HK 31: Instrumentierung VI

Zeit: Dienstag 16:30–19:00 Raum: HG IX

Gruppenbericht HK 31.1 Di 16:30 HG IX

Development of a GEM-based TPC for PANDA — •Bernd Voss for the GEM-TPC-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, 64291 Darmstadt, Germany

A Time Projection Chamber (TPC) is a very promising option for the central tracker of the PANDA experiment at the new Facility for Antiproton and Ion Research (FAIR) at Darmstadt, Germany.

Installed in a ring-type experiment with $2x10^7 p\bar{p}$ annihilations per second it has to be operated continuously despite the presence of space charge effects. These are kept at a bearable level using GEM-based amplification providing an intrinsic suppression of ion backflow. The system promises high-accuracy tracking as well as information on the specific energy-loss and features high momentum resolution of 1% as well as particle-identification capability with a highly homogeneous and low material budget. A test TPC with an active volume of 8 cm length and a diameter of 20 cm was operated in 2009 at the test-bench of the CB-ELSA experiment in Bonn. It served to investigate some of the relevant design features, the electronic foreseen for the readout as well as the analysis procedures. A large-volume TPC with a drift length of 70 cm and an active diameter of 30 cm is being built in parallel. Due to its very similar design it serves as a precursor prototype of a PANDA TPC. This detector will be installed and employed in 2010 within both the FOPI spectrometer at GSI and the Crystal-Barrel experiment at ELSA in Bonn. In this talk, we will present the status of the project; report on the results obtained with the test detector as well as the design and construction of the GEM-TPC prototype.

HK 31.2 Di 17:00 HG IX

Results from first beam tests for the development of a RICH detector for CBM — •Jürgen Eschke for the CBM-Collaboration — GSI, Darmstadt, Germany

The CBM experiment at FAIR will be a dedicated heavy-ion experiment exploring the intermediate range of the QCD phase diagram with A+A collisions from 10-45 AGeV beam energy. A key observable of the physics program is a precise measurement of low-mass vector mesons and charmonium in their leptonic decay channel. In CBM, electrons will be identified using a gaseous RICH detector combined with several TRD detectors positioned behind a system of silicon tracking stations.

The concept of the RICH detector and feasibility studies will be presented. As photodetector, we foresee an array of Multianode Photomultipliers (MAPMTs). First beam test results using the Hamamatsu H8500 MAPMT for Cherenkov light detection as well as measurements in the laboratory using an LED as light source will be discussed. The signals of the MAPMT were read out by a new, especially developed, self triggered readout electronics based on the n-XYTER ADC chip. A 2 GeV proton beam at GSI was used to produced Cherenkov photons in a 8(4) mm plexiglass radiator. The comparison of the expected number of Cherenkov photons with the detected number of hits in the MAPMT will be discussed taking into account the quantum efficiency and photon collection efficiency of the MAPMT as well as the absorption of UV photons in the plexiglass. The usage of wavelength shifter films in order to increase the photon conversion efficiency for wavelengths below 300 nm will also be addressed.

HK 31.3 Di 17:15 HG IX

Test von Disc DIRC Prototypen für PANDA mit kosmischen Teilchen und Protonenstrahlen — •Benno Kröck, Avetik Hayrapetyan, Irina Brodski, Klaus Föhl, Kristof Kreutzfeldt, Marko Zühlsdorf, Michael Düren, Michael Sporleder, Oliver Merle, Peter Koch und Stephanie Künze für die PANDA-Kollaboration — Justus-Liebig-Universität Gießen

Im PANDA-Experiment bei FAIR soll ein Disc DIRC zur Teilchenidentifikation der in Vorwärtsrichtung gestreuten Teilchen eingesetzt werden. In Gießen wird ein auf Laufzeitmessung basierender DIRC entwickelt, der eine hohe zeitauflösung ($\sigma < 50\,\mathrm{ps}$) für einzelne Photonen benötigt. Zwei DIRC Prototypen wurden gebaut. Ein Prototyp verwendet eine Scheibe, an deren Rand sich Micro Channel Plate Photomultiplier Tubes befinden. Er wurde mit kosmischer Strahlung getestet. Der andere ist mit Geiger-mode Avalanche Photodioden und fokussierenden Elementen versehen und wurde in einem Protonenstrahl an der GSI in Darmstadt getestet. Über die grundlegenden Tests und die gemessenen Zeitauflösungen wird berichtet.

