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M.Sc. in Medical and Health Physics

From 1992 this three semester course will be offered by the Department of Physics and Mathematical Physics, University of Adelaide and the School of Applied Physics, University of South Australia, in cooperation with the Department of Medical Physics, Royal Adelaide Hospital. It is designed for Physics (Honours) graduates or Physics graduates with appropriate experience to train for a medical or health physics career.

The course comprises four core subjects:
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- Physical Measurement & Instrumentation
- Radiation Biology, Epidemiology & Radiation Protection
- Anatomy & Physiology

Plus two specialist options chosen from the physics of:
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- Nuclear Medicine
- Radiology
- Lasers
- Environment, Mining & Health
- Non Ionizing Radiations

The core subjects and options will be taken during the first two semesters. In addition a short research project will be undertaken either in the Royal Adelaide Hospital or other approved institution during the third (summer) semester.

For more detailed information please contact:
Associate Prof. Alun H. Beddow, Department of Medical Physics,
Royal Adelaide Hospital, Adelaide SA 5000
Phone: 224 5536 Fax: 223 2071 or other University Department Co-ordinator
J. R. Patterson: phone: +61 8 228 5996 or D. Paix: phone: +61 8 343 3040
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The cover picture this month shows the recovery of KARIWARA during research and development trials on HMAS OXLEY. KARIWARA is the new generation slim-line acoustic array which can be towed by surface ships or submarines. It was designed by DSTO for detection of surface and undersea vessels.
PRESIDENT'S COLUMN

The Joy of Postgrads

This month's column contains two key messages. Firstly there is a word on the survey enclosed two months ago. Then it's postgraduate education and what you can contribute to education in general.

Thank you to all those who have returned the questionnaire. The response so far has been excellent, but that is no reason to stop! If you have not filled it in please do so, but even more important, pass it on. We need to know as much as possible about physicists in industry - whether or not they are AIP members. By design the initial questionnaire was brief but we will be able to follow it with more specific enquiries. Already it is apparent that there is a wealth of untapped talent willing to help in our schools.

Our annual postgraduate survey appears this month. For many of us employed in universities, the chance to work on front-line research problems with postgraduate students is a real joy. Of course they can be demanding, stubborn and occasionally slow, but mostly they are a delight and an inspiration. We must continue to encourage our best students to pursue Ph.D. studies, while ensuring that their eyes are open to the much wider career prospects outside of academia.

Australia will not be a truly clever country until like Philips, Volkswagen and other large companies in Europe and North America, our companies fight to recruit our best Ph.D. graduates.

Of course, prospective Ph.D. students are not spontaneously created. They are the end products of a continuous process of education lasting some sixteen years. Unfortunately, as the world's store of knowledge in physics increases, our school system seems to be seying away from difficult subjects like mathematics and physics. In South Australia the time devoted to science and maths in junior secondary schools has been cut by more than 30% over the past twenty years. So called reforms in post-compulsory education will see cuts of 15-20% there too. It is a major challenge to all of us to maintain the standards of our degrees in the face of reduced resources as well as this decrease in preparation.

Part of the answer is for all of us to put a little more inspiration into our teaching. We work in physics not because it's a job but because we love it! Let's try to communicate that feeling at all levels, primary, secondary and tertiary. If you are in CSIRO or government or private research and/or development, consider putting a little of your time into communicating your excitement to some students - at whatever level seems most appropriate. It is also time to look at our degree structures to see whether they are still appropriate to the students we receive. Finally, for us as members of an Institute of Physics, there is a need to re-examine our criteria for membership. Our Registrar and his committee are looking at all aspects of admission in the era postdawkinsisation and both he and I would welcome your views.

Tony Thomas
Honorary President

10TH NATIONAL CONGRESS

Papers needed on The History of Physics in Australia and New Zealand

Many members will be aware that the 10th National Congress of the Institute is to be held at the University of Melbourne from 10 to 14 February next year. Many sessions are planned, nearly all naturally related to the practice of physics R & D, physics teaching, etc.

May I use your columns to reach a wider audience - not necessarily part of the daily physics network - to invite contributions to the Congress session on the History of Physics in Australia and New Zealand.

Emeritus Professor Bolton has regrettably had to step down as coordinator for this session, and I have agreed to take over. Do write to me if you would like to present a paper at the Congress on the history of Australian and New Zealand physics.

John Jenkin
Physics Department
La Trobe University
Victoria, Australia
Research Excellence or Research Priorities

Many of the current Federal Government pronouncements relate to research priorities. The ARC has its priorities panels, which seem to have a passing relationship to Federal Government identified areas in which there might be an advantage were Australia to develop instantaneous and world beating research teams. DITAC identifies areas in which these might be commercial advantage, but be quick, the identified areas may change next month. CRC's are chosen with a view to the priority they establish with respect to commercialisation of their research programs.

The identification of priority areas is an important task for the Government, if only it would do the job properly. While different departments may have different priorities, surely this should still lead to the definition of broader based areas of emphasis rather than a series of related areas - related in subject but mutually exclusive between departments for funding. The Government must also remember it is picking priorities for research, not guaranteed winners. It must remember that priorities cannot change at the whim of a minister or his/her current chief adviser (especially when the adviser is an accountant). The identification of priorities on the basis of an argued and agreed program over a decade or so would be welcomed by all researchers.

The reason I started to think about priorities however came not from recent proclamations of DEET,DITAC, ARC, ASTEC or any other synonym. It came from advice from the AVCC, the bastion of academic excellence, who declare that, in respect of nominees for awards under the Overseas Postgraduate Research Award Scheme (OPRA'S) the University must declare that each applicant nominated for an award will be studying in a University priority area.

I would be crass as to suggest that, with the current shortage of support for post graduates, every area attracting high quality postgraduates is by definition a University priority area for research.

DEET follows quickly on the heels of the AVCC (it is usually the other way around) and declares that it will advertise the areas of priority in research for each University in respect of research but (please?) do not nominate more than 30% of your research areas as being priority areas.

The award of scholarships is about academic excellence. I have had some trouble in the past when the only criterion was academic excellence. I would have liked to have the freedom to recommend the distribution of awards to applicants on the basis of their excellence and the excellence (priority?) of the research group with whom they would wish to work. This would have allowed me to distribute scholarships among applicants who are almost equal in ability in such a way that the benefit of the awards and the scholar is not concentrated in either time or area of interest. But academic excellence must reign supreme.

Currently this ensures most recipients who gain awards are first class honours graduates.

I would prefer however to be able to determine academic excellence in the light of academic record and ability to survive and perform well in a postgraduate program. At the moment, H2 (A) students in my University do not fare well in receiving scholarships. Yet they are often superb research students. To accommodate the numbers of potentially excellent researchers currently applying for support, the Federal Government would have to double the number of scholarships. First class honours graduates are sometimes not the best researchers and sometimes do not want to work with the best researchers but current guidelines for scholarships do not allow for decisions on the basis of potential.

We are squandering a very important resource if we do not support our H2(A) graduates to the best of our ability. This fact must be brought home to the Government. All of these people (the H2 (A)’s) are potential academics past 1995-1996. We will need them.

R.J. MacDonald
Honorary Editor

Missing Physics

Dear Editor,

I wish to bring to attention a ‘missing’ piece of physics. The new field of solitons has led to much work on the inverse problem of determining the potential φ(r) from the eigenvalue spectrum of the operator (-Δ + φ(r)), in one and three dimensions (1). But no work has been done on the similar problem of reconstructing the vector potential A(r) from the spectrum of the three-dimensional operator (-Δ - A(r))², or on the general one of determining φ(r) and A(r) jointly from the spectrum of (-Δ + A(r))² + φ(r). Gauge invariance implies A(r) is reconstructible at best to within addition of the gradient of an arbitrary scalar function; equivalently we can only hope to determine B(r) = ∇A(r).

The solutions of these inverse problems in their own right, will lead to the solution of new nonlinear partial differential equations.

Anthony Garrett
Dept of Physics & Astronomy
University of Glasgow

Omission!

Dear Editor,

I read with interest the article by Jennings and De Laeter on Physics Enrolments in Australian Tertiary Education Institutions (ANZP May 1991). I am not sure how the data in this article was compiled and checked but at least one institution was omitted. The Footscray Institute of Technology began offering an undergraduate degree in physics (accredited by the Australian Institute of Physics) in 1987. Enrolments in this B.App.Sc. course in 1991 totalled 113 EFTSUs with 27 EFTSUs in third year. There is currently no Honours year but there are 2 masters by research and 2 Ph.D students working in the Department.

It is not accurate to state that RMIT ‘has become the Victoria University of Technology’ as that University was in fact produced by a merger of three partners including Footscray Institute of Technology. With the withdrawal of RMIT from the Victoria University of Technology, the Department of Applied Physics at Footscray Institute > Continued on page 153

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Australian & New Zealand Physicist Volume 28, Number 7, July 1991
OPPORTUNITIES FOR POST-GRADUATE STUDIES AND RESEARCH IN PHYSICS

J. D. Whitehead

ACT
Research School of Physical Sciences
Australian National University
GPO Box 4, Canberra City ACT 2601
Director: Professor J.H. Carver

The School consists of a General Physics Division (applied mathematics, atomic and molecular physics, laser physics, optical sciences, plasma research), and Engineering Division (computer sciences, electronic materials engineering, energy research, systems engineering) and Department of Nuclear Physics and Theoretical Physics.

Scholarships
Australian National University Scholarships and (Australian) Postgraduate Research Awards are available for applicants with first class Honours or good second class Honours, division A and a capacity for research. The School offers assistance to PhD students in the form of Graduate Scholar Assistantships. Some assistance is also available from sources such as grants.

General Physics Division
Department of Applied Mathematics
Head: Professor B.W. Ninham

This Department is devoted to research at the interfaces of sciences where physics, chemistry, mathematics and biology all join. It is not an Applied Mathematics department in any conventional sense. Nor is it one of Physical Chemistry, Chemical and Condensed Matter Physics, Colloid, Surface or Membrane Science or Immunotoxciology. But the groups that form this conglomerate grouping carry out research in all these areas, pure and applied, experimental and theoretical.

Atomic and Molecular Physics Laboratories
Head: Professor R.W. Crompton

Electron Physics
The Group is engaged in experimental studies of low energy (less than 20eV) electron and ion scattering by atoms and molecules with particular emphasis on the study of interactions of relevance to a wide variety of physical phenomena and technological applications. There is also a substantial interest in several aspects of high resolution electron spectroscopy. Close collaboration with theorists engaged in electron and ion scattering problems and transport theory is a feature of the Group’s work.

Diffusion Research
The Unit studies the interactions between particles in liquids, liquid mixtures and solutions by experimental measurements of diffusion, viscosity, conductance and p-V-T properties at pressures ranging from atmospheric to 400 MPa. Theoretical models, some based on computer simulations are being used and developed to complement the experimental work. There is extensive collaboration with overseas laboratories.

UV Light Physics
The Unit undertakes experimental and numerical modelling studies of problems of atmospheric, acoustic and astrophysical significance relating to the interaction of vacuum ultraviolet (VUV) radiation with matter.

Laser Physics Centre
Contact: Dr B. Luther-Davies


Optical Sciences Centre
Head: Professor A.W. Snyder

The Centre performs fundamental and applied research in optical physics and in vision research, stressing interdisciplinary approaches. Work in optical physics concentrates mainly on the theory of wave propagation along special optical fibres and fibre devices which are the building blocks for numerous optical devices and sensors. The Centre’s research in optical fibres is closely linked with experimental efforts worldwide.

The main emphasis in vision is to unravel the strategies of visual information processing of the brain with a view towards developing robotic vision and understanding parallel-processing in visual systems. In this regard, the Centre has a highly sophisticated visual biophysics laboratory and closely collaborates with the members of the Centre for Visual Sciences at the ANU. The Centre also has a strong interest in colour vision.

Plasma Research Laboratory
Head: Dr S.M. Hamberger

The Plasma Research Laboratory investigates plasma phenomena of relevance to a wide variety of applications, including thermonuclear fusion, space physics, and industrial processes. Its experimental and computational research is conducted in cooperation with the plasma physics group in the Department of Theoretical Physics, and in collaboration with other Australian and overseas groups.
LABORATORY IS WELL PROVIDED WITH FACILITIES FOR PLASMA DIAGNOSTICS, DATA ACQUISITION AND HANDLING AND COMPUTING.

ENGINEERING DIVISION
COMPUTER SCIENCES LABORATORY
HEAD: PROFESSOR R.P. BRENT

Computer Sciences Laboratory research is concentrated in: parallel computation, including parallel algorithms and parallel computer architectures; man-machine systems, including computer speech and image processing.

The Laboratory collaborates with the Department of Computer Science (Faculty of Science) and is affiliated with the Centre for Information Science Research.

