

Update on BSM Higgs searches

Xiaohu SUN, IHEP, Beijing, 02-04-2014

2HDM ggH [central prod]

- ggH (D3PD) **14/16** samples: already informed analyzers
 - mc12_8TeV.189076.MadGraphPythia8_AU2CTEQ6L1_ggH260_hh125_bbba.merge.NTUP_PHOTON.e2619_s1773_s1776_r4485_r4540_p1344
 - mc12_8TeV.189077.MadGraphPythia8_AU2CTEQ6L1_ggH300_hh125_bbba.merge.NTUP_PHOTON.e2619_s1773_s1776_r4485_r4540_p1344
 - mc12_8TeV.189078.MadGraphPythia8_AU2CTEQ6L1_ggH340_hh125_bbba.merge.NTUP_PHOTON.e2619_s1773_s1776_r4485_r4540_p1344
 - mc12_8TeV.189079.MadGraphPythia8_AU2CTEQ6L1_ggH350_hh125_bbba.merge.NTUP_PHOTON.e2619_s1773_s1776_r4485_r4540_p1344
 - mc12_8TeV.189080.MadGraphPythia8_AU2CTEQ6L1_ggH400_hh125_bbba.merge.NTUP_PHOTON.e2619_s1773_s1776_r4485_r4540_p1344
 - mc12_8TeV.189081.MadGraphPythia8_AU2CTEQ6L1_ggH500_hh125_bbba.merge.NTUP_PHOTON.e2619_s1773_s1776_r4485_r4540_p1344
 - mc12_8TeV.189082.MadGraphPythia8_AU2CTEQ6L1_ggH800_hh125_bbba.merge.NTUP_PHOTON.e2619_s1773_s1776_r4485_r4540_p1344
 - mc12_8TeV.189083.MadGraphPythia8_AU2CTEQ6L1_ggH1000_hh125_bbba.merge.NTUP_PHOTON.e2619_s1773_s1776_r4485_r4540_p1344
 - mc12_8TeV.189084.MadGraphPythia8_AU2CTEQ6L1_ggH260_hh125_bbbb.merge.NTUP_COMMON.e2619_s1773_s1776_r4485_r4540_p1575
 - mc12_8TeV.189085.MadGraphPythia8_AU2CTEQ6L1_ggH300_hh125_bbbb.merge.NTUP_COMMON.e2619_s1773_s1776_r4485_r4540_p1575
 - mc12_8TeV.189086.MadGraphPythia8_AU2CTEQ6L1_ggH340_hh125_bbbb.merge.NTUP_COMMON.e2619_s1773_s1776_r4485_r4540_p1575
 - mc12_8TeV.189087.MadGraphPythia8_AU2CTEQ6L1_ggH350_hh125_bbbb.merge.NTUP_COMMON.e2619_s1773_s1776_r4485_r4540_p1575
 - mc12_8TeV.189088.MadGraphPythia8_AU2CTEQ6L1_ggH400_hh125_bbbb.merge.NTUP_COMMON.e2619_s1773_s1776_r4485_r4540_p1575
 - mc12_8TeV.189090.MadGraphPythia8_AU2CTEQ6L1_ggH800_hh125_bbbb.merge.NTUP_COMMON.e2619_s1773_s1776_r4485_r4540_p1575

2HDM ggH [central prod]

- ggH (AOD) 2/16 samples: they were forgotten by sumbitter...
 - mc12_8TeV.189089.MadGraphPythia8_AU2CTEQ6L1_ggH500_hh125_bbbb.merge.AOD.e2619_s1773_s1776_r4485_r4540
 - mc12_8TeV.189091.MadGraphPythia8_AU2CTEQ6L1_ggH1000_hh125_bbbb.merge.AOD.e2619_s1773_s1776_r4485_r4540

2HDM ggH [central prod]

- bbyy guys produced another set of samples for ggH by using **HeavyScalar** package with MadGraph
- Only validated up to 500GeV, but produced up to 1TeV
- All ready with D3PD
 - mc12_8TeV.189433.MadgraphPythia_AU2_CTEQ6L1_H260_hh_yybb.merge.e2643_s1831_s1741_r4829_r4540_p1344
 - mc12_8TeV.189434.MadgraphPythia_AU2_CTEQ6L1_H300_hh_yybb.merge.e2643_s1831_s1741_r4829_r4540_p1344
 - mc12_8TeV.189435.MadgraphPythia_AU2_CTEQ6L1_H350_hh_yybb.merge.e2643_s1831_s1741_r4829_r4540_p1344
 - mc12_8TeV.189436.MadgraphPythia_AU2_CTEQ6L1_H500_hh_yybb.merge.e2643_s1831_s1741_r4829_r4540_p1344
 - mc12_8TeV.189437.MadgraphPythia_AU2_CTEQ6L1_H1000_hh_yybb.merge.e2643_s1831_s1741_r4829_r4540_p1344
 - mc12_8TeV.189432.MadgraphPythia_AU2_CTEQ6L1_sm_hh_yybb.merge.e2643_s1831_s1741_r4829_r4540_p1344

2HDM VBF [central/private prod]

- VBF H (D3PD) 4/4 samples ready:
 - mc12_8TeV.189506.PowhegPythia8_AU2CT10_VBFH500_hh_bbyy.merge.NTUP_PHOTON.e2730_s1773_s1776_r4485_r4540_p1344
 - mc12_8TeV.189507.PowhegPythia8_AU2CT10_VBFH1000_hh_bbyy.merge.NTUP_PHOTON.e2730_s1773_s1776_r4485_r4540_p1344
 - mc12_8TeV.189504.PowhegPythia8_AU2CT10_VBFH500_hh_bb.bb.merge.NTUP_COMMON.e2730_s1773_s1776_r4485_r4540_p1575
 - mc12_8TeV.189505.PowhegPythia8_AU2CT10_VBFH1000_hh_bbbb.merge.NTUP_COMMON.e2730_s1773_s1776_r4485_r4540_p1575
- The private production is nearly done by Yu
 - bbyy is fully ready in D3PD
 - bbbb close to the end

2HDM Hhh->WhadWhadyy

- Signal = $\sigma(gg \rightarrow H) * Br(H \rightarrow hh) * Br(h \rightarrow WW) * BR(W \rightarrow qq)^2 * Br(h \rightarrow \gamma\gamma) * 2 * Lumi$

Type I 8TeV Sin(b-a)=0.99875	tanb=1	tanb=0.1	tanb=5	Bbyy Upper limit
$\sigma(gg \rightarrow H)$	3.08	337.59	0.08	23.44
$Br(H \rightarrow hh)$	0.1493	0.1493	0.1493	0.1493
$Br(h \rightarrow WW)$	0.223	0.223	0.223	0.223
$BR(W \rightarrow qq)$	0.676	0.676	0.676	0.676
$Br(h \rightarrow \gamma\gamma)$	0.00228	0.00228	0.00228	0.00228
Lumi	2.03E+004	2.03E+004	2.03E+004	2.03E+004
N(evt)	4.34	475.45	0.11	33.02

mh=125.5GeV mH=300GeV, sin(b-a)=0.901314, thdm_grid_v160.root

*<https://twiki.cern.ch/twiki/bin/view/LHCPhysics/CERNYellowReportPageBR3>

*arXiv:1312.5571v2 [hep-ph] 28 Jan 2014

2HDM Hhh->WhadWhadyy

- Signal sample

ATLAS
Pythia8

Cannot produce ggH when using all→H (Jamie)
Cannot produce ggH when setting only ggH and narrowwidth



Standalone
Pythia8

Cannot produce narrowwidth,
but works well after mod the code
(suggested by the father of Pythia Torbjörn Sjöstrand)
Also needs a filter to select WWyy (done, working well)

MadGraph5
ATLAS-2HDM

Was studied by Du Chun and me
Found no H→WW process
New package “HeavyScalar” not fully validated yet
Not sure it has H→WW



MadGraph5
Pheno-2HDM

Maybe lack of support within HSG6
Huijun and Du Chun are working on it

2HDM Hhh->WhadWhadyy sample

- Zhang Yu and me produced 3500 events (Pythia8)



Path

/publicfs/atlas/atlasnew/higgs/hh2X/
ggF2HDM-HhhWhadWhadaa/1.lhe/

HhhWhadWhadaa.lhe (txt editor open)

HhhWhadWhadaa.lhe.root (root can open)



