Abstract Submitted
for the DAMOP20 Meeting of
The American Physical Society

Light-Atom Interfaces from 10^9 to 10^14 Hz DAVID MEYER, US Army Research Laboratory, ZACHARY CASTILLO, University of Maryland, KEVIN COX, PAUL KUNZ, US Army Research Laboratory — The character of specific light-atom interactions is a critical aspect to nearly all quantum technologies, from sensors to simulators to memories and repeaters. We consider the design of this interface for two ongoing experiments in our lab: a Rydberg electric field sensor and a multiplexed quantum memory. Rydberg electric field sensors suffer in sensitivity from the limited coupling strength to free-space modes as compared to antenna-based sensors. We will present our progress at increasing this coupling by orders of magnitude, opening the door to truly quantum-optical regimes. Our cold-atom quantum memory experiment takes advantage of a unique ring-cavity design to achieve strong coupling. Furthermore, our system is able to write, store, and readout hundreds of holograms in our atoms. This unique combination of large multiplexing capacity with efficient strong coupling to a single optical mode enables a path to a functional quantum repeater.

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Date submitted: 30 Jan 2020 Electronic form version 1.4