

Resistivity measurement 2022 and 2023 TB SHiP/LHCb

Giuliana Galati on behalf of the SHiP/LHCb Bari Group

29/04/2024

Introduction

Details about SHiP/LHCb chamber:

- Area: 70x100 cm²
- 1.6 mm thick bakelite electrodes
- Resistivity $\sim 10^{11} \Omega/cm^2$
- 1.6 mm single gas gap
- 2D readout, 32 strips per plane
- Strip pitch ~ 1 cm
- TDC readout

T3 trolley (3m from the source)

Gas Mixtures:

Std: 95.2% R134a-4.5% iC₄H₁₀-0.3%SF₆

eco2: 35% HFO-60% CO₂-4 % iC₄H₁₀-1% SF₆

eco3: 25% HFO- 69% CO₂- 5% iC₄H₁₀- 1% SF₆

$$\mathcal{E}(HV_{\text{eff}}) = \frac{\mathcal{E}_{\text{max}}}{1 + e^{-\beta(HV_{\text{eff}} - HV_{50})}}$$

where \mathcal{E}_{max} is the asymptotic value of the logistic function fitted; β describes the steepness of the curve; HV_{50} sets the voltage at which the chamber efficiency reaches 50%.

WP is defined as the HV_{eff} value at which the 2D efficiency reaches 95% of the asymptotic value approached by the logistic function

Integrated charge at TB 7/2023: 110 mC/cm²

ABS used in this analysis:

OFF	Used for 2023 plots and 2023-2022 comparison
100	available
69	
22	
10	
6.9	
4.6	
3.3	
2.2	
1	

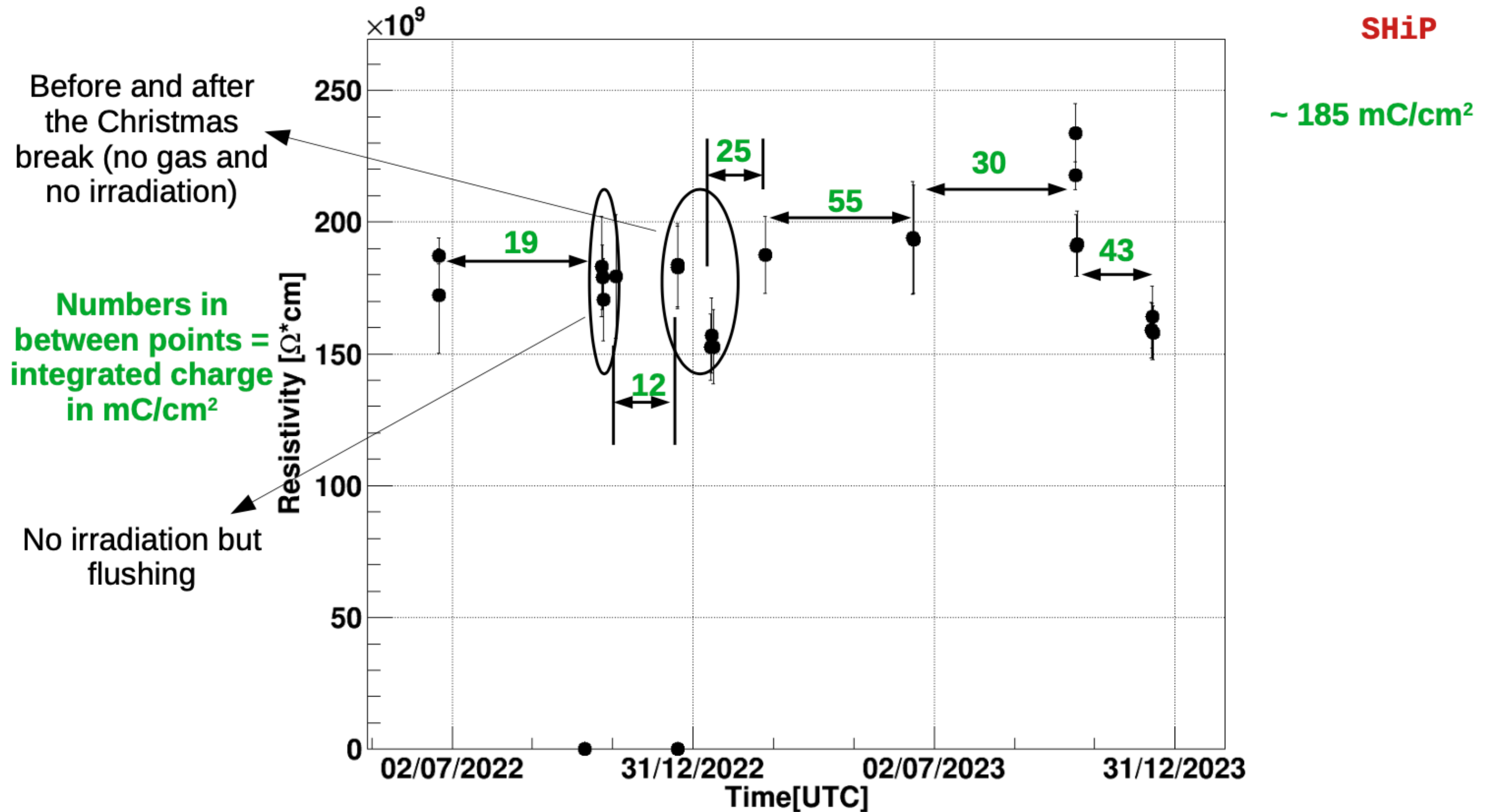
Summary formulas

$$R = \frac{\rho \cdot 2 \cdot s}{A}$$

- R = Resistance
- ρ = resistivity
- s = thickness = 0.16 cm
- A = area = 7000 cm²

