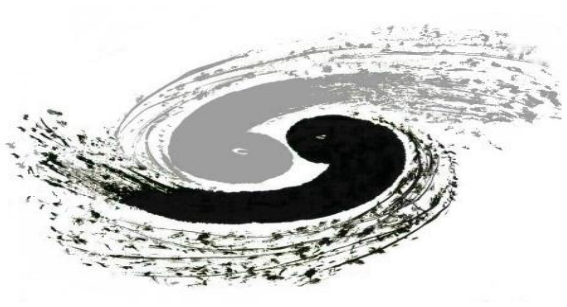

CEPC

Kaili Zhang

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CEPCSW 25.3.4

- 25.3.3 Fix the ITK Endcap -z order
  - Z->mumu momentum fixed.
- 25.3.4 Improve the momentum resolution
  - Fix the MCParticle Unit(MeV->GeV)
- Current sample: /cefs/higgs/zhangkl/Production/2503
- In specialized node, one H->bb event
  - Sim+Digi+Trk Time: ~24s per event. Memory: <4GB.
  - Rec Time: ~6s per event. Memory: <6GB.
  - Fail rate, for file existing: <0.2%. (34/24000 for 4 steps)
  - Fail rate, for event info complete: <2% (In JOI)

BMR

See Haoyue's slides

25.3.0

BMR results improved in 25.3.0.

Case	process	$ZH \to \nu\nu gg$	$ZH \to \nu\nu bb$	$ZH \to \nu\nu cc$	$ZH \to \nu\nu uu$	$ZH \to \nu\nu dd$	$ZH \to \nu\nu ss$
Physical level	BMR/%	3.87 ± 0.01	4.37 ± 0.03	4.09 ± 0.02		3.97 ± 0.01	4.33 ± 0.01
	Efficiency/%	74.4	74.5	74.8		74.8	74.8
Detector level	BMR/%	3.82 ± 0.01	3.70 ± 0.01	3.92 ± 0.01		3.94 ± 0.01	4.30 ± 0.01
	Efficiency/%	66.7	28.4	49.1		70.8	70.9

