HK 23: Instrumentation VII

Time: Thursday 16:30–18:30 Location: H2

Group Report HK 23.1 Thu 16:30 H2

Status of the CBM Time-of-Flight project — •Ingo Deppner and Norbert Herrmann for the CBM-Collaboration — Physikalisches Institut, Uni. Heidelberg

In order to provide an excellent particle identification (PID) of charged hadrons at the future high-rate Compressed Baryonic Matter (CBM) experiment the CBM-TOF group has developed a concept of a large-area Time-of-Flight (ToF) wall equipped with multi-gap resistive plate chambers (MRPC). The MRPC detectors reached by now the close to final design and were extensively tested in several beam campaigns at particle fluxes of up to a 25 kHz/cm^2. Prior to its destined operation at the Facility for Antiproton and Ion Research (FAIR) - starting in 2025 - this high-rate timing MRPC technology is being used for physics research at two scientific pillars of the FAIR Phase-0 program. At STAR, the fixed- target program of the Beam Energy Scan II (BES-II) relies on 108 CBM MRPC detectors for forward PID at interaction rates of up to 2.5 kHz with 3 to 31.2 AGeV Au beams. At mCBM, high-performance benchmark runs of Λ production at top SIS18 energies (1.5/1.9 AGeV for Au/Ni beams) and CBM design interaction rates of 10 MHz will become feasible with a PID backbone consisting of 25 CBM MRPC detectors. Apart from the physics perspectives, these FAIR Phase-0 involvements allow for high rate detector tests and long term stability tests and will help gathering experience in operating the final CBM TOF wall. The current status of the CBM-TOF project and latest achievements from our Phase-0 involvements will be presented. The project is partially funded by BMBF contract 05P15VHFC1.

HK 23.2 Thu 17:00 H2

Development of a high resolution scintillation time measurement system — Kai-Thomas Brinkmann, •Lara Dippel, Valera Dormenev, and Hans-Georg Zaunick — II. Physikalisches Institut, Justus-Liebig-Universität, Gießen

This project is dedicated to the development of a system optimized for coincidence time resolution (CTR) measurements, potentially utilized in the context of scintillation kinetics or time-of-flight measurements. Testing through a selection of different electronic and detector components available in our lab, we were able to assemble a setup with promising results for scintillation kinetics measurements. The most promising setup employs a TDC7200 on a custom board read out by a RaspberryPi and a BaF crystal coupled to a PMT as a reference detector, measuring against another "naked" PMT optimized for fast timing. However, the setup predominantly measures the prompt photons emitted by the material tested, effectively suppressing the slower components. To measure the full-timing response of the material, further adjustments to the setup are needed. This work was carried out in the framework of BMBF Project 05K2019 - UFaCal

HK 23.3 Thu 17:15 H2

Magnetic field performance of the latest 2-inch MCP-PMTs — •Steffen Krauss, Merlin Boehm, Katja Gumbert, Albert Lehmann, and Daniel Miehling for the PANDA-Collaboration — Physikalisches Institut , Universität Erlangen-Nürnberg

The PANDA experiment at FAIR will employ two Cherenkov detectors of the DIRC-type for pion/kaon separation. Since the focal planes of both DIRC detectors are located in a $\gtrsim$1 Tesla B-field, Microchannel-Plate Photomultipliers (MCP-PMTs) are the only viable option to detect the generated Cherenkov photons. Their magnetic field performance is an essential characteristic of the MCP-PMTs and was investigated at conditions similar to those of the later experiment. In this context the most important quantity is the gain behavior as a function of the B-field strength and direction. MCP-PMTs from Photonis with 10 μm pores, varied internal dimensions, and anode layout with 8×8 and 3×100 pixels were investigated. The further studied MCP-PMTs from Photek Ltd with 6 μm pore diameter show a different B-field behavior. Also internal properties like crosstalk and charge cloud width, time resolution and electron recoil distributions were measured with a FPGA based TRB/PADIWA DAQ system. This was done with xy-scans across the photo cathode inside the B-field for the first time.

