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Adiabatic Quantum Transport of Bosonic Atoms in Double Well Optical Lattices[1] YINYIN QIAN, CHUANWEI ZHANG, Department of Physics and Astronomy, Washington State University, Pullman, Washington, 99164 USA — Quantum charge pump, where the amount of pumped charges is controlled precisely through the quantized adiabatic charge transport in periodic crystals, has many important applications in electronics. The quantum pump of cold neutral atoms may play a similar significant role in atomtronics. Neutral atoms can be bosons, and their transport properties can be very different from electrons (fermions). We study the adiabatic quantum transport of bosonic atoms in double well optical lattices where the lattice parameters are adiabatically and periodically tuned. The effects of the interaction between atoms on the transport properties are characterized. In the strong interacting regime, the bosonic atoms behave similarly as fermions with quantized atom transport. In the weak interacting regime, the atom transport depends strongly on the paths in the lattice parameter space and the quantized transport may be destroyed. The effects of harmonic traps and disorder potentials are also studied. The investigation is based on the numerical simulation of the exact quantum dynamics of cold atoms in double well optical lattices using the time evolving block decimation algorithm.

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