Collaborative Comparison of High-Energy-Density Physics Codes

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March 22, 2012

Abstract

Performing radiation-hydrodynamic simulations is vital to the understanding of laboratory astrophysics experiments. A number of codes have been developed for this purpose. A collaboration has begun to compare several of these codes, including CRASH (Unversity of Michigan), FLASH (University of Chicago), RAGE and CASSIO (LANL) and HYDRA (LLNL). We are in the process of testing these codes on a wide variety of problems, ranging from very simple tests to full laboratory astrophysics experiments. The algorithms and physics models differ significantly between these codes, so complete agreement is not expected, especially on the full-experiment simulations. The goal is to understand the differences between the codes and how these differences influence the results. We intend to determine which codes contain the most accurate algorithms and physics models and, where possible, to improve the other codes to produce more faithful representations of the experiments. The first set of tests are simple temperature relaxation problems in an infinite, uniform medium. The second suite of tests was designed to test the diffusion solvers (both conduction and radiation) in the codes. Following this, tests will be

performed that include hydrodynamic effects. Results of these comparisons will be presented. The eventual goal is to compare the results from all of the codes on simulations of radiative shock experiments being performed by The Center for Radiative Shock Hydrodynamics at the University of Michigan and to understand any discrepancies between the results of the simulations and the experiments.