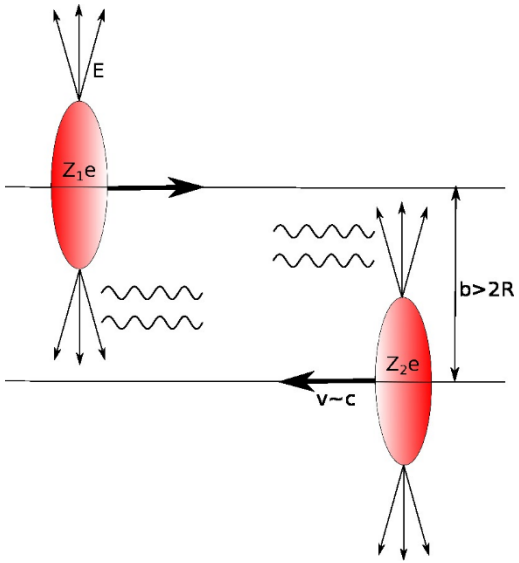
UPC Study

Beomgon Kim

Ultra Peripheral Collisions



- In collisions at large impact parameters($b > R_1 + R_2$), hadronic interactions are not possible.
  - ➢ No QGP state emerges.
- The colliding nuclei interact only electromagnetically.
- UPC events provide information to understand initial state.

Why We Need Di-jets? Di-photons?

- Di-photons
  - We want to measure the process called "light-by-light scattering"($\gamma\gamma \rightarrow \gamma\gamma$).
  - Nobody has measured it before but it is expected to occur.

- Di-jets
  - will allow us to expand on the UPC quarkonia program.
  - UPC quarkonia is sensitive to nuclear gluon effects(shadowing, saturation).
  - The same should happen for UPC di-jets.

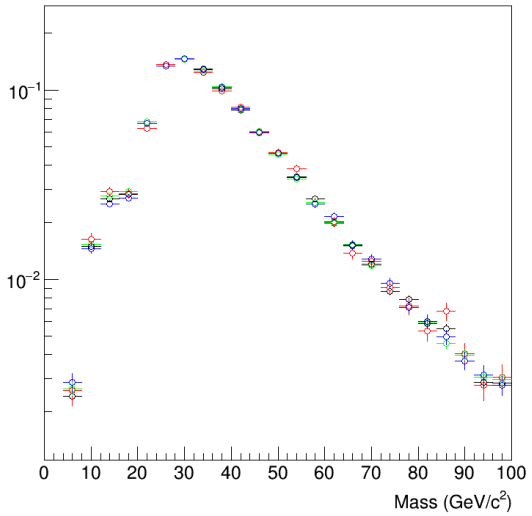
- This will be the 1st time we measure UPC di-photons & di-jets.

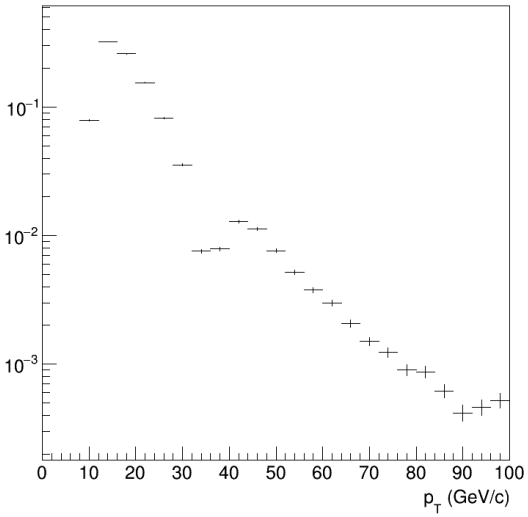
- We might find something beyond the theoretical models.