ELECTRONIC MATERIALS ENGINEERING
HEAD: PROFESSOR J.S. WILLIAMS

Research programs in the department are concentrated on microelectronic processing, III-V semiconductor layer growth, property modification and characterisation of the near-surface of materials. Silicon and gallium arsenide structures are of major interest, but the production and modification of metallic alloys, thin film structures, polymers and ceramics are also under investigation. Strong emphasis is given to MeV ion beam processes (both for material modification and analysis), metal organic vapour phase epitaxial growth and characterisation of III-V semiconductor films, solid state reactions, characterisation of defects, electrical and surface properties of materials and laser processing. The Department interacts strongly with the Microelectronics and Materials Technology Centre at RMIT and with CSIRO.

ENERGY RESEARCH CENTRE
HEAD: PROFESSOR S. KANEFF

Research is directed to gain appropriate knowledge and discover suitable means for developing substantial new energy sources which are benign, sustainable and cost-competitive. Central to this work is basic study into energy collection, conversion, transmission, storage and utilisation, especially involving new concepts; a further feature is the insistence that research findings are useful on a mass scale in the real world. Main preoccupation is with solar, solar derived and thermochemical processes and with thermo and photo conversion to work, electricity and energy rich products.

Basic and Applied studies of new energy sources with emphasis on economic, sustainable and benign characteristics. Studies include sophisticated solar thermal power systems, thermo-chemical energy conversion and storage, and the utilisation of waste industrial heat and waste farm products for energy generation.

The Department collaborates extensively with other universities and receives substantial funds and resources from outside organisations; PhD research and Post Doctoral studies are particularly encouraged.

SYSTEMS ENGINEERING
HEAD: PROFESSOR B.D.O. ANDERSON

The Department of Systems Engineering is a high profile but small department concerned with conducting state-of-the-art research and sponsored work into control systems, signal processing and telecommunications, and involves faculty members, postgraduate students, contract support staff and visiting academics.

DEPARTMENT OF NUCLEAR PHYSICS
HEAD: DR T.R. OPHEL

Study of nuclear structures and dynamics and of ion-solid interactions with beams of heavy ion provided by the 14UD tandem accelerator. Current topics are: investigations of rapidly rotating nuclei at low temperature through gamma-ray spectroscopy, and at high temperature through fission and particle decay; study of hyperfine interactions and applications to measurements of nuclear moments; masses and properties of nuclei far from stability; nuclear shapes and transition moments through Coulomb excitation; resonant heavy-ion reactions; study of Rydberg states with beam-foil spectroscopy; accelerator mass spectrometry, dating with 14C, 13C and development of applications with other radio-isotopes.

DEPARTMENT OF THEORETICAL PHYSICS
HEAD: DR B.A. ROBSON

The Department is engaged in research into theoretical aspects of several branches of physics: atomic and molecular physics, condensed matter physics, nonlinear dynamics, nuclear physics, particles and fields, plasma physics, quantum mechanics and statistical mechanics. A substantial part of the work relates to the experimental interests of the Research School.

ACT
RESEARCH SCHOOL OF EARTH SCIENCES
AUSTRALIAN NATIONAL UNIVERSITY
GPO BOX 4, CANBERRA ACT 2601
DIRECTOR: PROFESSOR K. LAMBECK

The research groups listed below conduct research based primarily upon the application of the principles and techniques of physics to challenging problems in the Earth Sciences.

SCHOLARSHIPS
In addition to Commonwealth Postgraduate Research Awards and ANU Ph.D Scholarships, a limited number of endowed scholarships are available for Honours Year and Ph.D. study.

SEISMOLOGY AND GEOMAGNETISM
LEADER: DR B.L.N. KENNETT

Investigation of the Earth’s internal structure via theoretical and observational studies of seismic wave propagation and electromagnetic induction in the Australasian region.

GEODYNAMICS
LEADER: PROFESSOR K. LAMBECK

Investigation by continuum-mechanical modelling of the processes responsible for deformation of the Earth’s crust and mantle leading to an understanding of phenomena such as the formation of sedimentary basins, and the loading of the lithosphere by seamounts and ice sheets.
**Geophysical Fluid Dynamics**
*Leader: Professor J.S. Turner*

Study of a variety of mixing, convection, and flow problems in fluids via laboratory experimental investigations and theoretical modelling of dynamical processes in the oceans and the Earth's interior. Particular interests: multiphase convection, crystallisation, dynamics of density-stratified flow, effects of rotation on ocean currents, mantle convection and its effects at and near the Earth's surface.

**Petrophysics**
*Leader: Dr I. Jackson*

Experimental investigations concerning the elastic, inelastic and rheological properties of minerals and rocks under the conditions of high pressure and temperature which prevail within the Earth's interior, with applications to seismology and structural geology; transmission electron microscope studies of the crystal defects in important rock-forming minerals and related materials, and their role in geophysical and geochemical processes.

**ACT**
Department of Physics and Theoretical Physics
Faculty of Science, ANU
GPO Box 4, Canberra ACT 2601
*Head: Professor R.J. Sandeman*

**Hypervelocity Aerodynamics and Shock Wave Physics**
High temperature non-equilibrium gas dynamics. Shock wave physics. Laser based diagnostics.

**Laser Physics and Spectroscopy**
Experimental quantum optics, nonlinear high resolution spectroscopy of atoms. Nonlinear propagation effects of light through gaseous media.

**Structure of Atomic Nuclei**
Study of structure of high spin states of nuclei by gamma-ray spectroscopy. Study of light nuclei using a low-energy Van de Graaff; also applied physics.

**Theoretical Physics**
Quantum measurement theory. Quantum optics. Aberrations in geometrical optics.

**Scholarships**
Australian National University Scholarships for the degree of Doctor of Philosophy, Master Degree Scholarships, Postgraduate Research Award Scheme (Commonwealth Government) are all available.

**Astrophysics**
Infrared spectrophotometric and spectro-polarimetric observations out to 22 μm using a unique instrument on large telescopes; composition and physical properties of the interstellar medium gaseous nebulae and "starburst" galaxies.

Infrared studies of star formation regions, interstellar and circumstellar dust and the Galactic Centre including observation and theoretical modelling; laboratory studies of dust particles characteristic of those in the interstellar medium.

Balloon-borne X-ray and γ-ray observations of southern sources and Supernova 1987a; development of improved detectors leading into space operations.

**Scientific Ballooning**
Maintenance and operation of the Australian Balloon Launching facilities for flying large scientific payloads at high altitudes.

**Atmospheric Physics**
Remote sensing of the first kilometre of the atmosphere using Doppler acoustic radar; wind profiles and turbulence para-meters of importance in pollution control and aircraft operations.

**Hyperfine Interactions**
NMR studies of oriented nuclei at millikelvin temperatures and with high magnetic field; measurement of electric field gradients in ferromagnets; observation of spin-spin interactions; search for superconductivity at ultra short wavelengths and gamma ray switching.

Pulsed NMR studies of transition element ferromagnetic alloys.

Specific heat measurements of ferromagnetic and antiferro-magnetic alloys over a temperature range of 0.25-4.2 K.

Mossbauer spectroscopic studies of magnetic and structural properties of amorphous alloys and hydrogen storage systems.

**Solid State Physics**
Temperature modulation methods are used to investigate critical phenomena of elemental metals and amorphous magnetic alloys. Susceptibility measurements of magnetic materials and high Tc superconductors.

X-ray research includes fundamental X-ray dispersion and attenuation coefficients, X-ray topography studying domain structures, X-ray diffraction observation of transition metal compounds and the effects of storage, and compositional analysis of minerals and alloys.

Electron microscope research using scanning transmission electron microscopy and scanning electron microscopy is conducted on a wide range of materials including high temperature superconductors and objects from museum collections.
the structure and stellar populations of the Milky Way Galaxy, the Magellanic Clouds, external galaxies, radio sources, quasars and cosmology.

The Observatories operate 10 optical telescopes (up to 2.3 metre aperture) on Mount Stromlo and Siding Spring Mountain, equipped with modern instrumentation permitting low and high resolution spectroscopy, photometry from near ultraviolet to infrared wavelengths, and faint object imaging. There is access to the 3.9 m Anglo Australian Telescope and the 64 m Parkes Radio Telescope while staff and students at MSSSO seek and are given access to overseas ground-based facilities such as the infrared facilities on Hawaii, the Kuiper Airborne Observatory, and the Very Large Array in the USA together with space-based facilities such as the International Ultraviolet Explorer, and X-ray and infrared satellites.

Theoretical work is currently being done on plasma astrophysics, stellar atmospheres, stellar and galactic evolution, galactic dynamics, and cosmological modelling. Powerful computing facilities (VAX 11/785 and 8700, Fujitsu VP100 and microcomputers) are available for data acquisition and reduction and theoretical model building.

Scholarships and Support

There is a postgraduate (PhD) student body of 22 at the Observatories. Scholarships supporting the PhD course are available through the APRA Scheme and directly through the Observatories. A Vacation Student Program for third year physics, mathematics or engineering students is conducted each year between December and March.

The School of Mathematics, Physics, Computing and Electronics
Macquarie University NSW 2109
Head: Professor J.A. Piper

The areas of physics research within the School are as follows:

Astronomy
Observations of variable stars, radio observations of active stars, computer control of data acquisition and telescope move-ment, astronomy.

Laser Physics
(including the Commonwealth Special Research Centre for Lasers and Applications).

Metal-vapour lasers (gold, copper, barium, strontium, calcium), excimer lasers, dye lasers, frequency shifting of laser outputs, soft-X-ray-excited lasers, tunable solid state lasers, infrared and waveguide lasers, nonlinear optics, optical design, laser-light scattering, industrial and medical applications of lasers.

Magnetism
Applications of magnetic materials in solid-state high-speed pulse circuits.

Materials Physics
High temperature superconductors, ceramic/polymer composites; electronic optical mechanical and thermal properties of conducting polymers; dielectric, electro-optic and piezoelectric properties of ferroelectric polymers, laser ablation of polymers, dielectric behaviour of oils.

Quantum Optics
The theory of the spectrum of a quantised light field, correlation properties of frequency-filtered light, studies of joint correlations between photons and photoelectrons in multiphoton ionisation, microscopic model of a maser.

Solid State Physics
Graded AlGaAs heterostructures, liquid-phase epitaxial growth, radio-frequency reactive sputtering, photodissociatively deposited nitride dielectrics, high-mobility semiconductors, cryogenic measurements, quantum theory and transport theory for electrons and phonons in imperfect crystals.

Theoretical Physics
Quantum theory and quantum electrodynamic effects of enclosed flux, scattering theory and group representations.

Scholarships
Commonwealth Postgraduate Research Awards, Macquarie University Postgraduate Research Awards.

NSW

School of Physics
University of Sydney, NSW 2006
Head: Professor L. Cram

Applied Physics
Optical, electrical and structural properties of thin films and applications to photothermal and photovoltaic devices; heat transfer; gas adsorption in thin films; molecular dynamics; transducers and instrumentation.

Astronomy
Stellar photometry and very high angular resolution stellar interferometry; fundamental stellar properties and astrophysics.

Astrophysics
Studies of radio emission from the Sun, stars, pulsars, super-novae, galaxies and quasars with the Molonglo Synthesis Telescope and the Australia Telescope; optical spectroscopy of high-redshift quasars using the Anglo-Australia Telescope.

High Energy Physics
Underground observations of solar neutrinos, emulsion studies of neutrino interactions, cosmic ray air showers, particle detector development.

Modern Optics
Optical instrumentation, Fourier optics, development and applications of scanning optical microscopy.

Optical Fibres
Fabrication and theoretical modelling of special fibres, non-linear and lasing effects, optical fibre based sensing devices.
Plasma Physics
Tokomak studies of wave-plasma interactions, development of plasma diagnostics, gyrotron and laser development and applications, laser and spectroscopic studies of magnetron sputtering and arc discharges.

Theoretical Physics
Plasma astrophysics, non-linear plasma theory, processes in laboratory plasmas, optical properties of surfaces, electro-magnetic scattering theory, optical fibre theory, transport properties of composite materials, quantum electrodynamics.

Scholarships and Support
CPRA and University Postgraduate Research Awards (the latter being restricted to candidates ineligible for the former). The School of Physics provides excellent research facilities and support from academic and technical staff.

Advanced Electronic Materials
High temperature superconductors, optical and optoelectronic ceramics, rare earth compounds and glasses, magnetic films, synthetic superlattice structures.

Applied Physics
Acoustics, mechanical properties of materials, polymers.

Astrophysics and Optics
Optical infra-red and radio-astronomy, automated telescope operation, laser photochemistry and industrial laser applications, optical and infrared detectors, atmospheric remote sensing.

Biophysics
Structure and properties of biological membranes; in-vivo NMR spectroscopy and imaging; x-ray diffraction, electrical cell fusion, molecular biology.

Condensed Matter
Surface and thin film physics, solar cells, semiconductors, magnetic materials, crystal growth and crystallography, materials irradiation, energy studies, superconductors, ion implantation.

Theoretical Physics
Laser-plasma interactions and fusion, condensed matter theory and statistical mechanics, particles and fields, atmospheric and ionospheric physics.

