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Using Rydberg atoms to the control electron temperature in an ultra-cold plasma[1] DUNCAN TATE, LAUREN RAND, CRISTIAN VESA, ROY WILSON, Colby College, THOMAS GALLAGHER, University of Virginia — In this presentation, we will describe recent results of experiments in which Rydberg atoms are embedded into an ultra-cold plasma. The plasma is created by partial photoionization of a dense, cold sample of rubidium atoms in a MOT using a Littman dye laser. After ionization, the ions have the same temperature as the parent atoms, while the initial electron temperature, T_e, depends on the Littman laser photon energy. At a controllable time delay (20 ns - 10 μs), neutral atoms embedded in the plasma are excited to a specific Rydberg state 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 $4k_BT_e$. Our preliminary results indicate that the evaporation rate of electrons from a plasma with $T_e = 50$ K is suppressed by the addition of 36d Rb atoms ($E_b = 2.6\ k_BT_e$). In addition, we find that recombination of ions and electrons into high-n Rydberg states is enhanced by addition of 36d atoms (indicating a lower T_e, since $\Gamma_{TBR} \propto T_e^{-9/2}$). On the other hand, recombination is suppressed by the addition of 26d atoms ($E_b = 5.2\ k_BT_e$) to the plasma, suggesting an increase in the electron temperature.

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