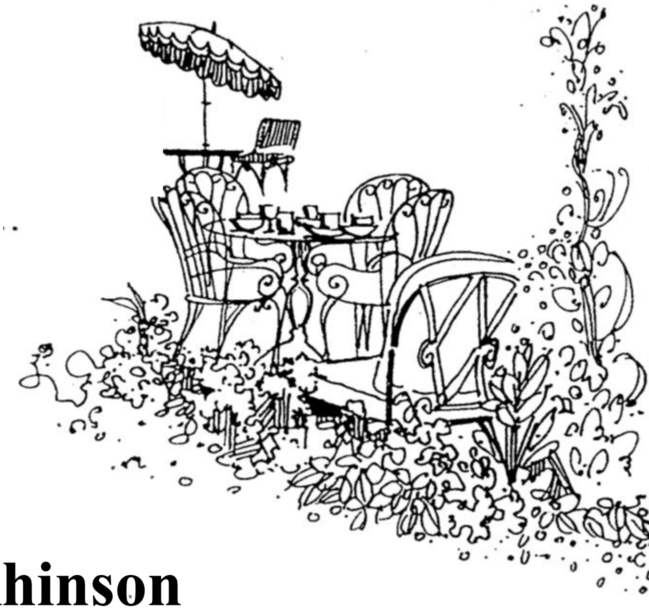
Chez Pierre

Presents ...

Monday, October 15, 2012
12:00pm
MIT Room 4-331



Leonid Rokhinson

Purdue University

"Observation of fractional ac Josephson effect: the signature of Majorana particles"

In 1928 Dirac reconciled quantum mechanics and special relativity in a set of coupled equations which became the cornerstone of quantum mechanics. Its main prediction that every elementary particle has a complex conjugate counterpart - an antiparticle - has been confirmed by numerous experiments. A decade later Majorana showed that Dirac's equation for spin-1/2 particles can be modified to permit real wavefunctions. The complex conjugate of a real number is the number itself, which means that such particles are their own antiparticles. The most intriguing feature of Majorana particles is that in low dimensions they obey non-Abelian statistics and can be used to realize quantum gates that are topologically protected from local sources of decoherence. While the search for Majorana fermions among elementary particles is still ongoing, excitations sharing their properties may emerge in electronic systems. It has been predicted that Majorana excitations may be formed in some unconventional states of matter. I will report the observation of the fractional ac Josephson effect in a hybrid semiconductor/superconductor InSb/Nb nanowire junction, a hallmark of topological matter. When the junction is irradiated with rf frequency f at zero external magnetic field, quantized voltage steps (Shapiro steps) with a height hf/2e are observed, as is expected for conventional superconductor junctions where the supercurrent is carried by charge-2e Cooper pairs. At high fields the height of the first Shapiro step is doubled to hf/e, suggesting that the supercurrent is carried by charge-e quasiparticles. This is a unique signature of Majorana fermions, elusive particles predicted ca. 80 years ago.