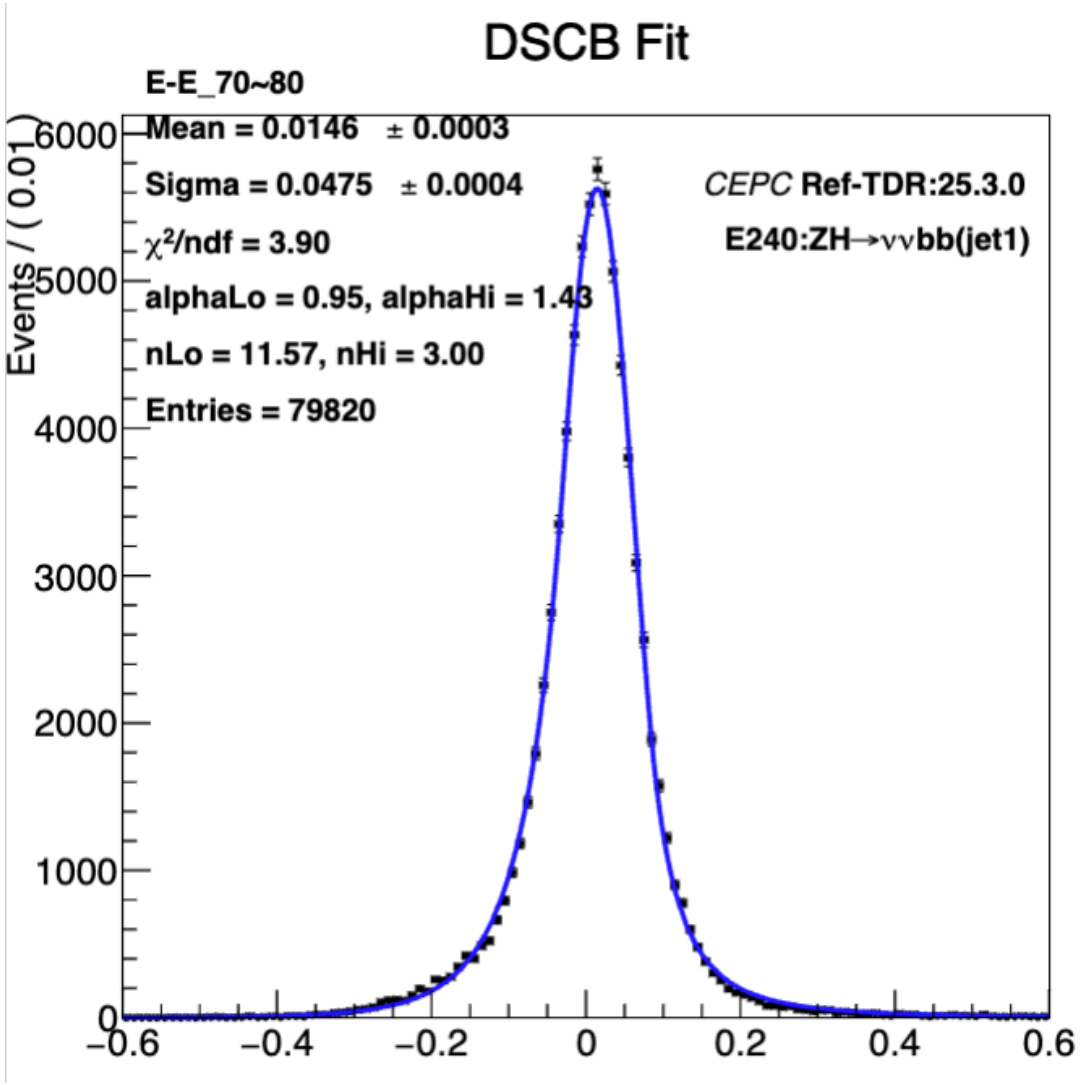
25.1.0

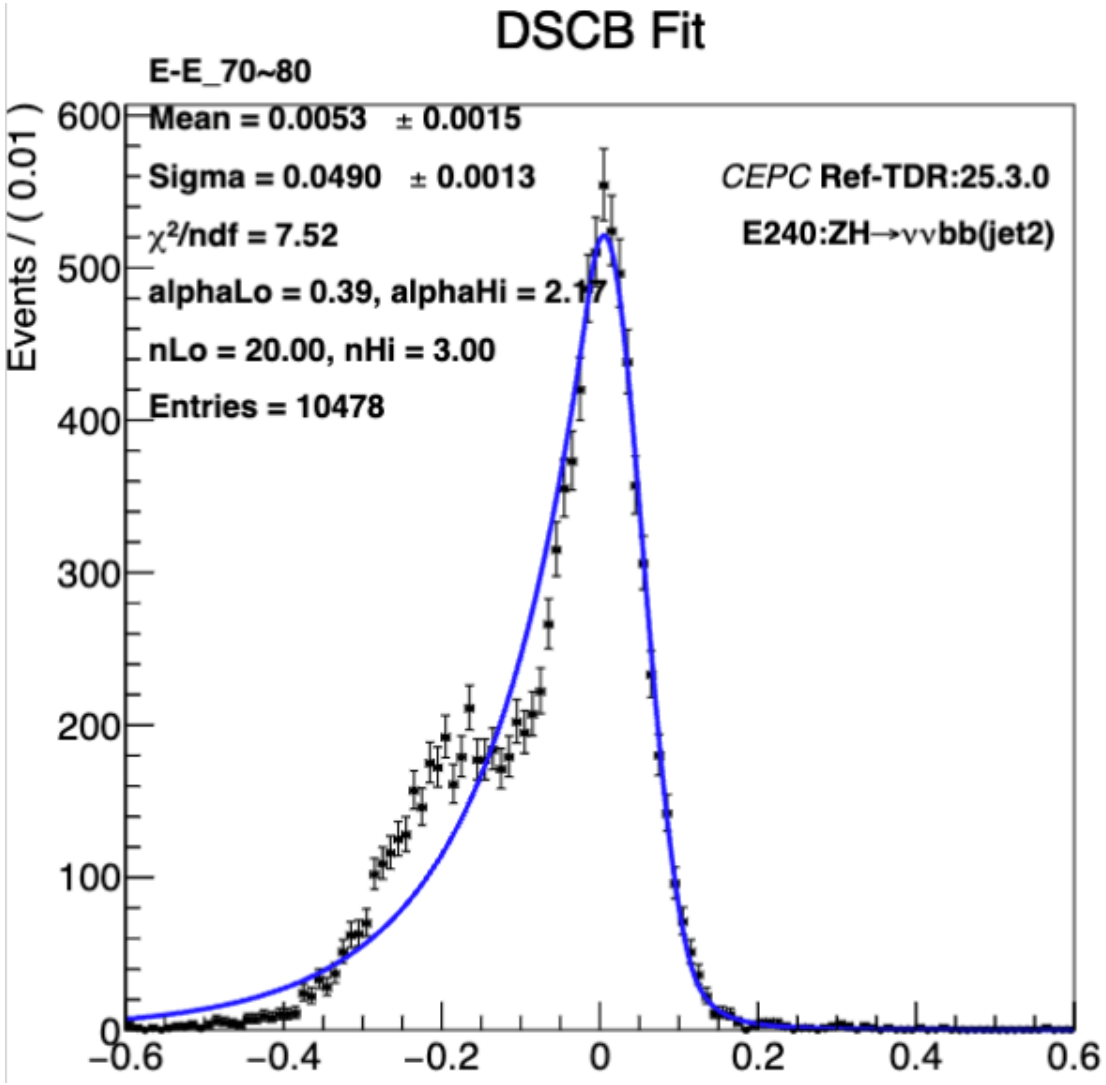
Case	process	$ZH \to \nu\nu gg$	$ZH \to \nu\nu bb$	$ZH \to \nu\nu cc$	$ZH \to \nu\nu uu$	$ZH \to \nu\nu dd$	$ZH \to \nu\nu ss$
Physical level	BMR/%	4.00 ± 0.01	4.36 ± 0.03	4.16 ± 0.03	3.79 ± 0.01	3.97 ± 0.01	4.44 ± 0.01
	Efficiency/%	73.3	73.7	74.0	74.2	74.1	74.1
Detector level	BMR/%	3.95 ± 0.01	3.74 ± 0.02	4.01 ± 0.01	3.77 ± 0.01	3.95 ± 0.01	4.40 ± 0.01
	Efficiency/%	65.7	28.1	48.6	70.3	70.1	70.2

JER

Previous -0.2 bump only happen in jet2(E<Jet1).
When Jet2 truth E~70, Higgs energy>140 in ZH 240GeV system.
So only using jet1 in 70-80 GeV region, issue disappeared.

