BE 15: Beam Dynamics and Fields III

Time: Thursday 15:00–18:00 Location: ZEU 255

Group Report BE 15.1 Thu 15:00 ZEU 255

Hochstrom Energy-Recovery-Linac B*ERLin*Pro - Statusbericht — •Stephan Wesch, Michael Abo-Bakr, Wolfgang Anders, Roman Barday, Alexey Bondarenko, Klaus Bürkmann-Gehrlein, Andrew Burrill, Volker Dürr, Andreas Jankowiak, Thorsten Kamps, Vasim Khan, Guido Klemz, Jens Knobloch, Oliver Kugeler, Bettina Kuske, Peter Kuske, Aleksandr Matveenko, Atoosa Meseck, Gerd Meyer, Roland Müller, Axel Neumann, Klaus Ott, Eva Panofski, Yuriy Petenev, Joachim Rahn, Jeniffa Rudolph, Martin Schmeisser, Susanne Schubert, Oliver Schüler, Julia Vogt und Jens Völker — Helmholtz-Zentrum Berlin HZB, Deutschland

Die im Aufbau befindliche Beschleunigertestanlage B*ERL*inPro am HZB ist ein 50 MeV supraleitender energy-recovery-linac (ERL), der von einem supraleitenden Photokathoden-Injektor gespeist wird. In Hinblick auf den Einsatz von ERLs als künftige hoch-brillante Strahlungsquellen ist das Hauptziel von B*ERL*inPro einen maximalen Strahlstrom von 100 mA cw zu demonstrieren. Gleichzeitig sollen Elektronenpakete mit einer normierten, transversalen Emittanz unter 1 mm mrad und mit Längen von einer Pikosekunde und kürzer erzeugt werden. Viele aktuelle physikalische und technologische Herausforderungen wie z.B. Emittanzerhaltung bei Rezirkulation, stabiler Hochstrombetrieb bei geringen Strahlverlusten und flexible Elektronpaketmanipulation werden mit diesen Projekt adressiert. In diesem Übersichtsvortrag wird B*ERL*inPro kurz vorgestellt und über dessen momentanen Status berichtet.

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Modelling of the short-bunch optics for B*ERL*inPro — •Andreas Ginter and Alexander Matveenko — Helmholtz-Zentrum Berlin für Materialien und Energie GmbH, Elektronenspeicherring BESSY II, Albert-Einstein-Str. 15, 12489 Berlin, Germany

BERLinPro is designed as an Energy Recovery Linac (ERL) test facility to develop and to demonstrate the technology and expertise required to drive next-generation lights sources that are based on ERL principle.

Compared to storage rings, ERLs can achieve bunch lengths that are at least two orders of magnitude shorter. As part of the technology demonstration the minimal obtainable bunch length in BERLinPro has to be determined. Lattice parameters are optimized in simulations. Limiting factors like coherent synchrotron radiation and space charge effects are discussed. Results for different bunch charges are presented.

BE 15.3 Thu 15:45 ZEU 255

Investigation of microbunching instability in energy recovery linacs - utilizing BERLinPro as an example — •Rädel Stephanie and Meseck Atoosa — Helmholtz Zentrum Berlin für Materialien und Energie GmbH, Berlin, Germany

In an Energy Recovery Linac (ERL), an electron bunch is accelerated during the first passage through a linac. After the usage (radiation generation or collider-experiments) the spent electron beam passes the linac a second time with a phase shift of 180 degree and is decelerated. This way the energy can be recovered. In an ERL the preservation of the low emittance and small energy spread is of major importance. Therefore, deep understanding and control of effects, which can degrade the emittance and energy spread such as space charge effects are of interest. The microbunching caused by the longitudinal space charge forces can lead to, on the one hand to an increase in emittance and energy spread in the arcs of the loop. On the other hand it can be used to generate coherent high brightness radiation. In this contribution, utilizing BerlinPro as an example, the impacts of the microbunching instability on the beam quality and its implication for an ERL are discussed.

BE 15.4 Thu 16:00 ZEU 255

Magnetic Optics of the Femto-Science-Factory Multi-Turn ERL Project — •Terry Atkinson — Helmholtz Zentrum Berlin

The heavy demands on the beam quality for future light sources: diffraction limited emittance, femto-second pulses and low energy spread require advanced magnetic optic designs. This talk highlights the magnetic optic that is presently being investigated in the ERL-simulation group at HZB. Start-to-End beam dynamic simulations are presented. The effect from higher order chromatic aberration terms have been minimized using multipole magnets and biased off-crest acceleration. Optic based on horizontal phase advance manipulation to suppress emittance growth due to coherent synchrotron radiation has been investigated.

