CMS RE1_1 chamber - July 2025 TB overview

- UMESH -

09-09-2025

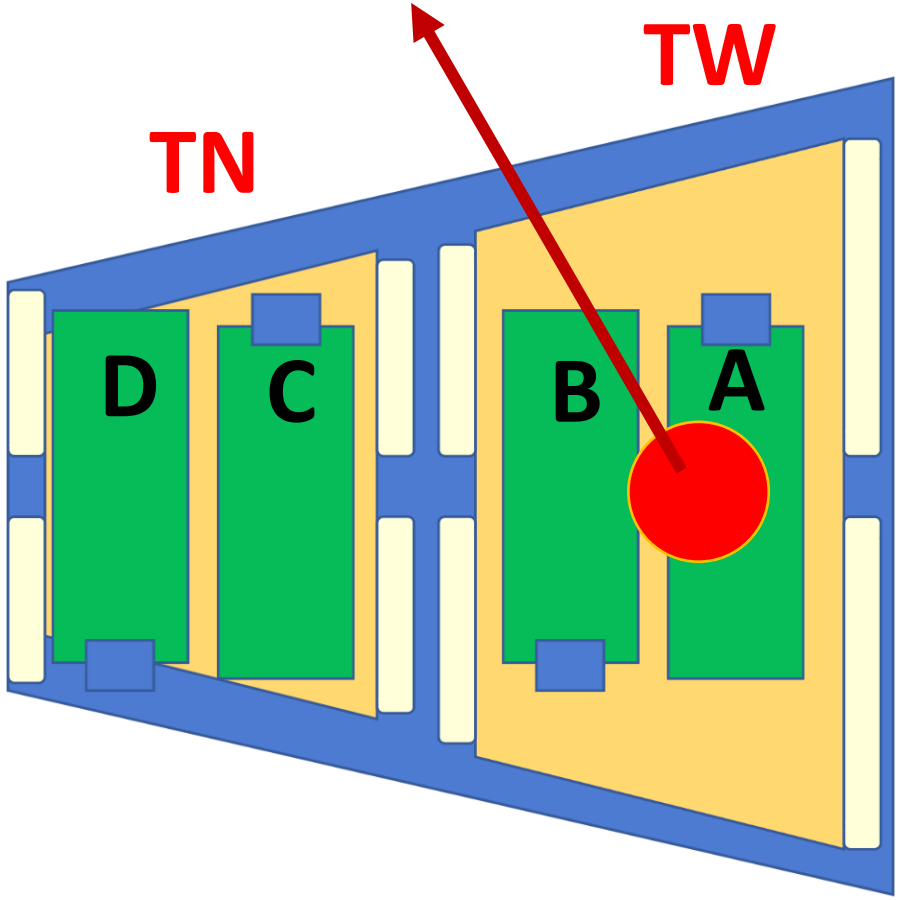
Scan details for RE1_1 chamber in July 2025 TB.

DG Scan #			
ABS	STD	ECO2	ECO3
S_OFF	1135	1191	1157
10	1143	1188	1175
6.9	1147	1216	1156
3.3	1148	1192	1162

TW gap Scan #			
ABS	STD	ECO2	ECO3
S_OFF	1136	1194+1196	1167
3.3	1155	1205	1169

BOT gap Scan #			
ABS	STD	ECO2	ECO3
S_OFF	1137	1200	1158
3.3	1153	1214	1163

Approximate position of the beam



Data analysed for Source off and ABS_3.3 scans:

- Efficiency vs HV_eff
- Current density vs HV_eff
- Muon cluster size vs HV_eff
- Resistivity
- Noise rates and gamma cluster size

Source_off

Efficiency vs HV_eff (July 2025)

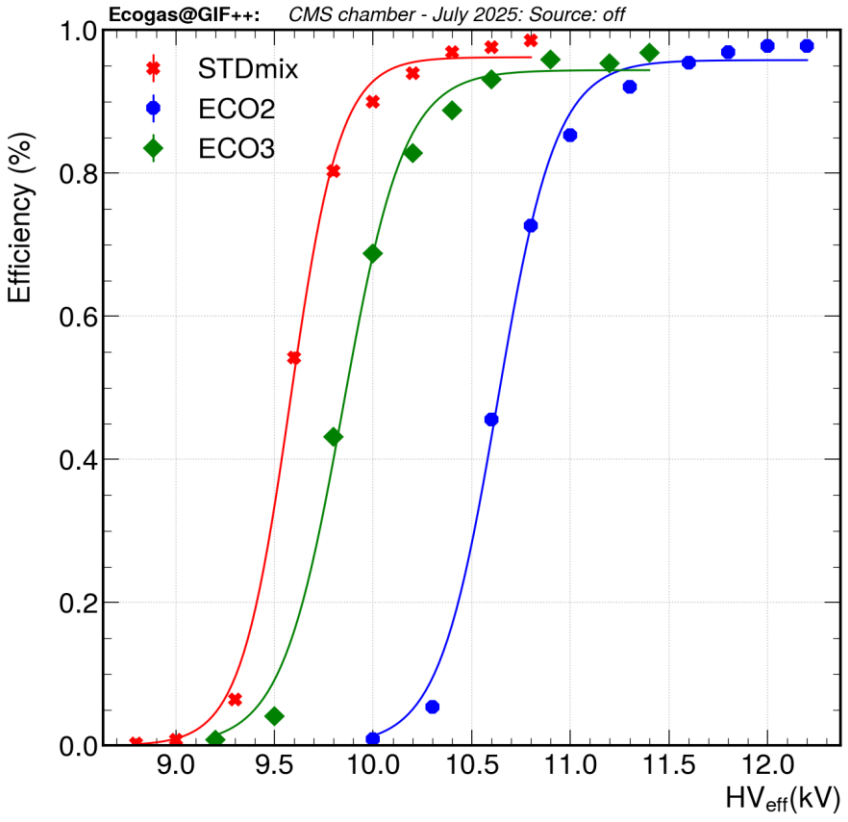


Fig 1a: Source_off - Double gap

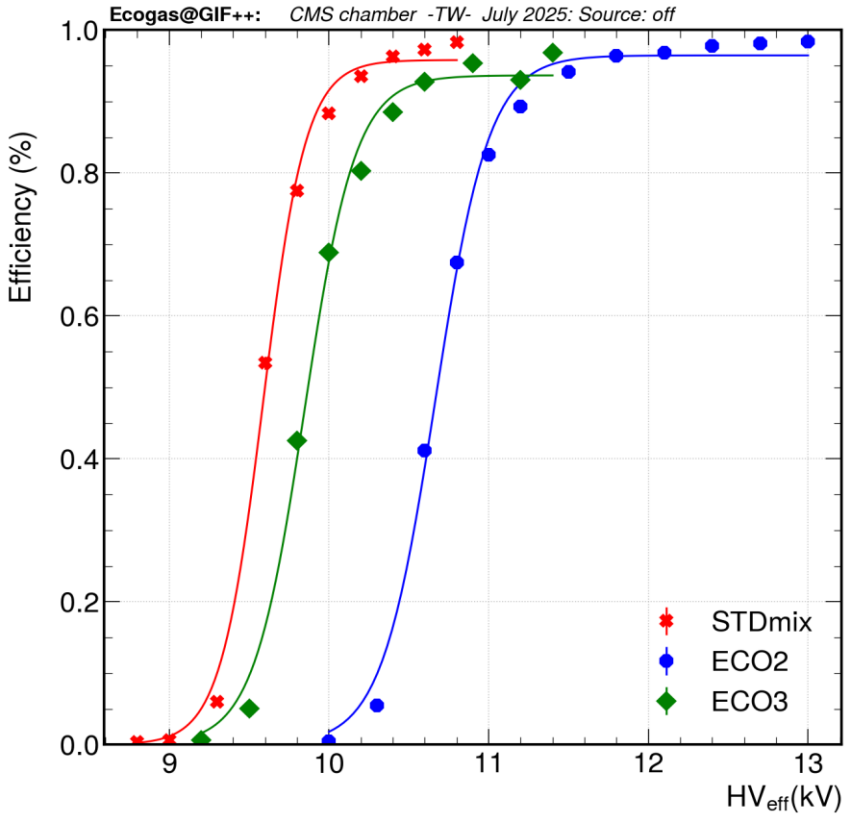


Fig 1b: Source_off - TW

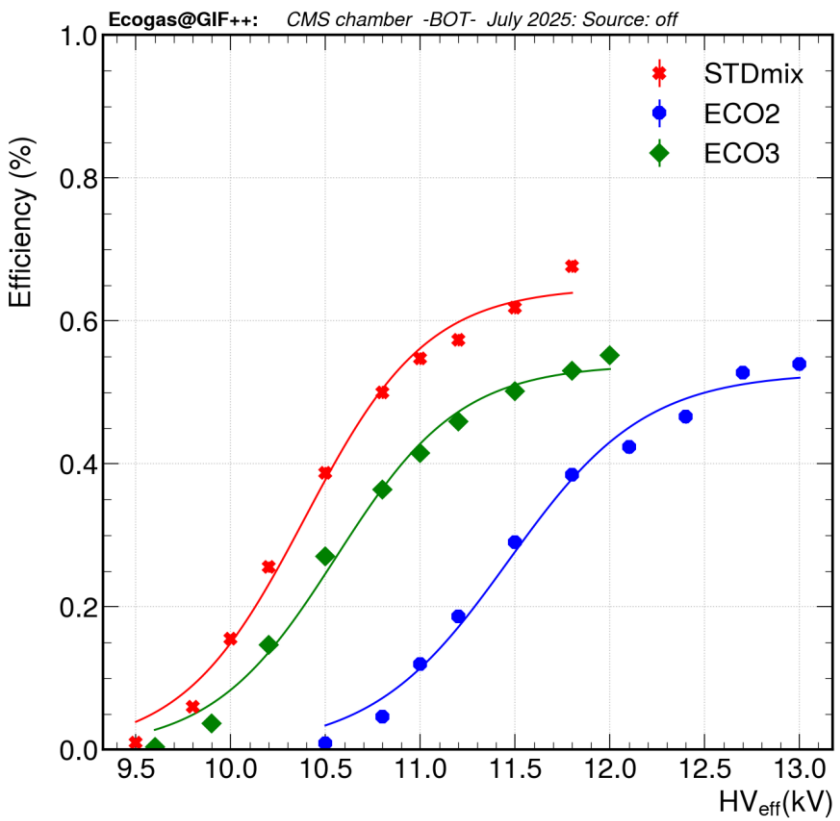


Fig 1c: Source_off - BOT

	Double gap	TW	BOT
STD	96.21% | WP: 10.13 kV	95.81% | WP: 10.15 kV	64.75% | WP: 11.25 kV
ECO2	95.80% | WP: 11.22 kV	96.45% | WP: 11.41 kV	52.78% | WP: 12.37 kV
ECO3	94.40% | WP: 10.44 kV	93.66% | WP: 10.46 kV	53.92% | WP: 11.34 kV

