HK 15: Instrumentation III

Zeit: Dienstag 11:00–12:30 Raum: F 3

Gruppenbericht HK 15.1 Di 11:00 F 3

The CBM First-level Event Selector — •Jan de Cuveland and Volker Lindenstruth for the CBM-Collaboration — 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 summarizes the status of developments for the CBM First-level Event Selector and includes results from recent demonstrator setups.

HK 15.2 Di 11:30 F 3

Readout and stimulus of a microwave multiplexed thermal sensor — •Panos Neroutsos and Udo Kebschull — Goethe University, Frankfurt am Main, Germany

This PhD research topic expands our knowledge regarding technology for broadband high energy resolution particle spectroscopy. This experiment comprises of a multiplexed readout system of large metallic magnetic calorimeter (MMC) detector arrays. This is an energy dispersive particle detector, which operates at temperatures below 100mK. The proposed readout system aims to a simultaneous readout of thousands of detectors by using a single pair two coaxial cables that are routed from the room-temperature electronics to the detector array. Therefore, in order to readout such an array, a frequency comb having all its tones adjusted to the different resonator frequencies must be injected to in the detector. The resultant signal must be acquired, analyzed and post-processed in order to determine the time dependent phase and amplitude variation, among others, of each sinusoids. A chain of FPGA is the core of this readout system along with the ADC/DAC boards and it is responsible for the manipulation of the ADC/DAC boards, the comb generation, the channelizing process and the digitization respectively. We are using the approach of High Level Synthesis (HLS) Tools, optimized for streaming data applications for the implementation of the post-processing algorithms and Hardware Description Languages (HDL) for the readout of the ADC/DAC boards and the data propagation to our target FPGA(s).

HK 15.3 Di 11:45 F 3

Integration of redundancy logic in the hardware event builder of the COMPASS DAQ — •Dominik Steffen[1,4], Yunpeng Bai[1], Martin Bodlak[2], Vladimir Frolov[3], Stefan Huber[1], Vladimir Jary[2], Igor Konorov[1], Dmitri Levit[1], Joseph Novy[2], Ondrej Subrt[2,4], and Miroslav Virius[2] — [1]Technische Universität München (DE) — [2]Czech Technical University (CZ) — [3]Joint Institute for Nuclear Research (RU) — [4]European Organization for Nuclear Research -CERN (CH)

This contribution will introduce the principles of the event building process in Data Acquisition systems (DAQ) of high-energy physics experiments. Since 2014, the COMPASS experiment at CERN exploits the superior properties of FPGAs to execute this task. The talk will discuss the advantages and drawbacks of the COMPASS hardware event builder in contrast to the traditional approach which relies on software running on distributed computer nodes interconnected via a common Ethernet network. Moreover, it will describe in detail the necessary changes in software and hardware in order to implement redundancy logic into the hardware event builder. Redundant hardware nodes which can be activated in case of defective other nodes and thus prevent the system from failing will eliminate one of the major drawbacks compared to traditional event builders.

HK 15.4 Di 12:00 F 3

A prototype of the free-streaming data acquisition system for the Compressed Baryonic Matter experiment at FAIR — •David Emschermann for the CBM-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH

The Compressed Baryonic Matter experiment (CBM) will be based at the new Facility for Antiproton and Ion Research (FAIR), which will deliver heavy-ion beams up to energies of 14 A GeV. In nucleus-nucleus collisions at these beam energies strongly interacting matter with densities up to 10 times normal nuclear matter is expected to be produced. The key objective of CBM is to investigate the QCD phase diagram in the region of high baryon-densities, where a first order phase transition from hadronic to partonic matter as well as a chiral phase transition is expected to occur, representing a substantial discovery potential at FAIR energies. As a fixed-target experiment CBM is consequently designed to cope with very high interaction rates up to 10 MHz. This will allow to perform high precision measurements of extremely rare probes which have not been accessible by previous nucleus-nucleus experiments in this energy regime. To achieve the high rate capability CBM will be equipped with fast and radiation hard detectors employing free-streaming readout electronics. A prototype high-speed Data Aquisition (DAQ) system was built in 2016. It has been successfully deployed at a CBM beamtest at the SPS accelerator at CERN, where it has forwarded data from the detector front-ends of the TOF and MUCH subsystems to a prototype of the First Level Event Selector (FLES). We will report on the status of this CBM DAQ prototype.

HK 15.5 Di 12:15 F 3

mCBM@SIS18 - a CBM full system test-setup at GSI — •Christian Sturm, David Emschermann, Jochen Frühauf, Pierre-Alain Loizeau, Wolfgang Niebur, Florian Uhlig, and Junfeng Yang for the CBM-Collaboration — GSI Helmholtzzentrum für Schwerionenforschung GmbH

The Compressed Baryonic Matter experiment (CBM) at FAIR will measure relativistic nucleus-nucleus collisions with unprecedented collision rates up to 10 MHz leading to data rates up to 1 TB per second. To achieve the required performance a free-streaming data acquisition system is being developed. A CBM full system test-setup called mCBM@SIS18 ("mini-CBM") will be installed at GSI/SIS18 in the years 2017/2018 in order to develop, commission and optimize (i) the free-streaming data acquisition system including the data transport to a high performance computer farm (GreenIT cube) (ii) the online track and event reconstruction and event selection algorithms and (iii) the offline data analysis as well as the controls software package. Furthermore, the setup offers additional high-rate tests of the final detector prototypes in nucleus-nucleus collisions. Hence, mCBM@SIS18 will allow to test and optimize the performance of the detector systems including the software chain under realistic experiment conditions which will significantly reduce the commissioning time for CBM at SIS100. At this presentation an overview on the project will be given.