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Novel Boundary driven mechanism of generating long scale magnetic fields and charge density fluctuations in laser plasma interaction

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The conventional mechanism of long scale magnetic field generation in laser plasma interaction primarily relies on Weibel instability [1,2]. However, in this scheme the magnetic field initially forms at the skin depth scale and nonlinear cascade is the only process by which long scale magnetic field can possibly get generated. There are indications from certain experiments [3,4], that magnetic spectra at scales much longer than the skin depth is observed at very early times. In the talk a new mechanism of long scale magnetic field generation will be presented which occurs much before the Weibel instability would set in [5]. Analytical description and Particle – In- Cell (PIC) studies using OSIRIS have been provided to illustrate this mechanism. It essentially relies on the finite transverse extent of the beam current. The oscillating beam current acts as an antennae releasing electromagnetic radiation. The radiative leakage in turn acts as a source for certain dissipative phenomena leading to long scale magnetic field generation at the scale size of the beam width. Our studies show that the beam width matters but the sharpness of the beam profile is inconsequential. At slower evolution time scales some electrostatic charge density fluctuations are also observed which have been identified as the upper hybrid fluctuations [6].

References

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