Australian Synchrotron

LIGHTSPEED August 2010

TOP STORIES

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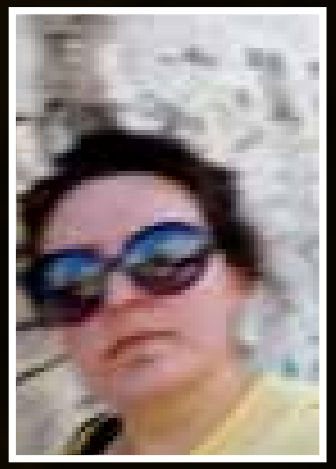
From the Acting Director



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Background image:Equipment detail from the SAXS/WAXS beamline at the Australian Synchrotron

From the Acting Director - An event for everyone

The Australian Synchrotron Open Day on 15 August 2010 is an important occasion for us and a great opportunity to showcase our facility to several thousand members of the public. Our open days enable us to share our enthusiasm for synchrotron science and demonstrate the benefits that research undertaken at the Australian Synchrotron offers the community. This year, Open Day will also kick off National Science Week, celebrating the importance of the Australian Synchrotron in the local science, development and innovation landscape.

Another way we're working to increase support for the Australian Synchrotron is through consultation with government stakeholders and foundation investors. Following an extensive consultative process, the Australian Synchrotron recently completed and submitted its strategic growth and expansion plans to the Victorian and federal governments. The documentation, which comprises a comprehensive Investment case and a detailed 'science case', was also provided to the New Zealand Synchrotron Group. We look forward to further discussions and negotiations with our major stakeholders.

The Science Case includes an exciting plan for expansion of the Australian Synchrotron by adding 10 new beamlines to our existing suite. A team of national and international experts has rigorously reviewed the final document, which we feel represents a robust and rational plan for the future of our Facility.

In July 2010, the Hon. Kim Carr, Minister for Innovation, Industry, Science and Research, launched the Australian Collaboration for Accelerator Science (ACAS). ACAS unites the Australian Synchrotron, the University of Melbourne, The Australian National University (ANU) and the Australian Nuclear Science Technology Organisation (ANSTO) in a collaboration that will help us to maintain state-of-the-art accelerator-based facilities in Australia and train a new generation of young Australians to continue our contribution to this critical area of research.

Also in July, we hosted the second Australian Synchrotron Winter School. We received positive feedback from everyone involved, with all participants ranking the school as either 'excellent' or 'very good'. The Winter School was an excellent opportunity to work closely with the Australian and New Zealand Association for the Advancement of Science (ANZAAS) to encourage early career researchers to further develop their careers. ANZAAS presented the three most outstanding Winter School applicants with awards in recognition of their achievements. I would like to offer my congratulations to the recipients: Yuan Mei (University of Adelaide), Matthew Dunstan (University of Sydney) and Kasimu Yiliyasi (University of Sydney). We are already planning our 2011 Winter School and I ask you to encourage any young scientists you work with to consider applying for this school to help advance their scientific career.

