Abstract Submitted
for the DAMOP14 Meeting of
The American Physical Society

Quantification of the effects of Rydberg atoms on ultra-cold neutral plasma evolution[1] DUNCAN TATE, ETHAN CROCKETT, RYAN NEWELL, Colby College — We describe recent developments in our ongoing research in which Rydberg atoms are embedded into an ultra-cold neutral plasma (UNP). Atoms in a specific Rydberg state are embedded in the UNP within 10 ns of its creation using a second pulsed laser system. In such an environment, it is predicted that the plasma electrons may be heated or cooled by the Rydberg atoms (see, for example[2]). We identified an experimental signature that correlates with the plasma electron temperature change, namely, the "crossover" between heating and cooling, where the UNP lifetime remains the same when Rydbergs are added. More recently, we have been working on quantifying the amount of heating or cooling that can be achieved using a passive technique. Specifically, we measure the time (t_δ) it takes for the UNP to shed a certain fraction of its electrons (δ) as it expands in a small, externally applied, electric field. The work reported in[3] shows that the quantity t_δ^{-1} is a good proxy for the UNP asymptotic expansion velocity, which in turn depends on $T_{e,0}$.

[1]Research supported by Colby College and NSF.
[2]T. Pohl *et al.*, *Eur. Phys. J. D*, **40**, 45 (2006)
[3]K. Twedt and S. Rolston, *Phys. Plasmas*, **17**, 082101 (2010)

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Date submitted: 29 Jan 2014 Electronic form version 1.4