

---

## Research

The Research School of Physics and Engineering (RSPE) is the largest university-based institution in the country for physics research and its applications by some measure, with over 140 academics, 130 general staff and 140 post graduate students.

The School's research thrusts in selected areas of strength cover the entire spectrum from fundamental research (understanding nature) through applied research to pre-commercial development. The research program is built around three "big picture" themes: quantum science and technology; advanced materials and technology, and energy and environmental science and technology.

The School continued to excel in its research performance, with almost 500 journal publications in 2010 and its staff involved in more than 200 major international conferences.

The link between research and teaching is critical to the future of the School and the nation. The School has made a major commitment in using its research strength and scale, together with its unique mix of outstanding researchers, teachers and infrastructure, to developing world leading education programs for gifted students that link directly to postgraduate research study. The research and teaching links are not only confined to the Physics discipline but have significant involvement with Engineering in CECS and in other science disciplines in CPMS and CMBE.



[Professor Ken Baldwin, Deputy Director \(Research\)](#) is also Deputy Director of the Australian Research Council Centre of Excellence for Quantum-Atom Optics and Professor in the Atomic and Molecular Physics Laboratories.

RSPE is comprised of nine research departments. A brief description of each department is detailed in the following pages as well as a list of staff dedicated to that area.

- **Applied Mathematics**
- **Atomic & Molecular Physics Laboratories**
- **Electronic Materials Engineering**
- **Laser Physics**
- **Nonlinear Physics**
- **Nuclear Physics**
- **Plasma Research Laboratory**
- **Quantum Science**
- **Theoretical Physics**

---

## Applied Mathematics



*Dr Vince Craig*

Condensed matter and materials research dominates the research performed in the Department but we are notoriously difficult to pigeon-hole as the range of research programs currently underway are numerous and diverse; for example, statistical mechanical studies of liquids at interfaces, specific ion effects in soft matter, modelling and experiments of multiphase flow properties of oil-bearing rocks, tomographic imaging of fossils, nanobubbles for cleaning, low dimensional geometry and topology as structure descriptors and studies of networks and are all part of the department's ongoing research programs. This large portfolio of research is possible due to our strong network of collaborators around the world and the contribution of individuals in the Department to areas outside of their core areas of interest.

A significant part of the Department's effort has been funded by a large international consortium of oil and gas companies and the Department has recently spun-off a start-up company, Digicore, to service a strong and growing worldwide demand for X-Ray CT experiments and analysis of rock cores.

We are also commercializing a puzzle toy that has developed from one of the long-term research themes of the Department.

---

## Academic Staff

### Heads of Department

Vince Craig PhD, ARC FF (from July)  
Mark Knackstedt BSc Columbia, PhD Rice  
(until July)

### Professors

Stephen Hyde PhD Monash, ARC FF  
Mark Knackstedt BSc Columbia, PhD Rice  
David Williams BSc Sydney, PhD Cambridge

### Senior Fellows

Tomaso Aste DipHons Genova, PhD Milan  
Vince Craig PhD, ARC FT  
Tim Senden PhD  
Adrian Sheppard BSc Adelaide, PhD

### Research Fellows

Lilliana De Campo PhD Graz  
Andrew Fogden PhD Docent Lund  
David King BSc  
Shannon Notley PhD  
Drew Parsons PhD  
Vanessa Robins PhD Colorado  
Ross Stephens PhD Sydney  
Arthur Sakellariou PhD Melbourne  
Rob Sok BSc PhD Groningen  
Trond Varslot PhD NTNU

### Postdoctoral Fellows

Nicolas Francois PhD Bordeaux (from September)  
Anthony Jones PhD (until September)  
Andrew Kingston PhD Monash  
Shane Latham PhD UQ  
Guangming Liu PhD China  
Mahyar Madadi BSc Tehran, PhD IASBS  
Glenn Myers PhD Monash  
Mohammad Saadatfar PhD (from November)  
Vincent Tariel PhD Ecole Polytechnique (from July)  
Peter Wood PhD Flinders (until June)

## General Staff

### Technical, Administrative & IT Officers

Holger Averdunk  
Anthony Hyde AssocIE  
Janet James (until July)  
Jill Middleton  
Tim Sawkins  
Paul Veldkamp BSc BEc

