CEPC

Samples, Jets, and summary for Wednesday working meeting

Kaili Zhang

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Sample list

For cross section, refer to: cepc_sample_note_latest.pdf, https://docs.ihep.ac.cn/link/AA749814584F654E8FBAADA4D766223B1F

ECM		Z process	H process	Path	CEPCSW Release	EvtNumber	Sim+Digi+Trk	Rec	Status
240		mm	bb	/cefs/higgs/zhangkl/Production/25035/E240_mmHbb	25.3.5	500k	D	D	D
240		mm	cc	/cefs/higgs/zhangkl/Production/25035/E240_mmHcc	25.3.5	500k	D	D	D
240		mm	tautau	/cefs/higgs/zhangkl/Production/25035/E240_mmHe3e3	25.3.5	500k	D	D	D
240		mm	ww(fullhad)	/cefs/higgs/zhangkl/Production/25035/E240_mmHww	25.3.5	500k	D	D	D
240		mm	zz(fullhad)	/cefs/higgs/zhangkl/Production/25035/E240_mmHzz	25.3.5	500k	D	D	D
240		mm	gg	/cefs/higgs/zhangkl/Production/25035/E240_mmHgg	25.3.5	500k	D	D	D
240		mm	ss	/cefs/higgs/zhangkl/Production/25035/E240_mmHss	25.3.6	500k			
91.2		bb		/cefs/higgs/zhangkl/Production/25035/E91.2_eebb	25.3.6	100k	D		
91.2		cc		/cefs/higgs/zhangkl/Production/25035/E91.2_eecc	25.3.6	100k	D		
91.2		dd		/cefs/higgs/zhangkl/Production/25035/E91.2_eedd	25.3.6	100k	D		
91.2		uu		/cefs/higgs/zhangkl/Production/25035/E91.2_eeuu	25.3.6	100k	D		
91.2		ss		/cefs/higgs/zhangkl/Production/25036/E91.2_eess	25.3.6	100k	D		
240		ee	inclusive	/cefs/higgs/zhangkl/Production/25036/E240_eeHX	25.3.6	1M	D	D	
240		mm	inclusive	/cefs/higgs/zhangkl/Production/25036/E240_mmHX	25.3.6	1M	D	D	
240		qq	inclusive	/cefs/higgs/zhangkl/Production/25036/E240_qqHX	25.3.6	3M	D	D	
240		vv	inclusive	/cefs/higgs/zhangkl/Production/25036/E240_vvHX	25.3.6	1M	D	D	
240		tautau	inclusive	/cefs/higgs/zhangkl/Production/25036/E240_tautauHX	25.3.6	1M	D	D	
240	4f	each 200k;		/cefs/higgs/zhangkl/Production/25036/4fermions	25.3.6				
240	2f	ee		/cefs/higgs/zhangkl/Production/25036/E240_e1e1	25.3.6	100k	D		
		mm		/cefs/higgs/zhangkl/Production/25036/E240_e2e2	25.3.6	100k	D		
		tautau		/cefs/higgs/zhangkl/Production/25036/E240_e3e3	25.3.6	100k	D		
		qq		/cefs/higgs/zhangkl/Production/25036/E240_qq	25.3.6	500k	D		
341	ttbar	semi-lep			25.3.6	100k			
342.75	ttbar	semi-lep			25.3.6	600k			
344	ttbar	semi-lep			25.3.6	200k			
346	ttbar	semi-lep			25.3.6	100k			
91.2		bb		/cefs/higgs/zhangkl/Production/25036/E91.2_eebb	25.3.6	2M	D	D	
91.2		dd		/cefs/higgs/zhangkl/Production/25036/E91.2_eedd	25.3.6	2M	D	D	
91.2		uu		/cefs/higgs/zhangkl/Production/25036/E91.2_eeuu	25.3.6	2M	D	D	
240	smuon								
80		ee->bb(withoutISR)		/cefs/higgs/zhangkl/Production/25036/E80_eebb_woisr	25.3.6	100k	D	D	
120		ee->bb(withoutISR)		/cefs/higgs/zhangkl/Production/25036/E120_eebb_woisr	25.3.6	100k	D	D	
160		ee->bb(withoutISR)		/cefs/higgs/zhangkl/Production/25036/E160_eebb_woisr	25.3.6	100k	D	D	
200		ee->bb(withoutISR)		/cefs/higgs/zhangkl/Production/25036/E200_eebb_woisr	25.3.6	100k	D	D	
240		ee->bb(withoutISR)		/cefs/higgs/zhangkl/Production/25036/E240_eebb_woisr	25.3.6	500k	D	D	
240	H124.8	mm	inclusive			15k	D		
	H124.95	mm	inclusive			15k	D		
	H125.05	mm	inclusive			15k	D		

Several samples listed are not reco yet(no “D” in rec), please wait.