Path

/publicfs/atlas/atlasnew/higgs/hh2X/
ggF2HDM-HhhWhadWhadaa/2.evgen/

HhhWhadWhadaa.000001.EVNT.pool.root

HhhWhadWhadaa.000001.EVNT.ntuple.root (root can open)

2HDM Hhh->WhadWhady sample

- Zhang Yu and me produced 3500 events (Pythia8)



Path

/publicfs/atlas/atlasnew/higgs/hh2X/
ggF2HDM-HhhWhadWhadaa/3.simul/

*.root



Path

/publicfs/atlas/atlasnew/higgs/hh2X/
ggF2HDM-HhhWhadWhadaa/4.digiti-reco/

*.root

2HDM Hhh->WhadWhady sample

- Zhang Yu and me produced 3500 events (Pythia8)



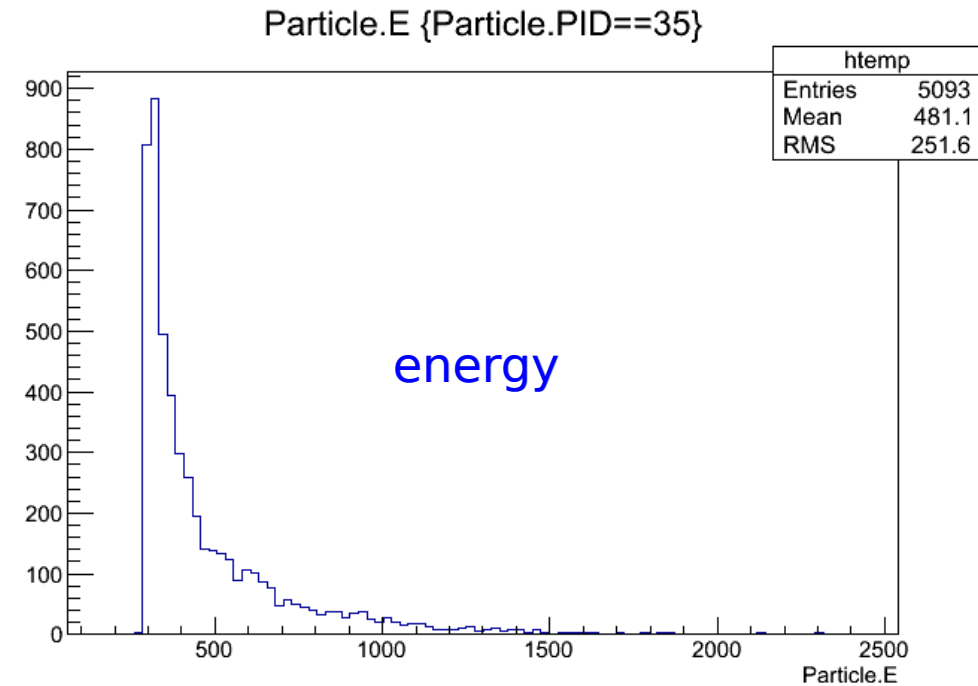
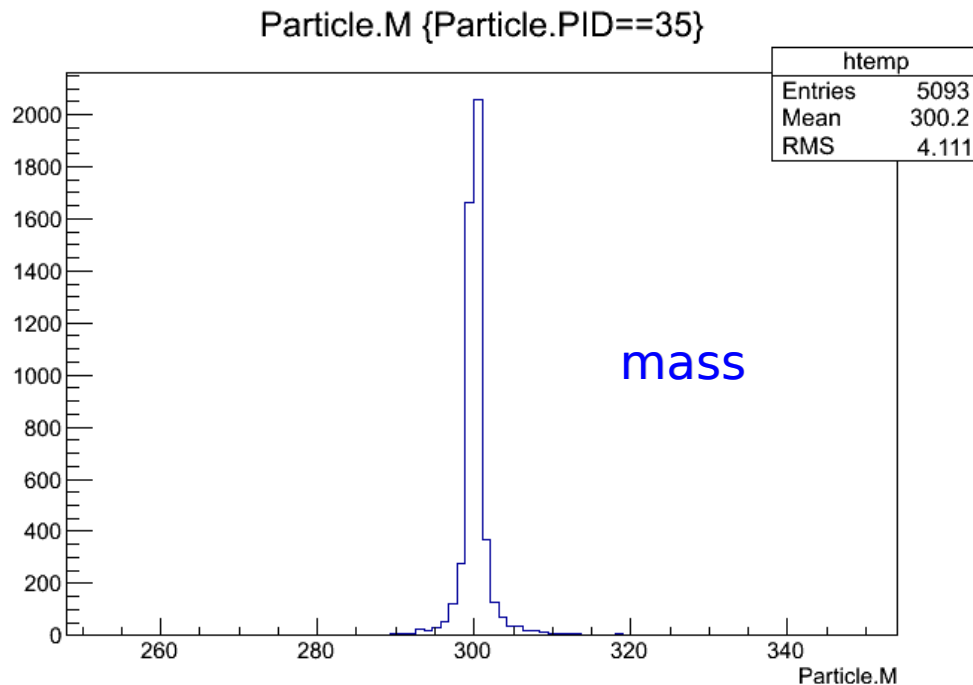
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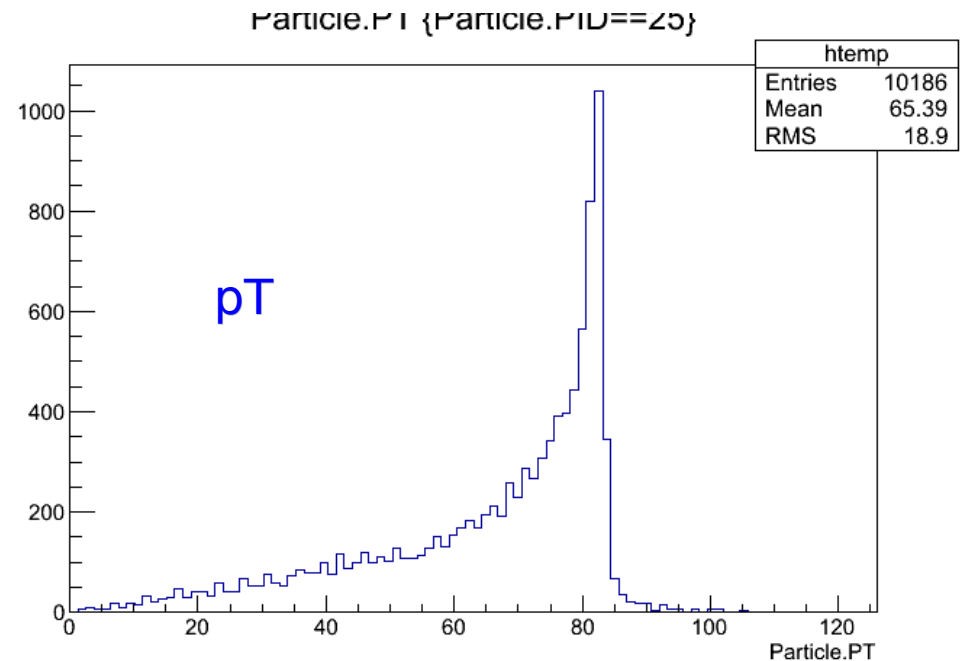
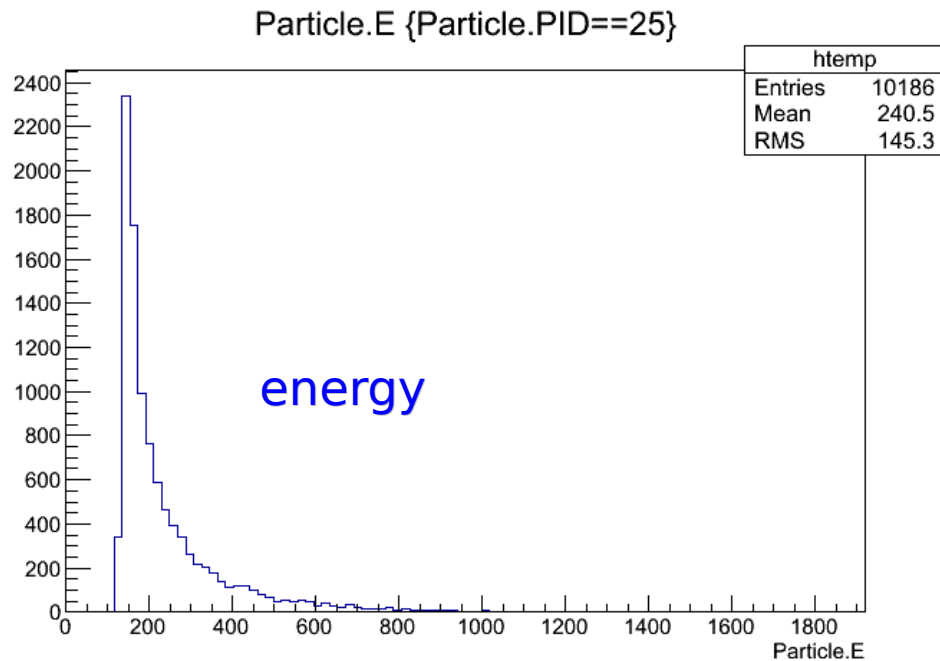
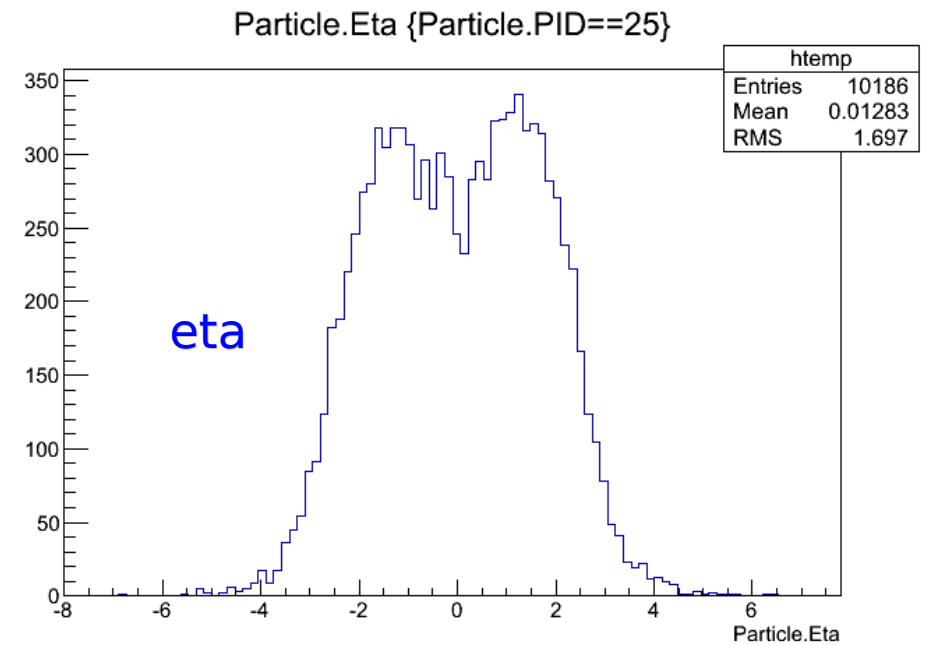
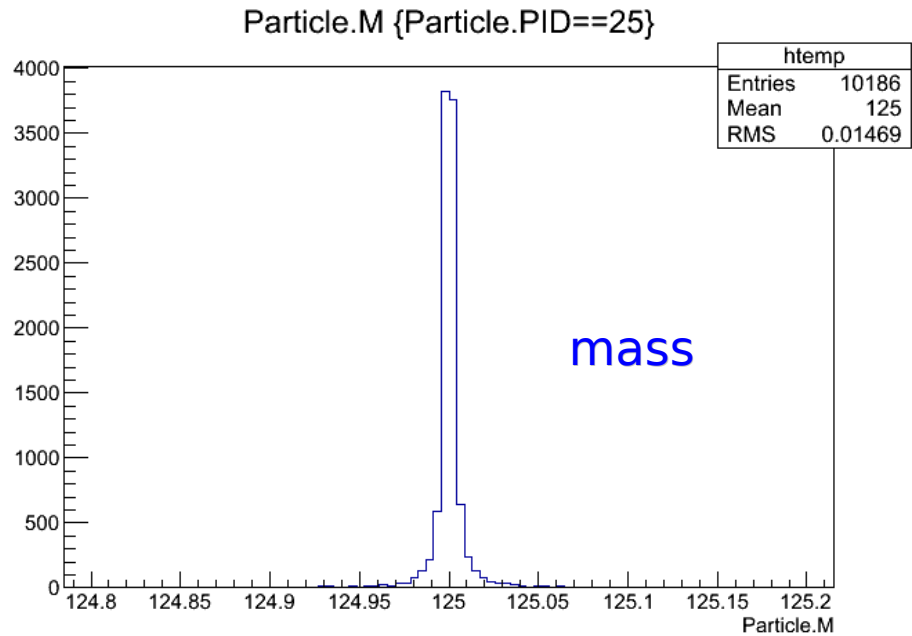
*.root (root can open)