### Departmental Administrator

Margo Davies DipDent Tasmania

## Visiting Fellows

Dr Christoph Arns, UNSW  
Dr Ji-Youn Arns, UNSW  
Dr Judith Caton  
Mr Arthur Davies  
Dr Gareth Delaney  
Dr Tiziana Di Matteo  
Ms Christine Henry  
Prof Stjepan Marcelja, University of Rochester  
Dr Yasmin Melean, University of Venezuela  
Prof Norman Morrow, University of Wyoming  
Prof Barry Ninham  
Mr Jafar Qajar, UNSW  
Dr Ewa Radlinksa  
Mr Rodney Urquhart

---

## Atomic & Molecular Physics Laboratories



*Prof Stephen Buckman*

The Atomic and Molecular Physics Laboratories are engaged in a broad range of experimental, theoretical and computational studies of the interaction of electrons, positrons, and photons with atoms, molecules and solids, in order both to further our knowledge of fundamental physical and chemical processes, and to provide essential information that is critical to applications in other scientific disciplines, technology, and the environment.

The Laboratories research activities include Photon interactions: VUV/XUV laser spectroscopy, laser photodetachment and photofragment spectroscopy, computational molecular physics, computational planetary atmospheres, computational multiple photo ionization); Positron and electron interactions: low-energy positron and electron physics, materials studies with positrons, (e-2e) studies of gases, Electron Momentum Spectroscopy studies of gases and solids, and computational studies of charged particle interactions; and Quantum-Atom Optics: Bose Einstein condensation studies of helium atoms, atom manipulation, experimental tests of QED theory, and quantum-atom optics.

The Laboratories also host two Australian Research Council Centres of Excellence: the Australian Research Council Centre of Excellence for Quantum-Atom Optics (ACQAO), which plays a leading role in the study of the quantum properties of Bose-Einstein condensates and atom lasers via insights gained from quantum optics; and the Australian Research Council Centre of Excellence for Antimatter-Matter Studies (CAMS), whose experimental and theoretical program is based on the study of the interaction of positrons and electrons with matter.

---

## Academic Staff

### Professors and Heads of Laboratories

Brenton Lewis PhD DSc Adelaide, C Phys, FlInstP, FAPS, FOSA, FAIP (until June)  
Stephen Buckman BSc PhD Flinders, FAPS, FAIP, FlInstP (from July)

### Professors

Kenneth Baldwin MSc, DIC PhD London, FAIP, FlInstP, FOSA, FAPS  
Anatoli Kheifets BSc PhD St Petersburg, FAPS

### Senior Fellows

Stephen Gibson BSc PhD Adelaide  
Robert Robson BSc Queensland, DMBoM, PhD, FRMetS (until July)  
Maarten Vos MSc PhD Gröningen

### Fellows

Julian Lower BSc Adelaide, PhD Flinders (until August)  
Franklin Mills BSE Princeton, MS PhD Caltech  
James Sullivan BSc PhD  
Andrew Truscott BSc PhD Queensland

### Research Fellows

Steven Cavanagh BSc PhD Griffith  
Robert Dall BSc Queensland PhD  
Mitsuhiko Kono MSc KyotoIT, PhD GUAS Tokyo (until February)  
Igor Ivanov PhD DSc Moscow

### Postdoctoral Fellows

Casten Makochekanwa BSc Zimbabwe, MSc PhD Yamaguchi  
Eskender Mume BSc PhD Uppsala (ANSTO)  
Selvakumar Sellaiyan BSc PhD (ANSTO)  
Daniel Slaughter BSc PhD Flinders (until April)  
Michael Went BSc Newcastle, PhD Griffith (until August)

## General Staff

### Technical Officers

Stephen Battison AssocDip MechEng CIT  
Colin Dedman AssocDip Scilnst Bendigo CAE  
Ross Tranter

### Departmental Administrators

Deborah Bordeau SBM CIT (until June)  
Julia Wee BA Sydney, GCM MGSM (from September)

### CAMS Chief Operating Officer

Colin Taylor BSc, PhD (UWA) (until July)  
Adam Edwards LLB Nottingham, BSc Wollongong,  
GDM Western Sydney, MAppFin Charles Sturt (from August)

## Visiting Fellows

Prof Lewis Chadderton  
Em Prof Robert Crompton AM  
Dr Mitsuhiko Kono (from March)  
Prof Robert McEachran  
Em Prof Erich Weigold AM  
Prof Robert Robson (from November)

---

## Electronic Materials Engineering



*Prof Robert Elliman*

The Department of Electronic Materials Engineering (EME) conducts interdisciplinary research under four broad research themes:

- a) materials science and engineering;
- b) semiconductor device engineering;
- c) nanoscience and nanotechnology; and
- d) ion-solid interactions and ion-beam modification of materials.

