Contribution ID: **157** Type: **Live Presentation**

Operating the Resistive Plate Chambers with new eco-friendly gases

Wednesday 23 February 2022 14:25 (20 minutes)

In this presentation we report the performance of the Resistive Plate Chambers (RPC) working with new eco-friendly gases which are intended to replace the traditional standard mixture($C_2H_2F_4/i-C_4H_{10}/SF_6$). The new gaseous components have Global Warming Potential (GWP) and Ozone Depletion Potential (ODP) both at very low or null level. Indeed the $C_2H_2F_4$ (GWP˜1430) is replaced by a proper mixture of CO_2 and Tetrafluoropropene ($C_3H_2F_4$, GWP ˜ 6) and the SF_6 (GWP ˜ 23900) is replaced by a new molecule, the Chloro-Trifluoropropene ($C_3H_2ClF_3$, GWP ˜ 5).
We present here, for several tested mixtures: detection efficiency, streamer probability, prompt and ionic charge as a function of the high voltage. Prompt and ionic charges are generated by electrons fast drift and ions slow drift motion respectively.
We also focus the attention on a new category of signals having intermediate properties between avalanche and streamer. This category is negligible for the standard gas mixture but relevant for HFO based gas mixtures. The timing properties are studied and the detector time resolution is measured.
A direct comparison between SF_6 and $C_3H_2ClF_3$ is performed to study in depth the possibility to replace an industrially very important molecule like SF_6 .

Primary experiment

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Session Classification: Gaseous Detectors

Track Classification: Gaseous Detectors