Australian PHYSICS

May/June 2008 Volume 45 Number 3

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

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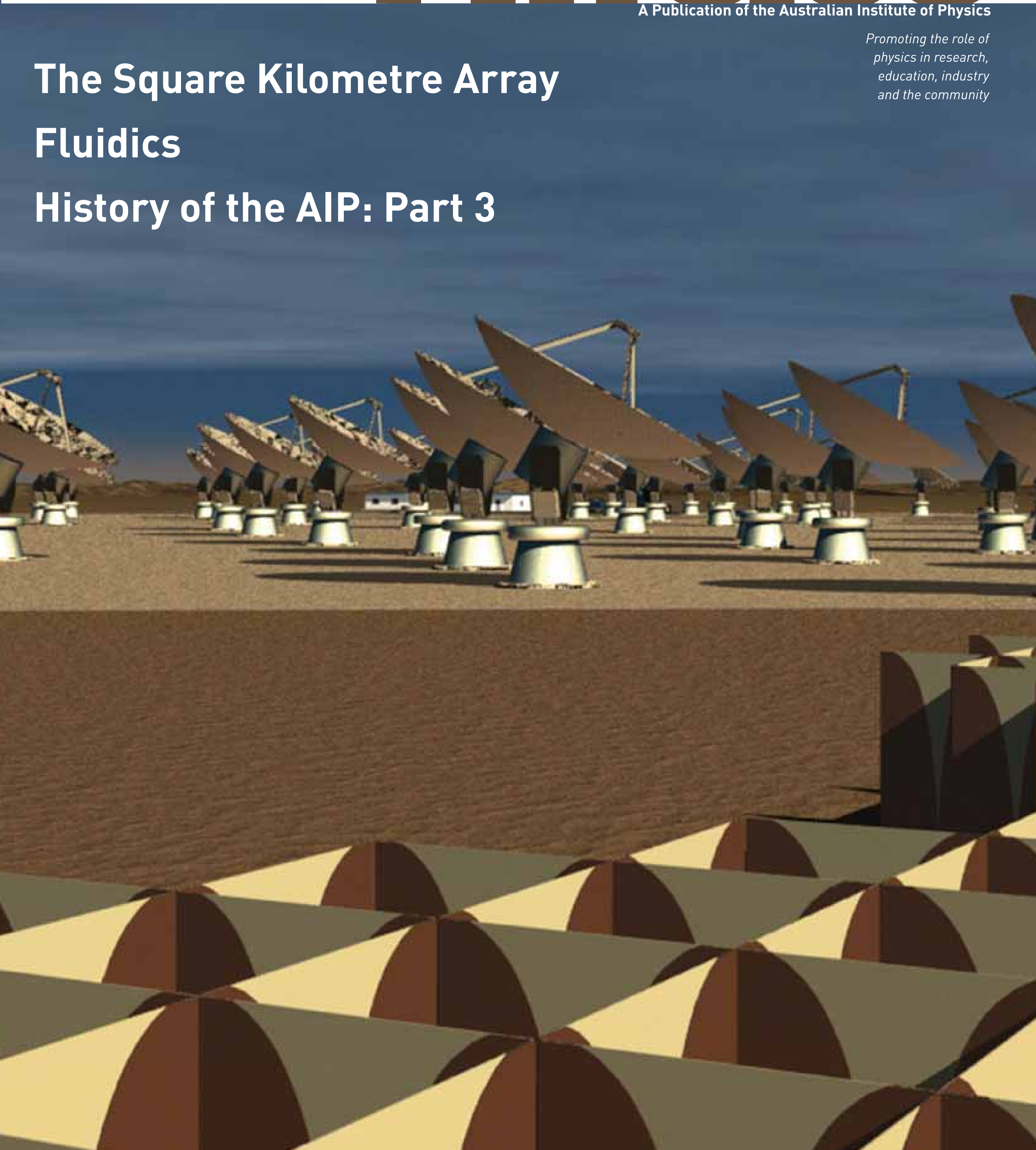
History of the AIP: Part 3



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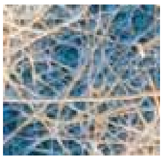
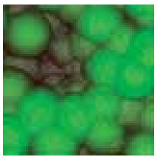
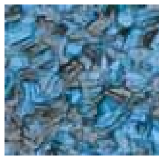


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The SKA reference design, including aperture arrays (foreground) and small dishes (background).

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Image credit: Xilostudios

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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: Stop the planet I want to get off...

Everything seems to be changing more quickly. A change of government has probably predicated this pace with over 120 different government reviews currently underway looking at universities, innovation, and space industries to name a few. And when something is reviewed the result rarely implies: "Wow, you are going well, just keep doing what you are doing." A review usually makes a list of recommendations requiring significant changes to initiate the "improvements".

So why do we review things to make changes? Does it really make things better, more effective and efficient?

Employees of any organisation commonly have all the answers to make things run better. My research group would call ourselves the "Alternative Government" at the morning tea table! If only the boss would do things our way, all would be well.

After joining "management" I discovered two things. First, you get to see all of the issues and realize that the situation is never that simple. Judgement, priorities and competing interests all need to be taken into account; the "Alternative Government" solutions don't seem as easy and obvious any more.

Secondly, it becomes difficult to see the "woods from the trees." Conflicting priorities and lack of time bog me down, and it is not long before the "Alternative Government" thinks I should do things better... Is this the time to review? If only it were possible to rise above it all and take a full view of the situation without the biases, hurts, personal ambitions and issues getting in the way. The truly greatest leaders can do this!

Over the last 20 years my work place has had considerable change. Gone are the typing pool of secretarial staff, cleaners and gardeners, and photographers - a consequence of new technology and outsourcing of support services for financial efficiency. Mergers, de-mergers and more mergers again have led to various divisional names, chiefs and management structures. It has also led to significant staff turn over, decisions to stop research in specific areas and a shift in the mission of CSIRO.

During each of these increasingly more frequent events, employees experience a roller coaster ride of emotions dealing with the change. However, if my division was the same today as it was 23 years ago, it would be a very out-of-date, inefficient and irrelevant. Innovation requires us to keep moving in new directions. Science is dependent on new ideas and concepts that we physicists embrace willingly. Yet when there are changes in our management structures and ways of facilitating the science to make it effective, both scientifically and financially, we rarely say "wow, wonderful I can't wait to see the new change implemented". Instead the "Alternative Government" is in its prime pointing out how everything will be worse off, often for good reason.

So why is this? Why can't the changes that obviously have to happen (to keep an organisation financial, relevant and effective) rarely have employees cheering on the side lines pushing through reforms or recommendations that could really make our workplace better? And are the changes really the ones needed to achieve their vision?

All improvements require change. Whether it encompasses a whole organisation or a team of people, the principles are still the same[1]. Unfortunately "change management" has come to mean downsizing and layoffs. This ends up affecting individuals who feel the impact greatly, while the larger organisation feels but a ripple. Even though the pragmatic interpretation of change management is the link between the "vision" (i.e. the case for change) and its "implementation", too often the process is done poorly.

There are many models of change management[2] but they all state that it is not a neat sequential process that occurs in three stages. These (fictional) stages are: taking a flawed entity that is awakened to the need for a new reality; moving it through an arduous transitional stage by disengaging with the past and recognising that the old way of doing things is no longer acceptable; and finally, leading it into the future in an enriched and desired state. Unfortunately, there is usually strong resistance to change by the employees.

The original model for change management by Lewin[3] uses "force fields" to conceptualise the organisational change as a "process shaped by the interaction of driving forces for change with restraining forces impeding the change". Reasons for the resistance to change usually include the following factors[2]:

- Self-interest (loss of power, face, income, job security and additional workload);
- Resentment (of particular people implementing the change, change fatigue, increased power and authority in a few);
- Different perceptions of change (based on one's position in the organisation and access to information);
- Misunderstanding and lack of trust (usually due to poor organisational communication); and
- Low tolerance for change (as new skills and work behaviours will be required).

All are reasonable perceptions.

Reading many different theories of organisational change suggests it is easy, but major change programs recorded by the Fortune 1000 companies have an estimated success rate of between 20 and 50%[2]. The reason for this failure is simple - leaders see change as an opportunity, a survival strategy or a chance to further their careers. The employees see it as disruptive, intrusive and with little to gain for themselves.

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Editorial

When it comes to technological innovation we tend to overestimate long-term predictions, while underestimating the short-term predictions, the case of the paperless society being one such situation. Most of us were around when the media, along with technological wizards like Gates and Wosniak, told us paper would be a thing of the past. It is far more likely that the amount of harvestable trees on the planet will dictate when our paperless society comes to fruition long before we do it through technology; but that's beside the point, because there are significant benefits to a "papered" society, where reading (and archiving) hard-copy documents still exists.

Consider Anna Binnie's third and final History of the AIP appearing in this issue (*Parts 1 and 2 appeared in Vol. 44 no. 2 July-August 07 and Vol. 44 no. 4 Nov-Dec 07 respectively*). Binnie acknowledges that her research (for Part 3) is based on one source: *Australian Physics* and its many incarnations over the past 44 years. Binnie writes that AP has been our "public face" in telling our "public story" since it started in 1964. She is correct in both respects.

There is little doubt that any membership driven journal like AP is important in providing its members with an opportunity to participate in the discourse that all organisations as diverse and geographically disparate as we are, rely on. Non-academic journals like AP depend on member's interest for articles, news and knowing what (should) matter to the organisation; but more importantly we are the record and archive of this information. But what if only a few members read it or wanted to participate in producing it? Should we still print it wasting paper and sending copies to each member? Why not just go online for most, if not all, of it?

There certainly are advantages to going online: the immediate reduction in the use of paper, not to mention the decrease in printing costs, would be astounding; add in video and audio elements, and the availability to reach anyone who chooses to read it from anywhere in the world...oh the advertising revenue that would come from a worldwide market.

Unfortunately, digital documentation is not without its flaws and setbacks. Reading long documents off the screen is tedious at best, and the sale of e-books has been a resounding failure (to date). Nevertheless, I have done my part by no longer printing your articles and therefore doing all of my editing completely "on-screen", small as it is.

If AP were to become entirely digital, then 44 years from now when another scholar of Anna Binnie's quality and passion comes along, she could do all of her research from the comfort of her home (on the moon possibly). But 44 years is a long time in the digital world, think of how many software versions and hardware updates you have gone through since owning your first computer alone, not to mention the many ISO updates that have come to pass, and will.

Governments the world over are struggling to deal with the archiving of official emails given that the original software and hardware no longer exists. (Do you .wpd, or .doc or .docx?) And what would the archives look like? The dramatic change in storage devices alone from floppies to USB sticks in about 20 years is staggering. What would a museum display in 44 years? Simply terminals?

Australian Physics will proceed with the production of an online component in due course; but hard-copy paper documents, like the one you hold in your hand right now, are valuable and here to stay for the long-term future. And that's a good thing, since last time I checked the human wetware for reading documents has not changed in a few thousand years.

John Daicopoulos

Submission deadline for the July/August 2008 issue is July 1, 2008

President's column – continued from page 71

Successful change can only be achieved when there is strong trust, based on predictability and capability, between all involved. Employees want to know that the change process will work, that they will be treated fairly, and that it will deliver what was promised. Berwick[4] has identified 6 requirements to achieve quality improvements by a change program:

1. A strong, well-articulated and communicated case for change (usually labelled the vision) that is maintained throughout the change process.
2. Behaviour that reflects the rhetoric of leaders.
3. Involvement of a cross-section of staff in planning and implementation.
4. Quality training and development of all employees for the new roles and skills required with rewards for adopting the change.
5. Effective communication that is extraordinarily difficult to achieve. It is recommended to communicate the facts and to act out the values, not to rely on videos, newsletters or large meetings as the main vehicle of communication. Acknowledge the critical importance of face-to-face quality communication, deal with rumours head on, and be straight and complete with the information disseminated.
6. The costs of any change program being budgeted adequately, both in the time-off tasks for those involved (dropping productivity) and the cost of creating the necessary infrastructures.

I am tired of change; but then I can see that if we keep doing things the way we always have, we may not be as effective, creative and innovative as we could be. However it is important that we really understand the motivation for any program of change. A change program should be a consequence of a vision to improve, achieve a greater good or to deal with a new economic reality, not to boost ones' career, deal with a difficult staffing issue or "keeping up with the Jones".

So with all the reviews initiated by the new government, let's hope that the inevitable changes ahead will be for the better and implemented wisely and humanely.

Endnotes

[1] R. Beckhard and R. Harris, Organisational Transition, 2nd edition, Reading, MA, Addison Wesley (1987).
[2] P. Garside, Organisational context for quality: lessons from the fields of organisational development and change management, Quality in Health Care (1998) 7 (Suppl), S8-S15. R.T. By, Organisational Change Management: A Critical Review, J. Change Management, (2005) 5, 369-380.
[3] K. Lewin, Frontiers in group dynamics, Human Relations, (1947) 1, 5-41
[4] D.M. Berwick, Continuous Improvement as an ideal in health care, N. Engl. J. Med. (1989) 320, 53-6.

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).

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AUSTRALIAN INSTITUTE OF PHYSICS

Australian Institute of Physics (AIP)

18th National Congress

Incorporating the 27th AINSE Plasma Science Conference

30 November - 5 December 2008

The University of Adelaide, South Australia

Advance Notice and Call for Abstracts

It is with great pleasure that we invite you to participate in the 18th Biennial Congress of the Australian Institute of Physics. The Congress will be held from 30 November to 5 December 2008 at the University of Adelaide, close to the central business district of the City of Adelaide.

The Congress will bring together physicists from around Australia and internationally. Plenary and keynote lectures by world-leading researchers, both national and international, will ensure a vibrant and exciting program. The five-day scientific program will also include parallel presentations, poster sessions and a trade exhibition.

Submission of Abstracts

Abstract submissions are now being accepted for the Australian Institute of Physics (AIP) 18th National Congress. Abstracts of no more than 300 words should be submitted by Monday 30 June 2008. Please refer to the web site for submission details and format instructions.

http://www.aipc2008.com

Important Dates

Close of call for abstracts	30 June 2008
Notification of acceptance	8 August 2008
Congress commences	30 November 2008

If you wish to have your paper included in the proceedings:

Full (refereed) papers due	29 August 2008
Referees comments and acceptance notified	October 2008
Full (corrected) final paper due	10 November 2008

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Branch News

ACT
The ACT branch of the AIP held its annual student physics prize awards night on April 29th. Around 30 or so undergraduate students and other branch members and friends saw cash prizes and certificates for the top 2nd year undergraduates in the ACT awarded to Officer Cadet Timothy Farrell (UNSW@ADFA) and Kirill Talanine (ANU) (see photograph). In keeping with the celebration of the achievements of our physics students two talks were then given by ANU graduate students who are well known for their accessible and interesting presentations:
Ramin Rafiei on "An Exotic Radioactive Ion Beam Capability for Australia" and Lachlan McCalman on "Tomography of Porous Materials." Both talks were very well received.

A chilly evening in Canberra was warmed up afterwards with some hot pizzas, cold drinks and good cheer. The prizes acknowledge the outstanding results achieved by both winners and hopefully will inspire them to continue to work hard and do well.

Kirill Talanine (left) and Officer Cadet Timothy Farrell (right) proudly display their certificates which acknowledge their achievement as the top 2nd year undergraduates in the ACT.

New South Wales
The Australian Institute of Physics has been very active each year in acknowledging prizes for the best graduating students from each University in recognition of their outstanding achievements in Physics. This initiative has been set-up to recognise and target students to be involved in future AIP initiatives. On Tuesday 16 April the AIP (NSW) Chair Dr Fred Osman attended the UNSW prize giving ceremony and presented a $400 cheque and an AIP certificate to Mr Ian Watson for his outstanding recognition in attaining the highest aggregate in the Bachelor of Science program. On Tuesday 22 April the AIP secretary Dr Graeme Melville attended the Macquarie University prize giving ceremony to award the AIP prize to Mr Joshua Brown for his outstanding achievements in Physics. The AIP congratulates both students on their achievements.

Mr Ian Watson (left) receiving the AIP prize from Dr Fred Osman (AIP Branch Chair) at the UNSW prize giving ceremony.

The April meeting of the NSW branch was held at the University of Sydney on Tuesday 22 April 2008 and featured Professor Peter Robinson a Federation Fellow from the University of Sydney. Professor Robinson's work spans several areas of wave physics and its application, including brain dynamics, space physics, plasmas, photonics, astrophysics, and biological physics. He is currently involved in work with the Brain Resource Company, which helped he helped found, and in the STEREO spacecraft launched by NASA in 2006.

Professor Robinson's talk was entitled "Multiscale Brain Dynamics: Toward a First-Cut 'Working Brain' Model" covering work conducted by the Schools of Physics and Medicine at the University of Sydney and the Brain Dynamics Centre at Westmead Hospital.

Despite the ever-increasing power of computers, modeling of the human brain at the individual neuron level remains a long way off. Professor Robinson described an alternative approach that, although simplified, has demonstrated close agreement with brain measurements, led to insights into brain function and provided the world's first fully standardized brain function database, the Brain Resource.

Professor Robinson's current approach was pioneered in the 1970's and is referred to as the continuum model. Instead of using a 3D technique aimed at simulating every single neuron, the continuum model treats the brain as an approximately 2D network of ~0.1mm-sized elements. This network is constructed with brain anatomy and physiological processes inbuilt so that a macroscopic entire brain picture emerges.

The end result is a closed set of non-linear, second order equations linking axonal propagation, synaptic & dendritic dynamics, and non-linear threshold response. Solution of the equations reveals two steady states of the brain: normal (low stimulation levels) and seizure (high stimulation levels).

Professor Robinson demonstrated how the fusion of physics, physiology and anatomy leads to new insights into brain modelling.

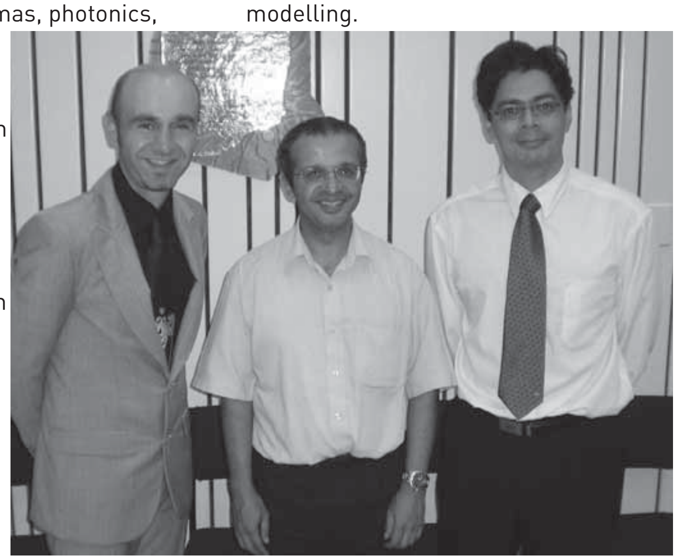


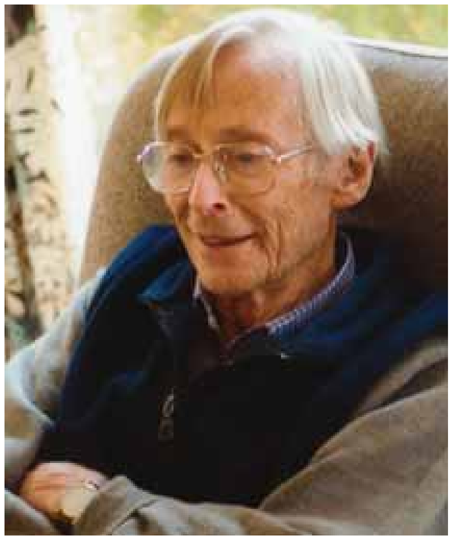
Photo NSW2: From left to right, Dr Fred Osman (AIP Branch Chair), Professor Peter Robinson and Dr Scott Martin.

Branch News

Tasmania
Dr Arthur Geoffrey Fenton
(1920 - 2008)
Dr Arthur Geoffrey Fenton AM FAIP, a long-standing member of the Tasmanian Branch died on 30 April, aged 88. Invariably known as Geoff, he spent his entire career based at the University of Tasmania, where he was first appointed as a Lecturer in Physics in 1944. Isolated from overseas suppliers, Australia at that time had to produce its own lenses and prisms. Geoff became part of a physics team constructing these in the "Optical Annexe" adjacent to the University as part of the War effort.

