

Resistivity measurement 2022 and 2023 TB SHiP/LHCb

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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	

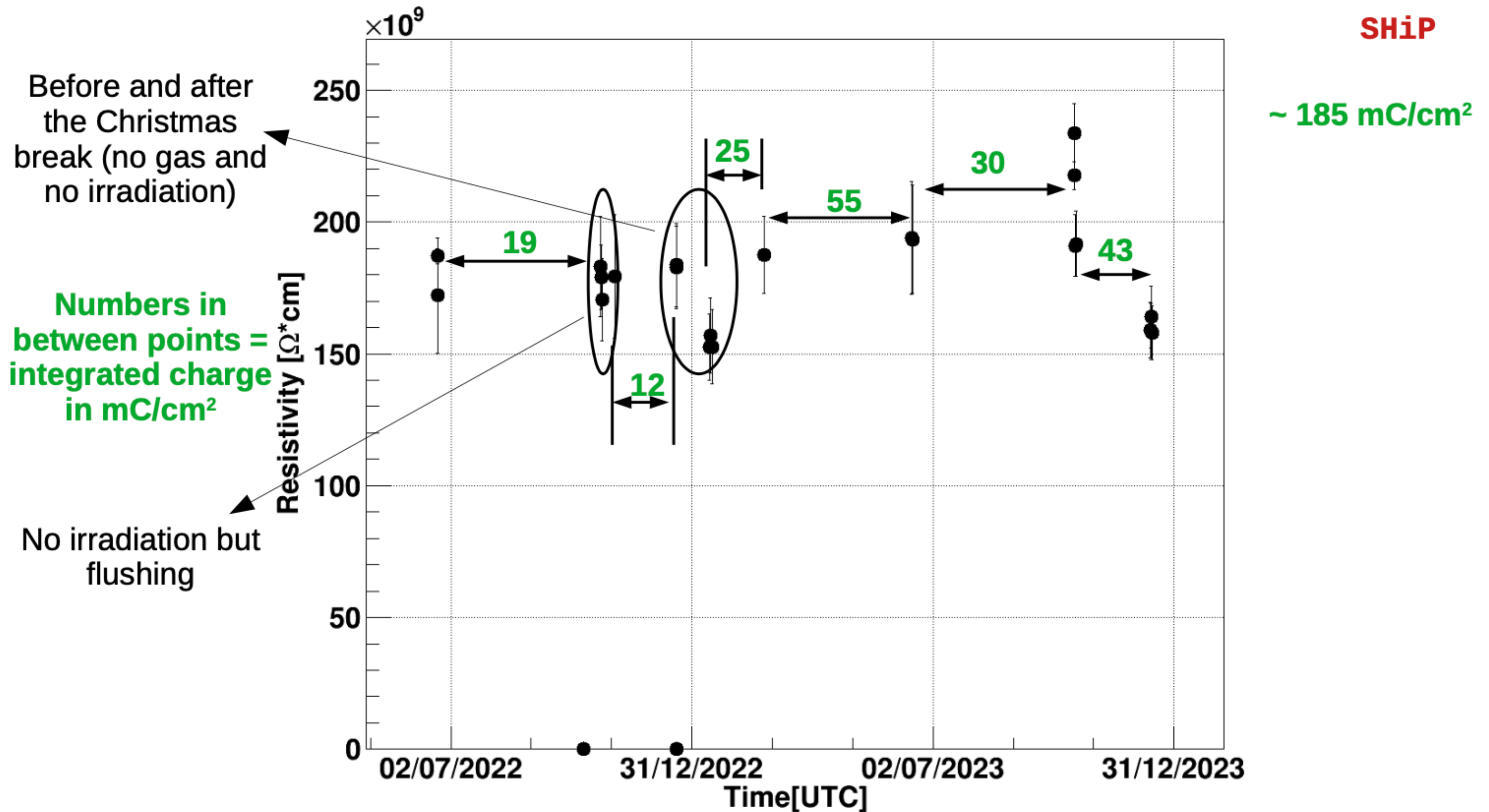
Summary formulas

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

- 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)



SHiP Resistivity (HV50)

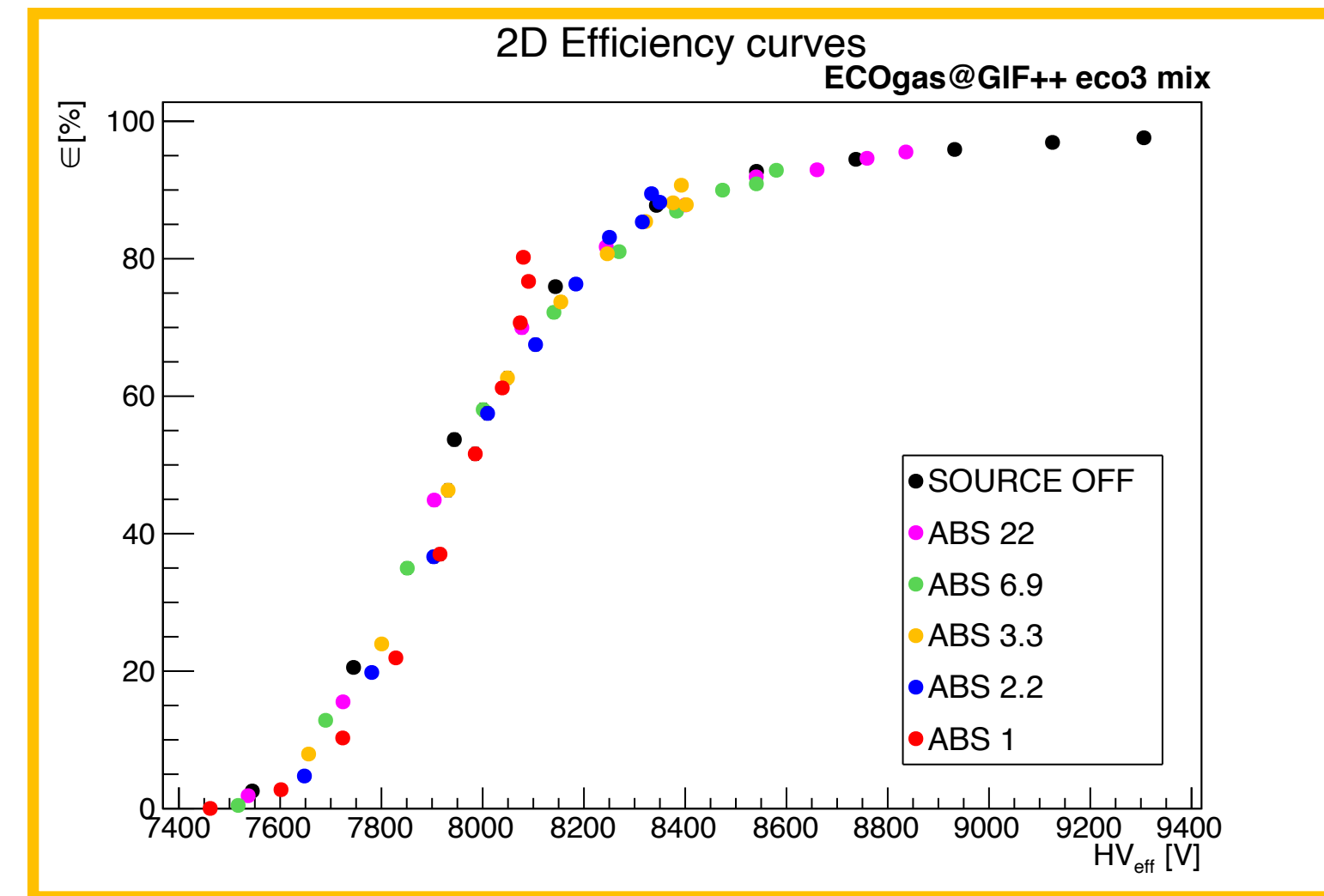
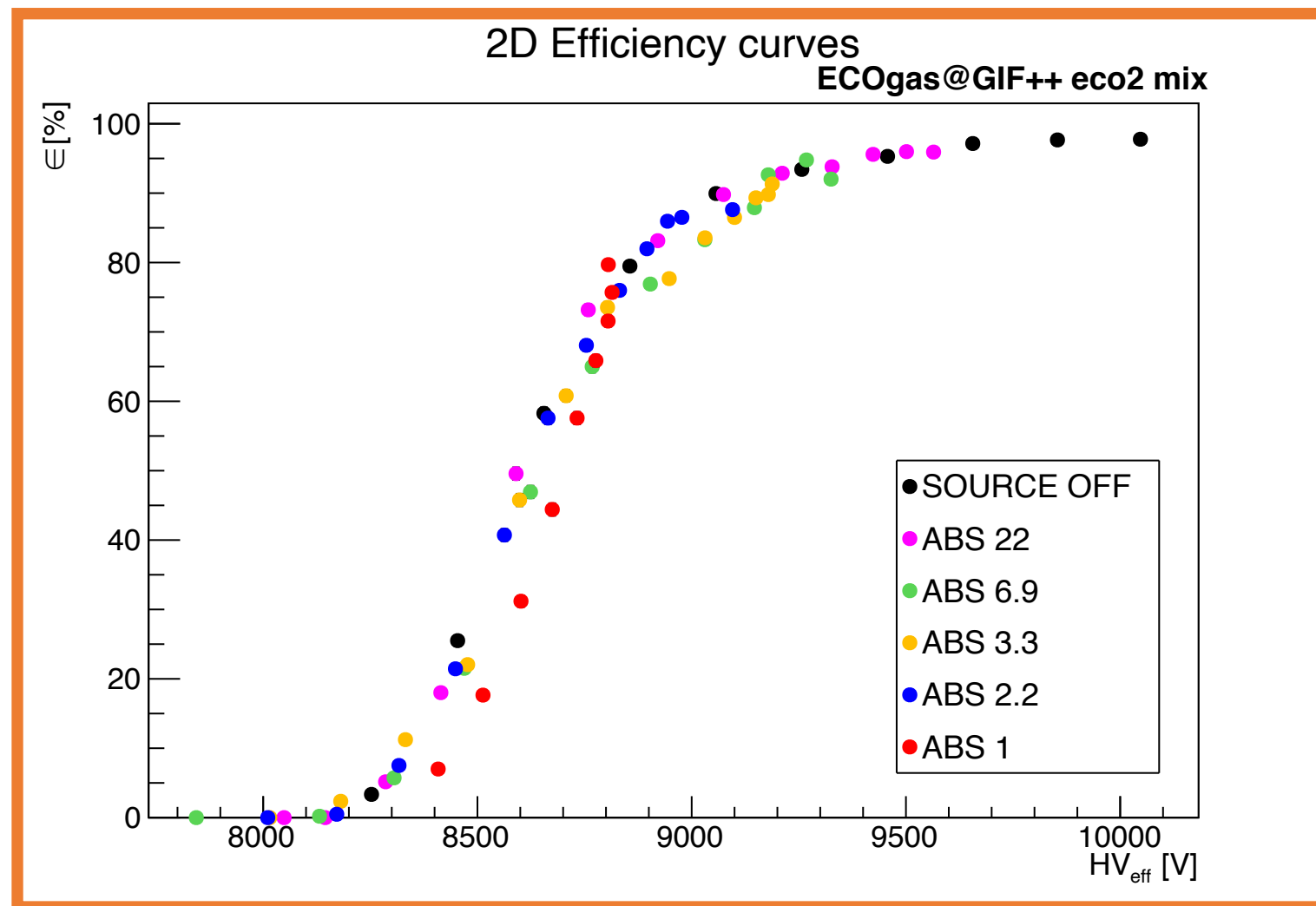
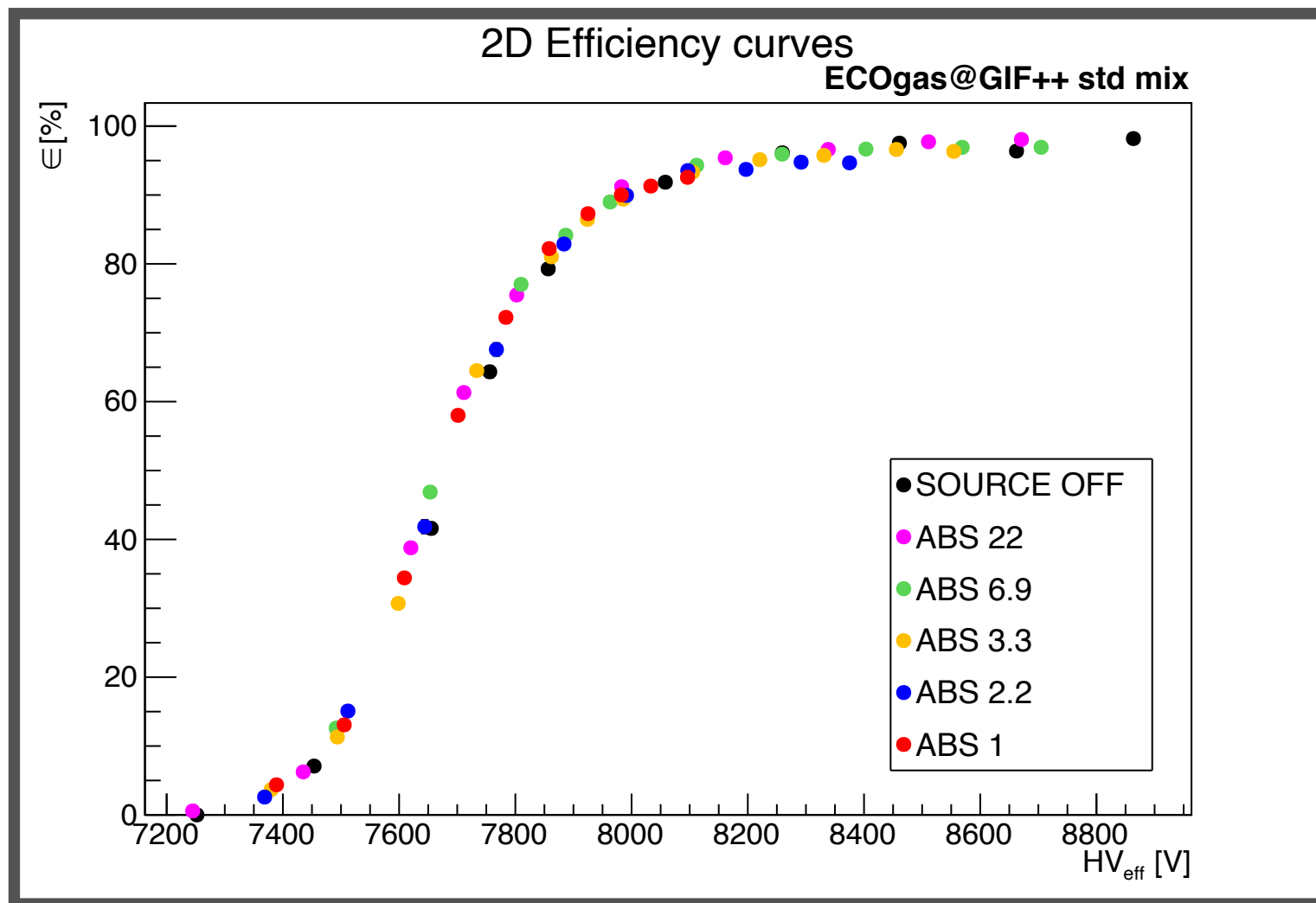
	rho (10 ¹¹ Ohm/cm)					Argon rho (10 ¹¹ Ohm/cm) [*]		Ratio
	std mix	eco2	eco3	Mean	Error	Mean	Error	
07/2022	0.35	0.38	0.37	0.37	0.02	1.8	0.2	0.20
07/2023	0.55	0.50	0.49	0.51	0.03	1.9	0.2	0.27

Procedure:

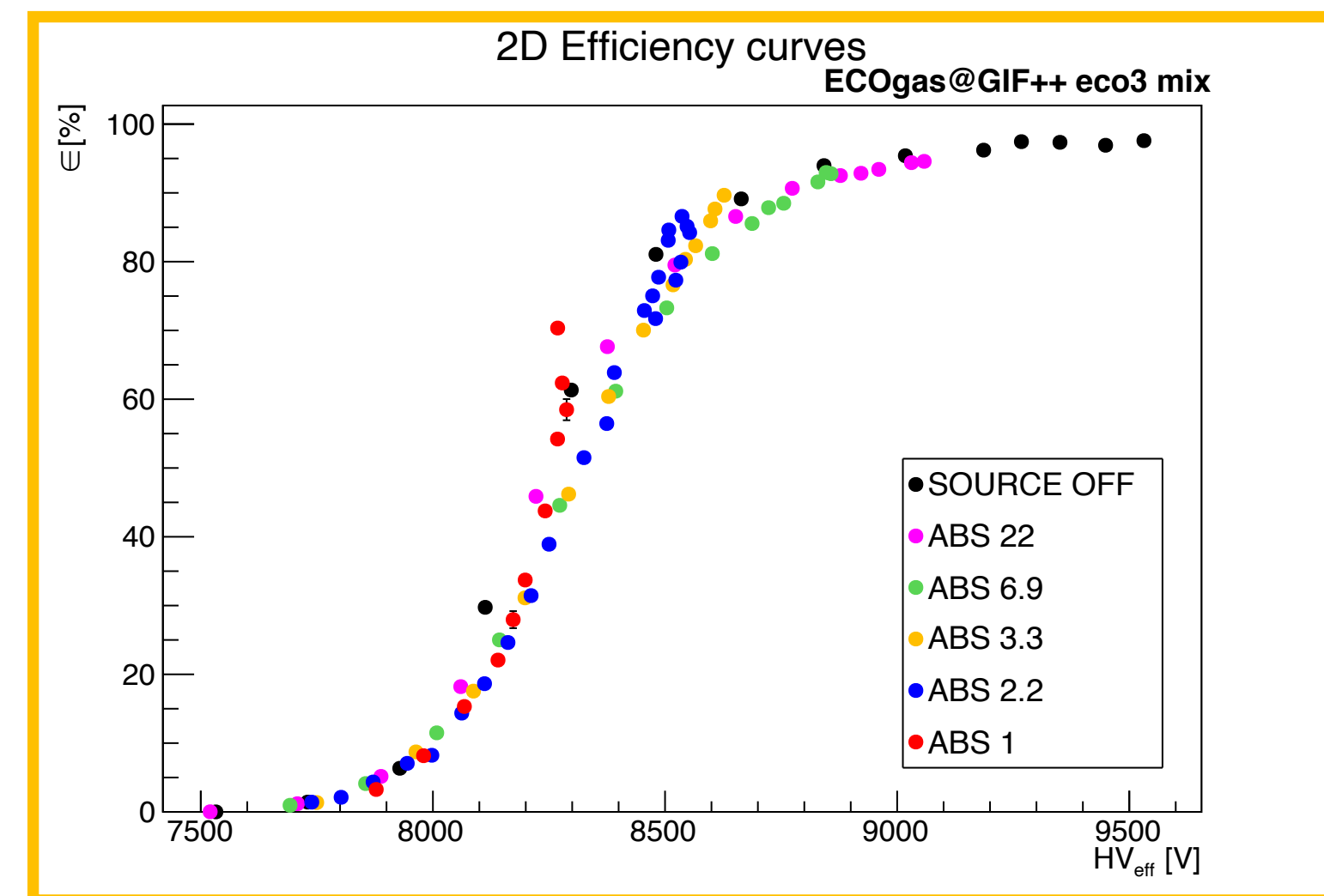
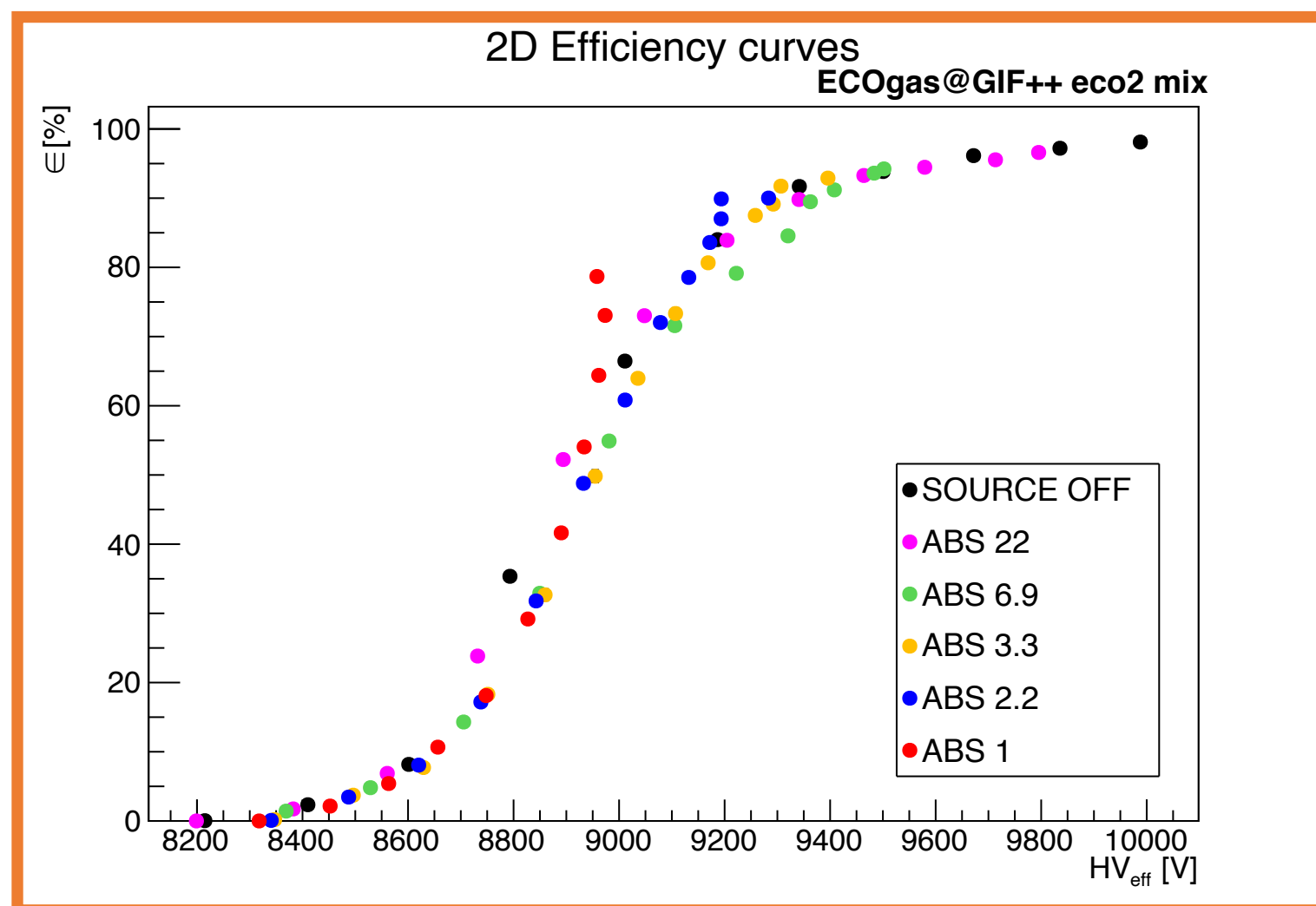
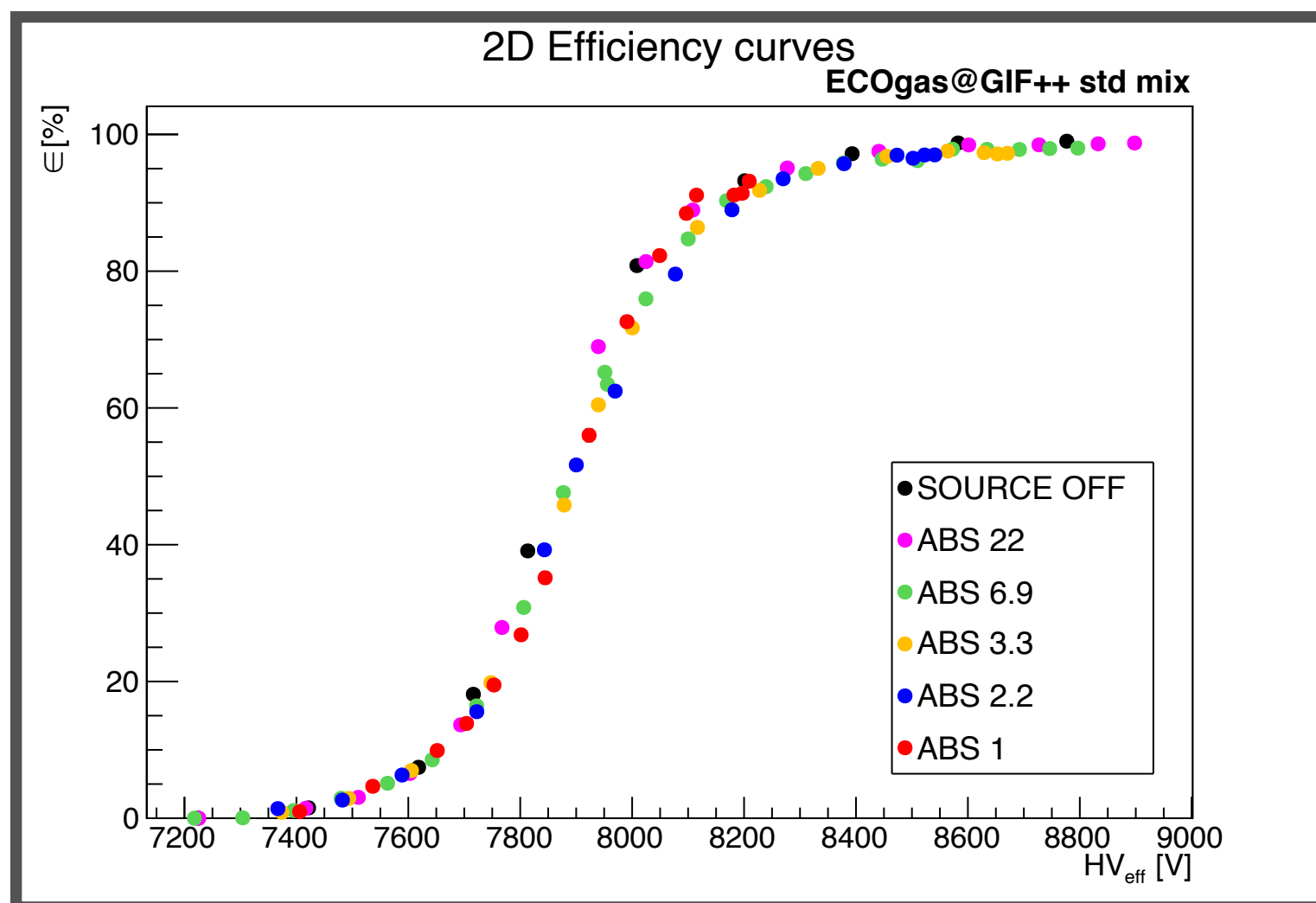
- I evaluate the variance of HV_{gas} at HV50 (parameter taken from the logistic fit) for selected ABS (1, 2.2, 3.3, 6.9, 22, OFF) changing ρ with steps of $0.01 \cdot 10^{11}$ Ohm/cm
- I take the lowest variance for each gas mix and I do the mean. The error is the half-range of the three results

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

2022 TB - $\rho = 0.37 \cdot 10^{11}$ Ohm/cm



2023 TB - $\rho = 0.51 \cdot 10^{11}$ Ohm/cm



SHiP Resistivity (HV0) Eff fit with Richards generalised function

	rho (10 ¹¹ Ohm/cm)					Increase	Argon rho (10 ¹¹ Ohm/cm) [*]		Ratio
	std mix	eco2	eco3	Mean	Error		Mean	Error	
10/2021	0.42	0.36	0.37	0.38	0.03		1.3	0.3	0.29
07/2022	0.37	0.45	0.41	0.41	0.04	3%	1.8	0.2	0.23
07/2023	0.57	0.54	0.55	0.55	0.02	14%	1.9	0.2	0.29

Richards generalised logistic function for efficiency evaluation:

$$\epsilon = \frac{\epsilon_{\max}}{\left[1 + \psi \cdot e^{-\beta(HV_{\text{eff}} - HV_0)}\right]^{1/\psi}}$$

where ϵ_{\max} represents the asymptotic efficiency; β describes the steepness of the curve; ψ ranges between 0 and 1 and is introduced, with respect to the standard logistic function, to parameterise the slower growth of the curve observed for eco-gas mixtures; HV_0 sets the displacement of the curve along the x-axis for fixed ψ and β .

