100 Years of Physics at Victoria

TE WHARE WĀNANGA O TE ŪPOKO O TE IKA A MĀUI

VICTORIA

UNIVERSITY OF WELLINGTON

100 years of Physics at Victoria University of Wellington

When: Thursday 2nd December from 6.00pm
Where: Maclaurin Lecture Theatre 103
Maclaurin Building
Gate 5 or 6
Kelburn Parade

Physics—as it was and as it is

Victoria University of Wellington invites you to celebrate the centenary of the opening of the first dedicated physics laboratories.

Come and view the displays and demonstrations from 6.00pm while mixing and mingling with your former Physics colleagues.

Presentations will start at 6.30pm and speakers include Professor Sir Paul Callaghan, Professor Denis Sullivan, Associate Professor Andy Edgar and Post Doctoral Fellow Dr Pauline Harris.

Refreshments will be served from 7.30pm.

To accept, email scps@vuw.ac.nz with '**100yrs Physics**' in the subject line, or contact Helen Rowley on 04-463 5335.

Please forward this invitation onto anyone else who may like to attend.

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Welcome from the Head of School – Prof. John Spencer

It is my pleasure to welcome you all to this event marking 100 years of Physics at Victoria University. During the last century, science has played an important role in the development of Wellington and the growth of New Zealand. From refrigeration and telecommunication to X-rays and atomic energy, physics at Victoria has reflected changing times and the growth of a nation.

Today, state of the art research equipment and excellent laboratory facilities, including the new Alan MacDiarmid Building, promise to keep Victoria University at the forefront of science education and research in New Zealand and continue to attract the best and brightest from all over the world.

Today we celebrate the innovation and determination of those who were here before us. Thanks to the hard work of staff past and present, the School of Chemical and Physical Sciences at Victoria is stronger than ever and we look forward to the next 100 years with great confidence.

Cover Photo*: Physics Lab c.1955: From left, clockwise: Jim Souness, Gus Schafer, Hugh Melhuish, Noel Chapman, Ron Rosen, Colin Gordon, Tony Hanley, Don Thompson, Pete Andrews, Harry Shilling, Ron Humphries*

Introduction from Dr Howard Lukefahr

It is the goal of science to understand how the universe works, and physics is at the forefront of this ongoing, great adventure. From galaxies to quarks, physicists seek to understand the inner workings of nature.

Physicists at Victoria University are expanding our horizons, illuminating more of nature through experimental and theoretical research. From the use of nuclear magnetic resonance to study complex fluids to theoretical study of quantised electromagnetic waves, from searching for extrasolar planets and mapping out the history of reversals the earth's magnetic field to spectroscopic studies of individual molecules, from investigating the electronic and optical properties of novel rare-earth and carbon-based materials to nanoelectronic devices, physicists at Victoria University are modern explorers.

Physics labs around the world continue to produce new technology as they open up new parts of nature to exploration. Physicists are inventors as well as explorers. Quantum mechanics of the early twentieth century is part and parcel of the microelectronics revolution. Updated and expanded quantum theory now drives nanotechnology that promises advances in everything from medicine to construction materials, and may one day give us astonishingly powerful quantum computers. And that's just one part of physics.

In 2110 we will celebrate the second century of physics at Victoria University. What will the world be like then? A lot of that depends on the young physicists now exploring nature in their labs.

A Brief History of Physics at Victoria University

Earnest Rutherford (left) who recommended Thomas Laby to Victoria College's Chair of Science Thomas Easterfield

In the beginning...

Physics began life at Victoria University in 1899 as part of an all-encompassing science department. Under the guidance of chemist Thomas Easterfield, science quickly established itself as a key element within the fledging college. Easterfield had arrived at Victoria from Cambridge with the intention of 'establishing in this city a research school whose fame shall be the pride of our University'. In his 20 years at Victoria, Easterfield succeeded in his goal and established research as a defining characteristic of the college's science faculty.

