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FANTASTIC, an indirect geometry ToF spectrometer designed for the ICONE neutron source

The ICONE project of a French HiCANS is aimed at delivering an instrument suite for the French scientific community at the 2035 horizon. ICONE will produce moderated neutrons in the energy range of < 200 meV, making them suitable for use on neutron scattering instruments. A major challenge is the design and optimisation of instruments to make full use of the ToF flux. To address this, digital twins of the instruments are developed using advanced simulation tools to support performance prediction, optimisation, and virtual experiments.

FANTASTIC is an indirect geometry ToF spectrometer, meaning that the incident beam is polychromatic and the energy discrimination is made by a set of analysers placed after the sample. A total of 30 analysers are foreseen with tunable take-off angle to select a range of final wavelengths. This allows to access a large $(\hbar\omega, Q)$ space. A detailed digital twin of FANTASTIC has been implemented in McStas to evaluate and optimise instrument performance. The calculated energy resolution (FWHM) is in the range of 0.15meV(elastic) and 1 meV at $\Delta E=20$ meV. The elastic Q-resolution lies between 1-4%.

Dedicated data-reduction workflows have been developed to treat the large volumes of ToF event data produced by such instruments. These routines, based on tools such as SCIPP, process NeXus data to compute $(\hbar\omega, Q)$ and support both powder and single-crystal measurements with UB-matrix handling.

FANTASTIC is designed to tackle a wide range of scientific challenges, from frustrated magnetism to lattice dynamics. The instrument performance has been benchmarked against measurements from IN8@ILL and simulations of BIFROST@ESS. We will present the instrument design, digital-twin methodology, guide optimisation, resolution characterisation, and benchmarking results.

Session

Instrumentation

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