Top FCNC at LHeC and FCC-he

O.Cakir (AU), A.Senol (AIBU), H.Denizli (AIBU),
A.Yilmaz (GU), I.Turk Cakir (GU), H.Karadeniz (GU)

collaboration with LHeC / FCC-he top physics group

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TOP QUARK FCNC INTERACTIONS

- The top quark FCNC interactions would be a good test of new physics at present and future colliders. These interactions can be described by the effective Lagrangian

$$\mathcal{L}_{FCNC} = \sum_{q=u,c} \frac{g_s}{2m_t}\bar{q}\lambda^a\sigma^{\mu\nu}(\zeta^L_{qt}P^L + \zeta^R_{qt}P^R)tG^a_{\mu\nu} - \frac{1}{\sqrt{2}}\bar{q}(\eta^L_{qt}P^L + \eta^R_{qt}P^R)tH -$$

$$-\frac{g_W}{2c_W}\bar{q}\gamma^\mu(X^L_{qt}P_L + X^R_{qt}P_R)tZ_\mu + \frac{g_W}{4c_W m_Z}\bar{q}\sigma^{\mu\nu}(K^L_{qt}P_L + K^R_{qt}P_R)tZ_{\mu\nu} +$$

$$+\frac{e}{2m_t}\bar{q}\sigma^{\mu\nu}(\lambda^L_{qt}P_L + \lambda^R_{qt}P_R)tA_{\mu\nu} + H.c.$$

scaled to top mass

- *J.A.A-S,NPB812(2009)181*

Madgraph: model topFCNC_UFO from FeynRules

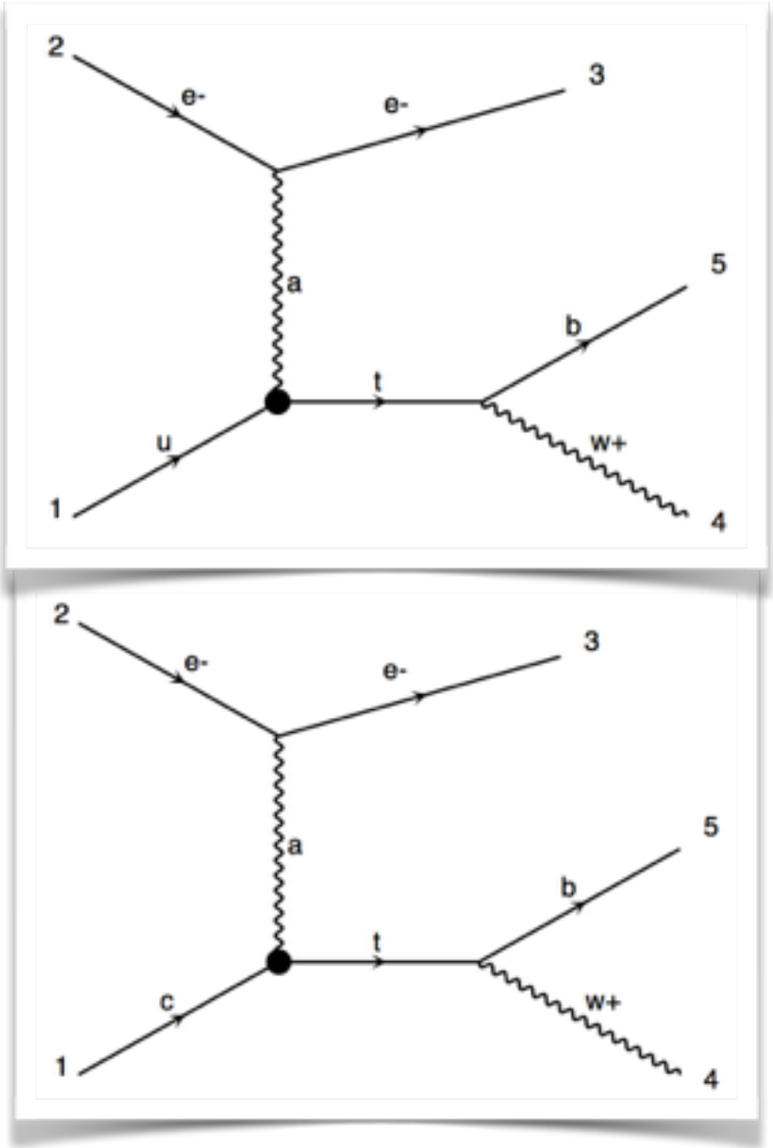
LHEC : DELPHES SIMULATION WITH LHEC CARD

Physics process: p e- >e- ww bb (ww = w + w- and bb = b b~) (includes S+B)