Science at Victoria proved popular and student numbers steadily increased. The demand by industry for experts in key growth areas, such as refrigeration and telegraphy led to the development of an independent physics department. In 1909, Thomas Laby was appointed to the new chair in physics. Laby's pioneering research in radioactivity at the University of Sydney had taken him to the famous Cavendish laboratory at Cambridge where he worked alongside his friend and mentor Earnest Rutherford. During his years at Victoria, Laby established his laboratory, campaigned to reform the University of New Zealand, and completed work begun in Cambridge with G. W. C. Kaye leading to the publication of their Tables of Physical and Chemical Constants with some Mathematical Functions (London, 1911).

Victoria's first physics laboratory, a low-roofed basement room underneath the laboratory building, was opened to the public by Governor-General Lord Islington in October 1910 with talks and demonstrations. The Evening Post later reported on the novelty of what attendees had witnessed:

"Some of the rooms were darkened in order to obtain the full effects of the weird lights from electrically charged vacuum tubes. Sounds from a phonograph were "exhibited" in the forms of ribbons of light. There was everywhere much to see, and the time passed all too quickly."

The legacy of war

War would play a decisive role in the direction physics would take throughout the twentieth century. During the two great wars, the work of Victoria's science departments was diverted to military purposes. The chemistry laboratory produced morphine for military hospitals, whilst in the physics workshop 'a good deal of attention has been given to signalling and bomb-throwing apparatus.'

Smoking c.1950s

The aftermath of war led some scientists to have reservations over the practical applications of their research. In 1951, the chair of physics, Charles Watson-Munro gave his inaugural lecture on 'Peacetime applications of atomic energy'. Watson had earlier been honoured for his work on the Manhattan Project. Twenty years later, a new professor of organic chemistry contrasted the 'sinister side effects' of modern science with what he imagined to be the 'untainted wholesomeness' of pre-war research, and warned of the potential misuse of knowledge.

In the 1950s, Victoria's Physics Department, like every other, had a decidedly nuclear science bent. Watson-Munro had begun his atomic career at the DSIR surveying the country's uranium resources and later helped build Britain's first nuclear reactor. His successor, Darcy Walker, was a research nuclear scientist from the UK. He fostered nuclear physics, solid-state physics and geophysics as the three main fields of the Victoria department.

Physics Lab 1966: (l-r): Bill Stevenson, Bill Matthews, Murray Bartle, Roger Sparks, Jim Callaghan, Darcy Walker, Noel Chapman

1960s: The growth years

Other developing fields in physics in the 1960s included radio physics and applied electronics. The first professor of theoretical physics, N.F. Barber, who was appointed in 1964, was a geophysicist who had recently headed the radio research division of the Dominion Physical Laboratory. A professor of physical electronics, David Beaglehole, was appointed in 1969.

Superconductors, however, would generate real excitement in physics in the 1980s. Research in this area began at Victoria in the mid–1970s under David Beaglehole. In 1987, a Victoria team led by Joe Trodahl succeeded in producing a superconducting ceramic material only months after this had first been achieved in the United States.

After a review in the mid 1990s a decision was made to reunite physics with chemistry under the name Chemical and Physical Sciences. Combining expertise in chemistry and physics, it was reasoned, would give Victoria an edge in materials science research.

Since then, physics at Victoria has gone from strength to strength. Today, our staff and research groups are recognised internationally and regularly publish their work in peer-reviewed journals. Students join a lively intellectual environment offering innovative teaching and world-leading research.

The School has cultivated strong, ongoing relationships with a number of the nation's leading research institutes such as Industrial Research Ltd, GNS Science, NIWA and the Malaghan Institute for Medical Research. The University also hosts the MacDiarmid Institute for Advanced Materials and Nanotechnology, the first of seven Centres of Research Excellence in New Zealand and the only centre in the area of physical and materials science.

This year also saw the opening of the new Alan MacDiarmid Building. With state of the art research equipment and laboratory facilities, the new building promises to keep Victoria University of Wellington at the forefront of science education and research in New Zealand.

