

Formation of a forward beam of antihydrogen

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Status MCP-CMOS analysis

-

December 2024

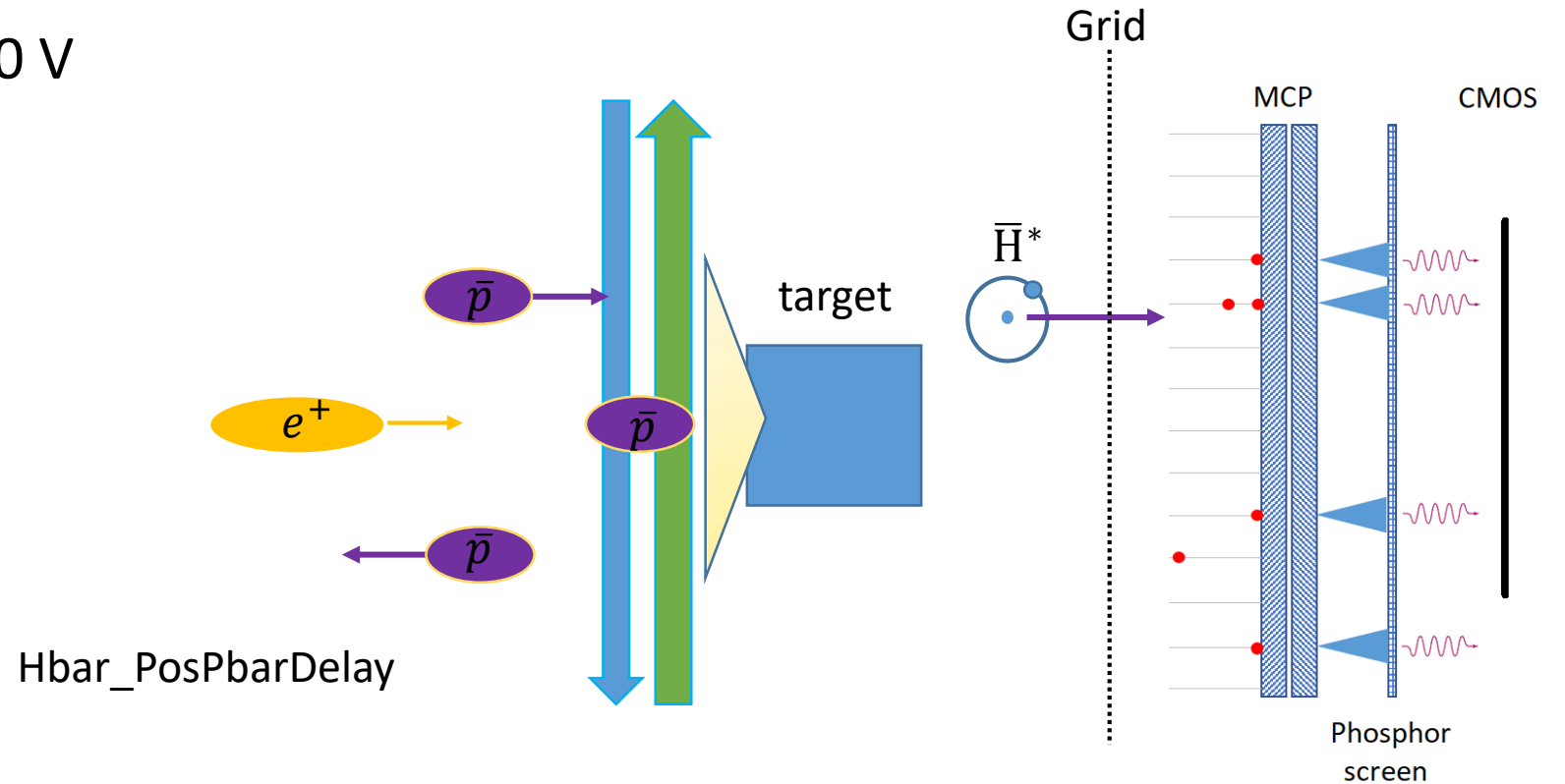
-

Tassilo Rauschendorfer

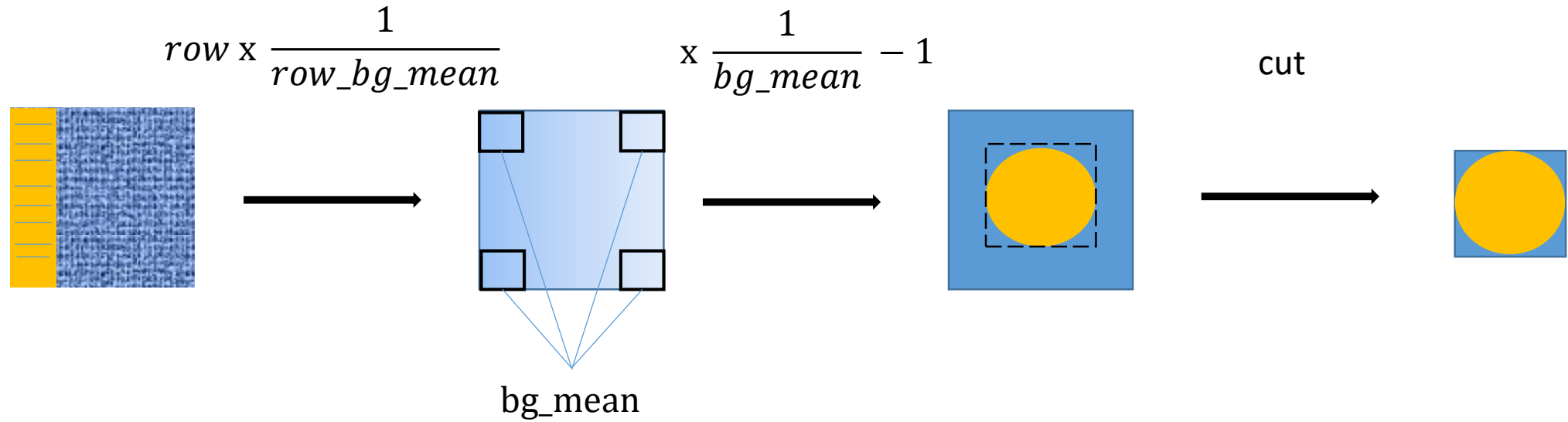
Detector & Operation

Hbar detection with the 1TMCP-CMOS assembly

- MCP1T_InOut=1400.0 V
- MCP1T_OutPhosphor=2600.0 V
- Camera: PCOEdge
- Grid: -400 V
- Camera Exposure time: 1ms

