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Distribution of entanglement in an ion trap array[1] J.D. JOST, C. LANGER, R. OZERI, R.B. BLAKESTAD, J. BRITTON, J. CHIAVERINI[2], D.B. HUME, W.M. ITANO, E. KNILL, D. LEIBFRIED, R. REICHLE, T. ROSENBAND, S. SEIDELIN, J.H. WESENBERG, D.J. WINELAND, NIST, Time and Frequency Division, Boulder CO, 80305 — Atomic ions confined in radio frequency traps provide a scalable system for quantum information processing. To implement complex quantum algorithms, sympathetic cooling, long coherence times, multiple trapping zones, and high fidelity coherent operation are necessary. These requirements have been demonstrated in separate experiments. Current experimental work at NIST involves combining these elements. This report describes progress towards the use of $^{24}Mg^{+}$ to sympathetically cool $^{9}Be^{+}$ qubits, which will mitigate motional heating and enable multiple high fidelity entangling operations in different trapping zones. Combined with laser beams that address multiple trap zones, this should allow the realization of distributed entanglement and advanced quantum algorithms.

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