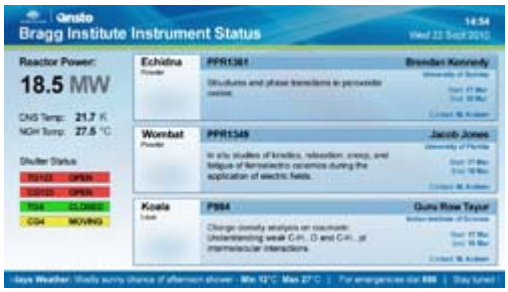
Bragg Peaks > for neutron users
ISSUE 17 | JAN 11

OPAL news

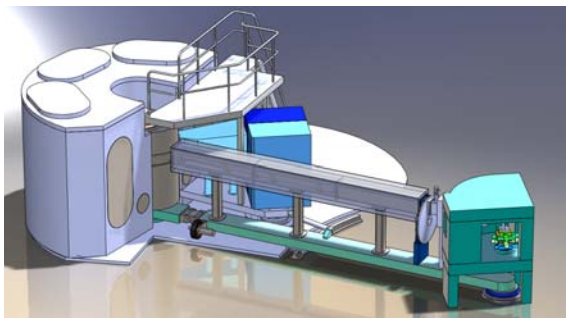
In general, the OPAL reactor has continued to run well, despite one unplanned 11-day shutdown in early November. Thermal neutron availability has been good throughout.

However, on 26th December one of the two primary compressors for our cold-neutron source failed, and it has unfortunately not operated since then. The estimated date for return to service for PLATYPUS is 1st March 2011. In addition, we have had problems with the main detectors on QUOKKA and it will not return to service until May 2011.

Bragg Institute news



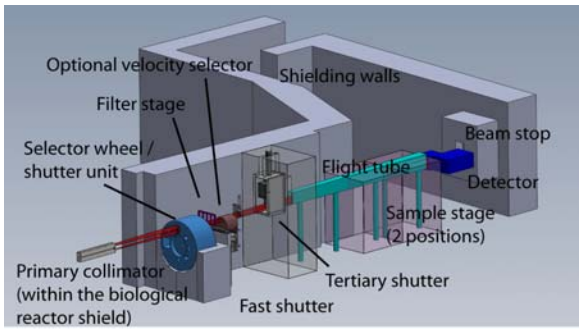
In December we launched a set of new display monitors in the OPAL Facility, showing the status of experiments on each of our neutron and X-ray instruments. The displays are visible in a number of locations throughout the facility.



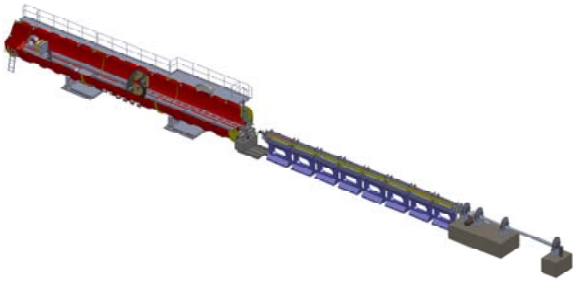
EMU conceptual layout

The $37M Neutron Beam Expansion Project is progressing to schedule; In January the conceptual design review was completed for the EMU high-resolution backscattering spectrometer. Following a critical design review, the analyser arrays are now re-configured to increase Q_{max} from 1.76 to 1.97 $Å^{-1}$.

A new (and improved) instrument layout has been developed for DINGO, the neutron radiography/tomography/imaging station, following the results of floor load calculations.



The DINGO flight path configuration



Conceptual design of the BILBY beam path

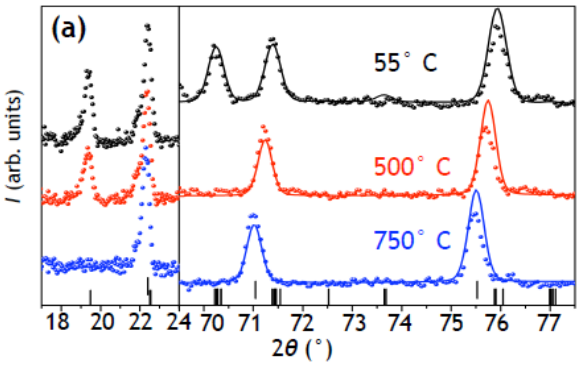
The detailed designs for the detector tank and neutron guides for the new time-of-flight SANS instrument, BILBY, have been completed. Detailed designs for the collimators and the shielding between them are nearing completion and the choppers and detectors have been procured.

