

Comparison of Test beam 2023 vs 2021 with the CMS Chamber

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- The principal idea is to study the aging effect of the CMS RPC chamber (RE1_1) by comparing the various parameters for the 2021 and 2023 data.
- We then collected the 2021 data and software from Mapse Barroso and 2023 data from Amrutha. Thanks.

	2021			2023		
ABS	STD	ECO2	ECO3	STD	ECO2	ECO3
OFF	4795	4943	4873	660	669	650
460	4798	4946	4872			
220	4791	4947	4870			
100	4806	4948	4826	662	672	651
22	4800	4979	4829	656	663	649
10	4813	5014	4920			
6.9	4801	4992	4863	654	665	576
4.6	4816	5015	4888			
3.3	4817	4981	4936	657	670	648

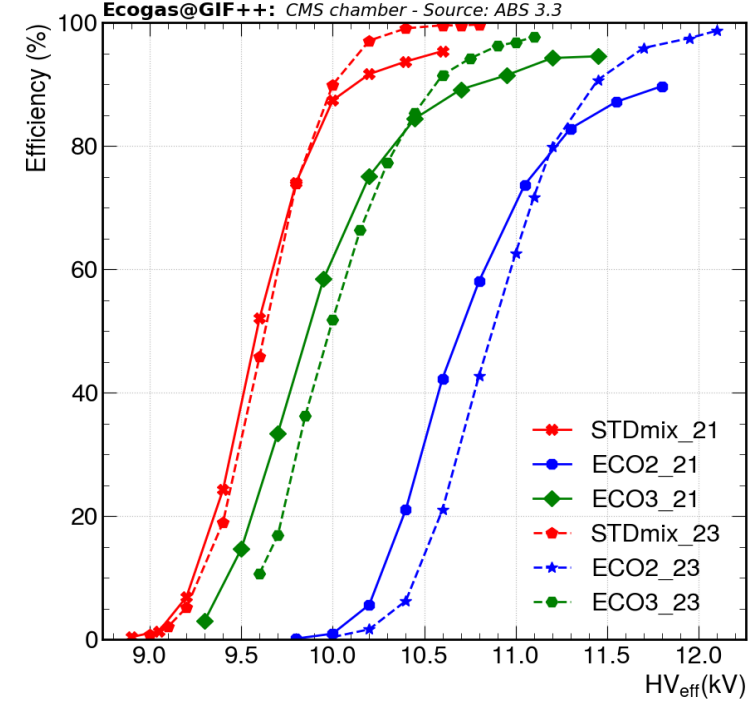
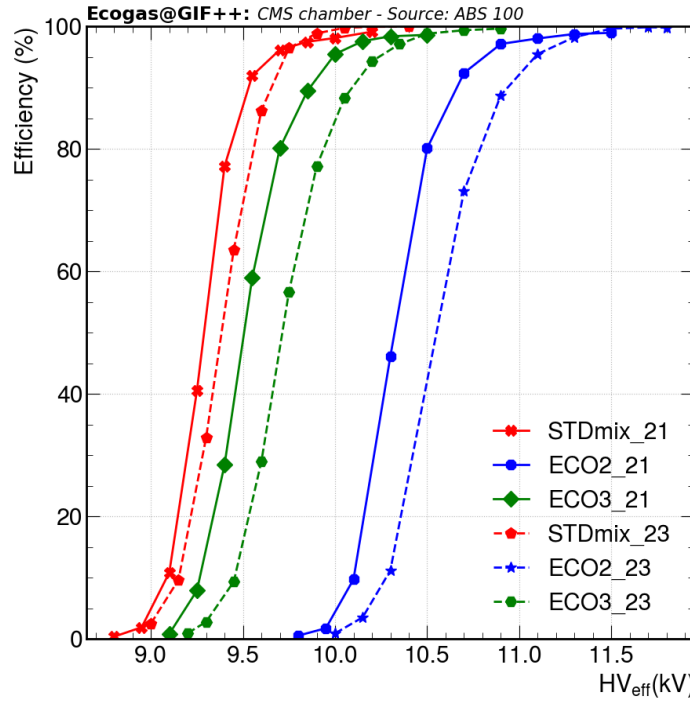
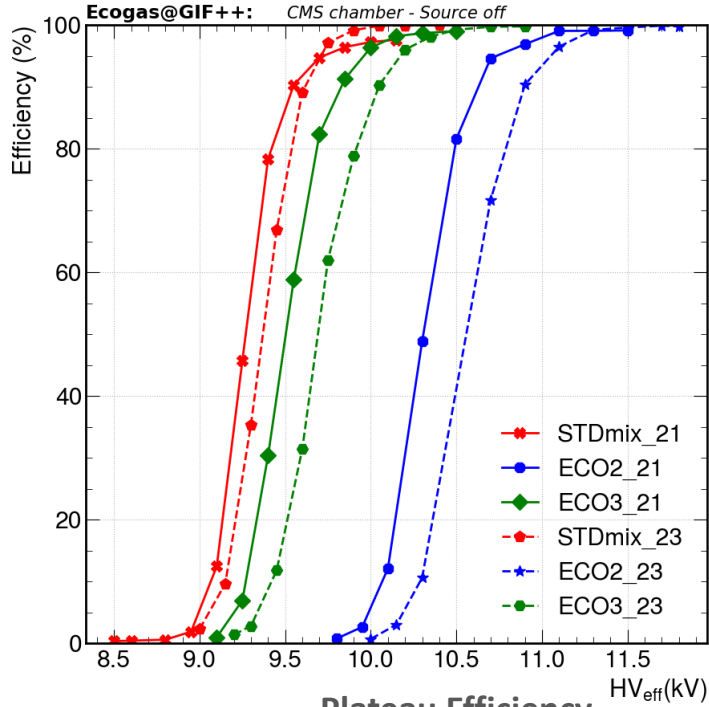
STD : 95.2% R134a, 4.5% i-C₄H₁₀ and 0.3% SF₆

