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Bayesian Inference of Energy Transfer in Gigabar Convergent Experiments[1]

JOHN RUBY, Lab for Laser Energetics

High-energy-density experiments (HED) in convergent geometry can produce extreme thermodynamic states at pressures in excess of 1 Gbar (~10^9 atm). Understanding the flow of energy in these dynamic experiments is critical to constraining the states that are produced and in using these platforms to understand fundamental physics in extreme environments. Diagnostic measurements of these implosions are highly integrated (i.e., over space, time, spectrum), and quantitative deduction requires advanced approaches to how experimental data is analyzed. In this work the self-emission of an in-flight, laser-driven, glass shell interacting with a gigabar rebounding shock wave is measured giving the outgoing trajectory of the shell. These measurements in conjunction with a mechanical model of the shell, conservation laws, and Bayesian inference techniques are used to infer the complete trajectory of the shell and the temporal history of the pressure profile at the shell-fuel interface. This combination of in-situ measurements results in the temporal history of the kinetic energy of the inflight shell and the time history of the work done on the fuel by the shell in a self-consistent picture. This technique can be applied to a variety of different implosion types to infer the flow of energy and constrain the assembled HED states.

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