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The upgrade of the CMS Electromagnetic Calorimeter for the High-Luminosity LHC

The High Luminosity upgrade of the LHC (HL-LHC) at CERN will provide, starting in 2030, unprecedented instantaneous and integrated luminosities of around 5 x 10^34 cm-2 s-1 and 3000/fb, respectively. The expected average of 140 to 200 collisions per bunch-crossing (pileup) represents a severe challenge for the detectors. While the endcap part of the calorimeters will be replaced by a new detector, the ECAL barrel's lead tungstate crystals and photo detectors are expected to sustain the new conditions.

The Very Front End electronics will be equipped with two already produced custom ASICs per crystal: a dual gain trans-impedance amplifier and an ASIC providing two 160 MHz ADC channels, gain selection, and data compression. The noise increase in the photo detectors, due to radiation-induced dark current, will be mitigated by reducing the ECAL operating temperature from 18 ℃ to 9 ℃. The trigger primitive formation will be moved off-detector and performed by powerful and flexible FPGA processors. The upgrade of the ECAL electronics will allow maintaining the excellent energy resolution of the detector and, in addition, greatly improves the time resolution of electrons and photons above 10 GeV, down to a few tens of picoseconds.

The final 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.

Secondary track

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