging diseases that are threatening biodiversity and ecosystems worldwide. The project will benefit Australia by fostering collaborations between universities and CSIRO, as well as with leading research laboratories in Europe. This will result in Australian researchers continuing to excel in the growing field of wildlife health, while tackling aims of the national Threat Abatement Plan for chytridiomycosis.							
DP220101372	**Engineering screw piles to secure offshore wind energy turbines**	67,250.00	164,925.00	188,775.00	91,100.00	0.00	0.00	512,050.00
Cassidy, Prof Mark J	This project aims to tackle the scientific challenges of using screw piles as foundations for deep water offshore wind turbines. Current foundations for offshore infrastructure developments have reached their limits, and conventional screw piles are designed for land use. This project will use innovative geotechnical methods to develop verified designs, guidelines and numerical tools for predicting the forces required to install screw piles into the seabed and their capacity to resist extreme wind and wave forces relevant to these structures. As foundations cost up to 35% of construction, screw piles will provide significant economic and environmental benefits in reducing costs and unlocking substantial renewable energy from our oceans.							
	National Interest Test Statement							
	Wind turbines installed offshore require strong foundations, especially when turbines are large or further offshore in deep water, where cyclic winds and waves are extreme. This project will use a land-based foundation system, screw piles, to design a new foundation system for the installation and anchoring of large offshore wind turbines in deep waters. These new engineering tools will create a world-first ability to build large offshore screw pile foundation systems that can withstand extreme weather. This project will build on Australia's leadership in the offshore industry providing significant economic, environmental and social benefits. Firstly, it will reduce costs of offshore wind turbine farms as foundations account for 35% of capital costs. Secondly, it will unlock new areas for Australia's renewable wind reserves providing cheap renewable energy production for Australians. Finally, it will help secure Australia's environmental and economic future in the global transition from traditional hydrocarbons to renewable energy.							

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DP220101495	**Remote sensing of biotic stress with hyperspectral-fluorescence imaging**	107,500.00	192,500.00	155,000.00	70,000.00	0.00	0.00	525,000.00
Zarco-Tejada, Prof Pablo J	This project aims to investigate new indicators of crop biotic stress using innovative airborne remote sensing and imaging spectroscopy for biosecurity applications. Current satellites used to monitor crops and forests do not meet the spectral and spatial details that are required for the early -previsual- detection of biotic and abiotic stress. Accordingly, this project's significance focuses on new insights to detect the alteration of photosynthetic indicators of plant functioning, building on recent breakthroughs with airborne hyperspectral imaging and remote sensing technologies. The outcomes will provide significant benefits to Australia in the detection of harmful diseases and improved water and nutrient monitoring methods.							
	National Interest Test Statement							
	Robust remote sensing monitoring methods to enhance biosecurity and support the efficient use of water and nutrients are critical for Australia. Findings from this study will underpin innovative surveillance methods which are urgently needed due to increases in harmful diseases worldwide that threaten crops and plants. For example, the plant bacteria, Xylella fastidiosa, currently exotic to Australia, is the top threat for the country, and is destroying large agricultural areas in Europe, America and Asia. Other harmful diseases are already established in Australia, such as TR4, which is affecting banana plantations worldwide. The efficient use of resources such as water and nitrogen for fertilization is vital to ensure sustainability. Developing robust indicators of early (pre-visual) crop stress due to biotic and abiotic sources is thus essential. Remote sensing plays a critical role as part of innovative surveillance protocols being adopted, with significant national benefits for the Australian economy and environment.							
DP220101503	**Authoritarian populism and livelihood change in the Philippines**	37,884.00	87,983.50	113,708.50	63,609.00	0.00	0.00	303,185.00
Dressler, A/Prof Wolfram H	This research aims to explore the impacts of authoritarian populism on development, governance, and livelihood change in the Philippines. The project will generate new knowledge on the consequences of the interrelated erosion of environmental protections, acceleration of development projects, and human rights violations for poor people in Southeast Asia. Expected outcomes of the project include new empirical insights into how poor, resource-reliant households respond to converging environmental and political pressures across rural and urban areas in the Philippines. Project outcomes will provide significant benefits for Australian responses to declining social and environmental safeguards occurring in the region.							
	National Interest Test Statement							
	This project addresses the interlinked social and environmental outcomes of rising authoritarian populism, one of the most significant political transformations occurring throughout the Southeast Asian region. There are clear strategic benefits to Australia from understanding the relationship between populist politics, poverty and environmental conditions in major regional trading partners and recipients of development aid. In the Philippines alone, the concurrent decline of natural resources and worsening human rights situation will impact the economic well-being of millions of rural and urban households and has important implications for bilateral relations, development objectives and regional security. This project will provide rigorous and policy-focused evidence that can (1) refine diplomatic responses to the erosion of social and environmental safeguards occurring both in the Philippines and throughout the Southeast Asian region, and (2) inform Australian efforts to meet international development obligations by promoting more effective anti-poverty and environmental governance interventions.							

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DP220101544	**Defining and engineering the rhizosphere for Australian rainfall patterns**	66,103.00	133,426.00	128,526.00	61,203.00	0.00	0.00	389,258.00
Watt, Prof Michelle	The manner in which plants use carbon and water defines agricultural and natural landscapes. Today's models that predict plant improvement rely on carbon and water usage by plant leaves. However, the first interaction between plants, carbon and water occurs in the rhizosphere; a diverse zone with dynamic root-microbiome interactions. We will use advanced visualisation and mathematics to determine fine scale relationships between microbes and roots in the rhizosphere when exposed to water levels reflective of current and projected rainfall values. From generated knowledge of water and carbon dynamics caused by intimate microbe-root interactions, we will provide water saving, soil regeneration and improved carbon biosequestration strategies.							
	National Interest Test Statement							
	The economic prosperity of Australian agriculture and the sustainability of natural landscapes may increase from project outcomes. Australian climates cycle through drought and rainfall, however plant and soil sciences; the foundation of agriculture; rarely cover water dynamics. It is urgent that we address this gap: rainfall events are shortening from five to two days due to climate change, and today's climate models use leaves, because roots and their soil: the rhizosphere, are hard to study. We will obtain unique data and new mathematics to deal with plant roots and soil processes in Australian climates, to capture rainfall more effectively, allowing use of nutrients and land more efficiency by roots and soil organisms. If the research identifies root-carbon genes and microorganism types that lead to deeper and healthy root systems, farmers may sequester more carbon below ground, offsetting atmospheric CO2. Second benefits would be social through better prosperity of regional communities and maintaining affordable and accessible food grown in Australia.							
DP220101633	**Economic, political and cultural brokers in remote Papua New Guinea**	37,500.00	75,000.00	97,500.00	60,000.00	0.00	0.00	270,000.00
Minnegal, A/Prof Monica	This project aims to understand the role of brokers in shaping flows of knowledge and wealth at in resource frontiers in Papua New Guinea; the intent is to investigate the demands that brokers service, their positioning, and the tensions they mediate. The project plans to generate new knowledge by studying cultural, political and economic brokers in a region where encounters with church, state and corporations are comparatively recent. Expected outcomes include contributions to the scholarly literature on brokerage, and building capacity of PNG researchers. This should provide significant benefits, informing better management of processes that threaten viability of development projects, legitimacy of the state, and stability of communities.							
	National Interest Test Statement							
	The project will increase understanding of processes that threaten viability of development projects and legitimacy of states and, by distorting equitable access to resources, threaten the stability of local communities. It offers economic, strategic, and social benefits for the Australian community. 1) Australian corporations are significant partners in resource-extraction projects in PNG, some of which have also been underwritten by the Australian government; the project may contribute to greater security for those projects. 2) The Australian government has a vested interest in ensuring the legitimacy of the PNG state; the project may provide guidance for those seeking to increase the standing of government in local communities, and enhance qualifications of PNG policy-makers. 3) Australia now must compete with China for influence in PNG; the project may provide guidance to diplomats seeking to broker such relations at local scales. 4) The Australian community has a longstanding moral obligation to the people of PNG; the project has potential to enhance the well-being of local communities in PNG							
DP220101652	**Smart site investigation for offshore energy installations in sand**	75,000.00	135,000.00	110,000.00	50,000.00	0.00	0.00	370,000.00
Chow, Dr Shiao Huey	This project aims to develop a next generation tool for seabed site investigations. It will use free-fall penetrometers, advanced physical modelling and novel probabilistic methods to investigate fundamental science of sand responses at low stress level and generate new interpretation methods. Outcomes of this project include a scientific framework to predict soil design parameters at unsampled seabed locations. A game changer in offshore site investigations, the project will provide cheaper and faster geotechnical site investigation in sand at a time of global increase in offshore energy installations (worth 4 trillion over the next decade).							

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	National Interest Test Statement This research will produce a novel site investigation tool to map the spatial variability in seabeds that will reduce the uncertainty in geotechnical design of offshore energy infrastructures and address the current design challenge identified by industry. The novel outcomes will produce essential cost savings and risk reduction that will directly benefit the offshore energy industry. This project is particularly timely as it will support ongoing natural gas exploration and emerging offshore wind farms in Australia requiring cost-effective site investigation. It will ensure the sustainable economic growth of Australia's blue economy and maintain Australia's competitiveness in ocean energy developments. Furthermore, the project will significantly enhance the international competitiveness and prestige of Australian research and produce high quality next generation engineers and researchers to ensure our research capabilities will continue to be at the leading edge worldwide.							
DP220101675 Kneebone, Prof Susan Y	**The role of community sponsorship for refugee resettlement in Australia** This Project aims to conduct the first large-scale comparative study of community or private sponsorship of refugee resettlement in Australia and other jurisdictions. It will generate ground-breaking insights into Australia's role historically in community sponsorship of refugee resettlement and identify the legal and policy background of current successful community sponsorship programs. Expected outcomes include clarity and policy guidance about how community or private sponsorship is understood, conceived and implemented globally; and better knowledge about the motives of community sponsors. This Project will position Australia as a world leader in practice and research on community or private sponsorship for refugee resettlement.	45,000.00	105,000.00	120,000.00	60,000.00	0.00	0.00	330,000.00
	National Interest Test Statement This Project will have multiple benefits for Australia. Economic and environmental benefits will arise from increased community participation in refugee resettlement sponsorship which will increase and extend the distribution of refugees beyond urban to rural and regional areas, thereby relieving pressure on infrastructure in urban centres and sharing responsibility and the cost of resettlement between community and government. It will strengthen resettlement for refugees from Southeast Asia and contribute to security by fostering stronger regional relationships, including trading partnerships. Social and cultural benefits will flow from new knowledge of Australia's historical and contemporary practice of community sponsorship, through richer understanding of citizenship and national identity. It will contribute to social and community cohesion, and to understanding of how to engage community goodwill for sponsorship of refugees, leading to more effective programs. It will provide guidance for Australia to develop a best practice model and become a world leader in community sponsorship.							
DP220101689 McConville, Prof Malcolm J	**Characterization of the dark metabolome of eukaryotic cells** The project aims to investigate the full metabolic potential of a group of eukaryotic organisms using advanced analytical and computational techniques. It will identify novel metabolites and enzyme activities that are currently not predicted from genome annotations. Expected outcomes of the project include the delineation of new metabolic processes that are common to all eukaryotes, the characterization of new enzymes families, and the generation of comprehensive metabolic databases. An improved understanding of cellular metabolism will provide direct benefits in biotechnology, food production, environmental monitoring and the diagnosis and treatment of human metabolic and infectious diseases.	95,300.00	196,370.00	201,050.00	198,455.00	98,475.00	0.00	789,650.00
	National Interest Test Statement This project will provide fundamental new information on cellular metabolism that underpins all aspects of life. The work will contribute to Australia's national interest by (1) improving our ability to model microbial metabolism and generate improved strains in the biotechnology industry, (2) improving our understanding of a wide range of human diseases, including obesity, diabetes, metabolic syndrome, (3) building capability in advanced analytical technologies in Australia, including national facilities, that underpin developments in the environmental, biotechnology and biomedical sciences, (4) providing outstanding training opportunities for higher degree students and post-doctoral researcher in advanced analytical, computational and genomic sciences and (5) building important international linkages with one of the leading centres for genomic research in North America.							

