MLZ
Heinz Maier-Leibnitz Zentrum

News

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W. Schürmann/ TUM

Evaluating MLZ

By the cooperation of the TUM and the Helmholtz centres in Jülich, Geesthacht, and Berlin and the subsequent foundation of the MLZ in 2013 four well recognised neutron scattering operators offer a novel neutron scattering research facility to the German academic and industrial communities. Over the last three years, the MLZ developed an impressive and successful work of integration always motivated by science. I had the pleasure to chair the first evaluation after three years of this cooperation.

The international evaluation committee was unanimously impressed by the coherence and the consistency coming out of the written report prepared for this review, the discussions, and the ongoing projects at all levels. The panel acknowledges the important missions of the young MLZ as a large scale facility combining an in-house research programme and a firm commitment to education in a strong German network of universities, research centres, and industrial partners.

Bringing together world class instruments from different operators is a challenge which is well realised in the Matrix Structure of MLZ in terms of instruments and scientific topics. The review panel welcomes the high third party funding obtained over the last years; it illustrates the integration of a new culture of applying for funding and supporting MLZ projects. The theme of merging facilities with universities comes through very strongly. This approach of partnering with universities is particularly evident in the innovative instrumentation that has been made possible by accessing the technological and methodical expertise at those universities.

The enduring role of MLZ is to maintain and prepare the next generation of researchers who really know how to design, build and use world class neutron instrumentation. Presently MLZ fulfils this role perfectly interconnecting big science and universities.

Christiane Alba-Simionesco
Directeur du Laboratoire Léon Brillouin

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FRM II: Ten Years of Operation

It is a cold winter day in Garching on March 2nd, 2004. But downstairs in the FRM II's control stand, nobody notices it this afternoon. With undivided attention, all those present fix their eyes on the monitors. At 14:01, they have achieved their goal – after so many years of planning, preparing, building and fighting at the administrative front. The shift leader writes it down in the shift book:

14:01 – reactor critical with ca 1kw

How it all began

In 1979, it became obvious that the FRM, the so-called Atomic Egg, had to be improved. During the following three years, a concept for a compact core was developed. By this, a higher flux should be reached. The power should be 20 MW – the FRM could only deliver 5 MW. Furthermore the risk management could be improved by this, radioactive waste would be reduced, and costs would decrease.

In 1984, financial support for a feasibility study was granted by the Bundesministerium für Forschung und Technologie. During this study, it became clear that a strenghtening of the existing Atomic Egg could not be the goal. Thus, two years later a new building was recommended by the task force „Zukunft der Neutronenforschung" („Future Perspectives of Neutron Research") and the federal ministry's committee of experts. The new reactor should not only deliver neutrons for research but also for industrial and medical applications. This new orientation was very important from the Free State of Bavaria's point of view. It took another five years to produce a preliminary draft of the plant's planning and safety concept. Within the last, the inherent safety features were the most important ones: The reactor always shuts down when for example problems within the cooling circle occur.

March 2nd, 2014: Everybody is thrilled in the control stand.

Informing the public

From 1990 on, the public was informed about the planned reactor and for example involved in panel discussions. Besides the support of the Bavarian state government and the state parliament, there were also critical voices. A local protest group had formed and objections as well as petitions against the FRM II had to be dealt with. As a result, the building's precaution measures were improved. Globally, the research source's building became the first one providing full protection aganst airplane crashes, earthquakes, explosions, lightning discharge, and flood. Therefore the walls got a thickness of 1.80 m. In 1994, the final decision for the building was made.

Cut of the spade: Anton Axmann, Adolf Hüttl, Fritz Schaumann, Wolfgang A. Herrmann, Edmund Stoiber,Hans Zehetmair, Helmut Karl (from left to right).

The Technische Universität München (TUM) acted as the client and financial support was promised by the Federation and the Free State of Bavaria. A French company built a first dummy fuel element which was put through its paces at the Ruhr-Universität Bochum.

The cut of the spade

Minister-President Edmund Stoiber, Minister of Science Hans Zehetmair, and the recently elected President of the Technische Universität München Wolfgang Herrmann, made the first cut of the spade on August 1st, 1996. With this ceremony, the biggest construction project in the TUM's history started. A few months earlier, the 1. partial construction license for the building of the new reactor building had been received. Fortunately, complaints against it could be dismissed. Thus, five months later the laying of the foundation stone could take place after the 2.70 m thick concrete floor slab had been casted.
The 2. partial construction license dealing with the rest of the planned buildings as well as all mechanical and electrical structures was granted in October 1997. Several conditions were made but the construction could go on. The construction site itself was a magnet for visitors at the first Open Day: Nearly 1000 persons were really curious about it! Summer 1998 finallly saw the topping out ceremony after the structure had been completed.
Simultaneously, plans were entertained which instruments should take up space in the new halls. In 1997, a list of the construction of 21 instruments as well as for preparations of two new sources (ultra-cold neutron and fission neutrons) could be presented. The selection criterion? They should be at least on a level with other instruments worldwide – or even better, if possible!

1998 – hanging in the balance

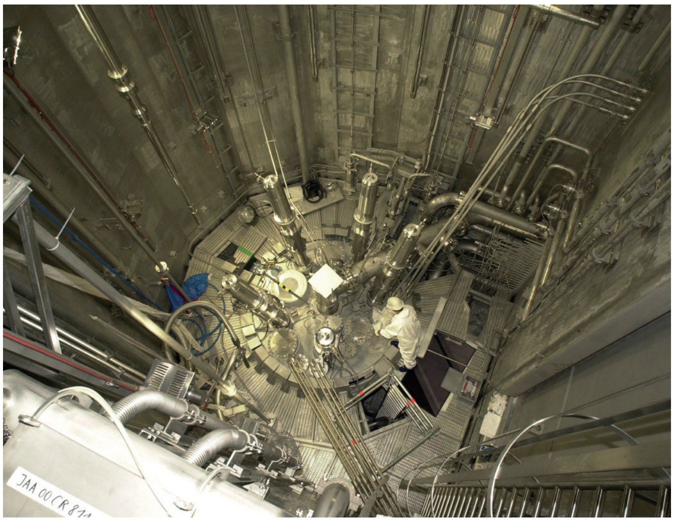
So everything looked fine on the eve of the Bundestag election 1998 that resulted in a change of government. One of that new governement's goals was nuclear power phase-out. Under these circumstances, it would have to be still a long way to go to receive the 3. partial construction license – the final one! Without this, no operation would be possible and the whole project would become a disaster. A think tank took a close look, if operation would also be possible with low riched Uranium. Result: An immediate change of the system would take eight years and the costs for this change would be in the range of about 300 MioDM. That was enormous and therefore a compromise could be found. For the first ten years, the FRM II would run on high riched Uranium - but during this period, the development of a low riched fuel element should make progress.
In the same year's autumn, a public petition for a referendum was allowed by the Bavarian Higher Administrative Court. It resulted in a one-year delay.
When the Atomic Egg was finally shut down in summer 2000, the 3. partial construction license was still missing. Its topic was the commissioning and routine operation of the neutron source. For that reason, the first two fuel elements, built in France, could not be transported to the FRM II, and had to be stored there.


In 1997, one could look into the cellar of the FRM II. (G. v. Hassel/ TUM)

In 2001, the building was ready and a contract regarding the 3. partial construction license had been concluded. Furthermore the organisational structure of the FRM II had been decided: Lead by a three-part directorate, and as a Zentrale Wissenschaftliche Einrichtung directly be under the president of the TUM. But it took some more time. To be precise, it took more than two more years. In May 2003, the operating license was signed!

Here we go!

Now, about 105 special barrels containing 24 t of heavy water could be delivered from Cardarache/ France to Garching. It was needed for the moderator tank. A month later, the first two fuel elements reached the FRM II, driven in a highly secured transporter. They could be tested and prepared for operation. In February 2004, the start of homopolar power tests was allowed by the authorities. They included for example the fuel element's installation – this could only be done after the both delivered elements had been tested regarding the mass of fissile Uranium. In the end of February, the converter plates were arranged for the first time and the fuel element was fitted into the central canal. After closing the central canal and bringing the primary cooling circle into opera-



The reactor pool - still without water.

tion, the heavy water could be poured into the moderator tank. During this procedure the control rod was extended completely and it could be shown that the reactor could be kept uncritically by the five regulating rods. A few tests later, the authorities permitted the first start of the self-preserving chain reaction of nuclear fission. The date was March 2nd, 2004.

Starting experiments

Until April, the reactor was running with low power – but the first neutrons could already be delivered to some of the already installed instruments! The scientists were really thrilled by this because they waited just as long. In the end of 1997, the first 14 instruments had been selected by the instrument committee. Ten instruments should be supported by the FRM II, another four by Verbundforschung of BMBF. Groups from German universities and the Helmholtz Centres in Jülich, Geesthacht, and Berlin as well as of the Max-Planck-Society were higly engaged in the constuction of the instruments - this included financial support and man power. The budget was unbelievable low from today's point of view: Only about 1-2 Mio€ per instrument were available for their basic construction. When the FRM II organised the **I**nternational **C**onference on **N**eutron **S**cattering (ICNS) in 2001, the first instruments under construction could be shown during guided tours of the halls. This was very interesting for the participants from all over the world.
At the same time the central service groups dealing with instrument control, IT-service, sample environment, and detectors and electronics were established. The neutron optics group had started with the concept of the neutron guiding system a few years earlier because the results became the basis for the construction of the beam tubes. During the instruments' construction phase, many times unknown territory had to be entered. For example air-bearings were developed further regarding materials and components. The former version had already been used at the Atomic Egg in order to move and position heavy instrument parts. The same applies for tanzboeden – the usually used marble was replaced by a natural stone from Gabbro.

Welcome users!

In autumn 2004, full load operation could be started. The global neutron scattering community received the first call for proposals in November 2004. 119 proposals had to be discussed by two referee committees and 668 beam days could be distributed from the routine operation's start on in the beginning of 2005. During the year, the focus was on calibration, testing, and improving the instruments. The biggest help came from our first external users. They examined the instruments thoroughly and thus took part in the development and improvement. The number of users and that of the submitted proposals increased really fast and therefore a dedicated User Office had to be founded. It dealt with all issues of the review process, the visiting scientists, and all tasks in the scope of the scientific use. A special software for all this was developed inhouse. One person managed the whole user operation in the beginning – today we are a team of five, we receive about 400 proposals per round, deal with six review panels, and organise 1000 visits per year!

DIDO's shutdown

In 2006, DIDO, the reactor at Forschungszentrum Jülich was finally shut down. Two years before, a cooperation contract between the Forschungszentrum and the TUM had been concluded. It aimed to the foundation of a branch at the FRM II formed be around 30 staff members. The best instruments from Jülich were transferred to Garching. Thus, the instrument suite grew and especially the soft matter community was delighted by these – during the commissioning phase - completely improved instruments. For the long KWS-1 and -2 (about 40 m), the Neutron Guide Hall West had to be extended to the outer wall of the Atomic Egg. For the colleagues from Jülich, a whole new buidling had to be constructed.

Neutrons not only for research, industry – but also for medicine

In 2007, medical application could be started. At the Atomic Egg, 700 patients had been irradiated during its time of operation. At the FRM II, the therapy facility could be improved compared to the old one. The dose is higher, what results in much shorter irradiation times. The beam's cross section was increased and a multi-leaf-collimator allows for the adaptation of the beam field's shape and dimension to the tumour's region.

We look back to ten really successful years and we look forward to just as successful next years of operation!

This article is an english synopsis of our festschrift published this year. You can order it from mlz@mlz-garching.de (available only in German).

Celebrating Ten Years FRM II

Garching: March 12th, 2014

On March 2nd, 2004, the new reactor became critical for the first time – a "magic moment for science" as TUM President Wolfgang A. Hermann said. This was reason enough to invite many VIPs of politics, science, and society for a big anniversary celebration. The day began with a special tour only for journalists of the FRM II. What to show a group who always has the possibility to ask for a guided tour of the facility? So we offered them a tour of restricted areas which no regular visitor had ever seen: the Houston-like control room, the cellars, the security measurements, the units for exit air and exit water and … Anton Kastenmüller, Technical Director of the FRM II, was a great and inspiring guide whose obvious pleasure was to explain all these special units. Six journalists followed the invitation and some more, especially from broadcast and television, asked for interviews and filming permits before and after the celebration day.

The celebration started in the afternoon with the exhibition of paintings, created by pupils of the Werner-Heisenberg Gymnasiums in Garching. About 400 visitors listened in the lecture halls of the TUM Physics Department to the greetings and congratulations of the Bavarian State Minister Ludwig Spaenle, the former Bavarian Prime Minister and longstanding supporter Edmund Stoiber, TUM President Hermann, and Karl-Eugen Huthmacher as representative of the Federal Ministry of Education and Research (BMBF). Anton Kastenmüller finally showed the past ten years of operating the FRM II in ten images. An anniversary is not only a cause to look back, but also one to look in the future. Since the production of Mo-99m is one of the big challenges in the future, Jörg Kotzerke, President of the German Society for Nuclear Medicine, informed about the worldwide usage and shortage of Tc-99m and Mo-99m in diagnosis.

