HZB Helmholtz Zentrum Berlin

FOCUSSING ENERGY *REALISING VISIONS*

TWO SOURCES – ONE CENTRE, ONE VISION

IN BRIEF

The Helmholtz-Zentrum Berlin (HZB) operates two scientific large scale facilities for investigating the structure and function of matter: the research reactor BER II for experiments with neutrons and the synchrotron radiation source BESSY II, producing ultrabright photon beams ranging from Terahertz to hard X-rays.

HZB was founded in January 2009 by merging the former Hahn-Meitner-Institute and the Berliner Elektronenspeicherring-Gesellschaft für Synchrotronstrahlung (BESSY), two of Berlin's largest research centres. Due to the merger, HZB is now one of the few centres world-wide to offer the whole range of instruments for neutron and synchrotron radiation within one laboratory structure.

We intend to promote the combined research with both probes and to open new frontiers for the scientific community. A common user gateway provides a unified proposal procedure with one scientific selection panel. This panel organised in thematic colleges for both probes will foster the **synergetic use of neutron and synchrotron radiation.**

Facts and Figures

The HZB employs approximately 1100 staff members, of whom 800 work at Wannsee and 300 at Adlershof. It has a total budget of about 110 million Euros. About 100 doctoral candidates from the neighbouring universities are involved in research and training at the HZB. Beyond the Berlin-Brandenburg region, the HZB cooperates with more than 400 partners at national and international universities, research institutions and companies.

View onto the electron storage ring at BESSY II.

A compressor turbine prepared for non-destructive evaluation of stress states using neutron diffraction method.

LARGE SCALE FACILITIES FOR RESEARCH

Both facilities, the neutron source BER II and the synchrotron radiation source BESSY II, provide outstanding and highly sophisticated analytical tools and methods for interdisciplinary research from biology to engineering materials.

The complementary research with photons and neutrons places the HZB in a unique position to address the needs of the international scientific community in physics and chemistry, as well as materials and life sciences.

About 2500 scientists from universities, research institutes and industry conduct their research projects at the two sources every year. They use about 80 percent of the available experimental time. Users also take part in decision-making concerning the development of the equipment and hence help to guarantee an excellent support.

For more information, please contact our **User Office** with its two outposts – in Berlin-Adlershof and in Berlin-Wannsee.
www.helmholtz-berlin.de/userservice

The HZB operates two additional large scale facilities for external institutions: an accelerator for the **Charité**, producing proton beams for eye tumour therapy (at Wannsee), and the Metrology Light Source, the dedicated storage ring of the **Physikalisch-Technische-Bundesanstalt** (at Adlershof).

The combined access to both excellent neutron and photon experimental facilities is of great benefit in consolidating new scientific findings in the field of solar energy research.

RESEARCH IN MODERN MATERIALS

How are the technical properties of a material connected to its microscopic structure? This is of major interest for the scientists at the Helmholtz-Zentrum Berlin für Materialien und Energie.

Our Focus

- Magnetic Materials
- Functional Materials
- Materials for Solar Energy Technology

In our research we address the atomic and magnetic structure of solid state matter and investigate how it functions on the atomic scale. The structure-property relationship of materials is a main focus, as are inner dynamics and phase transitions in condensed matter. Our researchers also work on the next generation of solar cells, including new kinds of materials and innovative cell structures. The long-term goals are to develop efficient and competitive thin film solar cells and multispectral cells.

All subjects which contribute to the development of instrumentation and methods, particularly within materials research and analysis, are of major interest for our investigation.

3-Axis Spectrometer FLEX with high field sample environment. Most experiments on high temperature superconductivity are done here.

HZB NEUTRONS

The HZB operates more than 20 instruments at the research reactor BER II and has established itself as a major research facility for neutron science on an international scale meeting the high demands of the research community.

HZB neutrons offer access to a great variety of neutron scattering and radiography instruments with partly unique features suited for research in many fields of science. At present, 14 instruments are in routine operation, embedded in a programme for external users. These instruments cover virtually all neutron scattering and radiography techniques, except backscattering. Several of these instruments provide neutron intensities and resolutions which can keep up with the best instruments world-wide.

