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Studies on tetrafluoropropene-CO2 based gas mixtures for the Resistive Plate Chambers of the ALICE Muon IDentifier

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Due to their simplicity and comparatively low cost, Resistive Plate Chambers are gaseous detectors widely used in high-energy and cosmic rays physics when large detection areas are needed. However, the best gaseous mixtures are currently based on tetrafluoroethane, which has the undesirable characteristic of a large Global Warming Potential (GWP) of about 1400 and, because of this, it is currently being phased out from industrial use. As a possible replacement, tetrafluoropropene (which has a GWP close to 1) has been taken into account.
Since tetrafluoropropene is more electronegative than tetrafluoroethane, it has to be diluted with gases with a lower attachment coefficient in order to maintain the operating voltage close to 10 kV. One of the main candidates for this role is carbon dioxide. In order to ascertain the feasibility and the performance of tetrafluoropropene-CO2 based mixtures, an R&D program is being carried out in the ALICE collaboration, which employs an array of 72 Bakelite RPCs (Muon Identifier, MID) in order to identify muons. Different proportions of tetrafluoropropene and CO2, with the addition of small quantities of isobutane and sulphur hexafluoride, have been tested with 50x50 cm2 RPC prototypes with 2 mm wide gas gap and 2 mm thick Bakelite electrodes.
In the presentation, results from tests with cosmic rays will be presented, together with data concerning the current drawn by a RPC exposed to the gamma-ray flux of the Gamma Irradiation Facility (GIF) at CERN. Moreover, a beam test at GIF is scheduled in July, 2021 and some of its preliminary results will be shown.

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