ABS_3.3

Efficiency vs HV_eff (July 2025)

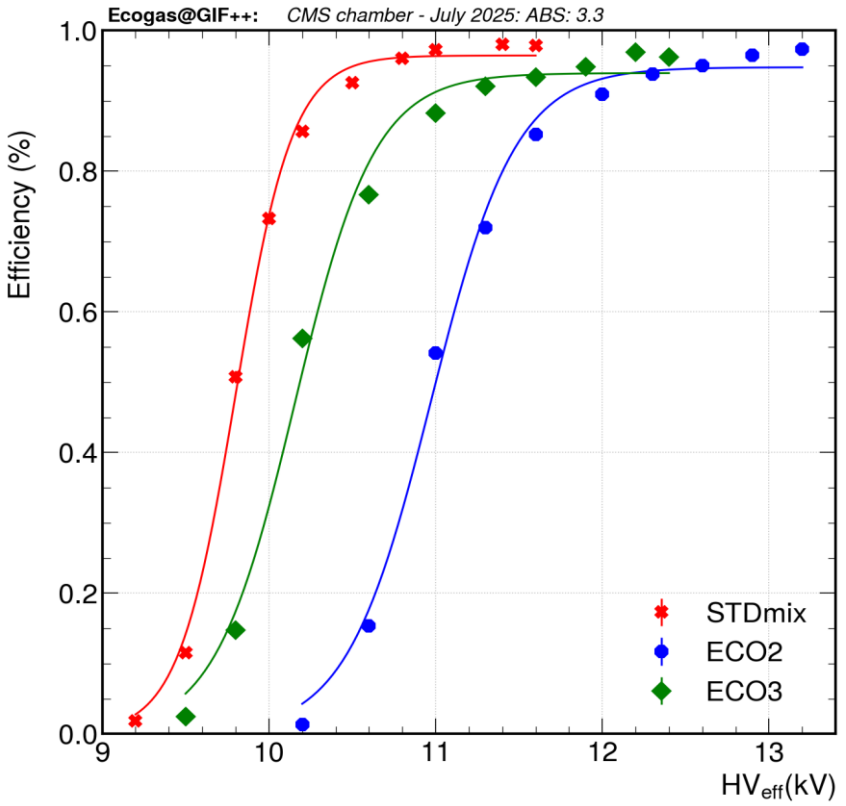


Fig 2a: ABS_3.3 - Double gap

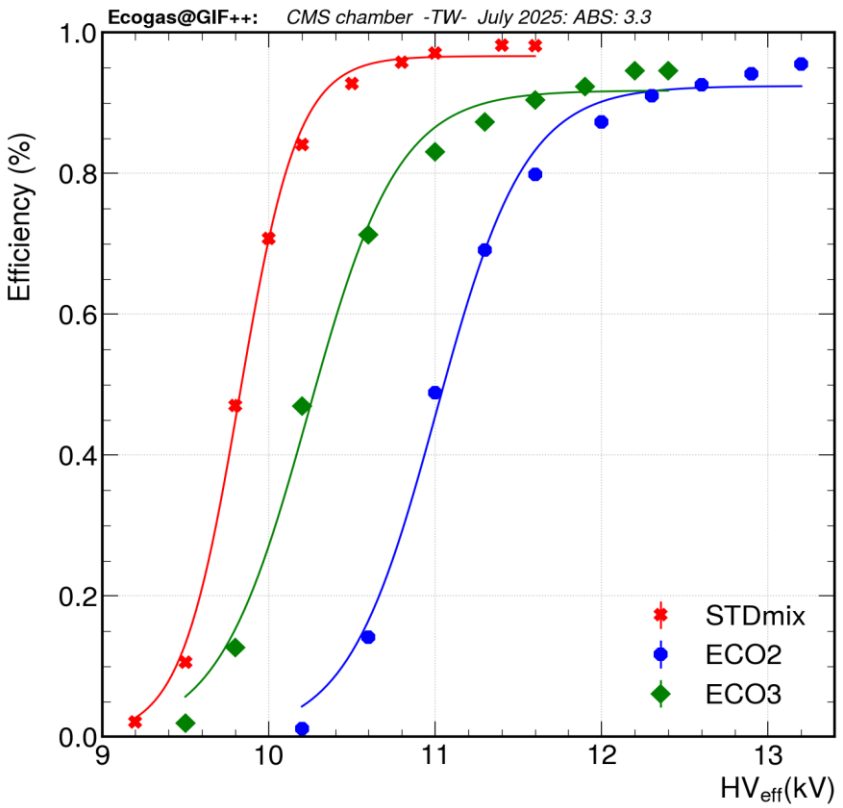


Fig 2b: ABS_3.3 - TW

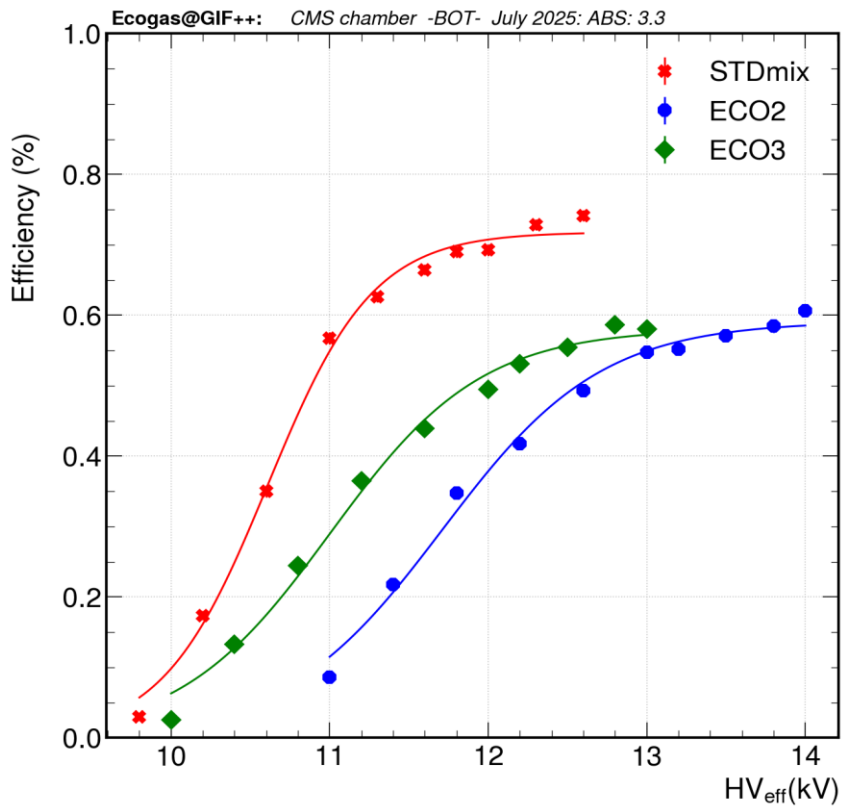


Fig 2c: ABS_3.3 - BOT

	Double gap	TW	BOT
STD	96.45% | WP: 10.47 kV	96.66% | WP: 10.51 kV	71.81% | WP: 11.65 kV
ECO2	94.78% | WP: 11.83 kV	92.41% | WP: 11.93 kV	59.14% | WP: 13.22 kV
ECO3	93.95% | WP: 10.99 kV	91.78% | WP: 11.15 kV	58.10% | WP: 12.24 kV

Source_off

Current density vs HV_eff (July 2025)

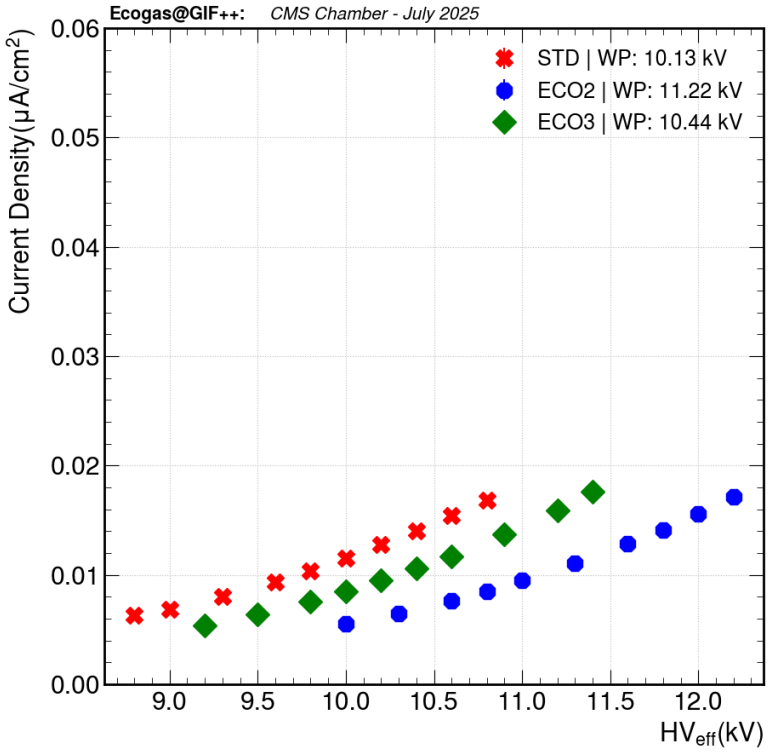


Fig 3a: Current density vs HV_eff (TW+BOT)