F.l.t.r: Hannelore Gabor, Klaus Seebach, Hans Zehetmair, Winfried Petry, Otto Schily, Anton Kastenmüller, and Manfred Solbrig (Mayor of Garching 2002-2008). (*W. Schürmann/TUM*)

The last part of the celebration belonged to three current research projects at the FRM II in a science slam. Tobias Schrader came up with the fairy tale of Prokis and Eukis, who fight against each other as long as mankind is old, but some hope to find the final weapon by research with neutrons. Sebastian Mühlbauer showed the combed hedgehog and how this special animal can help us understanding what skyrmions are and what possibilities they have for the daily life. Christoph Hugenschmidt complained that nobody realised that positrons also celebrate their 10th anniversary! He explained how they prolong their life by finding the right hole and what this means for the surface. That was a great fun and all scientists were generously acknowledged with long ovations.

The official photo: Ten-years old FRM II in the background with Hannelore Gabor, Karl-Eugen Huthmacher, Johanna Rumschöttl, Hans Zehetmair, Wolfgang A. Hermann, Ludwig Spaenle, Anton Kastenmüller, Winfried Petry, and Wolfgang Heubisch. (*Uli Benz/TUM*).

The party ended up with fingerfood, beer, wine, and accompanied by the music of the "Occational Five" group who came by three this evening and performed some jazz music. Many companions were obviously happy to meet each other; they worked together for many difficult years from the first plans during the whole construction time till the first neutrons in 2004. Among the guests were e.g. some former Ministers as Hans Zehetmair, Otto Schily, and Wolfgang Heubisch. All visitors enjoyed the event which produced a lot of resonance in newspapers, television, and broadcast and in the long run many additional visitors from unknown target groups as the Green party from Erding or the IHK Munich.

A. Voit (FRM II)

Winfried Petry and Otto Schily, in the back Klaus Böning. (*W. Schürmann/TUM*)

POLI Warmly Welcomes Neutrons!

Dedicated beam line for polarised single crystal diffractometer at the hot source

Fig. 1: The neighbours' doors: On the right access to the instrument POLI, on the left to HEiDi.

Spherical neutron polarimetry had been implemented on the **Pol**arisation **I**nvestigator (POLI) using the monochromatic incoming beam of the single crystal diffractometer at the hot source HEiDi in 2010. We reported about this in our previous newsletter issues nos 3, 5, 7, and 9. Taking into account the large demand on the beam time for both polarised and non-polarised experiments (overbooking factor is more than 3), it was decided to build a dedicated beam port for POLI on the available and not used channel SR 9a in the front of FRM II's hot neutron source. The three-year project, granted by BMBF with 1,4 Mio€ and managed by the Institute of Crystallography of RWTH Aachen, started in July 2010.

The main objectives of this project were:

- Opening of the available but to that time plugged beam line SR 9a in the front of the reactor's hot neutron source. In this way the doubling of hot neutrons available to users at MLZ could be reached.
- Design, production, and installation of the necessary biological shielding for the new beam line.
- Development and implementation of the dedicated monochromators for the new single crystal diffractometer with polarised neutrons, POLI.
- Rebuilding of the old instrumental infrastructure in HEiDi's experimental field in order to allow fully independent operation of both instruments (HEiDi & POLI) using the same space.
- Transfer of POLI and its adapting to the new beam line.

It is worth noting that all these goals should be reached without closing or significantly reducing the normal user operation on the heavily overbooked HEiDi. Now, after three and a half years of intensive work, we are happy to report that all those objectives could be successfully reached. First test measurements using a monochromatic neutron beam at the new beam line SR 9a at the dedicated POLI position could be performed in February 2014. The results of these tests as well as some important developments on the way to reach the proposed goals, are described below.

In order to open the plugged beam line SR 9a, major changes on the primary optics of beam tube SR 9 and HEiDi had to be done. Two concrete blocks should be removed from the beam tube's channel a. Previously, three different collimators used for HEiDI must be removed from the revolver shutter. In order to get access to the neutron window on beam tube SR 9 at the reactor wall, the complete biological shielding of the instrument HEiDi had to be dismounted. Afterwards. the dedicated inserts for the optimised beam cross section and reducing background scattering at POLI could be inserted into channel a. Subsequently, HEiDi's collimators were rebuilt into the new changer mechanics. This together with better neutron aperture adjustment, new shutter and shielding elements in the primary beam, and additional shielding of the monochromator "drum" with boron rubber, led not only to physical separation between the channels a and b in beam tube SR 9, but also to HEiDi's significant improvement of performance after reassembling. The total neutron flux intensity at HEiDi increased by more than 20%, while the background scattering reduced to 50% of the initial value. The rebuilding work on the beam tube could only be done when the reactor was shut down, and therefore had been performed during the long maintenance reactor stop in 2011.

In 2012 the biological shielding for POLI was installed. We reported briefly about it in our newsletter issue no. 9. The main challenge for this shielding was that on the one hand side it should be possible to screen much more radiation than the HEiDi "drum", taking into account the larger beam cross sections on POLI, on the other hand side, it should be more compact and lighter than the HEiDi "drum" built of heavy concrete, due of both limited space and accepted floor load. Intensive calculation using Monte Carlo package were performed in order to optimise the shielding design. The real energy spectrum and intensities of the neutron and gamma primary beams measured on HEiDi, as well as secondary emitted gammas by neutron absorption in the shielding, and secondary emitted neutrons by hard gamma collision were used as input data for the numerical modelling. The result of the calculation was a multilayer shielding consisting of

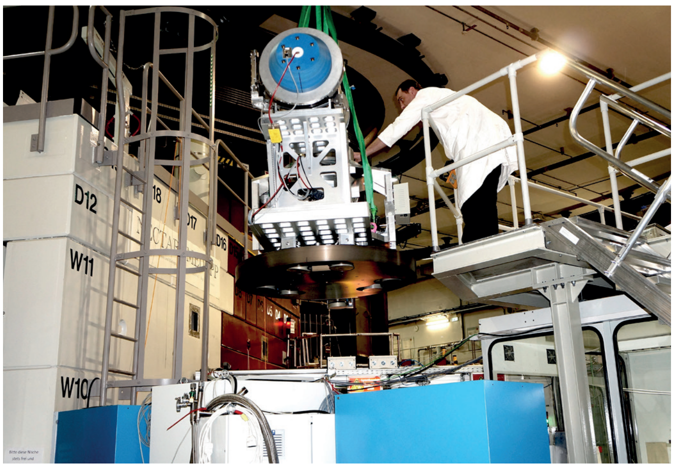


Fig. 2: Crane transport of the POLI diffractometer to its new home on beam line SR 9a.

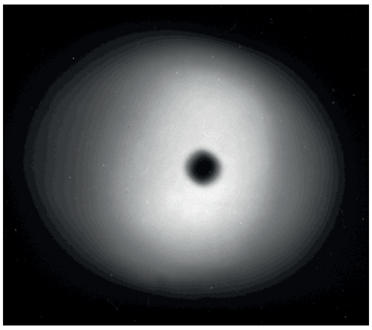


Fig. 3: Homogeneous illumination with monochromatic neutron beam. Picture was taken using a neutron camera behind the sample.
Black spot in the middle: 6 mm diameter Cd disc at the sample position on POLI.

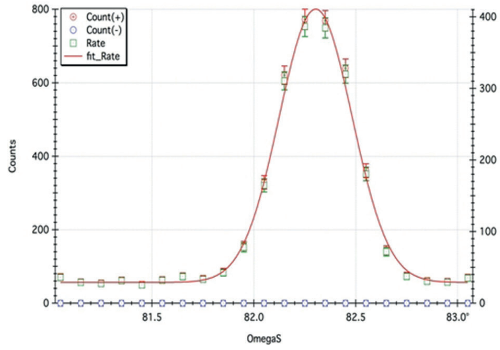


Fig. 4: First Bragg reflection from a Si sample measured on POLI using a test monochromator.

boron-doped polyethylene, boron rubber, lead, and a novel shielding material mixture of iron powder, ferrobor and liquid paraffin cast into steel containers patented by FRM II. This concept allows to develop high efficient and rather non-expensive shieldings without using traditional heavy concrete blocks, which have significant drawbacks latest by the decommissioning of the instrument. The thickness of the all layers was precisely calculated in order to meet the radiation protection requirements. The precision of those calculations could be confirmed later on by measuring the shielding efficiency of both the singular layers and the whole shielding. The final radiation tests were passed successfully in 2013.

The monochromator is a key element for the efficiency of a neutron instrument. Typically for polarised hot neutron diffractometers, a Heusler alloy monochromator combining both polarisation and monochromatisation functions in one device is used (e.g. D3 at ILL or 5c1 at LLB). It was shown that separating these two functions e.g. using a focussed Cu monochromator and dedicated polariser (e.g. ^{3}He spin filter) a higher instrument performance can be reached. On POLI we introduced this separation: Double focussed mosaic crystal Cu 220 and vertically focussed and horizontally bent perfect crystal Si 311 are two non-polarising monochromators which will be used. Cu 220 at the take-off angle of 25° is dedicated to the shortest wavelength of 0.55 Å. And Si 311 at the take-off angle of 41° is designed for the longest available on POLI wavelength of 1.17 Å. A few different wavelengths between these two values are also available. Thus, polarised and non-polarised beams from hot to lower thermal neutrons will be available on POLI. Tuning the pressure in the ^{3}He spin filter cell offers the possibility to optimise the polarisation parameter for any available wavelength. During the first neutron test in February 2014 non-focussed Cu 220 crystal plates similar to those which will be used in the focussed monochromator were adopted. The result exceeded all expectations: POLI reached 6 x 10^6 n/s/cm^2 flux density at the wavelength of 0.9 Å on the sample position. According to our calculations using the focussing mode should increase the flux density by a factor of 5.4. According to these estimations POLI will be one of the most powerful short wavelength instruments worldwide. The dedicated Cu monochromator is now in production at the Institut für Physikalische Chemie of Göttingen University and we are keen to install it on POLI during this fall. The Si monochromator, which was produced by Bisson Technologies Inc. in cooperation with ILL Grenoble arrived recently and should be commissioned on POLI after the reactor start in August 2014. The λ/2 beam contamination found during the first experiment in February was of 4%. Similar to Heidi, Er resonance filter will be used in order to suppress λ/2 contamination for Cu and λ/3 contamination for Si monochromators.

In 2013 significant efforts in order to seperate the infrastructure for the independent operation of the POLI and HEiDi were made. Independent electric power, pressure air, and cooling water supply were installed. The tanzboden at the POLI position was extended. A separate instrument computer network and an experiment hut were built for POLI. New secondary shielding and independent security access control were introduced at each of two instrument areas. Physical separation (by the wall) between the experimental fields of POLI and HEiDi is performed. Fully independent operation of both instruments could be proved during the test measurement before the reactor shut down. During the reactor stop in March-August 2014 further important steps to improve the functionality of both POLI and HEiDi diffractometers could be reached. After the planned restart of the reactor and commissioning of the new dedicated monochromators and the other new components we are looking forward to welcoming first external users at the new single crystal diffractometer POLI still in 2014.
Taking into account the successful development of the POLI project and in order to assure both completing the commissioning of the whole instrument at the new beam line and implementing new single crystal diffraction methods on POLI, a new BMBF project granted with more than 1 Mio€ have been approved for the next three years: 2013-2016.

V. Hutanu (RWTH Aachen)

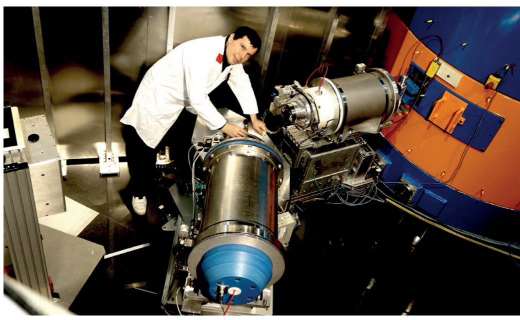


Fig. 5: Instrument scientist V. Hutanu shows POLI on its own beam port.

The Birmingham 17T Magnet @ SANS-1

Where high flux meets high magnetic field

Fig. 1: The 17T magnet at SANS-1 during the initial helium filling prior to the installation at the instrument.

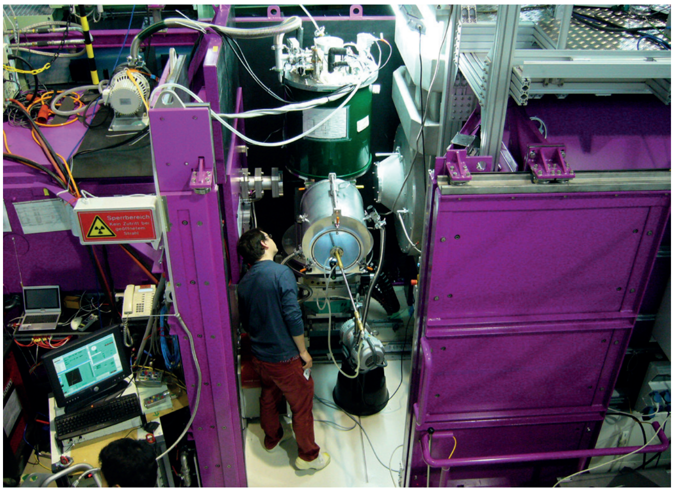


Fig. 2: The 17 T magnet installed at the sample space of SANS-1 with Alex Holmes (Condensed Matter Group, University of Birmingham) working on the air-lock manipulator system to change a sample. For measurements, the air-lock is removed and the magnet is turned by 90° around the vertical axis.