Di-jet Mass Distribution(Full Statistics)

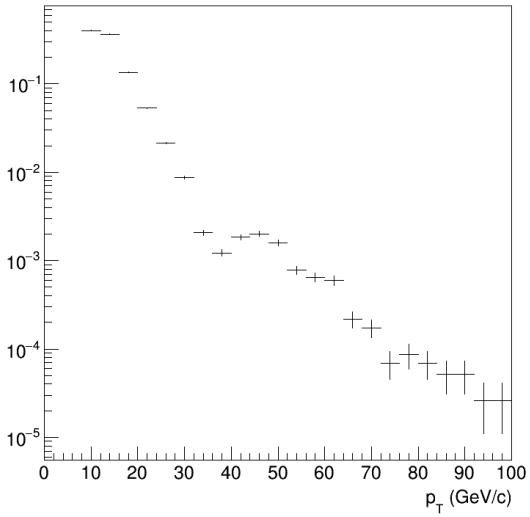
- The events have exactly 2 jets.
- Jet algorithm: akPu5PFJets

HLT_HIUPCL1DoubleEG2NotHF2: 57416
HLT_HIUPCDoubleEG2NotHF2Pixel_SingleTrack: 13113
HLT_UPCL1SingleEG5NotHF2: 64278
HLT_HIUPCSingleEG5NotHF2Pixel_SingleTrack: 24250





Leading jet

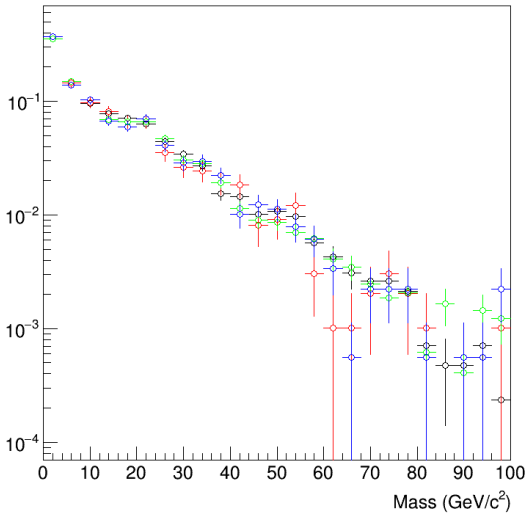


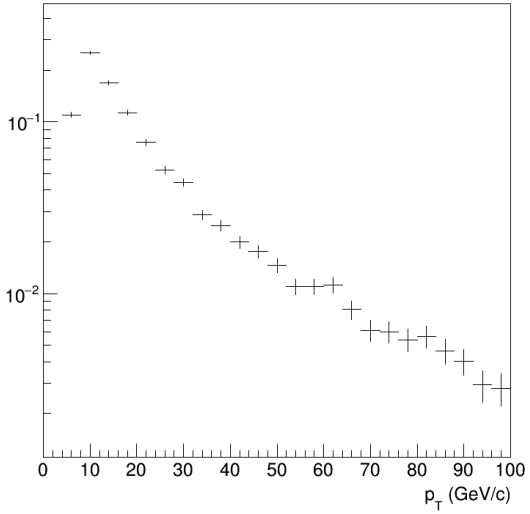
Subleading jet

Di-photon Mass Distribution(Full Statistics)

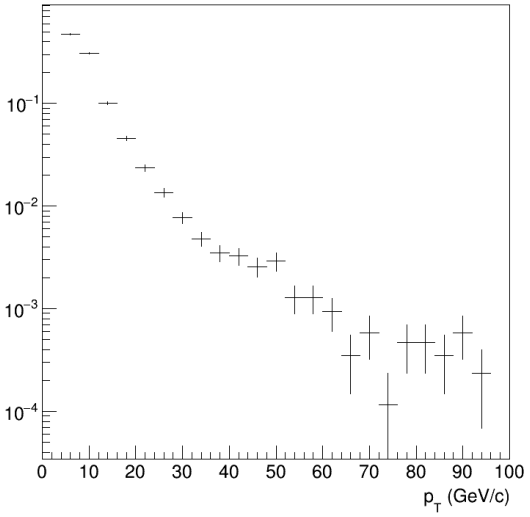
- The events have exactly 2 photons.

