MLZ
Heinz Maier-Leibnitz Zentrum

Newsletter 16

MLZ is a cooperation between:

JCNS Jülich Centre for Neutron Science

Helmholtz-Zentrum Geesthacht
Zentrum für Material- und Küstenforschung

TUM
Technische Universität München

The Heinz Maier-Leibnitz Zentrum (MLZ):
The Heinz Maier-Leibnitz Zentrum is a leading centre for cutting-edge research with neutrons and positrons. Operating as a user facility, the MLZ offers a unique suite of high-performance neutron scattering instruments. This cooperation involves the Technische Universität München, the Forschungszentrum Jülich and the Helmholtz-Zentrum Geesthacht. The MLZ is funded by the German Federal Ministry of Education and Research, together with the Bavarian State Ministry of Education, Science and the Arts and the partners of the cooperation.

Bavarian State Ministry of
Education, Science and the Arts

SPONSORED BY THE
Federal Ministry
of Education
and Research

Looking ahead

An editorial by

Winfried Petry

Scientific Director FRM II
Scientific Director MLZ

For the MLZ as an international neutron provider, it is a continuous task and challenge to know and understand the needs of its scientific and industrial users. In order to invest proactively in instrumentation and method development, we have to identify future trends in science and technology for the application of neutron and positron beams. Looking into the crystal ball might help, but it is only funny if you don't do it yourself. So we have started to evaluate our own science projects at the MLZ and in a second step to discuss future trends in science with our external users on the occasion of the last User Meeting. As an outcome of this joint adventure we have compiled a Road Map for science with neutrons and positrons at the MLZ. As a living document, which we intent to update regularly, it will guide us on our decisions for investments in our instrumentation. This process is accompanied by our Scientific Advisory Board and its subcommittee, the Instrumentation Advisory Board.

Two key messages could be cited. The MLZ is and will continue to be a full service provider for continuous neutron beams. In view of the upcoming new neutron source ESS being actually under construction in Lund, it is essential to provide a broad range of applications for neutron research in Garching to secure a powerful home base for neutron scientists in Germany. An important milestone to extend our capacities was reached in April this year by the exchange of the beam plug of neutron guide SR5, providing three thermal neutron beams for the instruments in the future Neutron Guide Hall East. A second key message concerns the usage of neutrons for complicated and complex in-situ and in-operando studies. Here the particular advantage of neutron research – its high penetration depth using sophisticated sample environment – was identified as guarantor for a bright and future-proof method.

It is a pleasure to thank our collaborators and colleagues on-site for the support to compile our MLZ Road Map.

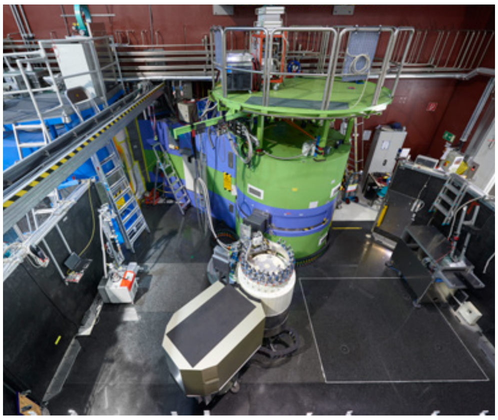
Read more

P. 12 about the exchange of the beam plug

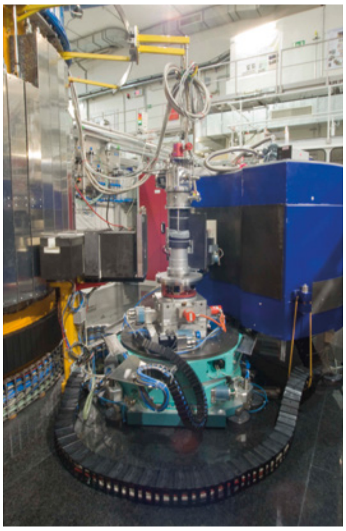
and

P. 18 about the MLZ Road Map!

Three axes spectrometers waiting for you!



PANDA



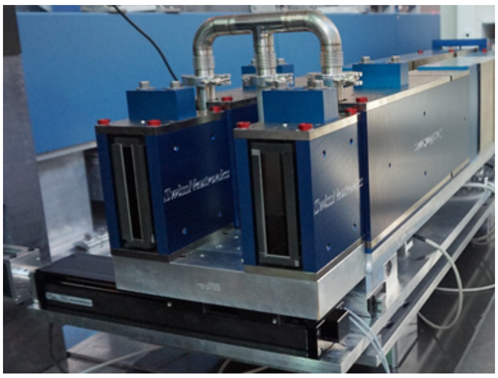
PUMA

MIRA

A **t**hree **a**xes **s**pectrometer (TAS) is defined by the three diffraction axes of the instrument, namely the monochromator (1st axis) selecting according to Bragg's law the incident wavelength λ_i, being scattered a the sample position (2nd axis) and finally again diffracted at the analyser (3rd axis) to define the detected wavelength λ_f in the following detector. Adjusting the crystallographic orientation of the single crystalline sample to the energy transfer as defined by the first and third axis, selective measurement points in the q, ω space are defined. A TAS is ideally suited to investigate phonons and magnons as it offers an appropriate momentum and energy resolution in the order of meV or better. Compared to modern direct time-of-flight spectrometers its excellent energy and q-resolution and the peak-to-background ratio helps in resolving weak branches in the dispersion relation and allows for "zoomed" focus on special points in q-energy space. The method had been developed by Bertram Brockhouse at Chalk River (Canada), who was honoured with the Nobel prize for Physics in 1994. The first true TAS was built in 1956.

In this newsletter we present the different three axes instruments currently being operated or set up at the MLZ. Emphasis is on the different specialised applications of each instrument beyond the standard applications of TAS instruments. We also give an overview of newly installed options and present some key results obtained from recent publications.

TRISP



KOMPASS (under construction)
Parabolic and straight guide ends (from left to right) on the motorised translation table. The vertical guide fields are installed in the blue casings.

PANDA

Cold three axes spectrometer

PANDA is a cold TAS with end-position, double-focussing monochromator/ analyser optics and overlap to thermal wavelengths when starting operation in 2005 [1]. Its success is based on an excellent peak-to-background ratio and the possibility for extreme sample conditions. Being designed for studies of magnetic excitations at low temperatures/ high fields, it serves now a broad user community investigating excitations related to unconventional superconductivity, quantum phase transitions, frustrated magnetism, phonon softening, correlated electrons and heavy fermion systems, spin fluctuations in intermetallic compounds etc.

PANDA's normal operation uses a doubly focussing HOPG monochromator as well as an analyser with cooled Be-filter in front of the analyser allowing final energies up to $E_f \leq 5$ meV. The resolution of the incoherent elastic line is FWHM ≤ 150 μeV in this case, usually a little higher than found on comparable instruments (see fig. 1). A cooled BeO-filter is available to be used instead of ($E_f \leq 3$ meV) or in addition to the Be-filter, as well as PG-filters for thermal wavelengths. Increased q-resolution can be obtained by decreasing k_f, working with vertical focussing only and/ or using collimation – all on cost of intensity. While the incident momentum range varies from 1.05 Å^{-1} ≤ k_i ≤ 4 Å^{-1}, the experimentally useful energy transfer (ΔE ≤ 25 meV available) is determined by kinematic constraints.

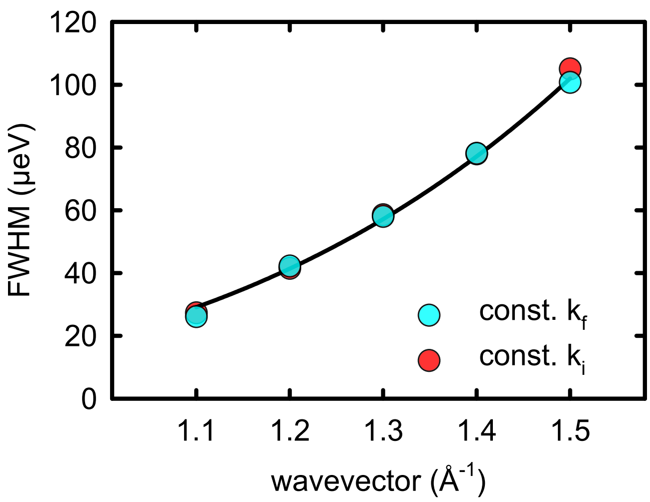


Fig. 1: PANDA resolution taken from Vanadium scans.

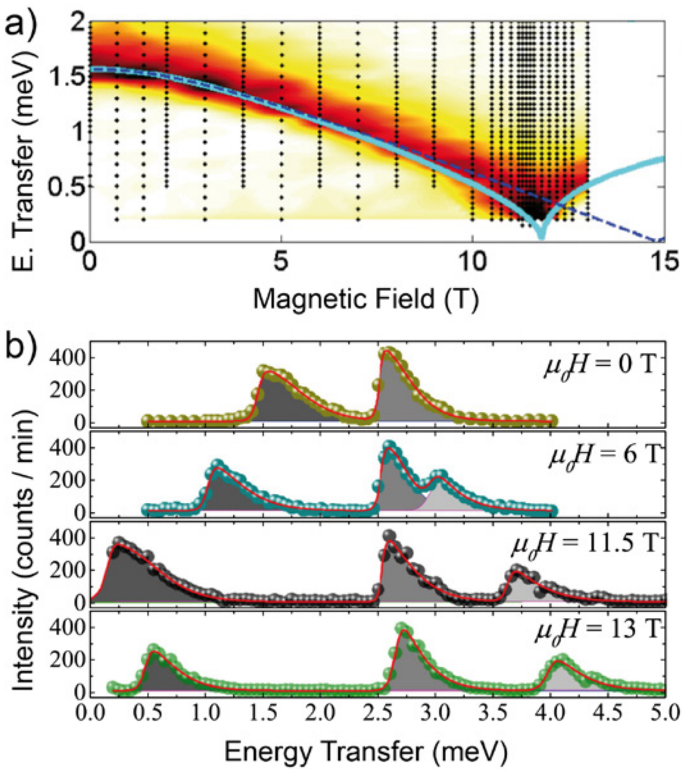


Fig. 2: Field dependence of triplet states in the $SrNi_2V_2O_8$ at 2K. (**a**) With the application of magnetic field the lowest singlet mode (turquoise) shifts to the lower energy and becomes gapless at the critical field 11.5 T, resulting in a quantum critical point. (**b**) Selected scans measured at PANDA.

For many scientific cases, PANDA and PUMA (see below) ideally complement each other not only in energy transfer and q-range, but also in resolution aspects. An example is the study of copper selenide Cu_2OSeO_3, performed by colleagues from TU Dresden, who measured the complete spectrum of the magnetic excitations. By this, the existence of a large energy gap between different parts of the spectrum was confirmed, and the spectrum could be determined quantitatively. The resulting knowledge of the exact positions of the dispersions and of the energy gap allowed accurately calculating the strength of the magnetic interactions [2]. In a study performed by A. Bera [3] on the coupled Haldene chain compound $SrNi_2V_2O_8$ under magnetic field, a field-induced quantum phase transition at $\mu_0H_c \approx 11.5$ T was confirmed by measuring the spin excitations. The system changes from a disordered gapped singlet to a long-range ordered state; the quantum criticality could be shown by the scaling of the energy and the linewidth of the lowest triple mode (see fig. 2a). Typical scans performed on PANDA with relaxed resolution (k_f = 1.57 Å^{-1}) are shown in fig. 2b.

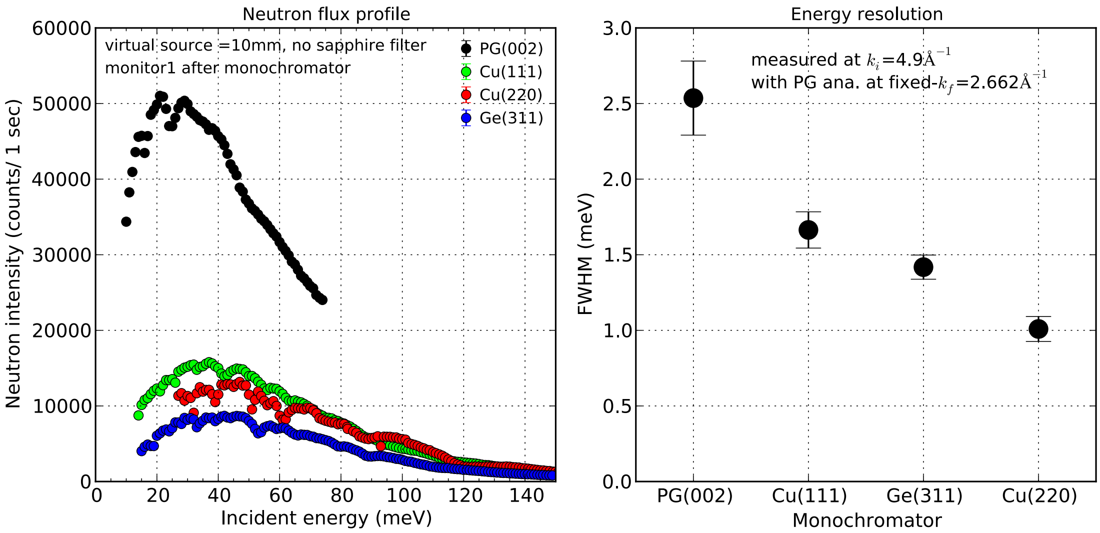


Fig. 3. Neutron flux profiles versus incident neutron energy for the four monochromators installed at PUMA. Data were recorded before the sample table without filters (**left**). The energy resolution of the four monochromators measured at the same neutron incident energy (**right**).

