AKBP 16: Spin Polarized Beams

Time: Friday 9:30–11:00 Location: E 020

AKBP 16.1 Fri 9:30 E 020

High-Precision Measurements of Asymmetry and Quantum Efficiency in Photocathodes for Polarised Electron Beam Experiments — •Jennifer Trieb, Valery Tioukine, and Kurt Aulenbacher — Johannes-Gutenberg Universität, Insitut für Kernphysik, Mainz, Deutschland

At the new, energy-recovering superconducting accelerator MESA in Mainz, spin-polarised electrons are required in the P2 experiment. Here the requirements increase considerably compared to the experiments at the microtron MAMI in Mainz. A very sensitive part of the photocathodes lies in the specially prepared surface, characterised by its negative electron affinity. This surface is highly sensitive to residual gases in vacuum and subjected to ion back bombardment. Traditionally, this negative electron affinity is achieved through a preparation involving caesium and oxygen. High current losses induce a degradation of quantum efficiency and the asymmetry, i.e the spin polarisation undergoes significant change. The exploration of the intricate relationship between asymmetry and quantum efficiency bears considerable importance, especially for the P2 experiment. Our aim is to clarify this connection and its implications, offering insights into managing spin polarisation and quantum efficiency in photocathodes.

AKBP 16.2 Fri 9:45 E 020

Determination of the Invariant Spin Axis in a COSY model using Bmad — •Maximilian Vitz — Forschungszentrum Jülich, Jülich, Germany — RWTH Aachen, Aachen, 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, if detected with the experimental accuracy currently achievable, would be an indication of a CP violation beyond that 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, effective dipole shortening, longitudinal fields and steerer kicks. 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 16.3 Fri 10:00 E 020

Optimization of spin-coherence time for electric dipole moment measurements in a storage ring — •Rahul Shankar[1,2], Anna Piccoli[1], Paolo Lenisa[1,2], and Andreas Lehrach[3,4] — [1]Università degli studi di Ferrara, Ferrara, Italy — [2]Instituto Nazionale di Fisica Nucleare, Ferrara, Italy — [3]Forschungszentrum Jülich, 52425 Jülich, Germany — [4]RWTH Aachen University and JARA-FAME, 52056 Aachen, Germany

Electric dipole moments are very sensitive probes of physics beyond the Standard Model. The JEDI collaboration is dedicated to the search for the electric dipole moment (EDM) of charged particles making use of polarized beams in a storage ring. In order to reach the highest possible sensitivity, a fundamental parameter to be optimized is the Spin Coherence Time (SCT), i.e., the time interval within which the particles of the stored beam maintain a net polarization greater than 1/e. To identify the working conditions that maximize SCT, accurate spin-dynamics simulations have been performed using BMAD. In this study, lattices of a "prototype" storage ring, which uses combined electric and magnetic fields for bending, and a "hybrid" storage ring using only electric bending fields with magnets for focusing, are investigated. This talk presents a model of spin behaviour in frozen-spin lattices that has been verified in both situations, as well as a technique to optimize the second-order beam optics for maximum SCT at any given working point.

AKBP 16.4 Fri 10:15 E 020

Overview of Inverse Compton Scattering feasibility studies for MESA — •Christoph Lorey — Buchenweg 28, 65812, Bad Soden

At the Johnnes von Gutenberg University Mainz (JGU), the Institute of Nuclear Physics (KPH) is building the Main Energy Recovering Linear Accelarator (ERL) named MESA. As an ERL, MESA features a high brightness electron beam of up to 155 MeV. Different use cases of this beam for Inverse Compton Scattering (ICS) or Thomson Backscattering have been explored and their impact studied with a new quasi-analytical simulation code "COMPARSE". This presentation will give an overview of the mathematical foundation and results of our feasibility studies.

AKBP 16.5 Fri 10:30 E 020

Simulations of Beam-target Interaction for Prototype Electric Dipole Moment Storage Ring — •Saad Siddique — GSI GmbH Darmstadt Germany — RWTH Aachen University Germany — JEDI and CPEDM Collaborations

The matter-antimatter asymmetry observed 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 Frozen spin method 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 Forschungzentrum Jülich Germany, a prototype EDM ring, and finally an all-electric EDM ring. The intermediate prototype EDM storage ring (PTR) 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. Beam storage and beam polarization measurement are challenging due to low beam energy and small size of ring. The preliminary results suggest that the PTR lattice with maximum vertical betatron function < 100m could be acceptable to store beam for more than 1000s. However, these results need detailed studies of beam-target interaction which plays an important role in beam losses as well as in beam polarization measurements. The beam-tracking simulations are being performed with various sizes of external pellet targets and also with different positions to minimize beam losses as well as to increase the efficiency of beam polarization measurements.

AKBP 16.6 Fri 10:45 E 020

Status of the 5 MeV Mott polarimeter at MESA — •Rakshya Thapa — Institut für Kernphysik, Mainz, Germany

P2 experiment at Mainz Energy-Recovering Superconducting Accelerator (MESA) desires to achieve Weinberg angle with an uncertainty of 0.15 %. This imposes that the uncertainty of the beam polarisation measurement has to be less than 1 %. A polarimetry chain with polarimeters operating at different energy and principles is planned to achieve this.

A Mott polarimeter operating at 5 MeV will be installed in this chain. The polarimeter has been designed. A study of the feasibility of several constituents of composite geometry is being carried out via computer simulation, which will be reported during this talk.