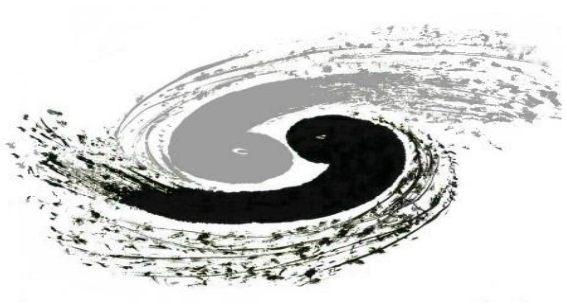


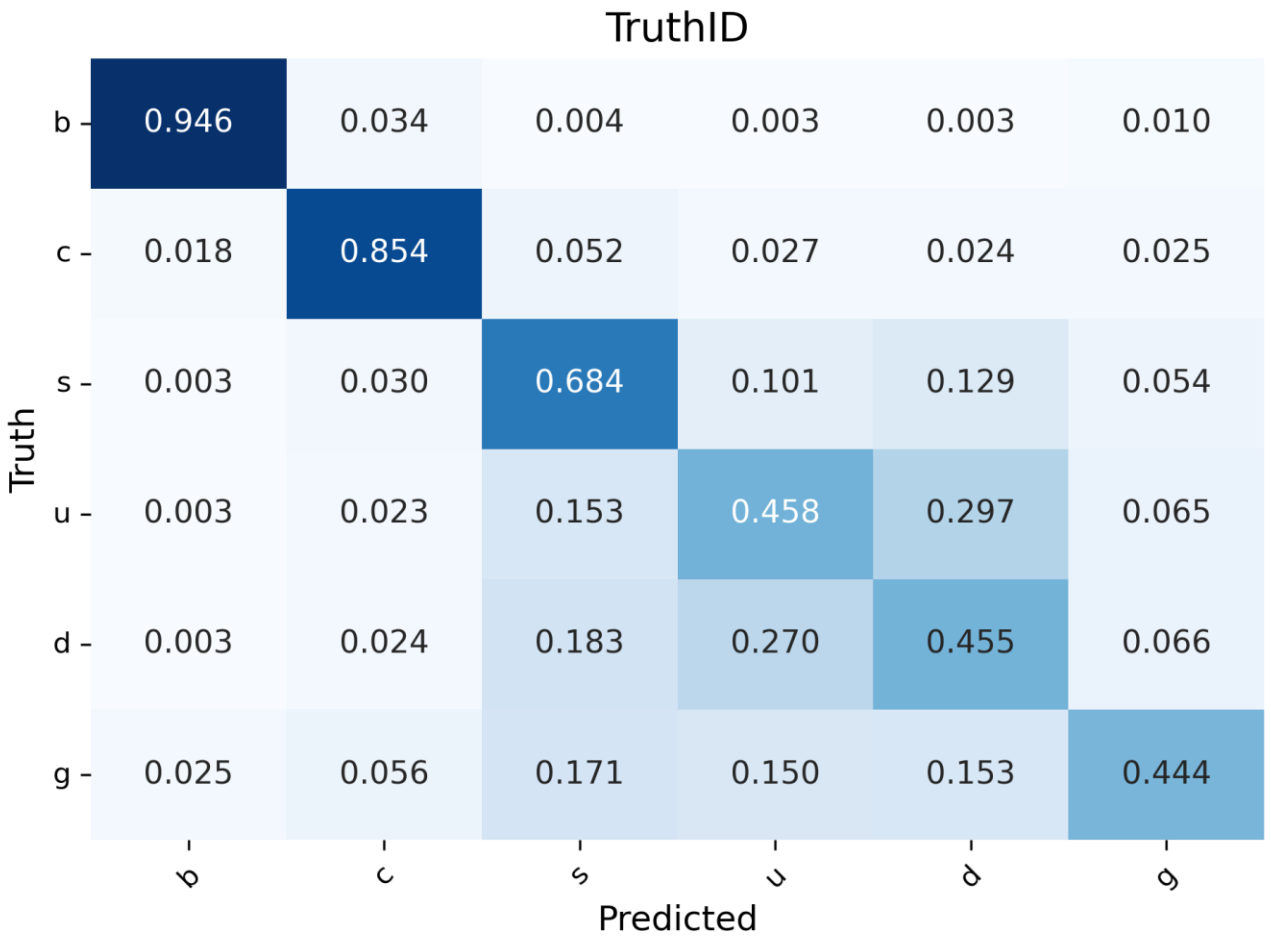
CEPC

Jets, samples and Wednesday working meeting

Kaili Zhang

zhangkl@ihep.ac.cn

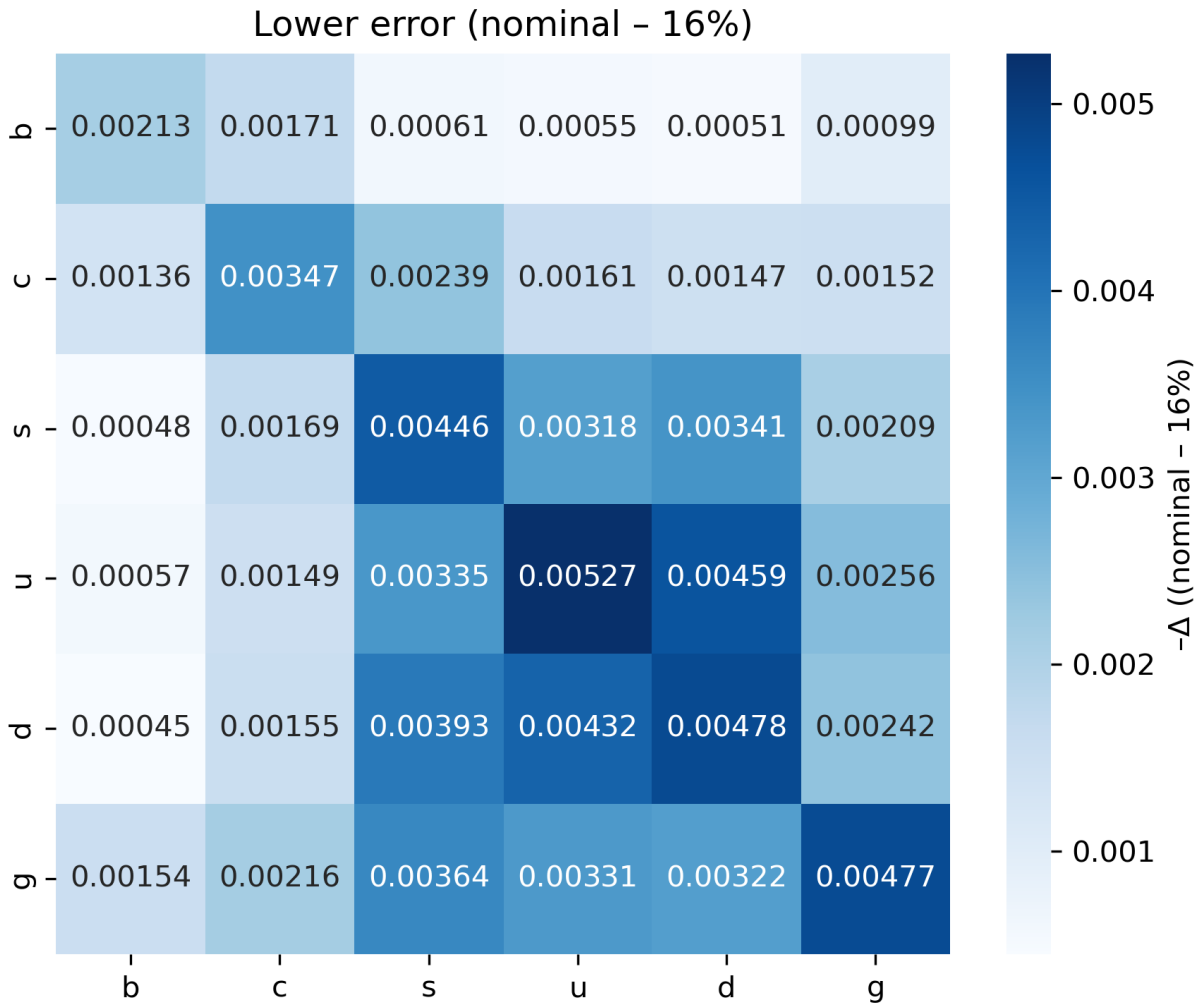
Statistical uncertainty of JOI

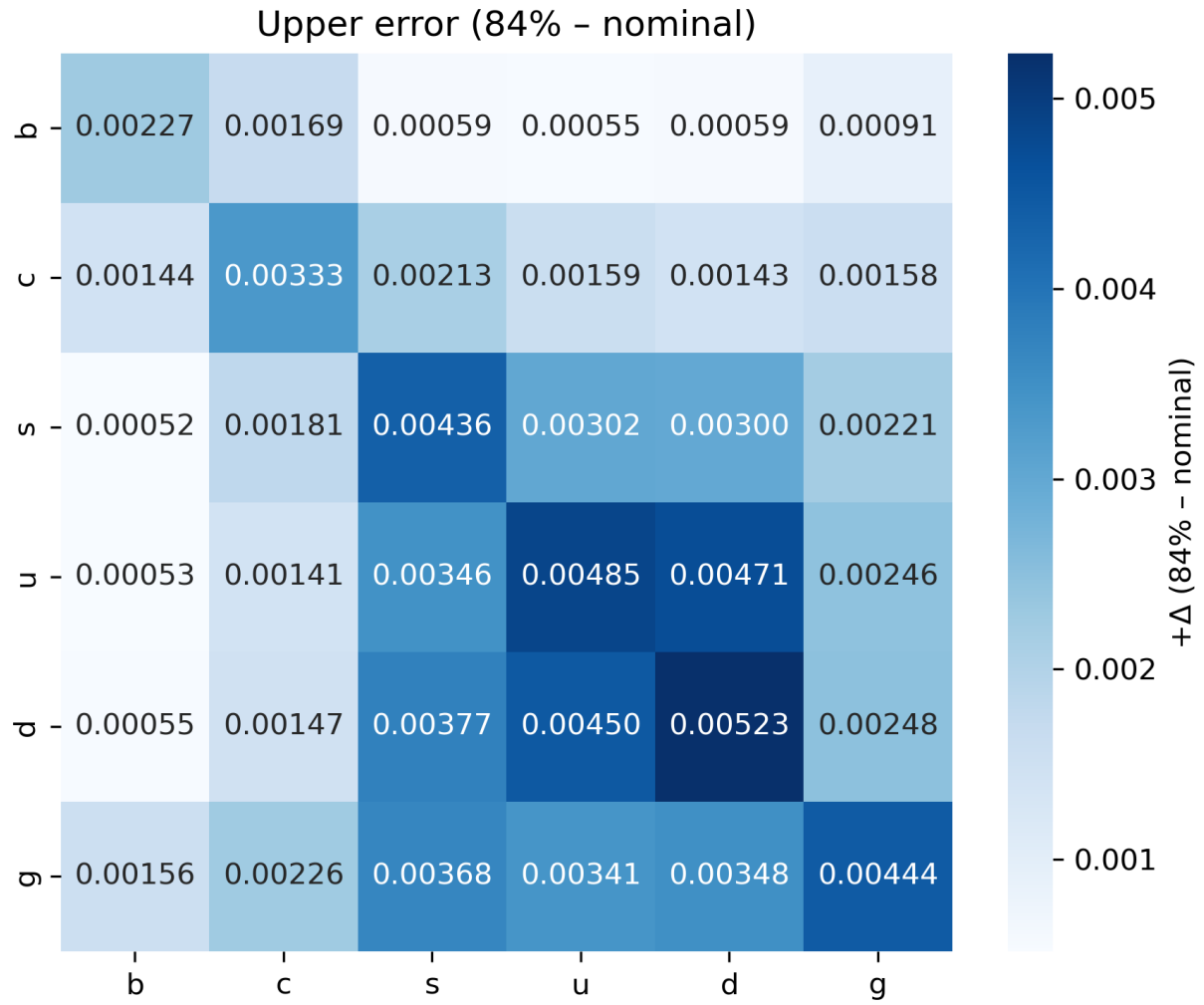


- Each category 1M, in total 11M
- Training:Validation:Test 8:1:1
- Confusion Matrix from Test sample.(each ~100k).
- Use bootstrap method to estimate uncertainty
  - Times=1000, N_sample=10k
  - Each time choose 10k sample from the total to estimate

