Raman scattering in the charge-density-wave phase of the spinless Falicov-Kimball model

O.P. Matveev[a], A.M. Shvaika[a] and J.K. Freericks[b]

[a] *Institute for Condensed Matter Physics of the National Academy of Sciences of Ukraine, 1 Svientsitskii Str., 79011 Lviv, Ukraine*
[b] *Department of Physics, Georgetown University, Washington, DC 20057, USA*

One of the simplest model with the strong electron correlation is the Falicov-Kimball model. The model possesses such quantum mechanical effects as metal-insulator transition, order-disorder phase transition and phase separation. Besides, the Falicov-Kimball model has exact solution within the dynamical mean-field theory (DMFT).

Raman scattering spectrum, including the nonresonant, mixed and resonant components, is determined for the charge-density-wave (CDW) phase of the spinless Falicov-Kimball model at half filling within DMFT. Its frequency dependence is investigated for different values of Couloumb repulsion (ranging from dirty metal to the Mott insulator) and for different temperatures. Obtained spectra reflect the structure of the many-particle density of states. The nonresonant response function is also determined for the case of the inelastic X-ray scattering (when both energy and momentum are transferred) [1]. In this case the most important features of spectra at low temperatures depend on the transferred momentum and an effective screening of uniform charge fluctuations, that is revealed by the careful examining of the first Brillouin zone. All investigations are performed for B_{1g}, B_{2g} and A_{1g} symmetries (which are usually examined in experiments).

Obtained results about the strong and weak temperature dependence of the low and high energy excitations, respectively, and the influence of the Couloumb potential on the shape of spectra give information about the charge dynamics in CDW-ordered phase which could be useful in experimental investigations of the corresponding compounds.

1. O.P. Matveev, A.M. Shvaika, J.K. Freericks, Phys. Rev. B **79**, 115130 (2009).