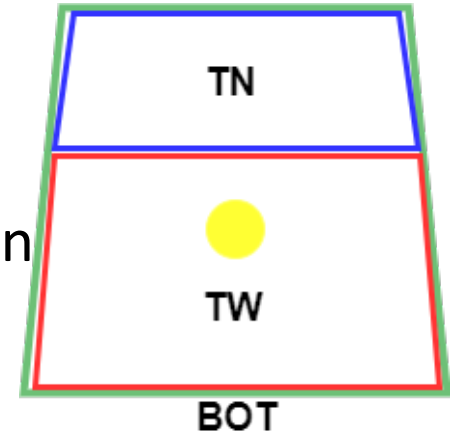
Comparison of Test beam 2023 vs 2021 with the CMS Chamber

Continuation…

- To understand the shift in working points between 2021 and 2023, we started to study the HV_{gas} parameters for the RPC.

$$HV_{gas} = HV_{eff} - RI$$



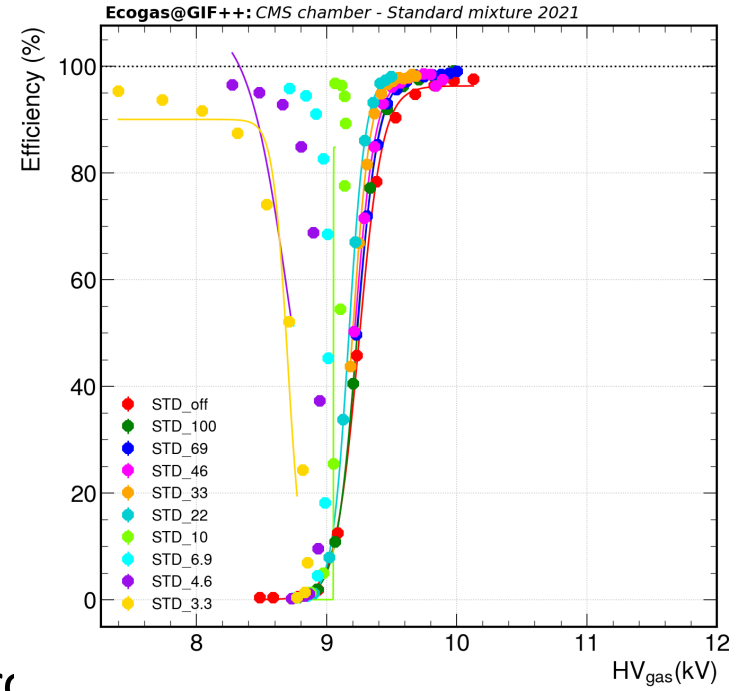
- For this study, We only considered Bottom RPC and Top Wide RPC from CMS chamber. Since Top Narrow RPC was not participating in the irradiation

$$HV_{gas}\,(BOT) = HV_{eff} - R\,(BOT) * I\,(BOT)$$

$$HV_{gas}\,(TW) = HV_{eff} - R\,(TW) * I\,(TW)$$

Measured Resistance values			
Oct-21		Oct-23	
RPC	R (Ω)	RPC	R (Ω)
BOT	11×10^6	BOT	20×10^6
TW	29×10^6	TW	93×10^6
TN	19×10^6	TN	48×10^6

- Initially we try to obtain the ΔV = RI values by using the measured resistance values and current drawn by the RPCs.
- This is the 2021 data for std gas mixture for all absorption filters.
- From ABS_10 onwards the HV_{gas} observed to be shifting in the opposite direction, which means there is a reduction in HV_{gas} .



- It is impossible to achieve such outcomes, i.e., efficiency will not grow when the HV_{gas} value falls.
- So, we varied the value of R to bring down the plateau region in the appropriate way.

$$HV_{gas} = HV_{eff} - \frac{1}{2} R (I_{BOT} + I_{TW})$$

- The Estimated value of R for 2021 is 9.5 x 10^6 Ω. (9.5 M Ω) (for all Std, ECO2 and ECO3)
- The Estimated value of R for 2023 is 15 x 10^6 Ω. (15 M Ω)

