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Spherical neutron polarimetry at MAGiC

Spherical neutron polarimetry has been routinely established using Cryopad [1], measuring in zero-field the full polarization tensor for single Bragg peaks. This is a precise tool perfectly suited for monochromatic instruments at reactor sources. How to achieve this goal at ESS and at pulsed sources in general with polychromatic beams?
There are two feasible solutions. Since such experiments are essentially not limited by flux, a straightforward solution for pulsed sources would be to use the Cryopad as a sample environment at instruments that are already equipped for longitudinal polarization analysis.
Here we consider an alternative approach based on a precession technique [2,3] that can be fully adapted to a pulsed, polychromatic neutron beam to cover a large section of the reciprocal space in time-of-flight Laue diffraction. Since this method accepts the non-precessing component for polarization analysis, it applies as well to inelastic scattering. In order to make use of the full wavelength band, the $\pi/2$-flipper, which initiates the precession mode, needs to be ramped in time according to the neutron's wavelength and its time-of-flight. A common phase of the precession angle at the sample is not a necessary requirement but can be favorably achieved by an additional spin-echo setup. For an instrument like MAGiC at ESS, spherical polarization analysis can be a straightforward extension of the existing setup for longitudinal polarization analysis. We are considering this potential upgrade for the MAGiC instrument and present a relatively simple scheme how to modify the magnetic field setup for the incoming beam to enable spherical polarimetry. Full simulations of the polarized neutron transport not only demonstrate the feasibility of spherical polarimetry but also its excellent performance.
[1] Tasset, F. (1989). "Zero field neutron polarimetry". Physica B: Condensed Matter, 156, 627-630.
[2] Schweika, W. (2003). "Time-of-flight and vector polarization analysis for diffuse neutron scattering." Physica B: Condensed Matter 335 (1 - 4), 157 -163. https://doi.org/10.1016/S0921-4526(03)00229-1
[3] Schweika, W., Easton, S., & Neumann, K. U. (2005). "Vector Polarization Analysis on DNS". Neutron News, 16(2), 14-17. https://doi.org/10.1080/10448630500454262

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