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Precision Timing with the CMS MIP Timing Detector

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The Compact Muon Solenoid (CMS) detector at the CERN Large Hadron Collider (LHC) is undergoing an extensive Phase II upgrade program to prepare for the challenging conditions of the High-Luminosity LHC (HL-LHC). A new timing layer is designed to measure minimum ionizing particles (MIPs) with a time resolution of ˜30ps and hermetic coverage up to a pseudo-rapidity of |eta|=3. This MIP Timing Detector (MTD) will consist of a central barrel region based on LYSO:Ce crystals read out with SiPMs and two end-caps instrumented with radiation-tolerant Low Gain Avalanche Detectors (LGADs). The precision time information from the MTD will reduce the effects of the high levels of pile-up expected at the HL-LHC and will bring new and unique capabilities to the CMS detector. The time information assigned to each track will enable the use of 4D-vertexing which will render a 5-fold pile-up reduction thus recovering the current conditions. Precision timing will also enable new time-based isolations and improved b-tagging algorithms. All of this translates into a ˜20% gain in effective luminosity when looking at di-Higgs boson events decaying to a pair of b-quarks and two photons. We present the current status and ongoing R&D of the MTD, including implications on the physics reach at the HL-LHC and test beam results.

Secondary topics

Applications

Primary topic

Crystals

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