Wed3.4 Drake et al.

Nonlinear mixing behavior of the three-dimensional Rayleigh-Taylor instability at a decelerating interface

R.P. Drake[1], D.R. Leibrandt[1], E.C. Harding[1], C.C. Kuranz[1], M. Blackburn[1], H.F. Robey[2], B.A. Remington[2], M.J. Edwards[2], A.R. Miles[2], T.S. Perry[2], R.J. Wallace[2], H. Louis[2], J.P. Knauer[3] & D. Arnett[4]

1. University of Michigan
rpdrake@umich.edu

2. Lawrence Livermore National Laboratory

3. University of Rochester

4. University of Arizona

Results are reported from an experiment to explore the evolution of the Rayleigh-Taylor (RT) instability from intentionally three-dimensional (3D) initial conditions at an embedded, decelerating interface in a high-Reynolds-number flow. The experiments used ~ 5 kJ of laser energy to produce a blast wave in polyimide and/or brominated plastic having an initial pressure of ~ 50 Mbars. This blast wave shocked and then decelerated the perturbed interface between the first material and lower-density, C foam. This caused the formation of a decelerating interface with an Atwood number ~2/3, producing a long-term positive growth rate for the RT instability. The initial perturbations were a 3D perturbation in an "egg-crate" pattern with feature spacings of 71 µm in two orthogonal directions and peak-to-valley amplitudes of 5 µm. The resulting RT spikes appear to overtake the shock waves, moving at a large fraction of the pre-deceleration, "free-fall" velocity. Their morphology also becomes complex. This result was unanticipated by prior simulations and models.

Financial support for this work included funding from the U.S. Department of Energy to the University of Michigan under grants DE-FG03-99DP00284 and DE-FG03-00SF22021, and to the Lawrence Livermore National Laboratory under Contract No. W-7405-ENG48.