Scholarships and Support
University of New South Wales Postgraduate Scholarships, similar to Commonwealth Postgraduate Research Awards. Supplementary scholarships include those offered by the Faculty of Science and Gordon Godfrey Scholarship in Theoretical Physics. Most postgraduate students undertake some part-time teaching in the School.

NSW

Department of Applied Physics
University of Technology, Sydney
PO Box 123, Broadway NSW 2007
Head: Associate Professor A.R. Moon
Postgraduate Coordinator: Dr J.M. Bell

Applied Physics
The major research interests of the Department are in the areas of materials technology, electron microscopy, physics education, theoretical physics and computational physics. There are several major funded research projects currently underway in all these areas, and several of the projects link closely with industry. There is also significant interaction between members of the Department and other research organisations such as CSIRO, ANSTO and other Australian universities. Extensive experimental facilities and computing facilities are available within the University and through external collaboration.

Some of the research projects underway are:

Materials Technology and Electron Microscopy
Inclusions, defects and optical properties of high temperature ceramic materials; optical and electronic thin films; x-ray and neutron diffraction studies of materials; high temperature superconductors; structural studies of the stability of SYNROC; electrochromic and angular selective window coatings; solar energy technology and photovoltaics.

Theoretical Physics and Computational Physics
Electromagnetic methods in geophysical exploration; satellite data retrieval; climate modelling; fractals and chaos in solid state physics; Monte Carlo simulation of high Tc superconductors; defects and impurity states in semiconductors and insulators and image analysis.

Physics Education
Computers in science education; cross-cultural science education; diagnostic testing of science students as a guide to teaching strategies.

Scholarships
Candidates for Postgraduate Degrees are eligible to apply for Commonwealth Postgraduate Awards and University Awards. Part-time study is available to all Postgraduate courses, and some positions may be available from time to time through funded research projects.

NSW

Department of Physics
University of New England
Armidale NSW 2351
Head: Professor S.C. Haydon

Gaseous electronics, including gas discharges, plasmas and lasers; solid state physics; ionospheric physics. Specific current interests include:
Nanosecond time-resolved optical studies of ionised gases; laser-induced opto-galvanic studies, the role of metastable excited states in...
conduction through gases; discharges in highly electronegative gases and vapours; energy transfer in corona discharges; development of optical measuring techniques for discharges and plasmas; the role of rotating magnetic field current-drive in high temperature confined plasmas.

Theoretical studies of hydrogen in metals, diffusion of atoms in crystals and nuclear spin relaxation in solids; ultrasonic wave propagation in powders and aerogels.

Total electron content using satellite radio signals; F-region dynamics, analysis and theory of geomagnetic variations.

Scholarships
In common with other Australian universities, the University of New England offers Commonwealth Postgraduate Research Awards. Also available are University of New England Research Scholarships. The stipend and other allowances for both are very similar and are currently under review. Applications for both normally close on 31 October in the year preceding the year in which candidature commences. The opportunity for research students to undertake paid casual teaching also exists.

**NSW**

Department of Physics
University of Newcastle
Rankin Drive, Shortland NSW 2308
*Head: Dr D. J. O'Connor*

**Surface Physics**

Ion-surface interaction: low and medium energy ion-surface scattering for composition and structural analysis; electron exchange processes in ion-surface interaction; molecular effects in ion-surface scattering; sputtering and secondary ion emission; excited state distributions in sputtered atoms.

Ion implantation: recoil implantation from thin films; ion mixing and radiation enhanced diffusion; surface property modification.

Electron surface interaction: low energy electron diffraction; Auger electron spectroscopy; electron loss spectroscopy; x-ray photoelectron spectroscopy and scanning Auger microscopy; electronic structure of transition metals and compounds; surface compositional analysis of alloys.

**Space Plasma Physics**

Generation and propagation of ULF waves in the earth's magnetosphere and ionosphere; heavy ion effects; ground-based spatial studies of geomagnetic pulsations; ground-space-craft correlations.

**Theoretical Studies**

Total energy calculations of semiconductor surface topologies; adsorbates on semi-conducting surfaces; hydrogen in metals and electronic band structure calculations.

**Postgraduate Scholarships**

Commonwealth and University of Newcastle Postgraduate Scholarships are available university-wide on a competitive basis. The Department may offer a Schmidt Postgraduate Scholarship for studies in space plasma physics.

**Astronomy and Astrophysics**

Infrared mapping and spectroscopy of star forming regions; applications of image digitising and analysis systems to the measurement of astronomical, survey plate material and archival storage; industrial applications of image analysis; photometric and spectroscopic studies of long period variable stars in the Magellanic Clouds; observational studies of extragalactic dynamics and gas dynamics.

**Nuclear Physics**

Neutron capture cross-sections, aspects of nuclear fission and reactor physics.

**Solid State Physics**

Piezo- and magneto-optical studies of the electronic states of impurities in semiconductors by far infrared spectroscopy; laser induced photoluminescence of compound semi-conductors, superlattices and quantum wells and the effects of hydrogen passivation on these materials.

**Theoretical Physics**

Theoretical studies of extragalactic dynamics and gas dynamics; computation of fundamental quantities of atomic systems; group theoretical analyses of the effects of perturbations on energy states and optical transition probabilities of various solid state phenomena; calculation of the band structure and properties of associated spectral features for semiconductor superlattices.

**NT**

Research School
Faculty of Science
Northern Territory University
PO Box 40146, Casuarina NT 0811
*Contact: Dr J. Singh*

Theoretical solid state physics; excitons, amorphous materials, solar cells; opto-acoustic and pump-probe modulation spectroscopy, CO₂ and SMM lasers; electromagnetic radiation, array design, VLF radio propagation.

**Scholarships**

NTU offers three scholarships every year. Contact: Registrar.

**QLD**

Department of Physics
University of Queensland
St. Lucia QLD 4067
*Head: Associate Professor J.S. Mainstone*
OPPORTUNITIES FOR POST-GRADUATE STUDIES AND RESEARCH IN PHYSICS

Astrophysics
Transfer of radiation through outer layers of the sun and stars; cosmic abundance, experimental determination of relevant atomic properties.

Geophysics
Testing Newton’s law of gravity, using a hydroelectric reservoir, and a mine; thermal properties of the earth, earthquake prediction, rock physics and magnetotelluric studies.

IR and Sub-mm Laser Physics
Nonlinear optical effects in semiconductors using a pulsed CO₂ laser; discharge and optically pumped sub-mm lasers; non-linear dynamics in lasers; propagation of radiation in waveguides; microwave studies of fluidised beds.

Marine Physics
Water flow in rivers and estuaries, hydraulic models; studies of dispersion coefficients; generation and propagation of waves in bounded sea.

Solid State Physics
X-ray and thermal neutron crystallography; structural phase transformations, molecular orientations, order-disorder, computing techniques.

Space Physics
E and F region disturbances using an advanced ionosonde, a large HF steerable radar and a computerised phase ionosonde; physics of sporadic E clouds and their stability; generation of travelling disturbances in the auroral zone. The radar will be used in 1990 to measure D region winds and detect ocean waves. In 1992, it will be used with a VHF radar to study E region instabilities.

Theoretical Quantum Optics
Interaction of light with atomic and molecular systems; multi-photon processes, non-classical radiation fields, squeezed states.

Scholarships and Support
As well as Commonwealth Postgraduate Research Awards, several students in Space Physics and Laser Physics have been supported by DSTO Cadetships.

Materials and Solid State
Microstructural and physico-chemical studies of ceramics, oxides, semiconductors, sulphides and glassy metals using analytical electron and tunneling microscopy and surface analytical techniques; electronic structure of high temperature superconductors; solid-state near surface and surface reactions practice and theory; STEM applications to near surface physics and ultra-fine line lithography; novel semiconductor devices and device structures; metal hydrides for hydrogen storage; small-angle neutron scattering; neutron and x-ray diffraction; magnetic materials.

Radio Physics
Low frequency electromagnetic techniques in geophysics; antennas and communications.

Laser/Atomic Physics/Collision Physics
The Laser Atomic Physics Laboratory undertakes research into electron-atom collision processes and laser-atom interactions.

Electron-atom collision processes with emphasis placed on the application of laser techniques to collision studies; stepwise electron-photon coincidence methods using laser techniques; super-elastic electron scattering studies from laser-excited atoms and electron-Auger electron coincidence experiments on atoms.

Laser-atom interactions; theory of atom-laser light interactions; laser beam manipulation of atoms and light traps; experimental tests of theory, laser spectroscopy and applications to atomic collision studies.

Theoretical Physics
Vibration theory and acoustics; solid-state and surface theory; theoretical quantum optics, interaction of radiation with atoms.

Medical Physics
Medical imaging; physiological measurements; occupational assessment of toxic heavy metals through in-vivo analysis; nutritional status analysis studies in children and animals utilising total body potassium measurements; biochemical techniques and thermal neutron capture gamma ray analysis; evaluation of radiological hazard from radiological dust associated with airborne dust in mines; low level radiation determination; environmental modelling and monitoring studies relating to daylighting, air and pollution dispersion etc.

Note: A Medical and Health Physics Centre located within the Department provides a focus for fostering through education, research and development, the application of physics to clinical and occupational health areas of our society.

Materials Studies
Utilising XRF, XRD and neutron activation analysis and other techniques; such studies are undertaken in both laboratory and industrial settings; studies involved in characteristics of modern materials, e.g., characterisation of shock wave formed materials from powders.

Imaging Studies
Being developed with the co-operative participation of a range of other professionals --- engineers, computer scientists, medical scientists, etc, with application to medical physics and materials performance.
Post Graduate Programs

Masters Degree - in addition to a program involving research and a thesis, programs involving course work and research project lead to the award of M.App.Sc. (Medical Science) with specific strands in Medical Physics and Medical Ultrasound. A candidate who exists after satisfactory completion of Stage I of these programs can be awarded a Graduate Diploma. Ph.D. programs are available in the areas cited above.

Scholarships and Support

Financial support during the period of the above studies is available on a competitive basis via the Australian Government Scholarships, the Owen J. Wordsworth Memorial Scholarship, and those funded by research grants. Some additional support can be obtained through the candidate undertaking a limited amount of tutoring in the Department.

QLD

Department of Physics
James Cook University of North Queensland
Townsville QLD 4811
Head: Professor M. Heron

Oceanography and marine meteorology involving HF radar backscatter; coastal sediment dynamics; boundary layer meteorology; line broadening of atomic spectral lines due to temperature and pressure effects; low energy elastic and inelastic gamma ray scattering measurements and studies of theoretical models; theoretical physics of ion mobility in gas discharges; elementary particles.

Scholarships

Australian Postgraduate Research Awards; James Cook University Scholarships (set annually to be of similar value to APGRA); Physics Department Scholarship. Some projects in the Physics Department are attracting financial support from industry and government agencies.

SA

Department of Physics and Mathematical Physics
University of Adelaide
Box 498 GPO, Adelaide SA 5001
Chairman: Professor A.W. Thomas
Vice-Chairman: Dr L.R. Dodd

The major areas of research activity in the Department in 1990 will be: Atmospheric Physics, High Energy Astrophysics (and Cosmic Rays), Mathematical Physics, Theoretical Nuclear and Particle Physics, Ultra-Violet Physics. In addition, following the retirement of Professor Prescott at the end of 1989, we shall establish a new experimental group in either condensed matter physics or modern optics.

Atmospheric Physics

The atmospheric physics group uses ground-based radars to study the dynamics of the atmosphere at locations within Australia, in the Antarctic and at the Equator. Three radars, located at a field site near Adelaide operate at frequencies of 2, 6 and 54 MHz; the 2 and 6 MHz systems use a 1 km diameter antenna array which is the largest of its kind in the world. Together, they are used to investigate dynamical coupling between different atmospheric regions, the meteorology of the lower atmosphere, turbulence and meteors.

High Energy Astrophysics and Cosmic Rays

This group has recently completed a major new telescope for studying very high energy gamma-rays (~10^9 eV) and an observing program has begun. At higher energies (~10^8 eV) photons are being observed from neutron star binary systems. Measurements are also made of the cosmic ray isotropy and spectra at these energies. The observational work is complemented by theoretical studies of both the sources and the detection processes.

Mathematical Physics

Research within the group covers a wide range of interests in mathematical physics. Particular areas of current interest are field theoretical models of hadron and nuclear structure, algebraic methods in statistical mechanics and quantum field theory, general relativity and cosmology.

Theoretical Nuclear and Particle Physics

Our concern is with the structure of matter at its deepest levels. Particular areas of interest include supersymmetry, chiral symmetry, chiral quark models (including chiral solitons), deep-inelastic scattering and structure functions as well as intermediate energy physics. We have very close contact with overseas centres, notably CERN, Los Alamos, Saclay and TRIUMF. Approximately a dozen overseas scientists spend at least a month each year working in this group.

Ultra-Violet Physics

This group studies atomic and molecular quantum states by experimental measurement and theoretical modelling of the absorption of ultraviolet radiation by atoms and small molecules. The experimental program is based on several vacuum ultra-violet monochromators, including a 6.7 m instrument. These instruments are equipped for high precision absorption measurements, photo electron spectroscopy and molecular beam studies. The theoretical modelling work is concerned with resonant processes such as predissociation and autoionisation, and is related closely to the experimental program.

