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Scaling a High-Energy-Density Shear Experiment from Omega to the National Ignition Facility (NIF)

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Shear instability in high-energy-density (HED) physics is important for elucidating issues in compressible turbulence and in understanding the late time quenching of, for example, inertial fusion capsules. A counterflowing shear experiment initially designed for the Omega Laser Facility studies shear instability in isolation by launching 100+ km/s shocks into opposite sides of a foam-filled shock tube bisected by an Al tracer plate. When the shocks cross at the tube center, a region of intense shear is created ($\sim$ 150 km/s velocity difference from one side of the plate to the other). As the tracer layer goes unstable it mixes with the surrounding foam and expands into the tube volume. Radiography recording the spreading of the mixing layer is compared to simulations using the LANL hydrocode RAGE. Analysis of this data demonstrated the likely presence of features, such as strong coupling between the thermodynamics and turbulence during the experiment, of special or unique importance to the HED regime. However, the Omega experiments are limited to 1 ns impulsive drive, compared to the 16 ns of observation times, and are dominated by transients, barely if at all reaching the state of developed turbulence. Our recent shots on the NIF take the experiment to larger volumes, to faster speeds, and to the use of indirect drive halfraums to launch steadily supported shocks. These improvements take advantage of the increased energy of the NIF to eliminate transients and drive more steadily the approach to turbulent transition. Analysis of radiographs confirms our ability to model the hydrodynamic drive and evolution, while comparing images of the developing turbulence between the two facilities suggests morphological differences related possibly to the change in drive conditions. This work was supported by the US DOE and operated by LANS under Contract No. DE-AC52-06NA25396.