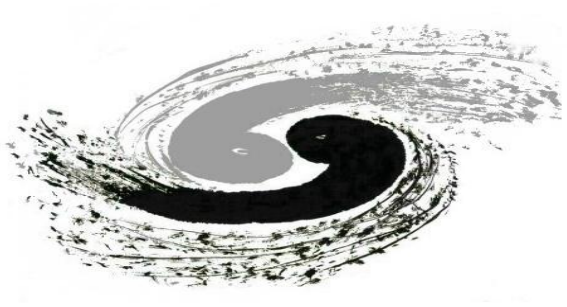

CEPC

Jets, samples and Wednesday working meeting

Kaili Zhang

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CEPCSW 25.5 Released

#249, #252 introduced in last report.

Evidence collection

tdr25.5.0-evidences-265.json ••• 2a02f0c6

Collected 17 hours ago

Release notes

- Detector
  - Geometry: fix the issue of lacking gap in ITK. See MR !246.
  - Geometry: update MDI support. See MR !254.
  - Geometry: modify mask structure and increase au layer thinkness. See MR !259.
  - Geometry: update silicon tracker. See MR !256.
- Simulation
  - DetSim: introduce a fixed time window mode. See MR !247.
  - DetSim: allow user to override the nbatch, nbx per batch, bx spacing. See MR !250.
  - DetSim: fix the missing MCParticle and mute the output. See MR !258.
  - DetSim: Update ITK/OTK time window. See MR !261.
- Digitization
  - Digi: external shift for mixed backround hits in TPC. See MR !251.
  - Digi: fix Digi for ITKE. See MR !255.
- Reconstruction
  - CyberPFA: Fix the memory leakage in CyberPFA. See MR !249.
  - CyberPFA: add a protection in matching. See MR !252.
  - Tracking: improve performace for circle and sepcial angle. See MR !262.
  - Rec: Optimize memory usage during Reconstruction by implementing WriteGeomMetaData. See MR !257.

- Geometry update
- Beam background mixing available.
- Metadata method to reduce memory
  - Under migration. Currently works in rec.
  - All steps can be done in 4GB memory.

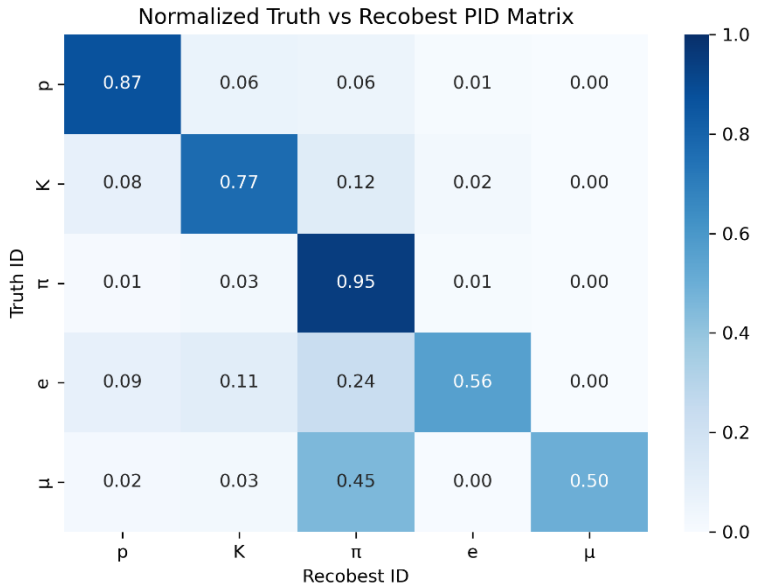
CyberPFA: Ecal Cluster-MCP link under testing. Not in the 25.5.