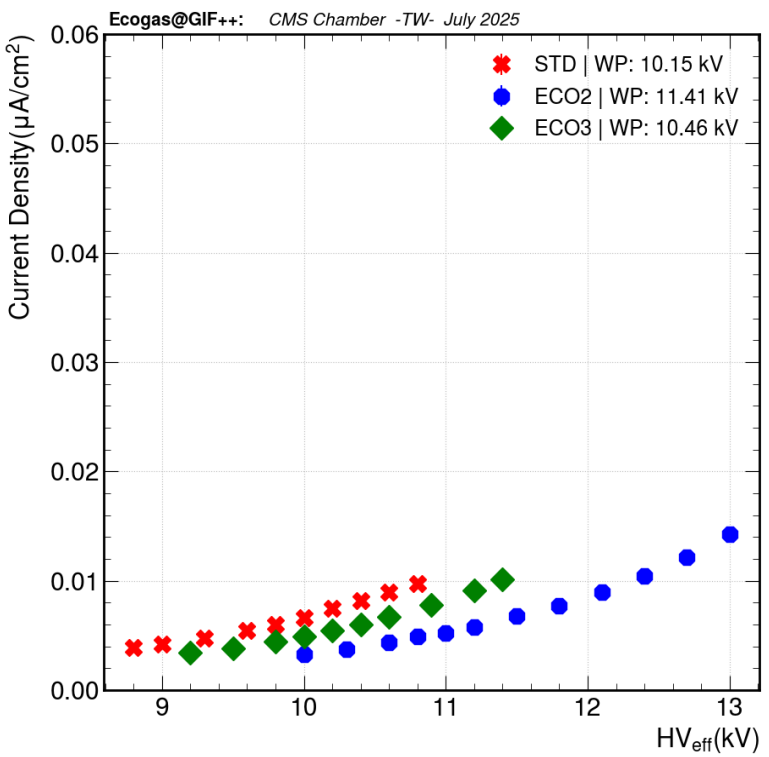


Fig 3b: Current density vs HV_eff (TW)

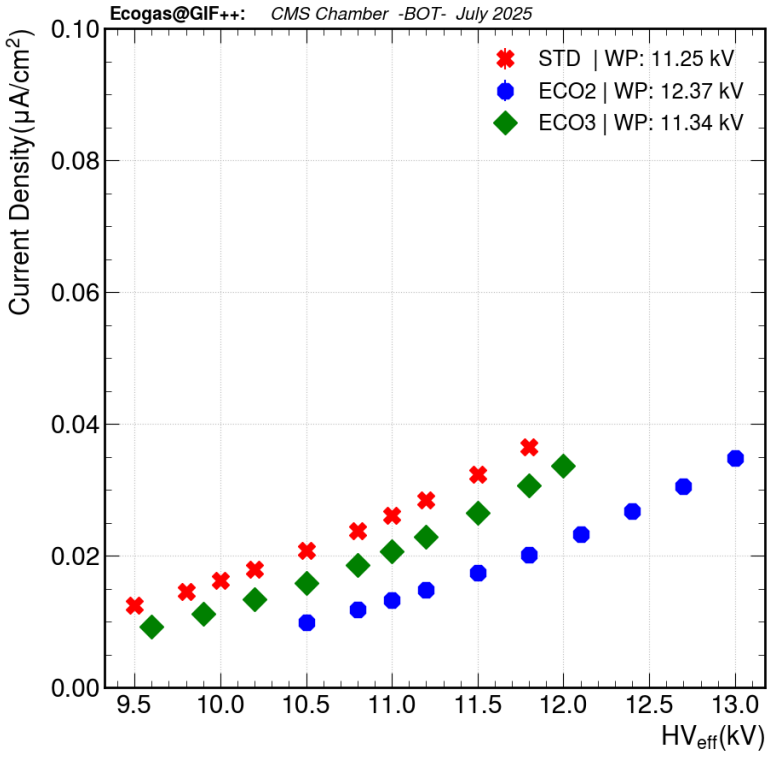


Fig 3c: Current density vs HV_eff (BOT)

Source off:

- Combined RPC (TW+BOT): the current densities for STD, ECO2, and ECO3 gas mixtures is approximately 10-12 nA/cm^2 respectively, at their WP.
- Top Wide RPC: the current densities for STD , ECO2, and ECO3 gas mixtures is approximately 5-6 nA/cm^2 at their WP.
- Bottom RPC: current densities for the STD, ECO2 and ECO3 is around 25-27 nA/cm^2 respectively at their WP.
- Muon cluster rate in the STD gas mixture is higher than that of ECO2 and ECO3 mixtures.

ABS_3.3

Current density vs HV_eff (July 2025)

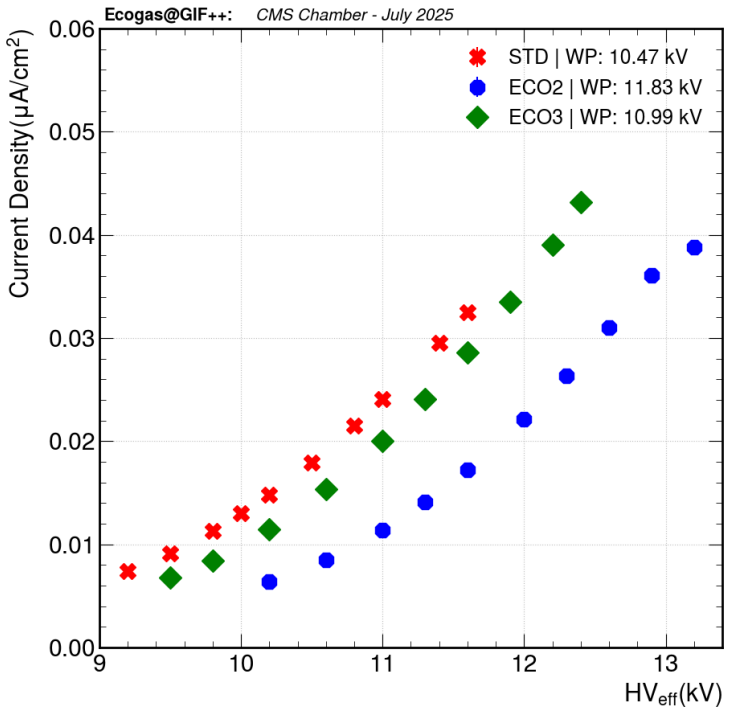


Fig 4a: Current density vs HV_eff (TW+BOT)

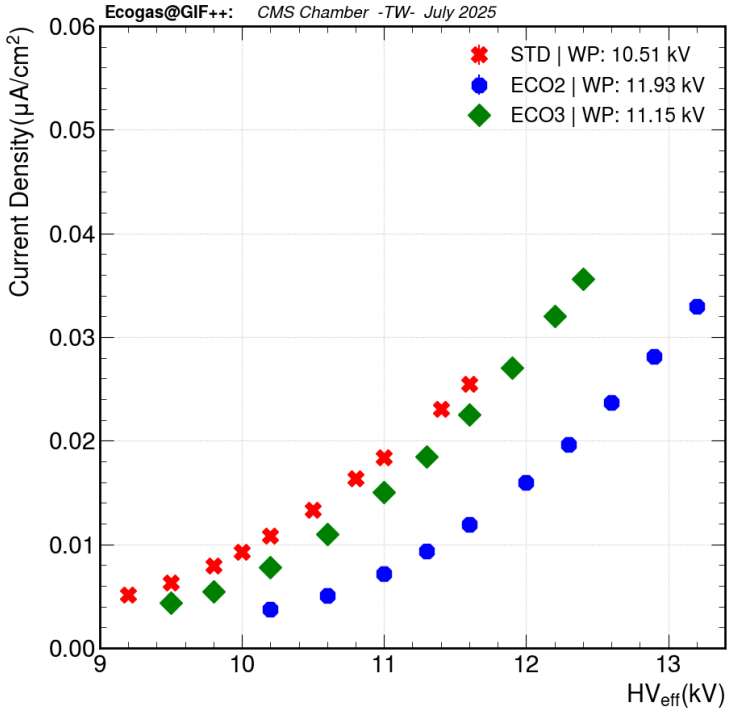


Fig 4b: Current density vs HV_eff (TW)

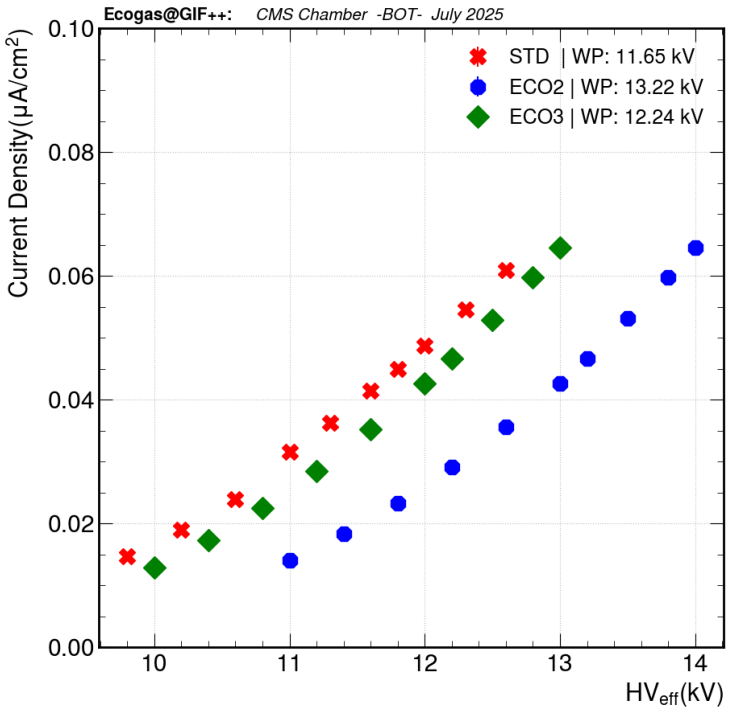


Fig 4c: Current density vs HV_eff (BOT)

ABS_3:

- Combined RPC (TW+BOT): the current densities for STD, ECO2, and ECO3 gas mixtures is approximately 18-20 nA/cm^2 respectively, at their WP.
- Top Wide RPC: the current densities are approximately 14 -16 nA/cm^2 respectively, at their WP.
- Bottom RPC: current densities are approximately 42, 45 and 45 nA/cm^2 respectively, at their WP.

