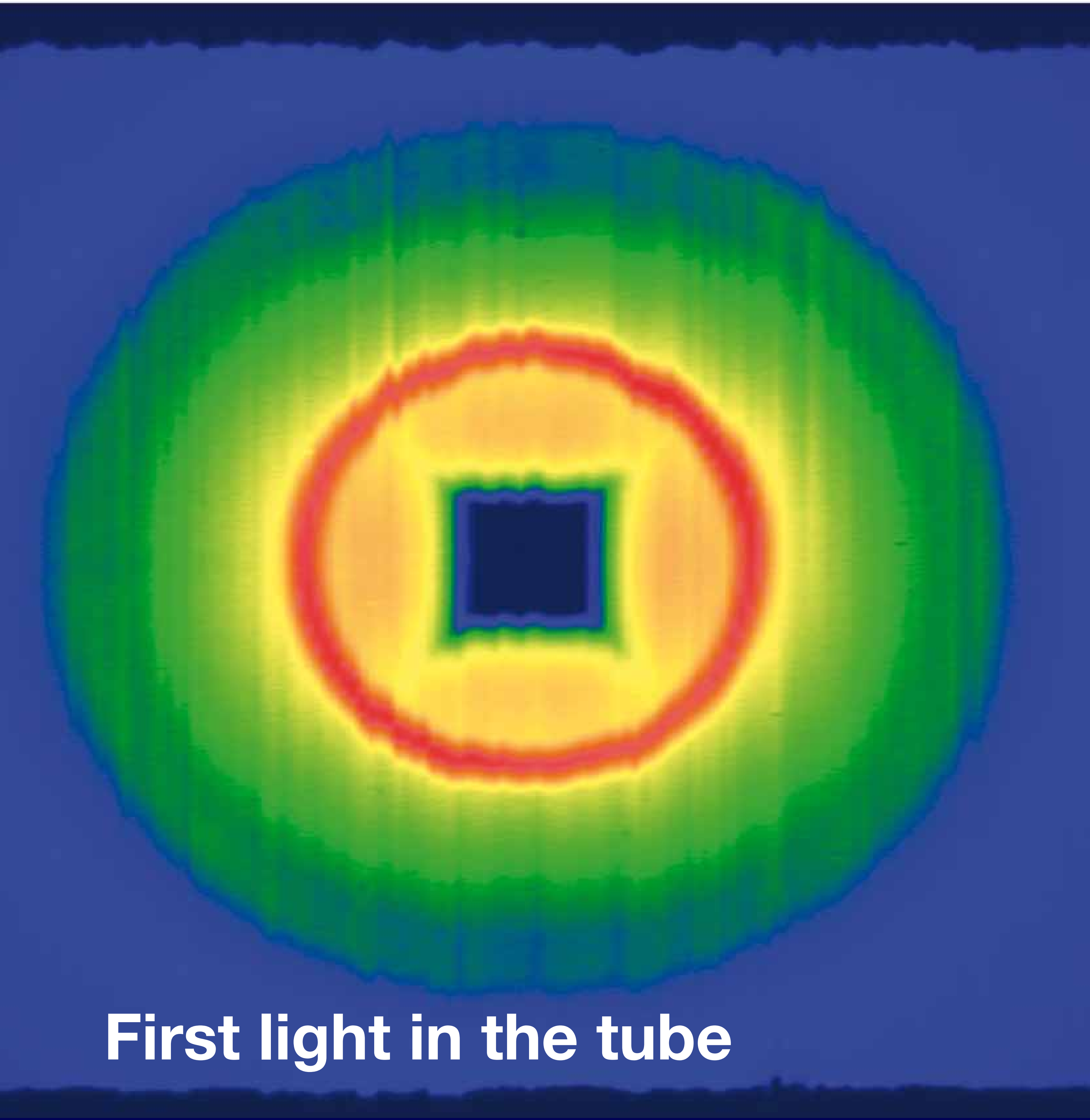
FRM II
Forschungs-Neutronenquelle
Heinz Maier-Leibnitz

JCNS Jülich Centre for Neutron Science

Helmholtz-Zentrum
Geesthacht
Zentrum für Material- und Küstenforschung

HZB Helmholtz
Zentrum Berlin



First light in the tube

FRM II news

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Next deadline: July 20th, 2012

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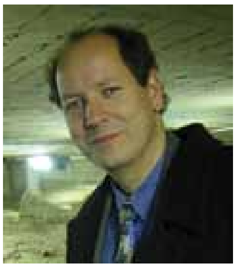
TUM

A part of the European Research Area

Neutron centres in Europe have always collaborated in scientific projects and instrumental developments since the early days of neutron research at the end of the 1950s. By the establishment of the *Neutron Round Table*, these initiatives have been supported by the Framework Programmes of the EU since FP2. Right from the beginning, with the start of routine operation in 2005, we actively participate in the club, now named the *Neutron Scattering and Muon Spectroscopy Integrated Initiative*, NMI3.

A new funding period for four years has just started in February 2012 as NMI3-II. Being part of the FP7-Infrastructures programme, the consortium of eighteen partners provide access to the neutron and muon sources for European researchers, develop technical components and methods and undertake a series of networking activities including the support of education like summer schools or the e-learning platform called *Virtual Neutrons for Teaching*.

After the shut down of the sources in Jülich and Geesthacht we joint our forces and merged the access programme of the FRM II, JCNS and GEMS to a common project. By this and the access to the BER II source of the Helmholtz Zentrum Berlin, the amount of beam days for European scientists to German facilities could be maintained. Thereby we provide a significant contribution to the European Research Area of large scale facilities. The open access to our neutron source, i.e. the selection of proposals solely on its scientific merit is one of our important strategies which we would like to continue. This necessitates a continuous funding by the EU in future, in which the large success of the NMI3 consortium provide good arguments for a sustainable European support of the FRM II.



Jürgen Neuhaus
FRM II Deputy Scientific Director

A Facility for Nuclear and Particle Physics

The cold white neutron beam MEPHISTO

Fig.1: RASPAD at the NL3a in the empty neutron guide hall of the FRM II in 2005.

Since the FRM II went in operation there has always been an experimental area dedicated to nuclear and particle physics: MEPHISTO, the **ME**asurement facility for nuclear and particle **PH**ys**I**c**S** with cold neu**T**r**O**ns. Beam time can be requested by interested users twice a year by submitting proposals via the online FRM II User Office system.

MEPHISTO offers the possibility to build up experimental setups using a cold white neutron beam with high intensity. It allows experiments with a reasonable degree of specialisation and complexity. Because experiments are usually built up from scratch, the duration of experiments typically ranges from weeks to several reactor cycles, whereof a large part is dedicated to building up, calibrating and commissioning of the experiments.
Typical applications include experiments dealing with free neutron decay or using the neutron as probe or trigger for nuclear reactions.

During the first reactor cycles (2005-2006) MEPHISTO was located at the end of the neutron guide NL3a in the middle of the neutron guide hall west. In 2006 MEPHISTO moved to the neutron guide NL1, making room for the new small angle neutron scattering machines. The NL1 is shared with the upstream instrument NREX. Although the new position only provides limited space due to the small distance to the NL2 neutron guide, several new experiments had been successfully built up and operated.

One of the first experiments, RASPAD, dealt with the neutron decay. In addition to the common decay into proton, electron and anti electron neutrino, there is another decay channel with an additional gamma quantum emitted, called “radiative decay“. The aim was to measure the branching ration (~0.1%) of this decay mode, using the triple coincidence of proton, electron and gamma.
This measurement also showed a common problem of nuclear physics experiments in the vicinity of other neutron experiments, whose shielding often involves neutron capture and production of high energy gammas (e.g. in boron or cadmium) resulting in a high background for gamma detection.

The next experiment at MEPHISTO, the proton spectrometer aSPECT, addressed the determination of the upper left element of the Cabbibo-Kobayashi-Maskawa-Matrix (CKM), V_{ud}, describing the mixing of the u and d quark. Using neutron decay V_{ud} can be accessed by neutron lifetime experiments or through measurements of the neutrino correlation coefficient a. The recoil spectrum of protons from neutron decay is sensitive to this parameter and was measured with high accuracy by the aSPECT group.
This experiment is an example for the research

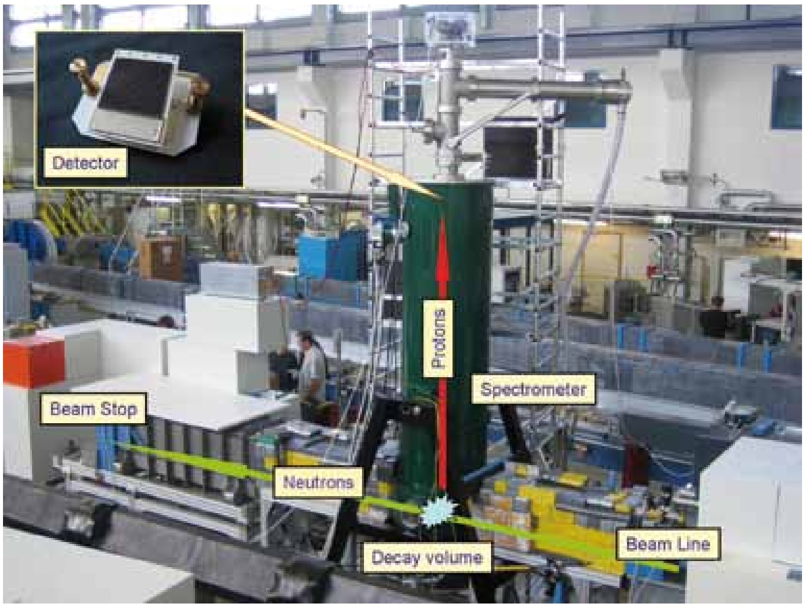


Fig. 2: aSpect with schematic setup.

field of free neutron decay at low energies. Other elements of the CKM are mainly accessible from the high energy side at large accelerator facilities.

Another type of experiments at MEPHISTO is focussed on the production of **u**ltra **c**old **n**eutrons (UCNs). The experiment cubeD2 for example used a frozen deuterium crystal (T = 6 K) as converter for cold neutrons. Because the MEPHISTO beam at NL3a was not strong enough to produce a sufficient UCN flux for measurements the experiment moved to the TRIGA reactor in Mainz where it could be built up near the core. Anyway, this must be seen as the starting point of the effort to build a strong ultra cold neutron source at the FRM II.
Instead of solid material also liquid ^{4}He in a tank can be used to produce UCNs, which was done in the experiment HeliMephisto. Based on common cryo technique this approach offers the possibility to produce a medium amount of UCNs at a cold neutron guide for experiments. At MEPHISTO mainly technical questions had been solved to build a more powerful source as successor which is now continued at the ILL.
In several measurement cycles other solid converter materials were tested at MEPHISTO for UCN production. Not only solid deuterium, as measured with cubeD2, but also oxygen, nitrogen-15 and deuterated methan were tested and compared. The results are quite valuable for the technical design of the new UCN source at the FRM II at SR6.

Since 2008 a series of experiments dealing with induced fission of different uranium isotopes have been performed at MEPHISTO. Inducing fission with polarized cold neutrons, an asymmetry in the emerging light and heavy fragments (called ROT effect) could be observed by mapping out the spatial distribution of neutrons, fission fragments and gammas. A theoretical model to understand these asymmetries is still under discussion. These measurements are coincidence measurements and require a very high accuracy in the preparation of the electronic signal processing.

