CMP Seminar
Michigan State University

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Quantum transport in topological insulators

Three-dimensional (3D) topological insulators (TI) are a novel class of electronic materials with topologically-nontrivial band structure such that the bulk is gapped and insulating yet the surface has topologically protected gapless conducting states. Such "topological surface states" (TSS) give helically spin polarized Dirac fermions, and offer a promising platform to realize various other novel physics such as topological magnetoelectric effects and Majorana fermions, and may enable technological applications in areas such as spintronics and thermoelectrics. However, it is often challenging to unambiguously access and study the transport properties of TSS in many practical TI materials due to non-negligible bulk conducting states. I will discuss some of our experiments on high-quality "intrinsic" TIs with insulating bulk and surface-dominated conduction that allow us to reveal a number of characteristic quantum transport properties of spin-helical Dirac fermion topological surface states, such as the "half-integer" quantum Hall effect [1-2] and "half-integer" Aharonov-Bohm effect [3]. I will also discuss some issues and cautions related to interpreting commonly measured magnetotransport signatures such as "2D" quantum oscillations, weak antilocalization and linear magnetoresistance that may or may not arise from topological surface states or be unique to topological insulators [4-6]. If time permits, I may discuss other ways of probing TI transport using magnetic (spin-dependent) or superconducting (phase sensitive) electrodes.

References:

[1] Y. Xu et al., Nature Physics 10, 956 (2014)
[2] Y. Xu et al., Nature Communications 7, 11434 (2016)
[3] L. A. Jauregui et al., Nature Nanotechnology 11, 345 (2016)
[4] H. Cao et al., Physical Review Letters 108, 216803 (2012)
[5] L. A. Jauregui et al., Scientific Reports 5, 8452 (2015)
[6] J. Tian et al., Scientific Reports 4, 4859 (2014)

Monday, October 10, 2016
4:10 p.m.
BPS 1400
Prof. Norman Birge - Host