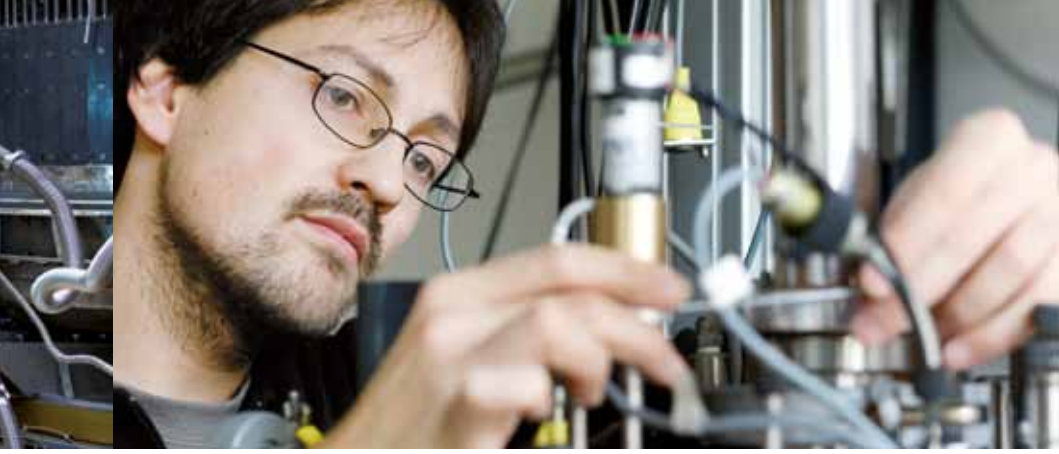
A unique and world-wide recognized strength of HZB neutrons is the **large range of sample environment equipment** available to conduct experiments under extreme conditions. Highest magnetic fields (up to 17,5 Tesla) and lowest temperatures (down to 30 Millikelvin) are routinely offered.

BER-II IN SHORT

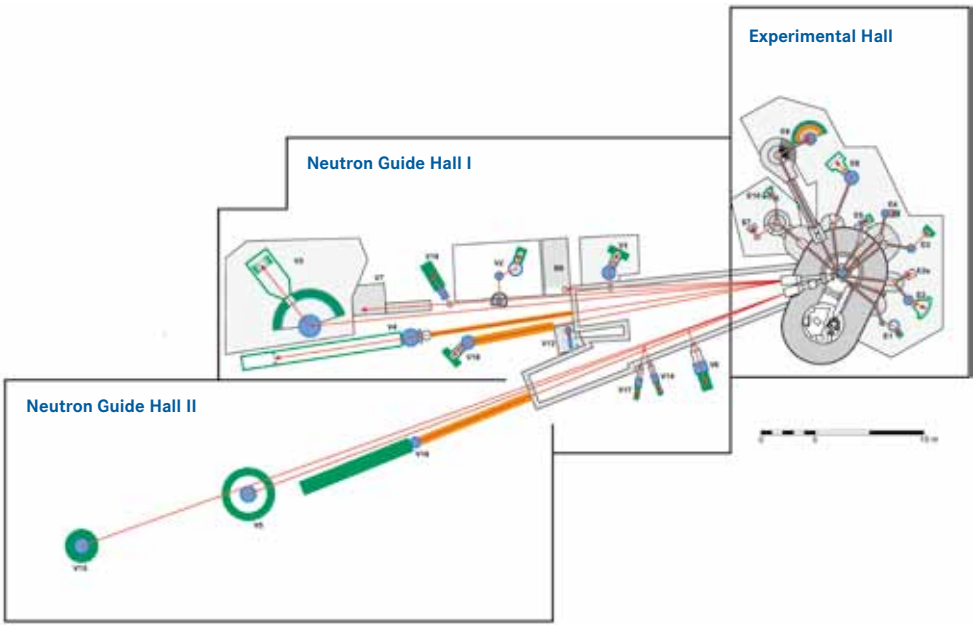
- Thermal Power: 10 MW
- Low enriched Uranium (LEU)
- Neutron Flux: $1.2 \cdot 10^{14}$ $n \cdot cm^{-2} \cdot s^{-1}$
- Cold Source (hydrogen at 13.6 bar, 25 Kelvin)
- 9 beam tubes (thermal neutrons)
- 8 neutron guides (cold neutrons)

Ongoing Upgrade projects for HZB neutrons

- New Cold Source: gain factor for cold neutron intensity > 1.5
- New Super-Mirror guide system and instrument renewal program: gain factor 10 on average
- High-Field Magnet > 33 Tesla for neutron scattering experiments



A cryomagnet is prepared for a measurement at very low temperature and high magnetic fields.



