Abstract Submitted
for the DAMOP16 Meeting of
The American Physical Society

What is the electron temperature in a plasma which evolves from a sample of ultra-cold Rydberg atoms?[1] DUNCAN TATE, GABRIEL FOREST, EDWIN WARD, Colby College, ANNE GOODSELL, Middlebury College — Dense samples of cold Rydberg atoms evolve rapidly to an ultra-cold neutral plasma (UNP) due to ionizing collisions mediated by dipole forces, and other mechanisms. The subsequent plasma evolution is mediated by three-body recombination (TBR) of electrons and ions, and electron-Rydberg collisions, which can lead to de-excitation, excitation, and ionization of the Rydberg atoms. However, in contrast with UNPs formed by direct photoionization, the plasma evolves in the presence of a large reservoir of Rydberg atoms, and we have been investigating how this affects the UNP dynamics. Specifically, we excite cold Rb atoms in a MOT to a selected Rydberg state using a tuneable pulsed laser. We then measure the UNP expansion velocity using the ion time-of-flight spectra, as a function of the binding energy of the initial Rydberg state ($E_b = 0 - 400$ K), and the initial Rydberg density. Preliminary results show that the UNP expansion velocity, which is a manifestation of the effective electron temperature, has only a weak sensitivity to E_b, but is strongly dependent on the Rydberg density.

[1]Research supported by Colby College and NSF.

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Date submitted: 29 Jan 2016 Electronic form version 1.4