Error matrix

B eff= 0.946±0.002
U eff= 0.458±0.005
D eff= 0.455±0.005

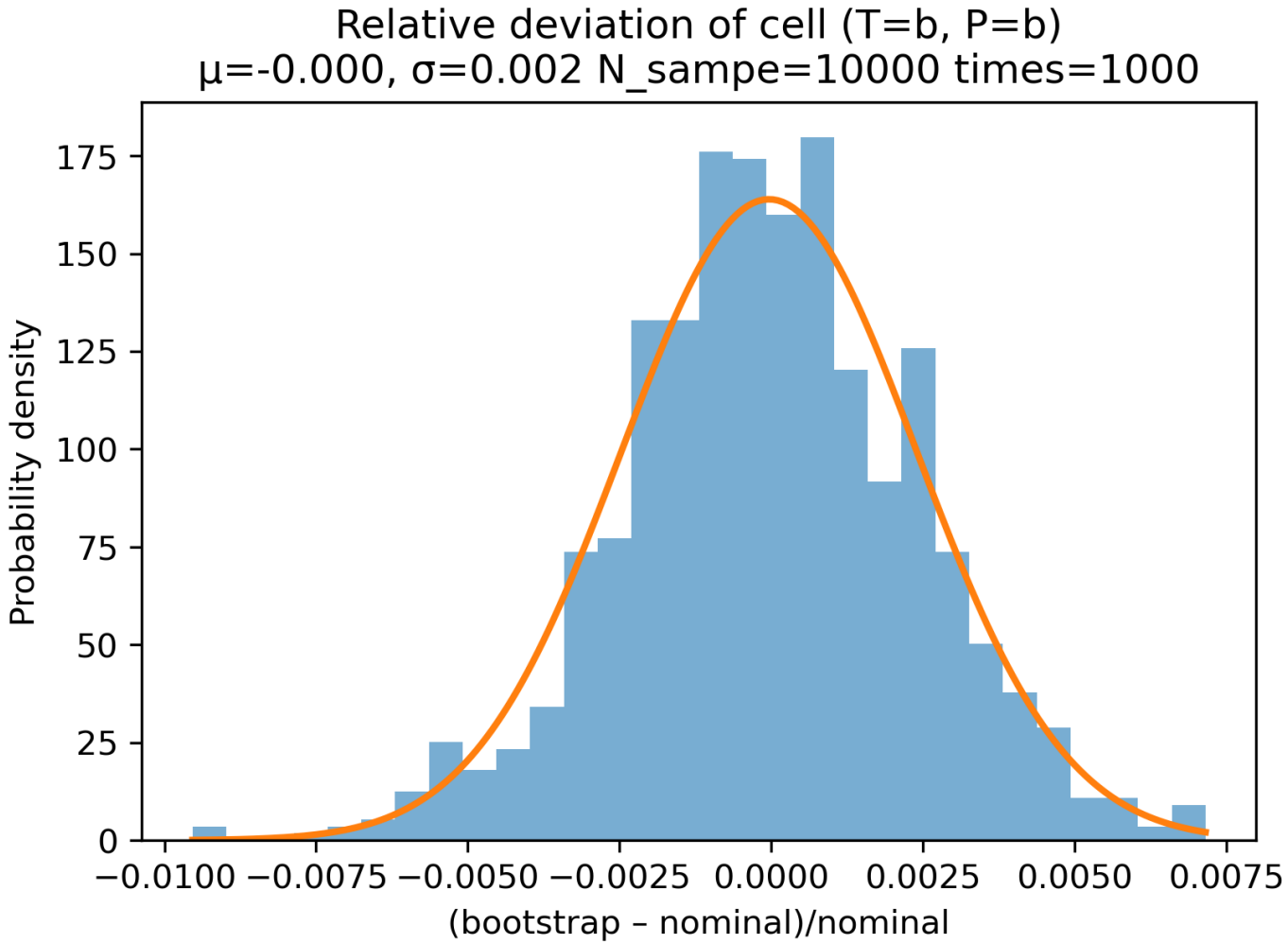




Maximum element ~0.005

Gaussian shape test

Maximum deviation ~1%
Average deviation ~0.2%



Stats uncertainty discussion

- Bootstrap derives uncertainty 94.6%±0.2% for b tagging
  - Bootstrap uncertainty can be made as small as desired.
  - 10x sample ∝ sqrt(10) suppressing.
- Performance test to other samples under testing
  - Zpole, 2f, 4f, E360…
  - Downgrading performance is different with this stats.

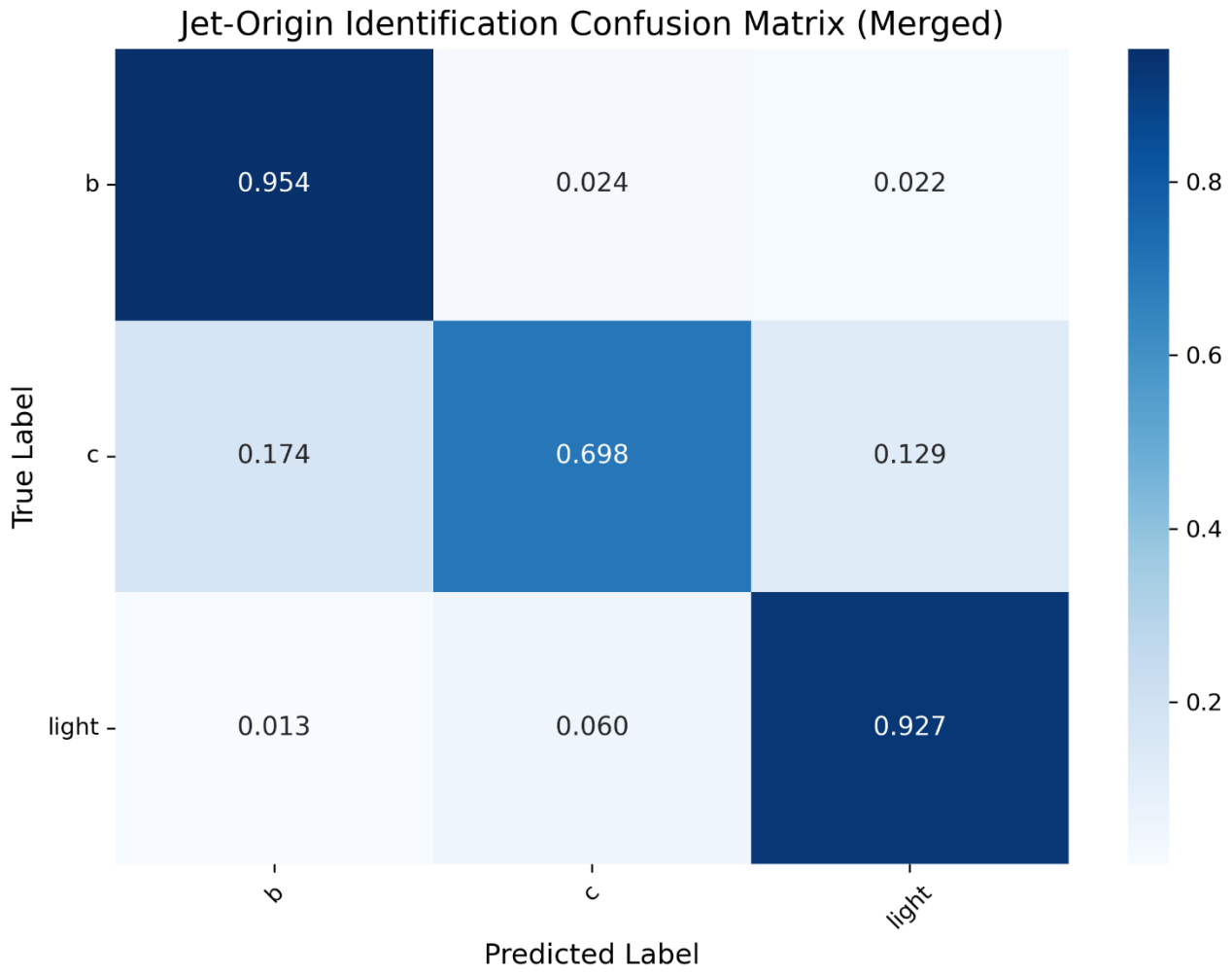
Class bias for s quark

ZH	Truth	Predict	Diff
b	186823	183901	-1.59%
c	185617	183967	-0.90%
d	187096	182944	-2.27%
s	185954	215191	13.59%
u	186815	173326	-7.78%
g	86597	79573	-8.83%

- Current model tends to predict more s quark.
  - Reweighting
    - (keep the bias model, but change output of M11)
  - Post-Recalibrating(let model output in certain ratio)
    - Also correlated to input and environment, like Higgs, Z.
  - Physics or just model–training artifact?
    - Trying to dig out with differential analysis.

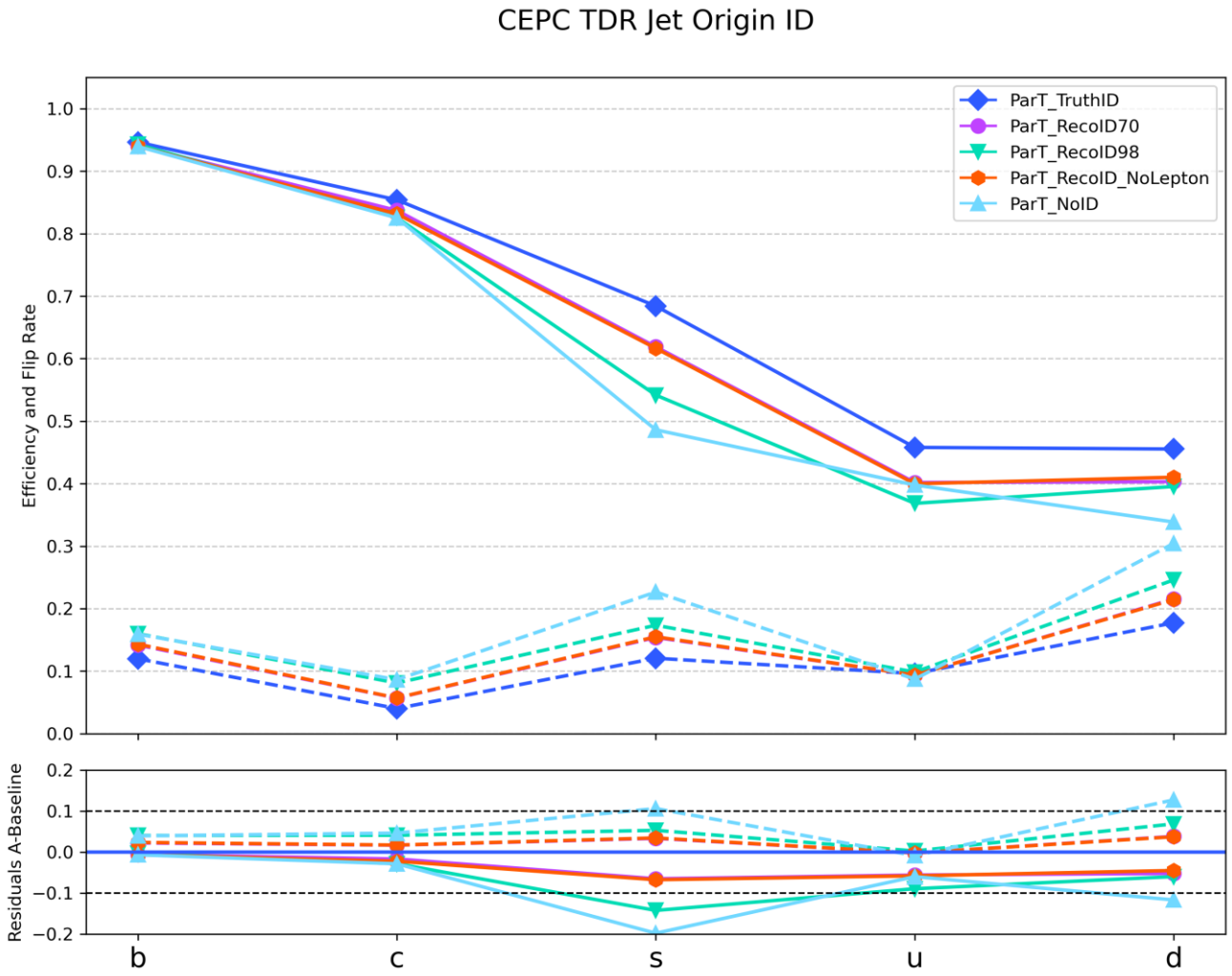
Application on Zpole Rb

Unexpected behavior for c quark tagging.
Under tuning with Hancen, Mohan.

