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Polarized neutron diffraction studies on weak ferromagnets at instrument POLI at MLZ

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Polarized neutron diffraction (PND) is a powerful method to investigate magnetic structures. PND can be used for very precise magnetization measurements even for weak magnetic contributions. It allows the high-quality determination of magnetic form factors, to untangle complex (e.g. chiral) magnetic structures, and to follow the movement of magnetic domains. By conserving the phase relation between the nuclear and magnetic structure, this technique is also a valuable tool to investigate the Dzyaloshinskii–Moriya interaction (DMI) [1], which is an important driving force in many magnetic materials including weak ferromagnets.
Using the Flipping Ratio (FR) setup [2] of POLI [3] at MLZ, the magnetic structures of two prototypical weak ferromagnets, hematite (α-Fe_2O_3) and rhodochrosite ($MnCO_3$), have been studied in detail as function of the applied magnetic field and temperature. This allowed us to determine the magnetic susceptibility tensor and, for the first time with neutrons, the absolute sign of the DMI in both compounds. Moreover, due to the large q-range access of POLI, we were able to reconstruct field induced magnetization density distribution maps by using the maximum entropy method.
[1] V. E. Dmitrienko et al., *Nat. Phys.* **10**, 202 (2014)
[2] H. Thoma, W. Luberstetter, J. Peters, and V. Hutanu, *J. Appl. Cryst.* **51**, 17-26 (2018)
[3] V. Hutanu, Heinz Maier-Leibnitz Zentrum, *Journal of large-scale research facilities*, **1**, A16 (2015)

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