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## From the Acting Director - Accelerating the pace for 2010



It has been a busy and interesting time at the Australian Synchrotron as our activities really accelerate for 2010. Our work on the Australian Synchrotron Development Plan will help to ensure that we can support and enable world-class research well into the future. The Development Plan or 'Science Case 2' includes a plan for capital expansion of the Australian Synchrotron to include 10 new beamlines. This has been peer-reviewed with the help of national and international experts including the Australian Synchrotron Science Advisory Committee. Science Case 2 will be complemented by a business case, which provides a rationale and justification for existing and projected expenditure. Both documents are nearing completion and will be submitted to the state and federal governments for

consideration in the near future.

We are continuing to build the Australian Synchrotron's local and international standing, including hosting recent visits from the Honourable Alan Griffin, our local Member of Parliament, and Professor Eric Isaacs, the Director of Argonne National Laboratory in the US. Minister Griffin was highly impressed with the calibre of the facilities and science undertaken here. Professor Isaacs was in Australia to discuss the contribution of synchrotron science to the field of clean technology, and held several discussions with Australian Synchrotron staff.

We are also actively participating in events such as Science Meets Parliament, organised annually by the Federation of Australian Science and Technology Societies (FASTS) to bring politicians and scientists together to help shape the future of research policy in Australia.

The Australian Synchrotron has an important role in helping to inspire Australia about science and research, particularly the youngest members of our community, encouraging them to consider science-related careers. In addition to our usual educational tours and laboratory sessions, we are jointly hosting the ANZAAS – Australian Synchrotron Winter School in July, and supporting students to attend similar events at overseas facilities, such as the Cheiron School in Japan.

This year, the Australian Synchrotron's annual Open Day will happen on 15 August as part of National Science Week. More information will be made available on our website shortly. Our work continues to attract public attention and has recently featured in the Sunday Herald Sun, on Catalyst and on Maori Television.

We are also reviewing some of our communications activities – including this newsletter and our dealings with stakeholders. Many of you will have received an email inviting you to complete a [short online survey](#) about Lightspeed; I would encourage you to spend a few minutes providing us with feedback to help us improve and refine this publication to better meet your needs.

**George Borg**

Chief Operating Officer, Australian Synchrotron

## Up to speed: Chris Glover



**This month our short interview features Chris Glover, principal scientist XAS (x-ray absorption spectroscopy) at the Australian Synchrotron.**

**Describe your job in 25 words or less.**

Secretary, concierge, waiter, teacher, trainer, mechanic, electrician, engineer, programmer, safety consultant, motivator and occasional

beamline police enforcer ... and scientist in the time that's left.

### **Best aspect of your job?**

It's so dynamic. Exposure to new and different people and experiments makes the job interesting and engaging. There's a great sense of achievement in sending users away with the answers they were looking for.... especially when it wasn't clear it was going to work.

### **Worst aspect of your job?**

That it's so dynamic. There are constant pulls on my time from different areas, and it's hard to find a work life balance. Every user considers their experiment to be the most important, but we need to balance the time we can devote to each user. Managing expectations – my own and users – isn't always fun. The lack of opportunities to perform my own research.

### **Apart from the Australian Synchrotron, what's the coolest job you've ever had?**

I think working as a beamline scientist is a pretty cool job. I also still like making hay on the farm where I grew up on, though I've never been paid for any of it!

### **Best things about living in Melbourne and why?**

I can afford to live right on the bay. There's no way that would happen in a warmer city! Melbourne offers good surfing and attracts lots of events, which Melburnians come out to enjoy rain, hail (or sometimes) shine.

### **Your favourite overseas destination and why?**

I love anywhere warm. I love continental Europe in August – finding somewhere to go running under the late sunset and then eating a late dinner. San Francisco is a favourite for the lifestyle and people. Japan, Singapore and Asia are awesome because I'm very drawn to Eastern culture. I always keep my eye out for upcoming conferences in India, Thailand and Bali.

### **What's the most unusual or interesting sample you've seen on the XAS beamline here?**

Last week we analysed what looked like large pieces of paper but turned out to be a special gel embedded with proteins that had been treated with certain drugs.

### **What is the biggest achievement to date for your section at the Australian Synchrotron?**

The biggest achievement will be completing the final touches to the beamline. Commissioning our most recent addition – a \$1.8 million detector – has been extremely challenging, but the initial results look extremely good.