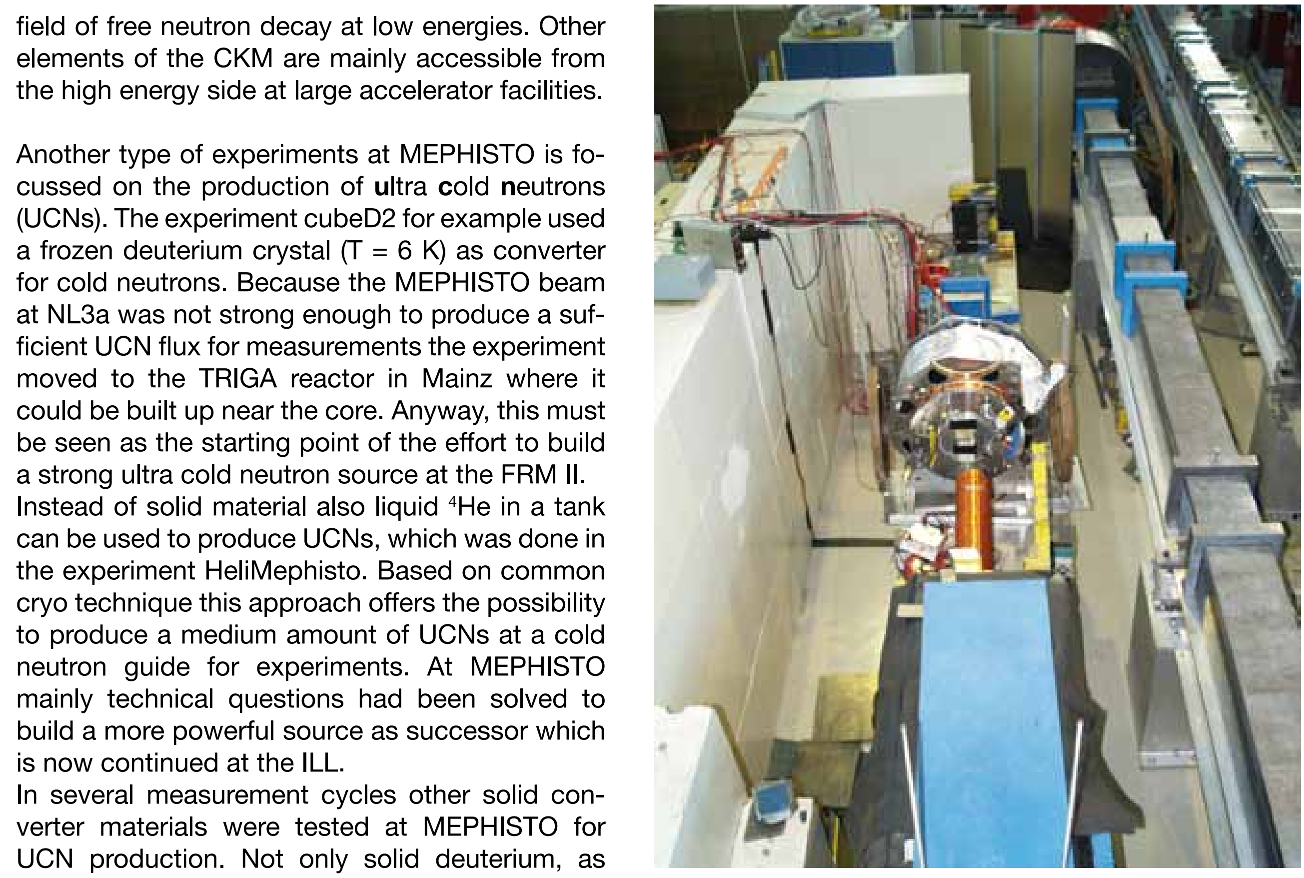


Fig. 3: Fission chamber at NL1 with surrounding coincidence detectors.

Fig. 4: UCN cryo converter partly dismantled.

In 2013 MEPHISTO will start moving to the new neutron guide hall east offering numerous improvements:

- a more intense beam,
- a spacious experimental area, and
- a low background.

Operation will hopefully start in 2014.

The first setup PERC (**P**roton **E**lectron **R**adiation **C**hannel) will provide a neutron guide as decay volume for neutrons where the decay protons and electrons will be guided to changing spectrometers for determining several characteristics of the free neutron decay using the same source. At the end of this year test measurements are planned for preparing the successful start of PERC and the new MEPHISTO.

Jens Klenke, FRM II

First Light in the Tube

The new small-angle neutron scattering instrument

The new small-angle scattering instrument SANS-1 is installed on beam line NL4a at the Forschungs-Neutronenquelle Heinz Maier-Leibnitz (FRM II). It is a joint venture of the Technische Universität München and the Helmholtz-Zentrum Geesthacht (HZG).

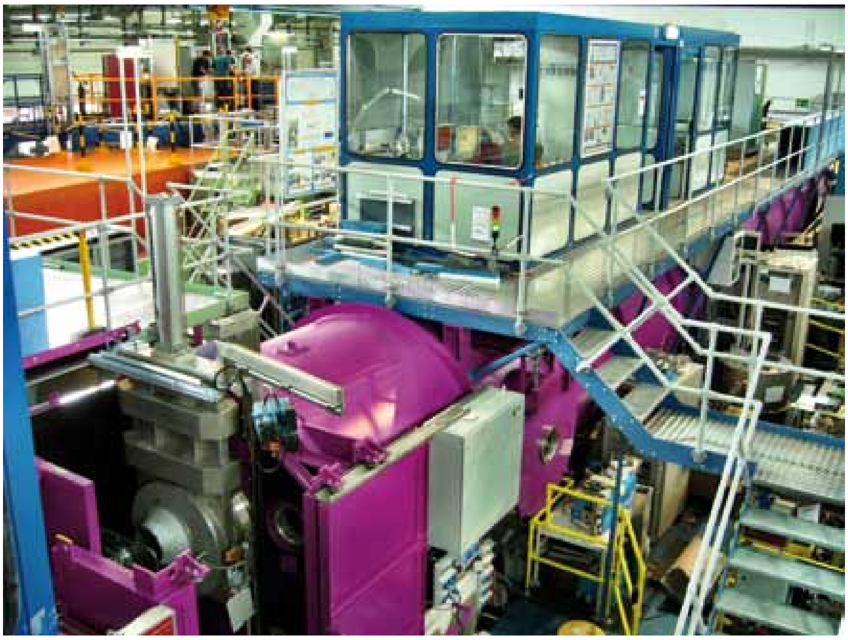


Fig. 1: SANS-1 instrument with sample position and hutch on top of the detector tube.

SANS-1 is optimised to be one of the most intense and versatile small-angle scattering instruments with an outstanding range in momentum transfer and dynamic range. SANS-1 is dedicated to investigations of materials science and magnetism, both in basic research and applied sciences. The instrument was designed using the program McStas to optimise the dimensions and the features of the different optical components within the boundary conditions given by the provided space and interaction with neighbouring instruments. The SANS-1 instrument is currently in the commissioning phase and looking for first external users.

To optimise the SANS-1 instrument with the claim to be at the “state of the art” many calculations and variations of instrument parameters were performed in advance by Monte Carlo simulations.
They resulted in a vertical S-shaped neutron guide with extreme suppression of fast background neutrons optimised for complementary wavelength packages, a tower with two exchangable selectors, one for medium resolution at high intensity and one for high resolution (optional), followed by two optimised Fe/Si transmission polarisers.

Fig. 2: Gerd Musielak, Juri Stell and Oliver Frank of HZG insert the apertures in the collimation system.

After passing the selector tower a collimation system with four parallel horizontal tracks is installed: One track is equipped with a neutron guide, another one with apertures for an exactly defined collimation length and divergence. A laser system and position sensitive detectors for precise and reproducible alignment are mounted on the third track. The last track is equipped with background apertures and could be used for lenses, a multi-SANS slit system, an optional MIEZE setup or other future options.
The acentric detector tube of around 2.4 m inner diameter and 22 m length allows the use of an area detector of 1 x 1 m^2 size with lateral movement of more than 0.5 m. The detector is equipped with 128 position sensitive detectors to provide 8 mm x 8 mm pixel resolution. To optimise the signal to noise ratio, great effort has been put into shielding all parts to avoid parasitic background scattering.
As a response to the rising demand in diffraction in small angle scattering geometry, in particular for magnetic condensed matter systems, a 3D “Huber”-table positioning device takes up all the sample environments. It is designed to support heavy equipment like magnets, like the new 5 Tesla dry SANS magnet, various cryostats, and furnaces, or a tensile rig.
A LabView based fully automated instrument control will allow very effective experiment supervision with a visual display of all the important in-

Fig. 3: Ralph Gilles (TUM) testing the sample tower with the manual control.

strument parameters. This will allow an effective use of the measurement time at our high flux instrument.

Together with the detector group of the FRM II (Ilario Defendi and Karl Zeitelhack) an exposure on the 1 m^2 detector was performed in order to get a first impression of the beam quality. A sample of silver behenate powder [$CH_3(CH_2)_{20}COOAg$] was used, providing cold neutron Bragg reflections in the angular range of 4-26°. A full diffraction pattern of the corresponding Debye-Scherrer rings was recorded on the large detector (see fig. 4). Afterwards a calibration on each of the 128 tubes concerning position and efficiency is foreseen. It is planned to measure with friendly users in the period of summer up to October. Adjacent first users will be served with beam time.

The instrument SANS-1 is dedicated to study correlations of magnetic and non-magnetic samples on a length scale of 10 to 3000 Å. In particular, SANS is used to study the shapes and sizes of the particles dispersed in homogeneous medium. The technique provides valuable information over a wide variety of scientific and technological applications:

- chemical aggregation,
- defects in materials, surfactants, colloids,
- alloy segregation,
- polymers, proteins, biological membranes, and
- porosities.

In magnetism, polarized neutrons additionally help to separate the nuclear and magnetic signal. The following problems can be addressed with small angle scattering:

- domain structures and domain walls in ferromagnetic systems,
- non-trival magnetic structures in helical magnets,
- vortex lattices in superconductors,

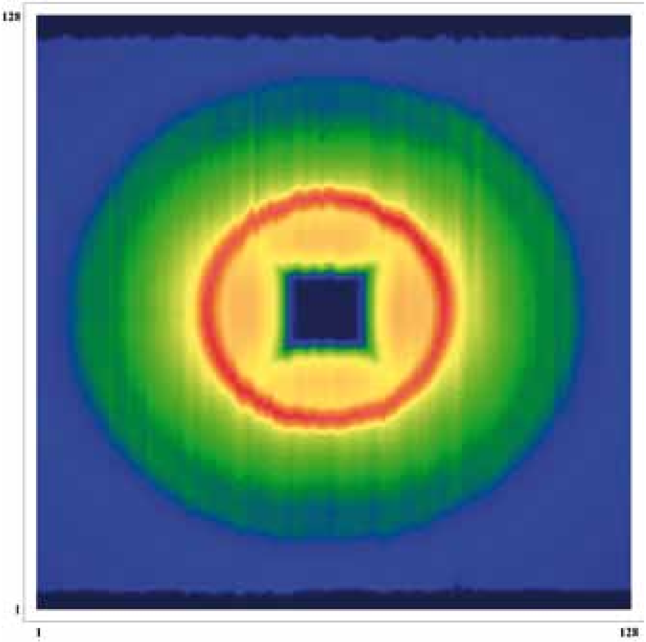


Fig. 4: First test of the inhouse built 1 m^2 detector with a AgBE sample.

- magnetic colloids and ferrofluid samples, and
- superparamagnetic samples.

We would like to acknowledge all persons working for the set up of SANS-1 from the two main institutes Forschungs-Neutronenquelle Heinz Maier-Leibnitz (TUM) and Helmholtz-Zentrum Geesthacht (HZG).

Ralph Gilles, FRM II
André Heinemann, HZG

Fig. 5: A part of the SANS-1 set up group in front of the 1 m^2 detector.
Back (left to right): Dennis Heims, Oliver Frank, Svato Semecky, André Heinemann, Jurij Stell.
Front (left to right): Gerd Musielak, Ralph Gilles, Andreas Wilhelm.

