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Phase-fluctuating superconductivity in overdoped $\text{La}_{2-x}\text{Sr}_x\text{CuO}_4$

P.M.C. ROURKE, I. MOUZOPOULOU, University of Bristol, X. XU, C. PANAGOPOULOS, Nanyang Technological University, Y. WANG, Peking University, B. VIGNOLLE, C. PROUST, LNCMI Toulouse, E.V. KURGANOVA, U. ZEITLER, HFML Nijmegen, Y. TANABE, T. ADACHI, Y. KOIKE, Tohoku University, N.E. HUSSEY, University of Bristol — In underdoped cuprates, an energy gap (pseudogap), appears in the electronic density of states well before superconductivity develops. Similarities between the pseudogap and superconducting gap have led to the idea that the pseudogap is a precursor superconducting state in which the superconducting order parameter is finite but the phase fluctuates. However, this picture of precursor pairing has been challenged by measurements indicating that the pseudogap itself closes at a critical doping concentration just beyond optimal doping. By tracking the restoration of the normal state magnetoresistance in overdoped $\text{La}_{2-x}\text{Sr}_x\text{CuO}_4$, we show that the phase fluctuation regime remains broad across the entire superconducting composition range, in contrast to the evolution of the pseudogap. The universal low phase stiffness is shown to be correlated with a low superfluid density, a characteristic of both underdoped and overdoped cuprates. The formation of the pseudogap, by inference, is therefore both independent of and distinct from superconductivity.

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