The University of Sydney School of Physics

Alumni News

April 2005

Prime Minister's Prize for Science awarded to CUDOS head

Last September, scientists, teachers and dignitaries gathered in Parliament House for the annual presentation of the Prime Minister's Science Prizes.

Prof. Ben Eggleton in the CUDOS laboratory

And it was here that Professor Ben Eggleton was awarded the Malcolm Macintosh Prize for Physical Scientist of the Year, given to an Australian researcher under the age of 35.

Ben is the Research Director of the Centre for Ultra-high Bandwidth Devices and Optical Systems (CUDOS) and an ARC Federation Fellow here in the School of Physics.

The prize was awarded for "pioneering research in photonics, for his leadership in optical physics – connecting science and industry – and for the invention, and development of optical devices that will change our lives in the decades to come."

"The theme of my research has been not to use optical fibres as the pipes for information, but use fibres as switches and valves," commented Ben. At Bell Laboratories he invented and lead the team that developed an optical component that was commercialised by Lucent Technologies and subsequently deployed in high-speed communications networks.

Ben is motivated by the impact his research could have on our daily lives, in terms of more efficient telecommunications and computing.

At the awards night, Ben had the chance to chat with the then Minister for Science, Peter McGaurin, discussing research that CUDOS is undertaking, and the future of Australian science.

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An Excess of Success

Research in the School of Physics usually involves collaboration between people working at universities and research organisations across Australia and the world. And around the world. The recent awards and honours to School members certainly highlight this.

One successful collaboration is the Optical Fibre Technology Centre (OFTC), formed in 1989 as an interdisciplinary research group of the University. There is a close association between many OFTC and Physics staff. Several Physics PhD students spend much of their time working at the OFTC.

At the Eureka Prizes ceremony in August, a group from OFTC won the Australian Computer Society Eureka Prize for Information and Communication Technology Innovation. The list of ten participants included three Physics PhD students: Nader Issa, Alex Arygros and Steve Manos. It also included two Honorary Associates of the School, Maryanne Large and Martijn van Eijkelenborg, plus Leon Poladian, now based in the School of Mathematics and Statistics but with strong connections to the School over a long period of time.

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Headline

Assoc Prof **Brian James**

As you may know this year, 2005, has been designated by the United Nations as the International Year of Physics in recognition that physics provides a significant basis for the development of the understanding of nature, and that physics and its applications are the basis of many of today's technological advances.

To celebrate the IYOP, the School has mailed complimentary calendars for 2005, highlighting the School's current research and outreach, to all high schools in NSW. Other activities run through the External Relations Committee and the Physics Students' Society are under way. The School website www.physics.usyd.edu.au has more detail.

So why 2005? This year marks the centenary of the publication by Albert Einstein of three papers in different areas of physics which changed the direction of modern science. It is interesting to reflect on the significance of these three publications.

Max Planck had found that if he assumed that radiation was emitted and absorbed by matter in units or quanta of energy the blackbody spectrum could be correctly predicted. Einstein showed that there were advantages to considering electromagnetic radiation as a collection of particles, now called photons, and in particular it enabled him to explain the photoelectric effect, not explicable at the time in terms of classical electromagnetism.

In 1905 some still doubted the atomic nature of matter, but after Einstein's paper showing that easily observed Brownian motion was a direct statistical consequence of collisions of atoms with small particles, this view became untenable. His third paper that year, on special relativity, revolutionised our understanding of space and time, and energy. Although this is the work for which he is best known, he was actually awarded the Nobel prize in 1922 for his "services to theoretical physics and in particular his discovery of the law of the photoelectric effect".

All three papers were significant to the many following developments in quantum mechanics and our understanding of the structure of matter. So much of our current technology flowed from these beginnings. To this, Einstein later added the general theory of relativity, the foundation for modern cosmology.

