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The CMS ECAL upgrade for precision timing measurements at the High-Luminosity LHC

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The High Luminosity upgrade of the LHC (HL-LHC) at CERN will provide unprecedented instantaneous and integrated luminosities of around 5 x 10^34 cm-2 s-1 and 3000/fb, respectively. An average of 140 to 200 collisions per bunch-crossing (pileup) is expected. In the barrel region of the Compact Muon Solenoid (CMS) electromagnetic calorimeter (ECAL), the lead tungstate crystals and avalanche photodiodes (APDs) will continue to perform well, while the entire readout and trigger electronics will be replaced.

A dual gain trans-impedance amplifier and an ASIC providing two 160 MHz ADC channels, gain selection, and data compression will be installed. The noise increase in the APDs, due to radiation-induced dark current, will be mitigated by reducing the ECAL operating temperature. The trigger primitive formation will be moved off-detector and performed by powerful and flexible FPGA processors.

The upgraded ECAL will greatly improve on the time resolution for photons and electrons with energies above 10 GeV. Together with the introduction of a new timing detector designed to perform measurements with a resolution of a few tens of picoseconds for minimum ionizing particles, the CMS detector will be able to precisely reconstruct the primary interaction vertex even with 140-200 pileup interactions per event.

The design of the full ECAL barrel readout chain and the status of the individual component R&D will be presented and results from recent test beam campaigns at the CERN SPS, using electron beams with energies of up to 250 GeV, will be summarised. In particular, we will present measurements of the energy and timing resolution performance of the latest HL-LHC ECAL readout electronics prototypes.

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