- Funded by BMBF and GSI -

HK 23.4 Thu 17:30 H2

Performance of highly pixelated Microchannel-Plate PMTs — •Katja Gumbert, Merlin Böhm, Steffen Krauss, Albert Lehmann, and Daniel Miehling — Physikalisches Institut, Universität Erlangen-Nürnberg

In the PANDA experiment at the new FAIR facility two DIRC detectors will be employed to identify hadrons using Cherenkov light. Since the photo-sensors of these detectors will be located inside magnetic fields of $\gtrapprox$1 Tesla, Microchannel-Plate Photomultipliers (MCP-PMTs) are the chosen type of sensors. One of the two DIRCs, the Endcap-Disc-DIRC (EDD), which is located in the forward direction of the interaction point, requires a high spatial resolution in one dimension to reconstruct the Cherenkov angles. For this purpose PHOTONIS has built 2-inch MCP-PMTs with a backplane of 3x100 anode pixels.

In Erlangen measurements are being carried out to verify that these MCP-PMTs meet the performance requirements of the EDD. The sensors must have a high detection efficiency (DQE = QE · CE) because only a small number of single photons is expected per track. Thus the quantum efficiency (QE) and the collection efficiency (CE) have to be high. Furthermore the gain needs to be at least 10^6 and should not drop significantly in the magnetic field. Moreover the sensors are required to have a good time resolution of $\lessapprox$100 ps and need to sustain high photon rates of up to 10 MHz/tube. The results of the performance measurements of four tubes will be presented in this talk.

- Funded by BMBF and GSI -

HK 23.5 Thu 17:45 H2

Development of a Raspberry Pi high resolution time-to-digital converter board for scintillatior based detectors — Kai-Thomas Brinkmann, Valera Dormenev, •Marvin Peter, and Hans-Georg Zaunick — II. Physikalisches Institut, Justus-Liebig-Universität, Gießen

A Raspberry Pi time-to-digital converter (TDC) board based on the TDC-GPX2 chip from Sciosense has been developed for measuring scintillator-based detector signals with high time resolution. Coincidence time measurements (CTR) based on different scintillator setups have been conducted utilizing the TDC board. Its design and performance measurements will be presented. This work was carried out in the framework of BMBF Project 05K2019 - UFaCal.

HK 23.6 Thu 18:00 H2

A Beam Halo Veto Detector for the MAGIX Experiment — •Judith Schlaadt for the MAGIX-Collaboration — Institute for Nuclear Physics, Johannes Gutenberg University Mainz, Germany

The MESA accelerator will host the MAGIX experiment, which is based on the scattering of an electron beam on a gas jet target. This enables the scattering on gases like hydrogen without scattering on any other materials before and after the scattering process. The gas jet target is realized by using a nozzle to inject the gas into the scattering chamber as well as a funnel-shaped structure called the catcher, into which the gas streams behind the interaction zone.

So-called beam halo electrons can occur in the accelerator. These do not move exactly along the beam axis and can increase background by interacting with the catcher and the nozzle. To reject these scattering reactions, the beam halo veto detector was implemented. This detector is positioned upstream of the gas jet target inside the scattering chamber. It allows the detection of single electrons by using a scintillator, a lightguide and a photomultiplier tube. Therefore, covering the front of the nozzle and the catcher with this detector allows suppressing the described background.

HK 23.7 Thu 18:15 H2

Performance of the MAGIX Jet Target with an optimized Nozzle Geometry — •Philipp Brand, Daniel Bonaventura, Sophia Vestrick, and Alfons Khoukaz for the MAGIX-Collaboration — Institut für Kernphysik, Westfälische Wilhelms-Universität Münster, 48149 Münster, Germany

The MAGIX experiment (MAinz Gas Internal target eXperiment) aims for high precision measurements of, e.g., electromagnetic form factors, the astrophysical S-factor, and to search for light dark matter. It will be located in the energy recovery arc of the MESA accelerator which is currently under construction in Mainz. This extensive physics program requires a windowless gas target, that achieves target thicknesses of more than 10^{18} atoms/cm^2 and that can operate with various gases like, e.g., hydrogen, oxygen, or argon.

Therefore, a cryogenic gas-jet target was developed at the University of Münster which is already installed at the A1 experiment within the MAMI facility at Mainz. The jet leaves the target through a convergent-divergent Laval nozzle and already several millimeter below the nozzle the interaction with the electron beam takes place. The jet is then pumped away through a conical catcher that is connected to a powerful pumping station. The jet divergence is crucial for the target performance, since a smaller jet would increase the target thickness at the interaction point and the efficiency of the catcher system. To reduce the divergence of the jet, different Laval nozzle designs have been studied in numerical simulations. The results of measurements with an optimized nozzle will be presented and compared to the simulations.