In January 2014, a team of scientists from the University of Birmingham together with the SANS-1 team installed a large green barrel, puffing white clouds of smoke into the Neutron Guide Hall, at the sample space of SANS-1 (fig. 1). The green barrel in fact is part of a unique cutting-edge cryomagnet, which is specially designed for small angle neutron and X-ray scattering and offers a world-leading magnetic field of 17 T, with the field parallel to the incoming neutron beam. The magnet belongs to and is operated by the Condensed Matter Group led by Elizabeth Blackburn (University of Birmingham, UK) [1]. It has been specially designed to be moved between different beam-lines at various large scale facilities and has already been used at neutron and X-ray facilities all over Europe, including PSI, ILL, DESY, and ISIS.
The magnet is based on a single cryogenic solenoid coil to reach the highest field possible with a compact and light design. As this compact configuration leaves no room for a vertical sample tube, samples are directly loaded into the centre of the coil and the **v**ariable **t**emperature **i**nsert (VTI) with a sophisticated air-lock manipulator chamber (see fig. 2): For this purpose, the magnet is rotated by 90° around the vertical axis, the air-lock chamber is attached to the magnet and pumped. After opening the sapphire windows under vacuum, the sample can be changed using the manipulator tool.
The reason why the magnet and four scientists from Birmingham travelled to Garching was the high intensity of the small angle neutron scattering instrument SANS-1 ideally suiting studies of superconducting vortex lattices and other magnetic samples. Moreover, the special non-magnetic sample area of SANS-1 is necessary to accommodate the rather large stray fields of the uncompensated 17T coil. Four different experiments have been successfully carried out in cooperation between the SANS-1 group and the Condensed Matter Group from Birmingham over a time-slot of two weeks. Two experiments were based on external proposals from Birmingham: The structural "crystallographic" properties and the phase diagramme of the vortex lattice of the high temperature superconductor $YBa_2Cu_3O_y$, doped with calcium were studied in high magnetic fields. With the signal decreasing with magnetic field due to the vanishing form factor of the vortices, a high flux instrument is essential for these kinds of measurements. In a second experiment, a series of metamagnetic transitions seen by bulk magnetisation in gallium-doped manganite perovskites were studied at high magnetic fields. Two more experiments, based on in-house research of the SANS-1 group were performed on the magnetic structure of Co-diluted MnGe and $EuPtSi_3$.
A successful test of the 17T magnet on the neighbouring neutron spin echo spectrometer RESEDA, where a quasi-elastic MIEZE signal was observed at 17T in a proof-of-principle experiment (see the opposite page), completed a very intense and prosperous excursion to MLZ, Garching.

S. Mühlbauer (TUM),
A. Heinemann (HZG)

Reference

[1] A.T. Holmes et al., A 17 T horizontal field cryomagnet with rapid sample change designed for beamline use Rev. Sci. Instrum., 83: 023904 (2012).

Contact 17T Magnet

E. Blackburn, Condensed matter Group,
University of Birmingham,
Birmingham (UK)

European Tour Continues: Birmingham 17T Magnet Stops at RESEDA

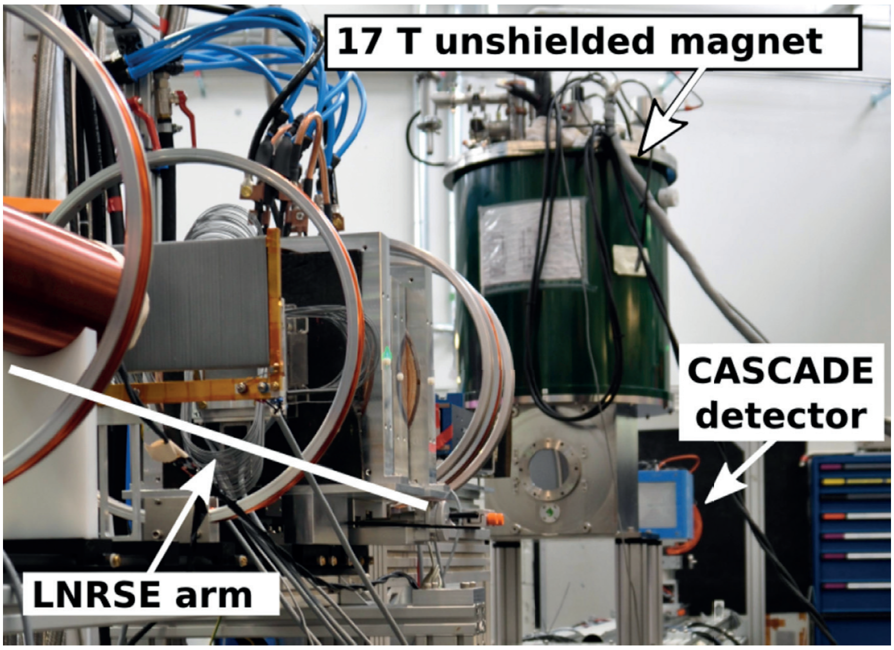


Fig. 1: The 17T magnet mounted at the sample environment of RESEDA. On the left, some of the magnetic field devices belonging to the Longitudinal NRSE setup are shown. The LNRSE coil (supplied by electrical current and cooling water from the top) is operated as resonant flipper coil of the MIEZE setup used for the test experiment. The oscillating MIEZE signal is detected by the CASCADE detector visible behind the 17T magnet.

In the end of January 2014, the chance was seized to catch a unique cryomagnet on its "European tour" for a test experiment at the **N**eutron **R**esonance **S**pin **E**cho (NRSE) instrument RESEDA (fig. 1). The magnet from the Condensed Matter Group at the University of Birmingham/ UK ([1], see p. 10) led by Elizabeth Blackburn produces a world-leading maximum magnetic field of 17T in strength directed parallel to the incoming neutron beam. On its tour to several large scale facilities (PSI, ILL, DESY, and ISIS), neutron and X-ray experiments at different beam-lines had already been performed.

More details about the cryomagnet itself are presented by S. Mühlbauer and A. Heinemann on the previous page. Here we report about the particular test experiment, for which the cryomagnet was adapted to the sample environment of RESEDA by a team of scientists from the MLZ and the Physik Department of the Technische Universität München (research area "Strongly correlated electron systems"). Within very short time, the mechanical support in order to carry the vessel and the control unit needed to drive and read back the magnetic field values were realised and put into operation.

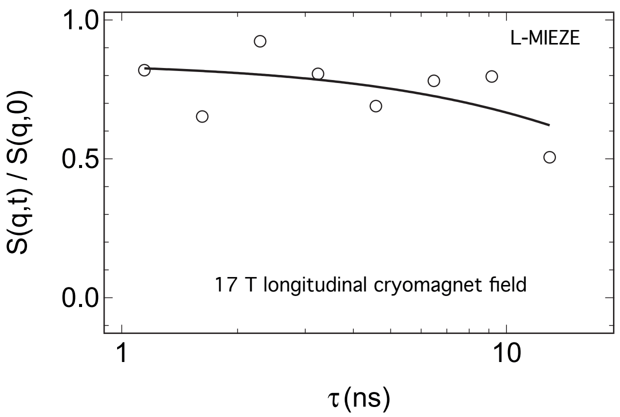


Fig. 2: The MIEZE resolution curve taken with the 17T magnet at full operation. The data points of the elastic resolution curve measured in the direct beam show, that the resolution exceeds τ = 15 ns, bearing comparison with the performance without cryomagnet (the data points are slightly scattering due to scarce time for optimum tuning at every single MIEZE time τ).

Besides the mechanical, electrical, and electronical preparations, the cryomagnet had to be included into the magnetic field landscape of RESEDA. In contrast to other neutron spectrometers, NRSE's function being related to classical **N**eutron **S**pin **E**cho (NSE) is based on the precession of the neutron spin in magnetic fields. Important magnetic stray fields as produced by the 17T magnet are orders of magnitudes too strong as to allow for standard NRSE (or NSE) operation.

Thanks to two fortunate circumstances, the test experiment at RESEDA could anyway be successfully performed [2]: first, the NRSE setup operated in January at RESEDA used magnetic fields mainly pointing parallel to the neutron beam direction (Longitudinal NRSE). Therefore, the superposition of these magnetic fields with the stray field of the cryomagnet ended up in a simple linear addition of longitudinal field strengths, while the superposition of perpendicular magnetic fields would have created severe complications. As second and main advantage, we just had accomplished first successful experiments with a NRSE variant reducing the spectrometers magnetic fields to the region before the sample region, called MIEZE (**M**odulation of **I**nt**E**nsity with **Z**ero **E**ffort). By providing sufficient distance between this spectrometer arm and the cryomagnet enthroning at the sample position (fig. 1), the interference between the two magnetic field regions could be reduced.

By fine-tuning of the spectrometer fields, the same excellent MIEZE performance as without cryomagnet could be demonstrated. The magnet was set to arbitrary field values between 3T and 17T, and the MIEZE signal could be well maintained until the highest field value (fig. 2) demonstrating the potential of MIEZE to open up the parameter space for spin echo experiments towards high magnetic fields.

W. Häußler (TUM)

Reference

[2] J. Kindervater, N. Martin, W. Häußler, M. Krautloher, C. Fuchs, S. Mühlbauer, J. A. Lim, E. Blackburn, P. Böni, C. Pfleiderer, arXiv:1406.0405 [physics.ins-det].

MARIA

JCNS' new high-intensity polarised neutron reflectometer

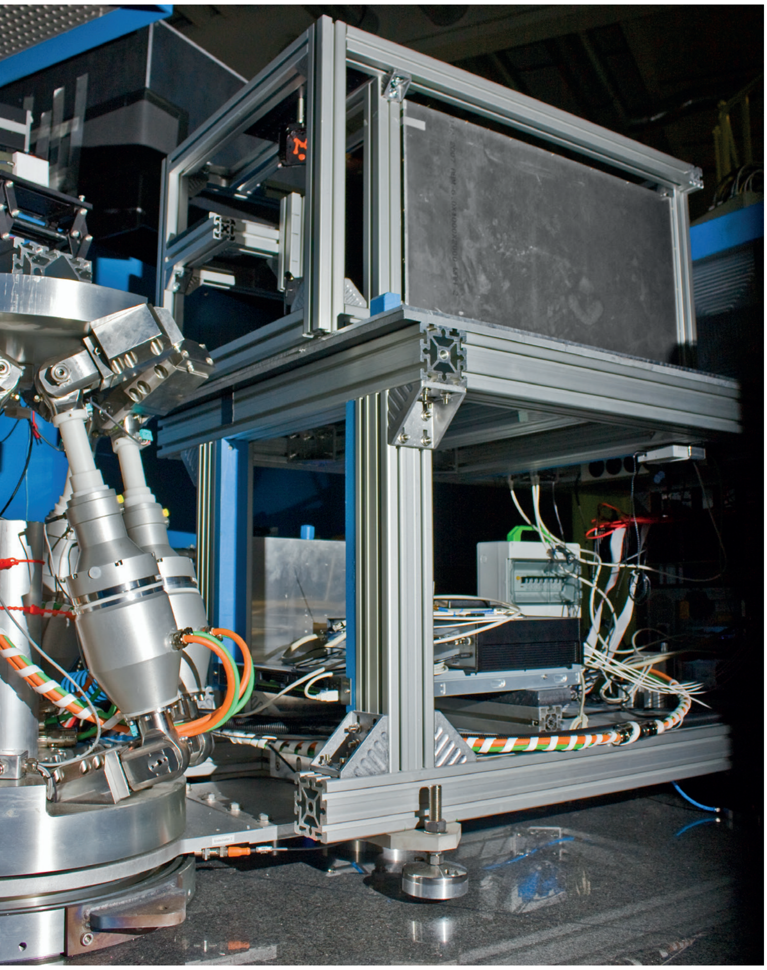


Fig. 1: The sample position of MARIA with Hexapod, ^{3}He-SEOP-analyser and detector.

The JCNS has installed the new, high-intensity reflectometer MARIA in the Neutron Guide Hall of the FRM II neutron research source in Garching. This instrument uses a velocity selector for the monochromatisation of the neutron beam, an elliptically focussing guide to increase the flux at the sample position, and a double-reflecting supermirror polariser to polarise the entire cross-section of the beam delivered by the neutron guide.

Unique features of MARIA

- vertical focussing with an elliptic guide from 170 mm down to 10 mm at the sample position,
- reflectometer and GISANS mode,
- polarisation analysis over a large 2d position sensitive detector as standard,
- adjustable wavelength spread from 10 to 1% by a combination of velocity selector and chopper,
- flexible sample table using a Hexapod for magnetic field and low temperature sample environment, and
- in-situ sample preparation facilities.

Together with a 400 x 400 mm² position sensitive detector and a time-stable ^{3}He polarisation analyser based on **S**pin-**E**xchange **O**ptical **P**umping (SEOP), the instrument is dedicated to investigate specular reflectivity and off-specular scattering from magnetic layered structures down to the monolayer regime. In addition, the GISANS option can be used to investigate lateral correlations in the nm range. This option is integrated into the reflectometer's collimation, so it can be chosen during the measurement without any realignment.

The direct measurements 120 mm behind the end of the elliptically focussing collimation section of MARIA reach for the polarised neutron flux of about $0.5 \cdot 10^8$ n/cm²/s and for the unpolarised neutron flux of about $1.25 \cdot 10^8$ n/cm²/s at 4.5 Å with a horizontal divergence of 6 mrad. This makes MARIA one of the most powerful neutron reflectometers worldwide.

