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Kelvin-Helmholtz Experiment

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Disclaimer

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Kelvin-Helmholtz (KH) growth experiment was performed using a platform successfully developed in earlier OMEGA experiments [1-3]. Figure 1 shows target schematic, which consists of a plastic ablator and a shock tube. In the shock tube the interface between low-density foam and high-density plastic was either flat or had pre-imposed sinusoidal modulation at a wavelength of 400 μm and amplitude of 30 μm, as in previous experiments. The central part of the plastic target contained a layer of I-doped CH to increase a contrast to 5 keV backlighter x-rays. The ablator of the target was directly driven with laser light, producing strong shock that propagated through the target. The shock produced a velocity gradient at the interface between foam and plastic. This velocity difference between two materials resulted in the KH growth of the surface modulations. The density of foam was 100 mg/cc. Previous experiments detected a mixing layer development due to 3D, short-scale modulations growing in addition to pre-imposed 2D, 400-μm wavelength modulations. New experiments were performed with flat CH-Foam interfaces; they were aimed at measurements of 3D turbulent mixing since in previous experiments the growth of large 400-μm wavelength modulations could have modified the growth of 3D short-scale modulations.

Figure 2 shows experimental data. Figures 2(a) and (b) present flat-interface data at 35 ns and 75 ns, respectively. Figure 2(c) shows data with 2D pre-imposed modulation at 75 ns, taken to confirm evolution measured in previous experiments. The shock travelled from left to right, so the modulations at the left part of the image had more time

to grow than the modulations at the right part. The light color in the image corresponded to foam material, while dark color to plastic. Mixing layer has been developed behind the shock front, as expected since the Reynolds number was high in this experiment, Re~1e6. Mix width was about ~60 μm at ~700 μm behind the shock front, inferred from the measured image at 35 ns, close to mix-model predictions. Growth of 2D pre-imposed modulations [Fig. 2(c)] was similar to previous experiments, confirming the repeatability of the drive. In addition, growth of 3D modulations at the Be tube – foam interfaces was also detected, as shown in both 75-ns images. These experimental data are used to develop and validate mix models that are based on post-processing of hydrodynamic simulations [4-6].

References:

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3. O. A. Hurricane *et al*., Phys. Plasmas **16**, 056305 (2009).
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6. O. A. Hurricane *et al*., Phys. Rev. Lett. accepted.

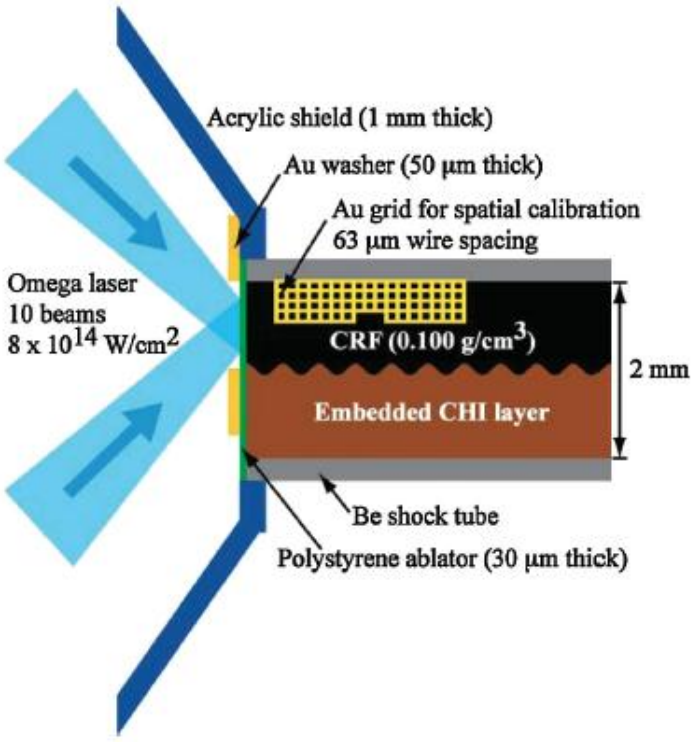
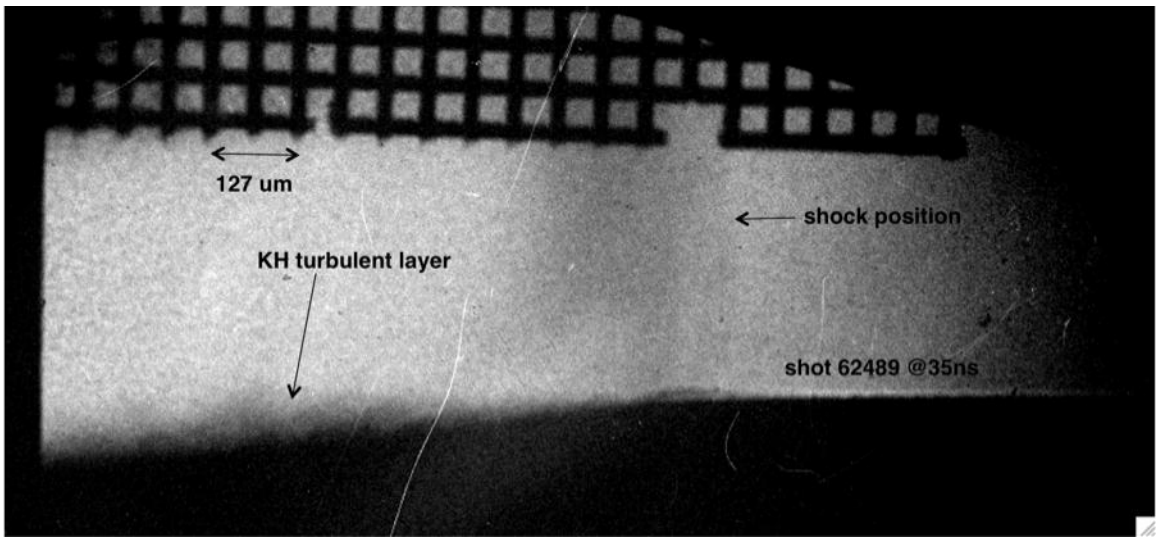
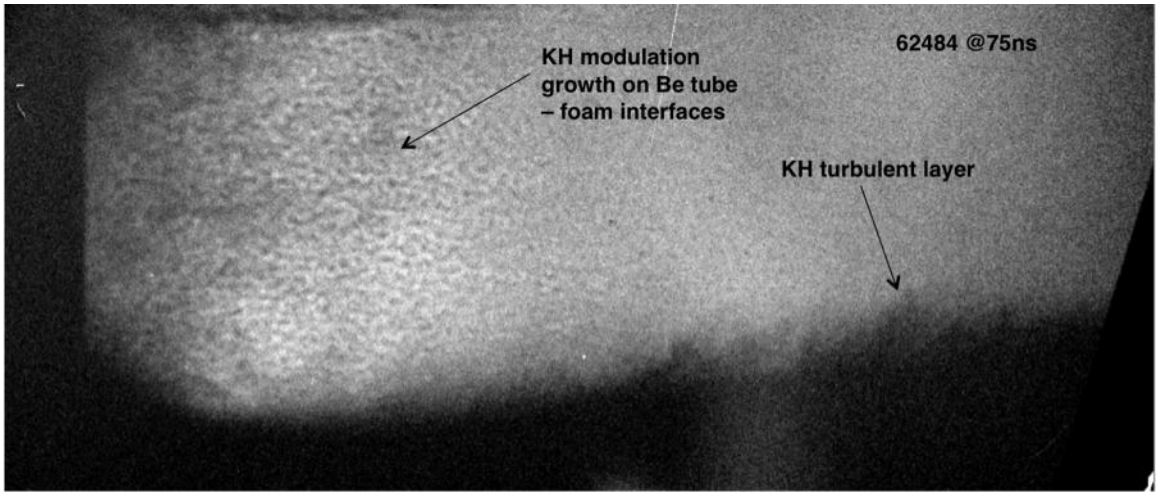


