AKBP 15: Beam Dynamics / Simulation III

Zeit: Donnerstag 16:45–19:00 Raum: F.10.01 (HS 4)

AKBP 15.1 Do 16:45 F.10.01 (HS 4)

Beam Transfer Functions and Tune Spread in Bunched Beams — •Paul Görgen[1], Oliver Boine-Frankenheim[1], and Wolfram Fischer[2] — [1]Institut für Theorie Elektromagnetischer Felder (TEMF), Technische Universität Darmstadt, Schloßgartenstr. 8 64289 Darmstadt, Germany — [2]Brookhaven National Laboratory, Upton, NY 11973, United States

We present our results on measurement of transverse tune spread due to transverse nonlinearities in high energy synchrotrons using Beam Transfer Functions (BTF). We work under the assumption of frozen or near-frozen synchrotron motion commonly found in high energy machines. We discuss the analytic equation for the BTF in absence of coherent modes. We show that the tune distribution can not be recovered from the transverse BTF alone. We then show that even in absence of additional knowledge, the BTF can be used to measure the tune spread. We discuss the application and applicability of this method and show agreement between analytic results, simulation and measurement.

AKBP 15.2 Do 17:00 F.10.01 (HS 4)

Fast determination of optical functions using multiturn and closed-orbit data — •Stephan Kötter, Bernard Riemann, Peter Hartmann, Benjamin Isbarn, and Thomas Weis — DELTA, TU-Dortmund, Dortmund, Germany

Today closed-orbit measurements via conventional beam position monitor (BPM) systems are established tools to derive twiss parameters in storage rings. While the application of turn-by-turn data acquisition techniques increases the availability of fast measurement data, the required expensive hardware and the related synchronization issues hamper its use. It was shown in a proof-of-principle experiment* that a minor addition of two turn-by-turn data acquisition sources to conventional beam position monitor systems holds the potential of combining the advantages of turn-by-turn and closed-orbit methods.

The introduced fast beam position monitors need to be set up in a drift space with two small orbit corrector magnets installed. By deriving the ß-function at the position of the corrector magnets, the ß-function at all conventional monitors in the storage ring can be calculated via the orbit response matrix.

Currently the described system is being implemented for robust daily use at the DELTA facility in Dortmund. This presentation will give an overview on the applied method and will illustrate the approach chosen for the implementation and the progress of developing dedicated software to steer the magnets, read out monitor data and compute beam optics parameters.

*B. Riemann et al., Phys. Rev. ST Accel. Beams 14, 062802 (2011)

AKBP 15.3 Do 17:15 F.10.01 (HS 4)

Influence of Transient Beam Loading on the Longitudinal Beam Dynamics at BESSY VSR — •Martin Ruprecht[1], Paul Goslawski[1], Andreas Jankowiak[1], Markus Ries[1], Godehard Wüstefeld[1], and Thomas Weis[2] — [1]Helmholtz-Zentrum Berlin, Germany — [2]Technische Universität Dortmund, Germany

BESSY VSR, a scheme where 1.5 ps and 15 ps long bunches (rms) can be stored simultaneously in the BESSY II storage ring has recently been proposed[1]. The strong longitudinal bunch focusing is achieved by superconducting high gradient RF cavities. If the fill pattern exhibits a significant inhomogeneity, e.g. due to gaps, transient beam loading causes a distortion of the longitudinal phase space which is different for each bunch. The result are variations along the fill pattern in synchronous phase, synchrotron frequency and bunch shape. This paper presents investigations of transient beam loading and depicts the consequences on bunch length, phase stability and longitudinal multi-bunch oscillations for the projected setup of BESSY VSR.

