

TOFHIR2: The readout ASIC of the CMS Barrel MIP Timing Detector

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Abstract

The CMS detector will be upgraded for the HL-LHC to include a MIP Timing Detector (MTD). The MTD will consist of barrel and endcap timing layers, BTL and ETL respectively, providing precision timing of charged particles. The BTL sensors are based on LYSO:Ce scintillation crystals coupled to SiPMs with TOFHIR2 ASICs for the front-end readout. A resolution of 30-60 ps for MIP signals at a rate of 2.5 Mhit/s per channel is expected along the HL-LHC lifetime. We present an overview of the TOFHIR2 requirements and design, simulation results and measurements with TOFHIR2 ASICs. The measurements of TOFHIR2 associated to sensor modules were performed in different test setups using internal test pulses or blue and UV laser pulses emulating the signals expected in the experiment. The measurements show a time resolution of 24 ps initially during Beginning of Operation (BoO) and 58 ps at End of Operation (EoO) conditions, matching well the BTL requirements. We also showed that the time resolution is stable up to the highest expected MIP rate. Extensive radiation tests were performed, both with x-rays and heavy ions, showing that TOFHIR2 is not affected by the radiation environment during the experiment lifetime.