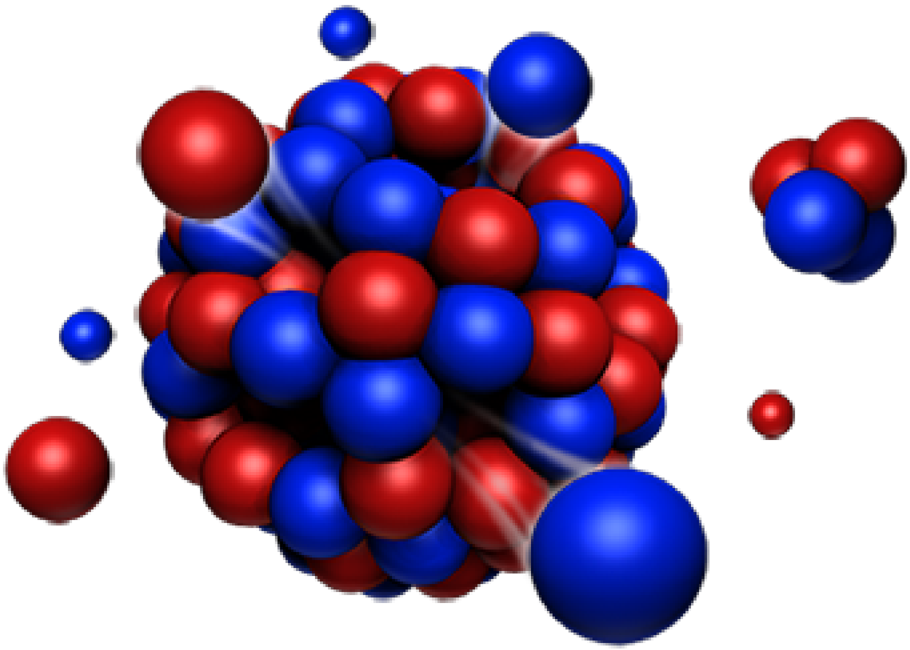
International Collaboration on Advanced Neutron Sources (ICANS XXIII)



Report of Contributions

https://conference.sns.gov/e/ICANS

Contribution ID: **2** Type: **Oral Presentation**

Breaking the mould: monochromatic diffraction at a pulsed spallation neutron source

Monday 14 October 2019 14:30 (25 minutes)

Structure determination of materials on the atomic scale requires diffraction techniques and accurate structure is essential in order to understand physical properties. Neutron diffraction is complementary to X-ray diffraction but relies on large-scale neutron facilities, of which there are relatively few *cf.* X-ray sources, and the favourable properties of the neutron for material investigations: high penetration depth, light element sensitivity, isotope dependent scattering, low energy and magnetic interaction.

For powder diffraction, there are two types of neutron powder diffractometer (NPD), monochromatic and time-of-flight (TOF). The former uses a narrow wavelength band, selected by a monochromator, and either scan a set of point detectors over the scattering angle (D2B [1] type) or employ wide-angle area detectors (D20 [2] type) to obtain diffraction data. TOF diffractometers use a wavelength band, defined by the total instrument length, available time-window and moderator characteristics (related to the duty cycle of the source and/or chopper frequency), and fixed angle detector banks, e.g. Polaris [3].

Reactor neutron sources pioneered the development and use of monochromatic NPDs and pulsed spallation neutron sources established the TOF method. The design of NPDs follows the general premise: *continuous sources build monochromatic instruments, except where significantly restricted geometry constraints are present, where TOF methods are preferred or necessary, and pulsed sources build TOF instruments*. Most research reactors are ageing and several have closed in the last 12 months. The majority of the current world class and next generation large-scale facilities in Europe and beyond are spallation sources.

While science cases for monochromatic NPDs are well established, what impact will large-scale facility type have on future NPDs? If reactor sources have seen their heyday, what will become of the monochromatic NPD? Are there possibilities for next generation NPDs other than TOF instruments at current and future pulsed spallation sources? Instrument design, construction and operation must always be science case driven. Are there science cases that remain better addressed with monochromatic NPDs? How will the landscape change with source closures over the next 10-15 years with respect to capacity and capability for the user community? Here I will describe some possibilities that need investigation and evaluation while expertise is available at operational reactor sources.

[1] E. Suard, A.W. Hewat. Neutron News 2001, 12, 20-25.
[2] T.C. Hansen, P.F. Henry, H.E. Fischer, J. Torregrossa, P. Convert. Meas. Sci. Technol. 2008, 19(3), 034001.
[3] R.I. Smith, S. Hull, M.G. Tucker, H.Y. Playford, D.J. McPhail, S.P. Waller, S.T. Norberg, Rev. Sci. Instrum., (accepted).

Author: HENRY, Paul (ISIS Neutron & Muon Source)

Presenter: HENRY, Paul (ISIS Neutron & Muon Source)

Session Classification: Instruments

Track Classification: Instrument

Contribution ID: **3** Type: **Oral Presentation**

Engineering design and transient fluid dynamic simulations of the second generation of low dimension cold Moderator for the European Spallation Source ESS

Tuesday 15 October 2019 11:45 (25 minutes)

Studies by the ESS neutronic team have shown that low-dimensional moderators can improve the neutron brightness by more than a factor of two, compared to the common volume moderators. ESS will therefore be equipped with such a moderator. The intended time-averaged proton beam power is 5 WM. Due to ramp up of the accelerator the first generation will operate under partial load of less than 2 MW time-averaged proton beam power, with the so-called butterfly-2 moderator (BF2), consisting of two separate aluminum vessels filled with liquid hydrogen. Further parametric studies have shown that geometrical optimizations can lead to an additional gain of brightness of up to 30% for several beamlines, which resulted in the butterfly-1 (BF1) moderator (single vessel) design. Therefore, the BF1 cold moderator should be used in the second generation of ESS. The following paper will cover the verification of the technical feasibility of the optimized neutronic design. The transient fluid dynamic simulations will be in the focus of this work. Based on the existing requirements, i.a. avoiding local boiling, a theoretical maximum allowable beam power will be estimated. Pulsed heat deposition and resulting temperature fluctuations and pressure waves will be analyzed as well.

Authors: BESSLER, Yannick; Prof. NATOUR, Ghaleb (Forschungszentrum Juelich GmbH)

Presenter: BESSLER, Yannick

Session Classification: Target

Track Classification: Target/Moderator

Contribution ID: **4** Type: **Oral Presentation**

Development of measuring systems for the target of the European spallation source (ESS)

Tuesday 15 October 2019 15:15 (25 minutes)

The target of the European spallation source (ESS) consists of a rotating wheel, divided up into 36 cassettes containing tungsten. The wheel is flanged to a 6m long shaft. Primal the rotation speed and the position of the target wheel are defined and measured by the drive unit at the top of the shaft. However there are degrees of freedom which cannot be measured by the drive unit e.g. thermal expansion and tilting of the wheel itself. Also the temperature can be measured only indirectly by measuring the in- and outlet temperature of the cooling fluid. The target monitoring plug (TMP) is a component to measure the x,y,z position, the tilting, the thermal expansion and the temperature of the target wheel. It contains different measurement techniques to measure the absolute position of the target wheel and the shaft relative to the spallation center. Furthermore the temperature of the cooling fluid of each individual cassette of the rotating target wheel and the temperature of outer edge of the wheel are measured. Four chromatic confocal distance measurement systems register the angle of the shaft and its relative xy-position. The z position of the target is determined by a laser distance measurement based on a phase comparison method. One pyrometer determines the temperature of the cooling fluid based on the amount of the thermal radiation emitted by the inner surface of so called moving cups which extend into the cassettes. The second pyrometer measures the thermal radiation emitted by the edge of the wheel and calculates its temperature. The TMP itself, our solutions to avoid electronic components inside the vacuum vessel and mounting all optical components in safe distances to radiation sources with no direct streaming path are presented as well as the first experimental test results.

Author: ROSENTHAL, Eberhard (Forschungszentrum Jülich)

Co-authors: BESSLER, Yannick; Prof. NATOUR, Ghaleb (Forschungszentrum Juelich GmbH); Mr GIESEN, Ulrich (Forschungszentrum Jülich); Mr GRATES, Carsten (Forschungszentrum Jülich); Dr LOHOFF, Robert (Forschungzentrum Jülich); Mr HAPPE, Christop (Forschungszentrum Jülich)

Presenter: ROSENTHAL, Eberhard (Forschungszentrum Jülich)

Session Classification: Operations/Safety

Track Classification: Operation/Safety

Contribution ID: **5** Type: **Poster**

Fast neutron measurements with solid state detectors at pulsed spallation sources

Monday 14 October 2019 16:30 (2 hours)

Fast neutron measurements have been performed with silicon and diamond detectors at ChipIr and nTOF facilties.
ChipIr, for Chip Irradiation, is a new beamline at the ISIS spallation neutron source of the Rutherford Appleton Laboratory, where the 800 MeV proton beam is collided on a tungsten target. The 14 meters long beamline has been designed to extract a fast atmospheric-like neutron spectrum. The neutron flux of about $5 \cdot 10^6 s^{-1} cm^{-2}$ with E > 10 MeV is deemed to be ideal for single event effect testing of microelectronics.
The neutron Time-Of-Flight facility (nTOF) at CERN is a 200 meters long beamline designed mainly for cross section measurements. Neutrons are produced by spallation of 24 GeV protons from the Proton Synchrotron accelerator on a lead target.

The pulsed nature of the spallation sources gives very high instantaneous counting rates that dictate the use of a fast electronic chain, with a current preamplifier, and digital acquisition, 1 Gsample/s. All the waveforms are recorded using the digitizer in oscilloscope mode, triggering on the accelerators extraction. The off-line analysis extracts for every neutron interaction the time-stamp and the pulse area, so that time of flight and deposited energy spectra can be built.
At nTOF, the short pulses and long flightpath allow for a selection in energy of the neutrons by means of the time of flight. Therefore response functions of detectors to fast neutrons can be presented and compared to Monte Carlo simulations.
At ChipIr, the longer and more complex pulse structure and shorter flightpath does not allow the same analysis. Therefore the measurements at nTOF are used for interpretation of the ChipIr measurements.

Authors: CAZZANIGA, Carlo (STFC); Dr REBAI, Marica (IFP-CNR); Dr TARDOCCHI, Marco (IFP-CNR); Dr GARCIA-ALIA, Ruben (CERN); Dr FERNANDEZ-MARTINEZ, Pablo (CERN); Dr CECCHETTO, Matteo (CERN); Dr FROST, Christopher (STFC)

Presenter: CAZZANIGA, Carlo (STFC)

Session Classification: Poster

Contribution ID: **6** Type: **Oral Presentation**

Making ESS a success –A landscape of European accelerator based neutron sources

Tuesday 15 October 2019 09:50 (25 minutes)

With the construction of the high power European Spallation Source (ESS) the European neutron community will have access to the most powerful neutron source worldwide. On the other hand the dwindling of reactor based neutron sources in Europe and the US will lead to reduced access opportunities to neutrons. Training of young scientists and the development of experimental methods will be hampered. An alternative to the classical neutron sources providing scientist with required neutrons, accelerator driven neutron sources present with high brilliance neutron provision.
The Jülich Centre for Neutron Science has started a project to develop and design compact accelerator driven high-brilliance neutron sources (HBS) as an efficient and cost effective alternative to current low- and medium-flux reactor and spallation sources. Such compact sources will offer access of science and industry to neutrons as medium-flux, but high-brilliance neutron facilities. HBS will consist of a high current proton accelerator, a compact neutron production and moderator system and an optimized neutron transport system to provide thermal and cold neutrons with high brilliance. The project will allow construction of a scalable neutron source ranging from a university based neutron laboratory to full user facility with open access and service. Embedded within international collaboration with partners from Germany, Europe and Japan the Jülich HBS project will offer flexible solutions to the scientific requirements and establish a new opportunity to exploit neutrons beyond current limitations.
We will describe the currents status of the project and its partners, the next steps, milestones and the vision for the future neutron landscape in Europe with the perspective to guarantee the success of the ESS.

Authors: GUTBERLET, Thomas (Forschungszentrum Jülich GmbH); RÜCKER, Ulrich (Forschungszentrum Jülich GmbH); ZAKALEK, Paul (Forschungszentrum Jülich GmbH); MAUERHOFER, Eric (Forschungszentrum Jülich GmbH); BAGGEMANN, Johannes (Forschungszentrum Jülich GmbH); LI, Jingjing (Forschungszentrum Jülich GmbH); CRONERT, Tobias (Forschungszentrum Jülich GmbH); DOEGE, Paul (Forschungszentrum Jülich GmbH); BÖHM, Sarah (RWTH Aachen); RIMMLER, Marius (Forschungszentrum Jülich GmbH); VOIGT, Jörg (Forschungszentrum Jülich GmbH); BRÜCKEL, Thomas (Forschungszentrum Jülich GmbH)

Presenter: GUTBERLET, Thomas (Forschungszentrum Jülich GmbH)

Session Classification: Plenary

Track Classification: Facility Update

Contribution ID: **7** Type: **Oral Presentation**

ICE-MAN and VirtuES, the Integrated Computational Environment-Modeling & Analysis for Neutrons at ORNL

Thursday 17 October 2019 14:55 (25 minutes)

ICE-MAN is a modeling and analysis workbench for multi-modal studies, specifically design with neutron science in mind. The integrated and extensible environment will provide scientists with a common interface to a suite of tools, and developers with a common API to seamlessly add new functionality. This project aims to reduce the barrier to analyze and interpret neutron scattering experiments in combination with other multi-technique research studies. It will streamline the workflow between different experimental techniques, computer modeling, and databases and reduce the time and learning curve needed to access them thus making a holistic approach to data interpretation more amenable and efficient as well as multi-model studies more accessible.
1) ICE-MAN overcomes the limitation of an individual's expertise to utilize different atomistic modeling techniques and to quickly compare simulated and experimental data.
2) ICE is fully HPC integrated it will expose the methods to an HPC environment. It is a step towards the realization of a vision of routine "on-the-fly"computer modeling, analysis and interpretation in multi-modal neutron experiments. 3) At the SNS, ICE-MAN will provide tools that can be used in 14 instruments.
ICEMAN runs as a virtual machine in VirtualBox and uses Docker containers. At present, it has two main modules, OClimax and QClimax. There are several small modules to generate input files and read output files.
OClimax software can model phonon and vibrational spectra on VISION (BL-16B) as well as other inelastic neutron scattering instruments and can be used to rigurously model both polycrystalline and single crystal spectra. Currently, OClimax is principally used on VISION (BL-16B) but can also be used to analyze data from the direct geometry or triple-axis spectrometers.
A necessary step in analyzing data with OClimax is performing DFT calculations. On the VirtuES cluster, calculations can be performed using CASTEP, VASP, Quantum Espresso, Gaussian, CP2K, etc. The ICEMAN project aims to simplify this step in the analysis procedure, allowing for fast setup of initial files and running scripts for different DFT packages. Maintaining this software stack, so it is ready for users requires significant effort, especially as these codes use specialized packages.
The focused resources applied to data analysis on VISION (BL-16B) have contributed to it being the world leader in neutron vibrational spectroscopy measurements. The scientific output of the spectrometer is roughly 80% dependent on these analysis capabilities and have significantly improved the scientific impact of the instrument.
QClimax, on the other hand, provides users with a flexible, straightforward environment to enable fitting to complex user-defined functions. It allows fits to be performed to data from multiple Q values simultaneously and provides global fitting parameters. This allows both the energy and wave vector response to be modeled at once utilizing the statistical power of the full data set. It represents a significant step forward in the analysis of quasielastic neutron scattering data. QClimax can be used to analyze QENS data from any quasielastic spectrometer, including BASIS (BL-2), DCS (NIST), and CNCS (BL-5). The ICEMAN project is still under active development, and the QENS analysis capabilities of QClimax are being refined with feedback from instrument staff and users.

Authors: Dr RAMIREZ-CUESTA, Timmy (CEMD ORNL); Dr CHENG, YQ (ORNL); Mr BILLINGS, Jay Jay (ORNL); Mr SMITH, Robert (ORNL)

Presenter: Dr RAMIREZ-CUESTA, Timmy (CEMD ORNL)

Session Classification: Software

Track Classification: Software

Contribution ID: **8** Type: **Oral Presentation**

Slowing Down of 14 MeV fusion neutrons and possible applications

Monday 14 October 2019 14:25 (25 minutes)

The spectral fluence rate of the thermalized neutron field obtained by slowing down the 14 MeV fusion neutrons produced at the accelerator-driven Frascati Neutron Generator is measured by means of the Bonner Sphere Spectrometer. Neutron thermalization is achieved by means of a moderator assembly made of a copper pre-moderator and a polyethylene moderator.
A Monte Carlo simulation reproducing the experimental set-up is also performed by means of the MCNP code and the results are compared to the experimental data. The benchmarked Monte Carlo is then used to predict the brilliance of a thermal moderator operating at a potential high intensity 14 MeV neutron continuous source featuring a neutron emission rate of 10^{15} s^{-1}. The results obtained show that if a D-T neutron source featuring a continuous neutron emission rate of 10^{15} s^{-1} could be made operative, it may be exploited for neutron science.

Author: PIETROPAOLO, Antonino (ENEA Department of Fusion and Technologies for Nuclear Safety and Security)

Co-authors: Dr FLAMMINI, Davide (ENEA); Dr MORO, Fabio (ENEA); Dr BEDOGNI, Roberto (INFN-LNF)

Presenter: PIETROPAOLO, Antonino (ENEA Department of Fusion and Technologies for Nuclear Safety and Security)

Session Classification: Sources

Track Classification: Target/Moderator

Contribution ID: **9** Type: **Oral Presentation**

^{100}Mo/^{99m}Tc and ^{64}Cu medical radioisotopes production using 14 MeV fusion neutrons

Thursday 17 October 2019 15:45 (25 minutes)

After the 2009 ^{99m}Tc global crisis, the scientific community is in search of alternative routes for producing ^{99}Mo, the precursor of ^{99m}Tc, presently produced at fission research reactors using U-235-containing targets.
International organizations such as IAEA, NEA and OECD have indicated a series of possible alternatives, based on particles accelerators as well as fast neutron reactions.
In this contribution we will present an approach based on the ^{100}Mo(n,2n)^{100}Mo reactions induced by 14 MeV fusion neutrons generated at a compact accelerator-driven D-T source.
Also, a brief discussion on the production of theranostic radionuclides like ^{64}Cu will be presented.

Author: PIETROPAOLO, Antonino (ENEA Department of Fusion and Technologies for Nuclear Safety and Security)

Co-authors: Dr CAPOGNI, Marco (ENEA); Dr CAPONE, Mauro (ENEA); Dr PALOMBA, Silvia (ENEA and Uni ToV); Dr DELLE PIANE, Gaia (LHEP University of Bern); Dr FALCONI, Rita (Università degli Studi di Roma La Sapienza)

Presenter: PIETROPAOLO, Antonino (ENEA Department of Fusion and Technologies for Nuclear Safety and Security)

Session Classification: Accelerator

Track Classification: Instrument

Contribution ID: **10** Type: **Oral Presentation**

Solid methane moderators: thermodynamics and chemistry

Tuesday 15 October 2019 10:55 (25 minutes)

The unique properties of solid methane enable the conversion of hot, energetic neutrons into cold neutrons, with an efficiency approximately 3.5 times that of liquid hydrogen based moderators. However, practical applications of solid methane in neutron moderators turned out to be much more challenging than initially expected. Exposure of solid methane at low temperatures to neutron radiation leads to a build-up of radiolysis products in the solid methane matrix. Accumulation of defects beyond some critical number can result in a spontaneous self-accelerated recombination process, which in combination with the expansion of hydrogen built up in bulk solid methane during irradiation, was believed to be responsible for the moderator's breakdown. Here we present a thermodynamic model, based on theory of thermal explosion, which allows us to simulate this phenomenon. Our model agrees well with the test results and operational experience of running the ISIS Target Station 2 solid methane moderator. We also compare the results of our simulations with test data obtained using methane moderators developed at the IPNS neutron source, based at Argonne National Laboratory. In the second part of the presentation we discuss the products of radiolysis reactions generated by exposure of the condensed methane to neutron radiation. The succession of radiolysis reactions may lead to a production of long chain hydrocarbons, which can contaminate the moderator system and significantly reduce efficiency of the heat-exchanger. We also discuss possible solutions for cleaning moderators using targeting solvents.

Authors: KIRICHEK, Oleg (The ISIS facility, STFC, UK); Dr LAWSON, Chris (ISIS, STFC, UKRI); Ms DRAPER, Gemma (ISIS, STFC, UKRI); Mr JENKINS, David (ISIS, STFC.UKRI); Mr HAYNES, David (ISIS, STFC, UKRI); Dr LILLEY, Steve (ISIS, STFC, UKRI)

Presenter: KIRICHEK, Oleg (The ISIS facility, STFC, UK)

Session Classification: Target

Track Classification: Target/Moderator

Contribution ID: **11** Type: **Oral Presentation**

ISIS TS1 Project progress summary

Tuesday 15 October 2019 14:00 (25 minutes)

The TS1 project; a circa £15M, 9-year (from definition to planned completion) technically complex sustainability project, to realise a raft of benefits for ISIS and allow continued running and development of TS1, has continued to progress since the update provided at ICANS XXII [1] and now has firm dates for the operational shutdown within which the bulk of the strip-out, installation and commissioning work is to be carried out. Design work has been completed in most areas and production, assembly and testing of the various components and systems is well under way.
In this paper I will summarise the project's progress including highlights, challenges and changes. It will also provide a look to future work, especially that to be carried out in the long shutdown 2020 –2021 [2].

[1] –ISIS TS1 Project Summary - Stephen Gallimore and Matt Fletcher 2018 J. Phys.: Conf. Ser. 1021 012053 https://doi.org/10.1088/1742-6596/1021/1/012053
[2] –proposed paper on shutdown and planning for this ICANS meeting

Author: GALLIMORE, Stephen (UKRI - STFC)

Presenter: GALLIMORE, Stephen (UKRI - STFC)

Session Classification: Operations/Safety

Track Classification: Operation/Safety

Contribution ID: **12** Type: **Oral Presentation**

Shutdown and commissioning planning for the ISIS TS1 Project

Tuesday 15 October 2019 14:25 (25 minutes)

The ISIS long shutdown 2020 -2021 is set to be a busy time; it is during this period that the strip-out, installation and commissioning of the TS1 project [1], [2] will occur. Marking the culmination and actualisation of nearly 8 years of preparation and work. The TS1 project is not the only large project taking advantage of the shutdown and with the significant amount of work to do and resource (human and material) limitations; carefully and robust planning is essential in order to ensure it is all completed successfully and safely.
In this paper, details of the planning for the commissioning (pre-installation, pre-beam and with-beam) as well the activities required during the equipment removal and installation phases, will be provided. It will look at the two areas of pre-build currently underway; one focussed on the replacement target, reflector and moderators (TRAM) assembly [3],[4] and one focussed on the construction of the new modular target services trolley. An overview of the shutdown and commissioning tasks, the approach for their planning and management will also be provided.

Author: GALLIMORE, Stephen (UKRI - STFC)

Co-author: Mr HAYNES, David (ISIS, STFC, UKRI)

Presenter: GALLIMORE, Stephen (UKRI - STFC)

Session Classification: Operations/Safety

Track Classification: Operation/Safety

Contribution ID: **13** Type: **Oral Presentation**

CHESS: A look into the next generation of neutron instruments

Monday 14 October 2019 11:35 (25 minutes)

CHESS is the new proposed direct geometry inelastic spectrometer dedicated to the analysis of small samples with modest energy resolution (2.5-5% of Ei). This relatively short instrument will take full advantage of both the increased peak brilliance of the SNS Second Target Station (STS) coupled moderators, and of the recent advances in instrument design and technology, to achieve unprecedented performance for inelastic scattering in the cold energy range. The simulations predict that it will exceed that of CNCS by at least a factor of 200. Two sections of ballistic octagonal guides will transport the beam to the sample position at 29.6 m from the moderator.
A new concept for double disk choppers will select the wavelengths and deal with frame overlap. CHESS will take full advantage of Repetition-Rate Multiplication (RRM) to analyze samples at multiple incident energies, maximizing the efficiency of the measurement. Finally, the detector tank will house a large array of curved 8-pack detector ^{3}He tubes giving a total solid angle coverage of 6.0 sr, and will incorporate Helmholtz coils for polarization analysis. Detailed Monte Carlo (MC) simulations of a real experiment on $K_2V_3O_8$ have been performed to optimize the instrument using McStas and MCViNE; these results were verified by running similar calculations on CNCS.

Author: SALA, Gabriele (Neutron Scattering, Spectroscopy Division)

Co-authors: EHLERS, Georg (Oak Ridge National Laboratory); LIN, Jiao (Oak Ridge National Lab); HERWIG, Kenneth (ORNL); Mr GRAVES, Van (Oak Ridge National Laboratory)

Presenter: SALA, Gabriele (Neutron Scattering, Spectroscopy Division)

Session Classification: Instruments

Track Classification: Instrument

Contribution ID: **14** Type: **Oral Presentation**

ISIS TS1 Project First Operational Target

Tuesday 15 October 2019 14:00 (30 minutes)

The ISIS Facility at RAL has been producing neutrons for science from the original Target Station (TS1 –40/50Hz) since 1984. The second, lower power, low-repetition-rate Target Station (TS2 – 10Hz) came on line in 2008.

The TS1 Project currently in preparation will include the complete replacement of the internal parts of the original Target Station, including redesign of the Target, Reflector and Moderators along with all associated cooling systems and services. (ICANS XXII - ISIS TS1 project target Design for manufacture
L Jones / Design and Optimisation of the ISIS TS1 Project Target D Wilcox / ISIS TS1 project summary S Gallimore and M Fletcher) All of this work will be completed in the ISIS shutdown starting in September 2020. One of the first major production milestones was completed earlier this year by assembling the first of the newly designed targets.

The Target Assurance Project was started in 2012; with the aim of bringing the production of Targets in house. Since that time, there has been a great deal learnt from mitigating failure routes. This knowledge has been fed back into the design of targets for both target stations. The production of targets is not a simple process and work is ongoing to develop methods and evaluate new machining technology. Future development plans are now in place focussing on the three main processes; Electron beam welding, Hot Isostatic Pressing (HIP), and Non Destructive Testing (ultra sound techniques). I will discuss the research paths of these technologies and also include the machining procedures including Electric Discharge Manufacture.

Our long-term aim is to achieve total self-sufficiency for target production required for ISIS operations and to set up a programme of knowledge transfer with other related facilities.

In this presentation I will outline the processes that were developed and cover the on-going studies needed to perfect the procedures used in the manufacture of targets at ISIS. Also included are quality assurance reporting and reviewing methods which are constantly being evaluated. I aim to describe the processes used and show the reasoning behind, (and validation of), the decisions that have been made. I will detail our plans to reduce HIP bonding failures to understand how best to increase target life and to develop methods of identifying these critical issues during manufacture. I will also discuss the main challenges faced, how these problems were overcome and highlight the ways in which the team reached a successful solution.

Author: Mr MOOR, Jeremy (Science and Technology Facilities Council)

Co-author: Mr CROSS, Daniel (Science and Technology Facilities Council)

Presenter: Mr MOOR, Jeremy (Science and Technology Facilities Council)

Session Classification: Target

Track Classification: Target/Moderator

Contribution ID: **15** Type: **Poster**

Dynamical studies in condensed matters on High Resolution Chopper Spectrometer (HRC) –2nd phase of HRC project –

Monday 14 October 2019 16:30 (2 hours)

The High Resolution Chopper Spectrometer (HRC) at MLF J-PARC delivers relatively high-energy neutrons with high resolutions for a wide range of dynamical studies in condensed matters, and we proposed the three types of inelastic neutron scattering (INS) experiments: high-resolution experiments in a conventional energy momentum space, neutron Brillouin scattering (NBS), and sub-eV neutron spectroscopy. In the 1st phase of our project (FY2008 - FY2013), we constructed the HRC and confirmed its basic performance. Based on the achievement, in order to realize a practical use of NBS and to demonstrate INS under external fields, we planned to improve the performance of the HRC in the 2nd phase (FY2014 - FY2019): improvement of low angle experiments, development of Fermi choppers for higher resolution, improvement of sample environments, and improvement of computational environment [1,2]. As the result, we successfully obtained scientific achievements for both purposes. First, we investigated spin waves in metallic ferromagnet SrRuO3 in the relation to Weyl fermion by means of NBS, and showed that the Berry curvature is an observable of INS [3]. Second, we investigated spin dynamics in frustrated magnet CsFeCl3 with noncolinear spin structure under high pressure, and found a new hybridization of the Nambu-Goldstone mode and Higgs mode near quantum critical point [4]. Furthermore, we have successfully investigated spin dynamics in condensed matters with a conventional manner of INS [5-9].

[1] S. Itoh et al., Physica B 568, 76 (2019), [2] D. Kawana et al., J. Phys.: Conf. Series 1021, 012014 (2018), [3] S. Itoh et al., Nat. Commun. 7, 11788 (2016), [4] S. Hayashida et al., to be published, [5] S. Hayashida et al., Phys. Rev. B 92, 054402 (2015), [6] Y. Ikeda et al., J. Phys. Soc. Jpn. 85, 023701 (2016), [7] S. Ibuka et al., Phys. Rev. B 95, 224406 (2017), [8] T. Haku et al., J. Phys.: Conf. Series 828, 012018 (2017), [9] D. Ueta et al., Physica B 536, 21 (2018).

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Presenter: Prof. ITOH, Shinichi (KEK)

Session Classification: Poster

Contribution ID: **16** Type: **Poster**

Conceptual design of abnormality sign determination system in general control system of Materials and Life Science Experimental Facility at J-PARC

Wednesday 16 October 2019 13:00 (2 hours)

Materials and Life Science Experimental Facility (MLF) at J-PARC generates pulsed muon and neutron beams by injecting highly intense proton beams supplied from accelerators through 3 GeV proton beam transport line (3NBT) into graphite and mercury targets. Then, it supplies the muon and neutron beams to user apparatuses in two experimental halls of MLF. For operating the targets stations safely and efficiently, a general control system (GCS) operates within MLF [1]. GCS administers operation processes and interlocks of many instruments for various statuses such as beam irradiation, target maintenance and emergency. Although GCS is an independent system that controls the target stations, it works closely with control systems of accelerators and other facilities in J-PARC. Since the first beam injection in 2008, it has operated stably without any serious troubles during a period of approximately ten years [2].
GCS has a data storage (DS) server storing operational data on status of target stations. It has functioned well to detect unusual situations around the target stations and investigate causes of trouble by checking data in the DS server. It also contributed significantly to investigate behavior and damage of the target stations when the Great East Japan Earthquake occurred in 2011 [3]. For the coming ten years, however, an introduction of abnormality sign determination system (ASDS) will be necessary for picking up potential abnormalities of the target stations caused by radiation damages, time-related deterioration and so on. ASDS is expected to judge potential abnormality on-line from slight state transitions of the target stations by utilizing algorithms based on analysis with various operational data during long-term operations. As one of key devices for developing ASDS, it requires an installation of integral data storage (IDS) server which can deal with various data integrally throughout proton beams, target stations, and secondary beams. Since 2019, we have produced the IDS server and tested its performance.
This report mentions a present status of GCS, a conceptual design of ASDS and an installation of the IDS server.

[1] K. Sakai et al., Nucl. Instr. Meth. A 600, 75 (2009)

[2] K. Sakai et al., JAEA-Conf. 2015-002 / KEK Proceedings 2015-7, pp.593-598 (2015)

[3] K. Sakai et al., Proc. of ICANS-XX, 2012, Conference proceedings ID 113 (2012)
http://www.neutronresearch.com/parch/2012/01/201201001130.pdf

Authors: Dr SAKAI, Kenji (J-PARC, Japan Atomic Energy Agency); Dr OOI , Motoki (J-PARC, Japan Atomic Energy Agency); Dr TESHIGAWARA, Makoto (J-PARC, Japan Atomic Energy Agency); Dr NAOE, Takashi (J-PARC, Japan Atomic Energy Agency); Dr HAGA, Katsuhiro (J-PARC, Japan Atomic Energy Agency); Mr WATANABE, Akihiko (Nippon Advanced Technology Co., Ltd)

Presenter: Dr SAKAI, Kenji (J-PARC, Japan Atomic Energy Agency)

Session Classification: Poster

Track Classification: Target/Moderator

Contribution ID: **17** Type: **Poster**

Design and Construction of the European Spallation Source (ESS) components - Activities of Research Centre Jülich

Wednesday 16 October 2019 13:00 (2 hours)

As a partner with more than 40 years of experience in designing and manufacturing of equipment and systems for excellent research, the central institute of engineering, electronics and analytics ZEA-1 of Forschungszentrum Jülich GmbH contributes to the design and construction of several main components for the European Spallation Source (ESS) in Lund. The ESS is a large-scale research project which is currently under construction.

Our contribution to ICANS is a poster showing different activities of ZEA-1 on basic infrastructure components, such as moderator & reflector system, target monitor plug, beam extraction system, light shutter, hydrogen cryostat and handling tools, as well as the scattering instruments DREAM, T-Rex, SKADI and MAGIC and the beam chopper systems. This poster will show a transparent, isometric model of the complete facility with the highlighted ZEA-1 contributions and the identification of the relevant activities (design, simulation, manufacturing and testing) and is the platform for further presentations and technical discussions at the ICANS.

Authors: Dr LOHOFF, Robert (Forschungzentrum Jülich); Prof. NATOUR, Ghaleb (Forschungszentrum Juelich GmbH); BESSLER, Yannick; Prof. BUTZECK, Michael (Forschungzentrum Jülich); Mr HELDMANN, Patrik (Forschungzentrum Jülich); Mr KOENEN, Mario (Forschungzentrum Jülich); Dr HANSLICK, Romuald (Forschungzentrum Jülich); Mr POQUÉ, Andreas (Forschungzentrum Jülich)

Presenter: Dr LOHOFF, Robert (Forschungzentrum Jülich)

Session Classification: Poster

Track Classification: Target/Moderator

Contribution ID: **18** Type: **Oral Presentation**

A direct-geometry spectrometer at the China Spallation Neutron Source

Monday 14 October 2019 12:00 (25 minutes)

We'll report the design of a direct-geometry spectrometer at CSNS

Author: Dr TONG, Xin (China spallation neutron source)

Presenter: Dr TONG, Xin (China spallation neutron source)

Session Classification: Instruments

Track Classification: Instrument

Contribution ID: **19** Type: **Oral Presentation**

Sample environment at the CSNS

Thursday 17 October 2019 15:40 (20 minutes)

The progress in sample environment at the China Spallation Neutron Source (CSNS) is presented. During the past years, the Sample Environment group has made substantial efforts towards the procurement, design, development and maintenance of a series of sample environments for the three commissioning instruments. The equipment includes cryostats, an 3He insert, magnets, furnaces, continuously-loaded pressure cells, clamp cells, a gas handling panel, automatic sample changers, etc. Most are already available for users' experiments.

Authors: Mr HU, Haitao (Institute of High Energy Physics, CAS); Mr YUAN, Bao (Institute of High Energy Physics, CAS); Mr BAI, Bo (Institute of High Energy Physics, CAS); Dr LUO, Wanju (Institute of High Energy Physics, CAS); Mr HUANG, Zhiqiang (Institute of High Energy Physics, CAS); Prof. ZHANG, Shaoying (Institute of Physics, CAS); Dr YANG, Hua (Institute of High Energy Physics, CAS); Prof. TONG, Xin (Institute of High Energy Physics, CAS)

Presenter: Mr HU, Haitao (Institute of High Energy Physics, CAS)

Session Classification: Instruments

Track Classification: Instrument

Contribution ID: **20** Type: **Poster**

Current Status of AMATERAS - a Cold-Neutron Disk-Chopper Spectrometer -

Wednesday 16 October 2019 13:00 (2 hours)

AMATERAS is a cold-neutron disk-chopper spectrometer installed at BL14 port of the Materials & Life Science Experimental Facility (MLF) at J-PARC [1]. AMATERAS is designed to carry out inelastic and quasielastic neutron scattering experiments in the range from cold to sub-thermal neutron energy with high intensity and fine and flexible energy resolution.