Parton level (Standalone Pythia8)

Parton level – Heavy Higgs

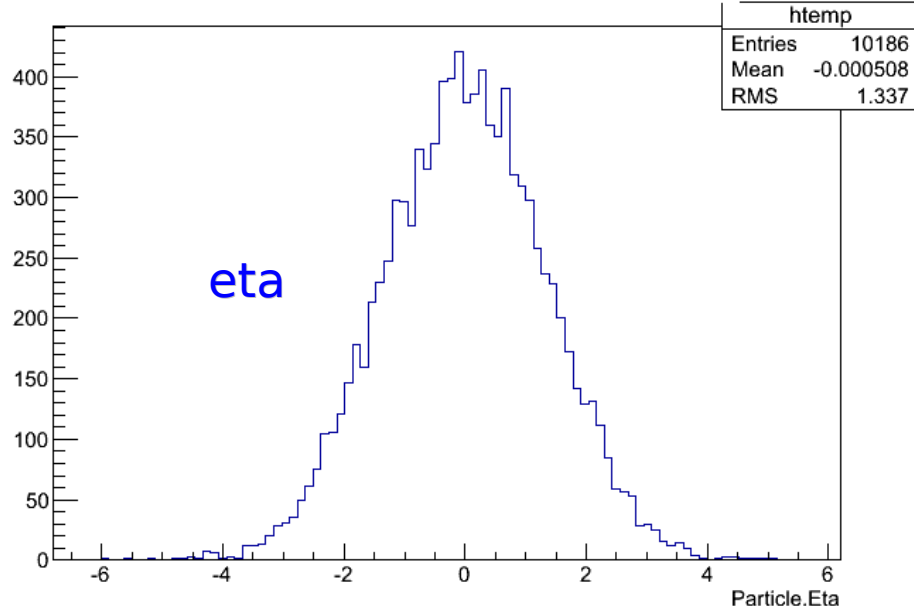


Parton level – SM Higgs

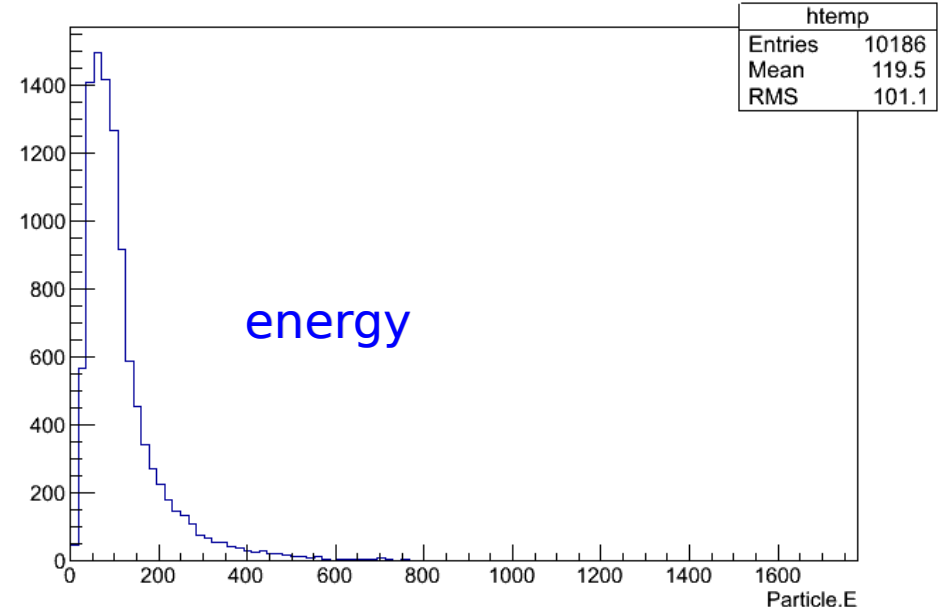


Parton level – gamma

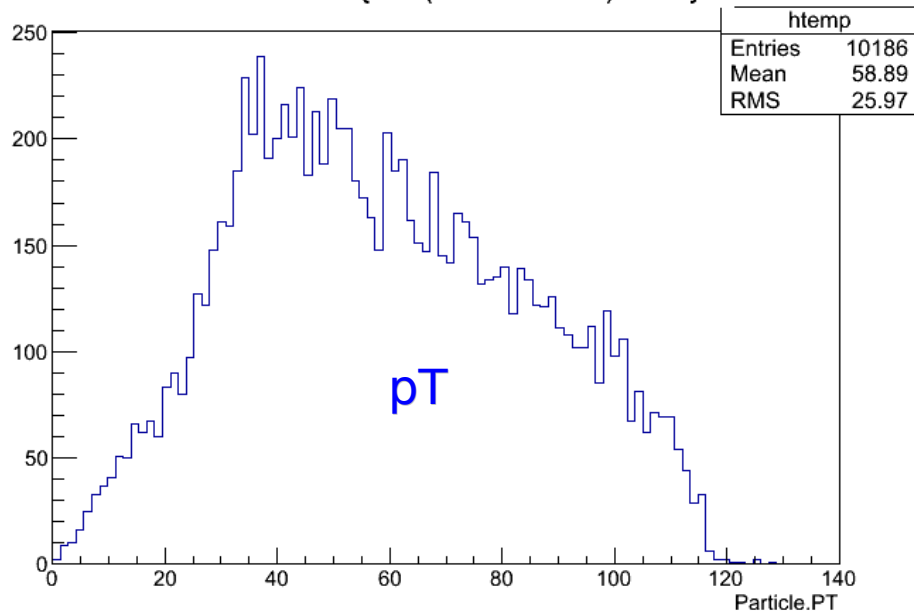
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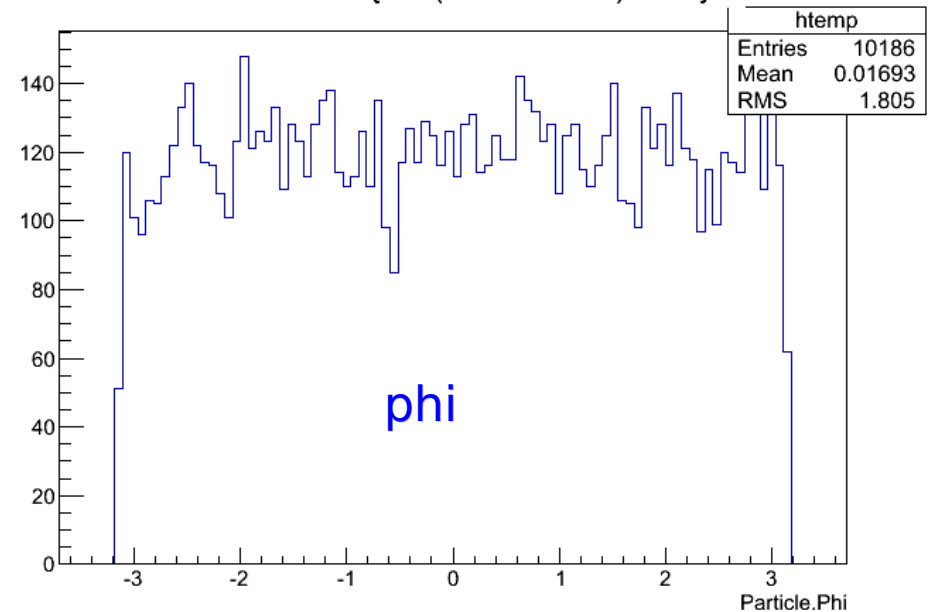