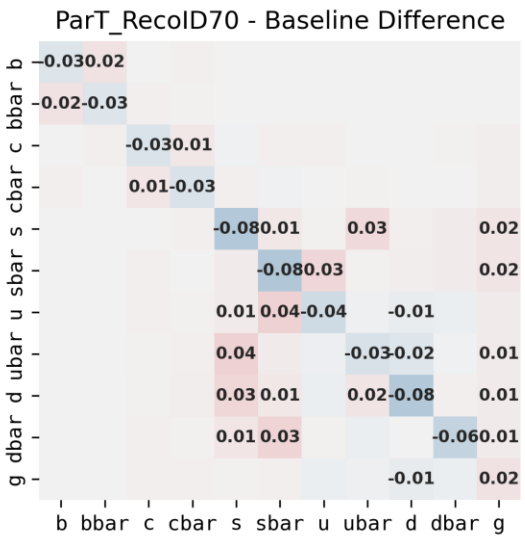


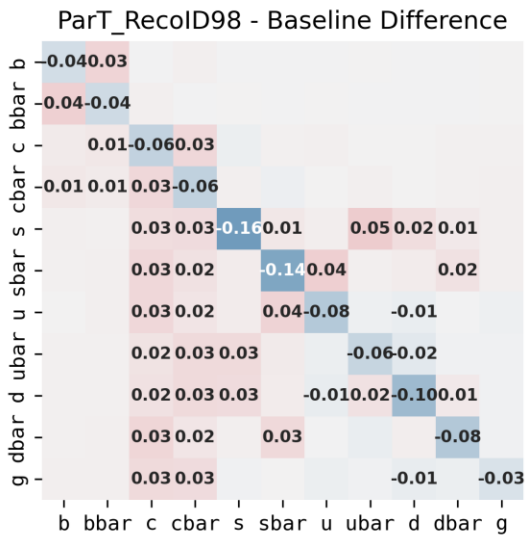
backups

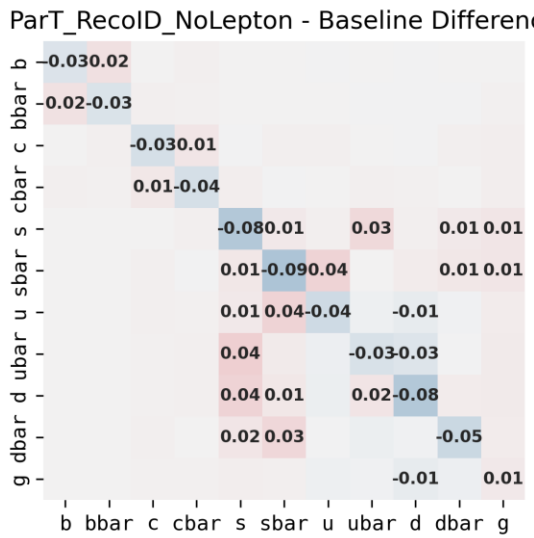
Current JOI

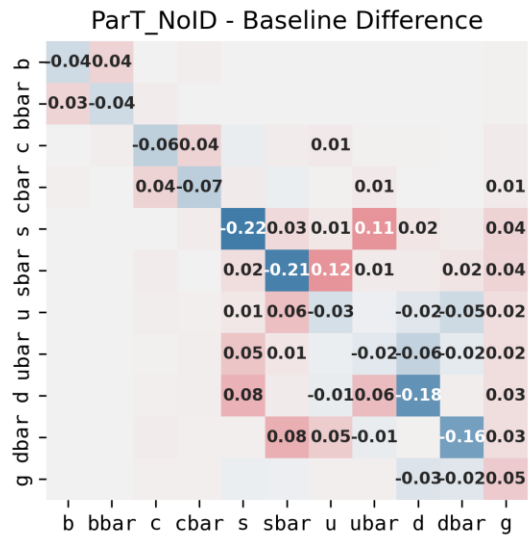


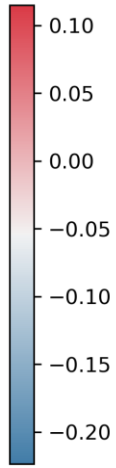
Truth:	0.5936
Reco70:	0.5510
Nolep:	0.5494
Reco98:	0.5153
NoID:	0.4825


ParT_RecoID70 - Baseline Difference
b bbar c cbar s sbar u ubar d dbar g


ParT_RecoID98 - Baseline Difference
b bbar c cbar s sbar u ubar d dbar g


ParT_RecoID_NoLepton - Baseline Difference
b bbar c cbar s sbar u ubar d dbar g


ParT_NoID - Baseline Difference
b bbar c cbar s sbar u ubar d dbar g

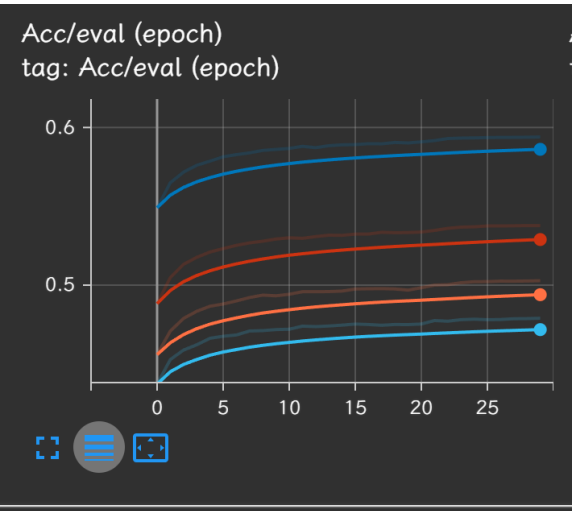

0.10
0.05
0.00
−0.05
−0.10
−0.15
−0.20

Tagging Eff & Charge Flip rate

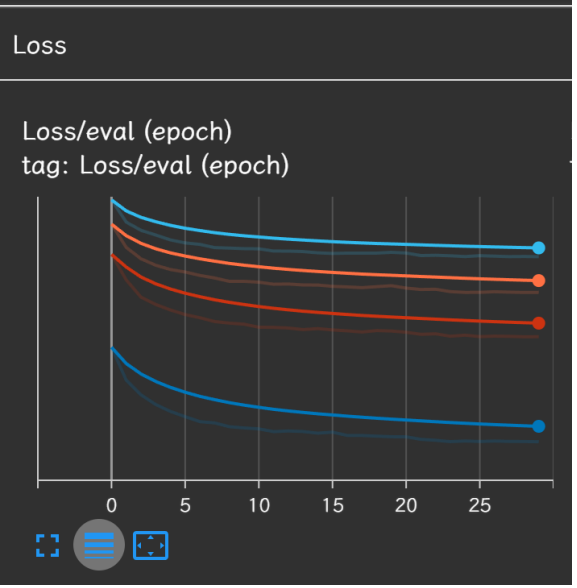
TruthID	Efficiency	Flip Rate	Reco70	Efficiency	Flip Rate	Reco98	Efficiency	Flip Rate	NoID	Efficiency	Flip Rate
b	0.95	0.12	b	0.94	0.14	b	0.94	0.16	b	0.94	0.16
c	0.85	0.04	c	0.84	0.06	c	0.83	0.08	c	0.83	0.09
s	0.68	0.12	s	0.62	0.15	s	0.54	0.17	s	0.49	0.23
u	0.46	0.10	u	0.40	0.09	u	0.37	0.10	u	0.40	0.09
d	0.46	0.18	d	0.40	0.22	d	0.40	0.25	d	0.34	0.30
g	0.44		g	0.46		g	0.41		g	0.47	
Metric	0.5936			0.5510			0.5153			0.5030	

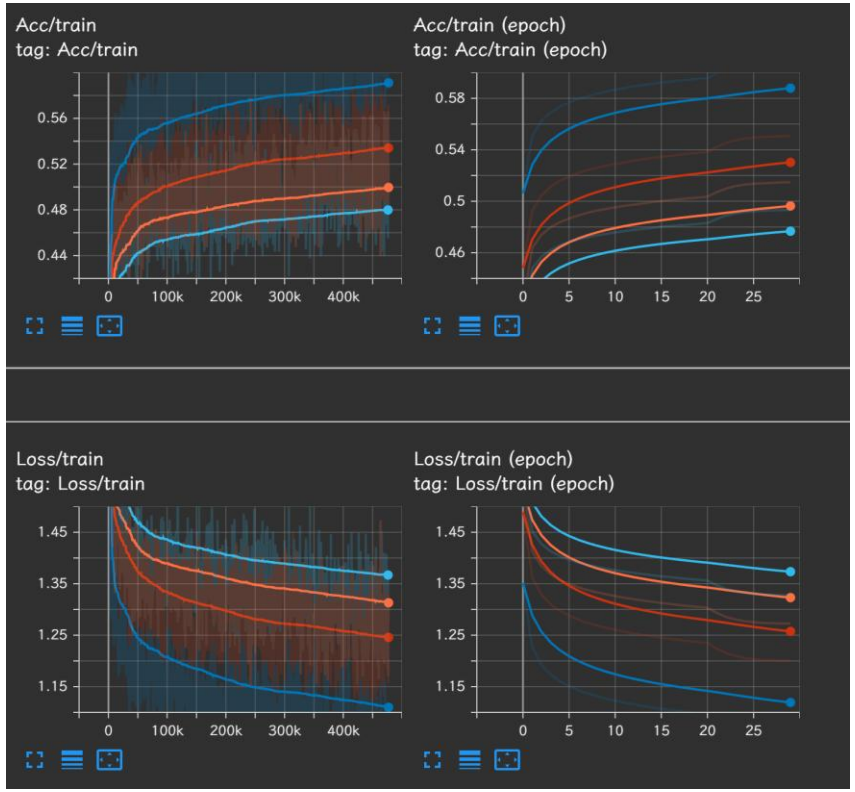
Overtraining:

TensorBoard convergence analysis confirms stable training convergence across all models.

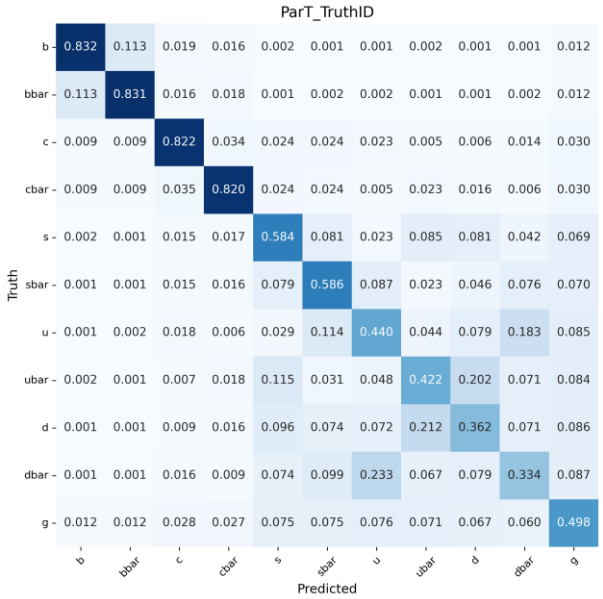


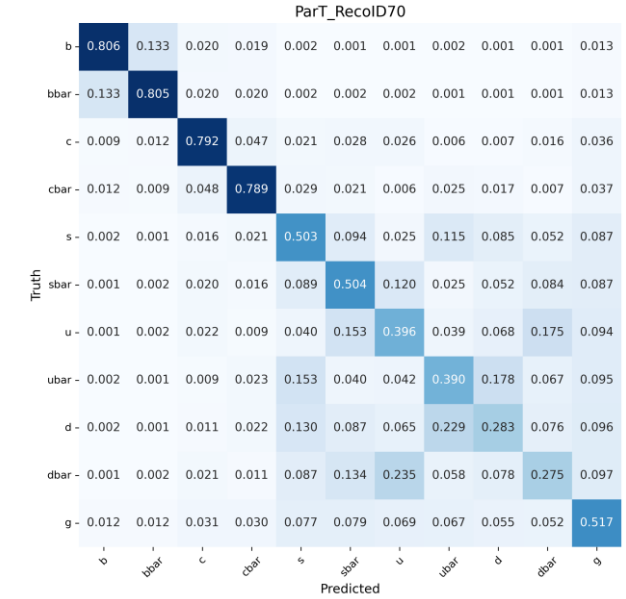
Name	Smoothed	Value	Step	Time	Relative
Apr15_06-24-56_gpu013.ihep.ac.cnJet_ParT0415NoID_higgs_full_ParT	0.4945	0.5026	29	Tue Apr 15, 23:13:31	16h 14m 52s
Apr15_06-34-40_gpu026.ihep.ac.cnJet_ParT0415TruthID_higgs_full_ParT	0.585	0.5935	29	Tue Apr 15, 20:51:00	13h 47m 43s
Apr15_10-30-36_gpu017.ihep.ac.cnJet_ParT0415CNoID_higgs_full_ParT	0.4749	0.4812	29	Wed Apr 16, 02:47:44	15h 44m 40s
Apr15_10-30-36_gpu019.ihep.ac.cnJet_ParT0415RecoID98_higgs_full_ParT	0.5271	0.5356	29	Wed Apr 16, 05:58:03	18h 49m 5s

