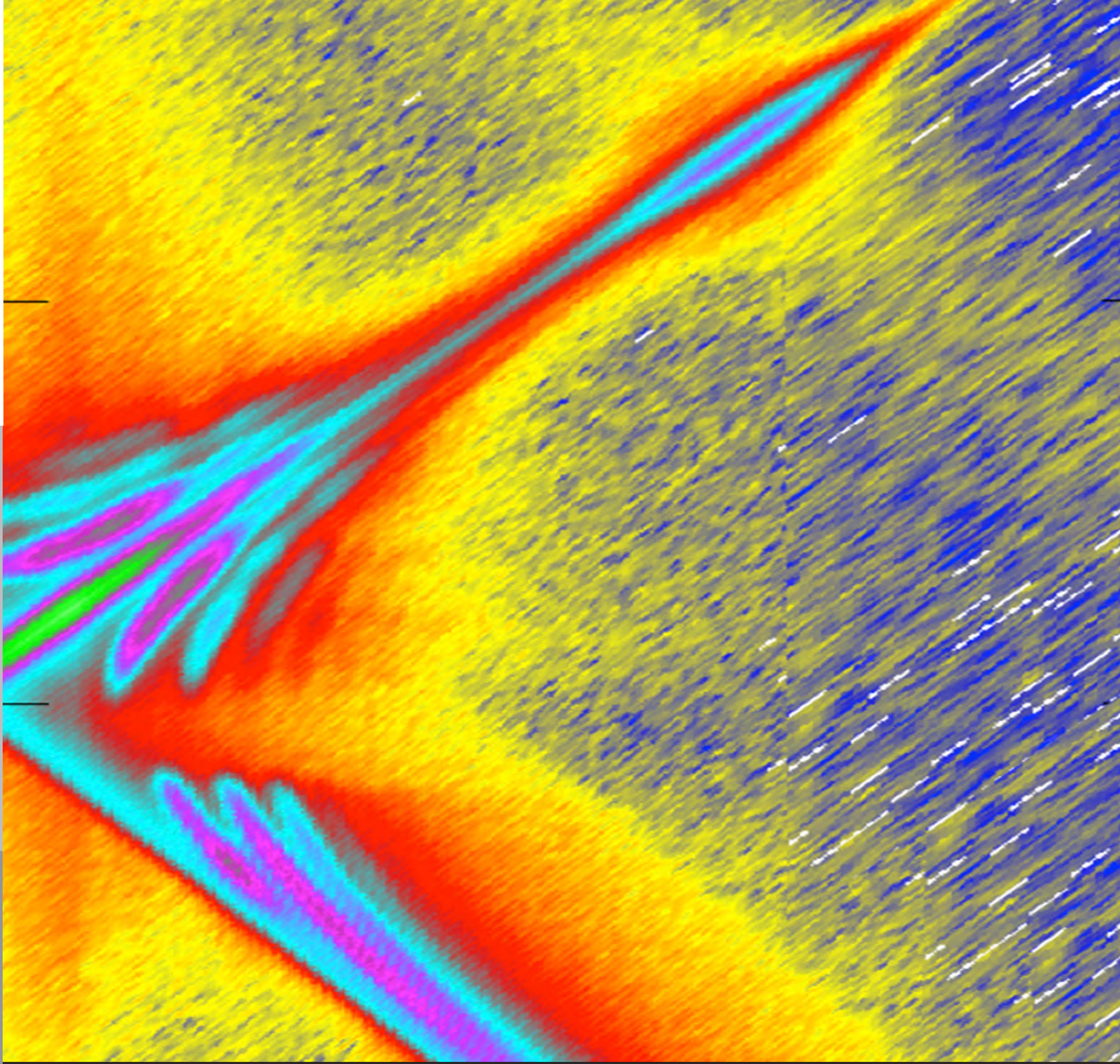


JCNS Workshop 2014
Trends and Perspectives in Neutron Scattering

From Spallation to Continuous Sources: a Positive Feedback on Neutron Instrumentation

Program and Abstracts

20 – 23 Oct. 2014, Tutzing **www.fz-juelich.de/jcns/JCNS-Workshop2014**

JCNS Jülich Centre for Neutron Science

MLZ Heinz Maier-Leibnitz Zentrum

JÜLICH FORSCHUNGSZENTRUM

Dear colleagues,

During recent years a number of new instruments have been designed for ISIS, J-PARC and SNS – some of these ideas and experience can be very useful for the instrumentation at continuous sources. The ESS at the horizon should be another trigger to intensify today's instrumentation upgrade. Many years of enormous intellectual efforts of the world neutron community, both users and instrument scientists aiming the definition of new instrumental challenges and developments of the instrumental concepts resulted in new ideas and approaches, which cover the whole neutron tract (target, cold sources, neutron delivery systems, instrument components and instruments themselves). This stockpile of knowledge can be fruitfully used for the improvement of the existing instrumentation.

The workshop will bring experts together to address the following topics:

- **New concepts and instrumentation**
- **Sources, shielding and guides**
- **Instrument components**
- **Advanced sample environment**
- **New instrumentation at ESS**
- **Advances in detectors**

During the next days about 30 invited and contributed presentations will be given and exciting posters will add additional information in the mentioned topics. We would like to believe that this workshop at a gorgeous site at the Starnberger See will advance the field and we are looking forward to fruitful discussions and to a stimulating exchange of knowledge.

Alexander Ioffe

Presentation Schedule

Program JCNS Workshop 2014 on Trends and Perspectives in Neutron Scattering

"From Spallation to Continuous Sources: a Positive Feedback on Neutron Instrumentation"

Monday, 20 October 2014

10:00	Registration
12:15	Lunch
13:15	Workshop Opening
13:30	Kulda
14:00	Stahn
14:30	Frick
15:00	Russina
15:30	Coffee break
16:00	Lohstroh
16:30	Yu
17:00	Brulet
17:30	Kennedy
18:00	Moulin
18:45	Dinner

Tuesday, 21 October 2014

09:00	Mezei
09:30	Di Julio
10:00	Farago
10:30	Pasini
10:55	Coffee break
11:25	Bertelsen
11:50	Filges
12:20	Smeibidl
13:00	Lunch
14:30	Eckold
15:00	Schmdt
15:25	Lim
15:50	Coffee break
16:20	Poster Session
18:30	Dinner

Wednesday, 22 October 2014

08:30	Andersen
09:00	Schweika
09:25	Rouijaa
09:50	Deen
10:15	Violini
10:40	Fenske
11:05	Coffee break
11:35	Jaksch
12:00	Mattauch
12:25	Monkenbusch
13:00	Lunch
15:00	Excursion Bus tour to the Franz Marc Museum in Kochel
18:30	Workshop Dinner "Grauer Bär" in Kochel

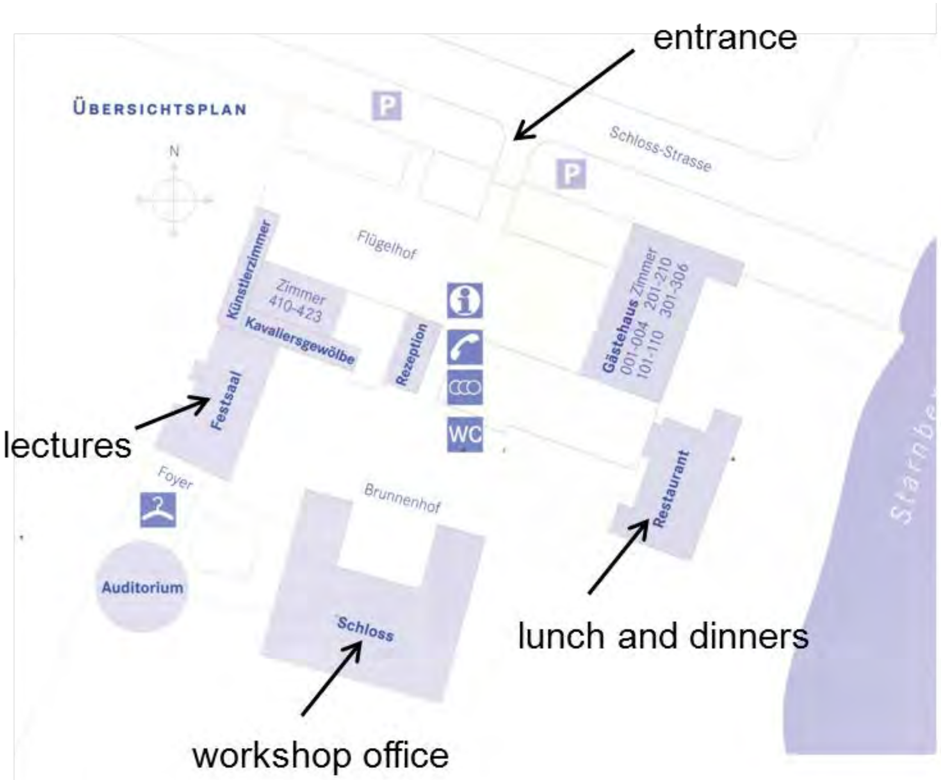
Thursday, 23 October 2014

09:30	Ronnow
10:00	Babcock
10:25	Lipfert
10:50	Coffee break
11:20	Nowak
11:45	Kanaki
12:10	Closing remarks
12:20	Lunch

as of 2014-09-29

Evangelische Akademie Tutzing

Site Map



JCNS Workshop 2014, Trends and Perspectives in Neutron Scattering
"From Spallation to Continuous Sources: a Positive Feedback on Neutron Instrumentation"
October 20-23, 2014, Tutzing

Program

Monday, October 20, 2014

13:15 Opening of the workshop and welcome

New Concepts and Instrumentation

1	13:30	Jiri Kulda, Institut Laue Langevin, France (invited) **Crystal spectrometers in the spallation age**
2	14:00	Jochen Stahn, Paul Scherrer Institut, Switzerland (invited) **The focusing *Selene* neutron guide and related concepts**
3	14:30	Bernhard Frick, Institut Laue Langevin, France (invited) **The new backscattering spectrometer IN16B at ILL - commissioning, first user experiments and ongoing extension projects**
4	15:00	Margarita Russina, Helmholtz Zentrum Berlin, Germany (invited) **Upgrade project of TOF spectrometer NEAT at Helmholtz Zentrum Berlin**

15:30 Coffee Break

New Concepts and Instrumentation (continued)

5	16:00	Wiebke Lohstroh, Heinz Maier-Leibnitz Zentrum and Department of Physics E13, Technische Universität München, Germany (invited) **The time-of-flight spectrometer TOFTOF**
6	16:30	Dehong Yu, Bragg Institute, Australian Nuclear Science and Technology Organisation, Australia (invited) **PELICAN – a multi-purpose time of flight cold neutron spectrometer-commission progress and performance test**
7	17:00	Annie Brulet, Laboratoire Léon Brillouin, France (invited) **Instrumentation and research using small angle neutron scattering at LLB**
8	17:30	Shane Kennedy, Bragg Institute, ANSTO, Australia (invited) **Development of a magnetic lens system for white beam neutron microscopy**
9	18:00	Jean-Francois Moulin, Helmholtz-Zentrum Geesthacht, Germany (invited) **REFSANS, the horizontal TOF-Reflectometer with GISANS option at MLZ**

18:45 Dinner

Tuesday, October 21, 2014

Sources, Shielding and Guides

10 9:00 Ferenc Mezei, European Spallation Source, Sweden (invited)
Enhanced brightness moderators for reactor and spallation sources

11 9:30 Douglas D. Di Julio, European Spallation Source, Sweden (invited)
Shielding studies at the European Spallation Source (ESS)

12 10:00 Bela Farago, Institut Laue Langevin, France (invited)
Upgrade of the ILL neutron spin echo instrument suite

13 10:30 Stefano Pasini, Jülich Centre for Neutron Science, Forschungszentrum Jülich, Germany
Design of superconducting solenoids for high resolution neutron spin-echo spectroscopy

10:55 Coffee Break

14 11:25 Mads Bertelesen, University of Copenhagen, Denmark and ESS, Sweden
Advances in neutron guide design, using the minimalist principle and guide_bot

Advanced Sample Environment

15 11:50 Uwe Filges, Paul Scherrer Institut, Switzerland (invited)
Adaptive optics and cryo-lenses: Neutron focusing within sample environment

16 12:20 Peter Smeibidl, Helmholtz Zentrum Berlin, Germany
Neutron scattering in very high magnetic fields: The new hybrid magnet (HFM) and extreme environment instrument (EXED) at Helmholtz Centre Berlin (HZB)