The strength of its research program is underpinned by core experience and expertise in key aspects of semiconductor materials science, a team of outstanding early to mid-career researchers, enthusiastic graduate students, a strong network of national and international collaborators, and a comprehensive suite of state-of-the-art experimental facilities. The latter are complemented by facilities and staff funded by the NCRIS Australian National Fabrication Facility (ANFF), which is hosted by the Department.

---

## Academic Staff

### Professor and Head of Department

Robert Elliman BAppSci MAppSci RMIT, PhD DSc  
Salford, FAIP, FIP

### Distinguished Professor

Chennupati Jagadish MSc PhD Delhi, FAA, FTSE,  
FAIP, FInstP, FloN, FIEEE, FAPS, FOSA FSPIE,  
FECS, FIET, FAAAS, FAVS, ARCF, ALF

### Professor

Jim Williams BSc PhD UNSW, FAA, FAIP,  
FIEAust, FTSE, FAPS, FMRS

### Senior Fellows

Mark Ridgway BSc McM, MSc PhD Queens  
Hoe Tan BE Melbourne, PhD  
Yin Yin (Jennifer) Wong-Leung\* BSc Bristol, PhD

### Fellows

Jodie Bradby BAppSc RMIT, PhD  
Lan Fu MSc UTSC, PhD  
Patrick Kluth DipPhys Dusseldorf, PhD Jülich  
Jiandong Ye PhD Nanjing China (from June)

### Research Fellows

Leandro Araujo MSc PhD UFRGS Brazil  
Almamun Ashrafi MSc PhD Hokkaido  
Qiang Gao MS BSc NEU China, PhD  
Wen Lei MSc CUG, PhD CAS  
Qing Li BSc BNU China, MSc CAS, PhD HKU  
(until March)

### Postdoctoral Fellows

Satyam Bhuyan PhD Iowa State  
Suprakit Charnvanichborikarn PhD (from August)  
Bianca Haberl PhD (from December)  
Tae Hyun Kim PhD  
Patrick Parkinson MPhys DPhil Oxon (from July)  
Matias Rodriguez PhD  
Simon Ruffell MEng Surrey, PhD UWO Canada  
Avi Shalav PhD UNSW, MSc DipTchg Massey  
David Sprouster PhD (from March)  
Dinesh Venkatachalam PhD RMIT, MSc BITS  
India  
Hao Wang MSc Jinan, PhD South China Normal  
(from September)

*\*jointly with College of Medicine, Biology & Environment*

## General Staff

### Research Assistants

Kidane Belay MSc AAU Ethiopia, PhD  
Gregory Jolley PhD (from April)  
David Llewellyn (joint CMBE)

### Technical Officers

Michael Aggett AssocDipMechEng CIT  
Dane Kelly  
Bernie King ONC London  
Craig Saint

### Departmental Administrator

Scott Yates

### ARCNN Manager

Elizabeth Micallef (until September)

### ANFF Manager

Fouad Karouta BSc LUB, PhD Perpignan, PhD  
Montpellier

### ANFF Processing Engineers

Xijun Li PhD CAEP  
Jie Tian PhD CAEP  
Kaushal Vora PhD Latrobe

### ANFF Administrator

Jeffrey Kealley

## Visiting Fellows

A/Prof Ping Ping Chen, SITP  
Professor Neville Fletcher  
Dr Haroldo Hattori, ADFA  
Dr Stefan Decoster, KUL

