

Summary Test Beam - ECOGAS

April 2024 - PRELIMINARY RESULTS

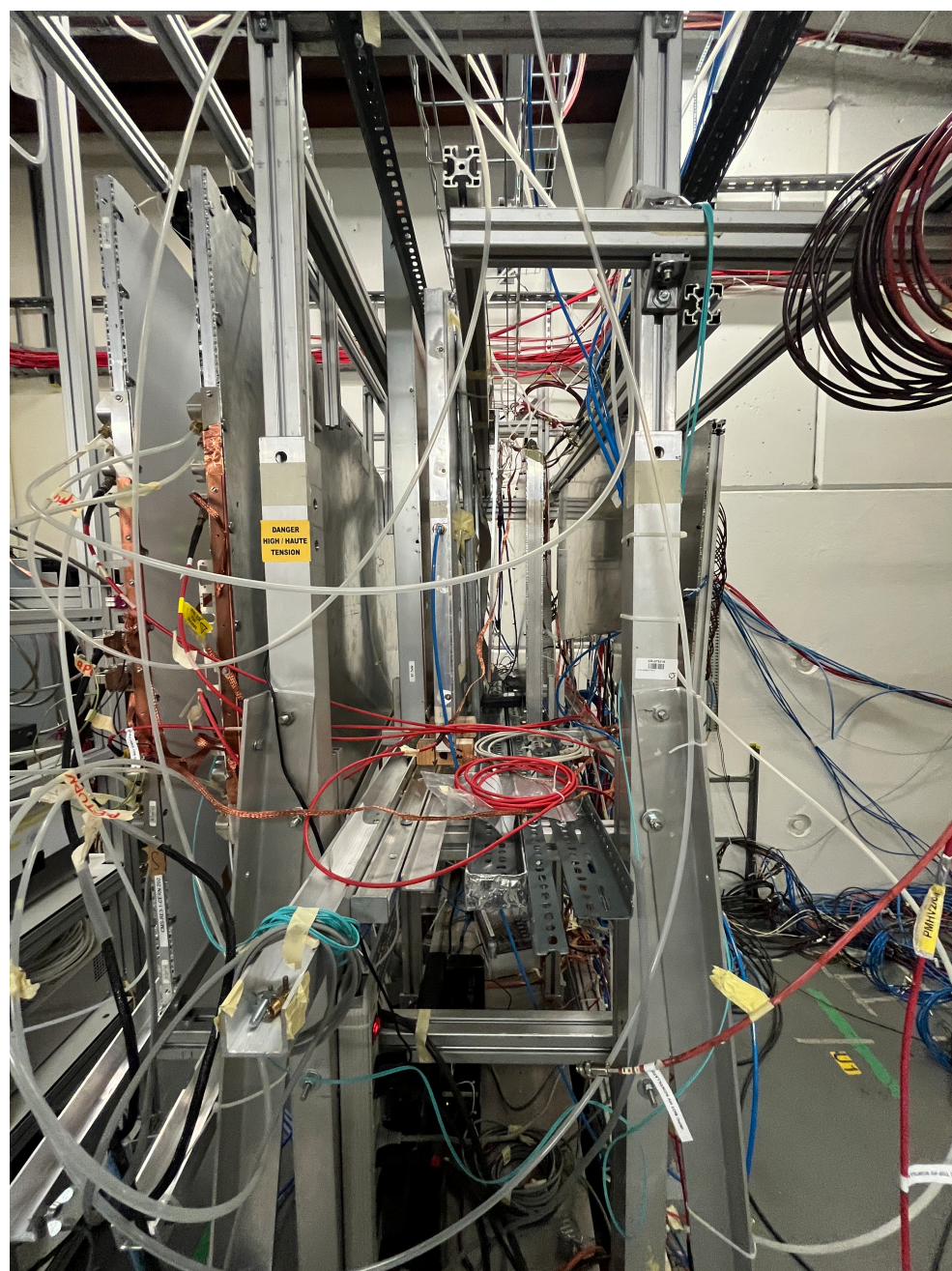
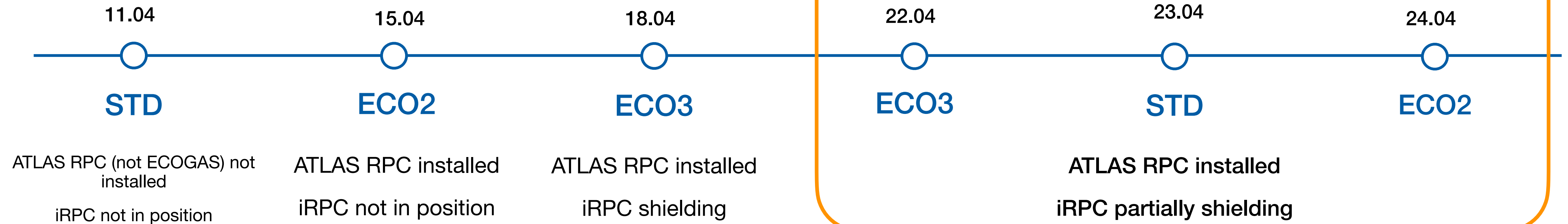
Stefania Juks & Mattia Verzeroli
29.04.2024



