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A New Generation of Charge Integrating ADC (QIE) for the CMS HCAL Upgrade

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The CMS experiment will upgrade the photodetection and readout systems of its hadron calorimeter through 2018. A central feature of this upgrade is the development of two new versions of the QIE, a custom ASIC for measurement of charge from detectors in high-rate environments. With 3 fC sensitivity, 17-bits of dynamic range, a time-to-digital converter with sub-nanosecond resolution, and dead-timeless operation at 40 MHz, the QIE is ideal for calorimetry at the LHC. We present performance characterization, radiation tolerance measurements, and plans for deployment in the upgraded CMS detector.

Summary

The CMS experiment at the CERN Large Hadron Collider (LHC) will upgrade the photodetection and readout systems of its hadron calorimeter (HCAL) through the second long shutdown of the LHC in 2018. A central feature of this upgrade is the development of two new versions of the QIE (Charge Integrating Encoder), a Fermilab-designed custom ASIC for measurement of charge from detectors in high-rate environments. These most recent additions to the QIE family feature 3 fC sensitivity, 17-bits of dynamic range with logarithmic response, a Time-to-Digital Converter (TDC) with sub-nanosecond resolution all with 16 bits of readout per bunch crossing. The device is capable of dead-timeless operation at 40 MHz, making it ideal for calorimetry at the LHC. We present bench measurements and integration studies that characterize the performance, radiation tolerance measurements, and plans for deployment in the upgraded CMS detector.

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