

Results and Consequences of Magnet Test and Cosmic Challenge for the CMS Barrel Muon Alignment System

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In the last year –as part of the CMS test called Magnet Test and Cosmic Challenge (MTCC) - about 25% of the full CMS Barrel Muon Alignment System was built and operated. The configuration enabled us to test all the elements of the system and its function under real conditions. In the paper the setup –including the read-out and control- is described and the first preliminary results are presented. The correct operation of the system has been demonstrated. About 500 full measurement cycles have been recorded and evaluated.

Summary

In the past years the development of the CMS Barrel Muon Alignment system has been reported in regular papers presented at LECC conferences. In the last year –as part of the CMS test called Magnet Test and Cosmic Challenge (MTCC) –two sectors of the CMS Barrel Muon detector was equipped with the elements of the Barrel Muon Position Monitoring (Alignment) system. It consisted of 42 muon chambers, 10 rigid mechanical structures called MABs and 2 z-bars. These elements were holding 1800 LED light sources and 100 video-cameras connected to 10 PC/104 computers (called Board PC). This setup represented about the 25% of the final position monitoring system. All the elements had been calibrated according to the calibration scheme reported earlier. During the MTCC 14 muon chambers were operated as active muon detectors. For these chambers the LED light sources were controlled thorough the chamber control system as it is foreseen for the final CMS operation. For the others special LED control units called PIConNETs have been developed and used.

The global control and readout was performed using a dedicated Ethernet network consisting of a central measurement controller PC, 10 Board PCs and 28 PIConNET units. There were several goals of the tests during the MTCC. One group is related to the operation of the system. The other group of tasks was related to the observation of the deformations and movements of the CMS barrel and the barrel muon chambers during the operation, especially the effects related to the magnetic field.

During the two phases of the MTCC the system was operated regularly, in the second phase (Oct 2007) continuously. More than 500 measurement cycles have been completed.

The results can be summarized as follows:

- The system worked correctly and provided results that could be interpreted.
- The dynamic running scheme has proved to be very efficient leading to fully parallel operation of the board PCs.
- A full cycle lasted about 100 minutes. This is already acceptable for future CMS operation, however, significant improvements are possible in the future.
- Control of the operating muon chambers through the chamber DCS system went smoothly even at the maximum load of this channel.
- A separate test has been made during the MTCC to check the operation of commercial Ethernet switch units in magnetic field. This test was also successful.
- The resolution of the system in the most important phi-direction is ~ 20 micrometer, well below the specification. This enabled us to detect even thermal deformations due to the daily cycle.
- The irreversible deformation (shrinkage) of the full barrel yoke during the first magnet operation as well as the elastic deformation under field during the changes of the magnetic field have been observed and the result is in good agreement with the

preliminary finite-element calculations.

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