---

## Laser Physics



*Prof Barry Luther-Davies*

2010 saw the celebrations of the 50th anniversary of the demonstration of the first laser by Theodore Maiman in May 1960. Members of the Laser Physics Centre (LPC) contributed to those celebrations through *Laserfest* events such as public lectures and special symposia at national conferences. In these 50 years lasers have become ubiquitous in science, in medicine and in industry. However, exciting new applications continue to emerge and members of the Laser Physics Centre are at the forefront of this research studying topics spanning fundamental and applied physics and engineering. Generally fundamental questions have been addressed in studies of the interaction of laser light with matter, in materials science, in ultra-high resolution spectroscopy of solids and the manipulation of quantum information. Research of more strategic nature includes work on photorefractive materials on the properties of solitons and other nonlinear waves, on nonlinear optical materials for photonics and quantum technology. Applied research includes the development of novel parametric devices, the production and application of novel waveguides, photonic crystals and other photonic devices. A major achievement during 2010 was the award of funding to two teams in LPC from the ARC Centres of Excellence scheme. From 2011-2017, funding will be received from the Centre for Ultra-high-bandwidth Devices for Optical Systems (CUDOS) for work on photonic devices, whilst work on quantum information processing will be funded from the Centre for Quantum Computing Technology. Research highlights for 2010 have included:

- work on laser trapping and guiding of airborne particles conducted in collaboration with the Non-Linear Physics Centre, was identified as in the 30 most exciting peer-reviewed papers in optics research in 2010;
- a heralded single photon source based on rare-earth doped crystals;
- spectroscopic investigations demonstrated the presence of electron-vibration effects within the electronic levels of the nitrogen-vacancy centre in diamond that give rise to novel optical properties;
- a high gain Tellurium dioxide based Erbium doped waveguide amplifier;
- the first high quality polarisation independent waveguide gratings and nanoimprinted arsenic trisulphide waveguides by nano-imprint lithography;
- broadband third harmonic generation in two-dimensional short-range ordered nonlinear photonic structures;
- experimental investigations on the Cerenkov-type second harmonic generation from a virtual beam and the cascaded nonlinear processes based on this mechanism; and
- high-Q 1D photonic crystal nanocavities in chalcogenide glass waveguides and demonstrated optical bistability.



## Academic Staff

### Professor and Head of Department

Barry Luther-Davies PhD S'ton, SIEE, FAIP, ARCFF

### Professors

Wieslaw Krolikowski MSc PhD Warsaw

Neil Manson PhD Aberdeen

Andrei Rode PhD Moscow

### Senior Fellows

Duk Yong Choi PhD Seoul

Eugene Gamaly PhD Moscow

Steve Madden PhD Imperial College

Matthew Sellars PhD

### Research Fellows

Douglas Bulla PhD Sao Paulo (until September)

Cyril Hnatovsky PhD Ottawa

Vladlen Shvedov PhD Taurida National, Ukraine

Rongping Wang PhD CAS

### Postdoctoral Fellow

Yan Sheng (from March)

## General Staff

### Technical Officers

John Bottega

Sukanta Debbarma

Romana Krolikowska

Craig Macleod AssocDip MechEng CIT

Anita Smith BSc Flinders

### Departmental Administrator

Belinda Barbour

## Visiting Fellows

Dr Graham Atkins

Dr Robbie Charters

Deng Feng Chen

Prof. Mark Humphrey

Dr Dax Kukulj

Dr David Pulford

Ms Joanna Olesiak, WUT, Poland

Dr Anna Samoc

Dr Marek Samoc

---

## Nonlinear Physics



*Prof Yuri Kivshar*

Nonlinear Physics are engaged in theoretical and experimental interdisciplinary research in a number of diverse areas unified by the general concepts of nonlinear physics and nonlinear photonics. Nonlinear Physics are defined by five major research directions and groups.

The experimental photonics group, led by Dr Dragomir Neshev, undertakes experimental study of linear and nonlinear properties of light propagation and localization in integrated and optically-induced photonic structures including waveguide arrays, photonic lattices, photonic crystals, as well as polychromatic light, nonlinear patterns and self-focusing. In 2010, the group's activities moved towards nonlinear plasmonics, nanophotonics, and the physics of optical metamaterials.

The theoretical photonics group, led by Dr Andrey Sukhorukov undertakes the study of different nonlinear optical systems. Currently, this involves the development of theoretical models and numerical simulations of the propagation of slow light in nonlinear photonic structures with close collaboration with the experimental group. More recently this included the development of novel concepts of light control in periodically modulated waveguide arrays and optomechanics.