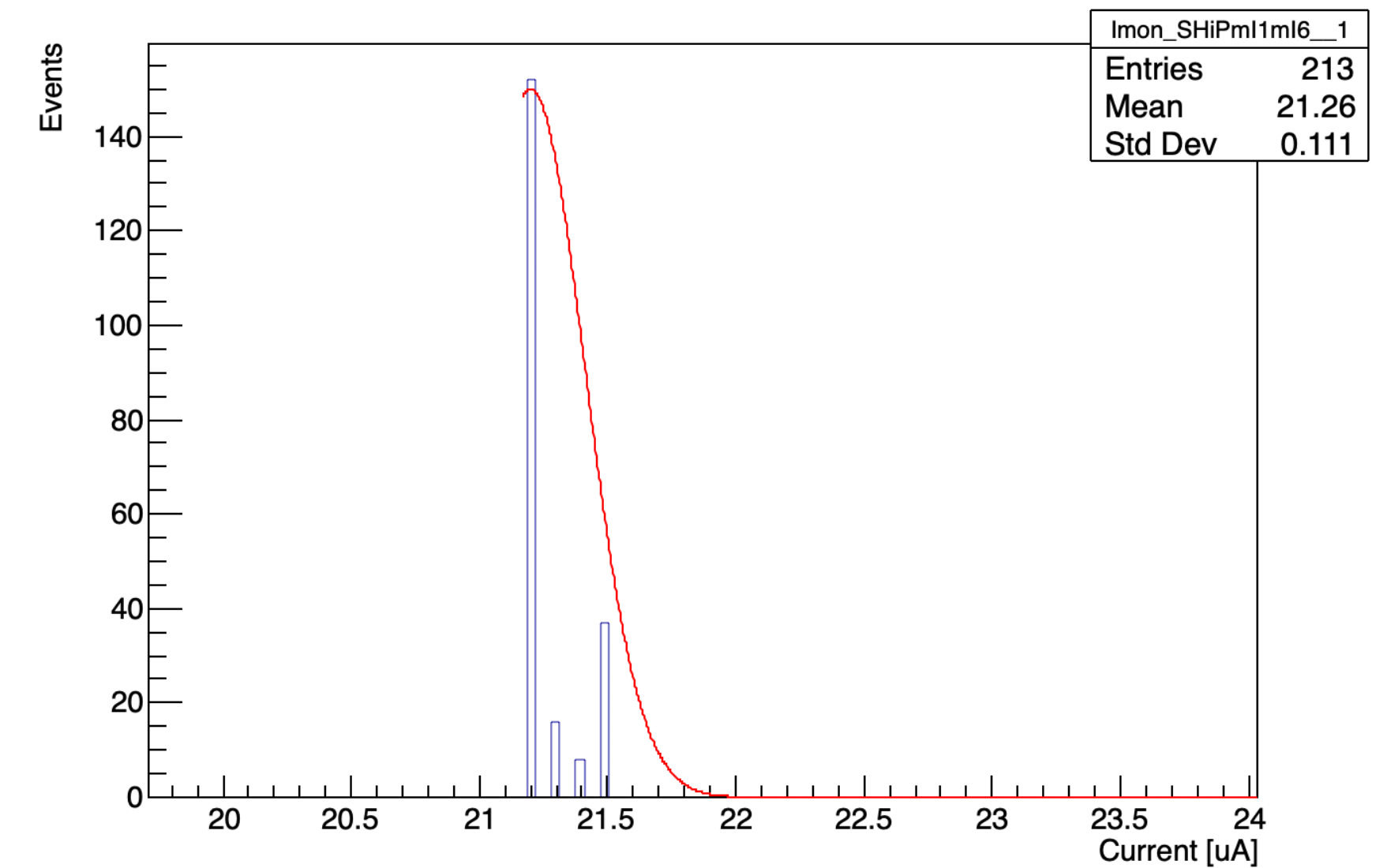
$$HV_{gas} = HV_{eff} - R \cdot I$$

Resistivity measured in Argon (see Luca's talk on 22/02/2024)



What's new

- Bug correction in the evaluation of out of spill current (some fit at HV50 were not good) —> small differences anyway
- Improvement of fits for particular cases at HV50 [e.g. half gaussian fit] —> small differences anyway
- Investigating Davide's Suggestion: use current IN spill to see if values are in better agreement with Argon measurements



