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The effect of Rydberg atoms on electron temperature in ultra-cold neutral plasmas[1] DUNCAN TATE, ETHAN CROCKETT, Colby College — We describe recent developments in our ongoing research in which Rydberg atoms are embedded into an ultra-cold neutral plasma (UNP). The UNP is created with initial electron temperature $T_{e,0}$ by photoionization of rubidium atoms in a MOT. At a controllable time delay (5 ns - 10 μs), atoms in a specific Rydberg state are embedded in the UNP by a narrow bandwidth pulsed laser. In such a system, it is predicted that the plasma electrons may be cooled if the Rydberg binding energy, E_b, is greater than $4k_BT_e$ (see, for example[2]). We have identified an experimental signature that correlates with the plasma electron temperature change, namely, whether the plasma lifetime increases or decreases when Rydbergs are added. The "crossover" condition, where the UNP lifetime remains the same when Rydbergs are added, can then be plotted (i.e., E_b vs. $T_{e,0}$ at crossover) and compared with theoretically derived crossover conditions for UNP expansion velocity, electron temperature, etc., using a model derived from the work of Robicheaux and Hansen.[3]

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[2]T. Pohl *et al.*, *Eur. Phys. J. D*, **40**, 45 (2006)
[3]Robicheaux and Hansen, *Phys. Plasmas*, **10**, 2217 (2003)

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