Abstract Submitted
for the DAMOP15 Meeting of
The American Physical Society

Effective three-body interaction in an asymmetric double-well optical lattice SAURABH PAUL, Joint Quantum Institute, University of Maryland, College Park, EITE TIESINGA, Joint Quantum Institute, National Institute of Standards and Technology and University of Maryland, Gaithersburg — We study ultracold atoms in a double-well optical lattice, with a view to creating an effective Hamiltonian that has large three-body interaction energy. The lattice has an asymmetric double-well geometry along the x axis and single wells along the perpendicular axes. We obtain tunneling and two-body interaction energies using numerically constructed Wannier functions from an exact band structure calculation. This gives a Bose-Hubbard (BH) Hamiltonian spanning the lowest two bands along the x axis, and the ground band along the perpendicular axes. We then obtain the many-particle (MP) states, $|\nu, N\rangle$, where $N(\leq 3)$ is the particle number per site, and $\nu \in \{1, N+1\}$, by diagonalizing the on-site BH Hamiltonian in the particle number basis. Starting with the ground MP states, we show that tunneling is predominantly confined to the ground state in each N sector. We thus create an effective Hamiltonian (H_{eff}) in the ground MP states, and show that H_{eff} has large three-body interaction energy (Γ_3), comparable to or larger than the two-body term (Γ_2). The ratio Γ_3/Γ_2 can be tuned by changing the lattice parameters. We are now investigating the possibility of having unique many-body ground states for such systems.

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Date submitted: 29 Jan 2015 Electronic form version 1.4