PID: XGBoost

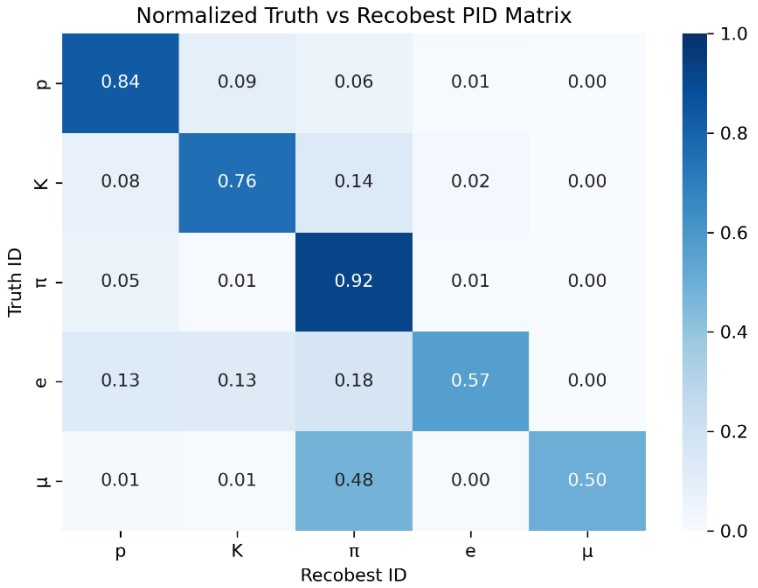
- Updated last weekend, under checking.

```
321 0.9216300139595568 0.9052553721442513 0.8343105212662703
```

I reported in 0506;



Current;



Invisible study

@Geliang

Event selecrtion move from 25.1.2 to 25.3.7,
with XGBoost lepton selection.

