RESEARCH DEPARTMENTS

The Research School of Physics and Engineering is comprised of nine research departments.

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

A brief description of each department is detailed in the following pages as well as a list of staff dedicated to that area. All students and visiting students are listed on pages 20 and 21.

Centres and networks are often formed by teams of scientists undertaking a common research activity and can span across various national and international institutions. Detailed reporting of these activities in most cases, will be available in their respective Annual Reports. For a full list of these associations, see page 22.

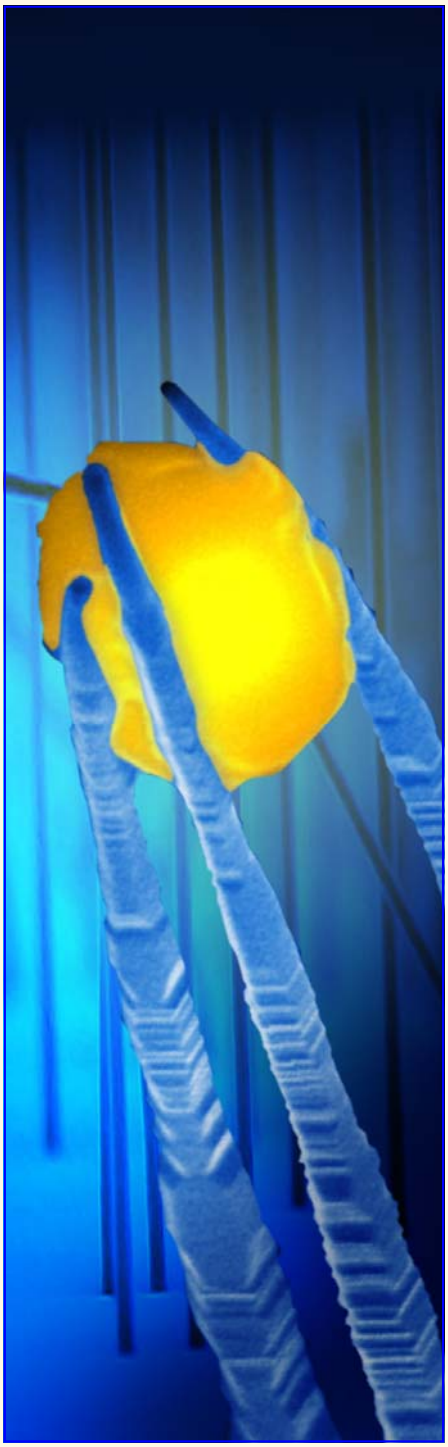

Photo by: Tim Burgess

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 part of the group'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 BSc PhD, ARC Future Fellow (from June)
Mark Knackstedt BSc Columbia, PhD Rice (until June)

Professors
Stephen Hyde BSc PhD Monash, ARC Federation Fellow
Mark Knackstedt BSc Columbia, PhD Rice
David Williams BSc Sydney, PhD Cambridge

Senior Fellows
Tomaso Aste DipHons Genova, PhD Milan
Vince Craig BSc PhD, ARC Future Fellow
Tim Senden BSc PhD
Adrian Sheppard BSc Adelaide, PhD

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

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

General Staff

Senior Software Designer
Paul Veldkamp BSc BEc

Technical Officers
Anthony Hyde AssocIE
Tim Sawkins

Departmental Administrator
Margo Davies DipDent Tasmania

Administrative Officer
Janet James

Visiting Fellows

Dr Christoph Arns, University of New South Wales
Dr Ji-Youn Arns, University of New South Wales
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, University of NSW
Dr Ewa Radlinksa
Mr Rodney Urquhart

Atomic and Molecular Physics Laboratories

Professor Brenton Lewis

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:

- photons (VUV/XUV laser spectroscopy, laser photodetachment and photofragment spectroscopy, computational molecular physics, computational planetary atmospheres, computational multiple photo ionization);
- electrons/positrons (low-energy electron and positron physics, materials studies with positrons, e-2e studies of gases, EMS studies of gases and solids); and
- Quantum-Atom Optics (He BEC studies, atom manipulation, experimental tests of led 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 electrons and positrons with matter.

