HK 22: Instrumentation VI

Zeit: Dienstag 14:00–16:00 Raum: S1/01 A3

Gruppenbericht HK 22.1 Di 14:00 S1/01 A3

Status of the R3B calorimeter CALIFA — •Max Winkel, Roman Gernhäuser, Benjamin Heiss, Philipp Klenze, and Patrick Remmels for the R3B-Collaboration — Technische Universität München

The R^3B detector system at the new Facility for Antiproton and Ion Resarch (FAIR) will allow high resolution experiments with the most exotic nuclei at the isospin frontier using kinematically complete measurements. Examples of the physics program to investigate the evolution of nuclear shells and single particle structure far away from stability are quasi-free scattering, Coulomb excitation and knockout reactions.

A crucial component for these purposes is the CALorimeter for In Flight detection of γ-rays and high energy charged pArticles (CALIFA) surrounding the reaction area. The electromagnetic 4π-calorimeter is highly segmented into 2656 scintillation crystals to enable an excellent Doppler reconstruction while maintaining good calorimetric properties. A major challenge is the high dynamic energy range, necessary for various experiments, reaching from $E \sim 100$ keV γ rays up to $E \sim 700$ MeV protons. This goal is achieved by a dedicated, fully digital readout using a real time signal processing firmware.

In this report, the detector design as well as recent developments and results of various prototype tests are presented, including an R^3B pilot experiment involving prototypes of all R^3B detectors.

Supported by BMBF (05P12WOFNF, 05P15WOFNA) and GSI (TMLFRG1316).

HK 22.2 Di 14:30 S1/01 A3

Calibration and Monitoring System for the CALIFA Calorimeter — •Patrick Remmels, Roman Gernhäuser, Benjamin Heiss, Philipp Klenze, and Max Winkel for the R3B-Collaboration — Physik Department, Technische Universität München

One of the major components of the R^3B-experiment at the upcoming Facility for Antiproton and Ion Research (FAIR) in Darmstadt is the 4π-calorimeter CALIFA. The stability of all 2560 detector channels depends on the experimental conditions and its monitoring is essential for a high resolution spectroscopy. A newly developed digital pulse generator emulates the complex signal created in the CsI(Tl) crystals in order to calibrate the online pulse shape analysis for particle identification, background suppression and energy measurements. Further applications include deadtime studies and pileup discrimination in the general readout. The full implementation of 160 channels of pulse generation on the digital readout platform FEBEX allows an in spill separation of physical and calibration events in the continuous data stream. Setup, performance and first applications will be presented in this talk. Supported by BMBF (05P12 WOFNF, 05P15 WOFNA) and GSI (TMLFRG1316).

HK 22.3 Di 14:45 S1/01 A3

Measurement of the CALIFA PETAL response to cosmic-rays and AmBe source — •Han-Bum Rhee, Alexander Ignatov, and Thorsten Kröll for the R3B-Collaboration — Institut für Kernphysik,TU Darmstadt,Germany

CALIFA is a calorimeter and spectrometer that aims to detect gamma-rays and light charged particles. It is a part of the R3B experiment at GSI and the future FAIR facility. CALIFA is divided into a cylindrical barrel[1] and a forward end-cap[2]. The CALIFA barrel consist of CsI(Tl) scintillating crystals, which are individually read out with Avalanche Photodiodes(APDs). The functional units for the CALIFA demonstrator are called PETALs containing 64 crystals each. The PETALs are built using the same construction procedures, materials and elements as for CALIFA.

In this work, we investigated response of one CALIFA PETAL using high-energy gamma-rays from a AmBe source and atmospheric muons. In addition, we compare the experimental data with simulations using the GEANT4 package in order to verify these.

This work is supported by German BMBF(05P12RDFN8,05P15DFN1),HIC for FAIR and GSI-TU Darmstadt cooperation contract.

[1] R3B Collaboration,Technical Design Report for the CALIFA Barrel, November 2011

[2] R3B Collaboration,Technical Design Report for the CALIFA Endcap, August 2015

HK 22.4 Di 15:00 S1/01 A3

Avalanche Photo Diode Based Readout of the Crystal Barrel Calorimeter — •Martin Urban for the CBELSA/TAPS-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Nussallee 14-16, 53115 Bonn

The CBELSA/TAPS experiment at ELSA in Bonn has measured double polarization observables in meson photoproduction off the proton in the last few years. To be able to extend these measurements in future also to purely neutral final states produced off a polarized neutron target with high efficiency, the main calorimeter consisting of 1320 CsI(Tl) crystals has to be integrated into the first level trigger.

Key requirement to achieve this goal was the upgrade of the existing PIN photo diode by a new avalanche photo diode (APD) readout. The main advantage of the new readout system is to provide a fast timing signal which allows a fast decision on the number of cluster in an event.

The upgrade of the calorimeter has been finalized during the last year. Beside the status of the upgrade, this talk will focus on the single crystal calibration and on the development of a new light pulser system.