The IYOP justifiably recognises that the last century has been dominated by scientific understanding and technology based in Physics. It is often stated that this century will be similarly dominated by biology. If this turns out to be correct it will in no small part be due to work of physicists as members of interdisciplinary teams (the discovery of the structure of DNA is surely a prime example of this), but also the contributions physicists are bringing to newly emerging disciplines such as complexity.

I wish all alumni of the School of Physics and the ISS a happy International Year of Physics.

Head, School of Physics
The University of Sydney

Delivering your Alumni News

If you are one of our School of Physics Alumni you will notice that Alumni News is now being mailed in sync with the University of Sydney's Gazette. By doing this we hope to give you a better overview of what's happening both in the School of Physics and on the University of Sydney campus. It also reduces paper waste and keeps our cost to a minimum.

As always Alumni News is for you, our alumni, and we value your input and encourage you to send us stories, photos and articles that update us on what you're doing, professionally or personally. Email Alison Thorn, Fundraising & Alumni Coordinator, at **a.thorn@physics.usyd.edu.au** with your contributions. If you would also like to receive our monthly e-newsletter, Alumni Update, then send your email details as well and we'll be happy to include you on the e-mailing list.

We hope you enjoy your latest copy of Alumni News and the University of Sydney Gazette.

Extragalactic Radio Station Provides History Lesson

You may not expect to find historians in the School of Physics. But a team of physicists from the School and CSIRO are unearthing the history of the largest galaxies in our universe.

An infrared image of TN J0924-2201, the highest redshift radio galaxy known to date, from the Keck 10-metre telescope in Hawaii, overlaid with radio contours from the Very Large Array in New Mexico.

PhD student Ilana Klamer, Prof. Dick Hunstead and Prof. Elaine Sadler from the School of Physics' Institute of Astronomy, and Federation Fellow Prof. Ron Ekers from CSIRO's Australia Telescope National Facility, are doing this by peering through the sands of time at distant radio galaxies

Why radio galaxies? Firstly, radio galaxies (those which can be seen in the radio wave part of the electromagnetic spectrum) are the most massive galaxies known. Secondly, present-day radio galaxies are always giant elliptical galaxies. Consequently, astronomers infer that the earliest, most distant radio galaxies are probably the progenitors of today's elliptical galaxies. Thirdly, radio emission is not absorbed by dust, which is a by-product of star formation. Radio telescopes can see straight through the dust back to the dawn of the universe.

A significant question about galactic evolution has emerged: have the massive galaxies of today formed from smaller galaxies merging or have they had their enormous structure for their entire existence? One way to find out is by investigating the content of carbon monoxide (CO) gas in the most distant observed galaxies.

"It is the astronomical equivalent of taking baby photos of one's relatives, to see what one's childhood was like."

These galaxies are located over 12 billion light years away which, thanks to the finite speed of light, also means we observe them on Earth as they were 12 billion years ago – just 1.5 billion years or so after the Big Bang.

Klamer and her colleagues recently used the Australia Telescope Compact Array in Narrabri, NSW, to discover roughly 100 billion solar masses of molecular gas in the most distant radio galaxy known to date: the galaxy known as TN J0924-2201, located approximately 12.5 billion light years away. Observing the galaxy at the lowest characteristic radio frequency of CO gas, they finally detected a signal after 35 hours. To make sure they had really seen CO, a month later they returned to look for a second frequency of CO radio emissions – and found the signal after observing for 40 hours.

These observations were amongst the first with the Australia Telescope's new millimetre receivers, funded mostly through the first round of the Commonwealth Government's Major National Research Facilities program. This detection is the first of its kind in Australia and one of only a handful of successful detections of CO in extremely distant galaxies worldwide.

The data revealed copious amounts of carbon monoxide, suggesting previous generations of stars had already manufactured these elements. The time needed for this amount of star formation was pretty tight – let alone the extra time required to produce stars in smaller galaxies, and then merge the galaxies to form TN J0924-2201. Additionally, the soup of molecular gas in this early galaxy looks similar to today's elliptical galaxies.

So the opinion of these extragalactic historians is that these massive galaxies have quietly existed in their current form for most of the universe's existence.