Cold, colder, ultra-cold

The UCN Laboratory

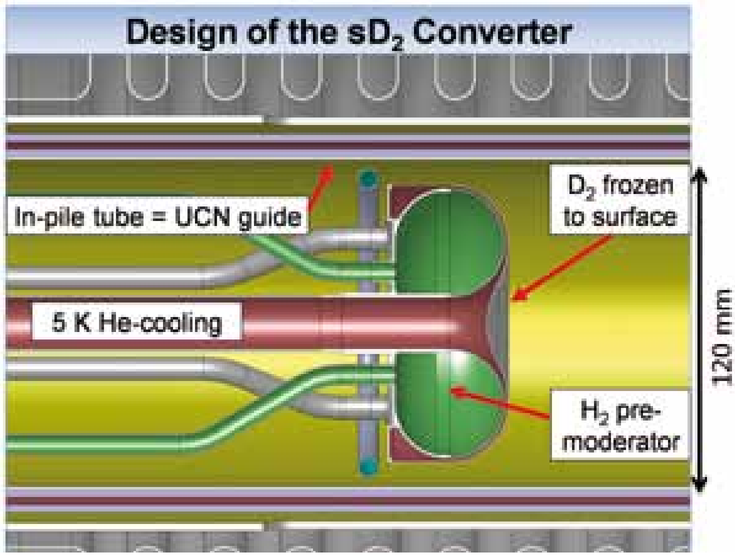


Fig. 1: Cut-view of the UCN converter vessel (schematic). Supercritical helium (indicated in red) at 5 K flows between the two walls of the aluminium converter cap, cooling the hydrogen pre-moderator (indicated in green) inside the vessel, and the deuterium converter (indicated in grey) frozen to the outer wall of the cap. The converter is positioned inside the horizontal through going beam tube SR6 at a distance of 60 cm from the central fuel element of the FRM II. The converter cap is connected to cryogenic supply lines coming from the left hand side. UCN are extracted to the right hand side and guided to connected experiments

Precision experiments with **u**ltra-**c**old **n**eutrons (UCN), such as the search for a possible **e**lectric **d**ipole **m**oment (EDM) of the neutron or the measurement of the lifetime of the free neutron, require high UCN densities. Stronger UCN sources are presently developed world wide, based on the principle of superthermal UCN production, using cryo-converters made of solid deuterium (sD_2) or superfluid helium. At the FRM II a UCN source with a sD_2 converter and sH_2 pre-moderator, placed at a distance of ~60 cm from the central fuel element inside the horizontal, through going beam tube SR6, is currently under construction. It can generate UCN densities of ~10^4 cm^{-3} in up to four connected experiments. These densities are more than two orders of magnitude higher compared to the currently strongest UCN source at the ILL.

The central part of the UCN source is the converter vessel, a double walled toroidal shaped aluminium cap piece (see fig. 1). Inside it contains 12.5 mol of solid hydrogen (sH_2) as pre-moderator (volume ~250 cm^3) to pre-cool the incoming thermal neutron flux (~10^{15} cm^{-2}s^{-1}) to an effective neutron temperature of ~40 K. Between the two walls the converter cap is cooled by a continuous flux of a closed supercritical helium cooling loop (T = 5 K, total He-mass 8.7 kg, p = 3400 h Pa). The necessary cooling power of 1.0 kW at T = 5 K is supplied by two cold boxes (AirLiquide Helial 2000, 500 W at T = 5 K each) to the closed supercritical He-loop. The sD_2 UCN converter (maximum amount 12.5 mol) is frozen to the outer surface of the converter vessel by re-sublimation of D_2 gas to the solid phase. The pre-moderated incoming neutrons can enter the sD_2 converter, where they excite solid state excitations (mainly phonons) of the crystal lattice. Solid ortho-deuterium has excited states in the energy range of 2 - 20 meV, so that by populating one single excited state by neutron scattering at the crystal lattice, the incoming neutron loses practically its total initial energy, and is converted into the energy regime of ultra-cold neutrons (< 300 neV). The UCN generated by this process can leave the sD_2 converter, and are guided to the SR6 beam port exit in the experiment hall, and feed into connected experiments.

It is foreseen, that up to four experiments can be connected to the UCN source port. Two experimental sites are located in the experiment hall close to the SR6 beam exit (see fig. 2). One site is dedicated to the PENeLOPE experiment (see fig. 3), measuring the lifetime of the free neutron to a precision of < 0.1 s. Therefore UCN are stored inside magnetic fields (storage volume ~750 dm^3), generated by superconducting magnets, for long times, up to several tens of minutes. During storage the decay protons are detected, and after storage the surviving UCN are counted. The neutron lifetime τ_n is a basic parameter in particle physics influencing the early evolution of the universe during Big Bang nucleosynthesis. Its precise knowledge may be used to test the Standard Model of particle physics through a unitarity check of the Cabibbo-Kobayashi-Maskawa matrix. The latest

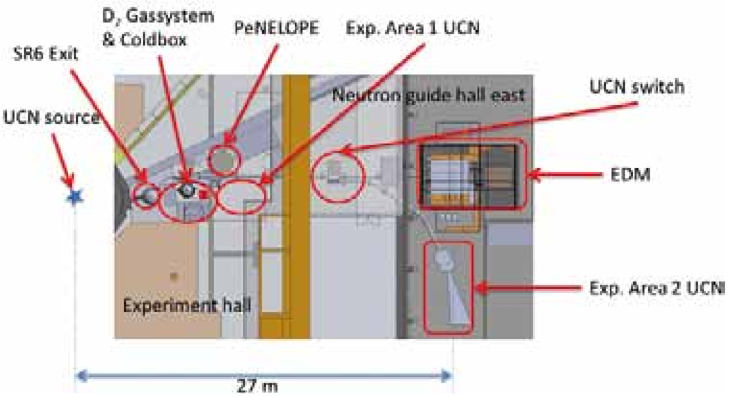
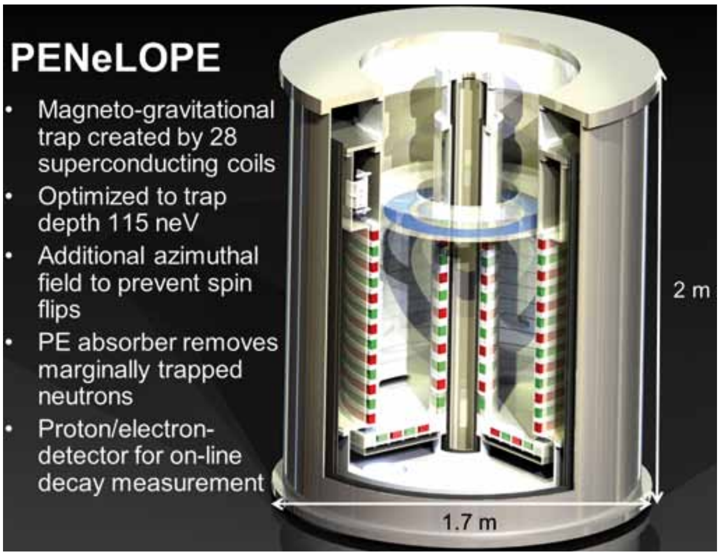


Fig. 2: Floor plan (schematic) of the experiments connected to the UCN source port (SR6 exit). Two experimental sites (PENeLOPE, Exp. Area 1) are foreseen in the experiment hall, two more sites (EDM, Exp. Area 2) are located in the neutron guide hall east.


PENeLOPE

- Magneto-gravitational trap created by 28 superconducting coils
- Optimized to trap depth 115 neV
- Additional azimuthal field to prevent spin flips
- PE absorber removes marginally trapped neutrons
- Proton/electron-detector for on-line decay measurement

Fig. 3: Conceptual layout of the PENeLOPE experiment for measuring the neutron lifetime. UCN are stored in a magnetic trap with detection of decay protons during storage.

precise measurement $\tau_n = 878.5 \pm 0.8$ s published in 2005 deviated from the world average value at this time, $\tau_n = 885.7 \pm 0.8$ s, by more than 6σ, a discrepancy to be resolved.

The second experimental site is a versatile place for short term experiments, which need a continuous UCN flux as high as possible. Due to its short distance to the UCN beam port, a continuous UCN flux density of $\sim 6 \cdot 10^5 \mathrm{cm}^{-2}\mathrm{s}^{-1}$ (energy range 110 - 230 neV) can be delivered to attached experiments at this place.

Two more experimental sites are foreseen in the neutron guide hall east. One site is dedicated to the EDM experiment, trying to improve the upper limit of a possible electric dipole moment of the neutron down to $10^{-28}\,e\cdot$cm. This EDM experiment is based on Ramsey's method of separated oscillatory fields, where the spins of trapped UCN precess in a homogenous and stable magnetic field for several hundreds of seconds. Additionally an electric field is applied either parallel or antiparallel to the magnetic field. A non-zero electric dipole moment of the neutron would change its precession frequency in the magnetic and electric field, which can be detected. Of course, any inhomogeneity or fluctuation of the magnetic field would also change the precession frequency. So a clean environment in terms of magnetic and electric disturbances, as well as mechanical vibrations is required to perform such an experiment.

The UCN transport from the source to the experiments is realized by newly developed high efficiency UCN guides (see fig. 4) with a transport efficiency of $(0.990 \pm 0.006)\ \mathrm{m}^{-1}$. With these guides it is possible to bring more than 50 % of the initial UCN flux to the experiments in the neutron guide hall east.

In summary, the UCN source at the FRM II, together with the infrastructure at the connected experimental sites, will offer the possibility to conduct next generation UCN-experiments, which outperform current measurements in terms of statistical and systematic precision.

Andreas Frei, FRM II

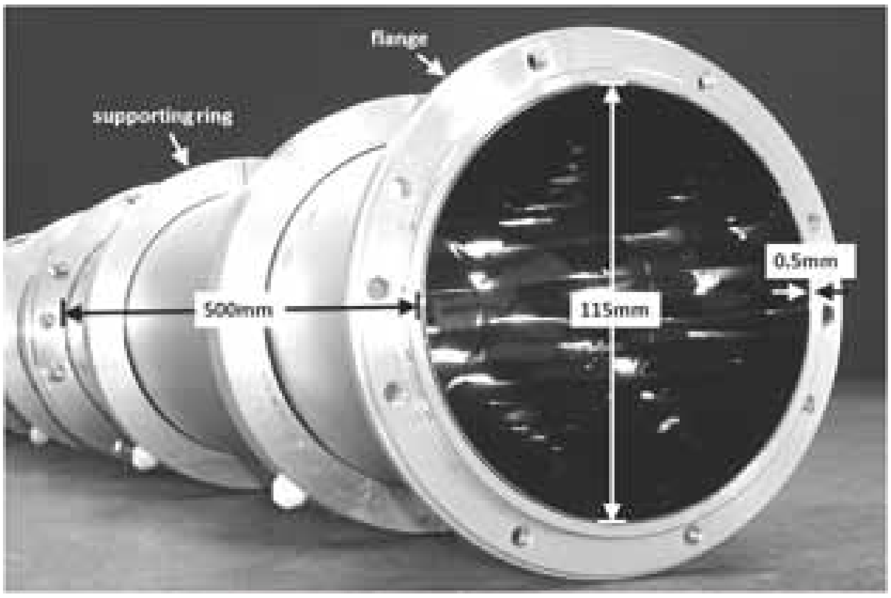


Fig. 4: High efficiency UCN guides, produced with the „replication“ technique: A NiV-layer is deposited on a smooth glass surface. After deposition the NiV-layer is detached from the glass, hereby copying its smooth surface, rolled to tubes (inner diameter 115 mm, max. length 500 mm), and electron-beam welded. Finally flanges, connecting one tube to another, are glued to the UCN guide.

Neutron Guides, not always perfect

Fig. 1: View along NL5, the broken element in the foreground.

Unfortunately this spring we needed to close down two out of the six guides serving neutrons to instruments in the guide hall west of the FRM II. On February, 22nd one element of neutron guide NL-5 at a distance of 50 m from the 6-fold shutter broke. Subsequently also an aluminum end window was damaged. As a consequence, the whole neutron guide system could not be evacuated any more. For the rest of cycle 27 the instruments in the neutron guide hall west had no neutrons any more. During the following maintenance period an element of neutron guide NL6-S broke in addition. At this time the whole guide system was in stand-by mode, no other sections where affected. Both failures happened without premonition and without external influence.

Already during the rest of cycle 27 we started to remove the shielding of NL5 in the neutron guide hall west and cleaned the whole neutron guide inside before and after the broken element from glass dust. Alongside this work we immediately ordered replacement pieces of all affected guide elements.