Source off

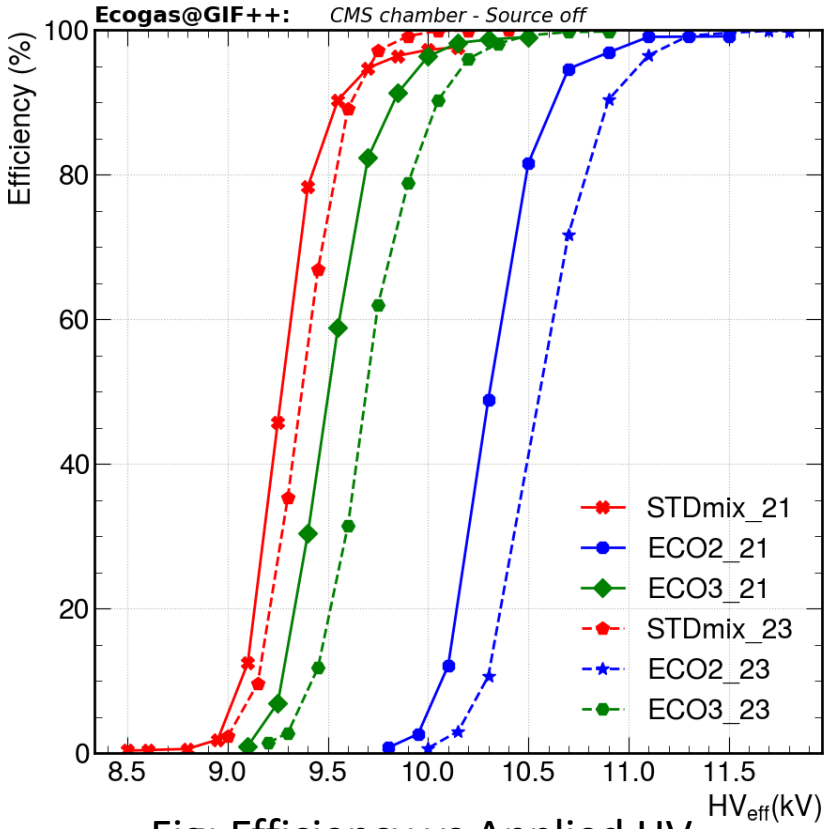


Fig: Efficiency vs Applied HV

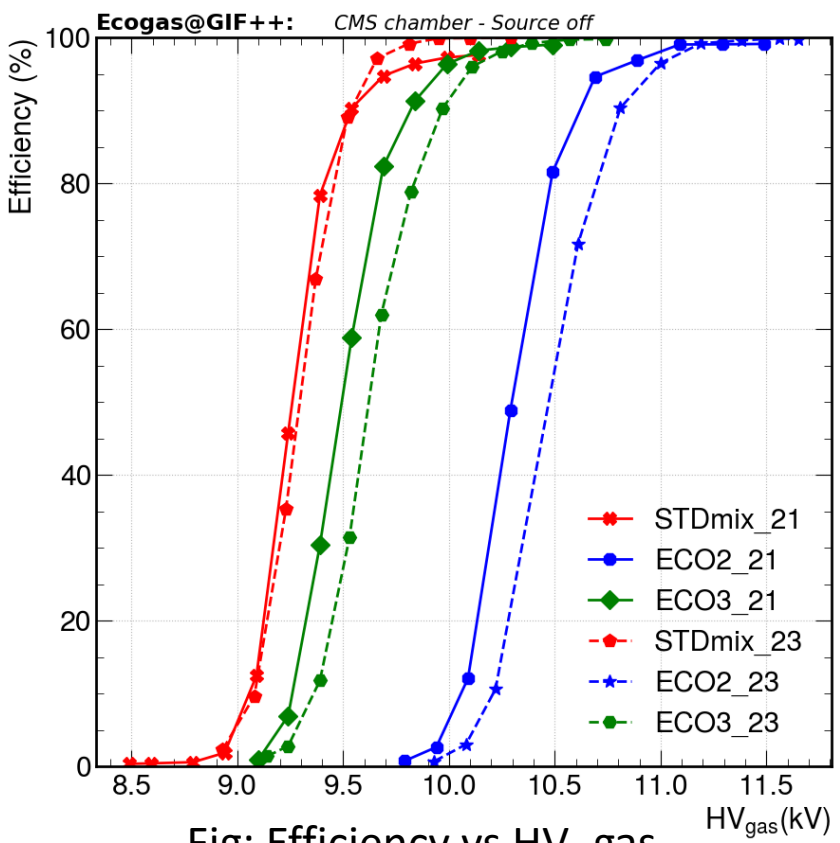


Fig: Efficiency vs HV_gas

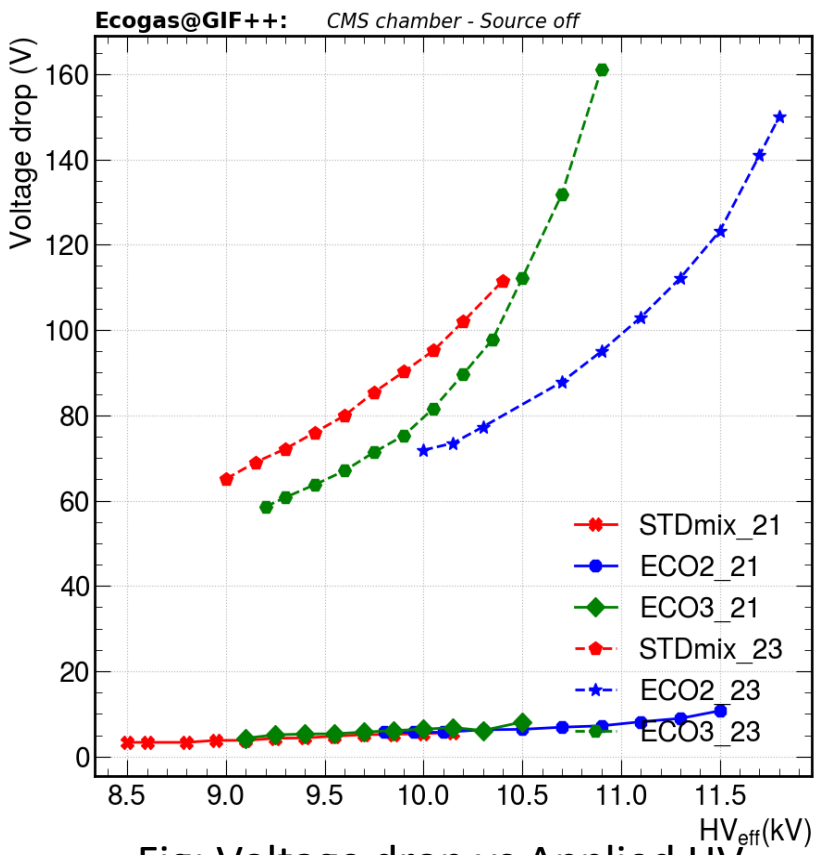


Fig: Voltage drop vs Applied HV

- There is a Shift in HV_gas for Std, ECO2 and ECO3 mixtures : 30 V, 190 and 130 V respectively
- Voltage drop at the electrode increased by approximately 90 to 100 Volts during 2023 at their working points.

S_off	HV_50% (kV)		Diff (V)
	2021	2023	
STD	9.26	9.29	30
ECO2	10.3	10.49	190
ECO3	9.49	9.62	130

S_off	ΔV (V)		Diff (V)
	2021	2023	
STD	1.08	87.8	86.73
ECO2	1.48	103	101.5
ECO3	1.35	92.3	90.98