Floor plan of the neutron instruments at BER II

Experimental Hall (thermal neutrons)

E 1	3-Axis Spectrometer
E 2, E 6, E 9	Powder Diffractometers
E 3, E 7	Residual Stress Analysis
E 4, E 5	Single Crystal Diffractometers
E 2a	Crystal Test Device
E 10	Dedicated Low-Temperature Diffractometer

Neutron Guide Hall I (cold neutrons)

V 1	Membrane Diffractometer
V 2	3-Axis Spectrometer
V 3	Time-of-Flight Diffractometer
V 4	Small-Angle-Scattering Instrument
V 6	Reflectometer
V 7	Cold Neutron Tomography
V 12	Double-Crystal Diffractometer
V 14	Mirror Test Device
V 17	Detector Test Station
V 18	Reflectometer for Biological applications
V 19	Polarized Neutron Tomography
B 8	Neutron-Autoradiography

Neutron Guide Hall II (cold and thermal neutrons)

V 5	Spin-Echo Spectrometer
V 15	Extreme Environment Diffractometer
V 16	Very Small-Angle-Scattering Instrument

View of the experimental hall building of the synchrotron radiation source BESSY II in Adlershof.

HZB PHOTONS

The storage ring BESSY II provides ultrabright photon beams from the Terahertz region to hard X-rays with complete control of the polarization of the radiation and energy range. More than 50 beamlines offer a multi-faceted mixture of experimental opportunities at undulator, wiggler and dipole sources with excellent energy resolution. The combination of brightness and time resolution makes BESSY II the ultimate microscope for space and time, since both femtosecond time and nanometer spatial resolutions are available.

The synchrotron radiation source BESSY II provides **25% of the XUV-infrastructure in Europe** and because of the radiometry activities of the Physikalisch-Technische-Bundesanstalt, BESSY II is the European calibration standard for electromagnetic radiation.

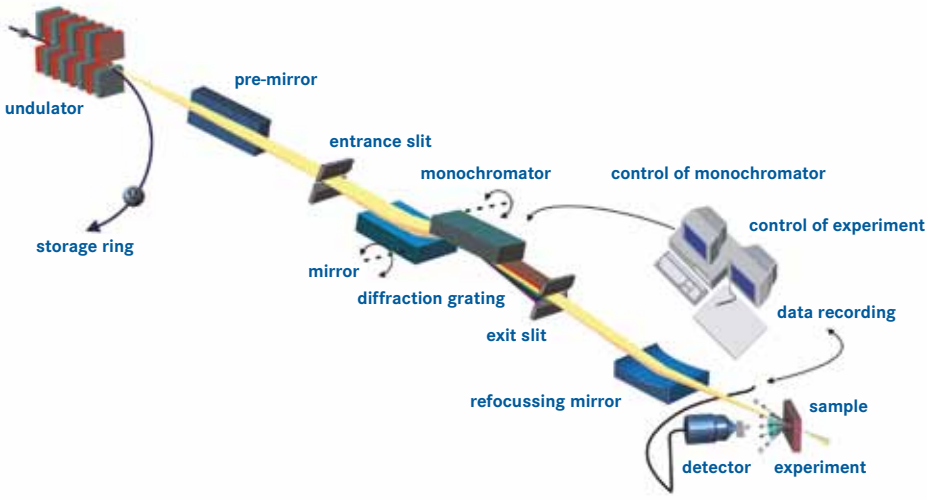
BESSY II IN SHORT

- Electron Beam Energy: 1.72 GeV
- Max. Ring Current: 300 mA
- Operating Modes: Multi Bunch Hybrid, Low-alpha, Single Bunch
- Pulse Lengths: 100 fs, 2 ps, 50 ps
- Energy Range: 6 meV-150 keV
- Horizontal Emittance: $6 \cdot 10^{-9}$ mrad
- 14 Insertion Devices: full polarisation control

Ongoing upgrade projects for HZB photons

- Continous improvement of the accelerator system: Linac injector, Fast Feedback Orbit, new HOM-damped cavities
- Installation of new beamlines/instruments for spectroscopy, microscopy, scattering

Specimens in the form of a fine needle are used for investigations at the three-dimensional atom probe. This instrument permits the elemental reconstruction of a small volume of metallic material with near atomic resolution.



