HK 32: Instrumentation 12

Time: Tuesday 17:00–19:00 Location: M/HS4

HK 32.1 Tue 17:00 M/HS4

Silicon Photomultiplier readout of NeuLAND — •Stefan Reinicke[1,2], Daniel Bemmerer[1], Thomas E. Cowan[1,2], Stefan Gohl[1], Klaus Heidel[1], Tobias P. Reinhardt[2,1], Marko Röder[1], Daniel Stach[1], Andreas Wagner[1], David Weinberger[1], and Kai Zuber[2] for the R3B-Collaboration — [1]Helmholtz-Zentrum Dresden-Rossendorf — [2]TU Dresden

Recent developements in the field of Silicon Photomultipliers indicate that they could be a potential alternative to the use of photomultiplier tubes for the detection of scintillation light at upcoming large neutron time-of-flight detectors like NeuLAND at FAIR.

With a focus on timing resolution, Silicon Photomultipliers from various manufacturers with active surfaces ranging from 1 x 1 mm^2 to 6 x 6 mm^2 were studied using inhouse developed preamplifier boards and a picosecond laser system. Tests were performed with small and large scale scintillators at the electron accelerator ELBE. The data are compared with Monte Carlo simulations.

— Supported by NupNET NEDENSAA (05 P09 CRFN5) and by GSI F&E (DR-ZUBE).

HK 32.2 Tue 17:15 M/HS4

High resolution MCP photon detectors for the PANDA Endcap Disc DIRC — •Julian Rieke[1], Klim Biguenko[1], Michael Düren[1], Erik Etzelmüller[1], Klaus Föhl[2], Avetik Hayrapetyan[1], Benno Kröck[1], Oliver Merle[1], and Mustafa Schmidt[1] for the PANDA-Collaboration — [1]II. Physikalisches Institut, Justus-Liebig-Universität, Gießen, Deutschland — [2]CERN, Genf, Schweiz

The PANDA detector at the future FAIR facility in Darmstadt will require excellent particle identification (PID) to achieve its physics goals. The forward region between 5 and 22 degrees will be instrumented with a novel Disc DIRC detector which utilizes internally reflected Cherenkov light and will provide separation of pions, kaons and protons with momenta up to 4 GeV/c.

The Cherenkov photon readout will be carried out with high resolution microchannel plate photomultiplier tubes (MCP-PMTs). A custom made anode layout with a narrow strip pitch of 0.5 mm will allow the reconstructing of the point of impact of single photons with high precision. The tubes will be read out by a modified version of the TOFPET ASIC. The current status of the prototype testing of the tubes and the ASIC will be presented.

HK 32.3 Tue 17:30 M/HS4

Measurements of recent microchannel-plate photomultipliers with significantly increased lifetime — •Fred Uhlig, Wolfgang Eyrich, Albert Lehmann, and Alexander Britting for the PANDA-Collaboration — Universität Erlangen, physikal. Institut IV

Microchannel-plate photomultipliers (MCP-PMTs) are the favored sensors for the DIRC detectors (Detection of Internally Reflected Cherenkov Light) of the PANDA experiment. They are usable in high magnetic fields of up to 2T and reach a time resolution of better than 50 ps (σ). The anticipated average luminosity of $2 \cdot 10^{32}$ $cm^{-2}s^{-1}$ in the detector requires a rate capability high enough to withstand a detected photon rate of about 200 kHz cm^{-2} at the MCP-PMT surfaces. The major drawback until recently was the limited lifetime of MCP-PMTs, which appears to be solved for the latest generation of MCP-PMT prototype devices. The aging parameter is the quantum efficiency as a function of the integrated anode charge, which will be in the region of 5 C/cm^2 for the Barrel- and the Disc-DIRC. We simultaneously measured the aging of several MCP-PMTs, which were treated with different methods to enhance the lifetime. Results of these measurements will be presented.

- supported by BMBF and GSI -

HK 32.4 Tue 17:45 M/HS4

Untersuchung der Zeitauflösung von verschiedenen Szintillator-/SiPM-Kombinationen — •Merlin Böhm, Fred Uhlig, Wolfgang Eyrich und Albert Lehmann für die PANDA-Kollaboration — Universität Erlangen-Nürnberg, Physikalisches Institut IV

Der Barrel-TOF-Detektor beim $\overline{\text{P}}$ANDA-Experiment soll die Zuordnung von Teilchenspuren zu den einzelnen Ereignissen unterstützen, sowie eine Teilchenidentifikation bei niedrigen Impulsen liefern. Dazu ist eine Zeitauflösung von <100 ps notwendig. Der Detektor ist als Hodoskop aus einigen Tausend szintillierenden Tiles (SciTils) in Kombination mit Siliziumphotomultipliern (SiPMs) geplant. Um die bestmögliche Zeitauflösung herauszufinden, wurden verschiedene Szintillator-Geometrien (z.B. 30x30x5 mm^3 bis 5x5x120 mm^3) mit SiPMs in unterschiedlichen Anordnungen untersucht. Hierzu wurden die SciTils mit einer Elektronenquelle abgescannt und die Zeitauflösung und Photonenausbeute als Funktion der Szintillatoroberfläche gemessen. Es wurden Auflösungen von ~50 ps (σ) erreicht. Die verschiedenen Messungen und Resultate werden diskutiert.

