Abstract Submitted
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Shaken Lattice Interferometry[1] CARRIE WEIDNER, HOON YU, DANA ANDERSON, JILA, NIST, and Deptartment of Physics, University of Colorado at Boulder — This work introduces a method to perform interferometry using atoms trapped in an optical lattice. Starting at $t = 0$ with atoms in the ground state of a lattice potential $V(x) = V_0 \cos[2kx + \phi(t)]$, we show that it is possible to transform from one atomic wavefunction to another by a prescribed shaking of the lattice, i.e., by an appropriately tailored time-dependent phase shift $\phi(t)$. In particular, the standard interferometer sequence of beam splitting, propagation, reflection, reverse propagation, and recombination can be achieved via a set of phase modulation operations $\{\phi_j(t)\}$. Each $\phi_j(t)$ is determined using a learning algorithm, and the split-step method calculates the wavefunction dynamics. We have numerically demonstrated an interferometer in which the shaken wavefunctions match the target states to better than 1%. We carried out learning using a genetic algorithm [1] and optimal control techniques [2]. The atoms remain trapped in the lattice throughout the full interferometer sequence. Thus, the approach may be suitable for use in an dynamic environment. In addition to the general principles, we discuss aspects of the experimental implementation.

[1] Pötting, S, et.al. PRA 64, 063613, (2001)
[2] Palao, J.P, et.al. PRA 77, 063412, (2009)

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