



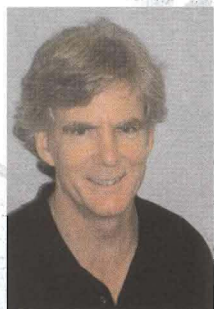
Alumni@Physics - The School of Physics Alumni Newsletter

Issue 1, 2005



THE UNIVERSITY OF
MELBOURNE

Welcome to the first issue of the School of Physics Alumni



Welcome to the first edition of our School of Physics Alumni newsletter. We plan on publishing bi-annually to help keep you in touch with some of our events,

achievements and aspirations. We are launching the newsletter as part of the 2005 International Year of Physics. Declared as such by the UN General Assembly in June, 2004, the year's activities will be a celebration of the anniversary of Einstein's miraculous year with papers on the photoelectric effect, special relativity and the Brownian motion; three diverse areas, three pivotal papers in modern physics. Look out for the many events that will take place here and internationally. On the back page you will find a list of events planned for 2005. We hope you can participate in some of these activities. In order for us to develop and maintain an accurate address list, we ask that you fill out and return the slip contained in this newsletter.

The University and research environment is constantly changing and the School must continually adapt to these changes, whilst maintaining a sense of direction based upon our own vision of what constitutes the great physics department that we aspire to be. We have consolidated the research groups in the School into the six fields: Astrophysics; Experimental Particle Physics; Microanalytical Research; Optics and X-ray Physics; Theoretical Condensed Matter Physics; and Theoretical Particle Physics. A profile of each of these groups is part of this issue (pages 3- 5). The consolidation has

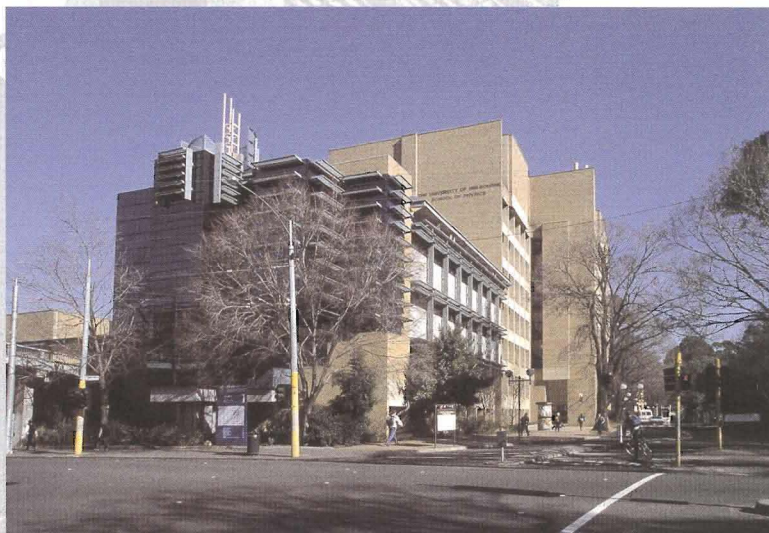
occurred with the hiring of excellent new staff: Dr Elisabetta Barberio (EPP); Dr Andrew Martin (TCMP); and Dr Stuart Wyithe (Astro) (see page 7). Staff renewal continues with a theorist position currently under advertisement and another to follow in 2005.

The School is well endowed with a bright team of over 30 post-doctoral fellows who provide important contributions to the research and research student supervision in the various groups.

Professor Keith Nugent has just completed

The Physics Post-graduate Students' Society is highlighted on page 6. On that page is also a description of our admin team and on page 7 information on important building works that are occurring in the School.

We intend to interact more fully with you, our alumni, via this newsletter, and also via alumni events. On 24th of February at University House, we will have an alumni cocktail party. Professor Helen Quinn, from Stanford will be the guest speaker. Professor Quinn is originally from Melbourne. After commencing a maths



the third of his 5-year Federation Fellowship, and was awarded the prestigious Victoria Prize in 2004. The School hosts the Melbourne node of the ARC Centre of Excellence in Quantum Computer Technology, and has applications for further centres and research programs in the pipeline.