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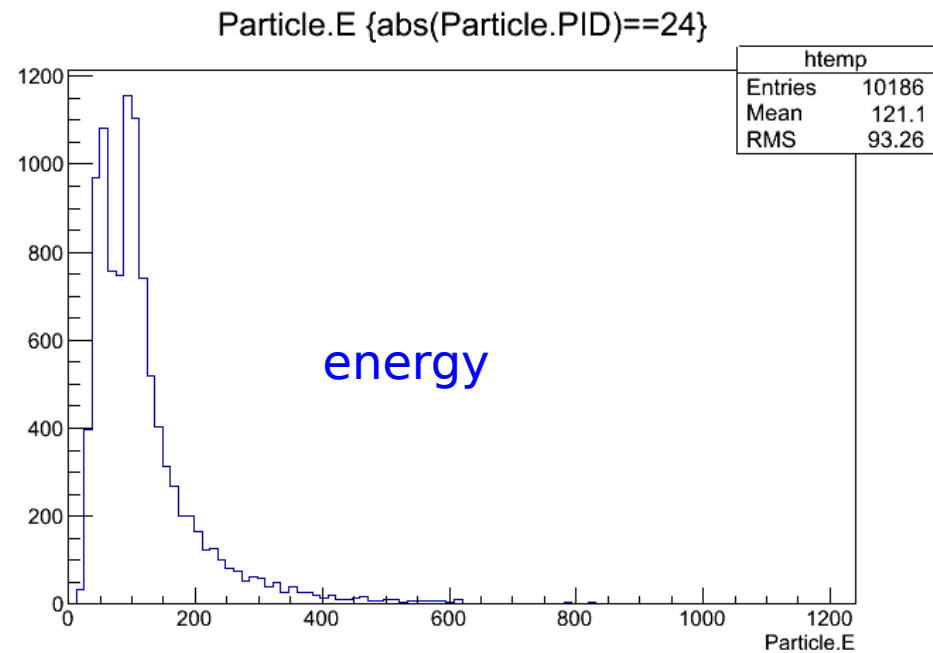
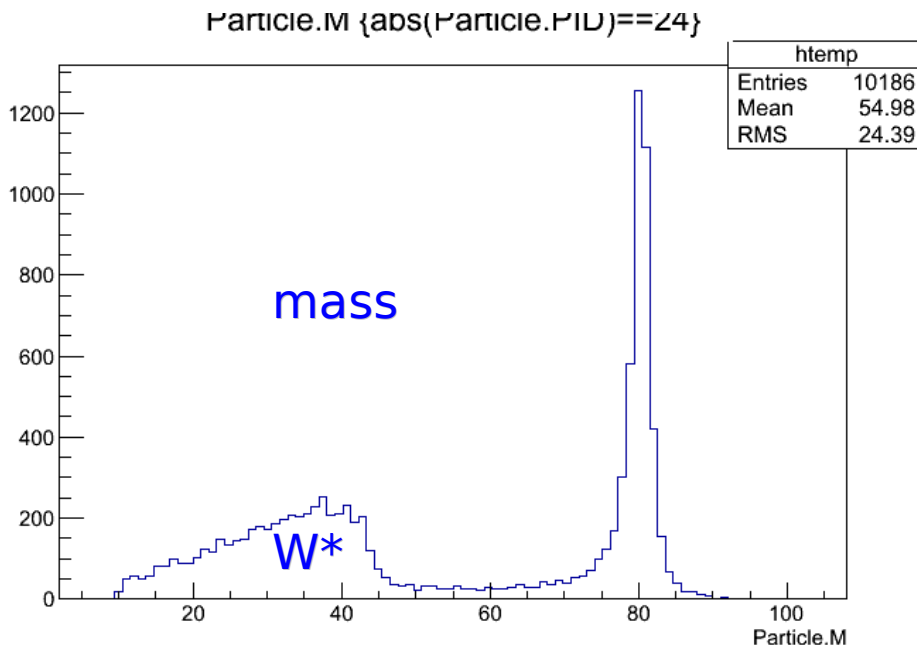
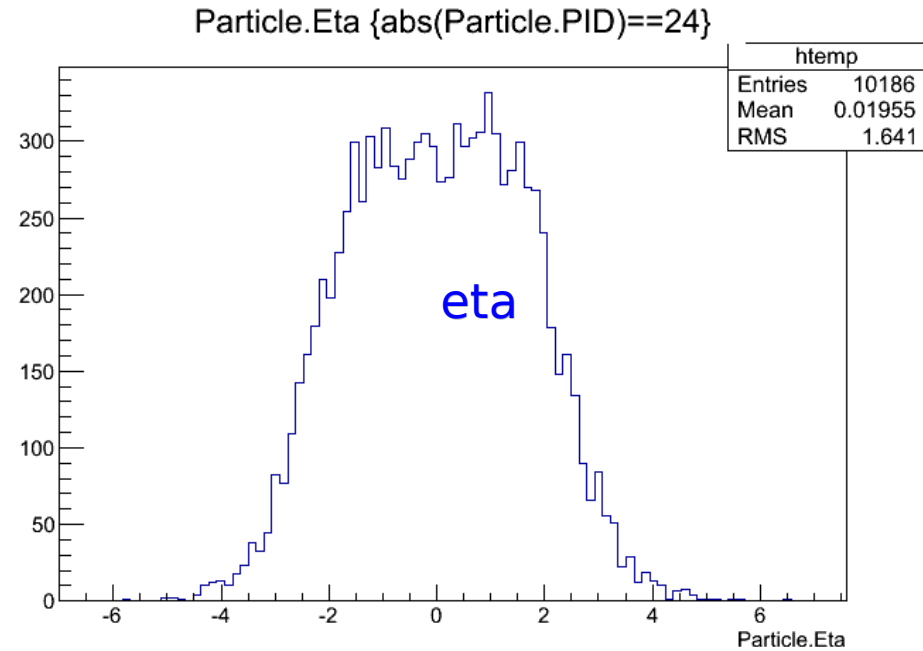
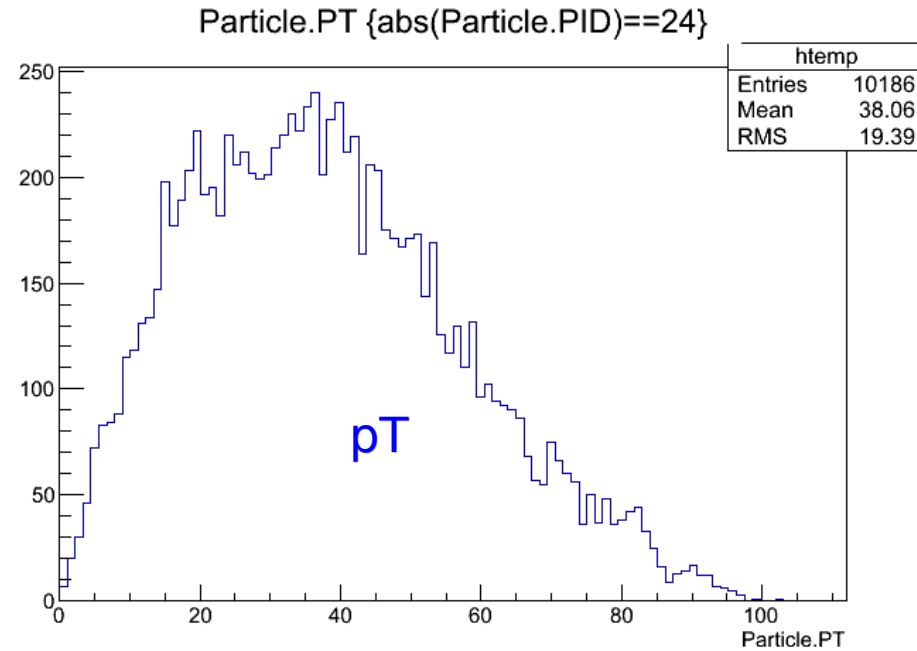
Particle.PT {abs(Particle.PID)==22}



