

CEPC Jet&Samples

Kaili Zhang

IHEP

zhangkl@ihep.ac.cn

Jet tasks to do

Tasks assigned last Jet meeting.



- Jet Gen Match @Jiarong
- JE, JA related plots @Yingqi
- BMR plots @Xiaotian
- Neutral jet superclusters
- Particle gun one-type particle response
 - Photon: @Reda
- Remove isolated lepton/photon in PFO then jet clustering. @Danning
 - Need a quick PID

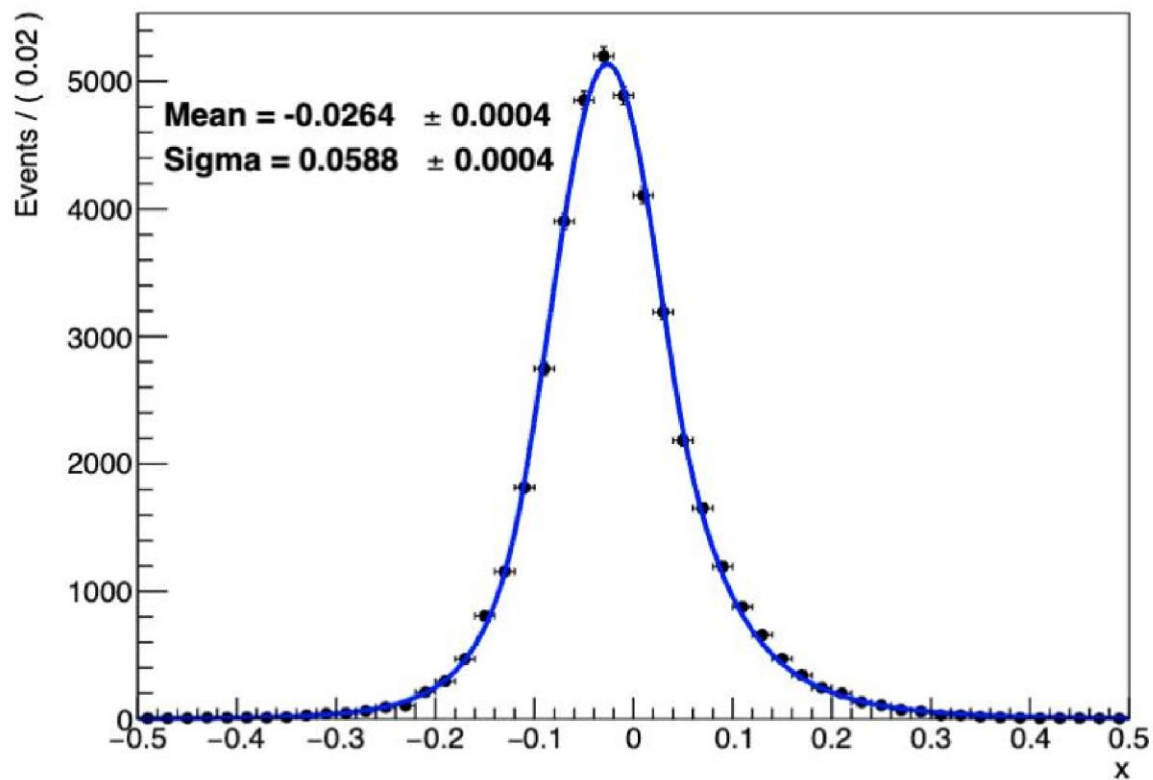
Tasks sub priority



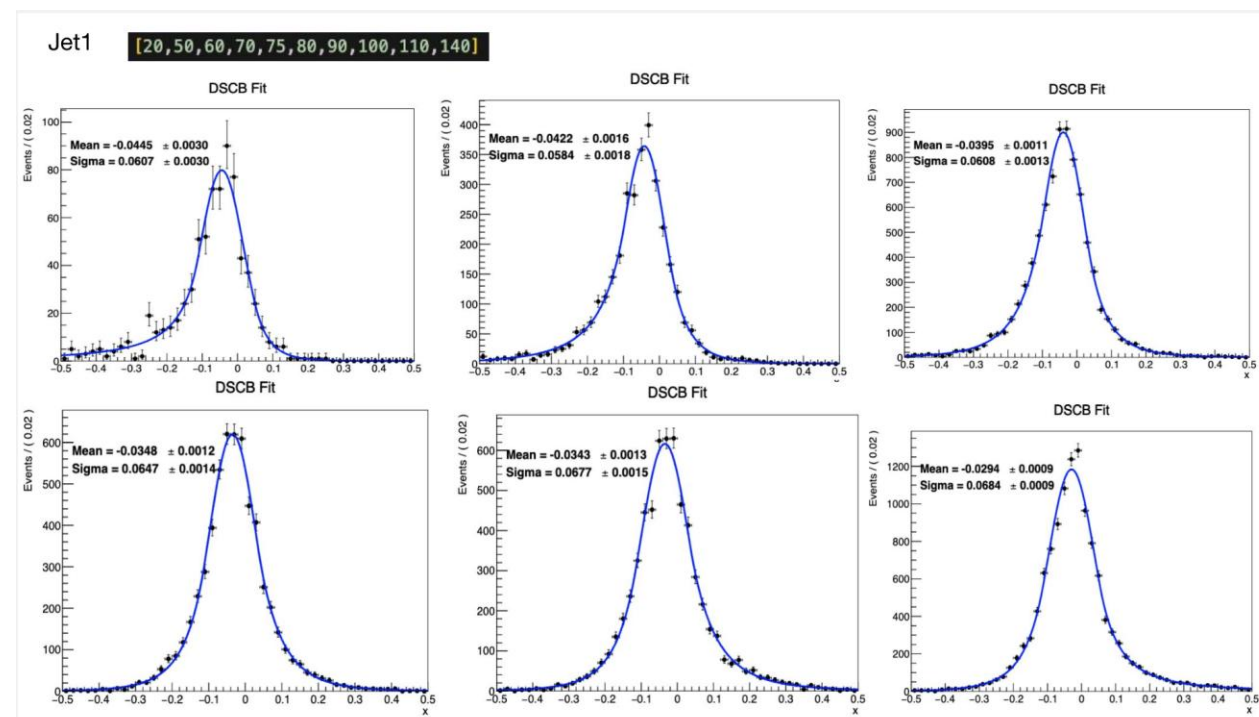
- Jet Event display
- Validation ee-kt algorithm with others.
- Validation generator Whizard with others.
- Flavors/JOI
- Endcap jet performance
- Repeat Ecal/Hcal performance

