

Effect of Dominant Three-body Interaction in Two-dimensional Square Lattice

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The effect of dominant three-body interaction to hard-core boson Hubbard model¹ is studied on a two-dimensional square lattice. In terms of quantum Monte Carlo method², it is shown explicitly a $\rho = 2/3$ solid phase with coexistence of charge-density-wave and bond orders appears due to the presence of the dominant three-body interaction. For strong three-body interaction, the $\rho = 2/3$ solid phase appears between superfluid phases and shrinks as decreasing the strength of the three-body interaction, forming a lobe structure in the phase diagram. For weak three-body interactions, superfluid phase exists for the whole range of hard-core densities except the full filled case, where the system is a Mott insulator.

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²A. W. Sandvik and J. Kurkijarvi, Phys. Rev. B **43**, 5950 (1991); Huaiming Guo, Yuchuan Wen, and Shiping Feng, Phys. Rev. A **79**, 035401 (2009).