ABS_100

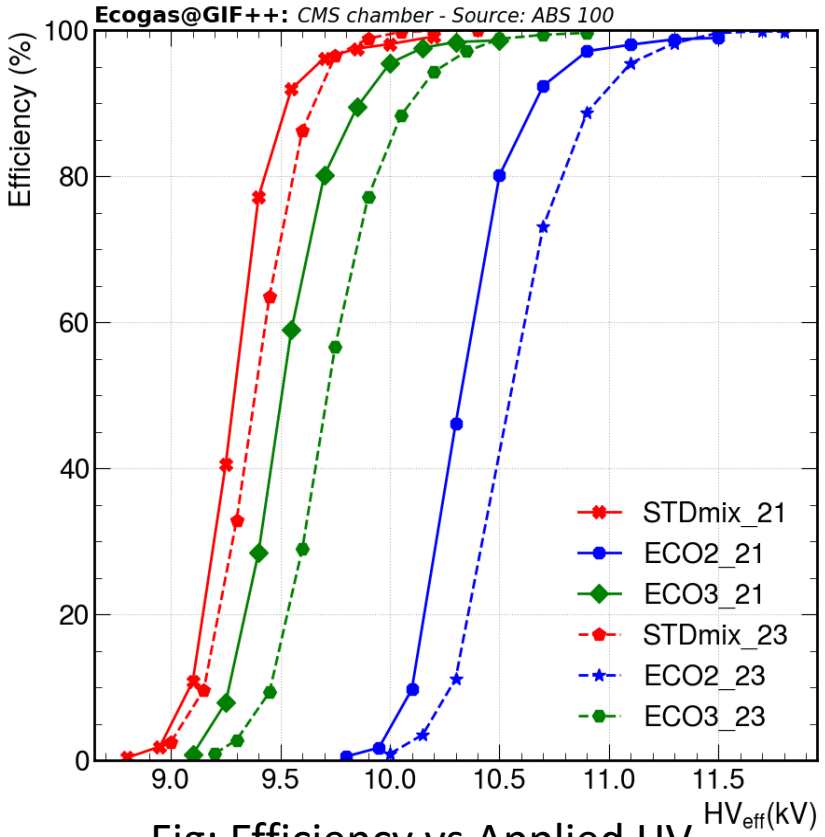


Fig: Efficiency vs Applied HV

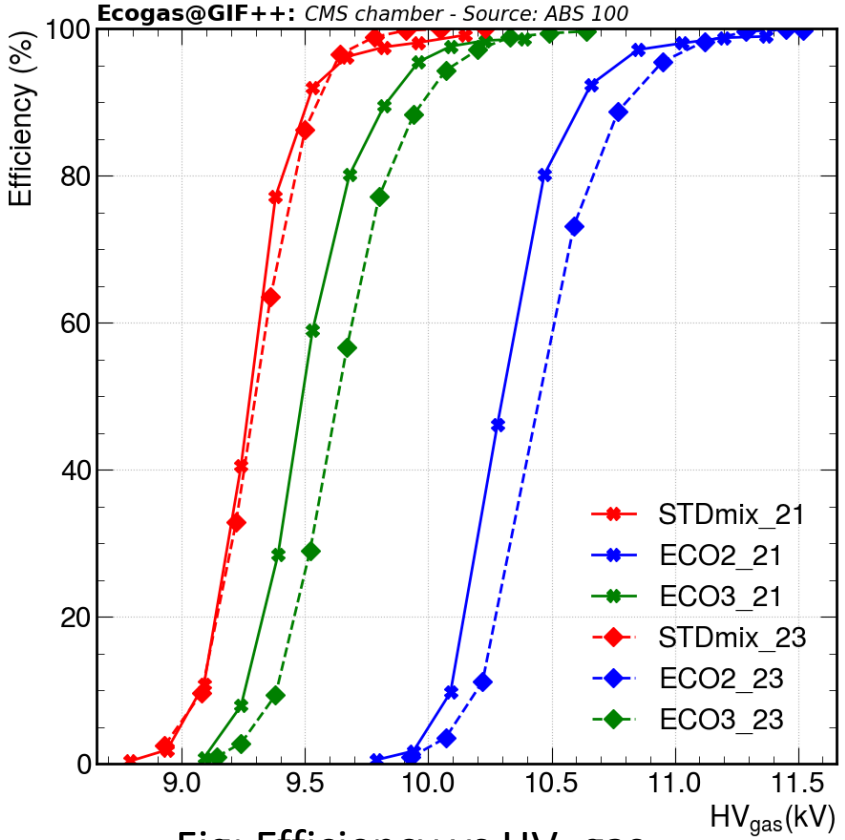


Fig: Efficiency vs HV_gas

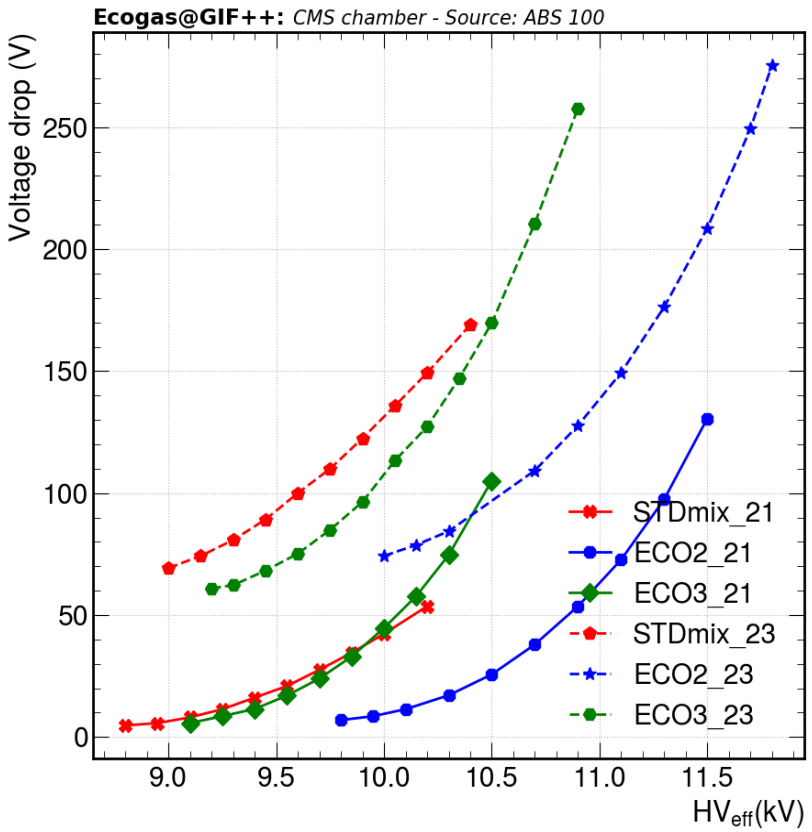


Fig: Voltage drop vs Applied HV

- There is a Shift in HV_gas for Std, ECO2 and ECO3 mixtures : 30 V, 160 and 140 V respectively
- Voltage drop at the electrode increased by approximately 100 Volts during 2023 at their working points. .