$v\bar{v}Hbb$. With $|\cos\theta| < 0.85$

jet1 + jet2
DSCB Fit



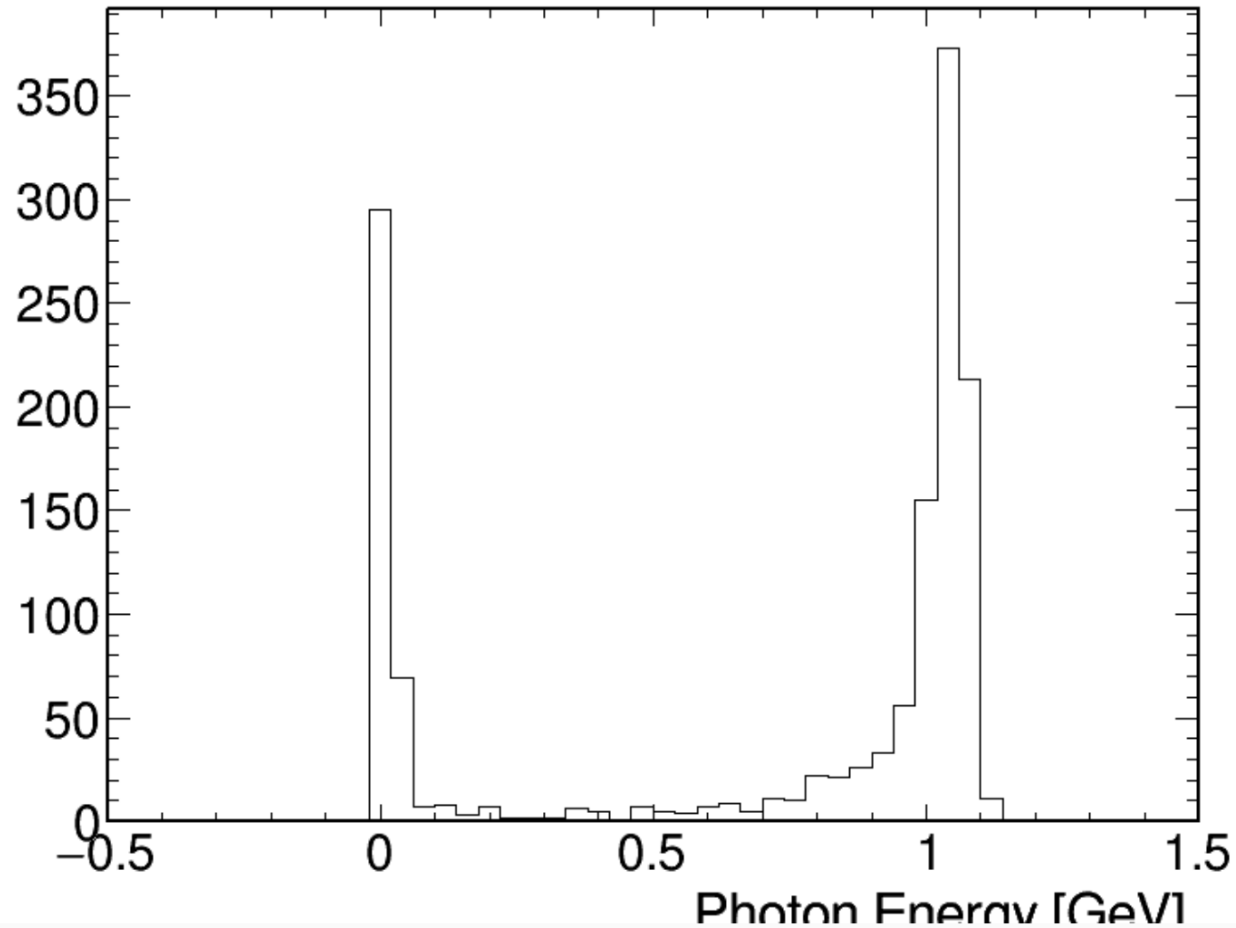
With different Energy bins.



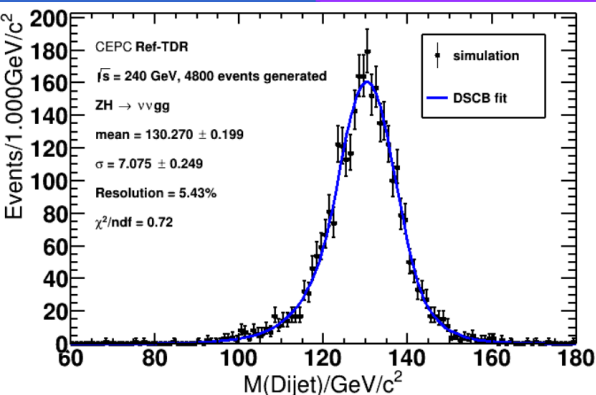
Single photon gun @ Reda

Start to look at the photon gun behavior.

For 1 GeV single photon events:



Performance study -- BMR



$ZH \rightarrow vvgg$
Release version:
CEPCSW_tdr24.9.1

$|\cos\theta_{jet}| < 0.85$:
 $m_H = 130.270 \pm 0.199$
Resolution 5.43%

Efficiency cutflow	
$ \cos\theta_{jet} < 0.85$	0.71
truthmatch	0.69
$\Delta R < 0.6$	0.65

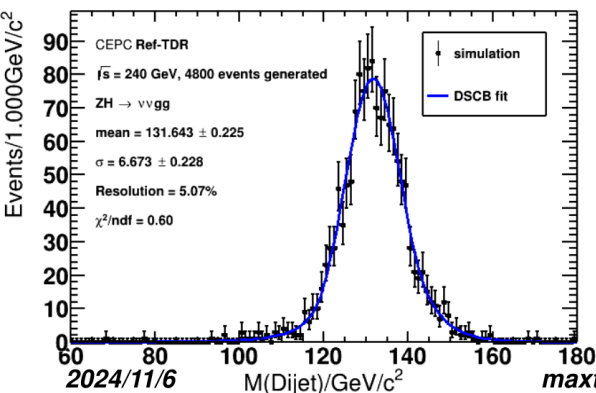
Efficiency cutflow	
$ \cos\theta_{jet} < 0.5$	0.32
truthmatch	0.31
$\Delta R < 0.6$	0.29

