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Ablative Richtmyer-Meshkov Experiments

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Disclaimer

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Figure 1 shows a schematic of experimental setup for nonlinear Richtmyer-Meshkov (RM) instability experiments on OMEGA. Planar 15, 30, and 50-μm-thick CH targets were driven with three UV beams using a 6-ns square pulse shape, total energy of ~0.7 kJ, and laser intensity of ~$5x10^{13}$ W/cm^2. Initial target modulations were imposed by laser imprinting using a beam with a special 2D phase plate with modulation wavelength of ~70 microns. The timing of this beam was advanced by ~200 ps, relative to other drive beams that have regular SG distributed phase plates (DPP's). Figure 2 shows laser beam images, with SG4 DPP [Fig. 2(a)], and with a special 2D DPP [Fig. 2(b)]. Growth of target modulations was measured with x-ray radiography using uranium (~1.3 keV), samarium (~1.8 keV), and tantalum (~2.2 keV) backlighters on a framing camera with 10-μm spatial resolution and 80-ps temporal resolution. Backlighter targets were driven with 2-ns square pulse shape and intensity of ~$3x10^{14}$ W/cm^2 using seven additional UV beams. Figure 3 shows an example of measured image at 1.1 ns (near the end of RM phase) taken with 50-μm thick CH foil and tantalum backlighter. Evolution of 2D broadband modulations was observed in RM phase for all target types during a shock transit time before beginning of acceleration and subsequent RT growth. Figure 4 summarizes areal-density evolution of 2D modulation at wavelength of 70 μm for 30-μm and 50-μm thick foils and compares data with predictions of 2D hydro code DRACO. Vertical dashed lines show expected times at the end of RM phase and beginning of the RT phase for these types of foils. Blue data points and curves correspond to 30-μm thick foils, while black curves and data points are for 50-

μm-thick foils. Areal density modulations grow throughout RM phase, their evolution is similar to code predictions, validating the simulations.

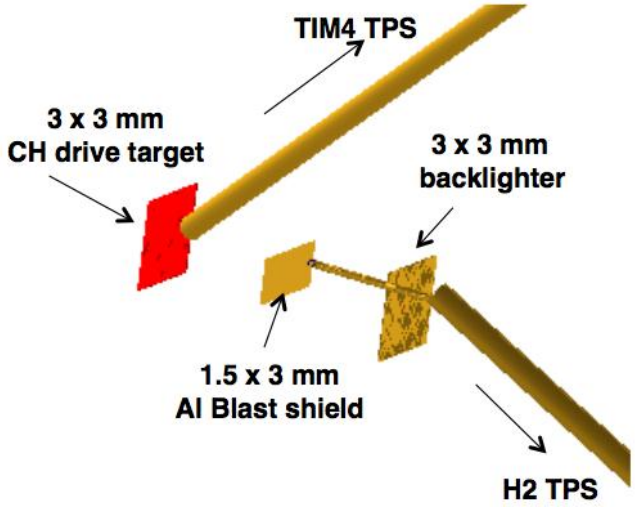

Figure 1: Experimental setup

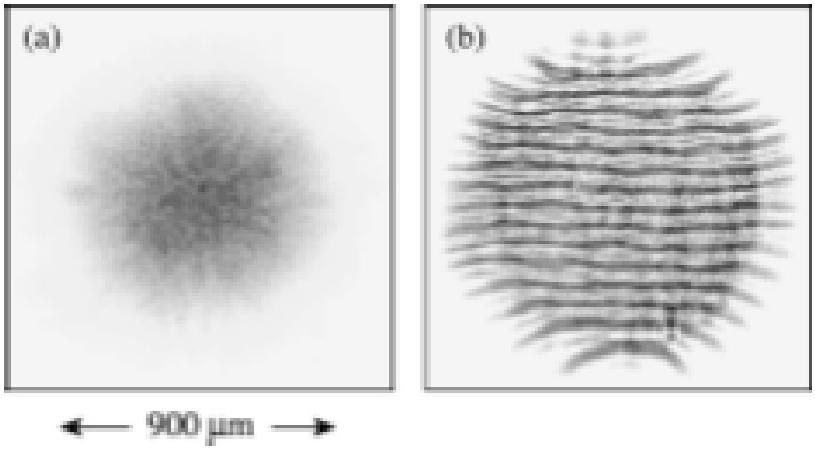

Figure 2: Laser beam images with (a) regular SG4 DPP, and (b) special 2D DPP.

