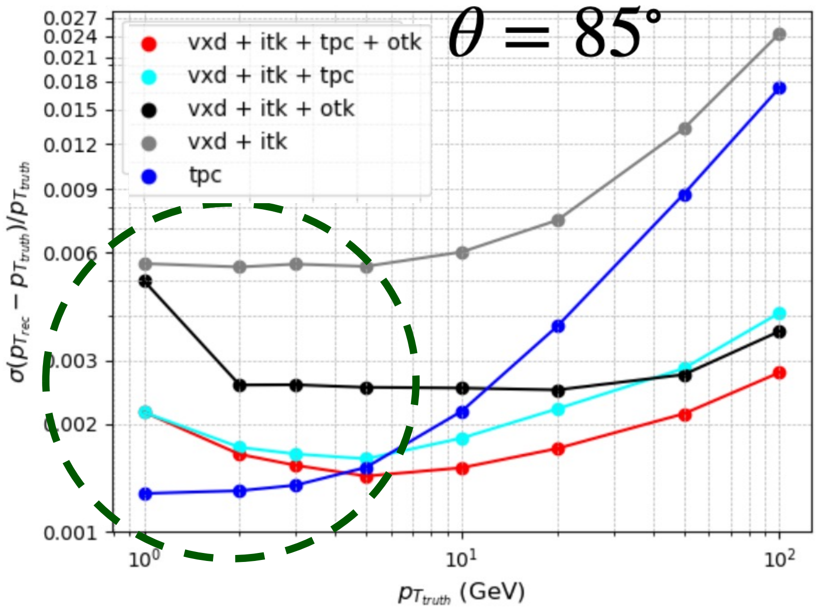
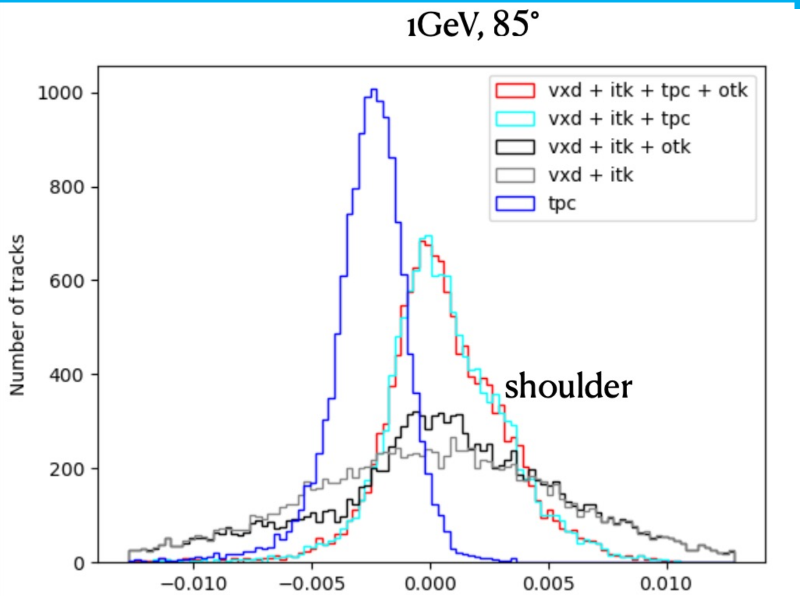
Tracking Performance