Main scientific applications at MARIA

The new high flux polarised neutron reflectometer MARIA (**MA**gnetism **R**eflectometer with high **I**ncident **A**ngle) of JCNS is optimised for the study of magnetic nanostructures, serving the rapidly growing field of spintronics or magnetoelectronics, i.e. information storage, transport and processing using the spin of the electrons.

The instrument offers unique features, such as polarisation analysis for large angular range, extreme focussing to small sample sizes, high flux, largely variable wavelength band selection, GISANS option, provision for ki-

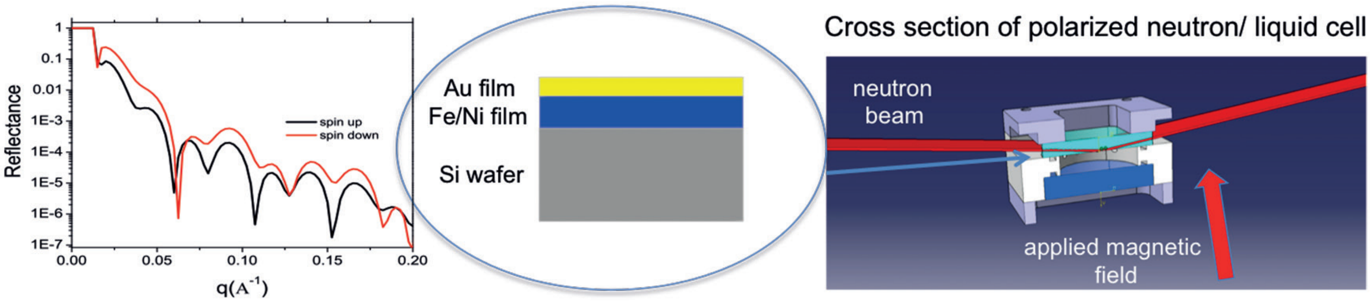


Fig. 2: Polarised neutrons for soft matter. Under this motto we will bring a technique from the NIST to MARIA, where the contrast variation can be matched by using a magnetic field to the backing of the film.

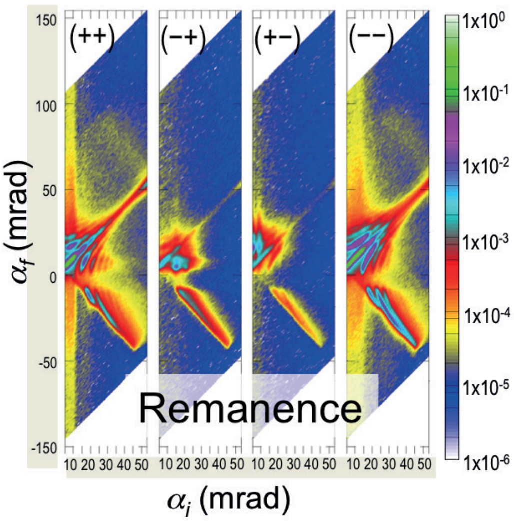


Fig. 3: $Fe^{nat}Fe^{57}$ multilayer with 4.5 µm grating measured with full polarisation analysis with a large area ^3He neutron spin filter covering ~80% of the large PSD (400 mm x 400 mm).

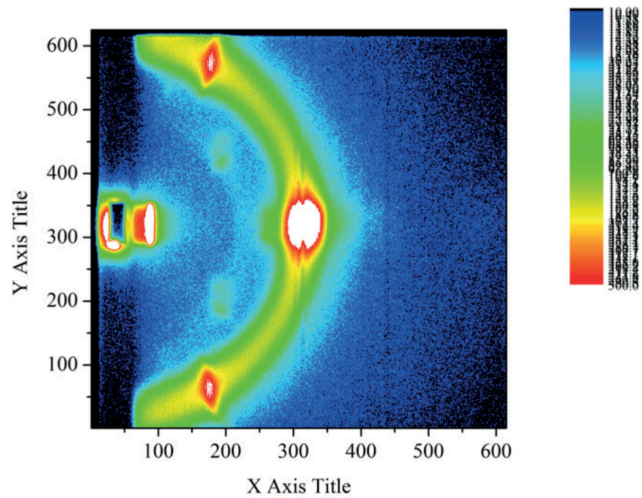


Fig. 4: GISANS soft-matter measurement with 10 Å in 1200 seconds of C10E4 + Pep15Peo5 on a silicon surface in the hexagonal phase.

netic studies by means of time resolution down to the s range, in-situ sample preparation.

Sample environment

As the standard sample environment for the hard matter groups we are using a closed cycle He-cryostat together with a Bruker electro magnet. The cryostat is working in a range of 3 to 300 K and if needed a electrical field of up to 500 V can be applied to the sample. Depending on the sample size the magnetic fields varies between 0.75 T (2" wafers) and 1.2 T (20 mm diameter). As a non-standard sample environment, a 5 T cryomagnet can be installed on demand of the user. For the soft matter community we have flow cell with a length of 150 mm (7 ml volume of the sample) that can operate in a temperature range between 280 K to 350 K.

In fig. 2 a new liquid cell is shown, where we would like to implement the well known [NIST, see Ref. 1] contrast variation method at MARIA for the soft matter community. With this method the contrast between substrate and sample can be varied controllable by applying a magnetic field to the substrate with a magnetic backing film. In this example, a Fe/Ni film is shown, that we can evaporate inside the MBE on the Si wafer. In this way, we bring together the different strengths of MARIA: Beam focussing and with that the ability to use small samples and sample amounts; MBE infrastructure for preparing high quality magnetic films and multilayers as well as the polarised neutrons with the installed magnet. Last but not least even the ^3He-analyser is available to measure precisely the incoherent background of the soft matter samples and to increase in this way the dynamic range in subtracting the background.

Furthermore we are installing a set of attenuators on MARIA, that is fully controllable by the instrument software and allowing to measure the direct beam on the detector. The set consist of three boron glass windows, where each single glass will have an attenuation factor of ten for neutrons with a wavelength of 4.5 Å, resulting in an overall factor of 1000. In this way sample even without a total reflectivity plateau can be investigated successfully.

To link the MBE to MARIA, we are in the process to develop a UHV-Transfer chamber allowing for quasi in-situ measurements. The base pressure of the chamber is better than $4.7 \bullet 10^{-10}$ mbar and the chamber can be installed inside the Bruker-Magnet with applied fields of up to 0.5 T.

An excellent example for the capability of the instrument is the αi- αf map of a $Fe^{nat}Fe^{57}$ multilayer with a 4.5 µm grating on top of it. The sample was fabricated by courtesy of Kristiaan Temst group from Leuven (Belgium) and lend from Andrew Wildes (ILL; France). The fully polarised and analysed measurement was taken at 10 Å in different magnetic field. In fig. 3 the remanence measurement at 5 Gauss is presented with a clear spin flip signal in the (+-) and (-+) channels indicating a canted magnets. For analysing the beam the large ^3He-spin filter was used, that is covering ~80% of the detector.

The last example shown in fig. 4 illustrates the capability of MARIA to switch in seconds between the reflectometer mode with a vertically focussing beam on the sample and the GISANS/ SANS mode with a pin hole geometry. This measurement was done with the heatable liquid cell, where the liquid/ solid interface is probed on a polished and chemically prepared silicon block.

S. Mattauch, A. Koutsioumpas,
U. Rücker, E. Babcock, A. Ioffe
Th. Brückel (JCNS)

Reference

[1] Berk & Majkrzak, PRB 52, 10827 and PRB 58, 15416.

New Versatile High T_C Magnet Provides Up To 2.2T

Fig. 1: Compact high T_C magnet.

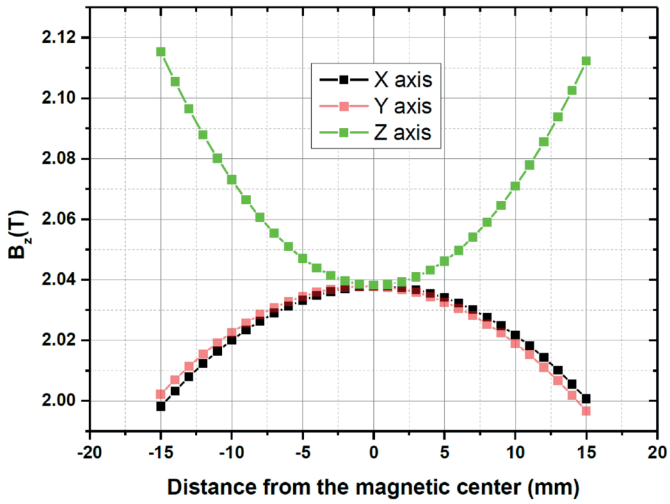


Fig. 2: Magnetic field profile around the sample area.

To cover the quite frequent demand of intermediate magnetic fields up to about 2 Tesla, a new compact magnet is available at the MLZ. Major applications cover small angle and reflectivity measurements to apply a horizontal or vertical field. That's why the design lasted in a cube with six **r**oom **t**emperature **b**ores (RTBs) with an opening angle of 40°. To achieve a handy operation, weight and size were to be minimised which required a superconducting coil design. The use of novel high T_C wires and the cooling done by a dry cold head, i.e. without the use of liquid Helium or Nitrogen, resulted in a design that fits even in the limited space of the sample chamber at the cold time-of-flight spectrometer TOFTOF. To include this application, two RTBs are combined to form a window with a wide opening angle of 130° in the horizontal plane, and 40° in the vertical direction.

The magnet was built in New Zeeland by the HTS-110 company. They supplied a compact split-pair magnet with a flux density of up to 2.2 Tesla in the centre with homogeneity better than 1.5% across the sample area of 25 mm in diameter. It is equipped with a powerful Gifford-McMahon type cold-head that enables operating the magnet in every orientation, by this providing a vertical, horizontal or longitudinal field with respect to the neutron beam. The yoke inside the magnet and the compact size solves the problem not to disturb neighbouring experiments due to the small magnetic stray fields even without active compensation.

Both the large RTBs of 80 mm in diameter and the arbitrary orientation give the user a maximum of flexibility in designing the experiment. The magnet has a mass of only 186 kg, resulting in a time for cool down from room temperature to operating conditions to less than 24 hours. This minimises the delay moving the magnet from one instrument to another. The time for ramping in the maximum field is less than 6 minutes, an advantage of the novel High T_C material used. A top loading cryostat to fit in the magnet is available, extending the temperature range down to lowest temperatures of about 50 mK using one of the low temperature inserts. Further equipment can be adapted on demand of our users.

The control of the magnet will be fully included in the instrument control by our modular TACO/TANGO system using the NICOS software as user interface. The easy control and the maintenance free dry cooling of the magnet aims for reliable and convenient operation which should be comparable to a standard cryostat.

H. Weiß (FRM II)

First 10-Year Overhaul Almost Completed

Ten years after its first criticality, regulations require the FRM II to do extensive tests on its main systems. Goal of these tests is to verify that the specified requirements are still met and therefore will allow for safe operation of the FRM II until the next scheduled inspection. Types of test are mainly pressure tests and visual inspection of the principal components close to the reactor core. Since such checks cannot be done under operational condition, the reactor was shut down on Feb. 9th, 2014 and is scheduled to be back in normal operation at nominal power in August 2014.

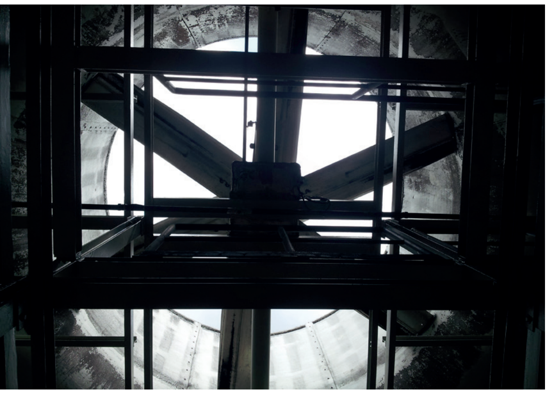


Fig. 1: View through the cooling tower, stripped of its inner components, and one of the fans into the sky.

The principal components to be tested are the central channel, the moderator vessel, the tips of the neutron beam tubes on the reactor side and their flanges on the experiment side, the cold and hot sources, and parts of the heavy water system. Also, calculations are under way to prove that sufficient safety margins are still present for the aluminum components that suffer embrittlement under the influence of neutron irradiation. As required, many of these inspections are to be carried out with participation of the expert organisation (TÜV SÜD). Their results have to be accepted by the licensing authority of the FRM II, the Bavarian State Ministry of the Environment and Consumer Protection (StMUV).

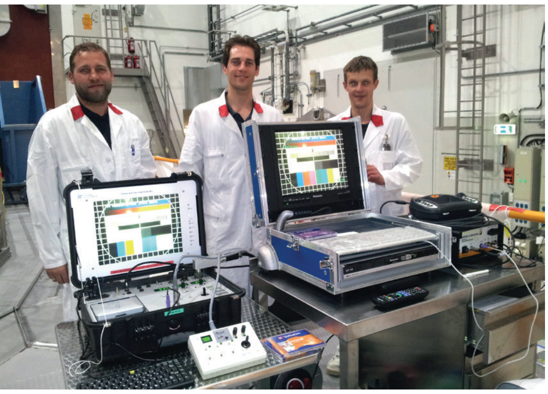


Fig. 3: V. Neff (TÜV SÜD), C. Willke (Westinghouse) and N. Wiegner (FRM II) (from left) after successful calibration of the camera system for visual inspection of the moderator tank.