Source_off

Muon cluster size vs HV_eff (July 2025)

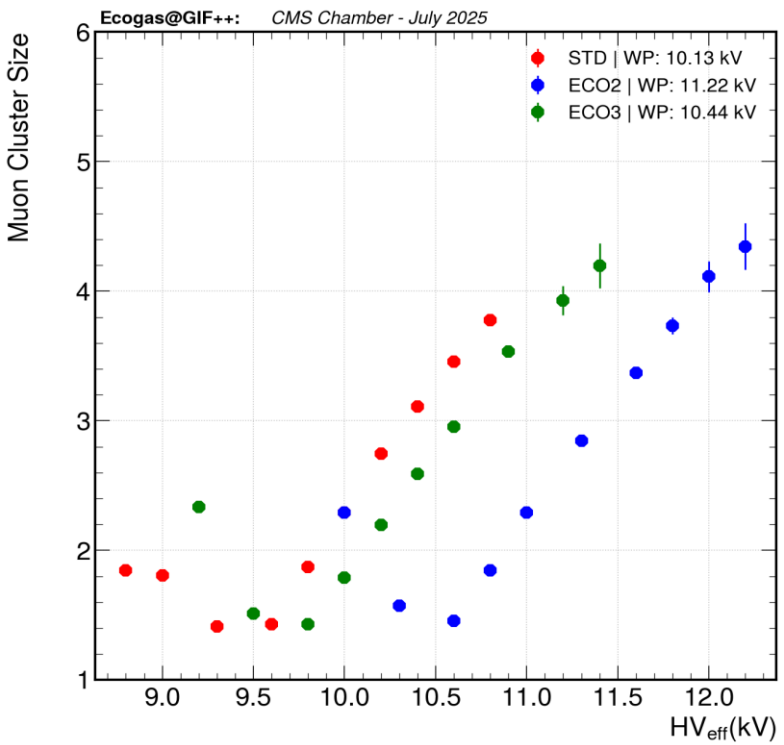


Fig 5a: Muon cluster size vs HV_eff (TW+BOT)

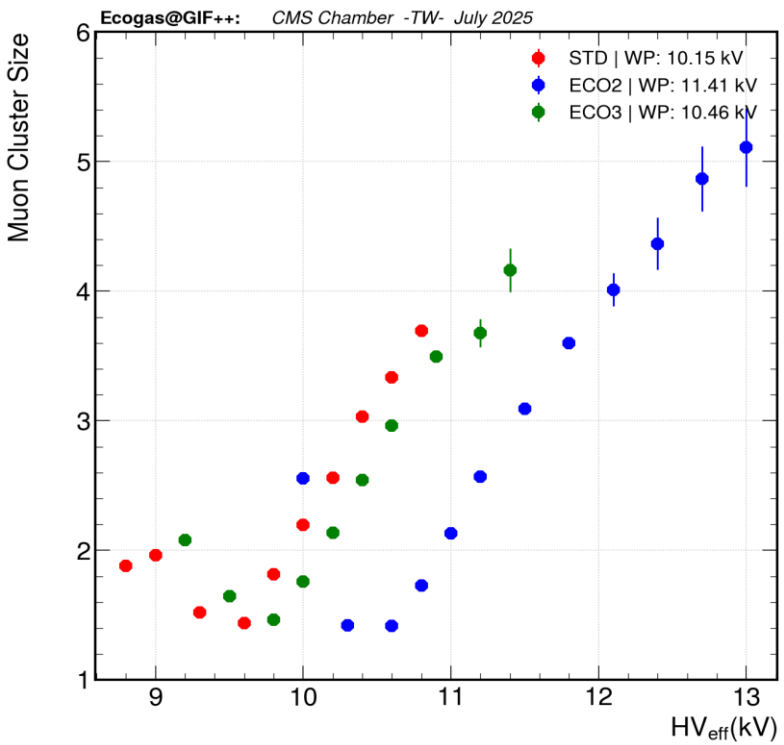


Fig 5b: Muon cluster size vs HV_eff (TW)

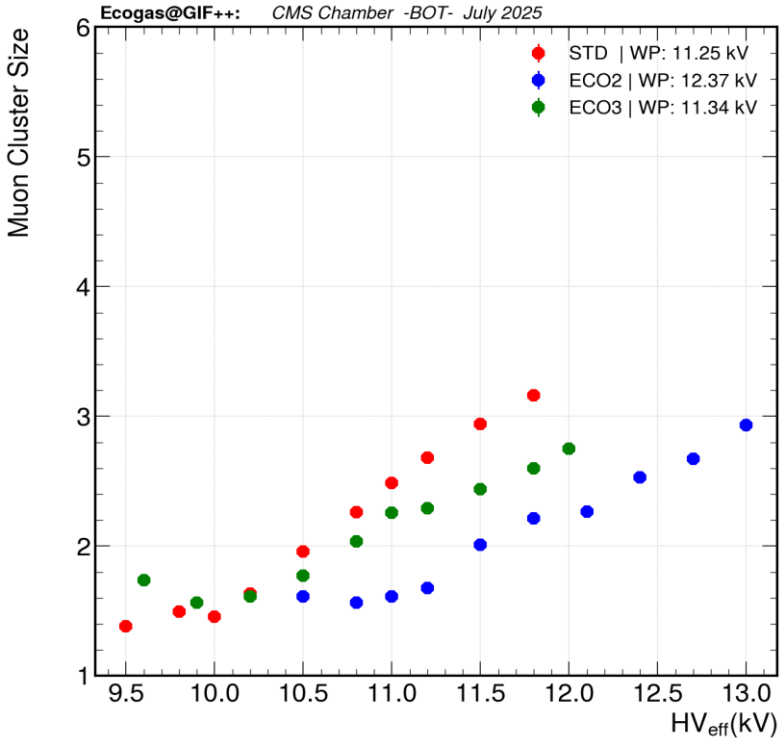


Fig 5c: Muon cluster size vs HV_eff (BOT)

Source off:

- Combined RPC (TW+BOT): muon cluster size for STD, ECO2, and ECO3 gas mixtures is approximately 2.4 -2.6 (# strip units) respectively, at their WP.
- Top Wide RPC: muon cluster size are approximately 2.6-2.8 (#strip units) respectively at their WP.
- Bottom RPC: muon cluster size for the STD, ECO2 and ECO3 is approximately around 2.2 to 2.5 (#strip units) at their WP.

ABS_3.3

Muon cluster size vs HV_eff (July 2025)

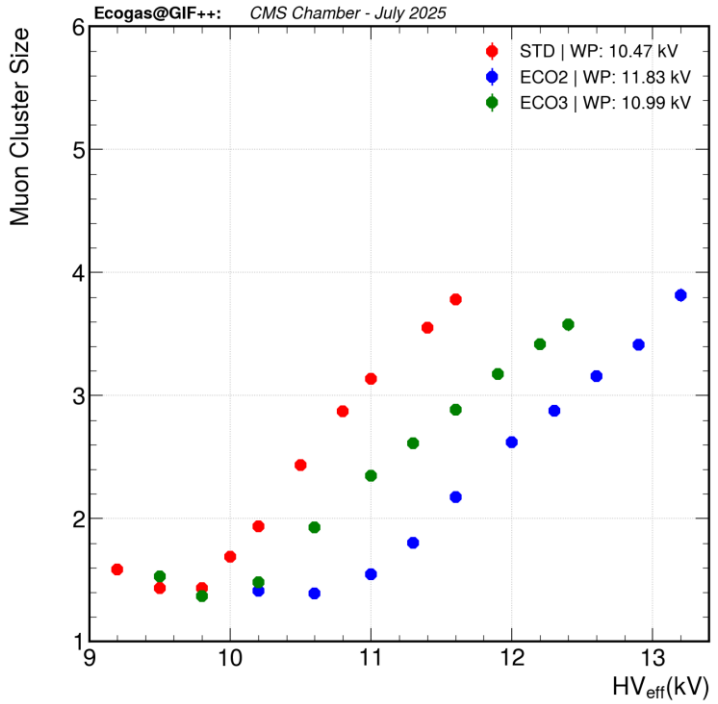


Fig 6a: Muon cluster size vs HV_eff (TW+BOT)

