

# KaonLT Meeting

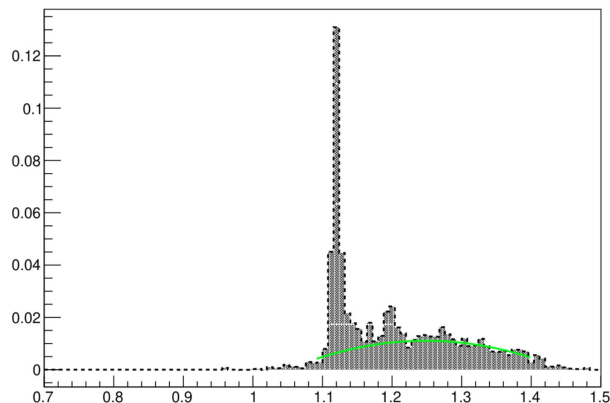
May 7-8<sup>th</sup>, 2026

Richard L. Trotta

# Q2=4.4, W=2.74 Center Low $\epsilon$

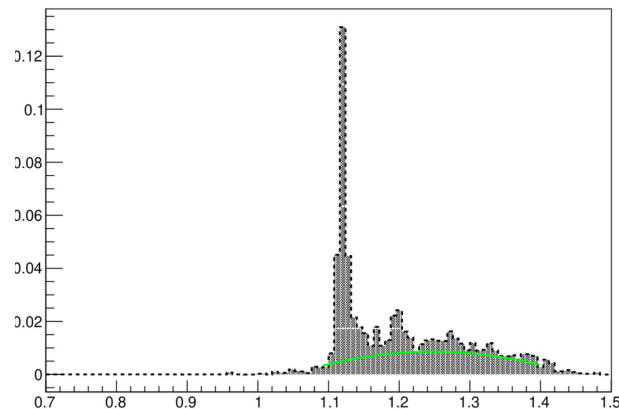
Scale = 1.0

MM\_fit1sub\_K



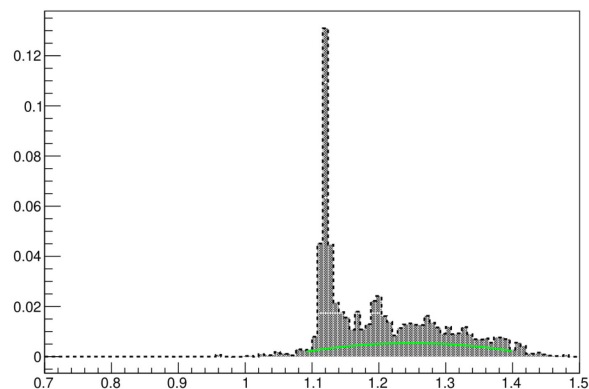
Scale = 0.75

MM\_fit1sub\_K



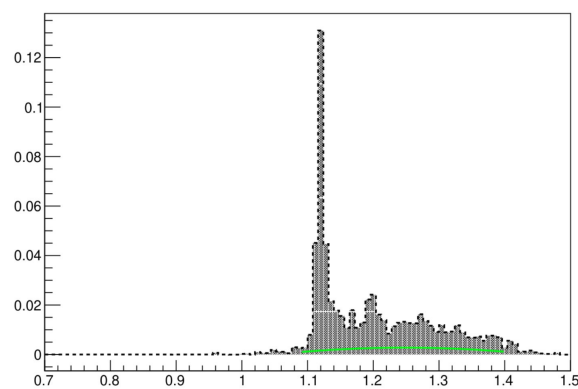
Scale = 0.5

MM\_fit1sub\_K



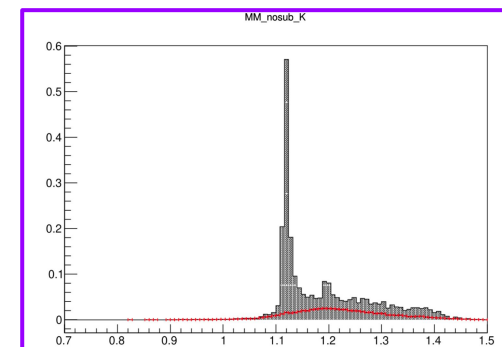
Scale = 0.25

MM\_fit1sub\_K



How is the empirical fit determined?

- Shape is Chebyshev (order 2)
  - Roughly based off pion subtraction
- Comparing data to SIMC (tail matching)
- Yet, still feels arbitrary
  - Need to quantify



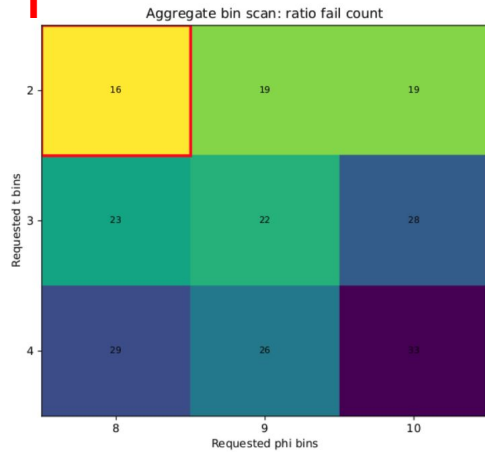
# Determining Best Binning and Empirical Fit Scale

- ratio\_fail\_count: how many (t, phi) bins have a data/SIMC ratio that is more than 3 sigma away from unity. **[Lower is better]**
- ratio\_mean\_dev: the absolute offset of the weighted mean ratio from 1.0. The weighting is  $1 / \text{ratio\_err}^2$ , so precise bins count more. **[Closer to unity is better]**
- ratio\_rms: the RMS spread of the per-bin ratios around 1.0. **[Closer to unity is better]**
- kinematic\_score: a data-vs-SIMC shape mismatch score built from the support histograms for Q2, W, theta\_cm, and mm. For each histogram pair it adds  $\text{chi}^2/\text{ndf}$  + relative mean difference + relative RMS difference, then averages over all available support histograms. **[Lower is better]**
- The background scale is scanned per phi setting
- Among valid candidates, the optimizer sorts them in this exact order:
  1. lowest ratio\_fail\_count
  2. then lowest ratio\_mean\_dev
  3. then lowest ratio\_rms
  4. then lowest kinematic\_score