Interested in radiation detection, Geoff developed external cathode Geiger counters while attaining his PhD at the University of Birmingham in 1947. Returning to Tasmania, he established a production facility for the new counters and used them in cosmic ray detectors at a time when it was still unclear whether the observed variations in cosmic ray intensity were of terrestrial or extra-terrestrial origin. Geoff showed great foresight by, in cooperation with ANARE, constructing a network of muon telescopes at different locations (initially Hobart, Macquarie Island and Mawson). Much of the equipment was constructed from war-surplus materials, such as the ~20,000 7C7 valves bought for a song and used for counting circuits. The telescopes rotated on ex-army gun turrets!

Geoff was promoted to Senior Lecturer in 1951 and to Reader in 1957. Shortly thereafter he was elected Dean of Science for a two-year term. In those days that was a purely academic position, with departmental funding allocated by the Standing Committee of the Professorial Board. Later, he was Acting Head of the Physics Department when the permanent Head, Prof Ellis,



was on study leave.
No doubt influenced by reports from his brother Peter (K B) Fenton, then working with Prof Simpson at the University of Chicago, Geoff found funding to construct two Simpson type neutron monitors, one to be installed at the Springs, part-way up Mt Wellington and the other at Mawson. At the time of the IGY only the University of Chicago rivalled the Tasmanian group's network of stations. The collected data were widely and promptly disseminated. With his students, he made major contributions to the understanding of the time variations and anisotropies of the galactic cosmic radiation, and in particular, the properties of cosmic rays generated in solar flares. In partnership with Peter, John Greenhill and other colleagues he also developed X-ray detectors for use in the fledgling field of X-ray astronomy with the earliest detectors flown on sounding rockets from Woomera and later very large area detectors flown on high altitude balloons from Mildura, Alice Springs and in central Brazil.

Geoff was a member of the International Cosmic Ray Commission for some years and was Chair of the 12th International Cosmic Ray Conference, held in Hobart in 1971 and the first ICRC held in the southern hemisphere. He was a Fellow of the Australian Institute of Physics, the Institute of Physics and the Astronomical Society of Australia, and was active locally in ANZAAS and served for many years on the Tasmanian Radiation Advisory Council. He was a quiet, reserved, individual. Notable for his persistence, he was most at home in the "string and sealing wax" form of science, yet he introduced a level of professional electronic and recording systems into the Tasmanian network that was remarkable for its time. He retired at the end of 1985 but remained active until late 2007. In 2003 he was appointed a Member of the Order of Australia "For service to science, particularly in the field of cosmic radiation research, through significant technical developments, sustained planning and leadership."

His three children and their families survive him.

John Humble and Marc Duldig

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).

Executive News

SUMMARY OF EXECUTIVE MEETING E273

Meeting held Friday April 4

New Executive Member

John Humble has been co-opted as a member of the executive, following discussions held at the Council meeting in February.

Governance of the AIP

The governance of the AIP is being examined to ensure that best practice is being followed.

Review of Higher Education

The government has instigated a review of higher education. The terms of reference are being examined to identify areas where the AIP could provide useful comment.

Outstanding Service to Physics

One nomination for the outstanding service to physics award has been received. Further nominations are now being sought.

Peer Review Process

It is understood that some members of our scientific community do not fully understand the peer review process. Work is being carried out on producing a clear statement for use by the scientific community.

AIP Foundation

The AIP is looking into setting up a Foundation for the support of physics, with a specific statement of the manner in which funds are to be disbursed. In the process, arrangements will be made so that donations will be tax deductible. It is planned that a proposal will be prepared for consideration at the next Council meeting.

AIP History

Work on the AIP history is proceeding. The aim is to have this finished so it is available for distribution at the 50th anniversary of the AIP.

Theoretical Physics Group

There has been a proposal to form a theoretical physics group. The executive is offering support to the proposers to prepare an application for the formation of a group to be presented to the next Council meeting.

Australian Physics

A lot of work had gone into obtaining quotes for the printing of Australian Physics. Negotiations are now in progress on these quotes, and it is anticipated that printing costs will be reduced.

Student Travel Support

There has been considerable variation in the student travel support provided by the various branches. Following a call made at the Council meeting, the executive will take over the administration of student travel support, commencing in the new financial year. There will be two calls for applications for travel support each year. Criteria for the approval of travel grants are being drawn up.

Student Link Scheme

There have been proposals to offer free membership to students. Closer examination showed that this would not be financially viable. An alternative scheme is being put into place, in which a limited number of services will be offered to students. This will involve setting up contacts in universities to link students to these services. Students will be provided with AIP newsletters, appropriate job advertisements and will be given access to Australian Physics.

Accreditation

Accreditations for the University of Newcastle and Monash have been completed.

Awards

The Massey, Walsh and Education medals will be presented at the Congress dinner. The DSTO award will be presented in Canberra.

Women in Physics International Conference

Support is being sought for Australian women to attend the conference later this year.

Web Site

The web site has been maintained by volunteers and the work done by those carrying out the work is very much appreciated. However, at some stage the maintenance of the web site will need to be devolved to a professional web site manager. A review of the web site was completed by Science in Public. In the short term, the appearance of the site is to be modernized and documentation updated. Discussions on a more extensive redevelopment of the site are proceeding.

General Matters

Consideration is being given to providing comments to the innovation review via the FASTs submission. Work is being done on the collection of student numbers in physics in universities and high schools. Data on the number of physics workers in Australia is to be examined, mainly with respect to how this data has been obtained.

Next meeting: Meeting E274 is scheduled for June 25.
Ian Bailey, Hon secretary.

News

Giant galaxy trawl nets astronomers prize

A "uniquely ambitious, far-sighted" project in which the Anglo-Australian Observatory played a central part has won an Australian and UK astronomy team the first Group Achievement Award from the UK's Royal Astronomical Society. The award was presented at the UK National Astronomy Meeting being held at Queen's University in Belfast, Northern Ireland on 3 April.

Led by Professor Matthew Colless (Anglo-Australian Observatory) in Australia and Professor John Peacock (University of Edinburgh) in the UK, the thirty-three-member team spent ten years mapping the distribution in space of 220,000 galaxies using the 3.9-m Anglo-Australian Telescope (AAT) in New South Wales — a project called the 2-degree Field Galaxy Redshift Survey (2dFGRS).

Professors Colless and Peacock received the award on behalf of their team.

"The scale of this project made it ground-breaking," said Matthew Colless. "For the first time we were able to map the positions of a huge number of galaxies and see the subtle effects that reveal the different types of matter in the universe."

What was needed was for the area of sky surveyed to be much bigger than, rather than the same size as, the "walls" and "strings" of galaxies being detected. Almost ten times larger than any previous survey, the 2dFGRS was the first study to meet this crucial condition.

The survey measured patterns in the distribution of galaxies, on scales from 100 million to 1 billion light-years. Two wedge-shaped pieces of sky were surveyed, so when the galaxies within them were mapped out, the result looked like a bow-tie cut from a sponge: a network of voids and dense regions.

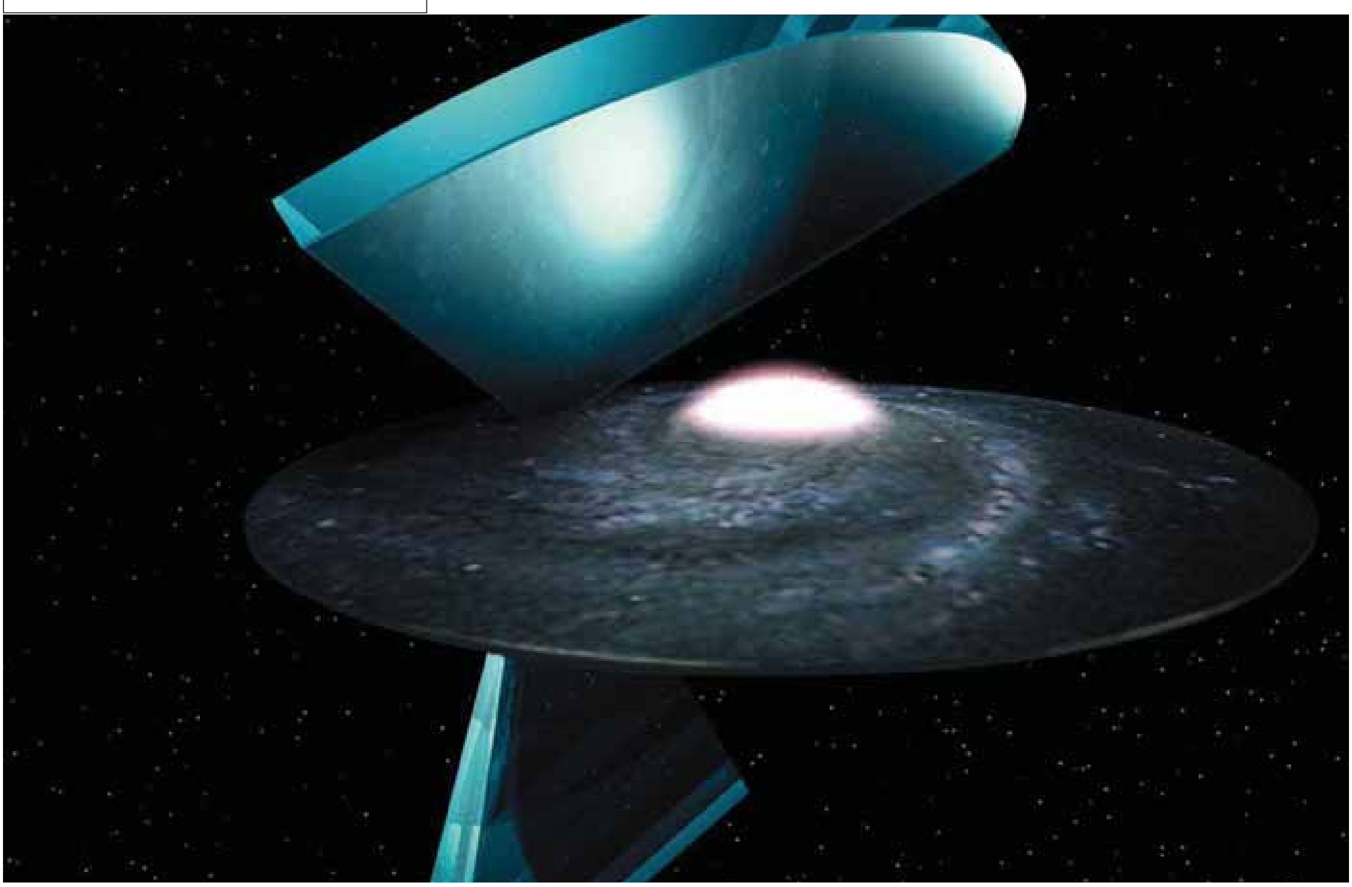
Key results from the 2dFGRS were:

• the first accurate ratio of the amount of normal ("baryonic") matter to the unseen "dark" matter in the Universe;
• confirmation that today's galaxies grew from tiny quantum density fluctuations in the early Universe by positive feedback, whereby dense structures grow and became more massive by attracting yet more matter;
• confirmation that the Universe does not have enough matter for its gravity to rein in the expansion of the Universe; and;
• the tightest constraint to that time on the mass of the neutrino.

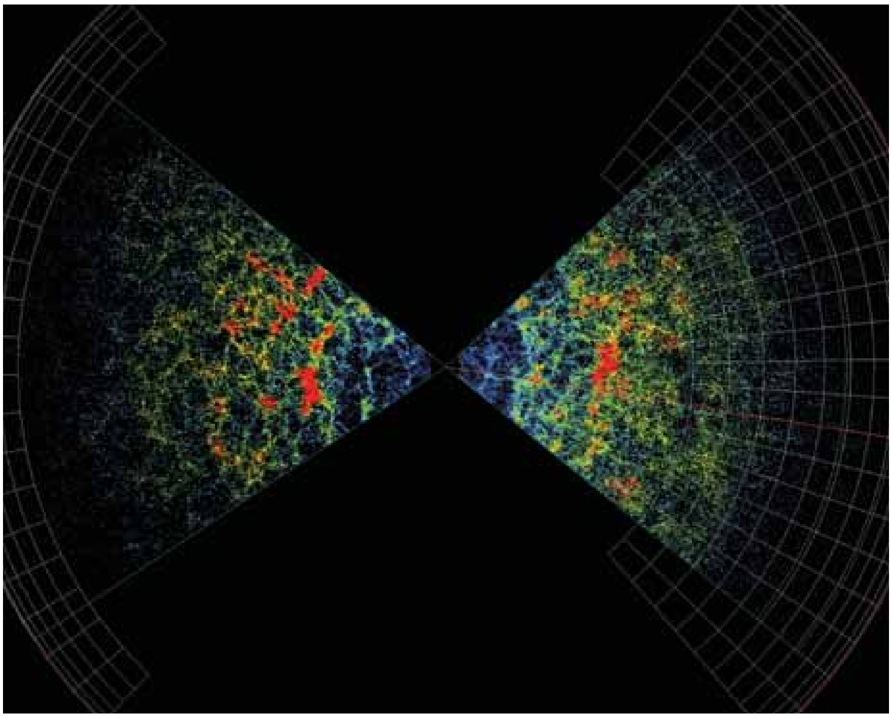
Seven members of the 2dFGRS team are currently based at Australian institutions: the Anglo-Australian Observatory (which operates the Anglo-Australian Telescope) in Sydney, the University of Sydney, Swinburne University of Technology in Melbourne, the Australian National University in Canberra, and CSIRO's Australia Telescope National Facility in Sydney.

The size of the 2dF Galaxy Redshift Survey was made possible only by technological advances developed at

A schematic illustration (not to scale), showing our Galaxy and the position of the "wedges" of space that were surveyed for the 2dF Galaxy Redshift Survey. Image credit: 2dFGRS team



News



The galaxy map produced by the 2dF Galaxy Redshift Survey. Each dot represents a galaxy: Earth, and our own Galaxy, is at the centre of the "bow-tie". The colour coding indicates how tightly the galaxies are clustered, with red being the most highly clustered regions. Image credit: Paul Bourke, University of Western Australia

the Anglo-Australian Observatory (AAO). The 2dF spectrograph used robotic technology to place optical fibres onto the telescope's focal plane, where each fibre could collect the light from a single galaxy. By using up to 400 optical fibres, this system allowed the light from up to 400 galaxies to be captured simultaneously.

The AAO has continued to develop this technology. It has exported an advanced optical fibre robot, called Echidna, to Japan's 8.2-m Subaru telescope in Hawai'i, and in February this year the AAO and partner institutions were contracted by the international Gemini Observatory to carry out one of two competing design studies for an instrument with more than 4000 fibres, the Wide-field Fiber Multi-Object Spectrograph (WFMOS). Key WFMOS projects will be to uncover the history of our Galaxy and probe the nature of Dark Energy.

In addition to designing and building instruments for other telescopes, the AAO is continuing to do excellent science with its own 3.9-m Anglo-Australian Telescope (AAT) in Australia. Since 2006 the telescope has been equipped with AAOmega, which is arguably the world's best wide-field spectroscopic survey facility, and which will be surpassed only by WFMOS itself.

The AAO was originally established as a bi-national facility, funded equally by the Australian and UK Governments. The AAO plans to continue to operate the Anglo-Australian Telescope with the support of the Australian Government past 2010, when, because of the UK's phased withdrawal, the Observatory will become a wholly Australian entity.
Anglo-Australian Observatory

New research classification welcomed
Australia will have a much better understating of investment trends in R&D following the release of a new comprehensive research classification by the Australian Bureau of Statistics.

The President of FASTS, Professor Ken Baldwin, said the new classification provides a much better picture of contemporary research than the previous 1998 classification.

"Nanotechnology, quantum computing, carbon sequestration science, green chemistry, bioinformatics and agricultural biotechnology are a few examples of important research that are now included in the ABS classification". "All research classifications become redundant as new areas emerge and previous staples become redundant so today's listings will need on-going monitoring and changes as required".

"Good data on R&D investment is essential to help institutions, funding agencies and Governments better understand where research investment is happening and how that sits with institutional or national priorities".

"A report on the ABS Research Classifications published by FASTS in August 2006 found that the 1998 classification was no longer adequate and had no analytic, policy or strategic value".

"A measure of the mismatch of the codes and actual research was the growing use of 'other' categories, which had grown to over 20% of university R&D expenditure by 2004. Moreover, 32% of university R&D could not or was not allocated to specific codes. That is, \$1.4b of the \$4.3b universities spent on R&D in 2004 was not adequately coded.

In response to the FASTS' paper, the previous Minister supported this revision of the codes with funding coming via the former RQF group in DEST (which is now located in the Australian Research Council).

"The ABS has done a fantastic job in developing a fresh, comprehensive but practical classification".

"The new classifications will be an important tool to ensure clarity in organising the new Excellence in Research for Australia (ERA) project to assist evaluation of publicly funded research", concluded Professor Baldwin.
FASTS

Square Kilometre Array

Prof. Steven Tingay
Curtin Institute of Radio Astronomy
Curtin University of Technology

For the last 20 years radio astronomers have been conceiving a plan to build the next generation of radio telescopes. Initially the pace was slow, back of the envelope calculations made to determine what level of sensitivity would be required to detect galaxies in the very early Universe, providing a probe of galaxy formation and evolution, as well as investigating the structure and evolution of the Universe itself. With foreseeable technologies, the numbers that came out of those calculations showed that a radio telescope with approximately one square kilometre of collecting area (one million square metres) would provide the required sensitivity. The concept of the Square Kilometre Array (SKA) was born.

From the outset, the SKA project has been international, with a Large Telescope Working Group established under the International Union of Radio Science in 1993 and an initial Memorandum of Understanding signed between eight institutions in six countries in 1997, describing the bases upon which the project would be developed. Australian astronomers have been among the driving forces behind the project from the beginning. Momentum behind the project gathered as the scientific and technical case was refined over the following decade. As it currently stands, the SKA science case has five areas of Key Science, aimed at asking and answering fundamental questions about the nature of our Universe and physics:

1. Galaxy evolution, cosmology, and dark energy

The SKA will be able to detect neutral hydrogen (HI) gas in normal galaxies at very large distances. Hydrogen gas in the neutral state emits a spectral line at a wavelength of 21 cm, which corresponds to a rest frequency of approximately 1.4 GHz. Due to the expansion of the Universe, with distant galaxies receding from us, the HI line is Doppler shifted to lower frequency (described as the redshift, denoted z). Redshift increases with recession speed, which increases with distance and, therefore, lookback time in the Universe. The SKA will be able to detect HI gas in galaxies at $z=3$, corresponding to an epoch approximately 2.2 billion years after the Big Bang (estimated to have occurred approximately 13.7 billion years ago).

Recent data from the Wilkinson Microwave Anisotropy Probe (WMAP), looking at the cosmic microwave background emission left over from the Big Bang, can be used to construct a "standard ruler" for the clustering of matter in the Universe at very early times, 300,000 years after the Big Bang. By observing the clustering of matter at other later epochs in the Universe and comparing to the standard ruler, the geometry and constituents of the Universe, and their evolution can be deduced. HI observations with the SKA are particularly powerful in this respect, since the clustering of galaxies can be directly observed at the same time as measuring the distance to the galaxy, by virtue of the redshifted HI spectral line.

These observations are critical in light of the WMAP results that lead to the conclusion that only 5% of the mass-energy of the Universe at the current epoch is made of atoms – the stuff of everyday life for humans. A further 23% is dark matter, non-atomic in nature, neither emitting nor absorbing light, but with gravitational influence. A staggering 72% of the mass-energy of the Universe at the current epoch is so-called dark energy, the nature of which is completely unknown, except that its postulated effect is as a form of anti-gravity, causing the Universal expansion to accelerate as time goes on. The nature of dark energy is shaping as a fundamental challenge to our understanding of the Universe and the laws of physics.

2. Probing the dark ages of the Universe

Related to cosmological studies is the study of the so-called dark ages of the Universe, the era in the Universe after the bright glow of the Big Bang faded but before the first stars and galaxies formed. WMAP has extensively observed the cosmic microwave background, the radiation leftover from the Big Bang. Prior to this epoch, the Universe was fully ionised. As the early Universe expanded and cooled, atoms formed from the ionised material (the vast majority being hydrogen atoms), allowing radiation to propagate, unimpeded, at approximately the 300 000 year mark. This is known as the epoch of recombination. The cosmic microwave background observed by WMAP traces radiation from this epoch. As the Universe expanded further, the gas of hydrogen atoms, under the influence of gravity, accumulated into galaxy-sized masses and into stellar-sized masses. Once stars and galaxies ignited, the radiation they produced re-ionised the surrounding gas, at a time known as the epoch of re-ionisation. Today, the matter in space between galaxies is fully ionised.

