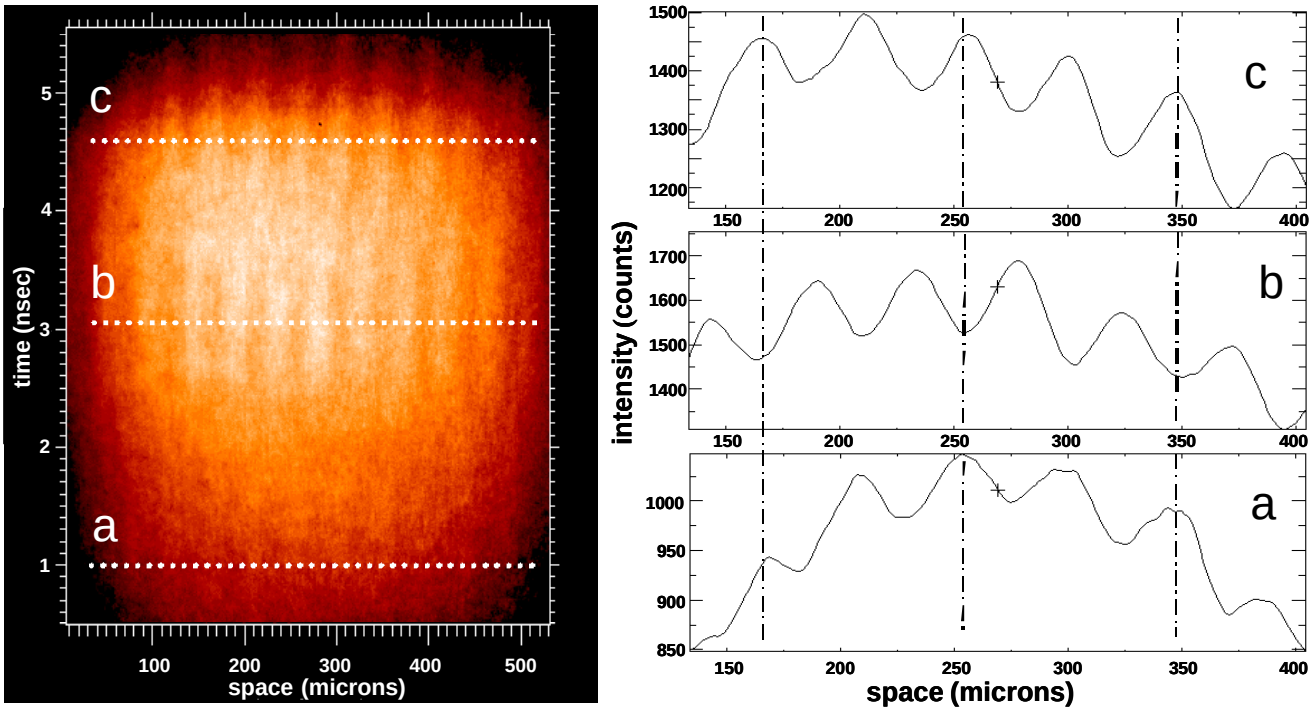
NRL LASER FUSION PROGRAM

March-April 2001

Bimonthly Highlights

Direct observation of feedout-related areal mass oscillations in planar plastic targets

"Feedout" means the transfer of mass perturbations from the rear to the front surface of a driven target. When a planar shock wave breaks out at a rippled rear surface of the target, a lateral pressure gradient drives sonic waves in a rippled rarefaction wave propagating back to the front surface. This process redistributes mass in the volume of the target, forming the feedout-generated seed for ablative Rayleigh-Taylor (RT) instability. The oscillations are expected if the perturbation wavelength l is not large compared to , where is the shock-compressed target thickness. The oscillations change the phase of mass variation, making the target thicker where it was initially thinner. We report the first direct experimental observation of areal mass oscillation associated with feedout, followed by the onset of exponential RT growth. Our experiments were performed with the Nike KrF laser (λ = 248 nm). The 4 ns long laser pulse was focused to a spot 750 μm in diameter FWHM, producing an intensity up to ~80 TW/cm^2. The mass redistribution in the target was observed with the aid of monochromatic x-ray imaging coupled to a streak camera. We used 40 μm to 60 μm thick CH targets rippled on the rear side with wavelengths of either 30 μm or 45 μm, the ratio thus being close to 2. Two phase reversals of mass variation predicted by the theory and simulations were consistently observed both on the original images and on the time histories of Fourier amplitudes.



Streak record (left) and its lineouts at three different times (right) for target thickness 60 μm, l = 46 μm, and peak laser intensity 5×10^{13} W/cm^2. Two phase reversals are clearly seen on both images.

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