

Australian

PHYSICS

June/July/August 2007 Volume 44 Number 2

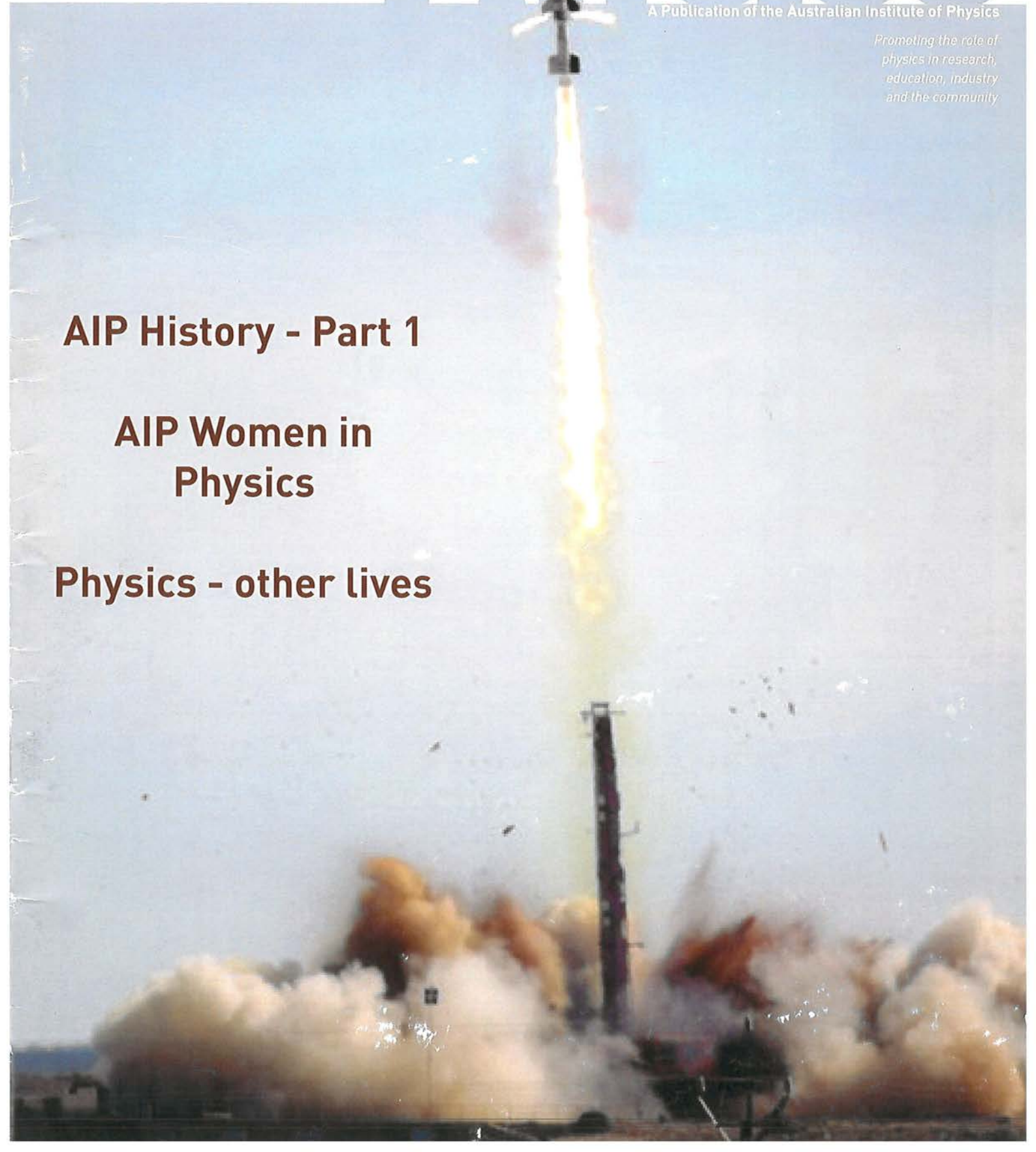
A Publication of the Australian Institute of Physics

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

AIP History - Part 1

**AIP Women in
Physics**

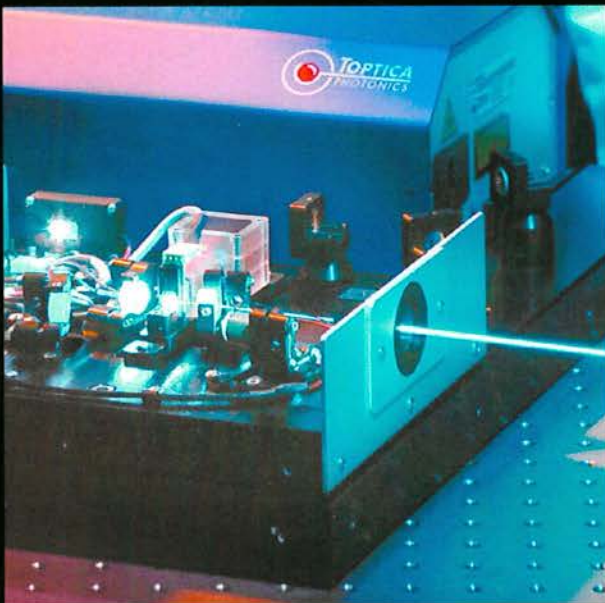
Physics - other lives





A Passion for Precision

- tunable stabilised laser diode systems
- DFB/DBR lasers
- iBeam/iPulse: DPSS lasers for gas laser replacement
- femtosecond fibre lasers
- optical media testing
- MOT optics
- and much more



Toptica Photonics represent the future of lasers and photonics: cutting edge technologies expertly designed and engineered. Now Toptica lasers are represented in Australia and New Zealand by Lastek. To receive a copy of the new Toptica literature pack, or for further information on any Toptica products, contact Lastek at the address below.

LAS TEK

Lastek Pty Ltd
Thebarton Campus, University of Adelaide,
10 Reid Street, Thebarton SA 5031 Australia
Ph (08) 8443 8668 Fax (08) 8443 8427
Email: sales@lastek.com.au Lastek website: www.lastek.com.au



Park Systems AFM / NSOM

Now Available in Australia & NZ

Park Systems (formerly PSIA) Technology Leader in Nanoscale Measurements

Looking for advanced, affordable Atomic Force Microscopes (AFM) & metrological systems to generate accurate nano-scale measurements? Park Systems has what you need.

Our AFM solutions meet the most rigorous scientific research and nano-manufacturing process control requirements in biological, polymer, and material sciences. Park Systems' independent, orthogonal XY&Z flexure scanners overcome non-linearities associated with conventional piezo tube based AFMs, and a fast Z-servo response enables True Non-Contact mode AFM imaging.

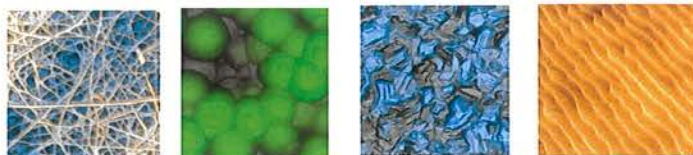
True Non-Contact AFM (NC-AFM) can image deep trenches and high walls, reduces tip-wear, eliminates sample damage and improves overall AFM resolution.

Scientists and engineers have relied on Park Systems quality AFM's for more than 10 years.



Park
SYSTEMS

Excellence In Nanometrology



Visit our image gallery at www.parkafm.com



WARSASH Scientific

Advanced Instruments for Research & Industry

Sydney
PO Box 1685
Strawberry Hills
NSW 2012
Tel: (02) 9319 0122
Fax: (02) 9318 2192
sales@warsash.com.au
www.warsash.com.au

Contents

Volume 44 Number 2

President's column	35	Physics at CISRA	57
Guest editorial	36	Physics - other lives	60
Letters	37	Conferences	63
AIP - a short history: Part 1	39	Samplings	64
News	47	The research-teaching nexus in physics	66
WIP lecture tour, 2006	48	Book reviews	71
Branch news	53	Product News	74
Obituary: Donald Hutton	56		

Cover image: TALOS rocket carrying the HyCAUSE scramjet experimental payload lifts off the launch pad at Woomera.

Image credit: DSTO

Editor-in-Chief

A/Prof Brian James

Guest Editor

John Daicopoulos

Reviews Editor

A/Prof CSL Keay
Physics, University of Newcastle
Callaghan NSW 2308
Tel: 02 4921 5451 Fax: 02 4921 6907
colin.keay@newcastle.edu.au

Editorial Board

Dr MA Box
Prof Ian Johnston
A/Prof CSL Keay
Prof RJ MacDonald
A/Prof RJ Stening

Associate Editor - Education

Dr Colin Taylor
Physics Director, RTASO
Box 7251, Canberra MC, ACT 2610
Tel: 02 6125 9780
Colin.Taylor@rtaso.org.au

Associate Editors

Dr Tony Collings
CSIRO Telecommunications
and Industrial Physics
PO Box 218, Lindfield NSW 2070
tonyc@tip.csiro.au

Dr John Humble
University of Tasmania
Tel: 03 6226 2396 Fax: 03 6226 2867
John.Humble@utas.edu.au

Dr Chris Lund
Physics & Energy Studies
Murdoch University, Murdoch WA 6150
Tel: 08 9360 2102 Fax: 08 9360 6183
clund@fizzy.murdoch.edu.au

Dr Laurence Campbell
Chemistry, Physics & Earth Sciences
Flinders University
GPO Box 2100 Adelaide SA 5001
Tel: 08 8201 2093 Fax: 08 8201 2905
laurence.campbell@flinders.edu.au

Contributions should be sent to

A/Prof Brian James
Australian Physics
School of Physics, A28
University of Sydney
NSW 2006
Tel: 02 9351 2471
australianphysics@aip.org.au
australianphysics2@gmail.com

Design

Sophie Campbell
Tel: 0402 101 090

Printing

Cliff Lewis Printing
91-93 Parraweena Road
Caringbah NSW 2229
Tel: 02 9525 6588
Fax: 02 9524 8712
matthew@clp.com.au

Layout

Corinna Horrigan
bedlam@iinet.net.au

Advertising Enquiries

Enquiries should be sent to the Editor-in-Chief.

Published 6 times a year on behalf of the Australian Institute of Physics by Cliff Lewis Printing Co. Pty. Ltd.
Copyright 2007 Pub. No. PP 224960 / 00008
ISSN 1036-3831

The statements made and the opinions expressed in *Australian Physics* do not necessarily reflect the views of the Australian Institute of Physics or its Councils or Committees.

President's Column - Does Physics need Diversity?



Science research teams are now required to deliver a level of impact with the expectation that an idea or concept is experimentally proven and then commercialized or implemented.

A quick review of physics journal articles indicates that the single-authored paper is becoming uncommon. In fact studies on the authorship of science journal articles have shown that multiple authored papers attract more citations and are usually of higher quality¹. This

also reflects the movement over the last few generations of physics research being performed by teams rather than by individuals. Furthermore these teams are getting larger and more complex with the surge of multi organisational research programs such as CRCs, Centres of Excellence and CSIRO Flagships which are important components of the Australian innovation process. Research over the years has moved away from an expectation that, when a researcher undertakes a project, the project was considered complete when the scientific journal article was written and published. Science research teams are now required to deliver a level of impact with the expectation that an idea or concept is experimentally proven and then commercialized or implemented.

Even though the expectations of research programs have broadened, we still tend to expect all scientists to demonstrate a single approach to their research. We expect research teams will form naturally to achieve the task at hand. However with our society wanting excellent science, as determined by science metrics, while undertaking research that has commercial impact and public benefit; we have not given much thought to the more detailed attributes needed by scientists to achieve the various stages of the innovation process from idea to product or solution. What are the best teams that are needed to achieve these multi-faceted requirements? Should all research scientists be the same?

Look at individual scientists and their contribution. Over the years I have come to understand that there are three stages of a science project which requires three different approaches for the project goal to be achieved. A science project is initiated to solve a problem or to test a hypothesis or idea. It is in this early stage the creative thinkers are in their element. They are often the scientists who come up with more ideas than many of us could ever consider. These creative scientists provide the ideas and directions that great science projects use as the basis for their research. Unfortunately these scientists are working at their best creating new ideas and usually find it quite difficult to follow through beyond the initial experiments or theory before they are coming up with their next great idea. The ideas come at such a rate, they often feel they have no time to write up their work for publication and consequently have poor publication records and can feel that their input goes unacknowledged or unrecognised. They can become increasingly protective of their ideas to the point where it could become an impediment for their career development.

The second type of scientist is the one who methodically

takes the terrific idea and makes it into solid science by undertaking more detailed theory and modelling development or experiments. They are usually not great ideas people but are very effective at transforming the initial creative idea into a successful research effort. They are usually good at writing up their work and have lots of publications (hopefully with their creative colleague as a co-author). They usually find they have all the attributes that make promotion in the science system easier for them as their output is of a more traditional nature that can be measured for scientific success.

The third type of scientist is the entrepreneur who can see the benefits of the creative idea progressed to solid science. They can see where an idea can be used and can design applications and develop prototypes or opportunities to capitalize on the creative idea that has been solidly researched and is now ready to transition to application. This type of scientist is not that common but is increasingly needed to help research projects achieve the impact expected by our stakeholders (community, research organisations, industry and government).

Each of these scientific roles are necessary to achieve all the components expected of a successful science project to achieve the transition of an idea to impact, and yet we often expect the same person to do all three roles. Recognizing this diverse approach to the science process should make a difference in project effectiveness and the needed respect between scientists who play the different roles but who often hold their colleagues in contempt.

Another important requirement of successful and effective research teams is the need for a balance in the constitution of the personality types that make up the team. There are several different ways to study the different personality types such as the Team Management Index². This index shows the need for a balance in the group roles from creative/innovators, explorer/promoters, thruster/organisers, inspector/controllers, upholder/maintainers, reporter/adviser and concluder/finishers. People have a natural preference to adopt one of these roles in their major work style and display two other roles with less dominance. For example, I am dominantly a creative/innovator but with explorer/promoter and reporter/adviser secondary preferences. However my role at work has required me develop concluder/finisher and thruster/organiser behaviours.

This method of analysing a team has found that a successful team requires its different members to demonstrate the range of roles with different people assuming roles based on their work preference. For example, a team of only concluder/finishers will get all the work done but usually not have many new ideas, and a team of creative/innovators have lots of ideas but never finish anything. The method of analysis can also help team leaders manage their teams effectively by preventing frustration resulting from a team member being required to undertake a role or responsibility

continued on page 38

AIP Web site: www.aip.org.au

AIP Executive

President

Dr Cathy Foley
CSIRO Industrial Physics
PO Box 218, Lindfield, NSW 2070
Tel: 02 9413 7413 Fax: 02 9413 7202
Cathy.Foley@csiro.au

Vice President

A/Prof Brian James
School of Physics, A28
University of Sydney, NSW 2006
Tel: 02 9351 2471 Fax: 02 9351 7726
B.James@physics.usyd.edu.au

Secretary

Dr Ian Bailey
Curtin University of Technology
PO Box 16, Willetton, WA 6955
Tel: 08 9332 1513 Fax: 08 9266 2377
i.bailey@curtin.edu.au

Treasurer

Dr M.L. Duldig
Australian Antarctic Division
203 Channel Highway, Kingston, TAS 7050
Tel: 03 6232 3333 Fax: 03 6232 3496
marc.duldig@aad.gov.au

Registrar

A/Professor Bob Loss,
Department of Applied Physics,
Curtin University of Technology,
GPO Box U1987, Perth, WA 6845
Tel: 08 9266 7192 Fax: 08 9266 2377
r.loss@curtin.edu.au

Immediate Past President

Prof. David Jamieson
Director, Microanalytical Research Centre,
School of Physics
University of Melbourne
VIC 3010
Tel: 03 8344 5376 Fax: 03 8347 4783
d.jamieson@physics.unimelb.edu.au

Special Projects Officer

Dr Olivia Samardzic
205 Labs, EWRD, DSTO
PO Box 1500, Edinburgh, SA 5111
Tel: 08 8259 5035 Fax: 08 8259 5796
olivia.samardzic@dsto.defence.gov.au

AIP ACT Branch

Chair: Professor John Howard
Plasma Research Laboratory, RSPHysSE
ANU, Canberra ACT 0200
Tel: 02 6125 3751 Fax: 02 6125 8316
John.Howard@anu.edu.au

Secretary:

Dr Anna Wilson
Department of Nuclear Physics, RSPHysSE
and Department of Physics
ANU, Canberra ACT 0200
Tel: 02 6125 2086 Fax: 6125 0748
Anna.Wilson@anu.edu.au

AIP NSW Branch

Chair: Dr Michael Lerch
School of Engineering Physics
University of Wollongong
Wollongong, NSW 2522
Tel: 02 4221 4954 Mobile: 0414 453 746
mlech@uow.edu.au

Secretary:

Graeme Melville
14 Herber Place
Wahroonga, NSW 2076
Tel: 02 9487 1619
gmelvill@bigpond.net.au

Guest editorial



This issue of Australian Physics is all about frontiers. The physics of our past, present and future. We focus on how we explore our physical, temporal and intellectual landscape to include unfamiliar territory and the value-added nature inherent in those pursuits.

A good place to start is with Anna Binnie's chronicle *A Short History of the Australian Institute of Physics* covering the early history of today's Australian Institute of Physics. Binnie looks at how the size and settlement of Australia shaped our focus and development, characteristics that define the AIP still to this day; and how creating a sense of community and networking played a key role in defining who we are today. More to the (modern) point she shows us that (even then) our growing physics graduate cadre resulted in an Australian physics graduate diaspora when local opportunities were sparse.

In Deb Kaner's article on the *AIP Women in Physics Lecture Tour 2006* she details how we, both as an institute and as a profession, must be clear and determined not to lose out on the academic possibilities that women add to physics, not in some clichéd "women bring a different perspective to physics" manner, but in a simple "how could we deny any critical thinking segment of our population the opportunity to participate in this great profession" way. We need to listen.

In *The Research-Teaching Nexus in Physics: Scholarship into Teaching and Learning* by Helen M. Johnston et al, we march to the front lines of physics education. As educators we need to self-assess our pedagogical outlook on a regular basis, then and only then, make our case for others to change by argument based on evidence, experience and data; but as the authors state "[W]e can tinker around the edges, jump on current fads like the use of technology, or seriously reconsider student learning" it is the students' learning that should dictate our approach.

If an emphasis on evaluating how we educate was not enough, then consider the depth of concern and focus our branches regularly show to education in their local activities. Public education through lectures and student activities will continue to be crucial for our future and the branches are certainly playing their role by leading the way for all of us.

The frontier adventure is all about going where the traditional motives of exploration and entrepreneurship take you. When I was a physics student over twenty years ago, financial institutions were crying out to hire physics graduates in order to assist with evaluating business proposals containing highly technical briefs. In this issue, Chris Carter reminisces in *Physics - Sometimes a Gateway to Another Life* on the possibilities for non-traditional careers for graduates, in his case one in law. Carter's success highlights the true spirit of an education, and a physics education in particular: to hone and stress critical thinking and problem solving skills in all aspects of life. It is hoped that this type of article, one that feature physics graduates who have pursued careers outside of traditional physics, a regular element.

The last frontier explored in this issue is one of my own; this is the first editor's role I have taken on - from writer to (guest) editor in a very short, and hectic, period of time. I came to this position without any particular experience with this journal beyond being a regular reader and must therefore thank Brian James and Corinna Horrigan for their invaluable assistance in helping me get through this issue.

Your feedback would be appreciated.

Enjoy the issue.

John Daicopoulos

Deadline for next issue: 21st September 2007

Submission guidelines

All articles for submission to Australian Physics should be sent in electronic format. Word or rich text format are preferred, but other formats, such as PDF, may also be accepted. Please check with the editor if your article is in a different format.

Images should not be embedded in the document but should be sent separately in high resolution JPEG or TIFF format.

Letters

I was very pleased to see the article in "Australian Physics" about Alan Harper and the Scholarships. They were set up as an AIP 25th anniversary project in 1988; it seemed appropriate to honour Alan and keep his name current in AIP affairs because he was the organizational mastermind behind the establishment of the AIP in 1963.

The last Institute of Physics (IOP) Australian Branch Committee, which became the founding Council of the AIP, included (to the best of my recollection) Prof LGH Huxley (President), Fred Lehany (VP), Alan Harper (Hon Secretary), Stuart Dryden (Hon Registrar), George Bell (Hon Treasurer), and Guy White (NSW Chairman), the last five, all members of the National Standards Laboratory (NSL). Alan was the man who conducted the very lengthy, and at times difficult, negotiations with the IOP. Alan gained the agreement of the IOP Council to very favourable conditions for the transfer of Australian Branch assets to the AIP and for perpetual subscription benefits for those physicists who retained membership of both bodies. The founders also had to deal with strong opposition to the formation of an AIP from some senior Australian physicists.

As correctly stated in the article, the metrification of Australia was extremely efficiently conducted. As I understood it, John Norgard was Metric Conversion Board Chairman and a man with the extensive political and industrial contacts necessary to have the concept accepted. Alan was Executive Officer, with experience as Secretary and later Chairman of the National Standards Commission, who knew the Australian standards (NSC, NATA and SAA) and state Weights and Measures systems and personnel in very great detail. He made the conversion process work and kept it to schedule, and he was deservedly awarded the OA for this achievement.

The photo attached to your article worries me. I do not believe that it is Alan and I suspect it is Prof Huxley who, as noted above, was the founding President of the AIP. I must declare an interest in all of this. Alan recruited me to CSIRO as a post-graduate student in 1957, and we travelled together in a car pool to NSL for years during the 1960s. He was my immediate superior in his role as head of the Heat Section, and he "volunteered" my services as a member of both the AIP and CSIROOA constitution committees, which he chaired in the early 1960s.

As you can tell, I have a great respect and affection for Alan. The Scholarships were set up during my Presidency and I am very appreciative of them being brought to the notice of new generations of members of the AIP.

*John Collins
(formerly of the CSIRO Divisions of Physics and Applied Physics)*

Reply

John Collins is correct. The photograph in the last issue was that of Professor Leonard Huxley, founding President of the Australian Institute of Physics. We apologise for this error, and provide below a photograph of Alan Harper.

*Brian James
Vice-President, AIP*



AIP QLD Branch

Chair: Dr Brad Carter
Department of Physics,
University of Southern Queensland.

