Contribution ID: **22** Type: **Plenary Talk**

R&D studies on eco-friendly gas mixtures for the ALICE Muon Identifier

Wednesday 21 February 2018 15:00 (20 minutes)

Resistive Plate Chambers (RPCs), used for the Muon Spectrometer of the ALICE experiment at CERN-LHC, are currently operated in maxi-avalanche mode with a low threshold value and without amplification in the front-end electronics. The gas mixture is made up of $C_2H_2F_4$, SF_6 and iC_4H_{10}. Since the first two gases have high global warming potentials (GWP), they will probably be phased out of production in the next years, due to the recent restrictions and regulations of the European Union; meanwhile their cost is progressively increasing. The iC_4H_{10} is present in the mixture for ALICE with such a concentration that makes it flammable.

RPC detectors have shown a good operation stability with the current gas mixture during the entire Run 1 and the ongoing Run 2 at the LHC. Nevertheless, finding a new eco-friendly gas mixture will become extremely important in order to reduce the emissions of greenhouse gases. In addition, components in non-flammable concentrations would be advisable to make the operation of detectors simpler and safer. In order to identify a gas mixture with the above characteristics and suited to cope with the requirements of the ALICE Muon Identifier in the forthcoming High-Luminosity runs, a dedicated experimental set-up has been used to carry out R\&D studies on promising gas mixtures with small-size ($50 \cdot 50 \cdot 0.2\ cm^3$) RPCs.

Hydrofluoroolefins (HFOs) are appropriate candidates to replace $C_2H_2F_4$ thanks to their very low GWPs, especially the $HFO1234ze$ which is not flammable at room temperature and has a GWP lower than 1. Several tests on HFO-based mixtures with addition of various gases are ongoing and encouraging results have already been obtained. Furthermore, the use of CO_2 as a quencher has been studied as it might represent a valid solution to avoid flammability of the mixture. Finally, medium-term stability of detectors exposed to the cosmic-ray flux will be shown.

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Session Classification: Eco Friendy Gases