Physics Staff 1967

Prof. Joe Trodahl c.1978

Physics Lab 1966

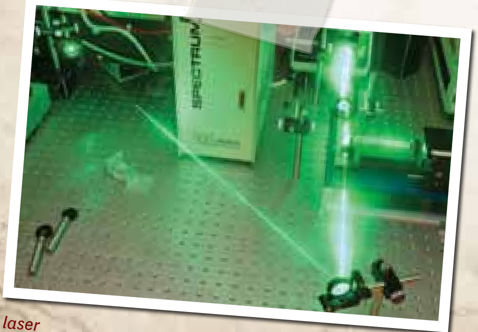
James Quilty - Laser Lab

Thomas Howell Laby – First Chair of Physics

Superconductor Levitation

Prof Denis Sullivan in action

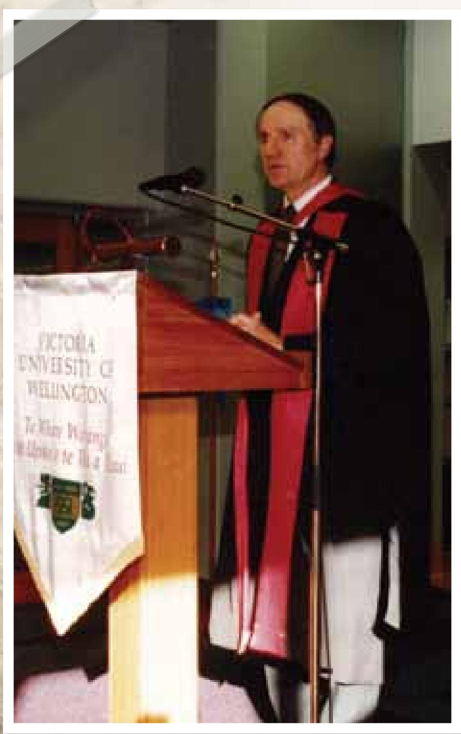
Physics Lab c1985



laser

Dr Ben Ruck with ultra high vacuum

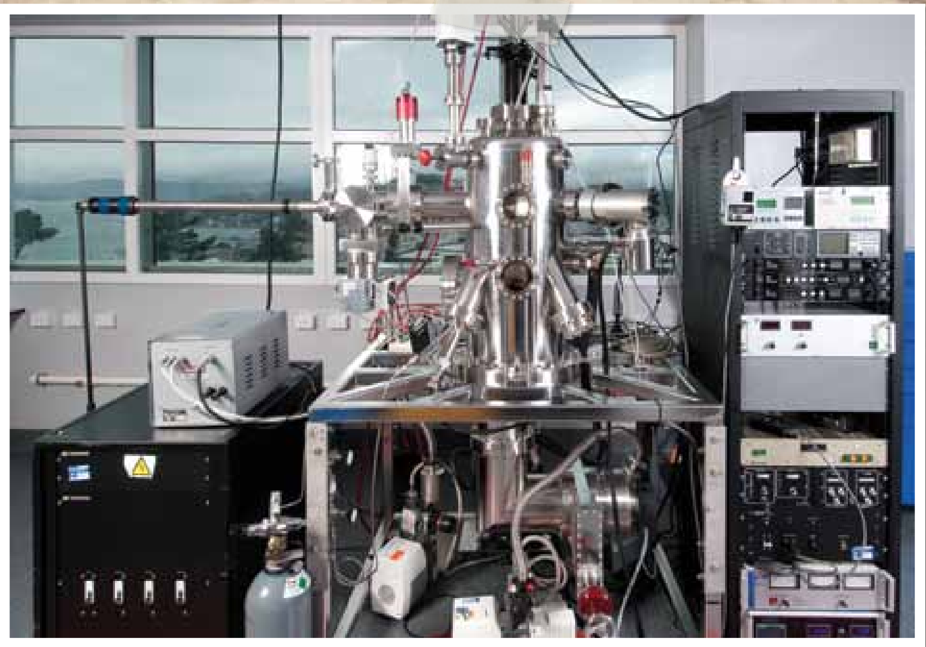
Gov General's visit 1999



Prof. Jim Johnston - Opening of Laby Building

X-Ray Spectrograph designed by Laby

Prof. Pablo Etchegoin Raman Lab



Ultra High Vacuum machine

Assoc prof Andy Edgar

ITS RELATION TO INDUSTRY.

