AKBP 6: Beam Dynamics 1

Time: Tuesday 14:00–15:30 Location: AKBP-H14

AKBP 6.1 Tue 14:00 AKBP-H14

Realization of the Multi-Turn Energy Recovery Mode at S-DALINAC* — •Felix Schliessmann, Michaela Arnold, Manuel Dutine, Marco Fischer, Ruben Grewe, Lars Jürgensen, Norbert Pietralla, Manuel Steinhorst, Lennart Stobbe, and Simon Weih — Institut für Kernphysik, Technische Universität Darmstadt, Darmstadt, Germany

The electron accelerator S-DALINAC at TU Darmstadt was successfully operated in the multi-turn energy recovery mode. Here, electrons were accelerated twice in the same LINAC and were decelerated afterwards in the very same LINAC just as often. During the deceleration in the LINAC, the electrons restore energy to the cavities, which can then be used to accelerate subsequent electrons. This principle enables a saving in acceleration power and an increase in the beam current, respectively. Therefore, this mode is a very promising basis for future accelerator facilities.
The multi-turn energy recovery mode is particularly challenging since several beams are superimposed in the same beamlines and the so-called phase slippage has to be taken into account in advance via beam dynamic simulations.
The content of this contribution covers the essential beam dynamics simulations, the setup of the multi-turn energy recovery mode and measured results.
*Work supported by DFG (GRK 2128), BMBF (05H21RDRB1), the State of Hesse within the Research Cluster ELEMENTS (Project ID 500/10.006) and the LOEWE Research Group Nuclear Photonics.

AKBP 6.2 Tue 14:15 AKBP-H14

Beam dynamics aspects of RF separated beams at the CERN M2 secondary beam line — •Fabian Metzger[1,2], Johannes Bernhard[1], Markus Brugger[1], Lau Gatignon[3], Alexander Gerbershagen[1], Bernhard Ketzer[2], and Silvia Schuh-Erhard[1] — [1]CERN, Meyrin, Switzerland — [2]Helmholtz-Institut für Strahlen- und Kernphysik, University of Bonn, Bonn, Germany — [3]University of Lancaster, Lancaster, United Kingdom

Radio-frequency (RF) separation is a technique to enrich the content of a certain particle type within a beam consisting of different species at the same momentum. This technique exploits the different velocities of the different particle types due to their mass difference. The successor of the COMPASS experiment, AMBER, is aiming in its phase 2 for high-intensity, high-purity kaon and antiproton beams which cannot be delivered with the currently existing M2 beam line.

This contribution introduces the principle of RF separation and explains its dependence on different parameters of beam optics and hardware. We discuss particle production rates, beamline transmission principles for specific lines studied, as well as limitations for beam intensity and purity imposed by beam line acceptance and radiation protection. Different beam optics settings have been examined, providing either focused or parallel beams inside the RF cavities. We will discuss the separation and transmission capabilities of the different optics settings for given characteristics of the RF cavities and show preliminary results of the potential purity and intensity of the RF separated beam.

AKBP 6.3 Tue 14:30 AKBP-H14

Layout of the interaction region for electron proton collisions in the LHeC collider — •Tiziana von Witzleben[1] and Bernhard Holzer[2] — [1]CERN, RWTH Aachen — [2]CERN

The LHeC (Large Hadron electron Collider) project studies the design of a future electron-proton collider at CERN. Deep inelastic scattering collisions between electrons and protons will run in parallel to the standard HL-LHC (High Luminosity-LHC) operation. The electrons would be accelerated to a kinetic energy of 50 GeV in a tangential energy recovery linear collider and brought into collision with one of the 7 TeV proton beams of the HL-LHC. The design luminosity of the order of $10^{34} cm^{-2} s^{-1}$ requires strong focusing of both beams in a compact interaction region. The e-p collisions would take place simultaneously with the HL-LHC experiments ATLAS, CMS and LHCb, and possibly alternating with the ALICE experiment in a novel design under study. This, therefore, requires a highly precise beam optics for three beams: the two proton beams of the HL-LHC, as well as the additional electron beam. Initial design studies of the optics and orbits of the three beams have been performed to provide estimates for the aperture and gradients of the required magnets. Different strengths of the mini-beta quadrupoles, as well as different magnetic separations schemes have been modelled and the results will be presented.

AKBP 6.4 Tue 14:45 AKBP-H14

Dynamic aperture studies for the Transfer Line from FLUTE to cSTART — •Jens Schäfer, Bastian Härer, Alexander Papash, Robert Ruprecht, Marcel Schuh, and Anke-Susanne Müller — KIT, Karlsruhe, Deutschland

The compact Storage ring for Accelerator Research and Technology cSTART is a test facility for the application of novel acceleration techniques and diagnostics. The goal is to demonstrate storing the beam of a Laser Plasma Accelerator (LPA) for the first time in a compact circular accelerator. Before installing a LPA, the linear accelerator FLUTE will serve as a full energy injector for the compact storage ring, providing stable bunches with a length of a few femtoseconds. The transport of the bunches from FLUTE to the storage ring requires a transfer line which includes horizontal, vertical and coupled deflections which leads to coupling of the dynamics in the two transverse planes. In order to conserve the ultra-short bunch length during the transport, the transfer line relies on special optics which invokes high and negative dispersion. This contribution presents dynamic aperture studies based on six-dimensional tracking through the lattice of the transfer line.

AKBP 6.5 Tue 15:00 AKBP-H14

Optimization Studies of Simulated THz Radiation at FLUTE — •Chenran Xu[1], Erik Bründermann[1], Andrea Santamaria Garcia[2], Jens Schäfer[1], Markus Schwarz[1], and Anke-Susanne Müller[1,2] — [1]IBPT, KIT, Karlsruhe — [2]LAS, KIT, Karlsruhe

The linac-based test facility FLUTE (Ferninfrarot Linac Und Test Experiment) at KIT will be used to study novel accelerator technology and provide intense THz pulses. In this paper, we present start-to-end simulation studies of FLUTE with different bunch charge and photoinjector laser properties. We employ a parallel optimization algorithm for different operation points of FLUTE to find optimized accelerator settings for the electron bunch length and generation of intense THz radiation.

C. Xu and J. Schäfer acknowledge the support by the Doctoral School KSETA "Karlsruhe School of Elementary and Astroparticle Physics: Science and Technology".

AKBP 6.6 Tue 15:15 AKBP-H14

Status of the MESA injector — •Simon Friederich — Institut für Kernphysik, JGU Mainz, Deutschland

The MESA injection system will produce the spin-polarized beam for the upcoming accelerator MESA at the JGU Mainz. The photoemission electron source (STEAM) will deliver 150uA of spin-polarized electrons from GaAs-based photocathodes for the P2 experiment. Afterwards the low-energy beam transportation system (MELBA) can rotate the spin using two Wien filters and a solenoid for polarisation measurements and to compensate for the spin precision in MESA. A chopper and buncher system prepares the phase space for the first acceleration in the normal-conducting pre-booster MAMBO. An additional separation line is designed for polarisation measurements and high bunch charge injection. The overview talk will cover the basic principles and the design of the MESA injector. Particle-in-Cell simulation results with the simulation code OPAL and the status of the build-up in the LINAC tunnel at the "Institut für Kernphysik" will be presented.