[1] G. Wüstefeld, A. Jankowiak, J. Knobloch, M. Ries, Simultaneous Long and Short Electron Bunches in the BESSY II Storage Ring, Proceedings of IPAC2011, San Sebastián, Spain

AKBP 15.4 Do 17:30 F.10.01 (HS 4)

A Semi-Analytic Model for The Determination of Wakefields in Dielectrically Lined Rectangular Waveguides — •Franziska Reimann[1], Ursula van Rienen[1], Peter Michel[2], and Ulf Lehnert[2] — [1]Universität Rostock, Institut für All- gemeine Elektrotechnik — [2]Helmholtz-Zentrum Dresden-Rossendorf

Dielectrically lined waveguides are planned to be used as a passive wakefield dechirper [1] for the electron beam at the ELBE facility of the Helmholtz-Zentrum Dresden Rossendorf. In this work we introduce a complete semi-analytical model based on eigenmode expansion [2] to determine the longitudinal wakefield in these structures. The result gained from this model is the point-charge wakefield, which serves as a Green's function for convolution with the ELBE beam shape. As an example, semi-analytical results for different beam shapes are compared to numerical results of commercial software, e.g. CST Studio [3].

[1] Antipov et al., *Passive Momentum Spread Compensation by a *Wakefield Silencer"", in: Proceedings of IPAC2012, New Orleans, USA, 2012

[2] Robert E. Collin, *Field Theory of Guided Waves, Second Edition*, IEEE Press, 1991, p. 419

[3] CST Studio Suite, CST AG, Darmstadt, Germany

AKBP 15.5 Do 17:45 F.10.01 (HS 4)

Multi Beam Storage in Transverse Resonance Island Buckets at MLS and BESSY II — •Paul Goslawski, Joerg Feikes, Tobias Goetsch, Ji Li, Markus Ries, Martin Ruprecht, Andreas Schälicke, and Godehard Wüstefeld — Helmholtz-Zentrum Berlin, HZB

Operating a storage ring at a working point close to horizontal resonances ($f_x/f_0 = 1/2$, $1/3$ or $1/4$) generates two, three or four resonance island buckets in the x, x' phase space. Several beams can be stored simultaneously in these buckets. First experiments with such an operation mode have been conducted at the Metrology Light Source (MLS) and then applied at BESSY II. This operation mode enables spatially or angularly separated beams with different properties such as filling pattern, bunch length, beam intensity or subharmonic revolution frequencies. We will present experimental results as well as operational experience at the MLS and BESSY II such as tuning the machine for high current, controlling intra-bucket diffusion rates or improving the overall lifetime.

This mode allows for a more flexible operation of the machine having the potential to simultaneously fulfil diverse user demands, e.g., real single bunch operation.

AKBP 15.6 Do 18:00 F.10.01 (HS 4)

Advanced Bunching Scheme at REGAE — •Benno Zeitler[1,2], Klaus Flöttmann[3], and Florian Grüner[1,2] — [1]University of Hamburg, Institute of Experimental Physics, 22761 Hamburg — [2]CFEL, Center for Free-Electron Laser Science, 22607 Hamburg — [3]DESY, 22761 Hamburg

The field of laser wakefield acceleration offers very high accelerating gradients. To combine the university research on this topic with the expertise of a large and well-established accelerator facility, the LAOLA Collaboration was formed between DESY and the University of Hamburg. One of the campaigns pursued within this framework is the external injection of an electron bunch from a conventional gun into a laser-driven plasma wakefield, which is a promising path towards increased control over the injected electron phase space. The Relativistic Electron Gun for Atomic Exploration (REGAE), a small accelerator located at DESY, is an interesting candidate for such an external injection experiment due to the short bunches on the order of 10 fs, required for the primary design goal of the machine: Time-resolved electron diffraction. In this case the particles are compressed using the ballistic bunching method. The shortness of the bunching is limited by non-linearities in the longitudinal phase space. We present a method that allows for a correction of these non-linearities, enabling even shorter bunches.

