L-O5 AAPPS-DPP2018

2nd Asia-Pacific Conference on Plasma Physics, 12-17,11.2018, Kanazawa, Japan

Novel technique of direct laser energy absorption by ions

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The well known mechanisms of laser energy absorption (resonance absorption , Brunel mechanism, **JxB** heating, collisional absorption, etc.) in plasma is mediated by the lighter electron species. The subsequent heating of the plasma then depends on the electron ion coupling which in general is not efficient. It is, therefore, of interest if a mechanism of direct coupling of laser energy to ions can be devised. It is shown here with the help of 2-D Particle - In - Cell (PIC) simulations using OSIRIS-4.0 that in the presence of external ambient magnetic field this can be achieved with the help of pulsed long wavelength CO_2 lasers[1,2]. Two different mechanisms have been identified by us. The first one relies on the fact that the **ExB** drift (in the presence of oscillating electric field of the laser and the ambient external magnetic field) is different for electron and ions. This leads to a charge separation and triggers ion plasma oscillations as the electrons remain tied strongly to the magnetic field. This leads to the preferential heating of ions. The second mechanism happens when the laser beam is chosen to have a transverse spatial profile. In this case it is demonstrated that the ponderomotive effect plays a role and leads to a preferential heating of ions. A detailed study of these techniques will be presented.

References:

[1] A. Kumar et.al arXiv:1804.02200v2[physics-plasm-ph],2018

[2] Atul Kumar et.al arXiv:1804.08327 [physics.plasm-ph], 2018