HK 30: Instrumentierung V

Zeit: Dienstag 16:30–19:00 Raum: HG VIII

Gruppenbericht HK 30.1 Di 16:30 HG VIII
First Collisions with the ALICE High-Level Trigger — •Jochen Thäder for the ALICE-Collaboration — Frankfurt Institute for Advanced Studies, Universität Frankfurt

The High-Level Trigger (HLT) for the heavy ion experiment ALICE is a high performance PC cluster of several hundreds of nodes, which has to reduce the data rate of up to 25 GB/s to at most 1.25 GB/s before permanent storage. In the 2008/2009 shutdown the HLT has finalized the hardware setup for proton proton (pp) collisions. The first 200 nodes have been installed and all ALICE sub detectors have been connected. Furthermore the installation of the full GigaBit Ethernet network and the InfiniBand backbone network has been completed and the first GPU co-processors have been installed.The HLT was running full on-line reconstruction during the ALICE commissioning with cosmics. Furthermore the HLT cosmics trigger has been exercised to enhance the L0 cosmic triggers and reduce the amount of stored raw data. During the first collisions of the LHC as well as in the normal pp data-taking the HLT was also performing full on-line reconstruction and vertex finding to give a fast feedback on the beam position.

The ALICE HLT performance results obtained during the commissioning phase and during the first ALICE data taking with beam at the LHC will be presented in this talk.

Work on the ALICE High-Level Trigger has been financed by the German Federal Ministry of Education and Research (BMBF) as part of its program "Förderschwerpunkt Hadronen- und Kernphysik - Großgeräte der physikalischen Grundlagenforschung".

HK 30.2 Di 17:00 HG VIII
Go4 Analysis and Online Monitoring Framework v4.4 — •Jörn Adamczewski-Musch, Hans G. Essel, and Sergey Linev — GSI, Darmstadt

Go4 developed at GSI is an analysis framework based on the C++ ROOT libraries (CERN). Application specific data processing code is integrated by a plug-in mechanism. A Go4 analysis may run either in batch mode, or under control of a non blocking GUI for configuration and visualization.

Analysis and GUI run in separate tasks - optionally on different nodes - communicating through asynchronous socket channels. Several distributed viewers may connect to one analysis. The GUI is implemented in Qt with embedded ROOT graphics. It provides hooks to attach user written GUIs. The GUIs have access to all objects of the analysis like histograms, parameter objects, or events. GUI elements may be updated from the analysis asynchronously. Standard ROOT macros can be executed interactively in the analysis or the GUI task, respectively. These features make the Go4 framework especially useful for on-line monitoring. The Go4 fit package (API and GUI) is a powerful and extendable tool to model and fit experimental data.

Go4 runs in production for several years mainly in the nuclear and atomic physics fields. It was applied for online monitoring during the test beamtimes of the future CBM (Compressed Baryonic Matter) experiment at FAIR. A new release Go4 v4.4 was published in 2009, supporting Qt3/Qt4 under Linux, Solaris, and Windows (XP and 7).

HK 30.3 Di 17:15 HG VIII
Calibration of the ALICE Transition Radiation Detector — •Raphaelle Bailhache for the ALICE-TRD-Collaboration — Institut für Kernphysik, Frankfurt, Deutschland

The ALICE Experiment is one of the four experiments installed at the Large Hadron Collider (LHC). It is equipped with a Transition Radiation Detector (TRD), a gaseous detector for electron identification and charged particle tracking located at a radius of 2.9 m. When a charged particle crosses the TRD, it ionizes the gas along its path and electrons drift in a uniform field of 700 V/cm over 3 cm before being amplified. To optimize the detector performance, the drift velocity of the electrons, the time-offset of the signal and the amplification factor have to be corrected for variations of the temperature, pressure and gas composition. Therefore a first determination of the calibration constants is done continuously during data taking. On the ALICE data acquisition system (DAQ) simple algorithms are executed. On the High Level Trigger (HLT), the tracks of charged particles are reconstructed online and used for the calibration. Offline improvements are achieved after the first reconstruction pass of the data. In this talk, we will show the results obtained with the seven TRD supermodules presently installed in ALICE. The performances of the different calibration steps are compared and tested on data taken with first proton beams and cosmic rays in the ALICE setup.

HK 30.4 Di 17:30 HG VIII
ALICE TRD GTU Tracking and Trigger Performance with First Data — •Stefan Kirsch and Felix Rettig for the ALICE-TRD-Collaboration — Kirchhoff-Insitute for Physics, University of Heidelberg

The Transition Radiation Detector of the ALICE experiment is designed to provide fast trigger contributions for different signature classes as well as full event information for offline analysis.
A total of 1.2 million analog channels is processed massively parallel in more than 65 000 multi-chip modules of the front-end electronics. Pattern matching algorithms are applied to find and parametrize short stiff track segments. Up to several thousand track segments are transferred to the second stage, the Global Tracking Unit (GTU), via 1 080 optical fibres.
The GTU consists of 109 dedicated FPGA-based processing nodes forming a three-level hierarchy. 90 Track Matching Units perform online 3D track reconstruction and momentum calculation based on the track segments within 1.2 μs. Track information is then forwarded to 18 Supermodule Units for trigger computation. The top-level Trigger Generation Unit finally delivers the overall TRD trigger contributions within 6 μs after the collision.
A first analysis of the online tracking performance of the GTU with early data taken at the LHC and a comparison to detailed hardware simulations is presented. The performance of first implementations of a single high-p_t particle trigger as well as a jet trigger is evaluated.