$|\cos\theta_{jet}| < 0.5$:
 $m_H = 131.643 \pm 0.225$
Resolution 5.07%

reference

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

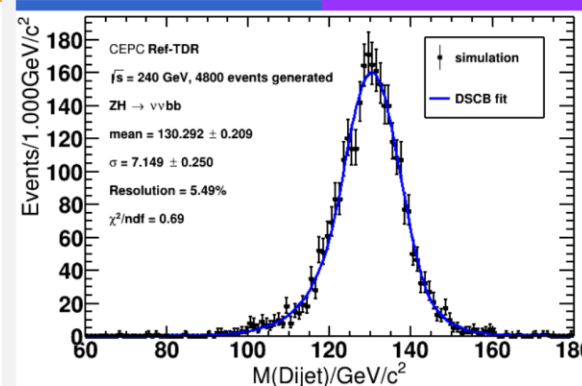
$H \rightarrow bb$	$H \rightarrow cc$	$H \rightarrow gg$	$H \rightarrow WW^*$	$H \rightarrow ZZ^*$
3.63%	3.82%	3.75%	3.81%	3.74%



maxt@ihep.ac.cn

1

Performance study -- BMR



$ZH \rightarrow vvb$
CEPCSW_tdr24.9.1
 $|\cos\theta_{jet}| < 0.85$:
 $m_H = 130.292 \pm 0.209$
Resolution 5.49%

Efficiency cutflow	
$ \cos\theta_{jet} < 0.85$	0.71
truthmatch	0.69
$\Delta R < 0.6$	0.65

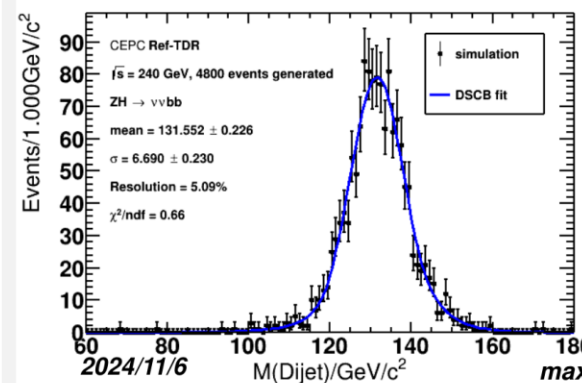
Efficiency cutflow	
$ \cos\theta_{jet} < 0.5$	0.32
truthmatch	0.31
$\Delta R < 0.6$	0.29