Secretary: John Wilkinson
Forest Lake College
jwilkinson@flc.qld.edu.au

AIP SA Branch

Chair: Dr Jamie Quinton
Chemistry, Physics and Earth Sciences
Flinders University
GPO Box 2100, Adelaide, SA 5001
Tel: 08 8201 3994 Fax: 08 8201 2905
jamie.quinton@flinders.edu.au

Secretary:

Dr Laurence Campbell
Chemistry, Physics and Earth Sciences
Flinders University
GPO Box 2100 Adelaide, SA 5001
Tel: 08 8201 2093 Fax: 08 8201 2905
laurence.campbell@flinders.edu.au

AIP TAS Branch

Chair: Dr John Humble
Private Bag 21, Hobart,
TAS 7001
University of Tasmania
Tel: 03 6226 2396 Fax: 03 6226 2867
John.Humble@utas.edu.au

Secretary:

Dr Elizabeth Chelkowska
Maths and Phys, University of Tasmania
Private Bag 21, Hobart, TAS 7001
Tel: 03 6226 2725 Fax: 03 6226 2867
Elzbieta.Chelkowska@utas.edu.au

AIP VIC Branch

Chair: Dr Andrew Peele,
QEI Research Fellow
Department of Physics
LaTrobe University
Bundoora, VIC 3086,
Tel: 03 9479 2651 Fax: 03 9479 1552
a.peele@latrobe.edu.au

Secretary:

Ms. Gaby Bright
PO Box 4355
Parkville Vic 3052,
Tel: 03 8344 3768
gabrielle.bright#versi.edu.au

AIP WA Branch

Chair: Prof. Ian McArthur
Department of Physics
University of W.A.
Stirling Highway
Nedlands, WA 6009
Tel: 08 6488 2737 Fax: 08 6488 1014
mcarthur@physics.uwa.edu.au

Secretary:

Dr Ron Burman
School of Physics, The University of
Western Australia
Mailing Address: M013 The University of
Western Australia Crawley, WA 6009
Tel: 08 6488 2729 Fax: 08 6488 1014
john@physics.uwa.edu.au

President's column - continued from page 35

that is completely outside their natural work preference. Understanding these work preferences can help teams to be more effective and also develop a respect for the different and crucial role each member plays in the team.

Research into cross functional teams needed to solve complex problems has been the subject of research in management and psychology theory³. This research has identified three characteristics of productive teams that are strongly related to individual differences that appear to dominate: effective leadership, intra-team communication, and group cohesion. However a fourth characteristic has been more recently identified, that of heterogeneity or diversity.

These four dominant individual difference characteristics of productive teams can form an evaluative model of the impact of personality type on team performance. That is, diversity in skills and knowledge combined with a balance of personality types is desirable for effective teams. The Myers-Briggs Type Indicator (MBTI)⁴, which is based on Jungian psychological type theory, is one proposed framework that can be used to discuss personality types and their potential influence on team effectiveness:

- How a person is energized – designated by extrovert (E) versus introvert (I),
- What information a person perceives – designated by sensing (S) versus intuition (N),
- How a person decides – thinking (T) versus feeling (F), and
- The life-style a person adopts – judging (J) versus perceiving (P).

Details of these personality types are given in references⁴⁻⁵. According to personality type theory, individuals are predisposed to one of each of these four preference alternatives in their behaviour. Myers⁶ and Kroeger and Thuesen⁷ suggest that presence of diversity of these psychological types in a team results in greater successful group performance. They suggest that a diverse team may take longer to accomplish a project, but the end result will always be better. Some examples of how opposing types help the group process are as follows: extroverts (Es) help open up lines of communication between group members, while

introverts (Is) provide internal reflection of group discussions. Sensing (S) types bring up pertinent facts and "what is", while intuitive (Ns) types bring up new possibilities and provide ideas of "what might be". Thinking (Ts) types present a logical analysis of the decision-making situation, while feelers (Fs) offer insights into how feelings of other group members and customers might affect the situation. Judgers (Js) help keep the team on schedule, while perceivers (P) help the team consider other alternatives in the decision-making process.

It is interesting to note that an article in the *Australian Physicist* some years ago reported on personality type and careers in physics⁸ and indicated that physicists were disproportionately INTJs one of the 16 combinations of the different personality profiles. (Note that at my work place, we have about 30% INTJ personality types compared to the wider population of 1%.) Physics may benefit from encouraging more diversity in the project team composition.

As it is often easier to work with like minded people, we naturally tend to create research teams with them. It may be that we would do better to analyse our research team composition to see if we do have diversity and consider ways to improve team diversity if it is lacking. Gender difference is an easy way to help increase the diversity of a team. For example, in Australia, women tend to be more often extroverted than men.

So in this era of undertaking science research in teams, we need to consider the team composition and when vacancies arise identify the type of scientist we need (creative ideas scientist, solid researcher that takes work through the rigor of the scientific process and the entrepreneur who creates the research impact), the personality or team role we need to fill to assist our teams in achieving their highest impact both in science quality and community benefit. But most importantly as professionals and decent human beings, we should be respectful of the differences in the ways our colleagues prefer to work and to recognise their value and contribution.

Cathy Foley
AIP President

References:

1. S. Wuchty, B.F. Jones and B. Uzzi, The increasing dominance of teams in production of knowledge, *Science*, 316 (2007) 1036-1039
2. British Psychological Society, Team Management Index (TMI), *Review of Personality Assessment Instruments (Level B) For Use in Occupational Settings*, (1995), 268-273.
3. J.H. Bradley and F.J. Herbert, The effect of personality type on team performance, *J. Management Development*, (1997) 337-353.
4. I.B. Myers and M.H. McCaulley, *Manual: Guide to the development and use of the Myers-Briggs type indicator*, Consulting Psychologists Press, Palo Alto, CA, (1985)
5. P. King, What makes teams work?, *Psychology Today*, Dec (1989) 16-17.
6. I.B. Myers, *Introduction to Type*, Consulting Psychology, Press, Palo Alto, CA (1991).
7. O. Kroeger and J.M. Thuesen, *Type Talk at Work*, Delacorte Press, New York, N.Y., (1992).
8. B. Boreham and J. Watts, Who does and does not do physics: personality type, learning style and recruitment of physics students, *Australian and New Zealand Physicist*, 33 (1996) 89-92.

A Short History of the Australian Institute of Physics

Part 1: From European Settlement to the Formation of an Australian Committee of the Institute of Physics

Anna Binnie

a.binnie@mail.aip.org.au

This paper is based on the lecture presented at the recent AIP Congress held in Brisbane in December 2006. A full scholarly version has been submitted for publication in 'Historical Records of Australian Science'.

Introduction

The story of how the Australian Institute of Physics came into existence started in 1923 when Professor A.D. Ross attempted to start an Australian Branch of the Institute of Physics. But this ignores the development of physics as an academic and professional discipline in Australia. To understand why it was possible, in 1923, for Ross (Fig 1) to even attempt to establish a physics based professional society we must consider the development, within Australia, of the scientific society and the professional society and we should realise that these are not the same thing. Further, it is worthwhile to consider the various movements in the United Kingdom that led to the establishment of the Institute of Physics (IoP). These factors all led to the development of an Australian Branch of the IoP and eventually to the establishment of the Australian Institute of Physics.

Australian Physics pre 1850

It is reasonably well known that the discovery of the east coast of Australia was the indirect result of an astronomical observation; Cook's observation of the transit of Venus in Tahiti. In 1788 when the first European settlers arrived the first priority was one of simple survival. Crops were sown and failed, water sources were sought and found, as was arable land outside of the immediate vicinity of Sydney town. Any scientific endeavor, in those early years of white settlement, was based solely with the survival of the colony. Physics is an abstract science and those who practice it must first be assured of the basic elements of human survival; food and water, shelter and clothing. It is not surprising therefore to realize that there was very little, if any, physics practiced in the early days of Australian colonisation.

However, Australia was visited by other European nations, not simply the British who established their penal colony here. The Dutch were early visitors to the west and south coasts; but these were essentially mercantile ventures and were not followed up. The French were also involved. They sent out scientific expeditions to the Southern Oceans and included Australia. These French expeditions were as much about collecting specimens as they were about carrying out investigations on astronomy, meteorology and the

magnetic field of the earth; 'in May 1792 D'Entrecasteaux set up a magnetic dip needle at the shore station on Recherche Bay and made a number of observations of the dip angle ... and the relative intensity of that field'¹. One could argue that the French were the first to conduct a physics experiment in Australia, but not on the Australian mainland.



Fig 1. Professor A.D. Ross

The population of the early colony included children and schools were established to teach basic literacy, numeracy, scripture and morality. This basic form of education was regarded as essential for the children of convicts and former convicts. Education beyond the most rudimentary was not available as such and many wealthier colonists sent their sons back to the UK for their secondary and higher education. Girls, at this time, were usually educated by governesses in their own homes or sent to local schools.

As early as 1818, magazines for the educated were being produced within the colony. These were essentially of a literary nature; but included reports from expeditions of exploration and some articles covering such scientific topics as geology, botany and zoology. Most of these magazines were relatively short lived and they were replaced by other short-lived publications. The colony now had within it a number of people with enough leisure time to allow them to consider the more cultured aspects of their society and environment, and when one considers that the first bank in the colony was established in 1821, there were emerging merchant and middle classes.

The first truly scientific society established in Australia was the 'Philosophical Society of Australasia'. It was established on 4th July 1821 by a group of eight 'gentlemen' in Sydney. These 'gentlemen' included medical practitioners, wealthy merchants and explorers who met weekly to listen to papers prepared by their membership, to hear reports of expeditions and to share books from their libraries. The Society

A Short History of the Australian Institute of Physics - Part 1

was based on the practice of the Royal Society of London and received a great boost when the new Governor arrived at the end of 1821. The new Governor was Sir Thomas Brisbane who, at the time, was a Fellow of the Royal Society. Brisbane agreed to become Patron of the new Society and frequently attended its meetings. Sciences in the colony was further advanced by Brisbane when he established an observatory at Parramatta and initially paid for it from his own pocket. This observatory was the first astronomical observatory in Australia. The Society, unfortunately, lasted a little over a year.

Some of the members of the Philosophical Society of Australasia revived the society as the Australian Philosophical Society in 1850 and later was transformed into the Philosophical Society of NSW, and finally it became the Royal Society of NSW. Interestingly, the Royal Society of NSW has maintained the patronage of the Governor of NSW and after Federation, also included the Governor-General. As the other colonies were settled and gained their own identities, Philosophical Societies similar to the one in NSW, were established, and all becoming, in due course, Royal Societies. These Royal Societies not only provided their members with intellectual stimulation, their members helped establish the first museums and often the first major libraries in their cities.

Some members from these Royal Societies formed the driving force for the establishment of universities in Australia. The impetus came when it was found desirable to provide further education for the more intellectually elite children of the colonies. The first university established was the University of Sydney in 1850 and was closely followed by the University of Melbourne and later the University of Adelaide. By 1900 most of the states had their own universities and the few that did not would soon follow.

Physics at Universities

Physics, or Natural Philosophy as it was then called, was offered to students as part of a liberal arts education. Science degrees were not awarded until the 1880s. Physics was often co-located with Mathematics or Chemistry and these subjects were often taught by the same individual; specialisation as we know it today was an unknown luxury in those early formative years. There was virtually no experimental work in physics for the undergraduate student, physics instruction was essentially a series of lectures and theoretical problem solving.

The early university building programs allowed for the development of specialist areas for physics containing laboratory space for both undergraduate students and staff. The academic staff, who were recruited to teach at these new universities had themselves been



Fig 2. Professor Thomas Laby

taught at established universities such as Cambridge and Glasgow. They brought with them the latest ideas on physics both as an experimental discipline and in teaching methodologies. The 1870s was an exciting time for physics with the new Cavendish Laboratory being built at Cambridge. The design and functions of Cavendish Laboratory was based on the laboratory established by Lord Kelvin in Glasgow. Australian universities were the beneficiaries of these new and exciting developments.

University teaching loads were heavy and were exacerbated when further specialisation resulted in the establishment of Science Faculties and other faculties such as Engineering and Medicine. Students other than Physics students now were studying physics as part of their professional training². Academic research was not seen as a priority at this time and indeed there was barely time for academics to establish their own research projects.

Career opportunities were somewhat limited for those few students who undertook studies in physics as a major component of their degrees; essentially they could either become school teachers or work in a university context which usually meant teaching³. At the conclusion of their undergraduate studies the more able students still went overseas to complete their postgraduate education. The more gifted were encouraged to apply for either the 1851 Exhibition Scholarship or the Rhodes Scholarship. The latter

A Short History of the Australian Institute of Physics - Part 1

allowed students to study whatever they fancied at Oxford University and did not require the student to undertake any form of research. The 1851 Exhibition Scholarship, however, had the expectation that students would be engaged in research of some form. Cambridge University had established a B.A. by research which was later changed to a Doctor of Philosophy degree, to cater for these scholars. A steady stream of Australia's most talented physics graduates arrived at the Cavendish Laboratory but only a fraction of whom would later return to Australia. The majority remained in Britain. Facilities for postgraduate research students in Australia would not become available until the 1890s.

Intellectual Life and Isolation

In the second half of the Nineteenth Century, isolation was a problem for these Australian academics. Isolation came in two forms, from each other, as well as from main-stream physics in Europe and Britain. Because of Australia's vast distances and the time taken for travel, most academic physicists worked in isolation within their universities. Travel back to Britain was very expensive and extremely long and not undertaken regularly.

The universities partly addressed this problem by purchasing the more popular journals for their libraries. However, much of this problem of isolation would be overcome by the production of local journals by the State Royal Societies. These commenced publication in the 1850s and each of the local Royal Societies swapped their journals. Thus allowing for some form of scientific communication to occur



Fig 3. Norman Esserman

between individuals in the colonies.

Later, in the 1880s, journal exchanges were organised between the local Royal Societies with other such learned societies in Europe, Britain and later the Americas. This meant that local academics now had access to the latest ideas and discoveries. Local

researchers published their papers in these local journals and 'sent the best of the them to England, usually to the "Philosophical Magazine" for parallel publication'⁴.

The Rise of the Scientific Society

The State Royal Societies were open to any gentleman, academic, professional or wealthy merchant. One was nominated for membership and was supported by members who knew you either professionally or personally. At this time, women were not normally admitted as members, but attended meetings as guests (women did not become members of the Royal Society of NSW until the 1920s). Visitors could also attend meetings as guests of a member.

Meetings of the Royal Societies did provide their local members with intellectual stimulation with the sharing of new scientific advances as well as those of a more cultural or literary nature. For example issues such as the future water supplies of Sydney were discussed and reported as early as the 1860s at the Royal Society of NSW. In some instances the academic scientists presented papers on their research or latest discoveries. However, there was very little activity linking either the Royal Societies or scientists between the colonies.

A small revolution occurred in 1888, Australia's centenary year, the Australasian Association for the Advancement of Science was formed. A Sydney based chemist, Archibald Liversidge FRS, had returned from a visit to Britain, in 1879. He had attended a meeting of the British Association for the Advancement of Science (BAAS) and was so impressed that he started almost immediately to suggest that Australia host a BAAS meeting. The BAAS had been established in York in 1831 as a way of spreading scientific knowledge in areas outside of London. It was a society for practicing scientists to share their findings within a framework of regular meetings, usually annual. The BAAS meetings formed the basics of what we now recognise as a scientific conference, the presentation of serious academic papers within disciplines and themes, some social events including family members of those presenting papers, public lectures and excursions to places of interest in the locality.

When Liversidge was elected President of the Royal Society of NSW he immediately suggested that there should be collaboration between all the scientific societies within Australia and New Zealand and suggested that a convention of all scientific societies be held in Sydney in 1888. His plan succeeded with the establishment of the Australasian Association for the Advancement of Science (AAAS)⁵.

A Short History of the Australian Institute of Physics - Part 1

Australasian Association for the Advancement of Science

The AAAS was a scientific organisation for those practicing science; while anyone could attend, only practicing scientists could present papers. The society provided a public outreach program by holding public lectures as part of their congresses and encouraged anyone with an interest in science to attend. It held biennial congresses in different cities and managed to attract a great deal of media attention for its various activities.

It provided, for the first time, a vehicle through which practitioners from the different disciplines within the science umbrella could meet face to face and discuss their own latest discoveries and those of others. The AAAS Congresses provided a venue for the young Australian Scientific Community to meet, to inspire each other and to support each other. Suddenly the isolation had been broken and physics research was given a great boost.

The 1888 Congress had an immediate impact on the young William Bragg who wrote 'I think this Association is going to do us a lot of good, especially such as, like me, are willing to work, but don't quite know where to begin'⁶. Bragg, who had not until this meeting realized the worth of doing original work⁷, was so inspired that on his return to Adelaide he immediately started his research.

The Rise of the Professional Society

The Professional Society was a society, which would only admit individuals who had undergone some form of education and training, usually university based. It stipulated the basic minimum standard of education and experience and the nature of the work experience one must attain for membership. Membership of such a society was an entry into the profession or recognition of professional status. The Professional Society also indicated the level of remuneration expected for its members at different stages of their careers. It was not open to all who may be interested in that discipline. In this manner the Professional Society differs from a scientific society.

The second half of the 19th Century, in Britain, saw the professionalisation of Law, Medicine and Engineering. Science and scientists were identified by their respective disciplines such as geology and chemistry and it was not long before the chemists had created their own professional society. Physics posed a slight problem, how could one identify the work or profession of a physicist?

The terms related to physics had, in earlier times, applied to those who practiced 'physic' or medicine; 'physician'. This term could not therefore be applied

to one who engages in Natural Philosophy or Physics. The term 'Physicist' was first used in 1840 by William Whewell, but was not universally accepted by those who practiced Physics until the early 20th Century⁸. Physicists were engaged in university research, and education both secondary and tertiary but what else? The industries that would employ physicists of the future were still in their infancy; industries such as the telegraph and wireless telegraphy, the development of applications from applications and discoveries in electromagnetism and discharge tubes and many others.



Fig 4. Alexander McAulay

It is no surprise then that physicists did not emerge as a professional group until after the First World War.

Physical Society of London and The Institute of Physics

The Institute of Physics, a professional society for physicists evolved from the scientific society, the Physical Society of London. The Physical Society of London was formed in 1873 as a consequence of concerns in the teaching of physics in secondary schools. Its membership, which included teachers some of whom were women, was open to anyone with an interest in physics as well as those involved in research in the physical sciences. Its meetings were held in Kensington in London and emphasised experimental or practical physics.

In 1917 the society started to explore ways in which to improve the status of the physicist. This included the expected educational levels and type of experience and suggested salary levels for physicists at various stages of their career. By this time physicists were not simply working at universities and schools but also in industry, the utilities and instrument companies. It was decided to form the Institute of Physics, a professional society for Physicists, which was a separate body from the Physical Society of London. Membership was open to all who had completed a university degree with a substantial research component. In Britain this meant that teachers could become members of the Institute. The IoP was incorporated in 1920 and had its inaugural meeting on 27th April 1921. The Institute and the Physical Society were very closely linked and members were members of Institute of Physics and Physical Society. The IoP carried this cumbersome name until well after the Second World War. (I shall refer to the combined organisation as the IoP for the duration of

A Short History of the Australian Institute of Physics - Part 1



Fig 5. Edward Kidson

this paper.)

Two aspects of the IoP formation would prove pivotal in allowing for the establishment of an Australian Branch. Firstly, the IoP would admit to membership any suitably qualified individual regardless of domicile. Secondly the IoP By-Laws allowed for the establishment of Branches of the Institute.

An Australian Committee

Alexander David Ross (1883-1966) arrived in Australia, from Glasgow in 1912, to take up the appointment of Professor of Mathematics and Science at the University of Western Australia. He later became Professor of Mathematics and Physics until 1929 when he was finally appointed as Professor of Physics, a position from which he retired in 1952. His wife had also trained as a physicist in Glasgow, and during his absences she would often give lectures in his place. Ross regularly returned to Britain and it was during one of these trips that he became a member of the newly incorporated Institute of Physics?

In 1922, barely a year after the IoP had been incorporated, Ross sent a letter to the Institute of Physics in London, requesting that any Australian Branch of the Institute be established. He received a polite but negative response, at the time there were only three members of the IoP resident in Australia and this was hardly enough to allow a Branch to be formed. The other two members at this time were Professor Thomas Laby (1880-1946) (Fig. 2) who was at the University of Melbourne and Norman Esserman (1896-1982) (Fig. 3) who was the first physicist to be employed by the Department of Defence.

Ross was undaunted and decided to find out how many people could be eligible to join the IoP. On 9th October 1923, Ross sent out letters to the heads of each of the university physics departments. He asked for information concerning those who may be eligible to be Fellows or Associates of the Institute of Physics and on the 'desirability of having a local section of the Institute in Australia which might meet once a year or at the time of the biennial meetings of the AAAS'¹⁰. Most Australian Physicists had not heard of this relatively new IoP and when approached most were quite happy to join.

Within weeks Ross started to receive replies, some were most supportive while others were a little reticent but he essentially obtained the information he had requested. The first to arrive was dated 24th October from Kerr Grant (1876-1947), from the University of Adelaide. Grant suggested that Ross 'endeavour to increase the number of Australian members. Until these number at least twenty, I consider that it would not be worth while to form a local branch or even to have a local secretary'. Grant went on to state that he and R. Burdon would be eligible for membership, as would two from the Adelaide Observatory: G. Dodwell and A. Kennedy.

The next response came from Thomas Laby, dated 25th October. Laby suggested that Mr. Hercus would be eligible for membership and stated 'I doubt if in the whole of Australia you would get a dozen members of the body'.

Thomas Parnell's (1881-1941) letter dated 26th October

CONTENTS.		Page.
Preface		
List of Members of the Conference.		
<u>Discussions:-</u>		
Discussion on the New Quantum Theory.		
I - By Mrs. G. H. Briggs, B.Sc.		1
II - By H. S. T. Massey, B.Sc.		4
Discussion on Geophysical Prospecting		
I - By Assistant Professor E. S. Bieler, M.Sc. Ph.D.		6
II - By Major E. H. Booth, M.C., B.Sc., F.Inst.P.		7
Discussion on Radio Research in Australia		
By Professor T. H. Laby, M.A., Sc.D., F.Inst.P.		8a
<u>Abstracts of Papers</u>		
The Thermal and the Electrical Conductivity of a Copper Crystal at Various Temperatures		
By W.G. Kennulnik, B.Sc., & Professor T.H. Laby, M.A., Sc.D., F.Inst.P.		9
High Vacuum Technique		
By J. Radcliffe		11
The Attachment of Electrons to Molecules		
By Assoc.-Prof. W.A. Bailey, M.A. D.Phil. F.Inst.P.		12
The Motions of Electrons in Ethylene & Pentane		
By J. Bannan, B.Sc.		12
Electrolytes & the Mass Action Law		
By R. Davis, M.Sc.		13
A Method for Determining the Calomel Electrode Potential against the Normal Hydrogen Electrode		
By R. Davis, M.Sc.		
Magnetic Properties and Metallographic Structure of Manganese Steels		
By Professor A.D. Ross, M.A., D.Sc., F.R.S.E., F.Inst.P.		16
Some Interference Effects with thin films of transparent material		
By Professor C. U. Vonwiller, B.Sc., F.Inst.P.		17
The Reflection of X-Rays		
By Professor T.H. Laby, M.A., Sc.D., F.Inst.P., J. Scaerer, B.A., M.Sc. & R. Bingham, M.Sc.		19
The Photographic Measurement of the Relative Intensities of the $I_{\alpha 1}$, $I_{\alpha 2}$, $I_{\alpha 3}$ Lines of Silver		
By H. C. Webster, M.Sc.		20
Intensity Measurement in Arc Spectra		
By C.W. Allen, B.Sc., & W.G. Duffield, B.A. D.Sc. F.Inst.P.		21
Relative Intensities of Spectral Lines		
By D. P. Mellor, M.Sc.		22
Photoelectric Stellar Photometry		
By A. J. Higgs, B.Sc.		22
Spectroscopic Parallaxes		
By F. B. Rimmer, M.Sc.		23
The Luminosity of the Night Sky observed at Canberra with a Rayleigh Photometer		
By the Director and Staff of the Commonwealth Solar Observatory		25
The Astrographic Chart - Sydney Observatory Section		
By J. Hangle, F.R.A.S.		26
Field Intensity Measurements of a Melbourne Broadcasting Station		
By R. O. Cherry, M.Sc.		26
The Leakage Tests for an Atmospheric Electricity Installation		
By C.W. Allen, B.Sc.		28
Redetermination of Reduction-Factor at Watheroo, for use with atmospheric potential-gradient records		
By I. F. Johnston and F. J. Wood		31
The Conductivity of the Atmospheric Potential-gradient Collector at the Watheroo Observatory		
By J.R.I. Cairns M.Sc., and G. Builder, B.Sc.		34.