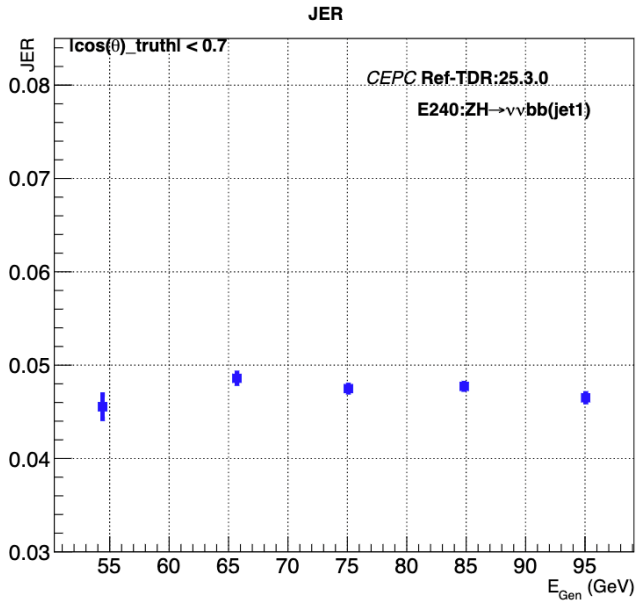
@Yingqi

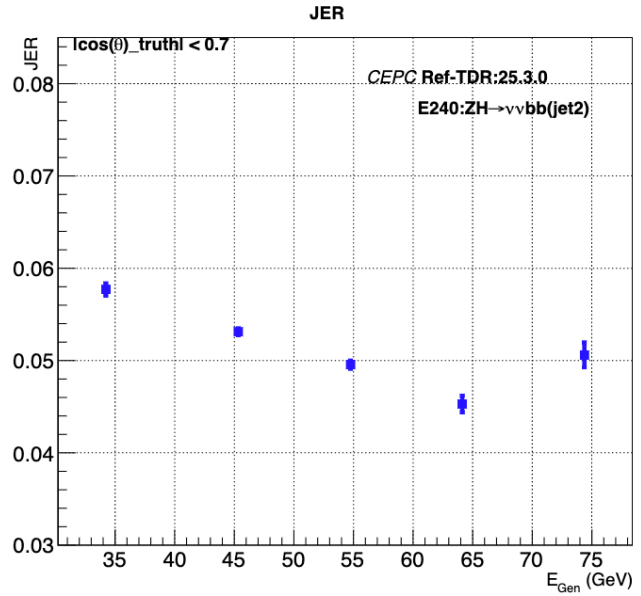


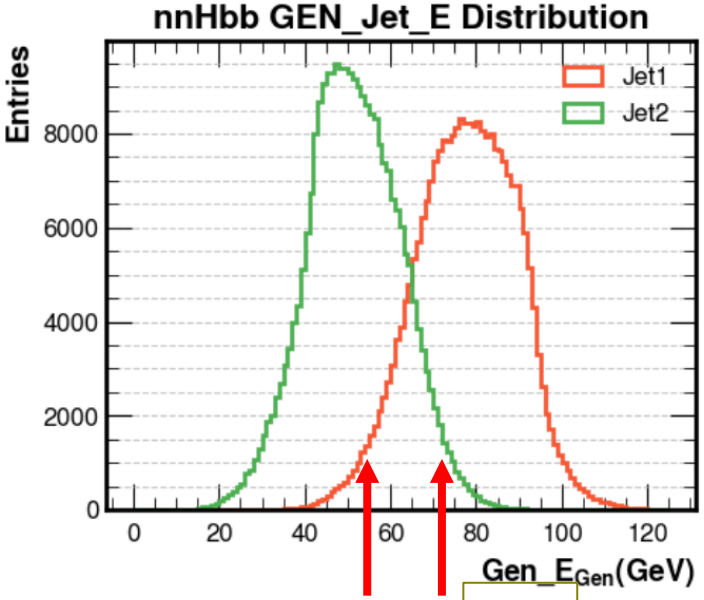


JER ZH->vvbb, jet1 and jet2

@Yingqi



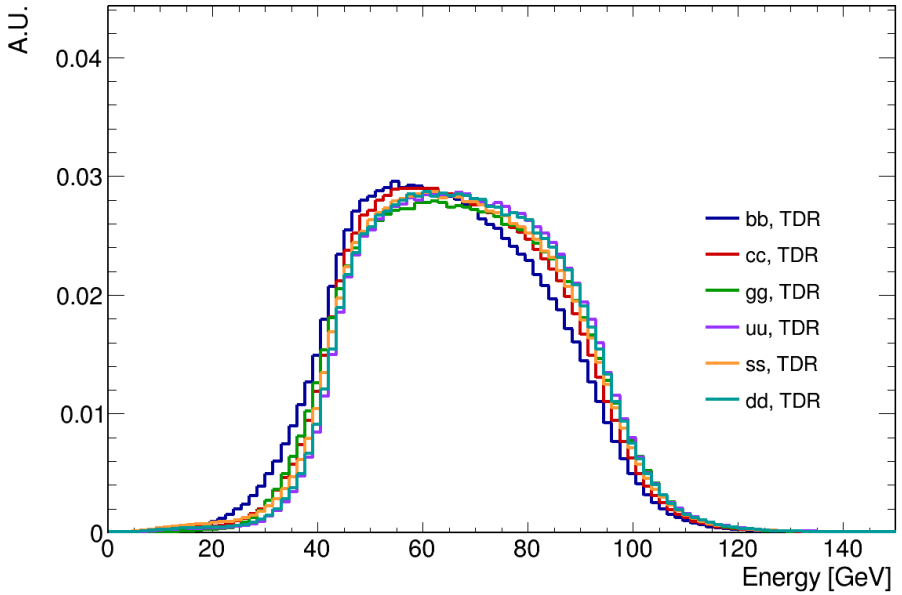


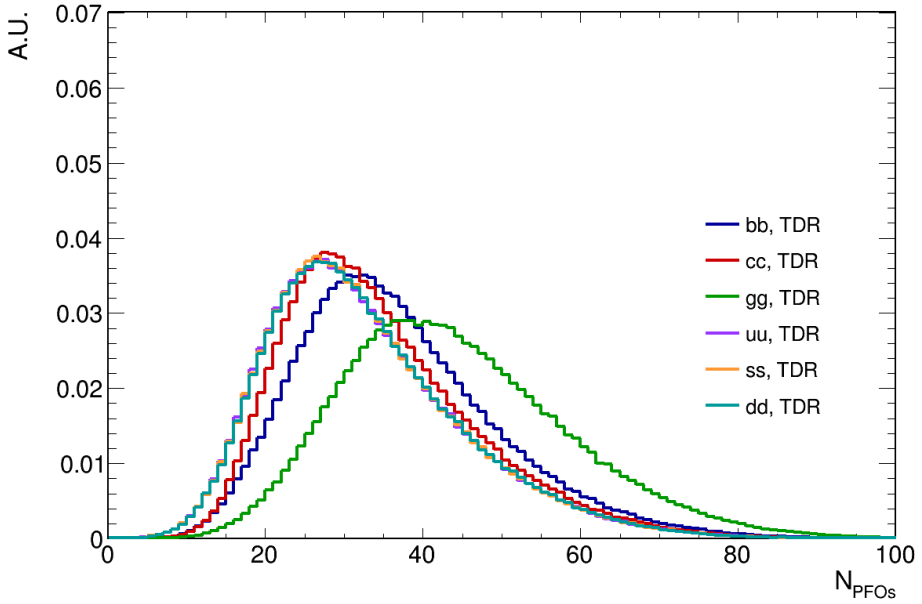


tail

- Also, Jet1~55GeV and Jet2 ~75GeV can not be used due to confusion.
- JER should be consistent with BMR. Discrepancy should be from clustering.
- eeqq sample, without ISR be used to avoid confusion issue.

