

# Performance of Eco-friendly Gas Mixtures in CMS Improved Resistive Plate Chambers in the HL-LHC Environment

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Resistive plate chamber (RPC) detectors in the Compact Muon Solenoid (CMS) operate with a gas mixture made of 95.2%  $C_2H_2F_4$  (providing a high number of ion-electron pairs), 4.5%  $iC_4H_{10}$  (ensuring the suppression of photon-feedback effects), and 0.3%  $SF_6$  (used as an electron quencher to further operate the detector in streamer-free mode).  $C_2H_2F_4$  is known to be a greenhouse gas with a global warming potential (GWP) of 1430. Several eco-friendly alternatives to  $C_2H_2F_4$  have been studied in the last few years with good performance for HFO based mixtures. Degradation studies for the chambers are now ongoing. Also in this context, one short- to medium-term approach for the coming years of LHC operation could be to focus on reducing the GWP of the RPC gas mixture by only adding  $CO_2$  instead of  $C_2H_2F_4$ . Studies were performed at the CERN Gamma Irradiation Facility (GIF++) in the North Area of the LHC where a 13.6TBq radiation source and a muon beam from SPS mimic HL-LHC conditions. In this work we present the performance and future perspectives of a 1.4 mm gap RPC chamber with HFO and  $CO_2$  based mixtures with a high gamma background.

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