https://docs.ihep.ac.cn/link/AR7D1FA68DEEB54F6782D63CF312B747C1

Higgs Group Jobs Status

- With max speed, I generated ~30M full simulation sample last week.
- But only ~10M for reconstruction, due to high memory requirement and high hold rate.

```
INFO: Setup CEPCSW externals (os: el9, lcg: 105.0.0): /cvmfs/cepcsw.ihep.ac.cn/prototype/releases/externals/105.0.0/setup-105.0.0-el9.sh
INFO: Setup CEPCSW: /cefs/higgs/zhangkl/CEPCSW/InstallArea/x86_64-el9-gcc11-opt
        Command being timed: "./run.sh /cefs/higgs/zhangkl/Production/25036/4fermions/E240_4f_ww_h0cuxx/job/sim_00001.py"
        User time (seconds): 5817.10
        System time (seconds): 22.37
        Percent of CPU this job got: 98%
        Elapsed (wall clock) time (h:mm:ss or m:ss): 1:38:46
        Average shared text size (kbytes): 0
        Average unshared data size (kbytes): 0
        Average stack size (kbytes): 0
        Average total size (kbytes): 0
        Maximum resident set size (kbytes): 4044456
        Average resident set size (kbytes): 0
        Major (requiring I/O) page faults: 5724
        Minor (reclaiming a frame) page faults: 1176580
        Voluntary context switches: 27550
        Involuntary context switches: 36524
        Swaps: 0
        File system inputs: 577768
        File system outputs: 8741768
        Socket messages sent: 0
        Socket messages received: 0
        Signals delivered: 0
        Page size (bytes): 4096
        Exit status: 0
        Command being timed: "./run.sh /cefs/higgs/zhangkl/Production/25036/4fermions/E240_4f_ww_h0cuxx/job/dig_00001.py"
        User time (seconds): 3111.58
        System time (seconds): 21.16
        Percent of CPU this job got: 95%
        Elapsed (wall clock) time (h:mm:ss or m:ss): 54:42.98
        Average shared text size (kbytes): 0
        Average unshared data size (kbytes): 0
        Average stack size (kbytes): 0
        Average total size (kbytes): 0
        Maximum resident set size (kbytes): 3972848
        Average resident set size (kbytes): 0
        Major (requiring I/O) page faults: 1
        Minor (reclaiming a frame) page faults: 1049617
```

For high amount sample requirement:

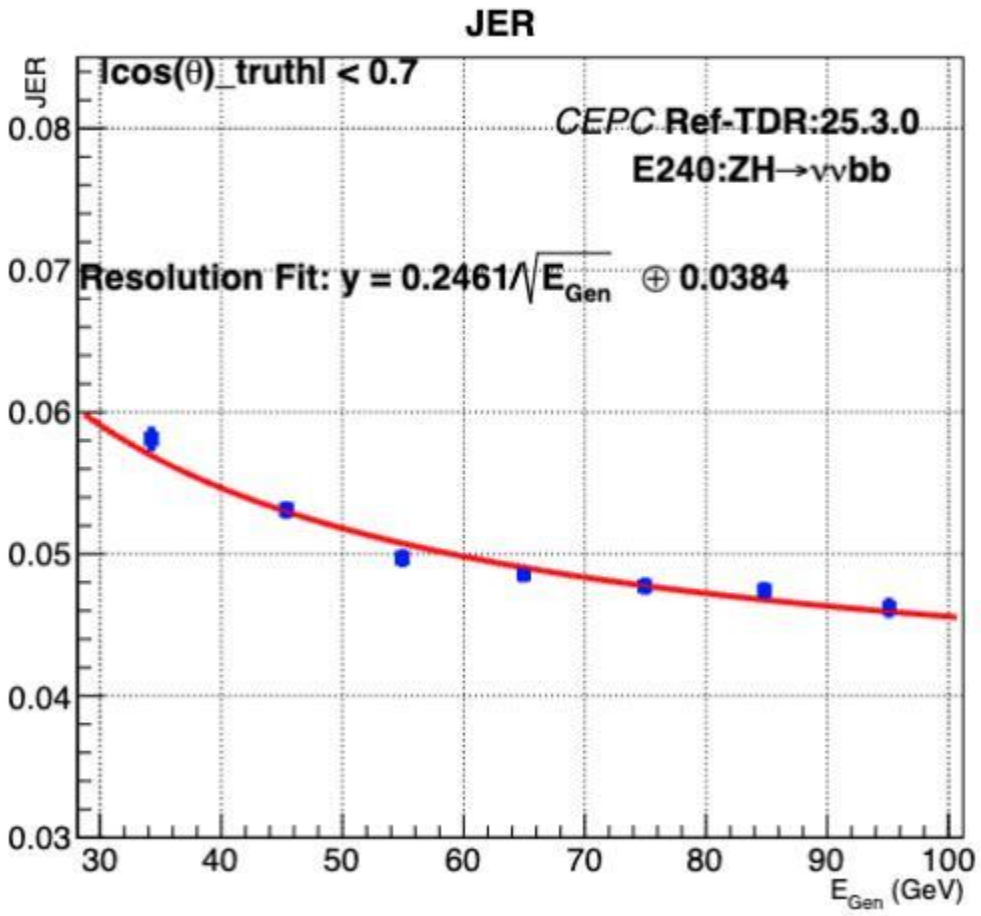
- CEPCSW Full simu can not handle them. 2 Options:
- Fast simulation: Delphes https://code.ihep.ac.cn/zhangkl/delphes_cepc
  - Jet, photon performance slightly different with full sim and different structure.
- Gen Filter @Wanghan

