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Magnetic Wollaston Prisms for spatial intensity modulations of polarized neutron beams at FRM II

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The MIEZE (Modulated Intensity with Zero Effort) resonant spin-echo technique at the RESEDA instrument at FRM II has its optimum resolution at small scattering angles, i.e. SANS type geometries. Recent upgrades (MIASANS) have further increased the resolution in the small angle regime. Going forward, there is the possibility [1] to extend the optimum MIEZE resolution to wide angles by incorporating superconducting magnetic Wollaston prisms (MWPs) into the beamline. These MWPs will produce controlled spatially intensity modulations in addition to the intensity modulations in time inherent to MIEZE. The resultant capability to make corrections to the neutron time of flight allows for the systematic spatial focusing of the MIEZE resolution function to any desired scattering angle. Additionally, MWPs will be useful in the context of intra-particle mode-entangled neutron beams for potential use in probing many-body quantum entanglement in materials [2]. Finally, the compact and modular nature of the MWPs will allow them to be used to measure diffraction peaks with enhanced resolution at several polarized beam instruments such as MIRA, KOMPASS, LaDiff, and in general at small angle neutron scattering instruments [3]. We present the plans for the construction of these superconducting MWPs for use at FRM II, and describe the details of their operation and the various possibilities they offer.

[1] F. Li., J. Appl. Cryst. 55, 90-97 (2022).

[2] S. Kuhn et al., Phys. Rev. B 3, 023227 (2021).

[3] F. Li et al., Sci. Rep. 7, 865 (2017)

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