WP is defined as the HV_{eff} value at which the 2D efficiency reaches 99% of the asymptotic value approached by the Richard function

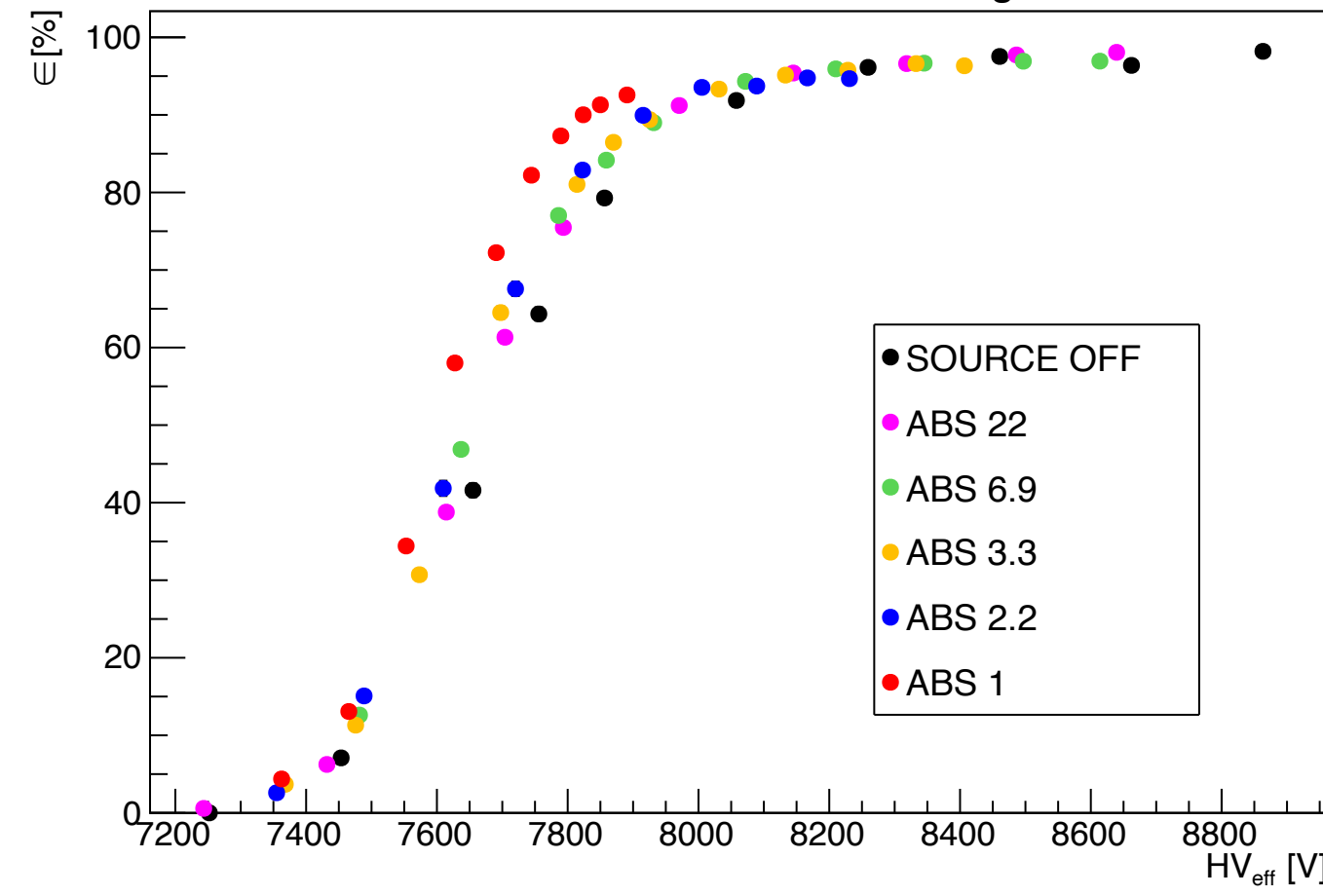
back up all plots

202207 stdmix

0.43e11

2D Efficiency curves

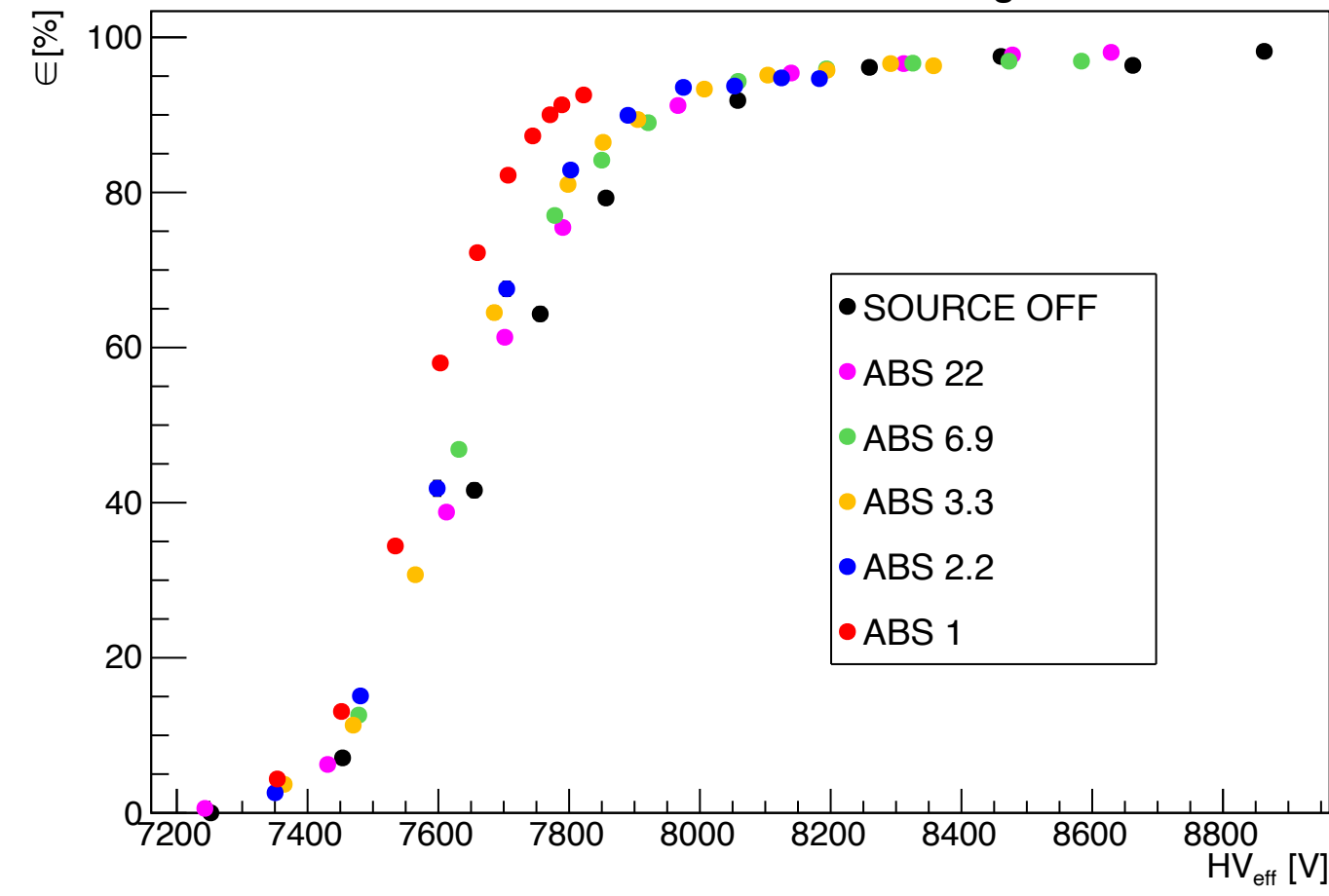
ECOgas@GIF++ std mix



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2D Efficiency curves

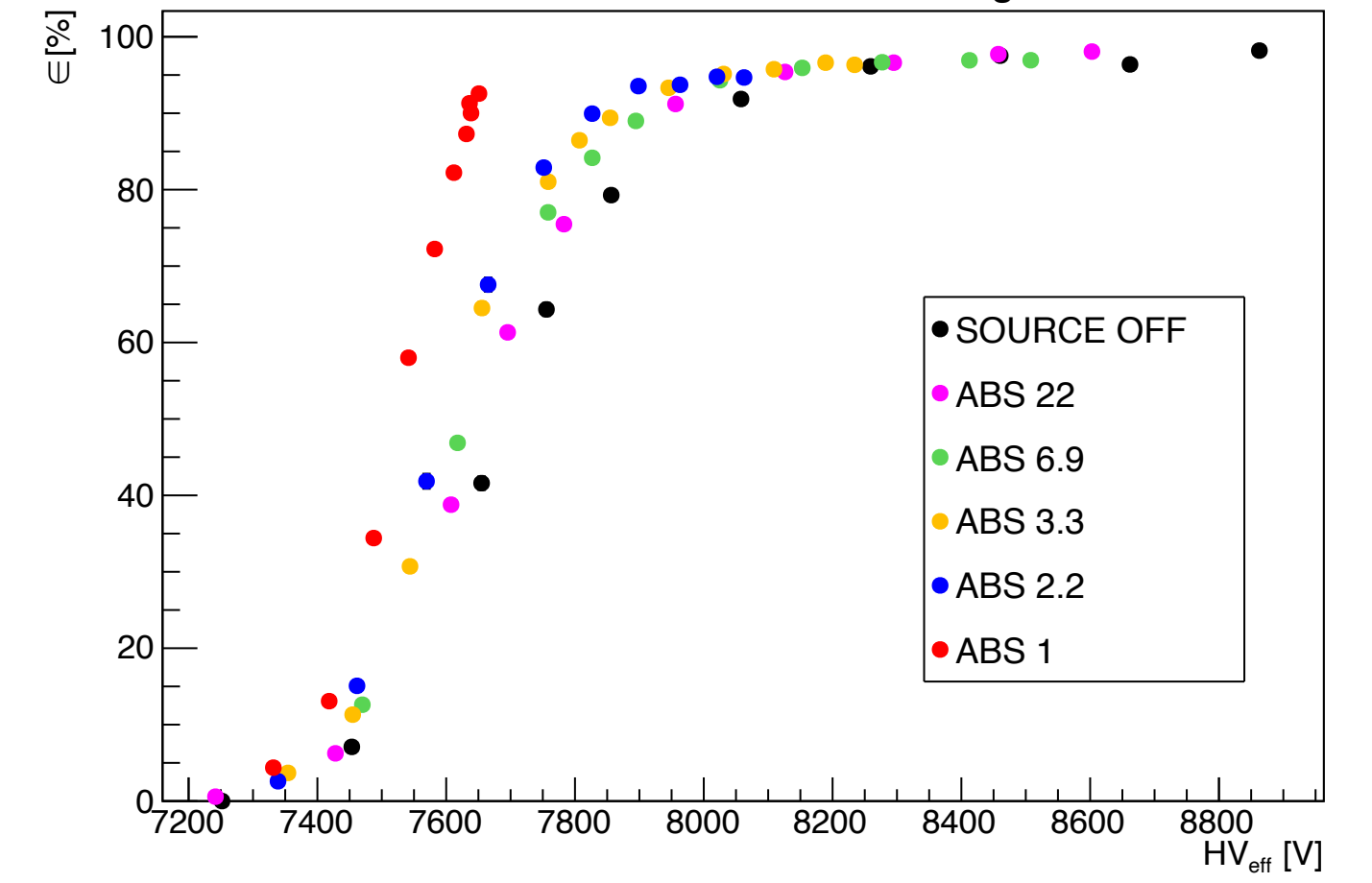
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2D Efficiency curves

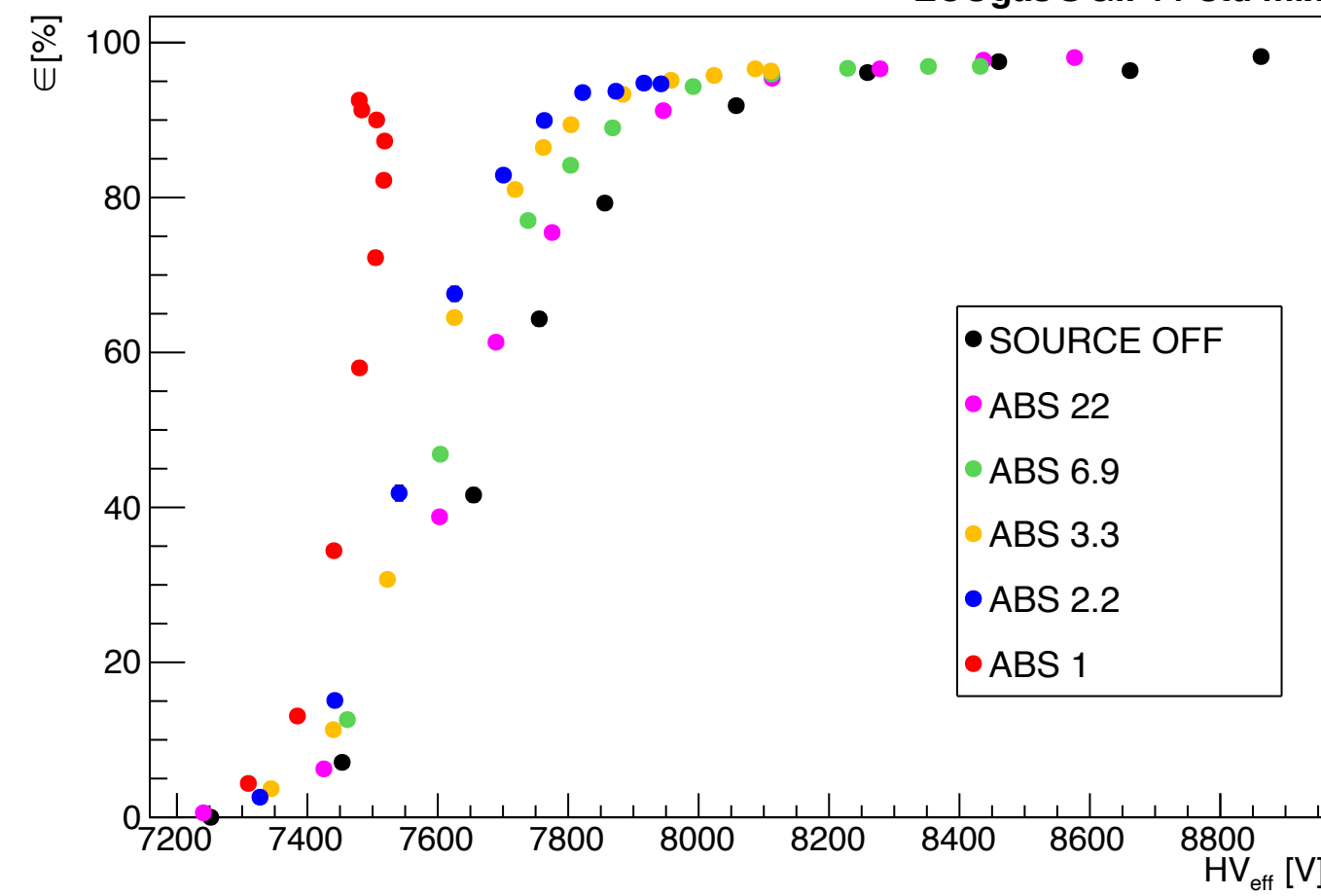
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0.55e11

2D Efficiency curves

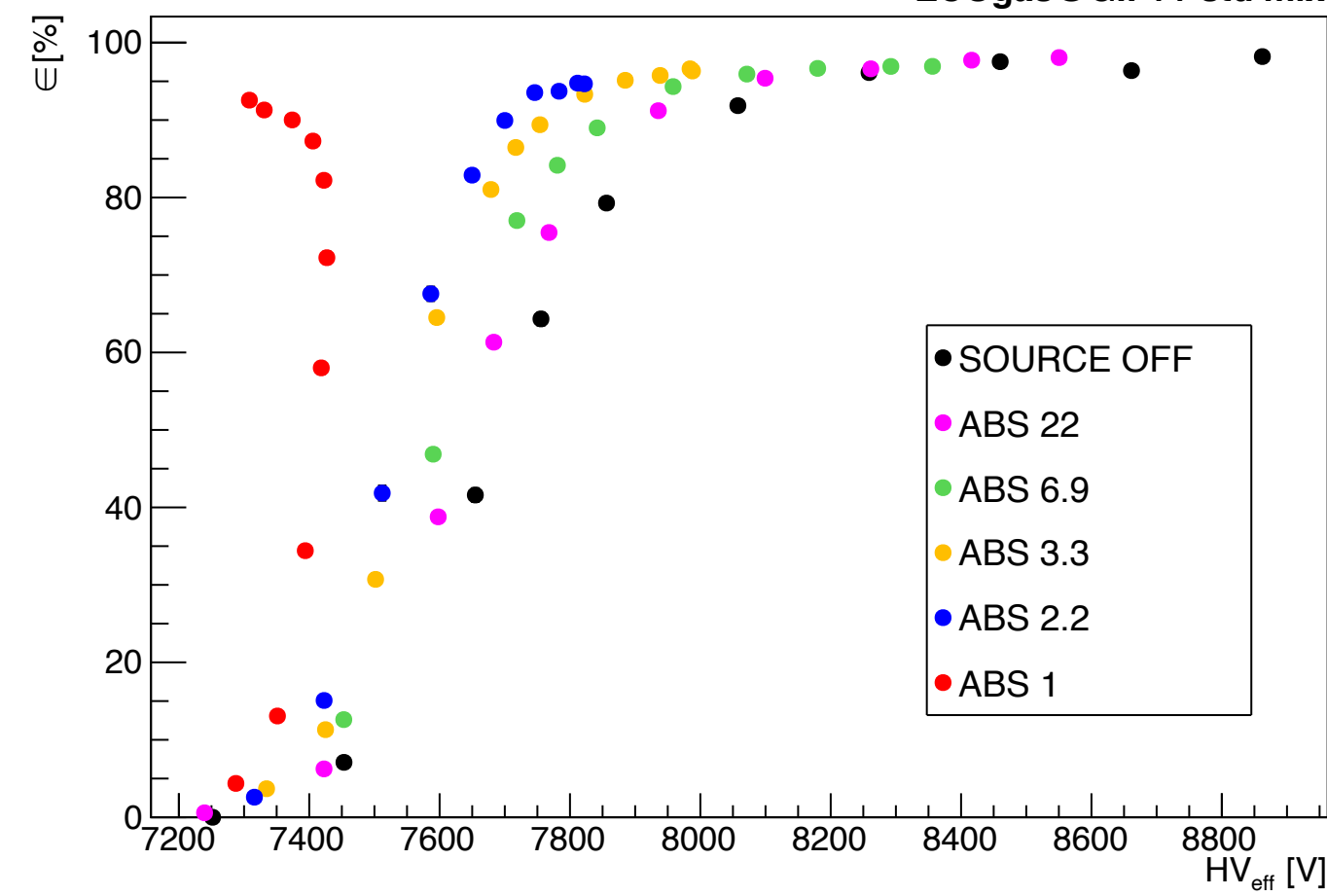
ECOgas@GIF++ std mix



0.6e11

2D Efficiency curves

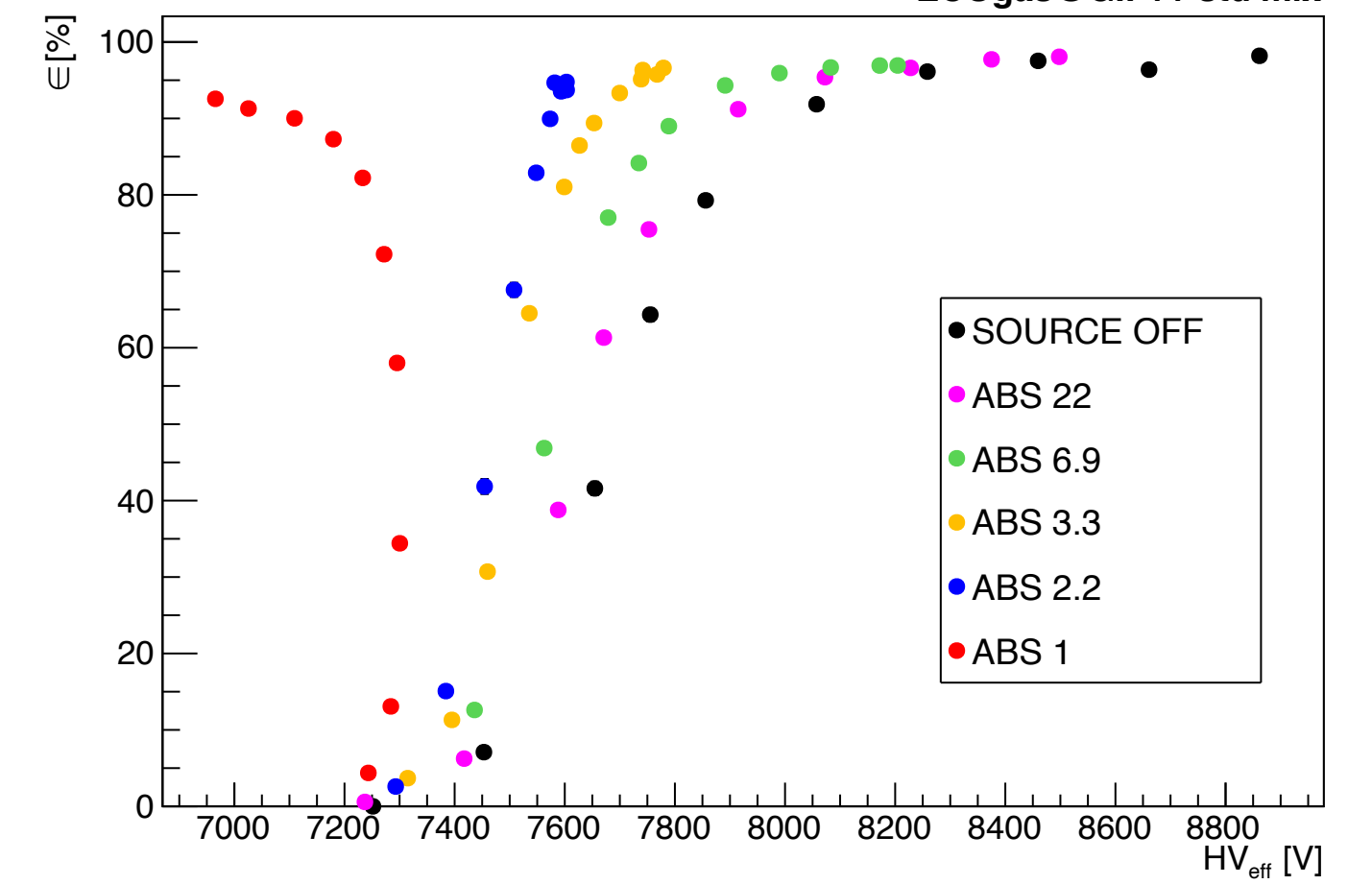
ECOgas@GIF++ std mix



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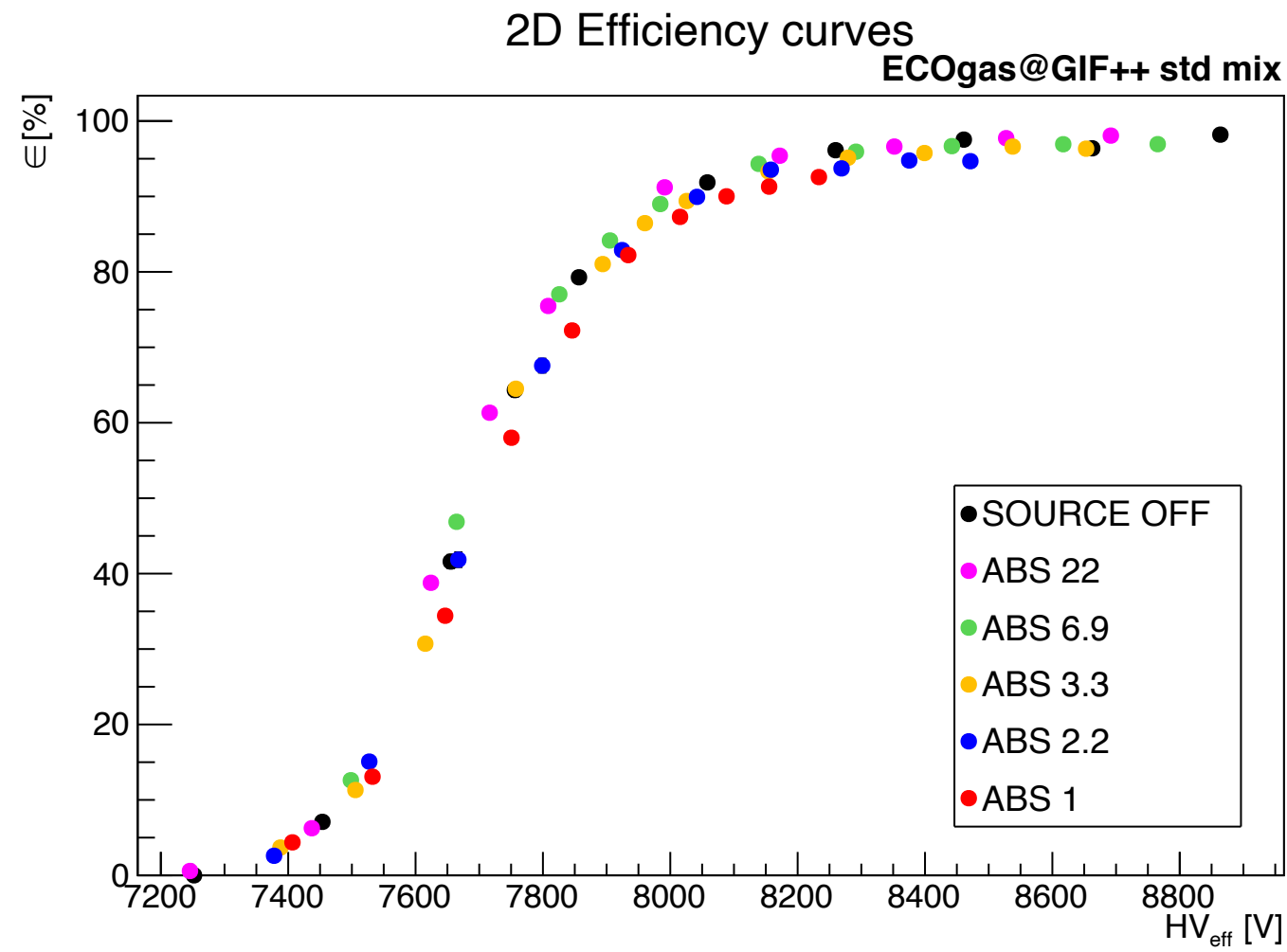
2D Efficiency curves

