HK 35: Instrumentation VI

Time: Thursday 13:45–15:45 Location: PHIL A 301

Group Report HK 35.1 Thu 13:45 PHIL A 301

First-level Event Selector of CBM — Jan de Cuveland[1,2], Dirk Hutter[1,2], and •Andreas Redelbach[1,2] for the CBM-Collaboration — [1]Frankfurt Institute for Advanced Studies — [2]Goethe University Frankfurt, Germany

In the upcoming CBM experiment at GSI/FAIR very high interaction rates with multiple free-streaming triggerless detectors create huge amounts of data which must be processed in real-time. The First-level Event Selector (FLES) serves as the central event selection system of CBM. It functions as a high-performance computer cluster performing the online analysis of physics data, including full event reconstruction, at the incoming design data rate. Combining data from approximately 5000 input links to self-contained, overlapping processing intervals and distributing them to compute nodes form the basis for subsequent steps of online reconstruction and event selection. Timeslice intervals can be built efficiently over a high-throughput InfiniBand network and distributed to online computing resources for full online event reconstruction and analysis in a heterogeneous HPC cluster system. This also includes specialized algorithms for efficient processing of timeslice intervals in 4-D, and finally selecting the events relevant for storage. This presentation summarizes the status of the CBM FLES project. A particular focus will be on the underlying design combining maximum performance and flexibility with minimum memory consumption. Also recent developments will be shown that have been successfully tested at the CBM predecessor experiment mCBM.

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HK 35.2 Thu 14:15 PHIL A 301

Implementation of the DOGMA DAQ for the P371 Experiment at CERN — •Huagen Xu and Michael Traxler for the DOGMA-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH

The P371 experiment at CERN investigates whether antiprotons are initially polarized during production in high-energy proton collisions with an unpolarized target. To test this hypothesis, a dedicated measurement was prepared at the T11 beamline in the East Area of the CERN PS. Assuming an analyzing power of approximately 4.5% in the CNI (Coulomb-Nuclear-Interference) region of antiproton-proton elastic scattering, the polarization can be detected by measuring the left-right asymmetry of elastic events at scattering angles around 10 mrad using a 3.5 GeV/c antiproton beam. The measurement concept is to use a liquid hydrogen target as an analyzer, with incident and scattered particle tracks reconstructed using tracking detectors, including straw tubes and microfibers, upstream and downstream of the target. Scattered antiprotons are identified and distinguished from background using a DIRC system for offline particle identification.

To fulfill this measurement, a new data acquisition system, DOGMA, was implemented for the first time, handling roughly 1800 readout channels. DOGMA is a modular DAQ board offering 32 input channels with an integrated amplifier (maximum gain of 30), discriminator, and TDC. The performance of the DOGMA system for the beam time will be presented.

HK 35.3 Thu 14:30 PHIL A 301

High throughput cluster finding on the readout FPGA for the CBM-TRD — •David Schledt for the CBM-Collaboration — Goethe University Frankfurt am Main, Germany

The CBM experiment at FAIR/GSI in Darmstadt, will measure rare diagnostic probes of the QCD phase diagram at interaction rates of up to 10 MHz with high sensitivity and statistics. The CBM DAQ is based on self-triggered readout electronics resulting in large amount of data, which has to be processed in real time. The SPADIC readout ASIC transmits the full pulse shape information and features forced neighbor readout. Therefore, the initially produced data volume is relatively high, which lends itself for processing on the readout FPGA. The first processing step to reduce the data volume is to extract the information encoded in the pulse shape, ie. the energy and time. The next step to further reduce the data volume before the online processing is to combine adjacent channel hits into clusters. As CBM runs without a trigger system the hits need to be grouped in time and space in real time. Therefore, a fast high throughput cluster finding algorithm is necessary to process the data without data losses. This work will present how such an algorithm can be implemented on the readout FPGA, with a particular focus on the implementation with high-level-synthesis (HLS).

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HK 35.4 Thu 14:45 PHIL A 301

Investigations of the integrating readout system of the P2 experiment at MESA — Sebastian Baunack[1], Michael Gericke[3], Boris Gläser[1], Shruti Gudla[1], Rahima Krini[1], Frank Maas[1,2,4], Jayanta Naik[1], •Moran Neher[1], Tobias Rimke[1], Siddharth Thakker[1], and Malte Wilfert[1] — [1]Institut für Kernphysik, Johannes Gutenberg-Universität Mainz — [2]Helmholtz-Institut Mainz, Johannes Gutenberg-Universität Mainz — [3]Department of Physics and Astronomy, University of Manitoba, Winnipeg, Canada — [4]PRISMA Cluster of Excellence, Johannes Gutenberg-Universität Mainz

The P2 experiment aims for a high precision measurement of the weak mixing angle, a fundamental parameter of the Standard Model. The weak mixing angle will be extracted from the parity-violating asymmetry in elastic electron-proton scattering at low momentum transfer, with an expected raw asymmetry of $A_{\mathrm{raw}} = 0.2403 \times 10^{-7}$. The central component of the detector system is an integrating Cherenkov ring detector, which measures the flux of scattered electrons. The flux depends on the helicity of the electron beam and gives rise to the production of Cherenkov light.