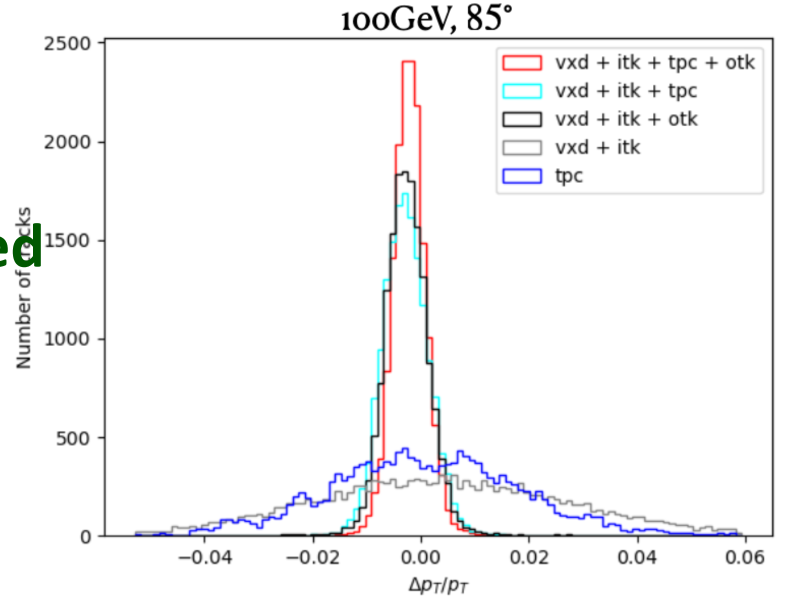
Chenguang Zhang
Chengdong Fu

- Full simulation



Tracking at low pT to be improved





- Current standalone TPC tracking resolution better than combined options at low pT region
  - could be due to different configurations of materials at simulation and reconstruction
- Investigation ongoing
  - e.g. checking also ϕ direction

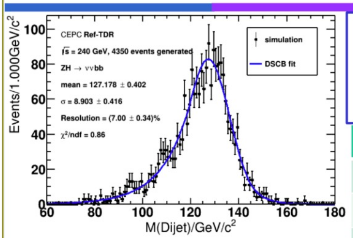
Jet Performance

Xiaotian Ma
Kaili Zhang
Chenguang Zhang
Yingqi Hou

Currently no vertex fit for b jet.
Chenguang working on it.
Use vertex information will help to b jet shape.

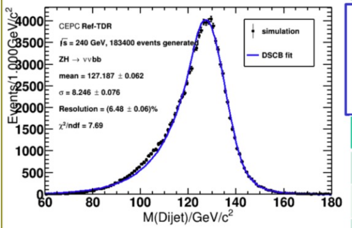
This improvement mainlu from

Performance study -- BMR



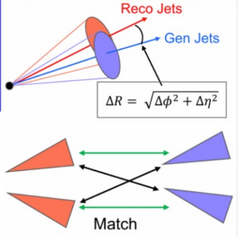
$ZH \to \nu\nu bb$
CEPCSW_tdr24.9.1
$m_H = 127.178 \pm 0.402$
Resolution $(7.00 \pm 0.34)\%$

Efficiency cutflow	
$\lvert\cos\theta_{jet}\rvert < 0.7$	0.516
Match&$\Delta R < 0.6$	0.499
Fit region	0.498



$ZH \to \nu\nu bb$
CEPCSW_tdr24.10.0
$m_H = 127.187 \pm 0.062$
Resolution $(6.48 \pm 0.06)\%$

Efficiency cutflow	
$\lvert\cos\theta_{jet}\rvert < 0.7$	0.577
Match&$\Delta R < 0.6$	0.564
Fit region	0.563



From Zebing

2024/11/20 maxt@ihep.ac.cn 3

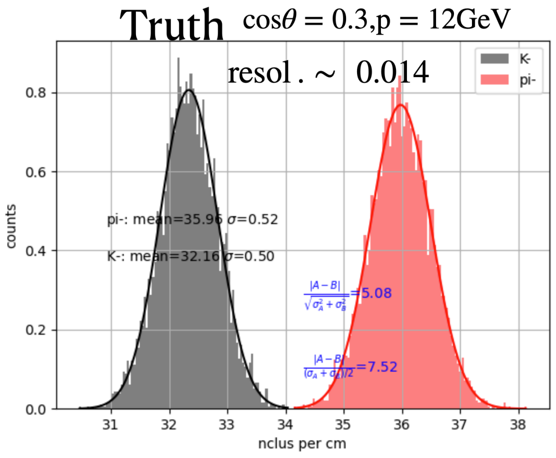
❖ Comparisons between tdr24.9.1 and tdr24.10.0 $\lvert\cos\theta_{jet}\rvert < 0.7$&Match&$\Delta R < 0.6$