Academic Staff

Professor and Head of Laboratories
Brenton Lewis PhD DSc Adelaide, C Phys, FInstP, FAPS, FOSA, FAIP

Professors
Kenneth Baldwin MSc, DIC PhD London, FAIP, FInstP, FOSA, FAPS
Stephen Buckman BSc PhD Flinders, FAPS, FAIP, FInstP
Anatoli Kheifets BSc PhD St Petersburg, FAPS

Senior Fellows
Stephen Gibson BSc PhD Adelaide
Robert Robson BSc Queensland, DipMet BoM, PhD, FRMetS (joint appointment with JCU)
Maarten Vos MSc PhD Gröningen

Fellows
Julian Lower BSc Adelaide, PhD Flinders
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
Igor Ivanov PhD DSc Moscow
Mitsuhiko Kono MSc KyotoIT, PhD GUAS Tokyo

Postdoctoral Fellows
Susan Bellm BSc PhD Flinders (until February)
Casten Makochekanwa BSc Zimbabwe, MSc PhD Yamaguchi
Subhendu Mondal MSc PhD Banaras (until April)
Eskender Mume BSc PhD (located at ANSTO)
Daniel Slaughter BSc PhD Flinders
Michael Went BSc Newcastle, PhD Griffith

General Staff

Technical Officers
Stephen Battisson AssocDip MechEng CIT
Graeme Cornish AssocDip MechEng CIT (until February)
Colin Dedman AssocDip SciInst Bendigo CAE
Ross Tranter

Departmental Administrator
Deborah Bordeau CertIV SBM CIT

CAMS Chief Operating Officer
Colin Taylor

Visiting Fellows

Adjunct Professors
Lewis Chadderton BSc DSc Durham, MA PhD Cambridge, C Phys, FInstP, FAIP
Robert McEachran MSc PhD UWO, C Phys, FInstP

Emeritus Professors
Robert Crompton AM FAA FAIP FAPS FInstP
Erich Weigold AM FAA FTSE FAPS

Dr Dennis Mueller, University of Texas

Electronic Materials Engineering

Professor Robert Elliman

The Department of Electronic Materials Engineering undertakes world-class interdisciplinary research into the growth, structure, properties, processing and applications of electronic materials and related structures and devices. The Department's diverse research program is underpinned by core expertise, a strong network of national and international collaborators, and a comprehensive suite of state-of-the-art equipment and facilities.

The Department also hosts two Australian Research Council networks, the Australian Research Council Nanotechnology Network (ARCNN) and the Australian Research Network for Advanced Materials (ARNAM) as well as the ACT node of the NCRIS Australian National Fabrication Facility (ANFF).

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, FIoN, FIEEE, FAPS, FOSA FSPIE, FECS, FIET, FAAAS, FAVS, ARCFF, ALF

Professor

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

Senior Fellows

Ying Chen BSc CAS, MSc Tsinghua, PhD Paris (until January)
Mark Ridgway BSc McM, MSc PhD Queens
Hoe Tan BE Melbourne, PhD

Fellows

Jodie Bradby BAppSc RMIT, PhD
Lan Fu MSc UTSC, PhD
Patrick Kluth DipPhys Dusseldorf, PhD Jülich
Jenny Wong-Leung BSc Bristol, PhD

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 (from September)

Postdoctoral Fellows

Raquel Giulian PhD (from May)
Gregory Jolley PhD (from April)
Matias Rodriguez PhD (from November)
Simon Ruffell MEng Surrey, PhD UWO Canada
Avi Shalav PhD UNSW, MSc DipTchg Massey
Qing Li BSc BNU China, MSc CAS, PhD HKU (until September)
Dinesh Venkatachalam PhD RMIT, MSc BITS India

General Staff

Research Assistants
Kidane Belay MSc AAU Ethiopia, PhD
David Llewellyn

Technical Officers
Michael Aggett AssocDipMechEng CIT
Dane Kelly (from June)
Bernie King ONC London
Craig Saint

Departmental Administrator
Scott Yates

ARCNN Manager
Elizabeth Micallef

ARNAM Manager
Belinda Barbour

ANFF Manager
Fouad Karouta BSc LUB, PhD Perpignan, PhD Montpellier (from March)

ANFF Processing Engineers
Xijun Li PhD CAEP (from February)
Jie Tian PhD CAEP (from August)
Kaushal Vora PhD Latrobe (from May)

ANFF Administrator
Jeffrey Kealley (from April)

