Materials and concepts for thin-film solar cells are at the centre of the solar energy research at HMI. These activities cover the entire spectrum from basic research to the design of actual devices. The focus is on the currently most promising technologies, namely thin-film poly-crystalline silicon and compound semiconductors of the I-III-VI_2 and III-V type. Research projects aim at the development of efficient photo-voltaic solar cells which allow substantial reductions in the costs of solar power generation. The strategy is to develop existing thin-film technologies to a state of maturity and, in parallel, to explore new materials and concepts for solar cells of the future, e.g. nanocomposite crystalline materials.

After closing the ion beam lab by end of 2006, research on Structure and Dynamics in Condensed Matter at the Hahn-Meitner-Institut is focused on experimental investigations of structures and materials using neutrons and synchrotron x-rays as probes. These two probes are provided by two large-scale facilities: The 10 MW research reactor BER II operated by HMI on its grounds in Berlin-Wannsee with the Berlin Neutron Scattering Center BENSC and the 3rd generation electron storage ring BESSY, an independent research institution in Berlin-Adlershof.

All facilities are primarily operated for a national and international user community. About 70 % of the beam time at the instruments is used by scientists from other research institutes, universities and industry from Germany and from abroad. It is HMI's policy to provide these users with full scale technical and scientific support, this way enabling them to make best possible use of the facilities. An outstanding highlight among the HMI activities are neutron scattering studies of samples in extreme sample environments such as very high magnetic fields and extremely low temperatures made possible by the institute's unique expertise on sample environment equipment. Fields in the focus of in-house structural research are magnetic phenomena, properties and design of engineering components and materials, soft matter and biological systems as well as theoretical physics.

Furthermore, HMI's accelerator facility provides the beam for the eye tumour therapy with protons operated by the University Hospital Charité.


Photo: Sebastian Frenkel

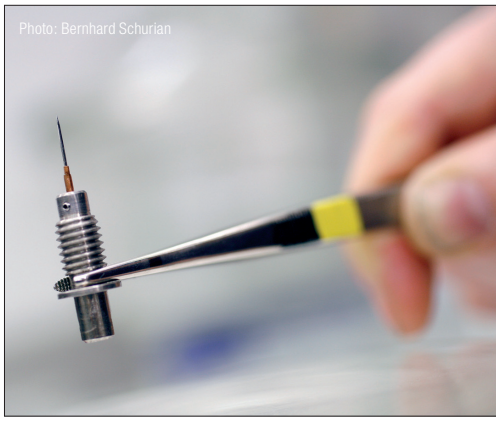


Photo: Bernhard Schurian

A model of the planned new high field magnet of the Hahn-Meitner-Institut. It will be the world's strongest magnet for neutrons scattering experiments.

News and Events 2006

(Photo: Bernhard Schurian)

Prof. Dr. Bernd Rech

Since 1 July the department SE1 Silicon Photovoltaics has been headed by Prof. Dr. Bernd Rech, who was also appointed Professor at the Technische Universität Berlin (TUB) on the 1 January 2007. Professor Rech was formerly employed at the Forschungszentrum Jülich (FZJ), where he was head of a working group for solar cell technology.

Bernd Rech, new head of the department Crystalline Silicon Photovoltaics

Prof. Dr. H.-W. Schock

Prof. Schock (SE3 Technology) took the post as head of the division in October 2006 from Prof. Tributsch (SE5 Solar Energetics), who went for a sabbatical to Australia.

Hans Werner Schock, Head of Division Solar Energy

Prof. Dr. Judith Peters

Prof. Dr. Judith Peters, instrument scientist at the department SF1 responsible for the set up of the high resolution diffractometer EXED, has been appointed professor of Biophysics at the Université Joseph Fourier in Grenoble France. She assumed office on 1 September 2006. In addition to her position at the university, she is responsible for the neutron scattering instrument IN13 at the ILL research reactor.

