

Comparison between 2023, 2024 and 2025 TB SHiP/LHCb

Giuliana Galati on behalf of the SHiP/LHCb Bari Group

Introduction

Details about SHiP/LHCb chamber:

- Area: 70x100 cm²
- 1.6 mm thick bakelite electrodes
- 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

Integrated charge at TB 7/2025: 350 mC/cm²

Available ABS:

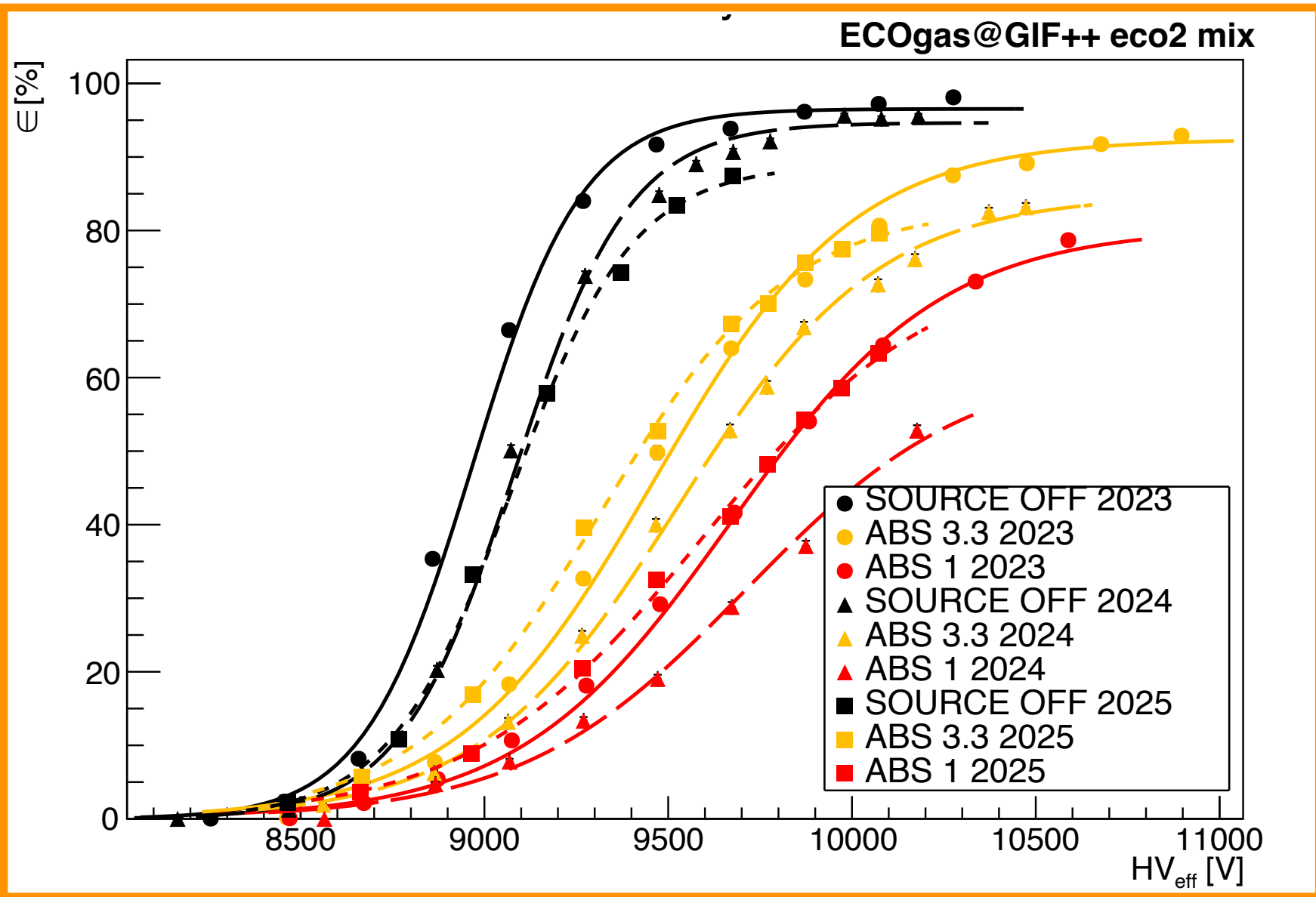
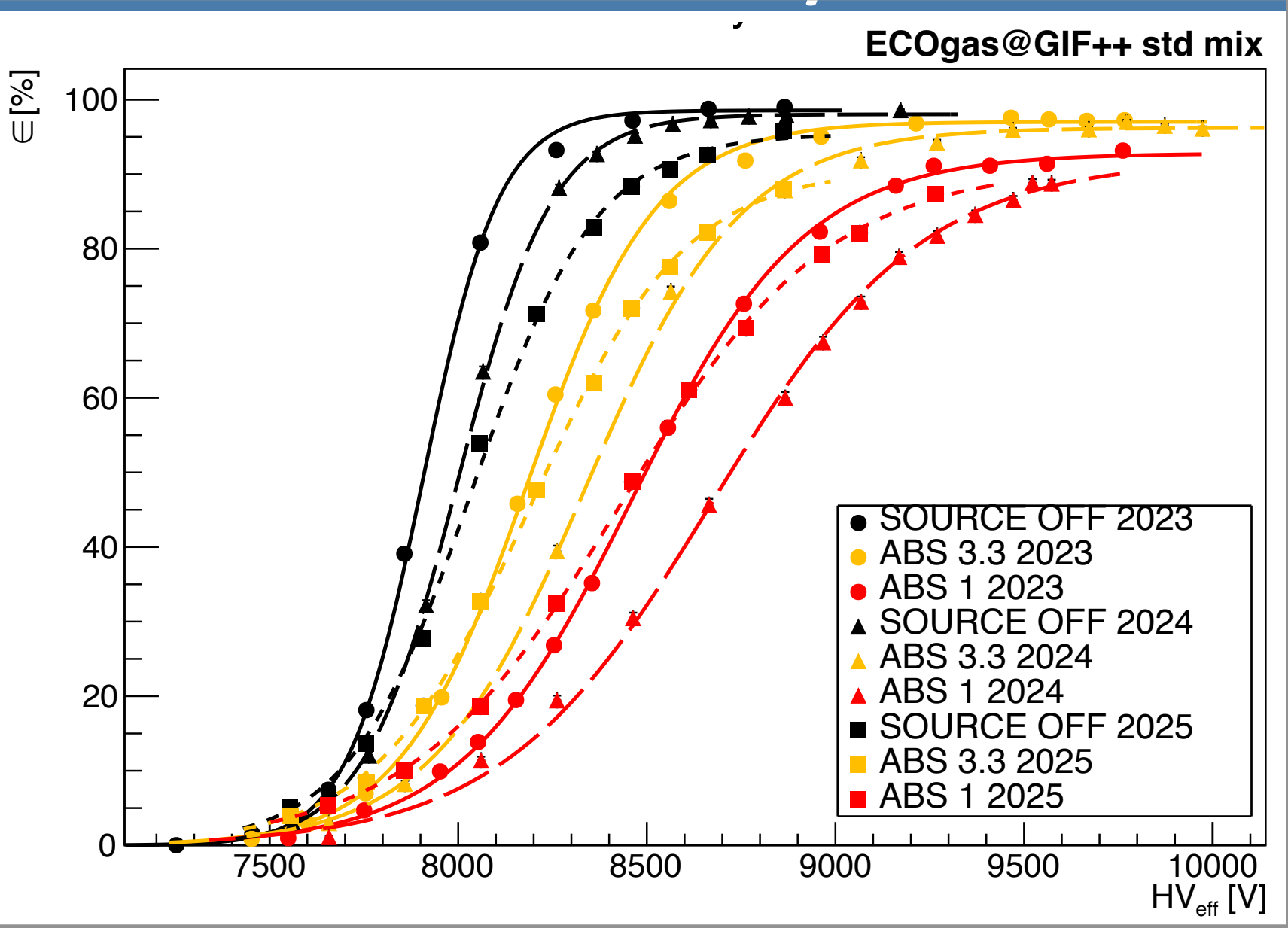
OFF
10
6,9
3,3
2,2
1

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

where $\mathcal{E}_{\text{max}}$ 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%.

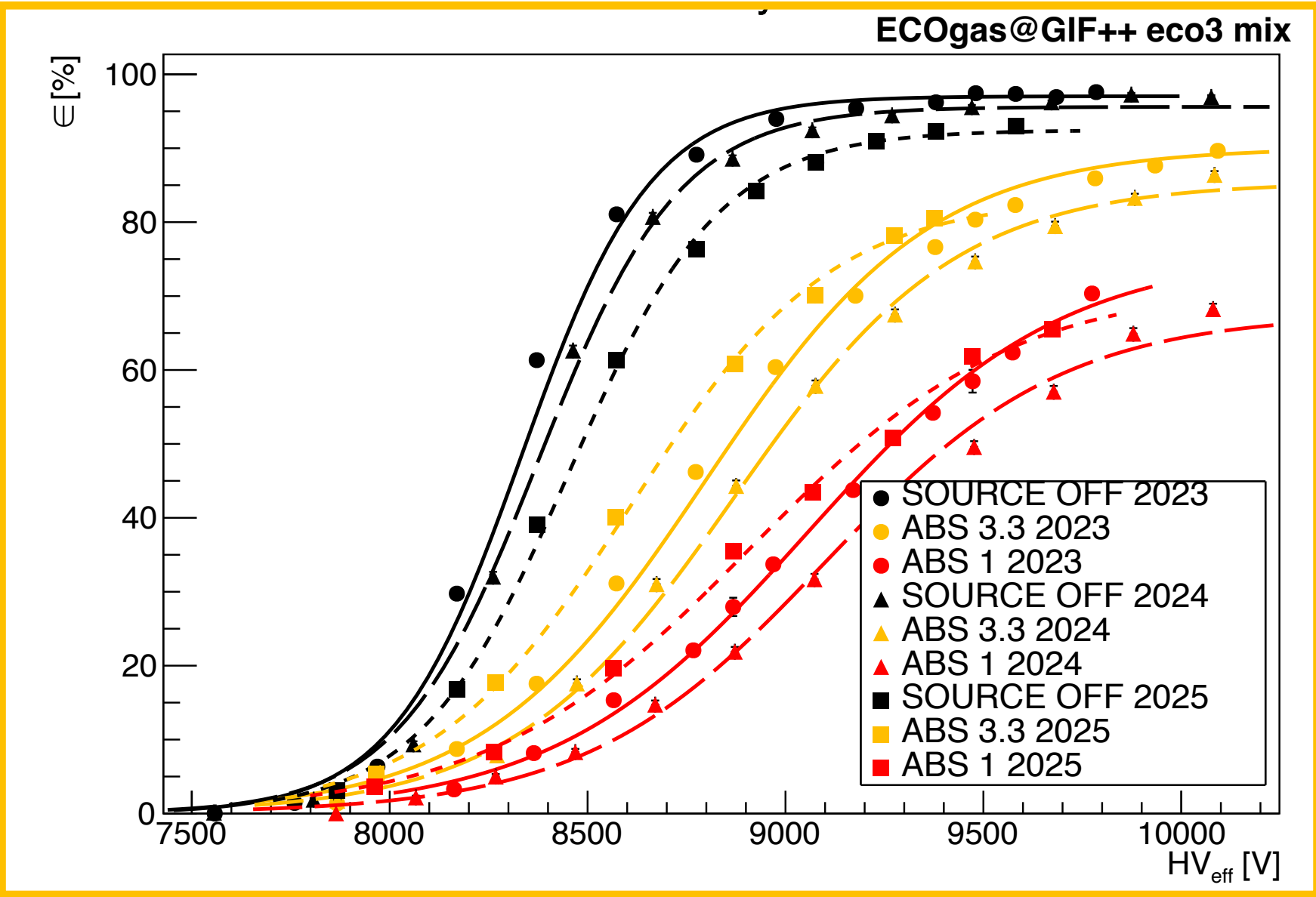
WP is defined as the HV_{eff} value at which the 2D efficiency reaches 95% of the asymptotic value approached by the logistic function