ECOgas@GIF++ std mix

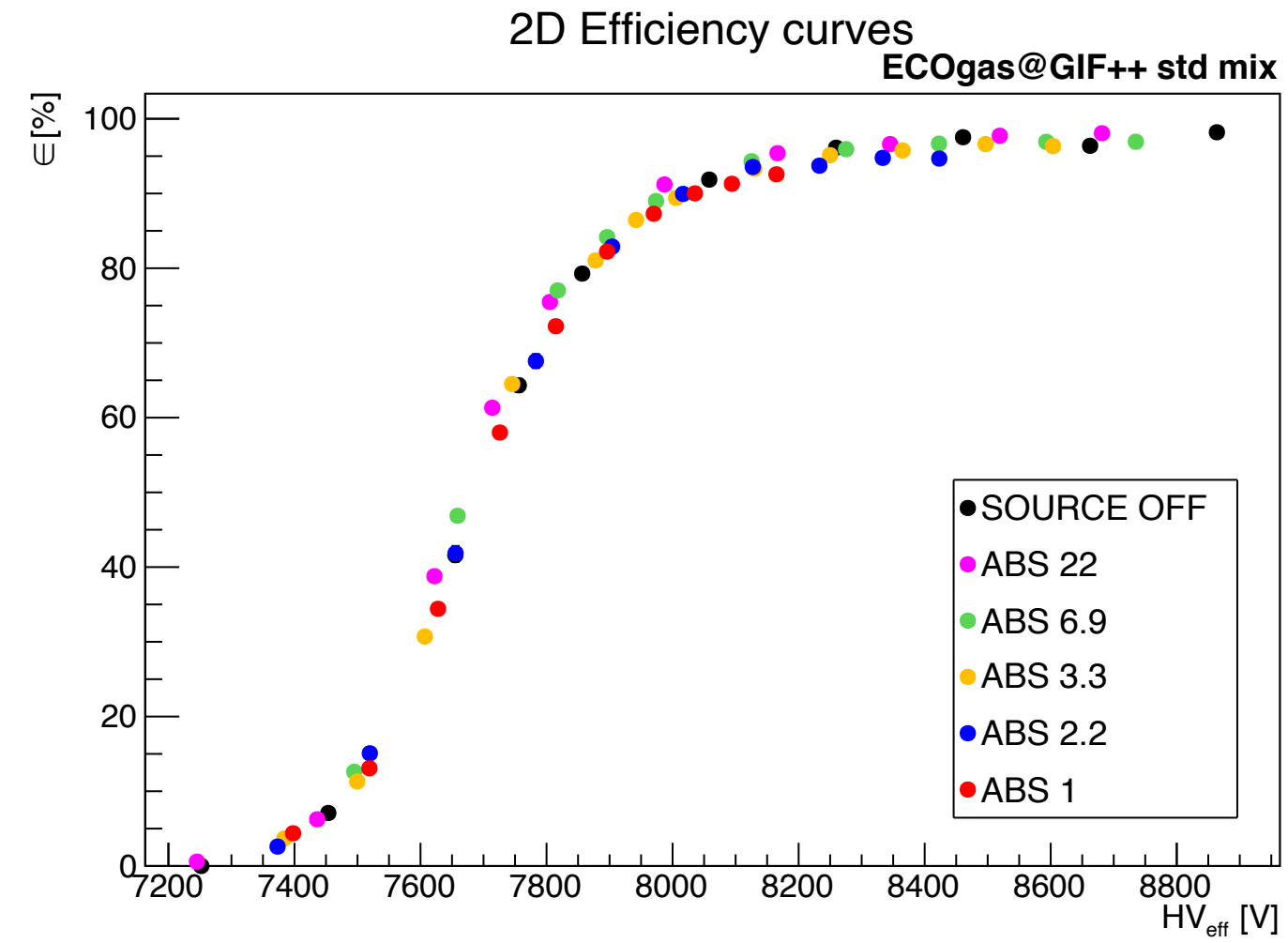


202207 stdmix

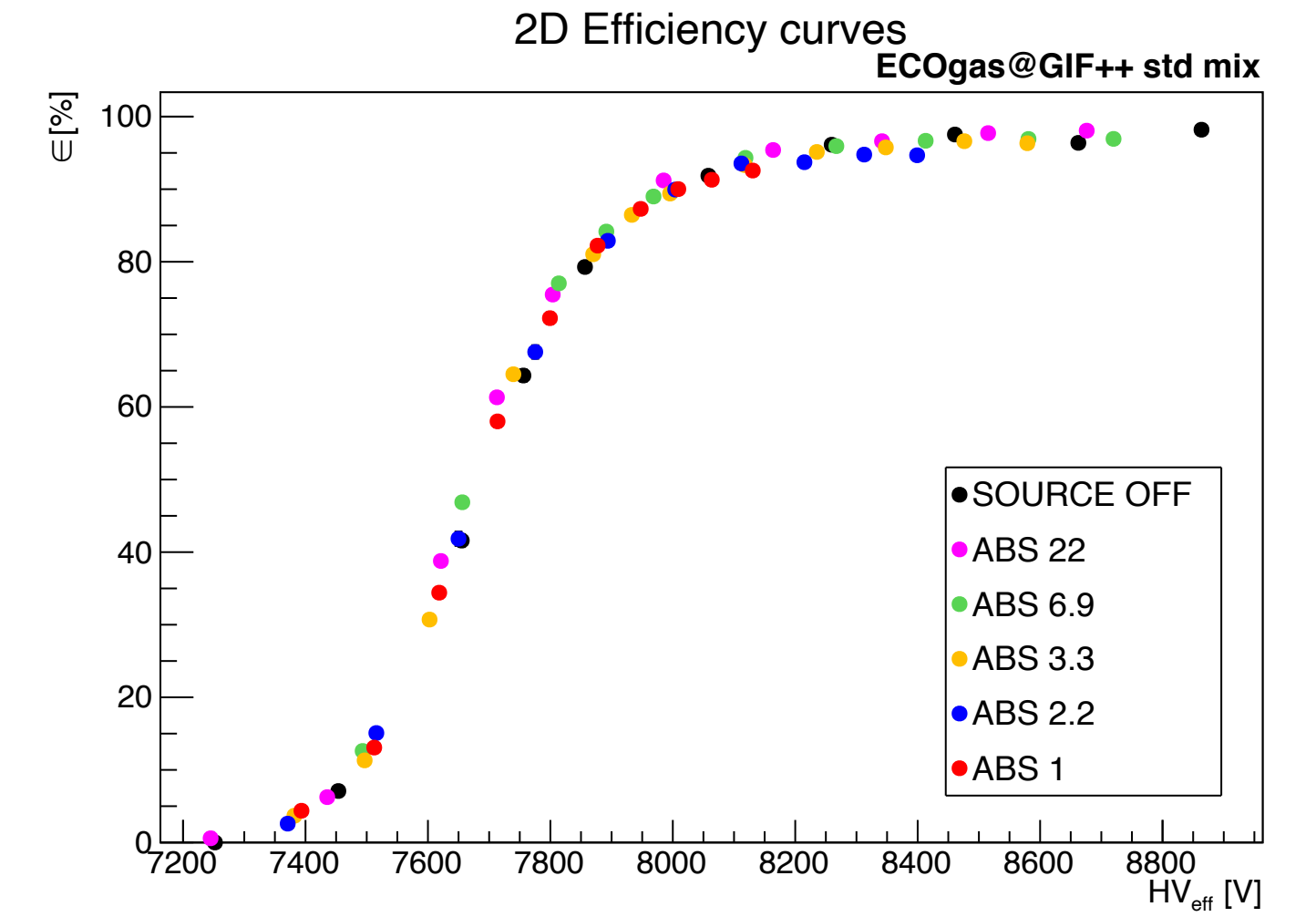
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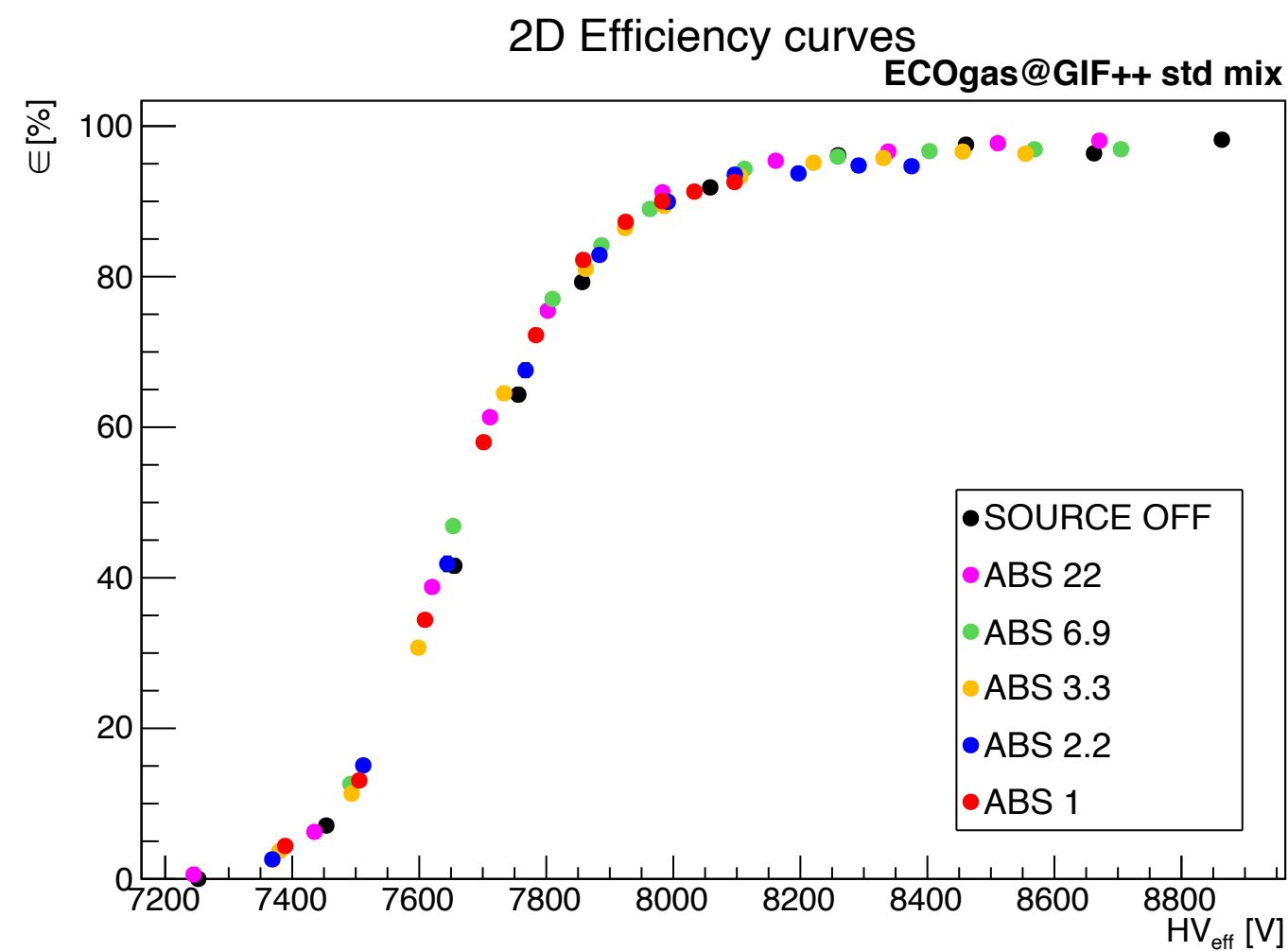
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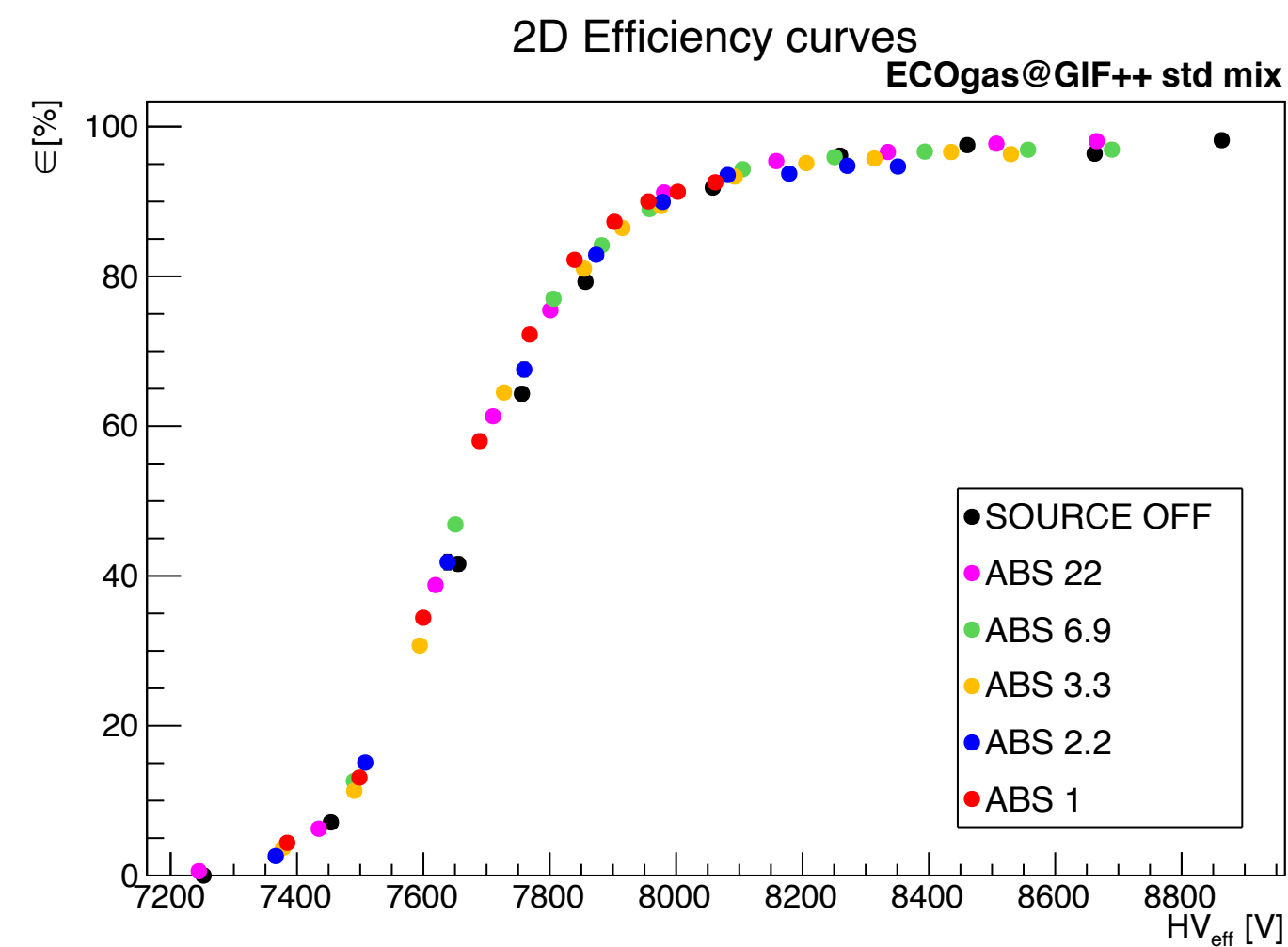
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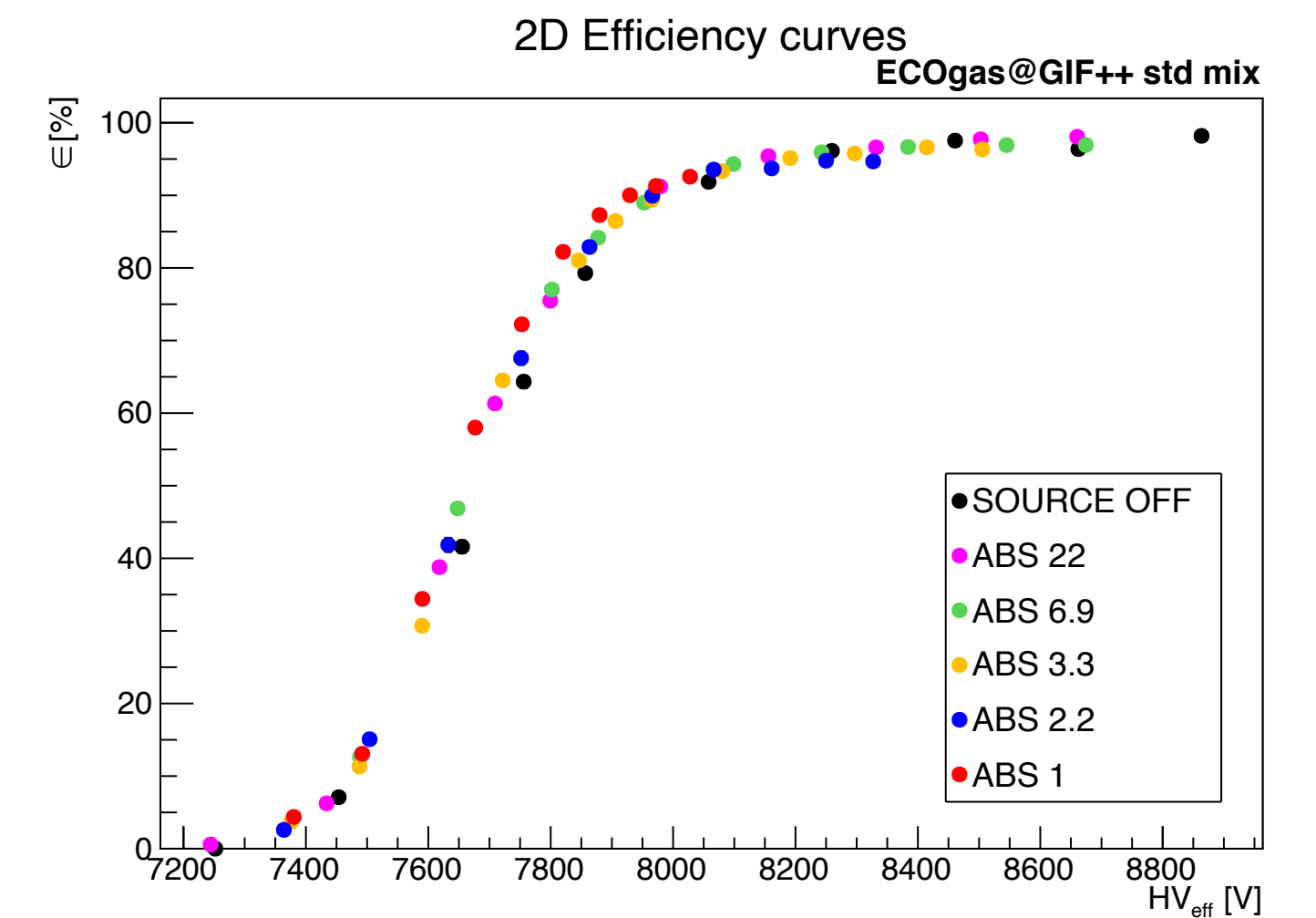
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0.38e11



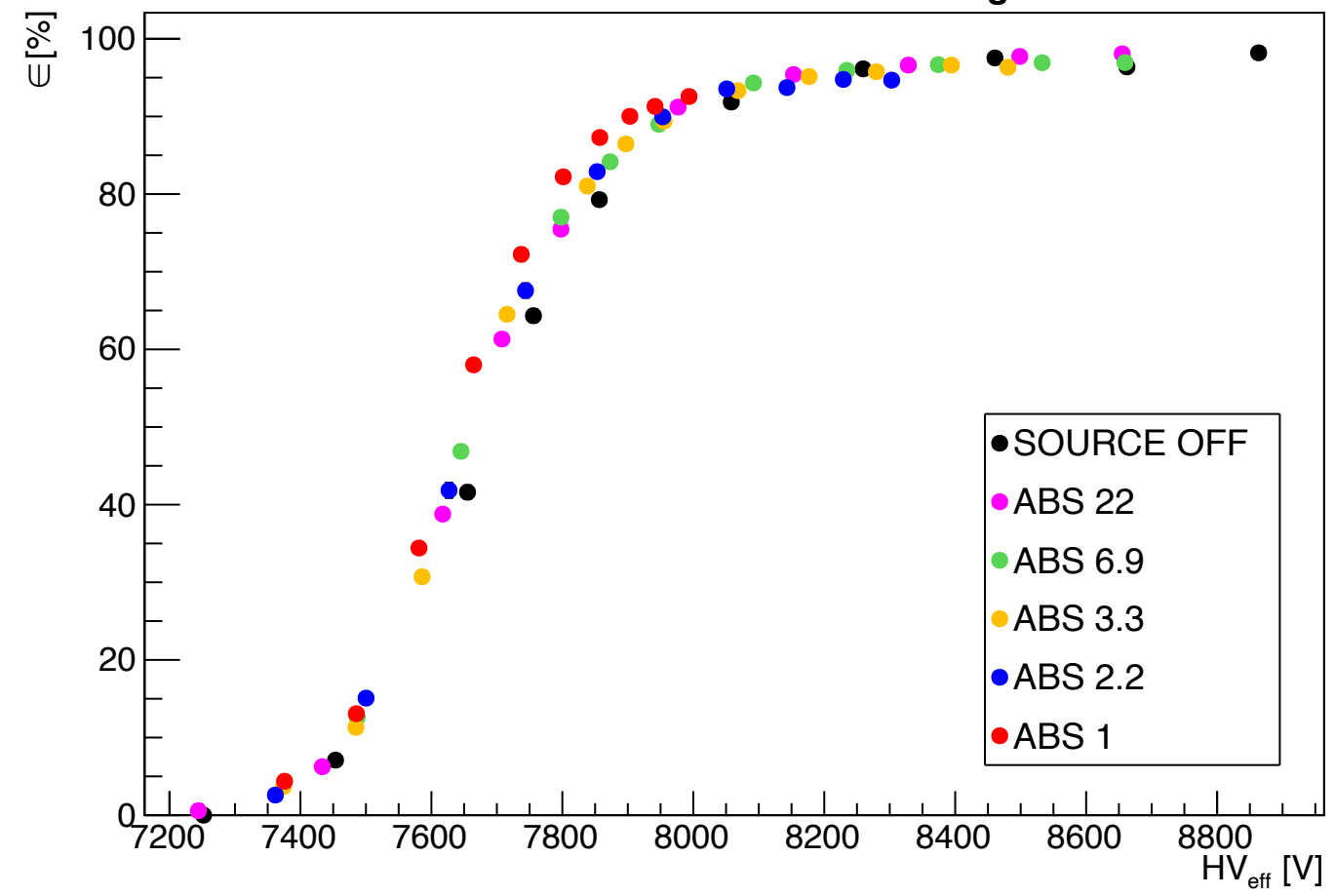
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202207 stdmix

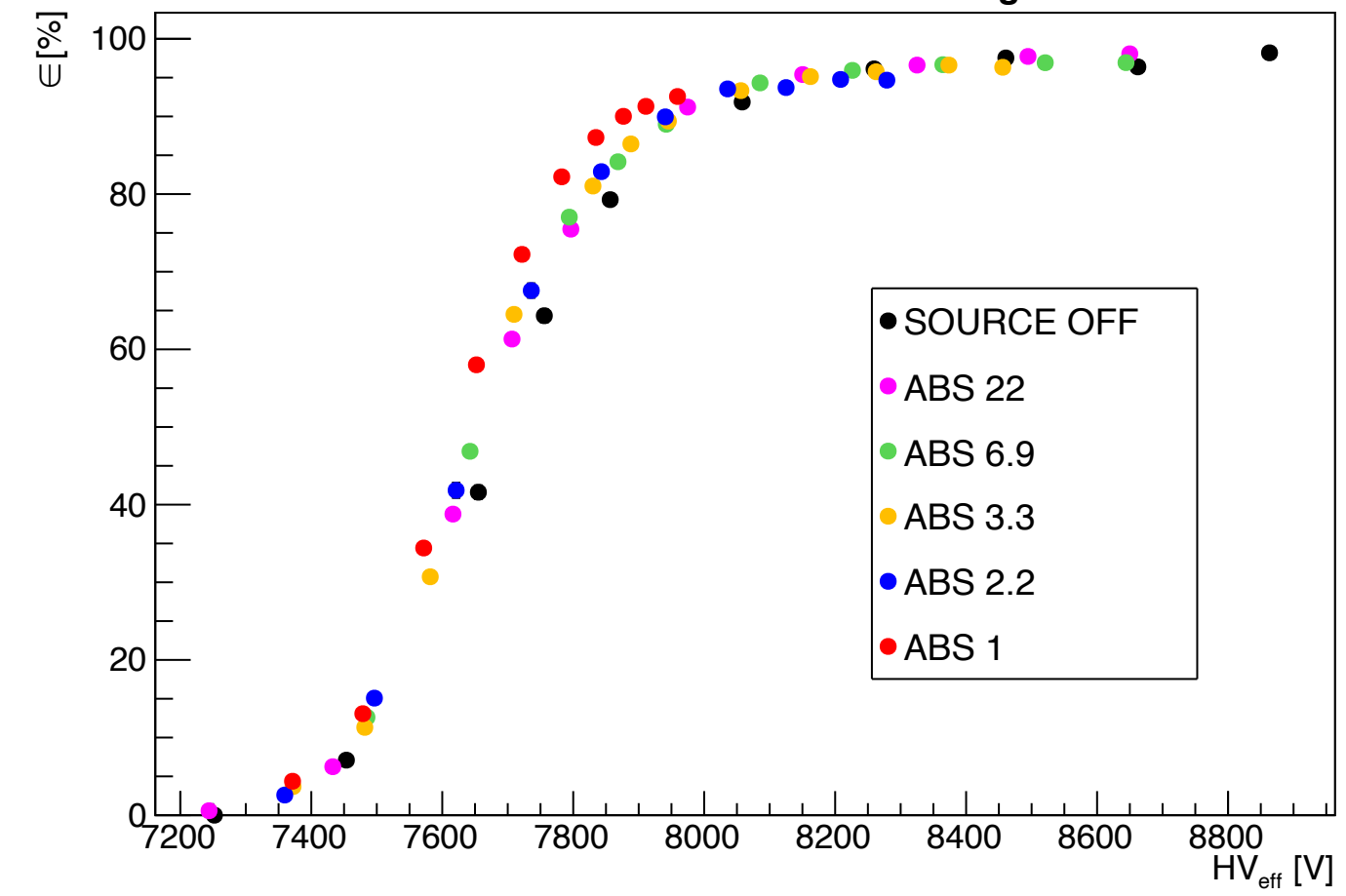
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2D Efficiency curves
ECOgas@GIF++ std mix

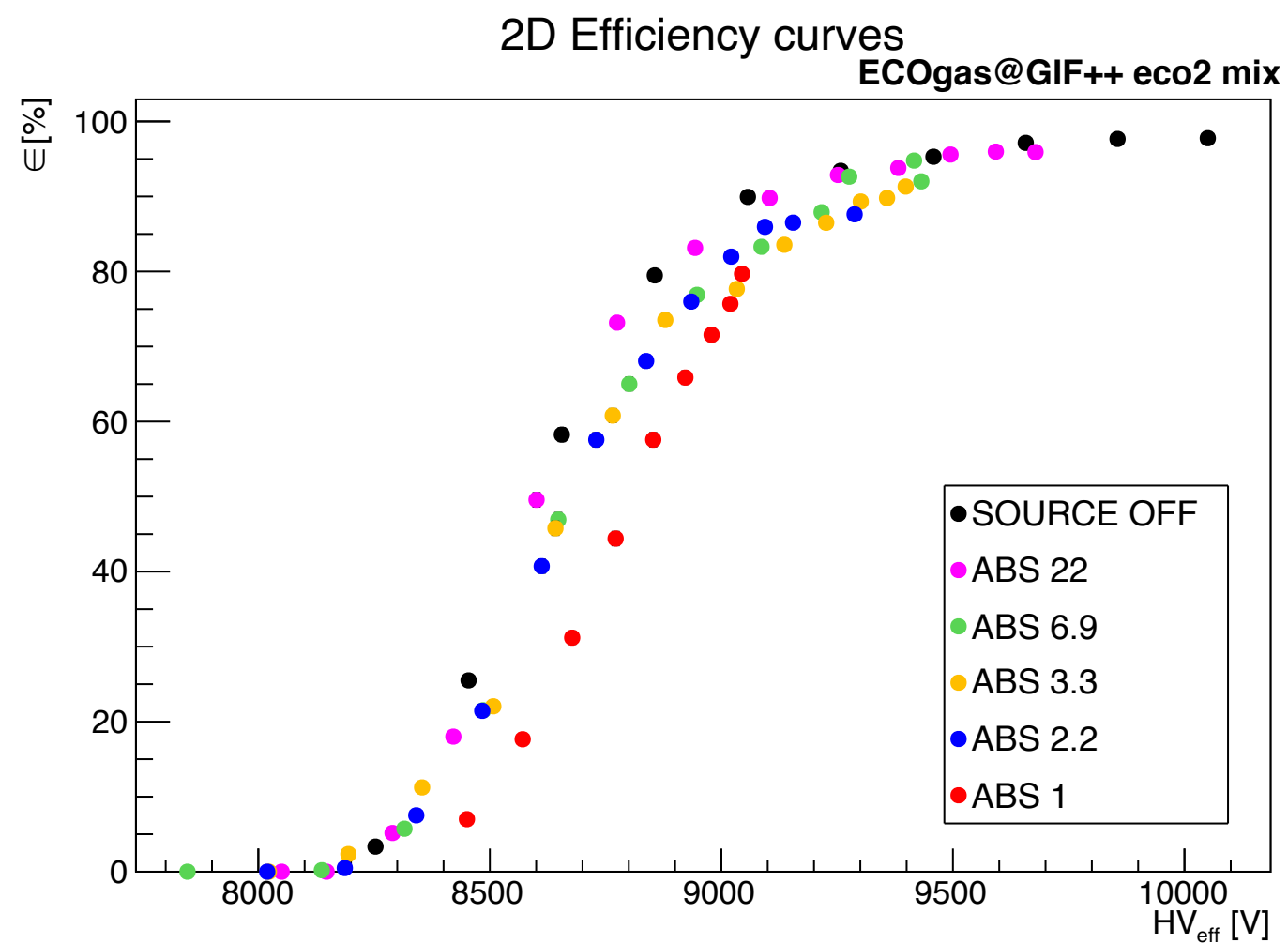


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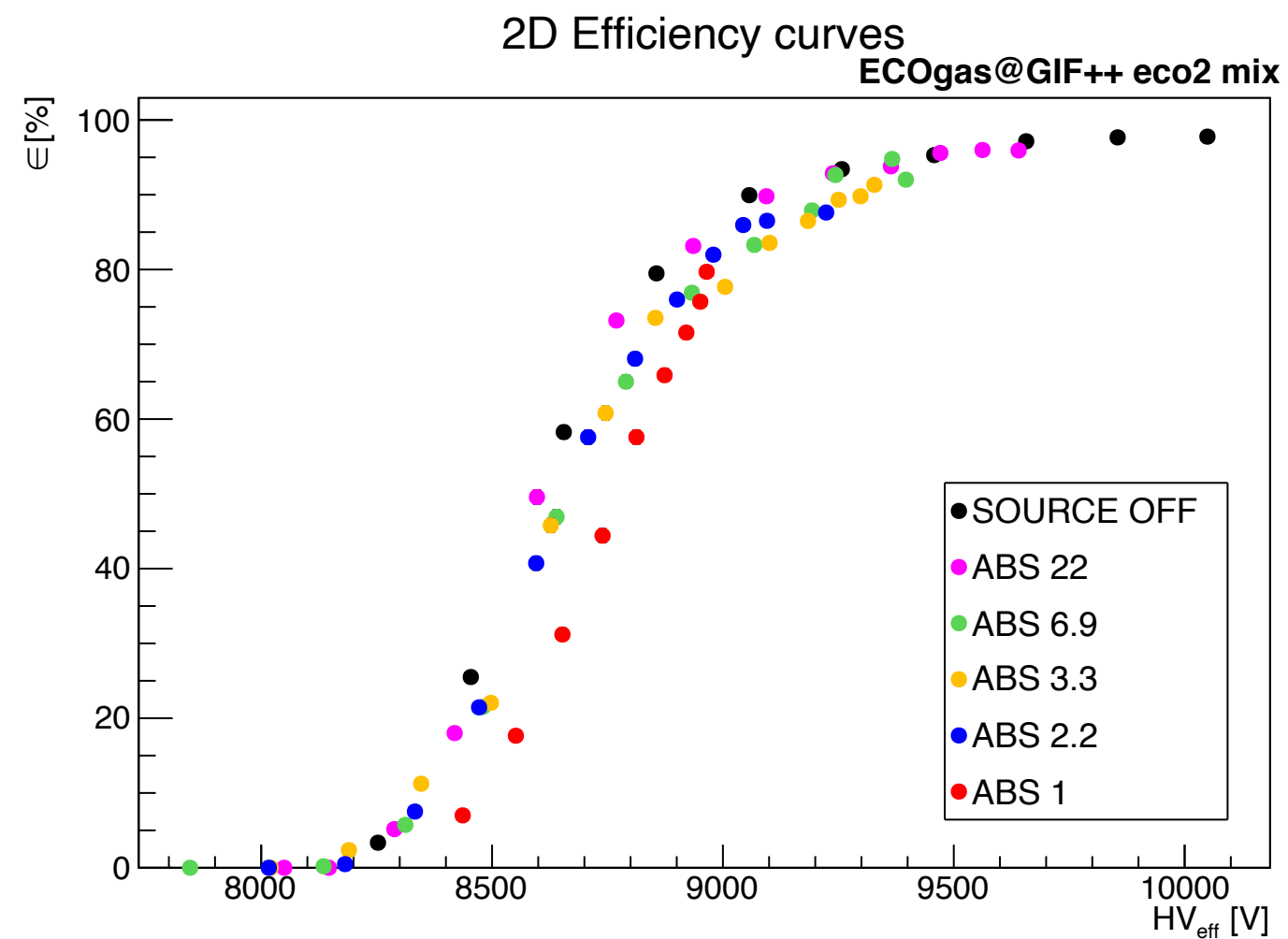
2D Efficiency curves
ECOgas@GIF++ std mix