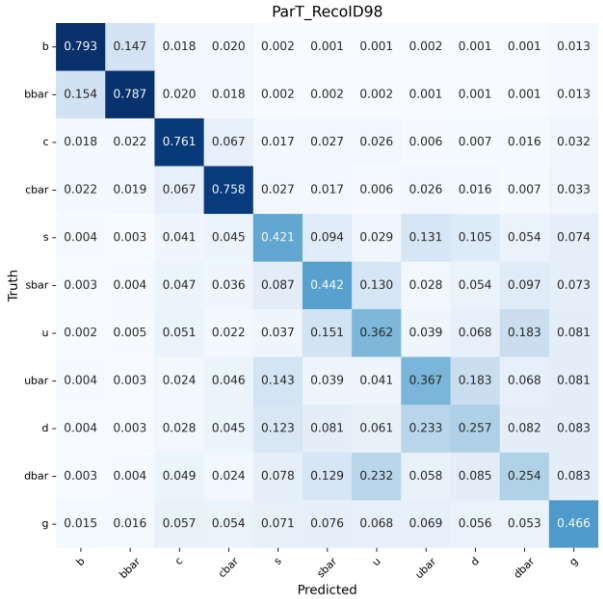


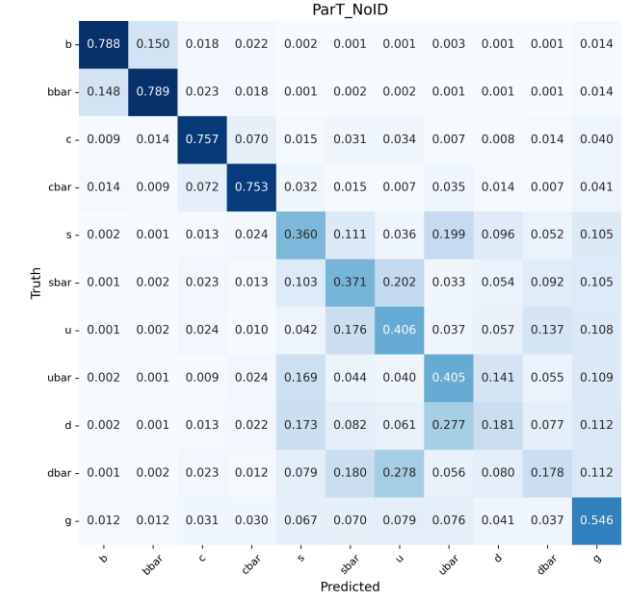


Confusion Matrix





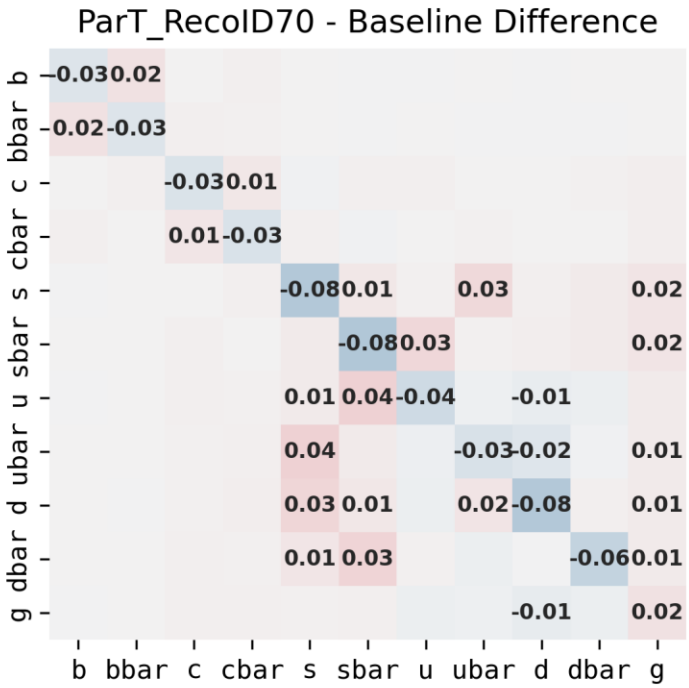


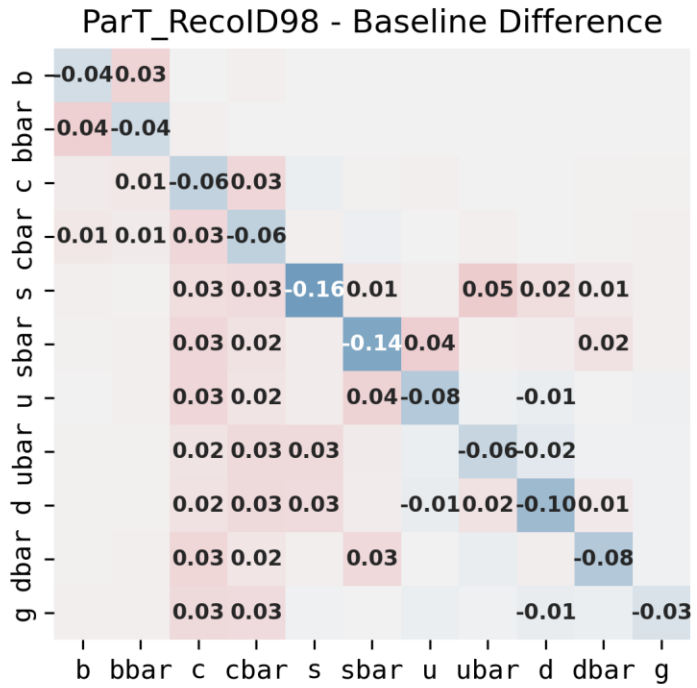


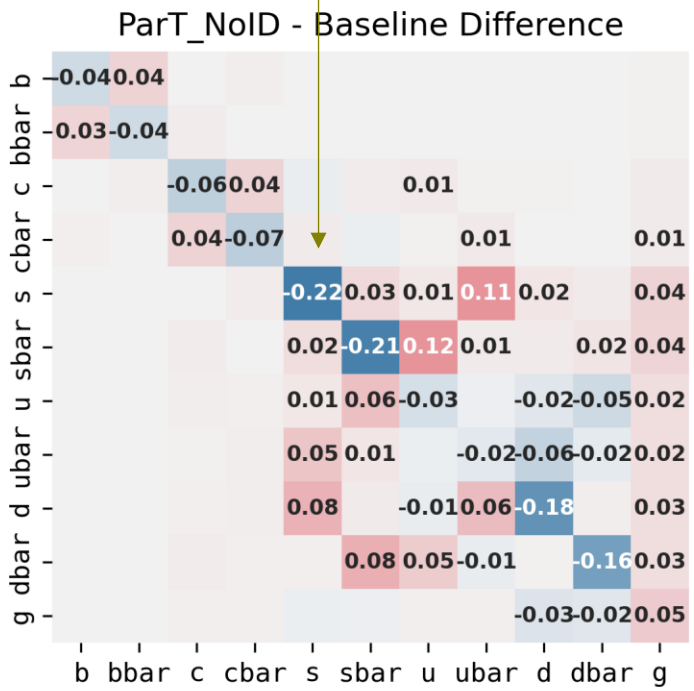
Matrix Difference

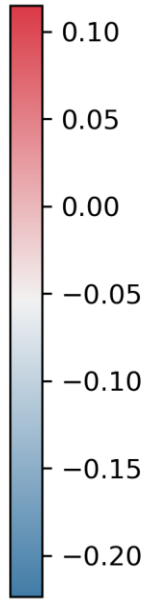
- Largest impact in S-Sbar tagging.
- Truth-label–wise normalization ensures row conservation

22% more truth s quarks are not tagged as s quark.
11% more truth s quarks are tagged as ubar quark.





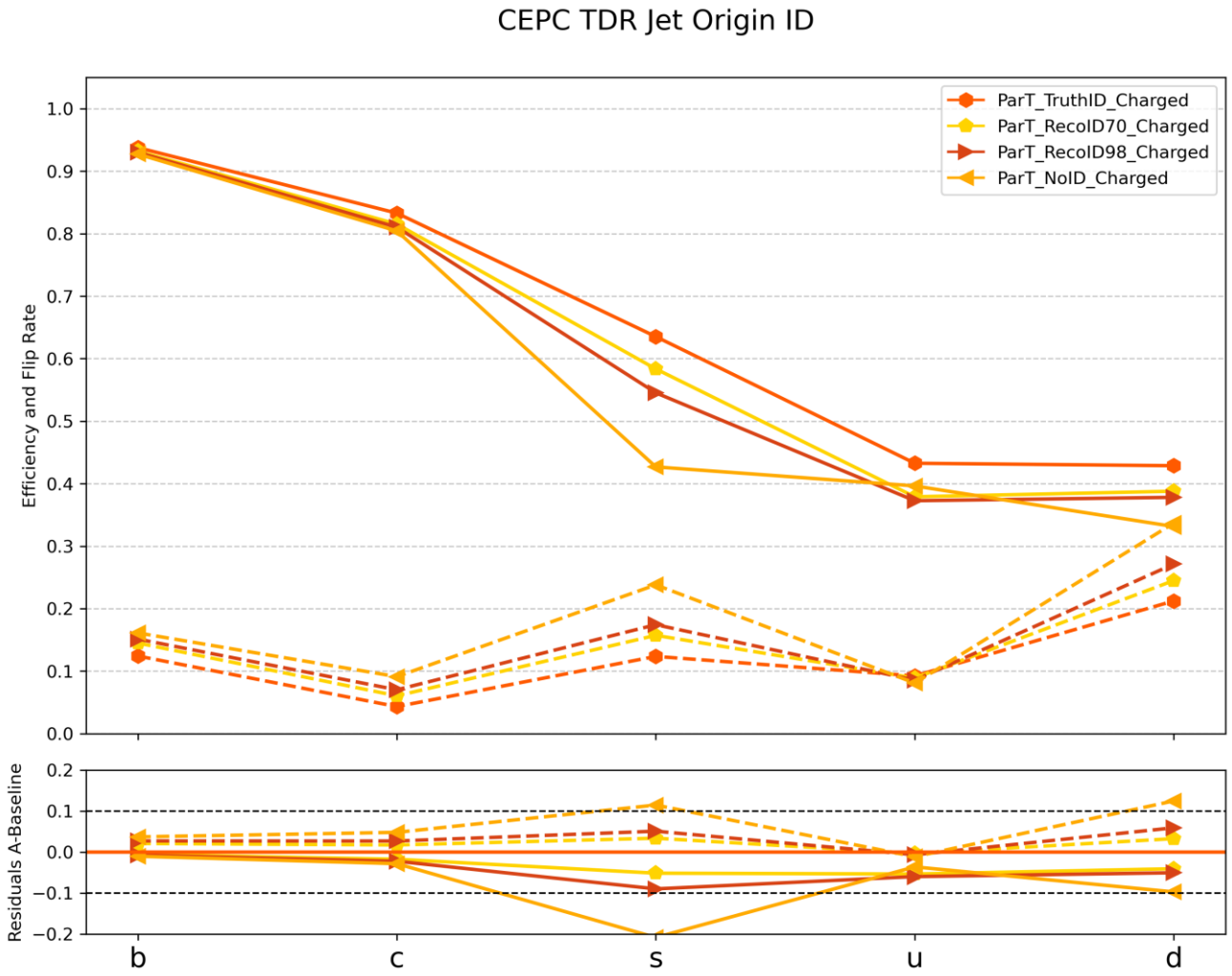




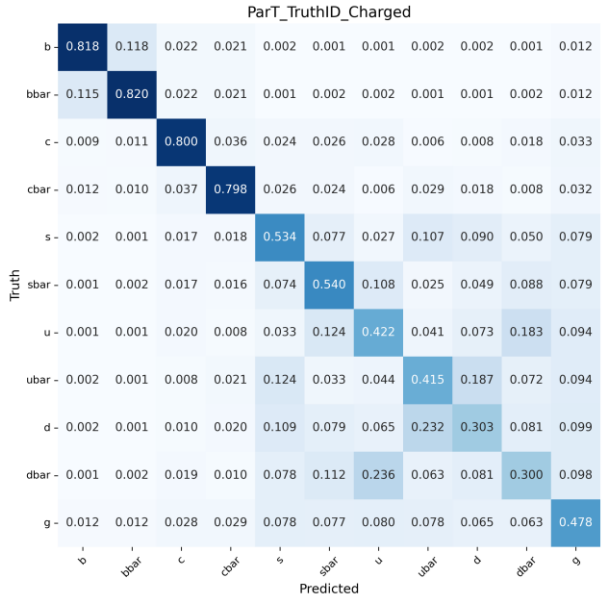
With/wo PID, b/c quark do not mix with udsg.
(but better separation b and bbar).