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DP220101727	**New Tests of Fundamental Physics & Astrophysics with Atmospheric Neutrinos**	66,855.50	139,648.50	149,242.00	76,449.00	0.00	0.00	432,195.00
Bell, Prof Nicole F	Neutrinos are the least understood of the known fundamental particles, yet they hold the key to some of the most important open questions in physics and astrophysics. This project aims create new knowledge, which is needed now, using existing and imminent atmospheric neutrino data. It will pave the way to better understand the origin of the matter-antimatter asymmetry of the universe, supernovae, and dark matter. The expected outcomes include significant advances at the forefront of modern science, which will contribute to the development of a world class research capacity in Australia. Significant benefits include high level training of students and early career researchers, contributing to a highly skilled STEM workforce.							
	National Interest Test Statement							
	Neutrinos are the least understood of known particles in nature. This project will use new data-analysis, simulation and statistical methods to study the fundamental properties of neutrino, and provide foundational support for the science program of the Stawell Underground Physics Laboratory, underpinning a significant investment of resources by State and Federal Governments. By asking fundamental questions about nature, the project will provide cultural benefits to Australian society by addressing the deep need to understand the nature of the universe and our origins. Such topics inspire students to engage in STEM, ultimately contributing to the knowledge economy in areas where critical skill shortages have been identified. It will deliver scientific and economic benefit to the Australian community through developing transferable STEM-based skills, with direct applications to data-intensive Australian industry sectors such as cybersecurity, information technology and finance, and the detection of neutrinos has downstream applications in areas such as defence.							
DP220101788	**How do signals cross the cell membrane: the betacommon receptor family**	95,000.00	195,000.00	205,000.00	105,000.00	0.00	0.00	600,000.00
Parker, Prof Michael W	This project aims to unravel missing molecular details of how a family of proteins, called the betacommon receptors, is able to signal across cell walls. This project aims to generate new knowledge about how membrane-bound receptors transmit biological signals in living organisms. Despite their fundamental importance in biology, how these proteins work remain enigmatic. Expected outcomes include discovery of novel mechanisms general to these types of protein receptors and fundamental insights in understanding vital physiological processes across all kingdoms of life. Ultimately, this new knowledge should benefit efforts to discover novel treatments in cases where malfunctioning receptors cause diseases in animals and humans.							
	National Interest Test Statement							
	This project will provide insights into the fundamental biology of a class of proteins called cell surface receptors. Cell surface receptor proteins respond to extracellular molecular signals and regulate major cellular functions in all kingdoms of life and thus have known importance and utlised in agriculture and biotechnology. This study will focus on cytokine receptors that are particularly associated with immune defence and for which Australia has been a pioneer. The discovery of cytokines by Metcalf in the 1970s launched a new field of biology, with Australian scientists making major contributions ever since. Findings from this research provide the foundations to lead the development of engineered proteins with great importance, with potential benefits for Australia's biotechnology industry, placing Australian science at the forefront of an emerging technology. This may have significant impact on the Australian economy through spin-off companies and licensing agreements.							
DP220102030	**Mechanisms maintaining mitochondrial copper homeostasis.**	89,500.00	182,000.00	185,500.00	93,000.00	0.00	0.00	550,000.00
Maher, A/Prof Megan J	This project aims to define the molecular mechanisms by which copper is trafficked and balanced within mitochondria. The project will employ an integrated biological, biochemical, biophysical and structural approach to examine the proteins which underpin the balance between the essentiality for copper and its toxicity, within this organelle. This project will deliver fundamental insights into how mitochondria contribute to and achieve cellular metal homeostasis, in addition to molecular explanations for how faults in this process result in mitochondrial defects. Major benefits include research training, strengthened international linkages and fundamental insights into mitochondrial biochemistry.							

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	National Interest Test Statement							
	Living cells contain tiny organelles called mitochondria that generate energy. This energy powers the multitude of chemical reactions taking place in cells at any one time. Many of these reactions require metal ions in the chemical processes that are vital to cells in all forms of life. This study will reveal how copper, an essential metal, is balanced within cells to optimally contribute to these chemical reactions. This knowledge is key to defining the chemical processes that support living systems and in understanding how defects in metals can lead to dysfunction in the cell. The research integrates biological, biochemical, biophysical and structural technologies to examine proteins and their interactions that underpin cell function. Australia will benefit from this interdisciplinary emphasis by creating multi-skilled students and trainees able to tackle other complex problems at the interface between disparate scientific disciplines. These skills will particularly impact on agriculture, food science and medicine.							
DP220102089 Little, Prof Melissa H	**Investigating Wnt signaling during human nephron commitment and patterning** Aims: To use gene edited stem cell lines that display cell location, identity and cell state to map human kidney tissue formation in the laboratory. By monitoring how each cell responds to those around it across time and space, we will for the first time map the formation of kidney tissue in the dish. Significance: Understanding how stem cells form a tissue will help us to improve and control the process. This is key to advancing tissue engineering. Expected outcomes: The proposal will pioneer state-of-the-art imaging, gene editing and machine learning approaches, generating models of human development that are currently unavailable. Benefits: This understanding will guide the development of novel approaches to tissue engineering.	74,600.00	150,360.00	152,680.00	76,920.00	0.00	0.00	454,560.00
	National Interest Test Statement							
	This proposal will use genetically manipulated stem cells to map formation of kidney tissue in a culture dish. Understanding how cells communicate to form a tissue will enable the process to be controlled and manipulated in biotechnology. The long-term applications of the knowledge gained relate to the burgeoning biotechnology sector, particularly around tissue engineering. For example, while kidney disease is a major economic burden, and particularly affects indigenous Australians, the project outcomes will be relevant for all organs in humans and livestock. The project therefore has significant potential to contribute to Australia's economic, commercial and social interests. The ability to generate biological tissues in a controlled and reproducible way has the potential to drive economic gain through commercialisation of the intellectual property. Outcomes will also include the development of cutting edge technology, enhanced international research reputation and potential commercial partnerships.							
DP220102133 Drysdale, Prof Russell N	**New insights on the forcing of Quaternary ice-age terminations** This project investigates the period when Earth's climate last experienced a major step change. Using novel techniques, it combines information from an exceptional archive of cave deposits and ocean sediments to precisely determine the timing of ice-age cycles. The results will provide the first robust test of hypotheses proposed to explain these cycles, leading to refinements in the astronomical theory of the ice ages. They will also provide an essential reference record of Northern Hemisphere ice-sheet history, which will complement data from forthcoming Antarctic ice cores. Together, this will better contextualise current and projected greenhouse warming.	85,000.00	160,000.00	120,000.00	45,000.00	0.00	0.00	410,000.00
	National Interest Test Statement							
	This project will produce new data to help us understand why Earth's climate took its last major turn, which occurred about one million years ago. This was a time when natural climate cycles became longer and shifted dramatically to a larger amplitude. Greenhouse warming is currently pushing our climate towards the next major turn, with potentially profound consequences for Australian society, economy and environment over the coming decades. Interrogating past turning points is fundamentally important for placing current climate change into context. The results from our project will reveal the links between natural external forcing (such as variations in the Sun's energy), the internal feedbacks between the atmosphere, ice sheets and oceans, and major episodes of environmental change. This will ultimately lead to a better preparedness of the Australian and international communities to tackle the current climate change problem.							

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DP220102134	**Millennial climate change in southern Australia during the Last Glacial**	87,500.00	162,500.00	150,000.00	75,000.00	0.00	0.00	475,000.00
Drysdale, Prof Russell N	Abrupt warming and cooling events were a persistent feature of Earth's most recent climate cycle. Surprisingly, little is known of how these events affected the climate of Australia. This project will produce precisely dated reconstructions of rainfall and temperature trends in southern Australia during these events. These new terrestrial and ocean data will be compared with model simulations to determine how rapidly abrupt climate perturbations in the Northern Hemisphere reached our region, and the processes by which this occurred. The results will advance theory on how abrupt climate change propagates globally and provide a long-awaited climatic context for capstone events in Australia's natural history.							
	National Interest Test Statement							
	The data produced in this project will test how well climate models can simulate the effects of abrupt climate change on southern Australia, where 75% of our population resides. Abrupt climate change is a potential consequence of global warming. Australia is particularly vulnerable given its susceptibility to climate extremes. Floods and droughts in regions such as southern Australia, where much of our food is grown, bring devastating economic, environmental and human costs. Their effects are firmly implanted in the national psyche. Our data-model comparisons will help us understand the atmospheric and ocean circulation adjustments that accompany abrupt climate change, and highlight areas where model improvements are needed. This will ultimately give greater confidence in the accuracy of model projections of future climate, which will benefit all Australians.							
DP220102135	**The impact of female sex hormones on neurodevelopment**	72,500.00	141,500.00	97,500.00	47,773.00	19,273.00	0.00	378,546.00
Whittle, A/Prof Sarah L	This project aims to characterise the contribution of sex hormones to the development of emotional brain circuits in female adolescents. Puberty is associated with profound changes in emotional behaviours in females, but we know little about the underlying brain mechanisms. In particular, research has neglected to consider the role of the sex hormones for which changes are a defining feature of female puberty (eg, oestradiol). This work will be the first to comprehensively advance our understanding of the unique role of sex hormones in shaping the adolescent female brain. It will provide critical understanding of how individual differences in hormonal factors increase risk for emotional problems in females, and inform treatment strategies.							
	National Interest Test Statement							
	Emotional problems (e.g., anxiety, depression), which are over-represented in females, are the leading cause of morbidity during adolescence and contribute to 60% of total disease burden in Australian adolescents. Research in adult females shows that sex hormones that fluctuate over the menstrual cycle impact emotional functioning by causing changes in the brain. This project will investigate how these hormones affect the brain during adolescence. Findings will contribute to a better understanding of the biological drivers of emotional problems in adolescence, and inform the development of specialised interventions for the pubertal period. This project will provide Australian health professionals, researchers and educators with new knowledge regarding the determinants of female adolescents' emotional behaviours and problems. The impacts of this research will have economic and societal benefits; for example, being better able to detect and treat emotional problems in adolescents will reduce societal financial burdens.							
DP220102163	**Topology in seven dimensions**	68,000.00	136,000.00	104,500.00	36,500.00	0.00	0.00	345,000.00
Crowley, A/Prof Diarmuid J	Aims: The project aims to give a complete classification of a certain class of 7-dimensional spaces; namely simply-connected spin 7-manifolds. We also present related programs classify G_2-structures on 7-manifolds. Significance: the proposed classification will be a signature achievement in the topology of manifolds, with applications likely in both geometry and mathematical physics. Expected outcomes: The project will produce a series of papers published in high quality journals and enhanced scientific collaboration between Australia and the United Kingdom. Benefits: The project will enhance Australia's research reputation by producing excellent research in a field not historically represented in the country.							