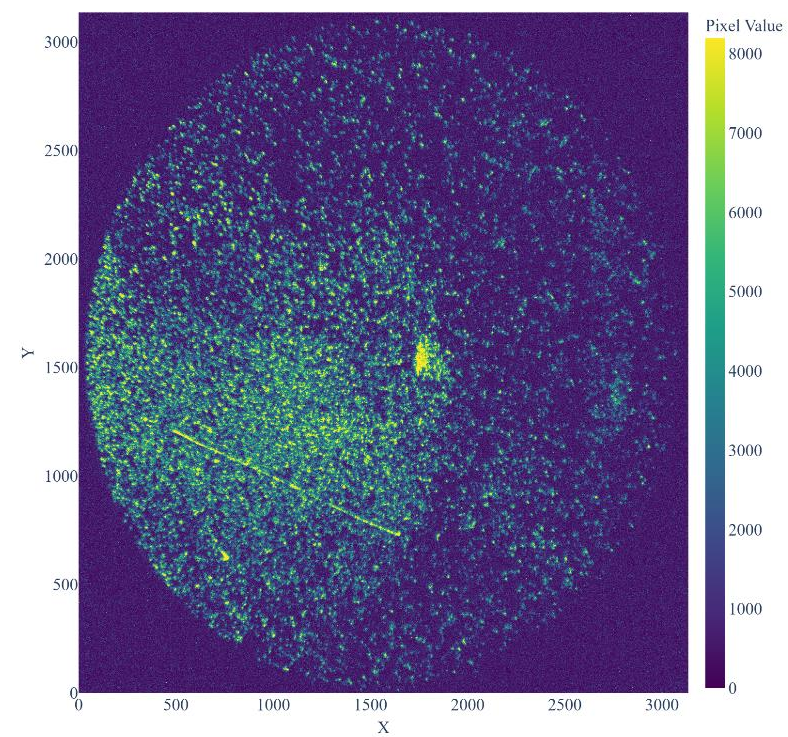


Single Image Pre-Processing



Background Subtraction within Dataset

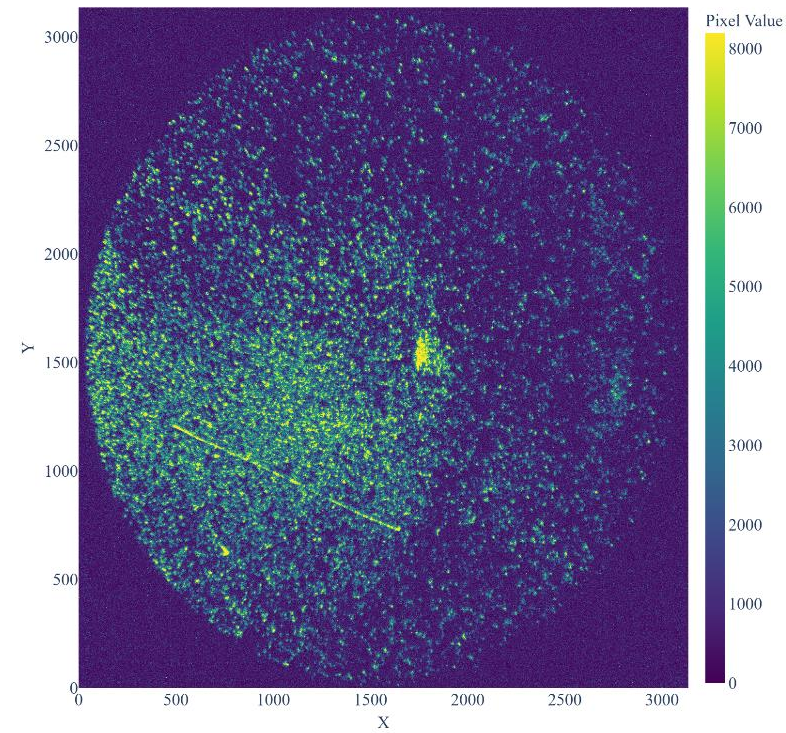
HbarLog165-433512



Image

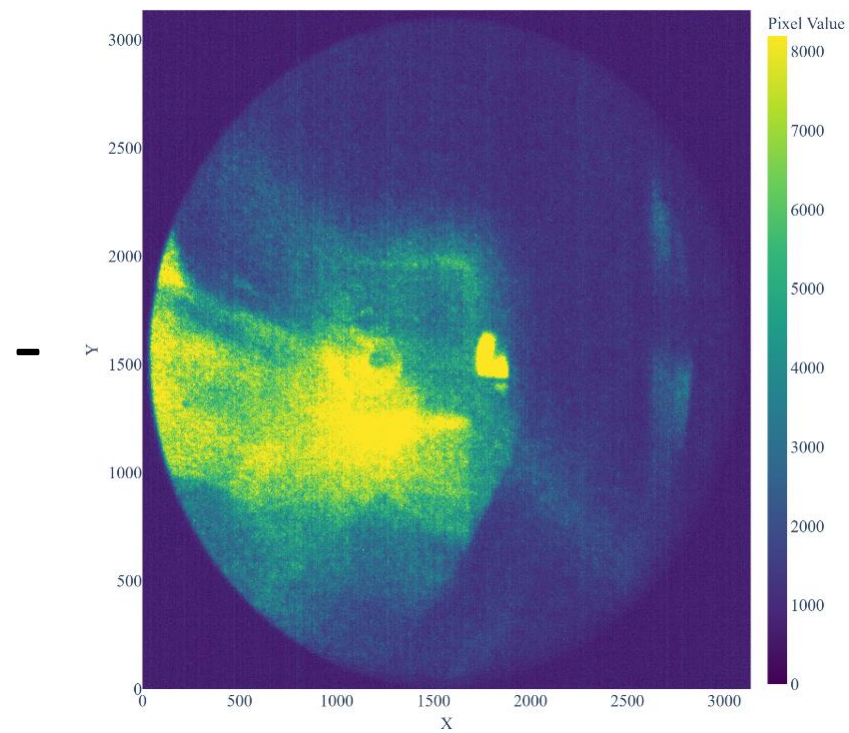
Background Subtraction within Dataset

HbarLog165-433512



Image

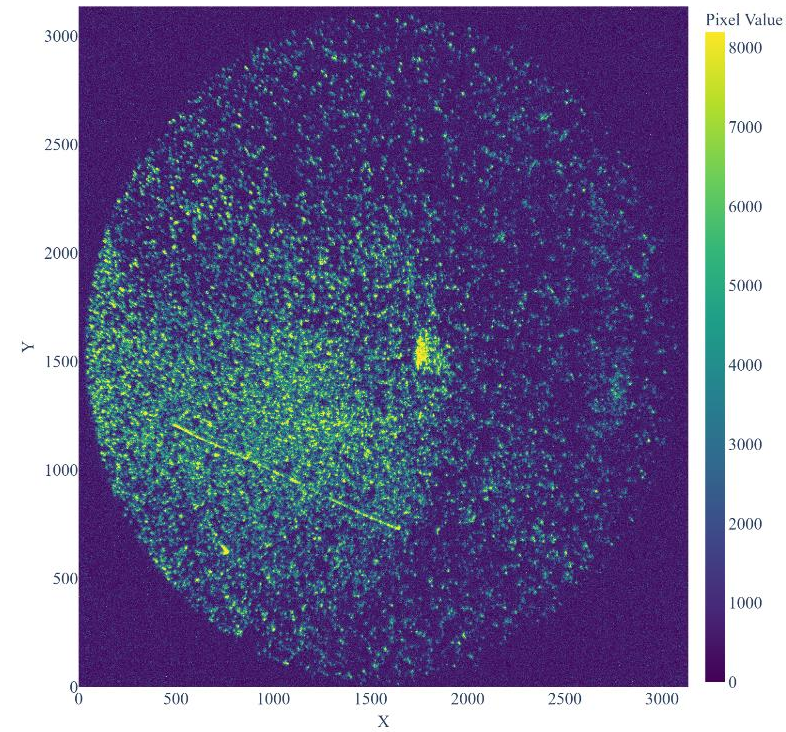
Median of HbarLog165 - 141 images



Median of all images excluding
the investigated image

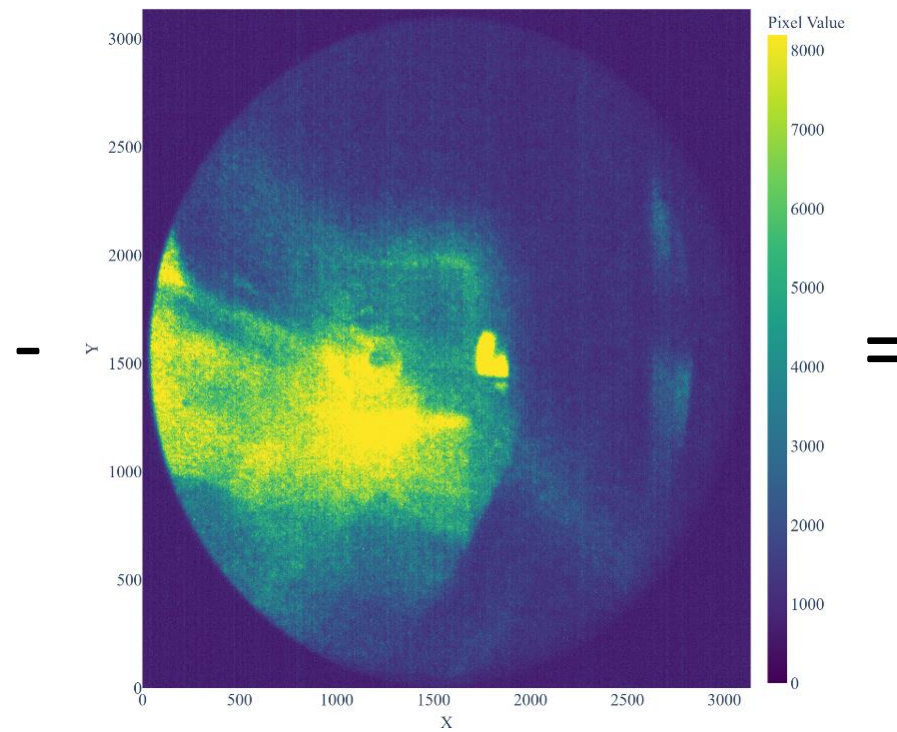
