HK 50: Instrumentation 15

Time: Thursday 14:30–16:30 Location: M/HS1

Group Report HK 50.1 Thu 14:30 M/HS1

The CBM First-level Event Selector — •Jan de Cuveland and Volker Lindenstruth — Frankfurt Institute for Advanced Studies, Goethe University, Frankfurt, Germany

The CBM experiment currently under construction at GSI/FAIR is designed to study QCD predictions at high baryon densities. The CBM First-Level Event Selector (FLES) is the central event selection system of the experiment. Designed as a high-performance computer cluster, its task is an online analysis of the physics data including full event reconstruction at an incoming data rate exceeding 1 TByte/s.

The CBM detector systems are free-running and self-triggered, delivering time-stamped data streams. As there is no inherent event separation, traditional approaches for global event building and event selection are not directly applicable. Instead of event building, the FLES combines the data from approximately 1000 input links to self-contained, overlapping processing intervals and distributes them to compute nodes. It employs a high-bandwidth InfiniBand network as well as dedicated custom FPGA input boards providing time-addressed access to buffered data. Subsequently, specialized event selection algorithms analyze these processing intervals in 4–D, identify events, and select those relevant for storage depending on the chosen CBM setup and selection scenario.

This presentation outlines the design of the CBM First-level Event Selector and summarizes the results from first prototype systems.

HK 50.2 Thu 15:00 M/HS1

The PASTA Chip - A Free-Running Readout ASIC for Silicon Strip Sensors in PANDA — •André Goerres[1], Tobias Stockmanns[1], James Ritman[1], and Angelo Rivetti[2] for the PANDA-Collaboration — [1]Forschungszentrum Jülich GmbH, Jülich, Germany — [2]INFN Sezione di Torino, Torino, Italy

The PANDA experiment is a multi purpose detector, investigating hadron physics in the charm quark mass regime. It is one of the main experiments at the future FAIR accelerator facility, using $\overline{\mathrm{p}}\mathrm{p}$ annihilations from a 1.5-15 GeV/c anti-proton beam. Because of the broad physics spectrum and the similarity of event and background signals, PANDA does an event selection based on the complete raw data of the detector. The innermost of PANDA's sub-systems is the Micro Vertex Detector (MVD), consisting of silicon pixel and strip sensors. The latter will be read out by a specialized, free-running readout front-end called PANDA Strip ASIC (PASTA).

It has to face a high event rate of up to 40 kHz/ch in an radiation-intense environment. To fulfill the MVD's requirements, it has to give accurate timing information to incoming events (< 10 ns) and determine the collected charge with an 8-bit precision. All this has to be done with a very low power design (< 4 mW/ch) on a small footprint with less than 21 mm^2 and 60 μm input pitch for 64 channels per chip. Therefore, a simple, time-based readout approach with two independent thresholds is chosen.

In this talk, the conceptual design of the full front-end and some aspects of the digital part will be presented.

HK 50.3 Thu 15:15 M/HS1

Abschätzung der strahlungsbedingten Fehlerrate in der CBM-ToF Frontendelektronik — •Sebastian Manz und Udo Kebschull für die CBM-Kollaboration — Infrastruktur und Rechnersysteme in der Informationsverarbeitung (IRI), Frankfurt, Deutschland

Für die Auslese der Frontendelektronik des Time-Of-Flight (ToF) Detektors des CBM Experiments sind SRAM basierte FPGAs angedacht. SRAM basierte Elektronik kann durch radioaktive Strahlung, insbesondere durch hochenergetische Hadronen, in der Funktion gestört werden.

Einen besonderen Störfaktor in SRAM basierten FPGAs stellen sogenannte "Sinlge Event Upsets" dar. Um diesem Störfaktor entgegenzuwirken können verschiedene Techniken eingesetzt werden.

Solche Techniken wurden für ein existierendes Auslesedesign implementiert. Hierbei wurden Kompromisse eingegangen um die Kosten des Detektors in realistischen Grenzen zu halten. Die Effizienz dieser Kompromisslösung wurde 2012 und 2013 in Strahltests gemessen.

Nach der Auswertung der Strahltestergebnisse kann nun eine etwas genauere Abschätzung der erwarteten strahlungsbedingten Fehlerraten in der Ausleseelektronik des CBM-ToF Detektors erstellt werden.

HK 50.4 Thu 15:30 M/HS1

Development of the timing branch electronics for the Crystal Barrel Calorimeter — •Peter Klassen for the CBELSA/TAPS-Collaboration — Helmholtz-Institut für Strahlen- und Kernphysik, Nussallee 14-16, 53115 Bonn

The excitation spectrum of baryons consists of many resonances which contribute selectively to distinct decay channels. To be able to measure purely neutral reactions on a polarized neutron target with high efficiency, the Crystal Barrel Detector which consists of 1320 CsI(Tl) crystals has to be integrated into the first level trigger. This requires an exchange of the existing PIN photo diode by a new avalanche photo diode (APD) crystal readout.

