

Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

Fluctuating charge density waves in a cuprate superconductor

FAHAD MAHMOOD, DARIUS TORCHINSKY, Massachusetts Institute of Technology, ANTHONY BOLLINGER, IVAN BOZOVIC, Brookhaven National Laboratory, NUH GEDIK, Massachusetts Institute of Technology — Cuprate compounds that host high-temperature superconductivity also exhibit various forms of charge and/or spin ordering whose role in the complex cuprate phase diagram is not fully understood. Static charge-density wave (CDW) ordering has been detected so far by diffraction probes only for special doping or in an applied external field. However, dynamic (fluctuating) CDWs may also be present more broadly while being difficult to detect by conventional techniques. To observe and characterize fluctuating CDWs in cuprates, and determine whether they favor or compete with HTS, is thus an important open problem. Here, we present a new method, based on ultrafast spectroscopy, to detect the presence and measure the lifetime of CDW fluctuations in cuprates. In an underdoped $\text{La}_{1.9}\text{Sr}_{0.1}\text{CuO}_4$ film ($T_c = 26$ K), we observe collective excitations of CDW that persist up to 100 K. This CDW is dynamic; it fluctuates with a characteristic lifetime of 2 ps at $T = 5$ K which decreases to 0.5 ps at $T = 100$ K. In contrast, in an optimally doped $\text{La}_{1.84}\text{Sr}_{0.16}\text{CuO}_4$ film ($T_c = 38.5$ K), we see no signatures of fluctuating CDW at any temperature, favoring the competition scenario. This work opens a path towards a broad study of fluctuating order parameters in various superconductors and other materials.

Fahad Mahmood
Massachusetts Institute of Technology

Date submitted: 05 Nov 2012

Electronic form version 1.4