Background Subtraction within Dataset

HbarLog165-433512



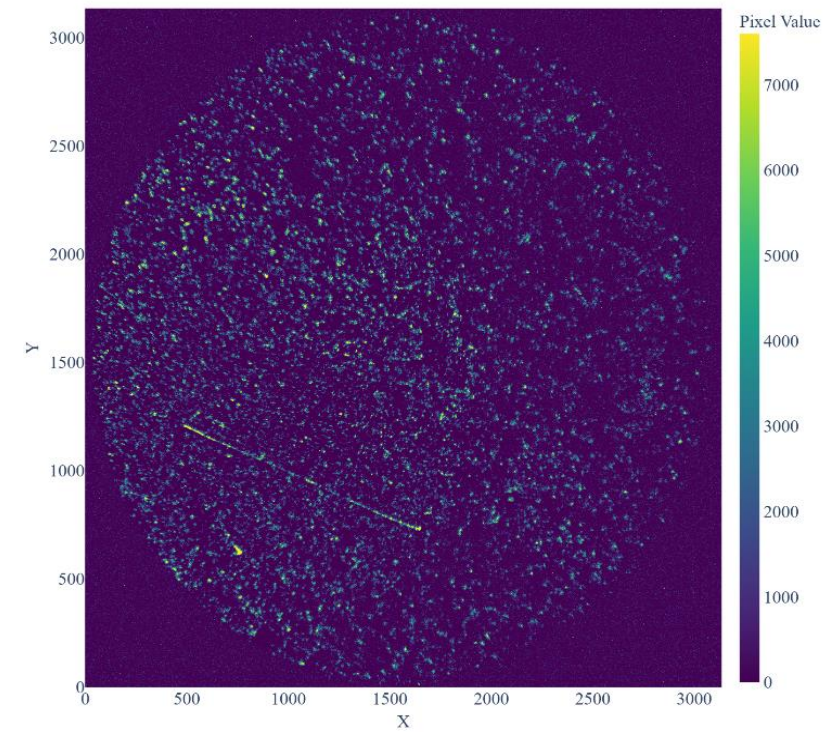
Image

Median of HbarLog165 - 141 images



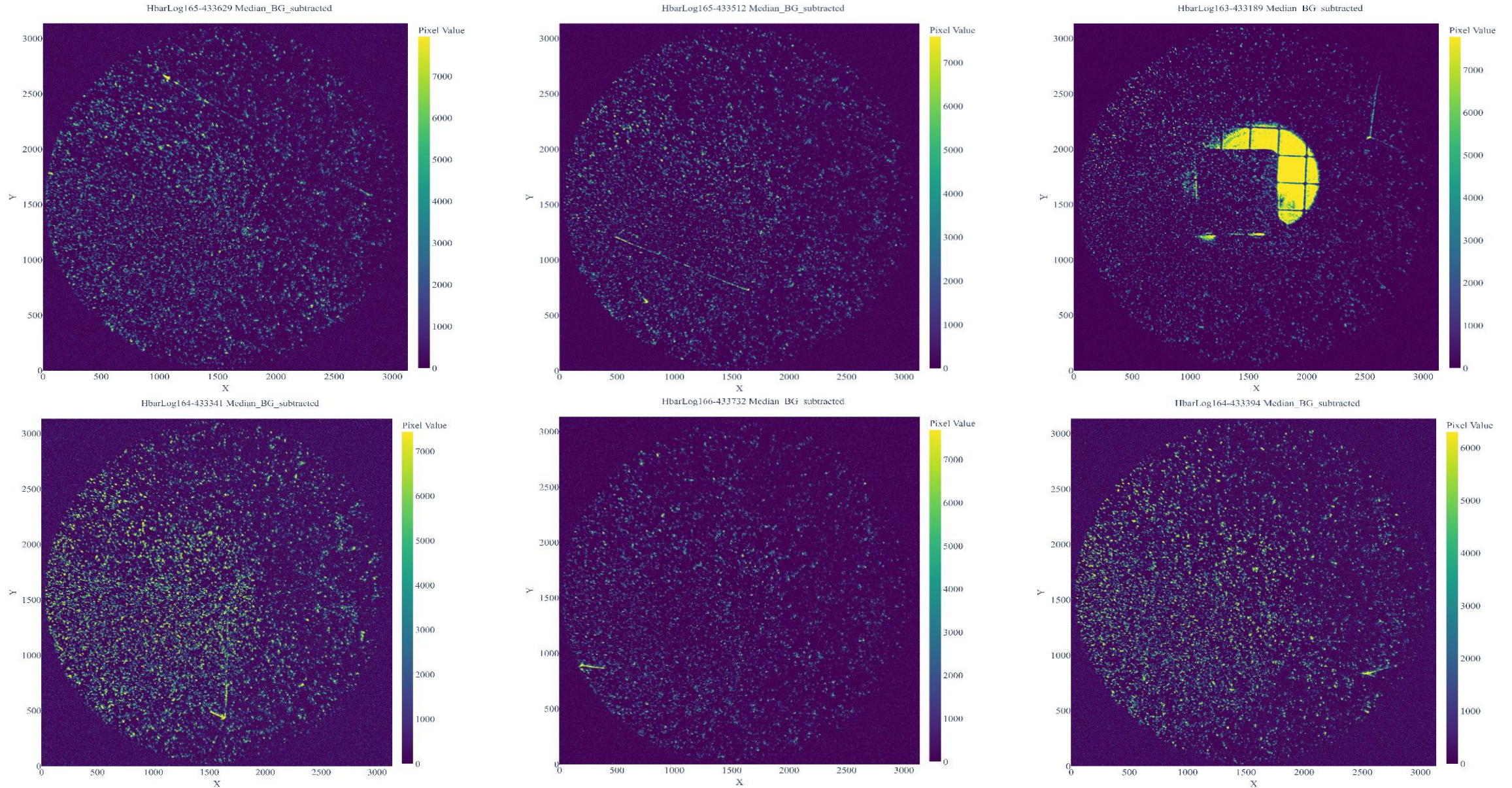
=

HbarLog165-433512 Median_BG_subtracted

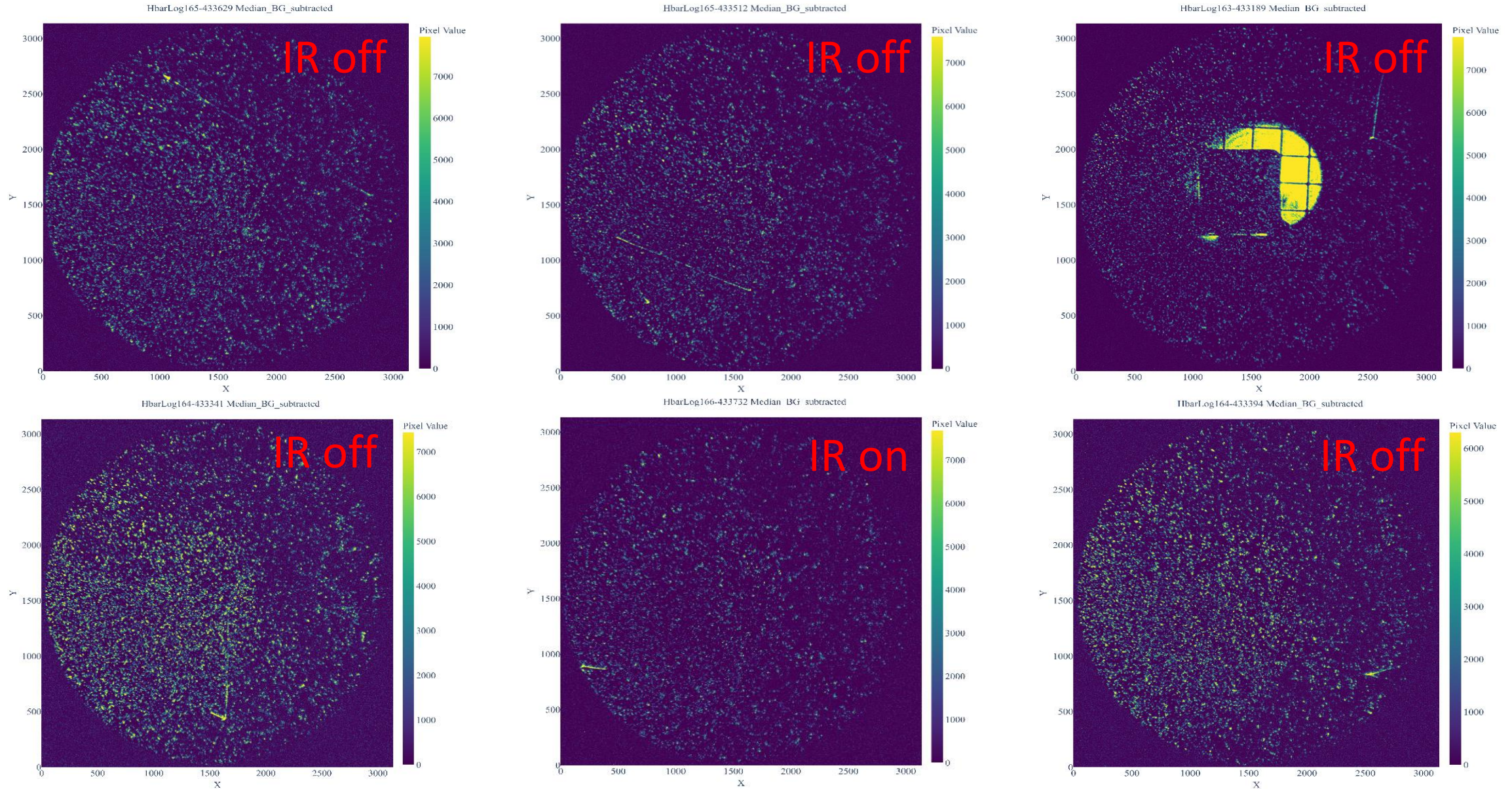


Median of all images excluding
the investigated image

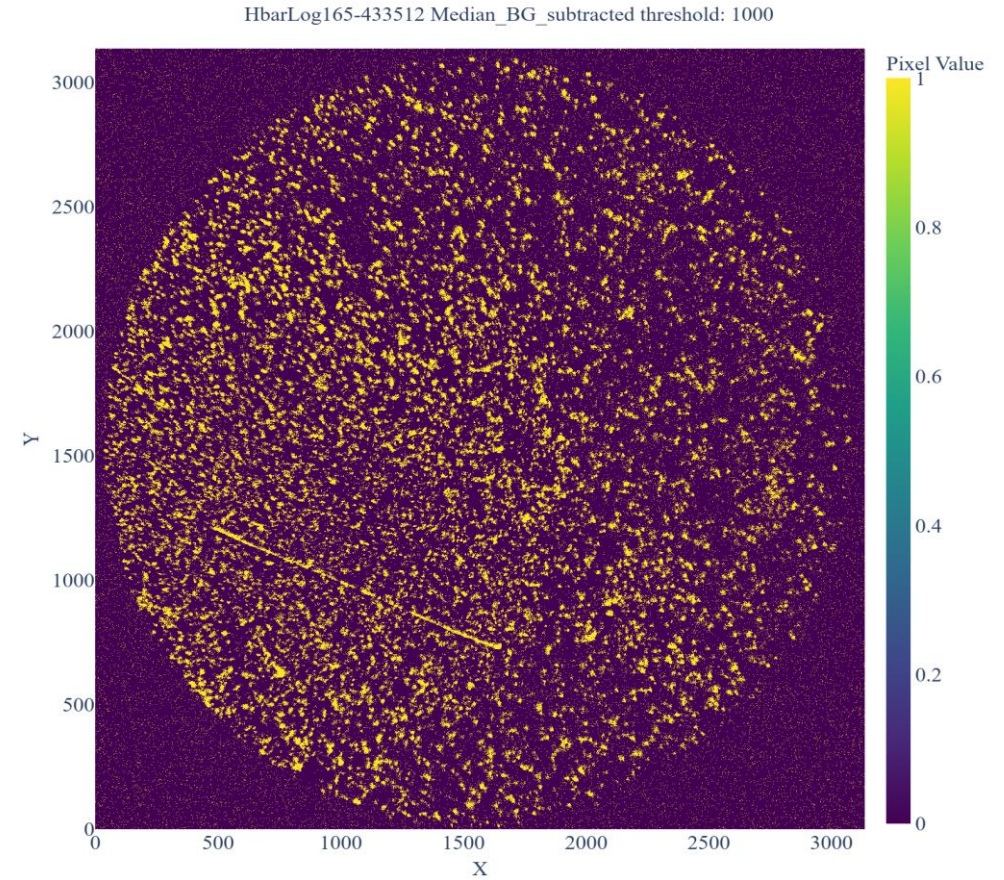
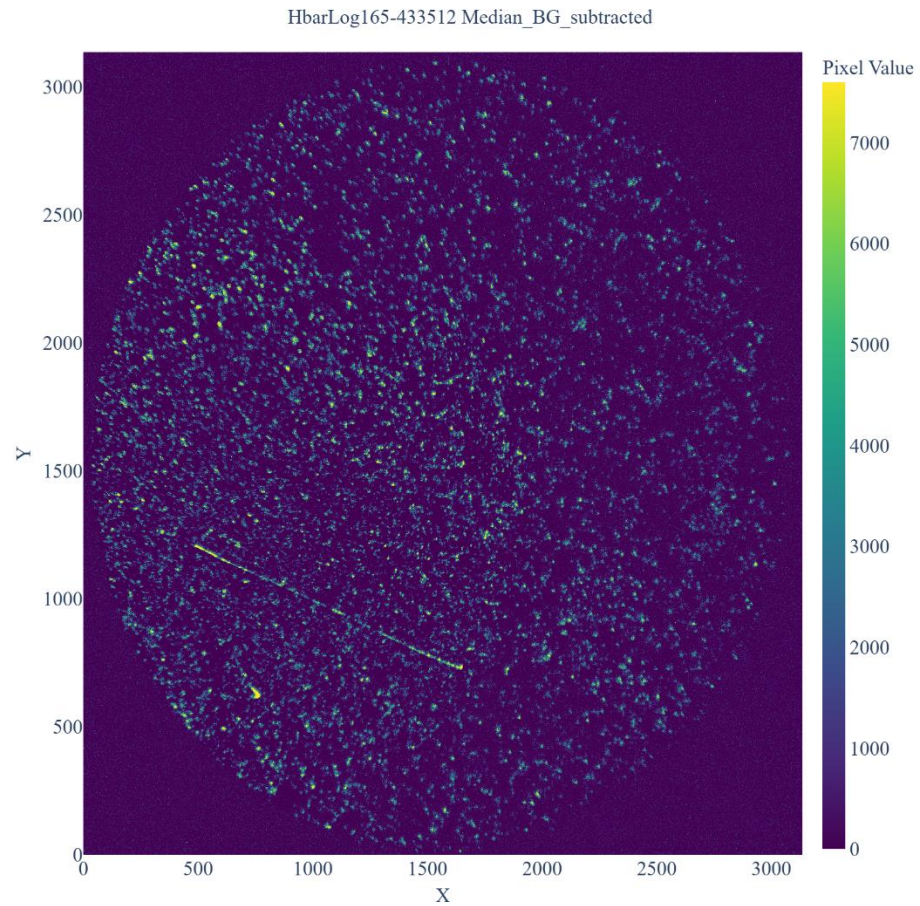
Breaking News: Visible traces