Between the epochs of recombination and re-ionisation, the Universe experienced the dark ages. Stars and galaxies were in the first stages of formation, and therefore no luminous

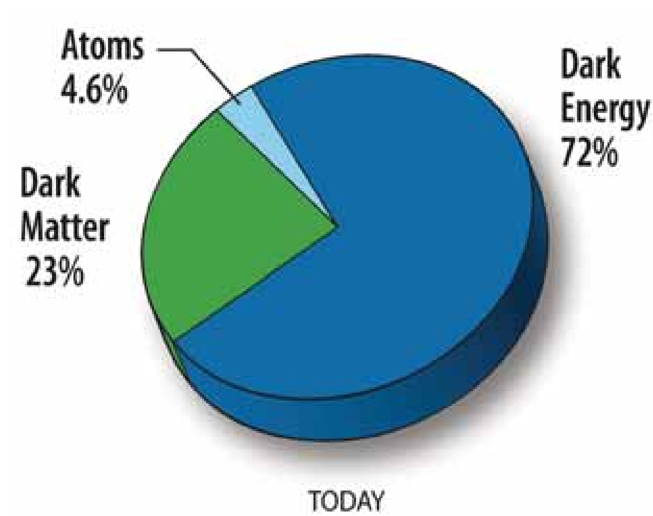


Figure 1: The mass-energy contributions of atoms, dark matter, and dark energy to the Universe at the current epoch. The nature of the majority of the mass-energy of the Universe is largely unknown. Image credit: NASA.

matter existed that can be seen with optical telescopes. Since the Universe was full of HI gas, the only probe of the Universe as the first galaxies and stars formed can be provided by very sensitive radio telescopes, looking for highly redshifted HI gas, perhaps in the redshift range ~6 ← z ← ~20, corresponding to radio frequencies between ~70 and ~200 MHz.

The SKA will be able to track the amount of HI gas in the Universe as a function of its age, accurately determining the early history of structure formation.

3. The origin and evolution of cosmic magnetism

Magnetic fields are vitally important to understanding in almost all areas of astrophysics, but are poorly understood. They are associated to planets, stars, and accretion disks around blackholes, they pervade galaxies and also the spaces between galaxies in clusters. However, important as they are, the question of the origin of magnetic fields poses fundamental questions for physics. For example, how did the magnetic fields we see today form, and when? Did primordial magnetic fields exist before the first stars and galaxies?

The best tool for studying cosmic magnetic fields are radio waves, in particular radio emission generated by charged particles spiralling around magnetic field lines. Also, the propagation of radio waves is affected by the presence of charged material and magnetic fields that lie in the paths of the waves, rotating the plane of polarisation of the radio waves in a way that is observable with radio telescopes.

Before we can understand the origin of magnetic fields in the Universe, we need to gather detailed data on their strength and distribution in three dimensions. Since magnetic fields are vector quantities, we need to estimate both the field strength and its direction. Current radio telescopes are limited to being able to study the magnetic fields associated with strongly emitting objects and are thereby limited to measuring the magnetic field distribution in only a vanishing small volume of the Universe. The SKA will be able to probe the magnetic fields of individual galaxies and stars in detail, as well as probe the three-dimensional distribution of magnetic fields across the entire sky. The resulting surveys will give vital information as to the origin of magnetic fields and clarify the critical role they play in the Universe.

4. Strong field tests of gravity using pulsars and black holes

General Relativity (GR) is one of the most successful physical theories ever devised, and its predictions have stood up to all observational tests yet undertaken. But is GR the last word in the description of gravity? The most promising regime in which to test GR is in the extreme case of proximity to massive compact masses, which have very strong gravitational fields. A convenient class of astronomical sources exist that can provide such a unique laboratory for tests of GR, pulsars, the rapidly and regularly rotating neutron star remnants of supernovae (exploding massive stars). The pulsars have strong magnetic fields that produce synchrotron radiation in a relatively tightly collimated emission cone from the magnetic poles. Since, in general, the magnetic poles and the rotational axis of the neutron star are not aligned,

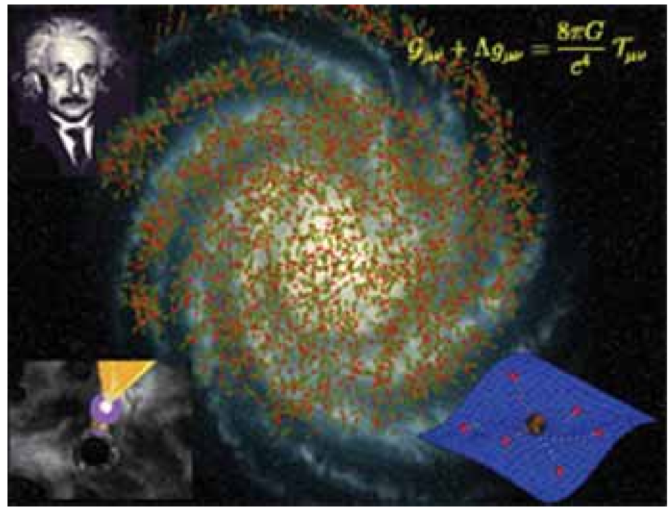


Figure 2: A simulation showing the expected distribution of pulsars in our galaxy, as detected by the SKA. Image credit: SKA Project Development Office.

the emission cone sweeps through our line of sight once per rotation, like a lighthouse, producing pulses of radiation that can be as short as a few milliseconds. The rotational period is incredibly regular, thus observing pulsars with a radio telescope gives access to the most accurate clocks in the Universe.

GR states that clocks run at different rates, depending upon the strength of the gravitational field that they experience, as judged by an outside observer. Thus, any time that a pulsar is found in a binary system with another massive object, such as a white dwarf star, another neutron star (especially if also a pulsar), or a black hole, tests of GR at various field strength levels are possible. Binary pulsars have been found previously but the "Holy Grail" of pulsar astronomy would be the discovery of a pulsar-blackhole system, since the most stringent tests of GR would be possible in the strongest magnetic fields.

Surveys for pulsars in our Galaxy are currently limited by sensitivity and narrow fields of view, which mean that survey observations take a long time to cover a significant area of sky. As a consequence, pulsars have been detected only out to modest distances from the Earth. The SKA is expected to detect the vast majority of pulsars in our Galaxy (Figure 2), as well as pulsars in other nearby galaxies, including approximately 100 compact relativistic systems suitable for high quality tests of GR. The sheer number of pulsars discovered means that the chances of finding a pulsar-blackhole system is maximised. The ability of the SKA to test the fundamental characteristics of General Relativity will be unique.

5. The cradle of life

How many habitable planets are there, apart from Earth? Do technically advanced civilisations, similar to ours, exist? The SKA will have the sensitivity and resolution required to observe the processes involved in planetary system formation, from the dusty disks surrounding young stars, in particular detecting the signatures of Earth-like planets.

Square Kilometre Array

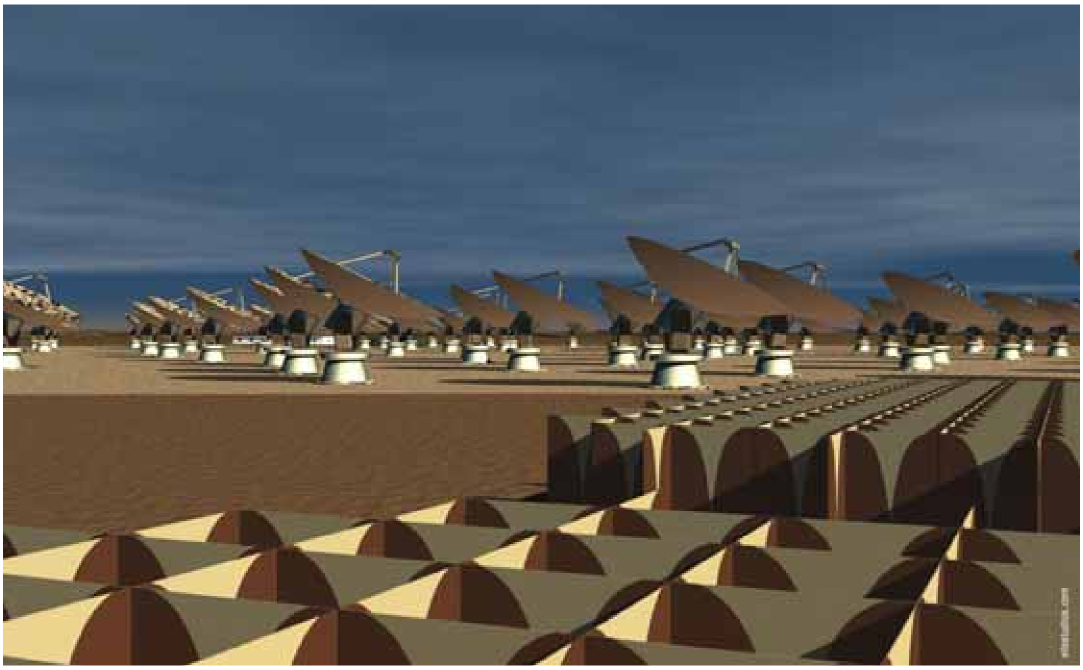


Figure 3: The SKA reference design, including aperture arrays (foreground) and small dishes (background). Image credit: Xilostudios.

Further, the SKA will have the sensitivity to detect radio signals comparable in strength to the stray TV transmissions that escape the Earth, from planets associated with the closest stars to our Sun. Detecting such signals would be evidence of technically advanced civilisations.

SKA technology and implementation

The technical case for the SKA is driven by the requirements of the science goals, listed above. The key technical characteristics of the SKA will be:

1. Sensitivity 50 times the most powerful current instruments. The increased sensitivity is provided by increased collecting area;

2. Angular resolution high enough to resolve sources of radio emission closely spaced on the sky and resolve detail in very compact objects. The level of detail that can be seen in images is proportional to the maximum spacing between antennas and inversely proportional to the wavelength. Thus, the SKA antennas will be distributed over 3000 km, giving an angular resolution of approximately a micro-degree. A micro-degree is equivalent to the angular width of an orange as seen from a distance of approximately 1500 km;

3. Large field of view to survey large portions of the sky very quickly. This will be achieved by the use of new antenna technologies;

4. Frequency range of 100 MHz to 25 GHz. The low frequencies are critical for redshifted HI observations and the high frequencies are important for the Cradle of Life;

5. Located in an environment that has the absolute minimum of interference at radio wavelengths caused by human activity.

The challenge is to design and build the SKA, a continent scale project, within a projected funding envelope of approximately Ð2 billion, and operate it for something in the region of 5% of the initial capital cost per year. This challenge has been addressed essentially by an international competition to devise the most effective technical solution that will meet the science goals and the technical requirements. The national and regional SKA consortia have each been working on particular feasibility studies for the SKA, ranging from the idea of a relatively small number (~40) of very large dishes (~200 m diameter), to very large numbers (~10,000) of relatively small dishes (~10 m diameter). A key technology that has emerged is the idea of phased arrays, arrays of small receiving elements that can either sit on the ground (in this case known as aperture arrays) or installed at the focus of a concentrating device, such as a traditional radio telescope dish (in which case they are known as phased array feeds). Figure 3 shows an artist's illustration of these technologies. The phased arrays are a critical key to obtaining the very large fields of view that will allow large samples of objects to be observed quickly to survey the sky to achieve the science goals in cosmology and dark energy.

It is important to note that, regardless of the form of antennas that are used for the SKA, the transport of vast data rates from those antennas to a central processing facility places enormous technology demands on high-speed networking. And the amount of signal processing power required in the central facility will be unprecedented, even taking into account projected improvements due to Moore's law.

In parallel to the investigations of the technology options for the SKA, an international process to select the best possible site for the SKA is being undertaken. In 2006 four sites formally submitted bids to the International SKA Steering Committee to host the SKA: Australasia (Australia and New Zealand), Argentina/Brazil, China, and Southern Africa. Two sites were shortlisted to advance in the site selection process, Australasia and Southern Africa, with a final decision expected on the site in the 2011/2012 timeframe.

Square Kilometre Array

The Australian bid centres around concentrating the majority of the antennas in Western Australia, in the Murchison Shire, north-east of the coastal town of Geraldton. The remaining antennas will be distributed across the Australian continent to the east coast, with a small number of antennas possibly in New Zealand. Western Australia was selected due to its remote location, very low population density, and therefore freedom from radio frequency interference due to mobile phones and FM radio stations. Figure 4 shows the proposed Western Australian site.

As part of the work to prove the sites, and prove some critical technologies for the SKA, both Australia and South Africa are building Pathfinder telescopes on their candidate sites, with collecting areas approximately 1% of the final SKA specifications. In Western Australia a CSIRO Division, the Australia Telescope National Facility, is spending $100m to build the Australian SKA Pathfinder (ASKAP). ASKAP will consist of up to 40 antennas of 12 m in diameter, using phased array feeds to obtain images of the sky over very wide fields of view (Figure 5). The science goals for ASKAP mirror the overall science goals for the SKA.

A great deal more information is available on the SKA from the International SKA Project and a number of national and regional consortia.

The International Project website is at:
http://www.skatelescope.org

The Australian SKA Project website is at:
http://www.ska.gov.au

The South African SKA Project website is at:
http://www.ska.ac.za

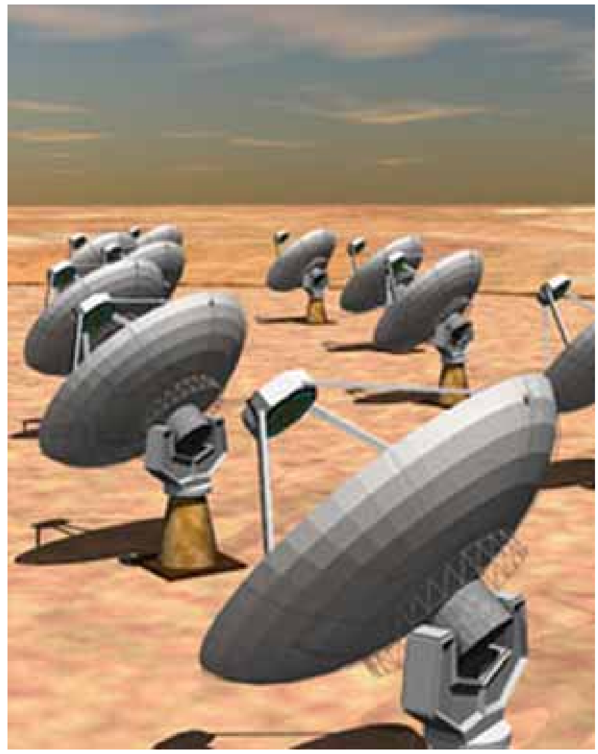


Figure 5: Artist's impression of some dishes of the Australian SKA Pathfinder telescope to be built in Western Australia. Image credit: Chris Fluke, Centre for Astrophysics and Supercomputing, Swinburne University of Technology.

Steven Tingay is Professor of Radio Astronomy at the Curtin University of Technology, and founding academic of the Curtin Institute of Radio Astronomy. Tingay has been working on the national and international SKA projects including as Chair of the international SKA Simulations Working Group.

Figure 4: The site in Western Australia, proposed as the core site for the SKA. Image credit: CSIRO

Small Matters

Dr Leslie Yeo, Micro/Nanophysics Research Laboratory, Monash University

It might very well be a scene from the movie 'Honey I Shrunk the Kids', only perhaps the missus wouldn't have been too crossed to discover that I shrunk the lab instead. Microfluidics, which is the science of actuating fluids or manipulating particles at micron and sub-micron dimensions, is essentially in layman's terms, small scale plumbing. As a broad concept, microfluidics typically involves shrinking and connecting pipes, pumps, valves, reactors and separators, the very components that typically make up a laboratory or chemical plant, onto a microchip. Whilst that's a lot of real estate to fit onto a chip, advances in micro/nano-fabrication technology dating back to the integrated circuit revolution has made the 'lab-on-a-chip' concept a reality (Fig. 1).

The ability to miniaturise, parallelise and automate batch processes using microfluidic technology presents significant opportunities particularly for the healthcare, pharmaceutics, biomedical and energy industries. Instead of painful extractions of an entire test tube of blood that is then sent off to the pathology laboratory for days before the results of a blood test are returned, portable low cost and disposable point-of-care medical diagnostic devices could enable general practitioners to take tiny samples of blood (with volumes less than a hundredth of that from a needle prick) from a patient and obtain the results of the test almost immediately. Tiny biosensors that rapidly and accurately detect minute amounts of microbes can be deployed inconspicuously in high-density metropolitan areas as early warning systems that alert first responders in the event of a bioterrorist attack. Miniaturisation of the high throughput drug testing arrays presently employed in the identification of potential drug candidates cannot only reduce the amount of expensive samples and reagents used, but also allow the screening procedure to be carried out at a fraction of the time and cost as a consequence of shorter residence and response times. Concomitantly, microdevices are been developed for immunoassays, chemical analysis, drug delivery, public

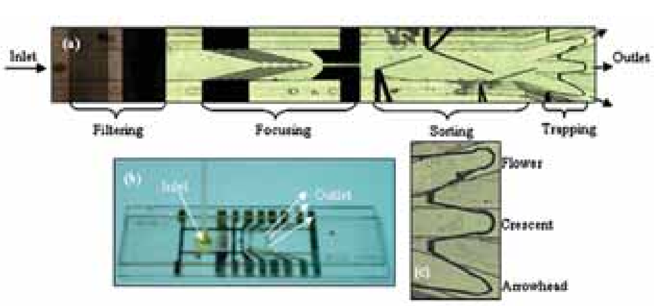


Fig. 1: (a) A microfluidic chip that filters, focuses, sorts and detects particles of different characteristics using dielectrophoresis (Cheng et al., 2007). (b) The chip comprises of a 25 micron high, 1 mm wide and 14.5 mm long fluidic channel enclosed by two glass microscope slides on which electrodes are patterned. (a,c) The electrode arrangements for the different particle processing stages are shown. In this case, the chip is configured to filter, sort and differentiate three different pathogenic species in a carrier liquid containing other particulate matter (debris). Figure courtesy of H-C Chang.

health and environmental monitoring, explosives detection, cell culture, and, polymerase chain reaction, amongst others (Craighead, 2006; deMello, 2006; El-Ali et al., 2006; Yager et al., 2006).

Scaling down the components required to store, load, actuate, meter, regulate, mix and react fluids or to separate/filter, manipulate and detect particles or microorganisms, however, is non-trivial. For a start, the surface area to volume ratio, which scales inversely with respect to the characteristic channel dimension, suggests the dominance of surface forces (such as viscous or capillary stresses, which, in general, tend to retard fluid motion) over body forces (such as inertial, gravitational or centrifugal stresses, which can generally be exploited to induce fluid motion) at very small scales. The resistance to fluid transport in pressure-driven flow scales inversely with the cube of the channel height in a long and wide rectangular microchannel and with the channel radius to the fourth power in a circular tube, typically rendering capillary syringe pumps ineffective for driving fluids in channels under 100 microns. Moreover, the large surface area to volume ratio characteristic of micron scale devices requires proper consideration of interfacial phenomena in their design. For example, microscopic effects such as disjoining pressure and wall shear pose significant design challenges during scale down.

Considerable progress in microfluidic research has been made in the past decade in addressing these challenges as well as those associated with the methods and materials for fabricating these small devices. In the latter, the development of soft lithography in poly(dimethylsiloxane) or PDMS, which is a soft elastomer that is optically transparent and biocompatible, has contributed significantly to the progress (Whitesides, 2006). In the former, there has emerged a large body of literature in which attempts to drive fluidic actuation and particle manipulation through various mechanisms (e.g., capillary, electric, magnetic and acoustic stresses) have been reported (Stone et al., 2004; Squires & Quake, 2005). With advances in micro/nano-fabrication technologies, it is also possible to drive microscale fluid and particle motion using tiny mechanical components, such as microgears and microactuators. Such micromachinery, known as micro-electro-mechanical systems (MEMS) (Ho & Tai, 1998) has not been widely implemented in microdevices due to the complexity, cost, reliability, and wear issues related with the tiny mechanically moving parts.

