Charged pion analysis

Single Spin Asymmetry

- Charge Compare, Cos Modulation Background study

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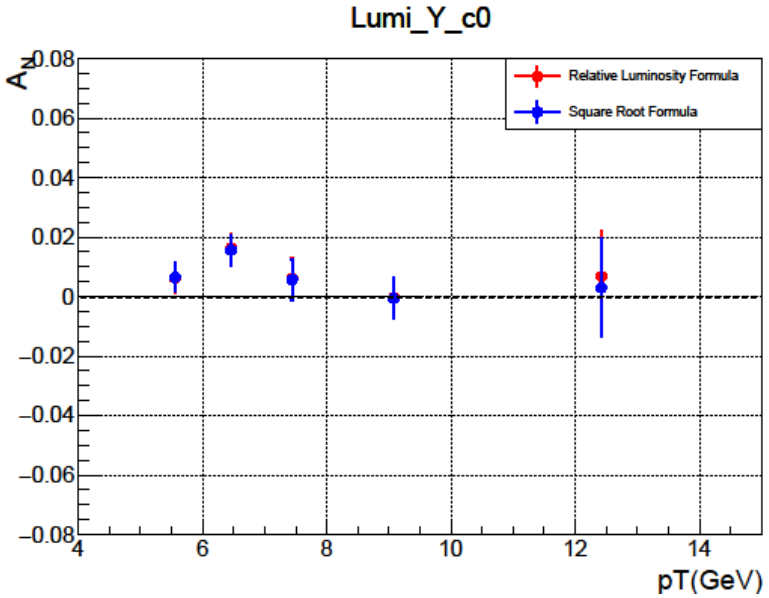
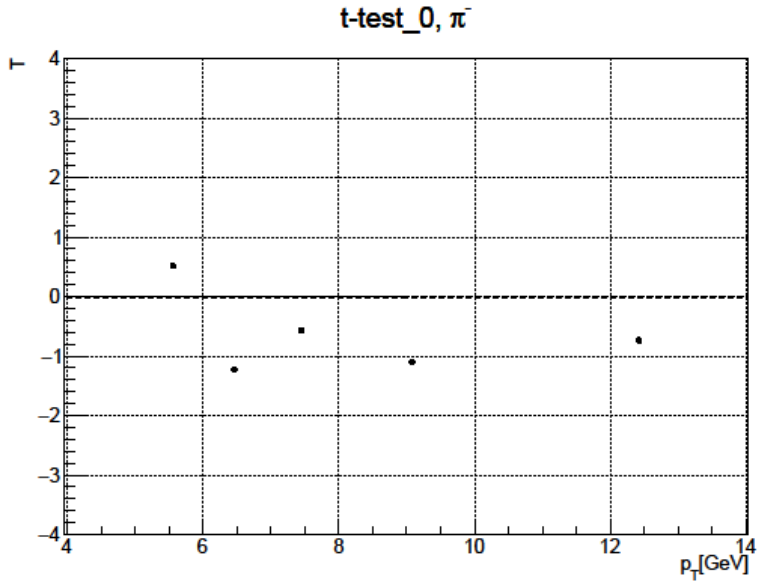
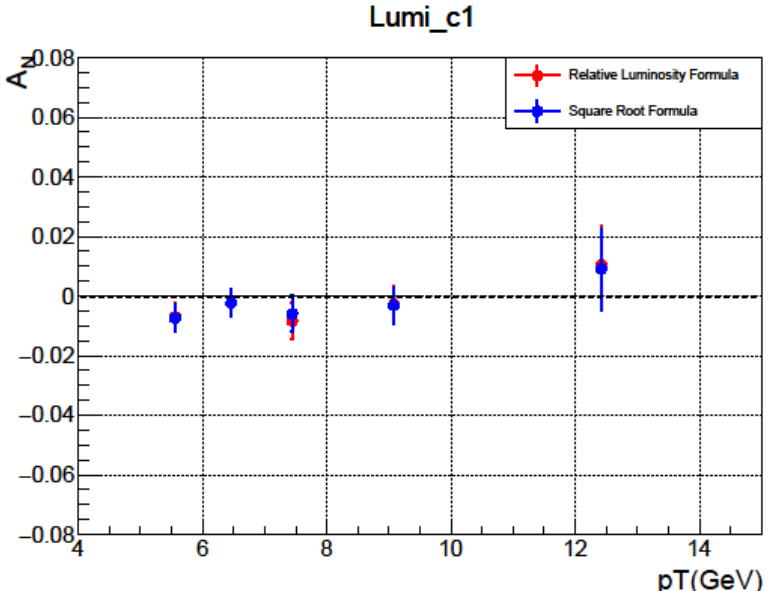
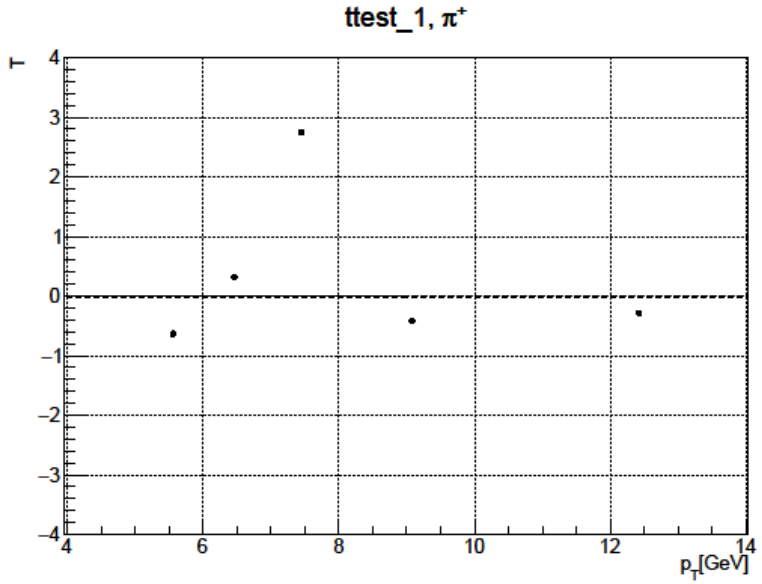
A_N - Formula Comparison (Averaged)







