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New micropattern gas detectors for the endcap muon system of the CMS experiment at the high-luminosity LHC

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For the era of the high-luminosity LHC, new detectors are planned to enhance the performance of the endcap muon system of the CMS detector. We report on two types of these detectors that will be installed during the third long shutdown (LS3) of the LHC. In the pseudo-rapidity region 1.6 < eta < 2.4, new triple-foil large-area gas-electron multiplier (GEM) detectors will be installed in the third of five detector stations in each endcap, the first station being closest to the interaction point. These GEM detectors are in addition to ones that will have already been installed in the second station during LS2. We present a design for the third station detectors that must cover a larger geometrical area than those in the second station, while maintaining good performance for efficiency and spatial resolution.

A new innermost (first) detector station will be installed in the endcaps to extend the range of muon identification up to about eta = 3.0. We describe the geometrical constraints and particle fluxes at the first station. The detector technologies under consideration include fast-timing micropattern (FTM) structures that can tolerate large particle fluxes and provide good time resolution. FTM detectors employ multiple layers of resistive-coated kapton foils with either hole or mesh electron multiplication structures. We report on the performance of prototype FTM devices for efficiency, space and time resolution measured using X-rays, cosmic-ray muons, and extracted high-energy particle beams.

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