Max Planck Lecture

Max Planck Institute for Solid State Research

Hybrid

Friday, September 29, 2023
Lecture Hall 2D5, 11 a.m.

Login data will be announced by email.

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Designing Topological Magnetic Materials for Innovative Quantum Electronics

The concept of topology in electronic structure has reshaped our understanding of materials properties, driving the discovery of various classes of systems such as topological insulators and nodal-point and nodal-line semimetals. In this talk, we show that by introducing such a notion of topology or quantum Berry phase in magnets, one may find novel properties useful for designing innovative quantum electronics. A prominent example is the antiferromagnetic Weyl semimetal Mn_3Sn, in which we discovered a large anomalous Hall effect for the first time in antiferromagnets. This further has enabled us to develop novel spintronic functionalities that have previously been thought absent for anti-ferromagnets, such as bidirectional electrical switching and quantum tunneling magnetotransport, paving a path for ultrafast operation of non-volatile memory. The second example is a ferromagnetic nodal line semimetal, producing the largest ever anomalous Nerst effect (ANE) at room temperature. In particular, a quantum Lifshitz phase transition of the Weyl cone may lead to the divergence in the transverse thermoelectric conductivity. Compared to the conventional Seebeck effect, the enhanced ANE is useful for distinct thermoelectric applications through a simplified fabrication process, extensive area coverage, and enhanced flexibility. Finally, I will discuss the perspective of designing topological magnetic materials and their applications for quantum electronics.