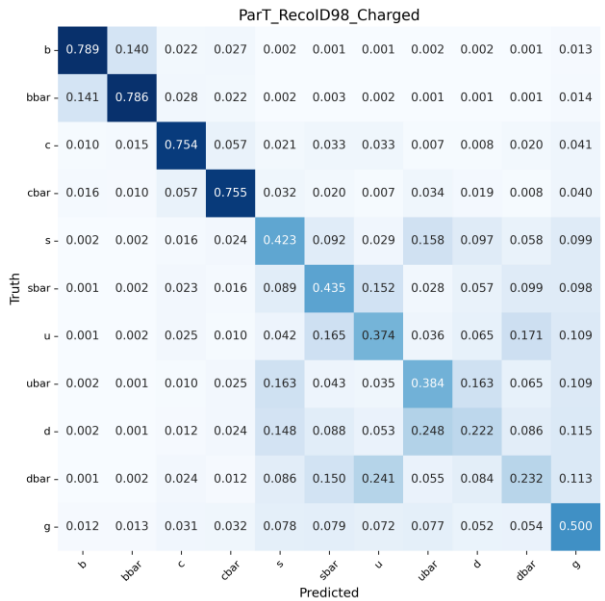
With RecoID98(higher lepton rate), uds are likely to be tagged as c quark;
While in NoID it disappeared. -> tagged as gluon.

JOI with charged only tracks

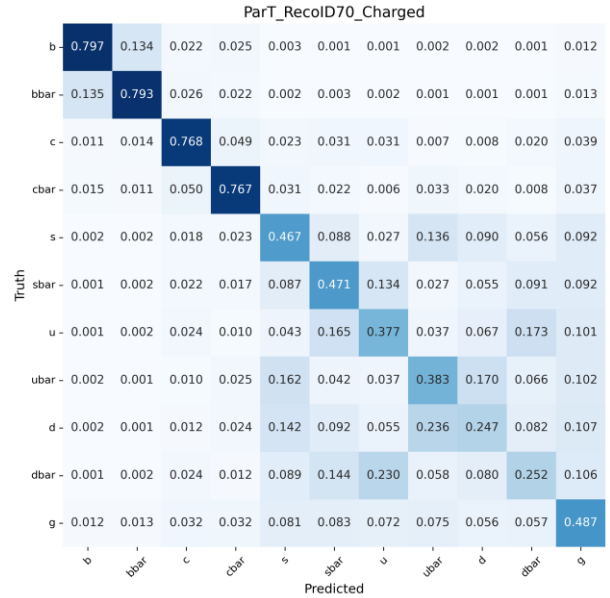


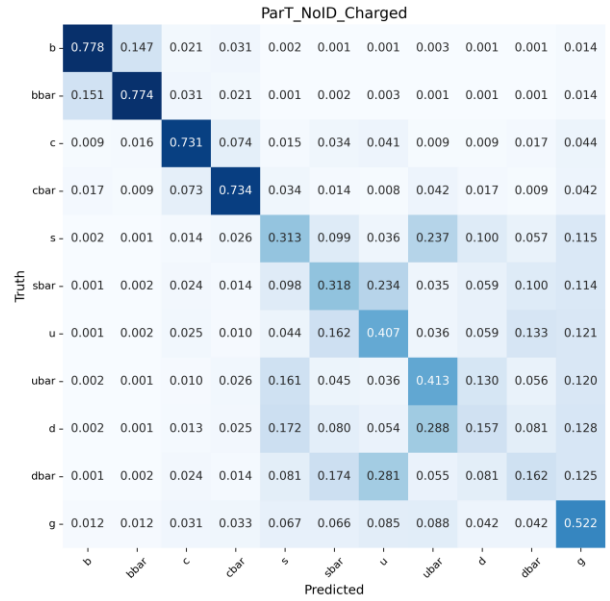
Charged Confusion Matrix





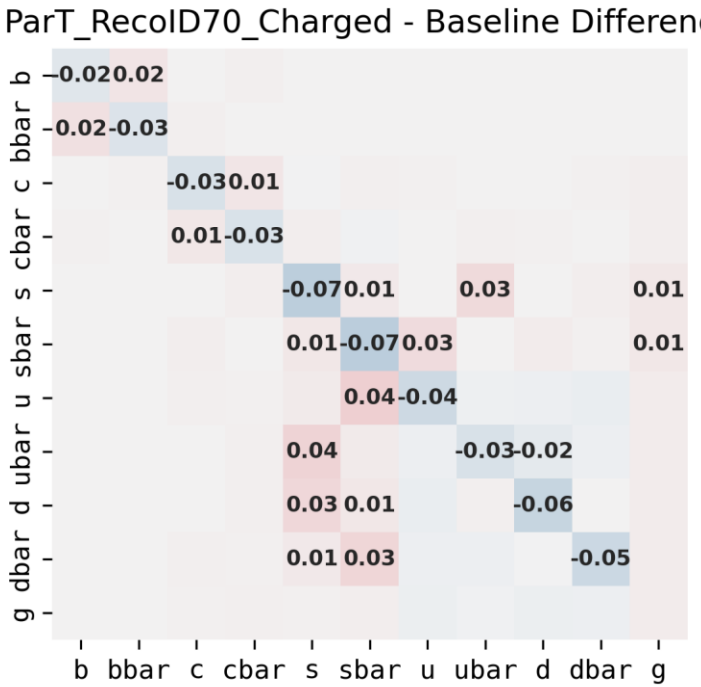
Truth:	0.5661
Reco70:	0.5281
Reco98:	0.5142
NoID:	0.4825

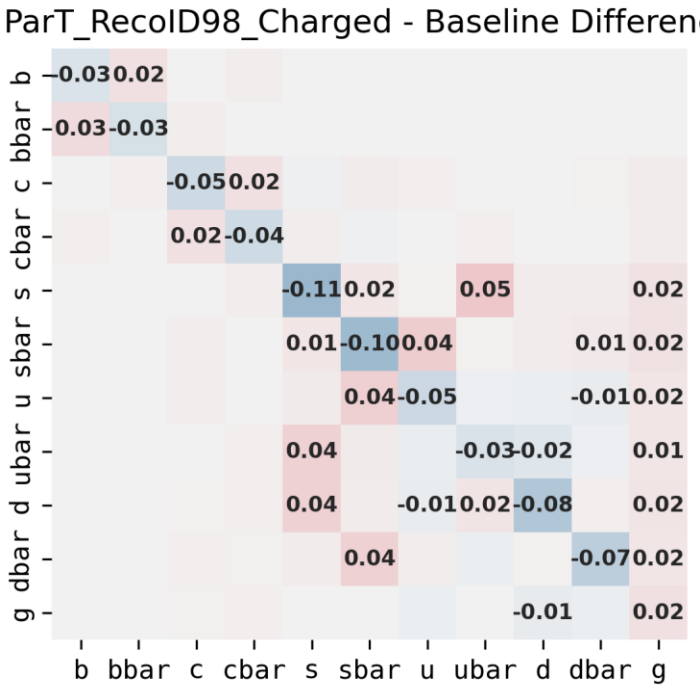


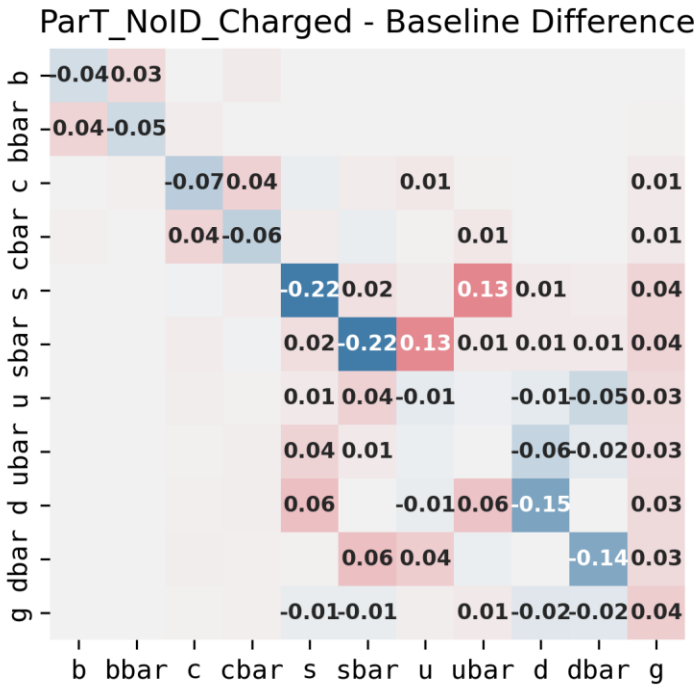


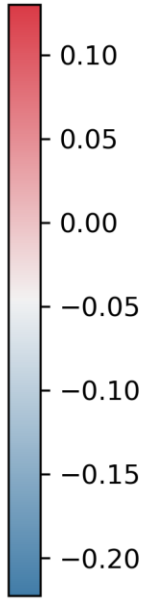
Charged Matrix Difference

Similar performance corresponds to FullPFOs.
Nertral PFO contributions are global and not for any specified flavor.

