Gamma rates for CMS RE1_1 Chamber
(Test beam 2024 –April-Single gap mode)

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1. ABS_100_Noise gamma rate = ABS_100_background_gamm_rate – Source_off_background_gamma_rate

   ABS_3.3_Noise gamma rate = ABS_3.3_background_gamma_rate – Source_off_background_gamma_rate

Source_off

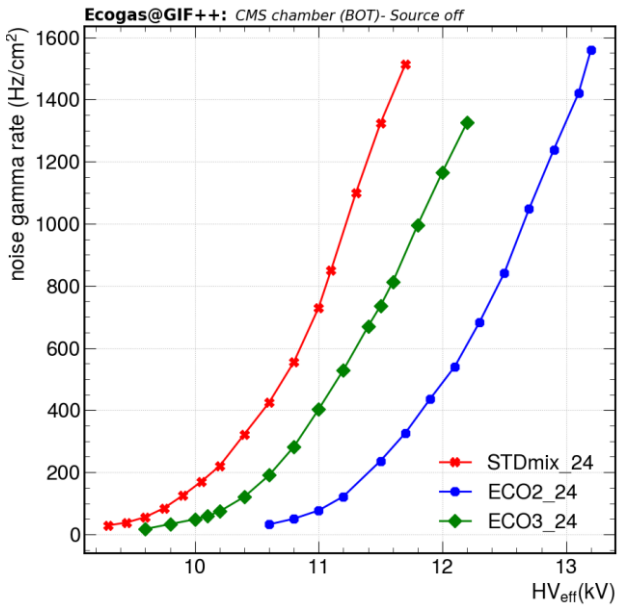

Fig: background gamma rate vs HV_eff (BOT)

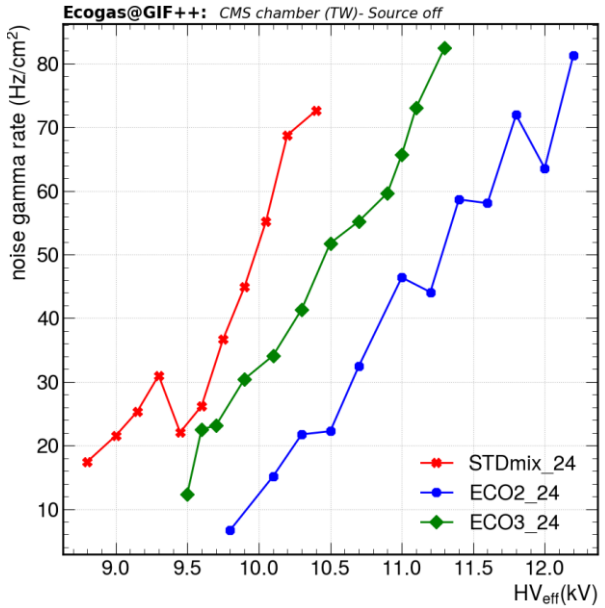

Fig: background gamma rate vs HV_eff (TW)

Source_off:

- Bottom RPC: background gamma rates for STD , ECO2, and ECO3 gas mixtures is approximately 490, 470 and 800 Hz/cm^2 respectively at their WP (10.68 kV, 12.00 kV and 11.51 kV).
- Top Wide RPC: background gamma for the STD, ECO2 and ECO3 is around 36, 46 and 40 Hz/cm^2 respectively at their WP (9.73 kV, 11.02 kV and 10.28 kV).

2. Cluster rate calculated for ABS_100 and ABS_3.3 by

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

3. Gamma rate calculated by normalizing the cluster rate with muon efficiency of the chamber (for respective gas mixtures).

$$\text{Gamma rate} = \text{CLR X } \frac{effi\_wp\_muon}{100}$$

ABS_100

Gamma rate vs HV_{eff}

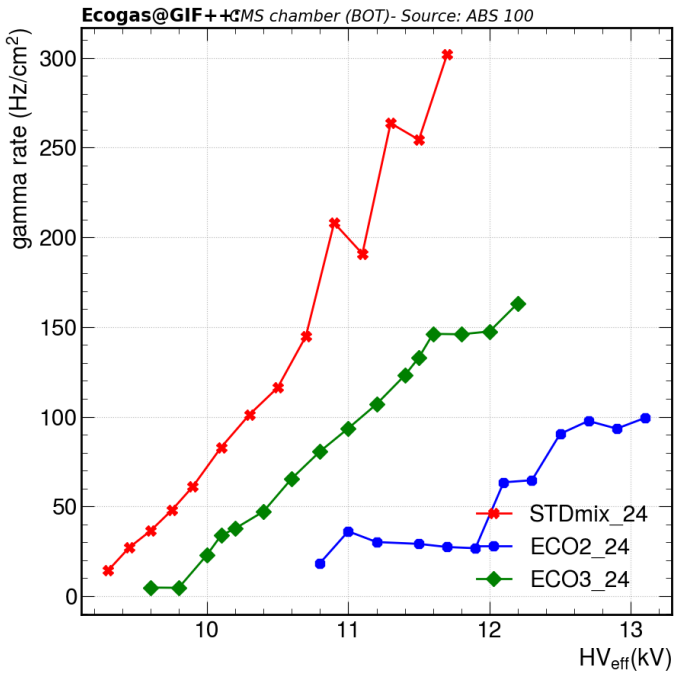

Fig: gamma rate vs HV_eff (BOT)

