Abstract Submitted
for the DAMOP12 Meeting of
The American Physical Society

Fractional Quantum Hall Effect of lossy Rydberg Dark-State Polaritons FABIAN GRUSDT, MICHAEL FLEISCHHAUER, MICHAEL HÖNING, Department of Physics and Research Center OPTIMAS, TU Kaiserslautern, Germany, JOHANNES OTTERBACH, Harvard Quantum Optics Center, Harvard University, Cambridge, Massachusetts, USA — Dark-state-polaritons (DSP) are bosonic quasiparticles arising in the interaction of light with 3-level atoms under conditions of electromagnetically induced transparency (EIT). When exposed to a strong artificial magnetic field, they can enter the lowest Landau level regime. With additional long range interactions, as realized e.g. when the 3-level atom contains a Rydberg-excited state, DSPs are natural candidates for a realization of the bosonic fractional quantum Hall effect. Besides their high controllability, they offer the possibility to examine open quantum Hall systems. We show how highly-correlated quantum Hall states of DSPs can be prepared, making use of nonlinear polariton losses. The possibility of realizing these states as stationary states of open systems is investigated. We propose a realistic quantum-optical setup, and show that different fractional quantum Hall states can be prepared, manipulated and observed. Numerical and analytical results for the excitation gaps of the $\nu = 1/2p$ Laughlin states are presented.

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Date submitted: 27 Jan 2012 Electronic form version 1.4