Australian Synchrotron
Annual Report 2010

The Australian Synchrotron vision – to be the catalyst for the best scientific research and innovation in Australasia

Australian Synchrotron

Supported by

Australian Government

State Government Victoria AUSTRALIA

About this Annual Report

This Annual Report is intended to provide an overview of the activities undertaken at the Australian Synchrotron over 2009-2010. It is written with a broad readership in mind and we encourage you to provide comments on this report by emailing info@synchrotron.org.au. This report is a public document and is freely available on the Australian Synchrotron website at www.synchrotron.org.au. On this website, you can also learn more about the facility and the work we do.

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About Us

The Australian Synchrotron provides a suite of powerful tools for analysing and visualising materials in a way that cannot be achieved with other technologies. These tools utilise the x-rays and infrared radiation generated by the synchrotron to enable advances in science and technology across a range of fields from medicine to nanotechnology.

Synchrotron light is millions of times brighter than light produced by conventional x-ray machines in laboratories and hospitals and even brighter than the sun. The unique properties of synchrotron light mean that experiments done at the Australian Synchrotron are more accurate, precise and faster than research using conventional equipment.

The establishment of the Australian Synchrotron as a national research facility has helped to drive scientific discovery in Australia to a new level and contributes to a strong and productive scientific workforce. The Australian Synchrotron also supports education and outreach activities that will grow and enhance the scientific community well into the future.

Discoveries made at the Australian Synchrotron are contributing to an improved understanding of our world. This leads to exciting new technologies, processes and products that deliver a range of health, social and economic benefits for our community.

Vision and mission

Vision

To be the catalyst for the best scientific research and innovation in Australasia. The key focus of the facility is on providing a thriving scientific research environment that is conducive to creating and nurturing the best scientific outcomes for users and the staff of the facility.

Mission

Develop a world-class synchrotron facility, maximising the quality, breadth and impact of scientific output.

Core values

Passion, respect, collaboration, innovation and continuous improvement.

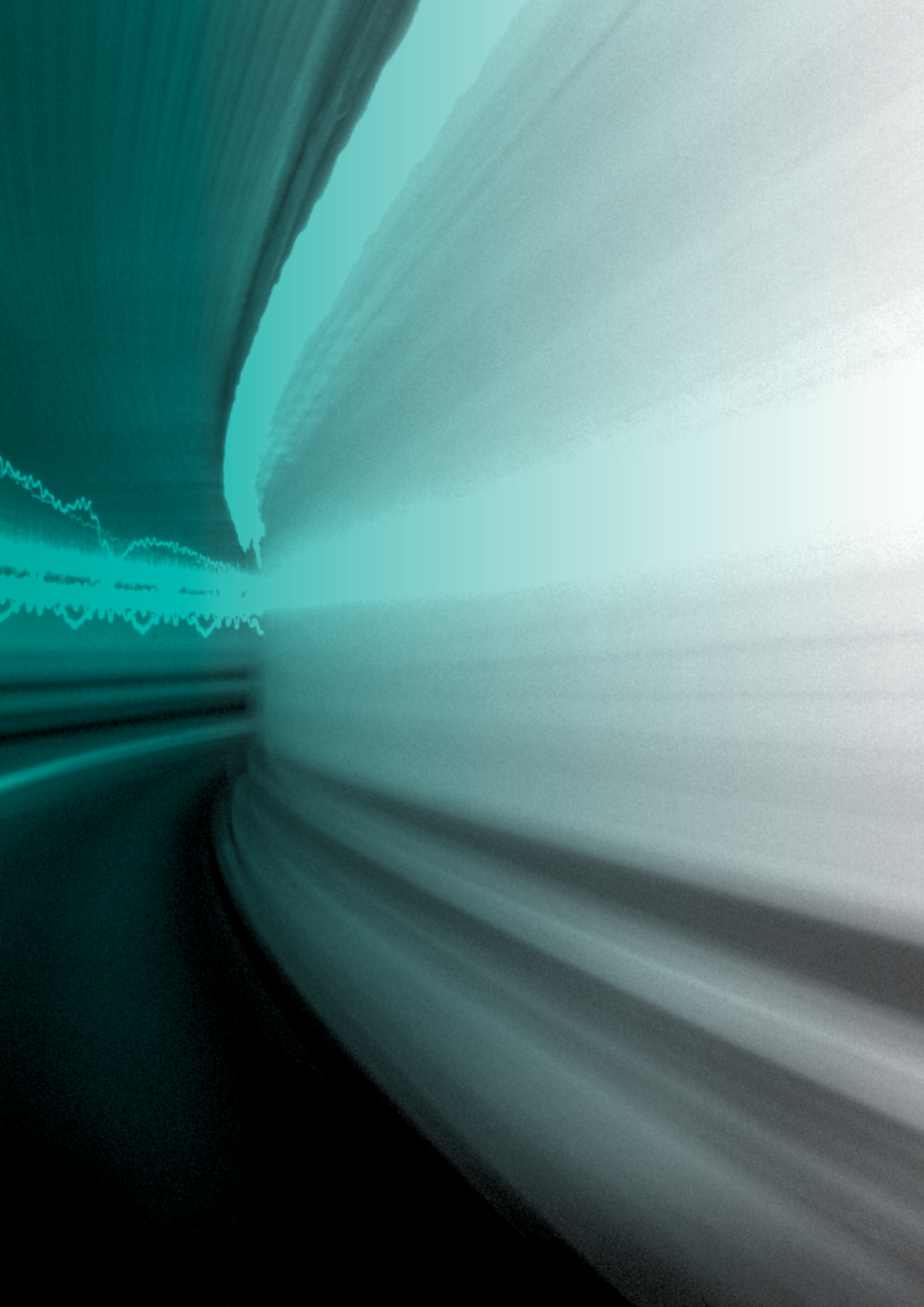
Synchrotron technology contributes to all of Australia's National Research Priorities, namely:

- advance an environmentally sustainable Australia
- promote and maintain good health
- support frontier technologies for building and transforming Australian industries
- safeguard Australia

Our research capabilities

The research capabilities available at the Australian Synchrotron are useful across many applications, including:

- Advanced materials: ceramics, polymers, biomaterials, semiconductors, magnetic, superconducting and battery materials and opto-electronics
- Agriculture: plant cells, plant tissues, plant cell and root uptake and soil analysis
- Biomedical: new diagnostic, imaging and therapeutic techniques and high-throughput structural biology
- Defence industries: new materials, sensors and heavy metal analysis
- Environmental technologies and services: analysis of soils, fresh and salt water, air and atmospheric samples, pollutants, toxins and contaminants, environmental remediation
- Food technology: analysis of food ingredients and packaging materials, product and process development
- Forensics: broad range of analytical capabilities and development of new techniques
- Manufacturing: metal alloys, catalysts, engineered components, stress analysis, fibres and textiles, adhesives, polymers and plastics, surfaces, interfaces and coatings
- Minerals: mineral exploration and mineral processing
- Nanotechnology and microtechnology: advanced nano and micro-device manufacturing and micro-circuits and sensors
- Oil and gas: exploration, pipeline reactions, fuel processing and fuel cells
- Pharmaceuticals: analysis of proteins, nucleic acids and viruses, cell imaging, quality control monitoring, bio-mimetic materials (artificial skin or organs), identification of drug targets and assessment of drug candidates
- Scientific instruments: detector technologies, measurement techniques, medical implants and delivery systems.



Chairman's Report

The Australian Synchrotron experienced change and some difficulties during 2010 while still achieving much and laying the foundation for future expansion and development. These achievements would not have been possible without the tireless work, expertise and skill of our staff and our ever-growing base of users. The Board of Directors pays tribute to them and to the ongoing commitment and collaborative effort of the many individuals and organisations that form the Australian Synchrotron community, especially, the outstanding contributions of our Advisory Committees, Scientific Panels, Councils and other stakeholders. Together our staff and stakeholders have enabled the Australian Synchrotron to deliver great science and significant benefits to the community.

We are particularly grateful for the support of the Victorian and Federal Governments during the changes which occurred and for their support and confidence, as well as that of our other investors.

Within the current economic climate we were able to achieve such outcomes well within our operational budget, producing a surplus that will be re-invested in the facility in the future. In the process we have enhanced our compliance procedures and effectiveness to ensure that we meet the expectations of those who fund us.

Over the course of the past year, the Australian Synchrotron has experienced significant restructuring which will continue into the next financial year. As a result we have strengthened our stakeholder engagement and enhanced the level of expertise and diversity across the facility. These changes include the appointment of three new Directors with significant scientific expertise and experience; additions to our Scientific Advisory Committee who hold strong international scientific reputations in the field of synchrotron science; and, the establishment of the National Science Colloquium chaired by Sir Gustav Nossal. The support of these individuals will help us to achieve our plans for the future of the Australian Synchrotron. The Board is conducting an international search for a new Facility Director. The new Director will help to take the Australian Synchrotron to the next stage of its development.

We have developed robust strategic plans to ensure the Australian Synchrotron delivers maximum benefits to our stakeholders including an investment case and a complementary scientific case to provide the rationale for the future expansion and the ongoing operations of the facility post-2012. Taken together, these documents recommend adding another ten new beamlines to our facility bringing the Australian Synchrotron in line with developments overseas and keeping us competitive on the global stage. Following an extensive consultation process with national and international experts and our stakeholders these funding cases were submitted to the State, Federal and New Zealand Governments for their consideration. Our growth plans outline our development and expansion over a five-year period from 2013-2017.

We are very grateful for the strong support the synchrotron science community and other stakeholders have provided during this process and thank all involved for their contributions. The support that has been received by the Australian Synchrotron since its establishment has been truly remarkable. It reflects the importance of this facility to the scientific community and the quality of the outcomes it has achieved to date. This is reinforced by the growing international reputation of the Australian Synchrotron. Our participation in a number of key international events such as the 10th International Conference on Synchrotron Radiation Instrumentation, the meetings of Biology and Synchrotron Radiation (BSR) and Medical Applications of Synchrotron Radiation (MASR) and the Italo-Australian Workshop "Photons for Medicine and Materials Science" has helped to further bolster our global position. Attended by hundreds of synchrotron science experts and other researchers from around the globe, these meetings facilitated a significant level of high quality scientific exchange between scientists and will help to drive greater collaboration and innovation throughout the synchrotron science community. The continued leadership of the Australian Synchrotron in such initiatives is crucial.

We also acknowledge the support of our funders, in particular the Victorian State Government, the Federal Government and our Foundation Investors, without whom the facility would not have been established. The Australian Synchrotron could not have achieved the outstanding scientific and other important community health, economic and social benefits without that support. With new, sustained investment in synchrotron science we expect to achieve even more.

The Australian Synchrotron is at a critical point in its development. Our ability to facilitate high quality research and capture scientific innovation is directly linked to the number of beamlines provided at the facility. Therefore, realising the full scientific potential of the Australian Synchrotron and fully leveraging the existing investment in the facility will require expansion of the number of beamlines. Securing the investment to allow even more great science to be produced will be the Australian Synchrotron's major priority during the coming year.

Mrs Catherine Walter AM

Chairman

Acting Facility Director's Report

At the Australian Synchrotron, our most important function is ensuring we provide high quality and safe facilities, expertise and support to our users. We do this for scientists from academia, government and industry organisations across Australia and the world. This support results in high quality scientific outcomes that enhance the opportunity for the Australian Synchrotron to deliver benefits to the community.

In the past year, one of our most significant achievements has been bringing all our beamlines into service and welcoming our 2000th unique user to the facility. These landmark achievements are only possible with the continued support of the Australian Synchrotron's employees and stakeholders. I would like to take this opportunity to recognise the skill, dedication and hard work of all our employees and thank them for their valuable contributions in a particularly challenging year.

The Australian Synchrotron continues to actively develop our user community through education and outreach. We have supported the Australian Synchrotron Postgraduate Awards and the Australian Synchrotron Thesis Medal for post-graduate students in the area of synchrotron science and play an active role in training the next generation of synchrotron scientists through the Australian Synchrotron Winter School. We recognise the importance of inspiring young Australians to take up a scientific career and are actively involved in working with parents, teachers and students to generate excitement about science. We also use our annual open day as an opportunity to provide the public with a unique opportunity to view our facility and learn more about the work we do.

Our work has also been rewarded through significant support from several funding agencies. In the past year, the Australian Synchrotron was awarded $36.8 million through the Education Investment Fund (EIF) of the Federal Department of Innovation, Industry, Science and Research. These funds will be used to build the support infrastructure required to optimise the use of existing research infrastructure at facility. Furthermore, the EIF funding will enable further expansion of the Australian Synchrotron to build the National Centre for Synchrotron Science - enhancing our ability to educate the public about synchrotron science, to work with our stakeholders and to continue to develop the synchrotron science community. The building of the new user accommodation block will also be very beneficial to our users and help to bring us into line with other synchrotrons around the world.

The Australian Synchrotron has not only achieved excellent scientific outcomes over the past year, but continues to improve its operational performance. We have sustained our excellent safety record, our machine continues to operate at worlds-best standard, whilst also meeting demanding operating criteria. In addition, we achieved international accreditation for our quality management systems, achieving ISO 9001:2008 accreditation in June 2009. This result reflects our commitment to the core values of the Australian Synchrotron and to achieving the highest possible standards in all aspects of operations.

Several major capital and building projects were also initiated over the past year, including the uninterruptible power supply (UPS) project and significant works on the Imaging and Medical Beamline (IMBL). Work is also proceeding towards achieving "top up" operating mode, which will provide the Australian Synchrotron with a constant beam current. Other important work also undertaken on the facility's computing capabilities attracted several million dollars in external funding for the facility.

The scientific standing of the Australian Synchrotron continues to grow through the development of new partnerships. We actively contribute to collaborations related to many areas of our operations from computing to public relations. We have launched several exciting partnerships, such as the Australian Collaboration for Accelerator Science (ACAS) with the University of Melbourne, the Australian National University (ANU) and the Australian Nuclear Science Technology Organisation (ANSTO). This exciting initiative will see us contributing to the development of powerful new tools for material analysis that will help provide major advances in science and technology. The Australian Synchrotron will also play an important collaborative role within the Clayton Biomedical Imaging Laboratories (CIBL). This program will deliver new innovations to support biomedical research and develop new technological capabilities to support a wide range of engineering and scientific research.

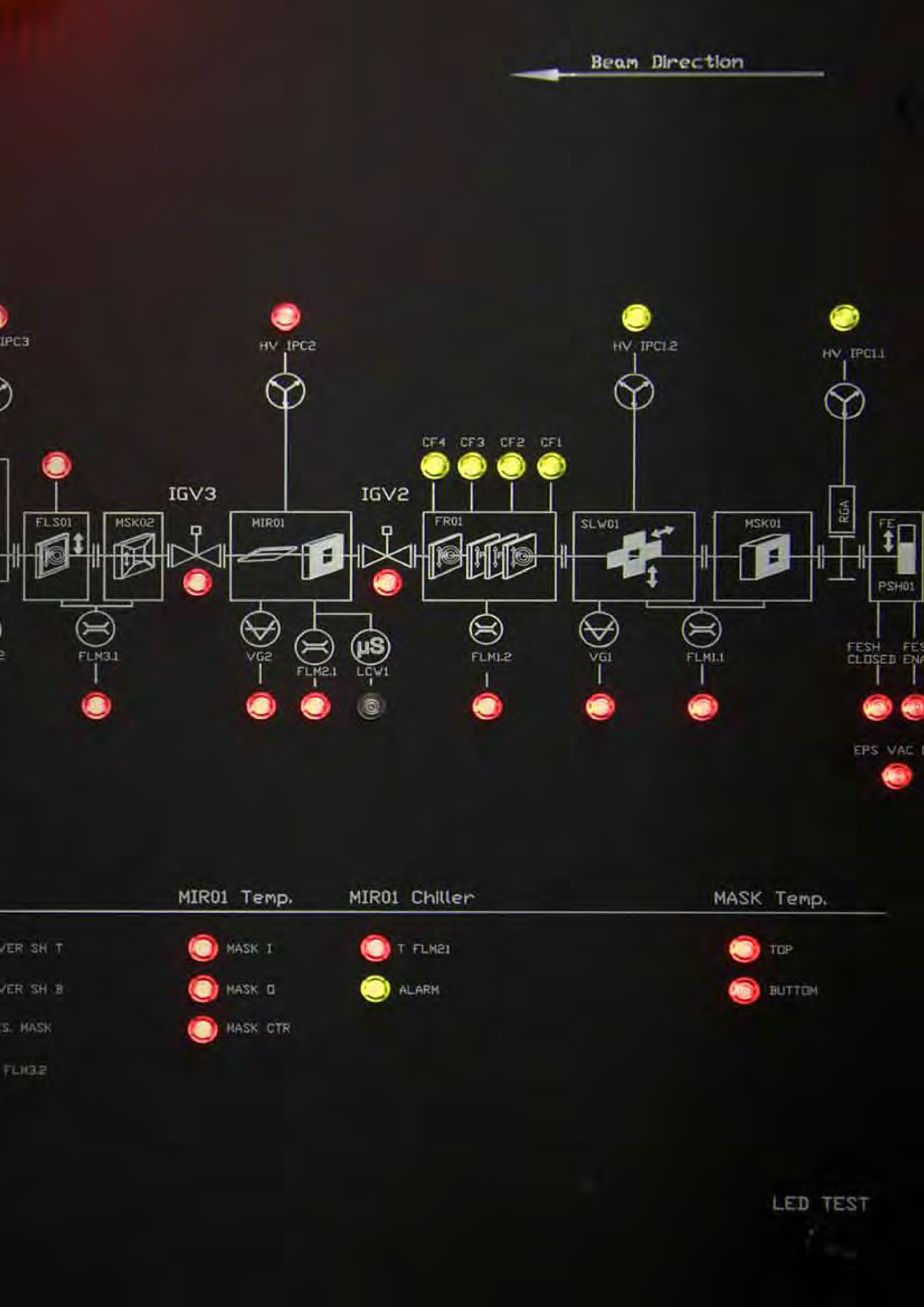
Our contribution to our precinct via the South East Melbourne Innovation Precinct (SEMIP) also continues, particularly through our industry engagement work. I have been particularly pleased to see the development of our work with industry and achievement of our key performance indicator for commercial revenue over the past year. This is a significant area of potential for the facility that we will continue to nurture and grow over the coming year.

