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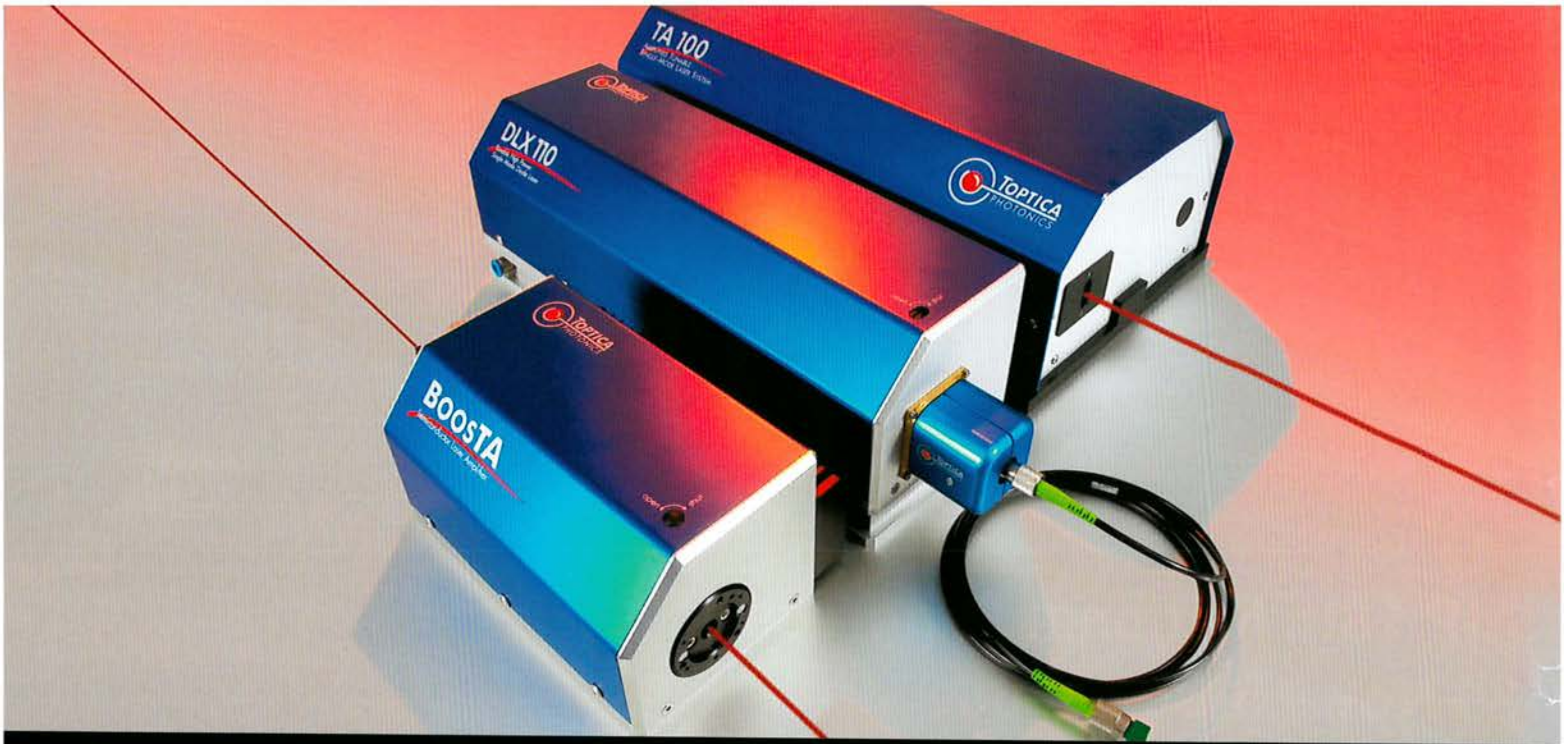
Promoting the role of physics in research, education, industry and the community

AIP 18th National Congress
30 Nov – 5 Dec 2008
Adelaide



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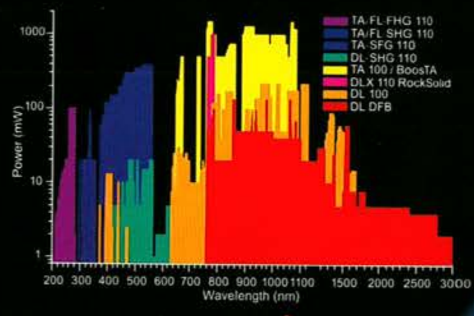

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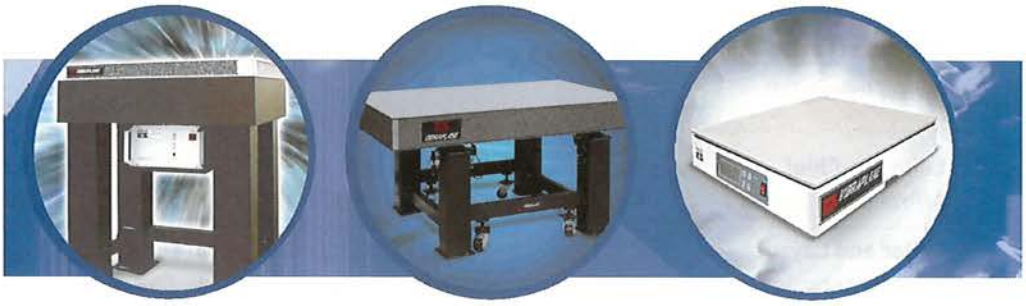

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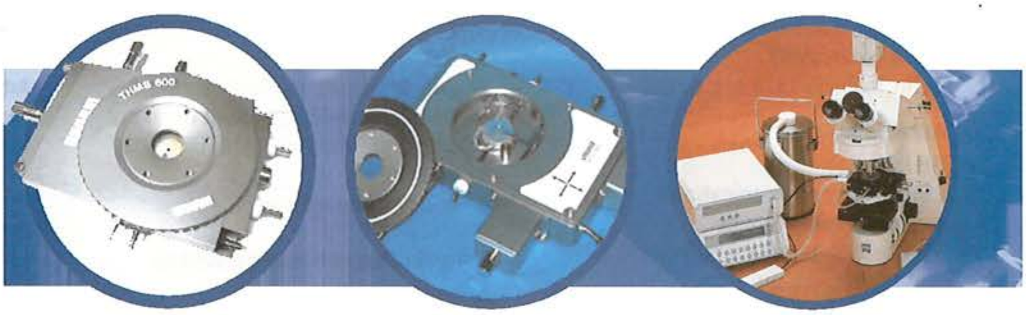

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Cover image:
A view of the Adelaide city skyline, host city for the 18th Biennial AIP National Congress 2008. More details on the Congress can be found on page 56 with further information coming in later issues of *Australian Physics.*

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Submission Guidelines

All articles for submission to Australian Physics should be sent in electronic format. Word or rich text format are preferred. Images should not be embedded in the document, but should be sent as high resolution separate attachments in jpeg or tiff.

Authors should also send a short bio of themselves and a recent photo.

The Editor reserves the right to edit articles based on length, space requirements and editorial content.

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President's Column: Volunteerism and Physics

We usually associate volunteering and unpaid work with charities, churches, school P&Cs and local community sport. In fact, Australian society is dependent on volunteerism and unpaid work with 58% of the economy (Gross National Product) and social welfare relying on volunteerism[1]. What we don't think about is how the whole basis for modern science - with conferences and workshops to share information; professional societies that engender the profession and the discipline; and the very fabric of science itself, peer review and publication of science research - requires significant effort from scientists over and above their paid role.

Conferences are one of the most exciting aspects of the life of a scientist. Travelling to meet and share research work with colleagues from many other institutions requires well over a year of planning and organisation by the conference chair and organising committee. There is usually a professional conference organiser undertaking much of the administration; but the program, planning and many hidden aspects of making a conference successful relies on many hours of unpaid work by all involved.

Professional societies such as the AIP also are dependent on the commitment and enthusiasm of the various executive and committee members to run the organisation which aims to provide support for physicists and their careers, to make sure that the role of physics is understood by the community and to ensure that future generations of physicists are well educated by both schools and universities.

Outreach programs also rely heavily on volunteers. In the Einstein International Year of Physics, the investment by the government and the AIP of $130.5k was leveraged with the unpaid work of many AIP members estimated to be over $200k and the contribution of teachers and community members estimated to be well over $500k. This enabled more than 160 events to be organised over the year.

However, the most important aspect of volunteerism and unpaid work in science is the foundation on which modern science is dependent and the corner stone of its success: peer review.

In 1665, Henry Oldenberg, the first editor of The Philosophical Transactions of the Royal Society, decided that a submitted manuscript should be carefully scrutinised *"before we give a publick testimony of it to ye world, as it is desired of us"* [2]. Peer review was used to differentiate scientific journals from book publishing with the use of reviewers to insist on the highest standards before reporting new research findings. The exacting scrutiny by fellow experts or peers is unparalleled in any other field and the *"lynchpin about which the whole business of science is pivotal"* [3]. Publication of an article in a journal reflects the work of the author and also the standards of the journal. The standing of the journal can be determined by the expectations, and demands, of the scientists who serve as reviewers.[4] Scientists donate significant time to review a manuscript submitted by fellow scientists. A recent report in Nature Nanotechnology[5] has indicated that the average time taken to review a paper is 8.6 hours. The number of published science research papers growing: 19378 papers were published in physics as listed on the ISI Thompson Scientific Data Base in 2007, compared with 15082 papers in 1997. Assuming a modest rejection rate of about 30%, in 2007, reviewing of scientific papers required at least 27 years of unpaid work across the physics community world wide.

But scientists derive benefits from reviewing papers. They learn about the cutting edge research before it is published, they improve their skills as critical appraisers by comparing their critiques against other reviewers, and they learn how to write more comprehensive manuscripts by seeing the faults of others. As Martin Tobin[4] indicates, the greatest reward is the self awareness that an individual's contribution is *"serving as a small cog in the wheel of scientific progress"*. As in any social enterprise, the best individuals volunteer their services without caring about the payment. They get their reward knowing that they are connected to a much greater process which has everlasting value.

Even though peer review is so important, it is surprising that little is discussed in the physics professional literature. How you learn to review a paper seems to be by "osmosis" and experience. Fredrick G Hoppin[6] wrote an excellent outline that provides guidance and is recommended to all embarking in reviewing scientific manuscripts for the first time. This "how-to-review" a paper enthusiastically presents the task as "informative", "exhilarating" and "inspiring"! He points out the importance of knowing the literature in your field and having mastery of the relevant science. He suggests that an insightful and articulate review can substantially improve the science and clarity of a submitted paper and can advance the author's knowledge and ability to conduct and report science. I have always found any one willing to review my work as giving me a gift even if the returned document is a marked up manuscript which I had sweated on and is covered in red pen showing how my paper can be improved or where I have got things wrong. When I was writing my first papers, I found the review process some what confronting and felt rather embarrassed that I had not achieved perfection. Experience has matured me to realise that perfection is a myth and unattainable. Enjoy the feedback with the spirit it is offered!

Peer review is also used to assess research grant applications and prioritise these applications based on scientific merit. Again the review needs to be influenced by the scientific merits and not influenced by the status of the applicants. Gate keeping by powerful individuals

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AIP Web site: www.aip.org.au

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Editorial

Back in 1989 Martin Fleischmann and Stanley Pons from the University of Utah created a very public debate, of a very scientific matter. They released their claim to having achieved cold fusion simultaneously to a peer-reviewed journal, the Journal of Electroanalytical Chemistry, and to the general public via a press conference. The way they managed to manipulate and control the claim and its related evidence, including giving Steven Jones from Brigham Young the collegial short end of the stick, has gone down in scientific infamy.