13:00 Lunch

Instrument Components

17 14:30 Götz Eckold, University of Göttingen, Germany
First Experiments with the New Multiplex-system at the Three-Axes-Spectrometer PUMA

18 15:00 Wolfgang Schmidt, JCNS, Outstation at ILL, Forschungszentrum Jülich, France
Advanced neutron optics on the new IN12

19 15:25 Joshua A. Lim, Technische Universität Dresden, Germany
BAMBUS: a new inelastic neutron multiplexed analyser for PANDA

15:50 Coffee Break

16:20 **Postersession**

18:30 Dinner

Wednesday, October 22, 2014

New Instrumentation at ESS

20 8:30 Ken Andersen, European Spallation Sourec, Sweden
ESS update

21 9:00 Werner Schweika, Jülich Centre for Neutron Science, Forschungszentrum Jülich, Germany and ESS, Sweden
DREAM: Diffraction Resolved by Energy and Angle Measurements

22 9:25 Mustapha Rouijaa, Helmholtz-Zentrum Geesthacht, Germany
Beamline for European Materials Engineering Research (BEER)

23 9:50 Pascale Deen, European Spallation Sourec, Sweden
VOR: a wide bandwidth chopper spectrometer at the ESS to explore uncharted scientific areas

24 10:15 Nicolò Violini, Jülich Centre for Neutron Science, Forschungszentrum Jülich, Germany
T-REX: A Time-of-flight Reciprocal space EXplorer for the future ESS

25 10:40 Jochen Fenske, Helmholtz-Zentrum Geesthacht, Germany
Chopper system and neutron optics of the Beamline for European Materials Engineering Research (BEER)

11:05 Coffee Break

New Instrumentation at ESS (continued)

26 11:35 Sebastian Jaksch, Jülich Centre for Neutron Science at MLZ, Forschungszentrum Jülich, Germany
SKADI – Small-K Advanced DIffractometer

27 12:00 Stefan Mattauch, Jülich Centre for Neutron Science at MLZ, Forschungszentrum Jülich, Germany
VERITAS, a vertical/horizontal reflectometer for long pulse neutron sources

28 12:25 Michael Monkenbusch, Jülich Centre for Neutron Science, Forschungszentrum Jülich, Germany
ESSENSE: Ultra high resolution spectroscopy for the ESS

13:00 Lunch

15:00 Excursion to the Franz Marc Museum in Kochel

18:30 Workshop dinner in the "Hotel Grauer Bär" in Kochel

Thursday, October 23, 2014

New Concepts and Instrumentation

29 9:30 Henrik Ronnow, École Polytechnique fédérale de Lausanne, Switzerland, (invited)
tbd

30 10:00 Earl Babcock, Jülich Centre for Neutron Science at MLZ, Forschungszentrum Jülich, Germany
Progress towards polarization analysis for the TOPAS spectrometer with PASTIS

31 10:25 Frederik Lipfert, Jülich Centre for Neutron Science at MLZ, Forschungszentrum Jülich, Germany
Evanescent wave resonators for grazing incidence setups

10:50 Coffee Break

Advances in Detectors

32 11:20 Gregor Nowak, Helmholtz-Zentrum Geesthacht, Germany
High quality $^{10}B_4C$ coatings for neutron detection in inclined geometry

33 11:45 Kalliopi Kanaki, European Spallation Source, Sweden
Building detectors for the European Spallation Source

12:10 **Closing remarks, end of the workshop**

12:20 Lunch

Poster Presentations

2014-1
Pavol Mikula, Nuclear Physics Institute ASCR, v.v.i., 250 68, Rez, Czech Republic
High resolution neutron diffraction and magnifying properties of double bent perfect crystal (+n,-n) and (+n,-m) settings employing the second crystal in the fully asymmetric diffraction geometry

2014-2
P. Jacobs, Institute of Inorganic Chemistry, RWTH Aachen University, Aachen, Germany
High-intensity neutron TOF diffractometer POWTEX

2014-3
Robert Aldus, Jülich Centre for Neutron Science at MLZ, Forschungszentrum Jülich, Garching, Germany
The TOPAS time-of-fight spectrometer at JCNS, progress to date and future plans

2014-4
Adam Aczel, Quantum Condensed Matter Division; Oak Ridge National Laboratory, Oak Ridge, USA
MANTA: A new cold neutron multi-analyzer triple-axis spectrometer at the HFIR

2014-5

(withdrawn)

2014-6
Artem V. Feoktystov, Jülich Centre for Neutron Science at MLZ, Forschungszentrum Jülich, Garching, Germany
KWS-1 high resolution SANS instrument at JCNS: current state

2014-7
Jörg Voigt, Jülich Centre for Neutron Science, Forschungszentrum Jülich, Jülich, Germany
Using Fermi choppers for spallation source based chopper spectrometers

2014-8
Peter Konik, Petersburg Nuclear Physics Institute, Gatchina and Saint-Petersburg State University, Saint-Petersburg, Russia
Design of neutron guide system for high-flux reactor PIK

2014-9
Thomas Krist, Helmholtz-Zentrum Berlin, Berlin, Germany
Neutron optics from Helmholtz-Zentrum Berlin

2014-10
Marina Khaneft, Jülich Centre for Neutron Science at MLZ, Forschungszentrum Jülich, Garching, Germany
New focusing neutron guide for the high resolution backscattering spectrometer - SPHERES

2014-11
Zahir Salhi, Jülich Centre for Neutron Science at MLZ, Forschungszentrum Jülich, Garching, Germany
PASTIS for XYZ polarization analysis using ^{3}He with SEOP polarized gas

2014-12
Franz Demmel, ISIS Facility, Didcot, United Kingdom
OSIRIS: Past, Present and Future

JCNS Workshop 2014
Trends and Perspectives in Neutron Scattering

From Spallation to Continuous Sources: a Positive Feedback on Neutron Instrumentation

Abstracts

Status: 29 September 2014

Crystal spectrometers in the spallation age

Jiri KULDA

Institut Laue-Langevin, Grenoble, France

With the advent of neutron sources based on spallation, mostly pulsed and matching the time-structure needs of direct geometry time-of-flight (TOF) spectrometers, the latter became a favorite instrument of many experimentalists. Their conceptual simplicity together with an extended coverage of the momentum-energy space have brought the possibility to collect "complete" data during the allocated beam-time, avoiding arbitrations between alternative threads during the experiment and offering the possibility to reanalyze the once collected data from previously unknown scientific perspectives and interpretation contexts.

Contrary to some pessimistic forecasts the three-axis spectrometers (TAS), using Bragg diffraction to define neutron energy and being the traditional workhorse of single-crystal spectroscopy at the (continuous) reactor sources continue to play their dominant role in parametric studies and in polarized neutron investigations of the inelastic response in a restricted range (or a single point) of the (***Q***,□) space. On the more exploratory side of the TAS scientific case the interest has moved from extended measurements of dispersion relations of well defined elementary excitations to explorations of more diffuse signals, related to dynamics of nano-scale entities. This shift has called for development of focusing techniques, bringing enhanced luminosity traded for relaxed momentum resolution, and for introduction of multianalyzer systems (FlatCone [1], MACS[2]), permitting parallelized data collection over ranges of a few Brillouin zones. One of the important results of this evolution was the effective reduction of sample quantity needed for a successful experiment - the traditional several cm^3 became hundred times smaller: 10-100 mm^3.

A common feature of some of the recently completed (Lagrange [3]) and forthcoming (CAMEA [4]) projects is the implementation of secondary spectrometers, using sophisticated crystal focusing schemes, capable of operation in a steady state regime at reactor sources as well as in an inverted TOF regime at pulsed spallation sources. This convergence promises new inspirations for future development of this still (heavily) intensity-limited technique.

[1] M. Kempa et al., Physica B 385–386, 1080 (2006)
[2] J.A. Rodrigues et al., Meas. Sci. Technol. 19 034023 (2008)
[3] A. Ivanov, M. Jimenez-Ruiz and J. Kulda; Proceedings of Dynamics of Molecules and Materials-II 2013, J. Phys.: Conf. Ser., (2014) in press.
[4] P. G. Freeman et al., Proceedings of QENS/WINS 2014, EPJ Web of Conferences (2014) in press.

E-mail of the corresponding author: kulda@ill.fr

October 20, 2014, 14:00h New concepts and instrumentation

The focusing *Selene* neutron guide and related concepts

Jochen Stahn

Paul Scherrer Institut, Laboratory for Neutron Scattering and Imaging, Villigen, Switzerland

Based on ideas of F. Ott [1] and on concepts realized at synchrotron beam lines, we developed a truly focusing neutron guide. This *Selene* guide [2] was first intended to be an add-on for the TOF reflectometer Amor at PSI to allow for wavelength-dispersive measurements using a continuous beam. Later it became the central part of the reflectometer *Estia* to be built at the ESS. *Truly* focusing in this context means that the guide or optics reshapes the phase space volume to a small spatial extend at a certain distance. This excludes slit optics cutting down the phase space, as well as conventional elliptic guides, which create a non-convergent beam right after the guide exit.

The conceptual work and the knowledge gained from the *Selene* prototype guide (now indeed in use as an add-on for Amor) revealed the limits of focusing guides and optics: restricted wavelength and divergence ranges, and an upper threshold for the guide length due to gravity. But these restrictions are overcompensated for many applications by the new possibilities for beam conditioning (see below), by enabling novel operation modes and by providing a clean convergent beam while intrinsically avoiding direct line-of-sight. The latter property results in a low background and no or minor over-illumination of the sample. At present our experience covers essentially TOF reflectometry, but the obtained knowledge (especially concerning the accuracy of the optics and background issues) can be transferred to continuous beams and other instrument types.

The imaging property of the *Selene* guide enables to define the beam footprint at the sample area far upstream at the initial focal point. The divergence is adjusted independently by an aperture located off the focal planes. This is comparable to the independent adjustment of the field of view and the resolution in optical microscopes. The possibilities for beam conditioning reach from the already realized polarization by transmission through a polarizing mirror with the shape of a logarithmic spiral, to the idea of an astigmatic focus-shifting reflector with hyperbolic shape.

[1] F. Ott, A. Menelle: Eur. Phys. J. **167**, 93-99 (2009).
[2] J. Stahn *et al.*: Eur. Phys. J. Appl. Phys. **58**, 11001 (2012).

E-mail of the corresponding author: jochen.stahn@psi.ch

October 20, 2014, 14:30h New concepts and instrumentation

The new backscattering spectrometer IN16B at ILL - commissioning, first user experiments and ongoing extension projects

Bernhard FRICK[1], Tilo SEYDEL[1], David BAZZOLI[1], Markus APPEL[1,2], Kristijan KUHLMANN[2], Andreas MAGERL[2]

[1]Institut Max von Laue – Paul Langevin, ILL, 71, Avenue des Martyrs, 38042 Grenoble, France
[2]Institut für Kristallographie und Strukturphysik, Universität Erlangen-Nürnberg, Germany

After 20 years of successful user operation the neutron backscattering spectrometer IN16 at ILL was shut down and its user program was taken over without interruption by IN16B, a new and much more powerful 3rd generation backscattering spectrometer. The neutron guide optics and the **P**hase **S**pace **T**ransformer (PST) of IN16B offer now an at least 10 times higher flux at the sample. The linear motor Doppler drive, the background chopper, the secondary spectrometer under vacuum and the new vertically extended large angle analysers add an additional increase of the count rate, a better signal-to-noise ratio, a doubled dynamic range and a slightly improved energy resolution. The main part of our presentation will address this outstanding performance of IN16B.

Furthermore the IN16B instrument concept has a built-in flexibility which allows for configuration changes and for new instrument developments without compromising the main task of backscattering at the Si111 reflection. Thus a later use of the Si311 and the GaAs200 reflection as well as an inverted time-of-flight option were enabled already in the instrument conception.

During the commissioning phase of IN16B the University Erlangen-Nürnberg and the ILL succeeded in receiving a BMBF grant for the BATS/GaAs project, which aims to implement two options into IN16B: the **B**ackscattering **a**nd **T**ime-of-flight **S**pectrometer project (BATS) and the GaAs backscattering project. These options have the potential to extend the dynamic range of IN16B by a factor 10 both in energy transfer (BATS) and in energy resolution (GaAs). We will report on the status of this project.

