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Collisionless Adiabatic Afterglow

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Kinetic evolution of a plasma initiated between absorbing walls is studied numerically and analytically. The flow is formed by rarefaction waves that originate at the boundaries, interact, and vanish after crossing through, leading up to the asymptotic stage of the decay. Macroscopically, this behavior resembles one recognized in isentropic gas dynamics: a near-flat density profile, with an accompanying linear velocity profile, forms and expands around the center as the rarefaction waves interact. At the wall, the density and the flux show little variation over the period when rarefaction waves are present. Afterwards, the density falls off as *1/t* (red-shift decay). The plasma potential, on the other hand, falls off rapidly (on the underlying ion-acoustic time scale). At 30% depletion, it is already as low as one T_e (with no dependence on ion mass). This is due to the adiabatic dynamics of electrons in a slowly varying potential well. The results have implications for pulse-driven afterglow plasmas utilized in industry. One property of interest is good uniformity of the decaying plasma that occurs after approximately one ion-acoustic time.

Short Bio

Dr. Alexander Khrabrov is currently affiliated with Princeton Plasma Physics Laboratory with which he collaborated on a number of projects over the years as a subcontractor. He received his doctoral degree from Dartmouth College. His current research focuses on kinetic theory and simulations of gas discharge and plasma-surface interactions, in projects of relevance to industrial applications of plasma technology. These studies addressed, for example, electron-rich (inverse) sheaths at emissive surfaces and dynamics of secondary electrons in RF discharges, physically correct angular scattering in Monte-Carlo simulations, accumulation of cold electrons in the negative glow, and ionization breakdown in gases at very high voltage when electrons are in a runaway state.