AKBP 5: Plasma Accelerators, Ions I

Time: Tuesday 9:30–10:45 Location: SCH/A117

Topical Talk AKBP 5.1 Tue 9:30 SCH/A117

Generation and Acceleration of In-Target Gold Fission Fragments using the ATLAS-3000 Laser System — •Laura D. Geulig, Veronika Kratzer, Erin Grace Fitzpatrick, Maximilian J. Weiser, Jörg Schreiber, and Peter G. Thirolf — Ludwig-Maximilians University Munich

In our experiment, the ATLAS-3000 laser system was used to accelerate ions from heated micrometer thing gold foils. A Thomson parabola spectrometer, optimized for high-resolution detection of heavy ions, was used to deflect ions with the same charge-to-mass (m/q) ratio on parabolic traces, which then can be matched to the ions with respective charge states. CR-39 track detectors were used to identify and characterize the accelerated ion species via their energy and charge states. In addition to remaining light contaminant species and highly-charged gold ions, an unexpected component of heavy (A 98) ions was observed in the m/q range below 2.5. We attributed those distinct pits to Au fission products. A similar in-target fission fragment component was observed in our previous experiment at the PHELIX laser. Details on our interpretation of the origin of these fragments will be presented.

AKBP 5.2 Tue 10:00 SCH/A117

Proton induced fission studies at CALA — •Maximilian J. Weiser, Erin G. Fitzpatrick, Laura D. Geulig, Runjia Guo, Jinbao Hong, and Syed A. Raza — Ludwig-Maximilians-Universität München

At the Centre for Advanced Laser Applications (CALA) we are investigating a novel fission-fusion reaction scheme [1] by employing the ATLAS-3000 laser with a central wavelength of 800 nm, energy per pulse < 60 J and a pulse duration of about 25 fs. This reaction scheme is in particularly interesting, as it could enable us to study extremely neutron-rich isotopes crucial for a quantitative understanding of the rapid neutron-capture, responsible for cosmic nucleosynthesis of heavy elements.

A necessary preparatory step for realizing this scheme is to gain a better understanding of the fission induced by laser accelerated protons in heavy elements. Therefore, we are improving a gas-flow transport system [2] and completed by aerosol-based transportation to transfer the fission products generated in laser-driven proton-induced fission of 238U to a shielded HPGe detector far from the EMP-contaminated experimental chamber. The status of fragment identification depending on laser and transport conditions will be presented.

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[1] D. Habs et al., Appl. Phys. B 103, 471-484 (2011)

[2] P. Boller et al., Sci. Rep. 10, 17183 (2020)

AKBP 5.3 Tue 10:15 SCH/A117

Pre-Expansion of Nano Rods in 2D PIC Simulations — •Franziska-Luise Paschke-Bruehl[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 nano rods under ultra-high intensity laser contrasts in 2D particle-in-cell simulations. We find that realistic contrasts, modelled by laser systems such as DRACO and ReLaX, lead to significant expansion, hindering the maximum intensities of the laser from seeing an intact rod structure. Based on that, we explore shorter pulse lengths and higher intensities of the laser pulse to ensure an intact rod structure at t_max.This shows that shorter pulse lenghts seem to be a promising alternatvie while higher intensities lead to more pre expansion, despite considering the relativistic critical density.

AKBP 5.4 Tue 10:30 SCH/A117

Characterization of Reflected Light Properties in PIC Simulations — •Vidisha Rana[1,2], Milenko Vescovi[1,2], Richard Pausch[1], Marvin E.P. Umlandt[1,2], Franziska Paschke-Brühl[1,2], 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) and Third Order Dispersion (TOD).

Reflected light properties provide a powerful diagnostic tool for understanding these interactions and optimizing proton energies. Experiments involving ultrashort laser pulses interacting with glass targets reveal prominent spectral shifts across changing dispersion 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 remain 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.