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Polarization Analysis of the Non-Reciprocal Skyrmion Dynamics in MnSi

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The chiral magnet MnSi possesses a non-centrosymmetric chemical unit cell. The non-centrosymmetry has profound consequences for spin-wave dynamics in all ordered magnetic phases of MnSi. Namely, it introduces a Dzyaloshinskii-Moriya term, which causes magnons to be created at different absolute energies than they are annihilated. This asymmetry ("non-reciprocity") in the dispersion is limited to reduced momentum transfer components parallel to the applied magnetic field direction, i.e. the skyrmion axis.

Using the new triple-axis spectrometer ThALES at the ILL, we performed a longitudinal polarization analysis of the skyrmion dynamics in MnSi for direction in reciprocal space both along and perpendicular to the skyrmion axis. Individual polarization-dependent dispersion branches could be clearly resolved in the first direction, while for the second direction we found a broad quasi-continuum of dispersion branches. Utilizing the Monte-Carlo convolution of a linear spin-wave model [1] and the instrumental resolution function, we achieved an excellent quantitative agreement between experiment and theory.

[1] M. Garst, et al., Journal of Physics D 50(29), 293002 (2017).

This work will be part of a comprehensive paper on skyrmion dynamics:

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