DPP17-2017-001702

Abstract for an Invited Paper
for the DPP17 Meeting of
the American Physical Society

**Late-time mixing and turbulent behavior in high-energy-density shear experiments at high Atwood numbers**[1]

KIRK FLIPPO, Los Alamos National Laboratory

The LANL Shear experiments on the NIF are designed to study the Kelvin-Helmholtz instability (KHI), which is the predominate mechanism for generating vorticity, leading to turbulence and mixing at high Reynolds numbers. The KHI is pervasive, as velocity sheared and density-stratified flows abound, from accretion disks of a black holes to the fuel capsule in an ICF implosion. The NIF laser has opened up a new class of long-lived planar HED fluid instability experiments that can scale fluid experiments over impressive orders of magnitude in pressure ( up to $>$ Mbar), temperature ( $> 10^5$ K) and space ($<$ 10s of $\mu$m) and still recover classical fluid instability behavior, and elucidate mixing and plasma effects. The reproducibility allows for the unique capability in an HED experiment to directly measure values comparable to those in the mix model, the Besnard-Harlow-Rauenzahn (BHR[3]) model implemented in the LANL hydro-code RAGE, like the mixedness parameter, $b$, and the turbulent kinetic energy using the observed coherent features. We have acquired time histories of 4 tracer materials and 3 surface finishes spanning dynamic Atwood numbers from 0.63 to 0.88 and developed Reynolds numbers around $10^6$. When the shocks cross, the layer is exposed to extreme shear forces and evolves into KHI rollers from an unseeded (but naturally broadband) surface. Two sets of data are acquired for each material type: an edge-view and a plan-view, through the plane of the material. The results hint at plasma physics effects in the layer. The edge-view is compared to BHR calculations, to understand mixing and layer growth. The BHR model matches the evolution and asymptotic behavior of the layer, and the initial scale-length used for the model correlates well to initial surface roughness, even when the surface is artificially roughened, forcing the layers evolution from coherent to disordered.

[1]This work performed under the auspices of the U.S. Department of Energy by LANL under contract DE-AC52-06NA25396.