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Gaussian expansion and annular analysis of ultracold Sr plasma
SAMPAD LAHA, CLAYTON SIMIEN, PRIYA GUPTA, THOMAS KILLIAN, Rice University — Expansion of plasma in vacuum is an important problem in astrophysics and when intense lasers ablate solid targets. In an ultracold neutral plasma, the details of a self-similar expansion of Gaussian density distribution can be seen by absorption images. The image of the plasma is divided into concentric annuli, which gives us the ability to probe the plasma properties spatially. This gives direct verification of the fact that the density maintains its Doppler profile over time. Thus, we can use existing theories of a self-similar gaussian expansion to calculate the initial electron temperature (Te), which plays a critical role in the evolution of the plasma. For example, calculating Te will tell us how many ions are we losing due to three-body recombination (TBR). The annular analysis of the plasma also allows us to probe other phenomena such as the dependence of ion temperature with position (which gives us the correlation energy) and ion density singularities at some points (shock waves).

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