For more information about research in the Institute of Astronomy, visit their web site at **www.physics.usyd.edu.au/ioa/ioa.html**

An optical image of a typical elliptic galaxy, M87, from the Anglo-Australian Telescope in Coonabarabran, NSW. TN J0924-2201 will likely grow up to look like this. Anglo-Australian Observatory.

Profile: The Honorable Ellen Gesmer

I(SS) Witness Account

The Honorable Ellen Gesmer, now a Judge in the Civil Court of the City of New York, attended the Professor Harry Messel International Science School (ISS) in 1966. Alumni News spoke to Judge Gesmer about her memories of her time at the ISS.

The Honorable Ellen Gesmer

What was your biggest impression of Professor Harry Messel International Science School?

I was most impressed by being with a large group of high school students who all wanted to spend their summer vacations studying physics and math. I was also impressed by the quality of the lectures, and the extraordinary joy that the lecturers conveyed about their subjects.

Like many students interested in science and math, I sometimes felt myself to be an oddity at my school. It was a tremendous luxury to be surrounded by students who revelled in using their extraordinary intellects to explore their love of science.

Did visiting the University of Sydney make an impact on you?

It was the first time that I had spent time in another culture. Although the US and Australia are similar in many respects, I saw many differences too. As a result, I began to see that aspects of American culture that I had assumed to be universal were unique to America.

With the world the way it is at the moment, do you feel the ISS, in its own way, can help foster a better understanding between different cultures and countries?

The ISS enables young scientists to meet their peers from other countries. Hopefully, many ISS participants stay in touch with their new friends over the years (as I have), and will continue to learn about and appreciate their friends' cultures.

You are now a Judge working in the Civil Court of the City of New York. What's a typical day in court?

I'm happy to say that I have no typical day. Sometimes I preside over trials; on other days, I hold dozens of conferences in cases that are not yet at the trial stage.

I hear all kinds of civil cases. They include suits for damages arising out of car accidents, disputes between credit card companies and customers, and disputes between family members over loans or damaged property. Recently, I held an attorney in contempt because he had caused a woman's bank account to be frozen, even though the lawsuit against her had been dismissed.

Do you think that science helps you when you're making decisions that will directly impact people's lives?

Definitely – or, if not science per se, a scientific way of thinking.

> **"I approach cases in a very logical manner, which I attribute in part to my scientific background. I think my approach helps me to weed through the evidence that I hear and focus with precision on the most important information."**

You've been a supporter of the Messel Endowment since it's establishment in 1999. Given that your career now revolves around law why do you feel it's important for the Science Schools to continue in perpetuity?

I think the Science Schools provide a unique opportunity for young science scholars from around the world to meet and get to know each other, while being exposed to some of the most amazing lecturers and teachers in physics.

You recently attended a dinner, hosted by the Consul General in New York, to honour the Science School's founder, Emeritus Professor Harry Messel; how did it feel to see Professor Messel after all these years?

A total delight – he hadn't changed at all!!

Finally, do you have a message that you would like to give to future ISS Scholars?

If you choose to pursue a different field, your time spent studying math and physics will enhance your ability to think logically and creatively in any field.

Farewell to Dr Jenny Nicholls …

… and welcome to Dr Chris Stewart …

… and Ms Alex Viglienzone

Staffing update:

Hello, I Must Be Going

After eight years with the Science Foundation for Physics, Dr Jenny Nicholls left the position of Executive Officer in September 2004. Over her time with the Foundation, Jenny organised four Professor Harry Messel International Science Schools (ISS), including the most recent, 'From Zero to Infinity', in July 2003.

An astrophysicist, Jenny started at the School of Physics in 1990 as a researcher. Emeritus Professor Richard Collins, then Head of School and Director of the Science Foundation, was impressed by Jenny's efficiency in organisational and administrative abilities and soon persuaded her to join the Foundation.

In addition to her many other duties (not the least being editor of *Alumni News!*) Jenny co-edited the ISS Book, compiled from the lectures given at the ISS and distributed, at no cost, to every secondary school in Australia.

