HK 23: Instrumentation

Zeit: Montag 16:45–19:15 Raum: WIL-A221

Gruppenbericht HK 23.1 Mo 16:45 WIL-A221

Testmessungen mit einem Prototypen für die Vorwärtsendkappe des PANDA-EMC — •Cathrina Sowa für die PANDA-Kollaboration — Ruhr-Universität Bochum, Inst. f. Experimentalphysik I, 44780 Bochum

Der PANDA-Detektor wird an der zukünftigen Beschleunigeranlage FAIR am Antiproton-Speicherring HESR aufgebaut. Es wird eine maximale Luminosität von $2 \cdot 10^{32}\mathrm{cm}^{-2}\mathrm{s}^{-1}$ durch den Beschuss eines Wasserstofftargets mit Antiprotonen aus dem HESR-Beschleuniger mit Impulsen von 1,5 bis 15 GeV/c erreicht. Einer der zentralen Detektoren ist das, aus einem Barrel und zwei Endkappen, bestehende elektromagnetische Kalorimeter, welches mit Blei-Wolframat-Kristallen bestückt wird. Die strahlnächsten Kristalle der Vorwärtsendkappe werden einer durchschnittlichen Ergeignisrate von $5 \cdot 10^5$/s bei maximaler Luminosität und höchstem Strahlimpuls ausgesetzt sein. Zur Verbesserung der Lichtausbeute werden die Bleiwolframat-Szintillatoren auf eine Temperatur von $-25°$C gekühlt.
Ein Prototyp bestehend aus 216 Kristallen, welche mit VPTTs und LAAPDs ausgelesen werden, wurde an den Beschleunigern MAMI (Mainzer Mikrotron) und SPS (CERN) weiteren Strahltests unterzogen. Am SPS wurde mit Elektronen der höchsten bei PANDA zu erwartenden Teilchenenergien gemessen, während an MAMI mit niederenergetischen, getaggten Photonen gemessen wurde. Die Strahlzeiten dienten der Bestimmung der Linearitaet der Auslesekette, der Auslese- und Rekonstruktionsschwellenwerte sowie der Energieaufloesung.
Gefördert durch das BMBF und die EU.

HK 23.2 Mo 17:15 WIL-A221

Investigation of PANDA EMC modules in a realistic high rate environment — •Marcel Werner, Martin Galuska, Hu Jifeng, Sören Lange, Yutie Liang, Wolfgang Kühn, Björn Spruck, and Matthias Ullrich — II. Physikalisches Institut, Justus-Liebig Universität Gießen

The future physics program of the Panda experiment at FAIR imposes high requirements on the performance on all subdetectors and in particular the electromagnetic calorimeter (EMC).

The installation of a Zero Degree Detector (ZDD) at the Bes III experiment, Beijing, China, using PANDA-type PbWO4 crystals with the purpose of studying the radiative return, offers a unique opportunity for a test under a realistic high rate environment similar to the future Panda operation. As the available space for the ZDD at Bes III is small and therefore the energy resolution of the ZDD is limited, the knowledge of the photon impact at the ZDD is of importance since it determines the event structure in the Bes III detector. Also online event processing using DSP-algorithms, matching Bes III detector and ZDD information, to pick out events of interest is necessary to handle the expected event rates (O(MHz)).

The prototype readout chain comprises a sampling ADC prototype with a fast optical interface and an ATCA-based Compute Node with 5 XILINX Virtex-4 FX60 FPGAs. The status of the system will be presented.

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HK 23.3 Mo 17:30 WIL-A221

Measurements and Simulations on Non-Uniformities in the Collection of Scintillation Light in $PbWO_4$-Crystals in PANDA Geometry* — •Daniel Bremer, Tobias Eissner, Valery Dormenev, and Rainer Novotny for the PANDA-Collaboration — II. Phys. Institut, Universität Gießen, Germany

