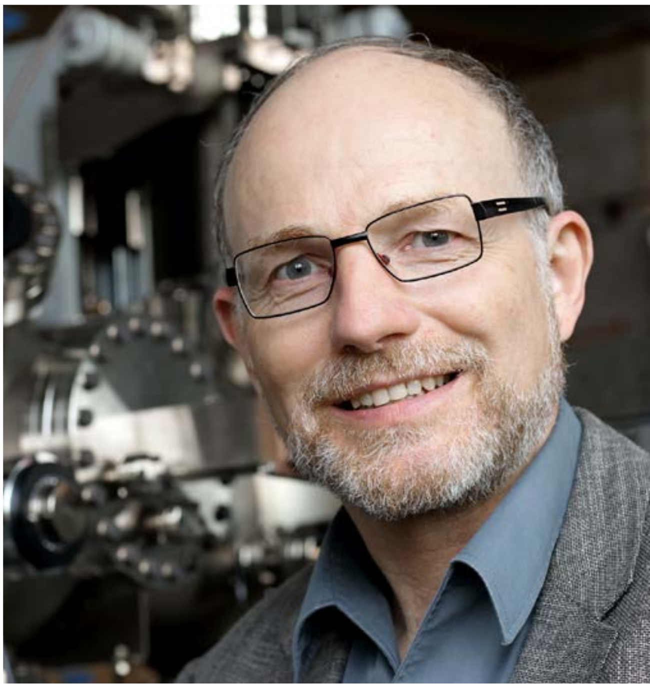
MLZ
Heinz Maier-Leibnitz Zentrum



Newsletter 20

MLZ is a cooperation between:

JÜLICH Forschungszentrum

Helmholtz-Zentrum Geesthacht
Zentrum für Material- und Küstenforschung

Technical University of Munich TUM

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 Science and the Arts and the partners of the cooperation.

Bavarian State Ministry of Science and the Arts

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Hand-over

The MLZ has renewed its management. Since February and April 2018, respectively, we have taken over the position as scientific directors for the JCNS and FRM II partner in the MLZ cooperation. For us, it still needs some time to get familiar with all the details of what has been achieved during the last years.

It goes without saying, that we appreciate the valuable and excellent work of Winfried Petry and Thomas Brückel, our predecessors. Winfried as one of the founding member of the FRM II director's board has guided the development of the instruments and corresponding infrastructure right from the first day. Even after his formal retirement, he stayed in the job until his successor was appointed. We are happy that we can still rely on his expertise whenever it is necessary. Thomas Brückel took over the task as MLZ director from Dieter Richter in January 2015. His distinguished knowledge in neutron instrumentation as well as his research area on magnetic materials have made a significant input to develop the MLZ.

Looking ahead for the nearest future, a major challenge will be the evaluation of the MLZ in autumn this year. This will include a vision for a continuation of the MLZ cooperation for the next ten years, i.e. up to the year 2030. We are happy and thankful for the opportunity to lead this endeavour. The success of this challenge relies on the common effort of all our staff in Garching with strong support from working groups at Jülich and Geesthacht.

An editorial by

Peter Müller-Buschbaum
Scientific Director FRM II
Scientific Director MLZ

Stefan Förster
Scientific Director JCNS
Scientific Director MLZ

Attracting users: Magnets at MLZ

Neutron scattering methods offer unique possibilities to investigate magnetic materials. Results from experiments with neutrons are the basis for achieving microscopic as well as mesoscopic understanding of magnetic properties. A wide range of materials is under investigation, covering besides others spintronic materials, magnetocaloric materials, multiferroic materials, permanent magnets, and molecular magnetic materials. Techniques cover diffraction, small angle neutron scattering, neutron reflectometry techniques and spectroscopy. Recently, experiments using polarized neutrons are gaining more and more importance. The instrument suite at MLZ offers a wide range of opportunities to perform outstanding experiments in the above mentioned fields. The key for the experimental scientist is the availability of high performance magnets offering stable high magnetic fields. Recently at MLZ, a couple of new magnets have been made available for the users covering magnetic fields between 3 T and 12 T. Future plans based on the MLZ magnet roadmap include a feasibility study for a 12 T SANS magnet.

A new vertical 12 T magnet for diffraction and spectroscopy

For diffraction and spectroscopy, a new highly compensated 12 T vertical magnet has been available since the beginning of 2018 (fig. 1). The magnet manufactured by Oxford Instruments is designed as a re-condensing system. The superconducting coils are conventionally cooled in liquid helium, but the evaporating helium is immediately liquefied again by means of a structurally integrated cold head. This construction minimises the losses of helium, reduces the operating costs, and is therefore gentle on the resources.

The magnet is designed for measurements with unpolarized neutrons as well as measurements with polarized neutrons. For the latter application, the coils are operated in the so-called “asymmetric” mode. This special field geometry leads to a minimisation of the depolarization background due to the magnet during the passage of neutrons through the magnet by shifting the zero flux density node position from the beam plane (background). In the symmetric mode the magnet reaches a maximum field of 12 T, in unbalanced mode a maximum field of 11 T is reached. Other important characteristics of the magnet include: Stray magnetic flux density at 1.2 m in the axial and radial directions in both symmetric and asymmetric modes is less than 0.0005 Tesla. The flux density homogeneity over a transverse cylinder of 10 mm diameter x 10 mm long is less than 0.5% in symmetric mode and less than 1,2% in the asymmetric mode, respectively.

Fig. 1: The impressive 12 T magnet for diffraction and spectroscopy

The neutron access in the vertical direction is 35 mm with ±4 mm to a 20 mm high x 20 mm diameter sample volume. The neutron access in the horizontal plane is 330° through aluminum alloy rings.

A minimum clear bore diameter 60 mm is available to give 34 mm diameter clear space within the variable temperature insert. The variable temperature provides sample temperatures from 1.5 K to 300 K. A motorised and remotely controlled sample rod allows sample rotation of 360 ° and manual vertical displacement of ±20 mm. This heavyweight of 850 kg can be used on the instruments MIRA, PANDA, POLI, PUMA, and RESEDA.

A technical detail is worth to be mentioned as it is of great importance for the users and, possibly, for the quality of the experiments. For the first time in a magnet, the coil former was coated directly with the neutron absorber gadolinium to prevent unwanted neutron scattering in the bobbin to minimize the measuring background. This work was carried out at Swiss Neutronics in Switzerland.

A working horse magnet for all SANS instruments: the new 3 T magnet

For the small-angle neutron scattering experiments in magnetic field there is the need for having a working horse system. For its utilisation at all SANS instruments it has to be compact, transportable with a minimum preparation time and be compatible with polarized neutrons and polarization analysis. Such a cryogen-free system has been designed by the Company HTS-110 based in New Zeeland and is available at MLZ since the beginning of 2018. Fig. 2 shows the magnet after delivery and unpacking.

Fig. 2: The brand-new 3 T magnet for the SANS instruments.

Fig. 3: The 3 T SANS magnet on top of the hexapod at KWS-1 (field direction is parallel to the neutron beam). To the left the magnetic cavity for the ^{3}He analyzer is seen.

The design comprises a pair of high-temperature superconducting coils surrounded by a returning yoke with an integrated cryo-cooler. The high-temperature superconducting coils cool down to operating temperature within 18 hours. The magnet produces a horizontal magnetic field of 3 T and has two orthogonal optical accesses so that the magnetic field direction with respect to the neutron beam is either parallel or perpendicular and can be quickly changed by physically rotating the magnet by 90 degrees around its vertical axis. A room-temperature vertical bore of 80 mm is available for an additional sample environment (e.g. a cryostat). The systems is provided with a bipolar power supply which allows the field to be set at any desired level or ramped continuously as required. Ramping to the full field can be done in a less than 5 minutes. Homogeneity of the field is better than 1.5% in a 15 mm diameter sample volume.

For the SANS experiments with polarized neutrons it is important to have no zero-field nodes on the beam path. The magnet is designed to have the zero-field node outside of the yoke and it can be easily crossed with external guiding fields. For polarization analysis, a ^{3}He spin filter has to be placed in the vicinity to the magnet to cover as much of the analysing q-range as possible. The strength of the magnet is its extremely low stray field – at 0.5 m in the axial direction it is less than 0.001 T and at 1 m in both axial and radial directions is less than 0.0001 T. The weight of the magnet with its cryocooler is 345 kg, which allows its utilisation on the KWS-1, KWS-2, KWS-3, SANS-1, and many other instruments. Thanks to its lightweight, the magnet can be positioned on a multi-axes system (or hexapod), which allows rocking curve measurements and grazing incidence SANS (GISANS). As an example for operation fig. 3 shows the magnet mounted to the hexapod sample stage of KWS-1. In the left part of the photo the magnetic cavity for the ^{3}He analyzer is installed. Meanwhile testing and commissioning had been finished and the magnet is ready for routine user operation.

A bumpy way back into user operation: the vertical 5 T magnet

Since summer 2017, the vertical 5 T magnet (fig. 4) is back in user operation. This is an asymmetrically shielded cryo magnet designed together with the company Scientific Magnetics. It is equipped with a variable temperature insert (VTI). Samples can be cooled down to 1.5 K. In the horizontal plane, the blind zone is as small as 30° and in the vertical plane the acceptance angle is ± 5°. This makes the magnet an universal tool to investigate samples under a magnetic field for a variety of neutron instruments. Recently, it has been used at the three axes spectrometer PANDA, the neutron reflectometer MARIA, the diffractometer POLI and the SANS instrument KWS1.

As the magnet was bought in 2011, it has already quite some history – and, this might be revealed – with a happy end. Due to its unreliable operation from the very beginning it was only rarely used. It was suspected that a perfidious cold leak was the reason for the unreliable operation of the magnet. Even after a careful investigation and exchange of suspicious parts at Scientific Magnetics in 2015 this leak came back during an experiment in user operation at MLZ. Upon heating the VTI the insulation vacuum broke down. A second time in the workshop at Scientific Magnetics in the United Kingdom was needed to perform a very careful leak test lasting two full days. This test revealed a tiny leak from the pipe connecting the He dewar with the VTI towards the insulation vacuum. Now, after this combined effort of the engineers on-site and the JCNS sample environment team a successful repair could be performed. Now finally, the 5 T magnet is back at MLZ and in user operation. It is fully compensated for experiments with polarized neutrons and, moreover, does not interfere with other instruments like the very sensitive positron beam facility NEPOMUC.