PUMA

Thermal three axes spectrometer

PUMA is a thermal TAS and was the first instrument that went into operation at the FRM II. One of the most attractive facts of PUMA is probably the high flux of thermal neutrons arriving at a sample position and the detector. This is made possible due to well optimised use of the double-focussing technique both at the monochromator and the analyser side. At PUMA, four different monochromator crystals – pyrolytic-graphite (HOPG) using the (002), copper using (111) and (220), and germanium using (311) reflections, respectively – are available depending on a demand of the experiment. Each monochromator possesses a characteristic neutron flux profile as well as energy resolution as shown in fig. 3. Generally, there is a trade-off between neutron flux and resolution, thus one needs to consider carefully which monochromator will be chosen for the measurements. Due to the different types of monochromator, PUMA can cover enormously wide energy and momentum ranges: For the energy transfer, one can reach up to 100 meV, and up to 12 Å^{-1} in momentum transfer. In case, a high momentum resolution is required, PUMA can be equipped with a series of four Soller collimators, i.e. before/ after the monochromator and before/ after the analyser.

An innovative option of PUMA is the multi-analyser/ detector system (fig. 4). It allows a unique and flexi-

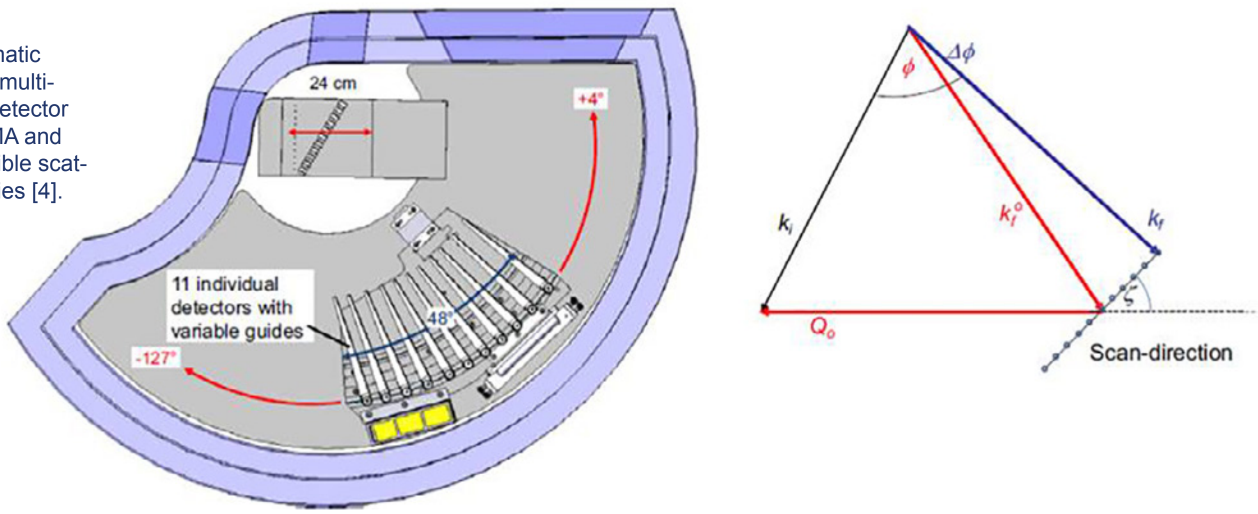


Fig. 4: A schematic drawing of the multi-analyser and detector system at PUMA and one of its possible scattering geometries [4].

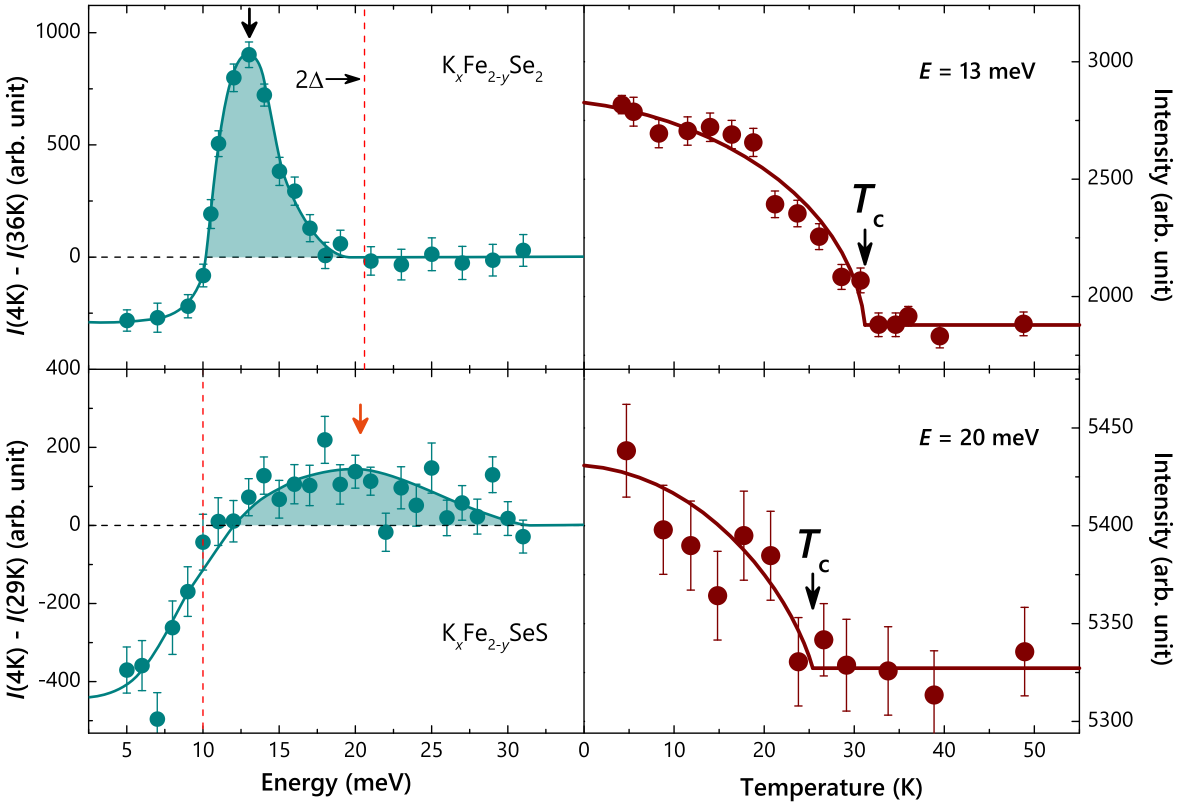


Fig. 5: INS data on the parent and sulfur-doped iron-selenide superconductors measured at PUMA. Left panels are data from energy scans at Q = (0.5, 0.75, 0) and right panels show the temperature dependence of scattering intensity measured at fixed energy. The upper two panels obviously reveal the presence of a magnetic resonant mode in the parent phase, whereas the mode completely disappears in the 50% sulfur-doped compound as shown in lower panels [6].

ble type of multiplexing. Using this option, a range of scattering angles of 16° can be measured simultaneously with eleven blades of analysers and detectors. A flexible momentum-energy path can be realised without repositioning the instrument. One of the most conceivable subjects for using such an option will be stroboscopic time-resolved measurements within microseconds. Here, the spectrometer settings will remain unchanged but an external parameter such as the temperature or the magnetic field can periodically stimulate the sample and the system records the time-dependent signals.

One of the main research topics of a thermal three axes spectrometer is the study of magnetic fluctuations in high-T_c superconductors. As a part of recent outcome, two independent study groups at Advanced Industrial Science Technology (Japan) and Fudan University (China) have conducted inelastic neutron scattering experiments at PUMA on different types of iron-based superconductors, namely the iron-arsenides and the iron-selenides. They came to the same conclusion about the nature of the pairing symmetry transition upon chemical doping in the systems. Under the unconventional momentum structure of superconducting energy gaps (Δ_{SC}), a peculiar spin-exciton mode is allowed to be formed as a bound state below $2\Delta_{SC}$ in the spin excitation channel below the superconducting transition temperature, known as the magnetic resonant mode. Such a mode is well observed in the optimal doping region of both the iron-arsenides and the iron-selenides (see fig. 5). But when the doping level crosses a certain level, the resonant mode suddenly disappears. This indicates that the superconducting energy gap structure becomes conventional [5, 6].

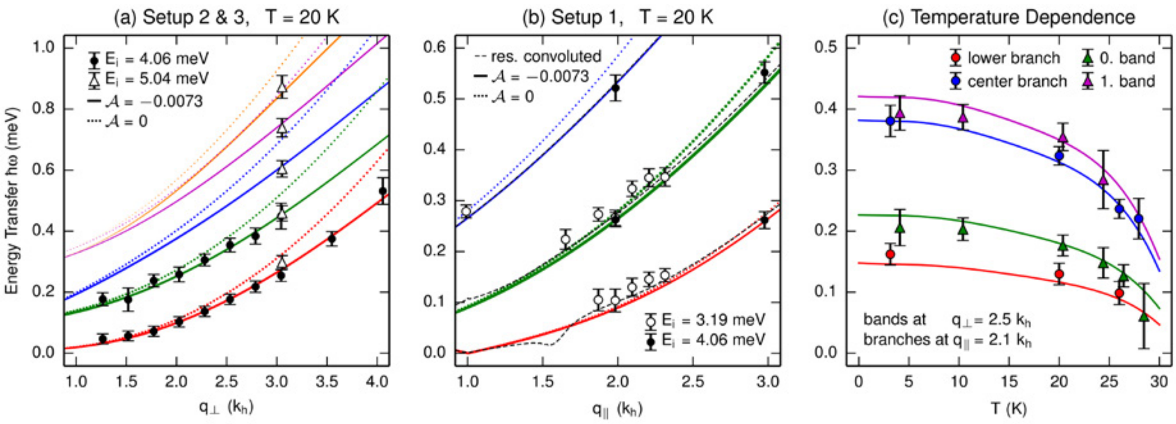


Fig. 6: Comparison of the experimental data from MIRA with the helimagnon theory. The parameter A describes the anharmonicity for larger q and is the only fit parameter [7]. The reduced momentum transfer q is given in units of the helix pitch in MnSi.

MIRA

Cold three axes spectrometer for incommensurate structures

At MIRA we were able to resolve the excitations of helimagnets, the so-called helimagnons, in the prototype helimagnet MnSi. Based on a theoretical model developed by our colleagues from the Universität zu Köln, we could measure the first five helimagnon bands and show an excellent agreement with the theory. For this only one fit-parameter (the anharmonicity of the helimagnon potential) was needed to explain dozens of spectra obtained by MIRA (see fig. 6).

MIRA offers an excellent q-resolution together with a very good energy-resolution for small energy transfers. It is specialised on incommensurate structures with a large modulation length and their excitations, like the helimagnons in the itinerant compound MnSi. As the instrument is situated in the middle of a neutron guide it can only be operated in constant k_i mode. For small energy transfers this is equivalent to the normal constant k_f operation mode of three axes instruments. It uses a vertically focussing PG monochromator and can also provide full polarisation analysis. An optfocussing guide [8] improves the inelastic intensity up to a factor of 30 - 40 for small samples (see fig. 7).

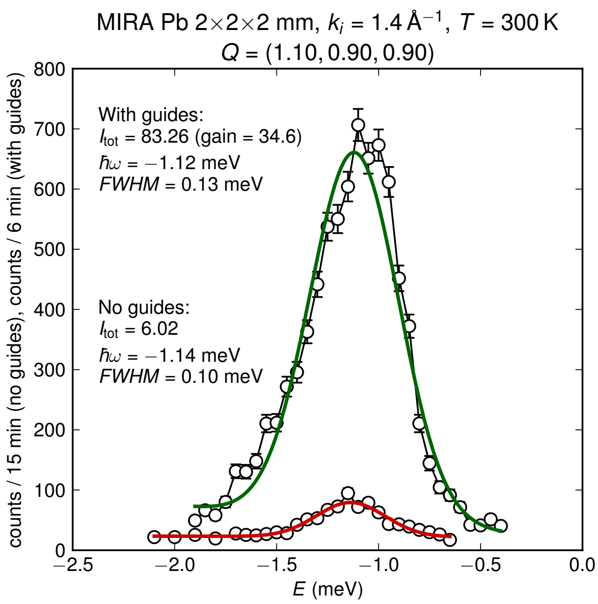


Fig. 7: The gain with elliptical guides for phonons in a 2 x 2 x 2 mm³ lead sample. The red line shows an energy scan over a lead phonon without the guides mounted and the green line with them in place. An intensity gain of 35 is observed with the guides.

KOMPASS

Under construction: cold polarised three axes spectrometer

The TAS KOMPASS [9] is currently under final construction at the end position of a cold neutron guide. The unique feature of the instrument is the permanently installed triple cavity, which will provide a highly polarised incoming beam. Thus, it works exclusively with polarised neutrons. Different motorised guide ends, straight and focussing in the scattering plane, allow for an optimisation of the neutron flux density at the sample position respecting the required instrument resolution in momentum and energy transfer.

