Abstract Submitted
for the DAMOP20 Meeting of
The American Physical Society

Multiplexed Spin Waves in the Strong Coupling Regime PAUL KUNZ, Army Research Laboratory, ZACHARY CASTILLO, University of Maryland, DAVID MEYER, KEVIN COX, Army Research Laboratory — A broad challenge faced among all quantum technologies is: how to scale up usable entanglement, the critical resource underpinning quantum enhancement. We have developed an atom-cavity interface in which hundreds of spin waves can be individually created, stored, and readout with high efficiency through a strongly coupled single-mode cavity. An ensemble of one million laser-cooled atoms trapped within a ring cavity yields strong collective coupling (cooperativity of 300) with the TEM00 mode despite the moderate finesse (110). The atomic ensemble has large intrinsic memory capacity as excitations can be stored as spatially distributed phase patterns (spin waves), which can be read out efficiently thanks to collective constructive interference. We have completed an initial demonstration with four independent modes read out superradiantly through the cavity showing less than 10% crosstalk between the modes. This system could be well suited as a high capacity quantum repeater, or even a quantum simulator in which spin wave interactions are mediated via the cavity.

Paul Kunz
Army Research Laboratory

Date submitted: 03 Feb 2020 Electronic form version 1.4