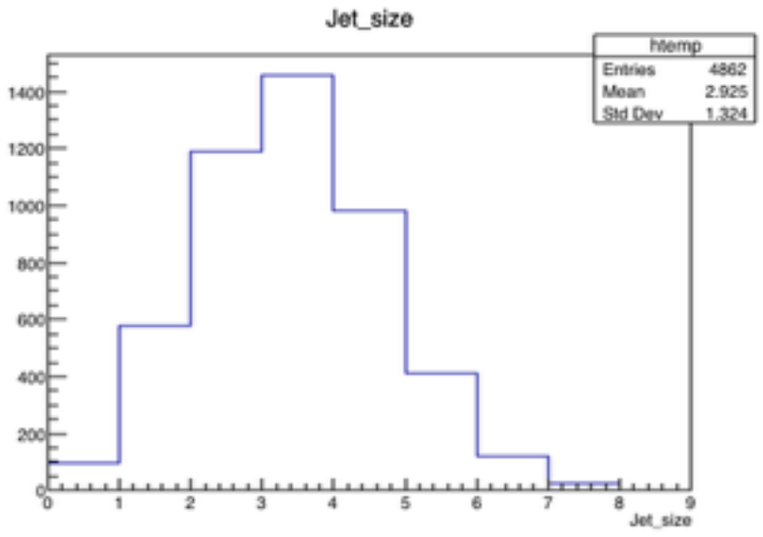
Energy setup: 7000 GeV x 60 GeV

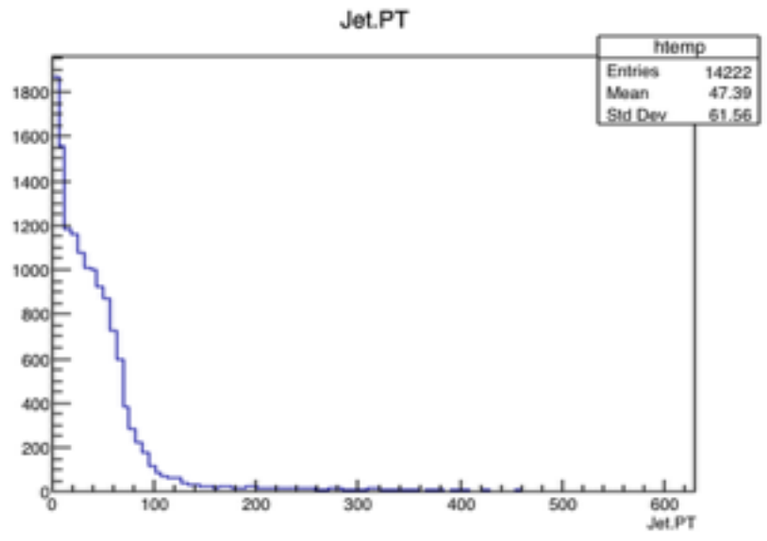
- **Event generation:** MadGraph5_aMC@NLO version 2.5.2
- **Hadronization:** Pythia 8
- **Detector simulation:** Delphes 3.4.0
- **Detector card:** delphes_card_LHeC_PK_V2_eFilter.dat
- **Analysis:** Root6

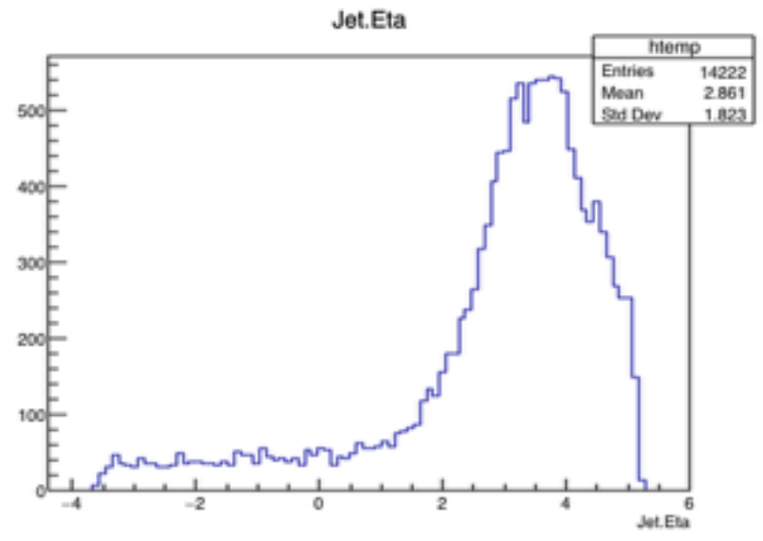
Diagrams for signal (p e- > e- w+ b)