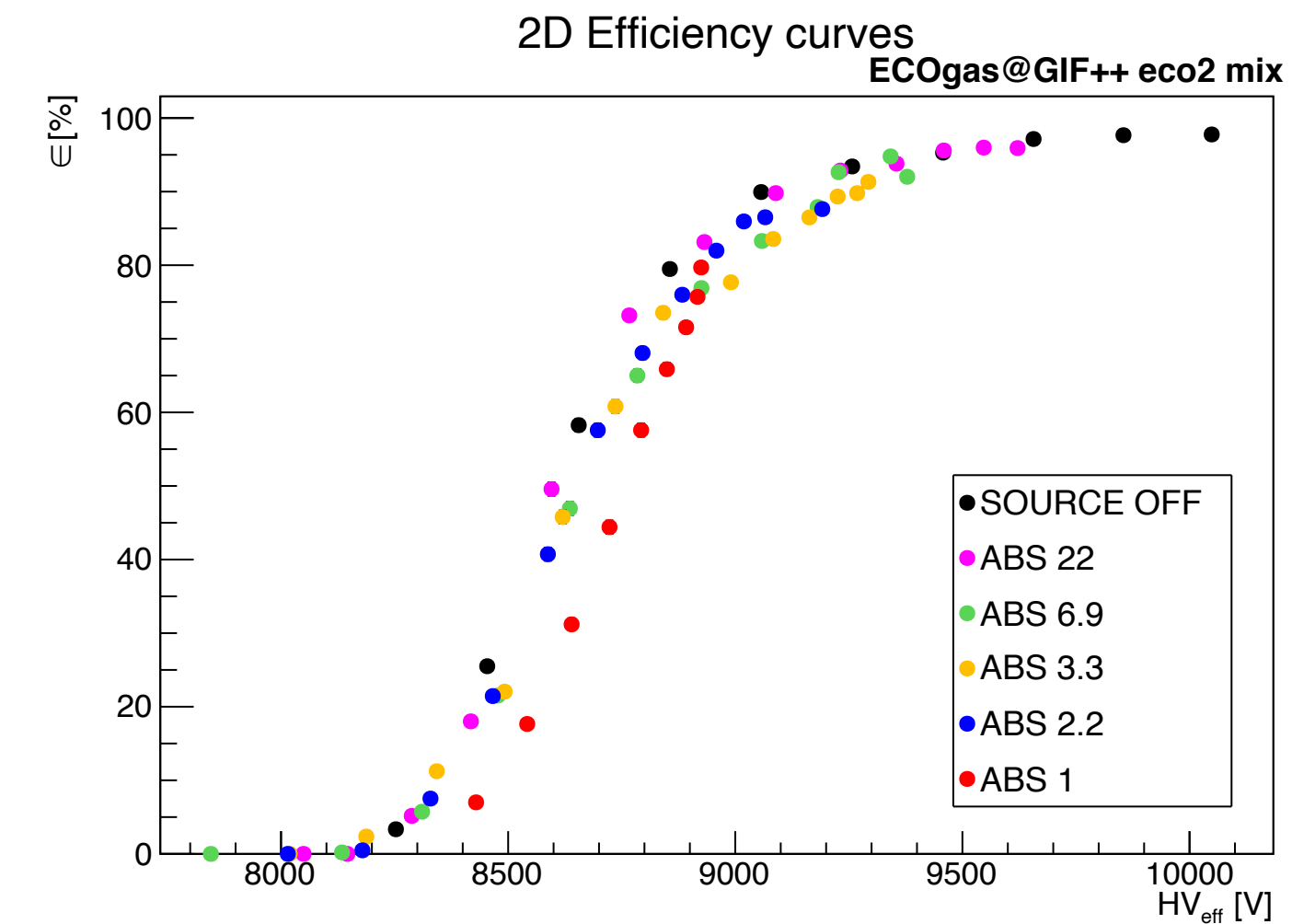
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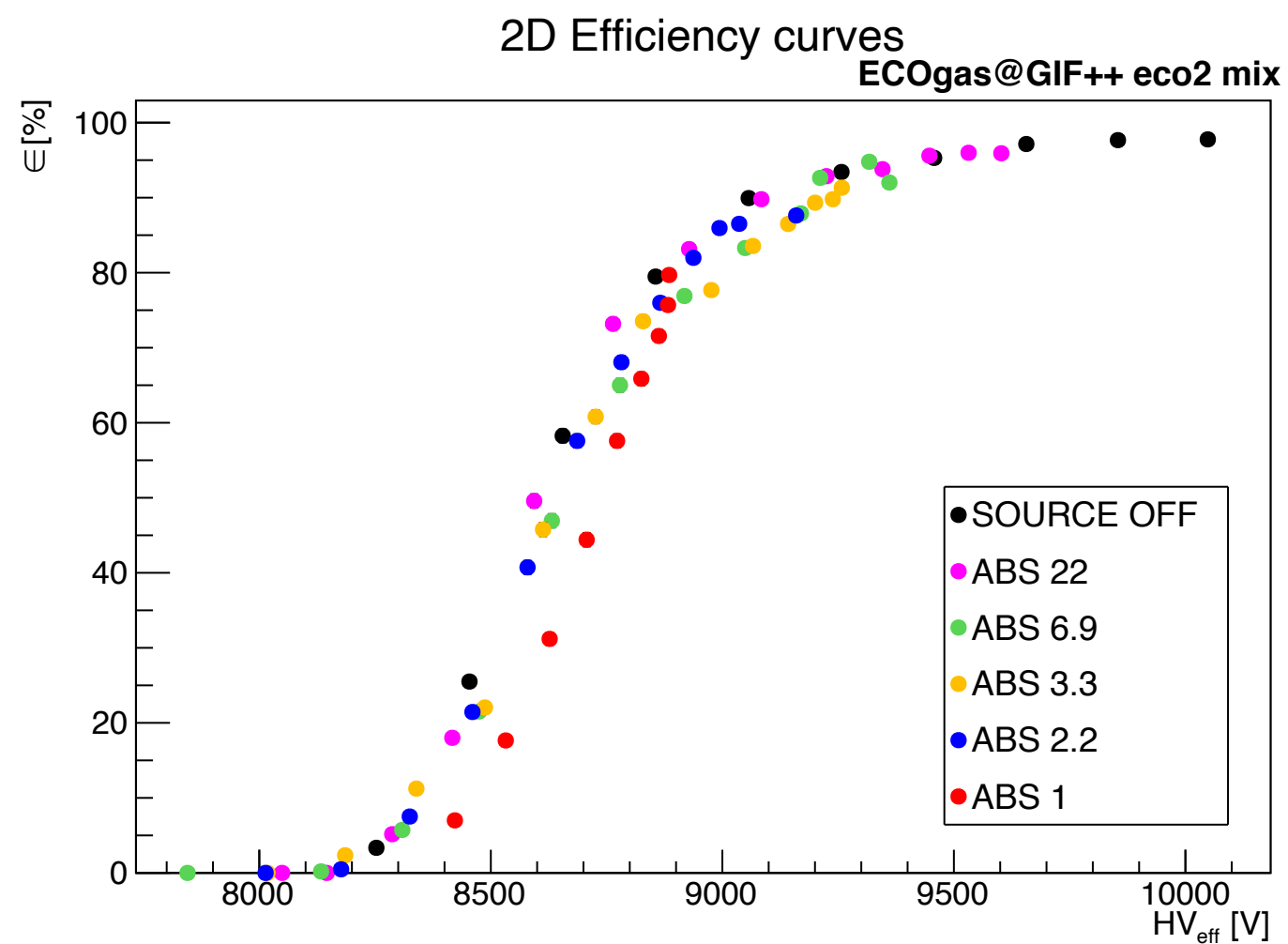
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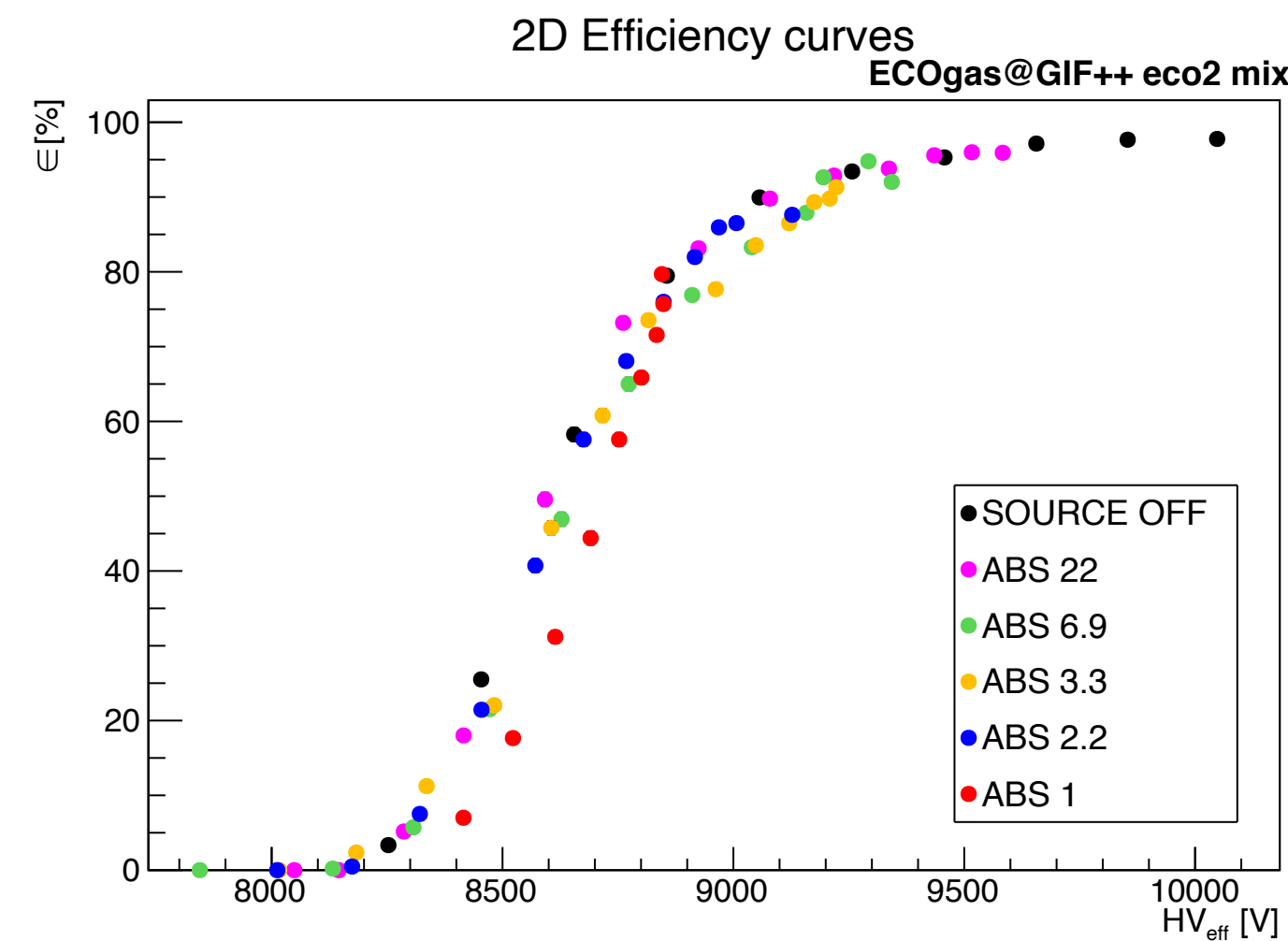
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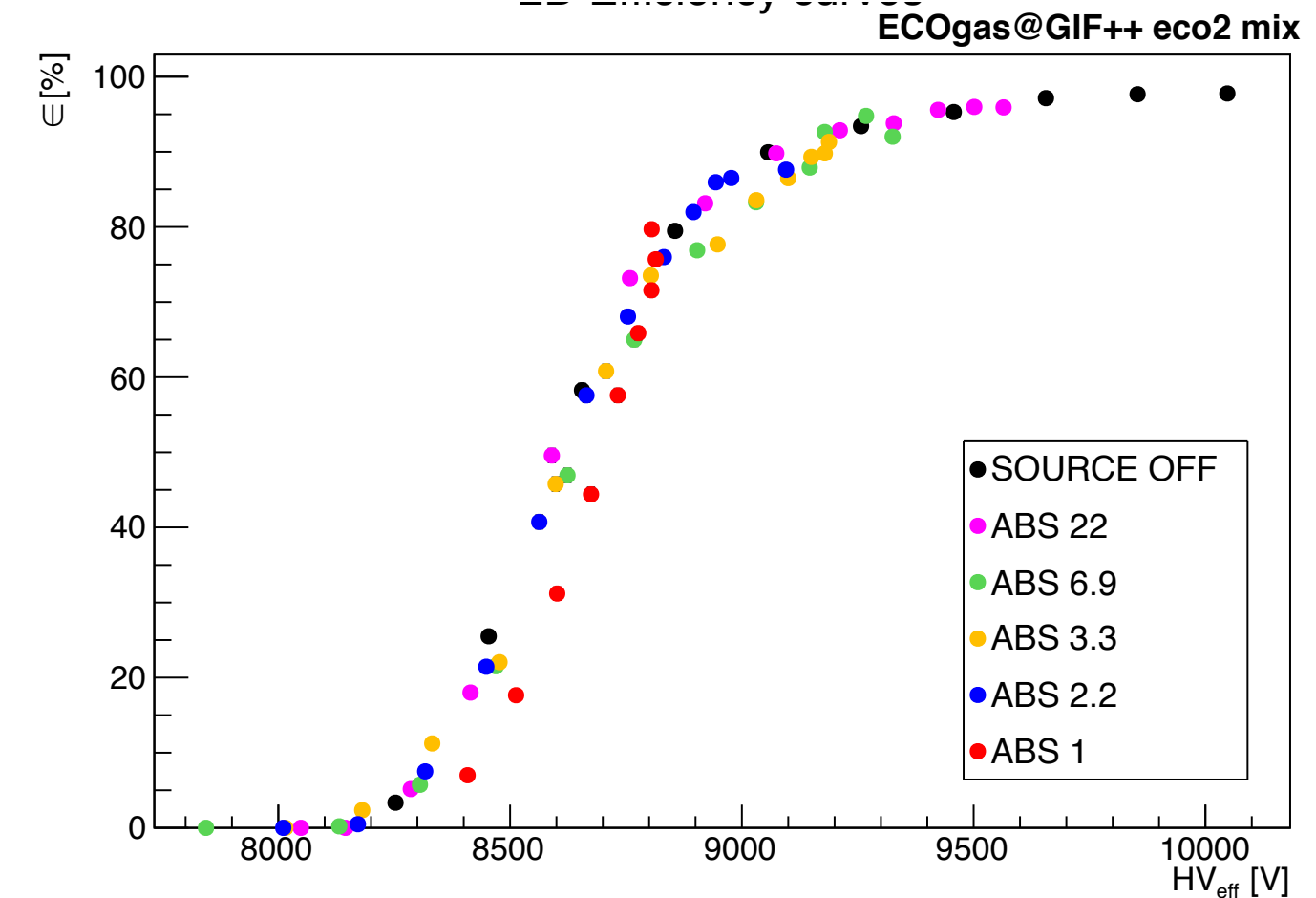
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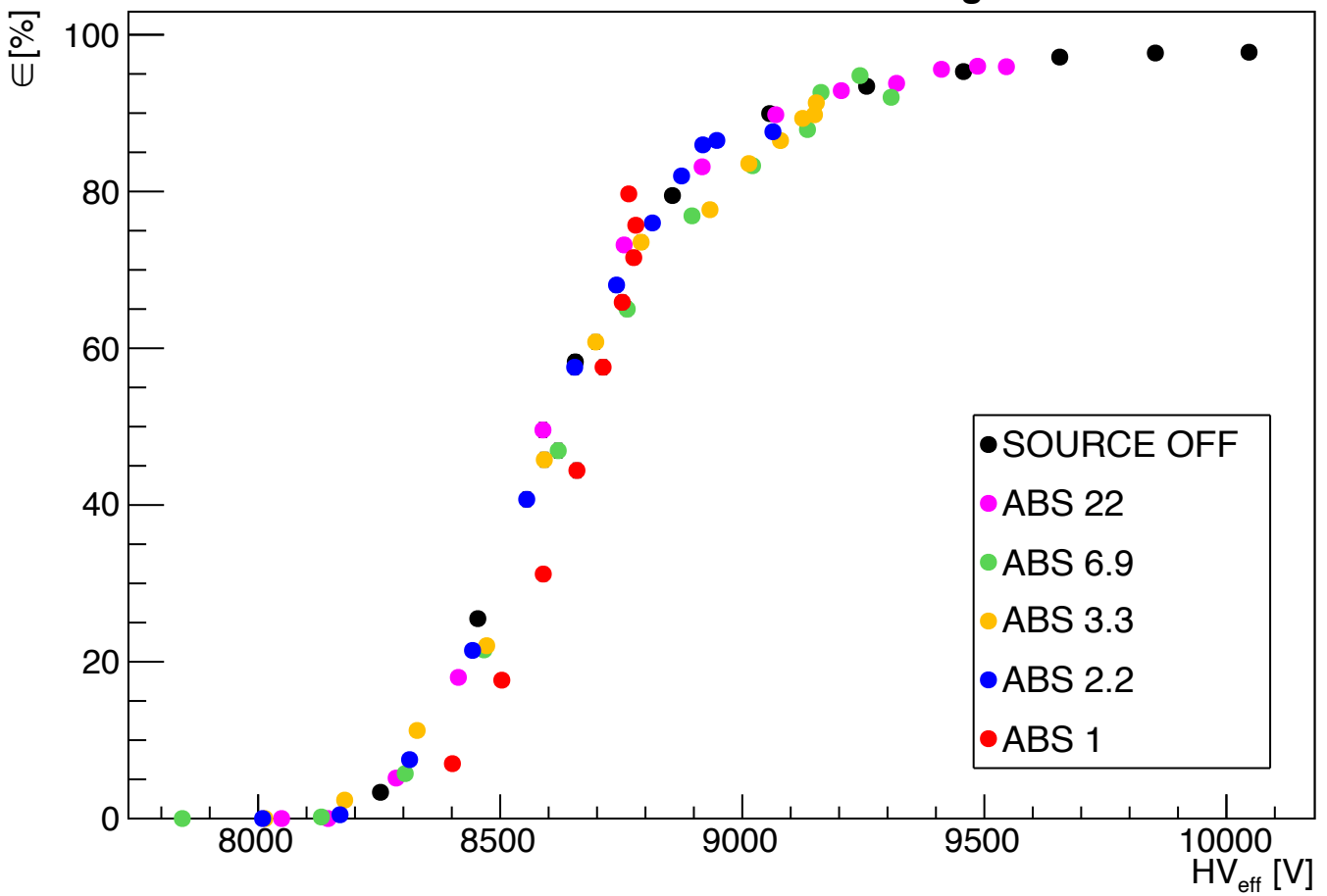


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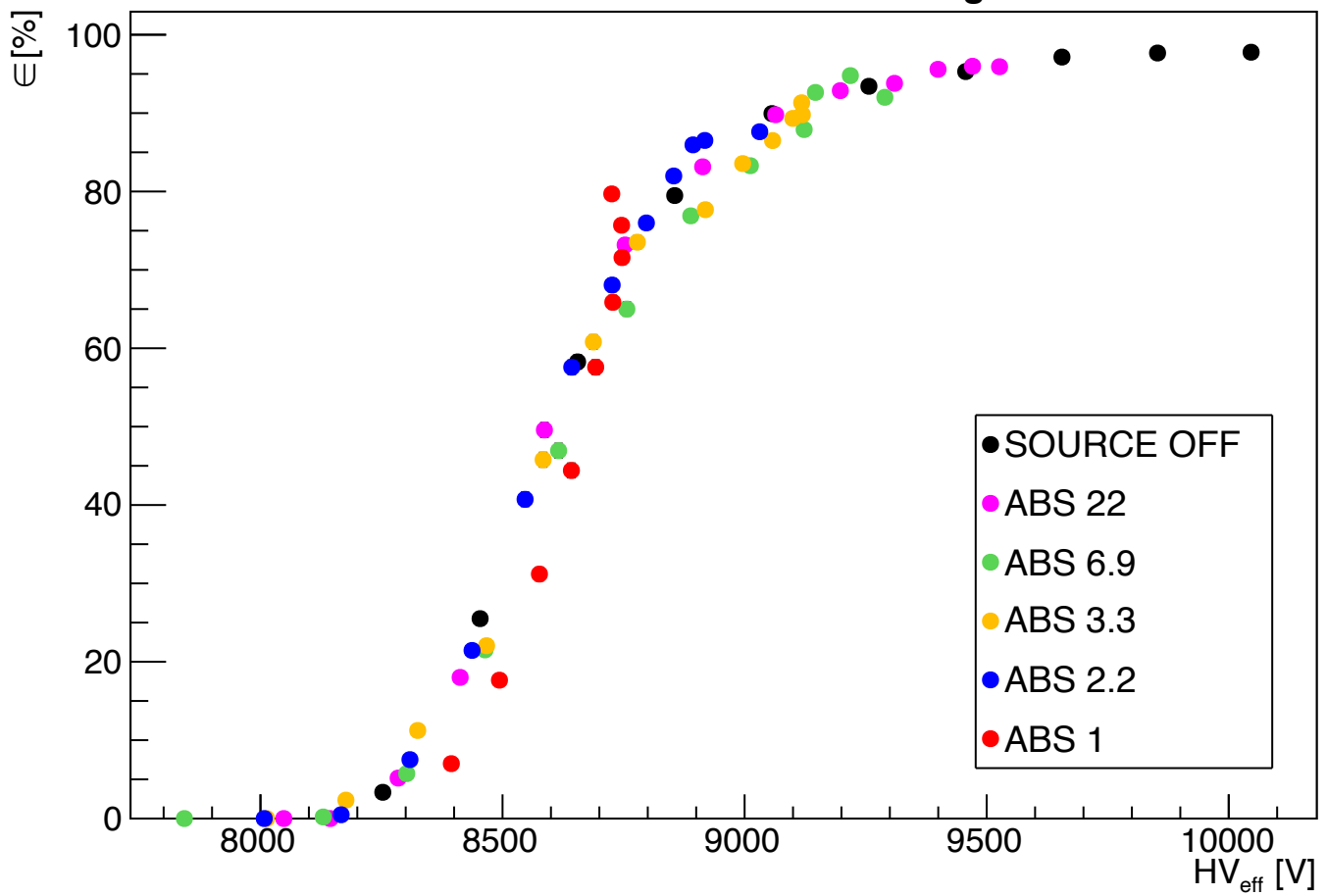
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2D Efficiency curves
ECOgas@GIF++ eco2 mix



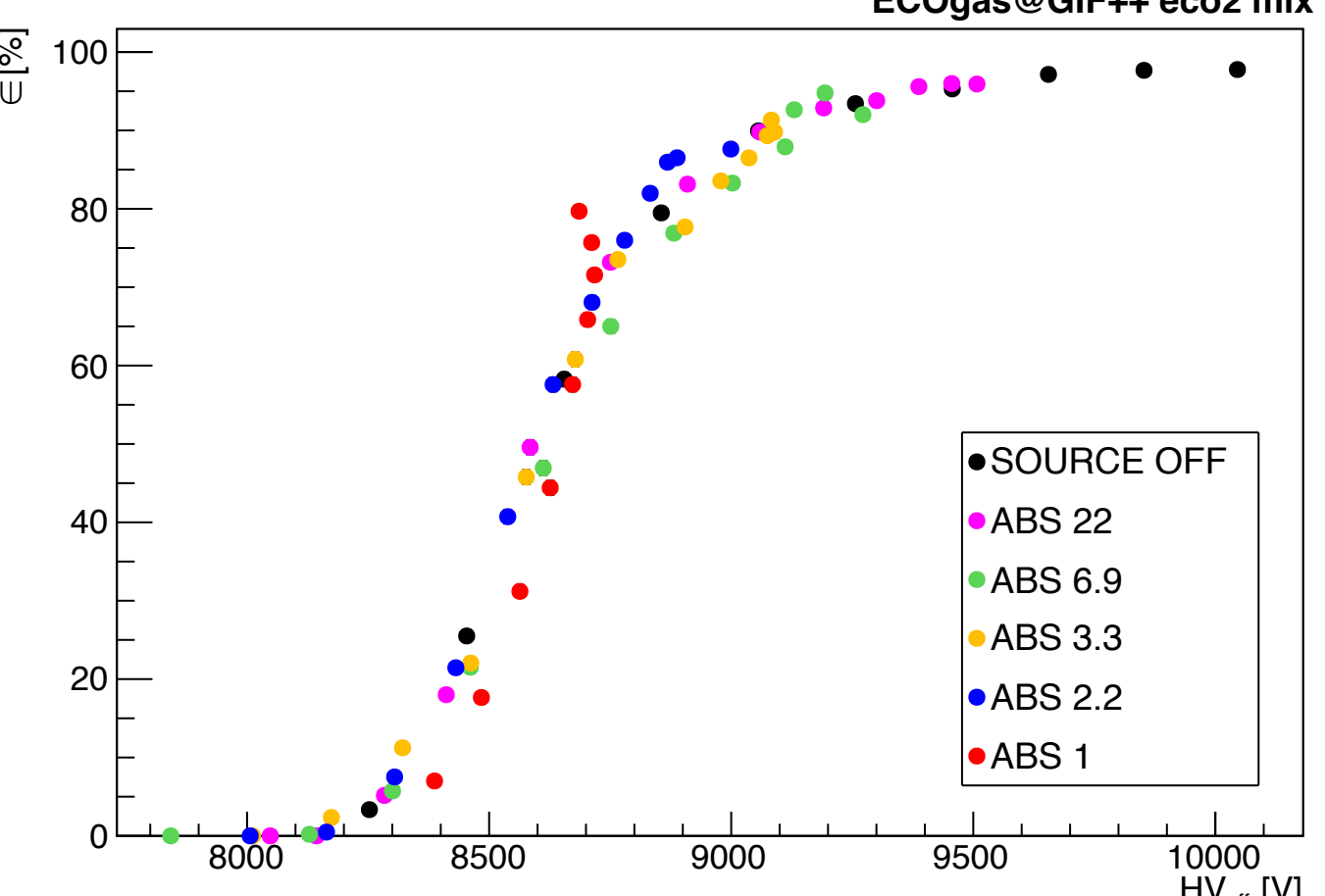
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2D Efficiency curves
ECOgas@GIF++ eco2 mix



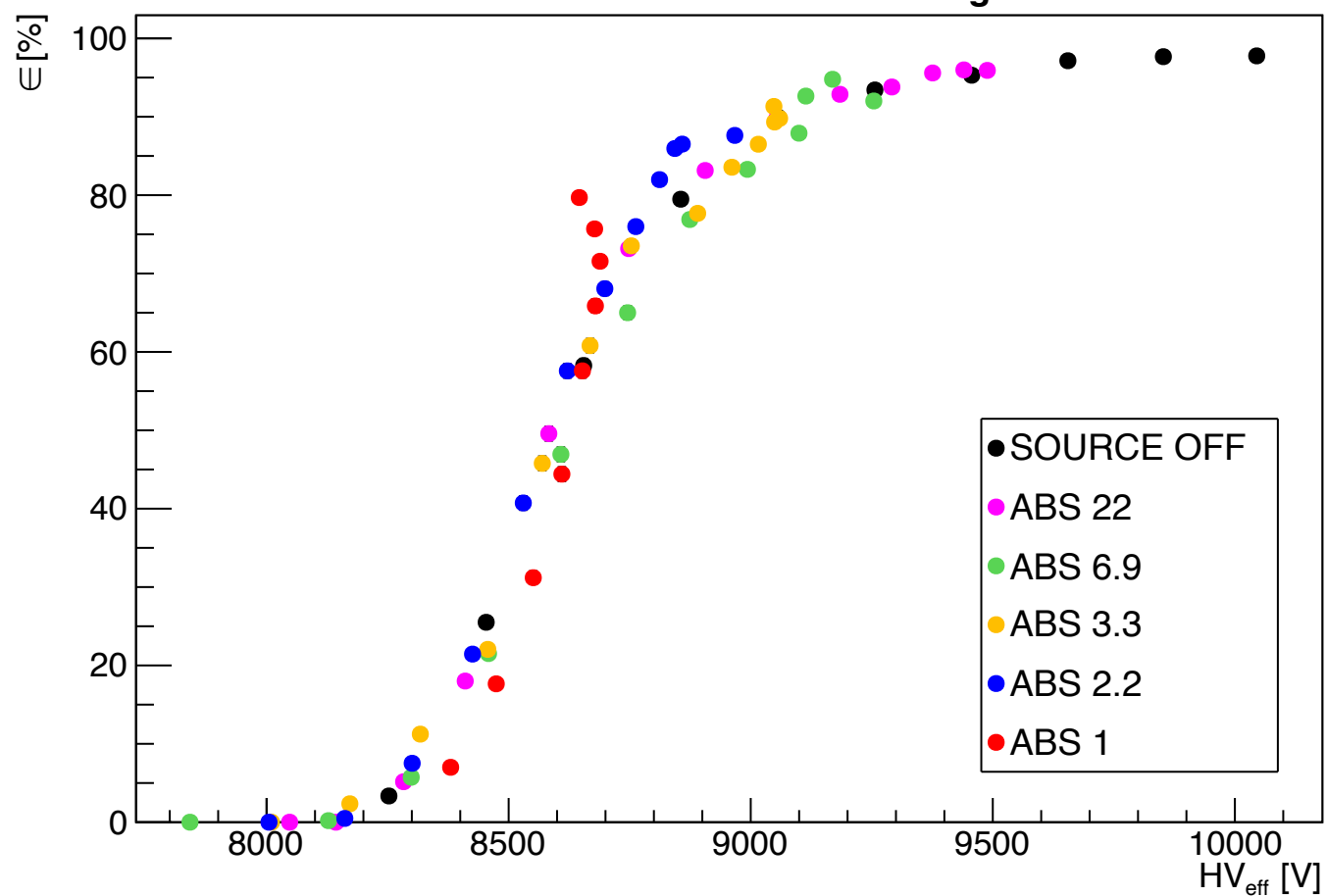
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2D Efficiency curves
ECOgas@GIF++ eco2 mix

