ACCELERATOR SEMINAR

"Effects of Impurities on the Superheating Field of Type-II Superconductors"

F. Pei-Jei Lin, Old Dominion University
A. Gurevich, Argonne National Laboratory

We consider the effect of nonmagnetic and magnetic impurities on the superheating field H_s in a type-II superconductor. We solved the Eilenberger equations, which take into account the nonlinear pairbreaking of Meissner screening currents, and calculated $H_s(T)$ for arbitrary temperatures and impurity concentrations in a single-band s-wave superconductor with a large Ginzburg-Landau parameter. At low temperatures, nonmagnetic impurities suppress a weak maximum in $H_s(T)$, which has been predicted for the clean limit, resulting instead, in a maximum of H_s as a function of impurity concentration in a moderately clean limit. It is shown that nonmagnetic impurities weakly affect H_s even in the dirty limit, while magnetic impurities suppress both H_s and the critical temperature T_c. The density of quasiparticles states $N(\varepsilon)$ is strongly affected by an interplay of impurity scattering and current pairbreaking. We show that a clean superconductor at $H = H_s$ is in a gapless state, but a quasiparticle gap ε_g in $N(\varepsilon)$ at $H = H_s$ appears as the concentration of nonmagnetic impurities increases. As the nonmagnetic scattering rate α increases above $\alpha_c = 0.36$, the quasiparticle gap $\varepsilon_g(\alpha)$ at $H = H_s$ increases, approaching $\varepsilon_g \approx 0.32\Delta_0$ in the dirty limit $\alpha \gg 1$, where Δ_0 is the superconducting gap parameter at zero field. The effects of impurities on H_s can be essential for the nonlinear surface resistance and superconductivity breakdown by strong RF fields.

Thursday, March 22, 2012
11:00 a.m.
CEBAF Center, Room B207

Coffee before seminar beginning at 10:45 a.m.

Jefferson Lab

For further info, please contact Alex Bogacz at x5784 or Anne-Marie Valente at x6073