HLT_HIUPCL1DoubleEG2NotHF2: 4213
HLT_HIUPCDoubleEG2NotHF2Pixel_SingleTrack: 986
HLT_UPCL1SingleEG5NotHF2: 4871
HLT_HIUPCSingleEG5NotHF2Pixel_SingleTrack: 1788





Leading photon



Subleading photon

$\Delta\varphi$ & $\Delta\eta$ of Di-jet(Full Statistics)

- The events have exactly 2 jets.
- Jet algorithm: akPu5PFJets

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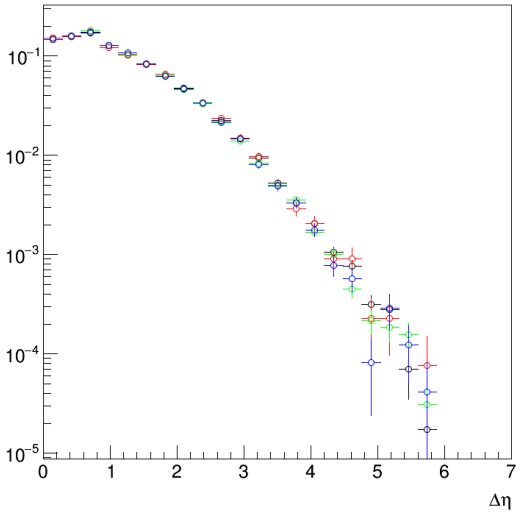

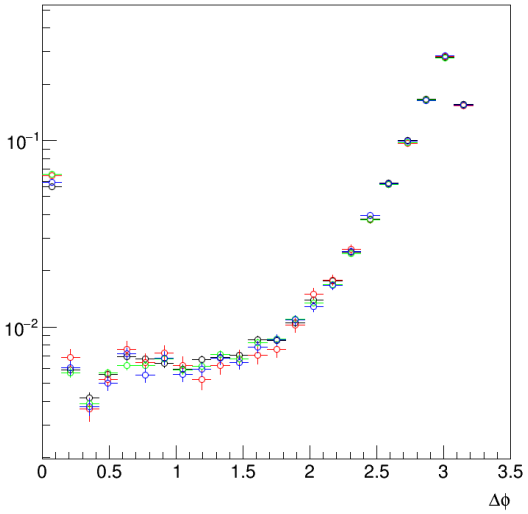

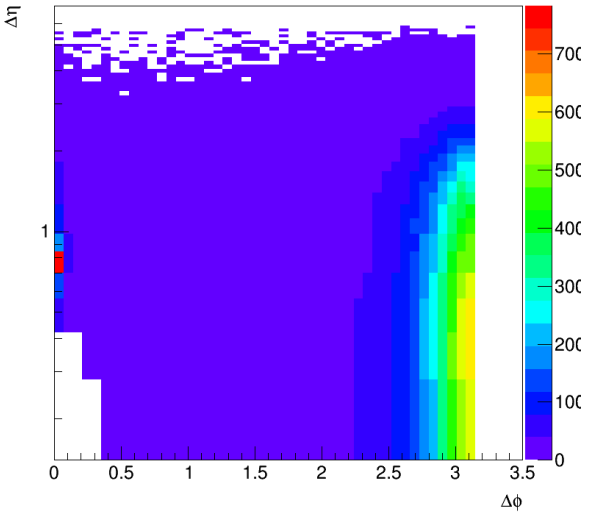

- There is a sharp peak in the region of very small $\Delta\varphi$ & $\Delta\eta$ is slightly smaller than 1.
  - ➢ There are events two jets are moving in almost same direction.

$\Delta\varphi$ & $\Delta\eta$ of Di-photons(Full Statistics)

- The events have exactly 2 photons.