AKBP 15.7 Do 18:15 F.10.01 (HS 4)

Untersuchung der Wirkung von Ionensäuberungsmaßnahmen an ELSA* — •Dennis Sauerland und Wolfgang Hillert — Elektronen-Stretcher-Anlage ELSA, Physikalisches Institut, Universität Bonn

Im ELSA Stretcherring der Universität Bonn werden Elektronen mit einer Energie von bis zu 3,2 GeV für hadronenphysikalische Experimente zur Verfügung gestellt. Hierbei akkumulieren Ionen, welche durch Kollision mit den Elektronen kontinuierlich produziert werden, im Strahlpotential und sind Ursache für inkohärente Arbeitspunktverschiebungen und Strahlinstabilitäten. Da die Effekte mit der Anzahl der Ionen skalieren ist es notwendig diese durch den Einsatz von Absaugelektroden und Füllstrukturlücken zu begrenzen. Die Ionenanzahl kann durch die Messung der Strahltransferfunktion bestimmt werden: Durch eine breitbandige Anregung des Strahls um seinen transversalen Arbeitspunkt mittels eines Stripline-Kickers ist es möglich die Transferfunktion des Strahls zu bestimmen. An Hand der Verschiebung und Verbreiterung des Arbeitspunktes kann die inkohärente Arbeitspunktverschiebung und somit die Anzahl der Ionen im Beschleuniger bestimmt werden. Im Vortrag wird diese Messmethode im Kontext der Effizienz der Ionensäuberung durch Absaugelektroden und Füllstrukturlücken an ELSA vorgestellt.

*Gefördert vom Bundesministerium für Bildung und Forschung unter Fördernummer 05K13PDA

AKBP 15.8 Do 18:30 F.10.01 (HS 4)

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

The Energy Recovery Linac principle allows compressing electron bunches to the length at least two orders of magnitude shorter compared to storage rings. At bERLinPro bunch compression and decompression can be done in two stages in the injector and main arcs. The distribution of compression between these two stages is subject to optimization.

Simulations show that the length and shape of the bunch in the injector and before the linac are the limiting factors for minimal bunch length. Injector simulations have to consider space charge effects, whereas CSR effects are limiting compression in the arcs. Current status of injector optimization and effect on the compressed bunch are presented.

AKBP 15.9 Do 18:45 F.10.01 (HS 4)

Laser Cooling of High Energy Ion Beams - from ESR and CSRe to FAIR and HIAF — •Michael Bussmann[1], Weiqiang Wen[1,2,3], Danyal Winters[4], Christina Dimopoulou[4], Fritz Nolden[4], Markus Steck[4], Shahab Sanjari[4], Tino Giacomini[4], Yuri Litvinov[4], Christophor Kozhuharov[4], Thomas Kühl[4], Matthias Lochmann[5], Johannes Ullmann[5], Rodolfo Sanchez[4,5], Wilfried Nörtershäuser[4,5], Thomas Stöhlker[4,6], Tobias Beck[5], Benjamin Rein[5], Thomas Walther[5], Sascha Tichelmann[5], Gerhard Birkl[5], Hanbing Wang[3], Dacheng Zhang[3], Zhongkui Huang[3], Bang Hai[3], Youjin Yuan[3], Xinwen Ma[3], Markus Löser[1,2], Matthias Siebold[1], and Ulrich Schramm[1,2] — [1]Helmholtz-Zentrum Dresden - Rossendorf — [2]Technische Universität Dresden — [3]Institute of Modern Physics, Lanzhou — [4]GSI Helmholtzzentrum für Schwerionenforschung — [5]Technische Universität Darmstadt — [6]Helmholtz-Institut Jena

We present results from laser cooling experiments at ESR, GSI Darmstadt and CSRe, IMP Lanzhou. We show that with a cw laser system it is possible to cool ion beams with large initial momentum spread and that laser cooling can overcome intra-beam scattering, regardless of the initial ion beam current.

We furthermore discuss first laser cooling tests with a pulsed laser system and present an outlook on how to optimize laser cooling for heavy ion beams at highly-relativistic energies, focusing not only on laser technologies but also on optical beam diagnostics.