AMATERAS started its operation from May 2009 and was opened for the user program from December 2009. Up to now, experiments of more than 160 proposals have been carried out, which resulted in more than 50 papers, 15 theses and 11 press releases. Along with performing a user program, we are continually maintaining and improving the performance of the spectrometer. During the operation, we had have number of technical problems, which we have overcome or are trying to do so.

In this presentation, based on our experience of 10 years of operation of the spectrometer, we will show the current status, issues and future plans of AMATERAS.

[1] K. Nakajima, S. Ohira-Kawamura, T. Kikuchi, M. Nakamura, R. Kajimoto, Y. Inamura, N. Takahashi, K. Aizawa, K. Suzuya, K. Shibata, T. Nakatani, K. Soyama, R. Maruyama, H. Tanaka, W. Kambara, T. Iwahashi, Y. Itoh, T. Osakabe, S. Wakimoto, K. Kakurai, F. Maekawa, M. Harada, K. Oikawa, R. E. Lechner, F. Mezei, and M. Arai, J. Phys. Soc. Jpn. 80, SB028 (2011).

Authors: NAKAJIMA, Kenji (J-PARC Center); Dr OHIRA-KAWAMURA, Seiko (J-PARC Center); Dr KOFU, Maiko (J-PARC Center); Dr MURAI, Naoki (J-PARC Center); Dr INAMURA, Yasuhiro (J-PARC Center); Dr KIKUCHI, Tatsuya (Sumitomo Rubber Industries, Ltd.); Mr WAKAI, Daisuke (Nippon Advanced Technology Co., Ltd.)

Presenter: NAKAJIMA, Kenji (J-PARC Center)

Session Classification: Poster

Contribution ID: **21** Type: **Oral Presentation**

Recent progress of the new spectrometer in MLF, POLANO

POLANO is the chopper type spectrometer with a polarization analysis capability in the Materials and Life Science Experimental Facility (MLF), J-PARC. After several years spending for designing, manufacturing and construction of the spectrometer, we finally commenced the beam commissioning and a part of user program with unpolarized neutron beam condition. With using neutron beam, its intensity, divergence of the neutron beam, time-of-flight beam profiles and direct imaging were measured. Since POLANO is targeting high-energy polarization experiment, all those components are designed as optimizing for 100 meV of neutron energy. In particular, 4 Qc converging super mirror guide tube can effectively transport such a relatively high energy neutrons to the sample position. Also, we are making our efforts to eliminate unintended contaminations (backgrounds). As mentioned above, POLANO principal concept is to achieve higher-energy polarization analysis of inelastic scattering beyond a reactor-based neutron source. We target the energy range (transfer energy) over dE = 40 meV with using SEOP for a polarizer and bender supermirror as an analyzer (phase I). We are now working on developing *in situ* SEOP system, achieve 70~75 % of 3He spin polarization. Also, magnetic devices and system are under development. Recently, both SEOP system and magnetic systems will be installed in the beam line, and will start polarization beam commissioning. In the second phase, we focus on higher energy experiments (0 meV < dE < 100 meV) with a wide solid angle SEOP/MEOP analyzer. In order to achieve a high flux polarized neutron experiment, we plan to adopt cross correlation method. R&D of the correlation chopper is now under way.

Author: Prof. TETSUYA, Yokoo (J-PARC)

Co-authors: Dr IKEDA, Yoichi (Tohoku Univ); Prof. ITOH, Shinichi (J-PARC); Prof. FUJITA, Masaki (Tohoku Univ); Mr KANEKO, Naokatsu (J-PARC); Mr OHKAWARA, Manabu (Tohoku Univ); Dr INO, Takashi (J-PARC); Mr HAYASHI, Kouhei (J-PARC)

Presenter: Prof. TETSUYA, Yokoo (J-PARC)

Session Classification: Instruments

Track Classification: Instrument

Contribution ID: **22** Type: **Poster**

FAST COOLING FURNACE PROJECT.

Monday 14 October 2019 16:30 (2 hours)

With improved data collection times due to improved detectors and neutron guides, and the increase in flux at new facilities under construction such as the European Spallation Source. There is a need to develop ways to increase the efficiency of sample environment equipment. As part of the SINE 2020 joint European project a task has been under taken to speed up furnace cooling times reducing them from hours to minutes, making high temperature neutron experiments more efficient. This will prove to be an essential piece of equipment for facilities like the European Spallation Source for the future as well as improve efficiency at existing neutron facilities. This poster explains the test, design and development procedure undertaken to deliver this task as well as the efficiencies it can deliver. With the addition of automation this modification to existing beam line furnaces will provide an efficient user friendly system.

Author: Mr GOODWAY, Chris (STFC)

Co-authors: Mr SEARS, Adam (STFC); Mr MCINTYRE, Paul (STFC); Mr BURGESS, Graham (STFC); Dr KIRICHEK, Oleg (STFC); Mr WAKEFIELD, Steve (STFC); Dr LELIÈVRE-BERNA, Eddie (Institute Laue-Langevin)

Presenter: Mr GOODWAY, Chris (STFC)

Session Classification: Poster

Contribution ID: **23** Type: **Poster**

Low background materials for high pressure cells used in inelastic neutron scattering experiments.

Wednesday 16 October 2019 13:00 (2 hours)

The signal-to-noise ratio is the ultimate limiting factor for high pressure neutron scattering experiments where sample environment equipment could create significant background signal which in many cases may significantly exceed the signal from the sample itself. This is the particularly serious issue in case of high-pressure sample environment for inelastic neutron scattering. Here we review materials which could be used for development of new generation of high-pressure cells for inelastic and quasi-elastic neutron scattering experiments. This results will allow designing and producing high pressure vessels with parameters desired for particular neutron scattering experiment.

Authors: Mr GOODWAY, Chris (STFC); Mr KIBBLE, Mark (STFC); Dr KIRICHEK, Oleg (STFC)

Co-authors: Dr LELIÈVRE-BERNA, Eddie (Institut Laue-Langevin); Dr KAMENEV, Konstantin (University of Edinburgh); Dr LALIENA, Victor (Instituto de Ciencia de Materiales de Aragón (ICMA)); Dr KLOTZ, Stefan (Sorbonne Université)

Presenters: Mr GOODWAY, Chris (STFC); Dr KIRICHEK, Oleg (STFC)

Session Classification: Poster

Contribution ID: **24** Type: **Oral Presentation**

Current Status and Science in J-PARC MLF

Wednesday 16 October 2019 09:00 (25 minutes)

Materials and Life Science Experimental Facility (MLF) at J-PARC (Japan Proton Accelerator Research Complex) is an accelerator-based neutron and muon experimental facility [1]. The facility is now operating very stably at a power of 540 kW. In the neutron facility there are 23 beam holes and 21 instruments are under operation for user program. In the muon facility we have 4 beam lines and now 2 beam lines are used for user program. Operation days in a year is about 180 days and more than 1100 users are performing experiments in our facilities. Using the neutron and muon facilities we together with worldwide users are intensively investigating molecular/atomic level structure and dynamics for various kinds of materials including Li ion battery, fuel cells, soft materials including polymers, biological materials, magnetic and strongly correlated electron systems, engineering materials, heritage materials.
In the presentation we will introduce the current status of our facility and our recent excellent outcomes, including battery research, high pressure science, and soft and hard material science.
References
[1] https://j-parc.jp/c/en/index.html

Author: Prof. KANAYA, Toshiji (J-PARC)

Presenter: Prof. KANAYA, Toshiji (J-PARC)

Session Classification: Plenary

Track Classification: Facility Update

Contribution ID: **25** Type: **Poster**

Cryogenic Sample Environment & Helium Recovery at ISIS

Thursday 17 October 2019 16:30 (2 hours)

Cryogenic Sample Environment & Helium Recovery at ISIS

M. Baston, D. Keeping, M. Devonport, J. Timms, R. Major, D. Bunce, C. Lawson, P. Frodsham, J. Keeping, **R B E Down**, O Kirichek

ISIS Facility, STFC, Rutherford Appleton Laboratory, Harwell Science and Innovation Campus, Didcot, UK

The ISIS Experimental Operations Division (IEOD) Cryogenics team has a large equipment base. This includes a large number of helium based cryostats providing low, ultra-low temperature and high magnetic fields. The facility also offers many Gifford McMahon and Pulse Tube based closed cycle refrigerator (CCR) systems. These include 4K bottom and top-loading dry cryostats and the top loading ISISSTAT which is capable of a sustained operation at 1.8K with a cooling power of 240mW. Systems are optimized for the user by using thinned windows and can offer a range of temperatures between 0.03 and 700 Kelvin for sample environment.

IEOD Cryogenics currently offer several superconducting magnets that include both conventional and zero cryogen boil-off systems. Zero boil off is achieved by the re-condensation of helium by a Pulse Tube Refrigerator CCR. The systems include a wide angle chopper magnet for spectrometry, a 3D vector magnet and a 14T magnet for diffraction measurements.

IEOD Cryogenics offers the User a number of Ø50mm low temperature inserts. These include sorption and dilution refrigerator systems which can be used with standard variable temperature inserts of cryostats or superconducting magnets. It also offers a powerful cryogen-free dilution refrigerator and magnet system for neutron scattering experiments; that is capable of cooling large and heavy samples. These parameters can be crucial for a number of neutron experiments that require a combination of extreme conditions like high pressure, high magnetic field or large sample size.

The IEOD Cryogenics Team also support the Helium Recovery infrastructure that is newly introduced to the facility, Helium recovery operations and future challenges will also be presented.

Author: Mr DOWN, Richard (STFC)

Presenter: Mr DOWN, Richard (STFC)

Session Classification: Poster

Contribution ID: **26** Type: **Poster**

Suite of the Neutron Spectrometers in J-PARC MLF

Thursday 17 October 2019 16:30 (2 hours)

Dynamical properties in materials are of great importance in the field of neutron scattering. There are 6 inelastic scattering neutron beamlines in the Materials and Life Science Facility (MLF) in the Japan Proton Accelerator Research Complex (J-PARC), covering a wide dynamic range from 10^{-4} meV to 10^{3} meV [1,2]. A high energy part above sub-meV is covered by 4 direct-geometry spectrometers: HRC, AMATERAS, 4SEASONS, and POLANO, while μeV and sub-μeV dynamics are covered by an indirect-geometry spectrometer DNA and the spin echo instrument suite VIN ROSE, respectively. HRC is a high-energy and high-resolution Fermi chopper spectrometer. It can reach the highest energy in the MLF spectrometers, and is equipped with the neutron Brillouin scattering option. The disk chopper spectrometer AMATERAS is a powerful instrument with cold neutrons, and is capable of controlling pulse shapes by a combination of multi disk choppers. 4SEASONS is another Fermi chopper spectrometer, and is designed to provide high flux with middle energy resolution with thermal neutrons. POLANO is a Fermi chopper spectrometer particularly designed for neutron polarization analysis. It started user programs with non-polarized beams quite recently, and the final goal is to achieve polarized neutron experiments with high energies over 100 meV. DNA is a near-back scattering crystal analyzer spectrometer. It can achieve high resolutions with a pulse-shaping chopper. VIN ROSE consists of two spin-echo instruments, NRSE and MIEZE. The former is suitable for studying the slow dynamics of soft condensed matter with high energy resolution, while the latter offers the advantage of flexible sample environments. VIN ROSE started user program recently with the MIEZE instrument. The suite of these 6 spectrometers in MLF now contributes the scientific research activities, and produced scientific outcomes in a diverse research fields such as superconductivities, quantum spin systems, energy materials, amorphous materials, liquids, and soft and biological matters. In this presentation, we review the major specifications, recent upgrades, and outcomes of the MLF neutron spectrometers.

References

[1] H. Seto et al., Biochim. Biophys. Acta, Gen. Subj. **1861**, 3651 (2017).
[2] R. Kajimoto et al., Physica B **562**, 148 (2019).

Authors: KAJIMOTO, Ryoichi (J-PARC); YOKOO, Tetsuya (KEK/J-PARC); NAKAMURA, Mitsutaka (J-PARC); KAWAKITA, Yukinobu (J-PARC); MATSUURA, Masato (CROSS); ENDO, Hitoshi (KEK/J-PARC); SETO, Hideki (KEK/J-PARC); ITOH, Shinichi (KEK/J-PARC); NAKAJIMA, Kenji (J--PARC); OHIRA-KAWAMURA, Seiko (J-PARC)

Presenter: KAJIMOTO, Ryoichi (J-PARC)

Session Classification: Poster

Contribution ID: **27** Type: **Poster**

Status of the Time-of-Flight Direct-Geometry Spectrometer 4SEASONS

Thursday 17 October 2019 16:30 (2 hours)

4SEASONS, also called SIKI, is a time-of-flight direct geometry spectrometer in the Materials and Life Science Experimental Facility (MLF) at the Japan Proton Accelerator Research Complex (J-PARC). It is designed for measurements of dynamics in the 10^0-10^2 meV energy range [1]. The momentum-energy region for this spectrometer occupies the middle of the momentum-energy space covered by all MLF neutron spectrometers [2]. Although the instrument has been conducting user programs for about 10 years, the upgrade of the instrument is continuously progressed. Examples of the recent upgrades are: Replacement of the most end part of the neutron guide tube, increase in the number of detectors, update to use a superconducting magnet, and replacement of the T0 chopper. In the presentation, we will show the specifications of the instrument, usage statistics, and recent examples of scientific outputs and instrument upgrades.

References

[1] R. Kajimoto et al., J. Phys. Soc. Jpn. **80**, SB025 (2011).

[2] H. Seto et al., BBA Gen. Subj. **1861**, 3651 (2017); R. Kajimoto et al., Physica B **562**, 148 (2019).

Authors: KAJIMOTO, Ryoichi (J-PARC); NAKAMURA, Mitsutaka (J-PARC); KAMAZAWA, Kazuya (CROSS); INAMURA, Yasuhiro (J-PARC); IKEUCHI, Kazuhiko (CROSS); IIDA, Kazuki (CROSS); ISHIKADO, Motoyuki (CROSS)

Presenter: KAJIMOTO, Ryoichi (J-PARC)

Session Classification: Poster

Contribution ID: **28** Type: **Oral Presentation**

Microscopic samples and high precision: challenges and solutions at the ESS

Thursday 17 October 2019 15:20 (20 minutes)

High-pressure science at the current generation of powerful spallation sources has provided a strong impetus towards increasingly tiny sample sizes. For example, high-pressure diffraction on the SNAP beamline at the SNS routinely employs samples with diameters of 500 μm or less [1]. Furthermore, as these small samples are necessarily contained within relatively massive vessels, stringent requirements are imposed on the relative alignment between beam, sample and sample-environment in order to minimize background scatter.

At the ESS, this trend towards smaller samples and higher alignment precision is only expected to increase. With over 50% of ESS instruments anticipating sub-millimeter sample sizes, the need for high-precision sample alignment will go far beyond high-pressure experiments. To address this need, the ESS sample-environment team has invested in developing a high-precision mounting standard for all ESS instruments. This system, based on principles of kinematic coupling [2], aims to define universal sample coordinates common to all ESS instruments. This approach will allow rapid sample-environment equipment exchange either on a single instrument or even between different instruments while minimizing the need for realignment.

In parallel, the ESS team has developed beam-scanning techniques that allow fast, energy-resolved spatial measurement of the neutron beam. By exploiting the reproducibility of the kinematic-mounting standard, absolute spatial information of the beam can be transferred to an offline station to facilitate pre-alignment of both sample and collimation. Moreover, by scanning the beam at multiple positions along its length, focal points and the (energy-dependent) divergence can be directly measured. This information is invaluable in designing next-generation beam collimation, that is perfectly matched to beam characteristics.

[1] S. Calder et al. Rev. Sci. Inst. 89 (9) (2018).
[2] A. Slocum Int. J. Mach. Tools & Man. 50.2 (2010).

Authors: GUTHRIE, malcolm (European Spallation Source, ERIC); Mr SAXTRUP, Lauritz; Mr PETTERSSON, Anders (ESS); Dr HIESS, Arno (ESS)

Presenter: GUTHRIE, malcolm (European Spallation Source, ERIC)

Session Classification: Instruments

Track Classification: Instrument

Contribution ID: **29** Type: **Poster**

Radiation chemistry of solid methane moderators

Thursday 17 October 2019 16:30 (2 hours)

Developing an understanding of the effects of neutron radiation in solid methane is of key importance for operations at spallation neutron sources. Solid methane is an excellent moderator material, efficiently enabling the conversion of hot neutrons into cold. However the use of solid methane moderators has so far proven challenging, due to the 'burp'effect [1]. Radiolysis products build up in the frozen methane, until a critical concentration of radicals is reached –after this point spontaneous, exothermic radical recombination reactions occur, causing an uncontrolled spike in temperature and pressure.

A side effect of this phenomenon is the accumulation of progressively larger hydrocarbon molecules in the moderator. The radical recombination reactions which cause 'burping'also produce hydrocarbons containing two or more carbon atoms. With continued moderator use these build up, and carbon chain length increases, until eventually a thin coating of heavy hydrocarbons is formed on the inner surface of the moderator's heat exchanger. The heat transfer capability of the moderator gradually worsens until the process is so inefficient as to make continued use of the moderator at low temperature impossible.

In this poster we outline key reaction pathways which lead to the build-up of heavy hydrocarbons in methane moderators. We present our strategies for chemical analysis of solid methane radiolysis products, and suggestions for moderator life extension.

[1] J. M. Carpenter, Nature, 330, 358 (1987)

Authors: Ms DRAPER, Gemma L (ISIS, STFC, UKRI); Dr KIRICHEK, Oleg (ISIS, STFC, UKRI); Dr LAWSON, Christopher R (ISIS, STFC, UKRI); Mr JENKINS, David (ISIS, STFC, UKRI); Mr HAYNES, David (ISIS, STFC, UKRI); Mr LILLEY, Steven (ISIS, STFC, UKRI)

Presenter: Ms DRAPER, Gemma L (ISIS, STFC, UKRI)

Session Classification: Poster

Track Classification: Target/Moderator

Contribution ID: **30** Type: **Poster**

Solid methane in radiation: Thermodynamic simulation using Arrhenius equations

Monday 14 October 2019 16:30 (2 hours)

The effects of radiation damage in methane are of great interest to both the spallation neutron source and astrophysics communities. Solid methane is by far the most efficient medium to use in neutron source moderators, taking energy from hot neutrons produced by the target at a rate 3.5 times that of hydrogen moderators. However the practical use of such moderators has been much more challenging than first expected, due to the production of radiation defects which, at some critical number, lead to a spontaneous self-accelerated recombination process, the 'burp'effect [1].

Here we present a thermodynamic simulation of the ISIS Neutron and Muon Source's solid methane moderator, which shows good agreement with moderator test data. Our model aims to include as many known values as possible, in order to provide a realistic view of moderator performance. It is hoped that by using our model as an investigative tool, we will be able to mitigate the 'burp' phenomenon in the ISIS moderators, thus increasing the instrument uptime and measurement stability.

[1] J. M. Carpenter, Nature, 330, 358 (1987)

Authors: Dr LAWSON, Christopher R (ISIS, STFC, UKRI); Dr KIRICHEK, Oleg; Ms DRAPER, Gemma L; Dr RIDLEY, Christopher; Mr JENKINS, David; Mr HAYNES, David; Mr LILLEY, Steven

Presenter: Dr LAWSON, Christopher R (ISIS, STFC, UKRI)

Session Classification: Poster

Track Classification: Target/Moderator

Contribution ID: **31** Type: **Poster**

ULTRA-LOW TEMPERATURE SAMPLE ENVIRONMENT AT THE ISIS NEUTRON AND MUON SOURCE

Monday 14 October 2019 16:30 (2 hours)

In the past few years, the ISIS Neutron and Muon source has seen an unprecedented increase in the number, and complexity, of ultra-low temperature experiments being performed. We fully expect this trend to continue as more and more extreme sample environment requirements are realized.

To meet this high demand for complex sample environments, a rigorous system of maintenance, performance monitoring and system upgrading has been implemented, resulting in an extremely high experiment completion rate.

We will begin with an introduction to our most used ultra-low temperature equipment, including dilution fridges and 3He systems. We will then describe how the intensity of the experimental cycles has led to interesting, and sometimes unforeseen, challenges and how we have overcome these. Finally, we will present some recent experimental highlights with our most unusual samples, before finishing with our vision of the future.

Authors: Dr LAWSON, Christopher R (ISIS, STFC, UKRI); Mr DOWN, Richard (ISIS, STFC, UKRI); Dr KIRICHEK, Oleg (ISIS, STFC, UKRI)

Presenter: Dr LAWSON, Christopher R (ISIS, STFC, UKRI)

Session Classification: Poster

Contribution ID: **32** Type: **Oral Presentation**

Super-resolution Inversion in Neutron Direct Geometry Time-of-flight Spectroscopy

Thursday 17 October 2019 15:20 (25 minutes)

Neutron spectroscopy is a tool of choice for studying exotic magnetic and vibrational excitations in solids. Direct Geometry Spectrometers (DGS) at Spallation sources allow the collection of massive datasets, but the excitations are obscured by asymmetric instrument broadening that varies in the dynamic range of measurement. Clearly resolving fine features in the excitation spectra of novel materials is a long-standing challenge that pushes the limit of DGS. Super-resolution (SR) techniques have revolutionized scientific fields such as fluorescence microscopy and biology, and new SR techniques continue to be invented for microscopy. More generally, sub-pixel enhancements in optical imagery for real-space observation are making significant contributions to science. In this presentation, we will discuss two super-resolution techniques for DGS spectroscopy. Multi-frame super-resolution imagery principles and techniques were found applicable to DGS data as each pixel in the detector system provides complementary information. Such a SR reconstruction workflow involves (1) resolution calculation based on Monte Carlo neutron ray-tracing; (2) modeling of the resolution function using a revised Ikeda-Carpenter formula; (3) iterative reconstruction. This work shows enhancements in the phonon density of states for graphite samples generated from measurements on the ARCS instrument. The second technique was inspired by image correlation techniques from satellite imagery. Spin-wave models can be constrained by 4-dimensional single crystal neutron scattering datasets measured at DGS instruments. Optimization procedures that account for instrument broadening, however, are computationally intensive and time-consuming. In this work a procedure leveraging image correlation techniques was demonstrated to greatly simplify and speed up the refinement of a spin-wave model based on datasets measured at the SEQUOIA and CNCS instruments.

Authors: LIN, Jiao (Oak Ridge National Lab); ISLAM, Fahima; ARCHIBALD, Rick (Oak Ridge National Lab); ABERNATHY, Doug (Oak Ridge National Laboratory); AL-QASIR, Iyad (University of sharjah); SALA, Gabriele (Neutron Scattering, Spectroscopy Division); STONE, Matthew (Oak Ridge National Laboratory); CAMPBELL, Anne (Oak Ridge National Laboratory); GRANROTH, Garrett (Oak Ridge National Laboratory)

Presenter: LIN, Jiao (Oak Ridge National Lab)

Session Classification: Software

Track Classification: Software

Contribution ID: **33** Type: **Oral Presentation**

Challenges for Grazing Incidence Neutron Scattering at Pulsed Sources: Beyond basic experiments and data analysis

Monday 14 October 2019 14:30 (25 minutes)

Conventional analysis of reflectometry data provides only structural parameters via fitting model to the data. Can we obtain access to the interaction parameters causing this structure? To realize this one needs a different approach to the data analysis, that includes development of computational workflow capable of generating theoretical models in quantitative agreement with the data. Grazing Incidence Neutron Scattering experiments simultaneously measure specular reflection, off-specular scattering (OSS) and grazing incidence small angle scattering (GISANS) and deliver the most exhaustive and detailed information on the 3-dimensional structure of thin films and hidden interfaces on enormous length scale.
At present, most of published data in reflectometry are obtained with specular reflectivity, from which the structural information perpendicular to the sample surface is obtained along the Qz component of the wave vector transfer. However, functionality often arises at the mesoscale, where defects, interfaces, and non-equilibrium structures are formed [1], which cannot be resolved only by specular reflectivity alone.
Spallation neutron sources deliver outstanding experimental conditions to perform simultaneously a combined measurement of specular reflection, OSS and GISANS using time-of-flight (TOF) [2]. GINS pilot experiments performed at the SNS on the Magnetism Reflectometer [2] on a multilayer heterostructure of magnetic nanoparticles self-assembled in a block-copolymer matrix will be presented.

Thus, a combination of GINS experiments with the computational workflow capable of generating theoretical models in quantitative agreement with experimental data establishes a direct and precise correlation between local interfacial characteristics and global physical properties. The first results on the implementation of a computational workflow integrating high performance computing (HPC) with GINS experiment via an intuitive, cross-platform user interface is being developed at SNS/ORNL and will be presented [3].

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[2] V. Lauter, H.J.C. Lauter, A. Glavic, B. Toperverg, book chapter in Reference Module Material Science Elsevier, 2016
[3] Mahalik J.P., Dugger J.W., Sides S.W., Sumpter B.G., Lauter V.V., Kumar R., "Interpreting Neutron Reflectivity Profiles of Diblock Copolymer Nanocomposite Thin Films Using Hybrid Particle-Field Simulations", Macromolecules, 51, 8, 3116–3125 (2018)

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Presenter: Dr LAUTER, Valeria (Neutron scattering Division, Oak Ridge National Laboratory)

Session Classification: Software

Track Classification: Software

Contribution ID: **34** Type: **Poster**

Recent developments of MCViNE and its applications at SNS

Monday 14 October 2019 16:30 (2 hours)

MCViNE (Monte-Carlo VIrtual Neutron Experiment) is an open-source Monte Carlo (MC) neutron ray-tracing software developed using C++ and Python. Its object-oriented design allows for flexible, hierarchical representations of sophisticated instrument components such as detector systems, and samples with shapes and scattering kernels of various sorts. Recently this flexible design has enabled several applications of MCViNE simulations at the Spallation Neutron Source (SNS) at Oak Ridge National Lab. MCViNE was found useful in assisting design of neutron instruments at the second target station (STS) such as CHESS, a direct-geometry spectrometer (DGS), and QIKR, a reflectometer. MCViNE was used in studying effects of instrument resolution function in powder and single crystal datasets measured by DGS instruments. MCViNE also helped design of novel sample environments, such as collimators (some were 3D printed) and high-pressure cells.

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Presenter: LIN, Jiao (Oak Ridge National Lab)

Session Classification: Poster

Track Classification: Software

Contribution ID: **35** Type: **Oral Presentation**

Engineering and Prototyping of ESS Neutron Beam Extraction System

Thursday 17 October 2019 11:00 (25 minutes)

In the development of the European Spallation Source, the engineering phase of the Neutron Beam Extraction System is approaching its end. Currently prototyping is ongoing to verify and increase the understanding of the manufacturing limitations in relation to the engineering aspects and beam extraction requirements from the instruments before the manufacturing of the suite of 16 neutron beam port inserts (NBPI) and light shutter systems (LSS) are phased into final detail design and manufacturing.
The NBPIs have been developed as a close collaboration between ESS' instruments design coordinators and intricately integrate a set of copper optics within a controlled atmosphere within the target monolith pressure vessel. The NBPIs therefore includes not only a processed atmosphere but also enables fine alignment of the optics assemblies within it, but also includes a system for inserting it into a very precisely aligned and measured position.
Outside of to the NBPIs, along the neutron beam paths, sits the Neutron Beam Windows and sequentially the LSS which incorporates an optical bridge beam guide before the beam enters the bunker area and the individual instrument beam transports.
ESS have chosen the concept of LSS, which generates very demanding requirements for alignment of moving shutter parts, these system parts are placed in the bunker area and bunker basement, areas that are partly accessible during maintenance periods.

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Presenter: LYNGH, Daniel

Session Classification: Instruments

Track Classification: Instrument

Contribution ID: **36** Type: **Oral Presentation**

Spallation Neutron Source (SNS) 2 MW Target Life Analysis

Monday 14 October 2019 10:45 (25 minutes)

The Spallation Neutron Source (SNS) at Oak Ridge National Laboratory has a Proton Power Upgrade (PPU) program underway to update the proton beam energy from 1.0 to 1.3 GeV and the power on target from 1.4MW to 2MW at the First Target Station (FTS). A critical requirement of this program is the design and operation of a 2MW target with a life of 1250 hours (4 targets per year), however, less targets per year is desirable. The approximately 40% increase in power translates to a similar increase in the pressure pulse created from the proton energy deposition into the target. The FTS target is composed of a 316L stainless-steel target mercury vessel (with liquid mercury flowing though it) and a water shroud that surrounds the mercury vessel, which is primarily for secondary containment of the mercury. The two primary failure modes for the target are erosion and/or local failure from cavitation damage and high-cycle fatigue (HCF) damage in the mercury vessel.
Several design and manufacturing techniques are used to mitigate these failure modes in the mercury vessel, such as local geometry optimization, near mirror-finish surfaces, and Kolsterising® (a manufacturing technique for increasing surface hardness of stainless steel). Nevertheless, a reduction of the loading itself is needed to achieve the 2MW target design life (or better) and this is currently aided by gas injection for 1.4 MW targets. Gas injection introduces small helium bubbles into the mercury flow to reduce the pressure pulse induced by the proton beam and to reduce cavitation. All these techniques help to improve the fatigue life of the target mercury vessel.
To assess the fatigue life of the mercury vessel, a reasonably realistic simulation of the pulse effect on the target is required. This is achieved through an explicit transient-dynamic simulation that includes the initial pressure mapped from the pulse energy deposition and a tensile failure condition to represent the cavitation behavior in the mercury. The resulting stress history is then used to perform global analysis of the parent material fatigue life or a local weld joint analysis. In this presentation, an iterative design-analysis process is described to optimize local geometry in the front of the target, as well as a sub-modeling technique used for a more intricate gas injection bubbler design, which is subjected to more pulse load than in previous targets. Furthermore, the limitations of this process are discussed along with development plans to improve target life analysis for PPU and future target designs at SNS.

Author: MACH, Justin (ORNL)

Presenter: MACH, Justin (ORNL)

Session Classification: Target

Track Classification: Target/Moderator

Contribution ID: **37** Type: **Oral Presentation**

Measurements of the Effectiveness of Gas Injection on Reliability of Liquid Metal Spallation Targets

Monday 14 October 2019 11:10 (25 minutes)

The Spallation Neutron Source (SNS) at the Oak Ridge National Laboratory produces intense pulses of neutrons for scientific experiments. The neutrons are produced 60 times a second as 0.7 microsecond long pulses of protons traveling at 1.0 GeV and carrying an energy of 23.3 kJ strike target. The elemental mercury target material produces neutrons through spallation reactions. The mercury flows through the system for heat removal. The part where the proton beam interacts with the mercury is called the target module. The target module is a replaceable 316L stainless-steel weldment. The intense loading from these pulses has been the cause of several unplanned replacements of target modules during the life of the facility, which requires stopping neutron production for the entire SNS for approximately two weeks. Such outages have a very negative impact on facility reliability and scientific productivity.
In October 2017, the SNS operated its first target module with intentional helium gas injection into the flowing mercury. This technique, first used in operation at the Materials and Life Facility at J-PARC, reduces the fatigue and cavitation damage from the pulse pressure wave. Since that first target, the SNS has operated four additional targets with varying levels of gas injection, and with three variations in internal target geometry. Each target module was instrumented with a suite of strain gauges to measure the effectiveness of the gas injection. In addition, three of the target modules have had samples removed from the beam entrance area. These samples have been scanned to measure the depth of cavitation erosion on their surfaces.
Gas injection has been a significant leap forward for SNS target reliability. Observations have shown that the mitigating effect of gas injection on target module strain varies spatially as well as with different amounts of injected helium gas. The observations from strain measurements will be presented along with hypotheses for the observed variations and the possible implications on future designs. Data from cavitation erosion measurements will be used to present evidence of the quantitative effect of erosion reduction. Future work will be discussed.

Authors: WINDER, Drew (ORNL); BLOKLAND, Willem (ORNL); Dr LIU, Yun (ORNL); MCCLINTOCK, David (Oak Ridge National Laboratory); BARBIER, Charlotte (ORNL); MACH, Justin (ORNL)

Presenter: WINDER, Drew (ORNL)

Session Classification: Target

Track Classification: Target/Moderator

Contribution ID: **38** Type: **Oral Presentation**

Developing position sensitive polarization analysis method for time-of-flight neutron

Tuesday 15 October 2019 14:30 (25 minutes)

Polarized neutron analysis has been widely applied to position sensitive experiment method, such as small angle neutron scattering

1. T. Wang, C. Y. Jiang, T. O. Farmer, L. Debeer-Schmitt, J. F. Wenzel, L. McDonald, J. L. Robertson, M. R. Fitzsimmsons, and X. Tong, Physica B 551, 492 (2018).

(SANS), neutron imaging

1. I. Dhiman, R. Ziesche, T. H. Wang, H. Bilheux, L. Santodonato, X. Tong, C. Y. Jiang, I. Manke, W. Treimer, T. Chatterji, and N. Kardjilov, Rev Sci Instrum 88 (9) (2017).

and neutron reflectometry

1. X. Tong, C. Y. Jiang, V. Lauter, H. Ambaye, D. Brown, L. Crow, T. R. Gentile, R. Goyette, W. T. Lee, A. Parizzi, and J. L. Robertson, Rev Sci Instrum 83 (7) (2012).

. However, current applications either limit the energy analysis to single wavelength or forgo complex neutron polarization manipulation. In this talk, we present our plan and effort to develop an integrated polarized neutron beamline that combines complex neutron polarization manipulation with time-of-flight neutron. The proposed beamline shall take advantage of the wavelength resolving nature of time-flight-neutron to better analysis the evolution of neutron polarization under external magnetic field, distinguishing neutron polarization shift caused by precession, depolarization and wavelength dispersion. The talk will introduce theoretical concept of the proposed beamline and set up as well as the development of such configuration on BL-20 at the China Spallation Neutron Source.

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Co-authors: Dr XIN, Tong (China Spallation Neutron Source); BUCK, Zachary (China Spallation Neutron Source)

Presenter: WANG, Tianhao (China Spallation Neutron Source)

Session Classification: Instruments

Track Classification: Instrument

Contribution ID: **39** Type: **Poster**

MIRACLES, the TOF-backscattering instrument at the European Spallation Source

MIRACLES will be the neutron time-of-flight backscattering spectrometer at the European Spallation Source in Lund, Sweden.[1] This high-resolution spectrometer will display a best energy resolution of δ(~2.5 μeV can be easily tuned to match the observation time of the system under study. Moreover, a unique dynamic range covering an energy transfer for quasielastic neutron scattering (QENS) measurements of E ~ ±500 μeV is anticipated. Finally, the flexibility to select the incident energy within a wide range will allow to carry out inelastic neutron scattering (INS) spectra of about 20 meV.

`The instrument design has been subjected to significant modifications in the conceptual design`

[1] N. Tsapatsaris et al, Rev. Sci. Instrum. 87 (8), 085118 (2016).
[2] P. Luna, et al. Physica B 564 64–68 (2019); P. Luna et al. (in preparation).

Authors: Mrs LUNA, Paula (Consorcio ESS-Bilbao); SORDO, Fernando (Consorcio ESS-Bilbao); VILLACORTA, Felix (ESS-Bilbao); Prof. NUNES BORDALLO, Heloisa (Niels Bohr Institute-University of Copenhagen.)

