HK 26: Instrumentation V

Zeit: Dienstag 14:00–16:15 Raum: F 102

Gruppenbericht HK 26.1 Di 14:00 F 102

MAPT—A New Detector System for Astrophysics and Radiation Monitoring — •Martin J. Losekamm, Thomas Pöschl, Daniel Greenwald, and Stephan Paul — Technische Universität München, Garching, Germany

We develop the Multi-purpose Active-target Particle Telescope (MAPT), a new detector system suitable for astrophysical studies and radiation monitoring aboard spacecraft. We use state-of-the-art silicon photomultipliers and plastic scintillators to create a very compact and efficient layout that allows to track charged particles omnidirectionally and determine particle energies between 25 MeV per nucleon and 1000 MeV per nucleon. MAPT is thus perfectly suited to characterize non-directional flux environments.

In this contribution, we give an overview of the detector concept, the data acquisition system, and the infrastructure needed to support the detector. We briefly describe the analysis framework and outline potential use cases.

This research was supported by the DFG cluster of excellence "Origin and Structure of the Universe" (www.universe-cluster.de).

HK 26.2 Di 14:30 F 102

Barrel Time-of-Flight Detector for the PANDA Experiment - Hardware Performance Validation — •Sebastian Zimmermann[1], Marius Chirita[1], Lukas Gruber[1], Dominik Steinschaden[1], Ken Suzuki[1], Merlin Böhm[2], Albert Lehmann[2], Carsten Schwarz[3], Herbert Orth[4], Kai Brinkmann[5], Kamal Dutta[6], and Kushal Kalita[6] for the PANDA-Collaboration — [1]SMI — [2]Erlangen — [3]GSI — [4]HIM — [5]Gießen — [6]Assam

We describe the technical layout and the expected performance of the Barrel Time-of-Flight detector (Barrel TOF) for the P*ANDA target spectrometer. The Barrel TOF detector has been designed to precisely measure the time at which a charged particle transits the detector with a resolution superior to the other sub-detectors. It will signal the topology of physics events, hence setting cornerstones for event classification. The implementation of the Barrel TOF is based on very fast organic scintillator tiles coupled to Silicon Photomultipliers, in total 2000 scintillators and 16k SiPMs will be used, covering 5 m2. The detector R&D is now in advanced stage and the technical design report is being reviewed by the collaboration. This talk will focus on the performance validation of the prototypes and hardware components.

HK 26.3 Di 14:45 F 102

Data Acquisition of the Crystal Zero Degree Detector at BES III — Achim Denig[1], Peter Drexler[1], Brice Garillon[1], •Leonard Koch[2], Wolfgang Kühn[2], Sören Lange[2], Werner Lauth[1], Yutie Liang[2], Torben Rathmann[1], and Christoph Redmer[1] — [1]Johannes Gutenberg Universität Mainz — [2]Justus-Liebig-Universität Gießen

The BES III experiment at the BEPCII electron positron collider in Beijing is collecting data in the charm-τ mass region. Being strongly peaked towards small polar angles, photons from initial state radiation (ISR) are detected with limited efficiency.

In order to increase the detection efficiency of these photons, we propose a small detector comprised of two arrays of scintillating crystals separated by a small gap to be placed in the very forward and backward regions. The scintillation light will be collected by silicon photomultipliers (SiPMs) and the signals will be digitized by feature extracting flash ADCs. This data stream is correlated with the BES III trigger in realtime on FPGA based hardware.

In this contribution the hardware of the data acquisition and the algorithms performing the feature extraction and the event correlation are presented.

This work is supported by grant DFG research group 2359.

HK 26.4 Di 15:00 F 102

High time resolution silicon photomultipliers coupled to plastic scintillators — Daniel Bemmerer[1], Thomas E. Cowan[1,2], Marcel Grieger[1,2], Tobias P. Reinhardt[2], Stefan Reinicke[1,2], Marko Röder[1,2], Daniel Stach[1], •Klaus Stöckel[2,1], Andreas Wagner[1], David Weinberger[1], and Kai Zuber[2] — [1]Helmholtz-Zentrum Dresden-Rossendorf (HZDR), Dresden, Germany — [2]TU Dresden, Germany

Semiconductor-based light detectors, so-called silicon photomultipliers (SiPMs) may in principle replace classical photomultiplier tubes in several applications. Recently, it has been shown [1] that for large, $270\times5\times5\,\mathrm{cm}^3$ plastic scintillator bars SiPM readout with efficiency close to unity and high time resolution is possible, when they are irradiated with 30 MeV single electrons from the ELBE superconducting electron linac. These results will be reviewed, and in addition, recent work at TU Dresden and HZDR on neutron/γ pulse shape discrimination capability of large (9-36 mm^2) timing SiPMs coupled to relevant scintillators will be summarized.

[1] T.P. Reinhardt *et al.*, Nucl. Inst. Meth. A 816, 16 (2016)

Supported by BMBF (05P12ODNUG) and GSI F&E (DD-ZUBE).

HK 26.5 Di 15:15 F 102

Precision Measurements of Quenching and Saturation Effects in Organic Scintillators Coupled to Silicon Photomultipliers — •Thomas Pöschl, Martin J. Losekamm, Daniel Greenwald, and Stephan Paul — Technische Universität München, 85748 Garching, Deutschland

Measuring the energy deposition of charged particles in scintillators is a common detection and identification method in particle physics. In the last years, the development of ultra-sensitive silicon photomultipliers (SiPMs) accelerated the development and allowed to diversify the applications for such detectors. The conversion of electronic energy loss by a traversing charged particle into scintillation light and its subsequent detection implicate several loss mechanisms that require precise understanding to determine properties of the primary particle.

