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CMS Muon Drift Tubes HL-LHC Slice Test

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To tolerate the High Luminosity LHC (HL-LHC) data taking conditions on the detector electronics of the CMS Drift Tubes (DT) chambers need to be replaced during Long Shutdown 3. The first prototype of the HL-LHC electronics for the On detector Board for the DT chambers (OBDT) have been installed in CMS connected to the DT chambers of one out of sixty sectors and integrated in the central data acquisition and trigger system. The signals from the chambers are split and reach both the legacy and Phase 2 demonstrator chains, which will allow them to operate in parallel during LHC collisions.

Summary (500 words)

After delivering an integrated luminosity of more than 160 fb-1 until the end of Run 2, at the beginning of 2019, LHC was shut down for two years (LS2) in order to get its accelerator-chain and detectors upgraded for the HL-LHC phase. During this LS2, the Compact Muon Solenoid (CMS) experiment aims to upgrade its electronics and detector performance to improve the data taking and a precise reconstruction of all the particles in high pile-up conditions of HL-LHC. The Drift Tube (DT) chambers are one of the important parts of the CMS muon system responsible for identifying, measuring and triggering on muons by the precise measurement of their position. The electronics of the CMS DT chambers will need to be replaced for the HL-LHC operation [1]. A DT muon station consists of an assembly of chambers around a fixed value of radial distance R, with four barrel stations labelled as MB1 to MB4, being MB1 the closest to the interaction point. Along the beam axis z DTs are divided into 5 slices, called wheels, with wheel 0 centered at z=0 and wheel+1 and wheel+2 in the positive z direction and wheel-1 and wheel-2 in the negative z direction. Within each wheel, chambers are arranged in 12 sectors at azimuthal angle. The first prototypes of the HL-LHC electronics for the CMS On detector Board for the Drift Tube chambers (OBDT) have been installed in one out of sixty sectors (wheel+2 sector 12) of DT chambers on the CMS detector, in the so-called Slice Test, and integrated in the central data acquisition and trigger system during LS2. The four chambers in this sector were instrumented with OBDT prototypes [2]. DT Chamber frontend pulses carrying the time information of the chamber hits reach both the legacy on detector electronics, so called minicrate, and the OBDTs through specifically designed splitter boards that take consideration to the signal integrity. Thirteen OBDTs distributed in five mechanical frames which also take care of the thermal interface to the water cooling loop are installed in this sector. The Phase 2 backend functionality (slow control, trigger generation and DAQ) is implemented in FW running on DT uTCA boards (TM7 [3]) developed for the Phase 1 upgrade. The stability and performance of the Phase 2 electronic demonstrator in cosmic events will be shown in this talk and compared with the present system. We plan to run this Phase 2 parallel system in collisions during Run 3, which will allow us to test final pre-production prototypes under realistic conditions (radiation, magnetic field) and further refine trigger algorithms.

[1] CMS Collaboration, The Phase-2 Upgrade of the CMS Muon Detectors, CERN-LHCC-2017-012, CMS-TDR-016,2017. [2] Andrea Triossi et al, Electronics Developments for Phase-2 Upgrade of CMS Drift Tubes https://pos.sissa.it/343/035/pdf [3] Andrea Triossi, A New Data Concentrator for the CMS Muon Barrel Track Finder, http://cds.cern.ch/record/1712905

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