The EM calorimeter of the PANDA target spectrometer is one major component to achieve the expected goals of the physics program. That requires high detection efficiency for photons and leptons combined with excellent resolutions over a large dynamic range. Therefore, a linear response to photons and charged particles, which depends on crystal homogeneity as well as light collection, is mandatory. Nevertheless, due to the tapered geometry of most of the 13 different shapes of $PbWO_4$ crystals, the obtained light yield depends on the longitudinal point of origin of the scintillation light. This contribution will present an experimental program to investigate the position dependent light collection in crystals cooled down to the final operating temperature of -25 °C. The measurement is based on the detection of collimated 511 keV γ-rays from ^{22}Na-Sources. Different approaches are studied to linearize the light collection by various reflector materials and shapes as well as surface modifications. Based on these experimental results simulations were carried out to evaluate the effect of a light output linearization on the performance of the electromagnetic calorimeter in direct comparison to experimental data obtained over the entire energy range with the PROTO60 prototype matrix. *Work supported by BMBF and GSI

HK 23.4 Mo 17:45 WIL-A221

Stimulated Recovery of Radiation Damage for the PANDA EMC — Till Kuske, •Valera Dormenev, and Rainer Novotny — Justus-Liebig-Universität, Gießen

The future Electromagnetic Calorimeter (EMC) of the PANDA detector at FAIR will be based on a new generation of lead tungstate crystals (PWO-II). It is optimized to measure particle energies from 10 GeV down to 10-20 MeV. The operating temperature of the EMC will be -25°C. Due to the operation in a strong radiation environment one of the most critical parameter of PWO-II is radiation hardness. The radiation damage of PWO-II can be compensated by spontaneous relaxation of the color centers via thermo-activation. The process is strongly suppressed at -25°C, which is limiting the energy resolution of the EMC. The recovery process can be accelerated by illumination of the crystal with light even in the infrared region.The applicability of this process is being studied for implementation primarily into the most forward region of the target spectrometer dealing with the highest rate of radiation damage. The present paper will discuss the conditions for on- and off-line operation for both considered photo sensors such as LAAPDs and VPTT tubes. The effectiveness and wavelength sensitivity will be shown and discussed based on recent experimental data using LEDs as well as LASER diodes as light sources.

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HK 23.5 Mo 18:00 WIL-A221

Current status of the new $LaBr_3$:Ce detector array GALATEA* — •Christopher Walz[1], Ronan Lefol[2], Peter von Neumann-Cosel[1], Philipp Ries[1], Norbert Pietralla[1], Heiko Scheit[1], and Linda Schnorrenberger[1] — [1]Institut für Kernphysik ,TU Darmstadt, Germany — [2]University of Saskatchewan, Canada

In contrast to common scintillation materials like NaI and BaF_2 the recently developed $LaBr_3$:Ce detectors allow measurements with excellent time resolution and high efficiency while retaining a good energy resolution. To perform successful (e,e′γ) and (γ,$\gamma'\gamma$) coincidence experiments at the linear electron accelerator S-DALINAC all three features are of utmost importance. We present the current status of the new $LaBr_3$:Ce detector array GALATEA (GAmma LAnthanum bromide Top Efficiency Array) consisting of 18 large 3"x3" $LaBr_3$:Ce detectors. One focus is on the completely digital DAQ based on flash ADCs and newly developed pulse shape analysis methods for timing and particle identification. The performance of GALATEA is discussed regarding energy resolution, time resolution, linearity and efficiency. The results are compared to GEANT4 simulations.

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HK 23.6 Mo 18:15 WIL-A221

Experimental Determination of the Time and Charge Resolution of a Flash-ADC System for the PANDA STT — •Timm Preuhs, Albrecht Gillitzer, Henner Ohm, and Pawel Kulessa for the PANDA-Collaboration — Forschungszentrum Jülich, Institut für Kernphysik, Deutschland

The PANDA STT detector needs not only a high time resolution for precise spatial reconstruction of the helical trajectories of charged particles but also good deposited energy resolution in order to separate protons, kaons and pions in the momentum region below about 1 GeV/c. Currently a readout system for the PANDA STT based on Flash-ADCs are being investigated as a candidate for the final readout system. This system measures simultaneously pulse-height and time information. While the pulse-height resolution of the system is reasonably well understood, it is not immediately obvious that the timing properties are sufficient. The flash-ADC samples signals with a frequency of 240 MHz so that the spacing between adjacent data points

is 4.16 ns. This is too coarse for the required time resolution of the STT. Thus, for timing applications a straight line is fit to the rising slope of a signal and the time of appearance of a signal is then calculated as the intercept of this line with a given signal level. This can provide a better resolution than the period between samples. Long signal integration times needed for full charge collection of signals, however, make the signal slope less steep, thereby reducing the timing resolution. In this presentation the results of the achieved time resolution will be presented for a wide range of signal rise times and amplitudes.

