T 112: DAQ Test/RO – GRID I

Time: Thursday 15:50–17:20 Location: HSZ/0301

T 112.1 Thu 15:50 HSZ/0301

Modular and Scalable Multi-Timepix3 Readout System — •Thomas Block, Klaus Desch, Markus Gruber, Jochen Kaminski, and Tobias Schiffer — Universität Bonn

The Timepix3 chip of the Medipix3 collaboration is a highly granular pixel chip. It can be used in combination with different detector components, e.g. with a bump bonded silicon pixel sensor, with a photolithographically postprocessed MicroMegas gas amplification stage (InGrid), or with a micro-channel plate (MCP). Therefore different detectors can be built, which can be used for various applications like beam telescopes, X-Ray detectors for axion search and polarimetry and neutron detectors. For these different detectors we are developing a fully open source solution: the Timepix3 readout system. It enables us to adapt to the different requirements (low- to high-rate events and single- to multi-chip design) efficiently. The system, which already has been used in test runs, supports different FPGA boards, which cover the different requirements. The Scalable Readout System (SRS), being one of them, together with of our own PCB designs, supports low- to medium-rate applications. Based on the basil framework, developed at SILAB Bonn, the firmware is written in Verilog and the software is written in Python. For the control system both a graphical user interface and a command-line interface have been developed.

In this talk I will present the readout and control system and the recent development from single-chip to multi-chip support. Also I will show the needed functionality like calibration, equalisation, readout and monitoring.

T 112.2 Thu 16:05 HSZ/0301

Scan Automated Testing for the ATLAS Pixel Detector — Marcello Bindi, Arnulf Quadt, and •Chris Scheulen — II. Physikalisches Institut, Georg-August Universität Göttingen

The ATLAS Pixel detector data acquisition system (DAQ) is distributed over several different physical components, such as front-end detector modules, read-out drivers, and PCs for operating and calibrating the detector. As a result, time-consuming manual tests are currently required to ensure the correct operation of the entire system after software or firmware changes in any one component. After the first year of detector operation during Run 3, this represents a bottleneck to the development work carried out during the end-of-year shutdown on the basis of the experience collected, such as observed dead-time desynchronisation instabilities.

To simplify software validation and free up manpower, a suite of automated tests is being developed for deployment in the DAQ software's continuous integration system on GitLab. Fully automated testing is only possible without involvement of the detector modules, whose operation requires some degree of manual supervision. Therefore, emulated detector responses are used for tests of read-out chain components under exclusion of the detector modules themselves.

This talk will provide a brief overview of required improvements to the Pixel detector's DAQ system based on the operational experience collected during the first data-taking year of Run 3. A special focus will be placed on the development of the automated testing framework being used to validate this firmware and software development.

T 112.3 Thu 16:20 HSZ/0301

Tests of the Mu3e DAQ in the Cosmic run 2022 — •Martin Müller for the Mu3e-Collaboration — Institute for Nuclear Physics, JGU Mainz

The Mu3e experiment will search for the lepton flavour violating decay $\mu^+ \rightarrow e^+e^-e^+$ and is aiming for a sensitivity of one in 10^{16} muon decays. Since this decay is highly suppressed in the Standard Model to a branching ratio of below $\mathcal{O}(10^{-54})$, an observation would be a clear sign for new physics.

In the Mu3e detector, four layers of silicon pixel sensors will be used to track electrons and positrons and a time resolution of $\mathcal{O}(100\ ps)$ will be provided by scintillating tile and fibre detectors. The overall detector is expected to produce a data rate from 80 Gbit/s (Phase I) to 1 Tbit/s (Phase II), which will be processed in a three-layer, triggerless DAQ system using FPGAs and a GPU filter farm for online event selection.

A prototype of the detector was operated in summer 2022 in the first Mu3e cosmic run with the intent to test and validate a variety of systems. The operated prototype included two cylindrical layers of pixel sensors, a scintillating fibre module and a vertical slice of the final data acquisition (DAQ) system. The talk will focus on the commissioning and validation of the DAQ in this run.