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	Research in the fundamental mathematical sciences underpins many developments in applied sciences and engineering, many of which would often not be possible without an appropriate mathematical framework. This project will develop a new classification mathematical structure with known applications in mathematical physics. A strong mathematical research community has historically been essential to educating and attracting the scientists and engineers crucial to economic success in a changing world, thereby laying the foundation for future national economic and social benefits for Australia. The project will also benefit Australia through supporting international scientific collaboration and crucially maintain and enhance Australia's pure research capability.							
DP220102188	**The Politicisation of Free Trade Agreements in the US, EU and Australia**	40,813.50	70,564.00	51,434.50	21,684.00	0.00	0.00	184,496.00
Postnikov, Dr Evgeny	This project aims to investigate why free trade agreements are increasingly politicised in liberal democracies. Politicisation has generated widespread public backlash against free trade but has also varied across agreements and countries. The project uses a novel comparative framework to explain the economic and political factors determining free trade agreement politicisation in the US, EU and Australia, actors with the most trade deals. Expected outcomes include new understandings of public backlash against free trade and globalisation. Expected benefits include recommendations on including civil society in trade policy-making and allaying populist protectionism, without jeopardising economic openness and the rules-based liberal order.							
	National Interest Test Statement							
	Australia has championed trade liberalisation by signing many free trade deals. It has benefited from the rules-based global trade system, gaining tremendous economic prosperity and stability. This system has recently come under attack from populist protectionist forces across the world. This development has led to the politicisation of trade agreements in many developed economies, including Australia, endangering the liberal economic order. Policy-makers' responses have often been slow and reactive. By identifying the causes of public backlash against trade agreements and drawing lessons from the EU and the US, this project will help Australian political and social actors, making recommendations on ensuring that trade policy works for all. Since Australia is a major stakeholder in the rules-based order, making trade deals accepted by the public and civil society is paramount to its future prosperity and global leadership role. The findings and recommendations will help Australian policymakers and their like-minded international partners to protect the liberal order from the rising protectionist tide.							
DP220102251	**Cultural knowledge in China's Belt and Road Initiative**	23,263.00	44,623.00	52,125.00	30,765.00	0.00	0.00	150,776.00
Hearn, Prof Adrian H	This project aims to clarify how the international expansion of China's Belt and Road Initiative (BRI) is shaped by cultural factors alongside economic and political diplomacy. New knowledge about the interaction of local priorities with global networks is drawn from ethnographic data gathered in China and its food suppliers Argentina, Brazil and Australia. It hypothesises that such interactions are mediated by individuals and institutions who research and communicate local ecological and territorial knowledge. Expected outcomes include academic publications, policy papers, and media pieces. Benefits include filling a gap in network theory, an updated approach to research ethics, and improved national capacity to manage BRI's impact.							
	National Interest Test Statement							
	The Belt and Road Initiative (BRI) is the Chinese government's signature platform for expanding outbound investment and securing the supply of natural resources. It encompasses 80 countries, one third of global trade and $350 billion in investments by the mid-2020s. The project compares how Australia and two of China's other leading food suppliers (Argentina and Brazil) are assessing BRI's risks and benefits. It does this in two ways: (i) by clarifying how key individuals research and communicate local territorial and environmental concerns to shape BRI networks, and (ii) by evaluating how these individuals can more ethically and openly manage political pressures. The project supports Australia's Science and Research Priority "Food" by explaining how the interests of Chinese investors and local producers may overlap or diverge. It achieves this through publications and media engagements that clarify the risks and benefits of BRI's expansion. This knowledge will benefit Australian policymakers, researchers, small farmers and agriculture operators.							

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DP220102269	**Safe Repeated Data Use and Model Release for Exploratory Data Science**	67,500.00	135,000.00	135,000.00	67,500.00	0.00	0.00	405,000.00
Rubinstein, Prof Benjamin	This project aims to develop new methods for repeated use of datasets and release of models trained on sensitive data. To achieve these aims, this project will develop efficient random samplers for estimating sensitivity of learning systems to data perturbation. This project expects to address the crisis of poor reproducibility and overfitting by repeated use of data sets in machine learning. Expected outcomes of this project include new methods and safety guarantees for repeated selection, training, evaluation, tuning and release of machine learners on fixed data sets. This should provide significant practical approaches for Australian industry to reuse valuable data and release privacy sensitive insights in data science pipelines.							
	National Interest Test Statement							
	Artificial intelligence is transforming industries. A crisis is looming, however, in which the scale and flexibility of modern machine learning has two unintended consequences. First, repeat data analysis, or reusing a single dataset, risks becoming a process of data dredging where conclusions lose all validity and overfitting is rife. Second, the release of raw data or models trained on sensitive data can lead to breaches of individual privacy. Safe data reuse and data sharing are critical to Australia's future, as recognised by Australia's AI Ethics Framework and new Data Availability and Transparency legislation. This project aims to deliver step-change progress in these two grand-challenges, through a unified methodology of stabilising machine learning algorithms using a new privacy-enhancing technology called differential privacy employed internationally by the likes of Google, Apple and the US Census. Well aligned with cybersecurity, this project is expected to facilitate trust in modern data analysis and data sharing for Australia's benefit through balancing guaranteed privacy with strong utility.							
DP220102271	**Molecular switches and genetic consequences of grain retention in cereals**	66,751.00	137,200.00	141,849.00	71,400.00	0.00	0.00	417,200.00
Pourkheirandish, Dr Mohammad	Grain retention at maturity was key for crop domestication and laid the basis for farming. Wheat and barley have evolved a novel mechanism for ensuring grain retention and, although the genes are known, the mechanisms for action are not. Grain dispersal in the wild relatives involves highly targeted changes in the walls of a small number of cells. This project will explore how the two identified genes control this process and clarify their mode of action. The genes ensuring grain retention have been so critical for domestication that the region surrounding them has become genetically fixed. The project will assess the implication of fixation on genetic diversity and develop options to bring novel variation into breeding programs.							
	National Interest Test Statement							
	For a cereal crop to be viable the seed must remain on the body of the plant until harvest. Understanding the mechanism of seed retention is important for facilitating the utilisation of variation present in the wild relatives of our crops and in the future domestication of new cereal crops. The project's outcome will support the ability of breeders to access the vast genetic diversity available in germplasm collections to produce improved, resilient crops in relatively short timeframes. Improved use of genetic diversity offers options to improve human health and food security by addressing climate change mitigation and enhanced crop production. This project will explore innovative areas of crop development that will be particularly relevant to Australia. Successful completion of this work will engender a paradigm shift in the domestication of existing and new grain species to increase genetic diversity in Australian breeding programs and help support future food security in the current era of climate uncertainty.							
DP220102288	**A novel axis of cooperation between innate and adaptive immunity**	91,684.50	194,072.00	207,230.50	104,843.00	0.00	0.00	597,830.00
Villadangos, Prof Jose A	The project aims to understand how two molecular components of the immune system, Complement and MHC, cooperate to protect the host. Further, these two molecules mediate trogocytosis, a little-studied form of intercellular communication, between two major immune cell types: dendritic cells and B cells. The project will be multidisciplinary, applying high-end microscopy, biochemistry, cell biology and immunology techniques. Personnel will be trained in cutting-edge techniques. The project will expand knowledge on basic immunology and cell-cell cooperation. It will generate intellectual property for the biotechnology sector to develop new commercial products that might improve the health of humans and also animals of economic importance.							

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	National Interest Test Statement							
	This project will study two specific proteins involved in immune defence and how they cooperate to protect the host from infection by triggering a little-studied type of cellular communication. This project will lead to new intellectual property that will afford opportunities for the development of new commercial products by Australian biotechnology companies, which will in turn result in local job opportunities and contributions to the national economy. The envisaged products will have applications in both veterinary and human health services, leading to increased productivity. New technology developed throughout the project and high-level training will also increase the competitiveness of the strategic biotechnology sector in Australia and raise the skills and competitiveness. Altogether, the project will contribute to increase the robustness of the Australian economy and the self-reliance of its biotechnology, farming and health sectors.							
DP220102666	**Modelling dynamics in spatial ecology**	75,989.00	150,109.50	158,564.50	84,444.00	0.00	0.00	469,107.00
Vesk, Prof Peter A	This project addresses how birth, death and movement drive patterns of plants and animals in space and time. We aim to apply and extend dynamical statistical models grounded in theory. Dynamical models are needed for us to understand how species and ecological communities respond to environmental change and disturbance including bushfires, climate change and extremes and species invasion. Using data from forest plots and animal movement, we aim to understand influences on individuals and species, and how to use that to generate robust predictions. The project is expected to produce statistical models and software for use by ecologists. This should help predict, and manage, ecological impacts of environmental change and disturbances.							
	National Interest Test Statement							
	In this project, we provide statistical models that help explain and predict how ecological dynamics affect species occurrence in space and time. The prediction of species' response to adverse climatic events is expected to help Australian managers in national forestry production. More broadly, we would help individuals mitigate the negative economic impacts of bushfires, deforestation, eutrophication and climate change. Indeed, we would first help quantify the impacts, and we could in addition highlight ecological communities that are more resilient. The enhanced understanding of the dynamics of ecological communities has in itself an important environmental benefit that is in Australia's national interest. For example, our proposal would help better understand the consequences of the invasion of a species into a suitable environment, coinciding with Australia's interest in preserving its native ecosystem. Finally, our research project is expected to contribute to understanding how a mixed human-natural system can be better sustained in the long run, thereby ensuring stable and resilient economic growth.							
DP220102827	**Functional identification of vaccine targets in pathogenic mycoplasmas**	88,500.00	184,000.00	219,500.00	124,000.00	0.00	0.00	616,000.00
Browning, Prof Glenn F	Mycoplasmas are important bacterial pathogens in domestic animals that are incompletely controlled by current vaccines. As a result current control measures for the diseases they cause rely on ongoing treatment with antibiotics. This project will aim to use functional genomics and metabolomics to determine the function of specific surface proteins of a model mycoplasma to identify targets for novel approaches to vaccines against these pathogens, and to then assess the potential for inclusion of these proteins in vaccines. Ultimately this will lead to improved vaccines against these important pathogens, improving agricultural productivity and reducing the use of antibiotics in intensively raised livestock.							
	National Interest Test Statement							
	The aim of this project is to generate better vaccines against infectious diseases caused by a group of pathogenic bacteria in livestock that are predominantly controlled using antibiotic treatment. These vaccines will be able to replace antibiotic therapy as the main measure for disease control, leading to better animal health and welfare, and increased agricultural productivity. Improved control of these bacterial diseases will also result in decreased use of antibiotics in animal production, with consequent environmental benefits, reflected in reduced selective pressure driving the development of resistance to antibiotics in pathogenic bacteria. Thus, the project outcomes will have a direct commercial benefits for Australian industry through creation of new intellectual property in vaccine technology, economic benefits through reduced costs in agricultural production, and social benefits to Australia through improved animal welfare, reduced selection for antibiotic resistance in the human food-chain and the environment, and increased prestige of Australian researchers.							

