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In-situ performance of the CMS Preshower Detector

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The CMS Preshower detector, based on silicon strip sensors, was installed on the two endcaps of CMS in March/April 2009. First commissioning showed that of the 137000 electronics channels virtually all were fully operational. This report summarizes the electronics integration (on-detector) and in-situ performance in terms of noise (including common-mode pickup), channel-to-channel variations, gain uniformities etc. Comparisons are made between these measurements and those made during assembly and system-tests. First observations of in-situ cosmic-rays are expected during the Summer.

Summary

This article describes the electronics performance of the CMS Preshower detector. The Preshower forms part of the CMS Endcap Electromagnetic Calorimeter system and is based upon layers of silicon strip sensors with their associated front-end electronics. Both endcaps were installed and commissioned in CMS during March/April 2009.

We start by giving an overview of the complete system, both on-detector and off-detector, with special focus on those parts that contribute to the electronics performance, such as the engineering design, silicon detectors, front-end electronics, power supplies (and associated distribution systems), cables and optical fibres. Indeed the integration of the on-detector components was a major challenge, given the extremely limited space available; Novel solutions were found to route all of the on-detector cables and fibres.

The off-detector control and readout electronics also contribute to the overall performance, so these too are described, including the algorithms implemented to perform data sparsification. These off-detector components also have the task of configuring the thousands of front-end chips, an operation that needs to be both fast and reliable. Finally in this section we give an overview of the slow control and safety systems (both hardware and software) that influence the performance - such as temperature and humidity control.

The second section presents the performance of the electronics, in terms of such quantities as intrinsic noise, linearity, dynamic range and susceptibility to influence from external (and internal) noise sources. We show these performances in absolute values and also in terms of uniformity across the detector. In our "calibration" mode we can obtain a signal to noise ratio (for single incident minimum ionizing particles - MIPs) of better than 9 with a linear dynamic range up to about 70 MIPs. In "normal" mode of operation the S/N for single MIPs is lower, at around 2.5, but the dynamic range is extended up to more than 400 MIPs. External influences (e.g. from neighbouring detectors) are shown to be small in relation to the intrinsic noise.

During the Summer the CMS detector will be configured to trigger on cosmic muons, both with and without the 4T magnetic field. We expect to detect the first in-situ signals inside the Preshower. A discussion on the results of these observations is foreseen.

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