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30ps precision timing calorimetry with the CMS High Granularity Calorimeter

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The existing CMS endcap calorimeters will be replaced with a High Granularity Calorimeter (HGCAL) for operation at the High Luminosity (HL-LHC). Radiation hardness and excellent physics performance will be achieved by utilising silicon pad sensors and SiPM-on-scintillator tiles with high longitudinal and transverse segmentation. One of the major challenges of the HL-LHC will be the high pileup environment, with interaction vertices spread by a few centimetres, equivalent to a few 100ps in time. In order to efficiently reject particles originating from pileup, the HGCAL is designed to provide timing measurements for individual energy depositions with signals above an equivalent of 10 MIPs. By this means, precision timing information at the order of 30ps for clusters beyond 5 GeV will be achieved. Given the complexity and size of the system, this poses a particular challenge to the readout electronics as well as to the calibration and reconstruction procedures. Recently, the proof-of-principle of the envisaged concept could be demonstrated using experimental data of more than 100 time-calibrated readout channels of an HGCAL prototype tested with particle beam in 2018.
In this contribution, we present the general challenges for the front-end electronics in the final design, the recent proof-of-concept with the HGCAL prototype in test beam, as well as the anticipated timing performance from simulation at HL-LHC.

Collaboration

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