P 24: Laser Plasmas

Time: Friday 11:00–12:00 Location: KH 01.013

P 24.1 Fri 11:00 KH 01.013

Characterization of Reflected Light Properties in PIC Simulations — •Vidisha Rana[1,2], Milenko Vescovi[1,2], Marvin E.P. Umlandt[1,2], Franziska Paschke-Brühl[1,2], Richard Pausch[1], Pengjie Wang[1], Tim Ziegler[1], Karl Zeil[1], Ulrich Schramm[1,2], and Thomas Kluge[1] — [1]Helmholtz-Zentrum Dresden-Rossendorf — [2]Technische Universität Dresden

Laser-driven ion accelerators offer several advantages over the conventional ones due to their potential of achieving high accelerating gradients over small distances. Recent experiments have demonstrated that one can achieve significantly high proton energies by modifying the temporal profile and controlling the spectral phase of laser pulses, specifically using Group Delay Dispersion (GDD). However, the entire mechanism still needs to be understood.

Reflected light properties provide a powerful diagnostic tool for understanding these interactions and optimizing proton energies. Experiments involving ultrashort laser pulses interacting with thin foils reveal prominent spectral shifts across changing GDD values. These shifts can offer valuable insights into plasma dynamics, relativistic surface motion, and laser contrast effects, which have a direct impact on proton energies but remains difficult to interpret solely through experiments. This challenge can be addressed by employing Particle-in-Cell codes to simulate these interactions to analyze the underlying mechanisms. By bridging the gap between experimental observations and theoretical predictions, this work aims to advance our understanding of laser-plasma interactions and optimize laser-driven ion acceleration.

P 24.2 Fri 11:15 KH 01.013

Expansion of Nano Rods under Realistic Laser Contrast in 2D PIC Simulations — •Franziska-Luise Paschke-Brühl[1,2] and Thomas Kluge[1] — [1]Helmholtz-Zentrum Dresden-Rossendorf — [2]Technische Universität Dresden

We present a computational study investigating the pre-expansion of 10 um long, 100 nm thick Silicon nano rods under realistic laser contrast of a 10^20 W/cm^2, 30fs laser pulse. The 2D particle-in-cell simulations give insight into the expansion of the electron density and thus where the laser is getting reflected. Significant expansion under the relativistic intensities in the leading laser ramp cause the peak intensities to be reflected before reaching the solid rod structure. Based on that, we investigate which conditions allow the propagation of the highest intensities into an intact nano rod structure. This allows a coulomb explosion to happen, accelerating Silicon ions to fuel a fusion reaction.

P 24.3 Fri 11:30 KH 01.013

Optical probing of plasma dynamics in laser-driven nanostructured targets — Ankit Dulat[1], Constantin Bernert[1], Thomas Cowan[1], Thomas Kluge[1], Georg Korn[2], Franziska Paschke-Brühl[1,3], Daniel Rivas[2], Hartmut Ruhl[2], Marius Schollmeier[2], Ulrich Schramm[1,3], Karl Zeil[1], •Tim Ziegler[1], and more collaborators[1,2,3] — [1]Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany — [2]Marvel Fusion GmbH, Munich, Germany — [3]Technische Universität Dresden, Dresden, Germany

Nanostructured solid targets are of strong interest in high-intensity laser-plasma interactions because they enhance absorption and particle acceleration. However, experimentally accessing the relevant interaction dynamics remains challenging due to their ultrafast and nanoscale nature. In particular, laser pre-pulses can pre-ionize and expand the target, modifying the nanostructure and degrading performance, making these dynamics critical to resolve for reliable modeling and target optimization.

We present an optical pump-probe setup to study pre-plasma dynamics in the interaction of an ultrashort high-power laser with nanostructured targets. Using combined scattering and Doppler spectrometry, we measure target expansion and particle dynamics under different laser contrast conditions, providing insight into how nanostructure modification influences laser-plasma coupling and ion acceleration.

P 24.4 Fri 11:45 KH 01.013

Spin Polarization in Plasma Accelerators — Gudrid Moortgat-Pick[1,2], •Maryam Hamidi[1], Maxence Thevenet[2], and Kristjan Põder[2] — [1]University of Hamburg — [2]Deutsches Elektronen Synchrotron

Plasma based compact accelerators are extremely attractive due to their ultrahigh acceleration gradients. A key property of the electron beam is stable and high spin-polarisation. Spin-polarised beams are substantial for many aspects of fundamental research. However, it is still unclear how a polarised beam behaves in a plasma accelerator. The aim of this project is to study the physics of spin depolarisation in plasma accelerators and to understand the effect of beam parameters on final polarisation. First conceptual ideas for the experimental realization of a spin-polarised plasma accelerator will be discussed. Given a pre-polarised electron source, these spin-aligned electrons must be injected into the plasma accelerator cavity without misaligning the spins to be further accelerated to result in a highly-polarised high-energetic electron beam. A status report of the planned experimental set-up is given and simulations results are discussed.