T 63: DAQ, trigger and electronics III

Time: Wednesday 16:30–18:30 Location: L-3.015

T 63.1 Wed 16:30 L-3.015

Der Level-1 topologische Prozessor bei ATLAS: Triggerperformance und zukünftiger Ausbau — Volker Büscher, •Johannes Damp, Christian Kahra und Ulrich Schäfer — Johannes Gutenberg-Universität Mainz

Das ATLAS-Triggersystem reduziert die hohe LHC *pp*-Kollisionsrate von 40 MHz auf eine Rate von 1 kHZ zur Datenspeicherung. Die erste Stufe dieses Triggersystems ist der hardwarebasierte Level-1 Trigger mit einer Ausgangsrate von 100 kHz und einer Latenz von 2.5 μs. Bei Erhöhung der Luminosität und Energie müssen die Triggerschwellen wichtiger Physiktrigger erhöht werden, um die Datenrate konstant zu halten, was allerdings mit einem Verlust interessanter Ereignisse verbunden ist. Um dieses Problem zu lösen, wurde der Level-1 topologische Prozessor (L1Topo) in die erste Triggerstufe eingeführt. L1Topo erhält sämtliche Objekte jedes Ereignisses von den Kalorimetern und vom Myonsystem, und verarbeitet diese Informationen um Triggerentscheidungen basierend auf topologischen Größen durchzuführen. Dies ermöglicht eine verbesserte Untergrundunterdrückung und eine Verbesserung der Signifikanz vieler ATLAS Physikmessungen, während gleichzeitig eine Reduktion der Raten erzielt werden kann.

In diesem Vortrag wird einen Überblick über die Triggerperformance von L1Topo in den LHC-Runs in 2017 und 2018 gegeben. Zudem wird ein Überblick über den aktuellen Status des Ausbaus von L1Topo für den in 2021 startenden Run-3 des LHC gegeben.

T 63.2 Wed 16:45 L-3.015

Particle selection and combinatorics in LHCb's Upgrade trigger — •Niklas Nolte[1,2], Sascha Stahl[1], and Oliver Lupton[1] — [1]CERN — [2]TU Dortmund

LHCb is undergoing a significant upgrade for Run 3 of the LHC, where one of the main changes is the transition to a full software trigger solution. Processing events at a 30-fold increased rate and a five-fold increase in instantaneous luminosity with respect to Run 2 is a challenging task. We expect O(1000) selections that have to be processed for each event in the second trigger stage, which will operate at 1 MHz event rate. Each of these selections filter particles based on their properties and reconstruct their entire decay chain with different mass hypotheses. To meet the tight performance requirements of these tasks, we introduce a new trigger event model and optimized algorithms to perform these selections.

T 63.3 Wed 17:00 L-3.015

First level EM trigger algorithms in the ATLAS forward region — •Julian Fischer and Stefan Tapprogge — Institut für Physik, Johannes Gutenberg-Universität, Mainz

The HL-LHC at CERN is a planned upgrade of the Large Hadron Collider (LHC) that will increase its instantaneous luminosity of up to a factor of five in *pp*-collisions. In order to exploit the full potential of the HL-LHC the first level trigger of the ATLAS experiment will have to efficiently find electromagnetic objects in the forward region. A dedicated 'forward Feature EXtractor' (fFEX) is in development for Run 4 to trigger jet and electromagnetic objects in the the ATLAS forward region making use of the full granularity of the calorimeters in pseudorapidity ranges of $|\eta| > 2.5$. Two hardware modules are to be developed to cover both forward directions of the detector. This contribution will highlight the development of candidate algorithms that are designed to trigger electromagnetic objects on the fFEX modules. Performance studies will be shown and different concepts investigated to tackle the challenging geometries in this particular detector region while considering the restrictions imposed by the firmware implementation.

T 63.4 Wed 17:15 L-3.015

Design of a Flexible Printed Circuit prototype for the High Granularity Timing Detector at ATLAS — •Maria Soledad Robles Manzano[1], Andrea Brogna[2], Peter Bernhard[2], Fabian Greiner[1], Lucia Masetti[1], Paul Plattner[1], Quirin Weitzel[2], and Atila Kurt[2] — [1]Institut für Physik, Johannes-Gütenberg Universität Mainz — [2]PRISMA Detector Lab, Johannes-Gütenberg Universität Mainz

The ATLAS detector at CERN is being upgraded to face the new HL-LHC challenges. In order to improve the physics performance of the ATLAS detector a High-Granularity Timing Detector (HGTD) is proposed. It will help to mitigate the pile-up contribution in the forward region by providing a timing resolution below 30 ps per track. 2×4 cm^2 sensors are bump-bonded two ASICs in the detector basic unit, the so-called bare module. The active area, consisting of 2 double-sided disks per end-cap, populated by about 8000 modules in total, is surrounded by the Peripheral Electronics Boards (PEB). In this scenario, custom electronics is required to transmit the signals (1.28 Gbps) from the active area to the PEB as well as to bias the sensor (800 V) and deliver power (1.2 V at 1 A) to the ASICs. A 220 μm thick Flexible Printed Circuit (FLEX cable) was selected as the optimal candidate for such purpose. The baseline of the FLEX cable as well as the most recent prototype design are presented.

