

Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

Topological charge pumping in a one-dimensional optical lattice

LEI WANG, MATTHIAS TROYER, Theoretische Physik, ETH Zurich, XI DAI, Beijing National Lab for Condensed Matter Physics and Institute of Physics, Chinese Academy of Sciences — A topological charge pump transfers charge in a quantized fashion. The quantization is stable against the detailed form of the pumping protocols and external noises. Such a quantum pump shares the same topological origin as the quantum Hall effect. We propose an experiment setup to realize the topological charge pumping of cold atoms in a one-dimensional optical lattice. The quantization of the pumped charge is confirmed by first-principle simulations of the dynamics of uniform and trapped systems. Quantum effects are shown to be crucial for the topological protection of the charge quantization. Finite-temperature and non-adiabatic effect on the experimental observables are discussed. Realization of such a topological charge pump serves as a firm step towards exploring topological nontrivial phases and non-equilibrium dynamics using cold atoms.

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Date submitted: 29 Oct 2012

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