HK 17: Instrumentation IV

Time: Tuesday 15:45–17:15 Location: HBR 19: C 2

Group Report HK 17.1 Tue 15:45 HBR 19: C 2

The $\overline{\text{P}}$ANDA Forward-Endcap EMC Test-Beamtime @COSY

— •Celina Frenkel for the PANDA-Collaboration — Institut für Strahlen- und Kernphysik, Universität Bonn

The forward endcap (FWEC) of the electromagnetic calorimeter of the $\overline{\text{P}}$ANDA-experiment equipped with ≈ 20% of its crystals was tested for the first time under final conditions at the COSY accelerator at FZ-Jülich. The assembly of the FWEC started in March 2023, where all detector components were put together including the mechanical structures, the built, tested and precalibrated detector modules, the cooling system and the readout electronics.

Two weeks of proton-beamtime in August and September were conducted using a beam momentum of 2.74 GeV/c and a plastic target. For a comprehensive data analysis, full waveforms from the FWEC-SADCs were recorded. During the second week of beamtime, a stable operation of the detector as a common system at the intended temperature of -25°C and therefore one of the main aims of the test-beamtime was achieved. The other aim was to measure photons as the decay products of the π^0 which will in future be the basis to perform a pion calibration for each individual readout channel.

This talk will give an overview on the assembly of the FWEC at COSY and present first data analysis results including the different steps of raw data pre-processing as well as results from data reconstruction using PandaRoot leading to the observation of a π^0-signal.

Supported by BMBF and supported within the MKW programme "Netzwerke 2021" (project "NRW-FAIR", ID: NW21-024-C).

HK 17.2 Tue 16:15 HBR 19: C 2

Using the Crystal Barrel-DAQ for the Test-Beamtimes of the $\overline{\text{P}}$ANDA Forward Endcap @COSY

— •Benedikt Otto for the PANDA-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Universität Bonn

In August and September 2023 two test-beamtimes for the partly equipped $\overline{\text{P}}$ANDA forward endcap EMC took place at COSY. For these a data acquisition originally developed for the Crystal Barrel/TAPS experiment at ELSA was deployed.

The $\overline{\text{P}}$ANDA Sampling Analog to Digital Converters (SADCs) were used in self-triggered mode. This comes with the challenge to avoid incomplete events which can be caused by the significant deadtime due to the full waveform readout. To assure a synchronous readout of the SADCs, a custom LVDS-based synchronization bus was implemented.

An adapted version of the CB-SADC firmware with support for the synchronization bus was developed. To handle the data, commercial computing and network infrastructure was used. A total of over 200TB of waveforms were collected and are now being analyzed.

Supported by BMBF and within the programme "Netzwerke 2021", an initiative of the Ministry of Culture and Science of the State of Northrhine Westphalia (project "NRW-FAIR", ID: NW21-024-C).

HK 17.3 Tue 16:30 HBR 19: C 2

The Gain Monitoring System for CALIFA

— •Carl Georg Boos, Christian Sürder, Thorsten Kröll, Anna-Lena Hartig, Han-Bum Rhee, Leyla Atar, and Fabian Raddatz for the R3B-Collaboration — Institut für Kernphysik, TU Darmstadt

The CALIFA array is part of the R3B setup used for kinematically complete measurements of nuclear reactions. Those measurements are conducted at GSI and later at FAIR, Darmstadt. CALIFA is one of the core elements, which can be used both as a calorimetre and a spectrometre for the measurement of light charged particles and γ-rays. It consists of CsI(Tl) crystals connected to avalanche photodiodes (APDs). As the gain is not constant for those detector systems, e. g. due to temperature dependencies of the APDs, a pulsed LED gain monitoring system (GMS) was developed. There, light of LEDs is coupled by optical fibres into the detector units mimicking scintillation light. This will provide a stable reference in the energy spectrum of the detector. As the reliability of such a GMS depends strongly on the stability of the light source, the prototypes were investigated in detail.

Different types of shifts of the LED peaks were determined and characterised. Here it was shown that the LEDs themselves are stable, but several factors are responsible for the observed instability. Currently it is worked on the improvement of stability and to investigate the correlation of shifts in different energy ranges.

This work was supported by BMBF 05P19RDFN1 and 05P21RDFN2.

HK 17.4 Tue 16:45 HBR 19: C 2

A neutron leakage detector for the free neutron lifetime experiment τSPECT

— •Julian Auler[1], Martin Fertl[1], and Dieter Ries[2] for the tauSPECT-Collaboration — [1]Institute of Physics, Johannes Gutenberg University Mainz, Mainz, Germany — [2]Paul Scherrer Institute, Villigen PSI, Switzerland

The neutron storage experiment τSPECT aims to measure the free neutron lifetime by confining ultracold neutrons (UCNs) in a three-dimensional magnetic trap. In contrast to material bottles, magnetic storage eliminates interactions with the trap wall, allowing for the neglect of systematic effects on the measured lifetime related to wall interactions, such as capture or inelastic scattering of UCNs. The presented neutron leakage detector is intended to investigate systematic effects related to the magnetic storage by detecting UCNs possibly escaping from the magnetic trap. Potential escape channels are, e.g., depolarization of UCNs in the radial confinement field produced by a cylindrical Halbach octupole array of permanent magnets or microphonic heating of UCNs due to vibrations of the trap. Because of the fast spatial drop-off of the radial octupole field, the detector covering the inner surface of the octupole must be very thin in order not to cut into the storage depth of the trap. For this purpose, a multilayer structure with a conversion and scintillator layer is used. Wavelength-shifting fibers are guiding the scintillation light from inside the experiment to the actual photosensor. In this talk, the design of the detector and first characterization measurements of suitable fibers will be presented and an outlook on future implementations will be given.

HK 17.5 Tue 17:00 HBR 19: C 2

An energy resolving ultracold neutron detector for the neutron lifetime experiment τSPECT

— •Konrad Franz[1], Martin Fertl[2], and Dieter Ries[3] for the tauSPECT-Collaboration — [1]Department of Chemistry, Johannes Gutenberg University Mainz, Mainz, Germany — [2]Institute of Physics, Johannes Gutenberg University Mainz, Mainz, Germany — [3]Paul Scherrer Institute, Villigen PSI, Switzerland

The defining feature of ultracold neutrons (UCNs) is, that they can be stored in material vessels and magnetic field gradients. This property allows for long observation times and thereby precision measurements of neutron properties like the free neutron lifetime. In the presented detector design, UCNs are converted into an electrical signal by employing a conversion layer stacked with a scintillation layer, in which the neutron induced α-particle generates a light pulse. The scintillation light is then guided onto an array of silicon photomultipliers via a 3D printed light guide. This setup is well suited for in-situ detection of UCNs in high magnetic field regions. Combining spatial resolution with a magnetic field gradient allows for UCN energy determination. The talk will explain, how this feature can be used to study systematic effects in the neutron lifetime experiment τSPECT and will present the first results of test measurements with a prototype.