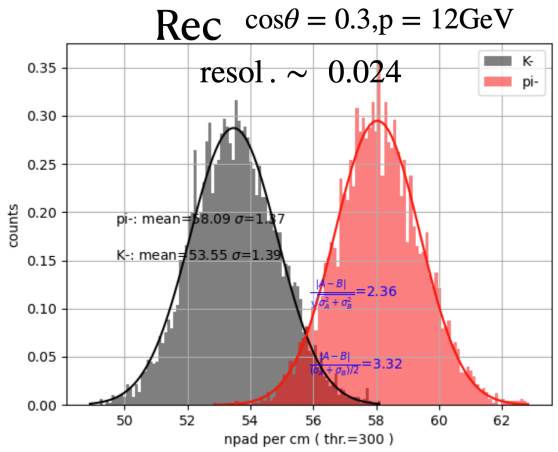
Release	process	$ZH \to \nu\nu gg$	$ZH \to \nu\nu bb$	$ZH \to \nu\nu cc$	$ZH \to \nu\nu uu$	$ZH \to \nu\nu dd$	$ZH \to \nu\nu ss$
CEPCSW _tdr24.9.1	BMR	$(5.28 \pm 0.19)\%$	$(7.00 \pm 0.34)\%$	$(6.32 \pm 0.20)\%$	$(5.39 \pm 0.16)\%$	$(4.93 \pm 0.18)\%$	$(5.45 \pm 0.22)\%$
	Efficiency	0.50	0.50	0.52	0.54	0.51	0.52
CEPCSW _tdr24.10.0	BMR	$(4.98 \pm 0.03)\%$	$(6.48 \pm 0.06)\%$	$(5.64 \pm 0.03)\%$	$(4.85 \pm 0.02)\%$	$(4.94 \pm 0.04)\%$	$(5.56 \pm 0.02)\%$
	Efficiency	0.57	0.56	0.57	0.57	0.57	0.56

Fangyi Guo, Yang Zhang, et. al.

- BMR ~ 5% in current CEPCSW release for barrel region
  - latest CyberPFA will deliver ~3.8% resolution, to be integrated into next release
  - endcap Ecal also planned for next release, but the memory explosion issue still to be fixed
- Work ongoing for vertex, single jet performance (differential)

PID performance





- $\frac{\sigma_{Rec}/\mu_{Rec}}{\sigma_{Truth}/\mu_{Truth}} - 1 \sim 0.7$

	TDR Truth (Garfield, dNdx)	
	Pi	**K**
mean	36.0	32.2
sigma	0.52	0.50
sigma/mean	0.014	0.015
separation	~ 5 sigma	
	TDR Rec (Garfield, dNdx)	
	Pi	K
mean	58.1	53.6
sigam	1.37	1.39
sigma/mean	0.024	0.025
separation	~ 2.3 sigma	

Guang Zhao, Linhui Wu, Jinxian Zhang, Chenguang Zhang, Xiaotian Ma, Ligang Xia, et. al.

- Reco Performance of TPC dN/dX degraded too much compared to truth level
  - 5.0 σ -> 2.3 σ for 12 GeV k/π separation
  - various sources understood
  - work ongoing to improve the reconstruction algorithm
- PID algorithms being developed (TPC+TOF for charge hadrons ID, calorimeters lepton ID, etc.), to be integrated into PFO

Chapter content

Backup

Comments/Recommendations on Performance

- The planned list of channels looks a bit too high for a few months of work, better to focus on demonstrating that the reference detector reaches adequate performance for physics
  - **Select fewer channels, aimed at demonstrating that the reference detector reaches adequate performance for physics. Include some simple topology (e.g. Z→mumu). Encompass H, Z, W and top physics.**
  - **Foresee in the TDR results and figures about performance on basic objects (leptons, photons, jets) as a function of energy and polar angle**
  - A measurement of V_cs during the WW run is probably a more relevant benchmark than V_cb ;
  - The channel to be used for the electroweak mixing angle measurement should be clarified

