MAR12-2011-004712

Abstract for an Invited Paper
for the MAR12 Meeting of
the American Physical Society

Light induced meltdown of quasiparticles in high temperature superconductors

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Ultrafast *time*- and angle- resolved photoemission spectroscopy (tr-ARPES) is emerging as a powerful tool to access the non-equilibrium quasiparticles dynamics and Cooper pairs formation in unconventional superconductors. In a tr-ARPES experiment a non-equilibrium transient state is created by pumping with an infrared pulse and is then measured via photoemission with an ultraviolet probe pulse. By varying the time delay between pump and probe we can directly access the recovery of the superconducting gap and the non –equilibrium quasiparticles population decay. Here we present a detailed momentum, temperature, doping and density dependent study of the response of a high temperature Bi2212 superconductor to a femtosecond pump-probe. In particular, through systematic pump fluence dependence we have induced the meltdown of quasiparticles and have driven the system normal by inducing a collapse of the superconducting gap. Interestingly we observed that only quasiparticles beyond a particular boson mode respond to the pump laser excitations, while the others remain untouched and that both quasiparticles recombination and gap dynamics are a density, momentum and doping dependent process, showing a crossover from a weakly perturbed to a strongly perturbed regime. These results point to a new dichotomy between the ultrafast gap and quasiparticles response within and beyond the Fermi arc and reveal a new window into the nature of the pairing interaction in high Tc superconductors.