

Preliminary Summary - Test Beam

June-July 2024

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11.07.2024



EP-DT
Detector Technologies

Overview

Test Beam June-July 2024

- In total, 11 mixtures were tested

- The Standard Gas Mixture x2
- 30% CO₂ + 0.5% SF₆ x3
- 30% CO₂ + 1% SF₆ x2
- 40% CO₂ + 0.5% SF₆ x2
- 40% CO₂ + 1% SF₆ x2

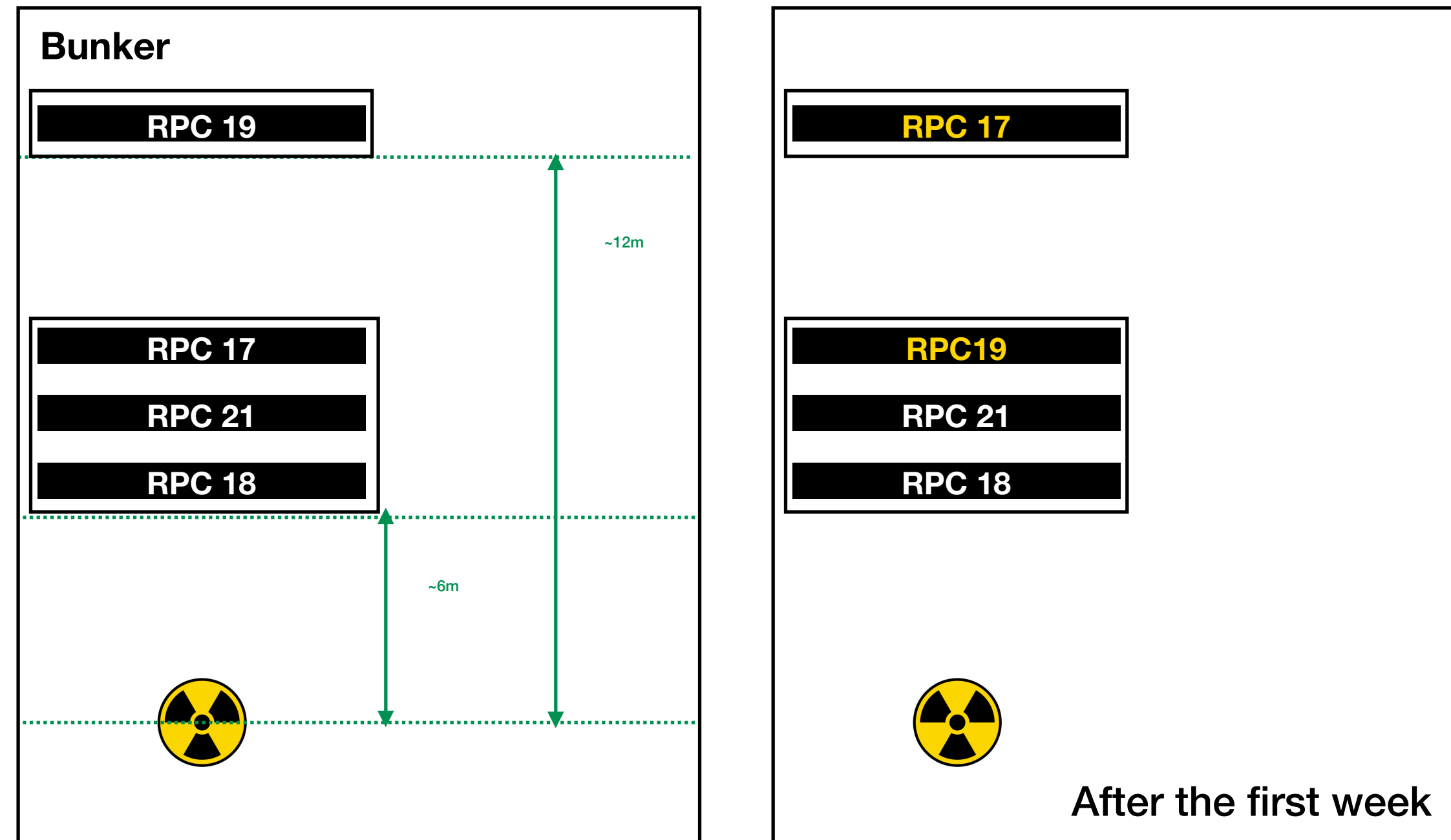
- Per RPC:

- RPC17 - 11 mixtures (ALL)
- RPC18 (NEW) - 5 mixtures (STD, 30% CO₂ + 0.5% SF₆, 30% CO₂ + 1% SF₆, 40% CO₂ + 0.5% SF₆, 40% CO₂ + 1% SF₆)
- RPC19 - 6 mixtures (STD, 30% CO₂ + 0.5% SF₆ x2, 30% CO₂ + 1% SF₆, 40% CO₂ + 0.5% SF₆, 40% CO₂ + 1% SF₆)
- RPC21 - 11 mixtures (ALL)

Preparation Area

RPC 22

Layout



Strip Alignment

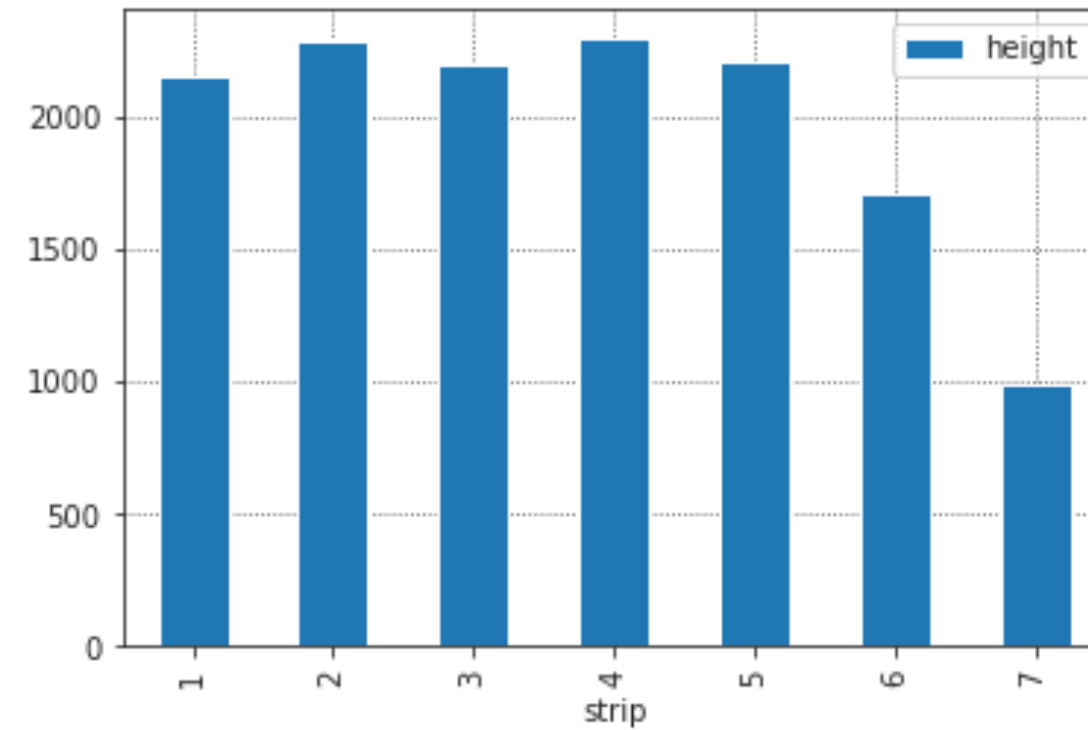
Test Beam - June-July 2024

Source Off

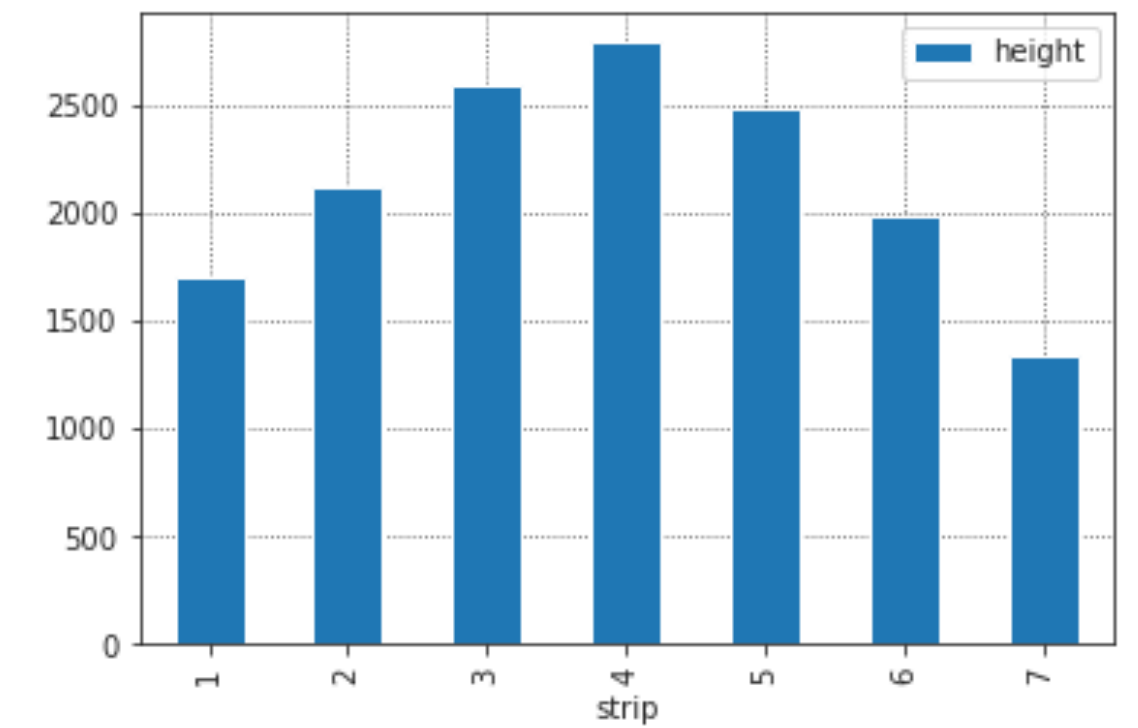
- In the first week, the beam profile was wider - thus, more difficult to align.
- More than 20 attempts were done to move the detector/scintillator/trolley, the following being the best configuration.

- In the second week, the beam was more collimated.

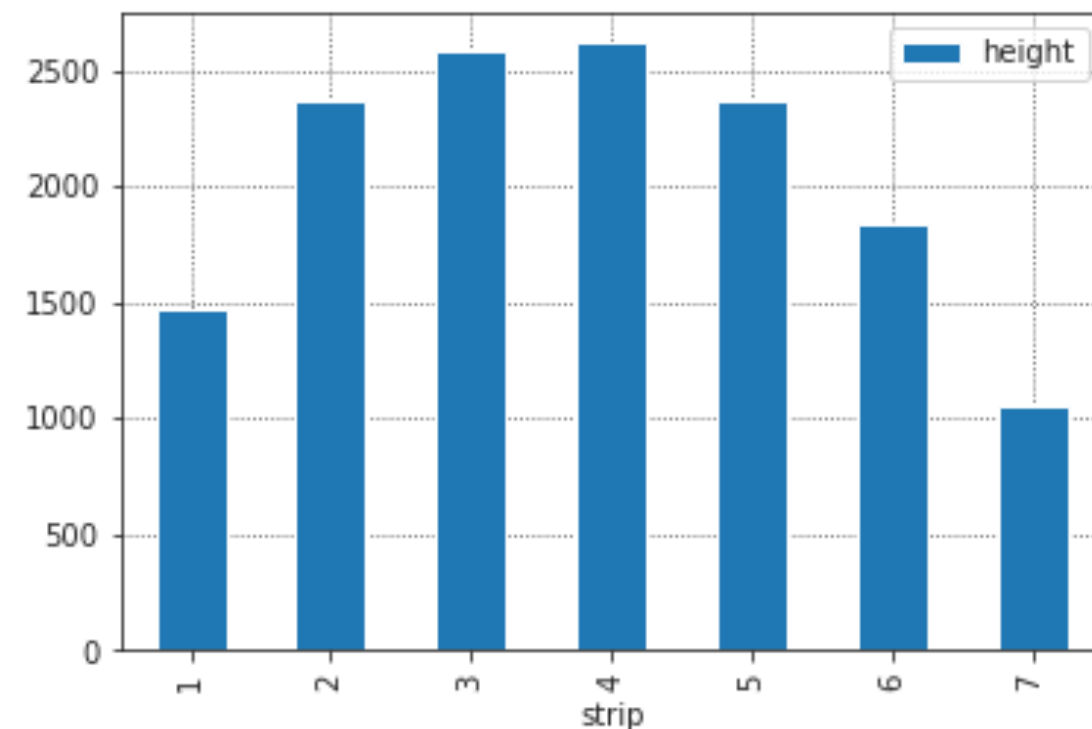
RPC17



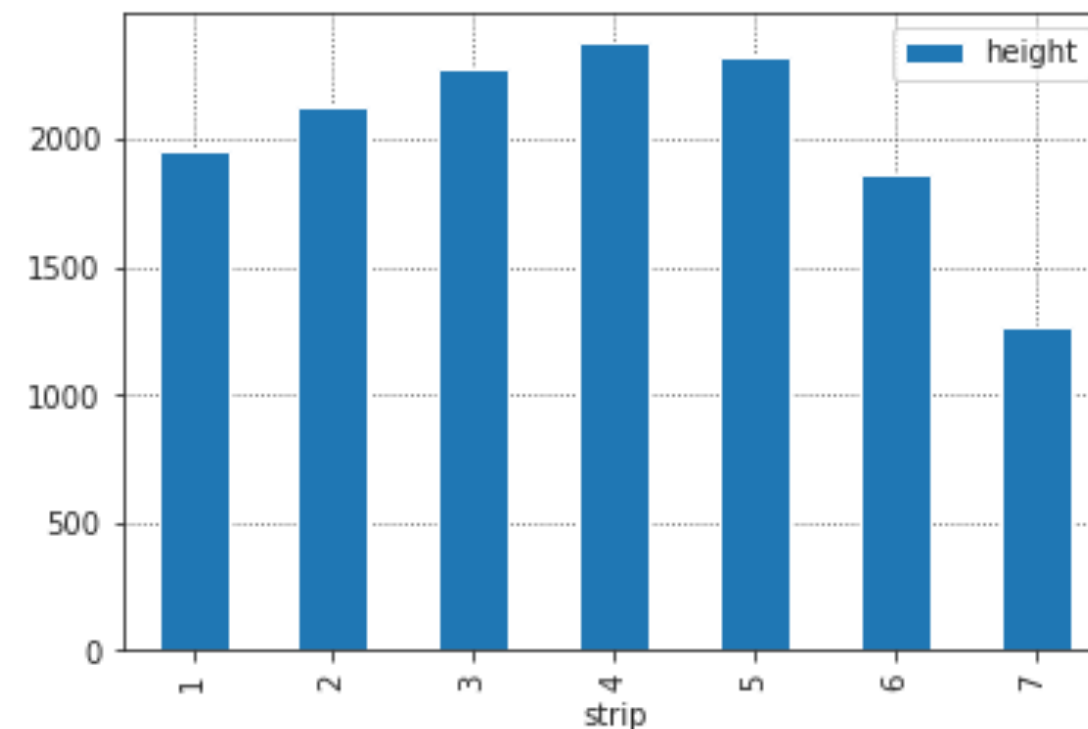
RPC19



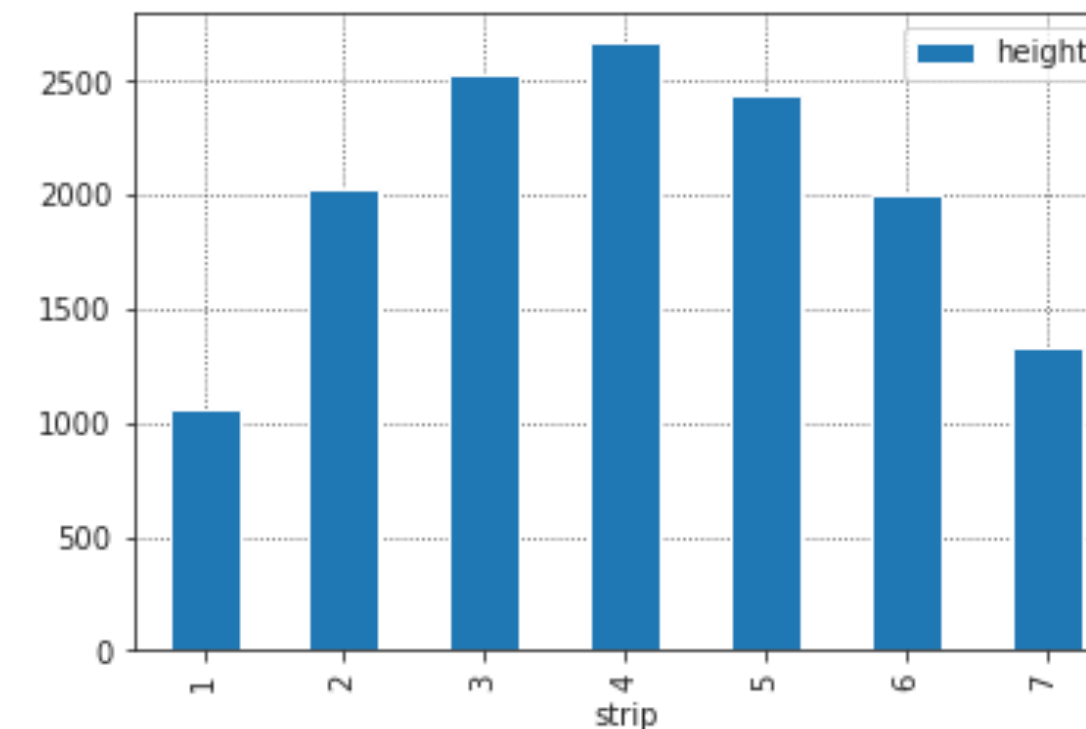
RPC18



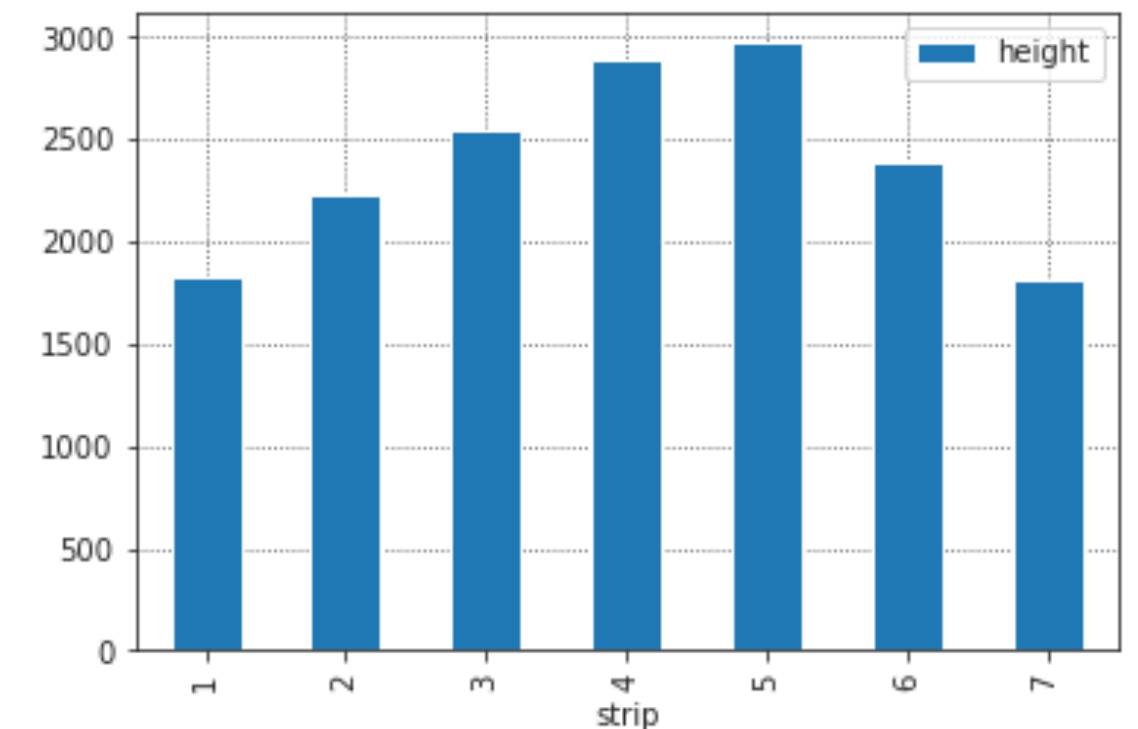
RPC21



RPC18



RPC21

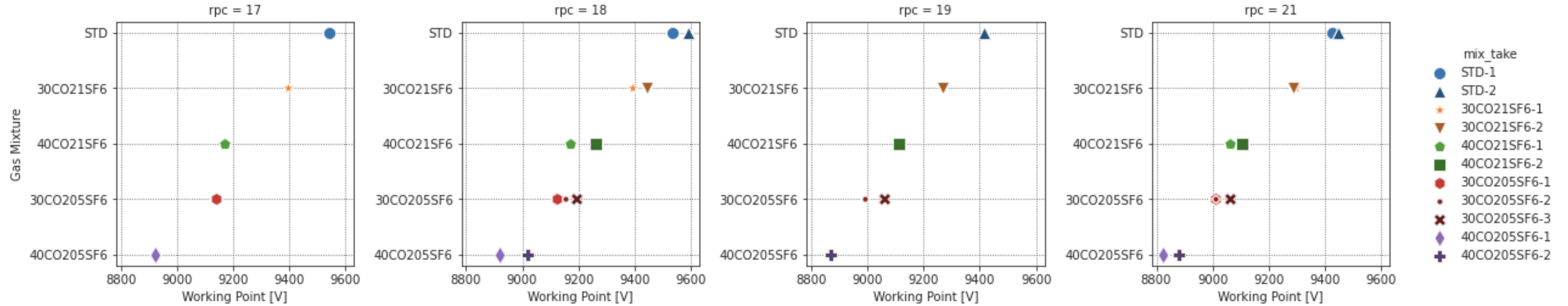


Working Points

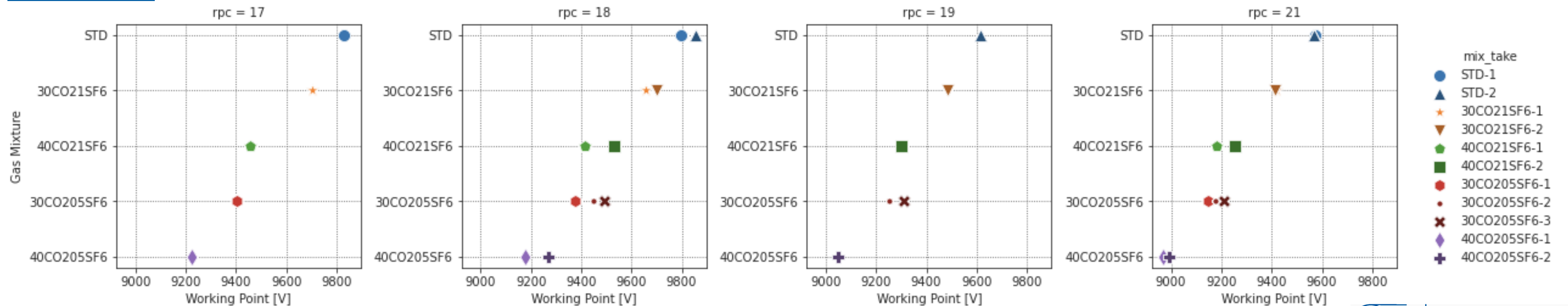
All gas mixtures tested

- RPC 18 is the newest detector installed.
- The difference between the mixtures is consistent between the detectors, with ~100V discrepancy from 30 -> 40% CO2 and ~200V from 0.5 -> 1% SF6.

