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Many-body dynamics and inelastic scattering in strongly correlated electron systems

Andrij Shvaika
Institute for Condensed Matter Physics of the National Academy of Sciences of Ukraine,
1 Svientsitskii Street, 79011 Lviv, Ukraine
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Some problems of the development of microscopic theory of many-body dynamics in strongly correlated electron systems within the dynamical mean field theory are considered. In particular, results for the many-body susceptibilities and resonant cross-sections of inelastic (Raman) scattering for the Falicov-Kimball model are presented.

In the first part of the talk we present results for the total Raman scattering near a metal-insulator and charge-density-wave transitions. The problem is solved exactly for the spinless Falicov-Kimball model with dynamical mean-field theory. We include the nonresonant, mixed, and resonant contributions in three common experimental polarizations, and analyze the response functions for representative values of the energy of the incident photons. Resonant effects can yield a double resonance enhancement of nonresonant peaks, a joint resonance of peaks when the incident photon energy is on the order of interband transitions, and the appearance of an isosbestic point in all symmetry channels. The complicated scattering response can be understood from the significant temperature dependence of the many-body density of states and includes a huge enhancement for photon frequencies near the energies of the interband transitions, including the charge-density-wave gap energy.

In the second part of the talk we consider the interaction of x-rays with strongly correlated electron system. An exact solutions for the core-hole propagator, which determines the x-ray photoemission spectrum (XPS), and two-particle core-hole—band electron response function, which determines the x-ray absorption spectrum (XAS), are derived for the spinless Falicov-Kimball model. The density of states of the x-ray edge problem and XAS are considered for the different temperatures and interaction strengths. It is obtained that both XPS and XAS contain two groups of peaks one of which corresponds to the absorption edge. Besides, the resonant inelastic x-ray scattering (RIXS) response functions are analyzed for different values of the transferred momentum and incident photon energies (below and above the edge).