

# Scatter Matters

## Australian Centre for Neutron Scattering



### From the Director's desk

#### Looking to the Future

Well the start to 2020 has been an interesting one with catastrophic bushfires and the COVID-19 pandemic which have both affected the user program and the COVID-19 pandemic us all.

On 23<sup>rd</sup> March ANSTO moved to an essential and critical operations mode with all scientific research infrastructure being shutdown unless they provide supporting functions for essential and critical operations (reactor operation, radiopharmaceutical production, site maintenance etc) or are undertaking COVID-19 related research. ACNS has had an open call for COVID-19 related research using our neutron scattering instruments (see the *Beamtime Applications* section). Since then the OPAL reactor continued to operate whilst the neutron scattering instruments were shut down and ACNS staff are mainly working from home.

Another direct impact of the COVID-19 pandemic was the postponement of the OPAL long shutdown that was scheduled to occur in June 2020. The primary reason for the OPAL long shutdown is to replace the TG123 primary shutter which feeds neutrons to the thermal neutron beam instruments in the Neutron Guide Hall. The benefits of TG123 primary shutter replacement are two-fold, firstly the in-pile neutron guides have deteriorated and we

have observed a decrease in neutron flux on the thermal instruments and secondly to install the TG2 neutron guide which will provide 2 additional beamlines for new instruments. Given the likely impact of COVID-19 was expected to be at least a year a decision was made to postpone the long shutdown to June 2021. The OPAL reactor schedule to the end of 2021 is available [here](#).

We commenced the return to the ANSTO site on Monday 25<sup>th</sup> May and we are currently undertaking maintenance, upgrades and commissioning activities now to ensure number of days available for our users is maximised later in the year as travel restrictions ease. The ACNS user program will recommence after the scheduled OPAL reactor shutdown finishes on the 23<sup>rd</sup> June. We will start with the current backlog of proposals that were not able to be run due to COVID-19 travel restrictions and the ANSTO shutdown, initially using mail-in and then progressively to Sydney-basin users, interstate users, New Zealand users (if the [Australia-New Zealand travel bubble](#) is created) and finally international users.

We have number of upgrade projects underway including: installation of a high-resolution detector on Bilby to allow measurements to lower Q; a redesign and upgrade of Koala Laue Diffractometer; two Australian Research Council (ARC) Linkage

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Infrastructure, Equipment and Facilities Grants both being lead by the University of New South Wales for rheometry and high-pressure sample environment equipment; NSW Research Attraction and Acceleration Program Grant for an in-situ Laser Metal Deposition System; and finally \$6.7M from the Australian Governments [Research Infrastructure Investment Plan](#) for equipment replacement and upgrades in 2021-22.

Stay safe and we are looking forward to seeing you again at ANSTO soon.

-Dr Jamie Schulz

## We have a new name!

The beady-eyed of you will notice that the ACNS newsletter now has a name! Congratulations to Dr Andrew Nelson for the winning suggestion of 'Scatter Matters', one of a number of excellent suggestions from Andrew who is one of our Platypus instrument team.

## Around the instruments

### Engineering & imaging

**Ghost imaging implemented at Dingo** The principle of ghost imaging was originally developed for visible light quantum optics. As shown in this publication it has a great potential for many types of neutron instruments as well.

Neutron ghost imaging enables position resolution to be incorporated into a variety of instruments, such as powder diffractometers, SANS and inelastic spectrometers, that are not equipped with position-sensitive detectors. A proof of concept enables several further applications. For example, in an imaging context, neutron ghost imaging can be beneficial for dose reduction and resolution enhancement.

The paper explores the principle of resolution enhancement by employing a variant of the method in which each pixel of a position-sensitive detector is regarded as an independent bucket detector; a

neutron ghost image is then computed for each pixel. It is demonstrated that this parallel form of neutron ghost imaging can significantly increase the spatial resolution of a pixelated detector such as a CCD or CMOS camera.

Further applications and extensions of the neutron ghost-imaging protocol are discussed. These include neutron ghost tomography, neutron ghost microscopy, dark-field neutron ghost imaging, and isotope-resolved colour neutron ghost imaging via prompt-gamma-ray bucket detection.

