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Scatter Matters

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From the Director's desk

I had the pleasure to attend the International Conference on Neutron Scattering in Argentina along with a number of ANSTO staff. It was a great opportunity to meet and discuss with our international colleagues and hear the status of the other neutron scattering facilities around the world.

We are looking forward to seeing you at the ANBUG-AINSE Neutron Scattering Symposium (AANSS) 2022 which will be held in person from the 9th to 11th November 2022 at Lucas Heights NSW. The abstract deadline closes on 11th September – so don't delay!

I would like to extend our congratulations to Vanessa Peterson who was awarded the Nancy Millis Medal for Woman in Science by the Australian Academy of Science.

The 2023-1 proposal round closes on 15th September with proposals submitted to the ANSTO Research Portal (ARP). We are pleased to include Scientific Computing Support services in this round. Koala will have a reduced number of days whilst we replace and upgrade Koala commencing in October 2022.

We extend our appreciation to those who engaged in the recent ACNS planning activities for the 2021 National Research Infrastructure Roadmap and ANSTO Decadal Plan.

Thanks to the great efforts of ACNS staff and support from our external partners, we have a number of new and refreshed capabilities available including the recently commissioned Laser Metal Deposition (LMD) system, ARC LIEF supported sample environment equipment in partnership with universities (rheometer, high pressure cells & sample positioning), equipment supported through the NCRIS Research Infrastructure Investment Plans (2018 & 2020) and asset renewal through ANSTO's internal funding.

A reminder that we value your feedback on your experience as a user of the ACNS facilities and welcome your feedback via our user survey. As an incentive to submit your feedback we are randomly selecting a user feedback response every quarter for a $100 AUD giftcard. Congratulations to Hsin-Hui Shen from Monash University & Paritosh Wadekar from National Sun Yat-Sen University who are the recipients of giftcards from earlier this year (cheque is in the mail…).

Jamie Schulz

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News from the Instruments

Diffraction

The diffraction instruments at ACNS are Echidna (high-resolution powder diffraction), Wombat (high-intensity diffraction) and Koala (Laue diffraction). The group also includes the computational cluster staff and runs the Physical Properties Measurement System (PPMS). They can all be reached at acnsdiffraction@ansto.gov.au

New Capability - Scientific Computing Support for experimental projects

We will provide a new Scientific Computing Support service for ACNS 2023-1 round. The service includes calculations and simulations to complement Neutron Experiments undertaken at the ACNS. Researchers can request the service via the ANSTO Research Portal as a part of the proposal submission. We will support the two highest ranked projects for up to six months based on their scientific merit and feasibility.

The service includes the following methods: Single point energy calculations, structure determination/geometry optimization, lattice dynamics/phonon calculations, molecular dynamics and Monte Carlo simulations.

ACNS' Scientific Computing Scientist will provide the computational work in collaboration with the Experimental Scientist. The service includes project planning, software configuration, production of simulations, data analysis, visualisation and interpretation.

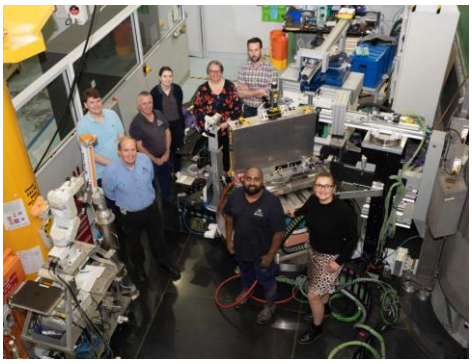
Find more information on the ANSTO website here.

Pablo Galaviz

Engineering & imaging

The engineering and imaging instruments at ACNS are Dingo (imaging) and Kowari (strain scanning). The group can be contacted at acnsimagingandengineering@ansto.gov.au

New capability – Laser Metal Deposition system



ANSTO's capabilities to support additive manufacturing have been greatly strengthened with the installation of the first-in-the-world custom-built powder Laser Metal Deposition (LMD) system that can be used for *in-situ* experiments at the Australia Centre for Neutron Scattering. The project was co-funded by a Research Attraction and Acceleration grant from the Office of the Chief Scientist and Engineer (NSW), the National Collaborative Research Infrastructure Strategy (NCRIS) and ANSTO. LMD is an additive manufacturing process in which a laser beam is used to form a melt pool on the surface of a metal object. Metal powder is injected using a gas stream, melting to form a thin "additive" layer of new material on top of the base material. It can be used to produce 3D parts or repair

existing components, such as high-strength steel aircraft or civil structure components, with a bond that is as strong as, or in some cases stronger, than the original. We expect that this unique LMD capability will greatly assist Australian researchers and companies to understand and optimise advanced manufacturing techniques and enhance sovereign manufacturing in Australia.

