P.019 Progress towards magic PASTIS (wide angle polarization analysis using 3He NSF for spectroscopy)

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Polarization analysis will be needed on modern neutron scattering instrumentation designed to measure wide dynamic Q-ranges. These instruments will often use large area detectors and potentially multiple neutron wavelength bands or pulsed sources. This will place high demands on the method used for the polarization analysis. Two methods, super mirrors and 3He neutron spin filters, are often considered as the only solutions. I will discuss the basic differences in these two methods for applications measuring a wide dynamic Q-range via the use of large area detectors. First we will present the simplified theory for conceptual understanding of how both wide angle SM and wide angle 3He analyzer devices perform. Then we discuss how the properties of each method will affect neutron performance taking into account practical considerations. Second I will present progress towards suitable instrumentation to implement such a 3He wide angle analyzer system for thermal beam spectroscopy applications. This will include discussion of an XYZ "magic PASTIS” style magnetostatic cavity design, prototyping, and testing, and wide angle 3He spin filter cells made of GE180 glass, their manufacture, and characteristics with respect to the considered application of analysis for thermal TOF spectroscopy.

P.020 The next generation humidity chamber for biological samples

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The complex ordering of biological samples can be probed and better understood through the use of neutron scattering. Taking advantage of the high resolution of the neutrons and the option for selective labelling of samples through deuteration allows for unique measurements that are not possible with other techniques such as x-ray scattering or magnetic resonance. The characteristics of biological samples are strongly coupled to both the temperature and relative humidity of the sample's surroundings. With this in mind, it is necessary not only to accurately observe the hydration and temperature of a biological sample, but also to have precise control over these parameters. Until now, the fine control of sample environment humidity has been difficult for relative humidity above 95%, due to various factors such as the unreliability of sensors at high humidity values and the presence of thermal gradients in sample environment which often lead to condensation.

In the framework of the NMI3 Soft Matter JRA-Work Package 20, the cooperation partners from HZB, ILL, JCNS started with the design and construction of a next generation humidity chamber for use with neutron scattering. With this chamber we aim to create a neutron scattering sample environment with precise and stable control of humidity, especially at high values (over 95% R.H.).

In the preliminary stages of this project, we present the capabilities and limitations of humidity chambers already in use and an outlook for our future design. This will include a special focus on the testing of various humidity sensors and the effectiveness of strategies for suppressing thermal fluctuations in humidity chambers.
P.021 A versatile sample stick for high voltage experiments

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The sample environment is an integral part of neutron scattering experiments. Precise and reliable control of external parameters such as temperature, magnetic and electric fields, or pressure, is essential for the success of an experiment. The renewed interest in multifunctional and multiferroic materials has led to increased demand for experiments which combine electric fields with both low temperatures and magnetic fields.

While standard equipment exists for the latter, the use of the former is often achieved only with cumbersome local solutions. For experiments involving electric fields, specific sample shapes are usually required, and which need to be in intimate contact with the voltage electrodes. The most common geometry is the parallel-plate capacitor, where a plate-like sample is placed between two parallel electrodes. Since typical sample volumes necessary for neutron scattering experiments are of the order of several mm\(^3\), rather large applied voltages are required in order to obtain the typical field strengths of kV/mm that are achieved across thinner samples in laboratory measurements. We have developed a high voltage sample stick which can easily be adapted to suit different scattering geometries, and which fits all cryomagnets and orange cryostats which are available at SINQ. We are further able to perform standard electric field experiments using our wide range of standard cryostats, thereby reducing the efforts required when preparing for neutron scattering studies.

P.022 Linear PSD signal processing

R Berliner

Instrumentation Associates, USA

Linear position sensitive proportional counters (LPSDs) can provide remarkably high resolution event position data. Position resolutions of 2.5 mm are routinely obtained. Arrays of LPSDs remain a cost effective way to assemble large area neutron detectors for many applications.

A simple Ohm’s law analysis demonstrates that the neutron event positions can be calculated as:

\[
x/L = Q_a/(Q_a+Q_b)
\]

where \(Q_a\) and \(Q_b\) are the charges collected at each end of the detector from the neutron capture event, \(x\) is the event position measured from the A-end of the detector and \(L\) is the detector active length. In practice, it is not the charges that are recorded but the digitized representations of the event signals after processing by a preamplifier-amplifier-ADC chain at each end of the detector. The characteristics of the preamplifiers, the gains of the amplifiers and the zero-offsets of the ADCs can all affect the apparent position sensing response. While the preamplifier input impedance and ADC offsets tend to shift the position response transfer curve for the detector, differences in the amplifier gains between the A and B-side of the detector signal chain leads to an easily detectable nonlinear position response. These effects are of secondary importance in pulsed source applications where the position resolution requirements are often 0.5 cm – 1.0 cm but become important in reactor applications where higher resolutions are required.
P.023 Enhancing polarized neutron measurement capabilities using $^3$He spin filters

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Abstract unavailable

P.024 Sample environment for soft matter and bio-materials

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Establishing how and where Sample Environment fits into soft matter and bio-materials experiments has become 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 sample environment equipment. ISIS has recently set up a Soft Matter Section in the Sample Environment Group, where we are attempting to review and learn about the existing equipment and science that is taking place. Understanding the large diversity that is needed such as temperature, pressure, sample changers, sheer, troughs, solid/liquid cells is one of the main challenges faced to provide stability, reliability, accuracy, control and flexibility in soft matter experiments.

