AKBP 2: New Accelerator Concepts

Time: Tuesday 14:00–16:00 Location: AKBPa

AKBP 2.1 Tue 14:00 AKBPa

Polarimeter Design for a LPA Electron Beam — •Jennifer Popp[1,2], Simon Bohlen[1], Jenny List[1], Gudrid Moortgat-Pick[2,1], Jens Osterhoff[1], Kristjan Põder[1], and Felix Stehr[1,2] — [1]Deutsches Elektronen-Synchrotron (DESY), Hamburg — [2]Universität Hamburg

Laser Plasma Acceleration (LPA) with its extremely high gradients promises compact accelerators and great progress has been made in that direction. However, many applications in material science, nuclear and high energy physics require polarized electron beams.

The motivation of the LEAP project at DESY is the first time demonstration of LPA with polarization. The electron polarization will be measured with photon transmission polarimetry. It makes use of the production of circularly polarized Bremsstrahlung during the passage of the electrons through a suitable target. The photon polarization is then measured with the aid of the transmission asymmetry related to the magnetization direction of an iron absorber.

In this contribution simulation studies and a design for the polarimeter for a future setup at DESY for the routine production of polarized electron beams are presented.

AKBP 2.2 Tue 14:15 AKBPa

The challenge and prospect of a plasma lens for the capture section of e+ sources in modern accelerator designs — •Manuel Formela[1], Gudrid Moortgat-Pick[1], Klaus Floettmann[2], and Niclas Hamann[1] — [1]Universität Hamburg — [2]DESY

The ILC is an ambitious international collaboration with its positron source especially being at the forefront of pushing technological boundaries. Part of this enterprise has to be the optical matching device responsible for catching positrons exiting a target and transforming them from a highly divergent beam with a small effective cross-section to a wide, parallel beam to be appropriate for the succeeding accelerator section. This problem has been approached by different types of sophisticated coils like the quarter wave transformer and flux concentrator for many years now. Today considerations exist to utilize a completely new principle based on an electric current passing a plasma. This so called plasma lens creates a magnetic field, which is potentially especially qualified for the usage as an optical matching device due to its pronounced azimuthal component in contrast to the radial component of conventional devices.

AKBP 2.3 Tue 14:30 AKBPa

Designing a matching device for positron sources — •Niclas Hamann[1], Manuel Formela[2], Gudrid Moortgat-Pick[3], and Klaus Flöttman[4] — [1]Uni Hamburg — [2]Uni Hamburg — [3]Uni Hamburg / DESY Hamburg — [4]DESY Hamburg

To realise a planned e+e- accelerators, as ILC, the accelerated particles have to be captured and matched according to the luminosity requirements. There exist several technical possibilities. In this talk a new promising alternative will be presented, the application of the plasma lense as an optical matching device. It will be compared with the current matching device namely the quarter wave transformer. An advantage of the plasma lense is a different magnetic field component which focuses the divergent beam in a more effective manner. Therefore we will show in this talk that the yield requirements could be achieved more easily. The plasma lense can actually be a promising alternative for focussing beams as soon as the technical feasibility has been approved.

AKBP 2.4 Tue 14:45 AKBPa

LEAP: Polarized electrons from LPA — •Felix Stehr[1,2], Simon Bohlen[1], Jenny List[1], Gudrid Moortgat-Pick[1,2], Jens Osterhoff[1], Kristjan Põder[1], and Jennifer Popp[1,2] — [1]DESY — [2]Universität Hamburg

In recent years, laser plasma acceleration (LPA) has become a promising alternative to conventional RF accelerators. Polarized beams are indispensable for many experiments in particle, atomic and nuclear physics as well as in material science, where spin-dependent processes are to be studied. Theoretically, it has been shown that the interaction of multiple laser beams with a gas target can produce polarized electron beams through LPA. The LEAP (Laser Electron Acceleration with Polarization) project at DESY aims to demonstrate this experimentally for the first time. For this purpose, a LPA for the generation of polarized electron beams will be set up, as well as an electron polarimeter. The polarization of the electrons will be studied as a function of the laser and plasma parameters. The talk will give a general overview of the LEAP project and the generation of polarized beams.

