

MONTE CARLO STUDY OF THE TWO-DIMENSIONAL MODEL OF SEMI-HARD-CORE BOSONS

V.A. Ulitko, Y.D. Panov

Ural Federal University, 620002 Ekaterinburg, Russia

vasiliy.ulitko@urfu.ru

We consider a model of charged semi-hard-core bosons [1] on a square lattice with a possible occupation number $n_i = 0, 1, 2$ at each node. The model Hamiltonian includes local (Δ) and interstitial (V) charge correlations and also transfer of boson pairs between neighboring nodes (t). In work [2] we used mean field approximation (MFA) method and showed that the following phase states can be realized: a charge ordering (CO), a superfluid phase (SF) and phase separation (PS).

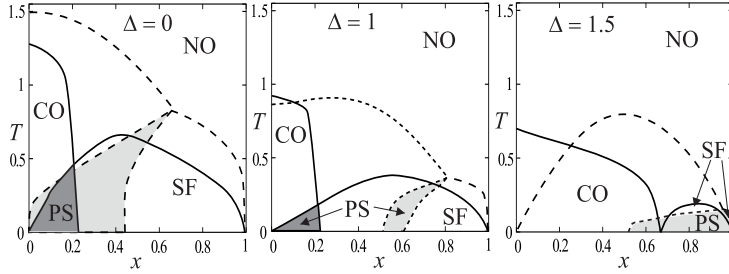


Figure 1: Temperature phase diagrams for the value $V/t = 0.75$. The dark (light) shaded area corresponds to the PS phase obtained by the SGF(MFA) method. The solid and dotted lines indicate the critical temperatures obtained by the SGF and MFA methods, respectively. Here x is the deviation of the boson concentration from half filling.

In this work phase diagrams of the model were obtained using the quantum Monte Carlo method (QMC). The general trend is the suppression of CO and SF phases with increasing Δ . Additionally, the proportion of the SF phase on the diagram is higher in the SGF method than in MFA. Meanwhile, the position of the tricritical point in SGF is always at lower values of x . We explain this by the fact that the consideration of quantum fluctuations reduces the kinetic energy of the system, making the SF phase more favorable.

References

- [1] A. S. Moskvina, *Pseudospin $S = 1$ formalism and skyrmion-like excitations in the three-body constrained extended Bose-Hubbard model*, Journal of Experimental and Theoretical Physics **V. 121**, 477(2015).
- [2] Yu. D. Panov, *Critical Temperatures of a Model Cuprate*, Physics of Metals and Metallography, **V. 120**, 1276(2019).