Shortly after the shut-down of the reactor after cycle 27, the neutron optics group started with the repair work inside the neutron guide tunnel. Here all guides needed to be cleaned from glass dust as well. The damaged aluminum end windows of the guides were replaced by windows with an increased thickness of now 1 mm instead of formerly 0.5 mm in order to increase its mechanical strength. Just in time for the start of cycle 28, the repair work in this section was finished and at least the beam-lines NL1 to NL4 were operational. The instruments on NL5 and NL6 namely MARIA, TREFF, RESEDA (NL5) and Mira, DNS, Spheres (NL6) of course had no neutrons during cycle 28 due to the long delivery time of the new guide elements.

Although the two incidents followed each other within a few weeks time, there is no obvious link between them. The broken element of NL5 was a previously exchanged element, which had due to technical reasons a reduced wall thickness of the side plates. The reduced mechanical strength had been compensated by additional ribs attached to the side plates. From the glass pieces found, we concluded that nevertheless these side plates did not withstand the stress imposed by the vacuum inside the guide. There were no hints of other origins of the failure.

A completely different situation we found at the destroyed NL6-S element. It was the first element after the splitting of NL6 into the sections NL6-S and NL6-N. Visual inspection of the guide elements showed here typical signs of neutron irradiation damage of the borofloat glass substrate. Actually the guide elements corresponded in their aspect to guide elements far closer to the cold source, which had been replaced previously in 2011. The irradiation damage here at a distance of more than 22 m from the cold-source coincided with a reduction of the super-mirror coating from m = 2 to m = 1.2. The reduced m value leads to an increased neutron flux absorbed in the glass substrate. Micro-cracks originating from the irradiation affected glass surface may have finally caused the break of the side plates of the element.

Fig. 2: Damaged guide element of NL6-S in the casemate.

With the delivery of the new guide elements, we are now prepared to restore both guides NL5 and NL6 during the shut-down period after cycle 28 in July 2012. Then finally with the start of cycle 29 all guides should be operational again, and all instruments in the neutron guide hall west will be served with neutrons.

Peter Link, FRM II

4th User Meeting at FRM II

Garching, March 23rd, 2012

Jointly organised by the FRM II and the JCNS, the 4th User Meeting was held in Garching on March 23rd, 2012. Even it was March, the weather was really Bavarian: sunshine, blue sky and some nice white clouds!

The last User Meeting in October 2010 marked the shut down of the reactor and the start of the long maintenance break. An invitation to a User Meeting just five months after the restart on October 29th, 2011? The User Office wasn't sure if many users could be attracted. There were not many beam days in between! Therefore we were very happy to receive more than 100 registrations for this one-day event.

Thirteen contributions were chosen as oral presentations and they show the wide range of science performed or planned at the FRM II: From small angle scattering and soft matter to ultracold netrons and to several aspects of material science.

Flavio Carsughi of the User Office welcomed the participants. He pointed out the high amount of upgrades at the instruments. Nearly all of them had seized the opportunity of the long maintenance break to improve several aspects. BioDiff and MARIA became ready for users and presented themselves in the second part of the poster session in the afternoon. While that part was dedicated to the instruments hosted at the FRM II as well as sample environment groups, software development, and planned instruments, the first part dealt with science and projects and showed the whole range of neutron scattering applications. As usual, Bavarian beer and fingerfood accompanied the poster session and therefore the discussions became very lively!

Ina Lommatzsch, FRM II

Non-destructive Testing of Materials and Components

Garching, April 17th, 2012

During lunch: Lively discussions and networking are going on.

Presenting various examples of well-established and more recent methods of non-destructive testing in an industry related field, the 4th expert forum organized by VDI and TUM gathered more than 60 participants at the faculty of mechanical engineering in Garching on April 17th, 2012. Eight proven experts from industry and research had been designated by the advisory board for *Application Oriented Non-destructive Materials and Component Testing* of the VDI, which had been introduced by Achim P. Eggert. During the one day meeting chaired by Ralph Gilles (FRM II), the different methods for non-destructive testing were discussed.

In his introductory presentation, Winfried Petry (FRM II) gave a survey of the possibilities with neutrons, from radiography to diffraction and from industrial to medical applications. Heinz-Günther Brokmeier (TU Clausthal/ HZG) presented anisotropy investigations in copper-tubes by using neutrons and x-rays. The tubes were explored at the diffractometer STRESS-SPEC, where a robot makes possible the precise rotation of large objects. Lattice parameters, grain sizes and inner tensions had been determined. It showed that there are texture gradients over the wall thickness due to inhomogeneous yielding. Michael Hofmann (FRM II) demonstrated investigations of a Na/ MCl_2-battery with neutrons conducted at the radiography station ANTARES and at STRESS-SPEC. The Na-fill level, the inner structure and the porosity as well as the phase distribution during charging and discharging procedures could be determined thereby. Astrid Haibel (Beuth Hochschule für Technik) talked about how tomographic data can further be explored by using data analysis.

“Please sign here”: Ulrike Kurz (FRM II) and participants at the registration desk.

The comparatively new method of 3D-imaging with THz-rays was presented by Stefan Becker (Becker Photonik). With frequencies between microwave and infrared radiation, THz-rays are suitable for investigating dielectric materials as synthetics and composites up to a maximum depth of 30 mm approximately. Especially large probes with unidirectional access can be inspected with this technique, Stefan Becker pointed out.

Overviews of ultrasound and thermography methods were given by Sebastian Gripp (intelligeNDT) and Peter Fey (Universität Stuttgart), respectively. These widely used techniques deliver remarkable results under well-defined conditions where the interpretation of the obtained signal can be assigned to known defects. Peter Fey showed depth resolved lock-in thermography images of the aerofoil of eGenius, an electro-aircraft developed by the Universität Stuttgart. With ultrasound testing quantitative measures are possible for hidden defects of several mm in metals as well as in carbon fibre reinforced plastics (CFRP), a material which is widely used in aircrafts nowadays. Both methods demonstrated how imaging of structures in non-destructive testing is used in a production environment with large test blocks.

In the final panel discussion, chaired by Winfried Petry, the different aspects of non-destructive testing presented in the talks were summarized, which then led to a lively discussion about – to some extent - the lack of correlation between data and material properties. Some highlighted that also the defect and its effect are not yet completely understood.

At the very end, the participants attended the experimental facilities of the FRM II.

Petra Riedel, FRM II

An Inspiring Workplace for International Students

The MaMaSELF-programme

It's the second time the Dutch student Marius van den Berg stays at FRM II. First time, he came here from Karlsruhe Institute of Technology for a beam-time at ANTARES during his bachelor thesis in applied physics. "It was also the first time, I came in touch with Large Scale Facilities", he says. But it was not the last. Now he is back for his master thesis, investigating hydrogen dynamics in complex hydrides for hydrogen storage at TOFTOF. Wiebke Lohstroh (FRM II) is his supervisor, the two of them got to know each other via a mutual colleague at EMPA in Switzerland, were Wiebke is well acquainted with a group of researchers. Luciano Avila Gray from Argentina is also fascinated by research with neutrons. After his degree in Materials Engineering he received from the Institute of Technology Jorge A. Sabato in Argentina, he started studying German at the Goethe Institute. He got to know the MaMaSELF Programme. He applied – and was accepted.

Both, Marius and Luciano, are in their last semester of the MaMaSELF programme, which is a two year **Ma**ster Course in **Ma**terials **S**cience **E**xploring **L**arge **S**cale **F**acilities using neutron and synchrotron radiation. "Gaining experience in neutron sources will allow me to give back my country part of all I've received, by helping in the development and use of a future research reactor", Luciano says. In June he had beam-time at PUMA, where he was analyzing the behaviour of magnetic shape-memory alloys.


Luciano Avila Gray (left), Marius van den Berg (right).

MaMaSELF aims at promoting international collaboration among Universities, Large Scale Facilities and Industry - and is strongly supported by Winfried Petry, the scientific director of the FRM II. The main objective is to form skilled scientists in Materials Science together with an advanced knowledge in the use of Large Scale Facilities for the characterization of high technology materials. The programme is split in four semesters: The first two semesters are entirely enrolled at one out of the five universities of the consortium, which are: Ludwig Maximilians Universität, Technische Universität München, University of Rennes, University of Montpellier and University of Torino. Semester three has to be conducted at a different university. The fourth semester is dedicated to the Master Thesis and can be carried out at any university or Large Scale Facility or at partner institutions situated in Switzerland, India, Japan, USA or Russia. In the first year, Marius attended lectures and tutorials in Rennes, followed by an internship at EMPA. For the third semester he attended lectures at both LMU and TUM; whereas Luciano spent his first two semesters at LMU and then came to Torino.

In May, Marius and Luciano went for three days to Switzerland for the MaMaSELF status meeting, which brought together the 29 second-year MaMaSELF students as well as their professors in Rigi Kulm. At 1800 m high on the mountain with a fantastic view over the mountains and lakes around they discussed scientific topics with specialists from research centres and presented the preliminary results of their master thesis work.

Luciano and Marius are, of course, not the first MaMaSELF students at the FRM II. And who knows, after their master theses, maybe we'll see them back for their doctorates?

Petra Riedel, FRM II

Interested to get more information?

www.mamaself.eu

From Nanomagnetism to Correlated Electron Systems

Research at JCNS-2 – Institute for Scattering Methods

The Institute for Scattering Methods JCNS-2 is one of the two divisions at the home base of the **J**ülich **C**entre for **N**eutron **S**cience, which operates neutron instruments at its outstations at FRM II, ILL and SNS. Research at JCNS-2 is devoted to the development of novel scattering methods (neutron and synchrotron X-ray) and the understanding of strong electronic correlations as well as of magnetism at the nanoscale. All systems studied at JCNS-2 have a potential for future applications either for information technologies or for energy technology. In neutron instrumentation, JCNS-2 is a driver in the application of polarized neutron scattering techniques. Materials or material systems studied at JCNS-2 span the entire range from bulk via thin films and multilayers, laterally structured layered systems, nanoparticles, and nanoparticle assemblies to molecular magnets. In Jülich we operate a broad range of laboratory equipment for sample preparation and sample characterization.

Bulk materials studied at the institute typically belong to the classes of frustrated magnets, multiferroics, thermoelectrics, magnetocalorics or superconductors. After the discovery of superconductivity in iron pnictides, we have investigated extensively their lattice dynamics, magnetic order and spin dynamics. Similar to high TC cuprates, superconductivity in iron pnictides is in proximity to magnetism and neutrons are ideally suited to give a detailed insight in the interplay between magnetism and superconductivity. In fig. 1, we show the magnetic structure for three different iron arsenide compounds. The case of $EuFe_2As_2$ is particular challenging for neutrons due to the high absorption cross section of Eu. Still the magnetic structure could be determined using hot neutrons at HEiDi. Magnetism in this compound is particularly intriguing since two sublattices exist, the Fe and Eu sublattices, which order independently. The bottom of fig. 1 shows a magnetic phase diagramme. Europium spins can be forced along the field direction changing the magnetic structure from antiferromagnetic to ferromagnetic. A giant spin-lattice-coupling is observed, which leads to a detwinning of the crystal at rather low magnetic fields. Moreover we discovered an anisotropic magnetoresistance effect, which proves the strong coupling between all three degrees of freedom: lattice, spin and charge.

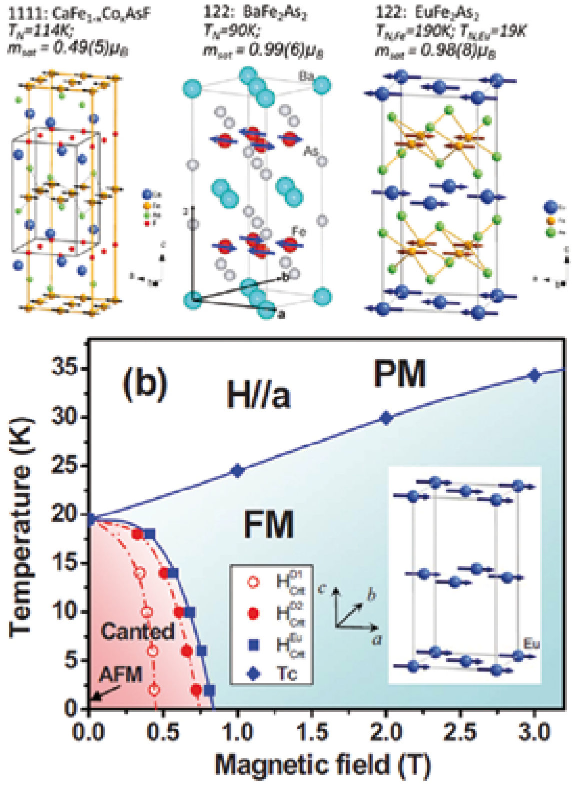


Fig. 1: Top: Zero field, low temperature magnetic structures of some parent compounds of iron based high temperature superconductors as determined by neutron diffraction.
Bottom: Magnetic phase diagramme for the compound $EuFe_2As_2$ with magnetic field applied along the a axis (only the Eu spin moments are plotted).