Physical Archaemetry

The physics of thermoluminescence, and its application to archaeological and geological dating, are the main activities of this group.

Medical Physics

Research in some areas of medical physics is carried out as a joint activity with the Department of Medical Physics at the Royal Adelaide Hospital.

Scholarships

Students within Australia are, of course, encouraged to use a Commonwealth Postgraduate Award to study at the University of Adelaide. In addition the university offers a number of postgraduate scholarships each year. The stipend is presently under review, but is generally very close to the value of the Commonwealth Scholarship.

SA

Discipline of Physics
School of Physical Sciences
Flinders University of South Australia
Bedford Park SA 5042
Head: Professor I.E. McCarthy
Experimental
Atomic and molecular reactions with electron beams; electron momentum spectroscopy involving the measurement in coincidence of the momenta and energies of all continuum electrons in a high-energy symmetric ionisation experiment; electron swarm physics using a technique of measuring electron distributions by observing the photons produced in reactions; gas discharge tomography and analogue imaging devices; plasma physics research which is concerned with an investigation of a method of driving plasma currents by use of the Hall term; the application of this technique to the generation and sustenance of compact torus and tokamak configurations.

Theoretical
Atomic scattering theory; nuclear theory involving the study of the pion-two nucleon system; quantum field theory; the application of functional integral techniques to quantum chromodynamics; theoretical plasma physics focussing on the stability of resistive plasmas and the generation of plasma currents by means of the non-linear Hall term.

Electronic Structure of Materials Centre
This is a Centre of Excellence specially funded by the Australian Government. Its purpose is to develop the instrumentation and computer programs for investigating the electron spectroscopy of solids and to use them to discover the electron motion and correlations in semiconductors, superconductors, metals, magnetic materials and surface-adsorbed molecules.

Scholarships
The closing date for applications for Commonwealth and Flinders University scholarships is October 31 in each year. Initial enquiries to the Co-ordinator of Physics are welcomed.

WANTED
Interesting transparencies or good colour photographs to be used for the Physicist front cover.
Please send submissions together with a descriptive caption to:
Production Manager
Australian & New Zealand Physicist
Imprint Studios, 41 Kemp Street
The Junction NSW Australia 2291

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and prepare your typewritten / word processed submissions to the editorial committee in the following way: lines of type 1 1/2 or double spaced, an extra return to show paragraphs and no indents unless absolutely necessary.

*To maintain a high quality journal we require original copies of pictures or diagrams; not photocopies!

SA
School of Physics
South Australian Institute of Technology
The Levels, PO Box 1, Ingle Farm SA 5098
Head: Associate Professor G.L. Goodwin

Research and development work is aimed wherever possible at practical applications of Physics. Projects underway are as follows:
- Solar irradiation measurements applied to primary industry;
- Solar ultra-violet measurements in South Australia;
- Micro-barograph recording of atmospheric disturbances, particularly related to weather fronts;
- Development of a digitally-coded ultrasonic underwater communication system;
- Development of an underwater diver acoustic navigation and surveying system;
- X-ray beam filtration and diagnostic radiology; assessment and development of optical systems of infrared radiometers; temporal characteristics of an extended ionosphere with application to long-distance radio communication;
- Measurement of radon gas concentrations in dwellings; x-ray crystallography and studies of organic compounds; optical studies of excitable membranes;
- The characteristics of Hall effect magnetic sensors; thermal and electrical circuit modelling of metal vapour lasers and diagnostic development of metal vapour systems.

TAS
Department of Physics
University of Tasmania
GPO Box 252C, Hobart TAS 7001
Head: Dr P.A. Hamilton

Astrophysics Groups
Optical astronomy and optics, radio astronomy and radio-physics, cosmic rays, X-ray and γ-ray astronomy. Projects range from techniques and instrumentation through to theoretical studies of the astronomical objects concerned. Available instruments include a 1-metre optical telescope, 26-metre and 14-metre radio telescopes, a 0.25 m² X-ray telescope and a range of cosmic ray detectors and telescopes. Current projects concern variable stars, X-ray and radio pulsars and collapsed objects, active radio sources using VLBI techniques, cosmic ray anisotropies and high energy particles from astronomical sources.

Theory Group
Gauge theory and supersymmetry, including electrodynamics, chromodynamics, flavour-dynamics and gravitation. Topics of current interest include the realisation of the quantum versions through dimensional reduction and non-perturbative solutions of gauge. Supersymmetric aspects of these theories are under study as well as more formal group theoretical aspects of superlie algebras and their applications. Chaotic behaviour in one-dimensional maps is also being studied.

Biophysics Group
Electric characteristics of plant cells and tissues. Current studies include the uptake of nutrients in growing roots, electrical changes induced by light stimulation of pigments and biological clocks in plants.
J. D. Cashion
Department of Physics
Monash University

The recent development of windsurfing has been one of the most innovative changes in the modern history of sailing. The concept of being able to steer a small yacht without the aid of a rudder required a real stroke of lateral thinking, even if there is evidence that the idea is thousands of years old, and, for our purposes, the dynamics of windsurfing provides many excellent examples for teaching the principles of physics. The rudderless steering was necessary, of course, to allow the sailor to have both hands free for the all-encompassing task of controlling the sail. The resulting freedom of action provides the sailor with a greater feeling of being alone in contest with the elements than probably any other sport. This "aloneness" is notwithstanding the fact that windsurfing now uses one of the widest ranges of high-tech equipment in its rapid rise to being one of the glamour sports of the moment.

The principal external force on the system of board + rider is clearly the wind and it is the rider's job to try and maintain a dynamic equilibrium of both forces and moments along or about the three principal axes. The dynamics of windsurfing really fall into two main regimes separated at a wind speed of about 10 - 15 knots with a further regime above about 25 knots in which the wave-jumping action takes place as shown on television. In this article I will only deal with the low speed regime because it is the easiest for non-participants to visualize. I will apologize in advance to the knowledgeable in the field. The article is not intended for them but for the many, like me, who did not sail in their youth and are faced with explaining the theory to students, many of whom know much more about the practicalities.

At the low speeds of the first regime the board does not plane and the sensations are more similar to yachting than at higher speeds. Conceptually, I consider that the riders' technique changes at this 10-15 knot mark from the role of a driver in charge of a machine to one where the rider and board must work as one. As an illustration of this, I can remember the alteration in my attitude when the thinking
changed from 'Let's steer the board over there' to 'WE will go over there'.

The basic physics of sailing is explained with the help of a vector diagram. The wind direction is shown to be from WSW, which means it is coming from the southwest. The wind vector is then added to the boat's velocity to get the apparent wind. This apparent wind is what the sailboat is actually facing. The illustration shows the wind vector with a corresponding velocity vector for the boat, resulting in a resultant vector, which is the apparent wind.

The diagram also includes a section that explains the concept of the board's velocity and apparent wind. The board's velocity is shown as a vector that is added to the wind vector to get the apparent wind vector. This is shown in the diagram with arrows indicating the direction and magnitude of each vector.

The article discusses the importance of understanding the wind direction and velocity for effective sailing. It explains how the wind direction is not constant and can change throughout the day. The sailboat's velocity and the apparent wind velocity are both important factors in determining the boat's course and speed.

The article also provides an equation for calculating the apparent wind:

\[ y = 0.4 \times x \]

This equation is used to determine the apparent wind direction and magnitude. The article goes on to explain how this calculation can be made easier by using a graph paper and measuring the angles and distances involved. It also explains how the equation can be modified for different wind conditions to achieve the desired results.

The article concludes with a brief summary of the key points discussed, emphasizing the importance of understanding the wind and its effects on the sailboat's performance. It encourages readers to practice and experiment with different techniques to improve their sailing skills.

The article is written in a clear and concise manner, making it easy for readers to understand the basic physics of sailing and how it can be applied to different situations. It is a great resource for anyone interested in improving their sailing skills or simply learning more about the sport.
small adjustable centreboard which projects down through the centre of the craft. Its sideways force on the water (to the right) reduces the sideways movement, while the sideways force (to the left) counteracts the rotation about the long axis of the board. The opposite effects on the daggerboard mean that the sideways force on it is not nearly as severe as those on the mast. The turning torque about the sideways horizontal axis is negligible compared to the reaction available from the relatively flat water at the speed considered, but it is countered at higher speeds by the rider moving to the rear of the board.

The daggerboard also serves to define a vertical rotation axis about which we can turn the board. The significance of being able to move the centre of effort along the board is now clear: the direction of the torque about the daggerboard can be reversed depending on whether the centre of effort is forward or aft of the vertical rotation axis. Thus we can steer the craft; tilting the mast forwards steers the board away from the wind (bearing away), while tilting it back steers towards the apparent wind (luffing up). In practice, this torque turns the board relatively slowly unless it is aided by the rider. This assistance can be generated by pushing forwards with one foot and back with the other and, at higher speeds, by tilting the board about the longitudinal axis so that it rides more on the edge (rail) which will be on the inside of the turn (compare with edge control in skiing).

It is important to keep the position of xE approximately midway between the position of the hands on the boom, which can involve moving the hands if the rake angle of the mast is made large. The rear hand adjusts the angle of the sail chord to the apparent wind which determines what proportion of the available wind power you will use. For example, if a sudden gust of wind hits the sail and accelerates it then unless the rider can ensure (by leaning back) that the acceleration also occurs to both him and the board, then the sail will be blown over the far side of the board, possibly taking the rider with it. The corrective measure is to release some of the tension maintained with the rear hand and thus keep constant the total wind force being used to propel the board.

By using these simple principles of forces and moments the board can be manoeuvred about by tacking and gybing in what I call a relatively quasi-static mode, with the board usually becoming stationary at some point in each course change across the wind direction while the rider walks around the mast. In a future article I will deal with the situation in higher winds when the forces and moments are much larger. In these circumstances the use of a harness becomes necessary because even the strongest person cannot maintain for more than about an hour the arm and shoulder effort required to keep control of the rig.

Photographs by W. Thompson

Send articles devoted to physics education at secondary level to:
The Editor
The Australian & New Zealand Physicist
Department of Physics
University of Newcastle NSW 2308
Phone (049) 21 5442
Fax (049) 21 6907

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OLYMPIAD exciting opportunities for students

Many teachers and students are unaware of the involvement of Australia in the International Olympiad programs and of the increasing success of Australia in these competitions. In recent copies of The Australian Physicist we have published reports of the rankings and reproduced the question papers. It will be obvious that the final competition is only for gifted individuals in the areas of Physics, Chemistry and Mathematics. Many people will be unaware however, of the advantages which can follow from involvement in the selection process.

The initial advertisements for nomination to be included in the group from which selection is made are distributed to schools at about the same time as the notices advertising the National Science Summer School held each January in Canberra. Indeed Dr. Jory, who organises the National Summer Science School, also organises the Olympiad team and travels with the team to the nominated venue. The selection procedure involves participation in a central school in Canberra at which students are given trial questions and laboratory exercises as well as an intensive instruction program in Physics. Students who are successful in selection for the team will be roughly at or above the level of a first year University student, when they leave for the Olympiad itself.

Universities and various schools have now realised the benefits of training for the Olympiads and a number of Universities in particular now offer extension courses in Physics, aimed at preparing students for the selection process. While five students ultimately will be selected for the team, the training groups by now would total 100 students or more and are expected to increase further over the next few years.

Students involved in the selection process are exposed to a real challenge and obtain a significant advantage in their understanding of Physics through the extra courses and tutorials to which they are exposed. Students selected in the team itself can be admitted later to tertiary institutions with exemptions from some first year coursework. This allows them to expand their studies in later year options.

Information on the Olympiad program is available from Dr. R. Jory, University of Canberra (phone 06-249 2777 or 06-249 2782).

Students with a real aptitude for Physics and Mathematics should be encouraged to apply for the program.
PROJECTILE PROBLEMS MADE EASY

David Wheeler
Foundation Studies Certificate Program, Unisearch Limited

Physics texts (and physics teachers) generally approach projectile problems as exercises in x and y components. This leads to some difficulties for students as to what is actually happening. (Are there two motions? What does all the maths mean? Must I solve simultaneous equations?)

An alternative method using complete vectors (i.e. not components) is described in the examples below. It is tempting to speculate, judging by the surprise shown by fellow teachers in discussions, that this method is original. Certainly it is not widely known.

The method consists of writing the equations:

\[ v = v_0 + at \quad \text{and} \quad s = v_0 t + \frac{1}{2} at^2 \]

in vector diagram form then using trigonometry. This has the advantage of producing correct answers quickly while at the same time providing a good understanding of the physics of the situation. It also requires surprisingly little maths - only a knowledge of basic trigonometry.

Trials of the method with year 11/12 type students in both the Foundation Studies Certificate Program (at Unisearch, UNSW) and the Day Matriculation Course (at St. George College of TAFE, Kogarah) have shown it to be very successful, with students reporting (and demonstrating) better competence and confidence with projectile problems in particular and with vector usage in general.

