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External control of electron temperature in ultra-cold plasmas[1]
DUNCAN TATE, ROY WILSON, MARGARET MARTEI, ANDERS WOOD, Colby College — In this presentation, we will discuss our progress towards achieving external control of the electron temperature and Coulomb coupling parameter of ultra-cold plasmas. The plasma is created by partial photoionization of a dense, cold sample of rubidium atoms in a MOT using a Littman dye laser (Rb density $\sim 4\times10^{10}$ cm^{-3}, temperature $\approx 100\mu$K). At a controllable time delay, neutral atoms embedded in the plasma are excited to a specific Rydberg state by a narrow bandwidth pulsed laser. We measure the plasma electron energy spectrum as a function of delay between the lasers, as a function of the Rydberg state populated by the second laser, and as a function of Rydberg atom density. We have made progress towards quantifying and maximizing the Rydberg atom density that can be achieved by using mm-wave spectroscopy to control the evolution of a cold, dense Rydberg sample to plasma. We have also begun preliminary investigation of plasma electron temperature measurements. We are also investigating the use of a dark SPOT to increase the Rydberg density.

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