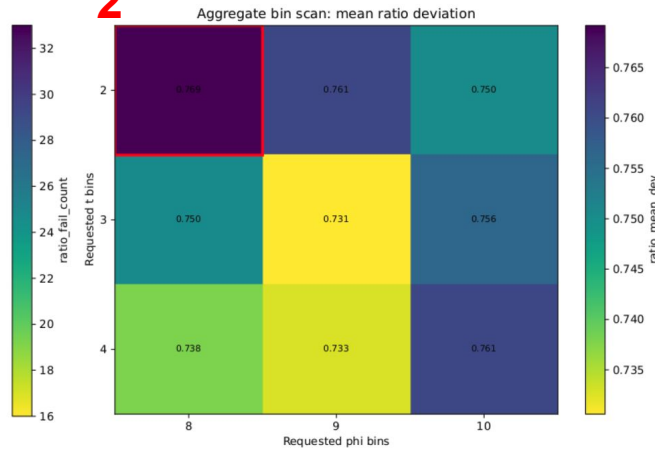
Procedure  
being refined to  
composite  
score system

# Determining Best Binning and Empirical Fit Scale

1



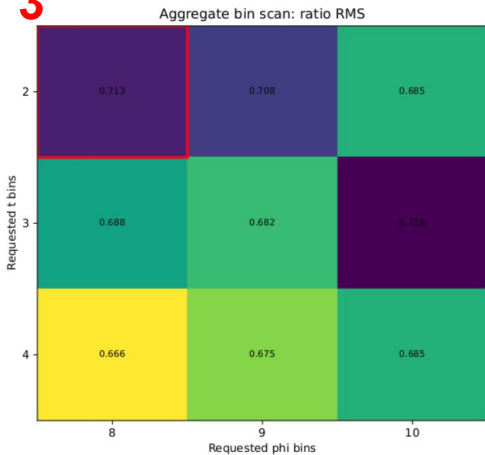
2



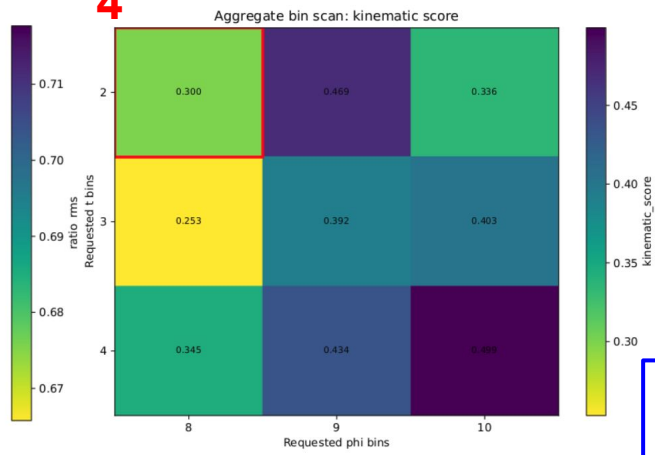
- The background scale is scanned per phi setting
- Among valid candidates, the optimizer sorts them in this exact order:

1. lowest ratio\_fail\_count
2. then lowest ratio\_mean\_dev
3. then lowest ratio\_rms
4. then lowest kinematic\_score

3

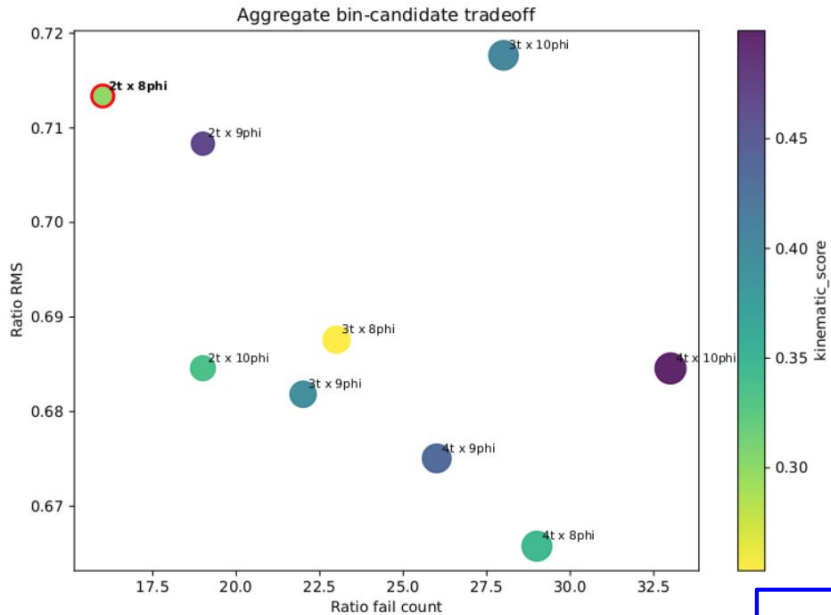


4



Q2=4.4, W=2.74 Low  $\epsilon$

# Determining Best Binning and Empirical Fit Scale Iteration 0

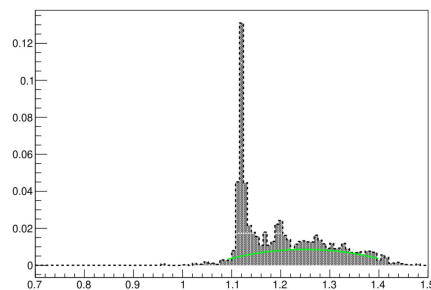


Top aggregate bin candidates by composite objective

rank	sel	bins	fail	mean_dev	rms	kin
1		4t x 8phi	29	0.7380	0.6658	0.3445
2		3t x 9phi	22	0.7306	0.6818	0.3916
3		3t x 8phi	23	0.7504	0.6876	0.2531
4		4t x 9phi	26	0.7329	0.6751	0.4343
5		2t x 10phi	19	0.7503	0.6846	0.3357
6	*	2t x 8phi	16	0.7692	0.7134	0.2996
7		4t x 10phi	33	0.7608	0.6846	0.4992
8		3t x 10phi	28	0.7563	0.7177	0.4029
9		2t x 9phi	19	0.7609	0.7083	0.4687