P.025 Development of BF$_3$ and $^{10}$B coating based position sensitive neutron detectors

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Bhabha Atomic Research Centre, India

Enriched BF$_3$ gas and $^{10}$B coating are most promising alternatives to $^3$He gas and are being used to develop Position Sensitive Detectors (PSDs) for neutron scattering applications.

A multi-PSD array covering 3.5 m$^2$ detection area with 87 linear PSD is under fabrication for the Time of Flight Instrument to be installed at Dhruva reactor at BARC. Efforts are also on to improve the efficiency of PSD using BF$_3$ gas and $^{10}$B coating. Effect of various geometries and BF$_3$ gas pressure to improve detection efficiency are being under investigation. Aging of BF$_3$ gas with various assembly materials is studied and implemented to improve the life of PSD.

$^{10}$B coated PSDs are developed using coaxial geometry and performance are being studied. Advantage of these PSDs is nontoxic nature compared to BF$_3$, though efficiency of $^{10}$B coated PSD is lower. Multiple $^{10}$B layers can be used to increase the efficiency. Multiple layers in plane geometry result in parallax at higher scattering angles, thus a curvilinear design of PSD with multiwire anode grids and charge division readout is being developed. Results from these studies will be presented.

P.026 Closed cycle refrigerator systems at ISIS

R Down, O Kirichek, J Keeping, R Major, C Chapman and Z Bowden

STFC, UK

Closed Cycle Refrigerator (CCR) based systems can significantly reduce and in some cases completely eliminate the use of liquid cryogens. These systems also offer the advantage of operational simplicity, require less space than conventional cryogen-cooled systems and can significantly improve user safety. The ISIS facility has large number of Gifford McMahon and Pulse Tube based closed CCR systems, these include bottom and top-loading cryostats.
These systems are optimized for neutron access by using thinned windows for both spectroscopy and diffraction and can easily offer the user a range of temperatures between 4 and 700K. Over the last few years ISIS has developed a top loading Pulse Tube based CCR that is capable of sustained operation of 60mW at 1.5K and has very good stability over a range of temperatures. ISIS has recently formed a collaboration with Oxford Instruments PLC to commercially produce this system, and the first system has been already delivered. ISIS uses a number of dilution refrigerator inserts which can be used with standard variable temperature inserts of cryostats or superconducting magnets. However the range of applications of the systems mentioned is limited by their relatively low cooling power and small sample space. 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. Oxford Instruments in collaboration with ISIS have developed a powerful cryogen-free dilution refrigerator for neutron scattering experiments. The fridge is capable of cooling large and heavy samples.

P.027 Advanced motion control technologies for neutron scattering instrumentation
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European Spallation Source (ESS), Sweden

Motion Control in neutron instrumentation is rather manifold and touches nearly every part of a modern neutron scattering instrument. The unique features of modern spallation neutron sources like the future ESS together with latest developments on neutron instrumentation towards higher grades of automation have a huge impact on motion control in that area.

High positioning precision for small samples sizes, minimized dead time between short experiment runs, application of radiation proof devices, characterisation of components for motion control in high magnetic fields; only to name a few of the new challenges. The use of modular high-level motion control units introduces performances like the coordinated motion of a large number of axes, movements along freely definable trajectories and advanced self- and distance diagnostics in neutron instrumentation.

In this contribution we will present new concepts to cope with the increasing demands; acquiring neutron events during the movement ("on the fly") by time-stamping neutrons and motor positions, adapting high-precision technologies for small samples well known in x-ray instrumentation or substitution of mechanical solutions by sophisticated control electronics are few of the key ideas. Main focus will be on applications in extreme environments like magnetic fields in the sample area or high radiation levels in the front parts of the instrument.

First results of an extensive test series on the behavior of different encoder technologies in static magnetic fields up to 1.2T done at the Paul Scherrer Institut, Switzerland, will complete the contribution.

P.028 High temperature gas and moisture flow system
C Goodway, O Kirichek, Z Bowden, M Kibble, M Dudman, R Haynes, S Hull and S Norberg
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Over the past three years a demand for running gas mixtures through samples and catalysts at high temperature has developed on POLARIS powder diffractometer at ISIS facility. Here we are going to present the new centre-stick designed in-house in collaboration between ISIS users, instrument scientists and pressure and furnace section. The design was implemented so, that it could be used in a standard beam line furnace. The centre-stick consists of two quartz tubes one inside the other making the stick removable and ease sample changes. Two sticks have been manufactured, so that one can be loaded while the second is running. The system runs at just over 1 bar absolute with a maximum sample size of 10mm diameter and 40mm high. With the addition of using gas mixtures with moisture the initial demand has increased further and this system is now in use on POLARIS, HRPD and WISH instruments.
P.029 Neutron detector development at the ILL with and without 3He
B Guerard¹, J-C Buffet¹, J-F Clergeau¹, S Cuccaro¹, M Ferraton¹, F Horst¹, A Khaplanov², J Pentenero¹, M Platz¹, P Van Esch¹ and G Viande¹

