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Finite-size effects and entanglement in ultracold atoms on optical lattices[1] L. D. CARR[2,3], R. C. BROWN[2,3], D. G. SCHIRMER[2,3], R. V. MISHMASH[2], S. P. SANTOS[2], [2]Physics Department, Colorado School of Mines, Golden, CO 80401, USA, I. DANSHITA[3], J. E. WILLIAMS[3], CHARLES W. CLARK[3], [3]Electron and Optical Physics Division, National Institute of Standards and Technology, Gaithersburg, Maryland 20899, USA — We study finite size effects in the phase diagrams of a number of Fermi-, Bose-, and Fermi-Bose-Hubbard Hamiltonians relevant to ultracold atoms in one dimension. Both exact numerical solutions and approximations via Vidal's algorithm (Time Evolving Block Decimation) are utilized. We characterize excited states by their entanglement, in particular comparing three entanglement measures: the entropy of entanglement, Meyer's Q-measure, and the Schmidt number. We show that the phase diagrams and the entanglement structure of excited eigenstates as a function of the Hamiltonian parameters depends strongly on the number of sites and the dimensionality of on-site Hilbert space. These results are vital for experiments on small systems, as they differ greatly from what is found in the thermodynamic limit.

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