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Longevity studies with full-scale CMS cathode strip chambers using gas mixtures with reduced CF₄ content

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Cathode strip chambers (CSCs) are a key component of the endcap muon system in the CMS experiment at CERN. There are 540 CSCs successfully operating at CMS with a gas mixture of 40% Ar, 50% CO₂, and 10% CF₄. The chamber longevity study is particularly important in anticipation of the upcoming HL-LHC upgrade and the corresponding CMS detector upgrade, which will result in a significant increase of background rates in the forward region. Due to the high global warming potential (GWP) of CF₄, the longevity tests also aim to probe CSC operation with a reduced content of this gas.

The longevity of CSCs is being investigated using two production CMS CSCs of type ME1/1 and ME2/1, at the Gamma Irradiation Facility (GIF++) at CERN, where the charge accumulation rate is approximately 30 times higher than the expected HL-LHC conditions. Currently, the accumulated charge in these chambers is approaching three times that expected from the HL-LHC. Throughout the irradiation studies, three gas mixtures—40% Ar + CO₂ with varying CF₄ concentrations of 10%, 5%, and 2%—were evaluated, with no observed degradation in chamber performance.

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