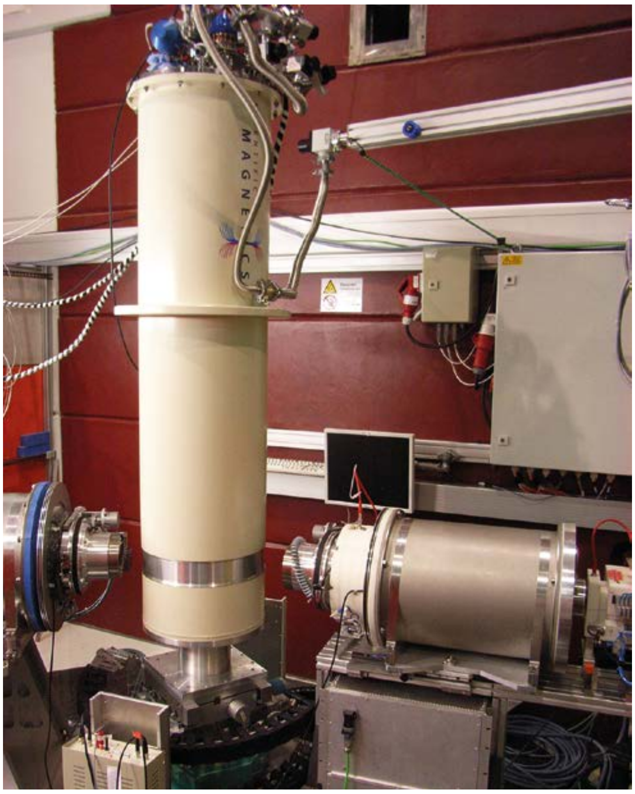


Fig. 4: The 5 T asymmetric shielded magnet has a slender design. With only little more than 40 cm diameter it can be mounted on almost any instrument. Here it can be seen on the diffractometer POLI on the hot neutron source.

Dedicated 8 T for diffraction on advanced magnetic materials

The new 8 T magnet for single crystal and powder diffraction is on-site since January 2018. The main design of this magnet is similar to those of the 12 T magnet described above. It is also fabricated by Oxford Instruments (fig.5). A special particularity is the large vertical access angle of -5/+25° which allows to observe the neutron scattering out of the equatorial plane of the magnet. The magnet has also a larger clearance between the coils in order to use larger powder samples.

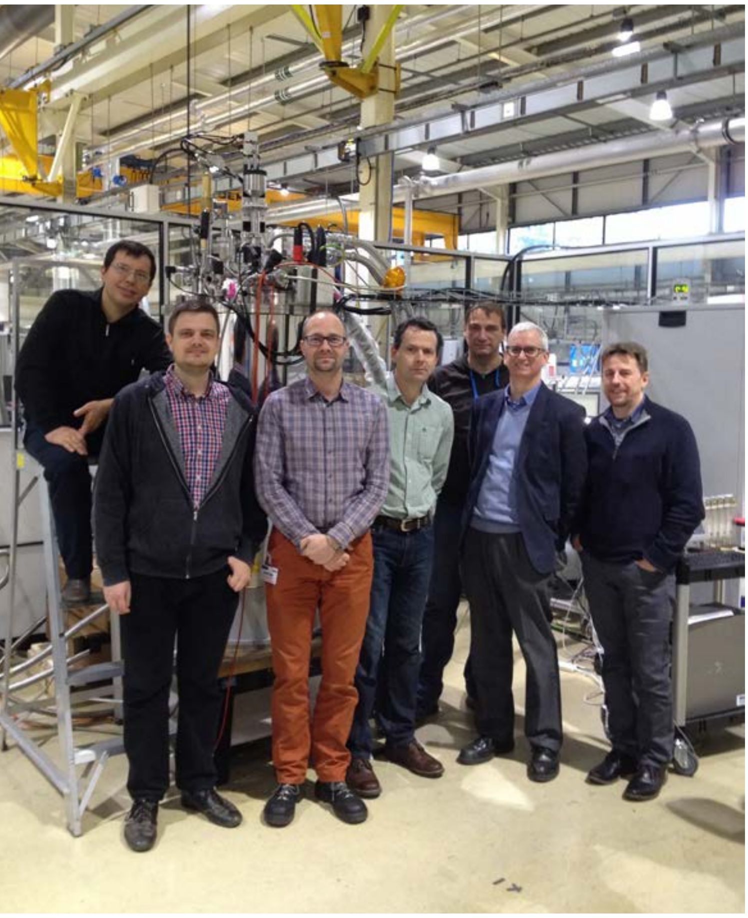


Fig. 5: MLZ representatives together with the Oxford Instruments developer team in front of the new 8 T magnet on the occasion of the factory acceptance test.

By this an optimal illumination of the large detector on the powder diffractometer SPODI is achieved. Vertical neutron access of 53 mm on the sample position is provided. An asymmetric field geometry to avoid neutron depolarization on the zero-flux density node implemented as an option in the 12 T magnet is a standard field configuration for the 8 T magnet, making it especially suitable for single crystal diffraction with polarized neutrons. Meanwhile first experiments using the new magnet for magnetic phase diagramme mapping and single crystal diffraction on the instrument POLI could be successfully performed (fig. 6). Another particularity of this magnet is the extended temperature range on the sample. Using the low temperature sample rod in the VTI, temperatures from 1.5 K up to 400 K can be adjusted. Using dedicated high temperature sample rod temperatures between 30 K and up to 800 K on the sample position are possible. This wide temperature range makes the magnet very attractive for the study of functional materials in the magnetic fields even at and above the room temperature. The dedicated motorised vertical translation stage with a travel length of 49 mm allows the quick and precise adjustment of the sample height in the beam. In addition, this device can also be used for multiple samples at different heights. This trick helps to minimise beamtime and losses of liquid helium and man-power effort for the process of warming and cooling during the sample change. The recondensing cryostat with zero liquid He boil-off in the steady state condition significantly reduces the consumption of liquid helium and the maintenance work for refilling. The magnet has been kept cold now over five months. During this time only one active refilling was necessary resulting in a total liquid He consumption of less than 100 l. An user friendly operation is achieved by the automatic control of many parameters like magnetic field, temperature, liquid helium level etc. by implemented into the MLZ instrument control standard using NICOS.

A. Feoktystov, A. Weber (JCNS)
V. Hutanu (RWTH Aachen)
J. Peters (FRM II)

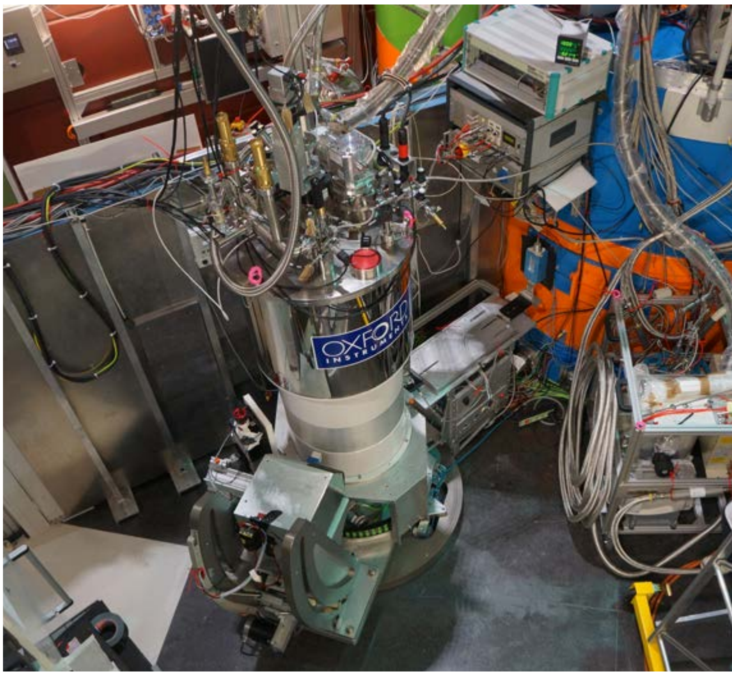
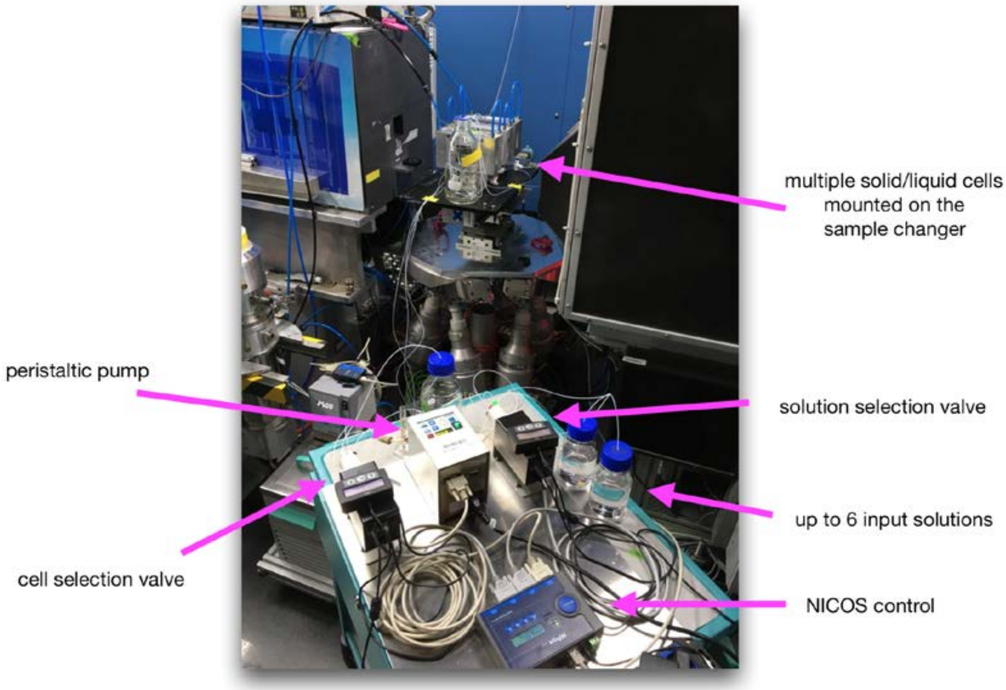


Fig. 6: The 8 T magnet at work during the commissioning phase on the singe crystal diffractometer POLI.

Soft Matter@MARIA reflectometer

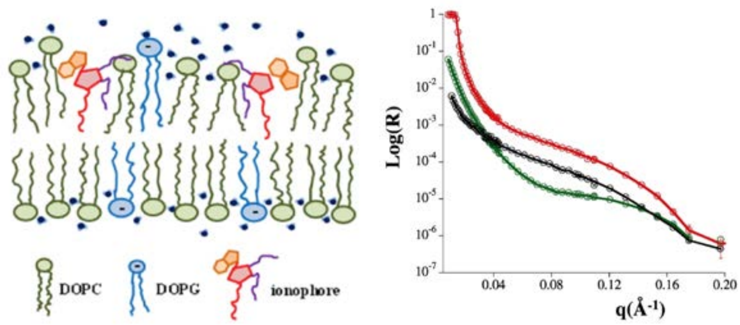


MARIA is the high flux neutron reflectometer of JCNS, having being designed and built primarily to serve the magnetism/ hard matter community interested in the structure of thin films and interfaces. In this respect, several features of the instrument (like beam focussing, electromagnet with integrated cryostat, wide 2-D detector, high flux polarized beam, and ^{3}He analyzer) make it attractive for specular, off-specular and GISANS studies of magnetic thin films.

However, recognising the existence of a large and dynamic user community that uses neutron reflectivity for the investigation of physicochemical phenomena involing soft materials at interfaces, steps have been taken so that MARIA could become attractive for soft matter experiments, thus widening the interdisciplinary character of our internal research and user program.