HLT_HIUPCL1DoubleEG2NotHF2: 4213
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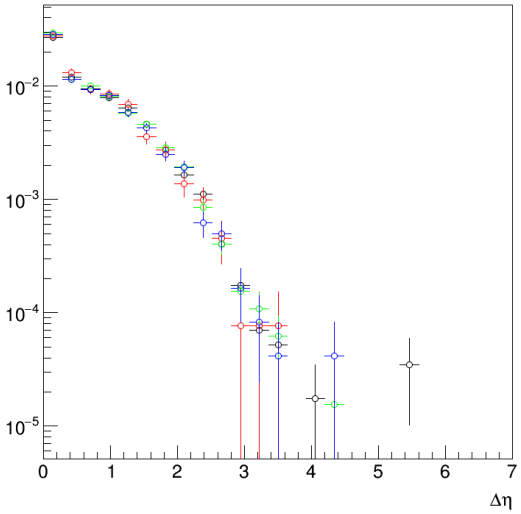
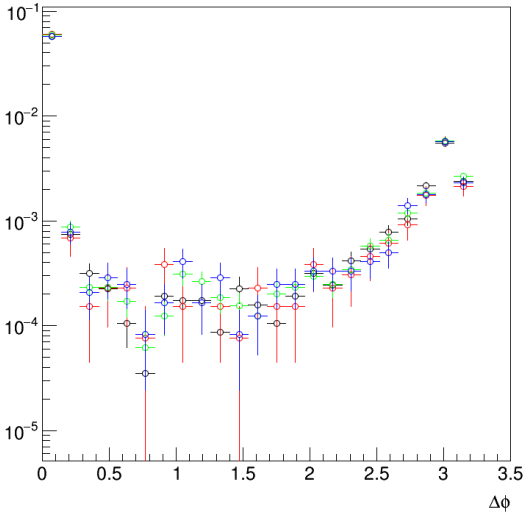
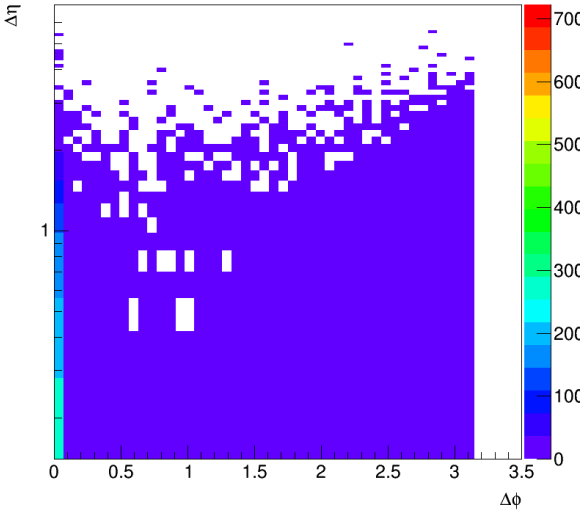






- There is a peak in the region of very small $\Delta\varphi$ & $\Delta\eta$ is smaller than 1.
  - ➢ There are events photons are moving in almost same direction.

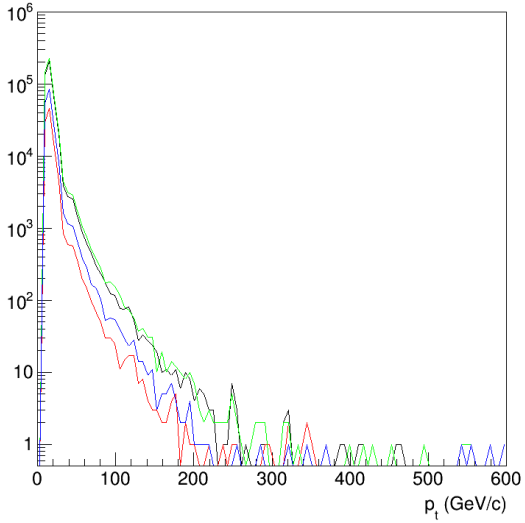
In Progress & Next Step

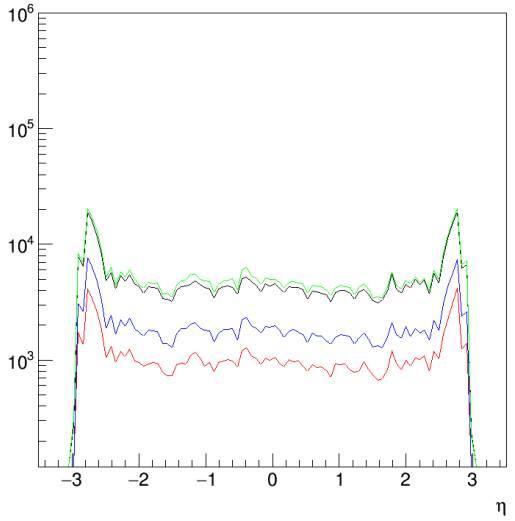
- Apply some cuts to reduce noise(Ecal noise, etc.)
- Look at other distributions(HF asymmetric events, etc.)
- Compare to the 5 TeV pPb results
- See the distribution in detail for the region which seems interesting.