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³He was often used as the neutron convertor for detectors in neutron scattering science, but this gas has become rare and expensive since 2008. The growing lack of Large Area Neutron Detectors becoming a major concern in most of the research neutron institutes, the development of techniques based on alternative convertors is of the highest priority. ¹⁰B is one of them; it can be used either in solid scintillators, or in proportional counters as thin films (¹⁰B or ¹⁰B₄C) or gas compound (¹⁰BF₃). In a ¹⁰B Multi-Grid detector, one grid consists of blades coated with thin Boron films on both sides mounted on a frame, whereas in a ¹⁰BF₃ Multi-Grid detector, one grid is made of a single block of Aluminium, machined to create the holes. A ¹⁰B Multi-Grid prototype with 30 layers of B₄C has been tested on a monochromatic neutron beam line, providing a detection efficiency of 50% at 2.5 Angstrom wavelength. These results as well as the results obtained with ¹⁰BF₃ detectors will be described. The ILL is also still active in developing ³He detectors; their performances will be illustrated by showing several examples of detectors considered as workhorse in their category: large area curved detectors for powder and single crystal diffraction, Multi-tube detectors for reflectometry and SANS, and the high resolution MILAND multi-purpose detector developed in FP6.

P.030 First test of Multi-Grid B10 detector in a time-of-flight spectrometer
R Hall-Wilton⁴, A Khaplanov¹, J Birch², J-C Buffet³, J Correa³, J-F Clergeau³, P van Esch³, B Guerard³, C Hoglund⁴ and F Piscitelli³

¹ESS, Sweden/ILL, France, ²Linkoping University, Sweden, ³ILL, France, ⁴ESS, Sweden

A neutron detector concept based on solid layers of boron carbide enriched in B10 has been in development for the last few years as an alternative for He3 by a collaboration between the ILL, ESS and Linkoping University. This Multi-Grid detector uses layers of aluminum substrates coated with B4C on both sides that are traversed by the incoming neutrons. Detection is achieved using a gas counter readout principle. By segmenting the substrate and using multiple anode wires, the detector is made inherently position sensitive. This development is aimed primarily at neutron scattering instruments with large detector areas, such as time-of-flight chopper spectrometers. The most recent prototype has been built to be interchangeable with the He3 detectors of IN6 at ILL. The B10 detector has an active area of 32x48cm2. It was installed at IN6 and operated for several weeks, collecting data in parallel with the regularly scheduled experiments, thus providing the first side-by-side comparison with the conventional He3 detectors. Results include an efficiency comparison, assessment of the in-detector scattering contribution, sensitivity to gamma-rays and the signal-to-noise ratio in time-of-flight spectra. The good expected performance has been confirmed with the exception of an unexpected background count rate. This has been identified as natural alpha activity in aluminum. New convertor substrates are under study to eliminate this source of background noise.

P.031 Astronomical CCD cameras for neutron diffraction and imaging
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NeutronOptics Grenoble, France

The last issue of Neutron News in 2012 reported on alternatives to He3 detectors, but did not mention CCD cameras. ILL's CYCLOPS Laue diffractometer already uses 16 image intensified CCDs, and more ambitious CCD arrays have been proposed for the next stage of the ILL Millennium Program. Arndt & Ambrose (1968) first used
video cameras for diffraction measurements, and with Gilmore (1975) they applied that technique to neutron diffraction at ILL. Toni Heidemann in the 1990s explored the use of CCD cameras developed for astronomy, and since then the cost and size of such cameras has fallen, while their efficiency has increased. Arrays of CCD cameras are commonly used in astronomy, and indeed the low-light conditions for astronomy are similar to the low-flux conditions for neutron sources, either reactors or accelerators.

Image acquisition and analysis techniques, originally developed for microscopic biology, can also be used for neutron imaging. The ImageJ Java environment has been adapted to treat arrays of ASCOM (AStronomy Component Object Model) CCD cameras so that the cameras can be exposed simultaneously and the resulting images stitched together in real time.

We will describe how efficient but inexpensive CCD arrays can be used for neutron diffraction and imaging. Not all neutron laboratories can pay the increased price of large area He3 detectors or their alternatives, yet neutron diffraction and imaging are the first techniques used to build user communities around developing neutron sources.

P.032 VacBox - a new sample environment equipment to optimize the signal-to-noise ratio in triple-axis spectroscopy

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To investigate increasingly smaller samples and weaker signals the optimization of signal-to-noise ratio is prerequisite for a successful inelastic neutron scattering experiment. Parasitic scattering and therefore the presence of any materials including air needs to be minimised and the beam shape and size optimized. A new sample environment device VacBox has been designed and built at ILL (*) to be used on the triple-axis spectrometers.

The principal part of VacBox is a 600 mm diameter vacuum tank replacing the tail of a standard cryostat. The sample is oriented and rotated using a sample stick with motorized movements. VacBox remains static during the experiment. All cryogenic shielding is positioned > 40mm away from the sample but room temperature diaphragms can be placed < 70mm from the sample. This design reduces the parasitic scattering and limits the beam to the sample size even for highly divergent beam geometries. Our tests on IN3 illustrate that the signal-to-noise ratio is improved and the background due to the incident beam remains low for 2Theta ≥ 6 deg.

