AKBP 3: Injectors, Laser II

Zeit: Montag 16:30–18:30 Raum: S1/05 23

AKBP 3.1 Mo 16:30 S1/05 23

Beam Transport and Stabilization System for the FLUTE Gun Laser — •Sophie Walther[1], Erik Bründermann[3], Stefan Funkner[1], Anke-Susanne Müller[2], Michael Nasse[1], and Gudrun Niehues[1] — [1]LAS, KIT, Karlsruhe — [2]ANKA, IPS, LAS, KIT, Karlsruhe — [3]IPS, KIT, Karlsruhe

The linear accelerator of FLUTE (Ferninfrarot Linac- Und Test-Experiment) is currently under commissioning at the Karlsruhe Institute of Technology. It is planned to use strong femtosecond to picosecond UV pulses for the photoinjection of electrons from the cathode into the linear accelerator structure. For this purpose a femtosecond laser system is located in a distance of more than 30 meters in a clean room environment. This study investigates the performance of optical setups to reach a stable optical layout for transport of the femtosecond to picosecond laser pulses to the cathode. To compensate drifts and movements of the laser beam over the more than 30 meters a stabilization system is evaluated and tested. The results of these measurements are presented in this contribution.

AKBP 3.2 Mo 16:45 S1/05 23

First On-table Results of Quasi Ellipsoidal Photocathode Laser Pulses at PITZ — •James Good[1], Alexey Andrianov[2], Ekaterina Gacheva[2], Efim Khazanov[2], Martin Khojoyan[4], Mikhail Krasilnikov[1], Sergey Mironov[2], Anatoly Poteomkin[2], Tino Rublack[1], Frank Stephan[1], Eugeniy Syresin[3], and Viktor Zelenogorsky[2] — [1]DESY, Zeuthen, Germany — [2]IAP/RAS, Nizhny Novgorod, Russia — [3]JINR, Dubna, Moscow Region, Russia — [4]SOLEIL, Paris, France

The optimization of photoinjectors is crucial for the successful operation of linac-based free electron lasers, and beam dynamics simulations have shown that ellipsoidal photocathode laser pulses result in significantly lower electron beam emittance than that of conventional cylindrical pulses. Therefore, in collaboration with the Institute of Applied Physics (Nizhny Novgorod, Russia) and the Joint Institute of Nuclear Research (Dubna, Russia), a laser system capable of generating quasi-ellipsoidal laser pulses has been developed and installed at the Photo Injector Test facility at DESY, Zeuthen (PITZ).

The pulse shaping was realized by utilizing spatial light modulators, and is characterized by both auto- and cross-correlation measurements in the infrared and ultraviolet. In this contribution the overall setup and layout, basic operating principles, stability measurements, and the first results at PITZ will be presented.

These results include preliminary calibration data, and comparative measurements in both optical regimes of applied guassian, super-gaussian, and elliptical temporal masks.

AKBP 3.3 Mo 17:00 S1/05 23

Generation of a ring-focus by the use of a deformable mirror — •Tim Ziegler[1,2], Karl Zeil[1], and Ulrich Schramm[1,2] — [1]Helmholtz-Zentrum Dresden-Rossendorf (HZDR), Bautzner Landstr. 400, 01328 Dresden, Germany — [2]Technische Universität Dresden, 01062 Dresden, Germany

The target-normal-sheath-acceleration (TNSA) is a very promising way to accelerate protons by relativistic laser-plasma interaction. A central issue is still to increase the energy of the accelerated protons and to reduce their divergence. Therefore one approach is to vary the intensity distribution of the incoming laser-beam and by that the electron sheath on the rear-side which accelerates the protons. A ring-shaped intensity distribution promises an improvement for both features, so a deeper understanding how to generate and control such a distribution is required. The use of a deformable mirror is one method to shape the focal intensity distribution of an intense laser-beam in such a way. In order to get the desired intensity distribution in the focal plane it is necessary to do numerical simulations to get the appropriated shape of the deformable mirror. The mirror itself comes up with some constraints which must be taken into account as well and require a special adjustment.

The results of the simulations and whether the theoretical results are technically feasible will be presented. The experimental investigations using a copropagating alignment beam and a closed loop adaptive optics were performed at the Draco Laser facility of the Helmholtz-Zentrum Dresden-Rossendorf.

AKBP 3.4 Mo 17:15 S1/05 23

Evaluation of the Photocathode Laser Transverse Distribution — Chaipattana Saisa-ard[1,2], Mikhail Krasilnikov[1], and •Grygorii Vashchenko[1] — [1]DESY, Zeuthen, Germany — [2]Chiang Mai University, Chiang Mai, Thailand

Many years experience of electron source developments at the photo injector test facility at DESY in Zeuthen (PITZ) show that the photocathode laser is the one of major tools to produce high brightness electron beams. The transverse distribution of the laser on the photocathode plays a significant role in the high brightness photo injector optimization. However, the imperfections in the laser beam profile according to the deviation from a radially homogeneous profile directly result in transversely distorted charged particle distributions. This includes inhomogeneous core as well as transverse halo which is due to not sharp edges around the core. The laser transverse distribution is measured at PITZ using a virtual cathode :this is a CCD camera located at the position which is optically equivalent to the photocathode position (so called virtual cathode). An algorithm is developed for the evaluation of the experimentally obtained transverse profiles. It fits a flat-top or an inhomogeneous rotational symmetric core with exponentially decaying tails to an experimental distribution. The MATLAB script with implemented algorithm is applied to a set of measured transverse laser distributions. Results of the analysis will be presented.