The shutdown period is also used for working on other components that require a longer time without reactor operation. The biggest one is doubtlessly the cooling tower, where all the inner parts were removed to inspect the steel frame for corrosion and to improve the rust-protective coating. Arguably the most important components are the shutdown rods, where extensive maintenance is carried out. However, numerous other parts and

Fig. 2: Crew doing maintenance in the cooling tower (S. Zahn, M. Schulze, S. Hosszu, from left to right).

components indispensible for the successful operation of the FRM II undergo thorough inspection, maintenance or even replacement, whatever appears appropriate or is required by law.

The maintenance break started with the usual tests that routinely need to be performed after every shutdown. Then, to get ready for the inspection and to minimise contamination and irradiation of both personnel and equipment, the heavy water (D_2O) was drained off the moderator vessel. It then was dried and filled with light water (H_2O). Pressure tests were carried out on the moderator vessel, the central channel, and the beam tubes, all accompanied by visual inspection. Also for the secondary sources the mandatory checks were successfully performed and confirmed their excellent condition.

Fig. 4: Getting ready to work in the reactor pond (N. Wiegner, B. Schweiger, A. Pichlmaier, from left).

Limited accessibility due to space and irradiation constraints made some of these tests a challenging task. Most of these have never been carried out at the FRM II before and are highly unusual due to the special nature of the FRM II. Even for the specialists from the expert organisation a combined water/gas pressure test where the vessel to be tested is located underwater and accessible for visual inspection only by camera is a quite unusual task!

At the time of writing, all major tests have been concluded and demonstrated the impeccable condition of the FRM II. We still have reports to write, calculations to perform and – certainly – to put everything back into working order. Yet we are confident to finish this first 10-year overhaul successfully and in time.

A. Pichlmaier (FRM II)

NEUWAVE-6 – The Energy-Dependent Neutron Imaging Workshop

Garching: April 6-9, 2014

In 2008, when plans for spallation neutron sources took shape in several countries, little knowledge existed to exploit energy-dependent effects for neutron imaging methods. Scientists of FRM II took the initiative to organise a first workshop for scientists from all over the world discussing potential instruments and scientific methods that would make use of the time-of-flight spectrum of neutrons at spallation sources, but also of other methods using specific neutron energies. With energy measurements, different elements can be identified and isolated within large conglomerate samples; even stress and strain in technical samples can be detected and measured.

The main techniques are Bragg edge imaging at low energies of a few meV, and neutron resonance imaging at several hundred keV.

Slow neutrons posess a wavelength in the order of magnitude of typical crystal lattices. They can be scattered coherently on crystal lattices if their wavelength is shorter or equal to the lattice constant. If the wavelength is bigger, coherent scattering is no longer possible – this is the so-called Bragg edge or Bragg cutoff.

Stress and strain in a crystal lattice alter the lattice constant, and its shift can be detected with a neutron wavelength scan. This technique can be performed at time-of-flight sources, or at steady-state sources with the help of a tuneable double crystal monochromator.

The other technique, neutron resonance imaging, uses the high-energy part of the neutron spectrum. Several elements, or to be more exact, their single nuclei, show a resonance in neutron absorption at high energies, so they can be detected by absorption images in a high-energy neutron scan. This technique is only possible at time-of-flight sources.

Originally planned as a one-time occasion, this first workshop was so successful that it was repeated almost every year in different countries. NEUWAVE (**Neu**tron **Wave**length-dependent imaging) has helped to establish neutron imaging instrument projects called IMAT at ISIS (UK), RADEN at J-PARC (Japan), VENUS at SNS (USA), and ODIN at ESS (Sweden), and to develop most of the available knowledge about energy-dependent imaging.

NEUWAVE-6 now returned to its place of origin in Garching, where 42 experts from 13 different countries discussed recent developments and future plans in an open atmosphere. The last day, the scientists visited the FRM II, the research source of Technische Universität München, where the new ANTARES neutron imaging facility provides a velocity selector and a double crystal monochromator for energy-resolved measurements with a thermal and cold spectrum, and the NECTAR facility, where a fission converter provides high-energy fast neutrons for the examination of very large samples.

NEUWAVE-7 will be held at J-PARC in 2015 to celebrate the inauguration of the new RADEN instrument, and 2016 at ISIS for the inauguration of IMAT.

B. Schillinger (FRM II)

Pictures: W. Schürmann/ TUM

DPG Spring Meeting of the Condensed Matter Section

Dresden: March 30th - April 4th, 2014

TU Dresden, welcoming the participants of the DPG Spring Meeting.

The first warm and sunny days this year, the condensed matter community spent at Dresden's Technical University at the annual DPG Spring Meeting: 5515 participants met here. It is the biggest German event in this field, therefore most of them, namely 4784, came from Germany. And the other ones? The arrived from USA, Canada, Chile, Brazil as well as Australia, China, Japan, and India! As usual, it was a very lively event. The MLZ booth was located directly behind the entrance of the lecture halls' building. It was a really great place because all participants had to pass our booth on the way to the next lecture. After all, 4858 talks asked for audience! Thus, we met a lot of well-known users and got the opportunity to introduce the Heinz Maier-Leibnitz Zentrum to so many people who never before used neutrons or positrons. They learned what they can achieve using our instruments, how they can apply for beam time, and - a really interesting part! - what possibilities for financial support we can offer.

Thank you for all the nice chats!

I. Lommatzsch (FRM II)

The MLZ booth in front of some beautiful paintings.

European Press Officers Meet At MLZ To Continue A Fruitful Collaboration

Garching: April 9th

For the fifth time, European Neutron and Muon press officers and public relations met on April 9th at the Heinz Maier-Leibnitz Zentrum (MLZ) in Garching. European neutron and muon science may benefit from this collaboration, as together the press officers can reach out to a broader public.

Over the morning, the participants had fruitful discussions on how to improve **Neutronsources.org**, the international neutron website that the group helped to launch. For instance, following an appeal from Gerry Lander, the website has now a history section with important historical articles and relevant references.

In the afternoon, a science communication session followed. Sara Fletcher from ISIS gave the group valuable advice on how to increase the impact of communication activities. To close the day, we were introduced to two innovative formats of communication. Antonia Rötger from the Helmholtz-Zentrum Berlin (HZB) explained the advantages of the recently launched **#HZBzlog** where HZB's scientists explain their daily work in videos and blog posts. Andrea Voit from MLZ showed us how the world can now take a look inside the FRM II reactor and experimental halls and learn about neutron research explained by scientists themselves in the new i-pano interactive panorama **Science 360°**.

The press officers' network was created in 2011 when the group met for the first time in Garching. During a second meeting in May 2012 in London they discussed the **Neutronsources.org** website content and finally agreed on a basic concept. The third meeting was held in Grenoble in October 2012 to discuss the website outline. Final decisions with regards to the launch and dissemination were taken over a virtual meeting in July 2013.

I. Crespo (NMI3)

Ultracold Neutron Guide Development At The MLZ

Ultra**c**old **n**eutrons (UCN), neutrons with energies on the neV scale, are unique probes for testing our actual understanding of particle physics and the universe. Playing a leading role in the worlwide UCN business in future, important projects, e.g. the development of a powerful UCN source and the installation of flagship experiments like the nEDM (**e**lectric **d**ipole **m**oment) and n-lifetime have been started at the MLZ in collaboration with the TUM universe cluster and the TUM Physics Department some time ago. In order to obtain highest performance within these projects, dedicated neutron optical devices for the UCN transport, storage, polarisation and detection are mandatory. Since 2012, a unique sputtering infrastructure has been established at the Maier-Leibnitz laboratory of the Ludwig-Maximilians-Universität München (LMU). Starting from 2013, these coating facilities enable the upcoming fundamental neutron community at the MLZ to develop and produce requested UCN and cold neutron optics and hardware in-house.

UCN guide development

At various institutes around the world, ultracold neutron sources of high intensity are currently under construction or in commissioning. Neutron guides connecting the UCN production or intermediate storage volumes and the experiments are among crucial components that need to be developed, produced, and tested for these sources. The world's largest UCN guide which will deliver UCN from the powerful FRM II UCN source to future experiments located in Neutron Guide Hall East will have an overall length of 28 m and an inner diameter of 115 mm. The transport of UCN over such long distances in common UCN guides made from polished stainless steel tubes is associated with significant losses of UCN (> factor of 20). In addition, long guides act as an intermediate storage volume and therefore storage losses resulting from material choice, slits, surface contaminations, and bad vacuum conditions are of great importance. In order to obtain the best performance for the Garching UCN source, we got interested in two different guide concepts, both dealing with a decrease in surface roughness. Some first guide prototypes successfully passed tests at the ILL. The first guide concept which is commercially available uses the so-called replication technique. Float glass with a minimal roughness of a few Ångstroms is coated from one side with a material of high neutron optical wall potential e.g. Nickel or its nonmagnetic compounds. After galvanic reinforcement of this layer a self-sustaining sheet can be peeled off from the substrate, resulting in a perfect copy of the glass surface. Starting with optimal parameters of 99%/m in transmission (2011) for guides produced from these sheets, further tests showed some degradation in performance and finally reached a transmission of 97%/m (2013).

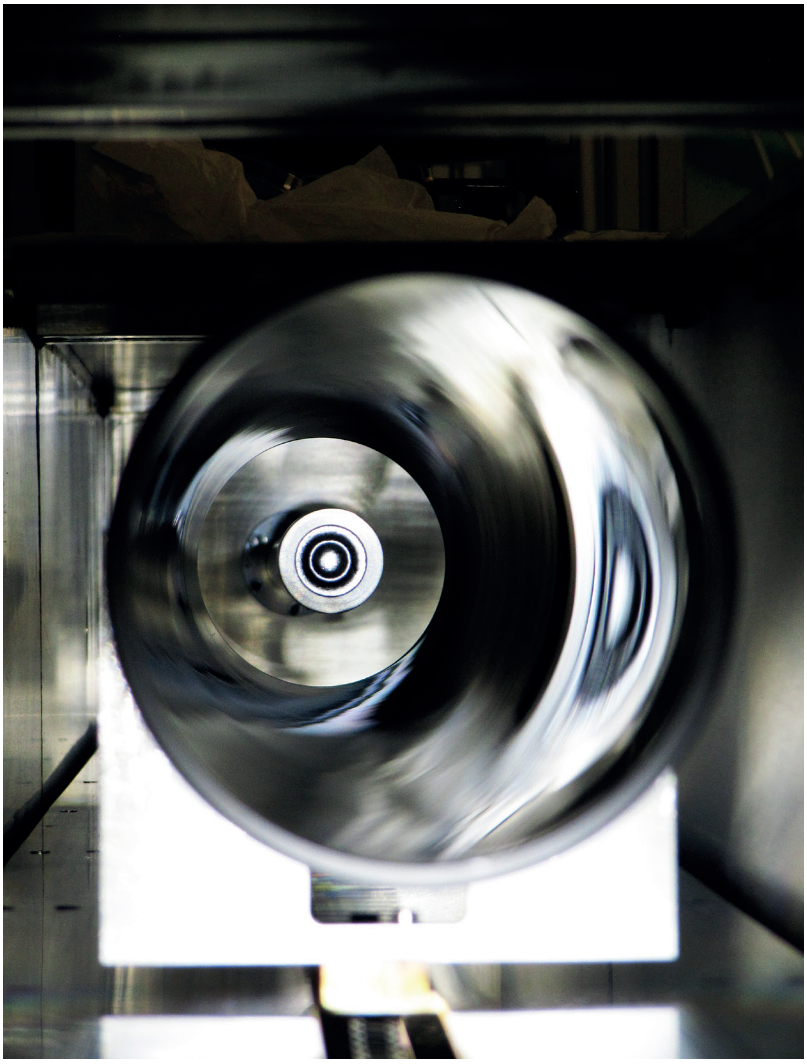


Fig.1: View inside of the UCN guide sputtering facility after finishing a 1.5 m guide element.

At the same time, UCN guides produced from glass tubes coated inside with various nonmagnetic Ni compounds were investigated. In combination with its lower costs, this guide technique proofed similar performance. Based on these results and the existing knowhow a dedicated and unique UCN guide coating facility was developed and built. With its total length (vacuum-chamber) of 3.6 m, tubes with a maximal length of 1.6 m and a maximal outer diameter of 200 mm can be coated inside with almost all common materials used in neutron optics. Embedded in the industrial environment of Munich (glass tube supply) and with the great support of the Neutron Optics Group at the FRM II, also dedicated UCN guide components like bent UCN guides up to 90° and UCN beam splitters can be produced. In order to test the performance of a future UCN guide system for the FRM II the facility is currently producing a real size UCN guide system of 21 m (14 UCN guide segments with a length of 1.5 m), which will be installed and characterised with UCN at the ILL UCN turbine in July/ August 2014.