HK 30.5 Di 17:45 HG VIII
ALICE TRD GTU Simulation Framework and Multi-Event Buffering Studies — •Dirk Hutter for the ALICE-TRD-Collaboration — Kirchhoff-Insitute for Physics, University of Heidelberg

The Transition Radiation Detector (TRD) is one of the main detectors of the ALICE experiment at the LHC. One part of the detector is the Global Tracking Unit (GTU). It consists of 109 dedicated FPGA-based CompactPCI boards arranged in a three-level hierarchy.
The GTU itself serves two major tasks. One is to reconstruct tracks in less than 6 μs to contribute to the Level-1 trigger decision. Furthermore it is an essential part of the TRD readout chain. It receives raw data from the Front-End Electronics (FEE) via 1 080 fiber optical links at an aggregate net bandwidth of 2.16 TBit/s while the maximum bandwidth to the data acquisition system is two orders of magnitude smaller. To minimize detector dead time during readout due to this bandwidth reduction it is indispensable to de-randomize the data stream by buffering multiple events. As the FEE only provides single event buffers this feature is implemented in the GTU.
For development and verification of multi-event buffering a detailed HDL simulation framework of the entire GTU is needed. It has to model all board types as well as inter-board connections. The interlaced trigger layout of ALICE additionally requires complex simulation input sequences covering all imaginable cases.
The simulation framework and studies for the implementation of multi-event buffering in the GTU will be presented.

HK 30.6 Di 18:00 HG VIII
First results of the ALICE-HLT fast clusterfinder preprocessor — •Torsten Alt and Volker Lindenstruth for the ALICE-HLT-Collaboration — FIAS, Frankfurt, Germany

The track reconstruction of the ALICE TPC in the High-Level-Trigger (HLT) computing farm is a two stage process. First the clusters of the charge distributions in the TPC are calculated which are then used as the seeds for the tracking algorithm. In the HLT the first stage, the cluster finding, can be done in software or in hardware. The hardware solution is implemented in an FPGA which is located directly in the data path from the TPC to the HLT. It processes the raw data in realtime and stores it in the main memory of the HLT computing farm for further processing by the tracker. For each of the more than 550.000 channels of the TPC a gain correction factor is applied. Furthermore the center of gravity of the charge clusters and the deviation are calculated. Depending on the multiplicity of the charged particles in the TPC a speed-up of factor 10-50 with respect to the software algorithm can be obtained thus allowing the HLT to analyze events online at maximum TPC rate. First results with real data obtained in the first collisions at LHC will be shown.

HK 30.7 Di 18:15 HG VIII

ALICE HLT Tracker — •Sergey Gorbunov for the ALICE-HLT-Collaboration — Frankfurt Institute for Advanced Studies, Frankfurt — Kirchhoff Institut für Physik, Heidelberg

The on-line event reconstruction in ALICE is performed by the High Level Trigger, which should processes up to 2000 events per second in proton-proton collisions and up to 200 central events per second in heavy ion collisions, corresponding to an input data stream of 30 GB/s.

In order to fulfil the time requirements, a fast on-line tracker has been developed. The algorithm combines a Cellular Automaton method, which is used for a fast pattern recognition, and the Kalman Filter method, which performs a fit of found trajectories and the final track selection.

The on-line algorithm has proved its high performance (99.9% for the proton-proton events and 95.8% for the central Pb-Pb collisions) in comparison with the off-line reconstruction (99.9% and 95.8% correspondingly). In addition to the the high efficiency, the on-line reconstruction is an order of magnitude faster than the off-line analysis: 19.6ms (pp) or 17.6s (PbPb central) in comparison with 66.0ms or 160.1s for the off-line.

An important feature of the on-line algorithm is an ability to use GPU hardware accelerators, giving another order of magnitude speed-up for the data processing. The GPU tracker is integrated to the High Level Trigger framework and is used for the on-line event reconstruction in the ALICE experiment.

HK 30.8 Di 18:30 HG VIII

ALICE on-line vertex finder — •Sergey Gorbunov for the ALICE-HLT-Collaboration — Frankfurt Institute for Advanced Studies, Frankfurt — Kirchhoff Institut für Physik, Heidelberg

A fast on-line vertex finder has been developed for the ALICE High Level Trigger. The algorithm reconstructs the event vertex using only measurements from the Silicon Pixel Detector. It processes up to 3500 events per second, providing the vertex position with the accuracy of 250um in XY and 170um in Z direction. The silicon vertexer supplements the main vertex finder and is used for the on-line monitoring of the ALICE interaction point.

HK 30.9 Di 18:45 HG VIII

Development of High Level Trigger for PANDA EMC Using an FPGA-based Compute Node* — •Qiang Wang[1,2], Dapeng Jin[2], Andreas Kopp[1], Wolfgang Kühn[1], Sören Jens Lange[1], Yutie Liang[1], Ming Liu[1], Zhen-an Liu[2], David Müchow[1], Björn Spruck[1], and Hao Xu[2] — [1]II. Physikalisches Institut, Universität Gießen, Germany — [2]EPC, IHEP, Beijing, China

The PANDA experiment at FAIR has a rich physics program. The EMC detector provides almost 4π coverage, good granularity and good energy resolution. Its data acquisition(DAQ) system features a novel self-trigger data pushed architecture. Data from EMC readout electronics are processed on the fly to reconstruct electromagnetic showers. The extracted features are combined with information from other detectors in order to discriminate photons from electrons and hadrons. The EMC detector, readout electronics and offline reconstruction algorithms are studied and an adaptive EMC DAQ scheme is proposed employing an FPGA based Compute Node(CN). The CN provides flexible connections with high bandwidth between processing modules, up to 10GByte DDR2 memory per board for data buffering and five high-end FPGAs for sophisticated algorithm applications. The algorithm partition strategy is designed based on the readout electronics layout and the CN's processing architecture. The functional verification and performance evaluation methods for the algorithms are also covered.

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