Judith Peters – formerly scientist at HMI, now professor of biophysics in Grenoble. (Photo: David Ausserhofer)

Dr. Eveline Rudigier

Dr. Eveline Rudigier has won the Shell She-Study-Award 2006. In her thesis the 32-year old showed how the production of pollution free solar cells can be improved. By correlating the material properties of the active layer made from copper indium sulfide (CIS) with the efficiency of the solar cells, she made an important contribution for the process optimization of CIS thin-film solar cells. A patent application affirms the practical relevance of her work.

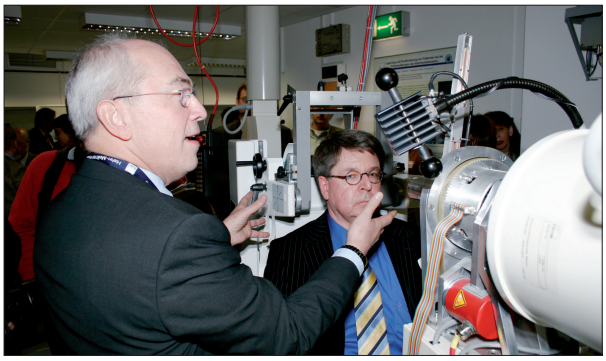
Eveline Rudigier was awarded the Shell She-Study-Award for her work on pollution free solar cells

Tumour Therapy at HMI continues

The eye tumour therapy at the Hahn-Meitner-Institut will be continued – this is the main result of the new contract between the HMI and the Charité, Berlin's university hospital. The original plan was to close down the therapy with the decision to close HMI's ion beam laboratory ISL. This would have meant the shut down of Germany's only facility, where eye tumours can be treated with protons. German patients would have been forced to travel abroad to be treated.

The decision to continue the operations at this unique facility was announced at a press conference on 16 February 2007 attended by Thomas Rachel, the Parliamentary State Secretary to the Federal Minister of Education and Research, and Prof. Dr. Jürgen Zöllner, Senator of Education, Science and Research of the City State of Berlin.

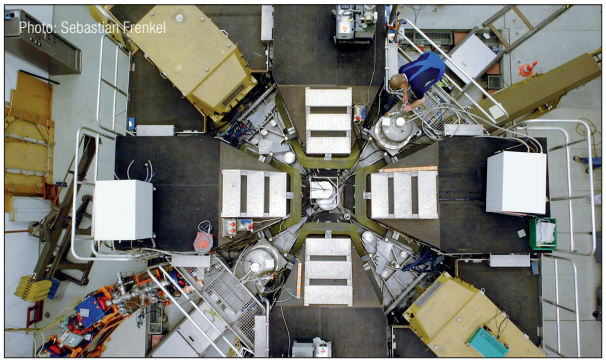
The new contract allows the continuation of the therapy with HMI operating the accelerators and providing the necessary proton beam and Charité taking care of all medical aspects. Thus the medical physicists responsible for the planning of the treatment, e.g. adjusting the range and shape of the beam to the needs of every single patient and the medical research, changed from HMI to Charité.



Michael Foerster, Head of the Ophthalmologic clinic of the Charité University hospital (left) and Thomas Dünow, the first person to be treated with protons at HMI in the therapy room.

Compared to other forms of cancer therapy, proton therapy has the advantage that one can confine the impact of the proton beam to the tumour, thus sparing the surrounding healthy tissue. This is particularly important in the case of tumours located in the vicinity of sensitive organs such as – in the case of the eye – the macula or the optic disc.

At the press conference announcing the continuation of the proton therapy at HMI:
From left to right: Detlev Ganten, head of the Charité university hospital, Jürgen Zöllner, Senator of Education, Science and Research of the City State of Berlin, Thomas Rachel, Parliamentary State Secretary to the Federal Minister of Education and Research, Michael Steiner, Scientific director of the Hahn-Meitner-Institut.



HMI's cyclotron accelerates protons to the velocity necessary for proton therapy.

