Seminar

Institute for Plasma Research

Title : Excitation of plasma wakefields by intense ultra-relativistic proton beam

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Date : 29th July 2020 (Wednesday)

Time : 03.30 PM

Venue : Online-join the talk:
https://meet.ipr.res.in/dr.mithunKarmakar_pdftalk

Abstract:

In the plasma based particle acceleration scheme, a real challenge is to accomplish the energy frontier of the present day high energy physics research i.e. to accelerate a charged particle up to an energy which is in the range of several TeV. A proton bunch carrying energy of the order of ~ kJ is capable of accelerating electrons to that energy limit. We attempted to explore the physics of such proton beam driven wake wave excitation process. We have developed a detailed theoretical model to describe stationary profiles of the wake field structures of the proton beam driven strong nonlinear plasma wave. It brings out the underlying physics of longitudinal electric field characteristics of the excited wake wave formed behind the drive beam.

The results are further supplemented by a fully relativistic particle in cell (PIC) code OSIRIS in 2D geometry. The plasma and beam parameters in the simulation are chosen in conformity with current experimental works (Plasma Density of 1.0×10^{14} /cm^3, Proton beam size of 9.3 mm × 5.3 cm) and it provides us the anticipated axial and transverse electric field profiles. The investigation is further extended by providing an analytical description of the wake wave excited by equi-spaced train of small proton bunches with the inclusion of the non-relativistic plasma ion dynamics. Our results show that the amplitude of the wake field does not grow indefinitely with the increase in the number of proton bunches. On the contrary, it saturates to a definitive limit. This investigation will have significant impact in the interpretation of the experimental observations, numerical simulation, or within the acclaimed AWAKE (Advanced Wake Field Acceleration) project at CERN devoted to achieve TeV order of particle energy by using proton drive beam.