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DP220102908	**How the digital remote working revolution is transforming Australian homes**	45,800.00	102,120.00	111,545.00	55,225.00	0.00	0.00	314,690.00
Bissell, A/Prof David J	This project aims to investigate how the recent rapid rise in digital remote working for many Australians is transforming homes by evaluating its diverse impacts on work practices, households and wider communities. Through world-first qualitative research, the goal of this project is to generate new knowledge of the social changes taking place using cutting-edge geographical theories of homemaking, mobilities and labour. Expected outcomes of this project include enhancing Australia's capacity in home and mobilities research. The project should provide significant benefits to a range of stakeholders by identifying opportunities for socially-just interventions by local, state and federal governments, industry, and the community.							
	National Interest Test Statement							
	This project will help to better understand the challenges and opportunities that have arisen through the rapid increase in working from home for many Australians. It will identify how the needs of workers, households, and their wider communities has changed as a result of these work practices. The project will benefit current and potential remote worker households by providing strategies to minimise negative social impacts. It will provide industry with a greater understanding of how working from home can be accommodated to maximise wellbeing. It will provide policy makers with a better understanding of where and how investment should be targeted in urban and regional centres. We will develop a stakeholder report, policy briefs, and input to government consultations and inquiries. More broadly, the project will ensure that Australia is a world leader in understanding the social implications of this globally significant work transformation.							
DP220102910	**Understanding How the Hungry Brain Regulates Metabolism**	100,000.00	200,000.00	200,000.00	100,000.00	0.00	0.00	600,000.00
Dodd, Dr Garron T	Energy homeostasis is essential for life as it ensures an adequate supply of fuel to cells of the body. This process is orchestrated by neurons in the hypothalamus of the brain. This project aims to determine the role of the extracellular matrix that surrounds hypothalamic neurons and how this regulates energy homeostasis, an area of science that is completely unexplored. This project expects to identify the composition the extracellular matrix within the hypothalamus and discover how it regulates energy homeostasis. The outcomes of this project are to provide new knowledge in understanding how the brain regulates metabolism, to promote population health & wellbeing, develop new technologies and training the next generation of researchers.							
	National Interest Test Statement							
	Cells in the body must receive an adequate supply of nutrients to ensure survival. This process is termed, energy balance and is orchestrated by neuronal circuits within the brain. Unfortunately, there is a knowledge gap in our basic understanding of how the brain regulates energy balance. The project aims to explore how the extracellular environment in the brain works (the substances between brain cells) and how this impacts the brains cells that coordinate metabolism. This area of science is completely unexplored and will build basic knowledge of a fundamental biological process essential for life. Outcomes from this research include knowledge gain, promotion of population health and wellbeing, training of Australians in cutting-edge research, enhancing Australia's international research standing and provide potential economic benefits through knowledge & health gains and biotechnology opportunities.							
DP220103223	**Korean Migration to Australia**	42,582.00	81,397.50	53,815.50	15,000.00	0.00	0.00	192,795.00
Song, Dr Jay	This project aims to investigate Korean migration to Australia from 1924 to 2024 by utilising undiscovered historical government data and advancing an innovative theory and methodologies for migration studies. The project expects to generate a great deal of new knowledge on early and contemporary Korean immigrants in Australia using archival research, statistical analyses, online surveys and interviews. Expected outcomes include a new public database, theory development and refined methods using technology. This should provide significant benefits such as advancing our knowledge on colonial, post-war and post-Cold War Korean migrants (both North and South) in Australia as well as Australia-Korea relations over the past century.							

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	South Korea is Australia's fourth largest trading partner, and third largest source country for international students. The two countries have maintained a strong diplomatic and strategic relations for 60 years. Koreans are among the fastest growing ethnic minorities in Australia. Yet there is no comprehensive account of Korean migration to Australia since the early arrivals. In-depth knowledge of Korean Australian communities is relatively scarce compared to what is known about other migrant groups. The multidisciplinary team aims to produce the first comprehensive accounts and integrated analyses of Korean migrants in Australia. The project will enhance a better understanding of Korean Australians and their role for Australian economy and society, and strengthen the Australia-Korea relationships. Research outcomes will benefit not only the next generation of academics but also policymakers and civil society actors in immigration, foreign affairs, multiculturalism, business, media and communication.							
DP220103281 Evans, Prof Jamie S	**Sensing and Communications for Tactical Radio: Mapping the RF Weather** This project investigates sensing, localisation and communication strategies to improve the performance of modern tactical radio networks. Such networks face all of the well-known design challenges of mobile ad-hoc networks (MANETs) but with added complication of a contested and adversarial operating environment. By exploiting the power of radio nodes to sense the radio spectrum, as well as to communicate over it, a distributed network of nodes can create a detailed picture of the surrounding radio-frequency (RF) environment: the nodes can work together to map the "RF weather". In this project we will design advanced sensing and localisation methods to accurately map the RF spectrum, and then exploit this map in communication system design.	70,000.00	140,000.00	140,000.00	70,000.00	0.00	0.00	420,000.00
	National Interest Test Statement							
	Australia's Tech Future sets out to deliver a strong, safe and inclusive digital economy. At the same time, Australian Defence Forces are developing battlefield communications system that will improve interoperability with systems from other countries during coalition operations. With respect to their network topological behaviours and connectivity attributes, such mobile battlefield networks have distinctive characteristics and vulnerable users when compared with generic mobile ad-hoc networks. Australian Defence Force's tactical communications systems thus require key technology and regulatory reforms in telecommunications, and network infrastructure that supports an advancing digital safety. This project aims to advance the development of smart software-defined networks providing a secure and efficient wireless communication strategies for tactical networks, even between different data types during electronic-warfare (EW) attacks.							
DP220103467 Jamieson, Prof David N	**Synthesis of enriched silicon for long-lived donor quantum states** We have discovered a method to make silicon highly enriched in the desirable spin-zero isotope using readily available ion implantation tools. This "semiconductor vacuum" is essential for building future quantum computer devices using the quantum spin of millions of implanted atoms with revolutionary capabilities. We have demonstrated long-lived implanted donor atom quantum states in prototype material, made possible by the depletion of background spins in natural silicon and now aim to push the enrichment to greater extremes. We will integrate the extreme material into functional devices that use electrically detected electron spin resonance to probe exceptionally durable quantum states and open a near-term pathway to large-scale devices.	83,633.00	167,606.00	173,064.50	89,091.50	0.00	0.00	513,395.00
	National Interest Test Statement							
	New quantum technologies promise to have a significant social impact. For example, quantum computers will solve problems that are inaccessible to traditional computing, benefiting sectors of society, from drug design to finance. Australian researchers have been leaders in this technology, with centres established in Australian universities and associated commercial operations. This research is critically dependent on enriched silicon provided from overseas. The enrichment technique we have discovered uses standard tools found in university laboratories and has the potential to provide researchers ready access to enriched silicon for developing new quantum technologies. We have protected our innovation with a patent that could bring economic benefits to Australia if our method becomes the best pathway to the construction of large-scale quantum devices in enriched silicon. The project provides a pathway to increase linkages with industries that are commercializing quantum technologies and aligns with the National Innovation Agenda.							

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DP220103498	**A systems materials engineering strategy for hybrid ion capacitors**	77,500.00	177,500.00	200,000.00	100,000.00	0.00	0.00	555,000.00
Li, Prof Dan	This project aims to develop a data science-driven approach to allow the use of materials systems engineering strategy to quantify the cell-level design of electrochemical energy storage devices such as hybrid ion capacitors. The intended outcomes of this project include new dynamic equivalent circuit models and a new quantitative approach to make the electrodes pairing predictable and realise their optimal design against the needs of the specific applications. It will also demonstrate a combined strategy of data science and discipline-specific experiments and theories to advance the emerging field of materials systems engineering.							
	National Interest Test Statement							
	High-performance batteries include electrochemical energy storage devices, such as hybrid ion capacitors (HICs). These devices are critical for many industries and key initiatives, such as renewable energy adoption or energy storage in remote communities. Yet, advancement in their engineering design is hindered by an inability to investigate individual components, both systematically and under dynamic conditions. This project will improve the optimal design of HICs, against the needs of the specific applications to improve the engineering knowledge and design of energy storage devices. The intellectual properties generated by the project will enhance Australia's research capacity and global competitiveness in this rapidly evolving field. With broad applications for HICs in transport, wearable electronics, sustainable mining and defence technologies, the project will benefit Australia economically, environmentally and socially. In addition, manufacturing high performance batteries in Australia will help grow Australia's knowledge-based advanced manufacturing industry into the future.							
DP220103545	**Understanding the diverse biology of CD4+ T cell resident memory**	95,000.00	195,000.00	195,000.00	190,000.00	95,000.00	0.00	770,000.00
Heath, Prof William R	This project aims to examine the biology of CD4 T cell memory in tissues. The previously unappreciated complexity of the CD4 T cell resident memory compartment in the liver will be characterised, focusing on the generation, maintenance and diversity of functions of these cells. Expected outcomes include the generation of fundamental knowledge in the disciplines of cellular biology and immunology, and unique, highly specialised student and personnel training through the interdisciplinary approach utilised, which spans cellular biology, live-imaging and transcriptomic analyses. Expected benefits include influential publications and the import of a novel, specialised technique to Australia through an international collaboration (Germany)							
	National Interest Test Statement							
	This project will define the varied biology and functions of a particular type of immune cell critical to the capacity of the immune system to respond rapidly to previous infections. Study of these cells (tissue-resident CD4+ memory T cells) will critically expand fundamental knowledge of cellular biology and immunology, contributing to Australia's world leadership in immunological and biological research. Identifying elements that promote formation of these cells will create national benefits and opportunities for future development of commercially valuable products for the improvement of human and animal health by the biotechnology sector in Australia. Use of cutting-edge techniques will provide specialised training of students, enhancing the competitiveness of the next generation of Australian scientists. An international collaboration with the PI in Germany will result in the import of a novel research technique to Australia that is applicable to multiple research fields, further enriching student training through exposure to international laboratories							
DP220103633	**Journals in Theory: Practices of Academic Judgment**	67,500.00	192,500.00	195,000.00	145,000.00	75,000.00	0.00	675,000.00
Clemens, A/Prof Justin	This project aims to examine the way key journals transformed the discipline of literary studies from 1946 to now. It expects to generate new knowledge of how editorial practices of academic judgement institutionalised and legitimated new modes of reading, thinking and writing. Based on archival research on journals including Critical Inquiry, Tel Quel and The Australian Journal of Cultural Studies, the project's outcomes will show how, in bringing together new intellectual passions, governance structures and imagined readerships, journals bestowed on criticism its current working definition. Expected benefits include a better account of the relationship between conceptual innovation and institutional mechanisms for research integrity.							

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	National Interest Test Statement							
	The project examines the emergence of new models of best practice in academic publishing through a study of the editorial practices of influential literary journals from 1946 to the present day. These findings will provide new historical perspectives on approaches to evaluating research quality and impact and improved understanding of the ways in which effective institutional structures have contributed to critical excellence and knowledge production. It will also document Australia's role at the forefront of the historical development of literary theory and methodology. In these ways it identifies and advances critical improvements to Australia's research infrastructure and associated platforms that support conceptual innovation. It provides cultural and national benefits that include determining policy refinements for supporting Australia's systems of disciplinary research; strengthening Australia's access to leading forums of intellectual judgement and evaluation; and fostering new research capability in advanced study in the humanities.							
DP220103711	**Is climate change altering the carrying capacity of the world's forests?**	106,000.00	213,500.00	215,000.00	107,500.00	0.00	0.00	642,000.00
Nitschke, A/Prof Craig R	Planting trees at a global scale has been proposed as a key strategy to reduce global atmospheric CO2 levels. However, changing climatic conditions threaten the ability of forests to be net CO2 absorbers. In a warmer and drier future, forests may not be able to support as many trees. This project aims to identify how climate will alter forest carrying capacity across millions of hectares of the world's forests. By combining recent advances in forest modelling with large-scale and long-term forest inventory data, the project will develop a novel framework to forecast forest dynamics under climate change. It will provide specific guidelines to inform global reforestation strategies and foster climate-smart forest management.							
	National Interest Test Statement							
	This project will generate actionable science to inform the management of tens of millions of hectares of forests around the world and provide specific guidelines for adapting these forests to a changing climate. It will identify combinations of species, regions, and management scenarios that promote forest resilience and reduce the impacts of climate change. This project will provide critical advice on climate-smart strategies for managing the ~5 million ha of forests in southeastern Australia recently impacted by bushfires. It will identify management prescriptions that can reduce the risk of excessive climate-induced mortality in established forests and guide regional and global reforestation projects. This project strongly aligns with the Australian Government's Environmental Change Research Priority, which seeks innovative approaches for responding and adapting our ecosystems to environmental change. It will provide specific, implementable recommendations to landowners (public and private) and policy makers that will benefit our forests and our society.							
DP220103715	**Unravelling the rules on particle assembly into superstructures**	42,500.00	150,500.00	148,000.00	40,000.00	0.00	0.00	381,000.00
Goudeli, Dr Eirini G	Nanoparticle superstructures are assemblies of particles that exhibit high surface-to-volume ratio, periodicity and large packing density useful for drug delivery, photonics, sensing and energy storage. To realise the potential of these materials requires a predicative understanding of how interparticle forces control superstructure formation. This project will create a one-of-its-kind multiscale simulation framework to tailor the assembly of anisotropic engineered nanoparticles into superstructures in liquids. Nanoparticle assembly simulation will be validated with a novel particle tracking microscopy in solution-based studies. This will enable the design and large-scale production of nanomaterials with controlled properties and functions.							
	National Interest Test Statement							
	Simple nanoparticles are prevalent in Australian industries and in commercial products but often lack the benefit of engineered nanoparticles that are evolving today. Nanoparticle superstructures are networks of nanoparticles that exhibit remarkable properties making them attractive for drug delivery, photonics, sensing and energy storage. Despite their superior properties, however, it remains difficult to harness their potential in commercial applications due to current restrictions in scalability, stability and control of their assembly and integration into devices. The project will provide a new framework to understand the underlying mechanisms that rule the assembly of nanoparticles into mesoscale superstructures. The outcomes will revolutionise the engineering of nanostructured materials manufactured in Australia and will open new avenues for their implementation into functional devices.							