For the polarisation analysis of the scattered neutrons, the secondary spectrometer can be equipped with a combination of a cavity of trapezoidal geometry and a solid-state-collimator to tune the performance in terms of polarisation and transmission. The compact design of KOMPASS is optimised for zero-field spherical neutron polarisation analysis for measuring all elements of the polarisation matrix. Together with the doubly focussing monochromator and analyser arrays, which are equipped with highly oriented pyrolytic graphite crystals the instrument is very well suited to study various types of weak magnetic order and excitations, including the possibility to conduct time-resolved stroboscopic measurements, e.g. for studying the domain distribution when switching an electric field in multi-ferroics.

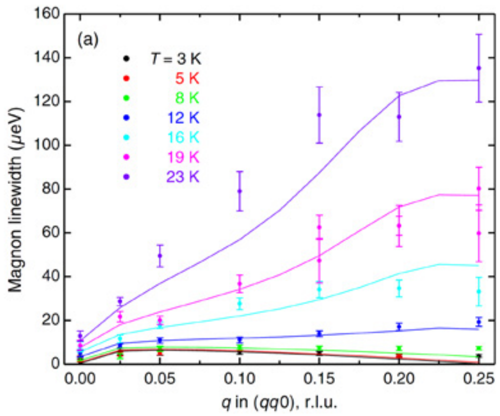


Fig. 9: Linewidth (inverse of the lifetime) of magnons in the S = 5/2 quasi 2-dimensional antiferromagnet Rb_2MnF_4. The small bump around q = 0.05 $Å^{-1}$ at low temperature results from scattering of the magnons at antiferromagnetic domain boundaries. The size of these domains is in the order of 500 nm and was measured by Larmor diffraction. [11]

TRISP

Three axes spin echo spectrometer

TRISP is a high-resolution spin-echo TAS offering energy resolution from 1 to 100 μeV for excitation energies from 1 to 50 meV. In Larmor-diffraction mode, the relative resolution for lattice spacing reaches 10^{-6}. The diagrammes show some typical applications of TRISP.

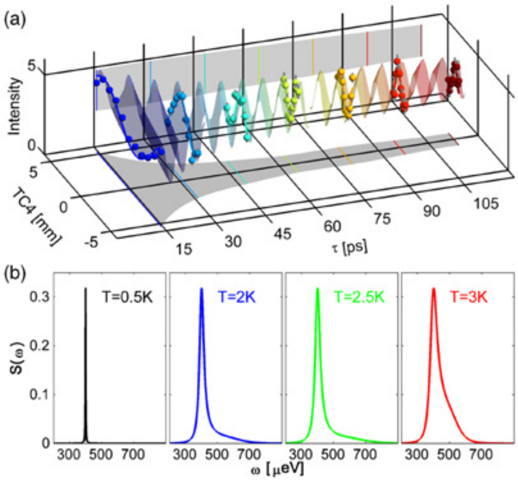


Fig. 10: The effect of temperature dependent asymmetric line broadening is investigated in $Cu(NO_3)_2$, a model material for a one-dimensional bond alternating Heisenberg chain.
(**a**) Raw data for T = 0.5 K and global fit (gray oscillating pattern). The fitting model includes spin flip processes and takes both the amplitude and the phase of the spin echo data into account. The model was implemented in Matlab as a ray tracing simulation of the spectrometer.
(**b**) The line shapes deviate from the usual Lorentzian and show a clear asymmetry, a signature of the interactions on the one dimensional chain. [12].

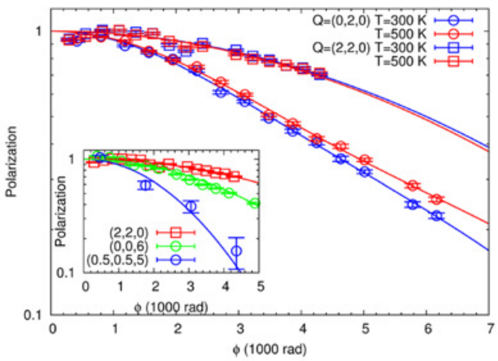


Fig. 8: Larmor diffraction on the undoped cuprate $YBa_2Cu_3O_6$ allows to measure sizes and morphology of antiferromagnetic and structural domains, showing the effect of different magnetostriction mechanisms. Domain sizes up to 1000 nm are resolvable. [10]

R. Georgii, J.T. Park (FRM II);
O. Sobolev (Universität Göttingen);
A. Schneidewind, P. Čermák (JCNS);
A. Grünwald (Universität zu Köln);
T. Keller (MPI für Festkörperforschung, Stuttgart)

Read more:

[1] A. Schneidewind et al., Neutron News 18 9 (2007)
[2] P. Portnichenko et al., Nature Communications 7 10725 (2016)
[3] A. Bera et al., Phys. Rev. B 92 060412(R) (2105)
[4] O. Sobolev et al., Nucl. Instrum. Method A 772 63 (2015)
[5]. C. H. Lee et al., Scientific Reports 6, 23424 (2016)
[6]. Q. Wang et al., Phys. Rev. Lett. 116 197004 (2016)
[7] M. Kugler, et al., Phys. Rev. Lett. 115 097203 (2015)
[8] G. Brandl, et al., Appl. Phys. Lett. 107 253505 (2015)
[9]. http://mlz-garching.de/instrumente-und-labore/spektroskopie/kompass.html
[10] Xingye Lu, Phys. Rev. B 93, 134519 (2016). B. Náfrádi et al., Phys. Rev. Lett. 116, 047001 (2016)
[11] S.P. Bayrakci et al., Phys. Rev. Lett. 111, 017204 (2013); S. Krannich et al. Nature Comm. 6, 8961 (2015)
[12] F. Groitl et al., Phys. Rev. B 93, 134404 (2016)

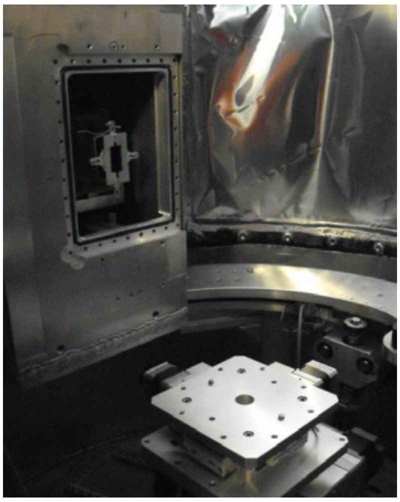
The focussing guide at TOFTOF

The raise of more specialised and more complex sample environments and the simultaneous decrease of sample sizes require smaller and more focussed neutron beams. In the optimum case, the focussing neutron optics increases the flux on the sample while keeping the spurious scattering of the environment at a minimum.

At TOFTOF, the challenges for a focussing device in the last section of the neutron guide system are twofold:

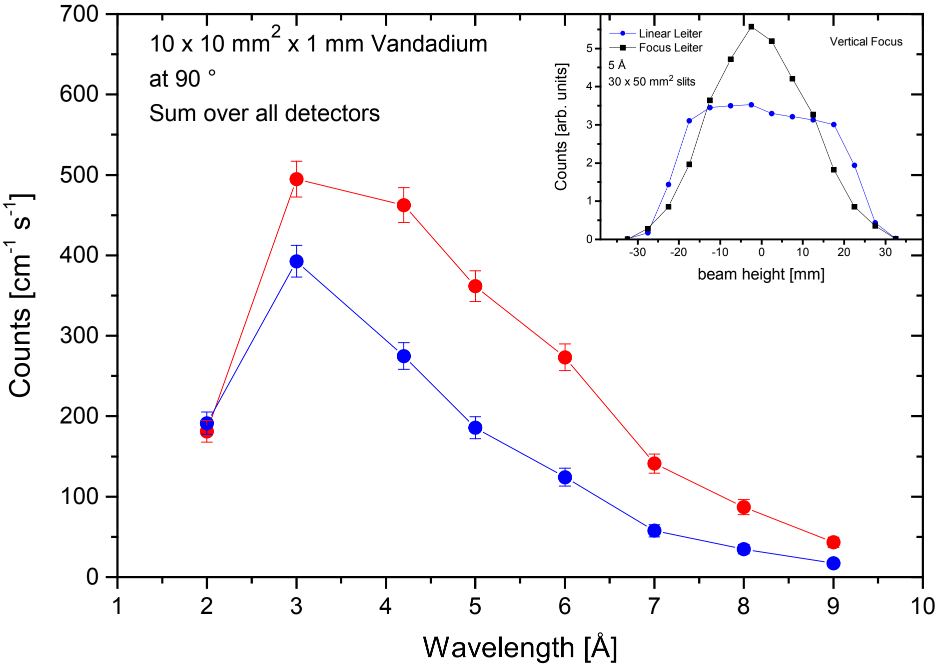
- First of all, TOFTOF operates in a large wavelength range and any focussing device should be able to adapt to the changing conditions.
- Secondly, the available space to insert the optional focussing device is limited.

The solution is a very compact device comprised of four supermirrors whose curvature can be adjusted independently by piezomotors. The resulting geometry approaches a parabolic shape and the focussing condition can thus be optimised for each wavelength. Both, the standard linear tapered guide and the focussing guide are now installed in the motorised lift system in the last section of the neutron guide, still within the vacuum system of the primary spectrometer. The change from one guide configuration to the other is fully automated and integrated into the instrument control software NICOS, and be routinely chosen for any experiment at TOFTOF that benefits from a smaller beam spot with higher intensity.



View from the sample chamber into the vacuum system of the primary spectrometer. The focussing guide is installed in the motorised lift system in TOFTOF. The linear tapered guide is located in the lower tray.

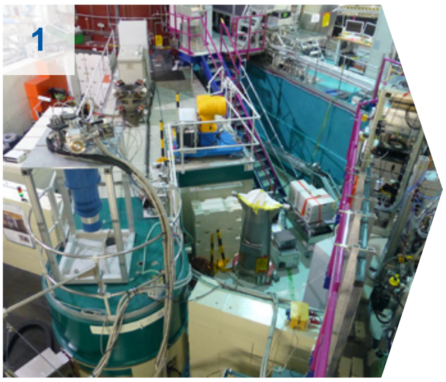
The performance of the device has been characterised using a 1 x 1 cm^2 Vanadium plate (thickness of 1 mm) placed at the sample position at an angle of 90° with respect to the neutron beam. The elastic scattered intensity is shown in the diagramme as a function of wavelength. As expected from McStas simulations, the compression of the beam works best for wavelengths larger than 4 Å. An intensity increase up to a factor of 2.5 is obtained in this basic characterisation which is well in agreement with the factors predicted by the McStas calculations. It should also be noted that the focussing neutron optics sends higher beam intensity to the central beam position, but the integrated flux over the extended sample area is lower compared to the linear taped guide configuration. The background scattering is thus further minimised and the effective gain in terms of signal-to-noise ratio is even higher. The beam compression (in vertical direction) at the sample position is shown in the diagramme's insert, measured with a fully opened beam aperture.



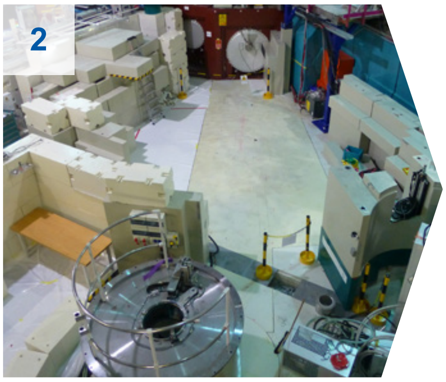
Intensity scattered from a 10 x 10 mm^2 Vanadium plate (thickness 1 mm) using the linear tapered guide and the focussing guide. The inset shows the vertical beam profile at the sample position (with the slits fully open).

W. Lohstroh (FRM II)

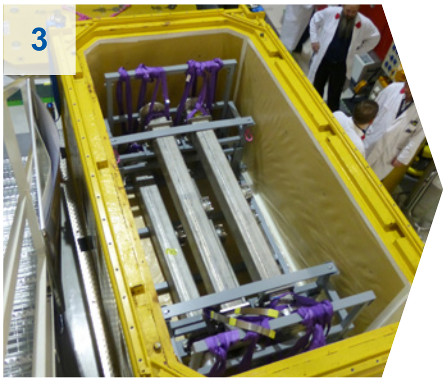
Exchange of a beam plug:
A further step towards neutrons for the Neutron Guide Hall East!



A nice - and crammed! - Experimental Hall.

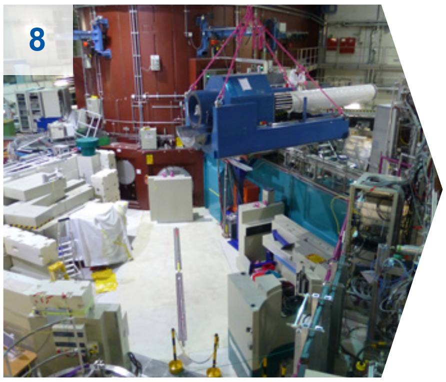


TRISP had been removed.

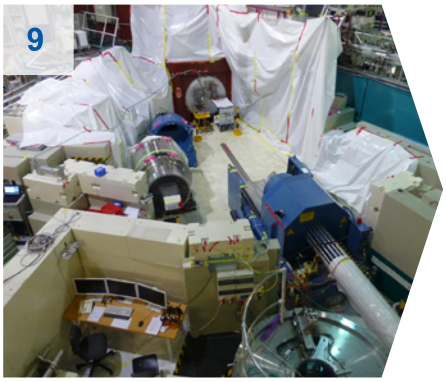


TRISPS neutron guides, safely stored in a transport container.