The conciseness of the vector method of solving projectile problems is best illustrated by comparison with the standard component method. To appreciate this it is suggested that readers of this article should first solve the following problems using the standard component method. The elegance, simplicity and directness of the vector solutions below will then become apparent.

Example 1

A ball thrown at an angle of 35° to the horizontal hits a target 15 metres away at a point 2.0 metres above the level of projection. Calculate, for this ball, (a) the time of flight and (b) the initial velocity.

Vector Solution

Draw a vector diagram of \( s = v_0 t + \frac{1}{2} at^2 \)

From this diagram,

\[ \tan 35° = \frac{4.9t^2+2}{15} \]

Hence \( t = 1.3 \text{ s} \) \( (a) \)

Also from the diagram,

\[ \cos 35° = \frac{15}{V_0 t} \]

Hence \( V_0 = 14 \text{ m s}^{-1} \) \( (b) \)

Example 2

A ball is thrown at 20 m s\(^{-1}\) at an angle of 30° to the horizontal. If the ball returns to the same level from which it was thrown, calculate (a) the time of flight, (b) the horizontal range and (c) the velocity of the ball after 1.5 seconds.

Vector Solution

At the end of the flight the displacement will be completely horizontal. This means the vector diagram for \( s = v_0 t + \frac{1}{2} at^2 \) becomes:

From this triangle, \( \sin 30° = \frac{1}{2} aT^2 \)

\[ \therefore T = 2.0 \text{ s} \quad (a) \]

Also \( \cos 30° = \frac{S}{V_0 T} \)

\[ \therefore S = V_0 T \cos 30° = (20)(2.0)(\cos 30°) \]

i.e. Range = 35 m \( (b) \)

Using \( v = v_0 + at \) we get a vector diagram at \( t = 1.5 \) seconds of:

From this we obtain (using a scale diagram or the cosine rule):

\[ v = 18 \text{ m s}^{-1} \] at 15° below the horizontal \( (c) \)
Scholarships
Details of courses, scholarships and other assistance are available from the Head of Department.

**VIC**

**Department of Physics**
LaTrobe University
Bundoora VIC 3083

**Electron Physics Group**
*Head:* Dr J.G. Jenkin

Much of the work of the group centres on the investigation of the electronic properties of materials, including:
Photon-electron spectroscopy of semiconductors, heterostructures and superlattices based on both silicon and gallium arsenide. Extensive use is made of the synchrotron radiation facility in Berlin. Facilities are available for the preparation of crystalline materials by the technique of molecular beam epitaxy.

The use of a wide variety of surface science techniques for the study of surfaces and interfaces; for example, the surface properties of industrial samples relevant to manufacturing problems, binding in newly-synthesised chemical compounds, the adsorption of chemical species on clean well-defined surfaces.

Electron-atom interactions, and particularly studies related to resonance effects in scattering processes; the history of science, and especially of Australian physics.

**Theoretical and Space Physics Group**
*Head:* Professor K.D. Cole

Theory of the earth's upper atmosphere, ionosphere and magnetosphere; general relativity, statistical mechanics, theory of liquids, atomic physics, musical acoustics.

Studies relating to the properties of the ionosphere and magnetosphere using radio and optical techniques, auroral physics, solar-terrestrial relations. The Theoretical and Space Physics Group operates a field station in Kilmore Shire and encourages collaborative projects with outside agencies, especially the Antarctic Division. Studies of atomion interactions are conducted in the group’s laboratories.

**Scholarships**
LaTrobe University postgraduate scholarships are available.

**BEMAL: Bendigo Electron Microscopy and Analytical Laboratories**

Current projects include imaging techniques in the scanning electron microscope, correction methods in electron microprobe analysis, and image analysis applications.

**Centre for Instrumentation**
Current projects include application of microcomputers and PLCs in vacuum systems, measurement of total available soil moisture content and other soil characterisation parameters, automatic measurement and recording of rainfall and evaporation rates, information transfer techniques in the agricultural environment, and direct measurement for field sheep classing.

**Physics Education**
The learning process and misconceptions in elementary physics are being investigated to enable definition of areas in which special care must be taken in the presentation of courses. The use of PCs in the laboratory to simulate experimental apparatus is beginning.

**Scholarships**
Candidates for graduate degrees are eligible to apply for Commonwealth Postgraduate Awards and for a limited number of College awards available to research centres. BEMAL supports one position which is half technical/half research. Enquiries to the Head of the Physics Department.

**VIC**

**School of Physics**
University of Melbourne
Parkville VIC 3052

*Head:* Professor A.G. Klein

**Experimental Nuclear Science**
Nuclear physics involving the study of nuclear structure, nuclear reactions, and intermediate-energy photnuclear physics; applied nuclear physics including interdisciplinary studies.

**Theoretical Physics**
Involving the study of elementary particle classification schemes and interactions (both strong and weak), field theory, nuclear reaction and nuclear structure theory, atomic collision theory, plasma theory, statistical mechanics, scattering of electro-magnetic waves and astrophysics.

**Fundamental Experiments**
Relating to the foundations of quantum mechanics and gravitation; studies of the electrodynamics of matter subject to gravitational and inertial forces.

**Optics**
Optics of light, X-rays, neutrons, particles and other radiations. This work includes studies of three-dimensional microscopy, incoherent X-ray holography, digital reconstruction of holograms and diffraction theory.
Experimental Particle Physics

Including participation in the UA2 experiment at CERN Geneva, a radiative muon capture experiment at TRIUMF Vancouver, in-house solid state detector development and prototype neutrino mass experiment. Research in Experimental and Theoretical Particle Physics has been enhanced by the formation of the Research Centre for High Energy Physics.

Solid State Physics

Including the study of crystal structures, crystal defects and their interactions and quasi-crystalline solids by the diffraction of X-rays, neutrons and electrons and by high resolution electron microscopy and spectroscopy; studies of advanced ceramics, particularly PSZ (partially stabilised zirconia) and high T, superconductors; surface studies using scanning tunnelling microscopy (STM) and other techniques. Research in Solid State Physics has been enhanced by the formation of the National Advanced Materials Analysis Centre (NAMAC) based on two electron microscopes—a high resolution JEOL, JEM4000EX and Philips CM30.

A Micro-Analytical Research Centre (MARC)

This research is based on a Proton Microprobe, a sophisticated form of high spatial resolution analytical microscope which uses a beam of protons from a 5 MeV Pelletron accelerator. MARC undertakes applied research in biology, medicine, geology, solid state and many other areas of technology. This proton-based microscopy will be increasingly supported by electron microscopy in the future.

Scholarships and Support

A graduate school prospectus may be obtained by writing to the School. This prospectus outlines the structure of our higher degrees, scholarships, and fees, as well as giving in greater detail the specific opportunities for research.

**VIC**

**Department of Physics**
Monash University
Clayton VIC 3168

*Head: Professor J. R. Pilbrow*

Behaviour of light beams at reflections, electron spin resonance, foundations of quantum mechanics, quantum electrodynamics, instabilities in solids, laser development, magnetism and neutron scattering, mathematical biophysics, Mossbauer effect spectroscopy, musical acoustics, speckle-pattern velocimetry, optical astronomy, polymer physics, surface diffraction (RHEED), the use of Raman spectroscopy in the study of lattices vibrations, superconductivity, the nature of electronic states in metals and the ultrastructure and growth mechanisms of hard tissue.

Full details of the above programs are described in *Physics Monash* available for no charge on request. Enquiries should be directed to the Chairman.

**VIC**

**Department of Materials Engineering**
Monash University
Clayton VIC 3168

*Research Coordinator: Dr. B. C. Muddle*

The Department of Materials Engineering offers, to suitably qualified students, the opportunity to undertake full-time supervised research leading to the award of the degrees of Master of Engineering Science and Doctor of Philosophy in one of six research programmes: ceramics engineering, corrosion engineering, metal forming, physical metallurgy, polymer engineering and surface engineering.

In each of these programmes, research focuses on aspects of materials processing, the influence of processing variable on microstructure, and on microstructure-property relationships in engineering materials. Consequently there is interest in fundamental aspects of phases equilibria in metals, ceramics and polymers, the role of microstructure in determining mechanical, electrical, magnetic and optical properties, and the resistance of materials to degradation in service. Studies of the effects of processing include work on the solidification processing of materials, metal forming, and solid state extrusion of oriented polymers. The importance of surface engineering is recognised with projects in the fields of electrochemistry and corrosion, coatings and adhesion. Developing research areas include composite materials, telecommunications materials, biomaterials, liquid crystalline polymers and polymer blends, degradation of polymers and numerical process modelling.

The major current research activities in the Department include: properties of engineering plastics, composites, rubbers and adhesives; polymer allows and blends; ageing of polymers; optical fibres; damage and remanent life in engineering materials; electrical and magnetic properties of alloys; phase transformations and theory of alloy phase equilibria; ultra-high strength aluminium alloys; thermo-mechanical processing of steels; yield and fracture of metals and alloys; metal forming; modelling of metal deformation processes; metal-matrix composites; solidification processing; corrosion and corrosion protection; biomaterials; thermally sprayed coatings; properties of surface coatings and films; ceramic powder processing; superconducting ceramic oxides; mechanical properties of ceramics; analytical electron microscopy.

The Department maintains excellent research facilities for vacuum melting and casting, strip casting, plasma and flame spraying, heat treatment, metal working, polymer and ceramics processing, mechanical and corrosion testing. It also provides access to a wide range of materials characterisation techniques including optical microscopy, X-ray diffraction, analytical scanning calorimetry, differential thermal analysis, thermogravimetric analysis, dilatometry, particle size analysis, dynamic mechanical analysis and ultrasonic flaw detection. All major items of equipment are interfaced to personal computers and there is ready access to mainframe and personal computers, a well-equipped workshop and photographic facilities.

**VIC**

**Division of Chemical and Physical Sciences**

**Section of Physics and Electronics**

Deakin University

Warne Ponds VIC 3217

*Chairman of Division: Mr H. Hudson*

Investigation of sampling techniques for occupational hygiene. Quantitative analysis using X-ray diffraction; electron spin resonance applications to electrochemistry; development of microcomputer based instrumentation; electrical methods for determining body composition; development of computer simulation techniques for electrochemistry; underwater mapping by acoustical positioning; development of a micro-computer controlled theatre lantern.
OPPORTUNITIES FOR POST-GRADUATE STUDIES AND RESEARCH IN PHYSICS

Investigation of techniques for real-time moisture content of grain; feasibility studies of millimetre wave radio systems for digital and wide band services applications.

VIC

Victorian University of Technology
GPO Box 2476V, Melbourne VIC 3001
Head: Dr H.K. Wagenfeld

Phase transformations in Al$_2$O$_3$ amorphised by ion implantation; acoustic absorption of various materials in high pressure nitrogen by the rapid impedance tube method; optical waveguides fabricated in polymers by ion implantation; ion beam induced epitaxial crystallisation; corrosion of protected metal films; investigation of fluorescence microspectrophotometry to classify dark wool fibres; computer modelling of the interaction of electrons with thin solid films; electron emission from surfaces; design of infrared imaging spectrometer; ultrasonic Doppler flow measurement; application of electron energy loss spectroscopy (EELS) to the study of magnesia-partially stabilised zirconia; dynamical scattering; warm superconductors; ion beam modification of metal surfaces; secondary ion mass spectroscopy (SIMS); superconducting thin films; a study of modification of ceramic surfaces by ion beams; phase stability and impurity diffusion in ion-implanted amorphous and crystalline silicon; toughening of diamond using ion beam irradiation; synthesis of thin film diamond; the analysis of ion beam irradiated glassy carbon; OTRANS - an optical transform computer package; porosity and small angle X-ray scattering in coal and sintered ceramics; studies of materials for electronics; observation of the lower tropospheric state using a Michelson interferometer; Fourier optical analysis of micrographs of biological specimens; enhanced adhesion of metal films to ceramics; computer modelling of interfaces; computer simulation of superdense colloids; phase transformations in ion-implanted silicon; particle dynamics in concentrated dispersions; comparative RBS/AES studies on radiation induced surface alloy formation; surface modification of silicon by ion beam mixing; a mineralogical analysis system for in-plant real time application; computer-generated holography; electronic speckle pattern interferometry; optical non-destructive testing and embossed holograms.

WA

School of Mathematical and Physical Sciences
Murdoch University
Murdoch WA 6150
Head: Professor B. Mainbridge

Surface Physics

Theory of the metal/vacuum interface; LEED fine structure measurements; density of states determination by Auger line shape analysis; studies of the metal-semiconductor interface; chemisorption and catalysis; scanning tunnelling microscopy; photovoltaic solar energy conversion and holography.

Atomic Physics

Theoretical modelling of electron-atom collisions; scattering theory; Auger electron coincidence spectroscopy of gases and positron scattering from surfaces.

