AKBP 2: Advanced Light Sources and their Instrumentation

Time: Monday 16:00–17:45 Location: CHE/0184

AKBP 2.1 Mon 16:00 CHE/0184

Powering test results of HTS undulator prototype coils for compact FELs at 4.2 K — •Sebastian C. Richter[1,2], Andreas W. Grau[3], David Saez de Jauregui[3], Amalia Ballarino[2], Axel Bernhard[1], and Anke-Susanne Müller[1,3] — [1]LAS, KIT, Karlsruhe — [2]CERN - 1211 Geneva 23 - Switzerland — [3]IBPT, KIT, Karlsruhe

Short-period and high-field undulators are crucial for the production of coherent light up to X-rays in compact free-electron lasers (FELs). Besides, future colliders like CLIC or FCC-ee demand high-field damping wigglers to reach a low beam emittance. Both applications may benefit from the use of high-temperature superconductors (HTS): magnetic field amplitudes in the range of 2 T become feasible for short periods of 15 mm and smaller with magnetic gaps of 6 mm at 4.2 K. Moreover, potential operation at higher temperatures may relax cryogenic requirements and reduce operational costs. This contribution presents and discusses the powering test results of several HTS undulator prototype coils, designed and manufactured at CERN, made from coated ReBCO tape superconductor. The coil set-up was already described in previous works and is based on non-insulated vertical racetracks with a period length of 13 mm, assembled with iron poles. Powering tests at 4.2 K were performed at KIT to explore the operation at high current densities (2 kA/mm^2) and the produced magnetic fields in the iron pole gap.

AKBP 2.2 Mon 16:15 CHE/0184

Spectro-temporal Properties of Coherently Emitted Radiation Pulses at DELTA — •Arjun Radha Krishnan[1], Benedikt Büsing[1], Shaukat Khan[1], Carsten Mai[1], Wa'el Salah[2], Zohair Usfoor[1], and Vivek Vijayan[1] — [1]Center for Synchrotron Radiation (DELTA), TU Dortmund, Dortmund, Germany — [2]The Hashemite University, Zarqa, Jordan

The short-pulse facility at the 1.5 GeV synchrotron light source DELTA, operated by the TU Dortmund University, employs the seeding scheme coherent harmonic generation (CHG) to produce ultrashort pulses in the vacuum ultraviolet and terahertz regime. Since the properties of the CHG radiation are based on the laser-induced energy modulation and the microbunching process, the spectral and temporal properties of the CHG pulses can be controlled by tuning the laser chirp and the strength of the dispersive chicane. The CHG spectra at several harmonics of the 800 nm seed laser were recorded using an image-intensified CCD camera and an XUV spectrometer for different seed laser chirps and chicane strengths. Convolutional neural networks were employed to fit the observed spectra with the simulations and extract the spectral phase information of the seed laser, taking the higher-order spectral phase of the seed pulse into consideration.

AKBP 2.3 Mon 16:30 CHE/0184

Highlights from seeded FEL@PITZ — •Georgi Georgiev — DESY Zeuthen

First results from a proof-of-principle experiment for a high-power accelerator-based THz source were obtained last year at the Photo Injector Test Facility at DESY in Zeuthen (PITZ). The THz source is an extension to the linac facility and it is based on a single LCLS-I undulator. A part of the research program includes studies on seeding methods for the FEL to improve the shot-to-shot stability of the THz pulses from what is expected from the self-amplified spontaneous emission (SASE) mode of operation. Several methods to achieve seeding are studied in simulation including pre-bunched electron beams, external radiation pulse and a super-radiant spike on top of the beam. Experimental measurements demonstrating the seeding effects from a pre-bunched electron beam are presented and discussed.