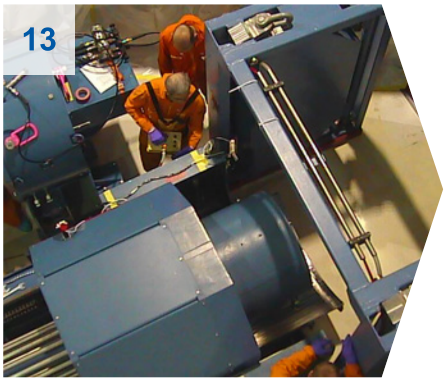
The machine for the exchange of the beam plug arrives in the Experimental Hall.



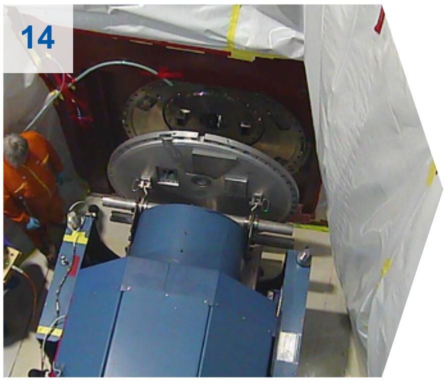
Still underway.



Everything covered, machine in place.



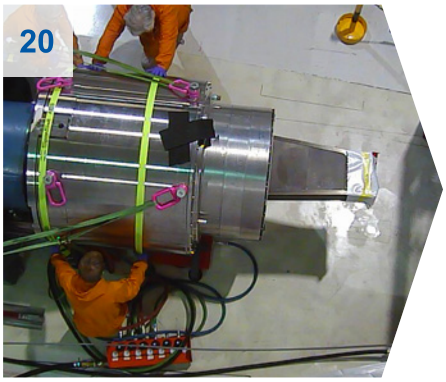
Machine ready to remove the old plug.



Pulling out the lid.

The team: well shielded for the following remote-controlled work steps.

Old beam plug nearly ready to leave the Experimental Hall.

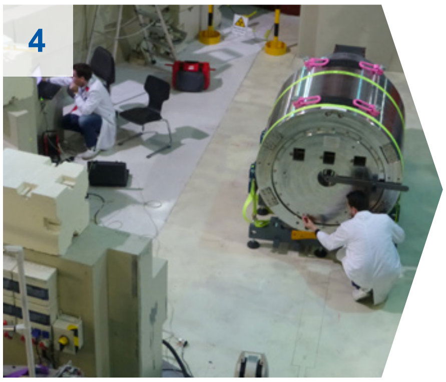


The new plug.

Fitting the new plug into the beam tube.

During the maintenance break we exchanged the old beam plug at neutron guide SR5 for a new one with three instead of two beam channels. It had been manufactured at the Forschungszentrum Jülich by the Central Institute for Engineering, Electronics and Analytics (ZEA) – Engineering and Technology (ZEA-1) during 2015. The installation was supervised and done be E. Calzada (FRM II) and his group.

4



Controlling the new beam plug.

5

The Neutron Optics Group inserting the new neutron guides.

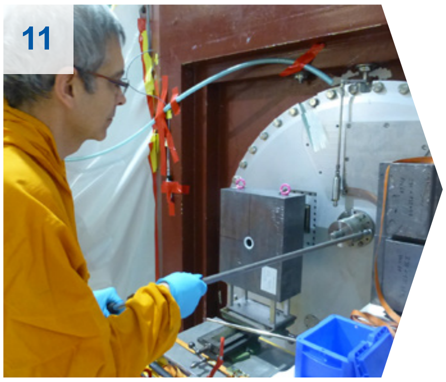
6

Moving the new beam plug on air cushion.

10

Dismounting the old plug's gear box.

11

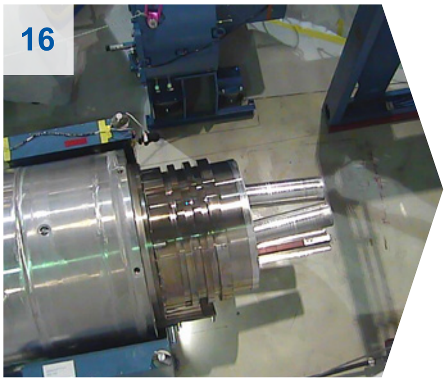


Dismantling its drive shaft.

12

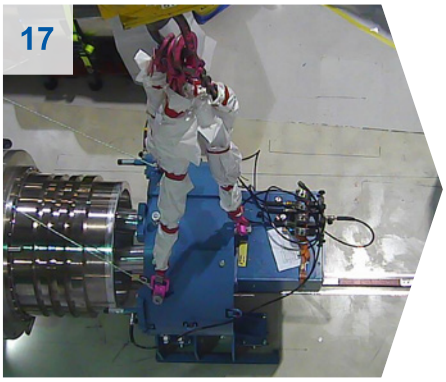
Loosing the lid's screws.

16



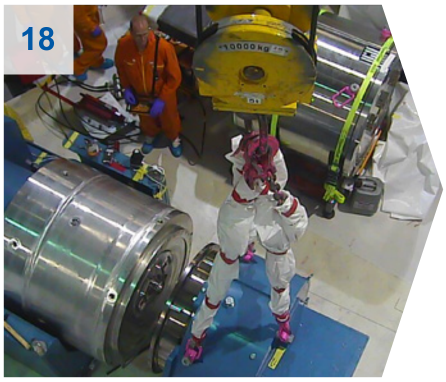
Pulling out the old plug.

17



Covering the plug's nose with the shielding flask.

18



Dividing the old plug for the transport.

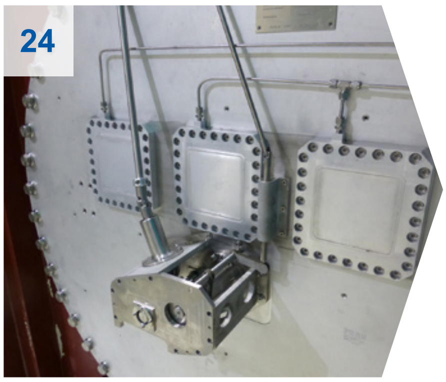
22

Adjusting the position of the neutron beam axis.

23

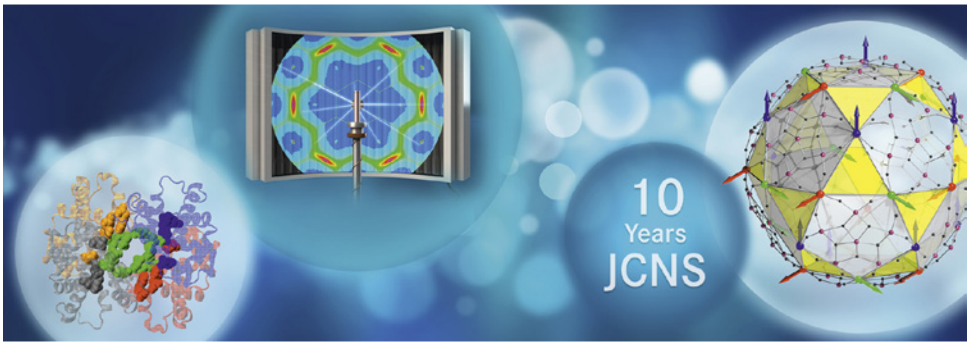
Neutron windows are mounted.

24



Ready!
Isn't it beautiful?

Jülich Centre for Neutron Science celebrated 10th anniversary



The event's key visual represents the two research fields in which JCNS specializes.

The Jülich Centre for Neutron Science (JCNS) celebrated its 10th anniversary together with colleagues from Forschungszentrum Jülich and the international neutron community on February 17th. To mark the occasion, ceremonial addresses and a scientific lecture were held on the campus of Forschungszentrum Jülich.

JCNS was founded in February 2006, shortly before the Jülich research reactor FRJ-2 (DIDO) was shut down, in order to pool neutron activities at Jülich and external sources. Since then, JCNS has successfully pursued its unique strategy in neutron research of providing its users with outstanding instruments at leading neutron sources worldwide, combined with an excellent scientific environment in selected research fields, such as "Correlated electron systems and nanomagnetism" as well as "Soft matter and biophysics". "Neutrons for energy" is soon to become a third pillar of research.

JCNS is currently involved in operating five instruments at the Institut Laue-Langevin (ILL) and eleven under the umbrella of the Heinz Maier-Leibnitz Zentrum (MLZ), together with partner institutions; two further instruments at MLZ are under construction. At the Spallation Neutron Source in Oak Ridge, USA, a Jülich neutron spectrometer is the only non-American measuring instrument currently in use there, enabling German and European researchers to gain valuable experience for the construction and operation of instruments for the ESS. Furthermore, Jülich has transferred three instruments to the China Advanced Research Reactor near Beijing to foster cooperations with the Chinese communities.

During the anniversary celebrations, Sebastian Schmidt, member of Jülich's Board, reviewed the history of the JCNS, while Dieter Richter, JCNS, presented the MLZ. Thomas Brückel, Director at JCNS, revealed a concept for a novel, extremely compact neutron source, which is set to ideally complement the larger, international facilities. Ghaleb Natour, Director at the Jülich Central Institute for Engineering, Electronics and Analytics (ZEA), introduced the audience to the services and competencies of the institute with regard to the construction of neutron instruments. Helmut Schober, ILL, showcased examples of successful research with neutrons. The event was chaired by Richard Wagner, former member of Jülich's Board.

A. Wenzik (Forschungszentrum Jülich)

The keynote speakers (from the left) Thomas Brückel, Ghaleb Natour, Helmut Schober, Dieter Richter, Sebastian Schmidt, and the chairman Richard Wagner.

Workshops organised by the MLZ Science Groups

Finding complicated magnetic structures using SpinW

The origin of atomic magnetism and magnetic interactions in solids is one of the main questions being addressed by studying the resulting magnetic correlations with neutron scattering. Classically there is always a spin wave solution to the problem as discussed in many textbooks on magnetism using the example of the ferromagnetic chain. Quantum mechanically the problem is equivalent to coupled harmonic oscillators. Solutions to more complicated lattice geometries can be found numerically with the help of computer codes like SpinW written by Sándor Tóth of the Laboratory for Neutron Scattering and Imaging, Paul Scherrer Institut (PSI).

The MLZ Science Group "Quantum Phenomena" organised a two-day workshop on February 25th and 26th, where Sándor gave an introduction to strategies on how to fit measured spin wave spectrum using SpinW in front of 26 neutron scatterer from USA and Europe. He addressed how to use basic scripting to calculate the spin wave spectrum of simple model Hamiltonians. Further topics included solving complex magnetic structures and symmetry analysis of the spin Hamiltonian. Sándor and the workshop's participants finally fitted inelastic neutron scattering data with selected hands-on examples.

Further, an introduction to inelastic neutron scattering data analysis using Matlab was given by Simon Ward (PSI), followed by a demonstration of the MLZ software TAKIN for fitting three axes data using the precise instrument resolution by Tobias Weber (FRM II).

R. Georgii (FRM II)

Solution of crystal structures using Fox

Crystal structure of new materials remains a relevant research task, whilst the complexity of studied objects and structures rises permanently. This requires the development and implementation of new approaches, algorithms, and scientific recipes for the solution of complex structures using the bounded data statistics provided by powder diffraction. A full-day workshop "Solution of crystal structures using Fox" was organised by the MLZ Science Group "Structure Research" at Gate Garching on December 1st, 2015.

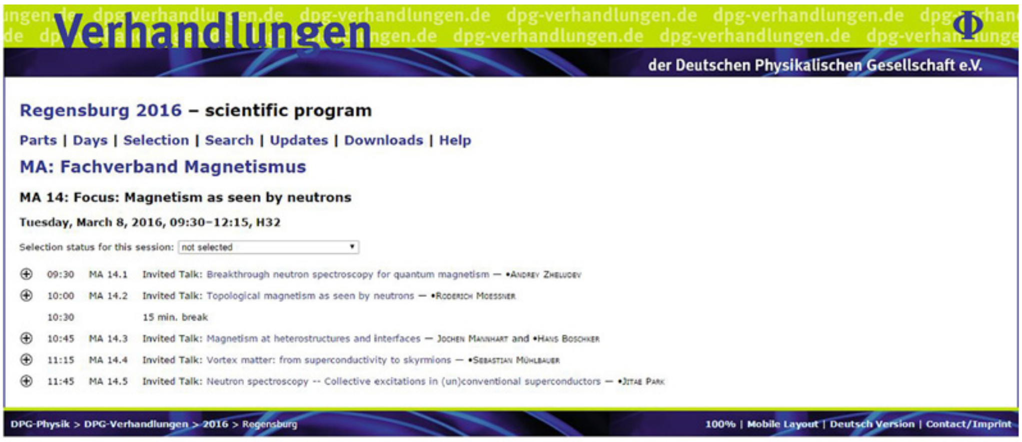
Fox (fox.vincefn.net) is a free, open-source program for the ab initio structure determination of powder diffraction data. FOX was developed by Vincent Favre-Nicolin (v.favrenicolin.free.fr), in collaboration with Radovan Cerny (www.unige.ch/crystal/cerny/rcerny) at the Laboratory of Crystallography in Geneva, Switzerland (www.unige.ch/crystal/lab).