AKBP 3.5 Mo 17:30 S1/05 23

First Characterizations of a 4 nC Electron Beam for THz Options at PITZ — •Prach Boonpornprasert[1], Galina Asova[1,2], Mahmoud Bakr[1,3], Matthias Gross[1], James Good[1], Carlos Hernandez-Garcia[1,4], Holger Huck[1], Igor Isaev[1], Davit Kalantaryan[1], Mikhail Krasilnikov[1], Osip Lishilin[1], Gregor Loisch[1], Dmitriy Malyutin[1], David Melkumyan[1], Anne Oppelt[1], Marek Otevrel[1], Gaurav Pathak[1], Yves Renier[1], Tino Rublack[1], Ivan Rybakov[1,5], Frank Stephan[1], Grygorii Vashchenko[1], and Quantang Zhao[1] — [1]DESY, Zeuthen, Germany — [2]INRNE, Sofia, Bulgaria — [3]Assiut University, Assiut, Egypt — [4]Jlab, Newport News, USA — [5]INR of the RAS, Moscow, Russia

The Photo Injector Test facility at DESY, Zeuthen site (PITZ) develops high brightness electron sources for modern linac-based Free Electron Lasers (FELs). The PITZ accelerator can also be considered as the proper machine for the development of an IR/THz source prototype for pump and probe experiments at the European XFEL. One of interesting options for the IR/THz generation at PITZ is to generate the radiation by means of a SASE FEL. Previous calculations have shown that by using an electron bunch with a bunch charge of 4 nC and a helical undulator with a period length of 40 mm, a saturation pulse energy of about 1 mJ is achievable within a saturation length of 3 m for a radiation wavelength of 100 μm. In this contribution, the experimental demonstration of generating electron beams with 4 nC bunch charge by the PITZ accelerator together with the results of the electron beam characterization are presented and discussed.

AKBP 3.6 Mo 17:45 S1/05 23

Efficient Acceleration Using Single-cycle THz pulses — •Arya Fallahi[1], Moein Fakhari[1], Alireza Yahaghi[1], and Franz Kärtner[1,2,3,4] — [1]Center for Free-Electron Laser Science, DESY, Notkestrasse 85, 22607 Hamburg, Germany — [2]Department of Physics, University of Hamburg, Jungiusstrasse 9, 20355 Hamburg, Germany — [3]The Hamburg Center for Ultrafast Imaging, Luruper Chaussee 149, 22761 Hamburg, Germany — [4]Department of Electrical Engineering and Computer Science and Research Laboratory of Electronics, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, Massachusetts 02139, USA

Novel structures for electron acceleration are introduced which operate with single-cycle pulses. Due to the considered excitation, the new types of guns are named as single-cycle ultrafast guns. The operating frequencies considered here are at THz wavelengths inspired by the recent progress in the optical generation of intense single-cycle THz pulses. Two distinct regimes, namely low energy and high energy THz pulses are considered. It is theoretically demonstrated that the proposed electron guns have potentials to provide 30 fs electron bunches at 30 keV energies and 100 fs bunches at 2MeV energies. More importantly, it is shown that the already achieved THz pulse energies of 20 uJ are enough to realize relativistic acceleration gradients. These structures will underpin future devices for fabricating miniaturized electron guns and linear accelerators.

AKBP 3.7 Mo 18:00 S1/05 23

Simulating THz generation for powering compact x-ray sources — •Anthony Hartin, Ravi Kostuban, Franz Kaertner, Xiaojun Wu, and Chun Zhou — DESY, CFEL, Notkestrasse 85, Hamburg 22607

Compact x-ray sources can be made compact by using THz electromagnetic waves to power scaled down accelerating structures. An efficient method of generating the THz is via optical rectification using tilted pulse fronts in a nonlinear optical crystal such as Lithium Niobate.

A phenomenological simulation code for the THz generation by an optical pump pulse impinging on a lithium niobate crystal is presented. linear and nonlinear optical parameters serving as inputs are obtained from the literature. A realistic optical system delivering the pump pulse to the crystal is modelled, and optical rectification is achieved in a 2D model.

The simulation model is validated by comparison with an experiment consisting of a 4.2 mJ, 1030 micron, 650 fs pump pulse incident on a 5.6% MgO doped $LiNO_3$ crystal. There is reasonable agreement between simulation and experiment. At a pump fluence of 500 J/m^2, THz is extracted with 0.6% efficiency at 300 K and 1.2% efficiency at 100 K. Optimisation of the extracted efficiency using the simulation is explored.

AKBP 3.8 Mo 18:15 S1/05 23

The ELSA Laser Beamline for Electron Polarization Measurements via Compton Backscattering — •Michael Switka, Florian Hinterkeuser, Rebecca Koop, and Wolfgang Hillert — Electron Stretcher Facility ELSA, Physics Institute of Bonn University

The Electron Stretcher Facility ELSA provides a spin polarized electron beam with energies of 0.5 - 3.2 GeV for double polarization hadron physics experiments. As of 2015, the laser beamline of the polarimeter based on Compton backscattering restarted operation. It consists of a cw disk laser with design total beam power of 40 W and features two polarized 515 nm photon beams colliding head-on with the stored electron beam in ELSA. The polarization measurement is based on the vertical profile asymmetry of the back-scattered photons, which is dependent on the polarization degree of the stored electron beam. After recent laser repairs, beamline and detector modifications, the properties of the beamline have been determined and first measurements of the electron polarization degree were conducted. The beamline performance and first measurements are presented.