Presenter: Mrs LUNA, Paula (Consorcio ESS-Bilbao)

Session Classification: Instruments

Track Classification: Instrument

Contribution ID: **40** Type: **Poster**

Moderator development at ISIS

Wednesday 16 October 2019 13:00 (2 hours)

Moderators are an essential part of neutron scattering facilities and there is an on going search for new moderator materials, new moderator designs and longer lived efficient moderators suitable for high power spallation facilities. ISIS has several moderators including light water, liquid Hydrogen, liquid Methane and solid Methane. Moderator development at ISIS is a mix of long term research into new moderator materials or designs and improvements to the current suite of moderators.
A recent focus of moderator development at ISIS has been the ortho-para concentration in the hydrogen moderators [1] and gaining a deeper understanding of the catalyst [2] by using the ISIS suite of neutron instruments.
Another strand to the moderator research has been the development of our capability to measurement cross sections and vibrational density of states at ISIS in order to produce scattering kernels for potential new moderator materials such as TPM [3]. This work has been done in collaboration with other institutes such as CNEA Bariloche.
Another recent aspect has been the testing of the ISIS Target Station 1 Methane moderator at 100k rather than 110k to compare with scattering kernels at different temperatures on both a new and old methane moderator. The aim here is to provide data for the Target Station 1 Project to evaluate the performance of a new Methane moderator once it is installed in 2021.
The improvements to current moderators include both neutronics improvements such as optimising the ISIS Target Station 2 Hydrogen moderator and engineering improvements such as the use of improved welding techniques for the encapsulation of the Gd poison foils.
Future plans include further moderator material testing, developing a PIE program for moderators and developing a robust monitoring system to examine the health of the moderators in service.
This paper gives a broad overview of the ISIS moderator development activities in the last few years and a brief outline of future plans.

References:

1. G Romanelli, et al, Measurement of the para-hydrogen concentration in the ISIS moderators using neutron transmission and thermal conductivity, NIMA, Volume 888, 2018, Pages 88-95, ISSN 0168-9002, https://doi.org/10.1016/j.nima.2018.01.039
2. G Romanelli, et al, J.Phys. Chem. C, 2019, 123, 18, 11745-11751 https://doi.org/10.1021/acs.jpcc.9b01858
3. Goran Škoro et al. Discovery of new neutron-moderating materials at ISIS Neutron and Muon Source, ND2019 conference proceedings in publication.

Authors: Mr LILLEY, Steven (ISIS); Dr SKORO, Goran (ISIS); Dr BEWLEY, Robert (ISIS); Mr JENKINS, David (ISIS); Dr ROMANELLI, Giovanni (ISIS); LANGRIDGE, Sean (ISIS); POOLEY, Daniel (ISIS)

Presenter: Mr LILLEY, Steven (ISIS)

Session Classification: Poster

Track Classification: Target/Moderator

Contribution ID: **41** Type: **Oral Presentation**

Detailed Supermirror physics in MCNP6

Thursday 17 October 2019 11:50 (25 minutes)

Neutron guide shielding is a complex problem that adds transmission through the guides via neutron mirrors to the traditional particle transport. The combination of these phenomena is rarely available in transport codes. PHITS started featuring neutron mirror starting with version 2.12, and F.X. Gallmeier implemented them in MCNPX in 2009. In this work, we have ported this physics into MCNP6 and greatly expanded its capabilities. The code now features event biasing for mirrors, with the possibility to split the particle into reflected and transmitted part. DXT spheres are also now compatible with these reflecting surfaces.

Furthermore, the latest development makes the neutron track follow a more realistic path in the mirror coating, including the walk into the Ni/Ti layers up to a depth dependant on its momentum transfer. This not only allows to more accurately represent the differences in reflectivity depending on wavelength, but it also provides a realistic gamma generation - A feature critical for shielding in beamlines, and not available, to the author's knowledge, in other transport codes-.

Authors: MAGÁN ROMERO, Miguel (ESS-Bilbao); Dr BERGMANN, Ryan M. (PSI)

Presenter: MAGÁN ROMERO, Miguel (ESS-Bilbao)

Session Classification: Software

Track Classification: Software

Contribution ID: **42** Type: **Oral Presentation**

Two Methods for Measuring Residual Strain in ISIS Target Plates

Wednesday 16 October 2019 10:45 (25 minutes)

Tantalum-clad tungsten targets are a popular choice for spallation neutron production, due to the combination of high neutron yield and corrosion resistance. Such targets typically use the Hot Isostatic Press (HIP) method to bond the cladding to the core; this produces a strong bond but also introduces large residual stresses in the target and cladding. This is a particular concern because cladding failures are currently believed to limit the lifetime of ISIS TS2 targets. Two different and complementary methods were used to measure the residual strain in a tantalum-clad tungsten strip manufactured using the same HIP process as ISIS targets. The strip was produced with deliberately asymmetric cladding, causing it to deflect in proportion to the residual stress. FEA simulations were used to back calculate the stress from the measured deflection. The strip was then placed on the ISIS instrument ENGIN-X, which allowed detailed through-thickness strain profiles to be measured via neutron diffraction. The results of both methods confirm the presence of large residual strains, and agree reasonably well with FEA simulations of the cladding process. Modern spallation facilities require higher beam powers and reduced cladding thicknesses, so understanding these residual stresses will become increasingly important to ensure target integrity.

Author: WILCOX, Dan (STFC)

Presenter: WILCOX, Dan (STFC)

Session Classification: Target

Track Classification: Target/Moderator

Contribution ID: **43** Type: **Poster**

Measurement and Simulation of Decay Heat in the ISIS TS1 Target

Thursday 17 October 2019 16:30 (2 hours)

Managing decay heat is an important safety concern for spallation facilities, but calculating the magnitude of decay heat relies on complex computer simulations which are difficult to validate. Of particular concern is the temperature rise due to decay heat in a loss-of-coolant accident (LOCA) scenario. Decay heats in an ISIS TS1 target were measured for cooling times between 1 minute and 2 weeks by switching off the cooling flow and measuring the temperature rises, essentially reproducing the first half hour of a cooling failure in a controlled way. The measurements, along with a simplified lumped thermal capacitance analysis, were recently published in two papers by D. Findlay et al. [1] [2]. The measured temperature rises were compared to simulations using a conjugate thermal-fluid model of the target in ANSYS CFX and decay heat values from the Monte Carlo code MCNPX. Simulations using this model produced a conservative but reasonably accurate estimate of temperature rise due to decay heat, as validated against the measured data. This is an important first step in establishing a reliable, experimentally validated approach for simulating temperatures in loss-of-coolant accident scenarios on this and other current and proposed spallation targets.

[1] D.J.S. Findlay et al., "Measurement and calculation of decay heat in ISIS spallation neutron target,"Nucl. Instr. Meth. A, vol. 908, pp. 91-96, 2018.

[2] G.M. Allen et al., "Decay heat in ISIS spallation neutron target as function of cooling time," Nucl. Instr. Meth. A, vol. 933, pp. 8-11, 2019.

Author: WILCOX, Dan (STFC)

Presenter: WILCOX, Dan (STFC)

Session Classification: Poster

Contribution ID: **44** Type: **Poster**

Shielding considerations for ESS LoKI

Wednesday 16 October 2019 13:00 (2 hours)

As an in kind contribution ISIS is building LoKI instrument to ESS (European Spallation Source) Lund, Sweden. ESS LoKI is Small Angle Neutron Scatterning (SANS) instrument one of the first three instruments going to be built at ESS therefore LoKI is part of the early science programme starting from 2023. First part of the major review milestones so called TG3.1 (Toll Gate) process is scheduled to the summer 2019. TG3.1 includes various sections of the instrument like: heavy shutter, collimator section and detector tank section. Highlights from the results of the neutronics calculations based on H1 and H2 events (the most frequent classes of possible events) is presented in this work. For H1 and H2 events different dose rate and dose requirements are defined according to the radiological zoning of the buildings which were the basis of the shielding design. Shielding calculations were done with MCNP, the geometry was developed with SuperMC a CAD to MCNP converter interface code. Activation calculations were done with FISPACT-II.

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Session Classification: Poster

Contribution ID: **45** Type: **Oral Presentation**

Sample Environment for Soft Matter at ISIS

Thursday 17 October 2019 15:00 (20 minutes)

Sample Environment for Soft Matter at ISIS

J. Vine D, R. Haynes, T. Charleston, A. Church, O. Kirichek

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Soft Matter is now well established within the ISIS Experimental Operations Division (IEOD) alongside Cryogenics, Pressure and High Temperature, where we are able to support user experiments with our existing, developed, modified and newly purchased equipment.
Establishing how and where Sample Environment fits into soft matter experiments is harder than first thought due to the diverse range of experiments that has rapidly grown over recent years. The complexity and variety of samples used in soft matter research demand special requirements on the design and operation of the Sample Environment Equipment.
With a small but expanding team we are in the early stages of expanding our Lab area to three times its original size, which demonstrates the advance in the sample environment equipment base we are able to offer. We are still learning and understanding the large diversity that is needed within this area; temperature, humidity and pressure being a few of the main challenges faced here to provide stability, reliability, accuracy, control and flexibility in the majority of soft matter experiments. This will enable us to develop some of our ageing equipment to bring it in line with user demands.

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Presenter: Mr CHURCH, Andy (STFC)

Session Classification: Instruments

Track Classification: Instrument

Contribution ID: **46** Type: **Poster**

Verification and validation of Light Shutter System for the European Spallation Source (ESS)

Monday 14 October 2019 16:30 (2 hours)

To protect the experimental areas inside the instrument halls at the European Spallation Source (ESS) from radiation and to safely feed neutron beams to the neutron instruments the target is surrounded with a shielding structure called bunker. To protect the bunker from gamma radiation during shutdown at ESS an subsystem of the Neutron Beam Extraction System (NBEX), the Light Shutter System (LSS) was developed by ESS. The LSS consists of a 4 m long frame with a fixed jackscrew connected to an actuator package with brakes, actuator and resolver mounted below of the frame. The two movable blocks Gamma Beam Shutter (GBS) and Bridge Beam Guide (BBG) as well as the fixed Floor Filler Block (FFB) are contained in the frame. Besides protecting the bunkers with GBS, the LSS can also be used to accommodate an optical unit in the Bridge Beam Guide (BBG). By positioning the BBG, a very high repeat accuracy must be ensured despite the heavy blocks. To verify this repeat accuracy of 50 microns as well as the LSS operability, the Vertical Handling and Test Stand (VHTS) is set up with a prototype of LSS at the institute ZEA-1 Engineering and Technology of the central institute of engineering, electronics and analytics of Forschungszentrum Jülich GmbH. In case of a fast shutdown or malfunction, the control loop of the actuator will be opened and the GBS, weighing a ton, falls down due to gravity. In this case the integrated shock absorber decelerate the blocks in a safe position and the bunker is protected from gamma radiation. To detect movement and deformation loads the test stand will be equipped with laser and motion trackers as well as markers. In addition, various shock / acceleration and force sensors will be installed. All sensors as well as the actuator will be connected to a control system, which enables operation and fast data acquisition. The VHTS, the LSS itself, a remote handling concept and all measurement and control components for concept verification are presented as well as the experimental test setup.

Authors: MARSCHALL, Dennis; BESSLER, Yannick; Prof. NATOUR, Ghaleb (Forschungszentrum Juelich GmbH); LYNGH, Daniel

Co-author: KONING, Jarich (European Spallation Source ERIC)

Presenter: MARSCHALL, Dennis

Session Classification: Poster

Track Classification: Target/Moderator

Contribution ID: **47** Type: **Oral Presentation**

SNS 2MW Target Design

Tuesday 15 October 2019 15:30 (30 minutes)

SNS 2 MW Target Design
Kevin C. Johns
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The Spallation Neutron Source (SNS) in Oak Ridge, TN is currently in the preliminary design phase of the Proton Power Upgrade (PPU) which will further advance neutron research at SNS. The upgrade will increase beam power from the current 1.4 MW to 2.0 MW and the beam energy from 1.0 GeV to 1.3 GeV. Reliable neutron production is a facility goal that must be maintained once the upgrades are complete. A key component of the upgrade is the design of the mercury target which must operate for 1250 hours, which equates to four targets per year, before replacement.

The target module operates in a severe environment where conditions such as high radiation, high-cycle fatigue, and cavitation erosion exist. The proton beam also generates a large amount of heat in the target which can lead to high thermal stresses that must be avoided. These conditions create a difficult challenge when designing a target module as they cannot be replicated and tested outside of target operation.

SNS has operated 21 targets to date. Target experience, design improvements, and analysis are being used to develop a target that will meet the operational requirements. Cavitation erosion and high cycle fatigue (giga cycle regime) have proven to be the two limiting factors for extended target operation. Factors such as manufacturability, robust weld design, and remote handling capability must also be accounted for. Although four targets per year is the project requirement, operating this many targets per year is an operational burden and a longer lifetime will be desired.

To date, post irradiation examinations (PIE) has shown gas injection to be effective in mitigating cavitation erosion. Target strain measurements have indicated that gas injection is a viable way to 'cushion'the intense pressure pulse which limits the fatigue life of the target. Current targets are limited to about 1 standard liter per minute (SLPM) of helium gas injection per bubbler. The PPU target will build on this recent success by increasing gas injection rates. The PPU target will utilize a swirl bubbler design for small gas bubble injection along with a means to supply a high gas void fraction to the nose of the target where cavitation damage is the most severe. Up to 20SLPM will be achievable with these new features which will require the installation of a gas liquid separator (GLS) that will remove the gas from the mercury loop after it leaves the target.

This presentation will describe the current status of the 2 MW target design and development implemented to achieve a target lifetime of 1250 hours at 2 MW operation.

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Presenter: Mr JOHNS, Kevin (Oak Ridge National Lab)

Session Classification: Target

Track Classification: Target/Moderator

Contribution ID: **48** Type: **Oral Presentation**

Preparing for 2 MW Operation of the SNS First Target Station

Tuesday 15 October 2019 15:00 (30 minutes)

Upgrades to the Spallation Neutron Source will double the power capability of the accelerator complex to enable operation of the new Second Target Station and increase power to the existing First Target Station (FTS). The Proton Power Upgrade (PPU) project achieves this with a 30% increase in proton energy along with higher current. Presently the FTS operates at 1.4 MW of 60 Hz pulses of 1.0 GeV protons. PPU project scope prepares the FTS for reliable operation with 2.0 MW of 60 Hz pulses of 1.3 GeV protons. The lifetime of the FTS is also extended to 60 years –20 more than originally envisioned. An overview of the evaluations and upgrades to prepare the FTS for 2 MW operation will be presented.

FTS Systems'PPU project scope PPU includes both re-evaluations of design bases and upgrades to achieve the beam power goal. A requirement is that no more than four target module replacements per year are needed; fewer are desired and achievable. Most of the FTS was designed for 2 MW with 1.0 GeV protons with the target module an exception. A redesign of the target is underway that exploits gas injection techniques to improve fatigue life and reduce cavitation damage erosion, two power dependent phenomena that risk target leaks. The gas injection rate will be higher than presently deployed, thus requiring new supply systems, methods to reduce gas hold-up in the mercury process piping, and measures to assure mercury will be contained under postulated accident scenarios.

Higher proton energy distributes heating power in the target station differently. Design basis temperatures, thermal stress and utility heat loads are being re-evaluated. Projected radiation damage to permanent components and accumulated radionuclide inventory have been examined. Impacts of PPU operation on the facility's safety basis are being addressed.

Author: Mr RIEMER, Bernie (SNS / ORNL)

Co-authors: BARBIER, Charlotte (ORNL); Mr BRADLEY, Craig (ORNL); GALLMEIER, Franz (ORNL); Dr IVERSON, Erik (ORNL); Ms JACOBS, Lorelei (ORNL); JOHNS, Kevin (Oak Ridge National Lab); LU, Wei (Oak Ridge National Laboratory); Dr MARTINEZ, Oscar (ORNL); Mr MONTIERTH, Donald (Process Engineering Associates); Mr STEPHENS, Gregory (ORNL); Mr WILLIAMSON, Matthew (ORNL); WINDER, Drew (ORNL)

Presenter: Mr RIEMER, Bernie (SNS / ORNL)

Session Classification: Target

Track Classification: Target/Moderator

Contribution ID: **49** Type: **Oral Presentation**

SEEMS –An SNS-Based Dual Purpose Target Station for Electronics Single Event Effects Testing and Muon Spectroscopy

Monday 14 October 2019 14:50 (25 minutes)

SEEMS is a proposed third target station using the Spallation Neutron Source (SNS) accelerator of Oak Ridge National Laboratory (ORNL) to serve two separate user communities. The first is that of electronics researchers and industrial users investigating single event effects (SEE), who are demanding greater test capacity and capabilities for simulating atmospheric high-energy neutron radiation originating from cosmic and solar rays. Technology trends and increasing use of digital electronics in critical systems increase potential for unexpected and possibly hazardous behavior of important systems. In the case of the aircraft industry, the regulatory landscape is evolving to require assurance that critical systems meet appropriate criteria for reliable operation. Existing facilities in the U.S. are at capacity and lack desired features, including large neutron beams to test complete systems and on-demand thermal neutrons, in addition to high-intensity beams for device irradiation. SEEMS will be fully featured for SEE users and offer more than 9,000 hours of annual test time for decades to come.

The technology used for the SEEMS target station is a low-power spallation neutron source using a helium-cooled tungsten target. A small fraction of the primary accelerator beam is diverted by laser stripping to SEEMS before the SNS accumulator ring injection point. The ideal high-energy neutron spectrum is obtained at +/- 30° off the proton forward direction. It happens that this is highly compatible with a co-located muon source for μSR science, that takes beams at +/- 90° from the target. The stripping laser can be operated with very short pulses (< 50 ns) at a repetition rate that will produce muon beams allowing exceptionally high resolution for muon spectroscopy. This second user community focuses on basic science research in condensed matter physics, radical chemistry, battery materials and beyond, which are extremely complementary with the existing neutron scattering research conducted at the SNS.

Authors: RIEMER, Bernie (SNS / ORNL); DELA CRUZ, Clarina (QCMD, ORNL); GALLMEIER, Franz (ORNL); Dr WILLIAMS, Travis (ORNL)

Presenter: RIEMER, Bernie (SNS / ORNL)

Session Classification: Sources

Track Classification: Target/Moderator

Contribution ID: **50** Type: **Poster**

Manufacturing Process Improvements of Bubblers for Helium Gas-Injection in SNS Pulsed Mercury Neutron Source Target

Thursday 17 October 2019 16:30 (2 hours)

The Spallation Neutron Source (SNS) at Oak Ridge National Laboratory (ORNL) currently produces spallation neutrons by the impingement of an accelerator-sourced 1.4-MW proton beam pulsed at 60-Hz onto a mercury source target. The subsequent deposition of energy within the liquid mercury target creates pressure waves of nonnegligible strength. This causes a rapid expansion and collapse of the mercury resulting in considerable material stresses and cavitation in the walls of the target vessel housing the mercury. Currently, the most effective way of mitigating this damage is by absorbing the expansion of the mercury within the mercury itself. To accomplish this, helium gas is injected into the mercury flow by arrays of orifice tubes in the mercury flow passages. These orifice arrays are commonly referred to as "bubblers."

Many practical challenges arise in the manufacture of helium bubblers. These challenges are due almost entirely to the relatively small diameter (10-20 μm) and quantity of holes prescribed to produce helium bubbles of appropriate size and concentration within the bulk mercury flow. Initially, the manufacturing plan was to press the individual orifice tubes into the bubbler bodies. This proved difficult because the relatively large imperfections in the fit-up between tube and body would often result in excessive gas leakage around the orifice tube.

To avoid the problems with leakage around the press fit orifice tubes, the current design calls for GTAW welding of the thirty separate orifice tubes into bubbler bodies. This configuration facilitates the interchanging of tubes with different sized orifices; however, while shipping, handling, testing, and installing these bubblers, there is ample opportunity to foul the bores and permanently block or greatly reduce the flow through these bubblers. Various attempts to clean blocked orifice tubes have proven only marginally successful. It is often necessary to drill out and replace plugged orifice tubes discovered in bubblers prior to installation into the mercury target module.

Initially, the vast majority of tubes had to be removed and replaced to assemble a successfully functional bubbler. To avoid rework, strict cleanliness and handling protocols were put into place while fabricating, handling, and installing bubblers. The result was a reduction in the cases of rework; however, blockage of orifice tubes still plagues the current process.

In an effort to further reduce the chances of fouling the orifices, a bubbler has been designed such that the individual orifices are not welded as individual piece parts but instead the body of the bubbler encompasses all features on the assembly in one machined part. This design means the final operation in the manufacture of the bubbler subassembly is the laser drilling of the orifice holes themselves such that the chance of fouling the holes is reduced as much as possible. Because the design has square-tipped extensions into the mercury flow, this design is referred to as "toothed bubblers."Four toothed bubblers have been produced to ensure a matched performance between the current design and this new design. A pair with 20 μm diameter holes and a pair with 18 μm diameter holes. Unfortunately, the 18 μm pair suffered from multiple clogged orifices and the flow data from them was unusable. The pair with 20-um diameter holes had a flow through all but one of a total of 60 holes and had total overall flow rates well matched between the two; however, the flow was significantly less than the targeted design flow. The reason for the shortfall in the achieved flow is not yet fully understood and is the subject of future study.

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Session Classification: Poster

Track Classification: Target/Moderator

Contribution ID: **51** Type: **Poster**

Preliminary design of High Energy Direct Geometry neutron spectrometer at CSNS

Wednesday 16 October 2019 13:00 (2 hours)

High Energy Direct Geometry neutron spectrometer(HD) is the most important and direct tool to study the mechanical properties of material lattice and spin. HD is the first material dynamics property research spectrometer planned and constructed in CSNS, which is widely used in physics, materials, chemistry, biology, medicine, earth science, anthropology and other fields. The construction of HD will make it possible to conduct the above research in China, expand the function of CSNS and promote basic scientific research.
The proposed HD at CSNS will be a versatile and flexible instrument. The spectrometer is designed and optimized according to the energy spectrum and pulse width of the Decoupled Water Moderator(DWM). The beam length of HD is 18 meters and the total length is about 25 meters. It is necessary to consider reducing beam loss and improving the utilization rate of high-energy neutrons on the basis of not sacrificing too large resolution. The energy range of HD is 10meV-1500meV.

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Presenter: Prof. TONG, Xin (CSNS)

Session Classification: Poster

Contribution ID: **52** Type: **Oral Presentation**

China Spallation Neutron Source Target Station Status

The China Spallation Neutron Source (CSNS) is an accelerator based multidiscipline user facility located in Dongguan, China. CSNS ramped the beam power to 50kW and consistently achieved an availability of more than 90%. This report emphasizes the status of CSNS Target Station during the operating period. The CSNS target is made of eleven tungsten plates with the different thickness. The interface bonding between the tungsten plates and the 0.3mm-thick tantalum cladding has been proved very stable and reliable. CSNS has three types of moderators to provides the different pulse shapes of neutrons to meet the requirement of the scientific research. Now the Moderator-Reflector (MR) plug has been installed in the target station and the cryogenic system guarantees the circulation of the supercritical and para hydrogen in the loop and moderator safely, which is very important to export the stable and continuous neutron beams. The target station water cooling system has three independent cooling loops. Two light water loops are used to remove heat deposition from pre-moderators, moderators, proton beam window and helium vessels. The other heavy water loop is used for cooling target and reflector. The water-cooling system has been operating smoothly during the whole operating period. The CSNS target station use the 4.8 meter-radius steel adding 1.2- meter-thick heavy barite concrete as the target shielding basis. The dose rate at the area outside the target station is much lower than 2.5μSv/h under the 50kW operating power.

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Session Classification: Target

Track Classification: Target/Moderator

Contribution ID: **53** Type: **Oral Presentation**

Development of a High Intensity Moderator for ESS

Tuesday 15 October 2019 11:20 (25 minutes)

The European Spallation Source will be the most powerful neutron source in the world for condensed matter studies. The design of ESS moderator system to deliver thermal and cold neutrons to the instruments was based on the novel concept of low-dimensional moderators which led, after an intense design effort, to a single high-brightness moderator system placed on top of the spallation target. All of the first 15 instruments built, plus a test beam line, will view that moderator. The facility was designed, however, having in mind possible upgrades without the need to build a second target station. In this respect, two design features of ESS are particularly remarkable: 42 beamports placed around the spallation target in approximately uniform grid, leaving upgrade areas available for future instruments; the beam extraction system which allows for neutron extraction below the target, where another moderator system can be placed in the future. Currently, we are investigating possibilities for this second moderator system, and one option is to develop a high-intensity moderator for applications such as fundamental physics, imaging, and spin-echo. A promising candidate for such moderator is a large liquid deuterium moderator, which is expected to deliver about 3 times the intensity of the top, 3 cm high, moderator. A preliminary study of the design and performance of this moderator suite will be presented.

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Session Classification: Target

Track Classification: Target/Moderator

Contribution ID: **54** Type: **Oral Presentation**

Application of ADVANTG Variance Reduction Parameters for MCNP6 at ESS

Thursday 17 October 2019 12:15 (25 minutes)

The Monte-Carlo method is the de-facto standard for radiation shielding calculations at spallation neutron sources. Calculations can often require the transport of particles through several meters of biological shielding, and there are continuous requests to simulate weaker and weaker phenomena. Therefore, variance reduction methods become absolutely critical for the success of a calculation. In this work, we report on the performance of generating variance reduction parameters for MCNP6 via the CADIS and FW-CADIS methodologies using ADVANTG with spallation neutron source applications in mind.

The CADIS and FW-CADIS methodologies have primarily been applied to low energy, i.e., less than 20 MeV, neutron and photon shielding applications. However, with the use of the HILO2K library, these methods can be extended up to 2 GeV for neutron and photon sources. At the European Spallation Source (ESS), we have recently been investigating the potential of generating variance reduction parameters for MCNP6 with the software ADVANTG and the HILO2K cross section library. For this study, we have selected a few representative problems that might be typically encountered at a spallation neutron sources to test ADVANTG's implementation of CADIS and FW-CADIS. These problems include neutron and proton sources. The use of a proton source in the MCNP6 simulation with the FW-CADIS methodology requires an intermediate step to generate a neutron source for ADVANTG's discrete ordinates simulations, i.e., a neutron source for DENOVO.

We will report on the performance of the variance reduction parameters generated by ADVANTG for MCNP6 for the scenarios that were investigated. We will also make some recommendations for applying CADIS and FW-CADIS to applications at spallation neutron sources.

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Presenter: Dr MILLER, Thomas (European Spallation Source)

Session Classification: Software

Track Classification: Software

Contribution ID: **55** Type: **Poster**

ISIS TS1 Project –Removal of the Target, Reflector and Moderator (TRaM) Support Structure using a Bandsaw within a Remote Handling Cell

Thursday 17 October 2019 16:30 (2 hours)

Target station 1 (TS1) is currently in the implementation stage of a large sustainability project to continue future operation, in addition to making improvements to the neutron performance, ease of operation, and various other factors [1]. One aspect of this project is the extraction of the current irradiated equipment situated within the target area to enable the replacement of the target, reflector and moderator assembly (TRaM). This new assembly will be modular to allow any future upgrades to be installed swiftly [2].
Removal of the current TRaM systems support structure is discussed within this paper. This extraction comes with challenges; due to its abnormal size, the welded structure cannot simply be placed in a shielded flask and removed, it instead must be cut up into 2 sections inside the remote handling cell (RHC) [3]. Testing has been completed using a gravity fed hydraulic bandsaw, and various components have been manufactured to allow ease of adjustment using the remote handling system. However, there is still work to be done before the shutdown in 2020.

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Presenter: TURNLEY, Ross (STFC)

Session Classification: Poster

Track Classification: Target/Moderator

Contribution ID: **56** Type: **Oral Presentation**

MR: the polarized neutron reflectometer at China spallation neutron source

Tuesday 15 October 2019 15:45 (25 minutes)

The multi-purpose reflectometer (MR) at China spallation neutron source (CSNS) is an instrument optimized for examining thin films with nanometer scale structure, especially in regard to their magnetic properties with the removable polarized neutron components. The MR has 3 choppers and 4-m-long bender. The main frame of wavelength is 2-7 A. The first step of commission is finished in the end of 2018 [1].
So far, more than ten user proposals have been done, although the current beam power of CSNS is about 50 kW. By using the 3He tubes as the preliminary detector, the lowest reflectivity of 10-5 can be reached. Meanwhile, 3 user's experiment papers have been published this year [2-4]. First, we report a polarized neutron reflectometry (PNR) study on NiFe/Pt/MgO thin film, which exhibited an enhanced inverse spin Hall effect when the thickness of Pt is below 3 nm [2]. Second, we report the magnetic reversal behavior of a ferromagnet (FM) coupled through an FeMn antiferromagnet (AF) to a pinned ferromagnet has been investigated by PNR measurements [3]. The results show that PNR is a technique sensitive to the compositional and magnetic depth profiles of multilayer samples. Finally, we will mention the applications of Neutron Reflectometry (NR), such as the probing the migration of helium atoms at the interface in He+ ion implanted W/Ni bilayer [4].
In brief, the MR at CSNS will accentuate the polarized/un-polarized neutron reflectivity with low background, which is a powerful technique to study the structures and magnetic structures of thin films.

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Session Classification: Instruments

Track Classification: Instrument

Contribution ID: **57** Type: **Oral Presentation**

Developments in Radioactive Waste Management at the ISIS Spallation Neutron Source

Tuesday 15 October 2019 10:30 (25 minutes)

The Rutherford Appleton Laboratory has over 60 years of history with proton accelerator operations and neutron science. Since 1983 the "ISIS Spallation Neutron and Muon Source"has continued this work. Now ISIS must manage the ongoing generation of radioactive waste and deal with both its and the site's historic radioactive legacy.

The formation of radioactivity is an undesirable, yet unavoidable by-product of the presence of free neutrons and high energy protons. Radioactivity is produced in the target environment, accelerator components, target services, beamline components, user samples, instruments and associated equipment. Whilst perhaps the most challenging wastes are the highly active target, moderator, reflectors and support structures, these represent only a minute fraction of the radioactive waste generated, with the vast majority or radioactive waste being very low-level but impacting almost all parts of ISIS operations. The accumulation and disposal of radioactive waste is strictly regulated and the specifics of how wastes are managed at ISIS is closely intertwined with UK Government policy as well as national and European legislation. The challenge of managing radioactive waste at ISIS is to ensure compliance with these regulations, minimize radioactive waste and minimize harm to the environment, all whilst supporting cutting edge science.

In this presentation I explore radioactive waste at a spallation neutron source, the types and nature of radioactive wastes formed, along with the techniques used to manage, characterize and dispose of those wastes. I share the mistakes made, lessons learnt, and the recent progress made in managing radioactive wastes at ISIS.

Finally, I report on the recent investment ISIS has made to its radioactive waste team and facilities, which are working to manage its radioactive legacy and support a major improvement programme for Target 1, LINAC and instruments in 2020/21 that will result in an intense period of radioactive waste generation.

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Presenter: Mr MCKAY, Christopher (UK Research and Innovation (ISIS))

Session Classification: Operations/Safety

Track Classification: Operation/Safety

Contribution ID: **58** Type: **Oral Presentation**

Report from the first ARIES workshop on efficient neutron sources

Friday 18 October 2019 10:20 (25 minutes)

On September 2-5, 2019 the Paul Scherrer Institut will host the first workshop on efficient neutron sources in Villigen, Switzerland, organized jointly with the European Spallation Source (Sweden) and funded by Aries, part of the EU-Horizon 2020 program. The Workshop on Efficient Neutron Sources —ENS2019 —will bring together nuclear physicists, chemists, material scientists and mechanical engineers to discuss the efficiency of neutron sources, and determine the most promising perspectives for improvement. With the aim of reaching more efficient reactor and accelerator-based neutron sources, ENS2019 will include sessions dedicated to the following topics:

- Neutron Production
- Moderators & Reflectors
- Neutron Guides
- Instruments & Detectors

We will report on the outcome and conclusions from the workshop.

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Presenter: CHARLES, Yoann (Paul Scherrer Institut)

Session Classification: Plenary

Track Classification: Target/Moderator

Contribution ID: **59** Type: **Poster**

Performance evaluation of the Boron Coated Straws detector with Geant4

Wednesday 16 October 2019 13:00 (2 hours)

The last decade has witnessed the development of several alternative neutron detector technologies, as a consequence of the world-wide shortage of ^{3}He, as well as the upcoming research facilities and upgrades. These future facilities and upgrades set high requirements for these detectors, that could otherwise become the bottleneck of the instrument's scientific performance. It is therefore important to understand every aspect of detector performance before qualifying it for a particular neutron technique.

Monte Carlo simulations could and should play a key role in the development and characterisation of detectors as a reliable, cheap and versatile tool. Simulations not only make it easier to analyse and compare detectors and detector arrangements without building a physical prototype every time, but also enable the quantification of otherwise unmeasurable properties.

This work focuses on a promising candidate for ^{3}He-substitute technology, a solid ^{10}B-enriched boron-carbide converter based, Ar/CO2-filled neutron detector, the Boron Coated Straws (BCS) by Proportional Technologies Inc. [1]. This detector is a commercial solution designed for use in homeland security and neutron science. In order to evaluate its performance for scientific application, a generic BCS detector model is implemented for Geant4 [2] simulations. With this, a complex analysis is carried out, investigating various aspects, like conversion and detection efficiency, absorption, activation and the impact of scattering on the measured signal. The parameter space of the study includes the material composition of the detectors, the number of overlapping detector layers (panels), and the incident neutron wavelength.

The results of this study are produced in the context of most realistic applications that might be envisaged, e.g., Small Angle Neutron Scattering (SANS) and direct chopper spectrometry. The aim is to have a complete set of generally applicable results.

References

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Session Classification: Poster

Contribution ID: **60** Type: **Oral Presentation**

Investigations on the Premature Failure of SINQ Target #11 and its Countermeasures

Monday 14 October 2019 11:35 (25 minutes)

The continuous wave spallation source SINQ has been in operation for 22 years. The proton beam power on target was gradually increased over the past decades and has now reached about 1.0MW. With one exception (the liquid metal target MEGAPIE) cannelloni-type solid state targets were used. These D2O cooled lead/Zr-based targets proved to be very reliable and underwent several design improvements over the past years in order to maximize the neutron yield. The strategy to run SINQ targets with solid state targets, which are periodically replaced every two years, appeared to be highly successful. This was demonstrated by a 96% annual availability of the facility averaged over the past 20 years.

However, in June 2016 an unexpected failure of target #11 occurred forcing us to replace it half a year before scheduled. The premature end of the target lifetime was caused by a sudden blockage of the cooling paths through the target. It should be emphasized that during the incident all inventory was contained safely inside the target, the primary cooling loop and its filters. No radioactivity was released from SINQ. A visual post irradiation examination (PIE) of the target in PSI's specially designated hot cell revealed extensive damage of many target rods and large amounts of molten lead blocking the interstices between the rods. Further extensive PIE was performed on some rods by using metallography, electron probe microanalysis (EPMA), gamma analyses etc. Results indicate strong irradiation-induced hardening. Together with the observed abundant presence of hydrides in the Zircaloy cladding tubes, this suggests strong embrittlement of the tubes.

Based on these findings, the design of the SINQ target was significantly altered. In addition, the capabilities to accurately monitor the proton beam position on the target and the temperatures within the target were enhanced. The newly designed target has been in operation since 2018.

This presentation will give an overview of the PIE of target #11 and the results obtained. It also tries to sketch a possible scenario how the incident took place. Furthermore, the improved target design will be presented and first operational experience with this target will be reported.

