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Making braids in non-Hermitian photonic systems

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The nontrivial topological features in non-Hermitian systems provide promising pathways to achieve robust physical behaviors in classical or quantum open systems. Recent theoretical work discovered that the braid group characterizes the topology of non-Hermitian periodic systems.
In this talk, I will show our experimental demonstrations of the topological braiding of non-Hermitian band energies, achieved by implementing non-Hermitian lattice Hamiltonians along a frequency synthetic dimension formed in coupled ring resonators undergoing simultaneous phase and amplitude modulations. With two or more non-Hermitian bands, the system can be topologically classified by nontrivial braid groups. We demonstrated such braid-group topology with two energy bands braiding around each other, forming nontrivial knots or links. I will also show how such braid-group topology can be theoretically generalized to two and three dimensions. Furthermore, I will also show how such non-Hermitian topology can manifest in the dynamical matrices describing bosonic quadratic systems associated with the squeezing of light, where our latest results reveal a highly intricate non-Hermitian degeneracy structure that can be classified as the Swallowtail catastrophe.

Keyword-1

Topological photonics

Keyword-2

Quantum photonics

Keyword-3

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