AKBP 9: Beam Dynamics I

Time: Wednesday 15:45–17:15 Location: CHE/0184

AKBP 9.1 Wed 15:45 CHE/0184

A Simulation for Ultrafast Electron Scattering Applications — •Simon Barg — Helmholtz-Zentrum Berlin

The superconducting radio-frequency (SRF) photoinjector is a photoelectron driven linear accelerator located at the SEALab facility at Helmholtz-Zentrum Berlin. With the injector, very flexible beam parameters can be achieved enabling many scientific applications like performing ultrafast electron scattering, with diffraction and imaging modalities, which is this work's focus. Complex structures such as biological molecules, which are not suitable for conventional crystallographic methods, could be imaged and studied with this technique.

To assess the feasibility of ultrafast imaging, a numerical simulation is developed to model an electron pulse from the gun that is deflected by a stream of molecules running perpendicular to the pulse's path to then create a (motion-) blurred image of an individual particle after passing through a magnetic lens system. Considering the injector's spatial coherence, this work's first goal is to find optimal imaging conditions to differentiate between two molecule orientations.

After showing that a contrast between different images can be successfully obtained, the simulation is currently being refined to work as a tool for parameter optimization. Given the pulse features, the model is able to output suitable lens settings. It is also used to compare different techniques, such as dark and bright field imaging, with the overall goal to find the most promising setups for future experiments.

AKBP 9.2 Wed 16:00 CHE/0184

Determination of the Invariant Spin Axis in a COSY model using Bmad — •Maximilian Vitz — Institute for Nuclear Physics IV, FZ Jülich, Germany — III. Physikalisches Institut B, RWTH Aachen University, Germany

The matter-antimatter asymmetry might be understood by investigating the EDM (Electric Dipole Moment) of elementary charged particles. A permanent EDM of a subatomic particle violates time reversal and parity symmetry at the same time. A finite EDM would be, if discovered with the currently achievable experimental accuracy, an indication for further CP violation than established in the Standard Model.

The JEDI-Collaboration (Jülich Electric Dipole moment Investigations) in Jülich has performed a direct EDM measurement for deuterons with the so called precurser experiments at the storage ring COSY (COoler SYnchrotron) in Forschungszentrum Jülich by measuring the invariant spin axis.

In order to interpret the measured data and to disentangle a potential EDM signal from systematic effects in the radial part of the invariant spin axis, spin tracking simulations in an accurate simulation model of COSY are needed. Therefore a model of COSY has been implemented using the software library Bmad. Systematic effects were considered by including element misalignments, etc. These effects rotate the invariant spin axis in addition to the EDM and have to be analyzed and understood. The most recent spin tracking results as well as the methods to find the invariant spin axis will be presented.

AKBP 9.3 Wed 16:15 CHE/0184

Simulations of Beam Dynamics and Beam Lifetime for the Prototype EDM Ring — •Saad Siddique for the CPEDM-Collaboration — JEDI Collaboration — GSI Helmholtzzentrum für Schwerionenforschung Darmstadt Germany

The matter-antimatter asymmetry seen in the universe may be explained through CP-violation by observing a permanent electric dipole moment (EDM) of subatomic particles. An advanced approach to measure the EDM of charged particles is to apply a unique method of Frozen spin on a polarized beam in a storage ring. To increase the experimental precision step by step and to study systematic effects, the EDM experiment will be performed within three stages: the magnetic ring COSY (Cool Synchrotron Forschungzentrum Jülich Germany), a prototype EDM ring, and finally an all-electric EDM ring. The intermediate ring will be a mock-up of the final ring, which will be used to study a variety of systematic effects and to implement the basic principle of the final ring. Simulations of beam dynamics of the prototype EDM ring with different lattices are carried out to optimize the beam lifetime and minimize the systematic effects. The preliminary design of the prototype EDM ring helped to estimate the beam losses by using analytical formulas. Beam-target effects with more detailed simulations are being studied for beam losses and the application of stochastic cooling to control beam emittance growth is also being studied by using a simulation program. Further investigations to reduce systematic effects are also in progress.

AKBP 9.4 Wed 16:30 CHE/0184

Compton transmission polarimetry of LPA-accelerated electron beams — •Jennifer Popp[1,2], Simon Bohlen[1], Louis Helary[1], Felix Stehr[1,2], Gudrid Moortgat-Pick[2,1], Jenny List[1], Jens Osterhoff[1], and Kristjan Põder[1] — [1]Deutsches Elektronen-Synchrotron DESY, Hamburg — [2]Universität Hamburg

For the study of spin-dependent processes polarised particle beams are indispensable. The LEAP (Laser Electron Acceleration with Polarisation) project at DESY aims to demonstrate the production of polarised electron beams exploiting the extremely high acceleration gradients of laser plasma accelerators. In this proof of principle experiment, spin-polarised electron beams with energies of tens of MeV will be generated in a sub-millimetre long plasma source. For electron beams of such energies, Compton transmission polarimetry is the ideal method to measure the polarisation. Gamma rays produced by bremsstrahlung are transmitted through a magnetised iron absorber core depending on their polarisation direction and that of the electrons in the iron. The resulting transmission asymmetry is proportional to the initial electron polarisation. In this talk, an overview of the LEAP project will be given and a polarimeter design, as well as its implementation and commissioning status will be presented.

AKBP 9.5 Wed 16:45 CHE/0184

Simulation studies on longitudinal beam dynamics manipulated by corrugated structures under different bunch length conditions at KARA — •Sebastian Maier[1], Miriam Brosi[3], Hyuk Jin Cha[1], Akira Mochihashi[2], Michael J. Nasse[2], Patrick Schreiber[2], Markus Schwarz[2], and Anke-Susanne Müller[1,2] — [1]LAS, KIT, Karlsruhe — [2]IBPT, KIT, Karlsruhe — [3]MAX IV Laboratory, Lund, Sweden

In the KIT storage ring KARA (KArlsruhe Research Accelerator), two parallel plates with periodic rectangular corrugations are planned to be installed. These plates will be used for impedance manipulation to study and eventually control the beam dynamics and the emitted coherent synchrotron radiation (CSR). In this contribution, we present simulation results showing the influence of different corrugated structures on the longitudinal beam dynamics and how this influence depends on the machine settings in the low momentum compaction regime, which are related to the bunch length changes.

This work is supported by the DFG project 431704792 in the ANR-DFG collaboration project ULTRASYNC. S. Maier acknowledges the support by the Doctoral School "Karlsruhe School of Elementary and Astroparticle Physics: Science and Technology".

AKBP 9.6 Wed 17:00 CHE/0184

Design of a Solenoid Magnet for the S-DALINAC* — •Merle Seeger, Michaela Arnold, Lars Jürgensen, Norbert Pietralla, and Felix Schliessmann — Institut für Kernphysik, Technische Universität Darmstadt, Germany

For the electron accelerator S-DALINAC, new focusing components in the low-energy injector section are needed. Small solenoid magnets can be used to focus low-energy beams in both transverse planes simultaneously. For this purpose, a precise magnetic field is beneficial. The effect of a specific magnet geometry on the magnetic field, as well as on the particle beam, can be investigated using computer simulations. Main influences to the magnetic field that are largely independent from installation constraints include the magnet radius and the yoke shape and material. To find an optimum design for a solenoid magnet for the S-DALINAC, variations of these magnet parameters were considered. Further calculations were made regarding the wiring and cooling of the magnet. In this contribution we will present the results of the computer simulations leading to the final design of the solenoid magnet, as well as detailing the challenges of the magnet construction.

*Work supported by DFG (GRK 2128 AccelencE).