The public and media flurry resulting from the hope of endless clean energy ending our dependence on mid-east oil had every scientist running for a cup of heavy water and sent platinum and palladium futures to record highs; but we know now that it was all for naught. The very public nature of the rise, led to the equally public demise of Fleischmann and Pons' credibility in all but a few marginal scientific arenas. Cold fusion is all but forgotten today, and for all intents and purposes Fleischmann and Pons are career dead (Steven Jones has been spared most of the ridicule, even having presented a paper on his experience at the 10th International Conference on Cold Fusion in 2003...dead horse anyone?)

Old news you say? There are some lessons to be learned from this incident, lessons for those of us interested in joining public debates of scientific matters.

Senator Kim Carr has made overtures about creating a charter to govern scientists who work at public research institutions wanting to participate in open and public debates that concern them or their research. Entering the public forum should not be a privilege granted to us by our legislative leaders; it should be a right that we exercise with caution. With issues of national safety aside, participation in public debates is part of our social contract, as long as it does not deter from, or cloud our scientific endeavours. We would not exclude farmers or plumbers from any debate, why scientists?

On the surface a charter may seem positive but we must be careful. Public debates have an entirely different set of expectations, rules and level of decorum than our scientific ones. This holds true particularly for matters relating to health issues, human origins and environmental concerns. A quick glance at the comment pages or letters-to-the-Editor following a report supporting climate change shows the level of invective, conspiracy theories, name-calling, and "poor science" doled out by just about anyone willing to put pen to paper, including non-climate specialists and non-scientists in particular. Public debates are more akin to verbal street fighting. Scientists and scientific debates are not immune to this behaviour, but our well-structured forums, conferences, institutions and peer-reviewed journals are not designed to encourage it; public forums are.

If the Minister follows through with the charter, and even extends it to include a legislative element as suggested by some, then we, public sector researchers and others, would be wise to tread carefully. This loosening of restrictions should be seen as strictly permissive, not instructive.

Stepping from the scientific sphere into the public realm will likely require different skills for the way we present evidence, arguments, claims and counter-claims. It may require a thicker skin too; just ask Fleischmann and Pons.

John Daicopoulos

Write an article for Australian Physics

We are looking for articles covering all aspects of physics in Australia. Perhaps your area of Physics is not well known, is unusual in some way, or you work at a smaller univeristy; perhaps your career has developed in uncoventional ways; if so, why not write an article for Australian Physics? For more information contact editor-in-chief A/Prof Brian James (B.James@physics.usyd.edu.au).

Submission deadline for the May/June 2008 issue is May 9, 2008

President's column - continued from page 43

needs to be avoided. Peer review could be seen as *"stifling innovation and favours the establishment"*[7]. However no other process has been able to be as effective over the 300 year history of modern science. Furthermore, in the peer review process, there is the opportunity to appeal. For refereed journals, the editorial board is set up to deal with these appeals and to be as fair as possible. However the best solution to make peer review work well is to include training in the review process as part of the development of a physicist and to provide for on-going mentoring and professional development. Is this a potential role for the AIP to play?

The peer review process is not perfect. In physics, the process of the double blind review where the reviewer and the author are anonymous is not common, if at all used. The normal process is for a journal to have one or two reviewers who remain anonymous while the authors and their affiliation are known. There is general acknowledgement that the double blind peer review process does have the advantage of removing various biases such as those against female authors. However the strongest criticism of peer review is that there is a lack of real evidence that it actually works with several studies concluding that there is no evidence to support peer review; but there is no evidence that is does not work either.[8] My experience from editorial roles on two international scientific journals suggests that high quality papers are agreed upon by two referees, and that poor quality papers usually have one referee that will reject the paper outright while another referee will require substantial rewriting and resubmission. Very few submitted papers have a rejection coupled with a strong positive recommendation. In this case, such a paper would be closely monitored by the editor in the next stage of the review process.

A report prepared this year for the Publishing Research Consortium, Peer Review in Scholarly Journals,[9] surveyed 3,040 academics on the peer review process and reported that 93% of respondents agreed that it was necessary and 85% agreed that it helped scientific communication.

So what would have happened to science if economic rationalism had been introduced 300 years ago and a user pays philosophy was the basis for reviewing papers, organising conferences, running professional organisations and undertaking outreach programs? I suspect we would have a very different scientific culture that may not have stood the test of time. So as a physicist, and a member of the world wide scientific community remember, that every one of us needs to volunteer some unpaid time to make the system work. What have you volunteered for lately?

Cathy Foley

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7 M. Eisenhart, The paradox of peer review: Admitting too much or allowing too little?, Research in Sci. Ed., 2002, 32, 241-255.

8 For example: P.M. Rothwell and C.N. Martyn, Reproducibility of peer review in clinical neuroscience: is agreement between reviewers any greater than would be expected by chance alone? Brain, 2000, 123, 1964-1969.

9 M. Ware, Peer review: benefits, perceptions and alternatives, Publishing research Consortium, 2008, www.publishingresearch.org.uk

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Letters

Dear Sir,
After reading the President's Column in the November/December issue of "Australian Physics" I felt compelled to write this letter to correct and update a small point that was made in that piece. It is undoubtedly a small point to a lot of people, but a much more important issue for me personally. In the column [Dr. Foley] referred to her work done under contract for the Royal Perth Hospital and Bruce Gray to investigate the possibility of using the heat generated in small magnetic particles exposed to an AC magnetic field as a way of treating cancer. She went on to say that "years later we have learnt that he has subsequently developed this idea further via a company called SIRTEX replacing the magnetic particles with radioactive ones with this treatment now being used clinically with good success".

This is a slightly misleading way to state the case since it was the idea of using radioactive microspheres to treat cancer that came first and this subsequently lead to the idea of using magnetic particles that could be heated as an alternative way to treat cancer. In fact, I was employed by Dr Gray to work as the physicist charged with developing the magnetic particle idea way back in 1990.

I am well aware of the work [Dr. Foley] did prior to my involvement in the project. In fact, the CSIRO report was one of the key pieces of literature I used to help get me started and provided me with some good ideas to follow up in the early stages. I now work for Sirtex Medical as Head of R&D and can report that this project, now known as the Targeted Hyperthermia Project, is still alive and kicking. The technology is still not quite ready for clinical applications and there continue to be problems to solve, but the project is an important part of Sirtex's R&D program.

It was a pleasant surprise to see this work referred to in Australian Physics. I'm hopeful that one day soon there will be much more publicity in relation to Targeted Hyperthermia technology once it proves to be successful in the clinic.

Steve Jones
Sirtex Medical
Head of Research & Development

Dear Sir,
I would like to offer a few comments on the draft AIP Community Policy published in the December 2007 issue of Australian Physics.

In the section on Perceptions of Science, I would make additional comments in relation to keeping science in the mainstream of education at all levels and emphasising the fundamental principles of the scientific method, particularly that any hypothesis or theory persists only until disproved by experimental evidence.

In the section on the Environment, item 2.2 offers a less than compelling reason (new business opportunities) for developing and technologies that protect the environment. Perhaps the obvious reason – that the environment underpins our lives, economic activities and the prospects of future generations, and all these are at risk if the environment is permanently degraded – seemed a bit too obvious to state in this context. New business opportunities are a spin-off from our efforts to implement sustainable technologies, but not the reason for developing them.

In item 2.3 of this section, I would suggest adding that AIP supports a rigorous approach to analyses and modelling in relation to climate change, particularly in interpreting their findings. Interpretation often neglects to mention the size of the error bars on the data.

In the section on Energy, I support items 3.2 and 3.3. However, item 3.1 is a bit too broad. I feel that the range of energy sources supported should be those that are sustainable, environmentally and economically. AIP should advocate the application of full lifecycle or environmental externality analysis to all energy sources.

Finally, item 3.4 is too specific and probably does not reflect a broad AIP view. I feel the policy statement should express AIP's support for effective mechanisms for reducing carbon emissions, including economic measures as well as others such as technology, information and education.

Dr Phil Morgan
MAIP

Dear Sir,
Is the remaining unidentified person on the Nov/Dec 2007 cover page the right-most of the two standing at the bottom of the stairs (dressed in the light-coloured suit and with arm resting on the balustrade)?

If so, I would venture to make the suggestion that this might be AR Hogg (1903-1966), who worked over many decades at the Commonwealth Solar Observatory, Mt Stromlo, which then became part of the ANU, becoming deputy director in the later years of his career.

While I never met Hogg, the man in the cover photo triggered memories of old staff photos on the wall at Mt Stromlo, so I googled "Stromlo + Hogg" which immediately leads to a biography of him by SCB Gascoigne, as part of the Australian Academy of Science memoirs of deceased fellows. The portrait photo accompanying this memoir does indeed look like the person in the AIP cover photo.

Perhaps someone with a more detailed knowledge of Mt Stromlo may be able to verify or refute this suggestion for you.

Bob Watson
Physics, University of Tasmania

AR Hogg, member of the first AIP Executive

Editor's note:
Emeritus Professor Bob Crompton (ANU) has independently confirmed that the unidentified person is AR Hogg.

Branch News

NSW
May Public Talk

Tuesday 27th May 2008 @ 6.00PM
"ANSTO - Australian Physics in Action"
Dr George Collins Chief of Research, ANSTO

Physics underpins much of nuclear science while nuclear techniques assist in solving some of the fundamental problems in physics. ANSTO is Australia's centre of expertise in nuclear techniques and applications, many of which have strong links with physics.

In this talk Dr Collins will describe the range of research activities undertaken by ANSTO as well as the wide range of research facilitated by the techniques that ANSTO provides for the Australian research community. While Physics is fundamental, the applications are broad - in environmental research, radiopharmaceutical development, materials engineering as well as advancing the understanding of the structure and function of materials at the atomic, molecular and nano levels.

George Collins is Chief of Research for the Australian Nuclear Science and Technology Organisation (ANSTO). George obtained a PhD in plasma physics from the University of Sydney and spent 4 years in fusion related plasma physics at the Centre de Recherches en Physique des Plasmas within the Ecole Polytechnique Federale de Lausanne in Switzerland. He joined ANSTO in 1986.

George led a multidisciplinary team in one of ANSTO's strategic research projects on new applications for thin oxide films. The intellectual property created is currently being developed for applications as diverse as abrasion resistance coatings on spectacle lenses to nano-sized inorganic matrices for delivery and controlled release of chemotherapy drugs. George was appointed Director, ANSTO Materials & Engineering Science in December 2001. He has been in his current role since February 2005

Note: All lectures take place at the Slade Lecture Theatre, School of Physics, University of Sydney

South Australia

On December 12th 2007 the SA branch, in conjunction with the Women-in-Physics group, hosted a public lecture by the 2007 AIP Women-in-Physics lecturer Prof. Tanya Monro.

In South Australia this lecture is called the Claire Corani Memorial lecture and includes a presentation of awards to the top second-year female Physics student at each SA University in the previous year. The winners this year were Emma Lawrance of Flinders University and Rebecca Baylis of the University of Adelaide.

Professor Stephen Buckman presents one of the Bragg certificates prior to his public lecture.

Plaques were presented to Dr Barbara Possingham and Dr Barbara Kidman in recognition of the 50-year anniversary of the award of their PhDs in Physics. Both Dr Possingham and Dr Kidman gave short talks about their experiences. Prof. Monro, who is the director of the DSTO Centre of Expertise in Photonics in the School of Chemistry and Physics at the University of Adelaide, then gave the public lecture on "New ways of molding the flow of light with optical fibres".