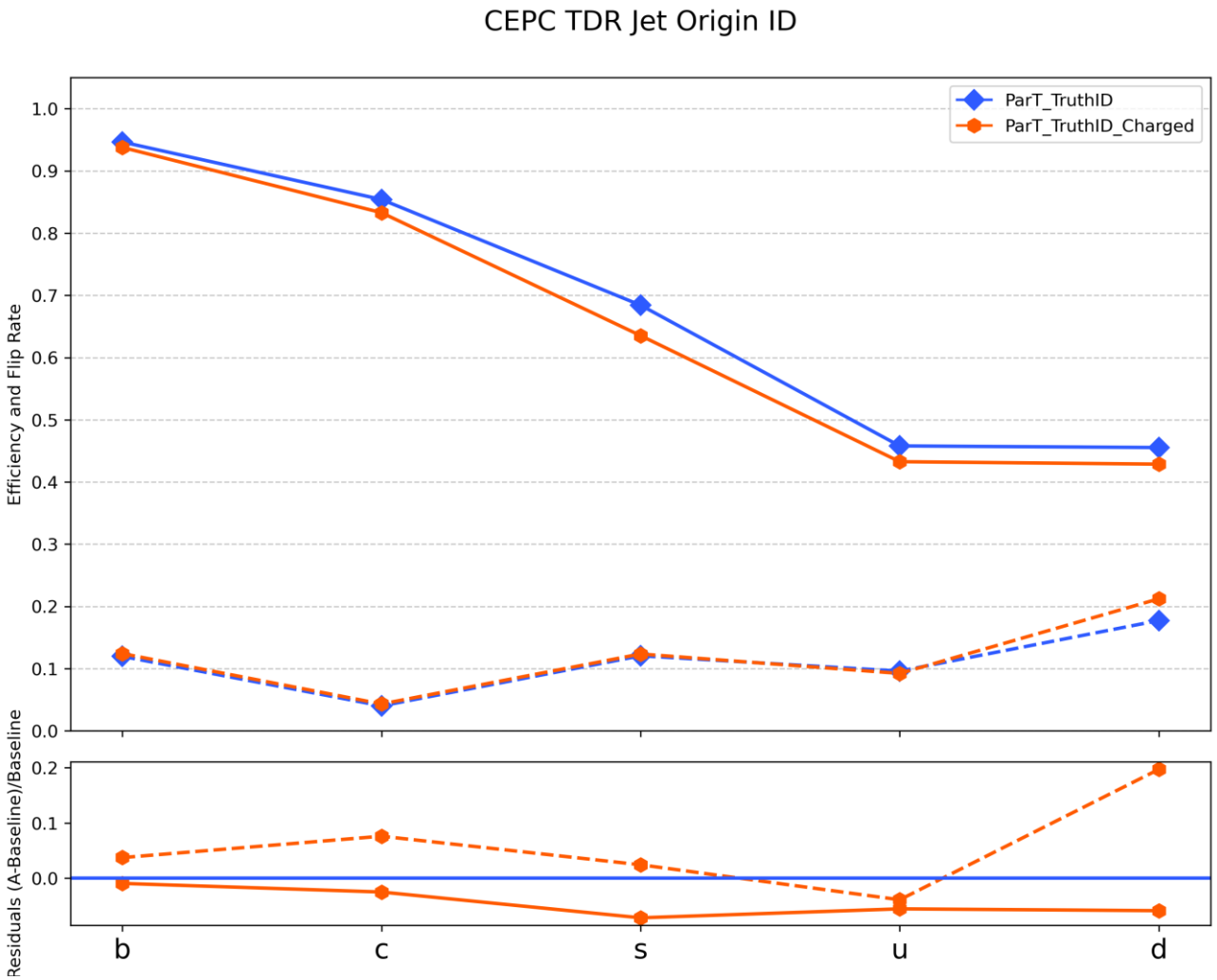






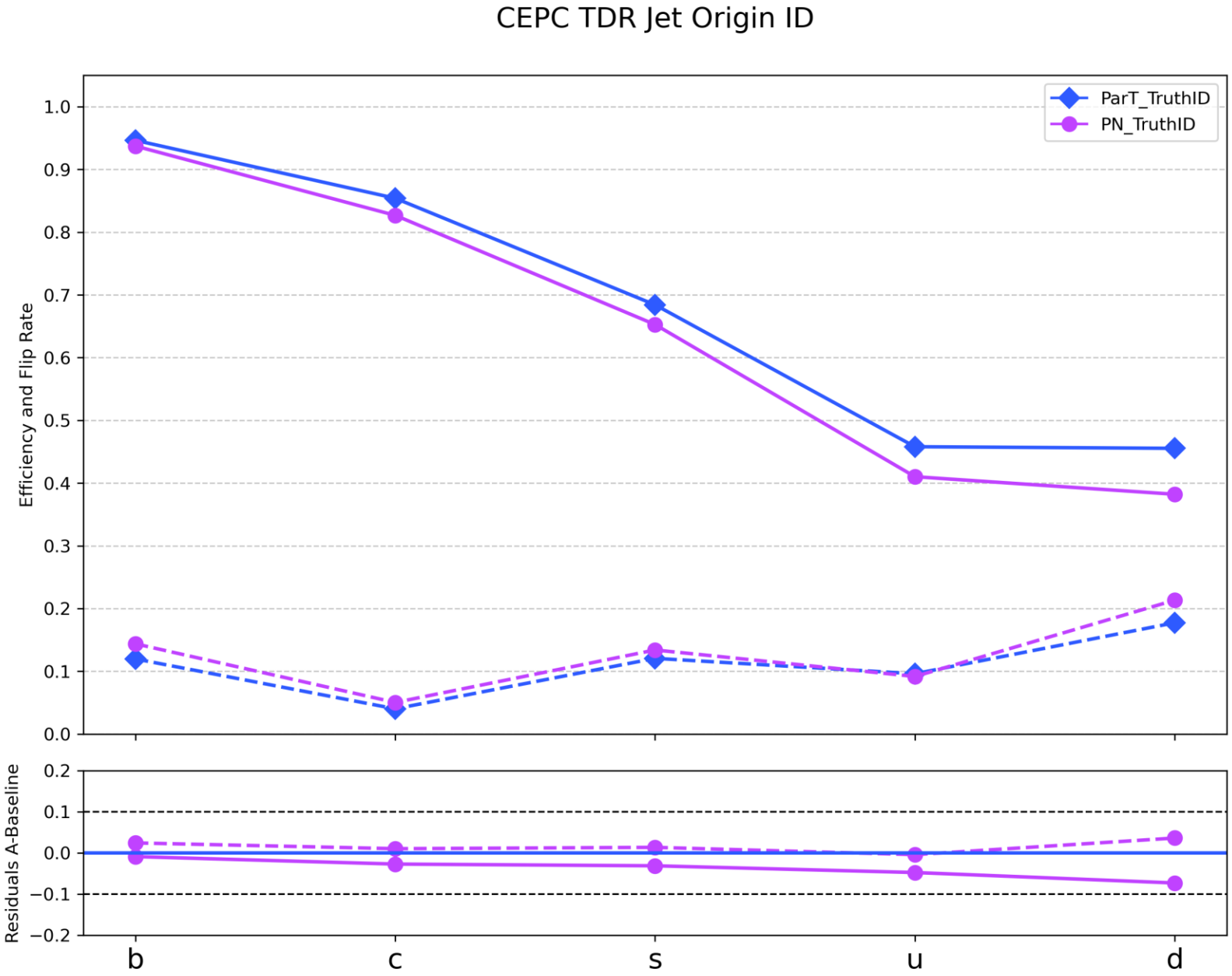


Residual: only charged tracks



Baseline	Efficiency	Flip Rate	Charged	Efficiency	Flip Rate
b	0.95	0.12	b	0.94	0.12
c	0.85	0.04	c	0.83	0.04
s	0.68	0.12	s	0.64	0.12
u	0.46	0.10	u	0.43	0.09
d	0.46	0.18	d	0.43	0.21
g	0.44		g	0.42	
Metric	0.5936			0.5661	

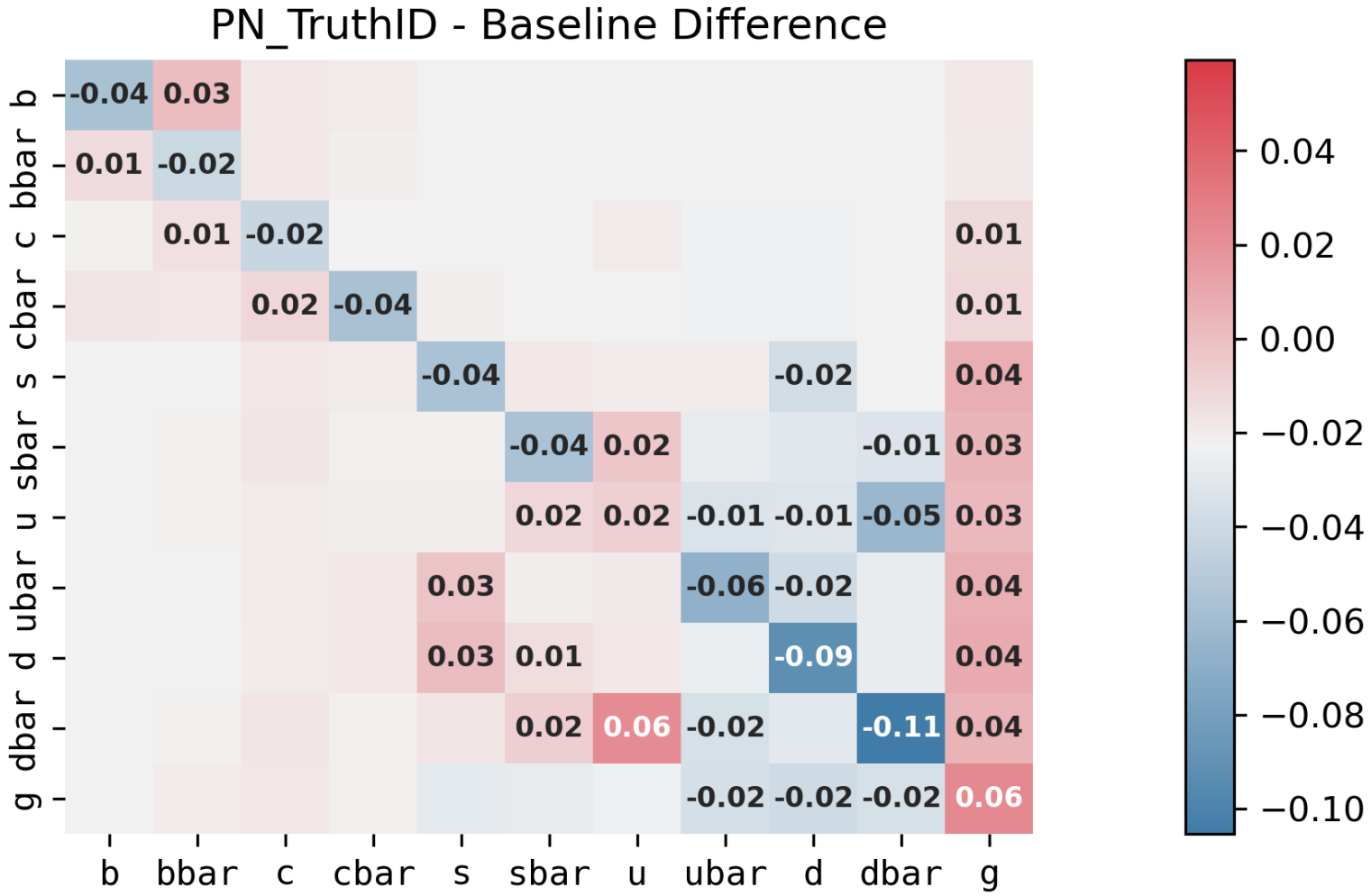
Consistent Analysis: TDR ParT vs PN Truth ID



0.5936: 0.5579

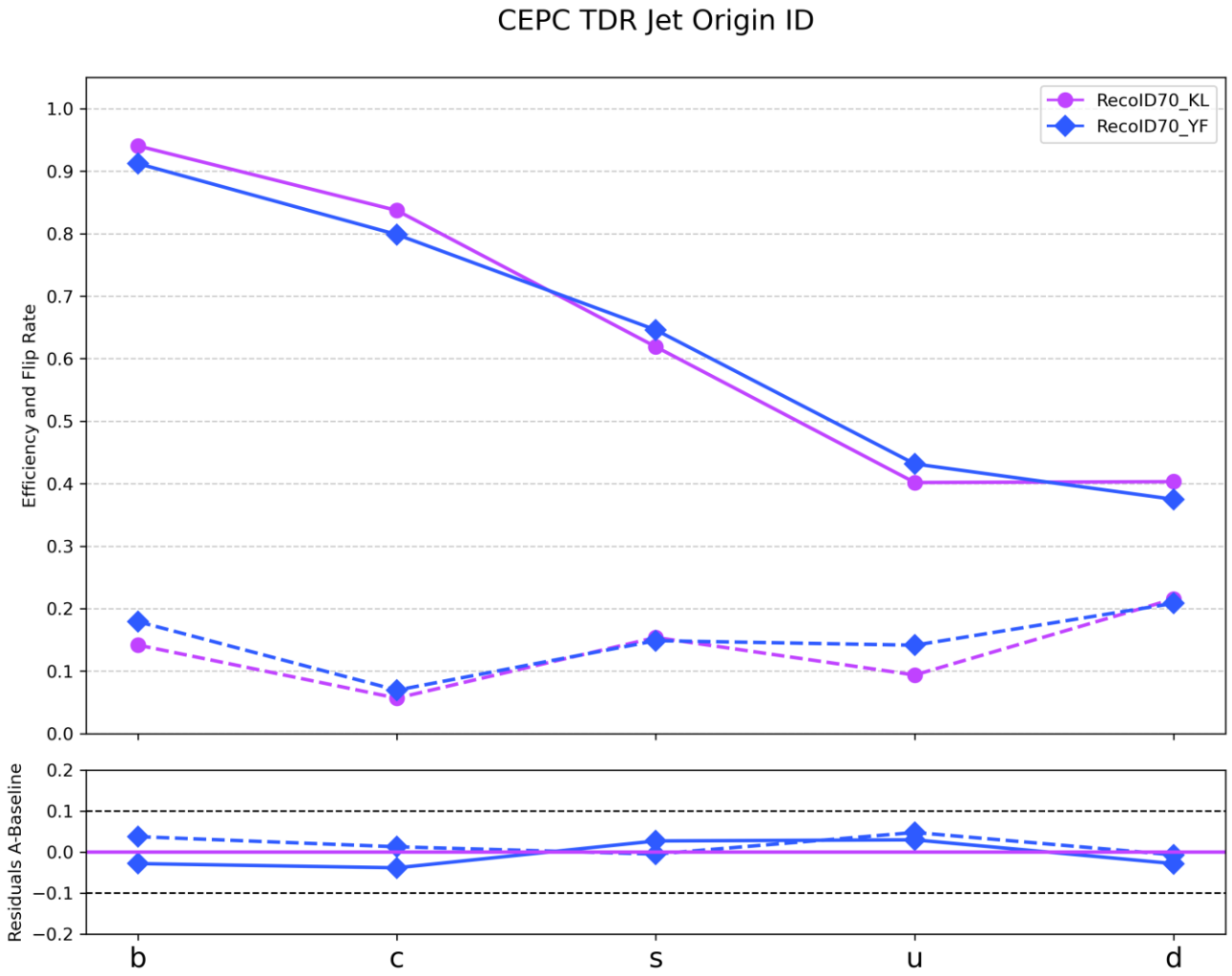
Matrix Difference

ParT with better metric, while PN has better gluon separation.
The improvement is believed from TLorentz vector information.