Back Up

Hiforest Jets & Photons Distribution(Full Statistics)

Jet





Black: HLT_HIUPCL1DoubleEG2NotHF2
Red: HLT_HIUPCDoubleEG2NotHF2Pixel_SingleTrack
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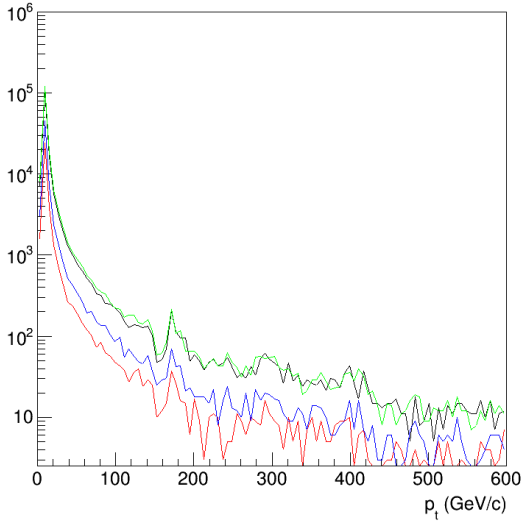
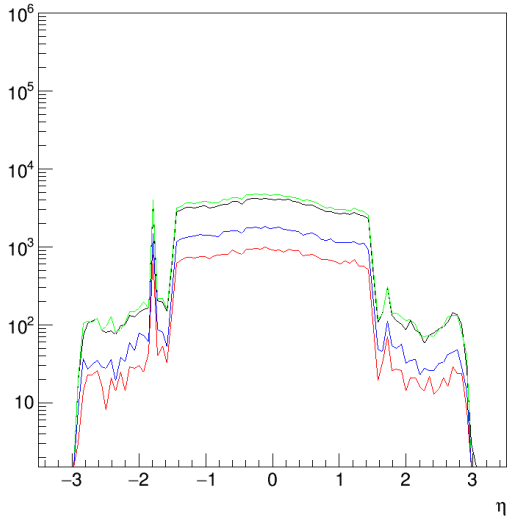
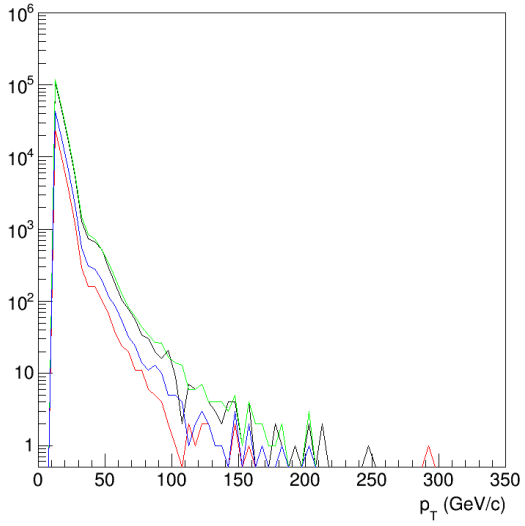
Photon

