Contribution ID: **110** Type: **Poster**

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

Thursday 7 September 2023 10:20 (10 minutes)

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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Session Classification: Poster Session II

Track Classification: Gas-based Detection Methods