CEPC Jet&Clusters

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Last Meeting

https://indico.ihep.ac.cn/event/24342/

2 hour + 6 contributions

Welcome to participate.

Jet @ Cluster

Wednesday Nov 27, 2024, 2:00 PM → 4:00 PM Asia/Shanghai

401 (Multi-disciplinary building)

Description Zoom link:
https://cern.zoom.us/j/64359854581?pwd=5GycaaaxtZRNbF5H0CzBfcGoyqzkEt.1

meeting id: 643 5985 4581
password: 517454

key for modification: cepc

2:00 PM → 2:20 PM	**Introduction** Speaker: Kaili Zhang (IHEP) 20241127_C···	20m	401
2:20 PM → 2:40 PM	**Jet Energy Resolution** Speaker: 瑛琦 侯 E240proces··· JES&JEA_E2···	20m	401
2:40 PM → 3:00 PM	**Photon** Speakers: Reda Mekouar (高能所) , Yang ZHANG (高能所) , Yang Zhang 20241126_··· Advancemen···	20m	
3:00 PM → 3:20 PM	**Gen Match** Speakers: Jiarong (嘉荣) Li (李) (Tsinghua University / Institute of High Energy Physics, Chinese Academy of Sciences) , Jiarong (嘉荣) Li (李) (Tsinghua University / Institute of High Energy Physics, Chinese Academy of Sciences) , Jiarong (嘉荣) Li (李) (Tsinghua University / Institute of High Energy Physics, Chinese Academy of Sciences) JetGenMatc···	20m	401
3:20 PM → 3:40 PM	**BMR** Speaker: Xiaotian Ma (高能所) BMR_1127.pdf BMR_1129.pdf	20m	401
3:40 PM → 4:00 PM	**Isolated Objects** Speaker: Danning Liu CEPC_Objec···	20m	401

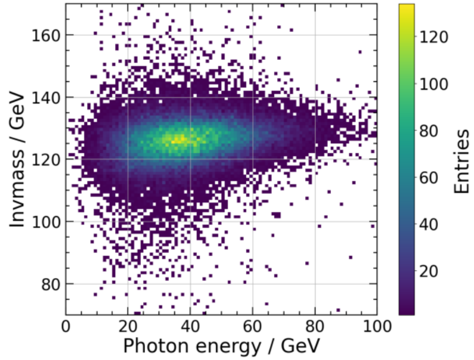
PFA algorithm update

@Zhang yang, Guo Fangyi
https://code.ihep.ac.cn/guofangyi/cepcsw-release/-/tree/calorec

New CEPCSW release soon;
New calibration factor applied.
New PFA algo (BMR expected to 3.8%)
New Geometry(Muon chamber, Endcap calo......)

Progress on BMR

- 刻度的优化
  - ECAL对电磁簇射与强子簇射的响应不同，需要不同的刻度系数



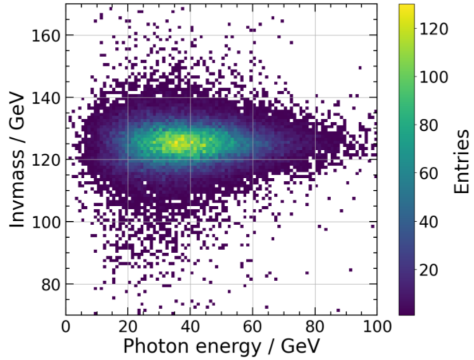
BMR = $4.06 \pm 0.04\%$

旧刻度：作用于所有 cluster

$k_{ECAL} = 1.06, k_{HCAL} = 4.00;$

导致光子的重建能量偏大。

m_H 的质量也会对事例中的光子能量有依赖



BMR = $3.89 \pm 0.02\%$

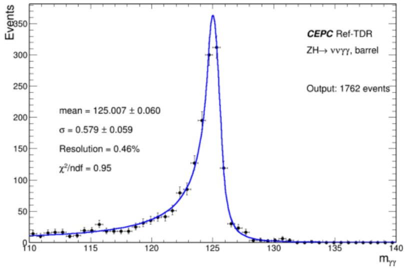
新刻度: 分别处理 charged cluster 与 neutral cluster

