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Experimental Investigation of Long-lived "ZEKE" Rydberg States in Ultracold Argon G. RANJIT, C.I. SUKENIK, Old Dominion University, Department of Physics, Norfolk, VA 23529 — Ultracold plasmas are typically formed by photo-excitation of ultracold atoms to an energy region near an ionization threshold. Excitation to highly-excited Rydberg states can lead to formation of a plasma via several processes, including collisions between the Rydberg atoms. Understanding the dynamics of ultracold Rydberg gases is therefore important for understanding the dynamics of ultracold plasmas. We will report on our study of a particular class of Rydberg atoms, known as ZEKE state Rydberg atoms, which are high angular momentum excited states formed by laser excitation in the presence of electric fields. We have investigated the creation and survival of ultracold ZEKE Rydberg states of argon in a MOT as function of principal quantum number for excitation to an energy region just below the second ionization threshold of the atoms. Here, low angular momentum states decay very quickly by auto-ionization, but ZEKE states live orders of magnitude longer because the high l, m Rydberg electron does not approach the core and auto-ionization is therefore suppressed.

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