EP-DT
Detector Technologies

Campaign Overview

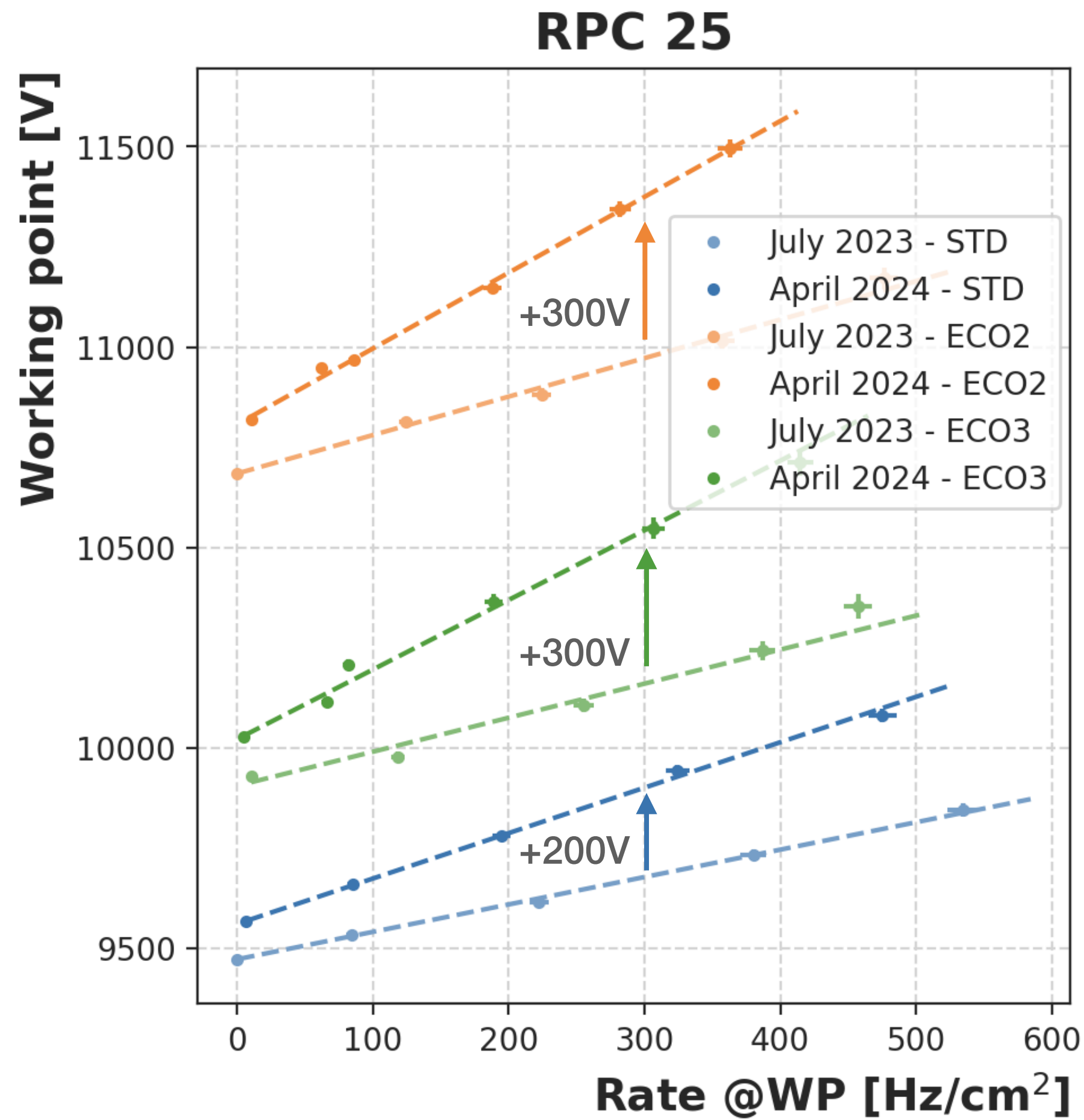
Set-up



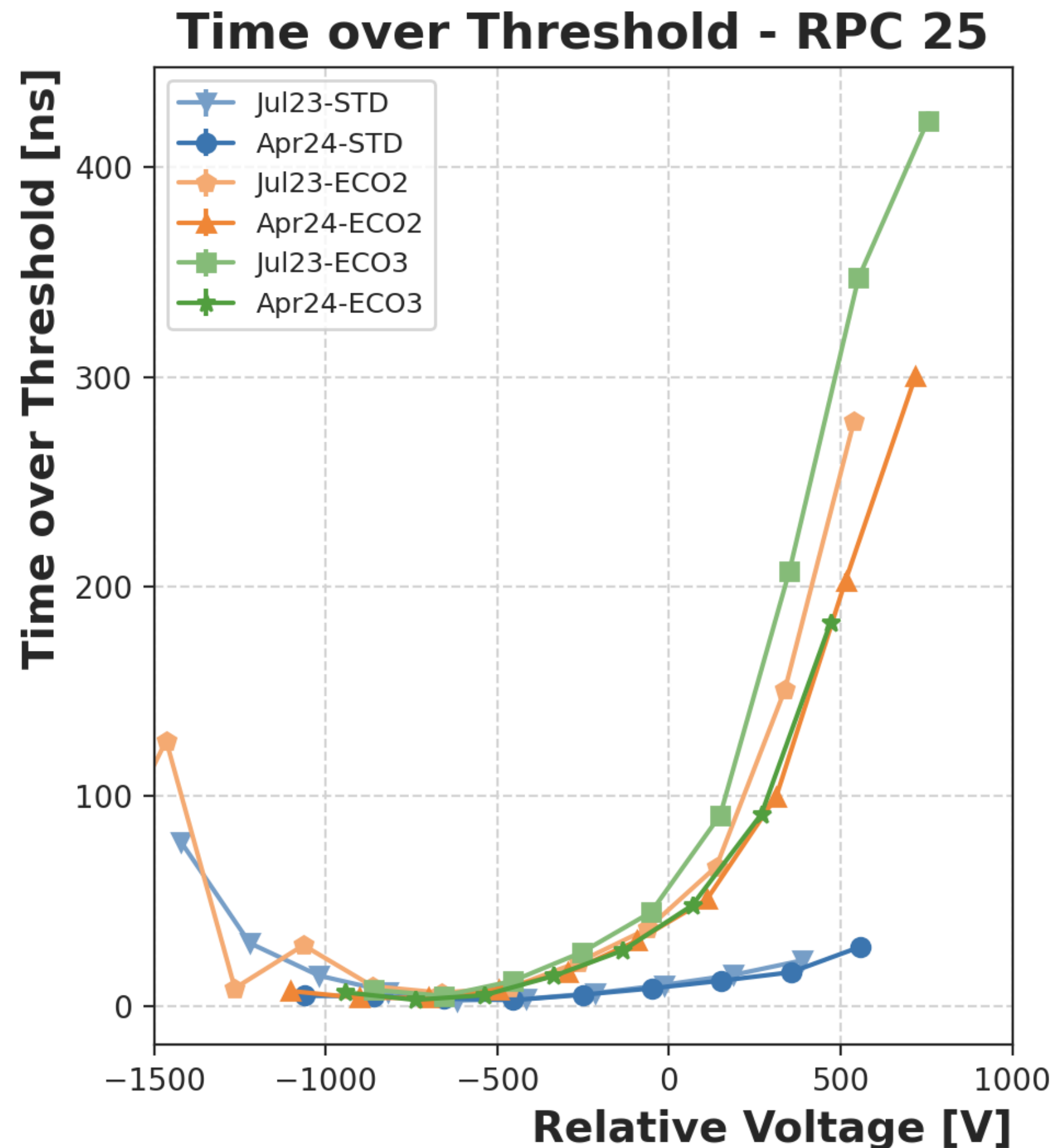
- In total, 6 runs of data were acquired for RPC 25 over 2 weeks
 - Standard Gas Mixture: 95.2% R-134a + 4.5% i-C₄H₁₀ + 0.3% SF₆ → x2
 - ECO2: 60% CO₂ + 35% R-1234ze + 4% i-C₄H₁₀ + 1% SF₆ → x2
 - ECO3: 69% CO₂ + 25% R-1234ze + 5% i-C₄H₁₀ + 1% SF₆ → x2
- Data was taken for Source Off and 5 upstream filters: ABS 100, ABS 69, ABS 22, ABS 10, ABS 6.9
- The dosimeter was installed, however since the detector was sometimes partially shielded, the rate is not accurate.
- Total Integrated Charge up to today: 61.5mC/cm²

Working Point VS Rate & Time over Threshold VS Rel. Voltage

July 2023 - Comparison



Defined as the voltage where efficiency = 95% + 150V.



Defined as the time from the threshold (2mV) up to the end of the signal (including streamers).

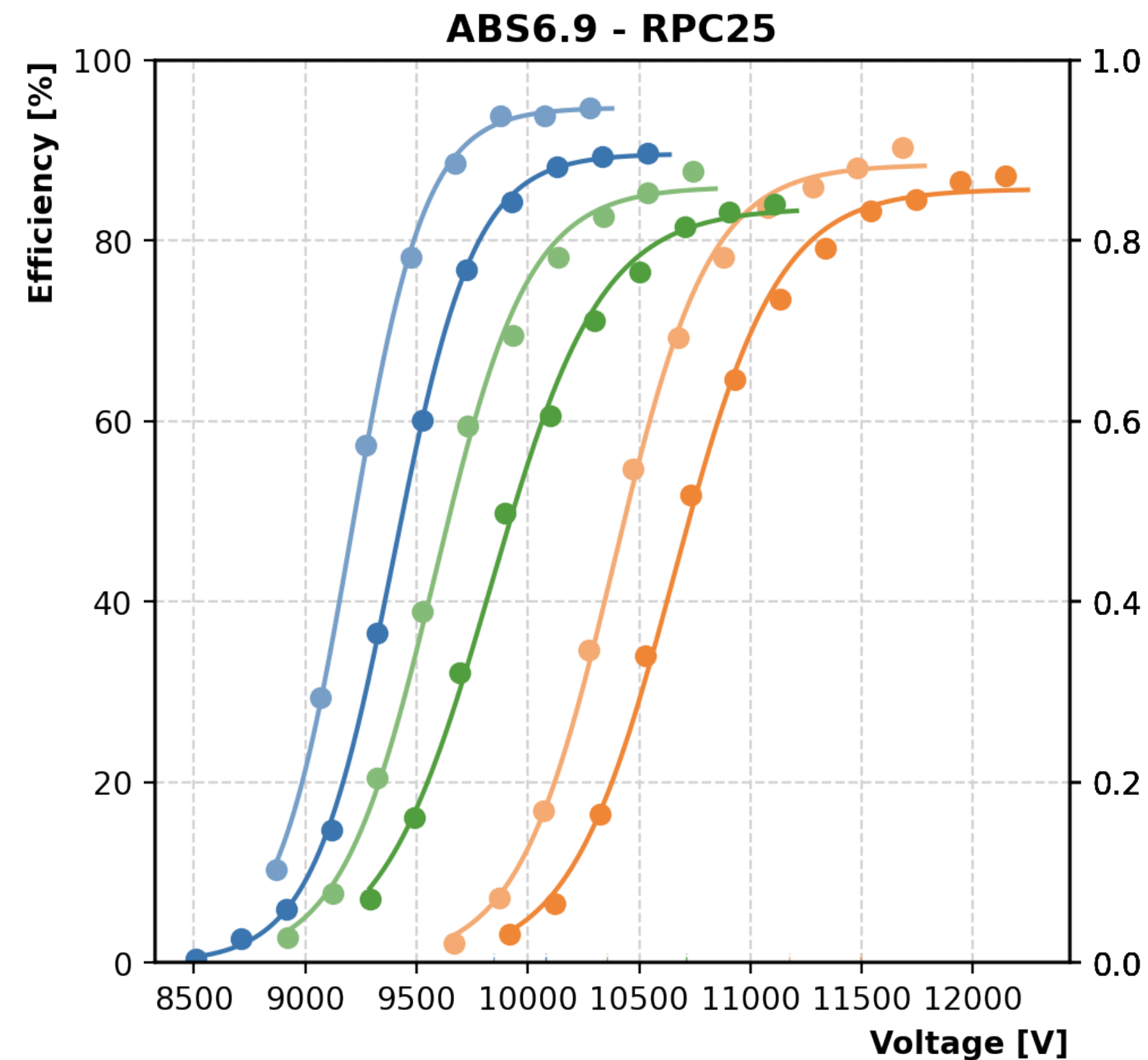
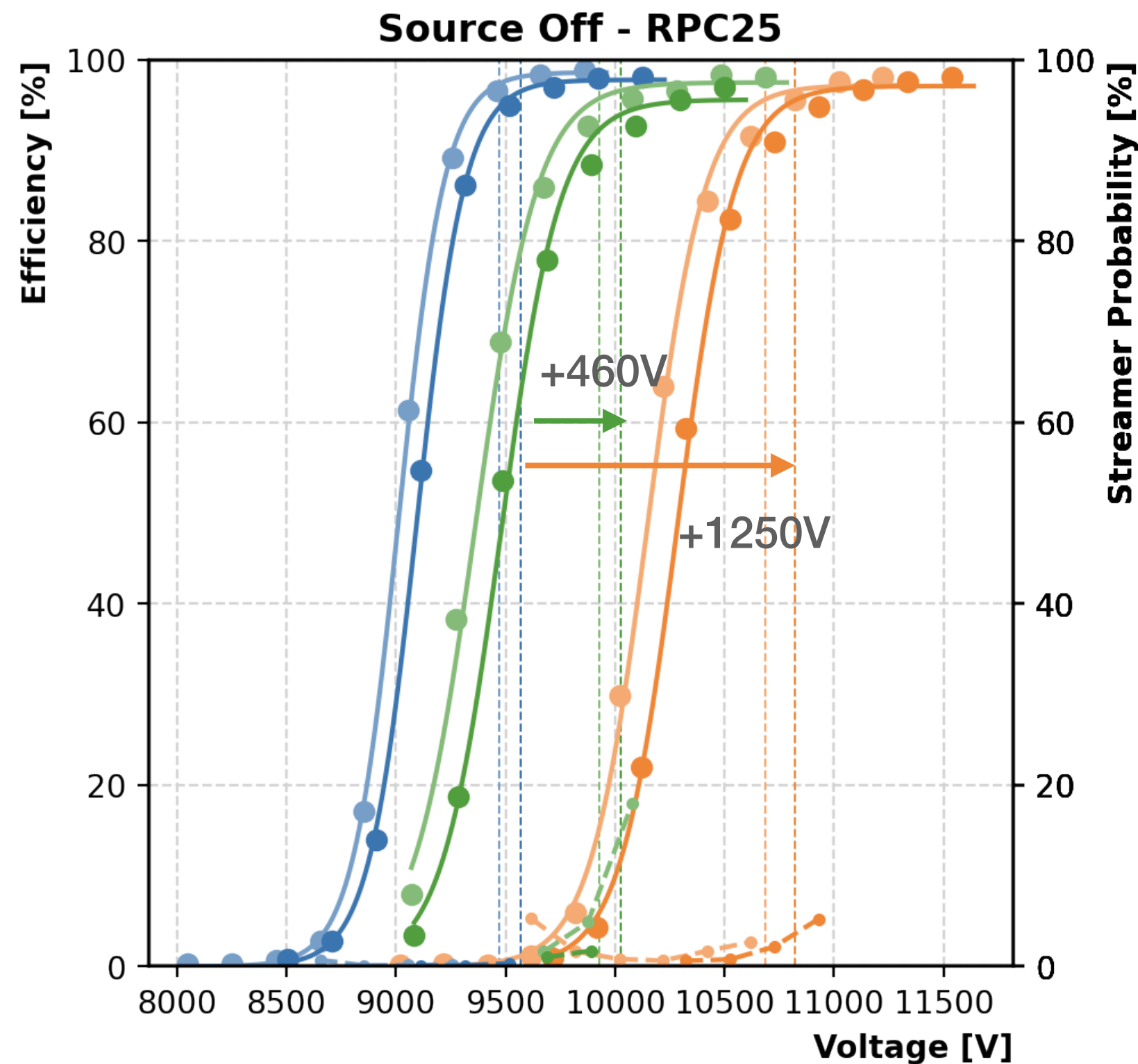
- Compared to the last TB (July 2023), the shift in the working point is ~300V at fixed rate (300Hz/cm²).
- The shift in working point is between the two gas mixtures taken: ECO2, ECO3, while for the STD mixture the shift is lower (of only ~200V).
- The working point shift increases at higher rates.
- At working point, the time over threshold is consistent between ECO2 and ECO3.