On March 13th 2008 the branch hosted a public lecture by Prof. Stephen Buckman, Director of the ARC Centre for Antimatter-Matter Studies at the Australian National University, on "Antimatter - Does it matter".

Before the lecture, Prof. Buckman presented the Bronze Bragg Awards. The Bronze Bragg medal was awarded to Christopher Savage as the top student in the Year-12 Physics exam in 2007. Unfortunately Christopher could not be present for the ceremony, but 15 other students were presented with certificates for attaining 20/20 in the exam.

Prof. Buckman gave some background to the discovery, production and uses of antimatter, and dispelled some of the myths surrounding it.

Branch News continues on page 65


As well as speaking at Queensland University of Technology and the University of Queensland, Prof. Monro actively engaged in presenting her work to high-school students. At her Lourdes Hill College lecture (pictured), she was met with an attendance of circa 100.

News

Matthew Flinders Medal is awards to Bruce McKellar

The Australian Academy of Science 2009 Matthew Flinders medal and lecture has been awarded to Bruce McKellar FAA, from the University of Melbourne. This award recognises scientific research of the highest standing in all of the physical sciences, and is awarded every two years. In general the whole research career of the recipient is taken into account.

Bruce has consistently provided leading edge research in physics, influencing a number of fields of particle physics. This has included important work on weak interactions in the nucleus; the classic calculation of the electric dipole moment of the neutron in the Standard Model of Particle Physics, and a comprehensive study of the limits placed on other models of time reversal non-invariance by data on electric dipole moments; the 'Tucson-Melbourne Potential' — a standard form of the three nucleon potential, which are now regarded as essential for precision understanding of nuclear structure; and the development of neutrino kinetic equations for the understanding of neutrino oscillations in a dense neutrino background, as occurs in supernovae and the early universe. His research has extended to other fields also — with Professor He, now of the National University of Taiwan he proposed the dual form of the Aharanov-Cahser effect, an effect now called the He-McKellar-WIlkens effect, and he has also studied the scattering of light by aerosol particles in the atmosphere. His various collaborators and many students have played key roles in all of this research.

Bruce devotes much of his energy to the scientific community in general, through teaching, training of students and post-doctoral fellows, and through his service to the University of Melbourne and key scientific institutions, including the Academy of Science and the Australian Research Council. At present he is a Vice-President of the National Union of Pure and Applied Physics, the third Australian resident to occupy that position.

Bruce obtained his PhD from the University of Sydney, and was appointed a lecturer there in 1965. He took up the Chair of Theoretical Physics at the University of Melbourne in 1972 and retired at the end of 2007, and was Dean of the Faculty of Science 1991 - 1997. In 2006, his research was also recognised by the award of the Massey Medal by the AIP and IOP (UK).

Australian Academy of Science

Pawsey Medal 2008

The Australian Academy of Science has awarded the Pawsey medal for 2008 to Dr Kostya (Ken) Ostrikov, Associate Research Professor, Australian Research Council QEII Fellow, School of Physics, The University of Sydney.

Ken Ostrikov has achieved international repute through his contributions to diverse multidisciplinary fields, particularly in plasma nanoscience, where he is widely recognised as a pioneer and world leading authority. He has used innovative approaches to the creation and manipulation of atomic and nanoscale building blocks, the organisation of nanomatter by plasma, and describing the interactions between plasma and solids. His research has created new ways to generate self-assembled nanomaterials, nanoelectronic and photonic structures, and devices for future computer chips, solar cells, communications systems and biosensors.

Australian Academy of Science

Tiny science, big prize

UNSW's Dr Frank Ruess has been awarded the 2007 Bragg Gold Medal by the Australian Institute of Physics. This is the first time a UNSW candidate has won the prestigious award, which honours the best physics PhD thesis nationally each year.

Before 2003 there was no known technology to make electronic devices in silicon at the level of single atoms. Indeed, the only tools that have allowed the manipulation of matter at the atomic level are scanning probe microscopes, which are typically used to observe atomic-scale features rather than fabricate devices.

Dr Ruess is pioneering a new way to make atomic-scale electronic devices using the atomic resolution capability of the scanning tunnelling microscope. Based at UNSW's Centre for Quantum Computer Technology, he is working with colleagues in the Atomic Fabrication Facility under the supervision of Federation Fellow, Michelle Simmons.

The success of Dr Ruess' PhD work has been highlighted by his subsequent demonstrations of very narrow conducting wires in silicon and the smallest silicon quantum dots, where the active components of the device were related directly to device characteristics.

This is a unique ability internationally and means UNSW researchers are now making the smallest transistors and interconnects. The technology allows a fundamental understanding of the crossover between classical and quantum electronics. It paves the way for unprecedented miniaturisation of electronic devices and the goal of creating silicon-based quantum computers.

"I'm overwhelmed and delighted to have been given this award," said Dr Ruess. "My PhD was a very challenging yet extremely rewarding experience and to receive such acknowledgement on a national level is the icing on the cake."

Commenting on the announcement, Professor Simmons said, "Frank has been an outstanding student and I congratulate him heartily. It is a real pleasure to work with international students of this calibre and we thank both the University and the Australian Research Council for supporting this research".

Reflecting this sentiment, Professor Les Field, Deputy Vice Chancellor (Research) added: "This is yet another example of the University's leading position in this frontier technology research."

The Bragg Medal was instituted by the AIP to commemorate Sir Lawrence Bragg and his father Sir William Bragg. The pair received the Nobel Prize for Physics in 1915 for their analysis of crystal structures using X-rays.

UNSW

News

World Space Congress for Youth
The World Federation of Physics' Students organizes the World Space Congress for Youth *(www.worldspace2008.com)* in Athens, Greece in 17 - 19 April. It is one of the most important scientific events globally and one of the greatest youth meetings internationally (participation is estimated for over two thousand people), with representatives from the forty Federation members attending. The goal of the Congress is for the academic community and the wider public to get to know the new developments on Space Sciences at Research as well as its applications in the fields of human activity.

Some highlights of the program are:
· Symposium of Globe's Space Agencies' Representatives presenting the space policy for the next 20 years.

· Symposium of Space Industry's Representatives presenting their program and their priorities.

· "The Astronaut's Life", where European astronauts will talk about their experiences from space and will exchange opinions with the public for what one must do to become an astronaut.

· Symposium for "Environment and Human Beigns", where the global environmental conditions and ways of ameliorating them will be presented by top scientists, celebrating the International Year of Planet Earth.

Syntagma Square, the central square of Athens, will be hosting a show dedicated to space (real dimension replicas, astronomic presentations at an outdoor planetarium, video installations)

The Opening Ceremony will feature a connection with the International Space Station

The congress is under the aegis of, the Ministry of National Education and Religious Affairs, the Ministry of Development, the Ministry of Tourism, the Ministry of Foreign Affairs, the General Secretariat of Research and Technology and has the support of the European Space Agency (ESA), the NASA, Japan Aerospace Exploration Agency (JAXA), UNESCO, ITER, International Year of Planet Earth, International Space University, the Planetarium of Athens and the Municipality of Athens that hosts the event.

World Federation of Physics' Students

Single particles of light - now for sale
The world's first commercial product delivering individual photons of light has been developed by researchers from Quantum Communication Victoria (QCV) within the School of Physics at the University of Melbourne.

The technology uses the unique properties of diamond to produce single particles of light (photons) on demand at room temperature.

"This is a critical moment in the development of quantum based technologies for practical use," said QCV CEO Dr Shane Huntington.

"The availability of a commercial single photon source will enable many viable quantum technologies to reach the market place."

The device which can be accessed with a standard optical fibre connection has the potential to be used as a component in secure telecommunications systems, for quantum metrology and other quantum based applications.

"As an initial application the Single Photon Source will be integrated into existing commercial Quantum Cryptosystems, drastically improving performance and providing one hundred percent secure telecommunications," said Dr Huntington.

QCV is considering commercial partners and investors to participate in a start-up which will pursue commercialisation of the Single Photon Source in various markets.

The Melbourne based development team are collaborating with Magiq Pty Ltd, a Boston based supplier of Quantum encryption equipment to optimise the integration of the Single Photon Source into existing Quantum Key Distribution systems, with testing and field trials the next step.

Further work is being undertaken in investigating the various other applications for the QCV Single Photon Source including: other quantum applications, microscopy and optical sensing.

QCV is supported by a State Government Infrastructure grant in Victoria, Australia and is the first group in the world to produce such a device

University of Melbourne

Australian Academy of Science elects new members
Seventeen of Australia's leading scientists were honoured on 19 March by election to the Australian Academy of Science.

Election to the Academy recognises a career that has significantly advanced, and continues to advance, the world's scientific knowledge. Scientific contributions of the new Fellows cover a wide range of specialities that include immune response to pathogens; physics of supernovae; photosynthesis; plasma physics; population dynamics of vertebrates; solvable lattice models; and mammalian embryonic development. The new Fellows, elected in 2008 from Australian universities, CSIRO and medical research institutions include three physicists:

Professor Roderick William Boswell distinguished for his work on basic and applied plasma physics.
FAA FAPS FTSE Research School of Physical Sciences and Engineering, Australian National University.

Professor Brian Paul Schmidt distinguished for his work on cosmology, physics of supernovae and gamma ray bursts, and 'Dark Energy'.
FAA ARC Federation Fellow, Research School of Astronomy and Astrophysics, Mount Stromlo Observatory, Australian National University

Professor Howard Mark Wiseman distinguished for his work on quantum measurement and control theory.
FAA Centre for Quantum Dynamics, Griffith University

Australian Academy of Science

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Declassification of Fusion Research

by Brian James

50th Anniversary of Declassification of Fusion Research – the Australian Connection

On 24th January 1958 the USA and UK released simultaneously details of their research in controlled thermonuclear fusion. Both countries, and the USSR had programs beginning not long after the end of World War II to find ways to release fusion energy in a controlled way for power generation.

Initially the work was classified due to concerns that fusion reactions might provide a ready source of neutrons for the production of fissile material. The realisation that this was not practical, and the fact that during a visit to Harwell (the site of UK fusion work) in 1956, I.V Kurchatov talked freely about fusion work in the USSR [1], led to the decision to declassify fusion research. From this time fusion research became a model of international cooperation with free exchange of research and people between nations. This has culminated in the international ITER project under way in France since 2006 (the ITER partners are China, Europe, India, Japan, Korea, Russia, UK and USA*).

The day after the announcement of declassification, newspapers around the world proclaimed the "breakthroughs" in controlling fusion. There was particular interest in Australia as the leader of the UK fusion research program, based around the toroidal device ZETA at Harwell (see Fig.1), was an Australian, Dr Peter Thoneman. Born in Australia, Thonemann completed a BSc at the University of Melbourne in 1939. During World War II he worked at the Munition Supply Laboratories at Maribyrnong and then Amalgamated Wireless (Australasia) in Sydney. After completing an MSc at the University of Sydney [2], he went to Oxford as a D. Phil candidate where, using a small glass torus, he carried out the first studies of toroidal discharges [3]. Thonemann became head of fusion research at Oxford, which moved to Harwell in 1952 so that it could proceed in secrecy.