E-mail of the corresponding author: frick@ill.fr

October 20, 2014, 15:00h New concepts and instrumentation

Upgrade project of TOF spectrometer NEAT at Helmholtz Zentrum Berlin

Margarita RUSSINA

Helmholtz Zentrum Berlin für Materials und Energie, Hahn-Meitner Platz 1, 14109 Berlin, Germany

Neutron time-of-flight spectrometer NEAT has a long history of successful application to the study dynamics and function in various energy related materials. It is best suited to probe dynamic phenomena directly in space and time in the large time domain 10^{-13} – 10^{-10} s and on the length scale ranging from 0.05 to up to about 5 nm. To address the needs of the user community the full upgrade of the instrument is currently being undertaken and will deliver more than 40 fold data rate increase. The new design of NEAT has a number of novel features: better matched choppers system, integrated chopper-guide design to provide optimum conditions for both quasielastic and inelastic analysis, exchangeable guide sections to deliver the neutron beam with variable divergence and variable sample sizes. The substantial increase of the detector solid angle coverage by using 412 ^{3}He position sensitive detectors from Reuter Stokes will result in another factor of higher count rate and will enable single crystal studies. The project started in 2010 and proceeds at full pace with the aimed start of the user operation in 2015. The new instrument will provide an outstanding experimental tool for a large spectrum of research areas ranging from hydrogen storage matter, to solar cells and to materials for quantum information technology. The collected know-how was also used in the concept development of the TOF instrument at ESS

E-mail of the corresponding author: margarita. russina@helmholtz-berlin.de

October 20, 2014, 16:00h New concepts and instrumentation

The time-of-flight spectrometer TOFTOF

Wiebke LOHSTROH,[1] Giovanna G. SIMEONI,[1] Jürgen NEUHAUS[1], Winfried PETRY[1]

[1]Heinz Meier-Leibnitz Zentrum (MLZ) and Department of Physics E13, Technische Universität München, Lichtenbergstr. 1, 85748 Garching, Germany

TOFTOF is direct geometry disc-chopper time-of-flight spectrometer located in the neutron guide hall west at the FRM II [1]. During its 10 years of operation, TOFTOF proved to be a state-of-the-art instrument suitable for both quasielastic and inelastic neutron scattering measurements, mainly addressing disordered materials in hard and soft condensed matter systems. Its strength originates from the large dynamic range, the freely tunable energy resolution ranging from 3 meV to 2 μeV; adjustable by appropriate wavelength and chopper settings, and its excellent signal-to-background ratio. Recent instrument developments are dedicated to the integration of magnetic samples and small sample sizes in their corresponding extreme sample environments. One step towards the reduction of sample size is the installation of an adaptive focusing guide in the last section of the neutron guide system that can be optionally chosen instead of the normal linear tapered guide. The curvature of the focusing device can be adapted to each wavelength. In comparison to the standard beam spot size (20 x 40 mm^2), the beam intensity on a 10 x 10 mm^2 spot is increased – depending on the wavelength – by a factor 1.5 - 2.

[1] T. Unruh, J. Neuhaus, and W. Petry, Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment, **580** 1414-1422 (2007).

E-mail of the corresponding author: wiebke.lohstroh@frm2.tum.de

October 20, 2014, 16:30h New concepts and instrumentation

PELICAN – a multi-purpose time of flight cold neutron spectrometer-commission progress and performance test

Dehong YU, Richard A Mole, Wai-Tung LEE, Tim D'ADAM, Margaret ELCOMBE and Shane KENNEDY

Bragg Institute, Australian Nuclear Science and Technology Organisation, New Illawarra Road, Lucas Heights, 2234, Australia

Pelican, a direct geometry multi-purpose cold neutron spectrometer, combines the state of the art triple monochromators [1] and Fermi chopper systems to perform inelastic and quasi-elastic neutron scatterings on a variety of materials of powder, polycrystal, single crystal, glass and liquid, covering fields of physics, chemistry and biology. The provision of a cryogenic vacuum from sample to detector maintains the scattered intensity, minimises the background from air scattering and surrounding materials such as from sample environment. The instrument is designed to accommodate various sample environments like high magnetic field, low and high temperatures, etc. [2].

Polarization analysis is an option of the Pelican instrument. The compact incident neutron polarization system is an integration of a solid-state bender-type supermirror polarizer with a gradient radio frequency (RF) spin flipper. The supermirror polarizer consists of three sections with 1 degree inclination between the outer sections relative to the central section in order to match with the three individual beams from the triple monochromators. The polarization analysis is achieved by ^{3}He polarization filter system containing a wide-angle ^{3}He polarization filter and a *Pastis*-type magnetic coil. The whole polarization analysis system is installed inside the high vacuum sample chamber through a dedicated vacuum adaptor flange. *In-situ* refilling of pre-generated polarized ^{3}He has been implemented.

Detailed commission progress and performance test will be demonstrated by several experiments of quasi-elastic and inelastic neutron scatterings, including the first test on the polarization analysis system. Problems encountered and lessons learnt so far will also be presented, including the identification and reduction of fast neutron generation from Be-filter.

[1] A. K. Freund and D. H. Yu, Nucl. Instr. and Meth. A **634**, S75-S80 (2011).

[2] D. H. Yu, R. A. Mole, T. Noakes, S. Kennedy and R. Robinson, J. Phys. Soc. Jpn. **82**, SA027 (2013).

E-mail of the corresponding author: dyu@ansto.gov.au

October 20, 2014, 17:00h New concepts and instrumentation

Instrumentation and research using small angle neutron scattering at LLB

Annie BRULET[1]

[1]Laboratoire Léon Brillouin UMR12 CEA-CNRS, C.E. Saclay, Bat. 563, Saclay, France

The SANS spectrometers suite at LLB is composed of two classical SANS spectrometers (PAXY, PACE) allowing to cover a q range from typically 2 10^{-2} nm^{-1} to 5 nm^{-1} and a recent VSANS instrument (TPA) based on the convergent pinhole multibeam principle allowing to reach lower q values, such as $10^{-3} nm^{-1}$. The ongoing project PA20, a SANS spectrometer of about two times 20 meters long, equipped with polarized neutrons and a slit geometry in the collimator to allow Grazing Incidence SANS experiments [1] is completed now. With these equipments, experiments on Nanomaterials of Soft Matter, of Biophysics, in Material Science and in condensed matter (magnetism and superconductivity) can be regularly performed. Recent examples in each of these research fields will be described.

All along the past three decades, major upgrades of these machines have been fulfilled to make the best use of neutrons produced by the reactor: super-mirror guides, performant velocity selectors, high counting rates and high efficiency detectors, focusing lenses … have been installed. All these tools combined lead to high technical performances, versatile but simple using machines, which are the keys of the success of the SANS technique. By offering on the new instrument PA20, the polarized neutrons option, we intend to develop the studies of magnetic nano-objects that recent progresses in solid state chemistry allow to synthesize.

Getting the SANS curve in a wide q range in a single run is an appealing result of the TOF method intrinsic to the ESS project. Combined with the high flux of ESS, we extend SANS capabilities and thus be able to develop kinetic experiments or studies smaller samples. In the future of SANS, progresses could focus on sample environments to meet user's needs. Sophisticated but "easy to use" data analysis recipes (2D and 3D fitting procedures) or calculations (Fourier Transform [2], Monte Carlo simulations…) are under developments. Some of them will be presented.

[1] PA20: a new SANS and GISANS project for soft matter, materials and magnetism. G. Chaboussant, S. Desert, A. Brûlet . Journal of Physics, Conference Series **340,** 012002 (2012).

[2] Numerical calculation of magnetic form factors of complex shape nano-particles coupled with micromagnetic simulations. F. Zighem, F. Ott, T. Maurer, G. Chaboussant, J.-Y. Piquemal, G. Viau, Physics Procedia, **42**, 66 (2013).

E-mail of the corresponding author: annie.brulet@cea.fr

October 20, 2014, 17:30h New concepts and instrumentation

Development of a magnetic lens system for white beam neutron microscopy

Shane KENNEDY[1], Yoshihisa IWASHITA[2], Masako YAMADA[3], Peter GELTENBORT[4], Ulf GARBE[1], Wai Tung LEE[1], Anna SOKOLOVA[1]

[1]Bragg Institute, ANSTO, Lucas Heights, NSW, Australia

[2]Institute for Chemical Research, Kyoto University, Uji, Kyoto, Japan

[3]RIKEN Center for Advanced Photonics, Wako, Saitama, Japan

[4]Institut Laue-Langevin, Grenoble, Cedex 9, France

Progress in many areas of science and technology requires structural characterization on micro- and nanoscopic length scales. Direct imaging methods are dominated by electron microscopy due to the exceptional (sub-nanometre) resolution obtainable. Despite this, radiography and tomography using X-rays and neutrons have found niche applications at resolutions down to ~1 μm and ~10 μm respectively, due in part to their deeper penetration. Small angle scattering of X-rays (SAXS) and neutrons (SANS) provides a complementary, indirect, probe of nanoscale structures, however a gap between length scales accessible by direct imaging and small angle scattering still remains. The neutron beam methods compete in selected applications due to their deeper penetration, sensitivity to hydrogen, unique elemental and isotopic contrast and their magnetic interaction. Never the less neutron imaging has the severe disadvantage of inherently poor resolution.

Improved resolution by magnification with neutron lenses has been demonstrated in a number of studies since the 1970's, with magnification of 50 times for ultra-cold neutrons [1] and 35 times for monochromatic cold neutrons [2]. Focusing of white neutron beams presents a far greater challenge. We have used a rotating magnetic sextupole lens array to focus a pulsed white beam of very cold neutrons (VCN) in order to assess its potential to improve the resolution for direct imaging and SANS [3,4]. Based on those results, we believe it should be possible to magnify a neutron image by more than an order of magnitude using a broad wavelength band of neutrons ($\lambda_{max}/\lambda_{min}$ = 2), such that sub-micron imaging resolution would be possible. We are currently adapting this method for white beam focusing on the TOF-SANS (*Bilby*) at OPAL, with a view to later progression to a magnifying lens for neutron imaging with cold neutrons. A description of the magnetic lens system will be provided, with selected SANS and imaging results from the white VCN beam study, along with an outline of the current developmental activities at ANSTO.

[1] P. Herrmann, et. al., Physical Review Letters, **54**, 1969-72 (1985).
[2] H. R. Beguiristain, et. al., Applied Physics Letters, **81**, 4290-92 (2002).
[3] M. Yamada, et. al., Physica B: Condensed Matter **406**, 2453-2457 (2011).
[4] M. Yamada, et. al., Progress of Theoretical and Experimental Physics (at press, 2014).

E-mail of the corresponding author: SJK@ansto.gov.au

October 20, 2014, 18:00h New concepts and instrumentation

REFSANS, the horizontal TOF-reflectometer with GISANS option at MLZ

JEAN-FRANÇOIS MOULIN, MARTIN HAESE-SEILLER and MATTHIAS POMM

[1]Helmholtz Zentrum Geesthacht Institut für Werkstoffforschung
Abteilung WP at Heinz Maier-Leibnitz Zentrum (MLZ)
Lichtenbergstr. 1, 85747 Garching, Germany

By using a reconfigurable chopper and a versatile collimation system the horizontal TOF reflectometer REFSANS makes it possible to perform specular and off-specular reflectivity as well as grazing incidence small angle neutron scattering (GISANS) measurements. In the later configuration, the TOF mode enables an easy and detailed exploration of lateral correlations in a Q range not accessible by conventional off-specular measurements.
In this talk we will describe the different instrument configurations and show recently measured data illustrating the variety of possible experiments. Recent as well as foreseen upgrades will be discussed.

e-mail of the corresponding author: Jean-Francois.Moulin@hzg.de

Enhanced brightness moderators for reactor and spallation sources

Ferenc MEZEI[1]

[1]European Spallation Source ESS AB, SE 22100 Lund, Sweden

Only a tiny fraction of the fast neutrons created in a neutron source ends up to become - in principle - available as slow neutrons to be extracted and transported to the neutron scattering instruments. By Liouville theorem the key characteristics of a slow neutron emitting moderator in a neutron source is its brightness, which sets the theoretical upper limit of neutron intensity on the samples. The degree to which the Liouville limit can be approached by the source to sample beam delivery system depends on a multitude of technical features and boundary conditions. For thermal and cold neutrons, state-of-the-art supermirror based neutron optical beam extraction systems can practically achieve for the common geometrical lay-out of scattering instruments (distances, collimations, etc) at least about 50 % efficiency in transporting the moderator brightness to the sample area, if the dimensions of this area are smaller than the those of the neutron beam emitting source moderator surface. This allows us to envisage moderators with considerably smaller beam emitting areas than in use by now.

