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Rapid coherent control of population transfer in lattice systems
SHUMPEI MASUDA, STUART RICE, The James Franck Institute, The University of Chicago — During the last three decades there have been dramatic advances in understanding of the requirements for control of quantum dynamics. Lattice models are widely used to describe quantum systems, examples of which are a BEC in an optical lattice, a network of nonlinear waveguides and optical fibers, etc. The existing studies clearly reveal the value of the ability to manipulate BECs in optical lattices for the purpose of preparing well-defined quantum states. We have been stimulated by this observation to extend the theory of accelerated adiabatic transfer to lattice systems so as to determine the potential that drives specified state-to-state population transfer without excitation of unwanted quantum states. In this talk we provide a derivation of that driving potential, and we apply the theory to site-to-site population transfer of a BEC in a quasi-one-dimensional optical lattice. We show that modulation of the lattice potential can transfer the population of the BEC between sites of the lattice without unwanted excitations. The theory is applicable to any lattice in which the on-site potential is tunable. We also demonstrate the robustness of the accelerated population transfer to approximation of the driving potential.

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