AKBP 8: New Accelerator Concepts

Zeit: Dienstag 16:30–17:45 Raum: HS 8

AKBP 8.1 Di 16:30 HS 8

TWEAC - Laser-plasma acceleration beyond the dephasing and depletion limits — •Alexander Debus[1], Richard Pausch[1,2], Axel Huebl[1,2], Klaus Steiniger[1], Rene Widera[1], Tom Cowan[1,2], Ulrich Schramm[1,2], and Michael Bussmann[1] — [1]Helmholtz-Zentrum Dresden - Rossendorf, Bautzner Landstr. 400, Dresden, Germany — [2]Technische Universität Dresden, 01062 Dresden

We present Traveling-Wave Electron Acceleration (TWEAC), a novel compact electron accelerator scheme based on laser-plasma acceleration. While laser-plasma accelerators provide multi-GeV electron beams today, the acceleration to higher energies is limited. The subluminal group-velocity of plasma waves let electrons outrun the accelerating field.

In order to control the speed of the accelerating plasma cavity, TWEAC utilizes two pulse-front tilted laser pulses whose propagation directions enclose an acute angle. The accelerating cavity is created along their overlap region in the plasma and can move at the vacuum speed of light. Thus, TWEAC provides constant acceleration which opens the way for electron energies beyond 10 GeV, possibly towards TeV class electron beams, without the need for multiple laser-accelerator stages.

AKBP 8.2 Di 16:45 HS 8

Pulse-front tilt in laser-plasma accelerators with short focal lengths — •Klaus Steiniger[1], Michael Bussmann[1], Thomas Kluge[1], Richard Pausch[1,2], Karl Zeil[1], and Alexander Debus[1] — [1]Helmholtz-Zentrum Dresden - Rossendorf, Bautzner Landstr. 400, 01328 Dresden, Germany — [2]Technische Universität Dresden, 01062 Dresden

Laser ion accelerators utilize high-power laser pulses in tight-focusing geometries to provide pulsed, high-intensity ion beams. Efficient capturing, transport and application of these beams is an ongoing effort which depends on precise knowledge of the accelerated ion distribution's properties and how to control these. For example, it is known that the propagation direction of the accelerated ions can be controlled by tilting the driving laser pulse-front. Since laser pulse-front tilts can be present accidentally, for example by a small misalignment of the compressor gratings in a chirped-pulse amplification system, knowledge of the scaling of the pulse-front tilt at a target position is desired. The talk gives relations for pulse-front orientation dependent on setup parameters and identifies regimes were pulse-front tilt has a sizable impact.

AKBP 8.3 Di 17:00 HS 8

Single Shot Emittance Measurements at LUX — •Lars Hübner[1], Björn Hubert[1], Timo Eichner[1], Sören Jalas[1], Manuel Kirchen[1], Vincent Leroux[1,2], Matthias Schnepp[1], Philipp Messner[1,3], Maximilian Trunk[1], Christian M. Werle[1], Paul Winkler[1,2], and Andreas R. Maier[1] — [1]Center for Free-Electron Laser Science & Department of Physics, University of Hamburg, Hamburg, Germany — [2]Deutsches Elektronen-Synchrotron DESY, Hamburg, Germany — [3]Max Planck Institute for the Structure and Dynamics of Matter, Hamburg, Germany

The LUX beamline is a novel laser-plasma accelerator, built in close collaboration of the University of Hamburg and DESY, and dedicated for the generation of laser-plasma driven undulator radiation. For beam transport design, the beam properties after the plasma target are crucial. Here, we discuss the characterization of the electron beam optics at LUX and report on emittance reconstruction from single shots using measured beam profiles and electron spectra.

AKBP 8.4 Di 17:15 HS 8

Gas jet targets and their application in laser-driven ion acceleration — •Alexander Schulze-Makuch[1,2], Stefan Assenbaum[2,3], Constantin Bernert[2,3], Florian-Emanuel Brack[2,3], Lennart Gaus[2,3], Stephan Kraft[2], Florian Kroll[2], Josefine Metzkes-Ng[2], Lieselotte Obst-Hübl[2,3], Martin Rehwald[2,3], Marvin Reimold[2,3], Hans-Peter Schlenvoigt[2], Karl Zeil[2], Tim Ziegler[2,3], and Ulrich Schramm[2,3] — [1]Albert-Ludwigs Universität Freiburg, Freiburg, Germany — [2]Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany — [3]Technische Universität Dresden, Zellescher Weg 19, 01069 Dresden, Germany

Currently, the acceleration gradients of conventional linear accelerators are limited to 10 MeV/m. However, the acceleration gradients of laser-driven particle accelerators can be in the order of 1 TV/m. This can lead to the development of compact accelerators including their use in medical applications, e.g. hadron therapy. Conventional targets for ion acceleration are operationally limited because of relatively low repetition rate and contamination of optics from debris. Therefore, alternative target schemes need to be investigated. One possible way forward are high-density gas jets which, in contrast to gas jets for electron acceleration, are near the critical density and thus offer a variety of physical mechanisms to accelerate protons or even heavier particles.

Here we present our recent developments in establishing a high-density gas jet at the DRACO laser in the Helmholtz-Zentrum Dresden-Rossendorf and highlight its properties and feasibility for laser-ion acceleration.

AKBP 8.5 Di 17:30 HS 8

Optimization of ionization injection in laser wakefield acceleration — •Philipp Messner[1,2], Lars Hübner[3], Sören Jalas[1], Manuel Kirchen[1], Vincent Leroux[3], Matthias Schnepp[1], Paul Winkler[3], and Andreas R. Maier[1] — [1]Center for Free-Electron Laser Science & Department of Physics, Hamburg University, Hamburg, Germany — [2]International Max Planck Research School for Ultrafast Imaging and Structural Dynamics, Hamburg, Germany — [3]Deutsches Elektronen-Synchrotron DESY, Hamburg, Germany

Laser-plasma accelerators are capable to produce GeV beam energies over only a few centimeter, making them interesting as driver for compact light sources. However, electron beam parameters have to be matched to the beam optics. Online tunability of energy, energy spread and charge are therefore mandatory for efficient electron beam transport. Controlling the injection mechanism of the electrons into the wakefield is one promising way to optimize these parameters. Here, we present the influence of the dopant concentration on electron beams generated with ionization injection. Using the 200 TW peak power laser system ANGUS at the LUX facility in Hamburg, we accelerated electron beams up to a few hundred MeVs in a gas mixture of nitrogen and hydrogen. We precisely scanned the nitrogen concentration online between 0.1 and 5% while keeping the background plasma density forming the wakefield constant. Changes in beam properties can therefore directly be related to the injection mechanism. We found that the amount of trapped charge is increased significantly for larger nitrogen concentrations, while energy gain is reduced.