Quasiparticle recombination dynamics in the model cuprate superconductor HgBa$_2$CuO$_{4+\delta}$

J.P. HINTON, E. THEWALT, J.D. KORALEK, J. ORENSTEIN, LBNL, UC Berkeley, N. BARISIC, University of Minnesota, CEA Saclay, X. XHAO, University of Minnesota, Jilin University, M. CHAN, C. DOROW, M. VEIT, L. JI, M. GREVEN, University of Minnesota — The cuprate family of high temperature superconductors is characterized by a variety of electronic phases which emerge when charge carriers are added to the antiferromagnetic parent compound. The structural simplicity of the single layer cuprate system HgBa$_2$CuO$_{4+\delta}$ (Hg1201) is advantageous for experimentally detecting subtle features of these phases. In this work, we investigate the recombination dynamics of photo-excited quasiparticles in Hg1201 as a function of doping, temperature, and magnetic field using pump-probe optical reflectivity. We observe two distinct onset temperatures above $T_C$ in the underdoped part of the phase diagram, corresponding to $T^*$ and $T^{**}$ as observed in transport and neutron scattering experiments. We also measure a suppression of the recombination rate near $T_C$ which peaks at 8% hole concentration. We associate this suppression with coherence effects. Lastly, we observe a complex, non-monotonic temperature dependence in the dynamics around optimal doping, providing evidence for reentrant phase transitions near the apex of the superconducting dome.

1Work supported by DOE-BES

James Hinton
LBNL, UC Berkeley

Date submitted: 15 Nov 2013  Electronic form version 1.4