Neutron scattering in magnetic fields up to 26 T using HFM/EXED facility

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Application of high magnetic fields is a powerful method for revealing a complex behaviour in modern materials. In combination with a microscopic probe such as neutrons it provides a direct access to static and dynamic correlations in matter. Until the shutdown of the BERII research reactor in 2019, Helmholtz-Zentrum Berlin (HZB) hosted a unique high field facility for neutron scattering. It combined neutron scattering with continuous magnetic fields as high as 26 T and temperatures down to 0.1 K.

Magnetic field was generated by means of horizontal solenoid High Field Magnet (HFM). The magnet utilised hybrid technology and reached 25.9 T at full power of 4 MW. The tapered inner coil allowed neutron scattering to detectors up to $\pm 15^\circ$ off the beam axis. Furthermore, the magnet could be rotated by an additional 15° to access a larger reciprocal space region. Neutron scattering in high fields was performed using the dedicated multi-purpose Extreme Environment Diffractometer (EXED). EXED used time-of-flight (TOF) polychromatic technique. Combined with 15° magnet rotation it provided a gapless coverage of Q-range from 0.1 up to 12 Å^{-1} for diffraction experiments. The low-Q range could be extended beyond 10^{-2} Å^{-1} using a pin-hole TOF Small Angle Scattering mode. A direct TOF spectrometer mode enabled inelastic neutron scattering experiments over a limited Q-range < 1.8 Å^{-1} with an energy resolution of a few percent and incident energies below 25 meV. In this talk I will give an overview of the HFM/EXED facility with focus on scientific examples obtained over several years of the facility's operation.