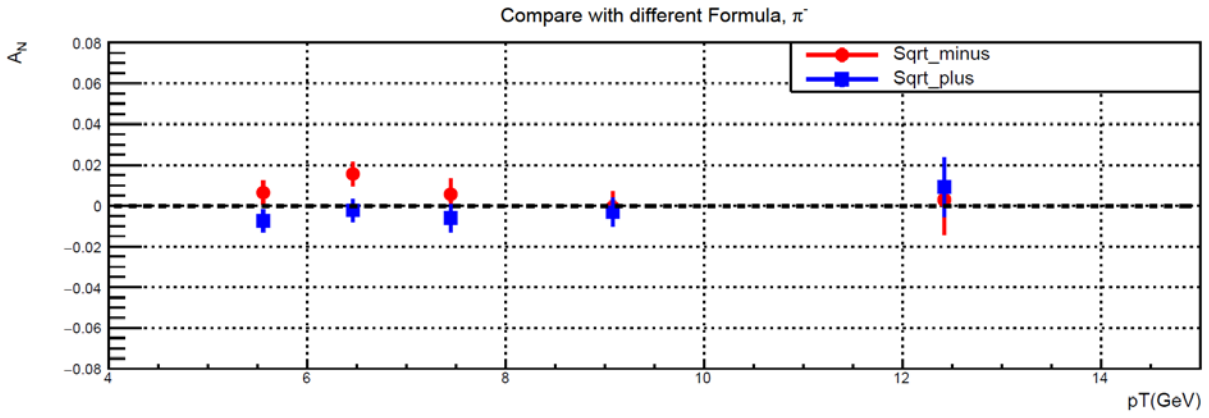


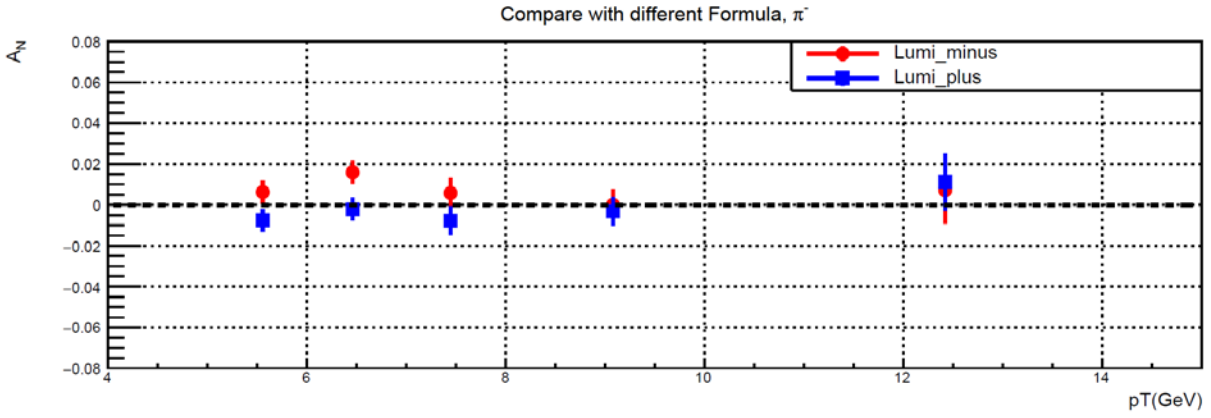
$$T(p_T) = \frac{A_N^{Sqrt} - A_N^{Lumi}}{\sqrt{|(\sigma^{Sqrt})^2 - (\sigma^{Lumi})^2|}}$$

