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Quantum Anomalous Hall Effect in HgMnTe Quantum Wells
CHAOXING LIU, Center for Advanced Study, Tsinghua University, Beijing, 100084, China, XIAOLIANG QI, Department of Physics, McCullough Building, Stanford University Stanford, CA 94305, XI DAI, ZHONG FANG, Institute of Physics, Chinese Academy of Sciences Beijing, 100084, China, SHOUCHENG ZHANG, Department of Physics, McCullough Building, Stanford University Stanford, CA 94305 —
Quantum Hall effect is usually observed in the two-dimensional electron gas with an external magnetic field, where the electronic states form Landau levels. In this work, we show that a new phenomenon, the quantum anomalous Hall effect, can be realized in HgMnTe quantum wells, without the external magnetic field and associated Landau levels. This effect originates purely from the magnetization of Mn atoms, and is closely related to the quantum spin Hall effect observed in HgTe quantum wells recently. The opposite signs of sp-d exchange coupling between the Mn atoms and conduction or valence band electrons is crucial for realizing this effect. The quantized Hall conductance is predicted for a range of quantum well thickness and concentration of Mn atoms. Within the experimentally accessible parameter regime, we propose an experiment to demonstrate that the quantized Hall conductance indeed arises from the Mn magnetic moments rather than Landau levels. This effect enables dissipationless charge current in spintronics devices.

Chaoxing Liu
Center for Advanced Study, Tsinghua University, Beijing, 100084, China

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