T 63.5 Wed 17:30 L-3.015

High Density Interconnects for the Mu3e experiment — •Lars Noehte for the Mu3e-Collaboration — Physikalisches Institut, Heidelberg, Germany

The Mu3e experiment is going to search for the charged lepton-flavor violating decay $\mu^+ \to e^+e^-e^+$ with a sensitivity of one in 10^{16} events in phase II. Since the tracking of the decay electrons (positrons) is dominated by multiple scattering, the detector material thickness has to be minimized. The tracking layers of the detector deploy the HV-MAPS pixel sensor MuPix, which can be thinned down to 50 μm. Achieving a thickness of $X/X_0 = 0.115\%$ radiation lengths per layer requires an ultra-thin readout structure, capable of transmitting 1.25Gb/s of data reliably over a high density interconnect. This talk focuses on design studies and characterizations of edge-coupled micro strips on 12 μm thick aluminum layers.

T 63.6 Wed 17:45 L-3.015

VMM3 Readout Chips Calibration and Performance Response to Pressure in Micromegas Detectors — •Ksenia Solovieva[1], Thorwald Klapdor-Kleingrothaus[2], Patrick Scholer[2], Vladislavs Plesanovs[2], and Ulrich Landgraf[2] — [1]Imperial College London, London, UK — [2]Albert-Ludwigs University, Freiburg, Germany

During the ongoing LHC Long Shutdown, the ATLAS detector upgrade includes the implementation of the New Small Wheels as part of the Muon Spectrometer. One of its detector technologies is the MicroMesh Gaseous Detector (MicroMegas) used for improved tracking and triggering in a higher particle rate environment.

For the purpose of investigating the MicroMegas detector readout, prototype detectors were set up and read out with dedicated Front End Boards containing VMM3 ASICs. Two logic chains for triggering were successfully implemented, one for cosmic muons and one including the ion signal of the micromesh in the detector. This presentation discusses the developed procedures and presents the results of calibration and gain studies.

T 63.7 Wed 18:00 L-3.015

Tests results of a Flexible Printed Circuit prototype for the High Granularity Timing Detector at ATLAS — •Paul Plattner[1], Andrea Brogna[2], Peter Bernhard[2], Fabian Greiner[1], Atila Kurt[2], Lucia Masetti[1], Maria Soledad Robles Manzano[1], and Quirin Weitzel[2] — [1]Institut für Physik, Johannes-Gütenberg Universität Mainz — [2]PRISMA Detector Lab, Johannes-Gütenberg Universität Mainz

A prototype of a Flexible Printed Circuit for the ATLAS High Granularity Timing detector (HGTD) has been designed and manufactured. A specific testing plan, based on both the mechanical and electrical specifications as well as the operational conditions of the HGTD, is required in order to check its performance. The signal transmission tests at 1.25 Gbps data rate additionally to the impedance measurements with the Time Domain Reflectrometry technique provide valuable information in terms of signal integrity. Power integrity simulations and measurements of the plane resistance with different methods are compared. Tests on high voltage insulation are also required to quantify its influence on the rest of planes and lines. Results of the tests of the prototype are presented.

T 63.8 Wed 18:15 L-3.015

Efficiency Study of the Neural Network z-Vertex Trigger in the Belle II Experiment — •Felix Meggendorfer[1,2], Sebastian Skambraks[1,3], Christian Kiesling[1,3], Steffen Baehr[4], and Kai Unger[4] for the Belle II-Collaboration — [1]MPI für Physik, München — [2]Technische Universität München — [3]Ludwig-Maximilians-Universität München — [4]Karlsruher Institut für Technologie

For the drift chamber of the Belle-II experiment located in Tsukuba, Japan, a first level hardware neural network trigger is used to identify tracks coming from outside of the interaction region. The neural trigger makes it possible to efficiently suppress the dominating portion of background tracks not coming from the interaction vertex and makes it possible to launch pure 2-track triggers without additional conditions. After a short introduction into the hardware design of the trigger system, the efficiency of the neural "z-vertex" trigger will be presented.