2D efficiency



	2023		2024		2025	
ABS	WP (V)	I (uA)	WP (V)	I (uA)	WP (V)	I (uA)
OFF	9407	53	9543	270	9561	364
6,9	9854	245	9903	401	9882	396
3,3	10259	443	10327	627	10066	511
2,2	10253	488	10416	746	10207	665
1*	10518	681	10609	979	10521	623

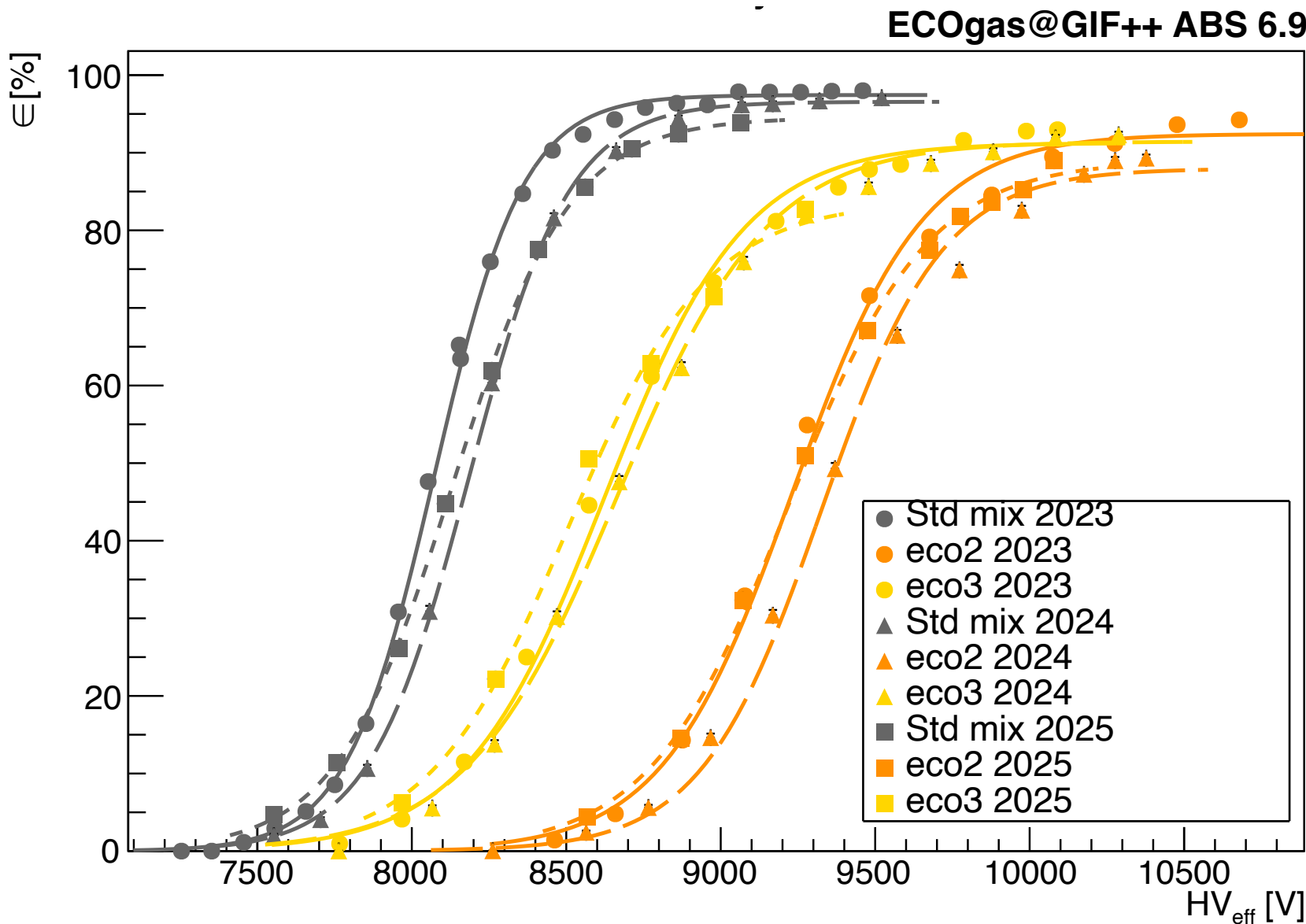
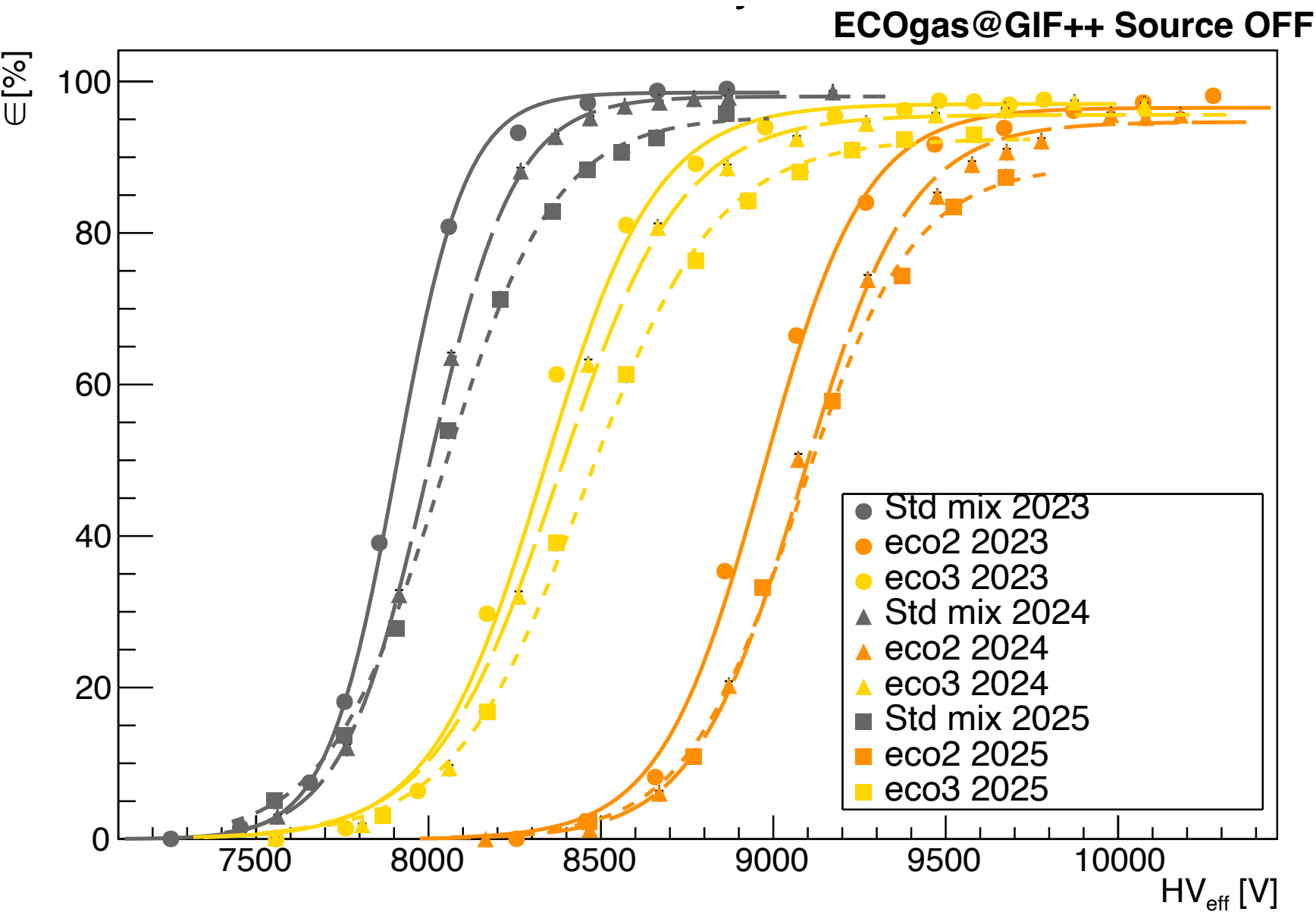
	2023		2024		2025	
ABS	WP (V)	I (uA)	WP (V)	I (uA)	WP (V)	I (uA)
OFF	8203	26	8366	173	8520	275
6,9	8497	134	8663	247	8689	330
3,3	8685	222	8947	399	8794	411
2,2	8812	272	9051	415	8887	432
1	9135	457	9495	668	9242	592



