

Fluctuating Charge Density Waves in a Cuprate Superconductor

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Cuprate materials hosting high-temperature superconductivity (HTS) also exhibit various forms of charge and spin ordering whose significance is not fully understood. So far, static charge-density waves (CDWs) have been detected by diffraction probes only at particular doping levels or in an applied external field. However, dynamic CDWs may also be present more broadly and their detection, characterization and relationship with HTS remain open problems. Here we present a method based on ultrafast spectroscopy to detect the presence and measure the lifetimes of CDW fluctuations in cuprates [1]. 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 dynamic CDW fluctuates with a characteristic lifetime of 2 ps at $T = 5$ K that 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 detect no signatures of fluctuating CDWs at any temperature, favouring the competition scenario. This work forges a path for studying fluctuating order parameters in various superconductors and other materials.

References

1. Darius H. Torchinsky*, Fahad Mahmood*, Anthony T. Bollinger, Ivan Božović, and Nuh Gedik *Nature Materials* **12** 387-391 (2013)