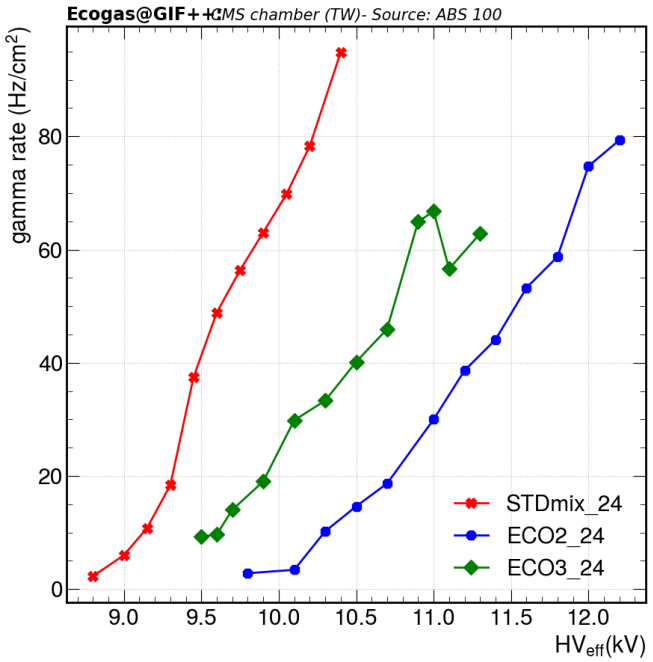

Fig: gamma rate vs HV_eff (TW)

ABS_100:

- Bottom RPC: gamma rates for STD , ECO2, and ECO3 gas mixtures is approximately 140, 90 and 130 Hz/cm^2 respectively at their WP (10.68 kV, 12.46 kV and 11.49 kV).
- Top Wide RPC: gamma for the STD, ECO2 and ECO3 is around 60, 35 and 36 Hz/cm^2 respectively at their WP (9.84 kV, 11.15 kV and 10.40 kV).
- In the bottom RPC the higher gamma rates are observed mainly due to high noise rates in the gap.

ABS_3.3

Gamma rate vs HV_{eff}

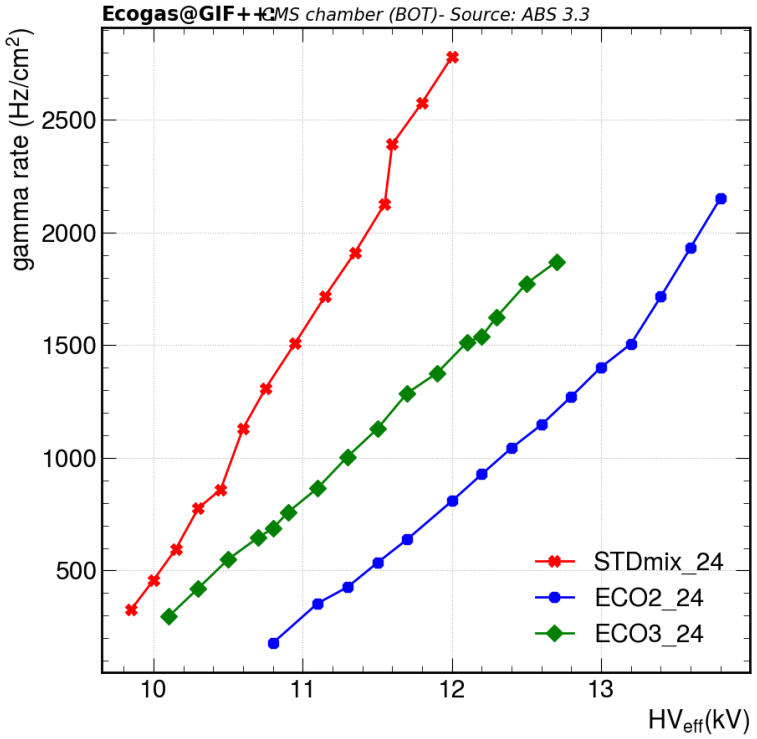

Fig: gamma rate vs HV_eff (BOT)

