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Controllable Transport of Ultra-Cold Atoms in 1D Optical Lattices with Uniform Peierls Substitution[1] CHIH-CHUN CHIEN, Los Alamos National Laboratory, MASSIMILIANO DI VENTRA, University of California, San Diego — We show that the recently developed optical lattices with Peierls substitution (PRL 108, 225303 and 225304 (2012)) – which can be modeled as a lattice with a complex tunneling coefficient – may be used to induce quantum transport of ultracold atoms. In particular, we show that by ramping up the phase of the complex tunneling coefficient in a spatially uniform fashion, a finite quasi steady-state current (QSSC) ensues from the exact dynamics of non-interacting fermions. The direction and magnitude of the current can be controlled by the overall phase difference but not the details of the ramp. The entanglement entropy does not increase when the QSSC lasts. Due to different spin statistics, condensed non-interacting bosons do not support a finite QSSC under the same setup. We also find that an approximate form of the QSSC survives when perturbative effects from interactions, weak harmonic background traps, and temperature are present, which suggests that our findings should be observable with available experimental capabilities. Our study could be useful in developing novel devices in the thriving field of atomtronics.

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