Massachusetts Institute of Technology
Department of Physics

Condensed Matter Theory Seminar

" Disorder-induced phase transitions in multichannel Majorana wires"

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Abstract: In a 1D spinless p-wave superconductor, disorder is known to induce a phase transition between a topologically nontrivial phase and a trivial insulating phase when the mean free path l becomes of the order of the superconducting coherence length ξ. We show that a multichannel spinless p-wave superconductor goes through a series of phase transitions thereby alternating between topologically trivial and nontrivial phases upon increasing the disorder strength. The number of phase transitions equals the channel number N and each phase transition is accompanied by a Dyson singularity in the density of states ν(ε) ∝ ε^(-1) |lnε|^(−3).

We show that this behavior is the result of an effective chiral symmetry allowing us to analytically investigate the phase boundaries and density of states. The last phase transition, from a nontrivial phase into the trivial insulating phase, takes place at a mean free path l = ξ/(N+1), parametrically smaller than the critical mean free path in one dimension. Away from the critical points, the latter displays a power-law singularity ν(ε) ∝ ε^(|α|−1) for small energies ε. Using the concept of "superuniversality", we relate the exponent α to the wire's transport properties at zero energy and, hence, to the mean free path and the superconducting coherence length.

12:00pm
Friday, November 21, 2014
***Low Room (6C-333)**

Host: Timothy Hsieh