$|\cos\theta_{jet}| < 0.5$:
 $m_H = 131.552 \pm 0.226$
Resolution 5.09%

reference

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

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



maxt@ihep.ac.cn

2

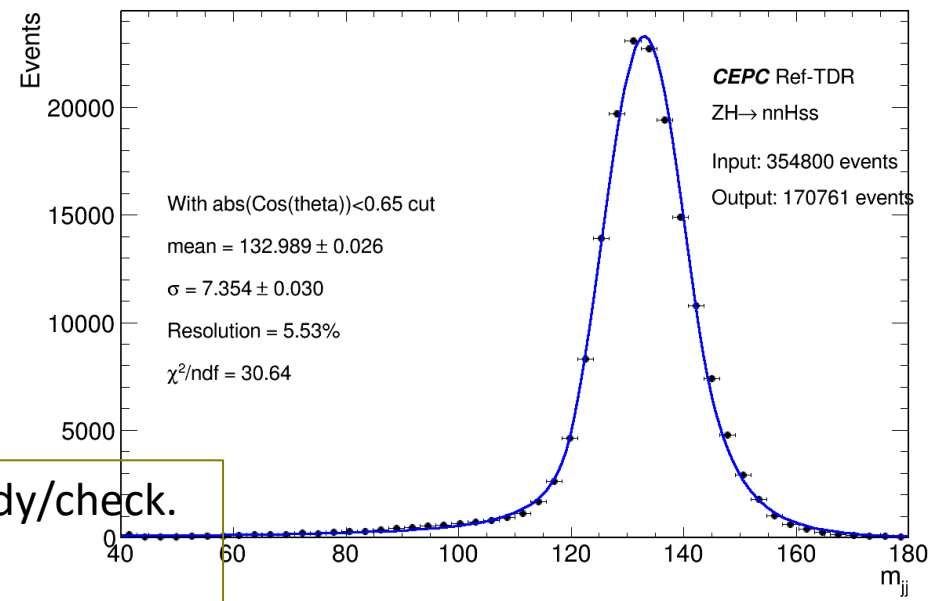
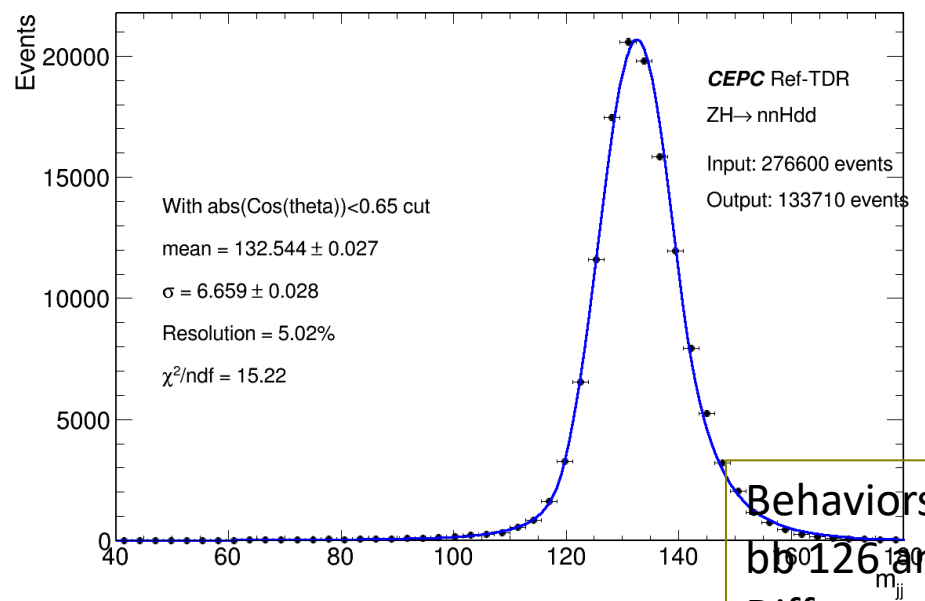
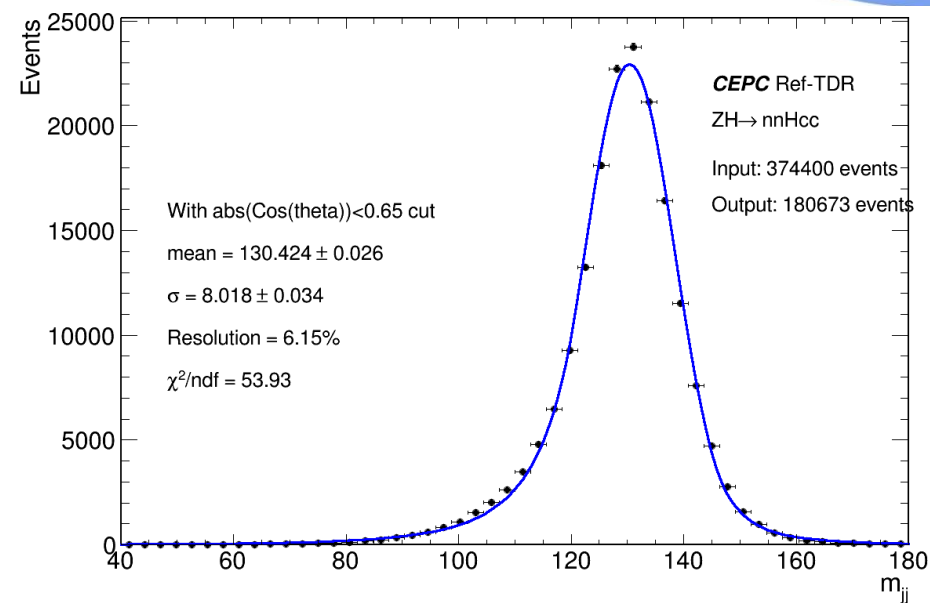
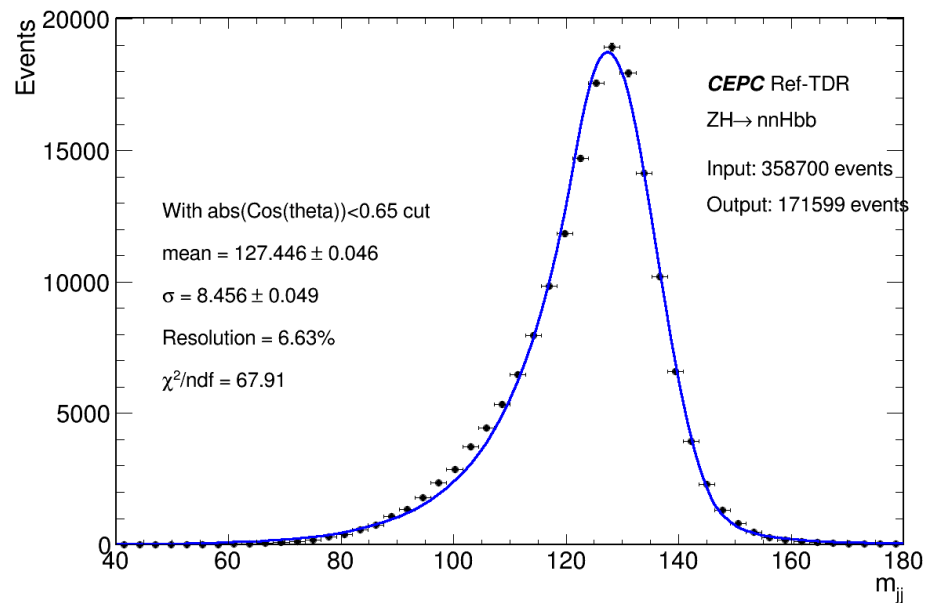
Samples



- /cefs/higgs/zhangkl/Production
 - 400k ZH->vvbb, cc, dd, ss samples ready.
 -
- Single Jet Gun available soon.

- Slides from Lianyou;

