Superconducting gap and pseudo gap in hole doped copper oxides

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Electronic Raman scattering measurements have been performed on hole doped cuprates as a function of temperature and doping level. In the superconducting state coherent quasiparticles develop preferentially over the nodal region in the underdoped regime. We then define the fraction of coherent Fermi surface, f_c around the nodes for which superconductivity sets in. We find that f_c is doping dependent and leads to the emergence of two energy scales. We then establish that the critical temperature $T_c \propto f_c \Delta_{max}$ where Δ_{max} is the maximum amplitude of the d-wave superconducting gap. In the normal state, the loss of antinodal quasiparticles spectral weight detected in the superconducting state persists and the spectral weight is only restored above the pseudogap temperature $T*$. Such a dichotomy in the quasiparticles dynamics of underdoped cuprates is responsible for the emergence of the two energy scales in the superconducting state and the appearance of the pseudogap in the normal state. This advocates in favor of a low temperature phase transition inside the superconducting dome.
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[1]A. Sacuto et al. "Electronic Raman Scattering in copper oxide Superconductors: Understanding the Phase Diagram", Comptes Rendus de l'Academie des Sciences 2011. arXiv:1103.5675