AKBP 10: Electron Accelerators and FEL's

Time: Wednesday 14:00–15:15 Location: AKBP-H14

AKBP 10.1 Wed 14:00 AKBP-H14

Particle tracking study for the new laser heater at FLASH — •Dmitrii Samoilenko[1], Pardis Niknejadi[2], Christopher Gerth[2], Lucas Schaper[2], and Wolfgang Hillert[1] — [1]Institute for Experimental Physics, University of Hamburg, Luruper Chaussee 149, 22761 Hamburg, Germany — [2]Deutsches Elektronen-Synchrotron DESY, Notkestrasse 85, 22607 Hamburg (Germany)

The FLASH (Free electron LASer in Hamburg) facility is currently in a scheduled 9-month shutdown during which some of the upgrades planned in the FLASH2020+ project are being implemented. Among these upgrades is a laser heater which will be installed just upstream of the first bunch compressor, allowing an uncorrelated energy spread in the electron beam to be induced. Increasing energy spread makes it possible to reduce the microbunching gain through the machine and thus counteract one of the most detrimental effects for FEL operation. The amount of induced energy spread has to be carefully balanced to suppress microbunching. At the same time the total energy spread at the end of the linac, which is enhanced especially during the bunch compression, should be kept at a reasonable value not to deteriorate FEL operation. In this work, we use particle tracking simulations to (i) evaluate the performance of the laser heater in terms of induced energy spread; (ii) investigate how the energy spread evolves throughout the rest of the linac. The results are expected to be valuable also for the commissioning of the laser heater.

AKBP 10.2 Wed 14:15 AKBP-H14

Simulation Studies on a XUV FEL Oscillator Setup at FLASH — •Margarit Asatrian[1], Wolfgang Hillert[1], Velizar Miltchev[1], and Georgia Paraskaki[2] — [1]University of Hamburg, 22761 Hamburg, Germany — [2]Deutsches Elektronen-Synchrotron DESY, 22607 Hamburg, Germany

Externally seeded Free Electron Lasers (FEL) deliver fully coherent radiation at harmonics of the input seed laser wavelength. However, due to the lack of seed laser sources in the EUV/XUV range and at high repetition rates with sufficient peak power, the shortest wavelength and maximum repetition rate of the seeded FEL radiation are limited.

In order to utilize the full potential of superconducting RF technology being exploited in the world leading FEL facilities like FLASH at DESY and enabling bunch repetition rates in the MHz regime for seeding, an oscillator-amplifier approach is considered, where the role of the seed laser is taken by an optical cavity. A cavity tuned to 13.5 nm is used to store the seed pulse and reuse it for the seeding of bunches at MHz rate. The possibility to build up the power in the cavity starting from shot noise allows the seeding at an already short wavelength.

We present design considerations and our first simulation results for the future setup.

AKBP 10.3 Wed 14:30 AKBP-H14

Simulation for THz FEL seeding at PITZ using pre-bunched electron beams — •Georgi Georgiev[1], Prach Boonpornprasert[1], Wolfgang Hillert[2], Mikhail Krasilnikov[1], and Xiangkun Li[1] — [1]Deutsches Elektronen-Synchrotron DESY, 15738 Zeuthen, Germany — [2]University of Hamburg, 22761 Hamburg, Germany

A THz source with high power and tunability is required for pump and probe experiments at the European XFEL. One option is to use a short accelerator to drive a THz FEL, which could produce THz pulses with the same pulse train structure as the XFEL pulses. The Photo Injector Test facility at DESY in Zeuthen (PITZ) serves as the site for these developments and proof-of-principle experiments on short THz FEL are currently under preparation at this facility. To improve the stability of the THz source, FEL seeding is considered. Arrival time jitter and spectrum from pulse to pulse can be improved by FEL seeding with respect to SASE. This is demonstrated in Genesis simulation results performed with pre-bunched electron beams.

AKBP 10.4 Wed 14:45 AKBP-H14

Status of the EEHG Upgrade Project of the Short-Pulse Source at DELTA — •Benedikt Büsing, Arne Held, Hubertus Kaiser, Shaukat Khan, Carsten Mai, Arjun Radha Krishnan, and Vivek Vijayan — Center for Synchrotron Radiation (DELTA),TU Dortmund University, Dortmund, Germany

At the 1.5-GeV electron storage ring DELTA, operated by the TU Dortmund University, a short-pulse source based on the coherent harmonic generation (CHG) scheme provides ultrashort pulses in the vaccum ultraviolet regime. In this scheme a laser-electron interaction leads to microbunching within a short slice of an electron bunch which results in coherent emission of radiation. The emitted wavelength is limited to low harmonics of the laser wavelength, higher harmonics are accessible by the echo-enabled harmonic generation (EEHG) scheme, where another laser-electron interaction is added. To implement this scheme, it is necessary to modify the short-pulse source and thus about a quarter of the storage ring. The status of the upgrade project is presented.

AKBP 10.5 Wed 15:00 AKBP-H14

Recent Developments at S-DALINAC* — •M. Arnold, J. Birkhan, A. Brauch, M. Dutine, J. Enders, M. Fischer, R. Grewe, L. Jürgensen, M. Meier, N. Pietralla, F. Schliessmann, D. Schneider, M. Steinhorst, L. Stobbe, and S. Weih — Institut für Kernphysik, Technische Universität Darmstadt

The superconducting Darmstadt linear accelerator S-DALINAC is a thrice-recirculating accelerator for electrons. Besides the conventional acceleration scheme with corresponding nuclear physics experiments, the accelerator of TU Darmstadt can also be operated as an energy recovery linac (ERL) [1]. Since its establishment in 1991, the S-DALINAC was mainly developed and operated by students. The latest achievement was the successful operation as a superconducting multiturn ERL in August 2021 [2]. Dedicated diagnostics to measure both beams in the same beamline simultaneously are in preparation or have been used for first measurements. The beam quality was improved significantly by a new capture cavity. Other projects are working on further improvements of the machine. This contribution will give an overview of the status of those projects.

[1] M. Arnold et al., Phys. Rev. Accel. Beams 23, 020101 (2020).

[2] Pressemitteilung des Informationsdienst Wissenschaft (idw), "Technologischer Durchbruch bei Energieeffizienten Teilchenbeschleunigern", MI-NR. 63/2021, acc/feu.

*Work supported by DFG (GRK 2128), BMBF (05H21RDRB1), the State of Hesse within the Research Cluster ELEMENTS (Project ID 500/10.006) and the LOEWE Research Group Nuclear Photonics.