In the multifaceted study of optimizing the neutron source performance of ESS we have examined several mechanisms for significantly enhancing the brightness of moderators by reducing their size and changing their shape. In particular, liquid para-hydrogen cold neutron moderators could be substantially improved by adopting quasi one or two dimensional shapes [1]. The phenomenon is due to the unique feature of para-hydrogen that it displays a large energy dependence of the neutron scattering mean free path in the thermal and cold neutron energy range. The simulated gains in cold moderator brightness can reach up to an order of magnitude at certain parts of the spectrum. This approach is well adapted to both spallation and reactor based neutron sources. Although low dimensional moderators show somewhat directional emission, they do not tap the often invoked large hypothetical potential of boosting slow neutron brightness by the use of “directional moderators”, i.e. achieving some directional preference in the creation of slow neutrons during the slowing down process. A way to realize this theoretically vast potential is still to be discovered, for the common benefit of all types of neutron sources.

[1] F. Mezei, L. Zanini, A. Takibayev, K. Batkov, E. Klinkby, E. Pitcher and T. Schönfeldt, J. Neutron Res, **17,** 101 (2014).

E-mail of the corresponding author: ferenc.mezei@esss.se

October 21, 2014, 9:30h Sources, shielding and guides

Shielding studies at the European Spallation Source (ESS)

Douglas D. DiJulio[1] Nataliia Cherkashyna[1], Phillip M. Bentley[1,2]

[1]European Spallation Source ESS AB, SE-221 00 Lund, Sweden

[2]Department of Physics and Astronomy, Uppsala University,
751 05 Uppsala, Sweden

At a spallation neutron source, the emission of high-energy particles from the primary target requires important shielding considerations which are not otherwise present at reactor based neutron sources. Additionally, the time-correlated nature of these high-energy particles can have a significant impact on the performance of a subset of instruments. At the European Spallation Source (ESS), a number of studies have been initiated in order to investigate this high-energy radiation background and its impact on neutron scattering instruments. These include extensive surveys of the background radiation at existing spallation neutron sources, such as the Spallation Neutron Source (SNS) at Oak Ridge National Laboratory, USA and the Swiss Spallation Neutron Source (SINQ) at the Paul Scherrer Institute, Villigen, Switzerland. The surveys provide important information for simulation models and also make it possible to identify features and regions where existing shielding concepts can be enhanced in the future. New shielding solutions have also been investigated, including copper and laminated shielding structures for example, through the creation of detailed physics models using the Geant4 simulation package. Improving the radiation background at a neutron scattering instrument not only enhances its performance but can also deliver significant cost savings. Suggestions on how to do this along with initial results from the above studies will be presented and discussed.

E-mail of the corresponding author: Douglas.Dijulio@esss.se

October 21, 2014, 10:30h Sources, shielding and guides

Design of superconducting solenoids for high resolution neutron spin-echo spectroscopy

Stefano Pasini, **Michael Monkenbusch**, Tadeusz Kozielewski

Jülich Centre for Neutron Science, Forschungszentrum Jülich, Jülich, Germany

In the framework of the ESS Design-Update Project an instrument proposal for a high resolution neutron spin-echo spectrometer (ESSENSE) was prepared [1]. A key part of the work was the design of optimized and stray-field compensated superconducting magnetic precession coils with minimal intrinsic field integral inhomogeneity. We report on the layout and properties of these coils and their embedding into the ESSENSE design as well as into the J-NSE, where it will replace the currently used cylindrical copper coils and boost the resolution. The new design will reduce the necessary corrector strength, which limits the resolution, by a factor of about 2.5 compared to present cylindrical coil designs and provide field integrals up to 1.5 Tm.

[1] With financial support by BMBF through the ESS Design-Update Project 05E10CJ1.

E-mail of the corresponding author: m.monkenbusch@fz-juelich.de

Advances in neutron guide design, using the minimalist principle and guide_bot

Mads BERTELSEN[1,2], Kim LEFMANN[1,2]

[1]University of Copenhagen, Nanoscience Center and eScience Center, Copenhagen, Denmark

[2]European Spallation Source, Lund, Sweden

For many years neutron guide design has been dominated by geometries for which it was possible to calculate the performance analytically, and thus were well understood. With the computing power available today, it has become normal to use numerical optimization of Monte Carlo ray tracing simulations to design ballistic neutron guide geometries [1] that are nearly impossible to describe in full using a purely analytical approach.

This work introduces important analytical constraints to be used when optimizing guide geometry. They will reduce the parameter space of the optimization to guides with neutron intakes that are just sufficient for achieving the perfect performance, a brilliance transfer of unity. These constraints minimize undesired background from thermal neutrons, but also direct background from the neutron source, as the guide entrance is as small as possible. These constraints are nicknamed the minimalist principle, and are derived using propagation of acceptance diagrams [2] from the moderator to the guide, and from the guide to the sample, while requiring a perfectly illuminated sample.

Because of the increased complexity of modern guides, there are many different combinations to be investigated before selecting an appropriate guide geometry for a specific instrument. Every alternative needs to have a full ray-tracing simulation written and optimized in order to evaluate the performance. For an experienced guide designer, this will take at least one day of work excluding running time. We have developed a program called guide_bot, that will reduce this time to a matter of minutes, as it will write a McStas [3] simulation and associated iFit [4] optimization script from a single line of code describing the guide to be optimized. Any combination of common guide geometries can be linked together to form more complex guides, and it is possible to use options to limit the parameter space of the optimizer. The program includes the minimalist principle, but it can be disabled in order to do a brute force optimization of every free parameter. In addition, there are comprehensive tools to block line of sight between two points in the guide. The program enables a guide designer to investigate orders of magnitude more guides, provided amble computing power is available.

Examples which demonstrate both the background reduction from the minimalist principle, and the high performance of guides optimized using guide_bot are shown.

[1] M. Bertelsen, H. Jacobsen, U. B. Hansen, H. H. Carlsen, K. Lefmann, Nuclear Instruments and Methods A, **Volume 729**, p. 387-398 (2013).
[2] J.R.D. Copley, J. Neut. Res., **Vol. 1**, No. 2, p. 21-36 (1993).
[3] P. Willendrup, E. Farhi, K. Lefmann, Physica B, **Vol. 350**, Suppl. 1, p. e735-e737 (2004).
[4] E. Farhi, Y. Debab, P. Willendrup, J. Neut. Res., **Vol. 17**, No 1, p. 5-18 (2014).

E-mail of the corresponding author: mads.bertelsen@esss.se

October 21, 2014, 11:50h Advanced sample environment

Adaptive optics and cryo-lenses: neutron focusing within sample environment

U. FILGES, M. BARTKOWIAK and E. RANTSIOU

Paul Scherrer Institut, Villigen, Switzerland

Sample sizes in the sub-mm range have become common practice in the study of novel phenomena in material science. However, neutron scattering techniques are flux limited and experiments on sub-mm samples suffer from long measurement times or low signal to noise ratios. Modern neutron focusing techniques can provide a way to surpass these problems.

We have successfully performed a powder diffraction experiment on the cold powder diffractometer DMC at SINQ combining a pressure cell with an integrated focusing element and a detached, adaptable, pre-focusing neutron lens. The results are compared with measurements using the standard setup of the instrument and Monte Carlo simulations. Finally an outlook for further developments will be presented.

E-mail of the corresponding author: uwe.filges@psi.ch

October 21, 2014, 12:20h Advanced sample environment

Neutron scattering in very high magnetic fields
The new hybrid magnet (HFM) and extreme environment instrument (EXED) at Helmholtz Centre Berlin (HZB)

Peter SMEIBIDL[1], Mark BIRD[2], Oleksandr PROKHNENKO[1], Bella LAKE[1]

[1]Helmholtz Zentrum Berlin, Dep. HFM, Berlin, Germany)

[2]Florida State University, NHMFL, Tallahassee, USA)

At HZB a dedicated facility for neutron scattering at extreme magnetic fields and low temperatures is close to completion, the new High Field Magnet (HFM) on the Extreme Environment Diffractometer (EXED). The aim is the construction of a multi purpose instrument which offers diffraction experiments as well as small angle neutron scattering and inelastic scattering. It is projected according to the special geometric constraints of analysing samples in a high field magnet.

To open up higher fields to neutron research HZB follows a new approach with completely different magnet technology. Magnet design and neutron instrumentation have to be adapted to each other. Following our past experience only steady state fields are adequate to achieve the goals of the project. In particular inelastic scattering studies, which proved in the past to be most rewarding, would virtually be excluded when using pulsed magnets. The new hybrid magnet, a 'first of its kind system' with horizontal field orientation, designed and constructed in collaboration with NHMFL, will not only allow for novel experiments, it will be at the forefront of development in magnet technology for neutron scattering experiments. With a set consisting of a superconducting cable-in-conduit coil and different resistive coils of conical shape at both ends of the system, maximum fields between 25 T - 31 T will be possible with cooling power between 4 MW - 8 MW for the resistive part.

For the first project phase we are planning a continuous ^3He cryostat combined with a closed cycle precooling cryostat for sample cooling.

The construction activities of the building for the three big technical infrastructure components needed for magnet operation, the 20 kA power supply, water cooling for resistive coil and 4 K Helium refrigerator for cooling of the superconducting coil are complete. All systems are commissioned and ready for operation since end 2013.

The coils and cryostat were delivered to HZB during the first quarter of 2014. The system assembly was completed in May. Commissioning of the resistive coil alone was successfully completed in June. The superconducting CICC coil was cooled to 4K and the full hybrid commissioning was started.

E-mail of the corresponding author: peter.smeibidl@helmholtz-berlin.de

October 21, 2014, 14:30h Instrument components

First Experiments with the mew multiplex-system at the three-axes-spectrometer PUMA

Götz ECKOLD and Oleg SOBOLEV

Institute for Physical Chemistry, Georg-August-University of Göttingen; Germany

A new type of multiplex technique for three axes neutron spectrometers has been realized and successfully commissioned at the PUMA spectrometer at FRM II. Consisting of eleven analyser-detector channels which can be configured individually, this technique is especially useful for kinetic experiments where a single excitation spectrum is recorded as a function of time without the need to move the spectrometer. On a time-scale of seconds an entire spectrum can be recorded thus allowing users to monitor changes during fast kinetic processes in single shot experiments without the need for stroboscopic techniques. Moreover, the multianalyser system provides an efficient and rapid tool for mapping excitations in ($\boldsymbol{Q}$, ω)-space. The results of pilot experiments demonstrate the performance of this new technique and an user-friendly software is presented which assists users during their experiments.

E-mail of the corresponding author: geckold@gwdg.de

October 21, 2014, 15:00h Instrument components

Advanced neutron optics on the new IN12

Wolfgang SCHMIDT[1], Karin SCHMALZL[1], Stephane RAYMOND[2], Thomas BRÜCKEL[3]

[1]Forschungszentrum Jülich, JCNS at ILL, Grenoble, France

[2]CEA-Grenoble, INAC SPSMS MDN, Grenoble, France

[3]Forschungszentrum Jülich, JCNS, Jülich, Germany

IN12, a three-axis spectrometer for cold neutrons, is operated as a CRG-instrument from the Jülich Centre for Neutron Science (JCNS) at the Institute Laue Langevin in Grenoble. In the framework of the Millenium Program of the ILL IN12 has been relocated to a new position at the end of a new guide. Along with this relocation the whole primary spectrometer has been upgraded with new state-of-the-art components.

The main improvements concern a new optimized focusing neutron guide together with a new double focusing monochromator. Compared to the old IN12 this combination of a modern neutron guide and the focusing Bragg optics has yielded up to a factor of 10 in flux on the sample position. We can now offer a peak flux of about 10^8 n/sec/cm^2 around k_i = 2 Å^{-1}. In addition an extended wavelength range far into the warmish region (max. k_i = 5.1 Å^{-1}) is now available.

Due to the large wavelength range the higher order reflections from the monochromator would of course be much more prominent. Therefore a neutron velocity selector is placed up-stream in the neutron guide that prevents all these contaminations and guarantees a clean beam at the sample.

For the use of polarized neutrons a new transmission polarizer (cavity) has been installed in the neutron guide, mounted on a guide changer together with a standard guide element. This guarantees high intensities and an easy change from non-polarized to polarized mode.

In this presentation we will show details of the design and optimization of the various neutron optical components. This includes the results of various model calculations that had been per-formed to match a curved focusing guide end with a double focusing monochromator, in order to combine high flux, good energy resolution and a smooth homogenous beam profile at the sample. Further, also the results for the design of the polarizing cavity will be presented.