Read more about this on the ANSTO website

Inelastic

The inelastic instruments at ACNS are Taipan (triple-axis spectrometer), Emu (high-resolution back-scattering spectrometer), Pelican (time-of-flight spectrometer) and Sika (cold triple-axis spectrometer). The team also operate Joey (Laue camera) and can be contacted at acnsinelastic@ansto.gov.au

Highlight on glass science on ANSTO website

In recognition of the International Year of Glass, ANSTO has written a wide-ranging overview of glass science on the website. The article also features recent work conducted on ACNS' inelastic instruments.

Researchers from the University of Wollongong and RMIT use neutron spectroscopy to study the atomic motion in low-temperature glasses that naturally form on aluminium surfaces. Electron microscopy had revealed well-defined columns in the crystalline phase but a blurry surface in the glassy phase.

In the paper published in Physical Review Research in 2020, the research team used neutron spectroscopy to investigate mysterious low-temperature vibrations, known as boson peaks, in ultrathin samples of alumina glasses (Al_2O_3) with a glassy and crystal phase.

Dr David Cortie (now ACNS reflectometry team member) undertook the research while at the University of Wollongong, along with colleagues from the Theoretical, Computational and Quantum Physics Group at RMIT led by Professor Jared Cole. ANSTO instruments Dr Richard Mole, Dr Nicolas de Souza, Dr Dehong Yu and Dr Gail Iles (now at RMIT), contributed to the study. They also made use of the GADI supercomputer to perform molecular dynamics simulations of the glass.

Thanks to David Cortie for assisting ANSTO communications department in producing the article that can be read here with the PRL paper available at DOI 10.1103/PhysRevResearch.2.023320

Reflectivity

The reflectivity instruments at ACNS are Platypus, Spatz and the X-ray reflectometer. The group also includes the ^{3}He polarisation staff, and they can all be reached at acnsreflectivity@ansto.gov.au.

Science highlight – A step to fighting antimicrobial resistance

Research led by Prof Jian Li from the Monash Biomedical Discovery Institute and Dr Hsin-Hui Shen from the Monash Department of Biomedical Engineering found an approach that could be an alternative when bacteria are resistant to the current 'last line of defence' antibiotic drugs.

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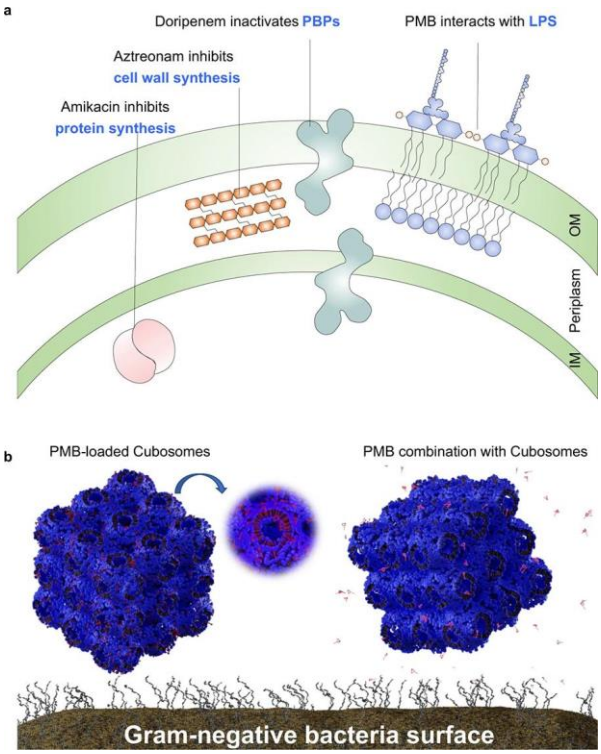


The interaction of antibiotics with Gram-negative bacteria. Reprinted under Creative Commons license from Nature Communications.

The study published in Nature Communications by a large collaboration of Australian, Taiwanese and Chinese scientists addresses a global health threat brought about by the misuse and overuse of antimicrobials against pathogens.

