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Single and pair-wise manipulation of atoms in a 3D optical lattice[1]

THEODORE A. CORCOVILOS, YANG WANG, DAVID S. WEISS, The Pennsylvania State University, Department of Physics — We describe the hardware used in a quantum computing experiment using individual Cs atoms in a 5 μm-spaced 3D optical lattice as qubits. Far-off-resonance addressing beams can be steered to any site in the array using MEMS mirrors within 10 μs, allowing the translation of individual atoms between lattice sites, for example to remove vacancies in the atom array, and the manipulation of single atoms for single qubit gates in $< 100\,\mu$s. Two-qubit gates on adjacent atoms can be performed via the Rydberg blockade mechanism using a second MEMS system and high-NA imaging objective. The lasers for the Rydberg excitation are built using a new extended cavity diode laser design utilizing an interference filter as the frequency selecting element following Baillard, et al. (*Opt. Comm.* 266: 609 (2009)), but using commercially available components.

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