Abstract Submitted
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Renormalization of Bose-Hubbard Parameters from Few Body Correlations of Cold Atoms[1] NIKHIL MONGA, School of Earth and Space Exploration, Arizona State University, JOHN SHUMWAY, Dept. of Physics, Arizona State University, KADEN HAZZARD, JILA, NIST and Dept. of Physics, CU Boulder, ERICH MUELLER, Laboratory of Atomic and Solid State Physics, Cornell University, STEVEN DESCH, School of Earth and Space Exploration, Arizona State University — Cold atoms in an optical lattices can be a nearly ideal physical realization of a Bose-Hubbard model. However, the effective lattice-model parameters t and J are significantly renormalized by quantum correlations of the atoms, and this renormalization can depend on the site occupations. This occurs because interactions populate low energy states not explicitly present in the Bose-Hubbard model. We use path integral quantum Monte Carlo (PI-QMC) to calculate the effective matrix element, t_{mn}, for a bosonic atom to hop from a site with m atoms to a neighbor site with n atoms. We consider systems of up to five bosonic atoms on two sites. For the simple case of two atoms on two sites, the imaginary-time exchange frequency and double-occupation probability uniquely determine t and U. For more particles, we extend our analysis to dynamics correlations of the site-occupation numbers, $\langle P_{mn}(\tau)P_{m'n'}(0)\rangle$, which are calculated by PI-QMC and compared with Bose-Hubbard correlations to infer the renormalized parameters. Unlike the present state-of-art determinations of these renormalizations, which use exact diagonalization for two-particles, our Monte Carlo approach is efficient for renormalizations arising from much larger numbers of atoms.

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