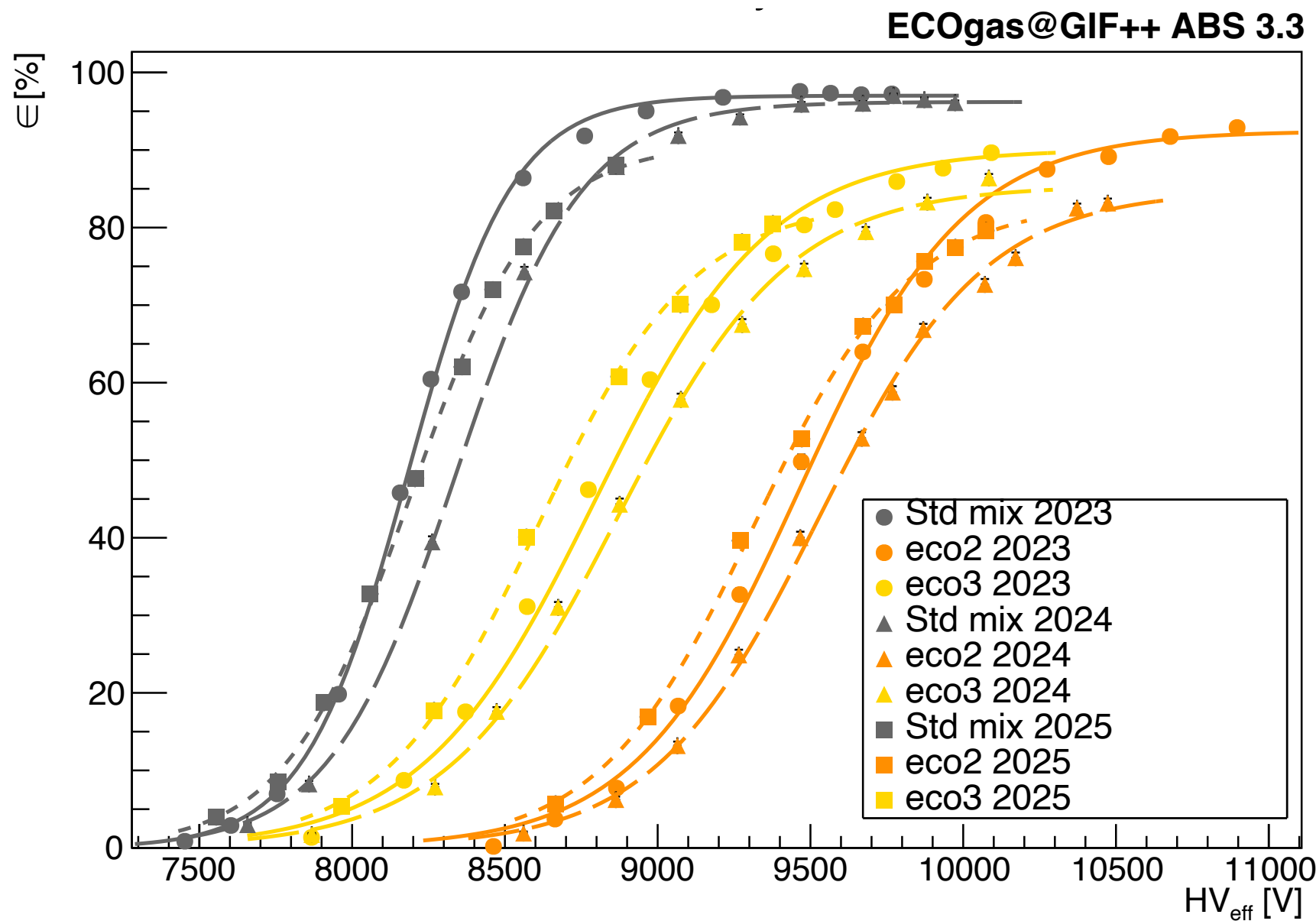
	2023		2024		2025	
ABS	WP (V)	I (uA)	WP (V)	I (uA)	WP (V)	I (uA)
OFF	8815	50	8900	147	9014	289
6,9	9293	277	9382	379	9173	443
3,3	9635	457	9697	518	9353	628
2,2	9823	551	9840	610	9536	599
1*	9996	797	9987	787	9885	1030

NB: * values at WP are extrapolated

2D efficiency



ABS	2023		2024		2025	
	WP (V)	I (uA)	WP (V)	I (uA)	WP (V)	I (uA)
OFF	8203	26	8366	173	8520	275
6,9	8497	134	8663	247	8689	330
3,3	8685	222	8947	399	8794	411
2,2	8812	272	9051	415	8887	432
1	9135	457	9495	668	9242	592

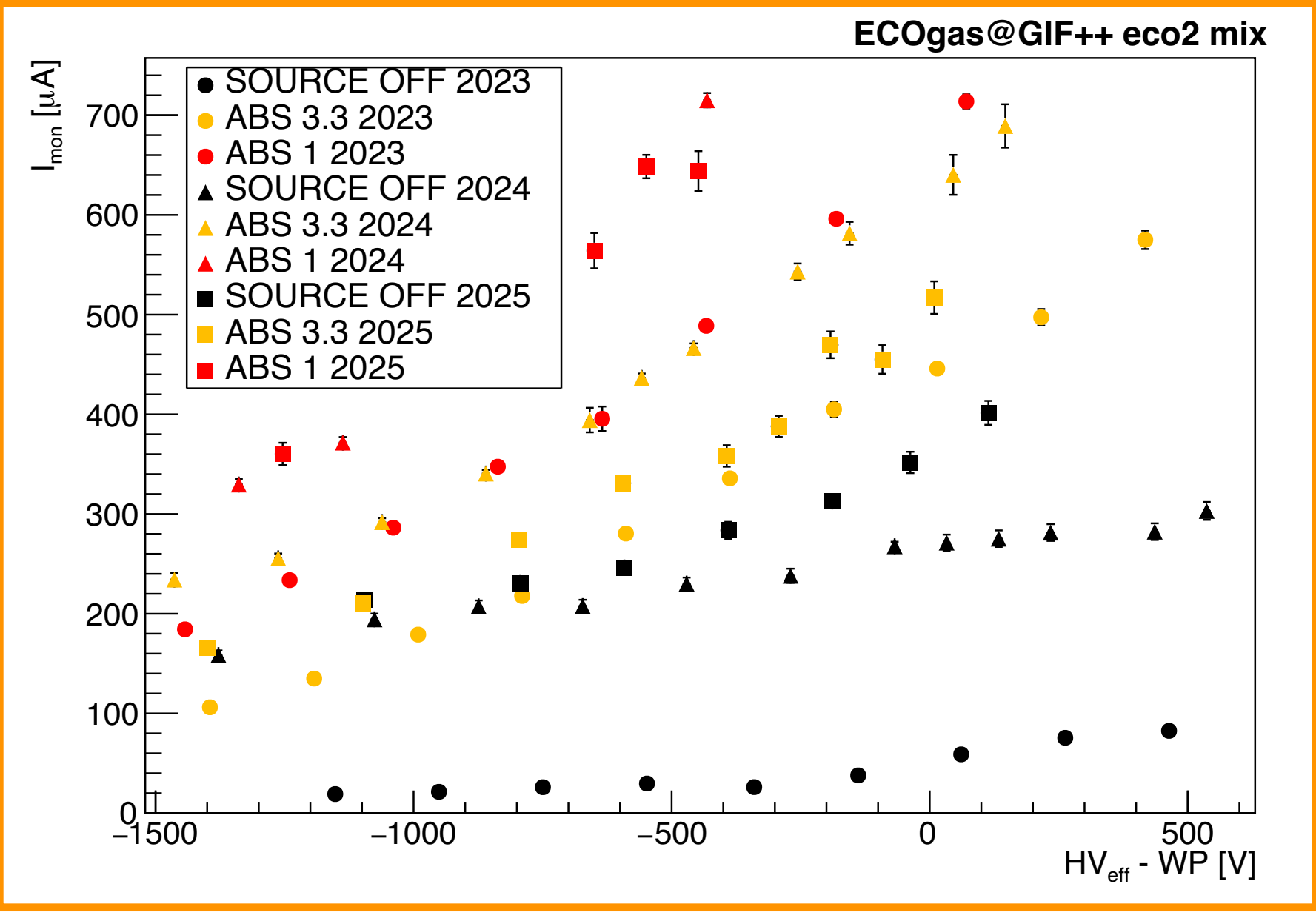
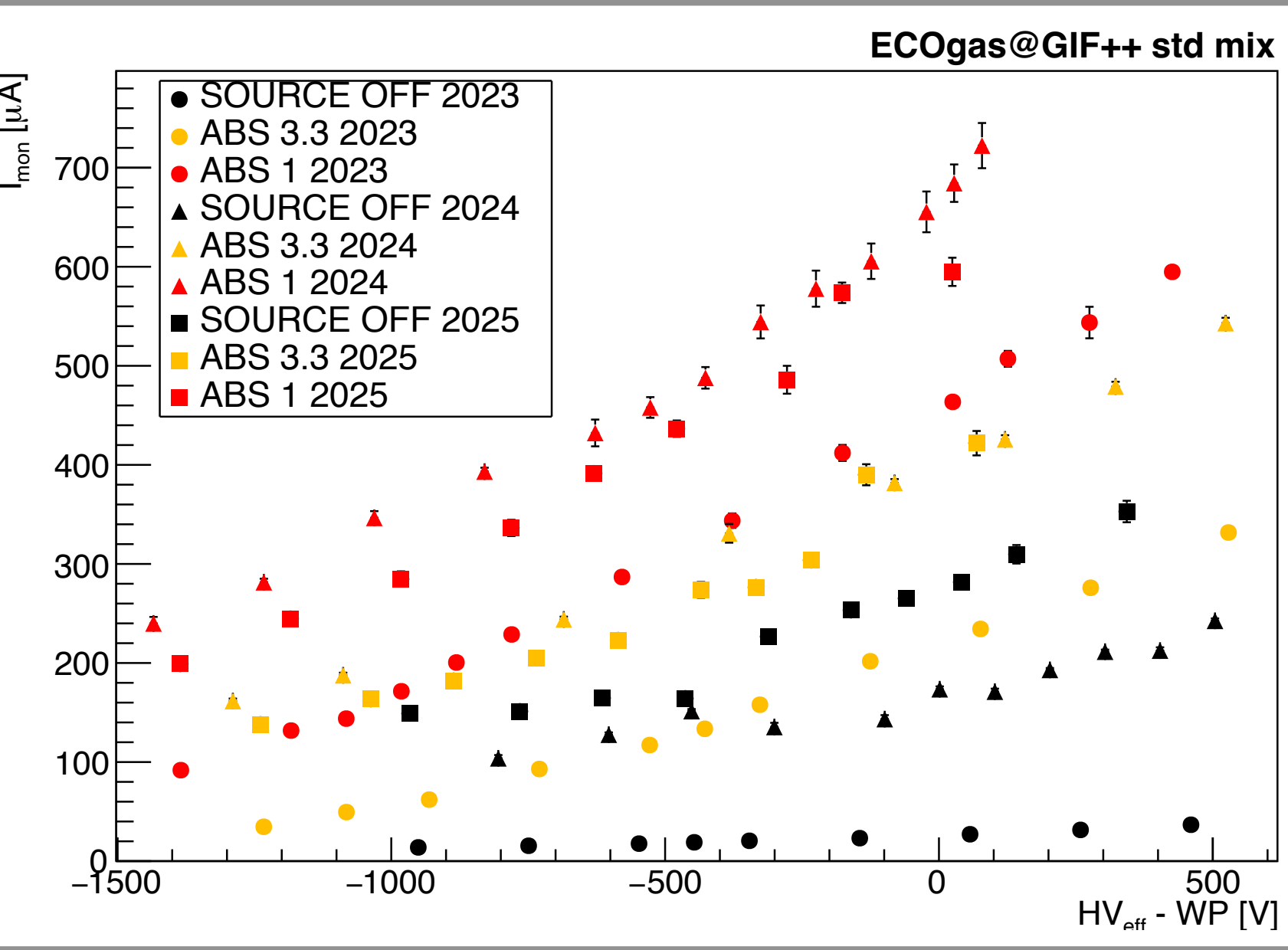