The Australian Synchrotron has made significant progress towards our vision of being the catalyst for the best scientific research and innovation in Australia. With the continued support of our funders for our future growth and expansion we all look forward to delivering continued benefit to all our stakeholders.

Dr George Borg
Acting Facility Director

Highlights

- On 12 November 2009, all beamlines at the Australian Synchrotron were simultaneously operational for the first time. Since then, all of the beamlines with the exception of the IMBL were operational the whole year
- By 30 June 2010, just three years after it opened for business, the Australian Synchrotron had attracted more than 2000 unique users
- The Australian Synchrotron development plan and investment case for future beamline and facility funding was presented to government in July 2010
- Significant works have been undertaken towards commissioning of our Imaging and Medical Therapy Beamline, including the preparation of a technical specification and procurement towards installation of a Super Conducting Multipole Wiggler and Monochromator
- MASSIVE 1 (Multimodal AS Synchrotron Image Visualisation Environment) – a high performance computer funded by Multimedia Victoria at a cost of $1.45 million and the ANDS (Australian National Data Service) project at a cost of $440K were launched to improve data storage, retrieval and sharing of information by providing a public repository for data
- Melbourne hosted the world's largest and most important forum for synchrotron radiation science and technology in September-October 2009, SRI09, which attracted 700 Australian and international researchers
- The Australian Synchrotron held an international workshop on 'top-up' operations at synchrotron light sources in October 2009
- The ANZAAS-Australian Synchrotron Inaugural Winter School for young researchers was held in July 2009
- More than 2200 visitors flocked to the Australian Synchrotron open day in October 2009
- The new Australian Synchrotron website went live in July 2009



Beam Direction
HV IPC2
HV IPC1.2
HV IPC1.1
CF4
CF3
CF2
CF1
IGV3
IGV2
FLS01
MSK02
MIR01
FR01
SLW01
MSK01
RGA
FE
PSH01
FLM3.1
VG2
FLM2.1
µS
LCW1
FLM1.2
VG1
FLM1.1
FESH CLOSED
MIR01 Temp.
MIR01 Chiller
MASK Temp.
MASK I
MASK CTR
T FLM21
ALARM
TOP
BUTTOM
LED TEST

Our Supporters

The Australian Synchrotron was established as part of a strategic partnership instituted by the Victorian Government and involving the support of the Federal Government. This generous support has been enhanced by investments from the New Zealand Government and research institutes, universities and state governments from across Australia and New Zealand.

As our Foundation Investors, these groups have played an essential role in the establishment of the Australian Synchrotron through the funding of the beamlines program, with each contributing a minimum of $5 million. They continue to play an active role as the primary advisers to the Board concerning the governance of the facility.

Our supporters include the Federal Government and five Australian state governments, the New Zealand Government, six publicly funded research institutes, 33 Universities and 37 medical research institutes.

Supported by

Australian Government

State Government Victoria AUSTRALIA

Foundation Investors

AAMRI

ANSTO

CSIRO

Monash University

University of Melbourne

New Zealand Consortium

New Zealand Government

Victoria University of Wellington

University of Auckland

University of Otago

University of Canterbury

Crop Grains Science Limited

University of Waikato

Massey University

Lincoln University

IRL (Industrial Research Limited)

Agresearch

AUSyn14 Consortium

NSW Government

University of Western Sydney

University of New England

Southern Cross University

Charles Darwin University NT

Charles Stuart University

University of Technology Sydney

University of Canberra

University of NSW

University of Newcastle

University of Wollongong

University of Sydney

University of Tasmania

Macquarie University

Queensland Consortium

QLD Government

Griffith University

James Cook University

Queensland University of Technology

University of Queensland

South Australian and La Trobe Consortium

Government of South Australia

Flinders University

University of Adelaide

La Trobe University

University of South Australia

Western Australian Consortium

Government of Western Australia

University of Western Australia

Curtin University

Our User Community

The user office

The User Office is the first point of contact for all current and prospective users, and central to the experience associated with working at the Australian Synchrotron and producing research outcomes.

In addition to ensuring that more than 600 proposals a year are properly reviewed, ranked and awarded beamtime, the User Office sees to the practical needs of the hundreds of users who come to the Australian Synchrotron annually.

The User Office oversees the review of all merit-based proposals to use the facility, beamtime scheduling and flow of information and advice to the user community. Post-beamtime, the User Office manages the collation of publications containing scientific work resulting from the Australian Synchrotron beamlines.

Additional to the operations based in Australia, the User Office runs the International Synchrotron Access Program, which funds Australian research groups travelling overseas to other synchrotron facilities.

The main achievement of this year was the successful management of 3300 safe user visits to the Australian Synchrotron. The ongoing user exit survey reported that for this period, the average user felt their experience with the User Office was between "good" and "excellent".

Looking forward, the group will continue improving its processes to meet the demand of growing user numbers, which will see an increasing utilisation of web-based systems.

The User Office Team

Dr Cathy Harland, Group Leader, User Support

Ms Amanda Louch, User Office Administrator

Ms Eva Christopoulos, User Office Administrator

User access

The allocation of user access to the beamlines is based on the following schedule:

Merit based
(approximately 50 percent)

Merit beamtime is allocated through a competitive, peer review process. There were three open 'calls for proposals' in 2009-2010 relating to three beamtime periods. Typically the call for proposals is open for one month, and closes two months ahead of the scheduling period.

Foundation Investor
(approximately 30 percent)

Foundation Investor proposals are not subject to peer review and are allocated beam time by the Foundation Investor Consortia subject to satisfactory safety and technical feasibility criteria. This arrangement remains in place for six years from the time of the first beamline becoming operational in September 2007.

Facility and commercial access
(approximately 20 percent)

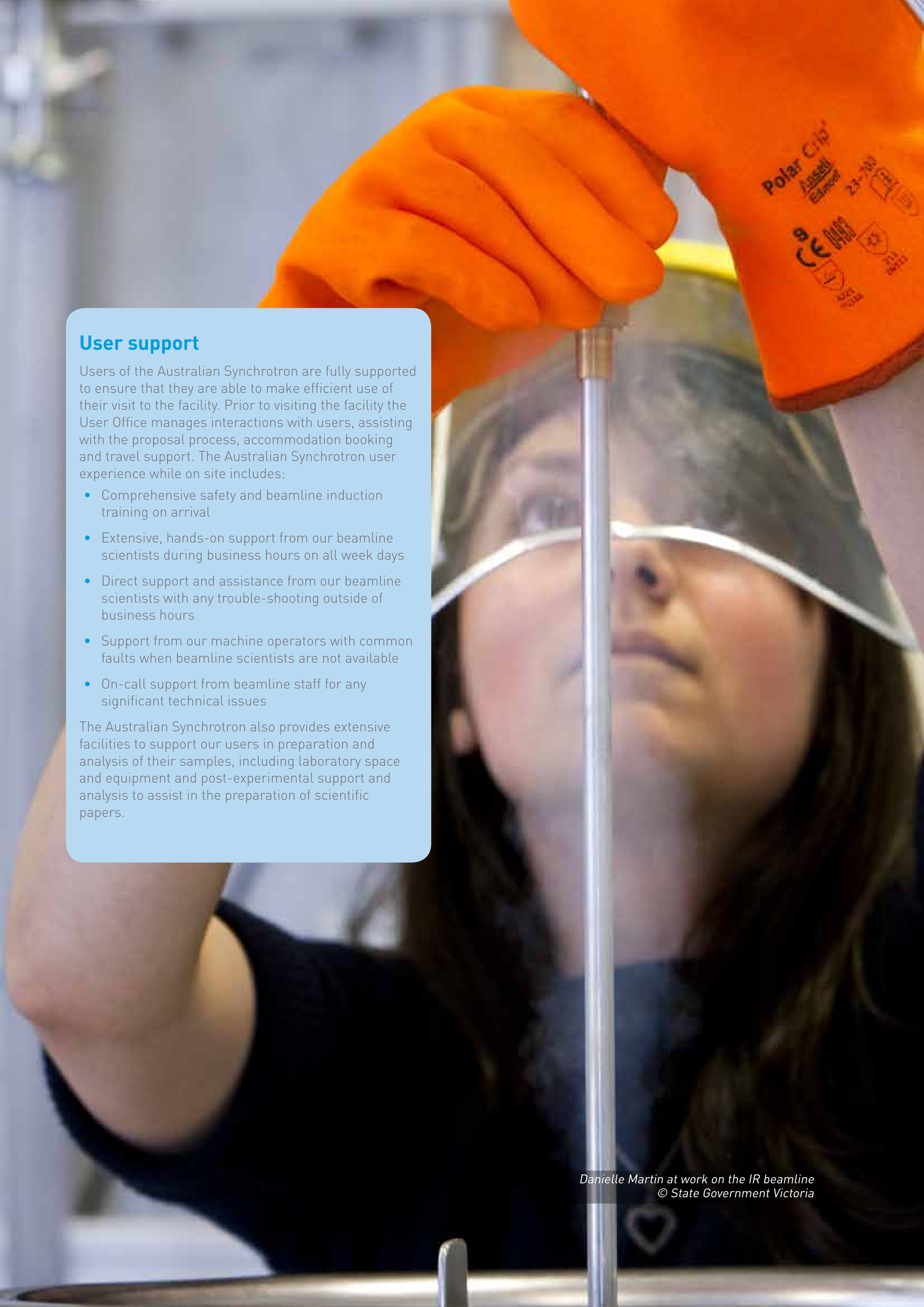
This includes access for scientists working at the Australian Synchrotron to further their own research projects. A commercial program is also in operation and achieved significant revenue over 2009-2010.

User support

Users of the Australian Synchrotron are fully supported to ensure that they are able to make efficient use of their visit to the facility. Prior to visiting the facility the User Office manages interactions with users, assisting with the proposal process, accommodation booking and travel support. The Australian Synchrotron user experience while on site includes:

- Comprehensive safety and beamline induction training on arrival
- Extensive, hands-on support from our beamline scientists during business hours on all week days
- Direct support and assistance from our beamline scientists with any trouble-shooting outside of business hours
- Support from our machine operators with common faults when beamline scientists are not available
- On-call support from beamline staff for any significant technical issues

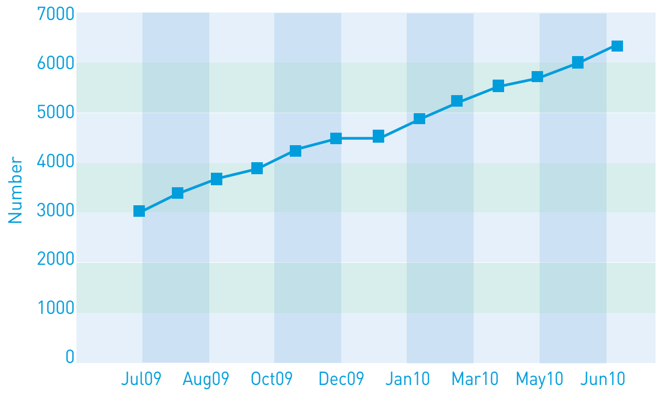
The Australian Synchrotron also provides extensive facilities to support our users in preparation and analysis of their samples, including laboratory space and equipment and post-experimental support and analysis to assist in the preparation of scientific papers.



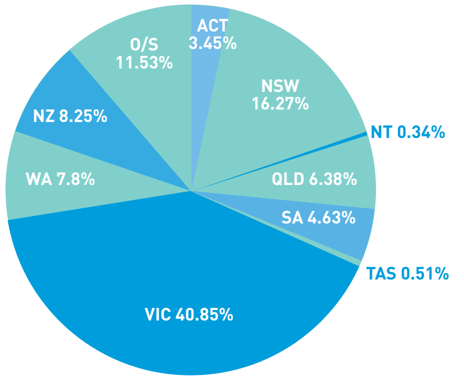
Danielle Martin at work on the IR beamline
© State Government Victoria

Our User Community

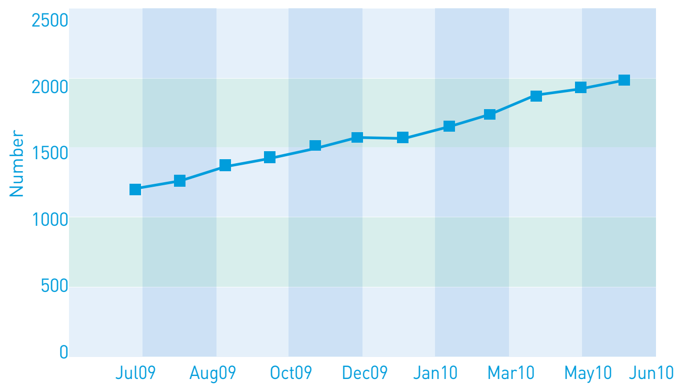
The Australian Synchrotron user community is growing and diverse. It includes a mix of government, academic and industrial scientists from all over Australia and New Zealand and the rest of the world. A number of our users are students and early career researchers, indicating the important role of the Australian Synchrotron in the development of the national and international synchrotron science community.



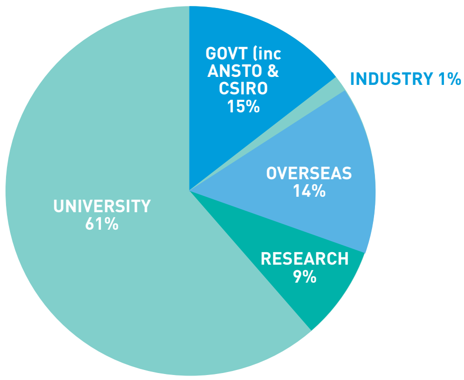
Cumulative number of AS user visits



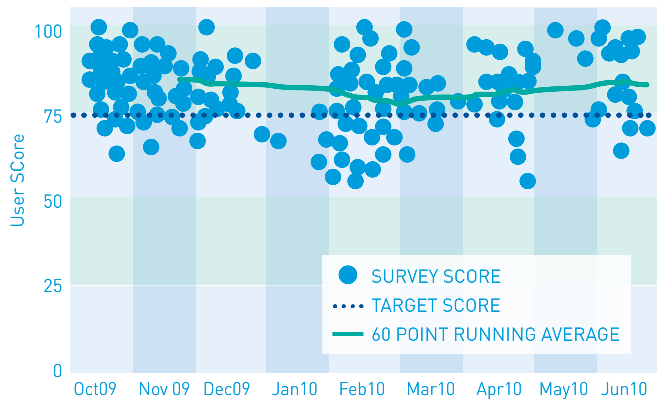
AS User location



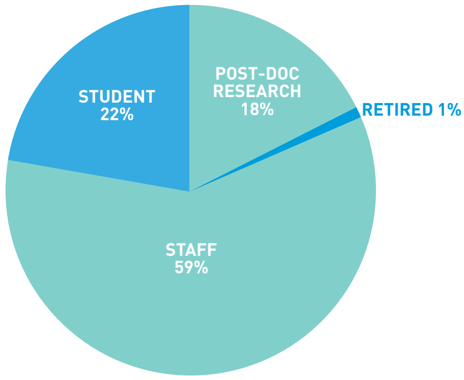
Number of AS visits by individual (unique) users