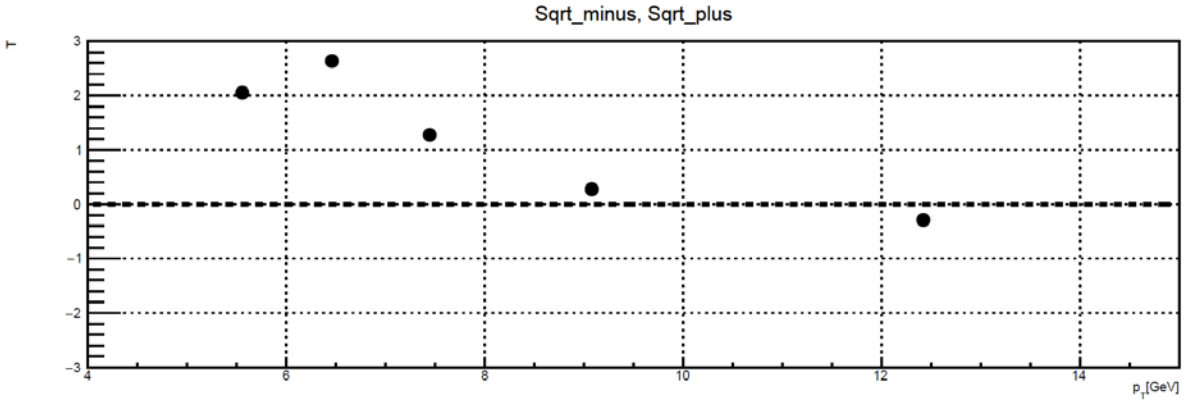
No systematic error

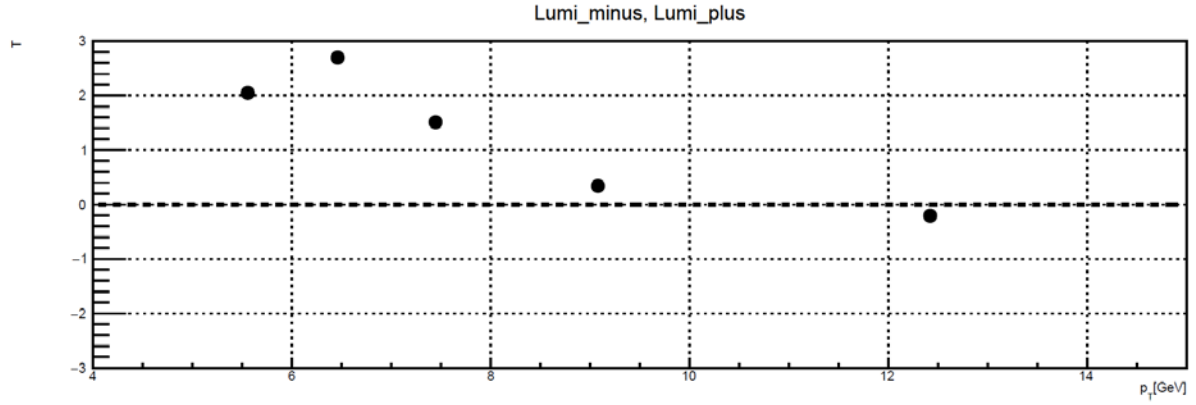
Before background correction

A_N - Charge Comparison



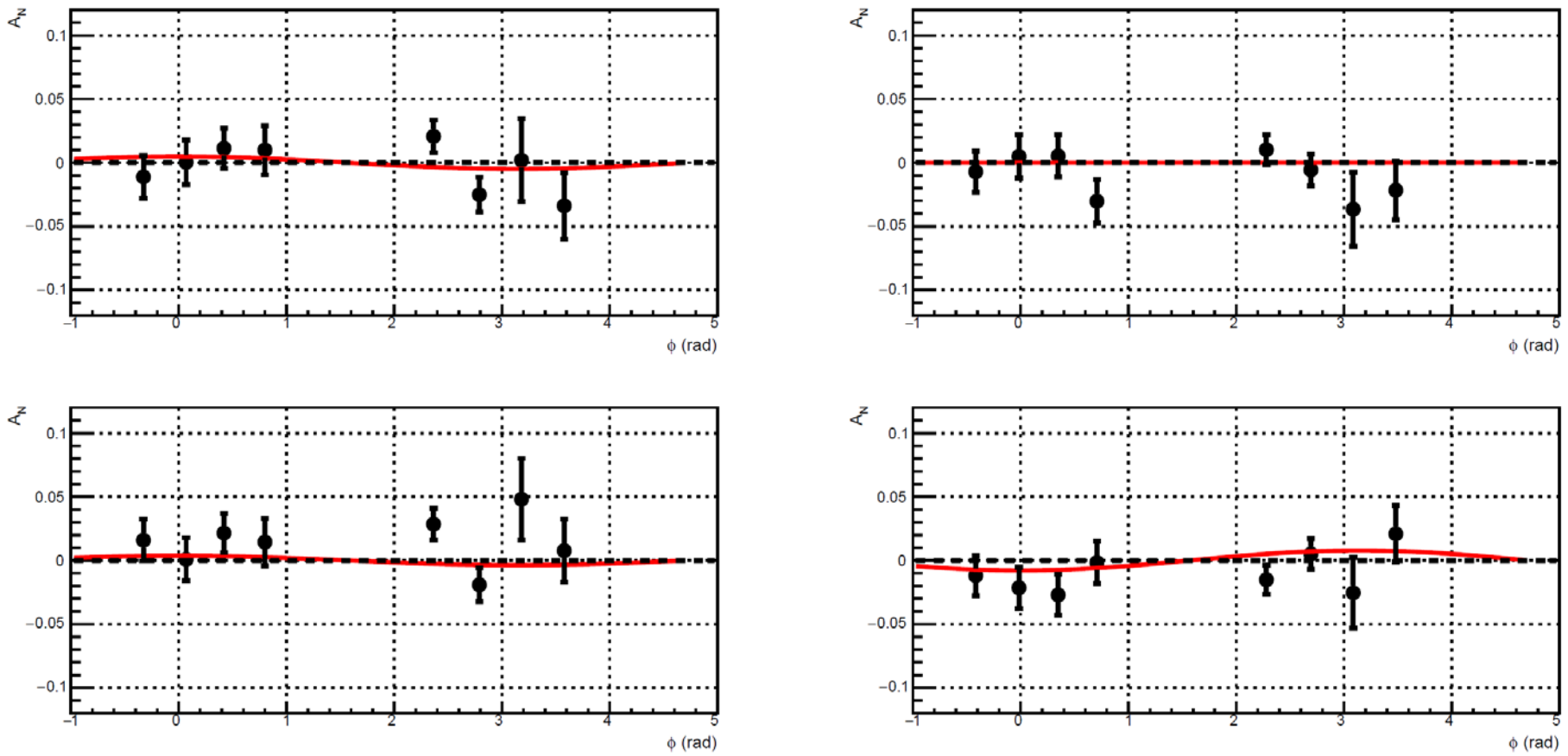






$$T(p_T) = \frac{A_N^{\pi^-} - A_N^{\pi^+}}{\sqrt{\left|(\sigma^{\pi^-})^2 + (\sigma^{\pi^+})^2\right|}}$$

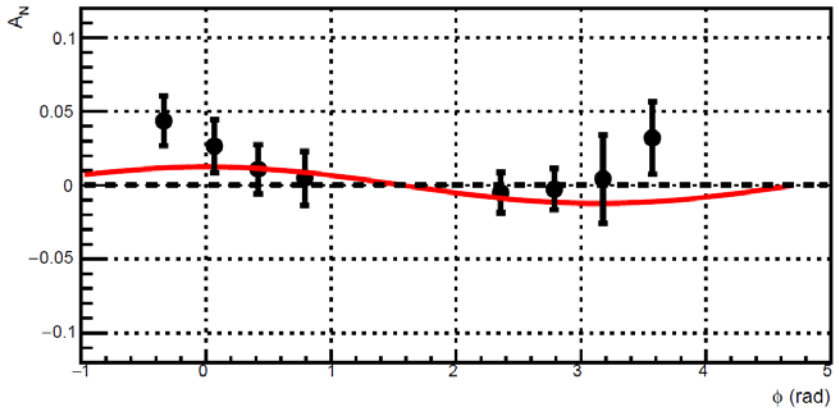
Asymmetry as a function ϕ of for $5 < p_T < 6$ GeV

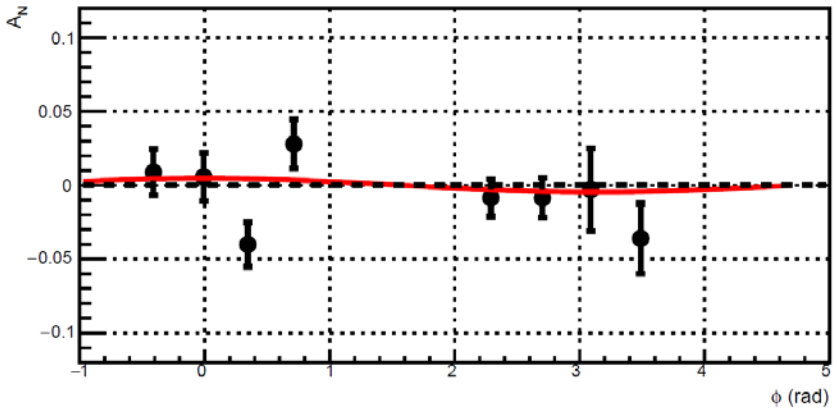


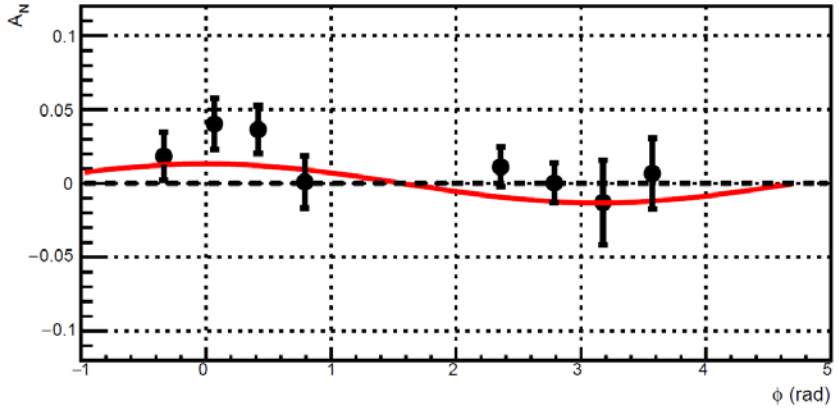
8 points mean 8 EMCal Sectors mean phi.

