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Microwave Ionization of Rydberg Atoms in an Ultracold Plasma[1]
ROBERT FLETCHER, XIANLI ZHANG, STEVEN ROLSTON, University of Maryland — Expanding ultracold neutral plasmas are dynamic systems, driven by electron pressure that is proportional to the electron temperature. This leads to adiabatic cooling, which is counteracted by heat produced by three-body recombination into Rydberg atoms. To date, the study of Rydberg production in ultracold plasmas has relied on field ionization techniques, which destroy the plasma. We are investigating the use of microwave ionization of Rydberg atoms in the plasma. The plasma does not respond at the microwave frequencies ($\sim$ 2 GHz), so Rydberg populations can be probed repeatedly during the plasma evolution. We apply multiple pulsed microwave fields at varying times to an expanding neutral ultracold Xenon plasma, followed by a final field ionization ramp. This technique provides a good tool for the investigation of the time- dependent populations of Rydberg atoms in the plasma, allowing for a better understanding of collisional processes in expanding ultracold plasmas and the role of Rydbergs in the equilibration of the plasma electron temperature. We also investigate the application of a continuously applied microwave field on the evolution of the plasma.

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