Source Off



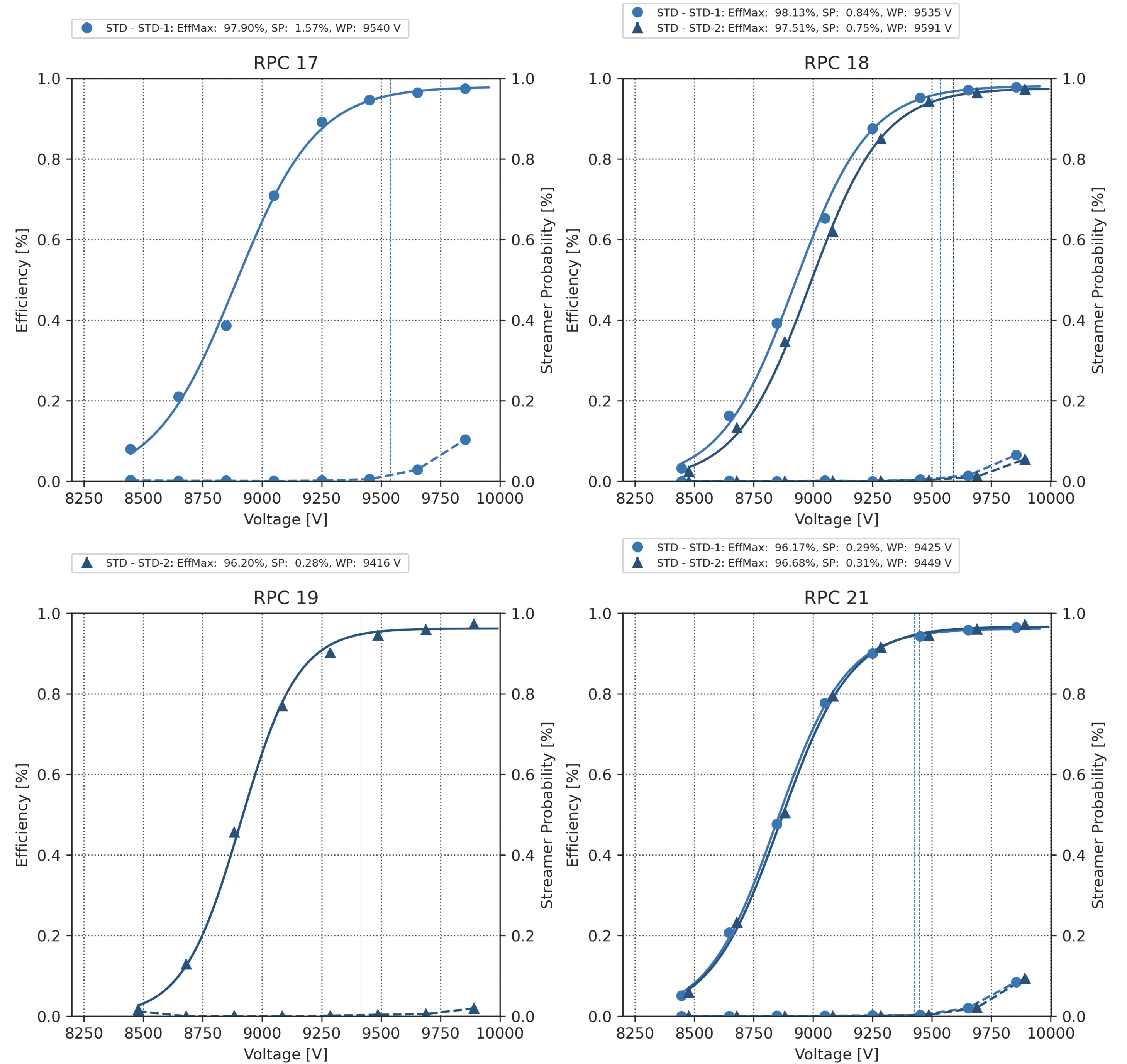
ABS 2.2



Differences between runs - Same Mixture

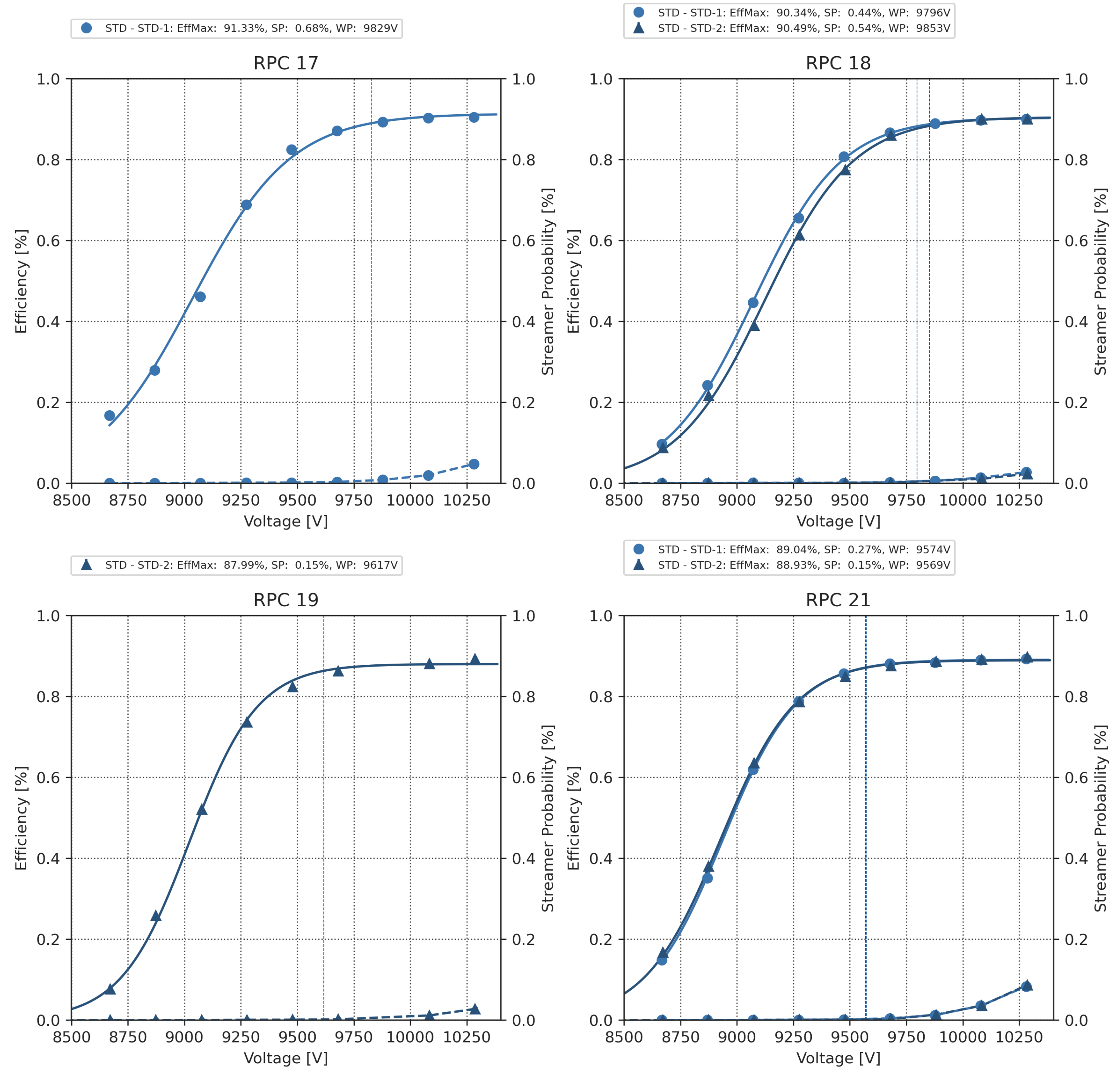
Efficiency @Source Off

Standard Gas Mixture



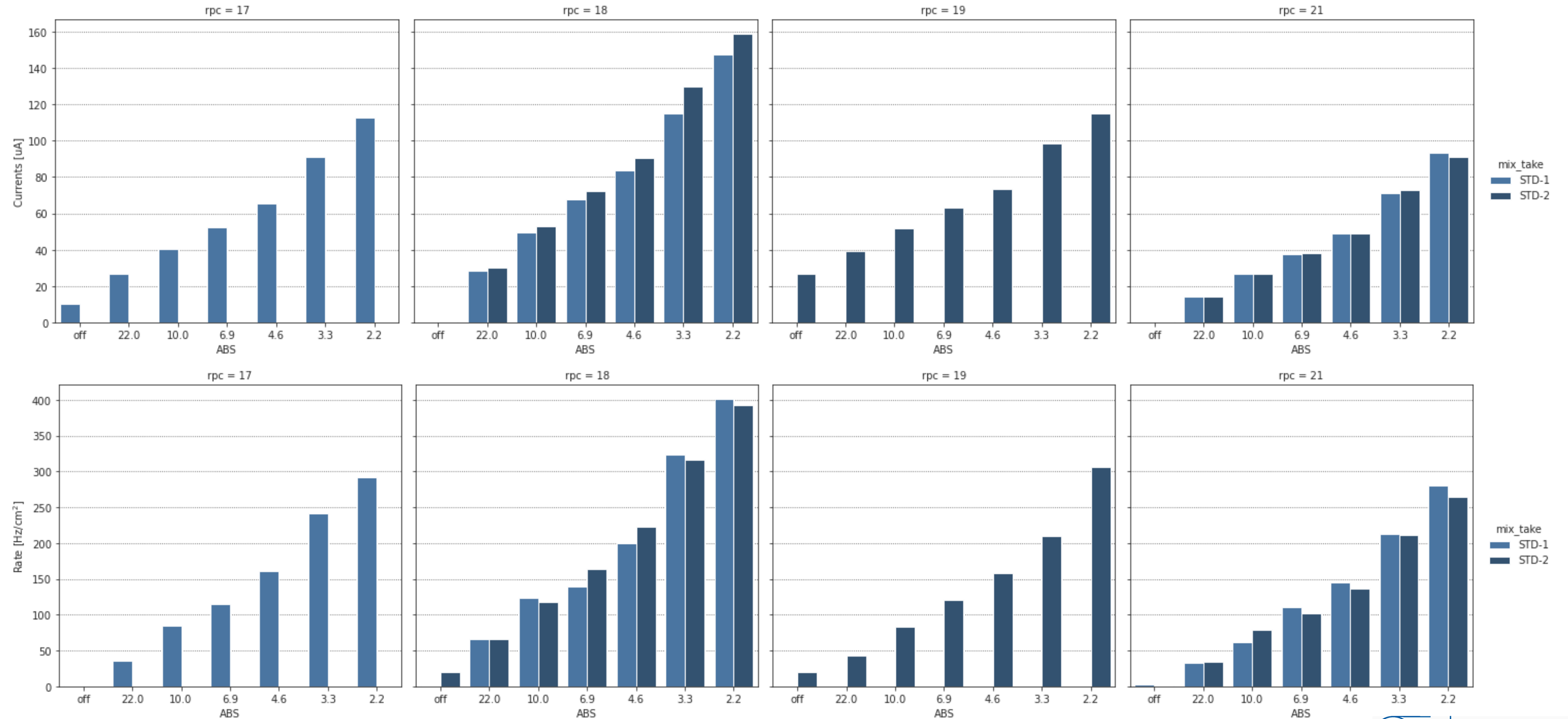
Efficiency @ABS2.2

Standard Gas Mixture



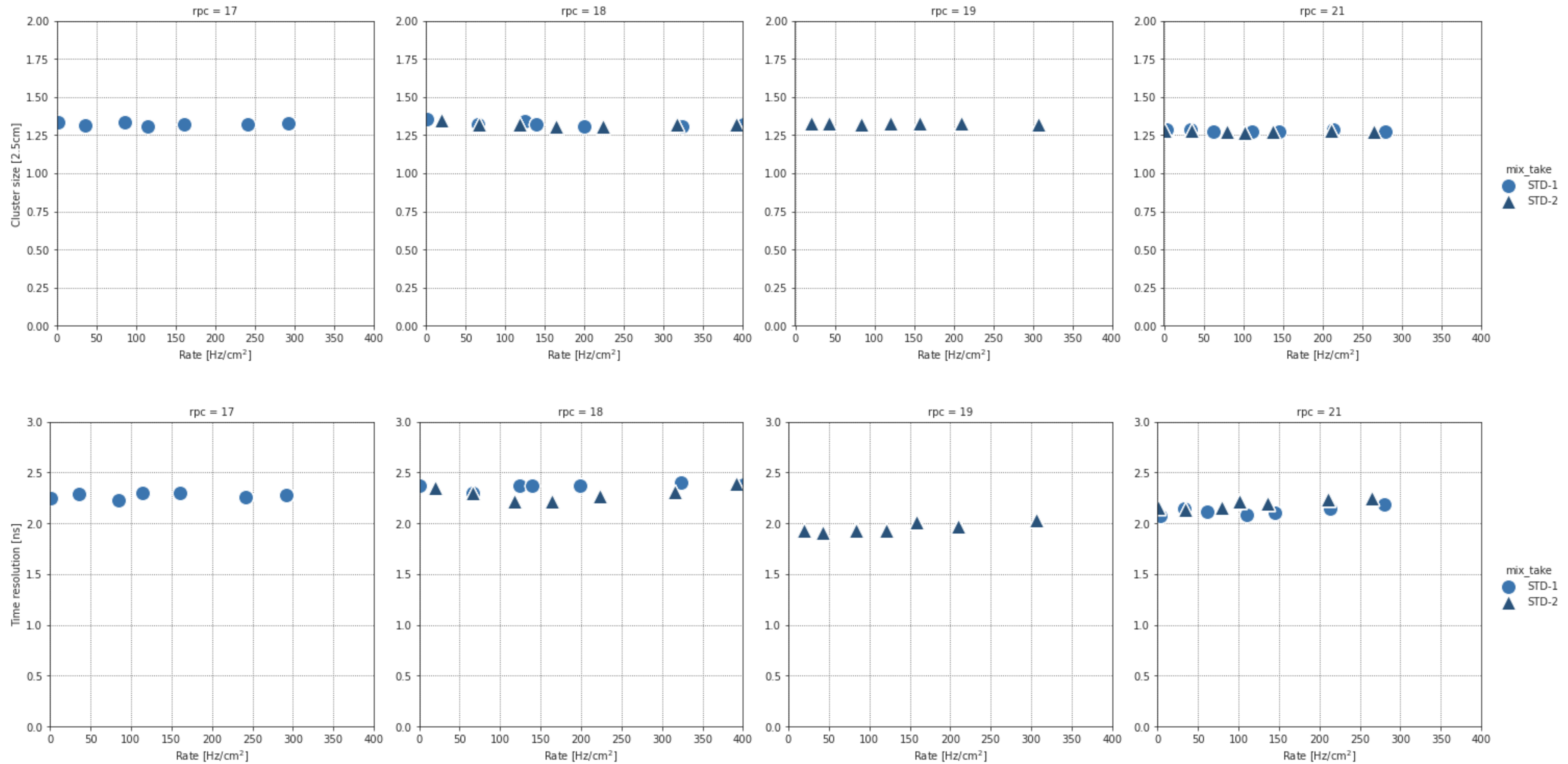
Currents and Rate VS ABS

Standard Gas Mixture



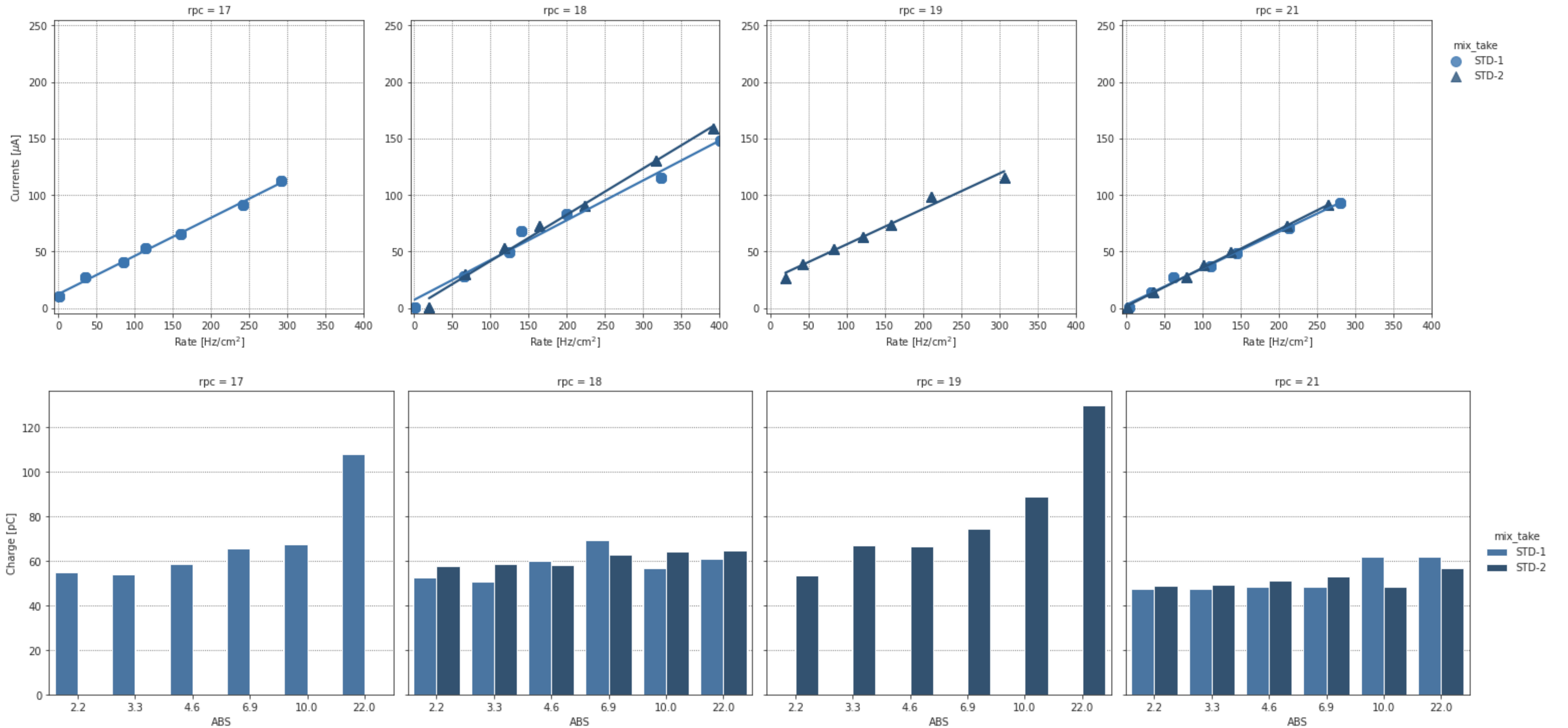
Time and Spatial Resolution VS Rate

Standard Gas Mixture



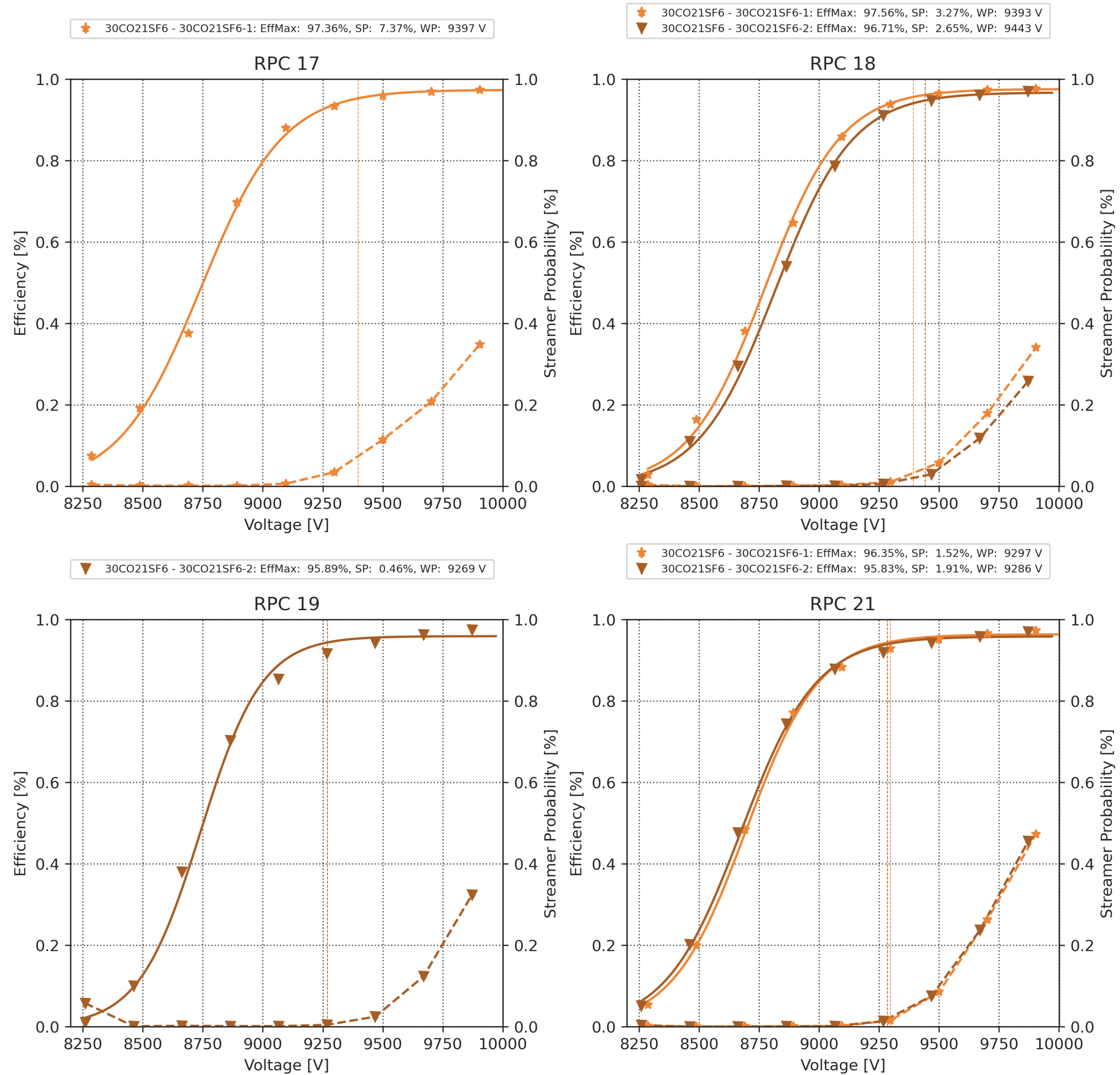
Currents VS Rate & Total Charge VS ABS

Standard Gas Mixture



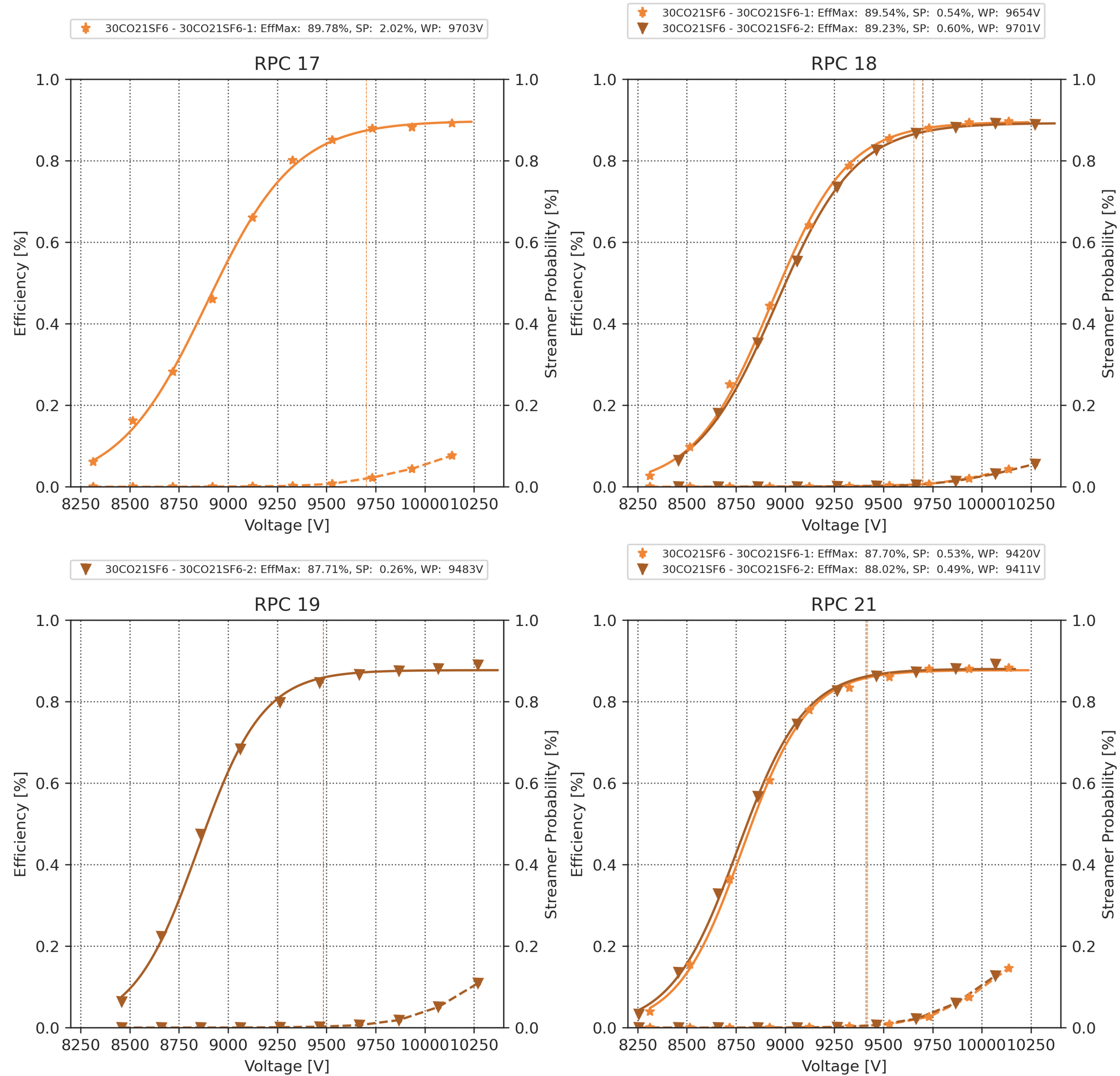
Efficiency @Source Off

30% CO2 + 1%SF6



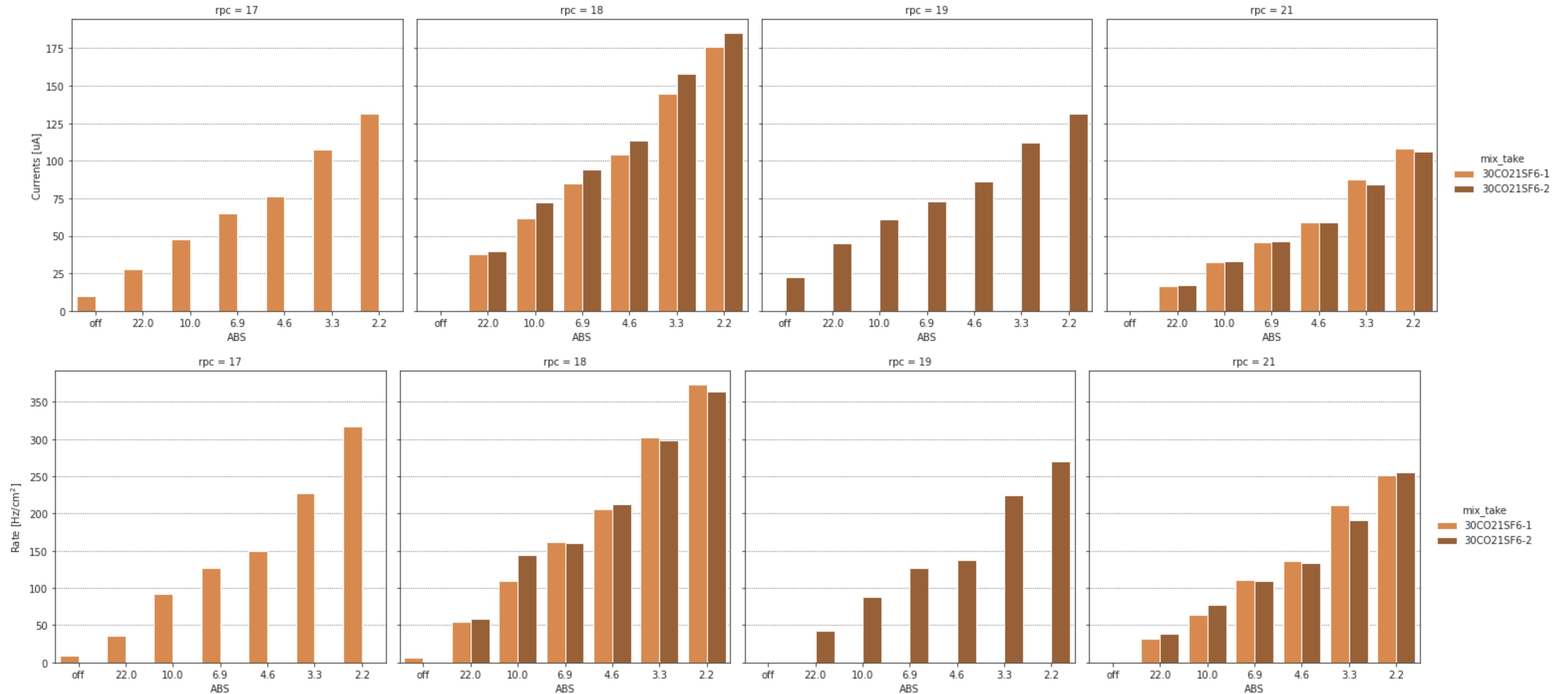
Efficiency @ABS 2.2

30% CO2 + 1%SF6



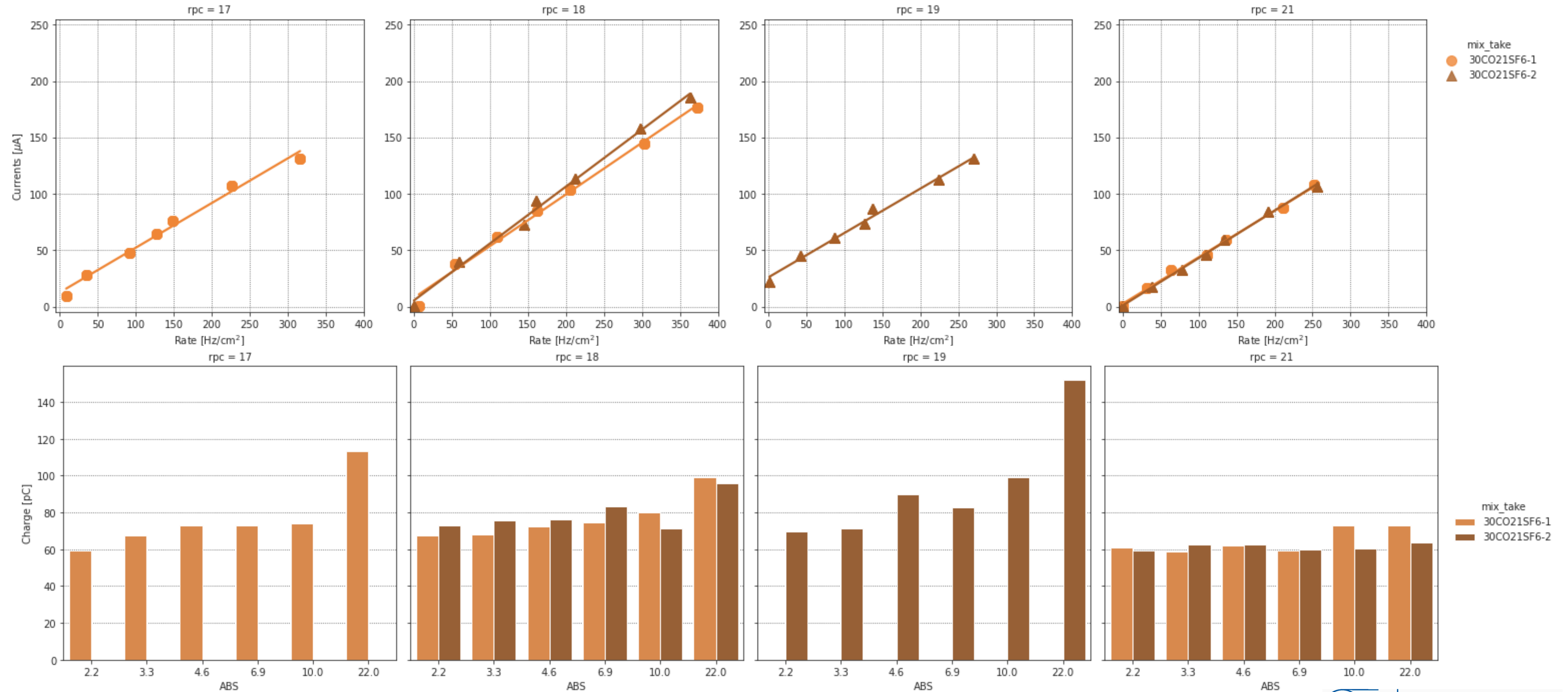
Currents and Rate VS ABS

30% CO₂ + 1% SF₆



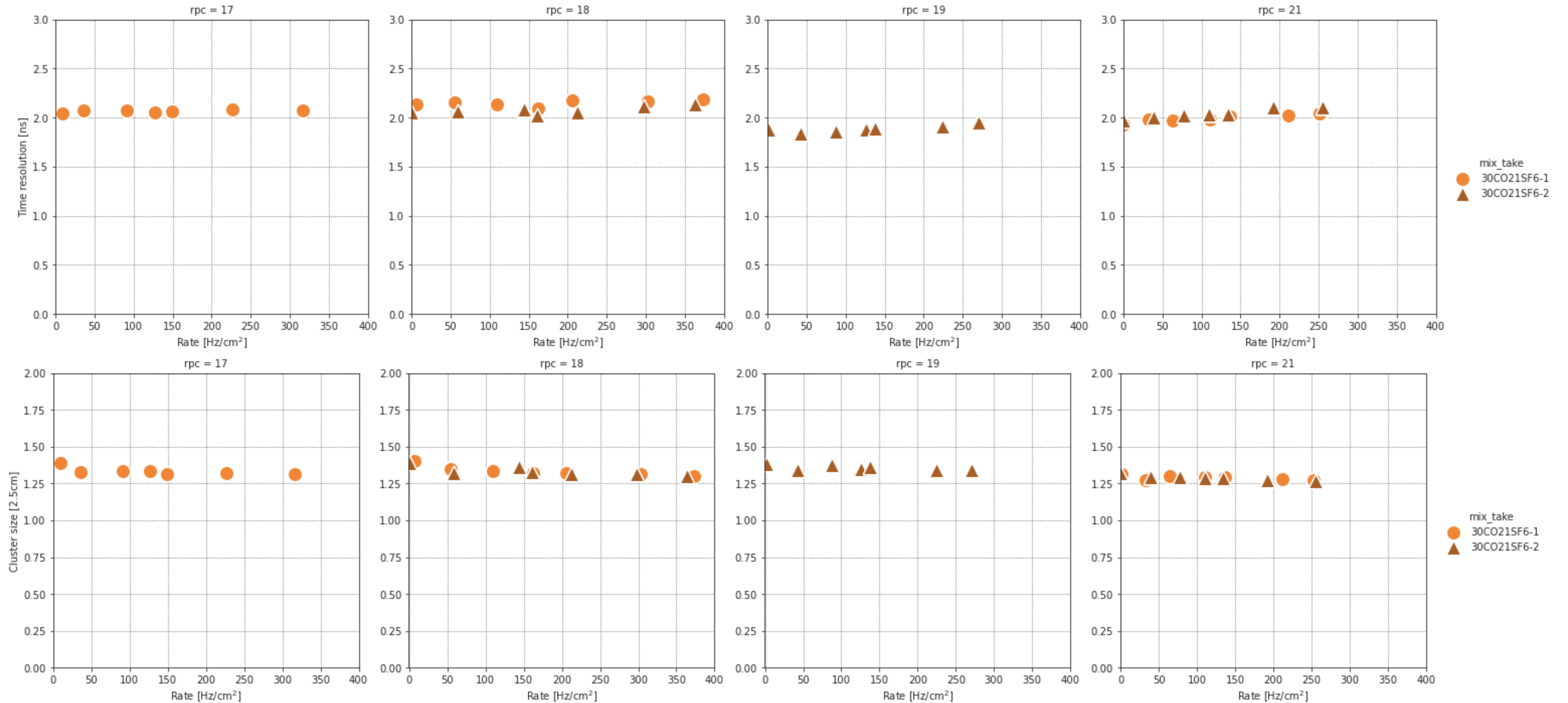
Currents VS Rate & Total Charge VS ABS

30% CO₂ + 1% SF₆



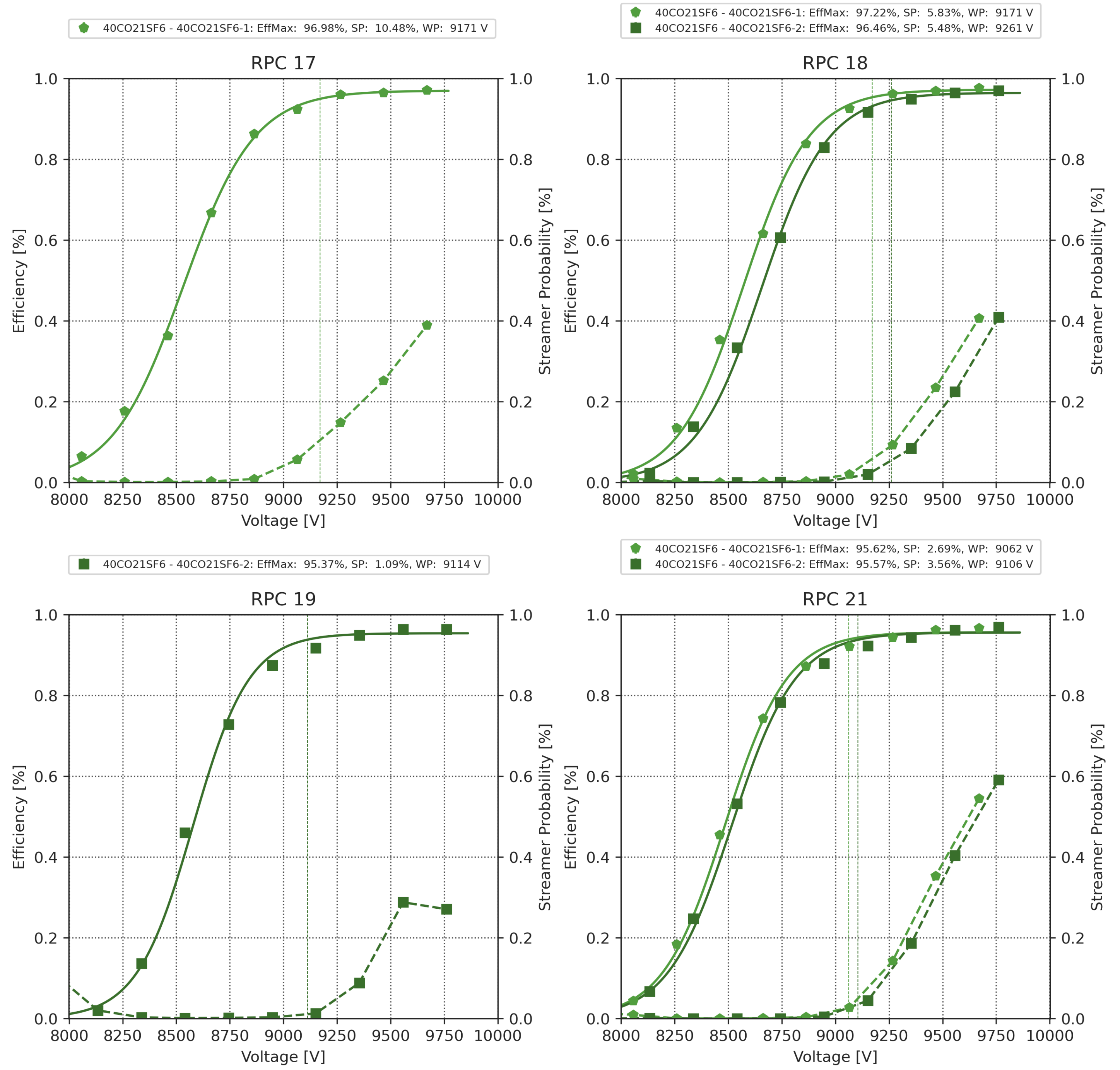
Time and Spatial Resolution VS Rate

30% CO₂ + 1%SF₆



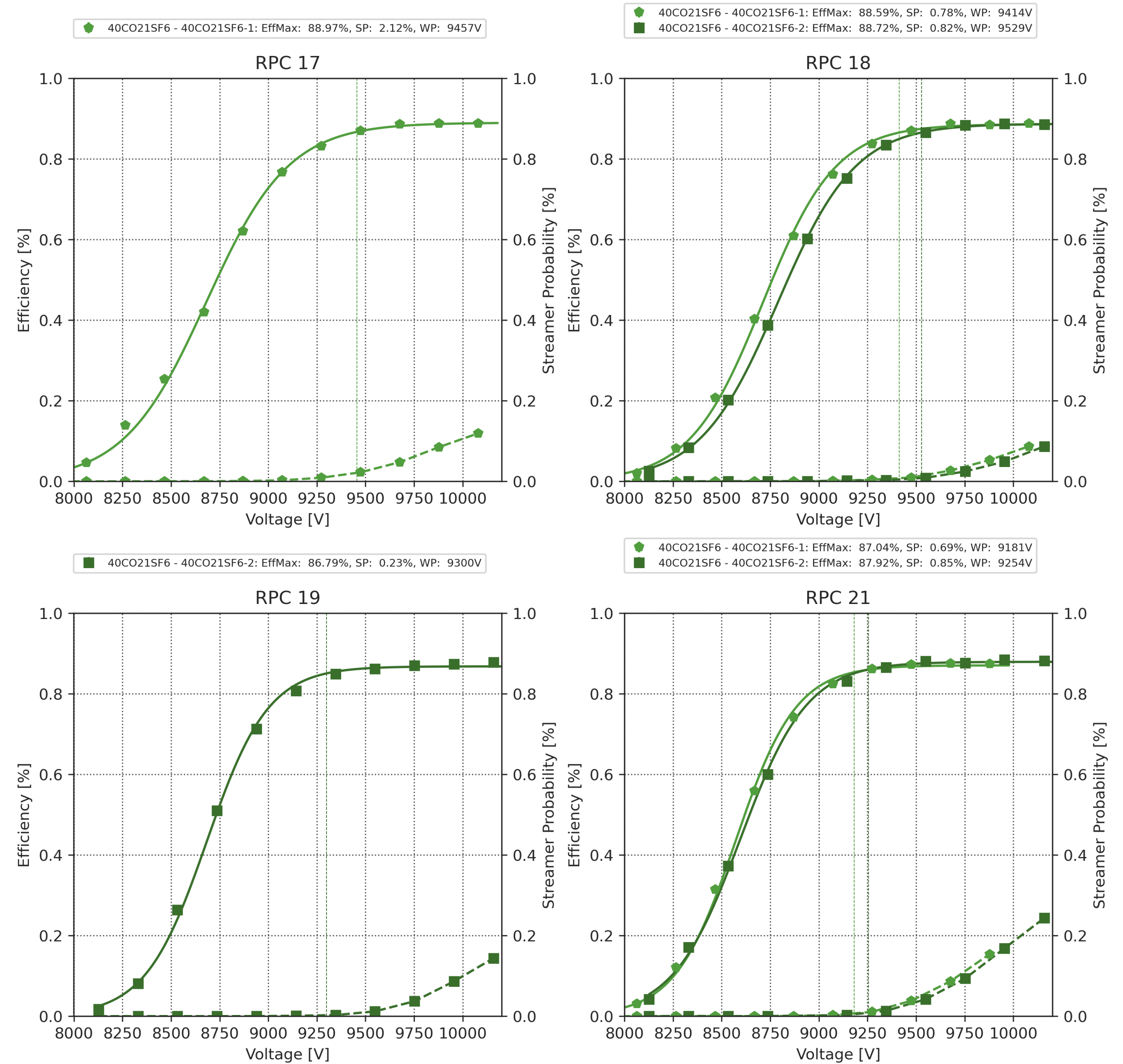
