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Supersolid 4He at Low Temperature HUAI-BIN ZHUANG, XI DAI, MICHAEL MA, FU-CHUN ZHANG, The University of Hong Kong — The observation of NCRI in solid He reported by Kim and Chan reignited interests in the existence of supersolid in nature. Though plenty of theories assume that the mechanism of the supersolid is BEC of point defects, namely vacancies and interstitials, some theories and experiments suggest that the defects cannot exist in solid He at zero temperature. Dai et al in our group proposed a solution to the quandary by introducing a low-energy bound state, called exciton, of a vacancy and an interstitial so that it is possible to have vacancy (interstitial) superfluid phase in solid He despite the high activation energy of defects in normal solid. In addition to the previous single-site meanfield treatment to the two-band Bose Hubbard model, we further retain adequate quantum fluctuations and correlations by employing a spin XY model with 'annealed vacancies' and resolving it in three-dimensional simple cubic lattice by a modified spin-wave method. We show that the supersolid phase could be favored at low temperature because of its gapless energy excitations, and that even on the zero-temperature normal solid side a 'reentrance' would occur. The results are strongly recommended by the zero-temperature exact solution and the finite-temperature mean-field outcomes from Jordan-Wigner transformation in one dimension. The method utilized could be further applicable to models dealing with spin systems, cold atoms in optical lattices and others.

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