HK 31.4 Di 17:30 HG IX

Experimental studies for a DIRC detector at the WASA-at-COSY experiment — •Adrian Schmidt, Christoph Adolph, Wolfgang Eyrich, Julian Jaus, Andreas Teufel, and Christian Vogel — Physikalisches Institut IV der Universität Erlangen-Nürnberg

The WASA-at-COSY experiment at the Forschungszentrum Jülich provides a nearly 4π detector including a forward spectrometer especially for studies on $\eta-$ and $\eta'-$meson decays in proton-proton collisions. Simulations have shown that an additional Detector of Internally Reflected Cherenkov light (DIRC) in front of the Forward Range Hodoscope improves the particle identification and energy resolution significantly. We report on the results of first DIRC prototype tests which show the feasibility. To optimize the detector new super and ultra cathode photomultiplier tubes (Hamamatsu Type H6568 an R8900) with high quantum efficiency were studied and their main properties will be presented.

supported by German BMBF and FZ Jülich

HK 31.5 Di 17:45 HG IX

Lifetime of microchannel-plate photomultipliers for the PANDA-DIRC — •Alexander Britting, Fred Uhlig, Albert Lehmann, Wolfgang Eyrich, and Sebastian Reinicke for the PANDA-Collaboration — Physikalisches Institut, Universität Erlangen-Nürnberg

At the PANDA experiment of the new FAIR-facility at GSI (Darmstadt) particle identification will be achieved by using DIRC-detectors (Detection of Internally Reflected Cherenkov Light). The photons of the Cherenkov cone are guided to the photosensors inside the radiator by total reflection.

With the planned optics at the barrel-DIRC a spatial resolution of about 5mm is necessary for the reconstruction of the Cherenkov cone. This implies photon rates of about $1\frac{MHz}{cm^2}$ at the sensor surface. To correct dispersive effects in the radiator, a time resolution of at least 100 ps should be achieved. Possible sensor candidates are microchannel-plate photomultipliers (MCP-PMTs), if a satisfactory lifetime can be obtained. With reaction rates of 20 MHz and a PANDA lifetime of about 10 years, an integrated charge of several $\frac{C}{cm^2}$ will be collected at the MCP anode. The lifetime behaviour of a few types of MCP-PMTs is currently under investigation in Erlangen. The first results will be presented. - supported by BMBF and GSI -

HK 31.6 Di 18:00 HG IX

Der Time of Propagation Disc DIRC für $\overline{\mathbf{P}}$ANDA — •Oliver Merle, Irina Brodski, Michael Düren, Klaus Föhl, Avetik Hayrapetyan, Peter Koch, Kristof Kreutzfeldt, Benno Kröck, Stephanie Künze, Michael Sporleder und Marko Zühlsdorf — Justus-Liebig-Universität Giessen

Zur Identifikation von geladenen Teilchen im $\overline{\mathrm{P}}$ANDA/FAIR Experiment wird ein neuartiger DIRC Čerenkov Detektor entwickelt, welcher eine besonders kompakte Bauweise mit nur wenigen Zentimetern Dicke erlaubt. Der im ursprünglichen DIRC Konzept direkt gemessene interne Reflexionswinkel im Radiator wird bei dieser Variante aus der Photonen-Flugzeit rekonstruiert. Dieses Verfahren erfordert eine Zeitauflösung von $\sigma < 50$ ps für die Messung einzelner Photonen. Neuartig ist auch der Mechanismus zur Dispersionskorrektur mittels dichroitischer Filter. Die Simulations- und Rekonstruktionsprogramme sagen eine Pion/Kaon Trennung von $> 4\ \sigma$ bei Impulsen bis zu 3.5 GeV/c voraus. Durch zusätzliche fokussierende Lichtleiter kann die Leistung des Detektors weiter gesteigert werden. Ein Prototyp dieses Detektortypes soll am WASA@COSY Experiment getestet werden.

