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The optical link system in the Upgrade project of the Drift Tubes electronics in CMS

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The upgrade of the second level electronics of the muon Drift Tube (DT) in CMS is focused on improving the electronic system to maintain its reliability at High Luminosity LHC. The project foresees the relocation of the Sector Collector electronics from the CMS cavern to the counting room. The system requires an electrical to optical conversion operated by the Copper to Optical Fibre (CUOF) boards. Prototypes have been produced and tested under radiation environment and during cosmic runs integrated within the DT acquisition and trigger system. The excellent results of those tests triggered the full production for the complete DT system that will be installed starting by the end of this year.

Summary

The program of upgrade for the Drift Tube (DT) system of the Compact Muon Solenoid (CMS) experiment foresees the relocation of the Sector Collector (SC) electronics which includes the second level readout and trigger electronics from the CMS cavern to the counting room. This Upgrade project will allow the DT detector to develop a new trigger architecture that will be able to face the high event rate expected for the High Luminosity Large Hadron Collider (HL-LHC). The fulfilment of this project envisages to turn electrical signals into optical signals for a total number of 3500 optical channels that run at 480 Mb/s data rate. The optical signals will then be converted again into electrical signals in the CMS counting room where the Sector Collector electronics will be relocated. The electronic system is based on the Copper to Optical Fibre (CUOF) boards that will positioned in the experimental cavern, in an environment where the radiation and the magnetic fields cannot be neglected. The complementary system for the Optical Fibre to Copper (OFCU) conversion will be positioned in the counting room, and will feed the DT data acquisition and trigger data streams. The CUOF electronics is composed of Mezzanines which convert the data into optical signals at high frequency. They are mounted on Motherboards which have the principal controls and monitoring functions of all the critical components. Different prototypes of mezzanines have been tested in an irradiation facility in conditions similar to what it is expected in HL-LHC. In this way all the chosen Components Off The Shelf (COTS) have been qualified and the global behaviour of the board passed the assessment with a very low Bit Error Rate (BER). In addition some integration tests of the electronics boards for the optical link in the full acquisition chain have been performed with the installation and running of the prototypes on the CMS experiment in the cavern under nominal magnetic field conditions. Real cosmic rays have been collected and further test pulse data have been generated and passed through the present system. Both the irradiation tests and the integration tests on the experiment have given positive results so to be confident to start the electronics mass production for the system. In the meanwhile the test set up for the qualification of the full production of the CUOF/OFCU boards is being prepared. The certification tests are focalised on the measurements of the BER as a function of the main parameters of the optical converter placed in the CUOF board. The installation of the DT optical links is planned to begin next autumn with the relocation of the SC electronics and the installation of the CUOF/OFCU system for a substantial number of channels both on the data and the trigger paths.

Primary authors: ROTONDO, Francesco (INFN); DE REMIGIS, Paolo (INFN); WHEADON, Richard (INFN); MASELLI, Silvia (INFN)

Presenter: DE REMIGIS, Paolo (INFN)

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