$k_{ECAL}^{charged} = 1.26, k_{HCAL} = 4.00;$

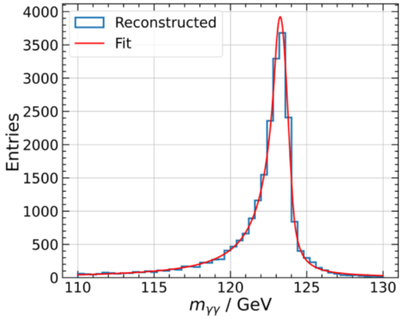
$k_{ECAL}^{neutral} = 1.00, k_{HCAL} = 4.00$

(中性强子能量占比小，假设所有 neutral cluster 都来自光子)

新的刻度方式解决了m_H对光子能量的依赖，
降低了BMR；
原则上也可以解决单光子重建能量偏大，
以及 $H \to \gamma\gamma$ 重建不变质量偏大的问题



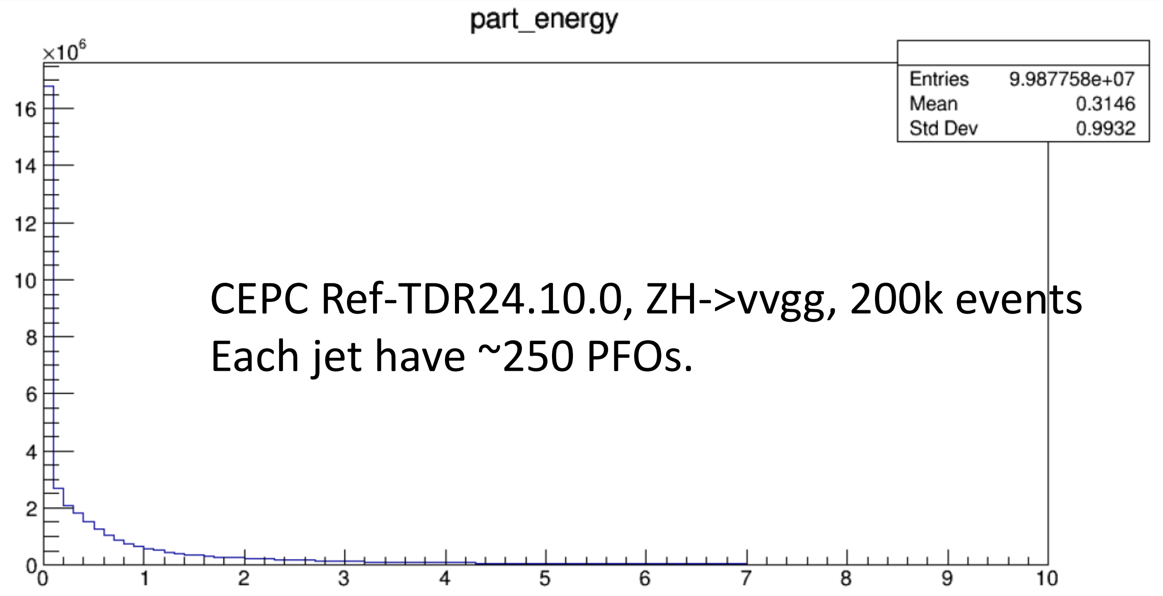
Raw mass: 130.3 GeV,
scaled to 125 GeV(By Kaili Zhang)



