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Electronics system of the CMS GE1/1 Muon upgrade and performance of the Slice Test during the 2017-18 LHC Run

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In this contribution, we present the status of the electronics system of the triple-GEM detectors for the CMS GE1/1 upgrade which is being installed in 2019-2020, as well as the performance of ten prototypes which have been operated in CMS during 2017-18. For this new CMS muon sub-detector, a new front-end chip, the VFAT3, has been designed. The VFAT3 communicates with the back-end microTCA electronics through the GBTx chipset and the versatile link. Each of the 144 triple-GEM detectors has 24 VFAT3s, 3 GBTx chipsets as well as a Virtex-6 FPGA. All powered by 9 FEAST DCDC converters.

Summary

In this contribution, we will present the status of the readout electronics system of the triple-GEM detectors of the GE1/1 system which is being installed into CMS in 2019-2020 (LS2), as well as the performance of the ten “slice test” detectors which were operated in the CMS muon endcap during the 2017-18 LHC run. Ten “slice test” detectors were installed into the CMS endcap in January 2017. These detectors are read out on the front-end using 24 VFAT2 chips and a corresponding v2 optohybrid board, and from the back-end utilizing a microTCA crate containing CTP7 and AMC13 boards. Two of the ten detectors also include temperature sensors, and are powered via a multichannel power supply, as the final GE1/1 detectors will be. Data was recorded throughout the 2017 and 2018 LHC runs. In February 2018 two of these detectors have been replaced by final GE1/1 detectors equipped with the final (called v3) electronics. The overall performance of the slice test detectors recorded over these two years of data taking will be reported in this contribution. Using the lessons learnt from this slice test allowed for the further development of the final GE1/1 v3 electronics which will be used in the LS2 installation. The new detectors are now read out by the VFAT3 chip, which runs at 320 MHz, four times higher than the frequency of the VFAT2 chip, as well as the v3 optohybrid board which is equipped with a Xilinx Virtex6 FPGA and three CERN GBT chipsets. The on-detector electronics is powered via nine CERN FEAST DC-DC converters. In February 2018 two of such v3 detectors have replaced two of the v2 “slice test” detectors. This contribution will report on the improvements made to the electronics in view of the installation of GE1/1 and on the very first results of the final GE1/1 v3 electronics obtained in CMS. We will also report on the performance recorded with GE1/1 production chambers in a large test bench where up to 30 chambers are recording cosmic events during several weeks before being installed in the CMS muon endcap.

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