Using a combination of techniques, the team found that using cubosomes (nanocarriers) loosely mixed with the antibiotic drug polymyxin showed promise in penetrating the impermeable outer membrane of the bacteria to reach the target.

In experiments, the cubosomes were tested as a vehicle to deliver the polymyxin, but the approach was less effective than the polymixture.

It is believed to be the first study to investigate bacterial killing using a polytherapy combination of antibiotic and nanoparticle carriers against gram-negative pathogens.

Dr Anton Le Brun, an instrument scientist at ANSTO's Australian Centre for Neutron Scattering and co-author, assisted with the analysis using the Platypus neutron reflectometer to probe what was occurring during the membrane interaction at the molecular level.

"This type of antibiotic is only effective against gram-negative bacteria because they target a specific molecule within the outer membrane," said Dr Le Brun, who has a longstanding research collaboration studying antibiotics with Dr Shen.

Read the full website article here and the paper at DOI 10.1038/s41467-022-28012-5

Small Angle Scattering

The small-angle-scattering instruments at ACNS are Quokka, Bilby, Kookaburra (ultra-small angle) and the X-ray small-angle camera. The team can be reached at acnssmallangle@ansto.gov.au

2022 Guinier Prize

The small-angle-scattering team, and all at ACNS would like to extend their congratulations to Prof. Jill Trewhella who has been announced as the recipient of the 2022 IUCr Guinier Prize. The Guinier prize is awarded in honour of the founder of the field of small-angle scattering, André Guinier.

Prof. Trewhella completed her PhD at the University of Sydney, before taking up a postdoctoral position

at Yale University with Prof. Don Engelman. Following this she took up a position at Los Alamos National Laboratories, rising through the organisation to become the Bioscience Division Leader. In 2005 Prof. Trewhella returned to Sydney as an ARC Federation Fellow, where she held a joint appointment with the Bragg Institute at ANSTO. In 2009, Prof. Trewhella was appointed to the role of Deputy Vice-Chancellor for Research at the University of Sydney, a position that she held until 2015.

Prof. Trewhella is a recognized global leader in small-angle neutron scattering from biomolecules. Through the careful application of X-ray and neutron scattering, she has provided significant insight into the biological implications of a wide variety of biomolecular interactions, publishing over 160 peer reviewed articles. Prof. Trewhella has also served as a co-editor of IUCrJ, contributed to the IUCr Commission on Small-Angle Scattering from 2007 in a variety of roles, (including her role as Chair from 2014-2017), and is the Chair of the Small-angle Scattering Validation Task Force (wwPDB). Prof. Trewhella is also a vocal advocate for data and publication standards for small-angle scattering. Her work in this area has gained significant traction with the small-angle scattering community and with many journals.

Prof. Trewhella made many important discoveries in the field of structural biology and leaves a number of important legacies to the small-angle scattering community. The Guinier Prize will be awarded at the SAS2022 conference in Campinas, Brazil on the 11th of September, in recognition of her significant scientific achievements and leadership in the field.

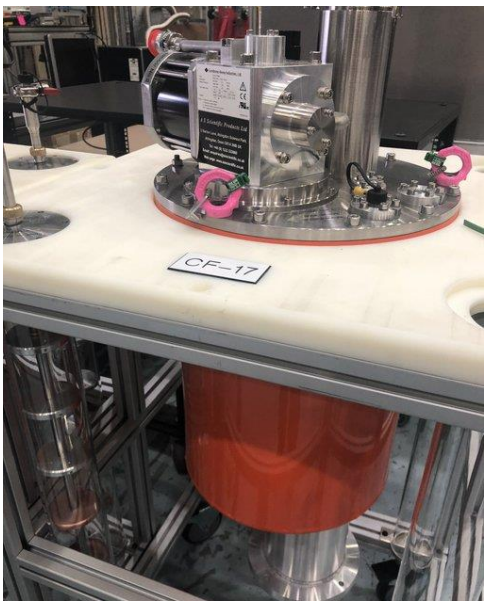
Andrew Whitten

Operations

The operations team at ACNS includes the technical group, laboratory group and sample environment group.

ACNS lab staff are available to assist with access to the laboratories and advise on chemical safety in support of your neutron proposals, and can be reached at acns_laboratories@ansto.gov.au

New sample environments arrive



The Sample Environment team are pleased to announce that they have received all the equipment funded by the NCRIS Research Infrastructure Investment Plan in financial year 2022. This was a large amount of funding (about $1.8M) for Sample Environment and was very welcome after several years where funding was scarce. What did we do with this windfall? The funding program is earmarked for research infrastructure investment. This meant that we were focussed on renewing our existing capabilities and utilising the money as efficiently as possible to ensure ongoing user support.