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

There are two and they are intimately related. Making the equipment work well enough to get very good data is a bigger challenge than most users realise. XAS is really, really sensitive to energy, flux and beam position stability all at the same time as scanning the monochromator. The second challenge is the broad diversity of the types of experiments users wish to perform, which means lots of different setups. We need to carefully balance the need to offer reliable stable measurements for standard samples with the potential to expand the range of measurement possibilities.

### **What is the best piece of advice you would like to offer users and potential users?**

Communicate with us. Read the information on the website and in the call for proposals carefully; if it's not clear then contact us. We always advise new users of the beamline to contact us before putting in a proposal so any issues can be identified and addressed; this part of the job is particularly rewarding for me – except in the last few days prior to the proposal deadline! Some people write proposals that are not feasible to perform here, but are on other beamlines where they have been previously. This is a shame given the effort that goes into preparation and review. Oh, and make sure to prepare really, really good samples ... it's concerning for us the number of issues that arise from poor sample preparation.

## We're having an Open Day

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 – more information will follow shortly

This event is hosted as part of National Science Week.

Australian Synchrotron Open Day on Sunday 15 August 2010



## Beamtime applications

Beamtime submissions open on 1 June 2010 for round 2010/3 (September-December 2010).

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](mailto:user.office@synchrotron.org.au)

## Dietary selenium: A fine balance

Selenium supplements may help prevent a wide range of cancers such as colon cancer, but too much selenium can lead to cardiovascular problems and other health issues. The gap between selenium benefits and selenium toxicity is surprisingly small, and is strongly influenced by the chemical form of selenium that is ingested.

Some health conditions are influenced by selenium-containing enzymes (organic selenium) while others are associated with smaller selenium-containing molecules (inorganic selenium). Both types can cause health problems if they are present at high enough levels.

Dr Hugh Harris from the University of Adelaide and his colleagues from the University of Adelaide and the University of Sydney are investigating selenium metabolism, storage, accumulation and general biology in mammals. The researchers are also looking at how selenium interacts with other metals such as copper and iron, which may play a role in how the body responds to various levels of selenium supplementation.

Synchrotron x-ray absorption spectroscopy (XAS) is the only technique that can determine the chemical form of selenium in biological samples without having to process the samples in ways that could change the chemical form from what it is in the body.

Led by Chris Glover, the Australian Synchrotron's XAS team recently installed a powerful new 100-element germanium detector on their beamline, making it one of only four beamlines in the world with this enhanced capacity.

Hugh and his colleagues visited the Australian Synchrotron in May 2010 to become the first users of the new XAS detector. They analysed a range of cultured human tissue samples to investigate the chemical forms that selenium takes in different organs. Data analysis is still underway but Hugh says that the group has already shown "that different chemical forms have distinct fates in the cells, a finding that is at odds with established literature".

After analysing their XAS data, the team plans to use the same technique to look at chemical forms of selenium in intact tissues from rats.

The XAS work is complemented by the team's studies on the x-ray fluorescence microprobe (XFM) beamline at the Australian Synchrotron. They are using the

microprobe to look at sections of rat kidney from rats that have been fed small quantities of selenite, with the aim of learning how selenium is distributed in this organ. "While we also travel to overseas synchrotrons, it is quicker, easier and much cheaper to travel to Melbourne," Hugh says. "The new XAS detector makes the Australian Synchrotron even more attractive for our purposes."