PHYSICS LABORATORY AT VICTORIA COLLEGE.

OPENED BY THE GOVERNOR.

A distinct advance in the practical treatment of science and its relation to commerce and industry was noted by several speakers at the ceremony of opening the new physics laboratory at Victoria College performed by the Governor on Saturday night. Advantage was taken of the occasion to hold a sort of conversazione, in which the work of the scientific side of the college was displayed in a popular form to a very large assembly. Lord Islington was received by the chairman of the College Council (Mr. H. F. Von Haast), and the chairman of the Professorial Board (Professor H. B. Kirk). The Victoria College Officers' Training Corps formed a guard of honour.

The opening ceremony took place in the workshop—a low-roofed basement room underneath the laboratory building. The crowd of distinguished people included Sir Robert Stout (Chancellor of the University), Mr. James Allen, M.P. (Chancellor of Otago University), Professor Laby, Mr. Justice Chapman, Dr. Chapple, Mr. W. Morton, and leading members of Parliament, professional men, educationists, and merchants and manufacturers of the city.

TO AID INDUSTRY.

The chairman (Mr. Von Haast), in opening the programme, reviewed the circumstances which had led to the appointment of a professor of physics. The council recognised that in Professor Laby, who came from the famous Cavendish Laboratory at Cambridge, they had got the right man. The devotion of the students to their work had shown that he had inspired them with his own enthusiasm. (Hear, hear.) In regard to the laboratory, it was a modest beginning, and, if any of those present would like to assist with further funds, they would be very welcome. The aim of the Victoria College Council was to bring the college into closer touch with the industry, commerce, and agriculture of the community. They wanted the manufacturers of the district, the ironfounders, engineers, electricians, and those connected with tramways and railways to take a pride and interest in the laboratory and to feel that the interests of the college were identical with their own. (Applause.)

How the news of the physics opening was reported in The Evening Post, Oct 10, 1910

PURPOSES OF THE LABORATORY.

Professor Laby explained the purpose and function of the laboratory. It was to give instruction in methods of science and, if possible, contribute something to original knowledge. The professor alluded to the increasing attention paid to applied science in Japan, America, England, and particularly Germany. In Germany science and industry were very closely associated, and university teachers frequently occupied high positions in large industrial concerns. With the co-operation of certain people in Wellington the laboratory might be very useful for electrical testing, such as was now done by the Government, by the City Council, and by some private firms. In conclusion, Professor Laby thanked the students for their special labours in preparing for that evening. He had never seen their enthusiasm exceeded anywhere. (Applause.)

THE GOVERNOR. CONGRATULATIONS.

The Governor, after acknowledging the cordial welcome he had received, referred to the extension of the education work of the college. He thought the new development would not only redound to the prestige of the college, but would be of the greatest use to the people of Wellington and the Dominion of New Zealand. (Applause.) Many people hardly realised how much modern manufacturers depended on the experimental laboratory. From the scientific study of heat had come what was making New Zealand a great exporting country—the freezing process. (Applause.) Then in hospitals were the Rontgen rays and Finsen treatment, the result of the study of light in laboratories. Of wireless telegraphy he could speak from his own experience as chairman of the commission which was set up to decide whether Great Britain should take part in the International Congress on Radio-Telegraphy. In conclusion, His Excellency congratulated Victoria College on the progress it had made in so short a career. He hoped the students, having received a sound basis of scientific training, would be able to carve out a future of usefulness to themselves and of credit to the British Empire. (Applause.)

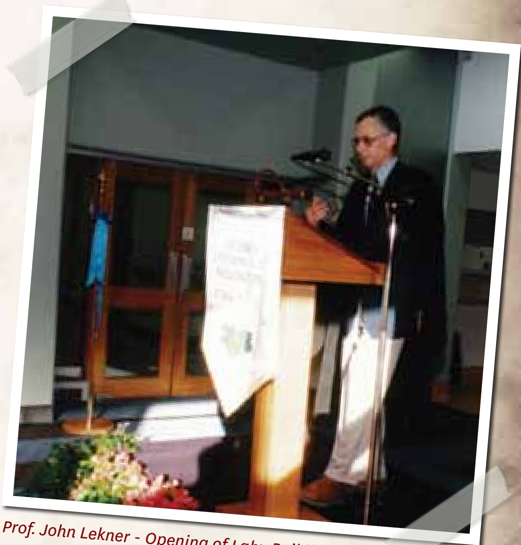
STARTING BY WIRELESS.