The singular photonics group, led by Dr Anton Desyatnikov undertakes both theoretical and experimental studies of the light beams with angular momentum, optical vortices, optical polarization singularities, and vortex lattices. The new activities in 2010 are associated with the physics of light localization and propagation in nematic liquid crystals.

The nonlinear matter waves and quantum-atom optics group, led by Dr Elena Ostrovskaya, is involved in the development of novel theoretical models, analytical and numerical studies of matter waves and nonlinear atom-optics problems, cold atoms, Bose-Einstein condensates in optical lattices and magnetic waveguides, atom lasers, quantum optics of nonclassical and squeezed light. More recently, the group developed several novel concepts, including the novel application of the ratchet effect to control the dynamics of matter-wave solitons in oscillating potentials.

The research on composite structures and left-handed metamaterials, led by Dr Ilya Shadrivov is in directions involving the phenomenon of negative refraction, nonlinear metamaterials and left-handed superlattices, optical cloaking and transformation optics. Recently, the group developed novel concepts for tunable metamaterials, and supported them by a series of experimental observations.

## Academic Staff

### Professor and Head of Department

Yuri Kivshar BSc PhD Kharkov, FAIP, FOSA, FAA, FAPS, ARC Federation Fellow

### Senior Fellows

Andrei Lavrynenko PhD Belarus (September-October)

### Fellows

Anton Desyatnikov PhD Moscow

Dragomir Neshev MSc PhD Sofia

Elena Ostrovskaya MSc Moscow, PhD

Alexander Savin PhD Moscow (January and from November)

Andrey Sukhorukov MSc Moscow, PhD

### Research Fellows

Tristram Alexander PhD (until August)

Andrey Miroshnichenko PhD Dresden

David Powell PhD Monash

Ilya Shadrivov PhD

### Postdoctoral Fellows

Ivan Garanovich PhD

Yana Izdebskaya PhD Simferopol

Mikhail Lapin PhD Osnabruck (from December)

Ivan Maksymov PhD Kharkov (from September)

Michal Matuszewski PhD Warsaw

Aliaksandr Minovich PhD (from October)

\*Thomas White PhD

Zhiyong Xu PhD Barcelona

## General Staff

### Research Assistants

Artur Davoyan (from November)

Sangwoo Ha (March to July)

Aliaksandr Minovich (July to October)

### Departmental Administrator

Kathy Hicks AdvDipAcct CIT

## Visiting Fellows

Prof Sergey Dmitriev, RAS, Russia

Dr Volodymyr Lashkin, NASU

Dr Yuriy Rubo, UNAM, Mexico

Prof Jose Salgueiro, UVL, Spain

Prof Roland Schiek, UASR, Germany

Dr Rangcao Yang, Shanxi University

*\*jointly with Laser Physics*

---

## Nuclear Physics



*Prof David Hinde*

The Department of Nuclear Physics carries out fundamental studies in experimental Nuclear Physics as well as developing and applying nuclear techniques for basic studies in interdisciplinary research, much of it accelerator-based. The Heavy Ion Accelerator Facility, maintained, developed and operated by the Department, provides a range of energetic heavy-ion beams produced with a suite of ion sources and accelerated by a 15 million-volt tandem electrostatic accelerator and a superconducting linear accelerator. Beams are delivered to ten separate beam-lines, each dedicated to specialized detector instrumentation.

The facilities are used by staff and students of the Department as well as external users from other Australian universities and institutions, and international scientists from a number of laboratories. Scientists from the United Kingdom, for example, have formal access to the facilities through the ANU-STFC agreement.

The Department and its facilities constitute the main laboratory in Australia for accelerator-based research and training in Nuclear Physics. It contributes to undergraduate and postgraduate training at honours, masters and PhD levels, conducts expert workshops in radiation physics and accelerator techniques, and manages a Master of Nuclear Science by coursework degree that was instituted in 2007. To complement the research carried out on the local facilities, Department members collaborate with international scientists and utilize major experimental facilities overseas, gaining access through competitive processes.