The activities of the School continue to thrive with the efforts, not only of the academic staff, but importantly, of the graduate students and the general staff.

degree here, she moved to Stanford University to finish her studies. She has received international acclaim for her work in theoretical particle physics, teaching, outreach, the role of women in physics, and more recently, through her role as President of the American Physical Society. It should be a great night and we hope to see you there.

Geoff Taylor, Head of School

Academic Staff

Prof Geoffrey Taylor - Head of School

Dr Jeff McCallum - Senior Lecturer

Prof Ray Volkas - Deputy Head of School

Prof Bruce McKellar - Professor, Chair of Theoretical Physics

Prof Keith Nugent - Federation Fellow

Dr Andrew Melatos - Senior Lecturer

Assoc/Prof Les Allen - Associate Professor and Reader

Prof Steven Prawer - Professor

Dr Elisabetta Barberio - Lecturer

Dr Roger Rassool - Senior Lecturer

Assoc/Prof Chris Chantler - Associate Professor and Reader

Assoc/Prof Ann Roberts - Associate Professor

Assoc/Prof Lloyd Hollenberg - Associate Professor and Reader

Assoc/Prof Robert Scholten - Associate Professor and Reader

Prof David Jamieson - Professor, Director of MARC, Director of Melbourne Node of CQCT

Assoc/Prof Martin Sevier - Associate Professor

Dr Girish Joshi - Reader

Prof Rachel Webster - Professor

Dr Michelle Livett - Senior Lecturer

Dr Stuart Wytthe

Dr Andrew Martin - Lecturer

General Staff Management Team

Ms Helen Conley - Executive Manager

Mr Nick Nicola - Laboratory

Mr Will Belcher - IT

Mr Roland Szymanski - Workshop

Mr Colin Entwisle - Teaching

Mr Russell Walsh - Finance

Ms Kamala Lekamge - Library

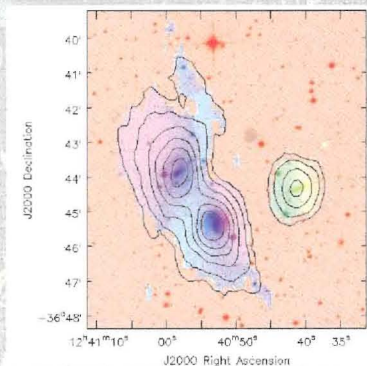
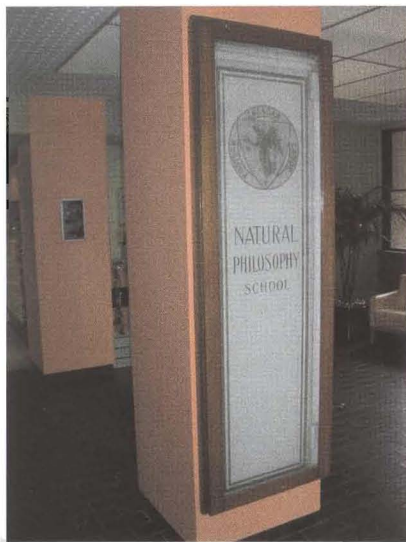
Message from the editor

Welcome to the first publication for alumni of the School of Physics at the University of Melbourne.

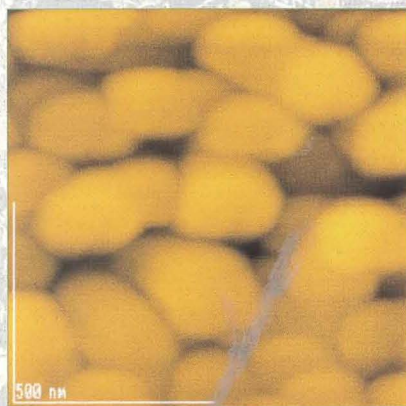
In this issue, we have articles from all the current research groups in the school. The Postgraduate Physics Students Society is profiled on page 6 - students are very active in the department at the current time. In recent years, the administrative team has undergone significant change - the new team, lead by Helen Conley, is introduced. See page 6. Three new academic appointments have been made - learn about them and their physics interests on page 7. Don't miss the back page for a listing of Einstein International Year of Physics 2005 events we are running!