"In her role as Executive Officer, Jenny was greatly respected by both the Foundation's Council and ISS alumni, who sent her piles of thank-you cards following each School."

Jenny told Alumni News that she is looking forward to a well-earned break and exploring new interests.

The Science Foundation is pleased to announce that Dr Chris Stewart has been appointed to fill Jenny's shoes as the Executive Officer. Chris has an avid interest in science communication and has demonstrated the Foundation's motto of 'The Pursuit of Excellence' by winning the 2004 Faculty of Science Teaching Award. He is looking forward to working with the Foundation Council and the School of Physics to push the Foundation's work into new and innovative areas, and is already hard at work organising the ISS2005, *Waves of the Future*.

But Chris isn't the only new addition to the Foundation – Ms Alex Viglienzone has also joined the ranks as Administrative Officer. Alex has worked with the School of Physics for a few years off and on, in the main office and with VisLab. She is a welcome addition to the Foundation's staff.

Prime Minister's Prize for Science awarded to CUDOS head *continued from page 1*

The research of the CUDOS team into new optic fibre technology may one day lead to far more powerful computers that transmit and modulate information using photons not electrons.

Conventional electronic circuits, as used in computers and telecommunications today, are limited by the resistance of semiconductors, and speed with which electrical currents can flow and interact. Photonic devices have the advantage that they literally operate at the speed of light. Most importantly the switching speed of optical devices can be thousands of times faster than switching speeds of electronic devices.

In much the same way as computers have shrunk from the size of a room to now fitting on a pinhead, the CUDOS team are working towards a small scale "photonic chip".

Recently, the CUDOS group has had breakthroughs in nanowires and microfluidics. Ben and his team have invented photonic nanowires ~ microscopic silica wires that can guide light over small scales and represent the building blocks for photonic circuitry. In their microfluidics research, they have developed ways of monitoring fluid samples on the microscopic scale with important applications in the bio-medical industry.

An Excess of Success *continued from page 1*

Dr Clive Baldock

Dr Geraint Lewis

Dr Manju Sharma

It is worth noting that Steve and Alex first became involved in this research via a project in the Physics Talented Student Program. The TSP is a key part of the School and Faculty efforts to attract and retain the very best students.

Also featured at the Eureka Prizes was Peter Tuthill, one of three finalists for the UNSW Eureka Prize for Scientific Research, but unfortunately not the winner. Peter's nomination was for innovative research that has pioneered a novel approach to high resolution astronomical imaging, revealing in exquisite detail a cosmic menagerie of stars and other phenomena at infrared wavelengths.

A big year for research

Collaboration also featured strongly in grant successes for the School, announced late in 2004. The ARC LIEF program funds infrastructure and equipment and requires collaboration between institutions. Among the successes was Gordon Robertson's national project worth almost $1.5 million to fund Australia's involvement in the International Gemini telescope project. $900,000 went to a project using a variety of innovative techniques for Imaging of Cells, Tissues and other Materials, shared between several universities. Sydney participants were Peter Lay from Chemistry with David McKenzie and Ben Eggleton from Physics.

As part of the School's rapidly increasing interests in Medical Physics, Clive Baldock (Physics), Steve Meikle (Health Sciences) and Roger Fulton (Royal Prince Alfred Hospital) received $200,000 from the NSW Cancer Council to develop motion compensation techniques in PET imaging for improved cancer diagnosis and treatment. Around $2 million more, spread over several years, was awarded in various other research grants to members of the School.

Honours all around

Several individuals in the School had their work recognised recently. As mentioned in the article on the cover, Ben Eggleton – Federation Fellow and head of CUDOS – received the Malcom McIntosh Prize for Physical Scientist of the Year at a ceremony held at Parliament House in September.

Laszlo Kiss has been awarded a University of Sydney Postdoctoral Research position, one of only 12 from 243 applicants, for his work on pulsations in red giant stars. Several other research-only staff – Justin Blows, Zdenka Kuncic and Qinghuan Luo – have been promoted in recognition of their work.