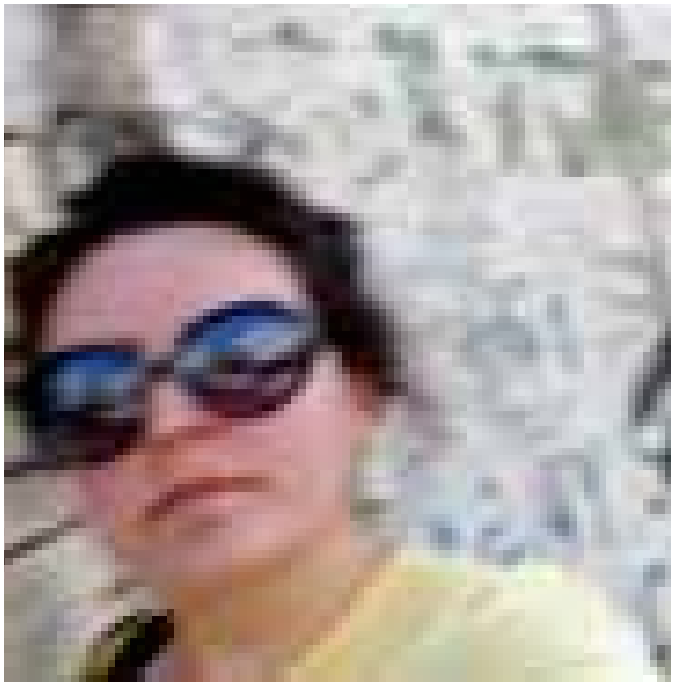
For many of you, our most important news is the announcement of our 2010 User Meeting, which will take place on 22-24 November. We are looking forward to welcoming users and synchrotron scientists from around the world. This meeting will enable current and potential users to hear from local and international synchrotron experts and swap ideas about how to make effective use of the experimental facilities here at the Australian Synchrotron. We have already had strong interest in this event and I encourage you and your colleagues to register early to avoid disappointment as places will be limited.

And finally, at the Australian Synchrotron we are always interested in your feedback. If you have a few minutes, please consider completing our short online survey about Lightspeed. Your input is crucial to ensure we continue to make effective use of this channel to provide you with timely and relevant information and help us improve and refine this publication to better meet your needs.

George Borg

Chief Operating Officer, Australian Synchrotron

Up to speed: Christine Latif



This month our short interview features Christine Latif, head of external relations at the Australian Synchrotron.

Describe your job in 25 words or less.

I look after relationships with external stakeholders – everything from organising user events and education programs to writing annual reports and communicating with government.

Our team helps promote the important work of the synchrotron, while also providing the organisation with an overview of the environment we're working in. *(Editor's note: I had to let her get away with more than 25 words – she is my boss, after all!)*

Best aspect of your job?

The people I work with – I've got a great team and colleagues and the vestigial geek left from my research career loves hearing about the work that's done at the Australian Synchrotron.

Worst aspect of your job?

Having to deal with last minute requests that aren't always as important as the tasks at hand.

Best things about living in Melbourne and why?

I love the fact that you really only get to know Melbourne by living here... all the best stuff is tucked away and half the fun is finding it.

Your favourite overseas destination and why?

New York, I'm obsessed! I watched Breakfast at Tiffany's as a kid and fell in love. I was worried when I first went it wouldn't meet my expectations, but it did... and then some!

What are the biggest achievements to date for your section at the Australian Synchrotron?

Broadening our work with some of our partners, getting some really positive media (a personal buzz!) AND finally being able to give a tour on my own despite my limited knowledge of physics!

What is the biggest challenge for your section at the Australian Synchrotron?

Getting things done to the standard I like to see while dealing with so many demands on our limited time and resources.

What's the most unusual or interesting question you've been asked about the Australian Synchrotron?

How hot does the beamline get? Really, I didn't know whether to laugh or give a technical answer. Kind of depends whose beamline! (The technical answer is that we use lots of liquid nitrogen to cool down some of the equipment because filtering out the light we don't need basically means absorbing the unwanted light energy – and that can generate quite a bit of heat.).

Open Day is almost here

The Australian Synchrotron Open Day on Sunday 15 August 2010 is your chance to encounter one of Australia's most exciting scientific facilities and see how synchrotron science can make life better for everyone.

We will offer tours, activities for kids, photography competitions and even the first online opportunity to see this unique facility. Come and see us for yourself...

10.00 a.m. – 4.00 p.m.

800 Blackburn Road, Clayton (car park entry off Wellington Road only)

Entry is free but bookings are essential.

If you'd like to volunteer your assistance behind the scenes, please contact Melissa Moyle at openday@synchrotron.org.au

This event is hosted as part of National Science Week.

Australian Synchrotron Open Day on Sunday 15 August 2010

Beamtime applications August 2010

Beamtime submissions open on 7 September 2010 and close 6 October 2010 for round 2011/1 (January-May 2011).