The APD readout electronics will provide a fast trigger signal down to 10 MeV energy deposit per crystal. The processing of these trigger signals requires an introduction of a previously not existent timing branch to the readout chain of the main calorimeter.

The final concept and current development status of the timing backend will be presented. It utilizes FPGA based boards for rise time compensation, time to digital conversion and the cluster finding.

Supported by the Deutsche Forschungsgemeischaft (SFB/TR16) and Schweizerischer Nationalfonds.

HK 50.5 Thu 15:45 M/HS1

ALICE Common Read-Out Receiver Card Status and HLT Implementation — •Heiko Engel and Udo Kebschull for the ALICE-Collaboration — IRI, Goethe-Universitaet Frankfurt am Main

The ALICE Common Read-Out Receiver Card (C-RORC) is an FPGA based PCIe read out board with optical interfaces primaryly developed to replace the previos ALICE High-Level Trigger (HLT) and Data Acquisition (DAQ) Read-Out Receiver Cards from Run1 with a state of the art hardware platform to cope with the increased link rates and event data volume of Run2. The large scale production of the C-RORCs for Run2 has been completed in cooperation with ATLAS and the boards are installed in the productive clusters of ALICE HLT, ALICE DAQ and ATLAS TDAQ ROS. This contribution describes the hardware and firmware of the C-RORC in the ALICE HLT application and its online processing capabilities. Additionally, a high level dataflow description approach to implement hardware processing steps more efficiently is presented.

HK 50.6 Thu 16:00 M/HS1

Self-Triggering Readout System for the Neutron Lifetime Experiment PENeLOPE — •Dominic Gaisbauer and Dominik Steffen for the PENeLOPE-Collaboration — Technische Universität München

The aim of PENeLOPE is a high-precision measurement of the neutron lifetime and thereby an increase of the parameter's precision by one order of magnitude. In order to achieve an increasingly higher accuracy, modern experiments naturally require state-of-the-art readout electronics, as well as high-performance data acquisition systems. This talk will therefore present the readout system for the neutron lifetime experiment PENeLOPE, which is currently being designed at the department of physics at Technische Universität München.

The system's readout chain involves preamplifier, shaper, sampling ADC, and a data processing stage implemented on field programmable gate arrays (FPGAs). Due to the incorporated signal detection, the system is able to process data from 1,000 self-triggering channels, each of which is hit by 10 particles/sec. The corresponding data rate of 1.5 MB/sec is transferred to the outside of the experiment by a high-speed optical interface, which has been developed to meet the special experimental requirements of PENeLOPE. The main focus of the talk will be set on the performance and tests of the trigger algorithm as well as on characteristics and properties of the optical interface. The project is supported by the Maier-Leibnitz-Laboratorium (Garching), the Deutsche Forschungsgemeinschaft and the Excellence Cluster "Origin and Structure of the Universe".

HK 50.7 Thu 16:15 M/HS1

Towards self-triggered digitization and data readout in the CBM time-of-flight system — •Christian Simon and Norbert Herrmann for the CBM-Collaboration — Physikalisches Institut und Fakultät für Physik und Astronomie, Ruprecht-Karls-Universität Hei-

delberg, 69120 Heidelberg, Deutschland

The design goal of the future Compressed Baryonic Matter (CBM) experiment is to measure rare probes of dense strongly interacting matter with an unprecedented accuracy. Target interaction rates of up to 10 MHz for heavy systems like Au+Au and the need to identify experimental signatures of probes like multi-strange hyperons in the online data stream place challenging demands on the experiment's data acquisition system. Each detector subsystem in CBM implements a self-triggered digitization and readout chain fitted to the respective front-end electronics sending continuous data streams to a high-performance computing farm called the First-Level Event Selector (FLES). Here, events are reconstructed online to identify the physically most interesting ones as only a fraction of the enormous data rate (up to 1 TB/s) can be stored permanently for later offline analysis. The time-of-flight (TOF) wall of CBM is composed of high-resolution timing multi-gap resistive plate chambers (MRPCs) which are estimated to deliver signal rates of up to 500 kHz per electronics channel. Prototypical readout schemes currently under test which are able to transport this high payload will be presented and an outline towards inclusion in the FLES network will be given. The project is partially funded by BMBF 05P12VHFC7 and by EU/FP7-HadronPhysic3/WP19.