Jet with flavor

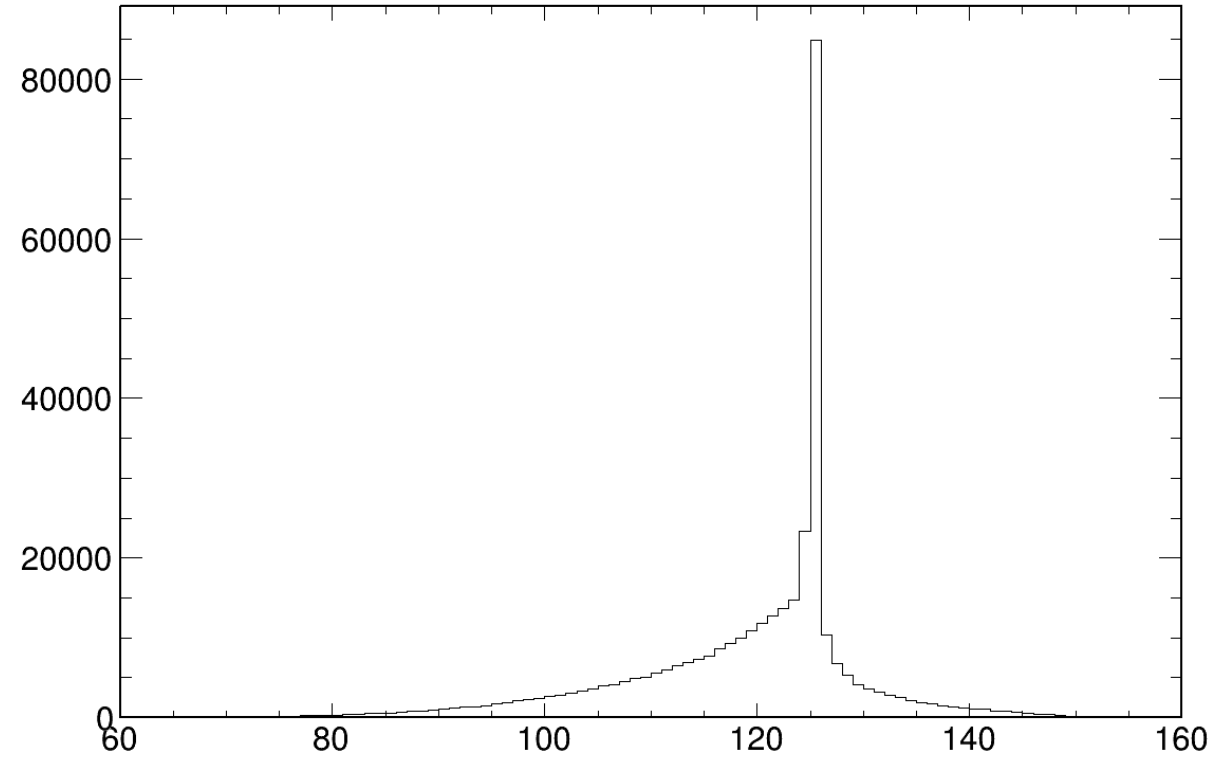
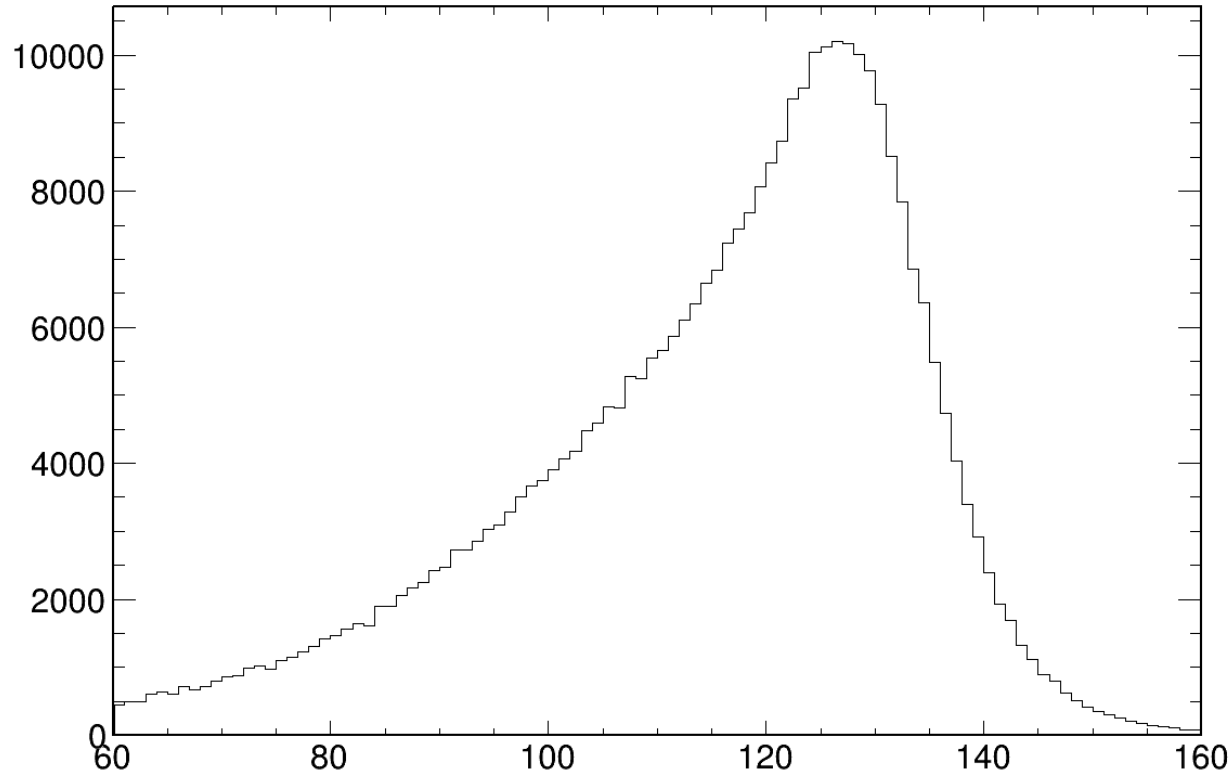


