Seminar

Institute for Plasma Research

Title : Terahertz Emission Using Laser-Plasma Methods
Speaker: Dr. Prateek Varsheney
IIT, Delhi
Date : 4th December 2020 (Friday)
Time : 03.30 PM
Venue : Online - Join the talk:
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Abstract :

The regime of terahertz (THz) radiations that are invisible to naked eyes lies in between microwave (photonics) and infrared (electronics) frequency regions of electromagnetic wave spectrum. THz technology has significant applications in various areas e.g. natural sciences, sensing, imaging, wireless communication and manufacturing industry. THz radiations can be classified as incoherent, broadband coherent and narrowband coherent radiations. Photoconduction and optical rectification are considered as conventional methods to generate broadband THz radiations. The photoconduction approach uses high speed photoconductors as transient current sources in the form of radiating antennas1 . Conventional narrowband THz emitters generally employ either the current surge in a large area photo excited semiconductor bias or intrinsic surface properties or optical rectification in second order nonlinear crystals2 . Since plasmas has no damage threshold limits, High-intensity short-pulse laser–plasma interaction at relativistic intensities is considered to be very good tabletop sources of highly energetic electrons, protons, ions as well as photons with high and low frequencies, ranging from hard x-rays to THz and even down to GHz frequencies. THz radiations generated in laserplasma methods are highly energetic, ultrashort and ultra-broadband in nature with wavelength ranging from the microwave to the infrared. The basic mechanism to generate THz radiations from laser-plasma is to sustain transverse current in plasmas. Experimentally, THz radiations have observed using laser filamentation3 and photoionization4 in plasmas with highly intense ultra-short picosecond or a femtosecond range laser pulses.
Out of various schemes based on laser plasma interaction, tunable and more efficient THz radiation can be generated by beating of two lasers (with different frequencies and wave numbers) in non-uniform plasmas. Density ripples are considered to introduce extra momentum (in propagation direction) to achieve exact phase matching condition for maximum energy transfer between nonlinear ponderomotive force (at difference frequency) and nonlinear current which is responsible for the excitation of THz radiation. THz sources based on beating can also be scaled to high peak powers. We have used laser profiles in the form of plane wave and short pulses (Gaussian, super-Gaussian, spatial triangular and cosh-Gaussian) to generate efficient THz radiations 5-10. A transverse static magnetic field has also been introduced to improve the tunability and directionality of excited THz radiation11 . Further, the study has also been extended in clustered plasmas using the shaped laser pulses to generate the energetic and efficient THz radiations12 .

References

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