Contribution ID: **91** Type: **not specified**

Development of Front-End Electronic Modules for CMS MIPs Timing Detector, End-cap Timing Layer

Thursday, 14 December 2023 17:45 (10 minutes)

In 2026, the Large Hadron Collider (LHC) will be undergoing an upgrade to the High-Luminosity LHC (HL-LHC). With this new upgrade, the Compact Muon Solenoid (CMS) detector will have to be able withstand challenging conditions and maintain performance with an increased number of collisions. To achieve this, a new timing detector in CMS will sense minimum ionizing particles (MIPs) with a timing resolution of ~40-50 ps per particle hit and coverage up to $|\eta|=3$. The new detector, MIP Timing Detector (MTD), will help extract particle traces of interest from bunch crossing areas with high levels of pileup using the precision timing information. The end-cap region of the MTD, called the end-cap timing layer (ETL), will have to endure a high number of particles passing through the region. Accordingly, this means it will have to withstand high doses of radiation which prompt the use of radiation tolerant silicon sensors with fast charge collection, called low-gain avalanche diodes (LGADs). LGAD sensors are expected to cover high-radiation pseudo-rapidity region $1.6 < |\eta| < 3.0$. The LGADs signal will have to be read out with a custom End Cap Timing Read Out Chip (ETROC), which is designed to convert precise timing data to digital signals. We will demonstrate advances in ETL detector, primarily on front-end electrical test results of Module PCB boards, their performance within a complete system integrated with power and readout board and connected to the backend data acquisition system (DAQ).

[in-person]

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Session Classification: Lightning Round Talks (2)