Q2=4.4, W=2.74 Low  $\epsilon$

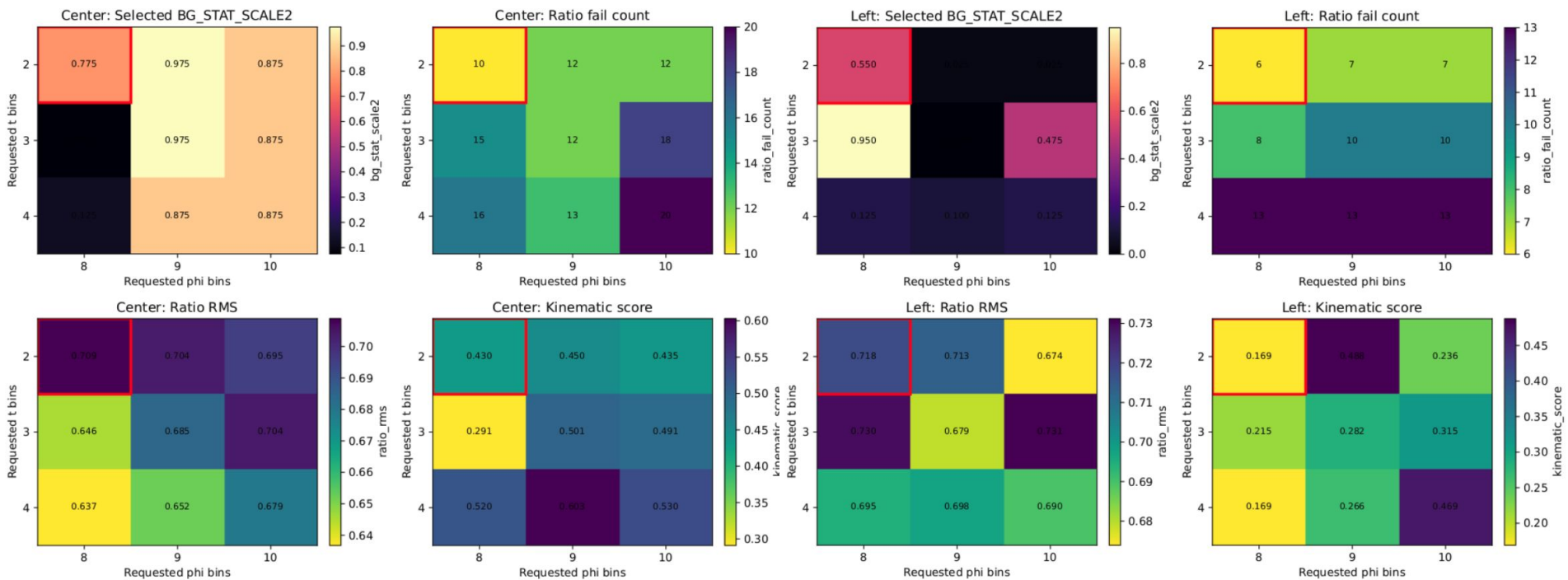
# Q2=4.4, W=2.74



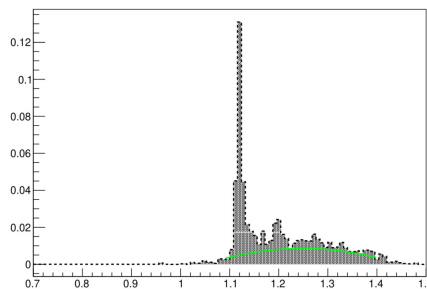
## Q2=4.4, W=2.74 Center Low $\epsilon$

Per-phi selected-scale behavior across binning: Center

Per-phi selected-scale behavior across binning: Left



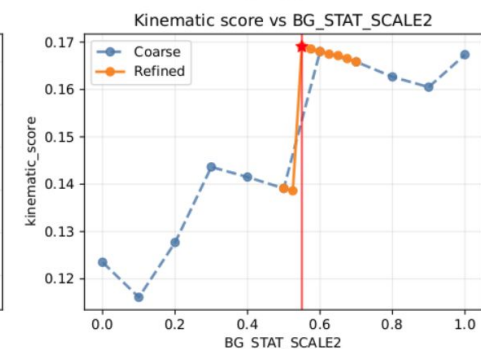
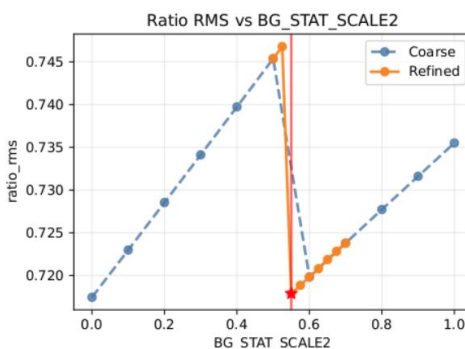
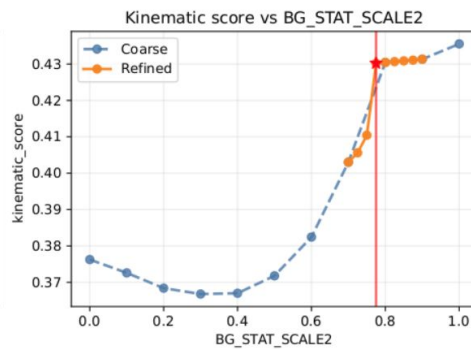
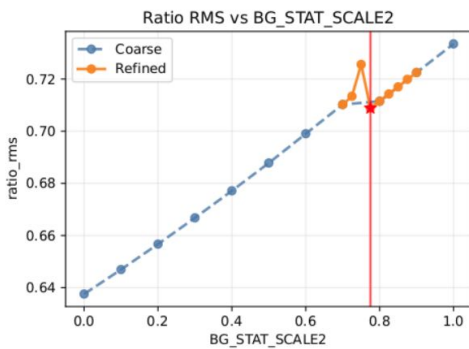
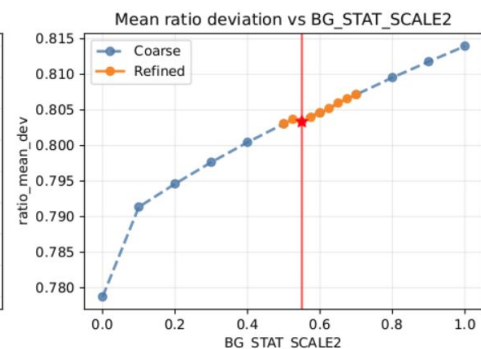
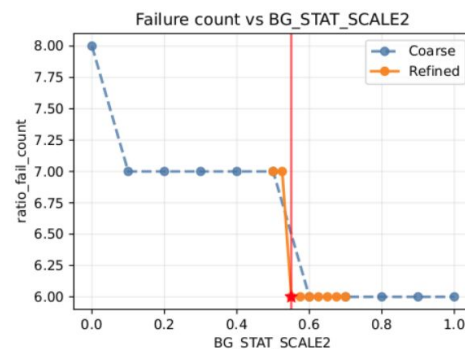
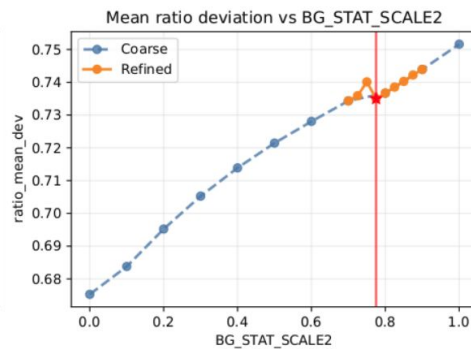
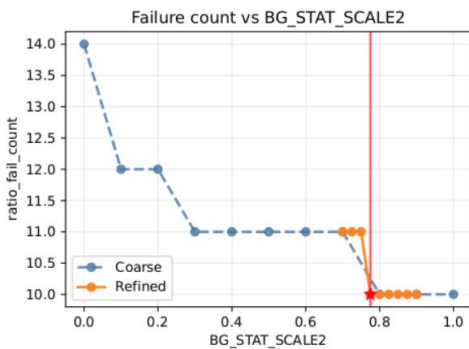
# Q2=4.4, W=2.74