Jet Energy, N_PFO

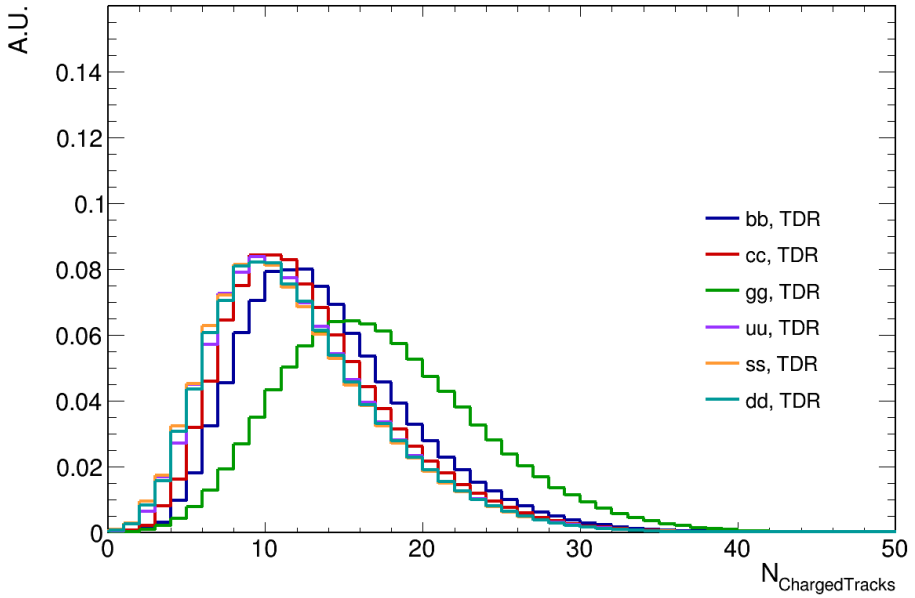




- 93% jets 40< E <100 GeV.
- 80% jets 20<N_PFO<60.
  - This 7%, 20% can be seen as bad clustering. Possible improvement?
- bb jet energy slightly lower due to neutrino energy loss.
- NPFOs, gg>bb>others

- Avoid Confusion
  - 1-1 Correspondence
  - CSI to avoid clustering
  - Thrust/Energy balanced algo
  - Multi-step clustering.

N_tracks:



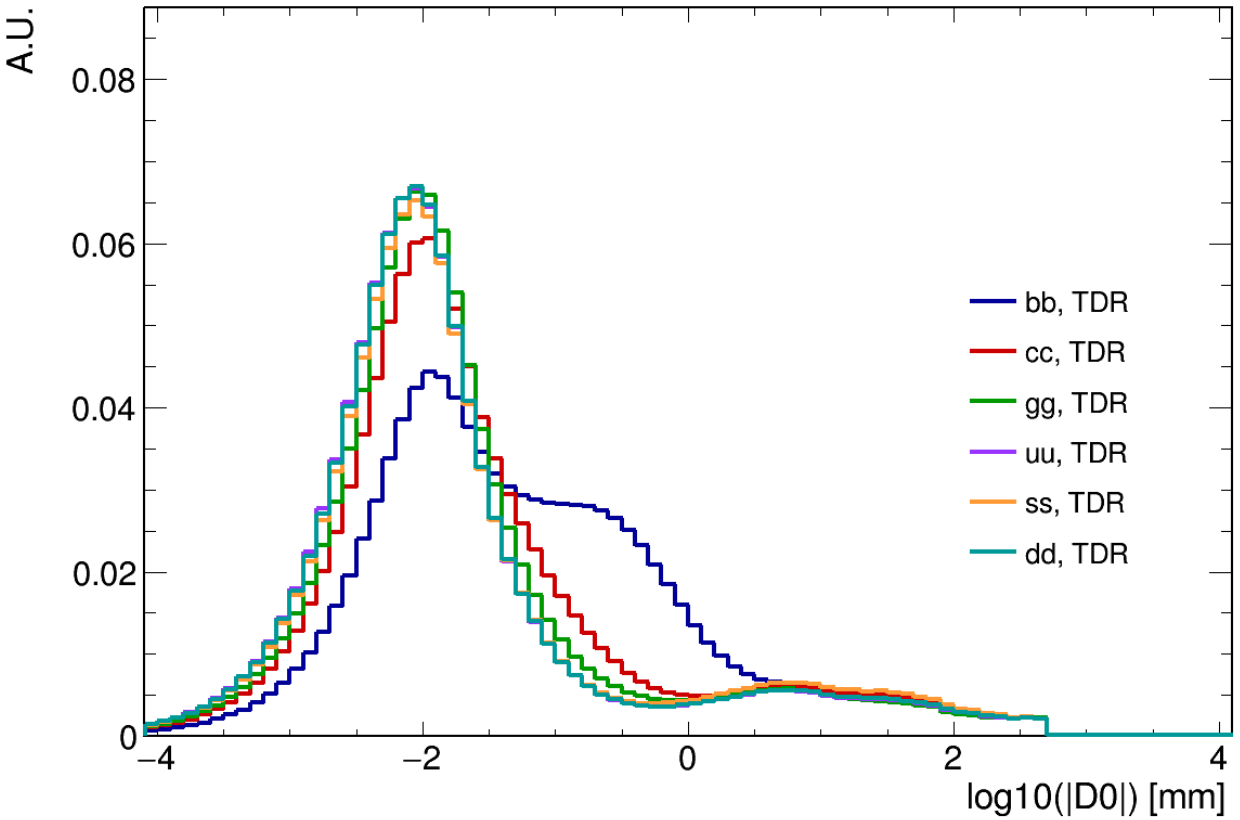
- bbTDR: 13.6093 ±5.57129
- ccTDR: 12.4619 ±5.43898
- ggTDR: 16.9754 ±6.46138
- uuTDR: 11.7313 ±5.4954
- ssTDR: 11.5422 ±5.51865
- ddTDR: 11.6648 ±5.50916