The authors and experts using Fox software were invited to Garching to guide potentially new and well-established users through the rich functionality of Fox. More than 20 participants from MLZ, Chemistry Departments of TUM and LMU, and Helmholtz-Zentrum Geesthacht took part in this intense workshop, where the hands-on tutorial was combined with "hints and tricks" presentations explaining the solution of complex inorganic and molecular structures.

A. Senyshyn (FRM II)

Focussed session at the DPG Annual Spring Meeting

With more than 4000 contributions and several thousand attendees, the annual spring meeting of the condensed matter section (SKM) of the Deutsche Physikalische Gesellschaft (DPG) is always one of the major national and international meetings. The universities at Berlin, Dresden, and Regensburg alternately host it – this year, it was Regensburg's turn. 5027 participants found their way to the UNESCO World Heritage. They came not only from Germany (although they were the majority!), they came from Switzerland and Austria, United Kingdom and USA, Czech Republic and Sweden, the Netherlands and France.... Even two persons from Singapore could be welcomed! This year, 3113 talks were given and 1493 posters presented between March 6th and 11th.


Verhandlungen
der Deutschen Physikalischen Gesellschaft e.V.

Regensburg 2016 – scientific program

Parts | Days | Selection | Search | Updates | Downloads | Help

MA: Fachverband Magnetismus

MA 14: Focus: Magnetism as seen by neutrons

Tuesday, March 8, 2016, 09:30–12:15, H32

Selection status for this session: not selected

09:30	MA 14.1	Invited Talk: Breakthrough neutron spectroscopy for quantum magnetism — •Andrey Zheludev
10:00	MA 14.2	Invited Talk: Topological magnetism as seen by neutrons — •Roderich Moessner
10:30		15 min. break
10:45	MA 14.3	Invited Talk: Magnetism at heterostructures and interfaces — Jochen Mannhart and •Hans Boschker
11:15	MA 14.4	Invited Talk: Vortex matter: from superconductivity to skyrmions — •Sebastian Mühlbauer
11:45	MA 14.5	Invited Talk: Neutron spectroscopy -- Collective excitations in (un)conventional superconductors — •Jitae Park

DPG-Physik > DPG-Verhandlungen > 2016 > Regensburg

100% | Mobile Layout | Deutsch Version | Contact/Imprint

To spread the impact of neutron research to the broader solid state and magnetism community, scientists at MLZ have successfully applied for and organised a special focussed session entitled "Magnetism as seen by Neutrons", comprising a row of five invited overview talks by neutron experts. The speakers tempted the audience by giving ideas about the broadness of the field as well as the diversity of methods and their impact on recent research.

Andrey Zheludev (ETH Zurich) started with an impressive talk about "Breakthrough neutron spectroscopy for quantum magnetism", showing how new phenomena in quantum matter can be explored by time-of-flight single crystal techniques. Roderich Moessner (MPI-PKS Dresden) presented results on topological magnetism, which is not restricted to magnetic monopoles. Hans Boschker and Jochen Mannhart (MPI-FKF Stuttgart) explained that even heterostructures and interfaces are topics of our method. Sebastian Mühlbauer (MLZ) focussed on the properties of vortex matter in superconductors as well as in skyrmions – and its properties related to domains, dynamics and crystallography. The last speaker, Jitae Park (MLZ), gave an overview about the contributions of neutron spectroscopy to the research on (un)conventional superconductivity – one of the examples, where neutrons are vital for the understanding of these fascinating materials.

We are deeply grateful to the speakers for preparing these exciting presentations. And it was worthwhile: The session got a huge resonance with a crowded lecture hall and attentive listeners.

A. Schneidewind (JCNS); R. Georgi, S. Mühlbauer, I. Lommatzsch (FRM II)

By the way, this is what it looks like really early in the morning: Sneaking to the MLZ booth, this time located in the so-called Lichthof, when nobody has arrived there...

The booth was a success as always and we were really delighted by all the young scientists interested in experiments as well as possibilities for theses!

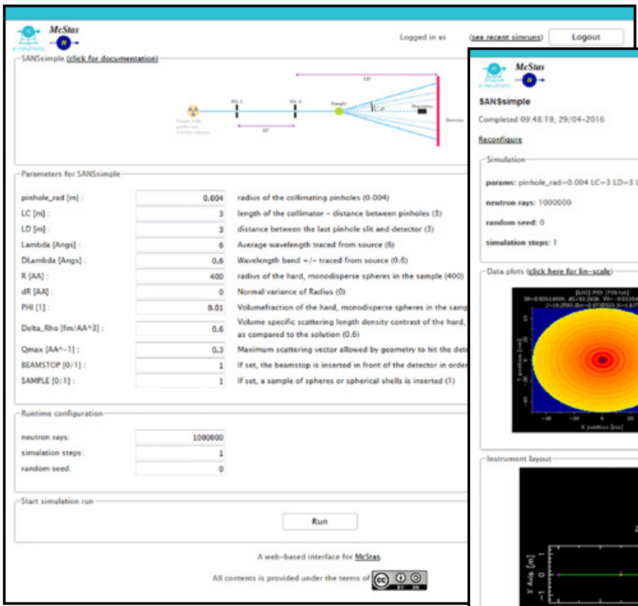
e-neutrons.org – The e-learning platform for neutron scattering

Curious about neutron scattering and searching for a modern way of learning about it? Teaching graduate students and looking for up-to-date material on neutron scattering techniques? Your search has an end!

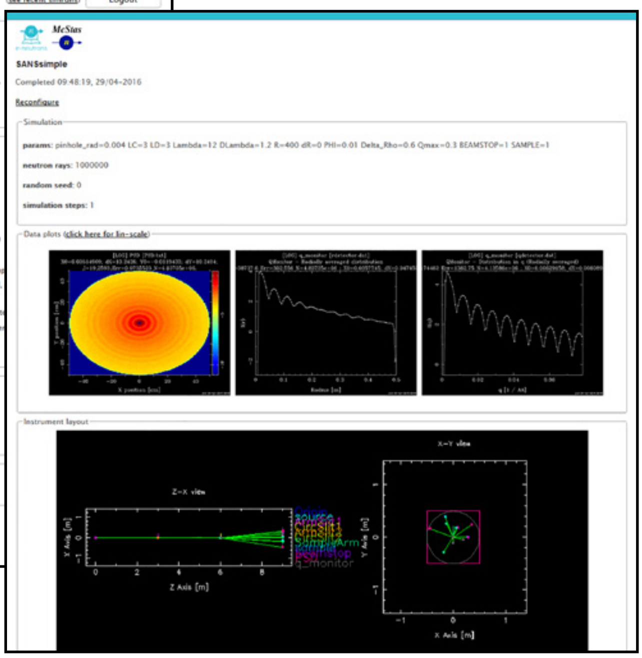
After typing www.e-neutrons.org in your browser's adressbar, the portal welcomes you with some tasters. Checking them directly from the home page gives you a first glimpse on the rich material prepared for your learning efforts. Why not performing a first small angle neutron scattering experiment using the simulation taster of such an instrument or reading about the basic properties of neutrons and testing your knowledge with the quiz taster?

Once registered at the portal, courses provide a well balanced mixture of underlying theory, description of experimental techniques, and hands-on exercises organised in three main parts.

1. Courses based on the **L**earning **M**anagement **S**ystem (LMS) Moodle provide exercises, quizzes and evaluation.
2. The role of textbook-material is played by a "WIKI-book"
3. A web simulator for the McStas neutron instrument simulation program allows performing virtual neutron scattering experiments.



Configuration page for a virtual SANS instrument



Simulation output from the same virtual instrument

Ten learning modules were thoroughly prepared by the interdisciplinary team leading you through a general introduction to neutron scattering and techniques. The modules are organised in two courses differing in learning path restrictions and guidance. Exercises and quizzes enrich these chapters stimulating your learning success. The subjects reach from the basics of the neutron scattering through diffraction from crystalline materials or biological applications of neutron scattering to inelastic magnetic neutron scattering.

Using the online simulator that contains virtual instruments with samples, you can tune pre-defined parameters to obtain synthetic data from Monte-Carlo simulations. The resulting data can be downloaded and analysed like real measured data. In the quiz-lessons connected to some of the instruments you may explore through theory and virtual experiments, how a neutron scattering technique is used to solve a scientific problem.

The portal is intended to be a vivid platform and experts in neutron scattering are invited to contribute with their teaching material or use the material of the platform for their own teaching tasks. Having all this material online makes it possible to continuously renew and update the content. The main funding for the project was provided by the European Union's 7th Framework Programme for research, technological development and demonstration under the NMI3-II Grant number 283883 and from the European Union's Horizon 2020 research and innovation programme under grant agreement No 654000.

P. Link (FRM II)

The MLZ Road Map – Planning our way into future

Our recently formulated Road Map identifies the main scientific drivers for research at MLZ, the present status for the key scientific areas, and the consequential science driven development of instrumentation and services offered to the users. This roadmap provides a perspective for the development of MLZ in the midterm future. It is intended as a “living document”, which will be regularly updated as science progresses and new opportunities emerge.

Neutrons provide unique microscopic information relevant for the understanding of structure – property relationships of materials. They therefore enable knowledge-based materials design with the goal to engineer materials and materials systems with specific functionalities. Neutrons provide essential contributions to solving the Grand Challenges of modern societies e.g. in Energy, Information Technology, Life Science and Health, Nano Science and Engineering, and Earth, Environment and Cultural Heritage.

With its high flux source, the modern neutron guide system, an instrument suite of 26 user instruments and 6 instrument projects underway, the MLZ is ranked among the topmost neutron facilities worldwide. MLZ understands itself as acting in a double role – providing excellent service to the user community and performing cutting-edge in-house research. This is reflected in the functions of the instrument scientists and the Science Groups. As the instrumentation of MLZ needs to be science driven, the instrument scientists connect to the user community anticipating the future trends in their field of expertise and deducing the need for corresponding neutron instrumentation. In addition, in-house research is performed in close cooperation with external groups on international level.

Examples of major scientific challenges identified by the MLZ Science Groups include:

Material Science

Development of new materials requires increasingly in-situ and in-operando studies, including an in-house focus on high strength and lightweight materials. In addition studies on batteries, fuel cells, surface properties with positrons, archeological objects etc. are in the focus of the group.

Soft Matter

Research in soft matter is climbing the stair of complexity towards intelligent systems that react actively to unpredictable stimuli; the in-house focus moves from bulk to surface and interface effects in soft matter systems.

Nuclear-, Particle-, and Astrophysics

The focus lies on precision tests of the standard model of particle physics, e.g. the search for the neutron electric dipole moment EDM or precise determination of the neutron decay parameters to understand the matter-antimatter asymmetry in the universe.

Quantum phenomena

The quest for novel quantum entangled, highly entropic and topological states is in the focus of fundamental studies, while application oriented research aims at improving functionalities of nanomagnetic systems relevant for information technologies.

Structure research

Improving topical complex functional materials requires rapid multiparametric studies as well as the ability to investigate weak phenomena and small sample quantities; owing to the multidisciplinary nature of structure research, in-house studies span all the way from electrochemical energy storage systems to catalytic cycle of enzymes.

The science drivers motivate the development of the facility in terms of instrumentation and service:

Neutron instrumentation

Main focus remains feeding neutrons into the guide hall east and taking into operation the six instruments currently under construction, including the UCN source. Further the development of the powder option at RESI will help to satisfy the high demand for structure analysis. This MLZ instrumentation program pushes neutron optics and detector technologies to the limits and requires corresponding in-house development.

Sample environment

The most urgent requests for new equipment are high magnetic field, highest pressure, combination of external load and high temperature, sample environment for soft matter and where ever possible in-situ and in-operando. While MLZ will continue to provide general purpose equipment, it aims at working closely together with experienced user groups in order to provide the specialized sample environment needed for ever more sophisticated neutron experiments. Among various funding sources available the “BMBF Verbundforschung” is an excellent chance to develop such equipment.

Data treatment and scientific computing

The scientific computing group currently focusses on providing user-friendly data treatment software. Recent examples are programs for the treatment of scattering under grazing incidence (freeware BornAgain) and for the evaluation of event mode data from time-of-flight spectrometers. In the medium term simulations accompanying neutron experiments will be supported. In view of limited resources, MLZ coordinates the necessary development with other neutron centres.

Theory

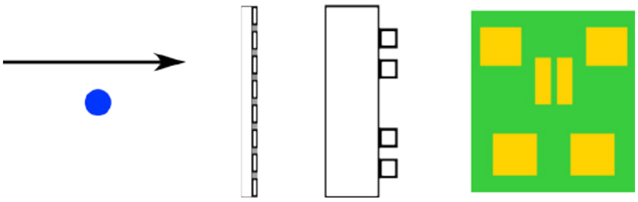
Neutron spectroscopy gives direct access in absolute units to self-, pair-, and spin-correlation functions, which are the fundamental quantities derived by modern ab-initio theories. The simplicity of the neutron cross sections and the fact that they can be measured on an absolute scale allows benchmarking of ab-initio theories and computer modeling with huge impact in many different scientific fields. In this important aspect, neutrons are unrivaled, as no other method can provide such stringent test of microscopic theories. While MLZ does not strive to establish its own theory group, it intends to benefit from its unique constitution and strengthen the links to the theory groups at its partners from Universities and Helmholtz centres.

Service

Already at present, the MLZ offers a range of user laboratories for biology, chemistry, materials sciences, sample preparation and thin films. These capabilities will be significantly extended, when the new science buildings become operational in 2019. A highly sought-after Deuteration Laboratory for the fully or partial deuteration of biological macromolecules, mainly proteins, exceeds the present capabilities of MLZ. However, in the wider Munich region, relevant facilities and know-how exists and an attempt will be made to obtain access through collaboration.