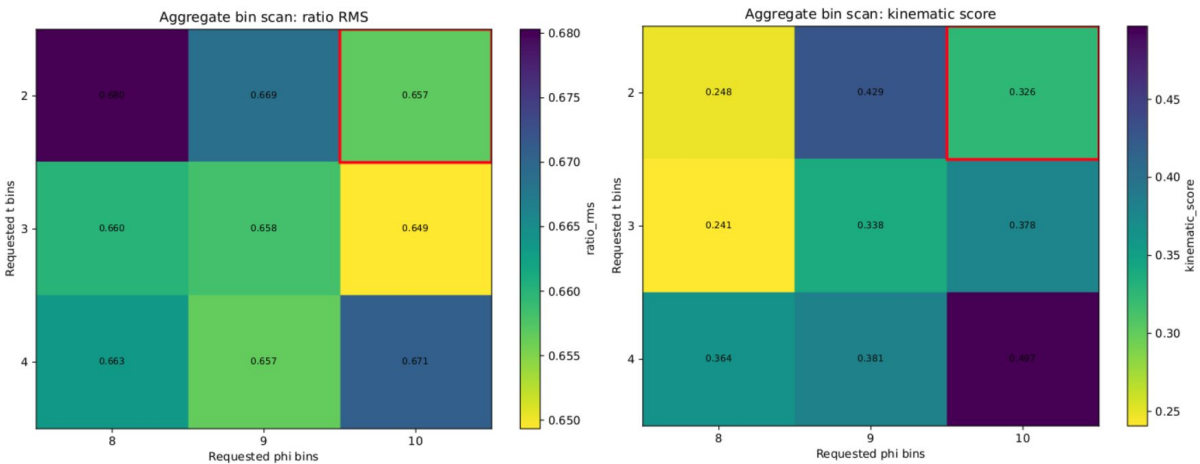
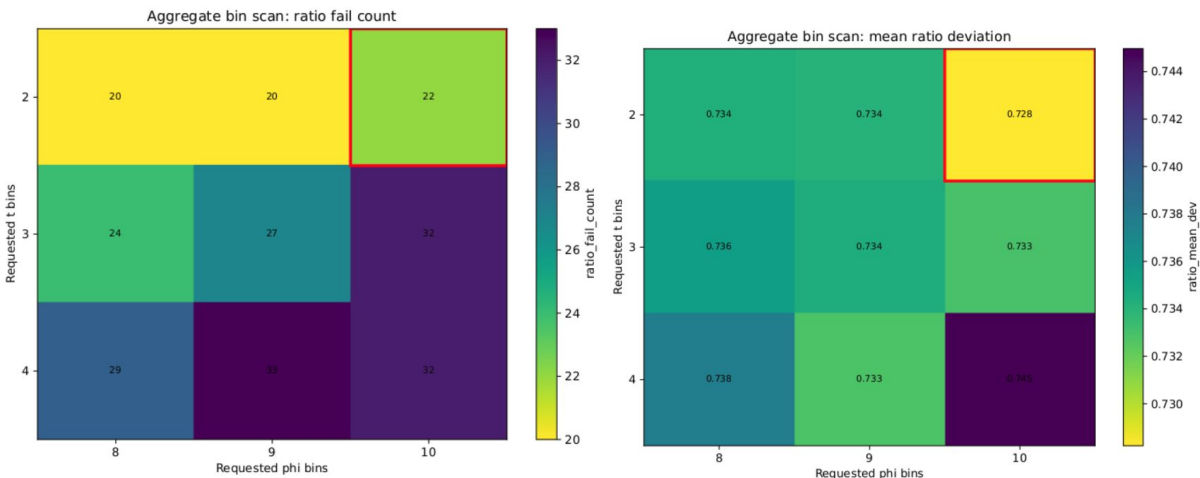
## Q2=4.4, W=2.74 Center Low $\epsilon$

Selected-binning scale scan: Center (2t x 8phi)

