DYNAMICS OF THE PHONON CLOUDS FOR ANDERSON-HOLSTEIN MODEL

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Strong correlation effect can occur in metallic systems due both to strong electron-electron interactions and strong electron-phonon coupling, including their interplay as well [1].

There are many systems with strongly correlated electrons where there is also a strong coupling to the lattice, for example V_2O_3 [2,3], manganites [4] and fullerides [5]. The strong electron-electron interactions can be described by Hubbard [6] and Anderson [7] models. The Holstein model [8] has been used to examine electron-phonon interactions. Anderson-Holstein model includes both types of interaction.

The advances in the field of molecular electronics have revived the interest to the problem of electron-phonon interaction because electron-vibrational coupling within the molecule is important for understanding the properties of such devices. From theoretical point of view it is the problem of small polaron discussed by Holstein [8].

We have developed a diagrammatic approach for the Anderson-Holstein model in the case of strong Coulomb intra-atomic interaction of impurity electrons and strong electron-phonon interaction of the impurity electrons with optical phonons. Both interactions are taken into account as the main part of the Hamiltonian.

In the perturbation approach elaborated by us we shall use the generalized Wick theorem proposed in [9-13] for strongly correlated systems. The generalized theorem will be employed for the impurity subsystem and the standard theorem will be used for conduction electrons and optical phonons.

Dynamics of the phonon clouds of polarons has been investigated and the renormalization of their collective frequency has been described in detail. We have proved that at zero temperature hybridization causes a continuous softening of the collective mode.

We have formulated the system of Dyson-type equations which determines the relation between the full propagators of impurity electrons and their correlation functions. We have also found the system of Dyson equations for the full Green‘s functions of conduction electrons and for their mass operators. As a consequence of his analysis we have proven the identity between the impurity correlation functions and the mass operators of the conduction electrons.

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