Efficiency and Streamer Probability

July 2023 - Comparison

- July 2023 - STD, EffMax: 98.64%, SP: 0.50%, WP: 9473V, Rate: 0Hz/cm²
- April 2024 - STD, EffMax: 97.81%, SP: 0.47%, WP: 9568V, Rate: 7Hz/cm²
- July 2023 - ECO2, EffMax: 97.23%, SP: 4.50%, WP: 10684V, Rate: 0Hz/cm²
- April 2024 - ECO2, EffMax: 97.13%, SP: 3.58%, WP: 10820V, Rate: 11Hz/cm²
- July 2023 - ECO3, EffMax: 97.52%, SP: 8.33%, WP: 9930V, Rate: 10Hz/cm²
- April 2024 - ECO3, EffMax: 95.62%, SP: 5.03%, WP: 10027V, Rate: 5Hz/cm²

- July 2023 - STD, EffMax: 94.74%, SP: 0.23%, WP: 9846V, Rate: 535Hz/cm²
- April 2024 - STD, EffMax: 89.64%, SP: 0.29%, WP: 10081V, Rate: 475Hz/cm²
- July 2023 - ECO2, EffMax: 88.43%, SP: 1.28%, WP: 11171V, Rate: 476Hz/cm²
- April 2024 - ECO2, EffMax: 85.74%, SP: 1.49%, WP: 11494V, Rate: 363Hz/cm²
- July 2023 - ECO3, EffMax: 85.99%, SP: 1.28%, WP: 10353V, Rate: 457Hz/cm²
- April 2024 - ECO3, EffMax: 83.64%, SP: 2.11%, WP: 10711V, Rate: 415Hz/cm²

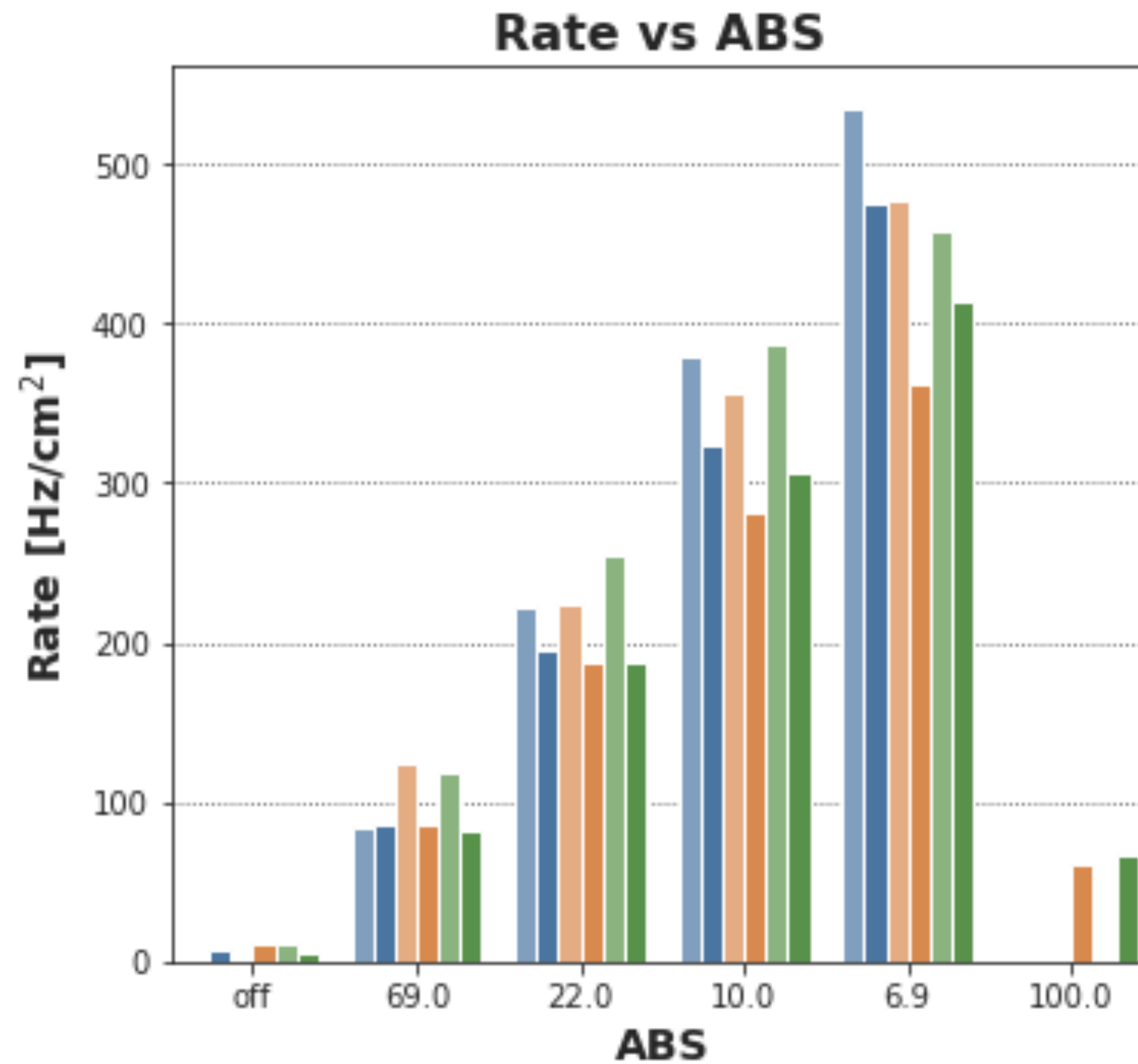
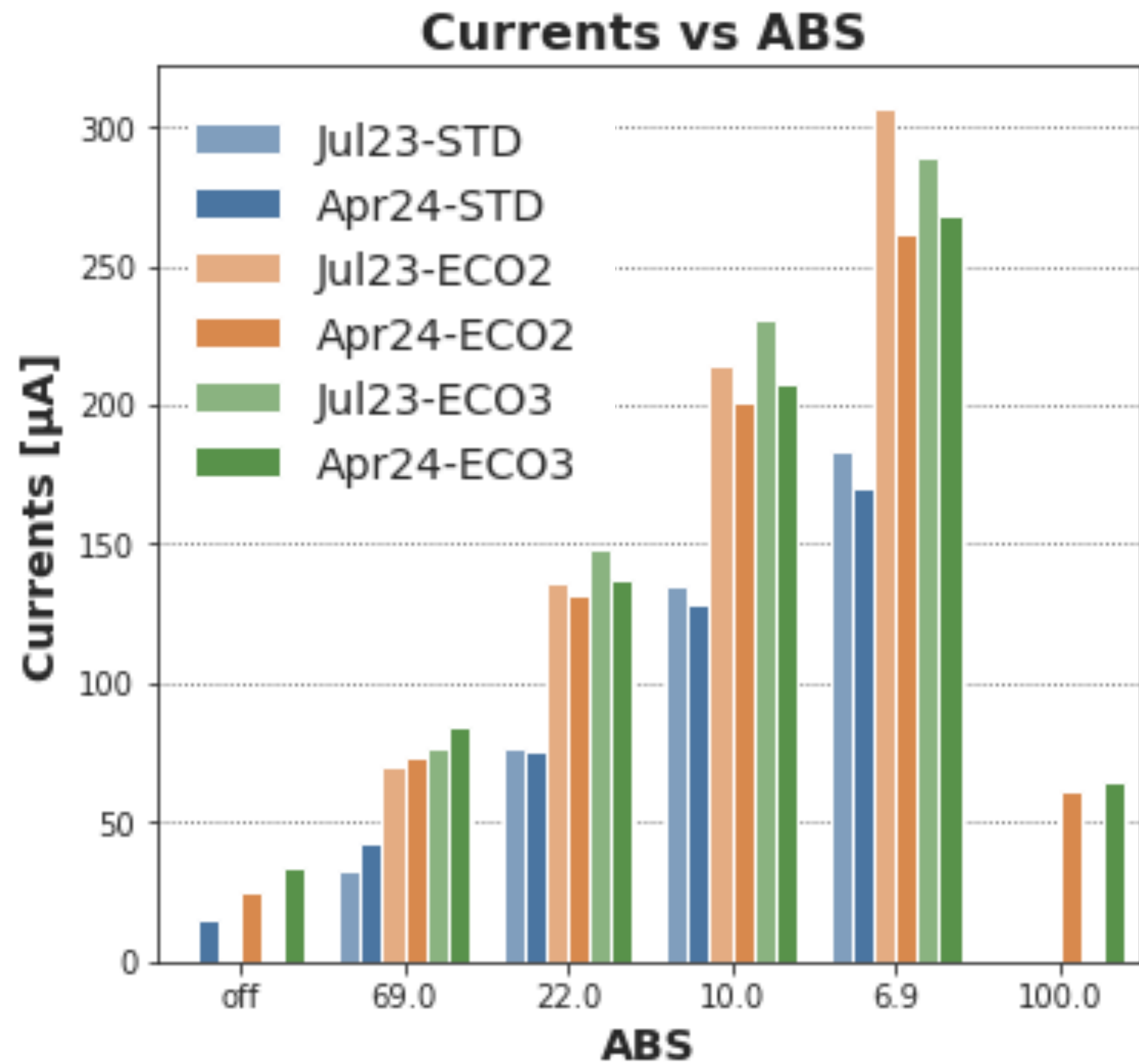


- Between the three mixtures, the efficiency drops at maximum ~2% (depending on the mixture and ABS filter) - which could result from the alignment.
- The streamer probability is reduced for all runs for all the mixtures taken; the ECO3 shows more streamers than ECO2;
- The working point is increased, yet the rate for all runs is consistently lower.
- ECO2 shows a higher increase in working point than ECO3.