The success of this newsletter will depend upon your input. In future issues we hope to profile alumni, disseminate information on events and provide articles on current School of Physics staff and activities. If you have something of interest for the alumni network, please email alumni@physics.unimelb.edu.au

James McCaw (PhD student), Editor



21cm radio contours of neutral hydrogen emitted from a local group of galaxies



1 micron x 1 micron AFM image of clusters of PMMA formed by He-ion irradiation.

Astrophysics

The Melbourne Astrophysics group is involved in observational and theoretical research in a range of areas. The observational program spans radio to X-ray wavelengths, using the Australia Telescope Compact Array, the Gemini Telescopes, the Hubble Space Telescope, and the Chandra X-ray Observatory among other instruments. The theoretical programs currently extend from pen-and-paper calculations to the development of numerical codes, including relativistic particle-in-cell plasma codes and spectral Navier-Stokes and vortex-in-cell codes for numerical hydrodynamics.

Our current scientific interests include the theoretical study and detection of the reionisation of the universe, gravitational lensing, the structure of galaxies and quasar emission regions, predictions of the properties of gravitational waves from astrophysical events, the structure of neutral hydrogen clouds in the local universe, and the physics of compact objects. The group also works in the

development and implementation of the Australian Virtual Observatory (Aus-VO).

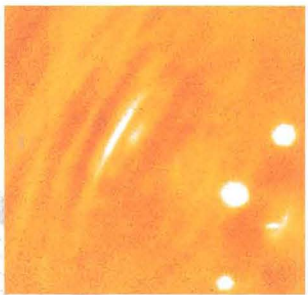
The Astrophysics Group is a principal member of the collaboration designing and building the Mileura Widefield Array (MWA) in Western Australia. The array will detect signatures of reionised bubbles in neutral hydrogen during the epoch of reionisation in the early universe.

The group comprises three faculty members and three research staff, as well as eight postgraduate and four honours students, and hosts a number of international visitors each year.

Cath Trott, on behalf of the Astrophysics group



Rachel Webster, Astrophysics group leader



Gemini image of the Crab pulsar nebula interacting with the surrounding interstellar medium

Experimental Particle Physics

The Experimental Particle Physics Group participates in the Belle Experiment at KEK in Japan and the ATLAS experiment at the Large Hadron Collider (LHC) at CERN in Switzerland. The Belle experiment is collecting data right now while the ATLAS detector is under construction and scheduled for completion in 2007.

The Belle experiment utilises the KEKB accelerator which collides 8 GeV electrons with 3.5 GeV positrons to create B-mesons in unprecedented quantities. To date Belle has recorded the creation and decay of around 640 million B mesons. B-mesons contain the b-quark, the lightest of the 3rd generation of quarks. The main goal of the Belle experiment is to study the process of CP violation in the decay of B-mesons. CP violation provides a means of unambiguously distinguishing matter from antimatter. CP violation was first observed in the neutral K-meson system in 1964.

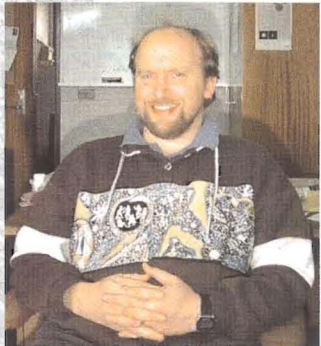
The Belle experiment first observed CP violation in B-meson decays in 2001. Since then, we have made numerous measurements of this process in B-meson decays. Some of these results show intriguing departures from the expectations of the Standard Model.

The goal of the ATLAS experiment is to explore

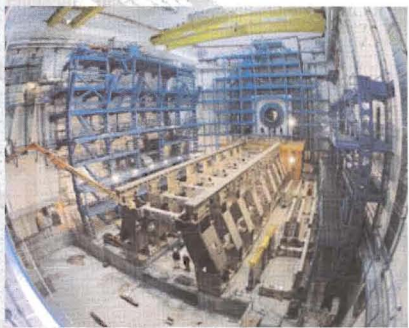
the new realms high energy physics made available by the CERN LHC which will provide 7 TeV on 7 TeV proton-proton collisions. The energy and intensity with which these collisions will occur enable the exploration of physics processes over an order magnitude higher in energy than previous experiments. One of the primary goals of ATLAS is the discovery of the Higgs particle, which is predicted to exist by the Standard Model but has not yet been observed. The Higgs particle is the carrier of a spin-0 field which, according to the Standard Model, permeates all of space. Particle interactions with this field determine the mass of elementary particles. Thus the search for the Higgs particle is often called the search for the origin of mass.

