Designing of Aspherically-Diverging, Multi-Interface Experiments to Model Rayleigh-Taylor Growth in Supernovae

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One branch of work in the laboratory astrophysics community has been focused on developing the understanding of hydrodynamic mixing in supernovae. Current experiments have been limited to studying these processes in planar systems due in large part to limitations of drive energy. The National Ignition Facility (NIF) is now capable of providing experiments with far more than ten times the energy than has been previously available on laser facilities. In the context of supernova-relevant high-energy-density physics, this will enable experiments in which hydrodynamic instabilities develop from a blast-wave driven through multiple, coupled interfaces in a diverging system. This presentation discusses the design of such target designs, both spherical and aspheric, in which the relative masses of the layers are scaled to those within the star. It reports scaling simulations with CALE to model the global dynamics of such experiments. The simulations probed the instability growth and multi-interface interactions in mass-scaled systems to assess the diagnosability and experimental value of different designs using a variety of materials. Analysis of cases using non-uniform drive across the inner radius of the target will determine whether an experiment investigating aspheric supernova is a feasible extension from the current design and what observable dynamics would be able to be expected.

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