CMT O7 A NOVEL DIAGRAMMATIC TECHNIQUE FOR STRONGLY CORRELATED ELECTRON SYSTEMS

L. A. Dohotaru[1,2*]
[1]*Technical University of Moldova, Chisinau, Moldova;* [2]*Institute of Applied Physics, Chisinau, Moldova*
[*]E-mail: leonid.dohotaru@mate.utm.md

We dedicate this paper to the memory of the outstanding Moldavian scientist and remarkable person Academic Vsevolod Moskalenko, who deceased so early but whose papers and monographs left a deep trace in science, contributing remarkably to the theory of multiband superconductivity, polaron theory, multiparticle physics, etc.

V. A. Moskalenko and colleagues elaborated a new approach to the theory of strongly correlated electrons using the original diagram methods for the Hubbard model of the main model of strongly correlated electron systems. He was the one to formulate a new concept of correlation functions as the carriers of all quantum spin, charge and couple fluctuations of the system on the basis of which he managed to derive the equation of the Dyson type for the full single-particle propagators. The new type of investigations made it possible to determine a number of significant properties of transformations such as a metal-dielectric transition, the wave of a spin density and superconductivity. He contributed greatly to the development of the polaron theory in the strongly correlated systems. Further on, we shall dwell on the main results of these investigations.

First, we shall start with the development of the new variant of thermodynamic perturbation theory of strongly correlated electron systems [1]. The presence of a strong Coulomb repulsion of electrons in the above systems necessitates to formulate the generalized theory of Wick for the chronological products of fermion operators. New elements in the proposed diagram methods are one-particle irreducible Green functions or Kubo cumulants. These functions contain all spin, charge and couple correlations induced by the Coulomb interaction. Based on these irreducible functions, the correlation function of the system is constructed. Using this system it is possible to formulate the Dyson type equation for the one-particle renormalized Green's functions. Since there is no Dyson equation for the correlation function, the approximations were used for it being based on a selected summing of diagrams of particular classes. The diagram methods are generalized for a case of a superconducting phase of a system. In the works, the metal-dielectric transition is studied [2] and a critical value of the Coulomb repulsion is determined, as well as the critical temperature of the superconducting transition is obtained [3, 4]. This diagram approach, that was initially offered for a single-zone Hubbard model, was then generalized for more complicated systems, such as Anderson periodic model [5-7] and Hubbard-Holstein model [8,9].

A new mechanism of superconductivity is proposed that is conditioned by the exchange of polarons by their phonon clouds [11].

Interesting results were obtained in the study of competing phase transitions into the superconducting phase and the phase with a wave spin density [12].

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