Task 4, Higgs to gammatautau

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Signal Production

- Typical ATLAS/CMS setup is lhe files produced by dedicated generator.
- Powheg box H+j used for this.
- Then decayed with Pythia8 to HEPMC3.
- Delphes with CMS card used to emulate the detector.
- This part is running well now.

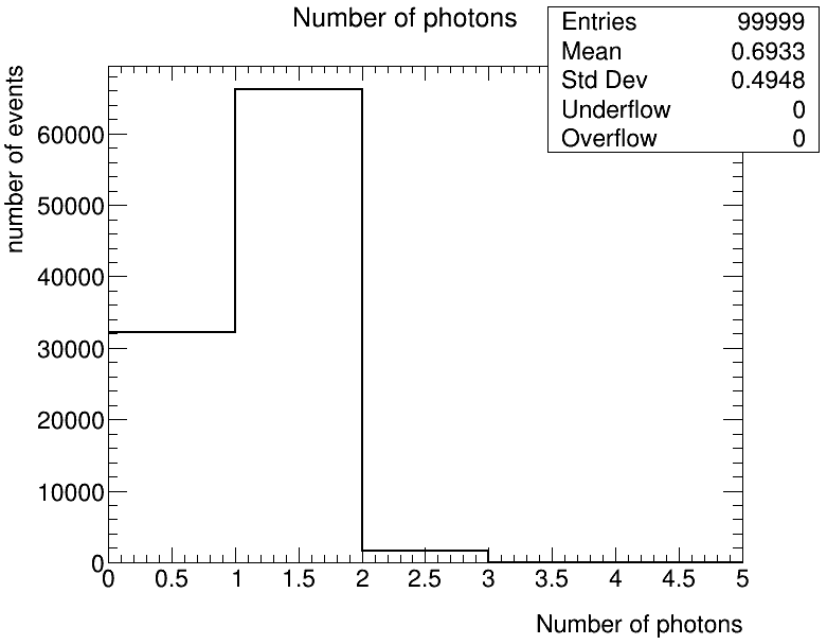
Specifics

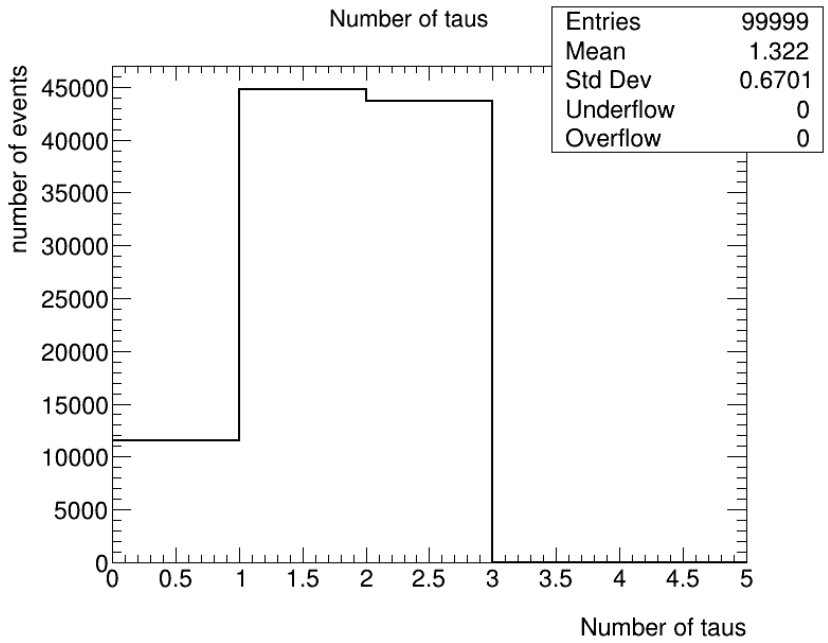
- Use default muon/electron/gamma efficiencies, eta and pt dependent.
- Allow taus to have 100% efficiency, so that we don't throw away too many events.
- From Delphes output have access to rudimentary reconstructed and truth information.
- Transform into flat root format, Delphes format is based on root, but requires Delphes-specific libraries to run.