Fluid actuation via modulation of capillary stresses is mainly useful in open microfluidic systems (such systems are also described by the term digital microfluidics) that involve free drops discretely transported across the surface of the devices (Fig. 2); in contrast, closed microfluidic systems involve the continuous flow of liquids within closed microchannels. These open systems, although not particularly suited for large liquid volumes and continuous flow analysis, allow minimisation of liquid-surface contact, which is essential in systems involving biomolecules since surface adsorption is undesirable in these cases. In addition, open systems also eliminate attenuation of detection signals through channel walls and allow direct access to the samples. The downside of open systems, however, is the likelihood of contamination and evaporation.

The basic principle behind the use of capillary stresses for microfluidic actuation is the alteration of the wettability of the liquid on the substrate surface (Darhuber & Troian, 2005). There are two ways that this can be carried out. First, the surface tension or contact angle can be altered such that a capillary pressure difference is generated which, in turn, gives rise to fluid flow. This can be carried out by either applying a thermal gradient, or an electric field, the latter being known as electrowetting (Mugele & Baret, 2005; Yeo & Chang, 2006). Alternatively, chemical patterning or topological texturing of surfaces on which the liquid drops are placed can also be employed. The second method is to employ spatial gradients in the interfacial tension at a fluid-fluid interface. This gives rise to the so-called Marangoni stresses, inducing fluid flow towards regions of larger interfacial tension. These interfacial tension gradients can be produced by chemical (e.g., the use of surfactants), thermal, optical or electrical gradients. In either method, it has been a general view that with the exception of the use of electric fields, none of the techniques described above has yet to be developed into a practical method for rapid and sufficient manipulation or control of drop transport. Chemical modification of surfaces and interfaces allow for only passive control and could be incompatible with the working fluid. Temperature control, on the other hand, does not allow for sufficient local manipulation precision. Rapid switchability and long term reliability/reproducibility issues have also yet to be addressed.

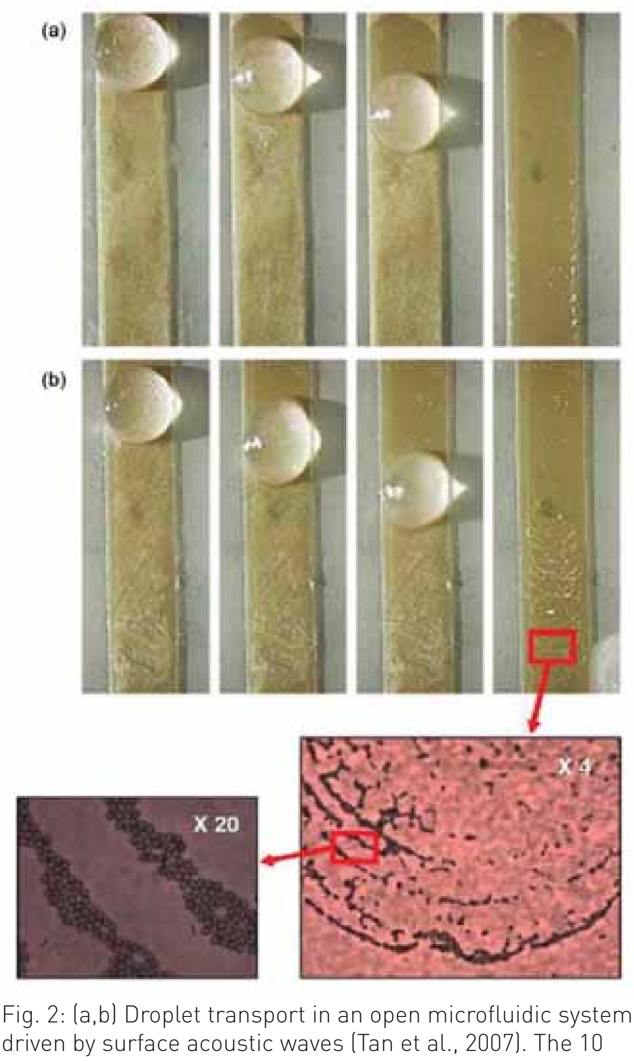


Fig. 2: (a,b) Droplet transport in an open microfluidic system driven by surface acoustic waves (Tan et al., 2007). The 10 microlitre liquid drop travels on a 3.5 mm wide and 17 mm long Teflon® track patterned onto the substrate. In this particular example, pollen particles roughly 20 micron in diameter were deposited on the track prior to the translation of the droplet. As the droplet is swept across the track, it picks up the pollen, thereby constituting an effective microparticle collection mechanism for biosensor sampling. Enlarged images of the particle footprints left behind the droplet are also shown.

To date, electrokinetics, which exploits the use of electric fields, has been the most popular way to induce microscale fluid flow and particle manipulation. There are many advantages of using electric fields, including the ease and low costs associated with the fabrication and incorporation of electrodes on microfluidic chips as well as the ability for precise fluid control and handling.

The underlying principle behind electrokinetic actuation lies in the formation of an electric double layer. When a surface is in contact with an electrolyte solution, i.e., an aqueous or polar solution containing ions, it acquires a net positive or negative charge either due to ionisation or dissociation of its chemical (e.g., carboxylate or silanol) groups, preferential adsorption of the ions in the solution onto it, or by some other surface charging mechanism. In any case, the charged surface attracts oppositely charged ions in the solution towards it and repels like charged ions, thus creating a polarised layer adjacent to it that is rich in counter-ions and lean in co-ions. This polarised layer is known as the electric (or Debye) double layer (Fig. 3a).

If an electric field were applied along the length of the microchannel, for example, the ions in the double layer will be attracted to the electrode with the opposite polarity. The Coulombic force arising from this interaction then induces the fluid in the double layer adjacent to the microchannel surface to flow, thus creating fluid motion known as electroosmotic flow akin to that which would arise if the sidewalls were moving like a conveyer belt dragging the rest of the fluid in the channel along with it (Fig. 3b). In the past 5 years, there has been significant research dedicated to developing electroosmotic micropumps that are efficient and reliable (Laser & Santiago, 2004).

Similarly, electric fields can be applied to move particles in a process known as electrophoresis (Fig. 3c). In fact, capillary electrophoresis, in which the concept was adapted to carry out separations in microanalytical devices during the 1960s, was one of the technologies that led to the emergence of microfluidics. Given its good reproducibility, sensitivity and wide applicability to both small and large molecular separation, capillary electrophoresis is currently a major workhorse in genomics, proteomics and metabolite profiling. Despite its widespread use in analytical chemistry applications, its insensitivity to particle size means that electrophoresis is unable to precisely manipulate particles particularly of nanoscale dimensions (Hughes, 2000).

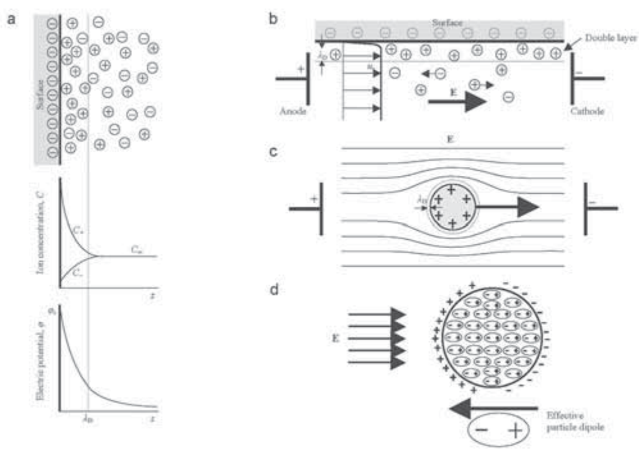


Fig. 3: (a) Schematic illustration of an electric double layer that arises when a surface is in contact with an electrolyte solution. The surface acquires charge (in this case, a negative charge) and hence attracts oppositely charged (in this case, positively charged) ions thus forming a polarised layer of thickness λ_D that is rich in counter-ions and lean in co-ions as seen in the sketch of the concentration profile below. There is also an increase in the electric potential close to the surface, as shown by the sketch of the potential distribution. (b) Principle of electroosmotic flow. Upon applying an electric field at two ends of a channel, the counter-ions (positively charged ions in this case) in the double layer are attracted to the electrode of opposite polarity, causing a net motion of the fluid in the double layer. This gives rise to a slip velocity at the walls which drags the rest of the fluid in the microchannel with it. For simplicity, only half the microchannel is shown. (c) Principle of electrophoresis. A particle immersed in an electrolyte solution acquires a charge (positive in this example) on its surface which leads to the formation of a double layer of negative charge around it. Upon applying an electric field, the ions in the double layer are attracted to the electrode of opposite polarity, thus generating a force on the particle in the opposite direction. (d) Principle of dielectrophoresis. A dielectric particle suspended in a dielectric medium upon application of an electric field develops an interfacial charge due to the difference in the electric permittivities between the particle and the medium, giving rise to an effective induced particle dipole. Applying a non-uniform electric field then produces a net force on the particle.

Alternative techniques such as dielectrophoresis and electrorotation, which rely on the effect of non-uniform electric fields to generate a net force on a dielectric particle suspended in a dielectric medium, are thus employed (Pohl, 1978; Jones, 2002). Such forces arise due to the net dipole induced on the particle due to the difference in electric permittivities between the particle and its surrounding medium (Fig. 3d).

An example of a microfluidic device that continuously sorts and detects different pathogenic species in a tiny fluid sample is shown in Fig. 1 (Cheng et al., 2007). Using a variety of three-dimensional electrode architectures, various sample/particle processing stages can be integrated onto the chip. Parallel arrays of planar electrodes are first employed to filter the sample in order to remove unwanted debris particulates. The remaining particles distributed throughout the channel width are subsequently focused using planar and interdigitated electrodes into a single line trajectory at the centre of the channel. Once the particles are aligned along the centre they are sorted by three-dimensional gate electrodes by deflecting particles of similar characteristics into the various bins where they are then trapped and concentrated using a variety of electrode shapes. In each stage, dielectrophoretic separation is employed for filtering, focusing, sorting and trapping the particles based on their size/shape and dielectric properties (electrical permittivity and conductivity) as well as that of the medium. Consequently, live and dead pathogens of different species can be filtered and sorted using dielectrophoresis, and finally differentiated using surface enhanced Raman spectroscopy.

A particular disadvantage of conventional electroosmosis is its inability to drive micro-mixing. Given that the flow streamlines are generally co-incident with the electric field lines, which are inherently irrotational, it is thus impossible to generate closed mixing vortices with electroosmotic flow. Other strategies have been developed to drive intense micromixing using electric fields. One scheme employs a sharp electrode tip mounted a small gap above a cylindrical microchamber in which the liquid is housed, as shown in Fig. 4a (Yeo et al., 2006b). Upon applying a large voltage, atmospheric ionisation ensues. Ions of opposite polarity to the electrode tip are then repelled, colliding into the air molecules in the process and generating a strong airflow known as ionic wind (Fig. 4b). By directing the needle and hence the airflow toward the liquid surface, the liquid surface is sheared generating fluid recirculation on the surface, and consequently, beneath the surface in the bulk of the liquid (Fig. 4c). This first concept of a microcentrifuge, without requiring the bulk rotation of the entire fluidic chamber or any other mechanically moving parts, was demonstrated as an effective micro-mixer (Fig. 4d) as well as a mechanism to separate or concentrate particles (Fig. 4e), for example, the separation of red blood cells from blood plasma (Fig. 4f) (Yeo et al., 2006a). The use of active micro-mixing schemes using electric fields are generally much easier than their passive counterparts, in which complex three-dimensional channel structures such as bends and grooves are patterned onto the microchannel to disrupt the laminarity of the flow (Ottino & Wiggins, 2004; Nguyen & Wu, 2005).

The 0.1 – 1 mm/s linear velocities achieved using electrokinetic devices, whilst comparatively fast with respect to the other microfluidic actuation strategies described above, nevertheless pale in comparison with acoustically driven microfluidics, which are typically one to two orders of magnitude quicker than the fastest electrokinetic devices due to the large sound velocities in liquids. For example, the same micro-mixing and particle concentration in Figs. 4d and 4e, which typically require one to several minutes, can be carried out in under 1 second using surface acoustic wave (SAW) devices (Fig. 5a) (Li et al., 2007a).

A SAW is essentially a 10 nm amplitude electroacoustic analogue of an earthquake wave that propagates along the

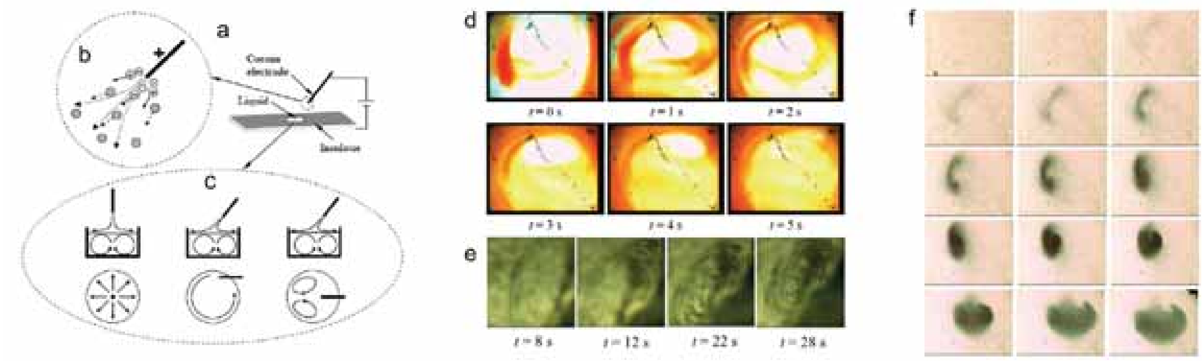


Fig. 4: (a) Schematic depiction of an electrohydrodynamically-driven microcentrifuge (Yeo et al., 2006b). (b) When a large voltage is applied across a sharp electrode tip (corona electrode), the air around it ionises. Oppositely charged ions (in this case, the negative ions) are repelled away from the electrode tip colliding into the air molecules and generating a bulk air thrust known as ionic wind. (c) By directing the electrode tip and hence the airflow at the surface of the liquid contained in a 5 mm diameter and 3 mm high cylindrical chamber, surface and bulk liquid recirculation patterns are observed. The surface recirculatory flows are exploited for (d) micro-mixing, and, (e) particle concentration. The bulk recirculatory flows are demonstrated for separating red blood cells from blood plasma, which was achieved in about 5 minutes (Yeo et al., 2006a).

surface of a piezoelectric substrate, generated by applying an oscillating electrical signal to the interdigital transducer electrodes patterned onto the substrate (Fig. 5b). SAW has been employed for decades for telecommunication signal processing and filtering. The ability for SAW to drive microfluidics, however, lies in the fluid-structural coupling of the device – the SAW which propagates along the substrate diffracts into the liquid due to the mismatch in the sound velocities in the liquid and in the substrate (Fig. 5c). This leakage of acoustic energy into the fluid generates a body force on the liquid and drives strong inertial recirculation in the fluid known as acoustic streaming (Li et al., 2007b). Recent studies have demonstrated that this can be exploited for fast microfluidic droplet transport (Fig. 2) and micropumping (Tan et al., 2007) as well as for rapid liquid atomisation and nanoparticle synthesis (Friend et al., 2008). The latter is potentially useful for portable pulmonary drug delivery applications; given that it is a rapid bulk atomisation technique, its ability for high throughput is a significant advantage over other point or nozzle atomisation techniques such as electrospraying (Yeo et al., 2004).

Microfluidics continues to be an active field of research, particularly on two fronts. There are continuing efforts to develop more effective mechanisms to drive fluid motion and particle manipulation. Efforts are also being undertaken to integrate these mechanisms for the development of on-chip mechanisms for a host of applications. However, few are simply contented to stop there – a growing number of microfluidics researchers are now exploring even smaller systems. Nanofluidics, which is the study of fluid mechanics in systems with dimensions under 100 nm, not only offers new insights due to the different physicochemical phenomena that arise as a result of molecular interactions but also presents many novel possibilities such as single cell manipulation and single-molecule DNA sequencing (Mukhopadhyay, 2006). Now, we're really getting into the small matters indeed... References over page....

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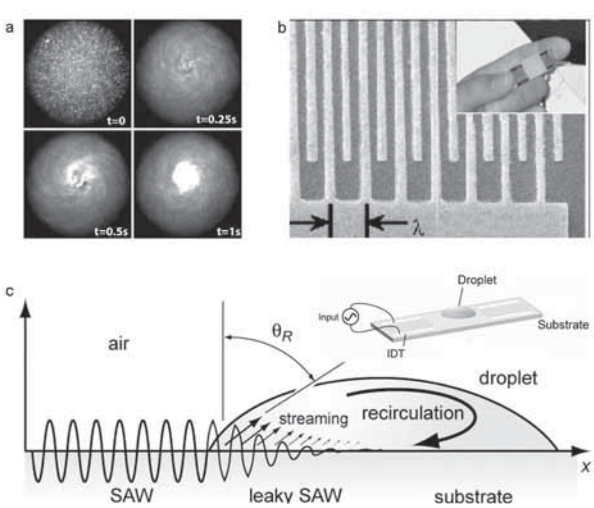


Fig. 5: Surface acoustic wave (SAW) microfluidics. (a) Rapid concentration of fluorescent 500 nm particles in under 1 second using focussed surface acoustic microfluidics (Shilton et al., 2008). (b) Interdigital transducer electrodes patterned via standard photolithography onto a piezoelectric substrate used to generate the SAW. The width and spacing of the electrodes λ determines the wavelength of the SAW; in this case, $\lambda \approx 200$ microns. (c) Leakage of the SAW into a fluid droplet placed on the piezoelectric substrate due to the difference in sound velocities between the phases. As a consequence, a body force is imparted onto the droplet which drives liquid recirculation within the droplet known as acoustic streaming. It is this fluid-structure interaction that enables SAWs to drive microfluidic actuation.

References

I-F Cheng, H-C Chang, D Hou & H-C Chang. An integrated dielectrophoretic chip for continuous bioparticle filtering, focusing, sorting, trapping, and detecting. Biomicrofluidics 1, 021503 (2007).

H Craighead. Future lab-on-a-chip technologies for interrogating individual molecules. Nature 442, 387–393 (2006).

AA Darhuber & SM Troian. Principles of microfluidic actuation by modulation of surface stresses. Annu Rev Fluid Mech 37, 425–455 (2005).

AJ deMello. Control and detection of chemical reactions in microfluidic systems. Nature 442, 394–402 (2006).

J El-Ali, PK Sorger & KF Jensen. Cells on chips. Nature 442, 403–411 (2006).

JR Friend, LY Yeo, DR Arifin & A Mechler. Evaporative self-assembly assisted synthesis of polymeric nanoparticles by surface acoustic atomisation. Nanotechnology 19, 145301 (2008).

C-M Ho & Y-C Tai. Micro-electromechanical-systems (MEMS) and fluid flows. Annu Rev Fluid Mech 30, 579–612 (1998).

MP Hughes. AC electrokinetics: Applications for nanotechnology. Nanotechnology 11, 124–132 (2000).

TB Jones. Electromechanics of Particles (Cambridge University, New York, 2002).

DJ Laser & JG Santiago. A review of micropumps. J Micromech Microeng 14, R35–R64 (2004).

H Li, JR Friend & LY Yeo. Surface acoustic wave concentration of particle and bioparticle suspensions. Biomed Microdev 9, 647–656 (2007a).

H Li, JR Friend & LY Yeo. A scaffold cell seeding method driven by surface acoustic waves. Biomaterials 28, 4098–4104 (2007b).

F Mugele & J-C Baret. Electrowetting: From basics to applications. J Phys Codens 17, R705–R774 (2005).

R Mukhopadhyay. What does nanofluidics have to offer? Anal Chem 78, 7379–7384 (2006).

N-T Nguyen & Z Wu. Micromixers–a review. J Micromech Microeng 15, R1–R16 (2005).

JM Ottino & S Wiggins. Introduction: Mixing in microfluidics. Phil Trans R Soc Lond A 362, 923–935 (2004).

HA Pohl. Dielectrophoresis (Cambridge University, Cambridge, 1978).

R Shilton, MK Tan, LY Yeo & JR Friend. Particle concentration and mixing in microdrops driven by focused surface acoustic waves. To appear in J Appl Phys (2008).

TM Squires & SR Quake. Microfluidics: Fluid physics at the nanoliter scale. Rev Mod Phys 77, 977–1026 (2005).

HA Stone, AD Stroock & A Ajdari. Engineering flows in small devices: Microfluidics towards lab-on-a-chip. Annu Rev Fluid Mech 36, 381–411 (2004).

MK Tan, JR Friend, LY Yeo. Microparticle collection and concentration via a miniature surface acoustic wave device. Lab Chip 7, 618–625 (2007).

