HK 34: Instrumentation VIII and Accelerators

Zeit: Mittwoch 16:45–19:00 Raum: F 073

Gruppenbericht HK 34.1 Mi 16:45 F 073

Ein Spurdetektor zur Luminositätsmessung bei PANDA — •Christof Motzko[1,2], Miriam Fritsch[3], Florian Feldbauer[3], Roman Klasen[1,2], Heinrich Leithoff[1,2], Stephan Maldaner[1,2] und Stefan Pflüger[1,2] für die PANDA-Kollaboration — [1]Helmholz-Institut Mainz — [2]Universität Mainz — [3]Ruhr-Universität Bochum

Das PANDA-Experiment, welches im Antiproton-Speicherring HESR an der im Bau befindlichen Beschleunigeranlage FAIR in Darmstadt stehen wird, ist für Fragen der Hadronenphysik optimiert. Mit dieser Anlage wird es möglich sein, neue Zustände zu entdecken und die Linienform dieser wie auch bereits bekannter Zustände sehr präzise zu vermessen. Zur Normierung der dafür verwendeten Energie-Scan-Messungen wird die exakte Kenntnis der Luminosität benötigt.

Die Luminosität wird bei PANDA anhand der Winkelverteilung der elastischen Antiproton-Proton-Streuung bestimmt. Um eine absolute Messgenauigkeit von 3 % zu erreichen werden die Spuren der gestreuten Antiprotonen gemessen. Dazu werden 4 Detektorebenen mit gedünnten Siliziumsensoren verwendet (HV-MAPS). HV-MAPS sind Pixelsensoren mit integrierter Ausleseelektronik. Sie werden mit einer Sperrspannung von 60 V betrieben um die Strahlenhärte zu erhöhen. Die 4 Ebenen, die verfahrbar montiert sind, bestehen aus CVD-Diamanten auf denen die Sensoren aufgeklebt sind. Zur Reduktion der Vielfachstreuung wird der Aufbau im Vakuum betrieben.

Das Konzept des Luminositätsdetektors wird vorgestellt und dabei technische Aspekte wie Vakuumsystem, Kühlung und Elektronik diskutiert, sowie Einblicke in die Datenanalyse gegeben.

HK 34.2 Mi 17:15 F 073

Absolute photon flux measurement at the BGO-OD experiment and Cross-Check with $\pi^0 p$ production* — •Katrin Kohl for the BGO-OD-Collaboration — Physikalisches Institut, Universität Bonn

The BGO-OD experiment at the ELSA accelerator facility at Bonn investigates the internal reaction mechanisms of meson photoproduction off the nucleon. Absolute normalisation of the flux of tagged photons is indispensable for cross section determination. In this talk the measurement principle is presented and the obtained flux is checked with the known cross section of the reaction $\gamma p \to \pi^0 p$.

* Supported by the DFG (SFB/TR-16)

HK 34.3 Mi 17:30 F 073

Concept and design of an alignment monitoring system for the CBM RICH mirrors* — •Jordan Bendarouach and Claudia Höhne for the CBM-Collaboration — Justus Liebig University, Gießen

The Compressed Baryonic Matter (CBM) experiment at the future FAIR complex will investigate the phase diagram of strongly interacting matter at high baryon density and moderate temperature in A+A collisions from 2-11 AGeV (SIS100).

One of the key detectors of CBM to explore this physics program is the RICH (Ring Imaging CHerenkov) detector, which is developed for efficient and clean electron identification and pion suppression. About 80 trapezoidal glass mirror tiles equally distributed in two half-spheres will serve as focusing elements with spectral reflectivity down to the UV range.

An important aspect to guarantee a stable operation of the RICH detector is the mirror alignment. To determine and quantify mirror misalignments, a method inspired from the HERA-B experiment is employed. The misalignment information is used in a correction cycle to allow a proper operation of the detector under these conditions.

First results of a study comparing the accuracy of the reconstruction method between inner and outer tiles will be presented. Results from an automated correction routine and the impact of the corrections on the matching efficiency will also be shown.

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HK 34.4 Mi 17:45 F 073

Precsion beam energy measurement by undulator radiation at MAMI — •Pascal Klag, Patrick Achenbach, Philipp Herrmann, Werner Lauth, and Josef Pochodzalla — Institut für Kernphysik, Johannes Gutenberg-Universität Mainz

The Mainz microtron is an electron accelerator, which delivers electron energies up to 1.6 GeV, with a small spread of the energy $\sigma_{beam} < 13$keV. Over time, the energy drifts, less than 1keV. On the other hand, presently the absolute energy can be determined with an systematic uncertainty of 160keV. In 2016 a complementary method which does not rely on magnetic field measurement is tested. The method is based on interferometry with two spatial separated light sources (Undulators) driven by relativistic electrons. A high resolving Monochromator is used to analyse the spectrum of the light. Noise in the camera has limited the error of the pilot measurement to 10^{-3}. In the future, systematic effects have to be understood and it is planned to use a cooled camera to reduce uncertainties to $\frac{\Delta E}{E} < 10^{-4}$.