Difficulties

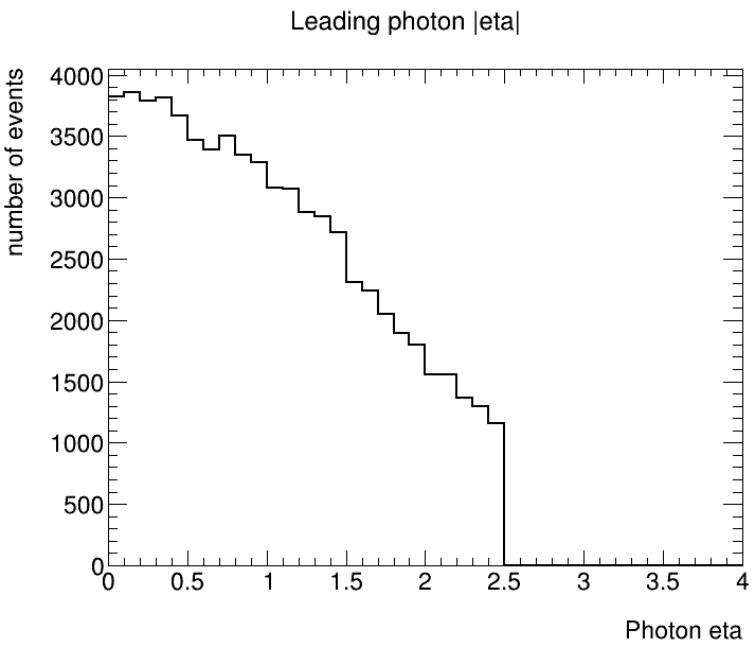
- No truth links from true taus to reco taus (that I can see at least).
- Have to do geometric matching between reco/truth.
- For $H \rightarrow \tau_{had}\tau_{had}$ it looks relatively good even without matching.
- Work ongoing on lephad and leplep (more neutrinos, more combinatorics).

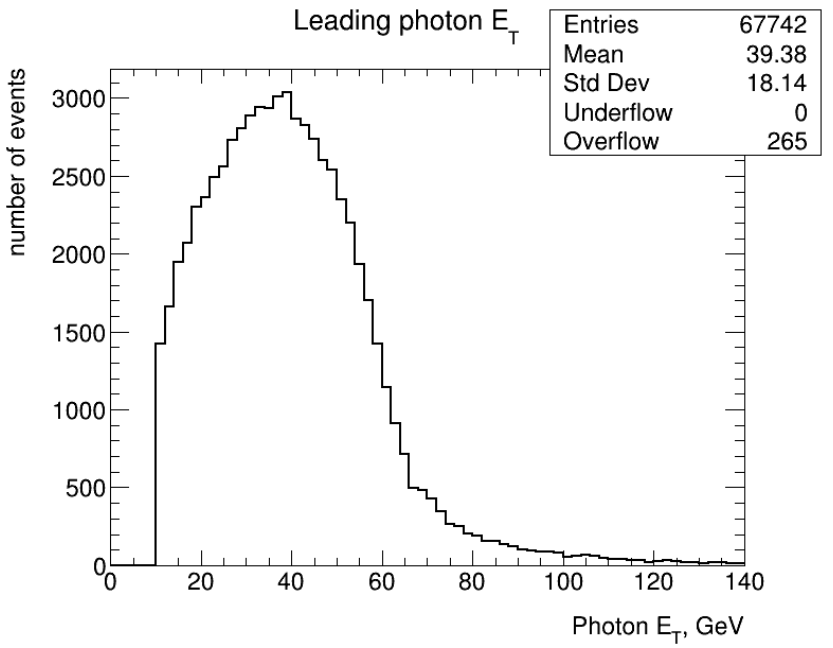
Some Plots


Number of photons
Entries 99999
Mean 0.6933
Std Dev 0.4948
Underflow 0
Overflow 0
number of events
0
10000
20000
30000
40000
50000
60000
0 0.5 1 1.5 2 2.5 3 3.5 4 4.5 5
Number of photons