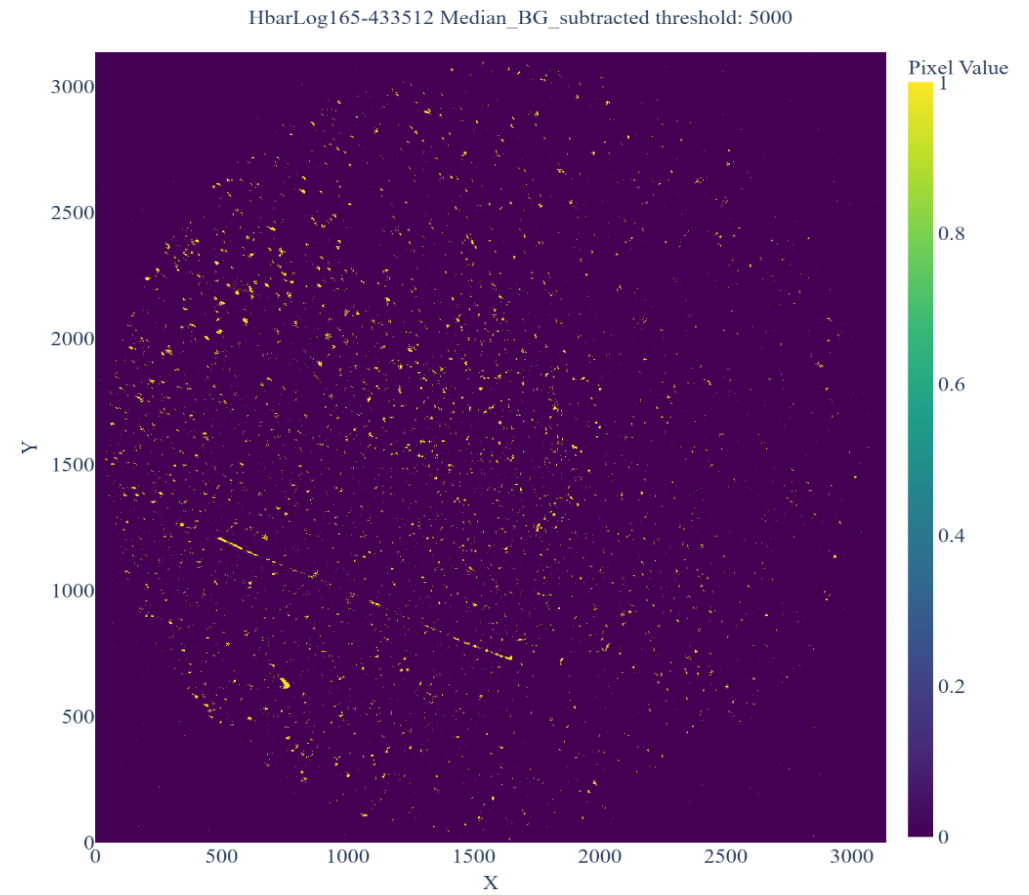
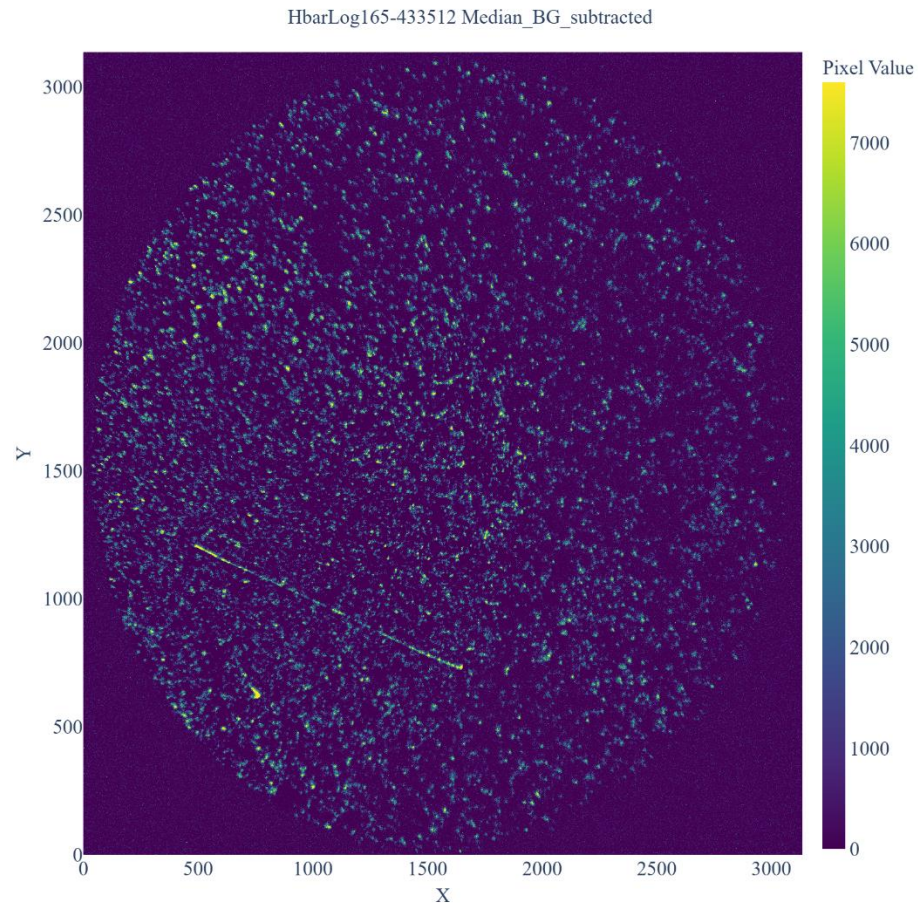
Breaking News: Visible traces



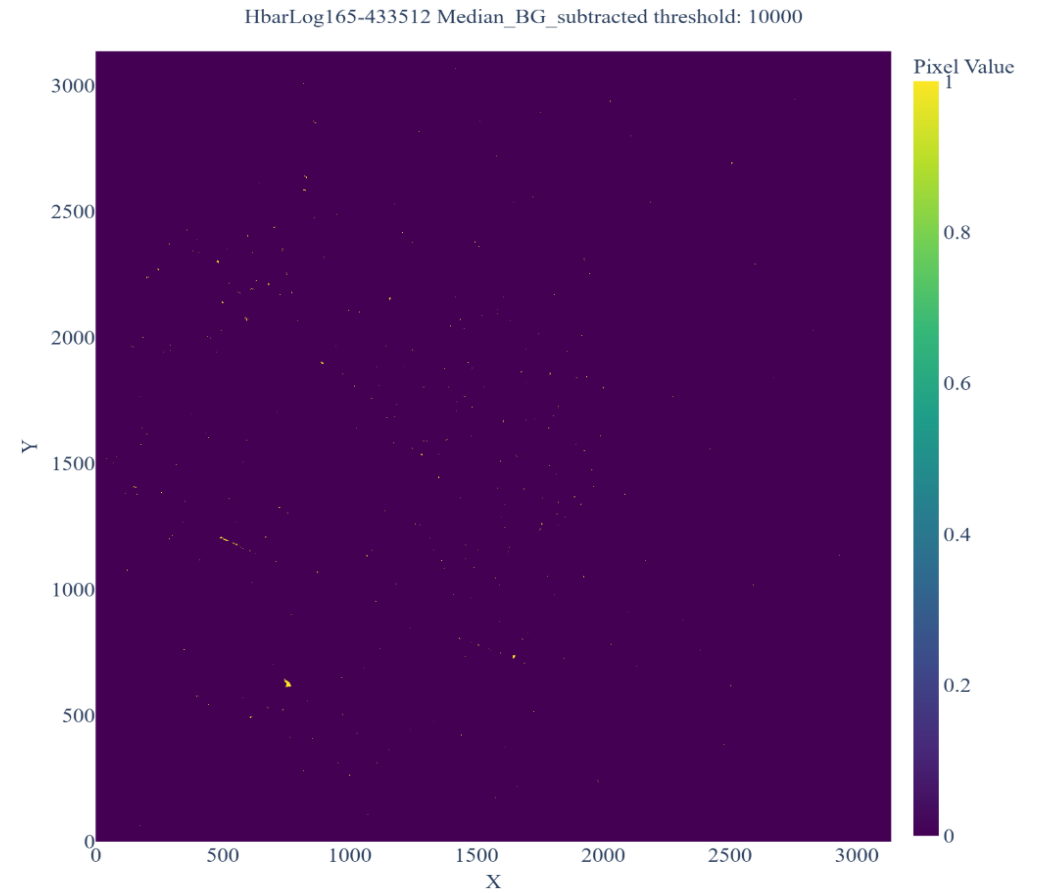
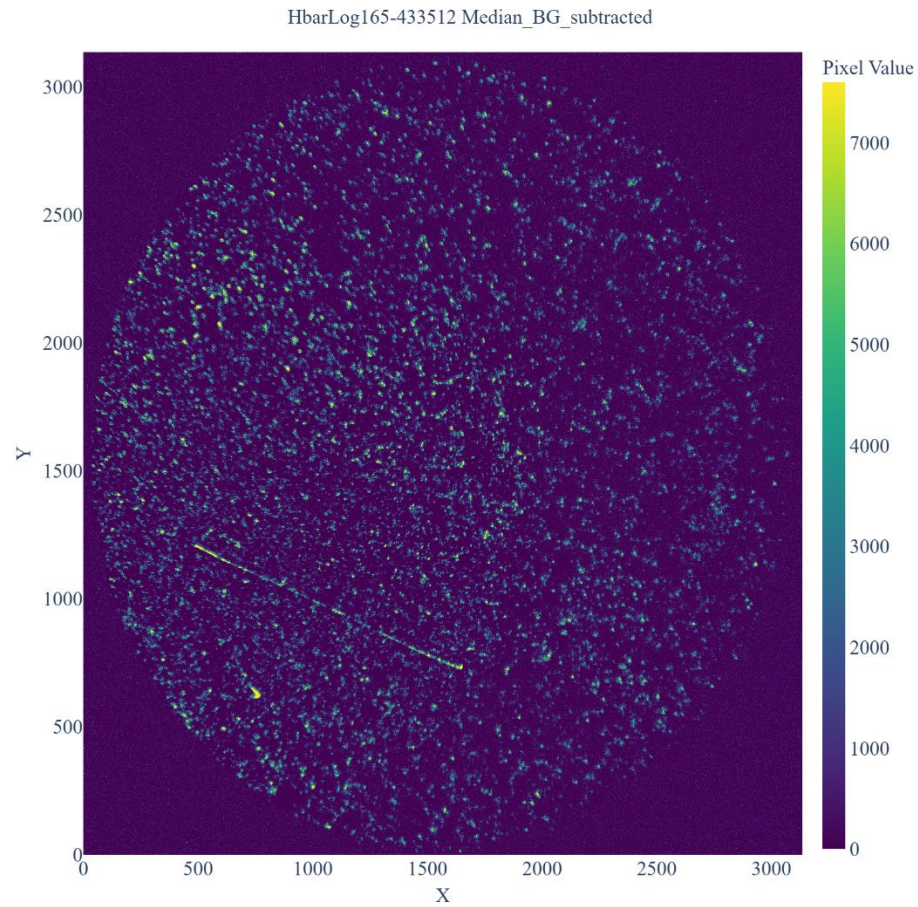
How to find Hbar?



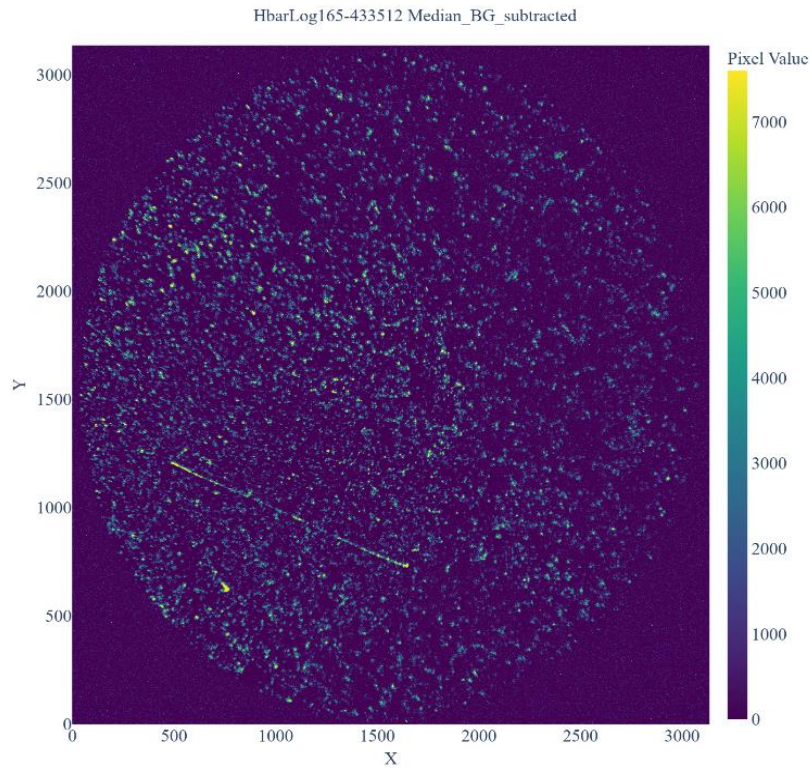
How to find Hbar?



How to find Hbar?