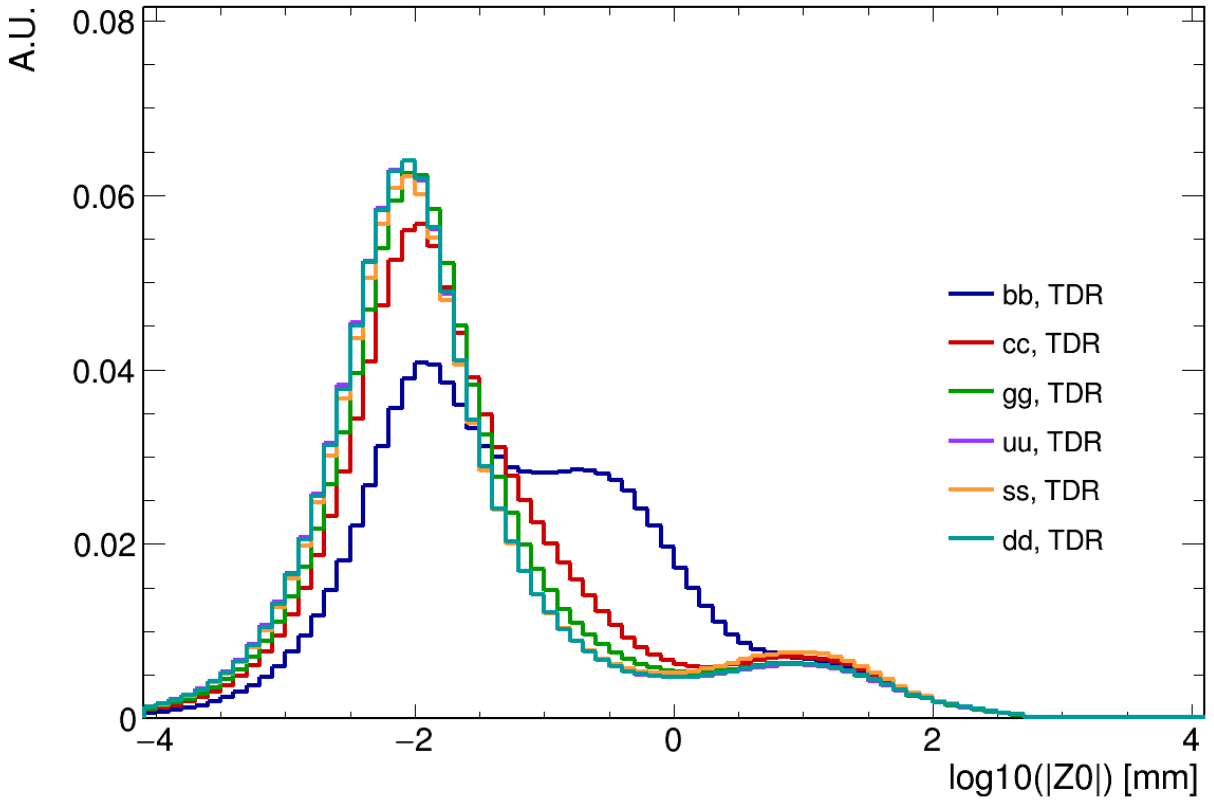
- In one b jet, typical 14 reco tracks.
  - Almost all of them can match with truth particles.
  - ~12.6 Pion, 1.2Kaon, 0.1Proton. 0.1 lepton.
  - N_CompleteTracks >> N_TPCTracks(Barrel, 200MeV, 60cm) >> N_TOFTracks(Barrel, 800MeV)
  - N_toftracks ~ 0.5 , 7 for one jet.

- High Pt track(>1 GeV) can be easily tagged but difficult for low energy tracks in jet.

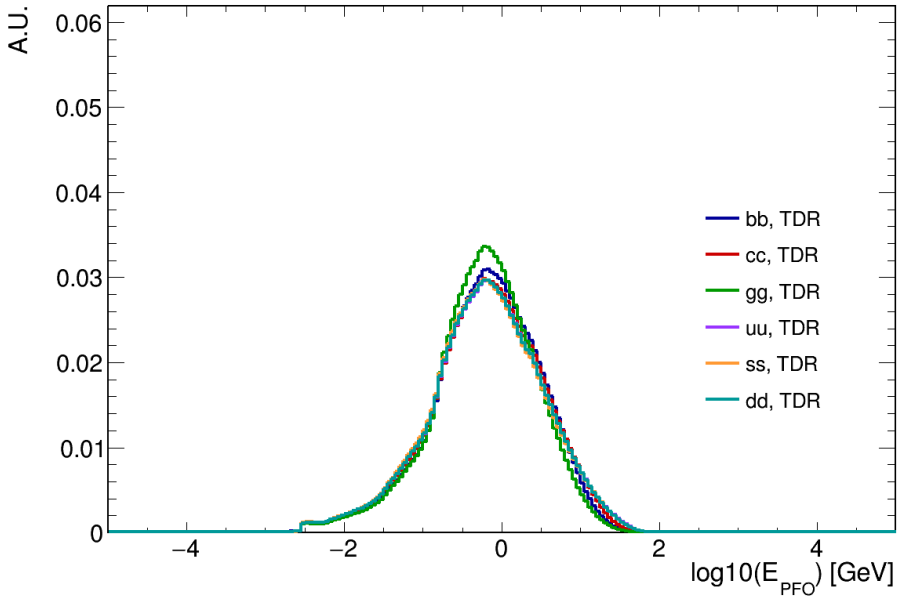
D0, Z0 Vertex

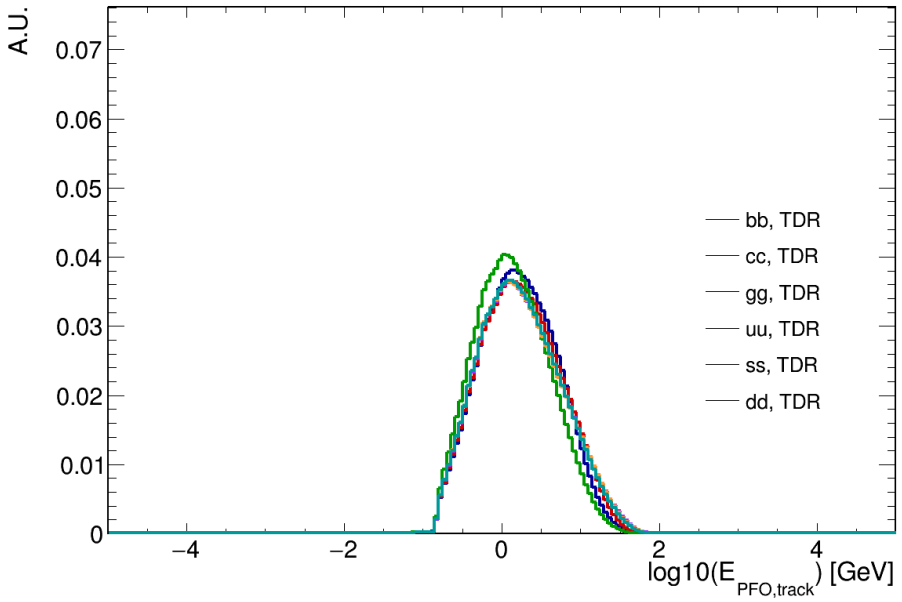
3 Pattern: Primary vertex, secondary vertex, long-live particles(Like Klong)





PFO Energy





- Minimum energy for one PFO: 3MeV;
- Minimum energy for one charged track PFO: 100MeV.
- In all charged PFOs
  - E<1GeV: 1/3
  - Pt<1GeV: 44%