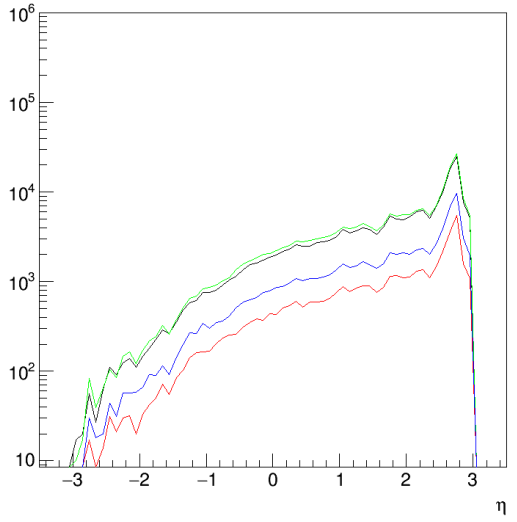




Asymetric Type of Events(Full Statistics): Jets

HFplus > 4 GeV && HFminus < 4 GeV





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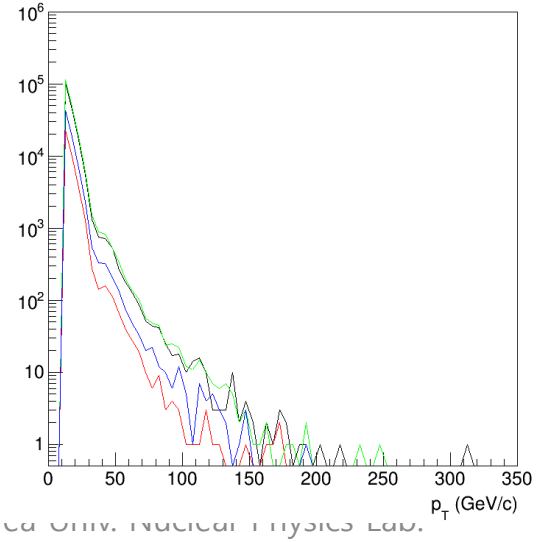
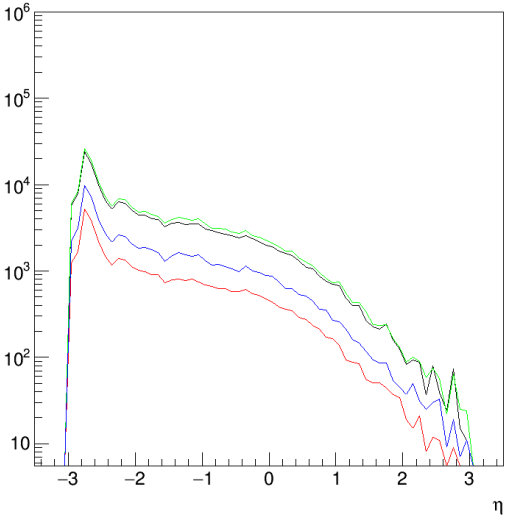
HFplus < 4 GeV && HFminus > 4 GeV





Asymetric Type of Events(Full Statistics): Photons

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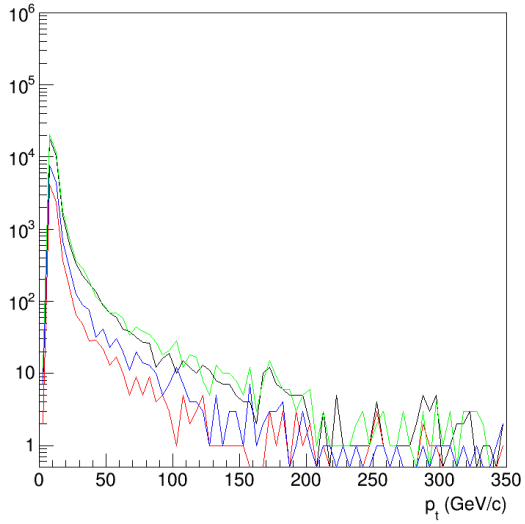

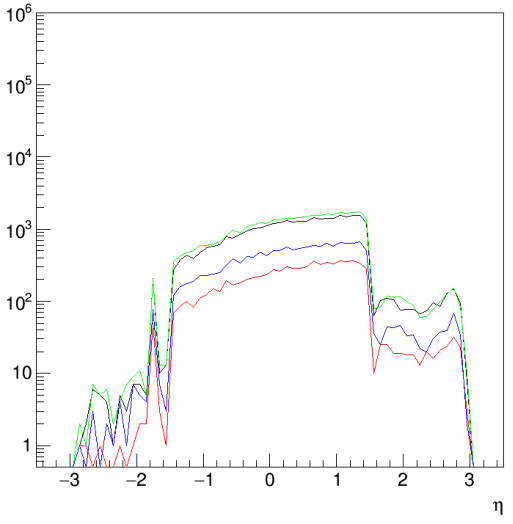

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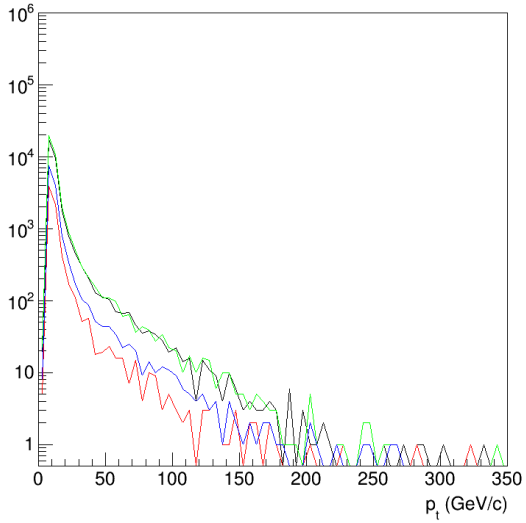

