Contribution ID: **172** Type: **Parallel Talk**

Challenges of front-end and triggering electronics for High Granularity Calorimetry

Thursday, 6 July 2017 17:45 (15 minutes)

A High Granularity Calorimeter (HGCAL) is presently being designed by the CMS collaboration to replace the existing end cap detectors. The HGCAL must be able to cope with the very high collision rates, imposing the development of novel filtering and triggering strategies, as well as with the harsh radiation environment of the High Luminosity LHC. In this talk we present an overview of the full electronics architecture and the performance of prototype components and algorithms. The requirements for the front-end electronics are extremely challenging, including high dynamic range (0-10 pC), low noise (˜2000e-) and low power consumption (˜10mW/channel), as well as the need to select and transmit trigger information with high granularity. Exploiting the intrinsic precision-timing capabilities of silicon sensors also requires careful design of the front-end electronics and the clock distribution. A new generation of highly performant "SKIROC"Front-End chips in 130 nm CMOS technology, including both ADC and TDC blocks and a Time-over-threshold architecture, is being developed to meet the requirements of the HGCAL. The HGCAL incorporates around six million readout channels and so presents a significant challenge in terms of data manipulation and processing for the trigger; the trigger data volumes will be an order of magnitude above those currently handled by CMS. 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, reconstruction of the particle clusters to be used for particle flow in events with high occupancy is a complex computational problem for the trigger. The status of the front-end and trigger architectures and designs, as well as the concepts for the algorithms needed in order to tackle these major issues, will be presented.

Experimental Collaboration

CMS

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Session Classification: Detectors and data handling

Track Classification: Detector R&D and Data Handling