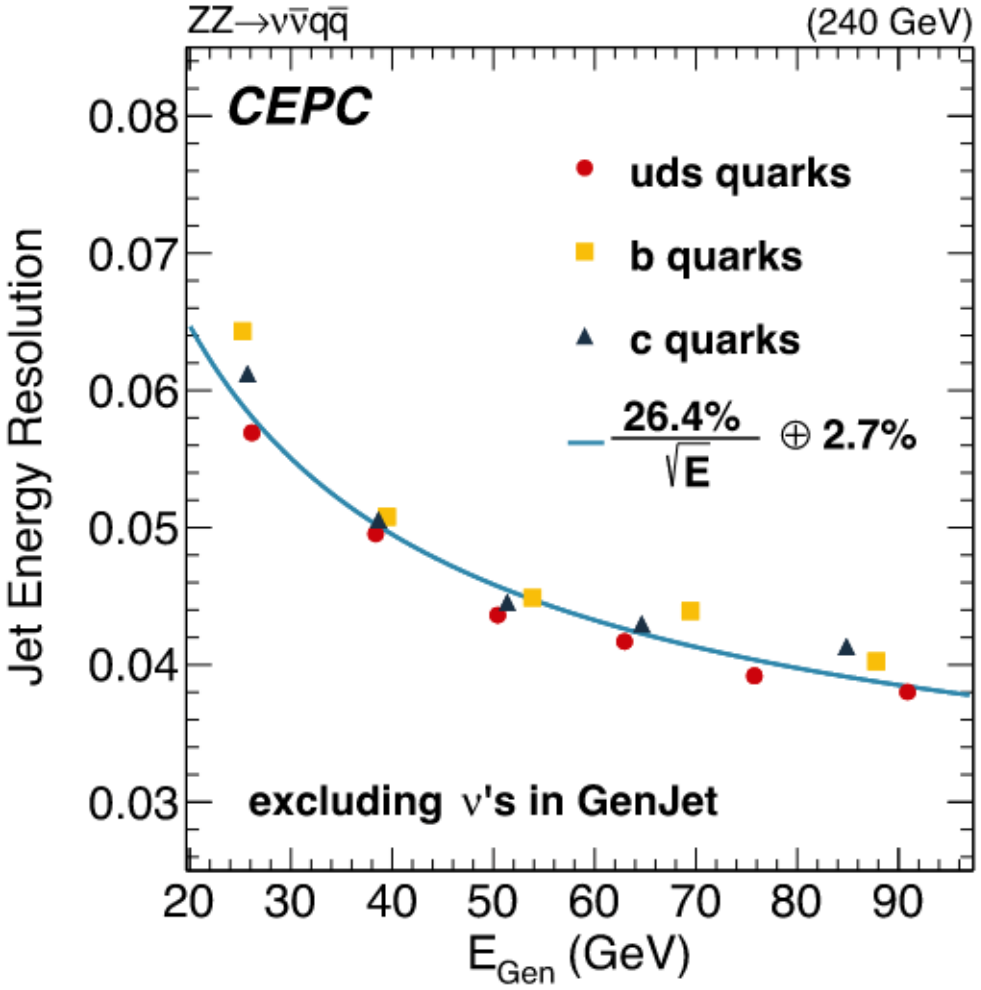
  One tutorial this Wednesday.
  - /cefs/higgs/wanghan/Modify_stdhep
  - Selection on Stdhep(Current only) then store in another stdhep.

JER

Fix one jet matching bug in code.

@Yingqi

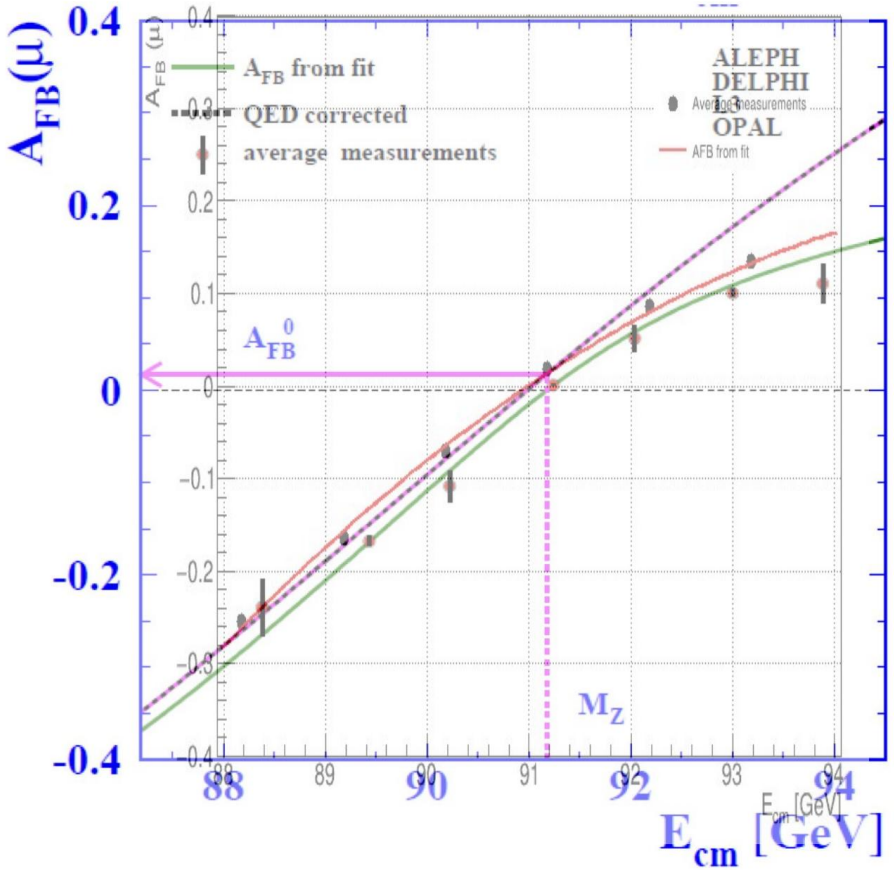




A_{FB} : Assemetry $Z \to \mu\mu$

- Whizard configuration determine A_{FB} in sample
  - Now use A_{FB} = 0.016±0.001
  - Need further correction.
  - Lab frame correction 0.3%
  - Energy spread uncertainty ~ 2e-5 by comparing