Until the shut down of ISL the accelerators producing the proton beam were providing mainly ion beams for experiments in ion-solid interaction and material analysis. As the proton energy available at the HMI corresponds to a range of about 4 centimetres in living tissue, in 1993 the then Klinikum Steglitz (now Charité – Campus Benjamin Franklin) and HMI signed a co-operation contract to install a facility for the treatment of eye tumours. The proton therapy at HMI started in 1998. Since then the treatment more than 800 patients have been treated. Most of them suffered from choroidal melanomas, malignant tumours, located at the posterior pole of the eye.

Competence center for thin-film- and nanotechnologies for photovoltaics to be built in Berlin

The Hahn-Meitner-Institut (HMI), the Technische Universität Berlin (TUB) and eight leading industrial companies signed a memorandum of understanding (MoU) in April. Together with the WISTA Management GmbH and the TSB Technologiestiftung Innovationsagentur Berlin GmbH, the HMI and the TUB are planning to working hand-in-hand with the industry to develop innovative products for photovoltaics and thus bridge the gap between fundamental research and industrial production.

One of the first tasks at hand for the competence centre is to address central questions emerging from the coating of thin-film solar modules. In doing so, prototypes are to be designed in close cooperation with the industry. In addition, innovative solar cell concepts and manufacturing procedures will be developed.

Integrated EU-Project ATHLET aims for advancement of photovoltaic thin film technology

Cost reduction is the central mission of photovoltaics today, and thin-film-technology one major approach to meet this challenge. To promote the transition from thin-film solar cell research to into the market, Europe's largest thin-film-technology research-project started in January 2006. On 19 February the kick-off meeting and press-conference took place in Berlin. 24 partners from 11 countries are working together on the development, assessment and consolidation of photovoltaic thin film technology. The Integrated Project with partners from industry, universities and research facilities is being coordinated by the HMI.

The Participants of the ATHLET project at their first meeting, 19 February 2006 in Berlin

Late night science

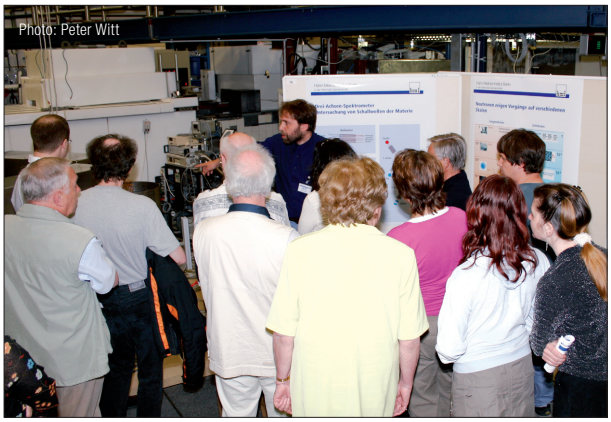
Reactor of the Hahn-Meitner-Institut opens to the public was the title of a newspaper article announcing the HMI's offer for the Lange Nacht der Wissenschaften 2006 – the open "day" of all the scientific institutes in Berlin and Potsdam on 13 May. And it probably was the prospect of accessing areas that are usually completely inaccessible to the public – the experimental halls around the research reactor and the accelerators of the Ion Beam Laboratory – that drew about 1600 visitors to HMI's campus at Berlin-Wannsee.

But HMI offered its visitors much more than guided tours to its large scale facilities. One could watch metals turn into foam, experience the force exerted by a very strong magnet on metal tools or learn how neutrons help art historians find out the story of painting.

A special focus of the Lange Nacht 2006 at HMI was the programme for children. The school lab opened its doors and gave older children the opportunity to operate a magnetic accelerator or to learn how to put the largest possible number of footballs into a huge box; special lab tours for children allowed them to experience various labs at their own pace. The highlight of the programme for smaller children was Klaus Kiefer's presentation "A day in the life of a physicist". Kiefer, a scientist in the sample environment group, not only showed what a scientist is doing all day, but also made the children experience what it feels to be an atom in a melting crystal.

But HMI is not only Wannsee. The parts of the institute located in Adlershof, also participated in the Lange Nacht. The scientists at the department Silicon photovoltaics answered countless questions about solar energy and let their visitors find out on an energy bike how much it takes to produce the energy necessary to operate a television set.