Current nuclear research areas of interest cover nuclear spectroscopy and the study of exotic nuclear quantum states heavy-ion reaction dynamics including nuclear fusion and nuclear fission, and reactions of weakly-bound nuclei, and the study and use of hyperfine interactions for moment measurements and for elucidating nuclear science. Nuclear techniques and heavy-ion detection techniques are used in a range of materials science applications including materials modification and characterization. The technique of Accelerator Mass Spectrometry is applied to a broad range of topics including research and applications in archaeology, hydrology, climate change, soil erosion and trace isotopic analyses applied to environmental pollution studies, both nuclear and non-nuclear.

---

## Academic Staff

### Professor and Head of Department

David Hinde BSc Manchester, PhD, FAIP, FlInstP, FAA

### Professors

Mahananda Dasgupta MSc Rajasthan, PhD Bombay, FAIP

George Dracoulis PhD Melbourne, FAIP FAPS, Hon FRSNZ, FAA (retired June)

Keith Fifield MSc Auckland, PhD Penn, FAIP

Andrew Stuchbery PhD Melbourne, FAIP

### Fellows

Tibor Kibédi PhD Debrecen

Gregory Lane PhD

Stephen Tims PhD Melbourne

### Research Fellows

Rickard Du Rietz PhD Lund

Chengjian Lin BSc Sichuan, MSc GSNM, DSc CIAE (until October)

Cédric Simenel MSc Paris, PhD Caen

### Postdoctoral Fellows

Maurits Evers PhD (from October)

## General Staff

### Manager Accelerator Operations

Nikolai Lobanov BSc Moscow, PhD St Petersburg

David Weisser PhD Minn, FAIP

### Technical & IT Officers

John Bockwinkel, AdvDip MechEng CIT

Alan Cooper, AssDip MechEng CIT

Gareth Crook

Gordon Foote BSc Lond, PhD

Angus Gratton

Alan Harding

Justin Heighway, AssDip AppSci CIT

Tom Kitchen, AdvDip Mech Eng CIT

Lorenzo Lariosa

Alistair Muirhead

Dimitrios Tsifakis

### Departmental Administrator

Petra Rickman

## Visiting Fellows

Emeritus Prof George Dracoulis

Dr Tezer Esat, ANSTO

Dr Toshiyuki Fujioka, ANSTO

Dr Kushal Kalita, Gauhati University

Dr Heiko Timmers, ADFA

## Plasma Research Laboratory

Plasma Research Laboratory conducts research in two main areas: toroidal and space plasma.



*Prof John Howard*

Toroidal Plasma research embraces a multiplicity of activities associated with the physics of magnetised plasma, electromagnetics, remote sensing and inverse methods. The Department operates the Australian Plasma Fusion Research Facility which is centred on the H-1 heliac, an innovative plasma confinement device with flexible magnetic geometry.

As a national focus for fusion-science research, collaboration and education, the Facility accommodates the study of basic plasma physics, advanced magnetic configurations and remote measurement systems for future fusion power plants. Advanced data mining techniques and novel remote-sensing technologies pioneered on the heliac, are now being applied to the world's largest fusion devices in the US, Asia and Europe. This year saw the commencement of the 4-year, \$7M upgrade of heating, vacuum and diagnostic H-1 infrastructure.

The Plasma Theory and Modeling group focuses on the fundamental physics and the modelling of magnetic confinement fusion energy devices. The group has active research links with the Culham Centre for Fusion Energy, (England) Princeton Plasma Physics Laboratory (USA) and a number of other major fusion research institutes in both Europe and Asia. The Physics of Fluids group undertakes research into physics of fluid turbulence, nonlinear wave phenomena and rotating fluids, including applications to environmental and atmospheric physics, weather and climate. The BushLAN project aims at providing wireless broadband to remote areas using distributed MIMO (Multiple transmitter and multiple receiver) techniques on the band I TV spectrum. An important research focus is the development of protocols to handle universal synchronization on the distributed MIMO network.



*Dr Christine Charles*

Space Plasma, Power and Propulsion research conducts work on both basic and applied plasma physics. The core research areas involve experimental and theoretical aspects of expanding radiofrequency helicon plasmas applied to space science, space propulsion and hydrogen fuel cells. The discovery of current free double layers and of the Helicon Double Layer Thruster led to a contract with EADS/ASTRIUM, Europe's largest Space company and an Australian Research Council Linkage grant. Work includes thrust measurement, prototype space qualification and plasma modeling. Furthermore, the laboratory double layers are being applied to understanding space plasma physics such as the magnetic funnels of the solar corona and the Earth's aurora. A large contract has been signed with LAM Research Corporation in Silicon Valley for the further development of an SP3 invention to be used for the next generation of plasma etching systems for microelectronics. This opens a new and exciting career path for students and researchers alike.