ECO2: 60% CO₂, 35% HFO, 4% i-C₄H₁₀ and 1% SF₆

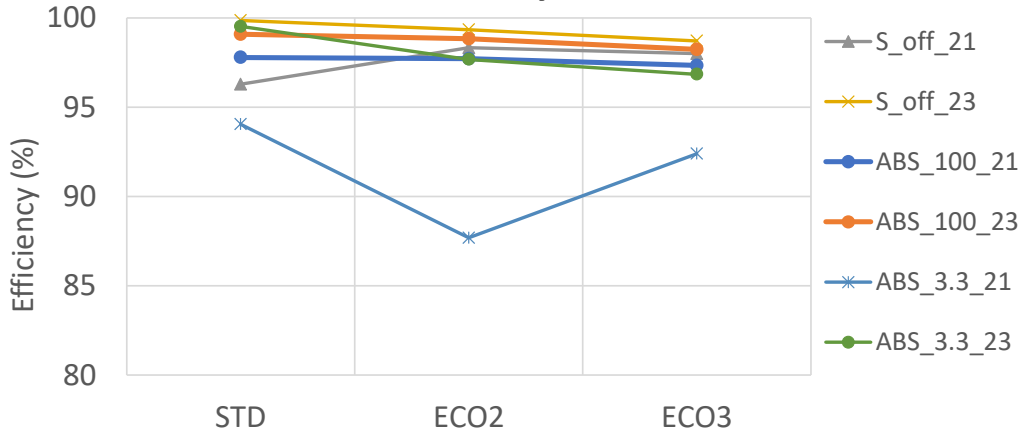
ECO3: 69% CO₂, 25% HFO, 5% i-C₄H₁₀ and 1% SF₆

- We selected the data to analyse in the following order: source off, ABS_100, and ABS_3.3.
- Initially, we started with the comparison of HV_eff vs. efficiency, current density, and muon cluster size.

