

170. Title: Temporal correlations of superconductivity above the transition temperature in  $\text{La}_{2-x}\text{Sr}_x\text{CuO}_4$  probed by terahertz spectroscopy

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Source: NATURE PHYSICS

Volume:7

Issue:4

Pages: 298-302

Publication year: 2011

Document type: Journal article (JA)

Abstract: The nature of the underdoped pseudogap regime of the high-temperature copper oxide superconductors has been a matter of long-term debate(1-3). On quite general grounds, we expect that, owing to their low superfluid densities and short correlation lengths, superconducting fluctuations will be significant for transport and thermodynamic properties in this part of the phase diagram(4,5). Although there is ample experimental evidence for such correlations, there has been disagreement about how high in temperature they may persist, their role in the phenomenology of the pseudogap and their significance for understanding high-temperature superconductivity(6-10). Here we use THz time-domain spectroscopy to probe the temporal fluctuations of superconductivity above the critical temperature ( $T_c$ ) in  $\text{La}_{2-x}\text{Sr}_x\text{CuO}_4$  (LSCO) thin films over a doping range that spans almost the entire superconducting dome ( $x = 0.09-0.25$ ). Signatures of the fluctuations persist in the conductivity in a comparatively narrow temperature range, at most 16 K above  $T_c$ . Our measurements show that superconducting correlations do not make an appreciable contribution to the charge-transport anomalies of the pseudogap in LSCO at temperatures well above  $T_c$ .