San Francisco State University

Physics & Astronomy

Monday, April 27th

Dr. David Goldhaber-Gordon

Stanford University

4:00 PM in TH 411
Refreshments served at 3:50 PM

The Quest for Perfect 1D Electrical Conduction: Can We Make a Wire Longer Without Adding Resistance?

Abstract:

I will explain "perfect" 1D conduction and describe several strategies for achieving it. Some require high magnetic fields and/or cryogenic temperatures, but there's now hope of achieving perfect 1D conduction at room temperature with no external magnetic field, through a phenomenon known as the quantum anomalous Hall effect. This effect was recently realized in thin films of Cr-doped $(Bi, Sb)_2Te_3$, a ferromagnetic 3D topological insulator. The presence of ferromagnetic exchange breaks time-reversal symmetry, opening a gap in the surface states, but gives rise to dissipationless chiral conduction at the edge of a magnetized film. Ideally, this leads to vanishing longitudinal resistance, and Hall resistance roughly h/e^2, where h is Planck's constant and e is the electron charge (this is a signature of one type of perfect 1D conduction). But perfect quantization has so far proved elusive. I'll show results on the quantum anomalous Hall effect in the limit of zero applied magnetic field, and measure Hall resistance quantized to within one part per 10,000. Deviation from quantization is due primarily to thermally activated carriers, which can be nearly eliminated through adiabatic demagnetization cooling. This result demonstrates an early but significant step toward achieving dissipationless electron transport in technologically relevant conditions.