Read more in the paper DOI:

[10.1103/PhysRevA.101.053844](https://doi.org/10.1103/PhysRevA.101.053844)

## Small Angle



**Insight into emulsions** An international team led by New Zealand food scientists at the Riddet Institute has used neutron scattering techniques to characterise the structure of an oil-in-water emulsion commonly used in foods, such as milk, cream, salad dressings and sauces. Oil and water do not mix and emulsions are inherently unstable so emulsifiers are used to prevent their components from separating.

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There are a number of ways to stabilise an emulsion. In food systems, the use of molecules such as proteins or food-grade surfactants is most common; however, particles can also be used.

Neutron scattering was used to determine the packing arrangement of the particles at the interface of the primary emulsion droplets which form a fractal network. Small angle and ultra-small neutron scattering measurements revealed that the nature of the network was influenced by the structure and concentration of the whey protein micro-gel particles.

Both the Bilby and Kookaburra instruments were used in the study that features in the journal *Langmuir*. Congratulations to ACNS scientists Prof Elliot Gilbert, Dr Liliana de Campo and Dr Andrew Whitten, who were all authors on the study. Read more on the ANSTO website [here](#) and the paper DOI: [10.1021/acs.langmuir.9b01966](https://doi.org/10.1021/acs.langmuir.9b01966)

## Operations

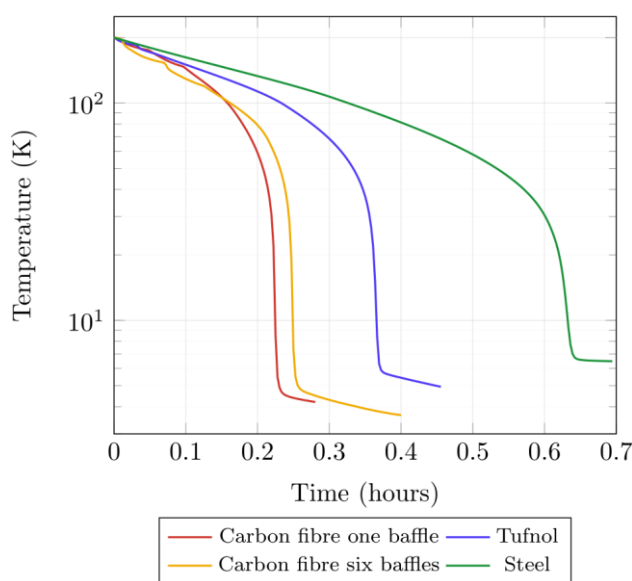
The Sample Environment team at ACNS is well known for their innovative and forward thinking. Their aim is to support the scientific community to collect neutron beam data in the most efficient way.

Cryostats are the bread and butter of experiments for many neutron experiments and they come in several forms and shapes. The fundamental neutron beam cryostat design did not change for many years since the first “top loader” cryostats were introduced at the ILL, and nor the sample positioning probe, or sample stick: the “device” that allows the experimentalist to place the sample inside the cryostat sample space and position it in the beam.

Since then, the sample positioning probes have traditionally been made from a simple stainless steel tube with a certain number of baffles and a copper plate at the end with sensors and heaters where the sample is physically attached. Is this the best way to position the sample in the beam? Is this the best set of materials? How can we reduce the

mass that need to be cooled (or heated) and therefore reduce the waiting time and make the cryostats more efficient and the users happier?

Andrew Manning and collaborators demonstrate in a recently published paper that if you change material and design, if you use a carbon fibre tube instead of stainless steel and reduce or eliminate the baffles, you can actually achieve up to 20% reduction in cooling time. Yes, 20% just by changing the materials and tweaking the design! Who would have thought so? Sometimes innovation is really as simple as thinking differently and questioning why we do things in a certain way.



The paper has been published in the *Journal of Applied Crystallography*. DOI: [10.1107/S1600576719016704](https://doi.org/10.1107/S1600576719016704)

## New Publications

Between 2007 and 2019, there have been 1334 publications with neutron data collected at ACNS by users and staff, which includes [61 in 2020 so far](#). Do please keep your portal account up to date with your publications from ACNS instrument time.