We used an 18mg de-twinned YBa2Cu3O6.67 single crystal on IN20 to find evidence for the charge density wave (CDW) previously observed with hard x-rays [J. Chang et al.; Nature Physics (2012) DOI: 10.1038]. Using VacBox reduced the background by an order of magnitude. Optimizing the focusing with the Si-111 monochromator improved the signal-to-noise by another factor of 4. We could identify an elastic signal of about 1 ct / min attributed to the CDW.

P.033 Boron-10-Based thin films for the next generation of neutron detectors

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Due to the urgent need for alternatives to 3He-based neutron detectors at large-scale neutron research facilities, a new generation of detectors uses 10B-containing thin films as the neutron-absorbing material. The detectors comprise thin films of 10B,C, deposited onto Al-blades or Si wafers. A full-scale detector needs in total ~ 1000 m² of two-side coated Al-blades with ~ 1 μm thick 10B,C films. Tough demands on film purity and thickness uniformities make it a big challenge upscale such a process to fulfill the demands of the European Spallation Source (ESS) of more than 7000 m².
Deposition processes like DC magnetron sputtering (PVD) (for flat surfaces) and thermally activated and plasma enhanced chemical vapor deposition (CVD) (for irregularly shaped substrates) have been developed for this purpose, at maximum 600 °C due to the Al substrates.

The coatings have been characterized with SEM, ERDA, XRR, and neutron scattering. Substrate temperatures of 400 °C result in PVD films with a high density, very low residual stresses, and good adhesion to thicknesses above 3 μm. The 10B content is close to 80 at.%, i.e. full isotope enrichment, with impurity levels of less than 1 at.% of H, N, and O. Various relevant properties, including neutron reflectivity and radiation damage, have been looked into.

These new 10B,C thin film based neutron detectors have a potential to replace most 3He-containing detectors. The development within the collaboration between the ESS, Linköping University and Institute Laue Langevin will continue far into the ESS construction phase, which lasts until ~2025.

P.034 Study of a time-of-flight neutron image intensifier system under intense pulsed neutron beam at J-PARC

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Required characteristics of imaging devices for the neutron transmission imaging at a pulsed source is a time-of-flight (TOF) detector with the high spatial resolution and high counting rate. A photon converting type detector is one of the most useful candidates, which is expected to be used at the high intensity field in keeping with the high spatial resolution. We are developing a C-MOS camera type imaging device with the neutron image intensifier (II). It consists of a high speed camera (HSC) for the time-sliced data-taking and a vacuum tube type neutron II. We have developed an time-sliced imaging data accumulating system and it enabled us to record the data over 7 days with the 25 Hz accelerator repetition although such long time measurement cannot be done by camera type system so far.

In this study we applied our system to the intense pulsed beam at BL10 of MLF in J-PARC, Japan at the power of 200 or 300 kW. In advance we developed the system at Hokkaido University Neutron Source, and the TOF system also worked well at J-PARC without any change. A problem was that the system needed the photo II between the neutron II and the HSC due to the low sensitivity resulted from the shorter time channel width. The burst gamma-ray at the flight time t = 0 made the photo II saturation. Nevertheless, we could obtain the transmission spectra from the series of the TOF images using the lower gain of the photo II.

P.035 Absorption in 1 conversion layer detector (A1-CLD): Status of the development

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As an in-kind contribution to the ESS instrumentation, and as a part of the German support to the “ESS Pre-Construction Phase and Design Update” the Helmholtz-Zentrum Geesthacht (HZG) develops a novel type of gaseous converter layer neutron detectors which is distinguished from other ones by very small angle (≈ 2° to 4°) between the converter surface and the incoming neutrons. This “extreme inclined geometry” opens up highest performance of A1-CLD’s: By using a test detector at the reflectometer REFSANS at FRM II very high neutron εn and extremely low Gamma quantum efficiencies of εg ≥ 80 % and εg < 10^-6 could be measured. The experiments revealed further that a position resolution perpendicular to the converter surface of less than 0.2 mm can be achieved.

Different A1-CLD types are being proposed: A1-CLD_e for elastic diffractometers (including reflectometry and SANS) may be designed with very high spatial resolution up to about 0.2 mm × about 2 mm, those detectors shall allow for...
covering medium sized areas (up to ~ 1 m²). Large detectors for inelastic instruments, A1-CLD_{inel}, with areas up to some 10 m² may designed with rather low spatial resolution (about 10 mm to 20 mm) and very high timing resolution due to high position read-out in beam direction (2 mm <dz < 5 mm).

Furthermore, we have started the development of a further detector type with perpendicular beam incidence on the converter which is distinguished by a “smart” design of electrodes and readout techniques.

P.036 Energy determination in neutron detector systems for neutron scattering systems by means of statistical methods

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The purpose of this contribution is to evaluate the feasibility of statistical determination of the neutron energy for thermal and cold neutrons in the new generation of neutron detectors. For the European Spallation Source (ESS), sited in Lund, Sweden, which is planned to be operational in 2019, and the world’s leading source for the study of materials with neutrons by 2025, novel neutron detectors represent a critical technology that needs to be developed. The discussion here is focused on Boron10 based thin-film detectors for neutron scattering science. By means of simulations and preliminary measurements an attempt is made to explore the possibility of determining the neutron energy from the penetration depth in the converter material by using mathematical statistical methods.