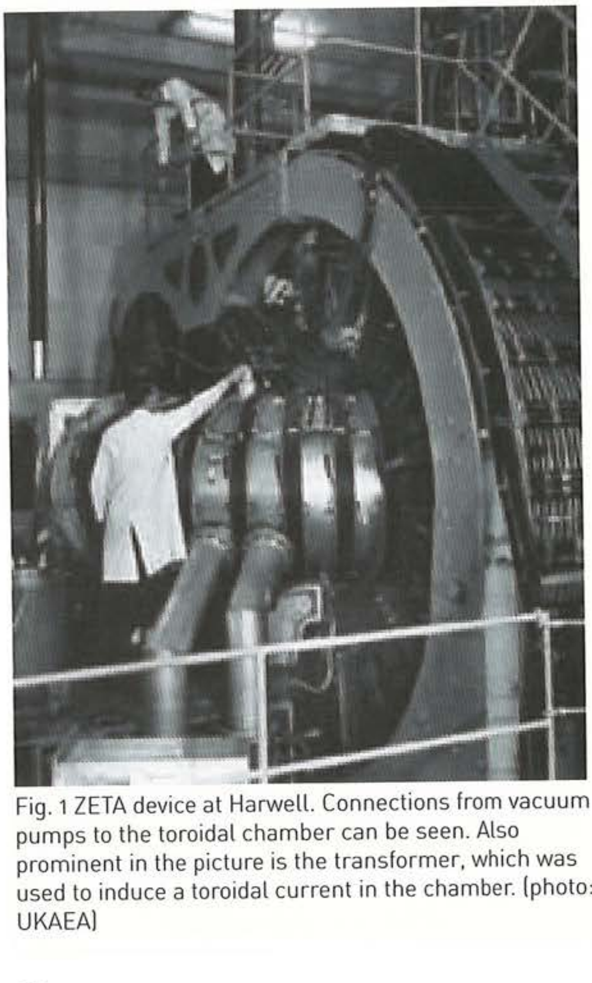

Fig. 1 ZETA device at Harwell. Connections from vacuum pumps to the toroidal chamber can be seen. Also prominent in the picture is the transformer, which was used to induce a toroidal current in the chamber. (photo: UKAEA)

The main story on the front page of the Sydney Morning Herald of 25 January 1958 was typical of many newspapers: "BIG H-POWER TRIUMPH; JOINT ANGLO-US ADVANCE IN 'TAMING' ATOMS". Lower down on the page another item headlined "Australian's Role in 'Atoms for Peace'" described Thonemann's role as leader of the ZETA group.

The declassification came at a time when the west was scientifically demoralised following the rapid development of the H-bomb and the launch of Sputnik I and II by the USSR. In fact in the months prior to declassification, there were rumours that the UK was holding back on announcing spectacular success of the ZETA project because the US "abashed at being left behind by the Russians on space satellites, had persuaded Britain to postpone the news [of ZETA's success]" [4].

Construction of ZETA (Zero Energy Thermonuclear Assembly) began at Harwell in 1955. It was a toroidal pinch with a major radius of 1.5 m and a minor radius of 0.5 m, a toroidal magnetic field of 16 mT, and toroidal currents, induced by transformer action, of up to 200 kA for 4 ms. ZETA commenced operation on 12 August 1957. During a discharge the toroidal field was trapped in the plasma, increasing in strength by an order of magnitude as a result of the current channel pinching to a radius of 0.15 m. Neutron emission was observed for currents above 84 kA.

From work on linear pinches, particularly in the US and USSR, it was well known that non-thermal mechanisms could result in the production of neutrons: the appearance of neutrons, therefore, was not evidence that thermonuclear temperatures had been reached. In fact, in his talk at Harwell in 1956, Kurchatov described how neutrons produced during linear pinch discharges in deuterium were not of thermonuclear origin; rather it was thought that they were the result of collisions between deuterium ions accelerated by electric fields due to instabilities and background deuterium.

Timed to coincide with the formal announcement of declassification, the 25 January 1958 edition of Nature contained seven papers describing US and British fusion research, of which the first one was a paper on ZETA with Thonemann as first author [5]. As to the origin of ZETA's neutrons, this paper was cautious indicating that: "The neutron flux so far obtained is insufficient to attain the desired accuracy of measurement" to "identify a thermonuclear process". At a press conference, however, the Director of Harwell Sir John Cockcroft, when pressed

by reporters, expressed the opinion that he was 95% certain that ZETA's neutrons were of thermonuclear origin. This comment was taken by the press, and the public as virtually certain confirmation that controlled thermonuclear fusion had been achieved, and that practical application was not far away.

Further research revealed that ZETA's neutrons, like those from linear pinches, were of non-thermal origin [6]. When this was revealed publicly ZETA was seen as a failure and the whole episode as an embarrassment. In reality, ZETA continued to run until the late 1960s by which time it had fired more than 10^6 shots. It made a major contribution to the physics of toroidal confinement. Its achievements in terms of magnetic confinement by 1968 were not surpassed by tokamaks, which became the workhorse for fusion research, until the mid 1970s.

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[6] B. Rose, A. E. Taylor & E. Wood, "Measurement of the Neutron Spectrum from Zeta", Nature 181 (1958) 1630

* Scientists in several other countries, including Brazil, Canada and Australia are considering ways of involvement in the ITER program at levels below that of partner. For Australian activities see the Australian ITER Forum website *http://www.ansto.gov.au/fusion.html*

Brian James is a plasma physicist with a particular interest in plasma diagnostics. He was head of the School of Physics at the University of Sydney 2003-6, and is currently an honorary associate professor. He is vice-president of the Australian Institute of Physics.

Professor of Experimental Physics

Monash University is seeking to appoint an outstanding research physicist as a Professor of Experimental Physics and future Head of the School of Physics in the Faculty of Science.

Monash Physics aims to position itself as one of the leading Schools of Physics in Australia. The Professor of Experimental Physics is pivotal to achieving this goal, and will lead the further development of experimental physics within the school.

Based at the Clayton campus, the School of Physics maintains teaching and research programs in astronomy, experimental physics and theoretical physics. It is a major contributor to the Cooperative Research Centre in Biomedical Imaging Development, the ARC Centre of Excellence for Coherent X-ray Science and the base for the Monash Centre for Synchrotron Science. The Australian Synchrotron, which began operation in 2007, is adjacent to the University.

The successful candidate will have: a research doctorate in a relevant discipline, an outstanding internationally recognised record of research in experimental physics; demonstrated success in establishing and leading successful research teams and innovative research programs; a proven capacity to attract competitive research funding; a record of successful supervision of postgraduate students; proven commitment to excellence in teaching and demonstrated skills in management and development of staff.

The appointment as a professor will be on a continuing basis. The school headship is typically rotated on three-year terms and the successful candidate may be required to serve as head within two years of appointment.

Remuneration: professorial salary (currently) $128,856 per annum, plus generous superannuation. An allowance will be applicable for the role of head of school. Relocation travel, removal allowance and salary packaging are available.

Selection documentation may be accessed electronically on the world wide web: http://www.adm.monash.edu.au/human-resources/employment/senior/

Confidential enquiries regarding the position may be made with Associate Professor Michael Morgan, Head of School: telephone (03) 9905 3645; facsimile (03) 9905 3637; email: michael.morgan@sci.monash.edu.au

Applications, which must specifically address all of the selection criteria, should reach Ms Bronwen Meredith, Senior Academic Appointments, Monash University, Victoria 3800 or by email to bronwen.meredith@adm.monash.edu.au no later than Friday 13 June 2008.

Enquiries regarding the application process may be directed to Ms Meredith, by email or telephone (03) 9905 6193.

The University reserves the right to appoint by invitation.

Monash respects the privacy of your personal information. For more details visit www.privacy.monash.edu.au

MONASH University

From Qubits to Climate Change

By Dr. Vincent I Conrad

A convoluted path to physics

I still clearly remember finishing my last maths exam in high school. I finished early (racing to get it over with), threw down my pencil and thought – "Finally it's over! If I ever see another equation again it'll be too soon". Seeing myself as a skateboarding artist, I'd never have imagined that I'd turn into a theoretical physicist. It's a peculiar but wondrous thing about life that often the best things that happen to us we wouldn't even conceive, let alone choose.

I left Queensland for the bright lights and cultural sophistication of Melbourne having secured a place at Melbourne University. Not knowing what I wanted to do with myself, I enrolled in an Arts & Commerce degree (hedging my bets I suppose). Surprisingly, I found philosophy much more interesting than accounting. Though some may argue that double entry book-keeping was the intellectual groundwork for much of our modern understanding of nature, such as the conservation of energy. At the time I couldn't help but feel that bean-counting just wasn't as stimulating or worthwhile as understanding the mind-body split or how words get their meaning. So I stopped the Commerce (even though there seemed to be something worthwhile in this economics stuff) and went head-on into the Philosophy, being still young enough to know that money is of no importance.

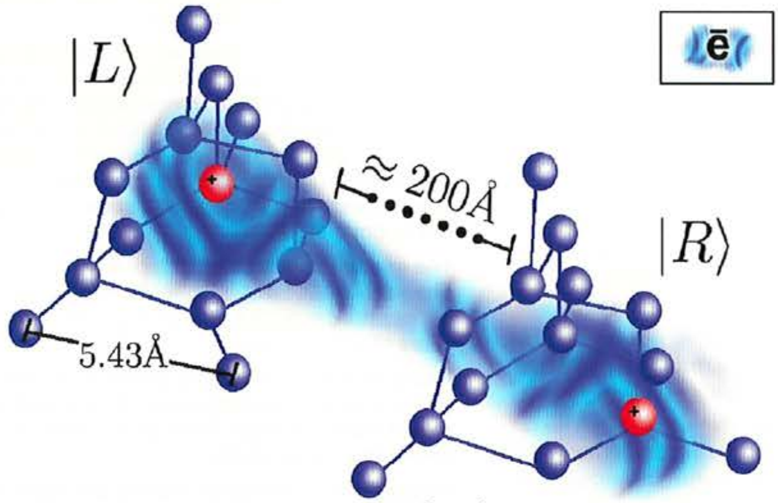


Fig 1. A charge based P in Si quantum-bit (qubit). The electron is shared between two P donor atoms in the Si substrate. The localization of the electron near each donor sites represents the two states of the system.

My tactic for navigating through ~4000 years of philosophical inquiry was to read the descriptions of the courses and take which ever ones made my head spin the most. While it's certainly true that Buddhist ideas of the non-existence of the self and Wittgenstein's discourse on a bug in a box are tricky to get your head around, it wasn't until, totally by accident, I came across Sam Lilley's Discovering Relativity for Yourself that I realised physics was the proverbial waste product I'd been searching for. Not only did my mind reel at time dilation and length contraction, it made so much sense and showed me everything I thought I knew was wrong. So I switched to an Arts & Science degree, thinking that not only would physics be fun, but that through the two I could finally resolve the Cartesian split, putting the issue to rest once and for all.

I never managed to resolve the Cartesian split, but I certainly enjoyed my undergraduate years in physics nonetheless. So much so, that even though I left for the snowfields of Canada and a life in the northern hemisphere after completing my degrees, I soon found myself back in Australia to do honours, and then my doctorate.

The Thesis Years

My years as a postgraduate student will always be some of my favourites. Being surrounded by people who share a love for physics was great fun and the freedom of work was fantastic. I worked in the field of quantum computing, looking at how to use quantum mechanics to process information. The field got a lot of impetus behind it in the mid 1990s once Peter Shore discovered that doing this would allow for efficient factorisation of large prime numbers, thus making much of the current encryption techniques vulnerable. However, I was more attracted to the idea of creating actual-realities (rather than virtual-realities) inside computers. My particular research was based around creating a solid-state quantum-bit (qubit) in silicon (see Figure 1 for a schematic of one type of such a qubit). I would make computer models of how electrons behave around phosphorus atoms in silicon and how we might manipulate these with nanoelectronics such as Single Electron Transistors.