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Session Classification: Target

Track Classification: Target/Moderator

Contribution ID: **61** Type: **Oral Presentation**

Detector rate estimate for the BIFROST instrument at ESS

Thursday 17 October 2019 11:00 (25 minutes)

The European Spallation Source (ESS) is going to be the most powerful spallation neutron source in the world and the flagship of the neutron science in the upcoming decades. The exceptionally high neutron flux will provide unique opportunity for scientific experiments, but also set high requirements for the detectors. One of the most challenging aspects is the rate capability and in particular the peak instantaneous rate capability i.e., the number of neutrons hitting the detector per channel at the peak of the neutron pulse.

In terms of rate capabilities one of the most challenging instrument at ESS will be BIFROST [2,3], a high flux, indirect geometry cold spectrometer, optimized for small samples and extreme environments. As an indirect time-of-flight (ToF) spectrometer, BIFROST will be able to use the full ESS neutron pulse and optimize flux on the sample. This will result in flux as much as 10^{10} neutrons per second on the sample, that in case of strong Bragg-peaks has the potential to saturate or even degrade the detectors, preventing them from being operational during the inelastic peaks.

The simulation of such complex system that contains a 160 meters long instrument with crystalline sample and analysers is far from trivial. 4 different simulation programs and tools, namely McStas [4], Geant4 [5], NCrystal [6] and MCPL [7] were used together to give an estimate of the rates on the detectors, and to serve as a basis for further analysis of the detector system requirements.

The primary purpose of this work is to give estimation of the incident rates that are anticipated for the BIFROST instrument, and also to demonstrate powerful simulation tools for crystallographic applications. Full simulation model of the instrument from source to detector position implemented with the use of multiple simulation software packages is presented, including the first application of a new pyrolytic graphite model with validation against measured data from real samples, and comparison of different simulation tools to highlight their strengths and weaknesses.

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Session Classification: Software

Track Classification: Software

Contribution ID: **62** Type: **Oral Presentation**

Combining Simulation and Measurement to Understand Complex Detector Geometries

Tuesday 15 October 2019 12:15 (25 minutes)

In order to make use of the high neutron flux expected at the European Spallation Source, alternatives to ^{3}He based detectors are required. Furthermore, to maximise the benefit of the time-of-flight method, instruments at ESS will make use of a wide angular coverage of detectors. The LoKI SANS instrument is being developed in a collaboration between ESS and STFC and will make use of ^{10}B based Boron Coated Straws from Proportional Technologies Inc.

In order to obtain acceptable efficiencies, these detectors consist of 7 boron coated copper tubes packed within a 1"aluminium tube, with each copper straw wired as a position sensitive detector. On LoKI, these 1"aluminium detector tubes will then be packed into arrays to make detector panels which will be placed in 4-panel banks around the beam at ~1.3 m and ~4 m from the sample, and a single panel bank on a carriage which will move between ~5m and 10 m from the sample.

The arrangement of the detector tubes and straws within each panel, combined with the placement of the detector banks, creates a complex detection geometry that presents challenges for calibration and normalization. To address this we are undertaking a combination of experimental measurements with detector prototypes, and simulations of the detector system using McSTAS and GEANT4.

Here we present our progress towards developing the detector calibration and data processing scheme for LoKI.

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Presenter: JACKSON, Andrew (European Spallation Source)

Session Classification: Instruments

Track Classification: Instrument

Contribution ID: **63** Type: **Oral Presentation**

The common shielding project at ESS

Thursday 17 October 2019 09:50 (25 minutes)

Radiation shielding on the ESS instruments has typically been budgeted at around 20% of the total instrument cost. Given the length of many instruments at ESS, that cost is dominated by the guide shielding. The ESS common shielding project aims to deliver cost-effective and standardized solutions for the guide shielding of all the long instruments at ESS. The design will satisfy the radiation dose requirements for the facility, while allowing for quick and convenient access to critical components, such as alignment features, minimizing activation and creation of nuclear waste, and reducing the background on the instruments. The design choices and economies of scale result in a typical cost saving of about 30%, compared to the estimates made at the time when the instrument budget was established. When summed over the 11 long instruments at ESS, that represents a cost saving of about 5 M€, as well as significant operational advantages resulting from the standardization.

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Session Classification: Plenary

Track Classification: Operation/Safety

Contribution ID: **64** Type: **Oral Presentation**

Assessment of shutdown dose rates at the ESS target cooling system using SCALE6.2

Tuesday 15 October 2019 12:10 (25 minutes)

The European Spallation Source (ESS), now under construction in Lund, Sweden, will be the largest and most advanced neutron scattering facility in the world. In order to produce high-energy neutrons through the spallation process, a 2 GeV proton beam will interact with a Tungsten target. This interaction may cause an erosion of the target and the release of radionuclides into its helium cooling system. Within the cooling system, a main filter will catch most of the larger fragments, while auxiliary filters called "getters"are used to capture volatile elements and gases, in particular tritium, as well as remaining dust. Regularly, the getters have to be replaced either manually or by means of robotic equipment.

In this work we apply the ORNL´s SCALE6.2 modelling and simulation suite for nuclear safety analysis to assess shutdown dose rates and determine if added shielding and/or robotic arms are needed for replacing the getters [1,2]. SCALE6.2 is well suited to this kind of assessment as it allows for isotope selection; the effective fraction of radioisotopes from the target wheel that are caught by the getters, i.e. the source term, is external input to the SCALE6.2 simulation.

Using conservative assumptions, the photon dose rate is evaluated for a range of cooling times (1 day, and 1, 3, and 6 months) and for two distances from the getter: at 1 mm corresponding to the case of a worker handling the getter wearing gloves and at 10 cm, corresponding to the case of a worker applying handles to carry the getter. For a cooling time of one day, the maximum dose rate at 1 mm from the getter is 4,42 mSv/h ± 0,01 mSv/h, while it decreases to 1,50 mSv/h ± 3 μSv/h at 10 cm distance from the getter.

These results are based on the assumption that the main filter will catch almost all (99%) of the particles released from the target. In the presentation, we will examine the sensitivity of the shutdown dose rates to the assumed released fraction, e.g. due to malfunction in the main filter.

At ESS, MCNP and CINDER'90 are baseline tools to neutronics assessment [3,4]. For cross validation of these codes with SCALE6.2, results obtained with SCALE6.2 will be compared to an MCNP simulation for selected radioisotopes.

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Session Classification: Operations/Safety

Track Classification: Operation/Safety

Contribution ID: **65** Type: **Oral Presentation**

Bubble Generation with a Micro-Orifice in a Liquid Cross-Flow

Wednesday 16 October 2019 11:35 (25 minutes)

The Spallation Neutron Source (SNS) at Oak Ridge National Laboratory uses a mercury target to generate neutrons. When a proton beam hits the mercury target, the deposited energy causes a very rapid rise in temperature that cause the mercury to cavitate and erode the vessel walls. To mitigate the cavitation erosion, small bubbles of Helium are injected into the mercury target using 50-60 small orifices (8-12 micron diameter) with a back pressure of 100 psig (choked flow condition). The bubbles generated by these bubblers have proven to be very efficient at reducing cavitation damage. However, the bubblers get clogged during operation and causing their flow rates to decrease with time. Consequently, there is interest in increasing the diameter of the orifices, such that the desired flow rate can be maintained constant during the target life and potentially extend the target lifespan. To get a better understanding on how the bubble size distribution will be impacted by the increase of the orifice diameter, a small water loop was built to determine the bubble size population generated by a single orifice inserted in a 2-inch pipe. Several orifices diameter, gas injection rate and water flow rates were used. It was found that above a certain water flow rate, the bubble size was independent of the orifice diameter. Thus, larger orifices could be used with lower back pressure during operation, and the pressure would be adjusted to maintain a constant flow rate as the orifices get clogged. Running the target at constant gas injection flow rate would allow to evaluate the efficiency of the gas injection more easily, and potentially allow us to have a better idea of what is the target lifespan with gas injection.

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Presenter: Dr BARBIER, Charlotte (ORNL)

Session Classification: Target

Track Classification: Target/Moderator

Contribution ID: **66** Type: **Oral Presentation**

Improving Beam Simulations as well as Machine and Target Protection in the SINQ Beam Line at PSI-HIPA

Tuesday 15 October 2019 14:50 (25 minutes)

With a nominal beam power of nearly 1.4 MW, the PSI High Intensity Proton Accelerator (HIPA) is currently at the forefront of the high intensity frontier of particle accelerators. Key issues of this facility are minimization of beam losses as well as safe operation of the SINQ spallation source. Particular attention is being recently paid towards an improved understanding of the properties of the SINQ beam line by both enhancing the beam transport simulations and developing new diagnostic elements which can also, in some cases, preserve the target integrity by preventing too large beam current density, inaccurate beam steering or improper beam delivery. Moreover, part of the SINQ beam diagnostic concept is being rethought in order to include important missing devices like BPMs. On the simulation side, newly developed particle transport programs like MCNP and BDSIM will deliver insights about beam losses and transmission through collimators. All recent and planned developments of the SINQ beam line will be discussed in this contribution.

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Presenter: REGGIANI, Davide (Paul Scherrer Institut)

Session Classification: Operations/Safety

Track Classification: Operation/Safety

Contribution ID: **67** Type: **Oral Presentation**

Design and performance of a superconducting neutron resonance spin flipper

Tuesday 15 October 2019 14:55 (25 minutes)

Despite the challenges, neutron resonance spin echo (NRSE) still holds the promise to improve upon neutron spin echo (NSE) for measurement of slow dynamics in materials. In particular, the modulated intensity with zero effort (MIEZE) configuration allows for the measurement of depolarizing samples and is naturally suited for combination with small angle neutron scattering (SANS) as a result of there being no spin manipulations performed after the sample. The application of NRSE and MIEZE require a high efficiency radio frequency (RF) spin flipper. We present a bootstrap RF neutron spin flipper using high temperature superconducting (HTS) technology, with adiabatic spin flipping capability. A frequency of 2MHz has been achieved, which would produce an effective field integral of 0.35 Tm for a meter of separation in a NRSE spectrometer at the current device specifications. In bootstrap mode, the self-cancellation of Larmor phase aberrations can be achieved by the appropriate selection of the polarity of the gradient coils and has been observed.

Authors: DADISMAN, Ryan (Oak Ridge National Laboratory); Mr WASILKO, David (Oak Ridge National Laboratory); LI, Fankang (Oak Ridge National Lab); Dr KAISER, Helmut (University of Missouri); Dr KUHN, Steve (Indiana University); Dr BUCK, Zachary (University of Missouri); Dr SCHAEPERKOETTER, Joseph (University of Missouri); CROW, Lowell (Neutron Technologies Division, ORNL); Dr RIEDEL, Richard (Oak Ridge National Laboratory); Dr ROBERTSON, Lee (Oak Ridge National Laboratory); JIANG, Chenyang; WANG, Tianhao (China Spallation Neutron Source); Mr SILVA, Nicolas (Oak Ridge National Laboratory); Dr KANG, Yoon (Oak Ridge National Laboratory); Mr LEE, Sung-Woo (Oak Ridge National Laboratory); Dr HONG, Kunlun (Oak Ridge National Laboratory)

Presenter: DADISMAN, Ryan (Oak Ridge National Laboratory)

Session Classification: Instruments

Track Classification: Instrument

Contribution ID: **68** Type: **Oral Presentation**

The ESS helium cooled rotating target. Design and manufacturing process

Tuesday 15 October 2019 14:30 (30 minutes)

The European Spallation Source is an ambitious project to build a 5 MW spallation neutron source. The Spanish contribution to this European project will be 3% of the total cost. Based on the new tendencies on Science construction projects a significant fraction of this contribution (up to 80 %) will be In kind. ESS-BILBAO Consortium has been committed to channel this contribution.

The ESS Target is compose by ~ 3 tones of tungsten bricks (10x30x80 mm) assembled in a cross flow configuration. To cooled the bricks we will use ~2.8 kg/s of helium at 10 bars that circulates in the gabs between the bricks. The spacing between the bricks is critical for the cooling system, thus, the bricks are assembled in a stainless steel structure,the cassette, that ensures the separation between them. Finally, 36 of this cassettes will be assembled in the target vessel to configure the complete system.

ESS Bilbao was selected as in kind partner for the ESS Target at the end of 2014. During the last years the design of the different component of the target system has been completed and the manufacturing is on going. According to the schedule, the complete production will be finished in the middle of 2020.

The aim of this presentation is to summarize the status of the Target manufacturing for the different sub systems including the spallation material, the cassettes, the target vessel and the shaft.

Authors: SORDO, Fernando (Consorcio ESS-Bilbao); MAGÁN ROMERO, Miguel (ESS-Bilbao)

Presenter: SORDO, Fernando (Consorcio ESS-Bilbao)

Session Classification: Target

Track Classification: Target/Moderator

Contribution ID: **69** Type: **Oral Presentation**

The final design and manufacturing process for the ESS Monolith Vessel

Wednesday 16 October 2019 11:10 (25 minutes)

The European Spallation Source is an ambitious European project with a budget of more than 1800 M€ to build a 5 MW spallation source in Lund (Sweden). For this purpose, it will use a proton beam with a total power of 5 MW which will impact on a tungsten Target cooled by helium gas. The spallation reactions produced in the ESS target will generate a large number of radioactive isotopes. The amount of activated material generated by this process is comparable to a ~5 MW fission reactor, thus enclosing barriers are needed to avoid damage to the public and workers.
In order to confine the activated material, the target systems are enclosed in a vacuum or helium atmosphere confined by a pressure vessel which we call the Monolith Vessel. The Monolith Vessel provides a leak-tight boundary between the outer air atmosphere and the Target Moderator Reflector system atmosphere. Once installed, the Vessel will not be changed during the 45 years of planned lifetime of the facility.

The design, manufacturing and inspection plans are completed and the production process is progressing on schedule. It is expected to be completed by the end of 2019.

The aim of this paper is to summarize the mechanical design of the Monolith Vessel and the progress on manufacturing process.

Author: SORDO, Fernando (Consorcio ESS-Bilbao)

Presenter: SORDO, Fernando (Consorcio ESS-Bilbao)

Session Classification: Target

Track Classification: Target/Moderator

Contribution ID: **70** Type: **Oral Presentation**

Technique Development Beamlines at the High Flux Isotope Reactor

Monday 14 October 2019 15:45 (25 minutes)

The neutron optics and polarization team operates development beamlines at the High Flux Isotope Reactor. The newest is the "Larmor" polarization development beamline at the CG4B guide position, commissioned in 2018. The first experiment on this beamline imaged He ions in turbulent flow. Measurements in the near future will include tests of resonant spin echo with superconducting rf flippers, and dynamical nuclear polarization with small angle neutron scattering. The HB-2D polarized component beamline has hosted measurements using Modulated Intensity with Combined Effort, preliminary tests of neutron Wollaston prisms, and will soon host spherical polarimetry tests. HFIR also hosts a detector development beamline at the CG1A guide position. These beamlines provide ongoing support for instrumentation developments at both the Spallation Neutron Source and HFIR, as well as technique demonstration for future instruments.

Author: CROW, Lowell (Neutron Technologies Division, ORNL)

Presenter: CROW, Lowell (Neutron Technologies Division, ORNL)

Session Classification: Instruments

Track Classification: Instrument

Contribution ID: **71** Type: **Oral Presentation**

Scope and Status of Materials Research for Source Technologies at ESS

Monday 14 October 2019 12:00 (25 minutes)

Beam interception devices and neutron moderating systems in the ESS target environment are exposed to intense radiations of primary and secondary particles. Radiation induced degradation of the affected functional and structural materials poses challenges to availability and reliability of the neutron production systems. Due to unprecedentedly high proton beam energy driving the spallation process at ESS, there are very limited materials data available that address high radiation damage effects of energetic protons and neutrons. This requires dedicated efforts for executing materials research program for applications in the ESS target environments. The scope of the materials research at ESS currently includes the studies on spallation materials, proton beam window materials, polymeric materials, moderator materials, reflector materials, and muography technologies for target imaging. In this paper, we report the progress status of the materials research in the addressed study fields. Also, a vision of the materials research for the future post-construction operational phase will be presented.

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Presenter: Dr LEE, Yong Joong (European Spallation Source ERIC)

Session Classification: Target

Track Classification: Target/Moderator

Contribution ID: **72** Type: **Oral Presentation**

Lifetime Criteria of Core Components in ESS Target Environment during Beam Energy Ramp Up

Monday 14 October 2019 12:25 (25 minutes)

The ESS Target Station is designed to convert the 2 GeV protons to a high flux of low energy neutrons for scientific research, at 5 MW beam power. It will start receiving proton beam from the linac for neutron production in 2022. Upon commissioning "beam-on-target,"the linac will deliver protons at 571 MeV, which is lower than the nominal value 2 GeV. For the first 5 years after the beam commissioning, the proton energy and beam power will be ramped up continuously towards 1.3 GeV and 3 MW, with sequential commissioning of super conducting cryomodules during long shut down periods. During neutron production, the spallation target, proton beam window, multi-wire beam profile monitor and moderators are exposed to intense flux of primary and secondary particles, suffering from radiation induced structural degradation. The service lifetimes of these components are limited mainly by the displacement damage, gas production rate, and solid transmutations, where the extent of the radiation damage depends on the kinetic energy of the impinging protons. To secure availability and reliability of the neutron production during this ramp-up phase, the proton energy dependent radiation damage rates in the core target components have to be assessed and the dose-limited lifetime be defined for the timely maintenance of the affected systems. In this paper, we present the lifetime criteria of core functional components in ESS target environments, during the proton energy ramp-up phase.

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Session Classification: Target

Track Classification: Target/Moderator

Contribution ID: **73** Type: **Oral Presentation**

The ESS Tuning Beam Dump

Thursday 17 October 2019 12:10 (25 minutes)

The European Spallation Source is an ambitious project to build a 5 MW spallation neutron source. The Spanish contribution to this European project will be 5% of the total cost. Based on the new tendencies on Science construction projects a significant fraction of this contribution (up to 80 %) will be in-kind. ESS-BILBAO Consortium has been committed to channel this contribution. One of the key in-kind contributions from the ESS-BILBAO is the Tuning Beam Dump (TBD), which will be implemented in direct downstream of the ESS linac. The TBD is made of CuCrZr, and it is designed to handle time averaged beam power of up to 12.5 kW. The deposited heat is removed by massive copper volume contacting the TBD, via heat conduction. The conducted heat is eventually removed by water-cooled stainless steel plate which is in contact with the copper volume. The reason why the TBD is not directly cooled by water is to avoid massive water radiolysis induced by the secondaries. In this paper, we present the design of the Tuning Beam Dump at ESS. The analyses of beam induced thermomechanical behavior, radiation damage effect on structural integrity, required shield, and radionuclides inventory and activation are presented. Also reported are manufacturing processes and factory acceptance test plan.

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Presenter: SORDO, Fernando (Consorcio ESS-Bilbao)

Session Classification: Target

Track Classification: Target/Moderator

Contribution ID: **74** Type: **Poster**

The ISIS TS1 Project: Instrumentation for the measurement of the moderator time structure and neutron flux across the ISIS instrument suite.

Monday 14 October 2019 16:30 (2 hours)

In 2020 ISIS will perform a major refurbishment of Target Station 1, modernising the target, reflector and moderator assembly (TRAM). The so-called "TS1 Project"[1][2] is the first major modification to the target station since it came online in the early 80's, with the primary aim of improving its reliability, maintainability and safety. This £15M project will affect a diverse suite of twenty neutron instruments, including diffractometers, SANS instruments, reflectometers and inelastic spectrometers. We report here on the development of novel instrumentation to measure two key performance indicators for the TS1 project: the moderator time structures (MTS) and the neutron flux delivered to sample. The measurements performed will be used to measure the success of the TS1 project against one of its secondary aims: that the changes to the TRAM will not be detrimental to any instrument's performance and improve the resolution and flux of instruments where possible.

To measure the MTS and flux at the sample position in an equivalent and methodical way across the instrument suite, we developed a calibrated rig that can be placed at the sample position for all ISIS instruments. This rig measures the neutron flux using a bead of GS1 scintillating glass in the beam and simultaneously performs high resolution backscattering diffraction, enabling extraction of the MTS. The MTS measurements use a standard CeO₂ powder and a pair of ³He gas detectors with B₄C masks to define partial Debye-Sherrer rings at 2θ=168^o. To ensure the rig is compatible with all instruments, it has to be both free-standing for 'table-top'sample areas (the reflectometers) and mountable into a standard vacuum vessel (on the diffractometers for example).

We report on the development of the calibration rig and present the MTS and flux data from a variety of instruments at ISIS.

[1] https://www.isis.stfc.ac.uk/Pages/TS1-Project-Spring-2019-update.aspx
[2] ISIS TS1 Project progress summary –paper to be submitted as part of ICANS XXIII

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Presenter: Dr POOLEY, Daniel (STFC RAL)

Session Classification: Poster

Contribution ID: **75** Type: **Oral Presentation**

Proposal for a Fusion Prototypic Neutron Source at LANSCE

Monday 14 October 2019 15:15 (25 minutes)

The U.S. Department of Energy's Office of Fusion Energy is evaluating options for a Fusion Prototypic Neutron Source (FPNS) to irradiate materials test specimens to high dose in an environment with characteristics that are similar to the first wall of a fusion reactor burning D-T fuel. One of the candidates under study is a spallation neutron source at the Los Alamos Neutron Science Center (LANSCE). Key parameter guidelines for the facility include the ability to achieve a damage rate in iron of 8 to 11 dpa per calendar year with a He-to-dpa ratio of approximately 10 appm/dpa within an irradiation volume of at least 50 cm3. The design proposed for LANSCE employs an innovative annular target with the fusion materials irradiation region occupying the central flux trap inside the annular target. The design employs a well-focused (1 mm rms in both transverse planes) beam painted on the front face of the annular target in an ever-expanding circular pattern 17 times over the course of the 850-µs beam pulse. Assuming 1 MW of 800-MeV protons incident on the tungsten target, calculations indicate a damage rate in iron of 20.6 dpa per full-power year averaged over a 53-cm3 volume. The calculated He-to-dpa ratio in this volume is 14.6 appm/dpa, near the desired value of 10 appm/dpa. The central irradiation zone is divided into three 120° sectors, each with its own independent temperature control, which satisfies another key parameter guideline. To save construction costs, the target station could take advantage of substantial existing infrastructure at LANSCE, including a large experimental hall with two adjacent unused hot cells, and a large amount of steel shield blocks on site. But the real cost savings comes from the use of the existing LANSCE accelerator to deliver 1 MW of proton beam, with only marginal investment in the accelerator itself.

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Presenter: PITCHER, Eric (Los alamos National Laboratory)

Session Classification: Sources

Track Classification: Target/Moderator

Contribution ID: **76** Type: **Oral Presentation**

Towards the engineering design of the next-generation spallation neutron source at LANSCE

Thursday 17 October 2019 10:30 (25 minutes)

We will review key features of the physics design of the next-generation spallation neutron Target-Moderator-Reflector-Shield (TMRS) assembly Mark-IV for the Manuel Lujan Jr. Neutron Scattering Center at the Los Alamos Neutron Science Center (LANSCE). The new TMRS was designed to improve the neutronic performance in the keV to MeV energy region to advance a variety of nuclear physics experiments, such as neutron capture and transmission measurements. The optimized physics design predicts an increase in neutron flux and improvement in energy resolution both by a factor of 10 at the neutron energy 100 keV. However, to ensure sufficient heat removal from the new solid tungsten target and to support the necessary pressure of the cooling water, we had to modify the physics design at a cost of neutronic performance. We will discuss the major modifications to the physics design as it evolved into more robust, engineering design, while still offering a significant neutronic improvement in comparison with the current TMRS Mark-III.

Authors: ZAVORKA, Lukas (LANL); MOCKO, Michael (LANL); OLIVAS, Eric (LANL); WOLOSHUN, Keith (LANL); O'TOOLE, Joe (LANL)

Presenter: ZAVORKA, Lukas (LANL)

Session Classification: Target

Track Classification: Target/Moderator

Contribution ID: **77** Type: **Poster**

MENUS - MATERIALS ENGINEERING BY NEUTRON SCATTERING

Thursday 17 October 2019 16:30 (2 hours)

The proposed MENUS beam line at the second target station will be a transformational high-flux versatile multi-scale materials engineering beamline with unprecedented new capabilities for the study of low symmetry, complex materials. It will support both fundamental and applied materials science and engineering research in a broad range of fields, including advanced alloy design, energy storage and conversion, nuclear energy, aerospace, transportation and civil infrastructure. MENUS will combine unprecedented long-wavelength neutron flux and high detector coverage to enable real-time studies of complex structural and functional materials behavior under mechanical, thermal, electrical and magnetic fields. The instrument will incorporate SANS and imaging capabilities to extend its sensitivity to larger length scales and higher spatial resolution. With large out-of-plane detector coverage, high spatial resolution residual/in-situ stress measurements can be performed rapidly at once and in-situ, full ODF/SODF (orientation distribution function/stress-orientation distribution function) can be recorded by rotating the sample around a single axis. MENUS will complement the strengths of the current VULCAN engineering materials diffractometer that uses the high wavelength resolution of thermal neutrons available at the first target station to study high symmetry crystal structures in engineering materials and components. Specifically, in the Q-range matched to low symmetry materials ($\lambda \geq 4$Å), MENUS will have a neutron flux exceeding 2 orders of magnitude higher than VULCAN can deliver because of the high cold neutron brightness available at STS.

This research is sponsored by DOE Office of Science User Facility at the Oak Ridge National Laboratory under Contract No. DE-AC05-00OR22725.

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Presenter: AN, Ke (Oak Ridge National Laboratory)

Session Classification: Poster

Contribution ID: **78** Type: **Poster**

High resolution dynamics and structure measurements enabled by neutron Larmor labeling

Monday 14 October 2019 16:30 (2 hours)

To measure the crystal lattice distortion or the lifetime of weak interactions among quasiparticles, such as phonons, electrons and magnons, with high resolution, the key is to break the inverse relationship between the resolution and useable flux. By using the Larmor precession of the neutron spin inside a given magnetic field, its momentum or energy change during the interactions with sample can be measured with ultra-high resolution. Therefore, this unique property of neutron provides us with another approach to overcome some of the limitations of conventional neutron scattering instruments. Also, it can make the best use of all the available neutrons by allowing the use of large divergent beams. The progress on upgrading the HB-1 polarized triple axis spectrometer at the High Flux Isotope Reactor of ORNL with superconducting magnetic Wollaston prisms will be presented. For neutron diffraction, the achievable resolution of the absolute peak splitting and relative lattice distortion (Δd/d) can be 2×10-4 and 1×10-6 relatively. While for inelastic scattering, for example phonon linewidth measurements, the resolution can be <10μeV.

[1] F. Li *et. al.*, J. Appl. Cryst. (2018). 51, 584-590
[2] F. Li *et. al.*, J. Appl. Cryst. (2019). 52, 755-760

Authors: LI, Fankang (Oak Ridge National Lab); SHEN, Jiazhou (Indiana University); CROW, Lowell (Neutron Technologies Division, ORNL); PARNELL, Steven (TU-Delft); MATSUDA, Masaaki; PYNN, Roger (Indiana University); KELLER, Thomas (FRM-II); DELAIRE, Olivier (Duke University); FERNANDEZ-BACA, Jaime

Presenter: LI, Fankang (Oak Ridge National Lab)

Session Classification: Poster

Contribution ID: **79** Type: **Oral Presentation**

Design and construction of a nitrogen-cooled Pb-based neutron spallation target for the neutron Time-Of-Flight facility at CERN

Thursday 17 October 2019 10:55 (25 minutes)

The neutron Time-Of-Flight (n_TOF) facility at the European Laboratory for Particle Physics (CERN) is a pulsed white-spectrum neutron-spallation source coupled to two flight paths, each one leading to an experimental area: EAR1, 200 m from the target, and EAR2, 20 m above the target. The spallation source is based on a lead target, impacted by a high-intensity 20 GeV/c proton beam. The facility is designed to study neutron-nucleus interactions for neutron kinetic energies from a few meV to several GeV, with astrophysics, nuclear technology, and medical applications. The facility will undergo an important upgrade during 2019 and 2020, which will include the installation of a new and upgraded neutron-spallation target (Target #3, 3rd generation spallation device). The target currently installed (Target #2, 2nd generation) consists in a water-cooled pure-lead cylinder, coupled to a moderator filled with borated water. The new spallation target will be cooled by gaseous nitrogen to avoid corrosion phenomena and contamination of the cooling water with radioactive lead spallation products. The new design will also be optimized for the vertical flight path. After three years of design, four project reviews, many extensive R&D and prototyping activities, and tests under beam irradiation, the production of the new target has begun and it will continue through 2020. The new target installation, commissioning, and operation are planned for early 2021. This contribution will detail the spallation target design and the annexed equipment, with focus on the design choices intended to improve reliability, avoid issues encountered during the Target #2 experience, and guarantee optimal physics performance for both experimental areas.

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Presenter: ESPOSITO, Raffaele (CERN / EPFL)

Session Classification: Target

Track Classification: Target/Moderator

Contribution ID: **80** Type: **Poster**

Direct Transfer of Monte Carlo Ray tracing Models to Additive Manufacturing Systems

Monday 14 October 2019 16:30 (2 hours)

Advanced computer-aided design (CAD) modelling is a general prerequisite in 3D printing or Additive Manufacturing (AM) processes. Monte Carlo simulations, used to model the neutronic performance of an instrument, have 3-D representations of the instrument, but transferring this to CAD models is usually done by hand and is the most time-consuming and error prone part of the entire process chain. This contribution describes a tool to take components modeled in McVine and convert them straight to a format ready for AM. Over the last three decades, the STereoLithography (STL) file format, has become the de facto standard, used in many, if not all, AM systems to exchange information between design programs and AM systems. Our system uses scripts to generate a computer model, in which python statements describe the geometry of the required object by using Constructive Solid Geometry (CGS). CGS is a way of building complex objects from simple primitives using Boolean operations. The script encodes the set of CGS primitives representing the object onto a hierarchical tree. This script saves the tree structure onto an XML file used in McVine for the Monte Carlo Simulation. We developed a program the leverages OpenSCAD to create CAD models from the geometry defined in the xml file. OpenSCAD directly exports the geometry to an STL file, which is used for 3-D printer open-source slicing programs. This tool was used to create CAD files representing two pressure cells with different complex shapes and collimators to reduce background from these cells. The neutron scattering from the components is simulated by MCViNE. Furthermore it has been used to generate collimator designs that are printed via AM.

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Presenter: ISLAM, Fahima

Session Classification: Poster

Contribution ID: **81** Type: **Oral Presentation**

A Novel Automated Optimized, 3-D Printed Collimator Design for High Pressure Scattering

Tuesday 15 October 2019 15:35 (25 minutes)

Many current neutron scattering experiments require use complex sample environments which invariably contribute significant background to the experimental data. Generally, collimators which are part of the instrument have been used to improve the sample to cell signal ratio. Particularly for high pressure, however, collimation should be customized for different pressure environments since different pressure environments produce different results. For example, in high pressure diffraction, the Bragg peaks move and change with pressure. Furthermore, no unobstructed view of the sample is inherently possible if pressure is to be applied. It is thus crucial to separate the sample signal from the background signal generated by the high pressure cell. Here we show a new avenue for custom-made collimators to overcome this challenge. Specifically, portable 3Dprinted collimators can be tailored to a particular pressure cell and thus are a step further in background reduction. An automated work-flow has been developed to design a custom collimator, optimized for a given pressure environment and manufacturing constraints. The end result is a file ready for 3D printing. The collimator is conical in shape with tightly spaced neutron absorbing blades which are stacked in vertical and horizontal directions to provide transmitting channels. The optimization parameters include blade size, materials and the length of the collimator. A Monte-Carlo neutron ray-tracing simulation model based on MCViNE was developed to evaluate the performance of the collimator. An optimized collimator will maximize the sample signal to background ratio without sacrificing too much neutron flux. Thus, the optimization must strike a balance between improving relative sample signals and minimizing the loss of intensities, and at the same time account for engineering constraints imposed by the 3D printing techniques. Two pressure cells of different complexities: Clamp cell and Diamond Anvil Cell were chosen for demonstration. Clamp cell consists of a cylindrical sample of ~ 4 mm, enclosed in a cylindrical CuBe inner-sleeve and an Al outer-body with an overall outer diameter of ~30-50 mm. Whereas, the outer diameter of DAC at its widest diameter is 50 mm with only 1 mm sample size. Note that there are significantly more cell materials than sample so the sample signal is very weak compared to the cell signal without a collimator. A collimator was designed, optimized, printed and tested on the SNAP neutron beam-line. The experimental results are then compared with the simulation results. The optimal collimator provides substantial improvement over the no collimator case. The developed computerized work flow for optimizing collimator will be readily extensible to novel integrated designs of the myriad sample environments required for any instrumentation.

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Presenter: ISLAM, Fahima

Session Classification: Software

Track Classification: Software

Contribution ID: **82** Type: **Oral Presentation**

Neutron Imaging at the High Flux Isotope Reactor and Spallation Neutron Source

Wednesday 16 October 2019 12:10 (25 minutes)

Abstract

In the past several years, the CG-1D neutron imaging facility at the High Flux Isotope Reactor (HFIR), Oak Ridge National Laboratory (ORNL), has successfully provided unique insights in many research areas including energy storage, additive manufacturing, plant physiology, archeology, transportation, geology, etc. It has been recognized as a key neutron imaging user facility in North America by the neutron imaging community. In this talk, recent scientific results, instrumentation development, and new software will be presented. Additionally, at the Spallation Neutron Source (SNS), a dedicated time-of-flight (TOF) neutron imaging beamline, the Versatile Neutron Imaging Instrument (VENUS), is under construction. This new instrument is expected to provide new capabilities, such as Bragg-edge and resonance imaging, that utilize the intrinsic capabilities of a pulsed source. In this presentation, an overview of the VENUS design and current development in TOF imaging will also be discussed.

Acknowledgments

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Presenter: Dr ZHANG, Yuxuan (Oak Ridge National Laboratory)

Session Classification: Instruments

Track Classification: Instrument

Contribution ID: **83** Type: **Oral Presentation**

New developments in the McStas neutron Monte Carlo ray-tracing package

Thursday 17 October 2019 10:30 (30 minutes)

The McStas neutron ray-tracing simulation package is a versatile tool for producing accurate simulations of neutron scattering instruments at reactors, short- and long-pulsed spallation sources such as the European Spallation Source. McStas It is extensively used for design and optimization of instruments, virtual experiments, data analysis and user training. McStas was founded as an scientific, open-source collaborative code in 1997.
This contribution presents the project at its current state and gives an overview of main new developments in McStas 2.5 (December 2018) and the forthcoming 2.6 and 3.0 releases, including a revised code generator and dawning support for execution on GPU processors.

Author: Mr WILLENDRUP, Peter (Technical University of Denmark and European Spallation Source)

Co-authors: Dr BERTELSEN, Mads (European Spallation Source, Data Management and Software Center); Dr BERGBÄCK KNUDSEN, Erik (Technical University of Denmark); Mr GARDE, Jakob (Technical University of Denmark); Dr FARHI, Emmanuel (Synchrotron Soleil, France)

Presenter: Dr BERTELSEN, Mads (European Spallation Source, Data Management and Software Center)

Session Classification: Software

Track Classification: Software

Contribution ID: **84** Type: **Oral Presentation**

Some Examples of Challenges of Radioactive Waste Characterisation at the ISIS Neutron and Muon Source

Tuesday 15 October 2019 11:45 (25 minutes)

The Rutherford Appleton Laboratory, based in Oxfordshire, UK, has a long history of proton accelerator operations. In late 1984 the first neutrons were produced in the ISIS Neutron and Muon Source and operations have continued since then and expanded with the opening of the second target station in 2008.

