

# *Chez Pierre*

Presents ...

**Monday, March 7, 2011**

**12:00pm**

**MIT Room 4-331**



## **SPECIAL CHEZ PIERRE SEMINAR**

### **Yulin Chen**

### **Stanford University**

## **“Visualization of Electronic Structures in Topological Quantum Materials and Advances on Electron Spectroscopy”**

Three-dimensional (3D) topological insulators (TIs) represent a new state of quantum matter with a bulk gap and an odd number of relativistic Dirac fermions on the surface. The unusual surface states of TIs can be the host for many striking quantum phenomena, such as an image magnetic monopole induced by an electric charge and Majorana fermions induced by the proximity effect from a superconductor.

Using angle-resolved photoemission spectroscopy (ARPES) to directly investigate the electronic structures, we identified two families of single Dirac cone 3D TIs. Furthermore, by simultaneously introducing magnetic and charge doping to break the time reversal symmetry and tune the Fermi-level, we realized the insulating massive Dirac fermion state, a state capable of harboring many topological phenomena, e.g. the half quantum Hall effect on the surface. The swift development of topological insulators has also inspired the study of other topological states such as topological superconductors (TSCs), and a recent study on a TSC candidate will be presented.

In the second part of the talk, I will briefly introduce the recent advances on photoemission spectroscopy, and use our newly developed spin- and time- resolved ARPES spectrometer as an example to show the great potential of advanced instrumentations - which not only enable us to perform the electron spin measurement with orders of magnitude's improvement in efficiency, but also provide the capability for the studies on electronic and spin-dynamics. These new capabilities will greatly extend our research spectrum in condensed matter physics.