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Quantum transport properties in topological photonics

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Robust transport of topological edge states has been experimentally demonstrated in photonic systems at microwave frequencies and optical frequencies, specifically in coupled waveguides and ring resonators. Subsequent works measured the topological invariants associated with these photonic systems. In this talk, we extend these ideas to investigate quantum transport properties of light. Specifically, we demonstrate that all-dielectric photonic crystals could exhibit similar topological physics, where two-dimensional edge states are confined by total internal reflection, enabling low-loss confinement of light in the third dimension. This structure addresses the challenge of experimental realization of topological photonic crystals in the optical domain and enables strong interactions with optical emitters. Moreover, we investigate quantum effects such as the transport of two-photon states and robust generation of photon pairs in such on-chip topological photonic devices.