Visiting Fellows

Prof Ying Chen, Deakin University
Dr Arijit Chowdhuri, Delhi University, India
Professor Neville Fletcher
Dr Naoki Fujisawa, IP Australia
Dr Haroldo Hattori, University of New South Wales
Dr Sung Kim, Kyung Hee University, Korea
Dr Malin Premaratne
Dr Giancarlo Rizza, Ecole Polytechnique, France
Dr Rajnish Singh, Wriota Pty Ltd
Dr Dinesh Kumar Sood, RMIT University

Laser Physics

Professor Barry Luther-Davies

Laser Physics are engaged in laser-based research on topics spanning fundamental and applied physics and engineering. Generally fundamental questions have been addressed in studies of the interaction of intense laser light with matter, nonlinear processes and ultra-high resolution spectroscopy of solids.

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 information. Applied research includes the development of novel parametric devices, the production and application of novel waveguides, photonic crystals and other photonic devices.

Research highlights for 2009 have included:

- a quantum memory for light with an efficiency of 70%, the first quantum memory to pass the critical threshold of 50% efficiency enabling it to store arbitrary quantum states;
- an on-chip gain of ≈ 10dB in compact Er-doped TeO_2 waveguides;
- production of high quality Bragg gratings in polysiloxane waveguide via nano-imprinting and highly nonlinear waveguides in chalcogenide glass by hot nano-embossing;
- an RF spectrum analyzer with a bandwidth >3THz using a nonlinear chalcogenide glass waveguide;
- dispersion compensation in high bit rate fiber communications system using optical phase conjugation in a nonlinear chalcogenide glass waveguide;
- discovery of a new transient state in ultrafast laser-irradiated bismuth crystal by dual-beam optical probing;
- development of a new optical trap based on optical vortices demonstrating record long touch-free transport of particles and glass shells in air over the distance up to 1500 mm,
- a new mid-IR pulsed source capable of single pulse ablation of polymers;
- discovery of third harmonic generation via cascading is a disordered quadratic nonlinear medium;
- a new laser-speckle multiple-trapping scheme based on a mono-directional laser beam; and
- an fs-laser pulses irradiating photorefractive crystals create the modification of refractive index through a transient phase in a drastically different way when compared to long-pulse and CW laser irradiation.

Research in photonics has been supported in part by the Australian Research Council Centre of Excellence for Ultrahigh Bandwidth Devices for Optical Systems (CUDOS).

Academic Staff

Professor and Head of Department

Barry Luther-Davies BSc PhD S'ton, SIEE, FAIP, ARCFF (until October)

Professors

Wieslaw Krolikowski MSc PhD Warsaw
Neil Manson MSc PhD Aberdeen

Senior Fellows

Duk Yong Choi PhD Seoul
Eugene Gamaly PhD DSc Moscow
Steve Madden PhD Imperial College
Andrei Rode MSc PhD Moscow
Anna Samoc MSc PhD Wroclaw (October-December)
Marek Samoc PhD DSc Wroclaw (until September)
Matthew Sellars BSc PhD (from June)

Research Fellows

Douglas Bulla PhD Sao Paulo
Cyril Hnatovsky (from September)
Vladlen Shvedov
Rongping Wang PhD CAS

Postdoctoral Fellow

Malte Duering

General Staff

Technical Officers

John Bottega
Sukanta Debbarma (from September)
Tony Kerr (until February)
Romana Krolikowska
Craig Macleod AssocDip MechEng CIT
Anita Smith BSc Flinders

Departmental Administrator

Belinda Barbour

Visiting Fellows

Dr Dax Kukulj
Mr Raju Malinger
Dr Katarzyna Matczyszyn, Wroclaw University of Technology, Poland
Ms Joanna Olesiak, Wroclaw University of Technology, Poland
Dr Anna Samoc
Dr Marek Samoc

Nonlinear Physics

Professor Yuri Kivshar

Nonlinear Physics are engaged in theoretical and experimental interdisciplinary research in a number of diverse topics unified by the general concepts of nonlinear physics and nonlinear photonics. They continue to play an important role in two Australian Research Council Centres of Excellence: the Australian Research Council Centre of Excellence for Ultrahigh bandwidth Devices for Optical Systems (CUDOS); and the Australian Research Council Centre of Excellence for Quantum-Atom Optics (ACQAO). Nonlinear Physics also host a Student Chapter of the Optical Society of America. Nonlinear Physics are defined by five major research directions.