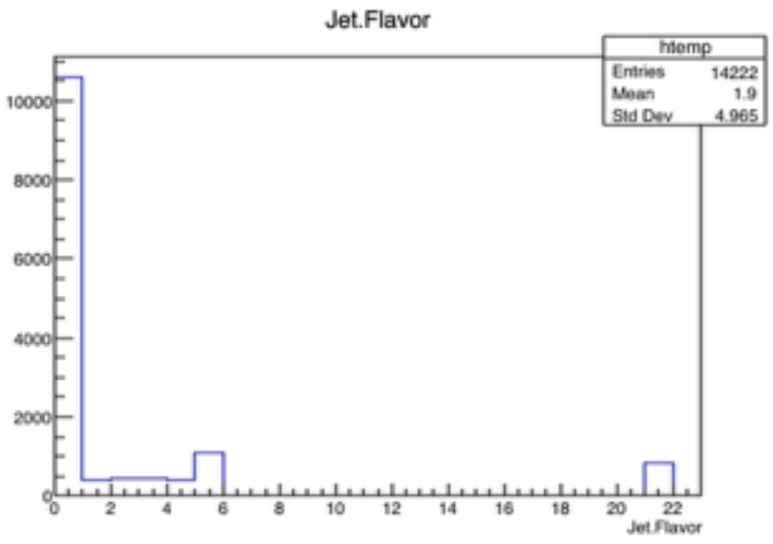


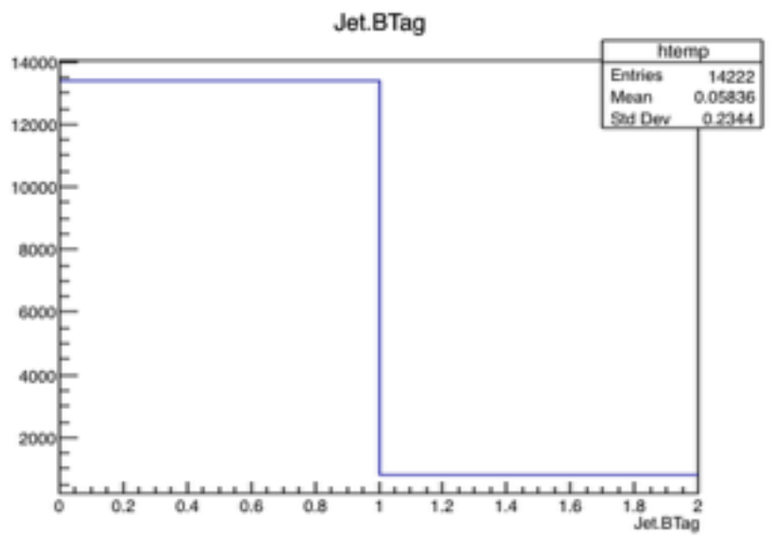
LHEC : JETS


Jet_size
htemp
Entries 4862
Mean 2.925
Std Dev 1.324
Jet_size

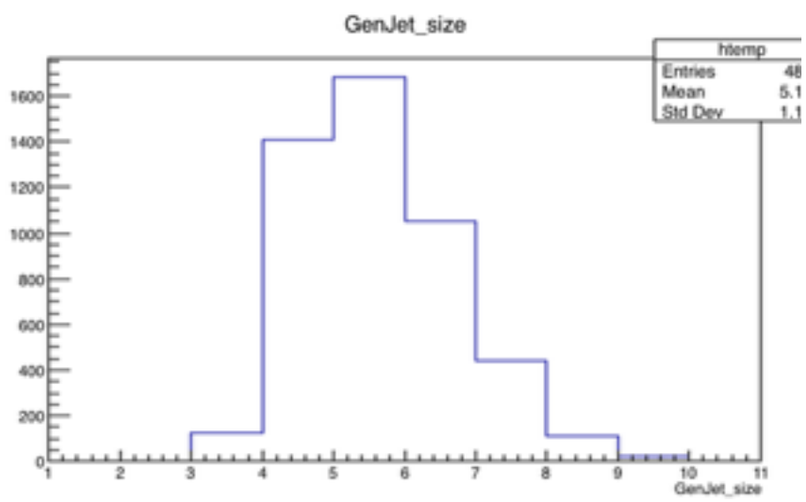

Jet.PT
htemp
Entries 14222
Mean 47.39
Std Dev 61.56
Jet.PT

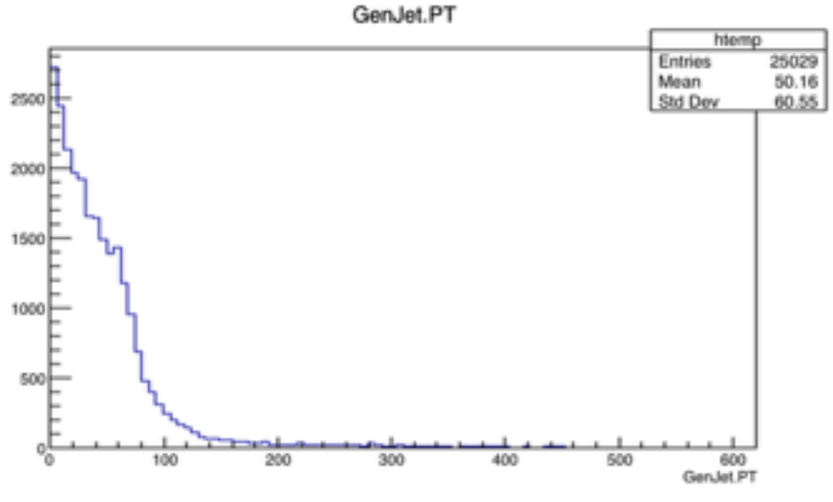

Jet.Eta
htemp
Entries 14222