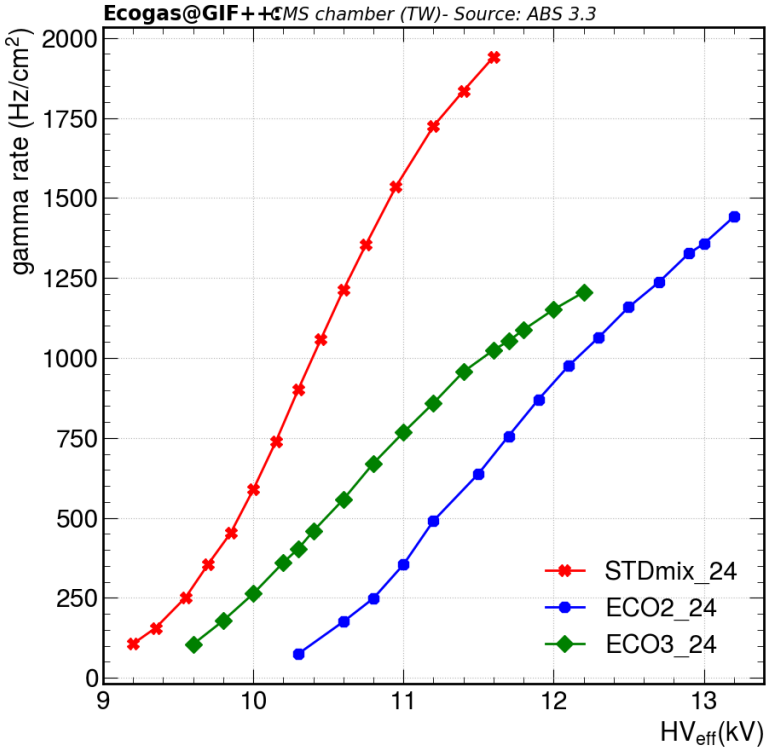

Fig: gamma rate vs HV_eff (TW)

ABS_3.3:

- Bottom RPC: gamma rates for STD , ECO2, and ECO3 gas mixtures is approximately 2390, 1400 and 1870 Hz/cm^2 respectively at their WP (11.58 kV, 12.96 kV and 12.68 kV).
- Top Wide RPC: gamma for the STD, ECO2 and ECO3 is around 1590, 1060 and 1080 Hz/cm^2 respectively at their WP (11.06 kV, 12.26 kV and 11.86 kV).

Conclusions: (Test beam 2024 –April-Single gap mode)

- Working points of Bottom RPC for STD gas are approximately 600 to 800 Volts higher than the working point of the TW RPC. For ECO2: 800 – 1000 V0lts, For ECO3: 800 – 1200 Volts.
- Background noise gamma rates (source off condition) for Bottom RPC for STD are roughly 14 times higher than background noise rates of the TW RPC. For ECO2: 10 times, For ECO3: 20 times.
- ABS_3.3: Gamma rates are higher for BOT RPC, roughly 1/3 times higher than the TW RPC.
- ABS_100: Gamma rates are higher for BOT RPC, approximately 2 to 4 times higher than the TW RPC.
- Chamber efficiency when operated with ECO3 gas mixtures is less compared with STD and ECO2 gas mixtures.
- Since the Readout electronics partitions (A&B) are same for both the TOP and BOT RPC, the problem lies with the BOT RPC itself, in terms of low efficiency (less than 80%). Current density rates are 3-5 times are higher and also the noise gamma rates.

Comparison of Test beam 2024 vs 2023 for CMS RE1_1 Chamber

(Double gap mode results)

