Exploring Multiband Topology in Exciton-Polariton Lattices

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Abstract

Exciton-polaritons, hybrid quasiparticles arising from the strong coupling between excitons and photons, offer a versatile platform to explore topological physics. Theirblight-matter nature allows for engineering topological bands, topological lasers, topological solitons.,, In this presentation, I will report on recent progress in the experimental investigation of multiband topology in exciton-polariton lattices.

Building upon earlier studies on two-band systems, we have implemented a generalized tomography technique that reconstructs the full Bloch eigenstate structure across the Brillouin zone for lattices with an arbitrary number of bands. This method relies on k-space interferometric measurements combined with controlled phase modulations between sub-orbitals, enabling us to extract the full Stokes vector for each Bloch mode. Applied to polariton honeycomb lattices (see Fig. 1) incorporating multiple orbitals and/or polarization-dependent effects, our approach allows the measurement of the Berry curvature and quantum geometric tensor of each band. We demonstrate this technique on a honeycomb lattices featuring up to six bands, and reveal clear signatures of topology beyond the
two-band paradigm.

Our work highlights the potential of exciton-polariton lattices as a testbed for exploring multiband topological effects in a highly tunable photonic platform, and paves the way for accessing more exotic phenomena, such as non-Abelian topology in driven photonic systems.

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