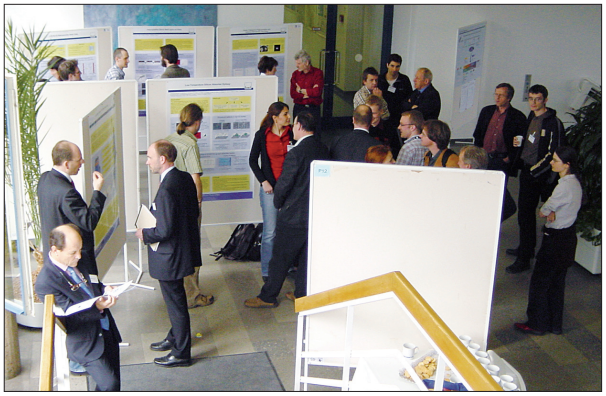
The marketplace of science



Explaining neutron scattering to visitors at the Lange Nacht der Wissenschaften

Experiencing a really strong magnet

Solar Energy evaluated



(Not only) members of the review panel took interest in the poster session during the SE-evaluation

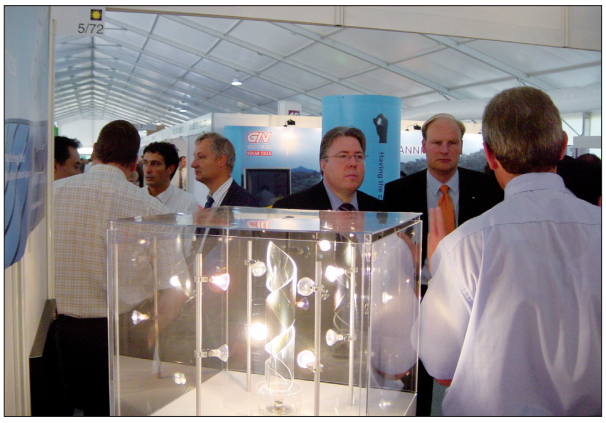
The division Solar Energy presented itself in the mid term evaluation of its first programme-period under the program-oriented funding (POF). This was the first evaluation for HMI since the start of the program-oriented funding in 2004. On 3 April, the intensive preparations proved to be worth their while: a full programme with presentations, poster sessions on tours through the laboratories offered the review a thorough picture of the research activities. The results of the evaluation were highly successful; the review panel gave a very optimistic and positive assessment of the R&D activities regarding solar energy.

HMI's Solar Energy presents itself

On the weekend 26 – 27 August, the German government invited to the *Tage der offenen Tür der Bundesregierung* (open days of the government). The HMI presented its solar energy research at the Federal Environment Ministry together with the Forschungsverbund Sonnenenergie (FVS). Visitors could learn all about the advantages and challenges of thin-film-technology. The HMI-Stand was visited by the secretary of state Astrid Klug who showed explicit interest in the research done at the HMI.

Europe's most important photovoltaics conference has always been a mandatory destination for the researchers of the division solar energy. But in September 2006, the HMI participated for the first time with a stand at the fair, together with the HMI spin-off Sulfurcell. The HMI booth, located in a crowded and hot tent, was visited by many experts as well as the interested public. After four days, the stand personnel was hardly able to talk any more, but all participants agreed to continue the participation at the next PVSEC as well as to carry on with the combined presentation of the HMI together with Sulfurcell.

The HMI is a steady participant at one of Berlin's largest fair for renewable energies. Besides information to various aspects of photovoltaics, visitors could learn about the everyday energy-consumption with the "Energy-Bike".



Visitors at the HMI-stand at the PVSEC fair in Dresden

HMI-stand at the exhibit with a Sulfurcell prototype (PVSEC Dresden)

Perspective for a growing business – innovations in photovoltaics

The “Day for the industry” (Industrietag) of the division Solar Energy reflected the current success in the photovoltaics business: around 120 guests were expected to come on 27 November to Berlin-Wannsee, more than 160 showed up to learn more about this successful technology. Speakers from industry and science gave an overview as well as important inputs for future developments. Besides these presentations, the participants could visit different laboratories and speak with the involved scientist. The day concluded with an informal reception in the evening, where guests and HMI employees could talk in a relaxed atmosphere.