ABS	2023		2024		2025	
	WP (V)	I (uA)	WP (V)	I (uA)	WP (V)	I (uA)
OFF	9407	53	9543	270	9561	364
6,9	9854	245	9903	401	9882	396
3,3	10259	443	10327	627	10066	511
2,2	10253	488	10416	746	10207	665
1*	10518	681	10609	979	10521	623

ABS	2023		2024		2025	
	WP (V)	I (uA)	WP (V)	I (uA)	WP (V)	I (uA)
OFF	8815	50	8900	147	9014	289
6,9	9293	277	9382	379	9173	443
3,3	9635	457	9697	518	9353	628
2,2	9823	551	9840	610	9536	599
1*	9996	797	9987	787	9885	1030

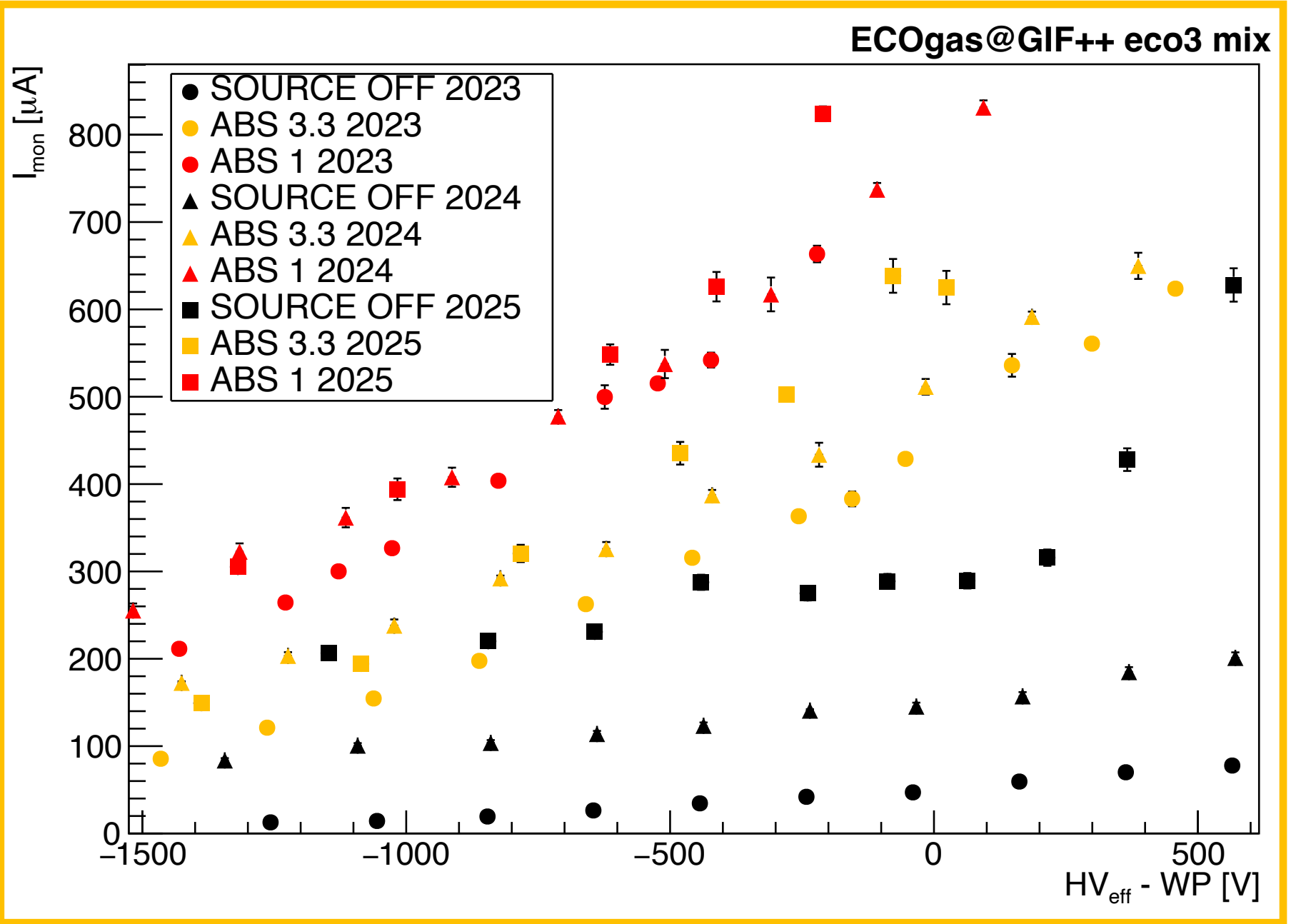
NB: * values at WP are extrapolated

Current



	2023		2024		2025	
ABS	WP (V)	I (uA)	WP (V)	I (uA)	WP (V)	I (uA)
OFF	9407	53	9543	270	9561	364
6,9	9854	245	9903	401	9882	396
3,3	10259	443	10327	627	10066	511
2,2	10253	488	10416	746	10207	665
1*	10518	681	10609	979	10521	623

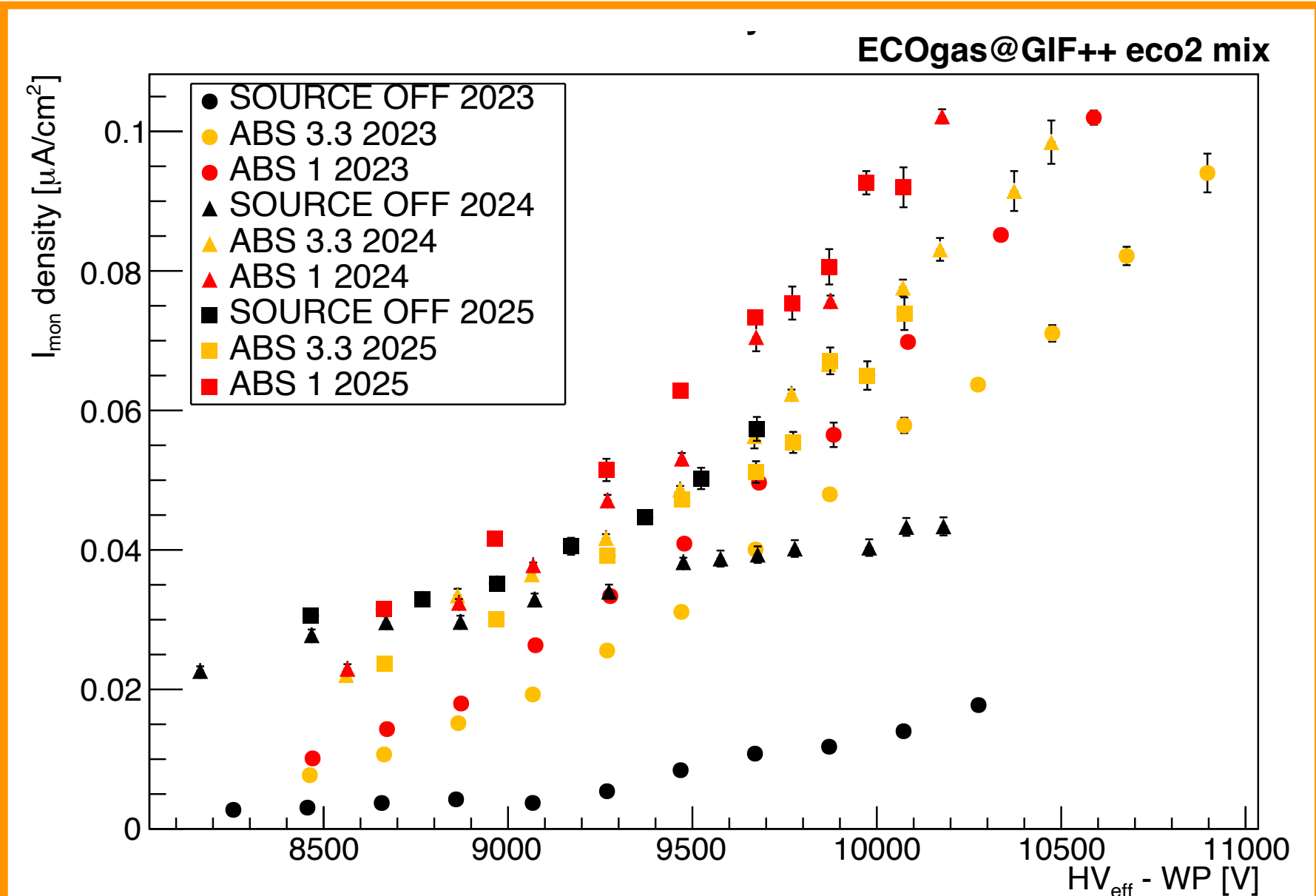
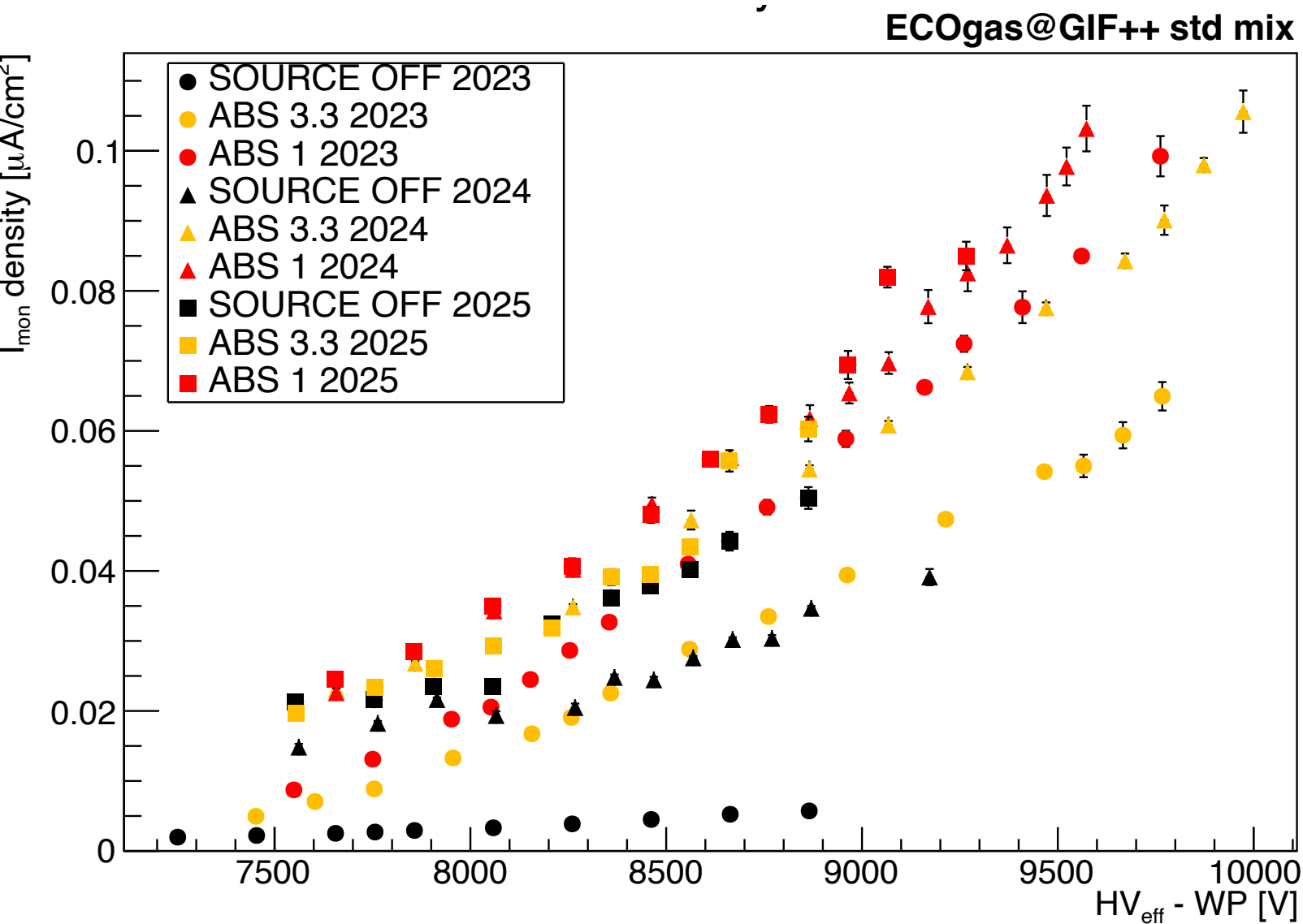
	2023		2024		2025	
AB S	WP (V)	I (uA)	WP (V)	I (uA)	WP (V)	I (uA)
OF F	8203	26	8366	173	8520	275
6,9	8497	134	8663	247	8689	330
3,3	8685	222	8947	399	8794	411
2,2	8812	272	9051	415	8887	432
1	9135	457	9495	668	9242	592



