

ACCELERATOR SEMINAR

“Penetration Depth Studies on $\text{YBa}_2\text{Cu}_4\text{O}_8$ Cuprate and Novel Iron-based Superconductor: LaFePO and Fe_2SeTe ”

Alessandro Serafin

The temperature dependence of the London penetration depth $\lambda(T)$ provides a sensitive probe for investigating the presence of low lying excitations and consequently the detailed features of the superconducting energy gap. Using a high resolution susceptometer based on a self-resonant tunnel diode circuit, penetration depth measurements were performed within two distinct projects. The first project investigated the role of CuO chains in the underdoped high T_c cuprate $\text{YBa}_2\text{Cu}_4\text{O}_8$. The in-plane anisotropy of $\lambda(T)$ revealed a clear enhancement of the superfluid density along the chain direction (b-axis) at low temperature. This results together with the fact such enhancement can be strongly suppressed by a small magnetic field, suggested plane and chain bands are coupled by the “proximity-effect” so that there is no intrinsic superconductivity on the chain structures. In the second project, we studied the symmetry of the order parameter in the recently discovered iron-based superconductors. We observed a linear T dependence of λ in LaFePO which strongly suggested the presence of nodes in the gap function. We found that this linear dependence evolved in a T^2 dependence upon isovalent substitution of Y atoms on the La site which supports the conclusion of the existence of sign-changing gap nodes in this material. Penetration depth in the iron-chalcogenide superconductor, Fe_2SeTe followed instead a higher power law $\sim T^{2.4}$. Although such behavior could be taken as evidence for nodes in the presence of disorder, other data (in particular thermal conductivity) seems to point rather to an intrinsically fully gapped state with strong pair breaking disorder.

Thursday, June 10, 2010

3:30 p.m. – 4:30 p.m.

CEBAF Center, Room F224/225

Coffee before seminar begins at 3:00 p.m.