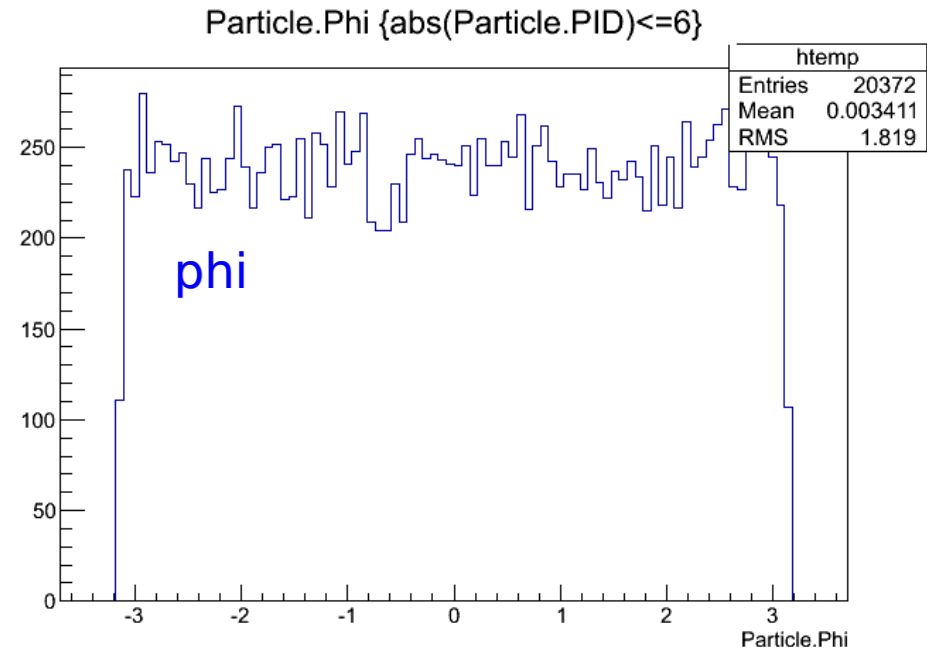
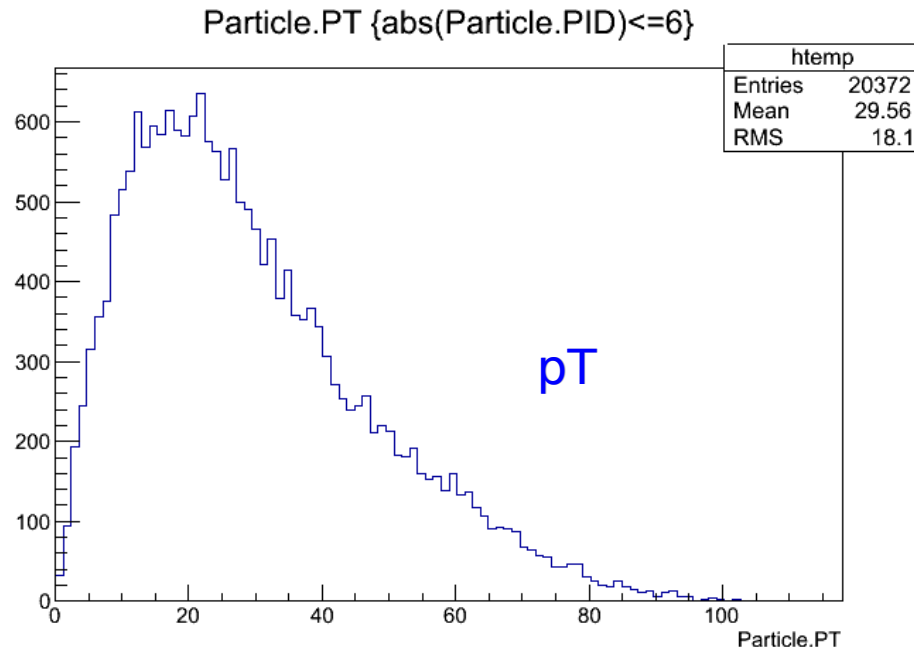
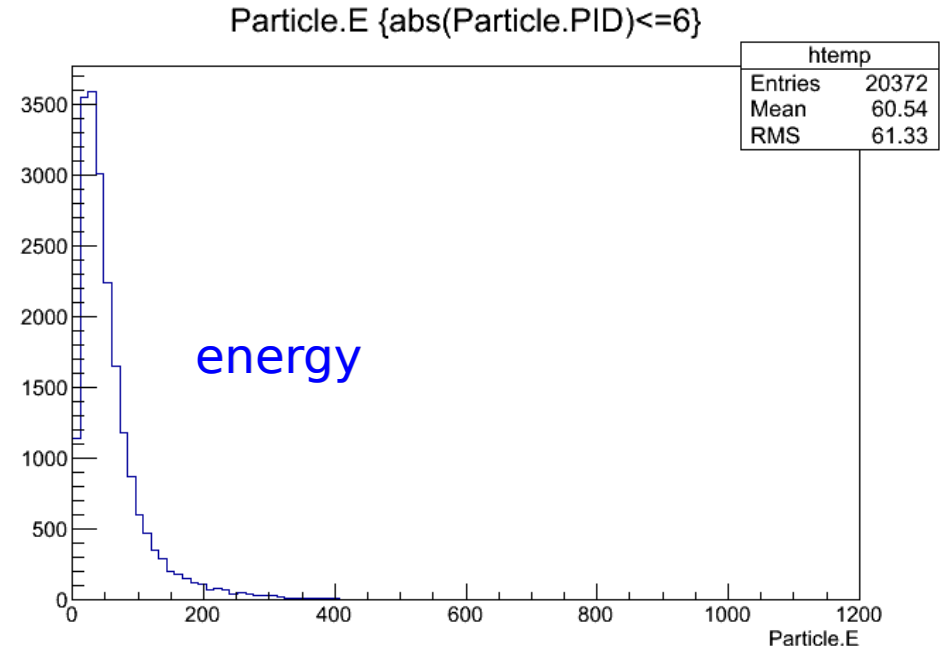
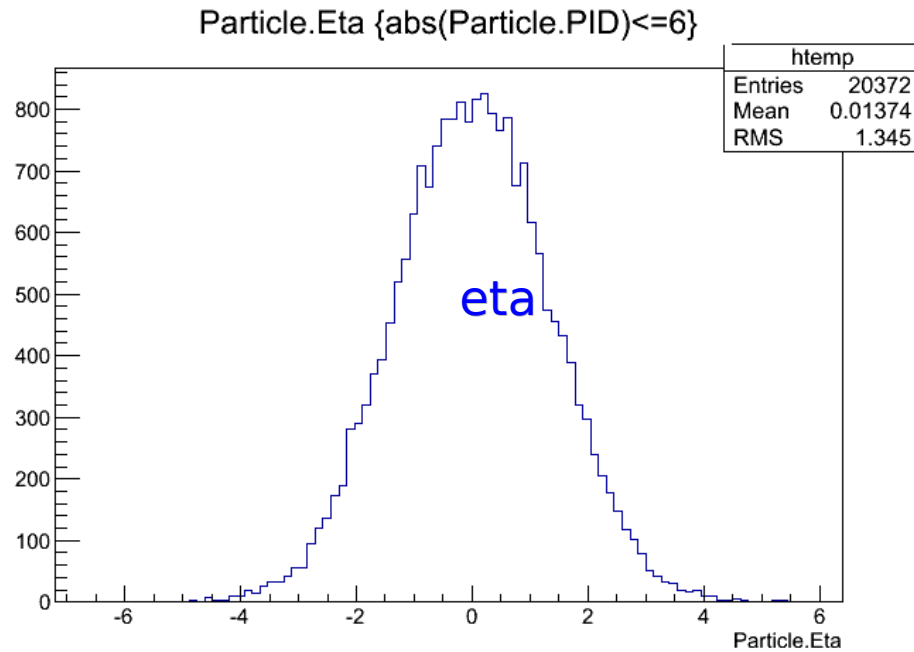
Particle.Phi {abs(Particle.PID)==22}



