Scaling of hot electron generation from two plasmon decay instability

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Hot electrons (HE) are a key component for Inertial Confinement Fusion (ICF), in particular for fuel pre-heat concerns [1], which can negatively impact the target's fusion yield. Laser plasma instabilities (LPIs) that occur in the coronal plasma are responsible for HE generation; an example common to OMEGA and sub ignition pulses is Two Plasmon Decay (TPD), a type of LPI where an electromagnetic wave decays into two electron plasma waves (EPWs) [2]. Electrons can acquire high energies either through Landau damping of EPWs that are trapped and subsequently amplified by a collapsing caviton [3]; or through EPW wave breaking [4] due to a local field increase up to a critical value, after which strong turbulence and HE generation appear.
Understanding how plasma and laser parameters dictate hot electron generation is an important step for proposing robust and credible ICF designs. Ultimately, hydrodynamic codes should include the generation and propagation of HEs from LPIs. To that end, we conduct a parametric study of HE generation through the use of the hybrid simulation code Laser Plasma Simulation Environment (LPSE) [5], to model HE generation in a parameter space of laser and plasma conditions, from which common HE quantities and behaviors have been investigated. The data will then be used as input parameters for macroscopic systems in hydrodynamic codes simulations.
We present an investigation of absolute TPD in 2D, in the presence of the saturation processes of Langmuir Decay Instability (LDI) and laser pump depletion. A scaling analysis of HE conversion fraction, temperature, transmission and angular distribution has been performed, depending on the parameters T_e, T_i/T_e, $I/I^{TPD}_{threshold}$ and L_n, over a set of 240 LPSE simulations. A preliminary investigation of the introduction of SRS in the system and its competition with TPD for the laser energy, will also be presented.

References

[1] A. Colaitis, G. Duchateau, X. Ribeyre, et al., Phys. Rev. E 92 041101 (2015); 10.1103/PhysRevE.92.041101

[2] William L. Kruer, the Physics of Laser Plasma Interactions, Westview Press

[3] V.E.Zakharov, Soviet Physics JETP, Novosibirsk State University 35, (1972)

[4] T. P. Coffey, The Physics of Fluids 14, 1402 (1971); 10.1063/1.1693620

[5] R.K. Follett, J.G. Shaw, J.F. Myatt, et al., Physics of Plasmas **26**, 062111 (2019); 10.1063/1.5098479