SHiP Resistivity (HV50) with current out of spill

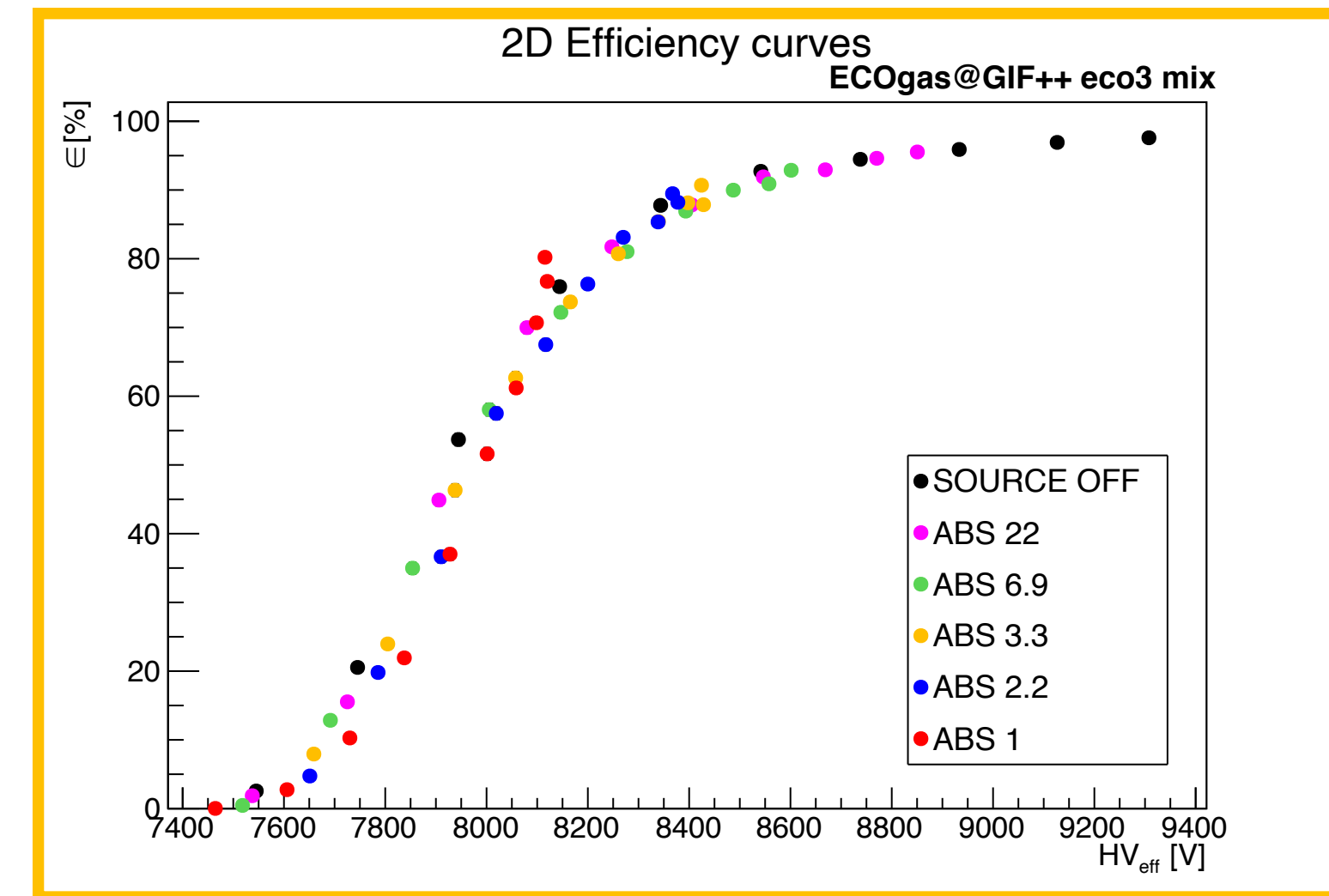
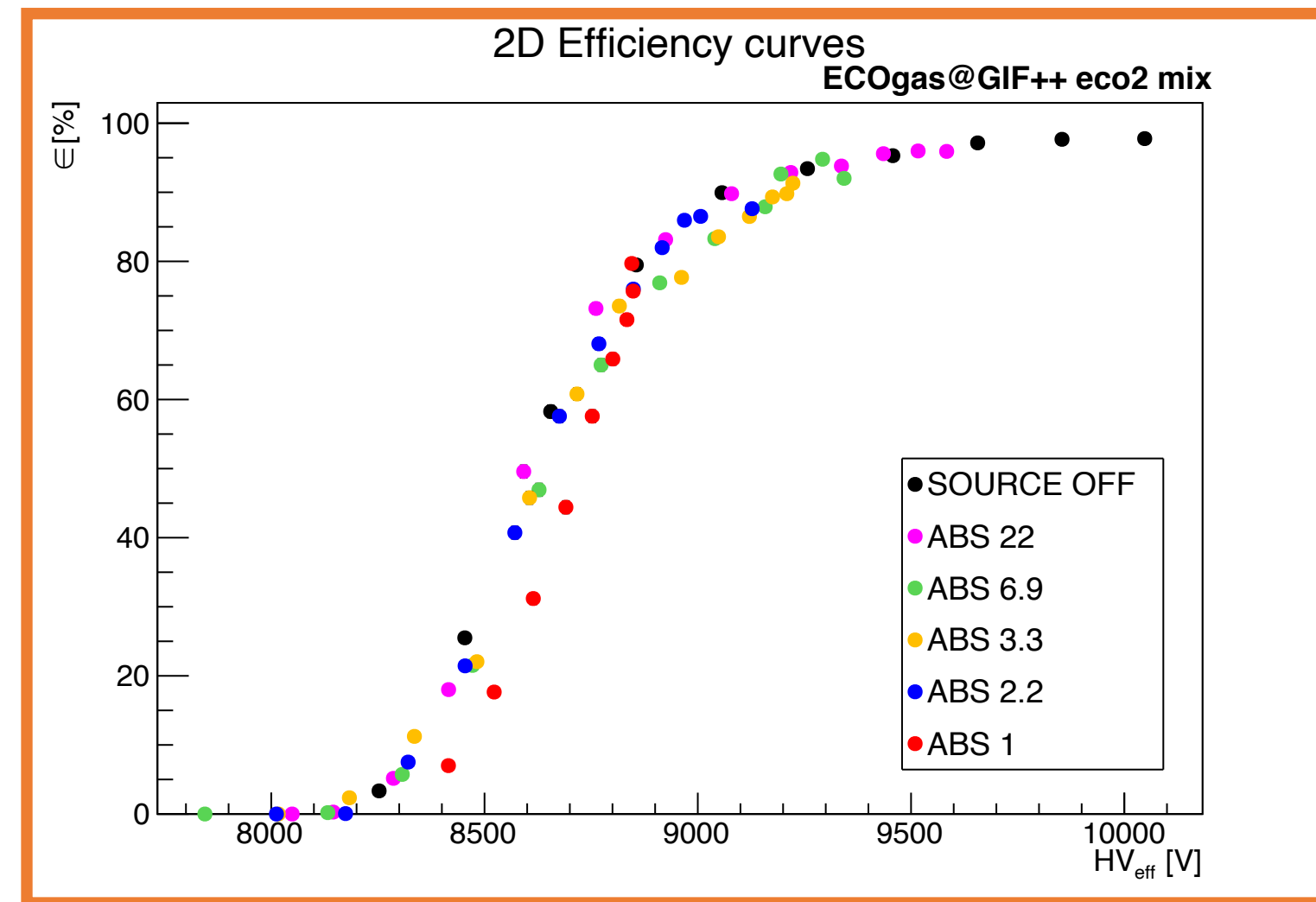
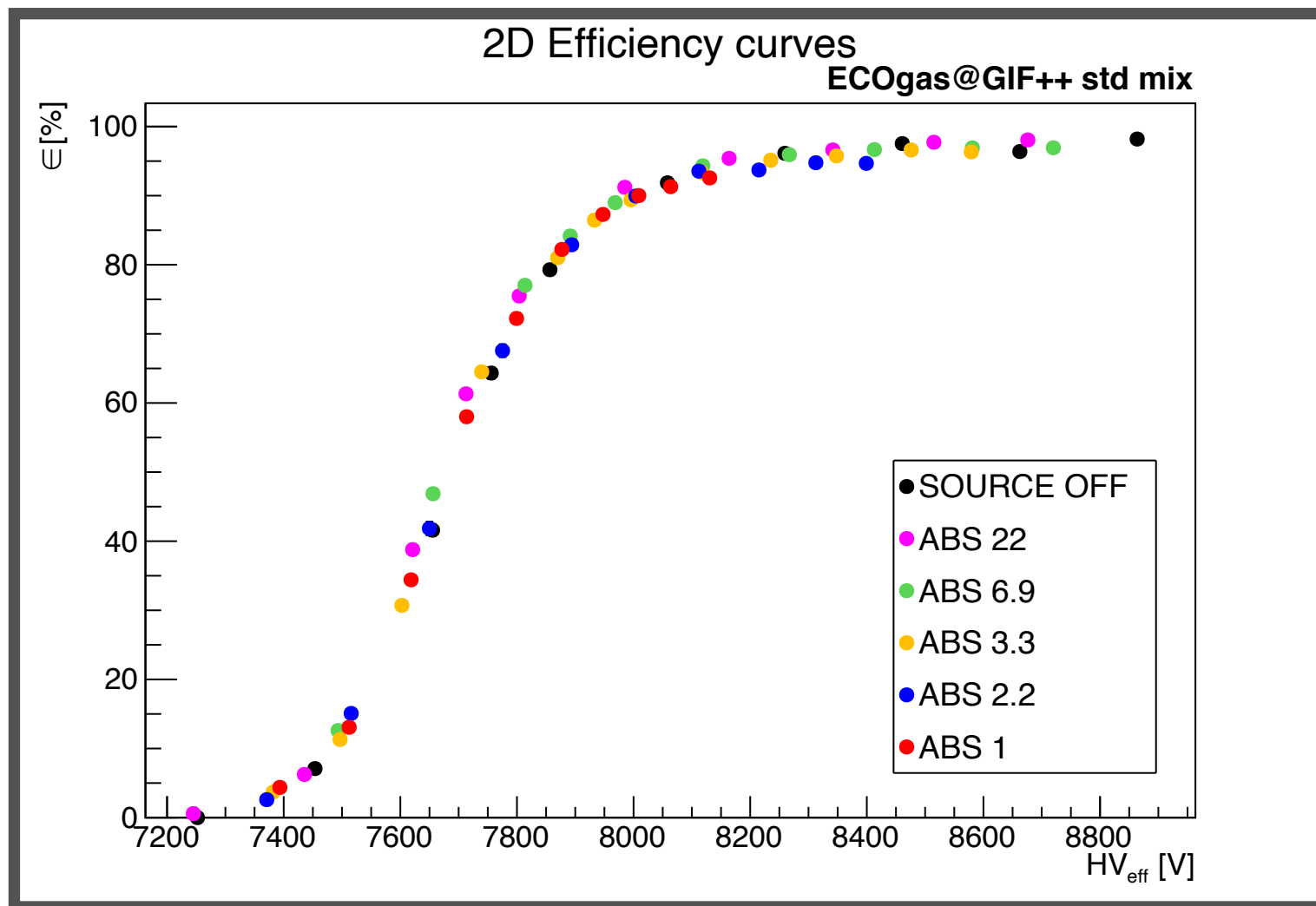
	rho (10 ¹¹ Ohm/cm)						Argon rho (10 ¹¹ Ohm/cm) [*]		Ratio
	std mix	eco2	eco3	Mean	Error		Mean	Error	
07/2022	0.35	0.38	0.36	0.36	0.02		1.87	0.03	0.19
07/2023	0.51	0.50	0.49	0.50	0.01	13.7%	1.93	0.03	0.26