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Auswirkungen des CLIC-Dämpfungswiggler-Prototypen auf die Strahldynamik an ANKA — •Julian Gethmann[1], Axel Bernhard[1], Edmund Hertle[1], Steffen Hillenbrand[1], Nigel Smale[1], Konstantin Zolotarev[2] und Anke-Susanne Müller[1] — [1]Karlsruher Institut für Technologie (KIT) — [2]Budker Institute of Nuclear Physics

Für hohe Luminositäten am Lepton-Collider CLIC werden Strahlen mit geringer transversaler Emittanz benötigt, die man durch Dämpfungsringe mit supraleitenden Wigglern erreichen will. Zu Testzwecken wird an ANKA ein Dämpfungswiggler-Prototyp installiert. Als vorbereitende Untersuchung wurden die Auswirkungen des Wigglers auf die Strahldynamik simuliert und das Modell mit an ANKA existierenden Permanentmagnet-Wigglern experimentell getestet.

15 min. break

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Short-pulse studies at FLASH — •Marie Rehders — Universität Hamburg, for the short bunches project at FLASH

Many users at FLASH work on pump-probe experiments, where time resolution is determined by the FEL pulse duration. Therefore they have expressed a keen interest in being provided with shorter XUV pulses. The shortest possible SASE pulse is a single longitudinal optical mode of the FEL radiation, resulting in radiation pulses of some 3 fs.

The most direct way to realize this at FLASH would be to reduce the electron bunch length to only a few μm at the entrance of the undulator section. The maximum tolerable bunch compression from the cathode to the FEL is limited to a factor of approximately 300 due to beam dynamics issues and RF tolerances. Thus, the bunch duration at the injector has to be as short as approximately 1ps, which in turn calls for low bunch charges to make space charge effects tolerable. A new photo-injector laser with adjustable pulse duration is thus used to optimize the initial bunch length at the cathode.

Beam dynamic studies are performed to optimize the injection and compression of low charge electron bunches, starting with the pulse parameters of the injector laser. Also, first experimental results with several injector laser settings are compared with beam dynamic simulations and presented in this contribution.

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Determination of a working point for double-bunch electron-beam generation and transport in the FLASH accelerator at DESY — •Carlos Manuel Entrena Utrilla and Steffen Wunderlich — Deutsches Elektronen-Synchrotron, Hamburg, Germany

The future studies on particle-beam driven plasma-acceleration in the FLASHForward project at the FLASH accelerator facility at DESY in Hamburg, as well as other projects like the two-color FEL, require the production and transport of two electron bunches with a spacing of hundreds of femtoseconds within one RF bucket. The bunches are generated at the cathode by dividing the injector laser pulses with a split-and-delay optic system. They are then accelerated and compressed using the FLASH linear accelerator and its two bunch compressors. A method for the determination of the machine's working point, the voltages and phases of the accelerating modules, is presented. The determination is done with a three step optimization process: an initial analytical approach, a subsequent numerical optimization with one dimensional tracking procedure including collective effects and the full three dimensional simulation with the ASTRA and CSRtrack tracking codes.

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Start-to-end error study for FLUTE — •Manuel Weber[1], Anke-Susanne Müller[1,2,3], Somprasong Naknaimueang[2], Mar-

cel Schuh[1], Markus Schwarz[1], and Pawel Wesolowski[2] — [1]LAS, KIT, Karlsruhe — [2]ANKA, KIT, Karlsruhe — [3]IPS, KIT, Karlsruhe

FLUTE, a new linac based test facility and THz source is currently being built at the Karlsruhe Institute of Technology (KIT) in collaboration with DESY and PSI. In this machine single electron bunches with charges from 1pC to 3nC will be accelerated to 40-50 MeV. Afterwards the bunches will be compressed longitudinally in a magnetic chicane to generate intense coherent THz radiation. The stability and repeatability of longitudinal bunch profiles are essential for optimum compression and THz emission.

Start to end beam dynamics error studies have been performed using ASTRA to determine the influence of various machine elements on the beam. Afterwards critical parameters are identified and tolerances are defined for those. In this contribution a summary of this error study will be given.

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SALOME: An accelerator for the practical university course in accelerator physics — •Daniel Riebesehl[1], Velizar Miltchev[1], Jörg Rossbach[1], Oliver Stein[2] und Maximilian Trunk[1] — [1]Universität Hamburg — [2]CERN

SALOME (Simple Accelerator for Learning Optics and the Manipulation of Electrons) is a short low energy linear accelerator for electrons built by the University of Hamburg. The goal of this project is to give the students the possibility to obtain hands-on experience with the basics of accelerator physics. The SALOME accelerator project offers a great bandwidth of learning the theoretical aspects of accelerator technologies and the realization of technical setups. In this contribution the layout of the device will be presented. The most important components of the accelerator will be discussed and experimental results characterising the beam energy and transverse phase space will be presented.