Streamer: Defined as a signal where the charge is above 10⁸ electrons (Raether, 1964)

Currents/Rate VS ABS

July 2023 - Comparison



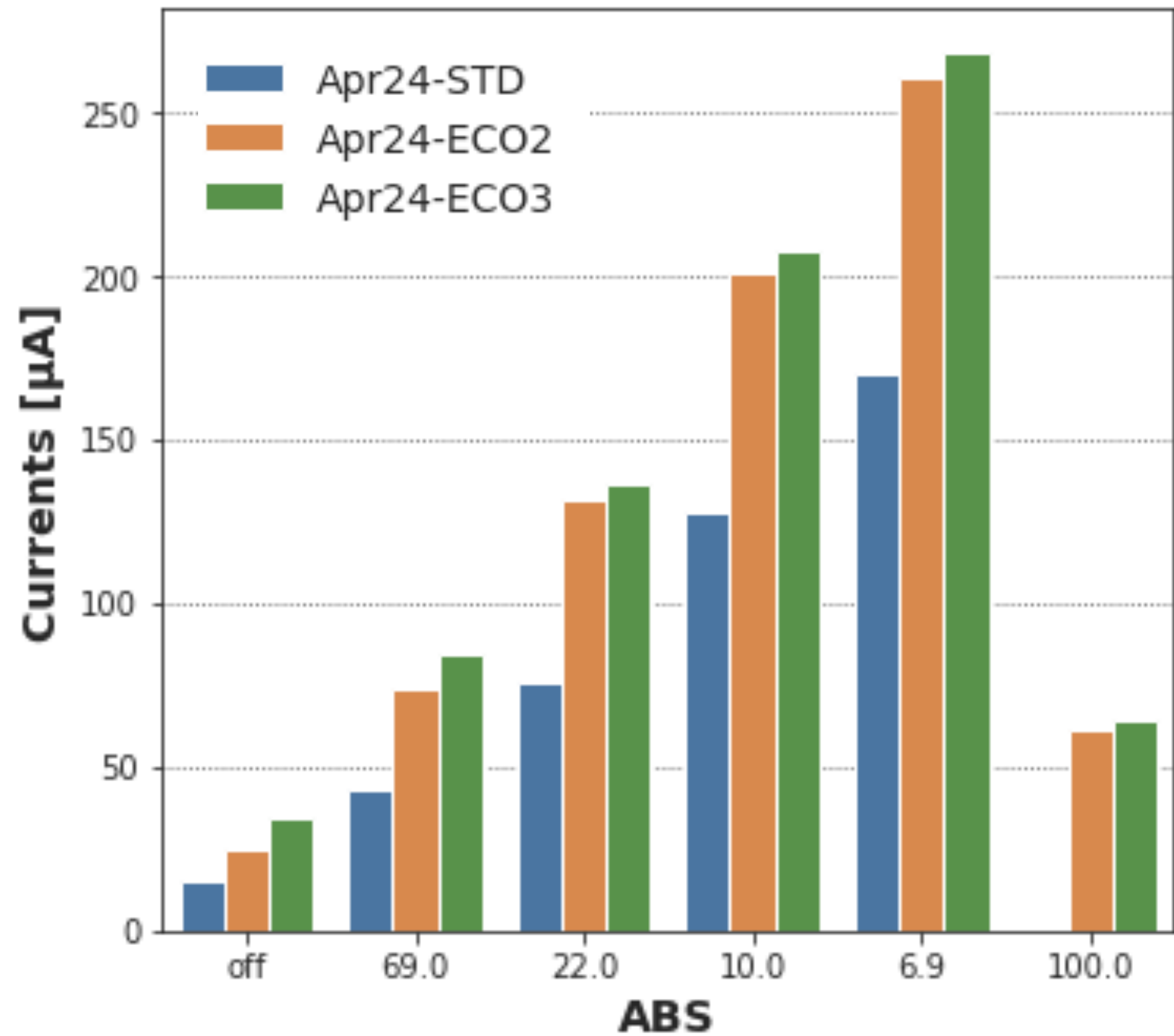
- At source off and ABS69, the currents are higher compared to last year's data, yet after ABS22, the currents are consistently lower wrt the previous test beam.
- This can be due to the lower rate recorded this year for all the filters -> different position of the detectors in front of our RPC.

• Thus, we can only compare within the test beam but not to last year due to the varying rate.