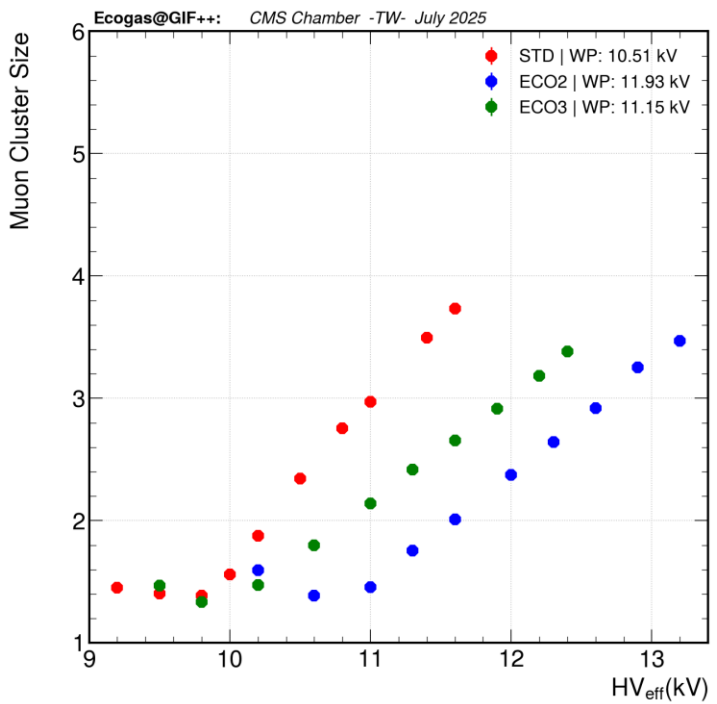


Fig 6b: Muon cluster size vs HV_eff (TW)

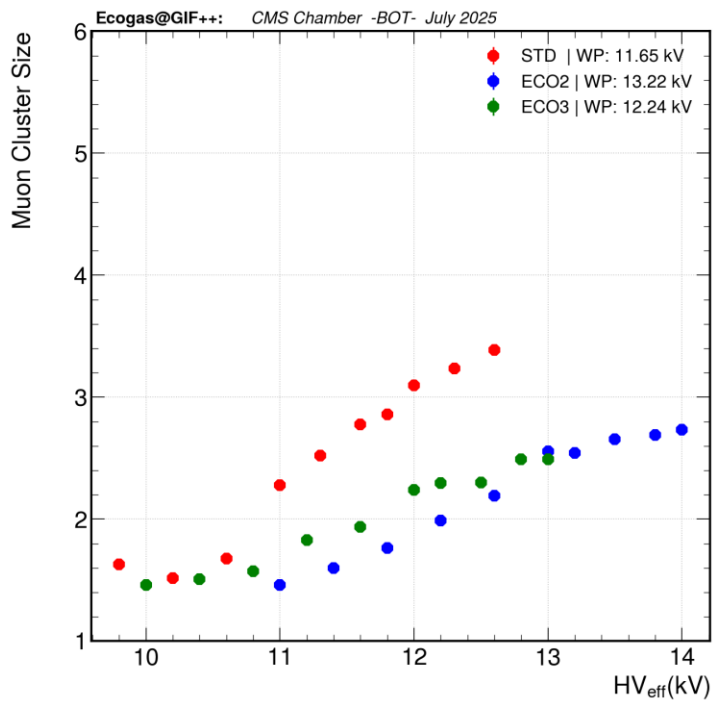


Fig 6c: Muon cluster size vs HV_eff (BOT)

ABS_3:

- The data showed that the muon cluster size decreased as the irradiation cluster rate increased.
- Combined RPC (TW+BOT): muon cluster size for STD, ECO2, and ECO3 gas mixtures is approximately 2.4-2.5 (# strip units) respectively, at their WP.
- Top Wide RPC: muon cluster size is around 2.3-2.4 (#strip units) at their WP.
- Bottom RPC: muon cluster size is around 2.8, 2.6 and 2.3 (# strip units) respectively, at their WP.

Noise rates- Double gap: No Beam spill and No Gamma Source

Before Masking

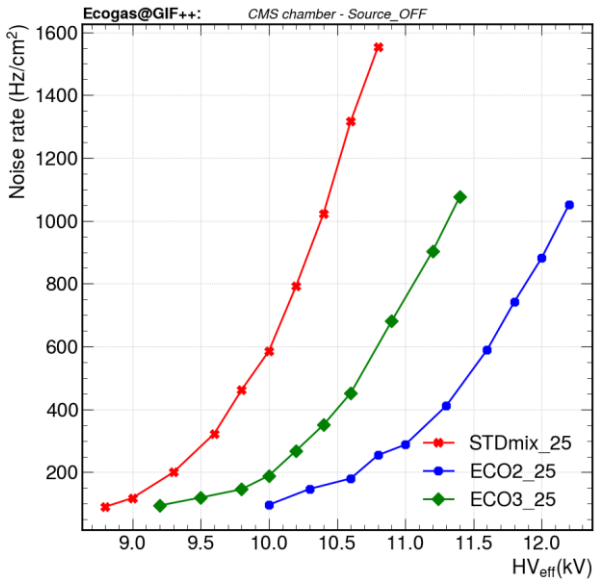


Fig 7a: Mean Noise rates

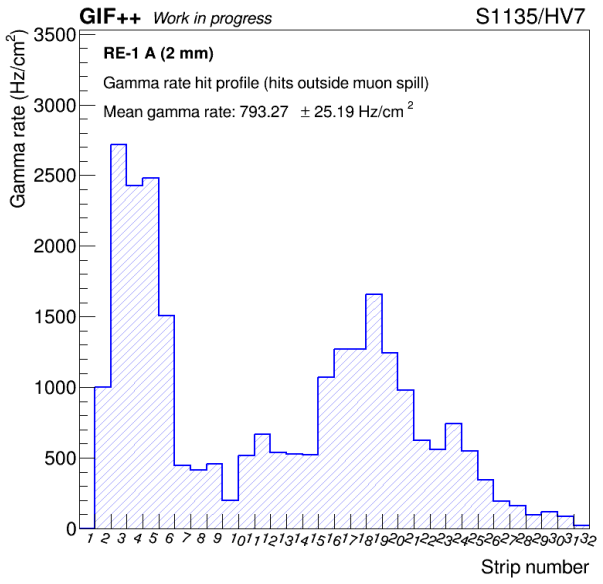


Fig 7b: Strip hits for STD at 10 kV

After Masking

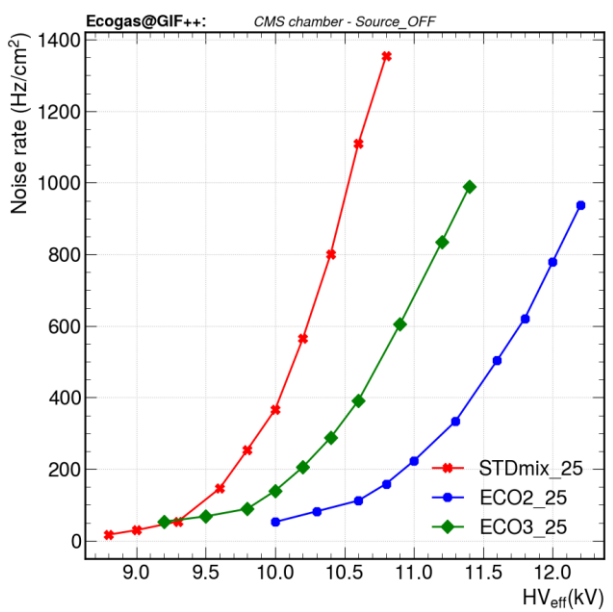


Fig 7c: Mean Noise rates-masked

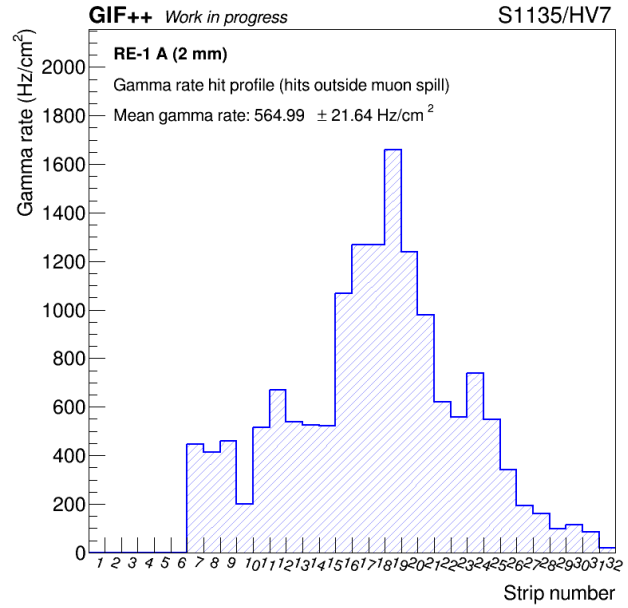


Fig 7d: Strip hits for STD -masked

- The noise rates at the WP for STD (10.13 kV): 720 Hz/cm^2, ECO2 (11.22 kV): 378 Hz/cm^2 and ECO3 (10.44): 370 Hz/cm^2
- It was observed that strips 2-6 are extremely noisy and Masked the strips 2,3,4,5,6.
- Mean noise rates are calculated for each HV points for all gas mixtures.
- After masking the mean noise rates at WP: 495 Hz/cm^2, 304 Hz/cm^2 and 308 Hz/cm^2.

