Chiral Hinge Magnons in Second-Order Topological Magnon Insulators

A. Mook,[1] S. A. Díaz,[1] J. Klinovaja,[1] and D. Loss[1]

[1] *Department of Physics, University of Basel, Klingelbergstrasse 82, CH-4056 Basel, Switzerland*

When interacting spins in condensed matter order ferromagnetically, their ground-state wave function is topologically trivial. Nonetheless, in two dimensions, ferromagnets can support spin excitations with nontrivial topology, an exotic state known as topological magnon insulator (TMI). Here, we theoretically unveil and numerically confirm a novel ferromagnetic state in three dimensions dubbed second-order TMI, whose hallmarks are excitations at its hinges, where facets intersect. Since ferromagnetism naturally comes with broken time-reversal symmetry, the hinge magnons are chiral, rendering backscattering impossible. Hence, they trace out three-dimensional paths about the sample unimpeded by defects and are topologically protected by the spectral gap. They are remarkably robust against disorder and highly tunable by atomic-level engineering of the sample termination. We predict that a van der Waals heterostructure built from chromium trihalide and transition metal dichalcogenide monolayers exhibits second-order magnon topology. Our findings empower magnonics, the harnessing of spin waves as information carriers, with the tools of higher-order topology, a promising route to combine low-energy information transfer free of Joule heating with three-dimensional vertical integration.

References:

[1] A. Mook, S. A. Díaz, J. Klinovaja, and D. Loss, arXiv:2010.04142.