	2023		2024		2025	
AB S	WP (V)	I (uA)	WP (V)	I (uA)	WP (V)	I (uA)
OF F	8815	50	8900	147	9014	289
6,9	9293	277	9382	379	9173	443
3,3	9635	457	9697	518	9353	628
2,2	9823	551	9840	610	9536	599
1*	9996	797	9987	787	9885	1030

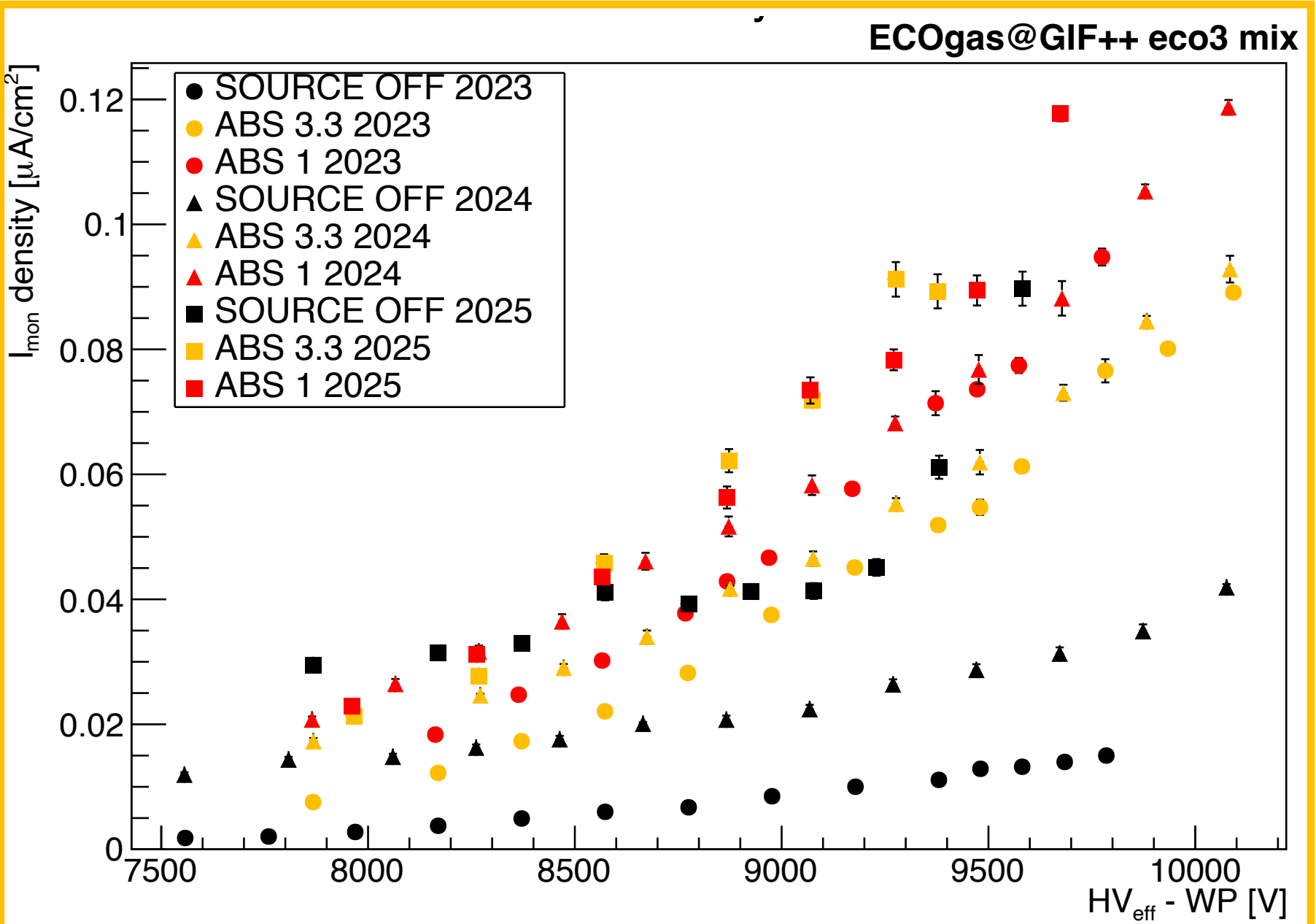
NB: * values at WP are extrapolated

Current Density



	2023		2024		2025	
ABS	WP (V)	I (μA)	WP (V)	I (μA)	WP (V)	I (μA)
OFF	9407	53	9543	270	9561	364
6,9	9854	245	9903	401	9882	396
3,3	10259	443	10327	627	10066	511
2,2	10253	488	10416	746	10207	665
1*	10518	681	10609	979	10521	623

