AKBP 3: Beam Dynamics

Zeit: Montag 16:30–18:15 Raum: HS 8

AKBP 3.1 Mo 16:30 HS 8

Beam-based alignment at the Cooler Syncrotron (COSY) — •Tim Wagner for the JEDI-Collaboration — Institut für Kernphysik, Forschungszentrum Jülich — III. Physikalisches Institut B, RWTH Aachen University

There is a matter-antimatter asymmetry observed in the universe that can not be explained by the Standard Model of particle physics. To resolve that problem additional CP violating phenomena are needed. A candidate for an additional CP violating phenomenon is a non-vanishing Electric Dipole Moment (EDM) of subatomic particles. Since permanent EDMs violate parity and time reversal symmetries, they also violate CP if the CPT-theorem holds.

The Jülich Electric Dipole moment Investigation (JEDI) Collaboration works on a direct measurement of the electric dipole moment (EDM) of protons and deuterons using a storage ring. The JEDI experiment requires a small beam orbit RMS in order to measure the EDM. Therefore an ongoing upgrade of the Cooler Syncrotron (COSY) is done in order to improve the precision of the beam position. One of part of this upgrade is to determine the magnetic center of the quadrupoles with respect to the beam position monitors. This can be done with the so called beam-based alignment method. In this talk the first results of the beam based alignment measurement performed in February 2019 will be presented.

AKBP 3.2 Mo 16:45 HS 8

Beam Dynamics Simulations for the ERL Mode at the S-DALINAC* — •F. Schliessmann, M. Arnold, J. Pforr, and N. Pietralla — Institut für Kernphysik, Darmstadt, Germany

The S-DALINAC [1] is a superconducting recirculating electron accelerator at TU Darmstadt. An additional recirculation beamline was installed in the years 2015-2016, so that the beam can pass the main accelerator up to four times in order to reach an energy gain of up to 130 MeV or to run the accelerator as a onefold or twofold Energy Recovery Linac (ERL) by shifting the path length of this recirculation beamline by 180°. Since the electrons' kinetic energy at injection and extraction in ERL mode is less than 8 MeV ($\gamma < 17$, $\beta < 0.9982$) and since eight 20-cell cavities designed for $\beta = 1$ are used in the main accelerator, the electrons suffer from the effect of phase slippage. In this contribution, the 6D beam dynamics simulations for ERL mode considering that phase slippage will be presented.

*Work supported by DFG through GRK 2128 and BMBF through grant No. 05H18RDRB2.

[1] N. Pietralla, Nuclear Physics News, Vol. 28, No. 2, 4 (2018).

AKBP 3.3 Mo 17:00 HS 8

Optimization of the injection beam line at COSY — •Benat Alberdi[1,2], Joerg Pretz[1,2], and Christian Weidemann[1] for the JEDI-Collaboration — [1]IKP FZ Juelich, Germany — [2]RWTH Aachen University, Germany

The Cooler Synchrotron (COSY) is a particle accelerator and storage ring operated by the Institute for Nuclear Physics (IKP) at Forschungszentrum Juelich. The facility provides polarized and unpolarized beam sources, a cyclotron, an injection beam line and the synchrotron itself, which besides many other features contains electron and stochastic cooling systems. The injection beam line of CoSy has been injecting 45 MeV proton and 75 MeV deuteron beams from the cyclotron into the ring since 1991. The optimization of the injection is done by hand and, therefore, the opportunity for improvement is substantial. Currently, a new approach is being developed in order to make this process of optimization automatic. The main objective is to rely on computational and machine learning methods to set the injection beam line parameters in order to achieve desirable results and match the synchrotron's properties such as its acceptance. We discuss the different necessary steps to reach this goal. The process includes a first analysis of the injection beam line lattice and the optimization of its sections using the Bmad software, the characterization of the beam in the injection beam line, the calculation of its main parameters and, finally, the identification and automatic optimization of the ones we are interested in.

