HK 75: Accelerators and Instrumentation I

Time: Thursday 16:30–19:00 Location: H-ZO 80

Group Report HK 75.1 Th 16:30 H-ZO 80

The Electromagnetic Calorimeter of PANDA at FAIR — •Aleksandra Biegun for the PANDA-Collaboration — KVI, University of Groningen, Groningen, The Netherlands

Antiproton-proton annihilations at the future FAIR facility at Darmstadt, Germany, will allow sensitive tests of QCD, the theory of strong interactions, in the regime of strong coupling. The PANDA detector aims at precision studies of charm-quark mesons, glue-balls, and mesons involving strong glue components. For these studies the electromagnetic calorimeter is one of the crucial detector components. The overall concept presented in the Technical Design Report [1] has been approved recently. The barrel part and the two end-caps of the calorimeter comprise more than 15000 PWO scintillation crystals of high quality with respect to optical performance and radiation hardness. Operation at low temperature and photo sensors, which are insensitive to strong magnetic fields, provide high light yield, optimum resolution and high count-rate capability. The performance of mass-produced PWO crystals and the quality of newly developed photosensors will be presented. The technical challenge of electronic developments and the prototype detector performance will be discussed. Performance characteristics have been incorporated in detailed large-scale simulations. Simulated results for specific reaction channels, e.g. the charmonium h_c decay into 7 photons, will be presented to demonstrate the sensitivity to specific final states of charm-quark and hybrid meson states.

[1] TDR for PANDA EMC (2008), arXiv:0810.1216v1

HK 75.2 Th 17:00 H-ZO 80

A Prototype for the Electromagnetic Calorimeter of PANDA — •Christof Motzko for the PANDA-Collaboration — Ruhr-Universität-Bochum, Germany

An electromagnetic calorimeter (EMC) consisting of about 16000 lead-tungstate crystals (PWO-crystals) will be build for the PANDA experiment located at the antiproton storage ring of the planned accelerator facility FAIR in Darmstadt. The kinetic energy range of the antiprotons will be 0.83 to 14.1 GeV. To increase the light yield of PWO the EMC will be operated at -25 °C. Large area avalanche photodiodes and vacuum phototriodes are developed for the photo detection.

The presentation will discuss the full scale prototype of the forward endcap EMC. The prototype consists of 192 crystals of 20 cm length forming the inner part of the detector. We are going to test the cooling and the mechanical stability as well as the mounting procedure of the EMC endcap. In addition the prototype allows to test different readout options and to study the long term stability of the EMC.

In this presentation the status of the development of the endcap prototype will be dicussed.

Supported by the BMBF and the EU.

HK 75.3 Th 17:15 H-ZO 80

Beam test of Lead Tungstate Crystals at ELSA, Bonn — •Florian Feldbauer for the PANDA-Collaboration — Ruhr-Universität Bochum, Germany

An electromagnetic calorimeter (EMC) consisting of about 16000 lead tungstate (PWO) crystals is developed for the PANDA experiment at the antiproton storage ring HESR at the future accelerator facility FAIR at Darmstadt. The high density and short decay time of lead tungstate allows the construction of a very compact calorimeter for high luminosity operation at PANDA. At the runtime of PANDA the crystals will be exposed to up to 30 mGy/h. The most common radiation damage is due to color center formation. Color centers affect the light transparency of the crystals, resulting in reduced light output. Therefore a precise study of possible radiation damage effects is mandatory. At the electron stretcher facility ELSA in Bonn PWO crystals of the latest generation are irradiated with high energetic electrons at count rates comparable to the highest expected rates in the PANDA calorimeter. The loss of crystal transparency is monitored with LED-Pulsers. The corresponding reduction in crystal light yields is recorded by measuring the energy loss spectrum of cosmic muons passing the crystals.

Supported by BMBF and EU.

HK 75.4 Th 17:30 H-ZO 80

New avalanche photo diode readout of the Crystal-Barrel-Experiment at ELSA — •Friedemann Zenke for the CBELSA/TAPS-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Nußallee 14-16, 53115 Bonn, Germany

The Crystal-Barrel-Experiment at ELSA in Bonn is a photo production experiment in hadron spectroscopy. The setup features nearly 4π-coverage with electromagnetic calorimeters and is optimized for the detection of multi-photon final states to measure double polarization observables.

One main aspect of the upcoming upgrades of the Crystal Barrel Experiment is concerned with extending the 1^{st} level trigger capability from the forward direction to the whole calorimeter. This step will significantly widen the trigger acceptance for neutral reaction channels and substantially help to suppress electromagnetic background.

Currently several different approaches are evaluated one of which is a new readout via avalanche photo diodes (APDs). In this approach a dual readout is the favoured solution. One readout branch provides a fast timing signal for trigger decisions while the other branch is optimized for energy resolution. The energy branch is fed into a flash ADC for digital feature extraction.