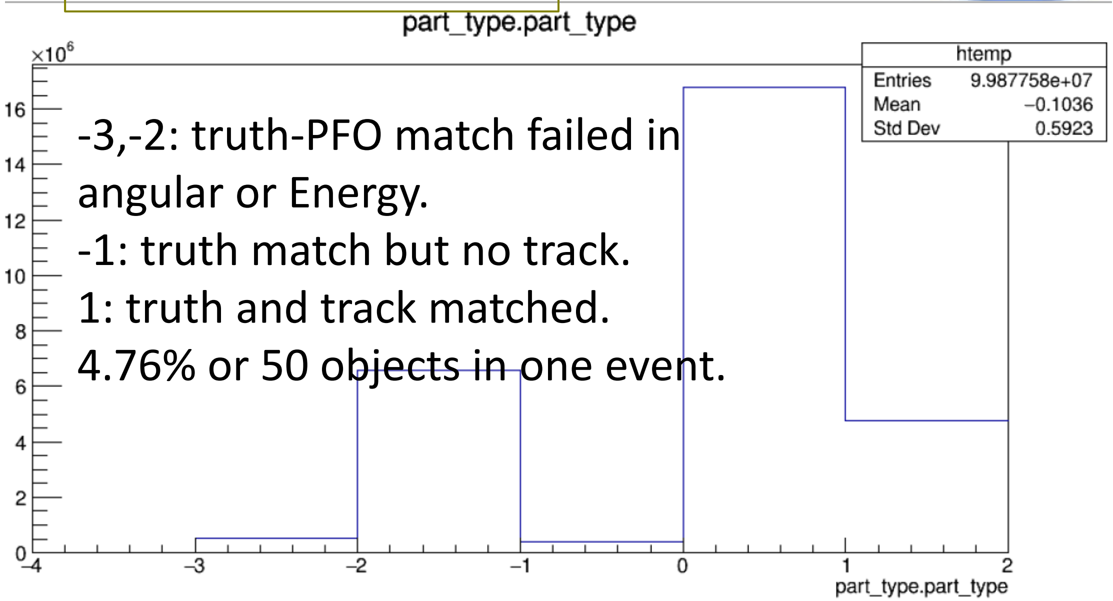
$m_{\gamma\gamma} = 123.3$GeV

Revisit of Jet PFO

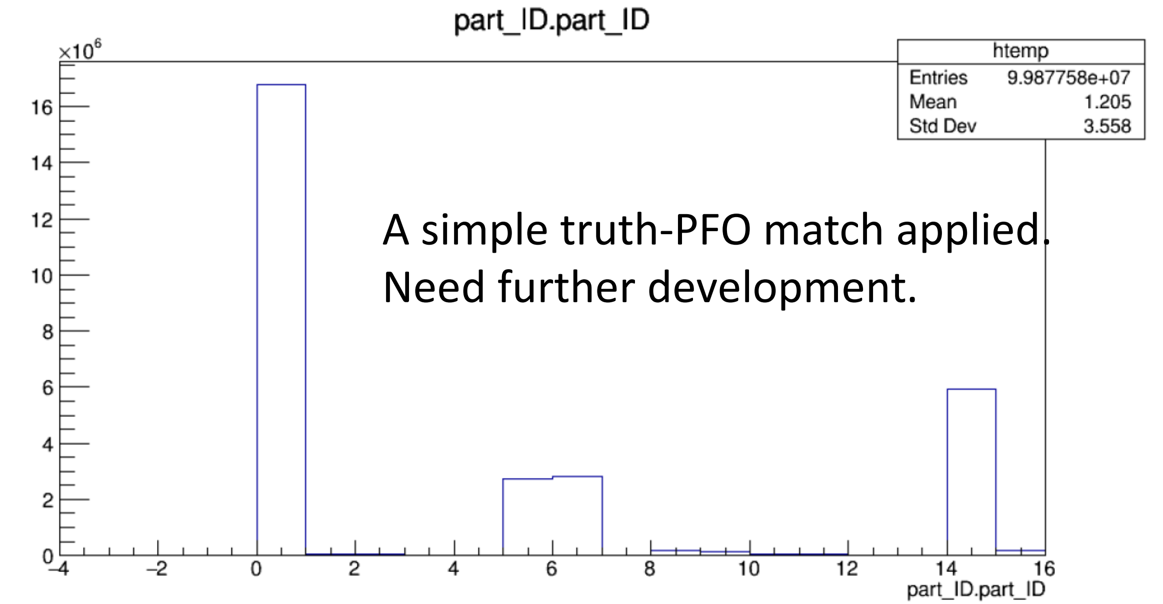
A sub-product of JOI.
Based in 24.10.0.



