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High rate capability studies of triple-GEM detectors for the ME0 upgrade of the CMS muon spectrometer

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The high-luminosity LHC (HL-LHC) upgrade sets a new challenge for particle detector technologies. In the CMS muon system gaseous detectors, the increase in luminosity will produce a particle background ten times higher than at the LHC. To cope with the high rate environment and maintain performance, the triple-Gas Electron Multiplier (GEM) technology was chosen for the high-rate capable detectors for the CMS ME0 upgrade project in the innermost region of the forward muon spectrometer. An intense $R\&D$ and prototype phase is ongoing to verify that such technology meets the stringent performance requirements of highly efficient particle detection in the harsh background environment expected in the innermost ME0 region. We describe recent rate capability studies on triple-GEM detectors operated with an Ar/CO_2 $(70/30)$ gas mixture at an effective gas gain of 2×10^4 by using a high-intensity 22 keV X-ray generator. In light of these rate capability studies, a novel foil design for the ME0 detectors was developed based on double-sided segmented GEM-foils and a high voltage distribution and filtering system. We describe the impact of the new design on detector performance and present a summary of ongoing R&D activities.

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