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DP220103927	**Understanding co-activator function in transcriptional regulation**	82,890.00	170,125.00	174,959.00	87,724.00	0.00	0.00	515,698.00
Dawson, Prof Mark A	A change in gene expression underpins all cell fate decisions yet there is scant knowledge about how transcription factors (TF), the master regulators of transcription, specifically interact with some, but not all, transcription cofactors to nuance gene expression. Aims: Using innovative molecular technologies we will identify and characterise the shared and unique relationships between TF and cofactors. Significance: This study is important to every biological process in plants and animals driven by a change in gene expression. Expected Outcomes: This study will increase our biological knowledge in transcription control. Benefit: The knowledge gained has future applications in genomics and broad implications for biotechnology and industry.							
	National Interest Test Statement This project seeks to provide fundamental knowledge by enhancing understanding of how cells, the basic building blocks for all living organisms, make decisions at the molecular level. Every decision a cell makes is underpinned by a change in gene expression and proteins called transcription factor, which are the master regulators that orchestrate this process. This research seeks to identify the broad principles that govern the activity of transcription factors which is likely to yield new avenues for academic and ultimately economic advancement. These insights will be broadly generalisable across plants and animals and consequently the knowledge generated in this project may be leveraged by Australian industry for the economic benefit specifically via biotechnology, bioengineering and agriculture.							
	The University of Melbourne	3,638,790.50	7,439,471.00	7,321,848.00	3,808,915.50	287,748.00	0.00	22,496,773.00
Victoria University								
DP220103991	**Privacy preserving and data utility in outsourced systems**	77,500.00	155,000.00	155,000.00	77,500.00	0.00	0.00	465,000.00
Wang, Prof Hua	Making the best tradeoff between data privacy and utility is a vital challenge in privacy-preserving outsourcing environments. This project aims to develop a balanced distributed framework to achieve the best utility of outsourced data while protecting private information. The framework consists of general structure of distributed evolutionary algorithms and a predefined topology for high optimization efficiency and a dynamic grouping recombination model. The project outcomes will be beneficial to applications in the nation as it incorporates new privacy constraints and utility requirements raised by emerging technologies to enable better protection of sensitive information and maximal data utility in outsourced systems.							
	National Interest Test Statement This project will develop a balanced distributed framework to study making a right tradeoff between privacy and utility that is a vital challenge in privacy-preserving data outsourcing. The developed algorithms and techniques will be implemented in freely available open-source prototype software that will attract researcher to involve in privacy and utility challenges. The publicly accessible software will make the developed methods more reliable and stronger. The prototype will be a web-based application supporting secure sensitive information in outsourced systems. The outcomes of the project have the potential to lead to new secure and database technologies that can help organizations to protect private data and maximal data utility. The research in the project is internationally competitive and will advance conceptual knowledge and have practical value in addressing security in outsourced environments. It is beneficial to end-users in Australia and also allows Australian researchers to share and link customers' confidential datasets securely and at reduced cost.							
	Victoria University	77,500.00	155,000.00	155,000.00	77,500.00	0.00	0.00	465,000.00
	Victoria	11,566,447.50	24,142,276.50	23,874,394.50	11,925,308.50	626,743.00	0.00	72,135,170.00

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Western Australia								
Curtin University								
DP220100051	**The molecular record in extraordinarily preserved plants and insects**	92,100.50	172,932.00	150,198.50	69,367.00	0.00	0.00	484,598.00
Grice, Prof Kliti	This project aims to unlock a hidden record of our planet's past and the life it supported, using a novel approach with benefits for environment and industry. Fossilised soft tissues of plants and insects preserved in sedimentary concretions will be analysed, extending the traditional inorganic fossil framework of major evolutionary events. Understanding the biofilm entombment and preservation mechanisms responsible for this unique organic fossil archive will extend our knowledge of microbial functionality. Expected outcomes are a new way for interpreting our planet's past, with improved understanding of extinction, disease, environmental change and consequent adaptation of plants and insects.							
	National Interest Test Statement							
	Molecular fossils in geological formations provide a wealth of information on the evolution of life, past environments and major climatic and tectonic events in Earth's history. This project will improve access to and identification of (currently) rare molecular (soft-tissue containing) fossils, providing unprecedented insights into our planet's environmental and evolutionary record. This new knowledge will be used to mitigate the impact of deepening environmental stressors (e.g., climate change, wildfire frequency/intensity) on modern ecosystems which represent some of humanities greatest challenges. Contributions to these issues will be of high economic and environmental benefit to Australia, as well as well as providing significant scientific outcomes to the international research community.							
DP220100307	**Development of Novel Metaconcrete to Resist Impulsive Loads**	57,500.00	123,500.00	124,000.00	58,000.00	0.00	0.00	363,000.00
Chen, Dr Wensu	This project aims to develop innovative metaconcrete for structural protection by utilising the concept of phononic crystals and metamaterials which has been recently developed by physicists. Traditional construction materials are used in new structural forms to mitigate dynamic loading effects by exploiting the unique characteristics of the proposed metaconcrete. Theoretical, numerical and experimental methods will be used to derive the best performing metaconcrete and verify its static and dynamic load resistant capacities. The expected outcomes of the project will lead to innovative extreme-loading resistant designs and provide significant benefit to the Australian construction industry, general public and economy.							
	National Interest Test Statement							
	Natural and manmade disasters caused an estimated US$1.5 trillion in damage, more than 1.1 million deaths and affected the lives of more than two billion people worldwide between 2003 and 2013. The impact of some of these disasters, including terrorist bombing, accidental explosion and vehicle/ship impact could be reduced through improvements in structural protection. This would help minimize damage to buildings and other infrastructure, leading to improved safety and lower re-construction and repair costs. The current designs for structural protection focus on enhancing the structural strength and ductility, which always lead to substantial increases in construction costs and bulky structures. This project utilizes the wave-mitigating characteristics developed in phononic crystals and acoustics to produce innovative metaconcrete for structure protection against impulsive loads. The will place Australia at the international forefront of advanced technologies, and result in robust and safer structures, as well as more economical construction for protective structure.							

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DP220100553	**On-water electrochemistry: redox catalysis at the water surface**	50,000.00	100,000.00	100,000.00	50,000.00	0.00	0.00	300,000.00
Ciampi, A/Prof Simone	From plastics to pharamaceuticals, chemists rely extensively on expensive and environmentally damaging solvents and reactants. In water, greener and cheaper electricity-driven reactions currently suffer from low velocity and poor selectivity. The project aims to develop the science of on-water electrochemistry, to make electricity-driven organic reactions in water viable. Demonstrating that for electrochemical reactions, rates and selectivities increase on water's surface rather than in its bulk will remove fundamental constraints on the viability of aqueous electro-synthesis – moving beyond current reactor designs to transform our view of electrochemistry and improve the sustainability of the chemical industry.							
	National Interest Test Statement							
	Synthesis of green chemicals is very attractive for sustainability of chemical manufacturing, which supports multiple industries. However, conventional synthesis is very energy intensive and often produces toxic wastes. To date, most chemicals cannot be manufactured -in- water, which is the ideal green solvent. This project introduces a new concept for green chemical synthesis called on-water electrochemistry. On-water electrochemistry uses the unique properties of the surface of water to act as a catalyst for chemical reactions. The water surface is made available for reaction using bubbles to create an interface. The new knowledge from the project will be suitable for integration into off-the-shelf reaction units already used by high-tech fine chemical and biotechnology companies. The project will contribute to the Australian government research priority for Advanced Manufacturing.							
DP220101990	**Microbially induced calcium carbonate precipitation in different substrates**	87,500.00	175,000.00	155,000.00	67,500.00	0.00	0.00	485,000.00
Dhami, Dr Navdeep K	Carbonates in the form of limestone represent an important reservoir of carbon on earth. They are recorded in several natural geological formations as corals, stromatolites, beach rocks. Microbes play an important role in the formation as well as dissolution of carbonates during microbially induced calcium carbonate precipitation (MICP) reactions on different substrates in natural and built environments. Much of our knowledge on MICP is limited due to poor understanding of the reaction kinetics at a molecular level. This project will develop new methods to enable and advance the knowledge of MICP process with profound implications for understanding natural geological formations as well as widen the scope of current engineering applications.							
	National Interest Test Statement							
	This project will enable us to understand the bio-geo-chemical processes involved in creation and dissolution of several geological natural formations as stromatolites, corals, speleothems and earth's crust. Our work will facilitate the identification and role of major governing factors in the formation and dissolution of microbially induced calcium carbonate precipitation (MICP). The outcome of this work will create new knowledge that will help us to understand bio-mineral interactions in natural and built substrates. This project will put Australia at the forefront in the area of Biomineralization across the globe. The resulting outcome is of vital importance to create more efficient bio-based, low energy, high sustainability technologies with applications in numerous sectors including civil and construction, oil & gas, CO2 storage, recovery of base metals through in-situ recovery pro-cessing, metal remediation and heritage conservation.							
DP220102593	**Criminal justice outcomes of injecting drug use and methamphetamine smoking**	71,570.00	191,645.50	181,271.00	61,195.50	0.00	0.00	505,682.00
Dietze, Prof Paul M	Injection drug use (IDU) and methamphetamine smoking are associated with the majority of illicit drug-related harms and associated costs in Australia. We will extend our studies of people who inject drugs and people who smoke methamphetamine through record linkage to social and criminal justice datasets. We will characterise the trajectories of participants through social services (e.g. public housing) and law enforcement systems to provide a comprehensive account of social and criminal justice impacts of injection drug use and methamphetamine use in Australia for the first time.							

