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The CMS ECAL Upgrade for High Precision Timing and Energy Measurements in HL-LHC

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Summary

The Electromagnetic Calorimeter (ECAL) of the Compact Muon Solenoid (CMS) experiment will be upgraded for the High-Luminosity phase of the LHC (HL-LHC). Data taking will begin in 2026 for the HL-LHC, where the number of simultaneous proton-proton collisions (pile-up) will reach 200 and a challenging increase in data rate is expected. The current lead tungstate crystals and avalanche photodiode detectors in the barrel region of the ECAL will remain, while the front-end and off-detector read-out electronics of the calorimeter will be upgraded. The new electronics will have to fulfill the requirements of the upgraded Level 1 hardware trigger system, in terms of increased latency and data bandwidth, in order to preserve detector performance despite the increased instantaneous luminosity (more than a factor 5 to the design luminosity). The upgrade will provide single crystal granularity for the hardware trigger and will enable a full read out of the detector. A crucial characteristic of the new design will be the capability to measure the timing of electrons and photons with an unprecedented precision, of the order of 30 ps for energies above 10 GeV. This excellent time resolution will improve the overall CMS physics performance under the expected pile-up conditions. For example, the precision timing information will improve the determination of the location of the production vertex for Higgs boson decays to two photons, a crucial channel for the measurement of Higgs properties. The status of the ongoing R&D activities will be presented, together with the latest beam test results with prototypes, and the development plan for the project up to installation.

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