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HK 22.5 Di 15:15 S1/01 A3

Testaufbau zur Vermessung von Avalanche-Photo-Dioden für das PANDA-Kalorimeter — •Jan Haase für die PANDA-Kollaboration — Institut für Experimentalphysik 1 - Ruhr-Universität Bochum

Das PANDA-Experiment wird an der im Bau befindlichen Beschleunigeranlage FAIR (Facility for Antiproton and Ion Research) am GSI Helmholtzzentrum für Schwerionenforsching in Darmstadt aufgebaut. Der Detektor wird über ein homogenes elektromagnetisches Kalorimeter basierend auf Bleiwolframatkristallen ($PbWO_4$) verfügen. Mit dem Kalorimeter soll ein Energiebereich von 10 MeV bis etwa 15 GeV abgedeckt werden. Dabei werden die ca. 16000 Bleiwolframatkristalle mit Hilfe von Avalanche-Photo-Dioden (APD) und Vakuum-Photo-Tetroden (VPTT) ausgelesen.

Es wird hier die Entwicklung eines neuen Testaufbaus zur Vermessung von Avalanche-Photo-Dioden der Firma Hamamatsu vorgestellt. Ziel der Messung ist es, die Eigenschaften entsprechend der Verstärkung bei verschiedenen Betriebsspannungen und Temperaturen zu untersuchen. Dabei wird ein LED-basiertes Lichtpulsersystem genutzt, welches die Szintillationspulse im späteren Experiment nachbildet. Es werden erste Testmessungen und Untersuchungen dargelegt.

Gefördert durch das BMBF.

HK 22.6 Di 15:30 S1/01 A3

Influence of the Light Collection Non Uniformity in Strongly Tapered PWO Crystals on the Energy Resolution of the PANDA EMC — •Stefan Diehl[1], Peter Drexler[1], Valery Dormenev[1], Till Kuske[1], Rainer W. Novotny[1], Christoph Rosenbaum[1], Peter Wieczorek[2], Andrea Wilms[2], and Hans-Georg Zaunick[1] — [1]2nd Physics Institute, JLU Giessen — [2]GSI Helmholtzzentr. für Schwerionenforsch., Darmstadt

The barrel part of the target EMC of the PANDA detector at the future FAIR facility will consist of 11 crystal geometries with a different degree of tapering. Due to the tapering the crystals show a non uniformity in light collection. For the most tapered crystals the light detected by the photo-sensor is enhanced by a factor 1.4, if the scintillation light is created in the front part of the crystal. This effect causes a smearing of the response, resulting in a reduction of the energy resolution. Therefore, one lateral crystal side face has been de-polished for a set of test crystals, decreasing the non uniformity from around 40% to less than 5%. The present contribution will compare the response of a 3x3 matrix of crystals with one de-polished side in the final PANDA EMC configuration, with an identical matrix of polished crystals using a tagged photon beam in the energy range from 50 MeV up to 1 GeV and the results from GEANT4 simulations. A significant improvement of the energy resolution can be observed for the matrix with de-polished crystals in the energy range above 200 MeV, while the resolution stays at the same level between 50 MeV and 200 MeV. *The project is supported by BMBF, GSI and HIC for FAIR.

HK 22.7 Di 15:45 S1/01 A3

Improved prototype of the backward end - cap PANDA electromagnetic calorimeter at FAIR — Heybat Ahmadi[1,2], Samer Ahmed[1,2], Alexander Aycock[1,2], Luigi Capozza[2,3], Alaa Dbeyssi[2,3], Frank Maas[2,3], •Oliver Noll[1,2], and David Rodríguez Piñeiro[2,3] for the PANDA-Collaboration — [1]Johannes Gutenberg-Universität Mainz — [2]Helmholtz-Institut Mainz — [3]GSI Helmholtzzentrum für Schwerionenforschung GmbH

The PANDA experiment wants to achieve a deeper understanding of the strong interaction. It is built at the new accelerator facility FAIR in Darmstadt. The electromagnetic process group in Mainz is developing the backward end-cap (BWEC) of the electromagnetic calorimeter. The prototype (PROTO16) serves for testing the final BWEC components for cooling, insulating, place consumption, photon read-out, electronics and signal transmission. PROTO16 got some major updates in the last year. The aim of these updates has been to improve the signal transmission for a better signal to noise ratio. New line driver boards have been developed. In the frame work of the signal enhancement, the latest version of the PANDA calorimeter preamplifier (APFEL-ASIC 1.5) has been introduced. Besides using geographical addressing, the key advantage is the individual biasing of the avalanche photodiodes. Furthermore, the slow control monitoring has been improved and detector stability has been enhanced. Two beam times with an 855 MeV electron beam at the Mainz Microtron Facility served for testing the improvements. This contribution will discuss the results in terms of signal quality and detector stability.