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, polychromatic light, nonlinear patterns and self-focusing, and more recently, singular optics and vortices. In 2009, the group's activities moved towards the nonlinear plasmonics and the physics of optical metamaterials.

The theoretical photonics group, led by Dr Andrey Sukhorukov undertakes the study of 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 such as light transmission in complex and quasi-periodic media, light shaping and control in periodically modulated waveguide arrays. The majority of the group's projects are linked to the activities of CUDOS.

The singular photonics group, led by Dr Anton Desyatnikov undertakes both theoretical and experimental studies of the complex light with angular momentum, optical vortices, optical polarization singularities, and vortex lattices. The new activities in 2009 are associated with the development of a novel type of a double-vortex trap and the three-dimensional guiding and controlling of adsorbing nanoclusters in air, as well as the physics of light localization on 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, this group demonstrated experimentally the first nonlinear metamaterial operating at microwaves. The group developed novel types of metamaterials including the structures with nonlinear electric response and backward-wave transmission lines.

Academic Staff

Professor and Head of Department
Yuri Kivshar BSc PhD Kharkov, FAIP, FOSA, FAA, FAPS, ARC Federation Fellow

Senior Fellows
Sergey Gredeskul PhD DSc Kharkov (June-August)
Andrei Lavrynenko PhD Belarus

Fellows
Anton Desyatnikov PhD Moscow
Dragomir Neshev MSc PhD Sofia
Elena Ostrovskaya MSc Moscow, PhD
Alexander Savin PhD Moscow (from October)
Andrey Sukhorukov MSc Moscow, PhD

Research Fellows
Tristram Alexander PhD
Konstantin Bliokh PhD Kharkov (to April)
Chaohong Li PhD Beijing
Andrey Miroshnichenko PhD Dresden
David Powell PhD Monash
Ilya Shadrivov PhD
Vladlen Shvedov PhD Simferopol (to April)

Postdoctoral Fellows
Ivan Garanovich PhD
Rumen Iliew PhD Jena (June-November)
Yana Izdebskaya PhD Simferopol
Mikhail Lapin PhD Osnabruck (May-August)
Michal Matuszewski PhD Warsaw
Zhiyong Xu PhD Barcelona

General Staff

Research Assistants
Jasur Abdullaev (March to June)
Daniel Buccoliero (May to July)

Departmental Administrator
Kathy Hicks AdvDipAcct CIT

Visiting Fellows

Dr Volodymyr Lashkin, National Academy of Sciences, Ukraine
Dr Jose Salguerio, Universidade de Vigo, Spain
Dr Rangcao Yang, Shanxi University, China

Nuclear Physics

Professor 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 electrostataic accelerator and a superconducting linear accelerator. Beams are delivered to ten separate beam-lines, each dedicated to specialised 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 (formerly the ANU-EPSRC 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 post-graduate 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 utilise 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 the study and use of hyperfine interactions for moment measurements and for elucidating nuclear structure. Both nuclear techniques and heavy-ion detection techniques are used in a range of materials science applications including materials modification and characterisation, while the technique of Accelerator Mass Spectrometry is applied extensively. It covers a broad range of topics with applications and basic research 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
George Dracoulis BSc PhD Melbourne, FAIP, FAPS, Hon FRSNZ, FAA (until June)
David Hinde BSc Manchester, PhD, FAIP, FInstP, FAA (from July)

Professors
Aidan Byrne MSc Auck, PhD, FAIP
George Dracoulis BSc PhD Melbourne, FAIP, FAPS, Hon FRSNZ, FAA (from July)
Keith Fifield MSc Auckland, PhD Penn, FAIP
David Hinde BSc Manchester, PhD, FAIP, FInstP, FAA (until June)

Senior Fellows
Mahananda Dasgupta MSc Rajasthan, PhD Bombay, FAIP
Andrew Stuchbery BSc PhD Melbourne, FAIP

Fellows
Tibor Kibédi PhD Debrecen
Gregory Lane BSc PhD
Anna Wilson BSc Bristol, PhD Liverpool

Research Fellows
Rickard Du Rietz MSc PhD Lund
Chengjian Lin BSc Sichuan, MSc GSNM, DSc CIAE (from April)
Cédric Simenel MSc Paris PhD Caen (from October)
Stephen Tims BSc PhD Melbourne

