

Materials Science and Technology Division
Materials Theory Group

**“Topological insulators, topological semimetals, and
quantum Hall effects without Landau levels”**

Kai Sun
The University of Maryland

Friday, April 13, 2012
10:00 a.m.
4100, Room J-302

Abstract

The search for novel topological states of matter, where the quantum phase is characterized not by an order parameter but by some underlying topology, has been the focus of extensive studies since the discovery of the integer and fractional quantum Hall effects in two-dimensional semiconductors. These studies not only improve our understanding about topological states, but also have important potential applications (e.g. topological quantum computing), due to the unique and nontrivial topological properties of these systems. In band insulators, it has been known that the key ingredient to stabilize a topologically nontrivial insulating state is to introduce either some external magnetic fields (e.g. the integer quantum Hall effect) or spin-orbit couplings (e.g. the Z_2 topological insulators). In this talk, I present the theoretical discovery of a novel class of topological insulators, which are stabilized by interaction effects in the absence of external field or spin-orbit coupling. In particular, I will focus on two systems (2D topological semimetals and 3D heavy-fermion Kondo insulators), in which such phenomena can be investigated using well-controlled theoretical techniques. I will further demonstrate that these ideas can be generalized to stabilize fractional topological insulators in the absence of Landau levels or external magnetic fields. Experimental implications will also be discussed.

References:

- [1] Kai Sun, W. Vincent Liu, Andreas Hemmerich and S. Das Sarma, Nature Physics, 8, 67-70 (2012).
- [2] Kai Sun, Zhengcheng Gu, Hosho Katsura and S. Das Sarma, Phys. Rev. Lett. 106, 236803 (2011).
- [3] Maxim Dzero, Kai Sun, Victor Galitski and Piers Coleman, Phys. Rev. Lett. 104, 106408 (2010).
- [4] Kai Sun, Hong Yao, Eduardo Fradkin and Steven A. Kivelson, Phys. Rev. Lett. 103, 046811 (2009).

Host: Di Xiao (576-0301, xiaod@ornl.gov)