EPJ plus focus point paper

Comment discussion

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On the role of each gas in the mixture

- Table 2: In the eco-friendly gas mixture, which gas is acting as a primary ionising gas under different compositions? Why SF6 concentration increased from 0.3% in STD to 1% in all other gas mixtures? Shouldn't this increased concentration should also be taken into account while comparing the performances with the STD mixture?

Table 2: Composition of the gas mixtures used in the tests described in this paper

Mixture	$C_2H_2F_4$ %	HFO %	CO_2 %	i-C_4H_{10} %	SF_6 %	GWP	CO_2e (g/l)
STD	95.2	0	0	4.5	0.3	1485	6824
MIX0	0	0	95	4	1	730	1480
MIX1	0	10	85	4	1	640	1490
MIX2	0	20	75	4	1	560	1495
MIX3 or ECO3	0	25	69	5	1	527	1519
MIX4	0	30	65	4	1	503	1497
MIX5 or ECO2	0	35	60	4	1	476	1522
MIX6	0	40	55	4	1	457	1500

- **L242: Is CO2 acting as primary ionising gas here?** The data we found is the following: I(CO2) = 13.8 eV, Np(CO2) = 36/cm; I(R1234ze) = 92, Np(R1234zw) = 89.5/cm, I(R134a) = 95, Np(R134a) = 80/cm From this paper and Sauli's book

On the role of each gas in the mixture

- L301: Is HFO acting as a quenching gas or an ionising gas? If this is a quenching then CO2 is ionising? This seems confusing because in L245-246 an opposite effect is observed where by decreasing the ionising gas (presumably CO2) the efficiency is claimed to increase though its not seen in Fig. 3. Please see above comments.

- Again in L320-321, it is being claimed that by increasing the HFO fraction above 50% is advisable in order to reach high efficiency plateau. This claim is opposite to the effect described in L301. So basically section 3.1.3 is not consistent with the earlier paras.

- L324-325: The statement about increase of working point also increases with the HFO concentration increase is true if HFO is acting as quenching gas.

- **We always claim that more HFO is added to the mixture the more the max eff increases (denser mixture so HFO seems the ionising gas) but also that the WP shifts to higher values so at the same time it seems that HFO is also quenching gas. What could we reply to all these comments? They are pretty much all centered on this subject**

Aging

- Section 4.2 ends without any analysis and conclusion so what the readers are supposed to learn from it? Its understood that these are very preliminary results for aging studies and hence authors may not be willing to draw any conclusion but the authors at least must explain what they learned from their observations and what other studies are needed in order to draw some concrete conclusions.

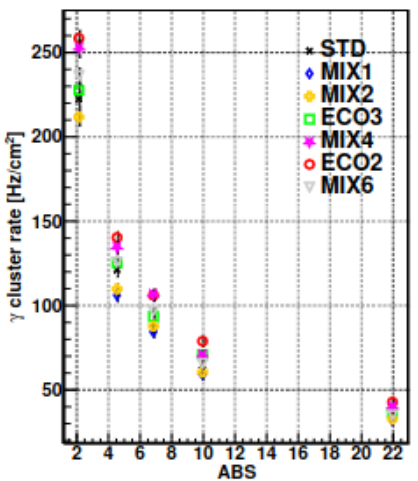
Also, from figure 17, it is possible to see that the Ohmic component of the dark current shows an increasing trend at the start of the irradiation, while it reaches a more stable behavior for higher values of integrated charge density. For what concerns the total dark current density, it shows a more uniform increasing trend during the whole irradiation campaign. This needs to be closely monitored in time, especially for some specific detectors, which showed a more significant increase of the total dark current density than others. To shed some light on this, the RPC ECOgas@GIF++ collaboration is planning to start the monitoring of other parameters, such as the presence of possible current leaks on the mechanical frame and the production of fluorinated impurities in the exiting gas mixture. Moreover, one also needs to monitor the detectors performance in terms of response to cosmic/beam muons, with time. This has been done in July 2023, when another beam test campaign was carried out and the data gathered is currently being analyzed. In this way, one will be able to estimate the performance evolution and have a first insight on the real aging observed on the detectors.

The integrated charge density during around one year of exposure to the GIF++ ^{137}Cs source, is shown in figure 18. The left panel shows the results for the three gaps of the CMS RE11 RPC while the right panel refers to the other detectors. The fact that the integrated charge density is not exactly the same across the detectors, can be explained by considering that the irradiation voltage chosen does not exactly correspond to the same efficiency value.

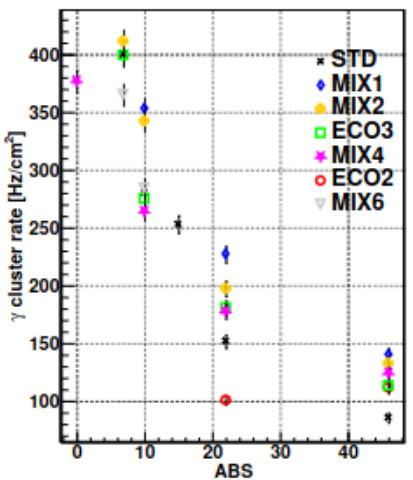
Various

- L213-215: The different digitizer time window for different RPCs would make the comparison of their performances difficult unless it has been accounted in while carrying out the analysis, for eg. While looking at the charge distribution or signal strength? I suggest re-writing this paragraph by adding more information and explanation.

- Fig. 8, right panel: There is also a big variation in the rates for various gas mixtures which doesn't show any particular pattern. For eg. ECO2 rates at around 20 ABS is about 100 whereas ECO3 is almost around 180 with STD in between. This is again very surprising. The similar variation is not present in the Fig. 8 left panel. In Fig. 9, the ECO3 and ECO2 rates are very similar for the ABS of 20 but again different for ABS of 10. So all these three figures doesn't seem to be in agreement with each other and appears to convey different messages.



Left panel



Right panel