Seminar

Institute for Plasma Research

Title : Radiation Reaction Effects on Laser Driven Acceleration of Charged Particles

Speaker: Mr. Shivam Kumar Mishra
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Date : 13th December 2021 (Monday)

Time : 10.00 AM

Venue : Online - Join the talk:
https://meet.ipr.res.in/Shivam_synopsis

Abstract :

The relativistic motion of a charged particle placed in an electromagnetic wave is a problem of fundamental interest and is of relevance for investigating the interaction of intense radiation with matter. Present day laser intensities can reach up to the order ~1023 W/cm2 and in very near future are expected to increase by two or more orders of magnitude. Under such extreme conditions, radiation reaction forces become extremely important. In the present thesis, radiation reaction effects on the relativistic dynamics of a charged particle placed in an intense light wave is studied analytically as well as numerically using in-house developed test particle codes. It is observed that in contrast to cases where radiation reaction effects are negligible, inclusion of radiation reaction effects allow the charged particles to accelerate to high energies by extracting energy from the incident light wave. The process of energy gain has been investigated in detail, in the present thesis under different conditions using the physically appealing Hartemann-Luhmann equation of motion and compared with other equations viz. Landau-Lifshitz and Ford O'Connell equations.

The Hartemann-Luhmann equation has been modified for analytical tractability following the prescription used by Landau-Lifshitz. It is found that the energy gain is independent of model equation and also independent of polarization of the wave. The above studies have further been extended to include focusing effects and an external static axial magnetic field along the direction of the propagation of the wave. Briefly put the main results are as follows. Inclusion of focusing effects show that irrespective of the choice of the initial conditions particles go through the focal point thus gaining forward energy; this is in sharp contrast from the reflection scenario observed in previous works. In the presence of static axial magnetic field, which is the scheme of auto-resonant particle acceleration, it is seen that particles gain energy even if the resonant condition is not satisfied; also under certain conditions non-resonant particles may even gain more energy than the resonant particles. In this synopsis talk the above results would be presented in detail.