Collective Excitations in Layered Organic Conductors

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We present the study on the spectral properties of quasi-one-dimensional bands, related to nonstandard ARPES data for the quasi-one-dimensional organic compound TTF-TCNQ [1,2]. In this material low energy quasi-particles are absent, and spectra comprise wide structures at higher energies showing one-dimensional dispersion of electron bands. Furthermore, the infrared optical measurements revealed the existence of unusual low frequency mode, along with the mode at the order of magnitude higher energy [3]. These anomalies were explained by using a dielectric formalism appropriate for the tight-binding multi-band systems [4] in the random phase approximation (RPA) taking two electron bands per chain of acceptor and donor molecules. Namely, within such an approach the simultaneous treatment of both intra-band and inter-band dipole excitations together with monopole-dipole coupling between them results with these modes.

Starting from the screened monopole-monopole long-range Coulomb electron-electron interaction in the above approach which comprises obtained collective modes, we use the G_0W_0 approximation for the calculation of the one-particle spectral function for conducting one-dimensional electron bands at acceptor and donor chain families. Obtained spectral properties comprising broad dispersions due to contributions of two collective modes are in qualitative agreement with ARPES data for TTF-TCNQ.

Finally, in this work we also address our recent efforts to extend previous considerations related to dielectric properties of TTF-TCNQ to quasi-two-dimensional conductor β''-(BEDT-TTF)$_2$SF$_5$CH$_2$CF$_2$SO$_3$ whose optical data comprise low energy collective mode as well [5].

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