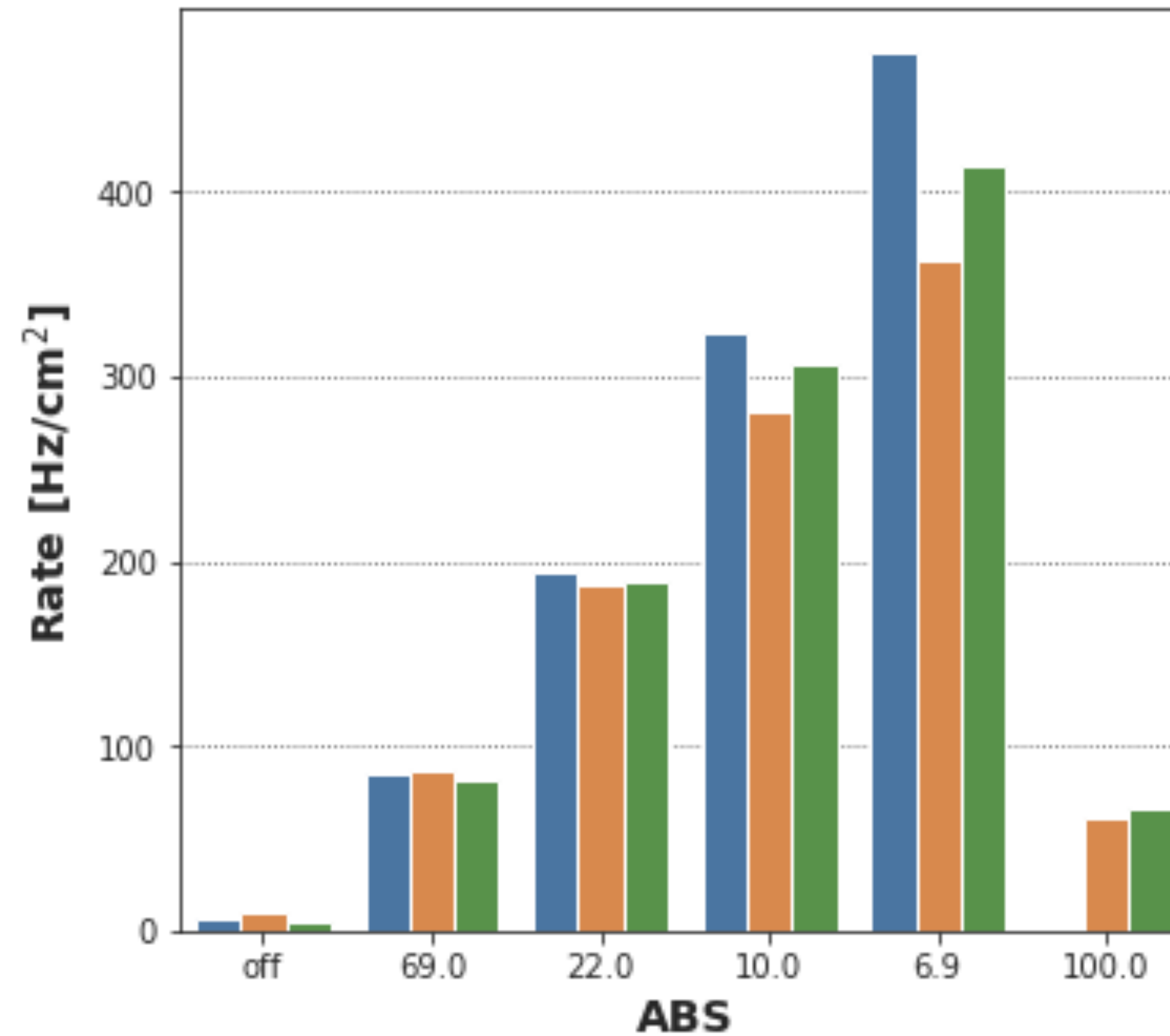
Currents VS ABS/Rate

April 2024 - Mixture Comparison

Currents vs ABS



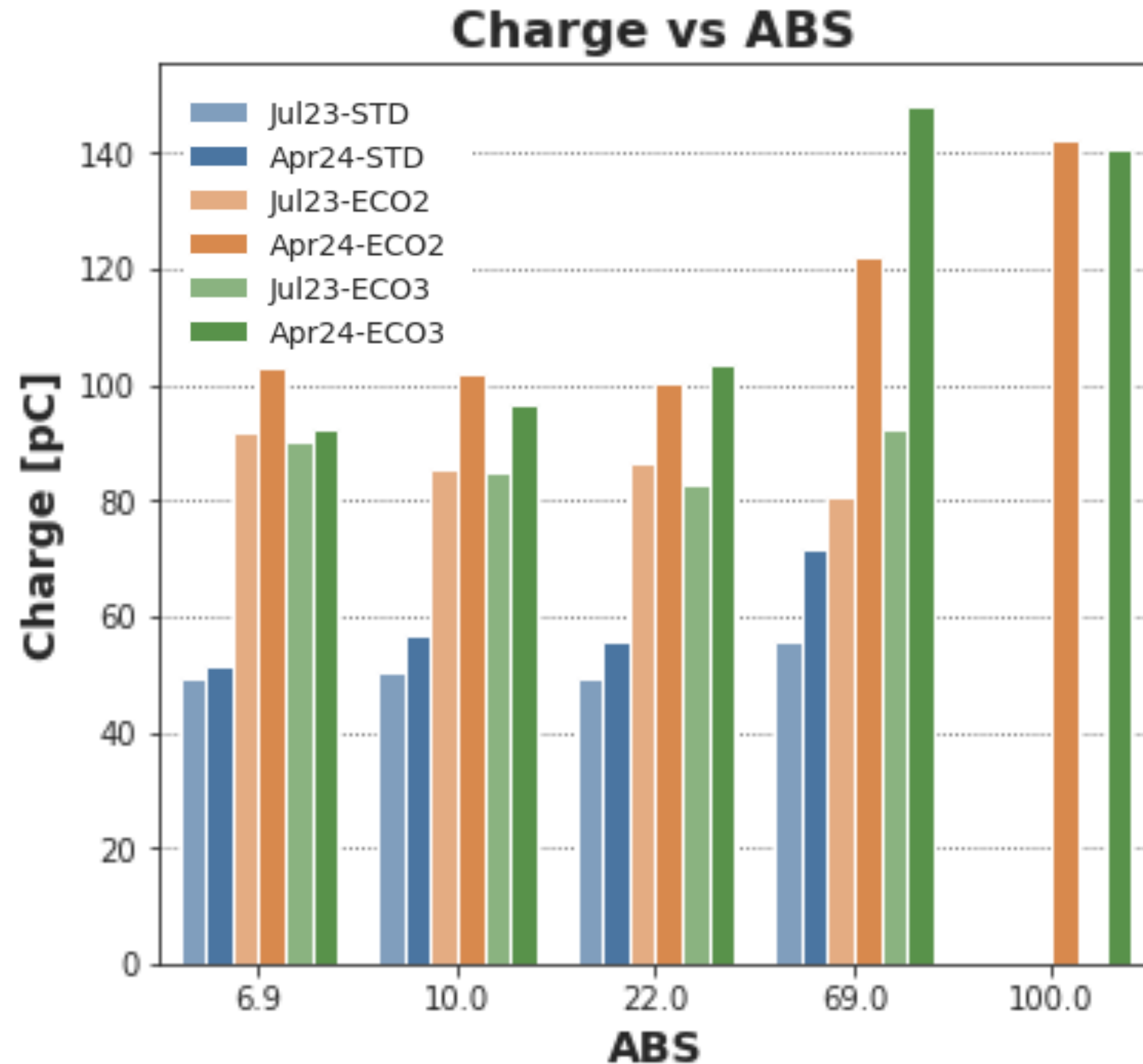
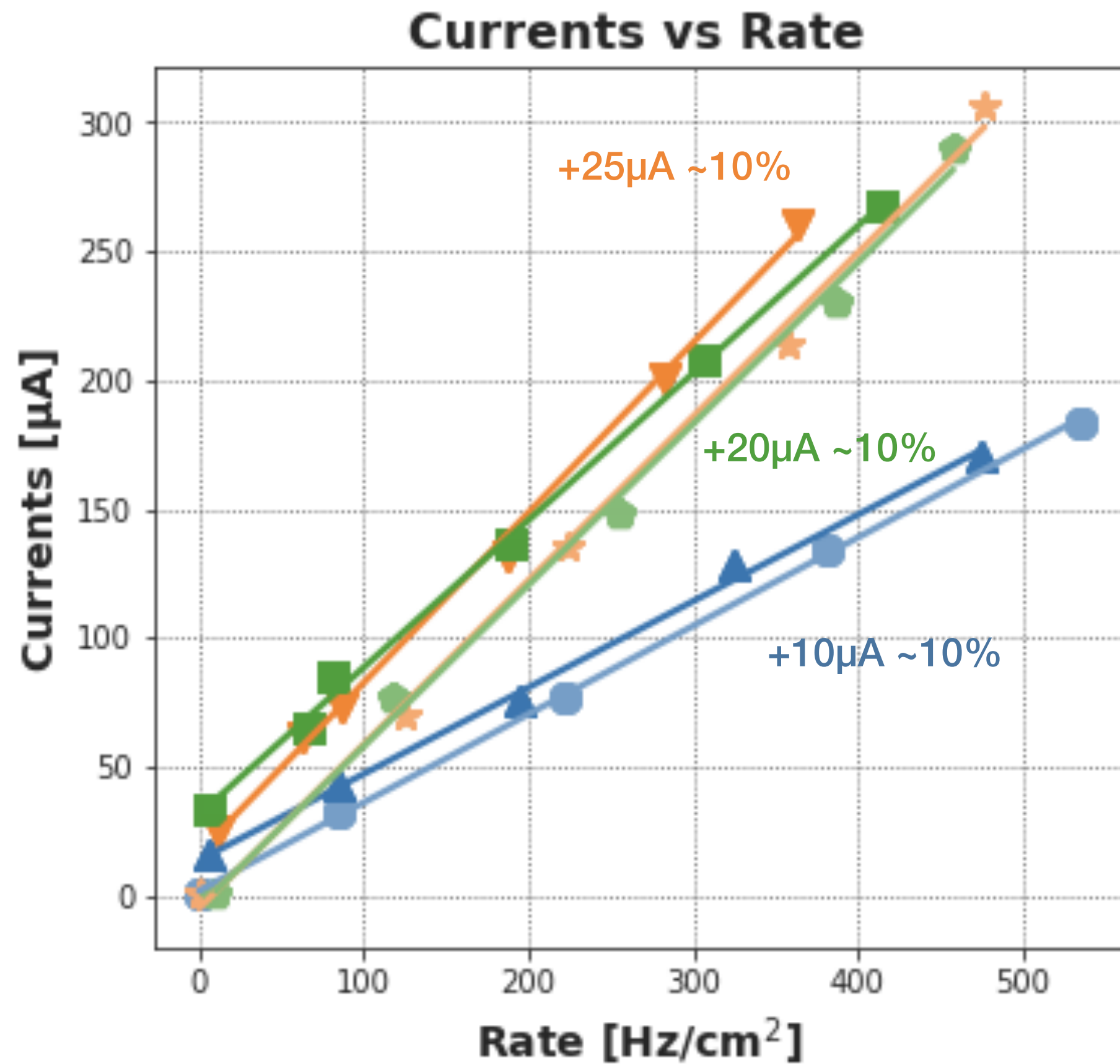
Rate vs ABS



- Both ECO2 and ECO3 show higher currents than the STD mixture, even if the rate at the same ABS appears higher.
- ECO3 shows slightly higher currents, but the rate is also a little increased for the same filter.

Currents VS Rate & Total Charge VS ABS

July 2023 - Comparison



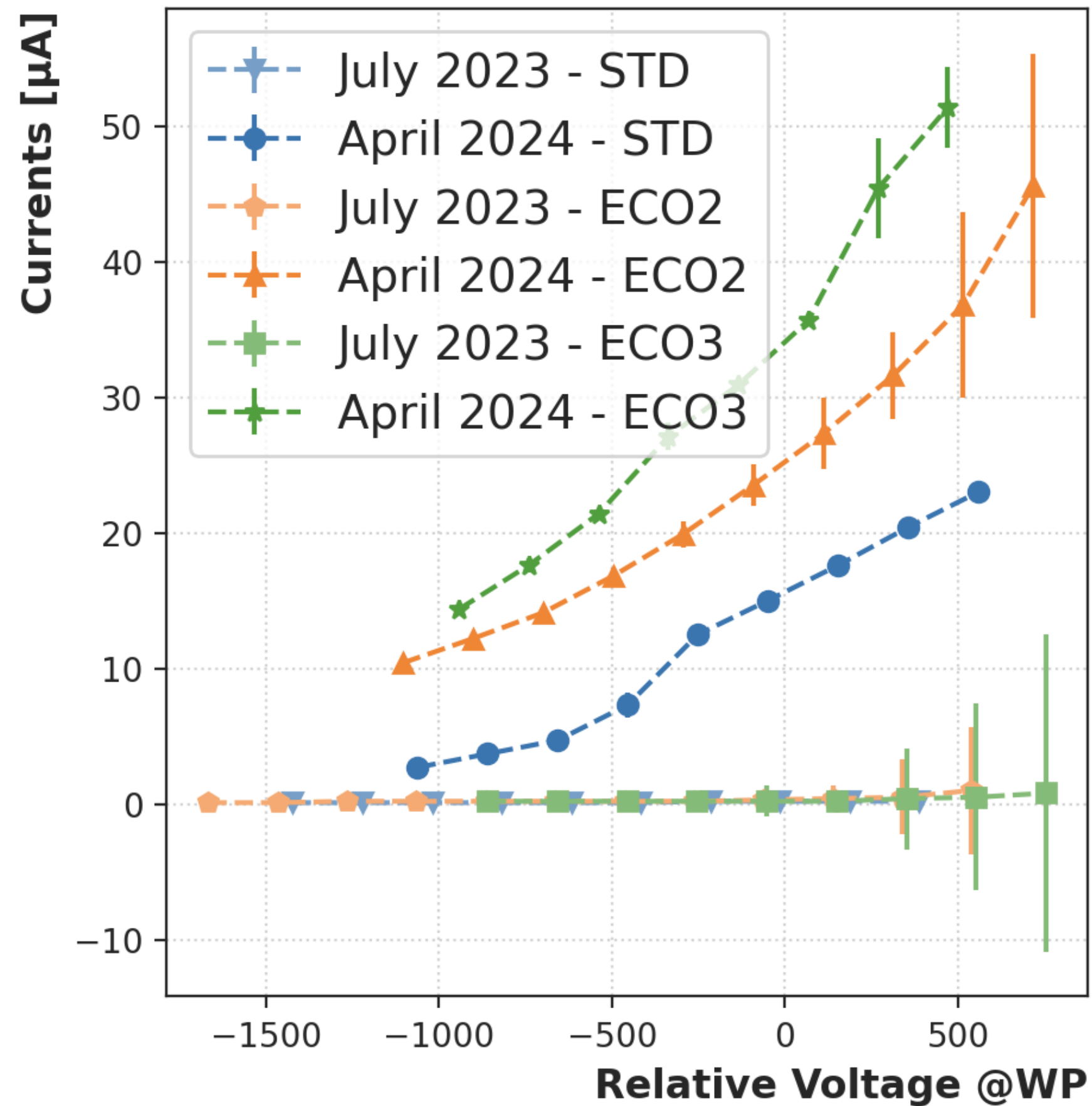
- The currents with respect to the rate are a little higher than in July 2023, ranging between ~10-25µA for the fixed rate of 300Hz/cm² -> meaning a 10% increase irrespective of the gas mixture
- The slopes for the STD and ECO2 are similar to the last year, only for the ECO3 mixture, the currents are slightly decreasing at higher rates.
- In terms of charge per ABS filter, this test beam it seems higher than last year, consistent with the higher currents and lower rate observed.
- Between the mixtures, for the STD, the charge is lower, but for ECO2 and ECO3 they are similar except for ABS69.