Fig 6 First conference proceedings

A Short History of the Australian Institute of Physics - Part 1

stated that there was no one in Queensland who would be eligible for membership except Parnell himself. He then added that 'at present practically the only avenue of employment for Physicists is teaching'.

In a letter dated 2nd November, Alexander McAulay (1895-1969) responded that he would be willing to join as a fellow. McAulay (Fig. 4) followed this with a letter listing all those working for the Zinc Company in Tasmania who could be eligible but none were interested enough to join.

The final response came, dated 6th November, from Oscar Vonwiller (1882-1972) from the University of Sydney who suggested a number of people for membership including himself. His list included; Edgar Booth (1893-1963), George Briggs (1893-1987), Professor John Madsen (1879-1969) and Rev Edward Pigot S.J. (1858-1929), from Riverview College, amongst others. Pigot was a Jesuit Physics teacher who had also established the Riverview Observatory¹¹.

On the 17th November Ross wrote back to the IoP stating that there could be a possible 15 Fellows and 20-25 Associates eligible for membership in Australia. On 3rd March 1924 the Institute of Physics wrote to Ross suggesting that 'a small Committee be formed ... from among the present corporate members, the convener of this committee acting as Local Hon Secretary of the Institute'¹². The AAAS Meeting for 1924 was to be held in Adelaide and Ross decided that this would be the time for all the corporate members of the IoP resident in Australia to meet and form the committee.

Three of the five Corporate Members met on 26th August in Adelaide. Ross wrote to the IoP on 4th October 1924 stating that Edward Kidson (1882-1939) (Fig. 5), Roland Thompson 1895-1950) and Ross had met and that a Committee had been formed made up of Kidson, Laby, McAulay and Ross. Esserman was not a university academic and did not attend this AAAS meeting.

At this stage the Australian Committee was not considered a Branch of the IoP, its status was that of a local Committee. Ross' next step was to get his small committee and group recognised as a Branch of the IoP. Ross 'initiated the practice of calling a formal meeting of Australian members of the Institute during each AAAS congress, thus giving the informally constituted branch a visible identity of its own'¹³. He also managed to increase local membership by encouraging everyone eligible, to join the IoP.

The first major event organised by the local IoP Committee was the first Conference of Australian Physicists (Fig. 6), held in Canberra from 15th to 18th August 1928 at the Canberra Hotel. It was 'held at the same period as the fourth meeting of Australian

corporate members of the Institute of Physics, and meetings of the Radio Research board and the Physics Sub-Committee of the Consultative Body for the Imperial Geophysical Experimental Survey'. Sessions were held in the 'forenoon and the afternoon' and there was an excursion to Mt Stromlo Observatory.¹⁴

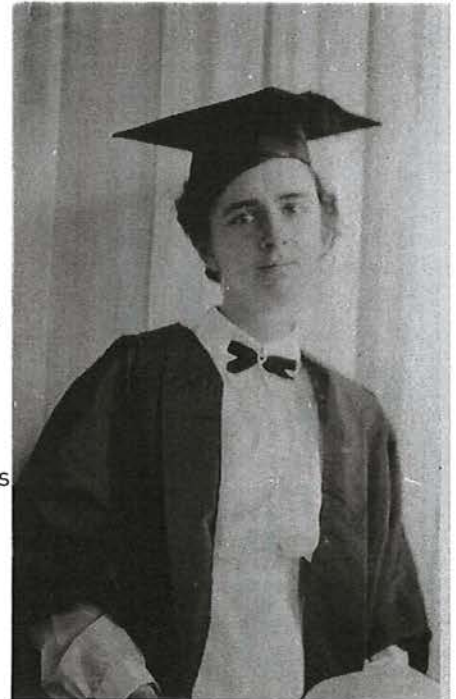


Fig 7. Edna Briggs

This first physics conference was remarkable in its day since women were also present, not as accompanying wives but as participants in their own right. Edna Briggs (1895-1983) (Fig. 7) who had been a lecturer in Physics at the Sydney Teachers' College before her marriage, led a discussion on 'the New Quantum Theory'. George, Edna's husband attended the Conference but did not give a paper. The Briggs' had just returned from Cambridge where George, a lecturer at the University of Sydney, had completed a PhD at the Cavendish Laboratory.¹⁵ It seems that Edna must have become involved in the intellectual life of the Cavendish.

The success of this conference was followed by a number of Conferences for Astronomers and Physicists which were held in 1929, 1931, 1933, 1936 and 1939. It was during these conferences that meetings of the Branch were held and slowly a system evolved by which the Branch would have regular meetings. It should be remembered that at this time, travel was expensive and took much longer than today.

Travel between the eastern states was done by train, but travel from Perth was usually done by steamer. It is worthy to consider the major decisions made during the meetings that were held during conference time. At the second Conference of Australian Physicists held 20-23 August 1929 in Melbourne, 'It has been decided not to hold a separate meeting next year in view of the Australian Association for the Advancement of Science meeting in Brisbane in May; but to hold a separate meeting of physicists again in August 1931 in Sydney'¹⁶. There was now an annual event at which physicists

A Short History of the Australian Institute of Physics - Part 1



Fig 8. Oscar Vonwiller

could meet; there were the biennial AAAS meetings and the IoP group Conferences held in the years that the AAAS did not meet. Details of the 1931 Conference have been lost. The 1936 Conference held in Sydney 25-27th May claimed to be the 5th Conference of Physicists and Astronomers.

The position of the group of IoP members in Australia evolved during the 1920s and 1930s. The Australian group was merely a local committee initially, in the IOP Annual Report 1933, Australia is listed as a Section and by 1936 Australia is listed as a Branch with an Honorary Secretary and Convenor who was A.D. Ross. However, Ross in 1962 stated; 'it was, I think, in 1928 that one of these acknowledgements from London referred to my Branch. It was too good an opportunity to be missed. I wrote to London asking on what date we had been made a Branch. There was a delay in getting a reply, but when it was received it stated that the chrysalis had emerged as a gorgeous butterfly, but that the date of its transformation was unknown'¹⁷.

The Australian Branch

Ross chaired all the meetings of the Australian Committee until 1939 when on 3rd May Board of the IoP 'granted the Branch autonomy in all matters arising in the Commonwealth'¹⁸. The Committee appointed Professor Laby as the first President of the Australian Branch. The Branch now had the autonomy to review and accept membership applications for the IoP but it did not have a Constitution. The 11th meeting of the Branch was held on 22nd August 1939 'on the motion of Professor Ross, seconded by Professor Vonwiller (Fig. 8), it was resolved that a Committee of 12 be appointed to consider the draft Constitution for the Branch'¹⁹. A month later Australia would be at war.

Despite the war, Australian physicists still continued with their push to consolidate their newly established Branch. Report of Australian Branch 26th February 1941 stated 'the draft Constitution drawn up at the Eleventh General Meeting was circulated to all members and unanimously adopted as the provisional constitution'. 'Arrangements were made by the 1937-39 Committee for the election of the 1940-41 Committee ... the

following were accordingly unanimously elected, President T.H.Laby, Vice President Kerr Grant, Hon Sec, A.D. Ross, Other Committee members; G. Builder, V.A. Bailey, E. Hercus, A. Hogg, R. Makinson, L. Martin, E. Sayce and H. Webster.' On the 21st June 1940 Bailey, Builder, Makinson and Webster resigned and in September 1940 Dr R. Woolley was appointed.²⁰ The war was taking its toll on the committee with members having virtually no free time to devote to the Branch committee. The newly adopted constitution of the Australian Branch envisaged the formation of local divisions in the various states, several of these came into being during the war years and began organising regular schedules of meetings at which one or more papers on physical subjects were read. The New South Wales division was first and was active from 1940; Victoria, Western Australia and South Australia followed later in the war.

The draft of the Constitution of Institute of Physics, Australian Branch, was approved by the Committee of the Branch on 16th September 1943. The introduction to the Constitution included a bit of history

'Whereas on 27th August 1924 a meeting of corporate members of the Institute of Physics resident in Australia was held in Adelaide, and, at the suggestion of the Board of the Institute, appointed a committee to receive and report on applications for membership from candidates in Australia and to convene meetings from time to time to consider matters which might lead to a fuller recognition of the profession of the physicist in Australia ... And whereas it was later found desirable to form in Australia a local Branch of the Institute ... And whereas on 3rd May 1939 .. the Board expressly authorised the Australian Branch to discuss with outside bodies any matters concerning professional conduct or status of physicists in the Commonwealth of Australia'²¹

The local members had finally agreed to a Constitution and on 2nd June 1944 George Briggs, the Secretary of the Branch, wrote to Members of the Committee of IoP Australian Branch 'After consulting with the president by telegram, I despatched to London the following cable and airgraph letter signed by five fellows formally asking for confirmation of the Branch: "following five members resident Australia Esserman, Vonwiller, Bailey, Reinmann, Briggs formally request Board Institute of Physics confirm establishment Branch in Australia (STOP) Ross asks formation branch be antedated to 1928 (STOP) signatures airgraph follow" ... In reply the following cable was received "Board approves constitution ... the Institute ... confirmed the creation of the Australian Branch 1928 and approved the regulations"'²²

Finally the Australian Branch of the Institute of

Physics had come into existence. It had a Constitution and a number of active Divisions. According to its own history, the IoP acknowledges that the Australian Branch came into existence in 1928²³ and on this basis and on the evidence presented above I believe that the Australian Branch can be deemed to have commenced in 1928.

Part 2 of the history (in the next issue) will deal with the activities of the Australian Branch during the war years and the immediate post war period.

References

1. P3 Fenton, A.G. *History of Physics in Tasmania 1792-1982* Australian Institute of Physics, Tasmanian Branch, Hobart 2005
2. Home, R.W. 'Origins of the Australian Physics Community' in *Historical Studies* Volume 20 Number 80 April 1983 p 383-400
3. Ibid
4. ibid
5. MacLeod, R. 'Organising Science under the Southern Cross' in *The Commonwealth of Science* R. MacLeod (editor) Oxford University Press Melbourne, 1988
6. MacLeod, R. 'From Imperial to National Science' in *The Commonwealth of Science* R. MacLeod (editor) Oxford University Press Melbourne, 1988
7. Home, R. 'Physical Sciences: String, Sealing Wax and Self-Sufficiency' in *The Commonwealth of Science* R. MacLeod (editor) Oxford University Press Melbourne, 1988
8. P7 Lewis, J. *Promoting Physics and Supporting Physicists* Institute of Physics Publishing Bristol 2003
9. p156 Home, R. 1988
10. Box 1 AIP Archives located in the Basser Library at the Australian Academy of Science
11. ibid
12. Correspondence 1924, 1 AIP Archives
13. p156 Home, R. 1988
14. Box 6 AIP Archives
15. p157 Home, R. 1988
16. Box 6 AIP Archives
17. Minutes of 30th general meeting IPPS 21st August 1962
18. Box 6 AIP Archives
19. ibid
20. Box 6 AIP Archives
21. Box 1 AIP Archives
22. ibid
23. p94 Lewis, J. 2003

Opportunities at Monash

For position information and application details visit www.monash.edu/opportunities

Associate Professor

Department of Marketing
Faculty of Business and Economics

Salary range: \$97,120 – \$106,993 pa Level D plus generous superannuation
Contact: Ms Carly Bloomfield, tel. (03) 9903 2782 or email jobs.mkt@buseco.monash.edu.au
Location: Caulfield or Clayton campus **Ref No:** A077754

Associate Professor, Teacher Education (Re-advertised)

Faculty of Education

Salary range: \$97,120 – \$106,993 pa Level D plus generous superannuation
Contact: Professor Margaret Somerville, tel. (03) 9902 6160 or email margaret.somerville@education.monash.edu.au
Location: Gippsland campus **Ref No:** A077586

Lecturer/Senior Lecturer

Faculty of Education

Salary range: \$65,843 – \$78,189/\$80,658 – \$93,003 pa Level B/Level C plus generous superannuation
Contact: Professor Margaret Somerville, tel. (03) 9902 6160 or email margaret.somerville@education.monash.edu.au
Location: Gippsland campus **Ref No:** A077859

Lecturer/Senior Lecturer, Curriculum Theory and Practice (Re-advertised)

Faculty of Education

Salary range: \$65,843 – \$78,189/\$80,658 – \$93,003 pa Level B/Level C plus generous superannuation
Contact: Associate Professor Brenton Doecke, tel. (03) 9905 2894 or email brenton.doecke@education.monash.edu.au
Location: Clayton campus **Ref No:** A077738

Lecturer/Senior Lecturer (2 positions)

Department of Economics
Faculty of Business and Economics

Salary range: \$65,843 – \$78,189/\$80,658 – \$93,003 pa Level B/Level C plus generous superannuation
Contact: Professor Dietrich Fausten, tel. (03) 9905 2345 or email dietrich.fausten@buseco.monash.edu.au
Location: Berwick campus (Ref No: A077854)/Caulfield campus (Ref No: A077861)

Lecturer/Senior Lecturer

Department of Marketing
Faculty of Business and Economics

Salary range: \$65,843 – \$78,189/\$80,658 – \$93,003 pa Level B/Level C plus generous superannuation
Contact: Ms Carly Bloomfield, tel. (03) 9903 2782 or email jobs.mkt@buseco.monash.edu.au
Location: Caulfield or Clayton campus **Ref No:** A077751

Lecturer/Senior Lecturer

School of Psychology, Psychiatry and Psychological Medicine
Faculty of Medicine, Nursing and Health Sciences

Salary range: \$65,843 – \$78,189/\$80,658 – \$93,003 pa Level B/Level C plus generous superannuation
Contact: Professor Bruce Tonge tel. (03) 9594 1354 or email bruce.tonge@med.monash.edu.au
Location: Monash Medical Centre **Ref No:** A077856

J.L. William Lecturer/Senior Lecturer, Experimental Physics

School of Physics
Faculty of Science

Salary range: \$65,843 – \$78,189/\$80,658 – \$93,003 pa Level B/Level C plus generous superannuation
Contact: Mrs Jean Pettigrew, tel. (03) 9905 3651 or email jean.pettigrew@sci.monash.edu.au
Location: Clayton campus **Ref No:** A077863

Applications must address the selection criteria, quote the reference number and include curriculum vitae and the names and contact details of three referees. Monash respects the privacy of your personal information. www.privacy.monash.edu

An Equal Opportunity Employer EOWA Employer of Choice for Women



News

Opening of the new Centre of Expertise in Photonics

Wednesday 31 May 2006 marked the official launch of the Centre of Expertise in Photonics with over 100 invited guests attending a special function in the School of Chemistry & Physics Seminar room in the Physics Building.

Founded in early 2005, the Centre of Expertise in Photonics is a world leading research centre focused on the design, fabrication, development and application of soft glass microstructured optical fibres. Please follow the link to find out more about the opening of the Centre: www.chemphys.adelaide.edu.au/recent/Photonics%20Opening.html

New head appointed to lead astronomy at ANU

The Australian National University will welcome back alumnus Professor Harvey Butcher with his appointment as the new Director of the Research School of Astronomy and Astrophysics (RSAA).

Professor Butcher, an astronomer with an outstanding reputation as a scientist, is known for his contributions to fields as diverse as the chemical abundances in the oldest stars to the evolution of distant clusters of galaxies.

"Professor Butcher brings substantial research and management experience to the role," said ANU vice-Chancellor Professor Ian Chubb.

"We are always pleased to welcome back an alumnus, especially one that has gone on to an exceptional international academic career."

Professor Butcher completed a PhD at Mt Stromlo Observatory in 1974. He subsequently held positions at the University of Arizona and the Kitt Peak National Observatory in the USA, and at the University of Groningen in the Netherlands.

From 1991 until recently Professor Butcher was Director of the Netherlands Foundation for Research in Astronomy, the national facilities organization for astronomy in the Netherlands. He has overseen Dutch efforts to develop innovative instrumentation for telescopes around the world and for the future James Webb Space Telescope satellite.

He has also been a strong proponent of the global Square Kilometre Array radio telescope project, and has led the development of LOFAR, an innovative low-frequency radio telescope aimed at looking back in time to study the earliest epochs of the Universe.

"I am very much looking forward to rejoining the RSAA after 33 years away," Professor Butcher said.

"I share the University's commitment to excellence in research, and as the new Director of the RSAA I will aim to ensure that its international reputation for world-class research in astronomy will be maintained well into the future."

Professor Butcher expects to take up his new duties in August of this year.

ANU

Australia's Defence Science and Technology Organisation (DSTO) has today successfully launched one of the world's fastest air-breathing engine experiments, the Parliamentary Secretary to the Minister for Defence, Mr Peter Lindsay announced.

The scramjet engine experiment reached speeds of up to Mach 10, approximately 11,000 km per hour, or ten times the speed of sound.

Scramjets are air-breathing supersonic combustion ramjet engines that could make it possible for a two hour flight from Sydney to London.

"This research is a major boost to Australian and international scramjet technology research," Mr Lindsay said.

"Today's flight rocketed to an altitude of 530km, and reached Mach 10 during re-entry," Mr Lindsay said.

"Australia is a world leader in hypersonics research."

"Scramjet research has taken place in Australia for over three decades. We have active research programs in niche technologies of scramjet propulsion as well as guidance and control at hypersonic speeds."

The flight took place at the Woomera Test Facility in South Australia under a collaborative effort between the United States' Defense Advanced Research Projects Agency (DARPA) and DSTO, also representing the research collaborators in the Australian Hypersonics Initiative (AHI).

"This test has obtained the first ever flight data on the inward-turning scramjet engine design," said Dr. Steven Walker, Deputy Director of the Tactical Technology Office at DARPA. "DARPA will compare this flight data to ground test data measured on the same engine configuration in the US."

"We are pleased with this joint effort between the US and Australia and believe

that a hypersonic airplane could be a reality in the not too distant future."

While DSTO was the lead Australian research agency for the flight, the AHI's collaborative partners include the University of Queensland, the University of New South Wales at the Australian Defence Force Academy, and the Australian National University, together with the State Governments of South Australia and Queensland.

DSTO scientist Dr Warren Harch said hypersonic propulsion using supersonic combustion ramjet (scramjet) technology offered the possibility of very high speeds and fuel efficiencies.

"This technology has the potential to put numerous defence and civilian aerospace applications within our reach during the next couple of decades," Dr Harch said.

Hypersonics is the study of velocities greater than five times the speed of sound (Mach 5) and could have a significant impact on Defence as well as on international transport and future access to space.

Future defence applications for hypersonic vehicles include long-range time critical missions, with civilian applications including low-cost satellite launching and high-speed aircraft.

Dr Harch said DSTO's scientific contributions to the research program had been the computer modelling of the combustion processes, non-linear mechanics, guidance and control, and trajectory analysis.

"Assisting with telemetry collection is another important area, which presents quite a challenge when working with a vehicle travelling at hypersonic speeds," Dr Harch said.

As part of its continuing commitment to a research program in Hypersonics, in November last year DSTO signed the \$74 million Hypersonics International Flight Research Experimentation (HiFire) Agreement with the United States Air Force. Up to ten Hypersonic flight experiments are planned to occur at Woomera over the next five years under the agreement.

DSTO

AIP Women in Physics Lecture Tour 2006

Professor Deb Kane

Department of Physics, Macquarie University ~Sydney NSW 2109

It was a pleasure to be nominated as the 2006 AIP WIP Lecturer and an honour to be selected. It had always been something I felt I should do "in the future", when I had time.

Being asked made me face the fact that there would never be time and I should make a decision that the role be given priority. It made me reflect that I had not put energy specifically into encouraging young women to choose physics as a subject in senior high school since initiating and running the Young Women and Physics Residential Schools at Macquarie University in the "nineties". I reflected on why I decided not to continue with the residential schools, despite them being very successful in their aim and being professionally satisfying. Since then I have been doing "my bit" as a "role model", as and when asked, but this is different to being an active campaigner. The lecture tour, though not specifically targeted at encouraging young women, would nonetheless be an opportunity to evaluate more widely the state of physics, especially physics education, in Australia.

I would be better able to make recommendations for future activity on encouraging young women at the end of the tour. I have always been of the view that anything that is done, by encouraging young women to engage with physics as a focus, is good for physics in general.

Being the WIP Lecturer is an award that comes with a strong service component. It is an opportunity to visit and speak in most of the state and territory capitals; giving public lectures, lectures to school groups and professional lectures in physics departments.

What are the purposes of the WIP Lecture tour? I suggest some below.

To show the audiences, public, school children and professionals, that there are women physicists succeeding at physics research and teaching in universities, both internationally and in Australia. Succeeding "in a man's world"?

To communicate on how new knowledge comes from research, and the value and excitement of the scientific research endeavour.

To encourage young people, especially young women, to think about whether a "life in physics" (in a broad sense) is for them. "If she can do it, so can I"

To connect with physics teachers and those involved in physics education to acknowledge and support their activities.

To facilitate women in physics networking within the AIP.

To challenge prejudice, as and where it may exist, that the physicist, especially a woman physicist, is "abnormal" or "unnatural".

It then becomes the responsibility of the WIP lecturer (or any public lecturer) to help achieve the purposes above, to be an "ambassador" for physics and women in physics. It is most important that whatever the WIP lecturer talks about, it must be at a level that can mostly be understood by the audiences attending, and that the lecturer is seen to be responsive to the audience. I have enjoyed many such WIP lectures over the years. I chose one of my research areas – encompassing laser cleaning, laser/material/particle interactions and, laser processing as tools in cultural heritage conservation – for the public and school lectures because it is more amenable to being discussed in a general way. I gave my professional talks on "Chaotic semiconductor lasers".