Key dates for beamtime submissions are listed on the synchrotron website at: http://www.synchrotron.org.au/index.php/features/applying-for-beamtime/2010-proposals-schedule

If you would like to discuss your ideas for future beamline proposals with the beamline scientists at the Australian Synchrotron, please allow plenty of time.

For more information about applying for beamtime at the Australian Synchrotron, contact the User Office: user.office@synchrotron.org.au

Something old, something new

Mark Eccleston from La Trobe University is studying ancient Egyptian artefacts coated with a blue-green glaze called faience.

Have you heard the one about the archaeologist, the physicist and the mineralogist? It's not just the beginning of a good joke, it's a team using the Australian Synchrotron to help reveal the methods used to make ceramics and jewellery in ancient Egypt during the reign of Pharaoh Akhenaten.

La Trobe University archaeologist Mark Eccleston is investigating the use of metals, primarily copper and copper alloys such as bronze, in Egypt during the New Kingdom (from around 1500 to 1100 BC). The work focuses on the site of Amarna, which was established as a royal capital during the reign of Pharaoh Akhenaten, who completely revolutionised Egypt's religious and political landscape.

"Amarna was only occupied for about 25 years," Mark says. "So it's a unique time capsule of life at around 1350BC."

Recent excavations at Amarna show that the metalworking industry and the faience industry were sometimes located together. Faience is a quartz-based, glazed material that is often light blue or green in colour due to copper or bronze.

"I'm interested in how the workshops were organised and what raw materials they used. One thing we'd like to know is whether the copper was added to the glaze mixture as a metal, a mineral or in some other form. At present this is not known, but it has been speculated that it was metals and not a mineral. We hope synchrotron techniques will give us a better understanding of the chemistry and mineralogy of the copper in the faience so we can prove this one way or the other."

From a broader perspective, identifying the raw materials will also provide insights into the micro-economic aspects of the industry, trade and distribution of raw materials in the wider economy and how different trade activities were organised within wider city life.

Mark is working closely with La Trobe physicist Peter Kappen, with assistance from Museum Victoria mineralogist Dermot Henry, and Kia Wallwork and other beamline scientists from the Australian Synchrotron.

Mark and Peter are using the x-ray absorption spectroscopy (XAS) and powder diffraction (PD) beamlines at the Australian Synchrotron with additional XAS studies at HASYLAB (Hamburg synchrotron radiation laboratory) in Germany.

Mark says their latest visit to the Australian Synchrotron XAS beamline, in June 2010, has "advanced our knowledge of the structure of faience and allowed us to direct future research proposals to target areas of interest identified in work to date.

"It has also been an invaluable pilot project in relation to working with museum collections, as we've been able to demonstrate quite convincingly the ability to analyse whole objects in the beamline."

"Based on our powder diffraction results at the Australian Synchrotron, we're hoping to actually fire some replica faience in the PD beamline's new furnace and monitor the change in structure over time. We'll start with a known group of materials and see what they look like after taking them to 900 degrees."

Mark and Peter will travel to HASYLAB in September for XAS work.

"One of the main reasons for going to Germany is to collaborate with the Neues Museum in Berlin, which has a major collection of material from Amarna. It's now impossible to export samples from Egypt for analysis, so accessing a collection outside of Egypt that is very well-documented in regard to where it was found is very important to being able to make some conclusions that relate to the industry at a specific site and time period in history."

The HASYLAB results will contribute to a reference database of results that the team can use to plan future work on the PD and XAS beamlines at the Australian Synchrotron.

Switching channels

Australian researchers have made a significant discovery about the biological mechanisms controlling the electrical currents that underpin sensory perception and nervous system function in humans.