Reco PID in 25.3

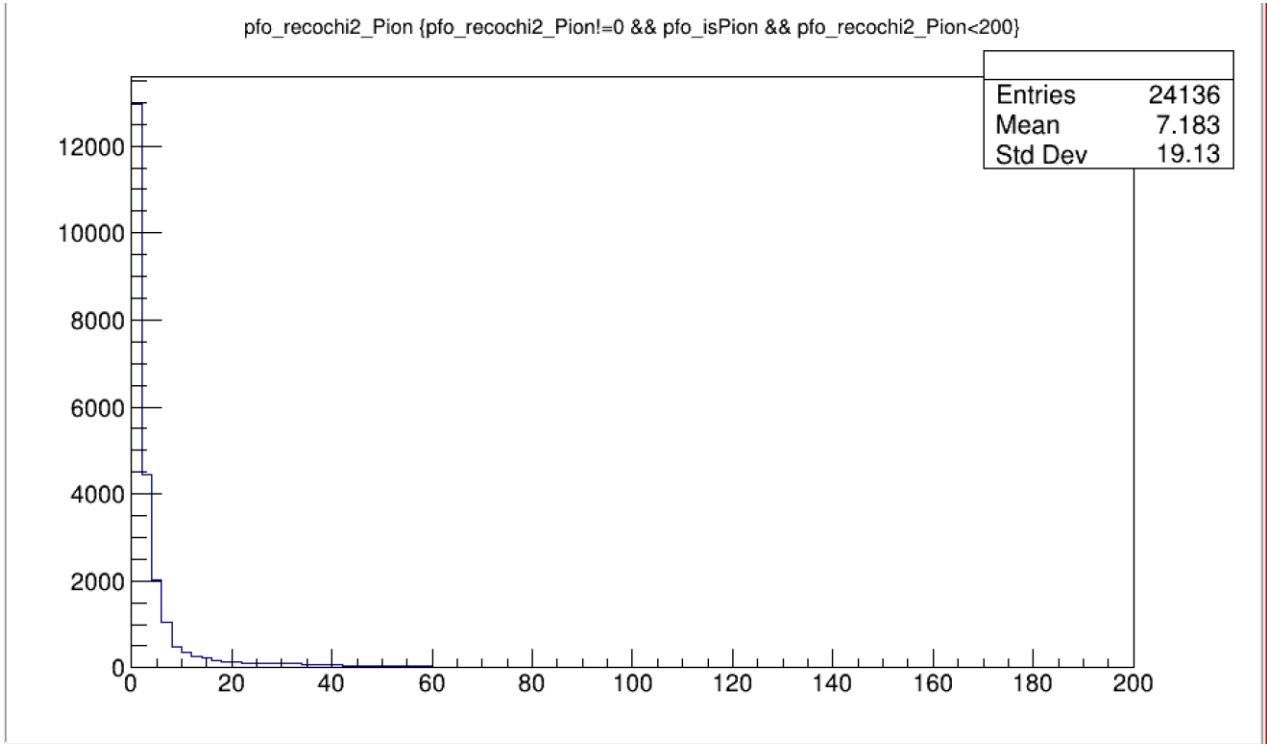
```
This Event 5000 TOF size : 18 dqdx size : 26
PFO Size: 81 Track size: 29
MCParticles Size: 263 Stable MCParticle: 74
Matched MCParticle: 34 Ratio: 0.459459
```

- Typically, one b jet with 36PFOs, 14 tracks. 22 neutral PFOs.
  - Possible for 1-1 correspondence.
  - 22 neutral PFOs. Confusion, fragment…
    - ~6 neutral PFO can do truth matching to photon, Klong, and neutron. Usually E > 1GeV.
- In TOF and TPC, a chi2 given for track itself with e, mu, pi, K, p hypothesis.
  - Current: TOF+TPC chi2 and give the minimum chi2 as reco PID.
  - Pi/K/P: minimum chi2 in 3 to avoid pi/mu contamination;
    - Consider WP shift more for Kaon/Proton

Current Reco PID Performance in Jet

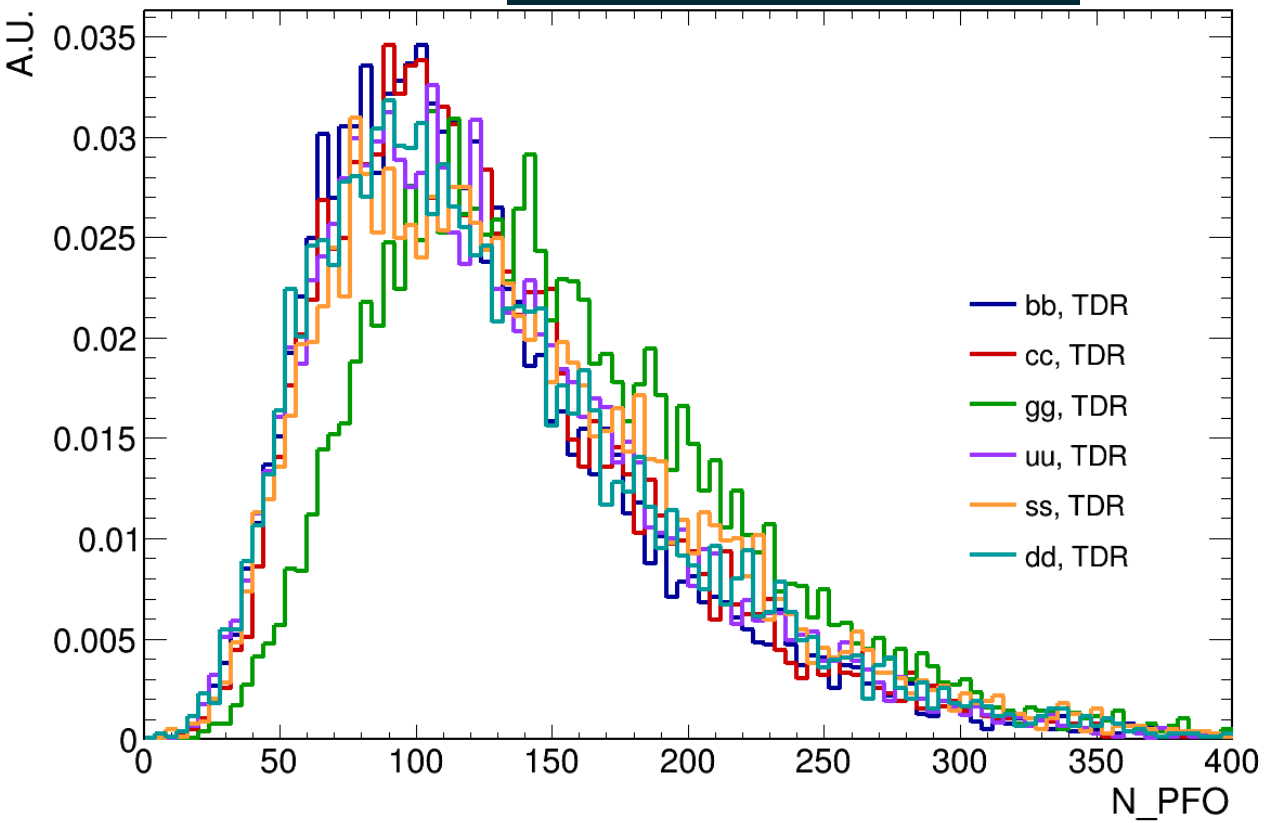
For one truth pion, the reco chi2 distribution.
~1% tracks with very high chi2.
Plan to veto events with chi2>200 as chi2 window.