The solid waste items produced from operation of ISIS are all considered against their potential to be radioactive. Many pieces of equipment that were near-beam when in use are both large and heavy and are clearly activated in some parts where energetic particles have hit. They pose different challenges with respect to characterization but common aspects are the presence of activated metals, and also in some cases concrete, and the inhomogeneity of the activation.
When the item is declared as waste, because of design change or failure of a component, decisions are needed as to how much work is needed to safely, legally and with minimum expenditure dispose of the item. A Best Available Technique (BAT) study is required as part of the UK Environment Agency permit to create and dispose of radioactive materials and this applies to ISIS. The BAT study examines the options for disposal and the "do nothing invasive"and the "do minimal invasive investigations"options involving not cutting or dismantling the item is always highly preferred as this minimises worker dose, secondary waste arisings, time and costs.

This presentation gives examples of waste characterisation of large items undertaken at ISIS, highlighting constraints, lessons learnt and opportunities for savings. Two specific examples are given of the characterisation of a neutron-beam shutter weighing about 7 tonnes and also of a moveable electro-magnet support, known as a trolley, weighing over 9 tonnes. The patterns of activation and the future work needed to dispose of similar items is considered.

Author: Mrs MCCROHON, Ruth (UK Research and Innovation (ISIS))

Presenter: Mrs MCCROHON, Ruth (UK Research and Innovation (ISIS))

Session Classification: Operations/Safety

Track Classification: Operation/Safety

Contribution ID: **85** Type: **Poster**

Status of LENS for 2019

Wednesday 16 October 2019 13:00 (2 hours)

The Low Energy Neutron Source at Indiana University has now entered its 15th year of operation. I will summarize our most recent activities, with an emphasis on the instrumentation development aspect of our mission. At this point in the facility's life, we have now gained some experience with the challenges associated with long-term operation of a compact source. Although some of these challenges are common to many facilities, the avenues to address them are more limited at compact source such as LENS and I will also discuss these differences.

Author: BAXTER, David (Indiana Unviersity)

Presenter: BAXTER, David (Indiana Unviersity)

Session Classification: Poster

Contribution ID: **86** Type: **Oral Presentation**

IDAaaS: ISIS Data Analysis As A Service - The Story So Far

Monday 14 October 2019 10:45 (30 minutes)

In this talk I will provide an overview of our experience of setting up, operating and using a cloud-based data analysis service in collaboration with STFC's Scientific Computing Department. The first year has seen the Excitations Group (who operate the LET, MERLIN, MAPS and MARI spectrometers) and the WISH diffractometer start to use this service, gradually moving away from the previous ISIScompute system. I will share some of the adventures we had along the way, and try to draw out some of the lessons that were learned. After a steep learning curve for the IDAaaS development team we have now reached a stage where the system is operating stably, and it is ready to be used by the users of more ISIS groups. I will outline the advantages of this, and will also highlight some areas that go beyond experimental support for which this system might prove very useful.

Author: Dr EWINGS, Russell (ISIS)

Presenter: Dr EWINGS, Russell (ISIS)

Session Classification: Software

Track Classification: Software

Contribution ID: **87** Type: **Oral Presentation**

Characterization of shielding materials for neutron scattering instrumentation

Monday 14 October 2019 15:20 (25 minutes)

We have performed a series of experiments using both reactor based and spallation based neutron scattering instruments to characterize the suitability of different materials for neutron absorption. In particular, we characterize the usefulness of these materials in the near vicinity of the neutron beams used in neutron scattering instrumentation. We examine boron carbide based coatings as well as borated aluminum alloys. Borated polyethelene and elemental absorbers like cadmium and gadolinium are examined in detail. We also characterize high density and traditional concrete.

Authors: STONE, Matthew (Oak Ridge National Laboratory); CROW, Lowell (Neutron Technologies Division, ORNL); Dr FANELLI, Victor (Oak Ridge National Laboratory); NIEDZIELA, Jennifer (Oak Ridge National Laboratory)

Presenter: STONE, Matthew (Oak Ridge National Laboratory)

Session Classification: Instruments

Track Classification: Instrument

Contribution ID: **88** Type: **Oral Presentation**

Ferromagnetic Resonance-Polarised Neutron Reflectometry

Wednesday 16 October 2019 11:45 (25 minutes)

Magnetisation dynamics is a growing area of materials characterisation in thin film magnetism and is particular of interest for magnetic exchange spring systems which consist of alternating thin hard and soft magnetic layers provide a great potential in applications such as (i) permanent magnets and (ii) magnetic data storage and spintronic devices.

There is significant enthusiasm to develop in-situ type sample environments to incorporate magnetisation dynamics such as ferromagnetic resonance with other means of probing the sample. Current methods are limited to X-ray magnetic circular dichroism (XMCD) which allows for element-selective hysteresis loops and dynamic measurements to be performed using XMCD for the magnetic contrast. However, this technique yields the average response of the material layer for a given element. There is a wealth of knowledge which can be obtained by combining the technique with Polarised Neutron Reflectometry (PNR). This would allow for the magnetisation direction and magnitude to be determined as a function of depth through the material which in turn provides detail on how the magnetisation precession as a function of depth changes, which is key in understanding multi-layered structures, and how the anisotropy of one layer can influence the second in particular at the boundaries and interfaces where currently this information cannot be obtained.

This talk highlights the recent ferromagnetic resonance developments for offline laboratory work and in-situ with neutron beamtime studies.

Author: Dr STENNING, Gavin (STFC)

Presenter: Dr STENNING, Gavin (STFC)

Session Classification: Instruments

Track Classification: Instrument

Contribution ID: **89** Type: **Poster**

SOFTWARE USER INTERACTION USING TOUCH SCREENS: A DISCUSSION OF BEST PRACTISE

Monday 14 October 2019 16:30 (2 hours)

Touch Screen Human Machine Interfaces (HMI) offer many benefits for system designers over discreet buttons and displays. They make an abundance of system information available to support and user personnel, speed up mechanical design and allow post release upgrades to be made without requiring mechanical changes, However, too much information and too many choices can make the screen bewildering to the user, the design of the screens and the whole user interaction (UI) needs to be carefully considered.

We present here some ideas of how HMI systems can be designed to best serve the user community. We show an example of a HMI which is being used on the ISIS Fast Cooling Furnace (FCF) part of the SINE2020 Program of developments. This HMI uses a simple graphic (very similar to the London Underground Map) to show system operation as a 'journey'with progress indicated as a coloured dot.

As on the Underground map, the states (stations) are evenly spaced on the diagram rather than by geography or time. Information is kept to the bare essentials with a pop-up screen to highlight occurring problems. Any system problems that arise are shown in order of importance so only one is visible at any time. When all the issues are resolved the map is once more displayed.

These ideas can also be applied to the computer based remote screen. The equipment needs to supply enough information to allow the remote user to be informed. It should be noted that all peripheral equipment needs to report to the remote screen, normally through the equipment controller, so that their issues can be seen.

The poster shows the FCF in operation including normal and fault conditions, as well as a list of suggested do's and don'ts aimed to generate discussion. It is hoped that from such discussions, guidelines will arise which could in the future will form the basis for an accepted standard.

Author: BURGESS, Graham (UKRI RAL)

Co-authors: Mr NUTTER, Jamie (UKRI RAL); Dr PAYNE, Steve (UKRI RAL)

Presenter: BURGESS, Graham (UKRI RAL)

Session Classification: Poster

Track Classification: Software

Contribution ID: **90** Type: **Oral Presentation**

Investigation of the impact of crystallite size on the performance of a Be reflector

Tuesday 15 October 2019 10:30 (25 minutes)

Beryllium reflectors are used at spallation neutron sources in order to enhance the low-energy flux of neutrons emanating from the surface of a cold and thermal moderator. The design of such a moderator/reflector system is typically carried out using detailed Monte-Carlo simulations, where the beryllium reflector is assumed to behave as an ideal poly-crystalline material. In reality, however, inhomogeneities and impurities in the beryllium could lead to discrepancies between the performance of the actual system when compared to the modeled system. The dependence of the total cross section on the crystallite size, in the Bragg scattering region, could influence the reflector performance, and if such effect is significant, it should be taken into account in the design of the moderator/reflector system.

While there are studies on the influence of the impurities in pure beryllium on neutron scattering behavior, the effect of crystallite structure on its neutronic performance has not been investigated explicitly. To investigate this phenomena in more detail, we have set up a program to examine the effect of crystalline structure on the neutron cross-section of beryllium, both theoretically and experimentally. In this paper, we report on the preliminary results of using cross-section libraries, which include corrections for the crystallite size effect, in spallation source neutronic calculations.

Authors: DI JULIO, Douglas (European Spallation Source ERIC); MUHRER, Günter (European Spallation Source ERIC); LEE, Yong Joong (European Spallation Source ERIC)

Presenter: DI JULIO, Douglas (European Spallation Source ERIC)

Session Classification: Target

Track Classification: Target/Moderator

Contribution ID: **91** Type: **Poster**

Simulating neutron transport in long neutron beamlines at a spallation neutron source using Geant4

Thursday 17 October 2019 16:30 (2 hours)

The transport of neutrons in long neutron beamlines at spallation neutrons sources presents a unique challenge for Monte-Carlo transport calculations. This is due to the need to accurately model the deep-penetration of high-energy neutrons through meters of thick dense shields close to the source and at the same time to model the transport of low-energy neutrons across distances which can be up to around 150 m in length.

Typically, such types of calculations may be carried out with MCNP-based codes or alternatively PHITS. However, in recent years there has been an increased interested in the suitability of Geant4 for such types of calculations. Therefore, we have implemented both supermirror physics and the duct-source variance reduction technique for low-energy neutron transport from the PHITS Monte-Carlo code into Geant4. Additionally, we have also extended the usage of the duct-source technique for neutron deep-penetration calculations.

In the current work, we present a series of benchmarks of these extensions with the PHITS software and also show some example neutron beamline calculations.

Authors: DI JULIO, Douglas (European Spallation Source ERIC); Mr SVENSSON, Isak (European Spallation Source ERIC); Dr CAI, Xiao Xiao (European Spallation Source ERIC, DTU Nutech); Prof. CEDERKALL, Joakim (Department of Physics, Lund University); Dr BENTLEY, Phillip (European Spallation Source ERIC)

Presenter: DI JULIO, Douglas (European Spallation Source ERIC)

Session Classification: Poster

Contribution ID: **92** Type: **Poster**

Neutron Spin Manipulation Devices Based on High Temperature Superconducting Technology

Monday 14 October 2019 16:30 (2 hours)

Polarized neutron beams have a range of applications from magnetic studies to enhancing resolution in elastic and inelastic scattering, all of which rely upon precise control of the neutron spin. In recent years we have developed a series of devices including a neutron flipper, a polarimeter, and magnetic Wollaston prisms using superconducting components. By bounding magnetic field regions between high Tc YBCO films we are able to exploit the Meissner effect to create very uniform regions of magnetic field generated by passing high currents through superconducting YBCO tape. These devices have now been used in a series of experiments including phonon focusing, spin echo modulated SANS (SEMSANS) and Larmor diffraction. We are currently developing an RF flipper for MIEZE type experiments and wide angle device for conventional quasi-elastic and inelastic spin-echo. In this poster we will present an overview of our current and new devices along with recent experiments.

Authors: KUHN, Stephen (Indiana University); SHEN, Jiazhou (Indiana University); DALGLIESH, Robert M. (ISIS Pulsed Neutron and Muon Source, Rutherford Appleton Laboratory); FENG, Hao (Indiana University); LI, Fankang (Oak Ridge National Lab); PARNELL, Steven (Indiana University/ TU Delft); WANG, Tianhao (China Spallation Neutron Source); BAXTER, David (Indiana Unviersity); PYNN, Roger (Indiana University)

Presenters: KUHN, Stephen (Indiana University); SHEN, Jiazhou (Indiana University)

Session Classification: Poster

Contribution ID: **94** Type: **Oral Presentation**

The small angle neutron scattering extension in MCNPX

Monday 14 October 2019 14:55 (25 minutes)

The MCNPX transport code is a commonly used code in the design of neutron sources. The traditional scattering kernels that describe materials in MCNPX do not capture small angle scattering effects. An implementation of small angle neutron scattering (SANS) has been developed in MCNPX. The implementation uses an analytical hard-sphere scattering with user-specified particle size, polydispersity, packing fraction, and contrast. Additionally, the implementation can use a user-supplied $I(q)$ vs. q data table. The implementation has been benchmarked with measurements at EQ-SANS. MCNPX studies of quasi-specular scattering in possible high-albedo materials for very cold neutrons, the simulation of divergence filters, and supplementing existing kernels for aluminum alloys with SANS will be discussed.

Authors: Dr GRAMMER, Kyle (ORNL); GALLMEIER, Franz (ORNL)

Presenter: Dr GRAMMER, Kyle (ORNL)

Session Classification: Software

Track Classification: Software

Contribution ID: **95** Type: **Oral Presentation**

Non-static surfaces in MCNPX: the Chopper Extension

Thursday 17 October 2019 11:25 (25 minutes)

Rotating objects, such as choppers, are common components of a neutron beamline, and the motion of these components is not described in the static geometry of an MCNPX model. The special case of non-static surfaces for rotation about a stationary point in space has been developed for MCNPX. In addition, velocity dependent kinematics due to the motion of the medium have been implemented. This implementation allows for the simulation of rotating objects at speeds comparable to the velocity of cold neutrons. Applications of the chopper extension will be discussed, including the direct simulation of a bandwidth chopper system, the thermalization of neutrons inside a spinning material, and the demonstration of a spinning single crystal.

Authors: GRAMMER, Kyle (ORNL); GALLMEIER, Franz (ORNL)

Presenter: GRAMMER, Kyle (ORNL)

Session Classification: Software

Track Classification: Software

Contribution ID: **96** Type: **Poster**

ISIS UNIVERSAL CRYOSTAT CONTROLLER – PROJECT CONCEPT

Wednesday 16 October 2019 13:00 (2 hours)

We provide an introduction to the 'ISIS Universal Cryostat Controller'(UCC) project.
The projects aim is to design a standard in-house controller with the ability to autonomously control various types of cryostat systems used at ISIS, including; Orange, Variox and Flow cryostats. Such a controller would provide a level of simplicity in the operation of our cryostat systems and reduce our reliance on third party control hardware and associated software.
We have drawn on the experience gained in the operation the ISIS Orange Cryostat Controller (OCC), together with user feedback, as a basis for this work. Automation and optimization of the helium flow, leading to efficient and economical helium management, for example, is addressed.
The expected development challenges that will be faced and the range opportunities this system will offer, is also discussed, as is timescales, customer requirements and the technology and techniques that are currently available to deliver a fully realized UCC.

Author: Mr NUTTER, Jamie (STFC)

Co-authors: BURGESS, Graham (UKRI RAL); Dr LAWSON, Chris (ISIS, STFC, UKRI); Dr PAYNE, Steve (UKRI, Rutherford Appleton Laboratory); DOWN, Richard (STFC); Mr KEEPING, Jeff (STFC)

Presenter: Mr NUTTER, Jamie (STFC)

Session Classification: Poster

Contribution ID: **97** Type: **Oral Presentation**

Solving Process Instrumentation Challenges for the ESS Target Safety System

Tuesday 15 October 2019 15:40 (25 minutes)

The European Spallation Source (ESS) will be a 5 MW neutron spallation research facility where an energetic proton beam incident upon a helium-cooled tungsten target is converted to neutron beams. From a radiation safety perspective, the helium cooling system, the tungsten wheel rotating system and the vacuum in the monolith vessel containing the tungsten wheel concentrate the most critical parameters. Helium gas mass flow, pressure and temperature will be supervised for the cooling system. In addition, the rotating speed of the tungsten wheel and the pressure inside the monolith vessel will also be supervised. Each of these parameters are instrumented in the Target Safety System (TSS), a defense-in-depth, level 3 safety interlock system designed to protect the public and the environment from a release of radioactive material from the facility.

Selecting field instrumentation to supervise these process parameters and meet the requirements of the safety system design comes with several challenges. Inherent to the monitoring of the helium process is the need to select suitable equipment for combining the necessary process information needed to calculate the mass flow (static pressure, dynamic pressure over a venturi tube, gas temperature, and data on helium density at different temperatures). In addition, instrument location options are limited and the instrumentation environment is often harsh. Finally, diversity requirements for the safety system design mandate that the instruments monitoring pressure in the monolith and helium systems must be technically different.

This paper will describe the details governing the selection of the field devices needed for the target safety system, TSS, along with the environmental qualification process for the chosen devices.

Author: Mr INGEMANSSON, Ola (ESS)

Presenter: Mr INGEMANSSON, Ola (ESS)

Session Classification: Operations/Safety

Track Classification: Operation/Safety

Contribution ID: **98** Type: **Oral Presentation**

Scientific software developments at the European Spallation Source.

Monday 14 October 2019 11:40 (25 minutes)

The European Spallation Source (ESS) is the largest investment in European Neutron scattering since the construction of the Institute Laue Langevin. The Data Management and Software Centre (DMSC) is responsible for the delivery of the scientific computing and data management for the ESS. In this presentation the current status of the ESS project will be discussed in relation to the development of scientific software for the ESS instrument suite.

The performance of a next generation neutron spallation source, the first one with long pulse characteristics, creates specific requirements for the data acquisition system, data processing and data analysis software. These requirements will be presented along with the design choices, prototype performance and test results for the core DMSC systems which are geared towards a paradigm where the core neutron detection technology has shifted from 3He to 10B. The contribution will also detail what is being done to be prepare ESS for the broader European desire for open access to research data and sustainable software projects.

The ESS is a pan-European project with 15 European nations as members and Sweden and Denmark as host nations. The role and benefits of collaborative open source software development will be examined in relation to the advantages and challenges for scientific software development at a green field research infrastructure.

Authors: Prof. TAYLOR, Jonathan (European Spallation Source ERIC); Dr RICHTER, Tobias (European Spallation Source ERIC); Dr HOLM ROD, Thomas (European Spallation Source)

Presenter: Prof. TAYLOR, Jonathan (European Spallation Source ERIC)

Session Classification: Software

Track Classification: Software

Contribution ID: **99** Type: **Poster**

Current status of the applications for a live data reduction method in MLF, J-PARC

Wednesday 16 October 2019 11:40 (25 minutes)

One of the recent successful developments in the computing group in MLF at J-PARC is about the "quasi-real-time" data reduction and visualization method, named a live data reduction. From the beginning of MLF running, users have strongly required to see the current data during the measurement to decide next experimental conditions and schedules. To realize "real-time" data treatment we considered that the message queue technology of an asynchronous communications protocol should be utilized for our data acquisition system and data reduction software. In these years, we decided to adopt a Publisher-Subscriber model using this technology and developed new modules working on our data acquisition system, DAQ middleware, which sends event-recorded data to a message queue server as a data publisher. In parallel, we started to develop the data reduction and visualization software working as a data subscriber to obtain the event-recorded data from the server. Consequently, at several instruments in MLF, we have successfully realized the live data reduction using Utsusemi, which is one of the software suite used as common data reduction and visualization in MLF, and the other visualization codes as a subscriber.
In addition, we have a plan to offer users the new methods to obtain speedily the result of the live data reduction for the current measuring data. We start to develop a new server cooperating with the DAQ middleware and the measurement control system with web user interface, called IROHA2, to execute the live data reduction code prepared by users and visualize the result which enables users to confirm them on web browser.
In this presentation, we will introduce our approaches for the live data reduction system and show the development plan.

Authors: Dr INAMURA, Yasuhiro (Japan Atomic Energy Agency); Dr YASU, Yoshiji (High Energy Accelerator Research Organization); Dr OHSHITA, Hidetoshi (High Energy Accelerator Research Organization); Dr NAKATANI, Takeshi (Japan Atomic Energy Agency)

Presenter: Dr INAMURA, Yasuhiro (Japan Atomic Energy Agency)

Session Classification: Software

Track Classification: Software

Contribution ID: **100** Type: **Poster**

Investigations of the cause of unexpected intensity tail observed in the Fermi chopper spectrometer 4SEASONS

Wednesday 16 October 2019 13:00 (2 hours)

We have introduced a new Fermi chopper with compact slit package into the direct geometry neutron spectrometer 4SEASONS in Materials and Life Science Experimental Facility at J-PARC, and succeeded in significantly improving the beam intensity compared to the old model[1]. On the other hand, the new Fermi chopper causes an unexpected intensity tail, which may adversely affects the data analysis. In order to solve this problem, we have proceeded with various inspections of a Fermi chopper blade such as Monte Carlo simulation, neutron transmission spectrum measurement and direct observation with a microscope. In this presentation, we will show some approaches taken to solve the problem and explain the rationale that led to the plausible assumption.

[1] R. Kajimoto et al., J. Phys.: Conf. Ser. 1021 (2018) 012030.

Authors: NAKAMURA, Mitsutaka (J-PARC); KAJIMOTO, Ryoichi (J-PARC); OIKAWA, Kenichi (J--PARC); SHINOHARA, Takenao (J-PARC); AIZAWA, Kazuya (J-PARC); STEFANUS, Harjo (J-PARC); IWAHASHI, Takaaki (J-PARC); KAMAZAWA, Kazuya (CROSS); IKEUCHI, Kazuhiko (CROSS); IIDA, Kazuki (CROSS); INAMURA, Yasuhiro (J-PARC); ISHIKADO, Motoyuki (CROSS)

Presenter: NAKAMURA, Mitsutaka (J-PARC)

Session Classification: Poster

Contribution ID: **101** Type: **Poster**

Quantitative phase analysis of neutron powder diffraction results by using the direct-derivation method

The direct-derivation (DD) method has been recently proposed for quantitative phase analysis (QPA) of powder X-ray diffraction (XRD). It can be used to derive weight fractions of individual components in a mixture by using a simple equation, called the intensity-composition (IC) formula. The DD method requires two kinds of parameters which are the sum of observed powder diffraction intensities for each component, and the total scattering power per chemical formula weight obtained from the individual chemical formula unit. The DD method allows a sufficiently reliable QPA result by using limited information on chemical phases in a mixture than the Rietveld analysis. In this study, we tested the DD method for the QPA of neutron powder diffraction (NPD) results for several samples. The IC formula of the DD method is not suitable for NPD in principle, but our work has yielded relatively reliable results compared to XRD. The QPA results using the DD method in XRD and NPD will be presented. In addition, the criteria for the application of the DD method to the QPA of NPD will be discussed.

Author: Dr CHO, K. (KEK)

Co-authors: Dr KAMIYAMA, T. (KEK); Dr TORII, S. (KEK); Dr HAGIHALA, M. (KEK); Dr SAITO, T. (KEK); Dr NOMA, T. (CROSS Tokai); Dr HAYASHI, M. (KMTL); Dr MINEMURA, T. (Ibaraki Pref.); Dr TORAYA, H. (Rigaku Corporation); Dr TSUBOUCHI, A. (Murata Manufacturing Co., Ltd.); Dr HOSOI, S. (Murata Manufacturing Co., Ltd.); Dr ISHIGAKI, T. (Ibaraki Univ.)

Presenter: Dr CHO, K. (KEK)

Session Classification: Poster

Contribution ID: **102** Type: **Oral Presentation**

The concept of an inverse geometry for a high power UCN source

Monday 14 October 2019 15:40 (25 minutes)

Ultra-cold neutrons (UCN) are an important experimental tool to advance the understand of particle physics, nuclear physics, astrophysics, and cosmology. Unfortunately, many of these UCN experiments are statistically limited. To help to overcome these limitations, we are proposing a so-called inverse target geometry. This geometry talks advantage of the same backscattering principle that was used in the design of the Lujan Center upper tier backscattering moderators. In this presentation we will present the underlying physics of the inverse target geometry and the neutronics optimization of a physics model.

Authors: Dr HUEGLE, Thomas (ORNL); Dr ITO, TM (LANL); Prof. LEUNG, Kent (NCST); LUTZ, EM (NCST); Dr MAKELA, M.; Dr MORRIS, C.L. (LANL); Dr MUHRER, Guenter (European Spallation Source ERIC); Dr PATTIE, R.W. (LANL); Dr SAUNDERS, A. (LANL); Prof. YOUNG, A.R. (NCST)

Presenter: Dr MUHRER, Guenter (European Spallation Source ERIC)

Session Classification: Sources

Track Classification: Target/Moderator

Contribution ID: **103** Type: **Oral Presentation**

UCN extraction system for a high power, inverse geometry UCN source

Ultra-cold neutrons (UCN) are an important experimental tool to advance the understand of particle physics, nuclear physics, astrophysics, and cosmology. Unfortunately, many of these UCN experiments are statistically limited. To help to overcome these limitations, we are proposing a so-called inverse target geometry. While this geometry has clear advantage for the production of neutrons, it also presents challenges for the extractions of the ultra-cold neutrons. In our presentation we will present how we propose to extract the UCNs and the expected extraction rate.

Authors: Dr SAUNDERS, A. (LANL); Prof. YOUNG, A.R. (NCST); Dr MORRIS, C.L. (LANL); LUTZ, EM (NCST); Dr MUHRER, Guenter (ESS ERIC); Prof. LEUNG, Kent (NCST); Dr MAKELA, M.; Dr PATTIE, R.W. (LANL); Dr ITO, TM (LANL); Dr HUEGLE, Thomas (ORNL)

Presenter: Dr MUHRER, Guenter (ESS ERIC)

Session Classification: Operations/Safety

Track Classification: Operation/Safety

Contribution ID: **104** Type: **Poster**

Electron Beam Welding SNS Targets

Thursday 17 October 2019 16:30 (2 hours)

Electron Beam (EB) Welding is a fusion welding process that utilizes a beam of high energy electrons to melt metals. It is a process that has been around since the 1950s. SNS uses two types of EB welding machines to manufacture Targets. The two types of machines are High Voltage and Low Voltage EB welders. EB welding provides SNS many benefits when it comes to building targets. Some of these advantages are cleanliness, quality, repeatability, flexibility, efficiency, and automation.

EB welding is performed under vacuum. The targets are welded at a vacuum of 100µTorr or lower. By welding under vacuum, the molten metal is not subject to any ambient gases. In other fusion welding processes such as Gas tungsten Arc Welding (GTAW) and Shielded Metal Arc Welding (SMAW) the molten metal is only protected by a small area of inert gas. This means that the molten metal is subject to atmospheric gases which can result in impurities and oxidation in the weld and heat affected zone (area of base metal which is not melted but has had its microstructure and properties affected by welding). The result of welding in a vacuum is a clean weld free of impurities.

Prior to welding, every piece of the target is precision machined, pre-assembled, and inspected to verify it meets the part print dimensions. Each part should meet these same print dimensions after it is welded. To do this, heat input needs to be kept at a minimum to prevent distortion. EB welding makes this possible. GTAW and SMAW processes require multiple weld passes, have significant heat input, and a large heat affected zone. The result is significant distortion of the part. EB welding has a very high depth to width ratio and can be performed in a single weld pass without filler metal. The result is a very small heat affected zone, and minimal distortion.

Prior to welding Target assemblies, samples are given to the weld operators to develop parameters. The first sample welded is a piece of flat plate that is machined to the same thickness as the Target joint to be welded. The operator will use this to come up with base settings. Next a sample is created that mimics the geometry and properties of the Target weld joint. With this sample the operator can fine tune the base settings to meet the given weld specifications. After this sample is tested and inspected to verify it meets all specified requirements the settings are saved, and weld programs are created.

Using written instructions, designated tooling, and EB welding CNC programs the welds of the SNS targets is a repeatable process. This is important for current and future planning, building, and testing of the Target assemblies.

Author: SUMMERLOT, Nick

Presenter: SUMMERLOT, Nick

Session Classification: Poster

Track Classification: Target/Moderator

Contribution ID: **105** Type: **Poster**

Study of the neutron absorbers materials coated on the back side of analyzer silicon crystal wafer

Wednesday 16 October 2019 13:00 (2 hours)

The silicon crystal analyzer is an important spectroscopic device in a high energy resolution neutron inelastic scattering backscattering spectrometer. Specifications of this spectroscopic device is thought to determine energy resolution and background.
In order to achieve a low background spectrum without degradation of the energy resolution, it was developed new crystal analyzer which was coated by thin film of neutron absorbers on the back side of Si wafer, and used it for the crystal analyzer for a new backscattering spectrometer.
In the presentation, it will be shown that the advantages and disadvantages of the coating methods that has been considered during the development. Then, it will be also discussed the performance of spectrometer which is constructed based on the new developed coating method.

Author: SHIBATA, kaoru (J-PARC Center, Japan Atomic Energy Agency)

Presenter: SHIBATA, kaoru (J-PARC Center, Japan Atomic Energy Agency)

Session Classification: Poster

Contribution ID: **106** Type: **Poster**

How To Design a Focusing Guide: The Large Moderator Case

Wednesday 16 October 2019 13:00 (2 hours)

As continuously shaped super-mirrors are becoming more available, the conceptual design of focusing guides should explore a wider range of possibilities to accomplish an efficient neutron beam extraction. Starting from a desired phase-space volume at the sample position and using an upstream ray-tracing approach, the acceptance diagram of any focusing guide can be calculated at the moderator position. To ensure high brilliance transfer and homogeneous coverage, the acceptance diagram should be fully included in the neutron source emission phase-space volume within the entire wavelength band of interest. Following this idea, the guide system can be scaled into dimensionless geometric figures that convey performance limits for a desired cross-section reduction. Moreover, if we impose a monotonic increase of the reflection angle with divergence angle at the sample position, the optimal shape of the mirror is analytically determined. This approach was applied in the design of SNAP and DISCOVER instruments at SNS-FTS, located at ORNL, USA. The results of McStas simulations are presented with different options included.

Authors: Dr STOICA, Alexandru (Spallation Neutron Source); FROST, Matthew (Oak Ridge National Laboratory); HUEGLE, Thomas (ORNL)

Co-author: Dr DOS SANTOS, Antonio (ORNL)

Presenters: Dr STOICA, Alexandru (Spallation Neutron Source); FROST, Matthew (Oak Ridge National Laboratory)

Session Classification: Poster

Contribution ID: **107** Type: **Oral Presentation**

Conceptual Design of the Target Systems for the Second Target Station (STS)

Wednesday 16 October 2019 12:00 (25 minutes)

The Second Target Station (STS) is a proposed major upgrade to the Spallation Neutron Source that will provide new cutting-edge neutron scattering capabilities enabling researchers to use the unique properties of neutrons to advance scientific discovery and to solve the most challenging technology problems.

STS Target Systems encompasses the technical components and support facilities necessary to convert the 0.7 MW 15 Hz proton beam into cold neutrons and direct the neutrons into the instrument guides. The Target Systems are optimized to produce the high brightness cold neutron beams that are the defining feature of the STS. This is accomplished by producing neutrons in as small a target volume as possible and by adopting compact moderator designs that are optimally coupled in location relative to this volume. The STS employs a solid rotating tungsten target, 2 coupled hydrogen moderators, and a beryllium reflector.

An overview of the Target Systems conceptual design is included, with focus on the most unique and challenging aspects of the design.

Author: ROSENBLAD, Peter (Oak Ridge National Laboratory)

Co-authors: DAYTON, Michael (Oak Ridge National Laboratory); GAWNE, Ken (Oak Ridge National Laboratory); JACOBS, Lorelei (Oak Ridge National Laboratory); MCMANAMY, Thomas (Oak Ridge National Laboratory); REMEC, Igor (Oak Ridge National Laboratory); RENNICH, Mark (Oak Ridge National Laboratory)

Presenter: ROSENBLAD, Peter (Oak Ridge National Laboratory)

Session Classification: Target

Track Classification: Target/Moderator

Contribution ID: **108** Type: **Poster**

The ISIS Data Acquisition Electronics Development

Thursday 17 October 2019 16:30 (2 hours)

D Templeman, J Norris, R Brumfitt and K Gascoyne
Science and Technology Facilities Council, UK

The Data Acquisition Electronics on ISIS supports 30 neutron and 5 muon Instruments. It interfaces to a variety of detector types and sizes. It also interfaces to beamline components and sample environment kit that can control the operation of the data acquisition process.

This poster provides an overview of development and future upgrades including:
- Parameterization of run time variables
- Sample Environment
- GPS timestamping
- Improved Data Readout

Author: Mr TEMPLEMAN, David

Co-authors: Mr NORRIS, Julian; Mr BRUMFITT , Ronnie; Mr GASCOYNE, Kelvin

Presenter: Mr TEMPLEMAN, David

Session Classification: Poster

Contribution ID: **109** Type: **Oral Presentation**

The LSWT engine SpinW and modeling ToF data

Thursday 17 October 2019 14:30 (25 minutes)

In Inelastic Neutron Scattering (INS) the study of spin-waves in magnetically ordered materials has always been a cornerstone of scientific output since the Triple-axis spectrometer (TAS). Since measuring these excitations is now an everyday occurrence, increasingly exotic materials are becoming the norm.
As materials have become more exotic, the need for data analysis and modeling of these systems has become as important. For modeling spin-wave excitations one of the most popular techniques has been Linear Spin-Wave Theory, which is semi-classical in nature. The traditional workflow of having a student develop a program incorporating LSWT for a specific material is no longer sustainable.
In recent years a few groups have tackled this problem and developed programs to generalise LSWT theory an make modeling simpler and less time consuming. One such program is SpinW, which has become the de-facto standard of LSWT modelling. This is primarily due to the simple and yet powerful interface and full featureset. Indeed, models and simulations are usually less than 15 lines of code, where crystal symmetry analysis of bonding and exchange matrices has been performed and complex magnetic structures described or optimised.
Complimentary to the modeling aspect is data analysis, which is increasingly complex when large Time of Flight (TOF) datasets are obtained. One such program for reduction is Horace, which integrates closely with SpinW.

In this presentation I will aim to introduce SpinW and the key features which have made it the de-facto standard in modeling spin-waves within the LSWT framework. Then, I'll introduce the compound Yttrium Iron Garnet (YIG), a material used in telecommunication infrastructure. I will describe my work on this compound, how the low temperature spectrum was modeled and optimised to a large dataset which was taken on the MAPS spectrometer at STFC ISIS. I will comment on the lessons learnt from this experience and how it affected the future roadmap with respect to the European Spallation Neutron Source and future developments.

Author: Dr WARD, Simon (ESS - DMSC)

Presenter: Dr WARD, Simon (ESS - DMSC)

Session Classification: Software

Track Classification: Software

Contribution ID: **110** Type: **Oral Presentation**

Progress of Z-Rietveld software

In this decade, high-intensity spallation neutron sources combined with the Time-of-flight (TOF) method such as SNS, J-PARC and CNCS are available, and ESS will be available in the future. Using such the neutron source, neutron powder diffraction data are collected with higher statistics and/or resolution than conventional reactor sources. After the data reduction is done correctly to change the XY data, Rietveld method is available to refine the crystal and magnetic structures. While we can use high quality TOF data, the peak shape of the profile is more complicated than the data of reactor source because of the energy distribution of the incident beam, the geometry of the spectrometer and the time focusing of the data. In addition, the TOF range of single detector bank is limited, so that the data of multi-detector banks must be included to Rietveld refinement for accuracy.
Z-Rietveld program, produced by KEK powder group, is mainly developed for the data collected at J-PARC. We can easy to perform multi-phase, multi-profile Rietveld analysis. Compared to other Rietveld software, Z-Rietveld provide the high convergence because of calculation method. Another advantage of Z-Rietveld is to perform the continuous refinement of Pawley and Rietveld method, which is useful for unknown structure and multi-phase analysis. Z-Rietveld does not only support other TOF data but also both neutron and X-ray angle dispersive data. The aim of Z-Code project is to provide the data analysis tools to many kind of users with the latest application feeling to many kind of users.
The main progress of Z-Rietveld in the past of three years are the refinement of magnetic structure represented by propagation vector (from ver1.0.0), and both Fourier and maximum entropy method (MEM) (from ver. 1.1.0). We can perform continuous refinement of Rietveld method and MEM. Improvement of these function is still in progress. We also have plans to provide automatic analysis, the direct-derivation (DD) method and some useful functions. In this presentation, we show some example of magnetic structure analysis and MEM analysis and roadmap of Z-Code project.

