Abstract Submitted
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Characterization of single- and two-qubit gates in a 2D neutral atom qubit array[1] TIAN XIA, KARA MALLER, MARTIN LICHTMAN, MICHAL PIOTROWICZ[2], ALEX CARR, LARRY ISENHOWER[3], MARK SAFFMAN, University of Wisconsin, Madison — We have developed a 2D array of optically trapped single atom qubits for quantum computation experiments. We characterize single qubit Clifford gate operations with randomized benchmarking achieving global and site selected gates with fidelities close to fault tolerance thresholds for quantum computation. An average fidelity of 0.9983, limited by the qubit T2 coherence time, is measured for global microwave driven gates applied to a 49 qubit array. Single site gates are implemented with a focused laser beam to Stark shift the microwaves into resonance at a selected site. At Stark selected single sites we observe fidelities of 0.9923 and an average spin flip crosstalk error at other sites of 0.002. A two-qubit Rydberg blockade interaction provides a CNOT gate which is used to create entangled Bell pairs. The fidelity is characterized with parity oscillation measurements. The influence of two-photon Stark shifts on the gate matrix and fidelity is studied. We show how to select excitation parameters to suppress the ground-Rydberg differential Stark shift.

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