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For all of the fans of CF-7 or CF-8, we now have two more of these cryofurnaces in commissioning right now. This will ease scheduling clashes, which you may not have noticed due to the mastery that is schedule management at ACNS. It will certainly make scheduling calmer for our instrument scientists.

We have also designed and have the parts for our own 4k-800K cryofurnace. This is the first step towards adaptable designs to suit the ACNS neutron beam instruments. The use of local suppliers for repairs also reduces our reliance on international shipping.

Those of you who work with universal testing machines will be pleased to hear we have a StepLab machine which will be commissioning soon for use on Wombat and Kowari.

For high temperatures, we designed and purchased the equipment and parts for an induction furnace. This is not a common type of equipment at neutron facilities, but we decided it was the best technology for us to deliver a range of options for the needs of ACNS users. The furnace will go to 1000 °C, have a range of susceptor materials and can be adapted in future for gas loading experiments. Our aim with our design was to provide a sample heating solution that we can later adapt to different instruments and experiments without being dependant on high value funding, The use of local suppliers and repairs where possible will help to reduce future repair times.

We also purchased two Biologic potentiostats, a six-axis robot, a stable of temperature controllers and pumps, spare cold heads and compressors and many small parts and consumables to help us function reliably for years. While we were doing all this, we were still operating our usual support and we bringing in equipment for grants. The new Anton Paar rheometer is in commissioning and the Laser Metal Deposition system was commissioned in June.

Additionally, the Cobra Plus, a wide-bore cryostream for larger samples, arrived for Koala.

In other news, we did say goodbye to Norman Booth, who most of you would have met in the last decade. He's made a tree-change and moved to the country.

We've got more funding this year and by next June we should have a new Oxford Cryosystems dilution insert. We are also starting work on small angle sample changers.

Looking forward to seeing you at the AANSS user meeting this year.

Rachel White

RIIP program update

FY2022 achievements

The Research Infrastructure Investment Plan has enabled ACNS to deliver a range of asset refreshments in FY2022. These include:

- New Xenocs Xeuss 3.0 Small Angle X-ray Scattering instrument (pictured above)
- New Rigaku SmartLab X-Ray Diffractometer Instrument
- A series of new vacuum pumps supporting the instrument tanks

- Refurbishments to detector components and upgrades to our data acquisition electronics
- Infrastructure replacement of instrument data servers and visualisation systems
- Additions and upgrades to the sample environment suite (see the update from Rachel White).

FY2023 plans

ACNS is on track to deliver further upgrades and replacements under RIIP to support the suite of instruments. Some highlights include:

- Upgrade of safety interlock systems and motion control systems across all the instruments
- Upgrade of velocity selector and chopper control systems
- Replacement of neutron guides for Quokka, Koala, Pelican and Platypus
- New focussing monochromator for Echidna
- New Quartz Crystal Microbalance
- Cryopump Vacuum System for the PPMS
- Replacement of the 1 T electromagnet
- Refresh of laboratory equipment, including the muffle furnace, oven, and ball mill
- New cells and computer infrastructure for the Helium-3 Polarisation System.

Stanley Lee

National Deuteration Facility (NDF) News

The National Deuteration Facility has expertise in both biodeuteration and chemical deuteration techniques, enabling access to a wide range of deuterated molecules. The breadth of molecules available can be found in our NDF Product List.

Although NDF is a separate ANSTO research infrastructure platform to ACNS, we share many of our users – so are using this corner of the ACNS newsletter to get in touch with you all!

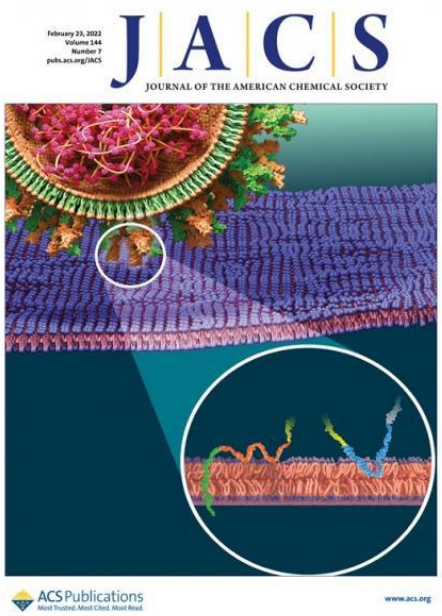
NDF Access Modes and Proposal Types

Information on NDF access modes can be found here

Reminder for the open ACNS& NDF 2023-1 Round closing 15th September 2022 – if you wish to request deuterated molecules from NDF for use with ACNS experiments, the Proposal Type 'Deuteration/Neutron' needs to be submitted.

