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Spherical Strong-Shock Generation for Shock-Ignition Inertial Fusion

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Recent experiments on the Laboratory for Laser Energetics' OMEGA laser have been carried out to produce strong shocks in spherical (SSS) targets. The shocks are launched at pressures of several hundred megabars and reach gigabar pressures upon convergence. The results are relevant to the validation of the shock-ignition (SI) scheme and to the development of an OMEGA experimental platform to study material properties at gigabar pressures. The SSS experiments investigate the strength of the ablation pressure and the hot-electron production at overlapping beam laser intensities of ~ 3 to 5×10^{15} W/cm^2. The measurements demonstrate the generation of convergent shocks launched by an ablation pressure of 300 Mbar, which is crucial to validate the SI concept and to develop an SI target design for the National Ignition Facility. The timing of the x-ray flash from shock convergence in the center of a solid plastic ball target doped with a small amount of Ti is used to infer the shock velocity and pressure in the experiment. It was found that the hot-electron temperature was moderate (<100 keV) and the instantaneous conversion efficiencies of laser energy into hot electrons reached $\sim$ 10% to 20% in the intensity spike. The large amount of hot electrons is correlated with an earlier x-ray flash time and a strong increase ($\sim 25\times$) of the flash intensity. This suggests that hot electrons contribute to the augmentation of the shock strength. This work was supported by the U.S. DOE under DE-NA0001944, DE-FC02-04ER54789.

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