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**Universality of commensurate 4$a$-period charge density modulations throughout the cuprate pseudogap regime** ANDREJ MESAROS, LASSP, Department of Physics, Cornell University, KAZUHIRO FUJITA, Condensed Matter Physics and Materials Science Department, Brookhaven National Laboratory, MOHAMMAD HAMIDIAN, Department of Physics, Harvard University, HIROSHI EISAKI, Institute of Advanced Industrial Science and Technology, Tsukuba, SHIN-ICHI UCHIDA, Department of Physics, University of Tokyo, J.C. DAVIS, MICHAEL J. LAWLER, EUN-AH KIM, LASSP, Department of Physics, Cornell University — Theories for the hole-doped Mott insulator, representing underdoped cuprates, are based upon the strong real space ($r$-space) interactions, and have long predicted a modulation of charge that is commensurate with the underlying lattice. Such a charge density modulation (CDM) state is unrelated to any momentum space ($k$-space) features such as the nesting of regions on a Fermi surface. Experimentally, with increasing hole density, the reported wavevector $Q$ of the CDM diminishes continuously with increasing hole-density as if driven by $k$-space phenomena. Using a novel technique based upon phase-sensitive electronic structure visualization, we demonstrate that the cuprate CDM actually exhibits a commensurate 4$a$-period throughout the entire underdoped region of the $Bi_2Sr_2CaCu_2O_8$ phase diagram. Our technique is designed for extracting $Q$ from inhomogeneous, short-ranged CDM, as the ones observed in experiments. Thus, a strong-interaction $r$-space perspective appears to be relevant to achieving a predictive theory for the cuprate pseudogap regime.

Andrej Mesaros
LASSP, Cornell University

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