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LIGHT INDUCED MELTDOWN OF QUASIPARTICLES IN HIGH TC SUPERCONDUCTORS

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We use high resolution time- and angle- resolved photoemission spectroscopy (tr-ARPES) to directly probe collective dynamics after optical excitation and study their influence on quasiparticles dynamics, Cooper pair formation, superconducting gap and other competing orders. In particular, through systematic pump fluence dependence we were first able to induce a meltdown of quasiparticles and measure their recovery dynamics. Interestingly we observed that only quasiparticles beyond a particular boson mode respond to the pump laser excitations, while the others remain untouched and that the entire decay is governed by two different time scale. We observe that quasiparticles recombination is also a fluence and momentum dependent process with enhanced recombination at the antinode. As we move away from the nodal direction and along the Fermi arc, we observe a closing of the superconducting gap, 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.

[1] J. Graf et al. Nature Physics 7, 806 (2011)
[2] C. L. Smallwood et al. Science 336, 1137 (2012)

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