Radiation Processing in a Beamline
Prior to the measurements, synchrotron radiaton is optimized in the beamlines by passing several optical elements (mirrors and greatings).

SUPPORT LABS

Our large scale facilities are complemented by **a cluster of laboratories,** which can also be used by external scientists. These labs are equipped with state-of-the-art instruments for magnetic measurements **(MagLab)**, for adsorption measurements **(GasLab)** and for the preparation and investigation of biological samples **(BioLab).**

In addition to that the **x-ray laboratory** offers various methods for material characterisation in combination with options to prepare samples for complementary methods like neutron diffraction, specific heat, and magnetisation.

The Novel Materials group operates a **solid state synthesis laboratory** for the preparation of ceramic powders involving transition metal oxides as well as two optical floating zone image furnaces for single crystal growth.

The Macromolecular Crystallography Lab provides the infrastructure for growing, mounting and characterisation of protein crystals.

School children focused on experiment in the school laboratory (left) and one of the young researchers controlling experimental conditions.

SUPPORTING THE NEW GENERATION

The HZB offers interested pupils, school graduates, students, doctoral students, and post-docs numerous opportunities to further their education.

A Bright Outlook for Students

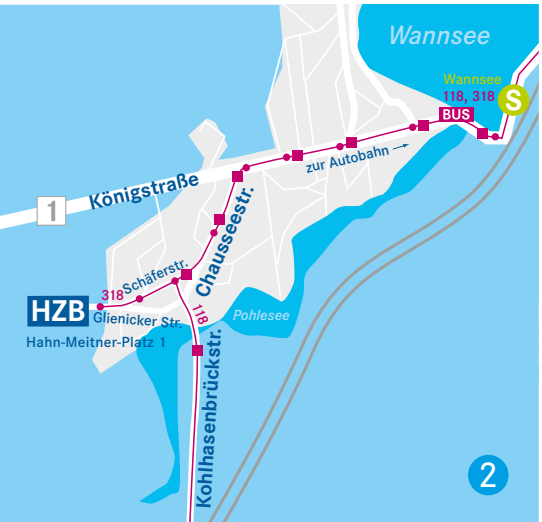
The HZB works closely with Berlin's and Brandenburgs universities. HZB scientists give lectures at the universities and supervise PhD theses. The Berlin School on Neutron Scattering, the International Photovoltaics Summer School and the HZB summer student programme take place every year. These programmes are arguably the best way to get to know the large scale facilities.

Smart through Experiments

In the school laboratory "Blick in die Materie" ("Looking into Matter"), school children can dive into the fascinating world of physics and – at the same time – get familiar with the work of a researcher. Those, who are interested, can take an even closer look at real applications by participating in a school internship at the HZB.

Taking Success into Professional Life

Young people can currently undergo future-oriented professional training at HZB – in the fields of administration, mechanical engineering, information technology, and environmental health physics.



Wannsee

Lise-Meitner-Campus

Hahn-Meitner-Platz 1
14109 Berlin
Tel +49 30 8062-0
Fax +49 30 8062-42181

Adlershof

Wilhelm-Conrad-Röntgen-Campus

Albert-Einstein-Str. 15
12489 Berlin
Tel +49 30 8062-0
Fax +49 30 8062-12990

Kekuléstraße 5
12489 Berlin
Tel +49 30 8062-0
Fax +49 30 8062-41333

Photo credits

Photographer: Bernhard Schurian, © HZB • S. 4 Photographer: Carsten Meißner, © HZB

Helmholtz-Zentrum Berlin für Materialien und Energie GmbH

Hahn-Meitner-Platz 1
14109 Berlin
Tel +49 30 8062-0
Fax +49 30 8062-42181

www.helmholtz-berlin.de