2024 (April) vs 2023 (Oct) Efficiency vs HV_eff

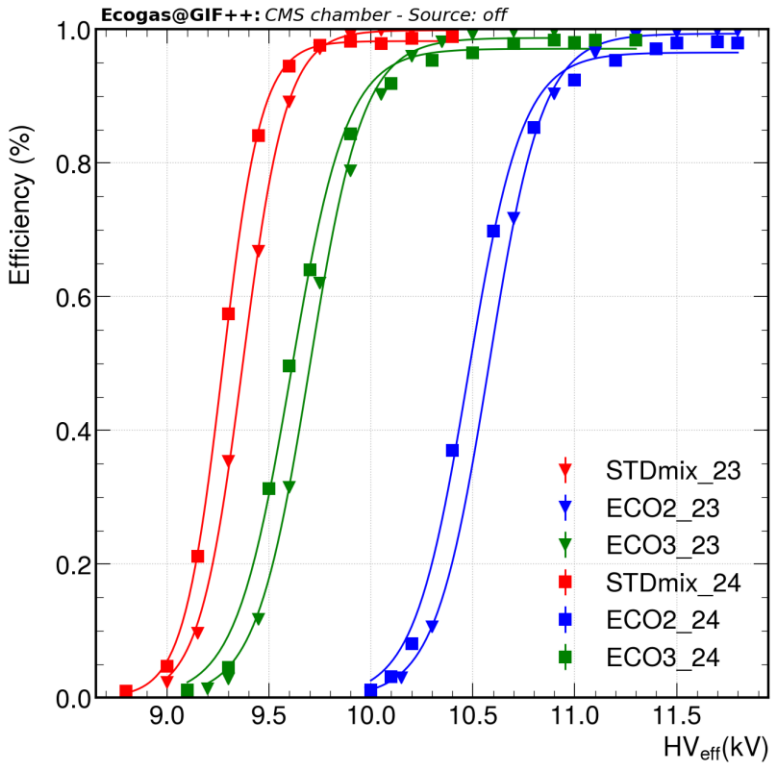

Fig: Efficiency vs HV_eff: S_off

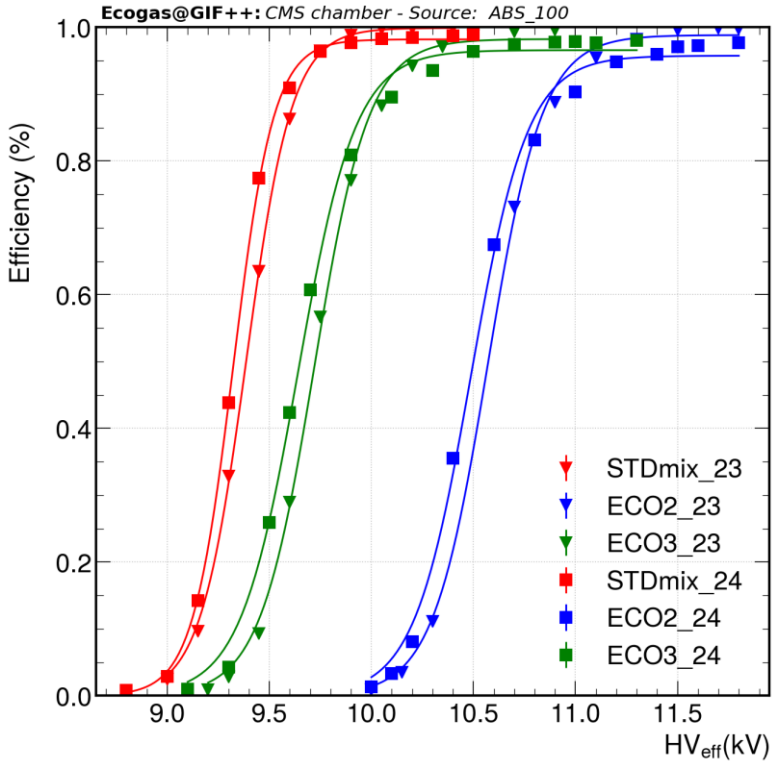

Fig: Efficiency vs HV_eff: ABS_100

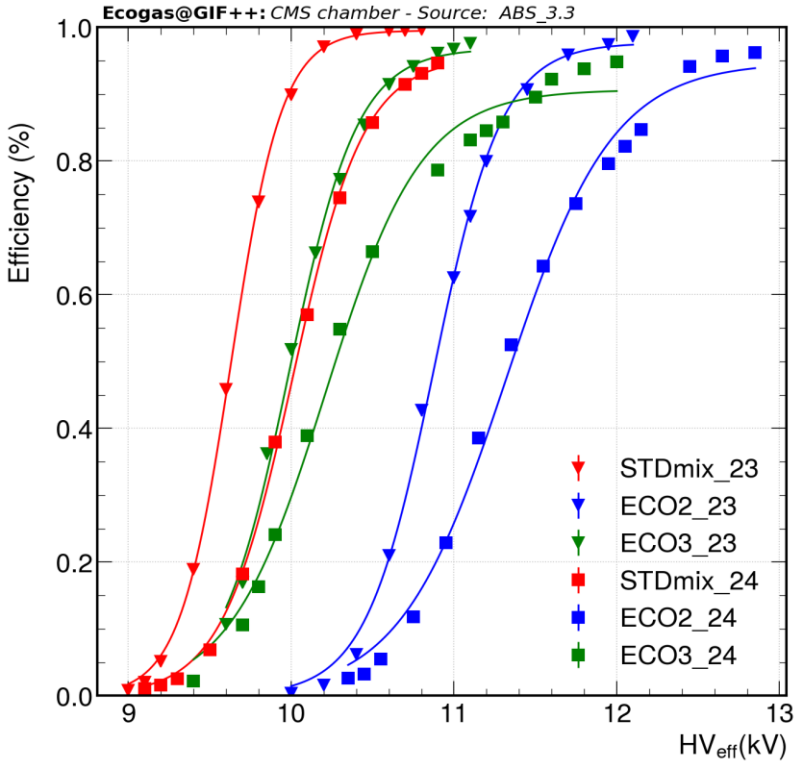

Fig: Efficiency vs HV_eff: ABS_3.3

- In Source off and ABS_100: In 2024, Efficiency and working points reduced for all the gas mixtures (STD, ECO2, and ECO3), compared with 2023 data.
- ABS_3.3: In 2024, efficiency reduced around 5%. WP increased around 500 V for all the gas mixtures.
- For source off: There is a 100 V shift of HV_50 towards negative side.
- For ABS_100: There is a 60 -80 V shift of HV_50 towards negative side.
- For ABS_3.3: There is a positive side shift of 380 V for STD mix, 450 V for ECO2 and 280 V shift for ECO3.