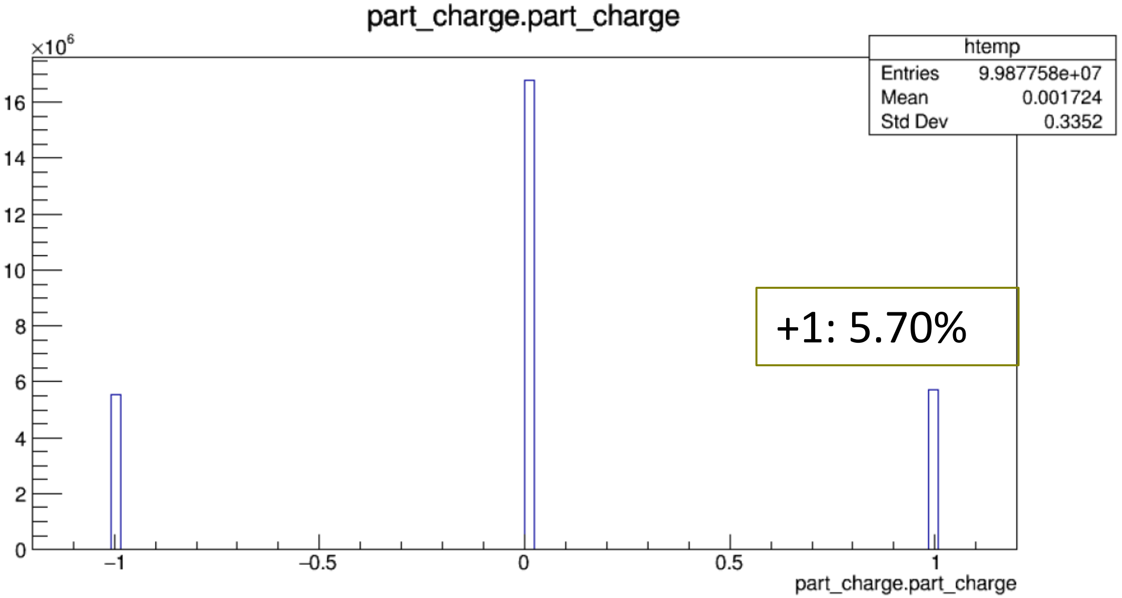
CEPC Ref-TDR24.10.0, ZH->vvgg, 200k events
Each jet have ~250 PFOs.



-3,-2: truth-PFO match failed in angular or Energy.
-1: truth match but no track.
1: truth and track matched.
4.76% or 50 objects in one event.



A simple truth-PFO match applied.
Need further development.



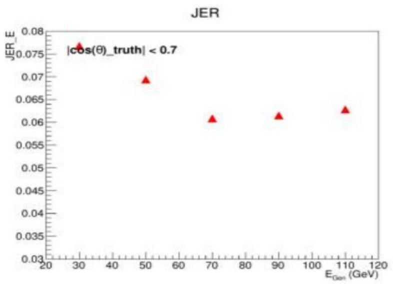
+1: 5.70%

JES, JER

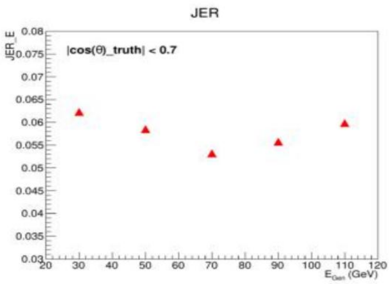
@Yingqi.
~700 differential plots attached. Most of plots fits well.