Since MARIA is a vertical reflectometer, the two use cases for soft matter that can be served are those of measurements at the air/ solid and solid/ liquid interface. Especially the latter case represents a quite frequently encountered experimental set-up in the literature for studying a multitude of systems such as polymer brushes, adsorbed proteins and biomimetic membranes. Related experiments aim to resolve the sub-nanometer structure of these layers at the solid/ liquid interface through fitting reflectivity data. The variation of the contrast of the solvent through hydrogenated/ deuterated solvent exchange in the solid/ liquid cell, provides multiple-contrast reflectivity datasets that largely decrease the ambiguity of the fits and provide robust models of the interfacial structure.

A dedicated sample environment for such applications has been built and offered to users in the past year. It is composed of a sample changer that may accommodate up to four custom solid/ liquid cells that can be thermostated through a connected liquid bath. Injection of solvents can be programmed automatically for up to six different inlets, using a pump/ valve injection “robot” that is connected to the solid/ liquid cells.



The use of this experimental set-up together with the high flux of MARIA has led among other soft matter studies to a series of experiments involving single supported biomimetic membranes on silicon substrates. We present as an example the work of Vitiello et al. *BBA-Biomembranes 1859 (2017) 2392*, where a series of 3-different contrast measurements (see above) allowed the acquisition of an in-depth picture of the effect of ionophores on membrane structure, and particularly the dehydration of lipid headgroups.

A. Koutsioumpas (JCNS)

Neutron Depth Profiling at PGAA

Neutron Depth Profiling (NDP), invented by J.P. Biersack and D. Fink in Berlin in the early 1970's, was tested and installed at several reactors (e.g. FRM at Garching, Řež in the Czech Republic, Dubna in Russia, Gaithersburgh in USA, also in Japan, later in Delft, the Netherlands etc.). In spite of the attractive phenomenon and the straightforward methodology, NDP had limited applications until very recently when the method has suddenly become an indispensable tool in the investigation of lithium-ion batteries, and now more and more instruments appear all over the world again [1].

Charged particles originating from nuclear reactions (α particles, tritons, or protons) are slowed down in condensed matter in 5–50 μm. The energy loss depends on the path length and the density. The charged-particle emission is generated in our case by a cold neutron beam which illuminates the sample uniformly, and so the emission rate depends on the number of the nuclei of interest. Thus, the energy spectrum shows the concentration profile for these nuclides as a function of depth in the sample's surface layers. The most important elements that can be investigated with NDP, are B and Li. Other important nuclides are ^{3}He, ^{14}N, ^{17}O, ^{33}S, ^{35}Cl and ^{40}K [1].

In the frame of a joint project supported by BMBF (No. 05K16WO1), we have installed and tested the NDP instrument at the PGAA facility. During a test run, about a dozen rapid-access and regular beamtime proposals have successfully been performed mainly ealing with the research of lithium-ion batteries [2]. Other projects covered the studies of boron implantation in silicon wafers, boron-containing glasses, ceramics and superalloys, lithium-containing thin films in optical waveguide materials [2], as well as polymer thin films etc.

The ongoing developments involve the automation of the instrument control, new detectors and faster spectrometers to serve the special needs of the improved technique. The high beam flux (up to 6×10^{10} cm^{-2} s^{-1}) will enable us to perform not just depth profiling, but also surface mapping combined with monitoring time dynamics, i.e. the investigation of the change in the active nuclide concentration in 4-D (hence the name: N4DP).

Z. Révay, R. Gilles (FRM II)
R. Gernhäuser, M. Trunk, L. Werner, B. Märkisch (TUM)

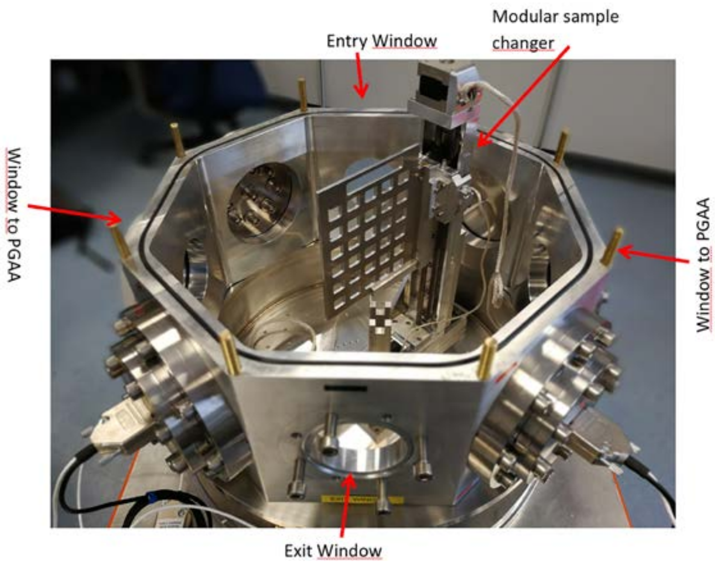
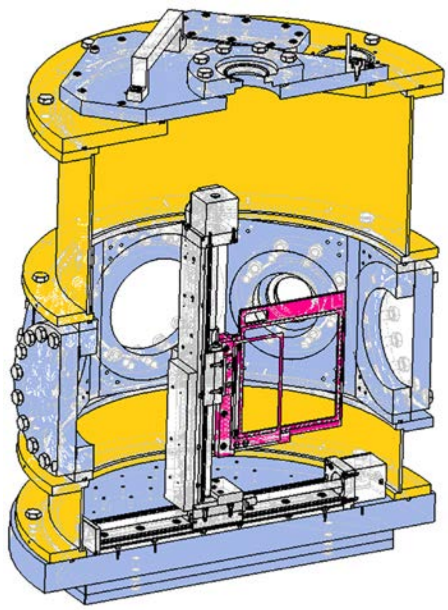


Photo and design study of the new sample chamber.



Read more

[1] https://sites.google.com/site/nistndp/home, a site on NDP maintained by Robert G. Downing, NIST, Gaithersburgh, USA.

[2] M. Trunk, M. Wetjen, L. Werner, R. Gernhäuser, B. Märkisch, Zs. Révay, H.A. Gasteiger, R. Gilles: Materials Science Applications of Neutron Depth Profiling at the PGAA of Heinz Maier-Leibnitz Zentrum, submitted

A new Neutron Depth Profiling spectrometer at JCNS

During the last two years, a new Neutron Depth Profiling (NDP) spectrometer was built and commissioned by JCNS to be used at the focussed neutron beam of the reflectometer MARIA and at the test beamline TREFF at MLZ (see fig. 1). The primary aim of the new spectrometer is to explore the migration of Li-ions in thin-film microbatteries. This project was triggered by the demand from the Institute of Energy and Climate Research (IEK-9) of Forschungszentrum Jülich (P. Notten and R. Eichel). The performance of the new NDP system allows in-operando battery measurements with a sampling rate of less than a minute and a depth resolution down to 10 nm.

The NDP vacuum chamber is made from aluminium and is equipped with 16 vacuum flanges. Four of these flanges are used for neutron beam entrance/exit at different heights and can be used depending on the beam. The remaining ports are used for detectors connection, motorised stages, vacuum pump connection and are reserved for future possible sample environment options. The interior of the vacuum chamber has been constructed to minimise gamma and fast electron background that may appear while an intense neutron beam is assing through the chamber. Extensive studies to reduce the background were carried out recently and resulted in the suppression of an unwanted signal (mainly coming from gamma rays of different energies) by more than two orders of magnitude. The interior of the chamber can be accessed via the top spherical aluminium cap. The desired vacuum conditions of less than 10^{-2} mbar are achieved in less than five minutes. All readout electronics are placed in a standalone rack, thus providing the mobility for moving between different instruments. The

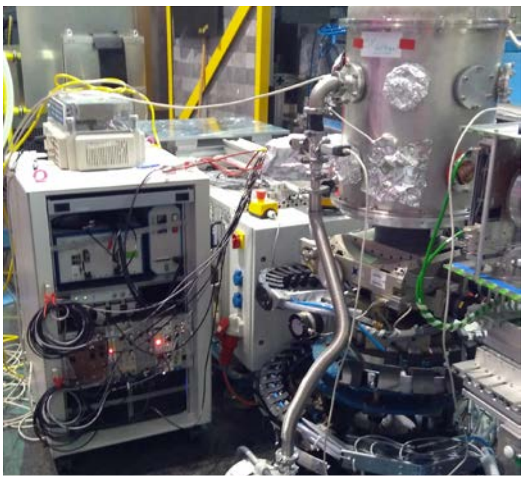


Fig. 1: The NDP spectrometer during measurements at the test beamline TREFF.

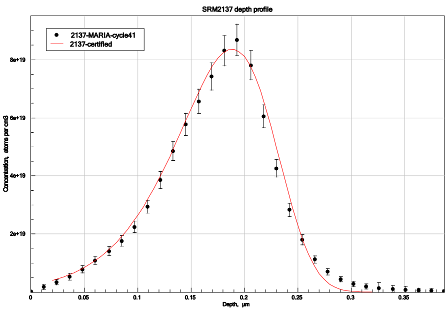


Fig. 2: Deconvoluted NDP spectra of NIST standard reference material 2137 (Boron implanted into silicon wafer) collected at MARIA in roughly 14 h. Solid line: certified values, dots: as measured at MARIA.

readout electronics can accept up to four independent charged particle detectors of different types and sizes, while more channels are planned for the near future. For the experiment one can use either an analogue readout scheme or a fully digital one, depending on the desired flexibility and acceptable energy resolution. Additionally the rack is equipped with an electrochemical station for performing charging and discharging of the battery samples if needed. The NDP spectrometer is fully integrated into the common MLZ instrument control software, NICOS. Therefore, it can easily be operated by a user without going into unwanted details of the spectrometer design.

A good example of the spectrometer performance is shown in fig.2: the deconvoluted spectrum collected from a standard NDP sample SRM 2137. The sample consists of natural boron implanted into a silicon wafer with certified depth profile of the boron distribution in silicon. Such samples are routinely used at NDP facilities around the world for calibration measurements. The results of our measurements are in a good agreement with the certified values. Small deviations on the right shoulder are likely caused, firstly, by the asymmetric response function of any NDP spectrometer and, secondly, by the naturally stronger background contribution in the lower energies region.

Measurements of half-cell thin-film batteries in as-deposited state (provided by IEK-9, Forschungszentrum Jülich) prove that with the current set-up one can achieve NDP sampling rates of less than 10 seconds, while maintaining a reasonable depth resolution. Initial experiments with in-operando studies of full thin-film battery cells are already scheduled for the forthcoming reactor cycles. JCNS is happy to announce its new development to all interested users.

E. Vezhlev, A. Ioffe, S. Mattauch, S. Staringer, H. Kusche, V. Ossovyi, A. Nebel, C. Felder, T. Brückel (JCNS)
J. Vacik, I. Tomandl, V. Hnatowicz (NPI, Řež)

T 1001(plus) — A gas pressure cell for SANS with low background in new light

In 2003, the former IFF of Forschungszentrum Jülich designed and constructed a pressure cell T1001 for the NSE in Jülich. Herbert Feilbach developed a design with sapphire windows, which made the cell pretty unique for gas pressures up to 500 bar. After the move to Garching, we found the pressure cell collecting dust in the MLZ warehouse. The sample environment team renewed the almost historic assembly to be used again, not only in NSE but also in SANS and reflectometry.