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	National Interest Test Statement Injection drug use and methamphetamine smoking are associated with the majority of illicit drug-related harms and associated costs in Australia. In response, most expenditure is on law enforcement strategies such as arrest and imprisonment but this does little to address individual and social consequences of these types of drug use. By leveraging two existing studies we will provide the first robust evidence on the incidence and impacts of arrest and imprisonment in a cohort of people who inject drugs or smoke methamphetamine in Australia. Our internationally novel findings will advance understanding of the social impacts of arrest and imprisonment of vulnerable members of the community and have a profound impact on policy and practice in the area, including debates around alternatives to incarceration.							
DP220102946 Gagne, Prof Marylene	**To use or not to use financial incentives for motivation and performance** For decades, compensation experts have advocated for the use of financial incentives to motivate work performance, yet organisations keep encountering performance issues caused by these incentives. Using agency, expectancy, and self-determination theory to inform a meta-analysis and a series of experiments, this research will help uncover the most important motivational mechanisms that explain how financial incentives influence different types of performance. Given that compensation accounts for an important proportion of an organisation's operating expenses and that employee engagement is on the decline around the world, this research will provide a strong empirical basis to develop more effective compensation systems.	40,957.50	75,063.50	67,062.00	48,709.00	15,753.00	0.00	247,545.00
	National Interest Test Statement Compensation accounts for almost one half of organisations' operating expenses and over 90% of organisations use incentive pay systems. Yet we keep encountering performance issues allegedly caused by financial incentives. The proposed research will advance our knowledge of the effectiveness of financial incentives to motivate good work performance that will help forge a stronger empirical basis through which more effective compensation and incentive systems can be developed, which is a crucial factor in increasing Australian productivity and growth. Given employee engagement levels globally stand at only around 15% and are on the decline in Australia, compensation systems need to be carefully designed to contribute to this engagement. Through a meta-analysis and a series of experiments, this project will help resolved ongoing theoretical and practical debates about the effectiveness of financial incentives to motivate good work performance.							
DP220103027 Clark, Prof Chris F	**What goes on inside subduction zones?** This project aims to decipher how rocks behave inside subduction zones. Subduction is a central tenant of plate tectonic theory and the project will test the hypothesis rocks can become trapped within giant long-lived eddies that circulate material within subduction zones. This international collaborative project will generate new knowledge regarding the time scales rocks can remain trapped inside subduction zones using pressure–temperature–age constraints from subducted rocks. We will use this information as a framework for numerical simulations of subduction zone behaviour. The project will provide significant benefits in training a new generation of Earth scientists, and in broadening public awareness of fundamental Earth science.	50,000.00	105,000.00	97,500.00	42,500.00	0.00	0.00	295,000.00
	National Interest Test Statement Understanding how the Earth worked in the Archean Eon (4.0–2.5 billion years ago) has fundamental implications, not least for the formation of major mineral deposits. For example, the distribution of gold, copper and platinum is likely controlled by processes at convergent margins, narrow belts in which the rigid tectonic plates that cover the Earth are colliding. Such processes are the result of plate tectonics, which has been the modus operandi on Earth for the past 2 to 3 billion years. However, whether or not these processes were active more than 3 billion years ago is fiercely debated, due largely to the scarcity of rocks of such antiquity. Australia has some of the best exposed areas of truly ancient rocks (greater than 2.8 billion years old), and is a key area of investigation if we are to answer some of the foremost outstanding questions in Earth Science. This knowledge gleaned from the project will permit a better understanding of the where and why of Australia’s natural resources, as well as helping educate Australians about our planet in its youth.							

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DP220103091	**Correlative Imaging of Brain Lipids**	85,000.00	170,000.00	125,000.00	40,000.00	0.00	0.00	420,000.00
Hackett, Dr Mark J	This project aims to develop imaging tools and protocols for the detection of lipids in brain tissue and cells. This project expects to generate advanced methodologies to display specific lipid classes and their corresponding structures within tissues and cells, with the ability to be detected and correlated with multiple techniques, which represent a currently unavailable capacity. The expected outcomes of this project are improved opportunities to study lipid biology at the cellular and sub-cellular level across a wide range of in vitro and in vivo models. The outcomes of this project should provide significant knowledge to tackle modern societal challenges in healthy ageing, brain pathologies and neurodegenerative diseases.							
	National Interest Test Statement							
	This research project will develop the necessary research tools to study lipids to elucidate the chemical and physiological mechanisms through which they support human health, specifically brain function. This research is, therefore, of national interest as it will ultimately provide the necessary capacity to improve the health and quality of life of Australians, and subsequently reduce the currently significant economic burden associated with neurodegenerative diseases. The imaging tools will not only be applicable to brain tissue, but can be adapted to study fundamental biology of many other cell and tissue systems (e.g. liver cells). Furthermore, this project will provide substantial knowledge gain around the design of targeted imaging tools, and this knowledge may then be used by others to study macromolecules in situ, in a range of applications ranging from environmental science, agriculture, and food productions.							
DP220103669	**Advanced Proton-Conducting Ceramic FCs for Power Generation from Ammonia**	85,000.00	160,000.00	100,000.00	25,000.00	0.00	0.00	370,000.00
Tade, Prof Moses O	The project aims to design an innovative ammonia fuel cell using a new perovskite substrate decorated with metal nanoparticles, which demonstrates multi-functionalities and tackles most challenges of conventional fuel cells (FCs). The key concept of this project is the designing of the novel architected smart perovskite as both anode and electrolyte of the fuel cell by systematic modelling and experimental development. The versatile cell components developed in this project will improve the operational stability and efficiency of the fuel cell, thereby providing a promising pathway for ammonia fuel cells to replace hydrogen fuel cells. This study will reinforce the development of the future supply of reliable, low cost and clean energy.							
	National Interest Test Statement							
	The ammonia fuel cells are ideal electrochemical conversion devices for the highly efficient conversion of chemical energy within inexpensive and easily-accessible ammonia to electric power, which are particularly suitable for Australia because of the abundant natural resources of Australia. The proposed ammonia fuel cell with improved operational stability, high efficiency, and minimum impact to the environment in this project will contribute significantly to the sustainable development of Australia. The technology developed in this project will play a significant role in future clean energy production and lead to new breakthroughs in the commercial viability of fuel cell industries. The development and application of this novel design will greatly improve the utilization of ammonia as a carbon-free fuel source in Australia and the advance of high-energy fuel cells will accelerate Australia's transformation towards a more competitive economy.							
	Curtin University	619,628.00	1,273,141.00	1,100,031.50	462,271.50	15,753.00	0.00	3,470,825.00

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Edith Cowan University								
DP220102907	**Improved hydrogen geological storage via zeta potential measurements**	72,500.00	145,750.00	151,250.00	78,000.00	0.00	0.00	447,500.00
Iglauer, Prof Stefan	Hydrogen is a clean fuel which has the potential to revolutionize the energy supply chain by complete decarbonisation. An estimated 50-fold increase in the global hydrogen market is expected by 2050, totalling AUD$16.3 trillion. However, the key barrier to a hydrogen economy is hydrogen storage, as hydrogen is highly volatile, compressible and flammable. Underground hydrogen storage, i.e. storage of hydrogen in sedimentary geologic formations, is a potential option to solve this problem. In this project we will provide fundamental data required to establish hydrogen underground monitoring techniques, and to develop associated large-scale models with which underground hydrogen storage efficiency and security can be predicted.							
	National Interest Test Statement This project will develop and test a comprehensive method to accurately predict the efficiency of underground hydrogen storage. A safe, cost-effective technique for assessing underground hydrogen storage options will significantly reduce the risks associated with the use of underground hydrogen storage and support its accessibility as a clean energy source. Reliable and efficient underground storage of hydrogen is a way for Australia to drastically decarbonize its energy supply chain and would contribute directly to the Government's National Science and Research Priority "Energy - 1. low emission energy production from fossil fuels and other sources". Additional benefits include improved understanding of the physics of Australia's earth crust, methane production processes and carbon dioxide geo-storage, all adding to this project's key importance to the Australian hydrogen economy, reducing Australia's carbon footprint and contributing to meeting Australia's Paris Climate Agreement targets.							
	Edith Cowan University	72,500.00	145,750.00	151,250.00	78,000.00	0.00	0.00	447,500.00
Murdoch University								
DP220102197	**Shape4D: Modelling the Spatiotemporal Deformation Patterns in 3D Shapes.**	82,500.00	165,000.00	165,000.00	82,500.00	0.00	0.00	495,000.00
Laga, A/Prof Hamid	This research will develop new mathematical methods and algorithms that will enable the use of population-level longitudinal studies to model the spatial and temporal deformation patterns in 3D biological objects. Using novel geometric and deep learning techniques, it will create new methods that will allow the characterization of how the 3D shape of objects deforms with ageing, disease progression and interaction with their environment, and the simulation of spatiotemporal deformations in anatomical organs. Benefits include a better understanding of growth processes, predictive models of how degenerative diseases progress and a computational framework that will assist in designing proper mitigation and intervention strategies.							
	National Interest Test Statement Mathematically characterizing the shape and deformation patterns of 3D objects such as human bodies, plants, brain artery networks and anatomical organs has important applications in the (1) early detection of abnormality in predictive clinical analysis, and (2) simulation of complex and dynamic phenomena such as disease progression. While modern 3D scanning technologies provide a unique opportunity to digitally capture these dynamic processes, resulting in large volumes of longitudinal 3D datasets, tools for their analysis are lagging behind. This research will address this significant gap by developing the theories and algorithms that will enable scientists to convert large volumes of longitudinal 3D shape datasets into knowledge. The ability to mathematically characterize such data and learn from them regression models will help scientists unveil the connections between the physical appearance and dynamics of natural objects with the genotype and the environment, paving the way to the design of more targeted and efficient prevention, intervention and mitigation strategies in medicine and biology.							
	Murdoch University	82,500.00	165,000.00	165,000.00	82,500.00	0.00	0.00	495,000.00

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The University of Western Australia								
DP220100116	**Carbon-Supported Iron Catalysts for Selective Catalytic Reduction of NO**	105,000.00	210,000.00	210,000.00	105,000.00	0.00	0.00	630,000.00
Zhang, Mr Dongke	Nitric oxide (NO) is a major pollutant from combustion systems. This project aims to develop cost-effective and environmentally benign zerovalent iron catalysts supported on carbon material for selective catalytic reduction (SCR) of NO using CO and unburned hydrocarbons as in-situ reductants. By applying differential reactor experimentation, kinetic modelling and advanced material characterisation techniques, the research will unravel complex relationships among catalyst structural features and activity, NO reduction mechanisms, and catalyst performance under practically relevant combustion conditions that underpin the development of an effective yet affordable SCR technology to control NO emission from industrial utilities and automobiles.							
	National Interest Test Statement							
	Australia emits about 2.7 million tonnes of nitrogen oxide (NO) per annum, ranking No. 1 in the world on a per capita basis. Existing technologies for NO emission control are costly and do not suit Australian industries and automobile sectors. This Discovery Project will advance the science that underpins the development of a new and high-performing alternative catalyst technology that is easy to manufacture, cost-effective and environmentally-friendly. The widespread application of this technology has important benefits for Australia's environmental sustainability, long-term economic prosperity and international reputation. These innovative catalysts will provide an effective and affordable method to significantly reduce the nation's NO emissions whilst also enabling us to tap into the huge global market for NO control technologies. As such, the research outcomes will enhance Australia's research and innovation capability and technological competitiveness, stimulate the nation's manufacturing capacity, support our export industry, and assist with the global efforts to eliminate NO emissions.							
DP220100120	**Choosing to persist: sexual selection in the wild**	93,094.00	205,727.00	188,562.00	75,929.00	0.00	0.00	563,312.00
Simmons, Prof Leigh W	This project aims to investigate the role of sexual selection in maintaining healthy wild populations. The prevailing story of sexual selection, in which the sexes either compete for or choose the other sex, has been of extravagant ornaments and displays that drive species to extinction. However, an opposing story has emerged, with elaborate ornaments reflecting a healthy genome and sexual selection instead sweeping away damaging genetic material. This project expects to generate new knowledge on the potential for sexual selection to remove harmful mutations in the wild. Expected outcomes include determining if sexual selection can help prevent extinction in wild populations, with direct benefits for conservation programs.							
	National Interest Test Statement							
	How organisms remove damaging genetic material from the genome is one of the central questions of evolutionary biology. Our research tests key theories at the cutting-edge of basic science research on how sexual selection may remove damaging mutations from the genome, that also has practical benefits across conservation, social and economic areas. Specifically, our findings are expected to have (i) broad conservation impact for endangered species through potential policy change on the type of rescuers used in genetic rescue programs, (ii) immediate direct conservation impact by attempting genetic rescue of vulnerable populations, (iii) the development of a significant resource for future Australian evolutionary & conservation science research through the continued building of a long-term field model system stretching back 25 years on an Australian endemic species, (iv) economic and social value through media coverage of internationally competitive research of the highest impact, and (v) social and mental health benefits through local community conservation engagement within the farming community.							

