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Observation and modeling of mixing-layer development in HED blast-wave-driven shear flow[1]

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This talk describes work exploring the sensitivity to initial conditions of hydrodynamic mixing-layer growth due to shear flow in the high-energy-density regime. This work features an approach in two parts, experimental and theoretical. First, an experiment, conducted at the OMEGA-60 laser facility, seeks to measure the development of such a mixing layer. This is accomplished by placing a layer of low-density (initially of either 0.05 or 0.1 g/cm^3, to vary the system's Atwood number) carbon foam against a layer of higher-density (initially 1.4 g/cm^3) polyamide-imide that has been machined to a nominally-flat surface at its interface with the foam. Inherent roughness of this surface's finish is precisely measured and varied from piece to piece. Ten simultaneous OMEGA beams, comprising a 4.5 kJ, 1-ns pulse focused to a roughly 1-mm-diameter spot, irradiate a thin polycarbonate ablator, driving a blast wave into the foam, parallel to its interface with the polyamide-imide. The ablator is framed by a gold washer, such that the blast wave is driven only into the foam, and not into the polyamide-imide. The subsequent forward motion of the shocked foam creates the desired shear effect, and the system is imaged by X-ray radiography 35 ns after the beginning of the driving laser pulse. Second, a simulation is performed, intending to replicate the flow observed in the experiment as closely as possible. Using the resulting simulated flow parameters, an analytical model can be used to predict the evolution of the mixing layer, as well as track the motion of the fluid in the experiment prior to the snapshot seen in the radiograph. The ability of the model to predict growth of the mixing layer under the various conditions observed in the experiment is then examined.

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