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Kinetics-Driven Superconducting Gap in Underdoped Cuprate Superconductors Within the Strong-Coupling Limit[1]

WEI KU, YUCEL YILDIRIM, CMPMSD, Brookhaven National Laboratory — A generic theory [1] of the quasiparticle superconducting gap in underdoped cuprates is derived in the strong-coupling limit, and found to describe the experimental "second gap" in absolute scale. In drastic contrast to the standard pairing gap associated with Bogoliubov quasiparticle excitations, the quasiparticle gap is shown to originate from anomalous kinetic (scattering) processes, with a size unrelated to the pairing strength. Consequently, the k dependence of the gap deviates significantly from the pure $d_{x^2-y^2}$ wave of the order parameter. Our study reveals a new paradigm for the nature of the superconducting gap, and is expected to reconcile numerous apparent contradictions among existing experiments and point toward a more coherent understanding of high-temperature superconductivity.

[1] Y. Yildirim and Wei Ku, PRX 1, 011011 (2011).

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