Background Subtraction within Dataset



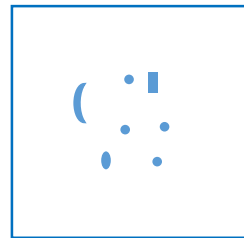
Threshold
cut

“signal_sum”

$$\sum_i pixel_i$$



Binary Image

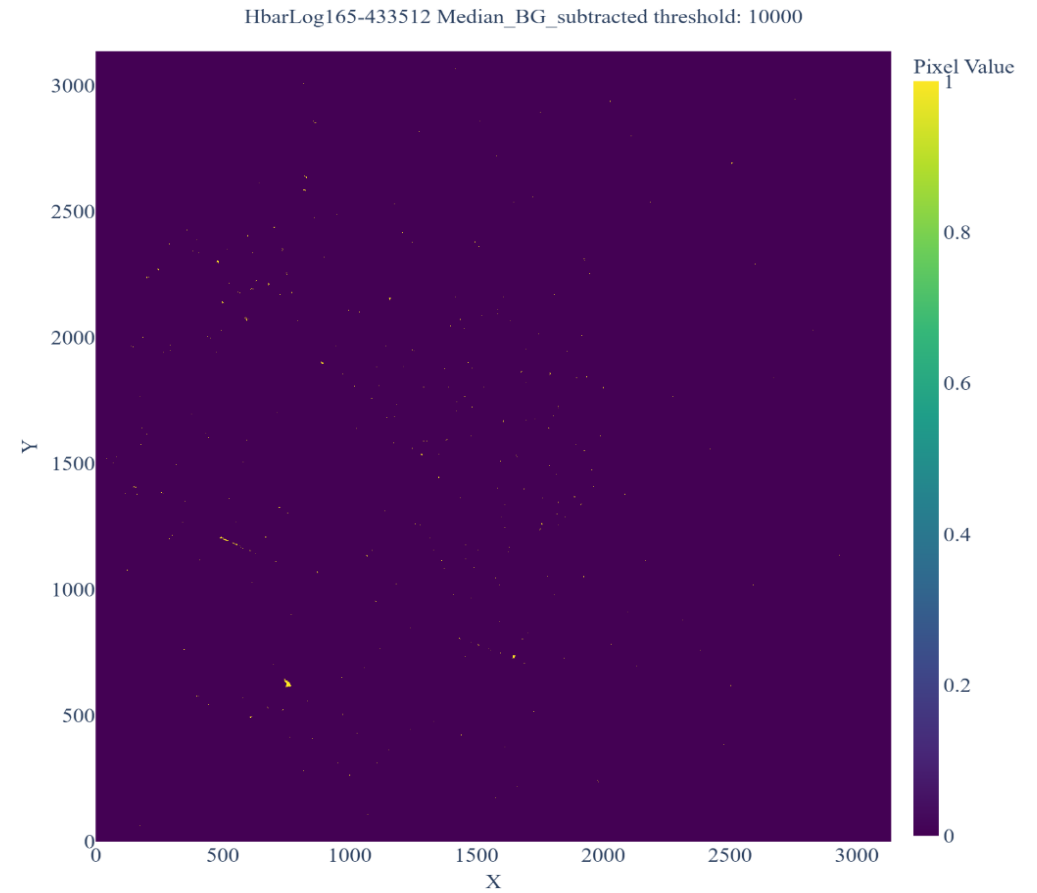
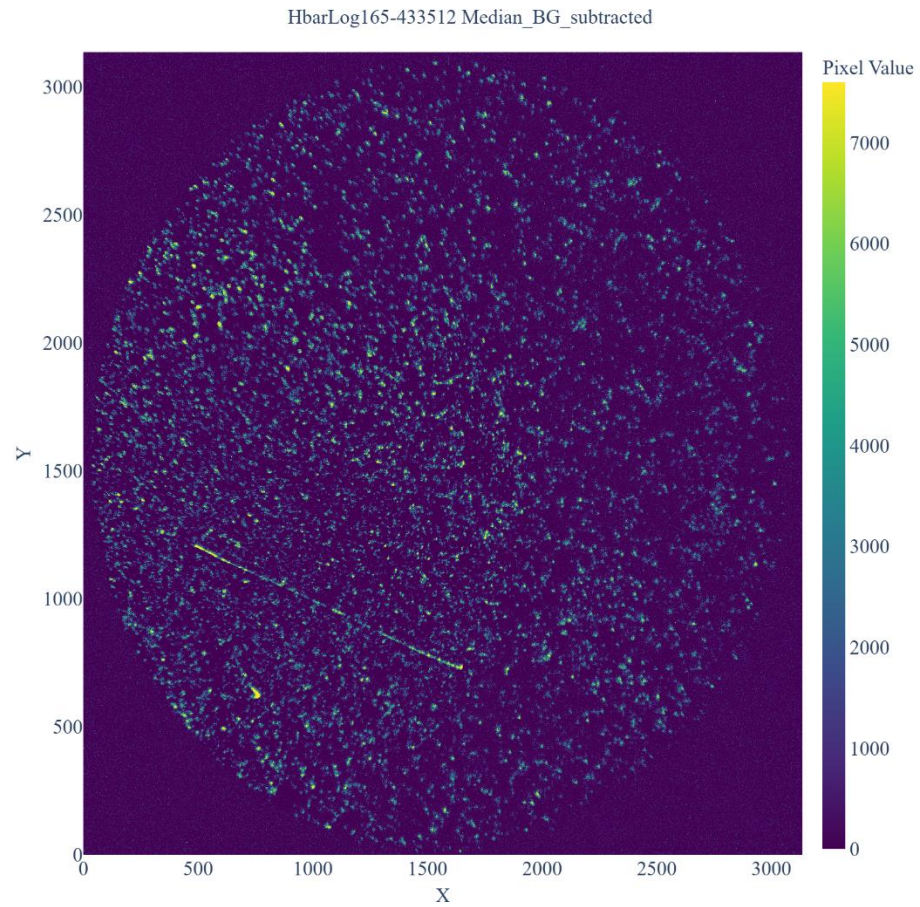


Clustering
(con. 4)