Efficiency vs HV_eff



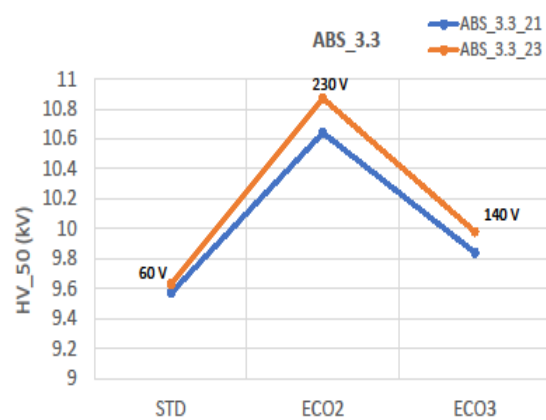
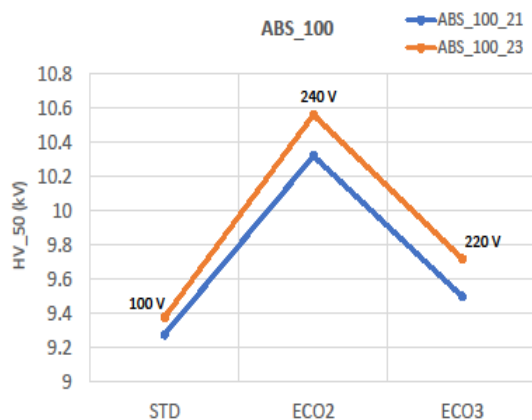
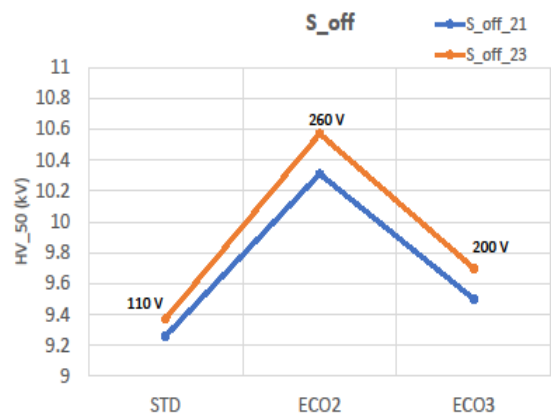
Plateau Efficiency



	HV Knee (kV)								
	S_off_21	S_off_23	Diff (V)	ABS_100_21	ABS_100_23	Diff (V)	ABS_3.3_21	ABS_3.3_23	Diff (V)
STD	9.69	9.83	140	9.71	9.86	150	10.16	10.23	70
ECO2	10.8	11.13	330	10.8	11.14	340	11.28	11.61	330
ECO3	9.98	10.25	270	9.99	10.28	290	10.62	10.78	160

Table 1: Working point voltages for all the three gas mixtures

HV 50 plots (chamber efficiency reaches 50%)

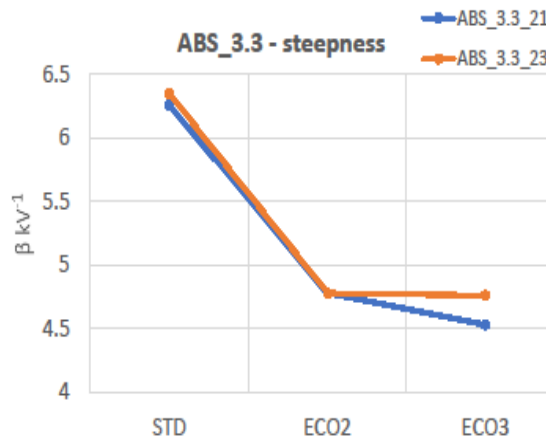
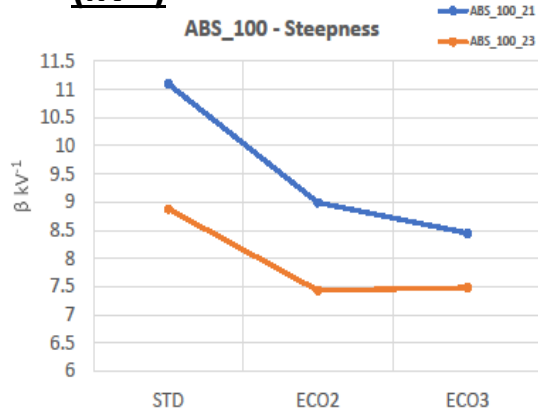
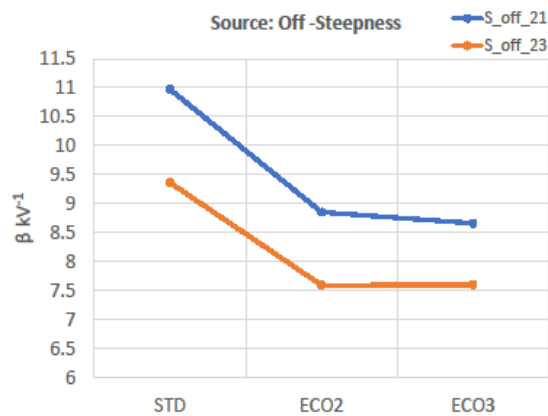