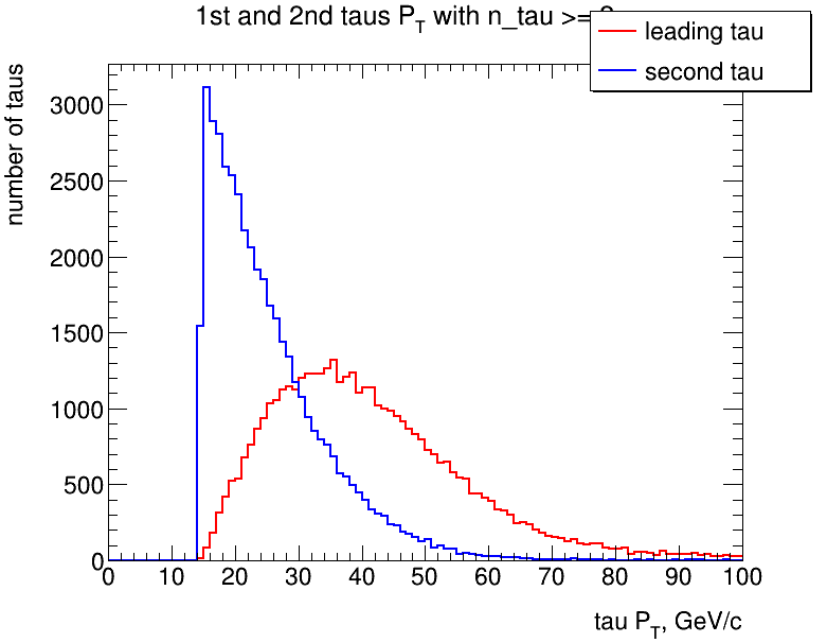

Number of taus
Entries 99999
Mean 1.322
Std Dev 0.6701
Underflow 0
Overflow 0
number of events
0
5000
10000
15000
20000
25000
30000
35000
40000
45000
0 0.5 1 1.5 2 2.5 3 3.5 4 4.5 5
Number of taus

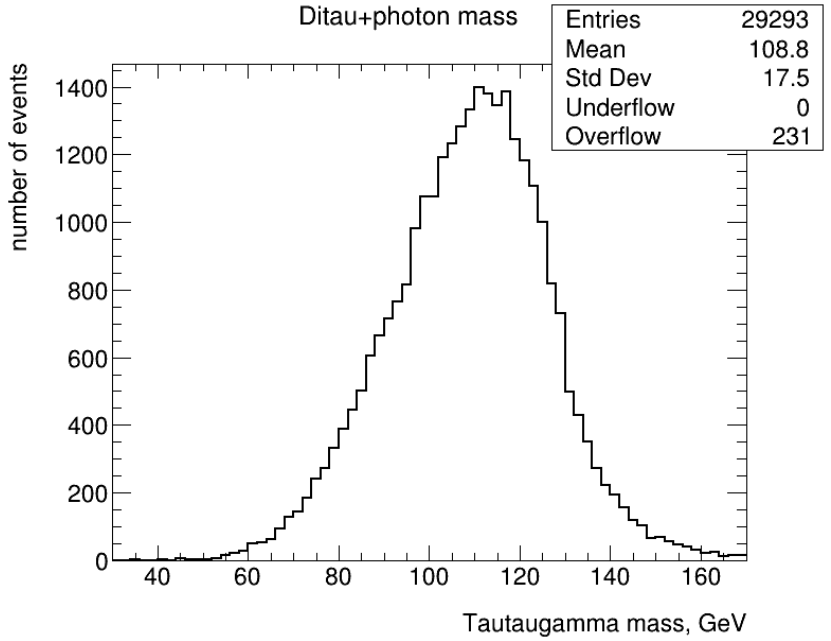
Some Plots


Leading photon |eta|
number of events
4000
3500
3000
2500
2000
1500
1000
500
0
0
0.5
1
1.5
2
2.5
3
3.5
4
Photon eta

