

# Precision Timing with the CMS MTD Barrel Timing Layer for HL-LHC

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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 detector in CMS will measure minimum ionizing particles (MIPs) with a time resolution of  $\sim 30$ -40 ps and hermetic coverage up to a pseudo-rapidity of  $|\eta|=3$ . The precision time information from this MIP Timing Detector (MTD) will reduce the effects of the high levels of pileup expected at the HL-LHC, enhancing and expanding the physics reach of the CMS detector. For instance, in the analysis of di-Higgs boson production, a timing resolution of 30-40 ps is expected to improve the effective luminosity by about 25% through gains in b-tagging and isolation efficiency. The central Barrel Timing Layer (BTL) will be based on LYSO:Ce crystals read out with silicon photomultipliers (SiPMs). The BTL will use elongated crystal bars, with double-sided read out (a SiPM on each end of the crystal), in order to maximize detector performance within the constraints of space, cost, and channel count. We will present an overview of the MTD BTL design, highlighting some of physics analyses impacted by the MTD. We will review the extensive R&D studies carried out to optimize the BTL design and the test beam results in which the goal of 30 ps timing resolution has been achieved.

## I read the instructions

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