ABS_100	HV_50% (kV)		Diff (V)
	2021	2023	
STD	9.27	9.3	30
ECO2	10.3	10.46	160
ECO3	9.49	9.63	140

ABS_100	ΔV (V)		Diff (V)
	2021	2023	
STD	5.8	118.3	112.5
ECO2	45.78	151	105.22
ECO3	44.69	137.2	92.51

ABS_3.3

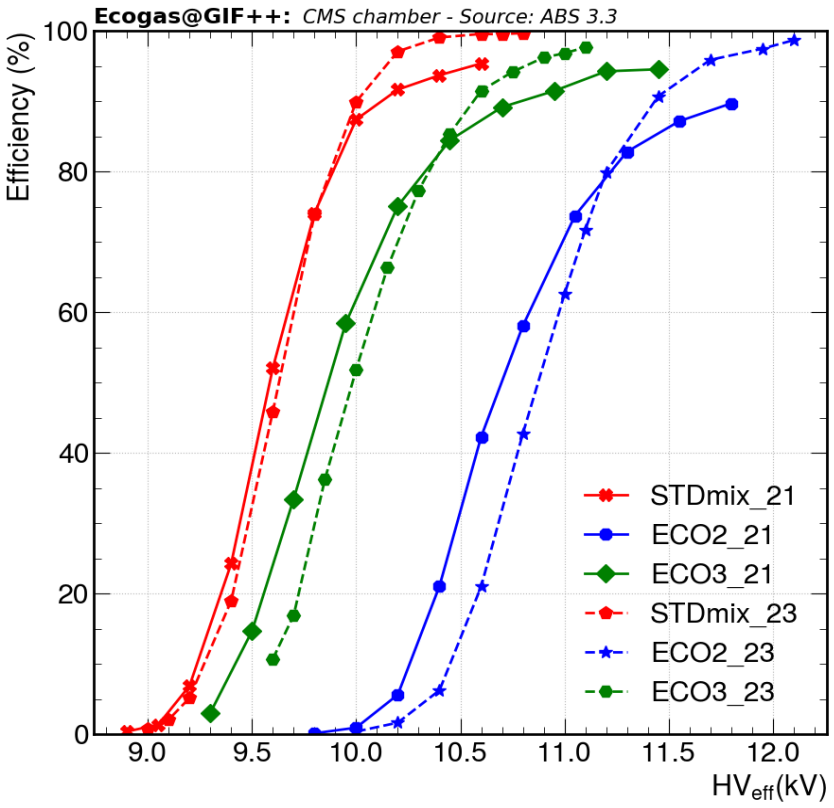


Fig: Efficiency vs Applied HV