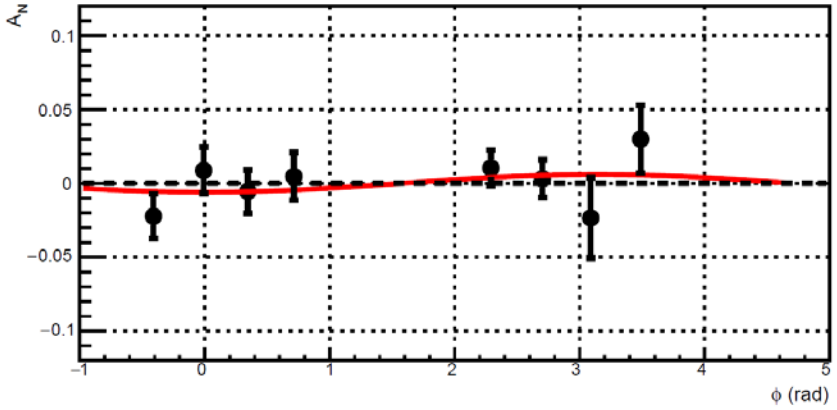
$$A_N \sin\phi_s = \frac{1}{P}\,\epsilon_N(\phi_s) = \frac{1}{P}\,\frac{N^{\uparrow}(\phi_s) - \mathcal{R}N^{\downarrow}(\phi_s)}{N^{\uparrow}(\phi_s) + \mathcal{R}N^{\downarrow}(\phi_s)}$$