However, the calculations of the Standard Model for Higgs interactions at energies above 1 TeV simply do not work. This implies that the Standard Model, as successful as it has been below 100 GeV interaction energy, does not describe Nature at 1 TeV or higher. We intend to explore this energy regime to determine what new physics and particles exist in this energy regime.

Martin Sevier

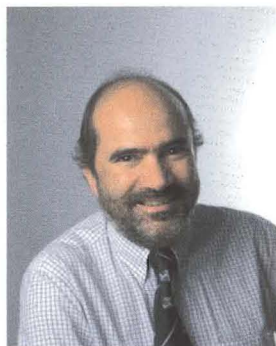


Martin Sevier, EPP group leader

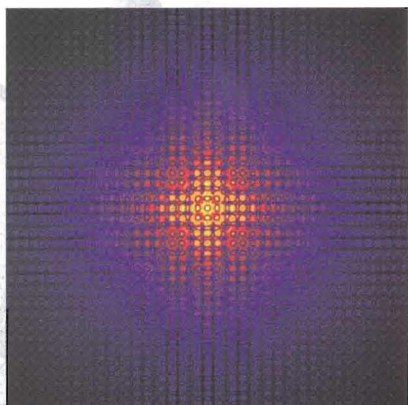


The 7 storey underground cavern that will house the ATLAS detector at the LHC experiment. The beam line can be seen. (Image courtesy of CERN)

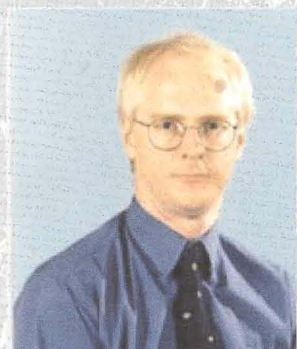
Microanalytical Research Centre



David Jamieson, MARC group leader



A plot of the probability density of a substitutional phosphorus donor electron in the [001] plane of the host silicon lattice



Keith Nugent, Optics group leader



Equipment in the School of Physics optics laboratory.

The Microanalytical Research Centre (MARC) conducts research in frontier areas of condensed matter physics. MARC is a member of the ARC Centre of Excellence for Quantum Computer Technology. This consortium involves MARC in a close collaboration with some of Australia's leading physicists on a high profile project aimed at the construction of a quantum computer device. The Centre addresses the key requirements for a solid-state phosphorus-doped silicon quantum computer which involve the fabrication of devices containing just two phosphorus atoms separated by only 60 nanometres in silicon devices and the control of single electron transfer between the two phosphorus atoms using metal gates on the device surface. As the result of a close collaboration between the MARC and the UNSW node of the Centre of Excellence we have observed gate-controlled sequential transfer of single electrons between ion implanted phosphorus atom clusters and the detection of this transfer with correlated radio-frequency single electron transistors.

We have developed a novel method of inserting single phosphorus atoms into silicon by ion implantation that uses the silicon substrate itself as an ion detector. In 2004 this

allowed us to mass produce two-atom devices which are being used to test fundamental and potentially useful quantum properties of single electrons in silicon. This work is complemented by allied research programs that involve diamond and high energy ion beams.

MARC houses a large array of state-of-the-art equipment for research in nanotechnology including a 5 MeV Pelletron accelerator and associated nuclear microprobe systems, a new clean room facility that houses lasers for Raman spectroscopy and a new focused ion beam microscope that is capable of producing images and machining materials with a resolution of 20 nanometres. These facilities are used by a team of 4 academic staff, 13 postdoctoral fellows and technical staff and 15 research students together with interstate and international collaborators.

David Jamieson

Optics

Members of the optics group pursue research in x-ray optics & physics, optical physics and atom optics; but within each broad area lies an array of diverse individual research topics. The group consists of four members of the School of Physics' teaching and research staff, nine research fellows and more than 15 research students. The optics group benefits from the strong synergies between the different research areas and has active collaborations with researchers in several countries including the United States, The Netherlands and France. PhD graduates of the optics group have obtained employment at prestigious international research institutions and with a wide variety of industry employers in Australia and overseas.

