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Momentum Resolved Microscopic Studies of High-Temperature Superconductors

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As illustrated by their complex phase diagrams, the transition metal oxides possess remarkable electronic properties. It is not rare to observe a metal-insulator phase transition accompanied by orbital, magnetic, charge or even superconducting instabilities. In order to better identify the relevant *microscopic* interactions controlling their *macroscopic* properties, it is crucial to obtain precise energy- and momentum-resolved information about the fundamental excitations in these materials. Neutron scattering and angle resolved photoemission spectroscopy (ARPES) provide powerful and complementary tools to investigate the subtle interplay that may exist between the spin and electronic degrees of freedom in the transition metal oxides.

In this lecture I shall concentrate on one particular class of oxides: the high-temperature cuprate superconductors. Thanks to instrumental improvements, it has become recently possible to establish quantitative comparisons between the one-particle spectral function obtained from ARPES and the 2-particles response (susceptibility) as measured from neutron scattering. Issues like the shape of the superconducting gap [1] and spectral functions [2], the magnetic resonance and spin gap [3] will be discussed. If time allows, our most recent neutron measurements in the Abrikosov (mixed-) state and their relation to the electronic structure will as well be presented [4].

References:

[1] Phys. Rev. Lett. 83, 840 (1999); Phys. Rev. B 70, 214511 (2004).
[2] Phys. Rev. Lett. 84, 1788 (2000); Phys. Rev. Lett. 86, 1070 (2001).
[3] Euro. Phys. Lett. 66, 840 (2004).
[4] Phys. Rev. Lett. 88, 217003 (2002); Phys. Rev. Lett. 93, 217001 (2004).

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