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Polarized SANS and GISANS at the ESS

Small-Angle Neutron-Scattering (SANS) with polarization analysis is a powerful technique to investigate magnetic order in hard condensed matter systems on the nanometer and mesoscopic length scales, and to suppress hydrogen incoherent scattering in soft matter materials. The high neutron flux expected at the European Spallation Source (ESS), coupled with novel instrumentation that will be supported by a wide variety of sample environments, will be combined with neutron polarization analysis on many instruments [1], enabling exciting new science projects.

The integration of data analysis with instrument work is crucial for a successful scientific study. The variety of sample environments and the broad scientific scope of time-of-flight SANS instruments with large position sensitive detectors at the ESS complicate the data workflow for polarized SANS experiments considerably. Comprehensive and user-friendly procedures for the collection, reduction, and analysis of polarized SANS data have to be established for ESS instruments. Firstly, I will present the status of polarized SANS development on ESS instruments, including design, the data reduction protocols for polarized SANS and its future implementation in the data reduction software Scipp [2], together with plans for the data analysis using the SasView software [3]. Secondly, I will demonstrate how those procedures are applied to two example systems exhibiting complex magnetic spin textures: (i) a magnetoelectric single crystal leading to magnetic chiral structures as a function of applied electric and magnetic fields and temperature, studied by polarized SANS, and (ii) magnetic chiralities in a superconductor/ferromagnet thin film structure with temperature dependent chiral domain walls [4, 5], studied by polarized GISANS.

[1] W. T. Lee et al., Report on ESS Polarisation Workshop, ESS-3549713 (2020).
[2] https://scipp.github.io/ess/
[3] www.sasview.org
[4] A. Stellhorn et al., New Journal of Physics 22, 093001 (2020).
[5] A. Stellhorn, Ph.D. thesis, RWTH Aachen University (2021).

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