The sample space of the gas pressure cell, 4 mm wide and 30 mm in diameter, is accessible for neutrons via sapphire windows. Due to the acceptance angle of more than 20°, the cell can be used as well for other techniques than NSE only. The sealing is done via a sophisticated combination of rubber and teflon gaskets. The temperature can be controlled via water or oil flow through the cell body. As the design of the cell could not be optimised, we left the cell itself untouched. But all the surrounding equipment of the cell was getting a bit long in the tooth. Originally, everything was mounted on a wooden plate and was solely manually controlled. This included the piston for building up the pressure, which was a good substitute for going to the gym, but not for our highly automised standards we are so used to nowadays. We renewed all connections, valves, gauges, and capillaries and put everything on a new frame. But, most importantly, we equipped the set-up with a motorised piston, which can be controlled via NICOS (fig. 1 bottom).

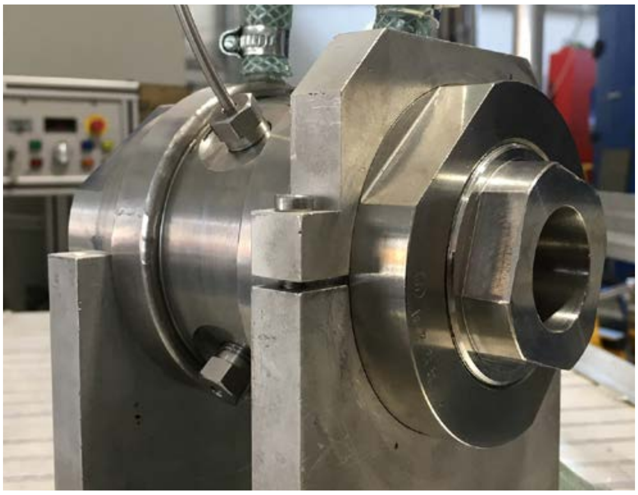


Fig. 1: The T1001pus gas pressure cell with sapphire windows (top).
The new control unit for automised pressure regulation via a motorised pressure piston.This makes the whole unit programmable via NICOS (bottom).

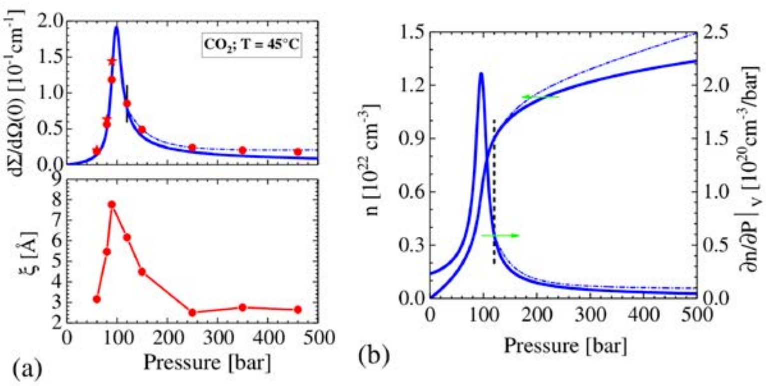


Fig. 2: Susceptibility and correlation length of thermal density fluctuations. (a). The solid line, describing the susceptibility, was evaluated on the basis of the number density n(P) depicted in (b). The maximum in both figures represent the Widom line at 45°C. The dash-dotted lines represent corrections of n (P) above 120 bar on the basis of the SANS data.

With these changes it is now possible, to program a measurement to run automatically at different temperatures and different pressures. Experiments with CH_4, CD_4, CO_2, N_2 have been performed at KWS-3, but mostly it is used for contrast variation. Fig 2 shows the results of a SANS measurement on CO_2 passing the Widom Line (Pipich, Schwahn, PRL 120, 145701 (2018)). Moreover, the pressure cell was asked for by the PSI and we did a reflectometry measurement at AMOR for the exact determination of the surface quality of a thin film by contrast variation due to pressure variation.

A. Weber (JCNS)

Boosting instrument performance with broomstick and wiping cloth

During the general review of the cold neutron guide performance carried out in mid-2017 (we reported in News 19), NL4 attracted our particular attention. The observed integrated neutron flux (Φ_{capt} = 3,0·10^9 n/cm²/s) measured by gold foil activation just before the velocity selector of the instrument SANS-1 was noticeable smaller than the expectation (Φ_{capt} = 7,2·10^9 n/cm²/s) from Monte-Carlo ray tracing simulations of the neutron guide. Also the instrument's logbook revealed a continuous diminution of the white beam monitor rates. Furthermore, the PGAA instrument situated at neutron guide NL4 b reported a reduction of flux, too. These findings were the starting point of our quest.

The neutron guides under suspicion start inside the neutron guide tunnel (see fig. 1) directly after the six fold main shutter of the beam plug SR1 sharing in this first section a common vacuum casing. The following section NL4 a and NL4 b lead separately through the casemate finally reaching the Neutron Guide Hall West and their end positions at the instruments.

Fig. 1: Neutron guide tunnel with the neutron guides inside the vacuum housings. NL1 to NL6 from left to right.

During the long reactor shut-down in late 2017, the neutron guide tunnel became accessible allowing for a visual inspection of the neutron guide inside the vacuum casings. The immediate finding after removing one vacuum casing from the beamline was a sticky dust layer covering all reflecting mirror surfaces of the neutron guides. Tests showed that this layer could be removed by wiping with soft cloth drained with ethanol; samples of the dust layer material were taken. Cleaning then the full length of 14 m for each of the two neutron guides in the tunnel section was the chal-

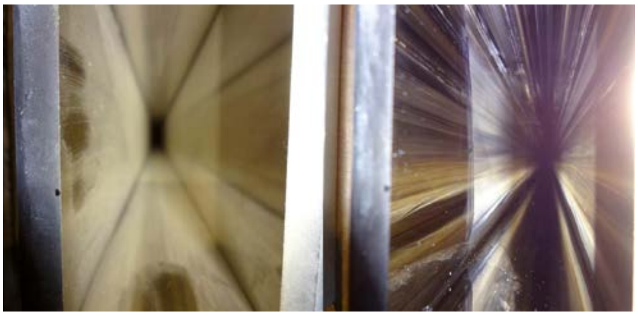


Fig. 2: View into NL4 a neutron guide before (left) and after (right) partially wiping the dust.

lenge mastered using prolongable rods to push the wiping soft blocks. Finally the removed vacuum casing was reinstalled; here the kinematic mount once more demonstrated its usefulness as no realignment of the guide elements was needed.

In January 2018 the flux at NL4a and NL4b was measured again by gold foil activation resulting in a measured flux of Φ_{capt} = 7,0·10^9 n/cm²/s. Fig. 3 shows the great success of the work exemplary demonstrated by the flux data of SANS-1. Both, white beam monitor rate and gold foil activation consistently yield an increase by more than a factor 2. Flux measurements at the NL4 b instrument PGAA are in agreement. Both instruments regained at least the full neutron flux registered upon their initial servicing.

Analysis of the gathered dust samples by PGAA and NAA suggest B_2O_3 loaded PE as origin. Shielding material of this type built into the vacuum casings as halo stopper will therefore be replaced at next occasion.

P. Link (FRM II)

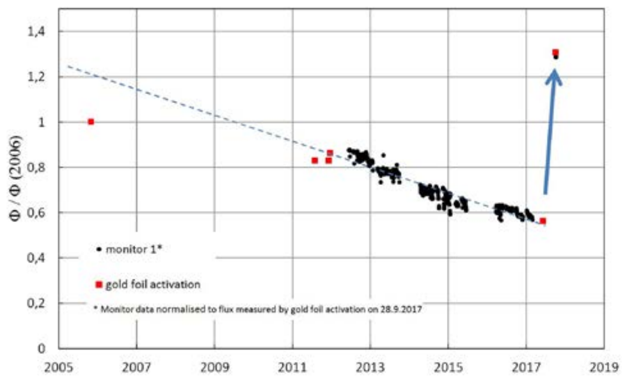


Fig. 3: White beam neutron flux measurements at NL4 a: All data has been normalised to the flux measured during commissioning of NL4 a in 2006. The monitor data has been normalised to gold foil activiation measurements performed 2017. Note the boost for 2018 indicated by the arrow!

Upgrades at RESEDA

Within the BMBF-project (05K16WO6), several upgrades aiming to establish the longitudinal resonance spin echo techniques (MIEZE & NRSE) at RESEDA are in full swing. Therefore RESEDA's main components underwent a serious rebuild in the past three years and is now in a competitive state (see the figure below).

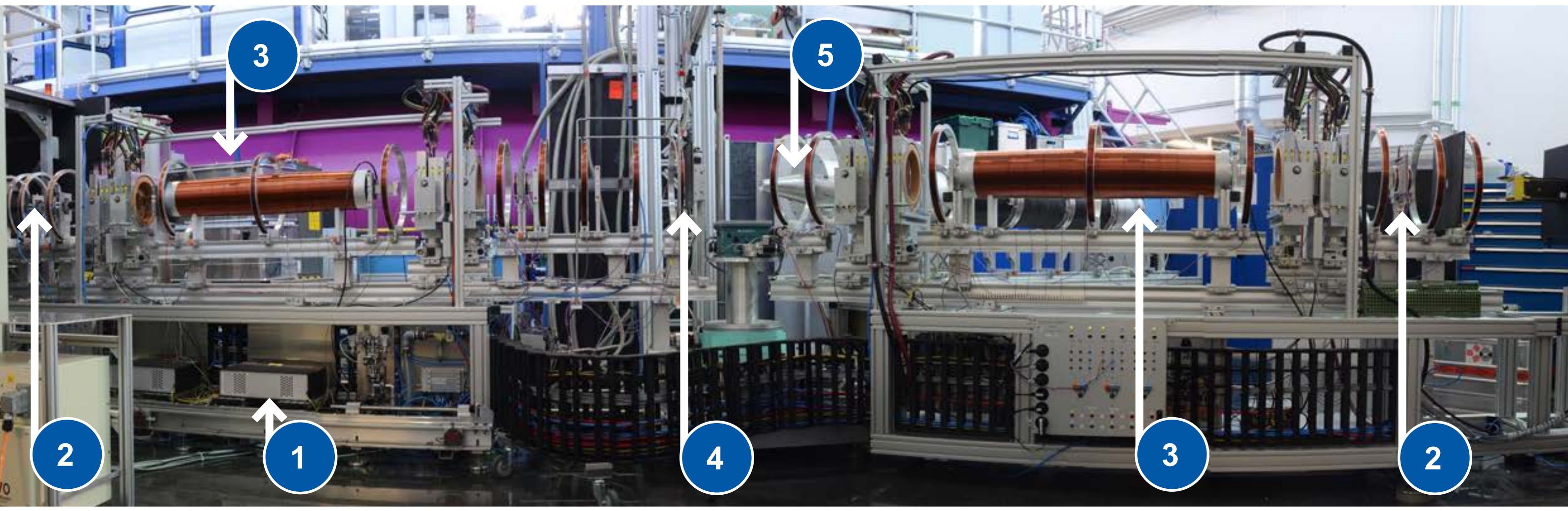
The first steps for a complete overhaul of RESEDA's heart – the resonance circuits - were achieved. Here we could develop, test, and implement novel capacitor cascades (1). In combination with new class-A amplifiers the resulting resonances show very low harmonic distortions (~1000 times lower for the 1st harmonic). An active amplitude control system allows their stable operation up to 1.5 MHz. We are confident that we will push this limit towards 4 MHz providing a field integral of 0.5 Tm with redesigned RF-coils.

