

CMS Upgrades at LHC

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Calorimetry, muon detection, vertexing, and tracking will play a central role in determining the physics reach for the High Luminosity (HL) Large Hadron Collider (LHC) era demanding unprecedented options and R&D efforts necessary to upgrade the current LHC detectors and enabling discoveries. Several detector upgrades are foreseen for the Compact Muon Solenoid (CMS) detector currently operational at the LHC which is expected to have an ultimate luminosity of more than $10^{34} \text{cm}^{-2}\text{s}^{-1}$ at 14 TeV targeted during Phase 1 (the first 10 year period of the accelerator) operation. In this paper, upgrade plans for Tracking, Calorimetry and the Muon system will be discussed. The Pixel system will be upgraded during Phase 1 while for Phase 2 upgrade, the entire Tracker will have to be replaced with a challenging requirement that it should contribute to the stringent first level trigger. Due to radiation damage to the active material of the Hadronic Endcap (HE) calorimeters, radiation hard quartz has been proposed. Photodiodes are being replaced by magnetic tolerant and with a better signal to noise ratio. For Electromagnetic Calorimetry (ECAL), the priority is to ensure stable and excellent performance throughout Phase 1 and to provide accurate predictions for performance in Phase 2 assuming no replacement of the ECAL. The muon Drift Tube (DT) system, performance, on the expectations of an adequate operation of the detector at higher luminosity, upgrades for Phase 1 are focused on improving the reliability of the system. The present Resistive Plate Chamber (RPC) detector, which serves as a dedicated muon triggering system, will be augmented with a fourth layer in the endcap region, along with CSC chambers on either side of the CMS detector; the details on improvements will be discussed.

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