HK 13: Beschleunigerphysik III (Strahlinstabilitäten I)

Zeit: Montag 11:00–13:00 Raum: WIL-C207

HK 13.1 Mo 11:00 WIL-C207

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

In an energy recovery linac (ERL), a Photo-injector produces electron bunches with very low emittance und energy spread to feed a superconducting linac section. After the acceleration in the linac, the bunches pass through a transport loop, which for example can include undulators to produce high-brilliance radiation. After the passage through the loop, the bunches pass the linac a second time with a phase shifted by a 180 degree, in this case the linac decelerates the bunches gaining back the energy. The spend bunches are deflected by a dipole magnet to a beam dump. Maintaining the low emittance and energy spread is of major importance in an ERL. 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 an increase in emittance and energy spread in the arcs of the loop. In this contribution, the impacts of the microbunching instability on the beam quality and its implication for an ERL are discussed.

HK 13.2 Mo 11:15 WIL-C207

Analyse von transversalen Beamtransferfunktionen für intensive Ionenstrahlen. — •Paul A. Görgen[1], Oliver Boine-Frankenheim[1] und Wolfram Fischer[2] — [1]Institut für Theorie Elektromagnetischer Felder, Darmstadt — [2]Brookhaven National Laboratory, Upton, NY, USA

Es werden Beamtransferfunktionen (BTF) von Ionenstrahlen im Relativistic Heavy Ion Collider (RHIC) unter dem Einfluss des Beam-Beam-Effektes sowie der im Aufbau befindlichen Elektronenlinse beschrieben. Dazu wird ein einfaches analytisches Modell der Beamtransferfunktion unter Einfluss der beiden Effekte entwickelt. Im analytischen Modell wird der Beam-Beam-Effekt bzw. die Elektronenlinse als gleichmäßig über den Ring verteilte betatronamplitudenabhängige Tuneabweichung angenommen. Desweiteren werden numerische Simulationen mithilfe eines Particle-in-Cell (PIC) Codes vorgestellt. Im PIC-Code wird der Beam-Beam Effekt durch eine zweidimensionale Interaktion approximiert. Die Speicherringgeometrie wird durch die lineare Transfermatrix des Rings miteinbezogen. Chromatizität ist als impulsabhängiger Betatronphasenvorschub implementiert. Die Simulation der Beamtransferfunktion erfolgt analog zum Experiment durch Anregung mit einem periodischen Signal bei verschiedenen Anregungsfrequenzen um die Betatronfrequenz und Beobachten der antwortenden Oszillation des Ladungszentrums des Strahls. Die numerischen Ergebnisse werden mit Messdaten sowie mit den analytischen Ergebnissen verglichen. Die BTF-Implementierung im Simulationscode wurde zuvor gegen analytisch bekannte BTF validiert.

HK 13.3 Mo 11:30 WIL-C207

Numerische Berechnung von Strahlkoppelimpedanzen im Frequenzbereich — •Uwe Niedermayer und Oliver Boine-Frankenheim — TEMF, TU-Darmstadt, Schloßgartenstr. 8, 64289 Darmstadt

Die transversale Impedanz von Ferrit-Kickermagneten stellt eine Ursache von Strahlinstabilitäten im geplanten SIS100 Synchrotron für FAIR dar. Die longitudinale Impedanz von Ferrit-Komponenten trägt unter anderem zur strahlinduzierten Erwärmung dieser Komponenten bei, was insbesondere im LHC ein Problem darstellt. Im Hochfrequenzbereich können diese Impedanzen mit kommerziellen Codes wie z.B. CST Particle Studio im Zeitbereich berechnet werden. Für niedrige Frequenzen ist dies jedoch wegen der langen Teilchen-Flugstrecken nicht möglich. Wir zeigen den Fortschritt in der Entwicklung eines Frequenzbereichs-Lösers auf Basis der FIT (Finite Integrations Technik) Methode. Die Implementierung basiert auf dem PETSc (Parallel, Extensible Toolkit for Scientific computation) Paket in C++. Der Code wird auf den Testfall eines zylindrischen induktiven Einsatzes und auf den SIS18 sowie SIS100 Kicker angewandt. Ein anderer Beitrag unserer Gruppe beschäftigt sich mit der Vermessung des SIS18 Kickers mit der Draht-Methode.

