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Interacting Rydberg atoms in an optical cavity to synthesize coherent collective states using dipole blockade[1] SANTOSH KUMAR, JITENG SHENG, JONATHON SEDLACEK, CHARLIE EWEL, HAOQUAN FAN, JAMES SHAFFER, University of Oklahoma — We investigate the coherent manipulation of interacting Rydberg atoms placed inside a high-finesse optical cavity for the preparation of strongly coupled light-matter systems. We consider a four-level diamond scheme with one common Rydberg level. One side of the diamond is used to collectively excite the atoms to the Rydberg level using a pair of pulses. The other side of the diamond is used to produce a collective state that is close to resonance with a field mode of a high-finesse optical cavity. The interaction between Rydberg atoms creates a blockade which is useful for synthesizing the coherent collective state. We use numerical simulation to generate non-classical states of light and also investigate different decay mechanisms affecting this system. We also analyze our system in the case of two Rydberg excitations within the blockade volume. In this case, we show that more elaborate few excitation quantum states can be prepared in the cavity to observe interesting dynamics and analyze the correlation of the two-photon emission.

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