Since the new IN12 has been commissioned recently we are now able to show first neutron measurements concerning flux, energy resolution and polarization and compare them to the calculations.

E-mail of the corresponding author: schmidt@ill.eu

October 21, 2014, 15:25h Instrument components

BAMBUS: a new inelastic neutron multiplexed analyser for PANDA

Joshua A. LIM[1], Petr ČERMÁK[2], Astrid SCHNEIDEWIND[2], Dmytro S. INOSOV[1]

[1]Institut für Festkörperphysik, TU Dresden, Dresden, Germany
[2]Jülich Centre for Neutron Science at MLZ, Forschungszentrum Jülich, Garching, Germany

Triple axis spectroscopy is a valuable tool in probing the excitations of correlated electron systems, however, it is a technique that is often signal starved and consequently much effort is devoted into engineering solutions to maximise the useful signal [1-4].

The planned upgrade of the PANDA spectrometer at the FRM-II (in cooperation with TU Dresden and supported by BMBF funding) is to develop a multiplexed and stacked analyser option to allow a more efficient data acquisition rate, whilst maintaining high (**Q**, E) resolution and flexibility.

This talk presents plans for a novel multiplexed analyser system, in terms of its experimental design and advantages. Preliminary simulations will also be presented.

[1] W. Schmidt, M. Ohl, Physica B, **386**, 1073 (2006).
[2] J. A. Rodriguez *et al.*, Meas. Sci. Technol., **19**, 034023 (2008).
[3] M. Kempa *et al.*, Physica B, **385**, 1080 (2006).
[4] K. Lefmann *et al.*, Physica B, **283**, 343 (2000).

E-mail of the corresponding author: joshua.lim@frm2.tum.de

DREAM: Diffraction Resolved by Energy and Angle Measurements

Werner SCHWEIKA[1,2], Nicolò VIOLINI[1], Earl BABCOCK[1], Michael MEISSNER[2], Paul F. HENRY[2], Klaus LIEUTENANT[3], Daniil NEKRASSOV[3], Carolin ZENDLER[3], Andreas HOUBEN[4], Philipp JACOBS[4], Gunar SVENSSON[5], Xiaodong ZOU[5], Niklas HEDIN[5], Mats JOHNSSON[5], Jekab GRINS[5], German SALAZAR-ALVAREZ[5], Mari-Ann EINARSRUD[6], Graeme BLAKE[7], Thomas T.M. PALSTRA[7], Reinhard K. KREMER[8], Raphael HERMANN[9]

[1]JCNS, Forschungszentrum Jülich, Jülich Germany;
[2]ESS AB, Lund, Sweden; [3]HZB, Berlin, Germany; [4] RWTH, Aachen, Germany; [5]Department of Materials and Environmental Chemistry, Stockholm, Sweden; [6]Norwegian University of Science and Technology; [7]Zernike Institute for Advanced Materials, Groningen, Holland; [8]Max-Planck Institute, Stuttgart, Germany; [9] University of Liege, Liege, Belgium

Within the ESS Design Update Program, funded by the German Federal Ministry of Education and Research, we developed the proposal of DREAM, a neutron powder diffractometer for the future European Spallation Source (ESS), which will be presented to the ESS Steering Committee by the end of 2014 for construction as a day-one instrument in 2019. The ESS design parameters provide truly new opportunities for science with neutrons. The peak brightness of the ESS is higher than any of the short pulse spallation sources, and more than an order of magnitude higher than the world's leading continuous source. The instrument design of DREAM utilizes most effectively the specific source parameters to serve best for a broad science community in powder diffraction. Typical applications will be the determination of structures in piezo-electric and ferroelectric compounds, metal-organic frameworks, microporous polymers, complex magnetic systems, organic and inorganic hybrids and nanoparticles, multiferroics, thermoelectric materials and in-situ phase transitions in reactive or functional materials, under conditions close to operation.

DREAM adopts a 10x10mm^2 eye-of-the-needle [1] at 6m from the moderator, which enables to fit in counter rotating disc choppers. With shaping the ESS pulse by choppers for adequate resolution, the instrument offers a new flexibility in time resolution. The best time resolution yields for backscattering a d-resolution of $2.8 \cdot 10^{-4}$Å, while tuning the instrument to high intensity the flux will be sufficient to study changes on the ms timescale. There is further flexibility in the choice of wavelength band, which most favorably covers simultaneously the peaks of the thermal and cold moderator fluxes (from 0.5 Å to 4.6 Å).

Recent developments led to a new detector concept [2] based on ^{10}B coated cathodes, which covers 2π sr solid angle almost free of any blind areas, with a high efficiency of 50 to 70%. The 2D high spatial resolution of 4 mm will support the recognition of preferred orientation and texture and single crystal diffraction. According to the VITESS simulations, DREAM will have 1-2 orders of magnitude more intensity than current world-class instruments.

[1] A. Houben et al., NIMA, **680**, 124 (2012).
[2] G. Modzel et al., NIMA, **743**, 90-95 (2014).

E-mail of the corresponding author: w.schweika@fz-juelich.de

Beamline for European Materials Engineering Research (BEER)

Mustapha ROUIJAA[1], Jochen FENSKE[1], Gregor NOWAK[1], Reinhard KAMPMANN[1], Peter STARON[1], Heinz-Günter BROKMEIER[1,4], Martin MÜLLER[1], Andreas SCHREYER[1], Jan ŠAROUN[2], Jan PILCH[2,3], Petr ŠITTNER[3], Pavel STRUNZ[2], P. BERAN[2], V. RYUKTHIN[2], L. KADRAVEK[2,3], Petr LUKAS[2]

[1]Helmholtz-Zentrum Geesthacht, Geesthacht, Germany

[2]Physical Nuclear Institute, Řež, Czech Republic

[3]Institute of Physics, Praha, Czech Republic

[4]Technical University of Clausthal, Clausthal-Zellerfeld, Germany

The continuous development of advanced structural materials and novel production processes are key for industrial manufacturing, e.g. in the transport and clean energy production sectors. Future successful research efforts will require understanding micro/nanostructure and residual stress evolution during processing and their role on the mechanisms that determine material and component performance. Therefore, the Beamline for European Materials Engineering Research (BEER) is proposed to be built at the European Spallation Source (ESS). The diffractometer combines the high brilliance of the long pulsed neutron source with high instrument flexibility. It includes a novel chopper technique that extracts several short pulses out of the long pulse, leading to substantial intensity gain of up to an order of magnitude compared to pulse shaping methods for materials with high crystal symmetry. This intensity gain is achieved without compromising resolution. More complex crystal symmetries will be investigated by additional pulse shaping methods. The different chopper set-ups and techniques offer extremely broad intensity/resolution ranges, which today do not exist at any other engineering instrument. Furthermore BEER offers the option of simultaneous SANS or imaging measurements without compromising diffraction investigations. This flexibility opens up new possibilities for in situ experiments studying materials processing and materials performance under service conditions. Therefore, advanced sample environments, dedicated to thermo-mechanical processing, are foreseen, e.g. a Gleeble or a quenching and deformation dilatometer. Due to its outstanding performance BEER will push the frontiers of in situ as well as ex situ characterization of engineering materials by neutron diffraction.

E-mail of the corresponding author: mustapha.rouijaa@hzg.de

October 22, 2014, 9:50h New instrumentation at ESS

VOR: a wide bandwidth chopper spectrometer at the ESS to explore uncharted scientific areas

P. P. DEEN[1,3], A. VICKERY[2,3], K. A. ANDERSEN[1,3]

[1]European Spallation Source. Tunavagen 24, 22100-Lund, Sweden.

[2] DTU Physics, Fysikvej, Building 307, DK-2800 Kongens Lyngby, Denmark.

[3] Niels Bohr Institute, University of Copenhagen, Universitetsparken 5, DK-2100,Denmark.

VOR, the versatile optimal resolution chopper spectrometer, is designed to probe dynamic phenomena that are currently inaccessible for neutron scattering due to flux limitations. VOR is a short instrument, 30.2 m moderator to sample, and provides instantaneous access to a broad dynamic range, 1 - 80 meV within each ESS period [1]. The short instrument length combined with the long ESS pulse width enables a quadratic flux increase by relaxing energy resolution from $\Delta E/E$ = 1% up to $\Delta E/E$ = 6-7%. This is impossible both on a long chopper spectrometer at the ESS and with instruments at short pulsed sources. In comparison to current day chopper spectrometers, VOR can offer an order of magnitude improvement in flux for equivalent energy resolutions, $\Delta E/E$ = 1-3%. Further relaxing the energy resolution enables VOR to gain an extra order of magnitude in flux. In addition, VOR has been optimised for repetition rate multiplication (RRM) and is therefore able to measure, in a single ESS period, 6 - 14 incident wavelengths, across a wavelength band off $1< \lambda < 8$ °A with a novel chopper configuration that measures all incident wavelengths with equivalent statistics [2]. The characteristics of VOR make it a unique instrument with capabilities to access small, limited lifetime samples and kinetic phenomena with inelastic neutron scattering.

[1] P. P. Deen, A. Vickery, K. H. Andersen, and R. Hall-Wilton, E. Phys. J. in press.

[2] A. Vickery and P. P. Deen, E. Phys. J. Rev. Sci. Instr. under Review.

E-mail of the corresponding author:pascale.deen@esss.se

October 22, 2014, 10:15h New instrumentation at ESS

T-REX: A Time-of-flight Reciprocal space Explorer for the future ESS

Nicolò VIOLINI, Jörg VOIGT, Thomas BRÜCKEL, Earl BABCOCK and Zahir SALHI

Jülich Centre for Neutron Science, Forschungszentrum Jülich, Jülich, Germany)

Within the ESS Design Update Phase program funded by the German Federal Ministry of Education and Research, we developed the proposal of a time-of-flight chopper spectrometer for the future ESS long pulse source.

The instrument promises the applicability to a wide manifold of scientific research activities: magnetism, strongly correlated electron materials, functional materials, soft-matter, biophysics and disordered systems. Thanks to the large neutron flux it will implement time-of-flight spectroscopy with Polarization Analysis (PA) as a standard option, e. g. for studying the effect of confinement on the magnetic excitations in nano-particles or to uniquely derive the vibrational hydrogen excitations in soft matter through separation of the nuclear spin incoherent scattering.

By making use of a super-mirror extraction system, the beam-line accepts neutrons generated both at the cold moderator and the thermal pre-moderator of the ESS source. The chopper system makes an efficient use of the flux provided by the source, by means of a combination of poly-chromatic operation methods: Repetition Rate Multiplication (RRM) and Wavelength Frame Multiplication. It is integrated with a specially developed pulse suppression chopper that enables variable acquisition time frames, by means of selective pulse suppression of the sub-pulses generated by the resolution defining choppers.

The secondary spectrometer features a wide area detector, yielding a dynamic range that extends from 1meV< E_i < 100meV and 0.05 $Å^{-1}$ < Q < 12 $Å^{-1}$, thus exploring a wide range of the reciprocal space. The energy resolution can be adapted by quantized variation of the commensurate chopper frequencies, within the limits imposed by the secondary path uncertainty. Anticipated typical choppers configurations were simulated by means of ray-tracing methods, showing that the elastic energy resolution (FWHM) can be freely adjusted in the range from 1% to 4% at 3meV and from 4% to 8% at 100 meV, thus providing flexible trading of resolution for flux. The performance of T-REX has been benchmarked against existing state-of-the-art TOF-spectrometers and shows flux gain factors between one and two orders of magnitude for maximal RRM.

The instrument is specifically designed to enable XYZ PA, by means of the so-called MAGIC Pastis coil layout. A prototype was constructed for the TOPAS spectrometer at the MLZ and is undergoing optimization and characterization. To cover a large range of scattering angle, both in horizontal and vertical direction, there is strong progress towards achieving suitable wide angle banana-shaped (^{3}He Neutron Spin Filter) cells of all-blown GE-180 glass.