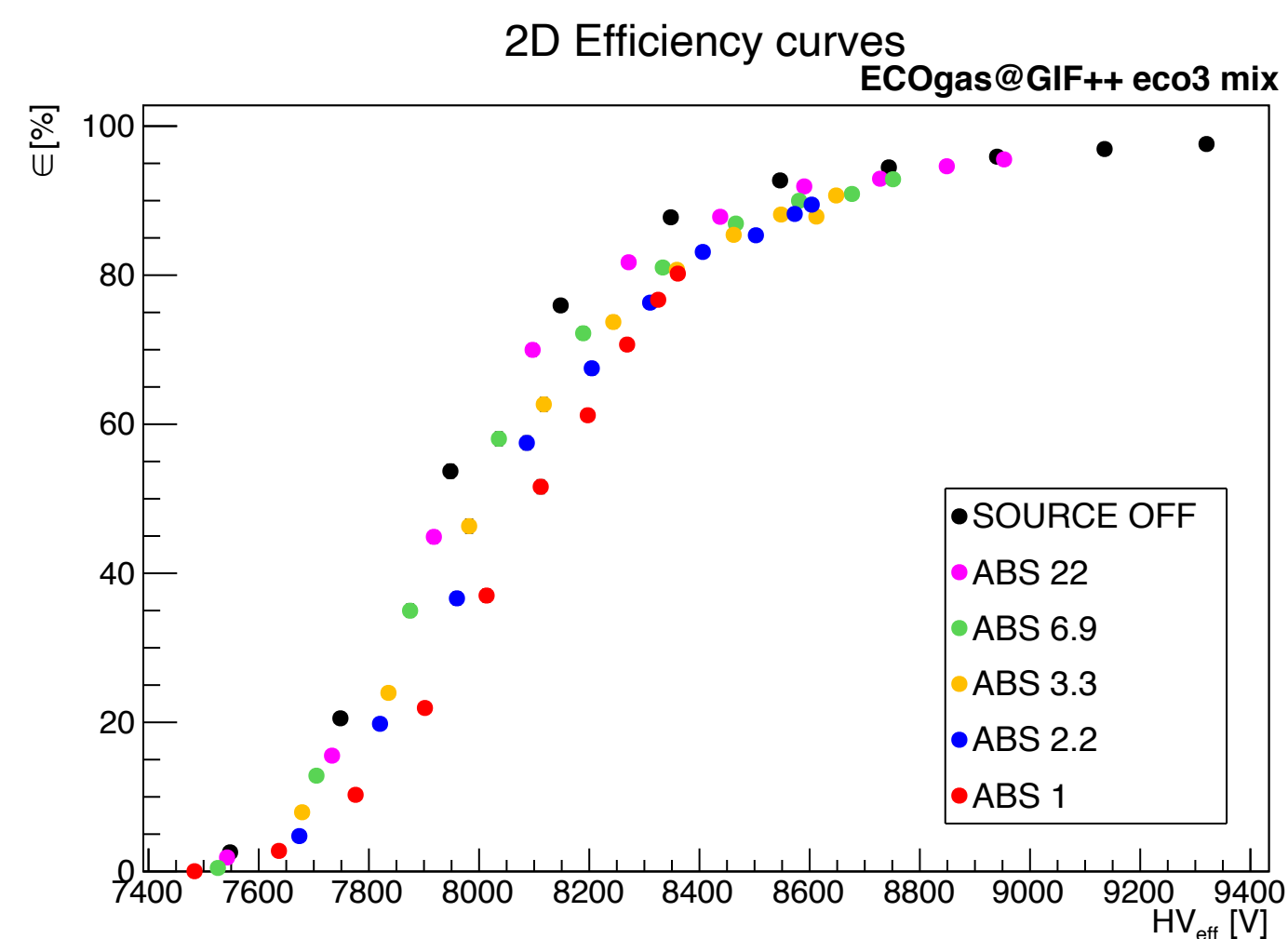


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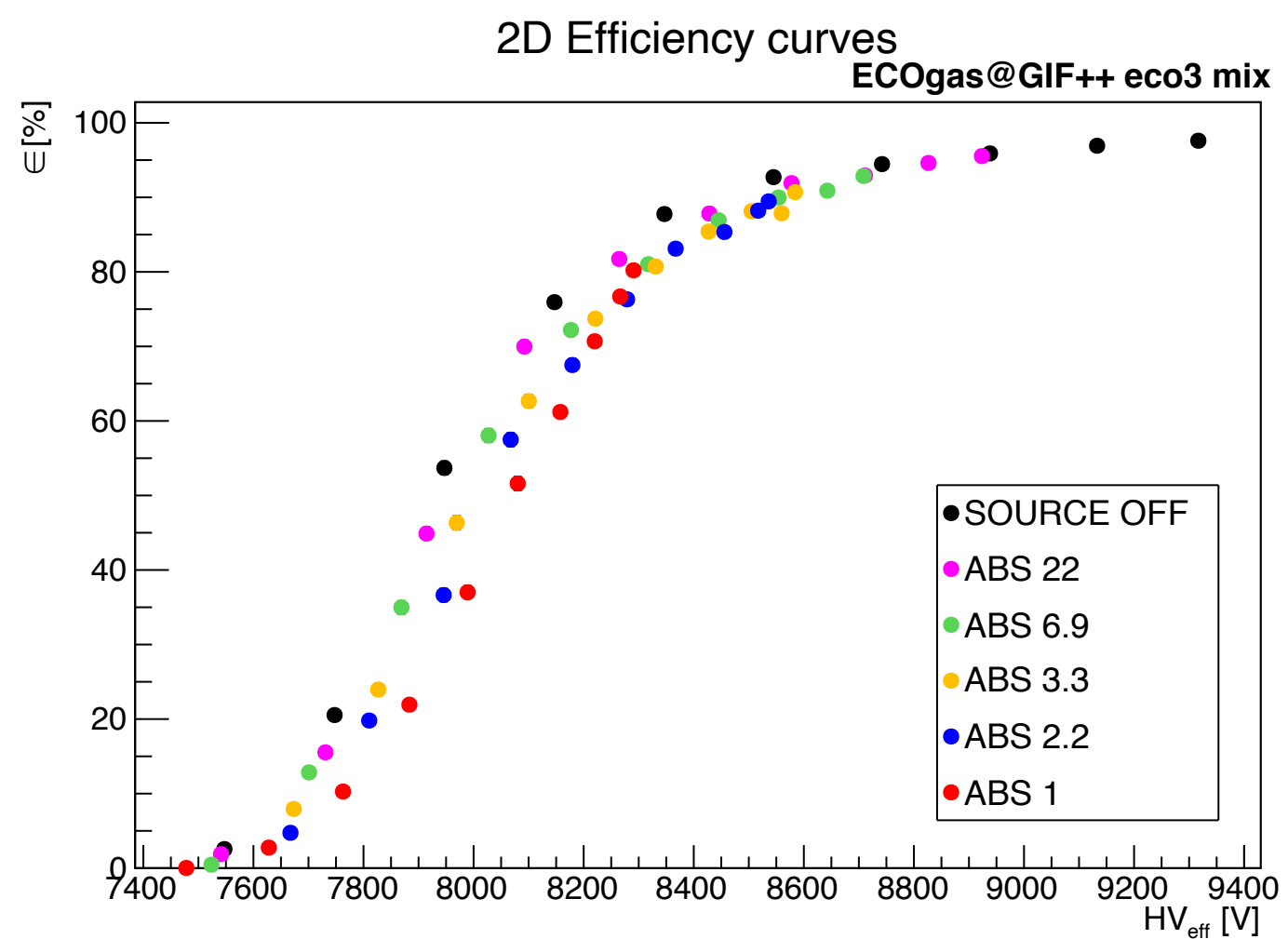
2D Efficiency curves
ECOgas@GIF++ eco2 mix



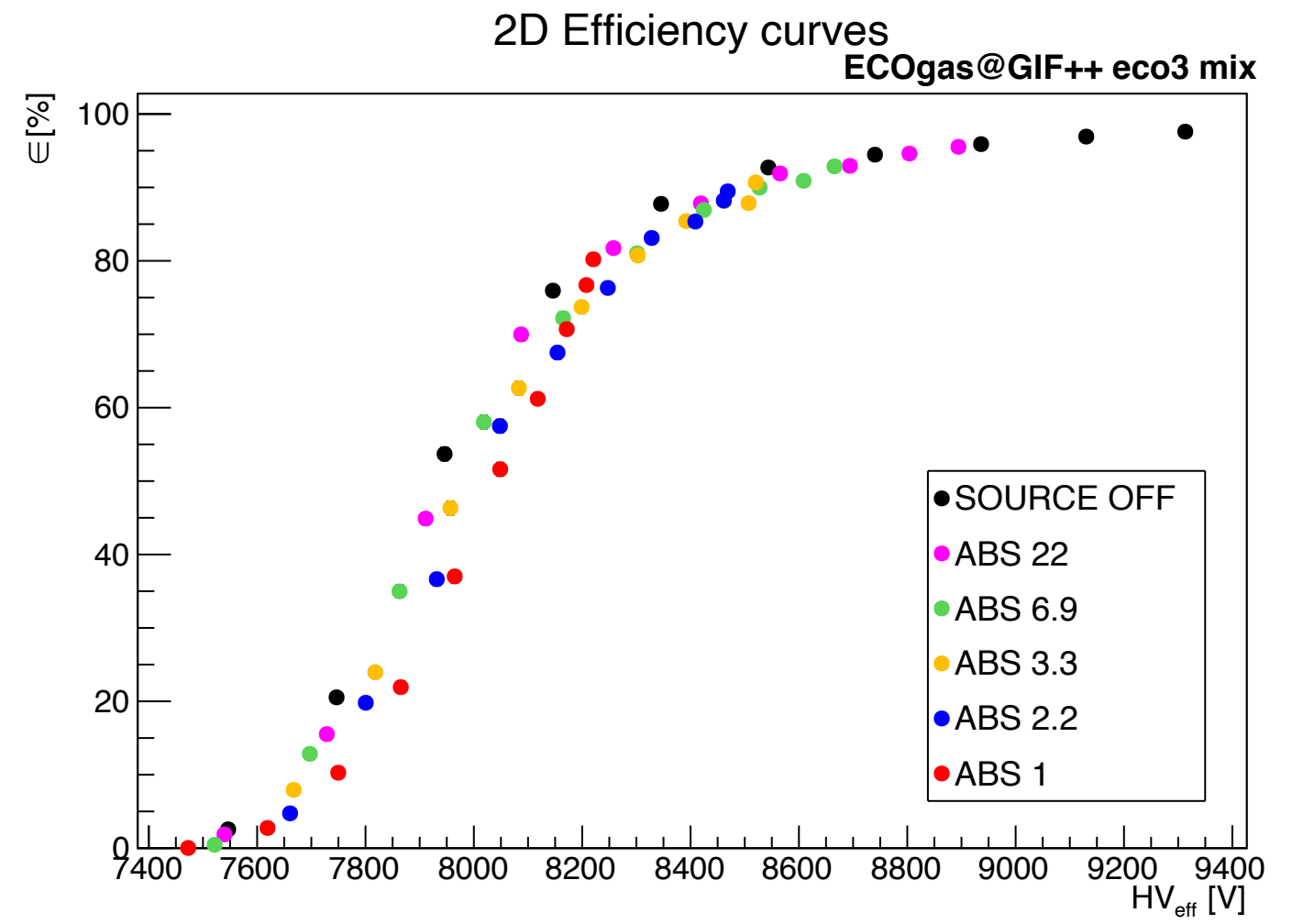
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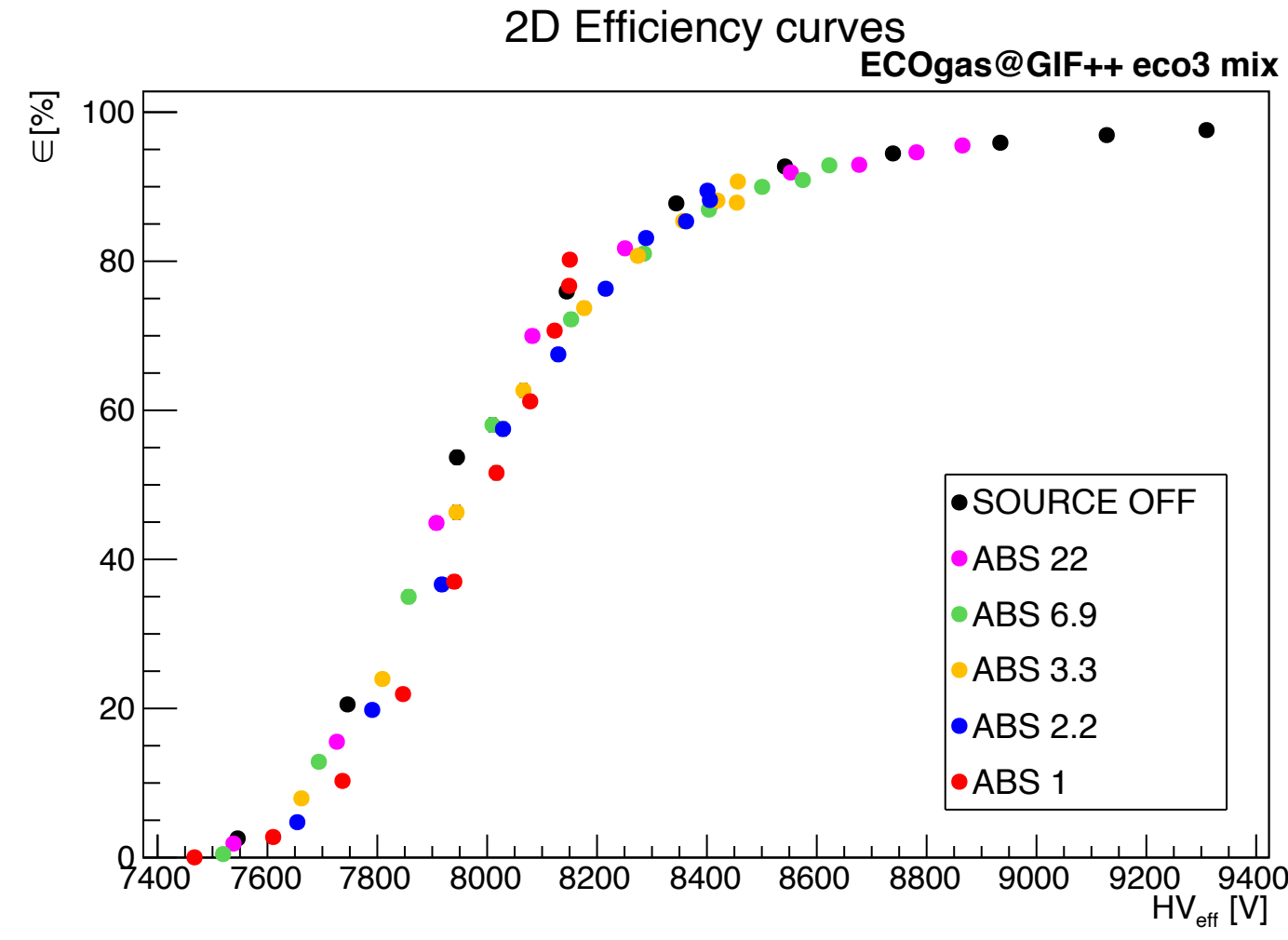
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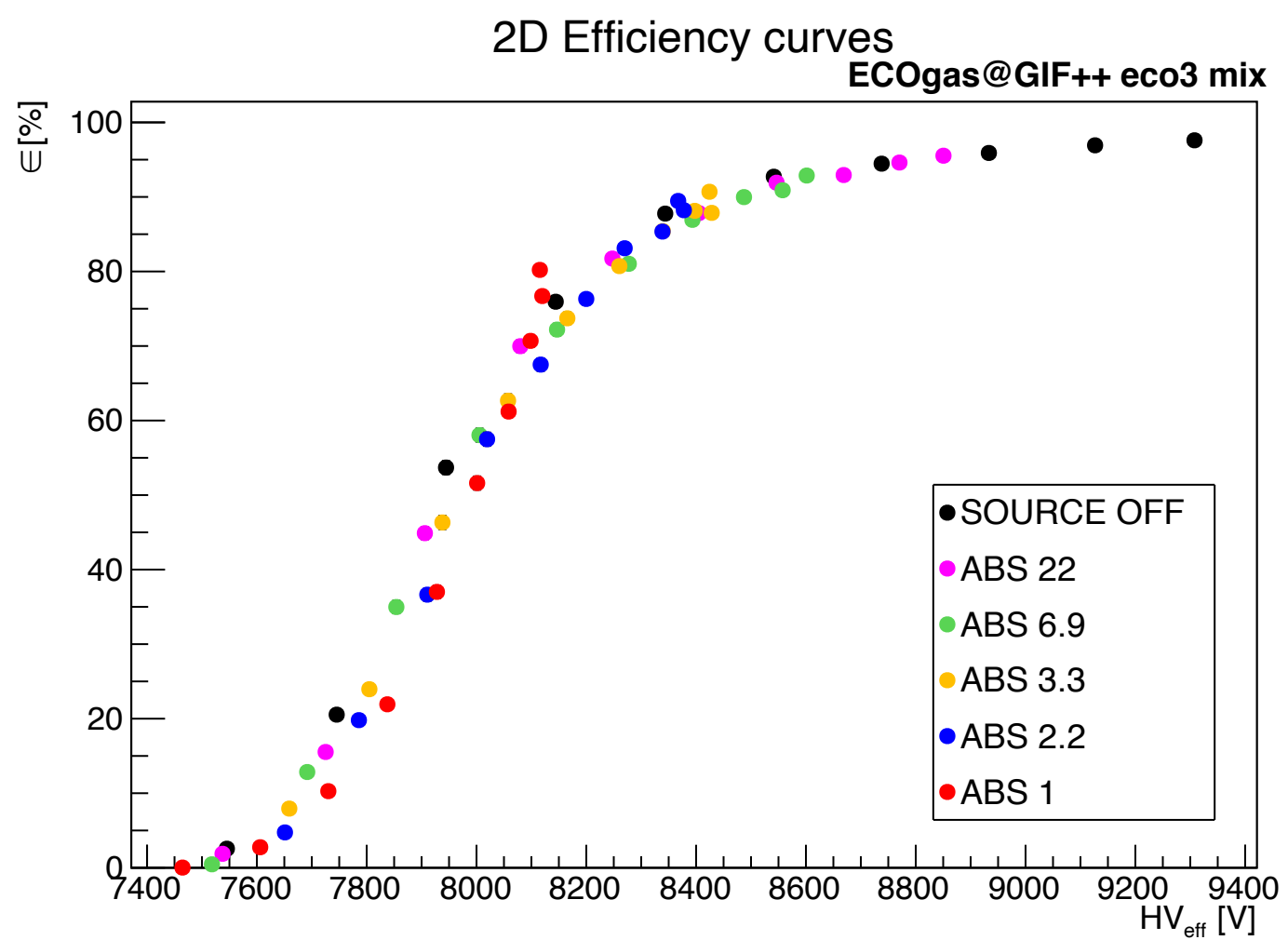
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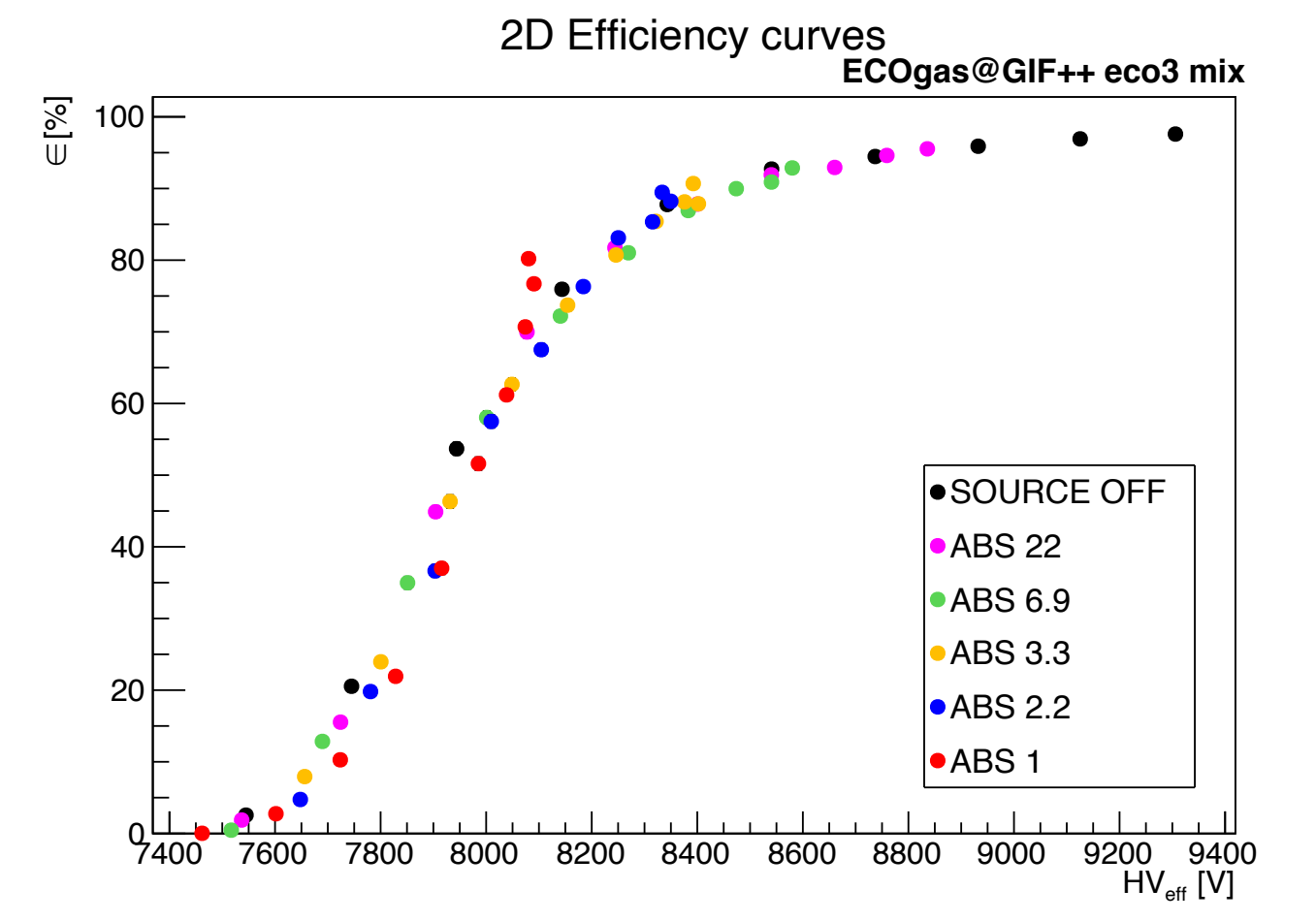
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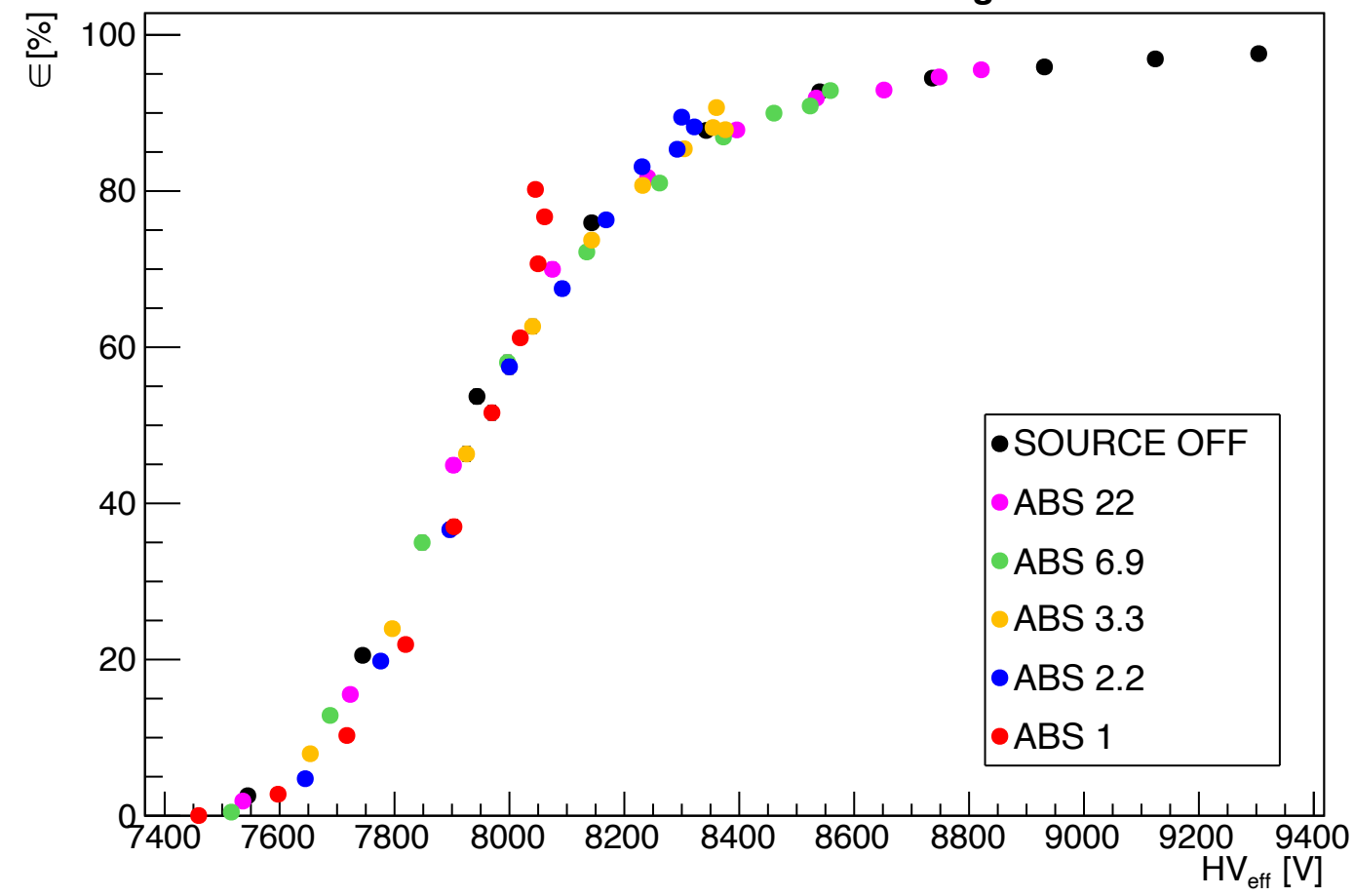


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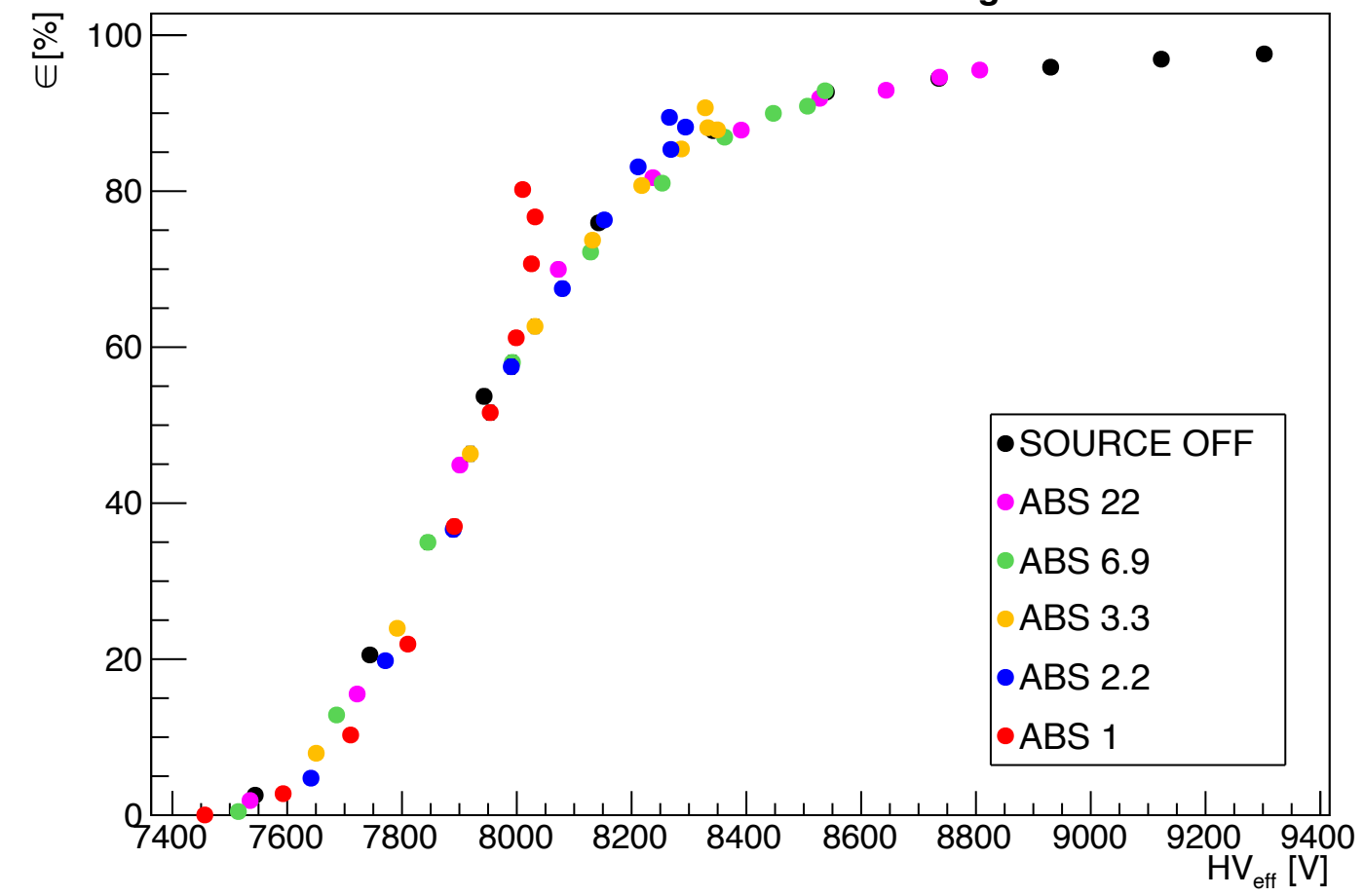
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2D Efficiency curves
ECOGas@GIF++ eco3 mix



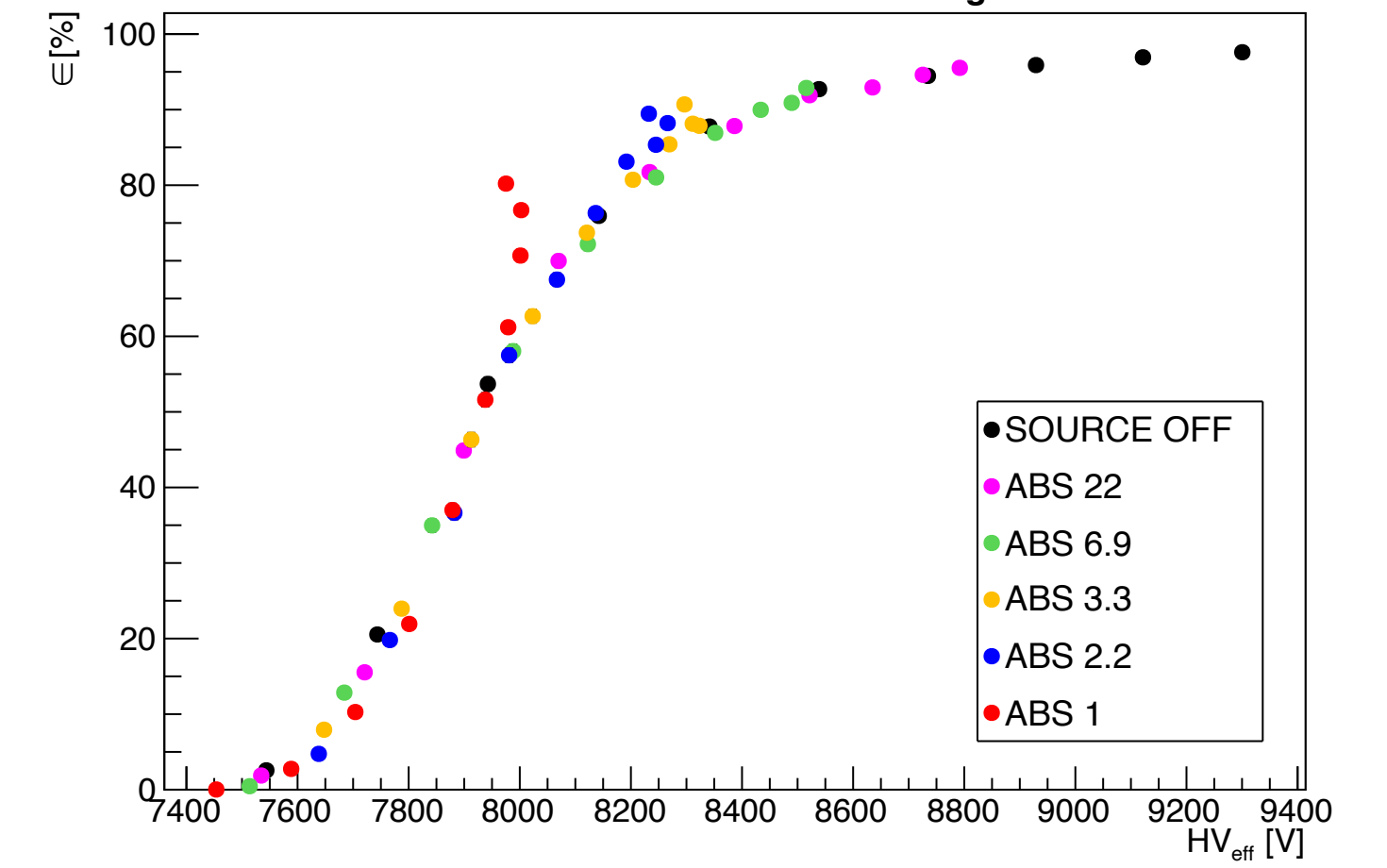
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2D Efficiency curves
ECOGas@GIF++ eco3 mix



