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Imaging the evolution of an ultracold strontium Rydberg gas[1]
XINYUE ZHANG, PATRICK MCQUILLEN, TREVOR STRICKLER, F. BARRY DUNNING, THOMAS KILLIAN, Rice University — Clouds of ultracold strontium 5s48s $^1S_0$ or 5s47d $^1D_2$ Rydberg atoms are created by two-photon excitation of laser cooled $5s^2$ $^1S_0$ atoms. The evolution of this ultracold gas of low-l states towards a plasma through l-changing collisions and collisional ionization is probed by imaging light scattered via the 5s $^2S_{1/2}$-5p $^2P_{1/2}$, core ion transition, a technique that provides both spatial and temporal resolution. For low-l states core excitation leads to rapid autoionization whereas for high-l states, and for strontium ions, strong fluorescence occurs. Evolution is seen to proceed more rapidly for S states, which display attractive interactions, than for D states which principally display repulsive interactions. Even more rapid evolution is observed in the presence of an ultracold neutral plasma allowing the number of Rydberg atoms initially produced to be measured.

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Xinyue Zhang
Rice University

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