

Abstract Submitted
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Bose-Einstein condensation and superfluidity in optical lattices and periodic porous media; a path integral Monte Carlo study ALI SHAMS, HENRY GLYDE, University of Delaware — We evaluate the Bose-Einstein condensate density and the superfluid fraction of bosons in a periodic external potential using Path-Integral Monte Carlo (PIMC) methods. A unit cell containing a potential well is replicated into a lattice along 1D using periodic boundary conditions. The aim is to describe bosons in a 1D optical lattice or helium confined in a periodic porous medium. The One-Body Density Matrix (OBDM) is evaluated and diagonalized to obtain the single boson natural orbitals (e.g. the condensate orbital) and the occupation of these orbitals (e.g. the condensate fraction). The superfluid density is obtained from the winding number. We investigate (1) the impact of the periodic external potential on the spatial distribution of the condensate, and (2) the correlation between localizing the condensate into separated parts and the loss of superflow along the lattice. For strongly interaction Bosons, as the well depth increases, the condensate becomes depleted in the wells (depletion by interaction). For weakly interacting bosons, as the well depth increases, the BEC is localized at the center of the wells (tight binding). In both cases, the localization of the condensate suppresses superflow leading to a superfluid-insulator cross-over. The temperature dependence is investigated and comparison with Hubbard models and experiment is made.

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