- Gefördert durch BMBF und GSI -

HK 32.5 Tue 18:00 M/HS4

Proton detection in the neutron lifetime experiment PENeLOPE — •Christian Tietze for the PENeLOPE-Collaboration — Technische Universität München, Physik Department E18

Although neutron lifetime plays an important role in the Standard Model of particle physics, τ_n is not very precisely know and often discussed. The official PDG mean value has been lowered during the last years by more than 6σ to the new value of $880.3 \pm 1.1s$. The new precision experiment PENeLOPE, which is currently developed at Technische Universität München, will help to clear this up. Ultra-cold neutrons are lossless stored in a magneto-gravitational trap, formed by superconducting coils. The combined determination of τ_n by counting the surviving neutrons after each storage cycle on one side and in-situ detection of the decay protons on the other side together with a very good handle on systematic errors leads to an unprecedented precision of the neutron lifetime value of $0.1s$. This contribution will give an overview of the challenges concerning proton detection under the exceptional requirements of this experiment. The developed concept of using avalanche photodiodes for direct proton detection will be presented as well as results from first measurements with a prototype detector read out by particular developed electronics. This project is supported by the cluster of excellence "Origin and structure of the universe", the Deutsche Forschungsgemeinschaft and the Maier-Leibnitz Laboratorium, Garching.

HK 32.6 Tue 18:15 M/HS4

Towards the final MRPC design - Performance test with heavy ion beam — •Ingo Deppner and Norbert Herrmann — Physikalisches Institut Uni. Heidelberg, Heidelberg

The Compressed Baryonic Matter spectrometer (CBM) is a future heavy ion experiment located at the Facility for Anti-proton and Ion Research (FAIR) in Darmstadt, Germany. The key element in CBM providing hadron identification at incident energies between 2 and 35 AGeV will be a 120 m^2 large Time-of-Flight (ToF) wall composed of Multi-gap Resistive Plate Chambers (MRPC) with a system time resolution better than 80 ps. Aiming for an interaction rate of 10 MHz for Au+Au collisions the MRPCs have to cope with an incident particle flux between 0.1 kHz/cm^2 and 25 kHz/cm^2 depending on their location. Characterized by granularity and rate capability the actual conceptual design of the ToF-wall foresees 4 different counter types called MRPC1 - MRPC4.

In order to elaborate the final MRPC design of these counters a heavy ion test beam time was performed at GSI. In this contribution we will present performance test results of 2 different MRPC3 full size prototypes developed at Heidelberg University and Tsinghua University, Beijing.

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HK 32.7 Tue 18:30 M/HS4

SiPM properties at cryogenic temperatures — •Maik Biroth[1], Patrick Achenbach[1], Evangeline Downie[2], and Andreas Thomas[1] for the A2-Collaboration — [1]Institut für Kernphysik, Johannes Gutenberg-Universität, Mainz, Germany — [2]George Washington University, DC, USA

At the electron accelerator Mainzer Mikrotron (MAMI) an active target build of polarizable scintillators will be operated at approximately 25 mK. To read out the scintillation light, the photodetectors have to withstand cryogenic temperatures of 4 K and high count rates. Therefore the properties of different types of silicon photomultipliers (SiPMs) were studied at cryogenic temperatures. In liquid nitrogen at 77 K, problems with quenching in Hamamatsu SiPMs and with the protective epoxy layer covering Zecotek SiPMs were observed. Tests with one Zecotek SiPM were successful after removal of the epoxy layer in liquid helium at 4 K and no after-pulses could be observed. Fundamental parameters like break-down voltage, single-pixel gain, crosstalk probabilty and the dark-count rate were measured and compared to room temperature. The photon detection efficiency was estimated by SiPMs response to short LED pulses. All these parameters were extracted by curve-fitting of SiPM charge spectra with a new analytical function.

HK 32.8 Tue 18:45 M/HS4

Monte Carlo simulations for the optimisation of low-background Ge detector designs — •Janina Hakenmüller[1], Gerd Heusser[1], Matthias Laubenstein[2], Werner Maneschg[1], Jochen Schreiner[1], Hardy Simgen[1], Dominik Stolzenburg[1], Herbert Strecker[1], Marc Weber[1], and Jonas Westernmann[1] — [1]Max-Planck-Institut für Kernphysik, Saupfercheckweg 1, 69117 Heidelberg, Germany — [2]Laboratori Nazionali del Gran Sasso, Via G. Acitelli 22, 67100 Assergi L'Aquila, Italy

Monte Carlo simulations for the low-background Ge spectrometer Giove at the underground laboratory of MPI-K, Heidelberg, are presented. In order to reduce the cosmogenic background at the present shallow depth (15 m w.e.) the shielding of the spectrometer includes an active muon veto and a passive shielding (lead and borated PE layers). The achieved background suppression is comparable to Ge spectrometers operated in much greater depth.

The geometry of the detector and the shielding were implemented using the Geant4-based toolkit MaGe. The simulations were successfully optimised by determining the correct diode position and active volume. With the help of the validated Monte Carlo simulation the contribution of the single components to the overall background can be examined. This includes a comparison between simulated results and measurements with different fillings of the sample chamber.

Having reproduced the measured detector background in the simulation provides the possibility to improve the background by reverse engineering of the passive and active shield layers in the simulation.