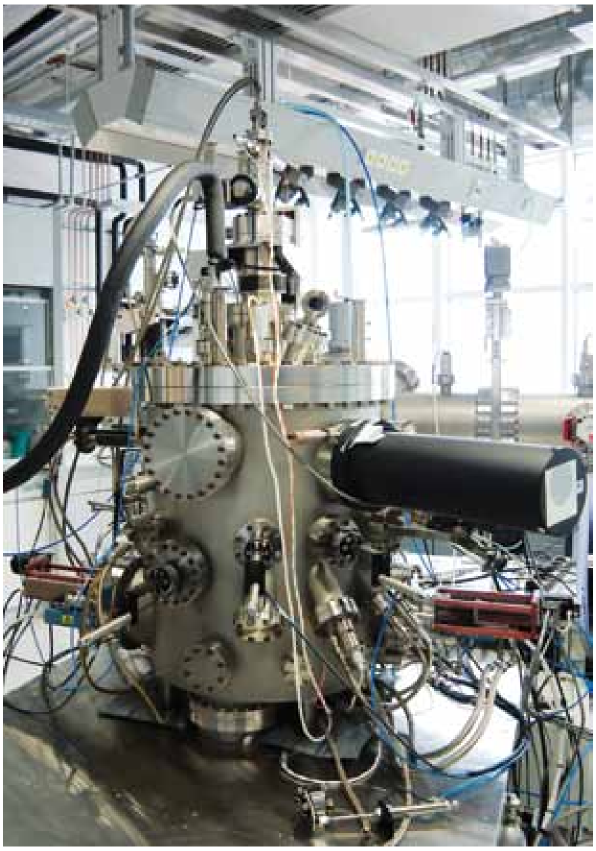


Fig. 2: Photo showing the oxide **M**olecular **B**eam **E**pitaxy instrument at JCNS Garching.

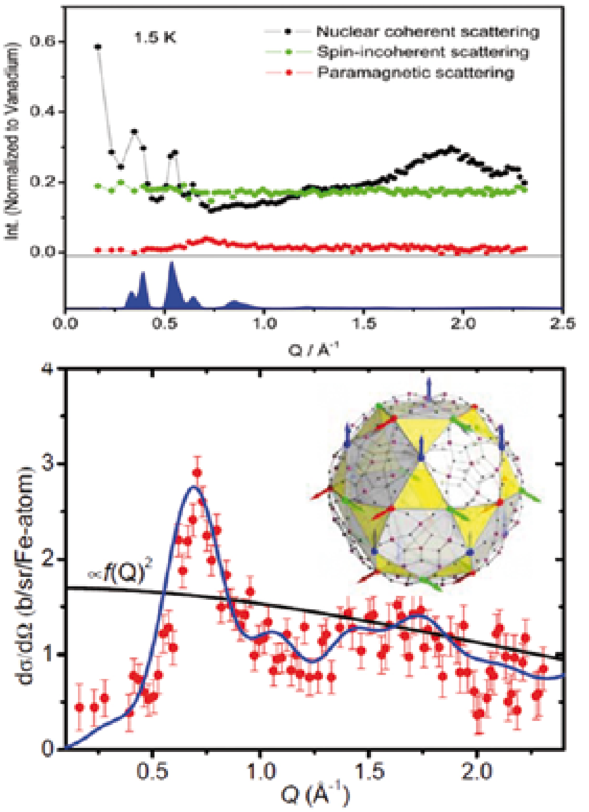


Fig. 3: Top: The various scattering contributions for {Mo$_{72}$Fe$_{30}$} at 1.5 K separated by xyz polarization analysis at DNS. Bottom: Magnetic diffuse scattering at 1.5 K and simulation. Inset: One {Mo$_{72}$Fe$_{30}$} molecule with spins arranged in the three sublattice model.

Spintronics, i.e. information technology based on the spin of the electron, is one of the main research subjects of the institute. In the past, we have studied 3d and 4f metal thin film systems, where such effects as interlayer coupling, giant magnetoresistance or exchange bias occur. Recently, we focused our research on transition metal oxide heterostructures, which combine the challenges of understanding electronic correlations and novel effects at interfaces.
To this end, we are operating oxide MBE chambers, see fig. 2. After full commissioning, the chamber in Garching will enter user operation in combination with grazing incidence neutron scattering at our new magnetism reflectometer MARIA, which features full polarization analysis.

Molecular magnets are the smallest magnetic entities, which can carry information. They are true quantum magnets and have been discussed as possible realizations of qubits for quantum computing. The polyoxomolybdate {Mo$_{72}$Fe$_{30}$} molecular magnet contains 30 spin 5/2 Fe^{3+} ions, but in addition several hundred hydrogen atoms. Therefore, even for deuterated molecules, the nuclear spin incoherent scattering is overwhelming and does not allow one to determine the spin arrangement in a normal diffraction experiment. As an example of the power of polarization analysis, fig. 3 (top) shows the separation of magnetic scattering from nuclear coherent and nuclear spin incoherent scattering, which together is nearly 50 times more intense. Still the magnetic scattering can be nicely separated by xyz polarization analysis at DNS and the modeling gives strong support for the so-called three sublattice model, where spins are arranged on the surface of the molecule in a 120 degree triangular structure (fig. 3, bottom).

Polarization analysis is absolutely crucial for studies of magnetism in Spintronic systems. Therefore nearly all JCNS instruments are or will be equipped with polarized neutrons. The institute has initiated a research programme on spin exchange optical pumped SEOP ^{3}He filter cells, where we achieve world leading performance. Such cells are employed as analyzer at the magnetism reflectometer MARIA. Polarization analysis is also the special feature for the future thermal Time-of-Flight spectrometer TOPAS, see fig. 4.
In the frame of the **J**ülich-**A**achen **R**esearch **Al**liance JARA, there is also a strong link to the RWTH Aachen. HEIDI-POLI operated by the Institute for Crystallography has joined the JCNS team in 2011. Together with the Institute for Inorganic Chemistry, a novel Time-of-Flight powder diffractometer POWTEX is being constructed. We are eagerly looking forward to installing the instruments POWTEX and TOPAS in the new guide hall east. This will enable new excting science at FRM II.

Thomas Brückel, JCNS

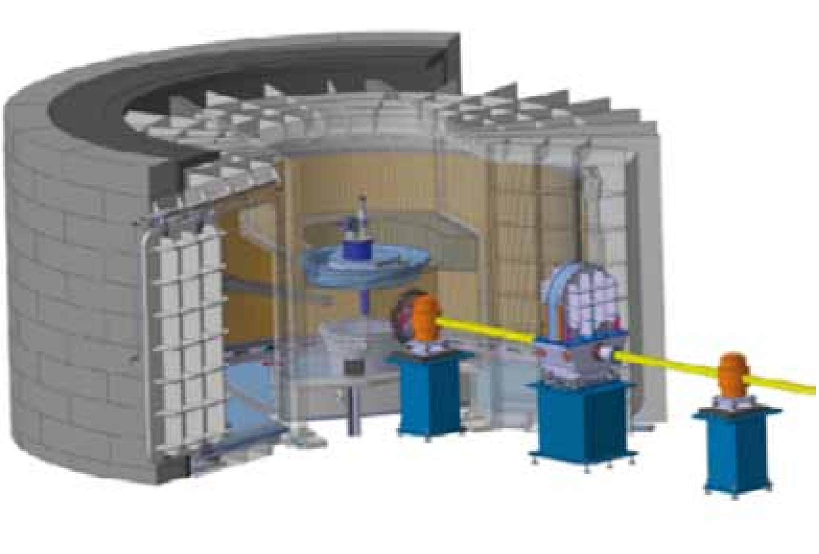


Fig. 4: Schematics of the future thermal **T**ime-**o**f-Flight Spectrometer with **P**olarization **A**nalysi**s** TOPAS.

Electronic Structure Studied with Positrons

New 2D-ACAR Spectrometer

Materials with strongly correlated electrons display a rich spectrum of interesting functional properties such as superconductivity and magnetism. Moreover, these materials often exhibit a strong coupling between various degrees of freedom (magnetic, electric, elastic, etc.) as well as phase transitions. Hence, novel correlated systems offer a fascinating potential for future generations of electronic devices.

The knowledge of the electronic structure, in particular of the Fermi surface, is essential for a microscopic understanding of electronic correlations, which lead for example to magnetic and structural phase transitions e.g. in Heusler alloys or the development of magnetic order and/or superconductivity. For this reason, it is aimed to understand and to characterize systems with novel properties originating from electronic correlations using advanced experimental techniques.

The determination of the electronic structure of solids using positron annihilation is becoming a powerful and attractive tool. After implantation into a sample, positrons come almost to rest before they annihilate with an electron. The momentum of the thermalized positron is hence small compared to the electron momentum at the Fermi surface. The annihilation of the positrons with the electrons leads to the emission of two photons. Their deviation from anti-parallel propagation directions is proportional to the transversal component of the electron momentum (see fig. 1). The spectroscopy of the **A**ngular **C**orrelation of **A**nnihilation **R**adiation (ACAR) is one of the least invasive methods for the investigation of the electronic structure, because no fields, to which strongly correlated materials are often sensitive to, need to be applied. In addition, ACAR can be performed in a broad temperature regime.

A single 2D-ACAR-spectrum delivers a planar projection of the electron momentum distribution. Therefore, the 3D distribution of the electron momenta in the sample can be reconstructed by recording spectra at several angles of the sample with respect to the detector axis. In particular, a detailed mapping of the Fermi surfaces can be obtained in 3D.

Since 2010 funding has been granted for the *Determination of the Electronic Structure Using Positrons**. Within this project our research group on positron physics has set up and put into operation a new 2D-ACAR spectrometer in the experimental hall of the **M**aier-**L**eibnitz accelerator **L**abo-