HK 34.5 Mi 18:00 F 073

Data analysis of the high-accuracy electron beam energy measurement at the Mainz Microtron — •Philipp Herrmann — Institut für Kernphysik, Johannes Gutenberg-Universität, Mainz

The Mainz Microtron MAMI delivers an electron beam of up to 1.6 GeV. The absolute energy is measured inside the third stage of the accelerator with an accuracy of $\delta E_{beam} = 160$ keV independent of the beam energy, with an energy spread $\sigma_{beam} < 13$ keV and long-term drifts of less than 1 keV when stabilized. To obtain an absolute energy measurement within $\delta E_{beam} \sim 20$ keV uncertainty, a 42°-dipole of the beam-line leading to the spectrometer facility is used as a high-accuracy beam spectrometer. A high-precision field mapping device was developed and a dedicated beam detection system of RF cavity position monitors and YAG:Ce screens was implemented. Therefor the goal was to achieve 10 μT, 10 μm uncertainties in the field mapping and an electron beam deflection angle measurement with $\delta\theta/\theta < 10^{-5}$.
With this setup we were able to obtain 10000 data points, in x, y and z field direction, for different field values and probe positions. Thus enabling us to use a linear approximation in order to calculate a complete field map along the path of the electrons through the dipole.
Using the the YAG:Ce screens to measure the offset of the RF cavity monitors every 30 min, we archived the high accuracy measurement of the beam position/deflection angle. In this presentation the results and difficulties will be presented, in regard to provide a well known incident particle energy for scattering experiments at MAMI.

HK 34.6 Mi 18:15 F 073

Absolute calibration of reference dividers for the KATRIN experiment — •Patrik Herud for the KATRIN-Collaboration — Institut für Kernphysik, Westfälische-Wilhelms-Universität, Münster

The goal of the KATRIN (KArlsruhe TRItium Neutrino) experiment is to search for the neutrino mass with a sensitivity of 200 meV/c^2 by measuring the endpoint region of the tritium β-decay spectrum. This sub-eV sensitivity is achieved by using a MAC-E-filter as the electron spectrometer. The precision of the retarding potential of the MAC-E-filter (up to −35 kV) has to be monitored with an uncertainty of 60 mV at the endpoint region (18.6 keV).
To measure the retarding potential we had build custom-made high precision voltage dividers in coorperation with the Physikalisch-Technische Bundesanstalt Braunschweig. To ensure the required stability, regular high precision calibrations are needed. For the complicated calibrations an absolute calibration of voltages up to 1 kV by commercially available voltage dividers (FLUKE 752A) is required.
In this talk we will present a new absolute calibration method for these 1 kV dviders and show first calibration tests.

HK 34.7 Mi 18:30 F 073

Energy calibration of the KATRIN experiment — •Oliver Rest for the KATRIN-Collaboration — Institut für Kernphysik, Westfälische Wilhelms-Universität Münster

The KATRIN experiment will measure the endpoint region of the tritium-β-decay spectrum to determine the neutrino mass with a sensitivity of 200 meV/c^2. To achieve this sub-eV sensitivity the energy of the decay electrons will be analyzed using a MAC-E-filter type spectrometer. The retarding potential of the MAC-E-filter of -18.6 kV has to be monitored with a relative precision of $3 \cdot 10^{-6}$.
For this purpose the potential will be measured directly via two custom made precision high voltage dividers, which were developed in cooperation with PTB, the German national metrology center. In order to

determine the absolute values and the stability of the scale factors of the voltage dividers, regular calibration measurements with ppm precision are essential.
In addition the HV will be compared to a natural standard given by monoenergetic conversion electrons from the decay of ^{83m}Kr. This will be done continuously in parallel with the KATRIN monitor spectrometer and regularly with a gaseous and a condensed Krypton source to guarantee a redundant calibration system.
The talk will give an overview of the energy calibration of the KATRIN experiment and will show a summary of the calibration measurements over the last years.
This project is supported by BMBF under contract number 05A11PM2.

HK 34.8 Mi 18:45 F 073

Detailed Cavity Design for the FAIR p-Linac — •Ali Almomani[1], Ulrich Ratzinger[1], Marco Busch[1], Rudolf Tiede[1], and Florian Dziuba[2] — [1]IAP - Frankfurt University — [2]GSI - Darmstadt

The research program of antiproton beams for the FAIR facility requires a dedicated 70 MeV, 70 mA proton injector. This injector will consist of a ladder RFQ and followed by six room temperature "Crossbar H-type" CH-cavities operated at 325 MHz. The MEBT section behind the RFQ has been optimized for beam matching into the CH-DTL. The beam dynamics for the DTL had been revised to reduce the emittance growth. As a consequence cavity voltage, gap numbers, lens layouts, and cavity end geometry were optimized. Consequently, the construction of cavities can be started in 2017. In this paper, the detailed design of these cavities with integrated focusing triplets will be presented and the main issues will be discussed.