

Summary of Discovery Projects Proposals for Funding to Commence in 2010

New South Wales

The University of Newcastle

DP1092458 Prof IV Belova; Dr DP Riley; Dr T Fiedler; Prof Dr A Oechsner

Approved Project Title **Design of reactive foils for joining amorphous alloys**

2010 : \$ 105,000

2011 : \$ 110,000

2012 : \$ 115,000

Primary RFCD 2506 THEORETICAL AND COMPUTATIONAL CHEMISTRY

Administering Organisation The University of Newcastle

Project Summary

Amorphous alloys or metallic glasses are special materials that retain the random structure of a liquid but in a solid form. They can show special properties of very high strength, toughness and corrosion resistance. The enormous difficulty in joining amorphous alloys to make larger assemblies is greatly curbing their uptake in technology. In this research, state of the art experimental and computational tools will be used to investigate the extremely fast high temperature reactions occurring in reactive foils of layered metals which, when inserted at the proposed join and ignited, quickly produce a bond. The research will lay the foundation for a robust and reliable means for joining amorphous alloys by means of reactive foils.

DP1093408 Prof IV Belova; Prof GE Murch

Approved Project Title **Design of hollow nanoparticles of titania for the sustainable production of hydrogen from water using sunlight**

2010 : \$ 120,000

2011 : \$ 120,000

2012 : \$ 120,000

Primary RFCD 2914 MATERIALS ENGINEERING

Administering Organisation The University of Newcastle

Project Summary

Hydrogen is a clean and non-polluting fuel that is the natural and sustainable replacement for greenhouse gas emitting fossil fuels. Because of its abundant sunlight and vast titanium reserves (the world's largest) Australia is especially well-placed to develop the technology of producing hydrogen directly from water and sunlight using a titanium dioxide photo-anode. This research, which consists of computational and experimental parts, is focused on laying the scientific foundation for that technology to be commercially viable. The national and community benefits are the availability of an inexpensive, limitless and clean fuel, reduction in reliance on energy imports, reduction in greenhouse gas emissions and resultant global warming.

DP1096356 Prof RE Betz; Dr DG Dorrell

Approved Project Title **Improved design and control of brushless doubly-fed reluctance machine generators for wind power applications**

2010 : \$ 110,000

2011 : \$ 100,000

2012 : \$ 100,000

Primary RFCD 2909 ELECTRICAL AND ELECTRONIC ENGINEERING

Administering Organisation The University of Newcastle

Project Summary

The growing importance of the reduction in greenhouse gas emissions over the coming years is driving the increased usage of renewable energy sources such as wind power. Currently the cost of wind energy is considerably higher than fossil fuel energy sources. Part of the reason for this is the initial cost and ongoing maintenance of the wind turbines. The proposed research considers a new kind of generator based on the Brushless Doubly Fed Machine (BDFRM) that has the potential to lower the initial cost of the generator/inverter hardware of the wind turbine, and also decrease the ongoing maintenance costs. If the research is able to show that the BDFRM is able to realise its potential, then this will aid the further use of wind energy.

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DP1093769 Prof JM Borwein
Approved Project Title **Computer Assisted Research Mathematics and its Applications**
2010 : \$ 160,000
2011 : \$ 150,000
2012 : \$ 170,000
2013 : \$ 75,000
Primary RFCD 2301 MATHEMATICS
Administering Organisation The University of Newcastle

Project Summary

The mathematics community will benefit from infusion of new computer-assisted techniques and modalities for research and training post-graduate students, both from my pure research project and through development of an associated research centre. Ultimately, this should also help more school students learn mathematics well and so play a part in addressing Australia's skill shortage. Also, the work on optimization algorithms promises to improve the performance and quality of many practical signal reconstruction methods. These are used by varied Australian industries from telecommunication to mining and by researchers in the digital arts and fields such as astronomy, physics, chemistry, bioscience, geoscience, engineering and medicine.

DP1094583 Dr N Byrne
Approved Project Title **Polymerization of amyloid fibrils and electroactive hybrid nanowires using ionic liquids**
2010 : \$ 105,000
2011 : \$ 105,000
2012 : \$ 105,000
Primary RFCD 2914 MATERIALS ENGINEERING
APD Dr N Byrne
Administering Organisation The University of Newcastle

Project Summary

The electronics world is constantly shrinking with devices being miniaturised and increasing levels of complexity built in. To maintain this trend, new technologies and new device fabrication approaches are required. APD Byrne, will develop new materials based on amyloid fibrils by their facile conversion to a range of novel high strength electroactive nanoscopic wires with application in many electronic devices. One such device that will benefit from these nanowires is organic solar cells. Solar is a clean renewable energy source that can reduce Australia's dependence on fossil fuels. The development of new approaches and materials aimed at increasing solar cell efficiencies is an important outcome for Australia.

