AKBP 6: Free-Electron Lasers

Zeit: Dienstag 14:00–15:45 Raum: HS 8

AKBP 6.1 Di 14:00 HS 8

High-temperature superconducting undulators for compact Free Electron Lasers — •Sebastian Richter[1,3], Axel Bernhard[1], Julian Gethmann[1], Kantaphon Damminsek[1], Daniel Schoerling[3], and Anke-Susanne Müller[1,2] — [1]LAS, KIT, Karlsruhe — [2]IBPT, KIT, Karlsruhe — [3]CERN, Genva, Switzerland

Future compact Free Electron Lasers driven by X-band LINACs or laser plasma accelerators might strongly benefit from the application of short-period superconducting undulators wound from high-temperature superconducting (HTS) tape. We present parameters studies exploring the potential of the HTS undulator technology for future compact FELs.

AKBP 6.2 Di 14:15 HS 8

Cryogenic Undulator for a Laser-Plasma Driven FEL Demonstrator — •Maximilian Trunk[1], Johannes Bahrdt[2], and Andreas R. Maier[1] — [1]Center for Free-Electron Laser Science & Department of Physics, University of Hamburg, 22761 Hamburg, Germany — [2]Helmholtz-Zentrum Berlin für Materialien und Energie GmbH Hahn-Meitner-Platz 1, 14109 Berlin

Laser-plasma accelerators are promising candidates to drive a next-generation FEL. The LUX accelerator, developed and operated by the LUX research group at the University of Hamburg, recently demonstrated spontaneous undulator radiation from laser-plasma generated electron beams. A future upgrade of the beamline will use the cryogenic undulator FROSTY to demonstrate first FEL gain from laser-plasma electron beams following the decomression scheme developed in our group. This contribution will report on the commissioning of the FROSTY undulator towards a first FEL experiment.

AKBP 6.3 Di 14:30 HS 8

Impact of electron beam chirp on seeded Free-Electron Lasers — •Georgia Paraskaki[1], Bart Faatz[1], Vanessa Grattoni[1], Wolfgang Hillert[2], Christoph Lechner[1], and Johann Zemella[1] — [1]Deutsches Elektronen-Synchrotron (DESY), Hamburg — [2]Universität Hamburg, Hamburg

Free-electron lasers (FELs) deliver transversely coherent light pulses of high brightness. However, the radiation produced in FELs with self-amplified spontaneous emission (SASE) has poor temporal coherence. In seeded FELs, this is enhanced by initiating the FEL amplification process using an external, coherent light pulse. One parameter affecting the properties of the generated radiation is the chirp of the electron beam driving the seeded FEL. In this contribution, the impact of this electron beam property will be discussed.

AKBP 6.4 Di 14:45 HS 8

Simulation studies for a EEHG seeded FEL in the XUV — •Vanessa Grattoni[1], Christoph Lechner[1], Wolfgang Hillert[2], Georgia Paraskaki[1], and Ralph Assmann[1] — [1]DESY, Hamburg, Deutschland — [2]Universität Hamburg, Hamburg, Deutschland

Echo enabled harmonic generation (EEHG) is a promising technique for seeded free electron lasers not only to go down to wavelengths of 1 nm, but also to simplify the schemes that are currently used to achieve a similar wavelength range (double-cascaded HGHG). Thus a study optimizing the EEHG performance in the wavelength range from 60 to 4 nm is performed, assuming a linear accelerator operated at electron beam energies of 750 MeV and 1.35 GeV. These two working points are analyzed in detail for two different seed laser frequencies: visible and UV.

AKBP 6.5 Di 15:00 HS 8

Resonant small angle x-ray scattering probing ultrashort pulse high-intensity laser-solid interactions — •L. Gaus[1], M. Bussmann[1], A. L. Garcia[1], S. Glenzer[2], C. Gutt[3], B. Nagler[2], A. Pelka[1], M. Rödel[1], H.-P. Schlenvoigt[1], T. Cowan[1], U. Schramm[1], and T. Kluge[1] — [1]HZDR — [2]SLAC — [3]Uni. Siegen

The development of second-generation short-pulse laser-driven radiation sources requires a mature understanding of the relativistic laser-plasma processes as e.g. plasma oscillations, heating and transport of relativistic electrons as well as the development of plasma instabilities. These dynamic effects occurring on femtosecond and nanometer scales are very difficult to access experimentally.

In a first experiment in 2014 at the Matter of Extreme Conditions facility at LCLS we demonstrated that Small Angle X-ray Scattering (SAXS) of femtosecond x-ray free electron laser pulses is able to make these fundamental processes accessible on the relevant time and length scales in direct in-situ pump-probe experiments [Kluge et al., Phys. Rev. X 8, 031068 (2018)]. Here we report on a recent follow-up experiment with significantly higher pump intensity reaching the relativistic intensity domain, improved targetry, XFEL shaping and particle diagnostics. We give an overview of the new capabilities in combining a full suite of particle and radiation diagnostics and SAXS scattering. Especially probing at resonant x-ray energies can give new insight into the ultra-fast ionization processes, plasma opacity and equation-of-state in non-equilibrium plasmas.

AKBP 6.6 Di 15:15 HS 8

Current status of the EEHG upgrade plan at the DELTA short-pulse source — •Benedikt Büsing, Shaukat Khan, Daniel Krieg, Carsten Mai, Arne Meyer auf der Heide, Maximilian Schmutzler, and Frederik Teutenberg — Center for Synchrotron Radiation (DELTA), TU Dortmund University, Dortmund, Germany

To generate short pulses at short wavelengths in storage rings, seeding schemes from free-electron lasers can be adopted. Energy modulation induced by laser-electron interaction leads to micro-bunching and coherent emission of radiation.

At DELTA, a 1.5-GeV synchrotron light source operated by the TU Dortmund University, a short-pulse source based on coherent harmonic generation (CHG) is used to generate sub-picosecond synchrotron radiation pulses in the VUV regime. An upgrade torwards echo-enabled harmonic generation (EEHG) is planed to reach even shorter wavelengths. The current status and simulation results including optics studies for the future lattice will be presented.

This project is supported by the accelerator initiative (ARD) of the Helmholtz Association and by the BMBF under contract 05K16PEA.

AKBP 6.7 Di 15:30 HS 8

Off-Angle Harmonic Seeding at the Short-Pulse Source at DELTA — •Arne Meyer auf der Heide, Benedikt Büsing, Shaukat Khan, Daniel Krieg, Carsten Mai, and Frederik Teutenberg — Zentrum für Synchrotronstrahlung (DELTA), TU Dortmund, Deutschland

At the 1.5-GeV synchrotron light source DELTA operated by the TU Dortmund University, coherent harmonic generation (CHG) is employed to provide ultrashort pulses in the vacuum ultraviolet and terahertz regime. Here, a modulation of the electron energy induced by an interaction of an ultrashort laser pulse with an electron bunch within an undulator (modulator) tuned to the laser wavelength is transformed into a density modulation by a magnetic chicane. This results in the emission at harmonics of the laser wavelength as well as pulses in the THz regime. Recently, seeding experiments were performed with the laser wavelength being a harmonic of the undulator wavelength. The energy modulation tends to follow the angular distribution of spontaneous radiation at the respective undulator harmonic, e.g., an off-axis maximum for the second harmonic when seeding with 400-nm pulses while tuning the modulator to 800 nm. Measurements and simulation results will be shown and possible applications will be discussed.
Funded by BMBF under contract 05K16PEA and by the Land Berlin