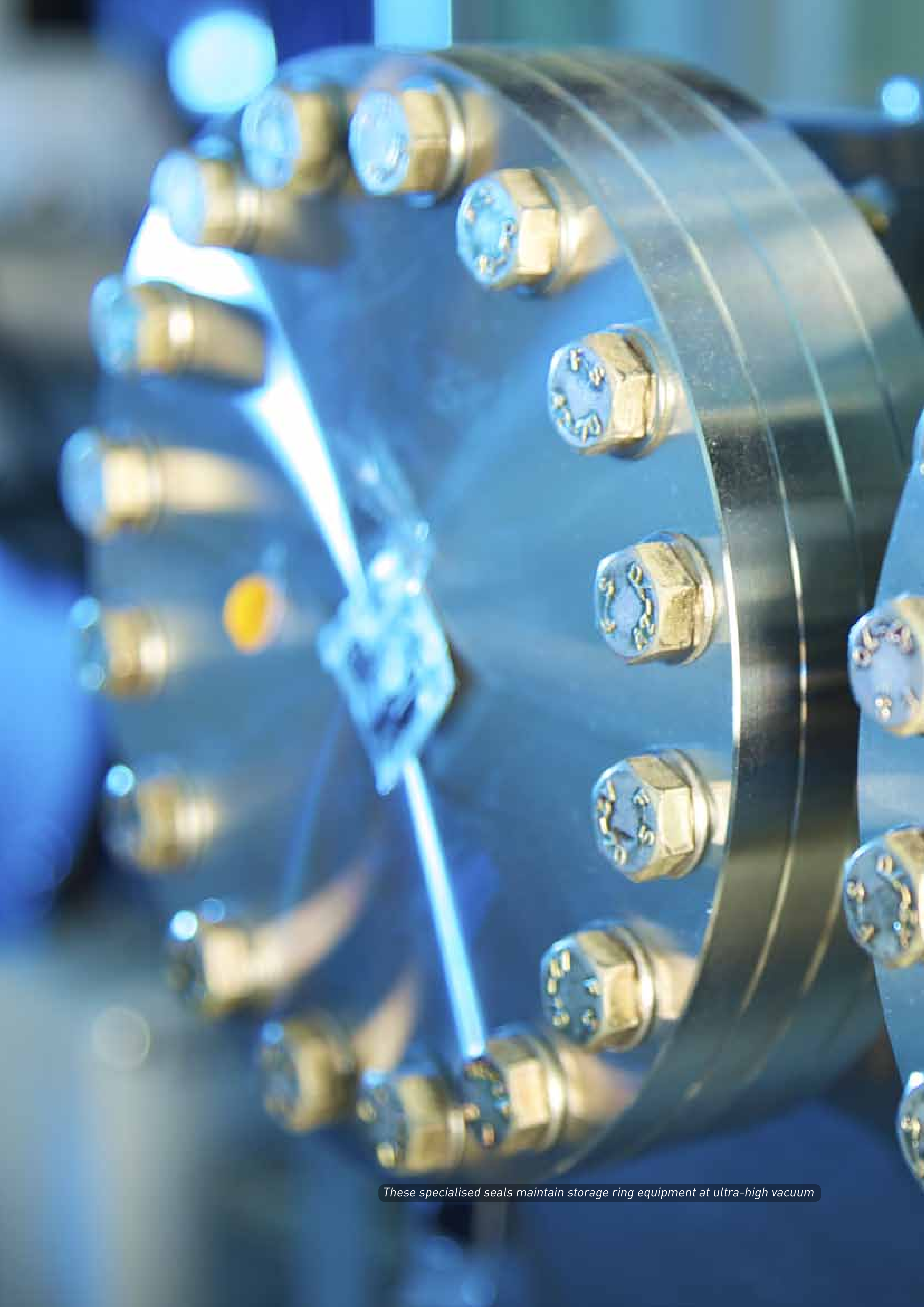
AS User affiliation



AS user satisfaction (based on user exit surveys)



AS User Career level



These specialised seals maintain storage ring equipment at ultra-high vacuum

Scientific Overview

This has been a very significant year for the scientific program at the Australian Synchrotron, foremost as it is the first full year in which all but our Imaging and Medical Beamline (IMBL) have operated with full user programs. Consequently, our user base, publication output and the awareness of synchrotron science have grown rapidly. The performance of our beamlines has met or exceeded expectations and several are now considered world-leading. This is not a term that is easily defined, however I feel the facility has met its aim to provide beamlines that equip Australian and New Zealand scientists with access to high quality tools that enable outstanding research outcomes and increase the scientific profile and productivity of our two nations.

The publication output of the Australian Synchrotron has risen from 17 in calendar year 2008 to 52 in 2009. Already in the first half of 2010, 73 publications that rely on data obtained at the Australian Synchrotron have been reported, which is an extraordinary achievement. User satisfaction levels, as measured by our user exit survey, continue to show a high level of satisfaction and most of our users are consistently complimentary of the dedication, professionalism and competence of our beamline staff.

Although we have done much to support our users, we continue to strive to improve our standards and processes. To this end, several initiatives have been introduced to enhance the productivity of staff and users, while strengthening the relationship between the facility and stakeholders. A key component of this work is the Australian Synchrotron Postgraduate Awards program. Through this program we offer "top-up" scholarships to the highest performing postgraduate students undertaking research programs with a strong focus on synchrotron science. A competitive internal research grants scheme and support for individual beamline scientists and their research has also been introduced to encourage scientific excellence amongst our staff.

An important scientific outcome for the past year has been the completion of the science case outlining the next phase of development for the Australian Synchrotron. We recognise that to remain at the leading edge of light sources, continued development of our facility is critical. To this end, a process was designed to plan the optimal mix of new beamlines and major upgrades for the next decade. The process involved wide consultation with the user community and we are grateful to the many scientists who contributed to this process, including our own staff, members of our advisory committees and international experts whose advice was critical in producing the final document. We look forward to implementing this ambitious plan and are confident that the continued growth of the Australian Synchrotron will ensure that our facility remains an enormous benefit to Australasian scientists and a facility of which we can be proud.

Professor Ian Gentle
Head of Science

Overview of Beamlines

- High Throughput Macromolecular Crystallography (MX1): dedicated to determining the structure of protein crystals and the initial assessment of more complex crystals, this beamline also provides rapid and detailed crystal structure information in addition to supporting the rapid determination of large numbers of protein structures.
- Micro Crystallography (MX2): uses multiple wavelengths of light to evaluate high-resolution crystal structures and allows characterisation of structures that were previously difficult to determine, particularly for small, weakly diffracting crystals.
- Imaging and Medical Beamline (IMBL): will provide high-resolution x-ray imaging of biomedical and other samples and enable micro-radiation therapy. When fully commissioned the IMBL will allow much greater contrast in two and three-dimensional images than is possible using conventional methods. It is one of only three beamlines in the world that will be configured for a range of bio-clinical research applications.
- Small and Wide Angle x-ray Scattering (SAXS/WAXS): provides information on the structure and dynamics of complex samples and allows the collection of dynamic process data that cannot be collected by any other means.
- X-ray Fluorescence Microscopy (XFM): provides extremely high resolution maps of elemental distribution across a diverse range of samples and can be tuned to analyse individual atoms within a sample, providing a wide variety of valuable structural and chemical information.
- X-ray Absorption Spectroscopy (XAS): provides structure or chemical information about a sample including data about chemical bond lengths, local atomic geometry, disorder and oxidation state. This is complementary to protein crystallography, which is used to determine challenging molecular structures.
- Powder Diffraction (PD): supports a range of experiments on multi-component samples that provide data on their structure, strain, phase, texture, and composition. The beamline allows rapid data collection with high resolution and can produce two-dimensional maps of data. This is the optimal technique for investigating atomic structures in materials that do not form as a single crystal.
- Infrared Spectroscopy (IR): Synchrotron infrared facilities are relatively new and provide significantly higher resolution than conventional infrared sources. The technique allows for high spatial resolution chemical images and high-resolution characterisation of gas samples.

The Global Synchrotron Science Community

The Australian Synchrotron maintains an active presence amongst the international community of synchrotron light sources. Scientists at the facility have developed close collaborations and formal arrangements with their colleagues across the globe in an effort to remain abreast of scientific and technical developments and through these networks are making important contributions to the development of the synchrotron science field.

In addition, the Australian Synchrotron aims to develop the Australian user community by providing support for synchrotron users at Australian institutes to access synchrotron facilities overseas through the International Synchrotron Access Program (ISAP). The Federal Government under the auspices of the National Collaborative Research Infrastructure Strategy provides funding to support access to synchrotron facilities that are not currently available in Australia. This ensures that the Australian research and broader community still benefits from research in these areas. In addition, it helps to develop an Australian pool of expertise in emerging synchrotron methodologies and ideas, ensuring Australian research remains at the cutting edge of the global scientific endeavour.

The Australian Synchrotron continues to facilitate access to the Australian National Beamline Facility (ANBF) in Japan. This facility is a mature beamline that provides fluorescence x-ray absorption spectroscopy (XAS).

Scientific highlights

- New understanding of control mechanisms underlying sensory perception
- Analysis of solar wind atoms from the NASA Genesis spacecraft
- First microbeam radiation therapy experiments on the Imaging and Medical Beamline, a promising therapy for cancer treatment
- Investigation of ion tracks for use in improving geological dating techniques

This corridor will house the 150 metre-long Imaging and Medical Beamline which is currently under construction

Macromolecular and Micro-Crystallography

The Australian Synchrotron provides two separate crystallography beamlines to address the Australian crystallography community's diverse and very productive user needs. As well as university researchers and researchers from government agencies, the protein crystallography beamlines have many commercially-funded users who pay to access the beamlines on a confidential basis.

A team of six scientists manages the beamlines, looks after users, and implements ongoing improvements to beamline precision, stability, reliability, performance and data quality. Team members have expertise in areas such as protein and small molecule crystallography and conduct research in their own right, usually in collaboration with users.

Research areas investigated over the last year include potential drug candidates for disease-related microbiological and human proteins, such as a malarial protein that could be targeted to starve the parasite to death. Other areas include the molecular basis of immune recognition, bacterial pathology, and the pore-forming toxins some microorganisms use to invade human cells.

Key achievements

A major research highlight was a significant discovery by researchers from the Walter and Eliza Hall Institute concerning the biological mechanisms controlling electrical (potassium ion) currents that underpin sensory perception and nervous system function in humans.

Another achievement involved the introduction of a micro-collimator on the micro-crystallography beamline (MX2) which means that users can reduce the beam size from 30x25 micrometres to smaller sizes such as 5x5 micrometres with just a mouse click. This is very useful in analysing small crystals.

The upgraded monochromator on the macromolecular crystallography beamline (MX1) produces a finer beam (160x160 rather than 240x220 micrometres) and three times the flux (beam energy), in an effort to significantly reduce data collection times.

New autoprocessing software written in-house was also introduced to provide real-time feedback on data quality so that users can quickly select the best crystals for further analysis.

An improved beam steering system on MX2 enables users to change the x-ray energy themselves, while a similar system has been installed on MX1 and is now being commissioned.

Future developments will include introducing a 'kappa head' for the goniometer on either beamline to allow small-molecule users to get better data through fine control of crystal orientation relative to beam direction. The team will also implement an automated system for preliminary screening of crystals.

About the beamlines

Macromolecular crystallography is the study of the structure of large biomolecules such as proteins and nucleic acids (DNA and RNA) using x-ray crystallography. Proteins are essential to life and carry out almost all reactions inside living cells. X-ray diffraction is the most widely-used method for protein structure determination, providing essential information for a wide range of applications, including drug development, food technology, agriculture, manufacturing and chemical processing.

Determining the structure of proteins provides valuable information on how these "molecular machines" work, how they evolved and how to design drugs to modify their actions. This information can be used to design specific drugs that target proteins involved in diseases such as cancer, HIV, tuberculosis and malaria.

The Australian Synchrotron has two crystallography beamlines. The macromolecular crystallography (MX1) beamline is a high-throughput beamline for users with large numbers of samples. The micro-crystallography (MX2) beamline also caters for difficult crystals that are small or weakly diffracting. Remote access is available on both beamlines by prior arrangement.

Beamline team

Dr Tom Caradoc-Davies, Principal Scientist

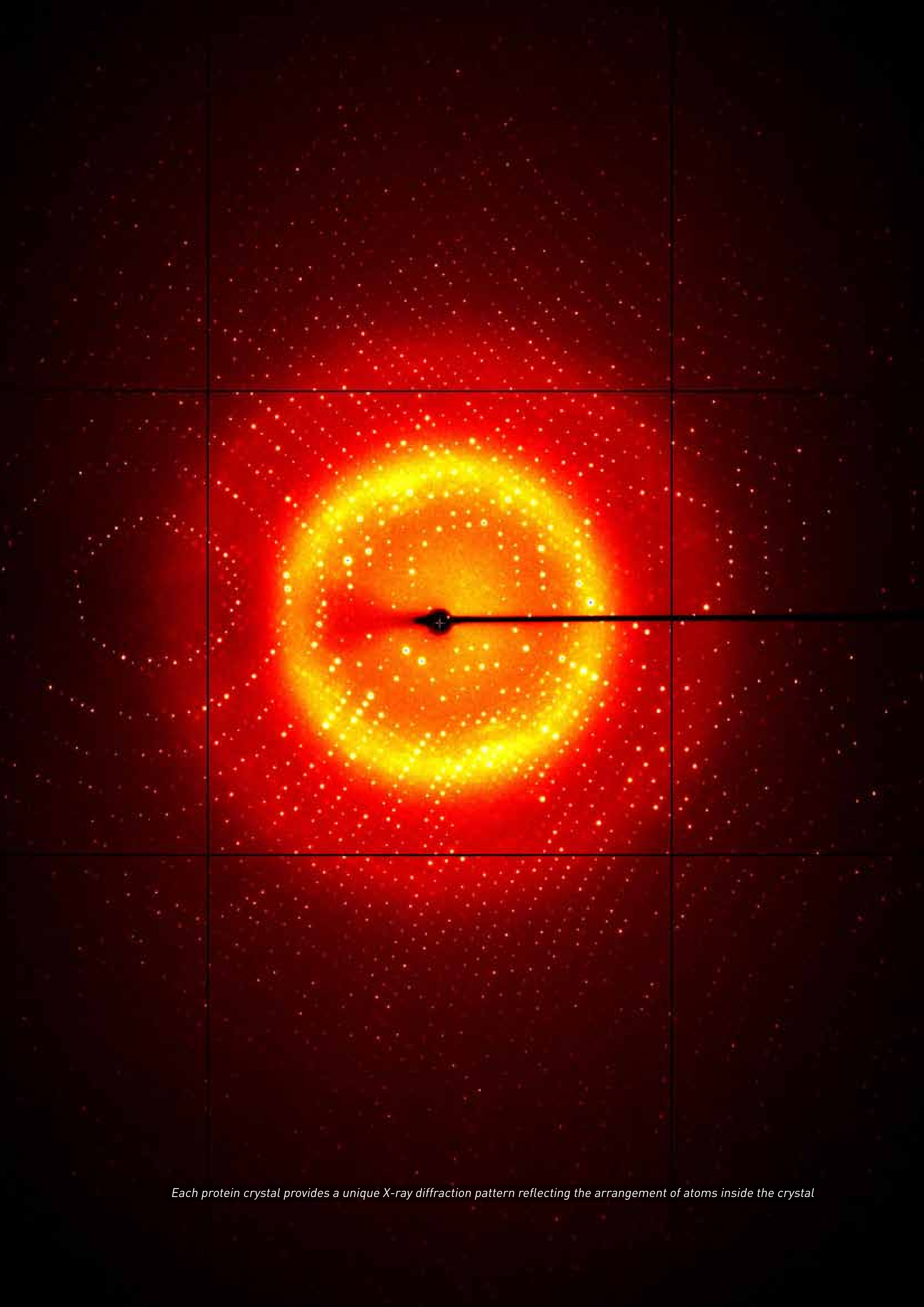
Dr Nathan Cowieson, Scientist

Dr Alan Riboldi-Tunnicliffe, Scientist

Dr Christine Gee, Scientist

Dr Rachel Williamson, Scientific Support Officer

Ms Ruth Plathe, Scientific Support Officer



Each protein crystal provides a unique X-ray diffraction pattern reflecting the arrangement of atoms inside the crystal

Mouse x-ray image showing important features of the trachea.
Image courtesy of David Parsons, Women's and Children's Hospital, Adelaide.

Imaging and Medical Beamline

As it nears completion, the imaging and medical beamline (IMBL) is attracting considerable attention from researchers keen to utilise its unique capabilities. The beamline will support Australia's strengths in biomedical and materials research and focus on two main research areas: novel forms of radiation therapy and leading-edge x-ray imaging. This will include the development of phase-contrast imaging techniques for biomedicine and materials research. The beamline team is also developing an impressive range of computed tomography (CT) techniques for 3-D imaging.

A Melbourne research team has been using the beamline's first experimental station to investigate microbeam radiation therapy (MRT), a promising new form of radiotherapy for cancer treatment. Research is still in the preliminary stages, but researchers already believe MRT is more effective than conventional treatments. The research community also sees this work helping to improve our understanding of how radiotherapy works, which could also lead to other novel and effective treatments for cancer.

The IMBL also has unique facilities that are of use in other areas of science and has also been used to examine wood, oil-bearing sand, bone and tooth samples, including a placoderm (mega shark) tooth.

A clinical advisory panel with a broad range of medical specialists and an animal ethics committee with animal welfare representation have been established to advise on appropriate research directions and animal handling protocols for all work undertaken on this beamline.

Key achievements

The beamline's second experimental station was completed and successfully tested in mid-2010. It will be used for objects up to 10cm in size, and for a phase-contrast imaging technique called Propagation Based Imaging (PBI).

In June 2010, Adelaide researchers performed some pilot experiments on the beamline so they could compare its current contrast and spatial resolution capabilities with the overseas facility they have been using. The group is assessing its cystic fibrosis treatments and developing phase-contrast x-ray imaging techniques for wider application in respiratory research.

Installation of the extended beamline is scheduled to begin in late 2010, with beamtime to become available in 2011 and clinical research commencing in 2013.

Other achievements will include expansion of the satellite building, a suite of laboratories, an animal holding area and a clinical area for human patients.