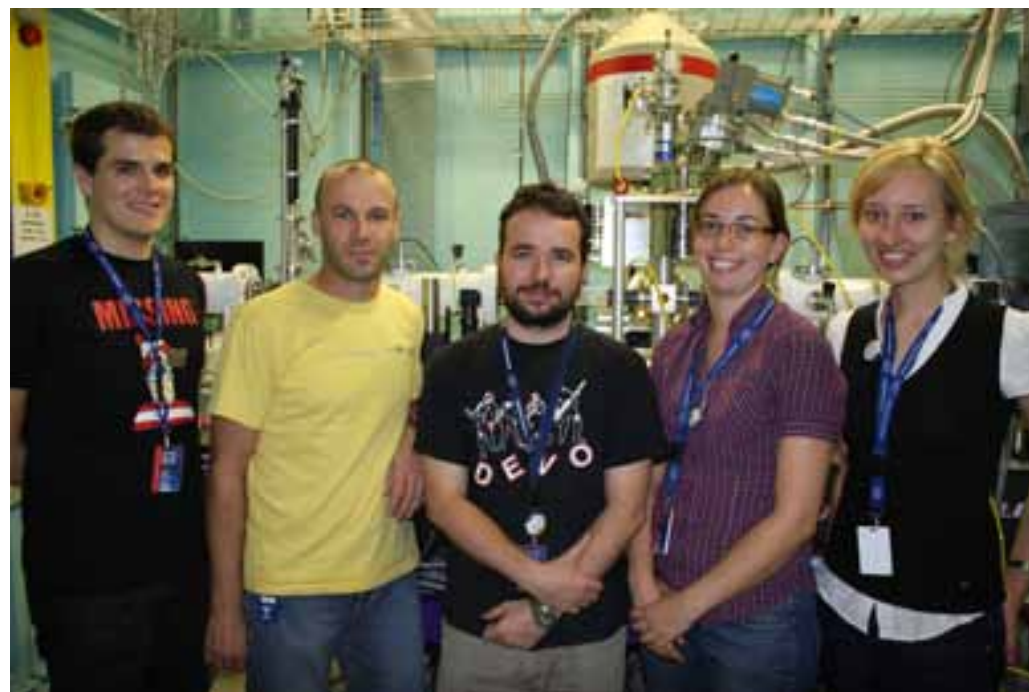


Image: Chris Glover (second from left) with the first users of the new XAS detector: (L to R) Jason Wedding, Hugh Harris, Claire Weekley and Casey Doolette, all from the University of Adelaide

## Drug delivery under investigation

**Drugs work best when our digestive system can absorb them completely so they can pass into the bloodstream and become available where they are of most use. Because most drugs are only partly soluble in the watery environments inside our bodies, new drug products are increasingly using oil-based 'soft-gel' formulations that keep the active ingredient in a dissolved form. Studies of how oily (lipid-based) drug products behave in our digestive system are helping to guide the development of more effective drug products.**



Dr Ben Boyd and his colleagues at the Monash Institute of Pharmaceutical Sciences (MIPS) are using an 'artificial tummy' (aka an 'in vitro digestion model') and other methods to examine what happens when lipid-based drug products undergo digestion in the human gut.

"When lipids and fats are digested, they form particles and other structures with nanometre-scale dimensions," Ben says. "Our aim is to learn which structures provide the right environment for maximum drug absorption and to find ways to manipulate

these structures by 'tuning' the lipids."

The pharmaceutical industry is taking a keen interest in this area because an estimated 25 to 40 percent of drug candidates fail to lead to successful drug products due to solubility limitations.

Ben and his colleagues Dallas Warren and Mette Anby recently set up their artificial tummy at the Australian Synchrotron, where they used the small angle x-ray scattering (SAXS) beamline to follow what happens when lipids are exposed to conditions similar to those found in the human gut.

"Our initial synchrotron findings show that unstructured lipid systems definitely form nano-scale structures during digestion, including lamellar, inverse hexagonal and cubic phases," Ben says. "The types, proportions and timing of the structures formed depend largely on the original lipid. We can also detect drug precipitation."

Ben says this new information about the link between nano-structure and how well drugs remain in a dissolved state will help researchers to reverse-engineer the best formulations for keeping drugs dissolved longer during digestion.

"We believe these promising findings will eventually lead to more rational drug design principles, less reliance on animal studies and more efficient development of products."

"While we could have conducted these studies at a synchrotron overseas, why would we? The Australian Synchrotron is a state-of-the-art facility with a great team of beamline scientists helping us out, we can dash back to our lab in Parkville at a moment's notice to get materials for an 'off-the-cuff' experiment that might arise from a new result, we don't need to package up and risk damage to our own equipment (in both directions) and the opportunity to crash on your own pillow is highly attractive!"

The next stage for Ben and his colleagues will involve more extensive studies into the evolution of structure with different lipids, using different drug types to get to the heart of the problem. Ben also plans to extend the studies into an in vivo model to see how well the 'artificial tummy' results relate to the in vivo reality.

"That will be quite a challenge," he says.

Image: Ben Boyd (right) and Dallas Warren from the Monash Institute of Pharmaceutical Sciences (MIPS) recently set up an 'artificial tummy' at the synchrotron to investigate oily (lipid-based) drug products that offer improved effectiveness.



## Synchrotrons in the news

### SAXS on the ABC: 9 June 2010

The New Inventors television program on ABC-1 on Wednesday 9 June at 8pm (check local papers to confirm screening time) featured the work of Veronica James, one of our long-term users. Veronica discovered the synchrotron SAXS method used to identify breast cancer from hair samples, and is now developing similar methods for other biological samples and health conditions. Watch out for cameo appearances from some of the SAXS beamline team!

