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Upgrade of the CMS luminosity instrumentation and the Fast Beam Condition Monitor for HL-LHC

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The high-luminosity upgrade of the LHC (HL-LHC) brings unprecedented requirements for real-time and precision bunch-by-bunch online luminosity measurement and beam-induced background monitoring. A key component of the CMS Beam Radiation Instrumentation and Luminosity (BRIL) system is a stand-alone luminometer, the Fast Beam Condition Monitor (FBCM), which is fully independent from the CMS central trigger and data acquisition services and able to operate at all times with an asynchronous readout. FBCM utilizes a dedicated front-end ASIC to amplify the signals from CO₂-cooled silicon-pad sensors with a few nanoseconds timing resolution also enabling the measurement of beam-induced background. FBCM uses a modular design with two half-disks of twelve modules at each end of CMS, with 4 service modules placed around the disk edge at a radius of reduced radiation fluence. The electronics system design adapts several components from the CMS Tracker for power, control and read out functionalities. The dedicated FBCM ASIC contains 6 channels with 600e⁻ ENC and adjustable shaping time to optimize the noise with regards to sensor leakage current. Each channel outputs a single binary high-speed asynchronous signal carrying the Time-of-Arrival and Time-over-Threshold information. The chip output signal is sent via a radiation-hard gigabit transceiver and an optical link to the back-end electronics for analysis. The paper reports on the design and the testing program for the FBCM detector.

Collaboration / Activity

CMS

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