P.037 The TOSCA duplex cryostat

J Keeping, D Chan, R Major, O Kirichek and R Down

STFC, UK

The system forms the integrated sample environment for the TOSCA Spectrometer Instrument at ISIS facility. It is top loading and consists of two Sumitomo SRDK 415 Gifford McMahon Closed Cycle Refrigerators (CCR’s). These CCR’s cool a central copper tube by thermal conduction. The tube joins a copper ring which seals against the sample volume. The sample cooling is carried out by thermal conduction through an amount of static helium exchange gas. In the original design the thermal radiation shield has been cooled by a third single stage CCR: Leybold RGS 120. A project was undertaken to improve the systems cool down time, base temperature and operating costs. The project was achieved by examining in detail the joining methods at low temperature and thus improving the thermal contact and cooldown times. Utilization of the SRDK 415’s first stages enabled the removal of the single stage CCR to reduce operating costs. The cryostat now reaches a base temperature of 4.5K (the original system cooled to 12 - 15K) from start up in 7 hours with a sample cool-down time to a usable 20K in 45 minutes.

P.038 10kbar hydrogen intensifier

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Hydrogen is seen as a clean and potentially plentiful energy source. The search for compounds that are capable of storing enough hydrogen and materials which could be used in efficient fuel cells is now an international priority. Neutron scattering is particularly suited for this purpose due to high sensitivity to hydrogen atoms. This vital tool is able to probe materials potentially promising for hydrogen technology under the extreme conditions such as high temperatures and high pressure. However these require specialised sophisticated high pressure gas handling
systems and intensifiers. We are going to present the design, assembly and preliminary test results of 10 kbar hydrogen intensifier, which is being assembled and tested at ISIS by the pressure & furnace section. Due to the financial restrains ISIS sample environment group has decided to design and assemble the Intensifier in-house from components supplied by commercial companies. All the components required for the system have been already purchased. The assembly and testing of the intensifier are in progress.

P.039 The International Society for Sample Environment

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Sample environment for neutron scattering plays a crucial role for the success of a neutron scattering experiment. For many experiments today the role of sample environment is shifted from the traditional role of purely technical supporting infrastructure to the role of the key component that in the first place is crucial for the scientific success of the experiment.

With more complex sample environment setups for increasingly complex questions to address the sample environment teams around the world started in 1999 a closer collaboration with a series of workshops. Moreover on the 7th Workshop for Sample Environment at Neutron Scattering Facilities in September 2012 in Sydney the International Society for Sample Environment was founded. The main purpose of this society is the promotion of scientific and technical developments of sample environment at scattering facilities. It will establish even closer links between the sample environment groups worldwide and it will ease the exchange of information. Schools and workshops are foreseen to disseminate the knowledge about the possibilities of modern sample environment both within the scientific community and within the technical staff of the neutron scattering facilities.

P.040 Top loading cryogen free cryostat for neutron scattering experiments

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1STFC, UK, 2Oxford Instruments NanoScience, UK, 3ISIS, STFC, UK

Today all advanced neutron facilities maintain a fleet of Orange cryostats, or similar systems, to provide low temperature sample environment in neutron scattering experiments. However, a global shortage of helium gas can seriously jeopardise low temperature experimental programmes of neutron scattering laboratories. Luckily the progress in cryo-cooler technology offers new generation of cryogen free systems with significantly reduced consumption and in some cases nearly a complete elimination of cryogens. We are going to discuss design and test results of new cryogen free top-loading cryostat developed by the ISIS facility in collaboration with Oxford Instruments. The cryostat provides neutron scattering sample environment in temperature range 1.4 – 300 K. High cooling power 0.23 W at temperature less than 2 K achieved at the cryostat’s variable temperature insert heat exchanger allows operating of a standard dilution refrigerator insert in continues regime. The main aim of the development is to create a cryogen-free system as a potential replacement for the Orange cryostat. From a user perspective, the system offers operating parameters very similar to a conventional cryostat but without the complication of cryogens.
P.041 Adaptive polarizer device for pulsed neutron beams
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The aim of the device is to extend the accessible phase space for pulsed beam polarization, by changing the polarizing supermirror (PSM) tilt angle with respect to the beam direction according to the energy of the arriving neutrons. The critical reflection angle of polarizing coatings has a strong chromatic character: the largest angle of total reflection expressed in degrees is a tenth of the product of wavelength in Ångström and critical momentum transfer compared to natural Ni (m). This means that a transmission polarizer tilt angle has to be set such that spin-up neutrons with the highest energy (lowest wavelength) in the band of interest are still reflected and spin-down neutrons with lowest energy are still transmitted. Both the accessible wavelength bandwidth and divergence range / beam width are limited by this effect. In case of pulsed beams (pulsed sources or chopped beams at continuous sources) different wavelength neutrons arrive at different times to the polarizer location and there is also a time interval when no neutrons arrive. This feature can be exploited when the tilt angle of a relatively short PSM is adjusted by a suitable mechanism to the ideal value for the arriving neutrons’ energy at a given time. This way the beam height and divergence range may increase with wavelength. Details of the tilt mechanism and neutron beam test results are presented.