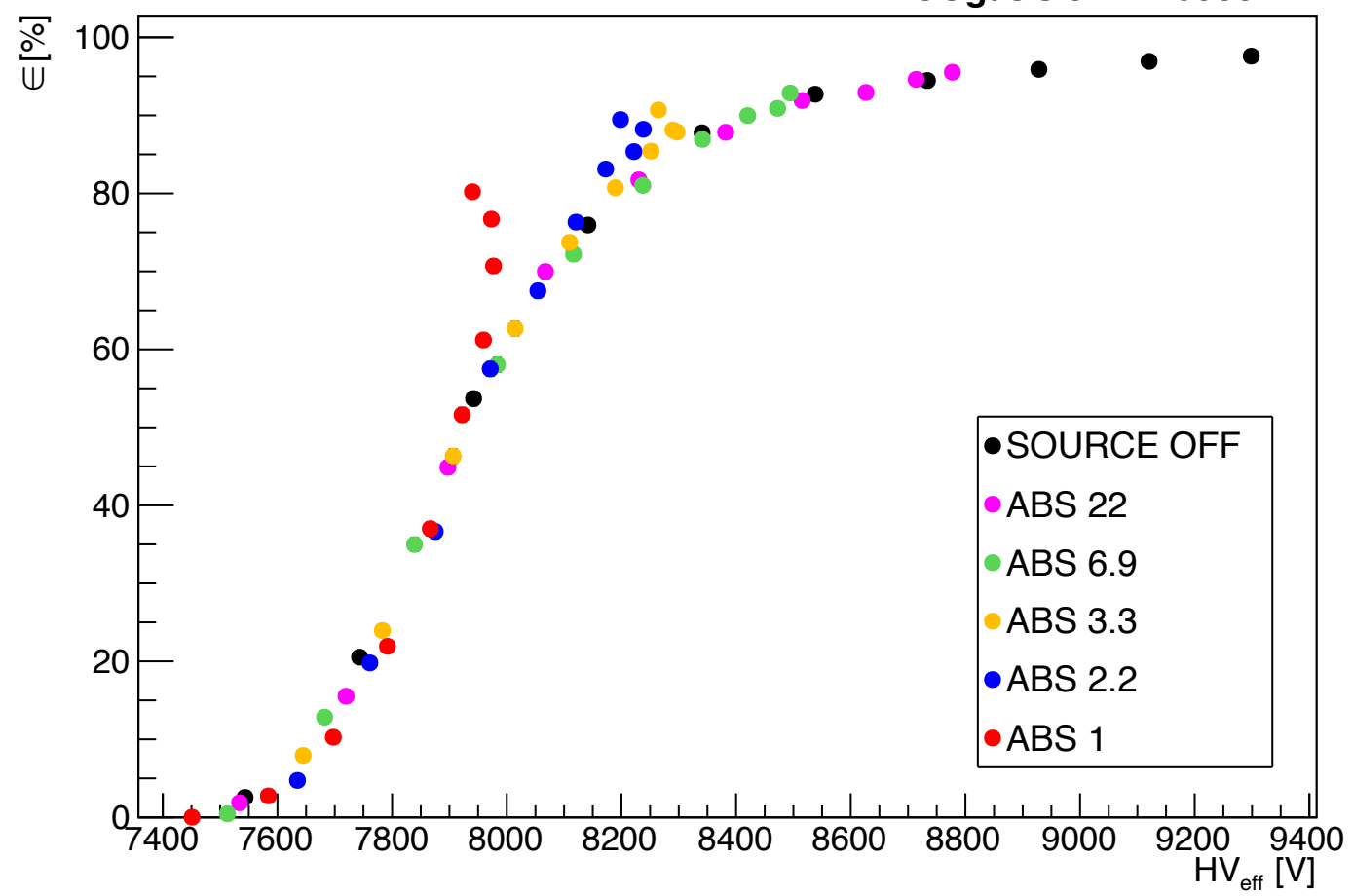
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2D Efficiency curves
ECOGas@GIF++ eco3 mix



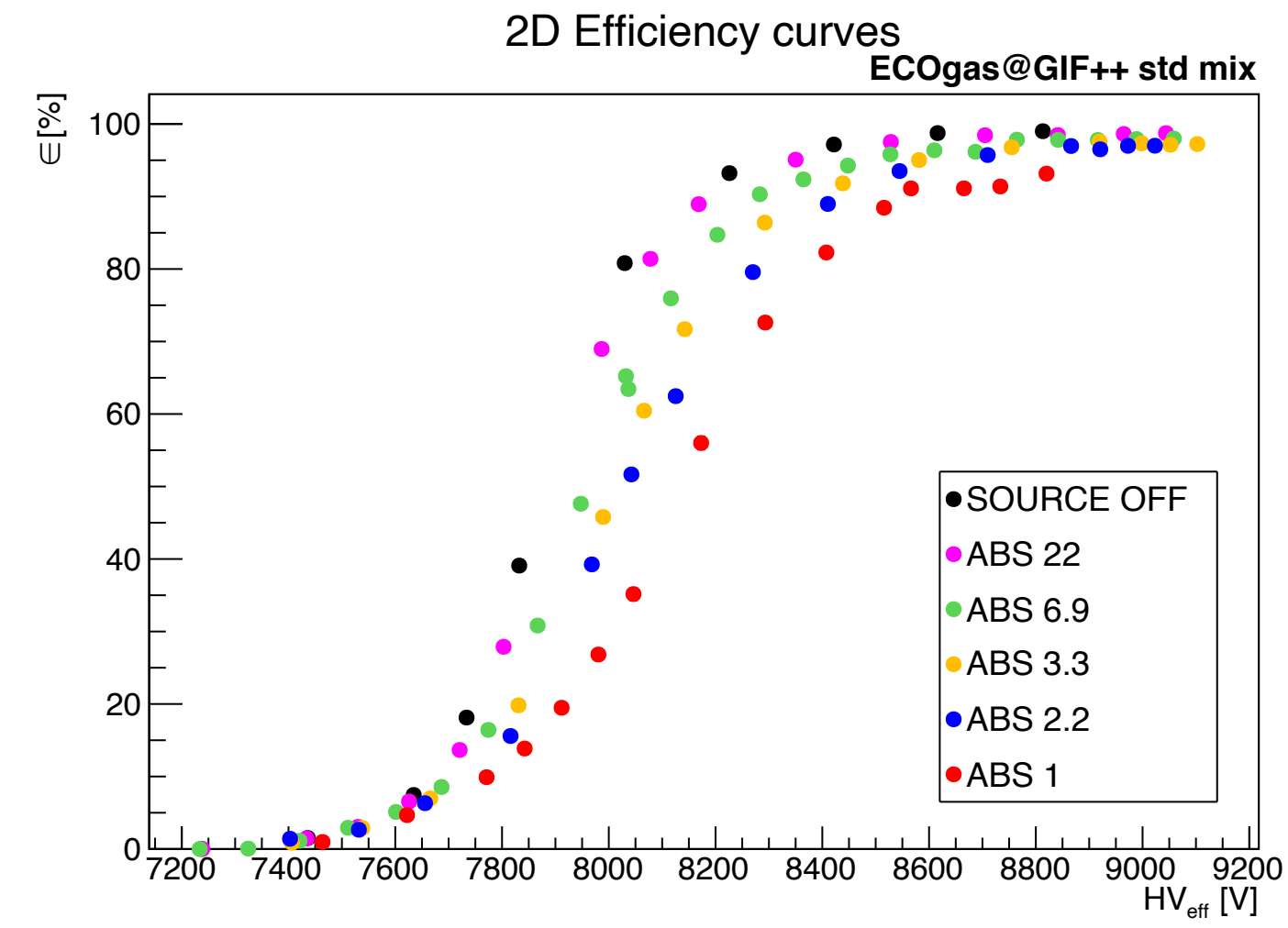
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2D Efficiency curves
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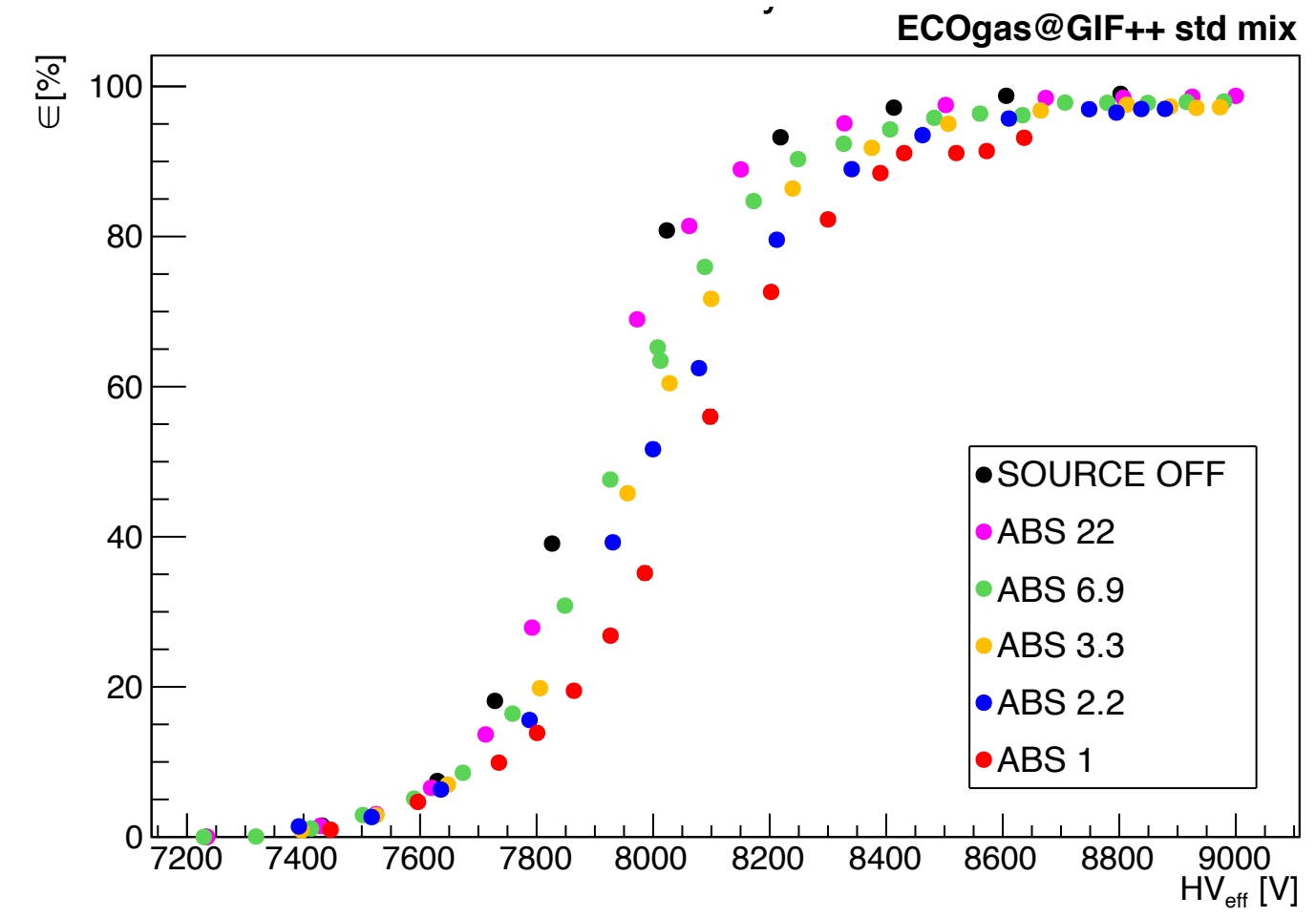


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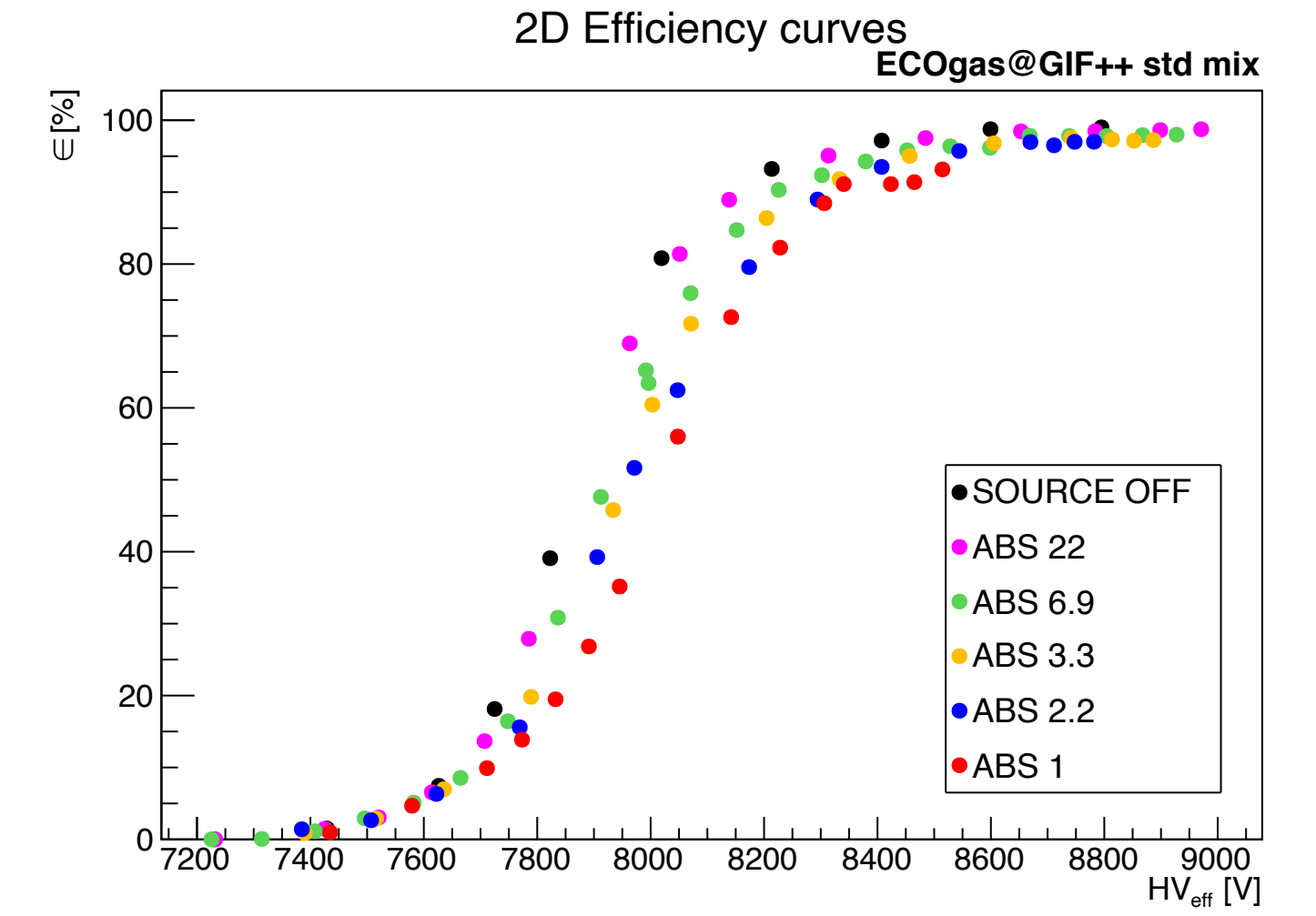
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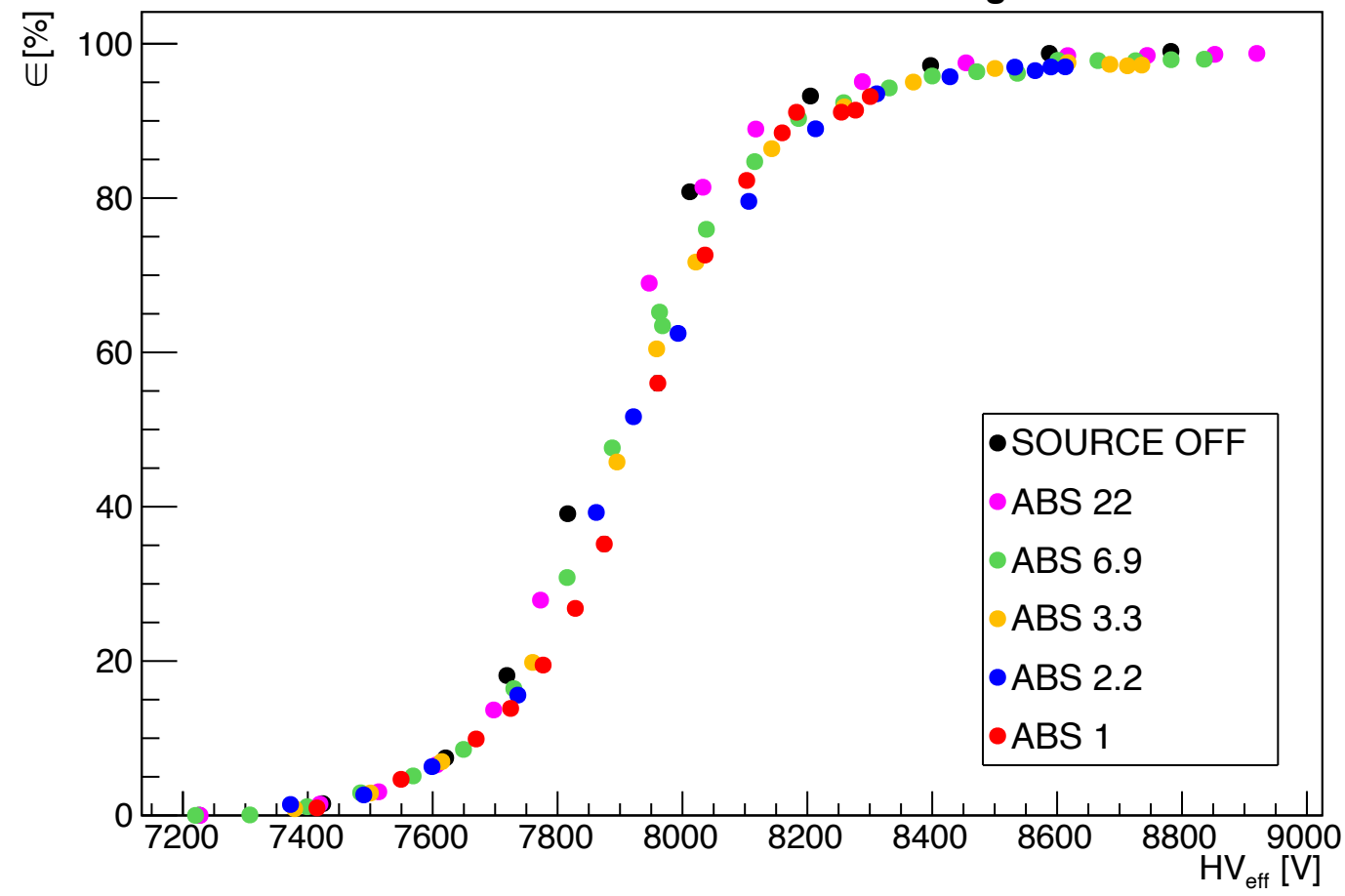
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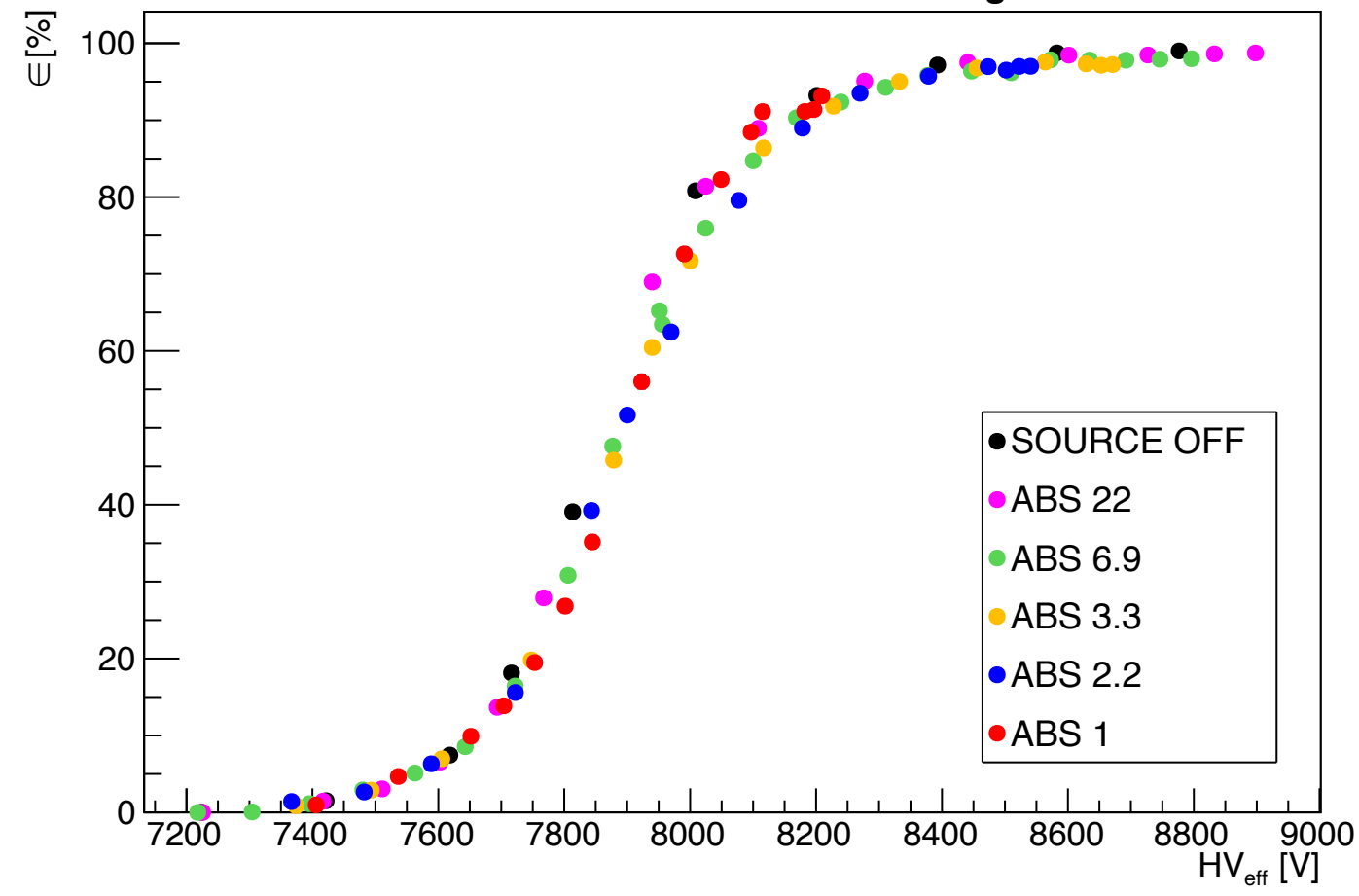
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2D Efficiency curves
ECOgas@GIF++ std mix



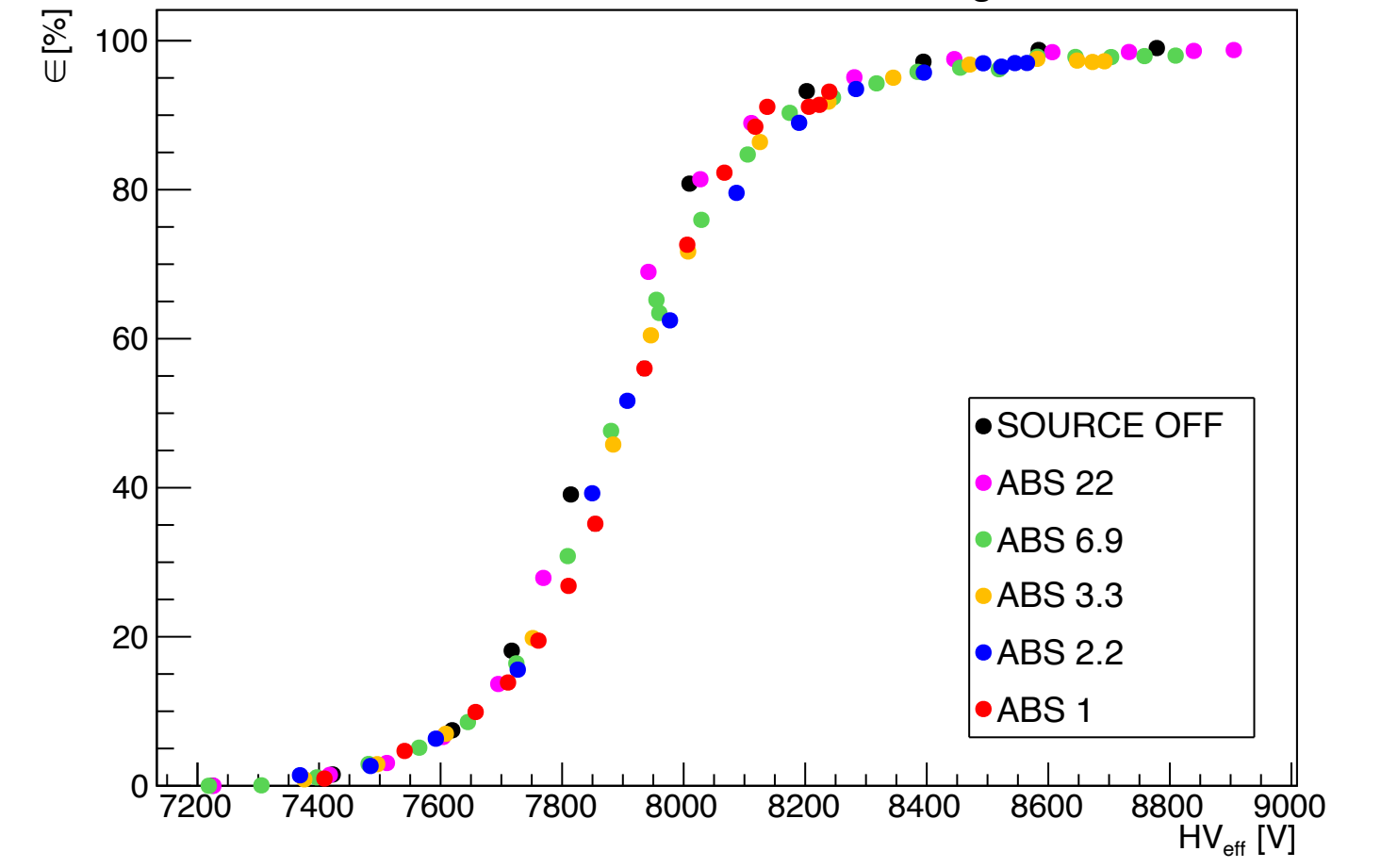
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2D Efficiency curves
ECOgas@GIF++ std mix



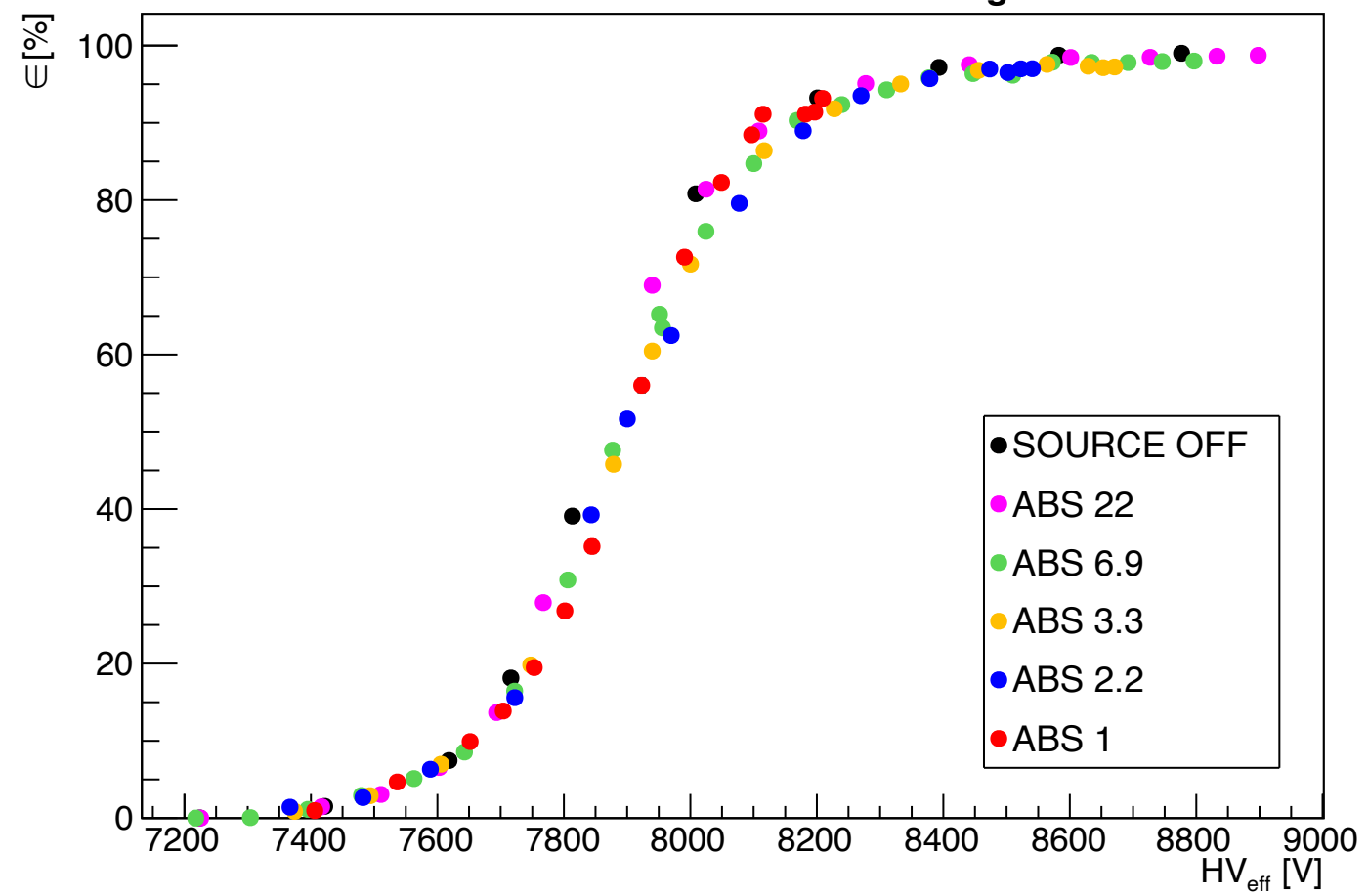
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2D Efficiency curves
ECOgas@GIF++ std mix



