Ambipolar surface quantum Hall effect in the 3D TI strained HgTe

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Topological insulators (TIs) are a new class of materials which are only conducting at their edge (2D TIs) or at their surface (3D TIs) [1]. These states are chiral, spin polarized and form a 2D electron system of Dirac fermions on the surface of a 3D TI, and, as in graphene, are described by the Dirac-Weyl equation, for massless relativistic particles.
The band structure of HgTe exhibits an energetic inversion of the Γ_6 and Γ_8 band order. Since HgTe is a semimetal, the Dirac-like surface states can only be probed if strain is applied, which leads to a gap opening between the light-hole and the heavy-hole band. Recently, experiments on strained HgTe have shown the surface quantum Hall (SQH) effect for electrons thereby proving the 2D nature of this system [2].

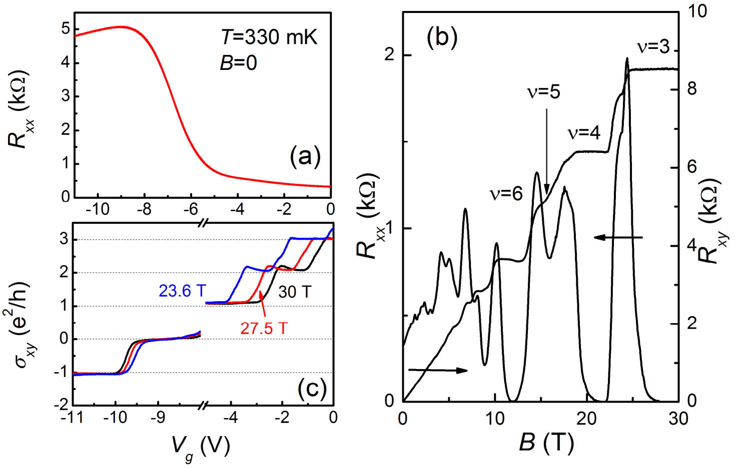

Figure 1: Magneto-transport measurements in a 3D TI: (a) Gatesweep at 0 T. (b) *B*-sweep at V_g=0 exhibits SQH effect for electrons. (c) Hall conductivity at high *B* shows the transition from electrons (ν=1) to holes (ν=-1).

We will present magnet-transport experiments where we observe the ambipolar SQH effect for the first time. The electric field effect (top-gate on the sample) enables us to tune the Fermi energy from the conduction to the valence band, i.e., through the bulk band gap, see figure 1(a, c). Furthermore, we discuss the properties of surface transport, such as the Berry phase, odd and even integer SQH effect, and address the physics of the charge neutrality point in order to demonstrate that high-quality strained 3D HgTe is an ideal material to probe surface states and properties of 3D TIs.

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