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Magnetism & NI: Neutron imaging on magnetic materials

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Owing to their zero net charge neutrons are able to pass through thick layers of matter (typically several centimetres), but are sensitive to magnetic fields due to their intrinsic magnetic moment. Therefore, in addition to the conventional attenuation contrast image, the magnetic field inside and around a sample can be visualized independently by detection of polarization changes in the transmitted beam. This is based on the spatially resolved measurement of the cumulative precession angles of a collimated, polarized, monochromatic neutron beam that transmits a magnetic field.
The configuration was used for quantitative polarimetric experiments, where the polarization vector of the magnetic field associated with a sample was measured in three orthogonal directions. By applying an iterative algorithm to the measured rotation angles, it was possible to reconstruct the flux density of the 3D magnetic field that produced them. In addition a neutron beam of high spatial coherence can be used for visualization of walls between magnetic domains (Bloch walls) by means of a grating interferometer. This is known as a dark-field imaging, which was used very successfully for an investigation of the magnetic properties of high-permeability steel laminates (HPSL) which are used in the core of transformers. In the present talk examples of investigation of various magnetic materials using neutron imaging techniques will be presented.

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Dr. Nikolay Kardjilov is a researcher at the Institute of Applied Materials of the Helmholtz Centre Berlin for Materials and Energy, Germany. He was a beamline scientists at the neutron imaging instrument CONRAD-2 before the shutdown of the research reactor BER-2 in 2019. Since 2020 he is a member of the Joint Research Unit Ni-Matters supporting the construction and the operation of the new neutron imaging instrument NeXT at ILL in Grenoble, France. His research interests relate to development of new experimental techniques for investigation of the structure and property of materials the help of neutron radiation. Dr. Kardjilov has worked on the development of methods using different contrast mechanisms like phase- and diffraction-contrast imaging, visualizing of magnetic fields by polarized neutrons and high-resolution applications. These methods are implemented nowadays at different facilities worldwide and are provided to the user community for addressing a broad spectrum of scientific and industrial problems.

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