

# Summary of Successful Linkage International applications - Round 10 Fellowships to Commence in 2006 by State/University

## **New South Wales**

### **Macquarie University**

**LX0666877** A/Prof JM Dawes; Dr A Rahmani; Prof RC McPhedran; Dr MJ Withford

**Title:** **Studies of near-field optical emission from waveguides and photonic crystals**

**2006 :** \$96,790

**Category:** 2404 - OPTICAL PHYSICS

#### **Collaborating Countries**

France

**Administering Institution:** Macquarie University

#### **Summary:**

Waveguides and microstructured optical materials (e.g. photonic crystals with defects) control the propagation of certain wavelengths of light, with applications in optical processing and sensing. Dr Rahmani, working with CIs Dawes, Withford and McPhedran, will model the behaviour of light confined within such structures, to compare with near field scanning optical microscopy measurements of actual devices fabricated at Macquarie. The enhanced understanding of light confinement and propagation in photonic crystals and waveguides, will enable us to refine and improve our fabrication techniques. A further outcome is the development of theoretical tools suited to modelling advanced optical materials giving improved device designs.

### **The University of New South Wales**

**LX0667316** Prof BJ Gillam; A/Prof R Allison

**Title:** **Stereoscopic Vision at Large Distances**

**2006 :** \$36,960

**Category:** 3801 - PSYCHOLOGY

#### **Collaborating Countries**

Canada

**Administering Institution:** The University of New South Wales

#### **Summary:**

Stereoscopic vision is the ability to use small differences in the images in the two eyes (resulting from their difference in viewpoint) to perceive depth differences in the world. It has traditionally been regarded as useful only in near space for tasks like reaching. However geometric analysis indicates that it should be possible to use it to detect useful depth differences up to a kilometre or even more. This ability has never been studied. We propose to investigate the ability to discriminate stereoscopic depth differences at distances of 5 metres to a kilometre as well as the stereo contribution at these distances to perceived absolute distance on a ground plane. We shall use monocular vision as a control.

**LX0666993** A/Prof BA Neilan; Dr Y Jeon; Prof PL Rogers; Prof K Lee

**Title:** **Metabolic engineering of *Zymomonas mobilis* for higher value fermentation products**

**2006 :** \$80,000

**Category:** 2702 - GENETICS

#### **Collaborating Countries**

Korea

**Administering Institution:** The University of New South Wales

#### **Summary:**

To produce high value commodities from cheap agricultural resources, *Zymomonas mobilis*, a bacterium with very high rates of sugar uptake and ethanol yields, will be transformed via metabolic engineering. As a typical example of a higher value products, this project will be focus on the overproduction of succinate. To achieve this goal a gene encoding pyruvate decarboxylase (pdc) involved in ethanol production pathway in this bacterium will be inactivated and transformed to express malate dehydrogenase to enhance succinate production. DNA microarray studies will be performed on the succinate-producing mutants to provide valuable information for optimisation and further strain improvement.

### **The University of Newcastle**

**LX0666274** Dr D Sheng; Prof X Li

**Title:** **Two-scale modelling of geomaterials**

**2006 :** \$80,640

**Category:** 2908 - CIVIL ENGINEERING

#### **Collaborating Countries**

China

**Administering Institution:** The University of Newcastle

#### **Summary:**

The ability to predict the response of soils and rocks under various loading conditions is of major importance in civil engineering

design. The traditional models for these materials are usually based on experimental observation at scales much larger than their microstructures. As such, they are very complex and require extensive experimental data to tune various model parameters. This project aims to develop a fully coupled micro-macro two-scale computational model for geomaterials, in which the macroscopic material behaviour is based on detailed modelling of the microstructure. The resulting model will improve the quality of engineering analysis and hence leads to more efficient and effective engineering design.

**LX0667294** Dr W Szymanski; Prof JH Hong

**Title:** The structure of quantum groups

**2006 :** \$57,440

**Category:** 2301 - MATHEMATICS

**Collaborating Countries**

Korea  
Poland

**Administering Institution:** The University of Newcastle

**Summary:**

Complex mathematical problems arising in sciences and engineering can often be given simple solutions if a suitable symmetry is found. Symmetries are mathematically captured through the concept of a group. However, modern quantum theories require that the groups themselves be modified. The recently found modification is called quantum group. In this project, we propose to investigate the internal structure of the most important classes of quantum groups. This will likely lead to immediate applications in the related areas of mathematics, like noncommutative geometry, and theoretical physics, like quantum field theory.

