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An architecture for quantum computation with magnetically trapped Holmium atoms[1] MARK SAFFMAN, JAMES HOSTETTER, DONALD BOOTH, JEFFREY COLLETT[2], Department of Physics, University of Wisconsin-Madison — Outstanding challenges for scalable neutral atom quantum computation include correction of atom loss due to collisions with untrapped background gas, reduction of crosstalk during state preparation and measurement due to scattering of near resonant light, and the need to improve quantum gate fidelity. We present a scalable architecture based on loading single Holmium atoms into an array of Ioffe-Pritchard traps. The traps are formed by grids of superconducting wires giving a trap array with 40 μm period, suitable for entanglement via long range Rydberg gates. The states $|F = 5, M = 5\rangle$ and $|F = 7, M = 7\rangle$ provide a magic trapping condition at a low field of 3.5 G for long coherence time qubit encoding. The $F = 11$ level will be used for state preparation and measurement. The availability of different states for encoding, gate operations, and measurement, spectroscopically isolates the different operations and will prevent crosstalk to neighboring qubits. Operation in a cryogenic environment with ultra low pressure will increase atom lifetime and Rydberg gate fidelity by reduction of blackbody induced Rydberg decay. We will present a complete description of the architecture including estimates of achievable performance metrics.

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