Selected-binning scale scan: Left (2t x 8phi)



## Different Method: Composite Score



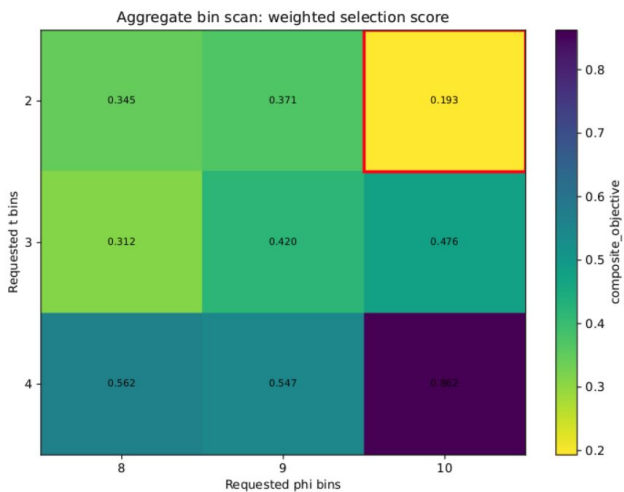
```
BG_OPT_METRIC_WEIGHTS = {
  "ratio_fail_count": 0.35,
  "ratio_mean_dev": 0.25,
  "ratio_rms": 0.20,
  "kinematic_score": 0.15,
  "valid_ratio_bins": 0.05,
}
```

Q2=4.4, W=2.74 Low  $\epsilon$

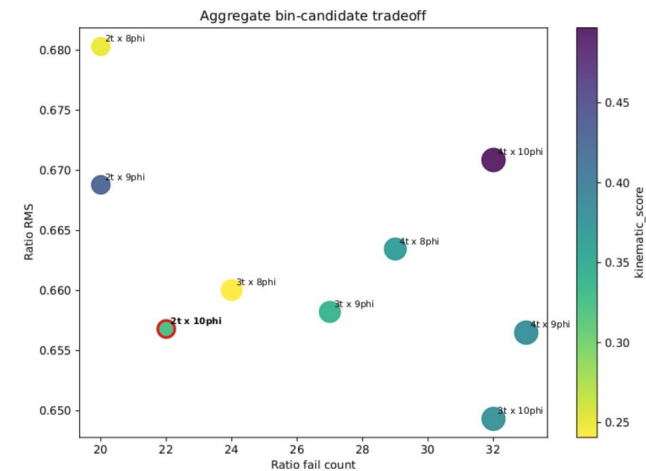
# Different Method: Composite Score

Top aggregate bin candidates by selection score

rank	sel	bins	fail	mean_dev	rms	kin	valid	score
1	*	2t x 10phi	22	0.7282	0.6568	0.3257	25	0.1931
2		3t x 8phi	24	0.7355	0.6600	0.2407	30	0.3123
3		2t x 8phi	20	0.7343	0.6803	0.2482	22	0.3455
4		2t x 9phi	20	0.7341	0.6688	0.4286	23	0.3706
5		3t x 9phi	27	0.7345	0.6582	0.3380	31	0.4198
6		3t x 10phi	32	0.7329	0.6493	0.3781	38	0.4765
7		4t x 9phi	33	0.7328	0.6565	0.3808	39	0.5467
8		4t x 8phi	29	0.7377	0.6635	0.3638	34	0.5623
9		4t x 10phi	32	0.7450	0.6709	0.4969	39	0.8621

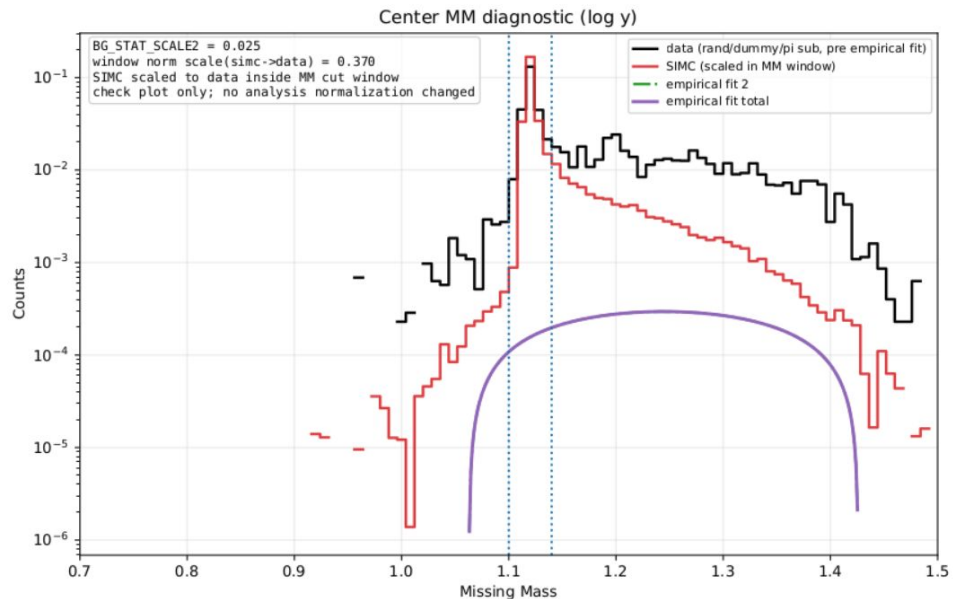
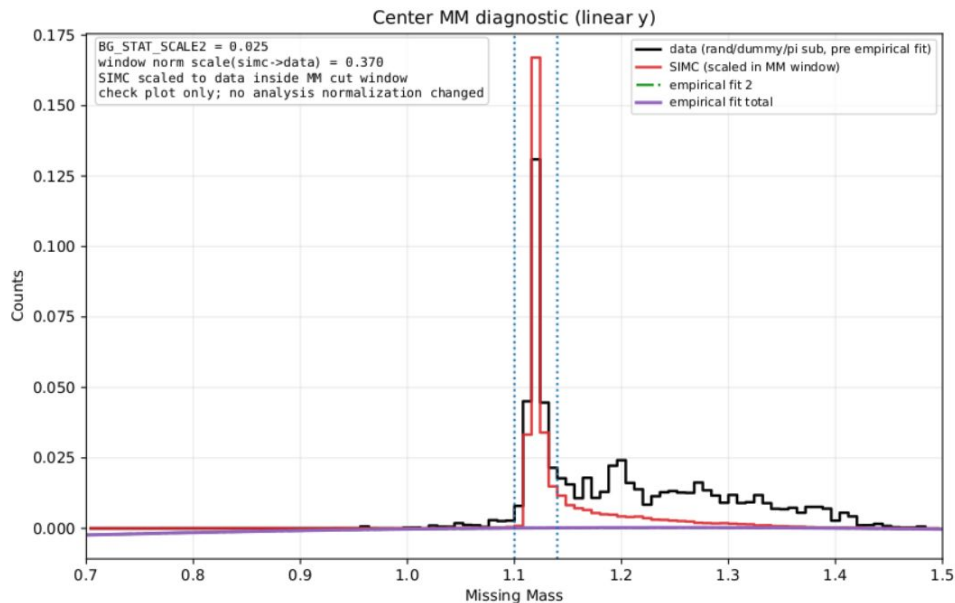