---

## Academic Staff

### Professor and Head, Toroidal Plasma

John Howard BSc PhD Sydney, FlinstP

### Head, Space Plasma, Power and Propulsion

Christine Charles BEng MSc Rennes, PhD Hab Orléans, BMus

### Director, Australian Plasma Fusion Research Facility

Boyd Blackwell BSc PhD Sydney

### Professors

Roderick Boswell BSc Adelaide, PhD Flinders, FTSE, FAPS

Robert Dewar MSc Melbourne, PhD Princeton, FAIP, FAPS, FAA

Michael Shats MSc KPI, PhD GPI Moscow

### Senior Fellows

Boyd Blackwell BSc PhD Sydney

Christine Charles BEng MSc Rennes, PhD Hab Orléans, BMus

### Fellows

Gerard Borg BSc PhD Sydney

Matthew Hole BSc BE PhD Sydney

### Research Fellows

Cormac Corr PhD Belfast

Shantanu Padhi PhD Delhi

Hua Xia, MSc Chongqing, PhD

Shuiliang Ma PhD (from February)

### Postdoctoral Fellow

Gregory von Nessi BSc Massachusetts PhD

Michael Fitzgerald PhD (from June)

## General Staff

### Research Engineer

Horst Punzmann BSc Regensburg, PhD

### Technical Officers

Peter Alexander

Mark Gwynneth

David Pretty PhD

John Wach BAppSci CAE Ball, GradDipEI CCAE

### Departmental Administrator

Maxine Hewitt BA UC

## Visiting Fellows

Dr Sudeep Bhattacharjee, IIT

Dr Frank Detering

Dr Andreas Fhager, CUT

Emeritus Prof Sydney Hamberger

Dr Jay Larson, ANL

Dr Kazunori Takahashi, Iwate University

---

## Quantum Science



*Prof David McClelland*

The experimental research programs in the Department of Quantum Science cover a broad range of activities linked by the quest to investigate the interface between the quantum and classical realms, to probe the quantum mechanical limits to measurement, to develop precision measurement using quantum sources, and to use these concepts in technological applications. These activities are pursued in three programs.

*Quantum Optics:* The quantum optics group aims to exploit quantum mechanical properties of laser field for metrological and information technology applications. A new centre will be

*Atom Optics:* The atom optics program has focused on the development of the atom laser as a useful tool for investigations in fundamental physics and in precision measurement. In 2009, the group developed a stable atomic local oscillator and quantum noise limited atom detection with the aim of producing and studying the first squeezed atom laser and making measurements with atoms at sensitivities that exceed the atomic shot noise limit. The atom optics group has recently added a major new research direction, to use classical and squeezed atom sources to develop high precision, field deployable, inertial sensors for rotation, acceleration, gravity and its gradients.

*Gravitational Wave Detection:* Gravitational wave detectors need to achieve a sensitivity to length change to better than 1 part in 10<sup>23</sup>! At this sensitivity, giant kilometer scale laser interferometers are limited by quantum noise on the readout laser over a large part of their signal band. The experimental gravity group is developing quantum optical techniques to reach and beat these limits.

The Centre for Gravitational Physics (CGP) undertakes research on many aspects of gravity, from mathematical relativity to searching for gravitational waves to developing technology for future generations of ground and space based gravitational wave detectors. CGP is also very active in exploiting spin offs from precision metrology into areas such as fibre sensing for oil and gas monitoring and satellite separation sensing for Earth Observations from Space. In 2010, the CGP won an Australia Space Research Program grant to develop technology for the next Gravity Recovery and Climate Experiment space mission.