Around the instruments

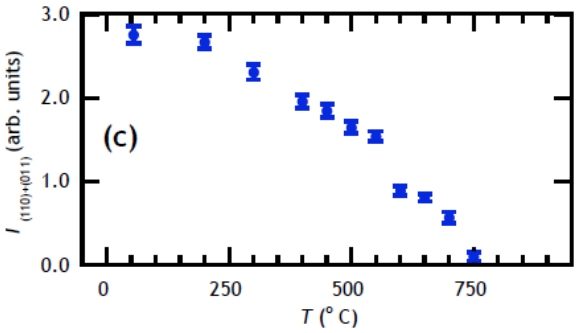
Echidna *(high-resolution diffractometer)*

Together with Sydney University and ANSTO's Institute of Materials Engineering, we have been studying the magnetism and crystallography of a number of technetium oxides, resulting in papers accepted for publication in both *Phys. Rev. Letters* ($SrTcO_3$) and *Journal of the American Chemical Society* ($CaTcO_3$). Strontium technate exhibits the highest magnetic transition temperature outside of the first-row *3d*-transition elements, as shown below.

Magnetic scattering by the Tc cations is substantiated given that the peak intensity and thus magnetic ordering is retained to 750 °C, well above a crystallographic transition of $SrTcO_3$ to the highest possible symmetry group for a perovskite, $Pm\bar{3}m$, at 500 °C.



Observed constant-wavelength profiles for$SrTcO_3$; select 2θ regions shown to highlight the change from Pnma to Pm3barm symmetry and the loss of the magnetic peak at 19.1° 2θ upon heating. Tickmarks for the cubic and orthorhombic structures are shown below the patterns, respectively.

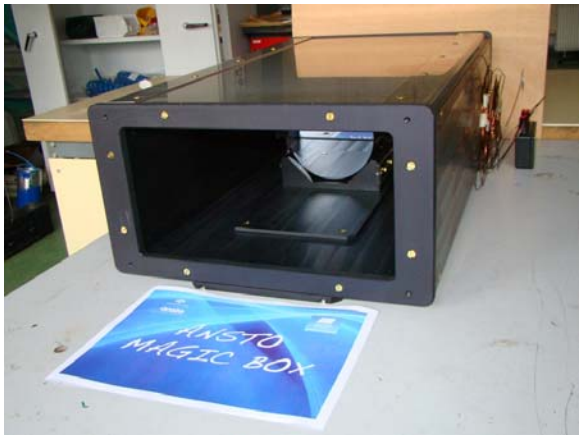


Temperature evolution of the magnetic peak at 19.4° from the CW data.

Electronic structure calculations were performed to shed more light on the magnetic ordering of $SrTcO_3$ and reveal extensive mixing between the technetium *4d*-states and oxygen states proximal to the Fermi level. This hybridisation leads to a close relationship between magnetic ordering temperature and moment formation in $SrTcO_3$. The resultant publication in the end involves samples made by another collaboration in the USA, using a different synthesis, and with neutron data taken independently at Los Alamos:

E. E. Rodriguez, F. Poineau, A. Llobet, B. J. Kennedy, M. Avdeev, G. J. Thorogood, M. L. Carter, R. Seshadri, D. J. Singh, and A. K. Cheetham, *High temperature magnetic ordering in the 4d perovskite $SrTcO_3$,* Phys. Rev. Lett. **106**, 067201 (2011).

QUOKKA *(SANS) &* ***Polarised Helium-3 Filter***



The first of the Magic Box delivered which is to be installed on QUOKKA.

