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HEiDi: Large Area Detector for High Q Studies

Wednesday, 26 April 2023 17:00 (30 minutes)

Using the hot source of FRM II the single crystal diffractometer (SCD) offers a high flux of unpolarized neutrons down to short wavelengths well below 1 Å, for instance at 0.55 Å. Shorter wavelengths give access to a large Q ranges, which provide very detailed/precise information, for instance, about partially disordered compounds like new materials for energy storage [e.g. G. Redhammer et al., Acta Cryst B 77 (2021), Adv. Mat. Interfaces 7 (2020)).
To take full advantage of the shorter wavelengths on HEiDi and for as many scientific cases as possible, we propose a large 2D Position Sensitive Detector (PSD) with high sensitivity in this neutron energy range. This increases the efficiency of the instrument for faster and more accurate data collection. Furthermore, the improved detection/separation of Bragg and diffuse scattering from the sample vs. modulated background by a PSD and the large Q range of ~22/Å at 0.55 Å will enable HEIDI to study additional scientific cases that benefit from modern methods like total scattering / pair distribution analysis (PDF) with neutrons for both powders (nPDF) and single crystals (3D Δ-PDF) [e.g. T. Whitfield et al., IUCrJ (2016), Dove & Li, Nucl. Analysis 1 (2022), Weber & Simonov, Z. Krist. (2012)).
The ideal PSD offers a high sensitivity > 50% at 0.55 Å, a beam angle of 130° horizontal x 13° vertical coverage and - due to the limited experimental field of HEiDi - a small installation depth. Given these requirements, we currently favour a 6Li scintillator-based system derived from a prototype currently under construction, (collaboration with JCNS detector group), although we also explore other options.
This presentation provides more details on the proposed PSD, an overview of the project timeline, estimated cost and resources required to successfully embed this project into the MLZ landscape.

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