Gamma cluster rate: Double gap

$$\text{Cluster rate} = \frac{gamma\ rates}{gamma\ cluster\ size}$$

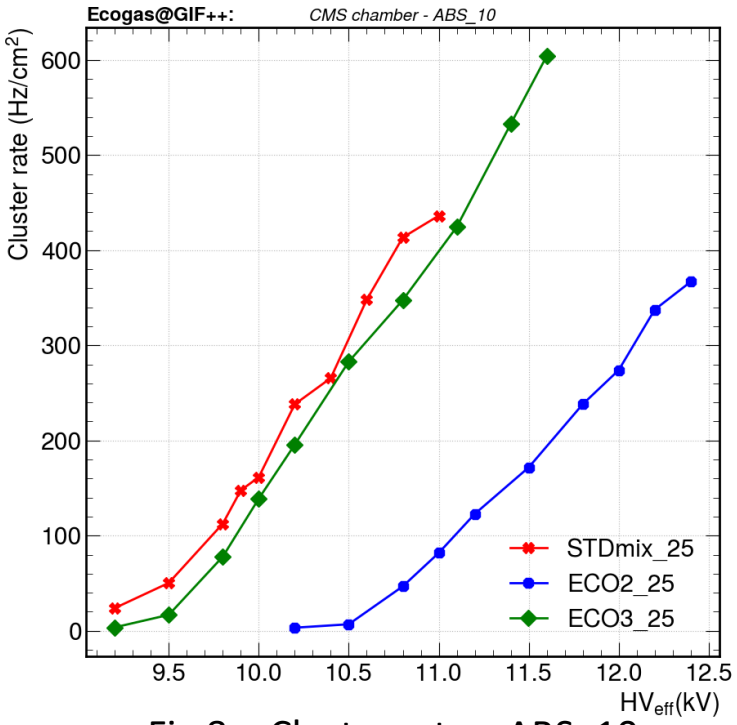


Fig 8a: Cluster rates: ABS_10

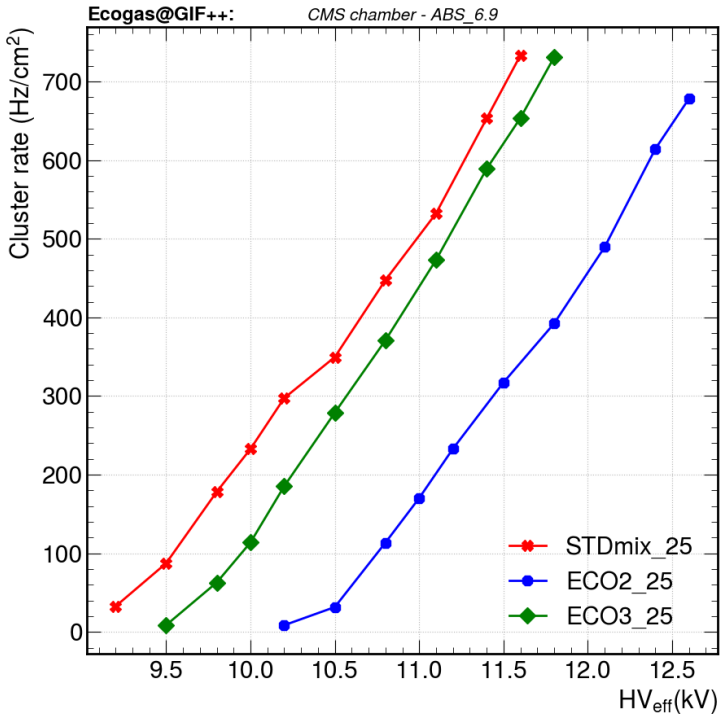


Fig 8b: Cluster rates: ABS_6.9

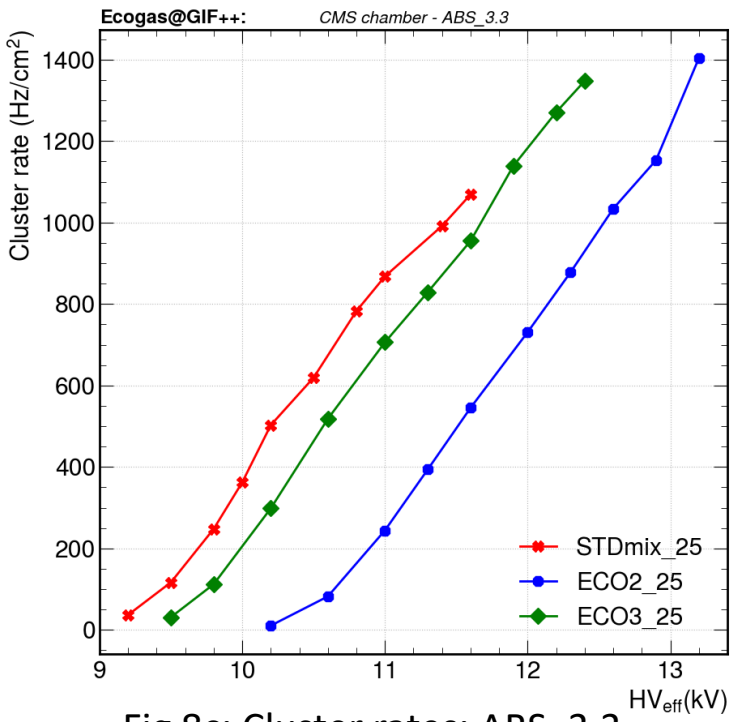


Fig 8c: Cluster rates: ABS_3.3

	ABS_10	ABS_6.9	ABS_3.3
STD	WP: 10.33 kV | CLR: 255.96 Hz/cm²	WP: 10.29 kV | CLR: 313.01 Hz/cm²	WP: 10.47 kV | CLR: 607.58 Hz/cm²
ECO2	WP: 11.48 kV | CLR: 168.48 Hz/cm²	WP: 11.47 kV | CLR: 308.78 Hz/cm²	WP: 11.83 kV | CLR: 657.89 Hz/cm²
ECO3	WP: 10.58 kV | CLR: 300.07 Hz/cm²	WP: 10.73 kV | CLR: 349.37 Hz/cm²	WP: 10.99 kV | CLR: 701.32 Hz/cm²

Single gap mode : Noise rates (No Beam and No source)

- possible indication of leakage Current in BOT gap ?:
- Low efficiency, low noise rate and high current

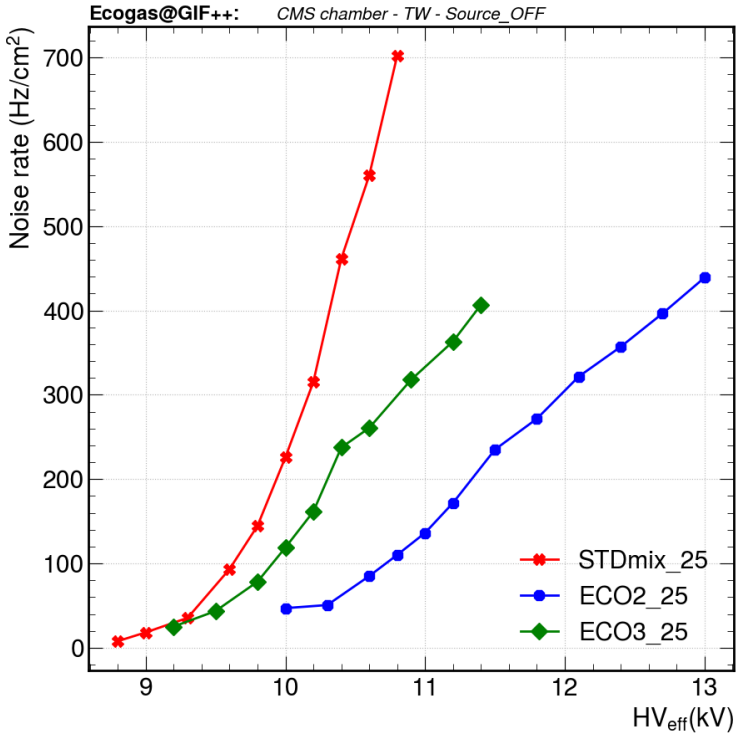


Fig 9a: Noise rates for TW

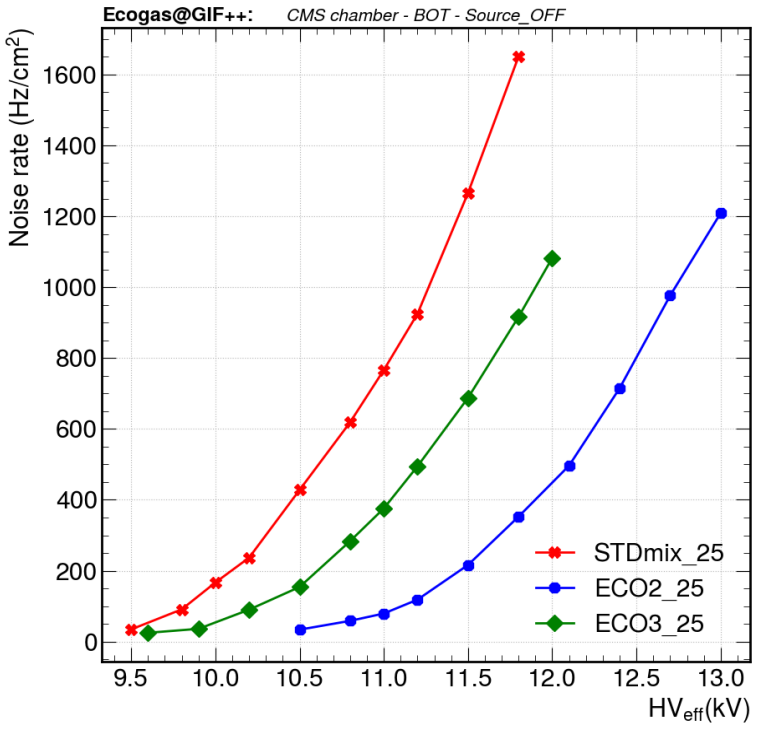


Fig 9b: Noise rates for BOT

Noise Rates (Hz/cm²)		
At DG WP	**TW**	**BOT**
STD | 10.13 kV	**283**	**212**
ECO2| 11.22 kV	**176**	**124**
ECO3| 10.44 kV	**242**	**141**