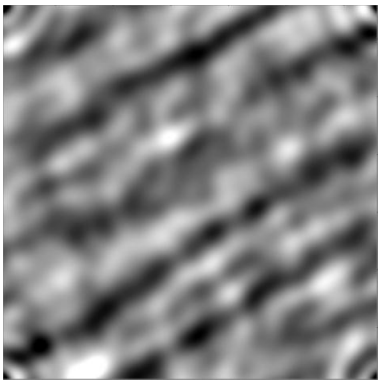

Figure 3: X-ray images of 2D broadband modulations near the end the Richtmyer-Meshkov instability growth phase measured in 50-μm thick CH targets.

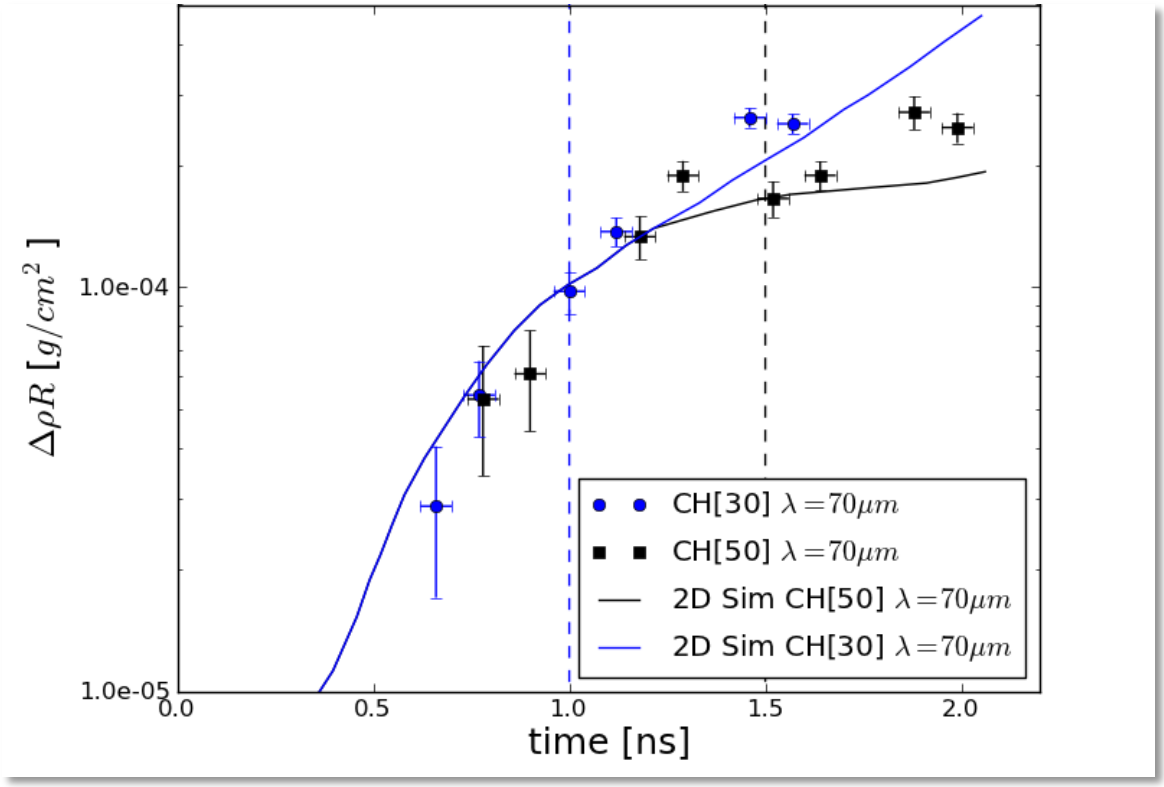

Figure 4: Evolution of 2D, areal-density modulations at wavelength of 70 μm measured in 30-μm thick foils (blue circles) and in 50-μm thick foils (black squares). Solid curves correspond to 2D DRACO simulations, while dashed vertical curves correspond to times of the end of RM phase and beginning of RT phase in 30-um thick foils (blue curves) and 50-um thick foils (black curves).

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