Colloquium

Department of Physics, Temple University

Massless and Massive Electrons: Relativistic Physics in Condensed Matter Systems

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Abstract

Electrons in free space have a well-defined mass. Recently, a new class of materials called topological insulators were discovered, where the low energy electrons have *zero* mass. In fact, these electrons can be described by the same massless Dirac equation that is used to describe relativistic particles travelling close to the speed of light. In this talk I will describe our recent experimental and theoretical investigations of a class of materials called Topological Crystalline Insulators (TCIs) [1]. TCIs are recently discovered materials [2,3] where topology and crystal symmetry intertwine to create linearly dispersing Fermions similar to graphene. To study this material we used a scanning tunneling microscope [3,4,5]. I will show how zero-mass electrons and massive electrons can coexist in the same material [3]. I will discuss the conditions to obtain these zero mass electrons as well the method to impart a controllable mass to the Dirac electrons [3,5].

[1] L. Fu, Topological Crystalline Insulators. *Phys. Rev. Lett.* 106, 106802 (2011).
[2] T. H. Hsieh et al., Topological crystalline insulators in the SnTe material class. *Nat.Commun.* 3, 982 (2012).
[3] Y. Okada, et al., Observation of Dirac node formation and mass acquisition in a topological crystalline insulator, *Science* 341, 1496-1499 (2013)
[4] Ilija Zeljkovic, et al., Mapping the unconventional orbital texture in topological crystalline insulators, *Nature Physics* 10, 572–577 (2014)
[5] Ilija Zeljkovic, et al., Dirac mass generation from crystal symmetry breaking on the surfaces of topological crystalline insulators, *Nature Materials 14, 318–324 (2015)*

Monday, March 28, 2016 at 3:00pm
SERC, Room 116
Refreshments served at 2:45pm