His Excellency then declared the laboratory open. He pressed a switch—there was a wireless response on the opposite side of the room in a crackle of sparks. Another touch, and the machinery was in motion. There were three lathes, a band saw, variable-speed drill, and other minor apparatus. This was explained to the visitors, among whom were a large number of ladies, by the students at each machine. In other departments of the laboratory building a number of interesting experiments were carried out. Professor Laby delivered a lecturette on Rontgen rays, radium, and high-frequency discharge. Among the students who assisted were Messrs. P. Burbidge, G. S. Callender, J. Strawbridge, G. H. Robertson, J. Russell, W. E. Fossette, R. J. Thompson, and R. Bruce, and Misses Clachan, Cook, and Gatenby. Refreshments were served in the gymnasium building.

PHYSICS AND BIOLOGY.

DEMONSTRATIONS AT VICTORIA COLLEGE.

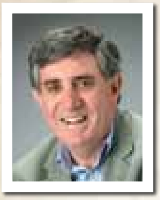
Phys & Bio Oct



Prof. John Lekner - Opening of Laby Building

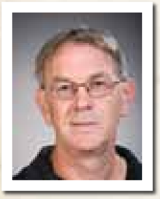
Prof. David Beaglehole and Prof. Paul Callaghan

Physics Staff and Research, 2010



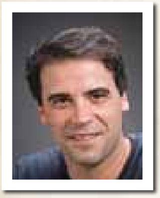
Paul Callaghan

- → NMR microscopy
- → Rheological applications of NMR
- → Low field NMR and portable NMR
- → NMR imaging methodologies for materials science
- → New magnet, data processing and probe technologies for NMR applications
- → Molecular dynamics and organisation of complex fluids, soft matter and porous materials



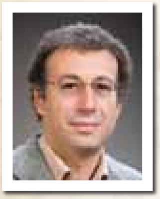
Andy Edgar

- → Glasses and glass ceramics and applications
- → Glasses and glass ceramics for radiation imaging and sensing with X-rays, gamma rays and neutrons
- → Optical spectroscopy of photo-active ions
- → Photorefraction effects and Bragg gratings
- → Medical imaging and non-destructive testing



Pablo Etchegoin

- → Laser Raman spectroscopy
- → Single molecule spectroscopy
- → Surface enhanced Raman scattering (SERS)
- → Surface plasmon resonances in metallic nanostructures
- → Theory of electromagnetic properties of nanoparticles
- → Polymer physics



Michele Governale

- → Theory of charge and spin transport in nanostructures (nanoelectronics and spintronics)
- → Time-dependent transport in nanoscale systems
- → Hybrid superconductor-normal systems
- → Strongly correlated electrons

Shaun Hendy

- → Theoretical description and modelling of nanostructures at the atomic scale
- → Nanoparticles, nanowires, ultrathin films, nanostructured glasses and microfluidics
- → Medical applications of magnetic nanoparticles
- → Growth of oxide films
- → Superheating of nanoparticles

Malcolm Ingham

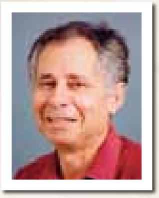
- → Electrical and electromagnetic techniques in geophysics
- → Electrical resistivity and the structure of volcanic and geothermal regions
- → Modelling the geomagnetic field through polarity reversals
- → Development of techniques for measuring the physical properties of sea ice
- → DC resistivity for detection of saline intrusion in coastal aquifers

Melanie Johnston-Hollitt

- → Radio astronomy - multiwavelength investigations of cluster dynamics (radio, X-ray and optical)
- → Understanding the generation and evolution of radio galaxies
- → Using head-tailed galaxy barometers to measure the largest 'weather systems' in the Universe
- → Scientific and technical requirements for the next generation of radio telescopes