AKBP 2.5 Tue 15:00 AKBPa

High stability OPCPA frontend for LPA Ti:Sapphire driver lasers — •Timo Eichner[1,3], Thomas Hülsenbusch[1,2,3], Julian Dirkwinkel[2], Tino Lang[2], Lutz Winkelmann[2], Guido Palmer[2], and Andreas R. Maier[1,2] — [1]Center for Free-Electron Laser Science and Department of Physics, University of Hamburg, Hamburg — [2]Deutsches Elektronen-Synchrotron (DESY), Hamburg — [3]These Authors contribute equally

Laser plasma acceleration (LPA) is a promising technology to drive the next generation of compact high brightness x-ray sources. Delivering the high electron beam quality, reproducibility and long-term stability required by applications is, however, still a major challenge. Here, we present a newly designed high-stability front-end for an LPA drive laser. The front-end consists of a white light seeded collinear OPCPA system, that is designed with the strict demands towards spatio-temporal beam quality and long-term stability in mind. We show first experimental results on the performance of the front-end that delivers highly stable >50uJ pulses with Fourier transform limit <25fs at a center wavelength of 800nm, suitable for seeding a high energy Ti:Sapphire laser system.

AKBP 2.6 Tue 15:15 AKBPa

Optimal beam loading in a laser-plasma accelerator — •Manuel Kirchen[1], Sören Jalas[1], Philipp Messner[2,1], Paul Winkler[3,1], Timo Eichner[1], Thomas Hülsenbusch[3,1], Laurids Jeppe[1], Trupen Parikh[3], Matthias Schnepp[1], and Andreas R. Maier[3,1] — [1]Center for Free-Electron Laser Science and Department of Physics Universität Hamburg, Luruper Chaussee 149, 22761 Hamburg, Germany — [2]International Max Planck Research School for Ultrafast Imaging & Structural Dynamics, Luruper Chaussee 149, 22761 Hamburg, Germany — [3]Deutsches Elektronen Synchrotron (DESY), Notkestrasse 85, 22607 Hamburg, Germany

Applications of laser-plasma accelerators demand low energy spread beams and high-efficiency operation. Achieving both requires to flatten the accelerating fields by controlled beam loading of the plasma wave. Here, we tailor the current profile of an ionisation-injected electron bunch and optimize the laser-plasma dynamics to operate at such optimal beam loading conditions. This enables the reproducible production of 1.2% rms energy spread bunches with 282 MeV and 44 pC, at an estimated energy-transfer efficiency of 19%. We correlate shot-to-shot variations to reveal the phase space dynamics and train a neural network that predicts the beam quality as a function of the drive laser.

AKBP 2.7 Tue 15:30 AKBPa

Optimizing Particle-In-Cell simulations of laser-plasma accelerators — •Laurids Jeppe[1], Sören Jalas[1], Manuel Kirchen[1], and Andreas R. Maier[2] — [1]Center for Free-Electron Laser Science and Department of Physics, Universität Hamburg — [2]Deutsches Elektronen Synchrotron (DESY)

Designing experiments for laser-plasma acceleration via simulations is typically an expensive task due to the complexity of the physics involved. Here, we use the GPU-accelerated, quasi-3D Particle-In-Cell code FBPIC in a boosted frame to reduce the computational cost of such simulations and combine it with Bayesian Optimization to efficiently optimize LPA experiments. This approach is applied to different example cases to show its robustness and flexibility.

AKBP 2.8 Tue 15:45 AKBPa

A new transport line for transverse gradient undulator experiment at the JETI-200 plasma accelerator — •Maisui Ning[1], Samira Fatehi[1], Kantaphon Damminsek[1], Axel Bernhard[1], and Anke-Susanne Müller[1,2] — [1]LAS,KIT,Karlsruhe — [2]IBPT,KIT,Karlsruhe

The Karlsruhe Institute of Technology (KIT) and the University of Jena develop the generation of monochromatic undulator radiation

with laser plasma-accelerated electron bunches by using a transverse-gradient undulator (TGU) designed to compensate the electron bunch energy spread. A proof-of-principle experiment with a superconducting TGU prototype, employing a specially designed beam transport line, is under preparation. A first experimental test of this transport line has been performed and evaluated. In this contribution, we describe the current status of the redesign of the beam transport line magnets and the beam optics, considering the results of this test as well as of the ongoing characterization experiments for both, the electron beam and the TGU, to prepare the experiment with the TGU at the laser-plasma accelerator setup at the JETI-200 laser facility in Jena.

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