DPP08-2008-000019

Abstract for an Invited Paper
for the DPP08 Meeting of
the American Physical Society

A High Energy Density Shock Driven Kelvin-Helmholtz Shear Layer Experiment

OMAR HURRICANE, Lawrence Livermore National Laboratory

In 2002, a high energy density Kelvin-Helmholtz (KH) instability experiment was designed (O.A. Hurricane, *High Energy Density Phys.*, 2008) for the National Ignition Facility (NIF) Early Light experiment. However, the long backlighter delay, required for the experiments success, could not be accommodated by NIF at that time. In early 2008, this experiment proposal was resurrected by our team, the target was fabricated at Livermore with final assembly at the University of Michigan, and then fielded at the Omega laser facility. The data return from the four shots of the experiment series exceeded expectation. In this paper, we describe the theory and simulation behind the experiment design, the unusual target construction, and present the radiographic data from the Omega experiment in raw form and a preliminary analysis of the data. Discussion of the target design theory and simulations focuses on the key role played by baroclinic vorticity production in the functioning of the target and also illuminates the key design parameters. The data shows the complete evolution of large distinct KH eddies, from formation to turbulent break-up. The data appears to graphically confirm a theoretical fluid dynamics conjecture about the existence of supersonic bubbles over the vortical structure [transonic convective Mach numbers (D. Papamoschou and A. Roshko, *J. Fluid Mech.*, **197**, 1988)] that support localized shocks (shocklets) not extending into the free-stream(P.E. Dimotakis, *AIAA 91-1724*, Proc. 22^{nd} Fluid Dyn., Plasma Dyn., & Lasers Conf., 1991). The consequences of these observations on understanding the turbulent transition, growth-rates and mixing in compressible supersonic turbulent shear layers will be discussed. This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344. A National Laser Users Facility grant also supported this work. Collaborators: J.F. Hansen*, E.C. Harding#, R.P. Drake#, H.F. Robey*, C.C. Kuranz#, B.A. Remington*, and M.J. Bono* (*Lawrence Livermore National Laboratory, P.O. Box 808, Livermore, California, 94551 #U. of Mich., Dept. of Atmospheric, Oceanic and Space Sciences, 2455 Hayward St., Ann Arbor, Michigan, 48109-2143)