Source_off

Current density vs HV_eff

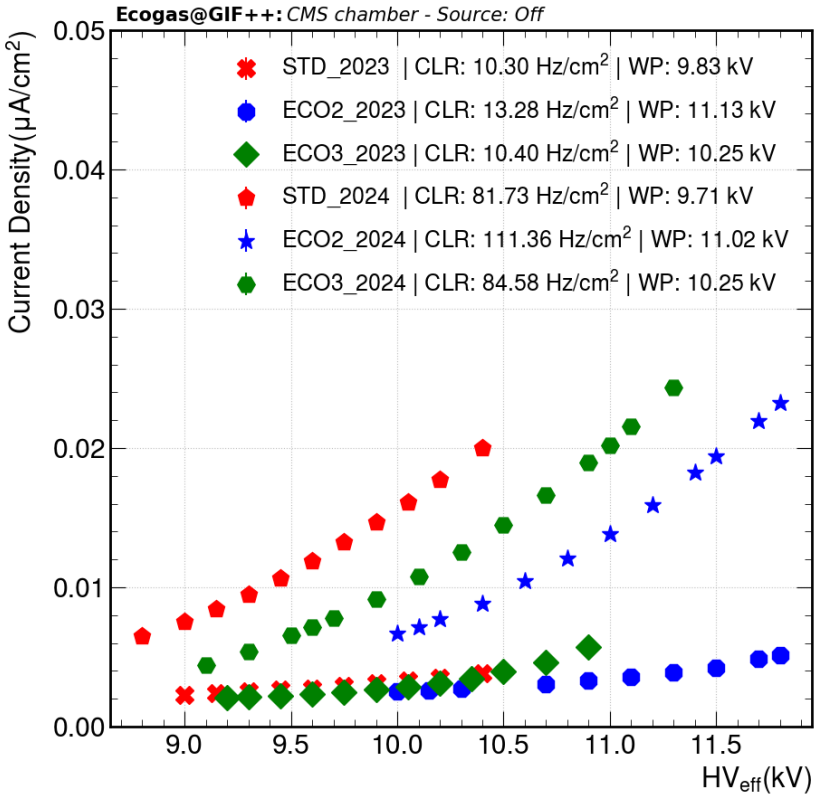

Fig: Current density vs HV_eff (BOT)

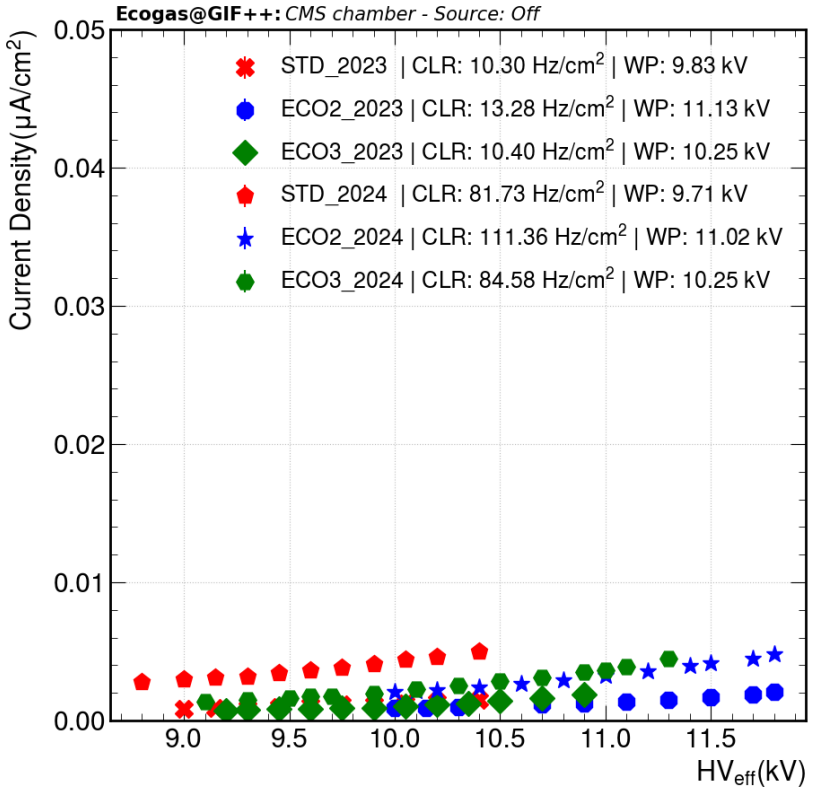

Fig: Current density vs HV_eff (TW)

Source off:

- Bottom RPC: In 2023, the current densities for STD , ECO2, and ECO3 gas mixtures is approximately 2 - 3 nA/cm^2 at their WP. In 2024 the current densities are increased to approximately 12-13 nA/cm^2 at their WP.
- Top Wide RPC: In 2023, the current densities for STD , ECO2, and ECO3 gas mixtures is approximately 0.5 - 1 nA/cm^2 at their WP. In 2024 the current densities are increased to approximately 1 - 2 nA/cm^2 at their WP.