GM Whitesides. The origins and the future of microfluidics. Nature 442, 368–373 (2006).

P Yager, T Edwards, E Fu, K Helton, K Nelson, MR Tam & BH Weigl. Microfluidic diagnostics technologies for global public health. Nature 442, 412–418 (2006).

LY Yeo & H-C Chang. Electrowetting films on parallel line electrodes. Phys Rev E 73, 011605 (2006).

LY Yeo, JR Friend & DR Arifin. Electric tempest in a teacup: The tea leaf analogy to microfluidic blood plasma separation. Appl Phys Lett 89, 103516 (2006a).

LY Yeo, D Lastochkin, S-C Wang & H-C Chang. A new ac electrospray mechanism by Maxwell-Wagner polarization and capillary resonance. Phys Rev Lett 92, 133902 (2004).

LY Yeo, S Maheshswari, D Hou & H-C Chang. Electrohydrodynamic surface microvortices for mixing and particle trapping. Appl Phys Lett 88, 233512 (2006b).

Macedon Ranges Observatory discovers nova

According to AAVSO Special Notice #105 released on April 19, another possible nova event occurred in Sagittarius. Through their quick actions, Macedon Ranges Observatory in Central Victoria, Australia was on top of the alert and imaging.

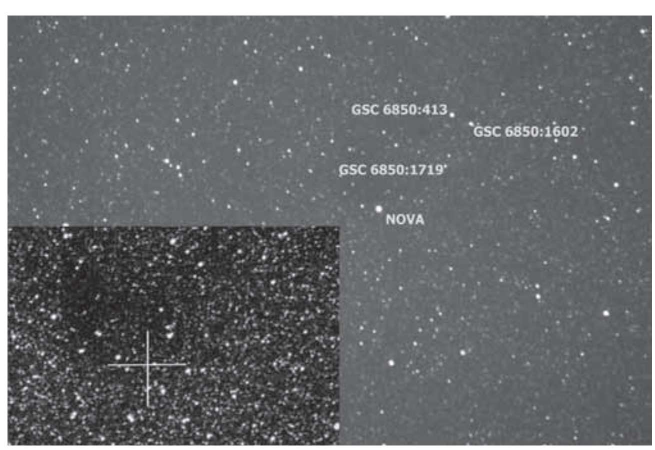
No magnitude is given, but the original discovery magnitude was 8.4C on 20080418. No star close to this position is seen in the USNO-B nor 2MASS catalogs. Kato (VSNET-ALERT 10075) indicates that this new outbursting object has a pre-discovery observation by ASAS but was not visible 3 days earlier.

The quick acting staff at MRO immediately went to work imaging the area and comparing their results to the sky survey plates. The results are clear... Yet another new nova had been discovered.

Says Observatory Director Bert Candusio: "This was as exciting as the first Alert exercise done by the MRO only a few days ago. Although MRO tried to get the observation to the AASVO, we decided to supply the images to Universe Today so the general public could get the first glimpses of this exciting new object."

Once the coordinates were in place, Joe Brimacombe immediately set to work with a 12.5" Ritchey Chretien Optical Systems telescope and began imaging the target area with a STL 6303 CCD camera. Within 90 minutes the images were processed and the painstaking process of comparison began. By isolating certain star patterns within the area, the nova event was quickly confirmed.

The Universe Today



The 2009 Bragg Gold Medal for Excellence in Physics

State Branches and Physics Departments are now invited to nominate candidates for the award of the Bragg Medal

Aim: The purpose of the prize is to recognize the work done by a Ph.D. student in Australia that is considered to be of outstanding quality.

Background to the Award: The Bragg gold medal for the best Ph.D. thesis by a student from an Australian University was established in 1992 as an initiative of the South Australian Branch, to commemorate Sir Lawrence Bragg (whose picture is inscribed on the medal) and his father Sir William Bragg.

Conditions of the Award: The medal is awarded annually to the student who is judged to have completed the most outstanding Ph.D. thesis under the auspices of an Australian university, whose degree has been approved, but not necessarily conferred, in the thirteen months prior to the closing date for applications to the State Branch (i. e., from the 1st of June 2007 to the 1st July 2008). No candidate may be nominated more than once. Only one medal shall be awarded; there is no possibility of a dual award. If the selection committee considers that none of the theses submitted reaches an appropriate standard, no award will be made.

Nominations: Each Australian university may nominate one candidate. These nominations are submitted to the State Branch committee. The committee selects the best thesis from their State (two for NSW and Vic), and three copies of the selected thesis are then forwarded to the AIP Special Projects Officer.

Time Line:Nominations from the universities should reach the secretary of the local State Branch by 1st July 2008.
The selected nominations from the State Branches, accompanied by three copies of the thesis, the citation and referees' reports, should reach the AIP Special Projects Officer at Olivia Samardzic, 205 Labs, EWRD, DSTO, P.O. Box 1500 Edinburgh, SA 5111. by the 1st September 2008.

The announcement of the winner of the 2008 Bragg Medal shall be made by the end of January 2009.

Presentation of the Award: The medal will be presented to the chosen candidate at the Congress in even numbered years, and in odd numbered years at a function to be arranged by the AIP Branch of the State of the candidate's university The medal will not be awarded in absentia; the candidate must be available for the presentation at a time which is mutually convenient. Reasonable expenses in attending the presentation will be met by the Council of the AIP.

Previous Winners:

2005	Dr. Philip Bartlett, Murdoch University
2006	Dr. Alex Argyros, University of Sydney.
2007	Dr. Frank Ruess, University of NSW

Further information about this award can be obtained by email from *aip_member_one@aip.org.au* or by phone on 0410 575 855.

Ian Bailey
Hon. Secretary

Life After Physics

Dr Selena Ng
Nuclear Business Development Manager
AREVA NC

I started life convinced I was going to be a lot of things, one of which was an astronomer (despite hardly ever observing the night sky). I wanted to know how the world began (if it began), and if it would end, and how. This line of thought led me to some rather sticky questions about a human being's role in all of this, and getting my head around eternity, and infinity. I neatly put these aside and focused on the conceptual universe-scale questions. The abstract mathematical concepts fascinated me, and when I discovered the link between differential geometry and general relativity in the Honours year of my Bachelor of Science at Monash University, I was hooked. Before I knew it, I was at the University of Cambridge studying for a PhD in string theory.

Cambridge was (is) an incredibly stimulating environment in all senses, and while the intellectual surroundings were without a doubt richer than anything one could experience in Australia, it also opened up my eyes to a new world – the diversity of cultures, subjects, viewpoints, the wide spectrum of personalities all driven in the pursuit of intellectual truth. Most of all I was struck by the passion with which the majority of my fellow PhD candidates pursued their research – to the exclusion of all else. In some cases this was driven by a pure ambition to succeed. But in more often than not, it was the sheer intellectual joy that they found in their subject that led to their single-mindedness. Don't get me wrong – I was fascinated by what I was studying, the quest for the 'theory of everything', and all the sublime mathematical concepts we encountered along the way. It's just that I discovered that I was fascinated by many other things. And that I wasn't fascinated enough by my area of study to spend breakfast, lunch, dinner, and the weekend as well discussing it. Perhaps more importantly, I discovered that I not only had to be interested in the subject that I was working on, but also had to be involved in some sort of teamwork or meaningful interaction with the people in my organisation in order to feel fulfilled in my day-to-day work. I had happened to pick the most theoretical and abstract area of physics that – at least in my particular experience – attracted people who mostly work alone, and are happy doing so.

I took the decision in the final year of my PhD to not pursue an academic career, against the wishes of many of my colleagues and professors, who were keen to see a female progress in this particularly male-dominated area.

Not being tempted by investment banking or strategic consultancy (logical next steps for many Cambridge PhD science graduates), and not keen to spend too much time retraining in another field, I serendipitously came across a ten-month fully paid MBA course at the Collège des Ingénieurs in the centre of Paris, aimed at young scientists and engineers, and of which six months would be an internship in a French company. It looked like the perfect vehicle to take me a little closer to the real world.

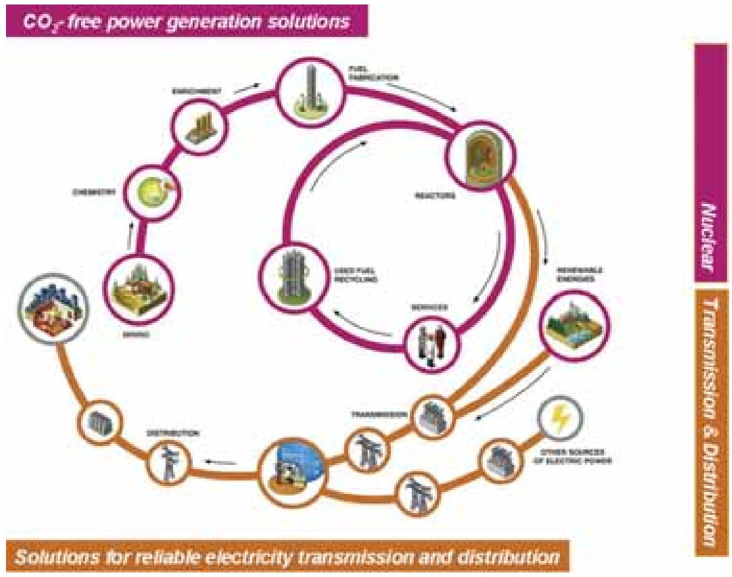
I fumbled through my first few months, with half of the courses being in French. The internship was with the French nuclear energy group AREVA, who in 2003 when I arrived was just two years old, having been formed from merging COGEMA – involved in all aspects of the nuclear fuel cycle – and FRAMATOME – designer and constructor of nuclear reactors. My six-month mission was to determine how COGEMA could expand its business in the management of used nuclear fuel in Europe. It was a steep learning curve, with most of the reading materials in Spanish (my target country) or French, all my colleagues speaking in French, my contacts speaking Spanish, and my not having the slightest clue about nuclear power, industry, or business! I quickly learned that I had to curb the academic urge to follow every train of thought to its logical conclusion as there were deadlines to meet, and not every train of thought was relevant to the mission goal. When I was asked to stay at the conclusion of my internship, my response was "why not?".

Following a lengthy wait for the working visa, I started in early 2004 continuing to work in the recycling and management of used nuclear fuel, on a mixture of technical and business strategy projects. My background and personal interest meant that I was always keen to talk to the scientists in the organisation and find out how a given process at one of AREVA's facilities really worked, and this remains true to today. However, I soon discovered new possibilities, gravitating in particular towards human resources issues, instigating a project to improve internal communication within the department where I was working, and constantly pushing for cross-departmental teamwork.

I moved to a higher-level strategy post at the end of 2005. In the three years or so I spent working in strategy in this business line, my regular work involved mostly developing arguments and position papers on a range of topics, ranging from how the company could position itself to target the used nuclear fuel market in a given country, to the nuclear non-proliferation aspects of a given technology. Having a technical background meant that I could interface easily with the scientific experts to translate the technical arguments for a business or political-minded audience. I naturally ended up at the interface between departments, between subsidiaries and head office, internal and external stakeholders, and the scientific and business-trained people, in an effort to make everyone work together no matter what 'language' they spoke (figuratively and literally).

Life After Physics

After a decade away from Australia, I decided that it was time to come home in 2007. AREVA's presence in Australia focuses mostly on its non-nuclear business lines, providing solutions for the transmission and distribution of electricity. However, AREVA is searching to establish a solid uranium exploration and mining presence in Australia, with Australia possessing the largest share of the world's known uranium resources. In a genuine cross-AREVA approach, I have three different hats in my role here – as the country representative for AREVA's nuclear activities, as the business development manager for its uranium exploration and mining activities, and one in which I retain some aspects of my previous role. This has pushed me into the more political and commercial arena, in frequent contact with our external stakeholders, and taking a more global view of AREVA's activities.



(AREVA 2008): AREVA aims to provide solutions for CO2-free power generation and the reliable transmission and distribution of electricity

People often ask if I use any of my physics research training in what I do today. More than anything, it trained me in a method – the scientific method – of viewing the world and tackling problems. It forces a rigour that is often lacking from other non-scientific approaches: to search for the fundamental roots of an issue, and to attempt to rationally and objectively order the various factors involved. This has proven invaluable particularly when dealing with complex human organisational issues where subjectivity and irrationality invariably reign.

People also ask if I can be as intellectually stimulated as if I were working as an academic in string theory. One of the things I was passionate about when undertaking my PhD was to demystify the subject. I encouraged my fellow colleagues to take time to explain the concepts in a simplified manner to non-experts, rather than artificially complicating the issue as many specialists in any subject – scientific or non-scientific – are apt to do. What I have discovered is that trying to constantly find the optimum way to push against the inertia of a large international organisation with a mix of management cultures, initiating change gradually from the inside, can be as complex as trying to understand why we have, say, confinement in quantum chromodynamics. Making 'sense' of a dynamic system of diverse humans, of which you yourself form part with your own motivations and irrationalities, and moving it in a non-dictatorial way towards achieving a common goal, is arguably one of the biggest challenges that democracies around the world face today, of which an organisation is but a small subset.

Most of the physicists employed within AREVA work in technical areas, focusing on subjects such as fuel design and performance, or reactor physics. With a growing trend in many high technology organisations of CEOs having little scientific training, it is encouraging to know that AREVA's CEO and founder, Anne Lauvergeon, trained originally as a physicist.

As a postscript, with our newly elected Federal government possessing very few (if any) ministers with any sort of advanced scientific or even engineering training – in a time when some of the most serious challenges facing Australia require a solid understanding of the scientific arguments or could benefit from a scientific approach – any readers out there with a passion to instill some scientific thinking in the running of our country can take heart from Angela Merkel, who has a doctorate in physics, and has been Chancellor of Germany since 2005. The fact that she is, as well, female, is of course incidental.

(Eurodif): At AREVA's gaseous diffusion plant in the Rhône-Alpes in France, which provides almost a quarter of the world's needs in uranium enrichment

Physics for 2008 the Future

Australian Institute of Physics (AIP) 18th National Congress

incorporating the 27th AINSE Plasma Science Conference

Major sponsor: The University of Adelaide, Australia

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30th November – 5th December 2008
Adelaide, South Australia
http://www.aipc2008.com

The AIP 18th National Congress is Australia's pre-eminent meeting for physicists. The Congress brings together a broad range of physicists from around Australia working in a variety of fields covered by AIP Topical Groups and Cognate Societies.

Held biennially in December, it attracts many of this country's finest physicists plus a number of prominent overseas attendees. It provides a forum for discussions within specialist physics topic areas, and opportunities for physicists from academia, government, and the commercial sector to keep up to date in areas outside their specialities.

The Congress has a tradition of attracting the very best international experts as plenary speakers, including several Nobel Laureates, and other notable speakers who have gone on to be awarded Nobel Prizes. In 2008, we anticipate a strong attendance of physicists, as well as a substantial number of trade and industry representatives from related fields.

The Congress will continue to cover special topic areas of:

- Acoustics, Music and Ultrasonics
- Astronomy
- Atomic and Molecular Physics
- Biomedical Physics
- Complex Systems, Computational and Mathematical Physics
- Condensed Matter and Materials and Surface Physics
- Education
- Environmental Physics
- Geophysics
- Meteorology and Climate Change
- Nuclear and Particle Physics
- Optics, Photonics, and Laser Physics
- Plasma Science
- Quantum Information, Concepts and Coherence
- Relativity and Gravitation
- Renewable Energy
- Solar-Terrestrial and Space Physics
- Synchrotron Science
- Women in Physics

Plenary speakers will include:

Professor Alain Aspect, CNRS, France
Professor Andy Buffler, University of Cape Town, South Africa
Dame Professor Jocelyn Bell Burnell, IoP, UK
Professor Steven Carlip, University of California Davis, U.S.A.
Professor John Ellis, CERN, Switzerland (to be confirmed)
Dr. Michael Geyer, Abengoa Solar, Spain
Professor Oliver Jäkel, German Cancer Research Centre, Germany
Professor Sir John B Pendry, Imperial College, UK
Professor Michelle Simmons, Uni.of New South Wales, Australia
Professor Howard Wilson, University of York, UK

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A Short History of the AIP Part 3

Anna Binnie

Australian Institute of Physics, the first four decades

Introduction
This is the last instalment of the current work on the History of the AIP, it is NOT however, the final or even the definitive word on the subject. It may be best regarded as a work in progress. Unlike the previous articles that were based on material from the AIP archives and previously published papers on the history of Australian physics, the data for this paper has come from one source. Oh 'not good research' you may say BUT the source is the public face of the AIP, its journal, under its various names and iterations. Why have I chosen to use this and not other sources such as the archives? For the simple reason that many of those involved with the AIP since 1963 are still alive, some are still active in AIP affairs and if I say the 'wrong' thing they may sue me, but if it has already been in print and no one took offence, at least I am morally safe.

Further, I regard material in archives as being effectively private and as such should not be used with out permission. While the AIP Executive has given me free access to any material I want, at this stage of writing up the story of the AIP, I feel more comfortable telling the story that comes from its public face. This public story that will unfold in the following pages is in itself fascinating but not complete; a complete story can only emerge after careful analysis checking with those involved. So here is the History of the AIP, as seen and celebrated in its journal over the last 40 and more years.

The AIP Organisation
The AIP Journal did not appear until 1964 and consequently for this early section I shall use the first couple of Annual reports from the AIP that are held in the National Library of Australia. The last Annual Report of the Australian Branch of the Institute of Physics and Physical Society, 1962 and a supplement to the 1962 report that included the activities of the Branch from 1st January 1963 until 28th February 1963 are also held in the Library. In its final year of existence the Australian Branch recorded as having: 132 Fellows, 270 Associates (i.e. Members), 138 Graduates, 90 Students, 19 Subscribers and 25 Fellows of the Society, a total of 674. The New Zealand Branch was formed on 1st May 1962.

The meeting of the Australian Branch that passed the motion to dissolve the Branch and establish the AIP was held on 21st August 1962, at Sydney University. The list of members present at this historical meeting was not included in my previous article and can now be seen in Table 1. As one looks at the names one can see many of the future presidents of the AIP as well as many of its future office bearers. The Australian Branch however remained in existence until 28th February 1963 when it finally ceased to exist. In this transition period between August 1962 and 1st March 1963, the future AIP Council had been established and its membership was the same as the membership of the Branch Council. The Inaugural meeting of the AIP Council was held in November 1962 and the first Official meeting of the AIP Council and Inaugural General Meeting was held in Sydney on 14th May 1963. We now have a number of dates that can be claimed as being the starting date of the AIP, they are: 24th August 1962, 1st March 1963 or 14th May 1963. I would suggest that we take the 1st March 1963 as the date for the formation of the AIP. I would argue that a body comes into existence once it starts producing Annual Reports and that commenced for the AIP on 1st March 1963.