Figure 1. Experimental configuration. The interface between lower density CRF foam and higher density I-doped plastic was either flat of had a pre-imposed 2D modulation with wavelength of 400 um, as in previous experiments. The surface roughness at the interface had rms amplitude of 100 nm. The density of CRF foam was 100 mg/cc.


127 um
shock position
KH turbulent layer
shot 62489 @35ns


62484 @75ns
KH modulation
growth on Be tube
– foam interfaces
KH turbulent layer

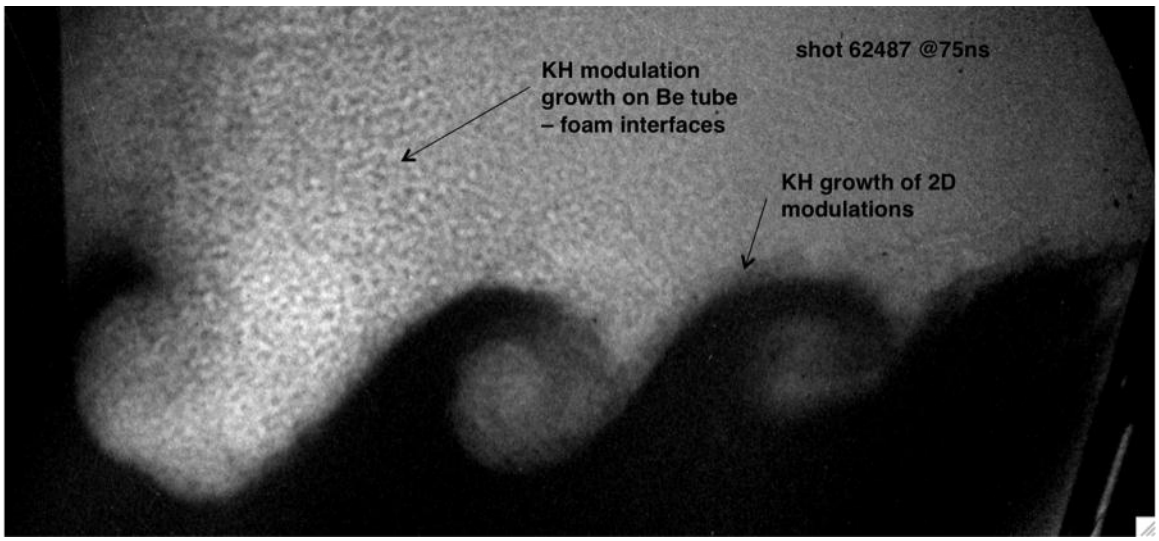

shot 62487 @75ns
KH modulation
growth on Be tube
– foam interfaces
KH growth of 2D
modulations

Figure 2. X-ray radiographs of KH growth with flat CHI-foam interface were taken at (a) 35 ns, at (b) 75 ns, and with interface having a 2D modulation at (c) 75 ns. The areas on right hand side of images experienced less KH growth than at left-hand side.

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