Canadian Association of Physicists
Association canadienne des physiciens et physiciennes

Contribution ID: **4321** Type: **Invited Speaker / Conférencier(ère) invité(e)**

Making braids in non-Hermitian photonic systems

Tuesday 28 May 2024 10:30 (30 minutes)

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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Session Classification: (DCMMP) T1-7 Light Matter Interaction | Interaction lumière-matière (DPMCM)

Track Classification: Technical Sessions / Sessions techniques: Condensed Matter and Materials Physics / Physique de la matière condensée et matériaux (DCMMP-DPMCM)