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Topological quantum states of light in coupled microwave cavities

RUICHAO MA, JOHN C OWEN, AMAN LACHAPELLE, TAEKWAN YOON, DAVID SCHUSTER, JONATHAN SIMON, University of Chicago — We present a unique photonic platform to explore quantum many-body phenomena in coupled cavity arrays. We create tight binding lattices with arrays of evanescently coupled three-dimensional coaxial microwave cavities. Topologically non-trivial band structures are engineered by utilizing the chiral coupling of the cavity modes to ferrite spheres in a magnetic field. We develop robust, minimal methods to completely characterize the tight-binding Hamiltonian, including all onsite disorder, tunnel coupling, local dissipation and effective flux, using only spectroscopic measurement on specific sites. These efforts pave the way to realize low-disorder, long-coherence, topological tight binding models, where the many-body states can be spectroscopically driven and probed in temporally- and spatially- resolved measurements. Using techniques from circuit QED, effective onsite photon-photon interactions may be introduced by coupling to superconducting qubits. This will allow us to explore the interplay between topology and coherent interaction in these artificial strongly-correlated photonic quantum materials.

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