Efficiency @Source Off

40% CO2 + 1%SF6



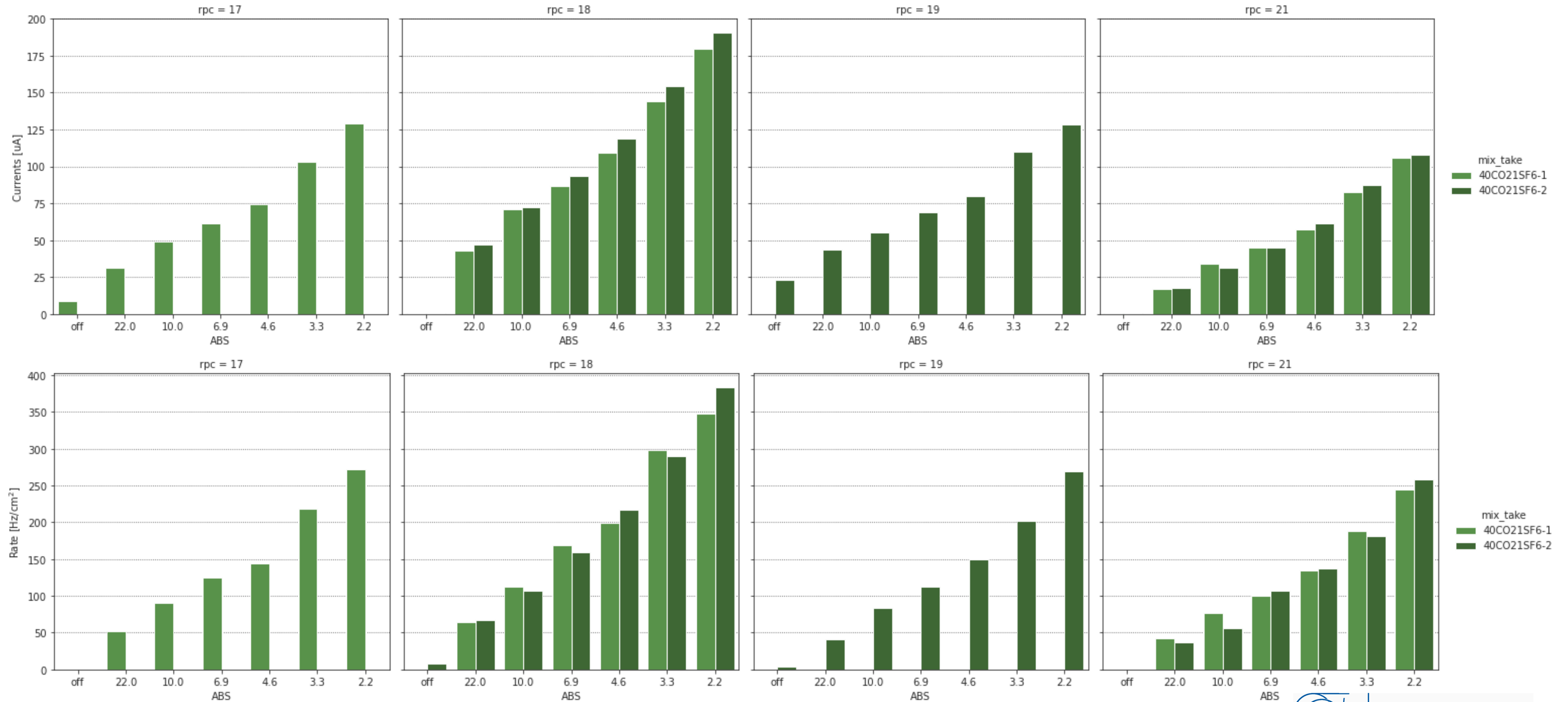
Efficiency @ABS 2.2

40% CO2 + 1%SF6



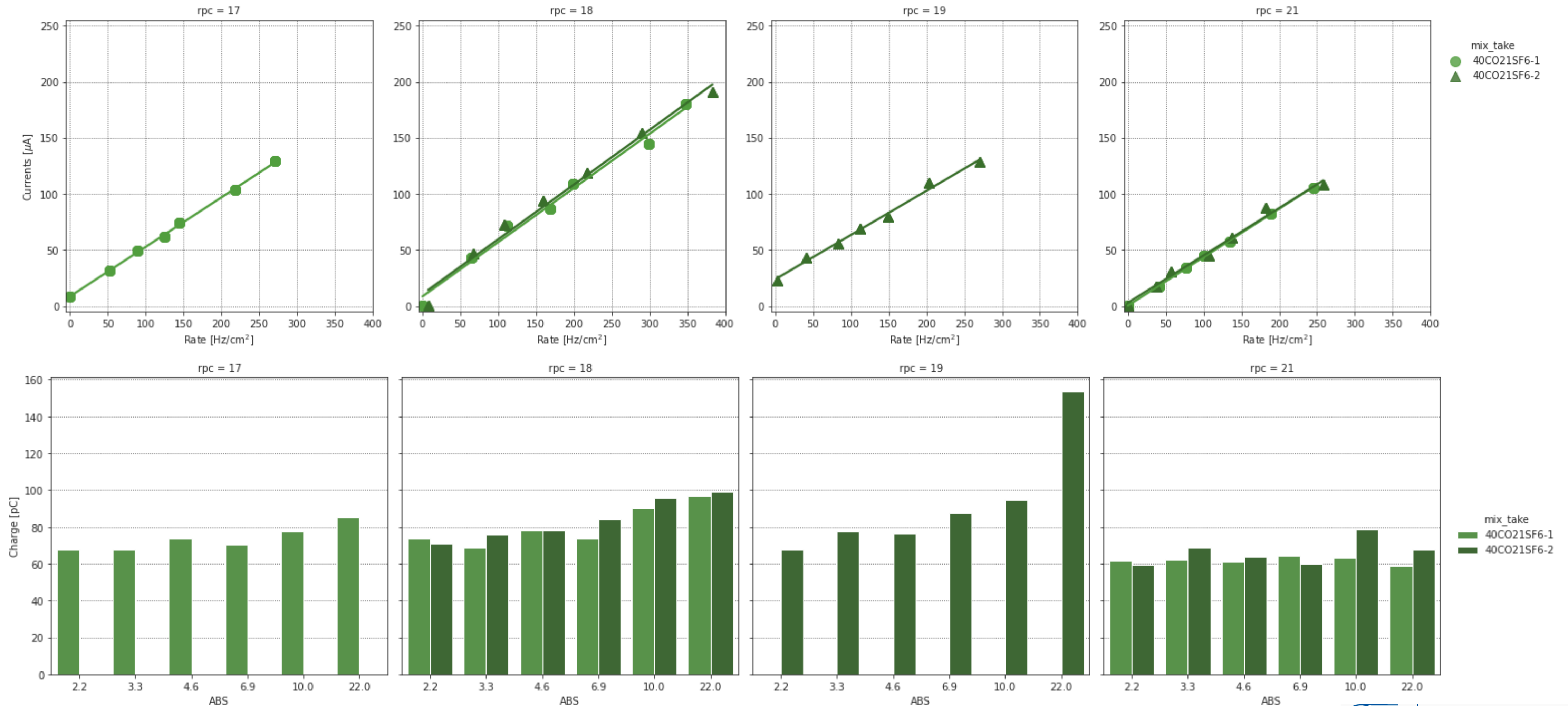
Currents and Rate VS ABS

40% CO₂ + 1% SF₆



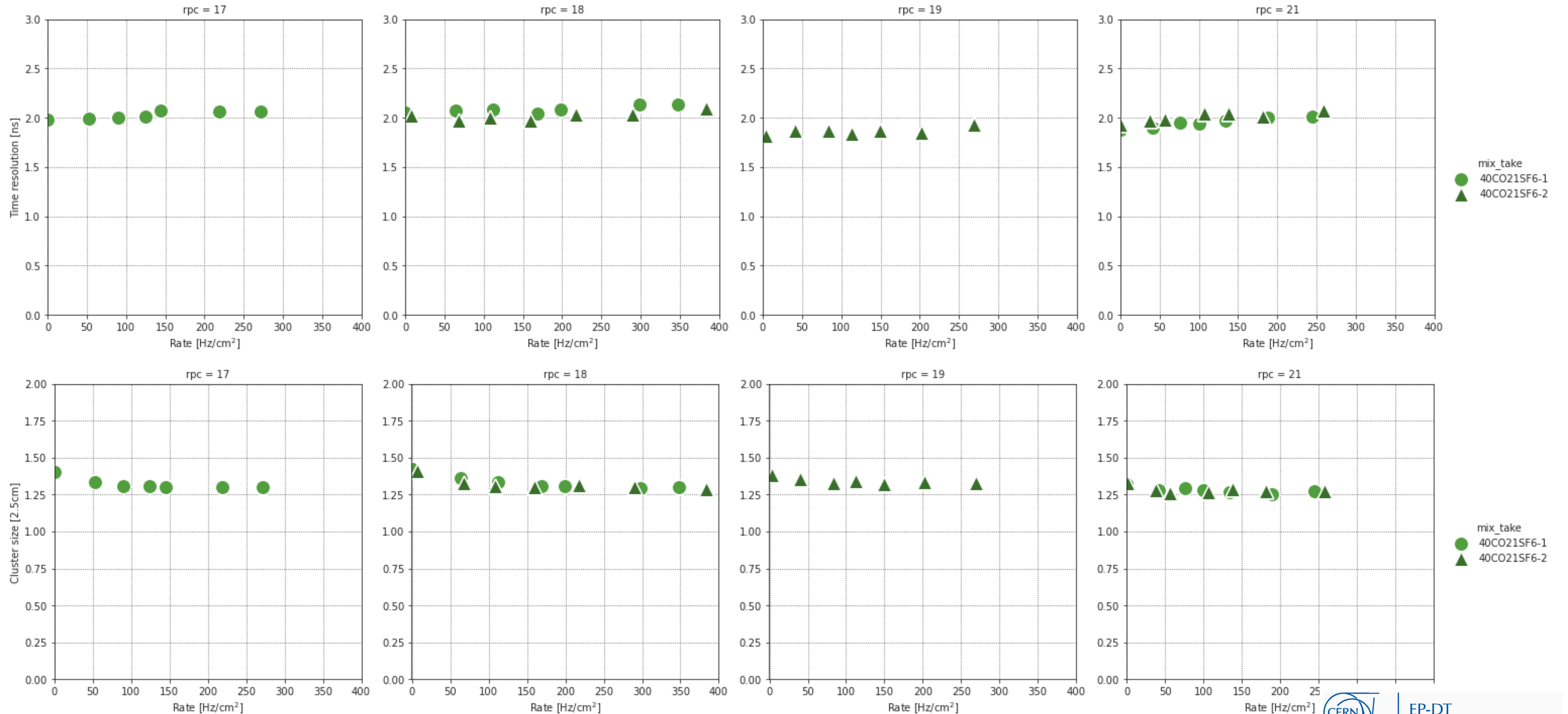
Currents VS Rate & Total Charge VS ABS

40% CO₂ + 1% SF₆



Time and Spatial Resolution VS Rate

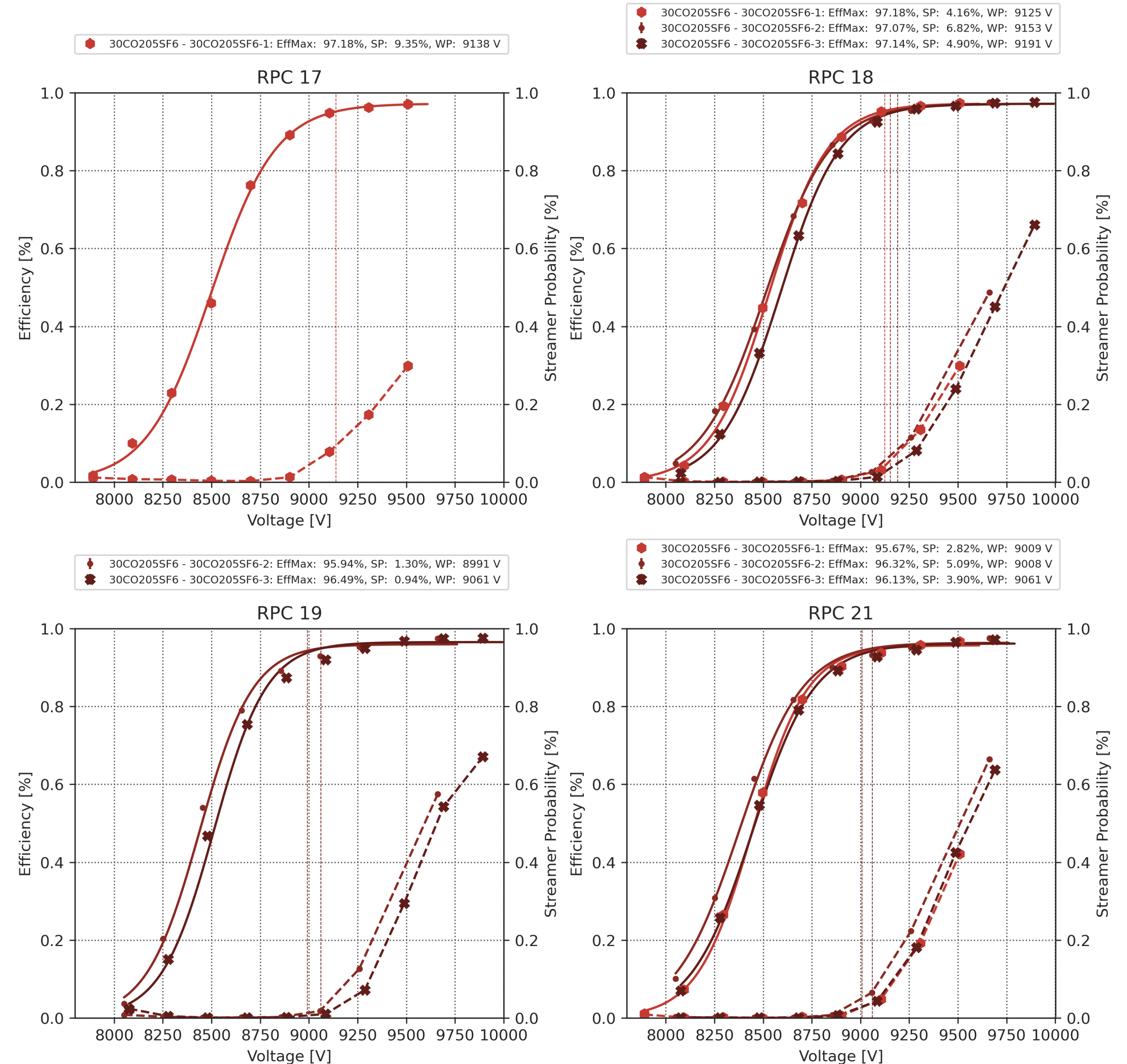
40% CO₂ + 1%SF₆



Efficiency @Source Off

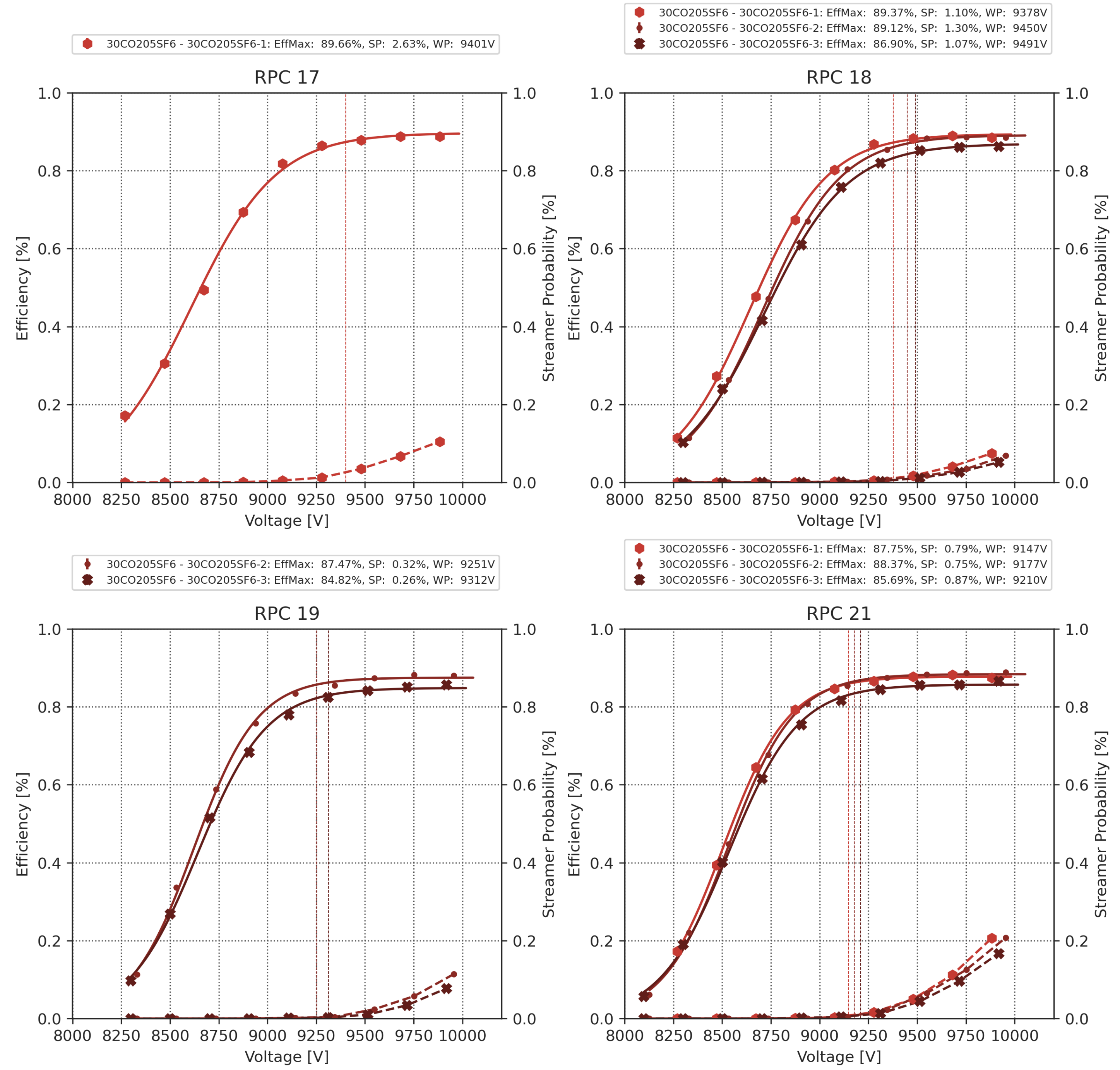
30% CO2 + 0.5%SF6

- In RPC 18, we see also a change in the shape on the last taken run, whereas in RPCs 19 and 21 the shape is similar.
- -> 18 could differ from lack of conditioning or it is the first time irradiated (its currents at source on are also higher than for the other RPCs that have been already irradiated)



Efficiency @ABS 2.2

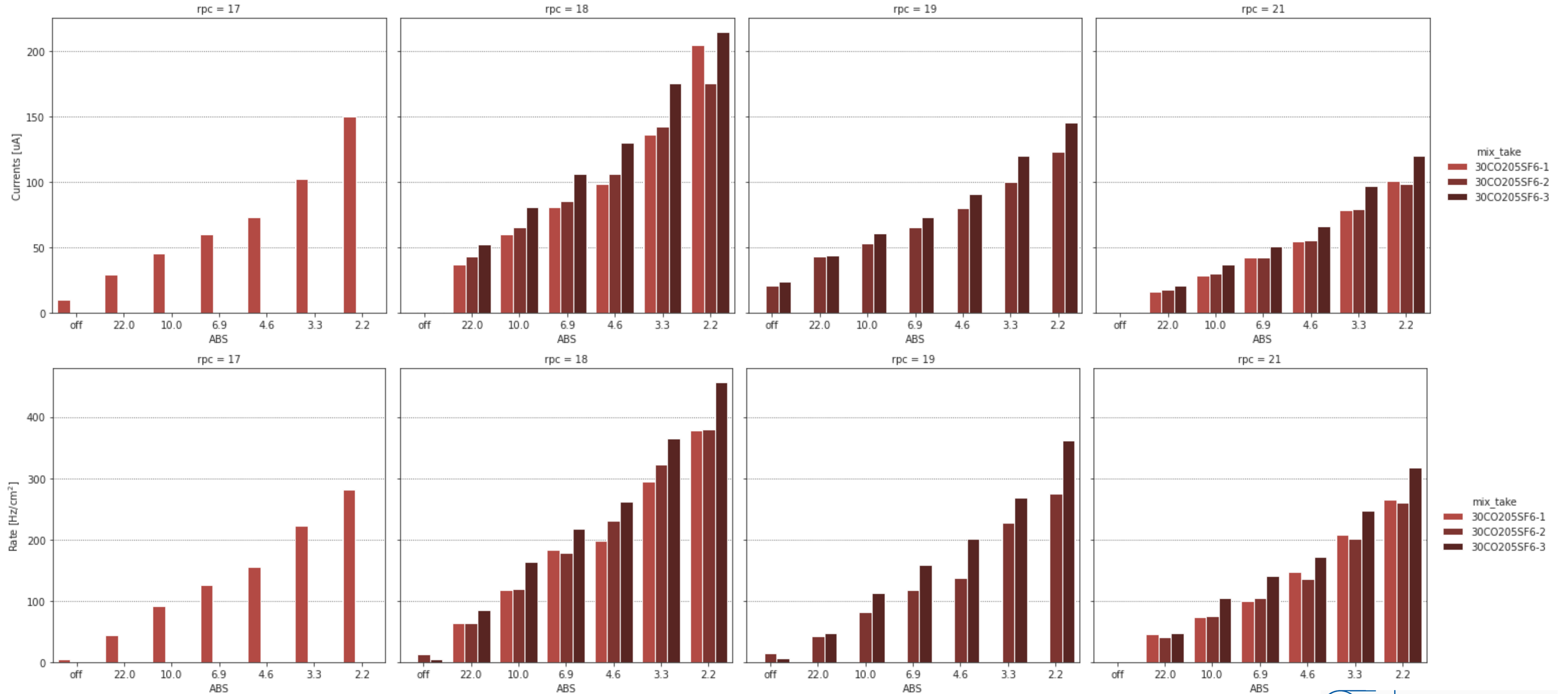
30% CO2 + 0.5%SF6



Currents and Rate VS ABS

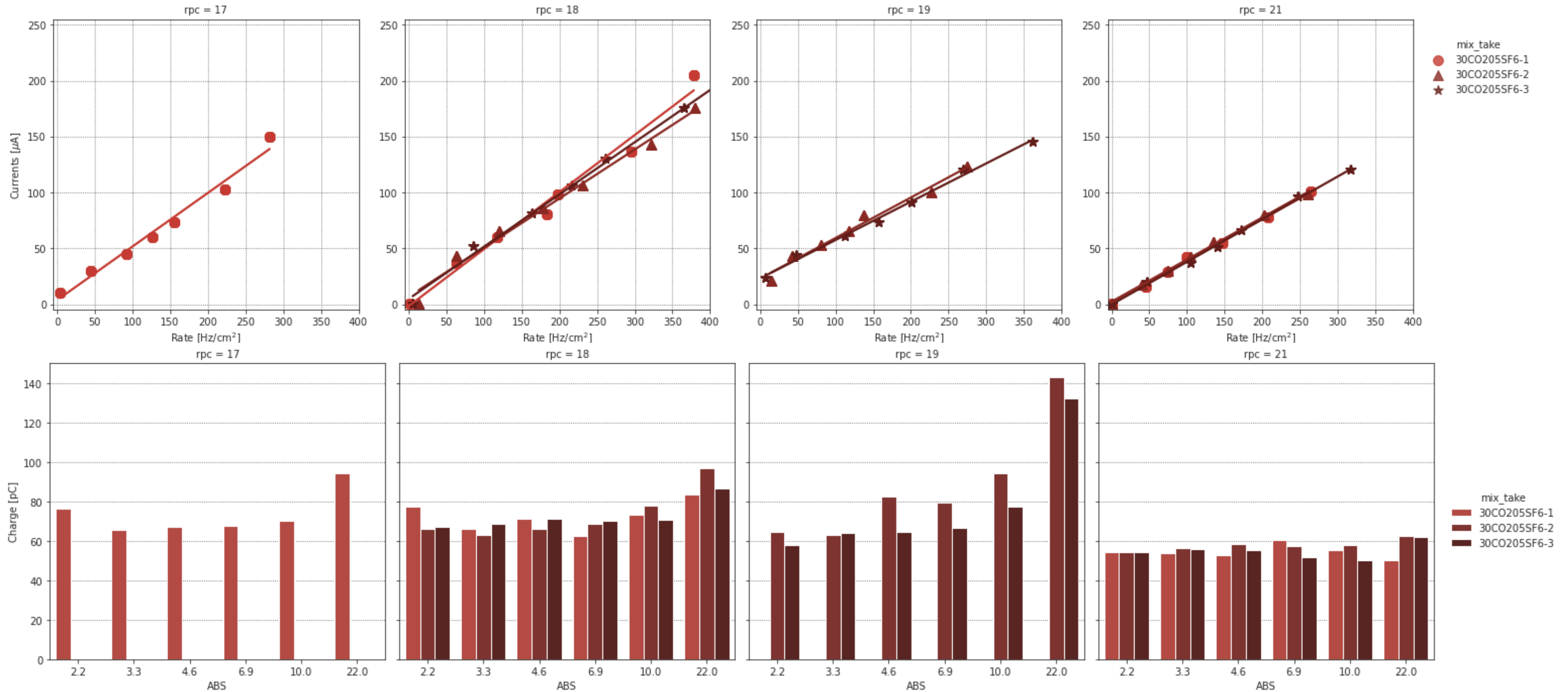
30% CO₂ + 0.5% SF₆

- On the last scan, the rate is higher -> we will check compared with the dose.