Gamma cluster rate: Single gap

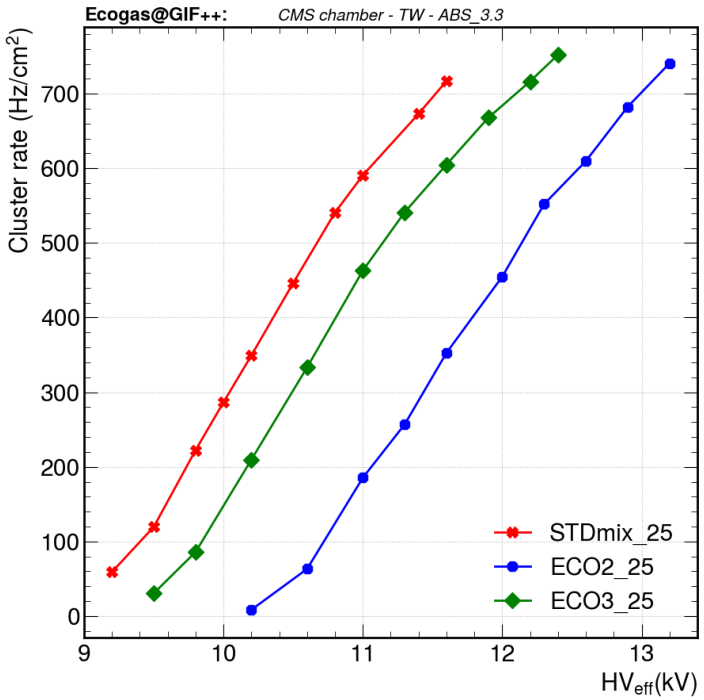


Fig 10a: Cluster rates for TW

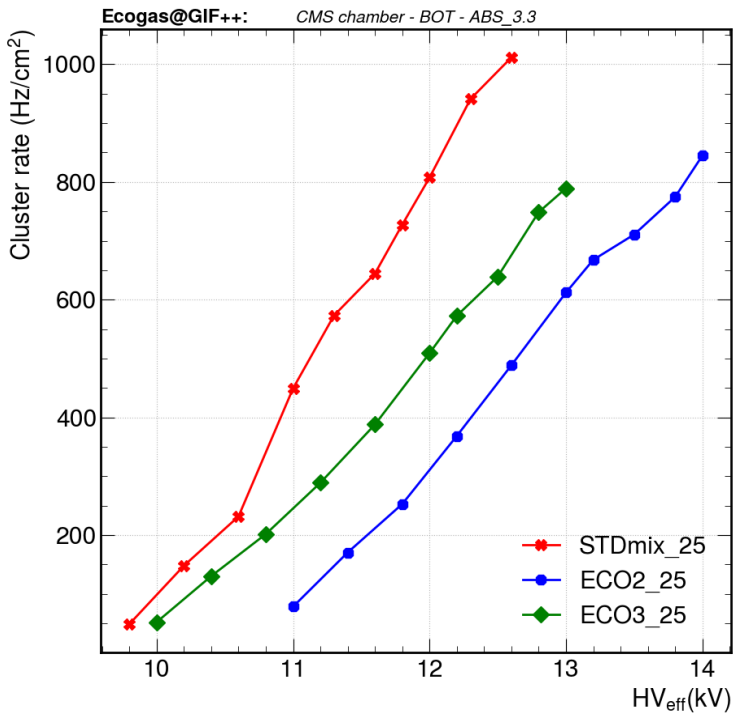
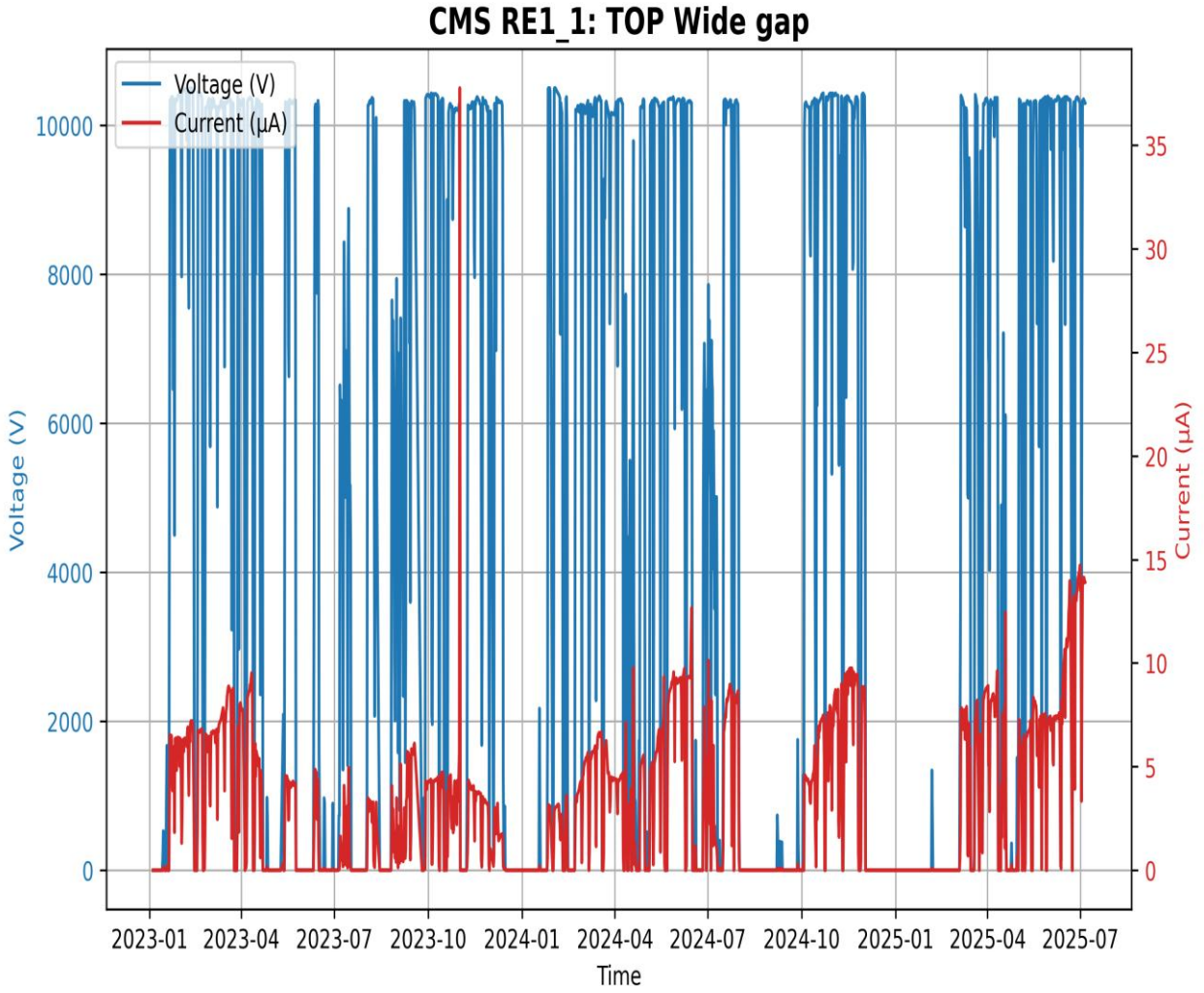
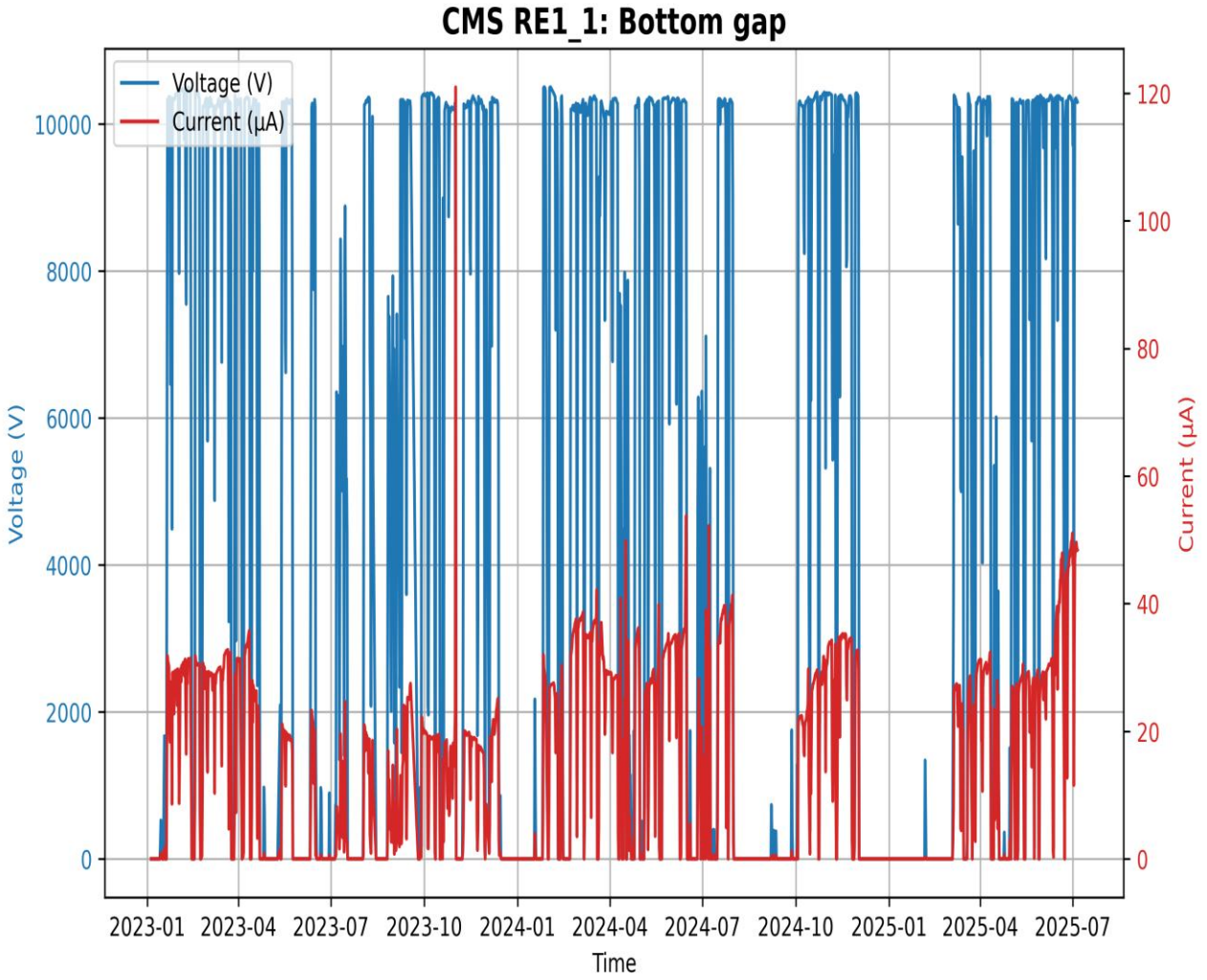


