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**Multiband effects in one-dimensional bosons in optical lattices**

WEI XU, MARCOS RIGOL, Department of Physics, The Pennsylvania State University, University Park, PA 16802, USA — We use path integral quantum Monte Carlo simulations to study quantum phase transitions of ultracold bosons in optical lattices. We restrict our study to one-dimensional systems where, in the absence of the lattice, we recover analytic results for the Lieb-Liniger model. The latter is the model that describes one-dimensional bosons with contact interactions. We first discuss how cold finite systems need to be in order for one to observe ground state physics. We then show that, in shallow lattice potentials, higher Bloch bands lead to renormalized two-body interactions. We present a study the phase diagram of these systems at intermediate interaction strengths in shallow lattice potentials, and report a detailed comparison with the phase diagram of the one-band Bose-Hubbard model.

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