Charge: Defined as the currents over the rate.

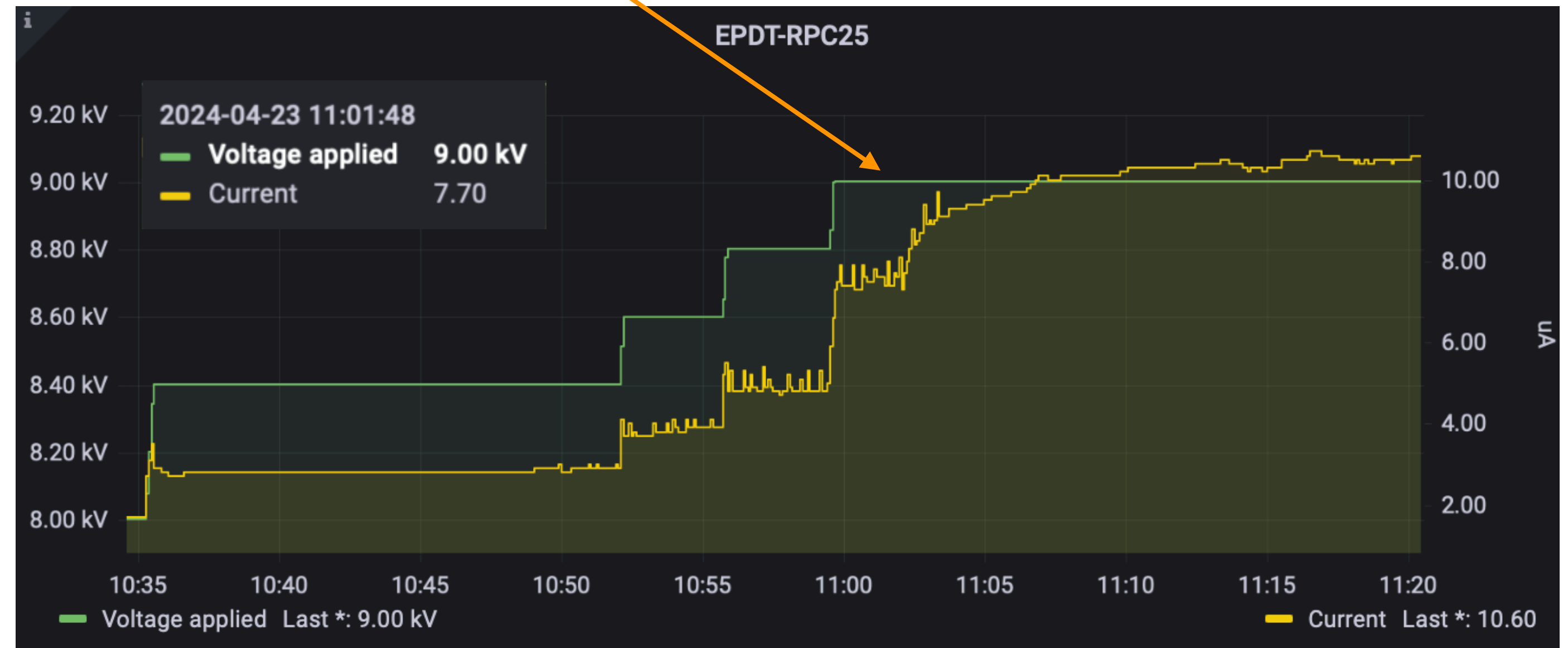
Currents VS Rel. Voltage

July 2023 - Comparison

Source Off - RPC25



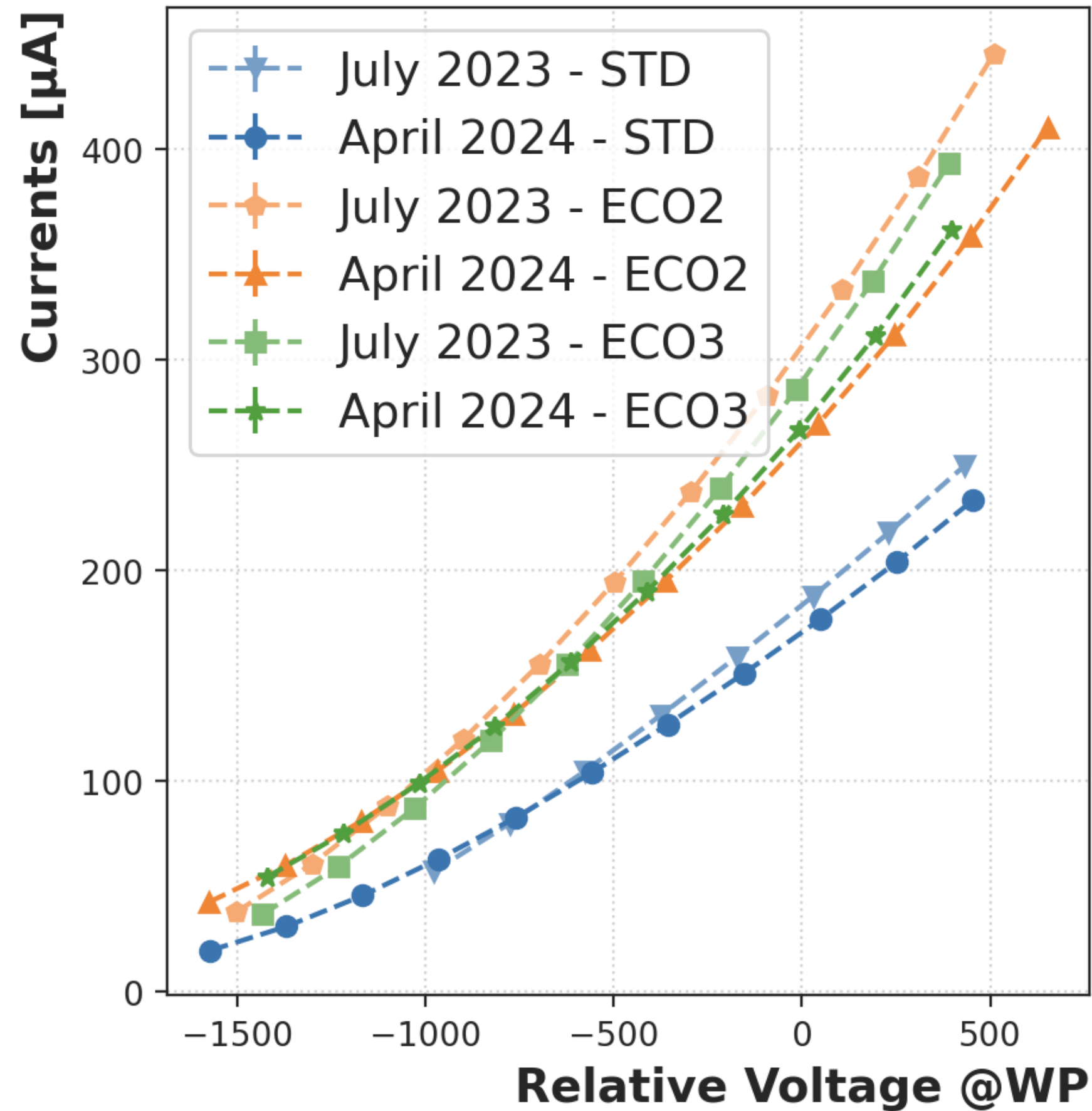
- There are some current jumps, when the detector is increasing in currents (usually after 9kV). In later runs, these were observed even only after 8kV.