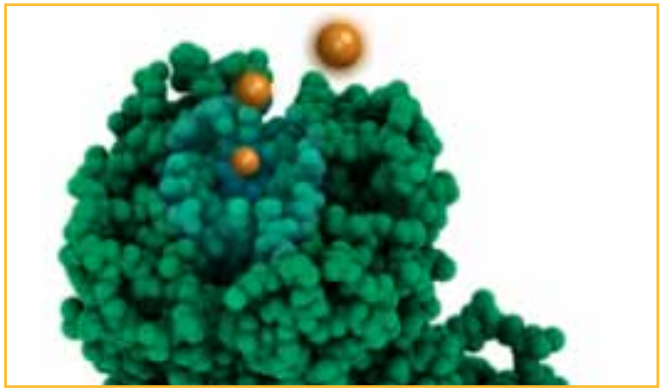
A collaborative research team from the Walter and Eliza Hall Institute (WEHI) and the Victor Chang Cardiac Research Institute has made a significant discovery about the mechanisms controlling electrical currents in the human body, using the facilities at the Australian Synchrotron.

Electrical currents within the human body involve coordinated interplay between different types of ion channels and underpin most bodily functions. Potassium ions and other ions carry charge, and as they pass through channels in the membrane the flow of particles can be measured as an electrical current.

"Potassium currents across cell membranes are important in many cellular processes, particularly those involving communication between cells," says Jacqui Gulbis from WEHI. "They play an essential role in the electrical signalling underlying organ function, sensory perception and neurotransmission. In the heart, for example, contractions occur in response to the rhythmic ebb-and-flow of potassium. Specialised pores responsible for these currents, known as potassium channels, are highly selective for potassium over other ions.

While previous studies have revealed the appearance and electrical properties of potassium channels, there is still only a very limited understanding of the molecular mechanisms by which conduction is switched off and on in response to regulatory signals.

Now Jacqui and her colleagues have used the Australian Synchrotron to obtain a new perspective on the



Potassium ions (orange) shown entering a Kir potassium channel. In living systems the upper lobe representing the pore would be embedded in a cell membrane, while the lower lobe is suspended within the cell. (Figure: Jacqui Gulbis)

mechanisms that allow these channels to control the flow of potassium currents across cell membranes – providing new and exciting insights into the control of some crucial functions such as sensory perception.

All potassium channels have a common pore structure with a characteristic region known as the ion selectivity filter. This region of the channel enables potassium, to permeate the membrane, while blocking the passage of sodium, and is responsible for conducting signals from cell to cell, in particular for the nervous system.

Jacqui and her colleagues used the MX2 micro-crystallography beamline at the Australian Synchrotron to identify a 'molecular gate' in the ion selectivity filter – revealing that changes in remote regions of the channel assembly enable the selectivity filter to act as an on/off switch in response to physiological signals, alternately curbing or permitting the flow of potassium ions. Their findings indicate that the selectivity filter may play a significant role in the gating process. Different families of channels are distinguishable on the basis of the assemblies that regulate their activity, and the study also reveals the mechanism by which members of the Kir family of potassium channels control the direction of potassium flow. Kir channels have many essential roles, such as in cardiac activity and the secretion of insulin from pancreatic beta cells, and were employed in the study as a model system for studying general principles of potassium channel gating.

The group's findings were made possible by continued regular access to synchrotron sources, and most of their data was collected at the Australian Synchrotron. Crystals of integral membrane proteins such as potassium channels typically have a higher aqueous content and 'softer' contacts between the individual molecules than do crystals of naturally soluble proteins, leading to weak, poor quality diffraction data that cannot easily be collected on laboratory systems. The microfocus optics on the MX2 beamline provided the x-ray flux and intensity needed to collect diffraction data from the crystals, while the narrow focus enabled sampling of different regions of each crystal, helping the team to overcome these technical challenges and progress their important research.

The next steps in the project will also rely on synchrotron access: testing some of the hypotheses derived from the study, using a combination of structural and functional data from potassium channels with small changes engineered into the structure.

The work was published in Cell on 3 June 2010.