Postdoctoral Fellows
Sanjay Chamoli MSc BEd HNB Garhwal, PhD Chandigarh (until July)
Alexis Diaz-Torres MSc Havana, PhD Giessen (until March)
Toshiyuki Fujioka MSc Osaka, PhD (until December)

General Staff

Accelerator Research and Operations Managers
David Weisser MSc, PhD Minn, FAIP
Nikolai Lobanov BSc Moscow, PhD St Petersburg

Computer Manager Heavy Ion Facility
Dimitrios Tsifakis (from July)

Technical Officers
John Bockwinkel, AdvDip MechEng CIT
Alan Cooper, AssDip MechEng CIT
Gordon Foote BSc Lond, PhD
Alan Harding
Justin Heighway, AssDip AppSci CIT
John Kennedy (until August)
Tom Kitchen
Lorenzo Lariosa
Alistair Muirhead

Departmental Administrator
Petra Rickman

Visiting Fellows

Dr Wolf-Dietrich Zeitz, Hahn-Metner Institute
Dr Kushal Kalita, Gauhati University
Dr Sanjay Kumar Chamoli, Birla Institute of Technology & Science
Dr Ray Spear

Plasma Research Laboratory

The Plasma Research Laboratory is comprised of two main areas of research:

Professor John Howard

Toroidal Plasma Research embraces a wide range of pursuits associated with the physics of magnetised plasma, electromagnetics, remote sensing and inverse methods. The group operates the Australian Plasma Fusion Research Facility (directed by Dr Boyd Blackwell) which is centred on theH-1 heliac, an innovative plasma confinement device with flexible geometry allowing exploration of basic plasma physics, advanced magnetic configurations and remote measurement systems for fusion power plants.

The facility is a focus for research, collaboration and education. Data mining techniques developed on H-1, are now being applied to the world's largest stellarators to unravel the mode structure of plasma instabilities. The laboratory has also pioneered a number of unique and powerful optical instruments which are installed at various fusion laboratories around the world, and which also find application in industry. The H-1 Facility was awarded a grant of $7M as part of the Super Science Initiative announced in the federal budget. This funding will be used to upgrade heating, vacuum and diagnostic infrastructure during 2010-2014.

The Physics of Fluids group led by Professor Michael Shats undertakes research into physics of fluid turbulence, nonlinear wave phenomena and rotating fluids, including applications to environmental physics, weather, climate and plasma physics.

The BushLAN project led by Dr Gerard Borg is aimed 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 synchronisation on the distributed MIMO network.

Dr Christine Charles

The **Space Plasma, Power and Propulsion** group conducts work on both basic and applied plasma physics and was lead by Dr Christine Charles from November this year. 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. Experimental work includes thrust measurement, prototype optimisation and plasma detachment.

In addition, the group has a major program to simulate and model the double layer phenomena observed in the laboratory plasma. 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. Other research on space plasma physics includes studying high-beta plasmas and wave-plasma interactions.

Academic Staff

Heads of Department
Boyd Blackwell BSc PhD Sydney (until February)
Roderick Boswell BSc Adelaide, PhD Flinders, FTSE, FAPS (until October)
Christine Charles BEng MSc Rennes, PhD Hab Orléans, BMus (from November)
John Howard BSc PhD Sydney, FInstP (from February)

Professors
Roderick Boswell BSc Adelaide, PhD Flinders, FTSE, FAPS
John Howard BSc PhD Sydney, FInstP
Michael Shats MSc KPI, PhD GPI Moscow

Senior Fellows
Boyd Blackwell BSc PhD Sydney
Christine Charles BEng MSc Rennes, PhD Hab Orléans, BMus

Fellow
Gerard Borg BSc PhD Sydney

Research Fellows
Cormac Corr PhD Belfast
Frank Detering BSc Oldenburg, PhD Saskatchewan (until April)
Ahmed Diallo PhD Iowa (to September)
Shantanu Padhi PhD Delhi
Hua Xia, MSc Chongquing, PhD

Postdoctoral Fellow
Gregory von Nessi BSc Massachusetts PhD (from April)

General Staff

Research Engineer
Horst Punzmann BSc Regensburg, PhD

Technical Officers
Peter Alexander
Ananda Galagali Raghuttam
Mark Gwynneth
David Pretty PhD
John Wach BAppSci CAE Ball, GradDipEl CCAE

