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Enhancing Particle Reconstruction and Identification with the MIP Timing Detector at CMS

The MIP Timing Detector (MTD) is a major component of the CMS Phase-II upgrade for the High-Luminosity LHC (HL-LHC), featuring a time resolution of $O(30)$ ps. It comprises the Barrel Timing Layer and the Endcap Timing Layer, covering complementary regions in pseudorapidity and enabling precision timing measurements across the detector.

The MTD will significantly enhance event reconstruction during HL-LHC operations by providing powerful tools to mitigate pileup and improve particle identification (PID). By incorporating precise time-of-flight (TOF) information, the MTD enables four-dimensional vertexing and mass hypothesis testing for charged particles.

This contribution presents a detailed study of TOF-based reconstruction techniques using the MTD, including an assessment of the associated uncertainties and their impact on vertex association and PID performance. These developments will help to enhance the detector's sensitivity to both Standard Model processes and searches for new physics in the challenging HL-LHC environment.

Secondary track

T12 - Data Handling and Computing

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