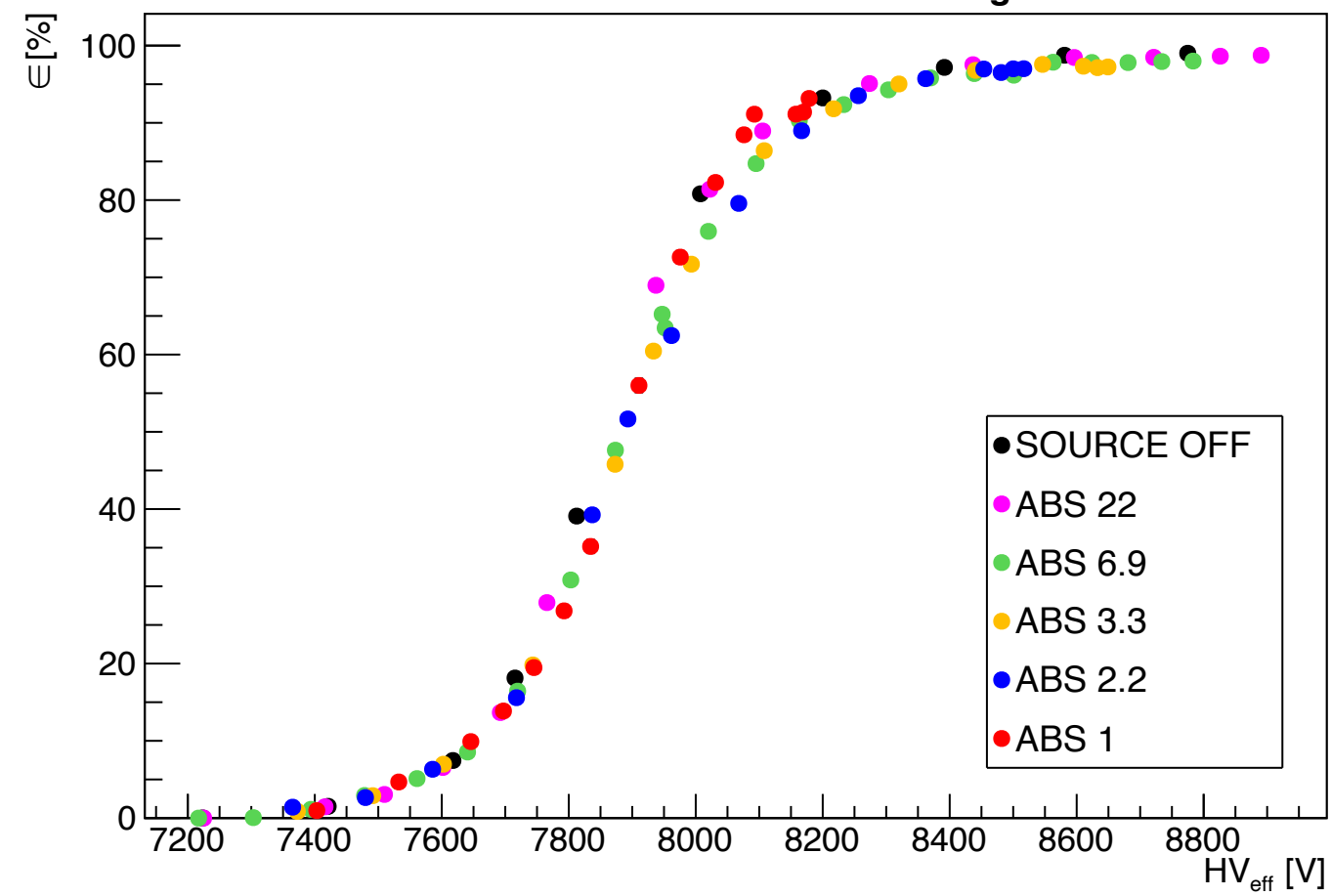
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2D Efficiency curves
ECOgas@GIF++ std mix



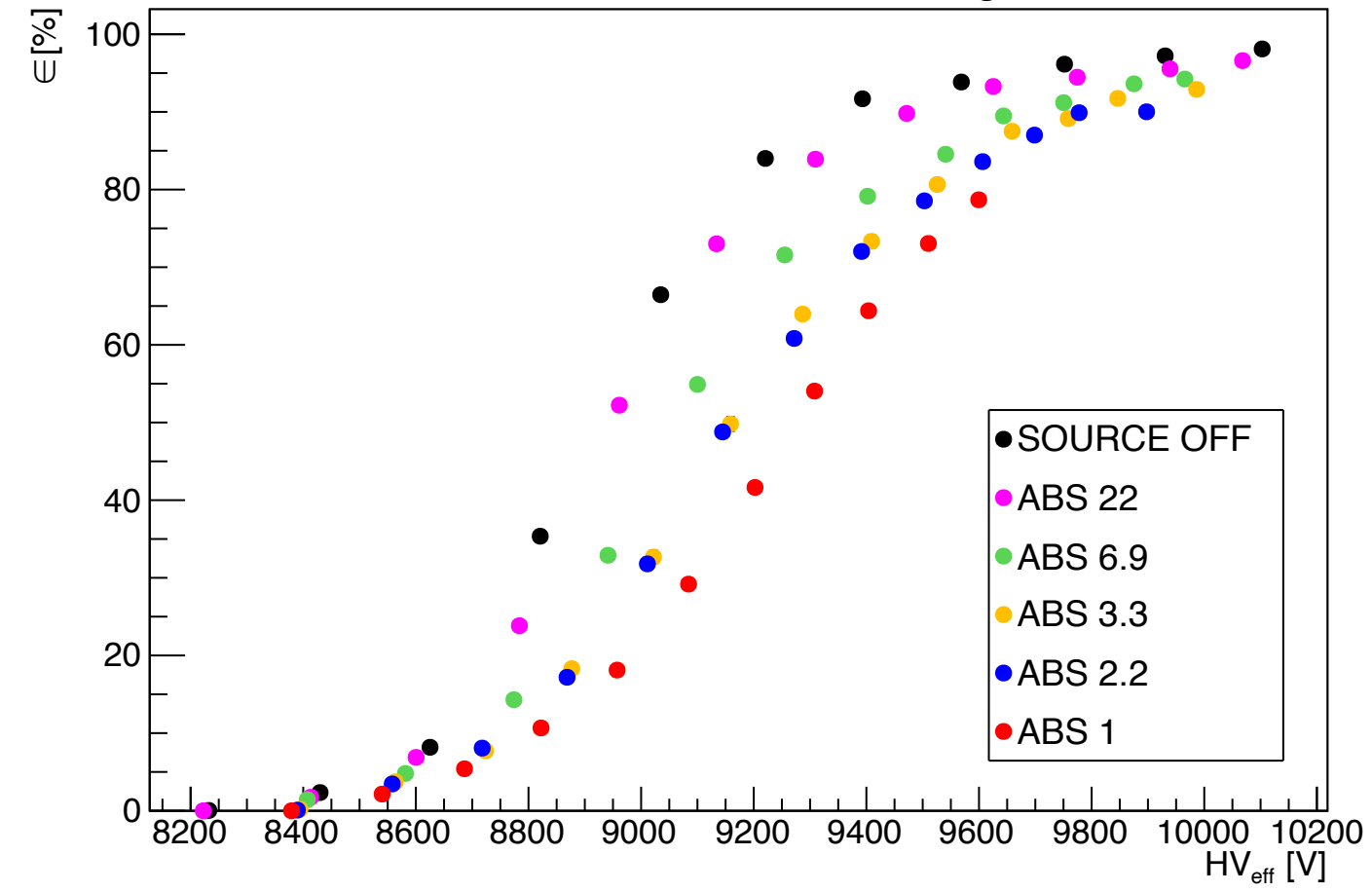
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2D Efficiency curves
ECOgas@GIF++ std mix



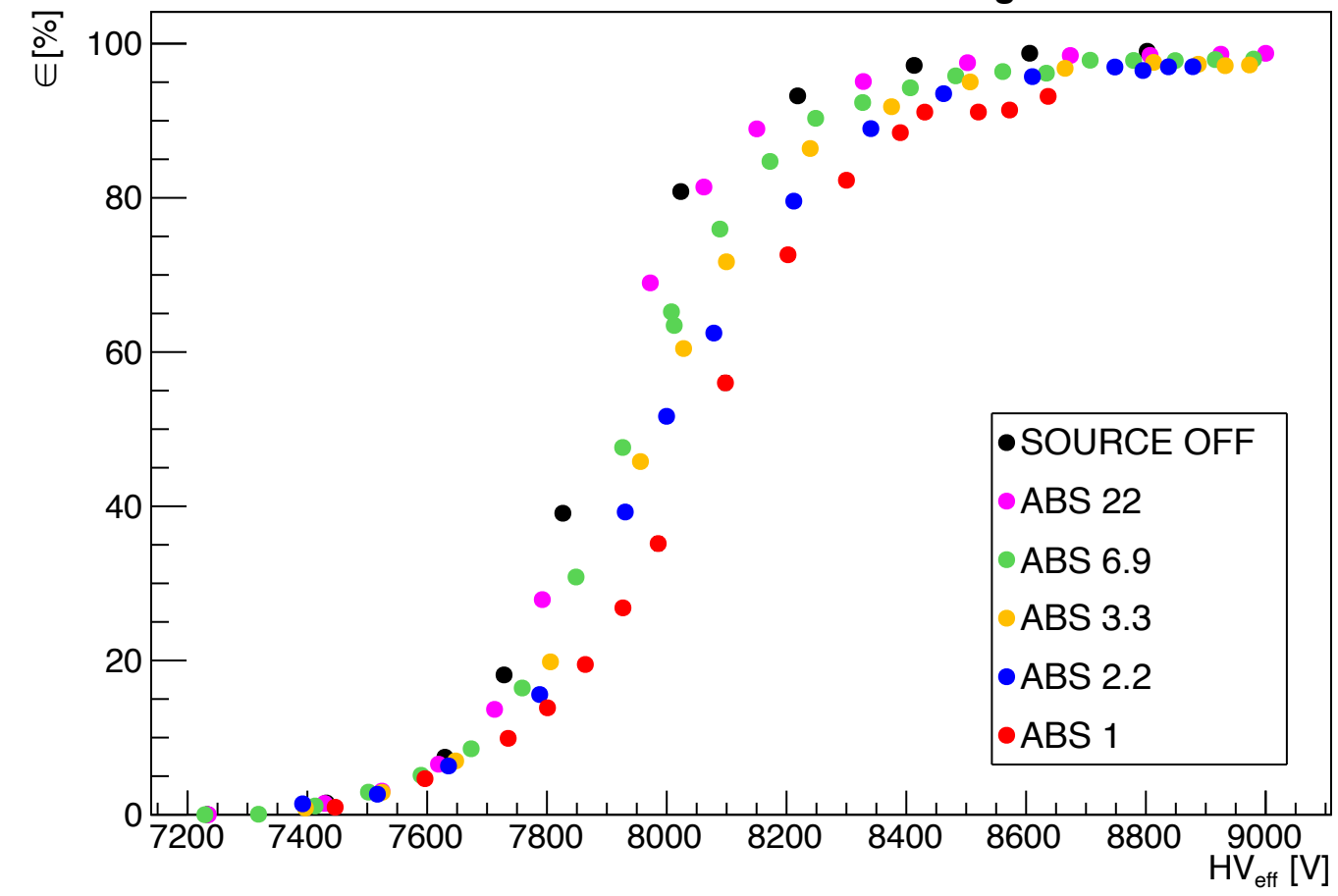
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2D Efficiency curves
ECOgas@GIF++ eco2 mix



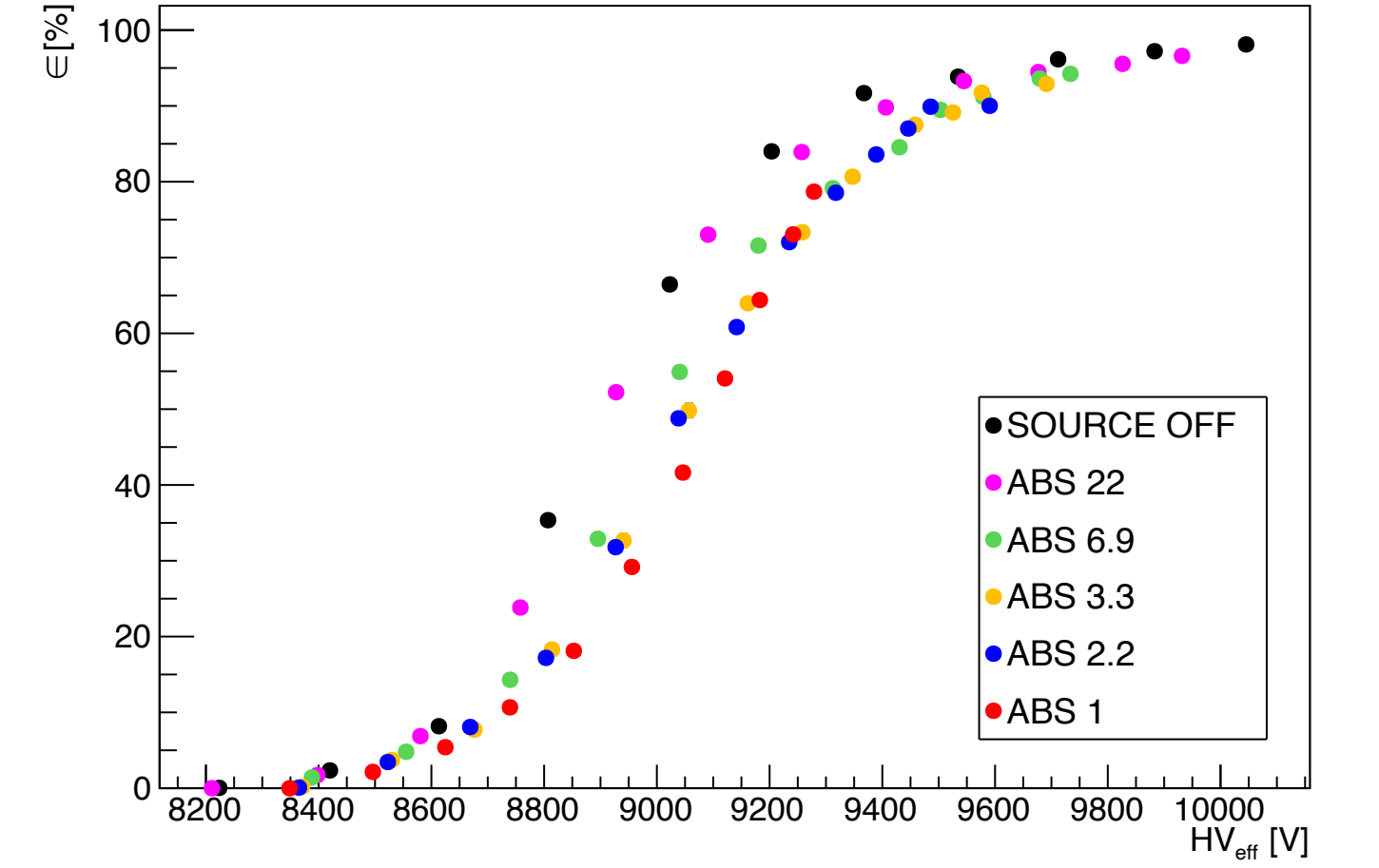
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ECOgas@GIF++ std mix

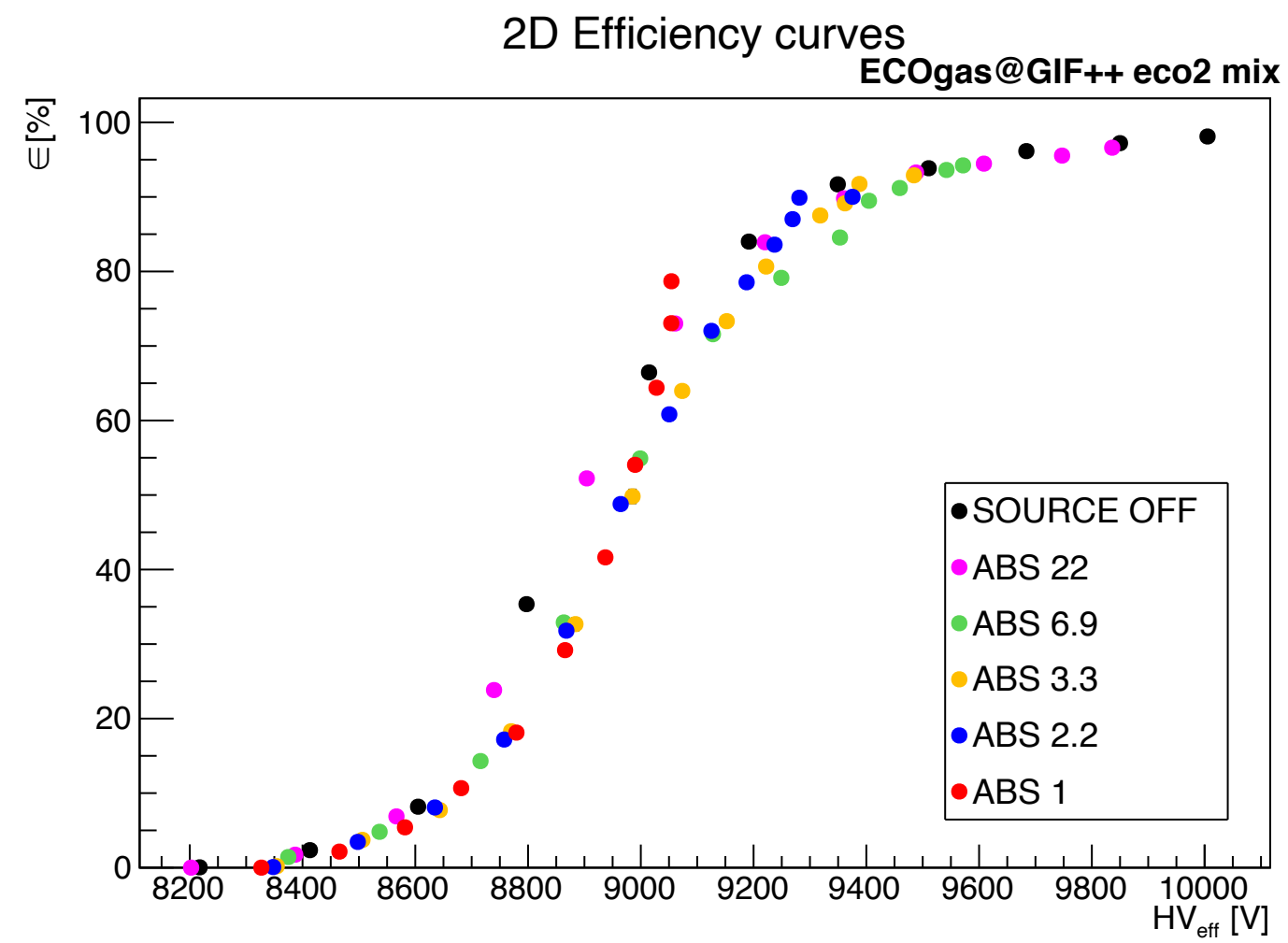


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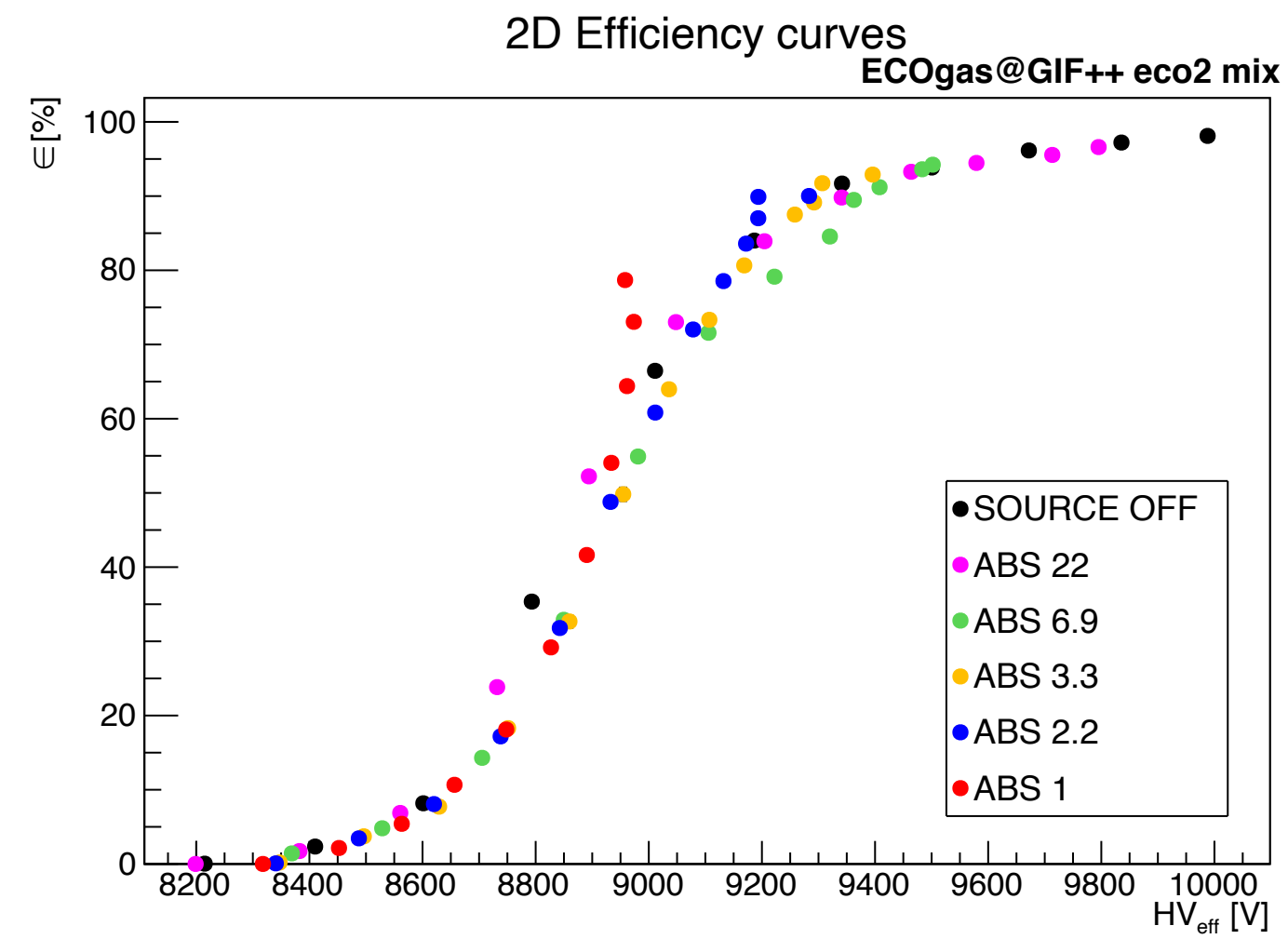
2D Efficiency curves
ECOgas@GIF++ eco2 mix