Mean 2.861
Std Dev 1.823
Jet.Eta

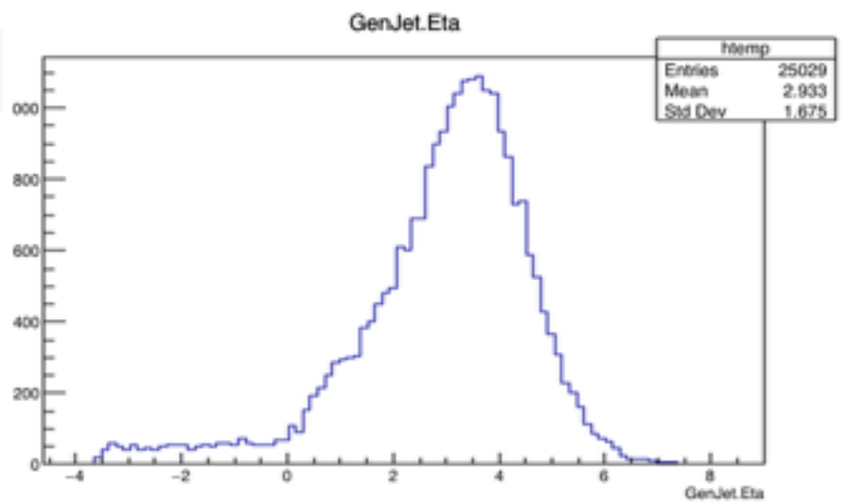

Jet.Flavor
htemp
Entries 14222
Mean 1.9
Std Dev 4.965
Jet.Flavor

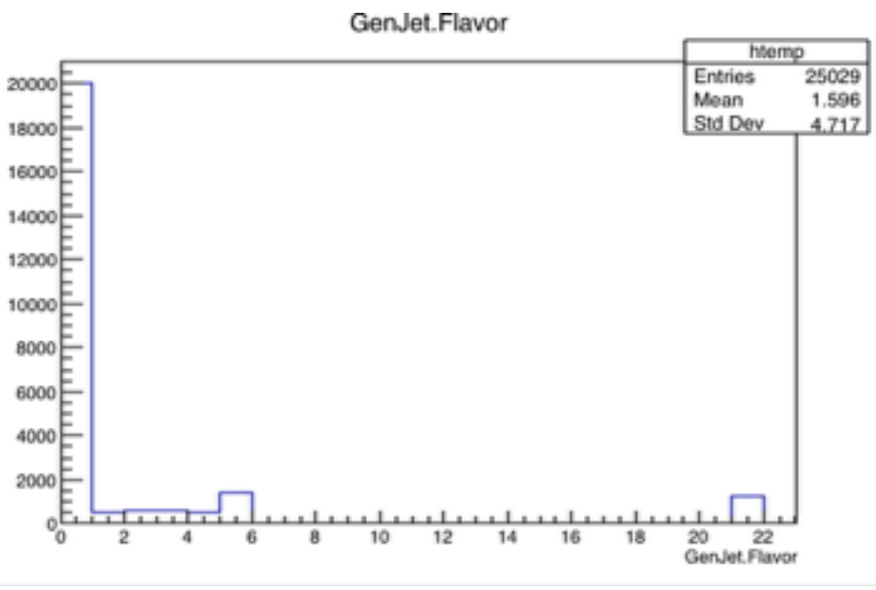

Jet.BTag
htemp
Entries 14222
Mean 0.05836
Std Dev 0.2344
Jet.BTag

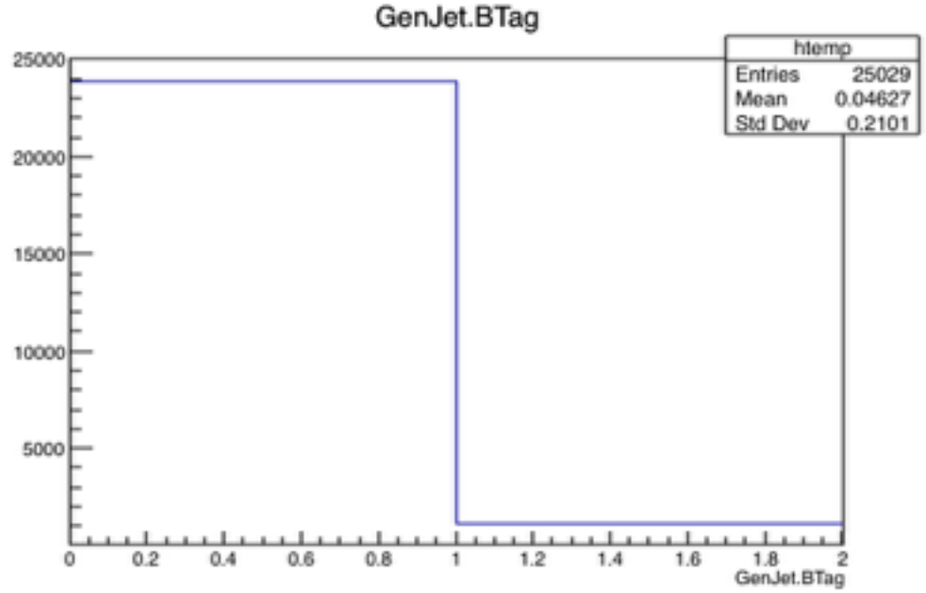
LHEC : GENJET


GenJet_size