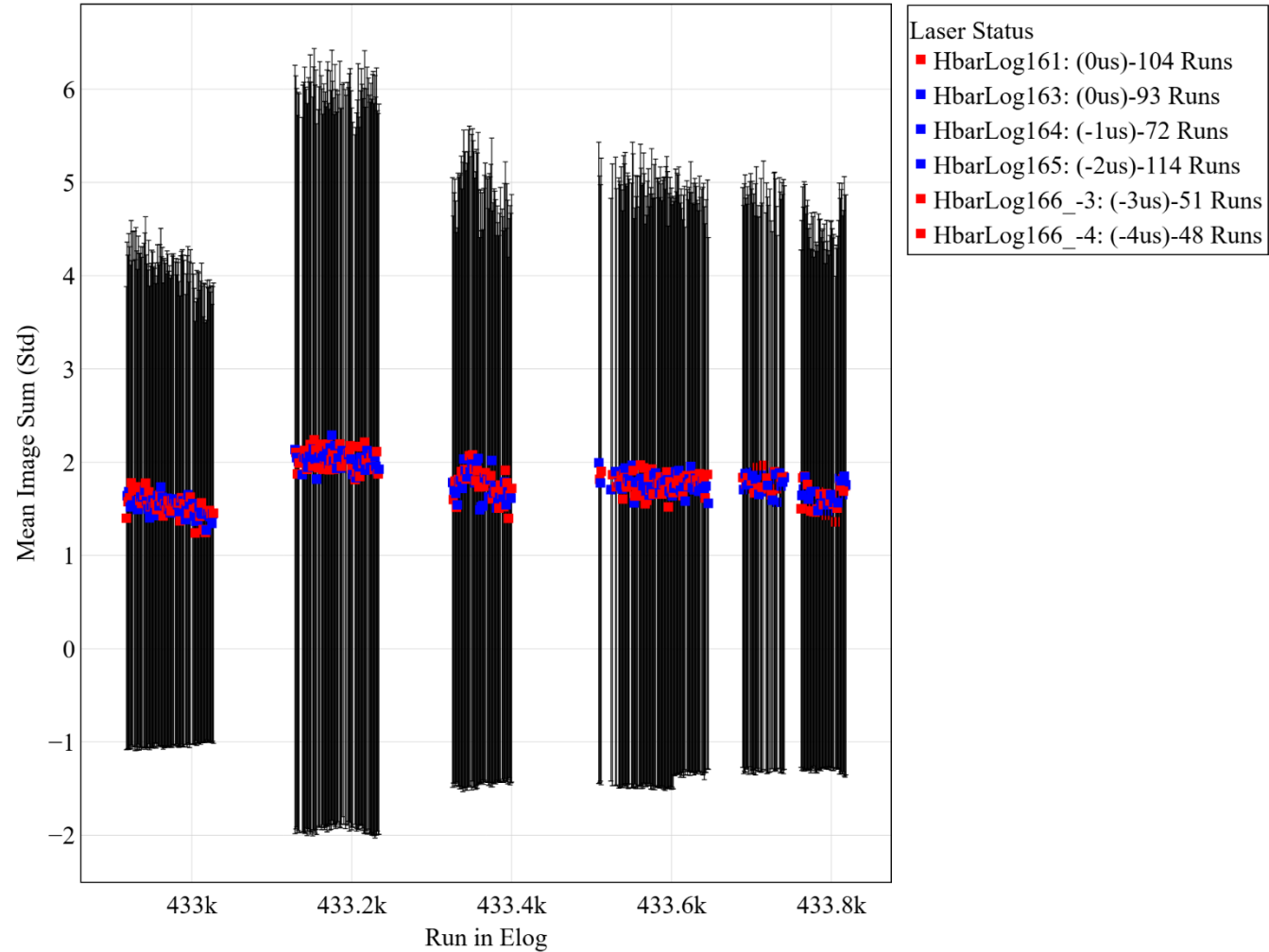
analysis

1. Signal Sum



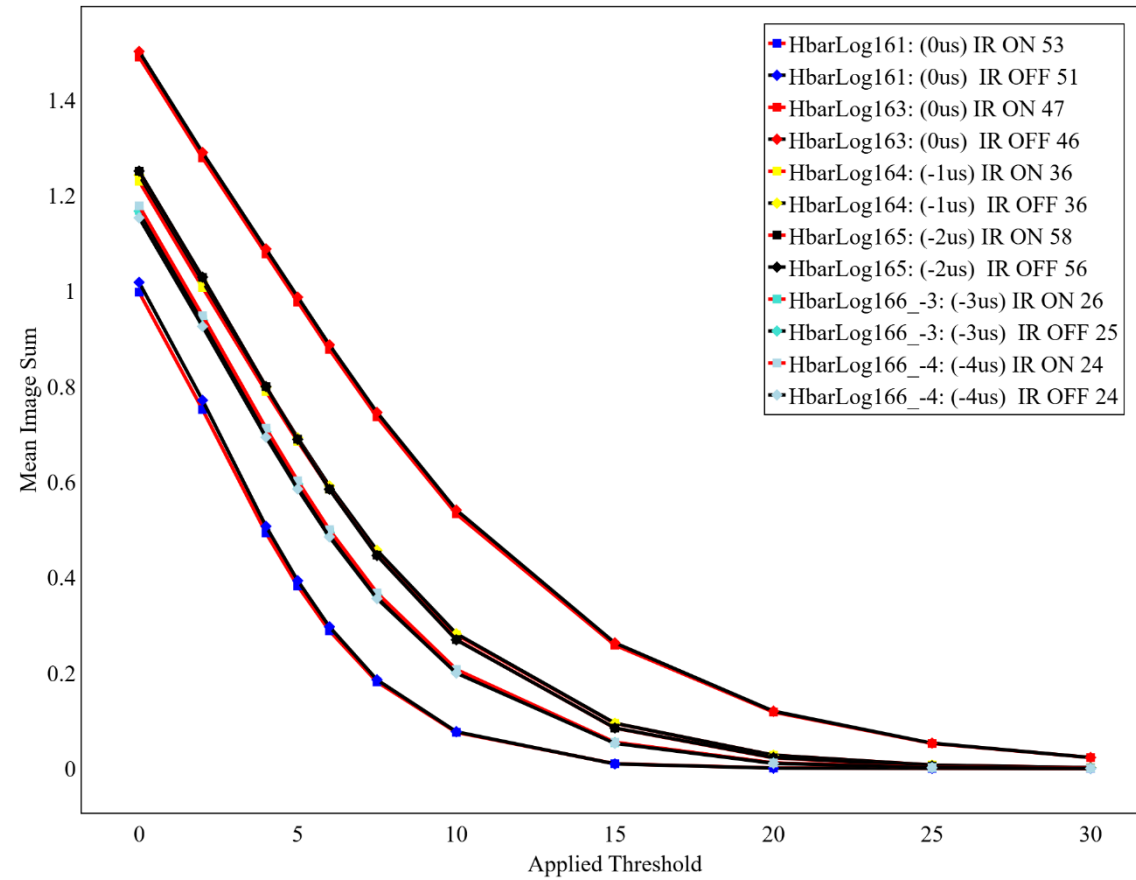
1. Signal Sum

Hbar PCOEdge CMOS Analysis Traces



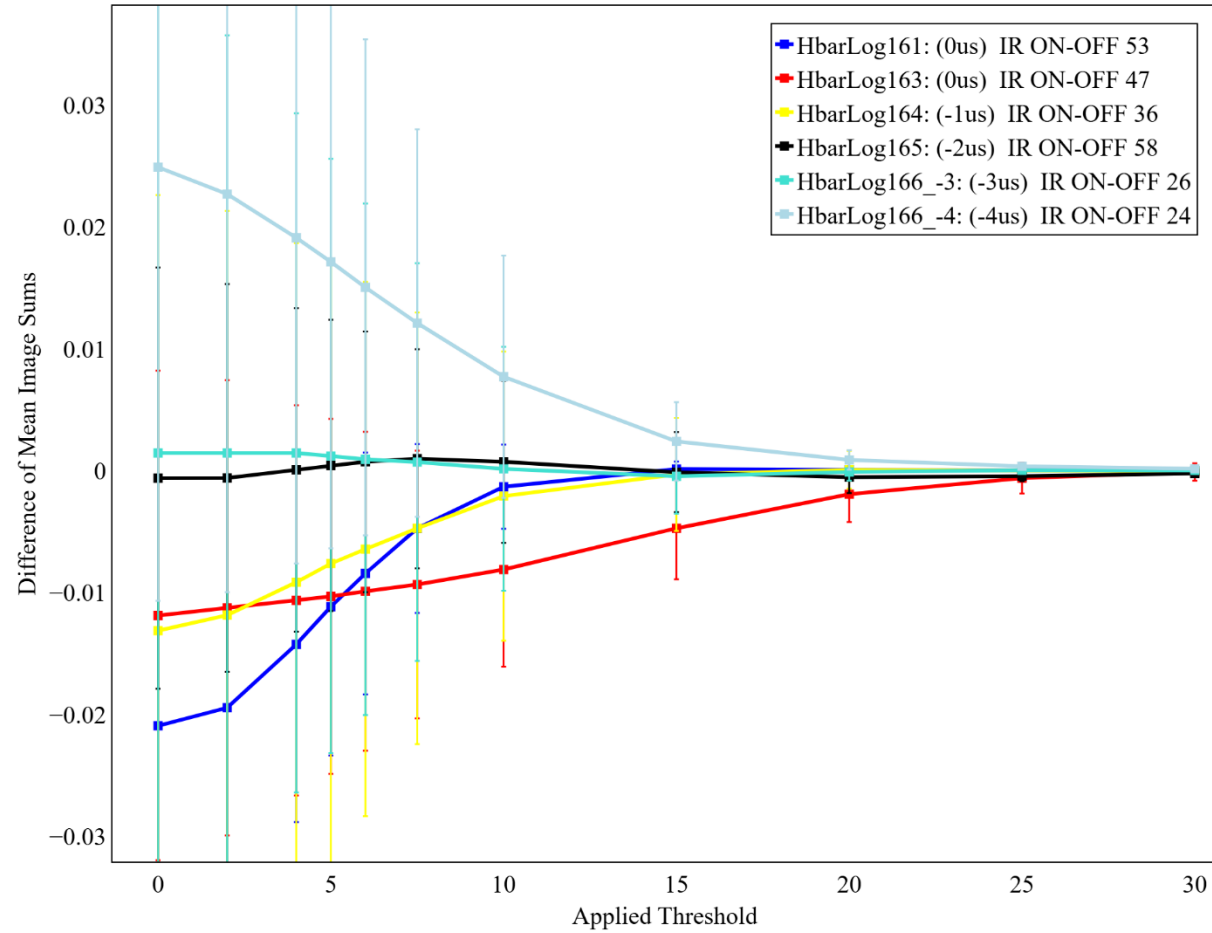
1. Signal Sum

Hbar PCOEdge CMOS Analysis



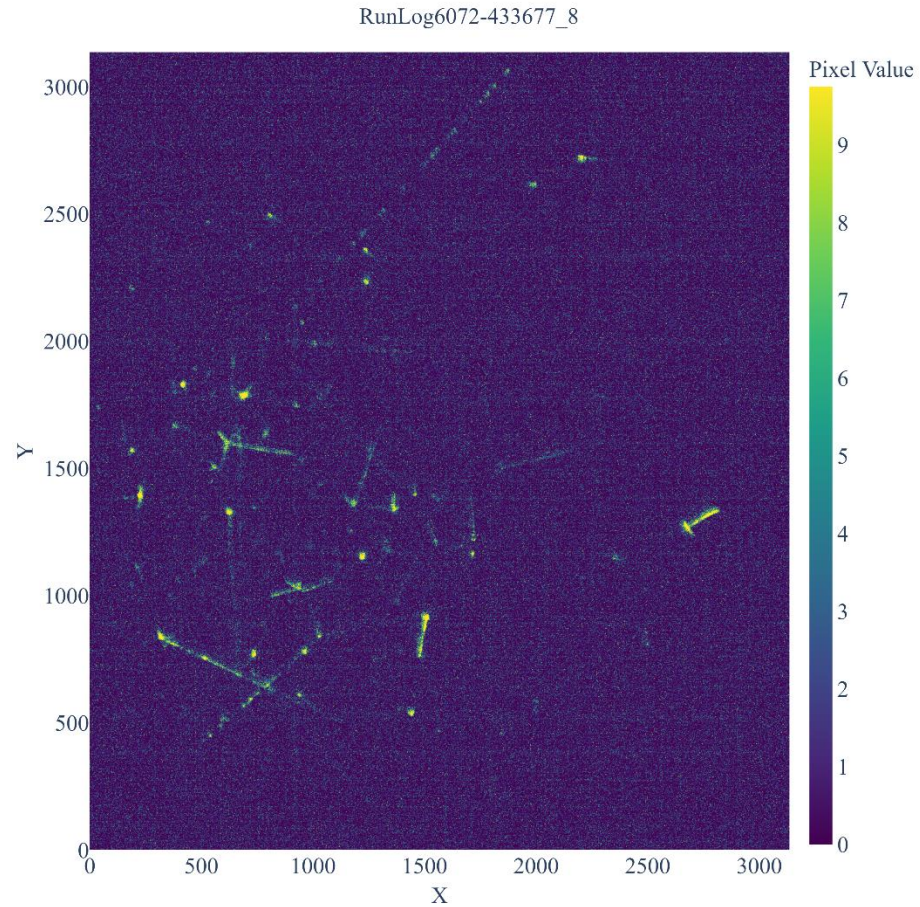
1. Signal Sum

Hbar PCOEdge CMOS Analysis

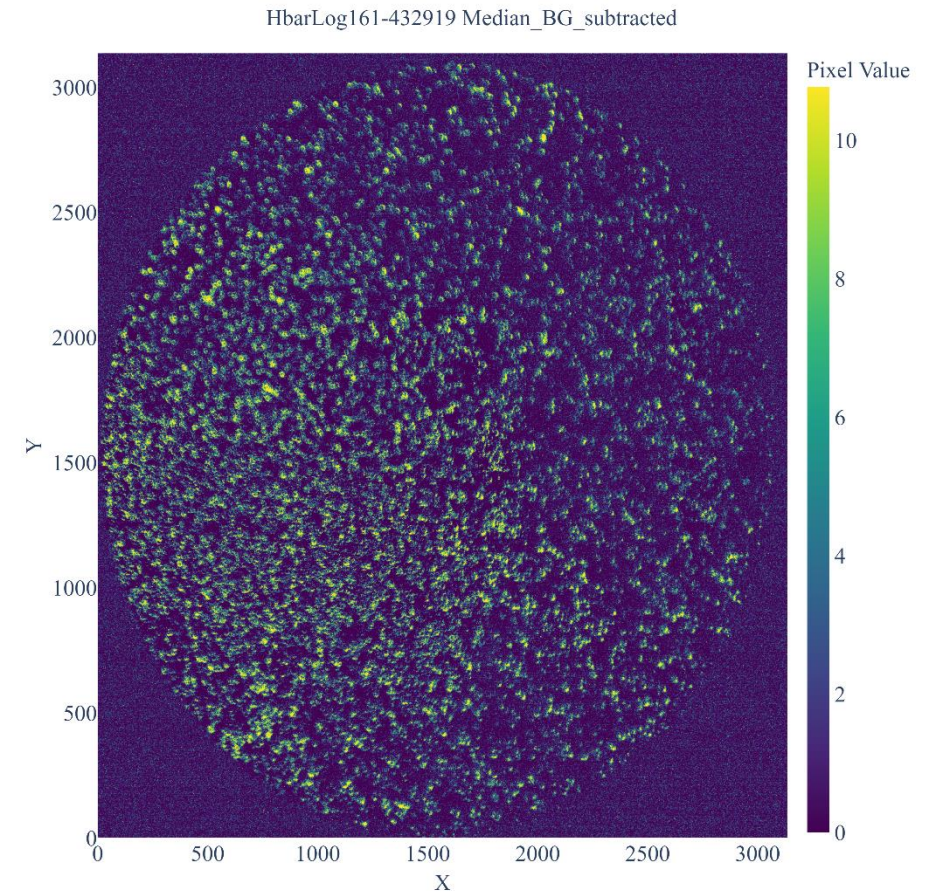


2. Learn From References

i) Pbars only (SinglePbarsOnMCP.py)