ABS_100

Current density vs HV_eff

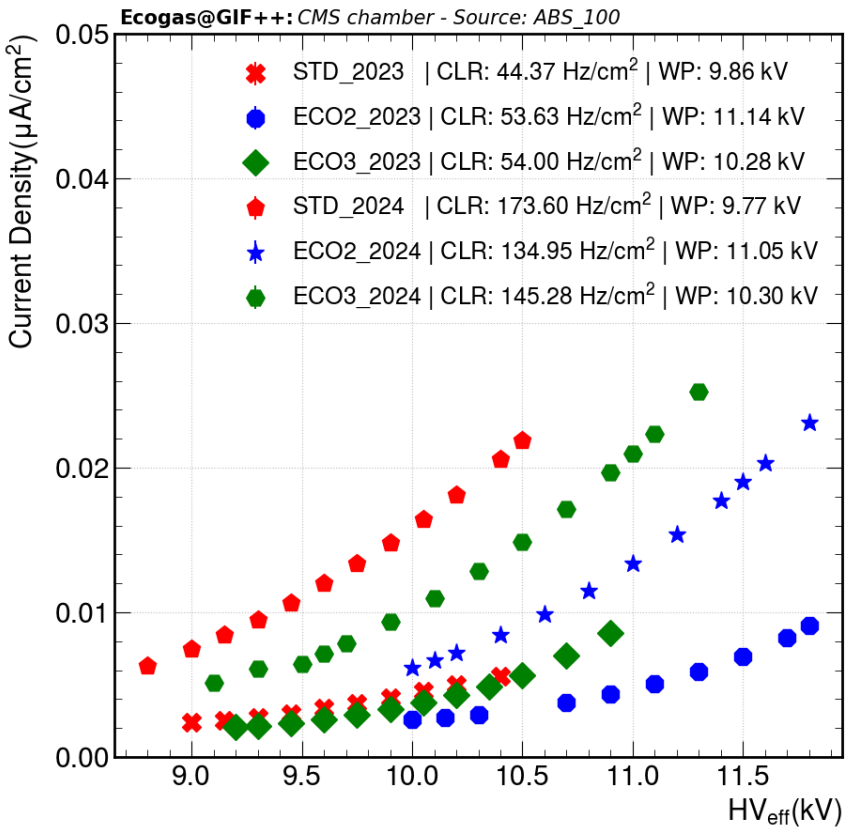

Fig: Current density vs HV_eff (BOT)

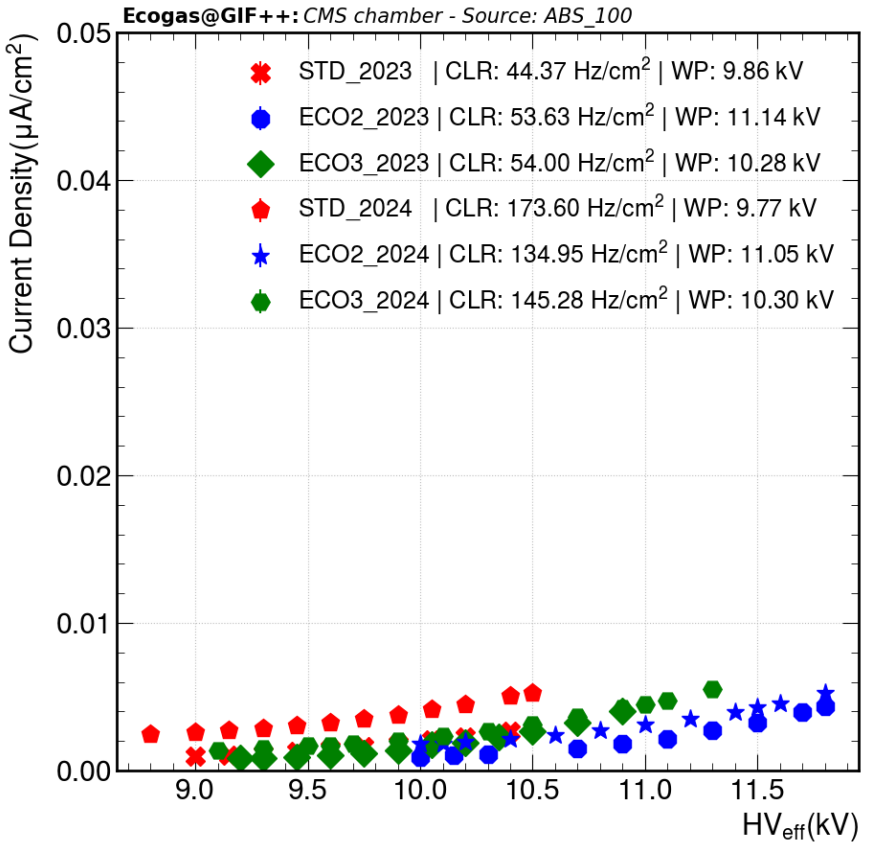

Fig: Current density vs HV_eff (TW)

ABS_100:

- Bottom RPC: In 2023, the current densities for STD , ECO2, and ECO3 gas mixtures is approximately 3 - 4 nA/cm^2 at their WP. In 2024 the current densities are increased to approximately 12 - 13 nA/cm^2 at their WP.
- Top Wide RPC: In 2023, the current densities for STD , ECO2, and ECO3 gas mixtures is approximately 0.5 - 1 nA/cm^2 at their WP. In 2024 the current densities are increased to approximately 1 - 2 nA/cm^2 at their WP.

