Experimental report

06/02/2026

Proposal: CRG-3281 **Council:** 4/2025

Title: Anisotropy crossover in YbBr3

Research area:

This proposal is a new proposal

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Samples: YbBr3
HoBr3

Instrument	Requested days	Allocated days	From	To
IN12	4	4	23/10/2025	28/10/2025

Abstract:

Anisotropy crossover in YbBr3

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The inelastic spectrum of YbBr3 was measured at the IN12 spectrometer using linear polarization analysis with Helmholtz coils centered at the sample position. The neutron spin polarization was manipulated by the coils and together with the Heusler(111) analyzer of IN12 we were able to determine the spin-flip (SF) and non-spin-flip (NSF) cross-sections of YbBr3 at chosen inelastic positions with the polarization directed along *x*, *y* or *z* (*x* || ***Q***, *z* vertical and *y* = *z* $\wedge$ *x*). The polarization was maintained by the use of guide fields. The flipping ratios determined at the non-magnetic (110) Bragg peak of YbBr3 were *Rx* = 19.79, *Ry* = 18.27, and *Rz* = 20.93 for all three Cartesian polarization orientations respectively. The sample temperature was *T* = 60 mK.

To extract the *My* and *Mz* dynamical spin correlation functions, we chose to focus on the SF intensities, from which *My* = SFx - SFy and *Mz* = SFx - SFz [cf. Fig.1(a, c)]. We confirmed that equivalent results for *My* and *Mz* were obtained at the ***Q*** = (1.2 0 0) vector at *E* = 0.3 meV—which coincides with the top of a single-magnon peak—by choosing instead to measure purely NSF intensities as *My* = NSFy - NSFx and *Mz* = NSFz - NSFx.

We determined the *My* and *Mz* correlation functions from 0 to 1.5 meV at 5 ***Q*** between the (*1 0 0*) and (*0.5 0.5 0*) positions in the reciprocal lattice. Additionally we measured the K point at (*⅔ ⅔ 0*). In our experiment the *Mz* (longitudinal) component possessed a single peak and a broad contribution, consistent with two-magnon scattering [cf. Fig.1(b)]. However, the *My* (transverse) component displayed a single-magnon peak and a broad contribution at higher energies [Fig.1(b)]. Because of this additional broad continuum in *My*, the continuum reported in previous unpolarized inelastic neutron scattering studies [1, 2] cannot find its origin in scattering from purely two-magnon states.

Proceeding towards the (*½ ½ 0*) point we observe that the intensity in the continua at *My* and *Mz* become roughly equal in intensity and the single-magnon peak in *My* acquires considerable damping. It is at (*⅔ ⅔ 0*), the edge of the Brillouin zone, where the magnon damping is maximal and where the longitudinal and transverse excitation continua are roughly equal in intensity as shown in Fig.1(c,d).

The results from this experiment are being interpreted with matrix-product state and exact-diagonalization calculations of the different components of the dynamical spin correlations of the Heisenberg antiferromagnet. Our interpretation on the origin of the continua observed based on the data generated during this experiment is part of a publication under preparation.

[1] *npj Quantum Mater.* **5**, 85 (2020).
[2] *Phys. Rev. Lett.* **135**, 146701 (2025).