Recent Publication Highlight - Insight into membrane fusion in COVID infection

The NDF provided deuterated cholesterol for international research to gain a better understanding of how the spike protein of the COVID virus, SARS-CoV-2, infects human cells through a membrane fusion mechanism. The research was featured on the journal cover. Read more and find link to the paper here on the ANSTO website.



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Find more NDF Science News and Highlights here on the ANSTO website.

For any NDF related questions, please contact the NDF team at ndf-enquiries@ansto.gov.au

Achievements

Invisible Revealed MAGMA award

The Invisible Revealed exhibition, which is featured at the Powerhouse, was recognised with a prestigious Museums and Galleries National Award (MAGNA) for research at a ceremony in Perth during June. The Invisible Revealed features collaborative investigations initiated through the unique research partnership. ANSTO's world-class research facilities, featuring neutron instruments at the Australian Centre for Neutron Scattering, synchrotron X-ray beams at the Australian Synchrotron and ion accelerators at the Centre for Accelerator Science, provided chemical, material, manufacturing, and cultural insights into selected objects from the Powerhouse collection.

Congratulation to Joseph Bevitt and all who were involved in collecting data for this fantastic exhibition.

Read more about this on the ANSTO website

Event Reports

AINSE Winter School

AINSE

WINTER SCHOOL 2022

This year, the AINSE Winter School was run in a hybrid format, giving students the opportunity to visit ANSTO in-person after being restricted to virtual meetings for the last two years. The 2022 school has two components. The first saw 91 final-year undergraduate students from 30 AINSE-member universities join a series of seminars and discussions in late July. These covered a wide range of activities at ANSTO, including a three-hour session showcasing each of the instrument groups at ACNS. The online component of the school was concluded with a Facility Roundtable Discussion session, which allowed students to interact directly with ANSTO staff and ask questions about what we do.

The second part of the school will be run in early September, where tours for around ten students each will visit four different facilities within ANSTO. In particular, the ACNS tour on Tuesday 6th September will give students the chance to see two of our neutron instruments (Wombat and Spatz), as well as the vast array of setups offered by the Sample Environment group. This tour will be followed by a networking afternoon tea, providing another great opportunity for students to discuss potential research ideas with ACNS instrument scientists in the leadup to their honours studies.

Feedback from the students about the school has been very positive so far, a credit to the significant number of people who contributed to this event, and we look forward to hosting the visiting students in the near future.

Andrew Manning

Advanced Characterisation of Colloids and Interfaces Workshop

The International Association of Colloid and Interface Scientists (IACIS2022) meeting, Brisbane July 2022, was immediately followed by a two-day characterisation workshop hosted by the Centre for Microscopy and Microanalysis, University of Queensland and Queensland University of Technology. The workshop consisted of a valuable series of presentations and hands-on sessions giving an outline of the theory and practice of the state of the art of characterisation tools that are relevant to the colloids and interfaces community. The workshop was oversubscribed, limited by space in the practical sessions, with in excess of 80 delegates in attendance.

Session topics included:

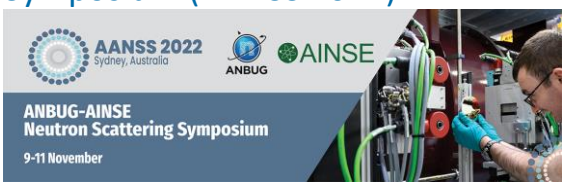
- X-ray and neutron diffraction and scattering
- X-ray photoelectron spectroscopy
- Small angle scattering of X-rays and neutrons
- Scanning and transmission electron microscopy
- Cryo-TEM
- X-ray and neutron reflectometry
- Synchrotron Infra-red microscopy
- Light scattering and particle imaging, and more

There were presentations and contributions from the UQ Centre for Microscopy and Microanalysis, ANSTO (ACNS and AS) and QUT, as well as Xenocs and ATA Scientific representing Malvern Panalytical. Sponsorship was received from ANSTO and AXT. There were 60 attendees from Australia (predominantly eastern states), as well as international participants from New Zealand, Switzerland, Hong Kong, Taiwan, Finland, Canada, Taiwan, the Netherlands, the UK, Japan and Germany.

