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Chiral magnetic structures probed by SANS & GISANS

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Chiral magnetic structures in single crystals and thin film structures probed by polarization-analyzed Small Angle Neutron Scattering (SANS) & Grazing-Incidence-SANS are often connected to complex analysis procedures and require the development of individual magnetic models. Additionally, precise data-reduction protocols are needed to distinguish sample scattering from instrumentational effects. The more involved the different interactions in one sample system, the more care has to be taken for a comprehensive understanding as function of, e.g., magnetic field, electric field, temperature, and further parameter sets. The key to a broad understanding then can be given by the comparison of various analysis methods.
Here, I will provide two examples on the complexity of magnetic (GI-)SANS data analysis on different materials: (i) a ferromagnetic/superconducting thin film with temperature dependent chiral magnetic domain walls, and (ii) a magnetoelectric single crystal with chiral magnetic phases depending on temperature, magnetic, and electric field. For study (i) we will compare polarization-analyzed GISANS data on Nb/FePd thin films with perpendicular magnetic anisotropy with results from CD-XRMS, and evaluate our conclusions together with information gained by Density Functional Theory (DFT) [1]. In study (ii), we present the dependence of magnetic chiral phases occurring in the magnetoelectric single crystal $Ba_{2-x}Sr_xMg_2Fe_{12}O_{22}$ [2] as function of temperature and magnetic field.
[1] P. C. Carvalho et al., Nano Lett. 23, 4854–4861 (2023).
[2] K. Zhai et al., Nature Communications 8, 519 (2017).

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