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DP220100163	**Dynamic Mechano-Microscopy for use in Mechanobiology**	81,000.00	158,500.00	155,000.00	77,500.00	0.00	0.00	472,000.00
Kennedy, A/Prof Brendan F	We will develop an innovative microscope that will enable new discoveries in biology. Most microscopes form images of a sample's optical properties, instead we will image a sample's mechanical properties. The reason our novel approach is needed is that cell behaviour depends on the stiffness of it's environment, but current microscopes are unable to image this. Our microscope will provide insights in biology that can improve our understanding of cells, the building blocks of life. We will achieve this by: 1. Developing a microscope that combines microscopic resolution with rapid imaging; 2: Developing the capability to image both within the cell and its surrounding environment; and 3. Using our microscope to make discoveries in biology.							
	National Interest Test Statement							
	The novel optical microscopy platform we will develop will allow Australia to remain at the forefront of global development of cutting-edge technologies in optical microscopy and tissue engineering. Due to its importance in regulating cell behaviour, mechanobiology is an ever-expanding area, but existing microscopy platforms are not fit for purpose. We will address this to develop an innovative mechano-microscopy platform to enable future breakthroughs in biology. The technology we will develop can become a vital tool for researchers to better understand cell biology, thereby improving clinical diagnosis and, as such, creating a positive impact on the health and well-being of Australians. Given the speed with which new microscopy platforms can be adopted, coupled with the team's track record in translating research to commercial outcomes, this project has clear potential to lead to the creation of new Australian jobs through the growth of microscopy markets.							
DP220100370	**The Ancient Today: Living Traditions of Classical Language Education**	48,098.50	108,397.00	113,605.00	53,306.50	0.00	0.00	323,407.00
Haskell, Prof Yasmin A	This project aims to compare, for the first time, ancient language education across world cultures with ‘classical’ literatures. It expects to illumine the purpose and value of classical language education in Chinese, Greek, Latin, and Sanskrit historically and within global education systems today by comparing pedagogic ideals and practices across times and cultures. It aims to test the potential of inclusive classical language learning to boost educational outcomes for disadvantaged students. Other expected outcomes include two books, scholarly articles, education policy reports, and PhD student training. This should strengthen intercultural understanding and benefit school students, educators, policy makers and the wider public.							
	National Interest Test Statement							
	This project aims to build Australian knowledge and capacity in literacy and foreign language education. In particular, it seeks to document contemporary student experiences and societal attitudes to education in ‘classical’ (ancient) languages in Europe, the UK, Australia and Asia. Classical language education — both Western and Eastern — is growing exponentially in China. Understanding the historical and cultural reasons for this phenomenon will be of great value for our social, economic, and political relationships. The state of classical language education in Australia will be benchmarked against that in the United Kingdom. Recent initiatives have helped to widen access to students from lower socio-economic backgrounds and to introduce classical languages into primary school classrooms to bolster literacy, including for students with special needs. This project aims to build on and extend that success. Finally, this project seeks to attract, train and retain excellent research students in an area of strategic importance to our nation’s prosperity: language competence and cultural literacy.							

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DP220100482 Schilizzi, A/Prof Steven G	**Redesigning Landcare policy to better coordinate across landholders** This project aims to study how landscape-sensitive economic incentives and social norms can be leveraged to enhance the short- and long-term effectiveness of conservation programs. It will yield new knowledge for innovative designs in conservation contracting that is urgently needed to address worsening environmental threats in Australia and worldwide. In collaboration with Nobel laureate Vernon Smith's team, new methods and protocols will improve our ability to generate better data and better understand how social and incentive mechanisms can constructively interact to facilitate collaborative environmental action. Results will help make the achievement of environmental targets and the use of public funds more cost-effective.	112,523.50	221,825.00	194,885.00	85,583.50	0.00	0.00	614,817.00
	National Interest Test Statement In spite of substantial efforts and billions of dollars spent over the last 20 years, including the current $1 Billion for the National Landcare Program (2017-2023), Australia's land and water quality, natural habitat, and wildlife have faced rising challenges. This project will test in the lab and the field novel policy instruments that, by achieving greater spatial coordination among landholders, increase the effectiveness of incentive payments and boost the value-for-money from investment in Landcare and similar programs. Will benefit: farmers' soil health in line with National Soils Strategy; rural communities from healthier landscapes and strengthened social capital; the Australian economy from more efficient use of public funds. Applying our project's innovations to National Landcare Program's four Strategic Objectives could create $60m in extra value. Even with half the benefits, the project's estimated benefit-cost ratio could still reach 30:1. Collaboration with Nobel laureate V. Smith's team and training 3 PhDs will build strong capacity, tooling up Australia to export its expertise.							
DP220100494 Lambers, Em/Prof Johannes (Hans) T	**Maintenance of high plant diversity in phosphorus-impoverished ecosystems** This project aims to determine the role of soil-inhabiting pathogens and symbiotic fungi in the maintenance of plant diversity in Australia's hyperdiverse shrublands. These are among the world's most species-rich systems, yet occur on extremely poor soils. This project tests the hypothesis that plants that are best adapted to acquire phosphorus in these extremely infertile soils are most susceptible to soil pathogens. This trade-off would equalise differences in competitive abilities among plant species and promote high plant diversity. The project will help elucidate how pathogens and symbiotic fungi together drive plant diversity in a globally significant biodiversity hotspot in Australia, with relevance to other biodiverse regions.	98,482.50	191,674.50	183,277.50	90,085.50	0.00	0.00	563,520.00
	National Interest Test Statement This project will contribute significantly to our understanding of the mechanisms underlying plant diversity maintenance in one of the world's most biodiverse regions: south-western Australia. That understanding will be pivotal for the managements of national parks and reserves in this biodiversity hotspot, and any other biodiverse landscapes that are similarly nutrient-impoverished. It will provide novel insights into the potential role of soilborne pathogens in combination with mycorrhizal fungi in maintaining plant species diversity in phosphorus-impoverished landscapes. Such understanding is pivotal to improve biodiversity conservation strategies which is important, because biodiversity conservation and restoration incur tremendous costs. The project focuses on south-western Australia's kwongan, which harbours some of the most species-rich plant communities in the world, holding considerable biodiversity values. They also hold significant economic values as important contributors to the apiculture and tourism industry. Better understanding of its functioning is important for conservation and management.							

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DP220100650	**Blue carbon potential of the Great Southern Reef**	84,718.50	171,777.50	174,043.50	86,984.50	0.00	0.00	517,524.00
Wernberg, Prof Thomas	As one of Australia's largest vegetated coastal ecosystems, kelp forests provide substantial climate mitigation opportunities. Although kelp carbon is ubiquitous in the deep ocean, the mechanism of transport and amount of kelp carbon reaching deep sinks remains largely unknown, significantly hampering their inclusion in ocean carbon budgets and mitigation action. We will use Australia-wide field data on kelp export, cross-shelf measurements of transport and decay, coastal ocean circulation and future distribution models to vastly improve estimates of kelp carbon transfer to deep ocean sinks. Our comprehensive data-driven assessment of kelp carbon sequestration aims to uncover the carbon sink capacity of seaweed forests now and in the future							
	National Interest Test Statement							
	Securing natural carbon sinks is key to confronting our current climate crisis. Vegetated Coastal Ecosystems are emerging as areas of enhanced 'blue carbon' storage. Despite potentially accounting for 30% of the total blue carbon in Australia, kelp forests are currently not being recognised for their role in binding and sequestering carbon. This project will uncover the transport and fate of kelp carbon as it travels from the coast to the deep ocean sinks now and in the future. Confronting this key knowledge gap will vastly improve confidence in the carbon sink potential of the Great Southern Reef, a unique marine ecosystem of growing interest to Australia, and a recent Mission Blue Hope Spot. This new knowledge will be important information for Australia's ocean management actions and conservation priorities. It also provides opportunities for new carbon sequestration projects, improving Australia's capacity to meet its emissions reduction target of 26 to 28 per cent below 2005 levels by 2030, and helping mainstream an oceans agenda into climate change initiatives							
DP220100790	**Molecular Thermoelectric Materials: A New Hot Topic**	90,000.00	165,000.00	150,000.00	75,000.00	0.00	0.00	480,000.00
Low, Prof Paul J	This project aims to use the principles of chemistry and molecular electronics to synthesize and study molecules able to directly convert waste heat into electricity through the Seebeck effect. This project expects to generate new knowledge concerning the wire-like properties of molecules and conditions that lead to a high Seebeck coefficient, together with interference effects to suppress thermal conductance. Expected outcomes of this project include a deeper understanding of chemical structure - molecular electronic property relationships, and enhanced international collaboration with the UK. This should provide benefits in terms of low-cost conversion of waste heat to electrical energy.							
	National Interest Test Statement							
	Molecular electronics is a fast developing field of science leading to an emerging materials technology in which Australia has opportunity to build leadership in key areas. In particular, this proposal seeks to develop molecular systems with thermoelectric efficiency to enable waste heat to be converted to electrical energy. Such thermoelectric materials are an emerging hot topic, with global interest driven by the fact that some 70% of global energy production is ultimately wasted as heat. The potential economic and societal benefits from being at the forefront of such an emerging frontier technology are compelling, with molecules offering features that can overcome limits of conventional solid state thermoelectric materials. Success will advance fundamental science and signpost directions for innovative molecular technologies. Increased Australian research capacity through integrated training and knowledge transfer activities will ensure a skilled future workforce with opportunities within and beyond the field of the proposal and may also contribute to future energy efficiencies.							
DP220101026	**Reading facial expressions from real and virtual humans**	58,621.50	165,185.50	163,835.50	57,271.50	0.00	0.00	444,914.00
Palermo, A/Prof Romina	This project aims to advance understanding of human emotional communication and improve human rapport with the virtual humans and avatars that are rapidly infiltrating our social world. Using two unique stimulus sets - naturalistic human expressions and highly realistic virtual faces - together with powerful genetic, experimental, and individual differences designs, the project expects to answer previously intractable questions in emotion science, as well as deliver tangible outcomes, such as new psychological tests to better understand human social connection. This should provide significant benefits, by improving emotion communication and offering a new perspective on how artificial intelligence can best serve human social needs.							