htemp
Entries 48
Mean 5.1
Std Dev 1.1
GenJet_size

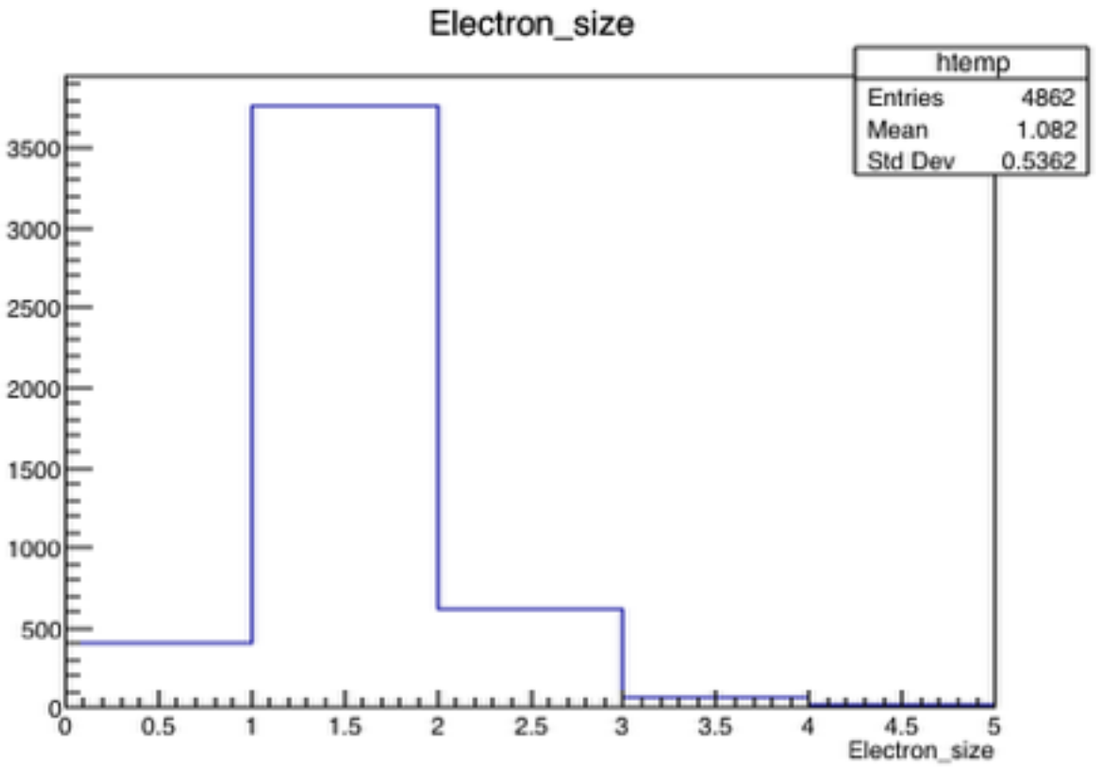

GenJet.PT
htemp
Entries 25029
Mean 50.16
Std Dev 60.55
GenJet.PT

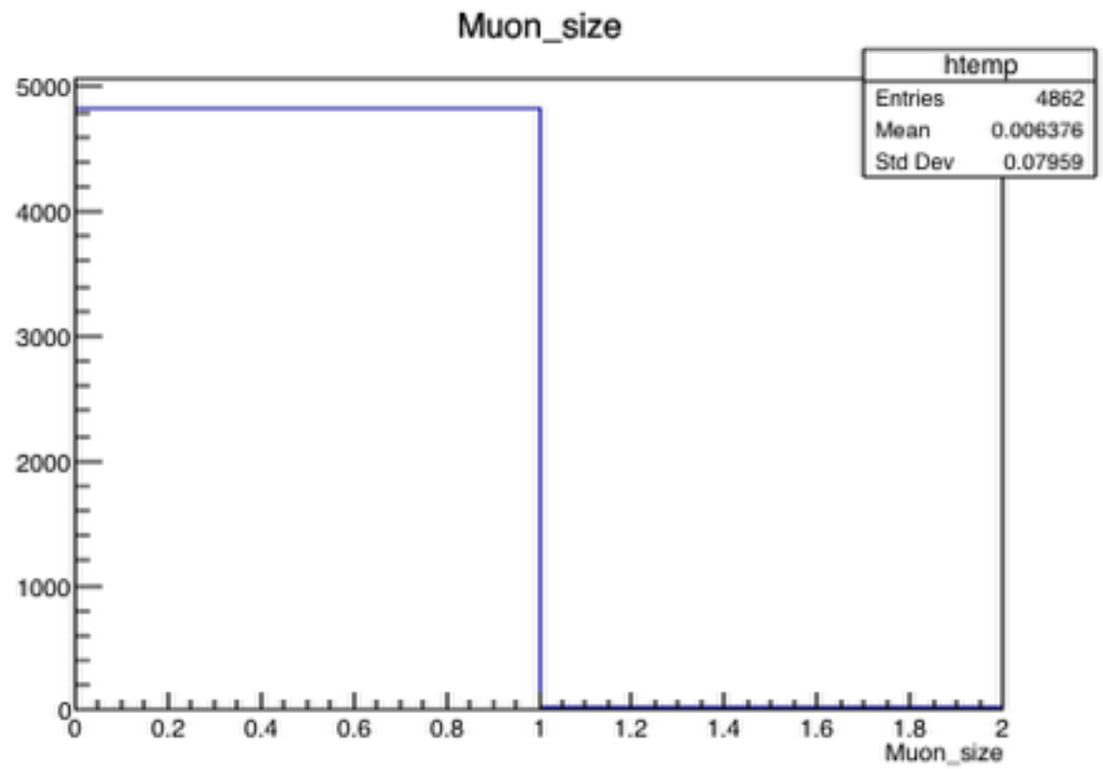

GenJet.Eta
htemp
Entries 25029
Mean 2.933
Std Dev 1.675
GenJet.Eta

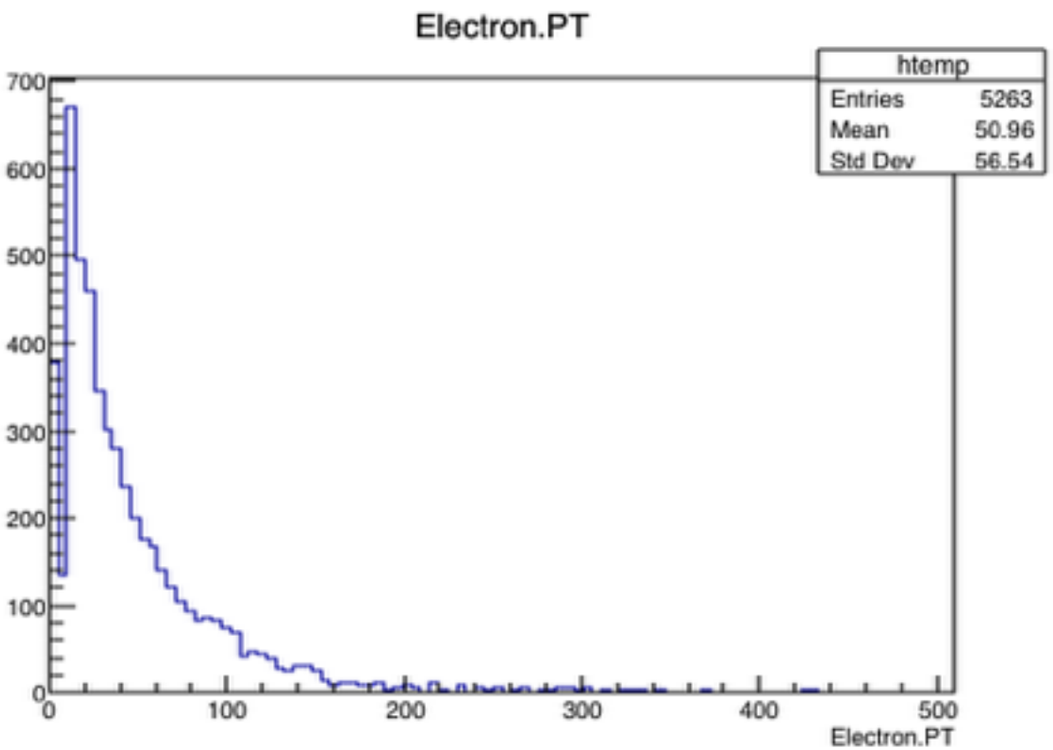

GenJet.Flavor
htemp