AKBP 3.4 Mo 17:15 HS 8

Influence of the Longitudinal Damping Time on the Micro-bunching Instability — •Miriam Brosi, Julian Gethmann, Patrick Schreiber, Johannes Steinmann, Benjamin Kehrer, Alexander Papasch, Axel Bernhard, Erik Bründermann, and Anke-Susanne Müller — Karlsruhe Institute of Technology, Karlsruhe, Deutschland

At the KIT storage ring KARA (KArlsruhe Research Accelerator), the momentum compaction factor can be reduced leading to natural bunch lengths in the ps range. Due to the high degree of longitudinal compression, the micro-bunching instability arises. During this longitudinal instability, the bunches emit bursts of intense coherent synchrotron radiation in the THz frequency range caused by the complex longitudinal dynamics. The temporal pattern of the emitted bursts depends on given machine parameters, like momentum compaction factor, acceleration voltage, and damping time. In this talk, the influence of the damping time is studied by utilizing the CLIC damping wiggler prototype installed in KARA as well as by simulations using the Vlasov-Fokker-Planck solver Inovesa.

AKBP 3.5 Mo 17:30 HS 8

Transfer Line for ultra short bunches from FLUTE to cSTART — •Jens Schäfer[2], Bastian Härer[1], Alexander Papash[1], and Anke-Susanne Müller[1,2] — [1]IBPT, KIT, Karlsruhe, Germany — [2]LAS, KIT, Karlsruhe, Germany

The FLUTE test experiment at KIT produces 50 MeV electron bunches with ultra short bunch lengths of only a few femtoseconds to create coherent THz radiation. These bunches will be transferred to the high acceptance storage ring cSTART which will be installed right above FLUTE. The low energy loss due to synchrotron radiation at 50 MeV results in a damping time of 20 s which makes cSTART an excellent tool to investigate short bunches in a non-equilibrium regime. This presentation adresses the status of the transfer line from FLUTE to cSTART which should maintain the ultra short bunch length and provide additional compression if needed. The layout of FLUTE and cSTART requires deflection of the beam in both transversal planes with only limited space. At the insertion point, the beam parameters have to be matched to the optics of cSTART with a given flexibility, taking non-linear effects into account. In addition cSTART serves as a test area for a LWFA as full-energy injector, therefore the transfer line has to allow modifications of the energy spread for preliminary studies.

AKBP 3.6 Mo 17:45 HS 8

A CLIC damping wiggler at KIT—from beam dynamics simulations to short bunch experiments — •Julian Gethmann[1], Axel Bernhard[2], Miriam Brosi[1], Benjamin Kehrer[1], Alexander Papasch[2], and Anke-Susanne Müller[1,2] — [1]LAS, KIT, Karlsruhe — [2]IBPT, KIT, Karlsruhe

(As a part of the CLIC collaboration) A CLIC damping wiggler prototype has been installed at the KArlsruhe Research Accelerator synchrotron light source in order to validate the technical design of the 3 T superconducting conduction cooled wiggler and to carry out studies on beam dynamics, including collective effects. This talk will focus on the influence of this device on the beam dynamics and its capability of deliberately varying the damping time, which was used for the detailed study of THz radiation in KIT's storage ring KARA's (KArlsruhe Research Accelerator) short bunch mode operation.

AKBP 3.7 Mo 18:00 HS 8

Coherent synchrotron radiation at the very large acceptance compact storage ring cSTART — •Andreas Kaiser[1], Bastian Härer[2], Alexander Papash[2], Jens Schäfer[1], and Anke-Susanne Müller[1,2] — [1]LAS, KIT, Karlsruhe, Germany — [2]IBPT, KIT, Karlsruhe, Germany

The planned very large acceptance compact storage ring (cSTART) at KIT is designed to cope with ultra-short bunches from a laser wakefield accelerator (LWFA) as injector. Because of their high intensity at wavelength larger than the bunchlength, these bunches have excellent characteristics for the production of coherent synchrotron radiation (CSR). In this contribution the effect of the CSR self interaction with the beam in cSTART is studied by tracking simulations using elegant.