## Academic Staff

### Professor and Head of Department

David McClelland MSc UWA, PhD Otago

### Professors

Hans Bacher PhD Hannover (until August)

John Close PhD Berkeley

Ping Koy Lam BSc Auckland, PhD

Susan Scott BSc Melbourne, PhD Adelaide

### Senior Fellows

Joseph Hope PhD

Craig Savage PhD Waikato

### Fellows

Nicholas Robins PhD

Daniel Shaddock PhD

### Research Fellows

Benjamin Buchler PhD

Vincent Daria PhD

Andre de Carvalho PhD UFRJ Brazil

Cristina Figl PhD Hannover (until September)

Mattias Johnsson PhD Canterbury

Thomas Symul PhD CNET

Bram Slagmolen PhD

Jiri Janousek PhD DTU Denmark

### Postdoctoral Fellows

Julien Bernu PhD ENS France

Jong Chow BSEE Vermont, PhD

Boris Hage PhD LUH Germany

Ra Inta PhD UNSW

John Miller PhD Glasgow

## General Staff

### Head Technical Officer

Andrew Papworth

### Technical Officers

Neil Devlin

James Dickson

Shane Grieves

Neil Hinchey

Paul McNamara

Paul Tant

### Departmental Administrators

Huma Cheema (until March)

Laura Walmsley (from May)

### Assistant Administrator

Gaye Burrato

## Visiting Fellows

Dr Mark Andrews

Prof Hans Bacher (from August)

Dr Peter Riggs

Prof John Sandeman

---

## Theoretical Physics



*Prof Murray Batchelor*

The Department of Theoretical Physics is one of the university's founding departments. The core research areas involve theoretical aspects of mathematical physics, condensed matter physics and optical sciences.

Research in the mathematical physics group is centred on the two related areas of string theory and integrable models. The string theory team is led by Professor Peter Bouwknegt. The main area of research focuses on the mathematical structures underlying string theory, in particular on duality symmetries and generalizations of geometry. Dr David Ridout from University of Montreal joined the Department in October on an ARC Research Fellowship to work on conformal field theory.

The integrable model team is led by Professor Murray Batchelor, Professor Vladimir Bazhanov, Dr Xiwen Guan and Dr Vladimir Mangazeev. Research is based on the development of theoretical models and methods of analysis for the exact physical description of fundamental interacting systems in statistical mechanics and quantum field theory. It includes the study of phase transitions and magnetic ordering in low-dimensional spin systems and cold atomic gases, along with the development of new approaches and applications in quantum geometry and computational many-body physics.

Staff and students were heavily involved in STATPHYS 24, the XXIV International Conference on Statistical Physics of the International Union for Pure and Applied Physics (IUPAP), held in Cairns on 19-23 July.

The optical sciences group is led by Professors Nail Akhmediev and John Love and involves studies in nonlinear optics and soliton theory. The group develops basic theory of solitons for optical systems that includes modern all-optical information transmission lines and ultra-short pulse lasers. The group is strongly linked to experimental photonics groups within the School, across campus, and to international research laboratories. Professors Akhmediev's group gained considerable publicity for their work on rogue waves.

Research activity of Adjunct Professor Mukunda Das includes the theory of electron transport and noise in mesoscopic systems, high-temperature superconductivity, density functional theory of disordered systems and strongly correlated electrons.

## Academic Staff

### Professor and Head of Department

Murray Batchelor BSc UNSW, PhD, FAIP, FAustMS, FInstP

### Professors

Nail Akhmediev MS PhD DSc Moscow, FOSA

Vladimir Bazhanov PhD Serpukhov FAA

Pier Bouwknecht MSc Utrecht, PhD Amsterdam, FAIP, FAustMS

John Love MA Cambridge, MA DPhil DSc Oxford

### Fellows

Adrian Ankiewicz BSc BE UNSW, PhD

Xi-Wen Guan BSc Qufu, MSc Sichuan, PhD Jilin

Vladimir Mangazeev MSc Moscow, PhD Serpukhov

David Ridout BSc, MSc UWA PHD Adelaide (from October)

### Postdoctoral Fellow

David Baraglia BSc Adelaide, PhD Oxford

## General Staff

### Departmental Administrator

Juan (Lucia) Lu (from February)

## Visiting Fellows

Professor Helen Au-Yang, Oklahoma State University

Dr Rowena Ball

Adjunct Professor Mukunda Das

Dr Michael Hall

Professor Jacques Perk, Oklahoma State University

Dr Brian Robson

Dr Lindsay Tassie

Professor Paul Wiegmann, University of Chicago

Professor JianBo Zhang, Zhejiang University