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Design and object performance of the CMS High Granularity Calorimeter Level 1 trigger

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The high luminosity (HL) LHC will pose significant detector challenges for radiation tolerance and event pileup, especially for forward calorimetry, and this will provide a benchmark for future hadron colliders. The CMS experiment has chosen a novel high granularity calorimeter (HGCAL) for the forward region as part of its planned Phase 2 upgrade for the HL-LHC. Based largely on silicon sensors, the HGCAL features unprecedented transverse and longitudinal readout segmentation which will be exploited in the upgraded Level 1 (L1) trigger system. Together with the tracking information, which will also be available at L1, this will open the possibility of pioneering particle flow-based techniques in the L1 trigger. The high channel granularity results in around one million trigger channels in total and so presents a significant challenge in terms of data manipulation and processing for the trigger, to be compared with the 2000 channels in the endcaps of the current detector. In addition, the high luminosity will result in an average of 140 interactions per bunch crossing that give a huge background rate in the forward region and these will need to be efficiently rejected by the trigger algorithms. Furthermore, 3-dimensional reconstruction of the HGCAL clusters, which will be used for particle flow, in events with high hit rates is also a complex computational problem for the trigger, unprecedented with the 2-dimensional reconstruction in the current CMS calorimeter trigger. The status of the trigger architecture and design, as well as the concepts for the algorithms needed in order to tackle these major issues and their impact on trigger object performance, will be presented.

Secondary topics

Applications

Design concepts for future calorimeter at the intensity frontier

Primary topic

Front-end readout and trigger

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