  with/wo energy spread



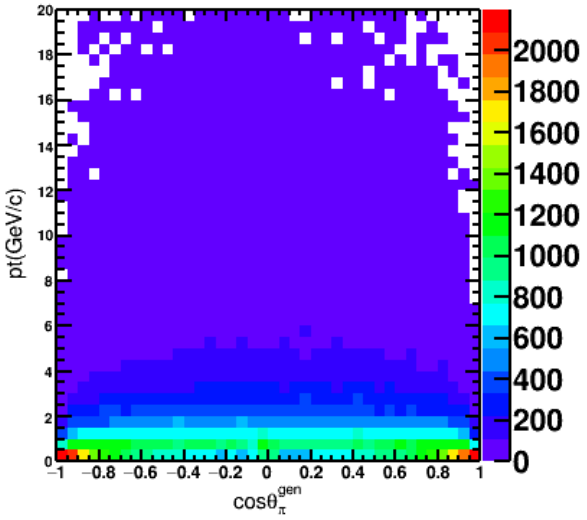
PID

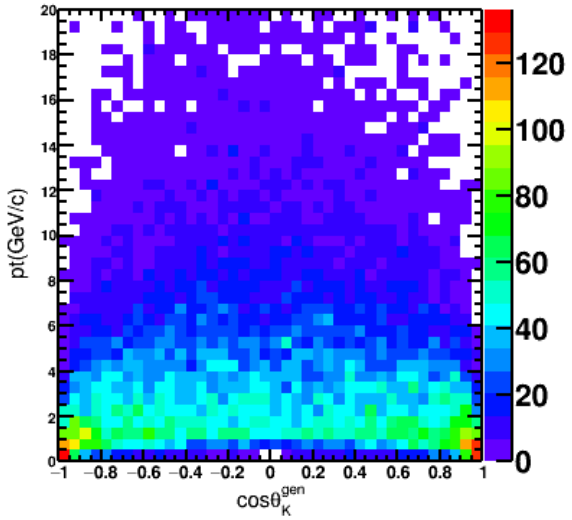
@Haoyue Xu, Kaili Zhang

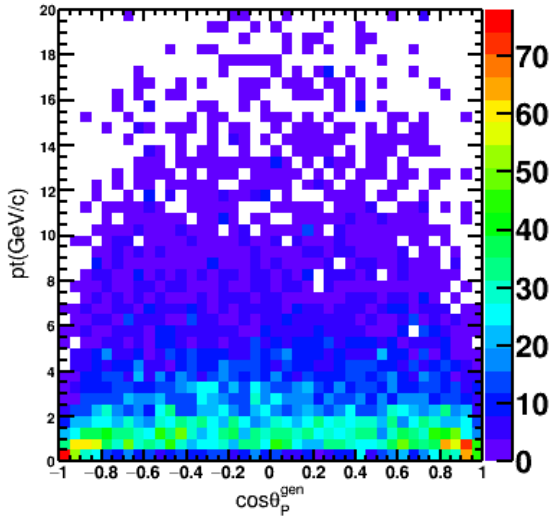
Truth match method using `CompleteTracksParticleAssociation`
Ensure each tracks match with one MCParticle. (Calo match not available yet)
Validate with old DR/DE, consistent.

- Using Geliang's package
- Now e, mu, k, pi, p pid information stored for JOI.
  - Using Algo @20th in Z->vv H->bb sample
  - Pion->Muon migration rate 18%. Reco muon purity < 20%.
  - Do not use reco e/mu in JOI. Need further developing for lepton ID.