E-mail of the corresponding author: n.violini@fz-juelich.de

Chopper system and neutron optics of the Beamline for European Materials Engineering Research (BEER)

Jochen FENSKE[1], Mustapha ROUIJAA[1], Gregor NOWAK[1], Reinhard KAMPMANN[1], Peter STARON[1], Heinz-Günter BROKMEIER[1,4], Martin MÜLLER[1], Andreas SCHREYER[1], Jan ŠAROUN[2], Jan PILCH[2,3], Petr ŠITTNER[3], Pavel STRUNZ[2], P. BERAN[2], V. RYUKTHIN[2], L. KADRAVEK[2,3], Petr LUKAS[2]

[1]Helmholtz-Zentrum Geesthacht, Geesthacht, Germany

[2]Physical Nuclear Institute, Řež, Czech Republic

[3]Institute of Physics, Praha, Czech Republic

[4]Technical University of Clausthal, Clausthal-Zellerfeld, Germany

Fundamental objectives of materials science are the development of new materials, their characterization and studies of their microstructure–properties relationship. One of the most used tools to achieve these goals is neutron time-of-flight diffraction in combination with in situ experiments. However, the modern materials are often complex and require novel techniques, allowing investigations under real working conditions and on realistic time scales. Thus, high time and spatial resolution even with small samples volumes are urgently required by a multidisciplinary community of scientists. For this purpose, HZG and NPI are proposing to build the engineering diffractometer BEER – Beamline for European Materials Engineering Research – at the European Spallation Source (ESS). The ambition is to serve the growing community of materials scientists with a sophisticated diffractometer, unique by its novel pulse multiplexing technique based on extracting several short pulses out of one long ESS pulse. Multiple short pulses enable diffraction with high resolution *and* high intensity.

Monte Carlo simulations have been performed using the McStas software package in order to optimize the beam line in respect of the chopper system (pulse shaping and pulse multiplexing techniques), of the neutron optics (curved and focusing guides) and of the bispectral extraction system. The simulations presented here show that BEER will outperform existing diffractometers for the case of high-resolution diffractometry e.g. for strain analysis in highly symmetric materials.

E-mail of the corresponding author: jochen.fenske@hzg.de

October 22, 2014, 11:35h New instrumentation at ESS

SKADI – Small-K Advanced DIffractometer

Sebastian JAKSCH[1], Henrich FRIELINGHAUS[1], Jacques JESTIN[2], Wim G. BOUWMAN[3]

[1]JCNS at Heinz Maier-Leibnitz Zentrum; Forschungszentrum Jülich, Lichtenbergstrasse 1, Garching, Germany

[2]Laboratoire Léon Brillouin CEA/CNRS, CEA Saclay, 91191 Gif/Yvette Cedex, France

[3]Delft University of Technology, Mekelweg 15, 2629 JB Delft, The Netherlands

The Small-K Advanced Diffractometer SKADI is a versatile SANS instrument, proposed for the European Spallation Source, which enables scientists to perform a wide range of investigations on topics requiring small Q-values to access long length scales [1]. The scientific areas targeted by SKADI include investigations of smart materials, biological and medical research, magnetic materials and materials for energy storage, as well as experiments on nanomaterials and nanocomposites or colloidal systems. To maximize the applicability of these studies SKADI is designed to accommodate in-situ measurements with custom made sample environments to provide "real-world" conditions.

To achieve all these goals SKADI will feature the following general design properties:

- Flexibility (sample area is approx. 3x3 m^2, and versatile collimation)
- Very small Q accessible through VSANS (using focusing collimation elements)
- Polarization for magnetic samples and incoherent background subtraction
- Good wavelength resolution, being the longest SANS instrument
- High dynamic Q-range (using two detectors)

With a flux at about 25 times higher than at the D22, an accessible size regime between the Anstrom and micrometer scale and the high dynamic Q range for fast data acquisition with a high resolution both in Q and time, this instrument will open the ESS for a wide scientific community.

[1] S. Jaksch, H. Frielinghaus et al., arXiv:1403.2534 [physics.ins-det], (2014).

E-mail of the corresponding author: s.jaksch@fz-juelich.de

October 22, 2014, 12:0h New instrumentation at ESS

VERITAS, a vertical/horizontal reflectometer for long pulse neutron sources

Stefan MATTAUCH[1], Dieter LOTT[2], Alexander IOFFE[1]

[1] Jülich Centre for Neutron Science JCNS at MLZ, Forschungszentrum Jülich, Germany
[1] Helmholtz-Zentrum Geesthacht, Geesthacht, Germany

Future long pulse sources (e.g. ESS) will provide an exciting opportunity to design a reflectometer of the next generation to meet the increasing demand and anticipated scientific challenges. The presented instrumental concept is focused on designing a machine that is dedicated to the major tasks under consideration of the scientific case. As the main outcome of it, the scientific community is requesting a reflectometer with high intensity at the lowest possible background due to the fact that most of the users will investigate thin layers or interfacial areas in the sub-nanometer regime. To investigate such samples by neutrons one requires unpolarized and polarized specular reflectivity for probing the thin layers and off-specular scattering (µm range) as well as the GISANS option (2-100 nm range) to derive the lateral structures of the sample. These key features should be optimized for the proposed instrument to deliver the maximum possible performance and by no means will be compromised by any of the additional features, such as the high resolution mode (1%, 3% and 5%), additional focusing options on a 1mm high sample and kinetic modes with Qmax/Qmin ratio of 9 (140ms), 12 (210ms), and 16 (280ms).
The choice of instrument length of 36m allows to achieve the resolution of 10% for the maximal use of neutrons emitted within a 2.86 ms long pulse (ESS). The integrated intensity over the full wavelength band of 8Å delivered to the sample amounts to $3.4 \cdot 10^9$ n/cm2/sec for a 3mrad horizontally collimated beam and is about 25 times higher than one can achieve at best reflectometers today, thus allowing to measure reflectivities down to 10^{-8} within minutes and down to 10^{-9} are accessible.

E-mail of the corresponding author: s.mattauch@fz-juelich.de

October 22, 2014, 12:25h New instrumentation at ESS

ESSENSE: Ultra high resolution spectroscopy for the ESS

Stefano PASINI, **Michael MONKENBUSCH**, Tadeusz KOZIELEWSKI

Jülich Centre for Neutron Science, Forschungszentrum Jülich, Jülich, Germany

The instrument concept for a very high intensity neutron spin-echo spectrometer with ultimate resolution properties has been made and such an instrument proposal was made. Effective intensity gain factors in the range of 20 compared to the best current instruments are anticipated. In addition the resolution will be boosted to the technical limits by newly designed superconducting precession solenoids. The intensity gain results from use of an optimized guide transporting the high flux from the ESS cold moderator on the one side and the utilization of an extended wavelength frame of 8 A yielding a multiplication of information collection rate. The instrument thus enables among many other filed novel views on dynamics of biological molecules with relevance for MD development for drug design, eventually employing new techniques for surface NSE (GINSE) it may contribute to knowledge in tribology and lubrication and other surface phenomena that currently are hampered by low intensity. Further new developments in “intelligent” polymers as e.g. self-healing depend on molecular mobility and dynamics that require many 100ns of correlation times at high intensity.

[1] With financial support by BMBF through the ESS Design-Update Project 05E10CJ1.

E-mail of the corresponding author: m.monkenbusch@fz-juelich.de

October 23, 2014, 10:00h New concepts and instrumentation

Progress towards polarization analysis for the TOPAS spectrometer with PASTIS

E. BABCOCK[1], Z. SALHI[1], P. PISTEL[2] H. SOLTNER[2] and A. IOFFE[1]

[1] Jülich Centre for Neutron Science at MLZ, Forschungszentrum Jülich, Garching, Germany
[2] ZEA, Forschungszentrum Jülich, Jülich, Germany

The new JCNS spectrometer TOPAS [1] will be designed to use polarized ^{3}He neutron spin filters for polarization and analysis. The polarization analysis is a particularly demanding application due to the high neutron energies and large solid angle coverage. The polarization analysis will use the PASTIS [2] concept. The techniques for this concept have continually been refined and developed. Our concept used the so-called magic PASTIS where magnetized mu-metal plates and coils are used to create the X-Y and Z holding fields. This device is prototyped and has been tested in lab to provide ^{3}He magnetic lifetimes of up to 240 hours for a typical 3 bar cell over the real neutron spin filter volume by testing the lifetime using a toroid-shaped 0.5 bar cell. Further progress has been made to create wide-angel banana-shaped ^{3}He spin filter cells of GE180 glass, which we have tested on TOFTOF to have favorable properties for neutron spectroscopy application. Neutron guide field configurations compatible with the 0.7 Å incident neutron wavelength and magic PASTIC magnetic environment have been studied with FEM calculations. Results of recent tests and developments will be presented.

[1] J.R. Stewart, et al. *Physica B* **385-386,** 1142R (2006).

[2] J. Voigt, et al. *Journal of Physics Conference Series* **211**, 012032 (2010).

E-mail of the corresponding author: e.babcock@fz-juelich.de

October 23, 2014, 10:25h New concepts and instrumentation

Evanescent wave resonators for grazing incidence setups

Frederik LIPFERT[1], Henrich FRIELINGHAUS[1], Olaf HOLDERER[1]

[1]Jülich Centre for Neutron Science at MLZ, Forschungszentrum Jülich, Garching, Germany

The behavior of soft matter materials like polymers, surfactants or phospholipid membranes or proteins near an interface can be investigated through neutron scattering under grazing incidence. The unique properties of neutrons are key to make such experiments a reality. Namely that through changing of isotopes, the scattering length density inside the samples can be changed whereby different constituents of the sample are highlighted. Also the high penetrating power of neutrons is necessary to probe near-surface structures as the neutrons can penetrate deep into and through the materials that are used to present an interface to the sample.

Grazing Incidence Small Angle Neutron Scattering (GISANS) makes it possible to examine the structure near the interface [1]. The variation of the contrast and the incoming angle makes it possible to probe different distances to the interface. It has been shown that the dynamics are also strongly influenced through the presence of interfaces as well. Porting the grazing incidence technique to Neutron Spin Echo Spectroscopy (GINSES) made these investigations possible for the first time. [2-5].

The recent GINSES experiments focused on investigating the near-surface dynamics of surfactant membranes. The low scattering intensity is the limiting factor for such GINSES experiments. In order to significantly improve signal intensity we have developed neutron resonators, consisting of multilayers silicon blocks that can be used during the experiments to increase the scattering intensity of the evanescent wave manifold. We will present the results from the first characterization measurements that will be performed this summer.

[1] M. Kerscher, P. Busch, S. Mattauch, H. Frielinghaus, D, Richter, M. Belushkin, G. Gompper, Physical Review E, **83**, 030401 (2011).

[2] H. Frielinghaus, M. Kerscher, O. Holderer, M. Monkenbusch, D. Richter, Physical Review E, **85**, 041408 (2012).

[3] H. Frielinghaus, O. Holderer, F. Lipfert, M. Kerscher, S. Mattauch, D. Richter, The European physical journal / Web of Conference, **33**, 03005 (2012).

[4] H. Frielinghaus, O. Holderer, F. Lipfert, M. Monkenbusch, N. Arend, D. Richter, Nuclear Instruments & Methods in Physics Research A, *686*, 71 - 74 (2012).

[5] F. Lipfert, H. Frielinghaus, O. Holderer, S. Mattauch, M. Monkenbusch, N. Arend, D. Richter, Physical Review E, **89**, 042303 (2014).

E-mail of the corresponding author: f.lipfert@fz-juelich.de

October 23, 2014, 11:20h Advances in detectors

High quality $^{10}B_4C$ coatings for neutron detection in inclined geometry

Gregor NOWAK[1], Reinhard KAMPMANN[1,2], Michael STÖRMER[1], Christian HORSTMANN[1], Hans-Werner BECKER[3], Martin HAESE-SEILER[1], Jean-Francois MOULIN[1], Mathias POMM[1], Thorsten KÜHL[2], Engelhard PRÄTZEL[2], Daniel HÖCHE[1], Richard HALL-WILTON[4], Martin MÜLLER[1] and Andreas SCHREYER[1]

[1]Helmholtz-Zentrum Geesthacht, Max Planck-Str. 1, 21502 Geesthacht, Germany

[2]DENEX – Detektors for Neutrons – GmbH, Stöteroggestr. 71, 21339 Lüneburg, Germany

[3]Ruhr-Universität Bochum, RUBION,Universitätsstr. 150, 44801 Bochum , Germany

[4]European Spallation Source ESS AB, P.O. Box 176, SE-221 00 Lund, Sweden

For neutron detection in scientific and industrial applications, detectors based on $^{10}B_4C$ thin films are required in the very near future in order to replace conventional ^3He counters. Therefore, thin-film preparation and analysis of $^{10}B_4C$ coatings are in the focus of R&D for novel detector systems using conversion layers containing ^{10}B. The Helmholtz-Zentrum Geesthacht (HZG) operates a unique facility for magnetron sputter deposition of large-area single and multilayer coatings (up to 1500 mm x 120 mm) as installed at fourth generation synchrotron sources. Neutron conversion layers of $^{10}B_4C$ have been deposited with thicknesses of up to 1.2 µm on 0.3 mm thin and up to 1430 mm long (100 mm width) Al substrates with this facility. The $^{10}B_4C$ coatings show excellent adhesion and a thickness uniformity characterized by thickness deviations of less than 2 % over the entire film area. The chemical and isotopic compositions of the converter coatings were investigated by means of XPS, SIMS, and RBS and the results are discussed with respect to the application. The neutron detection efficiency was tested at the ToF-beamline REFSANS at FRM-II (Munich) using a test detector of (**A**bsorption in **1** (one) **C**onversion **L**ayer **D**etector) A1-CLD type from the DENEX GmbH. At small angles of incidence (Θ_{in} = 1°) of the neutron beam with respect to the converter surface of the 1 µm thick $^{10}B_4C$ layer a relative quantum efficiency of up to 85 % of a ^3He (10 bar, 1' diameter) counting tube was measured. This high efficiency is attributed to a combination of a long absorption path (≈ 50 µm) of the neutrons with a short escape path (≈ 1-2 µm) for the α- and ^7Li-particles in the $^{10}B_4C$ conversion layer as fulfilled in the A1-CLD detector geometry. The second advantage resulting from the inclined geometry of the neutron beam and converter surface is a high position resolution which was determined to below 0.1 mm in direction of $\vec{Q}$ parallel to the normal of the converter surface for an angle of incidence of Θ_{in} = 4°. In summary, the results demonstrate the high potential of the detector concept and the magnetron sputtered $^{10}B_4C$ converter coatings as a replacement of ^3He-based detection systems. This activity is performed as an in-kind contribution to the ESS instrumentation, and is part of the German support to the ESS Pre-Construction Phase and Design Update.