JER-E

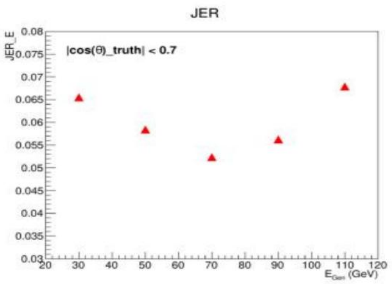
nnHgg



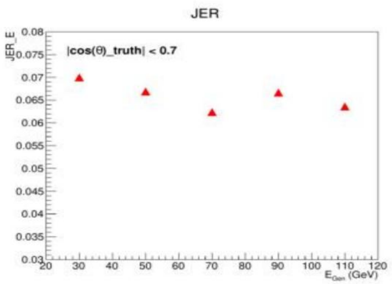
nnHuu



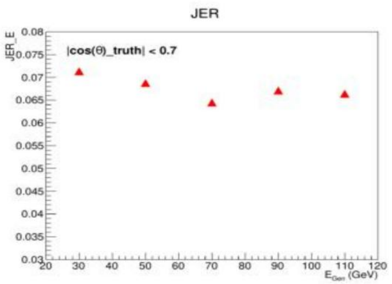
nnHdd



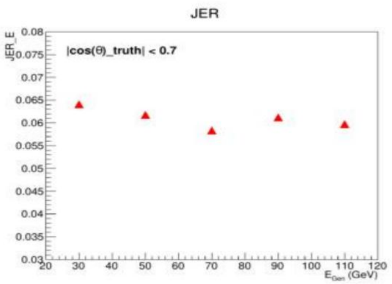
nnHcc



nnHss



nnHbb

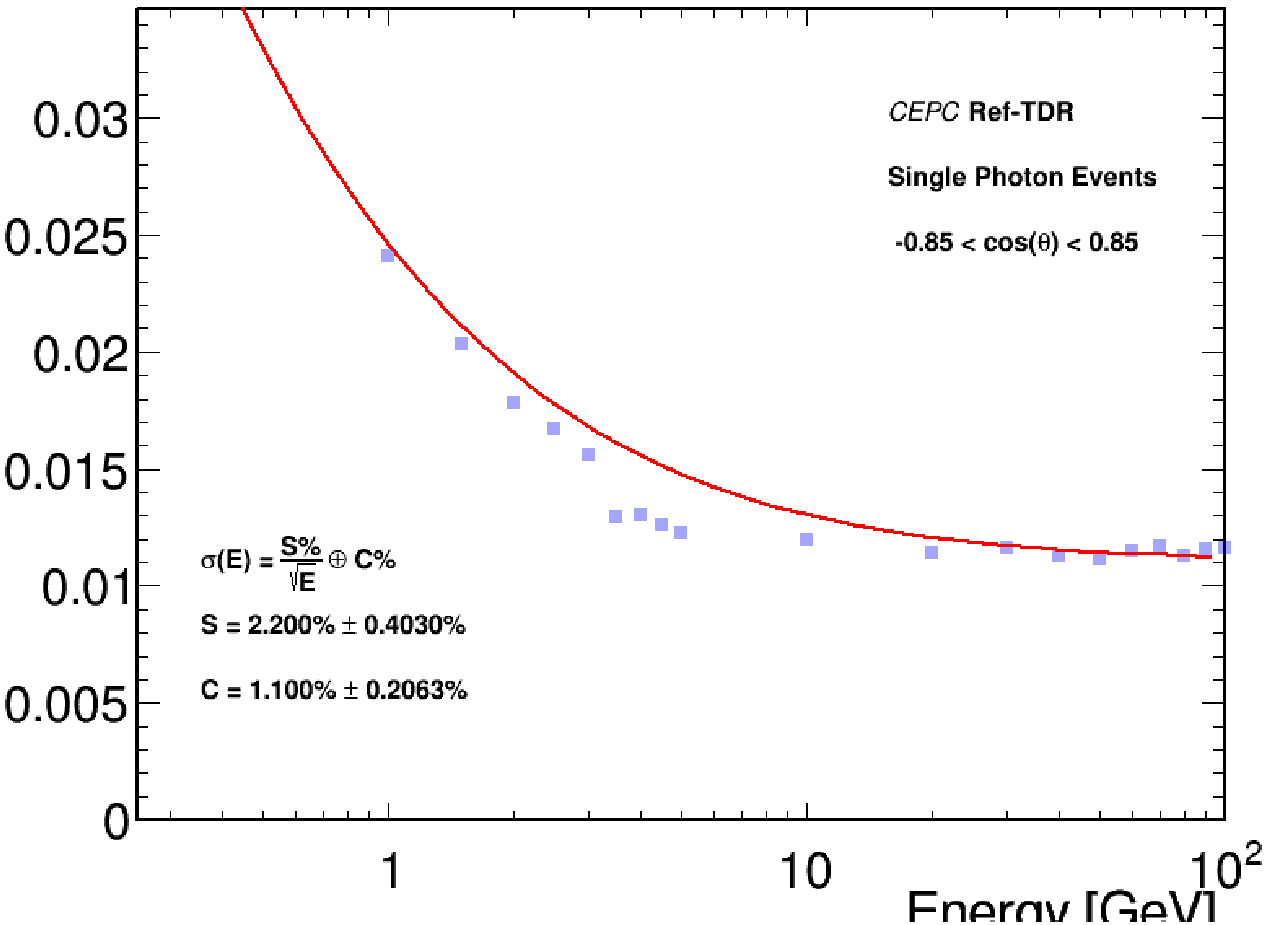


Several discrepancies found between tdr24.10 and CDR(Peizhu).