Stephen Holt

Upcoming Events

ANBUG AINSE Neutron Scattering Symposium (AANSS 2022)



The ANBUG-AINSE Neutron Scattering Symposium (AANSS) 2022 will be held in person from 9th to 11th November 2022 at Lucas Heights NSW, home to ANSTO's multi-purpose OPAL research reactor and the Australian Centre for Neutron Scattering. The symposium will be hosted at the AINSE and ANSTO conference facilities.

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AANSS is the biennial symposium of the Australian and New Zealand neutron scattering community and aims to bring together the users (both local and international) of Australia's neutron research infrastructure with other global experts and users of neutron instrumentation.

The organising committee chaired by Karyn Wilde of the National Deuteration Facility is developing an exciting line up of invited speakers from both the local and global neutron communities. These will be announced over the coming weeks on the AANSS 2022 website.

The symposium will take place over 3 days to encompass science talks and poster presentations across 8 topics and to provide many opportunities to network and engage with your fellow delegates to both renew and establish connections and collaborations.

Symposium Topics

- Advanced Materials
- Manufacturing, Engineering & Industry
- Earth, Environment & Cultural Heritage
- Chemistry & Crystallography
- Deuteration for Neutrons
- Biological Systems & Soft Matter
- Neutron Instruments & Techniques
- Magnetism & Condensed Matter

AANSS 2022 is suitable for undergraduate and postgraduate students, postdoctoral and early career researchers and scientists at all career stages.

Abstract submission deadline has been extended to 11th September 11:59 PM AEST. Head here to submit your abstract. Registration will be opening soon. The Organising Committee looks forward to welcoming you to AANSS 2022 in November and hearing about your research! Any queries, please email anbug2022@ansto.gov.au

ANSTO Small Angle Scattering Workshop 2022

Following the success of the last two virtual workshops, the Australian Centre for Neutron Scattering (ACNS) and the Australian Synchrotron (AS) at ANSTO are pleased to announce the 3rd joint (hybrid) Small Angle Scattering Workshop this year. The practical part of this year's workshop will run as "in-person" and will have limited seats of 20 participants only. The workshop will also feature lectures from eminent speakers over wide a range of research fields in a hybrid format, being made available to both in-person attendees and virtual attendees. Hands-on experiments will cover basics of data collection, processing, analysis, and interpretation. The workshop will also provide an opportunity to interact with likeminded colleagues and to see ACNS's state-of-the art facilities.

The workshop will provide a comprehensive overview of the theoretical and practical aspects of small-angle scattering, including scattering theory, data collection, data processing, data analysis and modelling, applying for beam time, and the application of small-angle scattering to specialised areas of research. Those selected to participate in-person, will have the opportunity to operate Bilby (SANS) and Kookaburra (USANS) instruments, experience a virtual tour of ANSTO's synchrotron SAXS instruments, and undertake workshops in data collection and treatment for both, neutron (ACNS) and X-ray (AS) small-angle scattering machines.

Although the registration for in-person practical part closed on 19th August 2022, anyone who is interested to attend virtual lectures are still able to register for no cost! The workshop will take place

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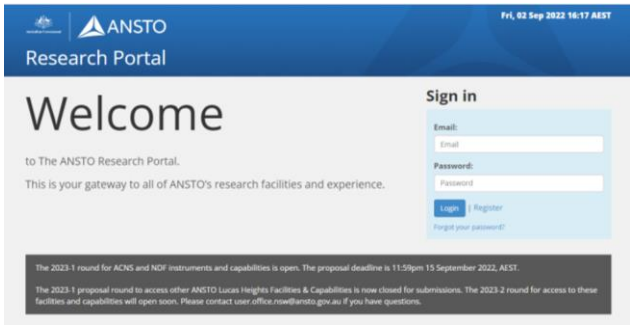
from Tuesday 15th to Thursday 17th November 2022 (inclusive) at ACNS, ANSTO in Lucas Heights.