A very time consuming but most necessary upgrade was changing the instrument control software from IGOR to NICOS. Especially NICOS's polling option allows for quick bug tracking. In this context, a new detector library was written providing the full implementation of the CASCADE-detectors including complete access to its internal detector electronics. Thereby its efficiency is boosted by 10% when operated at optimal conditions. The following major upgrades were successfully implemented:

- Double polarizing V-cavity with increased polarization (>95%) over a broader wavelength band (4-15 Å) without any noticeable parasitic beam artefacts
- New power supplies provide quick and accurate setting of static fields and flippers
- More robust π/2-flips by omitting zero field flips (MEZEI-configuration) (2)
- Optimisation of NSE-subtraction coils for lowest field inhomogeneity yielded a new design with increased diameter and a cos²-shape achieved with five subcoils. In total 2.66km of wire in 4000 turns were used for both coils (3)
- A pair of non magnetic motorised cross slits for quick and precise incoming beam collimation (4)
- Evacuated ^{58}Ni-coated neutron guides with sapphire windows between the neutron flippers and an elongated Cd-faced flight tube for the MIEZE-set-up suppressing parasitic air scattering (5)
- Short transmission bender to make use of the full wavelength band in MIEZE-configuration
- A complete mechanical rebuild of the spectrometer arms
- Individual high precession power supplies for the Helmholtz-Coils at the RF-flippers to compensate their distinctive inductances (ordered, implementation planed in August 2018)
- In the present state RESEDA's resolution allows measurements up to 50 ns

Finally, we like to express our gratitude to A. Hecht, T. Keller, our students and the MLZ groups Instrument Control, Neutron Optics and Detector Electronics for their indispensable support.

C. Franz, J.K. Jochum, C. Fuchs (FRM II)
O. Soltwedel, P. Böni, C. Pfleiderer (TUM)



May 13th-16th: CREMLIN workshop

Both scientists and engineers in the field of neutron instrumentation met in Peterhof near St. Petersburg or the CREMLIN workshop dedicated to “Engineering for advanced neutron instrumentation and sample environment”.

The Russian PIK Reactor at Petersburg Nuclear Physics Institute (PNPI) Gatchina will become operational and open to the neutron user community towards the end of this decade. In order to define PIK’s specific position within the European neutron landscape and to meet the demands of both European and Russian researchers, the workshop was aiming at developing guidelines for a general instrumentation concept for the PIK reactor and for the supporting structure of sample environment. The workshop was jointly organised by Winfried Petry (MLZ) and Sergey Grigoryev (PNPI)

Forty-five participants from the major neutron sources in Europe and Russia – ILL, Forschungszentrum Jülich, ESS, Helmholtz research centres of Geesthacht (HZG) and Berlin (HZB), the Joint Institute for Nuclear Research (JINR), Dubna, Institute for Nuclear Research (RAS) and from the organising institutes NRC KI-PNPI and FRM II/ MLZ – discussed in a two-days meeting challenges of the implementation of a first instrumentation of the new PIK reactor.

In their welcome and introductory talks, the organisers highlighted the potential of PIK for Europe’s supply with neutrons in the forthcoming decade. In order to cover different methods and approaches, experts in the field of instrumentation and sample environment design presented their views on engineering and design aspects of innovative instrumentation based on recent experience gained at facilities like ISIS, ILL, MLZ or the future ESS. More specifically, the topics included mechanical construction, neutron optics, electronic components, detectors, automatisation, instrument control- and software, and different aspects of sample environment.

In summary, scientific and personal exchange between scientists and engineers from Europe and Russia have been achieved in exemplary fashion not only during the scientific sessions but also during the social

©T. Potapova, PNPI

events, the impressive visit of the Peterhof Palace and the working dinner on Tuesday.

The most important outcome of the workshop might be summarised in the following key points:

- In view of a nowadays extremely automatised and computerised instrumentation, early agreement on standardisation of hard- and software in instrument control is highly advisable. Beginning this with the upgrade of the instruments stemming from the former HZG reactor and already present at the PIK site might be a unique opportunity
- Most of the proposed instruments require cold neutrons, i.e. the installation of the cold source is of primary importance.
- Scientists aim at the best measureable signal. Only the neutrons used at the instrument should be fed to the instrument, and minimisation of background is of equal importance compared to intensity.
- The worldwide Annual Meetings of engineers designing neutron instrumentation ISNIE seems to be an excellent platform for knowledge transfer. Engineers from PIK are warmly welcome.

The participants were enthusiastic about the possibilities of the High Performance Neutron Source PIK, however without neglecting the existing challenges. In this context, the further development of the CREMLIN project seems to be highly desirable.

Last, but not least, many thanks to the perfect organization of the workshop by Elisabeth Jörg-Müller (FRM II) and Anastasia Zayeseva (PNPI).

W. Petry

March 10th-16th: MLZ@DPG

It was the second time that the MLZ had a booth at the DPG Spring Meeting of the Condensed Matter Section at Berlin.

After a quiet place in the side wing three years ago, this time we could be found in the foyer of the first floor. It was a wonderful place – it felt like each participant came across! We got really busy at the booth, informing about the MLZ itself, what to do with neutrons: yes, there are many scientists who had never had used their possibilities so far! We explained how each interested scientist can apply for beam time free of charge and provided all needed information material.

Furthermore, we advertised our next big events: The MLZ conference "Neutrons for Culture and Arts" in June as well as the SNI 2018 in September. We will be happy to see many interlocutors again there!

I. Lommatzsch (FRM II)

April 9th-10th: Rain in April – Meeting of the RICE working group

Rain and cold temperatures expected the 17 participants of the Research Infrastructures Communication and Engagement (RICE) working group at their meeting at the ISIS neutron facility in Harwell, England. Nevertheless, the warm evening welcome at Cosener's House next to the Thames charmed the bad weather away. There was a lot to talk since the first founding meeting of the working group within the

The Science and Technology Facilities Council (STFC) welcomed the RICE members for dinner at a picturesque Thames-side house.

ERF-AISBL (Association of European-level Research Infrastructures) in May 2017: The next workshop on Public Awareness of Research Infrastructures (PARI) in 2019 with up to 200 expected participants has to be planned. After the two successful workshops in Garching in 2015 and 2017, the next one will be held in Harwell organised by ISIS. Discussion in small groups lead to a timetable with suggestions for more hands-on sessions.

Furthermore, Anke Görg (MLZ) presented the drafts for a new webpage of ERF-AISBL.

Another topic was the upcoming "Science in the City Festival" in Toulouse in July 2018 with a 200 m² exhibition from nine of the partnering facilities. The exhibition will show "The Olympic games of neutrons and photons", where visitors can become scientists and explore the service offered by the Research Infrastructures. The experience will be deepened by virtual reality, microscopes, telescopes, hearing the sounds of scientific results and many more attractions.

A. Voit (FRM II)

April 27th-29th: Big facilities for big questions – Edgar Lüscher Seminar

The participants in this year's Edgar Lüscher Seminar at the Gymnasium Zwiesel, Bavarian Forest, got an update of pioneering research work. The scientific heads of the seminar, Winfried Petry and Peter Müller-Buschbaum from the Technical University of Munich (TUM), had invited renowned speakers to give talks to the teachers in the school in Zwiesel.

On-site, the organisation team around the school director Heribert Strunz and the physics teacher Claus Starke proved as excellent hosts of this traditional seminar for approximately 100 teachers from all over Bavaria.

"We want to explore the secrets of nature", said Andreas Kratzer from TUM School of Education in the opening lecture, for the first time offered especially for science interested students from Grafenau, Straubing, Viechtach, and Zwiesel.

Peter Senger from the GSI Helmholtz Centre for Heavy Ion Research in Darmstadt showed, how the accelerator facility under construction, FAIR, will offer unprecedented insight into the structure of matter and development of the universe.

New large research facilities were also featured by Andreas Meyer from the Institute of Materials Science from the German Aerospace Center in Cologne. He explained the scientific benefit of experiments in the weightlessness for the development of terrestrial measuring methods

More interesting details from material research were presented by Stephan Roth from the Royal Institute of

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Technology in Stockholm, Sweden. He showed, how the accelerator PETRA IV at DESY in Hamburg soon could visualise processes inside a catalyst, a battery, or a microchip under realistic conditions.

New, direct insights into physical, chemical and biological processes of our everyday life are expected from the X-ray laser SwissFEL at the Paul Scherrer Institute in Villigen, Switzerland, which is planned to operate in 2019. Project manager Rafael Abela lectured about how his team is trying to determine the detailed structure of vital proteins in order to design new drugs.

Andreas Schreyer, director of the European Spallation Neutron Source under construction in Lund, Sweden reported on the world of neutrons. From 2023 on, the ESS will offer new possibilities in the area of material and bioscience.

Winfried Petry, now retired director of the research neutron source Heinz Maier-Leibnitz and the MLZ, explained how neutrons help to develop better batteries, antibiotics, and computers with more storage capacity as well as ensure the supply of electricity in Bavaria.

One of the highlights was also the talk from Michael Hauschild from the European Organization for Nuclear Research CERN. He had personally witnessed the exploration of the Higgs particle in 2012.

Finally, Christian Fruck from the projects IceCube and MAGIC at Technical University of Munich talked about neutrino and gamma radiation to understand processes in the universe.

T. Kufner (Gymnasium Zwiesel)

Looking for lithium – Projects with industry at the MLZ

Electro mobility and the urgent need for storage of electric energy stimulate research on lithium ion cells. Industry partners are increasingly aware of the unique possibilities, neutrons offer for a non-destructive, in-situ and operando investigation of batteries. We present two examples, where developers from industry and scientists from MLZ cooperated to examine lithium ion cells for hybrid cars and for stationary storage.

Filling lithium-ion cells faster

Developers from the mobility and industrial technology company Bosch and scientists at the Technical University of Munich (TUM) are using neutrons to analyze the filling of lithium ion cells for hybrid cars with electrolytes. Their experiments show that electrodes are wetted twice as fast in a vacuum as under normal pressure.

Fig. 1: H. Reisenweber of Universität Erlangen-Nürnberg while mounting and filling the lithium battery at the instrument ANTARES.

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One of the most critical and time-consuming processes in battery production is the filling of lithium-ion cells with electrolyte fluid following the placement of electrodes in a battery cell. While the actual filling process takes only a few seconds, battery manufacturers often wait several hours to ensure the liquid is fully absorbed into the pores of the electrode stack.

The fact that neutrons are hardly absorbed by the metal battery housing makes them ideal for analyzing batteries. That is why Bosch employees, in collaboration with scientists from the TU Munich and the University of Erlangen-Nuremberg, investigated the filling process at the neutron imaging and tomography facility ANTARES at MLZ.

