Magneto-transport in 3D topological insulator nanowires

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We investigate quantum transport in 3D topological insulator nanowires in external electric and magnetic fields. The wires host topologically non-trivial surface states wrapped around an insulating bulk, and a magnetic field along the wire axis leads to Aharonov-Bohm oscillations of the conductance. Such oscillations have been observed in numerous systems and signal surface transport, though alone cannot prove its topological nature. Furthermore, it is not known how they are affected by the wire specific geometry - never perfectly cylindrical as in standard theoretical models. We thus focus on two issues: (i) An accurate modelling of surface transport in gated, strained HgTe nanowires, accompanying experimental measurements performed by our collaborators (J. Ziegler & D. Weiss, Uni Regensburg, S. A. Dvoretsky & N. Mikhailov, Rzhanov Institute for Semiconductor Physics, Russia); (ii) A theoretical study of magneto-conductance through shaped (tapered, curved) nanowires. The nanowire non-constant radius leads to novel quantum transport phenomena. Notably, it implies a competition between effects due to quantum confinement and to a spatially varying enclosed magnetic flux, as well as offering the possibility of studying quantum Hall physics in curved space.