Experimental Thermodynamics

Determination of the thermophysical properties of natural gas from precise measurements of the speed of sound; studies of the phase behaviour of hydrocarbon mixtures (natural gas); hydrocarbon water heats of solution and phase behaviour; measurement of thermal conductivity, heat capacity and speed of sound in fluids; investigations into the mechanisms of formation of nitrogen oxides in gas burning appliances; equations of state and condensate yields from North West Shelf natural gas reservoirs.

Plant Biophysics

The development of non-invasive techniques for the study of transport processes in the xylem and phloem of plants. Bioelectric potential and laser holography measurement systems are in use.

Scholarships

Commonwealth Postgraduate Research Awards and Murdoch University Research Studentships are available to full-time students.

There are two major research groups: atomic and surface physics and gravitational physics, as well as smaller groups in solid state, surface physics magnetic materials, high T$_c$ ceramic superconductors, nuclear (γ/α) reactions, and geophysical mass spectrometry.

Experimental

Atomic and Surface Physics includes electron, atom and ion beam spectroscopies and scattering, laser and X-ray spectroscopy, the production and detection of spin polarised electrons, optical position-sensitive detectors, studies of the electronic and surface properties of materials, as well as crystallography and structural studies.

Gravitational Physics research includes gravitational radiation detection, gravity radiometry and the development of ultra-sensitive measurement techniques including ultra-stable oscillators for time measurement. The associated research includes astronomy in both the visible and radio regions including VLNI.

Both of the major areas include high vacuum, microwave and cryogenic technology as well as state-of-the-art computer and electronic technology.

Theoretical

Research includes phase transitions and critical point phenomena, cosmic electrodynamics, astrophysical plasma physics, high energy physics, atomic physics and chaos in non-linear systems.

Scholarships

University Research Scholarships may be available to Australian as well as overseas students who hold, or expect to obtain, a good honours degree or equivalent. These awards are presently valued at $12,250 pa (tax exempt) with allowances for dependents, travel and thesis preparation and are normally tenable for 3 years (PhD) or 2 years (MSC). Full details of these and other more specialised awards can be obtained from the Registrar, University of Western Australia. Most applications close in mid October each year.
Isotope Studies
Thermal ionisation mass spectrometry including application to astrophysics, meteoritics, fission products, environmental monitoring, geochronology, isotope geochemistry and medical research.

Marine Research
Coastal oceanography; numerical modelling; satellite oceanography; sea surface temperature and sea state; marine acoustics and marine technology. Collaborative research is undertaken with the Centre for Marine Science and Technology.

Materials Research
X-ray analytical science (diffraction and fluorescence), scanning electron microscopy and radiation physics; electrical, thermal and optical properties, abrasion resistance, deterioration due to ultraviolet and to other factors of a range of materials (metals, ceramics, polymers, rubbers, minerals); development of alumina-based toughened ceramic materials; high temperature superconducting ceramics and non-oxide rare earth ceramics.

Scientific Data Acquisition and Analysis
Digital image processing of scientific data including image enhancement procedures, feature/ pattern recognition, frequency and spatial domain transforms; use of low-cost image processing systems and associated video digitising facilities; system software for image arrays.

Scholarships and Support
Students are eligible for Commonwealth Postgraduate Award (CPGA) Scholarships. Supplementary loadings may be paid to CPGA recipients. Industry and public-sector scholarships, other than CPGA, are offered from time to time. Part-time teaching is also available. Some students undertake thesis studies part-time while working as research or teaching assistants within the Department.

Analytical Ultracentrifugation and Electrophoresis
Molecular transport studies using centrifugation and electrophoresis for the separation and characterization of macromolecules in solution; electrical conductivity and dielectrophoresis as methods for investigating biological particulate systems.

Biomechanics
Computational simulation of expiratory airflow from humans lungs and prediction of common clinical respiratory function tests in normal subjects along with simulation of pathological conditions; investigation of some aspects of the physics of the merging of unequal flows in a bronchial junction, as well as the relationship between tube properties and flow limitation mechanisms; investigation of osteoarthritis in the knee using real-time spectral analysis of joint sounds. Spectra, waveform, sound and knee angle are monitored and recorded on videotape. The important features of the spectra are being correlated with radiographic and clinical data.
Phonoarthography is intended to be used in epidemiological and drug efficiency studies in addition to clinical practice. The method promises a relatively cheap, non-invasive and safe diagnostic technique.

Electronics

There is a continuing programme involving the development of instrumentation for use in teaching and research. Recent projects include a waveform synthesizer and a microprocessor trainer. At present the design of a fast multibit digital correlator is being investigated with a view to eventually producing a VLSI correlator chip.

Nuclear Magnetic Resonance/New Techniques

An NMR imaging system has been developed to provide proton spin density maps of microscopic systems. Various pulse techniques enable relaxation contrast and the imaging of spin echoes under the influence of intense field gradient pulses. This latter experiment reveals molecular dynamics at specific locations in dispersed phases. The system is being used to investigate plant tissue, food materials and polymers.

Polymer Physics

Diffusion of large molecules in solution studied by observing the scattering of laser light; ternary solutions of two polymers in a low molar mass solvent are being investigated; dynamical properties of synthetic and biological polymer systems studied by various NMR techniques including pulsed field gradient spin echo NMR, proton density imaging and relaxation measurements. The work on synthetic polymers seeks to elucidate reptational motion and internal modes in high (>10^6 dalton) molar mass semi-dilute solutions and in gels using molecules labelled with both protons and deuterium; rheology of polymer solutions and melts.

Structural Biophysics

Developmental studies of connective tissues using electron microscopy as the major technique; relationships between the mechanical properties of a tissue and its collagen fibril diameter distribution; structural and functional roles of other components in connective tissues; image analyses techniques used to enhance the signal/noise ratio in electron micrographs and to deduce structural information from assemblies of biological macromolecules; computational analyses of the main acid sequences of fibrous proteins.

Theoretical Particle Physics

The relationship between low energy quark models of nucleons and the high energy scattering data

Scholarship and Support

As well as New Zealand Commonwealth Scholarships and NZ Vice Chancellors' Committee Postgraduate Scholarships, competitive Massey University PhD Scholarships and Graduate Assistantships are available.

Astrophysics

High energy gamma ray astronomy using a 76 scintillator cosmic ray shower recorder.

Cloud Physics/Applied Meteorology

Physical properties and behaviour of liquid drops collisions, optical scattering, depolarization; electrical charge transfer between hydrometeors; field studies on the mesoscale and microscale of the characteristics of raindrops, rainfall, and orographic influences; optical scattering in rain; development of instrumentation for microphysical studies of precipitation and radar studies of clouds and precipitation.

Ionosphere

F-region morphology and its relation to atmospheric and solar changes.

Laser Physics/ Optoelectronics

Research in the laser physics laboratory is concentrated on the construction of new lasers, mode locking of lasers and the application of short optical pulses; high peak powers generated by novel techniques are used to investigate a variety of non linear optical processes, notably optical parametric amplification, frequency doubling stimulated Raman scattering in optical fibres and modulation instabilities in optical fibres.

Nuclear Physics

Nuclear physics using 4MV vertical tandem accelerator AURA2. High accuracy; (10 ppm), measurements of proton energies relative to One volt standard; experimental parameters of pure fermi beta decays; surface elemental analysis by PIXE, (proton induced X-ray mission), of Polynesian obsidian artefacts and medical samples of muscle tissue.

In collaboration with ANU, Canberra; high spin studies of heavy ions using the tandem accelerator at ANU.

Quantum Optics

The Quantum Optics group undertakes theoretical research into the interaction of light with atoms; topics include photon statistics, squeezed states of light, laser theory and nonlinear optics; laser manipulation of light by atoms, laser cooling of atoms, and atomic interferometry. Quantum measurement theory and quantum non demolition measurements.

Signal Processing

Signal design for underwater acoustics applications; high gain signal processing using pulse compression of pseudo random sequences; optimal finite band signals.

Solid Earth Geophysics

Thermoluminescence and electron spin resonance dating; oscillations of the Earth's core; monitoring and theory of geothermal systems.

Underwater Acoustics

Theoretical studies of sound propagation. Topics include shallow water bottom interactions and complex ray and saddle point analysis of the acoustic field; long range, deep water propagation studies to monitor ocean temperature; ocean wave generation of seismic noise; fisheries SONAR.

Scholarships and Support

As well as New Zealand Commonwealth Scholarships and New Zealand Vice Chancellors' Committee Postgraduate Scholarships, competitive Auckland University Physics Department Postgraduate Scholarships are available.
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| **Physics Department**  
University of Canterbury  
New Zealand  
*Head: Dr. R. Syme* |

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| **Condensed Matter Physics**  
*Contact: Dr G. D. Jones* |

Several projects are offered in spectroscopic studies of the fundamental electronic and magnetic properties of ions doped into single crystals. Facilities include those for growing and treating doped single crystals and probing them through FTIR, laser selective, optical, EPR and Mössbauer spectroscopy. The group has cooperative programmes, particularly in holeburning and the development of up-conversion lasers, with ANU, Cornell (USA), Los Alamos (USA) and Regensburg (Germany).

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| **Atmospheric Physics**  
*Contact: Dr G. Fraser* |

Radar techniques are used to study upper atmosphere winds and temperatures, the orbits of meteorites striking the atmosphere and the nature of the ionosphere above Christchurch and the Antarctic. Current meteorological projects include the study of soaring conditions for glides above the MacKenzie Basin.

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| **Astronomy**  
*Contact: Dr J. Hearnshaw* |

The group operate the University observatory at Mt John which houses the 1m Telescope. Current projects include the study of pulsations and abundances in Cepheids and hydrogen deficient stars, the measurement of high precision stellar radial velocities and the use of remotely operated CCD cameras in astrophysical research.

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| **Theory**  
*Contact: Professor Stedman* |

Research interests include quantum field theory, solitons, fluid dynamics, the development of group theory for use in physics (solids and particles), Lagrangian wavefunctions, tests of Bell's inequalities and gyrotropic optical effects.

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| **Ring Laser**  
*Contact: Professor Stedman* |

A 1m ring laser is being built to test various predictions of quantum electrodynamics. (See The Australian and New Zealand Physicist Jan 1991)

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| **Medical Applications of Lasers**  
*Contact: Dr Buler* |

A yellow copper vapour laser is used to treat port wine birthmarks. The guidance of this beam is being developed and its interaction with human blood vessels and tissue is being studied.

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| **Department of Physics**  
University of Otago  
New Zealand  
*Head: Professor R. L. Dowdus* |

The group carries out theoretical and experimental research in the field of interaction of light with atoms. Topics under current study include dynamical switching in optical systems, fourwave mixing with fluctuating background fields, spatial reorganisation for interacting laser beams, the photorefractive effect, and a variety of photonics applications.

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<td><strong>Thin Films and Optics</strong></td>
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The anisotropic properties of optical coatings caused by thin film microstructure are being investigated by experiment and by computer modelling. Currently, particular emphasis is placed on in situ measurements of optical anisotropies during the early stages of growth of evaporated metals and dielectrics, during post-deposition ion etching. A cooperative medical optics project, with the Department of Ophthalmology, involves the development and testing of instruments for detecting defects in the vision of infants.

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<td><strong>Radio and Space Physics</strong></td>
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This group is concerned with plasma waves and aeronomy of the earth's magnetosphere. Propagation, amplification and generation of plasma waves as well as wave-particle interactions are investigated over the frequency range of millihertz to tens of kilohertz. Radio and plasma waves are also used for remote sensing of the constituents and plasma distribution of the magnetosphere.

Research involves both analysis of passive observations of the effects of natural events such as whistlers produced by lightning as well as active experiments for which the causes are artificially produced by the experimenter as in laboratory.

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<td><strong>Sea Ice</strong></td>
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Laboratory experiments on acoustic emission generated in artificial sea ice subjected to load are being carried out with the aim of identifying the source of the emissions. Field work on natural sea ice is planned in 1991/92. Facilities: Experiments are performed in the walk-in freezer at Portobello Marine Laboratory. Loading gear, acoustic emission transducers and a data acquisition system controlled by PC are available.

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<td><strong>Energy Utilisation</strong></td>
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The principal interest of this group is in the efficiency of energy processes, in particular in the study of dissipative mechanisms, and their effect on process efficiency. Current projects include practical investigations of heat pump applications, thermal power station loss mechanisms, and product drying. The group is increasingly involved in the numerical simulation of energy processes for the analysis of
opportunities for post-graduate studies and research in physics

losses by second law methods. This work, which includes Rankine and Brayton cycle heat pump dryers and Stirling cycle cryogenic refrigeration, are based on real plant operation data. The thermal power plant study utilises real time data from Huntly power station. The group is closely involved with a commercial facility for rating heat pumps and air conditioners at Unived Energy Ltd, Dunedin. Two 90m³ insulated chambers, each equipped with precision air conditioning (25kW) for use in the range 20 to 50°C have been set up as an independent standard rating laboratory and for contract development work. This facility is available to the group. Other facilities include data acquisition equipment for field studies and extensive software exists for thermodynamic property calculations.