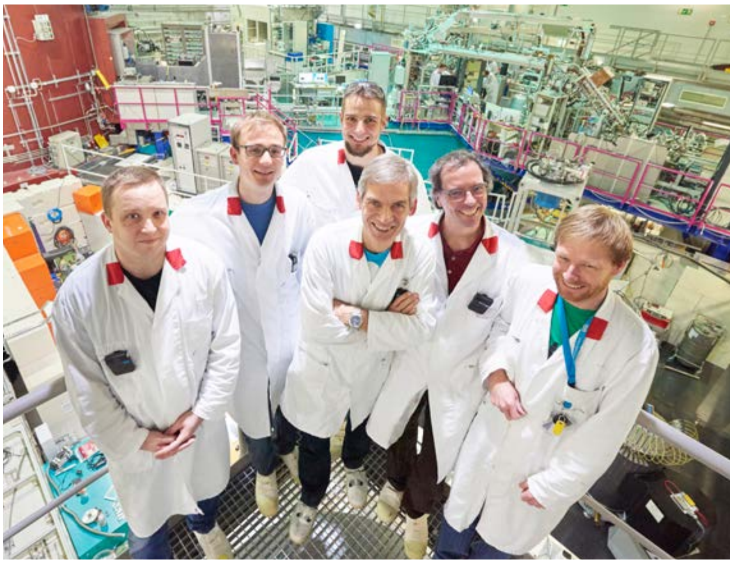

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Fig. 2: The scientists and developers of the project (v.l.): A. Gottschalk (Bosch), T. Knoche (IWB), H. Reisenweber (FAU Erlangen-Nürnberg), R. Gilles (FRM II), W. Weydanz (Bosch), M. Schulz (FRM II).

Manufacturers of lithium-ion cells often fill the empty cells in a vacuum. The process is monitored indirectly using resistance measurements. "T*o make sure that all the pores of the electrodes are filled with the electrolyte, manufacturers build in large safety margins,*" says Bosch developer Wolfgang Weydanz. "*That costs time and money.*" In the light of the neutrons, the scientists recognised that in a vacuum the electrodes were wetted completely in just over 50 minutes. Under normal pressure, this takes around 100 minutes. The liquid spreads evenly in the battery cell from all four sides, from the outside in. In addition, the electrodes absorb ten percent less electrolyte under normal pressure. The culprit is gases that hinder the wetting process, as the scientists were able to demonstrate for the first time using the neutrons.

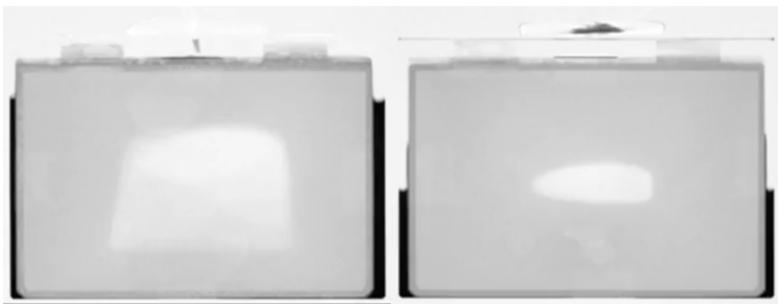


Fig. 3: Filling of a lithium-ion cell under vacuum: The wetting of the electrode (dark area) proceeds evenly from all sides.

Neutrons explain aging in lithium-ion cells used in stationary storage systems

Batteries consisting of lithium iron phosphate (LFP) and graphite are often used for stationary energy storage systems. They have to be cycled more than 5000 times, so they have to last much longer than, for example, cell phone batteries. LFP batteries can be based on different types of cell components, which can have a strong influence on their lifetimes. The main questions for the scientists are: What are the reasons for the loss of storage capacity? What happens inside the lithium-ion cells? Neutrons are ideal probes to solve these questions. They penetrate into the interior of the lithium-ion cells without destruction and provide information about the exact chemistry and structures from the cell interior. Neelima Paul of the Heinz Maier-Leibnitz Zentrum and Johannes Wandt of the Chair of Technical Electrochemistry have for the first time investigated prototype cells for stationary storage systems of the VW-VM research company with neutron diffraction.

The scientists examined two different types of lithium-ion cells: the so-called MCMB based cells contain graphite in the form of highly structured microspheres; the so-called needle coke based cells contain graphite with a platelet-like structure. In order to investigate the aging behaviour, one cell of each type was stored for two years and he other was cycled approximately 5000 times. The researchers then investigated all four lithium-ion cells at the neutron powder diffractometer SPODI at the MLZ with the help of the instrument scientists, Martin Mühlbauer and Oleksandr Dolotko. The MCMB cell showed only a relative loss of capacity of 8% after approximately 5000 cycles, and after the

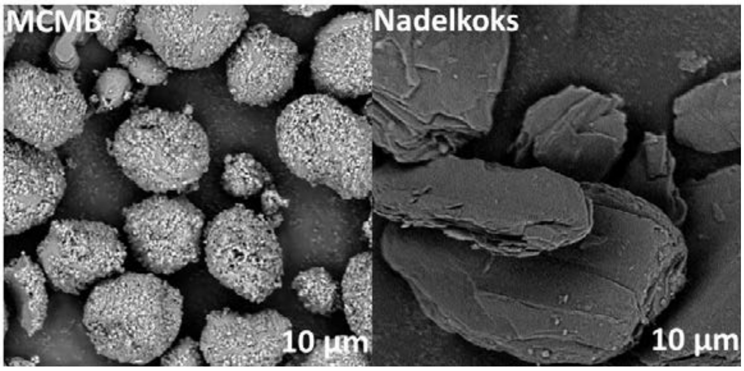


Fig. 5: Scanning Electron Microscopy images of the two anode materials examined: MCMB and needle coke (Nadelkoks).

two-year storage period even a slight capacity gain of 1.5%. On the other hand, the needle coke based cell disappointed with a relative capacity loss of 23% after cyclic aging and 10% less storage capacity after two years of storage. In search for reasons for the loss of capacity, Neelima Paul and her colleagues found that the active lithium ions, which migrate between anode and cathode, are lost. They probably collect themselves in the so-called Solid Electrolyte Interface (SEI) layer, which thereby permanently grows. "*It looks as if the platelet-like morphology and microstructure of the needle coke anode favours accelerated aging of the needle coke based cells,*" says Neelima Paul.

The neutron diffraction measurements of Neelima Paul and Johannes Wandt excluded other causes: for example, that the electrode materials are structurally degraded or the contact between the active electrode materials and the current collector is lost. This is important for VARTA, as Sebastian Schebesta of VW-VM emphasises. "*This is how we know that we are using the right material mix with the MCMB for these batteries and can therefore continue to work with these anodes to make stationary storage batteries.*"

The work was supported by the Bavarian Ministry of Economic Affairs within the framework of the EEBatt project.

R. Gilles (FRM II)

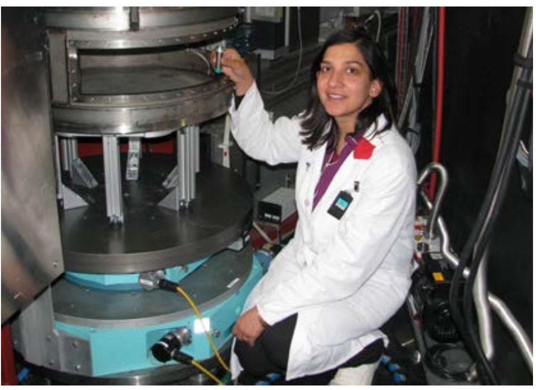


Fig. 4: N. Paul during the measurements at the neutron powder diffractometer SPODI of MLZ.

Read more

[1] W.J. Weydanz, et al.; Journal of Power Sources, Volume 380, 15 March 2018, Pages 126–134 https://doi.org/10.1016/j.jpowsour.2018.01.081

[2] N. Paul et al.; Journal of Power Sources 345 (2017) 85-96, http://dx.doi.org/10.1016/j.jpowsour.2017.01.134

EUSMI: Access to top level Infrastructure – Free of charge

The distributed research infrastructure EUSMI provides the community of soft-matter researchers with an open-access infrastructure to support and extend their research,

Geographical distribution of EUSMI partners.

ESMI is bundling top-level scientific infrastructure of 18 research groups in 15 partner institutions from 10 different countries, among them two industrial partners on three platforms for characterisation, synthesis, and modelling.

The use of EUSMI installations is offered free of charge and financial contribution to related travel and accommodation costs is granted to successful applications from academia and from industry, thanks to financial support from the European Union's Horizon 2020 research and innovation programme.

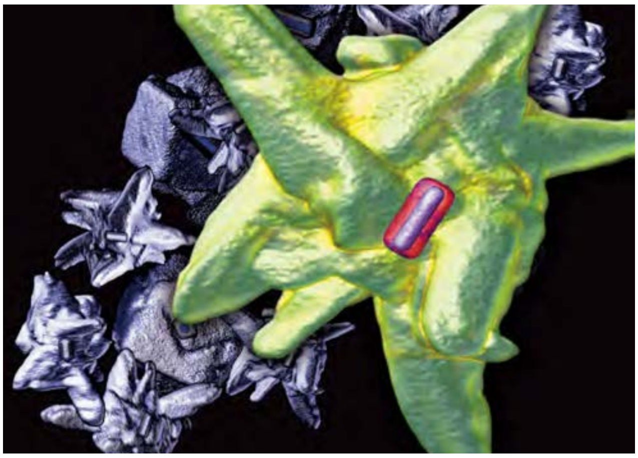
Read more

Further information about the network, detailed descriptions of the installations and the online proposal system are available at www.eusmi-h2020.eu.

Access is offered to infrastructures covering the full chain of functional soft-matter material research, ranging from advanced material characterisation by a full suite of specialised experimental installations, including large-scale facilities, chemical synthesis of a full set of soft-matter materials, up-scaling of laboratory synthesis, to modeling by high-performance supercomputing. In more detail, the offered installations comprise access to

- a neutron scattering facility
- a coherent X-ray beam line
- most advanced electron microscopes
- world leading synthesis laboratories
- Europe's leading labs for NMR and dielectric spectroscopy
- one of the fastest supercomputers in Europe
- about 70 highly specialised instruments for a large variety of experiments

Application for access to the infrastructure offered is possible after registration as a regular user at the EUSMI web portal (www.eusmi-h2020.eu). To guarantee high scientific standard of the proposed research, formally eligible proposals will be evaluated by the scientist in charge of the requested installation and by two members of the EUSMI Review Panel which consists of internationally renowned experts in the field.



3D visualisation of an electron tomography reconstruction of a Ag/Au nanorod encapsulated by a MOF. Sample courtesy: I. Pastoriza-Santos, J. Perez-Juste (University of Vigo).

The existing infrastructure is continuously improved and advanced by Joint Research Activities (JRA), and an ambitious networking programme is ensuring efficient dissemination and communication, as well as continued education of established researchers and training of an emerging generation of scientists.

P. Lang (Forschungszentrum Jülich)

Dear colleagues,

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Astrid Schneidewind

Chair of the 11^{th} KFN
(Komitee Forschung mit Neutronen)

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Komitee Forschung mit Neutronen

while successfully running experiments within the 45^{th} cycle of FRM II operation, the MLZ scientists are asked to prepare information for the upcoming evaluation – the referees will get a written report in September and visit the facility in November to discuss the status and the advancements at MLZ. It is a chance to proof the performance at the individual instruments as well as scientific goals and output, to re-orientate strategically and to prioritise. Therefore, the effort is worth to be invested!