You can access a full list of ACNS publications from 2007 online, [here](#).

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## Beamtime Applications

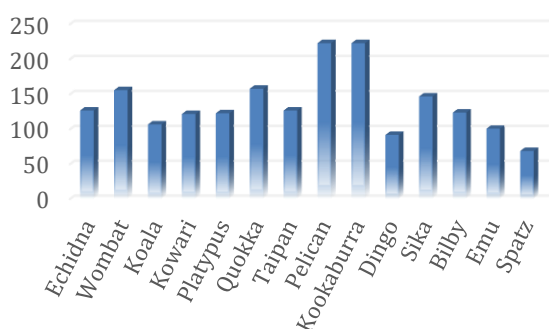
For submission advice see the [website](#) or contact the ANSTO NSW User Office team on:

T: +612 9717 9111

E: [user.office.nsw@ansto.gov.au](mailto:user.office.nsw@ansto.gov.au)

### 2020-2 Proposal Round

333 neutron proposals were received for a total of 1979 days for the 2020-2 proposal round. The instrument breakdown is given in the figure below. We have just completed the review by the Program Advisory Committee and will be sending out notifications to users within the next month.



## Powder Diffraction & Small-Angle Neutron Scattering Mail-in Rounds

Applications for mail-in powder diffraction measurements on [Echidna](#) and small-angle neutron scattering measurements on [Quokka](#) are continuously open.

### COVID-19 Proposal Round

Applications for rapid-access beam time in support of COVID-19 research are continuously open.

### 2021-1 Proposal Round

Applications for beam time for the first half of 2021 are now open. The call for proposal will close on Tuesday 15th September 2020 at 11:59pm (AEST).

## Event Reports

### ANSTO User Meeting 2019

Jointly organised by the Australian Neutron Beam Users Group (ANBUG) and the Australian Synchrotron User Advisory Committee (UAC) the second ANSTO User meeting was hosted in the MUSE building at Macquarie University, NSW, on the 2<sup>nd</sup> & 3<sup>rd</sup> December 2019. The meeting showcased the achievements of scientists who have accessed ANSTO's landmark infrastructure and capabilities in the last year, including the Australian Synchrotron, ACNS and the Centre for Accelerator Science.

A packed program demonstrated the great range of science that is undertaken at our landmark infrastructure, and gave instrument/beamline scientists an invaluable opportunity to connect with our user base. Thanks to the ANSTO Discovery Centre staff, who organised a mini science festival in conjunction with the meeting, many general public attendees were able to see the research first hand.



Rachel White  
@DrRachelWhite

Show and tell at #AUM2019

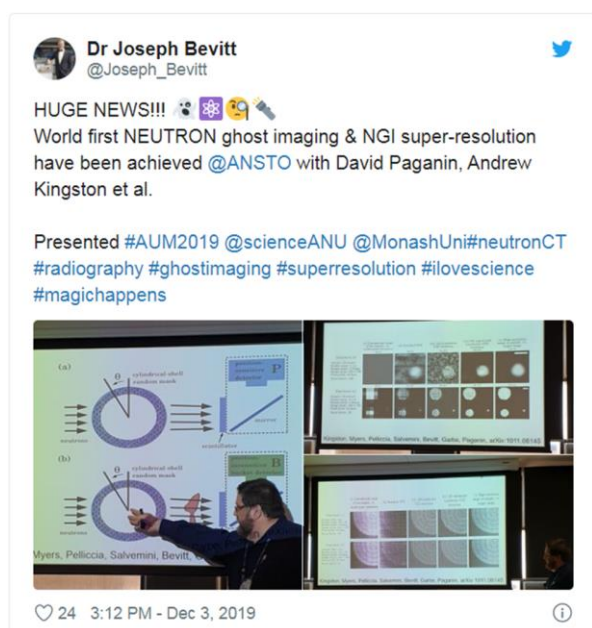


♥ 11 6:10 PM - Dec 2, 2019



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A much tweeted highlight was the presentation of the first neutron ghost imaging, by Dr David Paganin, Monash University, who had worked with the Dingo team to bring this to fruition (see the section in 'Around the Instruments' for more information).