Reza Hashemi-Nezhad was awarded the High Energy Physics Robert M. Walker medal at the 22nd International Conference on Nuclear Tracks in Solids. The medal is announced bi-annually to honour an individual or group of scientists who have made an outstanding contribution to 'track science' in high-energy physics.

Geraint Lewis received the Selby Research Award, given to assist an outstanding academic within five years of their first appointment at the university, to establish his or her research career. Geraint received the award to assist with his research on galactic archaeology: unravelling the history of our galaxy by looking at the astronomical structures that surround us in space.

Chris Stewart and Manju Sharma have collected two of the three Faculty of Science Teaching Awards for 2004. Manju is the head of the Sydney University Physics Education Research (SUPER) group and collaborates with Chris, studying ways to improve the learning experience for our undergraduates.

Finally, with all the changes in the School in recent years and the emphasis on the academic performance of the School, it is a pleasure to acknowledge the contribution of three members of the general staff who received long service awards from the University: Barry Napthali and David Young for 15 years' service, and Phil Denniss for 25 years' service.

Who did we miss?

With so many alumni from the School and the ISS, we're certain to miss individuals who have been honoured, awarded, funded, or who have simply excelled in their own way. Know of someone who deserves a mention in Alumni News? Let us know: **scifound@physics.usyd.edu.au**

Messel Endowment and ISS Update:

A Million Reasons to Encourage Indigenous Science Scholars

The Messel Endowment launced its Capital Campaign at the Science Foundation for Physics' 50th Anniversary Dinner on 5 March 2004 in the Great Hall. The Campaign seeks to raise $4.5 million over the next three years for the Professor Harry Messel International Science School so it may continue in perpetuity.

The Australian Government's Department of Education, Science and Training (DEST) has made a $1 million capital contribution to the Messel Endowment, the fundraising campaign set up to provide for the Professor Harry Messel International Science Schools in perpetuity.

The Minister for Education, Science and Training, Dr Brendan Nelson said, 'I am pleased to announce that the International Science School will initiate a strategy to actively encourage the participation of Indigenous students. The Commonwealth Department of Education, Science and Training will be assisting this strategy by promoting the School to Indigenous students across Australia.'

In 2003 there were more than 400 Indigenous students throughout Australia enrolled in courses of tertiary study in engineering, the mathematical sciences, and the natural and physical sciences. By enrolling in the Professor Harry Messel International Science School more Indigenous students may be inspired to participate in these courses.

Presenting the cheque before an enthusiastic audience in the CUDOS Laboratory at the School of Physics, Dr Nelson also added, "I commend Professor Messel for his visionary creation and for his tireless enthusiasm for science. Over five decades he has inspired many thousands of science students. Now, through the Science Foundation for Physics and the International Science School his legacy will continue for many future generations.'

The Minister for Education, Science and Technology, Dr Brendan Nelson, presents a Big Cheque for $1 million to Foundation Governor Albert Wong, Messel Endowment Chair John Hooke, Vice Chancellor Gavin Brown, Emeritus Prof. Harry Messel and Foundation President Pat Donovan.

For more information on supporting the **Messel Endowment** please contact **Alison Thorn** on +61 2 9036 5194, **email** a.thorn@physics.usyd.edu.au or **visit** http://www.physics.usyd.edu.au/messel/index.htm

Waves of the Future coming in July

The 33rd Professor Harry Messel International Science School, Waves of the Future, will run from 3–16 July 2005. In a nod to the International Year of Physics, this year's School will have a heavier than usual emphasis on physics and its impact on other fields of science.

The ISS2005 lecture series includes Dr Raffaella Morganti from the Netherlands Foundation for Research in Astronomy, Prof. David Cockayne from the Department of Materials at the University of Oxford, laser physicist Prof. Halina Rubinsztein-Dunlop from the University of Queensland, and many more. The School of Physics's own Prof. Martyn de Sterke, Dr Clive Baldock and Prof. Peter Robinson are also giving lectures at the ISS this year.

