APR05-2005-000114

Abstract for an Invited Paper
for the APR05 Meeting of
the American Physical Society

Hydrodynamics and Radiative Hydrodynamics with Astrophysical Applications[1]

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The high-energy-density research facilities of today can accelerate small but macroscopic amounts of material to velocities above 100 km/s, can heat such material to temperatures above 100 eV, and can produce pressures far above a million atmospheres (10^{12} dynes/cm^2 or 0.1 TPascal). Many of these facilities were built to pursue inertial confinement fusion. Their emergence as versatile experimental tools has created new opportunities in basic research with astrophysical applications. In the areas of hydrodynamics and radiation hydrodynamics, one can produce dynamic processes such as instabilities that occur in astrophysical systems but cannot be directly observed. One can do this in experimental systems that are well scaled to their astrophysical counterparts, either completely or in terms of relevant dimensionless parameters. This talk will provide examples from current research in the areas of hydrodynamic instabilities at interfaces shocked by blast waves and from radiatively collapsing jets and shocks. Hydrodynamic experiments have produced blast waves that shock and then decelerate unstable interfaces to produce high-velocity spikes of dense material at very high Reynolds number. Radiation-hydrodynamic experiments have produced jets that collapse radially and shocks that collapse axially through radiation losses. The results of such experiments and the issues that arise in connecting them to astrophysics will be discussed.

[1]The author acknowledges support by U.S. DOE/NNSA under grants DE-FG52-03NA00064, DE FG53 2005 NA26014 and other grants and contracts, and also collaborations and discussions cited in the talk.