By the early 1950s most the states had sufficient membership to warrant the formation of a division of the branch. Once the AIP was formed as an independent body these state divisions became

Table 1 AIP Exectuive since 1964

YEAR	PRESIDENT	VICE-PRESIDENT	HON. SECRETARY	HON. TREASURER	REGISTRAR	EDITOR
1964	L. Huxley	F. Lehany	A. Harper	G.A. Bell	J. Dryden	J. Symonds
1965	L. Huxley	F. Lehany	A. Harper	G.A. Bell	J. Dryden	J. Symonds
1966	F. Lehany	A . Walsh	A. Harper	G.A. Bell	J. Dryden	J. Symonds
1967	F. Lehany	A. Walsh	A. Harper	G.A. Bell	J. Dryden	J. Symonds
1968	A. Walsh	A. Harper	J. Campbell	H. Frost	J. Nicholas	J. Symonds
1969	A. Harper	R. Street	J. Campbell	J. MacKenzie	R. Fraser	J. Symonds
1970	A. Harper	R. Street	J. Campbell	J. MacKenzie	R. Fraser	J. Symonds
1971	R. Street	F. Jacka	J. Campbell	J. MacKenzie	R. Fraser	J. Symonds
1972	R. Street	F. Jacka	J. Campbell	J. MacKenzie	R. Fraser	J. Bird
1973	J.Jacka	J. Campbell	K.Clarke	J. MacKenzie	J. Rouse	J. Bird
1974	J. Jacka	J. Campbell	K.Clarke	J. MacKenzie	J. Rouse	J. Bird
1975	J. Campbell	T. Sabine	J. Pilbrow	J. MacKenzie	J. Rouse	J. Bird
1976	J. Campbell	T. Sabine	J. Pilbrow	J. MacKenzie	J. Rouse	W. Boundy
1977	T. Sabine	B. Bolton	J. Bird	C. Howard	J. Collins	W. Boundy
1978	T. Sabine	B. Bolton	J. Bird	C. Howard	J. Collins	W. Boundy
1979	B. Bolton	N. Fletcher	J. Bird	C. Howard	J. Collins	W. Boundy
1980	B. Bolton	N. Fletcher	J. Bird	C. Howard	J. Collins	W. Boundy
1981	N. Fletcher	G. Wilson	J. MacFarlane	J. Harries	J. Collins	J. G. Graham
1982	N. Fletcher	G. Wilson	J. MacFarlane	J. Harries	J. Collins	J. G. Graham
1983	G. Wilson	T. Smith	J. MacFarlane	J. Harries	J. Collins	J. G. Graham
1984	G. Wilson	T. Smith	J. MacFarlane	J. Harries	J. Collins	J. G. Graham
1985	T. Smith	J. Collins	I. Bassett	J. Harries	A.Pryor	J. G. Graham
1986	T. Smith	J. Collins	I. Bassett	J. Harries	A.Pryor	G. Thompson*
1987	J.G.Collins	J. Collins	I. Bassett	T.Freeman	A.Pryor	G. Thompson*
1988	J.G.Collins	A.Klein	I.Bassett	T.Freeman	A.Pryor	R.MacDonald
1989	A.Klein	A.Thomas	I.Bassett	T.Freeman	A.Pryor	R.MacDonald
1990	A.Klein	A.Thomas	J.Riley	R.Fleming	R.Leckey	R.MacDonald
1991	A.Thomas	R.Crompton	J.Riley	R.Fleming	R.Leckey	R.MacDonald
1992	A.Thomas	R.Crompton	J.Riley	R.Fleming	R.Leckey	R.MacDonald until Oct
1993	R.Crompton	R.MacDonald	J.Riley	R.Fleming	R.Leckey	J.Kelly
1994	R.Crompton	R.MacDonald	J.Riley until Sept.	R.Fleming	R.Leckey until July	J.Kelly
1995	R.McDonald	J.Oitma	M.Welch*	R.Fleming	D.Booth	J.Kelly
1996	R.McDonald	J.Oitma	M.Welch*	R.Fleming	D.Booth	J.Kelly
1997	J.Oitma	J.Pilbrow	M.Welch*	C.Osborne	D.Booth	J.Kelly
1998	J.Oitma	J.Pilbrow	M.Welch*	C.Osborne	D.Booth	C.Hamer
1999	J.Pilbrow	J.O'Connor	M.Welch*	C.Osborne	D.Booth	C.Hamer
2000	J.Pilbrow	J.O'Connor	M.Welch*	C.Osborne	D.Booth	C.Hamer
2001	J.O'Connor	R.Elliman	M.Welch*	C.Foley*	P.Johnston	C.Hamer
2002	J.O'Connor	R.Elliman	M.Welch*	C.Foley*	P.Johnston	C.Hamer
2003	R.Elliman	D.Jamieson	I.Bailey	C.Foley*	P.Johnston	C.Horrigan*
2004	R.Elliman	D.Jamieson	I.Bailey	C.Foley*	P.Johnston	C.Horrigan*
2005	D.Jamieson	C.Foley*	I.Bailey	S.Martin	P.Johnston	C.Horrigan*
2006	D.Jamieson	C.Foley*	I.Bailey	S.Martin	P.Johnston	C.Horrigan*
2007	C. Foley*	B. James				

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Branches of the AIP, the Tasmanian Branch was the last to be established, in 1965. The Northern Territory does not have a Branch as yet. The running of the AIP lies in the hands of the AIP Executive that includes the President, Vice-President, Treasurer, Secretary and Registrar. The Council of the AIP meets annually and includes the AIP Executive and the Chairs of each of the Branches. From time to time the AIP Executive has included other individuals in their meetings such as the Education officer or Policy Officer or Editor of its Journal.

The AIP has always prided itself on being a Professional Society and as such has been run from a secretariat that has changed location over the years. The first Secretariat was in Sydney where it had been from 1960. In 1967 it moved to Melbourne, in 1969 it moved to Clunies Ross House, 191 Royal Parade, Parkville Vic. In this location the AIP had use of an office administrator whose salary was paid by both the AIP and the Australia Institute of Refrigeration, Air Conditioning and Heating. In 1989 the secretariat was moved to Science Centre, 35-43 Clarence St, Sydney NSW and finally in 1990 it returned to Clunies Ross House. By 1993, the AIP secretariat had moved to the RACI secretariat in at 1/21 Vale St, North Melbourne. Today the Secretariat is located in Parkville Victoria.

Once the AIP had been established as a functioning professional association, one of its first actions was to establish a Benevolent Fund. The Benevolent Fund came into being in 1963 and was to be used by members and/or their families in the event of a member's untimely death or if the member came to severe financial difficulties. Members were encouraged to subscribe to the fund. The fund was closed in 1991 since no one had called on it for the previous 8 years. The funds still exist but interest accrued is being put back into AIP general funds.

In 1964 the AIP gave to the Institute of Physics a gift in recognition of the support and encouragement that the IoP gave to the Australian branch. The gift was a writing table and four occasional chairs that were to be used in the Members reading Room in the Institute's rooms in London. The photograph of the 1964 AIP Council and the table and chairs graced the cover of *Australian Physics* in December last year.

In 1964, the AIP established the Honorary Fellowships and elected George Briggs, A.D. Ross and J.S. Rogers as the first Honorary Fellows of the AIP. These fellowships recognise those physicists who have made significant contributions to the disciple and continue to be awarded. The AIP also established the first of its awards, on 22nd January; there was a suggestion at the Council meeting to commemorate Dr J. Pawsey by a medal and lecture. The Pawsey Medal and Lecture has been awarded to a physicist early in his or her career annually since 1965. Other Australian physicists have been honoured by medals and awards that carry their name. They include:

- Walter Boas Medal commenced in 1984 for a senior physicist
- Massey Medal commenced in 1988 for a senior physicist awarded jointly by the AIP and IOP alternating between a UK and an Australian physicist
- Bragg Medal commenced in 1992 for the best PhD Thesis
- Walsh Medal commenced in 2002 awarded biannually for Applied Physics.

The AIP also presents awards in other areas that do not as yet carry the name of a suitable physicist. These include;

- Physics Education Award commenced in 2004
- Women in Physics Lecturer commenced in 1997
- AIP Award for Outstanding Service to Physics in Australia commenced in 1996 and has only been awarded twice to Rod Jory and Moira Welch.

In May 1966, the AIP began its search for an AIP logo or insignia. The current logo was first pictured in August 1971 issue of the 'Physicist' and formally adopted in October 1971. In September1971 the IOP changes its Associate grade to Member Grade, the AIP follows in January 1973. The AIP now has the grades of Fellow, Member, Graduate, Associate and Subscriber. The latter two grades are open to anyone interested but the three corporate grades require educational qualifications and experience.

In July 1973, The AIP physics archives were established and material was sought and collected by J. Bird and S. Hogg. The AIP Archives have been housed in the Basser Library of the Academy of Science since May 1975. Recent archival material (i.e. material from the last ten or so years) is housed in the AIP secretariat in Melbourne. Material in the Basser Library is open to all scholars.

In the 1960's Institutes of Technology were established in all the states. These Institutes initially conferred diplomas on their graduating students. In many ways they were seen as superior to the TAFE colleges but 'not quite' a university. During the following decade these Institutes of Technology developed courses in the applied sciences that were in most

Prof Peter Johnston, RMIT. Former AIP membership registrar and chair of accreditation panel.

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cases of the same standard as universities. By the early 1970s these Institutes of Technology were allowed to confer degrees on the successful students and the AIP was asked by many of these to accredit their Applied Physics degrees. In January 1974, the B. Appl. Sci. (Physics) Degrees from Institutes of Technology were seen as acceptable qualifications for AIP membership.

The International Science Olympiads had been held since the mid 1970s and Australia became an active participant in these by the mid 1980s. In the 1990 December edition of the 'Physicist' Jory wrote about the International Physics Olympiads that were held in the Netherlands that year. This sparked interest amongst the physics community that culminated when Australia hosted the 1995 International Physics Olympiad in Canberra. Rod Jory organised the event and encouraged AIP members to contribute examination questions for the event. Needless to say, the AIP supported the event. Australia's participation in International 'Olympiad' style events branched out further when the First Asian Physics Olympiads were held in 2000, with Australia sending a team of talented high schools students to compete. In a manner similar to the sporting Olympiads, Australian teams at the International physics Olympiads have performed extremely well frequently returning with medals and other success. Unfortunately, intellectual success does not carry much publicity in the news media.

The AIP became a member of FASTS when it was formed to act as a 'lobby group' on behalf of all science organisations and scientists. When FASTS organised the first 'Science Meets Parliament' Day, in November1999, the AIP became involved and help sponsor many delegates to the event. The event has proved so popular that it is now repeated annually and has been copied by the Humanities disciplines. Further recognition for this event was made when a Eureka Award for Promoting Understanding in Science, was made to Ken Baldwin in 2004, the instigator and promoter of this event, in recognition for the value that these days have made to the scientific community as a whole.

The Australian Branch and later the AIP has encouraged individuals with similar disciplinary interests to form groups. The first such group was formed before the AIP was formed; it was the Biophysics group, which no longer functions. On 21st January 1964 the Geophysics group was formed and remained active until it was finally disbanded in 1971.

In September 1966, the Victorian Branch formed the Vacuum Physics Group. This group has developed and formed itself into a Society of its own, the Vacuum Society of Australia. The Vacuum Society of Australia has maintained its AIP ties and is a Cognate Society of the AIP.

In 1972 the Nuclear and Particle Physics group was officially constituted and this group has remained as an AIP group since. The Solar Terrestrial and Space Physics Group was the next AIP group to be formed and has been responsible for running many sessions at AIP Congresses. It has remained active since its inception. The newest AIP group is the Quantum Information, Concepts and Coherence that was formed in 2005. Two other groups within the AIP, the Women in Physics and Physics Education Groups will be discussed separately in the next sections.

As mentioned previously the AIP recognised a number of Cognate Societies. Some of the societies commenced as groups but grew and developed into societies in their own right. Others were formed as Societies and forged links with the AIP. The list of Cognate Societies are:

- Australian Optical Society
- Vacuum Society of Australia
- Australasian Society for General Relativity and Gravitation
- Astronomical Society of Australia
- Australian College of Physicists and Engineers in Medicine
- Australian Acoustic Society
- Australasian Radiation Protection Society

All of these societies and AIP groups provide the expertise to the Biannual Congress Organisers and often run their respective sessions at the AIP Congresses. The Cognate Societies also organise their own conferences and provide valuable links with international groups.

AIP Journal

The Journal of the AIP has also had a number of name changes. The Journal produced its first issue in April 1964 under the name of 'Australian Physicist'. In 1991 the Journal had its first name change to reflect the new relationship between the AIP and the New Zealand Institute of Physics and became 'Australian and New Zealand Physicist'. The content of the journal while having some New Zealand contributions was still largely an Australian Journal, and at the end of 1998 the Journal had another name change. In the Jan/Feb issue in 1999, the AIP Journal was now called 'The Physicist', a name it carried until early 2005 when it changed yet again to 'Australian Physics'. This final name changed occurred in the Volume 42 Number 2 March/April 2005 issue. The Journal has been well served by surprisingly few editors who seemed to have taken on the job and served well for several years, the names of all the editors are listed in Table 2. It should be noted that two of the editors were women, Trudy Thompson and Corrina Horrigan. Each editor in turn added their personal touch while at the same time maintaining a vehicle of communication between and amongst Physicists in Australia and New Zealand.

The issues discussed in the journal were those that reflected the issues pertinent to Physicists during the decades. One issue that seems to have NEVER gone away is that of

Table 2 Journal Editors

J. Symonds	'Australian Physicist'	1964-1971
J. Bird	'Australian Physicist'	1972-75
W. Boundy	'Australian Physicist'	1976-1980
J. G. Graham	'Australian Physicist'	1981-85
G. Thompson)	'Australian Physicist'	1986-7
R. MacDonald	'Australian Physicist' 'Australian and New Zealand Physicist'	1988-1991 1992
J. Kelly	'Australian and New Zealand Physicist'	1993-97
C. Hamer	'Australian and New Zealand Physicist' 'The Physicist'	1998 1999-2002
C. Horrigan	'The Physicist' 'Australian Physics'	2002-5 2005-6

education; articles and papers on physics education, issues relating to high school physics, discussions on forging links with teachers and teacher associations have appeared in the journal since its first issue. The discussions surrounding this subject appear to be almost circular in nature, as if each new generation of physicists seems to reinvent the ideas that had been expressed previously, sometimes even decades before. For example the following quote came from Minutes of Council 22nd January 1964 (second meeting) and is applicable today as it was then;

> *"Teaching of Physics. This matter is of very great importance and interest to the Institute, its Branches and its members. The President has been in correspondence on behalf of the Institute with the Directors-General of Education in the various States regarding the desirability of common courses for matriculation physics throughout Australia; the W.A. Branch is planning a conference on the subject; representatives of the Queensland Branch have met the Minister of Education on the training of physicists, and the NSW Branch has been in consultation with the Science Teachers' Association. It was agreed that each Branch should be asked to give an opinion on the suitability of the Physical Science Study Committee (PSSC) course for physics to matriculation standard throughout Australia and to consider what practical assistance it can render in its own State in encouraging the study of physics and improving the standard'*[1].

The PSSC course in physics was never adopted in Australia as part of any state curriculum, however, the materials that were produced by it have been used by many physics teachers throughout Australia since they appeared. Much of the material has as much relevance in today's classroom as it did in the 1960s.

Other issues have addressed in the journal decades before the general community has discovered that a problem may exist. A paper published in the August 1971 (volume 8, pages 113-7) entitled 'Climate Change' by A. J. Dyer was an early example of physicists being aware of what is now an urgent problem. In 1977, the issue of uranium mining became one for physicists following the publication of the Fox Report. The AIP established a uranium subcommittee to 'educate the public' on uranium issues. A series of articles on various aspects of the uranium fuel cycle were published in the next few years.

The journal was also a vehicle of communication from the AIP membership. In the form of letters or short articles the idea of an umbrella style congress was suggested in the journal and the issue of women in physics was also initially discussed in the journal. These will be detailed later in this paper.

Summer Schools, Conferences and Congresses

The Australian Branch of the Institute of Physics held regular conferences from 1928. Once the AIP was established it continued to organise conferences and summer schools.

These conferences and summers schools were organised by a branch of the AIP, the theme was on a single discipline, most of the speakers were invited by the organising committee and attendance was open to all interested physicists. These could best be regarded as an 'in-service' style of meeting where the purpose was to share the latest knowledge or techniques with the rest of the physics community. The first four summer schools are listed below and give an indication of the type of material discussed;

- First summer school organised by the NSW Branch on Solid State Physics, Ionospheric and Upper Atmosphere Physics held at the University of New England on 11th Feb 1966
- Second summer school organised by ACT Branch on Geophysics and Mathematical Physics held in Canberra from 23-27 January 1967
- Third summer school organised by the SA Branch held at Flinders University 5-9th Feb 1968 on Lasers and Plasmas
- Fourth summer school organised by the Victorian Branch on Physics of the Stratosphere, Diffraction Methods in Solid State Physics and Surface Physics in Feb 1969

While the summer schools had predominantly invited speakers, the conferences that were organised by the branches had a few invited speakers but most were papers offered by individuals. The first Conference organised for the AIP was held on 29-31st May 1968, when the NSW Branch organised a Conference on 'Ionic Solids'.

Most of the Branches were also involved with running in-service courses for physics teachers. As each state adopted a new science syllabus its teachers needed their skills upgraded and the AIP was there to ensure it occurred. Many universities ran their own in-service courses such as those that have been run by the School of Physics at the University of Sydney where funding comes from their Science Foundation.

Table 3 AIP Congresses
Special Congresses include:
- 10th where the first History of Physics held. Organised by J.Jenkin when B.Bolton became ill;
- 11th where the WIP group formed; and
- 13th where the PEG Group formed.

NUMBER	YEAR	LOCATION	DATES
1st	1974	Adelaide	21-24 May at Flinders
2nd	1976	Sydney	UNSW 23-27 August
3rd	1979	Perth	15-19 January
4th	1980	Melbourne	25-29 August
5th	1982	Canberra	23-27 August
6th	1984	Brisbane	27-31 August
7th	1986	Adelaide	25-29 August
8th	1988	Sydney	25-29 January at UNSW
9th	1990	Canberra	5-7 February
10th	1992	Melbourne	10-14 February
11th	1994	Brisbane	4-8 July
12th	1996	Hobart	1-5 July
13th	1998	Fremantle	27 September -2 October
14th	2000	Adelaide	10-15 December
15th	2002	Sydney	October
16th	2005	Canberra	31 January-4 February
17th	2006	Brisbane	3-8 December

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In March 1971 'Australian Physicist' published a letter from Max Brennan suggesting a biennial Physics Conference. The suggestion included the notion that the AIP Congress should be an umbrella event that would encompass as many physics disciplines as possible. There must have been some discussion of the idea because in 1974 the first AIP Congress took place in Adelaide, at Flinders University 21st-24th May.

Papers were invited under the following topics:
• Atomic and Molecular Physics
• Cosmic Rays
• Geophysics
• Nuclear and Particle Physics
• Physics Education
• Plasma and Discharge Physics
• Solid State physics and Optics
• Upper Atmosphere and Magnetosphere
• Physics in Society and Industry

The Congress brought together 214 delegates, from around the country who listened to 154 speakers. NSW hosted the second Congress and this time the AIP decided to encourage more students to attend and provided a student subsidy.

The Second Congress invited papers from the following topics:
• Geophysics, Astrophysics and Astronomy
Education
• Solid State Physics
• Nuclear, particle and General Physics
• Applied Physics and Instrumentation
• Plasma and Physics of Electrons and Ions
• Biophysics
• Hospital and Medical Physics

The AIP has been holding its biennial Congresses ever since. Each Branch has in turn provided the organising committee for the congress and each such committee has showcased the physics that is a specialty in its state. The Congresses have also included other conferences under its umbrella, regularly inviting AINSE to participate and even organise events in some streams of the congress. A list of Congresses are shown in Table 3.

The Wagga conferences were another AIP initiative. The First Solid State Physics meeting was held in Wagga Wagga between 8-11 February 1977 (first Wagga Conference). This conference attracted 100 participants who heard 36 talks with 28 posters displayed. These conferences have been traditionally held annually in February in Wagga Wagga, which was seen as a central location, i.e. a reasonable driving distance from Sydney, Melbourne and Adelaide. In 1980 the Wagga Conference was held, for the first and I believe the only time outside Wagga, in New Zealand.

In 1979 the AIP sponsored the First National Applied Physics Conference held in Rockhampton, 2-6 July.

Education

Education has proved top be the most important aspect of AIP concerns from its very beginning. This section is perhaps the most confusing of all in this article. Since I've based this article solely on the AIP's public face, many details are not present and the story of the evolution of various education groups within the AIP is incomplete.

In January 1965, the 'Physicist' reported that the AIP wanted to investigate the establishment of an education group within the AIP and want to increase the number of teachers who are members of the AIP. The NSW Branch had recently established a committee to provide input into the new physics syllabus, consequently in July the Council asked NSW Branch to propose structure of an AIP Education Group. Jak Kelly was appointed as the interim chair of this group and was responsible for recruiting members from all of the other Branches. By May 1976 AIP Council had formed an education group and had appointed Dr Mainsbridge as the first chair. I believe that this Committee has continued as the AIP National Committee on Education ever since.

During the 1990s this committee was responsible for producing a series of posters aimed at high school students. These posters were produced by a commercial artist, funded by the AIP and sent out to all schools in Australia. They comprised a series of 6 posters in cartoon format depicting how different physics is used in daily life from communication, to medicine to transport etc.

Former presidents of the AIP at the University of Melbourne. Left: Prof David Jamieson, Right: Prof Anthony Klein.

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Teacher qualifications were another issue that caused some concern within the AIP. It appeared that the majority of teachers teaching Physics in secondary schools were not physics graduate. The problem became dire when it became apparent that Biology teachers were being asked to teach Physics. The problem lay in the nature of the subject, teachers are relatively poorly paid and those graduates with 'Pass' qualifications in physics also tend to have similar qualification in mathematics which makes them ideal employees in a huge variety of positions in government, commerce and industry where salaries are much higher and recognition of ability and competence reflected in better promotion prospects. In recognition of these factors the AIP Education Committee produced the 'Science Education Policy for the Australian Institute of Physics' that was published in December 1990. The policy recommended that 'all teachers of years 11 and 12 Physics should have a minimum academic qualification of second-year Physics at the tertiary level'. The issue of recruiting and keeping well-trained physics teachers is far too complex for the AIP alone to solve.

