Session 26bB

Angle-Resolved Photoemission Study of Many-Body Physics in Cuprate Superconductors — 26bB1

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Angle-resolved photoemission spectroscopy is uniquely positioned to reveal direction, speed, and scattering mechanism of valence electrons. Enormously improved resolution and experimental collaborations have elevated this technique from a band mapping tool to an important many-body spectroscopy. This talk reviews new insights of complex many-body processes in oxides: 1) well defined Fermi surface in overdoped metal; 2)d-wave structure of the superconducting gap; 3) pseudogap in the normal state of underdoped metal; 4) the emergence of coherent quasiparticle peak upon the superconducting transition; 5) dynamics of a hole in an antiferromanget; 6) manifestations of the electron-lattice interaction. These findings have strongly influenced our thinking about these novel oxides.

Time reversal symmetry breaking in the high temperature superconductors — 26bB2

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The superconducting phase transition in the underdoped high temperature superconductors is rather unusual, in that it is not a mean-field transition as other superconducting transitions are. Instead, it is observed that a pseudo-gap in the electronic excitation spectrum appears at temperatures T* higher than Tc, while phase coherence, and superconductivity, are established at Tc. One would then wish to understand if T* is just a crossover, controlled by fluctuations in order which will set in at the lower Tc, or whether some symmetry is spontaneously broken at T*. Using angle-resolved photoemission with circularly polarized light, we find that, in the pseudogap state, left-circularly polarized photons give a different photocurrent than right-circularly polarized photons, and therefore the state below T* is rather unusual, in that it breaks time reversal symmetry.

26bB3 ARPES Study of Lightly-Doped Cuprates

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ARPES studies of high-T_c cuprates have been performed in the lightly-doped (hole concentration $< 10\%$) region. ARPES spectra of $La_{2-x}Sr_xCuO_4$ in the so-called spin-glass/diagonal-stripe phase show an “arc” of Fermi surface in the nodal direction, consistent with the metallic transport at high temperatures. Spectral weight in the $(\pi, 0)$ region recovers at higher doping levels, where vertical dynamical stripes appear. The same change occurs at a lower hole concentration in $YBa_2Cu_3O_y$, where stripes are always vertical. Spectral weight at E_F is generally much lower in lightly-doped Bi2212 compounds.
This work has been done in collaboration with T. Yoshida, K. Tanaka, H. Yagi, T. Mizokawa, X.-J. Zhou, P. Bogdanov, W. Yang, A. Lanzara, Z.-X. Shen, Z. Hussain, T. Kakeshita, H. Eisaki, S. Uchida, T. Sugaya, I. Terasaki, K. Segawa and Y. Ando.

26bB4 Direct Evidence for Superconducting Quasiparticle in Triple-layered High-T$_c$ Superconductor*

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We have performed angle-resolved photoemission spectroscopy on triple-layered high-T_c cuprate superconductor $Bi_2Sr_2Ca_2Cu_3O_{10+\delta}$. We found a direct experimental evidence for Bogoliubov quasiparticle in high-T_c cuprates by observing the full energy dispersion below and above the Fermi level. The excellent quantitative agreement in the dispersion as well as the coherence factors between the ARPES experiment and BCS theory establishes the validity and universality of the basic framework of BCS theory in high- T_c cuprates.

*work collaborated with H. Matsui, T. Sato, S.-C. Wang, H.-B. Yang, H. Ding, T. Fujii, T. Watanabe, and A. Matuda