Optical conductivity of cuprates from Yang–Rice–Zhang ansatz: Comparison with experiment

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Abstract
We report the results of a theoretical investigation on charge dynamics in weakly coupled CuO2 planes of the cuprate Ca2−xNaxCuO2Cl2 in the pseudogap regime by using the theory of Yang, Rice, and Zhang (YRZ) [1]. With a detailed numerical analysis at various impurity scattering rates (γimp), we observe that YRZ model is not able to reproduce (in magnitude) the experimentally observed frequency evolution of optical conductivity at a fixed doping level. Further, to analyze the doping evolution, we have done a detailed comparison of calculated YRZ conductivity with the experimental one using Two-Component Drude–Lorentz model. We find that YRZ model is capable of reproducing (qualitatively) the experimentally observed doping evolution of Drude processes (low energy scale) and processes at the pseudogap (intermediate energy scale). We also discuss physical reasons of the discrepancy seen in magnitudes.

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1. Introduction and YRZ ansatz

\[ H_{\text{eff}} = -g_{t} \sum_{i} \sum_{\sigma} c_{i\sigma}^{\dagger} c_{i\sigma} + g_{s} J_{i} S_{i} \cdot S_{i} , \]

where \( J \) is the nearest-