Entries 25029
Mean 1.596
Std Dev 4.717
GenJet.Flavor

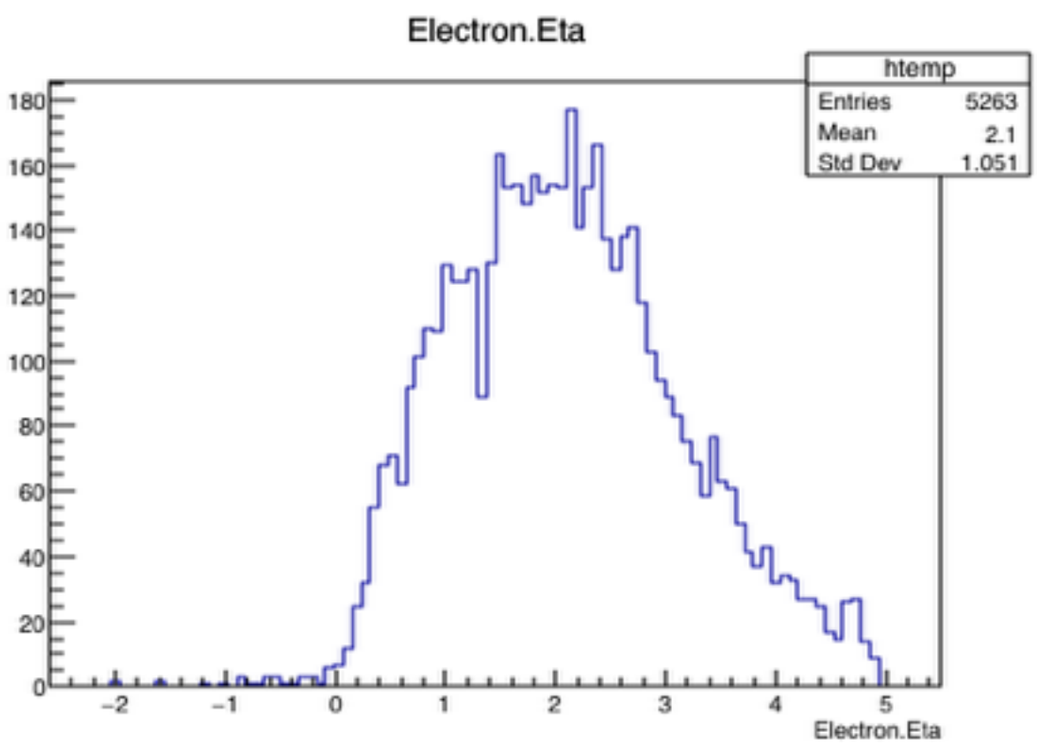

GenJet.BTag
htemp
Entries 25029
Mean 0.04627
Std Dev 0.2101
GenJet.BTag

LHEC : ELECTRON AND MUON

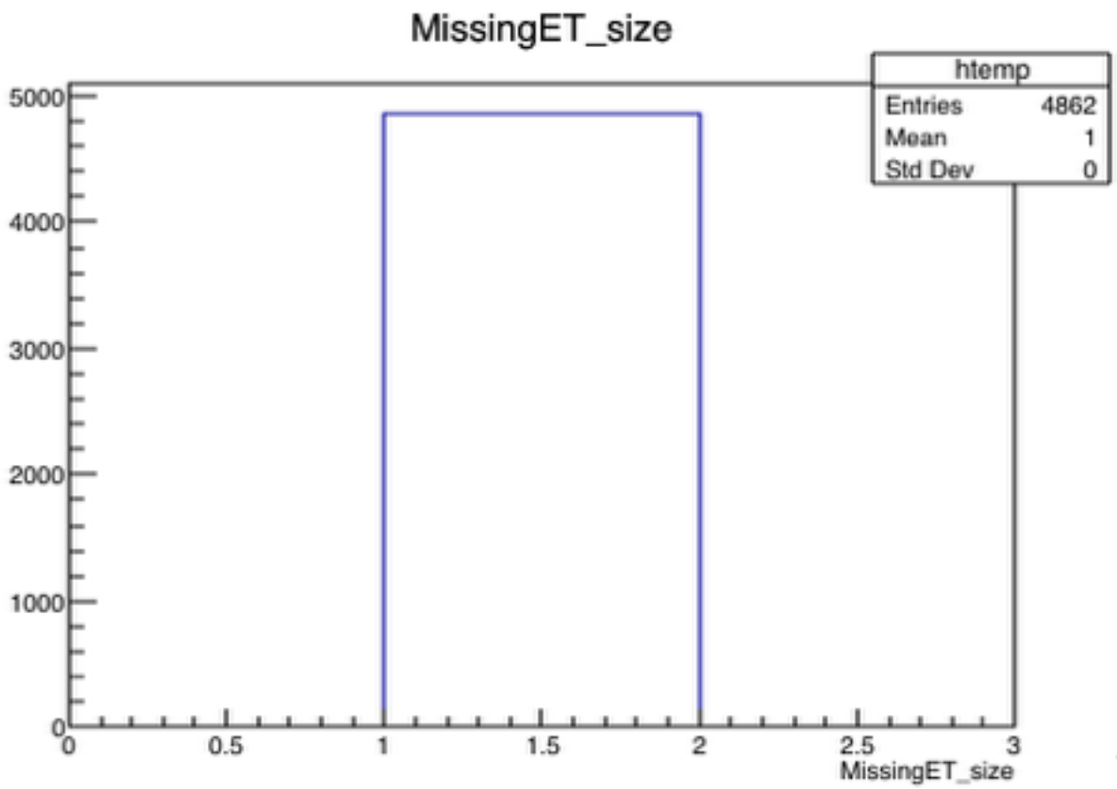








LHEC : MET


MissingET_size
htemp
Entries 4862
Mean 1
Std Dev 0