S_off	HV_50% (kV)		Diff (V)
	2021	2023	
STD	9.26	9.37	110
ECO2	10.31	10.57	260
ECO3	9.5	9.7	200

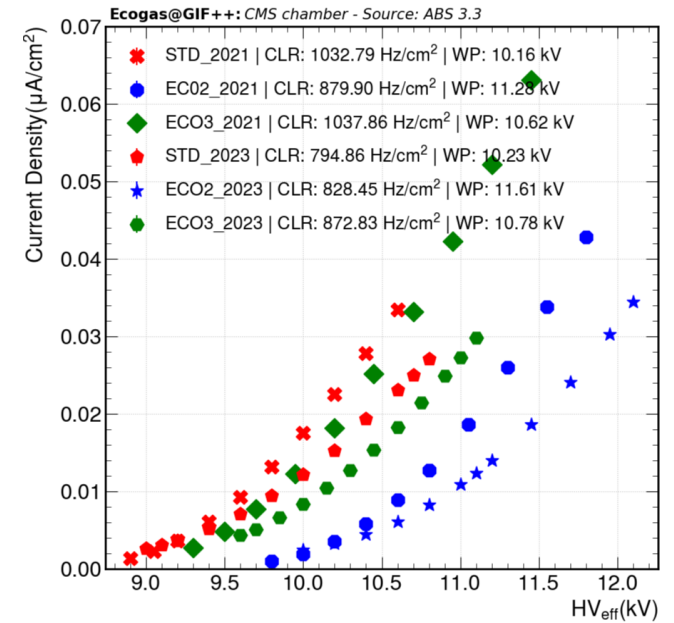
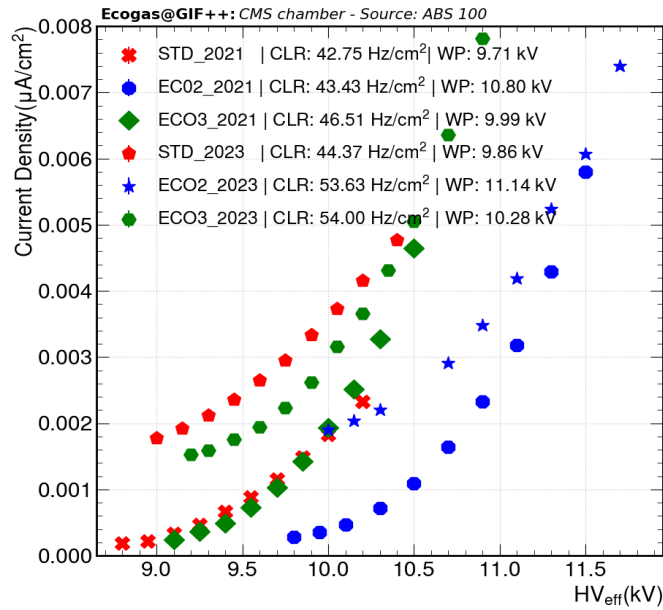
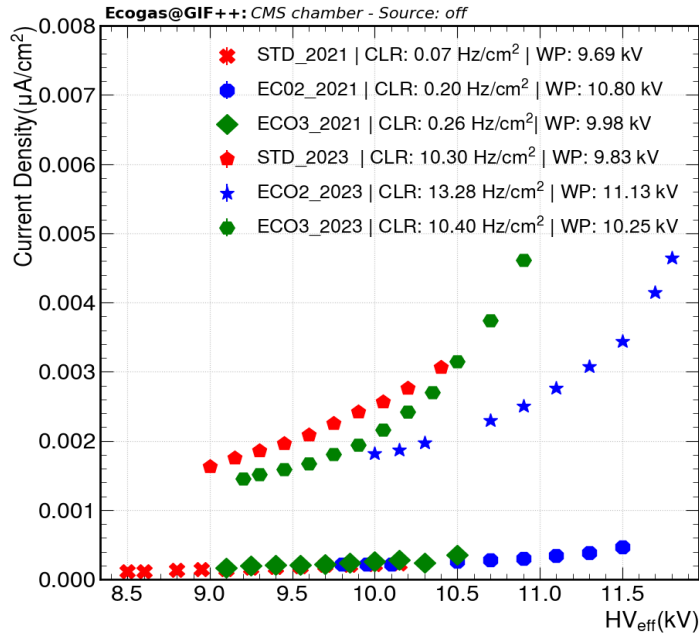
ABS_100	HV_50% (kV)		Diff (V)
	2021	2023	
STD	9.28	9.38	100
ECO2	10.32	10.56	240
ECO3	9.5	9.72	220