In addition, the unique German funding within in the BMBF framework ErUM-Pro – former "Verbundforschung" – is going to be prepared for a next period. The funding is dedicated to support universities to advance instrumentation at large scale facilities driven by their scientific interest. KFN strongly encourages the university groups to apply with new ideas and to influence the development at the facilities by their needs. Small projects are welcome as well as ideas for new instruments and options, consortia of several university groups would improve the efficiency of neutron instrumentation. KFN representatives are invited by BMBF to impact the call via the PRISMA Strategiegespräch in June.

SNI2018 (Garching, September 16^{th}-19^{th}) will be the perfect place to exchange ideas as well as experiences and to share results with German colleagues. It could also be an opportunity to discuss Verbundforschung/ Prisma projects between possible partners – from universities and facilities, but also between neutron, synchrotron, and accelerator communities.

At European level, the ILL-ESS user meeting will bring together neutron users to prepare for the upcoming huge changes in the European neutron landscape and the use of neutron scattering methods. German users should join these activities to be an active partner in shaping the future of neutrons' use in Europe.

Employing the impetuous technical developments is another aspect to increase efficiency and to counterbalance the loss of beamtime in near future. Not only request and support from BMBF by ErUM-Data should activate initiatives – we need to open our mind, embrace the prospects, and treat the risks, in a steady continuous process!

From Argentinia to Garching

Six Argentinian engineers and scientists are working at the MLZ in order to gather experience for the new research reactor in Argentinia RA-10 (www.lahn.cnea.gov.ar), planned to be operational in 2021.

PhD student **Diana Garcés**: *"I'm a physicist currently doing a PhD in hydrogen fuel cells at the Comisión Nacional de Energía Atómica (CNEA, Argentina). At the MLZ, I am training as instrument scientist at SPODI."*

Engineer **Andrés Glücksberg**: *„In Argentinia, I am responsible for the mechanical design of a diffractometer that will be installed in the future RA-10 research reactor. In Garching, I'm in the ultra cold neutron project. I participated in the design of an apparatus for preparing isotopically pure ^{4}He."*

Engineer **Gabriel Juarez**: *„I'm working at the instrument STRESS-SPEC with Michael Hofmann. I will be the instrument scientist of the Argentine diffractometer ANDES (Advanced Non-Destructive Evaluation of Stress)."*

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From left: M. Suarez, L. Romero, S. Bazzana, D. Garcés, A. Glücksberg, G. Juarez.

Manuel Suarez: *„During the last nine months, I was working in the Sample Environment Group under the direction of Jürgen Peters. The main task was to be trained in sample environment systems to be able to apply this knowledge in the future Argentine Neutron Scattering Laboratory."*

Engineers **Luis Romero** and **Santiago Bazzana**: *„We are working in the same group at CNEA-Argentina providing technical support to the research reactors and shielding design for RA-10 facilities. At the MLZ, we are in the Neutron Imaging Group, doing dose rate calculations for the new collimator for MEDAPP and some neutron transport and deposition energy calculations for NECTAR."*

A. Voit (FRM II)

A plastic bag full of samples – Humboldt Fellow Rajeev Ranjan

A plastic bag was the visible remainder from the first ten years of collaboration with Rajeev Ranjan. An enormous plastic bag full of samples. Samples, which the Indian material scientists had sent along with proposals from Bangalore to the MLZ in Garching after his first Humboldt fellowship visit in 2005/2006. Anatoliy Senyshyn meticulously measured them all at the powder diffractometer SPODI. The outcome: 35 common publications.

Now, Rajeev Ranjan from the Indian Institute of Science is back in Garching for a renewed research stay during hree months sponsored again by the Humboldt Foundation. His host is Anatoliy Senyshyn. Both of them are eager to use the time together for two proposals and some pilot-experiments. Their focus is on multiferroic and piezoelectric materials. And they want to perform neutron diffraction experiments in-situ with electric and magnetic fields.

"*We have a spontaneous and smooth collaboration*", says Rajeev Ranjan about his relationship to the MLZ instrument scientist Senyshyn and adds: "*I always get good data, SPODI has the best resolution and intensity in neutron powder diffraction worldwide.*" And Anatoliy Senyshyn says: "*Rajeev Ranjan was one of the first users at SPODI with the first paper published on SPODI data in 2006.*" He will always remember the huge plastic bag with samples.

A. Voit (FRM II)

Silicon doping at the FRM II – it's a crafts(wo)menship

"God definitely had a very good day when he designed silicon". That way Heiko Gerstenberg sums up the special characteristics of the element that is being doped at the FRM II for more than ten years. The physicist is in charge of the department Irradiation and Sources and explains the mechanism behind the doping process: *"The neutron activation of silicon leads to only one instable radioactive isotope that decays into stable ^{31}P with a half-time of only 2.62 hours. As phosphorus contains one electron more than silicon it acts as a donor within the Si-crystal and improves its electric conductivity."* The focussed introduction of impurities into pure materials is called doping and at the FRM II it is achieved by neutron irradiation.

Four hands are better than two: Operator J. Molch (l.) and safety engineer J.-M. Favoli (r.) lift a silicon crystal into the loading basket.

Five operators work in two shifts at the silicon doping system. Thereby a lot of muscle power and precise manual work is required, since the cylindrical Si-crystals with diameters of 125, 150 or 200 mm weigh up to 20 kilos. Always up to three crystals are carefully stacked into a loading basket and are being let down into the heavy water tank. Only there the operator rearranges the cylinders by crane into the actual irradiation basket that is placed in the heavy water moderator tank close to the neutron source. As there exists only one singless irradiation position and the irradiation times of the crystals differ widely from less than 30 minutes up to more than eight hours, the doping order has to be well organised. As system supervisor it is Heike Schulz, who is responsible for the smooth run. As most of her colleagues, she started as a lateral entrant at the FRM II, as one of the first and only female operators. Since six years she is now responsible for

Workplace at the cooling pond: Operator J. Molch rearranges the Si-crystals into the irradiation baskets.

the administration, client contacts and organisational issues. *"Currently there is a high demand for doped silicon and our system is used to capacity"*, Heike Schulz tells. Depending on the dopant concentration required by the customers up to 10 t of doped silicon are expected for 2018.

The clients are major semiconductor producers from Europe and Asia using the FRM II Si doping service regularly since many years. "*Our silicon is not used for computers or smartphones. We serve a niche market concentrating on high performance applications, for example for hybrid vehicles, railways or high-voltage direct-current cables*", Dr. Gerstenberg notices. There exist other chemical doping procedures, but the neutron method holds some specific benefits. *"Common manufacturers normally do not have any interest to transport their silicon halfway around the world to such unique institutions like the FRM II"*, the physicist states. *"But alternative procedures do not yet achieve the same quality manifested by the targeted accuracy and homogeneity of the specific resistance."*

T. Kiechle (FRM II)

Everything under control: System supervisor H. Schulz explains that each crystal is checked before and after irradiation.

Newly arrived

Gaetano Mangiapia

As a former post-doc at the KWS-1, I recently joined the REFSANS team where I will upgrade and optimise the equipment for the sample environment and will take care of the users with their reflectivity/ GISANS experiments.

My research will be focussed on the study of the processes that occur at the electrode-solution interface during the electrodeposition of metals.

I am also interested in the study of biological systems, with particular regard to surface interactions.

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Thomas Müller

I am the second instrument scientist at the diffuse scattering neutron time of flight spectrometer DNS.

Before that I studied physics at RWTH Aachen and conducted my PhD research in Jülich at JCNS, where I have done a lot of single crystal growth, X-ray and neutron diffraction on multifunctional oxides, especially rare earth ferrites.

My main scientific interest is magnetism combined with novel mechanisms for magnetoelectric multiferroics.

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Johanna Jochum

I am a new instrument scientist at the resonance spin echo spectrometer RESEDA.

Coming originally from Austria, I had studied at the ETH Zürich before I did my PhD at the KU Leuven in Belgium.

My favourite topics are nanoscale magnetism and superconductivity as well as multiferroic nanostructures.

johanna.jochum@frm2.tum.de

Newly arrived

Daria Noferini

I am the new second instrument scientist at the backscattering spectrometer SPHERES.

I did my PhD at ILL with Chalmers University of Technology on proton dynamics in materials for next-generation solid oxide fuel cells.

I am especially interested in dynamical properties of materials, in particular with application in the fields of sustainable energy and cultural heritage conservation as well as liquid in confinement and neutron scattering instrumentation in general!

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Igor Radelytskyi

I am the new second instrument scientist at the cold three axes spectrometer PANDA.

I finished my PhD at the Institute of Physics of the Polish Academy of Science in Warsaw. Mainly I worked with magnetic and magnetocaloric properties investigations of specific single crystals materials. Furthermore, I produced single crystals by Bridgman and floating zone techniques.

I am interested in continuing my work with the energy-saving materials. Also, I am open to new interesting themes, especially for the neutron scattering investigations.

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Baohu Wu

I am a new instrument scientist at KWS-3. I will be mainly responsible for the users' VSANS experiments at this very small angle scattering diffractometer, its maintenance and upgrade.

I got my PhD at University Konstanz and JCNS-MLZ in 2016. After that I held a short time postdoc position at the JCNS on bioinspired materials.

My research interest is focussed on biological/ bioinspired materials – thus, small angle neutron scattering is one of the most important methods for my research.

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The User Committee at MLZ

In 2017, the management of the MLZ established a User Committee to provide better communication between the Directorate and the user community. This recognises that many valuable ideas come forward as a result of users' experience. The committee also provides a means to resolve any difficulties that may arise in connection with a user's experiment. It has direct access to the directors. Importantly, specific problems can be handled entirely confidentially. It is recognised that this can be very valuable in maintaining good relations between users, staff and management.

The committee was first elected in late 2017. To ensure that there is a broad range of expertise and representation from across the user community, Diana Quintero Castro was co-opted to join the committee. Recognising the importance of close contact with the German user community, a repre***sentative of KFN, Rainer Niewa from Stuttgart, will also be invited to future meetings as an observer. The list of members is shown at the right. A meeting with the new Scientific directors was held in early May 2018.

The role of the committee includes bringing forward new strategic ideas to the MLZ directorate; it has the ultimate goal to improve MLZ user satisfaction. To fulfil this overall aim, the committee seeks the broadest possible range of input from users. Any suggestions that might affect the successful outcome of proposed research can be considered. These could, for example, concern handling of proposals, planning experiments, development and use of instruments, the support laboratories, the control and analysis software, as well as technical support. The committee is independent of the MLZ staff and management. It has regular meetings and brings ideas raised to the attention of the MLZ Directorate. Any of the committee members can be contacted You can meet members at various conferences and workshops, while they are performing experiments at MLZ, or reach them by e-mail. – your input is welcome!

