Abstract Submitted
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Dispersive Interactions for Strong Atom-Photon Coupling in a Guided Nanophotonic Fiber Geometry[1] XIAODONG QI, BEN BARAGIOLA, University of New Mexico, POUL JESSEN, University of Arizona, IVAN DEUTSCH, University of New Mexico — Nanophotonic systems offer a robust geometry to achieve a strong interaction between guided photons and trapped cold atoms in one dimension. We analyze the tensor interaction of atoms and quantized modes of the electromagnetic field in the presence of a guiding nanophotonic optical fiber, using both a dyadic Green function method and a Heisenberg-picture input-output formalism. When detuned from resonance, the tensor linear response yields phase shifts and polarization transformations conditional on the atomic spin. Such interactions can lead to strong entanglement between the collective atomic spin and the guided photonic modes, even in a regime where the Purcell factor for enhanced spontaneous emission into the guided mode is not large. We apply this to study QND measurement-induced squeezing of the pseudospin associated with the clock transition of atomic cesium, as well as squeezing of the physical atomic spin for applications in magnetometry. In both cases, we find one can achieve several dB squeezing with a few thousands atoms.

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