Abstract Submitted
for the DAMOP13 Meeting of
The American Physical Society

Metastable states in microwave ionization ALEXANDR ARAKELYAN, University of Virginia, TURKER TOPCU, University of Nevada, FRANCIS ROBICHEAUX, Auburn University, THOMAS GALLAGHER, University of Virginia — We report the excitation of metastable Li Rydberg atoms in the presence of a strong 38.3 GHz microwave field. We detect approximately 5% of the initial population in very high Rydberg states with $n > 215$ after the microwave pulse for a wide range of initial binding energies. The surviving population of atoms displays a periodic comb structure in energy with a periodicity matching the structure of the 38.3 GHz microwave field. A small static field displaces the entire comb to lower energy, and the high lying states disappear when the static field exceeds 30 mV/cm. We suggest that these atoms are trapped in metastable atom-field states during the microwave pulse, and relax to the high lying states when the field is turned off. We also perform 1-d quantum simulations at lower n using a scaled microwave frequency and field strength to elucidate the physical mechanism at play. We find that the surviving atoms are trapped in high-n states, and that the surviving population decreases as the duration of the microwave pulse becomes larger than the classical period of the electron in these states. In contrast, classical simulations predict negligible population of bound atoms after the microwave pulse, indicating that the survival of the atoms in the microwave field is a quantum effect.

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Date submitted: 25 Jan 2013

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