In this talk the current status and first results from a test beam time will be presented.

This work is funded by DFG (SFB/TR16).

HK 75.5 Th 17:45 H-ZO 80

APD development for the $\bar{P}$ANDA EMC — •Andrea Wilms for the PANDA-Collaboration — GSI Darmstadt, Darmstadt, Germany

The $\bar{P}$ANDA experiment is the part of the experimental program of the Facility for Antiproton and Ion Research (FAIR) with highest priority. The electromagnetic calorimeter will consist of nearly 16.000 lead tungstate (PWO) crystals read out with Avalanche Photodiodes which have an internal gain depending on the applied bias voltage. To increase the LY of the scintillator crystals the whole calorimeter will operate at a temperature of $T = -25°C$.
Each crystal of the calorimeter will be read out via two APDs so that a screening procedure for nearly 40.000 APDs has to be build up to ensure the correctness of the required device properties before their mounting on the rear side of the PWO crystals. The screening procedure includes the measurement of the main APD parameters like gain-bias dependence, dark current dependence on the applied voltage, surface uniformity of the gain, etc. To ensure a proper calibration during detector operation all measurements, including the test of radiation hardness, have to be done temperature dependent. The results of the screening of the first large area APDs with rectangular shape (active area: $(7 \times 14)\, mm^2$) will be compared to the results of the first APDs with quadratic shape used in the R&D process for the $\bar{P}$ANDA EMC readout concept.
This work is supported by EU contract number 506078 Hadron Physics.

HK 75.6 Th 18:00 H-ZO 80

Large volume PWO crystals in PANDA geometry provided by SICCAS — •Markus Moritz, Tobias Eissner, Werner Döring, and Rainer Novotny for the PANDA-Collaboration — 2nd Physics Institute, University Giessen

For the first time, full size tapered PbWO4 crystals in PANDA-geometry have been produced by SICCAS at Shanghai (China) and compared to the PWO-II quality as required for the electromagnetic target calorimeter of the PANDA detector. The report describes in detail the different test procedures on optical transparency, scintillation yield, homogeneity and kinetics of the scintillation processes at different temperatures. The investigations focus in particular on the radiation hardness at the operating temperature of T=-25°C. These measurements are performed at the ^{60}Co irradiation facility at Giessen. The report compares the achieved quality parameters with the specification limits of the EMC and discusses the results with respect to the growing technology and further improvements.

HK 75.7 Th 18:15 H-ZO 80

Quality of PWO Crystals for the PANDA-EMC — •Tobias Eissner, Markus Moritz, Rainer Novotny, and Werner Döring

— 2^{nd} Physics Institute, University Giessen

The electromagnetic calorimeter of the target spectrometer of PANDA relies on the high quality of Scintillator material $PbWO_4$. In collaboration with the manufacturer BTCP at Bogoroditsk (Tula district, Russia) a new standard PWO-II was developed. After the approval of the Technical Design Report the final mass production for the forward endcap and part of the barrel has been started immediatley. The first stage of quality control, which covers the geometrical dimensions, optical and scintillation properties, is performed similar to the CMS/ECAL project exploiting the semi-automatic robot ACCOS at CERN. The radiation hardness is tested for each crystal at the ^{60}Co irradiation facility at Giessen to guarantee the optimum performance at the final operating temperature of $T = -25°C$. The report describes in detail the test procedures and summarizes the achieved quality in comparison to the required specification limits for PANDA.

HK 75.8 Th 18:30 H-ZO 80

Measurements of Photon Response and Light Yield Homogeneity with PbWO4 Crystals for PANDA — •Sophie Grape for the PANDA-Collaboration — Uppsala University

The dynamic range for the crystals of the PANDA calorimeter is foreseen to span from 10 MeV to 15 GeV in order to make reconstruction of channels with both low and high energy photons possible. The synchrotron facility MAX-Lab in Lund, Sweden, provides a unique opportunity to measure response function of crystals at energies in the low energy regime. The photon energy resolution for an array of PbWO4 crystals has been measured in the range of 10 MeV to 100 MeV.

Another important feature is the homogeneity of the light yield response along the crystals. Results from these energy resolution and homogeneity measurements will be reported.

HK 75.9 Th 18:45 H-ZO 80

Linearity and Energy Resolution of Lead Glass Modules in the Electromagnetic Calorimeter of COMPASS — •Domagoj Ćotić — Institut für Kernphysik, Universität Mainz, Johann-Joachim-Becherweg 45, 55099 Mainz

The electromagnetic calorimeter at the COMPASS experiment at CERN are partly equipped with lead glass blocks of type TF1 (GAM) as Cherenkov light emitter. In order to determine the linearity and the energy resolution of these detectors, the performance of 5x5 matrix was studied at the H2-testbeam/CERN with a positron beam. The beam energy was varied between 12.5 and 90 GeV. The results of these test measurements aim an an improved energy calibration of the electromagnetic calorimeter.

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