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Performance of Atomic Ensemble-Cavity System for Long-Distance Entanglement Distribution KEVIN COX, Army Research Laboratory, DAVID MEYER, University of Maryland, PAUL KUNZ, Army Research Laboratory — A quantum repeater will be necessary for long-distance (>1000 km) quantum communication, and much progress has been made towards realizing such a device. Neutral atomic ensembles have shown particular promise as a repeater platform due their strength in terms of light-matter interface efficiency and coherence lifetimes. One remaining challenge is to improve the entanglement distribution rate between remotely located nodes. This rate has been primarily limited by the small probability for successfully writing to the relevant quantum memory mode, which must be kept low to avoid increased error rates. By spatially multiplexing the quantum memory this limitation can be alleviated. We are developing an atom-cavity system that simultaneously achieves state-of-the-art performance for quantum memory efficiency (i.e. photon collection efficiency >90%) and enables a high degree of spatial multiplexing (number of spatial modes N >100). Such a system can improve the entanglement distribution rate by more than a factor of N, and significantly reduce the requirements on memory lifetime. With these improvements a quantum repeater becomes realistically achievable in the near term.

Paul Kunz
Army Research Laboratory

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