E-mail of the corresponding author: Gregor.Nowak@hzg.de

October 23, 2014, 11:45h Advances in detectors

Building Detectors for the European Spallation Source

Michail ANASTASOPOULOS[1], Maddi ECHEGARAY[1], Kevin FISSUM[1,3], Richard HALL-WILTON[1,2], Carina HÖGLUND[1,4], Mewlude IMAM[1,4], **Kalliopi KANAKI**[1], Anton KHAPLANOV[1], Oliver KIRSTEIN[1,9], Thomas KITTELMANN[1], Scott KOLYA[1], Björn NILSSON[1,5], Luis ORTEGA[1], Dorothea PFEIFFER[1,6], Francesco PISCITELLI[1,7], Filippo RESNATI[1,6], Linda ROBINSON[1,4], Julius SCHERZINGER[1,3], Irina STEFANESCU[1,8]

[1]European Spallation Source (Lund, Sweden) [2]Mid-Sweden University (Sundsvall, Sweden) [3]Lund University (Lund, Sweden) [4]Linköping University (Linköping, Sweden) [5]MAX-IV Laboratory (Lund, Sweden) [6]CERN (Geneva, Switzerland) [7]ILL (Grenoble, France) [8]FRM-II Laboratory (Munich, Germany) [9]University of Newcastle (Callaghan, Australia)

The European Spallation Source (ESS) in Lund, Sweden will become the world's leading neutron source for the study of materials by 2025. First neutrons will be produced in 2019. It will be a long pulse source, with an average beam power of 5 MW delivered to the target. The ESS has just entered the construction phase, which started in 2013 with the completion of the Technical Design Report (TDR) [1]. The instruments are being selected in yearly rounds selected from conceptual proposals submitted by groups from around Europe. These instruments present numerous challenges for detector technology in the absence of the availability of ^{3}He, which is the default choice for detectors for instruments built until today and due to the extreme rates expected across the ESS instrument suite. Additionally a new generation of source requires a new generation of detector technologies to fully exploit the opportunities that the ESS source provides.

This contribution presents briefly the current status of detectors for the ESS, and outlines the timeline to completion. For a conjectured full instrument suite, chosen for demonstration purposes for the TDR, and updated based upon chosen instruments and submitted instrument concepts, a recently updated snapshot of the current expected detector requirements is presented. A strategy outline as to how these requirements might be tackled by novel detector developments is shown. In terms of future developments for the neutron community, synergies should be sought with other disciplines, as recognized by various recent initiatives in Europe, in the context of the fundamentally multi-disciplinary nature of detectors [2]. This strategy has at its basis the in-kind and collaborative partnerships necessary to be able to produce optimally performant detectors that allow the ESS instruments to be world-leading. This foresees and encourages a high level of collaboration and interdependence at its core, and the further development of European centres of excellence for particular technologies.

[1] S. Peggs et al., ESS Technical Design Report, ESS-2013-0001 (2013).

[2] ERDIT: www.erdit.eu

E-mail of the corresponding author: Kalliopi.Kanaki@esss.se

Posters

Poster 2014-01

High resolution neutron diffraction and magnifying properties of double bent perfect crystal (+n,-n) and (+n,-m) settings employing the second crystal in the fully asymmetric diffraction geometry

Pavol MIKULA[1], Vasil RYUKHTIN[1], Miroslav VRÁNA[1]

[1]Nuclear Physics Institute ASCR, v.v.i., 250 68, Rez, Czech Republic

The simplest way how to enlarge the cross-section of the diffracted beam is to use the asymmetric diffraction geometry, which has been studied many times and described in many text books related to neutron or X-ray diffraction. The extremum case of the asymmetric diffraction geometry is co called fully asymmetric diffraction geometry (FAD geometry). Such unique diffraction geometry employing crystal of a large dimensions is applicable only in neutron diffraction. Neutron has a high penetration ability and namely perfect Si crystals are very suitable for such experiments and studies. Two alternatives can be distinguished: the FAD geometry with the output beam compression and the opposite one - the FAD geometry with the output beam expansion. In the case of the former one e.g. a wide incident polychromatic beam is impinging the crystal and a narrow (compressed beam) is diffracted when passing the crystal perpendicularly to its thickness e.g. along its longest edge. This alternative was already tested in the eighties and nineties for exploitation and designing of new types of neutron monochromators [1,2]. In the latter case a narrow beam enters the bent-crystal slab through the end face and after passing along the longest edge of the slab, the diffracted monochromated beam can be expanded to a large cross-section and of very small divergence with some possible application use [3] e.g. for one dimensional magnifying or imaging of the edge refraction. Some new related experimental results will be presented.

[1] P. Mikula, J. Kulda, L. Horalík, B. Chalupa and P. Lukáš, J. Appl. Cryst. **91** 324 (1986).

[2] P. Strunz, J. Šaroun , P. Mikula, P. Lukáš and F. Eichhorn, J. Appl. Cryst. **30** 844 (1997).

[3] P.MikulaM. VránaJ.Šaroun,J. Pilch, B. S. Seong,W. Woo and V. Em, J. Appl. Cryst. **47** Part 2, 599 (2014).

E-mail of the corresponding author: mikula@ujf.cas.cz

Poster 2014-02

High-Intensity Neutron TOF Diffractometer POWTEX

P. JACOBS,[1] A. HOUBEN,[1] W. SCHWEIKA,[2] H. CONRAD,[2] P. MÜLLER,[1]
Th. BRÜCKEL[2] and R. DRONSKOWSKI[1]

[1]Chair of Solid-State and Quantum Chemistry, Institute of Inorganic Chemistry,
RWTH Aachen University, D-52056 Aachen, Germany
[2]Jülich Centre for Neutron Science JCNS and Peter Grünberg Institut PGI, JARA-FIT,
Forschungszentrum Jülich, D-52425 Jülich, Germany

POWTEX is a designated time-of-flight neutron powder diffractometer [1] to be installed at beam line SR5 of FRM II. The instrument is designed and built by RWTH Aachen University and FZ Jülich with additional texture analysis and sample environments provided by Göttingen University, all funded by Germany's Federal Ministry of Education and Research (BMBF). Several new concepts were developed for POWTEX including a ^{10}B solid-state detector and a double-elliptic neutron-guide system sharing focal points at the positions of pulse chopper and sample. The common focal point can be regarded as an "eye of a needle" in time and space, optimizing time resolution and reducing the source background. The second neutron guide also features an octagonal cross section which, combined with the graded supermirror coating, results in a Gaussian intensity and divergence distribution [2].
The detector concept is based on ^{10}B solid-state elements exclusively developed for POWTEX. The innovative ^{10}B jalousie idea [3] will allow for a detector arrangement with almost no blind spots, a remarkably large coverage of nearly 9 sr and a depth-resolved neutron detection, thereby allowing for an intrinsic collimation of background and an energy resolution, too. It will also allow to incorporate large sample environments, e.g., a unique uniaxial and triaxial deformation apparatus developed by the Göttingen group. The large angular coverage is important for texture measurements (*in situ* deformation, annealing, simultaneous stress, and texture measurements) because it avoids any need for sample tilting and rotation. For powder diffraction, the covered solid angle relates directly to the instrument's efficiency.
To best exploit the POWTEX data, we have developed new algorithms for refining angular- and wavelength-dispersive data sets (intensity I being a function of 2θ and λ). A proof of concept was achieved by successfully fitting simulated data based on the instrumental POWTEX design as well as real data obtained by measuring a powderous CuNCN sample at the POWGEN instrument (SNS, Oak Ridge). This approach benefits from the larger resolution in backscattering mode as well as the high intensity at lower angles.
High intensities will not only allow for short measurement times and a large sample throughput, they will also give access to *in situ* chemical experiments, e.g., to characterize phase transitions as a function of temperature, pressure, and magnetic field.

[1] H. Conrad, Th. Brückel, W. Schäfer, J. Voigt, *J. Appl. Cryst.* 41, 836 (2008).
[2] A. Houben, W. Schweika, Th. Brückel, R. Dronskowski, *Nucl. Instr. and Meth. A*680, 124 (2012).
[3] G. Modzel, M. Henske, A. Houben, M. Klein, M. Köhli, P. Lennert, M. Meven, C. J. Schmidt, U. Schmidt, W. Schweika, *Nucl. Instr. Meth. A* 743, 90 (2014).

E-mail of the corresponding author: philipp.jacobs@ac.rwth-aachen.de

Poster 2014-03

The TOPAS time-of-fight spectrometer at JCNS, progress to date and future plans

Robert ALDUS[1], Guido VEHRES[2], Earl BABCOCK[1], Jörg VOIGT[2]

Jülich Centre for Neutron Science at Heinz Maier-Leibnitz Zentrum (MLZ), Forschungszentrum Jülich, Lichtenbergstr. 1, 85747 Garching, Germany

[2] Jülich Centre for Neutron Science (JCNS).
Forschungszentrum Jülich, 52425 Jülich, Germany

The new thermal time-of-flight spectrometer TOPAS at JCNS at the MLZ in Garching will represent the world's premier thermal time-of-flight spectrometer with full XYZ polarization capability. We expect to measure excitations up to ~120 meV energy loss with a flux significantly higher than other available instruments of this type. We will achieve this by using both the high flux available to us in the East Guide Hall at MLZ Garching in combination with a chopper cascade capable of a high pulse rate and the PASTIS polarization system using our own ^{3}He cells with a custom-built high-vacuum tank and 288 2 m position-sensitive ^{3}He detectors.

In this report we will present the progress made to date towards bringing TOPAS into an operational state and possible future applications and opportunities for improvement.

E-mail of the corresponding author: r.aldus@fz-juelich.de

Poster 2014-04

MANTA: a new cold neutron multi-analyzer triple-axis spectrometer at the HFIR

Adam ACZEL

Quantum Condensed Matter Division; Oak Ridge National Laboratory, Oak Ridge, USA

A next generation cold triple axis spectrometer at the High Flux Isotope Reactor (HFIR) of Oak Ridge National Laboratory (ORNL) is a highly desirable tool for addressing several forefront issues in condensed matter physics. I will discuss current design concepts for the proposed MANTA instrument and outline the exciting capabilities that this instrument can bring to the neutron scattering program at ORNL.