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Prototyp eines Barrel-DIRC Segmentes für PANDA — Dipanwita Dutta[1,2], •Roland Hohler[1,3], Dorothee Lehmann[1], Klaus Peters[1,3], Bidyut Roy[1,2], Georg Schepers[1], Carsten Schwarz[1] und Jochen Schwiening[1] — [1]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt — [2]Bhabha Atomic Research Centre, Mumbai — [3]Goethe Universität Frankfurt

PANDA wird eines der großen Experimente an der neuen Beschleunigeranlage FAIR an der GSI in Darmstadt sein. Für die physikalischen

Ziele verlangt man eine gute Teilchenidentifikation und somit eine gute K/π-Trennung. Zu diesem Zweck ist ein Barrel-DIRC (Detection of Internally Reflected Cherenkov light) zylindrisch um die Strahlachse vorgesehen. Beim DIRC-Prinzip propagieren die Cherenkovphotonen mittels Totalreflexion durch den Radiator zu den Photondetektoren. Als Radiatoren werden lange Stäbe aus künstlichen Quarzglas eingesetzt. Die Transporteffizienz der Photonen hängt von der Güte dieser Quarzstäbe ab.

Im Vortrag werden sowohl Ergebnisse zur Radiatorqualität als auch die einer Strahlzeit präsentiert. Die Oberflächenrauhigkeit der polierten Radiatorstäbe wurde im Ångströmbereich gemessen. Die Rechtwinkligkeit der Seitenflächen konnte ebenfalls sehr genau bestimmt werden. Bei der Strahlzeit, die im September 2009 an der GSI mit 2 GeV Protonen stattfand, wurde erfolgreich ein Prototyp eines Barrel-DIRC Segmentes getestet. Die Cherenkovphotonen wurden durch ein Linsensystem fokussiert und mittels Mikrokanalplatten-PMTs ausgelesen. Die Daten wurden schließlich mit einer Simulation verglichen.

HK 31.8 Di 18:30 HG IX

A GEM-based TPC Test Chamber for PANDA — •Maxence Vandenbroucke for the GEM-TPC-Collaboration — Technische Universität München E18, Garching, Germany

A GEM-based Time Projection Chamber (TPC) is a very promising option for the central tracker of PANDA, an internal target experiment at the High Energy Storage Ring (HESR) at the new Facility for Antiproton and Ion Research (FAIR) at Darmstadt. This detector has to provide good position and momentum resolution, and a low material budget. The continuous nature of the antiproton beam requires a suppression of ion backflow from the amplification stage to the drift volume, which can be realized e.g. by a Gas Electron Multiplier (GEM) stack. A test chamber of 77 mm drift length and a 10×10 cm^2 active area read out with hexagonal pads has been build. This detector is connected to the AFTER-T2K front end electronics which shows noise performance of less than 800 e$^-$. This detector has been installed on an electron test beam at the ELSA accelerator at Bonn. Making use of an external tracking telescope, the performance of the test TPC has been studied under various experimental conditions. Preliminary results will be presented in this talk.

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HK 31.9 Di 18:45 HG IX

Design of GEM-based Trackers for PANDA — •Bernd Voss, Jochen Kunkel, and Radoslaw Karabowicz — GSI Helmholtzzentrum für Schwerionenforschung GmbH, 64291 Darmstadt, Germany

In the PANDA experiment at the new Facility for Antiproton and Ion Research (FAIR) at Darmstadt, Germany, particles emitted at angles below 22° may not be fully covered by the Central Tracker in the target spectrometer. They will be tracked with a set of up to four large-area planar gaseous micro-pattern detectors based on GEM foils as amplification stages. In order to optimize the acceptance, these GEM-Trackers have to be of large diameter of Ø0.9m, 1.12m and 1.48m and will be placed 0.81m, 1.17m, 1.53m and 1.89m downstream of the target, respectively. The current design assumes up to four double planes with two projections per plane. With the envisaged position resolution of 0.1mm the system promises sufficient momentum resolution and a double track resolution of 10mm and 5°, respectively, in the range of forward angles of 5 to 18°. The chambers have to sustain a high counting rate of particles peaked at the most forward angles due to the relativistic boost of the reaction products as well as due to the small angle pp elastic scattering. With the envisaged luminosity, the expected particle flux in the first chamber in the vicinity of the 6.5 cm diameter beam pipe is about $8*10^4 cm^{-2}s^{-1}$. Moreover, the chambers have to work in the 2T magnetic field produced by the solenoid. In this talk, we will present the status of the project and report on the design and construction of the detector system.