Q2=4.4, W=2.74 Low  $\epsilon$



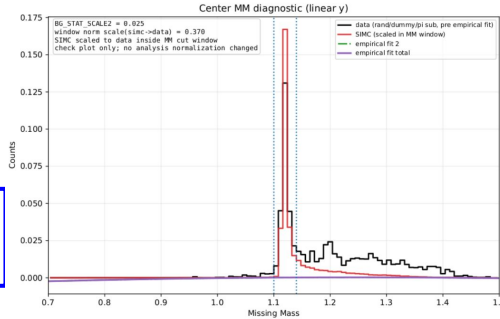
# Different Method: Composite Score

Q2=4.4, W=2.74 Center Low  $\epsilon$



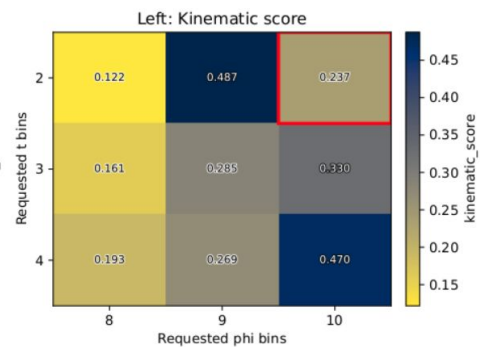
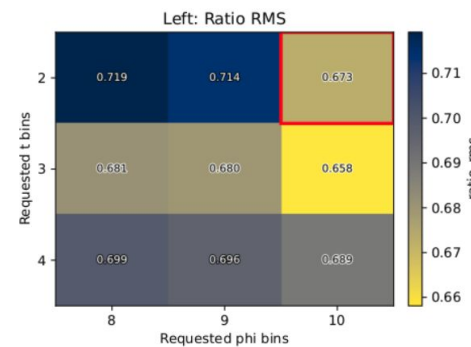
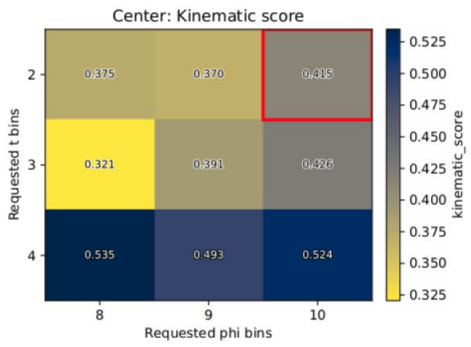
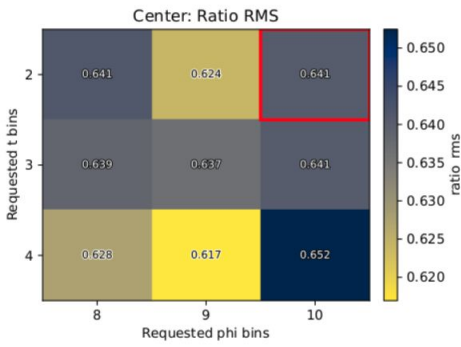
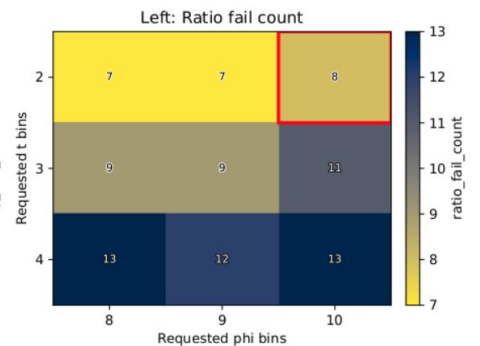
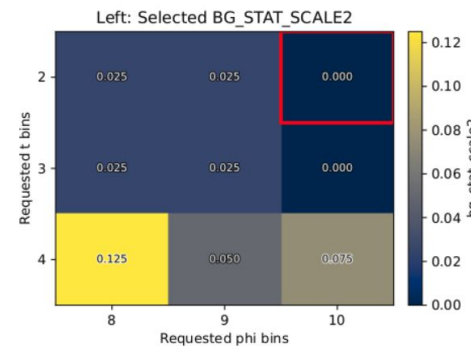
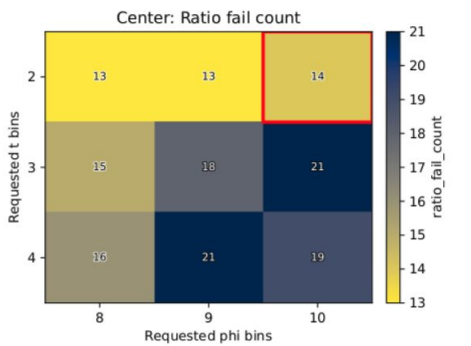
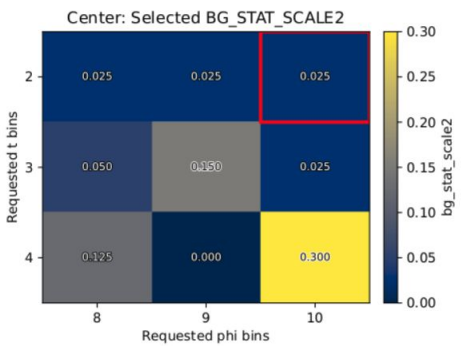
# Different Method: Composite Score

