

First Direct Observations of the ablative Richtmyer-Meshkov instability and “feedout” in laser-accelerated targets aids in understanding ICF target distortion (Invited paper CI1.001).

Researchers at the Plasma Physics Division of the Naval Research Laboratory will report the first direct observations of the oscillations due to the ablative Richtmyer-Meshkov instability and “feedout”. Both of these effects are important in modeling the behavior of the fuel pellet as it is being compressed by lasers in Inertial Confinement Fusion (ICF).

Distortion of the fuel pellet during compression remains a critical issue for ICF. Distortion is caused by laser non-uniformity as well as inner and outer pellet surface roughness and is amplified by the Rayleigh-Taylor (RT) instability as the fuel is accelerated inwards. An important part of being able to model this distortion is a quantitative understanding of how these initial non-uniformities become seeds for the RT instability. To this end, researchers have conducted experiments on planar plastic targets driven by the Naval Research Laboratory’s NIKE laser. The planar geometry allowed easy observation of target’s behavior and simplified theoretical modeling of the experiment. Targets had grooves either on the front or on the rear surface to simulate outer and inner fuel pellet surface roughness, respectively. The high uniformity of the NIKE laser ensured that development of distortion would be solely due to the initial grooves. Researchers used a novel diagnostic technique to observe the time development of distortions: monochromatic x-ray imaging using a curved crystal coupled to a streak camera. This technique permitted accurate measurement of the small ($\sim 1\mu\text{m}$) distortion amplitude. Using this technique, they have for the first time observed a non-monotonic evolution of the distortions. In the experiments with the front surface grooves, an oscillation due to the ablative Richtmyer-Meshkov instability was observed. An example is shown in Fig. A, where the distortion amplitude goes through a minimum at approximately 2 ns. In the experiments with the grooves on the rear, two phase reversals of the distortions were observed, as expected from oscillations due to feedout. As seen in the example of Fig B, phase reversals are observed at approximately 2 and 4 ns. These first-time observations allow verification of theory and benchmarking of codes used in design of fusion energy pellets. Paper CI1.001: Yefim Aglitskiy, SAIC, aglitskiy@this.nrl.navy.mil. Contact: Max Karasik, Naval Research Lab, karasik@nrl.navy.mil; (202) 404-7848.

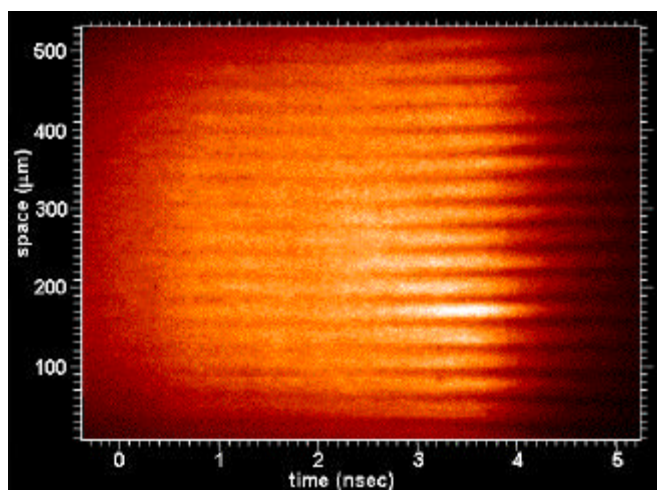


Figure A: First observation of ablative Richtmyer-Meshkov oscillation.

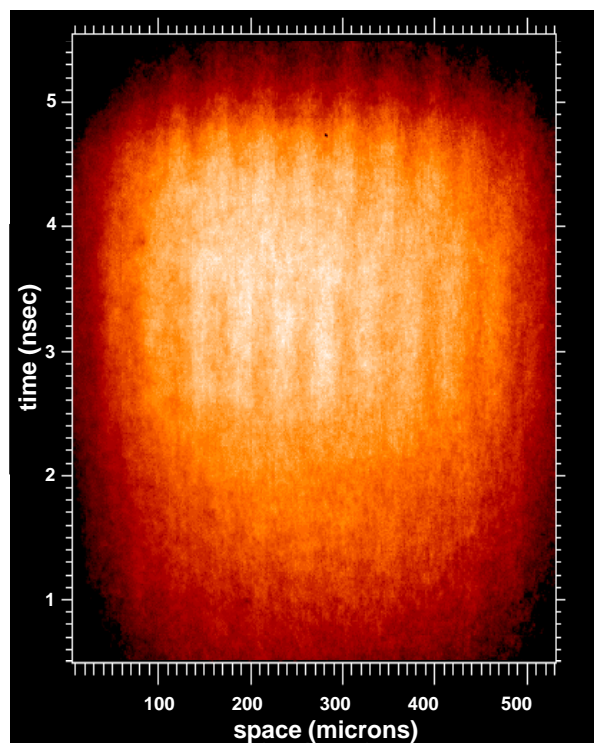


Figure B: First observation of oscillation due to feedout.