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Presenter: Dr HAGIHALA, Masato (KEK)

Session Classification: Software

Track Classification: Software

Contribution ID: **111** Type: **Poster**

SNS Inner Reflector Plug Design and Fabrication Status

Monday 14 October 2019 16:30 (2 hours)

The Spallation Neutron Source is in the process of completing the design and fabricating the third inner reflector plug for the facility (IRP-3). During the procurement of the previous inner reflector plug (IRP-2), several challenges arose that significantly extended the procurement time to approximately nine years. Lessons learned from IRP-2 are being incorporated into IRP-3 to drastically reduce the procurement time to less than four years.

The most notable design changes are the rerouting of the water and cryogenic moderator piping and moving the cadmium coating in the cryogenic moderator area from the moderator exterior to the interior of the housing surrounding the moderator. The rerouting of the piping allows for parallel fabrication of major sub-assemblies and easier leak checking. Relocating the cadmium coating eases the tight tolerance requirements in the moderator area.

To take advantage of the new design flexibility, a different procurement strategy is underway. Instead of the single, fixed-price contract approach used for IRP-2, the new approach is to release multiple contracts for major sub-assemblies to multiple vendors for later final assembly. The approach allows for better matching of vendors' technical abilities for particular sections of the IRP, reduces the risk for any single procurement, and allows for parallel manufacturing activities, ultimately reducing the overall manufacturing time.

Author: LYTTLE, Mark (Oak Ridge National Lab)

Co-author: Mr JANNEY, Jim (Oak Ridge National Laboratory)

Presenter: LYTTLE, Mark (Oak Ridge National Lab)

Session Classification: Poster

Track Classification: Target/Moderator

Contribution ID: **112** Type: **Oral Presentation**

User-friendly software for modeling collective spin wave excitations

Thursday 17 October 2019 15:45 (25 minutes)

SpinWaveGenie is a Python/C++ software library that simplifies the modeling of collective spin wave excitations, allowing scientists to analyze neutron scattering data with sophisticated models fast and efficiently. Furthermore, one can calculate the scattering function S(Q, E) to directly compare and fit calculations to experimental measurements. Its generality has been both enhanced and verified through successful modeling of a wide array of magnetic materials. By adding features such as the Python bindings, we have moved SpinWaveGenie from an early prototype to a free open source software package accessible to the scientific community. Usability has been improved by simplifying the edit, build and debug cycle. Furthermore, SpinWaveGenie can be leveraged in larger workflows using the large ecosystem of open-source scientific software written in Python or with a Python API. For example, the Atomic Simulation Envrionment has been used to help build the spin structures, LMfit has been used to fit exchange parameters, and Paraview has been used to visualize results. Several examples of its use to model the spin wave spectrum of powder and single crystal MnO and compare it to measurements from HYSPEC will be discussed.

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Authors: HAHN, Steven (Neutron Scattering Division, Oak Ridge National Laboratory); GRANROTH, Garrett (Oak Ridge National Laboratory); GARLEA, Ovidiu (ORNL)

Presenter: HAHN, Steven (Neutron Scattering Division, Oak Ridge National Laboratory)

Session Classification: Software

Track Classification: Software

Contribution ID: **113** Type: **Oral Presentation**

Beam Dump Facility (BDF) production target at CERN –technological challenges, beam irradiation and R&D activities

Thursday 17 October 2019 11:45 (25 minutes)

The SPS Beam Dump Facility (BDF) Project [1], currently in its comprehensive design phase, is a proposed general-purpose fixed target facility at CERN, dedicated to the High Energy Physics (HEP) community and specifically to the Search for Hidden Particles (SHiP) experiment in its initial phase in the framework of the Physics Beyond Colliders (PBC) initiative [3].

At the core of the installation resides a high-Z target/dump assembly, whose aim is to fully absorb the high intensity proton beam slowly extracted from the Super Proton Synchrotron (SPS) at 400 GeV/c (355 kW average power). One of the most challenging aspects of the proposed installation resides in the high beam energy and the deposited power density reached during operation, up 18 MW/m3 and 2.6 MW per pulse, and in its pulsed nature. These conditions are quite similar to those encountered in a new generation neutron spallation sources.

The foreseen BDF target/dump is a water-cooled TaW-cladded segmented TZM (Mo-alloy) and pure W hybrid core [4]. The assembly is 250 mm in diameter and 1500 mm total length with single blocks from 25 to 350 mm long, optimized in terms of physics and their thermo-mechanical response. The cladding is ensured by diffusion bonding by means of the hot isostatic pressing (HIP) technique. The target/dump design features are quite similar to neutron targets such as ISIS (UK) and the future STS (US).

Significant R&D has been dedicated to the optimisation of the cladding process, with detailed studies on the diffusion bonding, thermal conductivity and optimisation of the hot isostatic pressing cycles, also aimed at validating new materials such as TZM and Ta2.5W [5].

In order to validate the design of the BDF target, a scaled prototype target/dump has been constructed and a beam test has been executed in October 2018 at CERN. The prototype has the same configuration as of the final target, with the exception of the diameter, 80 mm rather than 250 mm.

The BDF target complex has been also studied in detail, in order to optimize the handling process of the target and the shielding components as well as to take into account all relevant radiation protection recommendations [6]. An online innovative He passivation system has also been developed, with the objective of having an inert helium gas atmosphere around the production target and the shielding assembly to reduce activation and radiation assisted corrosion.

The contribution will summarize the main aspects of the facility, highlighting relevant aspects of this HEP facility for the worldwide spallation neutron community as well as the future prospects and R&D.

[1] https://doi.org/10.18429/JACoW-IPAC2017-TUPVA126
[2] https://doi.org/10.1088/1748-0221/14/03/P03025
[3] https://arxiv.org/pdf/1902.00260.pdf
[4] https://arxiv.org/abs/1904.03074
[5] https://doi.org/10.1002/mdp2.101
[6] https://iopscience.iop.org/article/10.1088/1748-0221/13/10/P10011

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Presenter: CALVIANI, Marco (CERN)

Session Classification: Target

Track Classification: Target/Moderator

Contribution ID: **114** Type: **Oral Presentation**

Current Status of Scintillation Detector Development at ISIS

Tuesday 15 October 2019 11:25 (25 minutes)

Scintillation detectors using ZnS:Ag/^{6}LiF are currently used and being developed in a number of facilities such as J-PARC [1], SNS [2], CSNS [3] and ISIS[4]. At ISIS, these scintillation detectors have been employed for more than two decades and service approximately half of the instruments. There are currently three types of ZnS:Ag/^{6}LiF detectors in use on ISIS, scintillator viewed by photomultiplier tubes (PMTs) which are air coupled with aluminised reflector guides, scintillator coupled to PMTs with clear optical fibres [5] and scintillator coupled to multi-anode PMTs (MAPMT) with wavelength shifting fibre (WLSF).

Recent advances in scintillator detector technology at ISIS are presented here. WLSF detector technology is being developed for multiple applications at ISIS. Progress in mechanics and signal processing for reflectometry, single crystal and powder diffraction applications will be discussed. Improvements include neutron positioning to better than 0.5mm, higher rate capability and significant reduction in production cost.

In addition to the development work being carried out at ISIS with ZnS:Ag/^{6}LiF based detectors, an extensive investigation of neutron sensitive scintillators has been undertaken. This investigation has been prompted by advances in neutron instrumentation which have led to large increases in flux delivered to the sample. ZnO:Zn/^{6}LiF has been identified as a potential replacement of ZnS:Ag/^{6}LiF for higher rate applications. Some characteristics of ZnO:Zn/^{6}LiF based scintillation detectors will be presented.

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Session Classification: Instruments

Track Classification: Instrument

Contribution ID: **115** Type: **Oral Presentation**

Neutron beam extraction from small moderators: secondary source approach

Thursday 17 October 2019 11:25 (25 minutes)

The advance in manufacturing of neutron supermirrors allows for an efficient brilliance transfer and a versatile design of the neutron transport system from moderator to the sample position. In the case of beam extraction from small moderators, as STS will provide, elliptical shaped supermirrors seem to be the optical element of choice. Here we describe an optical system consisting of two parts: a primary deflecting guide, which creates a rather concentrated secondary source far away from the moderator, and a secondary focusing system of choice, which can deliver alternative distinct phase space selection at sample position. To preserve a high brilliance transfer, the acceptance diagram of the secondary system must be included into the secondary source emission phase space volume. McStas code was used to calculate the neutron tracing and the sequence of elements used in the simulations is described. We present the results obtained for two future diffraction instruments at STS: MENUS and VERDI, with desired high resolution and high intensity options. For the secondary focusing system, beside the basic Montel type mirror arrangement, we explore also a Wolter type sequence of mirrors for aberration-less focusing.

Authors: HUEGLE, Thomas (ORNL); Dr STOICA, Alexandru (Spallation Neutron Source)

Presenter: HUEGLE, Thomas (ORNL)

Session Classification: Instruments

Track Classification: Instrument

Contribution ID: **116** Type: **Oral Presentation**

Target Segment Design Analysis for the STS Conceptual Design

Thursday 17 October 2019 11:20 (25 minutes)

The objective of producing a high brightness neutron source required designing for a very high peak energy deposition per pulse in the tungsten with energy deposition times on the order of 800 nano-seconds. This produces high dynamic stresses in the tungsten. Average heat removal requirements for the 700 kW beam are reduced by using a rotating target and can be met with water cooling with a tantalum clad on the tungsten to minimize corrosion. Proton beam profiles and target sizes were evaluated with the objective of keeping the peak stresses close to what has been demonstrated in existing tungsten spallation targets.
The analysis required a sequence of separate calculations. For a given model, neutronic calculations provided the energy depositions in the segments. CFD calculations then found the temperature profiles for the hipped tungsten/tantalum block and the surrounding stainless steel vessel with the associated water temperatures. The temperature profiles were imported into an Abaqus standard model to calculate the thermal stresses just before a pulse. An Abaqus explicit dynamic analysis was then done for the tungsten/tantalum block using the thermal stress profiles as an initial condition. Irradiated tungsten properties were used for most cases.
An overview of the design and results including normal and off-center proton beams, peaked beam and diffuse beam cases will be given. Initial evaluation of the consequences of internal by-pass flows will also be given.

Authors: MCMANAMY, Thomas (ORNL); KAO, Min_Tsung (ORISE); Mr ROSENBLAD, Peter (ORNL); Mr REMEC, Igor (ORNL); Mr RENNICH, Mark (ORNL)

Presenter: MCMANAMY, Thomas (ORNL)

Session Classification: Target

Track Classification: Target/Moderator

Contribution ID: **117** Type: **Poster**

Investigations of Timing Uncertainties for Fermi Chopper Spectrometers

Monday 14 October 2019 16:30 (2 hours)

For direct geometry spectrometers time uncertainties of $< 10\mu$s are negligible for most measurements. However the ARCS and SEQUOIA instruments at the Spallation Neutron Source use a chopper that produces a time pulse as narrow as 5μs for the finest resolution measurements. Timing uncertainties $\sim 1\mu$s are important in this case. Furthermore superresolution techniques have been demonstrated where the relevant time scale for resolution calculations is now controlled by the slope of the moderator pulse shape rather than the pulse width; yet another case where fine timing uncertainties are relevant.

To understand these uncertainties, two studies have been performed on the SEQUOIA and ARCS instruments at the SNS to check the stability of the incident energy (E_i) over the coarse of time. First on SEQUOIA a depleted Uranium containing sample was measured with a nominal $E_i = 100$ meV. The beam monitors, the time of the fission neutrons on the detector, and the elastic signal on the detector were all used as fixed points in time. The measurement revealed a slow ($\sim$ 6 hour) drift of about 1.2μs that corresponds to an E_i change. During this measurement, the temperature of the water from the moderator was observed to vary by about 1° C due to power changes from the accelerator.
Since the value of E_i is sufficiently close to the temperature of the moderator, the mean emission time for a given energy changes quickly enough that a small temperature change may be observable in the results. To further correlate the connection between moderator temperature and time shift, measurements of Vanadium were carried out at $E_i = 100$meV on ARCS during the power ramp up at the start of a cycle. Similar time variations, correlated with water temperature, and consistent with incident energy variations, were observed with this measurement. This contribution will more fully describe these measurements and their correlation to moderator temperature. Furthermore other potential causes, like instrument dimension changes or chopper phase instabilities will be discussed and ruled out.

Authors: GRANROTH, Garrett (Oak Ridge National Laboratory); STONE, Matthew (Oak Ridge National Laboratory); IVERSON, Erik (ORNL); Ms JACOBS, Lorelei (ORNL); HARTMAN, Steven

Presenter: GRANROTH, Garrett (Oak Ridge National Laboratory)

Session Classification: Poster

Contribution ID: **118** Type: **Poster**

Examples on using the McStas Union components

Wednesday 16 October 2019 13:00 (2 hours)

Ray-tracing simulations have been an important part of neutron scattering since the inception of the field. Although ray-tracing simulations of instrumentation came later, they are now the standard tool of the trade for design of instrumentation. Instrument simulations are, however, not yet commonly used in experiment planning or data analysis where they have obvious potential. To reach this potential, Monte Carlo Ray-tracing simulations must be flexible enough to describe the relevant science, and should integrate seamlessly into established workflows. Here we present advances within the McStas simulation package both in terms of the achievable fidelity and use in modern Python workflows.

The McStas Union components were introduced at ICANS XXII in Oxford where early work was shown. These components allow the user to describe complex geometries using combinations of simple shapes and conducts simulation of all multiple scattering between these. Each volume can be given a material definition that includes any number of user-defined scattering processes. The Union components also contains powerful visualization tools that show scattering within the model.
This presentation will provide a brief overview of the Union components, but the main focus will be examples of their application for different types of experiments.
The primary use case of the Union components is to simulate the sample environment and sample in order to investigate possible spurions from multiple scattering. We show an example featuring a cryostat with a single crystal sample and a pressure cell with a powder sample. The Union components are also well suited to imaging experiments where it is important to have different materials embedded in the overall geometry. We show a calibration sample and a model of a Viking sword, both with an emphasis on the use of Bragg edges to identify materials.
We also demonstrate the possibilities for more advanced samples with a model of a lithium battery including repeating stacks of the 5 different layers. The temperature and charge level are adjustable and affect both the lithium concentration in the layers and a few selected Bragg peaks.
In order to facilitate advanced workflows, a python API for McStas called McStasScript has been written in connection with the PaNOSC project. The API has bindings for writing McStas instruments, executing the simulations and handling data/plotting. With this tool, it is significantly easier to use McStas in python workflows that include generation of scattering patterns (e.g. based on atomic-scale simulations), fitting or optimization.

This work is part of the work package on simulation in the PaNOSC project, which has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 823852.

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Presenter: Dr BERTELSEN, Mads (ESS)

Session Classification: Poster

Track Classification: Software

Contribution ID: **119** Type: **Oral Presentation**

Flight Path Shielding Study with the Next-Generation Lujan Target-Moderator-Reflector-Shield Assembly

Thursday 17 October 2019 14:00 (30 minutes)

The next-generation Lujan Target-Moderator-Reflector-Shield assembly (Mark-4 design) is currently being fabricated and is scheduled for installation during the upcoming extended outage period in Spring of 2020. The new design will offer significantly changed neutronic performance for the four upper-tier flight paths (FPs). The neutronic performance for the remaining lower-tier flight paths remains principally unchanged. For more details regarding the proposed physics design performance see Ref. [1]. The upper-tier flight paths will be viewing a thin spallation target surrounded by a water moderator resulting in higher fast neutron flux and improved energy resolution available for nuclear physics experiments. The changes in the neutronic performance for upper-tier flight paths require us to study the efficacy of the shielding package for the affected FPs. In this paper we will introduce the layout of the upper-tier FPs in the current configuration at Lujan Center at LANSCE. We will describe the detailed 3-D geometry implemented in MCNPX [2] and discuss the early results.

References:

[1] L. Zavorka et al., Nucl. Instr. and Meth. A, 901 (2018) pp 189-197

[2] MCNPX user's manual, D. B. Pelowitz editor, LA-CP-07-1473

Authors: MOCKO, Michael (Los Alamos National Laboratory); NIKOLAOS, Fotiadis (Los Alamos National Laboratory); ZAVORKA, Lukas (LANL)

Presenter: MOCKO, Michael (Los Alamos National Laboratory)

Session Classification: Target

Track Classification: Target/Moderator

Contribution ID: **120** Type: **Oral Presentation**

Polarization Developments at the Direct Geometry Spectrometer HYSPEC

Tuesday 15 October 2019 15:20 (25 minutes)

HYSPEC is a direct geometry spectrometer at the Spallation Neutron Source, with optional polarization analysis. The region around the sample is sufficiently configurable to accommodate a variety of polarization optics. Several optics have been prototyped, tested and in some cases implemented as part of HYSPEC's user program. Instrument upgrades and testing which did not introduce new optics have improved the polarization analysis operations and effectiveness at HYSPEC. The first such improvement is an elevator / oscillator system, which for the first time enables rapid change (~10 minutes) from an unpolarized mode to a polarized mode of operation, introducing significant flexibility and convenience. The second improvement leverages a new portable detector platform that employs the same data acquisition systems employed for all SNS instruments. This platform is temporarily used to explore shielding configurations for the HYSPEC detector vessel, both to reduce the time-independent background and to both reduce and shorten the time-dependent prompt-pulse background. HYSPEC serves as a useful test platform for novel techniques, including the planned commissioning of a new spherical neutron polarimetry system ultimately intended for use on a triple axis spectrometer at the High Flux Isotope Reactor. Optics upgrades for HYSPEC have been built but not yet commissioned with neutrons, including a newly built RF flipper and a new and compact 3D coil system.

Authors: GARLEA, Ovidiu (ORNL); WINN, Barry (ORNL NSCD); Dr KANG, Yoon (Oak Ridge National Laboratory); JIANG, Chenyang; SILVA, Nicolas (Oak Ridge Associated Universities); VODOPIVEC, Klemen; IVERSON, Erik B. (ORNL); GRAVES-BROOK, Melissa (ORNL); CONNER, David (ORNL); PARIZZI, Andre (ORNL); BERRY, Kevin (ORNL); HICKS, Steve (ORNL)

Presenter: WINN, Barry (ORNL NSCD)

Session Classification: Instruments

Track Classification: Instrument

Contribution ID: **121** Type: **Poster**

Onion plots for a quick estimate of moderator-instrument interplay

Wednesday 16 October 2019 13:00 (2 hours)

When designing a neutron scattering instrument, many decisions about the instrument parameters will need to be made for both the primary flight path (e.g. flight path length, maximum divergence of a guide system) and the instrument itself (layout of detectors, pixel size of detector, etc.). McStas offers a way to simulate instrument performance as a function of these parameters, but attempting to fill in the multidimensional matrix of parameters by individual simulations is time-consuming work. We will present an approach using layers of detectors around the sample position to quickly map out e. g. the resolution space of the currently planned Second Target Station moderators as a function of divergence and flight path length. The method relies heavily on McStas'ability to generate Mantid readable NeXus event data files.

Author: HUEGLE, Thomas (ORNL)

Presenter: HUEGLE, Thomas (ORNL)

Session Classification: Poster

Track Classification: Target/Moderator

Contribution ID: **122** Type: **Poster**

Brilliance Transfer calculations for the Second Target Station

Monday 14 October 2019 16:30 (2 hours)

Brilliance Transfer (BT) calculations have emerged as a useful tool to judge the overall efficiency of a guide system1. In this talk, I will present a source-to-sample approach to BT calculations and showcase one way to practically implement this into McStas simulations using standard components. I will discuss the BT calculation results for the preliminary guide design types of the initial suite of Second Target Station instruments at ORNL. Special attention will be paid to the advantages as well as the practical and theoretical limitations of this approach.

(1) Andersen, K. H.; Bertelsen, M.; Zanini, L.; Klinkby, E. B.; Schönfeldt, T.; Bentley, P. M.; Saroun, J. Optimization of Moderators and Beam Extraction at the ESS. J. Appl. Crystallogr. 2018, 51 (2), 264–281.

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Presenter: HUEGLE, Thomas (ORNL)

Session Classification: Poster

Contribution ID: **123** Type: **Oral Presentation**

Conceptual Design of the Moderator Reflector Assembly for the Second Target Station

Wednesday 16 October 2019 12:25 (25 minutes)

The proposed Second Target Station (STS) addition to the Spallation Neutron Source will provide world leading neutron scattering capabilities based on cold neutron beams optimized for high brightness.
The Moderator Reflector Assembly (MRA) surrounds the neutron production zone of the STS solid rotating tungsten target and is comprised of 2 coupled hydrogen moderators, one cylindrical and one consisting of tubes arranged in a triangle, nested within light water premoderators assembled within 2 beryllium reflectors. The moderator and premoderator vessels have been designed from shapes and sizes resulting from neutronic optimization and the wall thicknesses and gaps have been minimized. The beryllium reflector is designed to be edge cooled in order to maximize the volume of reflector adjacent to the moderators. The hydrogen moderators are extremely compact and located as close to the target as possible; therefore, alignment of the MRA is critical. The geometry of the rotating target requires horizontal translation of the MRA to during installation and removal, further complicating precision alignment.
The Moderator Reflector Assembly for the STS has been designed to produce high brightness cold neutron beams from the 0.7 MW 15 Hz target station.

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Presenter: JANNEY, James (Oak Ridge National Laboratory)

Session Classification: Target

Track Classification: Target/Moderator

Contribution ID: **124** Type: **Poster**

Towards a High-Throughput High-Resolution Neutron Pinpointing CMOS Camera System for Imaging

Tuesday 15 October 2019 11:00 (25 minutes)

High sensitivity CMOS cameras can collect neutron scintillation images at over 1000 fps. Individual neutron scintillation events can be pinpointed by a center-of-gravity image processing routine and a cumulative high-resolution image constructed using thousands of individual raw images. The time for such a data collection maybe 10 seconds but image processing on a CPU can take about 500 ms an image yielding total processing time of over a hour for all images. Multi-threading the processing of scintillation images across 1 or more GPGPUs should be able to achieve real-time generation of constructed high-resolution images.

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Presenter: Dr HODGES, Jason (Oak Ridge National Laboratory)

Session Classification: Instruments

Track Classification: Instrument

Contribution ID: **125** Type: **Oral Presentation**

Refined Radiation Safety Analysis and System Classification for the ESS Target Station

Tuesday 15 October 2019 10:55 (25 minutes)

During operations at the European Spallation Source (ESS), the high power proton beam will generate penetrating fast neutrons in the tungsten target, creating a significant inventory of nuclides in the target and adjacent components and structures. A systematic process has been executed to identify, evaluate, and prevent or control accidental events that potentially create a radiological hazard to the public, environment, or workers.

In the original qualitative analysis, several hundred top events associated with ESS Target Station operations were identified as having the potential to lead to scenarios with radiological consequences. From these initial events, 22 were selected for in depth accident analysis and were assessed to determine the potential radiological consequences and identify any necessary risk reducing measures. For each, a quantitative assessment was made of the likelihood of occurrence, the inventories and material at risk, the event development, the material released, and the unmitigated radiological consequences. This led to the selection of radiation safety functions (RSFs) to either prevent or mitigate the hazardous scenarios. Subsequently, structures, systems, and components (SSCs) that perform each RSF were assigned a safety class and role within the defense in depth strategy for the Target Station. This classification then determined requirements for the SSCs in terms of design, quality, and reliability.

Since the initial analyses, there have been new developments in the ESS radiation safety analysis and classification process. In particular, application of the deterministic approach to the analyses has been refined, the impact of SSCs present during normal operations has been included, and sensitivity studies have been added to the analyses to more thoroughly evaluate the impact of assumptions applied. In addition, analysis with respect to the consequences for the public have been separated from that with respect to the workers, with worker analyses permitted to apply a more probabilistic approach. Finally, system classification, with respect to regulations, is now determined solely by the analysis of the radiological impact with respect to the public. As such, the classification of many target systems and the corresponding requirements have changed since the initial assessments were performed.

The updates to the Target Station radiation safety analyses will be described, with emphasis on the changes to the process and the subsequent impact of those changes. Results from the accident analyses for several events, the radiation safety functions identified, and the classification of SSCs will be explained. In addition, new events under analysis and the strategy for evaluation of maintenance activities will be discussed.

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Presenter: CONEY, Linda (European Spallation Source ERIC)

Session Classification: Operations/Safety

Track Classification: Operation/Safety

Contribution ID: **126** Type: **Oral Presentation**

Neutronics Analyses for the Conceptual Design of the SNS Second Target Station

Thursday 17 October 2019 15:00 (30 minutes)

The Spallation Neutron Source (SNS) has been in operation since 2006 at the Oak Ridge National Laboratory. SNS was designed to accommodate two upgrades: the accelerator proton power upgrade (PPU), and a second target station (STS). The PPU project is currently funded and underway, while the STS project is preparing for the US Department of Energy Critical Decision 1 review. The PPU will double the proton beam power from 1.4 MW to 2.8 MW. Both targets, the existing first target station (FTS) and added STS, will operate in pulsed mode, receiving short (< 1 μs long) proton pulses with ~46 kJ of energy per pulse. The FTS currently operates at up to 1.4 MW power, with pulse frequency of 60 Hz. After the completion of the PPU and the construction of the STS, the FTS will receive 2 MW at 45 Hz, and the STS will get 700 kW of the proton beam power at 15 Hz. High proton beam power and pulsed operation create challenges and constraints for the target design due to high local heating rates, high stresses, high activation, and decay heat. The FTS operates with a liquid mercury target. The initial STS concept was based on stationary tungsten target, with small proton beam footprint of only 30 cm2. However, target activation simulations and subsequent accident analyses found that high residual heat from activation products concentrated in a small target volume could lead to target meltdown in case of the most severe loss-of-cooling accident. This moved the current conceptual design of the STS to the rotating target. The rotating target consists of a segmented tungsten disk with a diameter of ~ 1.1m, with tungsten plates clad with tantalum, cooled with water, and covered with stainless-steel shroud. The target disk will contain twenty-one segments, will perform one turn in 1.4 s, and will be synchronized with the proton pulses so that the consecutive proton pulses will hit adjacent target segments. In the rotating target, the proton beam heating, radiation damage, activation, and decay heat are spread over much larger volume compared to the stationary target. Spreading the energy across a larger target volume greatly reduces the consequences of accidents. The current status of neutronics analyses for the STS target conceptual design will be presented.

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Session Classification: Target

Track Classification: Target/Moderator

Contribution ID: **127** Type: **Poster**

The Beam Monitor Common Project for the Instruments of the European Spallation Source ERIC

Thursday 17 October 2019 16:30 (2 hours)

The design and deployment of 15 neutron instruments in three halls, equipped with more than 150 choppers and numerous optical components is a challenge the European Spallation Source ERIC is confronted with in the immediate future. In order to diagnose the correct transport of the neutron beam, approximately 50 beam monitors are required to be installed at various locations along the neutron instruments, e.g. in the bunker to offer information on the target moderator flux, behind choppers to ensure the correct energy selection and resolution, as well as before and after the sample for data normalisation. Parts of these use-cases are necessary for the science case of the instrument; others are required for instrument diagnostics and fault finding and facility performance monitoring. This abstract presents the effort to qualify, optimise and standardise existing detectors (multiwire proportional counters, ionisation chambers, fission chambers, GEM detectors, Vanadium monitors, scintillators) to this purpose by means of experimental campaigns and Monte Carlo simulations, as well as to optimise more novel designs of parasitic or less invasive beam monitoring approaches. The results of the experimental characterisation and optimisation are presented in terms of beam monitor efficiency, attenuation, scattering, time (time-of-flight) resolution and flux capability. Instrument requirements for beam monitors are discussed and the roadmap to the installation and the cold commissioning is presented. The overall aim of this common project is to ensure a homogeneous approach to monitoring the instruments at the facility, to enable a smoother start for ESS commissioning and initial operation and better diagnostic tools for issues that occur.

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Session Classification: Poster

Contribution ID: **128** Type: **Poster**

The Time-of-Flight Small Angle Neutron Scattering Instrument at CSNS

Thursday 17 October 2019 16:30 (2 hours)

The time-of-flight small angle neutron scattering (ToF SANS) instrument at China Spallation Neutron Source (CSNS) is operating now. As the first SANS at pulsed neutron source in China, it is designed to be a general-purpose instrument to probe the inhomogeneous structure of bulk, powder and liquid materials at nano-scale. The SANS@CSNS utilizes beam port #1 of the target station facing a coupled hydrogen moderator and adopts a short straight beamline configuration with the classic point-focusing pin-hole camera geometry. The instrument consists of pre-sample collimation in segments, one T0 chopper blocking prompt-strike fast neutrons and one double-disk band-width chopper selecting the working wavelength from 0.5 to 12 Å [1]. The incident neutron beam is shaped by a set of three beam apertures and counted by one pre-sample beam monitor. The sample transmission can be measured by a GEM monitor after it while the scattered neutrons are detected by a Linear Position Sensitive Detector, which composed of 120 3He tubes with 8 mm in diameter and 1 m in length. This detector arrays can move from 2 m to 4 m positions away from the sample, which are capable to cover a wide q range.
After a series of intensive hot -commissioning work, the beamline has been tuned to an optimum state. The instrument has been calibrated by three types of standard samples. The result demonstrates that the quality of the data from SANS@CSNS is comparable with those from other established SANS facilities. Increasing number of users from various fields have shown great interest in applying SANS in their research, as SANS provides an alternative/brand new view of their samples in nano-scale. The user program has been started since last October after the national acceptance test. For the next stage, we will start cultivating and serving the user community and keep exploring more scientific opportunities in the foreseeable future.

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[1] Ke, Yubin , et al. "The time-of-flight Small-Angle Neutron Spectrometer at China Spallation Neutron Source." Neutron News 29.2(2018):14-17.

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Session Classification: Poster

Contribution ID: **129** Type: **Poster**

Optimising complex neutron optical configurations with a global search in a high dimensional space

Monday 14 October 2019 16:30 (2 hours)

Modern pulsed neutron sources offer significantly higher peak brightness and a much higher time integrated neutron flux.The geometries of the moderators are more refined and optimised for beam experiments. The number and variability of readily available neutron optical components is increasing. Not surprisingly the demand from the experimentalists to develop highly sophisticated instrument concepts is growing accordingly. A consequence of this development is that the parameter space neutron beam instrumentation has to work with has more dimensions and a wider range of limits for the many of its variables. Instrument simulations with the purpose of optimising more than a few parameters are time-consuming, tedious and inefficient if done manually or with a brute force approach - even worse it is very likely that a 'local optimum' is chosen because the parameter space is too vast for a thorough exploration. We demonstrate how an efficient global search algorithm can help to find parameter vectors which are selected based on multiple, simultaneous objectives as defined by the science driving the instrument design.
Our example is the BER-SANS instrument at beamline STS-01 at the SNS.
The overall optimisation criterion is to provide as many neutrons as possible on a small sample (e.g., a few mm in diameter) with a moderate minimum q-value of 0.01A-1.The third objective is the capability to rapidly distinguish two states of samples, e.g., two conformations of the same protein, with a given instrumental resolution. Any neutron optical concept will compromise on each of those requirements in different ways and the scientific community has the opportunity to choose their preferred option.

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Presenter: WILDGRUBER, Christoph (ORNL)

Session Classification: Poster

Contribution ID: **130** Type: **Oral Presentation**

Observing the state of hydrogen in the JPARC moderator loop

Tuesday 15 October 2019 12:10 (25 minutes)

The spectrum moderators deliver to neutron scattering beamlines has to stay as consistent as possible throughout the runcycle of a facility. This means that for hydrogen moderators the ratio of parahydrogen to orthohydrogen especially needs to stay the constant. Especially low dimensional parahydrogen moderators are very sensitive to the ortho- to parahydrogen equilibrium and quickly lose their brightness when the orthohydrogen concentration becomes too high.

Keeping the moderator spectrum the same throughout operations poses a challenge with the increasing brightness of sources. High radiation fields present in the target area of these neutron sources cause the hydrogen in the moderator to convert from the desired parahydrogen to orthohydrogen thereby shifting the equilibrium to higher orthohydrogen contents than would be expected in non-irradiated hydrogen at equilibrium (e.g. 99.8% parahydrogen content at 20 K). One way of keeping the parahydrogen concentration high is using a catalyst such as ferric oxyhydroxide (FeOOH) in the hydrogen moderator loop to convert ortho- to parahydrogen. The continuous conversion of ortho- to parahydrogen allows to keep a high parahydrogen concentration in spite of a radiation field. This is being done at some spallation sources (ISIS, JPARC), and forseen at others (ESS, SNS). Some published results [Iverson, E.B. and Carpenter, ICANS-XVI(2003)707-718, M. Ooi et al. NIMA 566(2) (2006)699-705, M.Ooi, ICANS-XVI(2003) 801-808, G. Romanelli, J. Phys: Conf. Series 1021(2018)012055] suggest a back conversion rate for this reaction, however it has still not been directly observed.

We will present our first spectroscopic measurement of the hydrogen from the JPARC moderator. The parahydrogen to orthohydrogen ratio was measured with hydrogen released from the moderator loop during operations at 1 MW with the catalyst in place and after 3 hours of operations at 500 kW while bypassing the catalyst. Two different Raman setups were in use and the data of both is compared

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Session Classification: Target

Track Classification: Target/Moderator

Contribution ID: **131** Type: **Oral Presentation**

RF-driven H- Ion Sources for High Power Accelerators: Status and Challenges

Thursday 17 October 2019 14:55 (25 minutes)

RF-driven H- ion sources are becoming the preferred technology for driving high power accelerators. The Spallation Neutron Source (SNS) at Oak Ridge National Laboratory (ORNL) employs an RF-driven, multicusp H- ion source. This type of source was conceptualized and developed at Lawrence Berkeley National Laboratory (LBNL) initially for the Superconducting Super Collider project and then for the Spallation Neutron Source project in 1990s to early 2000s. Since the source was delivered to ORNL in 2002, it has been operated and further developed to a highly reliable, long lifetime (several months), persistent high current (>50 mA) H- ion source operating at 6% duty-factor (1 ms, 60 Hz). The Japan Proton Accelerator Research Complex (J-PARC) has developed an RF-driven H- ion source as its accelerator injector based on the SNS ion source RF antenna technology. The LINAC4 project at CERN and the ISIS Neutron and Muon facility in the UK are also developing RF-driven H- ion sources as candidate sources for their respective system or upgrade plan. This talk will present the status of RF-driven H- ion sources for high power accelerators, and discuss the challenges including more effective cesium management, improved handling of the co-extracted electrons, and robust and high efficiency beam transport at high beam current etc.

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Session Classification: Accelerator

Track Classification: Accelerator

Contribution ID: **132** Type: **Poster**

A Multi Grid Detector Design for the ESS CSPEC chopper spectrometer

Wednesday 16 October 2019 13:00 (2 hours)

This contribution presents the performance and project status of the Multi Grid detector design for chopper spectrometry, in particular in the context of the state of the design for the CSPEC spectrometer at ESS. The Multi Grid detector was introduced at the ILL in 2009, and has been co-developed by ILL, Linkoping University and ESS since then.