WIND ENERGY AND ACOUSTICS

Studies in meteorology relevant to wind energy utilisation; atmospheric turbulence using optical and anemometer measurements; applied acoustics relating to meteorology, buildings and music.

THEORETICAL PHYSICS

All of the above groups maintain theoretical programs. Independent fields of interest are those of classical electrodynamics, quantum field theory including gravitational field theory, aspects of elementary particle physics. Currently work is in progress on: difficulties confronting relativistic wave equations for particles of higher spin; supersymmetric theories.

NZ

Department of Physics
Victoria University of Wellington
Wellington, New Zealand
Chairman: Dr Warwick Darcey

MATERIALS SCIENCE

Electronic properties of materials; high temperature superconductors - the preparation of a series of perovskite superconductors and ruthenate perovskites, measurement and modelling of their vibrational and transport properties and magnetic susceptibility, microstructural studies using electron microscopy; superlattices - the preparation of superlattices of Tl₂/Ge, Ge₁₂Ge₇H and Ge₁₂Si with layers as thin as 5 atomic layers and the study of their structure, electrical properties and stability.

Interaction of light with condensed matter systems: ellipsometry studies of gas adsorption on solids; theory of reflection of electromagnetic, acoustic and particles waves from interfaces, with applications to ellipsometric studies; statistical mechanics of dielectric functions; study of gas adsorption on the surface of ice.

Accelerator physics, ion implantation and electron microscopy in the study of materials: the development of a technique for the energy calibration of Tandem accelerators using nuclear resonance reactions induced by heavy ion beams; research into accelerator and nuclear techniques for the study of materials of relevance to NZ science and the development of new technologies for industry; the application of computer based processing techniques to the electron microscopy of materials; a theoretical study of electron diffraction from ordered defect structures in metals.

ANTARCTIC PHYSICS

Physics in the Antarctic: the measurement and interpretation of the optical, thermal and microstructural properties of sea ice; properties of ultraviolet light in the Antarctic and interaction with algae.

astronomy

Photometry and Spectroscopy: photometric and spectroscopic observations on a range of cataclysmic variable stars; observations of selected southern hemisphere stars using the Vilnius photometry system and expansion of the observational base to include the two-channel photometer and CCD system at Mt John; photometric and spectroscopic observation and analysis of binary stars to derive meaningful parameters for such systems; hardware and software development of the two-channel photometric computer-based system located at Mt John Observatory, Lake Tekapo.

BIOTECHNOLOGY AND MEDICAL PHYSICS

Physics in Biology: continuation and development of the application of radiation physics, nuclear and allied techniques including electron microscopy in the area of biotechnology and medical physics.

SCHOLARSHIPS AND SUPPORT

NZ Universities Post-Graduate Scholarships and VUW Post Graduate Scholarships.

NZ

School of Science and Technology
University of Waikato
Hamilton, New Zealand
Head: Professor B. S. Liley

PLASMA PHYSICS AND KINETIC THEORY

Moment equations and application to transport in high temperature plasma; theoretical studies on anomalous transport in magnetically closed systems; experimental studies on MHD type instabilities in linear systems; plasma torch.

THEORETICAL QUANTUM OPTICS

Squeezed light and quantum noise; anti-bunched light; intensity correlations; fundamentals of quantum theory and proposed experimental tests.

REMOTE SENSING

Passive remote sensing, analysis of infrared AVHRR data, cloud properties; scatterometry applied to oceanography.

MEDICAL PHYSICS

Exercise quantification; ultrasonic phantom materials; radiotherapy dosimetry; ultrasonic imaging; objective testing (evaluation of medical technology); radiotherapy.

TECHNOLOGY

Electronics; plasma processing; battery systems; electric fences; biological effects of electricity; radio-astronomy.

PHYSICS EDUCATION

Frames of reference; expert systems.

SCHOLARSHIPS

New Zealand Universities Post-Graduate Scholarships and University of Waikato Postgraduate Scholarships.

australian & new zealand physicist Volume 28, number 7, july 1991
The Tightly Folded Resonator (TFR)

The TFR is a direct coupled, high power diode pumped Nd:YAG or Nd:YLF laser system now available from Spectra-Physics Laser Diode Systems. Both cw and Q-switched versions are available. An external LBO frequency doubler option is also offered.

A solid-state laser diode replaces the traditional arc lamp pump source for enhanced reliability and lifetime, plus superior efficiency and operating performance.

Unique Cavity Design

The TFR utilizes a 10 W laser diode array consisting of a series of 1 W emitting areas equally spaced over a 1 cm monolithic bar (see figure). The output coupler and high reflector are aligned so that the intracavity TEM00 mode bounces back and forth between the opposing sides of the laser medium with vertices located at each of the diode locations. The TEM00 mode volume is defined by the spacing of the diode pump nodes, which are accurate to sub-micron tolerances. Thus alignment is simplified, further enhancing mode matching and slope efficiency. The cw gain for the TFR is extremely high, suggesting that this geometry may be suitable for high power cw amplification.

In a Q-switch mode, the TFR offers a unique combination of high repetition rate and short pulsewidth with an excellent spatial mode. The ability to focus the high peak power beam makes this laser a candidate for pumping dye amplifiers for ultrashort laser systems.

To ensure diode lifetime, the specifications are conservatively set with the diode pump power derated approximately 20%.

For further details on TFR contact:
Spectra-Physics Pty Ltd
2-4 Jesmond Rd, Croydon VIC 3136
Ph: (03) 723 6600 Fax: (03) 725 4822

The new InstaSpec from Lastek

Oriel's new diode array detector - InstaSpec™, uses the latest low dark current diode arrays to achieve exposure times from 16ns to over 1 min, without cooling. Low 4W/cm² light intensities can be measured by cooling to -25°C. Low noise and a 15 bit converter supply the large dynamic range required for measuring absorbances of 0.0002 A.U.

The new detector is specifically designed for the analysis of transient and time dependent optical changes. Screen display rates are typically 20 traces per second on AT-386 type computers. Time courses can be displayed in real time in three dimensional fashion. A virtual strip chart recorder can display the continuous output of up to three diodes (wavelengths) and their ratios and differences.

The Autorigger captures random optical events such as picosecond laser pulses or lightning flashes without any need for electrical synchronization.

A fibre optic data link is provided for noise immunity and long distance remote control. Full software support is included for linear imaging.

MultiSpec™ compact size, excellent mounting flexibility, and extensive selection of inexpensive slits and gratings make it an ideal choice for OEM applications.

For more information contact:
Lastek Pty Ltd
GPO Box 2212, Adelaide SA 5001
Ph:(08) 231 2155 Fax:(08) 231 2169
Toll Free Ph: 008 88 2215
Toll Free Fax: 008 88 2216

Oriel MultiSpec™ Spectrograph

Oriel (USA) announces MultiSpec™, a new miniature high performance spectrograph for diode array detectors.

This unique product has a short 125mm focal length, F/3.5 optics, a flat focal plane for 1” diode arrays, and excellent stray light characteristics. Interchangeable gratings and a micrometer drive allow spectra to be taken anywhere between 180 and 1100nm with diode array detectors, making this the most versatile, small spectrograph available. Resolution is 0.4nm over a 160nm wavelength range.

Oriel also offer a selection of accessories to adapt MultiSpec™ to your needs. With the simple addition of an exit slit, MultiSpec™ converts to a monochromator for spectra from 180nm to 24 micron. Fibre optic cables and standard camera lenses simplify the input of a wide variety of light sources.
PRODUCT NEWS

spectroscopy, and calibrated radiometric measurements, with a full online help manual. In addition, a powerful and simple internal basic macro language can be used to program the system for automated control.

For information on InstaSpec™ III, please contact:
Lastek Pty Ltd
400 King William Street
Adelaide SA 5000
Ph: (08) 231 2155 Fax: (08) 231 2169

Precision Diode Laser Driver

The model 06 DLD 203 Precision Diode Laser Driver from Melles Griot is a microprocessor driven, low-noise current source and temperature controller offering a comprehensive solution to the control of diode lasers. The driver offers both current and power stabilized modes of operation, analog modulation capability and the ability to preset all laser and photocurrent values prior to laser turn-on. In addition, the driver simultaneously displays the laser drive current, photocurrent and voltage or temperature setpoints with the actual values. The unit is compatible with all Melles Griot collimated diode laser head assemblies and with any unmounted diode laser requiring up to 200mA drive current.

The driver provides a unique temperature control feature which uses the laser’s forward voltage to control the thermoelectric cooling and heating. Using this technique, a laser can be stabilised to a level previously unattainable. Superior stability is achieved because the diode junction temperature is monitored and controlled, rather than the temperature of a heatsink. The driver is also compatible with thermistors and IC temperature sensors for complete flexibility of temperature control.

Please contact Coherent Scientific for more information.

New 7 Watt Argon Laser with Specified Beam Quality

Coherent U.S. has announced the Innova-307, a flexible, small frame, scientific ion laser with a 7 watt multiline power specification and specified beam quality.

The Φ2 value of the 514nm and 488nm lines is guaranteed to be less than 1.1.

The Innova-307 also offers a variety of options, including a 600mW U.V. specification, the 'Power Track' automatic alignment system, and a temperature controlled etalon for single frequency operation.

Please contact Coherent Scientific for more information.

Mid-IR Array Detector

Princeton Instruments have just released two new Platinum Silicide detectors, model numbers PtSi-512 and PtSi-1024.

The arrays have either 512 or 1024 pixels with each pixel being 25µm wide and 2500µm high. The uniformity of the arrays is excellent and they are cooled to liquid nitrogen temperatures (77K) in order to reduce dark charge.

The detectors are responsive to electromagnetic radiation in the 1-5µm spectral range and are useful for a variety of spectrometric and spatial applications where signal levels are adequate, eg. laser beam profiling, NIT absorption etc.

As with all other diode array detectors offered by PI, these are operated by the ST-120 diode array controller or the new universal controllers models ST-121 (DMA) and ST-116 (GPIB).

For more information please contact Norman Jones or Paul Wardill at Coherent Scientific Pty Ltd
138 Greenhill Road, Unley SA 5061
Ph: (08) 271 4755 Fax: (08) 271 1202

LETTERS

Continued from page 135

of Technology becomes the only Physics Department in that University. While the Department is not large it is comparable to many others listed in the table.

I suspect there may well be other problems with the data of the Jennings and De Lacter article. A very cursory glance shows a surprisingly large fourth year (Honours, Graduate Diploma and Masters Preliminary) year enrollment of up to 79 at Swinburne Institute of Technology. I presume this is due to a lack of appreciation of the existence of a cooperative year in their undergraduate degree.

D.J. Booth
Head, Department of Applied Physics
Victoria University of Technology

Cuckoo in the nest

Dear Sir,

I am sorry that I appear not to have made my point in the mind of John Costella (ANZP April, Letters, May 1991). I did not say, nor did I imply, that the demand for physicists in Australia was equal to the demand for engineers. What I did was: first, to challenge the undocumented contention of the Vice President of the I.E.Aust. that there was only a limited demand for scientists in Australia; and, second, that students would be discouraged from doing science and should take up engineering.

I said then, "The real competition is with those who believe there is more virtue in pushing money around than in using it to create new wealth. We shall go further and get there faster if we work at it together. . . ." It seems a pity that, at a time when Australia needs all the scientists and engineers it can get, there should be an argument as to which of the two is the better. The real problem lies elsewhere'.

My views have not changed.

J.R. Prescott Hon FAIP

FIX on PHYSICS

The editorial board requires short, illustrated articles for publication in our education supplement "Fix on Physics". Articles, hints, ideas for experiments and discussion of material relevant to teachers and students of Year 11-12 Physics are sought. Please send all contributions to the Honorary Editor (see address on Contents page).
Tribute to Sir Charles Frank

Like most physicists I was enthralled by the TV series and subsequent book 'Most Secret War' by Professor R.V. Jones which described the vital role of scientific intelligence in the second world war. Of all the talented scientists whose names popped up time and time again as Professor Jones recounted the behind-the-scenes intellectual contest between the Allies and the Axis, the most intriguing was that of Dr Charles Frank. He and Jones formed a partnership that could be said to have changed the course of history. After the war, Dr Frank joined Sir Neville Mott at Bristol, and went on to head the Wills Physics Department and become a knight in his own right.

For those whose appetite to know more about Sir Charles Frank’s career after the war was whetted by the tantalising revelations in 'Most Secret War', an eightieth birthday tribute to him has just been published. In it, twenty-four eminent scientists reveal the breadth and depth of Sir Charles’ contribution to physics - a contribution which I for one did not really appreciate until this volume came along.

Like his contributions to scientific intelligence, Sir Charles Frank’s contributions to physics were extraordinarily wide-ranging, and seminal. It was, for example, a paper of Frank’s in Nature in 1947 which first advanced the possibility of muon-catalysed fusion reactions. The paper has since become a classic which is continually cited to this day. It was one of his first major contributions after arriving in Bristol, and was followed by many others of equal importance which are well described in the tribute.