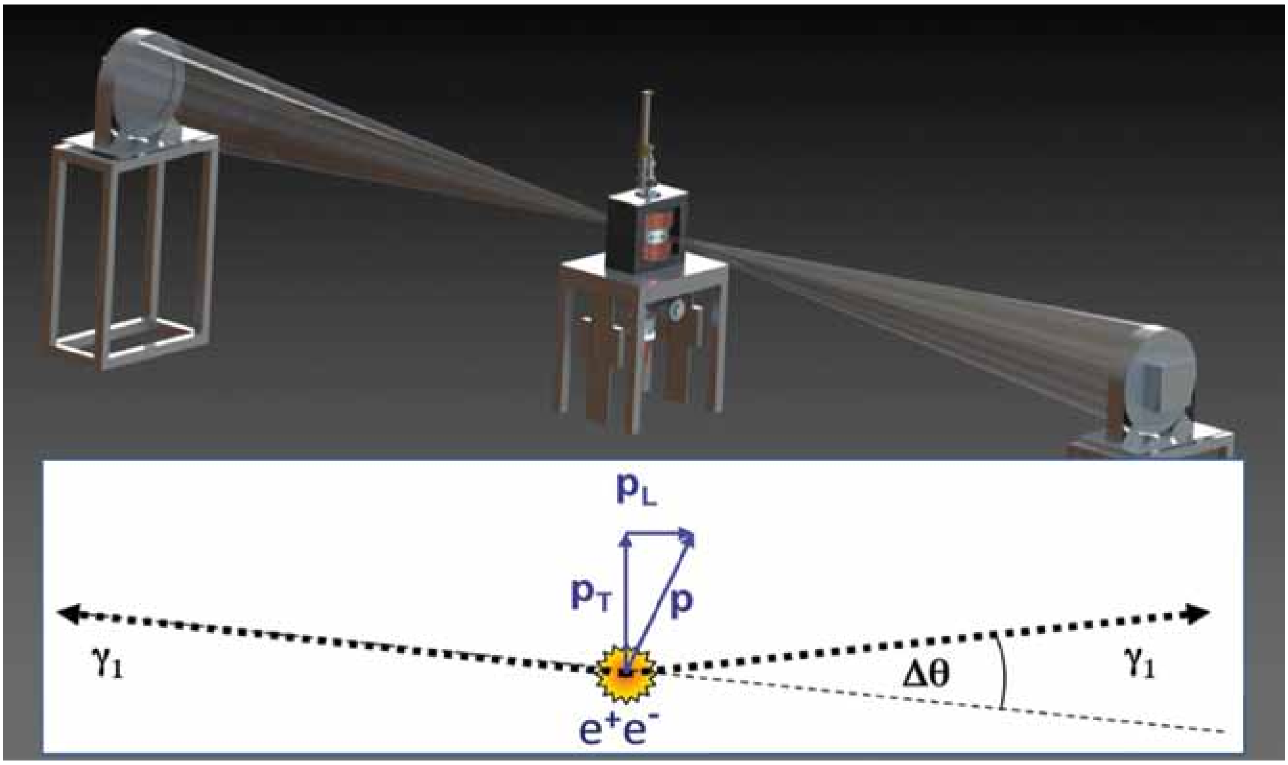


Fig. 1: The ACAR principle: After implantation in matter, positrons and electrons annihilate by the emission of two 511 keV γ-quanta. The coincident detection of the annihilation γ's with spatially resolved Anger-cameras enables the measurement of the angular deviation from the anti-parallel propagation direction. The 3D electron momentum distribution is reconstructed by collecting several projections under various angles.

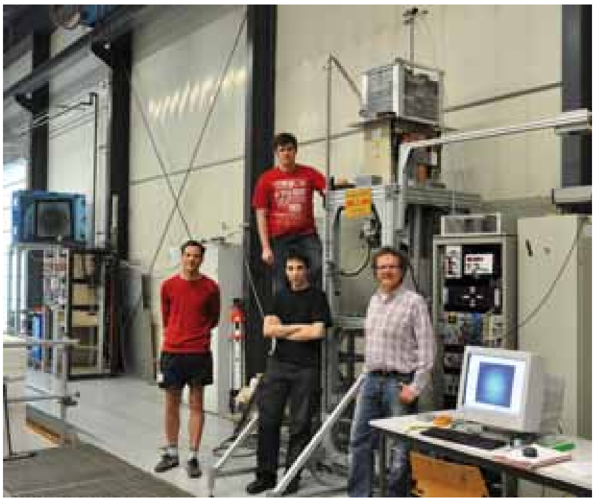


Fig. 2: The positron team and the new 2D-ACAR spectrometer at the accelerator laboratory MLL / TUM.

ratory (MLL) in Garching (see fig. 2). The ACAR setup consists of a central sample chamber with a 1.8 Bq ^{22}Na positron source and an optional magnetic guiding field of up to 1.2 T. A coolable sample holder allows for low-temperature measurements and increased resolution. Each of the two Anger-type γ-cameras consists of a 60 cm wide NaI(Ta) scintillation crystal with a 61 photomultiplier tube read-out for position reconstruction. Using the integrated weighting resistor network a spatial resolution of 2.8 mm with a 7 % detection probability for the 511 keV annihilation radiation is achieved. In order to obtain an angular resolution of ~0.5 mrad the detector sample distance has to be in in the order of 10 m.

After commissioning of the new neutron guide hall east at FRM II it is planned to transfer the ACAR spectrometer to NEPOMUC, the positron beam facility which provides the world's highest intensity of about 10^9 low-energy positrons per second. Using the mono-energetic positron beam would open a broad research field for novel ACAR applications. Fascinating examples will be:

- the evolution of the Fermi-surface from the bulk to the surface,
- the electronic structure in thin films, and
- 2D-electron systems at interfaces or at surfaces.

Recently, we recorded a 2D-ACAR spectrum of a quartz single crystal (fig. 3). In this first experiment, we succeeded in observing the annihilation of delocalized para-positronium, which is a bound singlet state of a positron and an electron.

Preliminary promising experiments have been performed on the Heusler alloy Fe_2TiSn, which is a strong candidate for heavy-fermion behaviour. Density functional band structure calculations for an ordered crystal yield a non-magnetic ground state and a pseudogap at the Fermi level. The calculated Fermi surface of Fe_2TiSn is shown in fig. 4. During the commissioning phase of the spectrometer, various d-metals like antiferromagnetic Cr will be investigated and compared with quantum oscillation experiments. In collaboration with various research groups of the Transregio TRR80* it is planned to extend the ACAR experiments to other intermetallic compounds with strong electronic correlations, e.g. the Heusler alloy NiMnSb, or to magnetic shape memory alloys such as Ni_2MnGa.

Christoph Hugenschmidt, FRM II

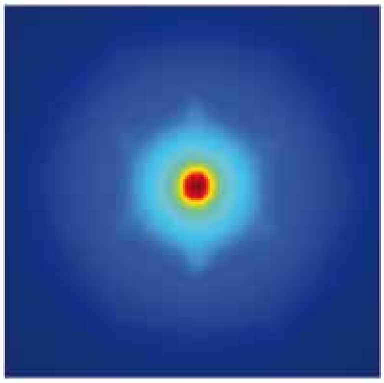


Fig. 3: First 2D-ACAR experiment on α-SiO2: The annihilation of delocalized para-positronium leads to an intensity distribution of the annihilation radiation, which clearly reflects the six-fold symmetry of the quartz single crystal even in the raw spectrum.

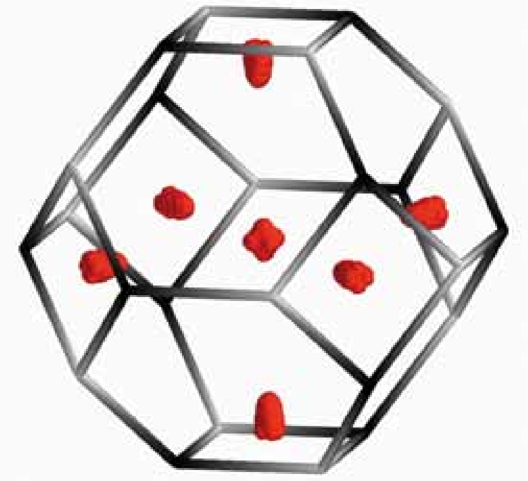


Fig. 4: Calculated Fermi surface of Fe_2TiSn for T > 0.

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*This project is funded by the Deutsche Forschungsgesellschaft (DFG) within the Transregional Collaborative Research Center TRR 80 *From electronic correlations to functionality*. The kind support from L. Beck of the MLL accelerator laboratory is gratefully acknowledged.

Neutrons for Medical Therapy

MEDAPP uses neutrons for medical applications

With conventional photon or proton therapy, the radiation beam interacts with atoms in human tissue primarily via electromagnetic interactions that may destroy molecular bondings in cellular DNA. Because the amount of energy transferred to the cell is relatively small in a single interaction, these interactions are called low **L**inear-**E**nergy-**T**ransfer (LET) reactions. Low LET damage to tumour cells can often be repaired, so that the tumour may continue to grow. In contrast, neutrons have a 5 to 50 times higher LET than the radiation from electron or proton accelerators used in hospitals, therefore depositing a large amount of energy (high LET), and often causing DNA double strand breaks. Due to their high ionization density neutrons may stop tumours which are otherwise radio-resistant. A tumour cell, whose DNA is damaged to this extent, can only rarely repair itself and therefore will ultimately die. This inability for the tumour to repair is one factor accounting for the higher **r**elative **b**iological **e**ffectiveness (RBE) of neutron therapy.

Neutron therapy at FRM II

The facility for medical applications (MEDAPP) at FRM II is the successor of the **R**eactor **N**eutron **T**herapy facility (RENT) at the former FRM which was shut down in 2000. Common for both is a ^{235}U thermal-to-fast-neutron converter delivering a fission spectrum with mean neutron energy of 1.9 MeV and a gamma contribution of about 25 % to the total energy dose rate.

Because of the RBE maximum near to 1 MeV, fast reactor neutrons are the most effective ones in deactivating otherwise radio-resistant tumour cells. Their administration, however, is restricted to shallow tumours near to the surface. The steep decrease of the neutron dose rate with depth allows for performing most irradiations at vertical incidence. In case of earlier completed courses of radiation therapy and tumour recurrence, usually a boost of neutrons is administered with palliative intention, whereas during a first course, a combination of photons an neutrons may be applied with curative intention; at the same time, the combination of high and low-LET radiation is the safest method with respect to side effects. About 38 % of treated patients at FRM II suffered from recurrence of breast cancer. Usually, 6 Gy are applied in 4 fractions, depending on the combination with photons (30 Gy). The standard single dose is 1.5 Gy with a minimum distance of three days. A further tumour entity suited for fission neutrons is the malignant melanoma with 17 % of patients at FRM II. An initiative has been started to acquire more melanoma patients, because this tu-

Country, Location	**Treatment Mode**	**Source, Reaction**	**Mean n-Energy [MeV]**	**50-%-depth [cm]**	**Beam Direction**	**Collimator**	**First Treatment**	**Patient number**	**Status**
USA Batavia/IL, Fermilab	FNT	LINAC, p(66)+Be	25	16	horizontal	Inserts	1976	3300+	active
USA Seattle/WA UW, CNTS	FNT	Cyclotron, d(50.5)+Be	20	14	Isocentric horizontal	MLC*, Inserts	1984	2900	active
USA Detroit, MI/WSU	FNT	Cyclotron, d(48.5)+Be	20	13	Isocentric, IMRT	MLC*	1990	2140	refurbishment
South Africa Somerset West, iThemba	FNT	Cyclotron, p(66)+Be	25	16	Isocentric	Variable jaws + multiblade trimmer	1988	2900	active
Russia Tomsk Polytechnic Univ.	FNT	Cyclotron, d(13.5)+Be	6.3	6	Horizontal	Inserts	1984	1500+	active
Russia Snezhinsk, VNIITF	FNT	D-T-Generator	10.5	8	Horizontal	Inserts	1999	990+	stand-by
Germany Essen, Univ. Hospital	FNT	Cyclotron D(14,4)+Be	6.5	8.5	Isocentric	Inserts	1978	780	indefinitely interrupted
Germany Garching, TUM	FNT	FRM-II	1.9	5.0	Horizontal	MLC*	2007	106	active
Finland Otaniemi/Helsinki	BNCT	FiR-1 250 kW	epithermal	-	horizontal	Inserts (?)	1999	250	active
Japan Kumatori/Osaka	BNCT	KUR 5 MW	thermal to epithermal	-	horizontal	Inserts (?)	-2006, 2010-	>100	active
Taiwan Tsing-Hua	BNCT	THOR TRIGA, 2 MW	epithermal	-	horizontal	Inserts (?)	2010-	11	active
Argentina Bariloche	BNCT	RA-6 -2007: 0.5 MW >2012: 3 MW	hyperthermal	refurbish ment	horizontal	Inserts	2003-2007 >2012	7	refurbishment

Table 1: The present neutron sources worldwide for FNT and BNCT. (*) MLC: **M**ulti **l**eaf **c**ollimator

Fig. 1: Therapy couch with mask for fixing the head and light projection.

mour seems better treated by high-LET radiation than by conventional radiation, where it is often refractory. Most of the patients are referred from the clinics of TUM and Medizinische Universität Innsbruck.

The two branches of neutron therapy

In principle, Neutron therapy has two branches: **F**ast **N**eutron **T**herapy (FNT) and **B**oron **N**eutron **C**apture **T**herapy (BNCT). The mean neutron energies used for FNT range from about 2 MeV to 25 MeV whereas the maximum energy for BNCT is about 10 keV. Neutron generators for FNT have been cyclotrons, accelerators and reactors, whereas BNCT is so far bound to reactors only. Both therapies use the effects of high-LET radiation (secondary recoil protons and alpha particles, respectively).

