Physics Colloquium

Monday

November 27

4:00 P.M.

Rm 123 NSH

Note special

day & room

What is experimentally topological in topological matter?

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When a Dirac fermion system acquires an energy gap (or mass), it is said to have either trivial or non-trivial band topology depending on the parity ordering of the conduction and valence band edges. A non-trivial (or topological) insulator is a parity inverted semiconductor, generally identified via the observation of topological Dirac surface states dispersing in its bulk energy gap. It is attributed a non-zero topological index. A topological insulator is thus thought to be a 'boring' bulk semiconductor surrounded by 'exotic' Dirac surface states. In this talk, I will challenge this paradigm and demonstrate two direct experimental signatures of non-trivial band topology stemming from the inverted character of bulk bands. In a first instance, I will – experimentally and theoretically – show how the topological index of a semiconductor can be directly determined by probing the band parameters of the bulk bands using magnetooptical Landau level spectroscopy [1]. Secondly, I will demonstrate that a negative magnetoresistance emerges as a result of the anomalous field dependence of the lowest Landau levels in topological insulators [2]. Both results are direct experimental manifestations of the topologically non-trivial aspect of bulk electronic excitations in topological insulators.

[1] B. A. Assaf et al. npj Quantum Materials 2 26 (2017)

[2] B.A. Assaf et al. Phys. Rev. Lett. 119 106602 (2017)

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