With these enabling facilities in place, research on the beamline is predicted to lead to new breakthroughs in understanding lung and cardiovascular disease, and cancer growth, all of which are associated with significant morbidity and mortality. As a result, clinicians will be positioned to implement this technology in therapeutic programs that will significantly reduce mortality in difficult or untreatable cancer cases.

About the beamline

When completed, the IMBL will deliver a 60 cm by 4 cm x-ray beam to a satellite building that is fully equipped for pre-clinical and clinical research. It will provide unrivalled x-ray imaging and radiotherapy capabilities for a wide range of research applications from medicine to specialised materials research.

The extended beamline and satellite building facility that are currently under construction will provide high-resolution imaging of cells, tissues and tumours, enable cell tracking using markers, and facilitate radiotherapy research. The beamline's cardiac and cardiovascular, lung and tissue (breasts, bones and organs) imaging capabilities will allow preclinical programs to be extended to clinical research with patients.

Beamline team

Dr Daniel Häusermann, Principal Scientist

Dr Chris Hall, Scientist

Dr Anton Maksimenko, Scientist

Dr Raphael Serduc, Scientific Services Officer

Small and Wide Angle X-ray Scattering

The small and wide angle x-ray scattering (SAXS/WAXS) beamline can support experiments on solid and liquid systems, as well as surfaces. Users can rapidly learn how to use the instrument from very simply graphical user interfaces (GUIs). The SAXS beamline is considered world-leading and the expertise of its team in running, maintaining and developing the beamline to its optimum level is widely recognised.

Many SAXS beamline users are looking at protein solution structures with the aim of better understanding the infection and defence mechanisms used by antibiotic-resistant bacteria and HIV. The excellent signal-to-noise ratio achieved on this beamline is absolutely crucial for successful outcomes in this area and the scientific impact of this work is high.

A research group from the Australian National University is studying ion tracks, the minute trails left behind by high-velocity heavy ions such as uranium and gold when they pass through crystalline solids and minerals. This technique is helping to improve geological dating techniques by providing complementary information on the thermal history of geological samples.

The longer-term benefits of research on the beamline include an improved understanding of how diseases work at the molecular level, leading to better methods for diagnosing and treating diseases and more effective drug delivery systems with fewer side effects. Other benefits include improved mineral processing, better control of manufacturing processes, and new materials with better properties.

Key achievements

Two Pilatus detectors were integrated into the beamline over the past year, offering fast data acquisition at tens of frames per second.

The Pilatus detectors have a high dynamic range and an outstanding signal-to-noise ratio. With a particularly good sample alignment system, the current setup can handle more than 2000 samples a day. The team is building a new loading system that will take several hundred samples at a time and a highly automated setup for protein solution analysis. Such developments are enabling a paradigm shift in experiment design and capabilities, such as the use of robotics in chemistry research.

A fast mechanical stage system has also been installed for the SAXS detector so that users can obtain full frame images despite the gaps in the detector, which are not xray sensitive. This is essential for samples that scatter non-uniformly, such as oriented polymers, tissues and nanomaterials.

The beamline team has optimised the optics system so the beamline offers very high levels of signal-to-noise ratios allowing very weakly scattering samples to be analysed reliably. Precise alignment of the beamline optics makes x-ray energy changes a routine task that can be done in seconds to minutes depending on the complexity of the experiment.

About the beamline

The SAXS and WAXS beamline provides information on the structure of materials on scales ranging from atomic to molecular to particle scale: from 1 angstrom up to 400 nanometres. Many types of materials have structure on the nano scale, including liquid emulsions, colloids, particles, proteins and surfaces.

SAXS provides useful structural information on a wide range of solids, powders, gels, liquids and solutions, including biological materials, polymers, coatings, biosensors, and mineral ores and products.

The beamline also offers simultaneous WAXs, which is useful for structures ranging down to the atomic level. The beamline's WAXS capabilities are used for projects such as phase analysis in minerals, molecular packing in polymers, and small-scale structures in surfactants, and in many cases, the SAXS and WAXS measurements are taken simultaneously to study dynamics at differing scales.

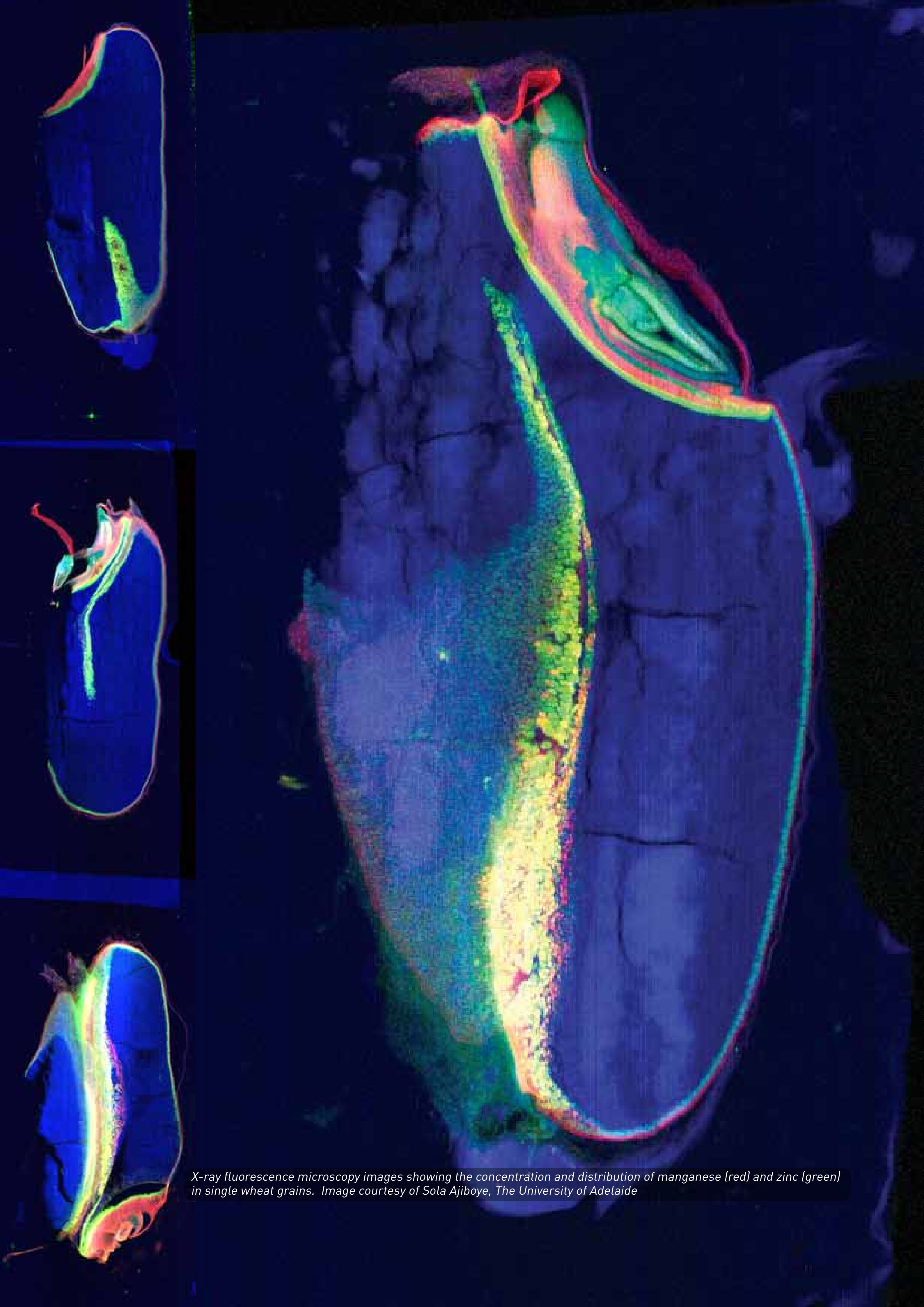
Beamline team

Dr Nigel Kirby, Principal Scientist

Dr Stephen Mudie, Senior Scientist

Dr Adrian Hawley, Scientific Support Officer

Principal scientist Nigel Kirby on the Australian Synchrotron's world-leading SAXS/WAXS beamline



X-ray fluorescence microscopy images showing the concentration and distribution of manganese (red) and zinc (green) in single wheat grains. Image courtesy of Sola Ajiboye, The University of Adelaide

X-ray Fluorescence Microscopy

The x-ray fluorescence microscopy (XFM) beamline has users from diverse areas that include medicine, biology, agriculture, geology, mining, environmental studies, forensics and the art world. The breadth of research on the XFM beamline is such that the beamline team have helped users to study samples ranging from stardust to hidden paintings and half a human heart.

Information about elemental distribution in single cells and tissue sections undertaken on the XFM beamline is helping scientists to better understand the biological mechanisms behind health conditions and diseases such as Alzheimers and Parkinsons.

Other researchers are examining geological samples such as gold mining ores to assist the development of improved techniques for assessing new mineral deposits.

The Australian Synchrotron XFM beamline design is considered an excellent model for other similar beamlines being built around the globe and the world-leading Maia detector is attracting widespread attention. Meeting user demand for such a popular beamline will continue to be a major challenge for the XFM beamline team.

Key achievements

Fluorescence tomography is a way of combining a series of linear sections across a sample to create a full two-dimensional 'slice' or a full three-dimensional image of the sample. The technique is being developed by the beamline team and used to investigate mineral distribution in cereal grains such as rice and barley as well as in living organisms.

In addition, the team has worked closely with CSIRO and overseas synchrotron scientists to develop the high-speed Maia detector. The installation of the final Maia 384 detector in April 2010 is enabling users to routinely collect data in a fraction of the time previously taken.

Over the next year or so, the beamline team expect 3-D fluorescence tomography and 2-D chemical imaging to become standard techniques on the beamline. Dr David Paterson says that further improvements to graphical user interfaces (GUIs) and other aspects of the beamline operating modes will make the beamline more efficient and easier to use. Fast sample scanning stages will mean that fluorescence scans can also be accomplished at a speed that takes full advantage of the fast Maia detector's capabilities.

About the beamline

The XFM beamline provides valuable elemental, structural and chemical information from a very diverse range of samples with micrometre and sub-micrometre resolution (less than one-hundredth the width of a human hair).

XFM produces a detailed x-ray image of a whole sample by collecting data from small sections and combining these to make up the full picture. It can simultaneously identify the presence and determine the level in the sample of multiple elements such as iron, magnesium, copper and gold. The technique is particularly useful in biology, geology and mining, environmental studies and forensics. The beamline's nanoprobe capabilities can resolve features as small as 200 nanometres, making it ideal for sub-cellular elemental mapping and imaging of biological samples.

Beamline team

Dr David Paterson, Principal Scientist

Dr Martin de Jonge, Senior Scientist

Dr Daryl Howard, Scientific Support Officer

X-ray Absorption Spectroscopy

The x-ray absorption spectroscopy (XAS) beamline is a versatile facility attracting roughly equal numbers of researchers, with materials and biological samples, as well as users from other scientific disciplines. Around the world, XAS beamlines are in high demand for a broad range of applications.

Over the past year, researchers have used the XAS beamline at the Australian Synchrotron to examine space wind samples, assess new detectors for medical imaging purposes, investigate ruthenium chemistry in proteins and identify the chemical species of iron and copper compounds in a soil nematode called *Caenorhabditis elegans*. The *C. elegans* nematode is considered a model organism for a surprisingly wide range of biological development studies.

The beamline user program is now running at full capacity and has been utilised for a variety of interesting research, such as work conducted by research teams from Sydney, who examined ruthenium chemistry in proteins using a combination of coarse-scale scanning and more careful measurements at selected points. In another study, researchers from Adelaide looked at the chemical form of selenium in tissue samples which is of scientific interest because selenium supplements may help prevent a wide range of cancers. The beamline is also used as a general-purpose high-energy x-ray beamline, to produce iodine absorption contrast images.

Key achievements

The keenly awaited 100-element germanium detector was successfully installed and commissioned in the first half of 2010, making the beamline one of only four in the world with this enhanced capacity. Users have noted that the beamline is producing high-quality fluorescence data and measurements can be done in around half the time that would be required on the beamline's counterpart in Japan, the Australian National Beamline Facility (ANBF).

The equipment setup in the first experimental hutch has been standardised to enable the most effective use of experimental time and minimise changeover time between experiments. In future, the standard setup will be complemented by a small number of interchangeable setups designed specifically for particular types of experiments.

The equipment setup in the second experimental hutch is almost complete. This hutch will enable users to bring or build their own customised experimental rigs.

About the beamline

XAS techniques provide chemical and structural information on atoms from calcium to uranium for a wide range of solid and liquid systems. XAS experiments require an intense, tuneable photon source only available at synchrotrons.

The x-ray absorption near-edge structure (XANES) region of an XAS spectrum yields chemical information such as local coordination geometry and oxidation state. The extended x-ray absorption fine structure (EXAFS) region provides structural information such as bond length, coordination number and disorder.

Widely used by both specialists and non-specialists, XAS is a mature technology that enables the advancement of new areas of science. The technique complements protein crystallography studies, and the two are frequently used in combination to determine challenging structures.

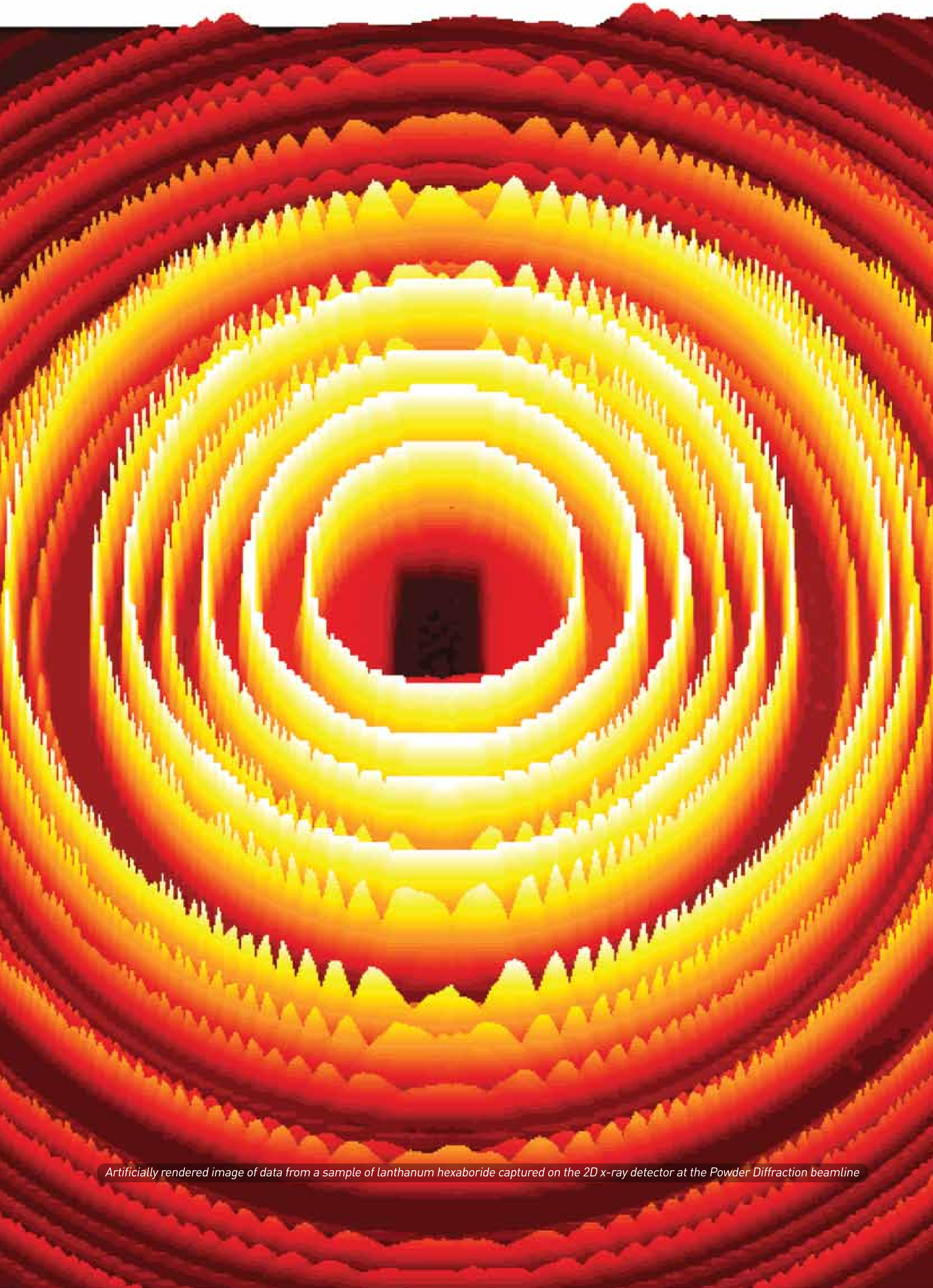
Beamline team

Dr Chris Glover, Principal Scientist

Dr Bernt Johannessen, Scientist

Dr Lisa Giachini, Scientific Support Officer *(until February 2010)*

Principal scientist Chris Glover working at the synchrotron's XAS beamline



Artificially rendered image of data from a sample of lanthanum hexaboride captured on the 2D x-ray detector at the Powder Diffraction beamline

Powder Diffraction

The powder diffraction (PD) beamline is a multi-faceted facility that provides users with a wide range of capabilities and allows them to achieve world-class scientific outcomes with relevance to a variety of scientific disciplines.

