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One gap, two gaps, and universality in high temperature superconductors JUNJING ZHAO, University of Illinois at Chicago, UTPAL CHATTERJEE, MIKE NORMAN, Argonne National Lab, MOHIT RANDERIA, Ohio State University, JUAN CARLOS CAMPUZANO, University of Illinois at Chicago — A dramatic change in energy gap anisotropy upon reducing carrier concentration has often been observed in the cuprate high temperature superconductors (HTSC). A simple d-wave gap in materials with the optimal Tc evolves with underdoping into a ?two-gap? structure, with different dependences in different regions of momentum space. It is tempting to associate the large antinodal gap with a second order parameter distinct from d-wave superconductivity. We use angle-resolved photoemission spectroscopy (ARPES) to show that this two-gap behavior, and the concomitant destruction of well defined electronic excitations, are not universal features of HTSC, and depend sensitively on how the underdoped materials are prepared. Depending on cation substitution, underdoped crystals either show two-gap behavior or not. In contrast, many characteristics of HTSC like the superconducting dome (Tc versus doping), nodal quasiparticles, antinodal gap that decreases monotonically with doping, and the pseudogap, are present in all samples, irrespective of whether they exhibit two-gap behavior or not. Our results imply that universal aspects of high Tc superconductivity are insensitive to differences in the electronic states in the antinodal region of the Brillouin zone.

Junjing Zhao
University of Illinois at Chicago

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