Asymmetry as a function ϕ of for $6 < p_T < 7$ GeV

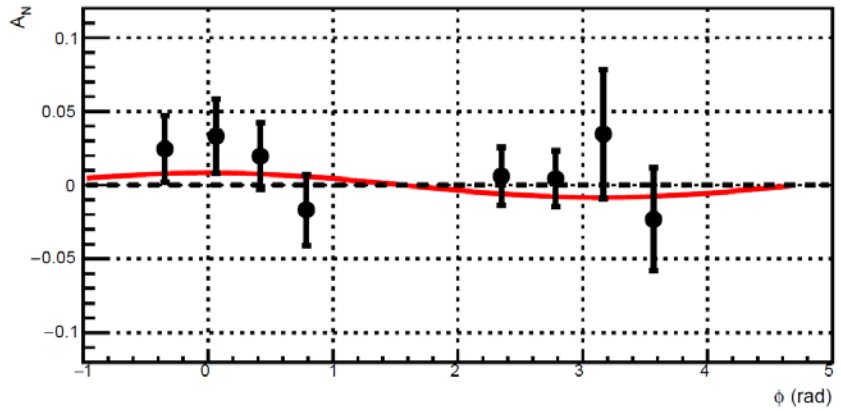


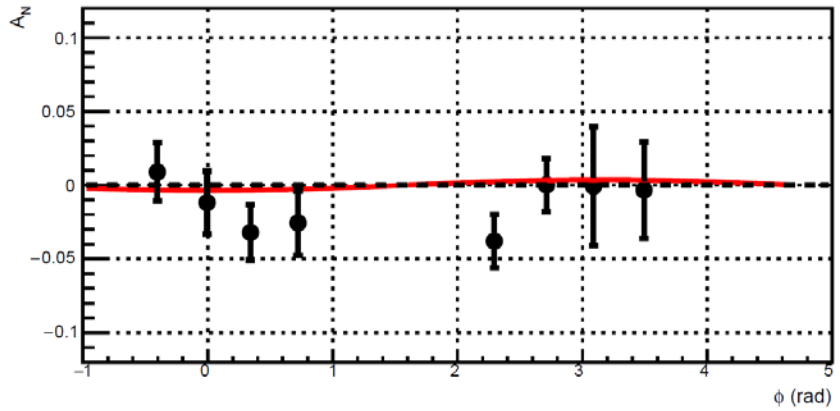


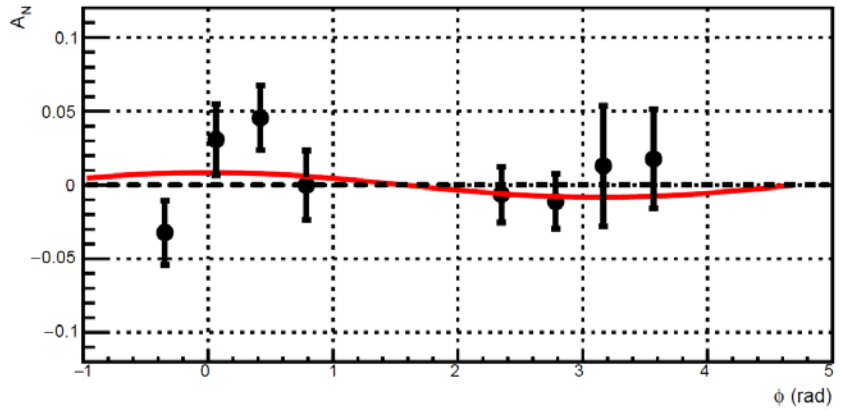


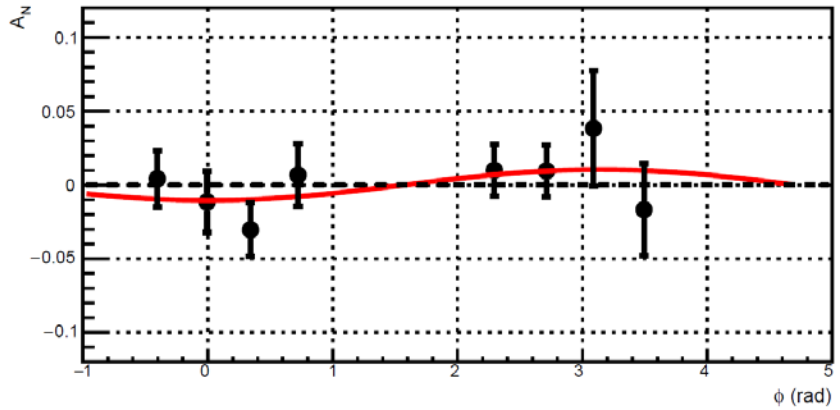


Asymmetry as a function ϕ of for $7 < p_T < 8$ GeV

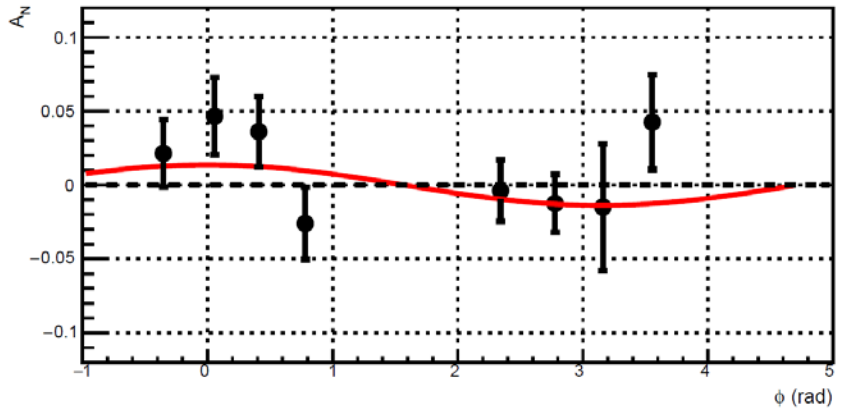


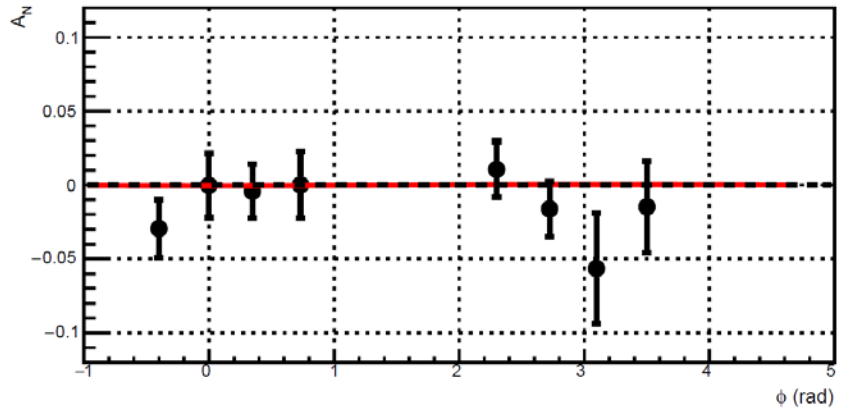


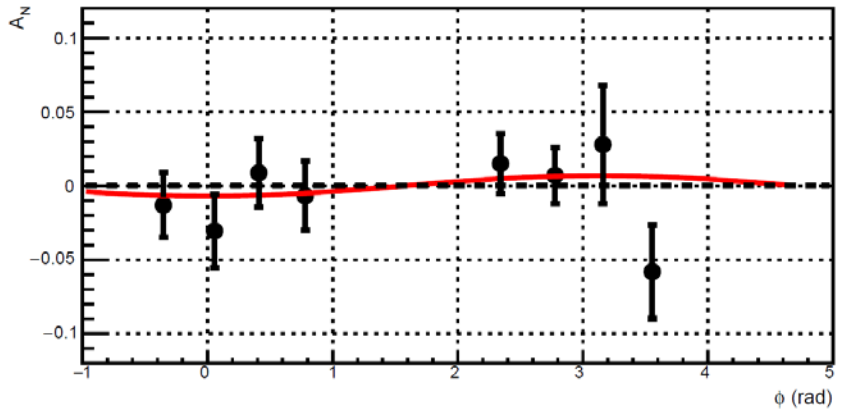


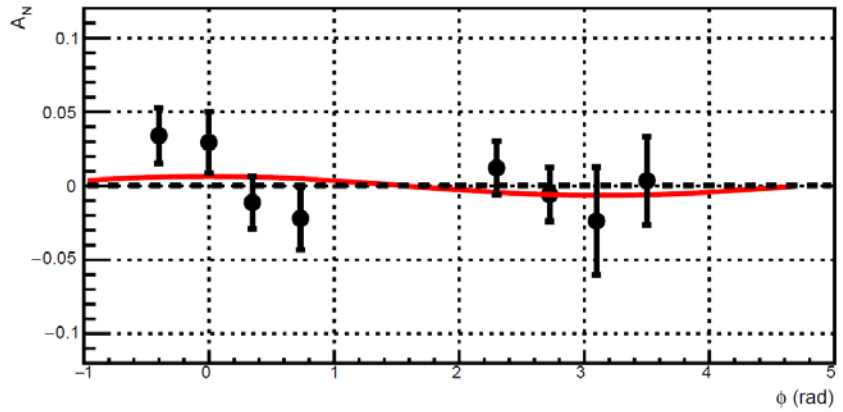