These signal-loss mechanisms have been determined using different scintillator-SiPM combinations exposed to protons and pions with momenta of 240 MeV/c to 450 MeV/c. Using Bayesian Inference techniques, we have determined the individual loss-mechanisms and their correlations in detail. The results will improve the current implementations of these mechanisms in simulation tools such as Geant4. This research was supported by the DFG Cluster of excellence 'Origin and Structure of the Universe' (www.universe-cluster.de).

HK 26.6 Di 15:30 F 102

Charakteristika von 700 HAMAMATSU H12700 MAPMTs* — •Jörg Förtsch, Karl-Heinz Kampert und Christian Pauly für die CBM-Kollaboration — Bergische Universität Wuppertal

Eine wesentliche Komponente des CBM Detektors und des HADES Detektor-Upgrades, ist ein Ring-abbildender Cherenkov-Detektor (RICH). Der CBM Detektor und der verbesserte HADES Detektor werden an der FAIR Beschleunigeranlage in Darmstadt in Betrieb genommen werden. Die photosensitive Fläche beider RICH-Detektoren wird mit ortsauflösenden Multianodenphotomultipliern (MAPMT) ausgerüstet. Hierfür wurden 1100 HAMAMATSU H12700 MAPMTs beschafft. Der H12700 ist ein 2×2 in^2 MAPMT mit 64 Anodenpads, guter Effizienz im UV-Bereich (QE @300nm ca. 30%) und gut separiertem Einzelphotonenpeak (PV>1.5:1). Um die 50 monatlich eintreffenden MAPMTs zu überprüfen und für den späteren Detektor zu gruppieren wurde vor Lieferbegin im Dezember 2015 ein Teststand in Betrieb genommen. Dieser Teststand vermisst die MAPMTs z.B. in Bezug auf Verstärkung, effiziente Fläche, Dunkelrate und Nachpulsen. Die Vermessung geschieht mittels positionsaufgelöster Beleuchtung der MAPMTs mit "einzelnen" Photonen. Die Kombination aus einem LED-Pulser, einer selbstgetriggerten Datenauslese (mittels eines nXYter ASIC) und einem automatisierten XY-Tisch erlaubt dann die Erfassung verschiedenster MAPMT Charakteristika. In diesem Vortrag werden Messergebnisse der ersten 700 MAPMTs zusammengefasst und vorgestellt.

*gefördert durch BMBF 05P15PXFCA, und GSI

HK 26.7 Di 15:45 F 102

Investigations of new 2 inch Hamamatsu Microchannel-Plate Photomultipliers — •Samuel Stelter, Merlin Böhm, Daniel Miehling, Albert Lehmann, Markus Pfaffinger, and Fred Uhlig for the PANDA-Collaboration — Physikalisches Institut, Universität Erlangen-Nürnberg

An important part of the PANDA experiment at the HESR/FAIR facility will be the two DIRC detectors. Their task is the identification of pions and kaons in the low GeV/c momentum region using the Cherenkov effect. The opening angle of the Cherenkov cone can be reconstructed from photons guided to the upstream end of a quartz radiator by internal reflection. Due to the fact that the DIRC focal planes will be located in a magnetic field of >1 Tesla, standard dynode photomultipliers (PMTs) are not usable for this experiment. Instead multi-anode Microchannel-Plate PMTs have to be used. The performance parameters of these MCP-PMTs have to be carefully measured concerning their suitability for the detector setup. The gain and its uniformity across the active surface, the cross-talk among the anode pixels, the behavior inside magnetic fields and the time resolution are some of the most important characteristics. Especially the finely segmented (0.4 mm pitch) sensors needed for the endcap disc DIRC require low cross-talk to reach the envisaged spatial resolution. This talk will present the measurement setups and the results of new 2x2 inch^2 Hamamatsu MCP-PMT prototypes (8x8 and 6x128 anode pixels) developed for the PANDA DIRCs.

- Funded by BMBF and GSI -

HK 26.8 Di 16:00 F 102

Investigations of a self-made potential-free picoammeter for MCP-PMT lifetime measurements — •Daniel Miehling, Merlin Böhm, Albert Lehmann, Markus Pfaffinger, Samuel Stelter, and Fred Uhlig for the PANDA-Collaboration — Physikalisches Institut, Universität Erlangen-Nürnberg

π/K identification in the PANDA experiment at HESR/FAIR will be done with DIRC detectors. These detectors are located in a magnetic field of >1 Tesla. This and other reasons leave the usage of Microchannel-Plate Photomultipliers (MCP-PMTs) as the only option. A serious concern of MCP-PMTs is their lifetime. While the integrated anode charge (IAC) increases the quantum efficiency (QE) of these PMTs decreases due to an aging process caused by feedback ions. A setup in Erlangen measures and monitors the QE, while the MCP-PMTs are illuminated. However, the time the most recent MCP-PMTs take to age at PANDA DIRC photon rates is rather long (up to years). We intend to accelerate this process by increasing the light intensity during the illumination. Unfortunately the limited MCP-PMT rate stability causes the anode signals to saturate at high light intensities. Then it is not possible anymore to directly correlate the IAC and the QE decline, i.e. the damage of the photocathode (PC). This can be avoided by measuring the charge directly at the PC or at the first MCP in combination with the IAC. For this purpose a potential-free picoammeter is needed. Because such devices are either not existent or very expensive, a "self-made" picoammeter was built and tested. The results will be presented in this talk. - Funded by BMBF and GSI -