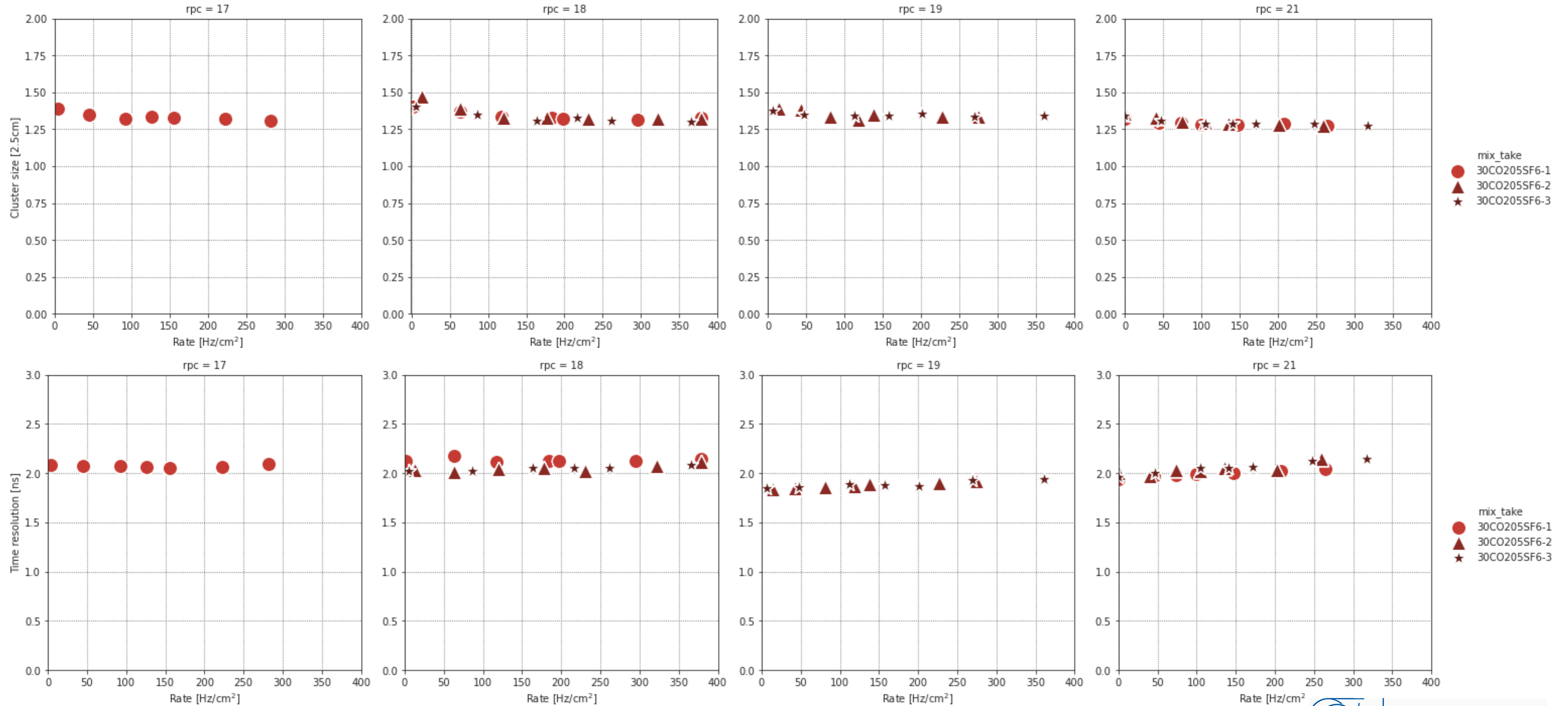
Currents VS Rate & Total Charge VS ABS

30% CO₂ + 0.5% SF₆



Time and Spatial Resolution VS Rate

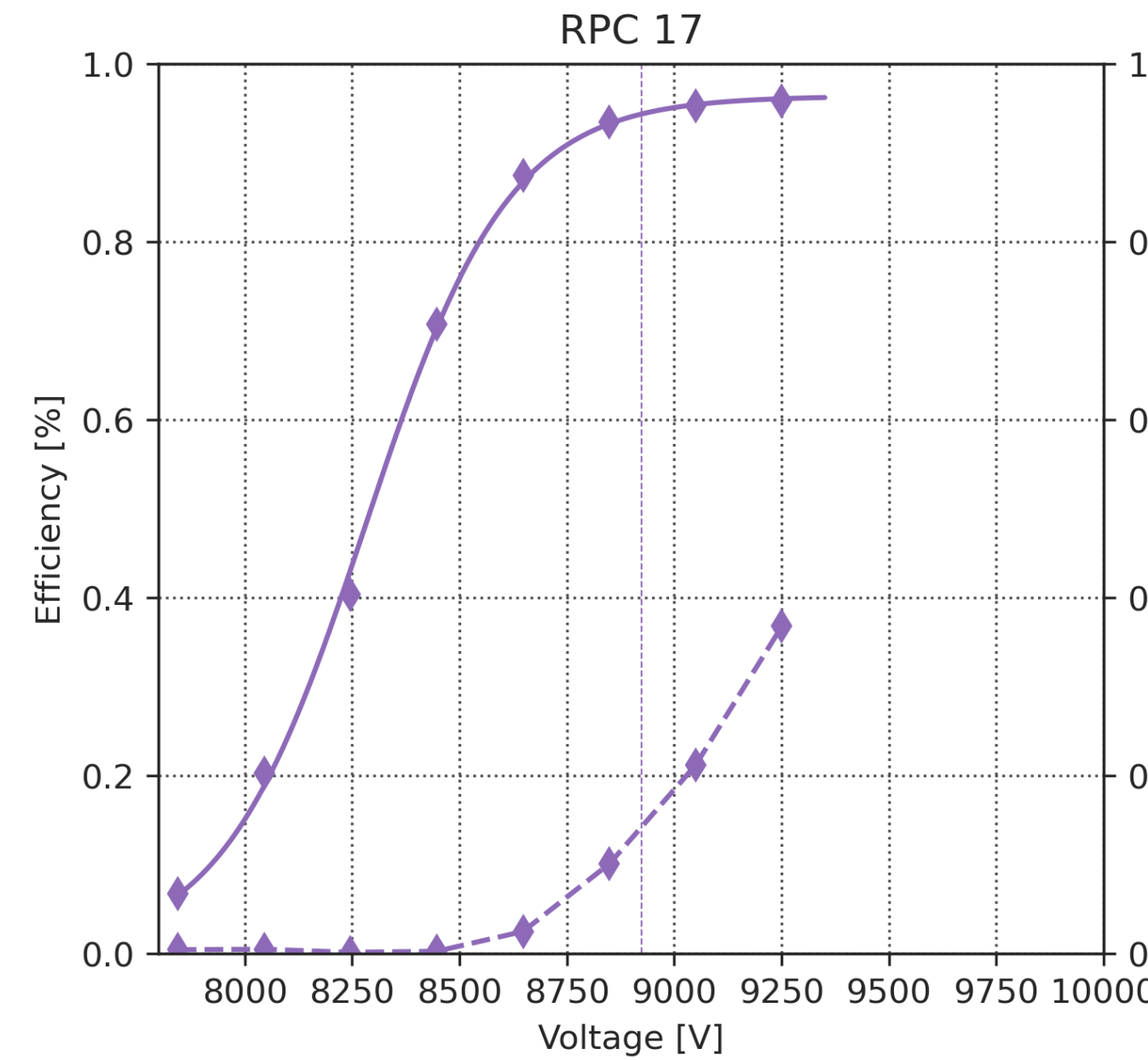
30% CO₂ + 0.5% SF₆



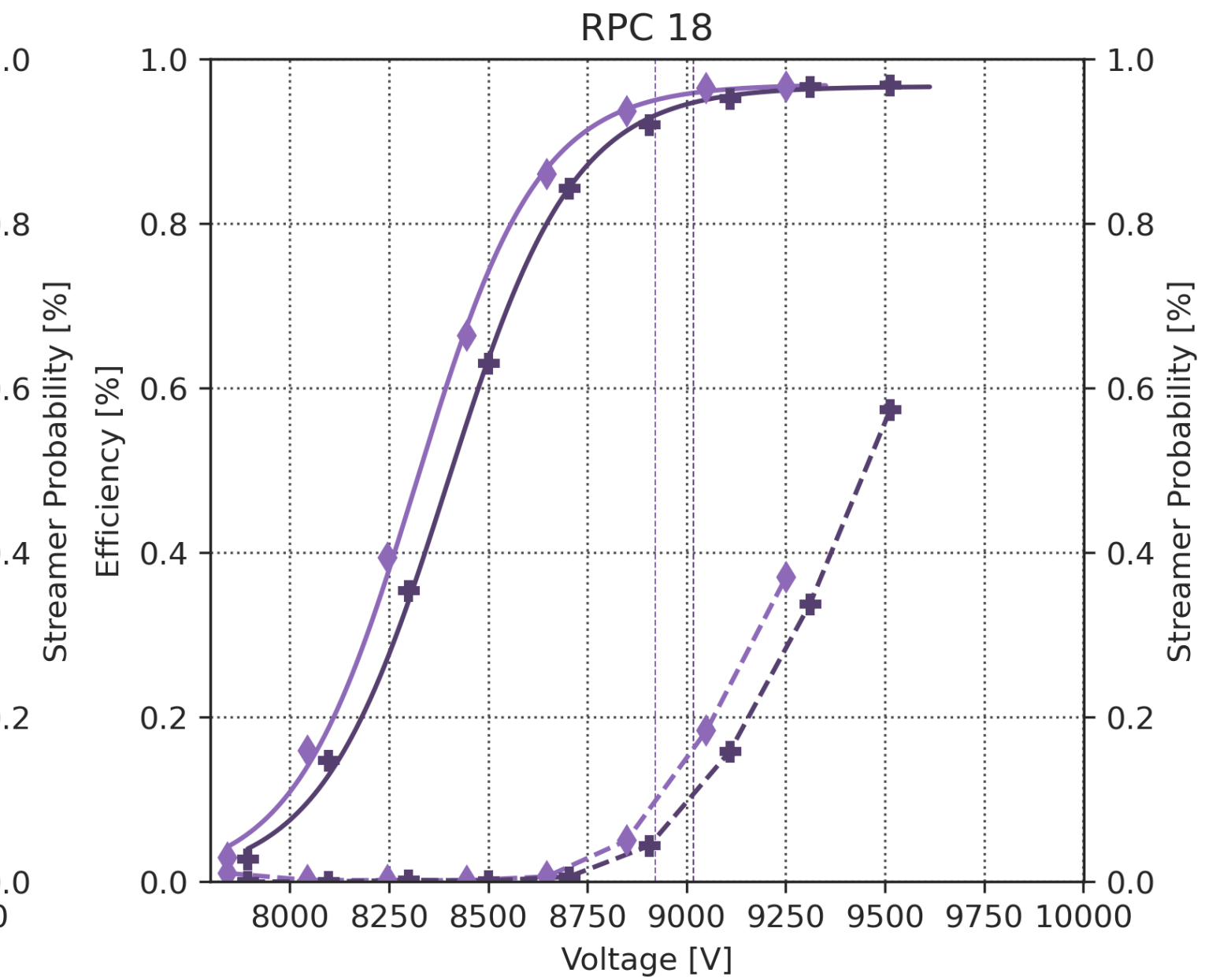
Efficiency @Source Off

40% CO2 + 0.5%SF6

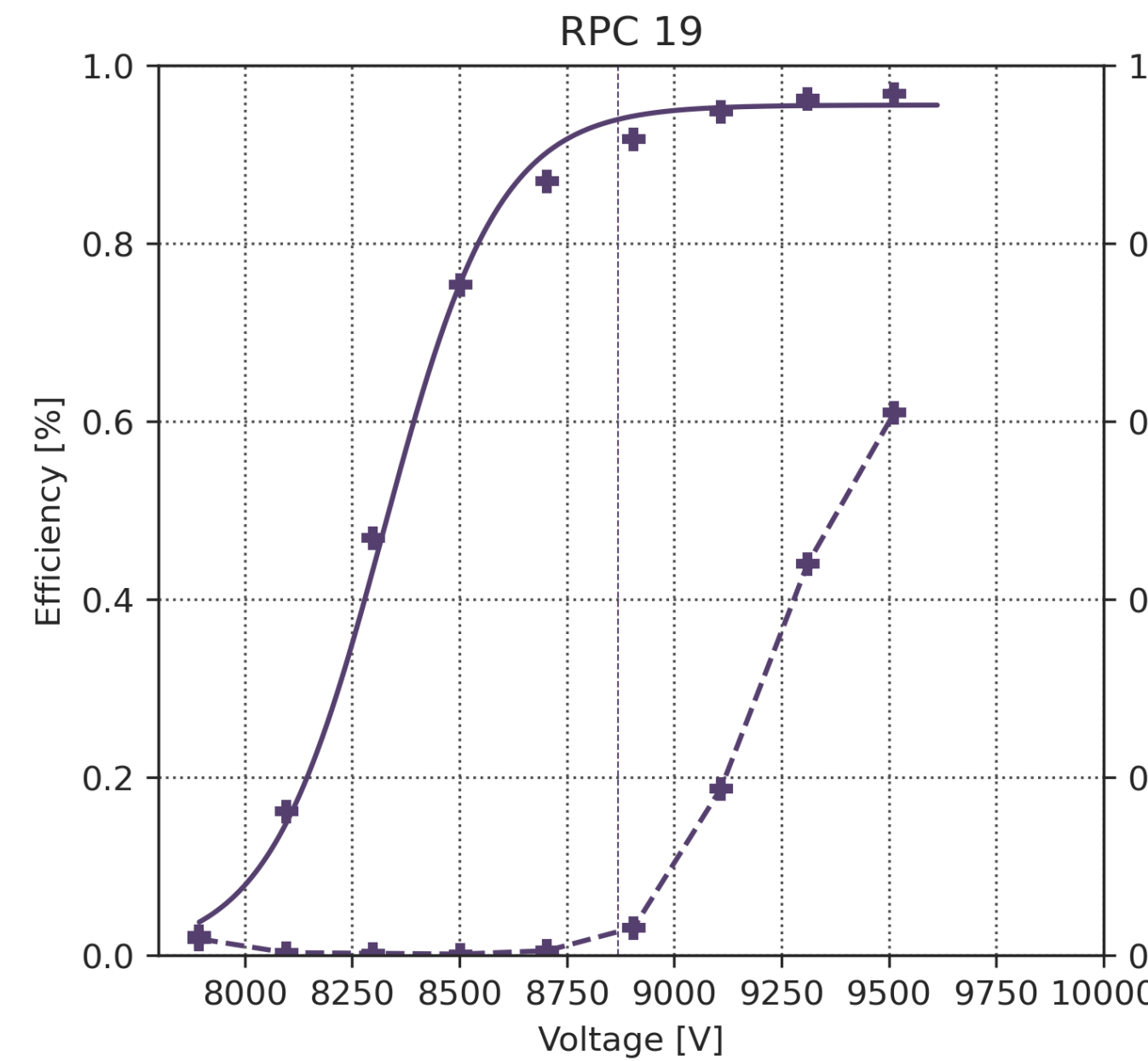
◆ 40CO205SF6 - 40CO205SF6-1: EffMax: 96.36%, SP: 14.19%, WP: 8923 V



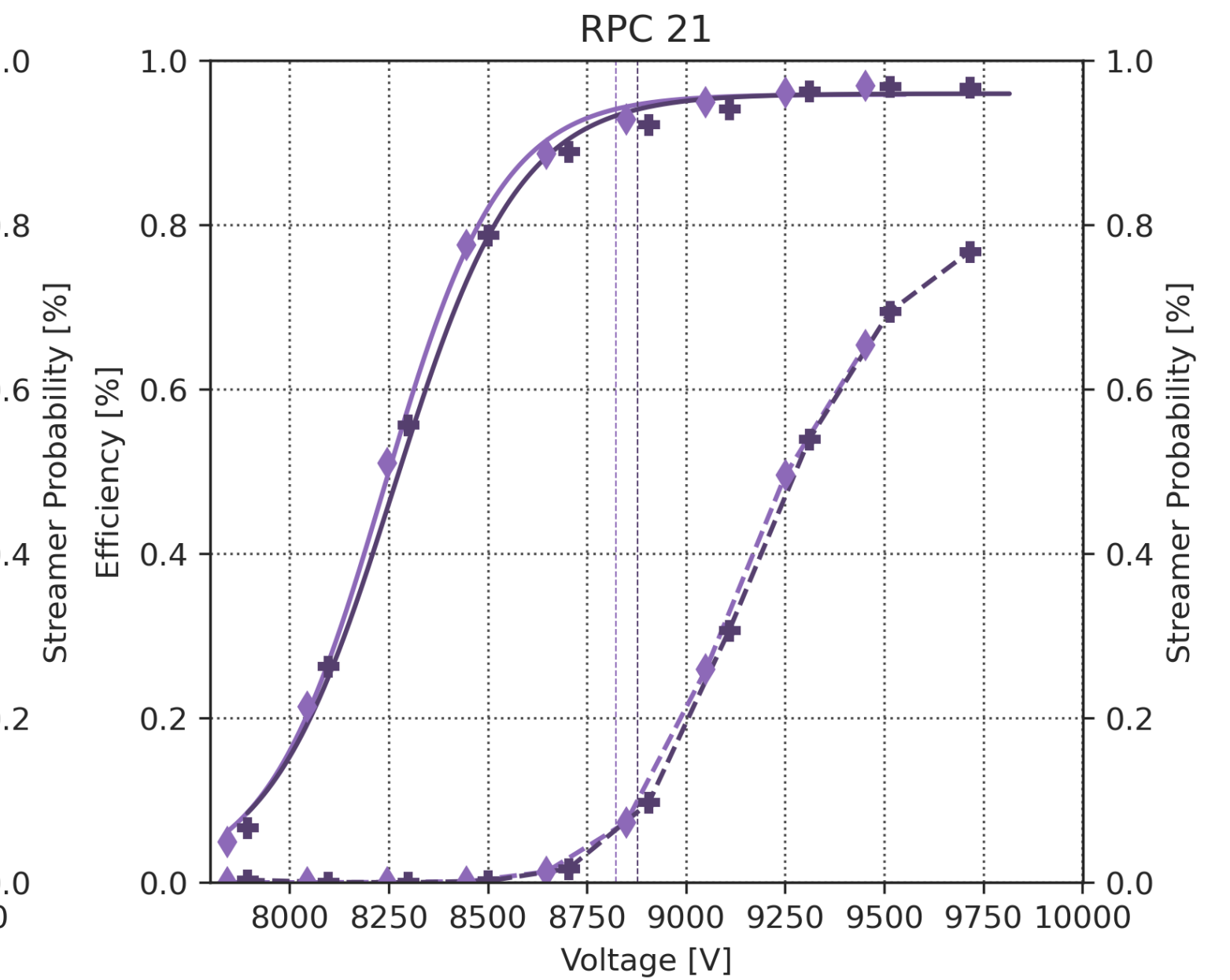
◆ 40CO205SF6 - 40CO205SF6-1: EffMax: 96.89%, SP: 9.84%, WP: 8922 V
 + 40CO205SF6 - 40CO205SF6-2: EffMax: 96.65%, SP: 10.66%, WP: 9017 V



+ 40CO205SF6 - 40CO205SF6-2: EffMax: 95.54%, SP: 2.66%, WP: 8869 V

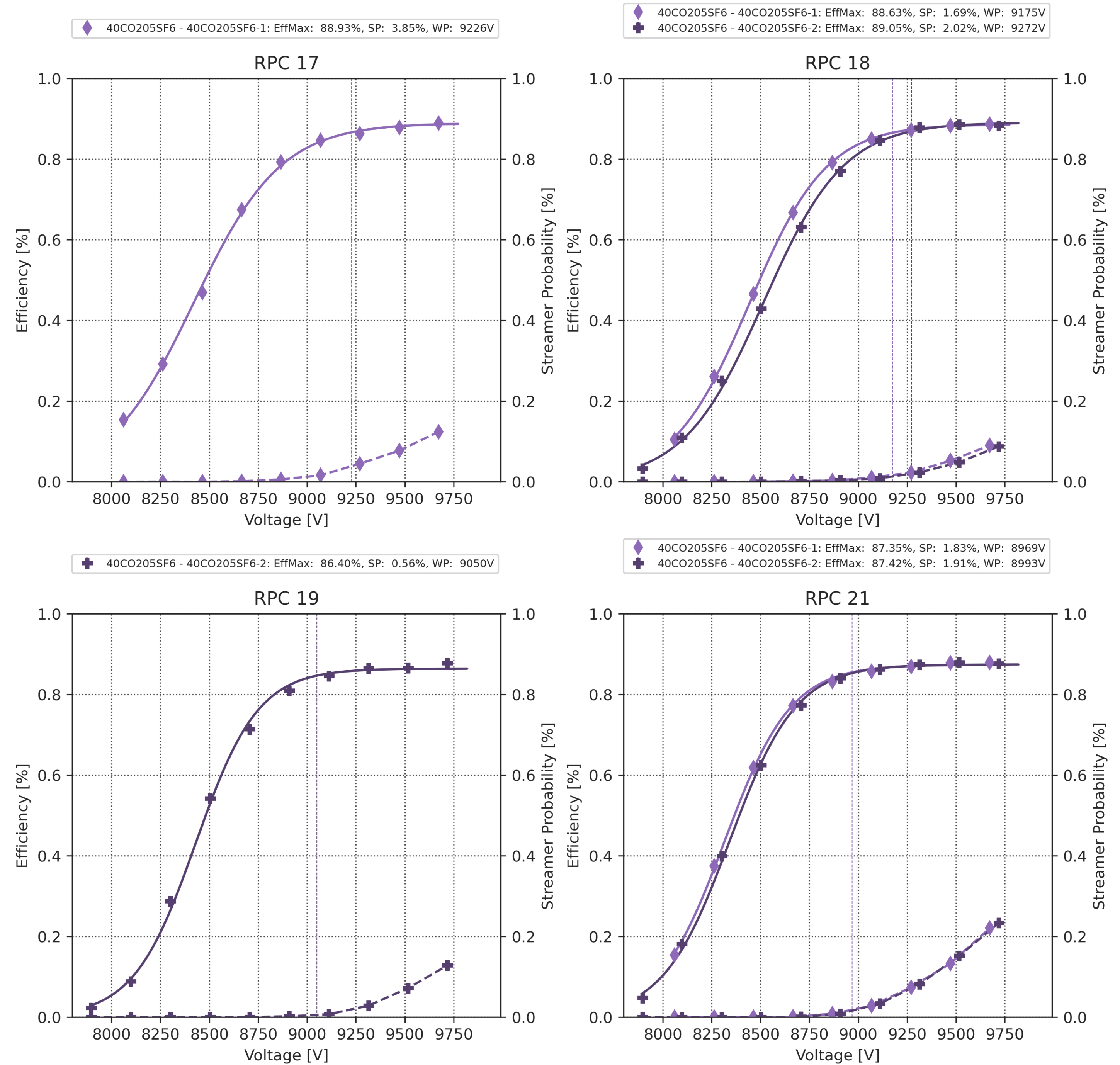


◆ 40CO205SF6 - 40CO205SF6-1: EffMax: 95.86%, SP: 6.52%, WP: 8823 V
 + 40CO205SF6 - 40CO205SF6-2: EffMax: 95.95%, SP: 8.58%, WP: 8878 V