A "Magic box", a device designed to produce a highly uniform static magnetic field and pulses of radio-frequency field, was delivered to ANSTO from the Institut Laue-Langevin in November. This device will house a cell of polarised ^{3}He gas located after the sample in the QUOKKA detector tank. By absorbing neutrons in a selected spin-state, while allowing the passage of neutrons in the other spin-state, the cell of polarised ^{3}He gas works as an analyser of the neutron polarisation. This setup will be used in the studies of magnetic materials such as magnetic nanoparticles and magnetic domains. It will also enable measurements of hydrogen-rich materials by screening out two-thirds of the high background from the spin-incoherent scattering from hydrogen.

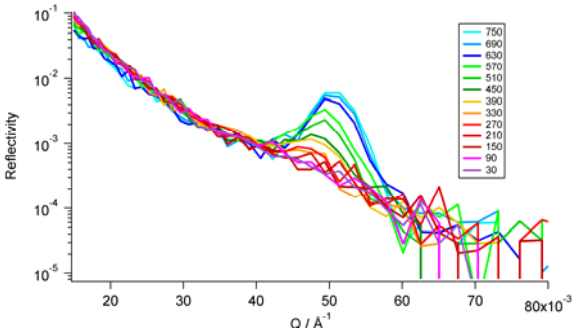
Platypus *(reflectometer)*

Recent measurements taken on PLATYPUS have demonstrated two key strengths of the instrument - its flexibility in employing novel sample environments and its ability to perform kinetic measurements.

The supplied cone and plate shear device

A group of researchers from the group of Prof. Dr. Andreas Magerl in Erlangen University, Germany were interested in the near surface crystallization of a concentrated tri-block co-polymer (Pluronic P123) system; in particular, the effect of shear on the phase

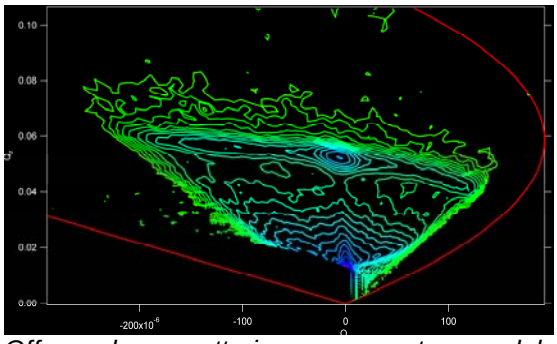
ordering of the micelles. To study these effects the group supplied a cone-and-plate shear device suitable for reflectometry: the neutron path is through a static silicon plate, above which is the thermostatted liquid of interest and the shear cone. Due to the cell geometry we operated in an inverted geometry with the neutrons being reflected downwards.



Evolution of surface Bragg Peaks with time.

One aspect of interest was the recovery of near-surface structure after shear was applied to the system. We observe a characteristic Bragg peak at Q ~ 0.05Å^{-1}, which is caused by micelle crystallization at the surface. This ordering is destroyed when the system is sheared, but recovers when shear is removed. We acquire reflectivity snapshots every 60 s (shorter times are possible). The data showed that the system reached equilibrium at ambient temperature after approximately 700 s, but that there was an induction time of ~200 s before any surface structure was visible again. With lower shear rates, the ordering recovers more quickly, but not to the same extent. This surface structure also manifests itself in the off-specular scattering from the system, which shows lobes extending out from the specular Bragg peak.

Recognising the importance of such kinetic measurements the data acquisition system on PLATYPUS has been configured to allow event streaming of neutrons. This method saves the position, time-of-flight and frame information for each reflected neutron. This means that every dataset acquired on PLATYPUS can be considered a kinetic run. By appropriate data manipulation it is possible to divide a single acquisition into a number of subdatasets, *after* the sample has been measured. For example, a one hour run can be subdivided into 60 – one minute datasets, or 12 - five minute datasets. The lower limit is the period of the chopper rotation (0.05 s at 20Hz).



Offspecular scattering apparent as lobes extending from the specular Bragg peak.