Future developments

The v^2 dependence of the UCN velocity spectrum leads to a storable UCN density in lifetime or EDM setups which scales with the neutron optical wall potential, V_F of typical material storage vessels as V_F3/2. Therefore, V_F has to be as high as possible to increase statistics in UCN experiments. At the same time, the neutron loss probability per reflection on the storage wall has to be low enough to reduce absorption and up-scattering losses. The material with the so far highest known wall-potential commonly used, is ^{58}Ni with V_F = 346 neV corresponding

Fig.3: M. Huber (right, bachelor student at MLZ), J. Weber (left, neutron optics group) and T. Zechlau (centre, PhD at MLZ) during assemblage of a 45° UCN guide bent section.

to a critical velocity of v_c = 8.1 m/s. ^{58}Ni as coating material, however, is extremely expensive (Euro/ mg). Another way to obtain a high neutron optical potential, which is similar to an increase in the critical scattering angle of the surface, is the use of supermirror technology. Standard supermirrors, which can be produced nowadays with more than six times higher critical angles than nickel, are built from a stack of alternating Ni/Ti double-layers. Unfortunately, these multilayers have so far been produced only on flat substrates, which are glued together to rectangular guide pieces. Using such guide segments for UCN, would result (especially for large guides)

Fig.2: T. Lauer and T. Zechlau (PhD at the MLZ) keeping their hands the first 1.5 m long UCN guide element produced at the MLZ.

in unavoidable losses due to slits in the abutting edges. To overcome the described problems, we started to investigate for the first time the possibility of producing supermirror coatings inside circular glass tubes. Adding a second sputtering magnetron station into the existing guide coating facility, we were able to produce first supermirrors consisting of 15 double layers.

First neutron reflectivity measurements succesfully proofed the expected 1.5 times higher critical angle. In a second step we are going to produce at least 6 m of UCN guide in order to demonstrate the advantage of a supermirror coatings (520 neV) in comparison to the commonly used NiMo single layer coating (230 neV).

T. Lauer (FRM II)

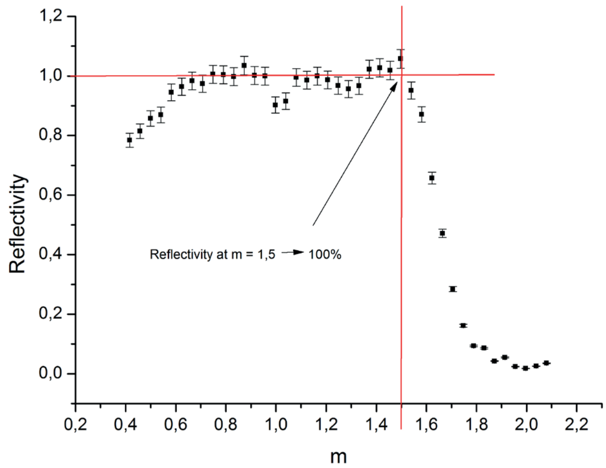


Fig. 4: Reflectivity measurement of a sample cut from one of the first glass tubes coated with a m = 1.5 supermirror resulting in a neutron optical wall potential of 520 neV. The measurement was performed at the cold neutron reflectometer TREFF.

ExZellTUM — Battery Research At TUM And MLZ

Fig 1: Members of the project ExZellTUM at a project meeting at MLZ.

Nowadays, Li-ion batteries are used in many applications from smart phones to electric cars, because they offer the best compromise with regard to weight, size, and electrical capacity. The basic concept of a lithium ion battery is simple and based on intercalation materials that can reversibly store lithium ions. During charge, lithium ions are “pumped” (forced by an applied field to move) from the positive to the negative electrode and move back during discharge, while electrical energy is released. This is a simple concept, but its realisation in an actual battery is very complex.

It is not sufficient to find active materials that can reversibly store lithium. All materials used in the battery (active materials, binder, conductive agent, current collector, electrolyte, separator, and cell casing) have to be chosen and optimised carefully in order to provide a good electrochemical functionality as well as long term mechanical and chemical stability in the cell under operation conditions. Additionally, the production of Li-ion cells demands advanced and very exact manufacturing processes. All this makes optimising Li-ion cells a challenging and time consuming process. After the introduction of the first Li-ion battery by Sony in the early 90’s, it took more than ten years to double the energy density of the cells — and we all know from personal experience with our mobile phones and laptops that although there has been some progress in recent years, there is still ample room for improvements of cell capacity and lifetime.

The project ExZellTUM, funded by the German Federal Ministry of Education and Research (BMBF) is devoted to optimising design and production of large format Li-ion pouch cells. One of the aims of the project ExZellTUM is building a Li-ion pouch cell with NMC ($LiNi_{0.33}Mn_{0.33}Co_{0.33}O_2$)/ graphite chemistry, made from scratch at TUM. The project combines fundamental research at the Institute of **T**echnical **E**lectro**c**hemistry (TEC, TUM) about electrode design, material behaviour and aging processes in small lab cells with the installation and operation of a cell manufacturing line at the Institute for Machine Tools and Industrial Management (iwb, TUM). At iwb manufacturing processes can be studied in detail and optimised. The cells produced in this way are tested at the Institute for **E**lectrical **E**nergy **S**torage Technology (EES, TUM). Here, cell performance, lifetime and safety are studied with the aim of improving cell design and management. Studies on single materials and fully functional Li-ion cells are complemented by ex and in-situ neutron research at MLZ using various methods as diffraction, radiography/ tomography, SANS, and PGAA. The project ExZellTUM is assisted by Fraunhofer IWU as well as several industry partners, including TÜV Süd, BMW, Manz and Brückner.

In our experiments at MLZ we focus on studying changes in the active material of the batteries during cycling, relaxation phenomena after charge and discharge, and the effects of cell aging under different conditions. Fig. 2 shows a typical diffraction experiment on a battery at the instrument Stress-Spec.

Under conditions like fast charging of Li-ion batteries or charging at low temperatures the deposition of metallic lithium on the graphite anode (so-called Li plating) can occur. Understanding this process is very important for battery safety, lifetime and low temperature performance. Li plating is a safety risk, since Li dendrite growth can short-circuit the cell. Unfortunately it is difficult to study lithium plating, because it is partly reversible – which means it might not be there any longer once the cell was opened and the electrodes extracted. Also, opening a cell in the charged state is tricky, because accidentally short-circuiting the cell has to be avoided, which becomes more dangerous with increasing cell size and energy content. Here, neutrons offer an attractive alternative. The experiments are facilitated by the neu-

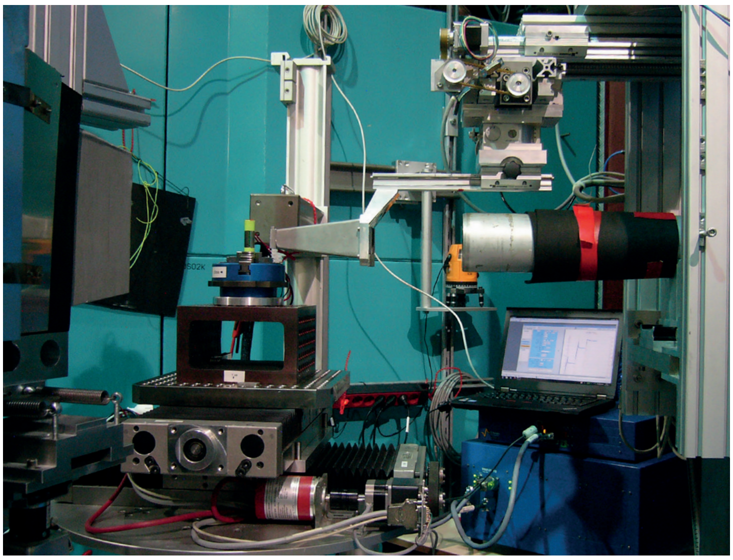


Fig. 2: Neutron diffraction experiment on a lithium ion cell at the instrument Stress-Spec.

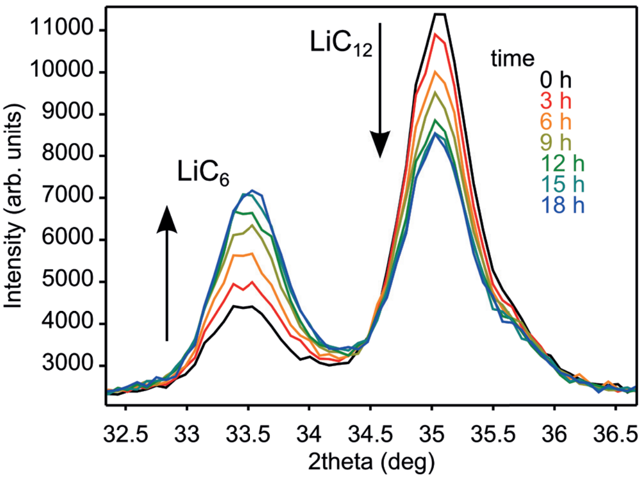


Fig. 3: Diffusion of lithium ions that originate from metallic Li deposited on the graphite anode causes LiC_{12} to transform to the higher lithiated LiC_6 during a 20 h rest period after charge.

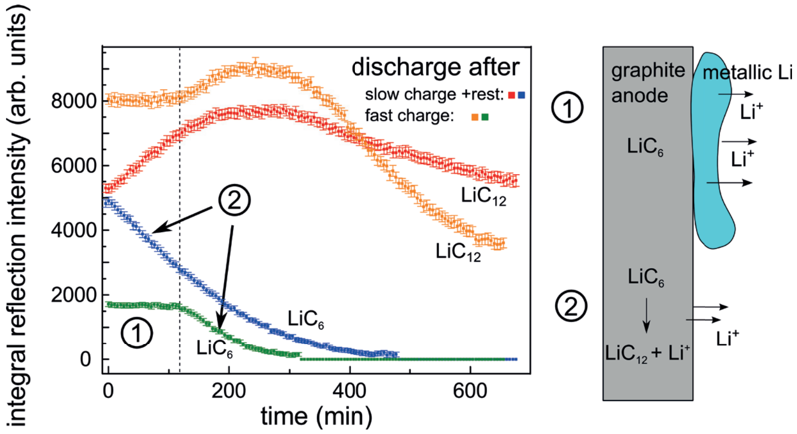


Fig. 4: The changes of integral reflection intensities of LiC_6 and LiC_{12} during discharge show a different behaviour, if lithium plating has taken place.

trons' sensitivity to light elements and their high penetration depth, which makes experiments on commercial Li-ion cells possible. The high neutron flux in combination with the area detector makes it possible to collect diffraction data on the (002) graphite, LiC_{12} and finally the (001) LiC_6 reflection in reasonable time intervals during charge and discharge. Thus neutron diffraction experiments at Stress-Spec are well suited to monitor in-situ the intercalation of lithium into graphite.

For the study, measurements were performed at sub-ambient temperatures to enhance the deposition of metallic lithium [1]. The battery was placed in a cryostat, cooled to ~-20°C and cycled at this temperature, while neutron diffraction was recorded. After charging sufficiently fast to expect Li plating, our measurements show the graphite is lithiated to a lower degree (we find less LiC_6 and more LiC_{12}) than after a much slower reference cycle [2]. This can be explained as follows: Since Li plating uses part of the active lithium in the cell, it is in competition with the intercalation of lithium into graphite, and a lower degree of graphite lithiation is observed as a result of lithium plating. As shown in fig. 3, during a 20 h rest period after the charge, we observe a gradual increase in LiC_6 and a decrease in LiC_{12} reflection intensity. This indicates a reaction of the plated lithium with the graphite anode and diffusion of lithium ions into the graphite particles takes place. Obviously, most of the metallic lithium plated on the graphite anode of the battery is not stable over a longer time. At room temperature, the process is expected to be even faster.

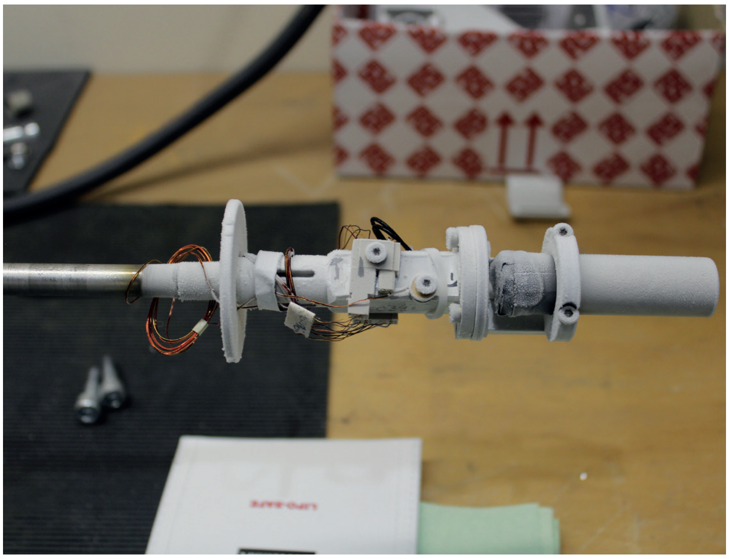


Fig. 5: Li-ion cell after low temperature experiment at Stress-Spec.

If the battery is discharged directly without a rest period, the metallic Li that has been plated on the graphite anode during charge has no time to diffuse into the graphite and is still present at the beginning of discharge. In this case, we observe no changes in LiC_6 and LiC_{12} reflection intensities for the first 115 min of discharge. This means no LiC_6 to LiC_{12} transformation is taking place, although charge is taken from the cell and lithium transferred from the anode to the cathode. The source for charge and lithium ions during this time interval must therefore be the discharge of metallic Li prior to the discharge of the lithiated graphite. With these measurements, we can estimate the amount of metallic lithium to be 19% of cell capacity. Further experiments are planned to quantify the amount of plated lithium at different charging levels. In the long term, the knowledge on lithium plating gained by neutron diffraction might help to understand the process of lithium plating in more detail and to develop more efficient and plating free charging protocols for lithium ion cells.