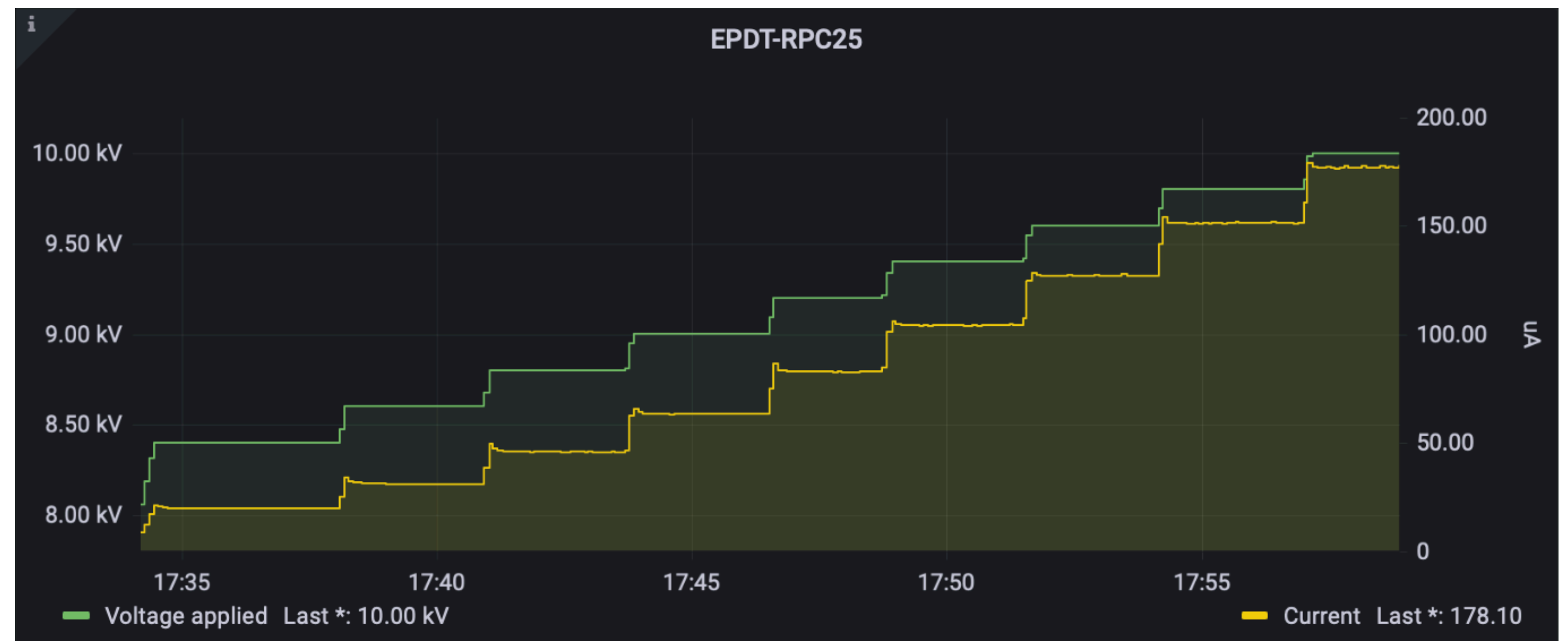
Currents VS Rel. Voltage

July 2023 - Comparison

ABS 6.9 - RPC25

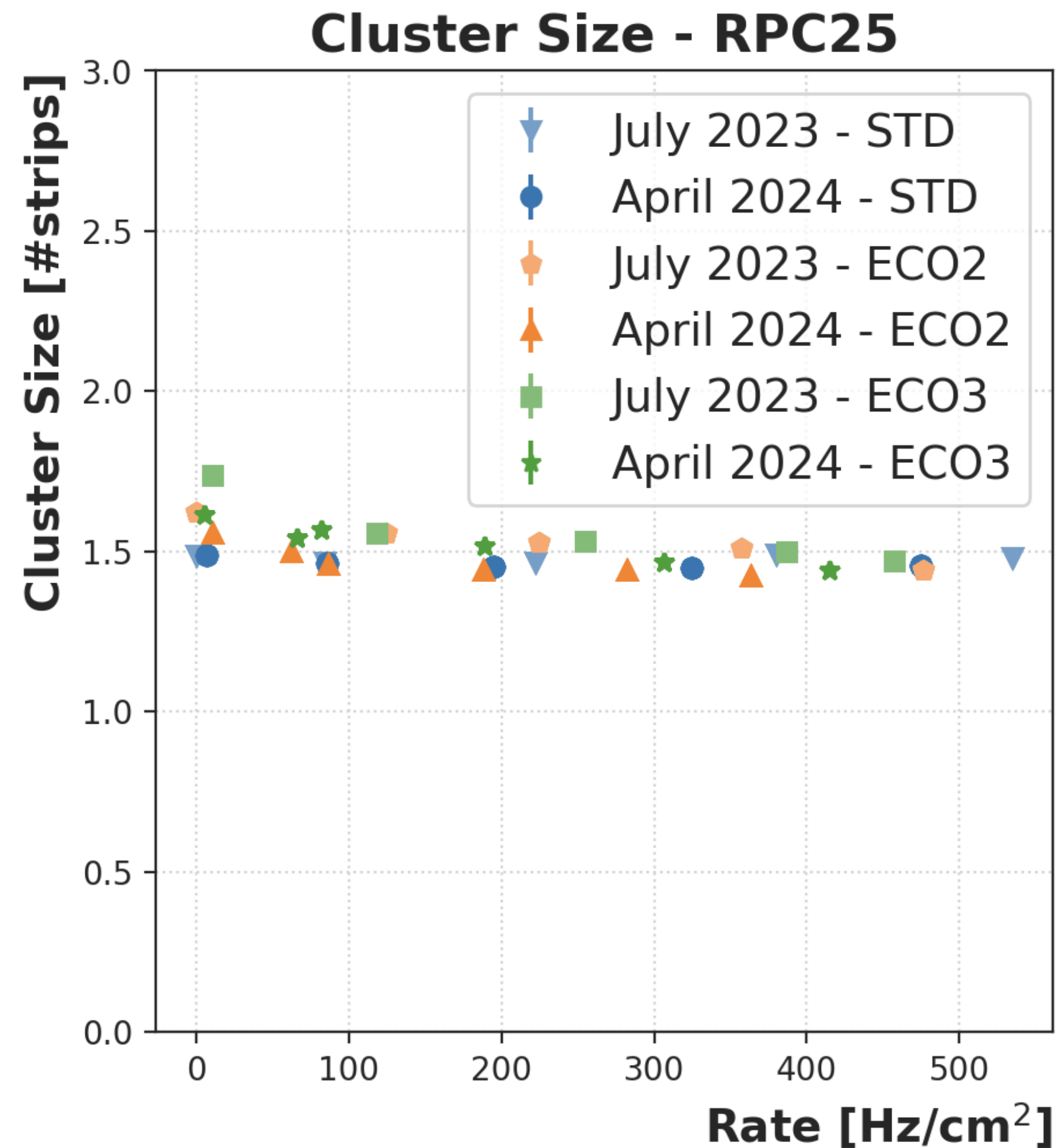
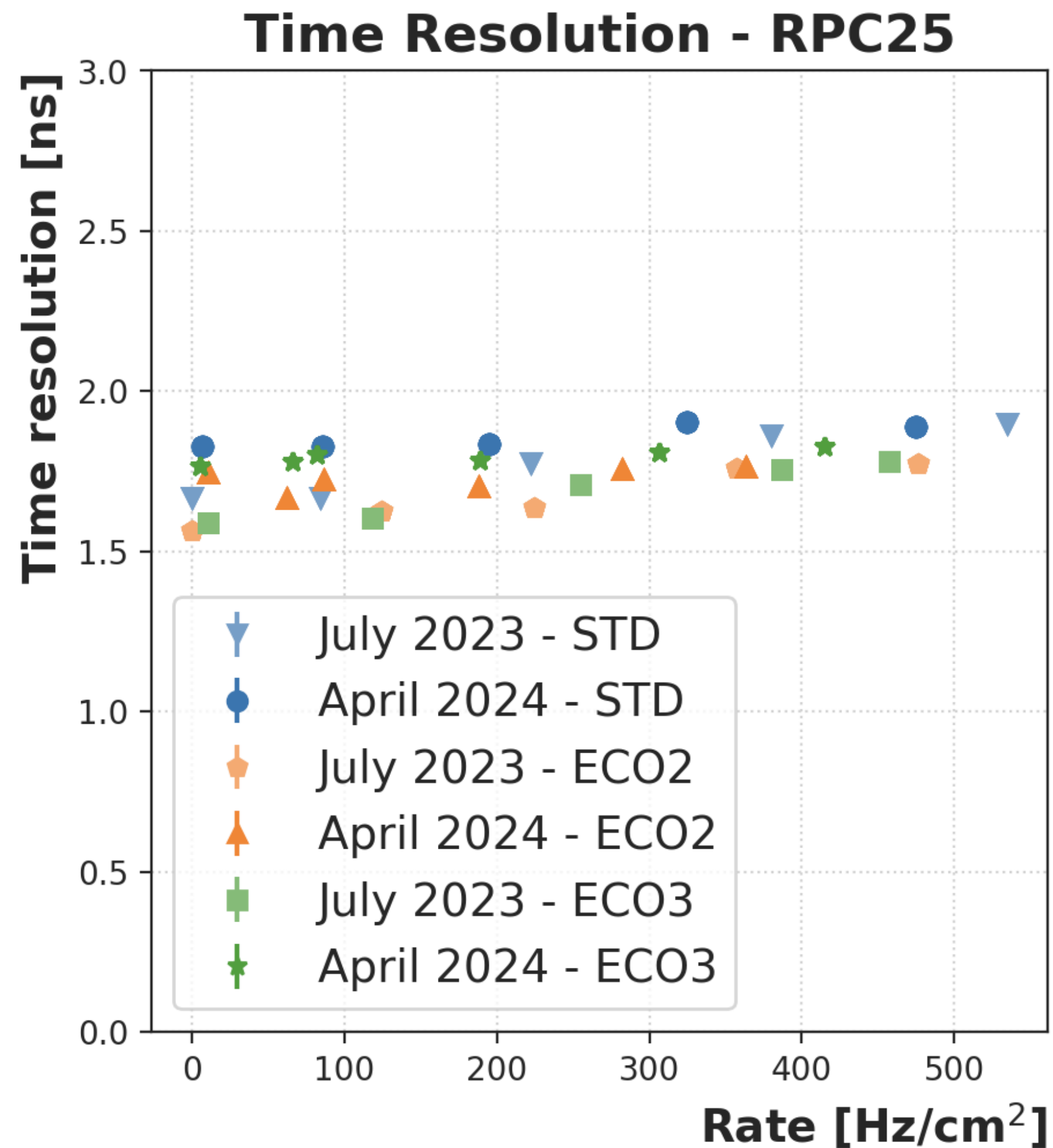


- With the background radiation, the jumps are no lower observed.
- The currents are higher, so the effect is probably covered.



