HK 23: Instrumentation 9

Time: Tuesday 14:30–16:30 Location: M/HS4

Group Report HK 23.1 Tue 14:30 M/HS4

Charged Particle ID with DIRCs in PANDA at FAIR — •Georg Schepers for the PANDA Cherenkov Group of the PANDA-Collaboration — GSI Helmholtzzentrum fuer Schwerionenforschung GmbH, Darmstadt, Germany

The PANDA detector at FAIR, the new international accelerator facility for antiprotons and ions in Darmstadt, will address open questions of hadronic physics. Experiments concerning charmonium spectroscopy are performed with antiproton beams colliding with hydrogen or nuclear targets. The beam momentum range between 1.5 GeV/c and 15 GeV/c allows tests of the predictions by perturbation theory, but will also reveal deviations originating from strong QCD. Excellent charged particle identification over a large momentum range is necessary for all these experiments. In the target spectrometer this will be accomplished by two Cherenkov counters using the DIRC principle, reducing the size of the solenoid and calorimeter. Both counters have to work in a strong magnetic field and withstand high event rates. The concept of the Barrel DIRC, covering the polar angles between 22 and 140 degrees, is based on the successful BaBar DIRC. It uses focusing optics with lenses and fast photon timing. The Endcap Disc DIRC works with a novel radiator geometry and covers the angular range from 5 to 22 degrees. In addition to a fast electronic readout it employs a compact photon detection system. Prototypes were tested with particle beams at GSI, CERN, DESY, and MAMI to validate the design choices. The results achieved and the status of the PANDA DIRC detectors will be presented.

HK 23.2 Tue 15:00 M/HS4

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 RD-Collaboration — [1]GSI Helmholtzzentrum fur 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 radially compact 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 potentially an attractive option.

The DIRC@EIC R&D Collaboration was formed by groups in the United States and Germany in 2011 with funding from DOE to investigate ways to extend the momentum coverage of DIRC counters for the EIC detector by up to 50% beyond the current state of the art. Possible design improvements include a complex focusing system, multi-anode sensors with smaller pixels, a time-based reconstruction algorithm, and chromatic dispersion mitigation.

Both Geant and ray-tracing simulations are used to optimize the design configuration of the DIRC counter in terms of the performance and the best integration with the EIC detector.

We will discuss the current status of the design studies and the possible improvements to the Cherenkov angle resolution and the photon yield.

HK 23.3 Tue 15:15 M/HS4

Simulation and Reconstruction of the PANDA Barrel DIRC — •Roman Dzhygadlo[1], Klaus Götzen[1], Grzegorz Kalicy[1,2], Harphool Kumawat[1,3], Maria Patsyuk[1,2], Klaus Peters[1,2], Carsten Schwarz[1], Jochen Schwiening[1], and Marko Zühlsdorf[1,2] for the PANDA Cherenkov Group of the PANDA-Collaboration — [1]GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt — [2]Goethe-Universität Frankfurt — [3]Bhabha Atomic Research Centre

Hadronic particle identification (PID) in the barrel region of the PANDA experiment at the new Facility for Antiproton and Ion Research in Europe (FAIR) at GSI, Darmstadt, will be provided by a DIRC (Detection of Internally Reflected Cherenkov light) counter. The design goal of the Barrel DIRC is to provide clean separation between pions and kaons with at least three standard deviations for momenta between 0.5 and 3.5 GeV/c and polar angles between 22° and 140°. To achieve this performance and reduce the detector cost, detailed simulations of the different design elements, such as the width of the radiators, the shape of the expansion volume and the type of focusing system, were performed using Geant. Custom reconstruction algorithms were developed to match the detector geometry. We will discuss the latest achievements in single photon resolution and photon yield as well as the PID performance for different design options of the Barrel DIRC detector.

Work supported by BMBF 05E12CD2, EU FP7 227431, HGS-HIRe.

