HK 37: Instrumentation IX

Time: Wednesday 14:00–15:30 Location: HK-H3

Group Report HK 37.1 Wed 14:00 HK-H3

The new Sampling-ADC readout of CBELSA/TAPS - Feature-Extraction, Pulseshape-Analysis and Pile-Up-Recovery — •Jan Schultes, Benedikt Otto, and Johannes Müllers for the CBELSA/TAPS-Collaboration — HISKP, Uni Bonn

The Crystal Barrel Calorimeter consists of 1320 CsI(Tl) scintillating crystals, which are read out by APDs. The signals are digitized using FPGA-controlled Sampling-ADCs.

Different feature-extraction algorithms are employed on the FPGAs to not only extract energy and timing information, but to perform online pile-up detection as well. In addition to the feature data, the sampled pulseshape can be stored in case of a detected pile-up event, to facilitate the recovery of affected features.

The talk's main focus lies on the subsequent analysis of the data and various custom methods developed to efficiently and accurately recover the features affected by pile-up. Since CsI(Tl) exhibits different scintillation characteristics dependent on the particle species, special care has to be taken in order to address this in the recovery process. Digital filtering as well as custom deconvolution methods are employed.

Finally, the setup's performance during the recent June2021 and November2021 beamtimes and the impact of the recovered data on the reconstruction of physical events is evaluated.

HK 37.2 Wed 14:30 HK-H3

Detector Readout Algorithms and Data Flow Programming on FPGAs with Intel HLS — •Thomas Janson and Udo Kebschull — IRI, Goethe-Universität Frankfurt am Main, Max-von-Laue-Straße 12, 60438 Frankfurt am Main, Germany

We discuss an alternative approach to implementing algorithms for detector readout with FPGAs. The talk is a continuation of past presentations and discusses the implementation of various algorithms that can be implemented on Intel FPGAs using Modern C++. The algorithms are implemented using a data flow C++ template library that we developed specifically for this use case of detector readout. We show how generic template programming can be used to describe algorithms as a data flow graph and compare the results with the conventional HLS C++ programming technique. Metrics such as latency, flow and resource consumption are discussed and compared. The results are then compared and evaluated with the traditional method, which implements algorithms using a hardware description language such as Verilog or VHDL.

HK 37.3 Wed 14:45 HK-H3

Investigations and improvements of the TRB3/DiRICH DAQ system used for the PANDA Barrel DIRC — •Merlin Böhm, Katja Gumbert, Steffen Krauss, Albert Lehmann, and Daniel Miehling for the PANDA-Collaboration — Physikalisches Institut , Universität Erlangen-Nürnberg

To identify charged and fast moving particles two DIRC (detection of internally reflected Cherenkov light) detectors will be built for the PANDA experiment at FAIR. A Barrel DIRC of 16 sectors surrounds the interaction point cylindrically and an endcap disc DIRC made of four identical quadrants covers the forward hemisphere. Since the focal planes of both DIRCs are located in a $\gtrsim 1$ Tesla B-field, Microchannel-Plate Photomultipliers (MCP-PMTs) are the only viable option to detect the generated Cherenkov photons. For the Barrel DIRC the FPGA based GSI TRB3/DiRICH data acquisition system is foreseen to read out the MCP-PMTs. Several improvements were applied to improve the performance of this DAQ system. E.g., with modifications of the power supply for the FPGAs on the TRB3 boards the timing precision was improved significantly. Furthermore, the TRB/DiRICH boards planned for the final PANDA experiment were operated in magnetic fields up to 3 T to investigate the B-field effects on the thresholds and pulse heights and different input stage modifications were tested. The recent modifications and the obtained measurement results will be shown and discussed in this talk.

- Funded by BMBF and GSI -

HK 37.4 Wed 15:00 HK-H3

The front-end signal path of the P2 experiment at MESA — Sebastian Baunack[1], Boris Gläser[1], Kathrin Imai[1], •Rahima Krini[1], Frank Maas[1,2], David R. Pineiro[2], Tobias Rimke[1], and Malte Wilfert[1] — [1]Institute for Nuclear Physics, Mainz, Germany — [2]Helmholtz Institute Mainz, Germany

The weak mixing angle $\sin^2\theta_W$ can be measured in parity violating elastic electron-proton scattering. The aim of the P2 experiment is a very precise measurement of the weak mixing angle with an accuracy of 0.15% at a low four-momentum transfer of Q^2=4.5·10^{-3}GeV^2. In combination with existing measurements at the Z pole with comparable accuracy, this comprises a test of the standard model with a sensitivity towards new physics up to a mass scale of 50 TeV. The experiment will be built at the future MESA accelerator in Mainz.

The small asymmetries $\mathcal{O}(10^{-8})$ and the high precision require very high statistics and therefore an integrating measurement with the associated integrating data acquisition readout chain. A joint read-out electronics for P2 experiment in Mainz and for Moeller experiment at the Jefferson Laboratory is under development in collaboration with a group of University of Manitoba. The first prototype of a full differential integrating detector signal chain was build and tested at MAMI (Mainzer Mikrotron). The results fulfill the requirements of the P2 parity violation experiment and will be presented in this talk.

HK 37.5 Wed 15:15 HK-H3

Streaming readout for the AMBER GEM detectors — •Michael Lupberger[1], Chiara Alice[2], Lukas Bayer[1], Karl Jonathan Flöthner[1,3], Christian Honisch[1], Marco Mignone[4], Jan Paschek[1], Benjamin Roth[1], Dimitri Schaab[1], Maxim Alexeev[2], and Bernhard Ketzer[1] — [1]Universität Bonn — [2]CERN — [3]Universita e INFN sez. Torino — [4]INFN sez. Torino

The Apparatus for Meson and Baryon Experimental Research (AMBER) will be a fixed-target experiment at CERN's SPS. In the approved phase I of the experiment, running also under the name NA66, a proton radius measurement by elastic muon-proton scattering is foreseen in 2023 and 2024. The recoil proton will be measured in a high-pressure Time Projection Chamber (TPC). The muon kinematics is determined with a spectrometer, which partly uses the existing COMPASS detectors.

Due to the higher beam rate and the need for a continuous readout to match the instantaneous muon track with delayed information of the recoil proton in the TPC, significant detector upgrades and novel developments are necessary. The muon reconstruction will rely on new large-area GEM detectors with self-triggering readout. Tests of prototype detectors with two possible candidate ASICs, the VMM and the TIGER chips, have been performed in order to evaluate their performance.

The contribution will report on the results of the tests of the GEM detectors with the new streaming readout.