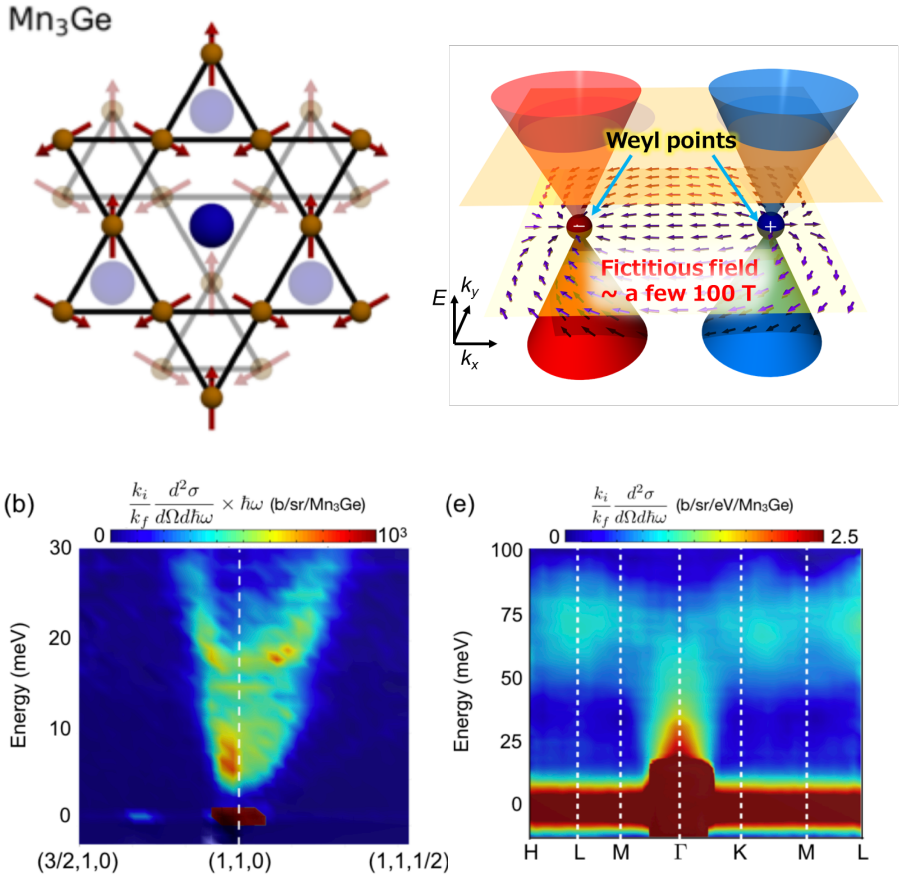
Anti-chiral spin order its Goldstone modes and their hybridization with phonons in the topological semimetal Mn_3Ge



Y. Chen, J. Gaudet, G. G. Marcus, S. Dagupsta, J. Lin, T. Chen, T. Tomita, M. Ikhlas, Y. Zhao, W. C. Chen, M. B. Stone, O. Tchernyshyov, S. Nakatsuji, and C. Broholm, arXiv.2001.09495 (2020).

Scientific Achievement

The anti-chiral spin structure of Mn_3Ge and its low energy excitations were determined using neutron scattering techniques. We developed a field theory of long-wavelength spin waves for Mn_3Ge and establish a spin-Hamiltonian model, which accounts for the spin order and low energy excitations. We identify two magneto-elastic modes that indicate an intimate relationship between strain, magnetism and transport in Mn_3Ge.

Significance and Impact

Non-collinear magnetism can produce anomalous electronic transport through impacts on the Berry phase of conduction electrons. This presents technological opportunities and new fundamental physics from the corresponding impacts of Weyl points on magnetic interactions. Our work is the basis for understanding and exploiting ferromagnet-like transport without stray fields.

Research Details

This work was possible via a close collaboration between materials discovery and synthesis (Nakatsuji), neutron scattering at NIST and SNS (Broholm) and theory (Tchernyshyov). The unique identification of the anti-chiral structure required single domain polarized neutron diffraction in multiple lattice planes on small high-quality crystals. The inelastic experiment required synthesis and co-assembly of large single crystals.

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