AKBP 8: Polarisation / EDM

Zeit: Dienstag 16:45–18:45 Raum: BZ.08.06 (HS 1)

AKBP 8.1 Di 16:45 BZ.08.06 (HS 1)

Towards an RF-Wien-Filter for EDM Experiments in Storage Rings — •Sebastian Mey and Ralf Gebel for the JEDI-Collaboration — Forschungszentrum Jülich GmbH, Jülich, Deutschland

The JEDI Collaboration (Jülich Electric Dipole Moment (EDM) Investigations) is developing tools for the measurement of permanent EDMs of charged, light hadrons in storage rings. While the standard model prediction for the EDM gives unobservably small magnitudes, a non-vanishing EDM can lead to a tiny build-up of vertical polarization in a beforehand horizontally polarized beam. This requires a spin tune modulation by an RF Wien-Filter *.

In the course of 2014, a prototype RF ExB-Dipole has been successfully commissioned and tested. To determine the characteristics of the device, the force of a radial magnetic field is canceled out by a vertical electric one to achieve a net Lorentz-Force compensation. In this configuration, it directly rotates the particles' polarization vector. We were able to verify that the device can be used to continuously flip the vertical polarization of a 970 MeV/c deuteron beam without exciting any coherent beam oscillations.

For a first EDM Experiment, the RF ExB-Dipole in Wien-Filter mode is going to be rotated by 90° around the beam axis and will be used for systematic investigations of sources for false EDM signals.

* William M. Morse, Yuri F. Orlov, and Yannis K. Semertzidis: Phys. Rev. ST Accel. Beams 16, 114001 (2013)

AKBP 8.2 Di 17:00 BZ.08.06 (HS 1)

Status of the Darmstadt Photo-Cathode Activation, Test, and Cleaning with atomic Hydrogen (Photo-CATCH) test facility — •Neeraj Kurichiyanil, Joachim Enders, Markus Wagner, Martin Espig, and Yuliya Fritzsche — Institut für Kernphysik

We report on the development status of a photocathode activation, test and cleaning using atomic hydrogen (Photo-CATCH) facility for semiconductor photocathodes used at the polarized electron source at the Darmstadt superconducting accelerator S-DALINAC. This standalone system consists of three ultra-high vacuum (UHV) chambers for atomic hydrogen cleaning, single- or multi-alkali negative electron affinity (NEA) activation and quantum efficiency (QE) as well as lifetime measurements and test of the activated cathodes at high-voltage, respectively. A beam-line featuring necessary characterization elements for a polarized electron beam of up to 60 keV will be available for operational QE and charge lifetime measurements and other possible experiments with spin-polarized electrons. The research is mainly aimed at improving vacuum conditions, cathode dark and charge lifetimes, exploring superior activation procedures and perfecting characterization techniques. Supported by DFG through SFB 634 and by the state of Hesse within the LOEWE centre HIC for FAIR.

AKBP 8.3 Di 17:15 BZ.08.06 (HS 1)

Tracking Studies towards EDM Measurements at COSY — •Marcel Rosenthal — Institut für Kernphysik, Forschungszentrum Jülich, Jülich, Deutschland — Physikalisches Institut III B, RWTH Aachen, Aachen, Deutschland

Electric Dipole Moments (EDMs) violate parity and time reversal symmetries. Therefore, direct measurements of charged particles' EDMs would be a strong hint for physics beyond the Standard Model. The JEDI collaboration investigates the feasibility of such measurements for protons, deuterons, and Helium3 in storage rings. Precursor studies are performed at the existing conventional Cooler Synchtrotron COSY in Jülich. A measurement time of about 1000 seconds is proposed. This requires a setup providing a long spin coherence time in the plane perpendicular to the invariant spin axis. During the measurement run, it is planned to use radiofrequency devices to create an EDM related signal. The contribution of imperfections, which could mimic such a signal, is explored in beam and spin dynamics simulations. The software framework COSY INFINITY is used to calculate transfer maps of the magnets and performs long term tracking studies. Recent efforts extend the code by the EDM contribution to spin motion and by the calculation of timedependent maps required for tracking in nonstatic fields. These enhancements are benchmarked with analytical predictions and with test measurements at COSY.

AKBP 8.4 Di 17:30 BZ.08.06 (HS 1)

Simulationsstudien zur Compton-Polarimetrie an ELSA — •Rebecca Koop und Wolfgang Hillert — ELSA, Physikalisches Institut der Universität Bonn

Für Doppelpolarisationsexperimente an der Elektronen-Stretcher-Anlage ELSA können polarisierte Elektronen auf eine Energie von bis zu 3.2GeV beschleunigt werden. Die Untersuchung auftretender depolarisierender Effekte soll durch ein Compton-Polarimeter erfolgen, welches sich momentan im Aufbau befindet. Der Konzeption des Polarimeters sind umfangreiche Simulationsstudien mit der Fortran-Software COMPTONSIM vorangegangen. Um Daten aus einer weiteren, unabhängigen numerische Methoden zu gewinnen, wurde der Compton-Streuprozess zudem unter Zuhilfenahme der Monte-Carlo Plattform Geant4 simuliert. Beide Methoden sollen vorgestellt und erhaltene Simulationsergebnisse verglichen werden.