Full house: the main auditorium of the HMI was at its carrying capacity, many visitors felt taken back to university as they had to scramble for a seat

The end of a success story

In 2004, HMI’s board of directors had decided to shut down Ion Beam Lab ISL at the end of 2006 and to concentrate the institute’s efforts in structural research on work with neutrons. The final colloquium on 19th December 2006, attended by colleagues from HMI and scientists from other institutes, marked the end of 12 years of successful scientific work on ion-solid interactions and ion analytics at HMI. The four invited speakers gave a taste of the variety of topics addressed in ISL’s activities: The physicists Sytze Brandenburg (KFI Groningen) and Arjen Vredenberg (University of Utrecht) talked about accelerator technology and ions as a shaping tool for the nanoworld, respectively. Michael Foerster, head of the Ophthalmologic clinic of the Charité University Hospital (Campus Benjamin Franklin) presented the story of the proton therapy at HMI and Dietrich Wildung, head of the Egyptian Museum in Berlin discussed the new paradigm for the research at European archaeological museums – instead of bringing more and more artefacts from abroad one concentrates on detailed investigations of the objects already in the museum. This requires modern scientific techniques such as the analytical tools that were available at ISL.

Finally, it was Arjen Vredenberg’s task to show that not only ISL had many talents, but also its users. In addition to his talk, he played two solo pieces on his cello.

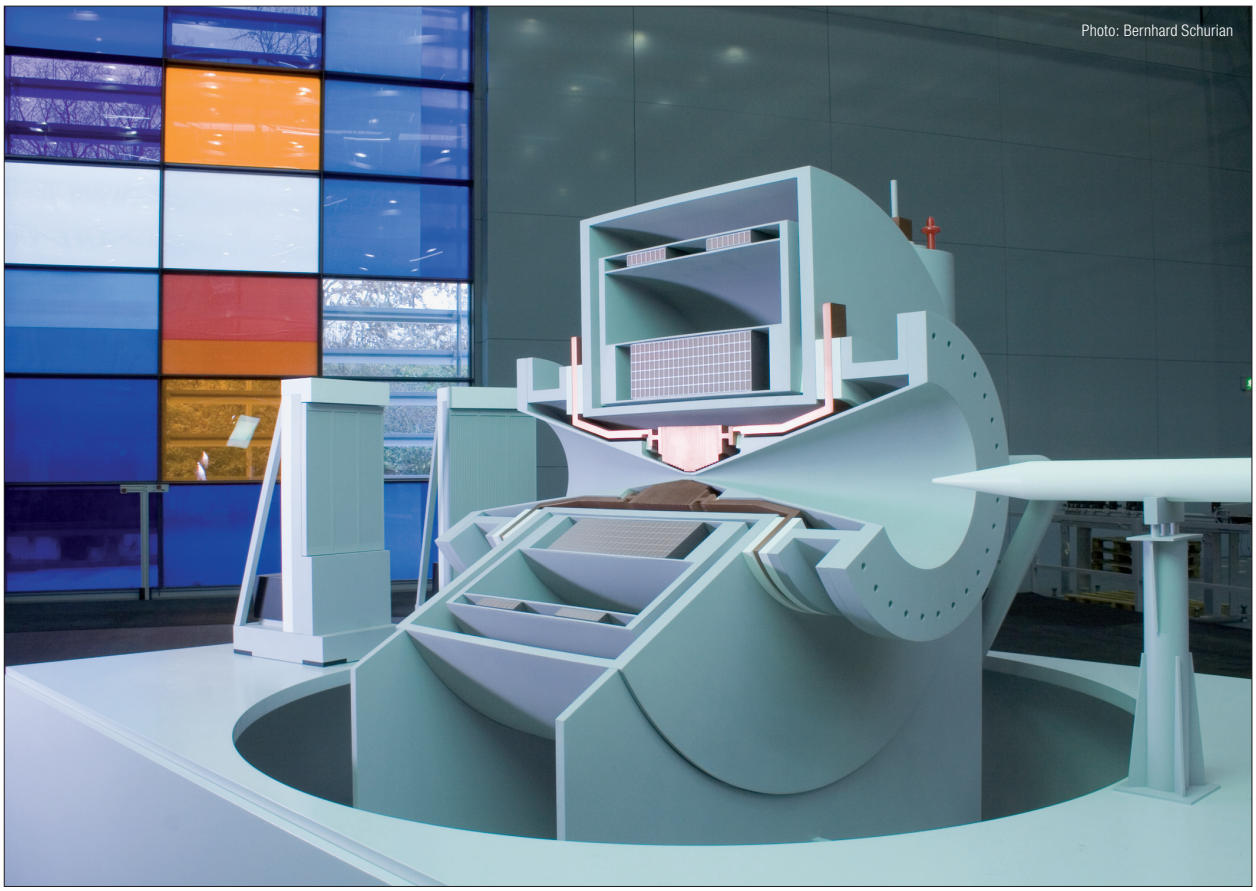
ISL final colloquium: Arjen Vredenberg, ISL user provided the music for the colloquium.