Members of the group have made significant advances in the development of novel imaging technique with a view to applications in biomedical imaging, x-ray crystallography, atom optics, photonics and in the study of cultural materials as well as asking fundamental questions about the universe and matter. The new synchrotron to be built in Melbourne brings a wealth of exciting opportunities for physics especially for our

group which has the highest profile in synchrotron physics in Australia. Despite many investigations, computational & theoretical aspects of atomic scattering by x-rays and wavefunctions are not well understood, and we are involved in the development of new theoretical and experimental tools for their investigation.

The interaction between light and neutral atoms provides a physicist's playground, with many remarkable phenomena to explore. We are working on theoretical and experimental aspects of several projects that exploit advantages offered by atom optics by comparison with photon optics. We are also interested in the fundamental study of the interaction of light with nanoscale structures.

Ann Roberts, on behalf of the Optics group

Theoretical Condensed Matter Physics

Theoretical Condensed Matter Physics is the newest research group in the School of Physics. In 2004 the group leader, Assoc/Prof Les Allen, was joined by a new tenured staff member, Dr Andy Martin, who was previously at the University of Nottingham. The range of research topics in the group has now broadened to encompass:

- The phase and inverse scattering problem for electrons multiply scattered by solids.
- Inelastic scattering of electrons in crystals; Scattering of fast electrons in crystalline solids; absorptive scattering; nonlocality in scattering, applications to microanalysis.
- Modelling of scanning transmission electron microscopy (STEM) images from first principles.
- Dynamics and stability of dilute gas Bose-Einstein condensates in optical lattices.
- The breakdown of the integer quantum Hall effect.

- Dephasing and charge fluctuations in mesoscopic conductors.

The group was recently successful in winning 0.44 million dollars in funding for two Discovery Projects from the Australian Research Council for the period 2005 - 2007. A third staff member will be appointed to the group within the next couple of years.



Les Allen, TCMP group leader

Les Allen



Members of the TCMP group

Theoretical Particle Physics

The study of neutrinos is one of the major research areas of the Theoretical Particle Physics group, with Prof Bruce McKellar and Prof Ray Volkas along with students and post doctoral fellows working in the field. They have worked on cosmological and astrophysical implications of neutrino oscillations and interactions, on the generation of neutrino masses in theories which go beyond the Standard Model of particle physics, on mirror matter, and on nuclear physics tests on new interactions of neutrinos and matter.

Another area of physics which hints at physics beyond the Standard Model is the violation of the CP symmetry which inverts space and interchanges matter and antimatter. While present experiments are consistent with the standard model, without some other source of CP violation the Big Bang would not generate the amount of ordinary matter necessary for our existence. Work is continuing in analysing the B-factory data on CP violation in B meson decays, in the hope of finding inconsistencies in the Standard Model analysis of the data.

There is much theoretical speculation about the influence on observable experiments of the extra dimensions which are necessary in some theories of matter. Prof Volkas is working on

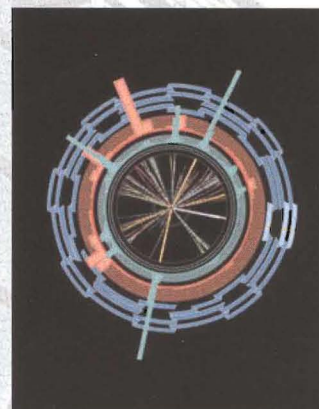
establishing a relationship between the extra dimensions and the Standard Model, which may help us understand the origin of mass, and Associate Prof Joshi is studying the possible influence of "mini black holes" on the experiments which will be carried out at the soon to be completed LHC accelerator at CERN in Geneva.

Prof Bruce McKellar, holder of the Chair of Theoretical Physics, and head of group, is now the Foreign Secretary of the Australian Academy of Science, and in that capacity was an Australian delegate to the Science and Technology in Society Forum in Kyoto in November 2004. The group is currently advertising for a new academic position, and, with the impending retirement of Dr Girish Joshi, will undergo some significant changes over the next few years.

