Optical Ladder Lattices With Tunable Flux

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Ultracold atoms in optical lattices provide clean and tunable systems to realize many-body quantum physics. They can be used to simulate a variety of effects ranging from superconductivity and superfluidity to novel phases of matter [1]. Particles trapped in an optical lattice are neutral so the Lorentz force does not affect them. A workaround resolving this issue is the introduction of an artificial gauge field that generates magnetic flux. It can be created by using laser assisted tunneling [2] and periodic driving schemes [3]. This also allows to realize a stronger magnetic flux per lattice plaquette than typically available in solid state experiments.

In this work, we propose a driving scheme for a quasi-one dimensional ladder lattice that induces a tunable artificial magnetic flux through the lattice plaquettes. By manipulating the shaking phase for each individual site, this flux can be made inhomogeneous in space. It allows us to explore the dynamics and control capabilities of an atomic wave-packet propagating in such a lattice.

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[2] M. Aidelsburger et al., Phys. Rev. Lett. **107**, 255301 (2011).

[3] A. Eckardt, Rev. Mod. Phys. **89**, 011004 (2017).