Leaving Physics

Towards the end of my PhD I found myself more interested in social and environmental issues than quantum computing. I felt I had a pretty good rudimentary understanding of inanimate matter by this stage, and began being interested in the wonderful complexities of animate matter instead. This interest, combined with a desire to stay in Melbourne and not pursue the international post-doc circuit, left me looking around for a change of career. What I interpreted as the simplistic profit motive of the private sector didn't appeal to my sensibilities after so long in the ivory towers of university and I was at a loss for what to do. Fortunately I was still engaged in the consuming task of thesis writing, and so these vagaries of my future were still in the enjoyable phase of opportunity searching when I came across an advertisement to apply for the Victorian Public Service graduate intake.

The breadth of work in the public service allowed me to begin directing my career in some fashion, while still not having to commit to a particular task. The structure of the graduate year meant I would move across a range of government departments, while getting a crash course in this 'Westminster System' thing. So I submitted an application and found myself being interviewed in between writing chapters five and six of my thesis. Fortunately for me, my background in physics was viewed as an unusual and desirable skill-set by someone at the Department of Premier and Cabinet, and shortly after submitting my thesis for assessment, I entered the curious new world of the public service.

From Qubits to Climate Change

Applying my skills outside physics

Precisely where I would apply the skills of my education was still uncertain and I had an enjoyable graduate year working on a range of topics across the Victorian Government. The graduate year had me moving Department's every four months and I immediately found myself in a vastly different world to that of the specialised and precisely focused realm of scientific research. One day I'd be writing speaking points for use with foreign ambassadors, the next writing correspondence regarding maritime heritage. From the ramifications of carbon reducing policy on exports to the processes required for ensuring disability funding was properly tracked, the entire year was a plethora of new concepts and endeavours. At times, being such a fish out of water could be daunting, however, the knowledge that I made it through the PhD certainly gave me confidence that I could tackle anything put before me.

While the specific mathematical skills and materials knowledge weren't readily applicable to any of this work, the analytical skills, rigour and ability to digest and communicate difficult concepts were. I also found, and this runs contrary to the popular myths of scientists in general and physicists in particular, that the people skills I'd gained through obtaining my doctorate where of much use too. Such abilities aren't usually talked of explicitly in physics and can sometimes be overlooked. Nonetheless, I'm that certain my time in physics imbued in me a good basis in these valuable, though somewhat less concrete skills.

Physics is a fantastic journey that attracts all manner of personalities to it. While the cliché of the socially awkward absent-minded genius was by no means absent from my extended group of colleagues during my postgraduate years, it was also by far the norm. Working with such a wide variety of personalities during my time in physics prepared me very well for entering general office culture. Furthermore, I'd gained experience in working closely with all levels the academic hierarchy, from professors to undergrads, and felt comfortable expressing my views to anyone who'd listen, and some who wouldn't. This is certainly an important ability to develop in any office place and I'm sure the years of doing my doctorate benefited me very much in this regard. In my new workplace we have team dynamics type training provided by experts in the field of corporate psychology. We are reminded of the need to appreciate the different working styles of others and how to gain the benefit that comes from having a diversity of styles in the workplace. I feel very comfortable with this, and I'm sure that this can be attributed to my years working in physics.

What lies ahead

I've now recently finished the graduate year and am fortunate enough to have secured a permanent position in climate change policy. Though it seams as though there's been a vast amount of change in the move from qubits to climate change (Figure 2), I'm still excited about the transition. I'm very much looking forward to knuckling down to work in the climate change area as it involves such a wide array of interesting aspects – climate science, economics, the environment and social equity to name but a few. The pace at which this area is progressing and the focus that has been given to it in recent years will also ensure that I continue to have a rapid injection into the world of governance.

The mathematical skills I have from my science days will be invaluable as I start to look more closely at economic issues associated with climate change and a move towards a carbon constrained economy. And as I now have a solid grounding in understanding physical phenomena and the scientific method, translating the science of climate change into succinct summaries for decision makers will also come more easily to myself than someone without a background in the natural sciences. While I won't have the opportunity to delve into the depths of specific areas of knowledge as one does in a PhD, the breadth of ideas and issues I'll be involved with will certainly be enjoyable and make up for this.

While I'm enjoying my new career path, it is natural that I do still sometimes miss physics. Physics is not the kind of area one devotes one's self to for money or fame. Though I'm loath to ever use absolutes, I feel somewhat safe in saying that physicists do physics because of a love for natural philosophy and understanding stuff. In the words of the late great Richard Feynman – "Physics is like sex: sure it may give some practical results but that's not why we do it." In the light of that, I don't plan to give up either, though for the time being, both will be purely recreational pursuits.

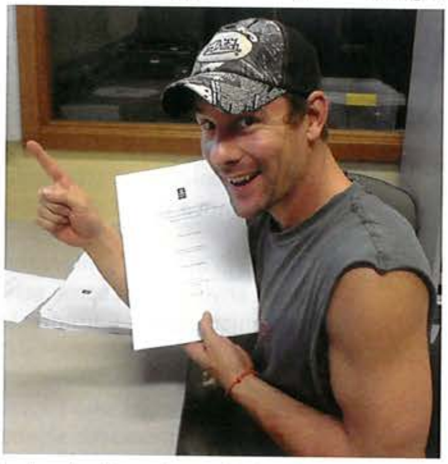


Fig 2 Left: Working in physics - first printing of doctoral thesis. Right: Working in the public service.

A view from NSW

by Dr Frederick Osman The March meeting of the NSW branch of the AIP was held at the University of Sydney on Tuesday 25 March 2008 and featured two unique topics in education and solid state physics to launch the branches first double meeting of the year. Our first speaker Dr Mark Butler from the Gosford High School gave us an insight into the current issues in secondary physics from the perspective of a practicing high school physics teacher. Dr Butler has taught for over twenty years in private and public high schools in NSW. He is currently the Head teacher in Science at the Gosford High school.

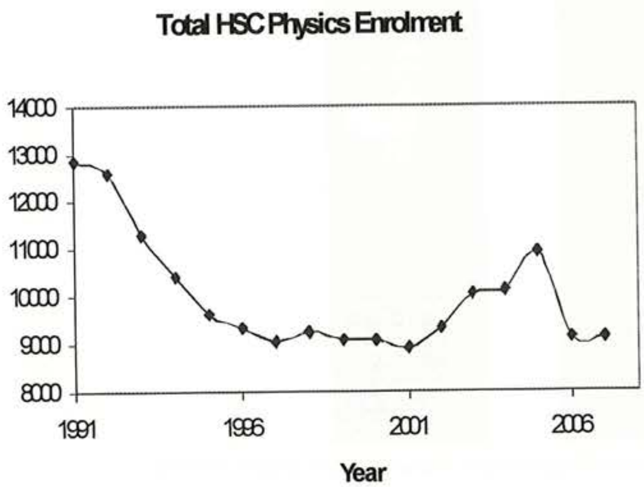
During the talk Dr Butler pointed out the physics being taught in Australian schools, who is teaching it and how it is being taught. Enrolment statistics, teacher qualifications and training, National Standards, the Australian Certificate of Education, and current small and large scale initiatives to attract more students and teachers to physics was discussed in detail. Other main topics that Mark covered during his presentation included:

- q Why do students choose to study subjects and why they choose not to?
- q How have some Australian schools managed to increase participation rates in the enabling sciences?
- q Is it really possible to make Physics and Mathematics 'cool' at school?

Dr Butler commenced his presentation by talking about the 2006 DEET Skills Audit, that showed the number of domestic students studying courses in the enabling sciences and engineering in Australia had remained static or decreased over the past decade. The report predicted that if this situation continued, the supply of science professionals from education by 2012/13 would fall short of demand by 20,000.

The Macquarie University SET Study in 2004 supported earlier research that showed the main reason students choose SET careers is a good experience in secondary high school and it would seem logical that we should focus our attention in this area if we are to address the looming skills shortage. An analysis of senior high school enrolments in Australia shows that after peaking in 1990/91, the number of students choosing to study physics has remained static or decreased in all states and territories. (See Fig 1)

Fig 1



From left to right, Dr Fred Osman (AIP Branch Chair), Dr Mark Butler, Dr Marlene Read and Professor Heinrich Hora.

The question is then: how can we attract more students to physics in senior high school? New syllabuses based on international best practice have been developed in all states over the past six years with little impact on physics enrolments. The proposed national curriculum, to be introduced in 2011, is also unlikely to have a significant impact on senior physics enrolments.

Studies in Australia and overseas have shown that in addition to the broader societal issues; the way science is taught in schools, poor careers advice and a lack of qualified teachers are the key drivers of the drift away from the enabling sciences. The Deans of Science Report, "Who is teaching Science' showed that only 43% of senior physics classes in Australia are taught by teachers with physics majors and 41% of schools found it difficult to recruit physics teachers. In addition, because most physics teachers are needed in the senior school very few are involved in teaching in years 7 and 8. Clearly recruiting more physics, chemistry and mathematics teachers is critically important and it is time that the states and the federal government developed some new policies to address this issue.

Poor careers advice and the way science is taught can be addressed immediately in schools. An influential ACER report by Tytler in 2007 suggested that science education needed to be 're-imaged'. That science must be taught from contexts children can relate to and that concepts/content should only be provided on a 'need-to-know basis' as students investigate specific contexts (such as alternate energy or motor car safety). I am not convinced that there is sufficient evidence to support changing science teaching in such a radical way. Perhaps it would be wiser to allow pockets of innovation to drive the evolution of science teaching and learning, rather than attempt a whole scale revolution.

With this is mind, it is interesting to note that even in the current environment some schools have managed to increase their senior physics enrolments. These schools generally have:

- A principal who supports the science faculty
- An enthusiastic science head teacher who gives science a high profile within the school
- Enthusiastic, caring, science teachers with expert

knowledge who; are given the opportunity to teach in their specialist area, discuss science careers regularly with their students, treat the syllabus as, 'the floor rather than the ceiling' and act as positive SET role models.

- Teaching programs that ensure junior science is relevant, enjoyable and accessible for students.
- Programs that ensure students are exposed to progressively more challenging and independent investigative/practical work as they progress through the school.
- A wide take up of extra-curricular science activities. (excursions, competitions, visits to and by scientists and engineers, workshops, clubs, etc.)

AIP March Meeting dinner with the speakers at Buon Gusto Italian Restaurant.

At Gosford high School, Dr Butler's team found that offering exciting one-term units in Physics, Chemistry, Biology taught by subject specialists also significantly improved science enrolments in year eleven. The year eleven physics unit we have developed is entitled, 'Space Flight and the Universe". If we are to attract more students to SET careers we must revitalise the way science is taught in our schools and lobby governments to support these changes and to develop policies to attract (and retain) more quality SET teachers.

The second talk of the night featured Dr Marlene Read from the University of New South Wales. Dr Read discussed the problem of energy states on metal surfaces and how to solve it.

The presentation firstly gave us an insight and background into the properties of surfaces and knowledge of the quantum electronic energy states. As devices get smaller, surface properties become more important. It has been suggested that systems such as organic molecules or alkali metal atoms adsorbed onto metal surfaces, such as sodium (Na) atomic layers on a copper (Cu) surface, could have possible applications as quantum electronic devices operating at room temperature.