Asymmetry as a function ϕ of for $8 < p_T < 11$ GeV

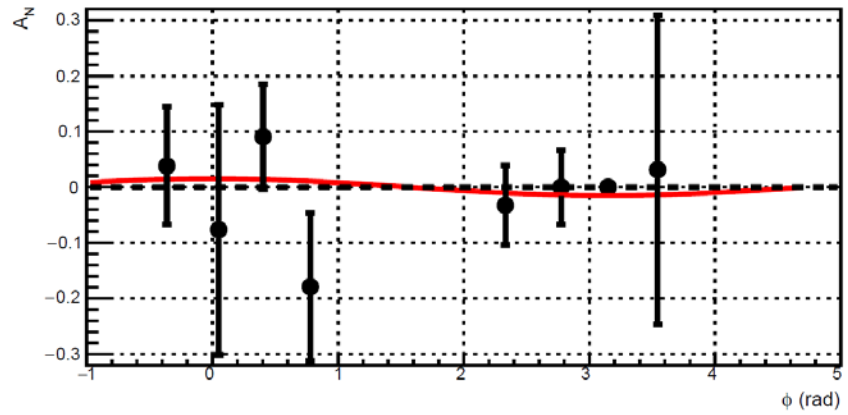


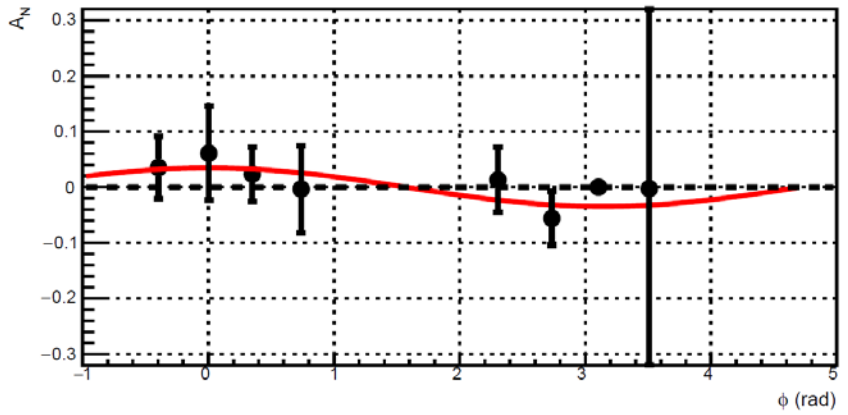


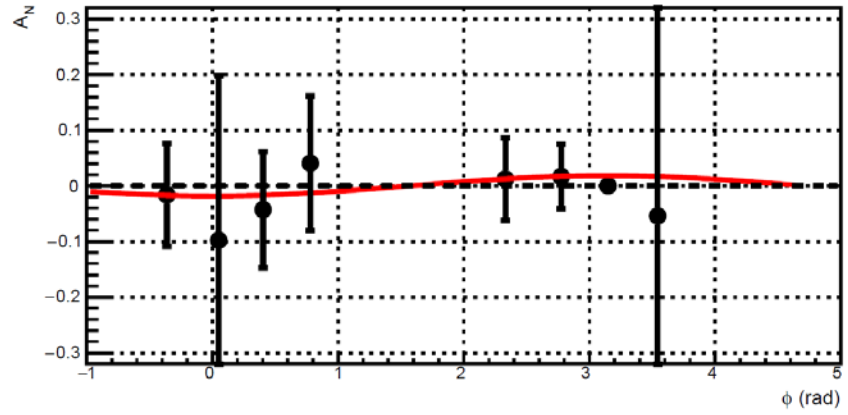


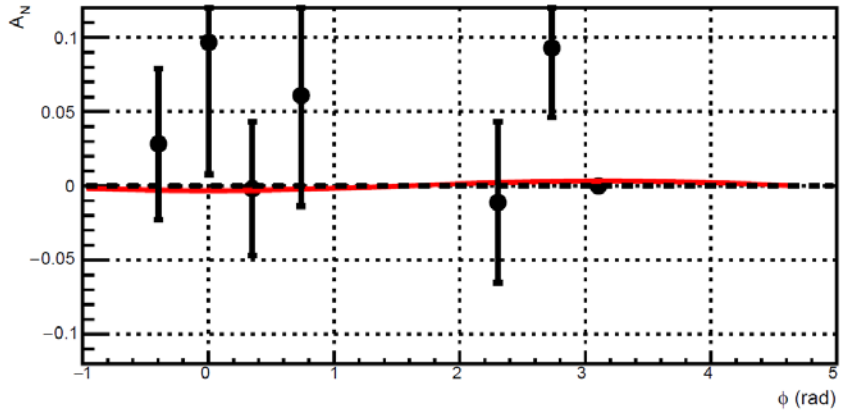


Asymmetry as a function ϕ of for $11 < p_T < 15$ GeV

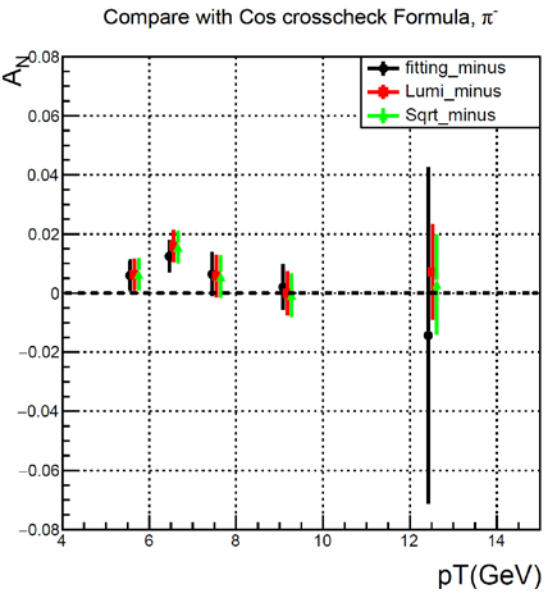


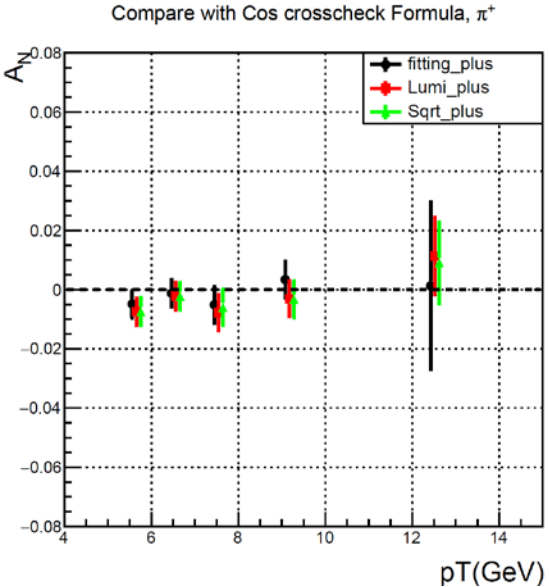


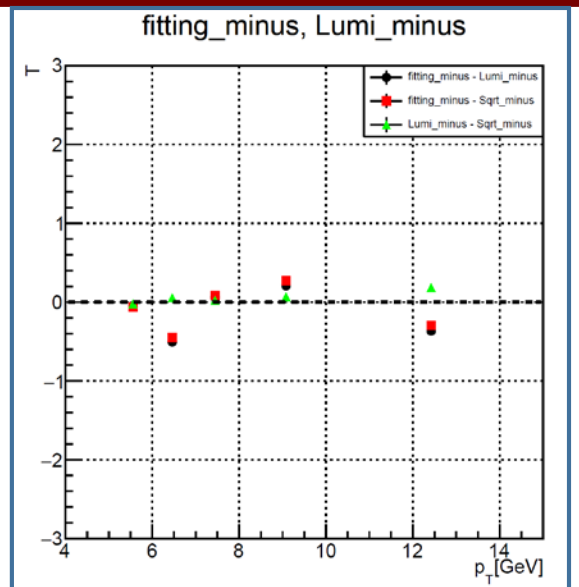


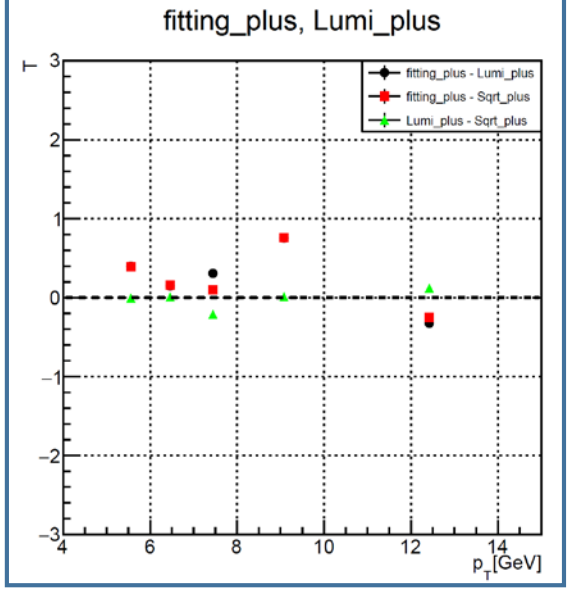


