

# Development and Commissioning of the CMS Luminosity Monitor

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We discuss the development and commissioning of a luminosity monitor. It is based on hardware that provides real-time histograms of data from the forward hadronic (HF) calorimeters in CMS. Measuring the total energy deposition and occupancy in these detectors allows us to calculate the relative instantaneous luminosity of the collider on a bunch by bunch basis also useful for machine diagnostics. Once calibrated with measurements from the LHC we will be able to make the first proton-proton inelastic cross-section measurement. The methods for achieving this will be discussed, as well as the readout hardware design and implementation details.

## Summary

Luminosity monitoring is a critical component of any particle physics experiment, allowing one to compute the cross-section for the physical processes occurring in the detector. The luminosity measurement in CMS will be used to monitor the LHC beam and provide overall normalization for physics analyses. For off-line analyses in CMS, the design goal is a systematic accuracy of less than 10% for a range of beam luminosities from  $10^{28}\text{cm}^{-2}\text{s}^{-1}$  to  $10^{34}\text{cm}^{-2}\text{s}^{-1}$ .

The CMS luminosity monitor is a system based on a mezzanine card called the HLX, mounted on the HCAL Trigger and Readout (HTR) board. It operates by histogramming data from the HTR boards for the forward hadronic (HF) calorimeters in CMS, which provide coverage from a pseudorapidity of 3 to 5 in both CMS end-caps. It computes both energy sums and counts of the number of physical towers below a preset energy threshold for this region, both of which can be extrapolated to measure luminosity. Combined with a careful off-line study, both the delivered and recorded luminosity can be measured. Using smaller sets of data, the real-time behavior of the system will be monitored online.

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