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Particle Simulation of Expansion of Plasma Induced by Resonance Enhanced Multiphoton Ionization in Argon Gas SIVA SASHANK THOLETI, VENKATTRAMAN AYYASWAMY, ALINA A. ALEXEENKO, School of Aeronautics and Astronautics, Purdue University, MIKHAIL N. SHNEIDER, Department of Mechanical and Aerospace Engineering, Princeton University — Rayleigh scattering of plasma generated by resonance enhanced multiphoton ionization (REMPI) provides a non-intrusive, time accurate measurement of electron formation and loss with many applications in plasma diagnostics. In this paper we study the non-equilibrium processes during the expansion of REMPI plasma. The particle in cell method with Monte Carlo collision (PIC/MCC) scheme is applied to account for the micron-sized characteristic length scale of the plasma and the non-continuum nature of the fast expansion process. Both 1D and 2D approximations are considered for the REMPI plasma expansion in Argon gas generated by a laser with a focal shape of a prolate ellipsoid at 100 torr and 5 torr pressures. The expansion of the plasma is found to be very sensitive to the initial velocity distribution of the electrons. REMPI plasma expansion is shown to be ambipolar in nature. Even though the radial expansion is predominant, there is a significant axial component requiring the 2D model. The deviation of the electron energy distribution functions (EEDFs) from that of the equilibrium Maxwell-Boltzmann energy distribution is presented both qualitatively and quantitatively. Based on this analysis the distinct plasma expansion phases have been delineated at various instances in time.

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