Q2=4.4, W=2.74 Center Low  $\epsilon$



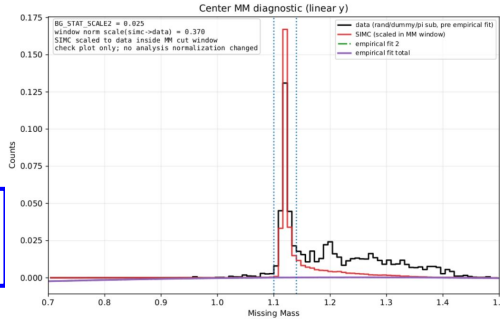
Per-phi selected-scale behavior across binning: Center

Per-phi selected-scale behavior across binning: Left



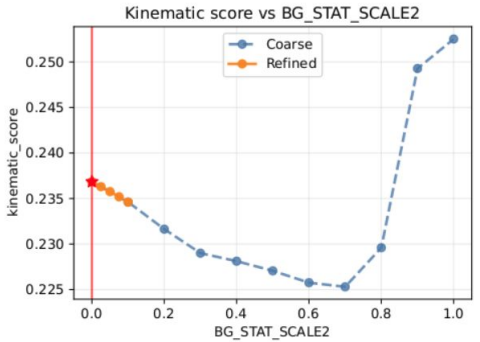
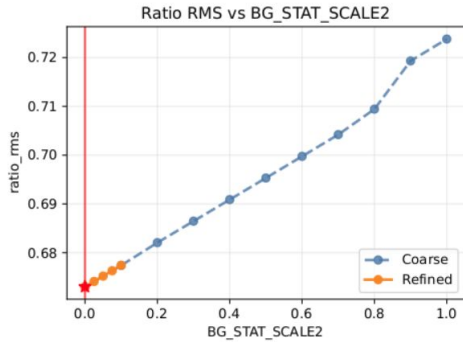
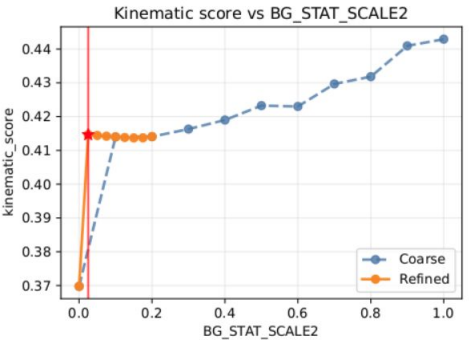
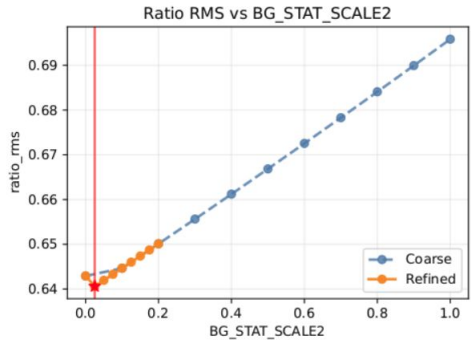
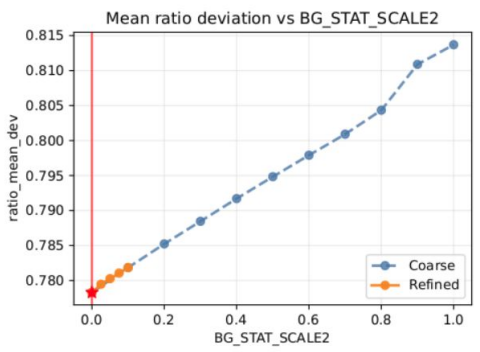
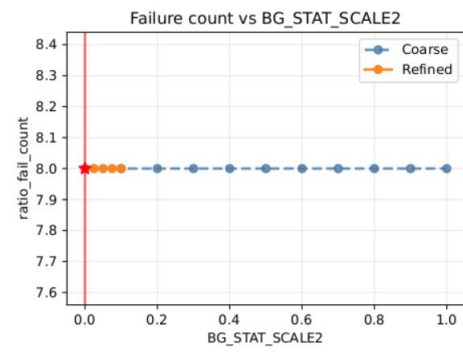
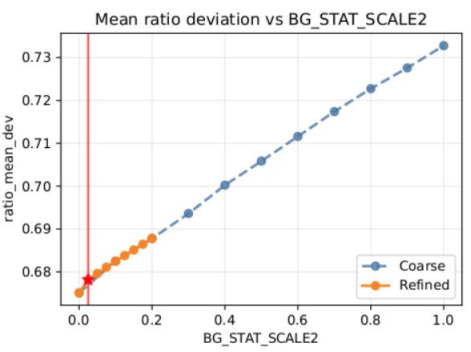
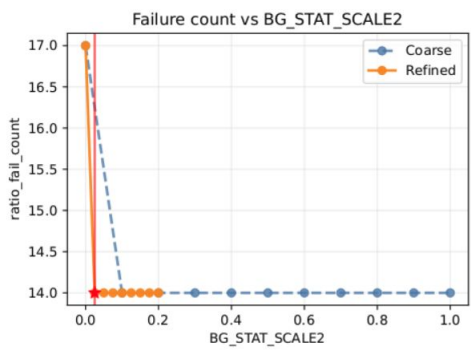
# Different Method: Composite Score

Q2=4.4, W=2.74 Center Low  $\epsilon$



Selected-binning scale scan: Center (2t x 10phi)

Selected-binning scale scan: Left (2t x 10phi)