PID in Jet

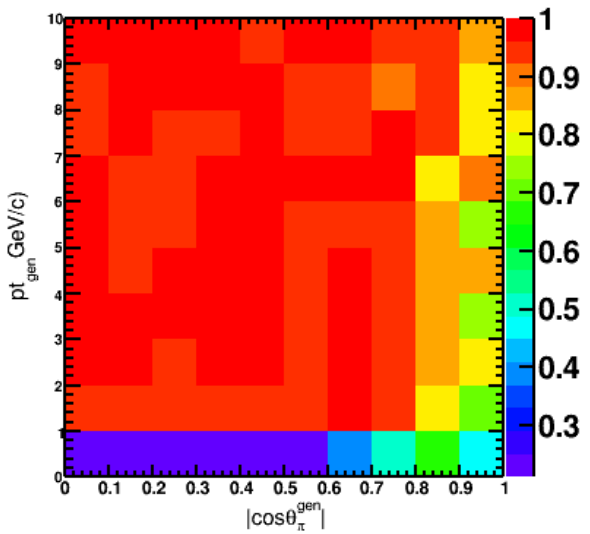


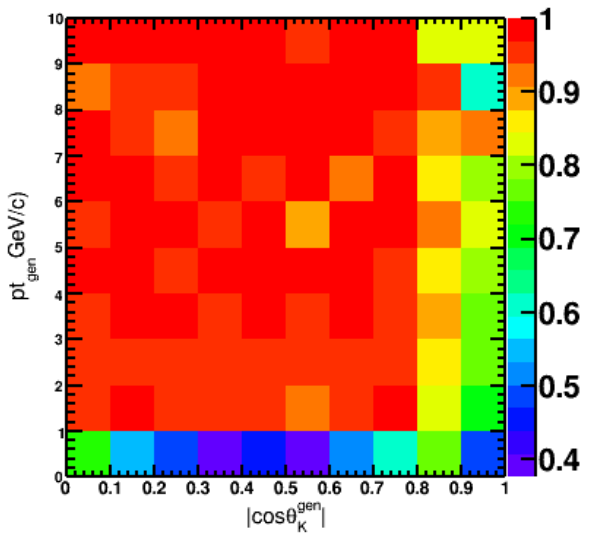


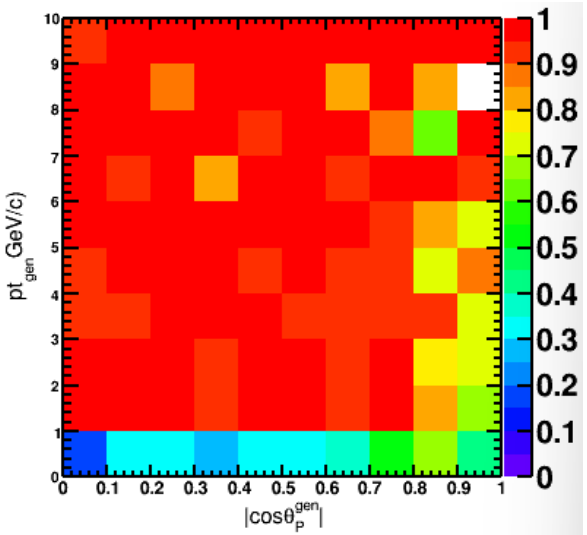


Phase space;

Track efficacy;
(With TOF&&TPC)