The facility caters to the research needs of scientists from the fields of materials research, solid state chemistry, nanotechnology, the earth sciences and minerals sectors. Samples examined on the PD beamline include cement, medicines, electronic components, and mineral ores that supply metals for everyday items, while other user groups are looking at energy storage problems, such as improving magnesium-air batteries.

Since beginning its operation the beamline has seen significant growth in the number and diversity of users seeking to expolit the beamline's unique capabilities. The increase in 'materials research' for example is an exciting development and one that will enhance the community of users dedicated to producing functional materials.

In keeping with the beamline's focus on continuous improvement, a number of sample stages and sample environments have also been introduced this year. This program of development seeks to meet the varying demands of the user community, while anticipating future user needs.

Key achievements

A data analysis workshop for PhD students and early career researchers held in January 2010 was well received. It achieved its aim of building the community's skill base in powder diffraction data analysis, and encouraging interest in further work.

An integrated high-temperature furnace is the latest addition to the PD beamline, which sees yet another increase in its range of capabilities. This enables 'in-situ' investigations of changes in structure over a temperature range of 25-2300°C.

The Australian Synchrotron engineering team is designing and implementing a multi-analyser crystal (MAC) detector for this beamline that will offer higher angular and energy resolution and improved signal-to-noise ratio (low background). This will be of particular benefit for samples that fluoresce and structural investigations that need the best possible peak separation. The MAC detector should be available to users by mid-2011.

A LIEF (Linkage Infrastructure Equipment and Facilities) grant was awarded at the end of 2009 for high-pressure equipment to be purchased for the powder diffraction and infrared beamlines.

In addition, a new user cabin constructed in June 2010 has greatly improved user comfort.

Future plans include: another data analysis workshop, and two new sample stages, an auto-aligning capillary sample holder, and an automatically-driven high-throughput sample stage capable of handling over 100 samples per day.

About the beamline

PD provides information on the crystal structure of polycrystalline natural and synthetic materials that can be related to the properties of those materials. It permits the study of bulk materials and provides a robust alternative for structural characterisation when single crystals are not available, as is often the case in nature and the laboratory.

Applications include in-situ studies of reaction mechanisms, investigations of crystal chemistry, phase identification and determination of how crystal structure affects physical, chemical or magnetic properties. The technique may be used for studying a wide variety of problems, from pharmaceuticals to radioactive waste materials, battery components including electrolytes and electrodes, to mineral ores and mineral processing conditions.

Compared to conventional laboratory-based powder diffraction, synchrotron powder diffraction offers superior, more accurate data, excellent signal-to-noise outcomes, faster time-frames and can be used to examine significantly smaller samples. A further advantage is that synchrotron x-rays can be tuned to particular wavelengths to suit sample composition and experimental requirements.

Beamline team

Dr Kia Wallwork, Principal Scientist

Dr Justin Kimpton, Scientist

Dr Qinfen Gu, Scientist

Infrared Beamlines

Use of synchrotron light greatly enhances the potential of infrared techniques, extending into the far-infrared region. The Australian Synchrotron offers infrared microspectroscopy and far-infrared techniques on two separate beamlines.

The infrared microspectroscopy (IM) beamline is regularly used to study biological samples such as tissue specimens and live microbiological systems, and for materials science work. For example, users from New South Wales and South Australia are assessing arsenic-based leukaemia drugs, investigating diabetes treatments and their impact on sugar concentrations in live cells, while Western Australian researchers are examining latent or invisible fingermarks with the aim of developing improved forensic methods.

In contrast, materials conservation experts in Melbourne are working with the IR beamline group to examine artworks and other culturally significant items, while Canberra scientists are developing new techniques for dealing with parchment deterioration caused by iron gall inks. In addition, researchers from New South Wales and Queensland are planning to study paints and pigments, including some used by Aboriginal artists.

The far-infrared and high-resolution infrared beamline is used to investigate the chemistry under atmospheric conditions of molecules such as the halofluorocarbons that are now used instead of chlorofluorocarbons (CFCs) in refrigerators and air conditioners. Other samples brought to the facility have included battery cell materials, ceramic semiconductors and biological macromolecular assemblies.

The Australian Synchrotron helped to support the 5th International Conference on Advanced Vibrational Spectroscopy held in Melbourne in July 2009. Three members of the infrared beamline team also presented papers at the 5th International Workshop on Infrared Microscopy and Spectroscopy with Accelerator Based Sources in Canada in September 2009.

Key achievements

The Infrared microspectroscopy team is developing specialised sample chambers to enable live cells in aqueous media to be examined under the beamline microscope. Collaborators at MiniFAB, a Melbourne-based micro and nanofabrication company, are manufacturing the sample chambers and have already received requests for these from other synchrotrons around the world.

The Australian Synchrotron's two infrared microspectroscopy specialists have also recently travelled to the Soleil synchrotron in Paris, France on the second of two visits funded under the bilateral French-Australian Science and Technology (FAST) program. The grant has enabled the two facilities to exchange expertise. Australian Synchrotron scientists have gained experience in studying mineral samples at high pressure while Soleil researchers have learnt about research into infrared sample chambers for live cell work.

The far-infrared team is installing and commissioning a gas cell for studying gases at liquid nitrogen temperature. This will provide improved access to vibrational bands, enabling users to identify changes in chemistry and interactions between molecules. The beamline will also soon have a new cryostat for low-temperature studies of solid materials.

A new FAST grant will enable an exchange of expertise in high-resolution gas spectroscopy between the far-infrared team, Monash University researchers and Soleil scientists. The Australian and French far-infrared beamlines each have unique capabilities.

About the beamline

The Australian Synchrotron has two infrared beamlines that are operated independently. One is used for infrared microspectroscopy, the other for far-infrared and high-resolution infrared studies.

Infrared spectroscopy is widely used in research, analytical and industrial laboratories. The synchrotron infrared microspectroscopy beamline extends the scope of this popular technique, and can locate and analyse individual components in samples with dimensions of only a few microns, producing high spatial resolution chemical images.

The far-infrared and high-resolution infrared beamline offers high spectral resolution infrared spectroscopy for characterising gas phase samples, solids and thin films on surfaces.

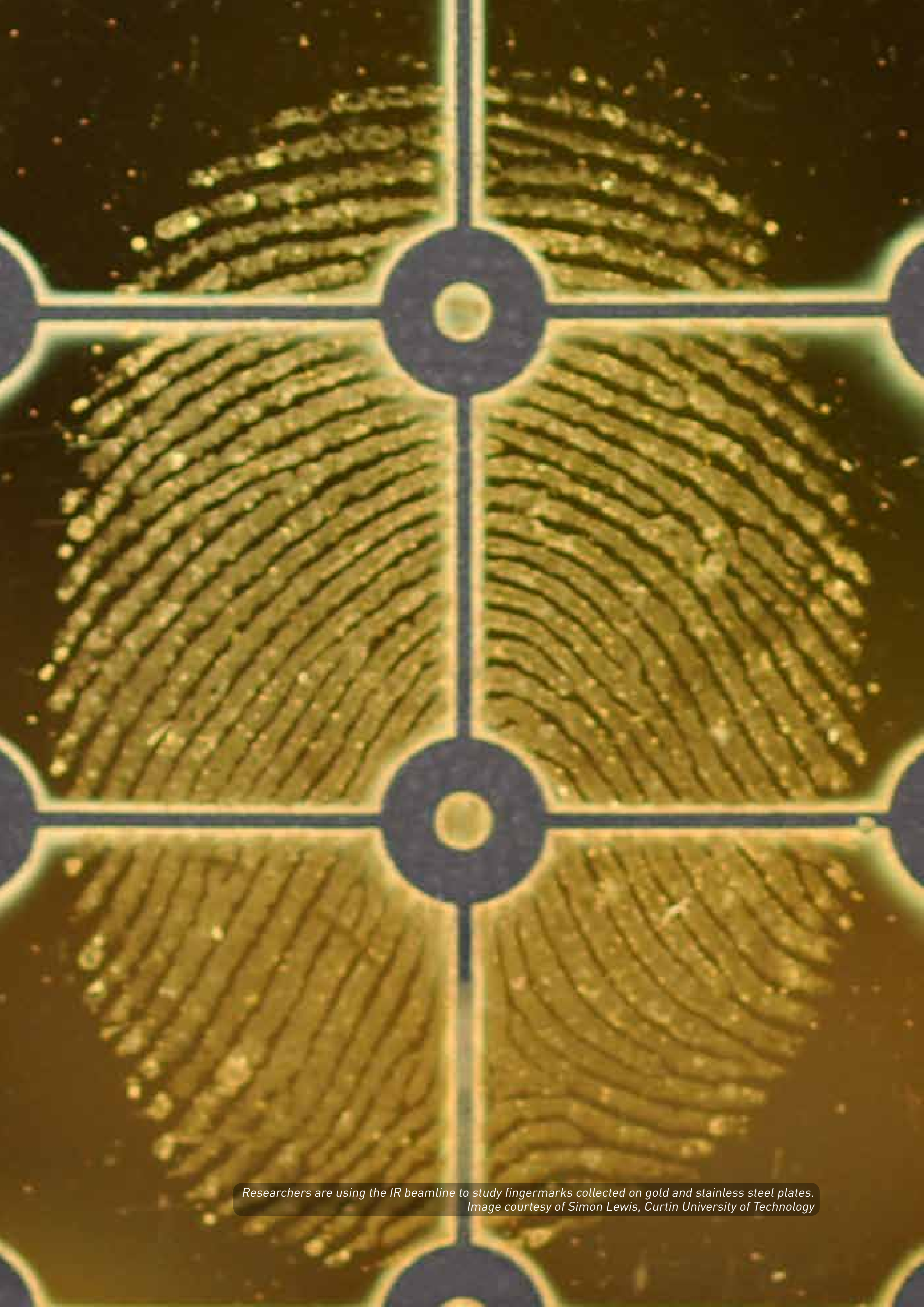
Beamline team

Dr Mark Tobin, Principal Scientist

Dr Ljiljana Puskar, Scientist

Dr Dominique (Dom) Appadoo, Senior Scientist

Dr Danielle Martin, Scientific Support Officer



Researchers are using the IR beamline to study fingermarks collected on gold and stainless steel plates.
Image courtesy of Simon Lewis, Curtin University of Technology

Principal scientist Bruce Cowie on the synchrotron's versatile soft x-ray beamline

Soft X-ray Spectroscopy

The Australian Synchrotron, soft x-ray spectroscopy beamline is unique to the facility because soft (low-energy) x-rays are not highly penetrating and the beamline is not housed in a protective hutch like the other x-ray beamlines, enabling its striking endstation (experimental) equipment to be seen by passers-by.

Soft x-rays are well-suited to characterising surfaces and near-surface interfacial layers. For example, several research groups are using the beamline to study the structural properties of diamond surfaces, including the electronic structure of freshly-cleaved diamond surfaces, and the electronic properties of diamond surfaces covered with 'buckyballs' (hollow spheres of carbon atoms arranged in five- and six-membered rings). This work could lead to advanced new components for chemical sensing and nanoelectronic devices.

A New Zealand research group is using the beamline to study lanthanum, titanium and strontium oxynitride pigments that could potentially harness visible light energy to split water into oxygen and hydrogen for use in hydrogen-powered fuel cells. About 43 percent of the sunlight that reaches earth is visible light; only five percent is ultraviolet light, the energy source of most existing photocatalysts.

Another New Zealand group is investigating the micro-structure of aluminium oxides and hydroxides to find ways to improve both the efficiency of the last step in the Bayer process and the performance of the resulting alumina as a raw material for aluminium production.

In addition to assisting research users, beamline team members also conduct their own research projects, often in collaboration with user groups. Their research areas include diamond surfaces, the production of chiral molecules for more effective pharmaceutical drugs (a chiral molecule has two non-superimposable mirror image forms, but only one form is active in the body) and a new class of polymeric organic semiconductors that could revolutionise the way electronics are manufactured.

Key achievements

During 2009-10, the beamline team continued to optimise beamline performance. Software modifications have extended the beamline's reach to higher-energy edges from elements such as sulphur, silicon and aluminium.

Implementation of a reference foil chamber to augment the beamline's excellent photon energy stability will allow users to measure a known reference spectrum concurrently with their samples.

The current user endstation will be augmented by a second end-chamber from La Trobe University to allow rapid mapping of the electronic band structure of materials. In 2011, a new branchline will be added for coherent diffraction imaging and scanning transmission x-ray microscopy.

About the beamline

This beamline can provide information on bond lengths, coordination numbers, coordination geometry and oxidation state for atoms with atomic numbers below 20 (hydrogen to calcium) for a wide range of solid and liquid samples.

It is mainly used for near-edge x-ray absorption fine structure (NEXAFS) studies. NEXAFS can only be done at synchrotrons because it requires the ability to scan through a range of x-ray energies. The beamline also offers soft x-ray photoelectron spectroscopy (SXPS), which gives higher photon resolution and sensitivity than conventional laboratory XPS.

Beamline team

Dr Bruce Cowie, Principal Scientist

Dr Lars Thomsen, Scientist

Dr Anton Tadich, Scientific Services officer

Accelerator Science and Operations

Controlling bunches of electrons moving at the speed of light inside a small metal vacuum tube that is 216 metres in diameter is a challenging task and an essential part of running the synchrotron light source. This is the massive array of high-tech equipment that generates synchrotron x-rays and infrared light for diverse research experiments at the Australian Synchrotron.

Greg LeBlanc, Head of Accelerator Science and Operations at the Australian Synchrotron and his team keep the Australian Synchrotron accelerators running, optimise their performance, and undertake accelerator research.

The major components of the synchrotron light source or 'the machine' include a linear accelerator, which accelerates electrons to almost the speed of light. Next, the electrons are injected into the booster ring, where the energy is increased from 100MeV to 3GeV. The final stage of the process is the storage ring, where the electron beam (made up of electron bunches approximately 60 centimetres apart) circulates for many hours, producing 'synchrotron light' that is used in experiments on the beamlines.

For around 38 hours a week the team conduct their machine research studies and start up the electron beam. They also conduct machine studies following routine maintenance shutdown periods several times a year.

As the electron beam circulates inside the vacuum chamber, it generates an 'image current' of electrons flowing the opposite way in the chamber walls. The image current makes the electron beam less stable, but this is addressed by adjusting the sextupole magnets. The accelerator team finally solved this problem by developing a feedback system that dampens the motion of the electron bunches.

The feedback system also enables the team to diagnose other electron beam issues, discard individual bunches, and deliver synchrotron light with particular characteristics for specialist analytical techniques.

A workshop on "top-up" operations was held at The University of Melbourne in October 2009. Top-up is a mode of operating the storage ring that maintains a consistent beam by injecting a small number of electrons every few minutes rather than a much larger number every 12 hours. From a user's point of view, that means a more stable photon beam.

In June 2010, the team directly measured the electron beam energy for the first time, which has only been done at a handful of laboratories around the world. They used a technique called 'resonant depolarisation', which involves exciting the electrons and using their response to calculate their energy to four decimal places.

Other noteworthy achievements include an improved capacity to manipulate the energy of the electron beam and shorten the length of each bunch. This creates a coherent light beam that is very useful for far-infrared experiments.

The accelerator science team also played a major role in the development of a new national venture called the Australian Collaboration for Accelerator Science (ACAS). ACAS unites some of Australia's brightest physics research talents and will help train young Australians to continue our contribution to this critical area of research.

Don McGilvery working on the synchrotron's linear accelerator

Machine Operations

Machine operators keep the synchrotron running, minimise the facility's down-time and maximise its operations continuously, twenty-four hours a day, seven days a week, for more than 300 days of the year. During most weeks in the calendar year the facility is only idle for one shift, when technicians, engineers and scientists maintain and upgrade the rings and the many beamlines running from it.

Group Leader, Don McGilvery said the group's work focuses on managing the injection of electrons into the linear accelerator, booster ring and storage ring; overseeing the safe and secure operation of the facility; managing the quality of the beamline and minimising the harmful radiation that occurs as a bi-product of the process.

The objectives of the group extend beyond the running and maintenance of the synchrotron rings and beamlines, to managing many of the fault recovery processes across the facility. A significant part of the group's work lies in minimising the frequency and duration of faults affecting the system, but with tens of thousands of variables to manage, monitoring changes is an ever present challenge for the team. However, it is one they meet with high success - over the past year the storage ring recorded only 99 downtime periods, achieving a record of 98 percent uptime.

Over the last year the group has also developed and optimised an automated injection process. When the machine was first installed the process of firing electrons into the ring meant 40 to 50 separate operations needed to be carried out. The Operators have simplified this process for good reason. It reduces the stress on operators, provides for greater consistency of performance and lessens the likelihood of human error.

Work already completed in this area has resulted in an improvement in injection efficiency of 20 percent from 70 percent up to 90 percent injection efficiency, while also leading to a significant reduction in stray radiation created by the facility and a reduced time period for injection (of electrons into the ring) by a factor of two to three.