Each state Branch formed its own Education Committee that included teacher and other members who were concerned with the progress of physics education. I believe that these state committees have, to varying degrees, made significant contributions to the physics syllabi of their respective states. From my own personal experience, in NSW when the Board of Studies decided to change their 7-10 Science Syllabus in 1995, Professional Societies such as the AIP and RACI were invited to make representations and presentations. As a consequence of AIP Branch involvement the 7-10 Science Syllabus that appeared in 1998 and implemented in 2000 had a significant physics content; 40% of the 7-10 Syllabus was Physics Based content.

Excellence and quality of Tertiary Physics Education is another issue that has gained recognition within the AIP community. In 1995 Ian Johnston, from Sydney University, organised the first Australian Conference on the use of Computers in Physics Education (OZCUPE). This conference focused and shared ideas on how computers can be used to enhance lectures and laboratory experiences for students. While this was predominantly aimed at the tertiary sector, the few high schools teacher who attended gained a great deal. This conference proved so popular that it was repeated regularly but began to widen and include research into physics education, concept formation, misconceptions and other related topics. It was not long before OZCUPE became a session within the AIP Congresses. It was at one such Congress in 1998 that it became apparent that research into all aspects of Physics Education was important and that a group within the AIP were committed to this type of work. The Physics Education Group (PEG) of the AIP was formed.

Apart from research into physics education and the applications of best practice principles into undergraduate physics lectures and laboratory work, PEG recognised that those individuals who dedicated themselves to physics education often did so at the expense of their own research. This has unfortunate consequence whereby the 'best educators' were not promoted because they did not a have a sufficient high research quantum compared to their peers. PEG wanted to recognise those exceptional individuals who made significant contributions to physics education by the award of the AIP Physics Education Medal that was presented for the first time in 2004.

Women in Physics

Women have always been welcome within the physics community. As I've mentioned in the previous two articles women were involved in the physics community and professionals from the beginnings of the profession in Australia. They largely filled the teaching roles both in schools and at tertiary level. Some were employed by CSIR and CSIRO. But the conventions of Australian society prevailed which meant that except in times of war, married women were not welcome in the workforce and were expected to resign as soon as they married. Unmarried women remained in the workforce but they too were subject to the conventions of their society and were paid less than their male colleagues. The justification for this situation was that men were expected to keep a wife and children and single women did not.
The Public Service and many Universities lead the way for implementing changes to women's employment.

As recently as August1970, the issue of equal pay for women physicists featured in the journal. There was a call for a considered policy on this subject. It was quite obvious to many physicists that this was an area of discrimination and the AIP supported women in their desire for 'equal pay for equal work'. 1975 was declared by the United Nations as International Women's Year. Issues such as those of equal pay were on the national agenda but this was no longer an issue of women physicists. In September 1975, an article in the 'Australian Physicist', 'Women in Physics, A Review of Current Thinking' by Gillian Robertson was published. As far as can be determined that was as far as the physics profession became involved in the activities that year, but the question must be asked did it need to do more? By and large women physicists were accepted as equals by their male colleagues and with equal pay everyone just got on with their jobs. However, then and now women are still under represented in the profession.

The journal is silent concerning women's issues until July 1980, when 'Women in Physics' letter written by Rachel Makinson from CSIRO was published. The letter alerted the community of a US study on the issue. This is the first appearance in the Australian physics community of any concern of the small proportion of the community that was female. This letter was followed in 1983 by two articles. In July 1983 an article entitled 'Women and Undergraduate Physics Education' by Roger Clay, p 139 was published. It was followed by another article entitled 'Women Students in Physics before and after International Women's Year' by Gillian Robertson, p141.

The following year two more articles appeared, the first in the Jan/Feb issue 'Employment of women in CSIRO' by R. Makinson. The second appeared in December 1984, 'Women in Physics' by W. Megaw who was from Canada and gave a different perspective. And in 1988 an article entitled 'Women in Physics' by Margaret Gallard Kevelson appears on page 213 of the September issue of 'Australian Physicist'. By this stage women physicists were attempting to actively encourage female undergraduate students to carry on with their physics studies. Most of these activities were on an ad hoc basis and were largely supported by their male colleagues.

It was not until the mid 1990s that a number of women physicists decided that the AIP should have a 'Women in Physics Group'. The notion was initially looked at with some scepticism by both male and female physicists, no one wanted a 'women's whinge group'. The issues at this time were not of maternity leave or childcare but career options for women and the perennial relatively small numbers of women in the profession compared to Law and Medicine. The Women in Physics (WIP) group had its inaugural meeting at the 1994 Congress with great support from the then AIP President, Bob Crompton. Cathy Foley, the current President of the AIP and first woman to hold this position, was elected the first Chair of the group. The AIP funded a survey of all its female members (and a set of male controls) to determine what factors affected the retention and promotion of women in the profession. These results were initially published at the AIP Congress in 1996 and later published in the journal. The survey revealed that women physicists were as content in their careers as their male counter parts and over all few differences emerged.

In the years following the establishment of the WIP group, each Congress has had a session set aside for reports, studies and research from WIP and the AIP has supported a WIP activity at the Congress. There has been an annual WIP lecture tour of Australia showcasing some prominent and talented women physicists both from Australia and abroad. Further, virtually every Physics Department in Australia has had a female Head of Department/School and the CSIRO has seen the promotion of women physicists into its senior ranks. The AIP has continued to encourage women into the profession and support its female members, but unfortunately, the proportion of women in the profession has not increased substantially, as yet.

Conclusion

The AIP has continued to grow and develop as a professional organisation, and has been fortunate to have been led by some of the most able administrators in the country. Its presidents have all looked to the future of the organisation while at the same time have dealt with current issues. Some such as education have been a continuing concern while others have been transient, such as uranium. The Executive of the AIP has been mindful of its membership, noted for listening and acting on the concerns of members. It has allowed members to form groups and has encouraged interchanges with cognate societies. One could simply sum up by saying the achievements have been quiet but significant and the future of the organisation continues to look bright.

Epilogue

You now have all the dates for significant anniversaries and celebrations in the future:
• 1924 Australian Committee of IoP formed
• 1928 first Physics Conference in Australia and Australian branch was deemed to have been formed
• 1962 Motion to wind up the Australian Branch and establish AIP
• 1963 AIP formally established.
• 1974 First AIP Congress

My suggestion of celebrations would be as follows:
• August 2012 start celebrations for the 50th Anniversary of the establishment of the AIP to culminate in March 2013.
• 2024 Centenary of first Physics Conference and 25th AIP Congress
• 2028 Centenary of the establishment of the first Professional Society for Physicists.
I would like to be so bold as to make some more suggestions. We should recognise the contributions made by some significant physicists. A. D. Ross should be commemorated by an award for significant contributions to the AIP. We have such an award, so why don't we name it the A.D. Ross Award?

Other individuals whom we should consider honouring by something such as a Plenary Lecture at a Congress or a lecture in a State Branch would be:
Thomas Laby
Kerr Grant
C. Eddy
J. Madsen
Leonard Huxley
F. Lehany
Alan Harper
Terry Sabine (Neutron Diffraction)
Bert Bolton (History of Physics in Australia)

Finally, may I say this has been a labour of love on my part. I have enjoyed all aspects of the research thus far and am looking forward to the oral history collection once the AIP Executive and I have come to an agreement. I would ultimately love to produce a book on the history of the AIP but in the mean time, the content of the three articles belong not so much to me as to the whole AIP membership, your fees have helped defray my expenses. So with my permission use whatever you find useful from these articles; some of the photos are covered by copyright restrictions but my text and tables are yours to enjoy.

Endnotes

1 'Australian Physicist' Volume 1 Number 1 April 1964

Anna Binnie is an independent scholar currently working on a History of the AIP and recently completed a History of AINSE to be published in December. She has been active in the AIP having held the positions of Chairman of the NSW Branch, co-ordinator of the NSW Post-Graduate Awards in Physics and is foundation member of the Women in Physics Group.

RISKS FROM LOW LEVELS OF IONIZING RADIATION

David Woods, Vice-President ARPS

Controversy continues in the radiation protection literature on whether or not ionizing radiation is harmful at very low doses. There is scientific uncertainty about the dose-effect relationship below a few tens of millisieverts in a year, and in order to settle what regulatory controls, if any, should apply in this dose region an assumption has to be made relating dose to the possibility of harm or benefit. The assumption made and, more particularly, the way it is applied can have far-reaching effects not only on the scale of regulatory compliance required but also on public perception of risk and therefore on the technological choices made by society.

It is important therefore that decisions reached concerning regulation of low doses of ionizing radiation have an ethical basis and derive from rational argument. It is also important that such decisions are neither portrayed nor perceived as resolving the scientific uncertainties: rather they serve merely to facilitate the implementation of appropriate safety measures.

Following a review of available information, the Australasian Radiation Protection Society has adopted the following position. Based on the features observed, the range of exposures has been divided into three broad dose groups, but it should be noted that the boundaries between them are not known with precision.

Doses above about 10 mSv in a year

There is strong epidemiological evidence that acute exposure to ionizing radiation of more than about 100 mSv carries a risk of developing fatal cancer that increases with dose, with some limited evidence supporting a risk at slightly lower doses. There are also epidemiological reports of statistically significant risk from long-term cumulative exposures that correspond to doses received at rates down to a few millisieverts in a year, but it is difficult to be confident that the observed effects can be reliably separated from possible confounding factors.

In light of the above, for the purpose of applying regulatory controls to radiation protection when effective doses exceed a few tens of millisieverts in a year, it is reasonable to assume a generalized risk coefficient for fatal cancer of 1 in 20 per sievert for a population of all ages, as recommended by the International Commission on Radiological Protection [ICRP Publication 60]. This assumption is less reliable for exposures below 100 mSv in a year than above.

Consistent with this assumption, an effective dose limit for occupational exposure of 20 mSv per year, averaged over 5 years and no more than 50 mSv in any one year, remains appropriate, as does a requirement to optimize protection below this value. Separately, safety measures are required to avoid deterministic effects of radiation at very high doses.

Doses between about 0.1 and about 10 mSv in a year

There is insufficient epidemiological evidence to establish a dose-effect relationship for effective doses of less than a few tens of millisieverts in a year above the background level of exposure. It is possible that both an adverse effect, through causation of cancer following radiation damage to DNA, and a beneficial effect, through stimulation of repair mechanisms, may operate. It has also been speculated that such a stimulatory effect might reduce mortality from cancer caused by agents other than radiation, resulting in a net decrease in risk. Consequently, neither harmful nor beneficial effects can be ruled out.

To put doses in this range into perspective, it is worth noting that the worldwide average exposure to natural radiation sources is estimated by the United Nations Scientific Committee on the Effects of Atomic Radiation to be 2.4 mSv in a year, with a typical range of 1 to 10 mSv in a year. There are a few areas of the world where much higher doses are received from naturally-occurring sources without causing discernible risks to health.

Taking an ethical position of caution in the face of uncertainty, the risk coefficient adopted above for higher doses may be used for the purpose of establishing control measures for exposure to radiation at lower doses. In particular, the use of an effective dose limit of 1mSv in a year for members of the public is appropriate for exposure caused by the conduct of business activities. This limit will ensure that the additional risk of harm, if any, arising from such activities is acceptably small. However, no inference may be drawn concerning the risk to health or risk of fatality of an individual from an effective dose below 10 mSv in a year. For individual doses less than some tens of millisieverts in a year, risk inferences are unreliable and carry a large uncertainty that includes the possibility of zero risk.

Doses below about 0.1 mSv in a year

The risk to an individual of doses less than a few hundredths of millisieverts in a year is so small, if it exists at all, that regulatory requirements to control exposure at this level are not warranted. Business activities causing individual effective doses of the order of 0.01 mSv in a year or less should be automatically exempted from regulatory control, provided that the activity is inherently safe: that is, there is little likelihood of accidents leading to significantly higher doses. Activities causing levels of exposure up to 0.1 mSv in a year may also be exempted if the regulatory body determines that the application of controls is not warranted, taking into account all relevant factors. In deciding whether control measures are warranted, or how stringent they should be, regulatory bodies should have in mind, inter alia, the principle that societal resources should not be wasted or freedoms inhibited through mandatory observance of unnecessary regulatory controls.

Collective dose

Estimates of collective dose to groups or to populations should be used with caution. In view of the uncertain association between low doses and risk, estimates of collective dose arising from individual doses that are less than some tens of millisieverts in a year should not be used to predict numbers of fatal cancers for the exposed group or population.

However, if collective doses to subgroups of an exposed population are each assigned an appropriate weight, they may play a role in making a choice between possible control measures and thus in optimizing protection. The component of collective dose arising from the summation of individual doses that are less than about 1 mSv in a year should be assigned little significance relative to components associated with subgroups receiving higher doses, and the component associated with doses less than some hundredths of millsieverts in a year may be assigned a weight of zero. Various values for this cut-off have been proposed, from 0.01 to 0.1 mSv.

What is 'safe'?

The word 'safe' may be used to describe business activities that meet currently prescribed radiation safety standards. While there may be some, as yet uncertain, risk arising from such activities, it is known to be small at most and, through application of the justification principle, to be outweighed by the benefits brought by the activity. It follows that exposures of this order may be described as 'safe', understanding that the word is used not in an absolute sense but with the meaning of causing an acceptably small risk, if any.

What is ARPS?

The Australasian Radiation Protection Society Inc (ARPS) is a professional society of members engaged in one or more aspects of radiation protection. ARPS was founded in 1975 and has more than 250 members engaged in radiation protection activities in medicine, pure and applied science, industry and mining. ARPS is the Australian/New Zealand Associate Society of the International Radiation Protection Association (IRPA) and publishes a quarterly journal, Radiation Protection in Australasia combining conference and other papers and articles with a quarterly Newsletter for its members. The primary objective of ARPS is to promote the principles and practice of radiation protection, and to this end it seeks to establish and maintain professional standards of radiation protection practice, encourage co-operation among persons engaged in radiation protection activities, and provide for and give support to scientific meetings on topics related to radiation protection encourage publications in the field of radiation protection.

ARPS would like to encourage those of you working in ionizing or non-ionizing radiation safety to join ARPS by offering a 5% discount on the ARPS membership fee to Members of the Australian Institute of Physics who are eligible (see our web site *http://www.arps.org.au/*) to join ARPS.

REPRESENTING

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The Walsh Medal

Aims: The award recognizes significant contributions by a practising physicist to industry in Australia.
Background: The Walsh Medal for Service to Industry was inaugurated in 2002 by the AIP. It is named for the late Sir Alan Walsh, who was the originator and developer of Atomic Absorption spectroscopy (AAS) and pioneered its applications as a tool in chemical analysis.

General Conditions: The award consists of a medal and is open for competition among persons resident in Australia for at least 5 of the 7 years preceding the closing date for applications. The award will be given for physics research and/or development that has led to patents, processes or inventions which, in the opinion of the judging panel, have led to significant industrial and/or commercial outcomes, such as devices that are being manufactured or have influenced a major industrial process.

Presentation of the Award: The medal will be presented at the AIP Congress in Adelaide in December 2008, at which the medallist will present a lecture on the subject of the award.

Nominations: Any member may nominate any qualified person. Nominations should be received, by the AIP Special Projects Officer, by 1st August 2008.

Previous Winners:

2002 Dr Ian Bassett and Dr John Haywood, Australian Photonics CRC.
2005 Dr Brian Sowerby and Dr James Tickner, C.S.I.R.O..
2006 Professor Andrew Blakers and Dr Klaus Weber, ANU.

Further information can be obtained by email from the AIP Special Projects Officer at *aip_member_one@aip.org.au* or by phone on 0410575855. Applications and nominations should be sent by email attachment to this address or to the Special Projects Officer at Olivia Samardzic, 205 Labs, EWRD, DSTO, P.O. Box 1500 Edinburgh, SA 5111.

The AIP Prize for Excellence in Physics Education

Aims: The purpose of the prize is to emphasize the importance of all aspects of physics education in Australia.
Background: The award was proposed as an initiative of the Physics Education Group at the 2000 AIP Congress in Adelaide.

General Conditions: The prize is awarded to any member of the AIP who is judged to have made a significant contribution to physics education in Australia. In determining the recipient of the award, the quality of the work, the significance to physics education, and the creativity displayed will be taken into account.

Presentation of the Award: The prize is presented every second year at the AIP Congress. It will not be awarded in absentia. The recipient is expected to present a paper at the Congress on some aspect of their work.

Previous Winners:
2005 Prof. M. Zadnik, Curtin University of Technology

Nominations: State Branches or individuals may nominate any qualified person. Nominations should be received by the AIP Special Projects Officer by 30th June 2008.

Further information can be obtained by email from the AIP Special Projects' Officer at *aip_member_one@aip.org.au* or by phone on 0410575855. Applications and nominations should be sent by email attachment to this address or to the Special Projects Officer at Olivia Samardzic, 205 Labs, EWRD, DSTO, P.O. Box 1500 Edinburgh, SA 5111

Samplings

"Pine tree" nanowires do the Eshelby twist
physicsworld.com/cws/article/news/34032
Frost, icicles and snowflakes are all too familiar to the people of Wisconsin, especially on winter mornings. But the icy-looking structures, created by scientists at the University of Wisconsin–Madison, US, didn't form in the cold — they are nanowire "pine trees" grown via chemical vapour deposition (CVD) of lead sulfide.

Nanowire "pine trees", imaged using a scanning electron microscope. (Credit: AAAS/Science)

Song Jin and colleagues have found that by modifying the flow of hydrogen gas used in CVD the growth of their nanowires can be driven by a type of defect known as a screw dislocation, which creates a spiral step for atoms to settle on.

Jin's team think their nanowire pine trees are so intricate they might be the best evidence yet for a theory of dislocations called the Eshelby twist. This theory, put forward by 55 years ago by materials scientist John Eshelby, then at the University of Illinois at Urbana, proposes that the stress created by a dislocation generates a torque at either end of the cylinder, forcing it to twist. "Lying beneath these beautiful nanostructures is a beautiful and fundamental science that goes back to the heart of crystal growth theory," says Jin.

A new type of high Tc superconductor
pubs.acs.org/cgi-bin/sample.cgi/jacsat/2008/130/i11/pdf/ja800073m.pdf
Recent discoveries by researchers in Japan have lead to a boom in new superconductors based on compounds of iron and arsenic. Like the cuprate-based high-Tc superconductors discovered in the mid-1980s, these compounds are layered, containing planes of iron and arsenic between which are elements like lanthanum, cerium and samarium, mixed with fluorine and oxygen. Further frenzied developments have yielded compounds with critical temperatures up to 55K (see *www.sciencemag.org/cgi/content/full/320/5875/432*. High-temperature superconductivity remains the biggest mystery in condensed matter physics, and some researchers hope the new materials will help solve it.

New probe measures magnetic fields inside solids
physicsworld.com/cws/article/news/33694
A new 3D imaging technique using neutrons has been invented by physicists in Germany. The technique, which can visualize magnetic fields inside bulk objects, is an improvement on existing magnetic methods that are limited to surfaces. The method could find use in a range of science and engineering fields and shed more light on various magnetic phenomena in solids, including superconductivity.

Nikolay Kardjilov of the Hahn-Meitner Institute in Berlin and colleagues used a beam of polarized neutrons from a nuclear reactor to irradiate samples in their experiments. As the neutrons travel through a sample, their magnetic moments rotate around the magnetic fields they encounter and the direction of their spin changes. The researchers measure the different spin angles, which depend on the strength of the magnetic fields.

These angles are then converted into intensities by a polarization analyser, located behind the sample. Next, a position-sensitive detector measures these intensities to build up a map of the magnetic fields inside the sample. Each image contains about a million pixels and is taken in just seconds or minutes depending on the sample.

Scattering of spin-polarized neutrons has been used in the study of bulk magnetism for years, but this is the first development of a 3D imaging technique.

'Racetrack' memory demonstrated
physicsworld.com/cws/article/news/33757
Physicists in the US have demonstrated for the first time that data can accessed from forest-like arrays of 3D nanowires or "racetracks". The demonstration indicates that so-called racetrack memory, which should be faster and cheaper than other forms of information storage, is on its way to becoming a commercial reality.

