MAR14-2013-020176

Abstract for an Invited Paper
for the MAR14 Meeting of
the American Physical Society

Quasiparticle dynamics and competing order in cuprate superconductors[1]

JOSEPH ORENSTEIN, University of California, Berkeley/Lawrence Berkeley Lab

We report time-resolved optical measurements that reveal quasiparticle and collective mode dynamics in the presence of competing order in cuprate superconductors. In these measurements, we use low-intensity short pulses of light to perturb the equilibrium state and time-resolve the ensuing change in optical reflectivity at a photon energy of 1.5 eV. The perturbing pulse generates a nonequilibrium population of quasiparticles near the Fermi energy by allowed dipole transitions as well as collective excitations through a Raman process. Tracking the relaxation of the single particle and collective modes through the phase space of temperature, carrier concentration, and magnetic field allows us to observe the interaction between the competing phases. In this talk I will describe measurements in

- YBCO ortho III and VIII in which photoexcitation is observed to generated collective oscillations of CDW order whose phase begins to rotate by 180 at the superconducting transition temperature (T_c).
- $Nd_{2-x}Ce_xCuO_{4+\delta}$ that indicate excitation of a collective mode that displays quantum critical dynamics above T_c and competition with superconductivity below.
- $HgBa_2CuO_{4+\delta}$ that indicate a cusp in the quasiparticle recombination lifetime at T_c that we associate with quasiparticle coherence effects. The size of the cusp is maximal at 8% hole concentration, possibly coinciding with the peak of a competing CDW phase, and decreases rapidly with applied magnetic field. Lastly, we observe a complex, non-monotonic temperature dependence in the dynamics near hole concentration of 18%, providing evidence for competing phases within the superconducting dome.

[1]This work was supported by the U.S. Department of Energy, Office of Basic Energy Sciences, Materials Sciences and Engineering Division, under Contract No. DE-AC02-05CH11231.