ABS_3.3	HV_50% (kV)		Diff (V)
	2021	2023	
STD	9.57	9.63	60
ECO2	10.64	10.87	230
ECO3	9.84	9.98	140

Slope of the efficiency curve β (kV⁻¹)

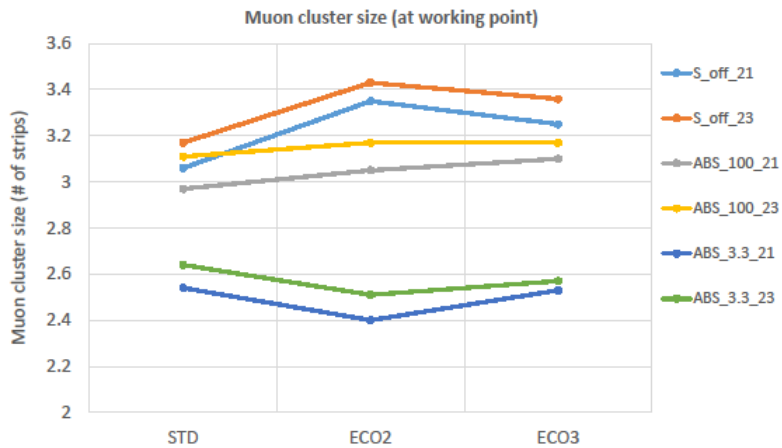
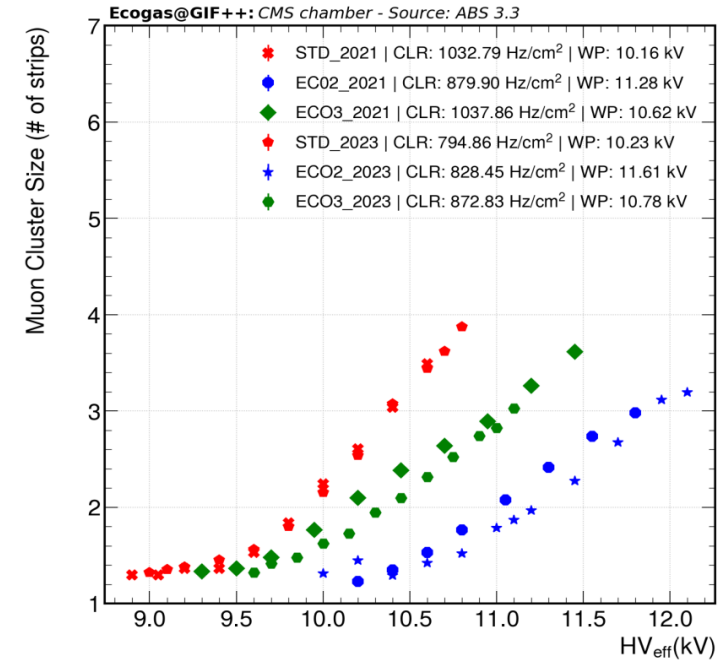
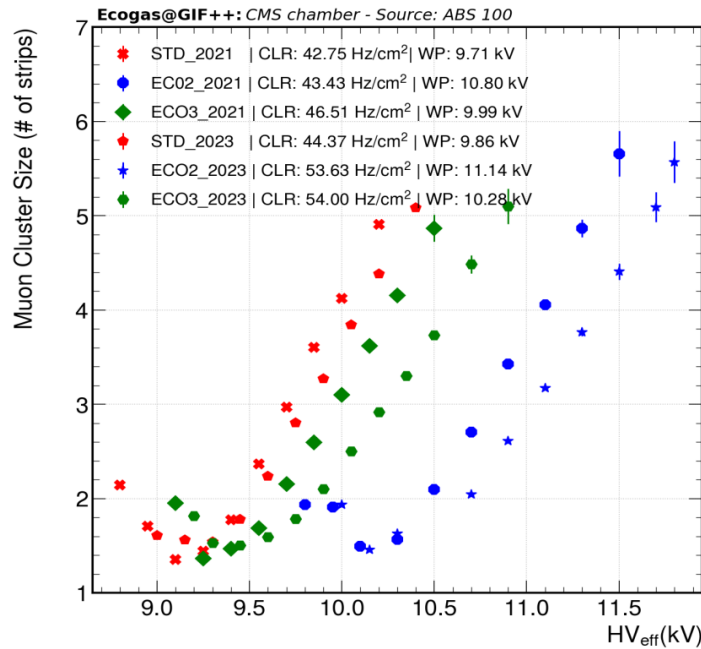
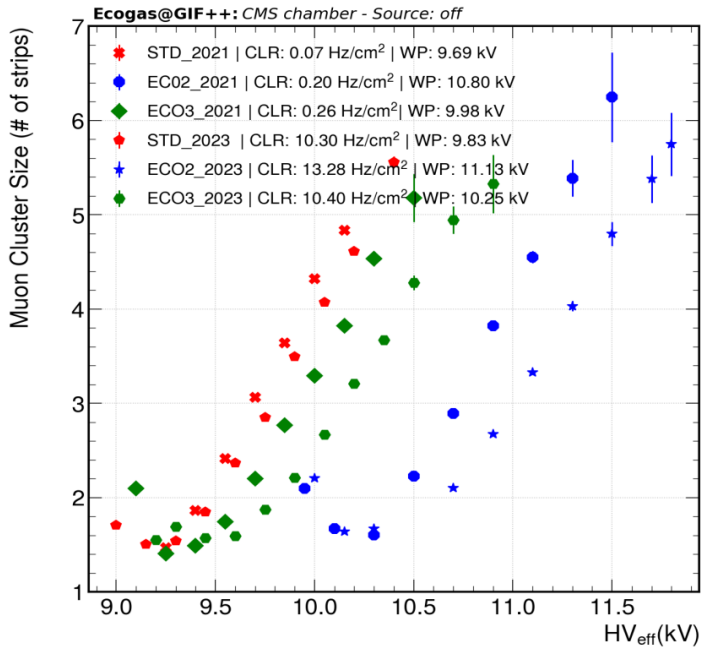