HK 23.4 Tue 15:30 M/HS4

Prototype tests with the 3D Barrel DIRC of PANDA — Roman Dzhygadlo[1], Andreas Gerhardt[1], Grzegorz Kalicy[1,2,3], Marvin Krebs[1,2], Harphool Kumawat[1,4], Dorothe Lehmann[1], Maria Patsyuk[1], Klaus Peters[1,2], Georg Schepers[1], •Carsten Schwarz[1], Jochen Schwiening[1], and Marko Zühlsdorf[1,2] for the PANDA Cherenkov Group of the PANDA-Collaboration — [1]GSI, Darmstadt, Germany — [2]Goethe University, Frankfurt, Germany — [3]Jefferson Lab, Newport News, Virginia, USA — [4]Bhabha Atomic Research Centre, Mumbai, India

The prototype tests of the Barrel DIRC counter, under development for the future PANDA experiment at FAIR, aim at the improvement of the original design, applied successfully by BABAR. Subjects of the R&D for this 3D Cherenkov counter include the focusing system and fast photon timing as well as the width of the radiators and the shape of the expansion volume.

A modular prototype was built which allows an easy exchange of all key components under investigation. Prototype radiators from several optical companies, were tested in hadronic particle beams at CERN and at GSI. Data were recorded with narrow bars as well as with wide plates, coupled via an optional focusing lens system to a large solid fused silica prism, used as expansion volume.

We present a study of the performance of the prototype in several configurations with a focus on the single photon Cherenkov angle resolution and photon yield. Work supported by BMBF 05E12CD2, EU FP7 227431, HGS-HIRe.

HK 23.5 Tue 15:45 M/HS4

Detector performance tests for the CBM TRD — •Martin Kohn — WWU Münster Insitut für Kernphysik, Wilhelm-Klemm-Str. 9 48149 Münster

The Compressed Baryonic Matter (CBM) experiment is a fixed target heavy-ion experiment at the future FAIR accelerator facility. The CBM Transition Radiation Detector (TRD) is one of the key detectors to provide electron identification and charged particle tracking. With the construction phase of the detector nearing, we will present results of the detector obtained with a close to final prototype. These results will be compared to simulation benchmarks in terms of pion rejection capabilities and spatial resolution.

HK 23.6 Tue 16:00 M/HS4

Upgrade of the ALICE Transition Radiation Detector Pre-Trigger System — •Sebastian Klewin for the ALICE-Collaboration — Physikalisches Institut, Heidelberg

The ALICE TRD pre-trigger system has been designed and built to provide an early wake-up signal for the TRD front-end electronics (FEE). This signal has to arrive 1.15 μs before the Level-0 trigger, which is generated by the Central Trigger Processor (CTP). This independent generation of the signal had during RUN1 some probability of not being confirmed by the CTP L0, which lead to some dead-times.

To avoid this, an upgrade strategy has been worked out in which a level-minus-1 (LM) trigger signal, generated by the CTP, replaces the pre-trigger signal. Several efforts had to be made to achieve the ambitious timing: cables had to be rerouted and some electronics had to be relocated to minimize the latency. Additionally a new device had to be developed, which mixes the LM into the TTC protocol and modifies it to a stream suitable for the TRD FEE. Further this device checks the timing of the signals, takes care of the busy handling and provides additional monitoring capabilities. In standalone mode it is also able to generate the necessary signals to trigger the TRD without the CTP. A standard CTP Local Trigger Unit (LTU) was used as hardware, for which a new firmware has been developed to provide these functionalities.

HK 23.7 Tue 16:15 M/HS4

The PANDA Endcap Disc Dirc and its opto-mechanical system — •Erik Etzelmüller[1], Klim Biguenko[1], Michael Düren[1], Klaus Föhl[1,2], Avetik Hayrapetyan[1], Benno Kröck[1], Oliver Merle[1], Julian Rieke[1], and Mustafa Schmidt[1] for the PANDA-Collaboration — [1]II. Physikalisches Institut, Justus-Liebig-Universität, Gießen, Deutschland — [2]CERN, Genf, Schweiz

The physics program of the PANDA detector at the future FAIR facility at GSI requires excellent particle identification. For the Panda forward endcap region a novel detector type called "Disc DIRC" has been designed. It covers the angular range between 5 and 22 degrees and uses internally reflected Cherenkov light in order to separate pions, kaons and protons up to a momentum of 4 GeV/c.
The concept of a Disc DIRC will be explained with an emphasis on the optics which play a major role for the detector design. Different types of optical components have to fulfill a number of requirements to allow a precision measurement. Further challenges arise from the necessity of an exact and robust alignment. Solutions will be presented and discussed along with the possibilities for an in-house quality assurance.