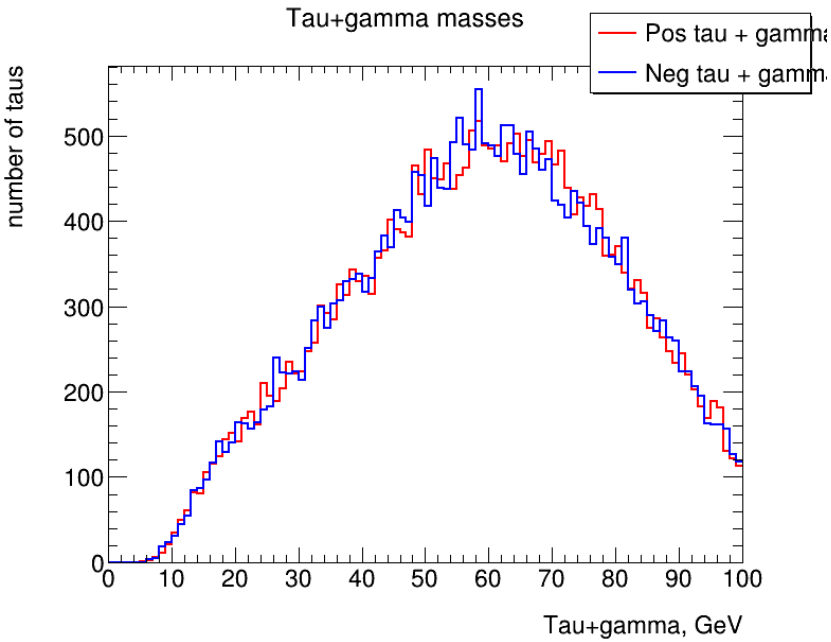

Leading photon E_T
Entries 67742
Mean 39.38
Std Dev 18.14
Underflow 0
Overflow 265
number of events
3000
2500
2000
1500
1000
500
0
0
20
40
60
80
100
120
140
Photon E_T, GeV

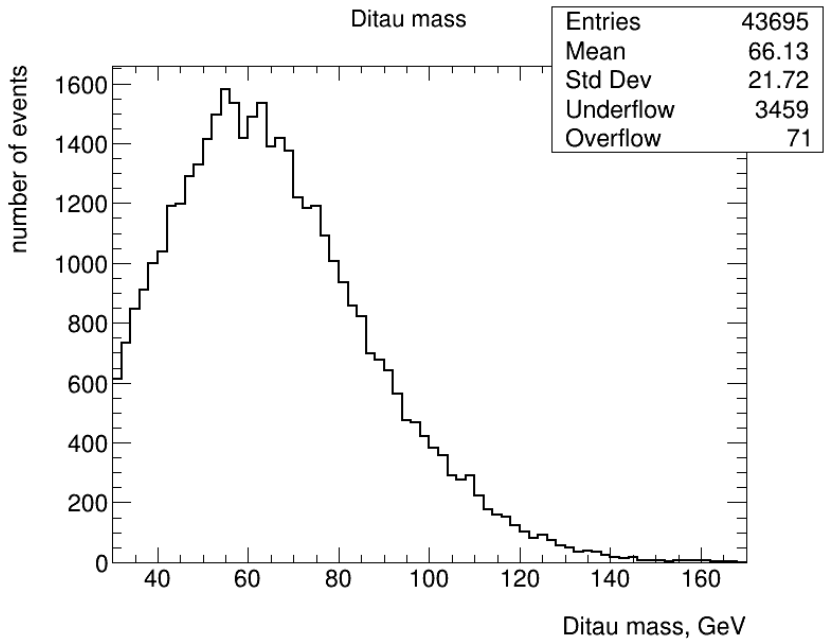
Some Plots


1st and 2nd taus P_T with n_tau >=
leading tau
second tau
number of taus
tau P_T, GeV/c

