High-precision quantum anomalous Hall state

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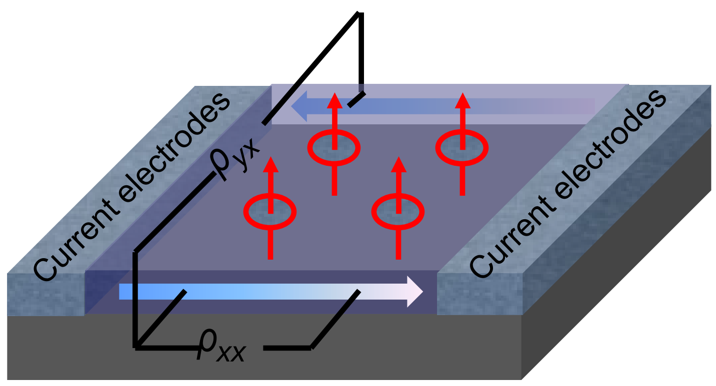

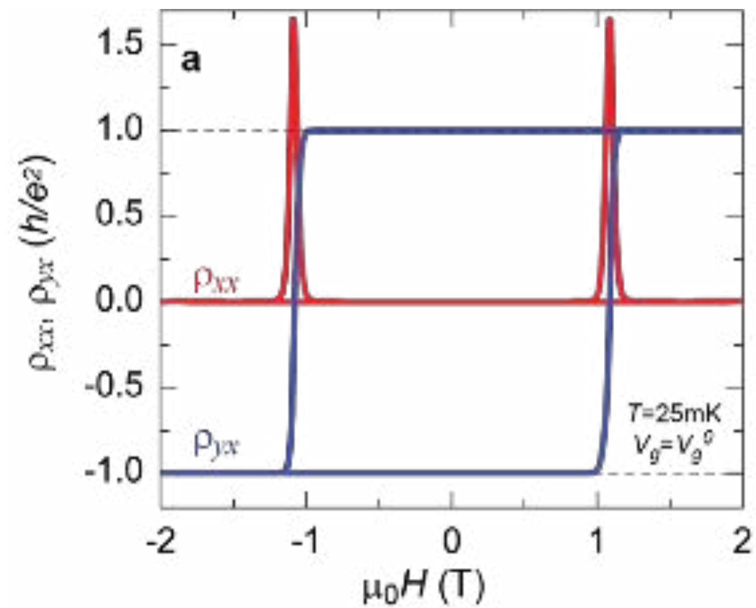

The discovery of the quantum Hall (QH) effect led to the realization of a topological electronic state with dissipationless currents circulating in one direction along the edge of a two dimensional electron layer under a strong magnetic field. The quantum anomalous Hall (QAH) effect shares a similar physical phenomenon as the QH effect, whereas its physical origin relies on the intrinsic spin-orbit coupling and ferromagnetism. Here we report the experimental observation of the QAH state in V-doped $(Bi,Sb)_2Te_3$ films with the zero-field longitudinal resistance down to 0.00013±0.00007h/e^2 (~3.35±1.76W), Hall conductance reaching 0.9998±0.0006e^2/h and the Hall angle becoming as high as 89.993±0.004º at T=25mK. This realization of robust QAH state in hard FMTI's is a major step towards dissipationless electronic applications and standard resistor without external fields.