See more tweets from the ANSTO User Meeting with the #AUM2019 hashtag.

## AOCNS 2019

The Asia-Oceania Conference for Neutron Scattering (AOCNS) is a platform for scientists in the Asia Oceania region to share their latest results and discoveries in neutron scattering science across multiple fields such as physics, chemistry, biology, material science, engineering materials engineering, neutron sources and instrumentations.

The third of these series of conferences was held 16<sup>th</sup> – 21<sup>st</sup> November 2019 in Kenting, Taiwan.



AOCNS organisers had curated a wide-range of sessions, encompassing all strengths of neutron scattering in the region. Over 300 attendees from 20 countries participated and celebrated the neutron science and engineering with in the Asia-Pacific region.

Similar to previous conferences, the first day of the event was a series of workshops themed about neutron instrument techniques and ACNS staff were heavily involved in the organisation and delivery of these.



*Pictured are organisers and attendees of the reflectometry (top), small-angle-scattering (middle) and strain scanning & imaging (bottom) workshops at AOCNS 2019.*

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## Recent Awards

### Australian Neutron Beam Users Group

The Australian Neutron Beam Users Group (ANBUG) awards recognise the achievements of the Australian and New Zealand user community. ANBUG presented following awards at the recent ANSTO User Meeting 2019.

**ANBUG Career Award** – Prof Stewart Campbell (University of New South Wales at Australian Defence Force Academy)

**ANBUG Neutron Award** – Prof Vanessa Peterson (ACNS)

**ANBUG Young Scientist Award** – A Prof Rico Tabor (Monash University)

**ANBUG Outstanding PhD Prize** – Dr Timothy Murdoch (University of Newcastle)

### Australian X-ray Analytical Association

Australian X-ray Analytical Association (AXAA) recently announced Prof Vanessa Peterson as the recipient of the **2020 Bob Cheary Award for Excellence in Diffraction Analysis**. [Read more here](#).

## Recent Grants

ACNS scientists are actively involved and participating in many successful Australian and international grants. Our staff are interested in partnering with the user community on future grant applications. The most recent successes are:

### 2019

ARC Discovery Grant – **Emergent Behaviours in Spin Crossover Materials**. Cameron Kepert (University of Sydney) with Vanessa Peterson (ACNS). Partners: University of New South Wales and University of Queensland.

ARC Discovery Grant – **All-Solid-State: New Hybrid Materials for the Next Generation Lithium Batteries**. Chris Ling (University of Sydney) with Max Avdeev (ACNS). Partners: University of New South Wales

ARC Discovery Grant – **Virus-inspired nanoparticles based on polyion complex micelles**. Martina Stenzel (University of New South Wales) with Chris Garvey (ACNS).

ARC Discovery Grant – **Programming anisotropy into responsive soft materials**. Jason Stokes (University of Queensland) with Elliot Gilbert (ACNS).

### 2020

ARC Linkage Infrastructure, Equipment and Facilities Grant – **Australian Rheo-Scattering Facilities**. Patrick Spicer (University of New South Wales) with Chris Garvey, Anna Sokolova & Jitendra Mata (ACNS). Partners: University of Sydney, RMIT University and Australian Synchrotron.

ARC Linkage Infrastructure, Equipment and Facilities Grant – **4D X-ray Microscopy Laboratory**. Klaus Regenauer-Lieb (University of New South Wales) with Ulf Garbe (ACNS). Partners: University of Sydney, University of Queensland and Queensland University of Technology.

NSW Research Attraction and Acceleration Program Grant – [Laser Metal Deposition System](#). Ania Paradowska (ACNS)

Cooperative Research Centres Projects (CRC-P) – [Novel Processing of Pyrite Ore to Produce Battery Grade Cobalt and Sulphur](#). Cobalt Blue Holding Ltd with Vanessa Peterson (ACNS). Partners: University of New South Wales and Anenergy

ARC Linkage Grant – [Development of Laser Cladding Technology to Maintain Rails in Tram Networks](#). Ralph Abrahams (Monash University) with Ania Paradowska (ACNS). Partners: LaserBond and Yarra Trams.