Plans:

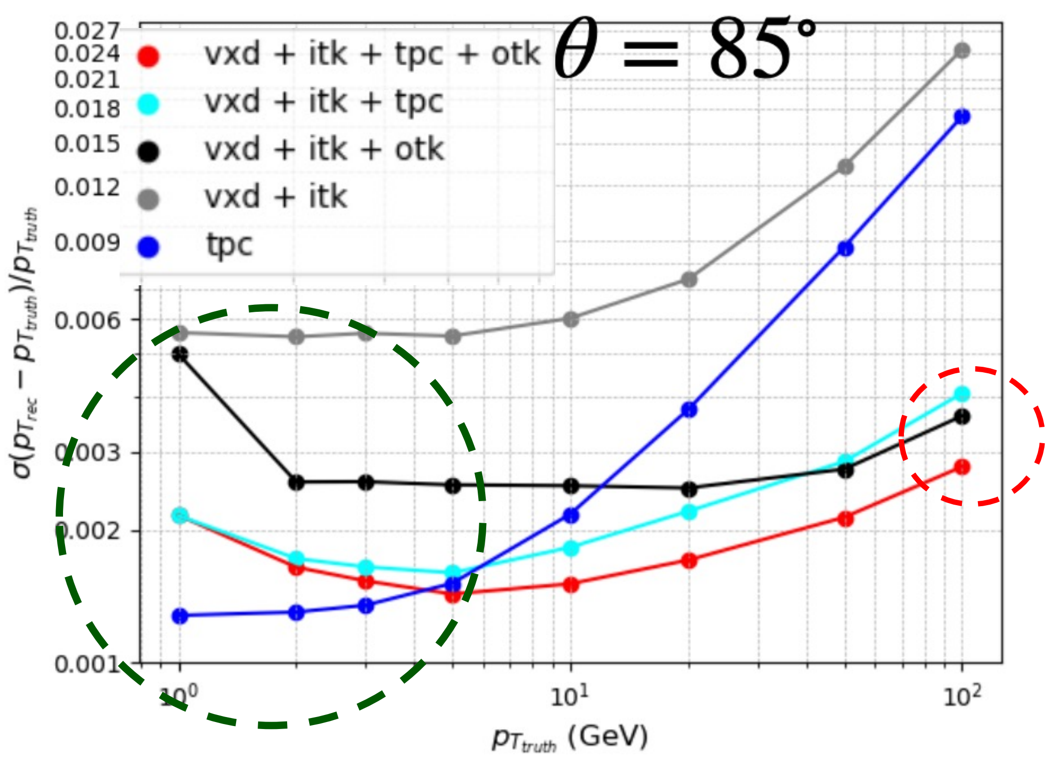
Priority: working closely with software team for the development and performance studies of basic objects

H→ss/cc/sb
H→inv
Vcb
W fusion Xsec
α_s
CKM angle $\gamma-2\beta$
Weak mixing angle
Higgs recoil
H→bb, gg
H→μμ
H→γγ
W mass & width
Top mass & width
Bs→$\nu\nu\phi$
Bc→$\tau\nu$
B0→2π^0
H→LLP
H→aa→4γ

	Process @ c.m.e	Domain	Relevant Det. Performance
Z→μμ	Z@ 91.2 GeV	Z	lepton ID, tracking
H→γγ	qqH	Higgs	photon ID, EM resolution
Higgs recoil	$\ell\ell$H	Higgs	Lepton ID, track dP/P
H→ss	ννH @ 240 GeV	Higgs	PID, Vertexing, PFA + JOI
H→inv	qqH	Higgs/NP	PFA, MET
Vcs/Vcb	WW→$\ell\nu$qq @ 240/160 GeV	Flavor	PFA, JOI + PID (lepton, tau)
H→LLP	$\ell\ell$H	NP	TPC, TOF, calo, muon detectors
H→μμ	qqH	Higgs	lepton ID, tracking, OTK
Top mass & width	Threshold scan @ 360 GeV	EW	Beam energy
Weak mixing angle	Z→bb @ 91.2 GeV	EW	JOI

