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Laser Plasma Instabilities at Large-Angle Oblique Laser Incidence

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Laser plasma instabilities (LPI) is a critical concern in inertial confinement fusion (ICF) due to the fuel preheating risk and its impact on the laser coupling efficiency. When a laser is obliquely incident at a large angle with respect to the plasma density gradient, the turning-point density where the laser gets reflected can be lowered to near its quarter-critical-density region. This region is overlapped with the density range where stimulated Raman scattering (SRS) and Two-plasmon decay (TPD) can be excited. Both the fluid simulations and the PIC simulations using OSIRIS show that TPD can be enhanced significantly when the angle is close to 60º. The TPD thresholds can be largely reduced under this configuration and a formula for the TPD threshold is obtained by theoretical analysis and numerical simulations. PIC simulations show that significant amount of hot electrons can be produced by an obliquely incident laser whose intensity is even an order of magnitude lower than typical ICF laser intensities, posing a potential preheating risk for ICF. The optimal incident angle for hot electron generation is found ~60º. The dominant type of LPI is found to switch from TPD to SRS when the incident angle is larger than 60º.