Departmental Administrator
Leanne Roberts (until April)
Maxine Hewitt BA UC (from May)

Visiting Fellows

Dr Frank Detering
Dr Haibin Li

Quantum Science

Professor 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 the quantum mechanical properties of laser field for metrological and information technology applications. The group is a world pioneer in quantum state engineering and quantum control systems. Highlights n 2009 include: a Nature paper on the experimental demonstration of a new scheme for optical memory and coherent optical pulse sequencer; a Review of Modern Physics paper and a Colloquium on Einstein-Podolsky-Rosen entanglement; and the first entanglement of co-propagating optical modes that opens ways to more powerful quantum protocols for quantum communication and logic. QuintessenceLabs Pty Ltd, a spin-off company of the department's quantum optics research, was firmly established with a home in the Department.

- ***Atom Optics:*** The atom optics program has focussed 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^{23}! At this sensitivity, giant kilometre 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 then beat these limits, including, in 2009, a quantum non-demolition readout scheme.

  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 2009, the CGP led Australia into a partnership with the US Advanced LIGO Project.

The Department also hosts the largest node of the Australian Research Centre of Excellence for Quantum-Atom Optics (ACQAO).

Academic Staff

Professor and Head of Department
David McClelland BSc MSc UWA, PhD Otago

Professors

Hans Bachor Dipl Phys PhD Hannover
John Close BSc, PhD Berkeley
Ping Koy Lam BSc Auckland, MSc PhD

Senior Fellows

Joseph Hope BSc PhD
Ian Littler BSc, PhD Kaiserslauten
Craig Savage BSc PhD Waikato
Susan Scott BSc Melbourne PhD Adelaide
Daniel Shaddock BSc PhD

Research Fellows

Benjamin Buchler BSc PhD
Cristina Figl Dipl Phys PhD Hannover
Nick Robins BSc PhD
Thomas Symul BSc ENS PhD CNET LAB

Postdoctoral Fellows

Julien Bernu BSc PhD ENS
Andre de Carvalho MSc PhD UFRJ
Jong Chow BSEE Vermont, PhD
Ra Inta BSc PhD UNSW
Mattias Johnsson BSc PhD Canterbury
Bram Slagmolen BSc PhD
Jiri Janousek BSc Palacky PhD DTU

General Staff

Head Technical Officer
Andrew Papworth

Technical Officers
Neil Devlin
James Dickson
Shane Grieves
Neil Hinchey
Paul McNamara
Paul Tant

Departmental Administrator

Huma Cheema

Administrative Officer
Gaye Burrato

Visiting Fellows

Professor John Sandeman
Dr Mark Andrews

Theoretical Physics

Professor 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, plasmas and fluids, condensed matter physics and optical sciences. The Department was also host to the Australian Research Council Research Network on Complex Open Systems (COSNet) which terminated in June this year.

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.

The integrable model team is led by Professors Murray Batchelor and Vladimir Bazhanov. 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 and the development of new approaches and applications in quantum geometry.

The plasmas and fluids group is led by Professor Robert Dewar. Much of the research is focused on the fundamental physics and the modelling of magnetic confinement fusion energy devices. The group has active research links with the Commonwealth Scientific and Industrial Research Organisation (CSIRO), Princeton Plasma Physics Laboratory and the United Kingdom Atomic Energy Authority (UKAEA), among others.

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.

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
Pier Bouwknegt MSc Utrecht, PhD Amsterdam, FAIP, FAustMS
Robert Dewar MSc Melbourne, PhD Princeton, FAIP, FAPS, FAA
John Love MA Cambridge, MA DPhil DSc Oxford

Senior Fellow

Matthew Hole BSc BE PhD Sydney

Fellows

Adrian Ankiewicz BSc BE UNSW, PhD
Rowena Ball BSc PhD Macquarie (until April)
Xi-Wen Guan BSc Qufu, MSc Sichuan, PhD Jilin
Vladimir Mangazeev MSc Moscow, PhD Serpukhov

Research Fellows

Ashwin Pande BSc Mumbai, MS PhD IISc Bangalore, MA PhD Maryland (until March)

Postdoctoral Fellow

Dr Raymond Vozzo (July-October)

