Energy Spectrum of Ground State and Excitation Spectrum of Quasi-particle for Hard-Core Boson in Optical Lattices

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(Received: 2005-3-15; Revised:)

Abstract: We investigate the energy spectrum of ground state and quasi-particle excitation spectrum of hard-core bosons, which behave very much like spinless noninteracting fermions, in optical lattices by means of the perturbation expansion and Bogoliubov approach. The results show that the energy spectrum has a single band structure, and the energy is lower near zero momentum; the excitation spectrum gives corresponding energy gap, and the system is in Mott-insulating state at Tonks limit. The analytic result of energy spectrum is in good agreement with that calculated in terms of Green's function at strong correlation limit.

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