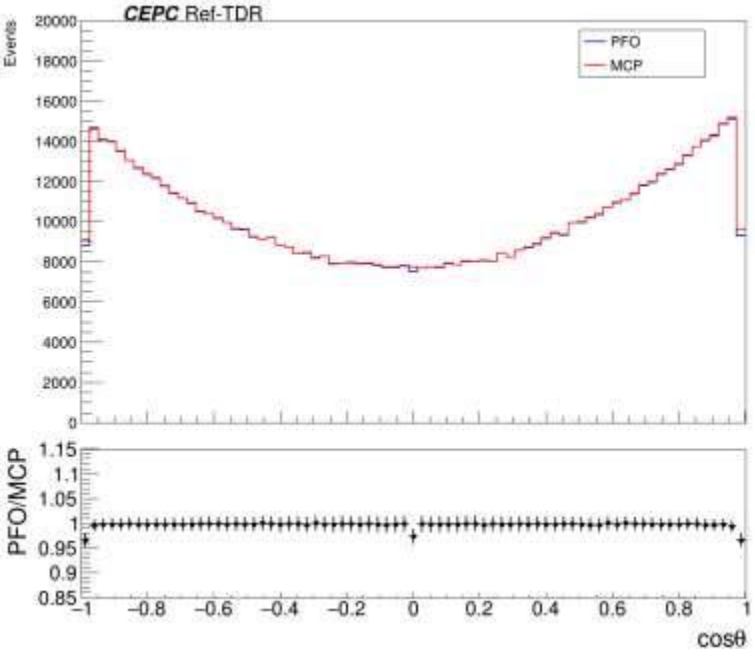
Event selection: qq

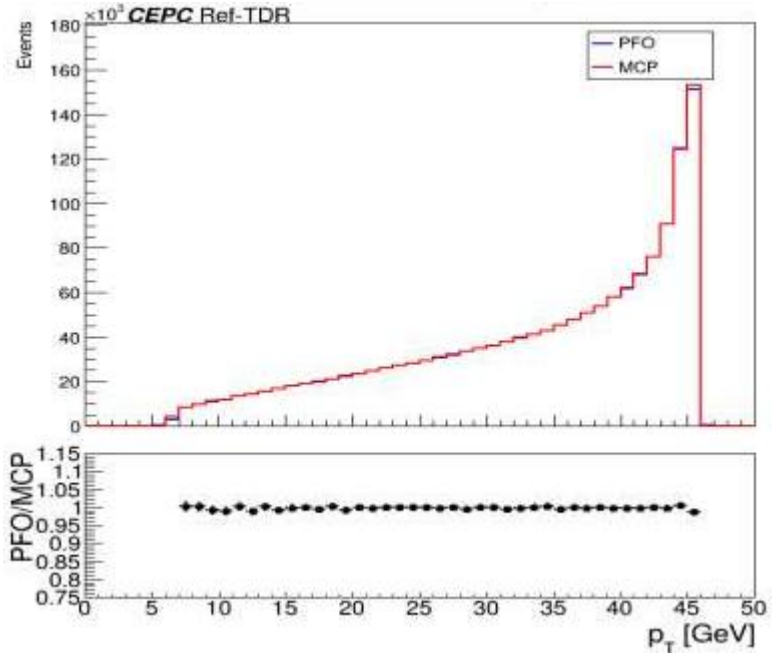
	qqH	sz	sw	szw	zz	ww	zzww	2f	Hincl
Total yield	2736200	32046835	69704759	4989450	22625137	181521998	72958479	1.68E+09	4069166
Base sel eff (%)	100	97.85	99.85	99.534	99.755	99.968	99.822	98.014	99.988
Evis ∈ [90, 117] (%)	87.219	8.793	5.767	15.756	9.296	2.822	2.059	6.141	4.003
Mvis ∈ [85, 102]	71.049	3.14	1.831	4.706	4.515	1.14	0.766	1.97	2.075
Pvis ∈ [30, 58] (%)	64.843	1.138	1.031	2.401	1.136	0.601	0.435	0.802	1.452
Ptvis ∈ [18, 60] (%)	60.767	0.842	0.919	2.017	0.818	0.526	0.371	0.07	1.314
Mmis ∈ [100,150]	60.767	0.842	0.919	2.017	0.818	0.526	0.371	0.07	1.314
Nc>5, Ec>1 GeV	**43.285**	**0.543**	**0.123**	**0**	**0.557**	**0.218**	**0.002**	**0.005**	**0.947**
eff 25.1.2 (%)	**59.460**	**0.754**	**0.184**	**0.000**	**0.800**	**0.332**	**0.028**	**0.009**	**1.351**

Zpole AFB

@Han Shuo

Using XGBoost Best WP.





Discussion of uncertainties

	Cut-based Method	Fitting to CosTheta
Statistical uncertainty (3e-5)	Norm to 1350M muon pairs during 1st year ZH	Same but though fitting CosTheta
Energy Spread (2e-5)	Obtained from AFB vs energy function	Same but though fitting CosTheta
Impact of y* (1e-5)	Obtained from S+B fit on mass	N/A
The acceptance of $\|\cos(\theta)\| >$ 0.05 and other kinematic cuts (7e-6)	Difference between MCP / PFO with same kinematic cuts	$\|\cos(\theta)\| >$ 0.05 is removed now, only need to estimate the $\|\cos(\theta)\|<0.99$ and pT > 1 GeV impact (negligible)
The θ_CM resolution (5e-6)	Difference between PFO and dR<0.05 matched MCP	Same but though fitting CosTheta
Mis-ID & backgrounds (<1e-6)	with / wo mis-ID muons, or with / wo background events	Same but though fitting CosTheta
The reweighting uncertainty	N/A	The non-close of using re-weighting function from another set of sample

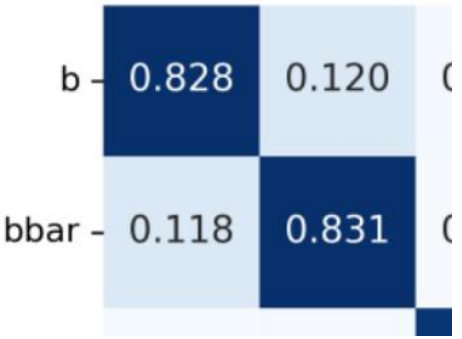
Zpole AFB with btagging

- Mentioned in IDRC's comment
- Fcc'ee result: 2501.17677

The A_{FB}^{b} value for the FCC-ee at the planned integrated luminosity of 150 ab^{-1} at the Z-pole is estimated to be $A_{FB}^{b} = 0.091170 \pm 0.004907\,(syst) \pm 0.00001\,(stat)$ with the lepton-based method and $A_{FB}^{b} = 0.08866 \pm 0.00296\,(\text{syst}) \pm 0.00001\,(\text{stat})$ with the jet charge method.