Fig 10b: Cluster rates for BOT

Cluster Rates (Hz/cm²)		
At DG WP	**TW**	**BOT**
STD | 10.47 kV	**436**	**204**
ECO2| 11.83 kV	**411**	**261**
ECO3| 10.99 kV	**459**	**243**

Current drawn- from Jan 2023 to July 2025





- Since 2025 June first week onwards current increased significantly in both TW and BOT gaps.
- At present the average current for TW: 14 uA and BOT: 45 uA.

Resistivity - July 2025

2021 ρ(T)	
BOT	82.86 x 10^9 Ω cm
TW	139 x 10^9 Ω cm

R_{BOT} = 8.67 MΩ

R_{TW} = 24.18 MΩ

2024 ρ(T)	
BOT	174.38 x 10^9 Ω cm
TW	533.46 x 10^9 Ω cm

R_{BOT} = 18.24 MΩ

R_{TW} = 92.82 MΩ

2025 July	Scan	GAP	ρ x 10^9 Ω cm
	1224	BOT	184
		TW	268

R_{BOT} = 19.25 MΩ

R_{TW} = 46.63 MΩ

Source_off

Efficiency vs HV_eff (2024 APR – 2025 JUL)

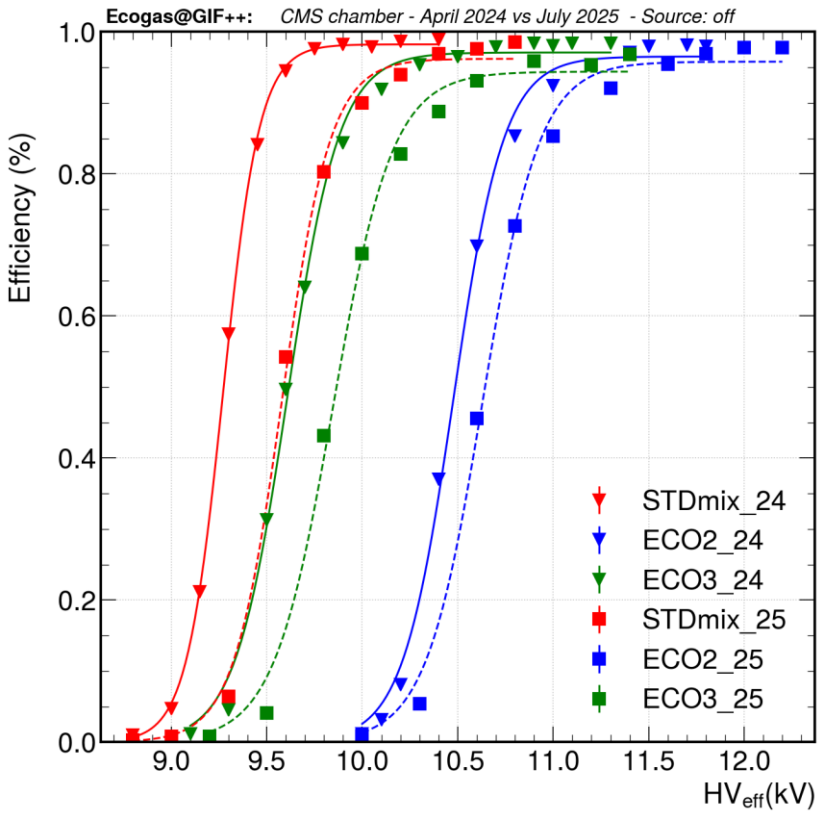


Fig 11a: Source_off – Efficiency -Double gap

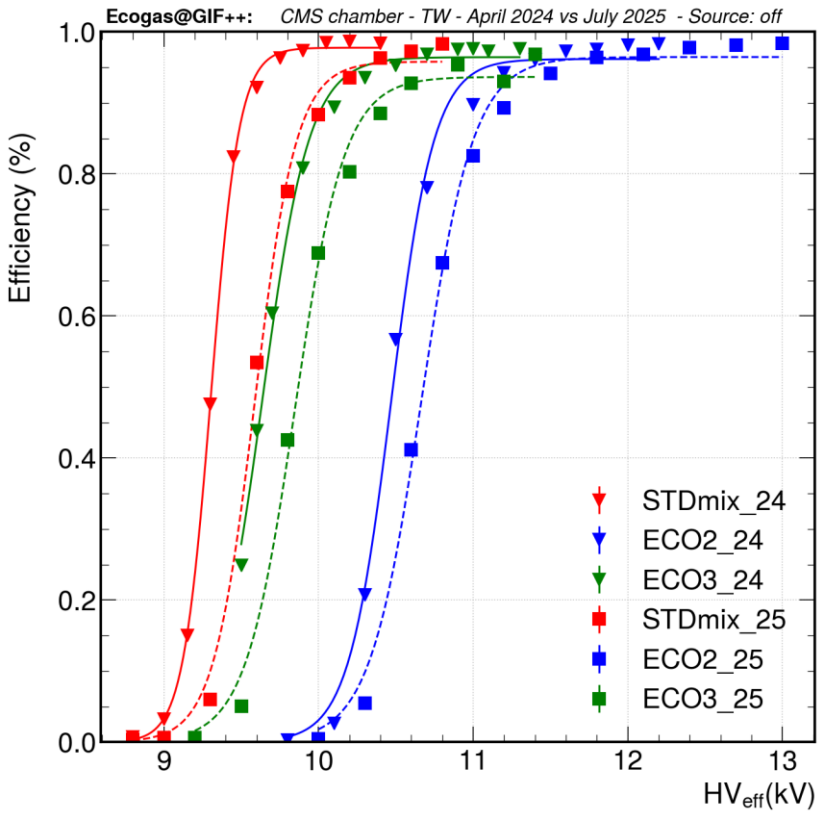


Fig 11b: Source_off – Efficiency –TW

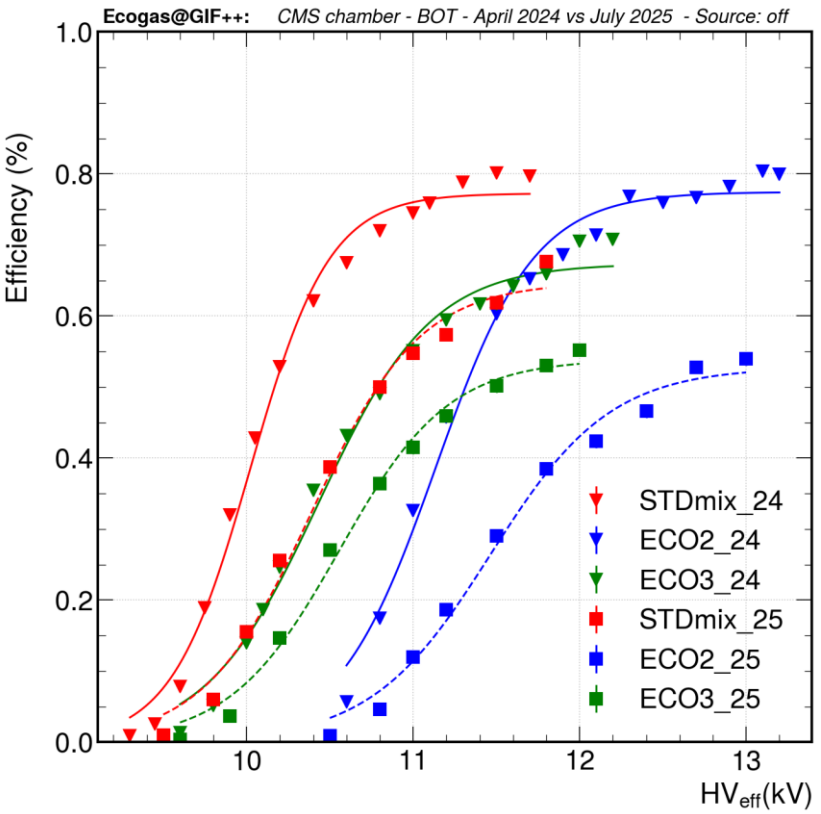


Fig 11c: Source_off – Efficiency –BOT

- Bottom gap efficiency dropped drastically from 2024 April to 2025 July for all gas mixture (roughly more then 15%).

Conclusions:

- Efficiency of the RE1_1 double gap ropped by 1-2% from the last year (2024 April) TB.
- Efficiency of the combined RPC is mainly from the efficiency of the TW RPC.
- Bottom RPC efficiency is less than 70%.
- Current densities: Source off : BOT gap 5 times higher than TW gap,

  ABS_3.3: BOT gap roughly 3 times higher TW gap.
- Muon cluster size for all the ABS and for all the gas mixtures is around 2.2 – 2.6 strip units.
- Resistance/Resistivity drastically reduced for TW chamber from Sept 2024 measurement to July 2025 measurement.
- Intrinsic noise rates of the chamber increased drastically.