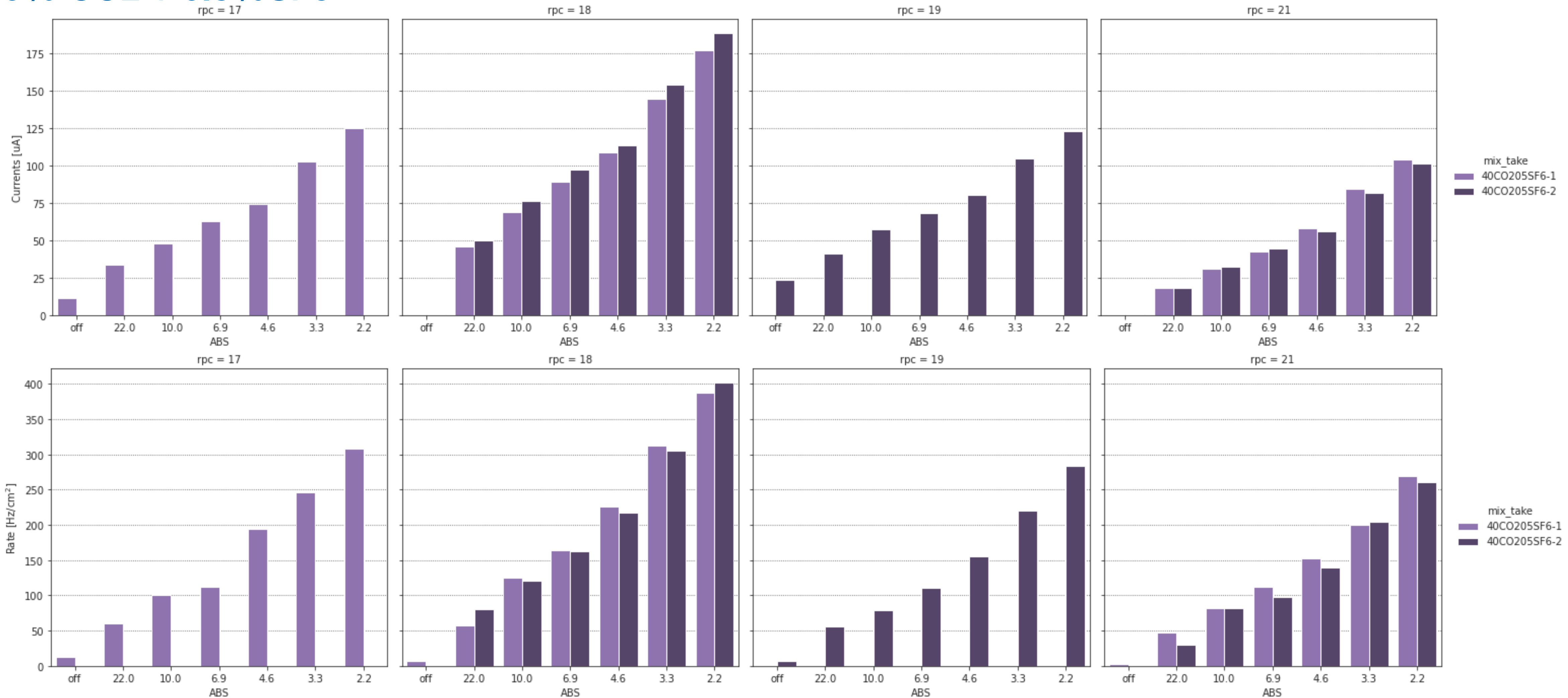
Efficiency @ABS 2.2

40% CO2 + 0.5%SF6



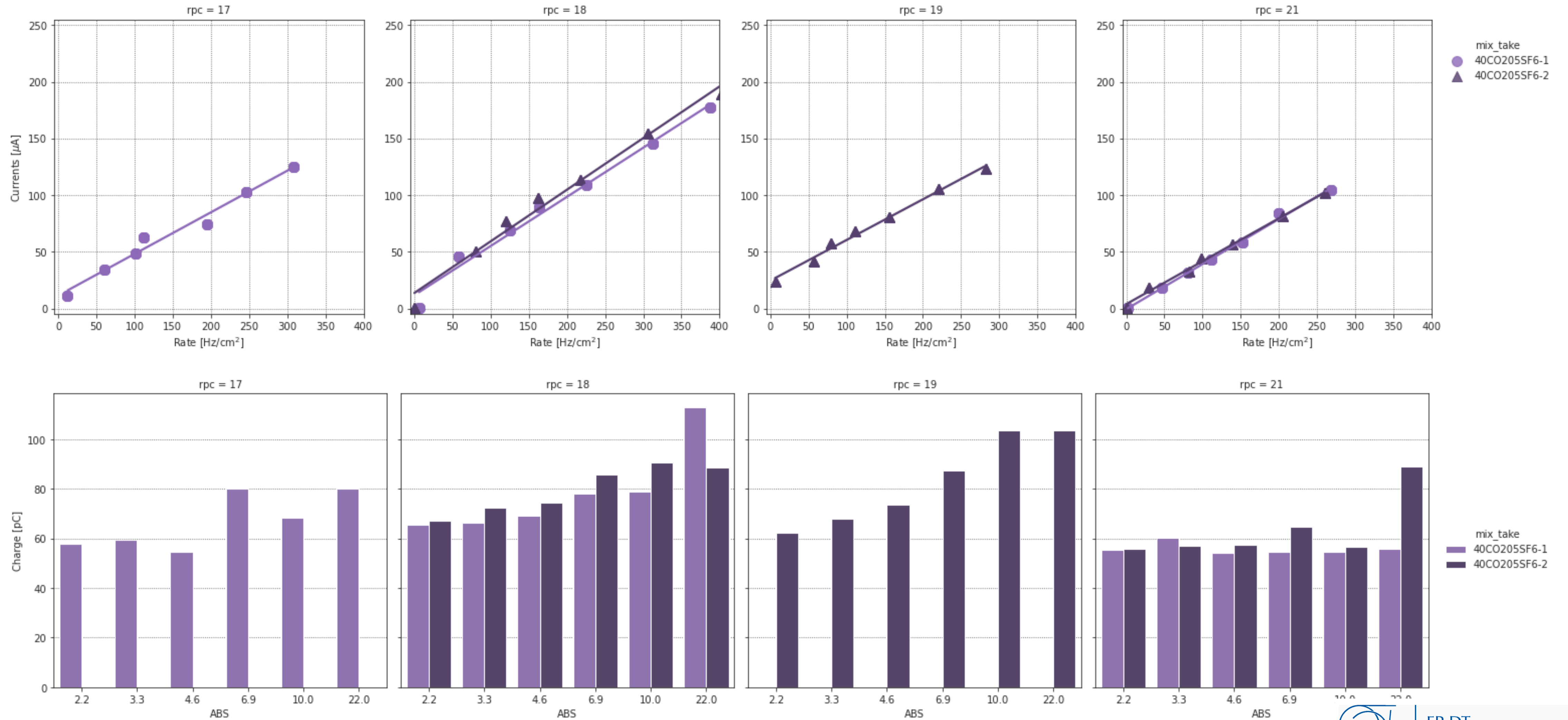
Currents and Rate VS ABS

40% CO₂ + 0.5% SF₆



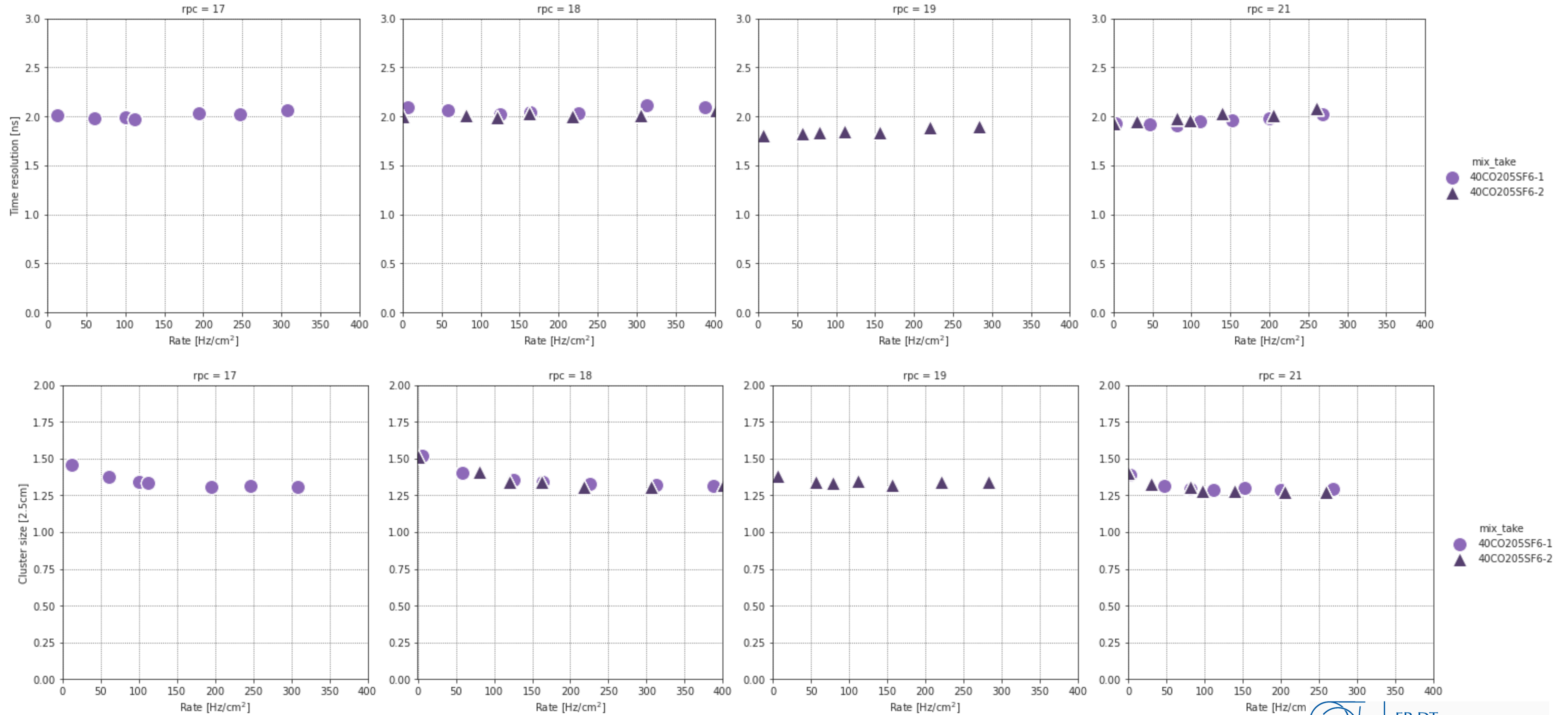
Currents VS Rate & Total Charge VS ABS

40% CO₂ + 0.5% SF₆



Time and Spatial Resolution

40% CO₂ + 0.5% SF₆

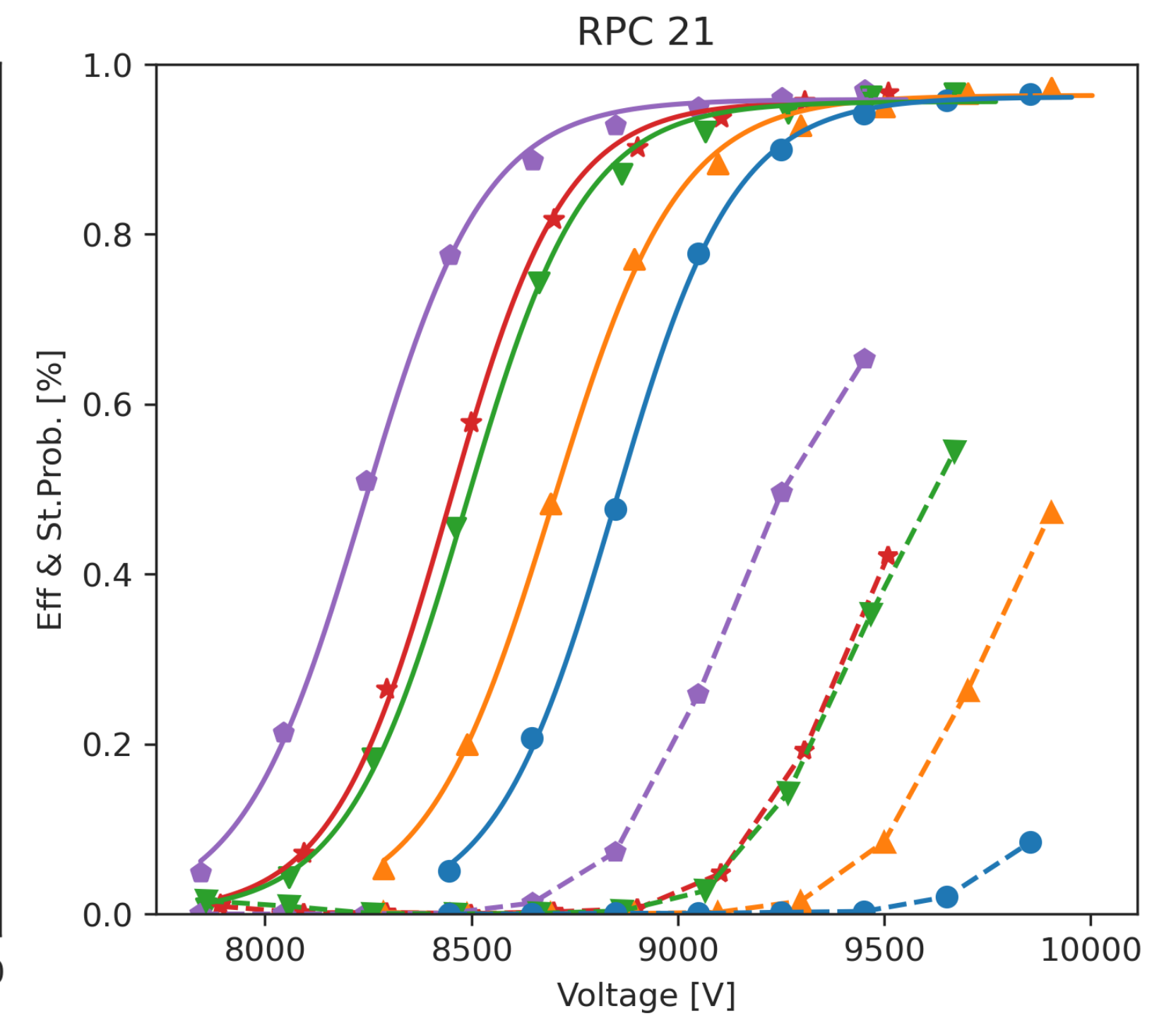
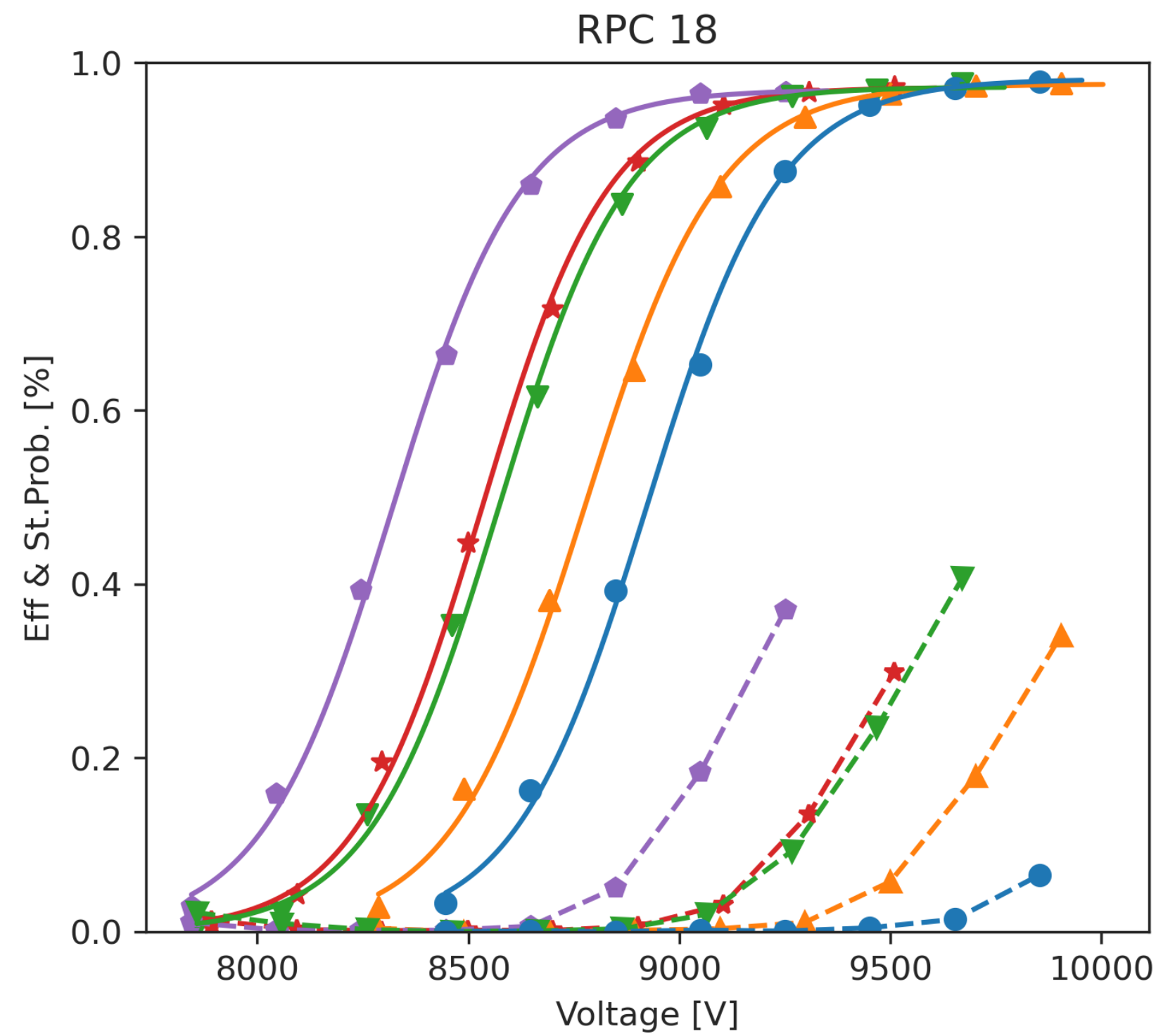
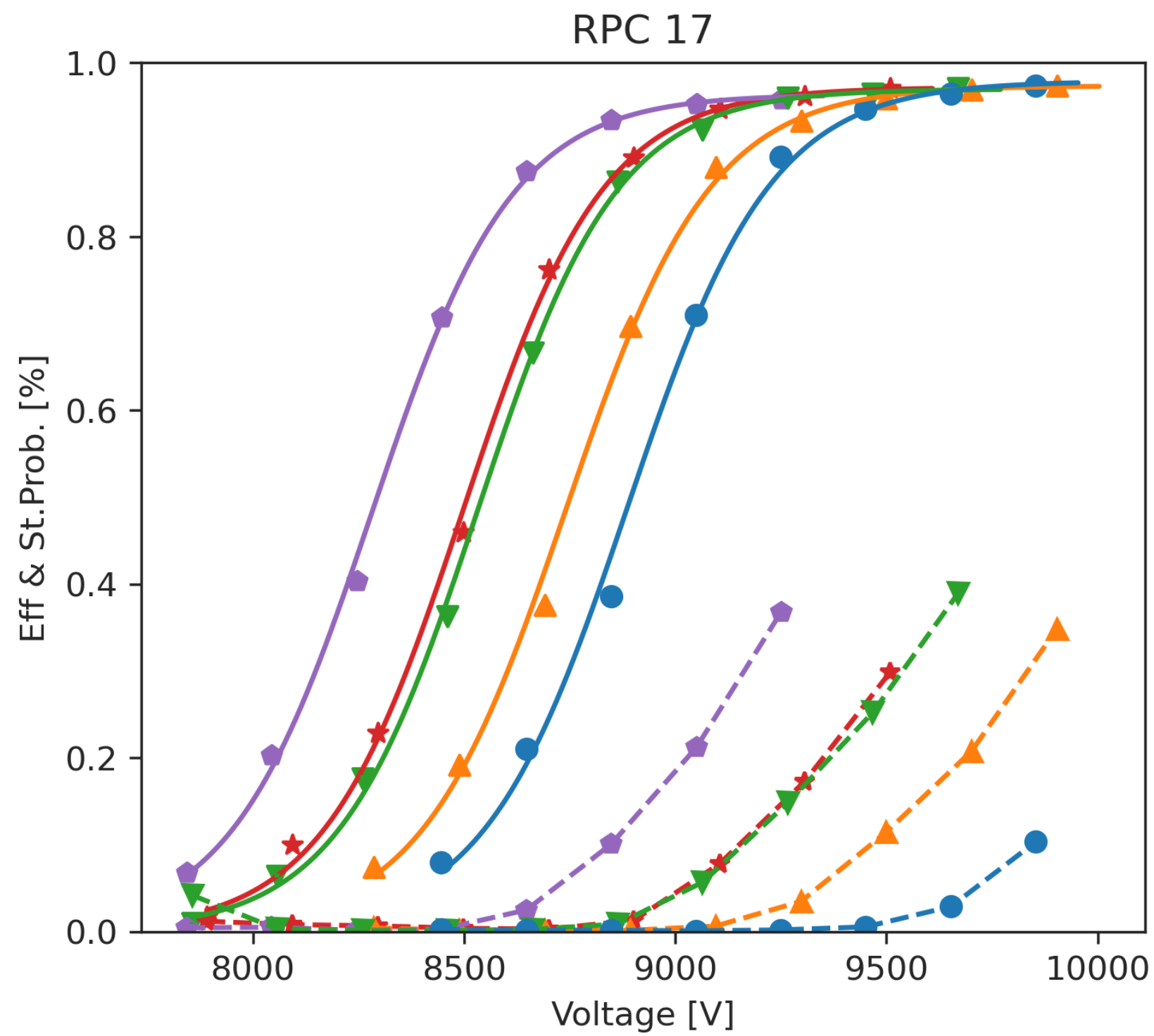
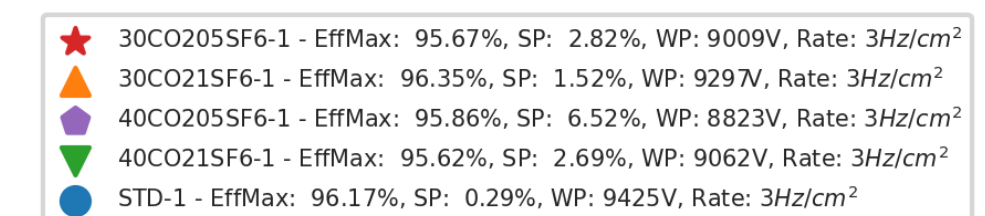
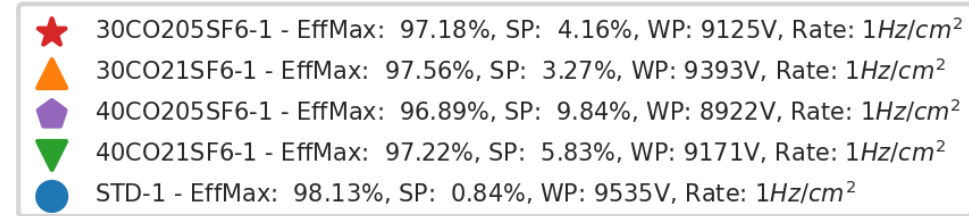


Comparison between Mixtures

Efficiency @Source Off

Different CO₂ & SF₆ Concentrations

- Between the mixtures, the results are consistent with the previous test beam (July 2023).



Efficiency @ABS 2.2

Different CO2 & SF6 Concentrations

- ★ 30CO205SF6-1 - EffMax: 89.66%, SP: 2.63%, WP: 9401V, Rate: 292Hz/cm²
- ▲ 30CO21SF6-1 - EffMax: 89.78%, SP: 2.02%, WP: 9703V, Rate: 292Hz/cm²
- ◆ 40CO205SF6-1 - EffMax: 88.93%, SP: 3.85%, WP: 9226V, Rate: 292Hz/cm²
- ▼ 40CO21SF6-1 - EffMax: 88.97%, SP: 2.12%, WP: 9457V, Rate: 292Hz/cm²
- STD-1 - EffMax: 91.33%, SP: 0.68%, WP: 9829V, Rate: 292Hz/cm²

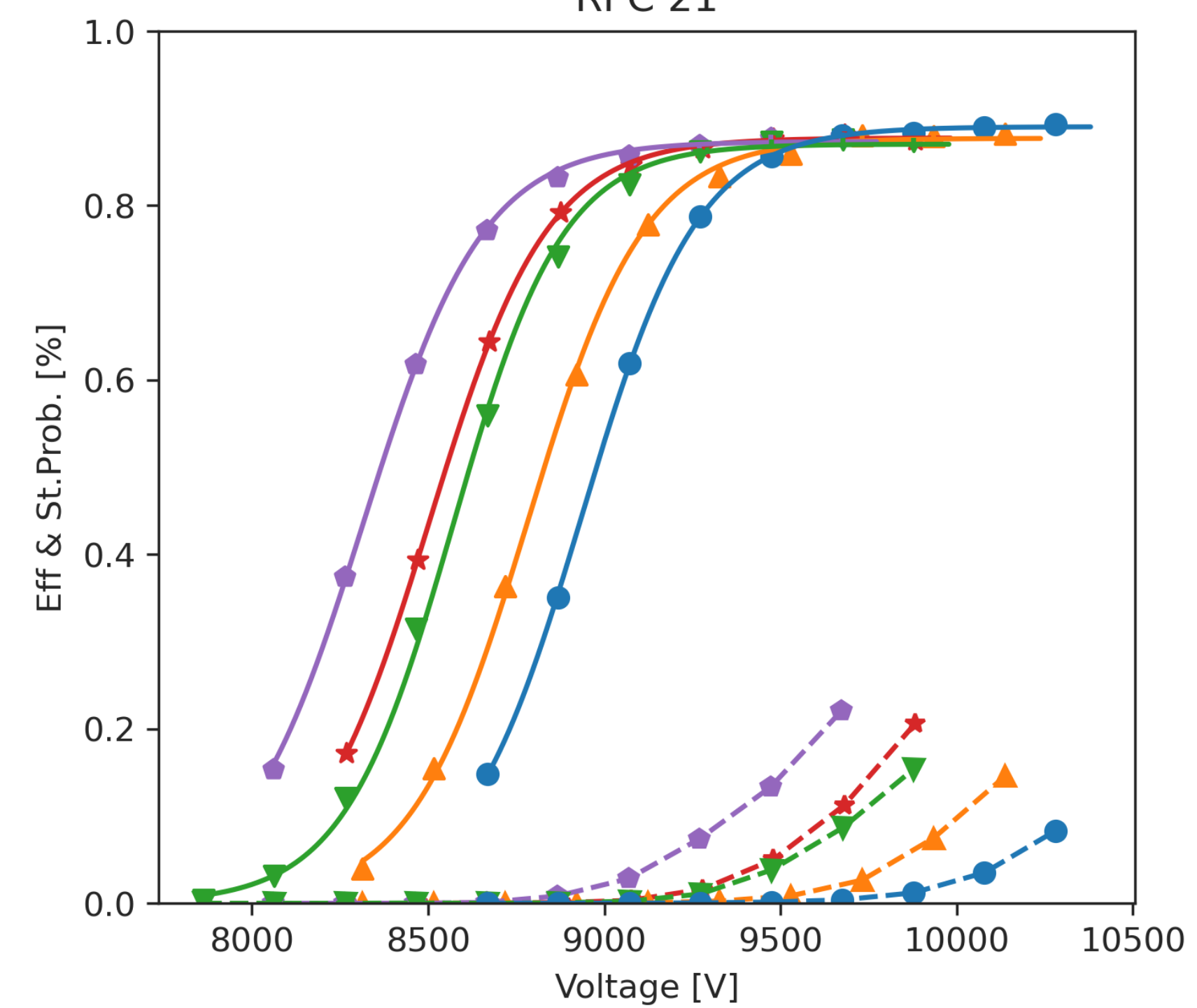
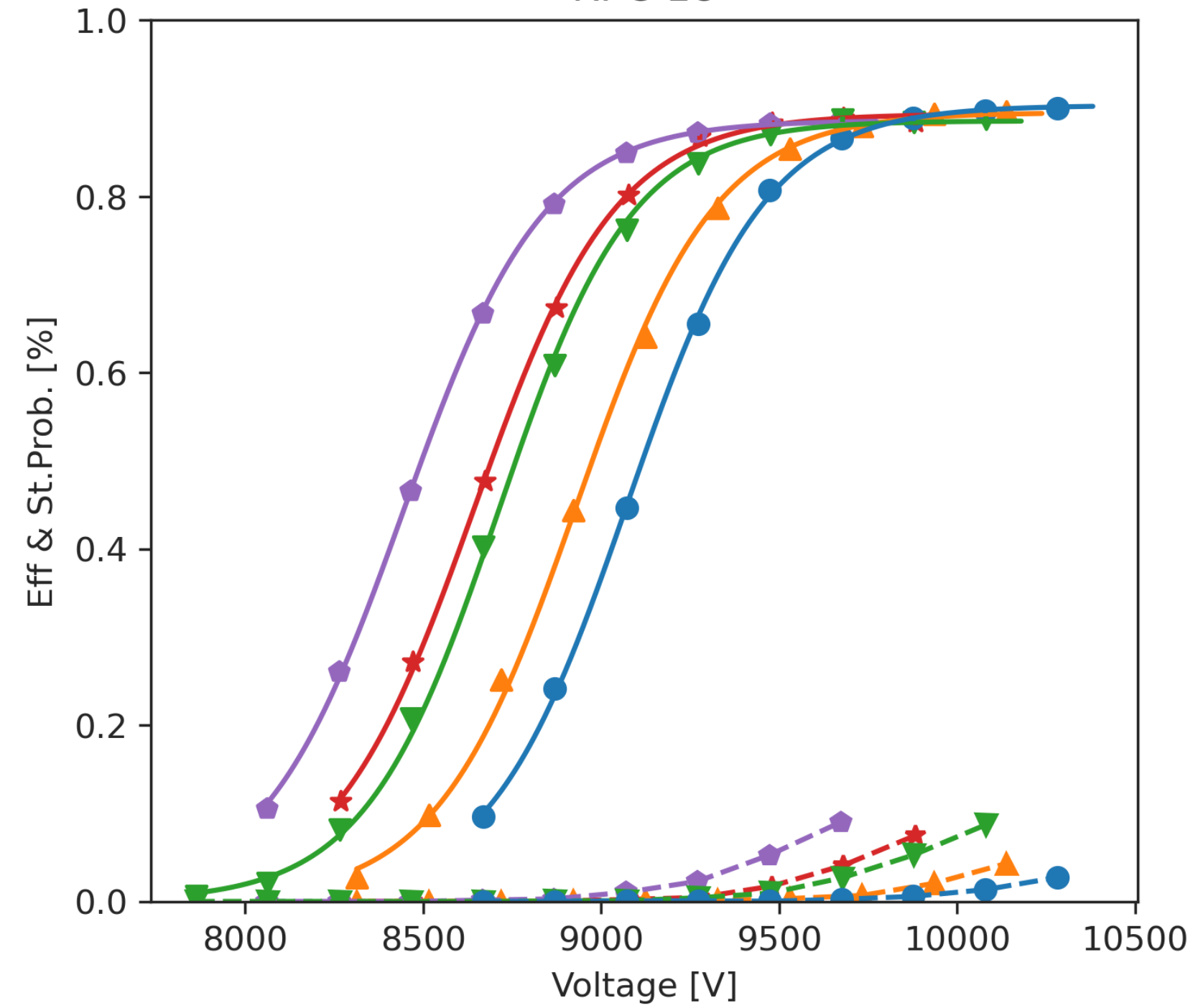
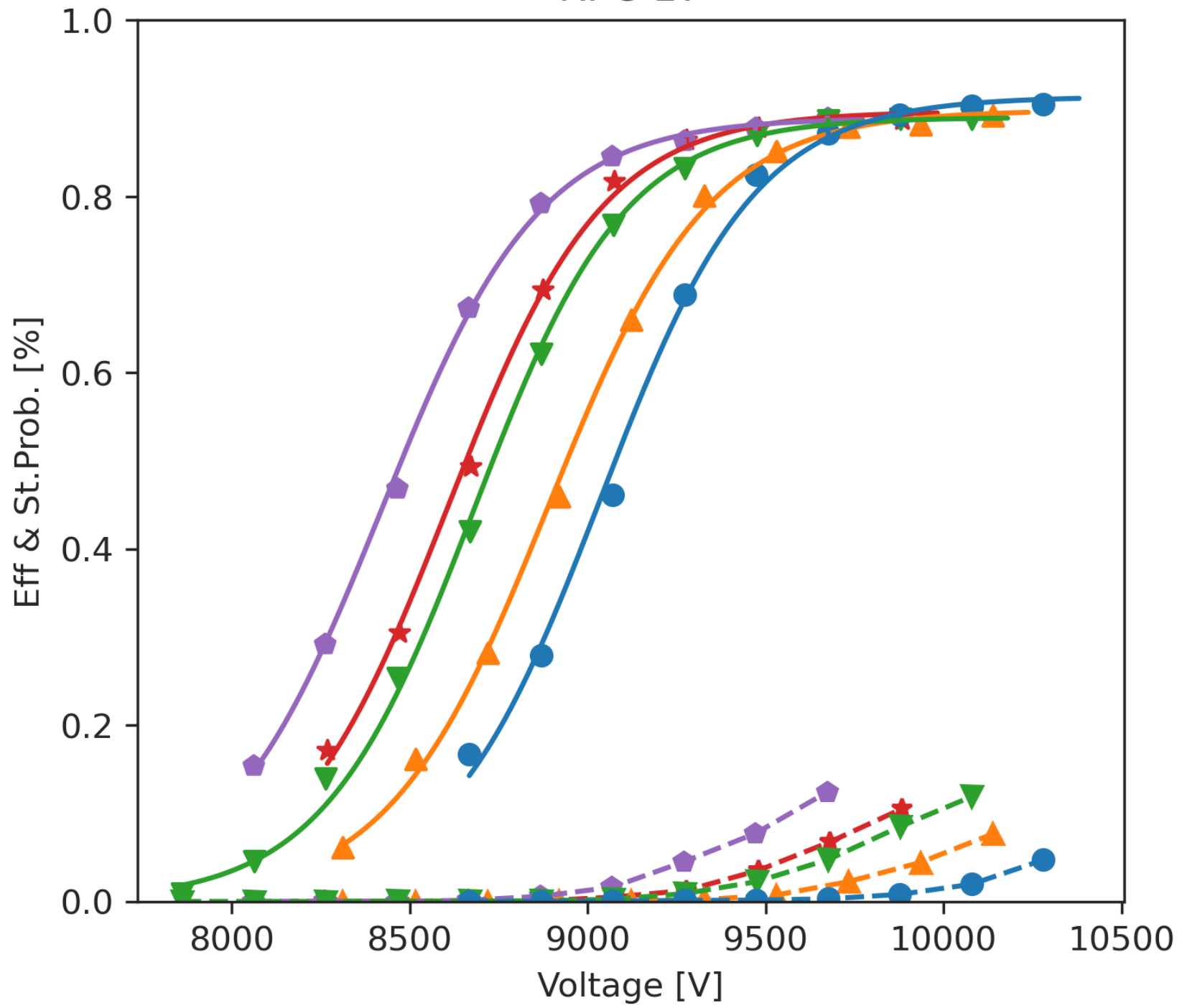
- ★ 30CO205SF6-1 - EffMax: 89.37%, SP: 1.10%, WP: 9378V, Rate: 401Hz/cm²
- ▲ 30CO21SF6-1 - EffMax: 89.54%, SP: 0.54%, WP: 9654V, Rate: 401Hz/cm²
- ◆ 40CO205SF6-1 - EffMax: 88.63%, SP: 1.69%, WP: 9175V, Rate: 401Hz/cm²
- ▼ 40CO21SF6-1 - EffMax: 88.59%, SP: 0.78%, WP: 9414V, Rate: 401Hz/cm²
- STD-1 - EffMax: 90.34%, SP: 0.44%, WP: 9796V, Rate: 401Hz/cm²

- ★ 30CO205SF6-1 - EffMax: 87.75%, SP: 0.79%, WP: 9147V, Rate: 280Hz/cm²
- ▲ 30CO21SF6-1 - EffMax: 87.70%, SP: 0.53%, WP: 9420V, Rate: 280Hz/cm²
- ◆ 40CO205SF6-1 - EffMax: 87.35%, SP: 1.83%, WP: 8969V, Rate: 280Hz/cm²
- ▼ 40CO21SF6-1 - EffMax: 87.04%, SP: 0.69%, WP: 9181V, Rate: 280Hz/cm²
- STD-1 - EffMax: 89.04%, SP: 0.27%, WP: 9574V, Rate: 280Hz/cm²

