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The GEM Gas Monitoring system: using a gaseous detector as a gas detector for CMS Triple-GEM safe operation

The CMS experiment will exploit the Gas Electron Multiplier (GEM) technology for the first time during the next LHC run. These detectors will work with Ar/CO2 (70/30) gas mixture at an effective gas gain of around 2×104 . Maintain the gas mixture quality and concentration is fundamental for the safe and correct operation of such gaseous detectors. An Ar concentration 1% higher or lower will respectively increase or decrease the detector gain of almost 15%. A lower gain will reduce the detection efficiency (>97% at 2×104 gain) decreasing the physics potential, on the other hand, a higher gain will increase the probability to develop streamers and sparks during the electron multiplication. The latter potentially could damage the GEM foils and/or the readout electronics.

The CMS GEM Group decided to develop a monitoring system of the gas concentration by exploiting a small Triple-GEM detector. The gain measurement of this test chamber, fed by the gas mixture derived from the CMS GEM gas system, allows retrieving information about the Ar/CO2 ratio. The accurate removal of the gain fluctuations due to environmental changes, gas flow etc. have been implemented. Detection of wrong gas concentrations in the test chamber will allow to trigger warnings or alarms before sending the gas to the GEM detectors and eventually to real-time tune the working point.

This contribution will describe the GEM Gas Monitoring system from the design to the commissioning foreseen for end 2021. It will report about the calibration procedure, illustrating all the necessary steps to detect gain changes of around 5% corresponding to a systematic variation of Argon (or CO2) concentration of 0.33 %.

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