AKBP 6: Synchrotron Radiation Sources (SR and FEL)

Zeit: Dienstag 16:30–18:30 Raum: NW-Bau - HS5

AKBP 6.1 Di 16:30 NW-Bau - HS5

Optimization of Synchrotron Light Sources using Machine Learning — •Tobias Boltz[1], Edmund Blomley[2], Erik Bründermann[2], Patrik Schönfeldt[2], Marcel Schuh[2], Minjie Yan[2], and Anke-Susanne Müller[1,2] — [1]LAS, KIT, Karlsruhe, Germany — [2]IBPT, KIT, Karlsruhe, Germany

The operation of particle accelerators often requires manual fine-tuning to achieve optimal conditions. For synchrotron light sources in particular, the machine settings have to be additionally tailored to the particular needs of different users, i.e. specific applications and experiments. Typical requirements concentrate e.g. on the intensity and temporal resolution of the generated light pulses. The optimization of these parameters yields challenging demands on beam characteristics and dynamics. As these are controlled by a multitude of different knobs (e.g. magnetic field strengths), optimization is a highly non-trivial problem. However, with recent developments in computer science similar problems have been solved in various fields by applying machine learning techniques. These are enabled by increasing amounts of data being collected as well as steadily rising computing power. In this contribution, we present recent efforts to employ machine learning techniques to optimize accelerator operation at the storage ring KARA (KArlsruhe Research Accelerator) as well as the linear accelerator and test facility FLUTE at KIT.

AKBP 6.2 Di 16:45 NW-Bau - HS5

Effects of different impedances on longitudinal beam dynamics — •Patrick Schreiber[1], Tobias Boltz[1], Miriam Brosi[1], Patrik Schönfeldt[2], and Anke-Susanne Müller[1,2] — [1]LAS, KIT, Karlsruhe, Germany — [2]IBPT, KIT, Karlsruhe, Germany

The beam dynamics in a particle accelerator are influenced by its impedance. In particular with high charge densities, the production of coherent synchrotron radiation is governed by the longitudinal impedance. With Inovesa, an in-house developed simulation tool, it is possible to simulate the development of the longitudinal phase space density inside a storage ring by solving the Vlasov-Fokker-Planck equation. To get a better understanding and with the long-term goal to design impedances for an explicit purpose, we did systematic studies of the longitudinal dynamics for multiple impedances. In this contribution, we give an overview of the resulting changes and effects in the longitudinal phase space density for various impedances, ranging from basic shapes to real world approximations.

AKBP 6.3 Di 17:00 NW-Bau - HS5

Generation and detection of tunable, narrowband sub-THz and THz radiation at DELTA — •Carsten Mai[1], Benedikt Büsing[1], Shaukat Khan[1], Nils Lockmann[1], Arne Meyer auf der Heide[1], Bernard Riemann[1], Boris Sawadski[1], Peter Ungelenk[1], Christopher Gerth[2], Martin Laabs[3], Niels Neumann[3], Miriam Brosi[4], Johannes Steinmann[4], and Franziska Frei[5] — [1]Center for Synchrotron Radiation (DELTA), TU Dortmund University, Dortmund, Germany — [2]Deutsches Elektronensynchrotron, Hamburg, Germany — [3]TU Dresden, Chair for RF and Photonics Engineering, Dresden, Germany — [4]IBPT, KIT, Karlsruhe, Germany — [5]Paul Scherrer Institut, Villigen, Switzerland

At the 1.5-GeV electron storage ring DELTA, operated by the TU Dortmund University, a broadband source for coherently emitted THz radiation was commissioned in 2011. The THz generation is based on the interaction of titanium-sapphire laser pulses and a single electron bunch in the storage ring. Recently, the laser setup was extended using a temporal modulation of the laser pulses to produce narrowband radiation which can be easily tuned to the desired THz or sub-THz frequency. One application is the measurement of the spectral sensitivity of THz detectors, such as a novel single-shot on-chip spectrometer developed by TU Dresden. A first characterization of the new source and a comparison of different THz detectors are presented.

AKBP 6.4 Di 17:15 NW-Bau - HS5

Control of FEL Radiation Properties by Tailoring the Seed Pulses — •Vanessa Grattoni[1], Hauke Biss[2], Christoph Lechner[1], Jörn Bödewadt[1], Mehdi Mohammad Kazemi[1], Ralph Wolfgang Assmann[1], Tim Plath[3], Armin Azima[1,2], Wolfgang Carl Albert Hillert[2], and Velizar Miltchev[1,2] — [1]DESY, Hamburg — [2]Universität Hamburg, Hamburg — [3]TU Dortmund, Dortmund

Seeded free-electron lasers (FELs) produce intense, ultrashort and fully coherent X-ray pulses. These seeded FEL pulses depend on the initial seed properties. Therefore controlling the seed laser allows tailoring the FEL radiation for phase sensitive experiments. In this contribution we present detailed simulation studies to characterize the FEL process and to predict the operation performance in these conditions. In addition we show an experimental measurement on the temporal characterization of the seeded FEL pulse performed at the sFLASH experiment.

