HK 4: Instrumentation 3

Time: Monday 14:30–16:30 Location: M/HS4

HK 4.1 Mon 14:30 M/HS4

Characterisation of a Prototype for the Backward End-Cap of the PANDA EMC. — Heybat Ahmadi[1,2], Samer Ahmed[1], Luigi Capozza[1,3], Alaa Dbeyssi[1,3], •Malte Deiseroth[1,2], Bertold Fröhlich[1,3], Dmitry Khaneft[1,2], Dexu Lin[1,3], Frank Maas[1,3], María Carmen Mora Espí[1,3], Cristina Morales Morales[1,3], Oliver Noll[1,2], David Rodríguez Piñeiro[1,3], Roserio Valente[1,2], Manuel Zambrana[1,2], and Iris Zimmermann[1,3] for the PANDA-Collaboration — [1]HIM — [2]UNI-MAINZ — [3]GSI

The PANDA detector at FAIR will be used to study interactions of antiprotons in a fixed target experiment. The electromagnetic calorimeter (EMC) of the target spectrometer, consisting of > 15,000 PWO crystals, with its expected excellent performance and efficiency, will be one of the central components to achieve the physical goals. A first prototype for the Backward End-Capt (BWC) containing 16 crystals has been build and tested during 3 days of beamtime. The test was done with tagged photons in an energy range from about 50 MeV to 700 MeV at the Mainzer Microtron (MAMI). The prototype was desinged to be as close as possible to the final desing of the BWC. This talk will give a short introduction in the design of the prototype and the latest updates, followed by a presentation of the results from the beam time. It will describe the data analysis and the extraction of the energy resolution.

HK 4.2 Mon 14:45 M/HS4

Digitale Echtzeit-Pulsformanalyse für CALIFA — Michael Bendel, Roman Gernhäuser, Benjamin Heiss, Philipp Klenze, Patrick Remmels und •Max Winkel für die R3B-Kollaboration — Physik Department E12, Technische Universität München

Das elektromagnetische 4π-Kalorimenter CALIFA des R^3B-Experiments an FAIR ist strukturell in drei Polarwinkelbereiche mit unterschiedlichen Anforderungen unterteilt. Während in Vorwärtsrichtung schnelle Phoswich-Detektoren verwendet werden um die Gesamtenergie von nicht gestoppten Teilchen zu rekonstruieren, kommen im Bereich größerer Polarwinkel CsI(Tl)-Szintillatoren zum Einsatz.

Um trotzdem ein homogenes System nutzen zu können, wird das von der GSI entwickelte *FEBEX* System als gemeinsame Hardware-Platform genutzt. Durch die Verwendung der neu entwickelten *QPID*, einem universellen Algorithmus zur Pulsformanlyse, können in jedem Bereich identische Hardware- und Firmware-Module verwendet werden.

Gefördert durch BMBF (05P12WOFNF, 05P12WONUE) und GSI

HK 4.3 Mon 15:00 M/HS4

Energiekalibration und Bestimmung der Energieauflösung eines Kalorimeter Prototypen anhand der Analyse einer Teststrahlzeit — •Markus Kuhlmann für die PANDA-Kollaboration — Institut für Experimentalphysik 1 — Ruhr-Universität Bochum

Mit dem PANDA Experiment, das an der im Bau befindlichen Beschleunigeranlage FAIR an der GSI in Darmstadt aufgebaut werden soll, wird die Erforschung einiger Aspekte der starken und schwachen Wechselwirkung, exotischer Materiezustände, sowie der Struktur der Hadronen beabsichtigt. Der PANDA Detektor wird über ein homogenes elektromagnetisches Kalorimeter im Target-Spektrometer verfügen, dessen Bleiwolframat-Szintillatoren (PWO) mit Hilfe von Avalanche-Photo-Dioden (APD) und Vakuum-Photo-Tetroden (VPTT) ausgelesen werden sollen. Dabei sollen Energien von 10 MeV bis etwa 15 GeV messbar sein. Während der Entwicklungsphase der Vorwärts-Endkappe des Kalorimeters, wurden mehrere Teststrahlzeiten mit dem Prototypen durchgeführt. Im August 2014 wurde der Prototyp am ELSA-Beschleuniger (Elektronen-Stretcher-Anlage) der Universität Bonn mit Elektronenstrahlen bei 1,25 GeV, 2,4 GeV und 3,2 GeV getestet. Anhand der aufgezeichneten Daten und mithilfe einer Simulation des gesamten Aufbaus stellt dieser Beitrag vorläufige Ergebnisse der Energiekalibration und Energieauflösung vor.

Gefördert durch das BMBF mit Förderkennzeichen 05P12PCFP5 und das Forschungszentrum Jülich.

HK 4.4 Mon 15:15 M/HS4

Performance of a Prototype for Stimulated Recovery of Radiation Damage for the PANDA EMC Forward Endcap and Barrel — •Till Kuske, Valera Dormenev, Rainer Novotny, and Hans-Georg Zaunick — II. Physikalisches Institut Justus-Liebig Universität

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. A prototype implementation of the stimulated recovery for the PANDA EMC forward endcap is shown. Detailed studies concerning flux and intensity for different recovery modes at -25°C are presented. Additionally a concept for the recovery of radiation damage in the barrel part of the EMC will be discussed.

This work has been supported by BMBF and HIC-for-FAIR.