Detector system for snapshots of biological and chemical processes

Neutrons are electrically-neutral building blocks of the nucleus of an atom. They are produced in specialised research facilities, and – with the help of so-called scattering instruments – are directed at the sample to be investigated. The neutrons “bounce off” the samples’ atomic nuclei and may alter their direction and speed in the process. This type of scattering gives information about the positioning and movement of the atoms in the sample that remains hidden to complementary methods such as X-ray or electron microscopy. Detectors transform the scattered neutrons into electronic signals using a multi-step process. This complicated process is necessary, as neutrons are invisible to the human eye and do not carry an electric charge.

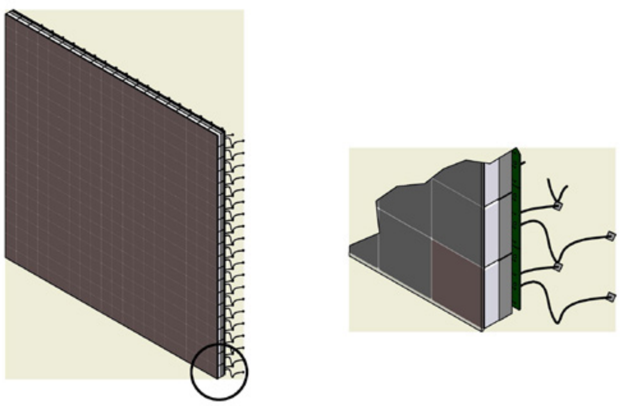


How a scintillation detector works (from left): a neutron (blue dot) produces a flash of light in scintillation material which in turn is transformed into an electrical signal by a photomultiplier. From this, the electronic evaluation unit is then able to produce a data set on the position, number and timing of the incoming neutrons.

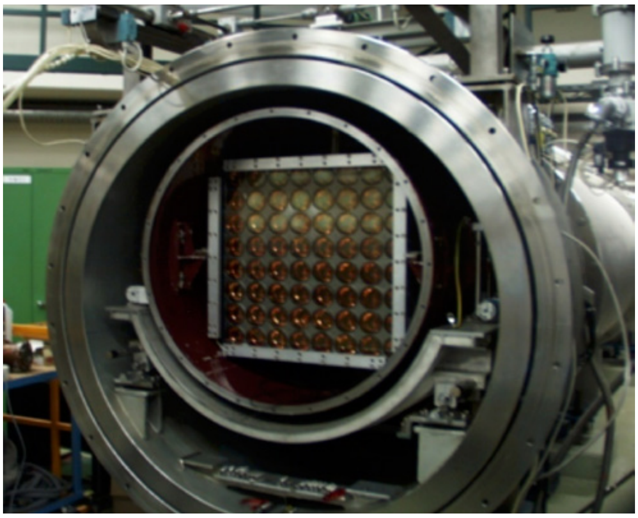
The so-called count rate of detectors – the number of neutrons identified per second – is currently limited to the low single digit MHz range. This places restrictions not just on the performance of experiments at modern neutron sources, but also on an even higher degree at future neutron sources with a high neutron flux. When too many neutrons hit detectors being too weak to cope in rapid succession, measurements are rendered impossible. For this reason, over the next four years researchers and engineers at the Jülich Centre for Neutron Science (JCNS) and the Jülich Central Institute for Engineering, Electronics and Analytics - Electronic Systems (ZEA-2) plan to develop a new detector technology which, along with other advantages, offers a count rate approximately twenty times better. They will work together with partners at the neutron research centres Laboratoire Léon-Brillouin (LLB) in France, the European Spallation Source (ESS) and Lund University in Sweden, along with the Norwegian company Integrated Detector Electronics AS (IDEAS). At the end of January 2015, the European Commission agreed to support this project, which will be coordinated by Forschungszentrum Jülich, with a grant of around four million Euros.

The detectors still contain so-called scintillation material as before, which emits a weak flash of light when a neutron comes into contact with it, hence the project acronym, Solid-State Neutron Detector. At the heart of the new technology are multi-anode photomultipliers (MaPMT), which replace the photomultipliers used up until now. Photomultipliers strengthen the light signal and transform it into an electrical signal. Conventional photomultipliers have a diameter of around 10 cm, but in future, this will be reduced to around 5 mm. In this way, it is possible to accommodate around a hundred times more sensors on each surface, and thus improving the count rate and the resolution of the detectors.

The aim of the project is to develop a prototype whose outstanding performance will later be shown at the European Spallation Source, currently still under construction. From 2019 on, the ESS should be able to produce about 30 times the number of neutrons compared to the output of current facilities. For this reason, the very short neutron flashes are long enough to collect data, which means that smaller sample sizes and more rapid processes can be investigated. Similar to a stroboscopic lamp, it is possible to record snapshots of tiny movements and put these together in a video, to show for example the aggregation of organic molecules or chemical reactions.



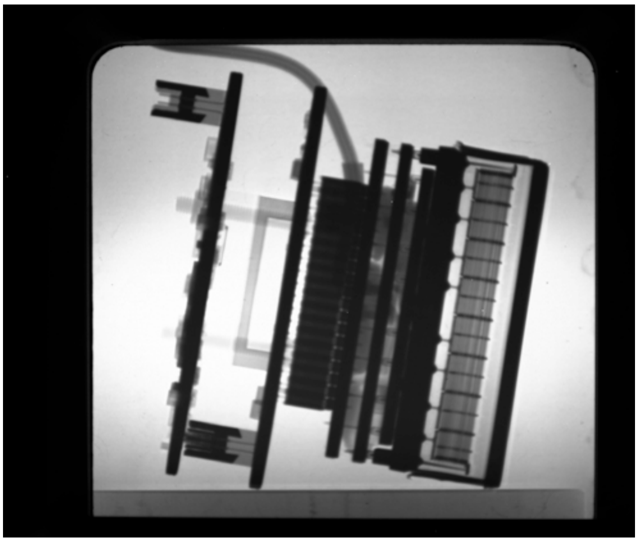
Aim of the SoNDe-Project: a detector made up of single, independent modules, around 5 x 5 cm^2 in size. They pass on measurement information independently regarding the position and timing of the incoming neutrons to a computer for analysis.



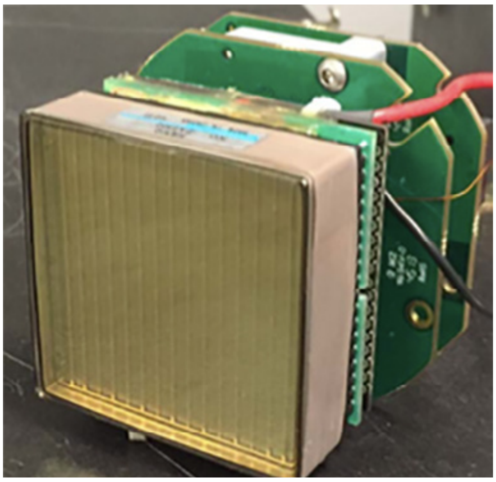
This conventional scintillation detector, around a square meter in size, set inside a neutron scattering instrument, has eight sequences, each with eight photomultipliers.

The detector will be using a modular construction, which has two significant advantages:

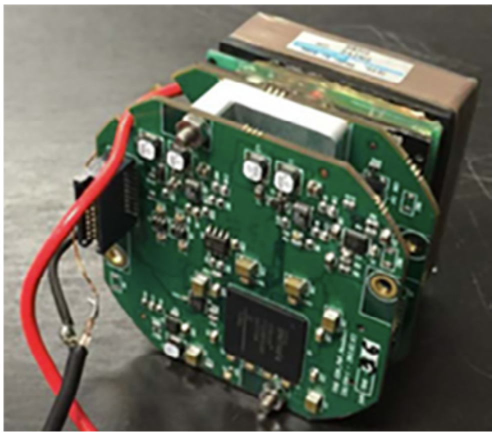
- first, it allows the technology to be easily adjusted to fit the requirements of different experiments, where, depending on the objective, detector surfaces can vary greatly from a few square centimeters to several square metres.
- second, single defective modules can be replaced within a matter of hours whereas repairs to conventional detectors can take up to several months to complete.



Radiography image of assembled system as shown above. The strongly absorbing boron glass in the front is clearly visible, while the metal parts are virtually transparent to the neutrons.



Photograph of back (**left**) and front (**right**) of the assembled 1 x 1 demonstrator. Here the glass sandwich is removed for protective reasons and better visibility. At the left, the ROSMAP system is visible as a stack from behind.



The circuit boards are nearly completely covered by the MaPMT when seen from the front. Further compactification of the board will make this possible and thus achieve the goal of hiding the complete electronics behind the MaPMTs and not creating additional dead space.

A further advantage of this technology is that it can work without the expense of using ^{3}He. This rare gas is both difficult and expensive to obtain, and is used increasingly for other purposes. As scintillation detectors are in principle suitable for use in a wide range of applications, such as imaging methods in medicine and engineering, the project is also keen to explore these avenues.

First results of the SoNDe project are the production of a 1 x 1 technical demonstrator and the respective tests. Using this demonstrator, the feasibility and projected performance of the module can be shown. First test of this demonstrator at the LLB resulted in projected counting rated of up to 250 kHz per module. Additionally a test under high radiation conditions did not reveal any defects after an exposure of $5 \cdot 10^{14}$ n/cm^{-2}s^{-1}. This corresponds to a projected lifetime of the module of ten years!

S. Jaksch (JCNS)

Strong support for research with neutrons by BMBF collaborative research initiative 2016

Tobias Unruh
Chairman of the 10th Komitee Forschung mit Neutronen (KFN)
Tobias.Unruh@fau.de

Komitee Forschung mit Neutronen

Dear friends,

it was a great pleasure for me to notice that the current round for collaborative research projects has been very successful for the neutron community. This time 26 applications are supported by more than 16 M€. Most of the projects will be located at FRM II. But also ILL, ESS, and the development of neutron detectors will strongly profit. So, the neutron community could compete very successfully with the other communities. But we have to state that the rate of accepted applications is especially high for our community. This, on the one hand obviously means that the proposals have been of high quality. On the other hand there is quite some potential for finding new groups and motivating more neutron researchers to engage in neutron instrumentation. We should start with this task already now and prepare to broaden the basis for the expected next proposal round.

The neutron source BER II could not be supported by collaborative research projects in this round due to the decision of HZB not to continue the research with neutrons in Berlin beyond 2020. Nevertheless, the KFN is very happy to see that HZB restarted the operation of BER II after its shutdown in March 2016

Finally, I would like to remind you to register for the upcoming German Neutron Conference 2016 taking place at Christian-Albrechts-University of Kiel from September 20th to 22nd, 2016. The programme committee could set up a very exciting programme of more than 80 talks and nearly 100 poster contributions. This includes three plenary and five keynote talks as well as one public evening lecture. It is a special pleasure that we could accept 36 contributed talks which will fill the main sessions besides more than 40 oral contributions of mini-symposia which will be held in parallel sessions. The full programme can be found at https://www.conftool.net/dn2016/sessions.php.

I am looking forward to seeing you in Kiel!

Newly arrived

Hao Deng

I am a postdoc/ second instrument scientist at POLI and HEiDi, that means that I will support users at both diffractometers. I obtained my PhD at SICCAS (Shanghai Institute of Ceramics, Chinese Academy of Sciences), where I focussed on fabrication and structure study (such as polarised microscopy and X-Ray diffraction) of large-sized piezoelectric single crystals. I'm especially interested in relationship between properties and structure of multiferroic materials.

+49 (0)89 289 54725
hao.deng@frm2.tum.de

Markos Skoulatos

I am based at the MIRA instrument of MLZ, supporting our user community. I have been using this and other neutron instruments at MLZ for my own research: quantum magnetism and orbital physics.
Previously, I have worked on the three axes spectrometers PANDA at MLZ, RITA-II at the Paul Scherrer Insitute, and V2-FLEX at HZB. In the last case, I was responsible for a large instrument upgrade.
I obtained my PhD from the University of Liverpool, in experimental condensed matter physics (magnetic materials investigations).
I am mainly interested in low dimensional magnetism, orbital effects, quantum phase transitions and new forms of matter, like for example spin-liquid and spin-nematic states.

+49 (0)89 289 14668
markos.skoulatos@frm2.tum.de

Christian Stieghorst

I joined the PGAA team as a second instrument scientist. The topic of my PhD at the Institute of Nuclear Chemistry / TRIGA Mainz (JGU Mainz) was the application of Neutron Activation Analysis (NAA). The first part of my work focussed on archeometry: I investigated the origin of ancient Roman limestone objects via INAA and multivariate statistics. In the second part of my work I analysed multicristalline silicon via PGAA with the objective to obtain energy and cost reduction in the manufacturing process of solar cells.
My favourite fields of research? Different neutron activation techniques, archeometry, material analysis of geological samples, and solar cells.

+49 (0)89 289 54871
christian.stieghorst@frm2.tum.de

Marcel Dickmann

During my PhD work at the Universität der Bundeswehr München, I prepared the installation of the Scanning Positron Microscope (SPM) at the positron source NEPOMUC. Now I am one of the instrument scientists and responsible for the NEPOMUC beam. My research interests are located in the fields of charged particle optics and acceleration, as well as positron annihilation lifetime spectroscopy. I'm looking forward to applying positron beam techniques in a wide range of material science.

