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New gas electron-multiplier detectors for the innermost stations of the endcap muon system of the CMS experiment: design, prototype performance, and installation

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The high luminosity operation of the LHC will require new detectors in the CMS endcap muon system to suppress the trigger rate of background events, to maintain high trigger efficiency for low transverse momentum muons, and to enhance the robustness of muon detection in the high-flux environment of the endcap. We report on recent progress towards implementing a new system of large-area, triple-foil gas electron-multiplier (GEM) detectors with geometric acceptance in the pseudo-rapidity region $1.6 < \eta < 2.2$. The detectors reported here will be installed in (what will be) the second of five muon detector stations in each endcap, the first station being closest to the interaction point. We describe the design of the chambers and readout electronics and report on the performance of a prototype system in tests with cosmic ray muons and extracted high-energy particle beams. We describe plans to install a prototype system in the CMS experiment in 2017, with subsequent operation during the current Run 2 of the LHC. The full system for the second endcap stations will be installed in the long shutdown planned for 2018-2019, ready for subsequent operation in Run 3.

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