AKBP 6.5 Di 17:30 NW-Bau - HS5

Overview of KIT short bunch activities — Axel Bernhard, Edmund Blomley, Tobias Boltz, Miriam Brosi, Erik Bründermann, Stefan Funkner, Julian Gethmann, Benjamin Kehrer, Michael J. Nasse, Gudrun Niehues, Alexander Papash, Robert Ruprecht, Thiemo Schmelzer, Patrik Schönfeldt, Marcel Schuh, Nigel J. Smale, •Johannes L. Steinmann, Minjie Yan, and Anke-Susanne Müller — Karlsruher Institut für Technologie, Karlsruhe

The KIT synchrotron KARA (Karlsruhe Research Accelerator) is regularly operated in a short bunch mode. The radiation of the short bunches can react back on the source bunch and trigger the microbunching instability. We present recent research on observing the instability by turn-by-turn measurements.

AKBP 6.6 Di 17:45 NW-Bau - HS5

Characterisation of the Second Stable Orbit Generated by Transverse Resonance Island Buckets (TRIBs) — •Felix Kramer[1,2], Paul Goslawski[1], and Andreas Jankowiak[1,2] — [1]Helmholtz-Zentrum Berlin, Deutschland — [2]Humboldt-Universität zu Berlin, Deutschland

Operating the storage ring near a transverse tune resonance can generate TRIBs in the corresponding phase space, providing a second orbit winding around the standard orbit. TRIBs represent a novel bunch separation scheme for photon sources. In combination with the variable bunch length storage ring BESSY VSR *, the proposed upgrade for BESSY II, they provide a promising alternative to dedicated single or few bunch operation modes. Lifetime and stability of the two orbits at BESSY II and MLS are on par with the standard user modes. Results from simulations and measurements of our current island optics at BESSY II will be presented. Beam parameters like the betatron motion, dispersion, and emittance of both the core and island beam will be discussed as well as the separation between the core and island beam. At BESSY II a test week with friendly users is scheduled for the first quarter of 2018.

* A. Jankowiak et al., eds., BESSY VSR Technical Design Study, Helmholtz-Zentrum Berlin für Materialien und Energie GmbH, Germany, June 2015. DOI: 10.5442/R0001

AKBP 6.7 Di 18:00 NW-Bau - HS5

Chicane Design Optimization for Echo-Enabled Harmonic Generation at sFLASH — •Hauke Biss[1], Jörn Bödewadt[2], Vanessa Grattoni[2], Christoph Lechner[2], Tim Plath[3], and Wolfgang Hillert[1] — [1]University of Hamburg, Hamburg, Germany — [2]DESY, Hamburg, Germany — [3]TU Dortmund University, Dortmund, Germany

The sFLASH experiment at the free-electron laser (FEL) FLASH at DESY in Hamburg is investigating phase-space manipulating seeding techniques. A scheme under investigation is the echo-enabled harmonic generation (EEHG). In this seeding scheme two laser pulses interact with the electron beam in two separate short undulators, each followed by a dispersive section. The resulting micro-bunched current profile has rich harmonic content, enabling the generation of seeded FEL radiation at high harmonics in a variable-gap undulator system further downstream. As, currently, the achievable harmonics of the sFLASH setup are limited by the dispersion strength of the magnetic chicanes, an upgrade is planned. In this contribution we discuss the parameter optimization aiming at sub-10nm seeded FEL radiation and present design considerations for integrating new magnetic chicanes under the boundary conditions given by the already existing hardware.

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AKBP 6.8 Di 18:15 NW-Bau - HS5

Inverse Thomson Scattering from a MeV Laser Plasma Accelerator and Plasma Mirror — •Andrea Hannasch[1,2], Rafal Zgadzaj[1,2], Alejandro Laso-Garcia[1], Ulrich Schramm[1], Arie Irman[1], and Michael Downer[1,2] — [1]Helmholtz-Zentrum Dresden-Rossendorf, Institut fur Strahlenphysik, 01328 Dresden, Germany — [2]University of Texas at Austin, Austin, Texas 78012, USA

We convert a MeV laser-plasma accelerator (LPA) driven by the DRACO Laser at HZDR into a compact, femtosecond-pulsed, tunable gamma-ray source by inserting a 25 um-thick transparent low Z Kapton foil ~mm after the accelerator exit. The foil acts as a plasma mirror (PM) that retro-reflects spent drive laser pulses (1.55 eV) with field strength a0 ~ 1 back onto trailing electrons (peak Lorentz factor tunable from 500 - 1000). Compton backscatter generated approximately 1e8 gamma-ray photons with few mrad divergence, and estimated peak brilliance 1e21 photons/s/mm2/mrad2/0.1% bandwidth. Scaling of the generated signal with PM position indicates that the nonlinear Thomson scattering regime is accessible with a PM, and further scaling of thickness and material indicates that bremsstrahlung generated by MeV electrons within the PM is negligible. Gamma-ray photon energy, inferred from the measured electron energy distribution on each shot and measured by a stack calorimeter, peaked at ~ 1 MeV, accessing a range otherwise available with comparable brilliance only from large-scale linac-based high-intensity gamma-ray sources.