The modern understanding of crystal structure owes much to Sir Charles Frank, who was the first to point out the importance of screw dislocations in crystal growth and the morphology of surfaces and interfaces. This work led to the concept of anholonomy (crudely, inability to be line-integrated) which is of particular importance in understanding the liquid crystals which are nowadays so commonplace.

Liquid crystals is the subject of Subramanyan Chandrasekhar’s tribute to Sir Charles, who not only published the landmark paper on liquid crystals but also predicted the biaxial nematic liquid crystal (parallel alignment) in 1958. This phase was eventually identified in 1980 - not a bad feat of prediction.

Then there are the chapters on the contributions of Sir Charles to polymer physics, a field in which he solved many problems. These are fascinating chapters - not too mathematical - which give a glimpse of the reasons for the highly anisotropic mechanical properties of polymers.

The tribute concludes with two chapters on the structure of diamonds (dislocations give distinction to diamonds) and two on solid-earth geophysics. Professor S.K. Runcorn pays handsome tribute to Sir Charles Frank’s contribution to the understanding of plate tectonics while Dr D.C. Tozer’s chapter is full of Tozer’s work on the evolution of the terrestrial planets without a single mention of Sir Charles or how it relates to him.

In my view every university library, and many others, should have R.V. Jones’ volume 'Most Secret War' and alongside it the rather different but complementary 448-page tribute to Professor Frank. 'Sir Charles Frank, OBE, FRG, An eightieth birthday tribute’ is published by Adam Hilger and costs £27.50 Pounds Sterling in hard covers.

Colin Keay
Book Reviews Editor

Reviews

Coulomb Interactions in Particle Beams: Advances in Electronics and Electron Physics (Supplement 21)

G. H. Jansen
Academic Press, Boston 1990
x+ 546 pp., US $89.50 (hardcover)

The text concerns particle interactions in low and medium density, non-relativistic and time-independent beams of identical particles and can be applied to situations where the

analogies between photon optics and charged particle optics break down, that is high density and low energy beams. The main achievement of the book is the development of an analytical model which describes beam characteristics and transport properties for most conceivable circumstances. A detailed description of the technique of Monte Carlo simulation, which here means random initiation of the particle coordinates but strictly deterministic ray tracing, is also given. The standard topics of Liouville’s theorem, principles of emittance and brightness invariance, space charge effects, the N-body Coulomb problem, the Fokker-Planck method are well covered. The chapters are well organized and the material presented so that most chapters can be read separately.

While the emphasis is on fundamental principles rather than applications, the designer of a practical system will find all the tools needed. Persons with lesser interest in the subject would be satisfied with a thirty seven page ‘summary for the one-minute designer’. This section is most useful. Copies of two computer programs, one using the analytical model and the other Monte Carlo ray-tracing, are available from the Physics Department, Delft University. The professional using electron or ion beams, probably in lithography or scanning microscopes and similar instruments, will have a copy of this book on his desk. The author has worked at Delft University, Netherlands and at IBM, New York and the mixture of academic and practical experience has produced a book which should have wide appeal.

J.F. Williams
Physics Department
University of Western Australia

Indium Phosphide: Crystal Growth and Characterization


This volume of the prestigious Semiconductors and Semimetals series is dedicated to InP. The increased interest in this material was stimulated by recent developments in optoelectronic and ultra-high speed devices.
Phenomena at The Lebedev Institute, Ursu is Professor of Atomic and Nuclear Physics at the University of Bucharest and Mihalescu is a senior researcher at the Institute of Atomic Physics, Bucharest.

Given the authors' background, it is not surprising that this book places heavy emphasis on the mathematical formulation of the interaction between light and metals. Given the enormity of the field which the authors are addressing, this approach turns out to be a successful one, as the theoretical results they reach are often applied to experimental observations, and can, with not a lot of effort, be applied to a variety of irradiation regimes, wavelengths and surrounding atmospheres. Readers will also be relieved to find that the book opens with a comprehensive list of symbols, to which one frequently refers, and also provides an adequate index.

The early chapters deal with the classical formalism of the optical properties of metals using the Drude method and the heating of metal targets by laser radiation. Temperature variations of both the optical and thermophysical properties of metals are treated comprehensively, an area often glossed over in other similar texts. Light-induced thermoelastic deformation is also covered, mainly to provide a basis for analysis of the behaviour of laser mirrors, where reversible and irreversible thermal deformations and vapourisation cause optical damage of these critical laser components. Other laser-induced surface phenomena which are 

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discussed are the interaction between laser light with resonant and non-resonant surface structures, both self-induced and pre-existing.

The last three chapters are the most interesting and useful for people involved in laser materials processing. There is a full description of the thermochemical processes which occur when metals are irradiated in chemically active environments. The products of such reactions influence, sometimes strongly, the course of the reaction itself, through either changing the optical properties of the irradiated sample, or releasing heat into the material from exothermic reactions. The concluding chapter draws together many of the results obtained throughout the book to illustrate how a laser user would go about selecting irradiation conditions such that the laser processing (heating) of materials is achieved with the highest efficiency.

This book is an admirable attempt to cover a wide and complex subject, with most attention directed towards theoretical detail, but a genuine effort to tie in results obtained experimentally. Given the background of the authors, it is not surprising that many of the experiments referred to involve continuous wave CO₂ lasers. However, one of the more rapidly expanding areas in laser materials processing involves pulsed solid-state lasers (primarily Nd:YAG lasers). An analysis of the problems associated with the field of high-power pulsed laser processing is often more complex than that of continuous wave laser processing. It is unfortunate although not surprising that this book does not address this growing area. The other minor quibble I have with this book is a problem almost universal amongst Russian and Eastern European authors, that of the references being predominantly Russian, a neglect which proves detrimental to the overall impact of the book.

This is not a book for your do-it-yourself laser person; but very useful for the more experienced laser scientist who wishes to extend his knowledge by gaining a deeper understanding through solid mathematical analysis, of this complicated field of the interaction of laser light with metals.

Andrew Scott
Industrial Laser Centre
CSIRO Division of Manufacturing Technology

The Relative Biological Effectiveness of Radiations of Different Quality
NCRP Report No.104
Bethesda 1990
vii + 218 pp., US$18 (paperback)

This report provides a detailed review of the literature on the relative biological effectiveness of radiations of different quality. The emphasis of the report is to small (<0.2 Gy) doses or low dose rates. Thus the information is particularly relevant to the field of radiation protection. However, there is relatively little data presented for humans with the focus of the report being on the RBE data for lower organisms.

The report is divided into chapters according to various end points or biological effects, namely cytogenetic effects, heredity effects, carcinogenesis and life shortening. There is also a chapter in which the literature on RBE from internal emitters is reviewed. The detail provided is of more interest to persons active in the area of radiation biology or radiation protection rather than to those with only a general interest in the biological effects of ionising radiation. The report includes a comprehensive list of references to relevant publications and will be a valuable source of information to those working in the field.

B.J. Thomas
School of Physics
Queensland University of Technology

New Books

Clusters of Galaxies and Extragalactic Radio Sources
A.D. Kuz'min (Ed.)
NOVA Science Publishers
Commack NY 1990
xiv + 326 pp. US$114 (hardcover)

Tunneling: An Environmental Solution?
G.C. Lowenthal & D.C. Carmichael
IMMT UniSearch Ltd, Kensington NSW 1990
102 pp. AS$15 (paperback)

Hydrogen in Semiconductors
J.F. Pankove & N.M. Johnson (Eds)
xii + 629. US$139.00 (hardcover)

Thin Films for Advanced Electronic Devices
M.H. Francombe & J.L. Vossen (Eds)
Academic Press, San Diego CO 1991
xii + 332 pp. US$89.50 (hardcover)

Symmetry Principles and Magnetic Symmetry in Solid State Physics
S. Joshua
Adam Hilger, Bristol 1991
xii + 270 pp UKE19.50 (paperback)

Relativistic Quantum Mechanics of Leptons & Fields
W.T. Grandy, Jr
Kluwer Academic, Dordrecht 1990
xii + 438 pp. US$99.00 (hardcover)

Mechanics
Springer Verlag, Berlin 1990
xiv + 431 pp. DME88.00 (softcover)

Non-Linear Phenomena in Science & Engineering, G. Rowlands
Ellis Horwood (Prentice Hall)
New York 1990
172 pp. A$79.95 (hardcover)

Liquid Crystals
P.J. Collings
Adam Hilger, Bristol 1990
xii + 222 pp. UKE29.95 (paperback)

Theory of Dielectric Optical Waveguides (2nd Ed.)
D. Marcuse
xv + 380 pp. US$99.50 (hardcover)

Quantum Theory of the Solid State
(2nd Ed.), J. Callaway
xiv + 954 pp. US$149.50 (hardcover)

The Science Achievement of Year 12 Students in Australia
ACER research monograph Number 40
Malcolm J Rosier and Michael G Long
xiii + 198 pp. (paperback)

Australia was one of the 17 countries participating in the Second International Science Study. This monograph gives detailed analysis of the Australian Year 12 data collected, together with preliminary comparisons with other countries. The information includes student enrolments in Science, home background, achievement in science, characteristics of science lessons and students attitude to school, science studied at school and the role of science in the wider society. Some test items are included for the attitude scales but not for scientific, mathematical and verbal abilities.
CONFERENCES & MEETINGS

1991

July 10 - 17  XVII International Conference on the Physics of Electronic and Atomic Collisions, Brisbane. Registration: Dr. M. C. Standage, Division of Science & Technology, Griffith University, Nathan Qld 4111. Tel (07) 875 7292, fax (07) 875 7656

July 15 - 19  Introduction to Optical Design Course
Continuing Education Office, Macquarie University. Tel (02) 805 7470

July 23 - 24  Asian Physics Education Network - 200 Years Faraday's Birthday Meeting
Registration: Professor Geoffrey I. Opat, School of Physics, The University of Melbourne, Parkville VIC 3052
Tel (03) 344 5121, fax (03) 347 4783

August 7 - 16  PICXAM X-Ray and Surface Analysis Conference, Hawaii (including workshops)
Picxam c/o - AXAA, PO Box 90, Parkville VIC 3052
Tel (03) 337 7211 (Don Williams) or (03) 351 7192 (Brian O'Connor) or (02) 218 9530 (Julius Bogi)

Sept 27 - 30  1991 Annual Meeting of the Physical Society of Japan
Hokkaido University, Sapporo-shi, Hokkaido
Enquiries: The Physical Society of Japan, Room 211, Kitai-Shinko Building, 3-5-8 Shiba-Koen, Minato-Ku, Tokyo 105, Japan. Tel (03) 3434 2671

Sept 29 - Oct 4  Australian Conference on Optics, Lasers & Spectroscopy - ACOLS '91
Australian National University, G.P.O. Box 4, Canberra ACT 2601
Tel 61-6-249 4244, fax 61-6-249 0029

Sept 30 - Oct 4  International Conference on Ion Sources (ICIS '91), Bensheim, W. Germany
B. Wolf, GSI, Postfach 110552, 6100 Darmstadt, W. Germany
Tel 49-6151 320, fax 49-6151 359 785

Oct 1 - 3  ANZAAS Congress 1991 - "Reproduction and Renewal"
Prof. David Boyd, The University of Adelaide, PO Box 498, Adelaide, SA 5001. Tel (08) 228 5843, fax (08) 223 7650

Nov 10 - 14  Anglo-Australian Observatory - "Fibre Optics in Astronomy II"
Power House Museum, Sydney
Peter Gray or Sandra Harrison, Anglo-Australian Observatory, PO Box 236, Epping NSW 2121. Tel (02) 868 1666, fax (02) 876 8536

1992

Jan 5 - 11  XIII International Conference on Few Body Problems in Physics, Adelaide
Registration and contributions: Prof. I.E. McCarthy, School of Physical Sciences, Flinders University, GPO Box 2100, Adelaide SA 5001
Tel (08) 201 2115, fax (08) 201 2905

Jan 13 - 31  5th Physics Summer School: Atomic and Molecular Physics and Quantum Optics, Canberra
B.A. Robson, Dept of Theoretical Physics, R.S. Phys.S.E., ANU, GPO Box 4, Canberra ACT 2601. Tel (06) 249 2971, fax (06) 249 4676

Feb 3 - 7  19th Australian Polymer Symposium - "Greening the Polymer Industry"
University of Western Australia, Perth WA
Mr. G.M. Ferguson, Chemistry Centre WA, 125 Hay Street, East Perth 6004, Ph 61-9-222 3010, fax 61-9-325 7767 OR Mrs. W. Fletcher, Lions Eye Institute, 2 Verdun Street, Nedlands WA 6009. Tel 61-9-389 3589, fax 61-9-382 1171

Feb 10 - 14  10th National Congress of the Australian Institute of Physics, University of Melbourne
(Sec) Dr. G.N. Taylor, School of Physics, University of Melbourne, Parkville VIC 3052, Tel (03) 34445456, fax (03) 3474783 AARNet: UCSV.C::RCHP::Taylor
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