Abstract Submitted
for the DAMOP15 Meeting of
The American Physical Society

Ponderomotive spectroscopy: Driving Rydberg transitions using harmonics and magic wavelengths of an intensity-modulated optical lattice[1] KAITLIN MOORE, GEORG RAITHEL, University of Michigan — We describe recent developments in a novel spectroscopic method that couples Rydberg states using an intensity-modulated optical lattice. The method is fundamentally different from traditional microwave spectroscopy: it engages the $\mathbf{A} \cdot \mathbf{A}$ (ponderomotive) term rather than the $\mathbf{A} \cdot \mathbf{p}$ term of the atom-field interaction Hamiltonian, allowing us to drive microwave transitions between Rydberg states with optical spatial resolution, free from electric dipole selection rules.[2] Experimentally, cold Rb Rydberg atoms are confined in a 1064nm optical lattice.[3] Transitions are driven by modulating the lattice intensity using a tunable electro-optic fiber modulator. Recently we have driven dipole-forbidden transitions in third and fifth order, at frequencies up to 94 GHz, using temporal harmonics in the intensity-modulated lattice. We also demonstrate, for two separate transitions, the novel use of a magic wavelength condition in ponderomotive spectroscopy. We discuss experimental results and propose applications of this method to a precision measurement of the Rydberg constant using circular-state Rydberg atoms.

[1]Support received from NSF, NIST, NASA
[2]KR Moore, SE Anderson, G Raithel, Nat Comm, 6:6090 (2015)
[3]SE Anderson, KC Younge, G Raithel, PRL 107:263001 (2011)

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Date submitted: 30 Jan 2015 Electronic form version 1.4