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**Rydberg Spectroscopy and imaging of single Holmium atoms**[1]
JAMES HOSTETTER, JONATHAN PRITCHARD, MARK SAFFMAN, University of Wisconsin, Madison — Neutral holmium with its large number of hyperfine ground states provides a promising approach for collective encoding of a multi-qubit register. Collective encoding relies on the use of Rydberg blockade to create a one-to-one correspondence between singly excited states of the atomic ensemble and logical register states. As a step towards collective encoding with Rydberg blockade in holmium we have precisely measured the energy of ns and nd Rydberg states from n=41-101 using MOT depletion spectroscopy[1]. These measurements have resulted in a precise determination of the first ionization potential as well as the quantum defects of the singlet ns and nd series. The strong 410.5 nm cooling transition with $\sim$ 33 MHz linewidth coupled with the large hyperfine splitting in the electronically excited state are predicted to enable fast, loss-free, and state sensitive measurements which are a prerequisite for collective encoding experiments. We report on progress towards single-atom trapping and state sensitive detection of holmium in a far off-resonant optical dipole trap.

[1] J. Hostetter, J. D. Pritchard, J. E. Lawler, and M. Saffman, Phys. Rev. A 91, 012507 (2015).

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