Dr Read first discussed the detailed knowledge of the surface and interface states of these systems that are needed. As a first step, methods to definitively determine all the surface states of clean metal surfaces must be developed. This includes higher-energy excited unoccupied surface energy states and resonances as well as occupied states for electrons of each spin orientation. Experimental probes include photoemission and inverse photoemission spectroscopy, target current spectroscopy, low energy electron microscopy and diffraction. Interpreting the features of the experimental data also involves the theoretical calculation of these states. The methods described in the presentation and the recent results of its first application to Cu, aluminium (Al) and palladium (Pd) surfaces were presented with comparison of other theoretical methods and experiments.

Dr Read stated and pointed out that present theoretical methods do not always predict all surface states and those predicted may deviate significantly in energy from measured features. Unoccupied higher-energy states and resonances are particularly difficult. This is, in part, because of the additional complication of substantial electron energy losses due to collisions with other electrons. A promising theoretical method that can potentially account for all surface states over their entire energy range is a scattering approach which builds up the metallic system by stacking a succession of atomic layers parallel to the surface.

The Australian Institute of Physics (NSW) would also like to thank Professor Heinrich Hora for acknowledging the vote of thanks for Dr Marlene Read.

Dr Osman has more than 10 years of academic/industry experience in teaching/research, in Mathematics & Physics education at the Tertiary, Secondary & TAFE institutions

Are you a physicist working in an industrial/commercial environment?

We would like to publish more articles about physics and physicists in industry or commerce. If you would like to write an article for Australian Physics on your area and activities to inform the Australian Physics community please contact editor-in-chief A/Prof Brian James (B.James@physics.usyd.edu.au).

Samplings

Fibres could generate electricity from body motion
http://physicsworld.com/cws/article/news/32871
'Power dressing' could take on an entirely new meaning thanks to novel energy-scavenging textile fibres created by researchers at the Georgia Institute of Technology in the US. They claim that a pair of trousers worn by a hiker or a tent fluttering in the breeze could generate enough electricity to charge a mobile phone, if they were made from fabric woven from the fibres.

The fibres consist of millions of 100 nm-diameter zinc oxide nanowires grown on the surface of much larger Kevlar strands. The nanowires are about 3.5 μm long and radiate outwards from the surface of the Kevlar, which can then be twisted together to create thicker fibres and ultimately woven to make a durable fabric.

When such a fabric is stretched, crumpled or otherwise disturbed, the nanowires would rub against each other and bend. Because zinc oxide is a piezoelectric material, this bending causes several millivolts to develop along the nanowire. Fig 1.

According to Georgia Tech's Zhong Lin Wang, who led the project, the key challenge in designing fibres for such a "piezotronic" material is how to extract tiny amounts of electricity from lots and lots of nanowires (Nature 451 809).

Firms call for support of 'nanophotonics' R&D in Europe
http://physicsworld.com/cws/article/news/32853
http://nanotechweb.org/cws/article/yournews/32765
An organization representing many of Europe's leading photonics firms and research labs has drawn up a roadmap recommending that the European Commission (EC) boost its support for research into improving the fabrication of photonic devices based on quantum dots, carbon nanotubes and other nanometre-scale technologies.

The European Roadmap for Photonics and Nanotechnologies is the culmination of a two-year effort coordinated by the Merging Optics and Nanotechnologies (MONA) group, which includes firms such as Aixtron and ASM; labs such as Belgium's IMEC; and the 78 members of the European Photonics Industry Consortium. The 161-page document offers recommendations for the next 5–10 years of nanophotonics R&D and includes contributions from more than 300 experts in the field. The document is available at: *http://www.ist-mona.org*

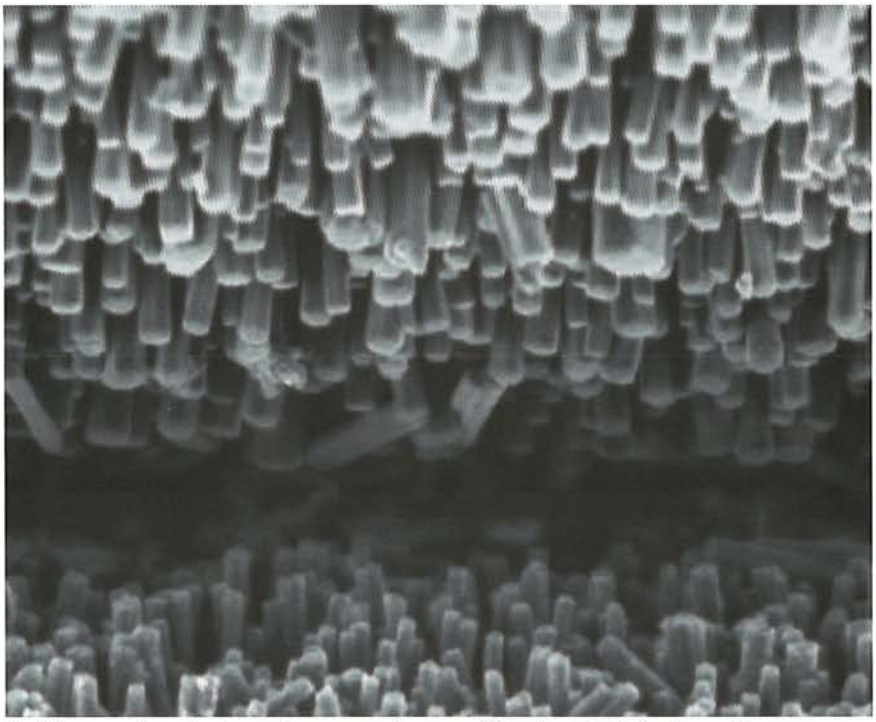


Fig 1 A scanning electron microscope image of the piezoelectric zinc oxide nanowires. The two sets of nanowires meet teeth-to-teeth, allowing the gold-coated microfibres to rub those not coated with gold to produce electricity.(Courtesy: Prof Z L Wang and Dr X D Wang, Georgia Institute of Technology)

Glassy metals that are tougher than steel
http://physicsworld.com/cws/article/news/33127
Researchers in the US have developed a class of materials that have the potential to be tougher than the best titanium or steel alloys, ranking them among the toughest known.

Bulk metallic glasses (BMGs) have shown promise in engineering for the past 15 years but have been let down by poor ductility, making them brittle and prone to fracture. But Douglas Hofmann, William Johnson and colleagues from the California Institute of Technology in Pasadena have found a way of modifying the structure of BMGs so that their ductility increases significantly.

One way of improving ductility and avoiding cracks, which has been adopted by the California team, is to introduce elements in the hot, initial BMG alloy that will nucleate dispersed crystals or "dendrites" when finally cooled. These dendrites act as a barrier to growing shear bands, preventing them from every developing into cracks. Instead, pulling the composite BMG will simply produce more, small shear bands, allowing the material to stretch and withstand a greater load.

Although BMGs are primarily used for cosmetics at the moment, Hoffman's group would like to exploit their new-found toughness in structural applications, for example in the aerospace industry. They are hoping to acquire some of the market for high-performance titanium alloys.

Nanotubes measure DNA conductivity
http://physicsworld.com/cws/article/news/33255
Ever since the famous double-helix structure of DNA was discovered more than 50 years ago, researchers have struggled to understand the complex relationships between its structural, chemical and electrical properties. One mystery has been why attempts to measure the electrical conductivity of DNA have yielded conflicting results suggesting that the molecule is an insulator, semiconductor, metal—and even a superconductor at very low

temperatures

DNA's apparent metallic and semiconductor properties along with its ability to self-replicate has led some researchers to suggest that it could be used to create electronic circuits that assemble themselves. Now, however a team of researchers in the US has shown that DNA's electrical conductivity is extremely sensitive to tiny structural changes in the molecule — which means that it could be very difficult to make reliable DNA circuits.

Colin Nuckolls of Columbia University, Jacqueline Barton of Caltech and colleagues were able to make reliable conductivity measurements by inventing a new and consistent way of connecting a single DNA molecule to two carbon nanotubes. Poor connectivity is thought to be behind many of the inconsistencies in previous measurements.

Secret of sandcastle building revealed
http://physicsworld.com/cws/article/news/32828
Making a sandcastle is child's play because adding a seemingly random amount of water to dry sand makes a sticky material that is easy to work with. However, exactly why sand is sticky over a wide range of water content had been a mystery, with important implications in civil engineering and especially the prevention of landslides. Now, an international team of researchers thinks that it has the answer, based on a microscopic study of exactly how water glues sand grains together. Fig 2

This glue is thought to be the familiar capillary force that causes water to move up the edge of a container. However, the structures that are formed when the grains stick together are extremely complex and vary greatly with how much water is in the sand. This has made it very difficult to understand exactly how the mechanical properties of sand are affected by water.

Fig 2 Upper row: Theoretical predictions of how capillary bridges bind glass beads together. Bottom row: Microtomography images of the bridges seen in wet beads. (Courtesy: Nature Materials).

Now, Stephan Herminghaus of the Max Planck Institute for Dynamics and Self Organization in Göttingen, Germany, and colleagues have tackled this problem by studying 3D images of wet glass beads using X-ray microtomography.

It is well known that light carries momentum. This is exploited in so-called optical tweezers, which use optical gradients to push small particles from regions of high to low light intensity. Less well known, however, is that spatial variations in an optical field's phase can also generate a force on a particle — as Yohai Roichman and colleagues show *(Phys. Rev. Lett. 100, 013602 (2008))*.

Using shape-phase holography, the authors generate a variety of optical fields with differently shaped phase gradients. They show that, for a linear phase gradient, a water-suspended glass microsphere is propelled along the gradient, similar to its behaviour in an intensity gradient.

More significantly, by combining the effects of intensity and phase, more complex control can be exerted, demonstrated by the circular motion of a microsphere in a ring-like intensity trap with an azimuthal phase gradient.

Researchers create 'self-healing' rubber
http://physicsworld.com/cws/article/news/32970
Rubbery materials can be easily stretched, but it is not easy to mend them when they break, as anyone who has ever had a punctured car tyre will know. Now, however, researchers in France have created a unique new rubber-like material that can "self-heal" at room temperature. If the material is snapped in half, the two torn pieces can be made to mend themselves simply by bringing the broken surfaces back in contact with each other. Fig 3

The new "supramolecular rubber" has been created by Ludwik Leibler and colleagues at the Ecole Supérieure de Physique et Chimie Industrielles (ESPCI/CNRS) in Paris, France. It consists of "fatty acids" — short chains of carbon atoms — linked together via hydrogen bonds to form a macroscopic 3D network. The material behaves just like an ordinary rubber in that it can stretch to several times its normal length when pulled.

Fig 3 The right ingot is able to withstand more tension before fracture because the dendrites help to prevent shear bands from developing into cracks. (Credit: Hofmann et al.)

But if the material is cut in half, the two broken pieces of the rubber can self-heal when brought together and simply held in contact for a few minutes. The fracture mends and the material can be stretched and pulled in all directions again.

Free-electron laser benefits from 'seed' light
http://physicsworld.com/cws/article/news/33332
Researchers in France and Japan have developed a technique that not only reduces the size of a free electron laser (FEL) but also generates coherent light at X-ray wavelengths down to 32 nm for the first time.

The technique, which involves seeding the laser with another light source, could be refined to produce fully-coherent pulses with wavelengths of 2-4 nm, opening up the "water window" crucial for studying biological samples.

Feeling the force on a single atom
http://physicsworld.com/cws/article/news/33061
Researchers have long used scanning tunnelling microscopes (STMs) to move single atoms around on the surface of material with atomic-scale precision — allowing them to make nanometre-scale structures such as "quantum corrals". However, it has never been possible to measure the force required

to move an individual atom, something that could improve our understanding of the structural and mechanical properties of materials. Fig 4

Now, however, an international team of physicists has used a modified STM to measure the force needed to move a single cobalt atom on both platinum and copper surfaces. The breakthrough could help researchers build new nanoscale devices such as high-density magnetic memories.

