第88回トポロジカル物質科学セミナー
Topological Materials Science Seminar (88)

Quantum Anomalous Hall effect in Magnetic Topological Insulators

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Time: 15:00-16:30
Place: Room 401, Science Bldg. 5 (Physics), Kyoto University

Abstract:

Quantum anomalous Hall effect (QAHE) is a new type of quantum Hall effect that can occur in zero magnetic field due to the spontaneous magnetization of two dimensional topological materials. In order to realize this effect, the system must fulfill the stringent requirements of being topological, ferromagnetic, and insulating simultaneously. Magnetic topological insulators have been proposed to be a promising system for realizing the QAHE. In this talk we will show how we fine tune the electronic and magnetic properties in Cr doped (Bi,Se)2Te3 topological insulator thin films, which eventually led to the observation of QAHE. We will then present more recent studies of magnetically doped TIs, in which a variety of interesting quantum phase transitions can be induced by varying the magnetic dopants, film thickness, applied electric field, and degree of disorderness. In Cr doped Bi2(Se,Te)3 near a topological quantum critical point, we found a gate-tuned ferromagnetic to paramagnetic phase transition. We propose that the most likely mechanism is the Stark effect induced electronic energy level shift, which causes a topological quantum phase transition followed by magnetic phase transition. In Mn doped Bi2Te3, we observe pronounced topological Hall effect only at a specific film thickness at the dimensional crossover regime. We propose that this is due to the coupling between the top and bottom surface states, which stabilizes the magnetic skyrmion structure.

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