Laser Plasma Instability in Indirect-Drive Inertial Confinement Fusion on Shenguang Laser Facilities

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The goal of laser plasma instability (LPI) study in the indirect-drive inertial confinement (ICF) fusion is to minimize its uncertainty during the coupling of laser energy to capsule. Because the quantitative interpretation of LPI reflectivity has always been a major challenge, continuous experimental efforts on laser-plasma couplings are conducted in different irradiation and plasma condition on Shenguang laser facilities.

These works focus on two major issues. First is suppressing the scattered light at acceptable levels to enable the exploration of high energy density physics on the existing laser facility, which is always achieved by optimizing the target design and beam smoothing. Second is assessing the LPI risk in the future laser fusion scheme on the next generation of laser facility in which the LPI gain was insufficient to have noticeable effects on energetics or symmetry. It is achieved by deliberately producing a large scale plasma and high laser intensity consistent with future ignition target design.

Reported here are experimental researches of laser plasma instabilities (LPI) conducted on Shenguang laser facilities during the past ten years. These researches generally consist of three phases: 1) developing platforms for LPI research in mm-scale plasma with limited drive energy, where both gasbag and gas-filled hohlraum targets are tested; 2) studying the effect of beam smoothing techniques, such as continuous phase plate and polarization smoothing, on the suppression of LPI; and 3) exploring the factors affecting LPI in integrated implosion experiments, which include the laser intensity, gas-fill pressure, LEH size, and interplay between different cones of beams. Results obtained in each phase will be presented and discussed in details.

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