DP1096538 Prof HM Carey; Dr DA Roberts
Approved Project Title **Liberty, Anti-transportation and the Empire of Morality**
2010 : \$ 51,000
2011 : \$ 62,000
2012 : \$ 50,000
Primary RFCD 4301 HISTORICAL STUDIES
Administering Organisation The University of Newcastle

Project Summary

The campaign to end convict transportation to Australia was a key step to the establishment of a liberal democracy founded on the highest moral principles. This project will safeguard Australia's national interest by creating new knowledge about the religious and political sources for the ideals of political and personal freedom that are foundational to the Australian national identity.

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DP1097129 Dr MR Fellows

Approved Project Title **Multivariate Algorithmics: Meeting the Challenge of Real World computational complexity**

2010 : \$ 108,000

2011 : \$ 108,000

2012 : \$ 108,000

2013 : \$ 100,000

2014 : \$ 80,000

Primary RFCD 2804 COMPUTATION THEORY AND MATHEMATICS

APF Dr MR Fellows

Administering Organisation The University of Newcastle

Project Summary

This Project will result in better methods for designing the algorithms that all computer applications depend on. Algorithms are the instruction sets that tell computers how to process information. Some information processing tasks are intrinsically difficult, even for computers working at enormous speeds. This Project will deliver new mathematical approaches to overcome these difficulties. More efficient algorithmic approaches for difficult problems enable advances in all areas of computer applications such as medical diagnosis and health prediction, national security, communications efficiency, industrial productivity and all fields of science and engineering.

DP1094696 Dr T Fiedler

Approved Project Title **Design of high performance heat sink composites**

2010 : \$ 110,000

2011 : \$ 110,000

2012 : \$ 120,000

Primary RFCD 2914 MATERIALS ENGINEERING

APD Dr T Fiedler

Administering Organisation The University of Newcastle

Project Summary

Heat sink composites are advanced materials that have the very substantial but widely untapped potential to reduce Society's energy consumption by means of utilizing waste energy or through energy-efficient temperature control. This Project uses computational analysis and parallel experimentation to design optimum heat-sink composites for highly energy-efficient temperature control of chemical batteries or electronic components as well as the means for the efficient heating/cooling of buildings. The outcomes of the project will lay the scientific foundation for the industrial scale development of advanced heat sinks that will lower energy costs and decrease climate changing emissions. This represents a new market for Australian industry.

DP1094769 Prof KP Galvin

Approved Project Title **The elutriation of ultrafine particles according to their density**

2010 : \$ 100,000

2011 : \$ 80,000

2012 : \$ 80,000

Primary RFCD 2906 CHEMICAL ENGINEERING

Administering Organisation The University of Newcastle

Project Summary

This study is concerned with exploiting a new and powerful mechanism for separating particles according to their density, with strong potential for recovering and concentrating tens of billions of dollars worth of valuable minerals annually. By coupling the new separation mechanism with a centrifugal force it should be possible to apply gravity separation technology, arguably for the first time, to the recovery of ultrafine particles from 200 microns to well below 10 microns, at high separation efficiency, and high feed rates. This study is also ideal for training new researchers, especially at the PhD level, in an area of importance to Australia's economic future.

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DP1096748 Dr PM Ireland
Approved Project Title **Mass transport in aqueous foams**
2010 : \$ 90,000
2011 : \$ 64,000
2012 : \$ 64,000
Primary RFCD 2499 OTHER PHYSICAL SCIENCES
Administering Organisation The University of Newcastle

Project Summary

Flotation is extremely important in the minerals industry, whose exports are \$110.5 billion annually. This project aims to significantly advance understanding of liquid transport in flotation froths, via a quantitative study of foam mass flow mechanisms. If successful, it may lead to modifications to current flotation devices, improving their froth-zone performance and saving money, water, energy and greenhouse gas emissions.

DP1093114 Dr SJ Johnson; Dr L Ong
Approved Project Title **Optimising Cooperation in Multiterminal Wireless Networks**
2010 : \$ 50,000
2011 : \$ 50,000
2012 : \$ 50,000
Primary RFCD 2805 DATA FORMAT
Administering Organisation The University of Newcastle

Project Summary

With more and more of our communications networks becoming wireless, new technologies are required to ensure optimal use of limited resources. This project develops and optimises cooperation for multiterminal wireless networks to increase the transmission rate and / or lower the power consumption of wireless networks. Benefits of this research are efficient deployment and operation of high-speed wireless networks such as broadband Internet and digital television, and improved lower-power wireless sensor networks for applications such as remote monitoring bushfire early warning systems.