I would recommend lecturers trial their public lectures on a year 10 school audience, or visit a year 10 science class to see a teacher in action, or look at a year 10 science textbook as part of their preparation. After doing this my public/school lectures were probably still a little challenging in parts, but it was a level of challenge that the audiences accepted. They knew I had made the effort. It can



School of Physics, Women in Physics Group lunch, Melbourne, 23 August 2006

AIP Women in Physics Lecture Tour 2006



Under the "cloisters", after lecture function, UQ, 18 October 2006.

not be stressed enough that we, the physics community, can ill afford to host and promote public and school lectures that are at a too challenging level. The audience may be left feeling they have been treated with contempt and we risk being seen as disconnected and self-obsessed - opposite to our aim. I also prepared a resource sheet for my school lectures so that it might facilitate enthusiastic, self-learners to explore the topics a little more (reproduced in part, in Appendix A). In Tasmania and Adelaide some students were given an assessment task on following up on aspects of the lecture.

Given the reliance on the good will of particular individuals in the AIP, and in schools to organise and promote the WIP events, this can only be maintained if the event is a positive one for the majority of participants. Audience growth, and then maintenance at good levels, over a period of years would be the benchmark against which to measure this positive interaction. There has been no history of reporting attendance at the WIP lectures over the years - lets start it and make it part of the responsibility of everyone involved

with the tour; and everyone who should be involved with the tour, to work towards growth in the public audiences. This will reflect growth in public interest in physics and be evidence of effective outreach by our professional society.

On the tour it was a common theme in Departments of Physics that staff were suffering from the intensification of work as part of ever increasing expectations for their performance, especially research performance as we move to the era of the Research Quality Framework. Vibrant activity within the AIP, and other relevant networks and societies, is one indicator of whether we are serving our "community responsibilities" as an important part of our work. In managing our time it is becoming an increasing need that we give sufficient priority to this aim. Community is important. There are clearly strong competitive drivers for individual universities to promote their own physics, and physics related activities, rather than to contribute to the AIP; but we should be having more discussion and evaluation of whether we can be more effective through greater cooperation rather than

competition. Genuine contribution in the AIP activities can facilitate this.

I was surprised that some of the teacher hosts were perhaps a little nervous when we first arrived at school venues. It is part of the WIP role to put teachers at ease and to communicate our interest in what they are doing. I was most impressed with some of the initiatives physics teachers had initiated and supported. I will mention some of these below. A diary of the tour would be tedious for readers but I would like to give some highlights and share some ideas and initiatives learned along the way.

I started the tour in Melbourne and was delighted to learn that the School of Physics still has a very strong and active Women in Physics Group. They organized one of their lunches for the day I spoke at the school and I was able to meet with a large group of women undergraduates, postgraduates and staff. One recent honours graduate was leaving to start a PhD at Harvard University the next day, and they were looking forward to their annual Women in Physics weekend by the beach. Well done to Melbourne for having this, long-lived, energetic and supportive group. I toured the Victorian Space Science Education Centre, gearing up for Mars exploration, before speaking to students from Strathmore Secondary College. Congratulations to teacher and director, Michael Pakakis and the team for securing and deploying ~\$5 million for this science education facility and experience [1]. I learned of a project to work with teachers to look at ways to get more female students to choose physics going into year 11. This had acted primarily as a safe environment in which teachers could gain help and support in teaching the physics component of the years 9 and 10 curriculum. We need to liaise with education

AIP Women in Physics Lecture Tour 2006



Clare Corani Prize winners: honours graduates Emma Kohlhagen (University of Adelaide), Keridwen Barber (University of SA) and Nadine Pesor (Flinders University) with Prof. Deborah Kane, 31 August 2006.

departments to drive the design and implementation of more such support programs for teachers. We have implemented a teacher drop-in program at Macquarie University.

Visiting Tasmania, I was impressed with the year 11 and 12 colleges, and the maturity in the students in this learning environment. The students were treated, and behaved, as young adults. An accolade goes to Mr Craig Kerr of Don College, Devonport for his science week initiative in which the whole school spent the week hosting busloads of K-6 children from local primary schools. The science students had to design and put together the activities to share with the kids (such as rockets). Whole school participation led to the dance group conceptualizing planetary motions, craft class making linen parachutes, etc. A \$5000 science week grant allowed subsidized bus fares and prizes for the visiting primary school students. What a great event. The contacts with the media in Tasmania are excellent – two radio interviews and a spot on the radio

news.

In Adelaide the high school talk is held at the Australian Science and Mathematics School, linked to the Flinders University campus [2]. I was hosted on a tour of the school by three enthusiastic young women from years 10 and 11. After my talk, Mr Medwell had a hard job bringing the questions to a close. We “retired” to a meeting room where a group of science enthusiasts continued to “debrief” me on science matters of interest to them. I reflected on how I would have loved to have attended a high school like this. The energy, enthusiasm and talent are uplifting. I had the best time. We should all be thinking about the future in science we would wish for such gifted and talented young men and women - that should inform much of our actions.

Do we still need Women in Physics Initiatives?

When women physicists get together the conversation sometimes turns to the question of whether it is right to strongly

encourage young women to “follow in our footsteps” given that there may be some difficulties along the way. It is part of my good fortune that I have never lost my love of physics and science and this has sustained me through some very tough times, professionally. In being the “ambassador for physics” one concentrates on the “love of physics” rather than the “tough times” but it is also important to think whether, to be fair, one should be issuing a warning or two – forewarned being fore-armed – to the young and inexperienced.

Though there are a broad range of science futures for our interested youth it was timely that the work of the US Committee on Maximizing the Potential of Women in Academic Science and Engineering published their major report [3] while I was touring. This became a topic of discussion around the dinner table. A shortened version of their summary findings is included here. The following is a direct and partial quote.

1. Women have the ability and drive to succeed in science and engineering.

....The drive and motivation of women scientists and engineers is demonstrated by those women who persist in academic careers despite barriers that disproportionately disadvantage them.

2. Women who are interested in science and engineering careers are lost at every educational transition....

As they move from high school to college, more women than men who have expressed an

interest in science or engineering decide to major in something else;.....

3. The problem is not simply the [leaky] pipeline.

4. Women are very likely to face discrimination in every field

AIP Women in Physics Lecture Tour 2006

of science and engineering.

Considerable research has shown the barriers limiting the appointment, retention, and advancement of women faculty...Well-qualified and highly productive women scientists have also had to contend with continuing questioning of their own abilities in science and mathematics and their commitment to an academic career....

5. A substantial body of evidence establishes that most people—men and women—hold implicit biases.

Decades of cognitive psychology research reveals that most of us carry prejudices of which we are unaware but, that nonetheless, play a large role in our evaluations of people and their work.

6. Evaluation criteria contain arbitrary and subjective components that disadvantage women.

Women faculty are paid less, are promoted more slowly, receive fewer honors, and hold fewer leadership positions than men. These discrepancies do not appear to be based on productivity, the significance of their work, or any other measure of performance.

7. Academic organizational structures and rules contribute significantly to the under use of women in academic science and engineering.

..... Structural constraints and expectations built into academic institutions assume that faculty members have substantial spousal support.About 90% of the spouses of women science and engineering faculty are employed full-time; close to half the spouses of male faculty also work full-time.

8. The consequences of not acting will be detrimental to the nation's competitiveness.

The Australian academic "women in physics" all nodded and spoke agreement with all of these

evidence based findings, even though they have been researched in the US. If anything we need a reinvigoration of the Women in Physics Lecture tour by the physics community as a whole, because we are not yet where we should be, and we are at risk of losing ground gained as work - life balance is put further to the background in an increasingly hostile competitive environment – especially with respect to the RQF. We need to maintain our humanity and our community, in the contexts of our lives in science, and in actions on issues like Women in Physics that are the benchmarks for our achievement with this. Doing so is best for everybody.

Acknowledgements

There are so many people who contribute to the WIP tour and I thank them all. I was shown warm and gracious hospitality in all the places I visited and I have benefited from sharing ideas, knowledge and experience with fellow physicists and teachers, male and female. To name a few people who contributed above and beyond: thanks to A/Prof. Marion Stevens-Kalceff for the fantastic job she has done being the national organizer of the WIPL tour for many years including 2006. Thanks to Dan O'Keefe for my visits to the school venues and to the Victorian Space Science Exploration Centre in Melbourne (Dan does great work monitoring student uptake in high school physics and initiating projects and plans for improvements). Thanks to Dr Marc Duldig who drove me from Burnie to Devonport to Launceston and then Hobart in order to fulfill the traditional "complete tour" of Tasmania – schools and media interviews (Marc is an excellent role model of an all rounder in physics contributing strongly to the AIP, ASA, Physics and Astronomy at the University of Tasmania, in addition to his position of responsibility at the Australian Antarctic Division).

Thanks to Melbourne: Dr Anne Roberts, Dr David Abbott, Mr dan O'Keefe, Mr Michael Pakakis, Ms Victoria Millar, Ms Sarah Brooker; ACT Canberra: Dr Anna Wilson, Dr Max Colla, Ms Sandra Box, Prof Neil Manson, Prof Hans Bacher; Tasmania: Dr Marc Duldig, Dr Elzbieta Chelkowska, Mr Craig Kerr, Mr Ross Mansfield, Mr Mr Brien Connor; Sydney: Dr Manjula Sharma, Dr Suzanne Hogg (UTS); Mr Derek Williams and Mr Michael Van Tiel (Powerhouse Museum); Brisbane: Dr Chris Vale, Prof. Halina Rubinsztein-Dunlop, Dr Paul Meredith, A/Prof Norm Heckenberg; Adelaide: Dr Olivia Samardzic, A/Prof Peter Veitch, Dr Jamie Quinton, Dr Laurence Campbell, Mr Doug Medwell; Dunedin, NZ: Prof. Gerry Carrington, Dr Pat Langhorn, Dr Warwick Bowen.

References

1. Website of the Victorian Space Science Education Centre, Melbourne. www.vssec.vic.edu.au/
2. Australian Science and Mathematics School, Adelaide. www.asms.sa.edu.au/
3. Beyond Bias and Barriers: Fulfilling the Potential of Women in Academic Science and Engineering. Copyright © National Academy of Sciences. Executive summary available at www.nap.edu.

AIP Women in Physics Lecture Tour 2006

Appendix A

Partial Resource Sheet (some images removed due to copyright)

2006 Australian Institute of Physics Women in Physics Lecture

www.aip.org.au/

Light, Particles, Action
Prof. Deb Kane

Department of Physics, Division of Information and Communication Sciences

Macquarie University ~ Sydney

www.physics.mq.edu.au/,

www.ics.mq.edu.au/

Want to find out more about the physics of the feasibility of Archimedes?

"Burning Mirror(s)"? The history of Archimedes mirror(s)?

Archimedes Death Ray: Idea Feasibility Testing,

Copyright © Massachusetts Institute of Technology, all rights reserved, 2005

http://web.mit.edu/2.009/www/lectures/10_ArchimedesResult.html, accessed 15 August 2006.

Archimedes and his Burning Mirror, Michael Lahanas,

<http://www.mlahanas.de/Greeks/Mirrors.htm>, accessed 15 August 2006.

Want to find out more about solar power?



Solar Power, from Wikipedia, the free encyclopedia,

http://en.wikipedia.org/wiki/Solar_power, accessed 15 August 2006.

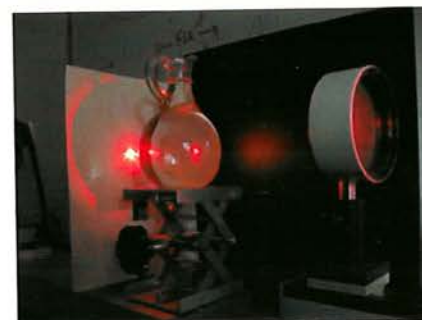
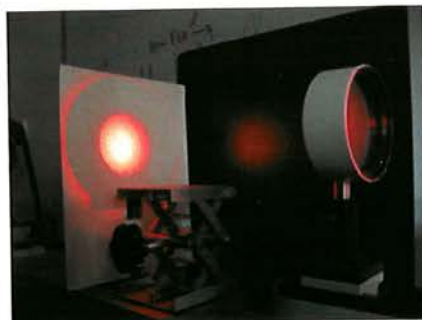
Want to find out more about the radiometer?

Crookes radiometer, from

Wikipedia, the free encyclopedia, http://en.wikipedia.org/wiki/Crookes_radiometer, accessed 15 August 2006.

Want to find out more about optical tweezers?

Optical tweezers, From Wikipedia, the free encyclopedia http://en.wikipedia.org/wiki/Optical_tweezers#Optical_tweezers_in_brief, accessed 17 August 2006.

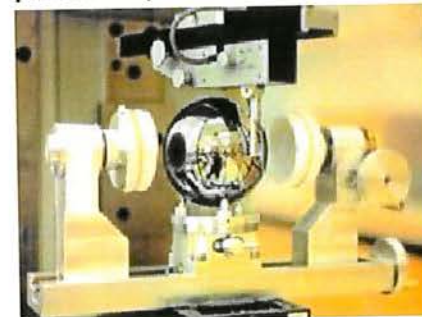


See a movie of a small vaterite bead inside a micelle manipulated using laser tweezers, on the UQ Physics website [in the research area of **AIP Women in Physics Lecturer in 2003**, Prof. Halina Rubinsztein-Dunlop], www.physics.uq.edu.au/cbls/

Want to find out more about adhesion?

Adhesion, from Wikipedia, the free encyclopedia, accessed 18 August 2006 <http://en.wikipedia.org/wiki/Adhesion>

Want to find out more about precision optics?



Australian Centre for Precision Optics <http://www.tip.csiro.au/IMP/Optical/Index.html>

Want to find out more about laser cleaning?

Laser cleaning and Surface modification processes



www.physics.mq.edu.au/research/laser_cleaning/dk1.html <http://www.physics.mq.edu.au/~debkane/>

National Conservation Centre, Liverpool Museums, UK www.liverpoolmuseums.org.uk/conservation/technologies/casestudies/index.asp#sculpture www.liverpoolmuseums.org.uk/conservation/technologies/sculptureandmonuments/laserclean.asp

Branch News

ACT branch report

We have been fortunate to assemble an interesting and eclectic array of talks and events for 2007. Our first outing in March was to the Mount Stromlo observatories which have been refurbished since the devastating ACT fires a few years ago. Chris Neil and Peter McGregor gave a facility tour with an impressive demonstration of adaptive optics technology. The April branch meeting is traditionally focused on the activities of physics students (both undergraduate and graduate) in the ACT. The Branch awards prizes to the students who perform best in second year courses from the undergraduate physics programs at the Australian National University and the University of New South Wales at ADFA. This year undergraduate prizes were won by Rose Ahlefeldt (ANU) and Midshipman Daniel Boettger (UNSW@ADFA).

In May we were presented a documentary film on the life and times of Bruno Pontecorvo (August 22, 1913 - September 24, 1993) by visiting professor Pier Luigi Braccini from the University of Pisa. Pontecorvo was an Italian-born atomic physicist, who was an early assistant of Enrico Fermi. He became notorious, even outside the scientific community, because of his voluntary move to the USSR in 1950, where he undertook research on neutrino and high energy physics. The meeting was conducted in association with ARIA, an association for cooperation between Italian and Australian research.

In association with the Australian Centre of Excellence for Quantum Atom Optics and the Academy of Science, and marking the launch of the "Physics for our Future" lecture program, Prof Hans Bachor gave a very well attended presentation entitled "Photons – quantum ideas that could influence your life". This program, which was conceived by Prof Bachor, aims to attract some of Australia's best scientists to give public lectures on various aspects of contemporary physics, and to compile the lecture materials into a useful teaching resource for Australian science teachers.

June also saw a joint meeting with the Acoustical Society and the Society

for Sustainability and Environmental Engineering where Dr Ra Ina gave a lively presentation on "How Termites Communicate Using Vibrations - a true multidisciplinary project". July's meeting will be held at the new technology Pool at the Australian Institute of Sport while future meetings include medical physics, quantum computing and more lectures in the Physics for our Future series.

The local branch has this year sponsored the 30th annual ACT Science Fair organized by the Science Educators' Association - ACT. The opening ceremony in June was attended by members of the local branch executive with Dr Charles Jenkins acting as one of the project judges. This was an important outreach activity and an opportunity to support local teachers. We have also sponsored T-shirts for the ANU physics students' society and are planning to broaden our involvement with students this year.

AIP Queensland Report

June 2007

The AIP Queensland Branch has been actively promoting physics in 2007 by staging a series of talks, with emphasis placed on events likely to be of interest to school teachers and their students. Our strategy is also to work with other organisations to contain costs and to circulate notices about our activities as widely as possible. A list of 2007 events for the branch can be found on the AIP website at <http://qld.aip.org.au>. A few highlights of our activities are:

Youth Lecture Series

This is the flagship activity for the branch and is run in August to coincide with National Science Week. Each year the Youth Lectures provide school students and their teachers with an engaging talk about physics from a professional, Michael Bleazard from Queensland Health. This year the Lecture has a medical physics theme and the Queensland tour is jointly sponsored by the AIP and the Australasian College of Physical Scientists and Engineers in Medicine. This enables talks to be given at 8 venues in metropolitan and regional Queensland.

Tools of Science

This informative series of talks

organised by Dr Norman Heckenberg is sponsored by the University of Queensland (UQ) School of Physical Sciences and is now also supported by the AIP thanks to special funds provided by the AIP Executive, that will enable videos of some talks to be made available to AIP members via DVD and the web.

New school physics syllabus

The AIP Queensland branch committee has been involved in productive discussions with the Queensland Studies Authority regarding the new physics syllabus for schools.

Physics Teachers Workshop

A Physics Teachers Workshop at Toowoomba has been organised by Education Queensland, the University of Southern Queensland (USQ) Faculty of Engineering and Surveying and USQ Physics staff representing the AIP. The aim of the Workshop is to assist teachers develop simple and effective practical means of demonstrating physics principles in class.

Astronomy events

The AIP Queensland branch is working with the UQ, the Queensland University of Technology and USQ to co-sponsor astronomy talks by well-known astronomers Fred Watson and Joe Silk visiting Brisbane. Astronomy events such as these have proved popular with AIP members, school students and the public.

Research Seminar Series

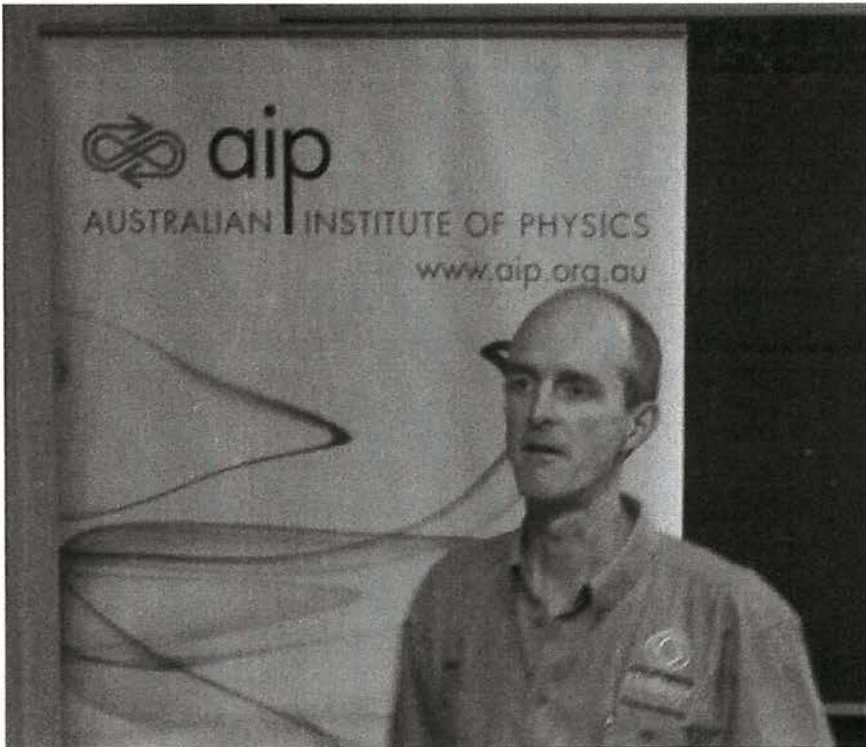
This Series is showcasing the physics research done in Queensland universities to an audience of school teachers and senior high-school students. The venues include UQ, Griffith University, and USQ.

Brad Carter, on behalf of the AIP Queensland Branch Committee

SA Branch news

The SA branch presented its second public lecture of the year on April 11th. This was given by US astronaut Marsha Ivins, who has logged 1318 hours in space as a mission specialist on 5 Shuttle flights. Marsha was in Adelaide for the South Australian Space School, and treated the School students, plus members of the public, to a fascinating, humorous and well illustrated talk on "Practical Space Flight", including

Branch News



Dr Terry Burns giving a members' lecture to the SA branch

how to eat, drink and use the toilet in weightless conditions.

On 28th May the branch presented a members' lecture: "An answer to the dwindling number of science graduates? Get more young people involved in science!", given by Dr Terry Burns, who is the founding director of the University of Newcastle's SMART program, and part of the Science and Engineering Challenge. Terry described both of these activities, sharing his experience in how to run Science shows and activities to present Science to school students and the public. He made the point that while the Science must be correct, it must also be interesting and presented in an entertaining way.

(Tasmania)

Each year the State Branch of the AIP combines with the State Branch of the Royal Australian Chemical Institute (RACI) to organise a professional development seminar for science teachers. More than 35 teachers from across the State attended the 2006 seminar, held in Launceston on December 11 and 12. The program included an opening address on the Importance of Science Teaching by Professor David Jamieson (National AIP President), and research talks on

astrophysics, analysis of explosives, cosmic ray exposure, and conducting polymers. Discussion sessions were also held on ways of assisting Tasmanian science teachers, developments in Tasmanian science education, and the teaching of generic skills across the secondary and tertiary levels. In 2006 a greater number of High School (Grade 7-10) teachers attended compared with previous years, with positive responses received from both the Senior Secondary and High School teachers. Curriculum and assessment were again major discussion points, whilst the linking of students with AIP and RACI members who can act as role models for students was seen as an ideal way of encouraging more students into careers in science. (Andrew Seen, RACI)

The branch has conducted two successful public lectures in Hobart so far this year.

The Early Days of Radio Astronomy: A Personal perspective; *Prof Bill Erickson, University of Maryland.*

On 19th April, Professor Bill Erickson of the University of Maryland, who lives in Tasmania for some months each year and runs a private radio-astronomy observatory on Bruny

Island in the south of the State, gave a fascinating talk on the earliest days of Radio Astronomy. About 55 members and guests attended. Bill started by outlining the contributions made by Karl Jansky and Grote Reber, reminding us that Jansky joined Bell Labs in 1928 with only one year of postgraduate experience. Assigned the task of identifying possible interference sources (static) for projected trans-Atlantic telephone speech circuits, Jansky built a rotating dipole antenna and, although frequently diverted to other projects, was able to show that one set of the sources he detected was located beyond the solar system. The work was published in *Nature* and *Proc IRE* in 1933 but was largely ignored at the time. His sky map was reconstructed in 1978 from surviving data.

