Laser-Plasma Instabilities of Frequency Doubled Pulses at the Extreme Light Infrastructure's L4 Beamline

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Laser Plasma Instabilities (LPI) are one of the principal problems in laser-driven inertial confinement fusion (ICF) schemes. When these instabilities grow, plasma becomes turbulent, scattering laser energy and producing hot electrons that can pre-heat a compressing ICF target [1]. Thus, minimizing LPI effects is of significant concern when designing laser-based inertial fusion energy facilities. ICF systems generally employ short wavelength lasers, in the ultraviolet range, as LPI effects scale strongly with wavelength. As such, instabilities of particular concern, such as Stimulated Raman Scattering (SRS), Stimulated Brillouin Scattering (SBS), and Two Plasmon Decay (TPD), have been well characterized in the UV regime [2]. However, high frequency light comes with some significant drawbacks. First, converting to the higher frequencies (3ω of Nd:glass lasers) loses laser energy that can otherwise be irradiated on target. Second, it can inflict significant damage to the optics in the laser chain. Compared to optics for green light (2ω of Nd:glass lasers), developments in UV optics have been slow to achieve durability to the higher photon energies associated with UV light. Recent literature indicates that 2ω light has promise as an ICF driver but these LPI effects have a lower threshold compared to 3ω [3,4]. This calls for further study of LPI with green light. To this end, we have built a backscatter diagnostic to measure SRS, SBS, and TPD at the Extreme Light Infrastructure's L4n beamline. This work details measurements made with this diagnostic of laser-plasma instabilities of a 527 nm laser (intensities ranging from 0.5×10−13 W/cm^2 to 1.6×1015 W/cm^2) with a plane solid target during commissioning of the beamline.

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