- 2 methods for jet charge:
  - Lepton in b jet
  - $$Q_{\text{jet}} = \frac{\sum_i q_i p_{L,i}}{\sum_i p_{L,i}},$$

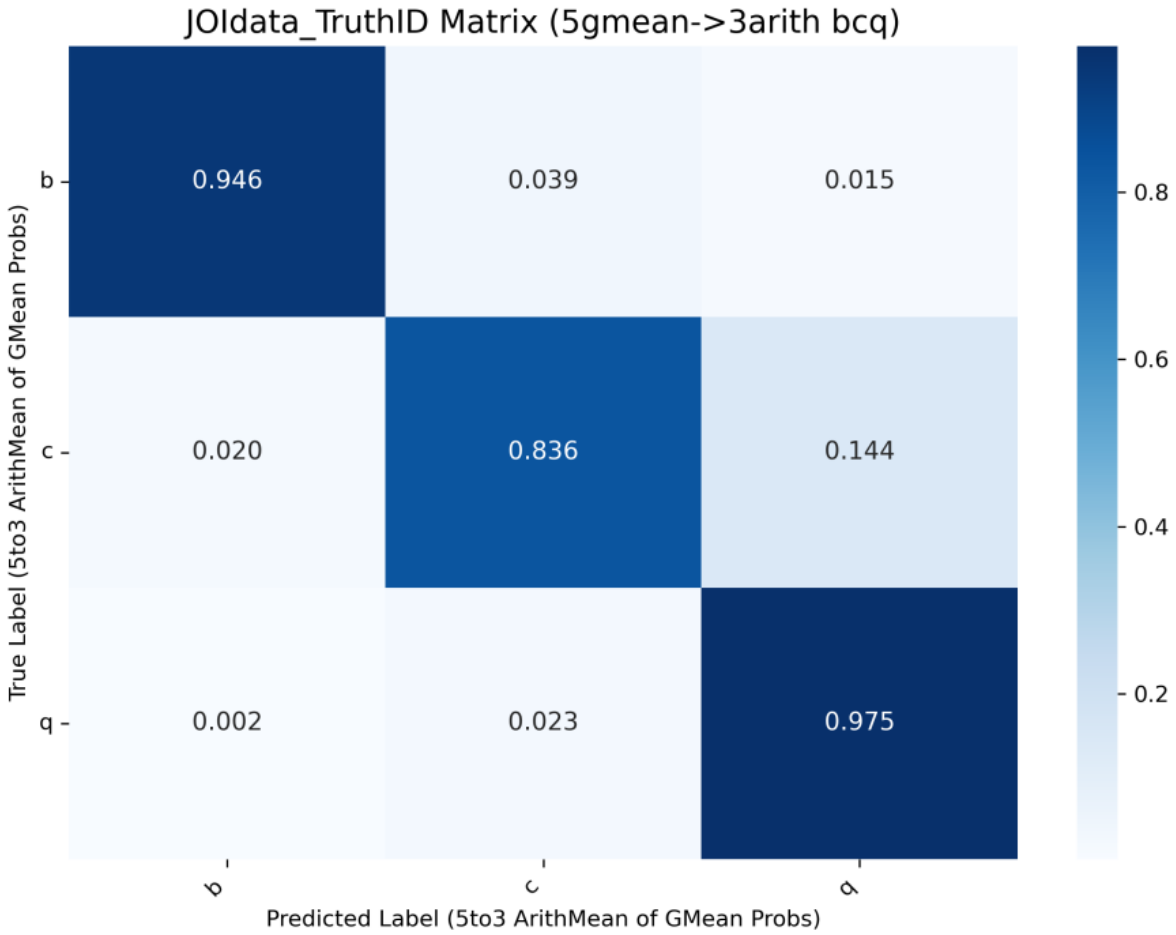
- In CEPC with



- CEPC has larger stats and better method compared to Fcc. Can be at least equal precision.
- But need careful systematic study.