AKBP 8.5 Di 17:45 BZ.08.06 (HS 1)

Präzise Bestimmung von Beschleunigerparametern über Polarisationsmessungen — •Jan Schmidt, Manuel Schedler, Jens-Peter Thiry und Wolfgang Hillert — Elektronen-Stretcher-Anlage ELSA, Physikalisches Institut, Universität Bonn

Ein polarisierter Teilchenstrahl ist ein wertvolles Werkzeug zur Bestimmung verschiedener Parameter eines Kreisbeschleunigers. So können Polarisationsmessungen bei Energien nahe einer ganzzahligen depolarisierenden Resonanz genutzt werden um die Strahlenergie experimentell zu bestimmen. Dabei werden hohe Genauigkeiten erreicht, da die Resonanzen sehr schmal sind. Darauf aufbauend können auch andere Parameter mit Bezug zur Strahlenergie präzise gemessen werden. Beispielsweise wurde mit dieser Methode an der Beschleunigeranlage ELSA eine Messung des Momentum Compaction Faktors mit einer Genauigkeit von 10^{-4} durchgeführt.

AKBP 8.6 Di 18:00 BZ.08.06 (HS 1)

Towards JEDI@COSY: systematic studies of spin dynamics in preparation for the EDM searches — •Artem Saleev[1,3], Nikolay Nikolaev[2], and Frank Rathmann[1] for the JEDI-Collaboration — [1]Institut für Kernphysik, Forschungszentrum Jülich, Deutschland — [2]Landau Institute for Theoretical Physics, Chernogolovka, Russia — [3]Samara State University, Samara, Russia

According to BMT equation, the EDM spin rotation in a storage ring is proportional to the bending Lorentz force. The troubling issue is that the so-called imperfection, radial and longitudinal, B-fields abound in the ring. The MDM rotation in the imperfection fields emerges as a background to the expected much weaker EDM rotation. One of the most precise quantities measured presently at COSY at 10^{-10} level is a spin tune. To study the systematic effects from the imperfection fields at COSY we proposed the original method which makes use of the two static solenoids acting as artificial imperfections. The emerging spin tune mapping, the measurements of the spin tune with respect to the strength of the solenoid's field, gives an access to the ring imperfections, and has been successfully tested in the JEDI September 2014 run at COSY.

AKBP 8.7 Di 18:15 BZ.08.06 (HS 1)

Lebenszeitmessung von Halbleiterkathoden — •Valentin Schmitt — Institut für Kernphysik, Mainz, Deutschland

Um an rezirkulierenden Elektronenbeschleunigern wie MESA an internen Targets eine genügende Luminosität zu erzielen, sind Ströme von mehr als 1 mA erforderlich. Die hierfür eingesetzten Halbleiterkathoden erwärmen sich jedoch mit steigender Laserleistung bis zu dem Punkt, an dem sie zerstört werden. Um die Erwärmung der Kathode zu reduzieren, wird versucht eine deutlich verbesserte thermische Ableitung zu realiseren, ohne die Funktionalität der Photoelektronenquelle zu gefährden. Die Untersuchung der Auswirkungen auf die Lebenszeit der Photokathode sind Gegenstand dieser Arbeit.

AKBP 8.8 Di 18:30 BZ.08.06 (HS 1)

Spin tune investigations for the storage ring EDM experiment at COSY — •Stanislav Chekmenev for the JEDI-Collaboration — III. Physikalisches Institut, RWTH Aachen, 52056 Aachen, Germany

An experimental method which is aimed to find a permanent electric dipole moment (EDM) of a charged particle was proposed by

JEDI (Juelich Electric Dipole moment Investigations) collaboration [1]. EDMs can be observed by their small influence on spin motion. The only possible way to perform a direct measurement is to use a storage ring.

For this purpose, it was decided to carry out the first precursor experiment at the Cooler Synchrotron (COSY). Since the EDM of a particle violates CP invariance it is expected to be tiny, treatment of all various sources of systematic errors should be done with a great level of precision. A recent achievement of the JEDI collaboration is the determination of the spin tune with a precision of 10^{-10} in a single accelerator cycle. In parallel with that achievement a new spin tracking code was developed. It is planned to use the spin tune measurement to benchmark the simulation code.

In the last data taking period, spin motion changes were generated by steerers and solenoids. Comparison of simulation results with data collected will be discussed.

[1] A. Lehrach, F. Rathmann, J. Pretz et al., "Search for Permanent Electric Dipole Moments at COSY, proposal #216.0, 2012, available: https://collaborations.fz-juelich.de