P.042 Recent developments of soft matter sample environment for SANS at ILL
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Small Angle Neutron Scattering (SANS) started at ILL 40 years ago, in 1972, with the commissioning of D11, the archetype of a long, pinhole geometry instrument.

The method is today well established and became an important standard tool for many different research fields such as soft matter science, biology, solid state physics and materials science. In 1995, the second SANS instrument D22, went into operation.

The persistent success, in particular at ILL, is illustrated by a continuing high demand for SANS over the years, with a constant overload factor of 3 for these most powerful instruments worldwide. As a consequence and hence further developing ILL’s SANS instrumentation a 3rd SANS instrument, D33, has currently being built and is in operation since June 2012.

All 3 ILL SANS instruments are designed to be extremely versatile, using in addition to standard sample changers a large variety of specialised equipment, such as magnets, cryostats, furnaces, shear cells, stopped flow cells, pressure cells etc.…

After recent refurbishments the ILL instruments are today optimized for providing the highest possible neutron flux at the sample position. Consequently, the focus is now on dedicated developments for sample environment, opening for instance new possibilities for kinetic/ time-resolved studies and in-situ experiments, in particular in the field of soft matter.

This contribution gives an overview of the ongoing activities, including the development of an in-situ DLS-SANS experiment, new possibilities with unique flow- and rheo-SANS equipment, and the project of a new SANS pressure cell. With some examples from recent experiments we will illustrate the impact on science.
P.043 Influence of scattering and air attenuation correction factors for a $^{241}$Am-be source in the IRD low scattering room

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This paper evaluates the distance's contributions in air attenuation and scattering to the neutron irradiation field of $^{241}$Am-Be sources in the Low Scattering Room of the Neutron Laboratory. LN irradiates samples and neutron individual and calibrates an area neutron monitor instruments. The used radioprotection operational quantities are ambient dose equivalent - $H^*(10)$ and personal dose equivalent - $H_p(10)$. To reduce its uncertainty, it is essential to understand the influence of other influence quantities. The main goal of this study is to evaluate, in the LN Low Scattering Room, the influence of neutron scattering and air attenuation in the neutron spectrum at the reference position according to its distance from a $^{241}$Am-Be source accordingly with a referenced spectrum field of this source placed at ISO 8529. The Bonner Spheres Spectrometry is used to perform this scattering spectrum of this source at the hall. The scatterings and attenuation corrections factors were calculated through measurements of values from the operational quantity at the irradiation of two referenced points to reduce uncertainty. The shadow cone's method was used to quantify experimentally the neutron scattering contribution at these distances. Two neutrons survey meters were used: FH 40 G / FHT 752 and FH 40 GL / FHT 762 (Swendi).

Key words: neutron dosimetry, metrology, neutron scattering, air attenuation, $^{241}$Am-Be source.

P.044 An oxide MBE system as a user instrument for quasi in-situ neutron reflectometry studies

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Molecular Beam Epitaxy (MBE) is a fascinating method to create high quality epitaxial thin films. The Jülich Centre for Neutron Science (JCNS) opens its state-of-the-art oxide MBE system at the FRM II in Garching to users who are interested in preparing tailored samples like transition metal oxide heterostructures for the investigation with the JCNS neutron reflectometer MARIA (magnetic reflectometer with high incident angle).

The MBE is equipped with 6 effusion cells, two electron guns for electron-beam evaporation with 4 crucibles each and an oxygen plasma source. Standard in-situ surface analysis tools like reflection high and low energy electron diffraction, Auger electron spectroscopy analysis are also available.

We will give examples for high quality metal and complex oxide thin film systems like e.g. $\text{La}_y\text{Sr}_x\text{MnO}_3$/SrTiO$_3$ with focus on stoichiometry, morphology and thickness and give detailed information about what kind of samples we can provide to you.

To realize quasi in-situ neutron reflectometry studies on thin metal films a transport chamber is required which keeps the sample in UHV (Ultra high vacuum) conditions during the transport from the laboratory of the MBE system to MARIA in the neutron guide hall. We report on the challenges of this project and on the progress of its realization.

P.045 Boron-10/Helium-3 hybrid detectors for neutron scattering

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As a result of the global shortage of Helium-3 (He-3) gas, the construction of large inelastic scattering instruments has been delayed over the past three years while research and development of alternate neutron detector technologies was conducted. In that time, working groups from the International Collaboration on Neutron
Detectors have designed and tested an assortment of wavelength shifting scintillators, Boron-10 (B-10) lined proportional counters, and Boron Trifluoride (BF3) detector technologies to assess their feasibility as a He-3 replacement technology for neutron scattering instruments. This work proposes the use of B10Plus+* detectors, comprised of B-10 lined proportional counters filled with gas mixtures containing small quantities of He-3 gas. These detectors improve the performance of a neutron scattering system based on B-10 lined detectors, while also minimizing He-3 consumption. The measured spectral response, neutron detection efficiency, and position resolution of various B10Plus+* detectors are reported and compared with pure He-3 based designs and designs containing BF3. A Monte Carlo study investigating the relationship between the efficiency, spatial resolution, B-10 coating thickness, and He-3 partial fill pressure is presented.