In the longer term the group will focus its attentions on a number of exciting initiatives aimed at bettering its performance and the function of the synchrotron. One such initiative will involve developing systems that can identify longer term trends in the synchrotron's operations; the aim being to create a programme alerting technicians and engineers ahead of time to a likely malfunction in the facility's hardware or software.

In another initiative the team is developing skills to augment the support delivered by the beamline scientists, so both domestic and international users are provided with a basic level of support, irrespective of the day, time and hour. Other initiatives will include projects with the Accelerator Physics team, which concentrate on improving the quality of the light delivered to the beamlines to improve the outcomes of scientific experiments undertaken by users.

Electromagnets are the core of the operation of the synchrotron storage ring

Computing

The Computing team, led by Richard Farnsworth, is responsible for providing and supporting the Australian Synchrotron's information technology needs. It comprises a mixture of in-house staff and externally sourced e-researchers from organisations such as VERSI, CSIRO and VPAC. It provides the necessary infrastructure, including computers, networking technology and e-services that keep the facility's information technology systems functioning.

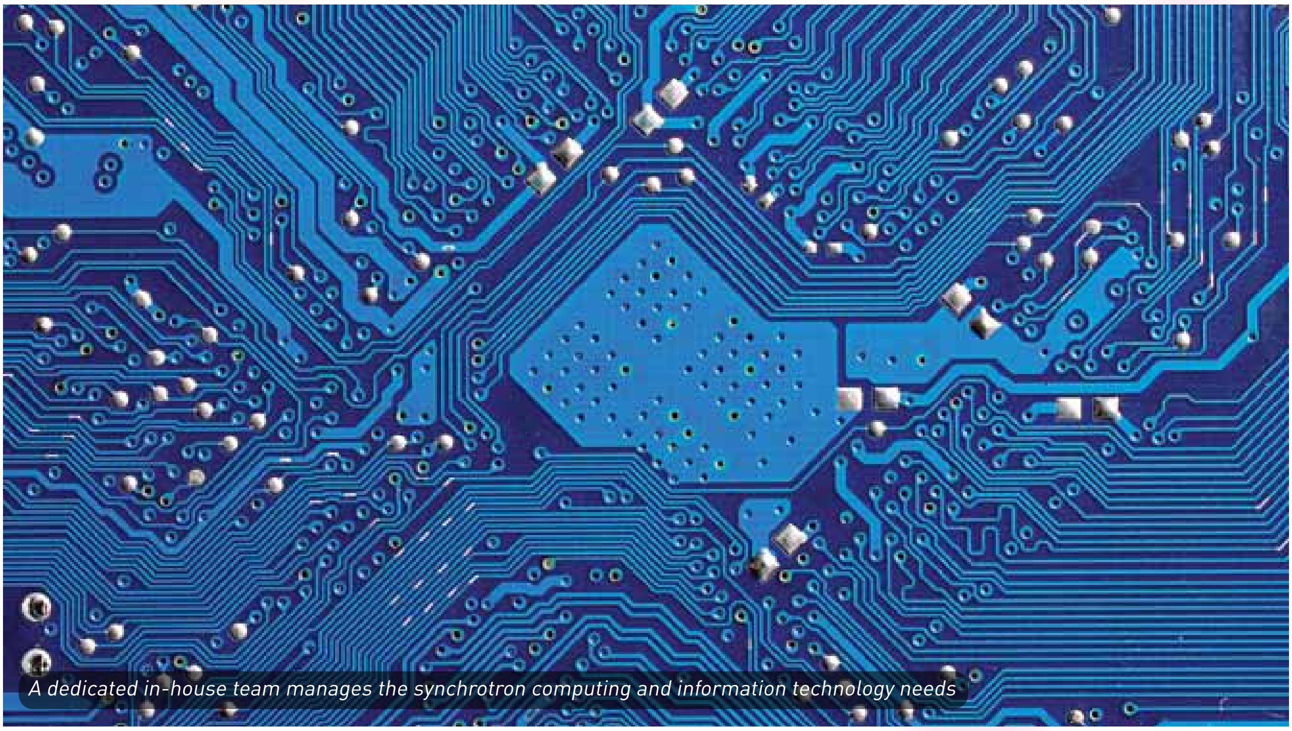
In addition to the computers that sit on every desk and every experimental end-station in the facility, the group manages the many hundreds of IT systems located across the facility including the Australian Synchrotron's high speed networking requirements. These networks support data and information transfer across the facility and to every external research lab in Australia and beyond. Computing also provides the facility with the necessary hardware and software allowing the synchrotron staff and employees to analyse significantly large amounts of complex scientific data.

An additional need sees the Computing team assist in the management of the Australian Synchrotron website and databases. These technologies provide an increasingly important interface for the organisation allowing people to see, interact with, book time and use the synchrotron's beamlines for experiments.

Key achievements over the year included the work undertaken to introduce a high performance computing platform in the form of the super computer MASSIVE (Multi-modal Australian Sciences Imaging and visualisation environment) and the commencement of a number of key metadata projects.

Other key achievements included: the management of a number of projects delivering Data Transfer Services (DTS) – that is moving data efficiently and accurately, data curation services (with names like MeCAT, utilising TARDIS) involving the publishing of data with "metadata" or information about how data was obtained, and the technologies that enable remote access for users, which supports the researcher by allowing certain activities to be undertaken without that individual needing to be physically present on the beamline.

A future aim of the Computing team will be to concentrate its attention on introducing state-of-the-art technology in scientific computing, data acquisition and data curation and to see its high performance computing project, MASSIVE, completed and running. Technologies like a petabyte storage array and higher speed links with increasingly sophisticated remote access are just around the corner.



A dedicated in-house team manages the synchrotron computing and information technology needs

Major Project and Technical services

Major Projects and Technical Services, led by Pat Arundell, is the division within the Australian Synchrotron that manages all aspects of safety, quality, facility management, and all small and major infrastructure projects. Activity for the group encompasses many things from building of the beamlines across the synchrotron, upgrading of the air conditioning units through to management of the facility's landscaping and security.

Major Projects and Technical Services were central to the management of small improvement projects such as building user facilities; construction of the MX1, MX2 and PD user cabins; the management of Hardcat, the Australian Synchrotron's work order system; and, the development of the IMBL.

The most significant achievement for the Major Projects and Technical Services team over the past year has involved the successful execution of Education Infrastructure Fund agreement. This $37 million dollar funding agreement, will allow the Major Projects and Technical Services team to build five new buildings on the site, including the National Centre for Synchrotron Science, the office extension building, a user accommodation building and a technical support laboratory. The design for these buildings has already been completed and work will start following a tender process and the selection of builders and contractors needed to construct the five buildings.

In what is seen as another achievement, Kathleen Muscat was appointed Quality Manager at the Australian Synchrotron during the year. The quality group ensures all activities undertaken at the synchrotron meet quality reporting and International Organisation for Standardisation (ISO) standards, which were achieved early in the year.

Artist impression of the new National Centre for Synchrotron Science

Engineering

The Engineering team is responsible for ensuring the facilities equipment works effectively and efficiently. The Australian Synchrotron's engineers work with beamline scientists, users and advisory committees to develop and introduce equipment and infrastructure that supports the scientific outcomes achieved at the facility.

The team works with beamline scientists to develop reliable and flexible equipment for use on the beamlines and machine, upgrading existing equipment and maintenance and troubleshooting to keep the facility and all its parts running efficiently and effectively. This is critical to support the high quality research undertaken at the facility.

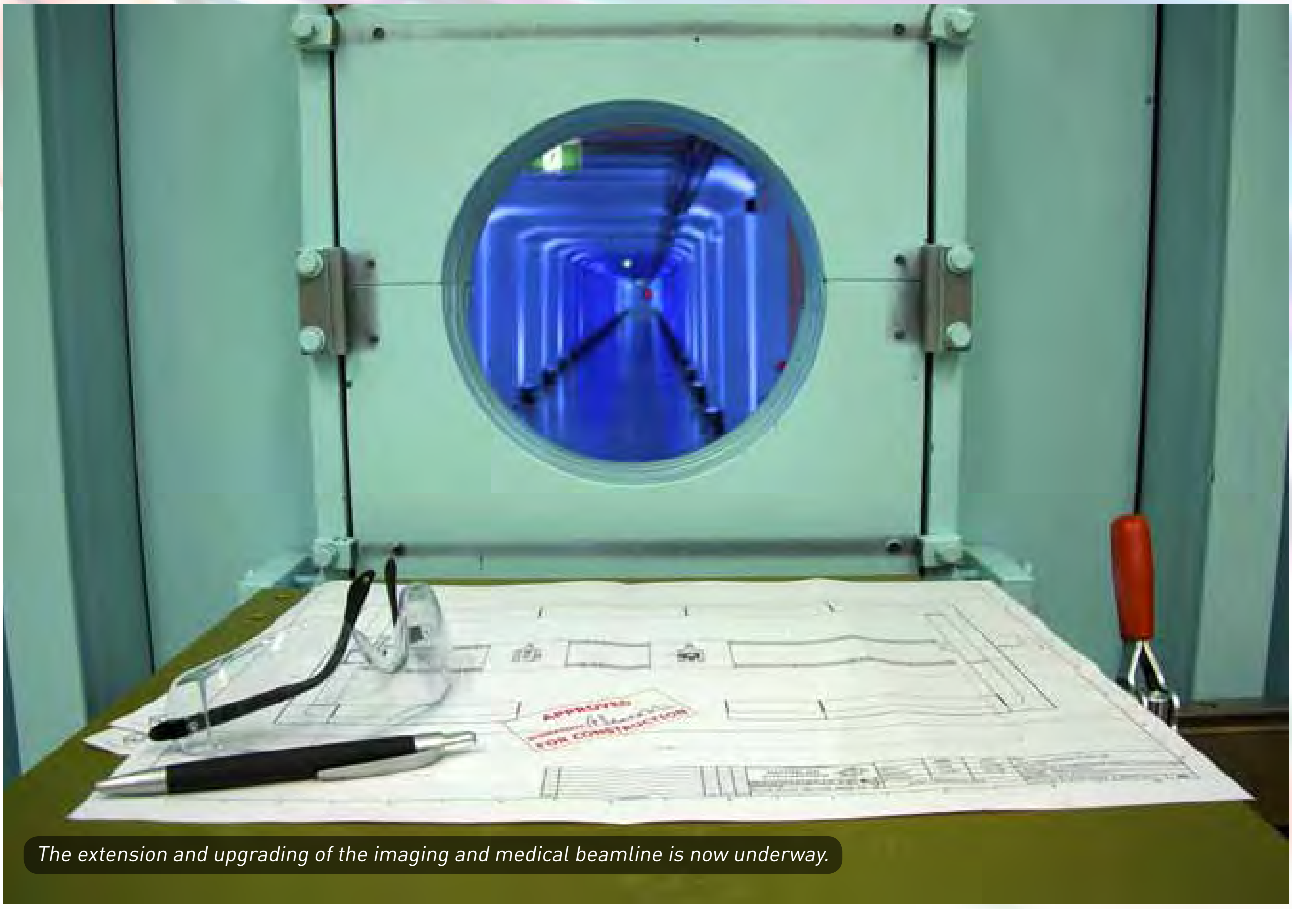
Head of Engineering, David Tokell, said the team continues to play a critical role in guaranteeing the facility's availability or 'up time', running at 98 percent of the time it's required to operate.

Objectives for the team have changed over time, as new beamlines are brought online. Tasks vary in size from small jobs to large-scale projects with values over $1M and involving many staff. Typically the Engineering team will address 100 or more of these smaller jobs a month. At any one time there are approximately 300 to 400 active jobs as well as roughly 50 larger projects, of which 10 to 20 are high priority.

Objectives during the year centred on a number of key initiatives including changing the 'earthing' of the facility and developing new pieces of equipment for use on the imaging and medical beamline.

Key achievements during the year included: the creation of new tools and equipment, the team's work in the area of detector integration (both hardware and software) and the ongoing upgrade and maintenance work (often performed during very tight shut-down periods), which was carried out by the team.

The introduction of a project management process will also allow engineers across the facility (electrical, mechanical and controls) to minimise risk, and maximise the benefits of their work.



The extension and upgrading of the imaging and medical beamline is now underway.

Occupational Health and Safety

The Australian Synchrotron Occupational Health and Safety (OHS) team at the Australian Synchrotron protects, promotes and monitors the health and safety of employees, contractors, users and visitors and enforces strict compliance standards across the organisation.

Head of Safety, Hock Ch'ng and his team focus their attention on ensuring OHS standards are consistently followed and new or improved training, systems and processes are introduced. Existing policies and procedures introduced by the Australian Synchrotron meet all Australian standard AS/NZS 4801:2001 Occupational Health and Safety Management Systems Standards.

Key achievements for the past year include delivery of training programmes allowing staff to manage contractors, the introduction of safety training programmes, and the adoption of a risk management approach to workplace safety. Additional achievements include the introduction of an automated online OHS process for OHSE and Radiation Safety Inductions and Refresher Inductions and the development and inclusion of an online video to support the *Search and Secure* procedure; which is a critical component of the beamlines' Personal Safety System (PSS) and is now used in the online induction process. As a result of all of this activity, only two lost time injury cases were recorded over the 2009-2010 financial year, resulting in a lost time injury frequency rate of 1.97.

Under an independent audit of OHS management performance, the existing OHS standards at the facility were ranked as strong. No notices or directives were issued pursuant to relevant sections of the Victorian OHS Act 2004, Accident Compensation Act 1985, Dangerous Goods Act 1985 and Radiation Act 2005.

In environmental management, OHS registered *and successfully lodged on behalf of the Australian Synchrotron its first* National Greenhouse and Energy Report for the 2008-2009 reporting period in accordance with the requirements stipulated under the *National Greenhouse and Energy Reporting (NGER) Act 2007*. Reporting under the EPA's 'Victoria's Water Management Action Plans' (WaterMAP) was also submitted. As a large user of electricity the Australian Synchrotron increased its use of "Green" electricity from 15 percent in 2008-2009 to 20 percent in 2009-2010. The Australian Synchrotron also collaborated with Monash University in redeveloping and expanding its water basin to facilitate the catchment of storm water, as well as, redirecting run-offs from the new Nanotechnology Centre to this basin.

In the new financial year, the OHS team will continue with its radiation management measures, including its bimonthly meetings held with the Department of Health's Victorian Radiation Regulator. These forums provide an update to the Victorian Radiation Regulator on new developments, operational performance and personal radiation monitoring results.

To date, recorded personal radiation doses have all been significantly less than the maximum dose constraint of 1 mSv per year, therefore the personal radiation doses recorded have been well below the legislated dose limit for public exposure. This is an outstanding achievement and a credit to the efforts of the OHS team.

Occupational Health and Safety are high priorities at the synchrotron.

External Relations

The Australian Synchrotron External Relations team helps to demonstrate the value of the work done at the facility to the community. This is achieved through education and outreach, industry engagement, stakeholder engagement and communications activities. The team arranges tours and events, develops and prints publications; facilitates user group forums and manages the Australian Synchrotron's relationships with media organisations, academia and government.

Over the past year, the team has helped the facility to achieve important outcomes – such as meeting the organisational target for commercial revenue, welcoming more than 2,000 visitors to the facility on Open Day: and, hosting more than 4,070 visits to the facility for students, academics and distinguished guests from across the globe.

As part of the Australian Synchrotron Education Program, the External Relations team organised the inaugural Australian Synchrotron Winter School. This enabled scientists at the facility to impart their knowledge to postgraduate students, with the aim of developing the synchrotron science community. The team also played a key role in coordinating the highly successful international SRI2009 conference in Melbourne, attended by thousands of scientists from Australia and overseas. The team has led the development and implementation of new communication tools – such as the Australian Synchrotron website and the transformation of the facility newsletter Lightspeed. This is complemented by a new evaluation framework that helps the team to capture and report outcomes and drive continuous improvement for the future.

The Head of External Relations, Christine Latif, said the team's future key aims are to grow the Australian and NZ synchrotron user communities and develop international linkages for user access and activities and cooperative research programs.

The team will also support the organisation to secure future funding, create industry engagement outcomes and income streams from commercial usage of the facility. The team will seek to utilise existing initiatives and policies designed to foster innovation and collaboration between the private and public sectors and academic researchers, and to adopt formal processes that ensure the group's marketing and stakeholder engagement efforts are best practice. Future challenges for External Relations include communicating the benefit of scientific research and development projects to the wider community.

The synchrotron holds events for all interest groups, including open days for the general public.

Human Resources

Human Resources (HR) at the Australian Synchrotron supports the long-term employment relationship between the facility and its employees by investing in recruitment, training and development. It also provides performance criteria, evaluation and compensation and benefits.

HR Head, Anne Ridgway, said the team's continuing role was to create a workable, but flexible model for attracting, retaining and developing talent, whilst increasing operational effectiveness, and helping create a positive culture.

Key highlights for the HR team include a recruitment drive inducting 16 new employees to the organisation since July 1 2009 (two from overseas) and transferring eight employees on temporary resident visas to permanent residency. The team also played a critical role in the organisational development of the external relations and finance functions and the training of the entire organisation, regarding EEO compliance.

A new Australian Synchrotron employee agreement 2010 was also facilitated by HR. This agreement responded to employees desire to be involved in all stages of the negotiation process. The agreement introduced in May 2010, now supports the employment needs of the facility's engineering, science and corporate employees. It provides a new remuneration system and other benefits, such as an Employee Representative Forum, which meets on a regular basis with the senior management team to discuss employment issues.

