AKBP 11: Synchrotron Radiation

Zeit: Mittwoch 11:00–12:30 Raum: HS 7

AKBP 11.1 Mi 11:00 HS 7

Feedback Design for Control of the Micro-Bunching Instability based on Reinforcement Learning — •Tobias Boltz, Miriam Brosi, Erik Bründermann, Bastian Härer, Patrick Schreiber, Minjie Yan, and Anke-Susanne Müller — KIT, Karlsruhe, Deutschland

The operation of ring-based synchrotron light sources with short electron bunches increases the emission of coherent synchrotron radiation in the THz frequency range. However, the micro-bunching instability resulting from self-interaction of the bunch with its own radiation field limits stable operation with constant intensity of CSR emission to a particular threshold current. Above this threshold, the longitudinal charge distribution and thus the emitted radiation vary rapidly and continuously. Therefore, a fast and adaptive feedback system is the appropriate approach to stabilize the dynamics and to overcome the limitations given by the instability. In this contribution, we discuss first efforts towards a longitudinal feedback design that acts on the RF system of the KIT storage ring KARA (Karlsruhe Research Accelerator) and aims for stabilization of the emitted THz radiation. Our approach is based on methods of adaptive control that were developed in the field of reinforcement learning and have seen great success in other fields of research over the past decade. We motivate this particular approach and comment on different aspects of its implementation.

AKBP 11.2 Mi 11:15 HS 7

Developing Beam Optics for the Future of BESSY II — •Felix Andreas[1,2] and Paul Goslawski[2] — [1]Humboldt University of Berlin — [2]Helmholtz-Zentrum Berlin

BESSY II is a third generation synchrotron light source located in Berlin. In operation for 20 years it provides extremely brilliant synchrotron light pulses in the range from Terahertz radiation to hard X-rays. First discussions about a successor have been started. However, at BESSY II due to the continuously increasing interest in short pulse operation, a major upgrade of the ring will enable simultaneous storage of long and short bunch. This Variable pulse-length Storage Ring (VSR) will be achieved by the installation of additional superconducting high gradient cavities. The cavities will be assembled into one cryomodule in one straight of the storage ring. As this module needs more space then initially assumed, one possible solution is to remove two quadrupoles to gain available installation length. We switched off the quadrupoles and optimized the linear beam optics in simulations. The different theoretical optics obtained were transferred to the storage ring. Storage of high current with reasonable injection efficiency and lifetime was possible with the best solution found. The proposed optics has to be further optimized in regards to nonlinear beam dynamics, but has shown that an the available installation length can be increased. The developed beam optics code will be further extended to study first lattice ideas for a BESSY II successor.

AKBP 11.3 Mi 11:30 HS 7

Spectrotemporal shaping of laser-induced THz pulses at the DELTA storage ring — •Carsten Mai, Benedikt Büsing, Shaukat Khan, Daniel Krieg, and Arne Meyer auf der Heide — 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 broadband source for coherently emitted (sub-)THz radiation was commissioned in 2011. The generation of both broadband and narrowband radiation is based on an interaction of short laser pulses with electron bunches in the storage ring. To enhance a narrowband spectral content, a periodic intensity modulation is applied to the laser pulses employing the chirped-pulse beating technique. The use of a spatial light modulator promises to allow a more flexible control of the laser pulse shape and the spectrotemporal properties of the resulting THz pulse.

Funded by BMBF 05K16PEB and by the Land NRW.

AKBP 11.4 Mi 11:45 HS 7

Alternative methods for Landau damping of transverse instabilities in synchrotrons. — •Vadim Gubaidulin[1], Oliver Boine-Frankenheim[1,2], and Vladimir Kornilov[2] — [1]TEMF, TU Darmstadt, Darmstadt, Germany — [2]GSI, Darmstadt, Germany

Octupoles are now the standard method of providing incoherent tune spread for Landau damping. This method scales poorly for higher intensity beams and coherent beam instabilities become harder to damp, requiring more and more octupole magnets. Alternative methods (such as electron lens or radio frequency quadrupole) can, in theory, be more effective for damping and less destructive for single particle stability. Beam stability in space charge dominated beams must account for effects of space charge induced tune spread and tune shift on Landau damping. We shall compare how alternative Landau damping methods compete with conventional Landau octupoles for different applications.

AKBP 11.5 Mi 12:00 HS 7

Two Orbit Operation at Bessy II - During a User Test Week — •Paul Goslawski, Felix Armborst, Felix Andreas, and Markus Ries — Helmholtz-Zentrum Berlin, BESSY II

Operating a storage ring close to a horizontal resonance and manipulating the non-linear dynamics by non-linear magnets could generate Transverse Resonance Island Buckets (TRIBs), which provide a 2nd stable orbit in the machine. Both orbits can be populated with different electron bunch fill pattern and provide to some extent two different radiation sources to the user community. At BESSY II, the aim is to establish a real operation mode and provide a multi-bunch train on the standard orbit for average brightness and a single or a few bunch fill on the island orbit for the timing user community. A first 'Two Orbit User Test Week' has been conducted in February 2018 and results and user feedback will be discussed in this contribution.

AKBP 11.6 Mi 12:15 HS 7

Measurement and Optimization of TRIBs Optics at BESSY II — •Felix Armborst[1,2], Paul Goslawski[1], Andreas Jankowiak[1,2], Peter Kuske[1], Marten Koopmans[1,2], Andreas Schälicke[1], and Markus Ries[1] — [1]Helmholtz-Zentrum Berlin für Materialien und Energie — [2]Humboldt-Universität zu Berlin

Transverse Resonant Island Buckets (TRIBs) correspond to a second stable orbit, longitudinally winding around the core orbit in the transverse x-x'-phasespace. The exploitation possibilities for stable TRIBs are under investigation at the third generation light source BESSY II in Berlin. The applicability for bunch separation is a main subject of these studies. Stable operation of TRIBs optics with a single or few bunches on the second orbit and a multibunch train on the main orbit has been shown. Photons emitted on the second orbit are well separated from those of the main orbit at all beamlines. This provides the possibility of bunch separation by beamline adjustment for the timing community without significant impact on the average brightness for other users. Simulations based on linear optics from closed orbits (LOCO) and on nonlinear optics derived from the measured chromaticity and tune shift with action (TSWA) predict this separation well. Friendly user experiments in 2018 confirmed these results. The scheduled upgrade BESSY VSR features simultaneously stored long and short bunches. Then TRIBs optics would in principle enable the separation of the different bunches at every beamline offering unique possibilities to our users. Simulations and measurements of further optimizations of the TRIBs optics are presented.