T 112.4 Thu 16:35 HSZ/0301

Integration of the Goettingen HPC resources to the WLCG Tier- 2 grid computing environment of GoeGrid — •Uday Saidev Polisetty, Arnulf Quadt, Daniel Schindler, and Sebastian Wozniewski — II. Physikalisches Institut, Georg-August-Universität Göttingen

The amount of data produced will significantly increase with the upcoming Run 4 of the LHC. To handle the incoming data there is a necessity to increase the computing resources for simulation, reconstruction and analysis in terms of storage and computing power. The important aspect of the solution is the integration of the High Performance Computing (HPC) resources. At Goettingen campus, there is both WLCG (Worldwide LHC Computing Grid) Tier-2 site (GoeGrid) and a large HPC cluster by National High Performance Computing (NHR) and North German Supercomputing Alliance (HLRN) supercomputer resources. In context of the FIDIUM project, the aim is to increase the computing resources by integrating the local HPC cluster to the GoeGrid. The unused quota from the external sources can be used to fill the shortage of computing resources required for the ATLAS experiment. This integration would lead to a solution to run all the job types provided by the ATLAS experiment.

T 112.5 Thu 16:50 HSZ/0301

Analysis benchmarking tests on selected sites — •David Koch[1], Thomas Kuhr[1], Günter Duckeck[1], Dennis Noll[2], and Benjamin Fischer[2] — [1]LMU München, Germany — [2]RWTH Aachen, Germany

A fast turn-around time and ease of use are important factors for systems supporting the analysis of large HEP data samples. We study and compare multiple technical approaches. This presentation will be about setting up and benchmarking the Analysis Grand Challenge (AGC) using CMS Open Data. The AGC is an effort to provide a realistic physics analysis with the intent of showcasing the functionality, scalability and feature-completeness of the Scikit-HEP Python ecosystem.

I will present the results of setting up the necessary software environment for the AGC and benchmarking the analysis' runtime on various computing clusters: the institute SLURM cluster at my home institute, LMU Munich, a SLURM cluster at LRZ (WLCG Tier-2 site) and the analysis facility Vispa, operated by RWTH Aachen. Each site provides slightly different software environments and modes of operation which poses interesting challenges on the flexibility of a setup like that intended for the AGC. Comparing these benchmarks to each other also provides insights about different storage and caching systems. At LRZ and LMU we have regular Grid storage (HDD) as well as and SSD-based XCache server and on Vispa a sophisticated per-node caching system is used.

T 112.6 Thu 17:05 HSZ/0301

Transparent extension of the Worldwide LHC Computing Grid to non-HEP resources — Manuel Giffels[1], •Alexander Jung[2], Thomas Kress[3], Thomas Madlener[4], Andreas Nowack[3], Alexander Schmidt[2], and Christoph Wissing[4] — [1]Institut für Experimentelle Teilchenphysik, Karlsruher Institut für Technologie, Deutschland — [2]III. Physikalisches Institut A, RWTH Aachen, Deutschland — [3]III. Physikalisches Institut B, RWTH Aachen, Deutschland — [4]Deutsches Elektronen-Synchrotron DESY, Deutschland

With the recently started Run 3 of the LHC, enormous amounts of data are expected. It is already foreseeable that the resources provided by the Worldwide LHC Computing Grid (WLCG) will be put under a lot of stress in the coming years, especially at the start of HL-LHC in Run 4. HEP computing is therefore increasingly developing in the direction of using external non-HEP dedicated resources and thus becoming more heterogeneous. This contribution reports on the work carried out as part of the BMBF (Bundesministerium für Bildung und Forschung) funded FIDIUM (Föderierte digitale Infrastrukturen für die Erforschung von Universum und Materie) project on the dynamic and transparent integration of non-HEP resources into the existing infrastructure of the WLCG and what challenges arise in the process. The currently ongoing integration of the high performance computing (HPC) resources at Jülich Supercomputing Centre (JSC) using the resource manager COBalD/TARDIS serves as an example.