Abstract Submitted
for the MAR11 Meeting of
The American Physical Society

How Topological Defects Couple the Smectic and Nematic Electronic Structure of the Cuprate Pseudogap States K. FUJITA, Cornell Univ., A. MESAROS, Universiteit Leiden, H. EISAKI, AIST, Japan, S. UCHIDA, Univ. of Tokyo, J. C. DAVIS, Cornell Univ., S. SACHDEV, Harvard Univ., J. ZAANEN, Universiteit Leiden, M. LAWLER, Binghamton Univ., EUN-AH KIM, Cornell Univ. — We study the recently discovered coexisting smectic and nematic broken symmetries in the pseudogap-energy electronic structure of underdoped $Bi_2Sr_2CaCu_2O_{8+\delta}$. By visualizing their spatial components separately, we discover 2π topological defects throughout the phase-fluctuating smectic states. Imaging the locations of large numbers of these topological defects simultaneously with the fluctuations of the electronic nematicity about its average, reveals strong empirical evidence for a coupling between them. We also found the same phenomenology in a single layer compound of $Bi_2Sr_{1.6}La_{0.4}CuO_{6+\delta}$. From these observations, we propose a Ginzburg-Landau free energy describing the quantum nematic/smectic coupling and demonstrate how it can explain the coexistence of these states and correctly predict their interplay at the atomic scale. This theoretical understanding of the coupling between the quantum nematic and smectic broken symmetries can lead to unraveling the complexities of the phase diagram of cuprate high-T_c superconductors[1]. [1]A. Mesaros, K. Fujita, H. Eisaki, S. Uchida, J. C. Davis, S. Sachdev, J. Zaanen, M. J. Lawler, and Eun-Ah Kim, *Submitted* (2010).

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Date submitted: 18 Nov 2010 Electronic form version 1.4