Synchrotrons in the news

Secrets of the Mona Lisa

French researchers have studied seven Leonardo da Vinci paintings at the Louvre Museum to analyse the master's use of successive ultra-thin layers of paint and glaze – the technique that gave his works their dreamy quality. The work was done in collaboration with ESRF synchrotron scientists.

http://hosted2.ap.org/APDEFAULT/2135/Article_2010-07-16-EU-France-Da-Vinci/id-34ba61bf12584d5781c6c500eabd1e4e

Butterfly wings

The vivid colour of butterfly wings is due to a nanoscale network of 'photonic' crystals made of air and chitin – the same material found in crustacean and insect exoskeletons. Yale University researchers used a synchrotron technique called small angle x-ray scattering to study the delicate structures without damaging them.

http://pubs.acs.org/cen/news/88/i25/8825notw7.html

Amber lights up at ESRF

Australia's only know amber, found on remote Cape York beaches in far north Queensland, contains a new species of beetle, a treasure trove of trapped animal and plant remains and air bubbles from millions of years ago. Scientists from the University of New South Wales recently examined their precious samples at the ESRF synchrotron in Grenoble, France.

http://www.science.unsw.edu.au/news/australian-amber/

http://www.physorg.com/news195991232.html

Water-splitting photocatalyst

Adding a small amount of nitrogen to titanium dioxide photocatalysts means they can be activated by visible light, not just ultraviolet light (which accounts for only five percent of sunlight). Recent work at the National Synchrotron Light Source (NSLS) in the US could bring 'green' fuel cells a step closer.

http://www.nsls.bnl.gov/newsroom/science/2010/06-418.asp?eid=62010&sid=2

Platinum standard

Nanoparticle clusters of platinum could potentially out-perform the single crystals of platinum now used in fuel cells and catalytic converters, according to recent synchrotron and scanning tunnelling microscope work at the Lawrence Berkeley National Laboratory in the US. With platinum currently worth about $55 a gram, the new discovery could significantly reduce the cost of fuel cells.

http://www.physorg.com/news196948982.html

National Science Colloquium

The Australian Synchrotron has established a National Science Colloquium (NSC) to complement its scientific advisory and user advisory committees. Colloquium chair Sir Gustav Nossal said in The Australian online that the new body "would advise on a strategy to make the most of the $206 million Melbourne-based facility" and would "hold its first meeting as soon as a newly-appointed facility director was available to attend".

http://www.theaustralian.com.au/higher-education/big-science-backs-national-synchrotron/story-e6frgcjx-1225880083723

IMBL update (August 2010)

Expert users are already taking full advantage of the imaging and medical beamline's current capabilities, and work is well underway to extend our imaging and medical beamline facilities.

Installation of the extended imaging and medical beamline (IMBL) is scheduled to commence later this year, with full beamtime available in 2011, and clinical research commencing in 2012.

The IMBL team of Daniel Häusermann, Chris Hall, Anton Maksimenko and Raphael Serduc (joint appointment with MIMR) is managing the development of the beamline with assistance from a clinical advisory panel, beamline advisory panel, and international advisers and collaborators. Their expertise and linkages with relevant facilities all over the world has been crucial in driving the construction of this unique facility.

The beamline is being constructed to provide high-resolution imaging of cells, tissues and tumours, enable cell tracking using markers, and facilitate radiotherapy research. Its cardiac/cardiovascular, lung and tissue (breasts, bones and organs) imaging capabilities will allow preclinical programs to be extended to clinical research with patients. The beamline team is also developing an impressive range of computed tomography (CT) techniques for 3-D imaging.

Among the first expert users is a group from the Women's and Children's Hospital in Adelaide. Led by David Parsons, the group's aim is to determine the effectiveness of its cystic fibrosis (CF) airway gene transfer protocols in the airways of mice, and apply and develop phase-contrast x-ray imaging (PCXI) techniques for potential wider application in respiratory research.

Progress in creating, testing and applying new therapies to prevent or overcome CF airway disease has been limited by the absence of direct, rapid and accurate outcome measures. These are needed to determine whether a potential treatment using a genetic (or pharmaceutical) therapy is successful and persistent.