General Staff

Departmental Administrator

Caroline Ashlin (until October)
Charlotte Litherland

Visiting Fellows

Professor Helen Au-Yang, Oklahoma State University
Dr Rowena Ball
Dr Kevin Bryant
Adjunct Professor Mukunda Das
Dr Michael Hall
Dr Ali Immaapur, Tarbiat Modares University, Iran
Dr Kailash Kumar
Dr Walter Larson
Professor Jacques Perk, Oklahoma State University
Dr Brian Robson
Dr Zaidong Sun, Qingdao University, China
Dr Lindsay Tassie

Students *

Abdullaev, Jasur
Afra, Boshra
Ahlefeldt, Rose
Altin, Paul
Armstrong, Seiji
Barry, Richard
Barter, Thomas
Bartholomew, John
Beavan, Sarah
Bennet, Francis
Bently, Chris
Bertram, Jason
Botman, David
Brown, Michael
Burgess, Timothy
Byrne, David
Byron, Lesa
Caballero-Benitez, Santiago
Caradonna, Peter
Castle, Toen
Chan, Keng
Chang, Wonkeun
Charnvanichborikarn, Supakit
Chen, Anderson
Chrzanowski, Helen
Chua, Sheon
Collin, Gabriel
Cox, Wesley
Cubis, Alex
Creese, Matthew
Dann, Rodney
Davoyan, Artur
Debs, John
Dedrick, James
Deniz, Vivianne
Dennis, Graham
Deshmukh, Sarita
Deshpande, Shriniwas
Devine, Natasha
Devlin, Alan
Dixon, Sam
Doering, Daniel
Dudalev, Mikhail
Dugne, Julien
East, Michael
Edwards, Michael
Evans, Myfanwy
Evans, Robert
Evers, Maurits
Farnell, James
Gai, Xin
Ganesan, Rajesh
Garretson, Joshua
Gibson, Ashley
Graham, Tony
Grosse, Nicolai
Ha, Sangwoo
Haberl, Bianca
Han, Ting
Hannam, Kirsty
Haskey, Shaun
Heays, Alan
Hedges, Morgan
Heenan, Kimberley
Higginbottom, Daniel
Hodgman, Sean
Holmes, Ryan
Hoo, Weeteck
Hosseini, Mahdi
Howard, Shaun
Hudspeth, Jessica
Hush, Michael
Hussain, Zohair
Jeppesen, Matthew
Jones, Adric
Joyce, Hannah
Kalinowski, Ksawery
Kang, Jung-Hyun
Kels, Andrew
Kim, Jong
Kim, Tae Hyun
Kim, Min-Chul
Kuffner, Peter
Kumar, Munish
Lade, Steven
Lafleur, Trevor
Lal, Rajeev
Lam, Timothy
Lebedeva, Evgenia
Lee, Jen-Yee
Lee, Boon
Lei, Chang
Lekhwar, Rajesh
Leslie, Russell
Lewis, Benjamin
Leykam, Daniel
Li, Luhua
Lim, Felicity
Liu, Danyu
Liu, Wei
Lu, Haofeng
Luong, Duc Huy
Lysevych, Mykhaylo
Manning, Andrew
McGann, Mathew
McKerracher, Ian
McMurtrie, Roger
Mills, Ruth
Minovich, Alexander
Morizur, Jean-François
Mow Lowry, Conor
Moylan, Andrew
Mullavey, Adam
Natali, Sonny
Nawaz, Muhammad
Nguyen, Thanh
Nicholls, Lachlan
Noble, Bill
Paiman, Suriati
Palihawadana, Prasanga
Pinson, Matthew
Poldy, Rachel
Pozzi, Francesco
Prasad, Amrita
Pyke, Daniel
Rabeling, David
Rafiei, Ramin
Ramesh, Vidya
Ramsden, Stuart
Ravindraraj, Gouthrekka
Read, Jesse
Reid, Nicolai
Ren, Dong
Roberts, Jason
Robertson, Kalman
Rofi'i, Imam
Rogers, Jeffrey
Rogers, Lachlan
Satterthwaite, Matthew
Shelly, Sonam
Smith, Madeleine
Smith, Michael
Solntsev, Alexander
Song, Won-Min
Sparkes, Benjamin
Sprouster, David
Stefszky, Michael
Stevenson, Robin
Summers, Paul
Supratman, Vincent
Sutton, Andrew
Szigeti, Stuart
Tattersall, Wade
Tayati, Ponlawat
Teng, Ying Ying
Threlfall, Philip
Valbuena , Johnny
Vickers, Byron
Vran, Alexander
Vu, Khu
Wagner, Katherine
Wakhle, Aditya
Walsh, Rick
Wang, He
Weed, Ryan
Weekes, Chris
Werner, Justin
West, Michael
Wette, Karl
Whale, Benjamin
Whitfield, Ross
Wu, Ju-Kuei
Wuchenich, Danielle
Xiao, Allan
Yu, Jun
Yuen, Sebastian
Zhong, Grace
Zhu, Jennifer