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## Upcoming Events

You thought there would be nothing here? Well, actually there are quite a few events that have moved into the virtual arena, presenting great opportunities to explore new areas of science from the comfort of your desk.

### SASSY 2020

## Sassy Sydney Surfaces And Soft Stuff

The Sydney Surfaces and Soft Stuff meeting is a one-day symposium for researchers in colloids and interface science who are based in and around Sydney. The idea is to get to know other people in the neighbourhood who are doing related work. Our aim is for the oral presentations to be predominantly given by 2<sup>nd</sup> and 3<sup>rd</sup> year PhD students. There will be an opportunity to discuss posters too.

The 2020 Sassy meeting will be hosted by the UNSW Complex Fluids Group and take place on Thursday, June 11, 2020, as a fully online event.

Best of all, there's no registration fee - it's free to get Sassy. We do need you to register in advance so that we can have the logistics of the day ready. See the [Sassy website](#) for more information

### #TheLightStuff - online lectures on scattering and diffraction



Following the success of the recent online “Better with Scattering workshop”, the BAM (Federal Institute for Materials Research and Testing, Germany) will team up with the Diamond Light Source to bring up a series of online lectures on scattering and diffraction, with emphasis on lectures from early-career researchers. The talks are intended to provide an insight into the uses, developments and theory of the scattering and diffraction techniques. See their [website](#) or check out their [YouTube Channel](#).

### Denver X-ray Conference

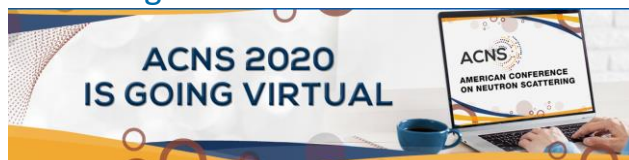


ICDD and the Conference Organizing Committee have made the decision and are pleased to announce that the Denver X-ray Conference will be held virtually this year, from 3-7 August, 2020.

We are committed to preserving the long history and high standards of the Denver X-ray Conference. Although our 69th Annual Conference will look and feel a little different, the tradition of connecting our community through a virtual platform promises to be an exciting experience. We welcome you to join us in this new endeavour, a [Virtual 2020 Denver X-ray Conference](#).

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## American Conference on Neutron Scattering



ACNS 2020 Announces Move to a Virtual Conference, Join us for the 10th American Conference on Neutron Scattering (ACNS 2020), held July 13-16, 2020. The Conference will provide essential information on the breadth and depth of current neutron-related research worldwide.

Hosted by the Neutron Scattering Society of America, this year's Conference will feature a combination of invited and contributed talks, poster sessions and tutorials. [See more here.](#)

## Meet the team

With all of the projects going on at ACNS there are always new faces joining the team and others heading off on new adventures. Here we will try to keep you up to date with team developments.

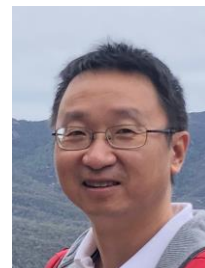
### Arrivals

**Dr Andrew Manning**  
*<sup>3</sup>He Polarisation  
Instrument Scientist*



Formerly one of our sample-environment professional officers, Andrew now changes his role to lead the polarisation capability at ACNS. Before commencing at ACNS in 2014 Andrew completed a PhD at the Australian National University on quantum statistics in ultracold atomic systems.

**Dr Luke Lu**  
*Data Acquisition Electronics  
team leader*



Before joining ACNS, Luke worked in the electrical and electronics industry developing commercial products for telecommunications, electricity metering, and electrical machine drives. He completed his PhD in electrical engineering at the University of Technology, Sydney in 2008.

## Contact us

Do you have a story you would like to share with the ACNS user community? Contact the ACNS outreach team via:

E: [helen.maynard-casely@ansto.gov.au](mailto:helen.maynard-casely@ansto.gov.au)