Parton level – W



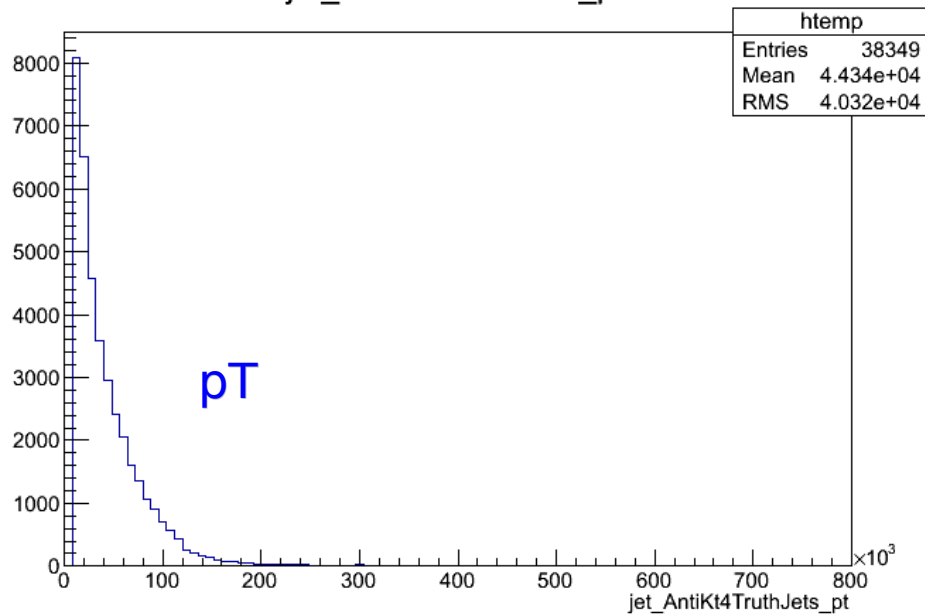
Parton level – quarks (Whad)



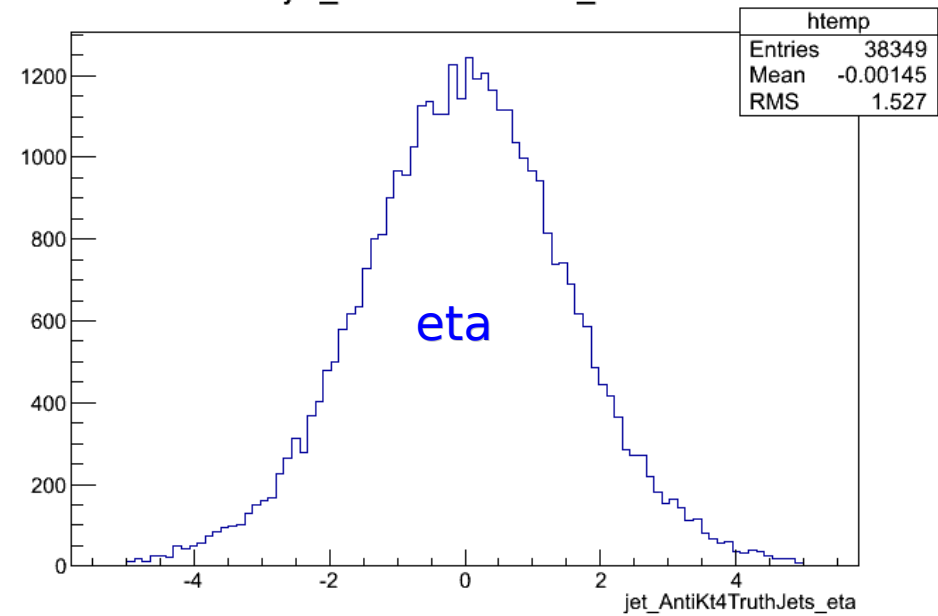
Hadronization (Pythia8)