AKBP 2.4 Mon 16:45 CHE/0184

Wakefield Study for a PCB-Based Arrival-Time Pickup for Electron Accelerators — •Bernhard Erich Jürgen Scheible[1,2], Marie Kristin Czwalinna[3], Holger Schlarb[3], Wolfgang Ackermann[2], Herbert De Gersem[2], and Andreas Penirschke[1] — [1]Technische Hochschule Mittelhessen, Wilhelm-Leuschner-Str. 13, 61169 Friedberg, Germany — [2]Technische Universität Darmstadt, Karolinenplatz 5, 64289 Darmstadt, Germany — [3]Deutsches Elektronen-Synchrotron DESY, Notkestr. 85, 22607 Hamburg, Germany

Many scientific applications utilize large-scale electron accelerators, e.g., for imaging in free-electron laser facilities such as the European XFEL or FLASH. Precise timing information is necessary for stable operation or to control and evaluate experiments. With growing demands on the accuracy of beam diagnostics especially with smaller bunch-charges, it is unavoidable that monitoring concepts significantly affect the beam. To prevent this interaction from becoming intolerable, it is necessary to quantify and compare it with existing state-of-the-art structures. In this contribution the wake loss factor of a pickup structure based on a printed circuit board is determined in electromagnetic simulations and compared to the pickups of the European XFEL.

AKBP 2.5 Mon 17:00 CHE/0184

Towards Fiber-Optics-Guided Synchrotron Radiation-Based Longitudinal Beam Diagnostics at the KARA Booster Synchrotron — •Marvin-Dennis Noll[1], Johannes L. Steinmann[1], Dima El Khechen[2], Christian Goffing[1], Christina Widmann[1], Erik Bründermann[1], and Anke-Susanne Müller[1] — [1]IBPT, KIT, Karlsruhe — [2]LAS, KIT, Karlsruhe

Before injection into the Karlsruhe Research Accelerator (KARA), the electron storage ring of the KIT Light Source, the beam energy is ramped up from 53 MeV to 500 MeV by a booster synchrotron. The whole booster is located in a concrete enclosure inside the storage ring and thus not accessible during operation. For the study of longitudinal beam dynamics, a cost-effective solution to leverage the synchrotron radiation emitted at the booster bending magnets is desired. To ensure durability of the setup and to not obstruct the removable concrete ceiling of the booster enclosure, it is required to place the radiation-sensitive readout electronics outside of the booster enclosure and outside of the storage ring. In this contribution, a fiber-optic setup consisting of commercially available optical components, such as collimators, optical fibers and high bandwidth photodetectors are used. As a proof-of-concept, we present experimental results of different components characterized at the visual light diagnostics port of the storage ring KARA. In addition, we report on further improvements of the setup along with planned future experiments.

AKBP 2.6 Mon 17:15 CHE/0184

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

Externally seeded high-gain FELs can generate fully coherent radiation with high shot-to-shot stability. With the application of harmonic conversion schemes, these qualities can be achieved at wavelengths down to the soft X-Ray range. However, at the moment, such FEL schemes aimed at the generation of short-wavelength radiation are limited in their repetition rate by the suitable seed laser sources and thus are unable to operate at the full repetition rate of superconducting machines. Cavity-based FELs have been proposed as a possible solution that would allow the generation of short-wavelength, fully coherent FEL radiation at high repetition rates. We present simulation studies for such a high-gain FEL oscillator, which is planned to be implemented at FLASH. The setup is aimed to operate at the repetition rate of 3 MHz, generating fully coherent radiation at the wavelength of 13.5 nm. The electron beam bunched at 13.5 nm can be further used in a harmonic conversion scheme to generate fully coherent radiation at much shorter wavelengths.

AKBP 2.7 Mon 17:30 CHE/0184

Advanced applications of laser heaters — •Linus Bölte[1], Philipp Amstutz[2], Christopher Gerth[2], Shaukat Khan[1], and Carsten Mai[1] — [1]Center for Synchrotron Radiation (DELTA), TU Dortmund University, Dortmund, Germany — [2]Deutsches Elektronen Synchrotron DESY, Hamburg Germany

Many FEL facilities use laser heaters to increase the electron energy spread and hence suppress microbunching instabilities. As part of the FLASH2020+ upgrade at DESY, a laser heater has been installed upstream of the first bunch compressor chicane. The goal of the FLASH Laser-Assisted Reshaping of Electron bunches (FLARE) project is to implement energy modulation schemes expanding the laser heater's basic purpose. This includes intentionally overheating regions of the electron bunch, as well as an up to now untested bunch compression method that will allow the generation of tunable few-femtosecond and possibly sub-femtosecond electron distributions. First studies on advanced applications of the laser heater will be presented.