HK 23.7 Mo 18:30 WIL-A221

Gain calibration of n-XYTER 1.0 — a prototype readout ASIC for the Silicon Tracking System of the CBM experiment. — •Iurii Sorokin for the CBM-Collaboration — Goethe University Frankfurt — Kiev Institute for Nuclear Research

n-XYTER is a 128-channel readout ASIC which measures both the integral signal charge and the time of occurance. Due to its self-triggering design, high gain, high rate capability and bipolar front-end, the chip has found a use as a prototype readout for the Silicon Tracking System, Muon and Cherenkov detectors of the CBM experiment. It is also going to be applied in other projects in Darmstadt, Heidelberg and Dubna.

To perform gain calibration of n-XYTER, reference charge pulses of a very small (down to 3000 e^-), yet precisely known amplitude had to be generated. This was achieved by attenuating a voltage step to a sub-millivolt level and passing it through a tiny (1 pF) capacitor. Special care had to be taken to check for possible systematic errors in the measurements of the attenuation factor and of the coupling capacitance. In addition, the system had to be well shielded against RF pickup, the parasitic capacitances had to be minimized and ensured to stay invariable.

Correct estimate of the systematic error was confirmed by performing a measurement with a different signal source — a planar silicon detector, exposed to γ-radiation of ^{241}Am. Finally, the dominating error came from the channel-to-channel gain variation.

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HK 23.8 Mo 18:45 WIL-A221

Das Trigger System des Double Chooz-Experiments — •Ilja Bekman, Dario Abu Shibika, Sebastian Lucht, Stefan Roth, Stefan Schoppmann, Achim Stahl, Anselm Stüken und Christopher Wiebusch — RWTH Aachen University, Germany

Das Double-Chooz-Experiment ist ein Reaktorneutrino-Experiment zur Bestimmung des Neutrino-Mischungswinkels θ_{13}. Nahe der Kernreaktoren in Chooz, Frankreich, werden dafür zwei baugleiche mit flüssigem Szintillator gefüllten Detektoren in unterschiedlichen Entfernungen installiert. Diese vermessen den Neutrinofluss, wobei der Neutrino Nachweis über den inversen beta-Zerfall geschieht. Zur Ermöglichung einer hocheffizienten Datennahme und einer Online-Klassifizierung der Ereignisse wird ein Trigger-System mit einem redundanten Konzept verwendet. Für die Triggerentscheidung wird eine Kombination aus der analogen Summe und der Multiplizität der Signale von Photomultipliergruppen ausgewertet. Der Ferndetektor des Experiments nimmt seit fast zwei Jahren erfolgreich Daten, der Nahdetektor soll in diesem Jahr fertiggestellt und in Betrieb genommen werden. In diesem Talk wird der Aufbau und die Funktion des Trigger-Systems vorgestellt, sowie bereits vorgesehene Optimierungen für den Betrieb mit dem Nahdetektor diskutiert.

HK 23.9 Mo 19:00 WIL-A221

Upgrade of the COMPASS calorimetric trigger — •Stefan Huber — Technische Universität München, Garching, Deutschland

In 2009 COMPASS performed a short measurement of neutral Primakoff reactions, characterised by highly energetic photons in one of the two electromagnetic calorimeters. A digital trigger was implemented in the existing readout electronics which calculates the energy released in the central region of the calorimeter. In 2012 a long measurement of these processes has been performed. In order to extend the kinematic range to lower energetic photons the trigger system has been upgraded in a way to be more selective to specific physics channels. The new ADC firmware preserves hit information and provides it to newly developed backplane trigger modules. There hits from all three thousand channels are processed and the trigger decision is made.