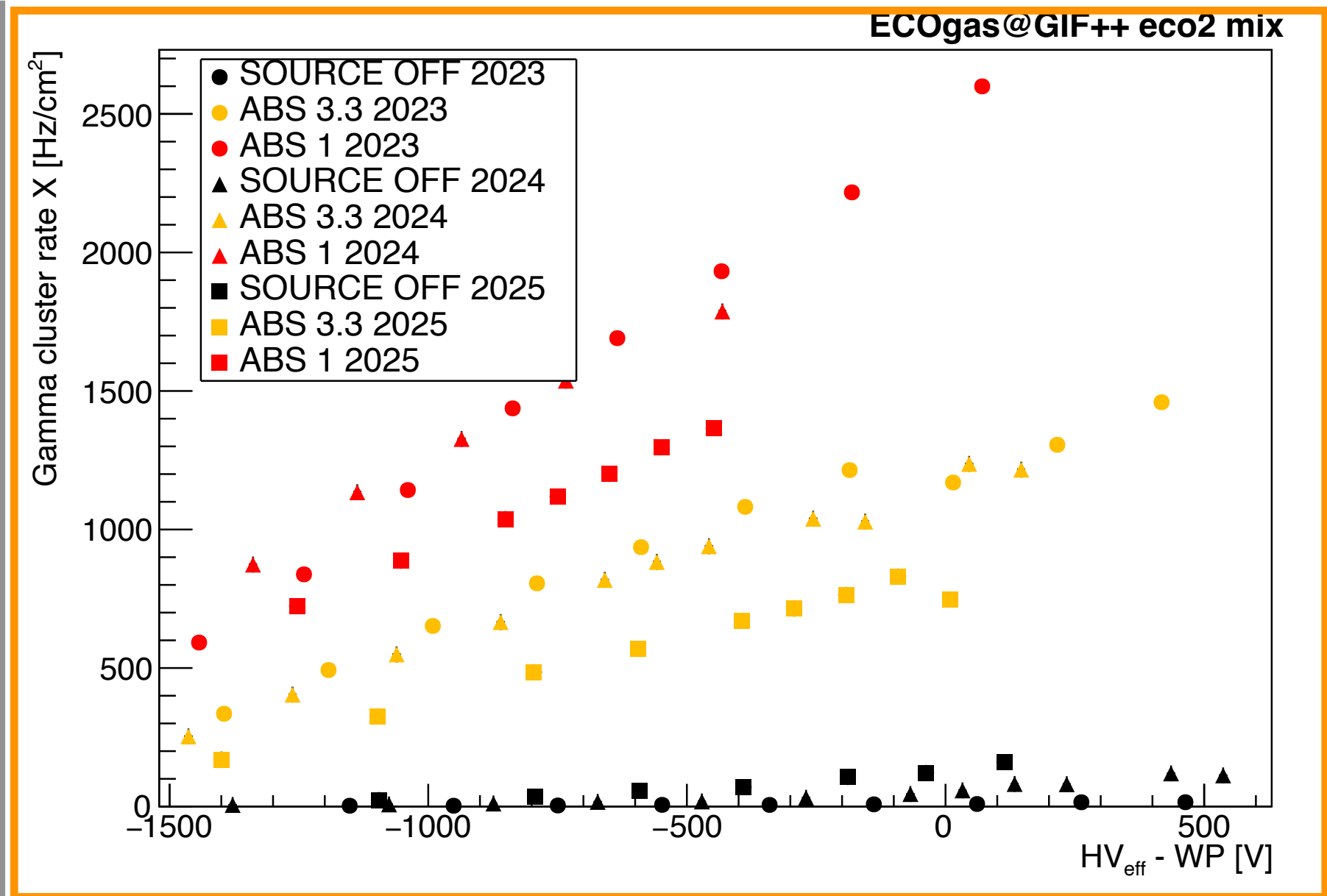
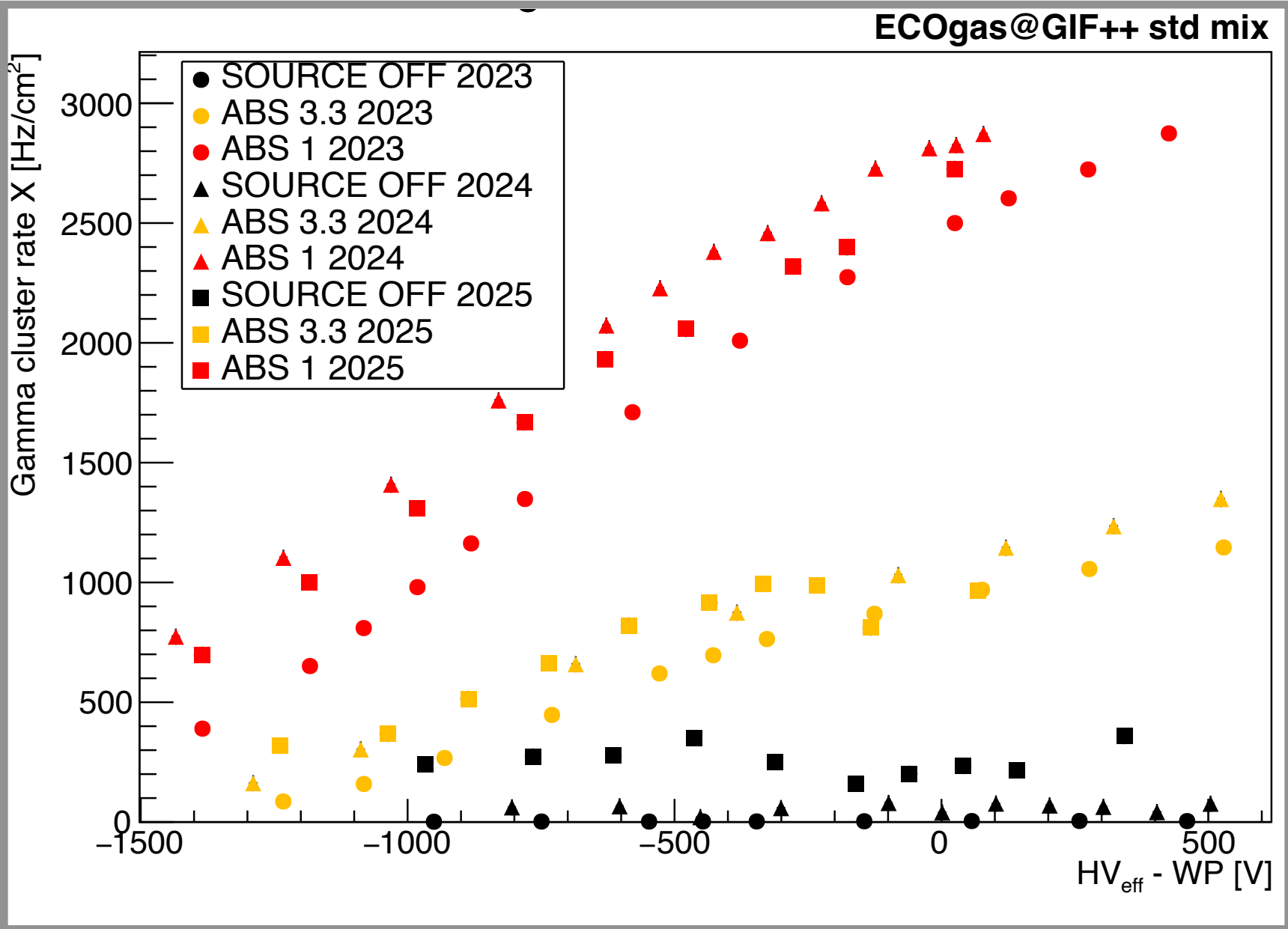
	2023		2024		2025	
ABS	WP (V)	I (μA)	WP (V)	I (μA)	WP (V)	I (μA)
OFF	8203	26	8366	173	8520	275
6,9	8497	134	8663	247	8689	330
3,3	8685	222	8947	399	8794	411
2,2	8812	272	9051	415	8887	432
1	9135	457	9495	668	9242	592



	2023		2024		2025	
ABS	WP (V)	I (μA)	WP (V)	I (μA)	WP (V)	I (μA)
OFF	8815	50	8900	147	9014	289
6,9	9293	277	9382	379	9173	443
3,3	9635	457	9697	518	9353	628
2,2	9823	551	9840	610	9536	599
1*	9996	797	9987	787	9885	1030

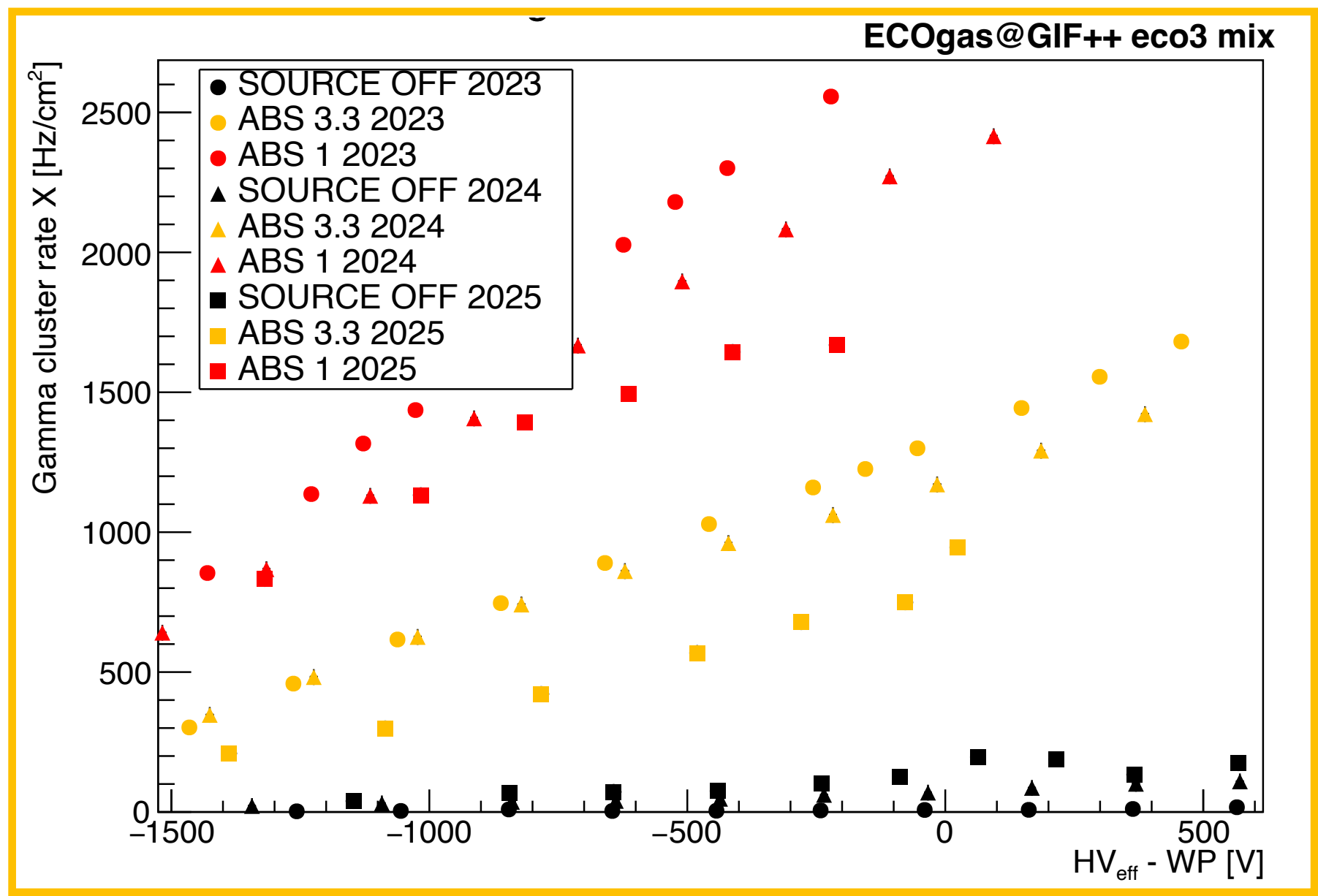
NB: * values at WP are extrapolated

Gamma cluster rate X



AB S	2023		2024		2025	
	WP (V)	cluster rate	WP (V)	cluster rate	WP (V)	cluster rate
OF	8203	8,8	8366	54	8520	131
6,9	8497	624	8663	596	8689	594
3,3	8685	1173	8947	1189	8794	754
2,2	8812	1373	9051	1439	8887	1110
1	9135	2492	9495	2143	9242	1677