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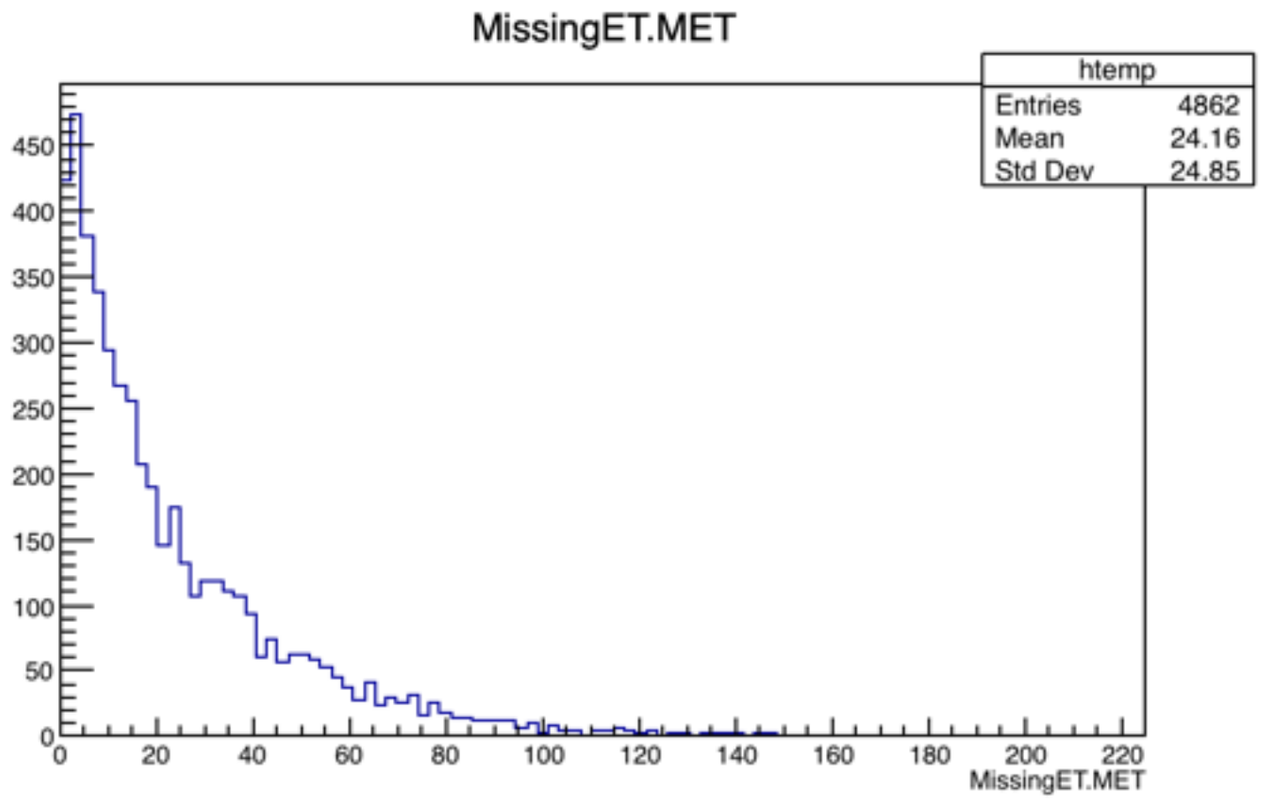
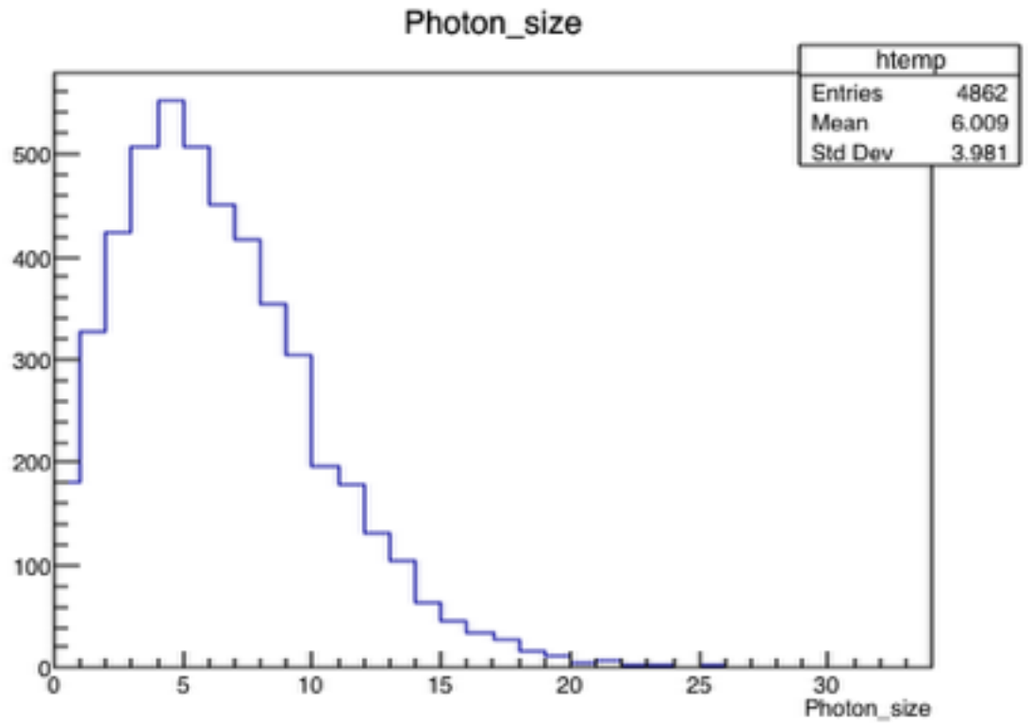
4000
3000
2000
1000
0
0
0.5
1
1.5
2
2.5
3
MissingET_size


MissingET.MET
htemp
Entries 4862
Mean 24.16
Std Dev 24.85
450
400
350
300
250
200
150
100
50
0
0
20
40
60
80
100
120
140
160
180
200
220
MissingET.MET

