Materials Science & Engineering Seminar Series

Carnegie Mellon University
Materials Science & Engineering

presents

Topological Insulators and Superconductors

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ABSTRACT:
The last decade has seen the rapid growth of interest in materials that are topological because of strong spin-orbit coupling. These samples exhibit electronic surface states that have only half the electrons that a carrier accumulation layer has. The surface states have energy between the occupied valence band and the unoccupied conduction band and the energy/momentum dispersion is linear forming two so-called Dirac cones that meet at the Dirac point, often k=0. They exhibit spin-momentum locking so that a surface state with momentum in some direction has spin projection in a direction given by a left hand rule. An electron with the same momentum but with the other spin direction exists on the opposite side of the sample. The most widely studied topological insulators (Tis) are materials structured like Bi2Se3. They are difficult to make insulating. I will discuss our work to make them insulating and show angle resolved photoemission spectra which show that the Fermi energy can be tuned from the valence band to the conduction band using compositional alloying. I will also describe our work to make them superconducting using the proximity effect. We have studied this with ARPES as well as in transport. The ARPES work studies the redistribution of fermionic states caused by the superconductivity and the transport study probes the bosonic nature of the induced superfluid.

BIOGRAPHY:
James Eckstein has been a professor of physics at the University of Illinois at Urbana Champaign since 1998. Prior to that he was a research manager at Varian Research Center in Palo Alto CA. He got his PhD in physics at Stanford University in 1978. During the 1980s he developed atomic layer by layer molecular beam epitaxy of complex oxides and used that method to make artificially structured samples incorporating high temperature superconductors. At UIUC his group has studied highly correlated materials and heterostructures combining phenomena such as magnetism, superconductivity to make composite samples in which new aggregate properties arise. Recently, his group has been focused on topological phases and the prospect of using them to make superconducting topological qubits.

Doherty Hall 2210, 11:30AM
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