Observation of momentum-space chiral edge currents in room-temperature atoms

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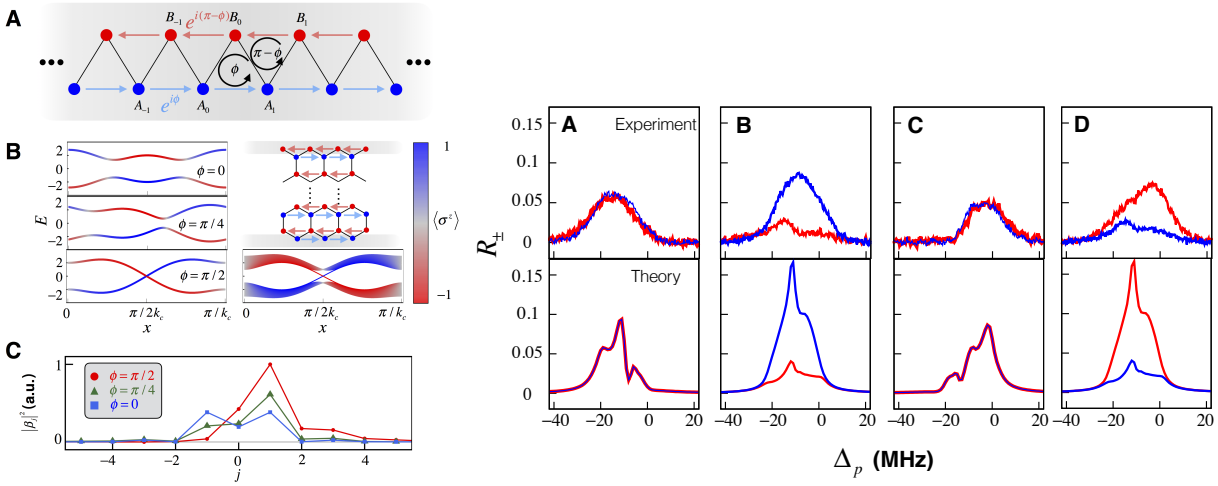
Chiral edge currents play an important role in characterizing topological matter. In atoms, they have been observed at such a low temperature that the atomic motion can be measured [1]. Here we report the first experimental observation of chiral edge currents in atoms at room temperature. Staggered magnetic fluxes are induced by the spatial phase difference between two standing-wave light fields (Left figure), which couple atoms to form a momentum-space zigzag superradiance lattice [2]. The chiral edge currents have been measured by comparing the directional superradiant emissions of two timed Dicke states in the lattice. The results can be explained by the topological phase diagram of an extended two-dimensional Haldane model (Right figure). This work paves the way for quantum simulation of topological matter with hot atoms and facilitates the application of topological physics in real devices.



Left: The lattice (A), band structure (B) and probability distribution under pumping (C).
Right: The probabilities of two timed Dicke states when $\phi = 0$ (A), $\pi/2$ (B), π (C), $3\pi/2$ (D).

[1] Mancini et al, Science 349, 1510 (2015); Stuhl et al, Science 349 1514 (2015).

[2] Wang et al, PRL 114, 043602 (2015). Optica 2, 712 (2015).