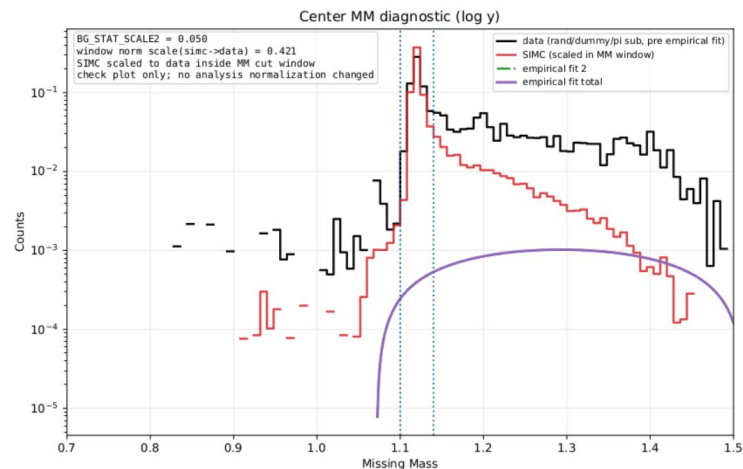
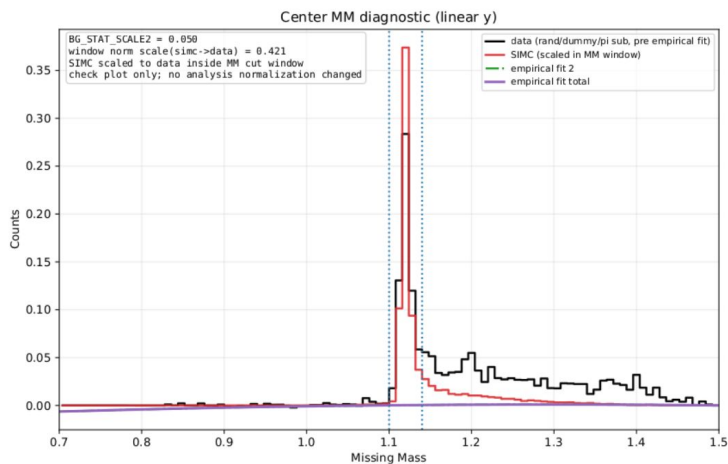


# Different Method: Composite Score

```
Fixed shared binning:  
requested bins: 2t x 10phi  
aggregate fail count: 23  
aggregate mean_dev: 0.5692  
aggregate rms: 0.5116  
aggregate kin score: 0.2863  
valid ratio bins: 36
```

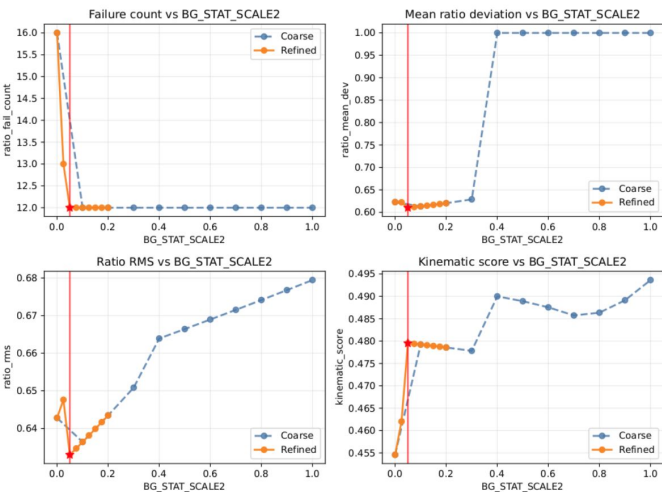
```
Per-phi selected BG_STAT_SCALE2:  
Center scale=0.050 fail=12 mean_dev=0.6103 rms=0.6330 kin=0.4795 score=0.2000  
Left scale=0.000 fail=6 mean_dev=0.6598 rms=0.5077 kin=0.1766 score=0.0000  
Right scale=0.025 fail=5 mean_dev=0.4374 rms=0.3941 kin=0.2029 score=0.3462
```

Q2=4.4, W=2.74 Center High  $\epsilon$

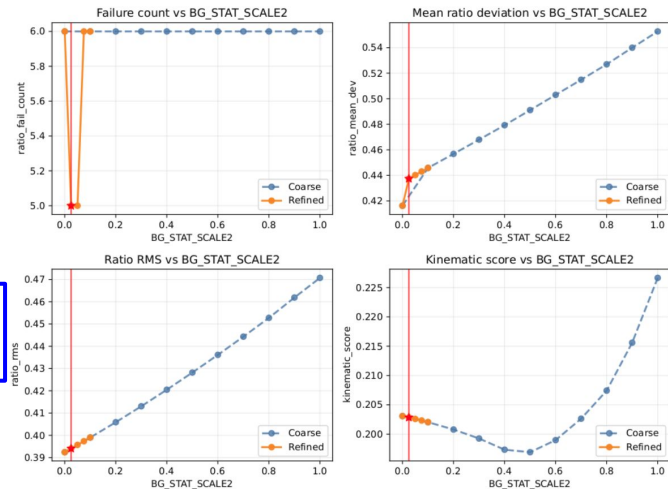


# Different Method: Composite Score

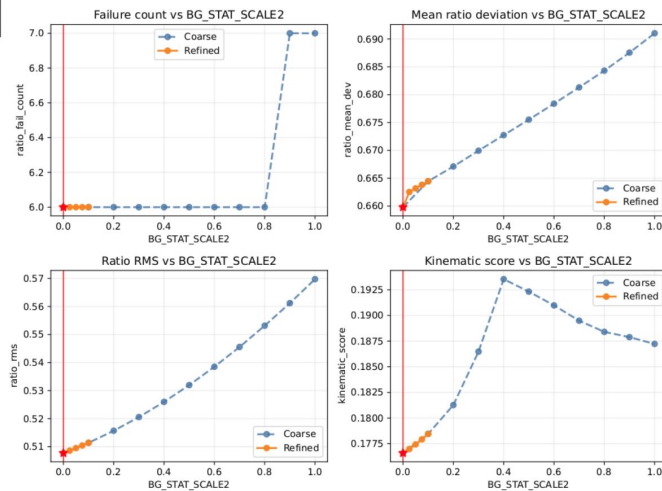
Selected-binning scale scan: Center (2t x 10phi)



Q2=4.4, W=2.74 High  $\epsilon$



Selected-binning scale scan: Left (2t x 10phi)



EXTRA