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Characterization of laser plasma coupling in the Shock-Ignition Regime

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In 2007 Betti et al. [1] proposed a novel approach to ICF. It consists of igniting the target by a very strong converging shock (P≈ several hundreds of Mbar), produced by intense laser spikes (1e16W/cm2). The shock must hit the target at the end of the compression phase and before the stagnation of the target center. The scheme represents a very attractive solution for HiPER high repetition rate regime. Within this framework, we performed an experiment at the Prague Asterix Laser Laboratory, using two beams of the PALS source, with time duration of 300ps. The first beam, at intensity I=1.2 e13W/cme2, was used to create almost 1 mm preformed plasma, and the second, at I=10e16W/cme2, to create the shock for compressing the central part of the pre-compressed fuel and reaching ignition conditions.
Several diagnostics were employed to characterize either the preformed plasma (Phase 1) or the shock formation and laser plasma interaction Phase 2). They include: Phase 1 –X-ray deflectometry for the plasma density profile; X-ray spectroscopy and x-ray pin-hole cameras to get plasma temperature but also to give evidence of the presence of hot electrons.
Phase 2 –Energy Encoded pin-hole camera to measure plasma extension and characterize its emission; shock cronometry to measure the ability to produce a strong shock and the effect of the extended plasma corona on the laser-shock coupling; optical imaging, spectroscopy, and calorimetry to get the amount of backreflected light from parametric instabilities (SRS, SBS, TDP).

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