CFEL SCIENCE

SEMINAR

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Various types of charge-ordered states in strongly correlated fermionic systems

Strongly correlated materials are a wide class of compounds that include insulators and electronic materials. They exhibit unusual electronic and magnetic properties (usually technologically very useful), e.g., insulator-metal (I-M) transitions, half-metallicity, and spin-charge separation. The essential feature that characterizes these materials is that their electronic properties cannot be described effectively in terms of non-interacting approaches. The extended Hubbard model (EHM) is one of the simplest models that captures the interplay between strong correlations and the charge-ordering effects [1-5] and it can describe the I-M transition between phases with the long-range charge-order of various types (e.g., checker-board, stripes, phase separations) [1-3]. This phenomenon is associated with the inhomogeneous spatial distribution of electrons and it can be observed experimentally in many systems, e.g., manganites, cuprates, magnetite, doped transition metal compounds, heavy-fermion systems and organic compounds. In the present presentation, after a general introduction, we will focus on the extended Falicov-Kimball model (EFKM) [4,5], which is a simplified version of the EHM, where only electrons with, e.g., spin down are itinerant and the other are localized. Because this model has a quite complex phase diagram with variety of ordered and non-ordered phases (which can be conducting or insulating), it is a good example for investigation of the correlation-driven I-M transition. It is also worth emphasizing that, for the EFKM, one can obtain analytical and rigorous (in the limit of large dimensions) results, what is not a very common feature of other strongly interacting fermionic systems.

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