V. Zinth (TUM)

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[2] V. Zinth et al., Lithium plating in lithium-ion batteries at sub-ambient temperatures investigated by in situ neutron diffraction, submitted to Journal of Power Sources.

A Mile Stone for the Users: Green Light for the ESS!

Komitee Forschung mit Neutronen

It is a mile stone for the German and the European neutron user community that was reached on July 4th this year. In a press release of the Federal Ministry for Education and Research it was declared that Germany had decided to contribute to the construction and the operation of the European Spallation Source ESS in Lund [1]. The decision in favour of a state-of-the-art European spallation source as a European flag ship facility for research with neutrons had been demanded by the community for many years. Thus, the KFN highly welcomes the decision of the German government. We appreciated the constructive cooperation over the last years which was characterised by a complex set of interests which could finally be solved.

The German decision led to an immediate approval of the start of the construction phase of the ESS [2] which has to be regarded as an essential partial victory on the way to secure a broad, competitive, and sustainable provision with neutrons for research in Europe.

However, the future of several national sources being of essential importance for the education and training of the future generation of scientists but also to satisfy the enormous demand of research with neutrons are not secured yet or have already been decided to be closed as for instance the BER II reactor in Berlin. Such top-down decisions as in Berlin have to be prevented in the future. It is important that the national governments, global partners such as large institutes, and the user community agree upon national and international road maps for the development of the German and the European landscape for neutron sources in due time.

To actively contribute to this process will be one of the major tasks to be tackled by the new KFN elected in July 2014 [3]. In this election, about 40% of all registered community members took part and I would like to thank the voters personally but also in the name of all elected colleagues very much for their trust. We are aware of the severe challenges associated with the development of a closely connected hierarchical network of neutron sources in Europe.

But there are several more important tasks on the agenda for the next years. It is important to further develop the highly important instrument for the participation of university groups to the development of instrumentation at large scale facilities the so-called collaborative research (Verbundforschung) funded by the BMBF. Furthermore, the KFN is severely concerned about the missing announcement of an access programme for neutron sources in the HORIZON 2020 frame programme by the European Union. It was the previous NMI3 access programme that guaranteed free access of European users to nationally funded neutron sources. If an equivalent funding scheme will not be provided in the future a severe loss of possibilities for research with neutrons but also a significant decrease of scientific exchange will follow. This would be a serious setback for the German community but especially also for the many users from European countries without national neutron sources.

Finally, it becomes clear that a mile stone was reached but a lot of work is still waiting. In this sense I would like to thank all the readers of this MLZ newsletter for their support and I would like to ask and invite you to help and support the KFN in working for the benefit of research with neutrons.

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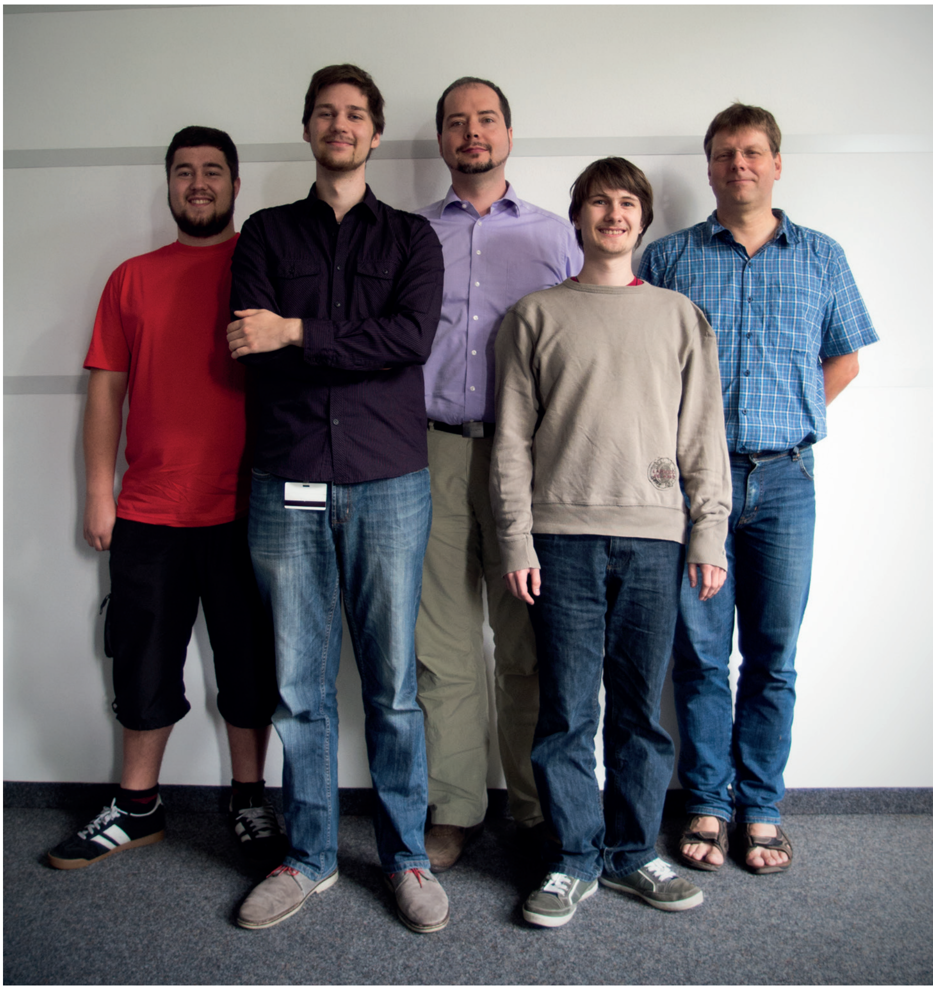
The Instrument Control Group

The Instrument Control Group was established in the summer of 2012. It aims to support all MLZ scientists regarding instrument specific control as well as interdisciplinary projects concerned with this topic. Beside its head Jens Krüger, five members belong to this group: Enrico Faulhaber (NICOS and electronics), Alexander Lenz (NICOS and TACO/TANGO servers), Stefan Rainow (apprentice), Stefan Huber (apprentice), and Pascal Neubert (apprentice).

Our group's major task is the design, implementation, development, and maintenance of the instrument control software. In order to offer a unified software system for all instruments and thus get a stable and user friendly instrument control software, a layered modular software architecture is used. It is based on TACO/TANGO device servers for the "intelligent" access to the hardware components. In addition, the functional instrument logic and graphical user interface NICOS have been developed by our group.

The MLZ is part of the international collaboration for the development of TACO's successor, TANGO. This distributed and network-based instrument control system is used by about 20 institutes to control their machines. Our group is strongly involved in this international community with its lively exchange of ideas.



Solutions for all problems regarding instrument control: Stefan Huber, Alexander Lenz, Enrico Faulhaber, Pascal Neubert, and Jens Krüger (from left to right).

The concept of bringing the computers with the TACO/TANGO servers close to the hardware and consider them as part of an experiment component was successfully set up in our TACO/TANGO boxes. Starting with the boxes for the sample environment (high temperature furnaces, cryostats, gas handling, and mixture systems for low temperatures, …) the concept was successfully extented to components of the instruments which are not permanently used. This concept together with corresponding software components allows for easy changes of the instrument set-up (including autodetection) for different experiments.

To reach our goal to create a robust and reliable instrument control software, we use a professional development environment and workflow in the software development. Based on a modern **s**ource **c**ode **m**anagment (SCM) each change in the software has to pass some automatically invoked checks before it will be given to a source code review process. Those are for example:

- syntax checks
- coding styles
- basic function tests.

For new features, tasks, ideas as well as for bug reports we use an agile tracking system, which is very close connected to the source code management and the integrated test suite. Following this workflow, code writing and testing is a very structured process and the code's quality can be improved noticable.

And there are even more tasks: One of it is to select and adopt the optimal instrument control hardware for the instruments due to the requirements. Preference is given to products based on common standards. For some further special applications, we work on the custom related PLC (**P**rogrammable **L**ogic **C**ontroller) programming for special hardware equipment. To simplify the remote access to the PLC we defined some standards to exchange data between the PLC and the 'outer' world. And in close cooperation with the Detector Electronics Group a data acquisition software for some detectors will be developed.

J. Krüger (FRM II)

Newly Arrived

Oleksandr Dolotko

I joined the team of the high resolution neutron powder diffractometer SPODI as a postdoc recently. Before, I worked on the project of TU Darmstadt devoted to in-operando studies of fatigue processes in commercial Li-ion batteries by combination of neutron diffraction and electrochemistry.
My scientific fortune allowed me to work also in France and USA, where hydrogen storage materials were the object of my research. My interests are primarily focussed on the investigation of different energy storage materials, which can be suited for Li-ion batteries and hydrogen storage.

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Anna Frontzek

I am a postdoc at JCNS and working on a project devoted to the study of dynamics of unfolded proteins using NSE. In order to get a complete picture of protein dynamics it is also planned to characterise the protein structure by SANS, RT-IR and other techniques.
My previous scientific work was the study of protein dynamics at phase transitions and phase transformations. I am interested in studying biopolymer dynamics, especially the changes at conformational transformations in biopolymers, glass transitions, phase transitions.

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Marina Khaneft

I joined the team at SPHERES as an instrument scientist. I obtained my PhD at Technical University of Darmstadt where I worked on polymers confined in carbon porous materials. My research interests are related to materials science: structure and dynamics in porous systems, specifically related to energy materials.

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Stefan Söllradl

I am instrument scientist at the instrument NECTAR. There I will perform neutron imaging experiments using fission neutrons. Before, I finished my PhD at the University of Bern and Paul Scherrer Institute in the field of prompt gamma activation analysis, materials science, and cold neutron imaging. My scientific interest is the non-destructive investigation of samples, particularly by means of neutron imaging with fission neutrons. I am interested in applications for neutron imaging as well as its combination with other radiation types for sample analysis.

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I am on the postdoc position in PGAA group. I prepare samples for measurements and analyse the results, also I participate in building and starting the low-background counting chamber for measurements of irradiated samples.
I'm a chemist and I dealt a lot with separation of artificial radionuclides from environmental samples. For measurements, among other techniques, I was using mostly liquid scintillation counting. I would like to apply liquid scintillation counting in the PGAA technique. This could be a good method for detection of charged particles produced in the beam and currently we are working on the instrument for that purpose.

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Amir Syed Mohd

I am a postdoc in the oxide thin film group working on MBE instrument and MARIA reflectometer. I did my PhD at UGC-DAE CSR, Indore, India. During my PhD., I studied surfactant mediated growth of magnetic multilayers. My field of interest is to study magnetic, surface and interface properties of functional multilayers.

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ERASMUS Lends Wings: Trainees from Garching to Grenoble

Do you remember us? We are the two trainees who reprted about their stay at the PSI in Switzerland in the last newsletter's issue. In spring 2014, we really got the opportunity for the visit at the other big European neutron source: The ILL at Grenoble. Organised by Elisabeth Jörg-Müller (MLZ), Eliane Jolie, and Anita Schober (both ILL) and financially supported by ERASMUS for staff members of the Technische Universität München, we changed to the ILL for three weeks.
Martin Weber and Thomas Hempel took care of us there: They introduced us to the electronics department. We made tours of the ILL area as well as of the reactor building. We received safety instruction (even with practice at a fire extinguisher), and the radiation protection department took us for a tour, taught us the rules at the ILL, and showed us some Geiger counters. You wonder how we understood each other? That was sometimes quite funny: We changed between German, English, and French. In case we would have been there for longer, we could have started one of the French courses they offer.
The work we did was really interesting: We helped changing relais cards, read their wiring schedules, wrote and dealt with permissions to work, controlled pumps and their signal lamps in the control room. Furthermore we learned about the construction of the radiation measurement instrument at the new entrance as well as the configuration and calibration of measurement instruments. During our last week, we joined the colleagues maintaining an emergency generator. Not only that we learned a lot about electrical engineering, it was also a very special experience to work in such loud surroundings that we could only make ourselves understood by using our hands.
We enjoyed our time very much and like to thank all those who helped us!

K. Bulla, F. Jaumann (FRM II)

The Tandem is 75

Birthday of Klaus Böning and Jürgen Großkreutz

Since the colloquium on the occasion of their 65th birthday, they are on a first name basis and meet several times a year: namely, they both have a subscription to the State Opera. In June, they celebrated their 75th birthday: Klaus Böning on June 30th and Jürgen Großkreutz already on June 6th.