RPC 17

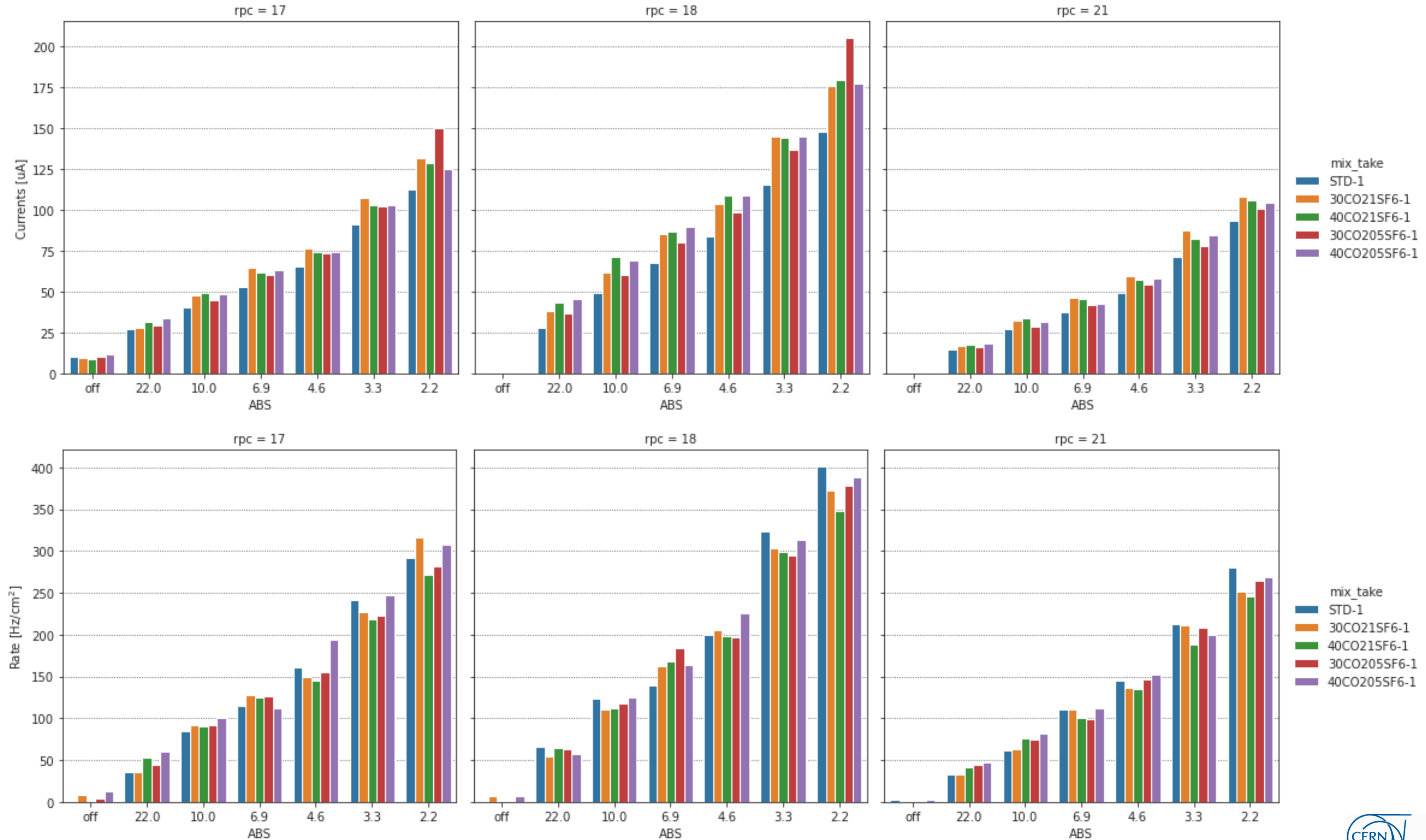
RPC 18

RPC 21



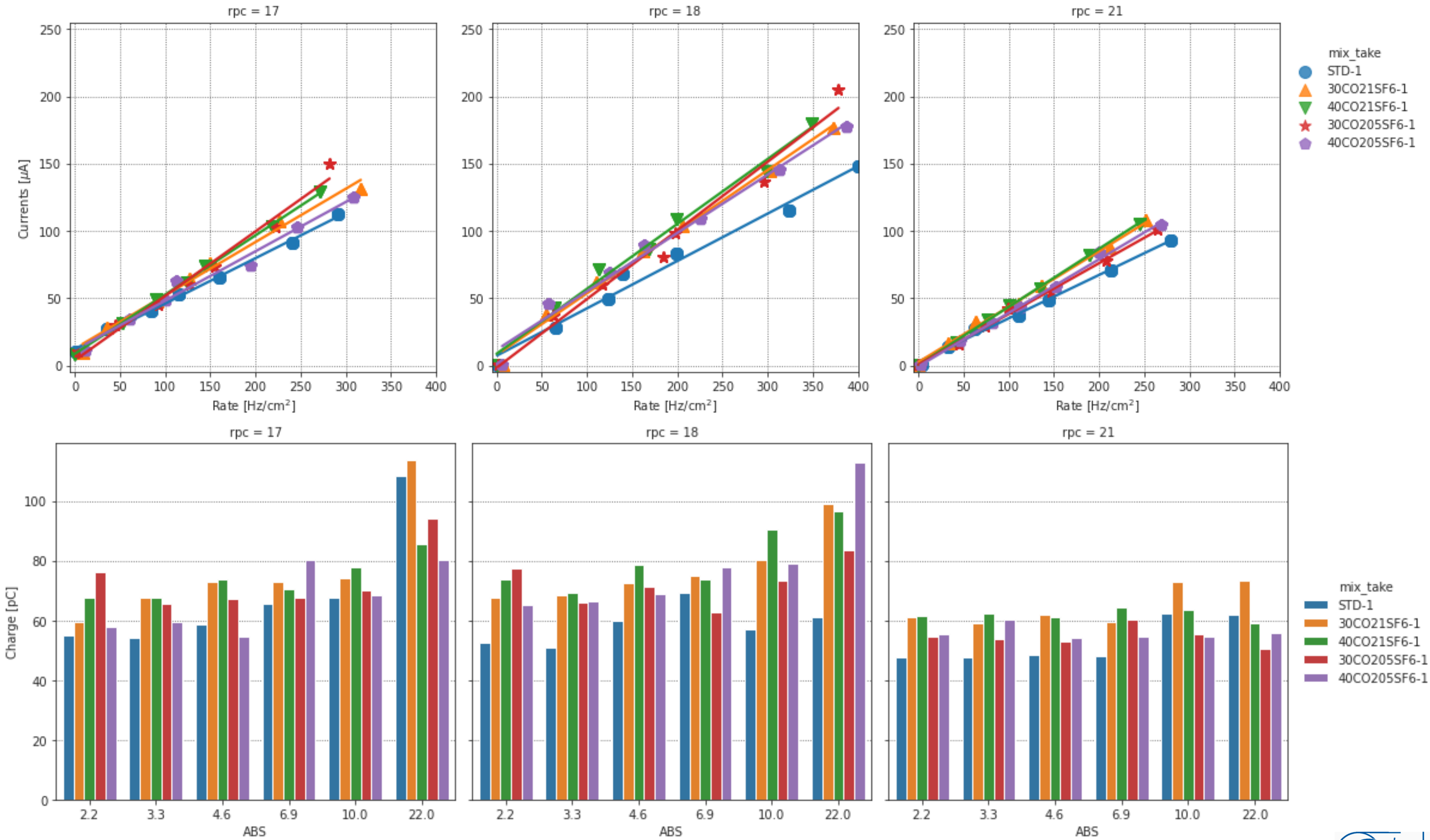
Currents and Rate VS ABS

Different CO2 & SF6 Concentrations



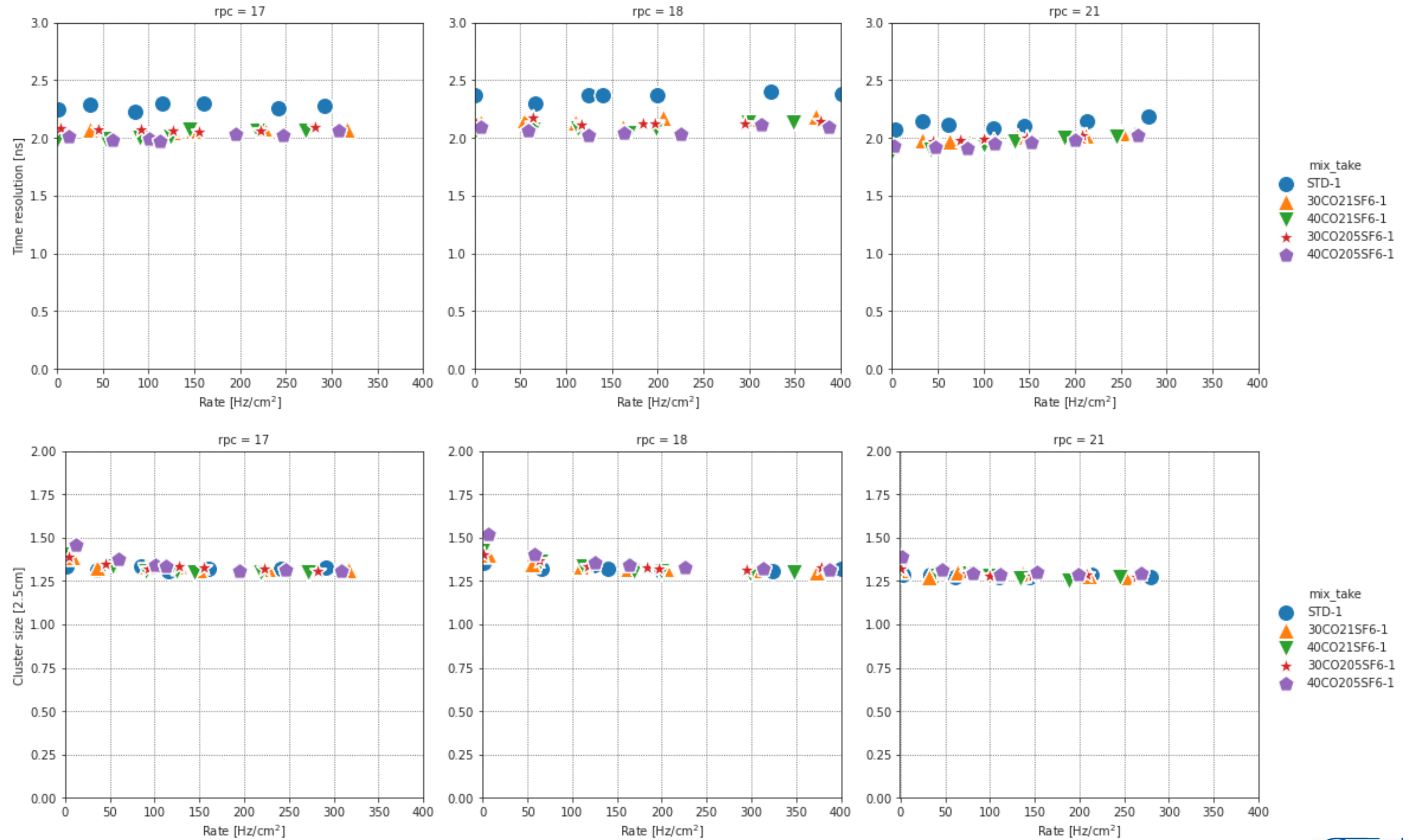
Currents VS Rate and Charge VS ABS

Different CO₂ & SF₆ Concentrations



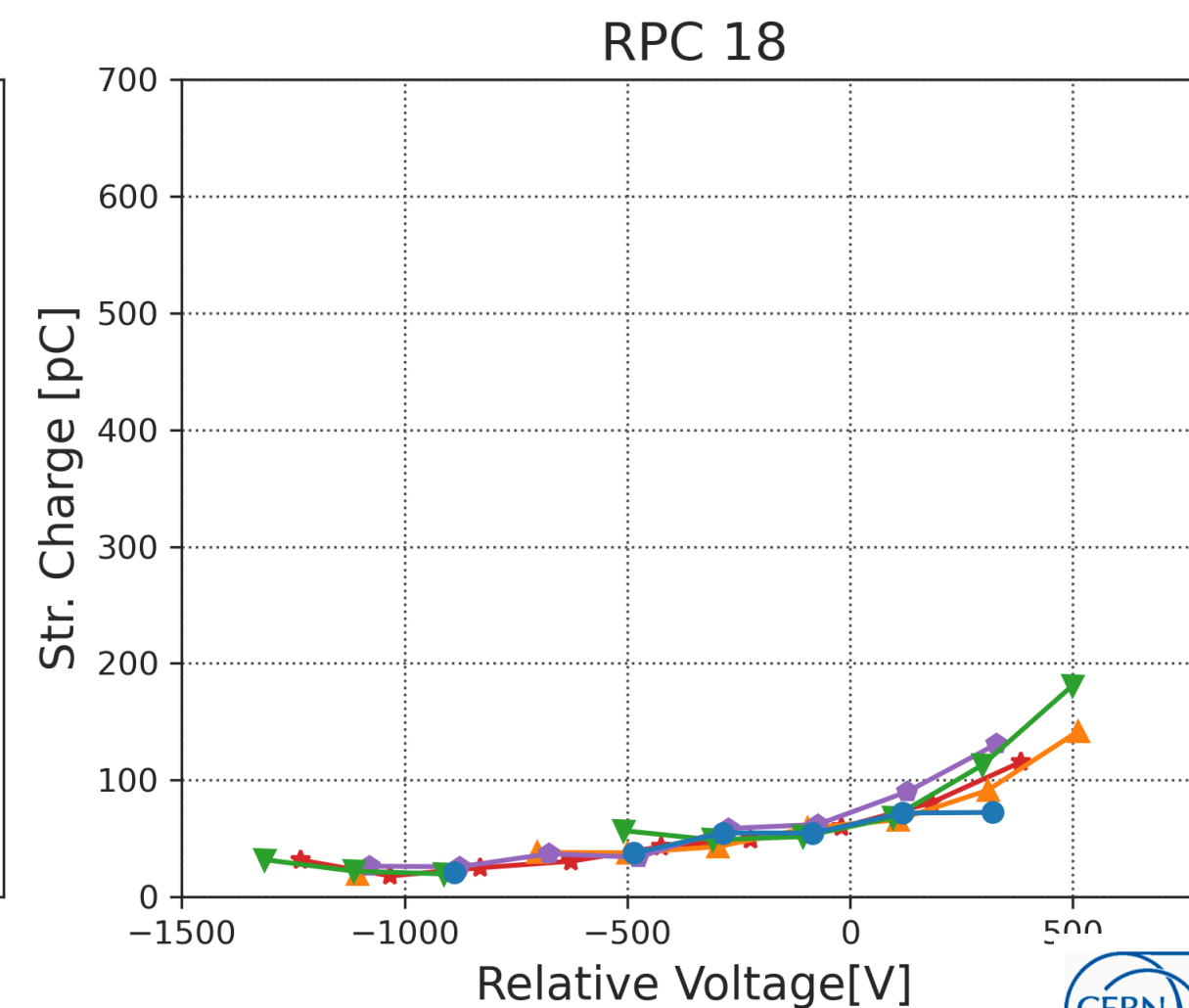
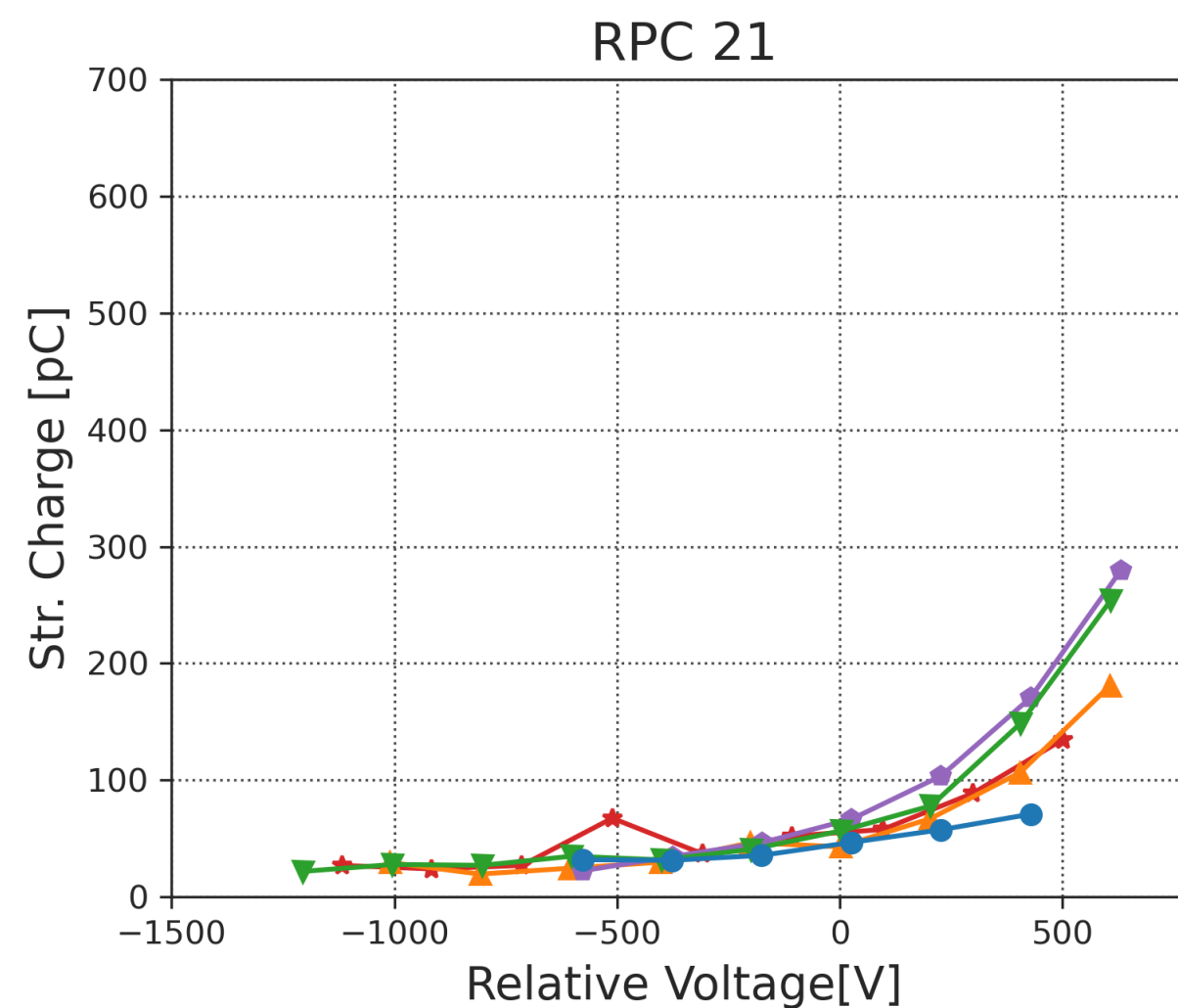
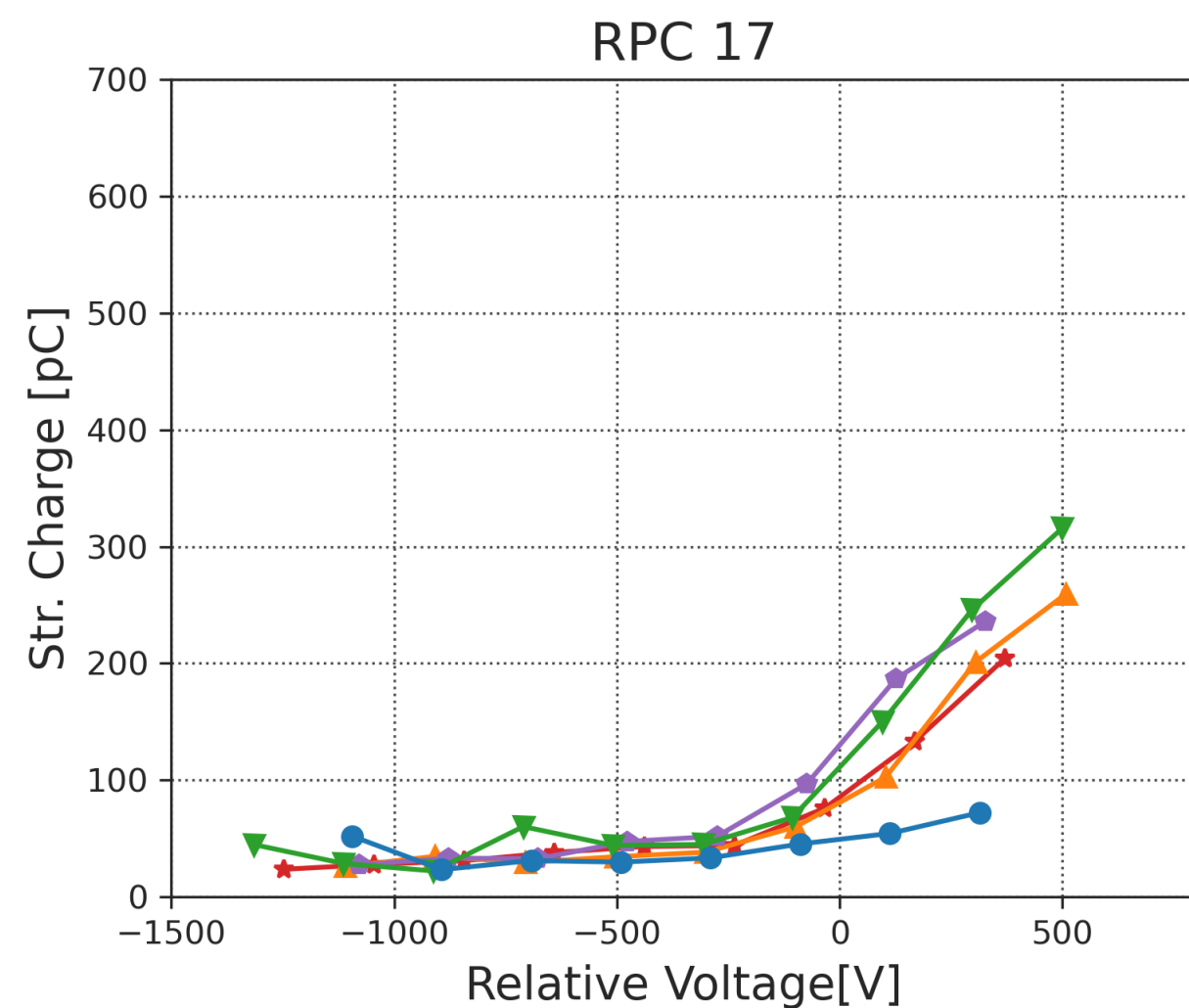
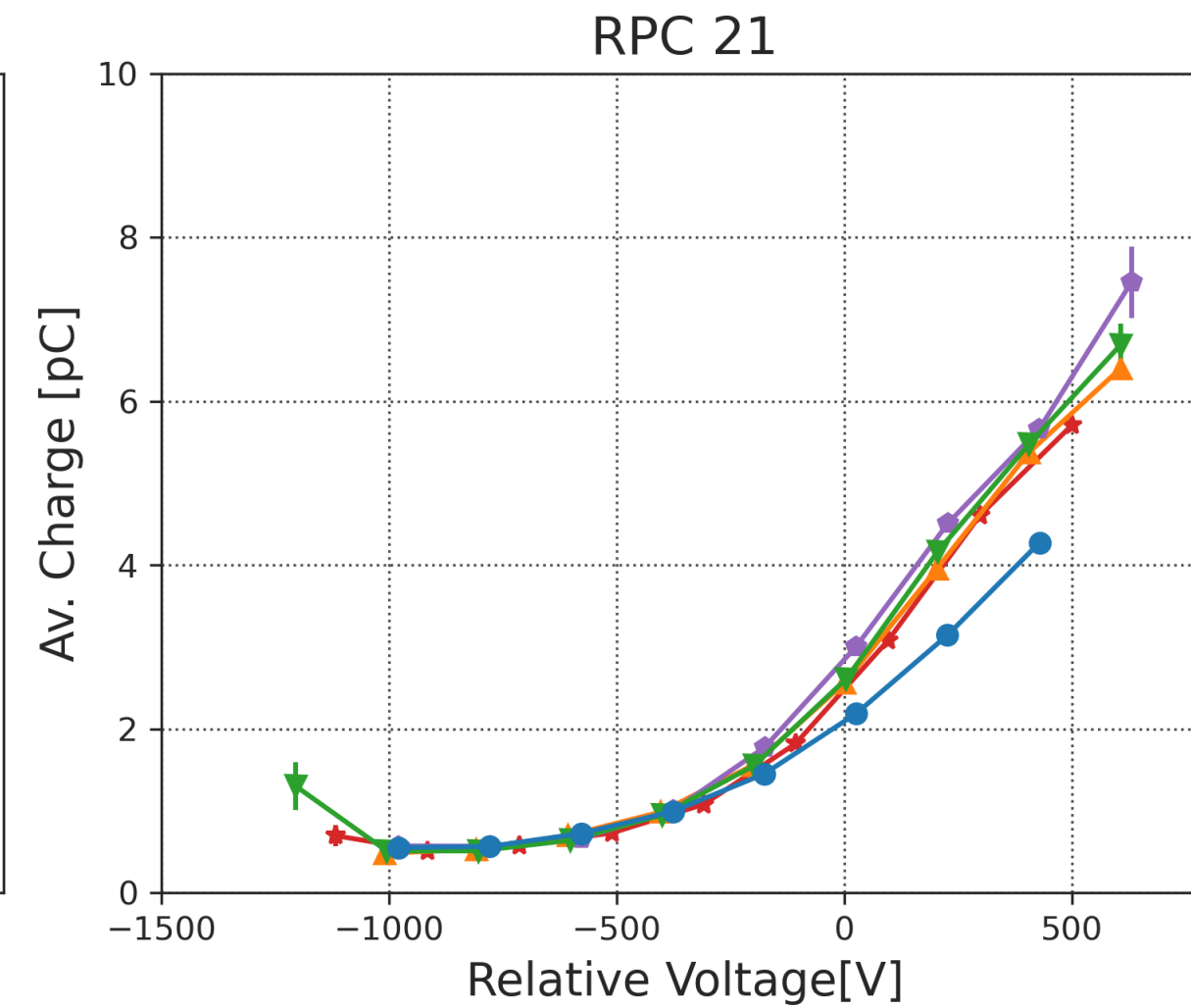
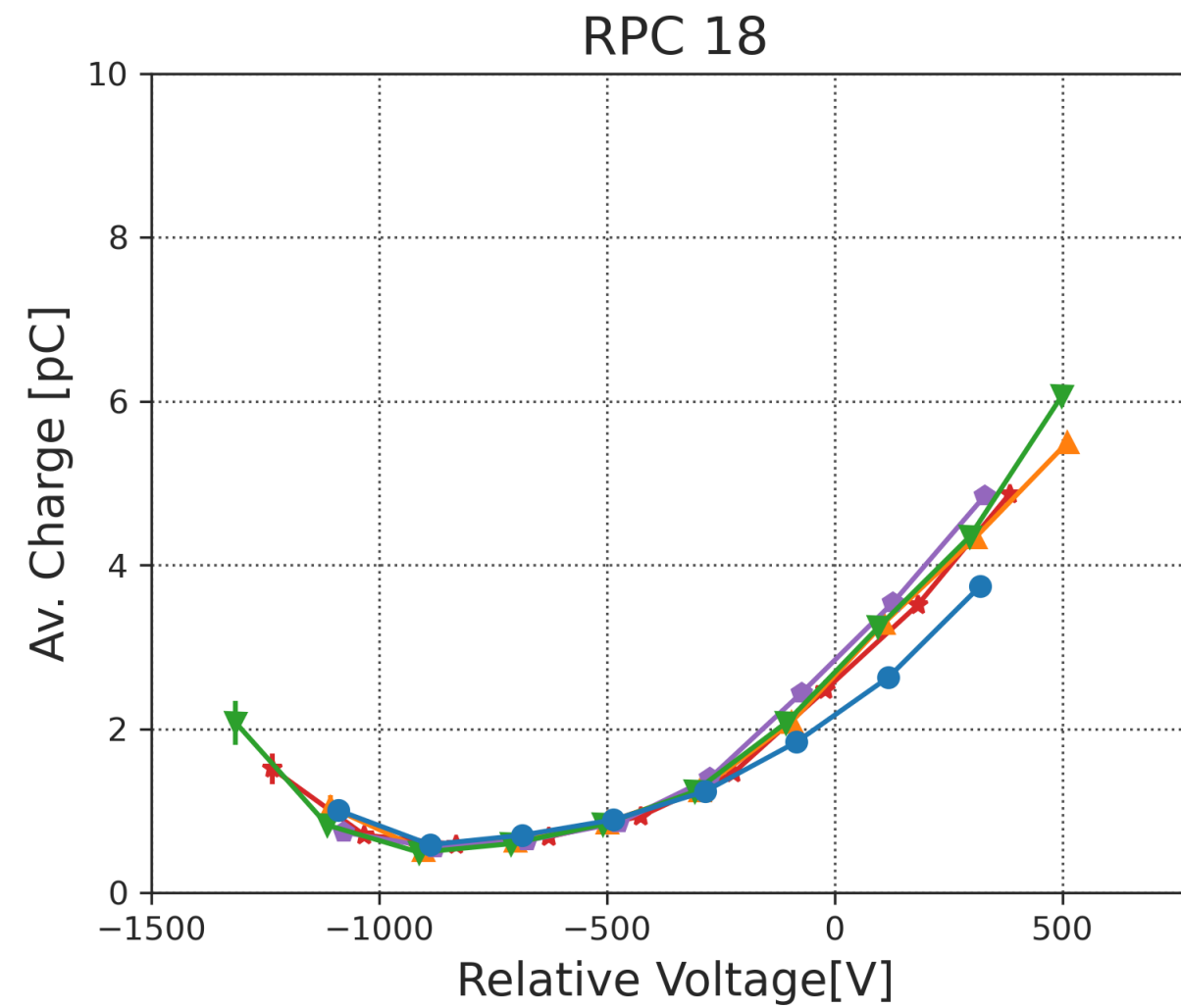
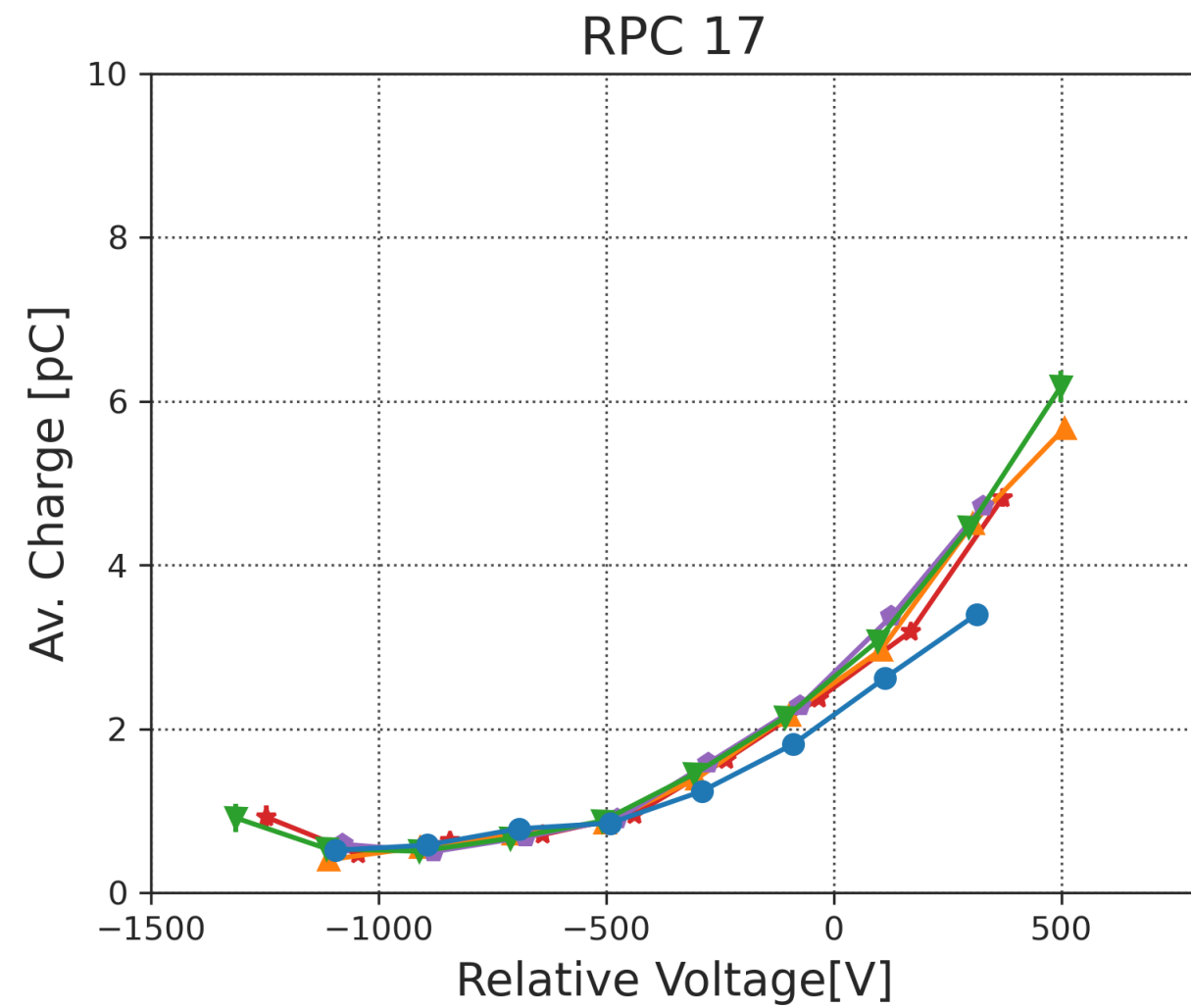
Time and Spatial Resolution