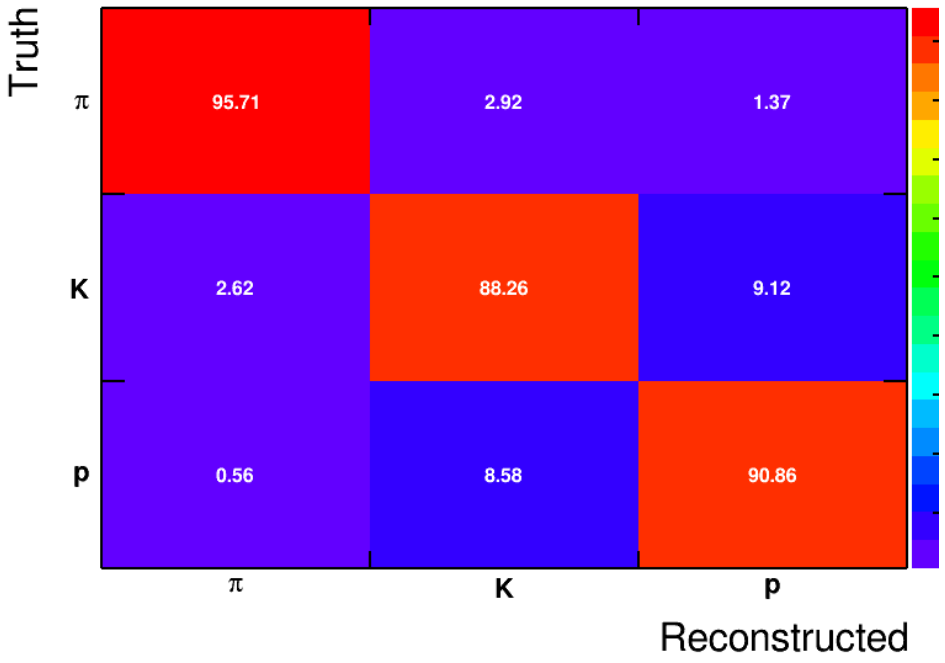




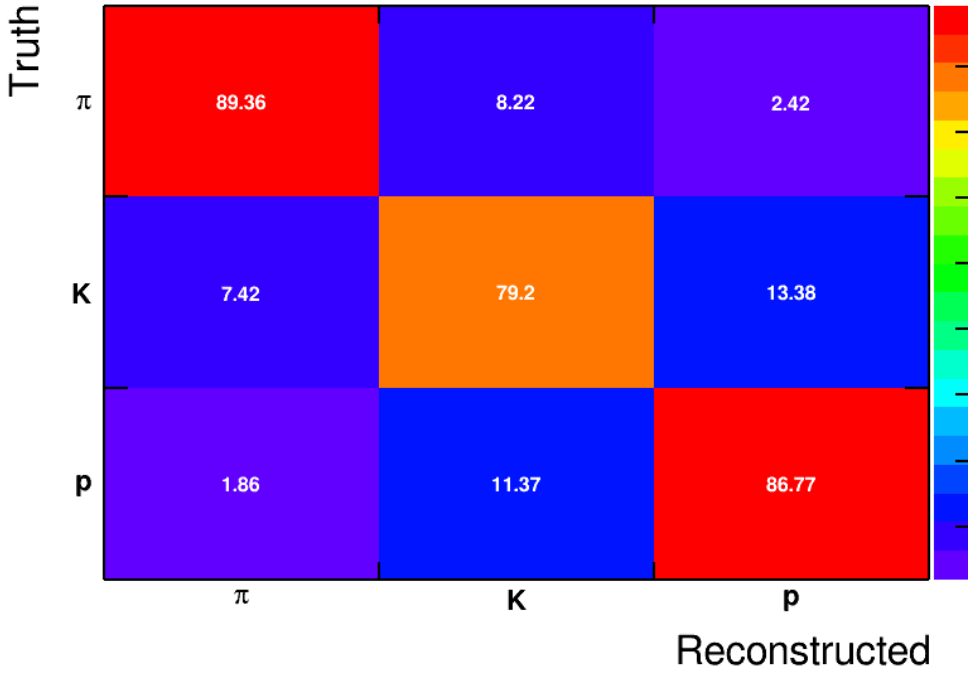
PID in Jet

	π	K	p
eff(pt>1GeV and |cosθ|<0.85)	95.7%	88.3%	90.9%
$purity$(pt>1GeV and |cosθ|<0.85)	99.2%	86.2%	69.4%
eff(pt>1GeV and 0.99>|$cos\theta$|>0.85)	89.4%	79.2%	86.8%
$purity$(pt>1GeV and 0.99>|$cos\theta$|>0.85)	96.8%	75.7%	57.5%

Barrel



Endcap



backups

PID in Jets

Tdr25.3.6; ZH->vvbb; stats: 100w events, 200w b jets.

@Haoyue Xu, Kaili Zhang

Tracks per jet						
Endcap:	e	mu	pi	k	p	Tot
Init	0.05	0.03	1.46	0.21	0.07	1.81
Tpc	0.03	0.02	0.83	0.14	0.05	1.07
Tof	0.02	0.02	0.58	0.11	0.03	0.76
Pt>1	0.01	0.02	0.34	0.09	0.02	0.49
Barrel:	e	mu	pi	k	p	Tot
Init:	0.33	0.19	9.83	1.33	0.42	12.10
Tpc	0.23	0.18	8.26	1.21	0.40	10.29
Tof	0.18	0.17	5.65	0.97	0.33	7.31
Pt>1	0.17	0.16	4.96	0.93	0.31	6.53

In average, for one b jet, initially it has 14 tracks: 11.19 Pion, 1.5 Kaon, 0.49 Proton. 0.38 electron and 0.22 muon.
For those 7 “good” tracks, it has 5.30 Pion, 0.96 Kaon, 0.33Proton, 0.18 electron and 0.18 muon.

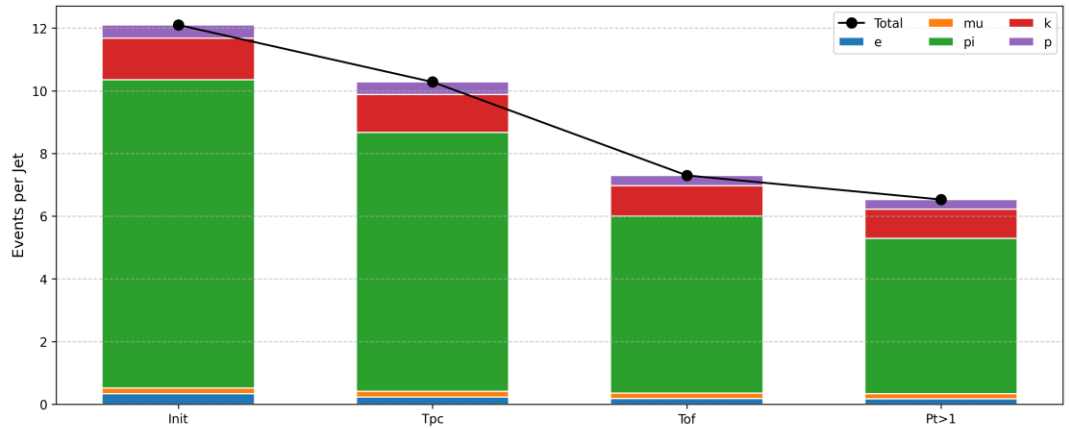
Charged track ratio

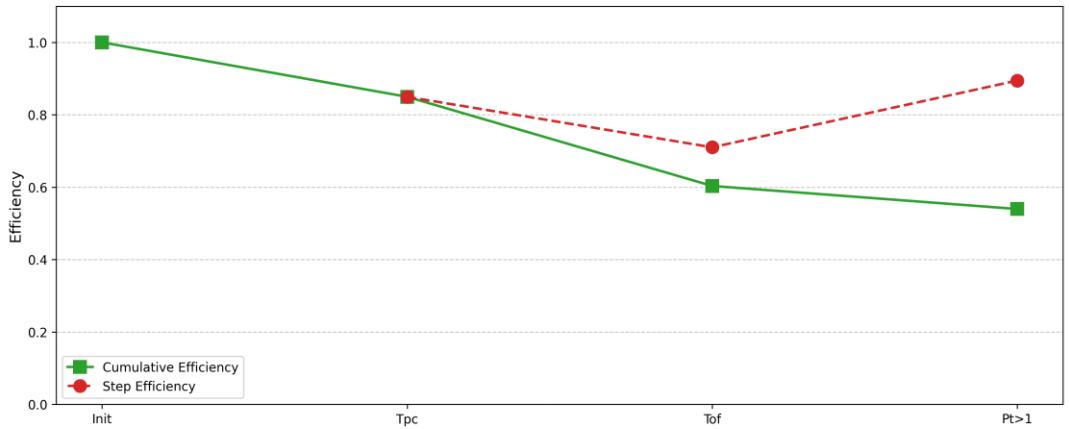
per jet						
Endcap:	e	mu	pi	k	p	Tot
Init	2.49%	1.70%	80.73%	11.50%	3.58%	100%
Tpc	2.41%	2.23%	77.40%	13.45%	4.51%	100%
Tof	2.39%	2.73%	76.27%	14.07%	4.54%	100%
Pt>1	3.07%	3.63%	70.46%	17.71%	5.13%	100%
Barrel:	e	mu	pi	k	p	Tot
Init:	2.72%	1.59%	81.23%	10.96%	3.50%	100%
Tpc	2.26%	1.79%	80.29%	11.76%	3.90%	100%
Tof	2.47%	2.30%	77.37%	13.29%	4.57%	100%
Pt>1	2.63%	2.48%	75.91%	14.21%	4.77%	100%