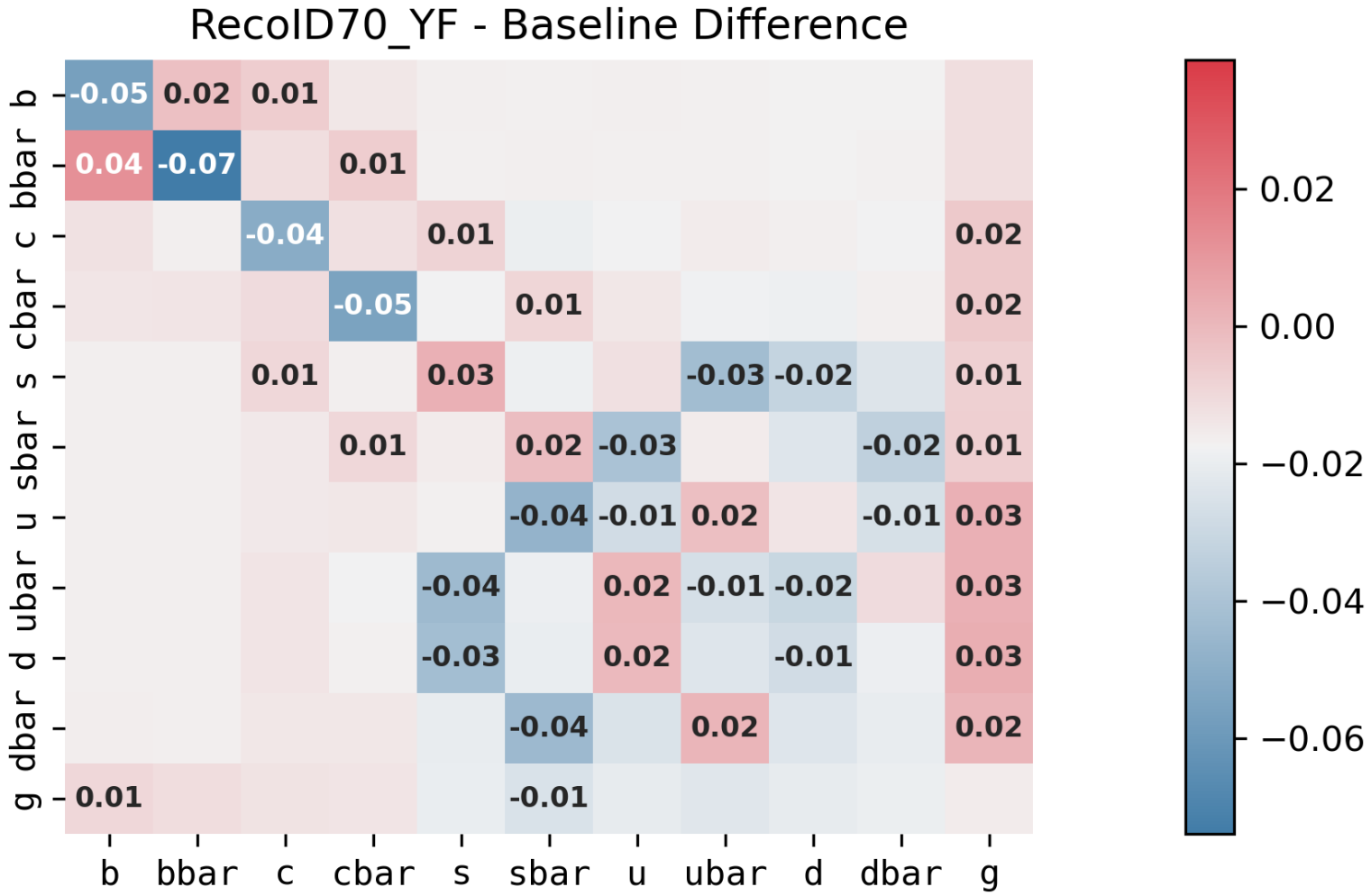
Consistent Analysis: ParT_Reco70

0.5510: 0.5319



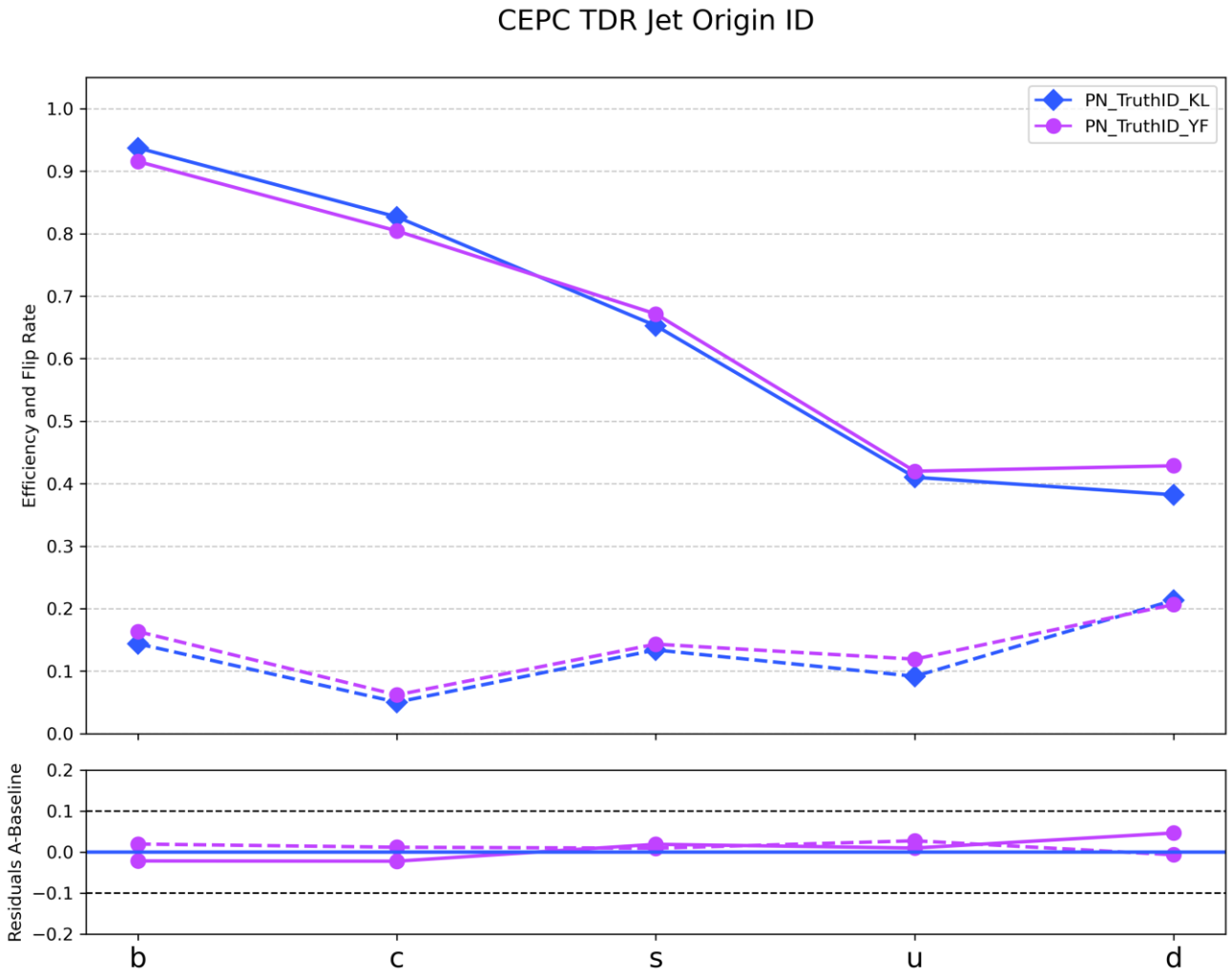
Matrix Difference

Under check for input variables and traing hyper parameter.