<http://www.abc.net.au/tv/newinventors/txt/s2919200.htm>

### Arsenic and toenails

The Catalyst television program on ABC1 recently broadcast an item about Dora Pearce using synchrotron techniques to investigate arsenic levels in the toenails of children living in the Ballarat area on arsenic. Although the work was done overseas before the Australian Synchrotron was built, the AS features in the clip, with footage shot on several beamlines here last year. Dora Pearce is no longer at the University of Ballarat, but will still be involved (as a University of Ballarat research associate) in some follow-up work, which may take place at the AS later this year. Clip and transcript of the 11 March 2010 Catalyst program are available on the ABC website.

<http://www.abc.net.au/catalyst/stories/2843289.htm>

### Arsenic and Phar Lap

It's now in the scientific literature: famous racehorse Phar Lap received a large dose of arsenic in the hours before his death, as revealed by synchrotron analysis of hair from his preserved hide. The work by Ivan Kempson (then at the Ian Wark Research Institute, University of South Australia) and Dermot Henry from Museum Victoria has been published in *Angewandte Chemie International Edition*.

<http://dx.doi.org/10.1002/anie.200906594>

<http://www.physorg.com/news192178886.html>

### New discovery could stop cancer in its track

US scientists have reported the discovery of new anti-cancer agents that stop cancer cells spreading from their original site. The Weill Cornell Medical College Team used synchrotron x-ray crystallography at Brookhaven National Laboratory's National Synchrotron Light Source to reveal how the new anti-cancer agent actually works. The spread of cancer (a process called tumour metastasis) is the primary cause of death for cancer patients.

<http://www.nature.com/nature/journal/v464/n7291/abs/nature08978.html>

[http://www.bnl.gov/bnlweb/pubaf/pr/PR\\_display.asp?prID=1117](http://www.bnl.gov/bnlweb/pubaf/pr/PR_display.asp?prID=1117)

### Australopithecus may have brains

The skull of a new species of human ancestor may contain traces of preserved brain tissue, according to x-ray synchrotron microtomography studies at the ESRF. The skeletal remains were discovered by Prof. Lee Berger of the University of the Witwatersrand (South Africa) and analysed at ESRF with the assistance of Paul Tafforeau, who visited Melbourne last year for the SRI 2009 conference.

<http://www.esrf.eu/news/general/first-studies-of-fossil-of-new-human-ancestor-take-place-at-the-esrf/>

### Honour for John Boldeman

Dr John Boldeman, who played a key role in the establishment of the Australian Synchrotron, has been honoured with a special Lifetime Contribution award in the 2010 ATSE Clunies Rosss awards. The award acknowledged John's "single-minded scientific brilliance combined with exceptional personal commitment to his goals – particularly in the establishment of two national icon projects: the ANTARES Tandem Accelerator and the Australian Synchrotron".

<http://http://www.atse.org.au/news/latest-news/147-australias-visionary-innovators-honoured>

### Synchrotron Kiwis feature on Maori TV

The 411 program on Maori TV featured an interview with synchrotron staff members Brad Mountford and Tom Caradoc-Davies on 14 May 2010.

<http://www.maoritelevision.com/Default.aspx?tabid=224&progid=535&epid=10155>

## Think small technologies for commercial success

Victorian businesses can now apply for up to \$50,000 in government assistance to use Australian Synchrotron capabilities in 'small technologies' such as microtechnology, nanotechnology, biotechnology, information and communication technology and advanced engineering technologies.

The Victorian Government's Small Technologies Industry Uptake Program (STIUP) supplies eligible businesses with vouchers that can be exchanged for access to small technologies facilities, services, advice or expertise from the Australian Synchrotron and other participating service providers. The aim is to help Victorian businesses develop internationally competitive new products, services and industrial processes.

Applications for the second round of STIUP trial vouchers are currently being accepted. Completed applications (including the required financial information) must be submitted online and received by 3pm Friday 18 November 2011.

[Click here for more information from the Victorian Government.](#)

Microtechnology and nanotechnology have the capacity to revolutionise virtually all aspects of manufacturing.

Microtechnology is engineering on the scale of one millionth of a metre. Nanotechnology is engineering

on the scale of one billionth of a metre, or at the scale of an atom.