Hadronization – jets

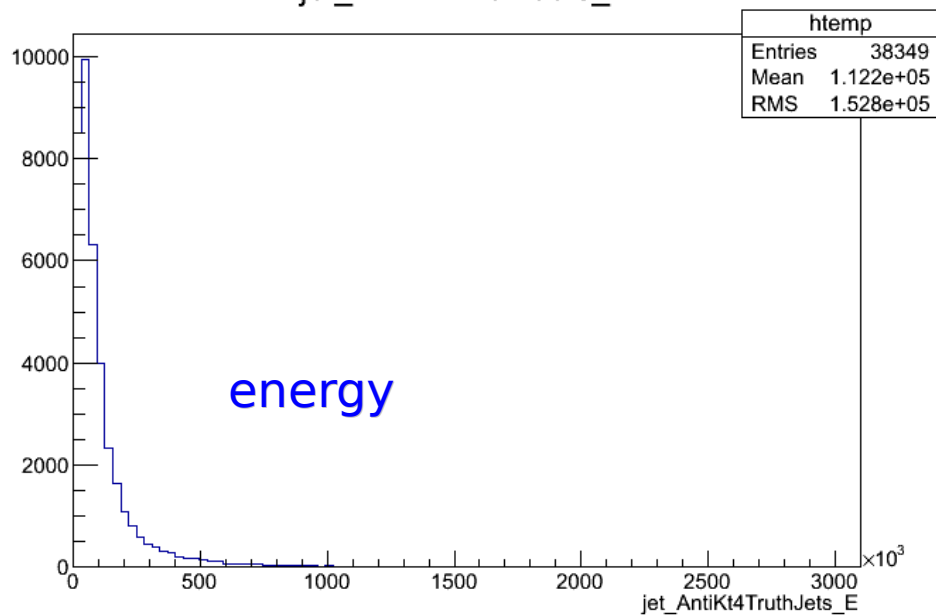
jet_AntiKt4TruthJets_pt



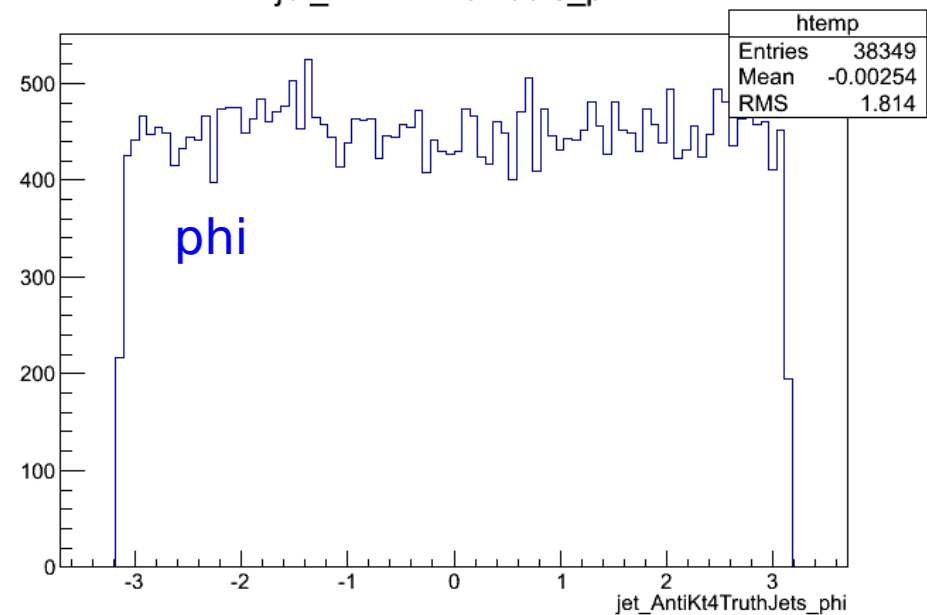
jet_AntiKt4TruthJets_eta



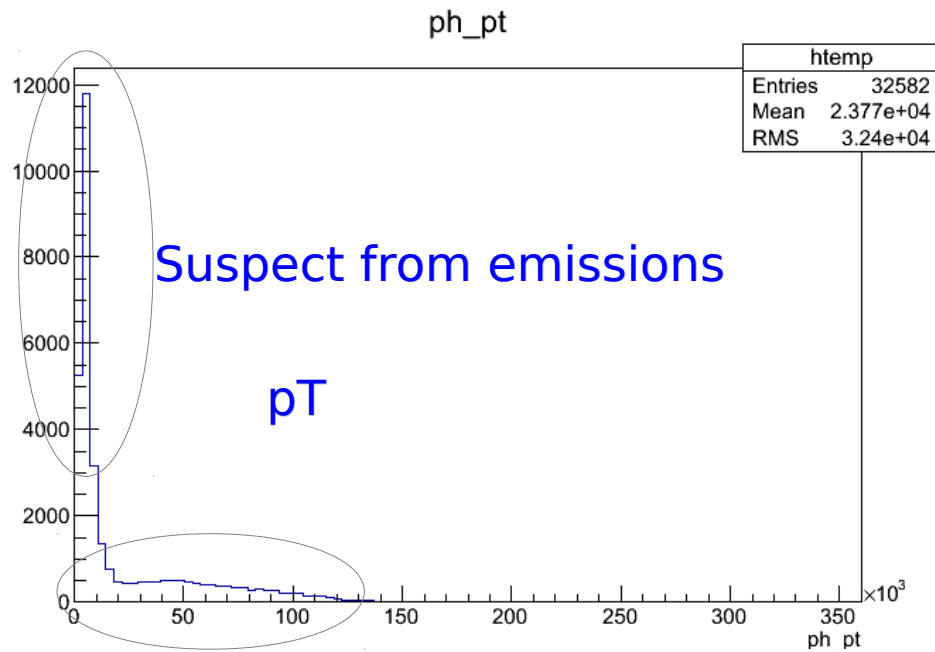
jet_AntiKt4TruthJets_E



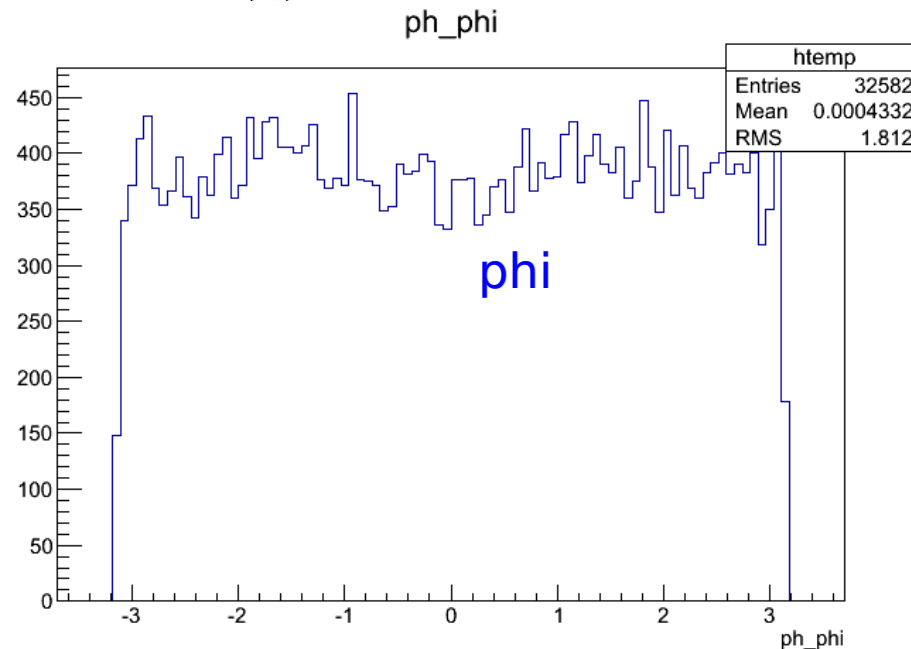
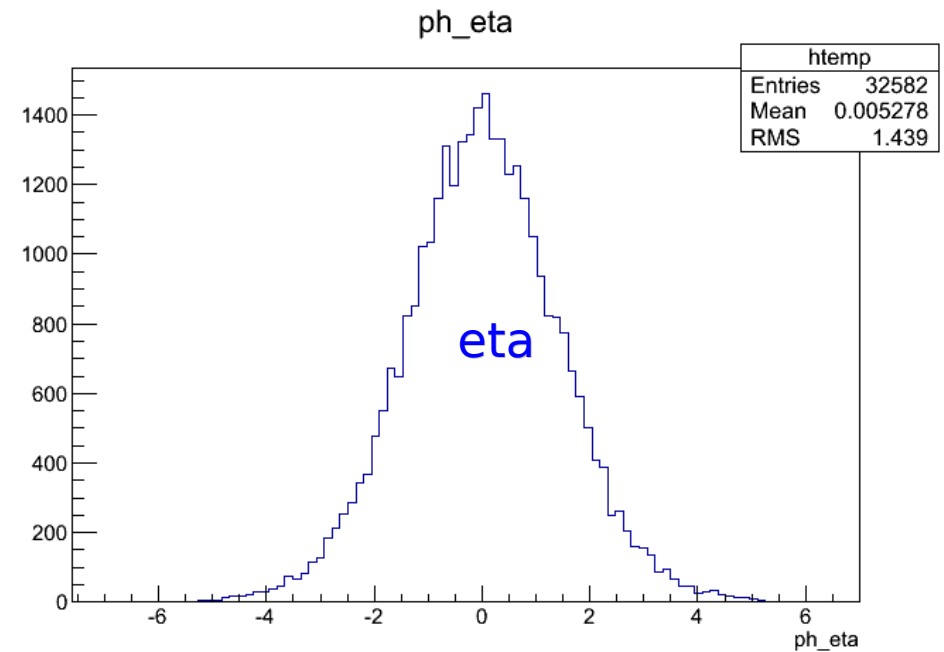
jet_AntiKt4TruthJets_phi



