Electric dipole interactions between Rydberg atoms in beams and in traps

Authors: V. Zhelyazkova and S. D. Hogan

High Rydberg states of atoms and molecules can possess very large electric dipole moments, exceeding 1000 D for values of the principal quantum number greater than 30. These large dipole moments permit efficient deceleration and electric trapping of gas-phase samples using inhomogeneous electric fields [1-3], but can also give rise to strong electric dipole interactions within these samples [4].

The results of a series of high resolution laser spectroscopy experiments in which we have investigated electric dipole interactions between helium atoms in Rydberg states with strong linear Stark energy shifts, and effective classical electric dipole moments approaching 10000 D, will be presented. These experiments were performed by subjecting the atoms to amplitude modulated electric fields to generate manifolds of Floquet states [5] with absorption minima at the spectral positions associated with the unperturbed atomic resonances. The effect of electric dipole interactions were then investigated by studying the dependence of the contrast of these Floquet features on the density of excited Rydberg atoms. The importance of the results of these experiments for measurements involving cold Rydberg atoms and molecules confined in electric traps will be discussed.

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