Stuart Parkin and colleagues at IBM's Almaden research centre in San Jose, US first came up with the concept of racetrack memory back in 2004. The idea is that arrays of U-shaped nanowire racetracks are planted on a bed of silicon wafer. Along the length of each racetrack are domains that are magnetized in one of two directions, with each domain boundary or "wall" acting as a single bit — either a 1 or 0 — of information. By sending a current of spin-polarized electrons into one end of a racetrack, these domain walls can be shifted to and fro.

Racetrack memory started creating a media buzz about a year ago, but many researchers doubt it will ever emerge as a commercially viable technology. Others have faith in Parkin, whose previous work led to huge leaps in computer hard-drive technology.

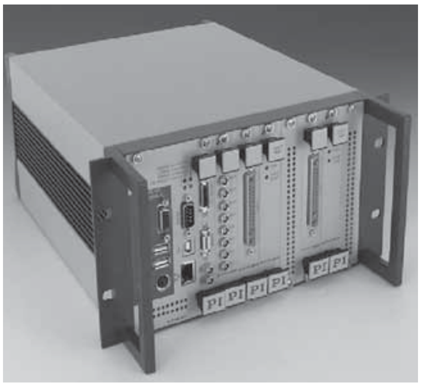
Vale John Wheeler
physicsworld.com/cws/article/news/33768
John Wheeler, one of the great physicists of the twentieth century, died at his home in New Jersey on 13 April 2008. Famous for coining the term "black hole" Wheeler did a postdoc with Niels Bohr, and went on to supervise such luminaries as Richard Feynman and Kip Thorne, in a wide-ranging career in astrophysics, cosmology, general relativity and quantum gravity. . See also the transcript of an interview Wheeler gave to Paul Davies back in 2003: *www.abc.net.au/rn/science/ss/stories/s941066.htm*.

Samplings by Don Price CSIRO

Product News

Warsash

New Modular Digital Piezo Motion Controller from PI



E-712 Modular Digital Piezo Controller System

Now available from Warsash Scientific is the new E-712 modular digital piezo controller from PI. The E-712's high-performance, real-time operating system can coordinate motion in up to 6 axes with nanometer precision and thus ensures excellent trajectory control even during complex motion. The modular design provides the greatest flexibility in meeting custom requirements with regards to the number of axes and channels required for the application.

Operation of the E-712 digital piezo controller is made simple using mature programs with intuitive interfaces. No programming knowledge is needed, whether commissioning, optimising system parameters, creating new user-defined motion profiles for the integrated wave generator, or recording data generated during the motion. The comprehensive package of supporting software, including LabVIEW drivers and DLLs, ensures easy integration in a variety of system environments.

Features

- Sensor and servo update rates of up to 50 kHz to assure continual updating of the position and control data
- 20-bit D/A converter on the output stage to make possible position resolutions of less than one nanometer
- Centrally coordinated motion of up to 6 axes via a high-performance embedded PC with real-time operating system
- TCP/IP, USB 2.0, RS-232 and analog interfaces ensure rapid communication with the positioning system as a whole.

Further information on this and other PI products is available from:
Warsash Scientific Pty Ltd
Tel: +61 2 9319 0122
Fax: +61 2 9318 2192
sales@warsash.com.au
www.warsash.com.au

New PIFOC Nanofocusing Systems for Specimen Holders

Warsash Scientific is pleased to present the new P-737 PIFOC Specimen Positioner from PI, featuring travel ranges up to 0.5 mm and resolutions of a few nanometers. The millisecond response of the piezoelectric drive makes it ideal for applications where throughput and high accuracy are important, like screening tasks or confocal microscopy.

Focusing involves moving either the optics or the specimen. One advantage of moving the specimen instead of the objective in phase-contrast microscopy is that the image is not degraded.

Furthermore, because of its small size, a vertical piezo drive can be integrated into a motorized XY scanner like the ones often already in place as one of the microscope system components. The adaptation can be made with minimal effort, and complete flexibility in the use of objectives is maintained.

For example, P-737 specimen-positioning PIFOC Z-drives can be installed in Märzhäuser XY scanners with no adaptive hardware at all. Standard specimen holders for objects from slides to Microtiter plates fit in the piezo Z drive directly. The total height of the resulting XYZ system, which is still quite small, allows its use with most common microscopes.

Further information on this and other PI products is available from:
Warsash Scientific Pty Ltd
Tel: +61 2 9319 0122
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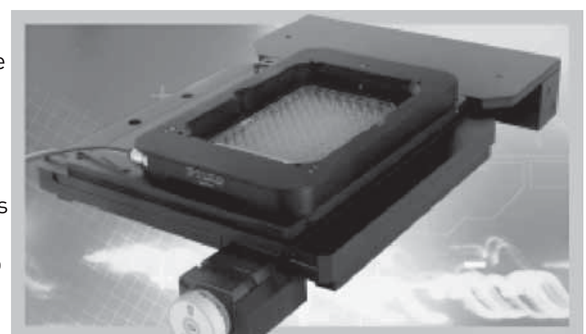
www.warsash.com.au



PIFOC nanofocusing specimen positioner

Long life-time HeCd lasers Kimmon Koha; Helium Cadmium Lasers

For further information on these and other laser products please contact:
Warsash Scientific Pty Ltd
Tel: +61 2 9319 0122
Fax: +61 2 9318 2192
sales@warsash.com.au
www.warsash.com.au

Kimmon's HeCd lasers

Erratum:
The incorrect image for this Product News item appeared in the March-April issue. The correct image should have been the image above. The Editor apologises for any confusion.

Product News

Coherent

IndyStar™1 kHz UV Excimer Laser

The IndyStar™ series represents a new generation of very stable, high repetition rate excimer lasers, building on the existing Coherent ExciStar™ excimer laser systems technology, of which there are hundreds of installations worldwide. The IndyStar™ series is suitable for high repetition rate spectroscopy, micromachining and direct writing applications.

Cost of ownership has been reduced by increasing tube, gas optics and overall system lifetime through use of the Almeta "all-metal" tube design. The electrostatic dust-particle trap design results in a very clean discharge that also increases gas lifetime and reduces consumable gas costs.

The solid-state switch creates a "soft" discharge, which in combination with corona preionisation, results in a more homogeneous discharge, better beam profile, better pointing stability and more consistent pulse-to-pulse energy stability. Temperature stabilisation pads also optimise tube temperature for fast warm-up.

In summary, the IndyStar™ excimer lasers offer:

• 193nm and 248nm configuration options for operation with premix gas
• Up to 16mJ energy per pulse
• 1 kHz repetition rate operation
• Almeta tube technology for longer lifetime and lower cost of ownership
• Energy stabilisation module for ease-of-use
• Efficient corona preionisation and all solid-state pulser for better beam parameters and pulse-to-pulse energy stability
• Compact footprint

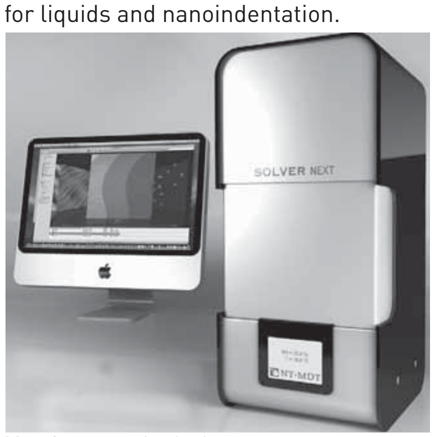
Please contact Gerri Springfield or Paul Wardill (*sales@coherent.com.au*) for further information.

Solver NEXT: The NEXT big thing in Scanning Probe Microscopy

The Solver NEXT is the first to offer a new concept in affordable, general purpose scanning probe microscopy (SPM) giving users the ability to configure the system and acquire quality images within minutes and with unprecedented ease.

The hassle of manual set-up has been eliminated. Intuitive automation guides the user through set-up, adjustment and sample measurements. The system incorporates smart software, automated head exchange, motorised sample positioning under video monitored control and ergonomic design.

Solver NEXT provides the versatility to work with a variety of samples, measuring modes and conditions through the use of built-in atomic force microscope (AFM) and scanning tunneling microscope (STM) heads, both with automatic exchange, and other removable head options including those for liquids and nanoindentation.



Key features include:

- Automated exchange of AFM and STM heads
- Automated alignment of optical feedback geometry between the cantilever, laser and photodiode
- Motorised software-driven sample positioning for ease-of-use
- Motorised positioning, focus and zoom of the optical view
- Motorised enclosure door for improved isolation
- Automated software driven control of measurement modes for ease-of-use
- Mac OS and PC/Windows compatible

Performance capabilities include:

- All basic AFM techniques including topography, phase imaging, measurement of electric properties, nanolithography and more
- Scanning tunneling microscopy
- Nanoindentation (optional)
- Wide range of operating conditions for experimentation in air or liquid
- Low-noise capacitive feedback loop in all three directions (X,Y and Z)
- Atomic resolution

For more information please contact Christian Gow (*sales@coherent.com.au*).

Lastek

New Multichanel Event Timer & TCSPC Module from PicoQuant

The HydraHarp 400 is a high-end, easy-to-use, plug and play Time-Correlated Single Photon Counting (TCSPC) system with scalability for multiple channels. It is connected to a PC through a USB 2.0 high speed interface. It provides identical synchronized but independent input channels. They can be used as detector inputs for coincidence correlation experiments as well as independent stop inputs for TCSPC. A dedicated common sync input is provided for TCSPC with fast excitation sources. This allows forward start-stop operation at a full repetition rate of mode locked lasers with stable repetition rate up to 150 MHz. Experiments with low repetition rate benefit from the HydraHarp's multi-stop capability.

Features:

- Compact box with modular, scalable design
- Up to four identical synchronized but independent input channels
- Common sync for all input channels
- 65536 histogram bins per channel, minimum width 1 ps, 32 bits deep
- Count rate up to 12.5 million counts/sec per channel
- Multi-stop capability for efficiency at slow repetition rates
- Histogrammer measurement range from 65 ns to 65 ms
- Time-Tagged Time-Resolved (TTTR) mode
- External marker signals for imaging or other experiment control
- External reference clock input

For more information please contact Lastek at *sales@lastek.com.au*
Lastek Pty Ld, Adelaide University
10 Reid St, Thebarton, South Australia
Australia 1800 882 215; NZ 0800 441 005
T: +61 8 8443 8668 ; F: +61 8 8443 8427
web: *www.lastek.com.au*

Product News

Horiba Jobin Yvon new Automated Spectroscopic Ellipsometer

HORIBA Jobin Yvon introduces the Auto SE, a new thin film measurement tool that allows full automatic analysis of thin film samples with simple push button operation. Sample analysis takes only a few seconds and provides a complete report of film thicknesses, optical constants, surface roughness, and film inhomogeneities. The Auto SE is a highly featured instrument that includes an automatic XYZ stage, real-time imaging of the measurement site with MyAutoView vision system and automated selection of eight spot sizes. Many accessories are available to suit a large range of applications.

The Auto SE includes built-in diagnostic indicators for the automatic detection and diagnosis of problems, with comprehensive operator guidance for troubleshooting. The Auto SE is a turnkey instrument ideal for routine thin film measurement and device quality control. Features:

- Automatic sample loading and adjustment
- Automatic sample mapping
- Fast measurement from 440-850 nm ← 1s
- Automated selection of eight spot sizes
- Accessories to suit all applications

"With Auto SE, routine work will never be the same!"

For more information please contact Lastek at *sales@lastek.com.au*
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10 Reid St, Thebarton,
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T: +61 8 8443 8668 ;
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NewSpec

ORIEL LED Light Sources

Newport are pleased to announce the release of our new family of Oriel® LED light sources. This release is for the low power version of the LED light source that is targeted at applications where a low power (up to 250mW), low heat, discrete wavelength light is required. These applications may include fluorescence, UV curing, microscopy, forensics, etc.

The LED heads will be available in 8 different wavelengths ranging from the near UV thru the visible light range and includes a broad-spectrum white light model. The unique design allows the Model-52 or Model-56 driver to recognize which LED head is attached and pre-set the operating parameters for optimal power output and performance.
The light sources will come pre-configured with a collimating optic for free space applications. Special focusing optics are available to interface to a liquid light guide or fiber optic (via SMA).

For further information contact Neil McMahon: *neil.mcmahon@newspec.com.au* or t:(08) 8463 1967

Veeco release the Innova SPM

The 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 colour 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 one of the best value SPMs available today.

For further information contact: Jim Efthimiadis: *jim@newspec.com.au* or t:(08) 8463 1967

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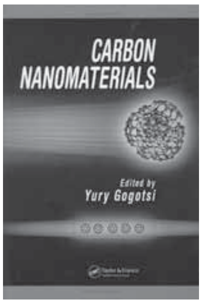
Reviews



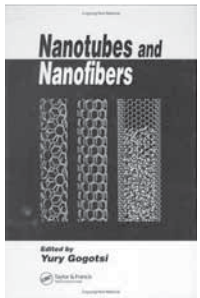
Carbon Nanomaterials
Edited by Yury Gogotsi
CRC Press, Taylor & Francis Group, 2006.
x + 327 pp. AUD 135 (Hardcover)
ISBN 0-8493-9386-8

Since Sumio Iijima's discovery of carbon nanotubes in 1991 a plethora of books and manuscripts have been published on carbon nanomaterials but none that covers the entire range of nanostructured carbons that are currently known. With this book Gogotsi has managed to collect and edit contributions from various highly esteemed authors on topics such as fullerenes, nanotubes, nanofibers, graphite cones and whiskers as well as nanodiamonds, making it a comprehensive work on nanostructured carbon.

This book is divided into 2 parts. In the first part several chapters have been devoted to describing and discussing each of the topics listed above. The second part, containing the last few chapters, draws attention to some of the many applications of nanostructured materials such as field emission and energy storage devices. Each chapter shows clear evidence of having been written by leading specialists working in the field but have had a healthy dose of broader understanding added to explain each topic in depth. This makes the book suitable for both novice students getting acquainted with the topic as well as for a reference book for researchers familiar to this field.

I found this book to be interesting and enjoyed the authors' easily understandable approach to the various carbon nanomaterial topics. If the reader wishes to explore any of the topics further, the presence of a substantial amount of references has been included in each chapter. It is my belief that this book will be useful to most people studying or working within the field of carbon nanomaterials.

Lars Thomsen
School of Mathematical and Physical Sciences
University of Newcastle



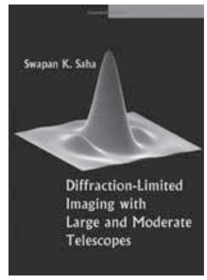
Nanotubes and Nanofibers
Yury Gogotski (Ed).
CRC Press, Taylor and Francis Group, Boca Raton, FL, USA, 2006
248pp A$135.00 (hardcover)
ISBN0-8493-93876-6

As a researcher working with carbon nanotubes, I first picked up this book with great anticipation. Through a collection of contributed chapters by specialists in their respective fields, this book comprehensively reviews up to date advances for just about every type of 1-D and some 2-D nanostructures (including tubes, wires, whiskers, rods, belts scrolls and cones) that are driving advances in the field of nanostructured materials.

All aspects surrounding the synthesis, growth, assembly and processing (including scale-up challenges that need to be surmounted for large-scale applications) is discussed throughout the text. Topics highlighted in depth include nanotubes (single- and multi-walled, amorphous, and crystalline graphitic carbon structures, inorganic nanotubes and fullerene-like nanomaterials, boron nitride and metal chalcogenide nanotubes); single crystal semiconducting functional oxide nanowires, and fibrous nanomaterials (polymer) of all sizes and shapes.

Reading each chapter, I was pleasantly surprised to find that each nanostructure type (its structural, mechanical, thermal, electronic, optical and functional properties) was introduced for non-specialists before getting into the technical details and forefront research. It is frequently difficult to strike a good balance for expert and non-expert in edited books such as this, but in this particular case it is a strength that will, in my opinion, make it the definitive work it aims to be and a potential bestseller. This book is a must-have reference for anyone researching or teaching nanostructures or nanostructured materials.

Jamie Quinton
School of Chemistry, Physics and Earth Sciences
Flinders University



Diffraction-limited Imaging with Large and Moderate Telescopes
Swapan K. Saha
World Scientific Publishing, Singapore 2007
xxix+604pp, US$78.00 (hardcover) ISBN 978-981-270-777-2

In the last couple of decades, telescopes operating at visible and infrared wavelengths have increasingly escaped the limitations of the Earth's turbulent atmosphere. The development of adaptive optics has started to pay dividends with remarkable discoveries such as the beautiful observations of stars orbiting the black hole at the centre of our galaxy. Long-baseline interferometry in this wavelength regime makes steady progress as well.

Improved imaging through turbulence relies on a wide range of technologies and detailed analysis of the physics of propagation in these circumstances. Much of the information is to be found in journals and conference proceedings. Systematic monographs are sparser; a graduate student in this area would still be pointed to the old but magisterial review by Roddier in Progress in Optics, following from texts by Hardy, Roggeman and Welsh, Tyson and Sasiela.

Saha's book enters this field as a development of graduate course notes. An immediate impression is that it is an uneven collection of material, large chunks of which can be found elsewhere. The section on adaptive optics is somewhat dated already and should not be one of the shortest chapters in a book with this title. The chapters on basic astronomy and applications are useful but the material can easily be found elsewhere.

The book does not qualify as a useful monograph for the researcher, as it is not sufficiently focussed on new topics. As a text it is a useful compendium but is not up-to-date enough for the hard-pressed student wallet. A lecturer designing a course will find much useful material in one place.

Charles Jenkins
Research School of Astronomy and Astrophysics

Conferences

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

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

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

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

July 27 – August 1
17th International Conference on Photochemical Conversion and Storage of Solar Energy
Sydney Convention and Exhibition Centre
www.ips17.com/

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/

September 21 - 26
The First International Conference on RARE EARTH MATERIALS
Poland
apollo.int.pan.wroc.pl/remat2008/default.html

October 8 - 10
The Third International Conference on Women in Physics
Seoul, Korea,
icwip2008.org/

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

October 26 - 28
7th WSEAS Int. Conf. on NON-LINEAR ANALYSIS, NON-LINEAR SYSTEMS AND CHAOS (NOLASC '08)
Corfu, Greece
www.wseas.org/conferences/2008/corfu/nolasc

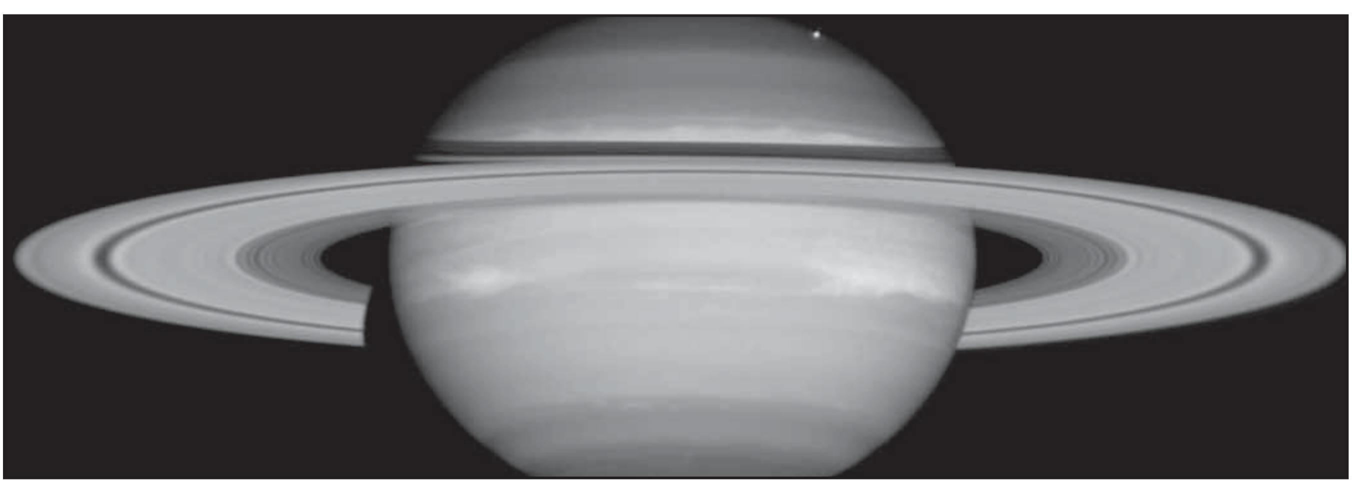
November 17 - 20
14th International Conference on Thin Films
Belgium, Ghent
http://www.ictf14.ugent.be/

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!

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