

Seminar

Institute for Plasma Research

Title : Tunable THz Radiation and Positron Generation by Dark Hollow Laser Beams

Speaker: Dr. Sheetal Punia
Indian Institute of Technology Delhi

Date : 12th February 2021 (Friday)

Time : 03:30 PM

Venue : Online - Join the talk:

https://meet.ipr.res.in/Dr.SheetalPunia_PDFtalk

Abstract :

Terahertz (THz) frequency (wavelength 1 mm to 0.1 mm) encircles various molecular vibrations (e.g., torsional, crystalline phonon, and intermolecular) that divulge important information about the chemical structure of a test sample instead of just their chemical make-up. In most of the explored schemes, the THz radiations generally emit with their highest intensity at a single point, while medical applications demand these radiations to peak at two or more places in a controllable manner. During my PhD tenure at IIT Delhi, I have analytically proved multifocal THz radiation by launching the dark hollow beams, having doughnut-shaped intensity distribution, in the plasma.

To explore all the features of plasma phenomena, the plasma behavior was studied in the presence of both external electric and magnetic fields. A special focus was then given in controlling the polarization of the emitted THz radiation based on the application of wiggler and solenoidal magnetic fields. Actually, the control over the electromagnetic vector of the emitted field (i.e., polarization) furnished the knob of another degree of freedom, which is very useful in numerous applications. In addition to this, the tuning of frequency of emitted radiation with laser, plasma, and magnetic field parameters was achieved. The suppression or the enhancement of any peak of the THz field by optimizing the wavenumbers of the density ripples and laser beams, beam orders, and the strength of the periodic field was found to be vital for the medical applications where one needs to tune the power and focusing of the THz radiation in diagnostics and treatment of the cancerous cells.

In addition to the above schemes, I had explored another phenomenon for the positron generation. Employing the Breit-Wheeler process, feasibility of positron generation was analyzed under quasistatic approximation by impinging Laguerre-Gaussian (LG) laser beam in an underdense warm plasma. During laser-plasma interaction, the electrons were found to execute transverse betatron oscillations inside the doughnut-shaped ion channel. There was also an on-axis sheath formation that can be used to focus and accelerate positrons. The calculations regarding pair-production and the energy associated with the high-energy photons radiated by accelerated charged particles were made to control the dynamics of electrons and emission of strong magnetic field.
