m36.o01

Magnetic and crystal structures probed by neutrons in 40 GPa pressure range

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Keywords: high-pressure research, neutron diffraction, phase transitions

Neutron diffraction provides key information on magnetic structures and position of light elements in solids. While usually neutron experiments are limited to relatively low pressures (2-3 GPa), we present neutron diffraction studies in the 40 GPa pressure range. The techniques developed in the Laboratoire Léon Brillouin allowed us to combine very low temperatures (down to 0.1 K), magnetic fields (up to 8 Tesla) with single-crystal and powder neutron diffraction [1]. The extended range of thermodynamical parameters revealed new phenomena in ''exotic'' magnetic material, such as molecular magnets (O_2) [2-3], topologically frustrated systems (Laves phases or pyrochlores) or systems close to the instability limit between the localized and itinerant magnetic states [4-7]. Pressure modifies magnetic interactions, changes the balance between different magnetic sublattices and can induce magnetic collapse when exceeds some critical value. The studied compounds exhibit many unusual pressure-induced magnetic and structural phenomena, such as pressure-induced spin crystallization in magnetically disordered pyrochlores, first-order magneto-structural transitions in Laves phases, and magnetic collapse in high-pressure oxygen. Complementarities between neutron and synchrotron techniques are emphasized. New pressure techniques allow to carry out neutron and synchrotron measurements on the same sample in the same pressure cell. The combination of the two diffraction probes was recently successfully used to study the crystal structure of the broken-symmetry phase in solid deuterium at the pressure of 38 GPa [8].

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m36.o02

Development of a new state-of-the-art beamline optimised for single crystal and powder X-ray diffraction under extreme conditions at the ESRF

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Keywords: high pressure, synchrotron, X-ray diffraction

We present a new state-of-the art synchrotron beamline fully optimised for monochromatic X-ray diffraction at high pressure and high (or low) temperature. In comparison with the old high pressure beamline ID30, this new beamline exhibits outstanding performance in terms of photon flux and focusing capabilities. The main components of this new instrument will be described in detail and compared to the performance of beamline ID30. In particular, the choices in terms of X-ray source, X-ray optics, sample environment and detectors will be detailed. The first results of the beamline commissioning are presented.