Developments in driving atomic transitions using the ponderomotive interaction\textsuperscript{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. The method allows us to drive GHz-frequency transitions between Rydberg states with optical spatial resolution and is not subject to the usual electric-dipole selection rules (i.e., higher-order multipole transitions are driven in first-order time-dependent perturbation)\textsuperscript{2,3,4}. We review our previous experimental results using cold atoms, including an extension of this method into the near-sub-THz regime via modulation harmonics. We present new theoretical results showing extensions of this method to odd-parity transitions. Finally, we discuss the proposed application of this method to a precision measurement of the Rydberg constant using circular-state Rydberg atoms.

\textsuperscript{1}This work was supported by NSF Grant No. PHY-1205559, NIST Grant No. 60NANB12D268, and NASA Grant No. NNN12AA01C.