Procedure:

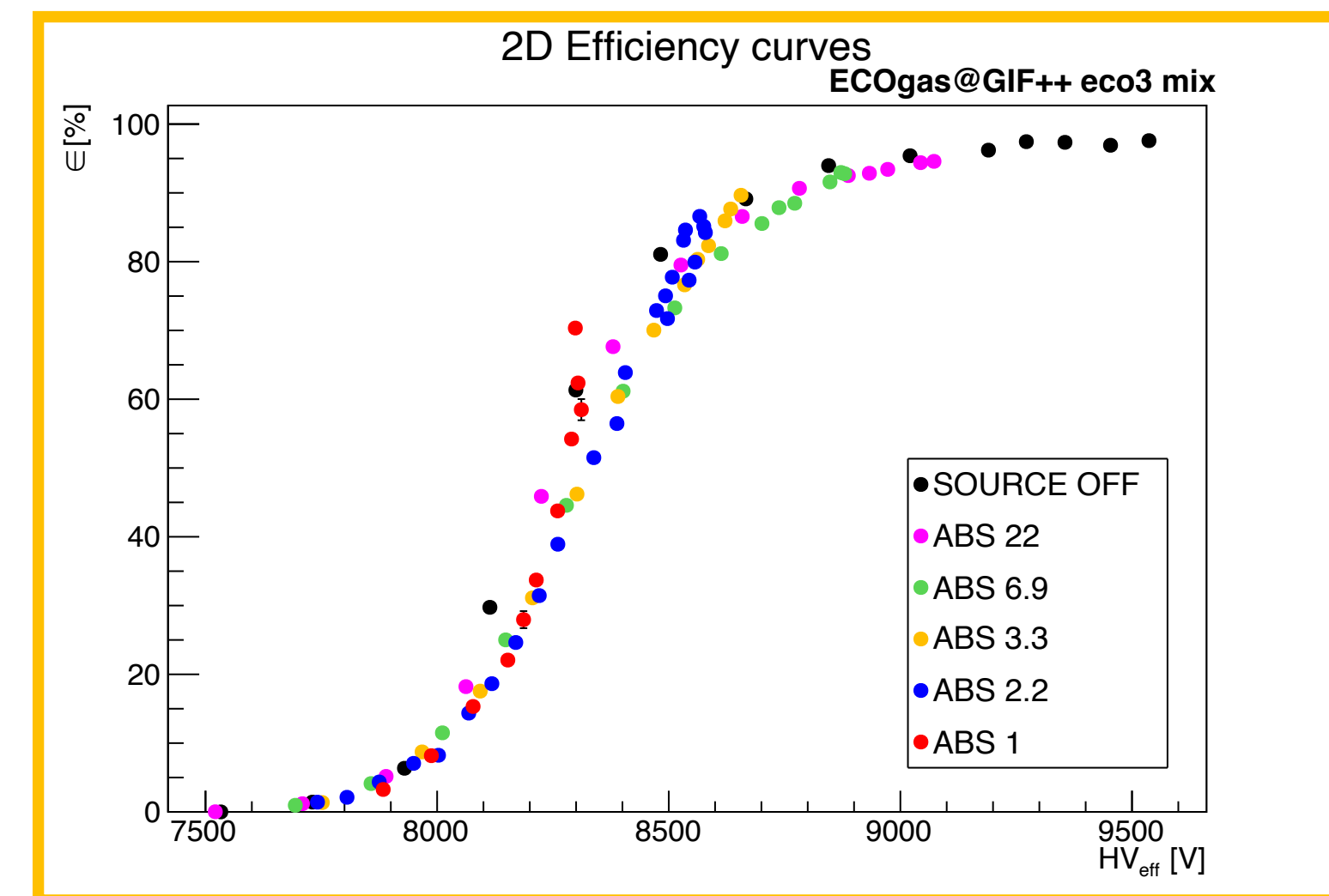
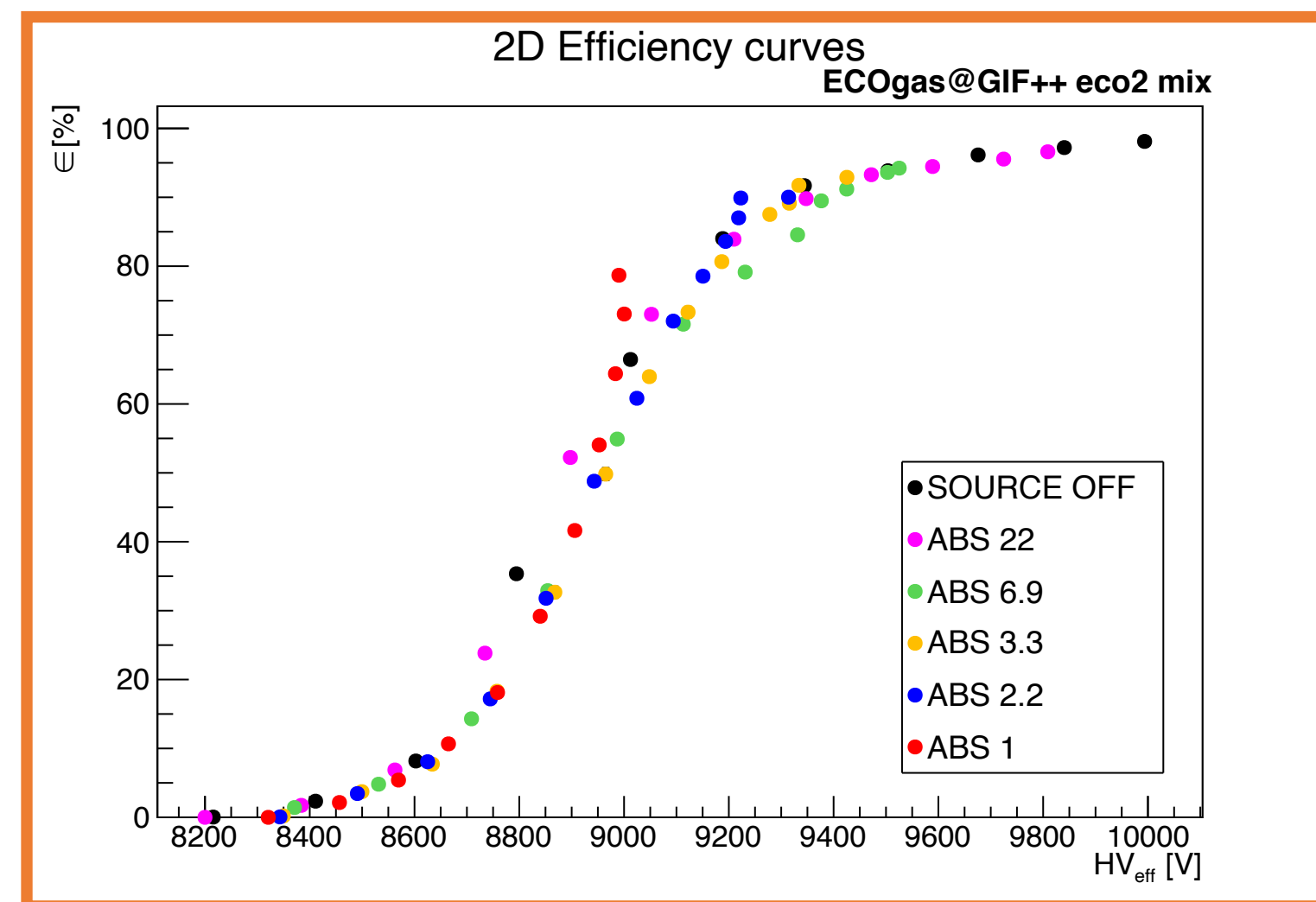
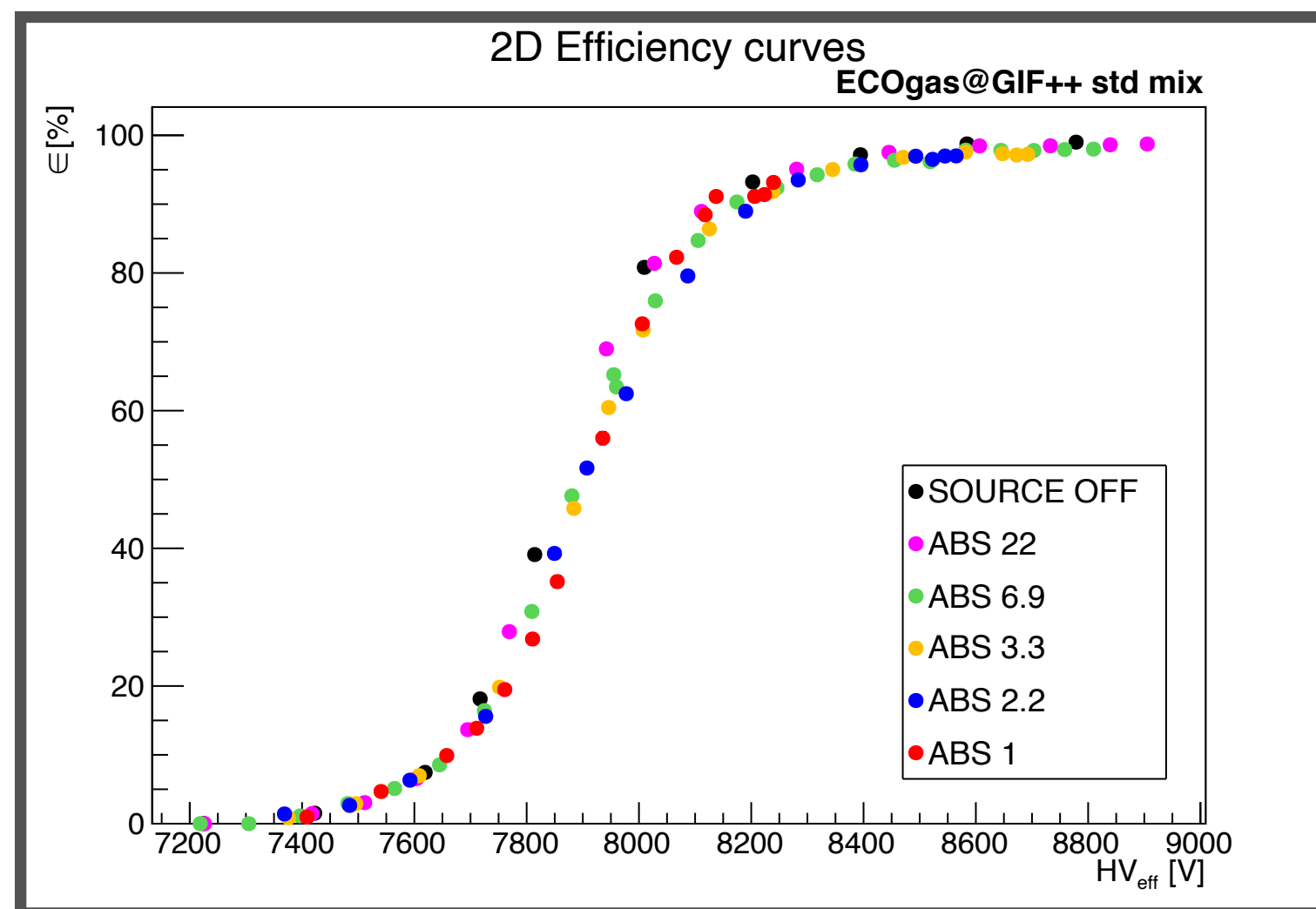
- I evaluate the variance of HV_{gas} at HV50 (parameter taken from the logistic fit) for selected ABS (1, 2.2, 3.3, 6.9, 22, OFF) changing ρ with steps of $0.01 \cdot 10^{11}$ Ohm/cm
- I take the lowest variance for each gas mix and I do the mean. The error is the half-range of the three results

