

Chez Pierre

Presents ...

Monday, September 30, 2019

12:00pm Noon

MIT Room 4-331

Chez Pierre Seminar



Dale J. Van Harlingen – University of Illinois at Urbana-Champaign

“S-TI-S (Superconductor-Topological Insulator-Superconductor) Josephson junction networks:
a platform for exploring and exploiting Majorana fermions for quantum information
processing”

One of the proposed approaches to realize a quantum computer is to make use of exotic Majorana fermion modes that can exist in hybrid systems which intertwine superconductivity and topological order. The goal is to take advantage of the delocalization of quantum information and the non-Abelian statistics of the Majorana states to avoid dephasing and minimize error corrections in what is known as topologically-protected quantum computing. In this talk, I will describe a potential platform for nucleating and manipulating Majorana fermions in multiply-connected networks of lateral Josephson junctions fabricated by depositing superconductor electrodes onto the surface of topological insulators. In a magnetic field, Majorana fermions are localized in the cores of Josephson vortices at locations in the junction where the phase difference is an odd multiple of π , and they can be moved by applying fields, currents, and voltages to perform quantum operations. Electronic transport measurements on Nb-Bi₂Se₃-Nb devices exhibit anomalous features consistent with a 4π -periodic $\sin(\phi/2)$ -component in the Josephson current-phase relation consistent with this picture. We are now exploring circuits for imaging, manipulating, and braiding these exotic excitations and developing schemes for reading out the parity of the Majorana pairs that encodes the quantum information.

