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## The CMS Beam Halo Monitor Electronics

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The CMS Beam Halo Monitor was installed during LHC LS1 to measure the machine induced background for Run II.

The system is composed of Cherenkov radiators coupled to photomultipliers.

The readout electronics uses new components developed for the CMS HCAL, adapted to beam monitoring requirements.

The signal is digitized by a charge integrating ASIC (QIE10), which also provides timing with ns resolution.

The backend electronics uses microTCA; it receives data via 5 Gbps optical links and records occupancy histograms.

The electronics has been operational since the first beams of Run II and has served as a demonstration of new technologies.

### Summary

The CMS Beam Halo Monitor has been successfully installed in the CMS cavern in LHC Long Shutdown 1 for measuring the machine induced background for LHC Run II. The system is based on 40 detector units composed of synthetic quartz Cherenkov radiators coupled to fast photomultiplier tubes. The readout electronics chain uses many components developed for the Phase 1 upgrade to the CMS Hadronic Calorimeter electronics, with dedicated firmware and readout adapted to the beam monitoring requirements. The PMT signal is digitized by a charge integrating ASIC (QIE10), providing both the signal rise time, with few ns resolution, and the charge integrated over one bunch crossing. The backend electronics uses microTCA technology and receives data via a high-speed 5 Gbps asynchronous link. It records histograms with sub-bunch crossing timing resolution and is readout by IPbus using the newly designed CMS data acquisition for non-event based data. The data is processed in real time and published to CMS and the LHC, providing online feedback on the beam quality. A dedicated calibration monitoring system has been designed to generate short triggered pulses of light to monitor the efficiency of the system. The electronics has been in operation since the first LHC beams of Run II and has served as the first demonstration of the new QIE10, Igloo2 and high-speed 5 Gbps with LHC data. This paper presents the Beam Halo Monitor and the performance of the electronics thus far in Run II.

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