Grote Reber, a professional Electrical Engineer from Chicago who eventually settled in Tasmania, became aware of Jansky's work and in 1936 built a 31 ft parabolic reflector in Illinois. Initially operating at the, then extraordinary, frequency of 3.3GHz; he got no signal so changed to 910 MHz in 1938 and further to 160 MHz the following year. Adequate signal strength appeared at the latter frequency, enabling him to make good sky maps by 1944 and to show that the radiation was non-thermal. Reber's angular resolution was insufficient to identify discrete sources.

Bill went on to detail his own career, building his first optical telescope while a young teenager, becoming a ham radio operator, gaining his PhD in Theoretical Physics in 1955 and then moving into Radio Astronomy as a potentially interesting field. He discussed how Radio Astronomy developed at Clark Lake, initially under the control of the Convair Division of General Dynamics. The unfortunate outcome of the Convair 880 project, designed as a competitor to the Boeing 707 and Douglas DC8, led to Convair handing the Clark Lake facility to the University of Maryland.

In Australia, the large quantity of radio equipment rendered surplus at the end of World War 2 led in part to foundation work in the CSIRO Division of Radio-Physics. J L Pawsey determined the brightness temperature of the sun at 100 MHz to be $\sim 10^6$ K and D F Martyn

Branch News

found strong circular polarisation in solar emission. Martin Ryle said at the time that these results were "grievously in error". The following years were exciting times for radio-astronomy in Australia, with the establishment of the Mills Cross and other observational facilities.

The search for extra-solar planets; *Dr John Greenhill, University of Tasmania*

This lecture, held on 10th May, attracted an audience of about 75, including an encouraging number of students. John pointed out the increase in our knowledge of planetary systems since 1995, when we knew of only one – our own. Now over 215 planets have been detected in other stellar systems.

There are several ways of detecting extra-solar planets. The most successful to date, with over 200 planets found, is the radial velocity method, involving spectroscopic measurements of orbital motion. It is biased towards identification of large planets close to their parent stars.

The transit method, which is biased towards large short-period planets, has so far found 10 to 15. Planet diameter and period are obtained directly but at least three transits are required.

The microlensing technique used by the PLANET consortium, of which the University of Tasmania is a member, relies on the gravitational lensing which occurs when one star passes in front of another. If the foreground star has a planet an anomaly may be observed in the light curve. Survey teams measure the brightness of around 100 million stars each night and issue around a thousand alerts per year when brightness changes are detected. PLANET measures the light curves of 20 to 30 of the most promising events each night, using telescopes in South Africa and at Christchurch, Hobart and Perth. Observations are made at 1 hr intervals and at least four systems have been discovered. As an example, the star OB 05071, ~5.2 kpc (~15,000 light years) away and about 0.36 solar masses, has a planet of ~1.5 Jupiter masses orbiting at ~3 AU from its star.

For the next few years, microlensing is likely to be the only technique able to detect cool rocky terrestrial-type planets. It is biased towards finding planets about stars of less than one

solar mass. The present success rate, about 1 in 3, indicates that planetary systems are likely to be very common.

John Humble

SUMMARY OF EXECUTIVE MEETING E268

Meeting held Thursday June 5

Conference Papers

A program for the handling of conference papers has been developed by T. McMinn. This program is available on request. It is not suitable for Council meeting papers, but could be used by conference organizers.

Outstanding Service to Physics Award

There have been four nominations for this award. Only three awards can be made each year. The nominations are to be considered.

PhD Supervision

A request has been made asking about the AIP policy on PhD student supervision. The AIP has no specific policy on this. Each university has its own guidelines. The matter will be raised at the next Heads of Department meeting.

Student Financial Support

The AIP gives some financial support to students to attend conferences. This is done at the branch level, and there is considerable variation in the policies of various branches. Current practices are to be reviewed with the aim of developing a more uniform policy.

Australian Physics

The editor has resigned and B. James is coordinating the production of the journal until more permanent arrangements can be put in place. Andrew Bell was the guest editor for the April/May edition and John Daicopoulos has agreed to take on this role for the June/July edition.

Research Quality Framework

Work is being done on developing a policy for the RQF. It is hoped that when this is implemented, it will be less complicated than the current model.

AIP Subscriptions

A preliminary review of the accounts has indicated that AIP subscriptions will have to be raised about 10% in order to balance income and expenditure. This will be looked at more closely. The increase in subscriptions would be smaller if membership could be

increased.

Membership

Work has started on developing strategies for increasing membership.

Physics teachers

It is thought that physics teachers play a very important role in the schools and special consideration could be given to teachers who wish to join the AIP. To begin with, teachers will be offered a 10% discount on subscriptions.

Production of Australian Physics

Publishers have been invited to tender for the publication of Australian Physics. One tender has been submitted and this is being reviewed. Many issues have to be resolved before any decision can be made.

Science Policy

As part of the ongoing updating of the AIP science policy, it was thought important to have a policy on climate change and the effect of greenhouse gases. A policy is to be drafted and considered for adoption. Branches will be expected to become involved in the discussion.

AIP Database

Consideration is being given to offering on-line registration. The current quotes are too expensive for adoption, but this is to be followed up further.

Media liaison

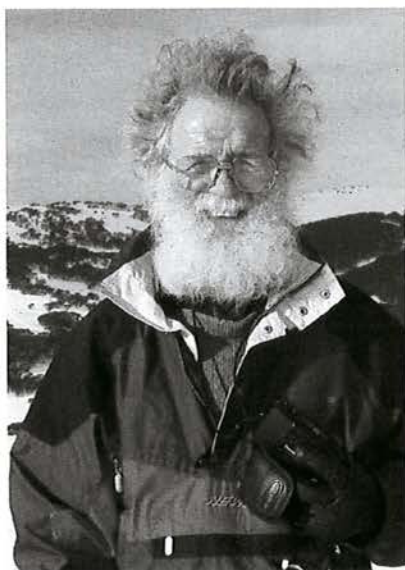
The AIP is continuing to use ScienceinPublic for media liaison, as directed by Council. Areas being followed up are news items, strategies for increasing membership, building on the visit of the Nobel laureate, and having an event in association with the Deakin lecture.

Next meeting : Meeting E269 is scheduled for July 26.

Ian Bailey,
Hon secretary.

Donald Robert Hutton 26 October, 1938 – 2 May 2007

Environmentalist, physicist and man of the mountains



Dr. Don Hutton (2005) (photograph by Robert Hutton)

Dr Don Hutton, who passed away on May 2nd, was a well-respected academic at Monash University.

The eldest of six children, Don's early years were spent on the Kaikoura coast, north of Christchurch, where he developed his nimble-footedness. Here he learned to love the mountains and the water, and thus mountaineering, skiing, canoeing and sailing became important parts of his life. His secondary education took place from 1952-

6 at Christchurch Boys' High School where he excelled in academic studies, played in the Rugby XV and was Secretary of the Radio Club, having gained his Radio Licence in 1955.

At the University of Canterbury from 1957-61, Don Hutton was a Senior Scholar, completing his MSc in Physics in 1961 with First Class Honours, based on research in Electron Paramagnetic Resonance (EPR), a field in which he was author or co-author of more than 50 papers over the years. From 1962-4 he carried out PhD research in the Physics Department, Monash University, under Dr Gordon Troup, as a General Motors Holden Postgraduate Scholar, using EPR spectroscopy to determine the suitability of the natural minerals, kyanite, zircon and quartz, containing small amounts of transition metal ions, as potential maser and laser materials. Six publications resulted in reviewed journals, including one in "Nature". From 1989-93 as the result of becoming aware of moves to gamma-irradiate food, along with three colleagues, Hutton participated in the International Atomic Energy Authority Program on Food Irradiation Monitoring.

Don continued to play Rugby at the University of Canterbury and at Monash, as a foundation member of the Monash University Rugby Club. He was also a founding member and President of the Monash Bushwalking Club.

Having completed his PhD, he returned to New Zealand to a Lectureship in Physics at the University of Canterbury followed by an appointment to Monash University in 1969. Initially Don's position, in the establishment of the Dean of Science, was shared between Physics (0.75) and Education (0.25) but later also included teaching Chemistry and subjects within the new Master of Environmental Science (MEnvSc) program. Within Physics he continued his research in the study of defects in crystals using EPR and numerous acknowledgements in PhD theses attest to his skills as a dedicated post-graduate teacher. He made a joint

presentation with Dr Alan Roberts to the Senate Enquiry into the Omega Navigation System, having published a paper on the Omega System in "Search" in 1977.

He was a major consultant to the HSC subject *Physical Science, Technology and Society* from 1977 – 1991, helping develop curricula and setting examinations. Within Physics, he played a major role in introducing a Level 2 course in Astronomy in the 1970's and in the 1990's, a Professional Studies Programme for Level 3 students.

When Don retired from Monash at the end of 2000 he continued his research as an Honorary Research Fellow. About six weeks before his death he could be found in the lab planning experiments.

Many of us will remember Don as both a "conservationist" and as an environmental activist. Following the painful loss of Lake Pedder, Don with others campaigned successfully against the damming of the Franklin River. Around 1975 he was a member of the first group to kayak down the Franklin River.

Leadership was exemplified in many of his outdoor activities. He actively contributed to ANGAIR, a field naturalist group based at Anglesea and Aireys Inlet, the Waverley Bushwalking Club, the Otway Ranges Walking Track Association and, since his retirement, the Geelong Bushwalking Club. Whether involved in clearing and track marking many of the tracks on the Otways Waterfall Walk, or leading bushwalking parties, Don Hutton always put in the hard work. He remained a Waverley Bushwalking Club delegate to Bushwalking Victoria, attending his last meeting on 28th March, just five weeks before his death. One of his technological achievements was the test rig that simulated the heat produced by the human body at rest. His results challenged exaggerated advertising claims made by manufacturers about how warm sleeping bags were. As a result, misleading advertising was withdrawn from outdoor magazines.

He helped form the APEA Ski Club and the Bunga Haven Co-operative at 90 Mile Beach. He was also a member of Happy Larry Ski Club. He served as treasurer of the Monash Primary School Parents' Committee and he was an untiring volunteer for Little Athletics.

Don remained throughout his life a very modest man, someone who never sought the limelight, but who was entirely trustworthy, thoughtful and wise. Those who knew him through his career at Monash University, have lost an esteemed and very dependable colleague and a loyal friend. He was who he was: Father, Husband, Teacher, Scientist, Activist.

Don died at Cabrini Prahnan after a year long battle with malignant melanoma. He was a devoted family man and was very proud of the achievements of his children. He is survived by his wife, Dorothy, and children; Elly, Robert and Cinnamon.

This obituary was prepared by Dr Hutton's wife, Dr Dot Hutton, Emeritus Professor John Pilbrow and Associate Professor Trevor Finlayson.

Physics at CiSRA

Kieran Larkin, David Morgan-Mar, Chris Deller

Image Processing Division

Canon Information Systems Research Australia (CiSRA)

Canon Information Systems Research Australia (CiSRA) is one of Canon Inc.'s global research and development facilities. Established in 1990, CiSRA has grown rapidly thanks to the efforts of highly skilled personnel. As a result, CiSRA is now one of the nation's leading R&D companies, with over 300 employees.

The association with Canon Inc. naturally means that CiSRA conducts research into fields related to imaging technology. Software engineer groups develop algorithms and code required for Canon products, such as the successful ZoomBrowser digital photo organising software, shipped with every Canon digital camera. Other CiSRA products form core components of popular printers, multifunction devices, and video cameras.

But it is at the research level where CiSRA uses the talents of a strong group of physicists, computer scientists, and mathematicians. Digital image processing is, of course, a major component, but there are plenty of diverse areas of research interest. Research is carried out in both the experimental and theoretical arenas.

For example, physically realising a better printer relies on developing precise techniques to measure the physics of ink deposition and mechanical misalignments down to the micron level, the interaction of light with various types of paper, spectral characteristics of the final prints, and so on. Better printers also have faster, smarter, and cheaper embedded algorithms for turning documents and images into ink dots on paper. From the experimental side, specialised equipment is required for research, including high powered microscopes, ultra-high resolution scanners, top end digital cameras and lenses, spectrometers, and a fully equipped optics lab. On the other hand, sophisticated mathematical analysis techniques are indispensable for theoretical research.

Corporate research vs academia

It is often assumed that corporate R&D tends to be more application specific than the fundamental research carried out at government research organisations and universities. However this is not necessarily true. CiSRA scientists are encouraged to spend time on fundamental research because

Canon recognises that many useful ideas that can lead to successful products have their genesis in basic experimentation and investigation, with no particular commercial goal in mind.

With funding set aside for such work, we do not have to submit research grant applications to a process with only a small probability of success. However, we do need to prepare detailed and convincing project proposals to those coordinating Canon's global research.

Our research success is measured in terms of how much intellectual property it generates, as well as how it improves Canon's productivity. So keeping up with the cutting edge of our fields and drafting workable patent applications is an important part of our work. We are also encouraged to publish in academic journals and present at conferences, although these are of secondary importance.

CiSRA's researchers come from extremely diverse fields of experience, as we value creative and innovative thinkers as much as the brightest minds. Team based research and cross-disciplinary interaction are encouraged because

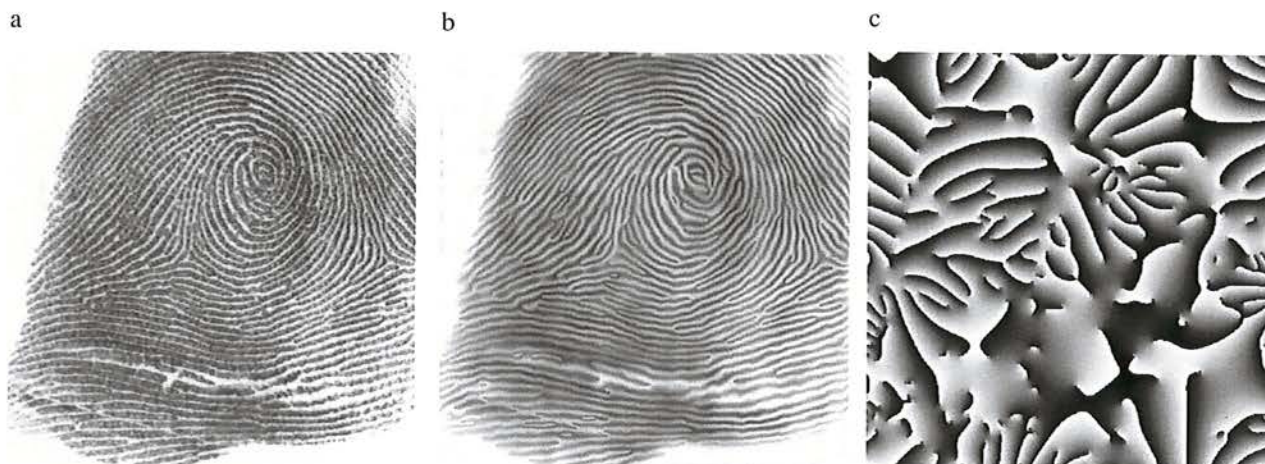


Fig.1 (a) Original image (262 kilobytes), (b) 229x compressed image (1095 bytes), and (c) spiral phase (minutiae) image.

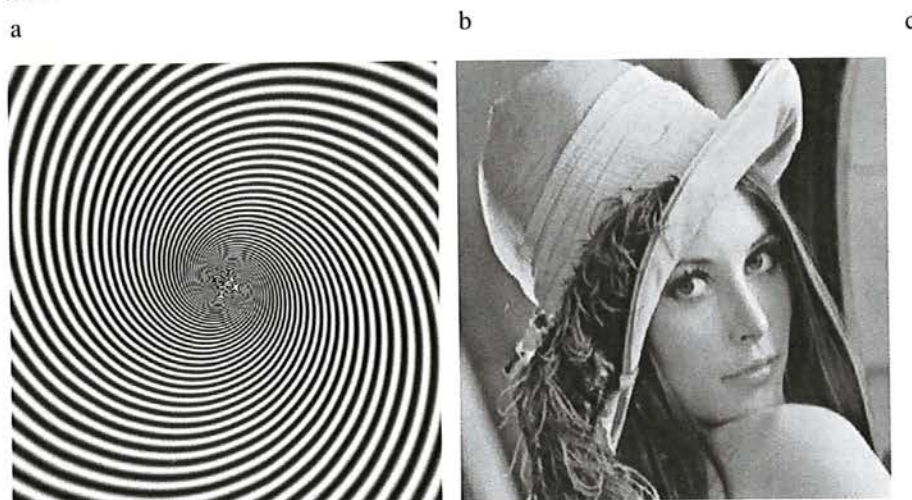


Fig.2 Image watermarking based on Logarithmic Radial Harmonic Functions

the best and most original ideas seem to come from interaction and the clash of different perspectives.

CiSRA research snapshot

CiSRA carries out research in various areas of image, video, and signal processing. Rather than outline all of this, we have concentrated on a specific sequence of research areas that exemplify a fruitful, long term, research strategy.

Fingerprint Analysis and Synthesis

Our work on fingerprint analysis and compression is a perfect example of how a seemingly academic piece of research can release a plethora of unexpected applications. An outline of the research can be found at the American Institute of Physics website [1].

The main idea is that a fingerprint image can be represented as a simple hologram. In particular, the key features of a fingerprint (ridge endings and bifurcations, also known as *minutiae*) are simply phase spirals in the hologram. There is nothing especially remarkable about this observation, except that it could only be made by someone familiar with both holography and fingerprint analysis.

It is easy to show that spiral phase modulations induce minutiae in fringe patterns like fingerprints.

The real problem is: how can we estimate the underlying phase pattern? Finding a solution that was not direction sensitive, like all the previous published solutions, required a major investment in personnel and computing power. An isotropic solution was eventually found using a mathematical device known as the spiral phase, or vortex demodulator [2]. Fig.1 shows a fingerprint (a) from the NIST fingerprint database [3], the image (b) reconstructed from just 1095 bytes of compressed data, and the corresponding spiral phase map (c) corresponding to all the detected minutiae in the original fingerprint. This mathematical representation allows the salient features of fingerprints (that are employed for fingerprint matching) to be stored at data compression levels much higher than previously possible.

At this point the fingerprint hologram representation problem was solved, but the mathematical tools developed were found to have much wider applicability, as we shall see.

Image Watermarking

A research area that has been of great interest from the late 1990s, and particularly more recently, is the area of image watermarking – imperceptibly hiding data in images. Hidden data can be used to track ownership, or to robustly

attach relevant data to a photo, such as location and creation date.

The major problem has been that most watermarking techniques do not survive common image manipulations such as rotation, scaling, printing, scanning, compression, and filtering. Rather fortuitously, the complex analysis developed for the fingerprint compression problem can be applied almost directly to generating and detecting imperceptibly embedded patterns in images.

The patterns used have the crucial properties of rotation and scale invariance, whilst the detection method is translation invariant. They are known as logarithmic radial harmonic functions (LRHFs) and have been extensively studied by optical target recognition researchers in the 1970s and 80s. It turns out that LRHFs easily fit into the model developed for fingerprint analysis, by using a logarithmic phase and multiple order spirals. LRHFs also have some other essential or useful properties:

- 2-D orthogonal basis
- Near perfect correlation properties (spread spectrum, spread space)
- Self Fourier transforms

Fig.2 shows how a collection of LRHFs (a) can be embedded in an

Physics at CiSRA

image (b) at imperceptible levels yet still detected (c) by a simple matched filter (correlator). The relative spatial arrangement of the correlation peaks can be used to encode a digital message [4].

Image Alignment and Image Quality

During our watermarking research we developed methods for robustly marking images regardless of their subsequent geometric distortions. Following on directly from this is the idea for using embedded patterns as invisible alignment markers.

Why would we wish to align images? The simple answer is that alignment allows us to fully automate a number of image quality evaluation procedures that would otherwise require substantial amounts of human intervention. Two parameters are of paramount interest: reliability and precision. It turns out that these two parameters are accentuated by the digital correlation techniques underpinning the LRHF watermarking technique ("chance favours the prepared mind", as Louis Pasteur noted). Unexpectedly, an expression of the uncertainty principle comes into play, so that the precision of locating a feature is inversely proportional to the size of that feature!

The image quality of many consumer devices is now so high that only experts can spot the most typical classes of defects in

images from printers, scanners, and cameras. To keep pace with the quality, we have had to develop ultra-sensitive analysis techniques to squeeze every bit of information from instruments that may be less than perfect imaging devices themselves.

Conclusion

Unfortunately there is not enough space to summarise all of the varied R&D work carried out at CiSRA. In many areas of Canon's R&D we have found that the physicist's approach to understanding and solving problems has great benefits. Astrophysics, optical diffraction theory, and general relativity all contribute to affordable high-tech devices resulting in superb image quality!

References

1. K. G. Larkin, and P. A. Fletcher, "Extreme compression of fingerprint images: squeezing patterns until the spirals pop out," in *Fifth International Workshop on Information Optics* (Toledo, Spain, 2006). <http://scitation.aip.org/dbt/dbt.jsp?KEY=APCPCS&Volume=860&Issue=1>
2. K. G. Larkin, D. Bone, and M. A. Oldfield, "Natural demodulation of two-dimensional fringe patterns: I. General background to the spiral phase quadrature transform," *Journal of the Optical Society of America, A* **18**, 1862-1870 (2001).

3. NIST Image Group's Fingerprint Research, "Fingerprint Test Data on CD-ROM," www.itl.nist.gov/iad/894.03/fing/fing.html.

4. P. A. Fletcher, and K. G. Larkin, "Direct Embedding and Detection of RST Invariant Watermarks," in *IH2002, Fifth International Workshop on Information Hiding*, F. A. P. Petitcolas, ed. (Springer Verlag, Noordwijkerhout, The Netherlands, 2002), pp. 129-144.

Check out the "Canon virtual lens plant", in the "Canon Camera Museum". There are documentaries on the making of camera lenses and their subsequent assembly into cameras.

Canon virtual lens plant:
[/www.canon.com/camera-museum/tech/L_plant/index.html](http://www.canon.com/camera-museum/tech/L_plant/index.html)

CiSRA website:
[/www.cisra.com.au](http://www.cisra.com.au)

Canon Australia website:
[/www.canon.com.au](http://www.canon.com.au)

Physics – Sometimes A Gateway To Another Life

By Chris Carter

(ccarter@davies.com.au)

A Beginning in Physics

I was 15 years old when I found and read the old classic *"The Neutron Story"*, by Donald J. Hughes in my high school library, which immediately captured my imagination. Beginning that day, I wanted to become a physicist working in research and I took steps towards that goal. I studied undergraduate physics at the University of Western Australia, graduating in 1994. I greatly enjoyed my time there and even a year away spent backpacking around the world did not lessen the call of a life in physics. I began a PhD program in experimental plasma physics under Dr Joe Khachan at the University of Sydney, submitting my thesis in 1998. I still greatly enjoyed research and the allure of physics itself, but other thoughts had slowly begun to enter my mind.

Leaving Physics

Whilst searching for a potential job in physics prior to graduating two things became apparent: I would likely find a job in physics, but I would probably not be able to choose the part of the world where I would end up; and jobs in physics research

Photo taken in 1997 in a lab at Université Joseph Fourier in Grenoble, France, during my PhD studies.



