Theory of Angel-Resolved Photoemission Spectra of the Many-Electron Frohlich Model

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Abstract

We have developed a new approach, starting from the Frohlich Hamiltonian [1] and by means of the unitary transformation with the perturbation treatment, to deal with the angel-resolved photoemission spectra (ARPES) of electron-phonon coupling system. The approach takes care of the fact that only those electrons near the Fermi surface within a layer of width ω_0 (phonon frequency) are scattered by phonons strongly. Our results show that the ARPES is mainly composed of two part: the zero-phonon part and the one-phonon one. When the bare electron energy ε_k is close to the Fermi energy μ, $\varepsilon_k-\mu\leq\omega_0$, the one-phonon part is quite significant and the ARPES shows a two-headed peak. But for $\varepsilon_k-\mu>>\omega_0$, the one-phonon part disappears gradually and the ARPES shows a single broad peak. In the following figure we show some of our calculations with Einstein phonons and $\varepsilon_k-\mu=0, -\omega_0,-2\omega_0, -3\omega_0,-4\omega_0$, where λ is the electron-phonon coupling, D the half bandwidth, T the temperature and n the band filling. These results qualitatively agree with recent experiments of ARPES on the Be(0001) surface and $Bi_2Sr_2CaCu_2O_8$ [2].

References:

[1] H. Frohlich, Phys. Rev. **79**, 845 (1950)
[2] K. Ji, H. Zheng, and K. Nasu, Phys. Rev. B**70**, 085110(2004).