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Quantum computing with atoms in a 3D optical lattice: addressing and sorting atoms

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Trapping long-lived neutral atom qubits in a 3D optical lattice will ultimately allow their entanglement with many near neighbors. To date, we have prepared 50 single atoms near the ground states of their lattice sites, and have demonstrated high fidelity single qubit addressing at each site, with minimal crosstalk despite the challenges of the 3D geometry [Y. Wang, A. Kumar, T.-Y. Wu & D.S. Weiss, *Science* **352**, 1562-1565 (2016)]. I will describe this work, and explain how we are going about sorting the atoms in 3D to generate arbitrary occupancy patterns, the next step before entangling nearby pairs of atoms.