- Assume all the charged PFOs are Pion
  - Eff-100%; Purity-90%
- While current:
  - Eff=N_recoPion/N_truthPion=93%
  - Purity= 98%

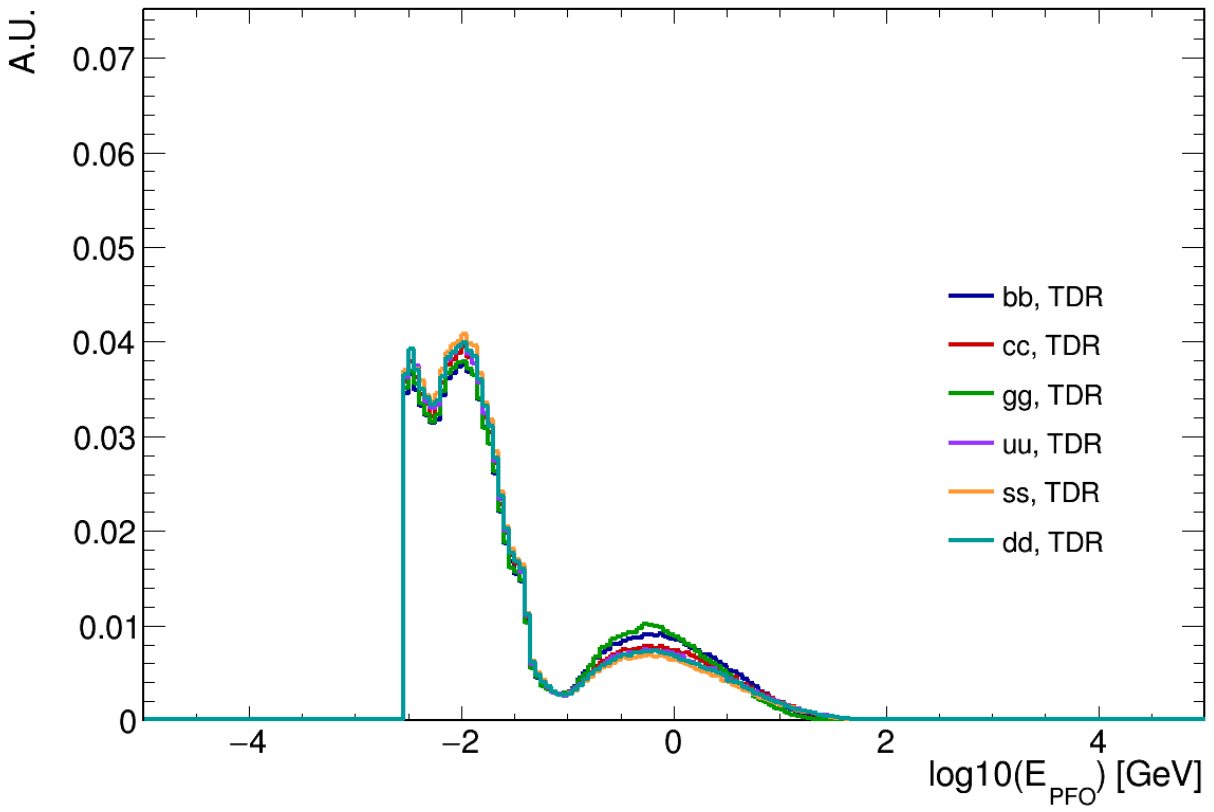


Before 25.3:

```
bbTDR: 123.738 ±60.9093
ccTDR: 128.538 ±61.7292
ggTDR: 150.318 ±64.4921
uuTDR: 127.983 ±62.172
ssTDR: 135.518 ±65.9203
ddTDR: 129.322 ±65.0416
```