HK 4.5 Mon 15:30 M/HS4

Optimization of the nonuniformity in light collection of tapered $PbWO_4$ crystals and its influence on the energy resolution of the PANDA barrel EMC* — •Stefan Diehl[1], Peter Drexler[1], Valery Dormenev[1], Myroslav Kavatsyuk[5], Svetlana Nazarenko[1], Till Kuske[1], Rainer W. Novotny[1], Christoph Rosenbaum[1], Philippe Rosier[2], Andrej Ryantsev[3], Peter Wieczorek[4], Andrea Wilms[4], and Hans-Georg Zaunick[1] — [1]II. Physics Institute, University Giessen — [2]IPN Orsay, France — [3]IHEP Protvino, Russia — [4]GSI Helmholtzzentr. für Schwerionenforsch., Darmstadt — [5]KVI-CART Groningen, The Netherlands

The barrel part of the electromagnetic (EM) calorimeter of the PANDA detector at the future FAIR facility will consist of 11 crystal geometries with a different degree of tapering. Due to tapering the crystals show a nonuniformity (NUF) in light collection. For the most tapered crystals the light detected by the photosensor is enhanced by a factor 1.4, if the scintillation light is created in the front part of the crystal. Due to the spread and the fluctuations of the EM shower within the crystal, this effect causes a smearing of the response, resulting in a reduced energy resolution. Therefore one lateral side has been depolished for 9 crystals, decreasing the NUF down to < 5%, with only a slighty reduced light yield. The contribution will compare the response of a 3x3 matrix of crystals with one depolished side, with an identical matrix of polished crystals using a tagged photon beam with energies < 1 GeV and the results from GEANT4 simulations, which indicate a significant improvement of the energy resolution. *Supp. by BMBF, GSI, FAIR

HK 4.6 Mon 15:45 M/HS4

Radiation damage and recovery of medium heavy and light inorganic crystalline, glass and glass ceramics materials after irradiation with 150 MeV protons and 1.2 MeV gamma-rays — K.T. Brinkman[1], A. Borisevich[2], •V. Dormenev[1], V. Kalinov[3], M. Korjik[2], D. Kozlov[2], M. Kavatsyuk[4], R.W. Novotny[1], A. Voitovich[3], and H.-G. Zaunick[1] — [1]II. Physikalisches Institut JLU Giessen, Germany — [2]INP BSU, Minsk, Belarus — [3]Institute of Physics of National Academy of Science, Minsk, Belarus — [4]KVI-CART, University Groningen, Netherlands

Further concepts of the detectors at HEP experiments will require using cheap, capable for a mass production and radiation hard materials, especially for application at collider experiments. A set of samples with volume 1-2 cm3 of the middle light and light materials: crystalline BaF2, Y3Al5O12: Ce, Y3Al5O12: Pr, Lu3Al5O12: Ce, LiF and newly developed glass and glass ceramics DSB: Ce and DSL: Ce were irradiated with gamma-quanta with absorbed dose 100 Gy and 150 MeV protons up to fluence 5x10^13 p/cm2. Here we report results of the comparison of the optical transmission damage and recovery after different types of irradiation. A significant acceleration of the induced absorption recovery is observed at the DSB: Ce samples illuminated with visible and IR light. This effect is similar to one observed by us in PWO. It indicates that radiation induced absorption in DSB: Ce

scintillation material can be retained at the acceptable level by stimulation with light at the conditions of a strong irradiation environment of the collider experiments.

HK 4.7 Mon 16:00 M/HS4

Digital signal processing applied to fast scintillators response — •Guillermo Fernández Martínez, Anna-Lena Hartig, Ilja Homm, Alexander Ignatov, Thorsten Kröll, and Han-Bum Rhee for the R3B-Collaboration — Institut für Kernphysik, TU Darmstadt, Germany

The future Facility for Antiproton and Ion Research (FAIR) will house the calorimeter and spectrometer CALIFA, whose design, construction and testing are currently being carried out by the R3B collaboration. CALIFA is an array of scintillation crystals arranged in a barrel configuration, which covers a large solid angle. Some of the scintillation materials under consideration ($LaBr_3$(Ce), $LaCl_3$(Ce) and $CeBr_3$) have been developed in the last few years. Their main characteristic is a combination of good energy and time resolution with high efficiency. On the other hand, fast digitisers allow the collection of data at increasingly higher sampling frequencies. They are also much more reliable and easily scalable for large arrays than traditional analog electronics. Our research takes advantage of these features and is therefore focused on the analysis of digitised pulses, which, in addition to energy and time determination, enables particle identification. In this contribution we present results obtained in different campaigns.
This work is supported by BMBF(06DA9040I, 05P12RDFN8), HIC for FAIR and GSI-TU Darmstadt cooperation contract.

HK 4.8 Mon 16:15 M/HS4

Simulations and Measurements of Response of $LaBr_3$(Ce) and $CeBr_3$ — •Han-Bum Rhee, Guillermo Fernández Martínez, Anna-Lena Hartig, Ilja Homm, 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 the future FAIR facility. CALIFA consists of the Barrel covering central angles and the EndCap covering forward angles. We investigated novel scintillation materials ($LaBr_3$(Ce) and $CeBr_3$) as an alternative solution for the EndCap. Scintillators were tested with proton-beam and gamma-rays at different energy ranges. In addition, we have simulated the response of the scintillation detector using the GEANT4 toolkit to understand the measured signals. In this presentation, we show the experimental data and compare them with the simulation results.
This work is supported by BMBF(06DA9040I, 05P12RDFN8) and GSI-TU Darmstadt cooperation contract.