HK 44: Instrumentation IX

Zeit: Donnerstag 14:00–16:00 Raum: F 102

Gruppenbericht HK 44.1 Do 14:00 F 102

Status of the Barrel- and the Disc DIRC detectors at PANDA — •Marvin Krebs for the PANDA-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt — Goethe-Universität Frankfurt

The PANDA experiment at the future FAIR facility will use antiproton annihilations to investigate open questions in hadron physics in the momentum range of 1.5-15 GeV/c. Two DIRC detectors will be built for the PANDA target spectrometer in order to achieve excellent charged particle identification (PID), which is needed to cleanly separate $\pi/K/p$. The Barrel DIRC will surround the interaction point and perform π/K separation for polar angles between 22° and 140° and momenta between 0.5 GeV/c and 3.5 GeV/c. It is based on the successful BaBar DIRC detector, but with several key improvements to perform a better-than 3σ π/k separation between 0.5 GeV/c and 3.5 GeV/c. In the (forward) endcap region, the Disc DIRC will be placed to cover the angular range from 5° to 22° to cleanly separate π from K for momenta up to 4 GeV/c. Both DIRC counters will use enhanced-lifetime MCP-PMTs for photon detection in combination with fast readout electronics. The radiators are made from highly polished synthetic fused silica to ensure that photons, propagating through the radiators by total internal reflection, conserve the Cherenkov angle and reach the photon detection plane without angular distortions. Geant4 simulations and tests with several prototypes at various test beam facilities have been used to evaluate the designs and validate the expected PID performance of both PANDA DIRC counters.

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The DIRC Upgrade for the GlueX Experiment — Ahmed Ali[1,2], •Roman Dzhygadlo[1], Klaus Peters[1,2], Carsten Schwarz[1], and Jochen Schwiening[1] for the GlueX-Collaboration — [1]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt — [2]Goethe-Universität Frankfurt

The GlueX experiment will provide the data necessary to perform quantitative tests of non-perturbative QCD by studying the spectrum of light-quark mesons and baryons. The addition of a Cherenkov-based particle identification (PID) system will significantly enhance the GlueX physics program by allowing the study of hybrid mesons decaying into kaon final states with significantly higher efficiency and purity.

The Detector of Internally Reflected Cherenkov light (DIRC) will be a compact and robust PID system utilizing optical components from the decommissioned BaBar DIRC detector. It will provide clean π/K separation for forward angles (θ<11°) and momenta up to 4 GeV/c.

Geant4 simulation are used to optimize the design configuration of the focusing photon camera. Two reconstruction algorithms were developed to provide the best PID.

We will discuss the status of the DIRC detector and the latest achievements in the reconstruction.

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DIRC-based PID for the EIC Central Detector — •Roman Dzhygadlo[1], Klaus Peters[1,2], Carsten Schwarz[1], and Jochen Schwiening[1] for the DIRC-at-EIC-Collaboration — [1]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt — [2]Goethe-Universität Frankfurt

One of the key requirements for the central detector of a future Electron-Ion Collider (EIC) is to provide charged Particle Identification (PID) (e/π, π/K, K/p) over a wide momentum range. It is expected that the PID system will need to include one or more Cherenkov counters to achieve this goal. With a radial size of only a few cm, a DIRC counter (Detector of Internally Reflected Cherenkov light) is an attractive option.

The ongoing R&D investigates ways to extend the momentum coverage of a DIRC counter for the EIC detector by up to 50% beyond the current state of the art. Possible design improvements include a complex focusing system in a form of multi-component lenses, multi-anode sensors with smaller pixels, providing fast single-photon timing in high magnetic fields, a time-based PID algorithm, and chromatic dispersion mitigation.

We will discuss the current status of the design studies with Geant simulations, improvements to the time-based imaging reconstruction, and the results of prototype tests with particle beams.

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Testbeam with the latest Disc DIRC prototype — •Julian Rieke, Simon Bodenschatz, Erik Etzelmüller, Michael Düren, Klaus Föhl, Avetik Hayrapetyan, Kristof Kreutzfeldt, and Mustafa Schmidt for the PANDA-Collaboration — II. Physikalisches Institut, Justus Liebig-University of Giessen, Giessen, Germany

The PANDA experiment at the future FAIR facility needs excellent particle identification to do precision studies of antiproton-proton reactions in the 1.5-15 GeV/c momentum range. To fulfill this need, two Cherenkov detectors will be installed in the PANDA target spectrometer, both based on the DIRC concept that uses internally reflected Cherenkov light to perform particle identification, with a focus on the separation of pions and kaons. The Disc-DIRC is designed to cap the forward region of theta angles between 5 and 22 degrees. It will be the first time that a Disc-DIRC is used for PID in a real physics experiment beyond prototyping. A new prototyping Disc-DIRC apparatus has been constructed at the JLU Giessen. It features a radiator and focusing elements made out of fused silica and close to final readout electronics. The entire prototype was tested with an electron beam of several GeV/c at DESY in Hamburg. The components, their setup and a first analysis of the recorded data will be presented.

