Charge orderings, superconductivity and phase separations in a zero-bandwidth extended Hubbard model

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9.7 cm

A simple effective model of charge ordered insulators and superconducting systems with very short coherence length is studied. The tight binding Hamiltonian consists of the effective on-site interaction U, the intersite density - density interaction W_{ij} (both: nearest - neighbor (nn) and next - nearest - neighbor (nnn) and the intersite charge exchange term I_{ij}, determining hopping of electron pairs. In the analysis of the phase diagrams and thermodynamic properties of this model we have adopted the variational approach, which treats the on-site interaction term exactly and the intersite interactions (W_{ij} and I_{ij}) within the mean - field approximation. Within such an approach, only the particular cases, (i) $U - W_{ij}$ ($I_{ij} = 0$, W_{ij} restricted to nn) and (ii) $U - I_{ij}$ ($W_{ij} = 0$), have been studied till now. Moreover, the phase separated (PS) states have not been taken into account in those analyses.

Our investigation of the general case shows that, depending on the values of interaction parameters and electron concentration n, the system can exhibit not only several homogeneous phases: charge ordered (CO), superconducting (SS), mixed (SS/CO), nonordered (NO), but also various phase separated states (CO - NO, CO - SS, particle droplets, etc). We will also present some rigorous results obtained for the ground state at $n = 1$ and point out the effects of intersite magnetic exchange interactions on the phase diagrams for $0 < n < 2$ and $U \to \infty$.

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