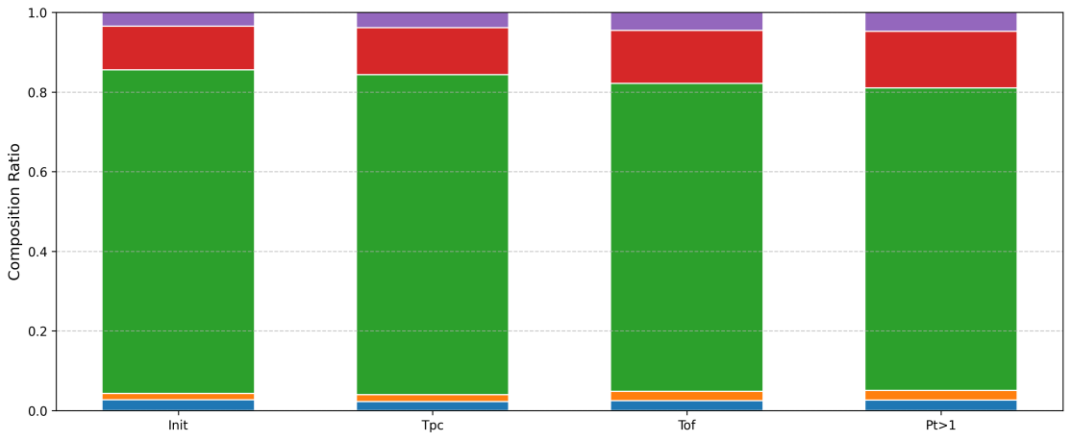
Charged track eff

per jet						
Endcap:	e	mu	pi	k	p	Tot
Init	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Tpc	57.12%	77.79%	56.73%	69.24%	74.49%	59.17%
Tof	40.17%	67.42%	39.56%	51.26%	52.99%	41.88%
Pt>1	32.95%	57.28%	23.35%	41.20%	38.26%	26.75%
Barrel:	e	mu	pi	k	p	
Init:	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Tpc	70.59%	95.91%	84.00%	91.19%	94.73%	84.99%
Tof	54.66%	87.60%	57.52%	73.24%	78.93%	60.39%
Pt>1	52.10%	84.28%	50.41%	69.94%	73.67%	53.95%

