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Gauge Field Induced Momentum Transport in an Optical Lattice PATRICK WINDPASSINGER, JULIAN STRUCK, MALTE WEINBERG, CHRISTOPH OELSCHLAEGER, JULIETTE SIMONET, KLAUS SENGSTOCK, Institute of Laser Physics, University of Hamburg, QUANTUM GASES TEAM — We present the experimental realization of a widely tuneable artificial gauge field for ultracold atoms in a one-dimensional optical lattice. We can simulate any Peierls phase ranging from zero to 2π in the tunneling matrix elements between nearest neighbours by applying an external periodic force to the atoms which is time-irreversible. This way it is possible to prepare ground state superfluids as well as out-of-equilibrium states at arbitrary, finite quasi momentum. We investigate the different time scales for adiabatic transport and relaxations mechanisms in the momentum space of the lattice. Extending these ideas to two-dimensional non-rectangular optical lattices it is possible to realize staggered magnetic field configurations with very large fluxes per plaquette. These results present a new step towards the emulation of strong field physics in optical lattices which may result in the realization of exotic phases like quantum hall states and other topological ordered phases with ultracold atoms.

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