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Commissioning of the on-detector electronics of a novel GEM-based detector for the CMS experiment

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New Gas Electron Multiplier (GEM) based detectors are developed in view of the forward muon system upgrade of the CMS experiment in Phase 2 of the LHC. With the prospective of the full installation of the detectors during the LHC long shutdown (LS) 2 in 2018/2019, a slice test will take place during the Year-End Technical Stop of 2016 with subsequent detector commissioning. This contribution will present the preparation status and plans, focusing on the development of the data acquisition system, detector monitoring, calibration and control tools.

Summary

There planned upgrade of the CMS detector to install the new GE-1/1 muon detector is essential for maintaining high muon tracking and triggering capabilities in the CMS forward muon system. To ensure fast and successful integration of the system following its installation in Long Shutdown (LS) 2, CMS has planned to install a pilot system consisting of 8 GEM detectors during the Year-End Technical Stop of 2016. These detectors will be complete with a full data acquisition system closely resembling the final GE1/1 system and the exercise will allow final validation of the system design, as well as will allow gaining important integration and operation experience.

The on-detector electronics of the slice test system uses custom readout chips mounted on a large PCB board enabling their connection to a custom designed OptoHybrid board utilizing a Virtex-6 FPGA and a radiation hard optical link. The off-detector part uses the standard for CMS components such as GLIB and AMC13 boards hosted in the VadaTech VT892 µTCA crate. We review the design and the ongoing work on the electronics and data acquisition system development, integration of the components of the system, online software systems and preparations for integrating the new system with the CMS global data acquisition system.

Among other key developments, we will discuss progress made in integrating the new system with the existing CSC detector readout system, which is required to ensure trigger data exchange, work on setting up detector monitoring and data acquisition systems using custom elements utilizing the xDAQ middleware framework, enabling calibration applications (such as threshold and latency scans), hardware monitor system, hardware management tools and data acquisition manager.

While the work is ongoing, the steady progress of the developments, extensive testing and early measurements using cosmic data suggest soundness of the system design and the high likelihood of the system readiness for successful commissioning during the slice test.

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