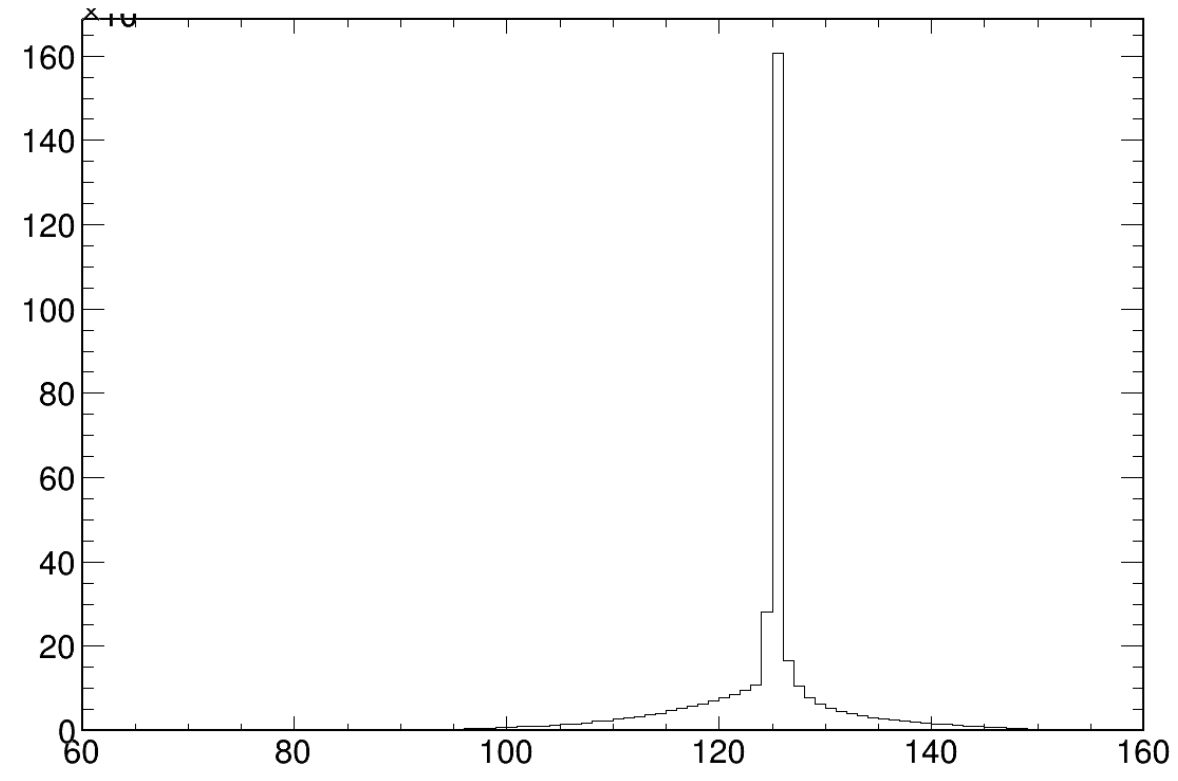
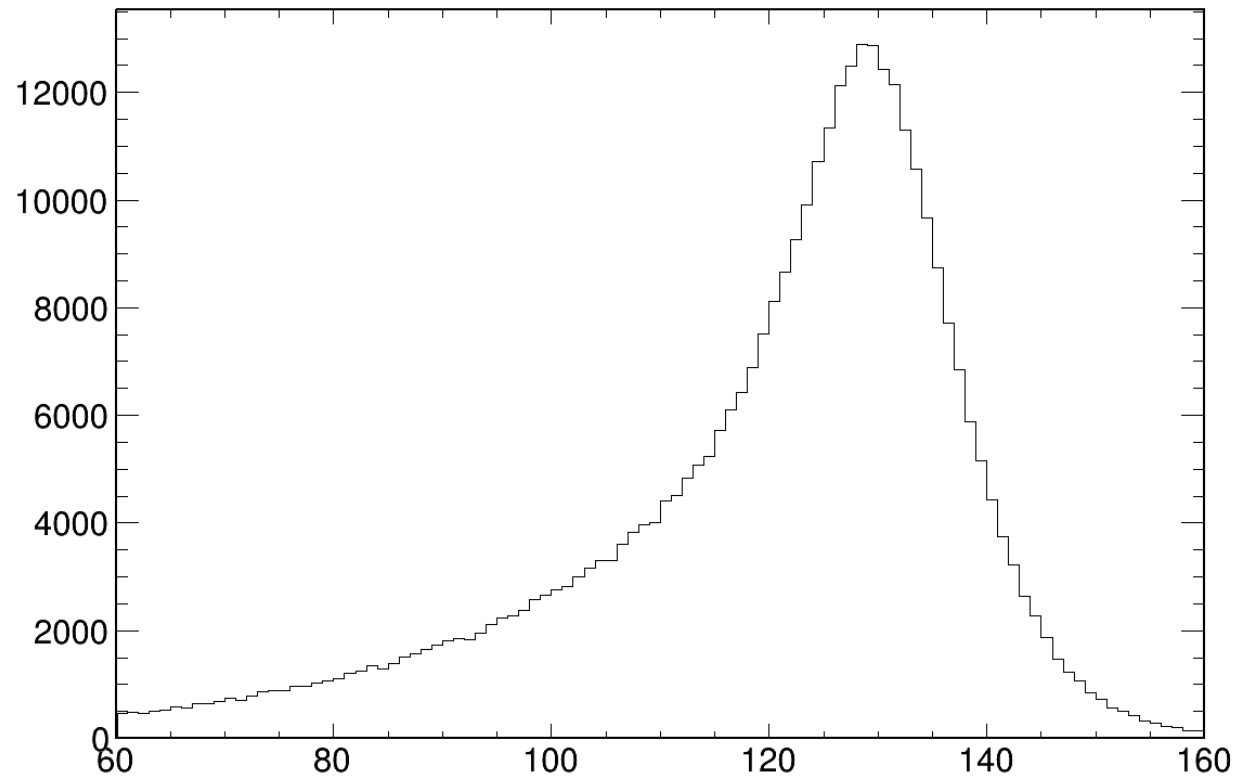
Behaviors need further study/check.
bb 126 and other ~ 130 ;
Different resolution...