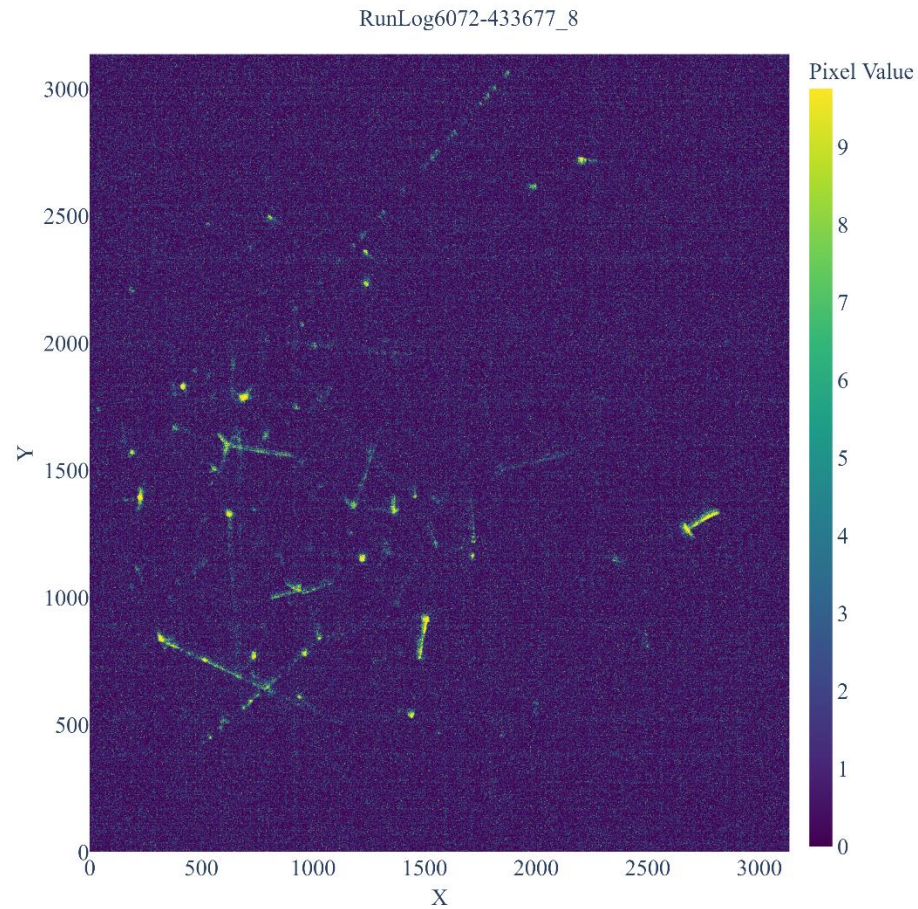


ii) Everything except Pbars (GV5 closed)

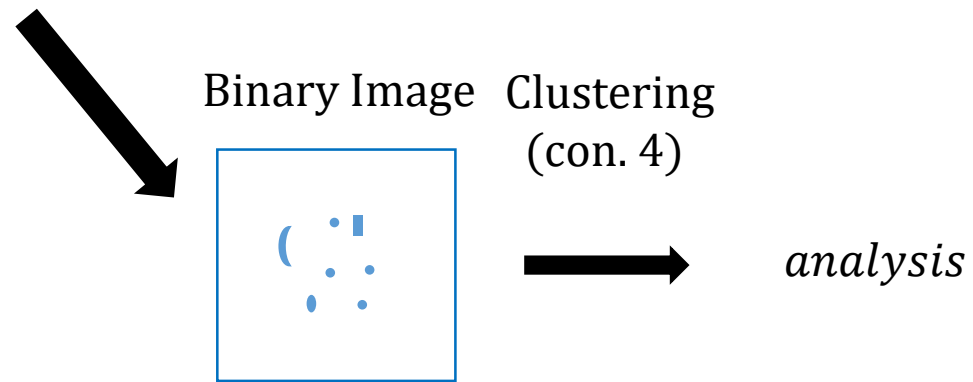


2. Learn From References

i) Pbars only (SinglePbarsOnMCP.py)

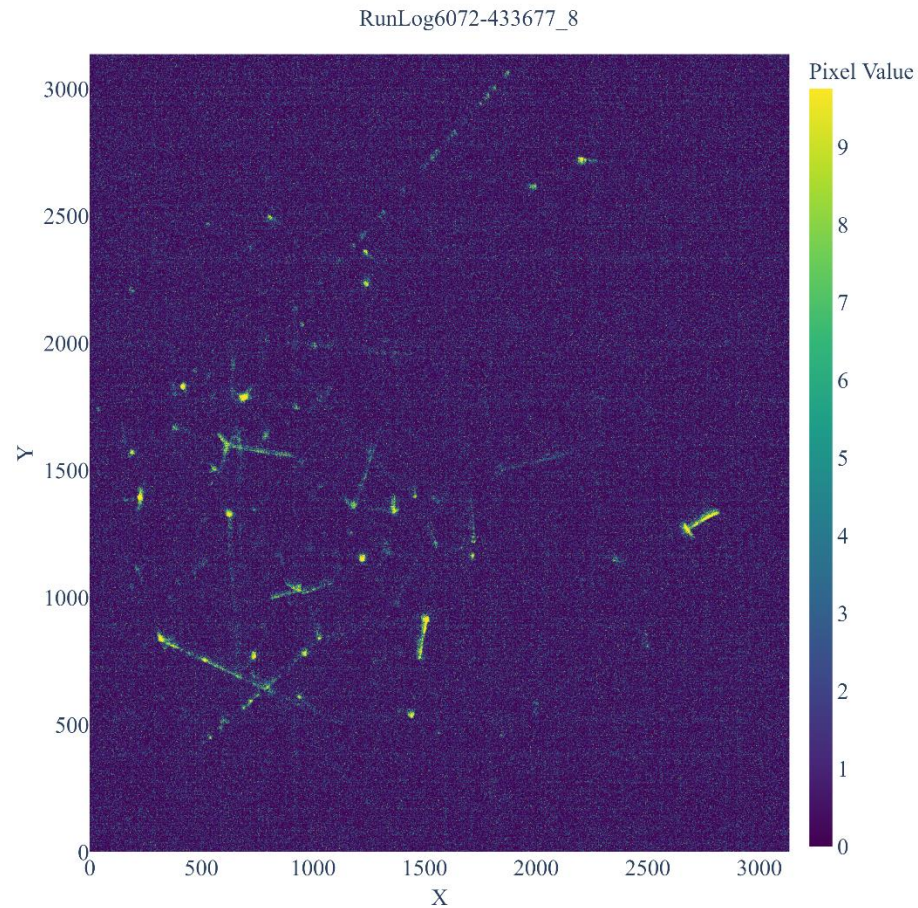


ii) Everything except Pbars (GV5 closed)

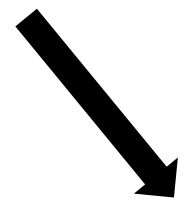


2. Learn From References

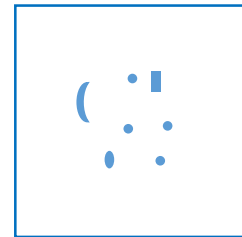
i) Pbars only (SinglePbarsOnMCP.py)



ii) Everything except Pbars (GV5 closed)



Binary Image



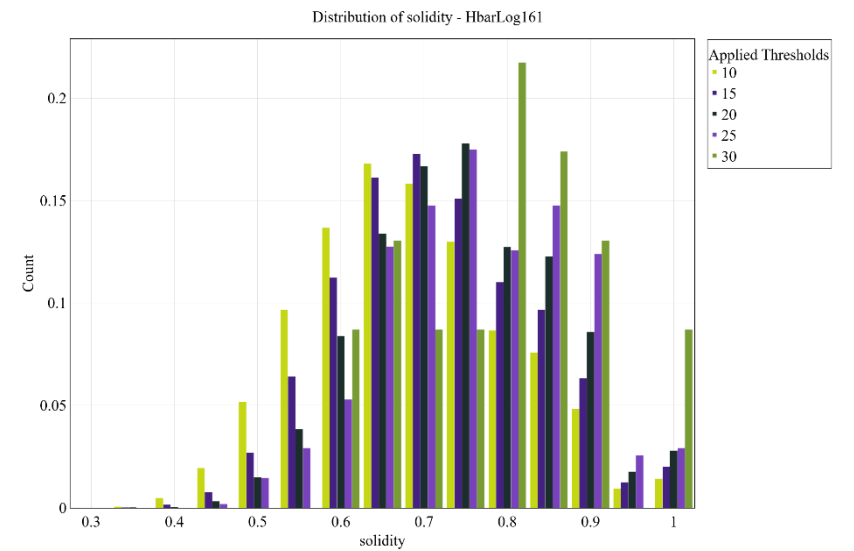
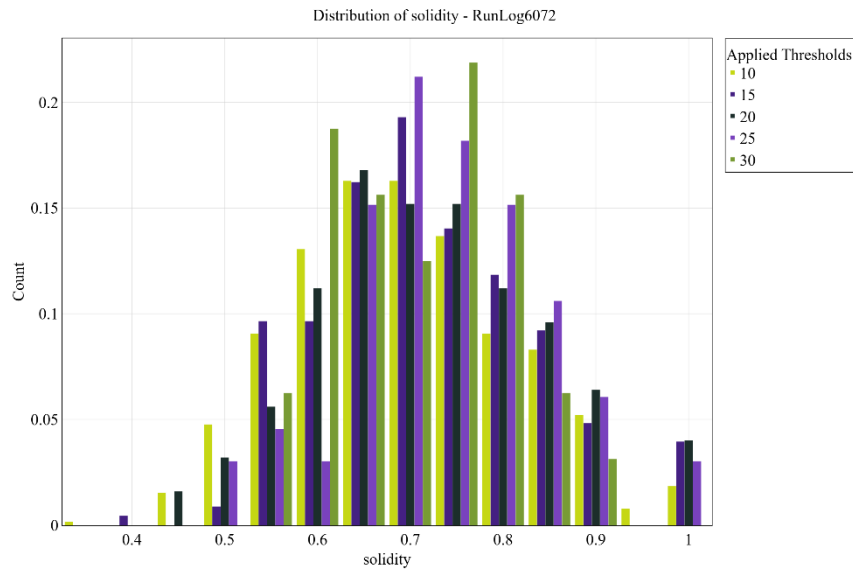
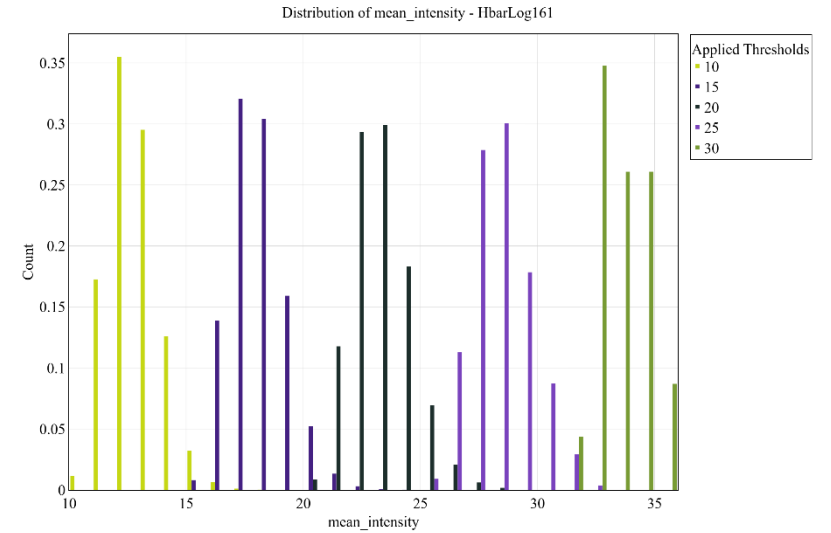
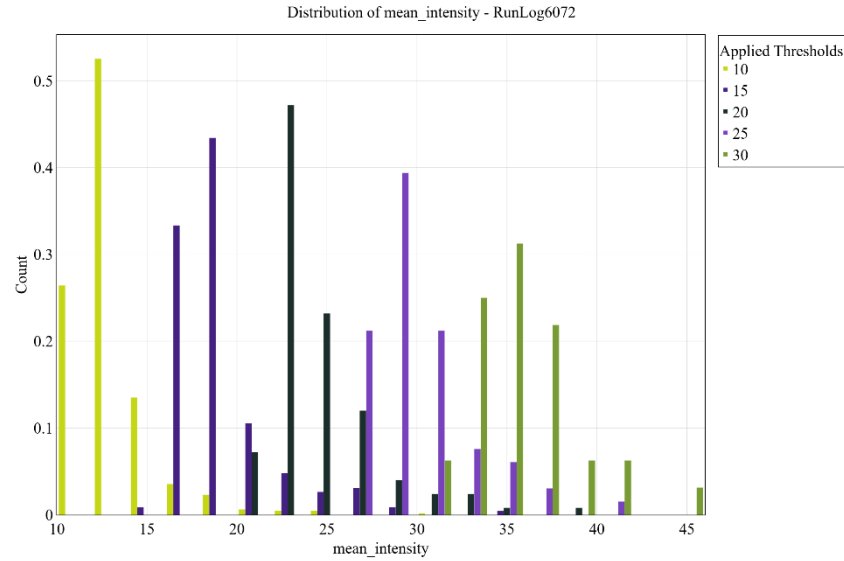
Clustering
(con. 4)



analysis:

