PHYSICS DEPARTMENT COLLOQUIUM

"Superconductor – Insulator Transition in One-Dimensional Nanowires"

BY

ANDREY ROGACHEV, PH.D.

University of Illinois at Urbana-Champaign

To test the limits of superconductivity in one dimension we have fabricated a series of ultrathin homogeneous Nb and MoGe wires with diameters below ~10 nm using suspended carbon nanotubes as templates. With decreasing diameters, nanowires display clear superconductor to insulator transition. On the superconducting side, the resistance of the nanowires drops exponentially with decreasing temperature in an agreement with the theory of thermally activated phase slips. Main characteristics of the insulating wires, the rising *R(T)* dependence and zero-bias resistance peak, can be well described by the theory of weak Coulomb blockade. Within this interpretation, a nanowire (which in our experiment is shorter than dephasing length) acts as a rigid coherent scatterer and combined system of nanowire and electrodes acts effectively as a capacitor. Test experiments on nanowire structures isolated from the rest of the system by means of high-ohmic on-chip resistors strongly suggest that the charging energy is determined by the size and geometry of electrodes. The effect has to reveal itself in systems with other coherent scatterers such as quantum point contacts, carbon nanotubes and single molecules.

THURSDAY, FEBRUARY 23, 2006
4:00 PM IN 102 JFB
REFRESHMENTS AT 3:30 PM IN 219 JFB