As part of the development programme, since 2010, numerous prototypes were built, to investigate both the detector design's technical and scientific performance. Of particular note is that 3 sets of scientific demonstrators were built and installed for tests on 3 leading chopper spectrometers; IN6 at ILL and CNCS and SEQUOIA at SNS. Detector and instrument simulation of the signal from the detector with the complete detector has led to a greater understanding of each of the background components; this is especially important for this application. Each of these results has led to improved understanding which has been fedback into the design.

In this contribution, the design is presented in the context of the detailed design for the CSPEC spectrometer at ESS. An overview of the performance compared to the current state of the art detectors - He-3 tubes - is given. The performance for scientific applications is broadly comparable. Great care must be taken in the design in selection of low radioactivity materials; also the design of the localised shielding inside the detector is key to optimise the extraction of the quasi-elastic signal. The design has potential significant advantages compared to He-3 tubes in terms of rate capability (both global and local instantaneous), and in terms of rejective power of beam-induced backgrounds, especially fast neutrons.

In summary, this technology is now ready for deployment on a chopper spectrometer. The current project status of the design for the CSPEC spectrometer at ESS is shown.

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Session Classification: Poster

Contribution ID: **133** Type: **Oral Presentation**

Recent Improvements in Straw Neutron Detectors for Large Scale Neutron Science Instruments

Tuesday 15 October 2019 11:50 (25 minutes)

Proportional Technologies, Inc. has previously developed a neutron imaging detector, based on boron-coated straws (BCS), a technology aimed to replace 3He tubes in large-scale neutron science instruments, like the Cold Neutron Chopper Spectrometer (CNCS) at the SNS (ORNL). That detector is composed of 1" tubes, each containing 7 straws. Each straw is 7.5 mm in diameter, and 1 m in active length, coated on the inside with 10B-enriched boron carbide (10B4C). We are currently providing tubes of this design to the ISIS (UK) group. Use of these tubes for the full implementation of the LoKI instrument at ESS is far along in the development path. In order to improve efficiency of our 1" tubes, we have now developed a modified BCS design with inner coated walls (septa) formed inside each straw. The outer straw diameter remains the same (7.5 mm), but the inner septa increase the coated wall area by 3 times. Prototypes with 12 septa ("Pie12") have been manufactured and tested. The thermal neutron detection efficiency for only 2 layers of the Pie12 7-pack is 57%, which is higher than that of 5 layers of the original round straws which have 53% efficiency. Using the planned four layers of modules efficiency can be improved to 68%.

In order to address requirements for high resolution instruments we present a totally new configuration based on rectangular channels. Small single crystal diffractometers, for instance, require 0.3-0.6 mm resolution, and neutron reflectometers require 1-2 mm. Other requirements include high rate, and excellent gamma rejection. The proposed structure satisfies the above in a close-packed array of rectangular channels, sealed inside a thin walled aluminum, laser-welded enclosure. Each channel is fabricated by squashing a round BCS into a rectangular shape, lined on the four inner faces with 10B4C. The BCS straw material is highly resilient to mechanical distortions without loss in coating adhesion, as demonstrated in the pie shapes that are being produced in large volume for military applications. In this fabrication inner septa are fabricated by collapsing a section of the coated wall onto itself, forming a rigid septum of only 50 µm thickness. The squashed straw array (SSA) proposed can be configured with any desired channel dimensions. Prototypes with 1x5 mm2 and 0.5x2.5 mm2 channels have been constructed and thoroughly tested. A ratio of 1-to-5 is optimal for adequate collection of ionization, while minimizing the number of channels in the direction of the neutron beam. The smaller SSA can achieve a resolution of 0.5 mm, and a thermal neutron efficiency of 50% in only 2 layers, and 68% in 5 layers. The design yields excellent gamma rejection and very low scattering material consisting of only thin (25 µm) Al foil contributing only 84 mg/cm2 Al per layer.

Finally, we present the design and performance of an electronic readout for resistive charge division capable of supporting very much higher rates than have been achievable with high pressure 3He. The design is based on a simple 2-transistor amplifier with tail cancellation and a 1.5-GHz following operational amplifier. It is shown to produce a neutron signal with a rise time of 15 ns. Using a positive ion cancelation circuit a fall time of 70 ns is achieved, producing a signal width that is more than 4 times faster than previous electronics tested at SNS. We expect the new readout will demonstrate the ability of straw detectors to generate a digitized rate exceeding 1 MHz using a streaming digitizer. Together with PTI's large scale 10B4C foil coating capability these developments are expected to effectively address many instruments at neutron sources around the world.

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Presenter: Dr LACY, Jeffrey (Proportional Technologies, Inc.)

Session Classification: Instruments

Track Classification: Instrument

Contribution ID: **134** Type: **Oral Presentation**

Radiation protection at the European Spallation Source

Tuesday 15 October 2019 11:20 (25 minutes)

The European Spallation Source is currently under construction in Lund, Sweden. Once completed it will deliver the highest quality of long-pulse neutron beams for fundamental and applied scientific research. Last year in 2018 commissioning of the ion source and the LEBT started and will continue with the start of operation of the test stand for the cryo-cavities this autumn and the commissioning of the normal conducting linear accelerator in Spring next year. For the installation and commissioning the radiation protection organization of the ESS needs to be developed which includes operational radiation protection as well as radiation protection services. Latter include radiological monitoring, tracking of activated material, dosimetry and radioactive waste management. In the presentation we will present our first experiences, challenges and lessons learned in radiation protection at the ESS during installation and commissioning.

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Session Classification: Operations/Safety

Track Classification: Operation/Safety

Contribution ID: **135** Type: **Oral Presentation**

HRPD-X; a proposed upgrade to the ISIS High-Resolution Powder Diffractometer

Monday 14 October 2019 14:00 (30 minutes)

The high-resolution powder diffractometer (HRPD) at the ISIS neutron spallation source has been in operation for almost 35 years and remains one of the leading instruments of its kind in the world. With a 95 m primary flight path and backscattering detectors covering 2theta; = 154–176° the instrument achieves Delta;d/d ≈ 6x10^{−4} for data focussed over the whole backscattering array with a minimum Delta;d/d ≈ 3x10^{−4} at the highest backscattering angles [1]. HRPD has an outstanding track record of high-impact science in the fields of phase-transition studies, *ab-initio* structure determination, thermal expansion, microstructure analysis and a range of other fields in which subtle peaks shifts or splitting and peak-shape measurements are crucial [2]. The instrument has undergone numerous upgrades and refurbishments over the years, of which the most significant was the replacement of the original glass guide with a ballistic super-mirror guide in 2007, realising a substantial flux increase principally at shorter wavelengths [3]. However, the complementary upgrades to the detector arrays required to capitalise on this upgrade of the guide did not occur. The current detector banks thus consist of 20-25 yr old ZnS:Ag/⁶LiF-scintillator modules (5 mm pitch in backscattering, 3 mm pitch at 90 degrees), coupled by clear fibres to single-channel PMTs [4]; in forward scattering there is a small array of ½-inch helium tubes covering 2theta; from 28–32°.

The aim of the HRPD-X upgrade proposal is to demolish the existing building in which HRPD is housed, erect a new building and then to replace the current instrument, including the detector arrays, sample tank and incident-beam conditioning devices. The proposed detector arrays will be based on wavelength-shifting fibre technology, and cover a substantially larger range of 2theta; than the current arrays, particularly in forward-scattering geometry. This ensures better count-rate matching between banks, eliminates gaps in Q that occur in the current detector array when using longer time-of-flight windows (100-200 ms), and extends the maximum observable d-spacing out to ~ 50 Å (currently it is ~20 Å). Provision of a non-magnetic sample tank will allow HRPD to carry out measurements in applied fields up to 10 T in principle. Furthermore, improvements in upstream conditioning and sample collimation will work to reduce the large vertical divergence of the super-mirror guide and reduce backgrounds from *in-situ* sample environments. Together, these developments will allow HRPD's exceptional capabilities to be applied to a range of new scientific problems, including supramolecular frameworks and complex magnetic structures.

This presentation will detail the current status of the HRPD-X project and summarise some recent refurbishment work designed to bridge the gap between the current and anticipated future state of the instrument.

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Session Classification: Instruments

Track Classification: Instrument

Contribution ID: **136** Type: **Oral Presentation**

Tailoring the phase space volume for instruments at accelerator based neutron sources

Thursday 17 October 2019 12:15 (25 minutes)

Neutron scattering instruments require specific bandwidths and timing structures according to the experimental resolution conditions. Recent developments of compact accelerator based pulsed neutron sources (CANS) enable an individual optimization of the neutron energy spectrum and pulse timing. This allows a large flexibility to tailor the spectral and pulse properties according to the instrument requirements and to feed every instrument with a suitable phase space volume.

At CANS neutrons are produced by the interaction of protons in the 10 to 100 MeV range in a suitable target. Embedding the target in a thermal moderator slows down a huge fraction of the released neutrons in a small volume. The reflector surrounding the moderator provides further means to tailor the pulse properties and to increases the thermal neutron flux inside the moderator. Extraction channels inside the moderator and reflector direct the neutrons to the instruments. Each extraction channel can be equipped with a specific one-dimensional cryogenic moderator to serve the associated instrument optimally. The target / moderator / reflector unit (TMR) is optimized to fulfill the specific requirements of the individual neutron instruments.

We will present the flexibility such a TMR offers and show different possibilities to tune the neutron spectra and the timing structures for typical instrument requirements.

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Session Classification: Instruments

Track Classification: Instrument

Contribution ID: **137** Type: **not specified**

The SNS Moderator Test Station

Monday 14 October 2019 14:00 (25 minutes)

We will describe the Moderator Test Station proposed for the Spallation Neutron Source facility. We will leverage the Beam Test Facility (BTF) at the Spallation Neutron Source (SNS) to provide a moderator neutronics test stand with which we will verify the anticipated performance gains expected and required from innovative moderator concepts central to the SNS Second Target Station (STS), as well as improve our understanding of the performance of the moderators on the First Target Station (FTS). These concepts include high brightness parahydrogen tube moderators and high volume parahydrogen moderators for the STS, and temperature / density effects on performance of water and hydrdogen moderators for the FTS.

The SNS BTF, already operational, incorporates an ion source and a 2.5 MeV Radio Frequency Quadrupole (RFQ) substantially the same as the SNS front end. We will use a proton beam chopper similar to that already used in the SNS at the RFQ exit, various proton beam transport components, a neutron-producing lithium target, a cryogenic moderator test stand, a reflector-shielding assembly, and a performance assessment neutron beamline. The MTS will provide the ability to test large-volume and compact moderator concepts in a prototypic wing configuration, measuring the wavelength-dependent transverse brightness distribution with imaging detectors and wavelength-dependent emission time distributions with time-focused analyzer arrays of the moderator concepts central to projected STS gains and FTS upgrades with significantly faster and in greater detail than at currently available test facilities. We here describe the planned layout of the Moderator Test Station neutron test beamline and moderator cryostat assembly, as well as outlining the current list of moderator configurations to be tested.

Author: IVERSON, Erik (ORNL)

Co-authors: GALLMEIER, Franz (ORNL); GRAMMER, Kyle (Oak Ridge National Laboratory); HUEGLE, Thomas (ORNL); LU, Wei (Oak Ridge National Laboratory); REMEC, Igor (Oak Ridge National Laboratory)

Presenter: IVERSON, Erik (ORNL)

Session Classification: Sources

Track Classification: Target/Moderator

Contribution ID: **139** Type: **Oral Presentation**

Moderator Performance at SNS Next Generation IRP (IRP3)

Thursday 17 October 2019 14:30 (30 minutes)

At SNS the moderators and reflectors are integrated into one component called inner reflector plug (IRP), which essentially delivers desired neutron pulses to all the instruments. The current IRP is operated at a beam power up to 1.4 MW and has an estimated lifetime of ~28 GWhr. The design for the next generation IRP (IRP3) has already been completed. While the main purpose of the design is to reduce the manufacturing difficulty and cost and to improve the operation stability and lifetime, its impacts on the moderator performance is also notable and worthy to be investigated. For improved efficiency and accuracy, a CAD model enabled Monte Carlo simulation method was adopted for this study, where DAGMC was used to track particle transport directly in a CAD model. However, it still requires significant efforts in revising and fixing a designing CAD model to make it compatible to DAGMC. In extending the IRP lifetime from ~28 GWhr to ~35 GWhr, the poison plate thickness was increased by 30% in the water moderator at a penalty of ~3% moderator performance. Nevertheless, with the increase of poison depth on the thin side of the moderator, it sees ~4% gain in the peak pulse intensity on both sides of the moderator and ~ 10% gain in the time-averaged intensity on the thin side. For the hydrogen moderators, their performance is mostly impacted by the thickness change of the moderator vessel boundaries, due to which the decoupled hydrogen moderator suffers ~2% drop of performance while the coupled moderators gains up ~10%. Other aspects of IRP3 design change on the moderator performance were also investigated.

Author: LU, Wei (Oak Ridge National Laboratory)

Presenter: LU, Wei (Oak Ridge National Laboratory)

Session Classification: Target

Track Classification: Target/Moderator

Contribution ID: **140** Type: **Oral Presentation**

DEMAND (HB-3A), a Dimensional Extreme Magnetic Neutron Diffractometer at the High Flux Isotope Reactor

Monday 14 October 2019 14:55 (25 minutes)

A two-dimensional (2D) Anger camera detector has been used at the HB-3A four-circle single-crystal neutron diffractometer at the High Flux Isotope Reactor (HFIR) since 2013. The 2D detector has enabled the capabilities of measuring sub-mm crystals and spin density maps, enhanced the efficiency of data collection and phase transition detection, and improved the signal-to-noise ratio. Recently, the HB-3A four-circle diffractometer has been undergoing a detector upgrade towards a much larger area, magnetic-field-insensitive, Anger camera detector. The instrument will become capable of doing single-crystal neutron diffraction under ultra-low temperatures (50 mK), magnetic fields (up to 8 T), electric fields (up to 11 kV/mm), and hydrostatic high pressures (up to 45 GPa). Furthermore, half-polarized neutron diffraction is also available to measure weak ferromagnetism and local site magnetic susceptibilities. With the new high-resolution 2D detector, the four-circle diffractometer has become more powerful for studying magnetic materials under extreme sample environment conditions; hence, it has been given a new name: DEMAND.

The research was supported by the U.S. Department of Energy (DOE), Office of Science, Office of Basic Energy Sciences, Early Career Research Program Award KC0402010, under Contract DE-AC05-00OR22725 and the U.S. DOE, Office of Science User Facility operated by the Oak Ridge National Laboratory.

Author: Dr CAO, Huibo (Oak Ridge National Laboratory)

Presenter: Dr CAO, Huibo (Oak Ridge National Laboratory)

Session Classification: Instruments

Track Classification: Instrument

Contribution ID: **141** Type: **Oral Presentation**

Two dimensional focusing of neutron beam under extreme conditions with Adaptive focusing optics

Thursday 17 October 2019 11:50 (25 minutes)

Co-authors: Uwe Filges1, Emmanouela Rantsiou1, Yutaka Yamagata2, and Takuya Hosobata2
1. Division Research with Neutrons and Muons (NUM), Paul Scherrer Institut, Villigen, Switzerland
2. RIKEN Center for Advanced Photonics, RIKEN, Saitama, Japan

Novel materials in strongly competitive fields such as nano-science or material science, are often only available in small volume in the order of 1 mm2 or below, whereas the beam cross section at the exit of the neutron guide is typically in the order of several cm2. Therefore, focusing neutron-beam between neutron guide to the small samples can increase the neutron flux effectively. Moreover, focusing can reduce the unwanted neutrons hitting the sample environments, which offers the options of measurements under extreme conditions. Consequently, the signal to noise ratio in the detector can be enhanced.

The flexible focusing optics system whose focal length, beam divergence, and beam size on the sample are variable has been developed at PSI, often referred as adaptive optics (AO). By bending the flat supermirror substrate on an adjustable support system which has elliptic and/or parabolic shapes, the required focusing function can be realized. To reinforce the robustness of the optics, metal substrates can be used as replacement to conventional glass substrates. Metal substrates are also able to withstand high level of irradiation and thermal stress. The resulting neutron optics system is a compact, user friendly, versatile, and fast adjustable add-on device.

Lately, the mechanical design was drastically modified to realize the series connection of several units and the two dimensional focusing in one optics unit. The results of the focusing performance test will be presented.

Author: YAMADA, Masako (Paul Scherrer Institute)

Presenter: YAMADA, Masako (Paul Scherrer Institute)

Session Classification: Instruments

Track Classification: Instrument

Contribution ID: **142** Type: **Poster**

Status and upgrade plan of Linac and RCS in J-PARC

Thursday 17 October 2019 16:30 (2 hours)

In J-PARC, a 3 GeV proton beam, which is accelerated by the 400 MeV Linac and the following Rapid Cycling Synchrotron (RCS), is provided to a neutron source in the Material & Life Science Experimental Facility (MLF).
The beam with a power of 500 kW has been stably provided to the MLF for the past year. High availability of 94 % during the MLF user operation was achieved in the fiscal year of 2018 with a 4129 hours operation time. Many efforts to reduce downtime causes have been performed such as rejection of undesirable large signals of the beam loss monitors by optimizing a time constant in the circuit, and suppression of discharge trips in the RFQ by vacuum pressure improvement, etc.
In addition, trial operations at 1 MW were achieved for 1 hour in July 2018 and 10.5 hours in July 2019. Although the beam was stopped several times during the 1-hour test in 2018 by beam loss signals due to vacuum pressure increase in the RCS, the number of beam stops during 10.5 hours in 2019 was only 3 times because of enough vacuum aging.
In response to the prospect of continuous operation of 1 MW, the accelerator group has begun to consider upgrades for the future operation with more than 1 MW beam power, such as an improvement of the Medium Energy Beam Transport 1 (MEBT1) for optimal beam matching between the RFQ and the DTL, a remodeling of the RCS injection magnets and vacuum chambers to install enough radiation shield materials, and a reinforcement of the RF system in the RCS.
In this presentation, summary of the current status and upgrade plans for higher beam power operation of the Linac and the RCS will be described.

Primary author(s): KAMIYA, Junichiro (J-PARC Center), Dr HASEGAWA, Kazuo (J-PARC Center), Dr KINSHO, Michikazu (J-PARC Center), Dr OGURI, Hidetomo (J-PARC Center), Dr YAMAMOTO, Kazami (J-PARC Center)
Presenter(s): KAMIYA, Junichiro (J-PARC Center)

Author: KAMIYA, Junichiro (Japan Atomic Energy Agency/J-PARC)

Presenter: KAMIYA, Junichiro (Japan Atomic Energy Agency/J-PARC)

Session Classification: Poster

Contribution ID: **143** Type: **Oral Presentation**

Jupyter Notebooks for Neutron Radiography Data Processing Analysis

Tuesday 15 October 2019 14:30 (25 minutes)

The High Flux Isotope Reactor (HFIR) CG-1D neutron imaging facility accommodates a broad range of research applications such as materials science, engineering, energy, physics, biology and plant physiology. This instrument is equipped with a modern data acquisition system that helps users to acquire data in a semi-automated fashion. Until now, raw data were processed using MatLab and/or ImageJ, which required extensive training by beamline staff. In order to improve user experience and to allow live feedback processing of the raw data, the imaging software team has developed tools such as semi-automated reconstruction and Jupyter Notebooks that can be adapted to the specific scientific questions from the research team. One of the advantages of the notebooks is that facility users do not need to be advanced image processing scientists, nor do they need expertise in Python programming. Another advantage is that an existing notebook can be readily adapted for a new experiment without a tremendous time commitment from the imaging software team. Using a few research examples, this talk will present the tools developed and used by the the scientific community coming to CG-1D.

Author: BILHEUX, Jean (ORNL - SNS)

Presenter: BILHEUX, Jean (ORNL - SNS)

Session Classification: Software

Track Classification: Software

Contribution ID: **144** Type: **Oral Presentation**

ESS Accelerator update and experience from ESS ion source and LEBT beam commissioning

Thursday 17 October 2019 14:00 (30 minutes)

On the site of the European Spallation Source (ESS) in Lund, Sweden, great progresses have been made in all areas of its linac construction. Highlights include that installations of the radio frequency quadrupole and the following medium energy beam transport are being completed, assembly of the first drift tube linac tank is also being completing, the cryomodule test-stand is about to start its operations, and steady progresses have made in installations and testing of the RF system. One of the recent biggest highlights was the first beam extraction on the ESS site, followed by an establishment of stable operations of the ion source (IS) and various types of characterizations and optimizations performed for the IS and the following low energy beam transport (LEBT). This contribution presents these recent highlights on the ESS site, with a focus on results from the first beam commissioning activities on the ESS site for the IS and LEBT.

Author: MIYAMOTO, Ryoichi

Presenter: MIYAMOTO, Ryoichi

Session Classification: Accelerator

Track Classification: Accelerator

Contribution ID: **145** Type: **Oral Presentation**

Extract microscopic information of materials from Neutron Scattering data using a Machine Learning assisted approach.

Thursday 17 October 2019 14:00 (30 minutes)

Precise modeling of a material is a key to understand its underlying interactions and physics but also revealing the competing phases in the nearby interaction space. Highly frustrated systems are important due to the richness in physics and diversity of phases including spin liquids with exotic topological states they display. Here, we present a machine learning workflow to fit multi-experimental data sets to find an optimal Hamiltonian while undertaking phase classification and extracting information about the topography around the region of interest. Experimental data from a spin-ice material, $Dy_2Ti_2O_7$ including diffuse neutron scattering, heat capacity and susceptibility are utilized. This approach is shown to provide the best model in an efficient and effective way but also is powerful at planning the best experimental strategies.

Author: SAMARAKOON, Anjana

Presenter: SAMARAKOON, Anjana

Session Classification: Software

Track Classification: Software

Contribution ID: **147** Type: **Oral Presentation**

test 2

blah blah

Authors: HOLDER, Talia; IVERSON, Erik (ORNL)

Presenters: HOLDER, Talia; IVERSON, Erik (ORNL)

Contribution ID: **148** Type: **Oral Presentation**

Welcome

Contribution ID: **149** Type: **not specified**

Welcome

Monday 14 October 2019 08:45 (15 minutes)

Presenter: HERWIG, Kenneth (ORNL)

Session Classification: Plenary

Contribution ID: **150** Type: **not specified**

Spectrometers Breakout DIscussion

Monday 14 October 2019 12:30 (30 minutes)

Presenter: EHLERS, Georg (Oak Ridge National Laboratory)

Session Classification: Instruments

Contribution ID: **151** Type: **not specified**

Data Management Discussion

Monday 14 October 2019 12:05 (30 minutes)

Presenter: Dr OTOMO, Toshiya (JPARC)

Session Classification: Software

Contribution ID: **152** Type: **not specified**

Target Discussion

Monday 14 October 2019 12:50 (10 minutes)

Session Classification: Target

Contribution ID: **153** Type: **Oral Presentation**

Advances in event based data structures for neutron scattering experiments

Tuesday 15 October 2019 14:55 (25 minutes)

This presentation will review and expand upon existing work in data processing made available using event mode measurements. Most spallation neutron sources in the world have data acquisition systems that provide event recording. The new science that is enabled by utilizing event mode has only begun to be explored. In the past these studies were difficult to perform because histograms forced either dealing with large chunks of time, or a large number of files. With event-based data collection, data can be explored and rebinned long after the measurement has completed. This talk will review principles of event data and how the method opens up new possibilities for in situ measurements, highlighting techniques that can be used to explore changes in the data and model independent methods of grouping data via clustering methods.

Author: Dr PETERSON, Peter F. (Neutron Scattering Division, Oak Ridge National Laboratory)

Co-authors: Dr OLDS, Daniel P.; Dr SAVICI, Andrei T.; Dr ZHOU, Wenduo

Presenter: Dr PETERSON, Peter F. (Neutron Scattering Division, Oak Ridge National Laboratory)

Session Classification: Software

Track Classification: Software

Contribution ID: **154** Type: **Oral Presentation**

Shielding development for VENUS instrument

Thursday 17 October 2019 15:30 (30 minutes)

VENUS is an imaging instrument that will have a broad range of neutron wavelengths, from epithermal to cold, and enhanced contrast mechanisms, and will offer novel energy-selective imaging techniques that directly connect the structures, properties, and function of complex engineering materials and systems to reveal practical and fundamental answers about their real-world performance. The instrument is to be built on SNS beam line 10 and will face the decoupled poisoned hydrogen moderator. The driving cost for the instrument is the beam line and enclosure shielding. Initial scoping analyses were performed to estimate thickness of possible shielding materials for the enclosure and the beam line. In light of the upcoming Proton Power Upgrade (PPU) project, these transport analyses were performed for proton beam on target at 1.3 GeV and 2 MW.

Authors: POPOVA, Irina (ORNL); GALLMEIER, Franz (ORNL)

Presenter: GALLMEIER, Franz (ORNL)

Session Classification: Target

Track Classification: Target/Moderator

Contribution ID: **155** Type: **Oral Presentation**

Update from the ORNL Neutron Scattering Facilites

Monday 14 October 2019 09:00 (30 minutes)

Oak Ridge National Laboratory (ORNL) operates two neutron sources as scientific user facilities on behalf of the Office of Science, US Department of Energy: the High Flux Isotope Reactor (HFIR) and the Spallation Neutron Source (SNS). Both facilities offer leading capabilities to an international user community, with access being provided on the basis of scientific merit as assessed through peer review of proposals submitted in response to two calls per year. Twelve instruments at HFIR and 18 at SNS provide complementary capabilities in diffraction, spectroscopy, small angle neutron scattering, and neutron imaging (see neutrons.ornl.gov). SNS and HFIR together host approximately 3000 user visits per year and process over 10,000 samples. This presentation will discuss recent scientific highlights, changes and upgrades to instrumentation, and opportunities arising with the construction of the Second Target Station at SNS.ORNL update

Author: Dr CHRISTEN, Hans M. (Neutron Scattering Division, Oak Ridge National Laboratory)

Presenter: Dr CHRISTEN, Hans M. (Neutron Scattering Division, Oak Ridge National Laboratory)

Session Classification: Plenary

Track Classification: Facility Update

Contribution ID: **156** Type: **Oral Presentation**

Machine Learning and Big Scientific Data: AI for Science

Monday 14 October 2019 10:00 (30 minutes)

There is now broad recognition within the scientific community that the ongoing deluge of scientific data is fundamentally transforming academic research. Turing Award winner Jim Gray referred to this revolution as "The Fourth Paradigm: Data Intensive Scientific Discovery'. Researchers now need tools and technologies to manipulate, analyze, visualize, and manage vast amounts of research data.
This talk will review the challenges posed by the ever-increasing growth of experimental and observational data generated by large-scale facilities such as the ISIS neutron and muon facility and the Diamond Synchrotron and the CryoEM Facilities at the Rutherford Appleton Laboratory. Increasingly, scientists are beginning to use machine learning and deep neural networks both to automate parts of the data pipeline and also to find new scientific discoveries in the deluge of experimental data. In particular, 'Deep Learning'neural networks have already transformed several areas of computer science and research scientists are now exploring their use in analyzing their 'Big Scientific Data'.
The talk will briefly review the advances made with deep learning neural networks and give some examples of the application of these methods to experimental data generated at the Laboratory. The talk will conclude with a discussion about possible benchmarks for scientific machine learning algorithms and their performance on HPC and GPU systems.

Author: Prof. HEY, Tony (Rutherford Appleton Laboratory STFC)

Presenter: Prof. HEY, Tony (Rutherford Appleton Laboratory STFC)

Session Classification: Plenary

Track Classification: Software

Contribution ID: **157** Type: **Oral Presentation**

ISIS - from TS1 to TS2 to ISIS-II

Tuesday 15 October 2019 09:00 (25 minutes)

This presentation will outline the current status of ISIS and future plans including major projects in the 2020-21 long shutdown (Linac Tank IV and TS1 target/moderator replacements) and the developments needed to realise a future 'ISIS-II'.

Author: Dr MCGREEVY, Robert

Presenter: Dr MCGREEVY, Robert

Session Classification: Plenary

Track Classification: Facility Update

Contribution ID: **158** Type: **Oral Presentation**

Update from the CSNS

Tuesday 15 October 2019 09:25 (25 minutes)

CSNS Update

Author: Prof. CHEN, Hesheng

Presenter: Prof. CHEN, Hesheng

Session Classification: Plenary

Track Classification: Facility Update

Contribution ID: **159** Type: **Oral Presentation**

LANSCE: A Center for Nuclear and Materials Research

Monday 14 October 2019 09:30 (30 minutes)

LANSCE is a NNSA National User Facility dedicated to solving national security problems. With 5 target stations and 16 flight paths, LANSCE possesses a broad range of experimental capability: neutron diffraction and radiography, proton radiography, isotope production, neutron irradiations, and nuclear science. In this talk I will discuss the experimental capabilities of LANSCE, the role of LANSCE within the national security complex, the status of the accelerator, and plans for capability enhancements into the future.

Author: Dr SINNIS, Gus (Los Alamos National Laboratory)

Presenter: Dr SINNIS, Gus (Los Alamos National Laboratory)

Session Classification: Plenary

Track Classification: Facility Update

Contribution ID: **160** Type: **Oral Presentation**

SINQ update

Wednesday 16 October 2019 09:25 (25 minutes)

Presently SINQ has a 16 month shutdown phase. The shutdown is used to realize the SINQ guide upgrade.

The official start of the SINQ guide upgrade project was launched by the PSI board in March 2017. In the course of the years 2017/2018 the focus of the project execution was on engineering and planning of the upcoming exchange of 340 m neutron guides.

The project hardware activities on site started with the disassembly of the MARS instrument and the laboratories above the existing workshop, which was completed already in June 2018.

In order to gain space for the installation of the new SANS instrument (PA20 will be transferred from Saclay, France) and related space for laboratories and storage, the SINQ hall was extended to provide a dedicated area for a magnet test stand. This extension was substantially completed in August 2018.

After the end of the SINQ operation period 2018 the dismantling of the components inside the bunker and in the neutron guide hall (guides, guide supports and shielding) started in January 2019. End of March 2019 the project moved into the next phase for the modification and preparation for the new guides and instruments. Inside the bunker the concrete structure needed substantial modification. By the end of April the two guide cassettes for the in-pile section were totally assembled by external companies and ready for the installation in Sector 10 (SINQ in-pile port). This installation was an important milestone of the project and was finished successfully in May 2019.

Presently installation of the first three neutron guides are ongoing and is expected to be finished by the end of October 2019. The four other guides will be installed from November 2019 until February 2020. SINQ operation is expected for May 2020.

Author: FILGES, Uwe

Presenter: FILGES, Uwe

Session Classification: Plenary

Track Classification: Facility Update

Contribution ID: **161** Type: **Oral Presentation**

World-wide activities in CANS

Wednesday 16 October 2019 09:50 (25 minutes)

The term Compact Accelerator-driven Neutron Sources (CANS) has been coined to refer to a novel class of neutron sources based on accelerators running at low enough energies to not induce spallation in the target material. Initially these sources have been used to provide neutron beams at a scale suitable for a University or small research organization. Such facilities have been centers of innovation and education for several decades, but recently organizations have been starting to consider this class of source at considerably larger scale. In this overview, I will summarize the current state of the art for CANS-style facilities and review a few recent examples of significant technology/technique development that demonstrate the importance of CANS facilities to the World's neutron ecosystem.

Author: Prof. BAXTER, David V. (Low Energy Neutron Source, Indiana University)

Presenter: Prof. BAXTER, David V. (Low Energy Neutron Source, Indiana University)

Session Classification: Plenary

Track Classification: Facility Update

Contribution ID: **162** Type: **Oral Presentation**

THE EUROPEAN SPALLATION SOURCE (ESS): CURRENT STATUS AND PLANS

Thursday 17 October 2019 09:00 (25 minutes)

The European Spallation Source (ESS), which is currently under construction in Lund, Sweden, is designed to push the limits of research with neutrons to new horizons. ESS will open up new scientific opportunities which are complementary to those at X-ray sources. These will include unprecedented in-situ and in-operando experiments which are only possible with neutrons due to their special properties.

After a short summary of the design and the specifications of the European Spallation Source an overview of the current status and schedule of the ESS construction project will be given. The overall goal of ESS is to begin first science with 3 instruments in 2023 and ramp up to 15 instruments in user operation by 2027.

The photo shows a recent view of the ESS construction site.

Author: Dr SCHREYER, Andreas (European Spallation Source)

Presenter: Dr SCHREYER, Andreas (European Spallation Source)

Session Classification: Plenary

Track Classification: Facility Update

Contribution ID: **163** Type: **Oral Presentation**

Instruments for the Second Target Station at the SNS

Thursday 17 October 2019 09:25 (25 minutes)

SNS second target station instruments

Author: HERWIG, Kenneth (ORNL)

Presenter: HERWIG, Kenneth (ORNL)

Session Classification: Plenary

Track Classification: Instrument

Contribution ID: **164** Type: **Oral Presentation**

The European Open Science Cloud: Promoting Open Science, FAIRness and Accelerating Scientific Discovery

Monday 14 October 2019 11:15 (25 minutes)

The European Open Science Cloud (EOSC) is the vehicle for the Open Science movement within the EU. Inspired by a data-centric view of scientific discovery, EOSC will provide a platform for the development of services and systems which encourage and enhance access to shared scientific data across disciplines. This talk will explore the motivations for the EOSC, some of the challenges which can be addressed, the principles which underpin this movement and how facilities within member states are currently engaging with this initiative.

Author: Dr MOORE, Lamar (UKRI - Science and Technology Facilities Council)

Presenter: Dr MOORE, Lamar (UKRI - Science and Technology Facilities Council)

Session Classification: Software

Track Classification: Software

Contribution ID: **165** Type: **Oral Presentation**

SASVIEW –DATA ANALYSIS FOR SMALL ANGLE SCATTERING

Monday 14 October 2019 14:00 (30 minutes)

SasView[1,2] is a data analysis package for Small Angle Scattering, developed by an international collaboration of facilities and universities. It primarily provides model fitting to 1D and 2D scattering patterns, including resolution smearing of the model. Fitting of polarised neutron scattering data, and data from oriented systems, is supported. There are also modules for performing inversion of scattering data to P(r), calculating the scattering invariant, and calculating scattering length densities.

This year saw the release of version 5.0 of the software as the culmination of effort from the SINE2020 project [3]. This new release has a fully re-written GUI, streamlined user experience and updates to the implementation of scattering models, including the introduction of the beta approximation for interacting systems.

This talk will present the capabilities of the latest version, and discuss how the collaboration and work is managed to deliver software that meets the needs of both small angle scattering users and facilities.

References

[1] Doucet et al. (2019), SasView version 5.0, DOI: 10.5281/zenodo.3011184

[2] http://www.sasview.org

[3] https://www.sine2020.eu

Author: JACKSON, Andrew (European Spallation Source)

Presenter: JACKSON, Andrew (European Spallation Source)

Session Classification: Software

Track Classification: Software

Contribution ID: **166** Type: **Oral Presentation**

Data acquisition at SNS and HFIR

Tuesday 15 October 2019 10:30 (30 minutes)

DAQ at SNS and HFIR

Author: HARTMAN, Steven

Presenter: HARTMAN, Steven

Session Classification: Software

Track Classification: Software

Contribution ID: **167** Type: **Oral Presentation**

Data Acquisition at ESS

Tuesday 15 October 2019 11:00 (25 minutes)

To cope with the projected data rates for the European Spallation Source (ESS) the data acquisition system needs to be scalable. ESS will deploy a cluster of message brokers running Apache Kafka as the common data backbone for all instruments. Neutron data as well as any ancillary metadata (chopper information, sample environment parameters and so on) will be time stamped with the appropriate accuracy, transcribed messages using the Google Flatbuffer serialisation library and send to Kafka. From there the information is available to subscribers for file writing, visualisation or online processing.

