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Material Hydrodynamics under Heated and Shocked Conditions

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A critical goal in the inertial confinement fusion community is an understanding of the effects on capsule mixing due to target defects and surface perturbations. Ignition experiments typically rely on pre-shot target characterization to predict how initial perturbations will affect the late-time hydrodynamic mixing. However, it is the condition of these perturbations at the time of shock arrival that dominates their eventual late-time evolution. In some cases these perturbations are heated prior to the arrival of the main shock forming temperature and density gradients that may differ significantly from initial, pre-shot, conditions. A laser-based experimental platform has been developed to study these pre-heated hydrodynamic phenomena in a controlled manner. This new experimental design has recently generated extremely high quality image data on the OMEGA laser facility that has been quantitatively compared to simulation. The design allows for controlled x-ray preheat of a target and subsequent shock drive through gaps and perturbations. X-ray images have shown detailed evolution of heated gap structures at initial shock interaction and as the shock passes. Gaps are seen to "heal" and then reopen determined by the initial gap size and preheat conditions. Sufficient image resolution and dynamic range allow determination of detailed material locations and densities. These results give quantitative physical insight into the behavior of material evolution under shocked and heated conditions.