Tata Institute of Fundamental Research
Survey No. 36/P, Gopanpally Village, Serilingampally, Ranga Reddy Dist., Hyderabad – 500 046

Internal Seminar

Particle Acceleration from sub-micron targets

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Laser-plasma interactions play a crucial role in high-energy particle generation and acceleration, where target geometry and pre-pulse shaping significantly influence energy transfer. In our previous work with 15-micron spherical targets, we observed a notable enhancement in electron temperature, increasing from 50 keV to 200 keV due to the presence of the pre-pulse. Electrons were accelerated to MeV energies, a phenomenon attributed to pre-pulse-driven pre-plasma formation and plasmon excitation. Remarkably, when we scaled down to targets comparable in size to the laser wavelength, we observed the same enhancement, demonstrating that the pre-pulse effect remains significant even for smaller targets.

Traditional radiation hydrodynamics models, commonly used to simulate plasma evolution, were insufficient for our setup due to the target size approaching the laser wavelength. As the target becomes smaller, the laser energy absorption efficiency decreases, leading to inaccuracies in energy transfer calculations. To address this, we are developing a novel computational approach that couples a Finite Difference Time Domain (FDTD) electromagnetic solver with plasma equations. While this approach is still under development, it aims to provide new insights into the early plasma dynamics, potentially improving our understanding of the interaction in targets of dimensions comparable to the laser wavelength and informing future modelling efforts.

Monday, Feb 3rd 2025

14:30 Hrs

Seminar Hall, TIFRH