Kaili

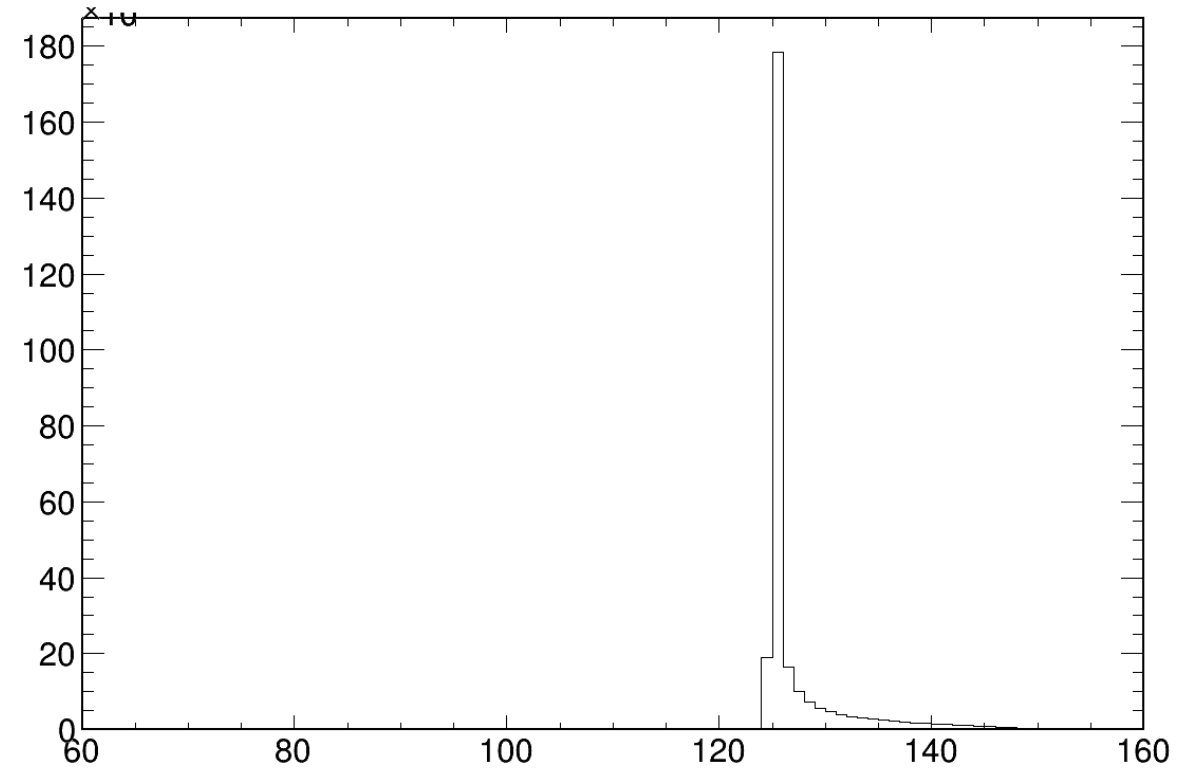
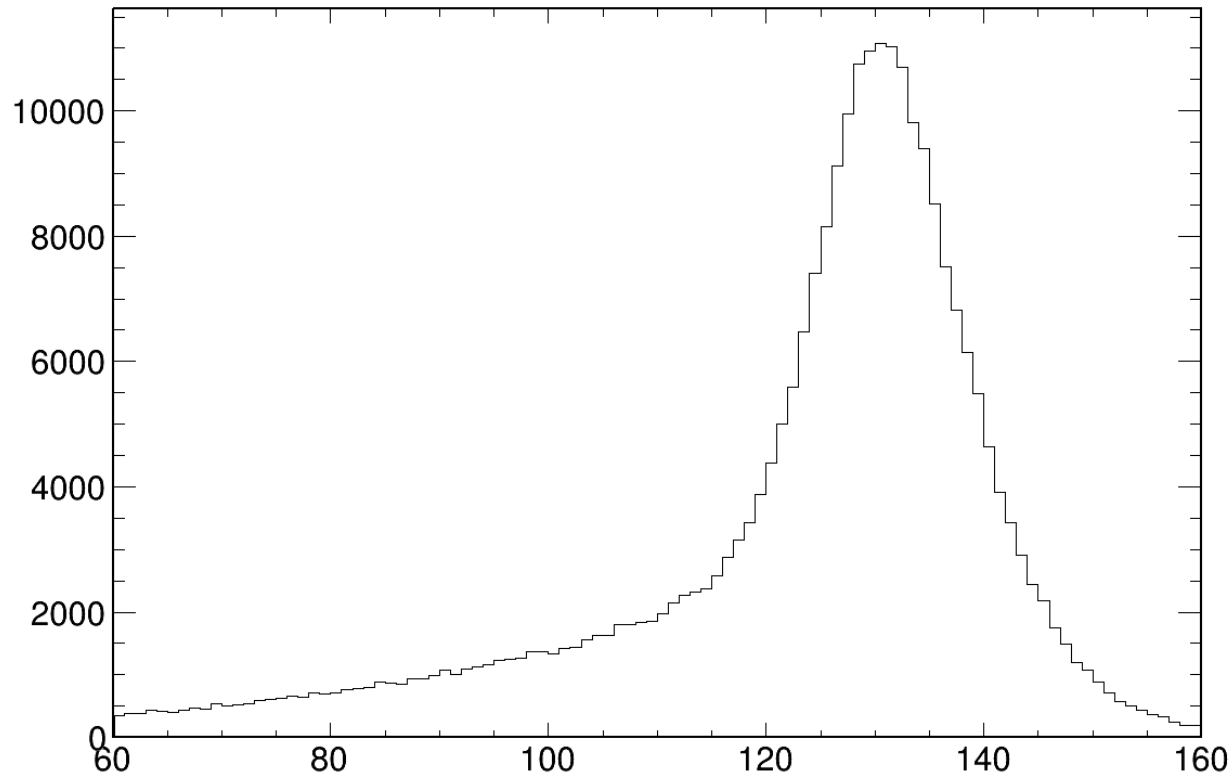
Backups