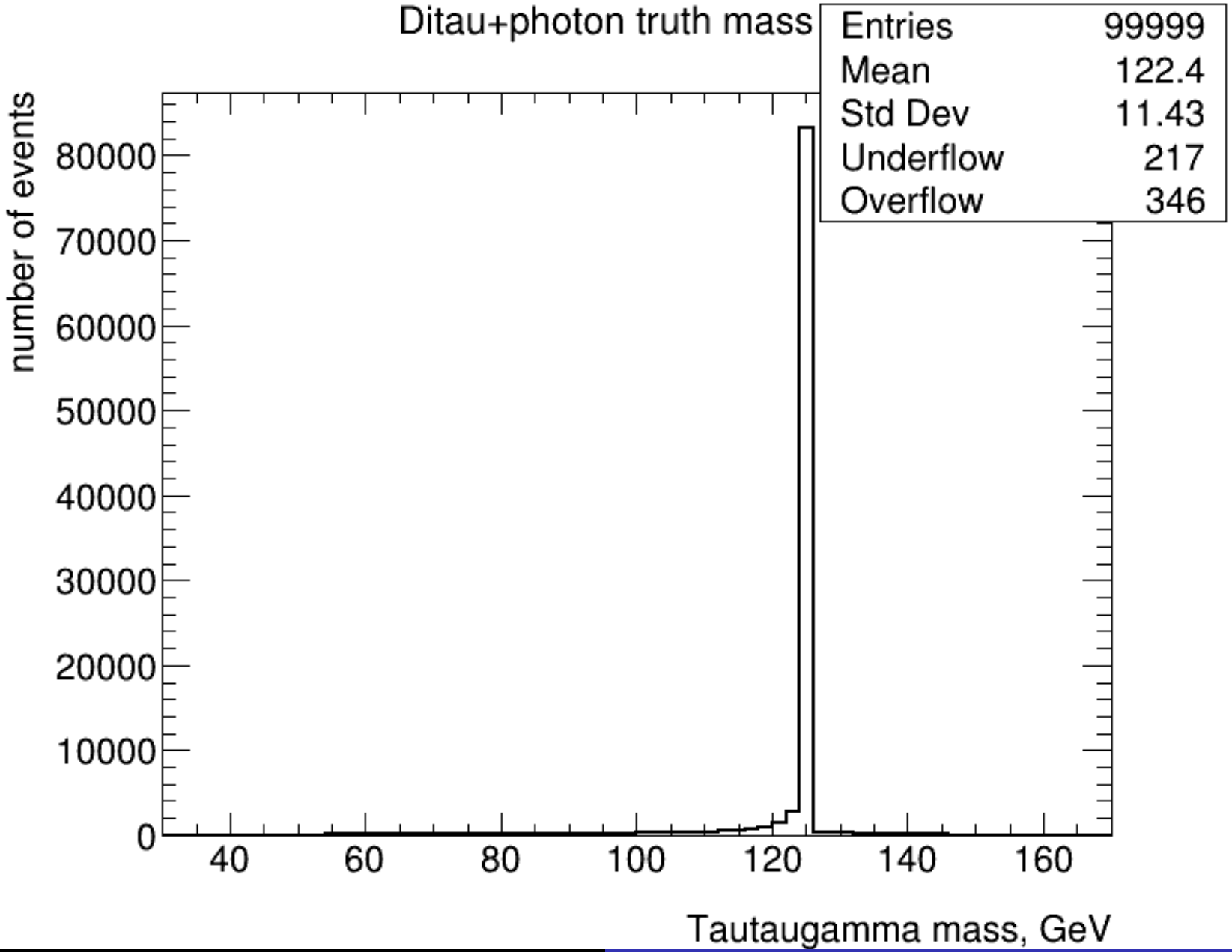

Ditau+photon mass
Entries 29293
Mean 108.8
Std Dev 17.5
Underflow 0
Overflow 231
number of events
Tautaugamma mass, GeV

Some Plots


Tau+gamma masses
Pos tau + gamm
Neg tau + gamm
number of taus
0
100
200
300
400
500
0
10
20
30
40
50
60
70
80
90
100
Tau+gamma, GeV


Ditau mass
Entries 43695
Mean 66.13
Std Dev 21.72
Underflow 3459
Overflow 71
number of events
0
200
400
600
800
1000
1200
1400
1600
40
60
80
100
120
140
160
Ditau mass, GeV

Some Plots


Ditau+photon truth mass
Entries 99999
Mean 122.4
Std Dev 11.43
Underflow 217
Overflow 346
number of events
80000
70000
60000
50000
40000
30000
20000
10000
0
40
60
80
100
120
140
160
Tautaugamma mass, GeV

Conclusion

- Work on signal production ongoing.
- Matching truth and reco particles.
- (Still) thinking about flat format to convert Delphes output to.
- The distributions look somewhat reasonable.
- We do 3-body decays, so momentum is distributed between 3 particles. Doing $H \to \tau\tau(\to \tau\gamma)$ would change pts of leading/subleading taus and photon.