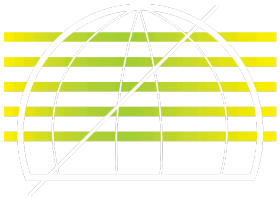

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Possible alternatives to SF6 for Resistive Place Chambers

Wednesday, 28 September 2022 11:00 (25 minutes)

Resistive Plate Chambers (RPCs) are widely employed in Particle Physics and at CERN LHC Experiments thanks to their excellent time resolution and low cost. In most of the applications, RPCs are operated with a humidified gas mixture made of C2H2F4, SF6 and iC4H10. Unfortunately, C2H2F4 and SF6 are greenhouse gases (GHGs) with a global warming potential (GWP) of 1430 and 22800 respectively. The SF6 is the world' s most potent greenhouse gas and, even if it is used in low concentrations (about 0.3% for bakelite RPCs and 7% in glass RPCs), it contributes considerably to the GWP of the RPC gas mixture. A search for alternatives to SF6 it is therefore advisable.

In the recent years, industry research has also focused on alternatives to SF6, which is mainly used as insulator for high-voltage plants. The 3M Company has developed two new alternatives to SF6 with a high dielectric strength and low GWP: 3M Novec 5110 (CF3C(O)CF(CF3)2) and 3M Novec 4710 ((CF3)2CFCN). Two other gases have been studied in this work: the CF3I, which has a GWP of 0.4 and is very electronegative but it is toxic, and the C4F8O, which has a high GWP (~8700) but has good electronegative properties. Furthermore, in the family of HydroFluoroOlefyn (HFO), the Amolea 1224yd (C3HF4Cl), which has a GWP less than 1 and it contains a Cl atom, was tested.

The studies on alternatives to SF6 have been performed by using the standard gas mixture as reference and replacing the SF6 with the new candidates. For each candidate, different concentrations were tested to better characterise its properties. Afterwards SF6 was also replaced in new eco-friendly gas mixtures. Detector performance were studied in terms of efficiency, streamer probability, rate capability, induced charge, cluster size and time resolution. Studies were done firstly in a laboratory set-up and afterwards, for some selected eco-friendly gas mixtures, at the CERN Gamma Irradiation Facility (GIF++), which provides a muon beam combined with a gamma source, allowing to simulate the background expected at HL-LHC.

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