NRL LASER FUSION PROGRAM
Bimonthly Highlights
November-December 2000

Direct observation of areal mass oscillations due to ablative Richtmyer-Meshkov instability in planar plastic targets

The areal mass variation in a laser-driven target caused by either its surface roughness or by the imprint of the laser beam non-uniformity amplitudes, has been theoretically predicted to oscillate during the early shock-rarefaction transit time when the Rayleigh-Taylor (RT) seeds are formed [1, 2]. The oscillations characteristic of the so-called ablative Richtmyer-Meshkov instability [2] have been reproduced in a number of simulations [3, 4] but never observed experimentally. The main problem associated with observing the ablative RM oscillations is their relatively low frequency, which is the reason why they have not been detected by the face-on measurements in earlier experiments [5]. Our experiments were performed with 4 ns long pulses of the Nike KrF laser using a novel diagnostic technique, monochromatic x-ray imaging coupled to a streak camera. A non-monotonic evolution of areal mass perturbations in an ablatively driven target during the shock-rarefaction transit has been observed for the first time. We used 40 μm to 90 μm thick CH targets rippled on the front side with perturbation wavelength l = 30 μm. This was short enough to make the oscillation half-period fit into the Nike pulse duration, but at the same time was resolvable by our diagnostics. We consistently observed the mass variation amplitude to grow, to reach a peak, and then to decrease due to the ablative RM instability, after which the exponential RT growth begins.

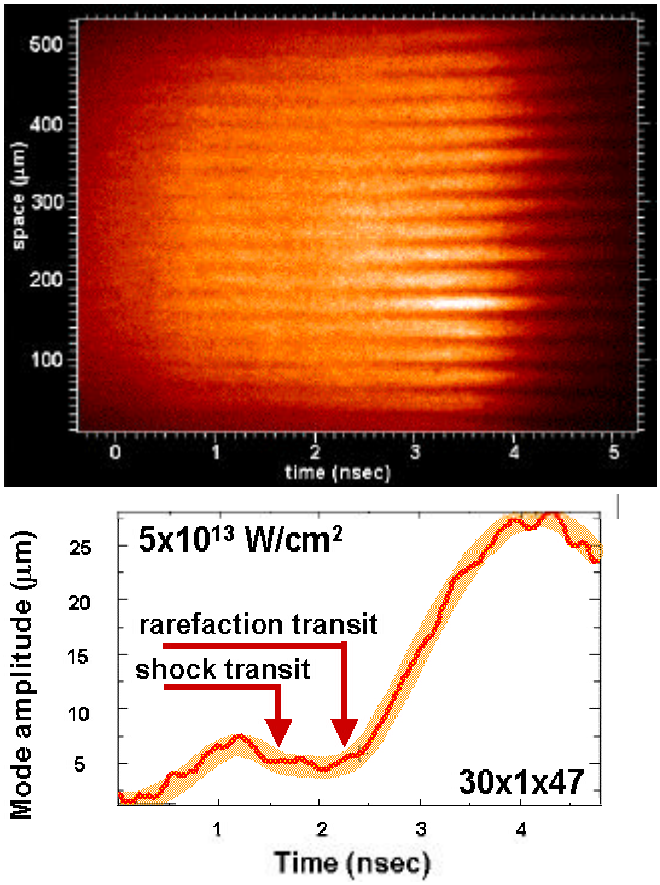

Fig. Streak record (top) and the peak-to-valley amplitude of the dominant Fourier mode l = 30 μm of the areal mass variation (bottom) for a 47 μm thick target. The minimum due to the ablative RM oscillation is clearly visible on both images.

[1] A. L. Velikovich *et al.*, Phys. Plasmas **5**, 1491 (1998).
[2] V. N. Goncharov, Phys. Rev. Lett. **82**, 2091 (1999).
[3] V. N. Goncharov *et al.*, Phys. Plasmas **7**, 2062 (2000).
[4] A. J. Schmitt *et al.*, Phys. Plasmas **8**, 2287 (2001).
[5] T. Endo *et al.*, Phys. Rev. Lett. **74**, 3608 (1995).

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