**LX0667119** Dr GA Willis; Dr L Carbone

**Title:** Totally disconnected groups, representations and discrete mathematics

**2006 :** \$60,000

**Category:** 2301 - MATHEMATICS

**Collaborating Countries**

USA

**Administering Institution:** The University of Newcastle

**Summary:**

Links that have been identified in recent years between the distinct research areas of Lie groups and discrete mathematics have led to innovations in information technology. This project aims to establish new links between these areas and my work on totally disconnected groups. Communication barriers between the distinct fields will be broken down and collaborations initiated which use the group concepts to tackle problems in discrete mathematics. Advances will be made in the theory of totally disconnected groups and in discrete mathematics. Discrete mathematics problems solved may lead to further innovations in information technology.

## The University of Sydney

**LX0665442** Prof HF Durrant-Whyte; Dr S Sukkarieh; Prof M Campbell

**Title:** Operator Decision Modelling in Autonomous Systems

**2006 :** \$89,730

**Category:** 2802 - ARTIFICIAL INTELLIGENCE AND SIGNAL AND IMAGE PROCESSING

**Collaborating Countries**

USA

**Administering Institution:** The University of Sydney

**Summary:**

The aim of this project is to explore and develop modelling methodologies which can encapsulate human operator decision making when controlling complex systems involving many autonomous agents. To provide a method of understanding operator decisions will pave the way for the creation of effective human-system interaction, adding a completely new dimension to how autonomous and semi-autonomous systems are designed and implemented.

The modelling technique will enable the design of highly efficient human-system interaction which can specifically adapt decision making to the given scenario and potentially in real time.

**LX0664539** Prof Y Mai; Prof Dr K Friedrich

**Title:** CNTs-modified polymer composites for tribological applications

**2006 :** \$155,000

**Category:** 2914 - MATERIALS ENGINEERING

**Collaborating Countries**

Germany

**Administering Institution:** The University of Sydney

**Summary:**

The project aims to establish a framework in design and development of polymer nanocomposites using carbon nanotubes (CNTs) for tribological applications. CNTs-modified polymer composites are produced using twin-screw extrusion with well dispersed CNTs in thermoplastic polymers. The roles of CNTs on wear performance are characterised using advanced techniques including nano-indentation and nano-scratching tests, in relation to sliding wear conditions such as load, velocity and temperature, and counterpart properties. Artificial intelligence is applied to predicate the wear properties, based on the relevant mechanisms and

data. The outcomes of this project will lead to technological advances in tribology for practical applications.

**LX0664854** Dr PF Rey; Dr P Philippot; Dr A Dutkiewicz; Dr CP Marshall; Dr MJ Van Kranendonk

**Title:** **Chemistry of the Archaean Ocean and its Impact on Earth's Early Atmosphere and Ecosystems**

**2006 :** \$133,670

**Category:** 2499 - OTHER PHYSICAL SCIENCES

**Collaborating Countries**

France

**Administering Institution:** The University of Sydney

**Summary:**

Pristine diamond drill cores recently collected in the Pilbara Craton of Western Australia present a unique opportunity to constrain the chemistry of the earliest ocean and the composition of the atmosphere and microbial ecosystems spanning the Archaean Eon. We propose to use high-resolution methods including synchrotron-based techniques and vibrational spectroscopy on microfossils and fluid inclusions to gain insights into interactions between hydrothermal circulation, ocean water and mantle-derived fluids. The project will greatly expand our knowledge of Earth's early habitats and the evolution of the primordial oceans and atmosphere. It may even provide new clues on the origin of life.

## Victoria

### RMIT University

**LX0667389** Prof SK Bhargava; Prof P Coloe; Prof AM Bond; Dr M Sastry; Dr A Ahmad

**Title:** **An investigation of growth processes, structure and properties of biogenically synthesised gold**

**2006 :** \$65,000

**Category:** 2918 - INTERDISCIPLINARY ENGINEERING

**Collaborating Countries**

India

**Administering Institution:** RMIT University

**Summary:**

Nanoparticles synthesised by biological agents or molecules have been shown to have interesting geometry-dependent properties. The main aims of this project are to investigate the nucleation and growth mechanisms of novel biosynthesised nanoparticles, which give rise to their structures, and thus their properties, such as optical activity and redox behaviour. The nanoparticles produced could have applications in drug delivery, coatings and electronic devices, and the information gained from the investigation of the nucleation and growth mechanisms will be beneficial for developing new-and refining existing-methods for nanoparticle production.