Rb Zpole

@Hancen



- Need careful treatment on jet-event
- B-C-S overlap and WP, combined fit?

Data Type	Total Events	Ave. Rb	Std. Rb (LSM only)
toyMC (Previous)	5e6	22.833	0.865
FullSim (Previous)	5e6	22.808	0.733
toyMC (Now)	5e6	21.9343	9.5e-4
toyMC (Now)	1e10	21.9297	5.2e-5
Ref	-	21.9300	-

Sample Preparation

For 25.3.6 and 25.3.7

	E91.2	E240	E360
2f_full	√	√	√
2f_slimmed			
4f		√	√
Higgs		√	√

Table 1.4: Cross sections of the Higgs boson production and other SM processes at $\sqrt{s} = 240$ GeV and numbers of events expected in 20 ab^{-1}. Note that there are interference between the same final states from different processes after the W or Z boson decays, see text. With the exception of the Bhabha process, the cross sections are calculated using the Whizard [8]. The Bhabha cross section is calculated using the BABAYAGA event generator [10] requiring final-state particles to have $|\cos\theta| < 0.99$. Photons, if any, are required to have $E_\gamma > 0.1$ GeV and $|\cos\theta_{e^\pm\gamma}| < 0.99$. ISR and FSR effects are included in all the final states.

process	cross section	expect numbers of events in 20 ab^{-1}
Higgs boson production, cross section in fb		
$e^+e^- \to ZH$	196.9	4×10^6
$e^+e^- \to \nu_e\bar{\nu}_e H$	6.2	1.3×10^5
$e^+e^- \to e^+e^- H$	0.5	1×10^4
total	203.6	4.1×10^6
background processes, cross section in pb		
$e^+e^- \to e^+e^-(\gamma)$(Bhabha)	930	1.9×10^{10}
$e^+e^- \to q\bar{q}(\gamma)$	54.1	1.1×10^9
$e^+e^- \to \mu^+\mu^-(\gamma)$	5.30	1.1×10^8
$e^+e^- \to \tau^+\tau^-(\gamma)$	4.75	9.5×10^7
$e^+e^- \to WW$	16.7	3.3×10^8
$e^+e^- \to ZZ$	1.1	2.2×10^7
$e^+e^- \to e^+e^- Z$	4.54	9.0×10^7
$e^+e^- \to e^+\nu W^-/e^-\bar{\nu}W^+$	5.09	1.1×10^7

We have completed the whole chain of main process studied in CEPC, in full simulation.
For those channels still lacking stats, gen filter method applied.
6fermion process in E360 proved to be negligible.

Current sample list: https://docs.ihep.ac.cn/link/AA7C0D8C58B13644FCA8F5C6E757B63657
Sample name convention: https://docs.ihep.ac.cn/link/AA7C7823456F0446FBACFBCF1014B71F1B
Tutorial link:
https://code.ihep.ac.cn/zhangkl/cepcsw_tutorial by Kaili
https://code.ihep.ac.cn/glliu/CEPC_PhyPerf_Intro by Geliang

JOI in E240: 4j case

- Tested in zz_h0dtdt, zz_h0utut. (dddd or uuuu quarks)
  - In original ee-kt clustering, metric 0.42 with b-tagging eff 0.7.
  - Hard to match quark jet flavor with reco jet. Boosted jet, deviated jet…
  - If constrain only matched reco jet in training, back to 0.55.
  - Issue in Reco jet clustering, but not in JOI. (same like JER?) under tuning.