Strong interplay between electron-phonon interaction and disorder in low doped systems

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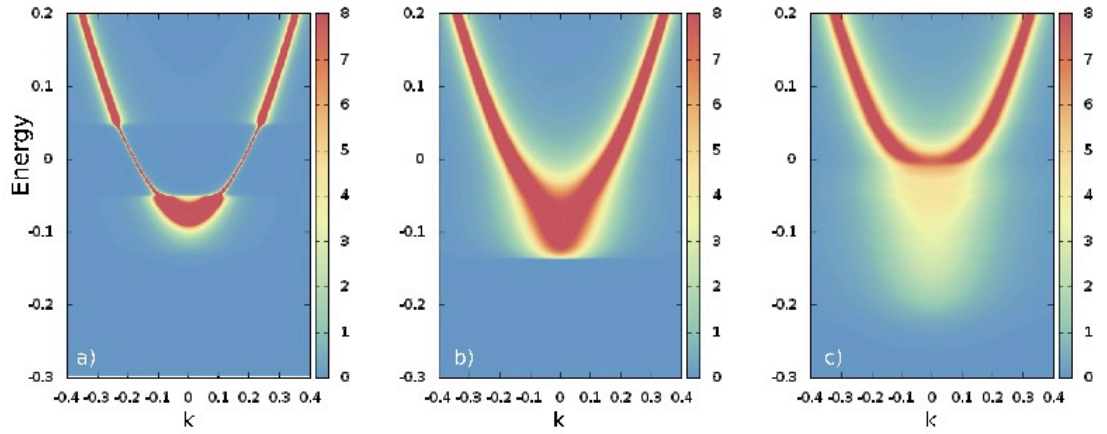
The effects of doping on the spectral properties of low doped systems are investigated by means of Coherent Potential Approximation (CPA) to describe the distributed disorder carried out by the impurities and Non-Crossing Approximation (NCA) to characterize a wide class of electron-phonon interactions which dominate the low-energy spectral features[1]. When disorder and electron-phonon interaction work on comparable energy scales, a strong entanglement between them arises, and the effect of disorder can no more be described as a mere broadening of the spectral features. As a consequence of this entanglement, the low doping Mott metal-insulator transition, is strongly affected by a weak or moderate electron-phonon coupling which is found to stabilize the insulating phase.
We apply this theory to the low-lying electronic states of La-doped Sr2TiO4, a quasi-two-dimensional counterpart of the widely investigated perovskite SrTiO3 [2]. We explain, in term of combined action of electron-phonon interaction and disorder, the experimental Luttinger volume which is substantially smaller than the La dopant concentration.



The spectral function A(k, ω). a) Electron-phonon interaction only λ = 0.22 b) Disorder only c) Electron-phonon interaction + disorder.

[1] D. DI Sante and S. Ciuchi Phys. Rev. B 90, 075111 (2014)
[2] Y.F. Nie, D. Di Sante, S. Chatterjee,P. D. C. King, M. Uchida, T. Birol, D. G. Schlom, S. Ciuchi, and K.M. Shen (to be published)

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