Abstract Submitted
for the DAMOP18 Meeting of
The American Physical Society

Growing of quantum Hall states for Rydberg cavity polaritons
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— Recently, the creation of photonic Landau levels in a twisted cavity has been demonstrated in Nature 534, 671 (2016). Here we propose a scheme to adiabatically transfer flux quanta in multiples of $3\hbar$ simultaneously to all cavity photons by coupling the photons through flux-threaded cones present in such cavity setup. The flux transfer is achieved using external light fields with orbital angular momentum and a near-resonant dense atomic medium as a mediator. Furthermore, coupling the cavity fields to a Rydberg state in a configuration supporting electromagnetically induced transparency, fractional quantum Hall states can be prepared. To this end a growing protocol is used consisting of a sequence of flux insertion and subsequent single-photon insertion. We discuss specifically the growing of the bosonic Laughlin state with filling 1/2, where we first repeat the flux insertion twice creating a two quasi-hole excitation. Then, the hole is refilled with exactly one photon using a coherent pump and the Rydberg blockade.

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Date submitted: 25 Jan 2018 Electronic form version 1.4