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Characterizing Radiation Trapping Effects in Precision Measurements of Atomic Excited State Lifetimes BRIAN PATTERSON, JERRY SELL, ALINA GEARBA, JEREMIAH WELLS, DERALD MADSON, RANDY KNIZE, United States Air Force Academy, STEPHEN SPICKLEMIRE, University of Indianapolis — Measurements of atomic excited state lifetimes provide a valuable test of atomic theory, allowing comparisons between experimental and theoretical transition dipole matrix elements. We previously measured the $6P_{3/2}$ state lifetime in Cs using a pulsed laser technique[1], achieving a precision of 0.15%. In that experiment, a single pulse from a mode-locked laser was used to excite cesium atoms in a thermal beam, and a subsequent pulse ionized the excited atoms. The ions were collected while varying the time delay between the excitation and ionization pulses. Two of the dominant systematic errors in the measurement included the effects of quantum beating and radiation trapping. We will present our recent efforts to reduce these systematic errors in lifetime measurements of the $5P_{3/2}$ state of rubidium. These efforts include using a gated CW laser to excite a single hyperfine level, greatly reducing quantum beats. We are also carrying out independent measurements of the atom beam density to better quantify the effects of radiation trapping on the measured lifetime. We use two-photon ionization of the atom beam and the known rubidium two-photon ionization cross-section to extract the rubidium density. Measurements of the Rb lifetime at various beam densities are compared to predictions of Monte Carlo calculations of the radiation trapping. [1]B. M. Patterson *et al.*, Phys. Rev. A 91, 012506 (2015).

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