Fast Neutron Therapy (FNT) in the world

Neutron sources for FNT have been mostly cyclotrons, but also D-T-generators, a large linear accelerator (FERMI-Lab), and thermal reactors with a thermal-to-fast neutron converter (FRM and FRM II). The mean neutron energies range from 2 MeV (fission neutrons) to about 25 MeV for cyclotrons bombarding Be with 66-MeV-protons (written as p(66) in table 1). Neutron energy, related penetration depth, beam direction, gantry, and collimator type physically confine the tumour sites which may be irradiated. The high-energy cyclotrons with isocentric beams have the potential for treating tumours at greater depth and at complex sites, and even allow for **I**ntensity-**M**odulated **N**eutron **R**adiation **T**herapy (IMNRT). All three facilities in USA work on this task; especially in Detroit, MLC and dose-planning programmes are ready.

In case of a fixed beam, the precise positioning of the patient needs a couch or chair movable in three dimensions, and also wedges, see fig. 1. For superficial tumours, this causes no major problem, but for deeper seated tumours, a gantry is obligatory. The introduction of (photon) IMRT in clinical routine led to a decrease of head and neck tumours (H&N) treated by neutrons. Especially for small target volumes in this region with highly critical adjacent organs, the new technique, based on well tuneable MLCs with thin leaves, are most precise in targeting and thus allow also for the application of the necessary high doses. The competition with new clinical methods has reduced the number of medical indications so that yearly patient numbers per facility nowadays are two-digit. During about 50 years of FNT, about 30,000 patients have undergone FNT.

FNT is mainly used in palliative situations, e.g., in cases of recurrences or unresectable tumours. Especially such patients take advantage of the facts that the number of fractions is smaller and that often a quicker improvement of the quality of life is attained. For fast neutrons, the adeno-cystic tumour of the parotid is a widely accepted indication where curating may be intended.

Boron Neutron Capture Therapy (BNCT)

BNCT initially was developed as cell-targeted treatment of extremely aggressive forms of brain tumours, mainly glioblastoma multiformis (GBM). GBM leads to death within very few years after diagnosis irrespective of all applicable medical treatments. Such a tumour rather quickly disseminates its cells in the brain which escape surgery and strongly focused irradiation. If one succeeds in selectively delivering a non-toxic boron compound to the tumour cells, one may irradiate a larger volume with epithermal neutrons which are thermalised in the brain and react with 10 B.

In 2012, BNCT can be performed only at three research reactors in the world - see table 1.

Baseline

FNT has its niche in medical treatment of selected malign tumours and their recurrences. BNCT may conquer applications to a broader spectrum of various tumour entities like malign neoplasms of H&N, prostate, lung, and skin and thus share several indications with FNT. Due to the nature of radio-resistant and/or unresectable tumours, both therapies so far gained their main merits in palliation. In the 1960s, serious side effects have been observed, but nowadays FNT and BNCT are safe therapy options for selected tumours, if the indications are strictly observed and appropriate therapy-planning is provided.

Franz M. Wagner, FRM II

Newly Arrived

JNSE

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I am second instrument scientist at the **J**ülich **N**eutron **S**pin **E**cho spectrometer. Before joining the JCNS, I was working at the University of Greifswald in the Biophysics and Soft Matter Group on structural properties of self-assembled organic thin films. At this time I was a frequent user at the HZB facility BER II (v6 reflectometer) in Berlin. Besides the interdisciplinary research in general, I am particularly interested in the structure and dynamics of soft matter systems, especially for applications in energy storage devices.

I am working on the nEDM project at UCN Lab of the FRM II: Using two new sputtering facilities at the MLL I am responsible for the development of dedicated neutron optics (polarizers, guides, ….) for fundamental neutron physics with cold and ultracold neutrons. Before I was at the University of Mainz where I had done my thesis and worked as the technical coordinator of the UCN source I had built up there. So, fundamental neutron physics and cold and ultra cold neutrons are my speciality.

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I am second instrument scientist at RESEDA. I have completed my PhD studies in Commisariat à l'Énergie Atomique (Grenoble, France) on studying magnetic properties of 1D and 2D magnetic systems by extensively using polarized neutron scattering. I am interested in the development of Neutron Resonance Spin Echo-based techniques for high resolution and time-resolved structural and dynamic studies. One of my main concerns is to provide an easy access to those methods for the scientific community.

I represent Andrea Voit as Press Officer during her maternity leave. I originally studied physics at LMU and subsequently worked at a Fraunhofer Institute. After being trained as a journalist I had been an editor at a magazine. At last I was a freelance journalist with a wide range of topics and I gathered also experience in the field of public relations. I am very happy to be back in physics now!

PR

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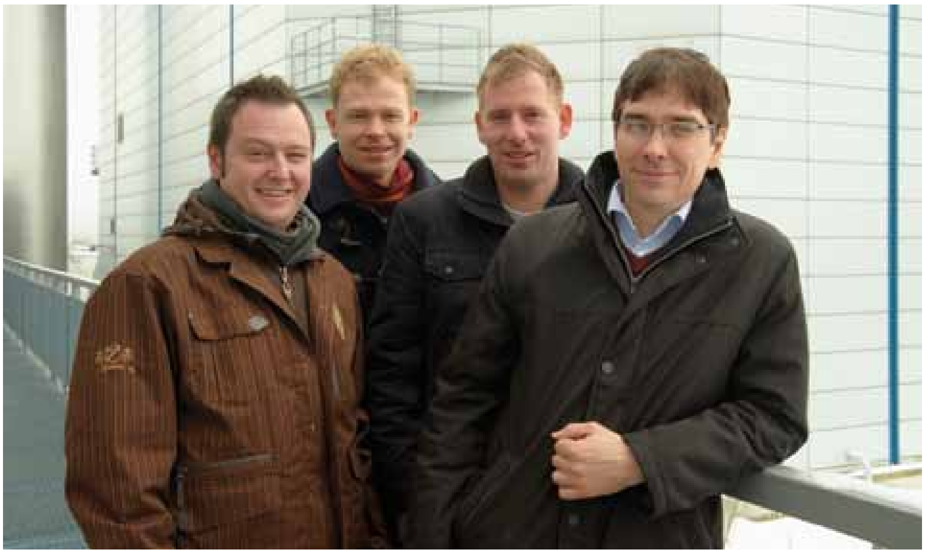
Scientific Computing - Off to Pastures New!



From left to right: Walter Van Herck, Joachim Wuttke, Christian Felder and Gennady Pospelov.

Performing a neutron scattering experiment is a pentathlon: write a proposal, prepare the samples, carry out the measurement, analyse the data, and publish the results. Of these disciplines, data analysis is often the most laborious one. Usually, it requires intensive computing, and therefore depends critically on adequate software. All too often, the power of the experimental method is underexploited because of insufficient software support.

The request for better software is exacerbated by progress in instrumentation. Two-dimensional detectors have caused a huge increase in data rates, resulting in an urgent need for automatized data reduction and fitting procedures. Qualitative improvements, such as an enhanced signal-to-noise ratio in inelastic spectroscopy, expose the limitations of established procedures and models, and prompt the need for more realistic models and more refined analysis procedures. At the same time, neutron scattering is evolving from a highly specialized field of physics into a service tool for application domain specialists: To remain attractive, neutron centres must strive for the same ease of use as it is customary, for instance, in NMR.

For all these reasons, large-scale facilities worldwide are giving high priority to data management and data analysis software, and several national and European initiatives are coordinating these efforts. On this background, Forschungszentrum Jülich and Technische Universität München have created a joint Scientific Computing Group.

The group is based in the JCNS outstation. The initial staff consists of: Joachim Wuttke, group leader, former instrument responsible of SPHERES; Christian Felder, software engineer; Gennady Pospelov, whose background is in experimental particle physics; and Walter Van Herck, software engineer and theoreticalphysicist. Recruitment for a fifth position has started.

The group coordinates the introduction of standardized data formats, organizes data management and data access, provides hosting for instrument-specific web services, and, most importantly, develops software to support instrument responsibles and their users at the diffractometers and spectrometers of FRM II.

The group participates in the **H**igh **D**ata **R**ate Processing and Analysis **I**nitative (HDRI) of the Helmholtz Association, it is observer in the European PaNdata Open Data Infrastructure network and in workpackage 6 (data analysis) of NMI3-II. Joachim Wuttke represents Forschungszentrum Jülich and TUM in the international advisory committee of the NeXuS data format.

The first projects of the group are determined by the participation in the HDRI. Jülich is formally involved in two of three workpackages. Workpackage 1 is about data archival and data access, with international embedding in PaNdata. It has been decided that experimental metadata will be managed by the open-source catalogue software ICAT, Christian Felder is currently setting up a demonstrator that will provide web access for catalogue search and data retrieval.

Workpackage 3 of the HDRI is concerned with data analysis. Specifically, software shall be developed for a relatively new experimental technique, **G**razing **I**ncidence **S**mall **A**ngle **S**cattering (GISAS). This technique is employed not only with neutrons (GISANS), but also with synchrotron radiation (GISAXS). Therefore, close cooperation has been agreed with Stefan Roth of DESY. Furthermore, collaboration has started with theoretician Laszlo Deàk (Budapest) and with GISAXS software author David Babonneau (Poitiers). Gennady Pospelov and Walter Van Herck are currently embedding their ansatzes into a more generic framework that will allow users to apply distorted-wave Born approximation to many different physical situations, including magnetic domains, rough interfaces, and nanoparticles.

Joachim Wuttke, JCNS

Komitee
Forschung mit
Neutronen

National neutron sources back in operation - A promising start-up of an important year for German and European neutron research

Last year we had a period with both of our national neutron sources shut down. After the restart of the FRM II in October 2011 we gratefully acknowledged that in March 2012 the BER II research reactor of the Helmholtz Zentrum Berlin with its unique experimental capabilities also went back into operation. This was a long expected and strongly required need for the user community. In such a situation of reduced or completely blocked national experimental facilities it becomes particularly obvious that the German strength in neutron science is essentially based on the well established access to the internationally highly competitive national experimental facilities.

I would like to take this opportunity to point out that the national neutron sources are most important also to effectively use the existing and upcoming international neutron sources including the ESS in Lund and to stimulate new developments and science at these centres. This is not only a personal opinion but expresses the feedback I receive from the users all over Germany.

The strength and enthusiasm of the user community was recently demonstrated at the *Science and Scientists at ESS* meeting in Berlin which was a great success with more than 300 participants. It could be felt that the ESS project gains more and more momentum and a strong progress on all aspects is observed. The German contribution is very well organized and due to its timely start-up it is now approaching a status in which proposals for really innovative instruments will be finalized soon.

It is frequently requested to include the user community, i.e. researchers from universities and other research institutes, already in this early stage into the development of the ESS instruments. I think that this aspect is highly important for the education of the next generation of scientists working in the field of research with neutrons and it is also valid for the continuous developments at existing instruments of the established neutron sources.

The German large scale facilities namely the neutron sources and Helmholtz centres should accordingly strongly extend their active interaction and generous support of research with neutrons and of development of neutron instrumentation at universities, Max-Planck and other research institutes. Simultaneously, the KFN supports the idea that applications for ESS projects can already be proposed in the next round of "Verbundforschung".

Finally, I would like to remind all neutron users to register for the German Neutron Scattering Conference DN-2012 which will take place from September 24th to 26th. We could compile an impressive list of distinguished colleagues agreeing to present their newest scientific results from neutron scattering and complementary methods. We will also have a session devoted to the science vision connected to the new possibilities provided by the innovative instruments at the ESS.

Do not forget to register immediately - only the first 180 registered participants will profit from accommodation costs included in the registration fee, so hurry up!

Tobias Unruh
Chairman of the 9th Komitee Forschung mit Neutronen (KFN)
Tobias.Unruh@physik.uni-erlangen.de

Newly Arrived at the User Office

There is a new staff member at the User Office: Ramona Bucher joined the team in February.

Do you like to introduce yourself?

I did an apprenticeship at the TUM Medialab and now I am media designer. I started working for the FRM II PR for a period of six months. From there I switched to the User Office.