Time Resolution & Cluster Size VS Rate

July 2023 - Comparison

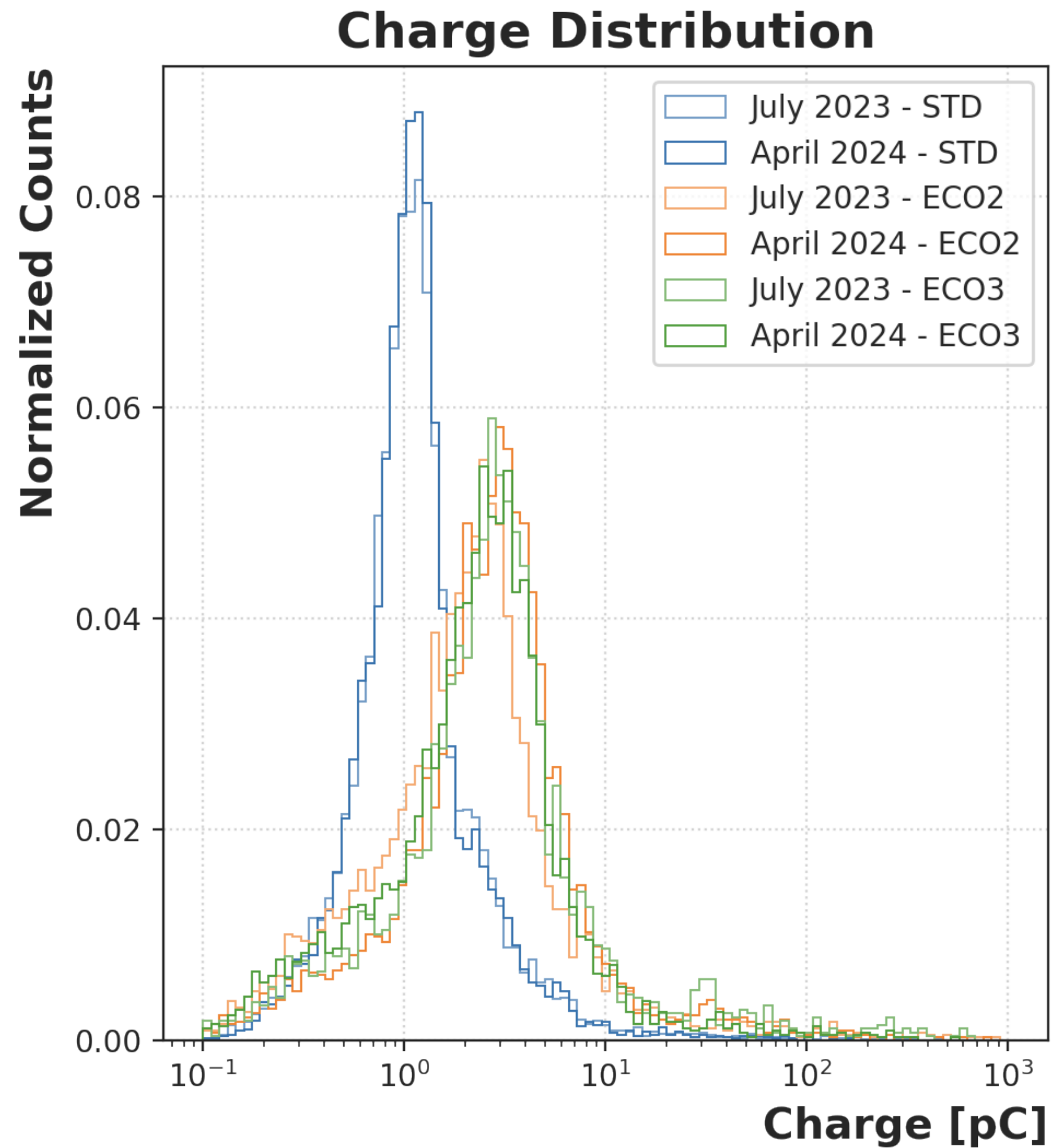


RPC 25 - 2.2cm strips

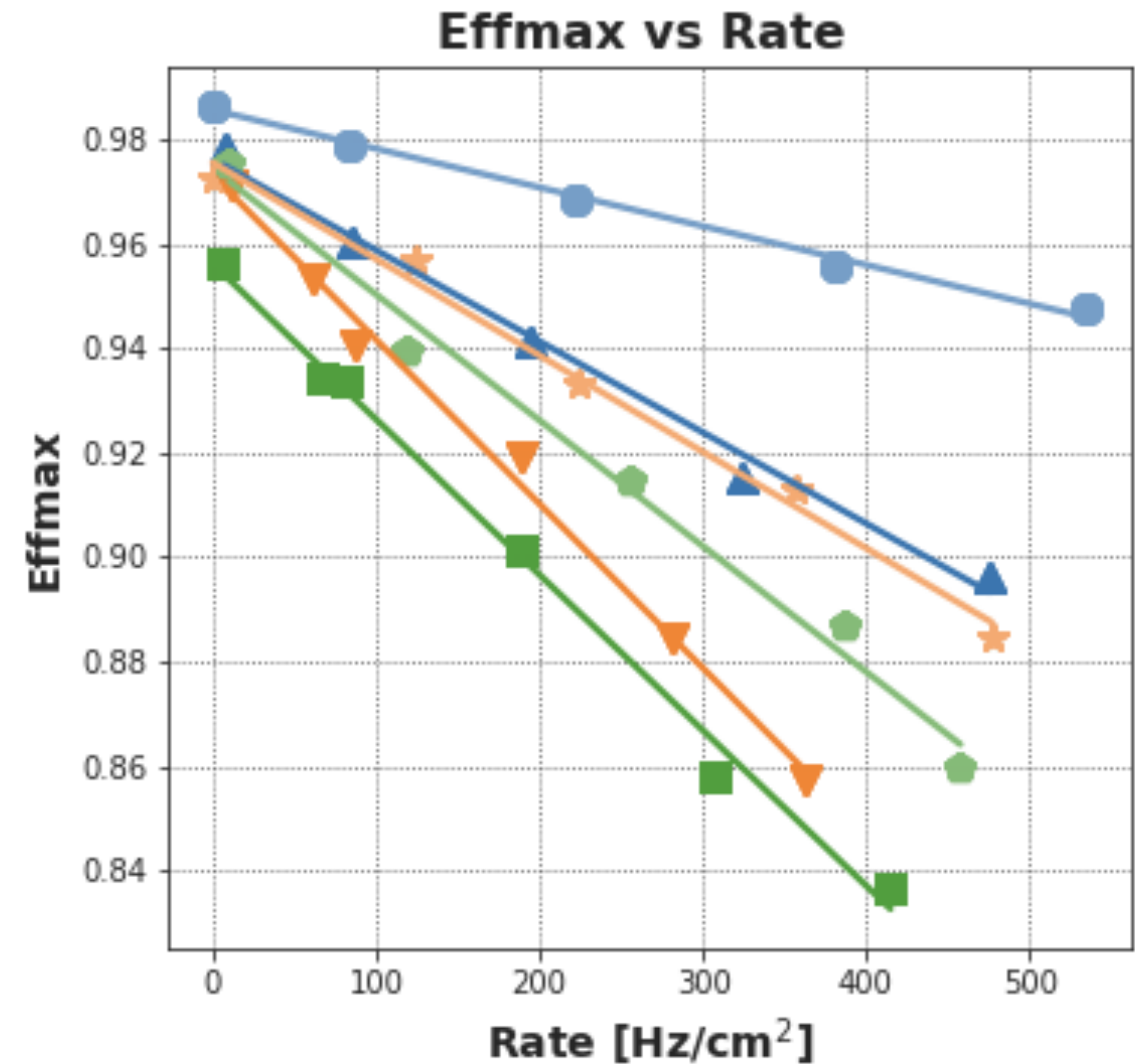
- The time resolution and cluster size are consistent with previous results from the last year.

Max. Efficiency VS Rate & Charge Distribution (Prompt Charge)

July 2023 - Comparison



- The maximum efficiency has dropped compared to the last test beam for all mixtures.
- In terms of charge distribution, calculated around the working point, there are no visible differences with the previous test beam.
- The ECO3 shows the increased streamer probability.



Summary

April 2024

- This year, the efficiency has dropped a couple %, but this could also be due to the alignment.
- The streamer probability is consistently lower for all taken mixtures and filters.
- The working point increases by ~100V at source off and more with the rate.
- The currents were higher for lower observed rate and with a different slope with respect to the rate. The relative increase with respect to last year is of 10%, irrespective of the gas mixture.

->>>We will need to check the resistivity, so we could Argon in the following week.

Source Off	Max. Efficiency ΔEffMax			Streamer Probability		$\Delta\text{St.}$	Working Point ΔWP			Time Resolution $\Delta\text{T.Res.}$			Cluster Size $\Delta\text{S.Res.}$		Currents @WP		ΔI	
	July 2023	April 2024	-	July 2023	April 2024		-	July 2023	April 2024	-	July 2023	April 2024	-	July 2023	April 2024	-		July 2023
STD	98.6 %	97.8 %	-0.8 %	0.5 %	0.5 %	-	9473V	9568V	+95V	1.7ns	1.9ns	+0.2ns	1.5	1.5	-	0 μA	15 μA	+15 μA
ECO2	97.2 %	97.1 %	-0.1 %	4.5 %	3.6 %	-0.9 %	10684V	10820V	+136V	1.6ns	1.8ns	+0.2ns	1.6	1.6	-	0 μA	25 μA	+25 μA
ECO3	97.5 %	95.6 %	-1.9 %	8.3 %	5.0 %	-3.3 %	9930V	10027V	+97V	1.6ns	1.8ns	+0.2ns	1.7	1.6	-0.1	0 μA	35 μA	+35 μA