Different CO₂ & SF₆ Concentrations



Avalanche and Streamer Charge VS Relative Voltage

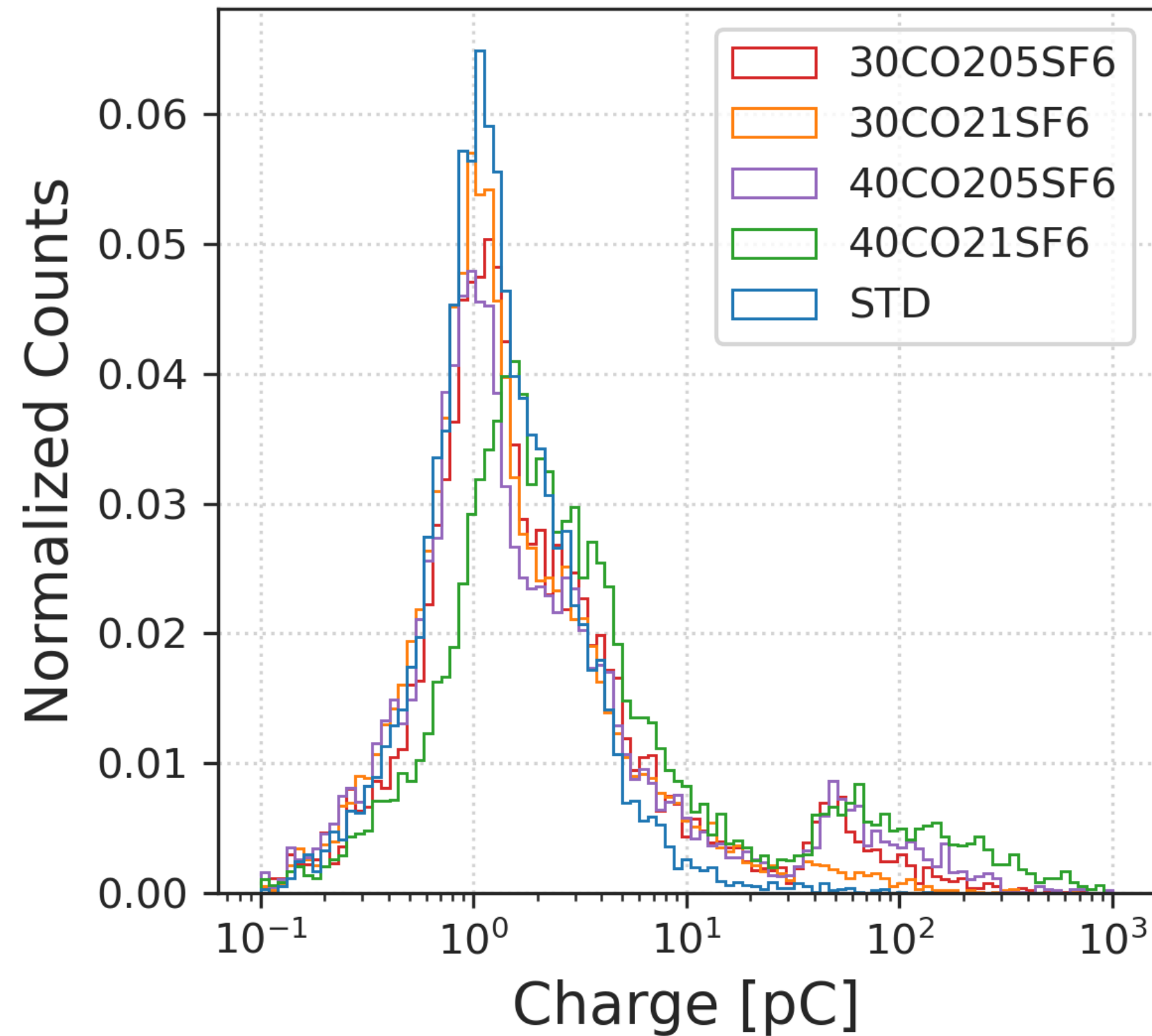
Different CO₂ & SF₆ Concentrations



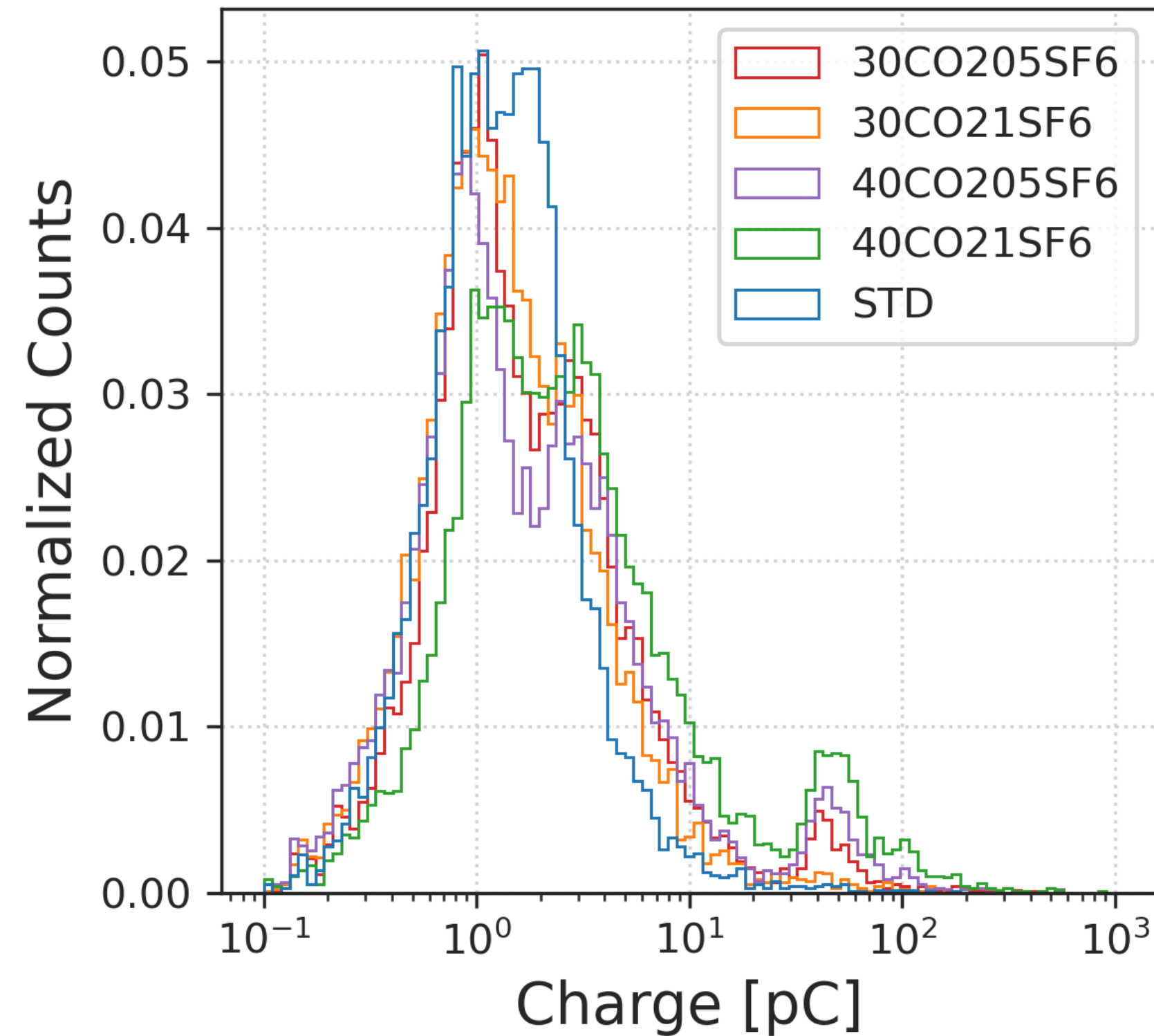
Charge Distribution

Different CO₂ & SF₆ Concentrations

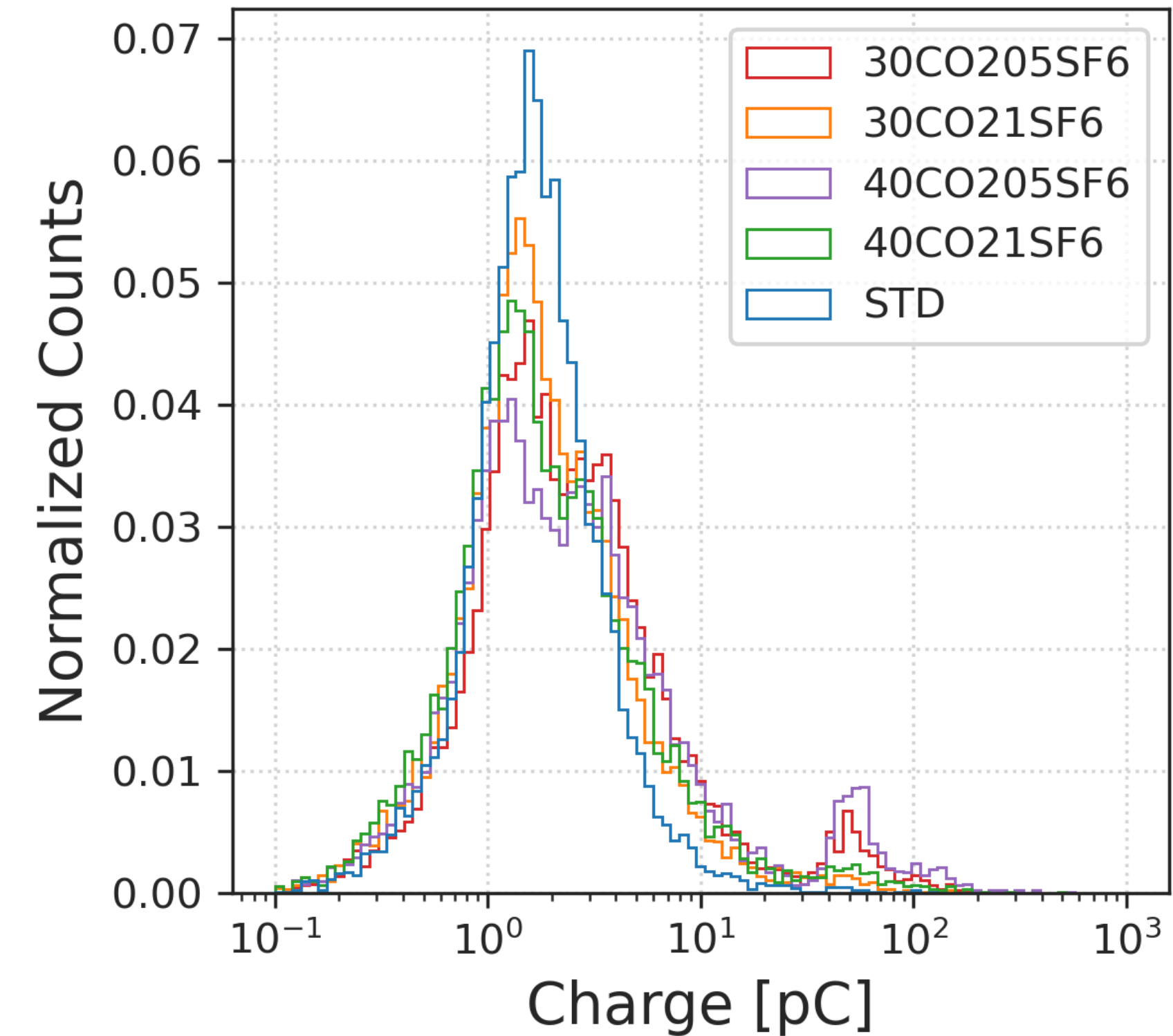
Charge Distribution, RPC 17



Charge Distribution, RPC 18



Charge Distribution, RPC 21

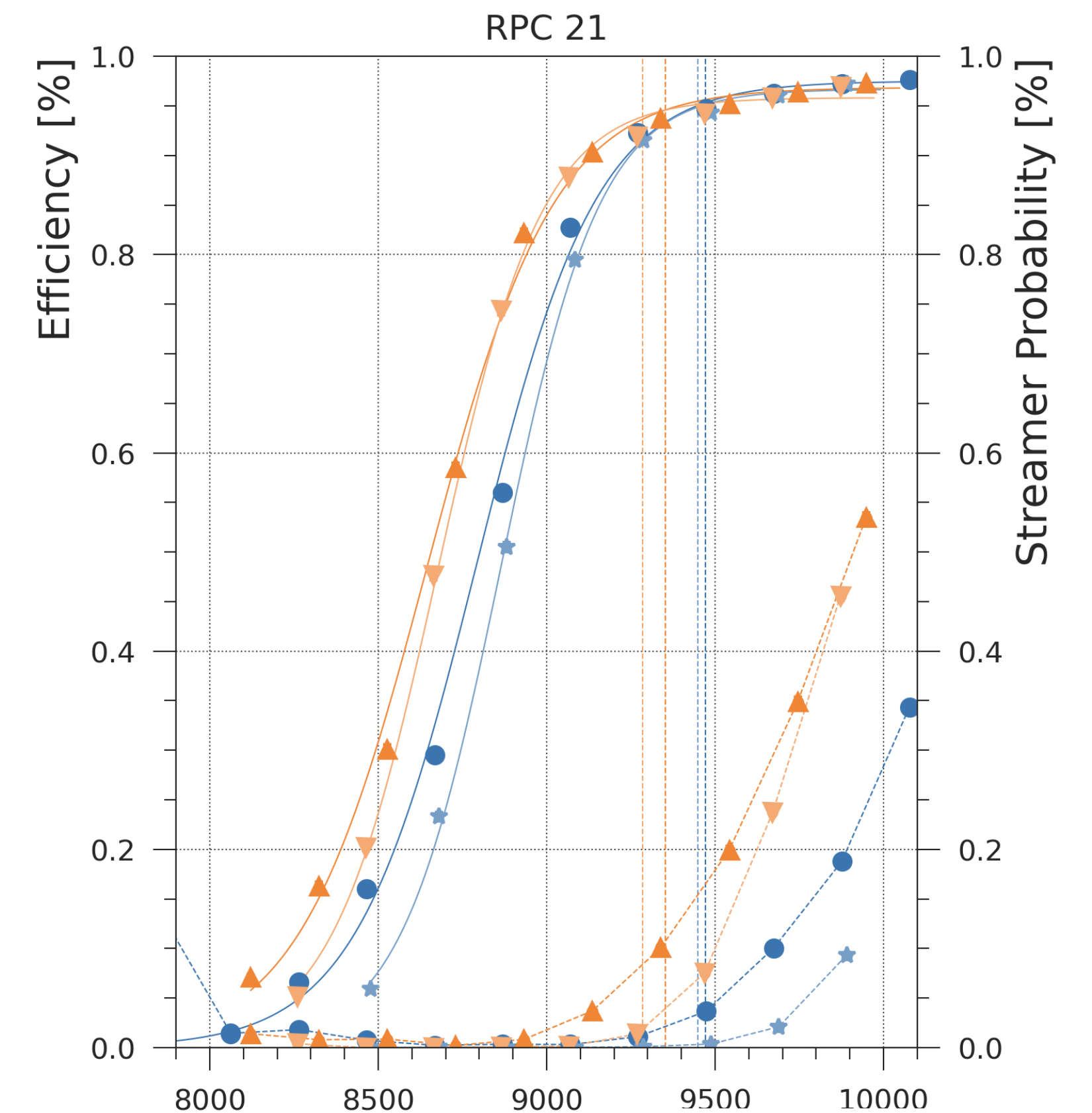
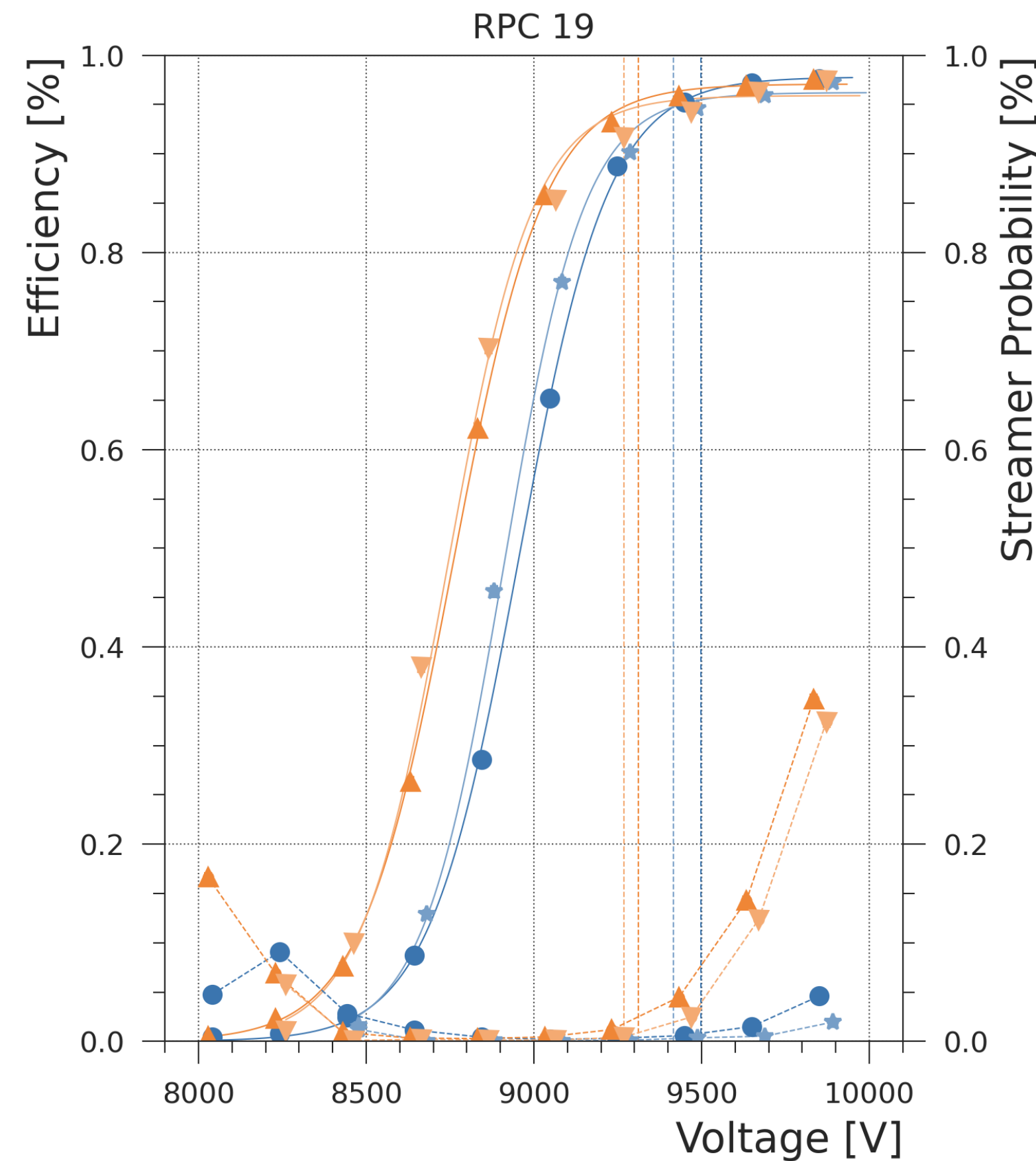
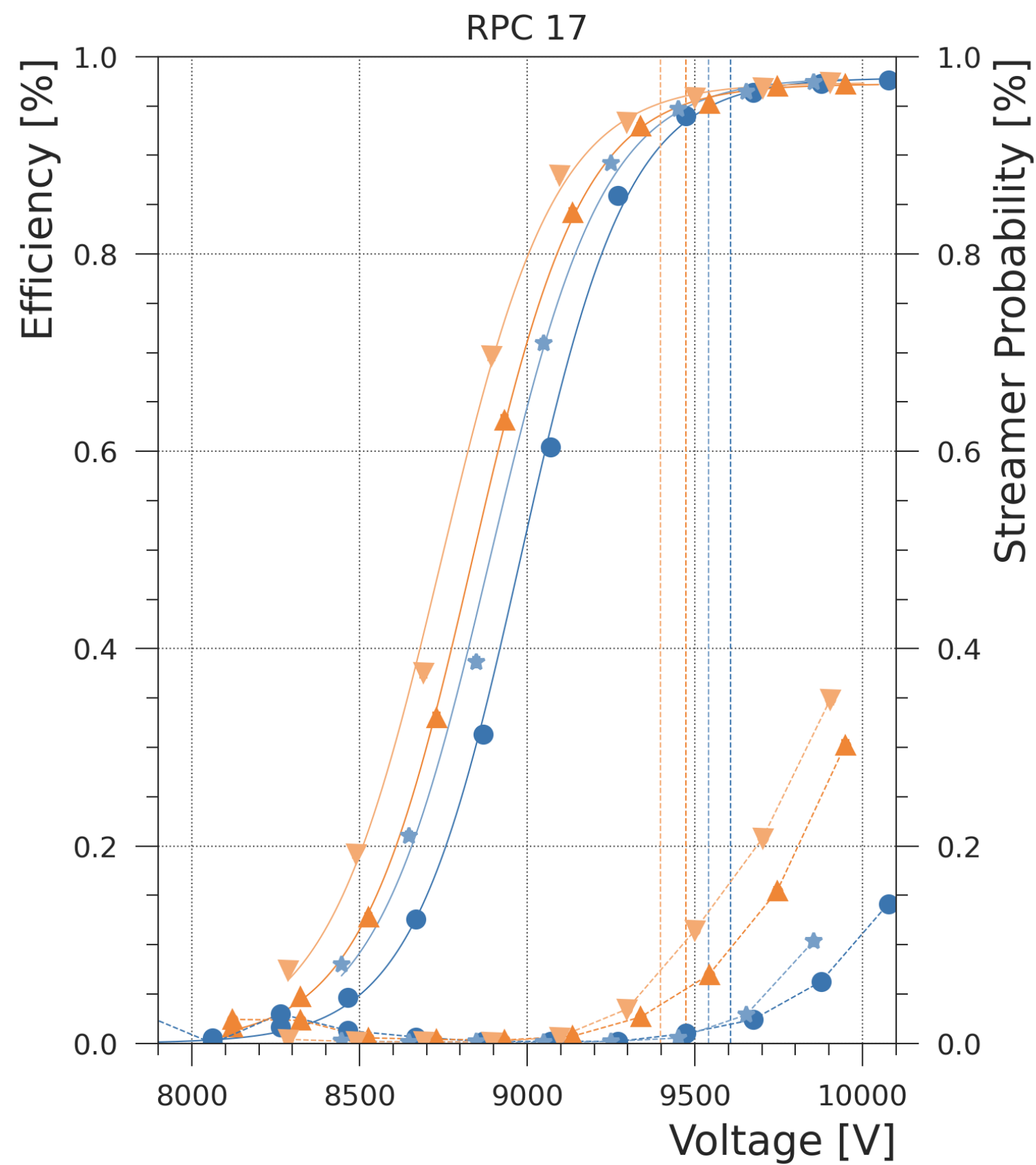
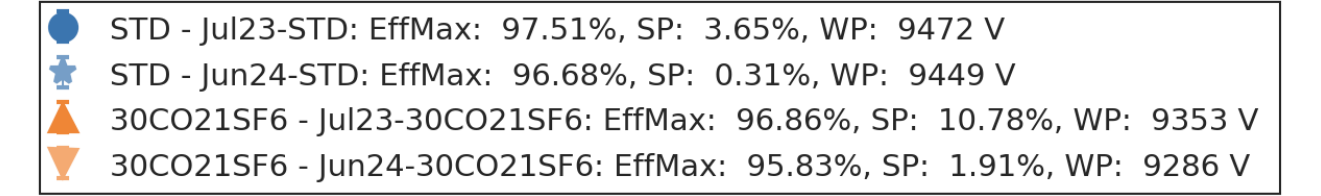
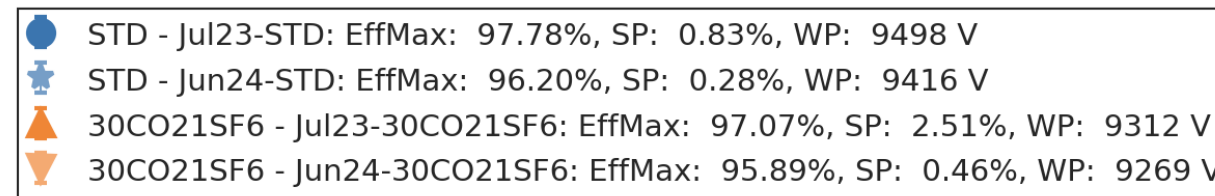
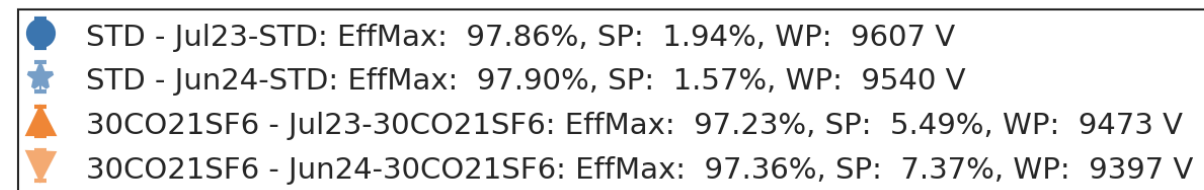


2023/2024 Comparison

Efficiency @Source Off

2023/2024 Comparison

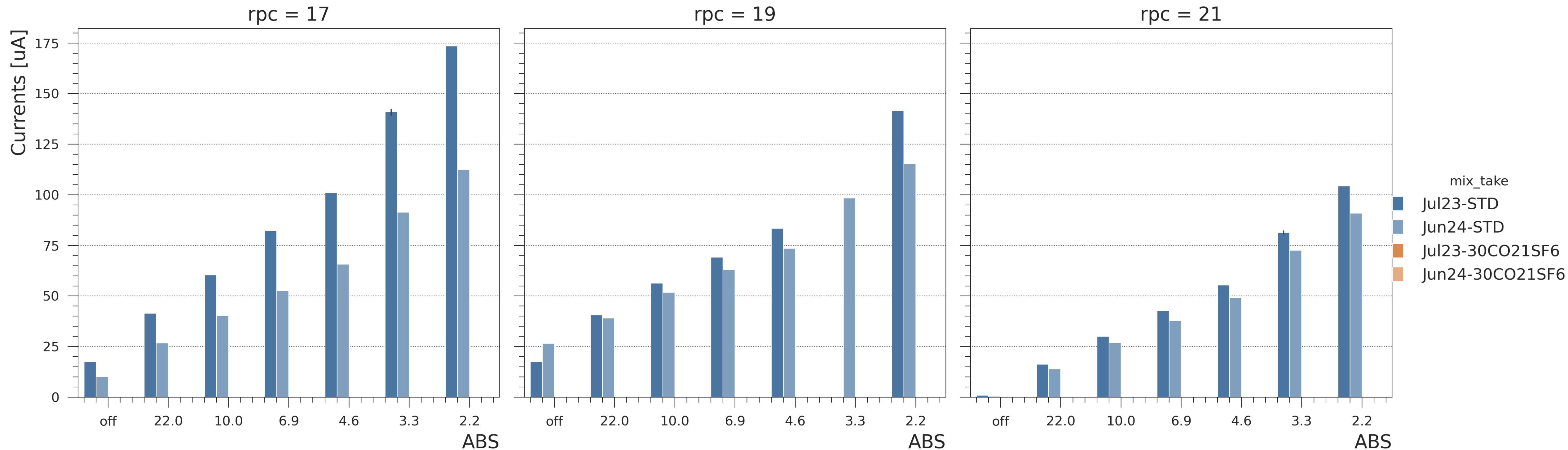
- The efficiency drops by 1-2%, with a small drop in working point and significantly reduced streamer probability.