For more information, please visit https://www.ansto.gov.au/whats-on/sas2022-ansto-small-angle-scattering-workshop

Applying for Instrument time



2023-1 Proposal Round

Applications for the 2023-1 round are open, with the deadline of 11.59 pm, AEST, Thursday 15 September 2022

Proposals are welcome on all of our neutron beam instruments, and for the first time scientific computing as well – proposals received before 15th September relate to access commencing February 2023 for a period of 6 months. For submission advice, see the website or contact the ANSTO NSW User Office team on:

T: +61 (0) 2 9717 9111

E: user.office.nsw@ansto.gov.au

Powder Diffraction Mail-in Round

Applications for mail-in powder diffraction measurements on Echidna are continuously open and should be submitted through the legacy portal.

Meet the new team members

Please join us in welcoming the new members of the Australian Centre for Neutron Scattering team.

Pablo Galaviz

Scientific Computing Scientist

Pablo recently joined ACNS to work on Scientific Computing support to complement Neutron Experiments. Pablo's research background is in computational physics. His research focuses on numerical simulations, particularly in the field of Numerical Relativity, post-Newtonian theory, Hydrodynamics and Molecular Dynamics.

Joshua Marlow

Industry Instrument Scientist

Josh has joined ACNS to help connect industry with the small-angle scattering beamlines. Josh's research background covers the study of self-assembled amphiphilic nanostructures, and the study of the structural and rheological properties of these systems. If you want to chat about soft matter, small-angle scattering, and/or superheroes, his door is always open.

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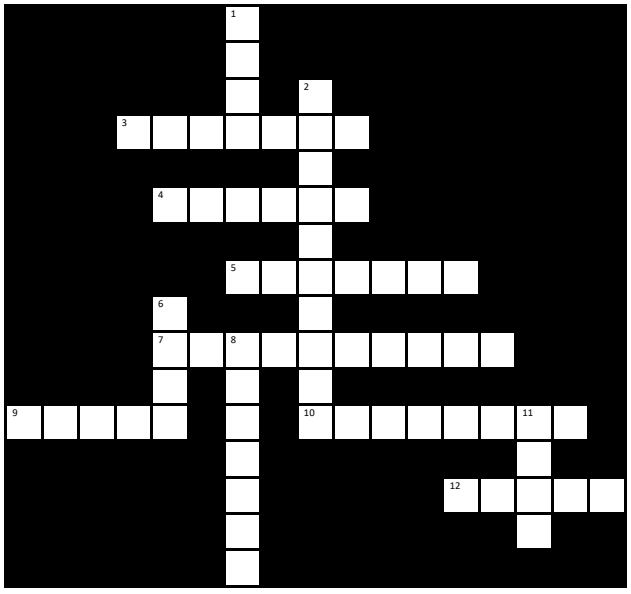
Alexandra Boyd

ANSTO Graduate

Alex has joined ACNS as part of her 3rd rotation, where she will be job shadowing Jamie Schulz part-time. Whilst Alex's undergraduate focussed on Human Health, she is keen to learn more about management at ANSTO and the higher-level considerations of undertaking research and running a user facility.

The lighter side of neutrons

Thanks to Joshua Marlow for the first Scatter Matter's crossword! Something to do on long nights at the instruments.



Cryptic Clues

Down:

1. Without Bilby or Quokka, in short
2. Spooner sold coarse neutrons for scattering experiments
6. Messy cans briefly a place to scatter neutrons
8. Half-fixed director Howard weighs about as much as a proton
11. Mineraloid Reactor

Across:

3. Audible fishin' results in neutrons
4. Young ovine lawyer represents wavelength
5. Is nothing with a broken poet an atom with the same number
7. Distinguished criminal Ed ingests absurd tarts
9. Researchers and young scientists initially followed ten Roman beams
10. Select ronin concealed subatomic particle
12. "Scattering!" boasts government head, lacking initial servility

Combo Clues

Down:

6. Technique used to investigate mesoscopic structures (abbr.)
7. Where scattering neutrons come from
7. Formerly the Bragg Institute (abbr.)
11. Subatomic particle with no net charge
13. The successor to HIFAR (abbr.)

Across:

8. Opposite of fusion
9. 11th letter of the Greek alphabet
10. Variant of an atom with the same number of protons
8. Compared to
12. Beams of electromagnetic radiation between UV and gamma radiation
13. Subatomic particle with a negative charge
14. Father and son Sir William Lawrence and Sir William Henry

Newsletter Editors

This edition of Scatter Matters was edited by Alexandra Boyd and Helen Maynard-Casely. If you have a story or event you would like to share with the ACNS user community, do get in touch - ACNSenquries@ansto.gov.au