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High Speed Heralded Entanglement of Remote Trapped Ion Qubits DAVID HUCUL, SUSAN CLARK, ISMAIL VOLKAN INLEK, CHRISTOPHER MONROE, Joint Quantum Institute, University of Maryland Department of Physics and the National Institute of Standards and Technology, College Park, MD, 20742 — Large scale quantum information processing systems may require different types of quantum systems in separate quantum processing units connected via a reconfigurable quantum network. In order to carry out complex quantum algorithms on large numbers of qubits, it will become necessary to connect different quantum processing units at a rate faster than the qubit decoherence rate. Here we report on the use of high numerical aperture lenses to form heralded entangled trapped atomic ion spins through the interference of their emitted photons. We show that the solid angle of light collection need not degrade the entanglement fidelity. The use of NA = 0.6 lenses increases the entanglement rate by several orders of magnitude, which should surpass the observed spin coherence time of a single trapped atomic ion. Supported by the U.S. ARO, IARPA, the DARPA OLE program, and the MURI program; and the NSF Physics Frontier Center at JQI.

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