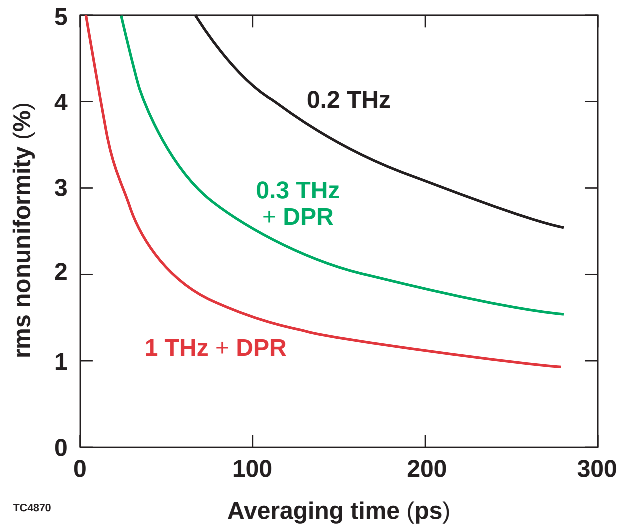
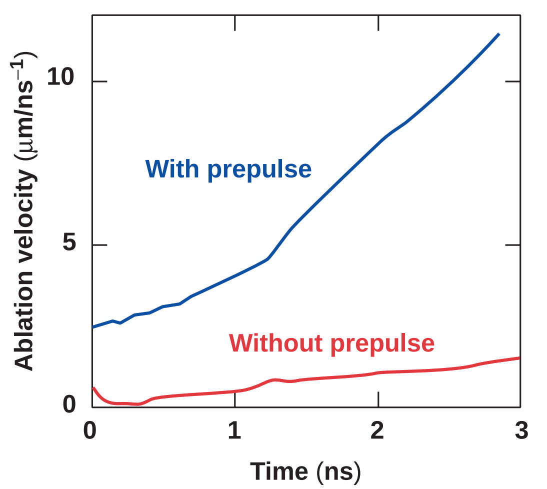
# November 1998 Progress Report on the Laboratory for Laser Energetics Inertial Confinement Fusion Program Activities

***Irradiation Uniformity:*** We completed plans for reducing the irradiation nonuniformity on OMEGA to less than 1% (averaged over 300 ps) in FY99. The total nonuniformity in the long-wavelength nonuniformities (spherical harmonic modes 5 to 20) can be smoothed to levels below 0.25%. This will be accomplished by the addition of three new features to the laser: (1) Second triplers will allow the high-efficiency tripling of 3 to 4 times the current bandwidth, resulting in a UV bandwidth of ~1 THz; (2) DPR's will be added to all 60 beams, which will result in an instantaneous reduction in nonuniformity by a $\sqrt{2}$ and increased smoothing of the longer wavelengths of nonuniformity; (3) the laser pinholes will be increased in size to double the allowed spectral spread in one direction from 50 $\mu$rad to 100 $\mu$rad. (The angular spread in the perpendicular direction will remain 50 $\mu$rad.) The combined effect of the polarization spread and the increased spectral spread will smooth spherical harmonic modes of nonuniformities as low as $\ell = 10$. In Fig. 1, we compare the effects of the different improvements in uniformity that are planned for OMEGA during 1999. The rms nonuniformity is plotted as a function of the time over which the laser intensity is averaged. The top curve shows the current level of uniformity on OMEGA with a UV bandwidth of ~0.2 THz. The middle curve shows the level that will be achieved in mid-1999 when DPR's are added to all 60 beams and the bandwidth is increased to ~0.3 THz with larger laser pinholes. (At this point the total angular dispersion of the beam has been increased from 50 to 100 $\mu$rad.) The bottom curve shows the result of replacing one of the ~3-GHz electro-optic modulators with an ~10-GHz modulator and increasing the bandwidth to 1 THz. Both the rate of smoothing and the absolute level of nonuniformity achieved should be adequate to perform the high-compression experiments planned for OMEGA. These uniformity improvements are directly applicable to the NIF. The NIF will achieve an even higher level of uniformity because of the larger number of beams.




***Control of Ablation Velocity with Shaped Pulses:*** Simulations have been performed at LLE to investigate the use of shaped pulses to reproducibly control the ablation velocity in planar direct-drive experiments. The growth of the Rayleigh–Taylor (RT) instability is reduced by ablation of the target surface. Since the ablation velocity varies approximately as the inverse of the ablator density, the RT instability may be reduced by decreasing the maximum density. In the simulations, the prepulse preheats the target, causing it to "puff up," reducing the ablator density. By investigating a range of prepulse durations and intensities, as well as a series of delay times between the prepulse and the main pulse, a pulse shape has been identified that results in the greatest ablation velocity without disintegrating the target (see Fig. 2). Once the dependence of ablation velocity on prepulse shape has been reproducibly demonstrated, pulse-shaping techniques may be used to control target stability. The results of a set of complementary experiments (13 shots) performed on OMEGA are currently under analysis.




***OMEGA Operations Summary:*** November operations included six days of target shot execution. The third week of November was the dedicated maintenance week for FY99 first quarter. During the maintenance week the LLNL Active Shock Break-Out (ASBO) diagnostic was installed on the OMEGA system. Initial tests of the ASBO diagnostic are scheduled for December 1998. Target shot campaigns receiving time on OMEGA in November included RTI (25 shots), diagnostic development (22 shots), and NLUF (8 shots). Also receiving shot time was the beam uniformity campaign (many single-beam-laser test shots).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