Seminar

Institute for Plasma Research

Title : Interferometric Observation of Laser-Plasma Induced Shockwaves And Laser Confocal Imaging

Speaker: Dr. Kaushik Choudhury, PhD, IIT Bombay, Monash University, Melbourne, Australia

Date : 1st October 2020 (Thursday)

Time : 3.30 PM

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

Abstract :

Interaction of nanosecond laser pulse with metal results in ablation of the metal and generation of transient plasma plume. The plume expands rapidly due to the temperature and pressure gradient an subsequently shockwaves are generated. These shockwave propagates in the medium compressing the medium ahead of shockfront while leaving a trail of rarified medium behind it. Essentially researchers earlier observed the shockfront and calculated shock velocities, pressure and temperature at the front; based on the shadowgraphic images recorded at different instances of time and finding the position of shockfront from these images. Eventually, reflection of shockwaves due to physical barriers was also observed and, interestingly, it was found that reflected shockwaves affects the emission spectra of the laser-produced plasma (LPP).

On these lines, attempts have been made to carry out a time-resolved wholefield observation of the LPP-induced shockwaves in air as well as liquid media of different densities. Interferometry was employed as the tool of observation and the refractive index changes in the medium due to the compression and rarefaction were quantified. The same observations were also made for reflected shockwaves and it was observed that the reflection of shock causes a delay in the thermalisation of plasma plume. Similar observations were made in liquid media (by carrying out ablation of metal in liquid media) and the effect of density on the shock propagation was also observed. There were considerable differences in the effects that the shockwaves created in air an liquid media.

Laser ablation has been used for in-situ fabrication of nanoparticles in liquid media for quite some time now. Observations made earlier were applied to the production of nanoparticles using laser ablation and it was found that placing physical boundaries, in the vicinity of the ablation site, and subsequent reflection of the shockwaves, has a bearing on the size-distribution of the nanoparticles produced. This was attributed to the variation in the thermalisation time due to the reflection of the shockwaves.

Apart from interferometry laser has also been used for confocal microscopy, which resulted in images with enhanced depth resolution. Working in this direction an indigenous confocal laser microscope was developed and tested. Optically sliced images were recorded and the slices were put in tandem to reconstruct the 3D microscopic object.. Further enhancements in this direction may lead to an integrated imaging modality.