The detector modules consist of a photomultiplier tube, the P2 voltage divider and pre-amplifier and the P2 sampling ADC. In this presentation, the P2 experiment is introduced and the current status of the readout system is presented.

HK 35.5 Thu 15:00 PHIL A 301

Trigger system based on time-spatial correlations for SiPM-RICH detectors — •Jesús Peña-Rodríguez for the CBM-Collaboration — Bergische Universität Wuppertal, Wuppertal, Germany

Future experiments in high-energy physics work on new detection technologies with higher time and spatial resolution. This will enhance data quality to search for specific decay channels or interaction products. Detectors employed for particle identification use different technologies, geometries, and algorithms. Ring Imaging Cherenkov (RICH) detectors are one of them; they record Cherenkov rings from charged particles traversing a radiator medium and discriminate between particles depending on the angle of the Cherenkov emission. New RICH techs explores Silicon Photomultipliers (SiPMs) as photon detectors. SiPMs provide high time resolution, spatial granularity, magnetic field immunity, mechanical robustness, and low material budget. Nevertheless, high dark count rates and low radiation tolerance challenge the implementation of SiPMs in RICH detectors. We explore a trigger system that exploits Cherenkov ring features: spatial correlation (circular/ellipsoidal shape) and time coincidence (picosecond arrival time) of Cherenkov photons. This approach rejects most of the fake events caused by DCR, saving buffer and bandwidth. We performed MC simulations to generate realistic SiPM noise and Cherenkov rings. These signals were injected into the digital implementation (FPGA Lattice ECP5) of the trigger system to evaluate its signal-to-noise ratio and detection efficiency.

HK 35.6 Thu 15:15 PHIL A 301

An Automated Test Setup for Pipeline ADC Characterization — Òscar Andújar Sabán[1], Ning Cao[1], Luigi Capozza[1], Harald Deppe[2], Holger Flemming[2], Ravi Gowdru Manjunata[1], •Alexander Lehnen[1], Frank Maas[1,2], Oliver Noll[1], Paul Schöner[1], Christoph Rosner[1], Peter Wieczorek[2], and Sahra Wolff[1] for the PANDA-Collaboration — [1]Helmholtz-Institut Mainz, Mainz, Deutschland — [2]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Deutschland

An analog-to-digital converter (ADC) chip is being developed at the GSI Darmstadt for the readout of the electromagnetic calorimeter of the PANDA detector. To enable characterization of this chip, a test setup was designed and implemented at the Helmholtz Institute Mainz. The setup allows fully automated measurements over a wide range of clock frequencies and input signal frequencies. This enables systematic investigation of both calibration behavior and dynamic performance. Its modular design provides flexibility, allowing extensions and improvements as needed. An implemented server allows multiple users to connect simultaneously and control measurements remotely. This architecture, combined with full automation, allows for reproducible testing of current and future ADC chips.

HK 35.7 Thu 15:30 PHIL A 301

Further Development of the Calibration Routine for the High-Voltage Regulation PCB for the $\overline{\text{P}}$ANDA Barrel Electromagnetic Calorimeter (EMC) —

•Karl Simon Habermehl, Kai-Thomas Brinkmann, Hans-Georg Zaunick, and Aniko Tim Fenske for the PANDA-Collaboration — 2$^{\text{nd}}$ Physics Institute, Justus Liebig University, Giessen, Germany

The barrel section of the electromagnetic calorimeter (EMC) of the PANDA experiment at the future FAIR accelerator is designed to achieve excellent photon energy resolution over a wide dynamic range. To reach this level of precision, the various calorimeter subsystems (in particular the readout and front-end electronics) require careful optimization.

One of the most important components is the high-voltage distribution electronics (HVD), which supplies the avalanche photodiodes (APDs) with the bias voltages and therefore defines their gain. Since the performance of the HVD is temperature dependent and the operating temperature cannot be predicted accurately, it must be calibrated over a wide temperature range. For this purpose, a routine for series calibration of the HVD-PCBs has been developed. This contribution will give an impression of the currently running calibration procedure and foreseen improvements as well as some of the calibration results.

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