Photo taken in 1995 of plasma processing apparatus at the School of Physics, Sydney University, on which I learnt a bit about the highs and lows of experimental physics.

in Australia are limited, especially outside of academia. Originally, I had always welcomed the idea of moving about the world following physics jobs, but the timing of meeting my future wife made me reconsider, and predictably enough, she later ended up travelling the world for work while I would stay in Sydney. In the context of this job market, another thing happened - I was increasingly

becoming interested in real world applications of physics. I was beginning to think of how exciting it might be to become involved with a start-up company based on a physics application. These were somewhat idle thoughts, but they instilled a greater change, I was beginning to think seriously about the commercial world. I began to consider jobs outside of physics and what they would be like, the types of jobs calling for non-specific but rigorous logical and methodic training, for example an advertised position as an analyst in an investment bank.

A Start Outside Physics

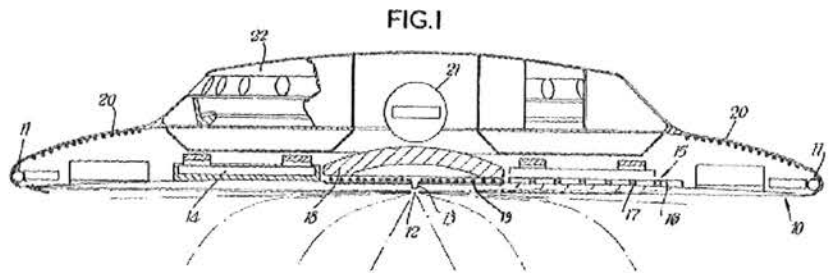
After getting a proper haircut and borrowing a suit, I ended up being offered a job training to become a patent attorney with a firm called Davies Collison Cave, where I was employed under the unglamorous title of a 'technical assistant'. Shortly before accepting the job offer in 1998 I had virtually no idea what a patent attorney actually did, other than being aware, like most other physicists, that Einstein

Physics – Sometimes A Gateway To Another Life

had spent some time working in the Swiss patent office. Like many outcomes in one's life, I did not end up at Davies Collison Cave by design, but happenstance. I was having a conversation with a teammate from Sydney University's AFL side who happened to be a patent attorney in the biotechnology field who suggested I apply for an advertised job that I had not come across (it was directed to engineers). I was offered the job and looking back, it reminds me of the importance of your networks and communicating with those people. This is something I have learned is critical in business, but you will not be taught in physics. I was unsure if I would be suited to life in an office in a legal environment, I had always enjoyed building things and had never even remotely aspired to enter the field of law, but I resolved to stay 12 months then decide one way or the other.

A New Pathway, Skills and Training

To qualify as a patent attorney at the time I was expected to pass a series of nine examinations on various areas of intellectual property law, which typically took people 4-5 years. The exams had a very high failure rate and although not as conceptually difficult as physics, were the hardest exams I have ever sat. These days most of the exams can be done through a university program and it is easier to qualify as a patent attorney in 2-4 years. The exams are done concurrently with "on the job" training. Patent attorney firms make a large investment in training people. To my surprise, I found I enjoyed learning about the law, it was such a new area to me and I found my general knowledge greatly improving as I learnt more about the history of Australia and the United Kingdom and how the law ebbs and flows with social circumstances over the decades. My previous aversions to the law were being broken down. I also enjoyed dealing with a large range of inventors and some ingenious ideas, from single



Not so world changing patent - UK Patent No. 1310990 for a controlled thermonuclear fusion propelled space vehicle (British Railways Board - 11 Dec 1970)

inventors to multi-national research teams. Effectively working and communicating with people from different backgrounds are intangible skills that are critical in life, especially as a patent attorney, but are skills that need to be developed beyond a normal course in physics.

I greatly enjoyed working at the interface between technology, business and the law, and decided I would stay and work towards a career as a patent attorney. Although not a necessary requirement, I thought if I was going to do this I should do it completely, so I also enrolled part-time in a law degree at Macquarie University, graduating in 2006. This is becoming increasingly common, and next to the more traditional law students with liberal arts backgrounds, you will now find an increasing number of science majors of varying ages and backgrounds. Again, and unexpectedly for a physicist, it was quite interesting to study the law in general. One of my early tasks was to make a trap purchase at a wholesaler of imitation sunglasses of a well-known brand, which led to me being escorted out after not being subtle enough with my attempted photography. I believe my physics training served me well for being able to draw important facts from a complex scenario and logically apply a set of rules to those facts, whilst being aware of many legal exceptions that I found akin to approximations or assumptions often used in physics problem solving.

Relevance of Physics Training

If it was not for my physics background I could not perform my present job. First and foremost, my physics training provided a good understanding of a wide range of technologies. All of my old physics textbooks are in my office and see regular use. Physics provided me with the ability to communicate effectively on a technical level with inventors from diverse scientific and engineering backgrounds. I find that some people from other more specialised technical backgrounds are often not as comfortable dealing with such a broad range of technologies. The rigours of logical analysis required for problem solving in physics lends itself well to a logical approach to the law, which might be viewed as one of the most complex, interrelated and recursive databases that morphs over time, ever developed by humans. A physicist-cum-lawyer always will be fundamentally different to a lawyer, I find myself trying to actually solve a legal problem, not complicate it to create a new problem. If I have taken nothing else from my physics training that serves me well today, it is that no problem is too daunting to be tackled logically, and as a physics student I was always encouraged to do so.

Life Today

I have now been working at Davies Collison Cave for over 9 years, with a secondment in Vancouver for a period of time. My day-to-

Physics – Sometimes A Gateway To Another Life

day roles include meeting various people such as inventors, business investors, company management, in-house legal counsel, etc., and discussing aspects of patent protection or infringement; writing patent specifications that are a legal document but draw heavily on my technical knowledge and understanding; prosecuting patent applications before various patent offices around the world which involves developing technical and legal arguments; providing general intellectual property or strategic development advice to a business commercialising new products; assisting people in disputes involving patents; or assisting in patent litigation when (rarely) matters end up in court. I write a completely new patent specification about every fortnight, meaning over 200 to-date, and enjoy the variation of seeing so many diverse projects.

Having a physics background sees me handling matters in a wide range of technologies, such as information and communications technology, electronics, digital hardware, medical devices, internet based business systems (e-commerce), mechanical systems, mining applications, and many others, including of course anything more directly physics-related such as optics, micro-electromechanical devices, plasma processing, etc... Intellectual property is a growing area and businesses are becoming far more active in this field, the U.S. Patent Office alone estimates it will receive 450,000 patent applications this year, up from about 350,000 five years ago.

Editor's Note: This is the first of what it is hoped will be a series of articles about people trained in Physics (typically to PhD level) who are pursuing a career outside of Physics. If you want to write an article about yourself, or suggest a suitable candidate, please contact A/ Prof Brian James (B.James@physics.usyd.edu.au).



Photo taken in 2004 as a patent attorney. Initially the hardest part was getting used to wearing a tie, a daily requirement that has now largely disappeared in legal firms.

Australian Institute of Physics Women in Physics Lecture Tour 2007

The Australian Institute of Physics Women in Physics Lecture Tour celebrates the contribution of women to advances in physics. The AIP Women in Physics Group is pleased to announce the AIP Women in Physics Lecturer for 2007.

Professor Tanya Monro,
Chair of Photonics and
Director, DSTO Centre of Expertise in Photonics (CoEP)
School of Chemistry and Physics, University of Adelaide
Bragg Gold Medal winner, 1998

Professor Monro is another outstanding addition to the proud tradition of Australian Institute of Physics Women in Physics Lecturers. Her research focusses on the development of optical fibres in new materials (in particular soft glasses) and the application of new fibre concepts to a range of applications, in particular in defence and sensing. The "Centre of Expertise in Photonics" is world-class, and the first of its kind in Australia. Since its establishment in 2005, Professor Monro has built the centre into a team of 20 researchers.

Professor Monro will visit each of the six Australian State capital cities and present lectures to varied audiences: professionals, school students and the general public. She may also visit universities and other scientific centres throughout Australia, to give research colloquia. AIP members will be notified when details of the lectures, their times and venues are finalized.

For further information: www.aip.org.au/

Or please contact

Australian Institute of Physics, WIP Lecture Tour Coordinator
Christine Deller, CiSRA (Canon Information Systems Research Australia)
cdeller@cisra.canon.com.au

Conferences

2007

Aug 5 - 9

Microscopy & Microanalysis Meeting

Ft Lauderdale, FL
<http://mm2007.microscopy.org>

Aug 06 - 16

Quantum Information School and Workshop

Paraty, Rio de Janeiro, Brazil
www.paraty07.net

Aug 13 - 17

9th International Conference on Biology and Synchrotron Radiation

Texas, USA
www.srs.ac.uk/bsr2007

Aug 22 - 27

International Symposium "Micro- and Nano-scale Domain Structuring in Ferroelectrics"

Ekaterinburg, Russian Federation
labfer.usu.ru/isds07/

Aug 27 - 29

Automata 2007: 13th International Workshop on Cellular Automata

Toronto, Canada
www.fields.utoronto.ca/programs/scientific/07-08/automata07/

Aug 30 - Sep 03

International Conference on Hadron Physics

Canakkale, Turkey
milonga.physics.metu.edu.tr/hep-th/troia07/

Sep 03 - 07

Nuclear Physics Conference (9th International Cluster Conference)

Stratford-upon-Avon, UK
www.iop.org/Conferences/Forthcoming_Institute_Conferences/CLUS07/event_7938.html

September 9 - 14

14th International Union of Air Pollution Prevention and Environment Protection Associations (IUAPPA) World Congress/ 18th Clean Air Society Conference

Brisbane, Australia
www.casanz.org.au

Sep 10 - 14

Frontiers of Modern Cosmology

Waterloo, Canada
www.perimeterinstitute.ca/Events/Frontiers_of_Modern_Cosmology/Frontiers_of_Modern_Cosmology/

Sep 17 - 19

IET 20th Pulsed Power Symposium

Didcot, United Kingdom
conferences.iee.org/pulsedpower/index.htm

Sep 24 - 28

Sixth International Heidelberg conference on DARK MATTER IN ASTRO & PARTICLE PHYSICS

Sydney, Australia
www.physics.usyd.edu.au/Dark2007

Sep 25 - 30

Conference on Magnetic and Superconducting Materials (MSM07)

Khiva, Uzbekistan
www.quantummatter.org/msm07

Sep 25 - 30

Special Session on Nature Inspired Machine Learning NIML'2007

Corfu, Greece
www.ruta.co.uk/niml.pdf

October 8 - 12

Advanced Infrared Technology and Applications 2007 Giorgio Ronchi 9th International Workshop (AITA 2007)
CIO, Leon, Guanajuato, Mexico
ronchi.iei.pi.cnr.it/AITA2005

October 9 - 13

SPERA 2006 - 9th South Pacific Environmental Radioactivity Conference

Royal Society Victoria, Melbourne
www.arpansa.gov.au/spera/index.cfm

Oct 14 - 18

Engineering and Physical Sciences in Medicine and The Australian Biomedical Engineering Conference 2007

Fremantle, WA
www.keynotewa.com/epsm-abec-2007/

Oct 25 - 27

5th conference on Physics Teaching in Engineering Education

Delft, Netherlands
www.tnw.tudelft.nl

Nov 19 - 22

19th International Geophysical Conference and Exhibition 2007

Perth, Australia
www.promaco.com.au/2007/aseg

November 21 - 23

15th AINSE Nuclear and Complementary Techniques of Analysis

Melbourne University, Melbourne, Australia

Nov 28 - Dec 1

International Student Summer School on Quantum-Atom Optics

Kioloa, NSW
www.acqao.org

Dec 3 - 6

OSA Topical Meeting on Quantum-Atom Optics Downunder

Wollongong, NSW
www.osa.org/qao

Dec 12 - 14

MULTIPHYSICS 2007

Manchester, United Kingdom
www.multiphysics.org/

2008

Jan 29 - Feb 1

32nd Annual Condensed Matter & Materials Meeting

Charles Sturt University, Wagga Wagga, NSW

Feb 16 - 21

POLYCHAR 16 : World Forum for Advanced Materials

Lucknow, India
www.polychar16.com

Mar 10 - 16

Solid State and Materials Chemistry

Mexico, Cancun
www.zingconferences.com/solidstate

May 01 - 06

38th Annual Scientific Meeting of the Australian and New Zealand Society of Nuclear Medicine

Gold Coast, Australia
www.anzsnm2008.com

May 28 - June 1

8th World Biomaterials Congress

Amsterdam, the Netherlands
www.wbc2008.com

Jun 08 - 10

2nd INTERNATIONAL CONFERENCE ON SCIENCE AND TECHNOLOGY (ICSTIE'07/'08)

Penang / Kedah, MALAYSIA
www.penang.uitm.edu.my

Jun 15 - 19

17th World Hydrogen Energy Conference

Brisbane Convention and Exhibition Centre
www.whec2008.com

July 7 - 10

21st Congress of the International Commission for Optics

www.iceaustralia.com/ICO2008

July 8 - 10

OECC/ACOFT

www.iceaustralia.com/OECC_ACOFT2008

Samplings

Casimir force could drive tiny ratchets

A physicist in France claims that the Casimir force between two neutral surfaces could be exploited to create tiny ratchets that could someday drive machines built at the micrometre scale. Thorsten Emig of the Université Paris-Sud has designed a ratchet based on surfaces with special corrugations that can be made to slide past each other in only one direction. Emig claims that Casimir ratchets, which have yet to be built, could be superior to current microratchets, which are based on the electrostatic forces between charged objects (*Phys. Rev. Lett.* **98** 160801).

PhysicsWeb

Negative refraction gets natural

Physicists in Germany claim to have found the first naturally occurring material that has a negative, rather than a positive, refractive index. The material, a metallic ferromagnet, is very different from all other negative-refractive-index materials known to date which have had structures that have been artificially engineered in the laboratory. The ferromagnets, which have been shown to exhibit negative refraction up to gigahertz frequencies, could be used in novel devices such as superlenses (*Phys. Rev. Lett.* **98** 197401).

After observing last year that materials consisting of layers of ferromagnetic and superconducting materials could exhibit a weak negative refractive index in some situations, Andrei Pimenov of the Universität Würzburg along with colleagues at other German institutions has shown that negative refraction can occur in metallic ferromagnets. The team shone light on thin films of the metallic ferromagnet $\text{La}_{2/3}\text{Ca}_{1/3}\text{MnO}_3$ and then measured how the amplitude and phase of the transmitted light changed using an interferometer. Using these values they could calculate the permittivity and the permeability, and hence the refractive index. For frequencies of light up to 150 GHz they found that the refractive index was negative. At higher frequencies, however, the effect began to peter out.

PhysicsWeb

Soft-matter pioneer dies

The pioneering French physicist and Nobel laureate Pierre-Gilles de Gennes has died at the age of 74. De Gennes, who was awarded the Nobel Prize in

Physics in 1991 for his ground-breaking work on liquid crystals and polymers, died May 18, 2007 in Orsay. Dubbed the "Isaac Newton of our time" by the Nobel-Prize committee, de Gennes also had an interest in many other fields of science and finished his career at the Institut Curie in Paris where he worked on cellular adhesion and brain function.

PhysicsWeb

Testing the equivalence principle

The "equivalence principle", first investigated by Galileo in the 16th century, holds that gravity accelerates all objects equally regardless of their masses or the materials from which they are made. It is a cornerstone of modern physics. But what if it is not strictly correct?

Galileo's experiments were only accurate to about 1%, leaving room for doubt, and skeptical physicists have been "testing EP" ever since. The best modern limits, based on, e.g., laser ranging of the Moon to measure how fast it falls around Earth, show that EP holds within a few parts in a trillion (10^{12}). This is fantastically accurate, yet the possibility remains that the equivalence principle could fail at some more subtle level.

Three separate satellite-based experiments are being planned to test the limits of accuracy of the equivalence principle.

NASA

Wireless power a reality

The mess of electrical cables that recharge our laptops, mobile phones and PDAs could soon disappear altogether - at least according to a team of MIT physicists, who have shown how power can be transmitted without wires using special "resonant" antennas that couple evanescent waves. The researchers used the system to power a 60W light bulb placed two metres from a wireless transmitter, and say that it could be scaled down for use in portable devices without a loss of efficiency (*Science Express* doi: 10.1126/science.1143254).

PhysicsWeb

European X-ray laser gets the go ahead

The building of a powerful new X-ray free-electron laser has been given final approval by the German government now that sufficient funding has been secured. The billion-Euro machine, known as XFEL, will be situated in Hamburg, Germany and will enable

researchers to observe chemical and physical processes at the atomic level as they occur in real time. Construction of the facility is set to start in early 2008 with an aim to commence data collection in 2013. XFEL will follow two other X-ray free-electron-laser projects around the world. These are the LCLS in the US, due to start up in 2009, and the Japanese SCSS facility, which is scheduled to come online in 2011.

PhysicsWeb

Telescope limitation could reveal exoplanets

Astronomers in the UK, the US and Germany are the first to use a new data-analysis technique that could boost a telescope's ability to search for "exoplanets" -- planets outside our solar system. Surprisingly, the technique makes clever use of the diffraction of light, an effect that had previously prevented telescopes from resolving many exoplanets from their parent stars. The astronomers used the technique to get a combined image and spectrum of a faint star 48 light-years away (*Astrophys. J.* in press).

The technique, first proposed in 2002 for space-based telescopes by the US-based astronomer William Sparks and Holland Ford, involves looking at how the Airy rings of the diffraction pattern grow as images are taken at increasing wavelength. If a bright area remained in the same place as the wavelength changed, it would be an indication of a companion object. Therefore, by subtracting the part of the image containing the spreading rings - a procedure known as "spectral deconvolution" - an image of the companion object would be left.

PhysicsWeb

Laser technique could help redefine the kelvin

Physicists in France have made the first direct measurement of the Boltzmann constant k_B by laser spectroscopy. The new technique, which involves observing how light is absorbed by ammonia molecules, is currently much less accurate than existing methods for measuring the constant. However, the researchers are confident that its accuracy could easily be improved and that the technique could help to create a new and improved definition of the kelvin unit of temperature (*Phys. Rev. Lett.* **98**

Samplings

250801).

Christian Chardonnet and colleagues at Université Paris 13 - Institut Galilée, claim to have developed a laser spectroscopy technique that could provide an alternative way of measuring k_B to ppm accuracy. The technique exploits the fact that the thermal motion of a molecule – ammonia in Chardonnet's experiment – smears out peaks in its optical absorption spectrum in a process called thermal broadening. The width of the broadening is determined by k_B as well as the pressure and temperature of the gas and the frequency of the light being absorbed. By measuring the width of the broadening as a function of pressure at a fixed temperature and frequency, Chardonnet and colleagues were able to determine k_B to an accuracy of about two parts in ten thousand. Although this is nowhere near the accuracy needed by the CIPM, the researchers believe that, in principle, the technique could be improved to 1 ppm.

PhysicsWeb

Single atom entangles two photons

Researchers in Germany and the UK are the first to entangle pairs of photons using a single atom. Their technique is based on an optical cavity containing one rubidium atom, and could provide a way to process information in a quantum computer (*Scienceexpress* DOI: 10.1126/science.1143835).

Gerhard Rempe and colleagues at the Max Planck Institute for Quantum Optics in Garching, Germany and Axel Kuhn at the UK's Oxford University first fired a laser pulse at a trapped atom, causing it to emit a single photon. As a result of this process, the atom and the photon are entangled. A microsecond or so later, a second laser pulse was fired at the atom, causing it to emit a second photon. Crucially, the second pulse cause the entanglement to be transferred from the atom to the second photon, and the two photons become an entangled pair. Rempe said that the photons could then be sent to interact with two different atoms. As a result of this interaction, the two atoms would become entangled with each other. This, he said, could form the basis of a "quantum repeater", which is an essential component of a quantum computer.

PhysicsWeb

Fundamental constant is pretty much

Australian Physics Volume 44 Number 2 June/July/August 2007

constant

The idea that fundamental constants do not actually stay constant over space and time has long played on the mind of physicists. But by looking at how a distant galaxy has absorbed the light from a quasar, Victor Flambaum and Michael Kozlov of the University of New South Wales have obtained a new limit on how much one fundamental constant – the ratio of the electron and proton masses – is changing with time. Their result, which is 10 times more accurate than previous measurements, gives the thumbs up to our current understanding of physics (*Phys. Rev. Lett.* 98 240801).

Fundamental constants are very finely tuned for our existence – if the strong nuclear force were just 1% stronger than it is today, for example, carbon could not be produced in stars, and we would not be here at all. This is one reason why many physicists are eager to check whether certain fundamental constants have changed over the history of the universe.

PhysicsWeb

Tiny spheres could control light

Light can be guided and manipulated at the nanometre scale by passing it through collections of tiny metal spheres, according to new calculations by scientists in the US. The effect involves the interaction of light with plasmons on the surfaces of the spheres and the researchers claim that it could be used to create sources of coherent and polarized light. Such sources could be important for making a variety of all-optical nanodevices including sensors, switches and information storage devices (*J. Phys. B: At. Mol. Opt. Phys.* 40 S283).

Maxim Sukharev and Tamar Seideman of Northwestern University have used a computer simulation to study the interaction between light and the plasmons on the surfaces of tiny metal spheres. Using the example of a T-junction composed of silver nanospheres, the simulation revealed that the path taken by the light through the spheres could be altered by changing the polarization of the light. The researchers believe that this effect – which has yet to be confirmed experimentally – could be used in an optical nanoswitch, or inverter.

PhysicsWeb

Magic cluster rules for hydrogen

storage

It has long been known that when two different kinds of atoms clump together, some of the resulting clusters are more stable than others. Physicists in the US and Germany have now devised a rule that predicts the ratios of aluminium and hydrogen atoms that will form such stable clusters. They also say that the clusters could be packed together to form a new type of material that can store hydrogen for use as an energy source (*Phys. Rev. Lett.* 98 256802).

PhysicsWeb

Graphene p-n junction is unveiled

Physicists in the US are the first to have created a locally-gated p-n junction in graphene, which is a 2D sheet of carbon just one atom thick. The charge density in the device is controlled by applying voltages to electrodes that are attached to the surface of the material. The fabrication technique could open the door to practical graphene transistors that could be much smaller and more efficient than today's silicon-based devices (*Scienceexpress* DOI: 10.1126/science.1144657).

Physicists had speculated that graphene could form a p-n junction -- which is a basic building block of a transistor -- by placing positive and negative electrodes next to the surface of graphene to create p-type (excess positive charge) and n-type (excess negative charge) regions adjacent to the electrodes, with a well defined "p-n junction" in the area between the two electrodes.

Now, Charles Marcus and colleagues at Harvard University have cracked the problem of depositing a very thin insulating layer on the graphene followed by the metal electrode, by using atomic layer deposition (ALD) to create a suitable insulating layer by depositing successive layers of nitrogen oxide, trimethylaluminium, and aluminium oxide onto graphene. A metal electrode of titanium and gold was then deposited on top of the insulator. Marcus says that the technique was borrowed from chemists, who had developed it to coat carbon nanotubes, which are essentially graphene sheets rolled up into tubes.