E-mail of the corresponding author: aczelaa@gmail.com

Poster 2014-05

(withdrawn)

Poster 2014-06

KWS-1 high resolution SANS instrument at JCNS: current state

Artem V. FEOKTYSTOV[1], Henrich FRIELINGHAUS[1], Zhenyu DI[1], Sebastian JAKSCH[1], Marie-Sousai APPAVOU[1], Thomas KOHNKE[1], Simon STARINGER[1], Manfred HEIDRICH[2], Romuald HANSLIK[3], Harald KLEINES[4], Alexander IOFFE[1], Dieter RICHTER[2], Thomas BRÜCKEL[5]

[1]Jülich Centre for Neutron Science at Heinz Maier-Leibnitz Zentrum (MLZ), Forschungszentrum Jülich, Lichtenbergstr. 1, Garching, Germany
[2]Forschungszentrum Jülich GmbH, Jülich Centre for Neutron Science JCNS-1 and Institute of Complex Systems ICS-1, Jülich, Germany
[3]Forschungszentrum Jülich GmbH, Central Institute for Engineering, Electronics and Analytics ZEA-1, Jülich, Germany
[4]Forschungszentrum Jülich GmbH, Central Institute for Engineering, Electronics and Analytics ZEA-2, Jülich, Germany
[5]Forschungszentrum Jülich GmbH, Jülich Centre for Neutron Science JCNS-2 and Peter Grünberg Institute PGI-4, JARA-FIT, Jülich, Germany

The KWS-1 small-angle neutron scattering (SANS) instrument operated by the Jülich Centre for Neutron Science (JCNS) at the Heinz Maier-Leibnitz Zentrum (MLZ) in Garching close to München has been recently upgraded. In the first half of the year 2013 the KWS-1 instrument was updated from its active collimation apertures to the detector cabling. Most of the parts of the instrument were installed for the first time, including: broadband polarizer, large cross-section radio-frequency spin flipper, chopper and neutron lenses. A custom designed hexapod in the sample position allows heavy loads and precise sample positioning in the beam for conventional SANS experiments as well as for grazing incidence SANS (GISANS) under applied magnetic field. With the foreseen in-situ polarization analysis the main scientific topic of the instrument tends towards magnetism. The polarization analysis will be realized with ^{3}He-cells which will be optimized for the used wavelength and scattering angle. It will make it possible to measure all four spin-flip and non-spin-flip channels (I^{++}, I^{+-}, I^{-+}, I^{--}). In-house made spin-exchange optical pumping (SEOP) cells from GE180 glass will are used as analyzer cells. In the conventional mode polarizations of 70% and lifetimes of 300 hours can be expected. Moreover, the KWS-1 is planned to be equipped with the in-situ SEOP. Thus neutron experiments performed using in-situ SEOP method will not need time dependent corrections to analyze the data.

Performance of the polarizer and flipper was checked with a polarized ^{3}He cell at the sample position. Results and comparison of test measurements on a ferrofluid in a magnetic field with polarized and non-polarized neutrons are presented.

E-mail of the corresponding author: a.feoktystov@fz-juelich.de

Poster 2014-07

Using Fermi choppers for spallation source based chopper spectrometers

Jörg VOIGT[1], Nicolo VIOLINI[1], Thomas BRÜCKEL[1]

[1]Jülich Centre for Neutron Science, Forschungszentrum Jülich, 52425 Jülich, Germany

On modern chopper spectrometers, Fermi choppers are employed for two distinct reasons: (i) Due to the comparably small distance from the axis of rotation they can spin at very high rotation spins compared to disc choppers and hence provide extremely short burst times even for large neutron windows, (ii) on chopper spectrometers with crystal monochromator one can use the fact that the chopper opens for different direction at different times for time focusing. The use of Fermi choppers has also some disadvantages: In contrast to disc choppers, the transmission in the open position is not unity due to front face and absorption losses and the transmission is wavelength dependent due to the finite time-of-flight through the chopper. The later is serious issue for spectrometers at spallation sources that use a polychromatic beam. To overcome the problem a magic Fermi chopper had been proposed and is under development for the 4SEASONS instrument [1]. We discuss the implications of the use of a Fermi chopper on a narrow band bi-spectral chopper spectrometer. Here the higher frequency of the chopper comes as an additional benefit as it increases the sampling density (in wavelength and energy). We compare the performance in the thermal and in the cold energy range with respect to disc choppers and distinct optimized modes of operation for the different solutions.

[1] M. Nakamura, *et al.*, Nucl. Instr. Meth. A **737**(0):142 – 147, 2014.

E-mail of the corresponding author: j.voigt@fz-juelich.de

Poster 2014-08

Design of neutron guide system for high-flux reactor PIK

Peter KONIK[1, 2], Evgeny MOSKVIN[1, 2]

[1]Petersburg Nuclear Physics Institute, Gatchina, Russia

[2]Saint-Petersburg State University, Saint-Petersburg, Russia

The construction of high-flux reactor PIK in Gatchina, Russia comes to the final stage. This continuous source would become the most intensive one in the world and, with thermal power of 100 MWt, would outperform HFR at ILL. The overall number of neutron instruments would reach 50 and many of them are to be installed in large neutron guide hall.

Two channels, namely H2 and H3, provide neutrons delivered further to neutron guide hall via extensive neutron guide system. H3 is installed on a standard spherical D_2 cold source, while H2 is equipped with horizontal cold source, which has cylindrical shape. It is important that such source provides triangle angular intensity distribution, so that all H2 guides should start parallel to channel axis. H3 guides diverges from channel axis as usual, like a fan.

It is planned to install 4 H2 guides. 3 guides of constant cross-section 30×105 mm^2 deliver neutrons to instruments that uses low divergent beams, like SANS machines, spin-echo spectrometer and double crystal diffractometer. These guides are curved in horizontal plane to avoid direct line of sight and one of them uses benders. Each of them further splits into 2 or 3 branches, thus every instrument has its own guide. The 4th guide is very wide one, having cross-section 165×30 mm^2, and it supplies two SESANS instruments and reflectometer with vertical scattering plane REVERANS. These instruments benefits from horizontal focusing and this guide is proposed to have ballistic profile. It was found that for such large source as H2 (165×165 mm^2) there is no significant intensity difference between linearly and parabolically divergent sections, so the first one is chosen. Further this guide is S-curved in vertical plane and is splitted in three branches for each instrument. All branches end with focusing section.

H3 channel is divided into several guides of different cross-sections. High divergence in both planes allows effective use of ballistic guides. Instruments like multi chopper spectrometer, triple-axis spectrometers and several reflectometers, gaining from focusing in one or both dimensions are to be installed at H3 guides. A considerable amount of space and free end positions is saved for future instruments.

The key point of this design project is use of individual guide for each instrument. Only such guides could be fully optimized to deliver maximal flux of useful neutrons with minimal background. Here we present results of Monte-Carlo simulations and founded optimal parameters for each guide.

E-mail of the corresponding author: konik@lns.pnpi.spb.ru

Poster 2014-09

Neutron optics from Helmholtz-Zentrum Berlin

Thomas KRIST, Jennifer SCHULZ, Jan HOFFMANN

Helmholtz-Zentrum Berlin, Hahn-Meitner-Platz 1, 14109 Berlin, Germany

Several neutron optical devices have been developed at HZB, mainly solid state elements where the neutrons are transported in thin silicon wafers with coated walls.
We show results of solid state polarizing benders, solid state collimators and a solid state radial bender for the polarization analysis of neutrons over an angular range of 3.8 degrees.
Another device consists of a solid state polarizing bender without absorbing layers used together with a collimator, which allows polarizing or analyzing neutrons without deflecting them from their original direction.
Two-dimensional polarization analysers for an angular range of 5 degrees in both directions are presented.
A polarizing cavity in a guide of 9 m length with a cross section of 60 mm x 100 mm was built which polarizes neutrons with wavelengths above 0.25 nm.
In all these polarizing devices polarisations of 95% were realised.
Recently a polarizing S-bender with a cross section of 30 mm x 100 mm was tested at a wavelength of 4.4 Å, showing a polarization above 98% and a transmission above 65% [1].
A focusing solid state lens was made from Si wafers coated with m=2 Ni-Ti supermirrors which can transport the full divergence of a neutron guide with the same coating. Here a focus with a FWHM of 2.4 mm was reached and an intensity increase of 5.6 compared to the intensity there without the lens.
Refractive focusing of neutrons can be realized by prisms. We used Si prism systems to analyse the energy of a collimated white neutron beam [2], [3] and to refocus a slit onto a detector.

[1] Th. Krist, F. Rucker, G. Brandl, R. Georgii: High performance, large cross section S-bender for neutron polarization, Nuclear Inst. and Methods in Physics Research, A 698 (2013) 94-97.
[2] J. Schulz, F. Ott, Ch. Hülsen, Th. Krist: Neutron energy analysis by silicon prisms, Nuclear Inst. and Methods in Physics Research, A729 (2013) 334.
[3] J. Schulz, F. Ott, Th. Krist: An improved prism energy analyzer for neutrons, Nuclear Inst. and Methods in Physics Research, A744 (2014) 69-72.

E-mail of the corresponding author: krist@helmholtz-berlin.de

Poster 2014-10

New focusing neutron guide for the high resolution backscattering spectrometer - SPHERES

Marina KHANEFT[1], Michaela ZAMPONI[1], Gerald J. SCHNEIDER[1] , Joachim WUTTKE[1]

[1]Jülich Centre for Neutron Science at Heinz Maier-Leibnitz Zentrum (MLZ),
Forschungszentrum Jülich, Lichtenbergstr. 1, Garching, Germany

The SPectrometer for High Energy RESolution (SPHERES) is a third generation neutron backscattering spectrometer with focusing optics and a phase space transform chopper. It provides high energy resolution (~0.65μeV) with a very good signal-to-noise ratio. By filling the instrument housing with argon in order to avoid air scattering in the secondary spectrometer the signal-to-noise ratio has been increased by about 40% [1]. The resolution of the small angle detectors have been improved by reducing the azimuth angle range of the analyzers [2]. A further gain in flux will be achieved by a more efficient phase space transform (PST) chopper which is currently under development.

The new PST chopper will also provide larger acceptance range in terms of the beam divergence which let us to consider new focusing neutron optics. Currently the instrument has a linear focusing neutron guide. Simulations of the instrument show the advantage of an elliptic focusing neutron guide which leads to a gain of intensity at the sample position. Parameters of the new guide such as cross section, length and mirror coating are varied and compared in order to find an optimum shape of the guide.

[1] J. Wuttke et al., Rev. Sci. Instrum. **83**, 075109 (2012).

[2] J. Wuttke and M. Zamponi, Rev. Sci. Instrum. **84**, 115108 (2013).

E-mail of the corresponding author: m.khaneft@fz-juelich.de

Poster 2014-11

PASTIS for XYZ polarization analysis using ^{3}He with SEOP polarized gas

Zahir SALHI[1], Earl BABCOCK[1], Ramil GAINOV[2] Alexander IOFFE[1]

[1]Jülich Centre for Neutron Science at Heinz Maier-Leibnitz Zentrum (MLZ); Forschungszentrum Jülich, Lichtenbergstraße 1, 85747 Garching, Germany.
[2]Helmholtz-Zentrum Berlin für Materialien und Energie,
14109 Berlin, Hahn-Meitner Platz 1, Germany.

We report on the progress of the construction of the newly proposed PASTIS coil set [1], which uses a wide-angle banana shaped ^{3}He Neutron Spin Filter cell (NSF) to cover a large range of scattering solid angle. The final goal of this insert is to enable XYZ polarization analysis to be installed on the future thermal time-of flight spectrometer TOPAS.The design assures relative field gradients < 10^{-3} cm-1 and large solid angle areas not interrupted by either coils or supports. In vertical direction nearly 40 deg are open and the blind spots in the horizontal scattering plane comprise only 3 deg due to the square X and Y coils. We present results of the neutron transport setup which insure an adiabatic rotation of the polarization to much the polarization supported by PASTIS. Additional, we present the progress of the fabrication of GE180 wide-angle banana cells that achieve both long relaxation times and high ^{3}He polarization [2].

[1] E. Babcock, Z. Salhi, P. Pistel, G. Simeoni, A. Ioffe, 2014, *Magic-PASTIS for XYZ polarization analysis using SEOP polarized 3He gas,* NOP&D; J. of Phys. Conf. Series.
[2] Z. Salhi, E. Babcock, P. Pistel, A. Ioffe, 2014, *3He Neutron Spin Filter cell development program at JCNS,* NOPD&D; J. of Phys. Conf. Series.

E-mail of the corresponding author: z.salhi@fz-juelich.de

Poster 2014-12

OSIRIS: Past, Present and Future

Franz DEMMEL

ISIS Facility, Didcot, OX11 0QX, UK

The Osiris spectrometer at the ISIS Facility is a cold indirect tof-spectrometer. Over the past 15 years this instrument started as a pure diffractometer and finally turned into a powerful spectrometer with diffraction capabilities. The performance of the spectrometer will be demonstrated. Future potential developments will be highlighted towards higher resolution and higher flux.

E-mail for corresponding author: franz.demmel@stfc.ac.uk