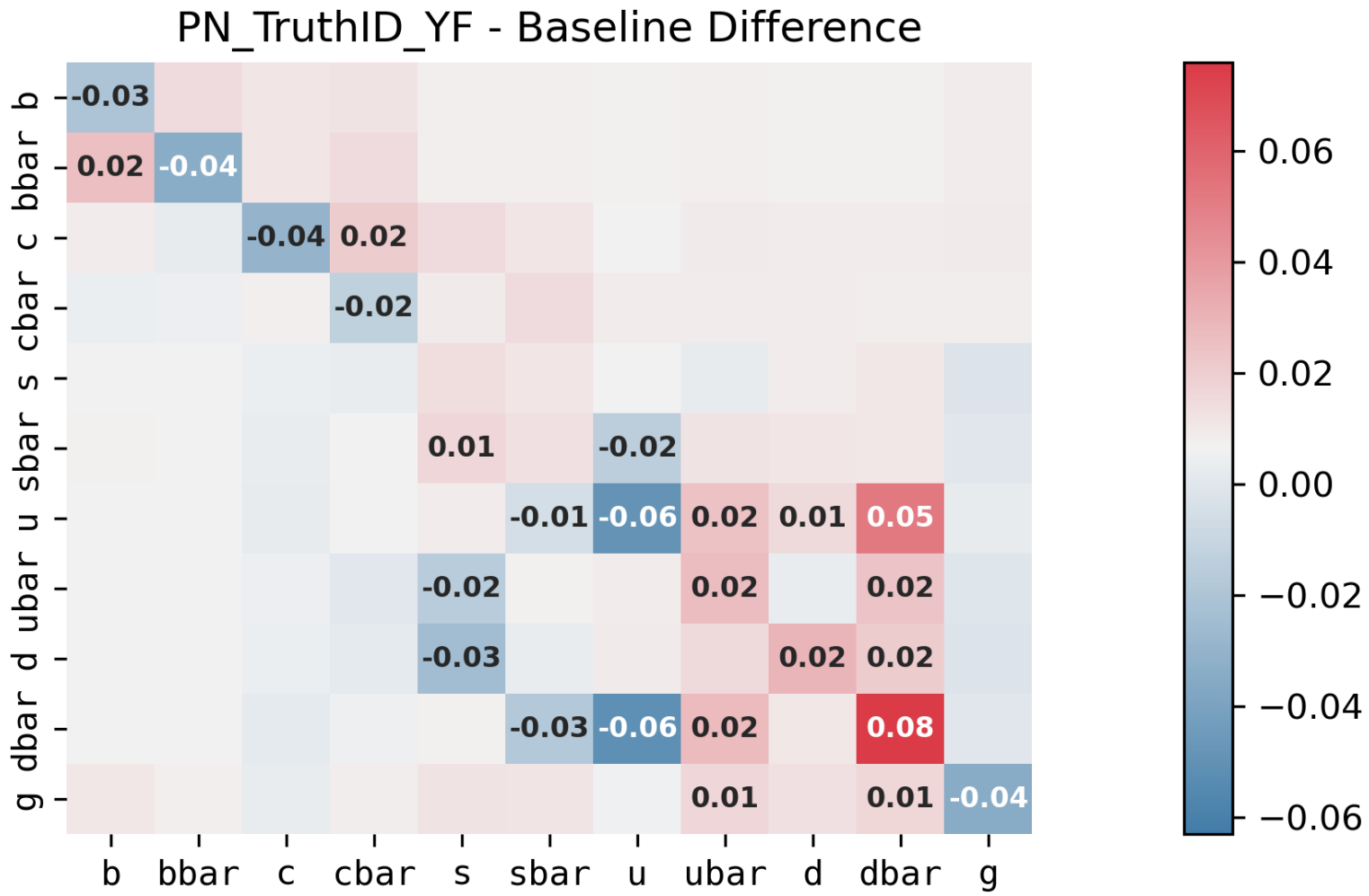
Consistent Analysis: PN_TruthID

0.5579: 0.5486



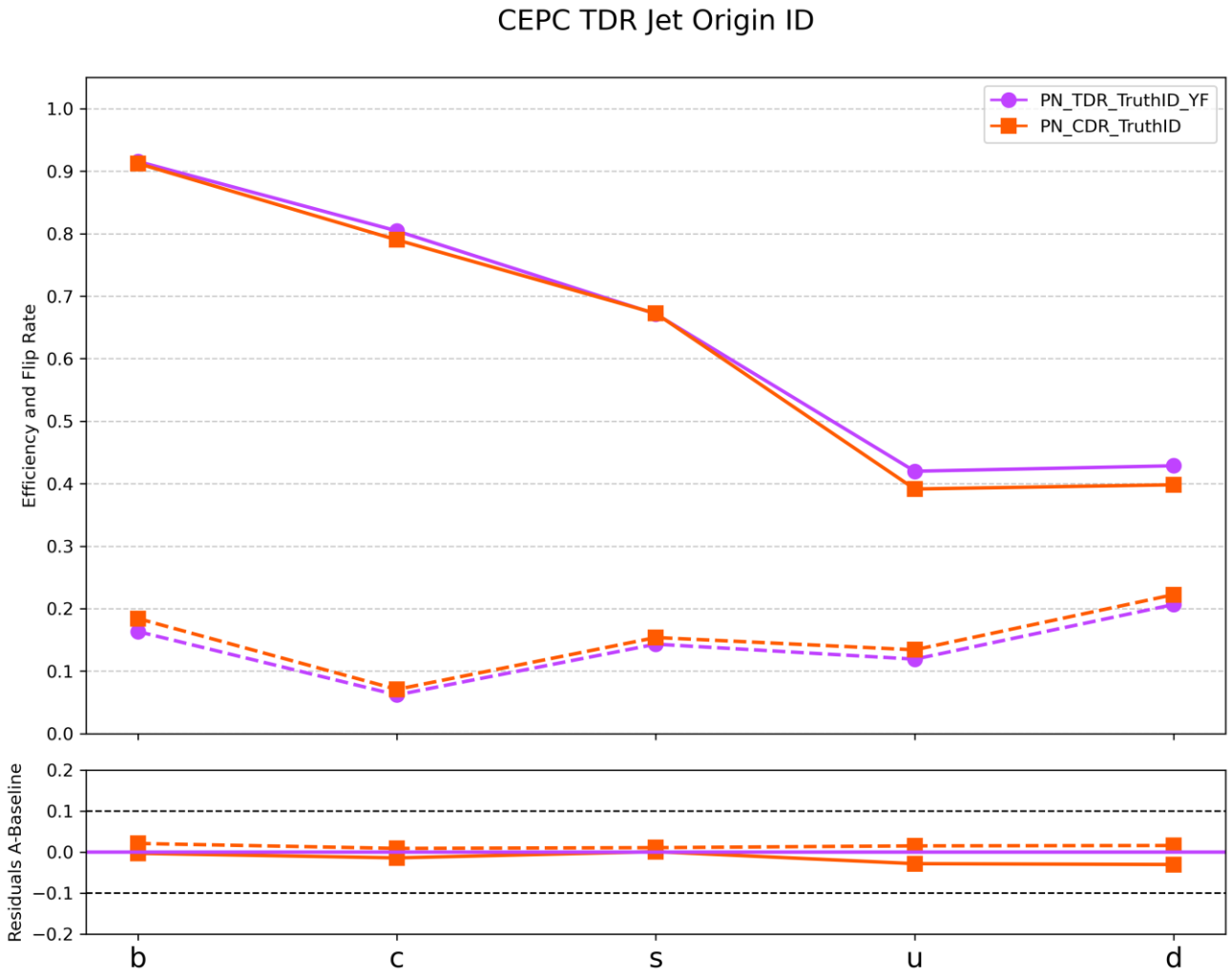
Matrix Difference

Similar performance while migration from u/dbar.



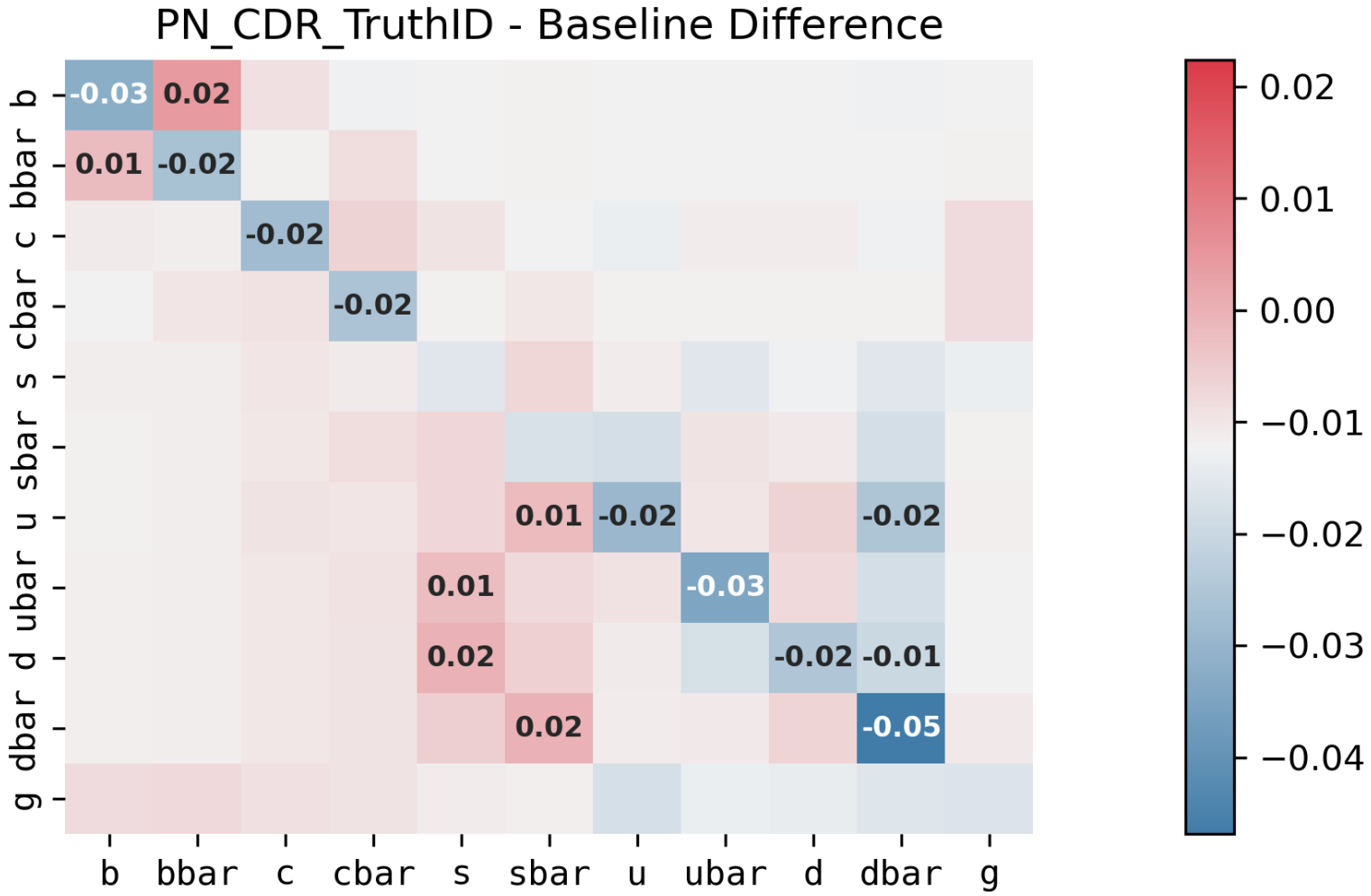
TDR/CDR, PN, truth ID:

0.5486: 0.5285



Matrix Difference

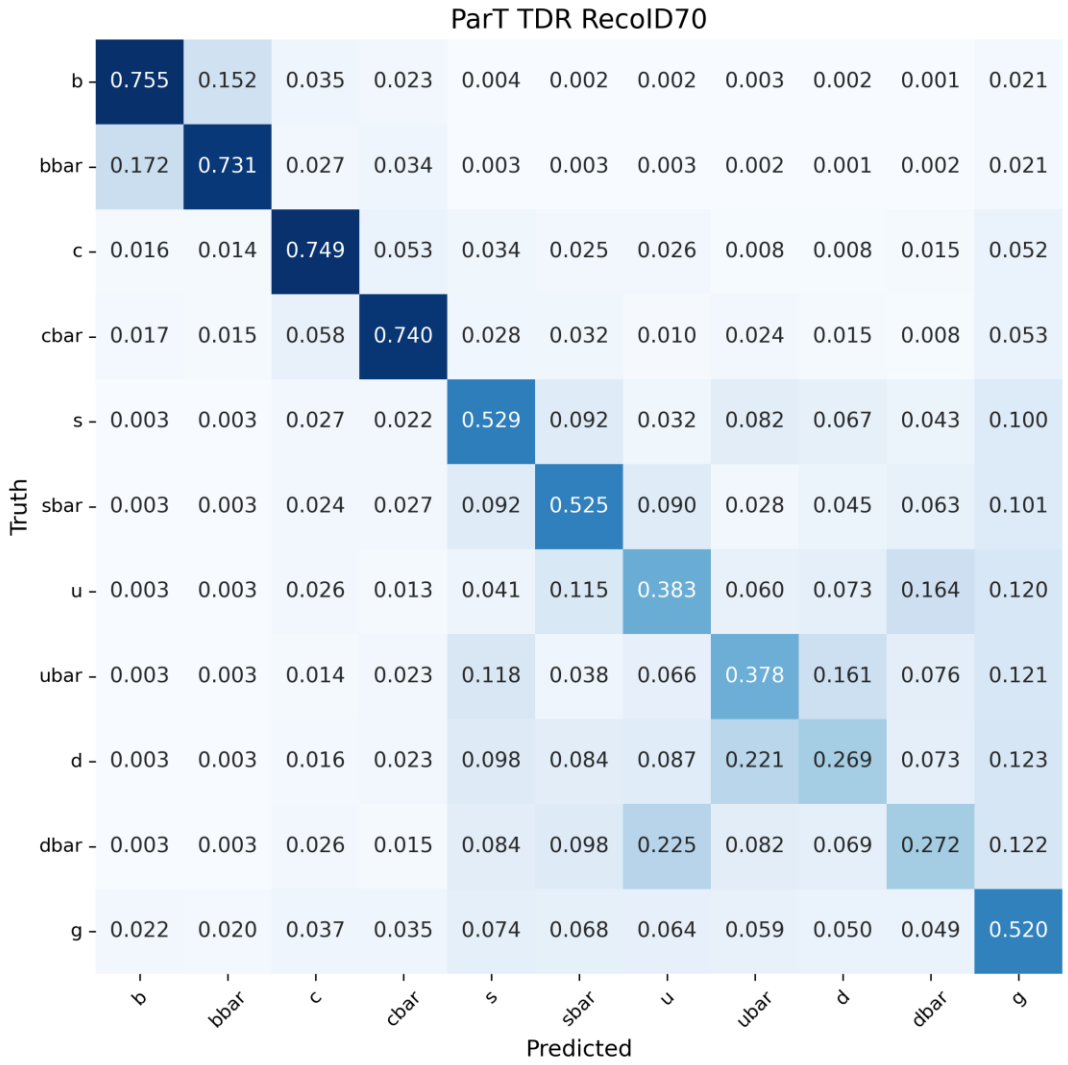
TDR improved from CDR in 2%.



To dos

- Further check inputs/outputs for consistence, like costheta
- After sanity check, applications:
  - b/c/g/s tagging, H->bb/cc/gg/ss analysis
  - Ability for genializing: JOI to Zpole, to E240 ZZ/WW/qq
  - Package for users
  - …

Results from YF



- ParT TDR RecoID70: 0.5319
- PN TDR TruthID: 0.5486
- PN TDR RecoID70: 0.5075
- PN TDR RecoID70Charged: 0.4952
- PN CDR TruthID: 0.5285

Results from YF