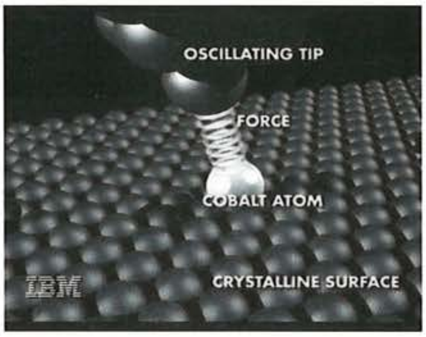


Fig 4 Artist's impression of the IBM microscope tip measuring the force it takes to move a cobalt atom on a crystalline surface. While the vertical force is shown, the AFM can also measure the lateral force on the atom.(Courtesy: Jenny Hunter, IBM).

Knee brace harvests 'negative work'
http://physicsworld.com/cws/article/news/32812
When you walk, one set of muscles drives your legs forward, while another does "negative work" by pulling in the opposite direction to control your stride. Now, researchers in Canada and the US have built a device that can convert this negative work into electricity. They claim that the device, which straps onto the leg around the knee, can generate 5 W of electricity — enough to power several mobile phones or even an artificial limb. Fig 5

The electricity-generating knee brace has been designed and built by Max Donelan and colleagues at Simon Fraser University in British Columbia along with researchers at the Universities of Pittsburgh and Michigan. It consists of a standard knee brace rigged with a generator and clutch system.

Scientists probe fireballs with X-rays
http://physicsworld.com/cws/article/news/32998
Scientists have been baffled for centuries about the strange drifting balls of light that appear occasionally during thunderstorms. Theories put forward so far suggest that this "ball lightning" is either a moving electrical discharge or that it is some kind of self-contained object.

Now, research from an Israeli group is making the latter seem more likely. The scientists have created artificial fireballs in a shoe-box-sized cavity and then used the European Synchrotron Radiation Facility (ESRF) in Grenoble to analyse their composition.

After passing X-rays through the cavity and generating diffraction patterns, they discovered that the fireballs contain about 10^9 particles per cm^3, each of which has an average diameter of about 50 nm (Phys. Rev. Lett. 100 065001).

They believe that this observation supports a theory put forward by John Abrahamson, a chemical engineer at the University of Canterbury in New Zealand, proposing that ball lightening occurs when ordinary lightning vapourizes carbon and silicon oxides within soil, allowing the carbon to chemically reduce the silicon into its elemental form. The silicon atoms then cool, condense and group together into nanoparticles, which oxidise in the surrounding air and give off thermal radiation.

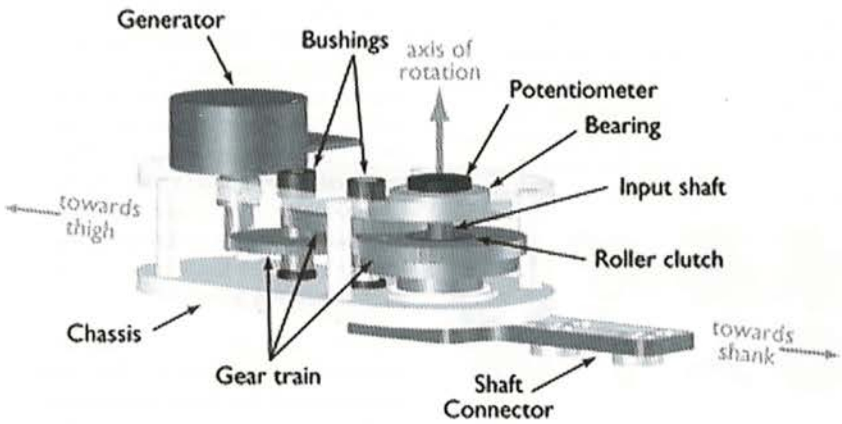


Fig 5 The inner workings of the knee-brace energy harvester. (Courtesy: SFU)

Atomic resolution

Nano. Lett. doi: 10.1021/nl073149i (2008)
Understanding the properties of nanoscale materials requires accurate information on the 3D structure and composition at the atomic scale. And although bright-field transmission electron microscopy (TEM) can offer a resolution of 2 Å, the images are 2D projections of the structures.

The application of aberration-corrected TEM has shown single-atom sensitivity, but the resolution of tomographic approaches for 3D reconstruction is limited to a volume of 1 nm^3. Knut Urban and colleagues demonstrate that negative spherical aberration imaging at low acceleration voltages can be used for tomography down to the atomic scale with reduced radiation damage. Their approach, based on phase-contrast imaging, enables 3D reconstruction of nested molybdenum disulphide nanoscale octahedra, and provides structural information on defects at the 2–3 Å scale.

The authors suggest that their method is applicable to the atomic characterization of a wide range of nanostructures where strong electron channelling is absent, such as inorganic fullerenes.

Samplings by Don Price CSIRO

Product News

Warsash

Low cost radiometer, power meter, joulemeter Spectrum Detector Inc.; Delta Series Radiometers/Joulemeters

Small and flexible, this series of radiometer and joulemeter probes are the perfect, economical fit for the lab bench, production test bed or on board a laser for measurement of optical power. The modular design of the Delta Series only requires the user to plug a Delta probe into an analog power supply (Delta-APM) to mate with oscilloscopes and lock-in amplifiers. Alternatively, plug it into a digital USB-based electronic module (Delta-DPM) to create a complete PC based radiometer or energy meter. A wide range of standard smart Delta probes, including Si, Ge and InGaAs photodiodes or Pyroelectric detectors are available, covering the spectrum from DUV to FAR IR and even the THz region.

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Modular Integrating Spheres for Light Measurement Applications Labsphere; Integrating Spheres (Modular)

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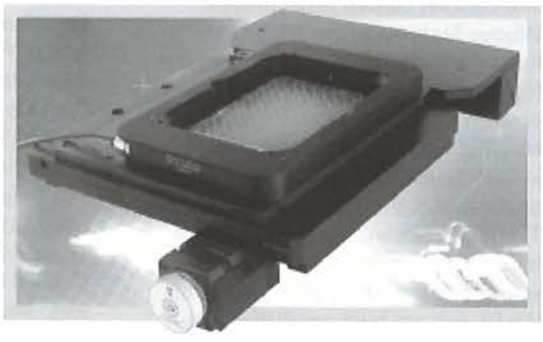

Product News

Kimmon HeCd lasers boast the industries longest operational lifetimes, with lasers averaging up to 10,000 hours use. This reliability allows them to offer the best warranty in the industry.

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Lastek

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The DL pro laser is a grating stabilized diode laser based on a novel engineering approach, innovative manufacturing techniques and specially selected AR coated laser diodes. Unique features of the DL pro are its large frequency tunability and its high frequency stability even in noisy environment.
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DL pro 780 laser head (with FiberDock)

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New ultra compact femtoREGENTM UC from High Q Laser

High Q Laser introduces the ultra compact femtoREGENTM UC – an all-in-one femtosecond regenerative amplifier - delivering 2 W power at 200 kHz repetition rate with 350 fs pulse duration on a footprint of 34 cm x 78 cm. The system presents industrial reliability and robustness and can be customized to an OEM integrator's needs for medical, industrial and scientific applications such as tissue engineering and nano processing.

The all-in-one regenerative amplifier system femtoREGEN UC (Ultra Compact) is based on the high end Yb-doped laser materials for future power and repetition rate scaling. It utilizes High Q Laser's patent pending Intra-Cavity-Chirped-Pulse-Amplification (ICCPA) for ultra compact design.

The femtoREGEN UC integrates all pump laser diode modules, the seed oscillator and the amplifier in a single ultra compact housing. The seed laser is designed as a High Q Laser ultra compact (UC) module itself for high stability and compactness. The UC seed oscillator is operating with "de-rated" nominal pump current for longest MTBF and is based on High Q Laser's patented resonator folding technique withstanding a 50 g shock test for most robust performance. The semiconductor saturable absorber mirror (SESAM) assures passive and self-starting mode locking for high temporal stability.

The femtoREGEN UC comprises the resonator of the regenerative amplifier and the Pockels cell in one monolithic module, the proven High Q Laser IC (Industrial Compatible) module. The Pockels cell and its electric driver modules can both be independently replaced for an easy service in the field.

Product News

The femtoREGEN UC has a single 19" unit "all-in-one-electronics" hosting all supply and control functions for easy and true "turn-key" operation and facilitates system integration for OEM customers with a CAN bus and 24V power supply supply.

Customers benefit from the ongoing OEM production in quality, performance and investment cost. The high modularity ensures high temporal and spatial stability as well as easy service and maintenance resulting in low operation cost and high MTBF.

The applications of the femtoREGEN are in various markets:

- Semiconductor: Mask repair, nano scale thin film ablation, waveguide writing, direct write lithography

- Medical/Life Sciences: "Cold Ablation" of biological tissue in ophthalmology and neurology, femtosecond laser dissection, cell nano manipulation

- Research: Ultrafast spectroscopy together with our High Q Laser wavelength conversion system (harmonics generation, OPA), non linear optics

- Nano Processing: Laser ablation for most precise material ablation or changes, e.g. photovoltaics, flat panel display repair

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- Single polarisation operation
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- Easy tuning from front panel
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For more information please contact Paul Wardill or Gerri Springfield.

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New! In-situ nanomechanical test instrument for TEM's

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NewSpec

Newport Universal Fibre Optic Detector

Newport's new 918D-IS series Universal Fibre Optic Detector uses a symmetrical integrating sphere design to ensure accurate calibration, regardless of the fibre type measured. The integrating sphere uses a novel dual detector design, with special optics that improve temperature sensitivity markedly from ordinary detectors.

Three versions are available, each with a different wavelength range. The 918D-IS-1 is fully calibrated to NIST traceable standards over the wavelength range of 400–1650 nm. The 918D-IS-IG uses a single InGaAS detector and is calibrated over the range of 800-1650 nm. The 918D-IS-SL uses a single Silicon detector and is calibrated over the range 400-1100 nm.
Maximum versatility is provided by the detector's dual port design. A variety

of adaptors for connector-terminated fibres are provided, and plug into the detector's front port. The rear port is designed to measure light from straight and angle cleaved bare fibres, using Newport's FP3-FH1 bare fibre holder. A complete kit of adaptors is included with each detector, together with a rugged carrying case. The 918D-IS series is compatible with Newport's new power meters with DB15 connectors.

Key Features:
• Integrating sphere design enables accurate and polarization independent measurements from all fibre optic sources
• Continuous measurements over the entire 400–1650 nm wavelength range
• Optical power input up to 200 mW
• Accepts bare fibre and FC, ST, LC, and SC terminated fibre inputs

For more information please contact Neil (Tel: 08 8463 1967, *sales@newspec.com.au)*

High-Power Laser Diode Mount

Newport's 763H Series high-power laser diode mounts provide an air-cooled solution for high power laser diodes and bars. Both free-space and fibre-coupled diode bars can be mounted.

An internal thermoelectric (TE) cooler provides for fine control of the laser diode temperature, enabling wavelength tuning and further device stabilization. The 763H Series mounts are compatible with Newport's Prolite BW, CW, and DCS series high power diode bars, and most other diode bars on the market. Connectors on the 763H mount are designed to interface with Newport's 5600 Series Laser Diode Driver and 3150 Series Temperature Controller allowing for a complete solution to your High Power Diode control needs. When connected to Newport's 3150 High Power Temperature Controller, up to 75 W of device waste heat can be dissipated using an advanced heatsink and cooling fan design.

