AKBP 8: New Accelerator Concepts

Time: Tuesday 14:30–16:00 Location: HSZ 301

AKBP 8.1 Tue 14:30 HSZ 301

Excitation of beam driven plasma waves in a hybrid LPWFA — •Susanne Schöbel[1,2], Yen-Yu Chang[1], Olena Kononenko[3], Sébastien Corde[3], Jurjen Couperus Cabadağ[1], Alexander Debus[1], Hao Ding[4], Andreas Döpp[4], Thomas Heinemann[5,6], Bernhard Hidding[6], Max Gilljohann[4], Stefan Karsch[4], Alexander Köhler[1], Alastair Nutter[1,6], Richard Pausch[1], Omid Zarini[1], Ulrich Schramm[1,2], Alberto Martinez de la Ossa[5], and Arie Irman[1] — [1]Helmholtz-Zentrum Dresden-Rossendorf, Germany — [2]Technische Universität Dresden, Germany — [3]LOA, ENSTA ParisTech, CNRS, Ecole Polytechnique, Université Paris-Saclay, France — [4]Ludwig-Maximilians-Universität München, Germany — [5]Deutsches Elektronen-Synchrotron DESY, Germany — [6]University of Strathclyde, Glasgow, UK

Here we present imaging of plasma wakefields driven by both, high intensity laser pulses or high peak current electron beams. In particular, a scheme of high-current electron beams from a LWFA as drivers of a beam-driven plasma wakefield accelerator (PWFA) is being extensively studied, aiming to fulfill the demanding quality requirements for applications such as FELs. Observing plasma wakefields in this regime demonstrates the capability of the LWFA beam to create the plasma as well as drive plasma wakefields. Additionally we observed a correlation between the drive beam charge and the shape of the plasma wave. This enables us to find an optimum parameter set towards the experimental demonstration of the hybrid LPWFA.

AKBP 8.2 Tue 14:45 HSZ 301

Ion acceleration from ultra-thin foil targets using a PW-class laser with optimized temporal pulse profile — •Tim Ziegler[1,2], Constantin Bernert[1,2], Florian-Emanuel Brack[1,2], Stefan Bock[1], Lennart Gaus[1,2], Stephan Kraft[1], Florian Kroll[1], Josefine Metzkes-Ng[1], Thomas Pueschl[1], Martin Rehwald[1,2], Hans-Peter Schlenvoigt[1], Ulrich Schramm[1,2], and Karl Zeil[1] — [1]Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany — [2]TU Dresden, Dresden, Germany

Laser-driven ion acceleration promises to provide a compact solution for demanding applications like radiobiological experiments. Controlling the particle beam parameters to achieve these goals is currently pushing the frontier of laser driven particle accelerators. The acceleration performance is strongly dependent on the complex plasma formation processes which in turn are determined by the temporal laser intensity profile and spatio-temporal couplings on a large dynamic range.

We present experimental results on the interaction of the DRACO Petawatt ultra-short pulse laser with ultra-thin foil targets. A combination of particle and plasma diagnostics for ions and electrons as well as reflected and transmitted light revealed clear indications of acceleration in the relativistic transparency regime. Furthermore, the implementation of a large suite of laser pulse diagnostic directly at the experimental area enabled an unprecedented level of laser pulse property characterization which allowed the laser plasma interaction to be optimized with extraordinary high precision and effectiveness.

AKBP 8.3 Tue 15:00 HSZ 301

Minimizing betatron coupling of energy spread and divergence in laser-wakefield accelerated electrons — •Alexander Köhler[1], Richard Pausch[1], Jurjen Pieter Couperus Cabadag[1], Omid Zarini[1], Yen-Yu Chang[1], Thomas Kurz[1,2], Susanne Schöbel[1,2], Michael Bussmann[1], Alexander Debus[1], Ulrich Schramm[1,2], and Arie Irman[1] — [1]Helmholtz-Zentrum Dresden - Rossendorf — [2]Technische Universität Dresden

Matched beam loading in laser wakefield acceleration (LWFA) flattens the accelerating electric field along the bunch and leads to the minimization of energy spread at high bunch charges. By using the self-truncated ionization injection scheme for controlling the injected charge, we demonstrate that minimal energy spread coincides with a reduction of the normalized beam divergence. Betatron radiation spectroscopy simultaneously confirms a constant beam radius at the plasma exit. Together, the decrease in divergence can be attributed to the reduction of chromatic betatron decoherence. Thus, beam loading enables the highest longitudinal and transverse phase space densities by optimizing energy spread and normalized divergence.