LHEC: PHOTON


Photon_size
htemp
Entries 4862
Mean 6.009
Std Dev 3.981
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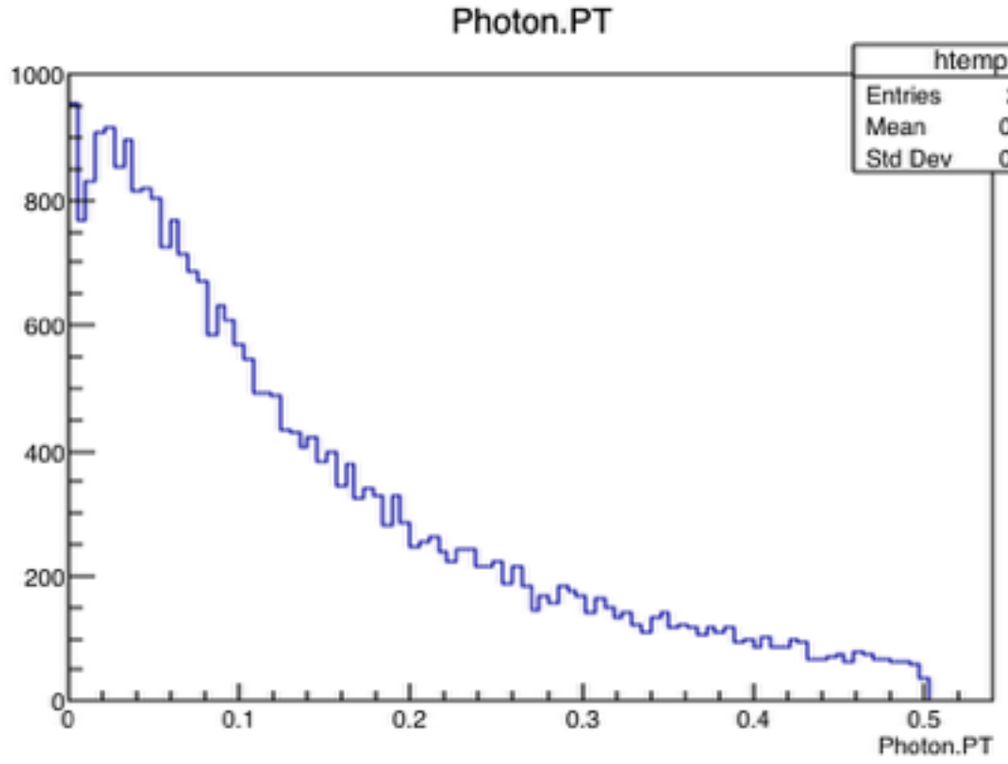
400
300
200
100
0
0
5
10
15
20
25
30
Photon_size


Photon.PT
htemp
Entries 29216
Mean 0.1406
Std Dev 0.1203
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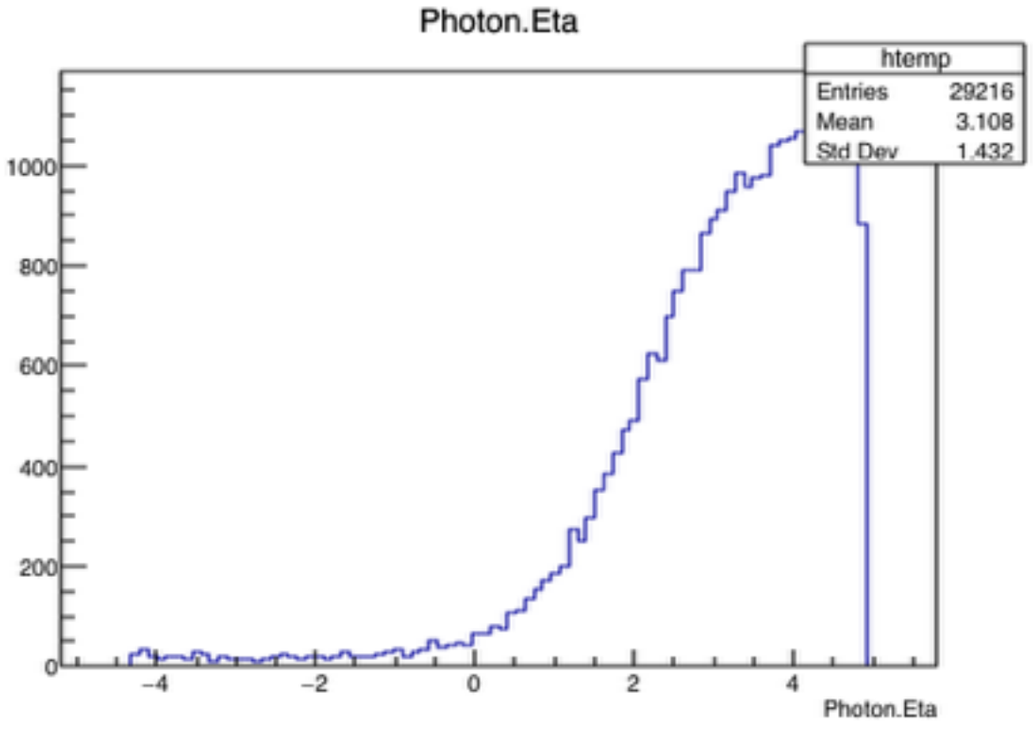
800
600
400
200
0
0
0.1
0.2
0.3
0.4
0.5
Photon.PT


Photon.Eta
htemp
Entries 29216
Mean 3.108
Std Dev 1.432
1000
800
600
400
200
0
−4
−2
0
2
4
Photon.Eta

CONCLUSION

We study process: “p e- > e- ww bb NP=1” (where ww=w+ w- and bb=b b~) (includes S+B)

- For **LHeC detector simulation** we use Delphes with card:
  - delphes_card_LHeC_V2_eFilter.dat (Uta has sent) for LHeC detector
  - Distributions for jet size, electron size, pT, eta, …
- Jet size is as expected
- BTag size is low
- Muon size is low (expectation from W leptonic decay)
- Photons have very low pT

Comments:

- Important improvement to previous versions
- Possible to study through validation procedure (available in Delphes version 3.4)

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