HR now aims to help introduce an inter-facility exchange programme allowing employees to organise work exchanges between facilities; and a more developed programme of in-house leadership training and cross departmental training aimed at better supporting the facility's 24 hour operation.

HR is also working to align the synchrotron's workplace policy with the Federal Government's Fair Work legislation; create a new and updated employer value proposition; develop succession planning across the organisation; support the continuation of quality standards in the form of ISO; and introduce an online HR system to fully automate processes such as payroll and performance development.

Anne Ridgway heads the synchrotron's busy human resources team.

Finance Report

The financial year 2009-2010 was one of consolidation for the finance department at the Australian Synchrotron. All of the beamlines with the exception of Imaging and Medical Beamline were operational for the whole year and the operations moved to maintenance of the facility and growth of its user groups.

The surplus for the year was $2,027,023 on revenues of $26,146,444. The main source of revenue was from the funding agreement between the Federal and State governments of $23,429,712, and the New Zealand Government of $780,281. Other revenue increased aided by some beamline revenue and a payroll tax refund. Further details are available in the Financial Reports of the Australian Synchrotron.

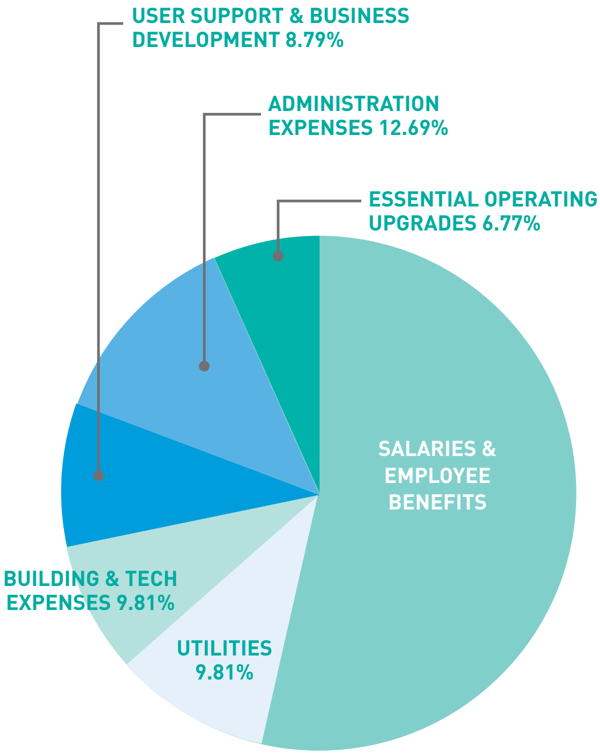
During the year there was significant focus on Australian Synchrotron expenses and a program of cost containment was implemented. The expenses for the year of $24,119,718 and higher than expected surplus, reflects these savings.

The Essential Operating Upgrades was increased to help maintain the Australian Synchrotron as a world class facility. The increase of $250,000 for the 2009-2010 year was used to purchase the table for the XAS beamline.

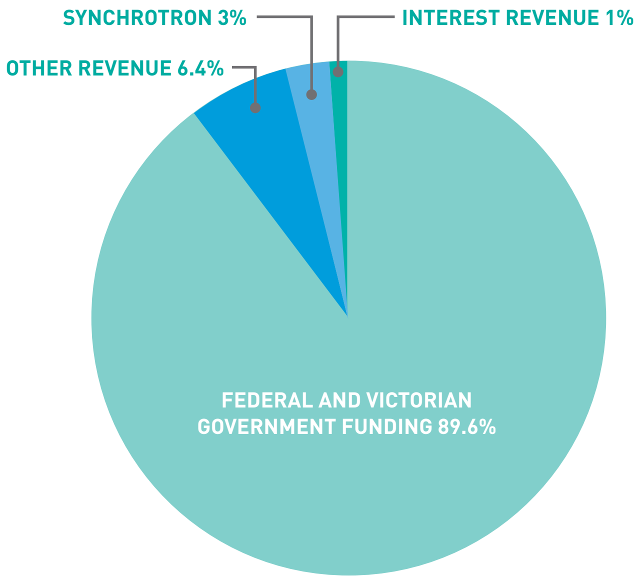
As the Australian Synchrotron moves into another year,

- the reserve set aside for the UPS of $2,500,000 is expected to be completed by the end of 2011;
- the largest capital works since the completion of the facility will commence. This $37 million was an Education Infrastructure Fund grant from the Federal Government which will see the Australian Synchrotron's Major Projects and Technical Services group build five new buildings at the facility, including the National Centre for Science, the office extension building, a user accommodation building and a technical support laboratory.

The Australian Synchrotron also continues to develop its risk framework and raise awareness of risk throughout the facility.

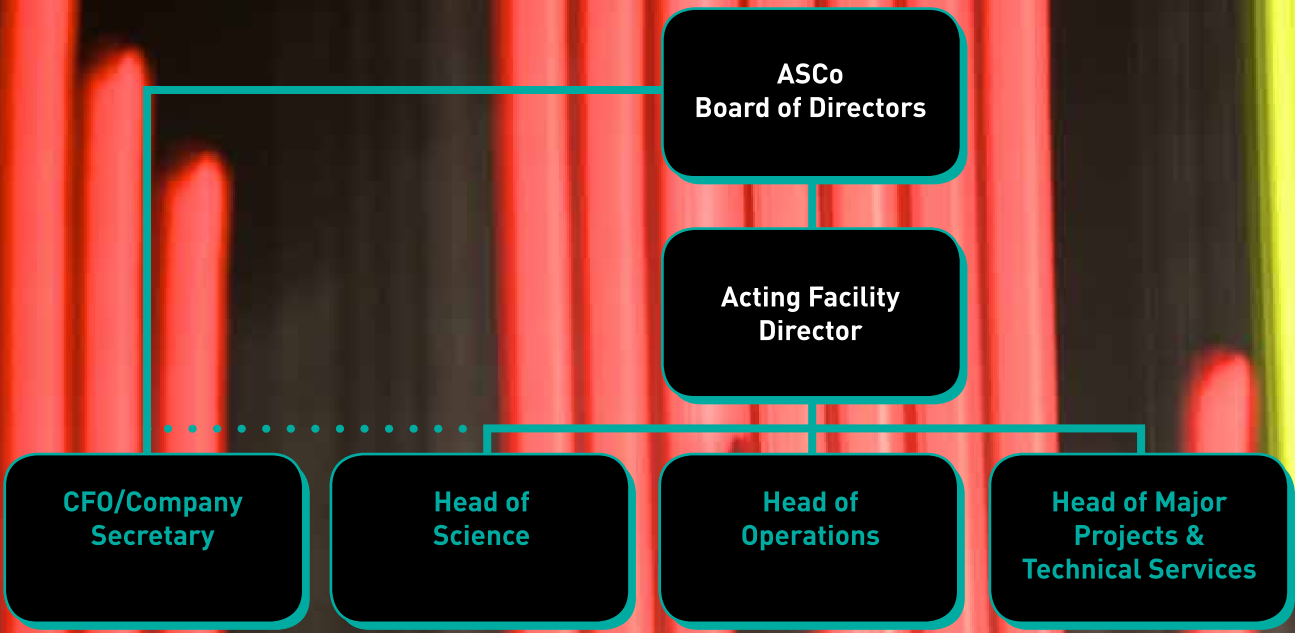


EXPENDITURE



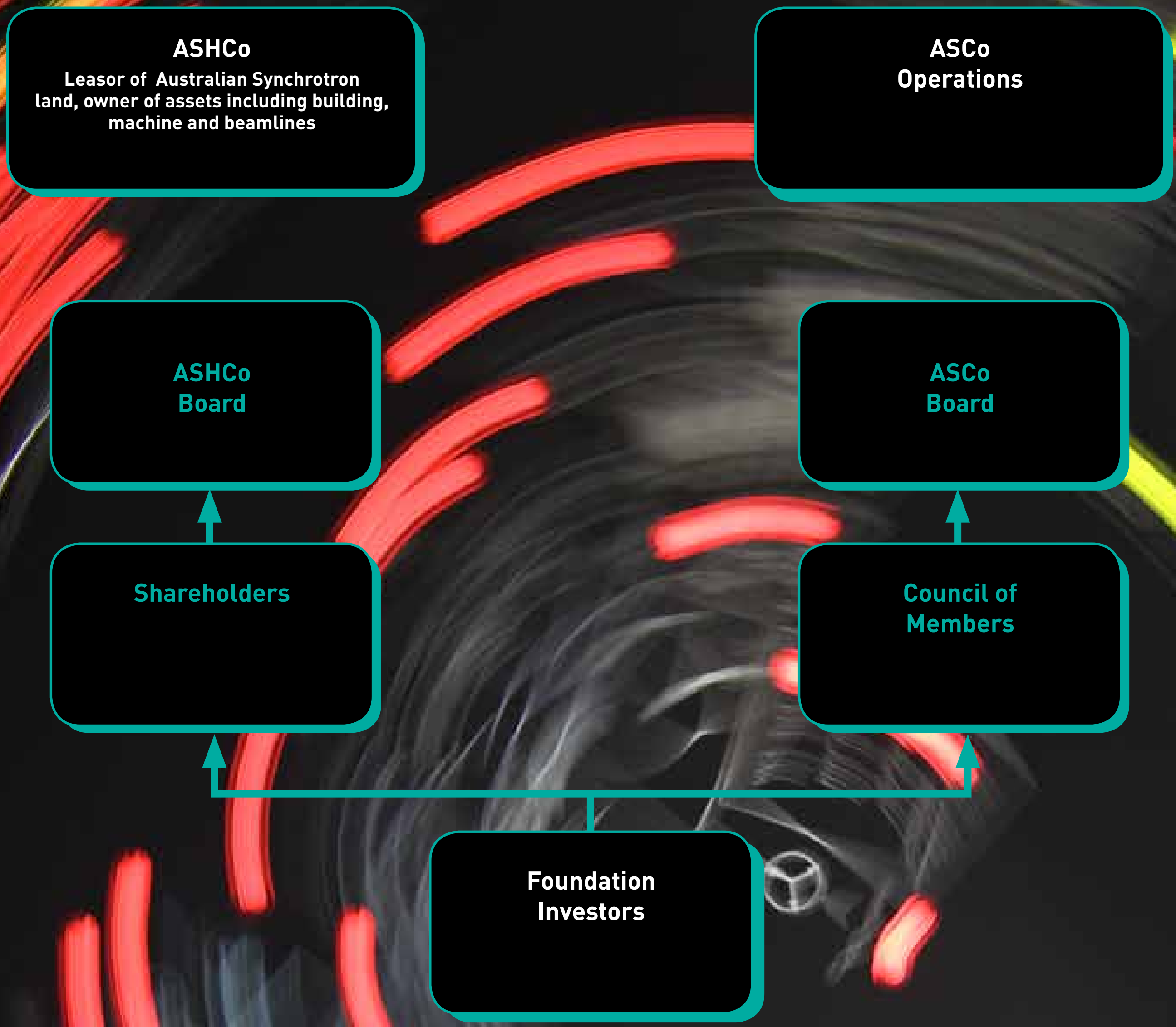
INCOME

Organisational Structure



The Australian Synchrotron Senior Management group (left to right) Juliann Byron, Dean Morris, George Borg and Ian Gentle.

Governance Structure



Advisory Committees and Councils

The Australian Synchrotron is managed under a dual entity structure, comprising two companies:

- Australian Synchrotron Holding Company (ASHCo) is the ownership entity and owns all the Australian Synchrotron assets
- Australian Synchrotron Company Limited (ASCo) is the management entity and has the exclusive right to operate, manage and develop the Australian Synchrotron assets under a lease with ASHCo

Foundation Investors in the Australian Synchrotron have interests in both companies in consideration of their capital investment, namely shares in ASHCo proportional to their level of capital investment (being a minimum of $5 million) and membership of ASCo.

Composition of the Australian Synchrotron Board of Directors

The Boards of Directors for ASHCo and ASCo, as at 30 June 2010, are listed below.

Further details of the Directors and activities of the Companies are contained in the Financial Reports 30 June 2010 for ASHCo and ASCo associated with this document.

ASHCo

Mrs Catherine Walter AM
Professor Rod Hill
Dr Garth Carnaby
Dr Sean Gallagher
Professor Linda Kristjanson

ASCo

Mrs Catherine Walter AM
Professor Rod Hill
Dr Garth Carnaby
Dr Sean Gallagher
Professor Linda Kristjanson
Professor Peter Colman
Professor Keith Nugent
Professor Max Lu

Advisory Committees and Councils

The Council of Members

The Council of Members is a representative committee of Foundation Investors. Its role is to advise the Board of ASCo on issues related to scientific policy, committee appointments and terms of reference and overall facility development.

Affiliation of Council of Members

Foundation Investor	Representative
Victorian Government	Dr Amanda Caples
Monash University	Mr David Pitt
AAMRI (Association of Australian Medical Research Institutes)	Prof Garry Jennings
ANSTO (Australian Nuclear Science and Technology Organisation)	Mr Doug Cubbin
CSIRO (Commonwealth Scientific and Industrial Research Organisation)	Ms Jan Bingley
Western Australian Consortium	Mr Anthony Tate
New Zealand Synchrotron Group	Dr Don Smith
University of Melbourne	Mr Allan Tait
South Australian and La Trobe University Consortium	Prof Richard Russell
Queensland Consortium	Prof Max Lu
AUSyn14 Consortium	Dr Chris Ling

Foundation Investor Liaison Group

The Foundation Investor Liaison Group meets regularly to coordinate foundation investor access to the synchrotron. Its members are the conduit for communication with the Foundation Investors and relevant researchers at member organisations.

Foundation Investor	Representative
Victorian Government	Ms Sue Heistein
ANSTO (Australian Nuclear Science and Technology Organisation)	Dr Richard Garrett
CSIRO (Commonwealth Scientific and Industrial Research Organisation)	Dr Jose Varghese
University of Melbourne	Dr Frances Skrezenek
Monash University	Dr Karen Siu
AUSyn14 Consortium	Dr Joseph Bevitt (until 2 March 2010)
	Dr Chris Ling (from 3 March 2010)
Queensland Consortium	Prof Jenny Martin
Western Australian Consortium	Prof Roland De Marco
South Australian and La Trobe University Consortium	Dr Peter Kappen (until 24 January 2010)
	Dr Hugh Harris (from 25 January 2010)
New Zealand Synchrotron Group	Dr Don Smith
AAMRI (Association of Australian Medical Research Institutes)	Dr Mike Lawrence

Advisory Committees and Councils

Science Advisory Committee

Reporting directly to the Board, the Science Advisory Committee provides strategic advice on current and proposed scientific programs, ensuring they are aligned with world's best practice and of continuing relevance to the requirements of the Australian scientific community.

The SAC Terms of Reference are to:

- Monitor international developments in synchrotron science and provide input to the Board on optimising the scientific and technical capability of the Australian Synchrotron
- Advise on the preferred mix of beamlines and skill set of operators and the ancillary laboratories and equipment required, having regard to the direction of leading edge scientific enquiry and national research and development priorities
- Develop procedures for the evaluation of proposals for the establishment of new experimental support facilities and to recommend mechanisms for monitoring progress towards the introduction of these facilities
- Respond to the Board's requirements for advice

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, The University of Sydney
- Prof Brendan Kennedy, Professor of Solid State Chemistry, The University of Sydney
- Prof Keith Nugent, Professor of Physics, The University of Melbourne (until May 2010)

International members

- Prof Hongjie Xu, Director of Shanghai Synchrotron Radiation Facility, China, 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, The 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), France

Advisory Committees and Councils

National Science Colloquium

The National Science Colloquium provides strategic advice, advocacy, expertise and experience in support of the Australian Synchrotron's research, development and expansion from leaders in Australia and New Zealand academies, professional bodies, government research organisations, funding agencies, universities, business and government.

National Science Colloquium membership

- Sir Gustav Nossal, AC, CBE, FRS, FAA, Research Biologist (Chair)
- Professor Warwick Anderson, Chief Executive Officer, National Health and Medical Research Council
- Professor Robin Batterham, President Australian Academy of Technological Sciences and Engineering
- Professor Lyn Beazley, Chief Scientist Western Australia
- Mr Tim Besley, ASE CRC for Greenhouse Gas Technologies
- Professor Gavin Brown, Inaugural Director, Royal Institution of Australia
- Professor Suzanne Cory, President Australian Academy of Science
- The Hon Barry Jones, former Science Minister
- Dr Peter Laver, Director Australian Centre for Innovation
- Professor James Metson, Leader Materials Cluster, University of Auckland
- Professor Brian O'Connor, Emeritus Professor of Applied Physics, Curtin University of Technology
- Professor Margaret Sheil, Chief Executive Officer, Australian Research Council
- Professor David Siddle, former Deputy Vice Chancellor, Research University of Queensland
- Professor Julio Licinio, Director, John Curtin School of Medical Research

Program Advisory Committees

Program Advisory Committees (PACs) comprise senior researchers who have an understanding of the latest developments in synchrotron science. PACs meet to discuss proposals submitted for access to the Australian Synchrotron and make recommendations to the Director about which proposals should be scheduled.