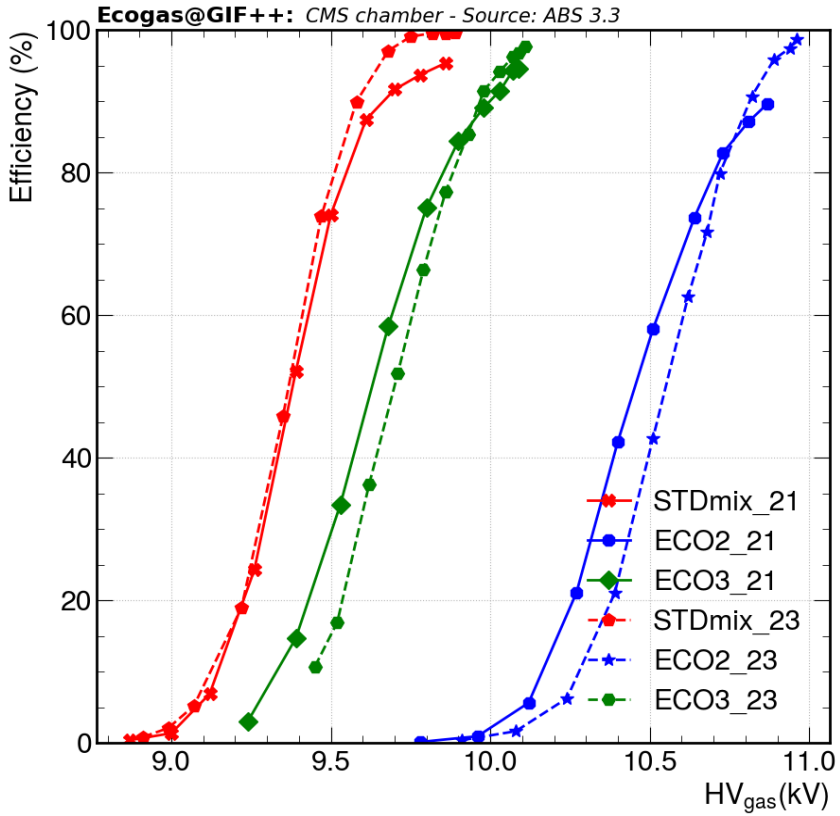


Fig: Efficiency vs HV_gas

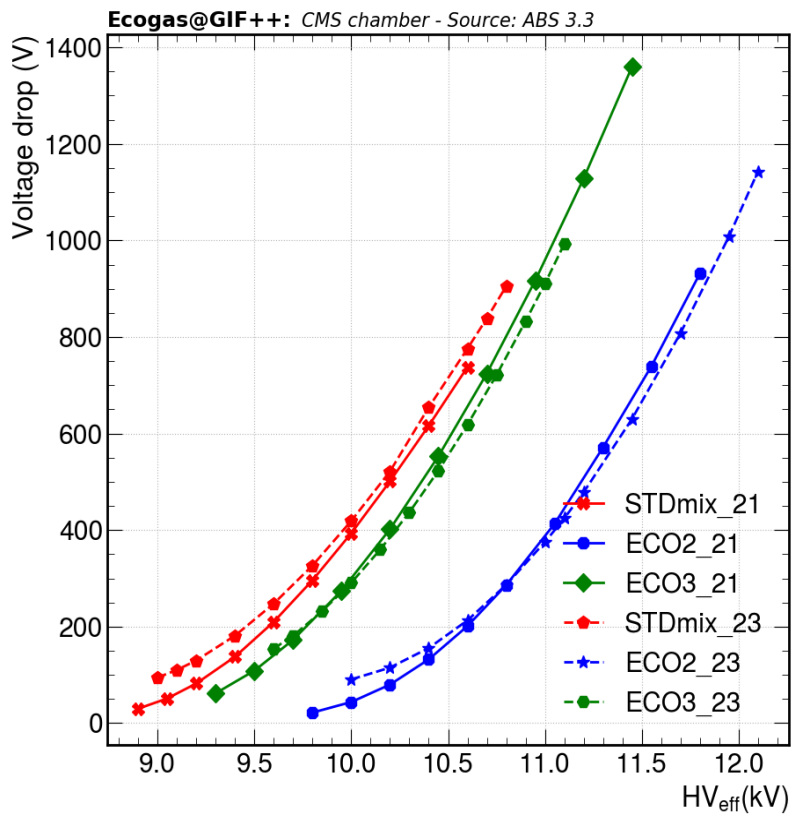


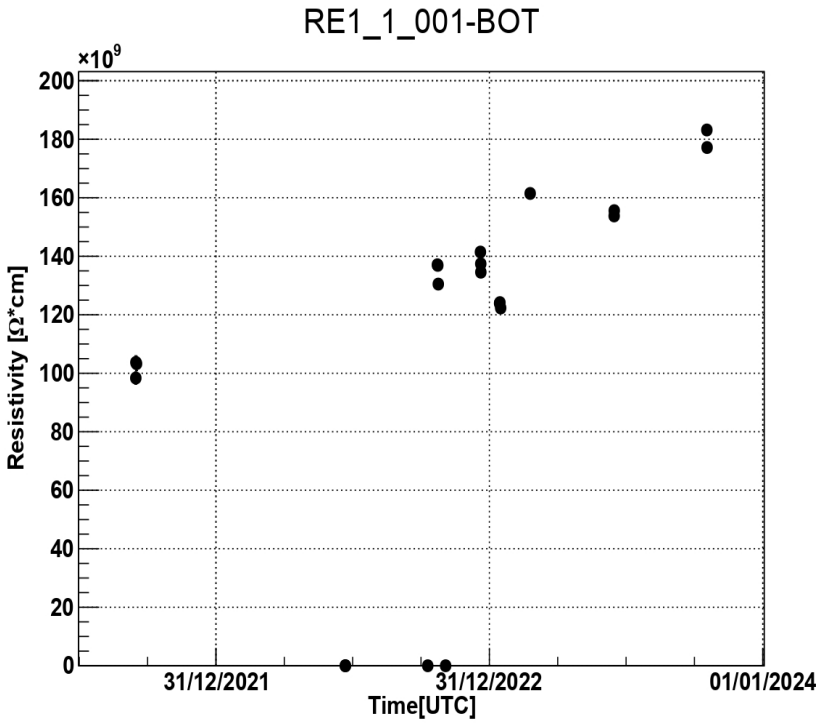
Fig: Voltage drop vs Applied HV

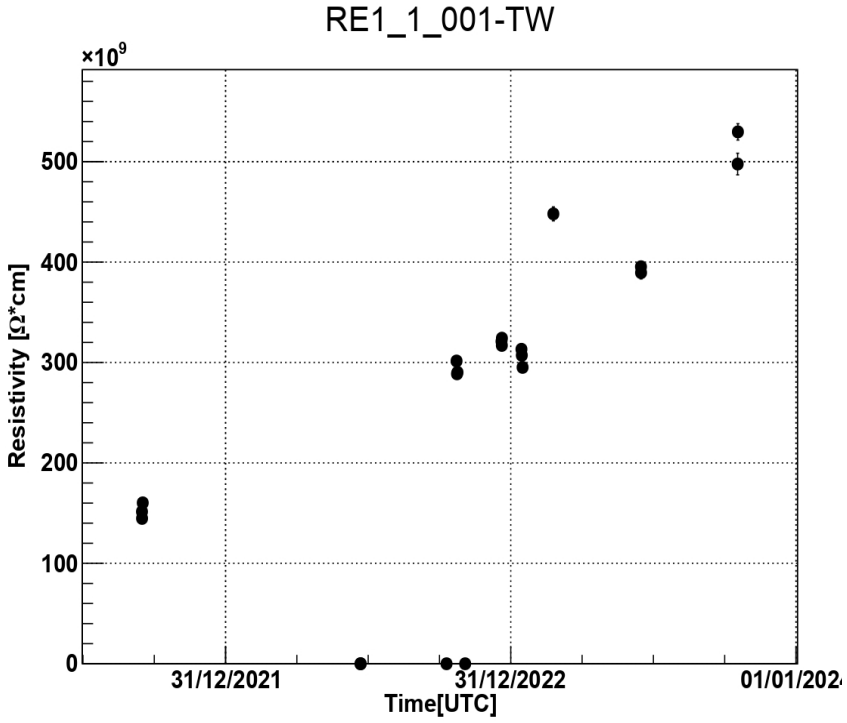
- HV_gas for std mixture seems to be superimposed, possible reason is the estimated R value chosen is neck to neck. Also in 2021 eff is 94%.
- ECO2 during 2021 is a bad run.
- Shift in HV_gas for ECO3 mixtures is 80 Volts
- Except ECO2, Voltage drop at the electrode increased by approximately 80 Volts during 2023 at their working points. .