High Field Magnet - HMI to get world's strongest magnet for neutron scattering

For many years, the prospect of performing neutron scattering experiments on matter exposed to extremely high magnetic fields has been attracting users from all over the world to come to HMI. Now, the Helmholtz Association has decided to support the set up of a new high field magnet that will secure HMI's leading role in this field in the years to come. The magnet will create fields above 30 Tesla in its final stage – fields exceeding by far anything available at any neutron centre worldwide. The overall investments of the project will amount to 17.8 million euros with 90% being covered by the Federal Government and 10% by Berlin.

Scientists expect that neutron scattering experiments in the new magnet will contribute to important insights in many fields of condensed matter research, such as quantum magnetism, new materials or high temperature superconductivity. In the latter case researchers hope that experiments at magnetic fields around 25 Tesla will lead to a breakthrough in understanding the mechanism that causes some materials to lose their electrical resistance at temperatures below around minus 200 degrees Celsius.

The new magnet will not only allow for novel experiments, it will be at the forefront of development in magnet design itself. The design of the magnet will follow the Series Connected Hybrid System Technology developed at the National High Magnetic Field Laboratory (NHMFL) in Tallahassee, Florida. The magnetic field will be produced by two coaxial horizontal coils connected in series: The external coil will be made of a low temperature superconductor, while the inner coil will be produced of a copper alloy. The advantage of this construction lies in the fact that the use of superconducting coils helps to reduce the energy costs compared to an all-copper magnet, while the copper part allows reaching fields that cannot be cre-



Model of HMI's new high field magnet. The model is cut open showing the inner design of the magnet.

Neutron Guide Hall II in December 2006. The magnet will be placed in front of the big window at the end of the hall. The blue tubes on the right hand side are the neutron guides of the instrument EXED that will be operated with the magnet.

High-field magnet: Signing of the contract between HMI and the National High Magnetic Field Laboratory (NHMFL), Tallahasse, Florida.
At the table (from left to right) Michael Steiner, Scientific Director of HMI, Kirby Kemper, Vice President for Research at Florida State University, Ulrich Breuer, Administrative Director of HMI. Standing: Jürgen Mlynek, President of the Helmholtz-Association, and Thomas Rachel, Parliamentary State Secretary to the Federal Minister of Education and Research.

ated by superconducting coils only because of the critical field of the available superconducting materials.
The magnet will be located at the end of HMI's Neutron Guide Hall II just in front of the stained glass window. Seen from outside, it will have the shape of a horizontal cylinder with conical openings on both sides. These openings will allow the neutrons from the reactor to access the sample located at the centre of the magnet and to continue towards the detectors after scattering. The magnet will be incorporated in the extreme environment diffractometer EXED – a neutron scattering instrument specially developed for that purpose.