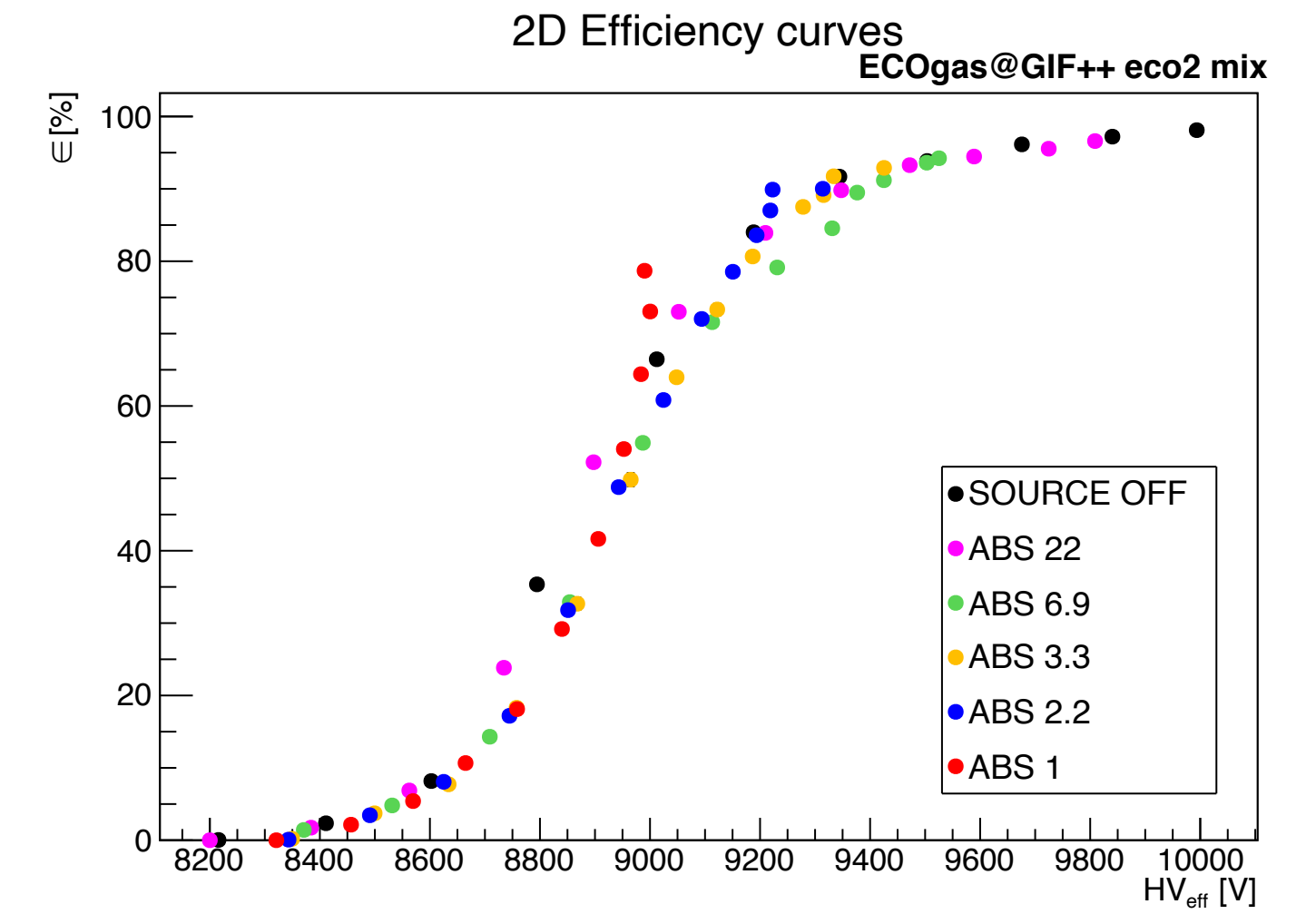
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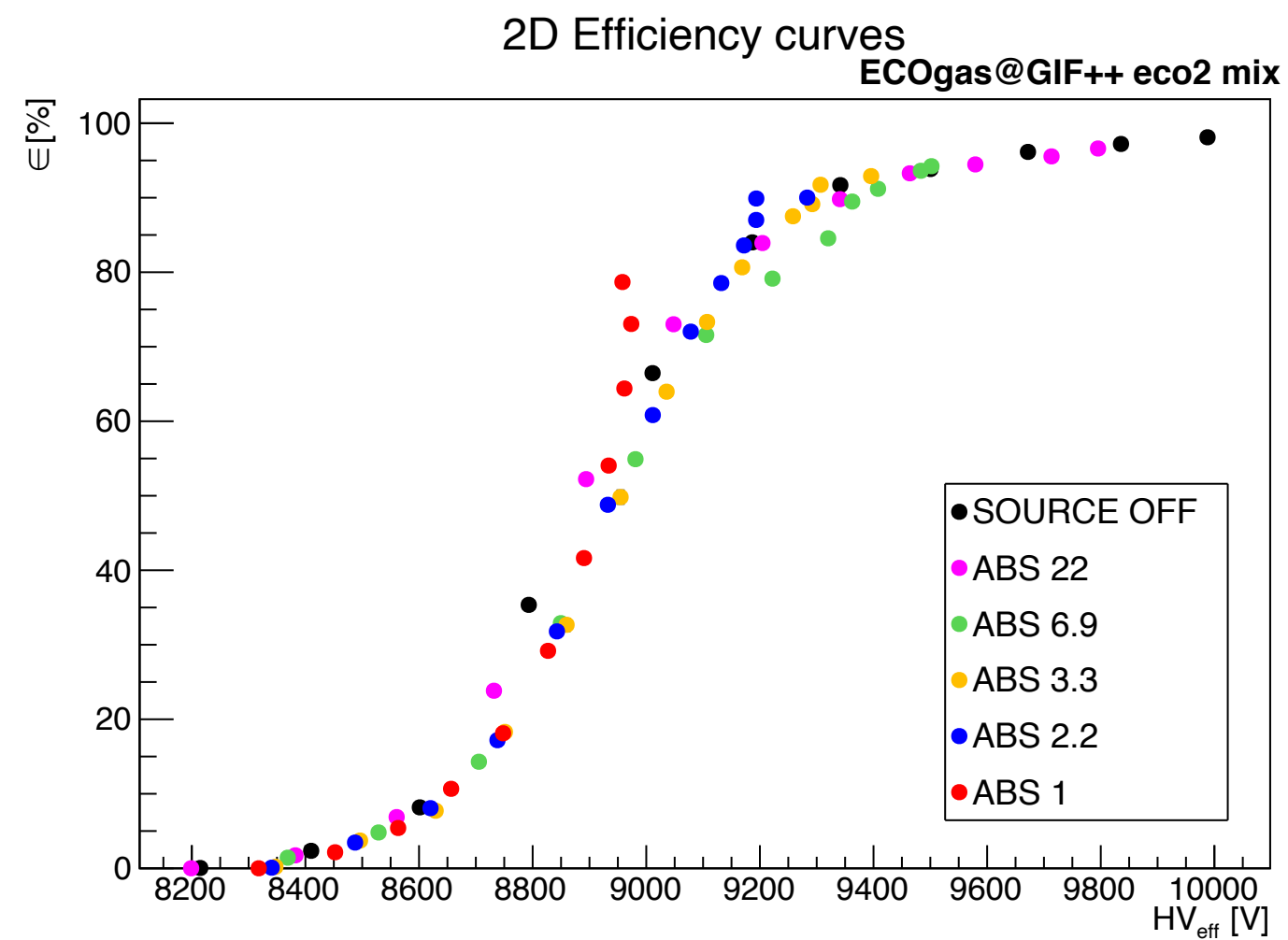
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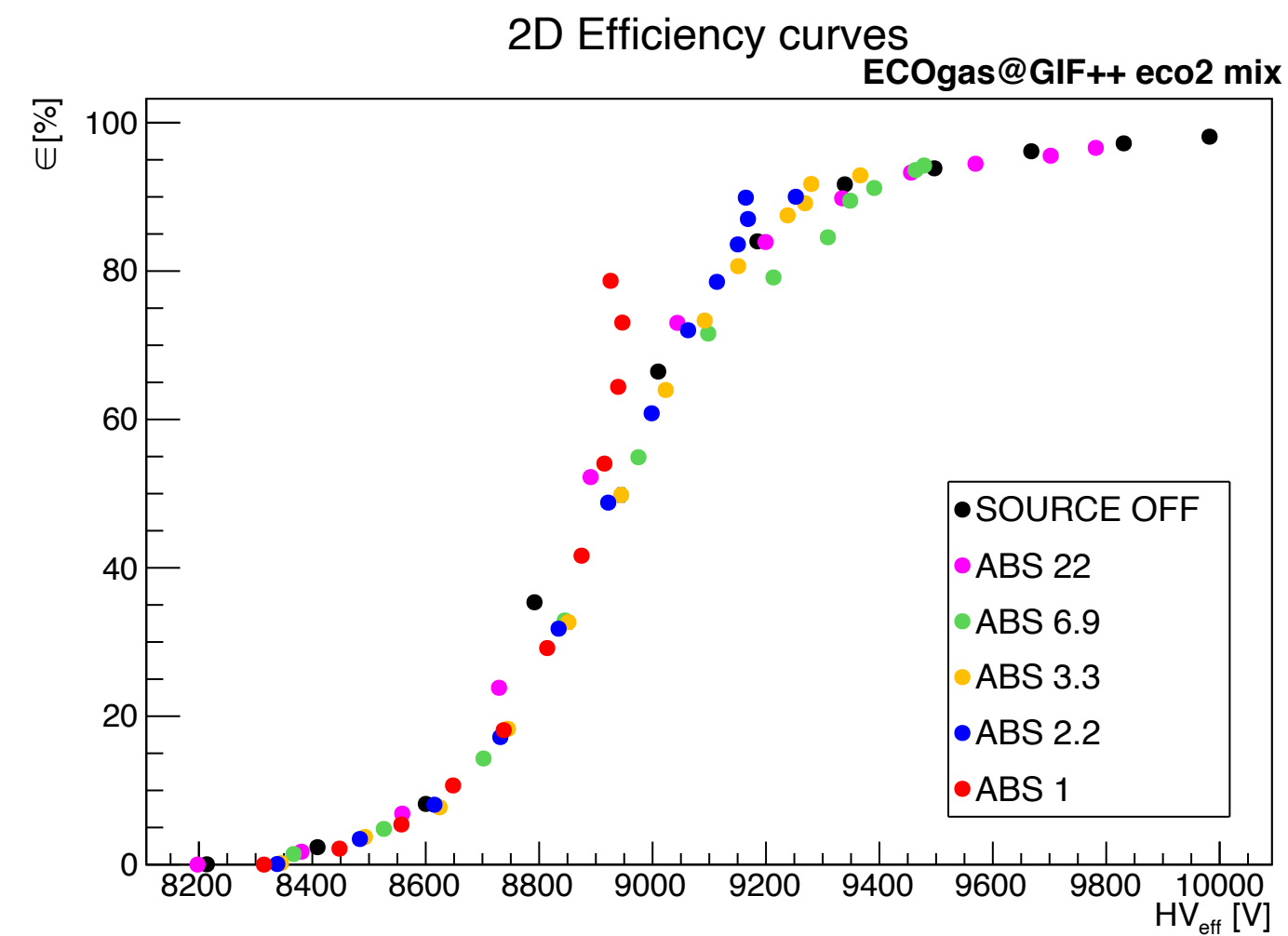
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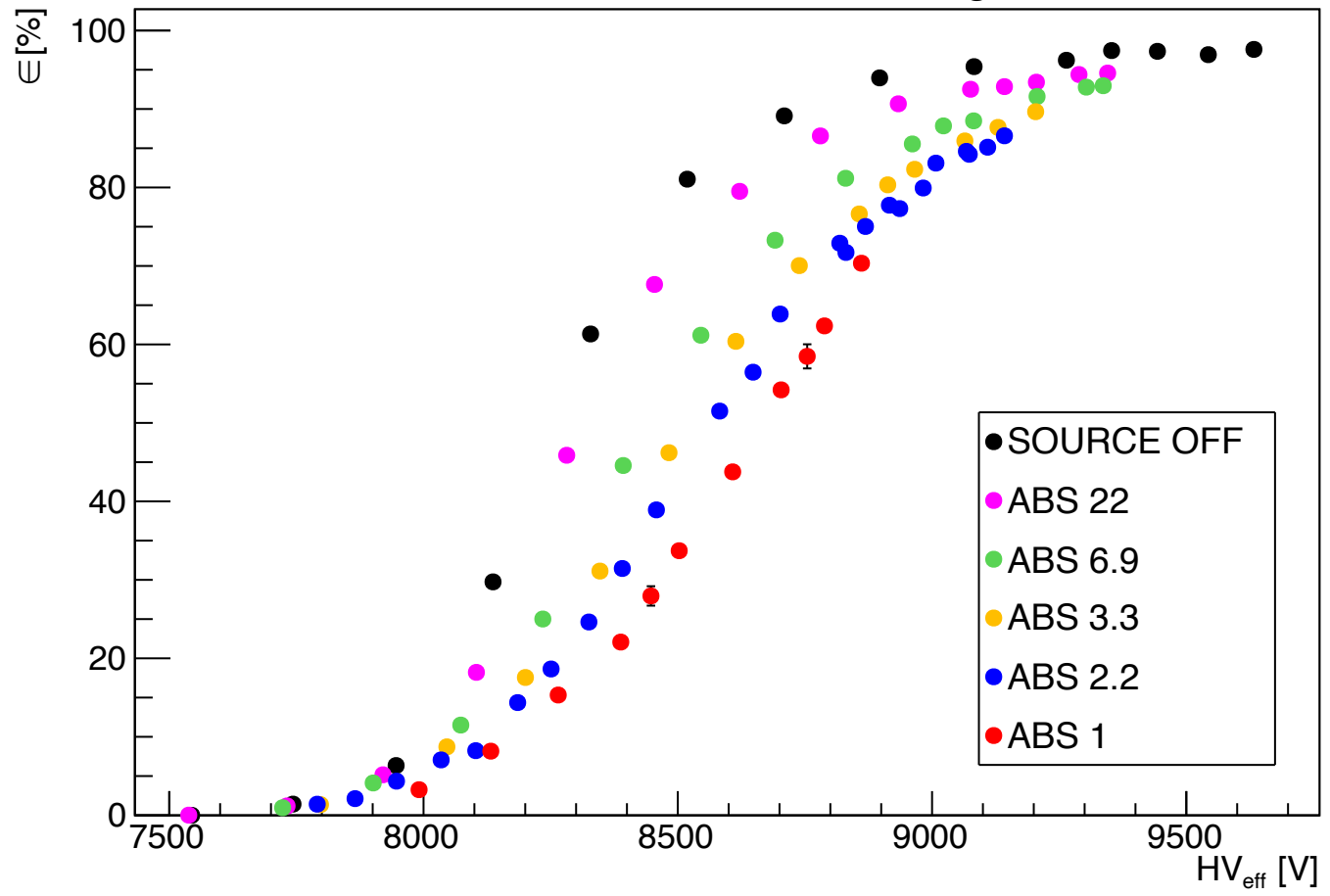
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202307 stdmix

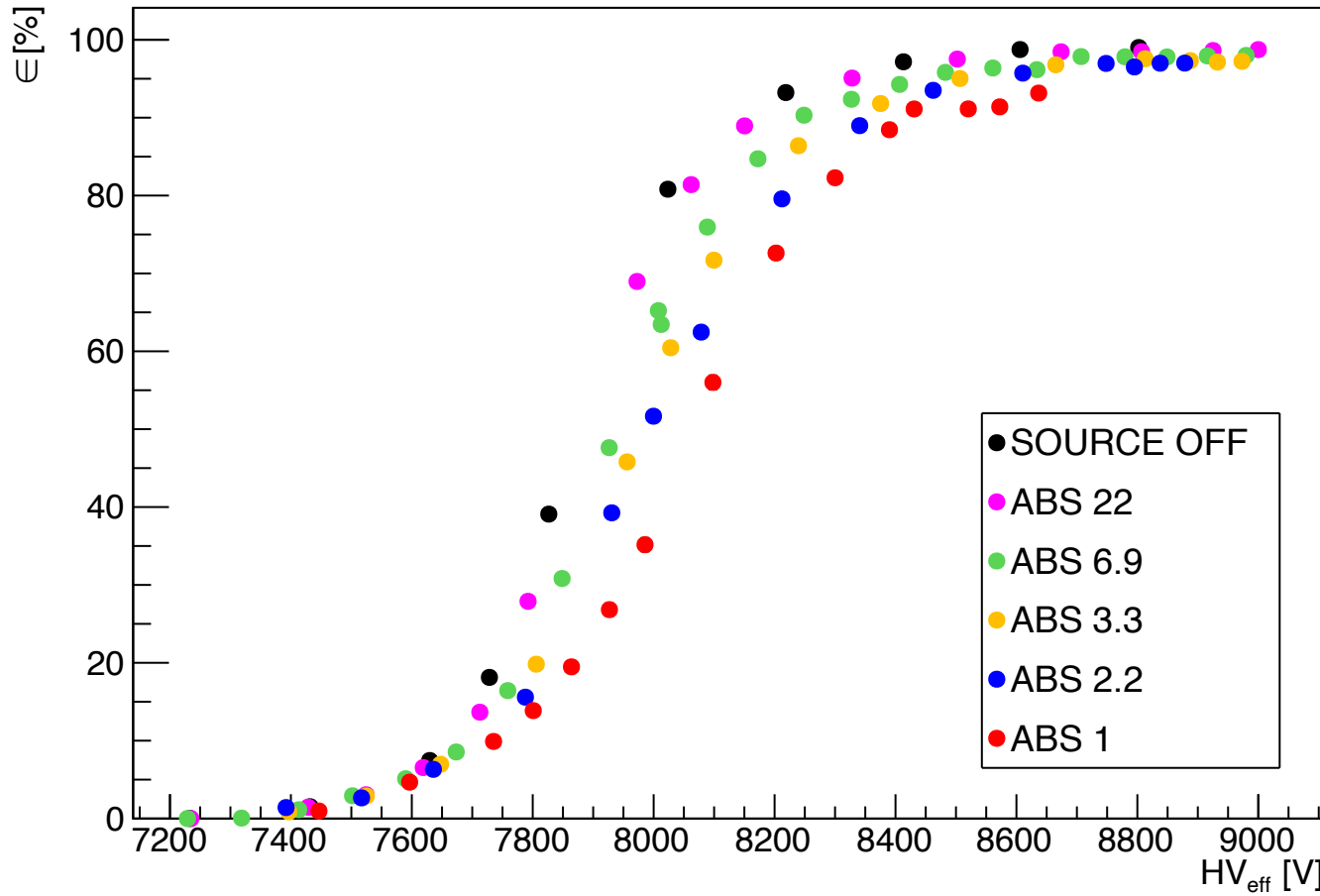
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2D Efficiency curves
ECOGas@GIF++ eco3 mix



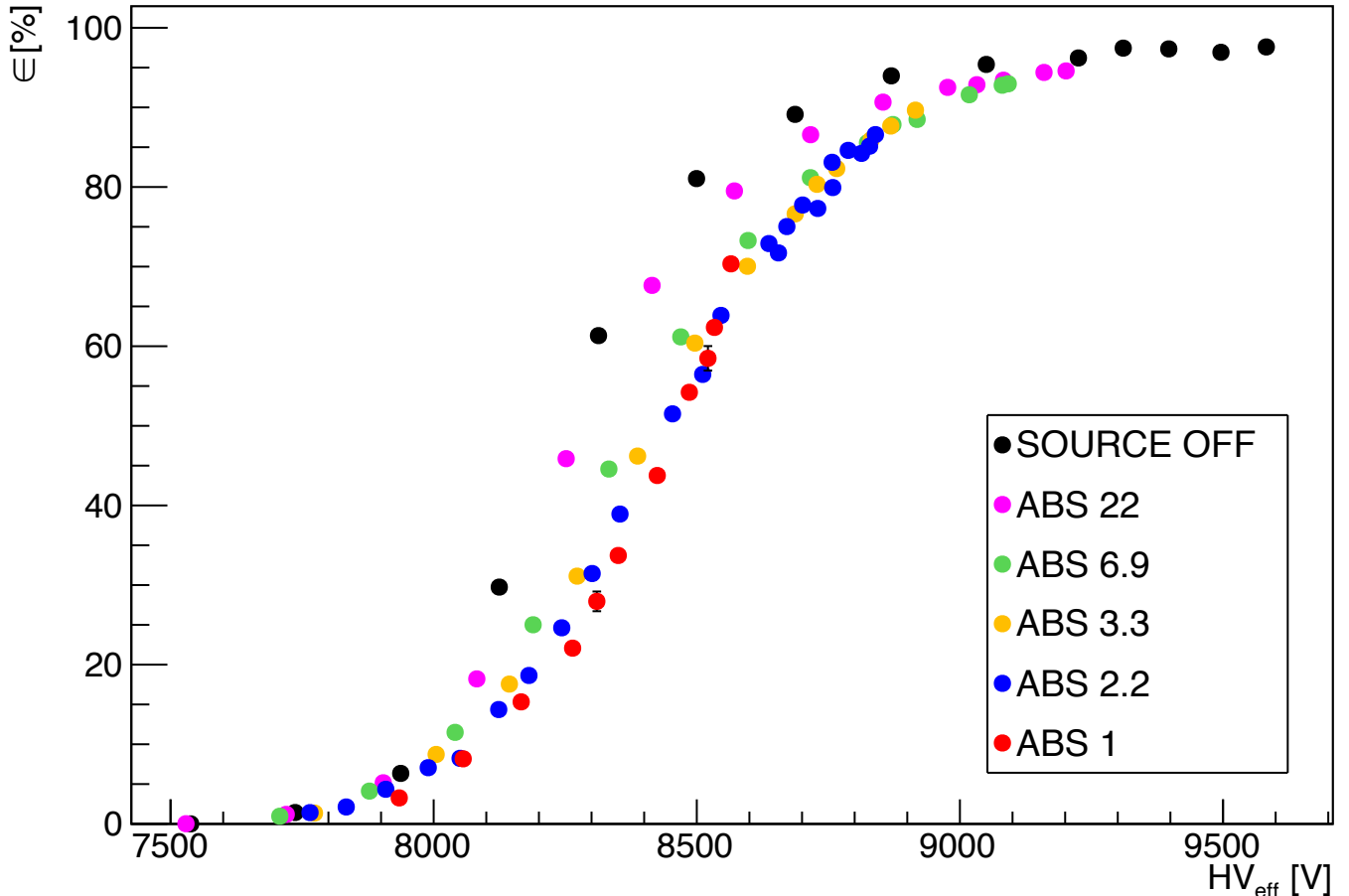
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ECOGas@GIF++ std mix



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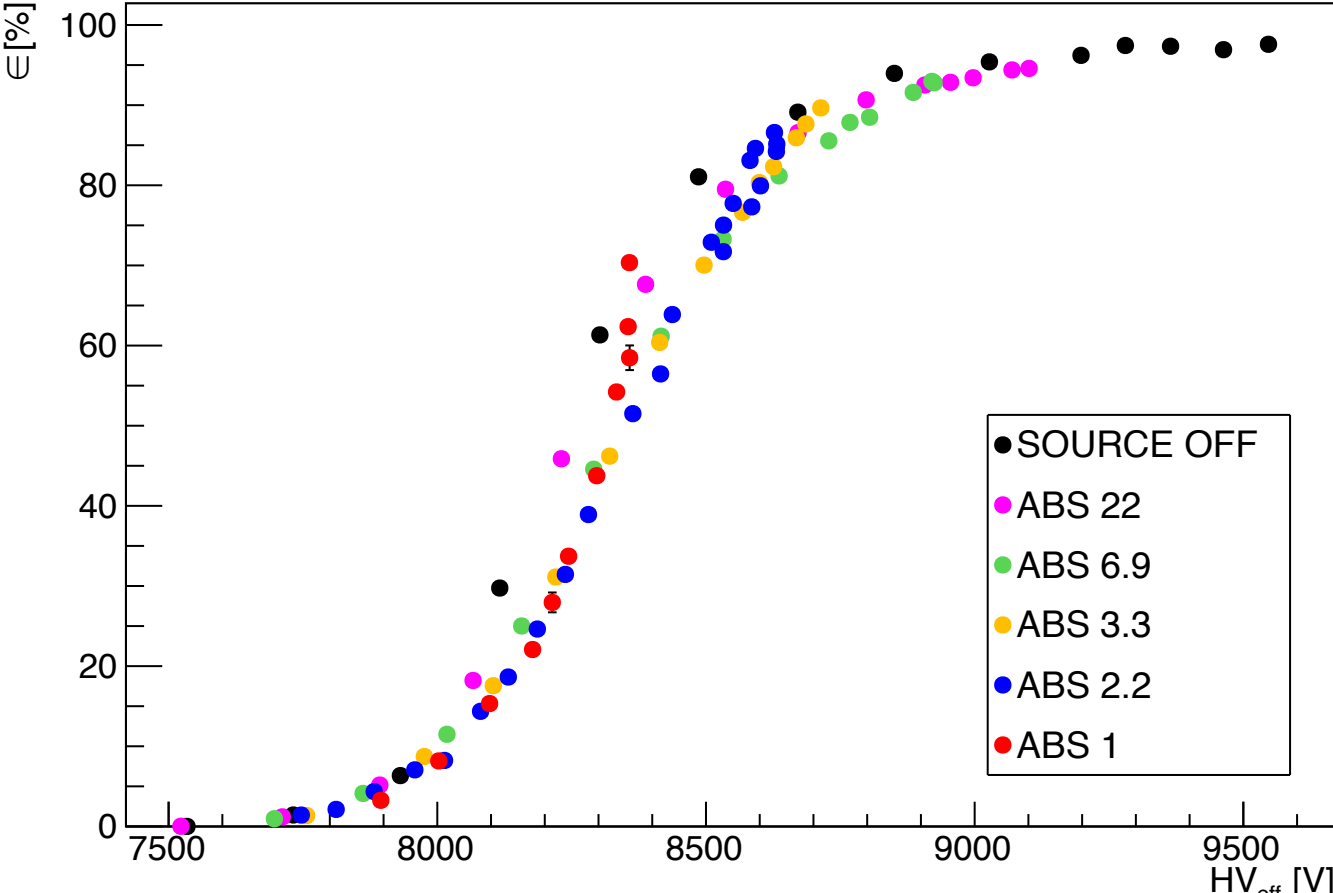
2D Efficiency curves
ECOGas@GIF++ eco3 mix



202307 stdmix

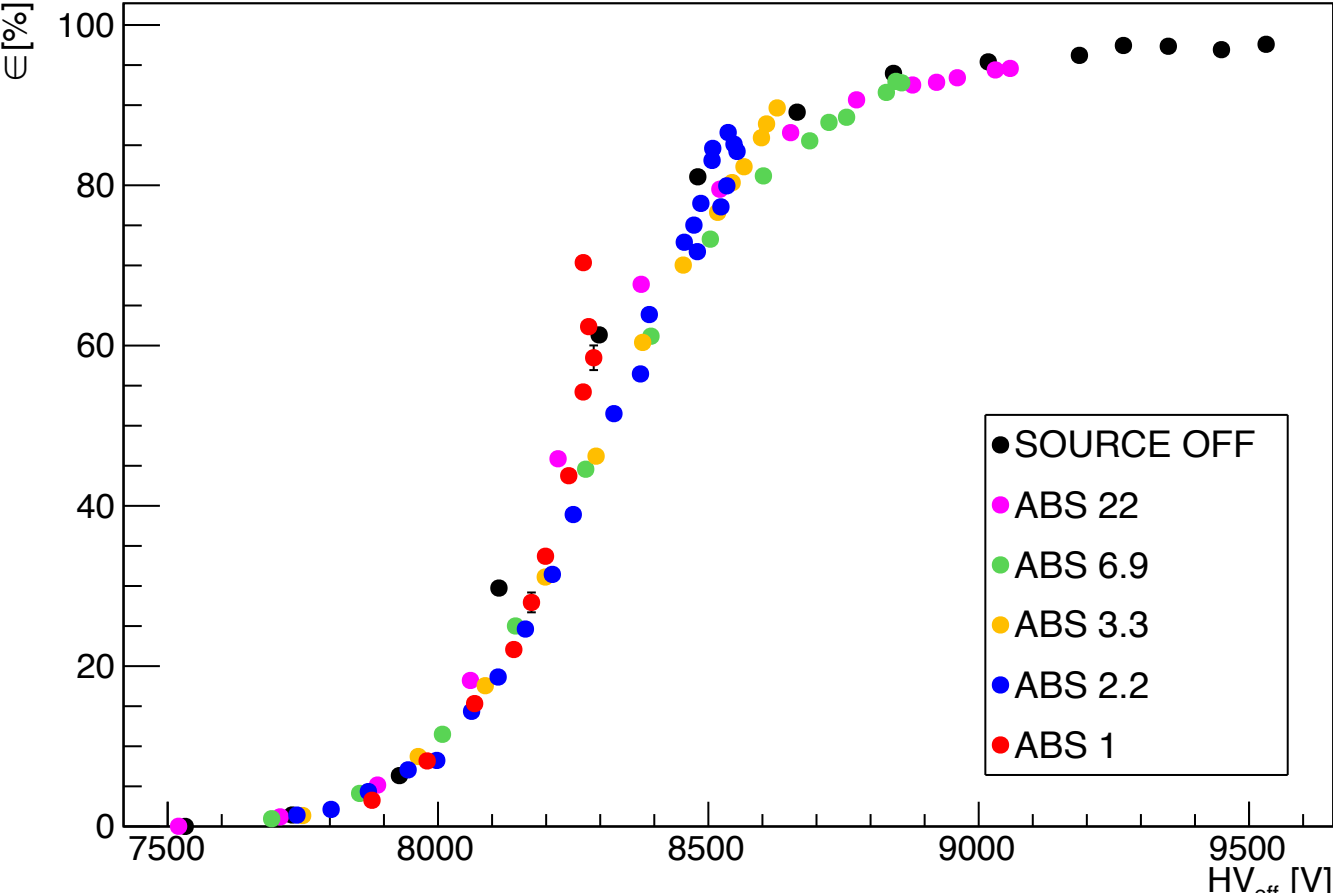
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2D Efficiency curves
ECOgas@GIF++ eco3 mix



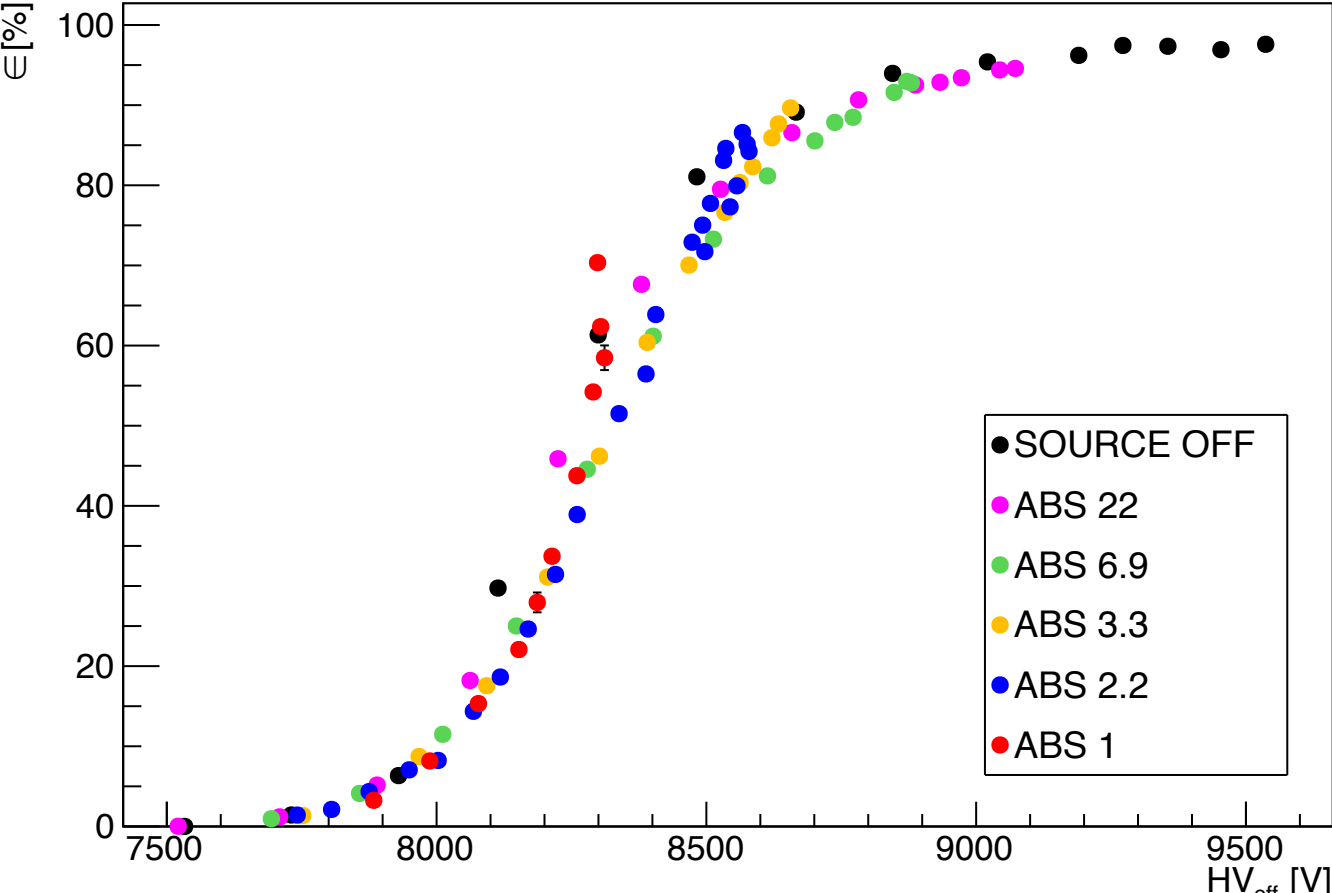
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2D Efficiency curves
ECOgas@GIF++ eco3 mix



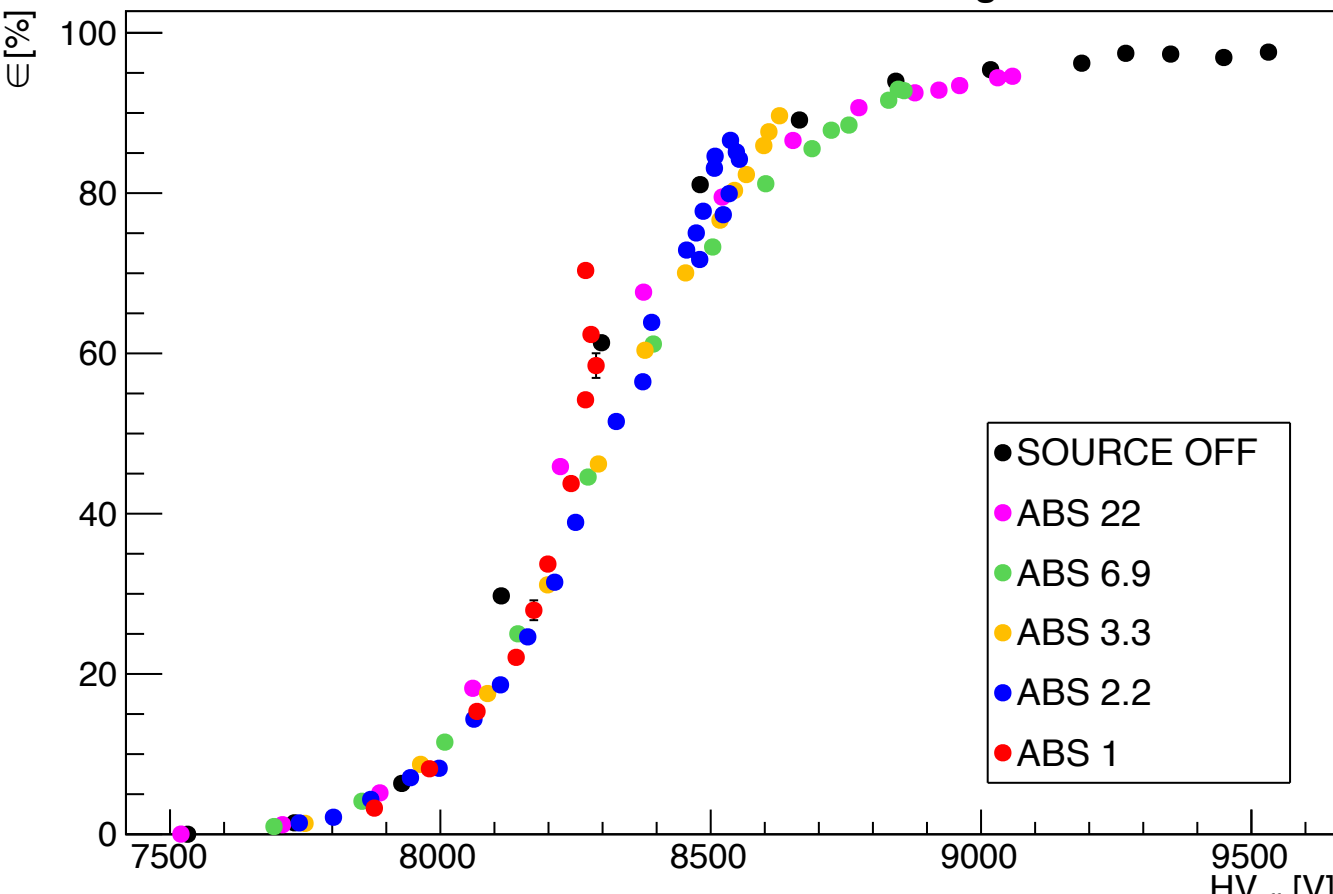
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2D Efficiency curves
ECOgas@GIF++ eco3 mix



0.51e11

2D Efficiency curves
ECOgas@GIF++ eco3 mix



0.52e11

2D Efficiency curves
ECOgas@GIF++ eco3 mix