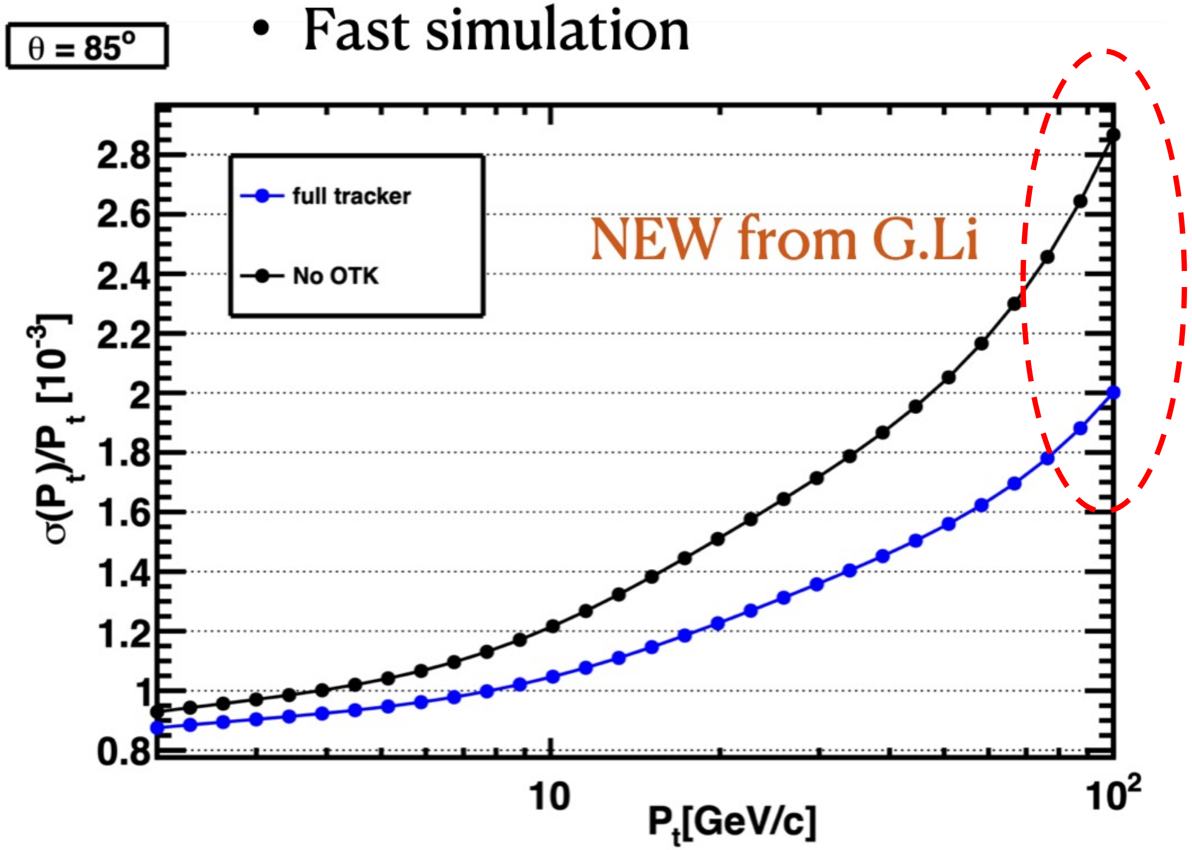
Performance studies

- Full simulation



Tracking at low pT to be improved

- Fast simulation



OTK impact on high pT resolution corrected (reduced)