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P.046 A trigger-less acquisition system for the EXILL large Ge detector’s arrays

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Presently a common characteristic trend in low and medium energy nuclear physics is to develop more complex detector systems to form multi-detector arrays. In view of this complexity, the front-end electronics must provide precise information about energy, time and possibly pulse shape. The large multiplicity of the detection system requires the capability to process the multitude of signals from many detectors, fast processing and very high throughput of more that 10⁶ data words/sec. The paper reports on a newly developed system using a combination of a 15-bit 100 MS/s and 10-bit 1 GS/s digitisers with a PowerPC-based VME single board computer. Real-time processing capabilities have been developed to handle total event rates of more than 1 MHz, providing on-line display for single and coincidence events as well as digital constant fraction (CFD) algorithm for sub-nanosecond time determination. The system has been recently used in the EXILL campaign of measurements performed at the PF1B cold neutron beam of the ILL. Preliminary results from neutron capture on stable targets as well as fissile targets (²³⁵U and ²⁴¹Pu) will be presented.

P.047 Recent developments in the fabrication and performance of magnetron-sputtered ¹⁰B₄C layers onto Si substrates and Al detector plates

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The recent progress in magnetron sputtering of enriched ¹⁰B₄C layers onto Si (001) substrates and onto Al (100 mm x 100 mm x 0.5 mm) detector plate elements is reported here. ¹⁰B₄C converter layers were prepared at room temperature with thicknesses ranging from 0.5 µm up to 2 µm, which is the relevant thickness range for neutron detection applications at grazing incidence angles. Layer properties were investigated and improved with respect to film adhesion, thickness variation and composition of elements and isotopes. First results showed that a 1µm thick B₄C film possesses high compressive stress of about 3 GPa and delaminate when deposited directly onto silicon substrate. A thin bonding layer of Ti improved the film adhesion fundamentally that it is now possible to deposit more than 1 µm B₄C onto Si. A pre-treatment of the surface of the Al plates has been developed in order to manufacture stable, continuous and up to 2 µm thick films of B₄C without a Ti-bonding layer. Moreover, a thickness uniformity of less than 4 % over the whole deposition area of 120 mm x 1500 mm was determined by a fast, non-destructive, optical thickness measurement method on B₄C coated Al converter plates. Spectroscopic and nuclear reaction analyses (NRA) measurements were performed to analyze the elemental and isotopic composition. The content of nitrogen and oxygen is below 4 % and the level of hydrogen is below 0.2 %. The isotopic composition is transferred from the target into the film material. The acquired knowledge has been used successfully to fabricate 1
m² of coated Al-plates with \(^{10}B_4C\) and \(^{18}B_4C\) conversion layers. This contribution results from the design phase of the European Spallation Source.

P.048 Spurious peaks arising from multiple scattering events involving cryostat walls in inelastic neutron scattering

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Well defined peaks with energies from 17 to 20 meV have been observed in a variety of inelastic neutron scattering experiments on single crystals and on powders using either the triple-axis or the time-of-flight technique. They can be easily mistaken for signatures of real excitations. We have found that they are due to multiple scattering events involving primarily walls of the sample environment. Hence, they are particularly troublesome in experiments using very small samples. It will be discussed what needs to be done to reduce the unwanted scattering to a minimum.

P.049 Diffraction-resistance measurements: Simultaneous investigation of structure, magnetism and transport properties

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The high count rates of modern neutron diffractometers afford the opportunity to collect powder neutron diffraction data at small increments over a wide range of some external variable within a realistic timescale. This allows, for example, the evolution of both nuclear and magnetic structure with temperature to be followed in real time. The value of studies of structure as a function of temperature may be greatly enhanced if relevant bulk properties can be simultaneously investigated, since a more direct correlation of subtle structural changes with physical properties is achieved.

We have sought to couple the collection of powder neutron diffraction patterns as a function of temperature, with the measurement of electrical conduction. Sample cells have been designed and constructed as inserts for standard ISIS furnaces and cryostats. These inserts enable electrical transport properties to be measured over a wide range of temperatures (4.2 ≤ T/K ≤ 1000), whilst simultaneously collecting powder diffraction data. The unique properties of the neutron mean that it is thus possible to probe structure, magnetism and transport properties of a material in a single experiment. We have applied the diffraction-resistance technique to a variety of complex metal sulphides, which exhibit discontinuities in the temperature dependence of their electrical conductivity at one or more critical temperatures. The development and construction of these sample cells will be outlined and the new insights diffraction-resistance measurements provide into the structure-property relations of transition-metal sulphides described.

P.050 Design study of magnetic environments for XYZ polarization analysis using \(^{3}He\)NSF

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Polarization analysis, PA, of polarized neutrons is a powerful tool for separation of nuclear spin-incoherent background, analysis of complex magnetic structures and the study of magnetic excitations. Several wide angle spectrometers with polarization analysis exist or are under construction in which PA is used. The PA can be performed in a variety of ways depending on the instrument’s parameters. We present a finite element calculation of the magnetic field (the MagNet software) taken with the newly proposed PASTIS coil, which uses a wide-angle banana shaped \(^{3}He\) spin filter to cover a large range of scattering angle. Such setup will enable XYZ
polarization analysis at the thermal time-of-flight spectrometer TOPAS (under construction). Two clear options exist, a magnetized mu-metal geometry, similar to ref [1], or a resistive coil set similar to ref [2], however in our proposed designs, certain key differences exist which build on the experiences from prior devices.