$cos\phi$ Modulation Cross Check



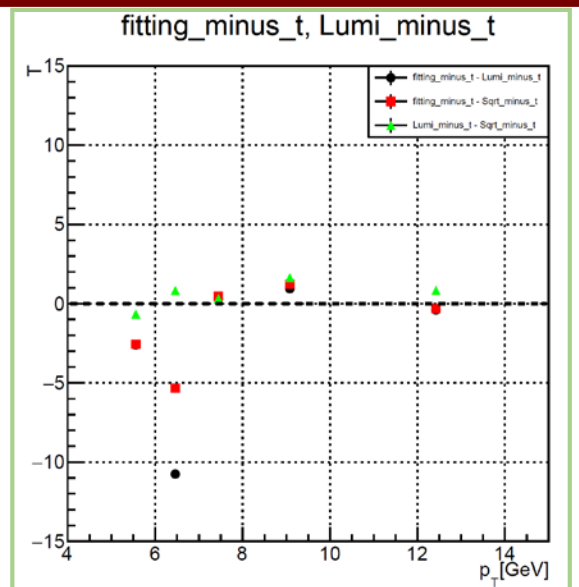


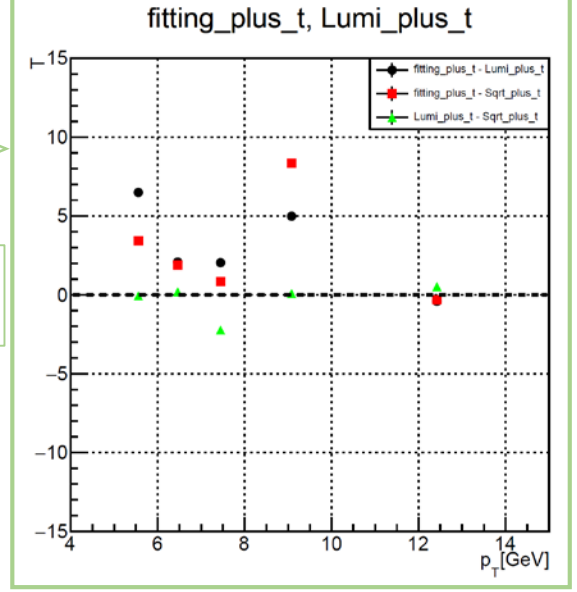




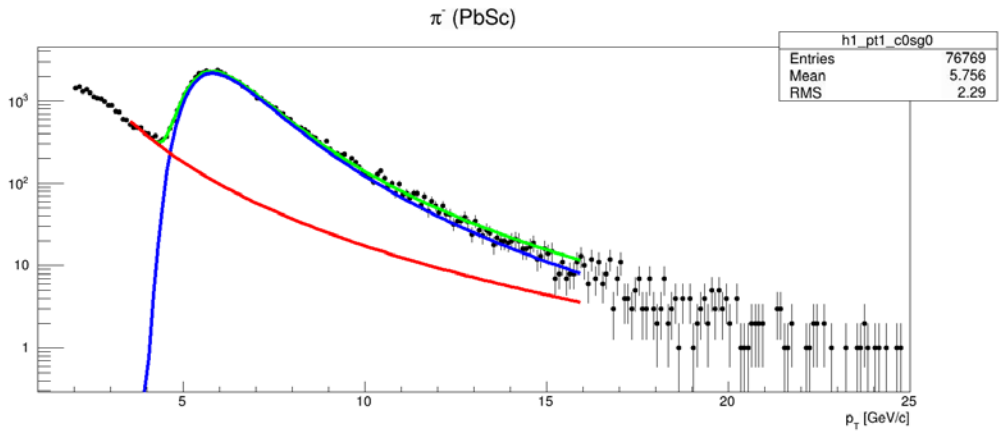
$$T(p_T) = \frac{A_N^{fit} - A_N^{Sqrt\ or\ Lumi}}{\sqrt{|(\sigma^{fit})^2 + (\sigma^{Sqrt\ or\ Lumi})^2|}}$$

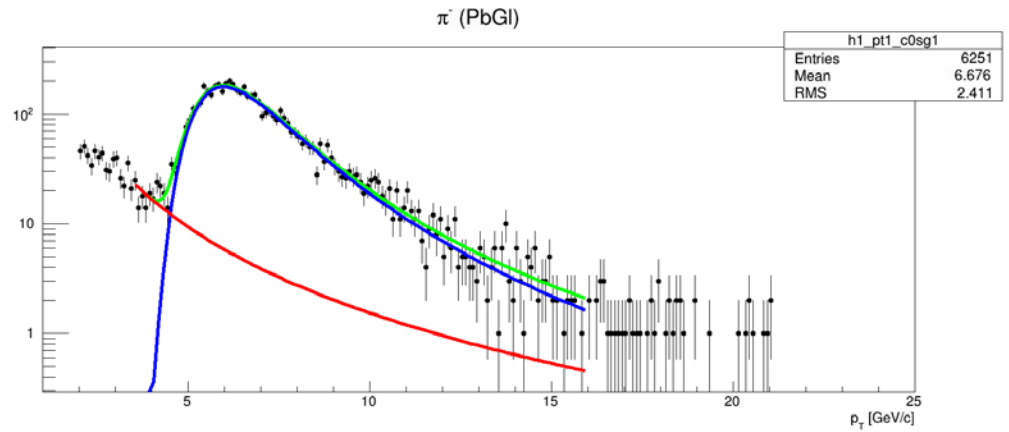
$$T(p_T) = \frac{A_N^{fit} - A_N^{Sqrt\ or\ Lumi}}{\sqrt{|(\sigma^{fit})^2 - (\sigma^{Sqrt\ or\ Lumi})^2|}}$$

