Abstract Submitted
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Quantum Information Processing using Scalable Techniques[1] D. HANNEKE, R. BOWLER, J.D. JOST, J.P. HOME[2], Y. LIN, T.-R. TAN, D. LEIBFRIED, D.J. WINELAND, Ion Storage Group, NIST, Boulder, CO — We report progress towards improving our previous demonstrations that combined all the fundamental building blocks required for scalable quantum information processing using trapped atomic ions. Included elements are long-lived qubits; a laser-induced universal gate set; state initialization and readout; and information transport, including co-trapping a second ion species to reinitialize motion without qubit decoherence. Recent efforts have focused on reducing experimental overhead and increasing gate fidelity. Most of the experimental duty cycle was previously used for transport, separation, and recombination of ion chains as well as re-cooling of motional excitation. We have addressed these issues by developing and implementing an arbitrary waveform generator with an update rate far above the ions' motional frequencies. To reduce gate errors, we actively stabilize the position of several UV (313 nm) laser beams. We have also switched the two-qubit entangling gate to one that acts directly on $^9Be^+$ hyperfine qubit states whose energy separation is magnetic-fluctuation insensitive.

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