Further study undergoing.

Single photon gun performance

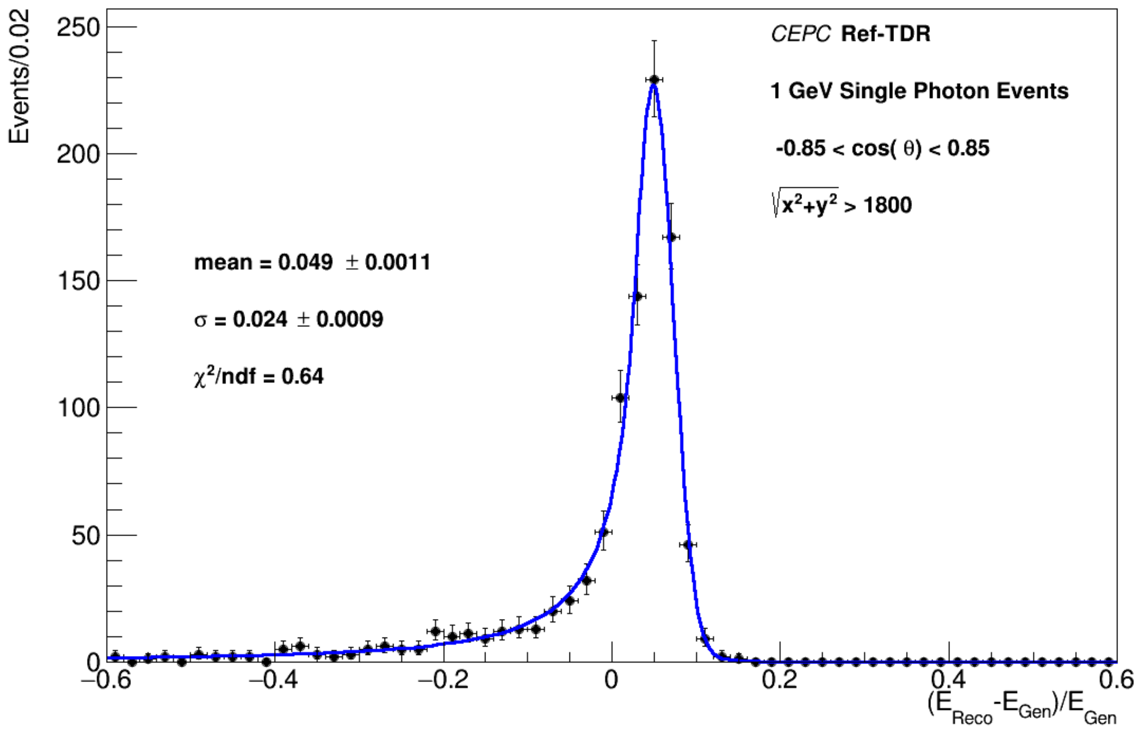
Repeating Ecal performance;



First look at converted photons.
Reda use truth photon endpoint in XY plane

$$\sqrt{x^2 + y^2} < 1.83m$$

Currently, ~0.8% photon converted.
ATLAS expect ~10%. Under study.