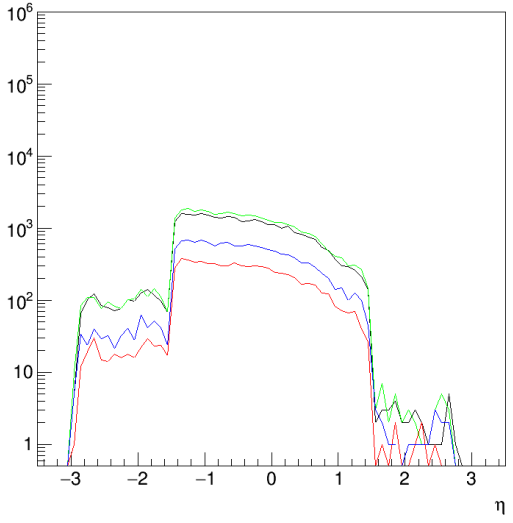

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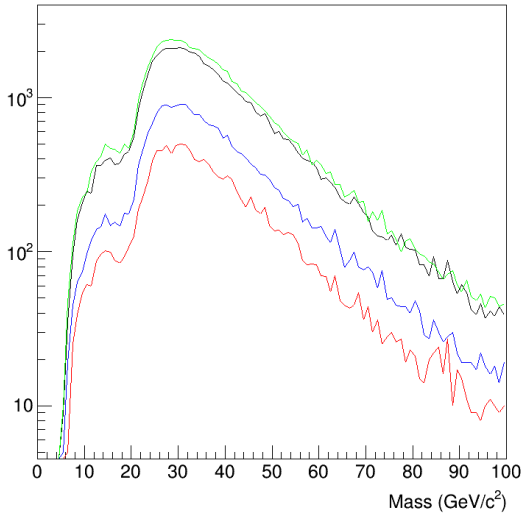
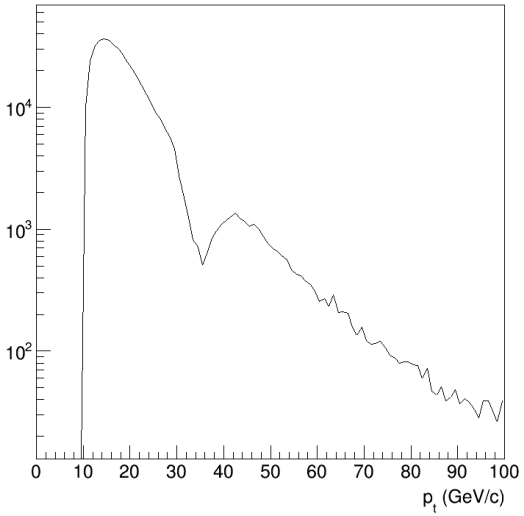
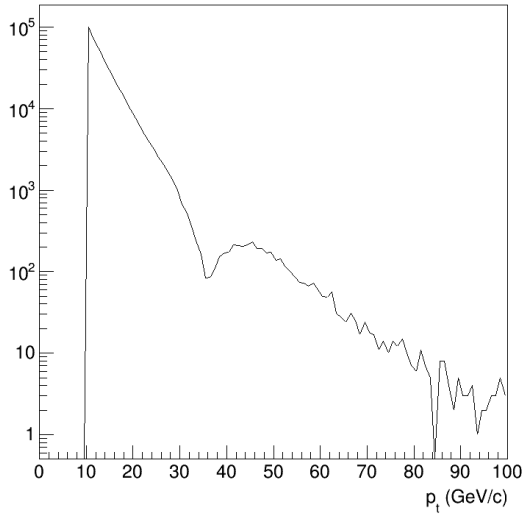




Leading jet



Subleading jet