9.7 cm

Electronic theory for elementary and spin excitations in high-T_c cuprates: interplay between magnetism and superconductivity

D. Manske, I. Eremin, and K.H. Bennemann
Institut für Theoretische Physik, Freie Universität Berlin, D-14195 Berlin, Germany

Angle-resolved photoemission spectroscopy (ARPES) and inelastic neutron scattering (INS) are powerful tools for studying the elementary and spin excitations in high-T_c superconductors. In particular, a kink feature at energies 50±15 meV has been observed in hole-doped cuprates like $Bi_2Sr_2CaCu_2O_{8-x}$, Pb-doped $Bi_2Sr_2CuO_6$, and $La_{2-x}Sr_xCuO_4$[1].
In our studies we have calculated self-consistently the pronounced momentum and frequency dependence of the self-energy $\Sigma(\mathbf{k},\omega)$ originating from scattering of the quasiparticles on spin fluctuations within a unified theory for Cooper-pairing in hole-doped high-T_c cuprates[2]. We find that this coupling results in a kink structure in the dispersion $\omega(\mathbf{k})$ which agrees well with recent ARPES experiments. Furthermore, using a two-dimensional Hubbard Hamiltonian we find that the resonance peak in the magnetic susceptibility, $\mathrm{Im}\chi(\mathbf{q},\omega)$, appears only in the superconducting state and it scales with T_c[3]. By taking into account the feedback of superconductivity on $\mathrm{Im}\chi(\mathbf{q},\omega)$ we obtain through our calculations that tunneling data and measurements of the optical conductivity are consistent with each other and with $d_{x^2-y^2}$-wave pairing.

[1] A. Lanzara et al., Nature **412**, 510 (2001).
[2] D. Manske, I. Eremin, and K.H. Bennemann, Phys. Rev. Lett. **87**, 177005 (2001).
[3] D. Manske, I. Eremin, and K. H. Bennemann, Phys. Rev. B **63**, 054517 (2001).

13.4 cm

Subject category :

1. Correlated Electrons and High Temperature Superconductors

Presentation mode :
oral

Corresponding author :
D. Manske

Address for correspondence :
Institut für Theoretische Physik
Freie Universität Berlin
Arnimallee 14, D-14195 Berlin
Germany

Email address :
dmanske@physik.fu-berlin.de