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The Technical Design of the PANDA Barrel DIRC — Ahmed Ali[1,2], Anastasios Belias[1], Roman Dzhygadlo[1], Andreas Gerhardt[1], Klaus Goetzen[1], Marvin Krebs[1,2], Dorothee Lehmann[1], Frank Nerling[1], Klaus Peters[1,2], •Georg Schepers[1], Carsten Schwarz[1], and Jochen Schwiening[1] for the PANDA-Collaboration — [1]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt — [2]Goethe-Universität Frankfurt

Excellent hadronic Particle Identification (PID) is needed to meet the objectives of the rich physics program of the PANDA experiment at FAIR, which includes charmonium physics, exotics, hadron spectroscopy, nucleon structure, and hypernuclei. The Barrel DIRC (Detection of Internally Reflected Cherenkov light) of the PANDA Target Spectrometer will provide a π/K separation of better than 3 standard deviations for particle momenta up to 3.5 GeV/c and polar angles between 22° and 140°. Several key aspects of the design, which was inspired by the successful BaBar DIRC, were improved. The Cherenkov photons produced in narrow radiator bars are focused by a three-component compound lens. The compact expansion volume consists of individual solid prisms made from synthetic fused silica. The photon patterns are detected by an array of lifetime-enhanced microchannel-plate photomultiplier tubes, which are read out by fast electronics with a time precision of about 100 ps. A second, cost-saving design uses wide radiator plates and a time-based reconstruction for the analysis of the resulting Cherenkov patterns. The two designs, and beam test results comparing their PID performance will be discussed.

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PID with the Disc DIRC in PANDA at FAIR — •Mustafa Schmidt, Simon Bodenschatz, Michael Düren, Erik Etzelmüller, Klaus Föhl, Avetik Hayrapetyan, Kristof Kreutzfeldt, and Julian Rieke — JLU Gießen, Gießen, Deutschland

The PANDA detector at the future FAIR facility at GSI is planed as a fixed-target experiment for proton-antiproton collisions at momenta between 1.5 and 15 GeV/c. This talk will mainly cover the Disc DIRC detector, which is placed at the forward endcap of the PANDA target spectrometer and is going to provide a 4σ separation of pions and kaons up to a momentum of 4 GeV/c for θ angles from 5°/10° and 22°.

This new detector concept requires the development of dedicated reconstruction and PID algorithms, which permit an efficient analysis of the measured time-correlated photon patterns. The online reconstruction is planed to be performed with a single FPGA card calculating the Cherenkov angle from the measured hit pattern and related tracking information for each event with a rate of more than 20 MHz.

Time and event based Monte-Carlo simulations within the PandaROOT framework have been used to analyse the evaluate the PID

performance for high momentum particles. In order to determine the overall performance near to real PANDA conditions, the benchmark channel $p\bar{p} \to f_0\pi^0 \to K^+K^-$ with stuitable background events has been studied by taking all additional tracking information into account. Results from various testbeams during the last years were used to validate the PID performance for the desired momentum range.

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Simulation results for the upgraded RICH detector in the HADES experiment.† — •Semen Lebedev[1,3], Jürgen Friese[2], Claudia Höhne[1], and Tobias Kunz[2] for the HADES-Collaboration — [1]Justus Liebig Universität Giessen, II. Physikalisches Institut — [2]Technische Universität München, Physik Department E62 — [3]LIT JINR, Dubna, Russia

A Ring Imaging Cherenkov (RICH) detector is used to identify electron-positron pairs in the HADES experiment. In cooperation with the CBM-RICH collaboration the existing gaseous photon detector based on a MWPC with CsI cathode will be replaced by multianode photomultipliers (MAPMT). The detector geometry of the upgraded RICH has been implemented in the HADES analysis package HYDRA. The upgraded detector simulation includes the versatile and optimized ring reconstruction algorithm developed for the CBM RICH and realistic photo tube readout response. Simulations show that the detection efficiency for electron-positron pairs increases significantly, in particular for pairs with very small opening angles.

We will present the expected detector performance and compare it to results obtained in a previous HADES experiment for the system p+Nb at $E_{kin} = 3.5\,\mathrm{GeV}$.

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