For more information please contact Neil (Tel: 08 8463 1967, *sales@newspec.com.au)*

Innova Scanning Probe Microscope from Veeco

High-Power Laser Diode Mount

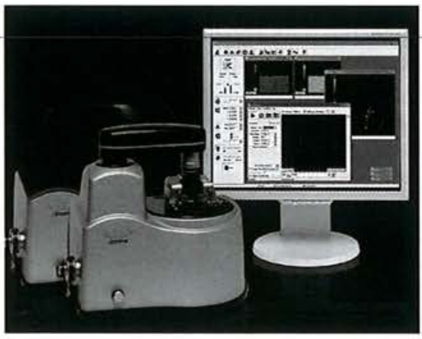
Product News

Veeco's revolutionary new Innova scanning probe microscope (SPM) delivers high-resolution scanning and a wide range of functionality for physical, materials, and life sciences, all at a much lower price than comparable systems. Innova scans from sub-micron levels up to 90 microns, with proprietary closed-loop scan-linearization that approaches open-loop levels, all without the need to change scanner hardware.

The integrated high-resolution color optics and programmable, motorized Z-stage make finding features and changing tips or samples fast and easy. The Innova's high-end functionality, compact footprint, and moderate cost make it the best value SPM available today.

Features and Benefits:
- Highest Resolution Optics
- Outstanding Closed-loop Scan Control
- Fast, Easy Tip & Sample Exchange
- Versatility and Value for Money
- Superior Performance and Flexibility
- Full Range of SPM Modes including: Contact Mode, Tapping Mode, LFM, STM, MFM, Pase Imaging, EFM, CAFM, SThM, Force Distance Spectroscopy and Nanolithography

For more information please contact Neil or Graeme (Tel: 08 8463 1967, *sales@newspec.com.au)*



News

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Announcement of Excellence in Research for Australia initiative

The Minister for Innovation, Industry, Science and Research, Senator Kim Carr, announced plans for a new research quality and evaluation system.

The Excellence in Research for Australia (ERA) initiative, to be developed by the Australian Research Council (ARC) in conjunction with the Department of Innovation, Industry, Science and Research, will assess research quality using a combination of metrics and expert review by committees comprising experienced, internationally-recognised experts.

"For the first time we will be able to measure our achievements against the world, and plan the future of research investment," Senator Carr said.

"The Commonwealth invests billions each year in research. The ERA model will provide hard evidence that taxpayers are getting the best bang for their buck in this critical area.

Senator Carr said that ERA would start with those disciplines where the metrics were most widely accepted, for example, in the physical and biological sciences.

The ERA will build on work done to date in defining areas of strength, and will aid the development of our 'hubs and spokes' model for research infrastructure that is based on all universities having centres of excellence in specified fields.

Senator Carr said that until the ERA was fully developed, the current arrangements for the block grants funding will be maintained and would remain the responsibility of the Department of Innovation, Industry, Science and Research (DIISR).

The ERA will replace the now defunct Research Quality Framework with an internationally recognised and transparent research quality assurance system.

Minister for Innovation, Industry, Science and Research, Senator Kim Carr

Branch News

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Victoria

The April meeting of the Victorian Branch will be held in conjunction with the opening of the art installation, Cluster. The installation draws on the role of the observer in quantum mechanics with the installation itself changing in response to visitors.

A special introduction by Dr David Paganin from the School of Physics at Monash University will provide a discourse on the connections between art and physics. The concepts of Quantum Mechanics, in particular the Uncertainty Principle, and how they relate to our perception of reality and our interaction with art will be explored.

CLUSTER By Plump
6.30pm Thursday 24th April, 2008
VCA Margaret Lawrence Gallery
40 Dodds St, Southbank
For more information:
http://www.clusterbyplump.blogspot.com/
http://vic.aip.org.au/#bm_next
http://vic.aip.org.au/program/2008/Cluster.pdf

Branch: Vic 2008 Committee:

Chair: A/Prof Andrew Peele, Reader, La Trobe University
Vice-Chair: Dr Alex Merchant, Senior Lecturer, RMIT University
Secretary: Ms Gaby Bright, eResearch Communications, VeRSI
Treasurer: Dr Chris Vale, Academic Staff, Swinburne University
Committee members:
Mr Paul Cuthbert, Physics Teacher, Camberwell High
Dr Nicoleta Dragomir, Postdoc, Melbourne University
Ms Sue Grant, Chair of Education Committee
Mr Andrew Martin, PhD student, Melbourne University
Dr David Paterson, Principal Microspectroscopy Scientist, Australian Synchrotron
Prof Steven Prawer, Melbourne U.
Mr Peter Robertson, Research Coordinator, RMIT University
Prof Andrei Sidorov, Swinburne U.
Dr Andrew Stevenson, Prinicpal Research Scientist, CSIRO
Dr Scott Wade, Research Fellow, Monash University
A/Prof Stuart Wyithe, Melbourne University

Conferences

June 13 – June 15
Third International Conference on the Nature and Ontology of Spacetime
Montreal, Canada
www.spacetimesociety.org/conferences/2008/

June 14 - 19
Nanotechnology for Sustainable Energy
Obergurgl, Austria
www.esf.org/conferences/08257

July 14 - 17
The 2008 International Conference on Scientific Computing (CSC'08)
Las Vegas, Nevada, United States
www.world-academy-of-science.org/sites/worldcomp08/ws/conferences/mlmta08

July 19 - 24
6th Congress of the International Society for Theoretical Chemical Physics (ISTCP-VI)
Vancouver, Canada
www.chem.ubc.ca/istcp6

June 27 – July 5
International School "Frontiers in Numerical Gravitational Astrophysics"
Sicily, Italy
astro1.phys.uniroma1.it/ericeschool/index.html

June 29 – July 11
BIPM Metrology Summer School 2008
France
www.bipm.org/en/events/summer_school/

July 28 – Aug 1
2008 International Conference on Electronic Materials -ICEM 2008
Hilton Sydney, Sydney
www.aumrs.com.au/ICEM-08/

July 7 – July 10
OECC/ACOFT 2008
Sydney Convention & Exhibition Centre, Sydney
www.iceaustralia.com/OECC_ACOFT2008/

July 7 – July 10
International Commission for Optics Congress (ICO-21)
Sydney Convention & Exhibition Centre, Sydney
www.iceaustralia.com/ICO2008/

July 13 - 20
37th COSPAR Scientific Assembly and Associated Events
Canada, Quebec
www.cospar-assembly.org/

July 28 - August 1
International Conference on Electronic Materials 2008 (ICEM 2008)
Sydney, Australia
www.aumrs.com.au/ICEM-08

August 3 - 10
Quantum Monte Carlo and the Casino Program III
Italy, Tuscany
www.vallico.net/tti/qmcatcp_08/announcement.html

August 13 – 19
XXVII International Colloquium on Group Theoretical Methods in Physics
Yerevan, Armenia
theor.jinr.ru/~group27/

August 25 – 29
International Workshop on Optical Superconducting
Vienna, Austria
www.cs.ubbcluj.ro/~moltean/osc2008

September 1 – 5
Trends in Nanotechnology (TNT2008)
Oviedo, Spain
www.tntconf.org/2008

September 15 - 17
Mie Theory 1908-2008 : Present developments and interdisciplinary aspects of light scattering
Halle, Saxony-Anhalt, Germany
www.physik.uni-halle.de/Mie/

October 10 - 18
Critical Stability of Quantum Few-Body Systems
Erice, Sicily, Italy
lpsc.in2p3.fr/Indico/conferenceDisplay.py?confId=29

November 17 - 20
14th International Conference on Thin Films
Belgium, Ghent
http://www.ictf14.ugent.be/

Nov 30 – Dec 5
18th National AIP Physics Congress
Adelaide, South Australia
www.aip.org.au

December 12 - 13
2nd International Conference on Science and Technology (ICSTIE'08)
Penang, Malaysia
www.icstie.com

2009

September 7 - 11
9th International DYMAT Conference on the Mechanical and Physical Behaviour of Materials under Dynamic Loading
Brussels, Belgium
www.dymat2009.org

Courtesy of NASA, ESA, and The Hubble Heritage Team (STScI/AURA)

New Agilis Piezo Driven Components

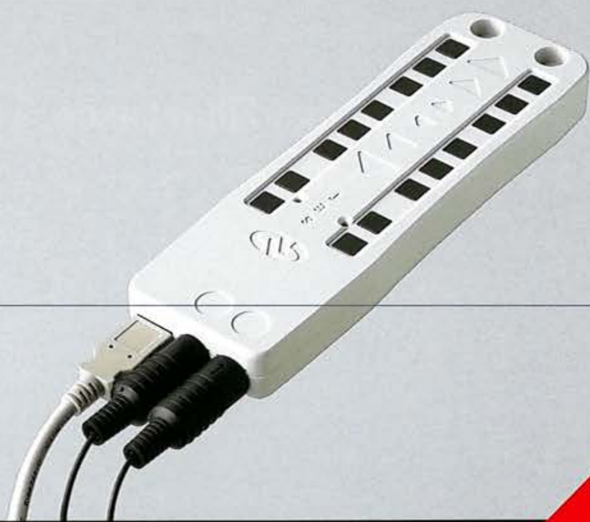
Newport's new piezo motor driven optical components take a completely new design approach to the adjustments needed for many laser setups. Agilis Mirror Mounts, Linear Stages and Rotary Stages provide the ultra-high adjustment sensitivity and convenient remote operation of a motorized component at the price and size of a manual mount or stage!

Agilis 12mm Travel Stage A$781

Agilis Mirror Mount A$473

Agilis Rotary Stage A$854

Agilis USB Controller A$399



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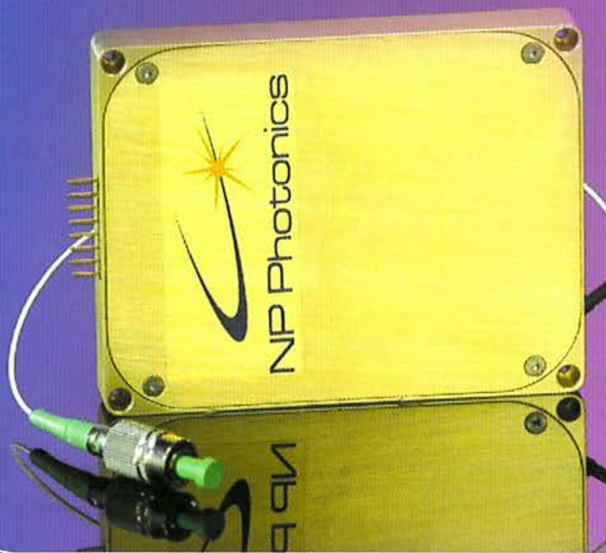

Scorpio 1-Micron & C&L Band ASE Modules & Sources

- Broadband spectral options : 1000nm - 1065nm and 1525nm - 1610nm
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- > 65nm bandwidth
- Integrated monitor electronics and pump laser ensure high power, spectral and temperature stability
- Microprocessor controlled
- Available as modules or benchtop turnkey systems with RS232 interface

Single Frequency Fibre Laser Modules & Sources

- Centre wavelength choices : 1030nm - 1080nm and 1530nm - 1565nm
- Up to 5 Watts output power
- Ultra-narrow linewidths down to < 1kHz linewidth with very long coherence lengths
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- Integrated noise reduction for excellent signal to noise stability
- Laser module features fast piezo wavelength modulation capability
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