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Study of environment-friendly gas mixtures for the Resistive Plate Chambers

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The standard gas mixture for the Resistive Plate Chambers (RPC), composed of $C_2H_2F_4$/i- C_4H_{10}/SF_6, has a high Global Warming Potential (GWP ~1430) mainly due to the presence of $C_2H_2F_4$. This gas is not recommended for industrial uses anymore, therefore it will be problematic to use it in the next future. We report the performance of the RPC working with new environment- friendly gases which could replace the standard mixture. The new gaseous components have the Global Warming Potential (GWP) at very low level. In this work the standard mixture main component, the $C_2H_2F_4$ (GWP~1300), is replaced by a proper mixture of CO_2 (GWP = 1) and Tetrafluoropropene ($C_3H_2F_4$, GWP~6). The other high-GWP component, the SF_6 (GWP ~ 23900), is replaced by a new molecule, the Chloro-Trifluoropropene ($C_3H_2ClF_3$, GWP ~ 5) never tested in the RPC detectors. The mixtures studied have a total GWP ~ 10. We report, for several eco-gas mixtures, the detection efficiency, streamer probability, electronic and ionic charge as a function of the high voltage. Moreover the timing properties are studied and the detector time resolution is measured. We also focus the attention on a new category of signals having intermediate properties between avalanche and streamer, called "transition events". This category is negligible for the standard gas mixture but relevant for HFO based gas mixtures. We show a direct comparison between SF6 and C3H2ClF3 to study in depth the possibility to replace an industrially very important molecule like SF_6.

In-person participation

Yes

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