Measuring post-reshock hydrodynamic growth rates with laser-driven high-energy-density experiments

Channing HUNTINGTON[1], Sabrina NAGEL[1], Kumar RAMAN[1], Jason BENDER[1], Steven MACLAREN[1], Shon PRISBREY[1], Alan WAN[1], Ping WANG[1], Ye ZHOU[1]

1) Lawrence Livermore National Laboratory, Livermore, CA, USA

The growth of Richmyer-Meshkov and Rayleigh-Taylor instabilities at an interface that is impulsively accelerated, for example by the passage of a shock, have been studied in many laser-driven experiments. However, investigation of instability growth subject to a second shock ("reshock") has to-date been limited to "classical" shock tubes [1, 2]. Here we describe the results of experiments, performed on the National Ignition Facility, to measure non-linear instability growth at a planar interface before and after reshock [3]. This work leverages several advantages unique to laser-driven experiments, including precise control of the initial conditions, shock strength, and Atwood number. The unstable mixing region has been directly imaged with side-on x-ray radiography, performed using a novel target configuration that ensures accurate measurement of the entire region of material interpenetration. We present the results of experiments employing single-mode and multi-mode initial conditions, and data is compared to 2-dimensional simulations. This work agrees with previous investigations that show rapid post-reshock growth rates and suggest that post-reshock growth is insensitive to the initial conditions.

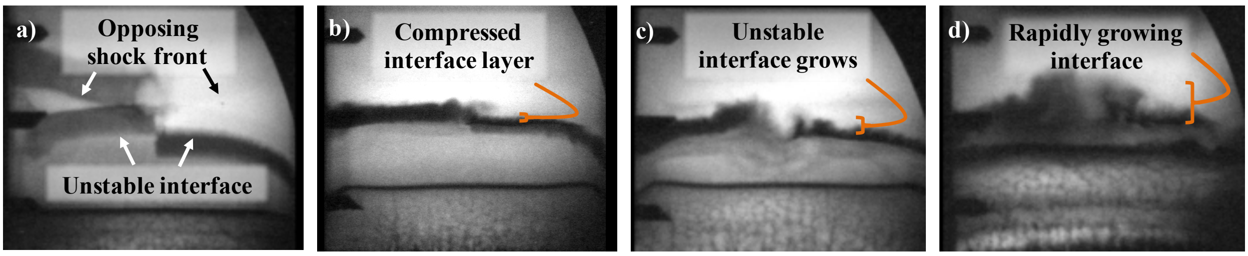

Figure 1: Four images capture the pre- and post-reshock interface growth. In each figure, the initial shock is launched from the bottom of the image, traveling upward, and the opposing ("reshock") is traveling from top to bottom. a) The unstable interface is measured 2 ns prior to reshock, establishing the initial mix width. b) – d) In images captured at 4, 10, and 18 ns after the reshock, the unstable interface is seen to be compressed, followed by a period of rapid growth.

References

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