P.051 Test measurements with 157Gd/Csl-MSGC neutron detector with readout based on MSGCROC ASIC
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The development of a hybrid Micro-Strip Gas-Chamber (MSGC) detector has been initiated by Helmholtz-Zentrum Berlin (HZB) in the EU Joint Research Activity DETNI (FP6, NMI3). The detector has a central neutron converter with two composite 157Gd/Csl layers of ≤1.5/≤1μm thickness deposited on either side of a support foil. After capture of a neutron in 157Gd a fast conversion electron is emitted in a random direction, which releases a detectable cluster of slow electrons from one of the columnar Csl secondary electron emitter layers into the adjacent detector gas. Both gas volumes are filled with 20 hPa of i-butane and closed in 4.5 mm distance from the converter by multi-layer micro-strip plates, each of them with micro-patterned X/Y readout planes. Thus, by further gas-multiplication in a constant field region and then at rising field strength close to the anode strips of the micro-strip plates, fast signals are obtained allowing operation at very high counting rates. Through diffusion broadening, analog signals above threshold are induced on more than 2 strips and read out (in addition to X, Y, T) for centre-of-gravity calculation via MSGCROC ASICs. The development was continued as in-kind contribution for the European Spallation Source ESS. In the presentation the current status of prototyping, the improved readout electronics, the developed FPGA code for online data processing and the results of recent measurements at the detector test station of HZB will be shown.

P.052 A new pressure cell for SANS at the ILL
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In collaboration with Nova Swiss a new pressure cell for the three SANS instruments D11, D22 and D33 at the ILL has been developed. The cell is made for pressures up to 5000 bar with a sample thickness of 2mm. Temperature control is obtained via connecting a water bath to the cooling circuit which is integrated into the cell corpus. Within a temperature range of 10°C up to 90°C the achieved homogeneity is better than 1°C. In addition, an insulation coat can be wrapped around the cell, thus increasing the temperature stability. The neutrons pass through sapphire windows of a total thickness of 30mm before hitting the detector. The transmission of the empty pressure cell at 6Å wavelength is approximately 85%. An optimised concept allows for a quick opening and closing of the cell for cleaning reasons etc.

The cell has been very recently commissioned on D11 [1]. We will present first results obtained with the new cell, dealing with the pressure dependence of the form factor of PNIPAM microgels in aqueous solutions. At ambient pressure, such microgels undergo a phase transition at 32 °C. Below this temperature, the PNIPAM chains in the microgel are hydrated, resulting in a swollen microgel. Above 32 °C, inter- and intramolecular hydrogen bonds form and the microgel particles collapse. FTIR measurements [2] suggest that upon increasing pressure solvent is pushed back into the microgel particles even above 32 °C. SANS measurements aimed at elucidating the internal structure of PNIPAM microgels.
P.053 Detector development for the fast neutron imaging

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Demand for nondestructive inspection inside the large-scale concrete structures such as bridges has been increased since the great earthquake in March 2011 at Northern Japan. We proposed a new method of the fast neutron imaging for such purpose. The fast neutron (~MeV) can penetrate thick concrete (> 0.5 m) so that we can investigate inside of the concrete structures using the fast neutron. An array of plastic scintillators and solid state Multi-Pixel Photon Counters (MPPC) is employed as an imaging detector. Detailed detector simulation was carried out for the neutron transportation and the optimization of the detector dimension with PHITS and GEANT4 codes, respectively. A prototype detector, in which a photomultiplier tube was used instead of MPPC, was made for the first test. The size of the scintillators was $3(W) \times 3(H) \times 5(D)$ cm$^3$. The detector was introduced at the RIKEN Accelerator-driven compact Neutron Source (RANS) beamline and the fast neutron was successfully measured. We compare the experimental measurement and the simulation prediction, and discuss the optimization of the detector.

P.054 An information-theoretical approach to image resolution applied to neutron imaging detectors based upon individual discriminator signals

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1D or 2D neutron imaging detectors with individual wire or strip readout using discriminators have the advantage of being able to treat several neutron impacts partially overlapping in time, hence reducing global dead time. A single neutron impact usually gives rise to several discriminator signals. In this paper, we introduce an information-theoretical definition of image resolution. We then apply this measure to quantify the power of resolution of different algorithms treating these individual discriminator signals which can be implemented in firmware. The method is then applied to different detectors existing at the ILL. Center-of-gravity methods improve the resolution over “best-wire” algorithms.

P.055 A precision time protocol (PTP) based timing system for neutron time-of-flight (TOF) instruments

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This paper describes a new timing system for Neutron Time-of-Flight (TOF) instruments. Timing systems are required to synchronize facility operations and to time-stamp event data to measure event timing differences. This paper describes the proposed architecture of the Precision Time Protocol (PTP) system, its component hardware, its synchronization mechanism, and the performance improvements over current event-based timing systems. Finally, the paper presents a discussion of additional ways to apply the new PTP timing system to improve performance and simplification of operations.