PhD, MPhil, Honours, PhB, Summer Scholars (ANU)

Visiting Students *

Aizel, Koceila *Université Paris Sud, France*
Abeysuriya, Romesh *University of Sydney*
Amuli, Ines *Polytech Clermont-Ferrand, France*
Andersson, Linnea *Stockholm University, Sweden*
Bekaroglu, Cemal Erdem *Ankara University, Turkey*
Bengtsson, Sebastian *Chalmers University of Technology, Sweden*
Boyack, Rufus *University of Wellington, New Zealand*
Carretero-Palacios, Sol *Universidad de Zaragoza, Spain*
De Cesar, Mario *Second University of Naples, Italy*
Duignan, Tim *University of Wellington, New Zealand*
Frost, William *University of Canterbury, New Zealand*
Ghous, Abid *University of New South Wales*
Hannam, Kirsty *University of Waikato, New Zealand*
Hansson, Tobias *Chalmers University of Technology, Sweden*
Haslinger, Franz *University of Applied Sciences Regensburg, Germany*
He, Peng *Chinese Academy of Sciences, China*
Hile, Sam *University of New South Wales*
Jian, Pu *Ecole Normale Superieure, France*
Johnstone, Shaun *Monash University*
Kedziora, David *University of Sydney*
Kessler, Patrick *Bonn University, Germany*
Kheifets, Simon *University of Texas, United States*
King, Eleanor *Adelaide University*
Kroesen, Sebastian *Westfälische Wilhelms Universität Münster, Germany*
Lechene, Balthazar *Ecole Polytechnique, France*
Ling, Julia *Princeton University, United States*
Mahony, Caitlin *University of Melbourne*
Malik, Anwaar *University of New South Wales (ADFA)*
Michl, Matthias *University of Applied Sciences Regensburg, Germany*
Nicholls, Lachlan *University of Adelaide*
Olesen, Martin *University of Denmark*
Parrain, David *Ecole Normale Superieure, France*
Qajar, Jafar *University of New South Wales*
Qi, Xinyuan *Applied Physics School, China*
Reed, Matthew *University of Surrey, United Kingdom*
Sax, Christian *University of Applied Sciences Regensburg, Germany*
Schroeter, Lina *University of New Zealand*
Simpson, Mark *University of Wellington, New Zealand*
Sliski, David *University of Massachusetts, United States*
Swan, Tom *University of Surrey, United Kingdom*
Teniswood, Clara *University of Tasmania*
Terhalle, Bernd *Westfälische Wilhelms Universität Münster, Germany*
Thapar, Nandika *University of Wollongong*
Turner, Sam *University of Wellington, New Zealand*
Uhe, Peter *Monash University*
Villis, Byron *University of Melbourne*
Verma, Manish *Delhi University, India*
Wang, Wenjie *Nankai University, China*
Yu, Hongyi *Chinese Academy of Sciences, China*

**includes Occupational Trainees and Summer Scholars from external institutions*

Research Centres (located at the School)

Many scientists at the School are involved in national and international collaborative work, and some are members of major research centres that span several host institutions.

- Australian Research Council Centre of Excellence for Quantum-Atom Optics (ACQAO)
- Australian Research Council Centre of Excellence for Antimatter-Matter Studies (CAMS)
- Australian Research Council Centre of Excellence for Ultrahigh Bandwidth Devices for Optical Systems (CUDOS) - node

Research Networks (hosted by the School)

- Australian Research Council Nanotechnology Network (ARCNN)
- Australian Research Network for Advanced Materials (ARNAM)
- Australian Research Council Complex Open Systems Research Network (COSNet) (until June)