- area,
- centroid,
- bbox,
- perimeter,
- eccentricity,
- extent,
- solidity,
- max_intensity,
- min_intensity,
- weighted_centroid,
- mean_intensity,
- std_intensity,
- skewness,
- kurtosis,
- pixel_value_histogram

2. Learn From References



2. Learn From References

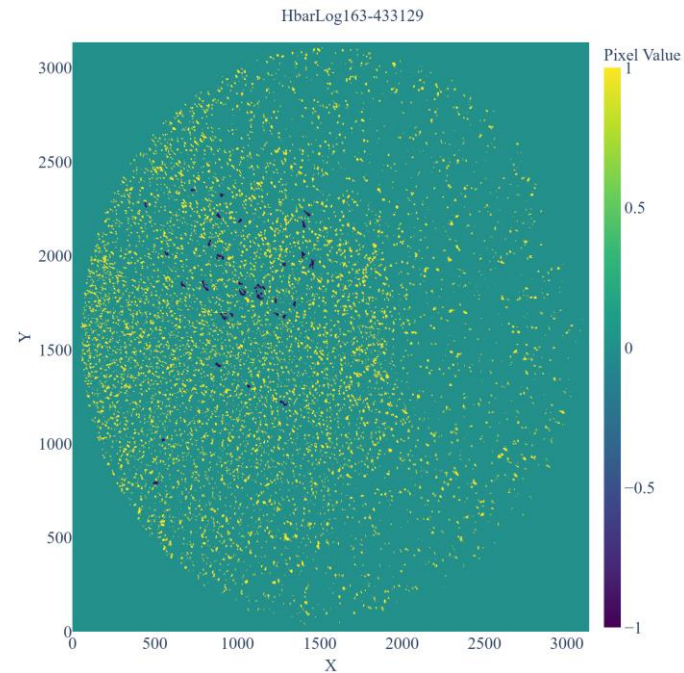
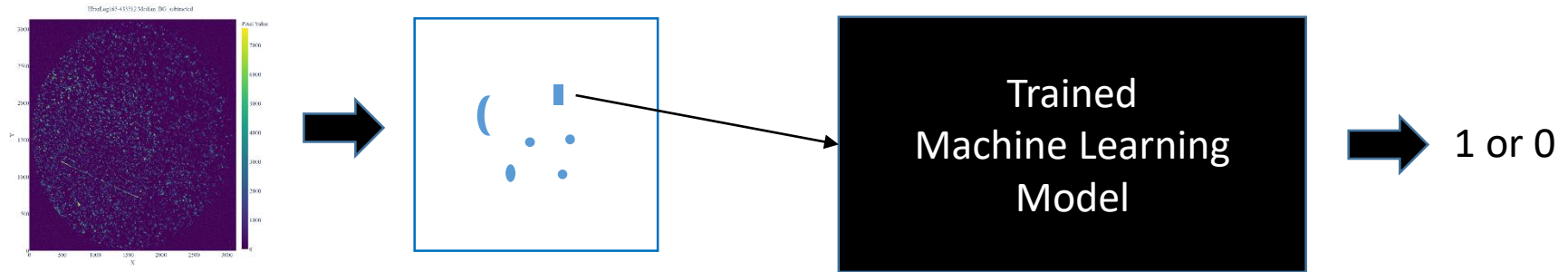
→ Binary Classification Task

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
	Threshold	Model	test_score	X_good	X_bad	scaler_used	PCA_used	Oversampled_by_SMOTE	accuracy	precision	recall	f1	roc_auc	logarithmic_loss	mcc	kappa	TruePositive	FalsePositive	FalseNegative	TrueNegative
0	10	logreg	0.716659	651	301278	TRUE	FALSE	FALSE	0.716659	0.732188	0.683218	0.706856	0.779572	0.576681059	0.43429	0.433318	45198	15058	19088	41168
1	10	rf	1	651	301278	TRUE	FALSE	FALSE	1	1	1	1	1	0.001809903	1	1	60256	0	0	60256
2	10	gb	0.829237	651	301278	TRUE	FALSE	FALSE	0.829237	0.830989	0.82659	0.828784	0.917781	0.432786646	0.658483	0.658474	50126	10130	10449	49807
3	10	hgbc	0.999925	651	301278	TRUE	FALSE	FALSE	0.999925	0.999851	1	0.999925	1	0.000845972	0.999851	0.999851	60247	9	0	60256
4	15	logreg	0.760843	228	53375	TRUE	FALSE	FALSE	0.760843	0.79087	0.709227	0.747827	0.844811	0.4898369	0.524488	0.521686	8673	2002	3104	7571
5	15	rf	1	228	53375	TRUE	FALSE	FALSE	1	1	1	1	1	0.003128902	1	1	10675	0	0	10675
6	15	gb	0.928384	228	53375	TRUE	FALSE	FALSE	0.928384	0.901987	0.961218	0.930661	0.97816	0.282684287	0.858621	0.856768	9560	1115	414	10261
7	15	hgbc	1	228	53375	TRUE	FALSE	FALSE	1	1	1	1	1	2.63945E-05	1	1	10675	0	0	10675
8	20	logreg	0.763965	125	6355	TRUE	FALSE	FALSE	0.763965	0.812093	0.686861	0.744246	0.835631	0.50037556	0.534322	0.527931	1069	202	398	873
9	20	rf	1	125	6355	TRUE	FALSE	FALSE	1	1	1	1	1	0.013309329	1	1	1271	0	0	1271
10	20	gb	0.945712	125	6355	TRUE	FALSE	FALSE	0.945712	0.92626	0.968529	0.946923	0.990239	0.205498201	0.892354	0.891424	1173	98	40	1231
11	20	hgbc	0.999607	125	6355	TRUE	FALSE	FALSE	0.999607	0.999214	1	0.999607	1	0.001079215	0.999214	0.999213	1270	1	0	1271
12	25	logreg	0.713636	66	549	TRUE	FALSE	FALSE	0.713636	0.764045	0.618182	0.683417	0.835372	0.470909513	0.435278	0.427273	89	21	42	68
13	25	rf	0.977273	66	549	TRUE	FALSE	FALSE	0.977273	0.956522	1	0.977778	1	0.079245332	0.955533	0.954545	105	5	0	110
14	25	gb	0.963636	66	549	TRUE	FALSE	FALSE	0.963636	0.947368	0.981818	0.964286	0.988182	0.159611873	0.927886	0.927273	104	6	2	108
15	25	hgbc	0.986364	66	549	TRUE	FALSE	FALSE	0.986364	0.973451	1	0.986547	1	0.093436104	0.973089	0.972727	107	3	0	110
16	30	logreg	0.7	32	23	TRUE	FALSE	FALSE	0.7	0.75	0.6	0.666667	0.92	0.386083708	0.408248	0.4	4	1	2	3
17	30	rf	0.9	32	23	TRUE	FALSE	FALSE	0.9	1	0.8	0.888889	1	0.253923934	0.816497	0.8	5	0	1	4
18	30	gb	0.8	32	23	TRUE	FALSE	FALSE	0.8	1	0.6	0.75	0.8	2.145806495	0.654654	0.6	5	0	2	3
19	30	hgbc	0.5	32	23	TRUE	FALSE	FALSE	0.5	0	0	0	0.5	0.693147181	0	0	5	0	5	0

Investigation ongoing...

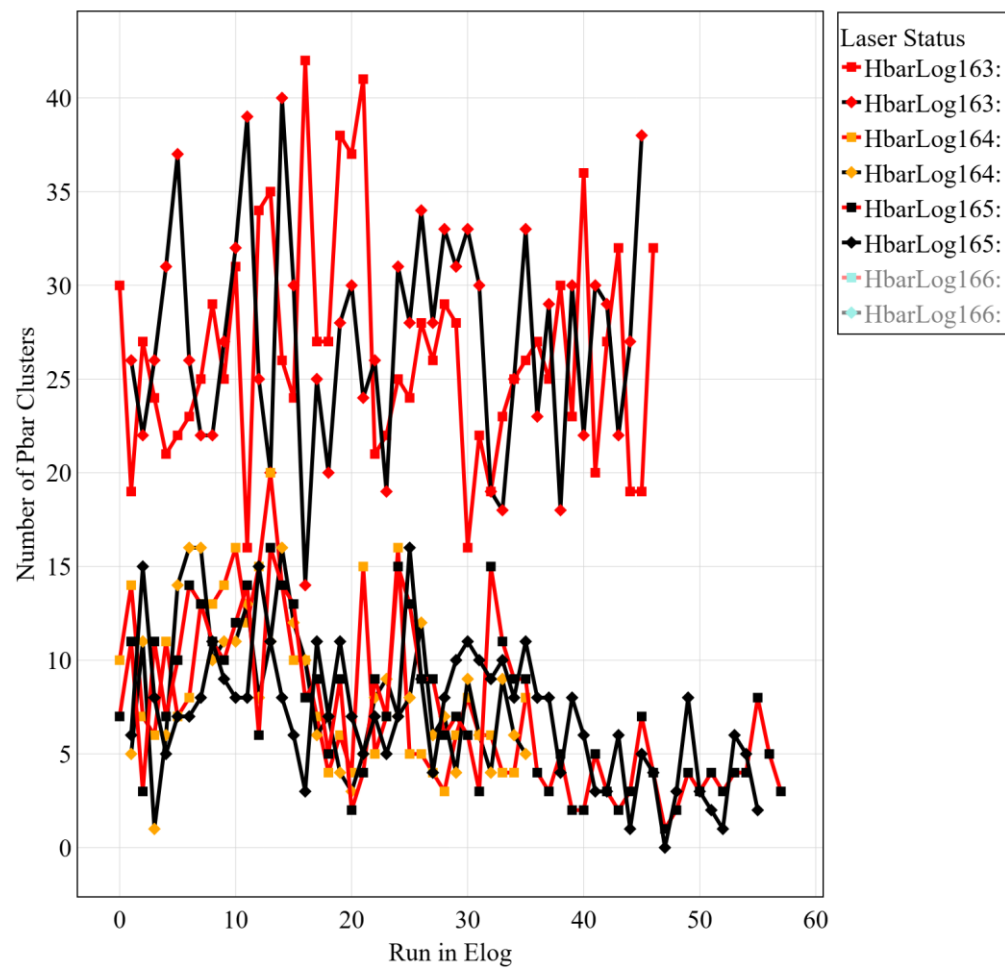
- Different Models, Settings, Thresholds
- Imbalanced dataset

2. Learn From References



Results

Hbar PCOEdge CMOS Analysis Traces / cluster_prop_approach



Hbar PCOEdge CMOS Analysis / cluster_prop_approach