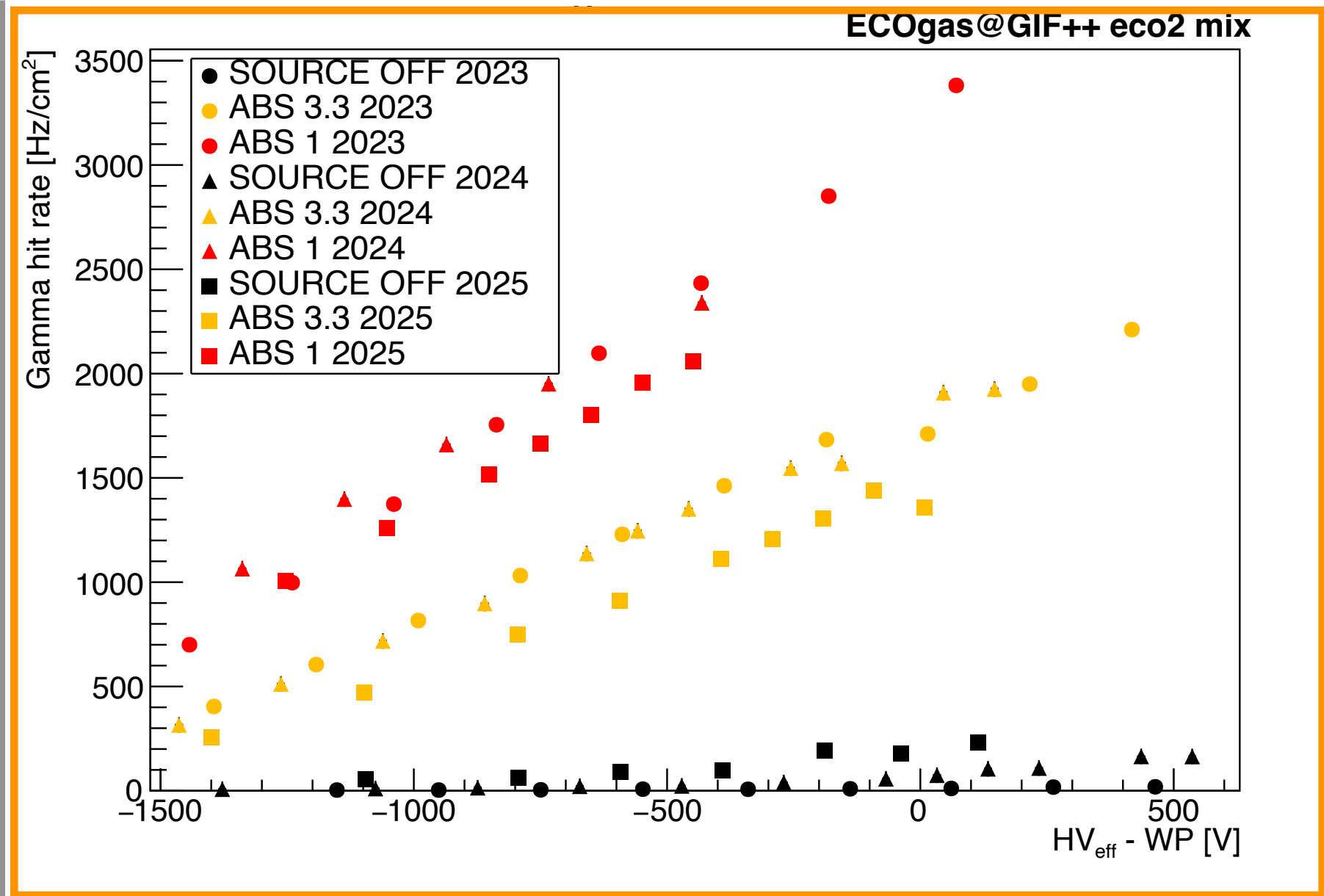
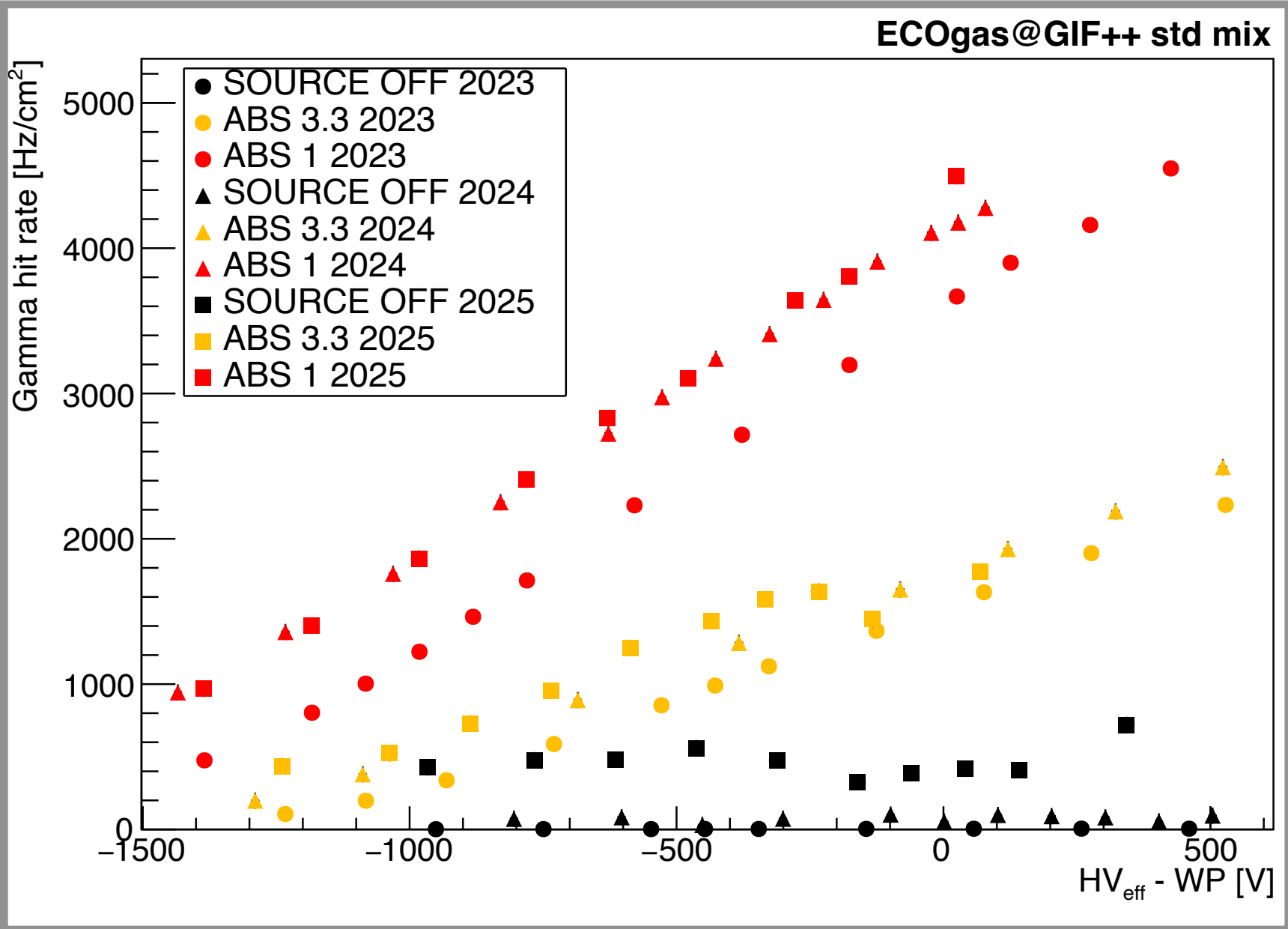
ABS	2023		2024		2025	
	WP (V)	cluster rate	WP (V)	cluster rate	WP (V)	cluster rate
OFF	9407	3,9	9543	40	9561	221
6,9	9854	452	9903	564	9882	607
3,3	10259	932	10327	1076	10066	913
2,2	10253	1227	10416	1447	10207	1362
1*	10518	2472	10609	2818	10521	2686



AB S	2023		2024		2025	
	WP (V)	cluster rate	WP (V)	cluster rate	WP (V)	cluster rate
OF	8815	7,3	8900	72	9014	167
6,9	9293	681	9382	630	9173	567
3,3	9635	1338	9697	1180	9353	900
2,2	9823	1722	9840	1363	9536	1306
1*	9996	2839	9987	2348	9885	1695

