Seminar

Institute for Plasma Research

Title : Excitation of wakefields and propagation of localized coherent structures in laser / beam-plasma systems

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Date : 17th January 2019 (Thursday)

Time : 03.30 PM

Venue : Committee Room 4, (New Building), IPR

Abstract :

The interaction of ulra-intense laser or ultra-relativistic electron beam with the plasmas exposes variety of nonlinear features having paramount importance in the areas of fast ignition laser fusion, generation of charge particle beams, bright source of X-rays, Gamma-ray flashes and generation of higher order harmonics, positron emitters for PET (positron emission tomography), and ultra-high energy cosmic rays (UHECRs) generation etc. We have explored several such novel nonlinear features in laser/beam-plasma interaction systems both analytically and numerically.

First, we have studied the excitation and breaking of a "Khachtryan mode", a relativistically intense electron-ion mode in a cold plasma, using fluid simulation techniques. To excite the wave, we have employed a relativistic, rigid electron beam inside a cold plasma. The beam drives a wake wave (wakefield) which is identical to corresponding Khachatryan mode. It is seen that the excitation eventually breaks after several plasma periods. The wave breaking time has also been scaled with the beam-plasma parameters.

In second problem, with the help of fluid and Particle-In-Cell (PIC) simulation techniques, we have studied the time dependent 1-D propagating localized structures in laser plasma system. Perturbing the localized stable structure, we have observed that the perturbed solutions form their nearby stable solution by radiating the excess amount of radiation. The results obtained from PIC simulations show a good agreement with the fluid-results, before the wave breaks.

Next, we have studied the propagation of magnetic dipoles in an inhomogeneous background plasmas using fluid simulation techniques. It is shown that the electron current pulse can be collimated and guided along a desired path by a suitable choice of plasma density profile. We have also demonstrated that a single electron current pulse can be bifurcated and send to distinct locations in a plasma.