

## The pseudogap phase in Bi2201 studied by ARPES

M. Hashimoto<sup>a,b,c,d</sup>, R.-H. He<sup>b,c,d</sup>, H. Karapetyan<sup>b,c</sup>, J.D. Koralek<sup>d</sup>, J.P. Hinton<sup>d</sup>, J.P. Testaud<sup>b,c,d</sup>, V. Nathan<sup>b,c</sup>, Y. Yoshida<sup>e</sup>, H. Yao<sup>b,c</sup>, K. Tanaka<sup>b,c</sup>, W. Meevasana<sup>b,c</sup>, R.G. Moore<sup>a</sup>, D.H. Lu<sup>a</sup>, S.K. Mo<sup>d</sup>, M. Ishikado<sup>e</sup>, H. Eisaki<sup>e</sup>, Z. Hussain<sup>d</sup>, T.P. Devereaux<sup>b,c</sup>, S.A. Kivelson<sup>b,c</sup>, J. Orenstein<sup>d</sup>, A. Kapitulnik<sup>b,c</sup>, and Z.-X. Shen<sup>b,c</sup>

<sup>a</sup>SSRL, SLAC National accelerator Laboratory, CA, USA.

<sup>b</sup>Geballe Laboratory for Advanced Materials, Departments of Physics and Applied Physics, Stanford University, CA, USA.

<sup>c</sup>SIMES, SLAC National accelerator Laboratory, CA, USA.

<sup>d</sup>ALS and Materials Sciences Division, LBNL, CA, USA.

<sup>e</sup>Nanoelectronics Research Institute, AIST, Ibaraki, Japan.

The nature of the pseudogap in cuprates is a major unsolved problem in condensed matter physics. We studied the commencement of the pseudogap state at temperature  $T^*$  in the optimally doped Bi2201 by ARPES. The results suggest that the pseudogap is a competing order with various symmetry breakings, which is consistent with the signature of the phase transition observed by a Kerr rotation and the time-resolved reflectivity measurements on the same sample. Further, the measurement below  $T_c$  suggests that the pseudogap and superconductivity coexist, entangled in an energy-momentum dependent manner.<sup>1 2</sup>

<sup>1</sup>M. Hashimoto and R.-H. He et al., *Nature Phys.* **6**, 414 (2010).

<sup>2</sup>R.-H. He and M. Hashimoto et al., *Science* **331**, 1579 (2011).

INVITED PAPER