The history of the FRM II is a story of tandems: Stoiber—Zehetmair, Gläser—Herrmann, and also the tandem Böning—Grosskreutz. Prof. Klaus Böning was over 15 years of his work life at the Technische Universität München as a project manager almost exclusively preoccupied with planning and development of the FRM II. Ministerialdirigent a.D. Jürgen Großkreutz was his congenial partner in the former Bavarian State Ministry of Education, Science and the Arts. The two are not only born in the same year, they also pursued the same goal: the challenge to act as midwife for the FRM II as the German research neutron source. "*In retrospect, the FRM II was an incredible success story of a network of people who all have fought for the same goal*," said Grosskreutz, whose last 15 years of service were also influenced mainly by the FRM II project. TUM-President Herrmann paid tribute to his hard work in a written congratulation on the 75th anniversary with the words, "*Neutrons are light, Grosskreutz also!*"

Sitting in the front row: Jürgen Großkreutz (left), Klaus Böning (right), both accompanied by their wives. (W. Schürmann/ TUM)

Klaus Böning bears the nickname "Mister Compact Core" very rightly: The concept of the compact core of the FRM II essentially bases on his research and calculation and also gave him an internationally known name. It was at that time in the early 80's, a real technical innovation, which met all the high performance expectations at the start of the FRM II on March 2nd, 2004. A few months later Böning retired after 40 years at the TUM. He had devoted the last 15 years solely to the project development and planning of the FRM II. To this day, he comes to his office regularly at least once a week, but now dedicates more time to his hobbies. He inherited the enthusiasm for physics from his father, who was an engineer in the engine development at BMW; from his maternal side he got love and talent for music right from the cradle. His grandfather managed to let him build his first violin in the harsh postwar years, later the piano has fascinated him more. During the promotion, time was running out because at the same time he played basketball very committed and at a high level with MTV Schwabing. He has cancelled just one game: namely, that one, which took place in 1965 on his wedding day! Later, he discovered a love for squash games because, "*it takes only one partner and so you have not to coordinate the schedule for a whole team.*" Meanwhile, he namely had become a father of two and a successful physicist. "*My most mad experiment was the one in which we have irradiated the samples at the Atomic Egg directly in the fuel core, but could not investigate, so we had to transport them to Grenoble by helicopter.*" At that time, he had examined together with colleagues the anisotropy of the electron scattering on point defects in aluminium and its influence on the electronic transport properties by irradiating the sample at -270°C. Individual atoms are pressed with enormous forces to other points in between the crystal lattice and this state is quasi frozen by the low temperatures. In order to investigate the grid, it had to be transported to Grenoble in this frozen state. For this, the largest transport helicopter, which the Air Force had available at that time, was organised with the help of colleagues from the Forschungszentrum Jülich. Nevertheless, that was a very difficult operation because the samples had to be transported in a 100 l Dewar container cooled by liquid helium. During flight more helium evaporates than at the bottom because of the smaller air pressure, and during landing, it condensed again. Nevertheless, the experiment succeeded and they were able to achieve important results for the migration of defects.

Klaus Böning studied at the TUM and never left; he stood in close international contacts anyway. He was, along with his wife on an extended lecture tour in China and several months at the ILL in Grenoble and the Nuclear Research Center NRC Democritos in Athens.

He did not want to celebrate his birthday on June 30th big, "*maybe my wife and I go out for dinner.*" Roswitha Böning will also grow 75 this year and so Klaus Böning is looking forward to a great "150th Celebration" a few weeks later, when he wants to invite family, friends and companions. The MLZ wishes the former tandem, Klaus Böning and Jürgen Großkreutz, a happy 75th birthday and especially health, but also many more jointly opera evenings!

C. Kortenbruck (FRM II)

News for Users Ahead!

With the next cycle (No. 35), we introduce some new features for our users!
First of all an online safety training. In case you have ever been for an experiment at the MLZ in Garching, you know the procedure: You had to watch a one-hour instruction movie on-site once a year. This was very uncomfortable for all users, because the experiments were delayed by this. Again and again, you have asked for an online safety training that could be done at home in advance in our user surveys. We are really happy to fulfill this request now!
Instead of watching the movie, you now read slides and answer some multiple choice questions in the end. It is possible to make a break and start later from that point you left the instruction before.
From now on, our User Office System checks each application for a visit if this person has already been registered in our instruction system called "UWEB". If not, a new account is created during the following night and an email containing login-information and another one informing you about the training waiting for you are sent. From then on, the system will send you emails as soon as your training has to be repeated.

The second point is the Sample Tracker. The Radiation Protection Ordinance asks for a balancing of samples. For this reason, we developed an online tool. In future, each sample that shall be used in the scope of an experiment at the MLZ has to be entered into this tool seven days before the experiment's start at the latest. This is possible as soon a your experiment is scheduled at the instrument and you received your invitation email.
You can reach the FRM II Sample Tracker at
user.frm2.tum.de/sampletracking
Your username and password are identical with those in the User Office System.

Please find all information about these two new features at **mlz-garching.de/englisch/user-office/your-visit-at-mlz/in-advance.html**

Call for Rapid Access Proposals: Next Deadline August 7th, 2014

Beam time will be scheduled between August 19th and October 17th, 2014

We are pleased to announce the present call for proposals within the MLZ Rapid Access programme for the following **three instruments**

Instrument	Description	Neutrons
Diffraction		
SPODI	High resolution powder diffractometer	thermal
SANS and Reflectrometry		
KWS-2	Small angle scattering	cold
Imaging		
PGAA	Prompt gamma activation analysis	cold

(W. Schürmann/ TUM)

By a fast response process we will allocate up to a **maximum of 3 beam days** on each instrument in the next reactor cycle. Each accepted proposal can receive up to a **maximum of twelve hours** of beam time.

Proposals submitted after August 7th, 2014, will be considered for the next FRM II reactor cycle, i.e. November 2014.

How to apply

- **Discuss** the proposed experiment with the instrument scientist well in advance – this step is mandatory!
- **Submit** a proposal via the User Office online system
  - for **PGAA** and **SPODI** **user.frm2.tum.de**
  - for **KWS-2** **fzj.frm2.tum.de**
- **Complete** all mandatory fields (marked orange) of the proposal form
- **Upload** the two page pdf file with all the technical and scientific details – you can download a template from **mlz-garching.de/englisch/user-office/downloads**
- Don't forget to **check** the checkbox *Rapid Access*!

Once the measurements have been carried out, please do not forget to upload all your experimental reports - please see more detailed information at **mlz-garching.de/englisch/user-office/your-visit-at-mlz/home-again**
Further information available at **mlz-garching.de/englisch/user-office/getting-beam-time**

Referees Met for the 18th Time

First discussions during the welcome buffet.

The number of proposals submitted to the MLZ proposal round in 2014 is the largest ever: 399 proposals had been submitted to 25 instruments, with an increase of 13% by comparison to the already very successful last proposal round. In total 2.519 beam days were requested - this indicates an increase of 9%.
All submitted proposals had to be distributed among the subcommittees of the MLZ Review Panel by the User Office. Each got an average of 57 proposals, with a maximum of 76 for the Soft Matter subcommittee.

The deadline of the proposal submission had been on May 2nd, 2014, and the MLZ Review Panel meeting took place on June 26th and 27th, 2014. The referees worked really hard to rank the scientific quality of the submitted proposals and allocate the available beam days. In total 305 proposals could be accepted, with a large increase of 67% compared to the the results of the last proposal round. The overall overbooking factor was about 1.5, with a peak up to 2.7 on the diffractometer for large unit cells BIODIFF.
The MLZ Review Panel members commit themselves to this work for at least six proposal rounds. For each proposal round, new members replace those who already reached their limit. For the 18th proposal round, MLZ welcomes two new members and thanks those former members who left the Review Panel.

Jürgen Neuhaus, Winfried Petry, and Flavio Carsughi welcoming the referees.

ESMI - The European Soft Matter Infrastructure

The ESMI (European Soft Matter Infrastructure) project is granted by the EU under the Framework Programme 7 as an infrastructure project. It provides free-of-charge access to world-class infrastructure for polymer and colloid synthesis, experimental soft matter physics and computer simulations to European soft matter scientists. Among the experimental instrumentation offered via the Trans-National Access programme, there are instruments for neutron scattering at MLZ, with a number of sample environment units for soft matter applications.

ESMI
EUROPEAN SOFT MATTER INFRASTRUCTURE

In order to access any ESMI infrastructure the proposed experiment shall be submitted through the ESMI online system and the ESMI Review Panel will provide the decision within about four weeks after the submission.

ESMI does not only provide free access to cutting edge instrumentation, but does much for the European soft matter scientists: Thanks to the EU financial support it covers travel, subsistence and accommodation costs to those users who have a proposal accepted by the ESMI Review Panel.

It is a pleasure to inform you that ESMI was extended by additional twelve months, which means until the end of the year 2015. The European Soft Matter scientists has twelve more months to benefit from the ESMI offer.

ESMI is a great opportunity for all European Soft Matter scientists! Please register at the ESMI web portal and learn more about the available instrumentation and how to apply for Trans-National Access at
www.esmi-fp7.net

Call for Proposals: Next Deadline January 16th, 2015

Instrument	Description	Neutrons
Diffraction		
BIODIFF	Diffractometer for large unit cells	cold
HEIDI	Single crystal diffractometer	hot
MIRA	Multipurpose instrument	cold
POLI	Polarized neutron diffractometer	hot
RESI	Single crystal diffractometer	thermal
SPODI	High resolution powder diffractometer	thermal
STRESS-SPEC	Materials science diffractometer	thermal
SANS and Reflectrometry		
KWS-1	Small angle scattering	cold
KWS-2	Small angle scattering	cold
KWS-3	Very small angle scattering	cold
MARIA	Magnetic reflectometer	cold
NREX	Reflectometer with X-ray option	cold
REFSANS	Time-of-flight reflectometer	cold
SANS-1	Small angle scattering	cold
Spectroscopy		
DNS	Diffuse scattering spectrometer	cold
J-NSE	Spin-echo spectrometer	cold
PANDA	Three axes spectrometer	cold
PUMA	Three axes spectrometer	thermal
RESEDA	Resonance spin-echo spectrometer	cold
SPHERES	Backscattering spectrometer	cold
TOFTOF	Time-of-flight spectrometer	cold
TRISP	Three axes spin-echo spectrometer	thermal
Imaging		
ANTARES	Radiography and tomography	cold
NECTAR	Radiography and tomography	fast
PGAA	Prompt gamma activation analysis	cold
Positrons		
NEPOMUC	Positron source, CDBS, PAES, PLEPS, SPM	-

Just **register** at the User Office online system. There you can access the proposal and reporting system. For additional information please have a look at
mlz-garching.de/user-office

Proposals have to be **submitted** via the web portals within your personal account
- for FRM II, HZG, MPG instruments

user.frm2.tum.de

- for JCNS instruments

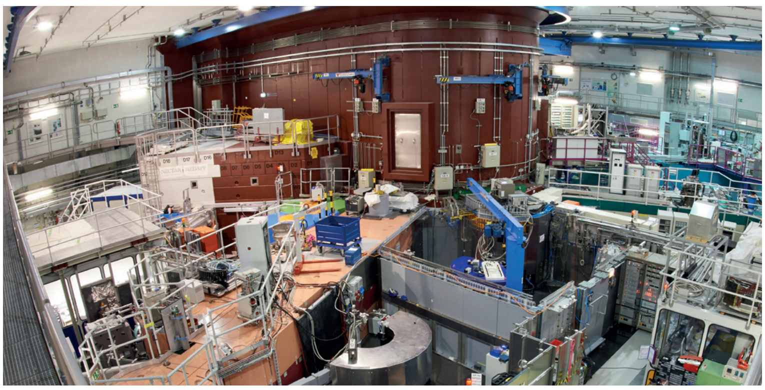
fzj.frm2.tum.de

The next **review** will take place on March 5th-6th, 2015. Results of that review panels' meeting will be online about two weeks later.

Financial Support
The FRM II is a partner in the EU supported network of European neutron facilities (NMI3-II in FP7). **Researchers working in EU Member States or Associated States** other than Germany can apply for travel and subsistence reimbursement.
Researchers working at German universities can apply for travel and subsistence reimbursement granted by the FRM II, JCNS, and HZG .
mlz-garching.de/englisch/user-office/your-visit-at-mlz/home-again

To ensure the **feasibility** of the proposed experiment please contact the instrument scientist in advance.

In addition to beam tube experiments, irradiation facilities are available for neutron activation analysis, isotope production and silicon doping.



Pictures: W. Schürmann/ TUM

Upcoming

September 01-12
18th JCNS Laboratory Course - Neutron Scattering 2014
(Jülich/ Garching, Germany)
www.neutronlab.de

September 11
VDI-TUM-Expertentreffen
(Garching, Germany)
www.frm2.tum.de/indico/conferenceDisplay.py?confId=10

September 18-19
DENIM 2014: Engineering workshop in the field of neutron scattering instruments
(Ismaning, Germany)
www.fz-juelich.de/jcns/EN/Leistungen/ConferencesAndWorkshops/JCNSWorkshops/2014DENIM/_node.html

September 21-23
German Conference for Research with Synchrotron Radiation, Neutrons and Ion Beams at Large Facilities
(Bonn, Germany)
www.sni2014.de
Visit our booth there!

September 24-26
ESS Science Symposium: Surface and Interface Reconstruction: A Challenge for Neutron Reflectometry
(Bernried, Germany)
www.events.tum.de/frontend/index.php?sub=16

October 20-23
JCNS Workshop 2014: Trends and Perspectives in Neutron Scattering
(Tutzing, Germany)
www.fz-juelich.de/jcns/JCNS-Workshop2014

Reactor Cycles 2014

No.	Start	Stop
30b	14.01.2014	10.02.2014
35	19.08.2014	17.10.2014
36a	10.11.2014	12.12.2014

Heinz Maier-Leibnitz (centre) looking at a model of the Atomic Egg (about 1957).

Imprint

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Slippery when wet

Inside the new building connecting the reactor building (behind the left wall) to the Neutron Guide Hall East (behind the right wall). On the right you can see three structured surfaces and a part of another, bigger one, on the left. These are the prepared wall penetrations for guides delivering neutrons to the instruments in the new hall. Starting all together from the reactor building, they will fan out inside the connection building and separately enter the Neutron Guide Hall East.

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