# HK 40: Instrumentation X

Time: Wednesday 15:45–17:15 Location: HBR 19: C 2

HK 40.1 Wed 15:45 HBR 19: C 2

**Magnetic field performance of recent 2-inch MCP-PMTs** — •Steffen Krauss, Merlin Böhm, Mirijam Götz, Katja Gumbert, Albert Lehmann, and Daniel Miehling — FAU Erlangen

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 a key feature of the MCP-PMTs and was investigated at conditions similar to those of the later experiment. MCP-PMTs from Photonis with 10 micrometer pores and an anode layout with 8x8 and 3x100 pixels were compared.

An important characteristic is the gain behavior as a function of the B-field strength and direction. But also the effect of the B-field on the electron trajectories inside the PMT need to be studied. This includes the focussing and spatial displacements of the charge cloud which lead to geometric shifts (e.g. Lorentz) of its center of gravity. The effects of electron focussing and shift were measured and compared to dedicated simulations.

In addition, afterpulses were studied as a function of the B-field strength by analyzing measurements with a CAEN digitizer (and a TRB/PADIWA DAQ system).

- Funded by BMBF and GSI -

HK 40.2 Wed 16:00 HBR 19: C 2

**Performance of the latest series production MCP-PMTs for the PANDA Barrel DIRC** — •Katja Gumbert, Merlin Böhm, Mirijam Götz, Steffen Krauss, Albert Lehmann, and Daniel Miehling for the PANDA-Collaboration — Physikalisches Institut, Universität Erlangen-Nürnberg

The PANDA detector at FAIR will use two DIRC detectors for particle identification through Cherenkov light. Given the placement of the photosensors within magnetic fields of $\gtrapprox$1 Tesla, the designated sensors are Microchannel-Plate Photomultipliers (MCP-PMTs). The Barrel DIRC, which surrounds the beam line and the interaction point, will apply 128 MCP-PMTs of the type XP85112-S-BA manufactured by Photonis. These sensors have an active area of 2x2 $\text{inch}^2$ with an 8x8 anode pixel configuration and two MCPs with a pore diameter of $10\,\mu m$. 155 MCP-PMTs of this type have been ordered and are subject to a quality control process in Erlangen before deployment in PANDA. This process includes among other measures test measurements of both the quantum and the collection efficiency, gain distribution analysis as well as measurements of the time resolution, the dark count rate, the afterpulse probability and the rate capability. The start of series production of these sensors led to new challenges and revealed new effects that require thorough analysis. The first >30 sensors have arrived in Erlangen and faced the quality control. The perfomance results obtained with the latest tubes will be presented in this talk. Furthermore, an update on the lifetime performance of the latest MCP-PMTs will be shown. - Funded by BMBF and GSI -

HK 40.3 Wed 16:15 HBR 19: C 2

**Development of microchannel plate detectors for ion identification for slowed down beams at FAIR with minimal interaction with the beam** — •Dennis Bittner[1], Gereon Hackenberg[1], Micheal Weinert[1], Micheal Armstrong[2], and Jan Jolie[1] — [1]University of Cologne, Institute for Nuclear Physics, Germany — [2]GSI, Darmstadt, Germany

At FAIR/GSI ion beams have energies of hundreds of MeV/u. To perform Coulomb excitation experiments the beam will be slowed down with a thick Degrader. Secondary reactions and scattering within the degrader result in a beam containing many secondary reaction products and a wide angular spread. For the experiments it is crucial to know the position, velocity, and direction of the single ions. The approach is to place two foil-MCP (micro channel plate) detectors with delay lines for position sensitivity in front of the experiment. The ions passing the foils generate secondary electrons, which are accelerated towards the MCP. Due to the great distance between the foil and the MCP, permanent magnets are used to force the electrons on circular trajectories. This increases the resolution of the detectors. This talk discusses the ongoing development focusing on the positional resolution and signal quality with a $^{32}$S Beam at the IKP Cologne. Support by BMBF is acknowledged under ErUM Verbundprojekt 05P2021 (ErUM"-FSP T07) grant 05P21PKFN1.

HK 40.4 Wed 16:30 HBR 19: C 2

**Characterization and trigger system of a SiPM-based RICH camera prototype** — •Jesús Peña Rodríguez for the CBM-Collaboration — Bergische Universität Wuppertal, Wuppertal, Germany

Ring Imaging Cherenkov detectors are moving towards new photodetection technologies to explore more accurate timing, spatial and amplitude resolutions. Silicon photomultipliers (SiPMs) can play such a role, traditionally played by vacuum-based photomultiplier tubes. SiPMs measure light intensities down to single photon-level with picosecond timing percision. Their photodetection efficiency surpasses those of traditional vacuum-based photomultiplier tubes, reaching up to 50% (even 60% in Near Ultra-Violet). The main SiPM drawbacks are temperature dependency and high dark count rates. In this talk, we present the noise characterization (dark count, afterpulse and crosstalk) and temperature dependency of three different SiPMs. In addition, we analyze the performance of the coincidence-based trigger system of a 4 x 4 SiPM matrix.

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HK 40.5 Wed 16:45 HBR 19: C 2

**Noise anaylsis of Silicon photomultipliers*** — •Jan Hendrik Lietz for the CBM-Collaboration — Bergische Universität Wuppertal

Silicon-Photomultiplier sensors (SIPMs) have evolved over the last years, providing large photon detection efficiency (up to 60%), good spacial fill factor, and excellent timing precision (down to picosecond level). In the form of pixelated arrays (MPPC-SiPMs) they are also potentially interesting for spatially resolved single photon counting in Ring imaging Cherenkov detectors. However, the large and strongly temperature dependent dark count rate (DCR) poses severe challenges for single photon detection, in particular if combined with a self-triggered, free-streaming readout concept as it is being implemented for the CBM RICH detector at the future FAIR facility.

As a first step towards a possible future upgrade of the CBM RICH photon detector using SiPMs we have started to evaluate several sensors from different vendors. In this talk we will discuss first measurement results on the DCR and cross talk at different operating temperatures and for different bias voltages.

* Work supported by "Netzwerke 2021", an initiative of the Ministry of Culture and Science of the State of Northrhine Westphalia.

HK 40.6 Wed 17:00 HBR 19: C 2

**A normalization detector for the neutron lifetime experiment $\tau$SPECT** — •Martin Engler[1], Martin Fertl[2], and Dieter Ries[3] for the tauSPECT-Collaboration — [1]Department of Chemistry, Johannes Gutenberg University Mainz, Mainz, Germany — [2]Institute of Physics, Johannes Gutenberg University Mainz, Mainz, Germany — [3]Paul Scherrer Institute, Villigen PSI, Switzerland

The $\tau$SPECT experiment aims to measure the free neutron lifetime, using fully magnetic storage. Neutrons with energies of $\approx 50\,\text{neV}$ are stored in a magnetic field gradient and then counted after varying storage times. The amount of neutrons filled into the trap in each measurement has to be normalized, in order to account for statistical and systematical changes in the yield of the neutron source. To monitor the flux of storable neutrons during the filling process, an in-situ neutron detector, has been built and installed into the experimental setup. The detector uses a $^{10}$B-coated ZnS:Ag scintillator coupled to an array of silicon photomultipliers. Neutrons are then detected by utilizing the neutron capture reaction $^{10}\text{B}\ (\text{n},\alpha)^{7}\text{Li}$ and detecting the light from the scintillator caused by the reaction's products. In October 2023 first measurements were taken with $\tau$SPECT and the normalization detector both in operation at the same beam port.

This talk will cover the detector's design, the results of the simultaneous run, as well as initial approaches to normalization.