Current density vs HV eff



- Source off: In the 2021 data, the current density rates for STD, ECO2, and ECO3 gas mixtures are approximately 0.2 ± 0.1 nA. In the same source-off condition in 2023, the current density rises to 2 to 3 nA for all gas mixtures at their working points, representing a nearly 10 times increase in current density.
- Under irradiation and with ABS_100, 2021 data shows that the current density rates for STD, ECO2, and ECO3 gas mixtures rise to 1.2, 1.6 and 2 nA. In the 2023 data, the current densities are 3.2, 3.5 and 4.2 nA for STD, ECO2, and ECO mixtures respectively, at their working points.
- Under irradiation and with ABS_3.3, 2021 data shows that the current density rates for STD, ECO2, and ECO3 gas mixtures rise to 22, 26 and 32 nA. In the 2023 data, the current densities are 14, 24 and 22 nA, respectively at their working points.
- The current density increases with increased irradiation as well as when employing ECO2 or ECO3 with respect to the STD gas mixture.

Muon cluster size vs HV_eff



- The data showed that the muon cluster size decreased as the irradiation cluster rate increased.
- Furthermore, there is a modest rise in cluster size between the data from 2021 and 2023 at their working points for all gas mixtures.

Conclusion:

- There was **no** significant **drop** in plateau **efficiency** from 2021 to 2023.
- A **shift in working points** of approximately **140 V, 330 V, and 270 V** for STD, ECO2, and ECO3 gases, respectively, from 2021 and 2023.
- From 2021 to 2023, a **shift in HV** to achieve chamber **efficiency for 50%** for STD, ECO2, and ECO3 gases are roughly **110 V, 240 V, and 220 V**, respectively.
- There is a **decline in the slope steepness** between 2021 and 2023 in the efficiency curves for all gas mixtures.
- From 2021 to 2023, **current density increases** by ten times for source off and twice as much for ABS_100.
- Muon cluster size was **slightly increased** from 2021 to 2023 data.

Future analysis:

- We plan to analyse the **Efficiency vs HV_gas** to **understand** about the **shift in voltages** between 2021 and 2023.