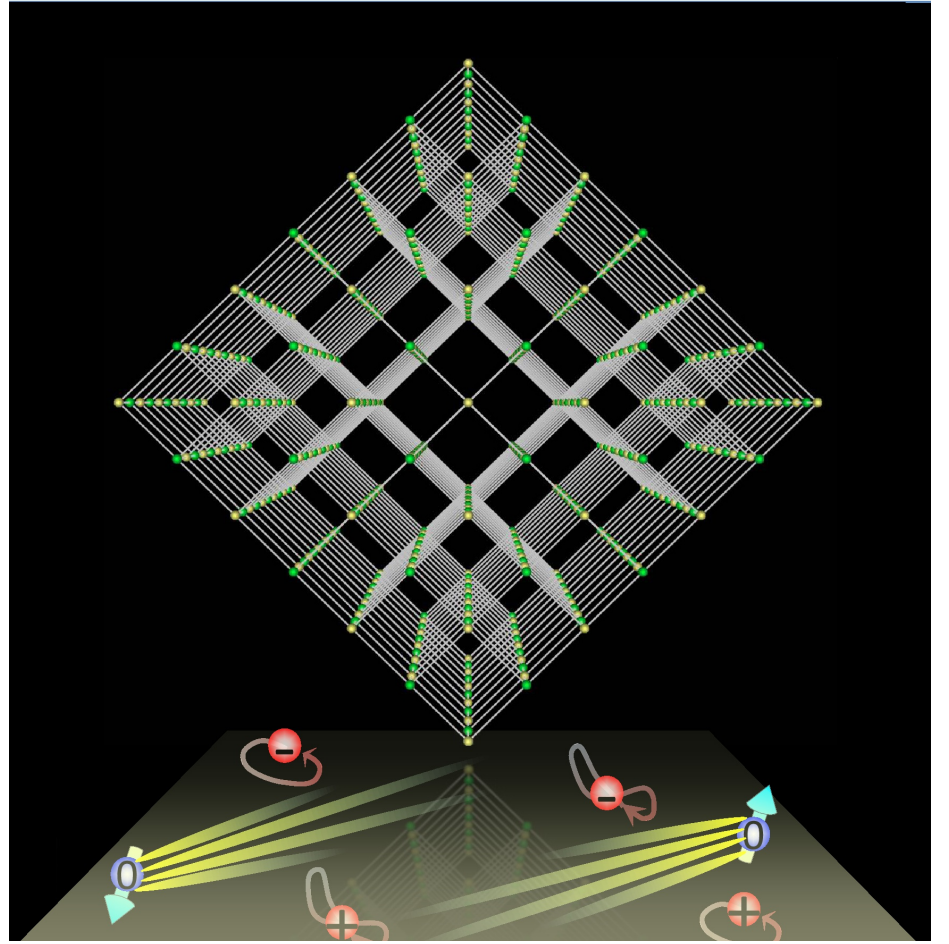
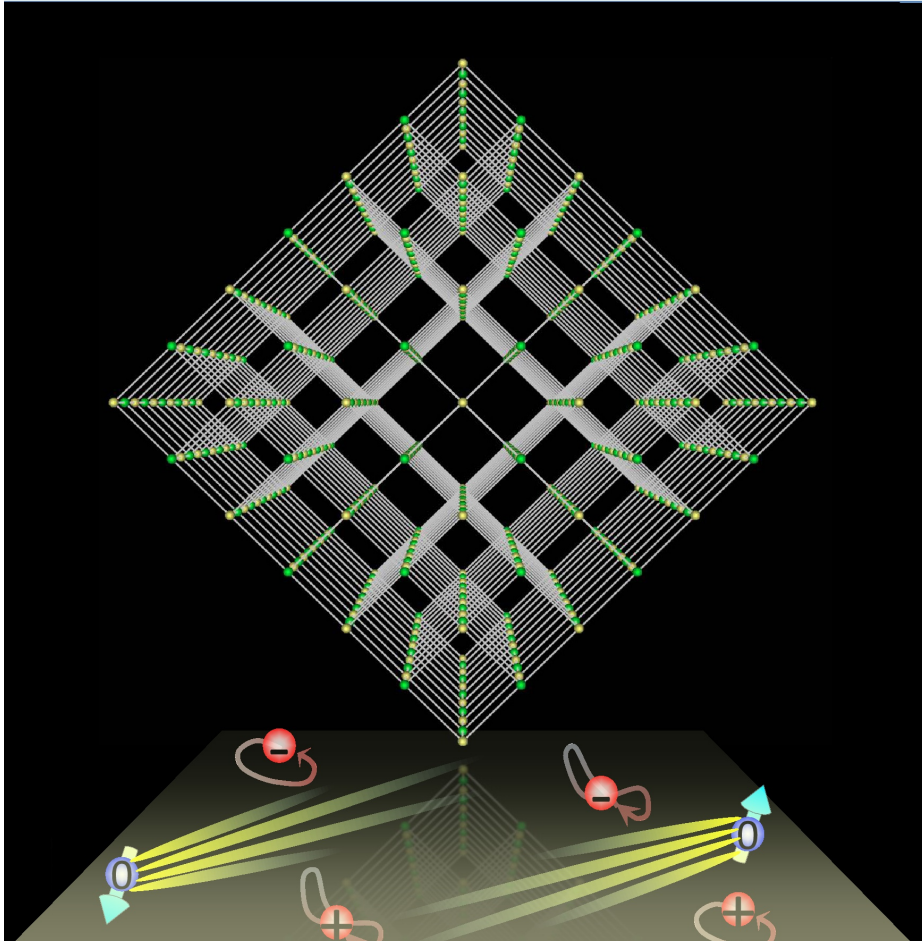


# Boston University Physics Colloquium



## Massless and Massive Electrons: Relativistic Physics in Condensed Matter Systems

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)<sup>[1]</sup>. TCIs are recently discovered topological materials<sup>[2,3]</sup> where topology and crystal symmetry intertwine to create linearly dispersing Fermions similar to graphene. To study this material we used a scanning tunneling microscope. With the help of our high-resolution data, I will show how zero-mass electrons and massive electrons can coexist in the same material. I will discuss the conditions to obtain these zero mass electrons as well the method to impart a controllable mass to the particles and show how our studies create a path to engineering the Dirac band gap and realizing interaction-driven topological quantum phenomena in TCIs.

[1] Y. Okada, et.al , Observation of Dirac node formation and mass acquisition in a topological crystalline insulator, Science 341, 1496-1499 (2013)

[2] L. Fu, Topological Crystalline Insulators. Phys. Rev. Lett. 106, 106802 (2011)

[3] T. H. Hsieh et al., Topological crystalline insulators in the SnTe material class. Nat.Comm. 3, 982 (2012).

Vidya Madhavan

Boston College

April 1, 2014 (Tuesday) at 3:30pm (Refreshments at 3:00pm)

SCI 109, Metcalf Science Center, Boston University

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Host: David Campbell