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	National Interest Test Statement							
	Humans communicate via their facial expressions, and this emotional decoding has critical social consequences, influencing our day-to-day interactions as well as legal judgments, government policy, educational curricula, the diagnosis and treatment of psychiatric illness, and more recently, the development of artificial intelligence. Despite intense research interest, the focus of past research has used facial expression stimuli taken in the lab and unlike those seen in everyday life. This project uses the novel datasets we have created to answer important questions about genuine facial expressions, such as: why do people vary in their ability to recognise naturalistic facial expressions?, what makes an emotional expression appear genuine?, why do some people differ in their perceptions of genuineness? Knowing how individuals interpret real-world facial expressions will help humans communicate, and is crucial for the development of virtual humans, with which people will increasingly interact.							
DP220101642	**The Political and Economic Agency of Africans in Australia**	74,107.00	143,994.00	143,545.00	73,658.00	0.00	0.00	435,304.00
Fozdar, A/Prof Farida	This project examines the nature and impact of political and economic agency among African migrants in Australia, using mixed methods (survey, interviews, media and policy analysis). With the right policy settings, African migrants and Australian communities stand to benefit enormously from projected African population growth. However, due to a two decade research focus on African refugees, little is known about the successful navigation of political and economic life among the wider African diaspora. This project will generate new knowledge offering a blueprint for such policy settings. Outcomes include a monograph, 8 papers, and evidence-based policy advice on enhancing African migrant political and economic engagement in Australia.							
	National Interest Test Statement							
	Research on African migrants in Australia focusses on negative phenomena: the challenges of refugee settlement and integration, conflict, and migrant mental health. However, little is known about their positive contributions in terms of civic engagement and economic development both here and in Africa. This project seeks to examine entrepreneurial and remitting activity, civic activity generally and on behalf of African communities, and political influence among African migrants in Australia. The findings will highlight best practice in African community and political leadership, as well as economic engagement and contributions. It will also showcase alternatives to unemployment, dislocation and economic marginalisation. The project will enhance national knowledge and policy resources in the areas of immigration, multiculturalism, social cohesion, economic development and national security and its outcomes will be of direct interest and relevance to Australian governments at all levels and African community organisations.							
DP220101894	**Passive Positioning and Tracking of Flying Objects Using Satellite Signals**	70,000.00	140,000.00	140,000.00	70,000.00	0.00	0.00	420,000.00
Huang, Prof Defeng D	Along with the deployment of low Earth orbit satellite constellations for global satellite Internet services, such as Starlink, Ku/Ka/V band microwave signals from space will be available anywhere on Earth 24/7. Utilising the microwave signals, this project aims to investigate a high-resolution cost-effective solution to position and track un-cooperative flying objects, and expects to generate new knowledge in the area of remote sensing and to make Australia the leader in passive flying objects positioning and tracking. This should provide significant benefits, such as enabling new applications for future drone delivery systems or aerial taxi services, and benefiting the air transport industry, the defence industry, and bird conservation.							
	National Interest Test Statement							
	Utilising microwave signals from existing Low Earth Orbit satellites originally designed for global Internet services such as the SpaceX Starlink constellation, this project enables a low-cost high-resolution solution to flying objects positioning and tracking in a passive manner. Current methods either require the active cooperation from the flying objects or are prohibitively costly. Leveraging existing Low Earth Orbit satellites such as Starlink and cloud computing of today, the proposed solution can be easily scaled up to position and track thousands of airplanes and drones, thereby enhance the safety of the air transport industry and allow the safe expansion of the future drone delivery systems/aerial taxi services. By utilising the obstruction and diffraction of microwave signals by flying objects, rather than back-scattering and reflection like radars, the proposed solution is immune to stealth technology, thereby benefit the defence of Australia. The proposed solution can also be used to monitor birds in the sky, benefiting bird conservation.							

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DP220102557	**Inequality, Trade, and Technology**	50,930.00	101,860.00	111,060.00	111,060.00	101,860.00	50,930.00	527,700.00
Madsen, Prof Jakob B	This project aims to improve our understanding of the causes of rising income inequality in the world economy and in Australia since the early 1980s. We focus on the increasing building costs and imports of machinery as significant contributors to the increasing inequality. We hypothesize 1) that the increasing costs of buildings have reduced the demand for workers that are complementary to non-residential building capital; thus, reducing real wages; and 2) that the marked increase in imports of machinery since the 1960s has reduced the demand for unskilled labour and widened the employment and wage gap between skilled and unskilled labour. Both factors may have driven the increasing inequality in Australia.							
	National Interest Test Statement							
	Increasing inequality, flat real wage growth, increasing housing costs, and reduced employment opportunities for unskilled workers since the 1970s have reduced the standard of living of many Australians. This project aims to investigate and identify the key causes of this trend. Increasing real building costs have reduced building investment, employment, and wages and increased the cost of housing. We will use long data to examine this relationship and identify the role of regulation, market forces tax policy and trade policy, on housing markets and inequality. Furthermore, the increasing imports of machinery to Australia during the last globalization wave have replaced unskilled labour and their real wages. The project gives insight into the causes of the increasing housing costs and income inequality in Australia and will provide insight into how tax and trade policies can be improved to address the increasing inequality without jeopardizing productivity growth.							
DP220103135	**Establishing Design Principles Of Polymers For Intracellular Delivery**	85,000.00	170,000.00	170,000.00	85,000.00	0.00	0.00	510,000.00
Swaminatha-Iyer, Prof Killugudi L	Engineered polymers have played a central role in the field of bionanotechnology by enabling targeted nanoscale cell interactions. Progress in the field of intracellular delivery is currently affected by a major bottleneck due to the absence of effective polymers that is applicable across the range of bimolecular cargoes. In essence depending on the type of cargo: DNA, RNA or protien, the polymer needs programmability. The limited tunability of traditional polymers agents makes them unsuitable for this particular application. The multidisciplinary project addresses this significant problem by engineering novel sequences of defined polymer based nanoscale agents to achieve efficient delivery in cells.							
	National Interest Test Statement							
	Technologies that enable efficient intracellular delivery of nucleic acids is essential for the latest innovative biotechnology applications. This multidisciplinary program brings together world experts in polymer science, nanoscale-cell interactions, state-of-the-art imaging and cell biology to achieve this overarching goal using sequence defined polymers. The team will develop technologies for programmable intracellular delivery of DNA and RNA. The project will advance both fundamental and practical knowledge by providing training to the research community at the cutting edge of cross-disciplinary science. The outcomes from the project will boost Australian capability in polymer chemistry and nucleic acid based technologies by delivering intellectual property, which will position Australia at the forefront of industrial biotechnology.							
DP220103484	**Behavioural resilience to climatic variability**	89,895.00	136,518.00	89,548.00	42,925.00	0.00	0.00	358,886.00
Firman, Dr Renee C	Despite Australian biota being adapted to high natural climate variability, modern climate change is leading to population collapses and shifts into novel ecosystems. This Project, which studies a unique native mammal in the Pilbara, aims to uncover whether changes in behaviour are effective for dealing with environmental extremes and unpredictable climatic conditions. It will integrate laboratory- and field-based investigations to examine behavioural responses to climatic variability and establish how these responses influence individual fitness and future population resilience. This research will advance knowledge on climate-driven behavioural adaptation and improve understanding of how species will cope with Australia's changing climate.							

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	National Interest Test Statement This research will benefit the nation by advancing knowledge on how Australia's fauna will adapt to contemporary climate change. Australia's future climate is expected to be drier, with a projected 10% arid expansion over the next 80 years. Australia is also set to experience an escalation in the frequency of extreme events. It is predicted that the dispersal capacities of most species will eventually be outpaced by climate change, in which case a change in behaviour(s) may be the only alternative to local extinction. Despite this, our current understanding of the context in which animals modify their behaviour in response to climate-driven environmental variability is far from complete. To address this important knowledge gap, we will study a native mouse that lives in the Pilbara, a unique region of Australia known for its climatic variability. This Project will provide new information on the limitations, demographic effects and fitness implications of climate-related behavioural responses and will therefore aid in securing a sustainable future for Australia's biodiversity in the face of climate change.							
DP220103667 Bond, Prof Charles S	**Engineering self-assembled intracellular biological condensates** Cells depend on proteins linking together to build cellular structure, but how weak interactions build stable structure is a mystery. New evidence suggests proteins come together and then change state, employing liquid-like behaviour that builds vital nanoscale structure, such as nuclear bodies called paraspeckles. This project will unlock the secrets of this mysterious behavior of proteins, using paraspeckles as a model. We will use this information for nanotechnology application to build a synthetic paraspeckle inspired structure with bespoke function. Benefits will include new concepts in how vital cell structure is assembled and disassembled, and nanotechnology and synthetic biology tools to manipulate cellular processes.	112,350.50	218,818.50	212,936.00	106,468.00	0.00	0.00	650,573.00
	National Interest Test Statement The new cell biology phenomenon of "liquid phase condensation" helps to explain the aging of cells and neurodegeneration, which affect 15% and 1% of Australians, respectively. Our project lays the fundamental groundwork for a search for new effective pharmaceuticals against these important conditions. The research will explain how these important liquid phase condensates form, and generate new tools to build and study novel condensates inside cells. The tools and principles being developed in our research will contribute to Australian growth in Synthetic Biology: a future-focussed part of our nation's Advanced Manufacturing endeavours. The Synthetic Biology industry in the US is valued at $40B, and Australia is investing in systems to facilitate the flow of new Synthetic Biology products. Our project will lead to new methods and concepts for controlling living cells, supporting the production of biology-inspired devices and high-value molecules for this Synthetic Biology market and contribute to training the next generation of scientists at the cutting-edge of these future-focussed areas.							
DP220103690 Moggach, Prof Stephen A	**Anomalous Structural Response in Porous Framework Materials** This project targets a key missing link in understanding the host-guest properties of porous framework materials, namely, the dynamic response of host lattices to their external environment and to the inclusion of molecular guests. By combining advanced chemical, physical and structural measurements the project expects to provide the first concerted picture of materials behaviour across an array of scientific and technological settings, with particular focus given to industrially relevant 'real world' conditions. This promises to greatly inform the on-going chemical design, formulation and process engineering of these materials, in turn accelerating their development in gas separation, energy storage and device componentry applications.	85,000.00	170,000.00	170,000.00	85,000.00	0.00	0.00	510,000.00
	National Interest Test Statement This Project will generate several new classes of tuneable porous functional materials worthy of commercial development. Profound economic benefits are anticipated in the development of materials-based technologies for high precision smart devices and in applications such as gas separations, drug delivery, sensing and gas storage technologies. The energy efficiency of gas separation technologies additionally promises considerable environmental benefits, while the development of cutting-edge materials design and manufacture will lead to a step-change in the methods used to manufacture porous framework materials. Commercialisation will proceed via patent protection and subsequent co-development of new technologies and spin-offs with local hi-tech industries, giving them a leading edge over international competitors. Cultural benefits will include high level research training that fosters creativity and leadership, in turn promoting an innovative national research culture.							

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DP220103823	**Understanding the impact of heat stress on cognition in a changing world**	48,500.00	122,500.00	150,000.00	76,000.00	0.00	0.00	397,000.00
Ridley, A/Prof Amanda R	Our research will determine how anthropogenic climate change effects the ability of animals to process information in their environment. This research is significant because it directly addresses the growing issue of wildlife adaptation to climate change. If heat stress, reported widely in wildlife both in Australia and globally, impairs an animal's ability to respond to stimuli in its surrounding environment, then this may cause lower reproductive success (eg lower predator detection rates) and population declines. We aim to identify critical temperature points beyond which the cognitive responses of animals decline rapidly - a significant finding for effective wildlife management priorities in the face of rapid climate change.							
	National Interest Test Statement The heatwaves and catastrophic bushfires that we experienced over the last few years has brought to the fore the climate change crisis that Australia, and the world, is facing. It is estimated that millions of animals perished from heat stress during the heatwaves of the 2019/20 austral summer, and tens of millions more are estimated to have been impacted by sub-lethal heat stress effects. Cognition, defined as how an animal processes and responds to external stimuli, is a fundamental aspect of adaptation to social and environmental conditions. Accordingly, there is an urgent need to understand how heat stress impacts an animal's ability to respond to its environment. Our research focuses on using cognition measures to investigate the impact of heat stress on an animal's ability to (a) respond to external stimuli, and (b) flexibly adjust their behaviour. This research combines behavioural, cognition and demographic data to understand the impact of high temperatures on animal behaviour and adaptation to prevailing conditions, and thus directly addresses an important aspect of future wildlife management.							
	The University of Western Australia	1,387,321.00	2,801,777.00	2,720,297.50	1,356,771.50	101,860.00	50,930.00	8,418,957.00
	Western Australia	2,161,949.00	4,385,668.00	4,136,579.00	1,979,543.00	117,613.00	50,930.00	12,832,282.00
		41,690,606.50	**86,298,652.50**	**85,315,716.00**	**42,898,553.50**	**2,339,313.50**	**148,430.00**	**258,691,272.00**

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