Alan Kaiser

- → Electronic conduction mechanisms in novel materials
- → Graphene and carbon nanotubes - modelling of properties
- → Semiconducting nanowire films

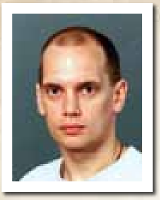


John Lekner

- → Theory of propagation, polarization and reflection of focused laser beams
- → Energy, momentum and angular momentum of electromagnetic and acoustic pulses
- → Theory of reflection of electromagnetic, acoustic and particle waves
- → Optical properties of anisotropic and chiral media
- → Theory of electromagnetic beams and pulses
- → Viscous fluid flow, with and without slip
- → Quantum wavepackets: propagation in free space and in force fields

Eric Le Ru

- → Optical properties of metals at the nano-scale (nano-plasmonics) - theory and applications
- → Electromagnetic modelling
- → Optics-based sensors and surface enhanced spectroscopies (Raman and fluorescence)



Ben Ruck

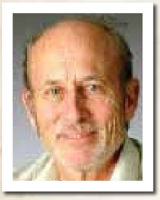
- → Experimental condensed matter physics: thin films of novel materials
- → Materials for spintronics
- → Dilute magnetic semiconductors
- → Rare-earth nitrides
- → Preparation of perovskite superconductors and ruthenate perovskites
- → Novel conducting materials: measurement and modelling of electronic properties

Denis Sullivan

- → Stellar variability and stellar structure
- → White dwarf structure and asteroseismology
- → Gravitational microlensing as an astronomical probe
- → Employing gravitational microlensing events to find extrasolar planets
- → Software development for astronomical image acquisition and analysis

Gillian Turner

- → Earth's magnetic field: polarity reversals and secular variations
- → Understanding the geodynamo in the Earth's core
- → Mathematical modelling of records of polarity reversals
- → Detailed analyses of historical secular variation and the source field



Joe Trodahl

- → Magnetic semiconductors - Rare-earth nitrides
- → Transport and optical properties of metals and semiconductors
- → Raman spectroscopy of semiconductors and ferroelectric oxides
- → Coupled ferroelectric/ferromagnetic devices

Speakers

Prof. Sir Paul Callaghan

Sir Paul Callaghan, GNZM, FRS, FRSNZ is the founding director of the MacDiarmid Institute for Advanced Materials and Nanotechnology at Victoria University of Wellington, holds the position of Alan MacDiarmid Professor of Physical Sciences and is also president of the International Society of Magnetic Resonance.

A native of Wanganui, Paul Callaghan took his first degree in physics at Victoria University of Wellington and subsequently earned a DPhil degree at the University of Oxford, working in low temperature physics. He was made Professor of Physics at Massey University in 1984, and was appointed Alan MacDiarmid Professor of Physical Sciences in 2001. The following year, as its founding director, he helped establish the multi-university MacDiarmid Institute for Advanced Materials and Nanotechnology.

Callaghan is past president of the Academy Council of the Royal Society of New Zealand and has published over 240 articles in scientific journals. His 2009 book, Wool to Weta: Transforming New Zealand's Culture and Economy, deals with the potential for science and technology entrepreneurialism to diversify New Zealand's economy.

In 2001 Callaghan became the 36th New Zealander to be made a Fellow of the Royal Society of London. He was awarded the Ampere Prize in 2004 and the Rutherford Medal in 2005. He was appointed a Principal Companion of the New Zealand Order of Merit in 2006 and in 2007 was recognised by a KEA/NZTE World Class New Zealander Award and the Sir Peter Blake Medal. He was knighted on 14 August 2009 and in 2010 was awarded the Günther Laukien Prize for Magnetic Resonance.