[*] Results for Argon measurements are taken by eye from the plot

2022 TB - $\rho = 0.36 \cdot 10^{11}$ Ohm/cm

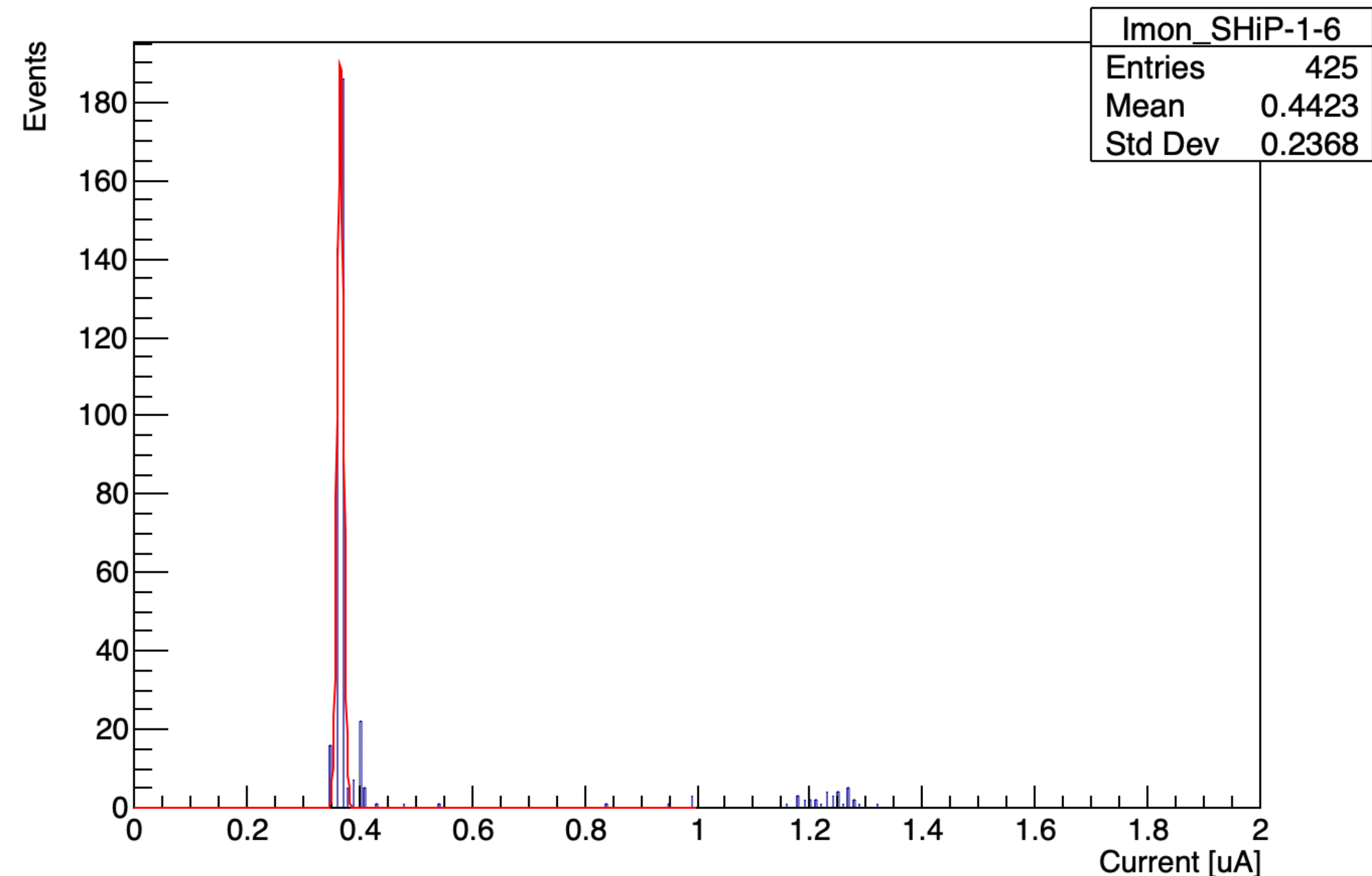


2023 TB - $\rho = 0.50 \cdot 10^{11}$ Ohm/cm



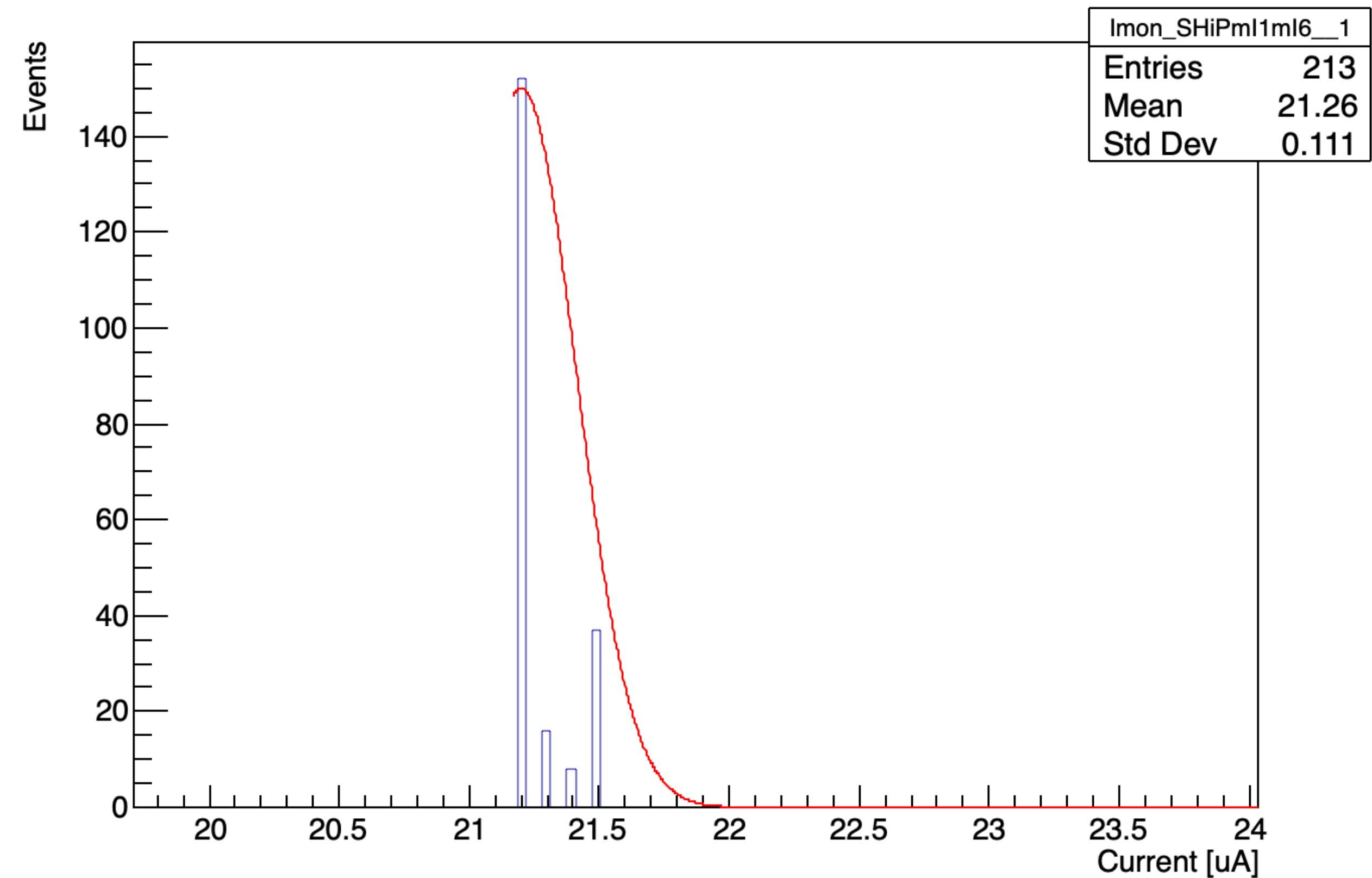
Current out of spill measurement

- Gaussian fit around the higher peak to get out of spill current
- Mean of values > 3 sigma (or 1 sigma)
- If there are no entries > 3 sigma (or 1 sigma) the same value of out of spill fit is used
- Problem 1: in cases like this one the peak at 0.4 μA has large impact on the mean value, which is ~ 0.8 μA , while looking by eye the in spill current is ~ 1.3 μA