Currents VS ABS

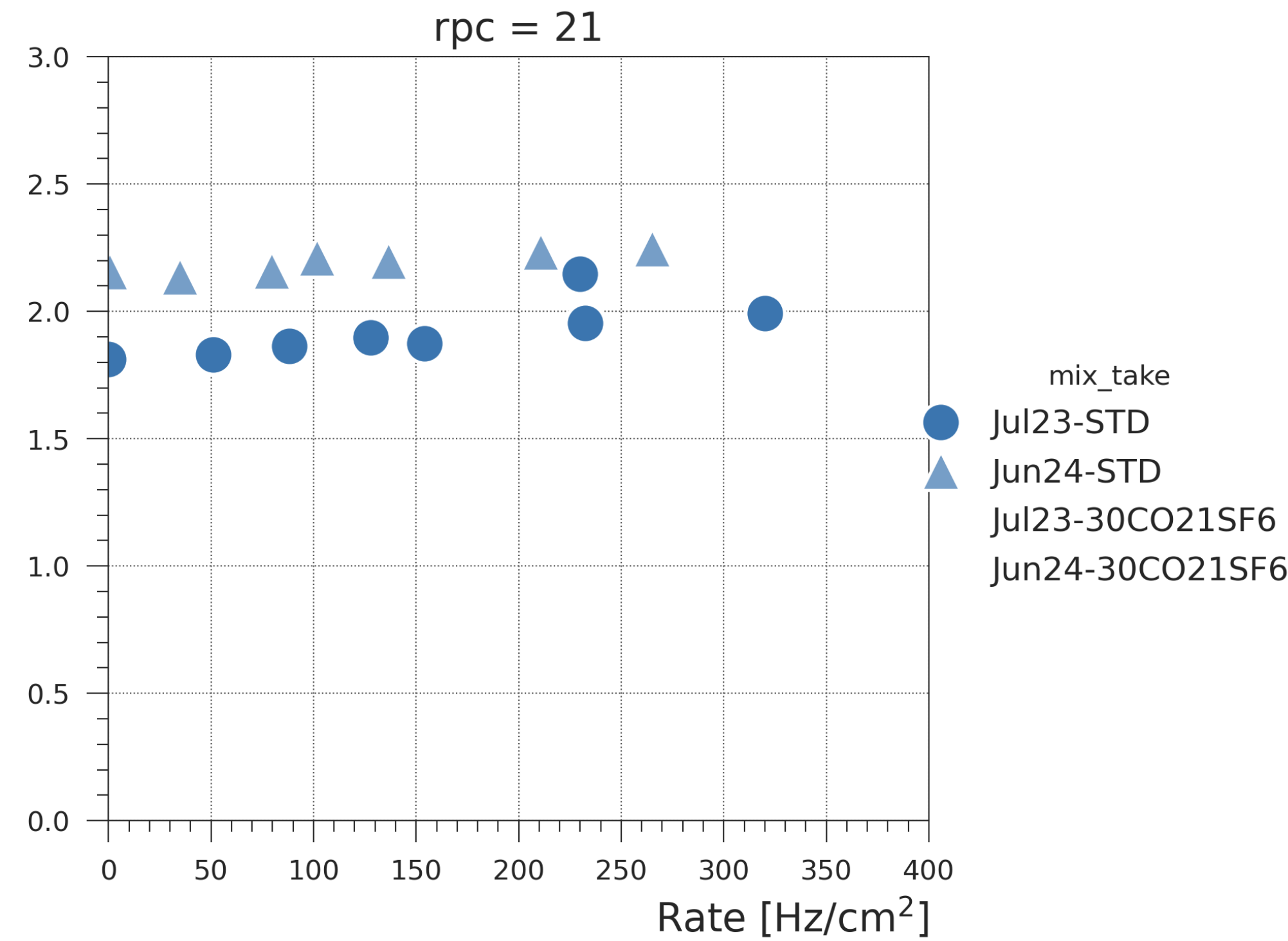
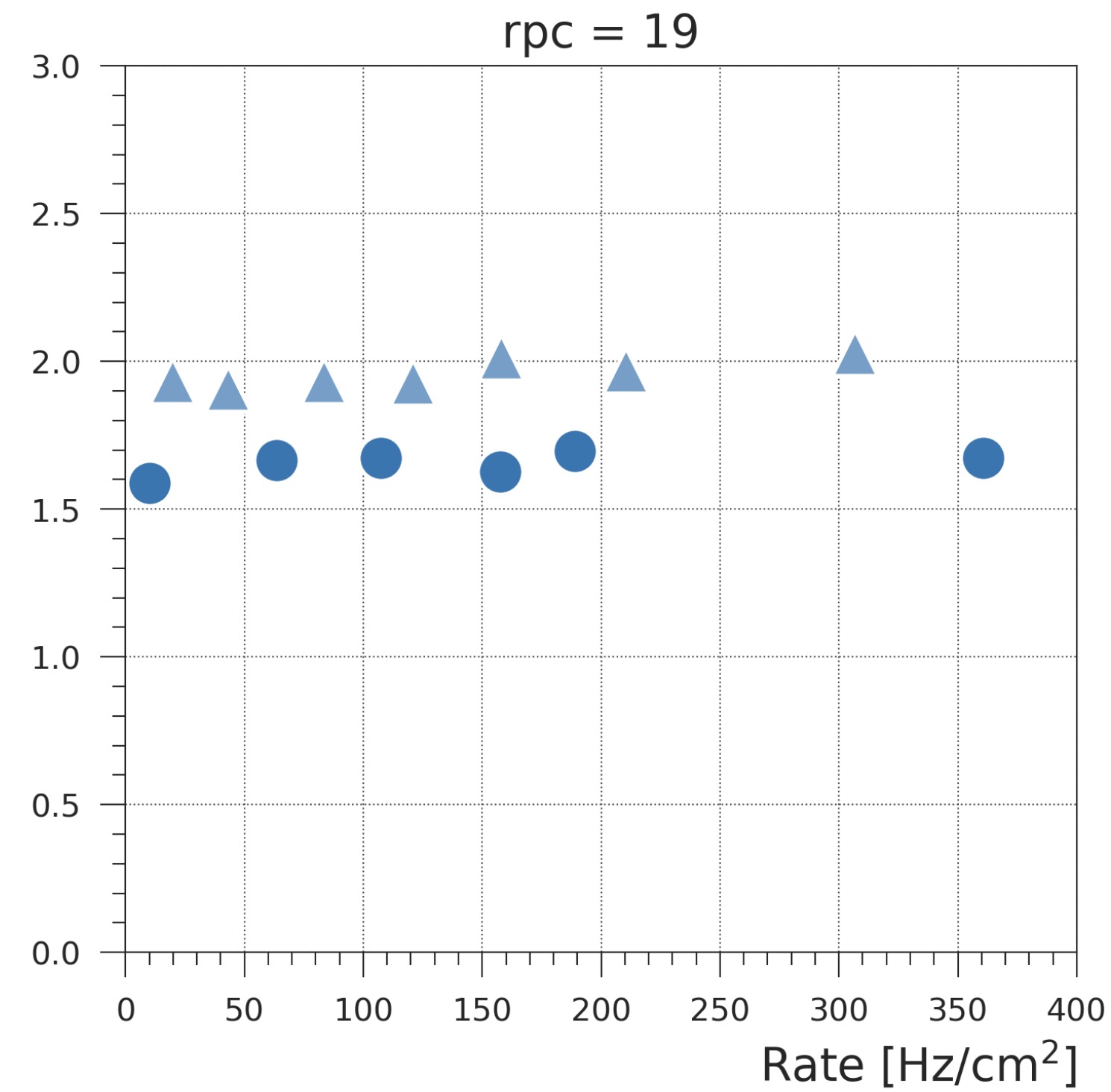
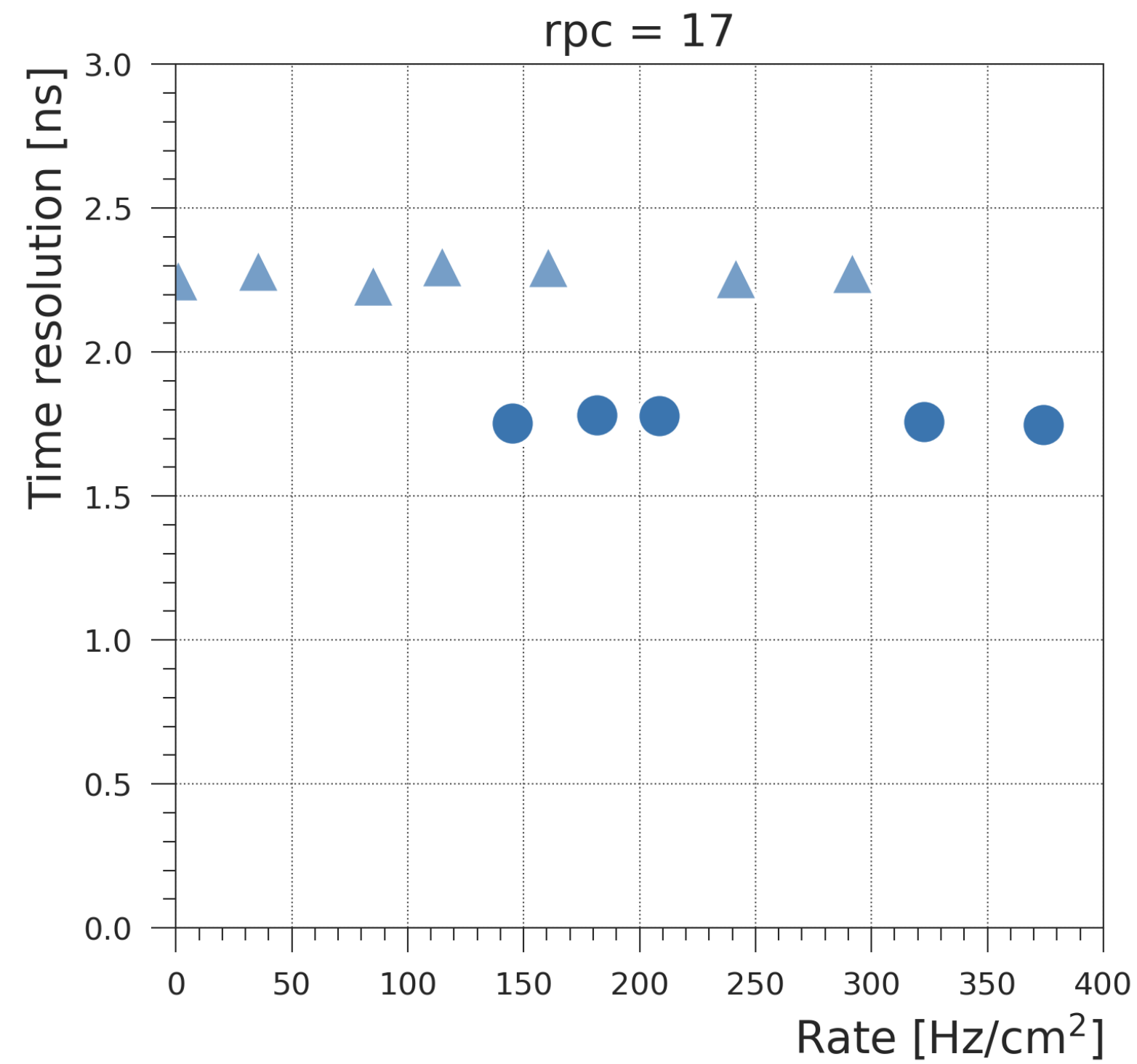
2023/2024 Comparison

- The dose for last year is not available, but the rate was lower this year.
- The currents were lower for all the runs this year for all the GIF detectors that were installed in the previous year.
- For RPC 17, the rate at source off seemed high -> will re-check the data



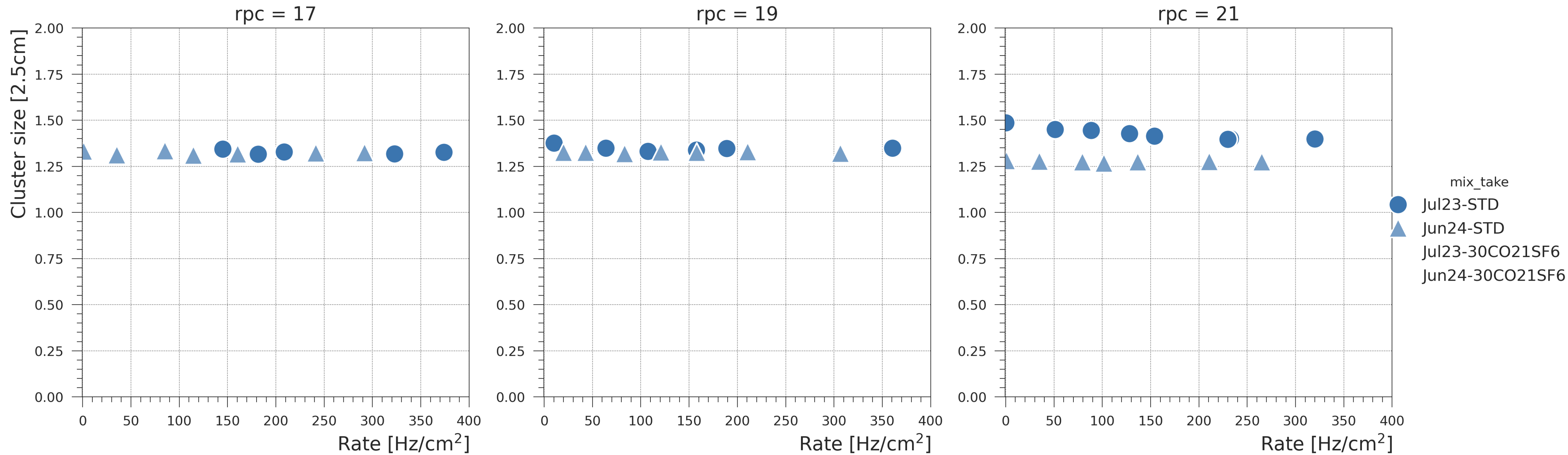
Time Resolution VS Rate

2023/2024 Comparison



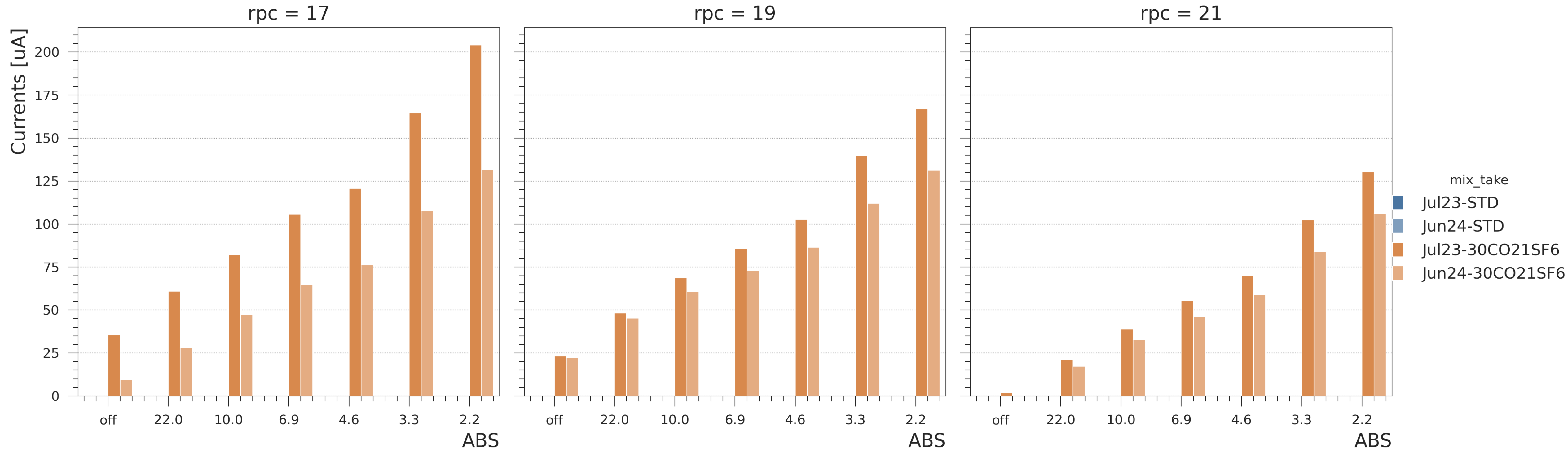
Cluster Size VS Rate

2023/2024 Comparison



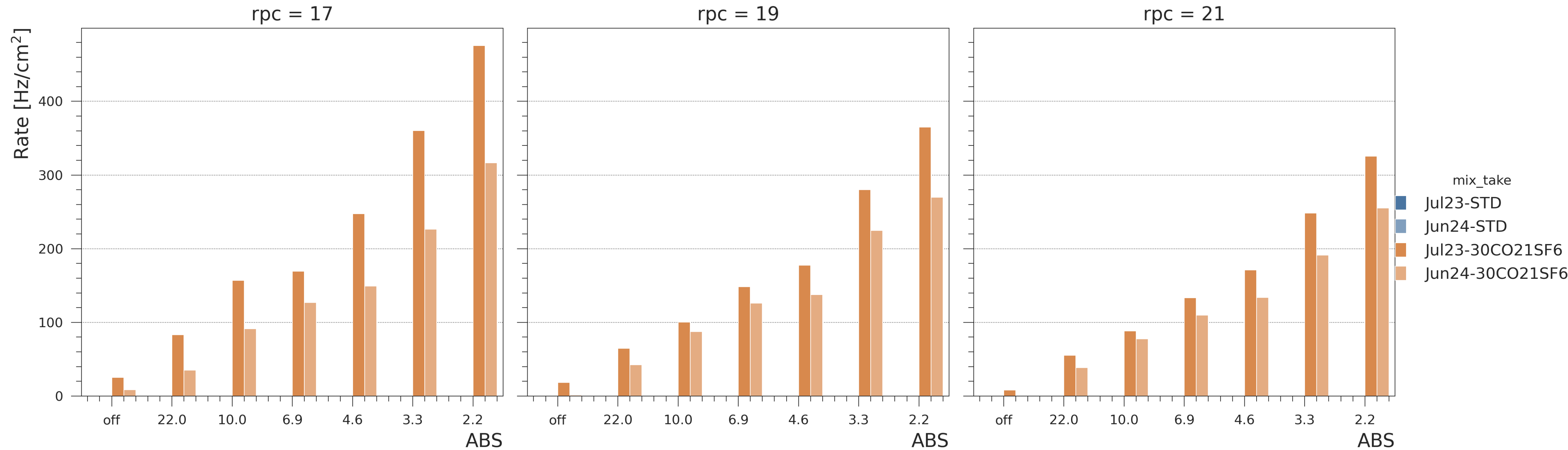
Currents VS ABS

2023/2024 Comparison



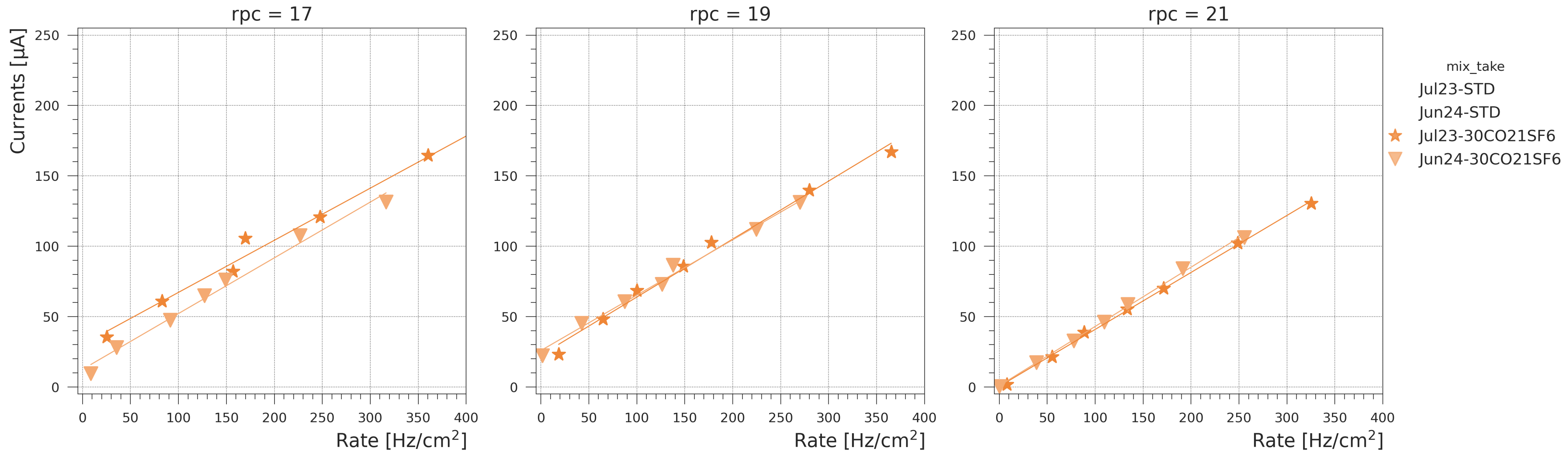
Rate VS ABS

2023/2024 Comparison



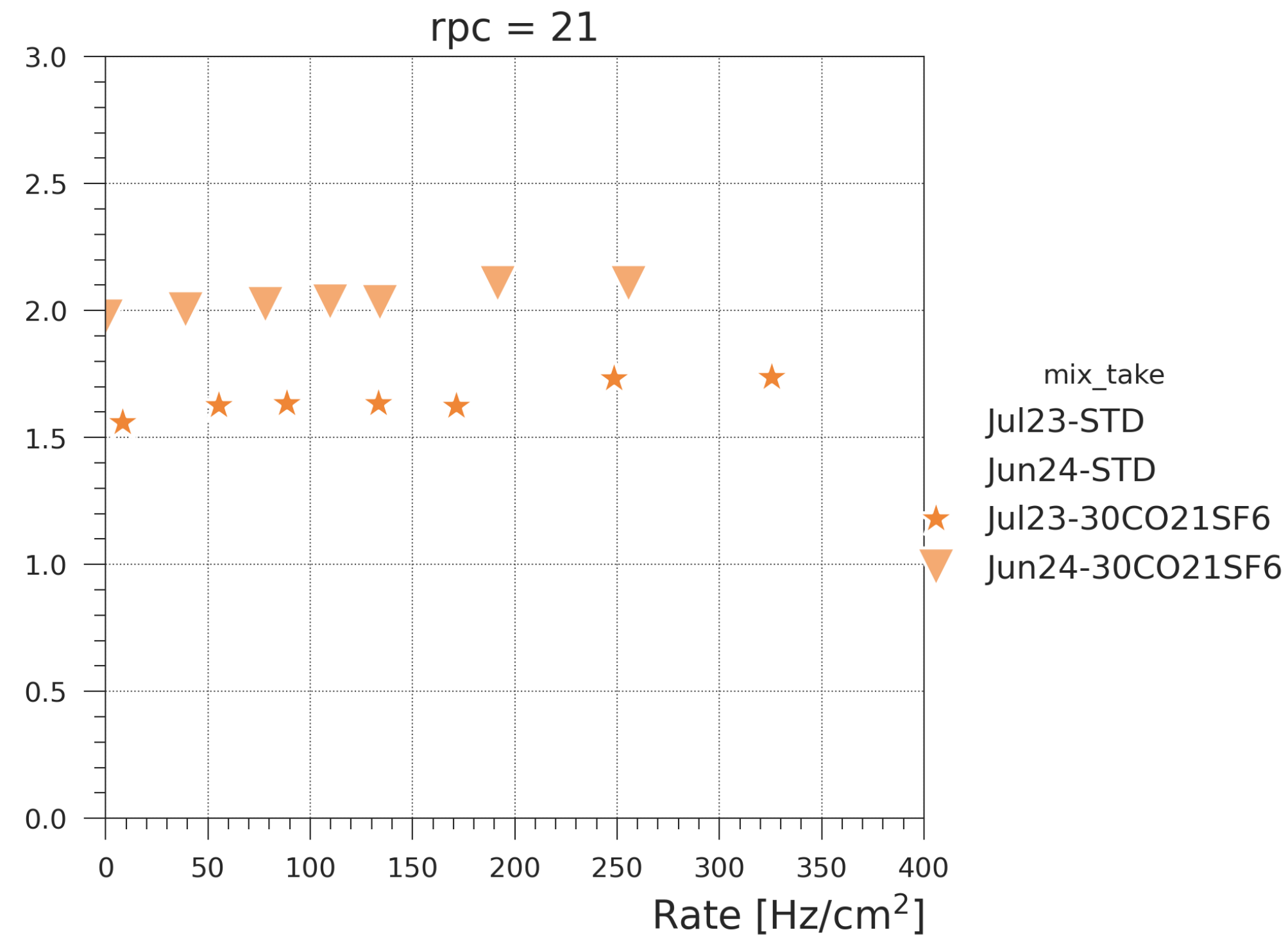
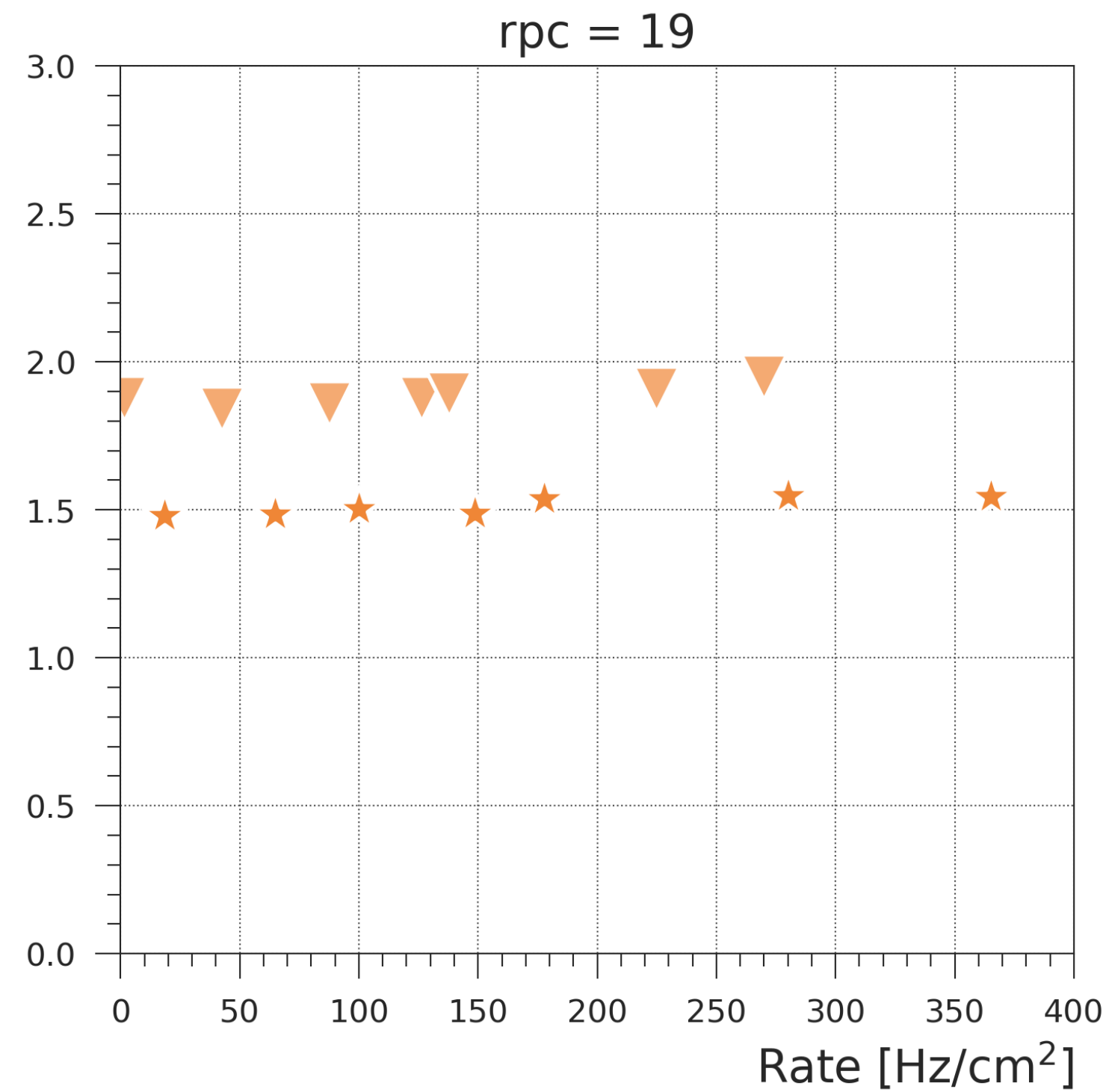
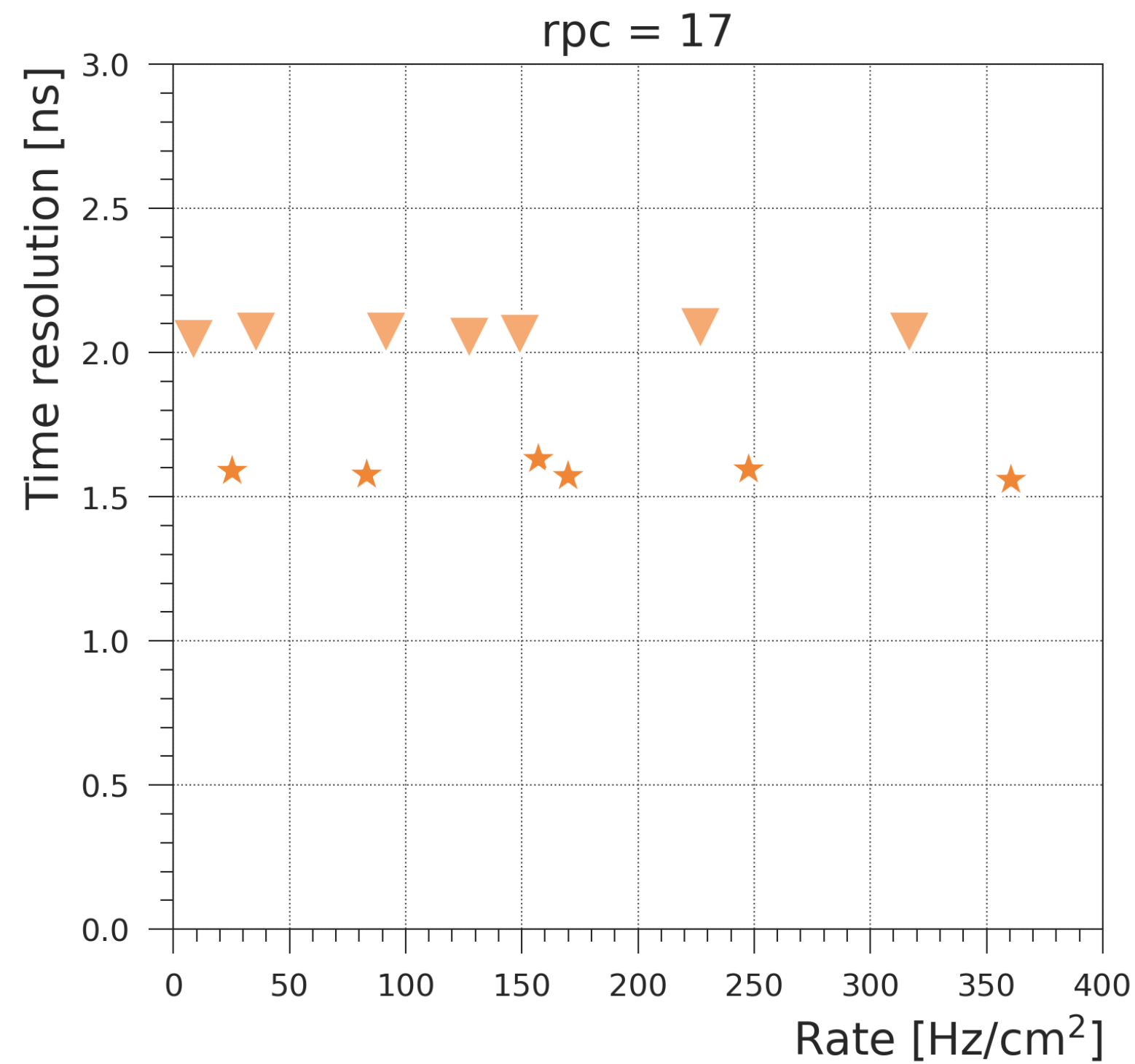
Currents VS Rate

2023/2024 Comparison



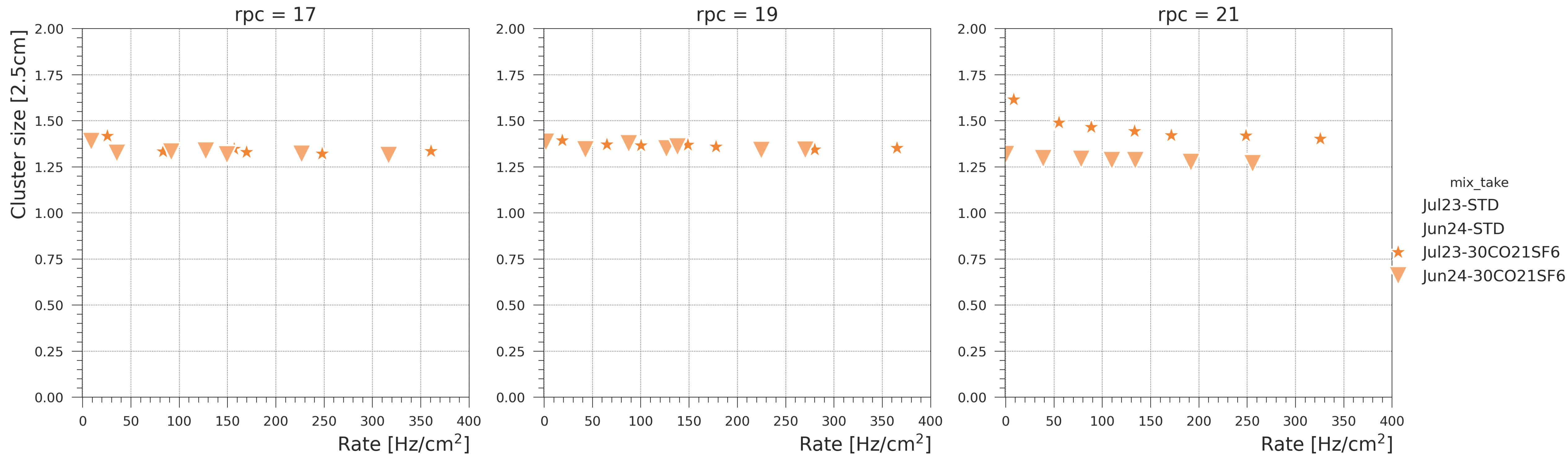
Time Resolution VS Rate

2023/2024 Comparison



Cluster Size VS Rate

2023/2024 Comparison



Problems Encountered & Status

GIF++

- HV Board not working -> replaced and now functional
- HV Controller for the run analysis -> now working
- We ran out space on CERNBox - ghg-studies -> granted an extra 100TB, but there are still some synchronization problems ->> to check

- TO DO:
 - Dose check for the 100Hz/cm² detector
 - Cabling campaign
 - Grafana alarms testing