### Swinburne University of Technology

**LX0666298** Prof M Gu; Mr Z Bomzon

**Title:** **Studying cell mechanics with a biophotonics-based tool**

**2006 :** \$80,000

**Category:** 2499 - OTHER PHYSICAL SCIENCES

**Collaborating Countries**

Israel

**Administering Institution:** Swinburne University of Technology

**Summary:**

Mechanical forces play a role in the adhesion, contraction and crawling of cells. Some cell types are known to convert physical forces into biochemical signals. This process is known as mechanotransduction. We propose to develop a system combining a multiphoton microscope and an optical tweezers for the study of cell mechanics. We will use the system to study the connection between intracellular organization and morphology and the mechanical properties of the cells. We will also use it to study the transduction of mechanical signals in cells. Our research will provide new insight into fundamental cellular processes such as adhesion, contraction, crawling and mechanotransduction.

## Queensland

### Queensland University of Technology

**LX0667431** Dr MA Keane; Prof X Zhang; Prof SJ Donald

**Title:** **The shift from cultural institution to creative enterprise**

**2006 :** \$20,000

**Category:** 4203 - CULTURAL STUDIES

**Collaborating Countries**

China

**Administering Institution:** Queensland University of Technology

**Summary:**

This project, which entails a three-month visit by the eminent scholar, Prof Zhang Xiaoming from the Chinese Academy of Social Sciences, will build a greater understanding of China's cultural economy and comparative cultural policy agendas within the Australian research community. It will investigate the development of enterprise dynamics in China in the context of post-WTO competition; how policy-making in China is being informed by, and modelled on parallel developments in Hong Kong, Singapore, and Australia; and best practices for information sharing across cultural research networks.

## The University of Queensland

**LX0665224** Dr BD Hankamer; Dr O Kruse

**Title:** Developing a competitive H2 production system based on engineered cells of green algae

**2006 :** \$140,000

**Category:** 2901 - INDUSTRIAL BIOTECHNOLOGY AND FOOD SCIENCES

**Collaborating Countries**

Germany

**Administering Institution:** The University of Queensland

**Summary:**

The aim of this project is to develop a competitive H2 production system, based on engineered cells of green algae. These cells have the natural ability to drive solar-powered hydrogen (H2) production from water (H2O). Combustion of H2 produces only H2O, completing the clean energy cycle. This project will integrate advances based on 5 parallel research streams being conducted in our laboratories, with the specific aim of developing a single system, with enhanced H2 production capabilities. This research program will incorporate improvements to enhance photon conversion efficiency, H+ and e- supply to the active hydrogenase, external feeding and will facilitate scale up to a 100l pilot study using an immobilized algal bioreactor system.

**LX0667367** Dr J Zhu; A/Prof M Zhao

**Title:** Molecular Modelling of Growth Mechanisms and Electronic Properties of Nanostructured Metal-Oxides

**2006 :** \$93,240

**Category:** 2914 - MATERIALS ENGINEERING

**Collaborating Countries**

China

**Administering Institution:** The University of Queensland

**Summary:**

This project aims to investigate the mechanism of metal atoms collision with metal oxides nanoclusters using molecular dynamics simulations combined with first-principles calculations, the corresponding issues such as stable configurations, electronic structures and optical properties of size-confined systems will be comprehensively studied. The successful completion of this project is expected to lead to the fundamental understanding of the growth mechanism and functionality of metal oxides nanoparticles, and new materials for photonic devices, which can be utilized in blood immunoassay, optically triggered drug delivery and targeted photothermal destruction of cancer cells, etc.

## South Australia

### The University of Adelaide

**LX0667264** Dr J Brugger; Dr D Testemale; Dr J Hazemann; Dr L Spiccia

**Title:** In-situ solubility and speciation studies in super-critical H2O-NaCl-CO2 mixtures using synchrotron

**2006 :** \$95,740

**Category:** 2603 - GEOCHEMISTRY

**Collaborating Countries**

France

**Administering Institution:** The University of Adelaide

**Summary:**

This project aims to investigate solvation processes in aqueous solution as a function of pressure, temperature and composition. The modifications of the solvation structure induced by the presence of CO2 and chloride will be explored under both sub- and supercritical conditions by studying metallic elements in model solutions (ion alone) and in solubility experiments where the ion is dissolved from a carbonate. The concentration and solvation of the ion will be followed in-situ using x-ray absorption and optical spectroscopy. This work will provide the fundamental physical and chemical understanding required to predict mass transfer in situations such as geological CO2-sequestration or the formation of hydrothermal ore deposits.

