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Electronics and triggering challenges for the CMS High Granularity Calorimeter for HL-LHC

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The High Granularity Calorimeter (HGCAL), presently being designed by the CMS collaboration to replace the CMS endcap calorimeters for the High Luminosity phase of LHC, will feature six million channels distributed over 52 longitudinal layers. The requirements for the front-end electronics are extremely challenging, including high dynamic range (0-10 pC), low noise (˜2000e- to be able to calibrate on single minimum ionising particles throughout the detector lifetime) and low power consumption (˜10mW/channel), as well as the need to select and transmit trigger information with a high granularity. Exploiting the intrinsic precision-timing capabilities of silicon sensors also requires careful design of the front-end electronics as well as the whole system, particularly clock distribution. The harsh radiation environment and requirement to keep the whole detector as dense as possible will require novel solutions to the on-detector electronics layout. Processing all the data from the HGCAL imposes equally large challenges on the off-detector electronics, both for the hardware and incorporated algorithms. We present an overview of the complete electronics architecture, as well as the performance of prototype components and algorithms.

Summary

In preparation for the high-luminosity upgrade of the LHC several upgrades are being prepared of the various detector systems, both because some systems are reaching their end of life due to radiation damage, but also to be able to cope with the higher pileup during high-luminosity operation and leverage new technologies to enhance the performance of the instruments. One of the major upgrades is that of the endcap calorimeters of CMS, the "High-granularity Endcap Calorimeter" (HGCAL). This talk will present an overview of the project, including the goals, main challenges and current progress.

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