BMR

Impact of event cleaning. (Same as Peizhu did for CDR)

- Perform BMR study in $ZH \to \nu\nu + gg/bb/cc/uu/dd/ss$ with $\sqrt{s} = 240\text{GeV}/c^2$
- Comparisons with/without event cleaning under $|\cos\theta_{\text{jet}}| < 0.7\&\text{Match}\&\Delta R < 0.6$

Case	process	$ZH \to \nu\nu gg$	$ZH \to \nu\nu bb$	$ZH \to \nu\nu cc$	$ZH \to \nu\nu uu$	$ZH \to \nu\nu dd$	$ZH \to \nu\nu ss$
Without event cleaning	BMR/%	4.99 ± 0.03	6.48 ± 0.06	5.61 ± 0.02	4.84 ± 0.02	4.92 ± 0.04	5.56 ± 0.02
	Efficiency/%	56.6	56.4	56.7	57.2	56.8	56.5
With event cleaning	BMR/%	4.89 ± 0.03	4.71 ± 0.04	5.07 ± 0.03	4.82 ± 0.02	4.90 ± 0.04	5.53 ± 0.02
	Efficiency/%	50.6	21.3	37.2	54.2	53.8	53.5

- Event cleaning: $\Sigma|Pt_{\text{ISR}}| < 1\text{GeV}/c\&\Sigma|Pt_{\nu}| < 1\text{GeV}/c$
- BMR improves especially for $ZH \to \nu\nu bb$ and $ZH \to \nu\nu cc$
- BMR ranges from 4.71% to 5.53%

BMR

Selection eff of event cleaning matched with CDR.
Neutrinos, bb, cc flavor suffered. ISR ~5%.

Table 1. Event cumulative efficiency for Higgs boson exclusive decay at the CEPC with $\sqrt{s} = 240$ GeV.