It will take another four to five years until the magnet will begin its operations in Berlin. In that time, HMI will build the necessary infrastructure that will supply the magnet with electricity, cooling water and liquid helium and take into operation the diffractometer EXED. The magnet will be designed and constructed by NHMFL in Florida and later shipped to Berlin and assembled at the Hahn-Meitner-Institut. By that time, many condensed matter scientists will have developed ideas for experiments at the new magnet and will be looking forward to new insights into the fascinating worlds of magnetism or superconductivity.

Berlin at the centre of the polarized neutron world

Scattering of polarized neutrons, neutrons with all their spins oriented in one direction, opens for great opportunities in investigating the magnetic properties of materials or – via the spin echo technique – the dynamics in soft matter and other complex systems. In various forms, polarized neutrons are used in experiments at the Hahn-Meitner-Institut and the institute is an important centre for the development of novel techniques in this field.

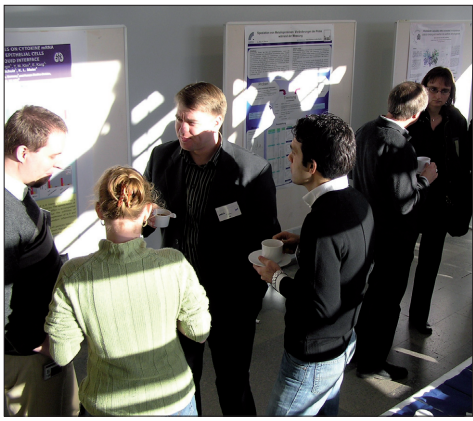
For a few weeks in September 2006, Berlin and HMI became the centre of the polarized neutron world – the Polarized Neutron School and the PNCMI conference (Polarized Neutrons in Condensed Matter Investigations) were organized by HMI in the German capital. The school, taking place from 19 to 22 September at HMI gave 30 diploma and Ph.D. students the opportunity to get acquainted with polarized neutron research – its experimental and theoretical aspects. The following week, almost 150 experienced researchers convened at the Berlin-Brandenburgische Akademie der Wissenschaften for the PNCMI conference to discuss the latest scientific trends

Speakers and students at the Polarized Neutron School held in Berlin in September 2006

and instrumental developments in this field. A field, which – as Ferenc Mezei remarked in his talk to the school participants – has an old connection with the Hahn-Meitner-Institut: Otto Frisch, the first to create a beam of polarized neutrons, was a nephew of Lise Meitner.

27th Tutorial Session on Neutron Scattering

International Conference on Atomic Collisions in Solids (ICACS)



5th Workshop on Metallo- and Metalloid proteins (Herbsttagung)

Meetings, Conferences organized by HMI

Several meetings, schools and conferences have been organised at or by the Hahn-Meitner-Institut in 2006. A table presents an overview.

Event	Organized together with	Location	Dates
27th Tutorial Session on Neutron Scattering		Hahn-Meitner-Institut	27 February – 2 March
Meeting of the European Neutron Radiography Association 2006		Hahn-Meitner-Institut	17 March
International Conference on Atomic Collisions in Solids (ICACS)	Technische Universität Berlin	Technische Universität Berlin	21 – 26 July
Summer student programme		Hahn-Meitner-Institut	August/September
PNCMI School		Hahn-Meitner-Institut	19 – 22 September
PNCMI Conference (Polarised Neutrons for Condensed Matter Investigations)		Berlin	25 – 28 September
WINS2006 (Workshop on Inelastic Neutron Spectrometers)		Hahn-Meitner-Institut	29 – 30 September
5th Workshop on Orbital Physics and Novel Phenomena in Transition Metal Oxides	University of Hamburg	Hahn-Meitner-Institut	5 – 6 October
5th Workshop on Metallo- and Metalloid proteins (Herbsttagung)	GSF – National Research Center for Environment and Health	Hahn-Meitner-Institut	6 – 7 December