
Observation of Extrinsic Topological Phases in Floquet Photonic Lattices

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Abstract

Discrete-step walks describe the dynamics of particles in a lattice subject to hopping or splitting events at discrete times. Despite being of primordial interest to the physics of quantum walks, the topological properties arising from their discrete-step nature have been hardly explored. Here we report the observation of topological phases unique to discrete-step walks. We use light pulses in a double-fiber ring setup whose dynamics maps into a two-dimensional lattice subject to discrete splitting events. We show that the number of edge states is not simply described by the bulk invariants of the lattice (i.e., the Chern number and the Floquet winding number) as would be the case in static lattices and in lattices subject to smooth modulations. The number of edge states is also determined by a topological invariant associated to the discrete-step unitary operators acting at the edges of the lattice. This situation goes beyond the usual bulk-edge correspondence and allows manipulating the number of edge states without the need to go through a gap closing transition. This work opens new perspectives for the engineering of topological modes for particles subject to quantum walks.

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