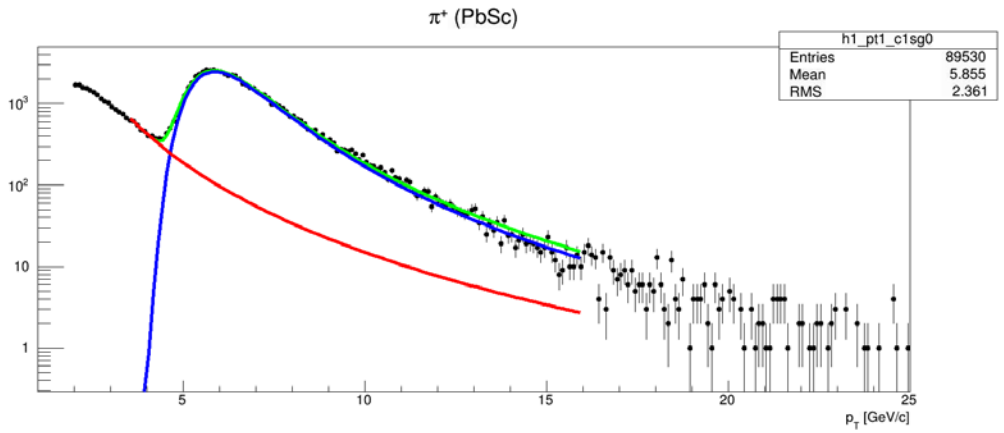


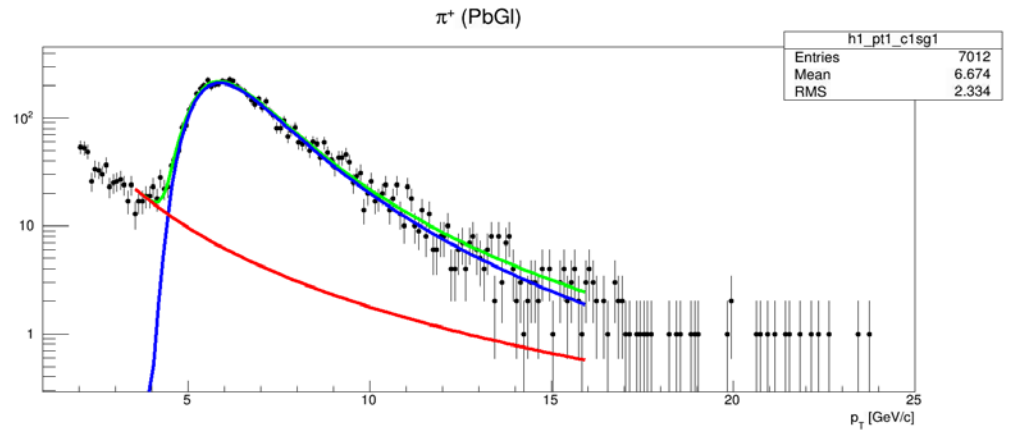


Background Fraction









Hadron Background

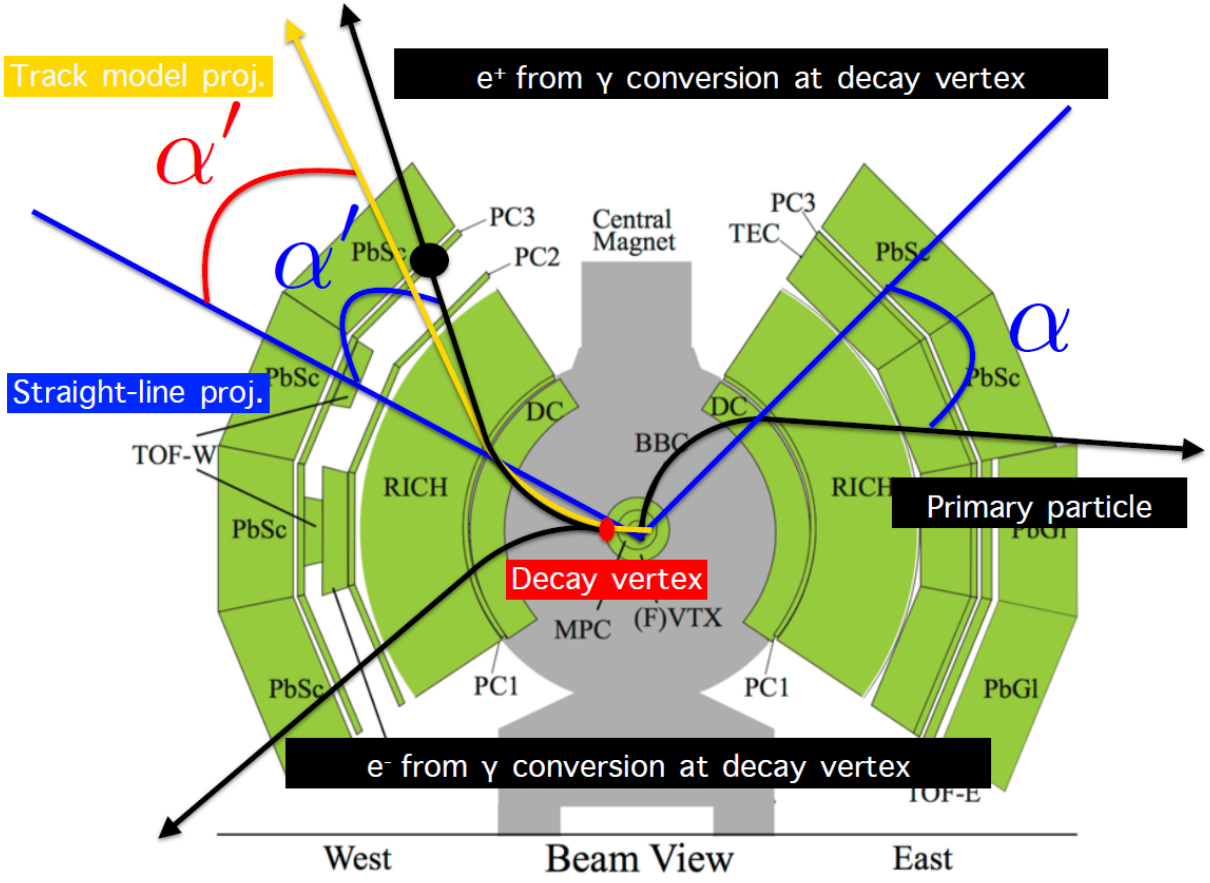
Tracks can be divided according to RICH response at 5 to 15 GeV/c.
Only electrons and pions can leave hits on the RICH PMT plane at 5 to 15 GeV/c but not for kaons and protons.
Pions below 5GeV/c do not create Cherenkov light and are therefore suppressed in the spectra.

Particle	Electron	Pion	Proton	Kaon
Threshold [GeV/c]	0.03	4.7	16	30

The energy threshold for the emission of Cherenkov radiation for each particle in the PHENIX RICH.

Electron Background

Electron deposits most of their energy in the EM shower and the EMCal can be used to determine the probability that the shape of cluster associated with the track is electro-magnetic.
So primary electron can easily be distinguished with the deposited energy/momentum and shower shape cuts from π±. (e/p < 0.8 cut)
The other background is secondary electron from photon conversion. (e/p < 0.2)



Background Subtraction

A_N Background correction method

$$A_N^S = \frac{A_N^{S+B} - rA_N^B}{1-r}$$

$$\sigma_{A_N^S} = \frac{\sqrt{(\sigma_{A_N^{S+B}})^2 + r^2(\sigma_{A_N^B})^2}}{1-r}$$

$$r = N^B/(N^B+N^S)$$

Questions

A_N^{S+B} is from data.

A_N^B is from Pythia simulation?
- I think Pythia simulation isn't reflected in spin physics.
- or electron from data by using E/p cut?

N^B is from Pythia simulation?
- I think It can be get from Pythia simulation
- Can I use # of electron from Cross section?

N^S is from Pythia simulation?
- I think It can be get from Pythia simulation
- Can I use # of charged pion from Cross section?