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Abstract

Thermodynamic and transport properties of the Falicov-Kimball model within dynamical mean field theory

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The research presented in this dissertation concerns the thermodynamic and transport properties of the Falicov-Kimball model which is one of the simplest lattice models describing strongly correlated electron systems. Considering the infinitely dimensional Bethe lattice and using dynamical mean-field theory made it possible to obtain exact formulas for the spectral function of the system, as well as the quantities characterizing the thermodynamic and transport properties of the Falicov-Kimball model. The calculations were performed for the case of a half-filled band, for a system with the number of electrons equal to the number of lattice sites. The impact of value of the Coulomb parameter U and V on the order parameter and the specific heat of the system was investigated. A particular interesting property of the Falicov-Kimball model is the presence of the emergent quantum critical point for the interaction value $U/t = \sqrt{2}$, which seperates two ordered insulating phases. The vicinity of this point is extremely interesting due to the behavior of the electrical conductivity of the system. One of the most important results of the dissertation is the calculation of the electrical conductivity in the vicinity of the emergent quantum critical point and finding non-trivial scaling law, different from the results found in the literature so far.