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Structure and dynamics in ultra-cold Rydberg gases and cold plasmas[1] DUNCAN TATE, ALEXANDER GILL, CRISTIAN VESA, WILLIAM WHITLEDGE, Colby College — In this presentation, we will discuss recent experiments using ultra-cold Rydberg atoms. We create dense samples of cold Rydberg atoms ($n \sim 1 \times 10^{10}$ cm^{-3}, $T \approx 100\mu$K) from $5p\ ^2P_{3/2}$ rubidium atoms in a MOT using a narrow bandwidth ($\approx$ 100 MHz) 480 nm light pulses. This light is generated by an amplified diode laser system whose output is frequency-doubled by a potassium niobate crystal. We are pursuing three avenues of research. First, we are investigating the effect of the cold Rydberg atoms on the electron temperature of an ultra-cold plasma, which is created by direct photoionization of the $^2P_{3/2}$ Rb atoms using a Littman dye laser. The Rydberg atoms (produced as described above) are then "embedded" in the plasma from 1-10 μs later. Second, we are performing mm-wave and optical spectroscopy of the dense Rydberg samples in a search for long-range molecular species. Third, we are improving the performance of a "dark SPOT" trap with the ultimate goal of increasing the achievable Rydberg density in the experiments described above.

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