Abstract Submitted
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Atomic excitation with propagating light pulse and quantum memory with a half cavity[1] YIMIN WANG, JIŘÍ MINÁŘ, VALERIO SCARANI, Centre for Quantum Technologies, National University of Singapore, Singapore, GABRIEL HÉTET, Institute for Experimental Physics, University of Innsbruck, Austria — State mapping between atoms and photons and photon-photon interactions play an key role in scalable quantum information processing. First, we consider the interaction of a single atom with a quantized light pulse propagating in free space. We show the dependence of the atomic excitation on (i) the quantum state of the pulse and (ii) the overlap between the pulse waveform and the atomic dipole pattern. We present a detailed study for both n-photon Fock state and coherent state pulses with various temporal shapes. The work is extended to the dynamics of two spatial modes propagating from opposite directions to the atom. Second, we propose a setup for quantum memory based on a single two-level atom in a half cavity with a moving mirror. We show that various temporal shapes of incident photon can be efficiently stored and readout by shaping the time-dependent decay rate $\gamma(t)$ describing the interaction between the atom and the light. We present an analytical expression for the efficiency of the storage and study its dependence on the ratio between the incident light field bandwidth and the atomic decay rate. We discuss possible implementations and experimental issues, particularly for a single atom or ion in a half cavity as well as a superconducting qubit in the circuit QED.

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