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Fractional Quantum Hall Physics with Photons NINGYUAN JIA, Univ of Chicago, NATHAN SCHINE, The University of Chicago, ALEXANDROS GEORGAKOPOULOS, ALBERT RYOU, CLAIRE BAUM, LOGAN W. CLARK, ARIEL SOMMER, JONATHAN SIMON, Univ of Chicago — Understanding and manipulating quantum materials is a long sought goal in both the condensed matter and cold atom communities. Rydberg polaritons have recently emerged as a good candidate for studying quantum many-body states due to their fast dynamics and convenient manipulation. Indeed, synthetic magnetic fields and nontrivial topology for photons have been realized using non-planar resonators. Moreover, Rydberg mediated interactions enable photons to collide with each other on a single quantum level. We have used these interactions to realize a polaritonic quantum dot in a single cavity mode. By manipulating the atomic state to couple with multiple cavity modes simultaneously, we explore the collisions of polaritons between modes. Finally, we discuss our latest work on combining all of these capabilities to prepare and characterize few photon Laughlin states. This work points the way to exploring topological quantum materials comprised of Rydberg polaritons.

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