Micro-scale and nano-scale objects such as miniaturised electrical and mechanical devices have unique physical and chemical properties, for example greater flexibility or strength, that are boosting the further development of a global market already worth many billions of dollars.

If your business would like to apply for a Small Technologies Feasibility Voucher (up to \$10,000) or Technical Voucher (up to \$50,000) to use the synchrotron, your first step is to contact the synchrotron for a confidential discussion about your needs.

For more information about commercial access to the small technology capabilities of the Australian Synchrotron, check out the '[Industry and commercial users](#)' webpage on the website or contact business development manager Kerry Hayes on 03 8540 4232 or [kerry.hayes@synchrotron.org.au](mailto:kerry.hayes@synchrotron.org.au)

Details of the voucher system and other elements of the Victorian Government's Small Technologies Industry Uptake Program are available from the [Small Technologies Cluster website](#) or through the [Business Victoria website](#).

## New Synchrotron Board members

The Australian Synchrotron has appointed two new members to the Board of Directors. The new directors are Professor Max Lu, Deputy Vice Chancellor (Research) University of Queensland and Professor Keith Nugent, Laureate Professor and ARC Federation Fellow, School of Physics, University of Melbourne.

Max Lu is an internationally renowned scientist in material sciences and nanotechnology. Keith Nugent is also Research Director at the Australian Research Council Centre of Excellence for Coherent X-ray Science.



## Science Advisory Committee

The Australian Synchrotron has appointed another new member to its Science Advisory Committee. Dr Harald Reichert is Director of Research at the European Synchrotron Radiation Facility (ESRF) in Grenoble France. He is the sixth new appointment to this AS committee since late last year.

The Australian Synchrotron's Science Advisory Committee (SAC) was established by the Australian Synchrotron (ASCo) Board to advise the Board on the strategic scientific direction of current and future scientific programs to ensure that these are of the highest quality and of continuing relevance to the requirements of the Australian scientific community.

The SAC held its inaugural meeting on 30 May 2008. It is currently chaired by Professor Ted Baker, Professor of Biological Sciences, the University of Auckland.

### International members

- Prof. Hongjie Xu, Director of Shanghai Synchrotron Radiation Facility, Member Chinese Synchrotron Radiation Special Committee
- Prof. Soichi Wakatsuki, Director, Photon Factory Synchrotron Radiation Facility Tsukuba, Japan
- Prof. Janet Smith, University of Michigan Medical School, Life Sciences Institute, USA
- Prof. Michael Hart, Emeritus Professor of Physics, University of Manchester, UK
- Assoc. Prof. Lisa Miller, National Synchrotron Light Source, Brookhaven National Laboratory, USA
- Dr Harald Reichert, Director of Research, European Synchrotron Radiation Facility (ESRF), Grenoble France
- Prof. Chi-Chang Kao, Associate Laboratory Director, SLAC National Accelerator Laboratory, Stanford University.

### Australia/New Zealand members

- Prof. Ted Baker, Professor of Biological Sciences, the University of Auckland, NZ (Chair)
- Prof. Mitchell Guss, Professor of Molecular and Microbial Biosciences, University of Sydney
- Prof. Brendan Kennedy, Professor of Chemistry, The University of Sydney
- Prof. Mark Ridgway, Head of Department, Electronic Materials Engineering, Research School of Physics and Engineering, Australian National University.

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

## Government to increase support for business R&D

Australian businesses stand to receive a significant boost in support for research and development, under new R&D tax incentive legislation introduced into federal parliament in May 2010.

Innovation Minister Kim Carr said that from 2010-11, the federal government would “replace the complex and outdated R&D tax concession with a simplified R&D tax credit that gives business better incentives to invest in research and development”.

“The new scheme will stimulate more of Australia’s two million businesses to undertake R&D rather than just the 8000 that benefit from the current concession,” Senator Carr said.

“The R&D tax credit doubles the incentive for small and medium enterprises – the engine room of the economy – while increasing by a third the incentive for big business to undertake R&D.

“Small innovative firms are big winners from the new R&D tax credit, with greater access to cash refunds for their R&D expenditure and more generous rates of assistance.

“This legislation follows an independent review of the national innovation system, and almost a year of consultation with key stakeholders,” Senator Carr said.

<http://minister.innovation.gov.au/Carr/Pages/INCREASINGSUPPORTFORBUSINESSRESEARCHDEVELOPMENT.aspx>

### 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](mailto:info@synchrotron.org.au) with ‘Lightspeed comments’ in the subject line.

### Use of Lightspeed material

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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>