ABS_3.3

Current density vs HV_eff

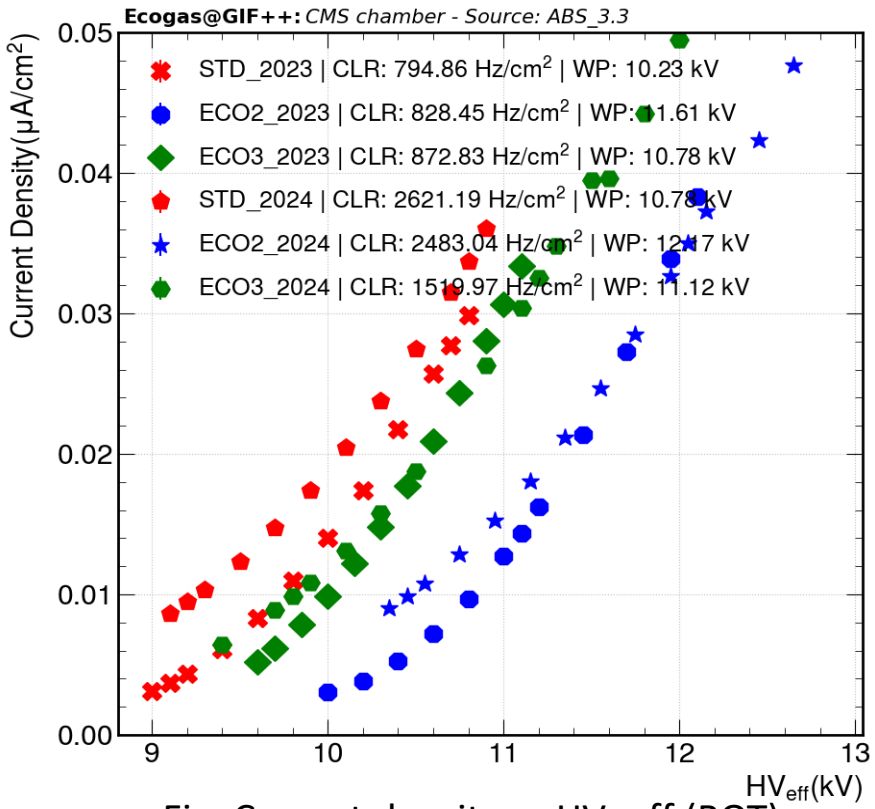

Fig: Current density vs HV_eff (BOT)

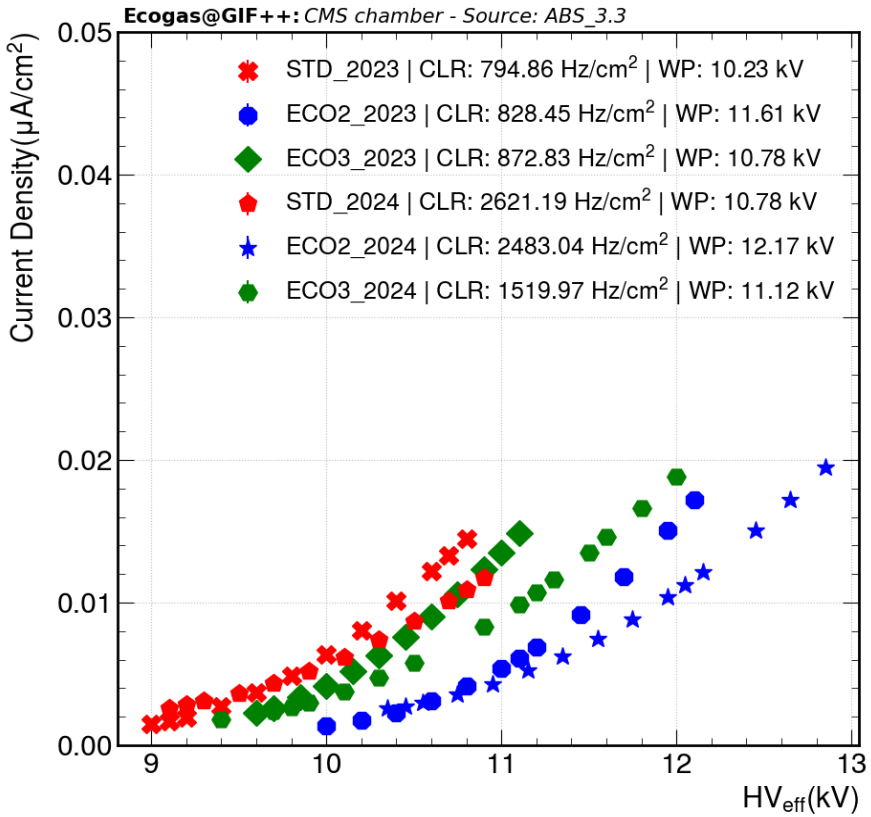

Fig: Current density vs HV_eff (TW)

ABS_3.3:

- Bottom RPC: In 2023, the current densities for STD , ECO2, and ECO3 gas mixtures is approximately 24 - 28 nA/cm^2 at their WP. In 2024 the current densities are increased to approximately 32 nA/cm^2 at their WP.
- Top Wide RPC: In 2023, the current densities for STD , ECO2, and ECO3 gas mixtures is approximately 8 - 11 nA/cm^2 at their WP. In 2024 the current densities are increased to 11 - 12 nA/cm^2 at their WP.