+49 (0)89 289 11770
marcel.dickmann@frm2.tum.de

Same procedure as last year: Test days for the primary cooling circuit always at carnival

It seems to become a habit: carnival is the test period of choice for the primary cooling circuit! Let's prove it:

Shrove Tuesday 2014

Discussions with external experts on details about the pressure test of the moderator vessel. This unavoidably also affects the primary cooling circuit.

Carnival week 2015

The mayor components of the primary cooling circuit are tested carefully. According to the FRM II license, these tests are focussed on welded seams and flanges in the primary cell. Methods used were ultrasonic (UT), X-ray (RT), and surface tests (PT), followed by integral visual inspection. A robot working on UT tests on one of the primary heat exchangers is shown in fig. 1.

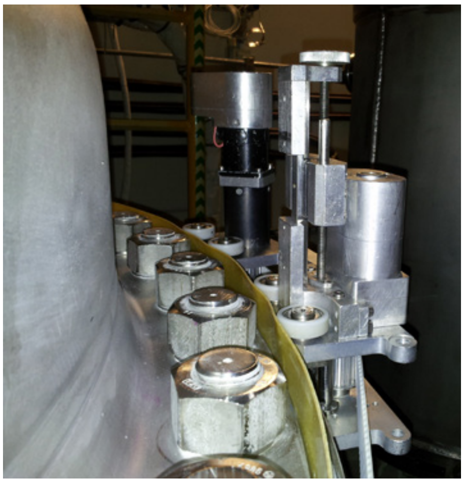


Fig. 1: A robot performing mechanised ultrasonic tests on one of the primary heat exchangers.

2016, once again during carnival

We are busy working on the primary cooling circuit. Meanwhile, I consider the timing a good omen. This time it is the central channel that houses the fuel element and is made of Aluminum (EN AW-5754) – other than most of the primary circuit which is made of Austenitic steel. Together with experts from the Westinghouse company we have arranged a setup for a detailed scan of the central channel wall using UT and Eddy-current testing (ET). Fig. 2 shows the always exciting moment when new equipment is used for the first time. Helping hands are given by N. Wiegner and

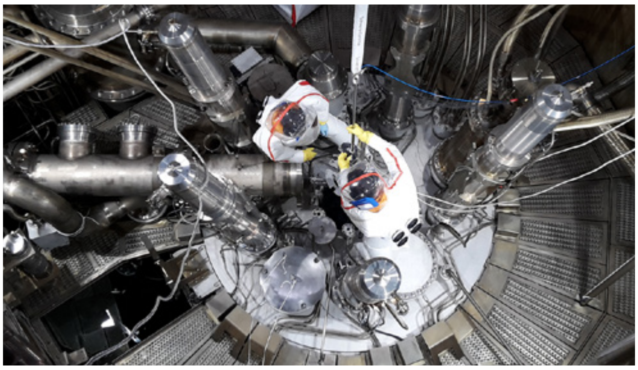


Fig. 2: The combined UT/ ET set up is lowered into the central channel by N. Wiegner (FRM II) and J. Funk (Westinghouse).

J. Funk in the reactor pool, while the crane driver, specialists of the radiation protection department, and experts on the set up are ready to act whenever required (fig. 3).

Fig. 3: J. Molch (FRM II), A. Debnar-Beinssen (Westinghouse), J. Werth, H. Hottmann (both FRM II), H. Bergh (Westinghouse), from left, have a keen eye on the installation in the reactor pool.

After successful installation and calibration of the sensor array, data are finally taken (fig. 4).

Fig. 4: J. Funk, H. Bergh, A. Debnar-Beinssen (all Westinghouse) during data acquisition in the Reactor Hall.

The setup can resolve even the smallest cracks and holes but is mainly designed to map the wall thickness of the central channel. The perfect result: No indication for deviation of the specified state of the central channel could be found!

A. Pichlmaier (FRM II)

From archive to work safety: The reactor development department

The once licensed installation state of the FRM II is subject to a constant change due to maintenance and modification works. Besides the technical implementation, the formal transactions take a significant effort, especially when technical experts and the authority must be involved. In any case, this always results in the need to update all the affected parts of the facility documentation. Directly associated is therefore the constant maintenance of an archive, which must be on paper, so that all necessary information is available at all times. There are roughly 50 modifications per year that have to be processed.

From left to right: A. Galsterer, Ch. Krokowski, P. Jüttner, V. Zill, T. Fliegner, P. Rögner, A. Scharl, M. Offtermatt, R. Schlecht, B. Pollom, Ch. Morgenstern, V. Urban, Ch. Herzog.

In order to implement a modification at the facility usually several professional disciplines are to be involved. In most instances, knowledge in the fields of systems, process, mechanical and civil engineering is required. In addition to internal also external resources must be very often consulted and coordinated. Thus, any modification also includes always more or less large parts of typical project management, requiring additional human resources.

An experienced mechanical workshop with detailed operational knowledge is essential for the diverse requirements in the modifications, services or maintenance work as well as for other operating structures and scientific instruments. Two apprentices for mechatronics are part of the mechanical workshop.

Besides the nuclear regulations the ones of conventional work safety must be respected in all activities. This applies to any person working on-site. The conventional workplace safety at the FRM II is of particular importance because of the nuclear environment. We are allowed to assess the safety of the instrumental equipment for scientific experiments in our own responsibility to a certain degree, i.e. without the involvement of experts and supervisory authority.

According to the operations license the FRM II has continuously to develop in view of the state of science and technology. For this purpose, internal and external operational experiences are evaluated continuously. Within Germany, the exchange of experiences is coordinated by the "**G**esellschaft für Anlagen- und **R**eaktor**s**icherheit" (GRS). They publish any reportable incident, which result in the so-called information notices (WLN). We examine each information notice in view of the relevance for the FRM II and prepare a statement for the supervisory authority and the experts. There are about ten such notices per year. Internationally, the so-called **I**ncident **R**eporting **S**ystem for **R**esearch **R**eactors (IRSRR) guarantees an exchange.

For example the department is currently involved in the manufacturing of the new thimbles for the temperature measurement in the moderator tank that have to be exchanged. The manufacturing is supervised, coordinated and documented, especially with respect to all quality requirements.

According to the mentioned tasks the department "Reactor development" with a total of about 20 employees is subdivided in the four sections "Documentation and modification management", "Instrument and work safety", "Project handling" and "Mechanical workshop".

C. Krokowski (FRM II)

Construction works

Construction work inside the fence is continuing: two new buildings have joined the FRM II site, a large hall for storage and a smaller one for power supply.

The yellow boxes, formerly stocked around the Atomic Egg will soon find a proper home: in the newly constructed light weight hall. It will house the material of the dismantled interior of the Atomic Egg. Also the clearance box to perform radiation measurements on the dismantled material will be integrated into the new hall. The radiation protection qualifies the dismantled material for a full release or for a restricted release. The construction measures 20 x 20 m and costs roughly 700.000 Euros. It is located between the Atomic Egg and the project building. Only the roof and the cladding as well as the access have to be finalised on the exterior, doors and floors in the interior. The light weight hall is planned to be ready in late summer 2016.

A new transformer station for emergency power supply was installed within the area of the FRM II in November 2015 and replaces an older and smaller one outside the fence. It guarantees an independent external supply, if the normal power grid and even the backup grid fails for a longer period of time and the two emergency diesel engines at the FRM II do not work anymore. The extra power supply can keep all systems necessary for monitoring the FRM II active, as well as the PA system used for alarms, automatic fire detection systems, and the safety and escape lighting. For the removal of the residual heat of the fuel element no external power is needed at all, this is guaranteed by a threefold redundancy of battery backuped internal supplies. Hitherto, the emergency transformer station was located outside the FRM II area and had only the possibility to supply one power rail. Now both power rails can be supplied in parallel and there is an additional set of connectors at the transformer station for mobile emergency diesel generators. So the FRM II meanwhile has five different possibilities for supplying the two emergency power rails with electricity.

A. Voit (FRM II)

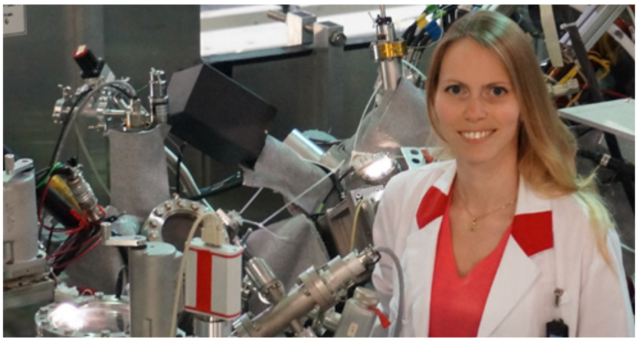
Prizes for PhD theses and discovery of skyrmions

Recently, four scientists working at the MLZ have been awarded prizes for outstanding research: Two PhD students and two professors of the Technical University of Munich (TUM).

Karl Wirtz Prize

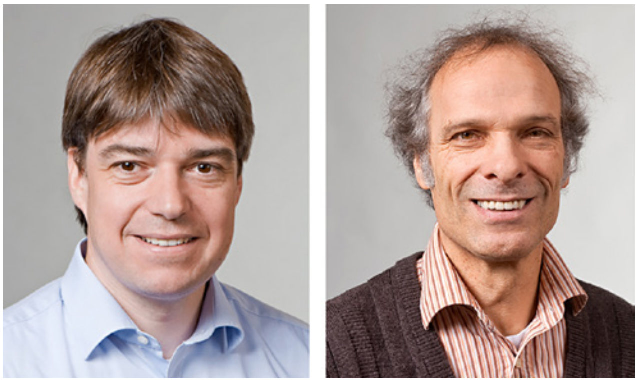
Tanja Huber's doctoral thesis 'Thermal Conductivity of High Density Uranium-Molybdenum Fuels for Research Reactors' convinced the jury of the Karl Wirtz Prize of the German Nuclear Society (KTG). It is awarded biannually "to promote the scientists and engineers in the field of nuclear technology or related disciplines". "*The award is proof of the continued high level of knowledge in Germany and of the competent junior staff in nuclear engineering and related disciplines*", says KTG Chairman Astrid Petersen.
Tanja Huber did her PhD with Winfried Petry in the research group 'High density uranium fuels and nuclear modeling' of the neutron source Heinz Maier-Leibnitz.

Laura Bassi Prize



Samantha Zimnik was granted the Laura Bassi Prize for her outstanding scientific achievements in the field of surface physics at the MLZ positron source NEPOMUC. The physicist has worked on her doctorate in the research group 'Physics with Positrons' of Christoph Hugenschmidt at the TUM Chair for Neutron Scattering (E21) of Peter Böni since 2013. "*Ms. Zimnik always shows outstanding interest in solving sophisticated scientific problems*", says Christoph Hugenschmidt being highly pleased about the award for his PhD student.
With the Laura Bassi prices TUM supports outstanding scientists. The Bavarian State Ministry of Education and Culture, Science and Arts provides the funding.

Europhysics Prize



Experimental physicists Christian Pfleiderer (**left**) and Peter Böni (**right**) from the Physics Department of TUM are awarded the European Physical Society's prestigious Europhysics Prize. The prize is granted for the "discovery of a skyrmion phase in manganese silicon" and shared with three theoretical physicists: Alex Bogdanov, Achim Rosch, and Ashvin Vishwanath.
In 2008, Christian Pfleiderer, Peter Böni, and co-workers had discovered the existence of skyrmions as topological objects with the help of neutron scattering carried out at the instrument MIRA at FRM II.
"*We are very happy about the recognition of our team work and that the topic has attracted so much further research*", says Christian Pfleiderer. Peter Böni is surprised by the award: "*I am particularly happy that our joint efforts are rewarded all of a sudden with this fantastic prize, almost unbelievable.*"
Since 1974 the EPS CMD Europhysics Prize is awarded every two years by the Condensed Matter Division of the European Physical Society for outstanding achievements in condensed matter physics.

C. Kortenbruck, A. Voit (FRM II)

The MLZ Rapid Access Programme: A success story

Since 2013, the MLZ Rapid Access programme allocates up to 5% of its total beam time on selected MLZ instruments, and it is by no means intended to bypass the established peer review evaluation of scientific proposals.

The MLZ Rapid Access proposal submission deadlines are usually about two weeks before each reactor cycle, and the proposal review is very fast. In fact, the MLZ Rapid Access proposals are processed in a few days and the notifications are sent out to the applicants before the reactor cycle starts.

Since its establishment three years before, the MLZ Rapid Access Programme has delivered a number of results, which yield either to a submission of a new regular proposal and/ or to a submission of a manuscript. Let's have a look at typical examples of successful MLZ Rapid Access proposals!

KWS-2

Small angle scattering diffractometer

SANS was used for the characterisation of porosity and microstructure in chemically-bonded ceramics as complementary technique to XRD [1] and of nano-sized Cu-precipitates that influence the material's strength, ductility, and strain-hardening behaviour under tension in Cu-alloyed 18CrNiMo7-6 steels as complementary technique to mechanical testing and optical and transmission electron microscopy [2].