DP1093809 Dr K Kypri; Dr J McCambridge; Prof Dr J Attia; Mr SJ Bowe
Approved Project Title **Experimental Studies of the effects of the research process on participant behaviour**
2010 : \$ 76,000
2011 : \$ 72,000
2012 : \$ 30,000
Primary RFCD 3212 PUBLIC HEALTH AND HEALTH SERVICES
Administering Organisation The University of Newcastle

Project Summary

A key national challenge for social science is to develop and evaluate cost effective health behaviour interventions that may have relatively small effects at the individual level, but which, when aggregated across a large population, produce a measurable benefit. The trials required to evaluate such interventions are typically subject to biases arising from study design and measurement of behaviour, and therefore result in poor estimates of efficacy and cost-effectiveness. By quantifying the extent to which aspects of the research process affect estimates of intervention efficacy, efforts to address national health priorities such as physical inactivity, smoking, hazardous drinking, and poor nutrition will be enhanced.

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DP1092646 Dr DR Lubans; A/Prof PJ Morgan; A/Prof R Callister; A/Prof CE Collins; A/Prof AD Okely; Prof RC Plotnikoff

Approved Project Title **Engaging economically disadvantaged adolescent girls in physical activity and healthy eating to improve health and prevent obesity**

2010 : \$ 64,000
2011 : \$ 47,000
2012 : \$ 44,000

Primary RFCD 3212 PUBLIC HEALTH AND HEALTH SERVICES

Administering Organisation The University of Newcastle

Project Summary

Secondary school represents the final opportunity to influence individuals as they develop adult lifestyle behaviours and enter a transitional period in their lives. Considering the increased prevalence of lifestyle diseases among Australian adults and increases in the prevalence of obesity among young Australians, targeting health-promoting behaviours in adolescents is clearly a national priority. Furthermore, rates of obesity are much higher in economically disadvantaged areas, with girls more susceptible to the SES disadvantages. This project has the potential to develop a knowledge base and improve the health behaviours of current and future Australians most at risk for the development of lifestyle diseases.

DP1097016 A/Prof JA Lucas; Prof TF Wall

Approved Project Title **Characterisation of Pyrolytic Thermal Regions in Coal Macerals using Computer Aided Thermal Analysis**

2010 : \$ 125,000
2011 : \$ 115,000
2012 : \$ 110,000

Primary RFCD 2906 CHEMICAL ENGINEERING

Administering Organisation The University of Newcastle

Project Summary

The research will assist in the fundamental understanding of coal pyrolysis mechanisms. All coal contains proportions of different fossilised plant material, which behaves differently when heated. This proposal studies thermal behaviour of the density separated fractions in Australian coals using a highly sensitive technique. The characterisation adds value and use to current coal reserves and is aimed towards producing an advanced modelling capability to promote efficient coal usage in existing and future technologies. Such innovative approaches support the sustainability of Australian coal reserves, particularly in the transition towards decarbonised energy.

DP1097146 A/Prof AV Lyamin; Dr OP Buzzi

Approved Project Title **Microstructure-Based Computational Homogenization of Geomaterials**

2010 : \$ 160,000
2011 : \$ 150,000
2012 : \$ 150,000

Primary RFCD 2908 CIVIL ENGINEERING

Administering Organisation The University of Newcastle

Project Summary

This project seeks to establish a basis for virtual testing of materials. This type of non-destructive testing has numerous applications of obvious benefit to society and will contribute to the continued growth and development of a large number of industries in Australia and worldwide. The methods developed will allow for cheaper, faster, and more accurate testing of materials. The outcomes of the project can find direct application in civil engineering as well as in environmental, mining and petroleum engineering which together make up a significant portion of the nation's industry.

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DP1095780 A/Prof A McCluskey; Prof PJ Robinson; A/Prof MR Larsen

Approved Project Title Streamlining the dynamin epilepsy drug pipeline

2010 : \$ 146,000

2011 : \$ 146,000

2012 : \$ 146,000

Primary RFCD 2701 BIOCHEMISTRY AND CELL BIOLOGY

Administering Organisation The University of Newcastle

Project Summary

Epilepsy affects up to one percent of Australia's population, yet one in three fail to respond to current medications. Our results will greatly impact on development of future epilepsy therapy. Identification of a new target for epileptic will allow better drug design to improve the potency of our lead drugs. This holds hope that new generation drugs will be more effective. The drugs are predicted to have fewer complications and side-effects. The outcome has the potential to vastly improve prospects for up to 200,000 Australians. Intellectual property (IP) retained in Australia will generate future biotechnology industry. The novel chemical biological approaches will facilitate training of future generations of Australian scientists.