A. Rennie (University of Uppsala)

User Committee members

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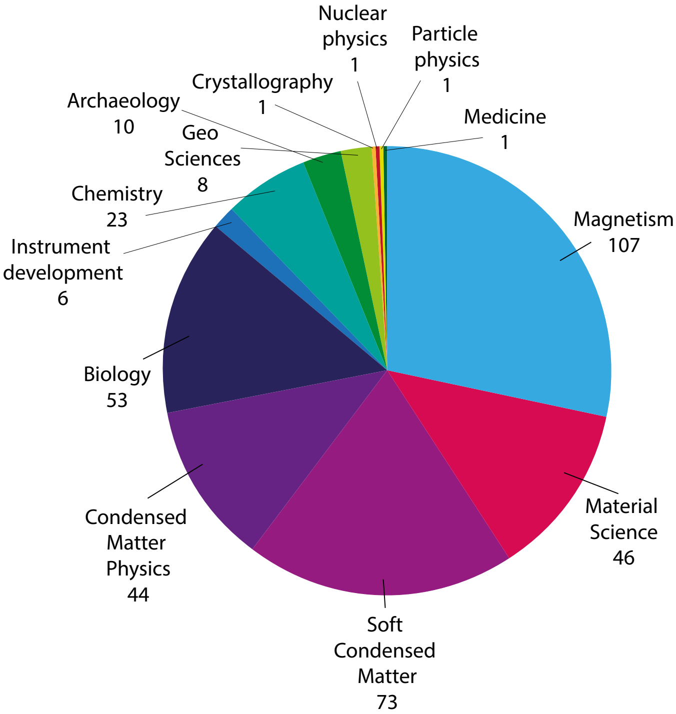
https://mlz-garching.de/user-office/user-committee.html

MLZ proposal round 2018-I

After the last proposal round with the largest number of proposal in the MLZ history, another successful proposal round at the MLZ took place. Despite the newly submitted proposals will start the measurements in the second part of 2018, the number of the proposals submitted to the 26 MLZ instruments was as high as 374, which represents the fourth highest number ever at MLZ, for a total number of requested beam days as high as 2.114.



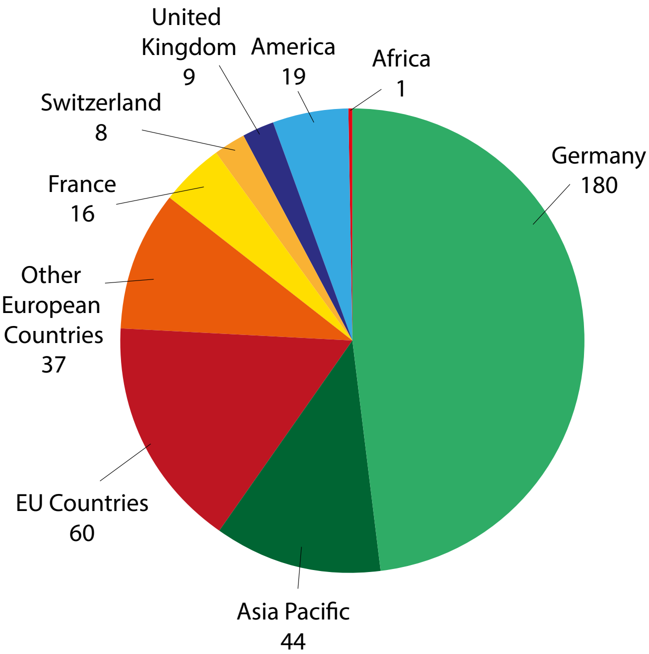
The scientific recommendations of the MLZ review panels were combined with the penalisation for missing experimental reports for previous experiments at MLZ; unfortunately, this may yield to the rejection of the proposal. Always less and less users tend to neglect the importance of submitting experimental reports after an experiment, however we had few undesired cases where a proposal was positively assessed by the MLZ Review Panel and, due to the penalisation for missing experimental reports, it falls below the acceptance threshold.

Due to the FRM II reactor schedule, the MLZ proposal round 2018-I allocated beam time for 1.5 cycles only. This reduced the number of beam days to allocate, however the success rate of the submitted proposals is more than 50%.

The conventional small angle scattering, with the KWS-1, KWS-2, and SANS-1 instruments, is the most requested technique, with a total of submitted proposal as high as 92, being KWS-2 the instrument with the largest number of submitted proposals. The instrument with the largest number of requested days (147) is BIODIFF. The overbooking factor, in terms of beam days, on single instruments ranges up to 8.0 on SPODI and 9.6 of J-NSE, being the average overbooking factor around 3.3.

The MLZ user community is based mainly in Germany, in Europe, and in the rest of the world with 48, 35 and 17% of the submitted proposals, respectively. It is worth to mention that the share of the Asian/ Pacific scientists is constantly above 10%.

As far as the scientific topics is concerned, the largest fraction of submitted proposals deal with magnetic investigations, about 29%, followed by those in soft matter, about 20%.



Last but not least, MLZ recognises the extremely professional and competent work of the MLZ Review Panel, with the actual 73 members in seven different panels, all strongly committed for the evaluation of the submitted proposals.

F. Carsughi (JCNS)

The updated MLZ Rapid Access Programme

The MLZ Rapid Access has been established in 2013 by allocating up to 5% of beam time on selected instruments with a rapid selection process, namely the deadlines are about ten days before the reactor cycles start and the decisions are notified to the users before the reactor cycles start.

The MLZ Rapid Access does not represent a backdoor to the MLZ instruments compared to the standard proposals, and it is thought mainly to test the feasibility of a measurement with the ultimate goal of submitting a standard proposal, or to characterise additional samples for completing a publication. The MLZ Rapid Access allocates up to 12 hours to a proposal, and therefore only the use of simple sample environments may be exceptionally considered.

2013-2017	Submitted	Accepted	Requested beamtime (h)	Allocated beamtime (h)	Measured beamtime (h)	Overbooking factor
BIODIFF	26	22	336	288	228	1,17
KWS 2	53	47	714	514	481	1,39
PGAA	46	42	708	478	464	1,48
SPODI	79	60	1290	714	684	1,81
Total	204	171	3048	1994	1857	1,53

The MLZ Rapid Access programme 2013 -2017.

In the first five years, the MLZ Users had a great interest in the MLZ Rapid Access, and they submitted more than 200 proposals to four instruments with a success rate higher than 83%.

The table below shows the statistics of the MLZ Rapid Access programme in the years 2013 -2017.

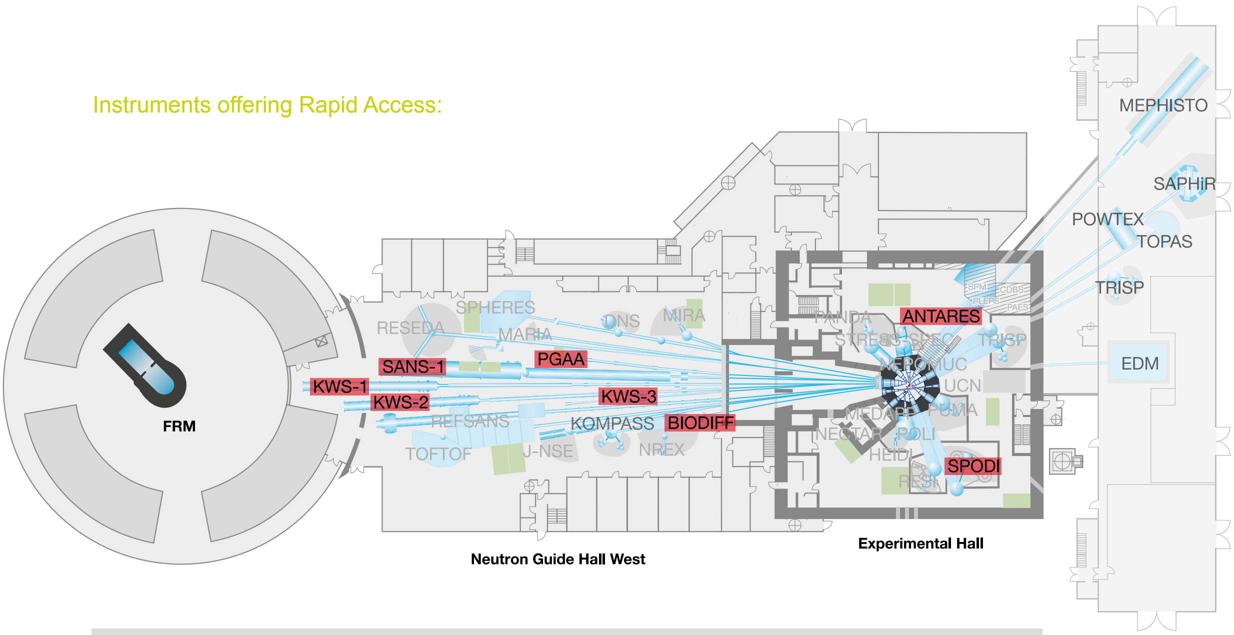
Due to its always larger demand, the MLZ directors decided to increase the offer and to improve its efficiency. A transparent review process is established to select the submitted proposals.

MLZ users have to submit a proposal with a detailed description and, very important, shall explain how the submitted proposal fits with the MLZ Rapid Access guidelines. Before submitting a MLZ Rapid Access proposal the users are warmly invited to discuss their ideas with the MLZ instrument scientist(s). The validity of the accepted MLZ Rapid Access proposals is limited to one reactor cycle only.

The MLZ Rapid Access measurements will be carried out by the MLZ staff, the users have only to send their samples and will receive raw as well as reduced experimental data for their scientific analysis.

F. Carsughi (JCNS)

Instruments offering Rapid Access:



ANTARES	Cold neutron radiography and tomography facility	PGAA	Prompt gamma and in-beam neutron activation analysis facility
BIODIFF	Diffractometer for large unit cells	SANS-1	Small angle neutron scattering
KWS-1/2	Small angle scattering diffractometer	SPODI	High resolution powder diffractometer
KWS-3	Very small angle scattering diffractometer with focusing mirror		

Next Proposal Deadline: September 28th, 2018

Find all information at

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

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Submit your proposal at

- fzj.frm2.tum.de
- user.frm2.tum.de

Next Rapid Access Deadline: August 23rd, 2018

Further information available at

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

UPCOMING

MLZ Conference 2018:
Neutrons for Culture and Arts
June 19th - 22nd, Lenggries (Germany)
https://indico.frm2.tum.de/event/56/

22nd JCNS Laboratory Course -
Neutron Scattering 2018
Sept. 03th - 15th, Jülich + Garching (Germany)
www.neutronlab.de

VDI-TUM Expertenforum
Additive Fertigung
September 13th, 2018, Garching (Germany)
https://indico.frm2.tum.de/event/100/

SNI 2018
Sept. 17th - 19th, Garching (Germany)
https://indico.frm2.tum.de/e/sni2018

JCNS-Workshop 2018:
Trends and Perspectives in Neutron Instrumentation: Advanced simulation and open source software in neutron scattering
Oct. 9th - 12th October, Tutzing (Germany)
www.fz-juelich.de/jcns/JCNS-Workshop2018

SAVE THE DATE!

50th IFF Spring School -
Scattering! Soft, Functional and Quantum Materials
March 11th - 22nd, Jülich (Germany)
http://www.iff-springschool.de/

MATRAC 2 School 2019
Application of Neutrons and Synchrotron Radiation in Materials Science with special focus on Fundamental Aspects of Materials
March 31st - April 05th, Herrsching + Garching (Germany)
https://www.hzg.de/ms/summerschool/058653

Reactor Cycles 2018

No.	Start	Stop
44	23.01.2018	23.03.2018
45	27.04.2018	26.06.2018
46	03.09.2018	01.11.2018

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Spring clean!
On the occasion of the celebration of 150 years of the Technical University of Munich, the FRM II also will look shiny.

Looking back on 10 years!