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A novel application of Fiber Bragg Grating (FBG) sensors in MPGD

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We present a novel application of Fiber Bragg Grating (FBG) sensors in the construction and characterisation of MPGD, with particular attention to the realisation of the largest triple GEM chambers so far operated, the GE1/1 chambers of the CMS experiment at LHC. The GE1/1 CMS project consists of 144 GEM chambers of about 0.5 m² active area each, employing three GEM foils per chamber, to be installed in the forward region of the CMS endcap during the long shutdown of LHC in 2018-2019. The large active area of each GE1/1 chamber consists of GEM foils that are mechanically stretched in order to secure their flatness and the consequent uniform performance of the GE1/1 chamber across its whole active surface. So far FBGs have been used in high energy physics mainly as high precision positioning and re-positioning sensors and as low cost, easy to mount, low space consuming temperature sensors. FBGs are also commonly used for very precise strain measurements in material studies. In this work we present a novel use of FBGs as flatness and mechanical tensioning sensors applied to the wide GEM foils of the GE1/1 chambers. A network of FBG sensors have been used to determine the optimal mechanical tension applied and to characterise the mechanical tension that should be applied to the foils. We discuss the results of the test done on a full-sized GE1/1 final prototype, the studies done to fully characterise the GEM material, how this information was used to define a standard assembly procedure and possible future developments.

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