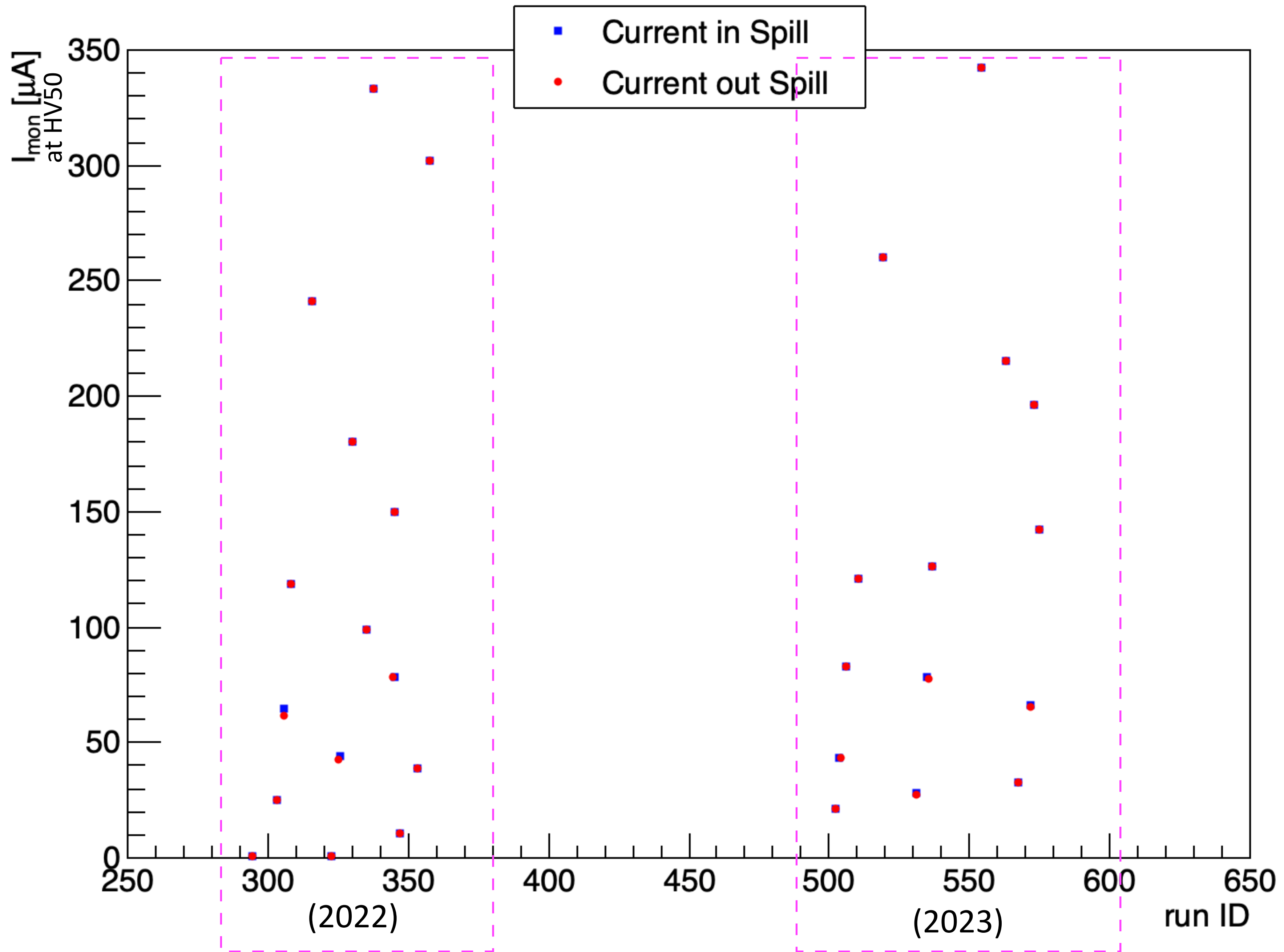


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- Problem 2: In this example current in spill is 21.5 μA ?

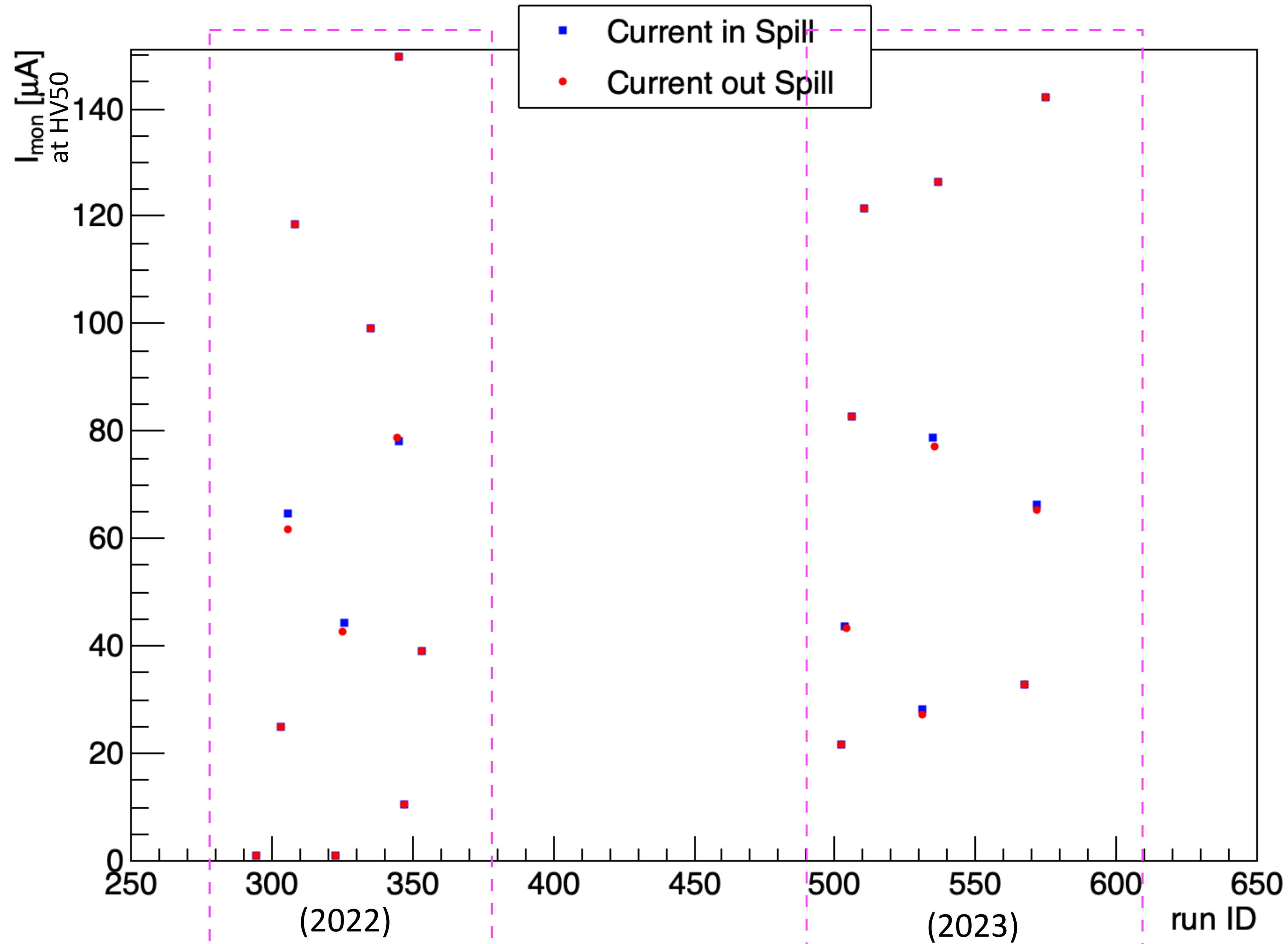


Difference between current in spill and out of spill



out of spill > 3 sigma

Difference between current in spill and out of spill (zoom)



out of spill > 3 sigma

SHiP Resistivity (HV50) with current in spill (3sigma)