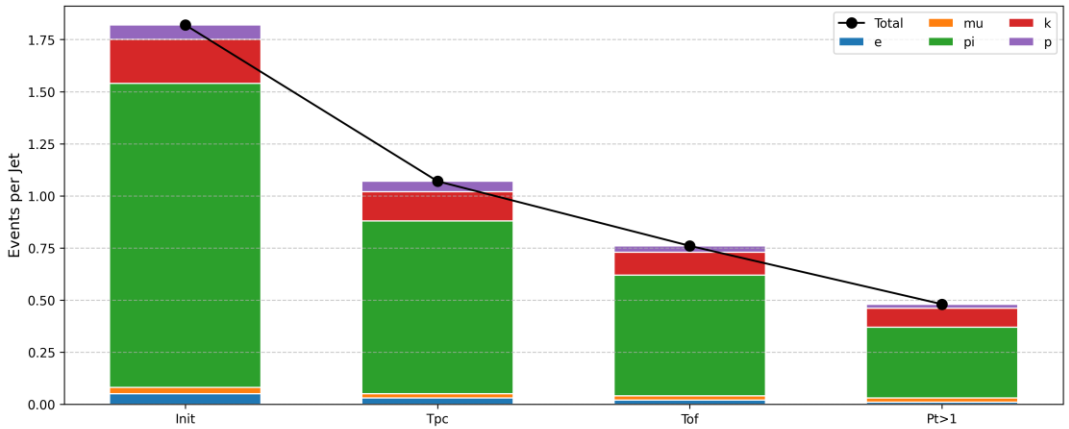
Particle Analysis - Barrel

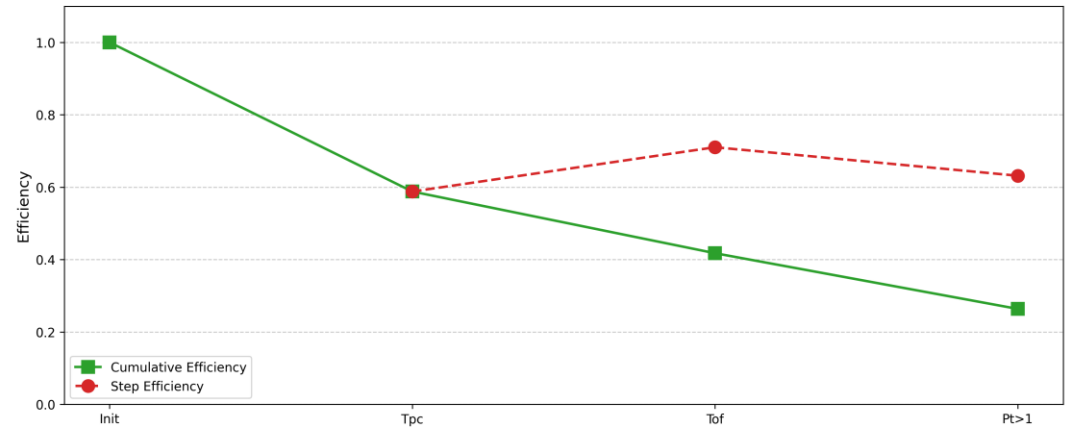


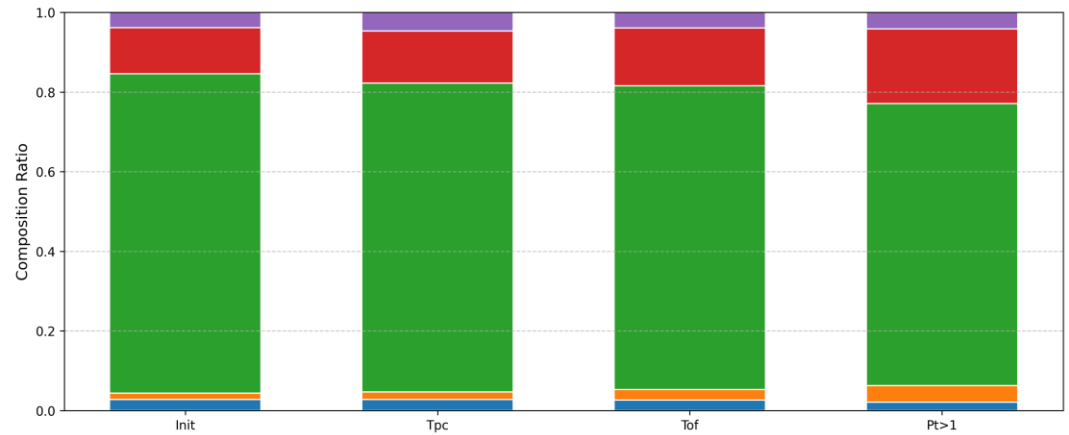




Particle Analysis - Endcap



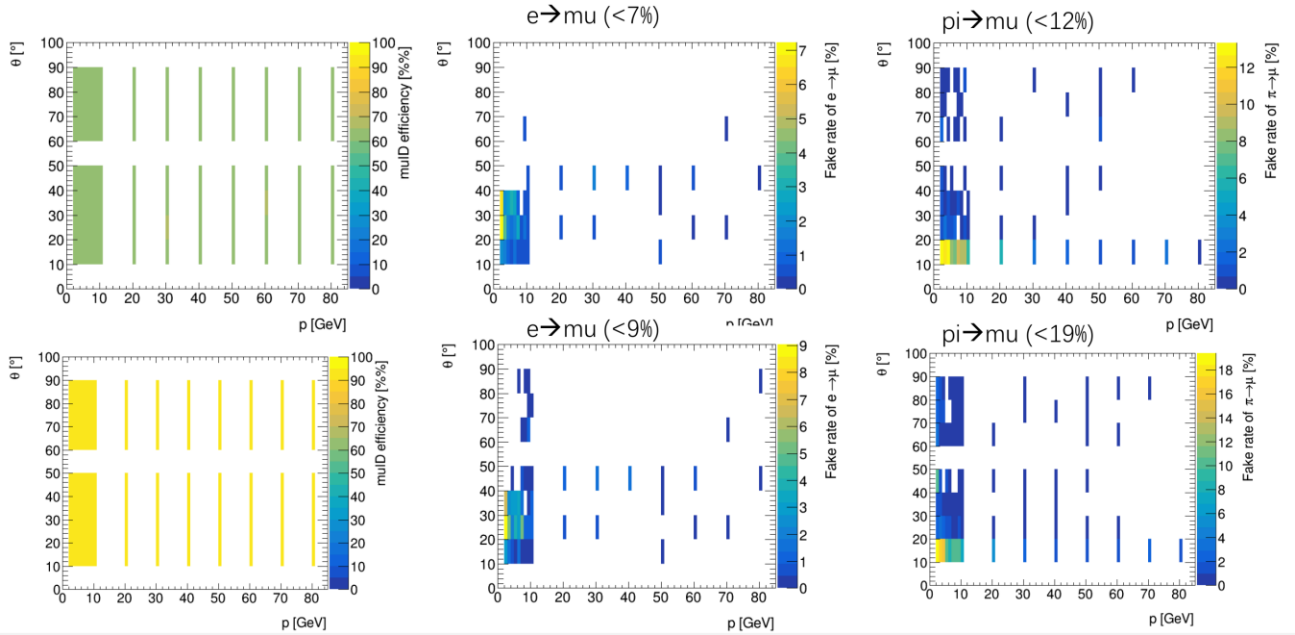




Roughly: lepton PID in jet

@Xia Ligang, Last Friday;

muID: 60%WP (top) and 90% WP (bottom)



In jet, charged tracks P ~<10GeV.

From charged track ratio, for one good track in jet,

N_Pion: N_Muon: 30:1. (2.48%:75.91%. For raw track, 50:1)

Pion to muon mistarget ratio, assuming 10%

Reco PID Pio purity < 1/(30*10%+1) = 25%

One good to use lepton ID require purity > 90% -> Mistarget ratio <1%.

purity > 99% -> Mistarget ratio <0.1%.

@Geliang, Muon chamber information also inefficient in low pt region.

Difficult to tag lepton in jet.

Lepton yield in jet; Impact?