PhysicsWeb

Items for Samplings have been supplied by Don Price, CSIRO.

The research-teaching nexus in physics: scholarship into teaching and learning

Helen M. Johnston, Andrew M. Hopkins, Kevin E. Varvell, Manjula D. Sharma

School of Physics, University of Sydney, NSW 2006, Australia and

Ronald K. Thornton

Centre for Science and Mathematics Teaching, Tufts University, Medford MA 02155, USA

1. Introduction

With continual evolution of both the student body and our understanding of how students learn, we are faced with a choice: to continue teaching the way we always have, or to change. Audits of teaching quality and increased accountability pressure us to improve the learning experiences we offer students. If we do decide to change, there are more choices and decisions regarding management and allocation of resources. We can tinker around the edges, jump on current fads like the use of technology, or seriously reconsider student learning. This report is on a serious reconsideration of student learning at the School of Physics, University of Sydney for a particular student cohort. Serious reconsideration generally involves changing mindsets as well as practices.

An interesting aspect of this study is the way in which it has emerged. The School sponsored an internationally renowned expert in physics education research, Professor Ronald Thornton for a ten-week visit. Prof. Thornton has also been invited to the Universities of Melbourne and Wollongong, sharing his work on Interactive Lecture Demonstrations [1]. Excited by Prof. Thornton's work, Dr Helen Johnston, a research staff member who also lectures, proposed using his methods with a class of 220 students enrolled in the Fundamentals of Physics course. She convinced the remaining three staff team teaching this course to join her. This report describes work-in-progress on the implementation of Interactive Lecture Demonstrations with the Fundamentals cohort.

2. The study

The Fundamentals class consists of students who range from those with no senior high school physics experience, to those who have not done too well in senior high school physics. The cohort is definitely not the poorest performing students as measured by senior high school achievement scores. Rather, some students have done very well indeed, ranked amongst the top 5% of the state with substantial mathematics experience. Another interesting feature of the cohort is that it is about 60% female while the other mainstream physics classes are about 30% female.

The Fundamentals class is taught in two parallel lecture series with three lectures and a workshop tutorial per week. Laboratory sessions are run over 8 weeks and are 3-hours long. The course starts with a module "Language of Physics" taught over four weeks with 2 weeks spent on buoyancy and pressure and 2 weeks on kinematics and orbiting. A five week module on "Mechanics" is next, followed by a 4 week module on "Oscillations and Waves". The report presented here concerns only the first two modules – Language of Physics and Mechanics.

The first physics lecture of the semester was used to administer a survey of background understanding – the Force and Motion Conceptual Evaluation (FMCE) [2]. This survey measures students' conceptual understandings in kinematics and Newton's Laws. The survey was repeated after the last lecture of the Mechanics module, after a 10-week gap. Hence we have pre- and post-test scores.

During each lecture series 5 complete lectures out of 27 are being dedicated to Interactive Lecture Demonstrations [3,4,5] to be described in the next section. The course content, assessment practices, tutorials and laboratories have not been changed at all. Accounting for the two lectures used to administer the FMCE, the total course content is taught in 7 fewer lectures – a challenge indeed.

The question is then: "Will there be a change in student understandings of Newtonian Mechanics when ILDs are used with the Fundamentals class, as measured by the FMCE survey?"

Why this is a serious reconsideration of teaching practices, involving changing mindsets as well as practices, is presented below.

3. The poles of learning and teaching

A teacher teaches with the hope and conviction that most, if not all students, will learn. A student turns up to classes with the hope and conviction that they will learn some, if not most, of what is taught. Just how challenging the tasks of both the teacher and the student are, we cannot overestimate.

Table 1 presents two poles of teaching and learning. Obviously what normally happens in practice is somewhere in between. Some features we can control as masters of our hour-long lecture slots while others are dictated by the system.

The Interactive Lecture Demonstrations are particularly attractive as they allow us to exercise the control we have over our lectures within the constraints

The research-teaching nexus in physics

Table 1: Poles in teaching and learning environments

Teaching as transmission Learning as absorbing	Teaching as facilitating Learning as constructing
Instructor and textbook are the authorities—sources of all knowledge, transmitting their knowledge. Students listen, absorb and know the knowledge.	Observations of the physical world are the authority. Students construct their knowledge from listening, discussing and observing.
Lectures most often present the “facts” of physics, with worked examples and show-and-tell demonstrations to illustrate points.	Results from real experiments are integrated into the learning cycle to explore alternative conceptions.
Laboratory work, if any, is used to confirm theories “learned” in lecture.	Laboratory work is primarily used to sift through a range of alternative conceptions.
Instructor’s role is as organizer and presenter.	Instructor’s role is as guide in the learning process.
Collaboration and discussions, teacher-to-students and student-to-student are not in the class plan.	Collaboration and shared learning with peers is essential.
Students may never even recognize differences between their beliefs and what they are told in class.	Changes students’ beliefs when students are confronted by differences between their observations and their beliefs.
Students’ beliefs are rarely overtly challenged. Knowledge is linear, logical and is presented in a systematic manner with experiments to demonstrate points.	Students’ beliefs are challenged by using learning cycles. Students are challenged to compare predictions (based on their beliefs) to observations of real experiments.

of the system. In the five Interactive Lecture Demonstration sessions the teaching and learning is as described by the right hand column in Table 1, while our remaining lectures do not need to vary much from our personal style of lecturing, and is typically situated somewhere in between the two columns.

4. Evidence of the efficacy of Interactive Lecture Demonstrations

The usefulness of Interactive Lecture Demonstrations has been evaluated by the FMCE administered as a pre-test prior to instruction and a post-test after instruction, similar to the study described here. The sum of the correct answers for questions on the Force and Motion Conceptual Evaluation (FMCE) provides a measure of student

understandings of force and motion. If we wish to compare different physics classes from different year cohorts or institutions, it is better to use the “normalized gain” which is the percentage of possible improvement: $(\text{posttest} - \text{pretest}) / (100\% - \text{pretest})$.

Figure 1 shows normalized gain across 7 institutions in USA and the University of Sydney, data gathered from 1991 to 1999 [6]. Furthermore a number of different teaching methods are also captured. The black bars at the top show normalized gains for traditional physics instruction, the third is from the University of Sydney in 1995. The dark grey bars indicate students that participated in the mechanics ILDs, including a group from the University of

Sydney who participated in the ILDs in 1995. The light grey bars indicate results from institutions using interactive methods other than ILDs. The results shown in Figure 1 show that using ILDs can greatly improve student learning of mechanics as measured by the FMCE.

5. Experiences with the current ILD study

We implemented the five Kinematics and Mechanics ILDs with the Fundamentals 2007 cohort. Each ILD involves 5 to 8 demonstrations and each involves using the 8-step procedure shown in Table 2. Here we discuss our experience using them as part of a pre-existing lecture course, in the situation where most of us had never used ILDs before so we were complete novices.

1. The instructor describes the demonstration and does it for the class without measurements displayed.
2. The students are asked to record their individual predictions on a Prediction Sheet, which will be collected at the end of the session, and which can be identified by each student’s name written at the top. (The students are assured that these predictions will not be graded.)
3. The students engage in small group discussions with their one or two nearest neighbors.
4. The instructor elicits common student predictions from the whole class.
5. The students record their final predictions on the Prediction Sheet.
6. The instructor carries out the demonstration with measurements (usually graphs collected with micro-computer-based laboratory tools) displayed on a suitable display (multiple monitors, LCD, or computer projector).

The research-teaching nexus in physics

Table 2: The Eight Step Interactive Lecture Demonstration Procedure

1. The instructor describes the demonstration and does it for the class without measurements displayed.
2. The students are asked to record their individual predictions on a Prediction Sheet, which will be collected at the end of the session, and which can be identified by each student's name written at the top. (The students are assured that these predictions will not be graded.)
3. The students engage in small group discussions with their one or two nearest neighbors.
4. The instructor elicits common student predictions from the whole class.
5. The students record their final predictions on the Prediction Sheet.
6. The instructor carries out the demonstration with measurements (usually graphs collected with micro-computer-based laboratory tools) displayed on a suitable display (multiple monitors, LCD, or computer projector).
7. A few students describe the results and discuss them in the context of the demonstration. Students may fill out a Results Sheet, identical to the Prediction Sheet, which they may take with them for further study.
8. Students (or the instructor) discuss analogous physical situation(s) with different "surface" features. (That is, different physical situation(s) based on the same concept(s).)

7. A few students describe the results and discuss them in the context of the demonstration. Students may fill out a Results Sheet, identical to the Prediction Sheet, which they may take with them for further study.

8. Students (or the instructor) discuss analogous physical situation(s) with different "surface" features. (That is, different physical situation(s) based on the same concept(s).)

The interpretation and use of these eight steps is challenging.

5.1 Experiences with the Language of Physics module

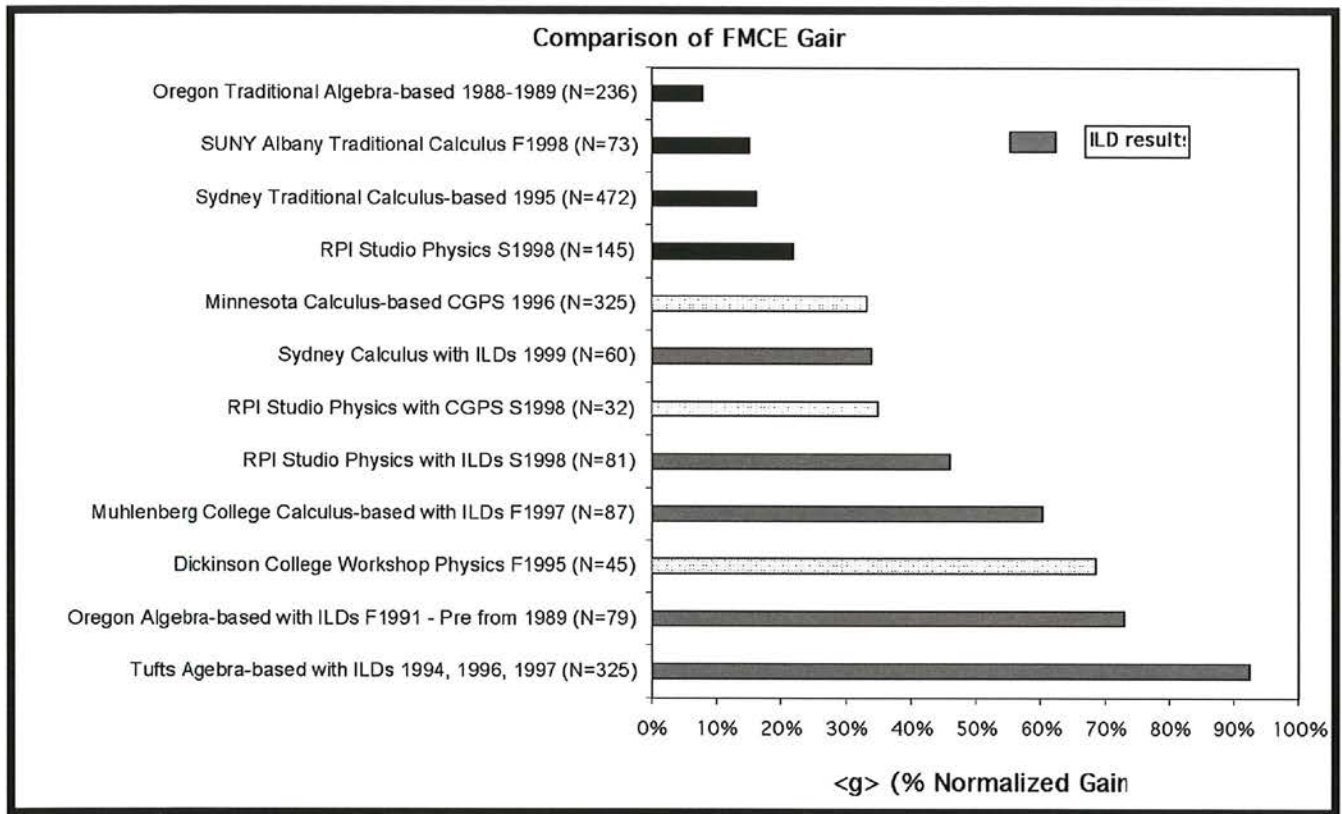
Dr Manjula Sharma and Dr Andrew Hopkins were the lecturers for the Language of Physics module, and they presented the first two of the five ILDs. These two demonstrations aim to make the concepts of displacement, velocity and acceleration more accessible and intuitive for students. This

is done through the real-time measurement and display of displacement-time, velocity-time and acceleration-time graphs, as an object (the lecturer, or a low-friction cart on a track) is made to undergo various kinds of motion (constant speed, constant acceleration). Both the hardware and software controlling the demonstration are simple and straightforward to use, and the graphs produced are large, well-labelled and visually appealing. Since the graphs are generated in real-time as the motion is taking place, the students (and the lecturer) can see exactly the consequence on the graphs of each of the various kinds of motion. This helps to cement elementary principles such as sign-conventions (e.g., motion towards/away from a detector), and the vector nature of motion (e.g., velocity towards/away from a detector having different signs). It also highlights the complex nature

of real motion, as the real-time displays show not only the period when the object moves at constant velocity, if that is the concept being demonstrated, but also the period when the object accelerated to that constant velocity, for example. If (as in this case) the object was the lecturer attempting to move at a constant velocity, the graphs also show very clearly any deviation from that motion (typically small, and sometimes not-so-small, oscillations about a roughly constant velocity). This has the advantage that the lecturer is required to explain the nature of data (uncertainties, measurement limitations), and that researchers focus on the data that obeys their selection requirements (concentrating on the constant velocity portion of the graph, and ignoring the initial and final accelerations).

The challenge in presenting this, and in following the 8 steps of Table

The research-teaching nexus in physics



2, is to maintain a careful balance. The lecturer needs a good sense of timing in order to describe the demonstration clearly, using a "dry run" by way of introducing the equipment and technique, then to give the students adequate time to make predictions and discuss them with friends, solicit predictions for how the graphs will appear, do the experiment, and finally discuss why the predictions were or were not correct. This process is repeated for each of the concepts being demonstrated, and the sense of timing is necessary in order to adequately explain each, while retaining enough time to complete the demonstration. Balance then needs to be struck between placing sufficient emphasis on explaining and describing the kind of motion being demonstrated in the context of the results shown on the real-time graphs, while acknowledging the other various features seen while not becoming too distracted or side-tracked by these. To help in achieving this balance it is necessary for the lecturer to take

some time beforehand to practice the demonstrations, to become familiar with the best techniques for operating the equipment to minimise artifacts appearing on the graphs, and to understand their origin in order to explain them in case they do appear.

Bearing all this in mind, the experience of actually presenting the ILDs was remarkably positive. The first ILD was quite straightforward to master with quite minimal practice (less than an hour), attesting to the ease-of-use of the equipment and software. Subsequent ILDs required somewhat more practice to attain a level of confidence in propelling the low-friction carts at appropriate velocities for each demonstration.

The students appeared to react quite positively to the presentation of the ILDs, taking part with loud enthusiasm in the prediction and discussion aspects of the demonstration. At least some of the more vocal students also showed an aptitude for the physics,

correctly predicting not only the motion being explored, but also how the detector would respond before and after that motion occurred. There was also positive feedback from a few students after the ILD lectures, including comments that seeing the graphs being generated in real-time helped to make much more sense of what each graph represented and how they described the motion.

5.2 Experiences with the Mechanics module

Dr Helen Johnston and Dr Kevin Varvell were the lecturers for the Mechanics module, where the final three ILDs were presented. These illustrated Newton's second and third laws and conservation of energy. The class was already thoroughly familiar with the basic set-up for the ILDs, the motion of carts and sign conventions and so on, so we only needed to demonstrate the action of the force probes, which are to directly measure and display on the screen the forces involved in various

The research-teaching nexus in physics

pushes, pulls and collisions. Like the kinematics demonstrations, each ILD consisted of 5 to 8 separate demonstrations, which are shown to the class without measurement, discussed and predicted, then carried out with measurement by the lecturer, following the procedure in Table 2. These ILDs required substantially more practice for the lecturers to feel they had mastered both hardware and software well enough to be able to present the ILDs in a seamless way. However, the immediacy of the display of the outcome of each demonstration made the physical concepts very obvious, for instance the display of equal and opposite forces during the Newton's 3rd law demonstration.

One problem we encountered in this section of the course was the challenge of fitting three ILDs, each of which occupies an entire 50 minute lecture, into a pre-existing lecture course. The ILDs should, at least to some extent, replace traditional lecture content explaining the material. However, we still felt the need to cover the concepts in lectures, particularly since it was the first time we had used them. This led to the module being rather more rushed than is desirable, and indicates the need for careful planning to incorporate ILDs into a course.

6. Summary

Overall, our experience with using the ILDs was positive. Three of the four lecturers had never used ILDs before, and in fact two of the four were teaching the material for the first time. We were pleased with the interaction which the ILDs generated, not only with the lecturer, but also between students. We noticed that it is quite difficult to stick exactly to the procedure outlined in Table 2. As the session proceeds, the tendency is not to allow sufficient time for

students to consider their answer, or to forget to tell them explicitly to discuss their predictions with their neighbour, or not to elicit all student predictions before the final demonstration. Doubtless this becomes easier as the lecturers become more proficient at running the ILDs. Our experience suggests there are no insuperable problems in including innovative methods like the ILDs into existing teaching programs.

In a followup article we will present the analysis of the pre- and post-test FMCE survey to explore the effectiveness of this very interactive approach to teaching physics. Physics has generally led the field in innovations in teaching and learning. This effort is particularly interesting as it has been initiated and is driven largely by research-intensive staff. We have capitalised on the opportunity raised by the presence of Prof. Thornton, and the availability of appropriate expertise and resources has made the project happen. We look forward to presenting more results in due time.

References

1. R. K. Thornton, and D. R. Sokoloff, "Learning motion concepts using real-time, microcomputer-based laboratory tools," *Am. J. Phys.* **58**, 858-867 (1990).
2. R. K. Thornton and D. R. Sokoloff, "Assessing Student Learning of Newton's Laws: The Force and Motion Conceptual Evaluation and the Evaluation of Active Learning Laboratory and Lecture Curricula," *Am. J. Phys.* **66**, 338-352 (1998).
3. R. K. Thornton, "Learning physics concepts in the introductory course, Microcomputer-based Labs and Interactive Lecture Demonstrations" in *Proc. Conf. on the Intro. Physics Course*, (Wiley, New York, 1996), pp. 69-85.
4. R. K. Thornton, "Using large-scale classroom research to study student conceptual learning in mechanics and to develop new approaches to learning," chapter in *Microcomputer-Based Laboratories: Educational Research and Standards, Series F, Computer and Systems Sciences, Vol. 156*, Robert F. Tinker, ed., (Springer Verlag, Berlin, Heidelberg, 1996), pp. 89-114. Also available on WWW.
5. R. K. Thornton and D. R. Sokoloff, "RealTime Physics: Active Learning Laboratory," *The Changing Role of the Physics Department in Modern Universities, Proceedings of the International Conference on Undergraduate Physics Education* pp. 1101-1118 (College Park, American Institute of Physics, 1997).
6. R. K. Thornton and D. R. Sokoloff, "Interactive Lecture Demonstrations: Active Learning in Difficult Settings," *Proceedings of the International Conference on Physics Education, ICPE2005*, Delhi, India, August 2007.

Reviews

FUSION06: AIP Conference Proceedings 853

L Corradi, et al., (eds.)
Springer, New York 2006
xvii + 510 pp., Euro 142.42 [hardcover]
ISBN 0-7354-0349-X

The triennial FUSION conference series is the major specialist forum for researchers studying nuclear fusion involving heavy nuclei (lithium and heavier). The 2006 conference "On Reaction

Mechanisms and Nuclear Structure at the Coulomb Barrier" was held in March on San Servolo Island, Venice. (in 2007 the conference was held in Australia).

In 510 pages, essentials of the 75 talks at the Venice conference are distilled. They were given by leading practitioners describing new measurements and insights since the 2003 conference. Major experimental advances include the formation (in Russia) of new metastable super-heavy elements

(with up to 120 protons), together with systematic measurements of the competing quasi-fission process. Particularly interesting, among new phenomena in the reactions of radioactive nuclei, is the behaviour of radioactive two-component neutron-halo nuclei, such as helium-6. Experiments indicate that the weak binding of the two halo neutrons to the alpha-particle core (resulting in the large radii of the neutron wavefunctions) changes the character of the nuclear interactions, and suggests the need for a new approach to understand and describe, theoretically, the reactions of such nuclei. One of the Australian participants gave new evidence for the failure of the "standard model" of nuclear fusion (also in the case of reactions of stable nuclei).

The introduction of the effects of quantum decoherence into the current formalism may be required in both cases.

To an expert, the contributions convey the current excitement and rapid developments in this field. However, they are aimed squarely at researchers in the field, and thus for the general reader, this

excitement is likely to be well-hidden!

David J Hinde
Department of Nuclear Physics
Australian National University



ISBN 3-540-32554-9

This book presents a comprehensive theory of coherent processes in semiconductor optics. As the title of the book indicates, it starts with the basic theoretical principles and concludes with the applications of optical and optoelectronic processes in nanostructure semiconductors.

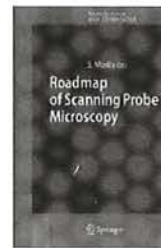
The development of the book in three parts provides readers learning various theoretical approaches in steps, which is different from most books where each chapter is developed from basic to advanced topics in steps. The Introduction chapter of the book is very informative and interesting to read. The rest of the book presents quite serious theoretical developments by considering the details of various interactions applicable in semiconductor optics. The book is very well organized and chapters on basic theories are condensed which makes it easy for readers to understand the ideas in progressive stages. Although Chapter 2 is titled as experimental techniques, it actually deals with the theoretical principles underlying them.

The book may be regarded as self sufficient in covering the topics on semiconductor optics. Not only crystalline and nanostructure semiconductors are considered, but the effect of disorders is also introduced very elegantly. It provides readers with the microscopic insight of the various linear and nonlinear optical properties of semiconductors and their nanostructures. The book may be expected to be very useful for graduate students and researchers interested in the theoretical principles in this field.

Jai Singh
Faculty of Technology
Charles Darwin University

Coherent Semiconductor Optics – From Basic to Nanostructure Applications

T Meier, P Thomas and S W Koch
Springer, Berlin 2007
xiii + 318 pp, EUR 64.15 [hardcover]



Roadmap of Scanning Probe Microscopy

S Morita (ed.)
Springer, Berlin 2007
xvii + 201 pp., EUR 96.25 [hardcover]
ISBN 3-540-34314-8

Scanning probe microscopy (SPM)

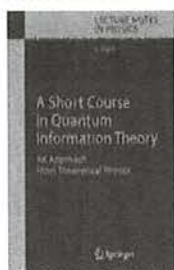
is a generic term describing the many techniques in which a sharp tip is scanned over a sample, yielding information (for example surface structure) about the sample with a resolution of ~0.01-10 nm, depending on the technique. This book results from a Japanese project aiming to predict the future development of SPM techniques and their potential applications out to the year 2020.

