Chez Pierre

Presents ...

Wednesday, February 22, 2012
4:00pm
MIT Room 4-331

SPECIAL CHEZ PIERRE SEMINAR

James R. Williams
Stanford University

"Signatures of Majorana Fermions in Hybrid Superconductor-Topological Insulator Devices"

The ability to measure and manipulate complex particles in the solid state is a cornerstone of modern condensed-matter physics. Typically, excitations of a sea of electrons, called quasiparticles, have properties very similar to those of free electrons. However, excitations with properties very different from electrons have been created in designer quantum materials: for example, Dirac quasiparticles in graphene and fractionally-charged quasiparticles in fractional quantum Hall systems. Here we report signatures of a new quasiparticle -- a Majorana fermion -- seen in a device in which a 3D topological insulator couples two conventional superconducting leads, forming a Josephson junction. We observe two striking departures from the common transport properties of Josephson junctions: a characteristic energy that scales inversely with the width of the junction, and an unexpectedly low characteristic magnetic field for suppressing critical current. We propose an explanation for these effects based on a model where a one-dimensional wire of Majorana fermions is present along the width of a junction, similar to the original theoretical prediction for these systems. These results should open a path for investigation of Majorana fermions in the solid state.