Macromolecular Crystallography PAC

- Professor Charlie Bond, University of Western Australia (Chair)
- Professor Geoff Jameson, Massey University, New Zealand
- Dr Michael Lawrence, The Walter and Eliza Hall Institute
- Dr Peter Turner, University of Sydney
- Dr Helen Blanchard, Griffith University
- Assoc Professor Matthew Wilce, Monash University

Advisory Committees and Councils

Powder Diffraction PAC

- Associate Professor Brendan Kennedy, University of Sydney (Chair) *until 19 January 2010*
- Dr Michael James, ANSTO (Chair) *from 19 January 2010*
- Mr Ian Madsen, CSIRO
- Dr Bridget Ingham, Industrial Research Ltd, New Zealand
- Assoc Professor Stuart Batten, Monash University, *from 19 January 2010*
- Assoc Professor Evan Gray, Griffith University, *from 19 January 2010*
- Dr Darren Goossens, Australian National University, *from 17 February 2010*
- Professor Allan Pring, Flinders University, *until 19 January 2010*

Infrared PAC

- Professor Don McNaughton, Monash University (Chair)
- Assoc Professor Peter Fredericks, Queensland University of Technology
- Assoc Professor Bill van Bronswijk, Curtin University of Technology
- Dr Phil Heraud, Monash University
- Dr Elizabeth Carter, University of Sydney

Soft x-ray PAC

- Research Professor William Skinner, University of South Australia (Chair)
- Professor Alan Buckley, University of New South Wales
- Professor Paul Dastoor, University of Newcastle
- Professor Jim Metson, University of Auckland
- Dr Craig Klauber, CSIRO
- Dr Narelle Brack, La Trobe University

Small and Wide Angle x-ray Scattering PAC

- Dr Robert Knott, ANSTO (Chair)
- Professor John White, Australian National University
- Professor Gregory Warr, University of Sydney
- Professor Craig Buckley, Curtin University
- Dr Kevin Jack, University of Queensland
- Assoc Professor Matthew Wilce, Monash University, *from 15 February 2010*

Advisory Committees and Councils

X-Ray Fluorescence Microscopy PAC

- Dr Hugh Harris, University of Adelaide (Chair)
- Assoc Professor Andrew Peele, La Trobe University
- Dr Chris Ryan, CSIRO
- Dr Rob Hough, CSIRO
- Dr David Cohen, ANSTO
- Dr Cassandra Schefe, Dept of Primary Industries

X-ray Absorption Spectroscopy PAC

- Dr Mark Ridgway, Australian National University (Chair)
- Assoc Professor Stephen Best, University of Melbourne
- Professor Peter Lay, University of Sydney
- Dr Weihua Liu, CSIRO
- Assoc Professor Mark Riley, University of Queensland

International Proposal Advisory Committee

The International Synchrotron Access Program Advisory Committee (IPAC) has responsibility for the International Synchrotron Access Program (ISAP)

International Proposal Advisory Committee membership

- Dr Chris Ryan, CSIRO (Chair) *from 24 May 2010*
- Professor Paul Dastoor, University of Newcastle
- Professor Lyndon Edwards, ANSTO
- Professor Andrea Gerson, University of South Australia
- Dr Mark Ridgway, Australian National University
- Professor Keith Nugent, University of Melbourne (Chair) *Until 20 May 2010*

Advisory Committees and Councils

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

User Advisory Committee membership

- Assoc Professor Matthew Wilce, Monash University (Chair)
- Professor Roland de Marco, Curtin University of Technology
- Research Professor William Skinner, University of South Australia
- Professor Don McNaughton, Monash University
- Professor Charlie Bond, The University of Western Australia
- Dr Michael James, ANSTO
- Dr Bridget Ingham, Industrial Research Ltd, New Zealand
- Dr Mark Ridgway, The Australian National University
- Dr Hugh Harris, The University of Adelaide
- Dr Robert Knott, ANSTO
- Dr Peter Kappen, La Trobe University
- Dr Helen Blanchard, Griffith University
- Assoc Professor Stephen Best, The University of Melbourne
- Dr Jamie Quinton, Flinders University

Machine Advisory Group

The Machine Advisory Group (MAG) is an independent monitoring and review of machine operations and is vital to the continued development of the Australian Synchrotron. Membership of MAG comprises experts in accelerator science from synchrotron across the world.

Machine Advisory Group membership

- Dr Jeff Corbett, Stanford Linear Accelerator Centre, United States
- Professor Mikael Eriksson, MAX Lab, Sweden
- Dr Erhard Huttel, Forchungszentrum Karlsruhe, Germany
- Dr Chin-Cheng Kuo, Synchrotron Radiation Research Centre

Please note all advisory committee and group memberships were current at the time of printing.

Staff Directory

The Australian Synchrotron recognises and thanks its employees for helping to achieve the excellent outcomes outlined in this report. Our current staff are listed below.

Mr GREGORY LE BLANC	Head of Accelerator Science and Operations	Accelerator Science
Mr YAW-REN (EUGENE) TAN	Scientist	Accelerator Science
Dr MARK BOLAND	Principal Accelerator Physicist	Accelerator Science
Dr ROHAN DOWD	Senior Accelerator Physicist	Accelerator Science
Mr CAMERON RODDA	Senior Operator	Accelerator Science
Mr JOEL TREWHELLA	Senior Operator	Accelerator Science
Ms ELEANOR DRYLEY	Accelerator Operator	Accelerator Science
Dr DONALD MC GILVERY	Group Leader - Accelerator Operators	Accelerator Science
Mr MICHAEL TEN HAVE	Accelerator Operator	Accelerator Science
Mr STEPHEN MC DONALD	Accelerator Operator	Accelerator Science
Mr ROBERT CLARKEN	Accelerator Operator	Accelerator Science
Ms ELSA VAN GARDEREN	Instrumentation Scientist	Accelerator Science
Mr DAJUN (DAVID) ZHU	Accelerator Physicist	Accelerator Science
Mr VILIAMI TAKAU	Accelerator Operator	Accelerator Science
Mr PETER JONES	Accelerator Operator	Accelerator Science

Dr MARK CLIFT	Senior Controls Engineer	Engineering
Mr BRADLEY MOUNTFORD	Group Leader - Mechanical Engineering	Engineering
Mr KARL-LUDWIG ZINGRE	Principal RF Engineer	Engineering
Mrs VESNA SAMARDZIC-BOBAN	Senior Controls Engineer	Engineering
Mr ADAM WALSH	Senior Mechanical Engineer	Engineering
Mr ANDREW STARRITT	Principal Controls Engineer	Engineering
Mr BRYCE KARNAGHAN	Principal Controls Engineer	Engineering
Mr HENGZI (DAVID) WANG	Senior Mechanical Engineer	Engineering
Mr PAUL LEONARD	Group Leader - Mechanical Technicians	Engineering
Mr JASON WIRTHENSOHN	Senior Mechanical Technician	Engineering
Mr CRAIG MILLEN	Group Leader - Electrical Technicians	Engineering
Mr TRENT SMITH	Mechanical Technician	Engineering
Mr NOEL BASTEN	Senior Electrical Technician	Engineering
Mr BRIAN JENSEN	Senior Electrical Technician	Engineering
Mr WESLEY HOFFMAN	Senior Electrical Draftsman	Engineering
Mr ANTHONY OWEN	Controls Engineer	Engineering

Staff Directory

Dr TERRY CORNALL	Senior Controls Engineer	Engineering
Mr ALAN EASDON	Mechanical Technician	Engineering
Mr ROBERT GRUBB	Senior Mechanical Technician	Engineering
Mr DAVID TOKELL	Head of Engineeing	Engineering
Mr ADAM MICHALCZYK	Electronics Engineer	Engineering
Mr CRAIG HODGSON	Mechanical Technician	Engineering
Mr ANDREW RHYDER	Senior Controls Engineer	Engineering
Mr JAIME ARIAS	Electrical Technician	Engineering
Mr JONATHAN PRIEST	Senior Project Engineer	Engineering
Mr MARK COLCLOUGH	Senior Electrical Technician	Engineering
Mr SEAN MURPHY	Electrial Engineer	Engineering
Mr ROBERT ROSTAN	Mechanical Technician	Engineering
Mr JIM DIVITCOS	Mechanical CAD Designer	Engineering
Mr MICHAEL KUSEL	Principal Mechanical Engineer	Engineering
Mr LUIGI CORVETTI	Group Leader- Controls Engineering	Engineering
Mr JONATHAN McKINLAY	Senior Beamline / Alignment Engineer	Engineering
Ms NANCY MILLS	Media & Communications Advisor	External Relations
Ms MELISSA MOYLE	Marketing & Comms Officer	External Relations
Mr JONATHAN De BOOY	Outreach Officer	External Relations
Ms KERRY HAYES	Business Development Manager	External Relations
Ms SAMANTHA CHAN	Receptionist	External Relations
Dr CHRISTINE LATIF	Head of External Relations	External Relations
Ms LEANNE WALLACE	External Relations Administrator	External Relations
Mr. NICHOLAS GREEN	Group Leader - External Relations	External Relations
Mr WORRELL LOUDEN	Stores Manager	Finance
Ms SUZANNE THURSKY	Financial Controller	Finance
Ms QI (SHARON) WANG	Finance Officer	Finance
Ms ANNE RIDGWAY	Head of Human Resources	Human Resources
Mrs GENEVIEVE LOBO	Human Resources Advisor	Human Resources
Ms CATRIONA STARR	Senior HR Advisor	Human Resources

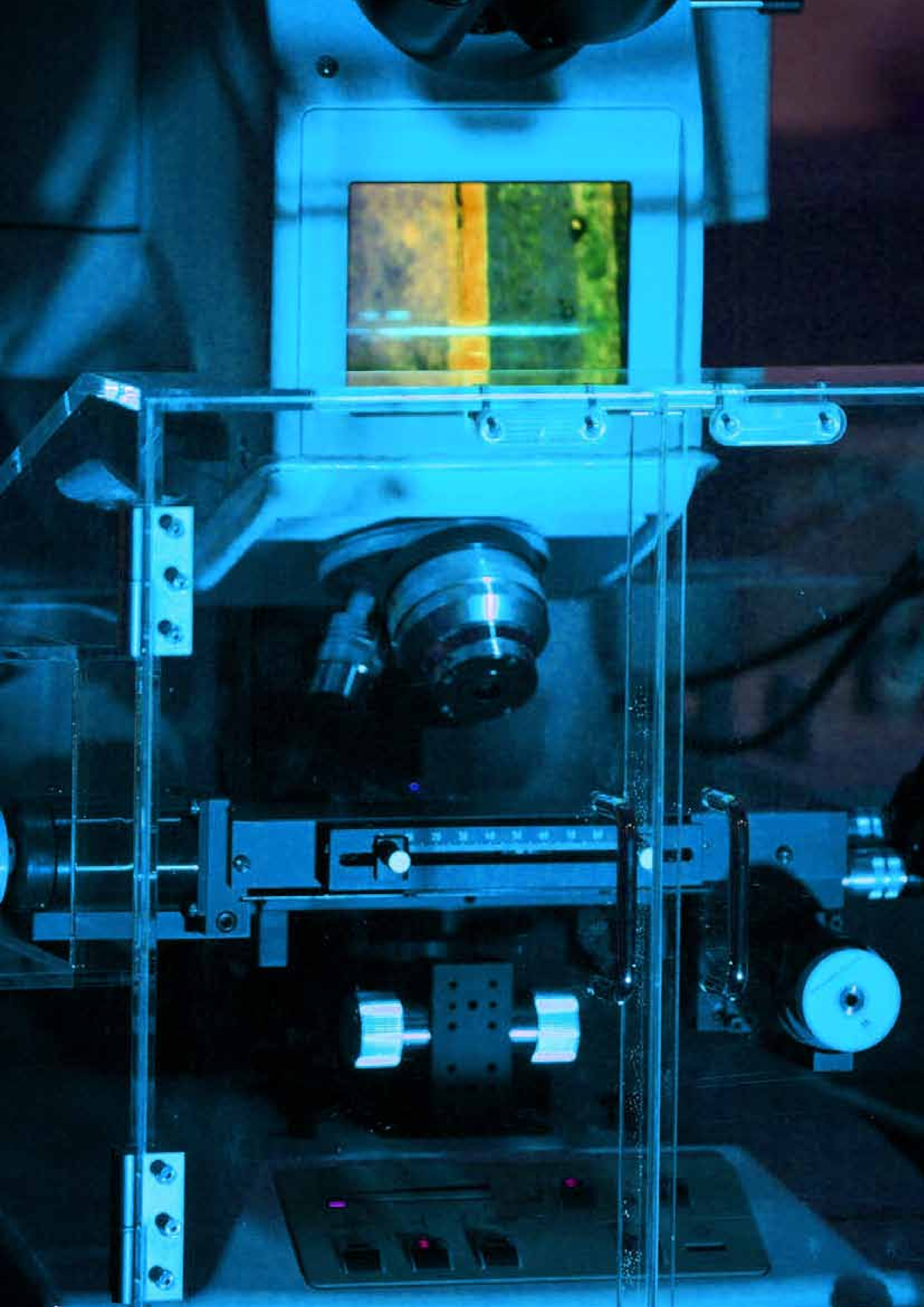
Staff Directory

Mr RICHARD FARNSWORTH	Head of Computing	IT
Mr TIMOTHY BUTLER	Senior IT Officer	IT
Mr NICHOLAS HOBBS	IT Officer	IT
Ms LAUREN BAIRD	Database Officer	IT

Mr SERGIO COSTANTIN	Senior Radation Safety Officer	Major Projects & Technical Services
Mr MAURIZIO MESSINA	Facilities Manager	Major Projects & Technical Services
Mr PIERS DAVENPORT	Safety Officer	Major Projects & Technical Services
Mr THEAN (HOCK) CH'NG	Head of Safety	Major Projects & Technical Services
Mr GORDON SPRATT	Mechanical Technician/ Handy Person	Major Projects & Technical Services
Ms SNEZANA VUKOVIC	Document & Configuration Control Officer	Major Projects & Technical Services
Dr KATHLEEN MUSCAT	Quality Manager	Major Projects & Technical Services

Dr CHRISTOPHER GLOVER	Principal Scientist - XAS	Science
Dr KIA WALLWORK	Principal Scientist- PD	Science
Dr BRUCE COWIE	Principal Scientist - SXR	Science
Dr MARK TOBIN	Principal Scientist - IR	Science
Dr DANIEL HAUSERMANN	Principal Scientist - IMBL	Science
Dr NIGEL KIRBY	Principal Scientist - SAXS	Science
Dr DAVID PATERSON	Principal Scientist - XFM	Science
Ms RUTH PLATHE	Scientific Support Officer - PX/MX	Science
Dr THOMAS CARADOC-DAVIES	Principal Scientist - PX/MX	Science
Dr LJILJANA PUSKAR	Scientist - IR	Science
Dr DOMINIQUE APPADOO	Senior Scientist - IR	Science
Dr RACHEL WILLIAMSON	Scientific Support Officer - PX/MX	Science
Dr STEPHEN MUDIE	Senior Scientist - SAXS	Science

Dr DAVID COOKSON	Head of Beamline Science & Operations	Science	
Dr MARTIN DE JONGE	Senior Scientist - XFM	Science	
Dr ANTON TADICH	Scientist - SXR	Science	
Dr ANTON MAKSIMENKO	Scientist - IMBL	Science	
Dr LARS THOMSEN	Scientist - SXR	Science	
Dr DARYL HOWARD	Scientific Support Officer - XFM	Science	
Dr QINFEN GU	Scientist - PD	Science	
Mr JUSTIN KIMPTON	Scientist - PD	Science	
Mr ADRIAN HAWLEY	Scientific Support Officer- SAXS/WAXS	Science	
Prof IAN GENTLE	Head of Science	Science	on secondment
Dr DANIELLE MARTIN	Scientific Support Officer - IR	Science	
Dr BERNT JOHANNESSEN	Scientist- XAS	Science	
Dr NATHAN COWIESON	Scientist- PX/MX	Science	
Dr ALAN RIBOLDI-TUNNICLIFFE	Scientist	Science	
Mr CHRISTOPHER HALL	Scientist - IMBL	Science	
Dr CHRISTINE GEE	Scientist - PX/MX	Science	
Dr DEAN MORRIS	Head of Operations	SMG	
Dr GEORGE BORG	Acting Facility Director	SMG	
Dr CATHY HARLAND	Group Leader - User Support	User Office	
Ms AMANDA LOUCH	User Office Administrator	User Office	
Mr SCOTT KENDALL	User Office Administrator	User Office	
Ms TIFFANY MORRIS	Executive Assistant	Executive	



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Cover Image: 'Lightbridge ' by Chris Henscke

Melbourne based digital artist Chris Henschke undertook a residency at the Australian Synchrotron funded through the Arts Victoria Arts Innovation program and the Australian Network for Art and Technology in 2007. During his stay he conducted experiments using the Australian Synchrotron to collect visual data. One visualisation experiment produced the image used on the cover of this report. Chris is now undertaking a second artistic residency at the Australian Synchrotron also funded by the Australian Network for Art and Technology.

Australian Synchrotron Company Limited
ACN 126 531 271

Australian Synchrotron Holding Company Pty Limited
ACN 126 506 205