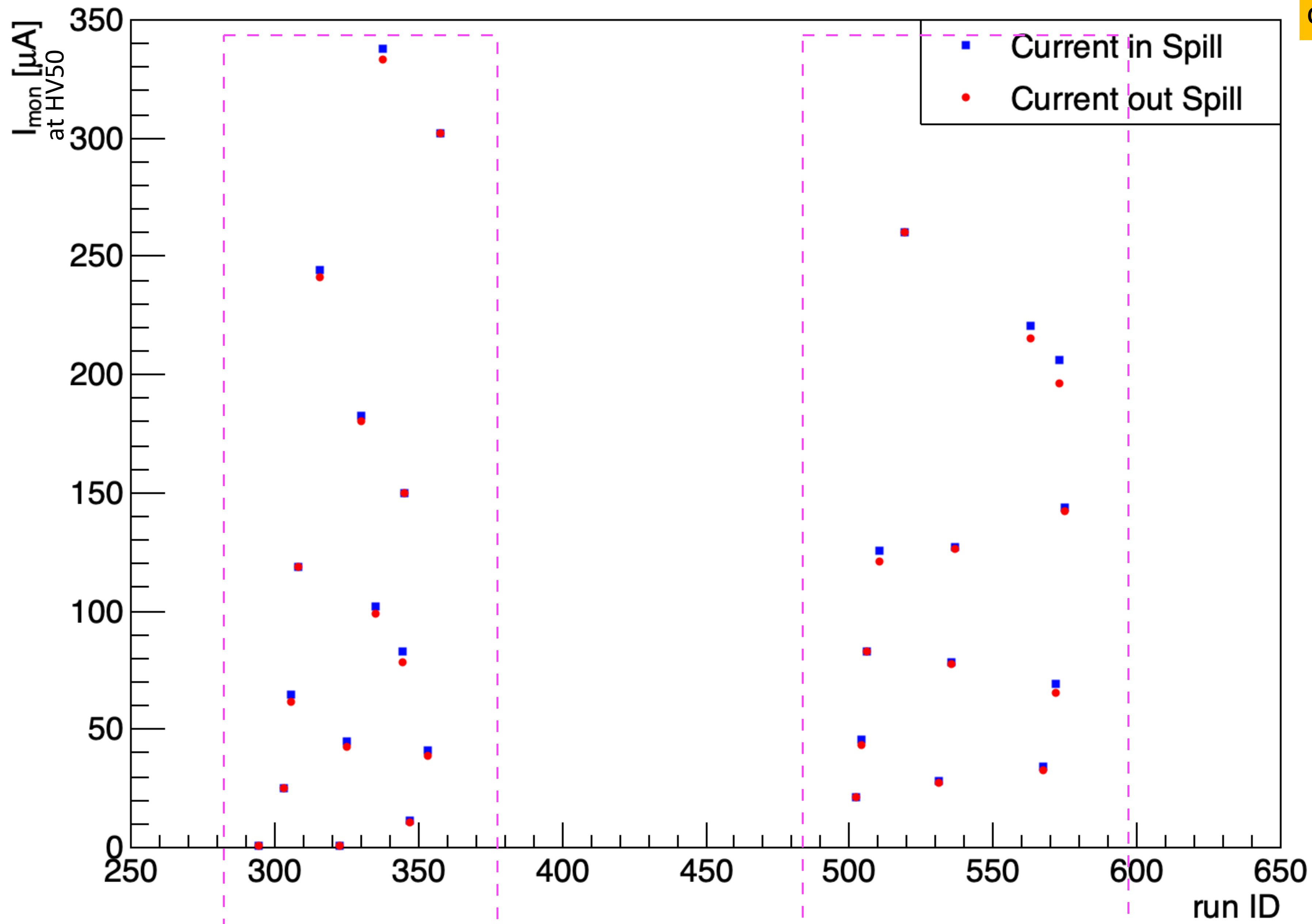
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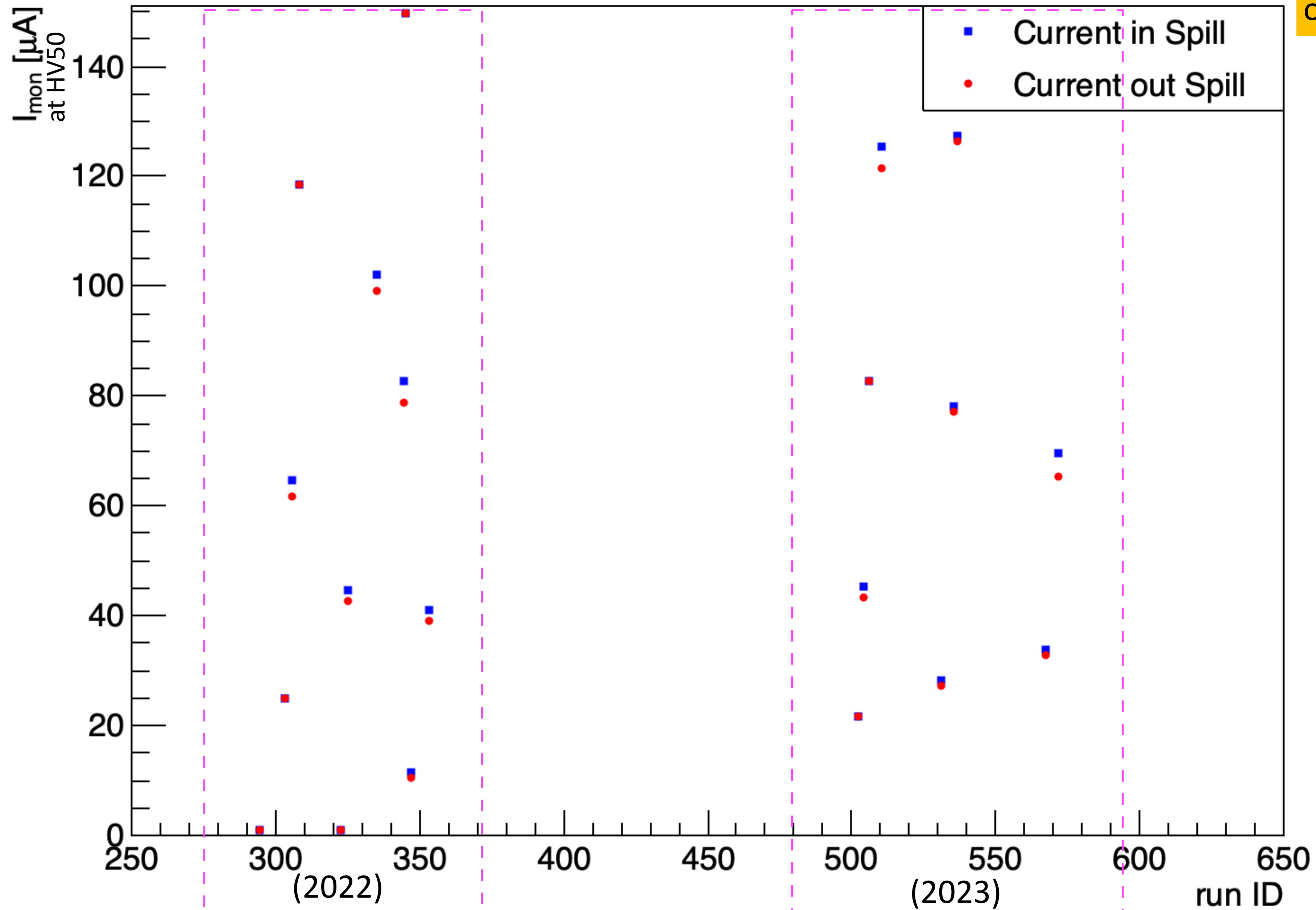
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Difference between current in spill and out of spill



out of spill > 1 sigma

Difference between current in spill and out of spill (zoom)



out of spill > 1 sigma

SHiP Resistivity (HV50) with current in spill (1sigma)

	rho (10 ¹¹ Ohm/cm)						Argon rho (10 ¹¹ Ohm/cm) [*]		Ratio
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Conclusions

- After bug corrections, resistivity value is consistent with previous one within the error
- No significant differences in using current IN or OUT of spill for resistivity measurements