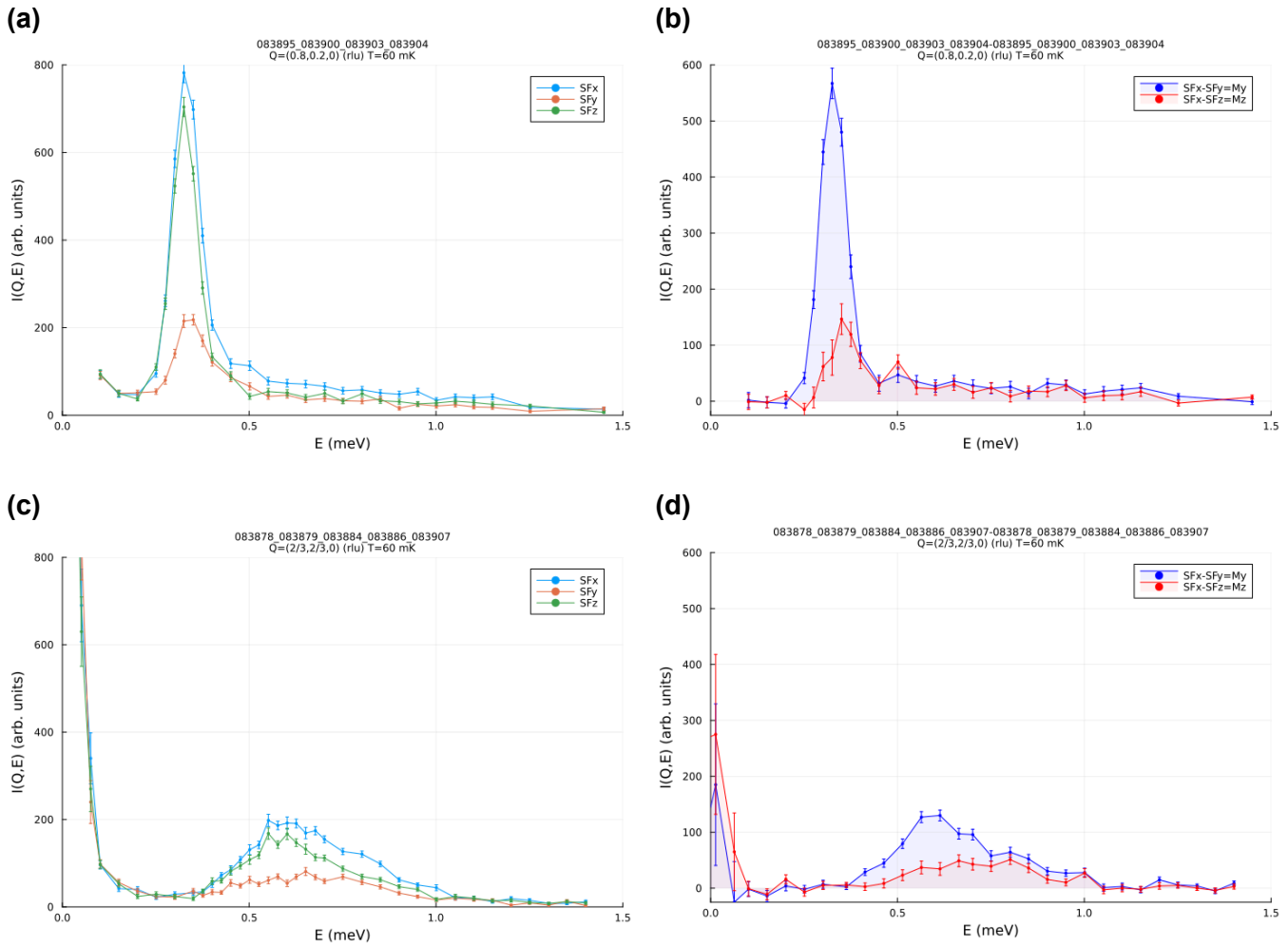


Fig. 1. Polarization-dependence of the magnetic excitations of YbBr3 at *T* = 60 mK from IN12. Panels (a) and (c) show the raw neutron counts per an average counting time of 7 minutes in the SFx, SFy and SFz channels in blue, green and orange respectively. The My and Mz correlation functions determined from the data are plotted in (b) and (d). Panels (a) and (b) show the scattering at ***Q*** = (0.8, 0.2, 0) close to the zone center where a single-magnon peak is clearly visible in the blue curve (My) as well as a peak and a broad contribution in the red curve (Mz). Panels (c) and (d) are at ***Q*** = (⅔, ⅔, 0) which is at the corner of the Brillouin zone and shows considerable intrinsic broadening in both My and Mz.