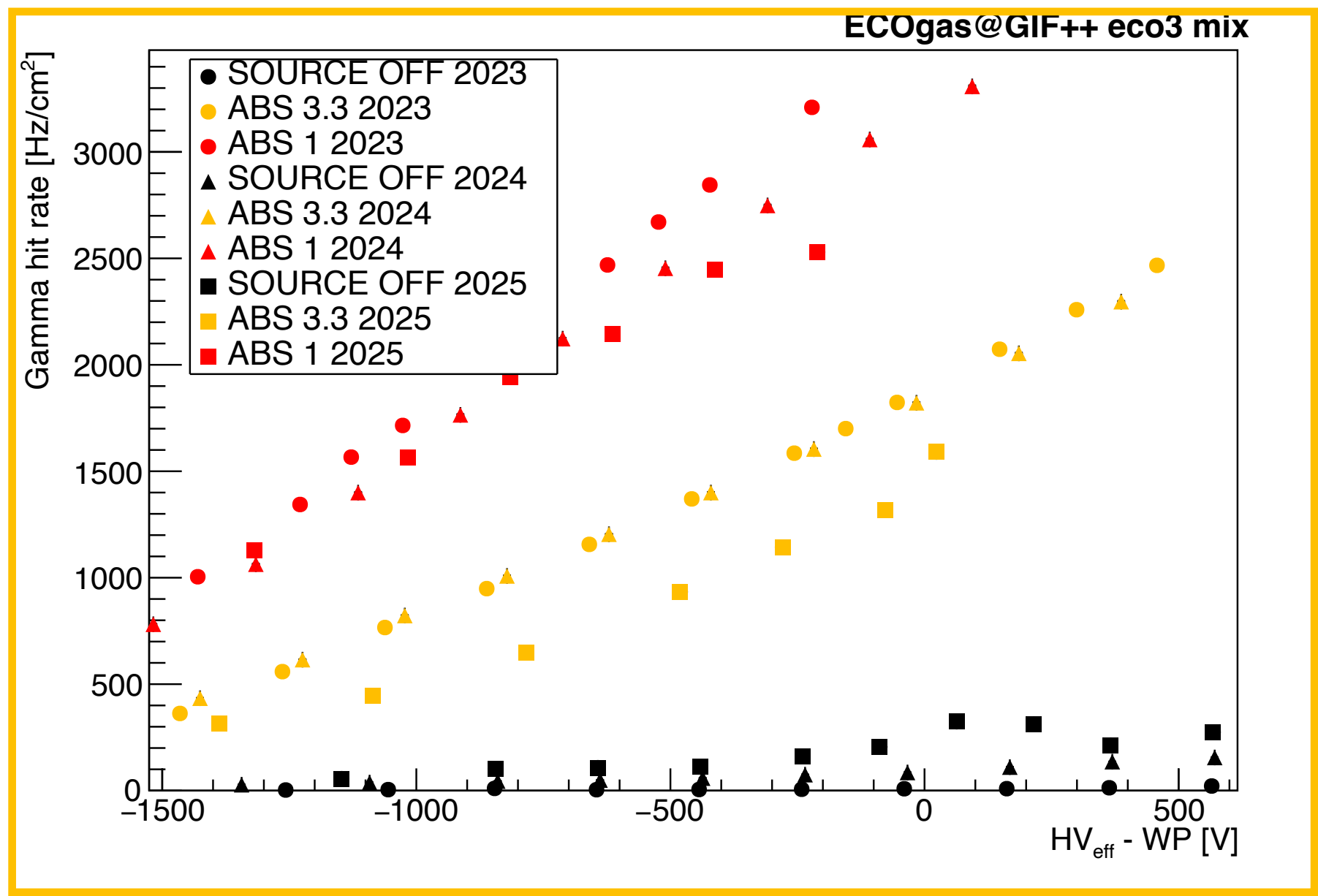
NB: * values at WP are extrapolated

Gamma hit rate X



	2023		2024		2025	
AB S	WP (V)	hit rate	WP (V)	hit rate	WP (V)	hit rate
OF	8203	11,5	8366	69	8520	191
6,9	8497	919	8663	949	8689	1029
3,3	8685	1709	8947	1831	8794	1364
2,2	8812	1937	9051	2132	8887	1893
1	9135	3232	9495	2892	9242	2521

	2023		2024		2025	
ABS	WP (V)	hit rate	WP (V)	hit rate	WP (V)	hit rate
OFF	9407	4,6	9543	55	9561	404
6,9	9854	793	9903	946	9882	1149
3,3	10259	1532	10327	1763	10066	1663
2,2	10253	1960	10416	2285	10207	2375
1*	10518	3609	10609	4137	10521	4411



	2023		2024		2025	
AB S	WP (V)	hit rate	WP (V)	hit rate	WP (V)	hit rate
OF	8815	8,8	8900	89	9014	274
6,9	9293	1010	9382	1039	9173	1021
3,3	9635	1890	9697	1840	9353	1527
2,2	9823	2387	9840	2084	9536	2148
1*	9996	3611	9987	3192	9885	2615

NB: * values at WP are extrapolated

Comparison: WP, Eff2D, Current STD

	WP (V)			Delta WP (V) 24-23	Delta WP (V) 25-24	Efficiency 2D al WP (%)			Delta Eff 2D 24-23	Delta Eff 2D 25-24	Current al WP (uA)			Delta Current 24-23	Delta Current 25-24
ABS	2023	2024	2025			2023	2024	2025			2023	2024	2025		
OFF	8203	8366	8520	163	154	93,6	93,1	90,6	-0,5	-2,5	26	173	275	147	102
6,9	8497	8663	8689	166	26	92,6	91,7	89,8	-0,9	-1,9	134	247	330	113	83
3,3	8685	8947	8794	262	-153	92,2	91,4	86,3	-0,8	-5,1	222	399	411	177	12
2,2	8812	9051	8887	239	-164	91,8	90,6	87,0	-1,2	-3,6	272	415	432	143	17
1	9135	9495	9242	360	-253	88,2	87,3	86,4	-0,9	-0,9	457	668	592	211	-76

NB: * values at WP are extrapolated

Comparison: WP, Eff2D, Current ECO2

	WP (V)			Delta WP (V) 24-23	Delta WP (V) 25-24	Efficiency 2D al WP (%)			Delta Eff 2D 24-23	Delta Eff 2D 25-24	Current al WP (uA)			Delta Current 24-23	Delta Current 25-24
ABS	2023	2024	2025			2023	2024	2025			2023	2024	2025		
OFF	9407	9543	9561	136	18	91,71	89,9	84,5	-1,81	-5,4	53	270	364	217	94
6,9	9854	9903	9882	49	-21	87,80	83,6	84,6	-4,2	1	245	401	396	156	-5
3,3	10259	10327	10066	68	-261	87,83	86,3	79,1	-1,53	-7,2	443	627	511	184	-116
2,2	10253	10416	10207	163	-209	85,52	84,4	79,9	-1,12	-4,5	488	746	665	258	-81
1*	10518	10609	10521	91	-88	76,38	59,0	72,6	-17,38	13,6	681	979	623	298	-356

NB: * values at WP are extrapolated

Comparison: WP, Eff2D, Current ECO3

	WP (V)			Delta WP (V) 24-23	Delta WP (V) 25-24	Efficiency 2D al WP (%)			Delta Eff 2D 24-23	Delta Eff 2D 25-24	Current al WP (uA)			Delta Current 24-23	Delta Current 25-24
ABS	2023	2024	2025			2023	2024	2025			2023	2024	2025		
OFF	8815	8900	9014	85	114	92,2	90,8	87,8	-1,4	-3	50	147	289	97	142
6,9	9293	9382	9173	89	-209	86,7	86,9	79,5	0,2	-7,4	277	379	443	102	64
3,3	9635	9697	9353	62	-344	85,6	81,1	79,2	-4,5	-1,9	457	518	628	61	110
2,2	9823	9840	9536	17	-304	83,9	78,9	79,6	-5	0,7	551	610	599	59	-11
1*	9996	9987	9885	-9	-102	72,2	64,2	68,0	-8	3,8	797	787	1030	-10	243

NB: * values at WP are extrapolated

Comparison: WP, Eff2D, Current STD

	Gamma hit rate X			Delta 24-23	Delta 25-24	Gamma cluster rate X			Delta 24-23	Delta 25-24	Gamma cluster size X			Delta 24-23	Delta 25-24
ABS	2023	2024	2025			2023	2024	2025			2023	2024	2025		
OFF	4,6	55	404	50,4	349	3,9	40	221	36,1	181	1,18	1,37	1,84	0,19	0,47
6,9	793	946	1149	153	203	452	564	607	112	43	1,75	1,68	1,89	-0,07	0,21
3,3	1532	1763	1663	231	-100	932	1076	913	144	-163	1,64	1,64	1,82	0,00	0,18
2,2	1960	2285	2375	325	90	1227	1447	1362	220	-85	1,60	1,58	1,75	-0,02	0,17
1	3609	4137	4411	528	274	2472	2818	2686	346	-132	1,46	1,47	1,64	0,01	0,17

NB: * values at WP are extrapolated

Comparison: WP, Eff2D, Current ECO2

	Gamma hit rate X			Delta 24-23	Delta 25-24	Gamma cluster rate X			Delta 24-23	Delta 25-24	Gamma cluster size X			Delta 24-23	Delta 25-24
ABS	2023	2024	2025			2023	2024	2025			2023	2024	2025		
OFF	11,5	69	191	57,5	122	8,8	54	131	45,2	77	1,19	1,27	1,46	0,08	0,19
6,9	919	949	1029	30	80	624	596	594	-28	-2	1,47	1,59	1,73	0,12	0,14
3,3	1709	1831	1364	122	-467	1173	1189	754	16	-435	1,46	1,54	1,81	0,08	0,27
2,2	1937	2132	1893	195	-239	1373	1439	1110	66	-329	1,41	1,48	1,70	0,07	0,22
1*	3232	2892	2521	-340	-371	2492	2143	1677	-349	-466	1,30	1,37	1,50	0,07	0,13

NB: * values at WP are extrapolated

Comparison: WP, Eff2D, Current ECO3

	Gamma hit rate X			Delta 24-23	Delta 25-24	Gamma cluster rate X			Delta 24-23	Delta 25-24	Gamma cluster size X			Delta 24-23	Delta 25-24
ABS	2023	2024	2025			2023	2024	2025			2023	2024	2025		
OFF	8,8	89	274	80,2	185	7,3	72	167	64,7	95	1,19	1,24	1,64	0,05	0,40
6,9	1010	1039	1021	29	-18	681	630	567	-51	-63	1,48	1,65	1,79	0,17	0,14
3,3	1890	1840	1527	-50	-313	1338	1180	900	-158	-280	1,41	1,56	1,70	0,15	0,14
2,2	2387	2084	2148	-303	64	1722	1363	1306	-359	-57	1,39	1,53	1,64	0,14	0,11
1*	3611	3192	2615	-419	-577	2839	2348	1695	-491	-653	1,28	1,36	1,54	0,08	0,18

NB: * values at WP are extrapolated

Comparison: WP, Eff2D, Current STD

	Gamma hit rate X efficiency corrected			Delta 24-23	Delta 25-24	Gamma cluster rate X efficiency corrected			Delta 24-23	Delta 25-24
ABS	2023	2024	2025			2023	2024	2025		
OFF	4,9	59	423	54,1	364	4,2	43	231	38,8	188
6,9	850	1027	1209	177	182	484	612	639	128	27
3,3	1656	1910	1772	254	-138	1007	1157	973	150	-184
2,2	2117	2488	2540	371	52	1325	1576	1457	251	-119
1	4042	4612	4719	570	107	2756	3141	2874	385	-267

NB: * values at WP are extrapolated

Comparison: WP, Eff2D, Current ECO2

	Gamma hit rate X efficiency corrected			Delta 24-23	Delta 25-24	Gamma cluster rate X efficiency corrected			Delta 24-23	Delta 25-24
ABS	2023	2024	2025			2023	2024	2025		
OFF	11,4	76	213	64,6	137	9,61	60	146	50,39	86
6,9	1039	1119	1145	80	26	705	702	661	-3	-41
3,3	1946	2217	1575	271	-642	1335	1440	872	105	-568
2,2	2265	2674	2176	409	-498	1606	1804	1277	198	-527
1*	4232	4899	3075	667	-1824	3262	3630	2046	368	-1584

NB: * values at WP are extrapolated

Comparison: WP, Eff2D, Current ECO3

	Gamma hit rate X efficiency corrected			Delta 24-23	Delta 25-24	Gamma cluster rate X efficiency corrected			Delta 24-23	Delta 25-24
ABS	2023	2024	2025			2023	2024	2025		
OFF	9,5	98	297	88,5	199	8	79	181	71	102
6,9	1156	1196	1182	40	-14	780	725	657	-55	-68
3,3	2193	2213	1778	20	-435	1553	1419	1048	-134	-371
2,2	2844	2572	2479	-272	-93	2052	1681	1508	-371	-173
1*	4761	4970	3445	209	-1525	3742	3656	2232	-86	-1424

NB: * values at WP are extrapolated