Hadronization – gamma



The real photons

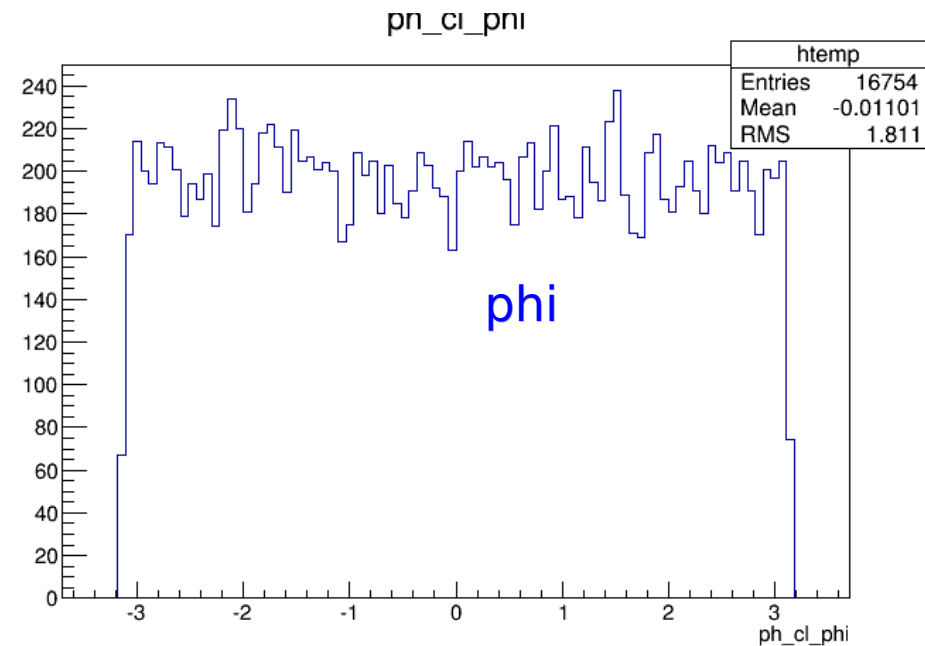
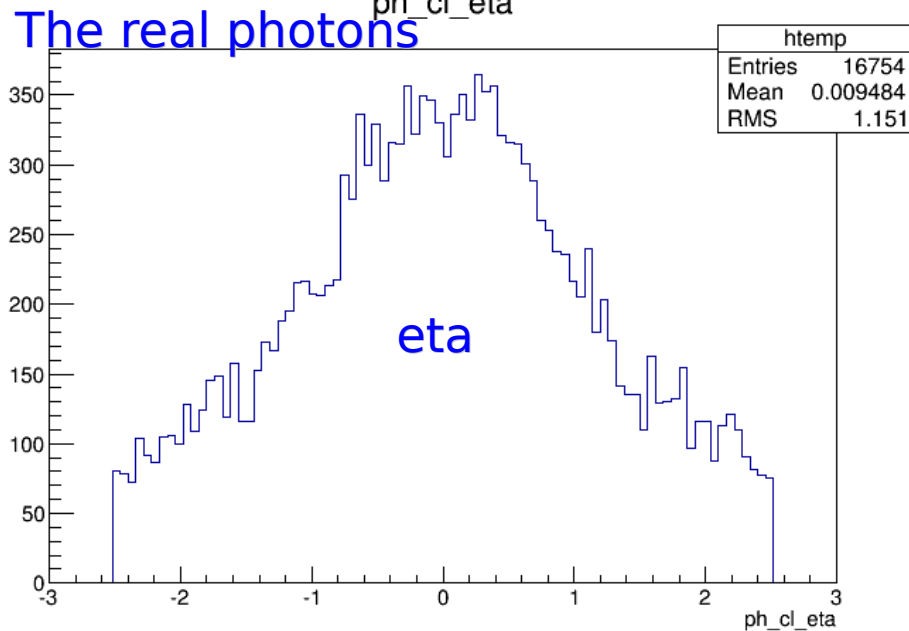
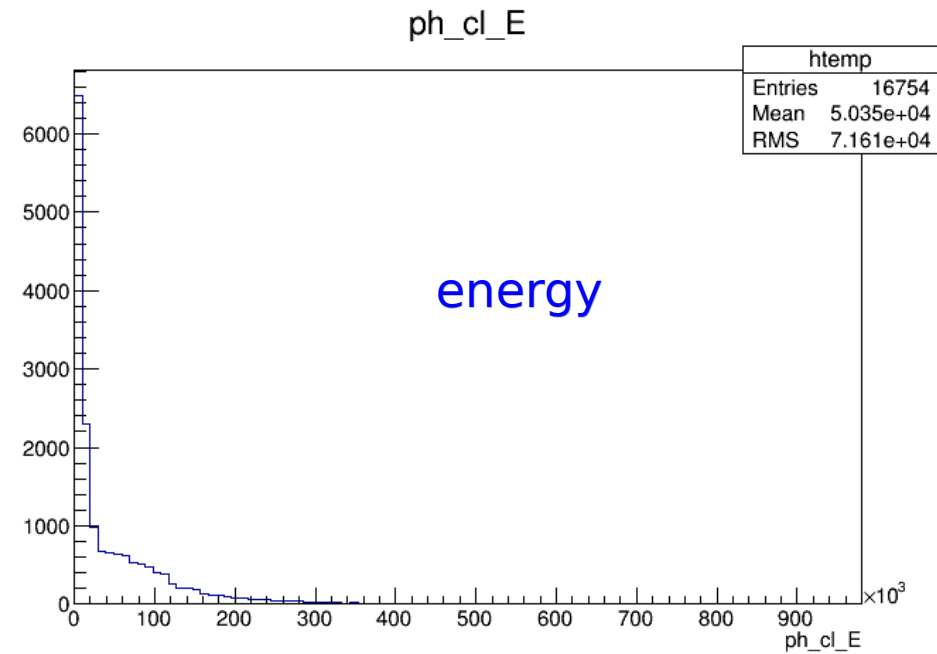
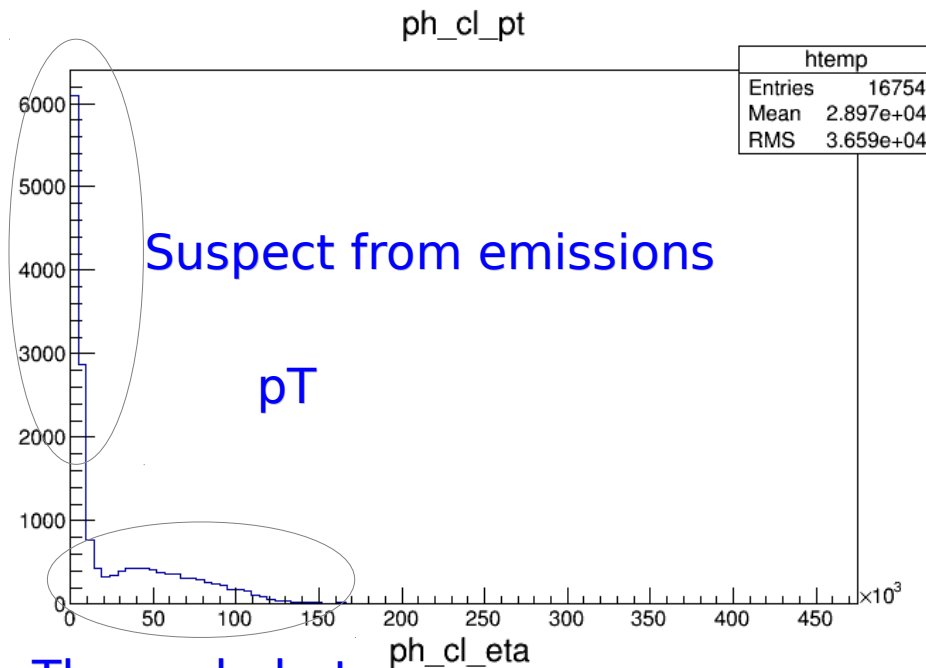


Digit&Reco → D3PD (Pythia8)

Official pileup files have been added properly



Reco D3PD – gamma



Reco D3PD – jets and MET