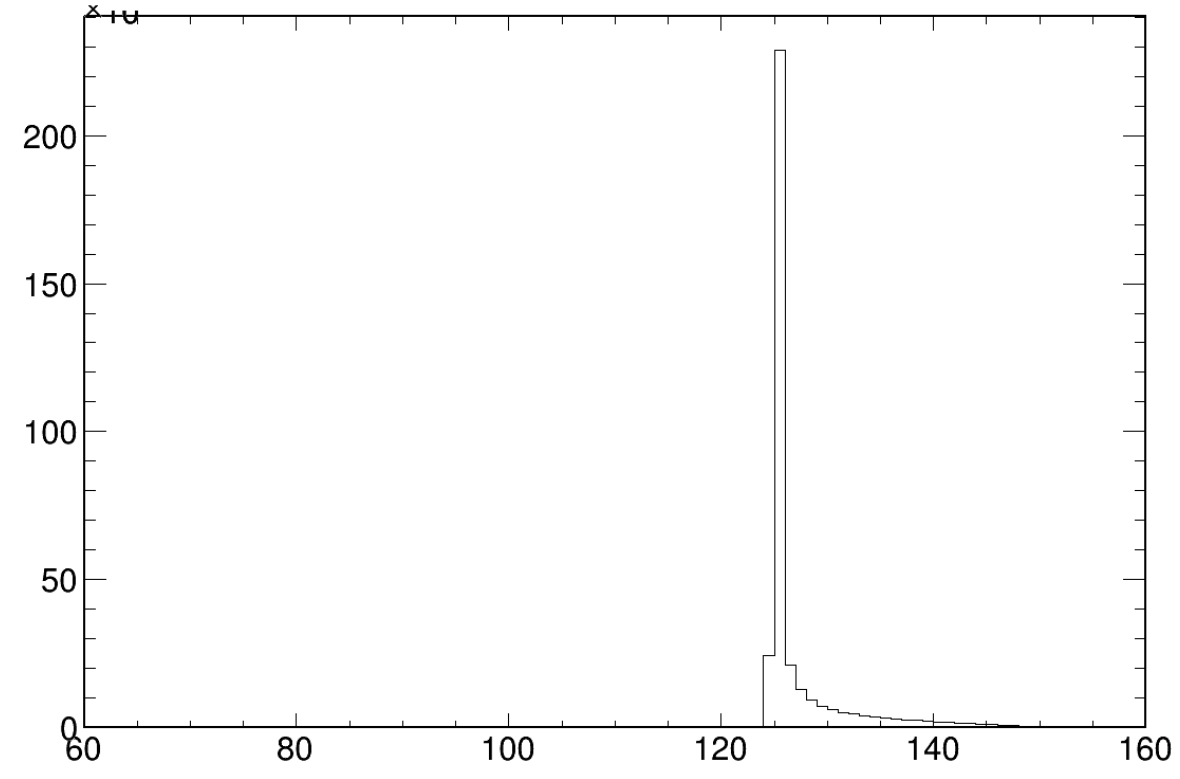
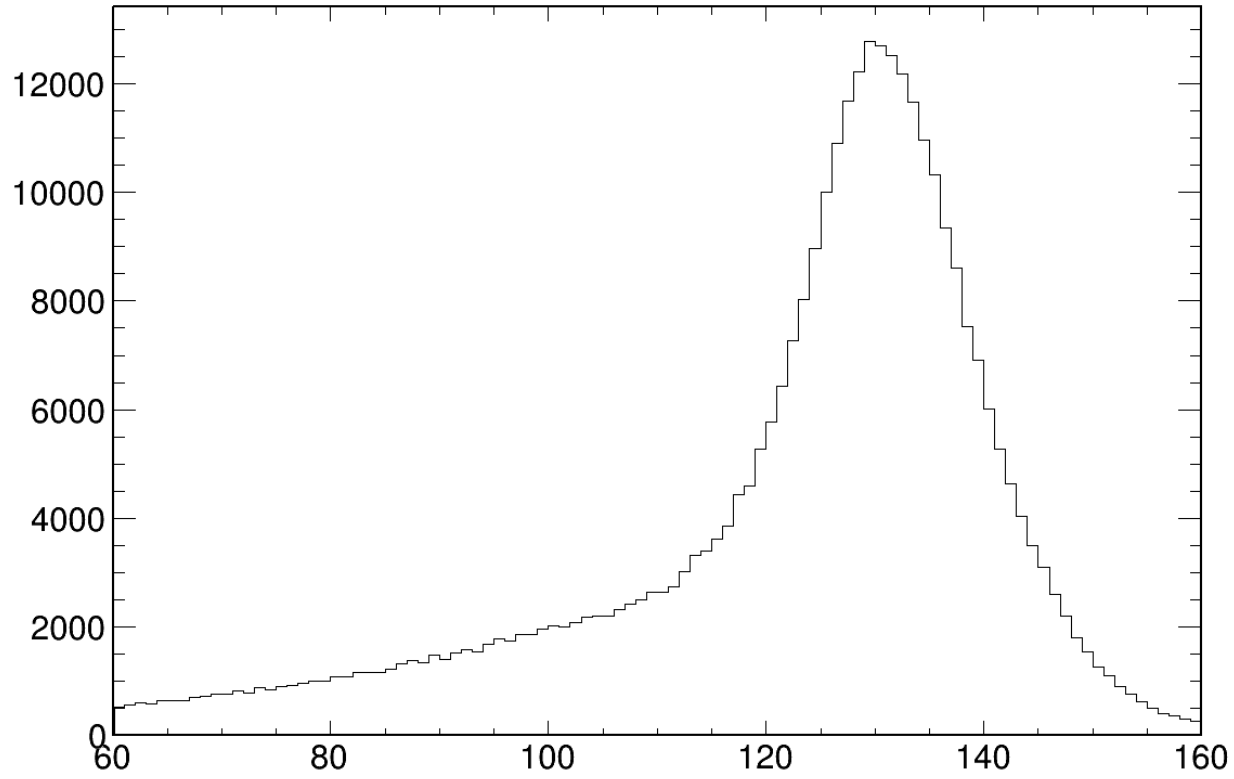
bb





dd





Machine Learnings on Jets



- P-CNN
 - <https://scipost.org/10.21468/SciPostPhys.7.1.014>
- Particle Flow Network
 - <https://arxiv.org/abs/1810.05165>
 - CEPC@Xiaotian : <https://arxiv.org/abs/2410.04465v2>
- LundNet
 - [https://doi.org/10.1007/jhep03\(2021\)052](https://doi.org/10.1007/jhep03(2021)052)
- ParticleNet
 - Arxiv:1902.08570
 - <https://github.com/hqucms/ParticleNet>

ParticleTransformer



- <https://arxiv.org/abs/2202.03772>
- https://github.com/jet-universe/particle_transformer
- Platforms: <https://github.com/hqucms/weaver-core>
- Application on CEPC: [2309.13231](#), [PRL 132, 221802 \(2024\)](#)
- Tutorial on CEPC: <https://github.com/ZHUYFgit/CEPC-Jet-Origin-Identification>
- Inputs from CEPCsoft: `/cefs/higgs/zhangkl/AI/datasets`
- Inputs from LHC, [JetClass](#): `/cefs/higgs/zhangkl/AI/jetclass`
- Require higgsgpu group. Request on <https://ccsinfo.ihep.ac.cn/>
- Follow the tutorial, build the env if you are interested.

ParticleTransformer @ CEPC



- Variable list in M11origin.cc
 - Under development to CEPCSW
 - Unit as one jet: 4 momentum, M11 id information.....
- Train in Weaver: JetClass_full.yaml
- Submit jobs on IHEP: train_JetClass.sh
- Output: Pred.root: Label and score for each jets.
- Application: onnx format