Muon cluster size vs HV_eff

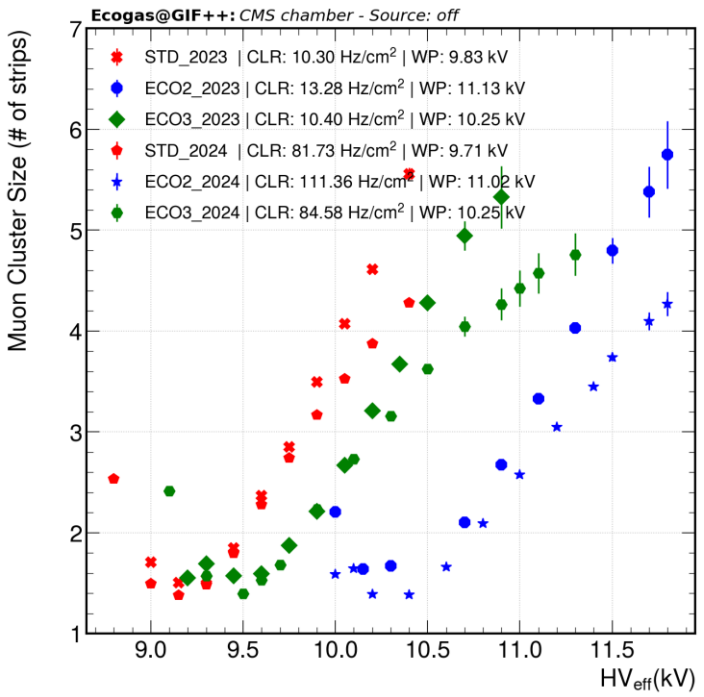

Fig: MCS vs HV_eff: S_off

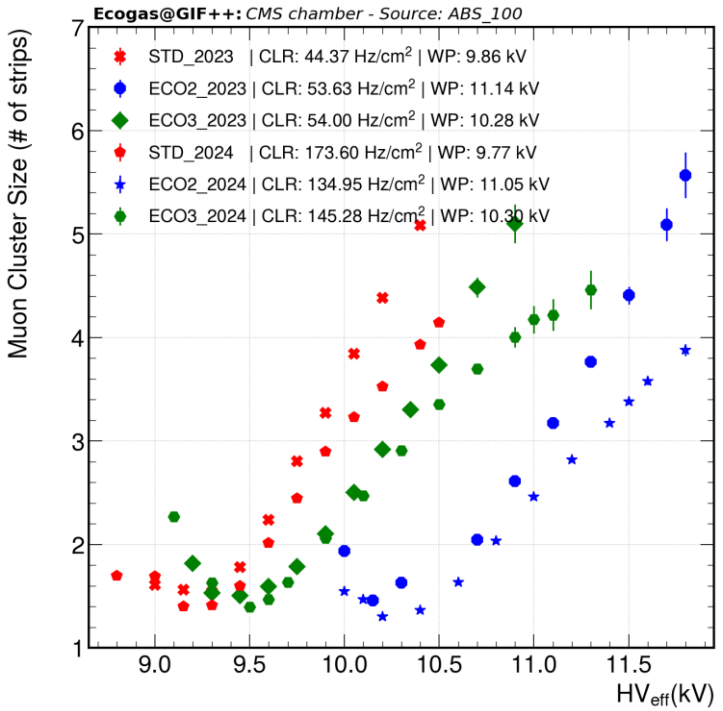

Fig: MCS vs HV_eff: ABS_100

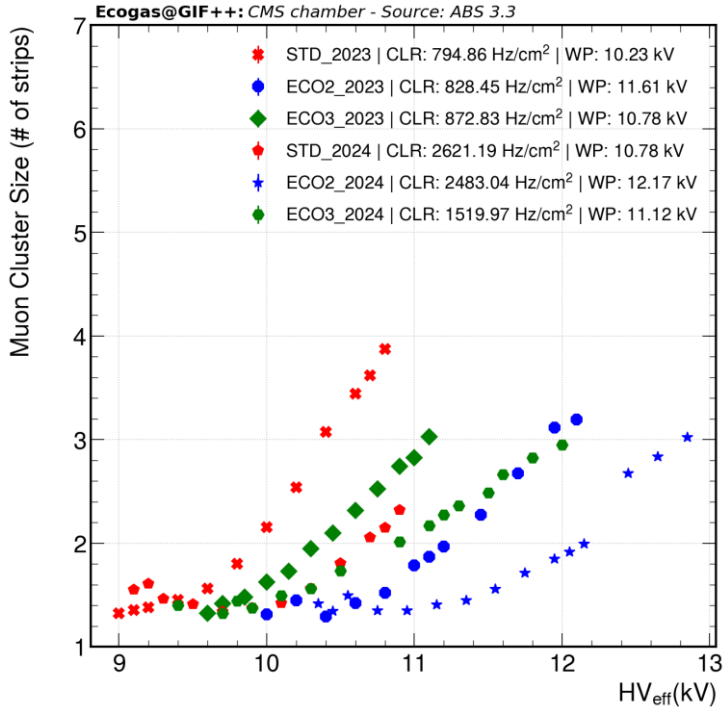

Fig: MCS vs HV_eff: ABS_3.3

- The data showed that the muon cluster size decreased as the cluster rate increased .
- For S_off and ABS_100 there is a modest decrease in cluster size between the data from 2023 and 2024 at their working points for all gas mixtures. In 2024 WP decreased is an additional information.
- For ABS_3.3 there is a decrease in cluster size between the data from 2023 to 2024 about 2.2 to 2 strip units for STD mix, 2.3 to 2.1 strip units for ECO2 and 2.4 to 2.2 strip units for ECO3 though there was an increase in WP (500 V) from 2023 to 2024

Conclusions(double gas mode):

- In 2024, the efficiency dropped for all the gas mixtures for source off and ABS_100 and ABS_3.3
- For ABS_3.3 the steepness of the efficiency curves dropped drastically.
- For ABS_3.3, ECO3 gas mixture efficiency is decreased comparing with STD and ECO2.
- From 2023 to 2024, for bottom RPC, the current densities increased about 4-5 times for s_off, 3 times for ABS_100.
- In 2024, Muon Cluster size decreased for all the ABS.
- In 2024 cluster rate increased for all the ABS.