Simulating the long-term evolution of radiative shocks in shock tubes

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March 22, 2012

Abstract

We present the latest improvements in the Center for Radiative Shock Hydrodynamics (CRASH) code, a parallel block-adaptive-mesh Eulerian code for simulating high-energy-density plasmas. The implementation can solve for radiation models with either a gray or a multigroup method in the flux-limited-diffusion approximation. The electrons and ions are allowed to be out of temperature equilibrium and flux-limited electron thermal heat conduction is included. We have recently generalized the CRASH laser package to 3D ray tracing, resulting in improved energy deposition evaluation. New, more accurate opacity models are available which significantly improves radiation transport in materials like xenon. In addition, the HYPRE preconditioner has been added to improve the radiation implicit solver. With this updated version of the CRASH code we will demonstrate radiative shock tube problems. In our set-up, a 1ns, 3.8kJ laser pulse irradiates a 21 micron beryllium disk, driving a shock into a xenon-filled plastic tube. The electrons emit radiation behind the shock. This radiation from the shocked xenon preheats the unshocked xenon. Photons traveling ahead of the shock will also interact with the plastic tube, heat it, and in turn this can drive another shock off the wall into the xenon. We are now able to simulate the long term evolution of radiative shocks and compare with X-ray radiographs obtained from

shock tube experiments at the Omega high-energy-density laser facility.