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High-Energy Density Hydrodynamics for Astrophysics and Fusion.¹

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High-energy-density (HED) science is the study of ionized material under extreme pressures (> 1 Mbar), which can alter the very atomic properties of matter. Many astrophysical systems are HED, from the interiors of gas giant planets to supernovae, and it is only with the modern development of large laser and pulsed power systems that scientists are able to create and study HED materials in the lab to gain insight into these phenomena. A fundamental question for understanding these systems is whether or not low-pressure, classical-hydrodynamic phenomena scale to high-pressure, high-density plasmas. This question is especially important in systems with significant hydrodynamic instability growth and turbulence, where mixing of materials can substantially change the temperature, pressure, and composition of the system. Prime examples of this phenomena are the dynamics of collapse and expansion of stars into supernovae and the quenching of inertial confinement fusion (ICF) experiments by mixing cold material into the hot fuel. In this talk we present some background on HED science as well as discuss recent work on laser-based HED hydrodynamic instability-growth and turbulence studies at Los Alamos National Laboratory.

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