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Construction of a single atom trap for quantum information protocols[1] MARGARET E. SHEA, PAUL M. BAKER, Duke University, DANIEL J. GAUTHIER, Duke University, The Ohio State University, DUKE PHYSICS DEPARTMENT TEAM — The field of quantum information science addresses outstanding problems such as achieving fundamentally secure communication and solving computationally hard problems. Great progress has been made in the field, particularly using photons coupled to ions and super conducting qubits. Neutral atoms are also interesting for these applications and though the technology for control of neutrals lags behind that of trapped ions, they offer some key advantages: primarily coupling to optical frequencies closer to the telecom band than trapped ions or superconducting qubits. Here we report progress on constructing a single atom trap for ^{87}Rb. This system is a promising platform for studying the technical problems facing neutral atom quantum computing. For example, most protocols destroy the trap when reading out the neutral atoms state; we will investigate an alternative non-destructive state detection scheme. We detail the experimental systems involved and the challenges addressed in trapping a single atom. All of our hardware components are off the shelf and relatively inexpensive. Unlike many other systems, we place a high numerical aperture lens inside our vacuum system to increase photon collection efficiency.

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