DP1093787 Prof RE Melchers; Prof MG Stewart

Approved Project Title Remaining life estimation for existing deteriorating reinforced concrete infrastructure

2010 : \$ 110,000

2011 : \$ 100,000

2012 : \$ 110,000

Primary RFCD 2908 CIVIL ENGINEERING

Administering Organisation The University of Newcastle

Project Summary

Structural deterioration affects the safety and performance of infrastructure facilities and so life extension is an area of increasing economic importance. The project will provide improved techniques for making sound assessments of the remaining safe service life of existing deteriorating infrastructure such as jetties, piers, bridges, buildings, etc. The incorporation of on-site inspection and test data will, in many cases, allow for the extension of safe service life beyond what was originally intended by the designers. This will provide substantial economic benefits since as much as 3% of Australia's GDP is lost due to corrosion and other forms of structural deterioration.

DP1097142 Prof BM Ninness; Dr AG Wills

Approved Project Title System Identification of Complex System Models

2010 : \$ 110,000

2011 : \$ 110,000

2012 : \$ 110,000

Primary RFCD 2802 ARTIFICIAL INTELLIGENCE AND SIGNAL AND IMAGE PROCESSING

Administering Organisation The University of Newcastle

Project Summary

This project lies within an ARC Research Priority Area. Namely, "Frontier Technologies". It involves the development of new technologies and fundamental theory that take data records from physical or abstract systems and generate mathematical models for use in prediction, control and diagnosis of the underlying system. In light of this, the project also lies within the ARC Research Priority Area of "Smart Information Use",

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DP1092849 Dr B Nixon; Dr HW Ecroyd; A/Prof RC Jones

Approved Project Title **Monotremes provide a key to understanding the molecular biology of mammalian gamete evolution**

2010 : \$ 90,000

2011 : \$ 90,000

2012 : \$ 90,000

Primary RFCD 2701 BIOCHEMISTRY AND CELL BIOLOGY

Administering Organisation The University of Newcastle

Project Summary

As the platypus and echidna (monotremes) are our most distant relatives among living mammals, interpreting their genome is important to determine the molecular sequences in human genes that are essential for fertility, and possibly responsible for infertility. As the only country with monotremes accessible for research, Australia has a responsibility to promote the work. The research can be applied to improve the poor breeding record in zoos of these unique, iconic Australian fauna which generate considerable tourist interest. Publication of monotreme research attracts considerable publicity internationally. Publication of the platypus genome sequence in 2008 attracted headlines all over the world.

DP1092679 Prof MJ Ostwald; Dr SK Chalup

Approved Project Title **Modelling and predicting patterns of pedestrian movement: using robotics and machine learning to improve the design of urban space.**

2010 : \$ 186,000

2011 : \$ 150,000

2012 : \$ 150,000

Primary RFCD 3101 ARCHITECTURE AND URBAN ENVIRONMENT

Administering Organisation The University of Newcastle

Project Summary

In a geographic region that is experiencing increasing urban density, the problems of the pedestrian are rarely considered from a design perspective. One reason for this is that there are few useful tools available for analysing the behaviour of pedestrians in existing urban spaces, and none to assist designers to optimise such spaces. As a result of this, there is an urgent need for the development of design tools to enable a higher level of understanding of pedestrians in public space. This project is a world-first combining urban design theory and machine-learning for creating more socially and culturally responsive environments.

DP1094154 Prof MJ Ostwald; Dr N Gu; Mr MJ Chapman

Approved Project Title **Recomputing the canon: using computational methods to develop an alternative understanding of the history of 20th century architecture**

2010 : \$ 148,000

2011 : \$ 125,000

2012 : \$ 137,000

2013 : \$ 136,000

Primary RFCD 3101 ARCHITECTURE AND URBAN ENVIRONMENT

Administering Organisation The University of Newcastle

Project Summary

Because buildings are designed to last for many generations, and they represent a substantial economic investment, architecture remains one of the most tangible and persistent reflections of a culture's spiritual, social and political values. This is why it is said, to understand architecture is to understand society and its principles. This research develops an alternative history of 20th century architecture that will not only allow for a deeper understanding of, and appreciation for, our own constructed heritage, but will also inform the design and production of future buildings which are both socially and culturally responsive.