Speakers

A/Prof. Dr. Andy Edgar

Andy Edgar gained his PhD at Canterbury University, followed by postdoctoral fellowships at the ANU and the University of Bonn (as an Alexander von Humboldt Fellow), before joining VUW physics in 1982 as a lecturer. He is currently an Associate Professor in the School of Chemical and Physical Sciences. Until the foundation of Victoria's Engineering School in 2008, he was largely responsible for Victoria's teaching program in electronics, whilst his research activities have always been focussed on solid state physics.

His current research activity is centred on the optical properties of glasses, ceramics and glass ceramics, particularly as they apply to radiation imaging and detection, and telecommunications.

In the past few years Andy Edgar and his research group have been developing glass ceramics that display a rare x-ray storage property which can be used for imaging. These materials, when used to replace the traditional x-ray techniques will vastly improve the efficiency and convenience of x-ray radiography systems. The applications include medical and security X-ray imaging, and materials testing. The group are also developing new radiation detection materials; these "scintillators" form the heart of many medical imaging techniques such as CAT and PET scanning systems. He is also investigating glasses and glass ceramics which display useful properties for telecommunications applications, such as optical regeneration and switching. What makes all these materials so useful is their novel optical behaviour – by careful design, normally opaque ceramics, or glass ceramics, can be as optically transparent as window glass, whilst offering all the advantages of a crystal-like material.

Andy is also a Principal Investigator in the MacDiarmid Institute and is currently investigating spin-dependent processes in organic light emitting diodes – light sources which can be made in large, flexible,   and cost effective sheets.

Speakers

Prof. Denis Sullivan

Prof. Sullivan's research interests are focussed on a number of areas in stellar astrophysics and astronomy.

A major activity involves the study of compact stars (primarily white dwarfs) using the techniques of asteroseismology, in which the photometrically detected pulsation modes of these stars are used to probe their interior structures and physical processes. Another research activity is conducted as part of the NZ/Japan MOA (Microlensing Observations in Astrophysics) collaboration, and it employs transient gravitational microlensing events as astrophysical probes.

A key theme of this particular research is a search for extrasolar planets. This research has been awarded four Marsden Fund grants over the past decade. "We detect these planets in combination with their host stars by using the fact that their gravitational fields act like lenses, which magnify the light from a background star in a characteristic way when the observer, star-planet system and background star are in near-perfect alignment."

Things that happen in space are often very complex, but we can understand them with physical models that use mathematics to make the concepts concrete. Mathematics is the underlying language of physics, but understanding the physics requires more than simply doing the maths.

"Mathematics makes ideas precise in physics, but really understanding the physics is a real challenge," says Denis. "This is one of the great attractions of this subject; there is always something more to learn, a deeper insight to achieve. It's rarely a matter of, oh well, I understand this, let's move on."

SPEAKERS

Dr Pauline Harris, Post Doctoral Fellow

Dr Pauline Harris is from Rongomaiwahine and has completed a Masters Degree in Astronomy and a PhD in Astrophysics at Canterbury University. This body of research investigated Gamma Ray Bursts (GRBs), which are large explosions in distant galaxies and possible sites of high energy neutrino production.

Pauline is currently a Te Tipu Pūtaiao Postdoctoral Award holder from the Foundation for Research, Science and Technology in the School of Chemical and Physical Sciences at Victoria University, where she dedicates her time between searching for extra-solar planets and the collation and revitalisation of Maori Astronomical star lore.

Pauline has been involved in the revitalisation of Maori star lore for the past 7 years and has given many talks pertaining to Maori Astronomy and Matariki/Puanga around the country and overseas. Pauline is involved with Maori research in other areas, such as the relationship between Science and Matauranga, as well as more specialized areas such as ethics in biotechnology. Dr Harris has co-authored two books, and published in a wide variety of forums.

A Special Thanks To

The admin team of School of Chemical & Physical Sciences, with a special mention to Kara Eaton and Dan Thompson

… to the MacDiarmid Institute who have provided state of the art research equipment and excellent laboratory facilities since 2002.

The MacDiarmid Institute
for Advanced Materials and Nanotechnology

The marketing and communication departments

Head of School John Spencer

Pro VC Prof Vice Chancellor

VC Pat Walsh

And a very special thanks to all the staff and students who have ever been a part of the physics department at Victoria University