Bruce McKellar



Bruce McKellar, TPP group leader



Simulation of a mini black hole decay in the ATLAS detector at the LHC experiment. (Image courtesy of CERN)

Postgraduate Physics Students Society



A PPSS trivia night

The Physics Postgraduate Students Society (PPSS) was formed in 2000 to enhance the postgraduate experience in the School of Physics.

The PPSS provides student representation on all the Departmental Committees to ensure students have an input on the running of the School, and organises fun and educational activities for the postgrads, honours students, and others in the School.



PPSS Soiree 2003

Over the last few years the PPSS has helped set up the Induction Day, a program designed to help new postgraduate students settle in and get the most out of their degree. In conjunction with the School, the PPSS has also developed a comprehensive supervisory panel program to assist new graduate students in their transition to research.

In 2001, the PPSS instigated, and now helps to run, the Geoff Opat Seminar Series (GOSS) which is held every Friday throughout the semester. Each week two students present seminars covering their research and current literature. Following the seminars, the School gets together over drinks and nibbles to socialise and discuss physics. The talks provide an excellent forum for young researchers to present their work.

Other activities the PPSS have organised include trivia nights, the end-of-year Soiree, and Mathematica and LaTeX tutorials.

Catherine Low, PPSS President 2004

The administrative team



Helen Conley, Executive Manager

The Teaching and Research effort of the School is well supported by six teams: General Administration, Information Technology (IT), Teaching Administration, Workshop, Laboratory and Library.

The Management team is led by the new Executive Manager, Helen Conley and comprises: Russell Walsh (Finance), Will Belcher (IT), Colin Entwisle (Teaching), Roland Szymanski (Workshop), Nick Nicola (Laboratory) and Kamala Lekamge (Library).

Changes in recent times include a bright new administration area on the Ground Level that sees the Head of Department and the Administration team located together for the first time.

The IT area is growing in complexity and size and next year welcomes a female into the team for the first time.

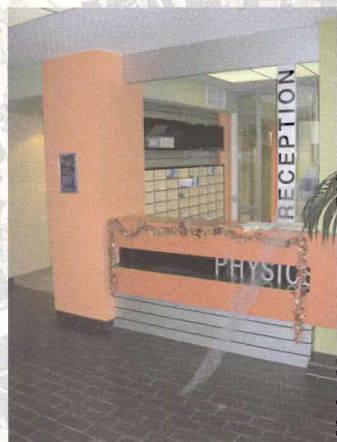
Our high quality teaching continues to be a feature of the School, with additional services, such as the First Year Learning Centre, being made available to support student learning.

The School continues to benefit from a highly skilled Workshop crew who produce outstanding innovations to support the research effort.

The Laboratories are a key feature of our teaching strength and we continue to upgrade them to ensure we attract and retain the best students.

And Kamala in the library - what a great operation she runs, complete with new scanning technology and other bells and whistles.

Helen Conley, Executive Manager



Recent academic appointments

The current academic staffing plan provides for each of the six consolidated research groups to have at least three academic staff. TCMP, EPP and Astro have all recently employed new staff. TPP is currently advertising for a fixed-term academic position.

Dr Elisabetta Barberio has joined EPP, moving on from Southern Methodist University in the United States and CERN in Switzerland where she has worked on both LEP, the electron-positron collider that confirmed the existence and properties of the W and Z bosons, and the Large Hadron Collider (LHC), due to begin taking data in 2007. Her strong ties to CERN and extensive experience in high-energy particle physics are welcomed in the School.



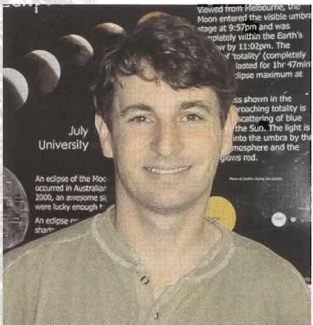
Elisabetta Barberio

Dr Andy Martin has joined TCMP, moving from the University of Nottingham in the UK. His research interests include: the study of dynamics and stability of dilute gas Bose-Einstein condensates in optical lattices; the breakdown of the integer quantum Hall effect; and dephasing and charge fluctuations in mesoscopic conductors.