Each chapter focuses on one particular SPM technique or application, first describing the history and current status of the technique/application and then providing a prediction (the 'roadmap') for the future. Sadly, the book spreads itself far too thinly, consisting of 24 chapters, each typically only eight pages long. The descriptions and historical backgrounds for each technique are adequately written, but brief. (Several detailed and informative books describing SPM techniques already exist). While examples of recent technological developments are provided and often interesting, they are far from comprehensive and usually do not provide a complete picture of the current state-of-the-art.

As for the roadmap itself, the predictions tend to be vague and lacking substantiation and often represent no more than a footnote to the sections discussed above. It is not obvious what audience the book is targeted at, but it will most likely find a use as a reference text and starting point for further reading. Finally, the translation from Japanese to English is far from perfect, leading to additional irritation.

N J Curson
School of Physics
University of New South Wales

Reviews



A Short Course in Quantum Information Theory: An approach from theoretical physics.

L. Diosi
Springer, Berlin 2007
xi + 126 pp., EUR 37.40
[hardcover]
ISBN 3-540-38994-6

The best things about this book are its brevity and clarity. In around 100 pages it provides a tutorial introduction to quantum information theory, including problems and solutions. Starting from undergraduate quantum mechanics it covers key concepts and techniques. The emphasis is on fundamental theory with topics first introduced in their classical version, where appropriate.

Two chapters concern classical theory, including the first major chapter, "Foundations of classical physics", which introduces projective and non-projective measurements, for example.

The longest chapter is on quantum correlations, including the quantification of entanglement. The discussion of Bell's theorem may have to be updated due to the recent work of Christian, which seems to show that Bell's theorem is violated if hidden variables are allowed to be elements of the (quite natural) Clifford algebra extension of the parameter space [Christian, quant-ph/0703179].

Applications such as quantum cryptography are only outlined; quantum computation is dealt with in a mere seven pages, and there is almost no discussion of experimental aspects. The quaint language is distracting in places, and the bibliography is brief and dated. Finally, it's hard to see how the high price of such a thin volume of lecture notes is justified.

Nevertheless, it's worth a look if you want to quickly get up to speed with the language and central concepts of quantum information theory, including the background classical information theory. A serious student of the subject would do better with Nielsen and Chuang's much more comprehensive "Quantum computation and information".

*Craig Savage
Physics Department
Australian National University*



Exploring the Cosmic Frontier: Astrophysical Instruments for the 21st Century

A Lobanov, et al (eds)
Springer, Berlin 2007
xxv + 270 pp., EUR
85.55 (hardcover)

ISBN 3-540-978-39755-7

This collection of 70 papers is the proceedings of a symposium by the same name, hosted by the Max-Planck-Society in Berlin in May 2004. They discuss the new astrophysical facilities under construction and proposed for the next few decades, and the problems they will address.

Divided into five parts, eleven review papers cover instruments and explorations over most of the electromagnetic spectrum. These are supplemented by shorter notes (typically two pages) devoted to specific instruments or topics. The subtitle is a little misleading, for it is only the first part that is specifically devoted to future astrophysical facilities. The remaining four parts deal with general justifications for these observatories and instruments and how they may solve existing problems in cosmology, galactic and stellar evolution, and address the public interest questions of extrasolar planets and the origins of life. Many of the papers have good lists of references, including web sites.

One big problem with this text is the overwhelming, although necessary, abundance of acronyms. Although many of these become apparent on further reading, many are not defined at all. The editors would have markedly improved the volume with a glossary of this shorthand. Although the symposium was designed to explore the "complementarity and synergies" between the different areas covered, the assumed familiarity of the specific subjects and the technical level of the papers will confine readership to graduate students and researchers in astrophysical and related fields.

*John A Kennewell
Australian Space Academy
Meckering WA 6405*



New Superconductors: From Granular to High T_c

Guy Deutscher
World Scientific,
Singapore 2006
xvi + 222pp., US\$
52.00 [hardcover]
ISBN 981-02-3089-3

Superconductivity is one of the most fascinating subjects of quantum physics. The field has been flourishing with unprecedented activities after the discovery of high T_c superconductivity (HTS) in 1986. However, there has been an immense need for a modern book with similar style like the classic texts by De Gennes and Tinkham. Unfortunately such a text is yet to be in sight.

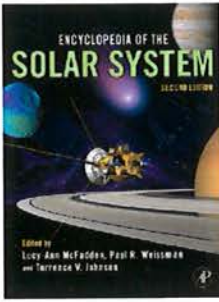
Guy Deutscher's book is a collection of selected topics as, in lecture notes. Those topics are preferentially chosen and ardently focused, where one easily finds the contrast between the new HTS with the conventional ones. Deutscher draws a parallel between HTS and granular superconductors because of several similarities in their properties. While this may be a part of the story, one wonders why the crucial physics of strong correlation in HTS is totally missing.

The book has first seven chapters dealing with the pedagogic aspect of superconductors. Deutscher recognises two important issues; (i) a pseudo-gap exists in the underdoped part of the high T_c phase diagram that may lead to a precursor of a superconducting gap and (ii) the van Hove anomaly of the electronic density of state leading to large value at the Fermi surface suggesting high value of T_c .

Last two chapters deal with a variety of prospects of low current applications. References for further reading are too sparse. I reckon the book is more suitable for someone with an engineering perspective, where fundamental physics, derivation of formulae and analysis of experiments are generally sans rigour.

*Mukunda Das
Theoretical Physics, IAS
Australian National University*

Reviews



Encyclopedia of the Solar System, second edition

Lucy-Anne McFadden, Paul R. Weissman and Torrence V. Johnson
Academic Press (Elsevier)

xx + 966pp., AUD\$180 (hardcover)
ISBN 0-12-088589-1

Available from: Elsevier Australia 1800 263 951 or customerservice@elsevier.com

The target audience of this book is schools, teachers, the general public, undergraduates and researchers looking for a general reference on the solar system. It achieves its aims admirably; being readable, well illustrated, informative, accurate, well indexed and with all glossary terms highlighted in the main text.

The book comprises 44 chapters and at just under 1000 pages in quarto format it is a very large and heavy volume – not

something that is easily read on your lap. I would have preferred to see it as 2 volumes for this reason. The book is arranged with introductory chapters on the solar system and its origins followed by the sun and solar wind, meteorites, the planets and asteroids, moons, rings, magnetospheres, comets, the Kuiper belt, the solar system at different wavelengths, planetary impacts, volcanism, astrobiology, planetary exploration missions and extrasolar planets.

Each chapter is written by one or more experts in a clear and concise style with limited mathematics so that the book will appeal to its intended audience. The inner planets have a couple of chapters each whilst the atmospheres of the gas giants are considered as a group as are their interiors. The Earth receives slightly more treatment with chapters on its atmosphere and oceans, surface and interior and on the sun-earth connection.

The book is up to date, including the reclassification of Pluto as a planetesimal but it is interesting to note

that the chapter devoted to Pluto is less accepting of the new classification than the introductory chapters. There is some overlap of material between chapters by different authors resulting in a few minor inconsistencies. For example, the introductory chapter on the formation of the solar system discussed the observations of extrasolar planets; mentioning the discovery of about 200 using Doppler radial velocity observations and transit observations. In the chapter devoted to extrasolar planets the most recent results from gravitational lensing and direct imaging observations of extrasolar planets, missing from the earlier chapter, are included.

Overall the inconsistencies are rare and quite minor and the book stands as an excellent reference for its intended audience including experts who want a single reference with a broad perspective of the solar system.

Marc Duldig
Australian Antarctic Division

Editor for Australian Physics

expressions of interest invited.

The Australian Institute of Physics is seeking an editor for Australian Physics. This is a part-time activity; remuneration will be by means of an honorarium, which is subject to negotiation.

The editor is expected to:

- provide editing services for Australian Physics; there are 6 issues per year
- develop, in consultation with the AIP Executive, a new editorial model for the journal including Branch representation, refereeing and sourcing reports, articles and other content
- liaise with advertisers
- prepare layout for the printer using appropriate software, and check printer's proofs
- be a point of contact for general enquiries

Expressions of interest, including a CV should be sent to:

A/Prof Brian James, School of Physics A28, University of Sydney, NSW 2006

Tel: 02 9351 2471; Fax: 02 9351 7726; email: B.James@physics.usyd.edu.au

Closing date 7th September, 2007

Product News

NewSpec P/L

Spectral Calibration Lamps



Newport's Oriel Pencil Style calibration lamps produce narrow, intense lines from the excitation of various rare gases and metal vapours. They are used for wavelength calibration of spectroscopic instruments such as monochromators, spectrographs, and spectral radiometers. Newport offers six different lamps each with excitation lines in a different spectral region. A range of accessories such as power supplies, lamp mounts, fibre optic couplers and aperture shields are available.

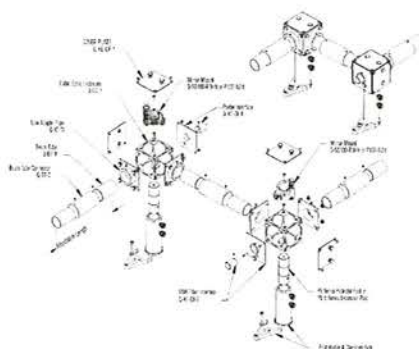
Key features

- Compact and simple tools for calibrating spectral instruments
- Narrow, discrete UV to IR wavelengths
- Excellent stability

For more information please contact Neil (Tel: 08 8273 3040, neil.mcmahon@newspec.com.au)

Aegis Cube Beam Routing System

The Aegis Cube™ Beam Routing System provides a modular and flexible



means for routing, shielding, and enclosing laser or similar light beams above an optical table. The system is composed of a hollow cube to hold and enclose a mirror mount, a stout post holder and clamping fork for mounting the cube to an optical table, and a large selection of tubes in various lengths to route the optical beam into and out of the cube. Cover plates are also provided to enclose the open sides of the cube.

The cube (Q-OC-1) will hold either a Newport SUPREMA or Performa series kinematic mirror mount. Both of these mirror mounts hold a 25mm diameter mirror or beam splitter. The Q-TMS-3 is a pedestal post holder with clamping fork, and is used to secure the cube to an optical table. The post holder is intended to be used with PS-series pedestal or extension posts that are at least 25mm long. The fork allows positioning of the post anywhere on the surface of the optical table. The Q-XE-TA-1 is a beam tube adaptor plate, which can be attached to any of the 5 open faces of the cube, allowing any of the Q-BT beam tubes to be interfaced to the cube. The fit between the Q-XE-TA-1 beam tube plate and the Q-BT beam tubes is designed to be loose to allow additional positioning flexibility. Set screws lock the beam tubes to the plates.

Key Features

- Encloses and routes optical beams

- Modular and flexible design
- Compatible with existing Newport mirror mounts
- Easy to assemble and align

For more information please contact Neil (Tel: 08 8273 3040, neil.mcmahon@newspec.com.au)

5-Axis Lens Positioner



Newport's new LA1V-XY and LPV-1 Compact Lens Positioners provides an economical solution for applications requiring two (XY) or five (XYZ θXθY) axes of precision adjustment. Their compact size makes them ideal for projects with limited space. Precise positioning is achieved with the integration of 100 TPI drive screws. Additionally, an integral M2 hex hole in the drive knobs allows for optional Allen key adjustment. Each unit is supplied with two non-marring Delrin retaining rings to safely secure optical elements with a maximum outer diameter of 1.0 in. (25.4mm). Post mounting on the LA1V-XY is achieved by accessing one of the tapped M4 threaded holes in the mount body. The LPV-1 is post mounted via a counterbored hole sized for M4 screws.

Key features

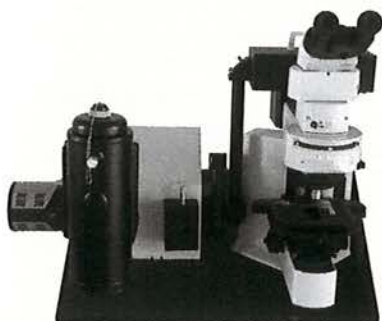
- Positions 1.0 in. (25.4) optical elements
- Precision positioning using 100 TPI adjustment screws
- Compact size is ideal for limited-space applications
- English/metric compatibility

For more information please contact Neil (Tel: 08 8273 3040, neil.mcmahon@newspec.com.au)

Product News

Coherent Scientific

Confocal Raman Microscopes from Princeton Instruments



PI/Acton's new TriVista Confocal Raman Microscope Systems combine the high resolution of their renowned triple spectrograph with an extensive range of high performance CCD detectors and upright or inverted microscopes. The result is a family of dedicated Confocal Raman systems with both macro and micro sampling capabilities.

At the heart of the TriVista Confocal Raman System (CRS) lies the TriVista triple spectrograph which allows investigation of minute structural changes requiring the highest possible resolution (up to 0.13cm^{-1}) and detection of low frequency Raman bands extremely close to the laser line (less than 5cm^{-1}). Its inherent tuning capabilities negate the necessity for multiple notch filters thus allowing several different excitation wavelengths.

Full integration with both upright and inverted microscopes allows spectral and structural information to be gained on the micro-scale. A high degree of confocality is achieved, thus improving fluorescence rejection and spatial resolution.

The TriVista CRS is seamlessly controlled through an intuitive yet powerful software interface. Switching between additive and subtractive modes is simply a mouse-click. Spectrograph calibration, grating selection and motion, slit and stage movements, as well as PI/Acton's complete range of CCD detectors are completely controlled within the software interface. Raman mapping and auto-focus software options are also available.

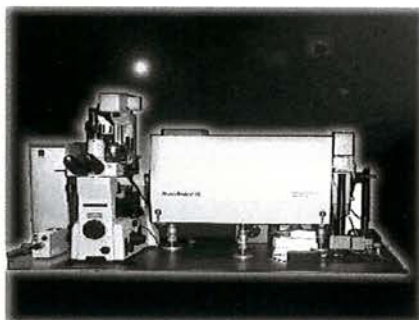
For less demanding applications,

the MonoVista Confocal Raman Microscope is also available and is based on a single, rather than a triple spectrograph.

For more information please contact

Dr Paul Wardill
Coherent Scientific
paul.wardill@coherent.com.au

Ntegra Spectra: Linking AFM with Spectroscopy



The use of micro-Raman spectroscopy has become an important tool for the characterisation of materials on the micron scale. The Ntegra Spectra from NT-MDT, combines state-of-the-art scanning probe microscopy (SPM) technology and scanning near-field optical microscopy (SNOM), with this powerful technique to enable the extraction of nanometre topographical information that contains spectroscopic information. The unique design enables in-situ Raman measurements for the effective exploration of evolving techniques, such as TERS (Tip Enhanced Raman Spectroscopy). Both inverted and upright configurations are available for transparent samples (such as single cells, tissue samples and biopolymers) and opaque samples (such as semiconductor materials, polymers, etc.), respectively.

For more information please contact
Dr Jen Weeks
Coherent Scientific
jen.weeks@coherent.com

Lastek P/L

nLIGHT launches "Pearl™" An innovation in High-Power Fiber-Coupled Architecture

nLIGHT is redefining the High-Power Fiber-Coupled Module Market with the formal introduction of its new Pearl™ product platform. The architecture cleverly uses multiple high-power AuSn-bonded, facet-passivated,

high-efficiency single emitters that are spatially combined into a single fiber core. Standard modules are now available up to 50W at 808nm and 5W at 639nm with detachable antireflective-coated 0.22 numerical aperture 400µm-core fibers. Samples at 88x and 9xx nm are also offered. The product is designed for a wide array of application spaces that range from pumping multiple gain media (including diode-pumped solid state lasers, disk lasers, fiber lasers) to direct diode-material interactions (including annealing, welding, cutting, surgical application) to laser-based displays.

Pearl™ is highly differentiated from pre-existing products, most notably in overall electrical-to-optical efficiency, which is typically in excess of 50%. Equally differentiating is the extreme reliability from the use of single emitters. Another key feature is low current operation enabled by configuring the single emitters in series. The 50W 808nm modules typically operate at 6A of current with a compliance voltage of 20V. The 5W 639nm modules typically operate at 1.3A of current with a compliance voltage of 21V. Standard wavelength tolerances are +/- 3nm (808nm) and +/- 4nm (639nm) with spectral widths less than 3nm.

This product also draws on nLIGHT's proprietary nXLT™ Diode Protection technology for its facet passivation to ensure maximum lifetime and high-brightness operation. Coupled with its compact size and plug-and-play electrical connections, Pearl™ provides the perfect solution for applications that require efficient and reliable fiber-coupled delivery of high brightness optical power.

Please see www.nlight.net.

For more information please contact Lastek at sales@lastek.com.au

New MM-16 Spectroscopic Ellipsometer from Horiba Jobin Yvon

The MM-16 is a competitively priced spectroscopic ellipsometer that uses liquid crystal modulators to modulate the polarization without any mechanical movement. This technology provides an ellipsometer that is very fast, very accurate, very compact and very simple to operate.

Product News

The MM-16 spectroscopic ellipsometer is unique in its ability to collect full spectral ellipsometric data and calculate the complete 16-element Mueller Matrix in < 2 seconds, in one measurement. As a result the ellipsometric angles Y and D are determined with very high accuracy and precision.

This unique feature extends the capabilities of a classical ellipsometer for the characterization of depolarizing and anisotropic samples.

The MM-16 spectroscopic ellipsometer provides experimental versatility including:

- Ex-situ and in-situ configuration, and;
- a large range of accessories and automation features fully compatible with the UVISEL spectroscopic ellipsometer.

The DeltaPsi2 software controls the MM-16 spectroscopic ellipsometer. The DeltaPsi2 software integrates a complete modeling and analysis database suitable for ellipsometry beginners as well as simple recipe procedure to automate both data acquisition and analysis for faster analysis.

The MM-16 is ideally suited for semiconductor, optical coatings, chemistry, biology, and in-situ real-time control applications.

Please see www.jobinyvon.com/

usadivisions/TFilms

For more information please contact Lastek at sales@lastek.com.au

High Finesse Releases Precision Laser Control System, plus Laser Spectrum Analyser available soon !

The Laser Control System is designed for controlling temperature and current of semiconductor laser diodes. Highly developed soft-turn-on and soft-turn-off circuits protect your laser diode from electronic transients while activating the current as well as from interruptions of the mains voltage.

The Laser Control System consists of two units, the laser temperature controller (LTC) and the laser current source (LCS). The LTC is designed for the temperature sensor PT10000 and thermo electric cooler (TEC) based on peltier elements.

LCS Technical Data:

- Extreme accurate temperature stabilisation (< 5 mK)
- Extreme low noise current driver - optimized for DFB-laser diodes
- Current output up to 200 mA @ 6 V; resp. 3 A @ 6 V
- Highest performance for competing prices!

The LSA is designed to analyse the multi-line or broadband spectrum of light sources like cw and pulsed lasers, gas discharge lamps, super luminescence diodes, semiconductor

laser diodes and LEDs.

LSA Technical Data:

- Spectral range: 350 – 1100 nm (Standard), 200 – 1100 nm (UV)
- Wavelength measurement: abs. accuracy 5 pm @ 633 nm
- Sensitivity for wavelength deviation: 1 pm
- Sensitivity: 5 nJ @ 633 nm
- High resolution stage: max. spectral range $\lambda/30$
- Spectral resolution: 30000 (SM fiber), 15000 (50 μ m fiber)
- First order resolution: 1 nm
- Linewidth measurement rel. accuracy: 5×10^{-6} (SM fiber)
- Repetition Rate up to 100 Hz

Please see www.highfinesse.com

For more information please contact Lastek at sales@lastek.com.au

Lastek Pty Ld
Adelaide University - Thebarton Campus
10 Reid St, Thebarton, South Australia
Toll Free: Australia 1800 882 215 ; NZ 0800 441 005
T: +61 8 8443 8668 ; F: +61 8 8443 8427
email: sales@lastek.com.au
web: www.lastek.com.au

Newport's new 1918-C Benchtop Performance in the Palm of Your Hand

Measure a lot, with just a little!
Newport's new 1918-C Series
handheld Power Meters bring the
leading edge performance and
advanced features you'd expect
to find in a benchtop instrument,
right into the palm of your hand.

In designing the 1918-C Optical
Power Meter, we combined the
feedback received from you the
customer, and our own 20+ years of
experience designing, manufacturing
and using laser measurement
instruments every day. The result is
an instrument that sets a new
standard in Optical Power Meters.

Whether you are using the power
meter to tweak up your laser, or in an
application such as laser spectroscopy,
multiphoton microscopy, biophotonics,
or nanophotonics, we think you'll be
impressed with the 1918-C.

Visit www.newport.com/1918-C



- > Compact and ergonomic design ideal for use in the lab and in the field
- > Power measurements from 1 nW – 6 kW
- > Energy measurements from 250 μ J – 75 J
- > Measurement rep rates up to 2 kHz
- > Built-in stand for flexible viewing
- > Compatible with all Newport “Smart” power and energy detectors

Contact us for a free copy of the Newport Resource catalogue

 **NewSpec**

Freecall 1800 153 811
Phone 08) 8273 3040
Fax 08) 8273 3050
sales@newspec.com.au
www.newspec.com.au
83 King William Road
Unley SA 5061
ABN 82 882 831 899

TMC™

Precision Vibration Isolation Systems for Photonics



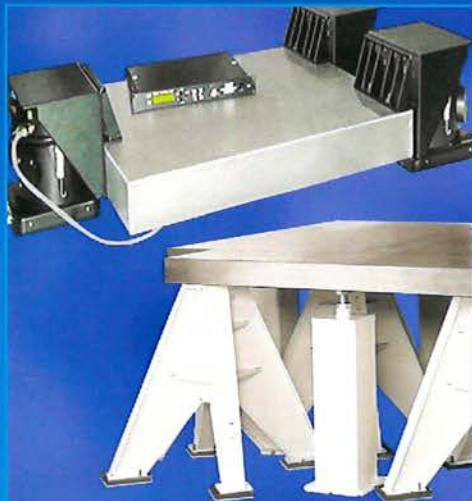
**Optical Tops
Breadboards
& Supports**



**Laboratory
Tables &
TableTop™
Platforms**



**STACIS® 2100
Active
Piezoelectric
Vibration
Control System**



**Raised &
Solid Floor
Platforms**



**Magnetic Field
Cancellation**



**2007
catalogue
available
today**

subscribe at
www.coherent.com.au

116 Sir Donald Bradman Drive,
Hilton SA 5033
Phone (08) 8150 5200
Fax (08) 8352 2020
Freecall 1800 202 030
sales@coherent.com.au
www.coherent.com.au

Coherent
SCIENTIFIC
Established in 1989

Coherent Scientific Pty. Ltd., Inc. in South Australia, ABN 20 008 265 969