For those who can't attend the ISS, this year's lectures will be webcast in collaboration with the ABC's Science Online website. Visit the ISS website scienceschool.usyd.edu.au for more details as the School approaches!

A reception to thank all ISS and Messel Endowment supporters will be held on Wednesday 13 July 2005 in the University's beautiful Great Hall, providing a wonderful opportunity for Scholars to meet personally with supporters and ISS Alumni.

For information about the **International Science School** contact **Dr Chris Stewart** on +61 2 9351 3622, **email** c.stewart@physics.usyd.edu.au or **visit** www.physics.usyd.edu.au/foundation

Where are you now?

Alumni report on themselves

Colin Mathers

(BSc 1975, PhD 1979)

Colin studied in Theoretical Physics Department under the supervision of Dr Neil Cramer. While at the School of Physics he was active in the School's Uranium Power Study Group, who contributed to the public debate on uranium mining in Australia. He developed an interest in the assessment of risks to population health and in epidemiological research, and following his PhD worked with the Commonwealth Institute of Health and Tropical Medicine to develop a database and statistical analysis system for monitoring the incidence of congenital malformations in Australia.

Moving to Canberra, Colin joined the Australian Institute of Health in 1986 where he published on health inequalities, and trends and summary measures of population health. Colin also pursued his interests in karate, jujutsu and various Japanese weapons disciplines. He represented Australia at the Sixth World Jujutsu Championships in 1995, winning silver, and was graded to fifth dan black belt in jujutsu in 1999.

We welcome contributions to this column

Colin moved to Geneva, Switzerland in 2000 to work with the World Health Organization, where he is now responsible for analysis and reporting on global mortality and the burden of disease. He has published numerous scientific papers and has written and edited several books on the topic, as well as two books on jujutsu. Colin has two teenage daughters in Australia, one now also studying at Sydney University, and a one-year-old son born in 2003 in Geneva. Apart from travel in Europe, Colin has also enjoyed the opportunity to walk in the Alps and to improve his skiing and white-water kayaking skills.

Dr Karl at large

Dispelling popular Mythconceptions: Quantum Leap

If you hang about in business circles, about once every month, you'll hear somebody say something like, "...and my plan will give a huge quantum leap in performance". The problem with this is that a quantum leap is not huge – in fact, it's the smallest possible change.

The first thing is to realise about quantum mechanics is not to worry if you don't understand it – you are in very good company. That's because quantum mechanics is very weird, and often goes against common sense. A typical example is: "The electron that is orbiting around the centre of that hydrogen atom is indeed orbiting around the centre of that hydrogen atom – but at the same time, it is everywhere else in the universe at the same time." You can see that quantum mechanics goes against the grain of every sensible atom in your body. But quantum mechanics works – almost all electronic devices that we use today were developed with the insights gained from quantum mechanics. That includes your mobile phone, TV, and the computers on your desk and in your car.

Quantum mechanics deals with the behaviour of matter and light on a very small scale – the land of atoms and sub-atomic particles. The times and distances involved are many billions of times smaller than we deal with in our normal existence.

One fundamental concept to quantum mechanics is that energy can be exchanged only in little packets. When you drive your car, it seems you can pick any reasonable speed you want. But if we scaled things down into the microscopic quantum world, we could vary the speed from one definite number (say, 45 km/h) only to the next number above it (say, 46 km/h) – and there would be no speed in between. It would be impossible for the speed of 45.5 km/h to exist.

This is almost certainly how the myth that quantum leaps are big, came into existence. A quantum leap is a very definite leap. You have left one state of existence (say 45 km/h) and reappeared in a very different state (say 46 km/h).

So when business people talk about "quantum leaps", they are really saying that there will be a definite change – but also, that it will be measurable only with the most sensitive devices made by the human race. So as the term "quantum leap" went from physics into common usage, it changed its meaning from very small to very large.

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