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A modular barium ion trap experiment for quantum information and remote entanglement JAMES SIVERNS, Joint Quantum Institute, University of Maryland, College Park, MD, QUDSIA QURAISHI, Army Research Laboratory, Adelphi, MD — Trapped ions remain a leading candidate for the implementation of large-scale quantum networks. Promising schemes include quantum information processing using deterministic local ion entanglement with ion chains and heralded remote entanglement using photonic links between separate nodes in a quantum network. In particular, trapped barium ions possess the ability to emit entangled single photons in the visible spectrum making them a promising candidate as a photonic link. We present a design for a modular barium ion trap experiment that is suitable for both local quantum information processing and as a node in a larger quantum network. We are currently in the process of building a segmented four-blade Paul trap which is known for its versatile trapping of both a single ion and a chain of ions. Traps of this type (R. Blatt and D. Wineland, Nature, vol. 453, p. 108-1015 (2008)) allow collection of large solid angles of emitted photons without obstruction from trap electrodes and, therefore, can increase remote entanglement rates. We also plan to implement quantum frequency conversion so as to demonstrate a system that is compatible with remote entanglement protocols and quantum frequency conversion for entanglement over large distances.

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