AKBP 8.4 Tue 15:15 HSZ 301

Simulations and applications for hollow-core photonic crystal fibers in the context of particle accelerators — •Luca Genovese[1], Francois Lemery[1], Frank Mayet[1,2], Max Kellermeier[1], Gordon Wong[3], Philip Russell[3,4], and Ralph Assmann[1] — [1]Deutsches Elektronen-Synchrotron DESY, Hamburg, Germany — [2]University of Hamburg, Institut für Experimentalphysik, Hamburg, Germany — [3]Max Planck Institute for the Science of Light, Erlangen, Germany — [4]Department of Physics, Friedrich-Alexander-Universität, Erlangen, Germany

Lasers have become an integral part of the development and performance optimization of modern high-brightness electron and light sources. Laser-based energy modulation of particle beams is routinely achieved using meter-scale magnetic undulators that provide the coupling between laser field and particles.

In this work we propose an alternative compact scheme based on hollow-core photonic crystal fibers, which support GV/m field gradients. We discuss several use cases for these fibers to charged particle beams

AKBP 8.5 Tue 15:30 HSZ 301

Online measurement of the fully angularly resolved energy spectrum of laser plasma-based accelerated protons. — •Marvin Reimold[1,2], Josefine Metzkes-Ng[1], Heide Meissner[1], Karl Zeil[1], and Ulrich Schramm[1,2] — [1]Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany — [2]TU Dresden, Dresden, Germany

Laser plasma-based accelerators promise to provide proton sources for radiobiological studies with extended possibilities compared to conventional accelerators due to short accerelation lengths, high pulse doses, high dose rates and the usage of compact pulsed operated magnets for beam guiding. For the generation of radiobiological relevant proton energies, Petawatt (PW) clase laser powers are required, which can be provided at the Helmholtz-Zentrum Dresden-Rossendorf (HZDR) by the DRACO laser system and the upcoming PENELOPE laser system. Both laser systems will be used to perform radiobiological studies. This requires the fully angularly resolved characterization of the produced proton energy spectrum at the source. At the moment no online detector is existing, which could fullfill this task. We present our detector system design based on scintillator emission tomography for the fully angularly resolved characterization of the proton energy spectrum at the source. We will focus on the reconstruction of the 3D dose distribution inside the scintillator volume and the reverse calculation of the angularly resolved proton energy spectrum from the reconstructed 3D proton dose distribution.

AKBP 8.6 Tue 15:45 HSZ 301

Controlled Plasma Generation for Beam-Driven Wakefield Acceleration — •Gabriele Tauscher[1,2], Lucas Schaper[1], Matthew James Garland[1], Bernhard Schmidt[1,2], Kristjan Poder[1], Lars Goldberg[2], Jan-Patrick Schwinkendorf[1], Gregory Boyle[1], Pardis Niknejadi[1], Theresa Brümmer[1], Simon Bohlen[1,2], Alexander Knetsch[1], Martin Meisel[1,2], Sarah Schroeder[1,2], Bridget Sheeran[1,2], Theresa Staufer[1], and Jens Osterhoff[1] — [1]Deutsches Elektronen-Synchrotron DESY — [2]Hamburg University

Plasma targets required for wakefield acceleration rely on establishing specific electron density distributions in longitudinal and transverse direction to allow for preservation of beam quality during the acceleration of electron bunches. In the FLASHForward project an electron bunch from the FLASH linac drives large amplitude wakefields in a pre-ionised plasma. The plasma can be generated by a multi-TW short-pulse laser or a high-current HV discharge. Especially in complex scenarios, where multiple gas species can be involved, the strength of the plasma generating source has to be adjusted to accommodate for the specific ionisation thresholds to e.g. generate strong gradient down ramps. To assess the plasma density distribution across the target experimentally, targets are investigated by different interferometry and spectroscopy. The comprehension of the underlying processes of laser and discharge induced plasma generation allows us to control and tailor plasma shapes.