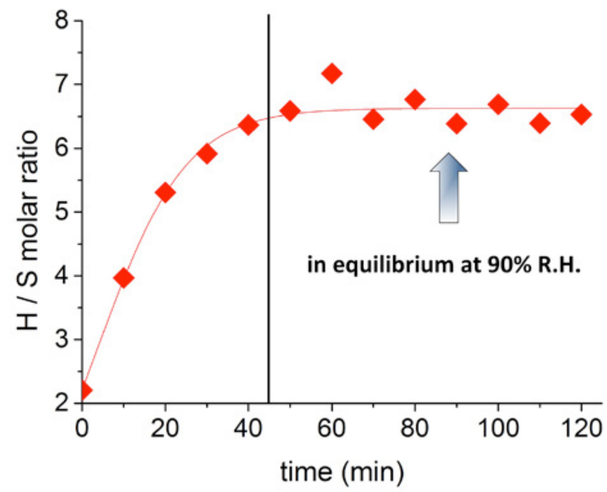
Studies of the squalene based nanoparticles as promising candidates acting as efficient anticancer drugs [3] and of the amyloid templated gold aerogels [4] were successfully completed. Recent results of the investigations of the effects of chelating agents on the iron-binding protein lactoferrin [a] and of the nano-domains in thiolated gold nanoparticles enabled the completion of these studies [b].

PGAA

Prompt gamma activation analysis

The degree of sulfonation in different membranes based on sulfonated syndiotactic polystyrene was determined. Due to the promising results of the feasibility test performed with the Rapid Access proposals, a regular proposal was submitted and accepted, yielding to very successful results. The sulfonation process was monitored using the H/S signal ratio in the prompt gamma spectrum, and compared to the structural changes checked using SANS [c].

Aluminum borates have a very low thermal expansion, high elastic modules and tensile strength. The exact boron content of a series of aluminum borate powders was determined, while the structures were checked with X-ray diffractometry [d].



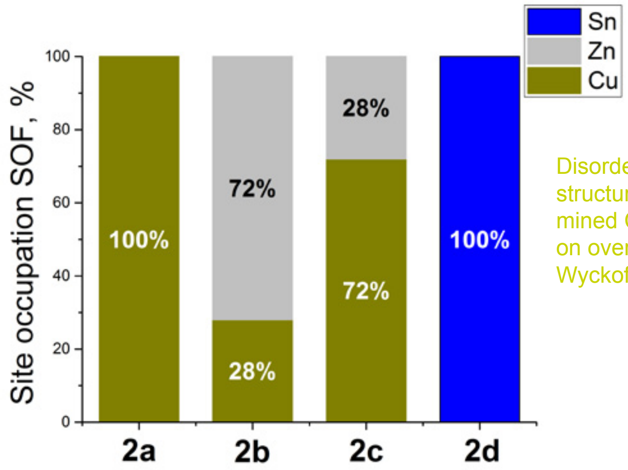
The change of the H-to-S molar ratio in the Nafion mebrane when changing the relative humidity from 5% to 95%.

A dry Nafion membrane was placed in a humidity cell providing 90% relative humidity. The membrane adsorbed water from its environment, while its volume was also expanding. The H/S molar ratio was determined in ten minutes time steps and the saturation of the membrane was observed in about 40 minutes. After this very successful proof of principle, a regular proposal was submitted and accepted [e].

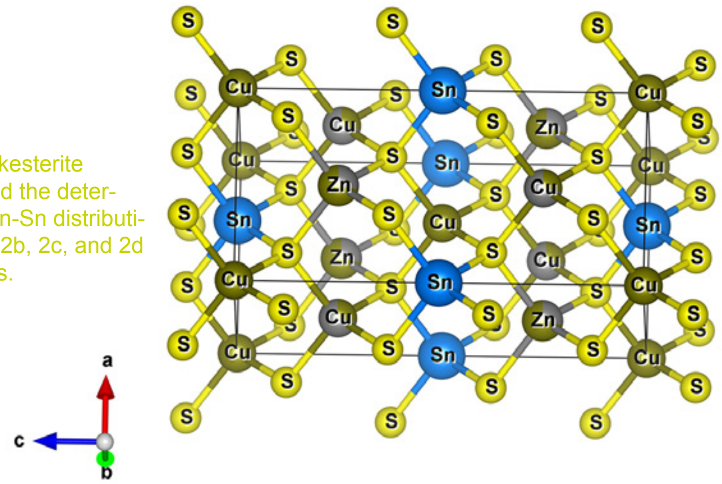
SPODI

High resolution powder diffractometer

The Cu-Zn-Sn distribution over four metal sites in a mechanochemically synthesized Cu_2ZnSnS_4, used as an absorber in solar cell technology, was investigated. Analytic evaluation of high-resolution powder diffraction data revealed a consistent picture with a distribution/mixed occupation of Cu-Zn over two sites, whilst



Disordered kesterite structure and the determined Cu-Zn-Sn distribution over 2a, 2b, 2c, and 2d Wyckof sites.



one atomic site in Cu_2ZnSnS_4 is fully occupied by Cu and one by Sn [5].

Functional alloys of Heusler-type have attracted increasing attention because of their intriguing physical properties, e.g. inverse magnetocaloric effect, exchange bias, Hall, magnetoresistance effect, and, moreover, of the magnetic-field-induced shape memory effect. High-resolution neutron powder diffraction and synchrotron radiation succeeded to determine the crystal structure of modulated martensite in Mn-rich off-stoichiometric $Ni_2Mn_{1.44}In_{0.56}$ alloy in the frame of (3 + 1)-dimensional superspace theory [6].

Semiconducting chalcogenide compounds received much attention because of their broad applications in different fields of science and technology, such as the thermoelectric refrigeration or portable power generation. The crystal structure of new chalcogenide from Li-B-S family - $LiBi_3S_5$ was probed combining high-resolution neutron powder diffraction and NMR measurements. It was found that the $LiBi_3S_5$ ternary sulfide crystallises in a variant of the known $AgBi_3S_5$ type with a highly disordered cation sublattice [7].

F. Carsughi, A. Radulescu (JCNS); Z. Revay, A. Senyshyn (FRM II)

Read more:

[1] A.Viani et al, Mat. Lett. 161 (2015)

[2] M.D.Bambach et al, Steel Research Int. 87 (2016)

[3] D.Saha et al, Soft Matter 11 (2015)

[4] G.Nyström et al, Advanced Materials, 28 (2016)

[5] A.Ritscher et al, J. All. Compd. 670 (2016)

[6] H. Yan et al, Acta Materialia 88 (2015)

[7] S. Nakhal et al, J. Sol. State Chem. 238 (2016)

Posters/ in preparation:

[a] R.V.Erhan et al, manuscript in preparation

[b] Z.Luo et al, manuscript in preparation

[c] M.Schiavone et al, SAS2015, Berlin, Germany; manuscript in preparation

[d] K.Hoffmann et al, 24th Annual Meeting of German Crystallography Society 2016, Stuttgart, Germany

[e] N.Szekely, Soft Matter & Neutrons GO Energy workshop 2015, Feldafing, Germany

Call for Rapid Access Proposals

We are pleased to announce the next call for Rapid Access proposals for the following four instruments

- the large unit cell diffractometer BIODIFF
- the small angle scattering instrument KWS-2
- the analytic facility for prompt-gamma-activation analysis PGAA
- the high resolution powder diffractometer SPODI

Find the next deadline at

mlz-garching.de/user-office

Further information available at

mlz-garching.de/englisch/user-office/getting-beam-time

Upcoming

Neutrons for Energy
July 18 - 21, Bad Reichenhall (Germany)
https://webapps.frm2.tum.de/indico/e/neuforenergy

50 Years of Neutron Backscattering Spectroscopy
Sept. 02 - 03, Garching (Germany)
https://webapps.frm2.tum.de/indico/event/30/

20th JCNS Laboratory Course
Sept. 05 - 16, Jülich + Garching (Germany)
www. neutronlab.de

Deutsche Neutronenstreutagung
Sept. 20 - 22, Kiel (Germany)
https://www.sni-portal.de/dn2016
visit our booth there!

Joint Workshop JCNS and Flipper 2016
Modern Trends in Neutron Scattering from Magnetic Systems – Single-crystal Diffraction with Polarized Neutrons
Oct. 3 - 7, Tutzing (Germany)
http://www.fz-juelich.de/jcns/JCNS-Workshop2016

MATRAC School
Oct. 10 - 14, Freising + Garching (Germany)
http://www.hzg.de/ms/summerschool/

Workshop on SoNDe application in neutron detection
Oct. 17 - 19, Freising (Germany)
http://www.fz-juelich.de/jcns/sondeworkshop

BornAgain School and User Meeting 2016
Nov. 21 - 22, Garching (Germany)
https://webapps.frm2.tum.de/indico/event/34/

Reactor Cycles 2016

No.	Start	Stop
40	18.10.2016	16.12.2016

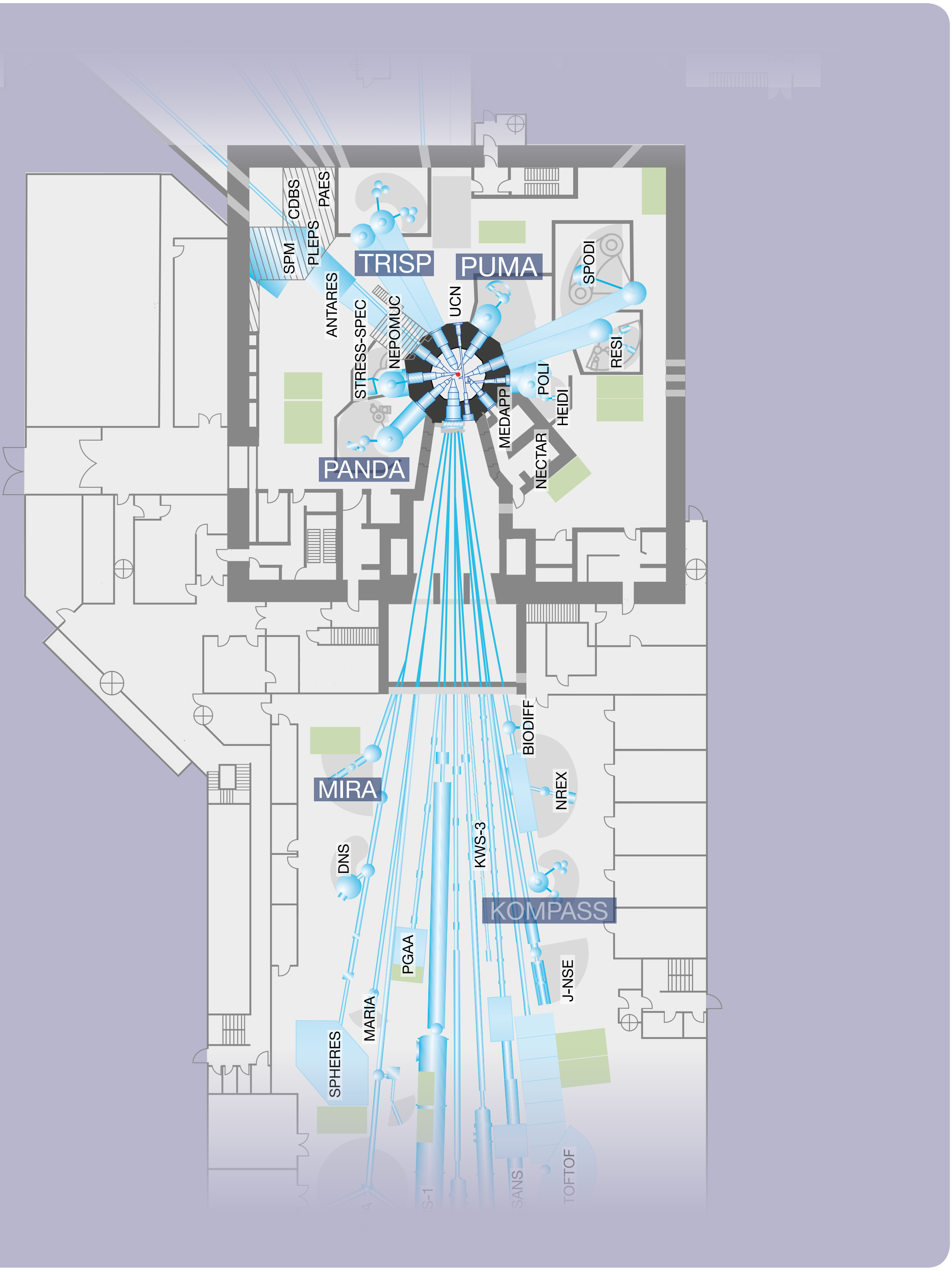
Imprint

Editors
Rainer Bruchhaus
Flavio Carsughi
Connie Hesse
Christine Kortenbruck
Ina Lommatzsch
Jürgen Neuhaus

Layout and Typesetting
Ramona Bucher
Ina Lommatzsch

Contact
Forschungs-Neutronenquelle
Heinz Maier-Leibnitz (FRM II)
User Office
Lichtenbergstraße 1
D-85747 Garching
Phone: +49.(0)89.289.10794
10703
11751
Fax: +49.(0)89.289.10799
e-mail: useroffice@mlz-garching.de
www.mlz-garching.de

Maybe not the best photo from an artist's view, but a really rare one:
The open reactor wall after removing the old beam plug.



CDBS
PAES
SPM
PLEPS
TRISP
PUMA
SPODI
ANTARES
UCN
STRESS-SPEC
NEPOMUC
RESI
POLI
HEIDI
MEDAPP
NECTAR
PANDA
BIODIFF
MIRA
NREX
KWS-3
DNS
KOMPASS
PGAA
J-NSE
MARIA
SPHERES
SANS
TOFTOF