In June 2010, the Adelaide group successfully performed some pilot experiments with laboratory mice on the IMBL so they could compare the current IMBL capabilities (contrast and spatial resolution) with the facility they have been using at SPring8. These experiments were conducted in collaboration with Chris Hall during commissioning of parts of the facility. The results were "pleasing", with the airways clearly visible in the images taken. No other non-invasive technique can visualise these important structures. CT data were collected to enable 3-D imaging, providing even better visualisation of the airway anatomy.

This x-ray image of a mouse was taken on the imaging and medical beamline. It shows important features of the structures in the trachea that transport foreign bodies out of the lungs, which is promising for future proposed research in airway imaging. Image courtesy of David Parsons, from the Women's and Children's Hospital in Adelaide.

Big science future for Australia

Australia could soon benefit from highly sensitive coloured x-ray imaging and powerful new tools to reveal the structure of materials in unprecedented detail and provide major advances in medicine and technology.

Together with a linear collider that will help unlock the mechanisms of how the universe was formed, this is the aim of a new collaboration announced today by The Hon. Kim Carr, Minister for Innovation, Industry, Science and Research.

The Australian Collaboration for Accelerator Science (ACAS) will unite some of Australia's brightest research talents in physics and help train a new generation of young Australians to continue our contribution to this critical area of research. As accelerator science underpins the development of new materials and processes in nanotechnology, environmental science and medicine amongst many others, this collaboration will help keep Australia at the forefront of science and innovation well into the future.

ACAS will bring together the Australian Synchrotron, the University of Melbourne, The Australian National University (ANU) and the Australian Nuclear Science Technology Organisation (ANSTO).

"As individual organisations we have been doing world class research, but by formally coming together, this will really strengthen Australia's position as a global leader in this field and provide benefits for all areas of science," says Dr Adi Paterson, CEO of ANSTO.

Professor David Hinde head of the department of Nuclear Physics at ANU says: "The synergy of this Australian team will enable great scientific developments in the coming years."

ACAS Deputy Director, Dr Mark Boland of the Australian Synchrotron, says "Over the past ten years, international assistance has helped us build local knowledge. We have created our own unique skills and expertise to improve the science undertaken in Australia. We feel that it is now time to give back to the international community and share our knowledge."

ACAS Director, Dr Roger Rassool from the School of Physics at the University of Melbourne, says: "ACAS will nurture and train the next generation of scientists, helping to secure Australia's future. A critical part of the development of young students is exposure to international research so they can learn from others and share our unique systems and expertise. ACAS will make this possible in accelerator physics."

This collaboration will support exciting developments in Australian research and innovation, with projects proposed including development of;

a linear collider, in which scientists will be able to probe, in finer detail, the discoveries of the Large Hadron Collider and in doing so, unlock the mechanisms of matter and how it was formed in the universe

technology enabling high speed images of single molecules dramatically expanding our knowledge of important biological molecules and other substances that are impossible to study with current technology

highly sensitive colour x ray imaging, allowing more specific imaging of the human body and in particular improving the delivery of therapeutic radiation and medical imaging for targeted tumour therapy.

For more information contact:

Nadia Levin (ANSTO) mobile 0457 505 438

Rebecca Scott (University of Melbourne) mobile 0417164 791

Christine Latif (Australian Synchrotron) mobile 0419 503 477

User Advisory Committee

The User Advisory Committee (UAC) is an independent group that provides advice to the Australian Synchrotron Director on issues from a user perspective.

The role of the UAC is to:

- represent Australian Synchrotron user interests to Australian Synchrotron management
- provide advice and feedback on the operation and development of the synchrotron and beamlines
- assist the Australian Synchrotron in providing feedback to users about synchrotron-related issues
- give feedback on Australian Synchrotron processes involving users, such as the proposal process and induction procedures.

The UAC has seven elected members, along with the seven Program Advisory Committee Chairs. The members cover a broad national and regional spread together with diverse discipline mix related to the major branches of synchrotron science, and will represent the interests of the wide synchrotron user community in Australia. The committee was announced at the Australian Synchrotron Users Meeting in December 2008.