Andy Martin

Dr Stuart Wytke has joined the Astro group, returning from the United States where he was a research fellow at both Princeton and Harvard. His primary research interests lie in the field of quasar formation and reionisation in the early universe. He also studies gravitational lensing.



Stuart Wytke

The School of Physics proudly welcomes our newest academic appointees.

New building works

Times of change!

In recent years, the ground floor of the physics building has been fully redeveloped. Administration, previously spread over the ground floor and Level 7, has been fully relocated to the ground floor. The Head of Department's office is now located with the general staff. The new office space, pictured here, is bright, open and welcoming.

With the administration rationalised on the Ground level, Level 7 can now be refurbished. These building works are currently in progress. The redeveloped western wing will provide high quality office space for the School's increasing number of professors. The new layout is hoped to further enhance cross-group collaboration and collegiality.

The eastern wing of Level 7 will house a state-of-the-art video conferencing room, also currently under construction.

In 2005, Levels 2 (MARC) and 5 (Optics) will be renovated.

On the teaching side, both the Hercus and Laby theatres will be fully refurbished in 2005, providing our undergraduates with lecture theatres of the highest quality.



The new administration area (above) and renovations on the 7th level (left)

Events - International Year of Physics 2005

Alumni Cocktail Party - 24th February.

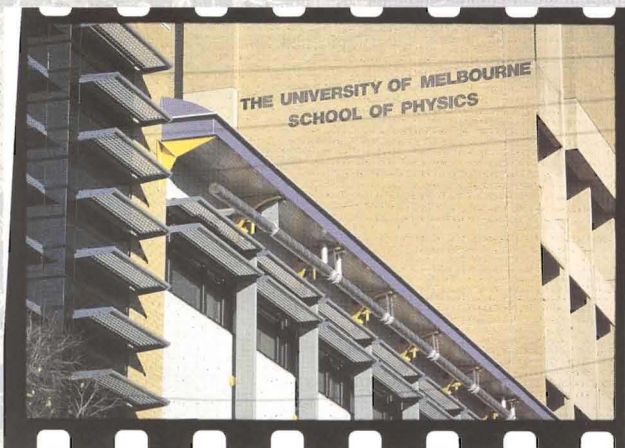
All alumni are invited to an Einstein International Year of Physics 2005 launch to be held on Thursday 24th February 2005 from 6-8pm. You should have received an invitation recently. Prof Helen Quinn, distinguished particle physicist from the Stanford Linear Accelerator Center will speak. RSVP early as numbers are limited. The night will provide an opportunity for you to catch up with old friends and see how the school is now operating. Put the date in your diary now!

Nobel Laureate lectures - dates to be announced.

The School of Physics has received funding from the University of Melbourne to bring two Nobel Laureates to Melbourne during 2005. The School is currently in negotiation with a number of potential visitors. Once confirmed, we will widely advertise the public events and talks to be presented. Keep your eye out for details!

July Lecture Series 2005 - July 1st, 8th, 15th and 22nd.

In 2005, as part of the IYP2005, the July Lecture Series: Einstein's Ideas Explained



will cover the light quantum, special relativity, Brownian motion and the link between energy and matter as a celebration of the amazing work of Albert Einstein. The lectures will also tour nationally.

Events for school children and the general public.

The School of Physics is running a broad range of public outreach programmes as part of the IYP2005. The highly successful MUPPETS programme will reach more primary school students than ever before. We are also running a high profile day in conjunction with the City of Melbourne for the general public and high school students.

Websites.

To get up-to-date information on Melbourne, Australian and worldwide International Year of Physics events, visit these websites:

<http://www.einstein2005.org.au>
<http://www.aip.org.au/wyop2005>
<http://www.physics2005.org>
<http://www.wyp2005.org>

School of Physics
<http://www.ph.unimelb.edu.au>

Text Copyright the School of Physics, The University of Melbourne 2004. Authorised by Geoff Taylor. Edited by James McCaw. Published by the School of Physics. Contact alumni@physics.ph.unimelb.edu.au

The information in this publication was correct at the time of printing. The University reserves the right to make changes as appropriate.

