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Self-similar hydrodynamics at low & high energy density

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ABSTRACT

Many advances have been made toward the understanding of turbulent mixing due to the classic hydrodynamic instabilities of Rayleigh-Taylor (RT), Richtmyer-Meshkov (RM) and Kelvin-Helmholtz (KH). The results have been captured in engineering models, such as the K-L model [1], that are then incorporated into multi-physics codes in order to describe applications such as inertial confinement fusion (ICF). Such models are validated using experiments, high-resolution 3D numerical simulations and analytic solutions for reduced unstable flows. In this talk, I review our validation efforts and summarize some of the outstanding issues we are studying. We begin by clarifying the single mode behavior of these instabilities [2, 3] that underlie the self-similar models in order to describe the effect of initial conditions on the turbulent growth rates [4, 5]. Additional experimental and numerical studies are described to study outstanding issues such as the effect of convergence on turbulent mixing, the shock-turbulence interaction, the stabilizing role of material strength, and the atomization rates in the fluid and solid regimes. These are studies are used to validate our mix models but also to develop a new model for ejecta formation based on the RM instability in solids. This ejecta model is being informed and tested with experiments and multi-scale numerical simulations, some of which are being performed with the Peta-Flop/s Roadrunner computer at LANL.

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