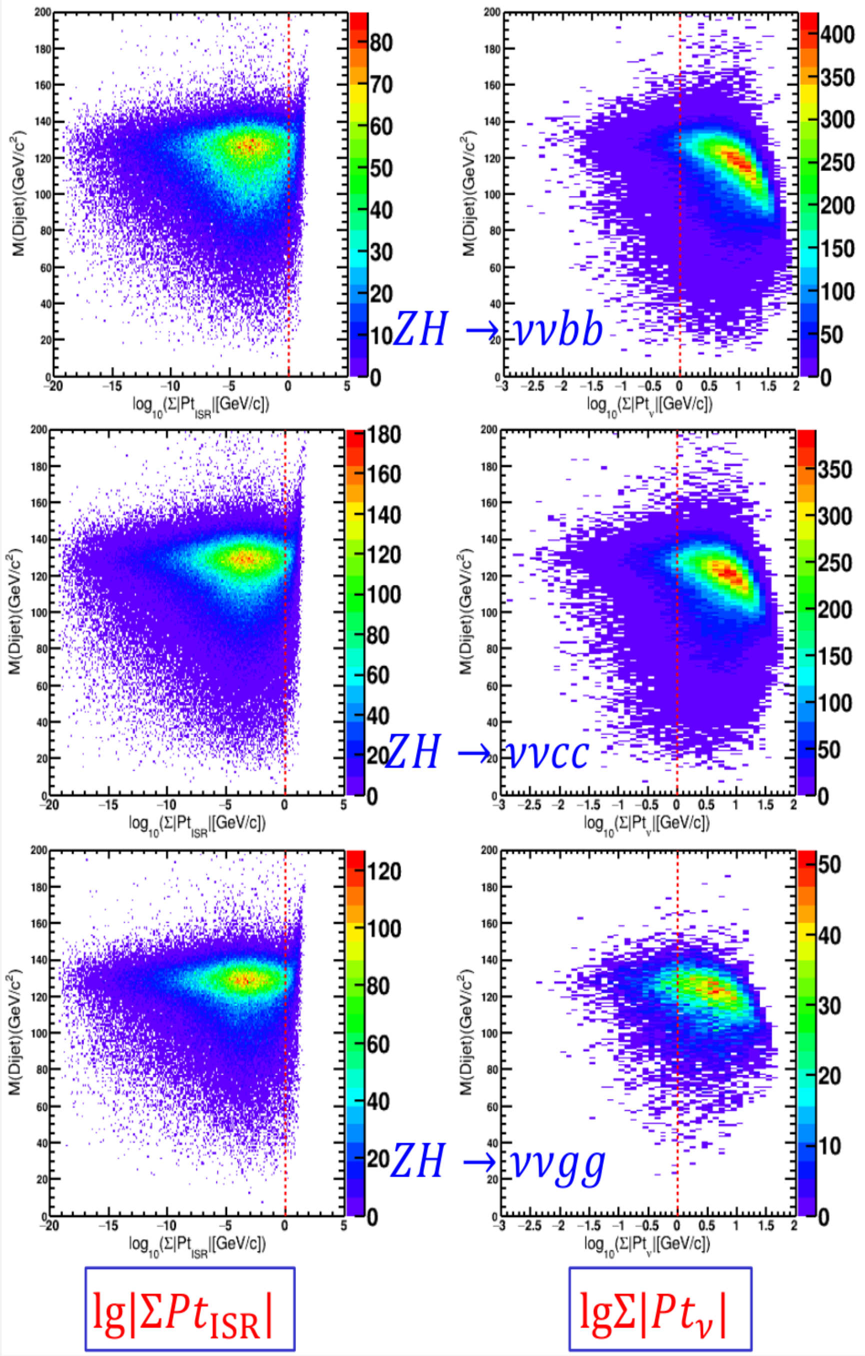
	gg(%)	bb(%)	cc(%)	WW^*(%)	ZZ^* (%)
Pt_ISR < 1 GeV	95.15	95.37	95.30	95.16	95.24
Pt_neutrino < 1 GeV	89.33	39.04	66.36	37.46	41.39
|Cos(Theta_Jet)| < 0.85	67.30	28.65	49.31	–	–

Table 3. Higgs boson mass resolution (sigma/Mean) for different decay modes with jets as final state particles, after event cleaning.

$H \to bb$	$H \to cc$	$H \to gg$	$H \to WW^*$	$H \to ZZ^*$
3.63%	3.82%	3.75%	3.81%	3.74%

CDR reference

Process		$ZH \to \nu\nu gg$	$ZH \to \nu\nu bb$	$ZH \to \nu\nu cc$	$ZH \to \nu\nu uu$	$ZH \to \nu\nu dd$	$ZH \to \nu\nu ss$
Cumulative efficiency /%	$Pt_{\mathrm{ISR}} < 1\mathrm{GeV}/c$	95.2	95.2	95.2	95.4	95.2	95.2
	$Pt_{\nu} < 1\mathrm{GeV}/c$	89.7	39.0	66.5	94.9	94.7	94.7
	$\lvert\cos\theta_{\mathrm{jet}}\rvert < 0.7$	52.9	21.7	38.0	55.3	55.1	54.9
	Match&$\Delta R < 0.6$	50.6	21.3	37.2	54.2	53.8	53.5
DSCB BMR/%		4.89 ± 0.03	4.71 ± 0.04	5.07 ± 0.03	4.82 ± 0.02	4.90 ± 0.04	5.53 ± 0.02



Isolated Object Removel

Package under developing.

Basic Criteria of Isolated Object

- Target :
  - e / μ / γ Seperation
- Table of criteria (Thanks Hengne and Kaili for providing parameters)

Objects	Charge/Track	E_{CAL}/E_{Total}	E_{Total}/P_{Track}	P_T
Electron	√	> 0.6	> 0.9	5 GeV
Muon	√	< 0.3	< 0.3	5 GeV
Photon	×	-	-	10 GeV

  - More selections to be determined

DANNING LIU | CEPC WEEKLY MEETING 11/27/24 3