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Quantum gates and algorithms in a 2D neutral atom array[1]
TRENT GRAHAM, MINHO KWON, CODY POOLE, XIAOYU JIANG, University of Wisconsin - Madison, ALPHONSE MARRA, University of Central Florida, BRANDON GRINKEMEYER, Havard University, JOSH CHEREK, ColdQuanta, MATTHEW EBERT, MARK SAFFMAN, University of Wisconsin - Madison; ColdQuanta — We present progress towards designing and constructing a neutral atom quantum computer. Atoms are loaded into a blue-detuned array constructed from a 16 X 16 array of cross-hatched lines which define a 15 X 15 grid of optical traps. These lines are created using acousto-optic modulators, which allow us to reconfigure site number and trap spacing. Optical tweezers are used to load atoms into targeted sites and form defect-free trapping regions, greatly increasing experimental repetition-rate. We perform CNOT gates between qubits based on Rydberg blockade. Novel CNOT gate protocols based on adiabatic rapid passage excitation of Rydberg states will be presented; such gates may prove more robust to variations in Rabi frequency over the trapping region. In addition, we present improved CNOT gate fidelity using previously implemented gate protocols. Using these upgrades, we demonstrate variational quantum algorithms and use them to estimate ground state energies of the Lipkin Hamiltonian.

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