What was your first big challenge?

That was the User Meeting in March. Everybody at the User Office is doing everything on such an event. It was exhausting but really thrilling!

User Office

Ramona Bucher

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A Joint Review Panel

The scientific cooperation between Technische Universität München and the three Helmholtz centres Berlin (HZB), Geesthacht (HZG) and Forschungszentrum Jülich GmbH imposed some organisational changes.

The previously seperately organised review panels for the proposals submitted via **fzj.frm2.tum.de** and **user.frm2.tum.de** are merged now to a common review organisation.

From the current round on, there will be only one panel consisting of six sub-committees:

- Material Science
- Soft Matter
- Magnetism
- Structure (includig magnetic structure)
- Imaging, Analysis and Nuclear and Particle Physics
- Biology

Each sub-committee is led by a chairperson and accompanied by a secretary and is affiliated to one of the cooperation partners. The panel will meet for the first time in September 2012 and review all proposals submitted via the above mentioned well-known web portals. And you can even access the FRM II user office web portal from the HZG web site:

www.hzg.de/central_departments/gems/information/forms

The next proposal deadlines:

Round	Deadline	Review
FRM II 15 JCNS 11	20.07.2012	13./14.09.2012
FRM II 16 JCNS 12	25.01.2013	21./22.03.2013
FRM II 17 JCNS 13	19.07.2013	05./06.09.2013

User Survey Still Online

In the beginning of this year, we started our user survey regarding the sample environment. Each user who did an experiment at the FRM II gets an email asking for the participition in this survey and providing him with the relevant link.

Until now we received a lot of feedback and so we like to thank all our users which have participated so far!

The FRM II is very eager to meet your demands - but we must know them! This is your opportunity to help to make the FRM II sample environment more comfortable for your needs.

The survey will be online until autumn 2012 - so please make time for answering our questions when receiving the email after finishing an experiment!

There will be a report on the results of the user survey in the next newsletter.

Reactor Cycles 2012

Cycle	Start	End
29	31.07.2012	28.09.2012
30	23.10.2012	21.12.2012

In 2013, four circles of 60 days as usual are planned.

In 2014, there will be a longer mainentance break. As you maybe know, the ILL starts its maintence break in 2013 and announces restart in June 2014. Our break shall start afterwards if somehow possible.

Dear users,

you are invited to apply for beam time at the German neutron source Heinz Maier-Leibnitz (FRM II).

Deadline for proposals: July 20th, 2012

- **Due to extensive rebuilding, ANTARES offers reduced beam time - please contact the instrument scientists!**
- **NEPOMUC is expected to be available from November on - please contact the instrument scientist!**
- **SANS-1 invites friendly users for commissioning in November/ December - please contact the instrument scientists!**

Just **register** at the digital user office. With your personal account you can access the proposal and reporting system. Have a look at

www.frm2.tum.de/en/user-office

for additional information and guidance to perform experiments at the FRM II.

Please note:
Proposals have to be submitted via the web portals within your personal account

- for FRM II, HZG, HZB instruments: **user.frm2.tum.de**
- for JCNS instruments: **fzj.frm2.tum.de**

They are **reviewed** twice a year. The next **review** will take place on September 13th-14th, 2012. Results of the review panel meeting will be online about two weeks later.

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**. Please find all details at

www.frm2.tum.de/en/user-office/nmi-3

Researchers working at German universities can apply for travel and subsistence reimbursement granted by the FRM II, JCNS, HZB and HZG.
Please have a look at

www.frm2.tum.de/en/user-office/financial-support

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

Furthermore you can apply for CRG beam time at JCNS instruments at ILL and SNS for German users. For more information about this please refer to

www.jcns.info/jcns_proposals

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

Call for proposals: Next deadline July 20th, 2012

HZB Helmholtz Zentrum Berlin

Helmholtz-Zentrum Geesthacht
Zentrum für Material- und Küstenforschung

FRM II
Forschungs-Neutronenquelle
Heinz Maier-Leibnitz

user.frm2.tum.de

Diffraction

BIODIFF
diffractometer for large unit cells; cold source
MIRA
multi purpose diffractometer; cold source
RESI
single crystal diffractometer; thermal source
SANS-1
small angle scattering instrument; cold source
SPODI
powder diffractometer; thermal source
STRESS-SPEC
material-science diffractometer; thermal source

Reflectometry

NREX
polarized neutron reflectometer; cold source
REFSANS
time-of-flight reflectometer; cold source

Positrons

NEPOMUC

- positron beam (open beam port)
- positron defect spectrometer (Coincidence doppler broadening)
- positron life time spectroscopy (PLEPS)

Spectroscopy

PANDA
three-axes spectrometer; cold source
PUMA
three-axes spectrometer; thermal source
RESEDA
resonance spin-echo spectrometer; cold source
TOFTOF
time-of-flight spectrometer; cold source
TRISP
three-axes spectrometer with spin-echo; thermal source

Radiography

ANTARES
radiography and tomography; cold neutrons
NECTAR
radiography and tomography; fission neutron source
PGAA
prompt gamma-activation analysis; cold source

Particle Physics

MEPHISTO
neutron beam port for particle physics; cold source

JCNS Jülich Centre for Neutron Science

fzj.frm2.tum.de

Diffraction

BIODIFF
diffractometer for large unit cells; cold source
HEIDI
single crystal diffractometer; hot source
KWS-1
high intensity small angle scattering diffractometer; cold source
KWS-2
small angle scattering diffractometer; cold source
KWS-3
very small angle scattering diffractometer; cold source
POLI
polarized hot neutron diffractometer; hot source

Spectroscopy

J-NSE
neutron spin-echo spectrometer; cold source
DNS
polarized diffuse neutron scattering; cold source
SPHERES
back-scattering spectrometer; cold source

Reflectometry

MARIA
magnetic reflectometer with high incident angle; cold source

User Office

Upcoming

September 3-14, 2012
16th JCNS Laboratory Course - Neutron Scattering
(Jülich/ Garching, Germany)
www.neutronlab.de

September 24-26, 2012
German Neutron Scattering Conference
(Jülich/ Bonn, Germany)
www.fz-juelich.de/jcns/EN/Leistungen/ConferencesAndWorkshops/DN-2012/_node.html
Visit our booth there!

October 08-11, 2012
JCNS Workshop 2012: *Trends and Perspectives in Neutron Scattering for Soft Matter and Biophysics*
(Tutzing, Germany)
www.fz-juelich.de/jcns/EN/Leistungen/ConferencesAndWorkshops/JCNSWorkshops/2012Workshop/_node.html

October 27, 2012
Open Day at the neutron source FRM II and the campus Garching
(Garching, Germany)
www.frm2.tum.de

February 26-28, 2013
24. SAAGAS - Seminar Aktivierungsanalyse und Gammaspektroskopie
(Garching, Germany)
www.frm2.tum.de/saagas24

February 25-March 08, 2013
44th IFF Spring School: *Quantum Information Processing*
(Jülich, Germany)
www.fz-juelich.de/pgi/EN/Leistungen/SchoolsAndCourses/SpringSchool/_node.html

July 08-12, 2013
International Conference on Neutron Scattering
(Edinburgh, United Kingdom)
www.icns2013.org
Visit our booth there!

September 15-20, 2013
13th International Workshop on Slow Positron Beam Techniques and Applications
(Garching, Germany)
www.slopos13.com

IMPRINT

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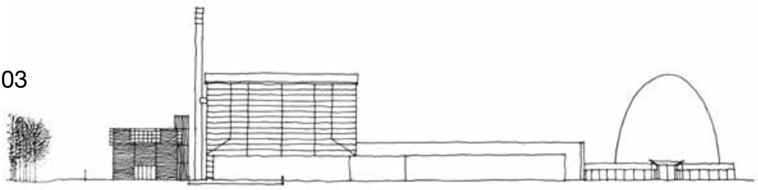

What do you see here?
An ordinary sunrise on a normal morning in Garching, the sky a bit cloudy enhanced by the steam plume from the FRM II cooling towers?
Not at all.
It was the extraordinary morning of June 6th, when the Venus was transiting through the sun – on a very normal morning in Garching, when the sky was a bit cloudy and the cooling towers were blowing steam plumes into the air.

Hopefully we will be more sucessful in 105 years - and we will be happy to print the picture in the newsletter issue 218!

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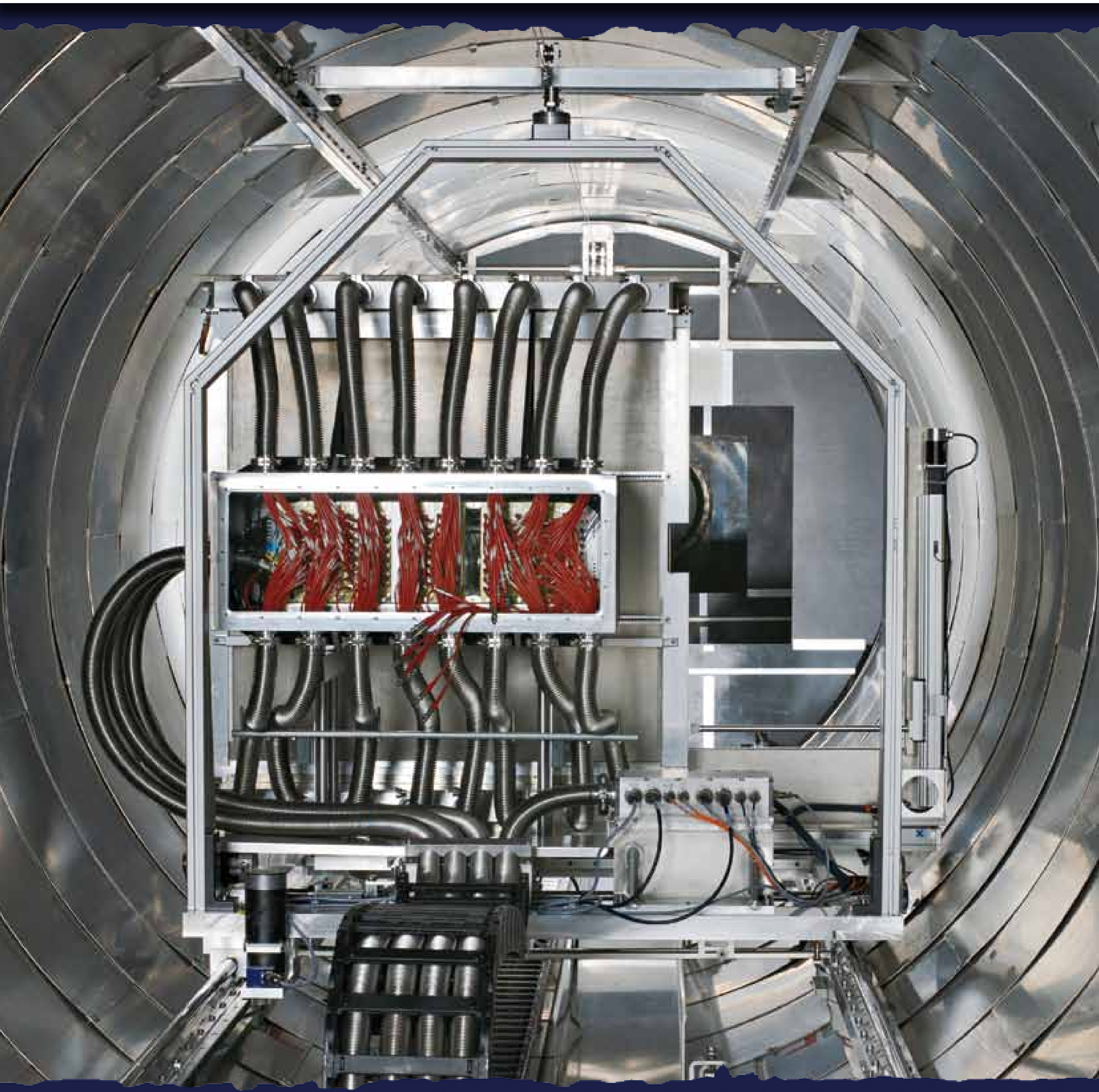

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