You can contact your UAC representative by following any of the email links provided below. As of mid-August 2011, we are in the process of providing email links for all UAC members.

Click here for details of UAC membership.

http://www.synchrotron.org.au/index.php/about-us/governance-committees/user-advisory

UAC member profile
Dr Richard Garrett (Chair)

ANSTO
NSW

Richard Garrett is Senior Advisor, Synchrotron Science, Australian Nuclear Science and Technology Organisation (ANSTO), and was the Facility Director of the Australian Synchrotron Research Program until 2009. Richard has over 20 years of post-doctoral experience working at major synchrotron facilities in the United States and Japan, in addition to the Australian Synchrotron. He has provided expert technical advice to the Australian Synchrotron in a number of capacities, and is currently a member of the Beamlines Development Working Group. Richard is Chair of the IUCr Commission on Synchrotron Radiation and a member of the Executive Council of the Asia Oceania Forum for Synchrotron Radiation Research (AOFSRR).

National characterisation roadshow

Researchers in Melbourne and Hobart recently took advantage of an opportunity to learn more about some of the exciting facilities and techniques available to all Australian researchers.

Whether participants wanted to characterise cells or steel, molecules or brain function, fuel cells or soils, the National Characterisation Roadshows held in Melbourne and Hobart in early August 2010 aimed to open the door to the advanced equipment and expert knowledge available around Australia at the Australian Synchrotron, Australian Microscopy & Microanalysis Research Facility, National Imaging Facility and National Deuteration Facility.

Participants heard talks from these four NCRIS Characterisation Capability members on how they can support research projects. Users of these facilities provided case studies, and participants were able to discuss their own research needs with experts from across the capability.

Similar events will be held in other states in 2011.

Tonga time

The South Pacific island kingdom of Tonga is renowned for its beautiful beaches, but accelerator operator Viliami Takau has another reason for visiting the island: he lectures students in fundamental physics.

A naturalised Australian with Tongan heritage, Viliami was born, raised and educated to high school level in Tonga before moving to Australia for further studies. He attended the University of Melbourne and graduated with a PhD in nuclear physics in December 2009 before joining the accelerator science and operations group at the Australian Synchrotron.

Four times a year, Viliami travels to Tonga to present lectures to 18 first-year students at the community-based Lavengamalie Christian University. During each visit he gives six to eight lectures, tutorial sessions and practical classes in an intensive week of presentations.

"Giving something back to the community is always a rewarding experience in itself," Viliami told Lightspeed. "The ultimate reward, however, is knowing that my investment, in time and monetary terms, may help to inspire some local students to go on and do great things. Hopefully by simply being there I may instil my passion for science, physics in particular, into the students."

The first Tongan to gain a PhD in physics, Viliami says Tonga probably has the Pacific's highest number of PhDs per head of population.

Australian Synchrotron accelerator operator Viliami Takau (third from right) discusses fundamental physics with Tongan university students.

Synchrotron scientists set the pace

A dedicated bunch of synchrotron people competed in the 'Run Melbourne' fun run in July 2010. The synchrotron's next running team event is being organised for the Melbourne Marathon Festival, which this year will celebrate the 2500th anniversary of the original Marathon run in ancient Greece.

Photo: Susana Barnes

Lightspeed events diary

Synchrotron-related events in Australia and overseas. Read more

Space for your event

To submit your synchrotron-related event for listing in Lightspeed and on the Australian Synchrotron website, click here.

Reader feedback

Lightspeed welcomes your comments and suggestions. Please send these to: info@synchrotron.org.au with 'Lightspeed comments' in the subject line.

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Careers at the Australian Synchrotron

The Australian Synchrotron offers a unique working environment for a wide range of specialists. For information on job postings, go to: http://www.synchrotron.org.au/index.php/about-us/working-at-the-synchrotron/employment-opportunities

Staff list

http://www.synchrotron.org.au/index.php/about-us/working-at-the-synchrotron/staff-contact