Invited lecture in Mexico

In January, one of the Bragg Institute based graduate students, Kun Yan (University of Wollongong), presented an invited lecture at the International Symposium on Plasticity 2011 in Puerto Vallarta, Mexico. Her presentation was on "Deformation mechanisms of twinning-induced plasticity steels investigated by individual 2D diffraction image texture measurements", and features work done both on WOMBAT and using high-energy synchrotron radiation.

Neutrons and Food Workshop

Delegates at the Neutrons and Food Workshop enjoy a view of Sydney Harbour aboard the catamaran 'Aussie Legend'.

In October we hosted the highly successful Neutrons and Food workshop in conjunction with European Union's NMI3 Program and Oak Ridge National Laboratory in the USA. The international workshop attracted 54 attendees from 15 different countries in 5 continents, and sought to identify the future scientific needs in the application of neutron scattering to Food Science. The application of neutron scattering to food based systems is still in its infancy but has significant potential to understand the complex

relationship between food structure, processing, rheology, nutrition, food quality and security.

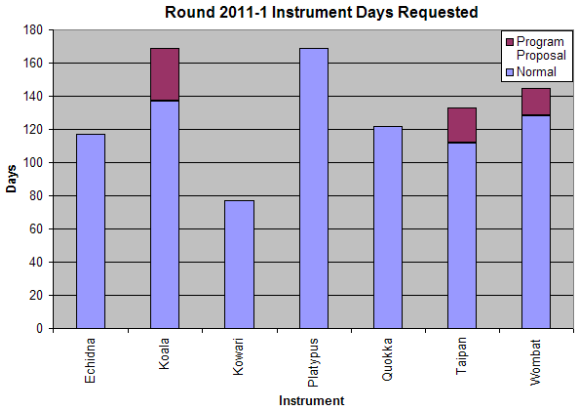
ANBUG Award to Maxim Avdeev

The Australian Neutron Beam Users Group recently awarded Maxim Avdeev the ANBUG Award for Neutron Science, for "outstanding research in neutron science and leadership promoting the Australian neutron scattering community". As part of the award ceremony, he gave a talk entitled "Powder diffraction data analysis: beyond the Rietveld method".

Proposal Round 2011-1 Summary

Our 2011-1 proposal round closed with 167 proposals across 7 neutron instruments and both Chemical and Bio-deuteration at the National Deuteration Facility. A total of 932 beam days were requested across all instruments. 36% of demand was from Australian universities and CSIRO and 12% from ANSTO itself. Roughly 52% of demand in the 2011-1 Round was from overseas (USA, Taiwan, China, New Zealand, UK, Germany, South Africa, Japan, Singapore, Hong Kong, Argentina, Netherlands, Italy and the Ukraine).

Approved experiments will be run in the period April to September 2011.



Announcements

The 2011-2 Proposal Round for beam time between October 2011 – March 2011 and access to all 7 initial neutron-beam instruments and the National Deuteration Facility is now open. Proposals should be submitted online at https://neutron.ansto.gov.au by **22 May 2011**.

Continuation of minibus service to ANSTO

Our Sutherland-ANSTO minibus service will continue with the same timetable and pick-up/drop-off arrangements until 30 June 2011. Information regarding travel options to ANSTO is available here.

Faces

Newcomers:

Richard Mole joins the Institute from the FRM-II Research Reactor in Munich, Germany. Richard is an expert on neutron spectroscopy and joins Dehong Yu in commissioning and running our PELICAN time-of-flight spectrometer.

James Doutch has joined the Food Science Project as a postdoc from the University of Liverpool, UK. In this role he will investigate the ultrastructure of starch, in various theoretical and experimental projects.

Departures:

After three years serving the neutron community at the Bragg Institute User Office, Donna Freeman has accepted a role with ANSTO Security. She will be sorely missed!

Jaroslav Blazek recently completed his post-doc with the ANSTO Food Science Project and is leaving to pursue a career with Darrell Lea Chocolates.

Jorden Lickiss completed her Certificate III in Office Administration and User Office traineeship and is working at AINSE as Events and Administration assistant.

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