

Emergence of topological pumping in atom-light interaction

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Pumps are transport mechanisms in which directed currents result from a cycling evolution of the potential. Thouless pointed out that pumping can have topological origin when considering the motion of quantum particles in spatially and temporally periodic potentials. We have discovered an emergent mechanism for geometric pumping in a quantum gas coupled to an optical resonator, where we observe a particle current without applying a periodic drive. The pumping potential experienced by the atoms is formed by the self-consistent cavity field interfering with the static laser field driving the atoms [Dreon et al., *Nature*, 608, 494 (2022)].

The fate of topological transport in the strongly correlated regime raises fundamental questions on the role of geometry in quantum many-body physics. We have studied topological transport in the regime of strong Hubbard interactions in a fermionic Thouless pump, facilitated by a dynamical optical superlattice. We observed a break-down of topological pumping for strong repulsive interactions. [Walter et al., arXiv:2204.06561]. Long-distance topological pumping in harmonic confining potential reveals the presence of an interaction-induced topological boundary [Zhu et al., arXiv:2301.03583]