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DP1094716 Em/Prof AW Roberts; Prof MG Jones; Dr CA Wheeler; Dr W McBride; Dr CM Wensrich; Dr A Katterfeld
Approved Project Title **Analytical, Numerical and Testing Procedures for Improved Design and Performance of Bulk Solids Systems**
2010 : \$ 100,000
2011 : \$ 95,000
2012 : \$ 105,000
Primary RFCD 2905 MECHANICAL AND INDUSTRIAL ENGINEERING
Administering Organisation The University of Newcastle

Project Summary

Mining and minerals production is Australia's most important export industry. Despite the global financial crisis, the Australian Bureau of Agriculture and Resources Economics (Australian Commodities, December Quarter 2008) has forecast that earnings from Australia's energy and minerals exports will increase by 37% during 2008-09 to A\$160 billion. Bulk materials handling operations constitute a major component of the minerals production and transportation costs. Through the research conducted in this project, greater efficiencies with reduced operating costs will be achieved while, at the same time, meeting the stringent environmental controls in accordance with the National priority goal of 'An Environmentally Sustainable Australia'.

DP1096161 A/Prof CL Waters; Prof R Lysak
Approved Project Title **First realistic modelling of the effects of Ultra Low Frequency (ULF) wave energy in the ionosphere over the Australian region**
2010 : \$ 110,000
2011 : \$ 110,000
2012 : \$ 110,000
Primary RFCD 2606 ATMOSPHERIC SCIENCES
Administering Organisation The University of Newcastle

Project Summary

Ultra Low Frequency (ULF) wave activity is known to produce perturbations of the ionosphere electron density. This affects technologies that involve High Frequency (HF) propagation in the ionosphere such as over-the-horizon radar (OTHR) and radio astronomy. Australia relies on OTHR for surveillance beyond our coastline using the Jindalee Operational Radar Network. Australia is also in competition for the next generation radio telescope (the SKA). This project will develop a world first model that combines ULF and HF physics to provide advanced understanding of the generation processes of radar Doppler clutter and differential phase errors in radio astronomy interferometer telescopes.

DP1095964 A/Prof MJ Watts
Approved Project Title **Evolving urban structure, mode choice, travel behaviour and energy consumption: A study of the Sydney planning strategy**
2010 : \$ 51,000
2011 : \$ 45,000
2012 : \$ 47,000
Primary RFCD 3704 HUMAN GEOGRAPHY
Administering Organisation The University of Newcastle

Project Summary

The project will analyse the emerging Sydney Strategic Plan which is designed to address excessive car reliance that is claimed to cause inefficient energy use, congestion, adverse health and excessive greenhouse gas emissions. The Project's policy framework will contribute to of an environmentally sustainable Australia and will promote public debate. While other funding will have expired, the professional academic network will continue to flourish at spatially oriented workshops and conferences which will provide the means of disseminating the analytical techniques, empirical results and policy analysis from the project, thereby enhancing the research capacities of network members.

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DP1095123 Dr JS Welsh; Dr JC Agüero Vasquez

Approved Project Title **Robust Dynamical System Identification**

2010 : \$ 75,000

2011 : \$ 75,000

2012 : \$ 70,000

Primary RFCD 2301 MATHEMATICS

Administering Organisation The University of Newcastle

Project Summary

Innovative robust system identification methods are a Frontier Technology for Transforming Australian Industries. Robust system identification will provide a technology for generating high fidelity models by the use of breakthrough science. With the majority of advanced industrial control systems reliant on accurate models significant savings could be made due to the implicit improvement in process control. Furthermore, system identification is a key enabling technology in most modern systems (e.g. in aerospace, manufacturing, mining, minerals processing and telecommunications) and is also important in the emerging areas of nanotechnology and systems biology.

DP1095645 Dr AG Wills; Prof BM Ninness; Dr G Knagge

Approved Project Title **New Model Predictive Control Design Methods**

2010 : \$ 65,000

2011 : \$ 55,000

2012 : \$ 50,000

Primary RFCD 2802 ARTIFICIAL INTELLIGENCE AND SIGNAL AND IMAGE PROCESSING

Administering Organisation The University of Newcastle

Project Summary

Automatic computer control is fundamental to sustaining a wide range of manufacturing, mineral processing, chemical processing, and other industries vital to the Australian economy. Furthermore, the efficiency, profitability, and environmental impact of these operations is directly linked to the quality of this computer control. In many situations, even a few percent improvement in automatic control delivers dividends measured in many millions of dollars. This project will develop design tools allowing for more sophisticated, high performance control to be more widely employed. This will deliver the potential for economic and environmental benefits and energy savings to be achieved across a range of industries.