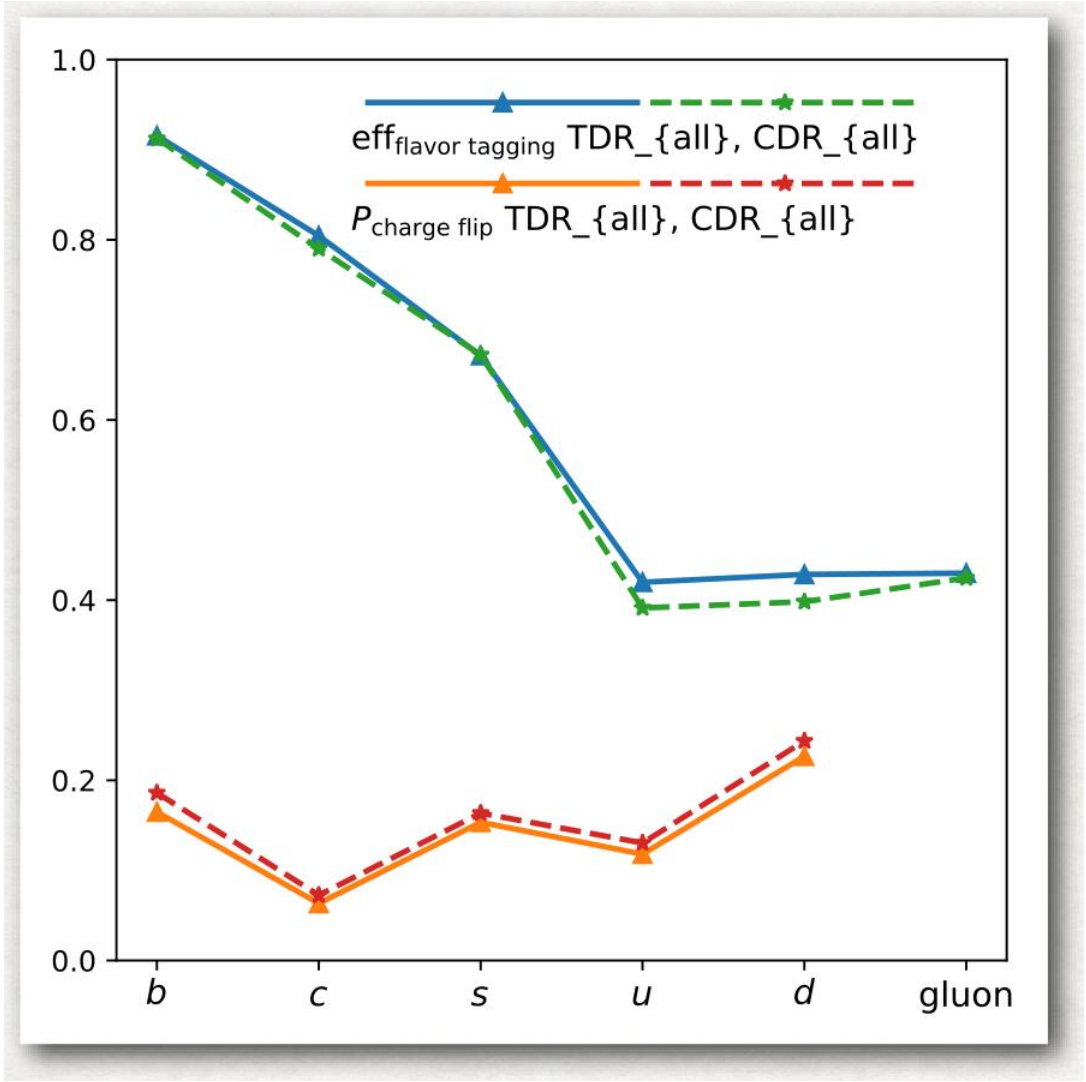

```
bbTDR: -1.48234 ±0.949577
ccTDR: -1.53376 ±0.926584
ggTDR: -1.50001 ±0.923936
uuTDR: -1.55966 ±0.91385
ssTDR: -1.58785 ±0.891898
ddTDR: -1.56168 ±0.910634
```

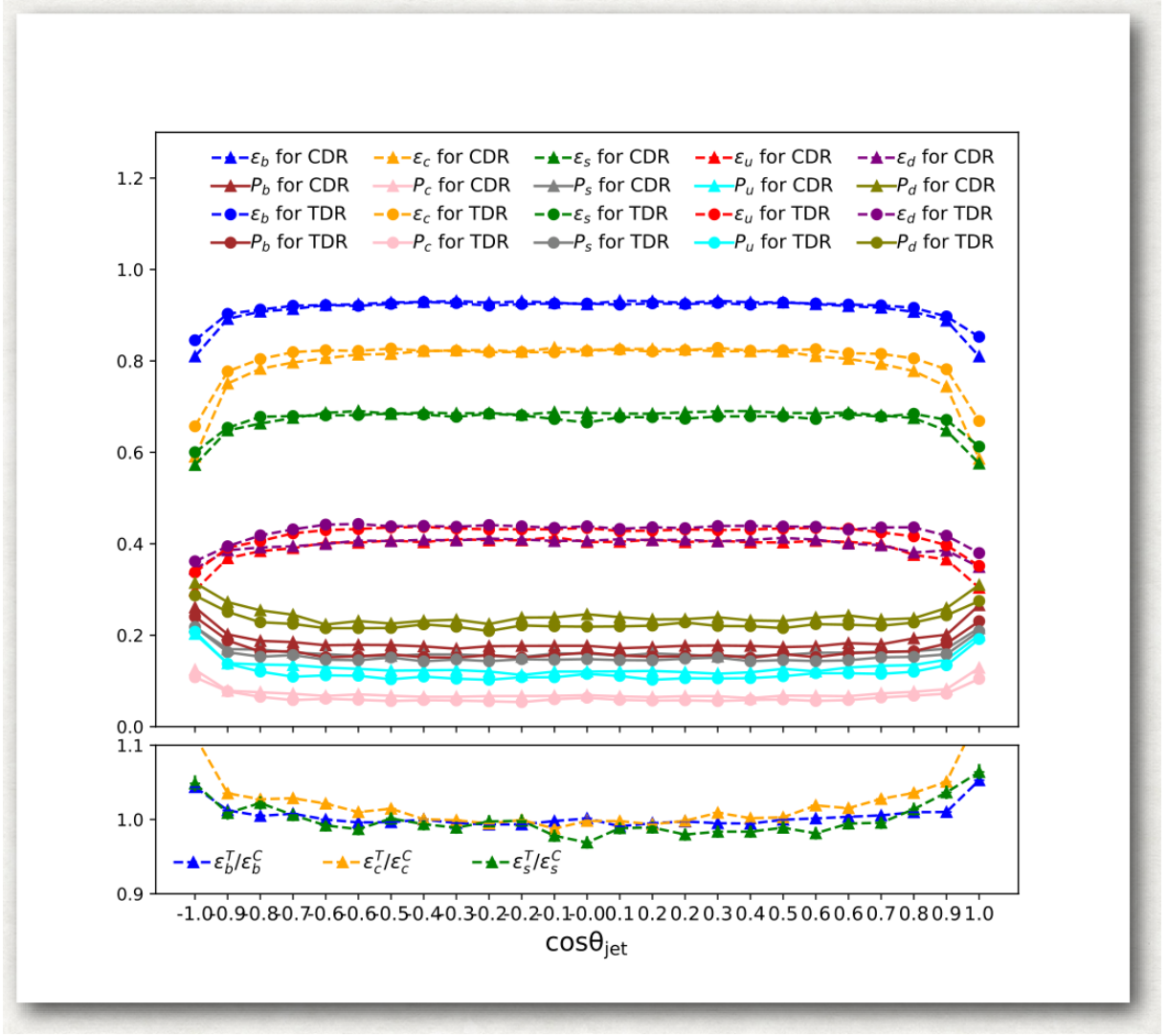


JOI CDR&TDR

@Yongfeng

TDR in 25.1 sample. Results for 25.3 under training.





JOI CDR&TDR

@Yongfeng

TDR in 25.1 sample. Results for 25.3 under training.