DPP10-2010-001636

Abstract for an Invited Paper
for the DPP10 Meeting of
the American Physical Society

Structure in Radiating Shocks[1]

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The basic radiative shock experiment is a shock launched into a gas of high-atomic-number material at high velocities, which fulfills the conditions for radiative losses to collapse the post-shock material to over 20 times the initial gas density. This has been accomplished using the OMEGA Laser Facility by illuminating a Be ablator for 1 ns with a total of 4 kJ, launching the requisite shock, faster than 100 km/sec, into a polyimide shock tube filled with Xe. The experiments have lateral dimensions of 600 μm and axial dimensions of 2-3 mm, and are diagnosed by x-ray backlighting. Repeatable structure beyond the one-dimensional picture of a shock as a planar discontinuity was discovered in the experimental data. One form this took was that of radial boundary effects near the tube walls, extended approximately seventy microns into the system. The cause of this effect - low density wall material which is heated by radiation transport ahead of the shock, launching a new converging shock ahead of the main shock - is apparently unique to high-energy-density experiments. Another form of structure is the appearance of small-scale perturbations in the post-shock layer, modulating the shock and material interfaces and creating regions of enhanced and diminished aerial density within the layer. The authors have applied an instability theory, a variation of the Vishniac instability of decelerating shocks, to describe the growth of these perturbations. We have also applied Bayesian statistical methods to better understand the uncertainties associated with measuring shocked layer thickness in the presence of tilt. Collaborators: R. P. Drake, H. F. Robey, C. C. Kuranz, C. M. Huntington, M. J. Grosskopf, D. C. Marion.

[1]Work funded by the DOE NNSA and SC-OFES Joint Prog. in High-Energy-Dens. Lab. Plas. grant DE-FG52-09NA29548, and by the NNSA Nat. Laser User Fac. Prog. grant DE-FG52-09NA29034, the Pred. Sci. Acad. Alli. Prog. grant DE-FC52-08NA28616, and the SSGF prog.