The design offers some fairly unique features. For example as Kafka can be configured to keep a redundant copy of the data safe for a configurable retention period (limited by the available storage at the broker nodes), file writing can be requested to begin a point in time in the past. Data processed live can also be send into Kafka, which helps decoupling the scalable data processing facility from the consumer, i.e. the user at the instrument.

The presentation will cover the overall system architecture, the data sources and their time stamping, results from tests at scale. The ESS software suite around Kafka will also we discussed. It includes some custom build application, but largely consists of third party open source code, including the experiment control programme NICOS and tools for diagnostics, commissioning and visualisation.

Author: Dr RICHTER, Tobias (European Spallation Source ERIC)

Presenter: Dr RICHTER, Tobias (European Spallation Source ERIC)

Session Classification: Software

Track Classification: Software

Contribution ID: **168** Type: **Oral Presentation**

Dissolve - Next generation software for the analysis of total scattering data

Tuesday 15 October 2019 14:00 (30 minutes)

The power of wide Q-range total scattering techniques can only be fully realised through judicious use of isotopic substitution and computer simulation. The more comprehensive the former, the more informed the latter, and consequently the more robust the resulting scientific conclusions on structural aspects of the systems. Investigation of a multitude of disordered systems in this manner has been possible through application of the Empirical Potential Structure Refinement package by A. K. Soper, spanning atomic glasses, molecular liquids and mixtures, confined systems, and crystals. The advent of new instruments such as the Near and InterMediate Range Order Diffractometer on Target Station 2 at ISIS has, however, broadened the scope of the studied science, as well as its complexity, beyond the capabilities of the present implementation. Herein we discuss the core techniques that allow investigation of total scattering data by guided computer simulation, the intended scope of a next generation package (Dissolve), and how this aligns with the apparent direction of scientific study within the Disordered Materials group at ISIS.

Author: Dr YOUNGS, Tristan (STFC Rutherford Appleton Laboratory)

Presenter: Dr YOUNGS, Tristan (STFC Rutherford Appleton Laboratory)

Session Classification: Software

Track Classification: Software

Contribution ID: **169** Type: **Oral Presentation**

Diffraction and Imaging Discussion

Tuesday 15 October 2019 16:00 (30 minutes)

Session Classification: Software

Contribution ID: **170** Type: **Oral Presentation**

Mantid: Building a framework to last

Wednesday 16 October 2019 10:45 (30 minutes)

The Mantid[1] project was started by ISIS (RAL UK) in 2007 to provide a framework to perform data reduction and analysis for neutron and muon instruments and to accommodate the increasing data volumes from newer instruments[2]. The project has now been running for over 12 years and has grown into a significant international collaboration between ISIS, Oak Ridge National Laboratory, the European Spallation Source and the Institut Laue-Langevin, with the software relied on routinely by thousands of users worldwide.

The Mantid project initially started to support a small subset of instruments being built at target station 2 of ISIS, but has developed over time to support over 52 instruments across eight facilities worldwide. This talk will look at some of the design and development approaches highlighting those that have stood the test of time and those that needed to evolve over the course of the project. The talk will cover topics such as code quality/architecture, changing dependencies, management, development and quality processes.

[1] www.mantidproject.org

[2] O. Arnold, et al., Mantid—Data analysis and visualization package for neutron scattering and μSR experiments, Nuclear Instruments and Methods in Physics Research Section A, Volume 764, 11, 156-166 (2014), http://dx.doi.org/10.1016/j.nima.2014.07.029

Author: DRAPER, Nicholas (Tessella)

Presenter: DRAPER, Nicholas (Tessella)

Session Classification: Software

Track Classification: Software

Contribution ID: **171** Type: **Oral Presentation**

Scipp: Scientific data handling with labeled multi-dimensional arrays for C++ and Python

Wednesday 16 October 2019 11:15 (25 minutes)

Scipp is heavily inspired by the Python library "xarray".
It enriches raw NumPy-like multi-dimensional arrays of data by adding named dimensions and associated coordinates.
Multiple arrays are combined into datasets.
On top of these basics, which xarray would also provide, scipp introduces:

- Implicit handling of physical units.
- Implicit propagation of uncertainties.
- Support for histograms, i.e., bin-edge coordinate axes, which exceed the data's dimension extent by one.
- Support for event data, a particular form of sparse data with arrays of random-length lists, arising when collecting neutron scattering data in event-mode.

Altogether, the features enable a more natural and more concise user experience.
The combination of named dimensions, coordinates, and units helps to drastically reduce the risk for programming errors.

The core of scipp is written in C++ to open opportunities for performance improvements that a Python-based solution would not allow for.
On top of the C++ core, scipp's Python components provide functionality for plotting and other visualization, e.g., for use in Jupyter Notebooks.

Scipp is currently developed at the European Spallation Source.
The released version 0.1 is for experimental use and not production-ready yet.
See also https://scipp.readthedocs.io for detailed documentation.

Author: Dr HEYBROCK, Simon

Presenter: Dr HEYBROCK, Simon

Session Classification: Software

Track Classification: Software

Contribution ID: **173**		Type: **Oral Presentation**

Spectroscopy analysis software

Thursday 17 October 2019 16:10 (20 minutes)

Session Classification: Software

Contribution ID: **174** Type: **Oral Presentation**

Conventional ring designs for ISIS II

Thursday 17 October 2019 14:30 (25 minutes)

The ISIS upgrade project is tasks with delivering a 1.25 MW, 1.2 GeV proton beam at 50 Hz shared between two target stations. Accelerator studies include conventional rapid cycling synchrotrons (RCS), accumulator rings and FFA's. This paper reviews the current status of the conventional RCS and Accumulator rings and includes lattice designs and injection studies for both H- and direct proton injection.

Author: Mr ADAMS, Dean (STFC/RAL)

Co-authors: CAVANAGH, H.; HICKS, P.; JONES, B.; PINE, B.; WARSOP, C. M.; WILLIAMSON, R.

Presenter: Mr ADAMS, Dean (STFC/RAL)

Session Classification: Accelerator

Track Classification: Accelerator

Contribution ID: **175** Type: **Oral Presentation**

CAMEA —A novel multiplexing analyzer for neutron spectroscopy

Monday 14 October 2019 10:45 (30 minutes)

CAMEA (Continuous Angle Multiple Energy Analysis) is a novel crystal analyzer concept optimized for detection efficiency in the horizontal scattering plane [1]. This is compatible with the geometrical restrictions imposed by extreme sample environments and enables rapid mapping of excitations. The design comprises consecutive, upward scattering analyzer arcs set to analyze different neutron energies and an array of position sensitive detectors. A focusing arrangement of the analyzer crystals together with distance collimation facilitate prismatic analysis of the scattered neutrons [2] and results in a quasi-continuous energy coverage with improved energy resolution.

We completed the construction of a CAMEA backend as a replacement of the cold triple axis spectrometer Rita-II at the Swiss Spallation Neutron Source SINQ. I will present an overview of the spectrometer design, engineering solutions for the analyzer detector system and first data taken during the commissioning of the instrument. The results demonstrate the large performance gain for overview studies of low-energy dynamics.

I will also introduce the indirect geometry time-of-flight spectrometer BIFROST, which is currently under construction at the European Spallation Source ESS [3,4]. BIFROST utilizes a variant of the CAMEA concept and promises to make best use of the unique brightness and long-pulse structure of ESS.

[1] F. Groitl. *et al.*, Review of Scientific Instruments **87**, 035109 (2016).
[2] J. O. Birk, *et al.*, Review of Scientific Instruments **85**, 113908 (2014)
[3] P.G. Freeman *et al.*, EPJ Web of Conferences **83**, 03005 (2015)
[4] H. Rønnow *et al.*, BIFROST Instrument proposal (2014)

Author: Dr NIEDERMAYER, Christof (Laboratory for Neutron Scattering and Imaging, Paul Scherrer Institut)

Presenter: Dr NIEDERMAYER, Christof (Laboratory for Neutron Scattering and Imaging, Paul Scherrer Institut)

Session Classification: Instruments

Track Classification: Instrument

Contribution ID: **176** Type: **Oral Presentation**

High pressure neutron scattering in a diamond anvil cell

Thursday 17 October 2019 14:30 (30 minutes)

Due to relatively low neutron fluxes, neutron experiments require sample volumes many orders of magnitude larger than comparable X-ray experiments. In the past, this need for large samples has severly limited the maximum pressures available for in situ neutron scattering. Although break-out experiments have been conducted, diffraction experiments are typically not conducted at pressures abvove ~20 GPa and inelastic experiments not at pressures above ~4 GPa.
Concerted efforts to address these challanges are underway at Oak Ridge National Laboratory. These efforts leverage the two neutron sources availabe, the Spallation Neutron Source (SNS) and the High Flux Isotope Reactor (HFIR), better collimation for high pressure cells and significant development and improvements in high pressure cell technology, specifically neutron diamond anvil cells. An express aim of these developments is the availability of these new capabilities to a wide audience in the neutron user program as well as new record experiments.
At ORNL, a group of neutron diamond anvil cells based on very large diamond anvils, single crystal anvils grown by chemical vapour deposition (CVD) and polycrystalline diamond anvils has been developed. These polycrystalline anvils are suitable for pressures to ~15 GPa and are typically used for the study of single crystal samples at a variety of diffractometers at SNS and HFIR. One advantage of these cells is their cooling capability (to ~5 K) while pressure is maintined through a spring mechanism. In contrast, the CVD anvils are typically used for diffraction studies that require above ~15 GPa. A record pressure of ~60 GPa has been achieved, whereby sufficient data quality was maintained for a full Rietveld refinement.
Furthermore, these CVD anvils are also used for diffraction and neutron spectroscopy studies focused on gaseous samples. Together with the development of a dedicated H2-rated gas loader, recent optimization in gasket materials and shapes now allows for high pressure neutron studies on H2 and other hydrides formed therefrom. This capability has not only been exploited for diffraction studies on SNS's SNAP diffractometer but also its VISION spectrometer for record pressure studies on hydrogen.
Finally, a range of further development and adaptation beyond these DACs is underway. For example, a clamp cell has been modified to allow for in situ pressure measurements while the Paris-Edinburgh cell is currently being adapted for quasi-elastic experiments.
This presentation here will give an overview over these recent developments and achievements and their application to diverse science questions as well as discuss future developmental directions.

Acknowledgments: This work was supported by the Laboratory Directed Research Development (LDRD) program. The research was performed at ORNL's Spallation Neutron Source and High Flux Isotope Reactor.

Author: Dr HABERL, Bianca (Oak Ridge National Laboratory)

Co-authors: MOLAISON, J. J. (Neutron Scattering Division Oak Ridge National Laboratory); DAEMEN, Luke (Oak Ridge National Laboratory); BOEHLER, R. (Neutron Scattering Division, Oak Ridge National Laboratory)

Presenter: Dr HABERL, Bianca (Oak Ridge National Laboratory)

Session Classification: Instruments

Track Classification: Instrument

Contribution ID: **177** Type: **Oral Presentation**

Magnetic imaging method using pulsed polarised neutrons

Wednesday 16 October 2019 11:15 (30 minutes)

We have been developing a magnetic imaging technique using pulsed polarized neutrons at the Materials and Life Science Experimental Facility (MLF) of J-PARC. In this method, we visualize magnetic field distributions in free space or within a material using wavelength-resolved polarization distribution images. The neutron spin experiences Larmor precession in a magnetic field, and its precession angle depends on the neutron wavelength and field strength integrated along the neutron flight path. Since a change of the neutron spin direction can be detected as a change in the polarization degree, the polarization image at a specified wavelength gives the distribution of the magnetic field along the neutron beam trajectory. Moreover, the integrated field strength at each position in the image can be quantitatively evaluated by analyzing the wavelength dependence of the polarization degree. We constructed the polarization analysis system for neutron imaging [1] and performed some application studies at BL10 NOBORU and BL22 RADEN. In this presentation, we will describe the present status of our polarized neutron imaging method and show some experimental results of recent studies.

Reference

[1] T. Shinohara, *et al.*, J. Phys.: Conf. Ser. **862**, 012025 (2017).

Author: Dr HIROI, Kosuke

Presenter: Dr HIROI, Kosuke

Session Classification: Instruments

Track Classification: Instrument

Contribution ID: **178** Type: **Oral Presentation**

The Neutron Resonance Spin Echo Spectrometers at J-PARC MLF "BL06 VIN ROSE"

Neutron spin echo (NSE) is a variation of neutron spectrometry for high-resolution inelastic and quasi-elastic neutron scattering methods [1]. Two types of NSE spectrometers, that is, a neutron resonance spin echo (NRSE) instrument and a modulated intensity by zero effort (MIEZE) instrument, have been installing into BL06 at Materials and Life Science Experimental Facility (MLF), Japan Proton Accelerator Research Complex (J-PARC), in collaboration with Kyoto University and KEK [2]. In both the instruments, neutron resonance spin flippers have been used to cause the neutron Larmor precession.
While the MIEZE spectrometer has been aimed to study slow dynamics in magnetism with magnetic field application at the sample position and polarization analysis up to a few nanoseconds, the NRSE spectrometer is designed to achieve better energy resolution (~ 100 nanoseconds).
The commissioning of the MIEZE spectrometer has been started prior to the development of NRSE spectrometer since 2014, and the characterizations between time-of-flight neutron spectroscopy and MIEZE was verified quantitatively [3]. Since the 2017B proposal round, the user program with the MIEZE instrument has been partially started. At the NRSE spectrometer, the two-dimensional ellipsoidal neutron-focusing supermirrors, which are essential for the achievement of high-energy resolution by correcting the neutron path difference [4], are now under development in close collaboration with the RIKEN center for advanced photonics [4], and the spin echo signals at the spectrometer with the ellipsoidal supermirrors (5Qc) have been successfully observed [5].
The current status of BL06 "VIN ROSE"will be given at the presentation in detail.
References
[1] F. Mezei ed., Neutron Spin Echo, Lecture Notes in Physics, (Springer, Berlin) **128**, (1982).
[2] M. Hino, T. Oda, M. Kitaguch, N. L. Yamada, H. Sagehashi, Y. Kawabata, and H. Seto, Physics Procedia **42**, 136 (2013).
[3] T. Oda, M. Hino, H. Endo, N. L. Yamada, Y. Kawabata, and H. Seto, JPS Conf. Proc. **22**, 011029 (2018).
[4] T. Hosobata, M. Hino, H. Yoshinaga, T. Kawai, H. Endo, Y. Yamagata, N. L. Yamada, and S. Takeda, JPS Conf. Proc. **22**, 011010 (2018).
[5] H. Endo, T. Oda, M. Hino, and T. Hosobata, Physica B **564**, 91 (2019).

Author: Prof. ENDO, Hitoshi (Neutron Science Division, Institute of Materials Structure Science, High Energy Accelerator Research Organization (KEK) and J-PARC Center)

Co-authors: ODO, T. (Institute for Integrated Radiation and Nuclear Science); HINO, M. (Institute for Integrated Radiation and Nuclear Science)

Presenter: Prof. ENDO, Hitoshi (Neutron Science Division, Institute of Materials Structure Science, High Energy Accelerator Research Organization (KEK) and J-PARC Center)

Session Classification: Instruments

Track Classification: Instrument

Contribution ID: **179** Type: **Oral Presentation**

Multi-Grid Boron-10 detector: from proof-of-principle to applications in time-of-flight spectrometers

Tuesday 15 October 2019 10:30 (30 minutes)

The Multi-Grid detector was introduced at the ILL and developed in collaboration with the ESS over the past 8 years. This detector technology emerged as a consequence of the need to find alternatives to ^{3}He in neutron scattering detectors, where the large area needed makes ^{3}He detectors prohibitively expensive. It has seen been demonstrated that the Multi-Grid and other similar detectors provide further advantages in the counting rate capability over that of ^{3}He, while holding their ground in other key characteristics. This contribution will summarize the development and characterization work on the Multi-Grid detector prototypes. This includes two testing campaigns where Multi-Grid prototypes have been installed at CNCS and SEQUOIA instruments at the SNS providing invaluable in providing real in-beam performance and side-by-side comparison with ^{3}He.

Author: Dr KHAPLANOV, Anton (European Spallation Source)

Presenter: Dr KHAPLANOV, Anton (European Spallation Source)

Session Classification: Instruments

Track Classification: Instrument

Contribution ID: **180** Type: **Oral Presentation**

Wide-angle polarization analysis using 3He spin filters on the LET spectrometer at ISIS

Tuesday 15 October 2019 14:00 (30 minutes)

LET is a cold time-of-flight chopper spectrometer installed on the second target station at the ISIS facility. With nearly π st. of continuous detector coverage, it is primarily used to map excitation spectra in single crystals of magnetic materials. Beyond this application, its high resolution makes it well suited for quasi-elastic scattering (QENS) studies of energy materials, soft matter, and biological systems. Here, we present the new uniaxial polarization analysis option on LET, which features a wide-angle 3He spin filter analyser that provides access to the full LET detector. The potential of the instrument to perform polarized QENS experiments is illustrated by the example of D2O, where the separation of the coherent and incoherent components of the cross section has proven essential to understand the evolution of the collective (coherent) and single-particle (incoherent) dynamics from atomic to intermediate length-scales.

Author: Dr NILSEN, Gøran J. (ISIS Neutron and Muon Facility, Rutherford Appleton Laboratory)

Co-authors: Dr RASPINO, Davide (ISIS Neutron and Muon Source); Dr GARCIA-SAKAI, V. (ISIS Neutron and Muon Facility, Rutherford Appleton Laboratory); Dr BEWLEY, Robert (ISIS)

Presenter: Dr NILSEN, Gøran J. (ISIS Neutron and Muon Facility, Rutherford Appleton Laboratory)

Session Classification: Instruments

Track Classification: Instrument

Contribution ID: **181** Type: **Oral Presentation**

The CANDOR Polychromatic Beam Reflectometer at NIST

Wednesday 16 October 2019 10:45 (30 minutes)

The design and development of the polychromatic beam reflectometer CANDOR (for Chromatic Analyzer Neutron Reflectometer Or Diffractometer) currently being commissioned at the NIST Center for Neutron Research is described. This includes the performance of an energy-dependent neutron detector which incorporates pyrolytic graphite analyzer crystals (54 separate elements in series) in conjunction with ^{6}LiF/ZnS(Ag) scintillation detectors and silicon photomultiplier (SiPM) devices. This array simultaneously detects neutrons within a 4 to 6 Angstrom bandwidth at a fractional wavelength resolution of approximately one percent and with an efficiency comparable to conventional ^{3}He tube detectors. How 18 such energy-dependent detector arrays are to be configured within the reflectometer is described, particularly in regard to achieving a focusing condition in the wavevector transfer Q for specular reflectivity measurements. For specular reflectivity measurements, an order of magnitude gain or more over a conventional monochromatic beam instrument at a continuous source is expected. Other principal components of this instrument, including polarizers, focusing optics, and filters to suppress undesirable portions of the incident spectrum, are described as well.

Author: Dr MAJKRZAK, Charles (National Institute of Standards)

Presenter: Dr MAJKRZAK, Charles (National Institute of Standards)

Session Classification: Instruments

Track Classification: Instrument

Contribution ID: **182** Type: **Oral Presentation**

Breakout Summaries

Friday 18 October 2019 09:00 (1h 20m)

Presenters: Mr HAYNES, David (ISIS, STFC, UKRI); EHLERS, Georg (Oak Ridge National Laboratory); MUHRER, Günter (European Spallation Source ERIC); TAYLOR, Jonathan (European Spallation Source ERIC); ANDERSEN, Ken (ESS)

Session Classification: Plenary

Contribution ID: **184** Type: **Oral Presentation**

Closing Remarks

Friday 18 October 2019 11:25 (1h 5m)

Presenters: HERWIG, Kenneth (ORNL); Dr MCGREEVY, Robert

Session Classification: Plenary

Contribution ID: **185** Type: **not specified**

Novel Instrumentation Discussion

Monday 14 October 2019 16:10 (20 minutes)

Presenter: Prof. RÜEGG, Christian (Paul Scherrer Institute)

Session Classification: Instruments

Contribution ID: **186** Type: **not specified**

Large Scale Structures Analysis Discussion

Monday 14 October 2019 15:20 (30 minutes)

Session Classification: Software

Contribution ID: **187** Type: **not specified**

Target 2 Discussion

Session Classification: Target

Contribution ID: **188** Type: **not specified**

Detectors Discussion

Tuesday 15 October 2019 12:40 (20 minutes)

Presenter: HENRY, Paul (ISIS Neutron & Muon Source)

Session Classification: Instruments

Contribution ID: **189** Type: **not specified**

Experiment Control Discussion

Tuesday 15 October 2019 11:50 (30 minutes)

Session Classification: Software

Contribution ID: **190** Type: **not specified**

Target 3 Discussion

Tuesday 15 October 2019 12:35 (25 minutes)

Session Classification: Target

Contribution ID: **191** Type: **not specified**

Polarization Discussion

Tuesday 15 October 2019 16:10 (20 minutes)

Presenter: ANDERSEN, Ken (ESS)

Session Classification: Instruments

Contribution ID: **192** Type: **Oral Presentation**

Target 4 Discussion

Tuesday 15 October 2019 16:00 (30 minutes)

Presenter: BESSLER, Yannick

Session Classification: Target

Contribution ID: **193** Type: **not specified**

Novel Instruments Discussion

Wednesday 16 October 2019 12:35 (25 minutes)

Presenter: GUTBERLET, Thomas (Forschungszentrum Jülich GmbH)

Session Classification: Instruments

Contribution ID: **194** Type: **not specified**

Data Processing

Wednesday 16 October 2019 12:05 (30 minutes)

Session Classification: Software

Contribution ID: **195** Type: **not specified**

Target 5 DIscussion

Wednesday 16 October 2019 12:50 (10 minutes)

Session Classification: Target

Contribution ID: **196** Type: **not specified**

Focusing guides for first and second target beamlines: a conceptual design perspective

Thursday 17 October 2019 10:30 (30 minutes)

Presenter: Dr STOICA, Alexandru (Spallation Neutron Source)

Session Classification: Instruments

Contribution ID: **197** Type: **Oral Presentation**

Optics Discussion

Thursday 17 October 2019 12:40 (20 minutes)

Presenter: FILGES, Uwe

Session Classification: Instruments

Contribution ID: **198** Type: **not specified**

Monte Carlo Discussion

Thursday 17 October 2019 12:40 (20 minutes)

Session Classification: Software

Contribution ID: **199** Type: **not specified**

Target 6 Discussion

Thursday 17 October 2019 12:35 (25 minutes)

Presenter: CHARLES, Yoann (Paul Scherrer Institut)

Session Classification: Target

Contribution ID: **200** Type: **not specified**

Accelerator Discussion

Thursday 17 October 2019 16:10 (20 minutes)

Presenter: Dr COUSINEAU, Sarah (Research Accelerator Division, Oak Ridge National Laboratory)

Session Classification: Accelerator

Contribution ID: **201** Type: **Oral Presentation**

High Field Magnets for Neutron Scattering

Thursday 17 October 2019 14:00 (30 minutes)

The National High Magnetic Field Laboratory has completed the highest field superconducting magnet worldwide, a 32 T system employing REBCO (Rare Earth Barium Copper Oxide) and traditional Nb3Sn and NbTi. This magnet was the product of an 8-year development effort and will be used for condensed matter physics experiments in Tallahassee, FL. Since then the NHMFL has initiated the development of a 40 T superconducting magnet.

The latest developments worldwide in ultra-high field superconducting magnets are presented along with their implications for magnets for high field neutron scattering.

Presenter: Dr BIRD, Mark (National High Magnetic Field Laboratory)

Session Classification: Instruments

Contribution ID: **202** Type: **Oral Presentation**

Sample Environment Discussion

Thursday 17 October 2019 16:00 (30 minutes)

Presenter: Dr NIEDERMAYER, Christof (Laboratory for Neutron Scattering and Imaging, Paul Scherrer Institut)

Session Classification: Instruments

Contribution ID: **203** Type: **not specified**

Target 7 DIscussion

Thursday 17 October 2019 16:00 (30 minutes)

Presenter: SORDO, Fernando (Consorcio ESS-Bilbao)

Session Classification: Target

Contribution ID: **205** Type: **Oral Presentation**

The Legnaro fast-neutron facility NePIR

Thursday 17 October 2019 15:20 (25 minutes)

NEPIR (Neutron and Proton Irradiation facility) is a project devoted to create a new irradiation facility at INFN Legnaro National Laboratories (LNL) in Italy. This contribution focuses on the most recent progresses of the project, that is in an advanced design phase and partially founded.
The facility will exploit the LNL 30-70 MeV, high current proton cyclotron of the SPES project to feed two different compact neutron sources in order to generate high flux neutron beams with different energy spectra. The first will produce a quasi mono-energetic neutron beam, with controllable energy peak in the 30-70 MeV range; the calculated flux at maximum energy and maximum current (10 μA, limited by radioprotection regulations) is 4.5x10^5 n/cm^2/s, at a test point 3 m downstream. This versatile tool will be an important addition to the park of research infrastructures for national and European research.
The second converter, ANEM (Atmospheric Neutron EMulator) will produce fast (E > 1 MeV) neutrons, with an energy distribution similar to that of neutrons naturally present at sea-level (atmospheric neutrons), generated by the interaction of energetic cosmic rays with the Earth atmosphere; the maximum expected flux, 4 m downstream of the source, is 3x10^6 n/cm^2/s. This will be used to study atmospheric neutron-induced single event effects in electronic devices and systems. Using additional moderator panels, the ANEM white spectrum can be shaped to resemble that of other environments (eg. surface of Mars or moon).
In this talk, the facility overview will be presented, together with some scientific cases related to electronic device SEE testing and material characterization for Mars and general space missions.

Author: MASTINU, Pierfrancesco (Istituto Nazionale di fisica Nucleare)

Co-authors: BISELLO, D. (Istituto Nazionale di Fisica Nucleare); ESPOSITO, J. (Istituto Nazionale di Fisica Nucleare); MAGGIORE, M. (Istituto Nazionale di Fisica Nucleare); PRETE, G. (Istituto Nazionale di Fisica Nucleare); SILVESTRIN, L. (Department of Physics and Astronomy, University of Padova); WYSS, J. (DiCEM, University of Cassino)

Presenter: MASTINU, Pierfrancesco (Istituto Nazionale di fisica Nucleare)

Session Classification: Accelerator

Track Classification: Accelerator

Contribution ID: **206** Type: **Oral Presentation**

Proton Power Upgrade Project Update

Friday 18 October 2019 11:00 (25 minutes)

The Proton Power Upgrade (PPU) project will upgrade the Spallation Neutron Source (SNS) proton beam power capability by a factor of two: from 1.4 MW to 2.8 MW. This upgrade will allow in increased beam power capability at the existing First Target Station (FTS) and will also provide beam power for the Second Target Station project, which is another ongoing SNS upgrade. PPU will increase the proton beam energy and the beam current by adding new superconducting cryomodules, new RF equipment and upgrading some existing equipment. Also, the FTS target systems will be upgraded to handle the increased beam power. The status, scope and future path of the PPU project will be discussed. The project has recently received approval to move forward on a significant amount of scope. Plans also include a gradual power ramp up over the 2023-2024 period.

ORNL is managed by UT-Battelle, LLC, under contract DE-AC05-00OR22725 for the U.S. Department of Energy. This research was supported by the DOE Office of Science, Basic Energy Science, Scientific User Facilities.

Author: Dr GALAMBOS, J. (Oak Ridge National Laboratory)

Presenter: Dr GALAMBOS, J. (Oak Ridge National Laboratory)

Session Classification: Plenary

Track Classification: Accelerator

Contribution ID: **207** Type: **not specified**

Source Development Discussion

Monday 14 October 2019 16:05 (25 minutes)

Session Classification: Sources

Contribution ID: **208** Type: **not specified**

Radiation Safety Discussion

Tuesday 15 October 2019 12:35 (25 minutes)

Session Classification: Operations/Safety

Contribution ID: **209** Type: **not specified**

Systems Design Discussion

Tuesday 15 October 2019 16:05 (25 minutes)

Presenter: Mr HAYNES, David (ISIS, STFC, UKRI)

Session Classification: Operations/Safety

Contribution ID: **210** Type: **Oral Presentation**

The ^{10}B based Jalousie neutron detector: its current status and its employment for DREAM and MAGIC at ESS

Jalousie is a modularized neutron detector in production phase, developed to serve as alternative for classical ^{3}He position sensitive detector tubes as used for large neutron scattering instruments. The design has been fully produced for the POWTEX instrument at FRM II, is now under production for DREAM and under design for MAGIC at ESS. The neutron converting material is 10Boron and replaces ^{3}He. The comparatively small overall detection efficiency of an individual layer is enhanced by tilting with 10° the layer towards the incoming neutron path, thus increasing the effective absorption depth by a factor of 6. Additionally, 8-12 such boron layers are arranged along any neutron path to further enhance overall detection efficiency to 54%-63% at 1 Å.
A Jalousie detector system comprises many lamella shaped individual modules, where each makes up an enclosed multi wire proportional chamber with two anode planes and one cathode plane that carry the converter layers. Several such lamellae, when stacked and tilted with respect to the neutron paths, may be arranged to cover square meter sized planes, or alternatively a cylindrical surface to enclose a scattering sample. A solution for the cylinder endcap coverage has also been developed. Spatial resolution of 5-7 mm (FWHM) and down to 1 mm (FWHM) in a special configuration along one dimension as well as time of flight resolution of 3-10 μs (FWHM) may be customized through design parameters.
The detector concept together with measurement results, the particular technical challenges encountered and the current state of these projects will be presented.

Author: KLEIN, Martin (CDT GmbH)

Presenter: KLEIN, Martin (CDT GmbH)

Session Classification: Instruments

Track Classification: Instrument

Contribution ID: **211** Type: **Poster**

ISIS TS1 Project - Reflector Engineering Development

Thursday 17 October 2019 16:30 (2 hours)

The goal of the ISIS Target Station project, is to replace the Target, Reflector and Moderators (TRAM) in the first Neutron Spallation Target station (TS1). After 34 years of successful operation this is an opportunity to incorporate technologies and lessons learnt from the 2008 Target Station 2 (TS2) build. This will bring about some performance enhancements and significant improvements to maintenance operations.
The project is currently in full swing making progress towards its completion in 2020 with the target assembly already completed and the reflector assembly at an intermediate stage of manufacture. This paper focuses on the engineering design of the solid beryllium reflector and the challenge of providing adequate cooling, maintaining tight geometry around the moderators and target in conjunction with providing access for target and moderator changes. The end result is a modular design that can accommodate future moderator upgrades and satisfy the cooling requirements within the confines of manufacturing limits.

Author: COATES, Dan

Presenter: COATES, Dan

Session Classification: Poster

Contribution ID: **212** Type: **not specified**

Welcome Reception

Sunday 13 October 2019 18:00 (2 hours)

Contribution ID: **213** Type: **Oral Presentation**

Neutronics Performance of CSNS Moderators

The China Spallation Neutron Source (CSNS) is an accelerator based multidiscipline user facility constructed in Dongguan, Guangdong, China. The CSNS consists of a linear accelerator, a rapid cycling proton synchrotron accelerating the beam to 1.6 GeV energy, a solid tungsten target station, and three instruments in phase one for neutron scattering applications.
The neutron wavelength spectra (>0.286A) of three moderators， 20K Coupled Hydrogen Moderator(CHM), 20K Decoupled and Poisoned Hydrogen Moderator(DPHM) and room temperature Decoupled Water Moderator(DWM)， were measured at beamline 1# 6# 9# and 20# by low efficiency He3 neutron detector and lithium glass neutron detector applying TOF method. The neutronic performance of the moderators provides evidence of strong coupling between the target and the moderators. The integral flux of cold and thermal neutron was verified by activation measurement of gold foil. The integral flux of three moderators is agree with the simulation results of engineering geometry model within 20%. The neutron pulse shape of DPHM was measured by time focusing technique and agree well with the simulation result. The detail of measurement methods and results and MC simulation will be introduced.

Author: Dr LIANG, Tianjiao (Dongguan Branch,Institute of High Energy Physics, CAS)

Co-authors: Mr WANG, Songlin (CSNS， Institute of high energy physics, CAS); Dr SHEN, Fei (CSNS，Institute of high energy physics, CAS); Mr ZHOU, Bin (CSNS，Institute of high energy physics, CAS); Mr HU, Zhiliang (CSNS， Institute of high energy physics, CAS); YIN, Wen (Institute of High Energy Physics, Chinese Academy of Sciences)

Presenter: Dr LIANG, Tianjiao (Dongguan Branch,Institute of High Energy Physics, CAS)

Session Classification: Target

Track Classification: Target/Moderator

Contribution ID: **214** Type: **Poster**

CHESS: A look into the next generation of neutron instruments

Thursday 17 October 2019 16:30 (2 hours)

CHESS is the new proposed direct geometry inelastic spectrometer dedicated to the analysis of small samples with modest energy resolution (2.5-5% of Ei). This relatively short instrument will take full advantage of both the increased peak brilliance of the SNS Second Target Station (STS) coupled moderators, and of the recent advances in instrument design and technology, to achieve unprecedented performance for inelastic scattering in the cold energy range. The simulations predict that it will exceed that of CNCS by at least a factor of 200. Two sections of ballistic octagonal guides will transport the beam to the sample position at 29.6 m from the moderator.
A new concept for double disk choppers will select the wavelengths and deal with frame overlap. CHESS will take full advantage of Repetition-Rate Multiplication (RRM) to analyze samples at multiple incident energies, maximizing the efficiency of the measurement. Finally, the detector tank will house a large array of curved 8-pack detector ^{3}He tubes giving a total solid angle coverage of 6.0 sr, and will incorporate Helmholtz coils for polarization analysis. Detailed Monte Carlo (MC) simulations of a real experiment on $K_2V_3O_8$ have been performed to optimize the instrument using McStas and MCViNE; these results were verified by running similar calculations on CNCS.

Author: SALA, Gabriele (Neutron Scattering, Spectroscopy Division)

Co-authors: EHLERS, Georg (Oak Ridge National Laboratory); LIN, Jiao (Oak Ridge National Lab); HERWIG, Kenneth (ORNL); Mr GRAVES, Van (Oak Ridge National Laboratory)

Presenter: SALA, Gabriele (Neutron Scattering, Spectroscopy Division)

Session Classification: Poster

Contribution ID: **215** Type: **not specified**

Discuss Posters and Sessions from Monday

Tuesday 15 October 2019 08:00 (30 minutes)

Session Classification: Plenary

Contribution ID: **216** Type: **not specified**

Discussion Planning with session chairs

Tuesday 15 October 2019 08:30 (30 minutes)

Session Classification: Plenary

Contribution ID: **217** Type: **not specified**

Discuss Sessions from Tuesday

Wednesday 16 October 2019 08:00 (30 minutes)

Session Classification: Plenary

Contribution ID: **218** Type: **not specified**

Discussion planning with session chairs; Poster presenters hang posters

Wednesday 16 October 2019 08:30 (30 minutes)

Session Classification: Plenary

Contribution ID: **219** Type: **not specified**

Discuss Posters and Sessions from Wednesday

Thursday 17 October 2019 08:00 (30 minutes)

Session Classification: Plenary

Contribution ID: **220** Type: **not specified**

Discussion planning with session chairs; Poster presenters hang posters

Thursday 17 October 2019 08:30 (30 minutes)

Session Classification: Plenary

Contribution ID: **221** Type: **not specified**

Discuss Posters and Sessions from Thursday

Friday 18 October 2019 08:30 (30 minutes)

Session Classification: Plenary

Contribution ID: **224** Type: **not specified**

Discussion planning with session chairs; Poster presenters hang posters

Monday 14 October 2019 08:00 (45 minutes)

Session Classification: Plenary