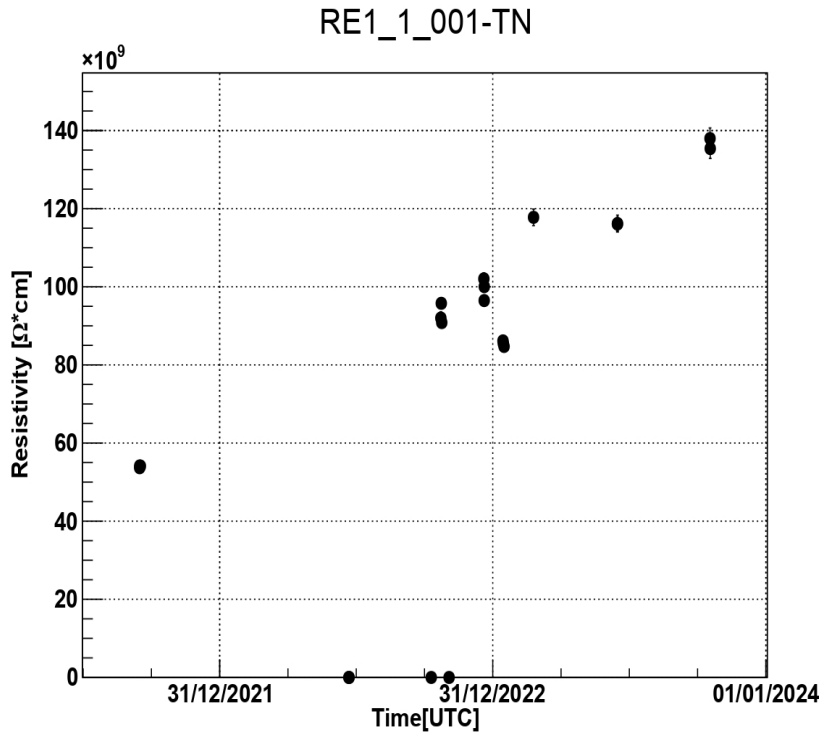
ABS_3.3	HV_50% (kV)		Diff (V)
	2021	2023	
STD	9.373	9.369	-4
ECO2	10.43	10.56	130
ECO3	9.62	9.7	80

ABS_3.3	ΔV (V)		Diff (V)
	2021	2023	
STD	474.2	545.59	71.41
ECO2	565.5	736.48	170.95
ECO3		743.4	87.62

Measured Resistivity(ρ) for CMS chamber (Thanks to Luca)







Resistivity (ρ) x 10^9 Ω cm.		
RPC	**2021**	**2023**
BOT	100	150
TW	150	390
TN	50	115

Conclusion:

- From 2021 to 2023, a shift in HV_{gas} for STD, ECO2, and ECO3 gases are roughly 30 V, 140 V, and 100 V, respectively.
- From 2021 to 2023, the voltage drop across the electrodes for all STD, ECO2, and ECO3 gas mixtures is increased to between 80 and 100 volts at their WP.
- There is a difference in measured resistance to estimated resistance.
- Drastic increase in the resistivity of the Top Wide CMS chamber.