HK 13.4 Mo 11:45 WIL-C207

High density plasma instabilities in intense laser irradiation — •Thomas Kluge[1], Josefine Metzkes[1], Martin Dommert[1], Michael Bussmann[1], Christian Gutt[2], and Thomas E. Cowan[1] — [1]Helmholtzzentrum Dresden-Rossendorf e.V. — [2]DESY Hamburg

Recent experimental results on the filamentation of laser accelerated proton beams at high laser irradiation intensities are compared to particle-in-cell simulations. In simulations, several qualitatively different mechanisms of filamentation of electrons can be observed. Depending on the specific laser and target parameters such as flatness or density, the relative role of individual electron instabilities can be actively controlled. It is demonstrated how filamentation of electron currents going into the target and heating the rear surface can translate into ion filamentation which consequently exhibit strong correlation with the front side laser-electron instability physics. The impact on ion energy scaling are discussed.

Experimental observation of proton filamentation can thus be a valuable diagnostics of the laser-electron interaction at the foil front surface. We moreover propose and discuss other more direct techniques for probing spatio-temporal electron density and ionization.

HK 13.5 Mo 12:00 WIL-C207

Numerical Studies of Designs of Clearing Electrodes for Ion Clearing in an ERL — Eden Tafa Tulu[1], •Gisela Pöplau[1], Atoosa Meseck[2], and Ursula van Rienen[1] — [1]Universität Rostock — [2]HZB, Berlin

Energy Recovery Linacs (ERLs) are the most promising candidates for next-generation light sources now worldwide under active development. An optimal performance of these machines requires the preservation of the high beam brightness generated in the injector. For this, the impact of the ionized residual gas on the beam has to be avoided as it causes instabilities and emittance growth.

Typical measures to reduce the effect of ion clouds are clearing electrodes. In this paper we present simulation studies for several designs of clearing electrodes that are in use at the Metrology Light Source (MLS) and under discussion for ion clearing in the Berlin Energy Recovery Linac Project - BERLinPro. The software tools we applied are CST Particle Studio and our in-house code MOEVE PIC Tracking.

HK 13.6 Mo 12:15 WIL-C207

Numerical wakefield calculations for electro-optical measurements — •Benjamin Kehrer, Andrii Borysenko, Edmund Hertle, Nicole Hiller, Vitali Judin, Sebastian Marsching, Anke-Susanne Müller, Michael J. Nasse, Marcel Schuh, and Markus Schwarz — Karlsruhe Institute of Technology, Karlsruhe, Germany

The usage of electro-optical measurement techniques allows precise and single-shot measurements of the length and shape of an electron bunch. At the ANKA storage ring such a setup for near-field measurements has recently been installed. The installation of such a setup changes the impedance of the storage ring and the corresponding effects have to be studied carefully. By using numerical codes it is possible to simulate the wakefields induced by the setup. In this presentation, first results obtained with the wakefield solver implemented in the CST studio suite are shown. [funded by BMBF under contract number 05K10VKC]

HK 13.7 Mo 12:30 WIL-C207

Electron Cloud Effects in Hadron Beams — •Fedor Petrov, Oliver Boine-Frankenheim, and Thomas Weiland — TU-Darmstadt, Institut für Theorie Elektromagnetischer Felder ,Schloßgartenstr. 8 64289 Darmstadt, Deutschland

Accelerators operating with intense positively charged beams can suffer from the electron cloud phenomenon. For example, it is the intensity limiting factor in CERN LHC and SPS. In past decades a lot of progress in understanding the electron cloud effects was made worldwide. Methods to suppress or weaken the electron cloud phenomenon were proposed. Theories governing the bunch stability in presence of the electron cloud were developed. Recently the theory was introduced to describe the bunch energy loss due to the electron cloud. However, most of the publications concern the single bunch electron cloud effects. In reality bunches are packed into trains. A disturbance of the cloud caused by the bunch in the beginning of the train affects the subsequent bunches. We present a further investigation of single-bunch electron cloud effects and planned activities to study the phenomenon in case of multiple bunches.

HK 13.8 Mo 12:45 WIL-C207

Phase error reduction in superconductive undulators using Induction Shimming — •Elisabeth Drayer, Axel Bernhard, Veronica Afonso Rodriguez, Andreas Grau, Peter Peiffer, Christina Widmann, and Tilo Baumbach — KIT, Karlsruhe, Germany

The reduction of field errors in superconductive undulators is more demanding than in room temperature permanent magnet undulators. Various basic concepts exist but most of them have the disadvantage that they require field measurements at liquid-Helium temperature and modifications of the undulator coils at room temperature. Thus one or more thermal cycles are needed for an iterative improvement of the field quality.

In order to avoid such a procedure it was proposed to cover the undulator coils with a thin layer of coupled superconductive loops which passively compensate the field errors via induction of persistent correction currents. In previous measurements this concept proved to work in principle and conclusions on an optimised shim configuration and field measurement setup could be drawn.

In this paper we present the results of new measurements using one 12-period superconductive undulator short model and applying an optimised induction shim configuration. Due to further improvements of the field measurement setup these experiments for the first time give a quantitative indication of the phase error reduction efficiency of induction shimming.