**LX0667361** Prof MA Tester; Prof Dr N von Wieren

**Title:** Development of advanced screening protocols for the identification of genes involved in nutrient sensing and nutrient efficiency in plants

**2006 :** \$68,000

**Category:** 3002 - CROP AND PASTURE PRODUCTION

**Collaborating Countries**

France

Germany  
UK

**Administering Institution:** The University of Adelaide

**Summary:**

Sensing proteins in plants are expected to be highly significant for the adaptation of plants to nutrient-deficient soils. The proposed research aims to develop screening protocols directed to isolate tagged Arabidopsis or rice lines with defects in nutrient sensing or nutrient efficiency. Novel screening protocols will build on the morphological response of a root to the localized supply of nutrient elements and then modified in a manner that it can be applied for high-throughput screening. Thus, the approach is highly complementary to two research project of the CI. It is expected that such protocols will not only serve for identifying novel genes from tagged plant lines but also to verify sensing functions of already known proteins.

## Western Australia

### The University of Western Australia

**LX0664516** A/Prof JM Whelan; Asst Prof J Kreuzwieser

**Title:** The impact of water logging on mitochondrial metabolism in leaves and roots of Grey poplar

**2006 :** \$96,740

**Category:** 2704 - BOTANY

**Collaborating Countries**

Germany

**Administering Institution:** The University of Western Australia

**Summary:**

Water logging and flooding cause oxygen deprivation in the root system of plants. Since oxygen is essential for mitochondrial respiration, this process cannot be maintained under anoxic conditions and must be replaced by other pathways. Whereas a few studies with crops have shown the impact of flooding on mitochondrial metabolism, nothing is known about trees. Particular tree species are of considerable significance because they are able to survive even prolonged periods of flooding due to metabolic rather than morphological adaptations that are presently not fully understood. The planned studies are aimed to achieve detailed knowledge on metabolic mechanisms of flooding tolerance in trees.

## Tasmania

### University of Tasmania

**LX0667174** Prof JJ Summers; Dr C Tandonnet

**Title:** Intracortical inhibition evaluated by paired-pulse TMS during choice and simple reaction time tasks

**2006 :** \$78,340

**Category:** 3801 - PSYCHOLOGY

**Collaborating Countries**

France

**Administering Institution:** University of Tasmania

**Summary:**

Our daily lives are characterised by our ability to adapt behaviour to environment demands. In particular, we constantly receive external stimuli to which we have, or not, to react. When a reaction is required, we often have to select quickly an appropriate behaviour to the particular stimulus. In the laboratory these situations have been studied using choice reaction time tasks. This project will investigate the brain processes, particularly inhibition, involved in choice behaviour. The research will provide a better understanding of the link between cognitive and neurophysiological processes.

## Australian Capital Territory

### The Australian National University

**LX0667392** Prof SJ Buckman; Dr JC Lower; Dr K Zrost

**Title:** Ionization and excitation of excited helium atoms

**2006 :** \$83,000

**Category:** 2403 - ATOMIC AND MOLECULAR PHYSICS; NUCLEAR AND PARTICLE PHYSICS; PLASMA PHYSICS

**Collaborating Countries**

Germany

**Administering Institution:** The Australian National University

**Summary:**

The aim of this project is to probe the nature of atomic excited-states using the electron-helium system as a benchmark. Beams of electrons will collide with laser-focussed-and-cooled long-lived metastable helium atoms and the reaction products detected using advanced nano-second timing technology. This work will lead to a better understanding of atomic energy-transfer processes which drive gas discharged-based devices and play a crucial role in the physics and chemistry of the upper atmosphere. Improvements to theory resulting from the provision of accurate reaction rate data will lead to an enhanced capacity to model gas-discharged-based devices.

**LX0666552** Dr DN Neshev; Prof YS Kivshar; Prof Dr AA Dreischuh

**Title:** Singular optics of polychromatic light

**2006 :** \$51,000

**Category:** 2404 - OPTICAL PHYSICS

**Collaborating Countries**

Bulgaria

**Administering Institution:** The Australian National University

**Summary:**

The interaction of light with matter is the basis of future all-optical technologies. With this project, we aim to control such interactions by engineering the energy flow of high intensity laser beams. For this purpose, we suggest using beams from femtosecond lasers having broad spectral bandwidth and complex spatial phase structure, called polychromatic singular beams. We aim to develop theoretical and experimental approaches to design the properties of such beams and study their interaction with materials. Our findings will be useful for a large variety of applications, including microscopy, lithography, and data storage, and will aid in the development of novel photonics technologies, where Australia has a strong international standing.