

Bose–Einstein condensation of hard-core bosons in flat bands

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Bose–Einstein condensation (BEC) in flat bands has recently attracted significant attention due to the emergence of features absent in single-band lattice condensates [1]. So far, most studies have focused on weakly interacting BECs, where interactions determine the geometric and collective properties[2].

In this work, we investigate the opposite regime of strongly interacting bosons in a multiband lattice with a hard-core constraint. First, we employ a variational ansatz to obtain the mean-field ground state of the condensate. Second, we analyze the collective excitations within the Holstein–Primakoff approximation. Finally, we characterize the geometric properties by projecting the condensate onto the lowest band. Our results demonstrate that the characterization of quantum geometry in quantum gases is not restricted to weakly interacting BECs, but extends naturally to the strongly interacting regime.

[1] A. Julku, G. M. Bruun, and P. Törmä, *Phys. Rev. B* **104**, 144507 (2021).

[2] A. Julku, G. M. Bruun, and P. Törmä, *Phys. Rev. Lett.* **127**, 170404 (2021).

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