Observation of non-Hermitian skin effect in a two-dimensional ultracold Fermi gas

Non-Hermitian concept has generalized the notion of band topology with associated exceptional points (EPs), also known as the parity-time symmetry breaking points, leading to the counter-intuitive phenomena. Non-Hermitian skin effect, involving the accumulation of eigenstates at the boundary, is one such circumstance, but its realization in a high dimensional quantum system remains unexplored. Here, we report the realization of a two-dimensional non-Hermitian topological band with ultracold fermions by combining spin-orbit-coupled optical lattices with tunable dissipation. In this platform, a pair of EPs are created in the band structure, connected to each other by an open-ended bulk Fermi arc, in contrast to the contours with closed loops in Hermitian systems. The associated EPs emerge and shift with increasing dissipation, leading to the formation of Fermi arc. Strikingly, evidence from the direct measurement of spectral topology in the complex energy plane indicates the existence of 2D skin effect in the reciprocal lattice system. Our work would shed a light on the connection between two distinct phenomena that only exist in non-Hermitian systems, i.e., the exceptional degeneracies and the non-Hermitian skin effect in high dimensions.

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