

Measurements of π^+ , K^+ and p spectra
in pp interactions at $\sqrt{s} = 27 \text{ GeV}$

Elena Zemlyanichkina, JINR/Dubna

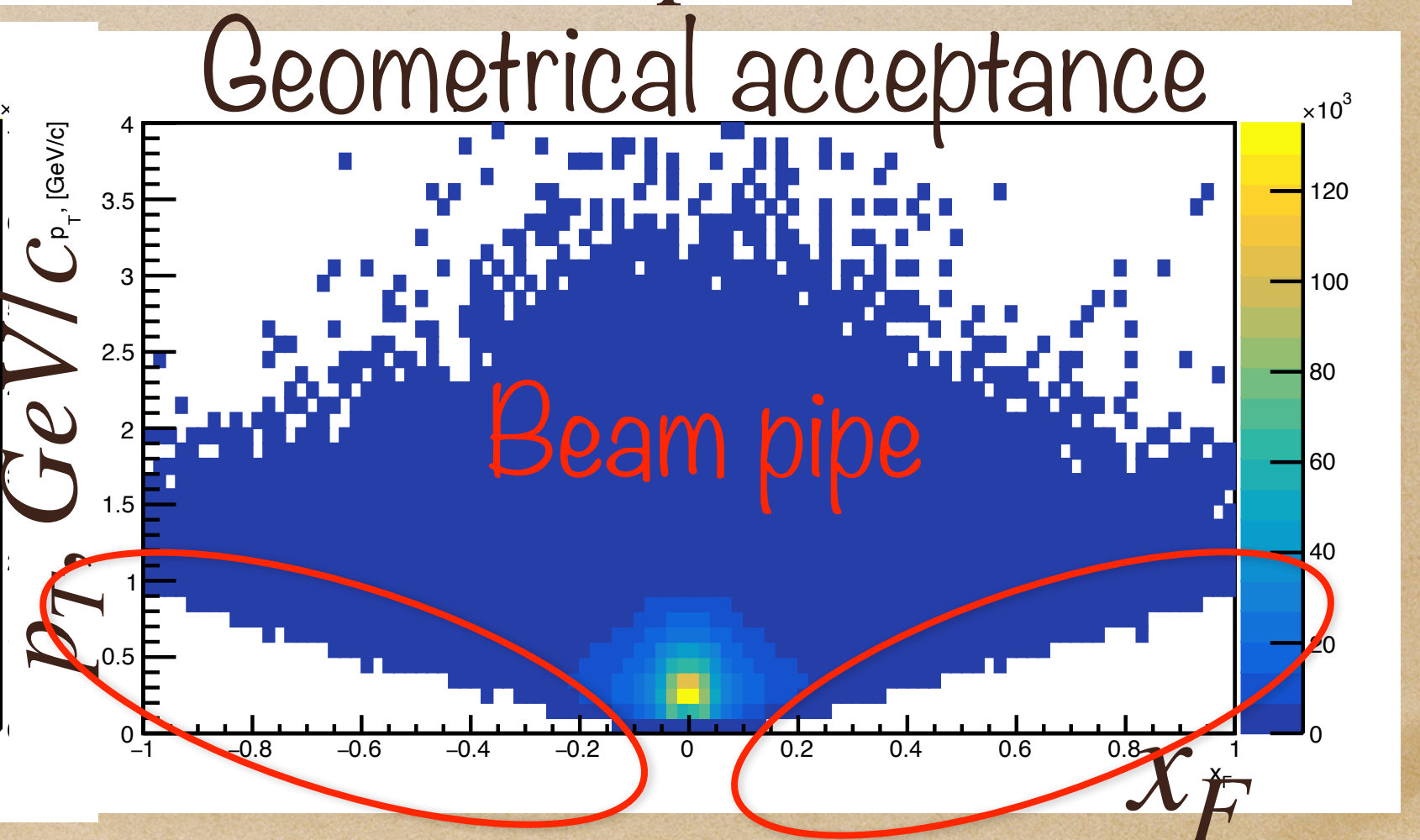
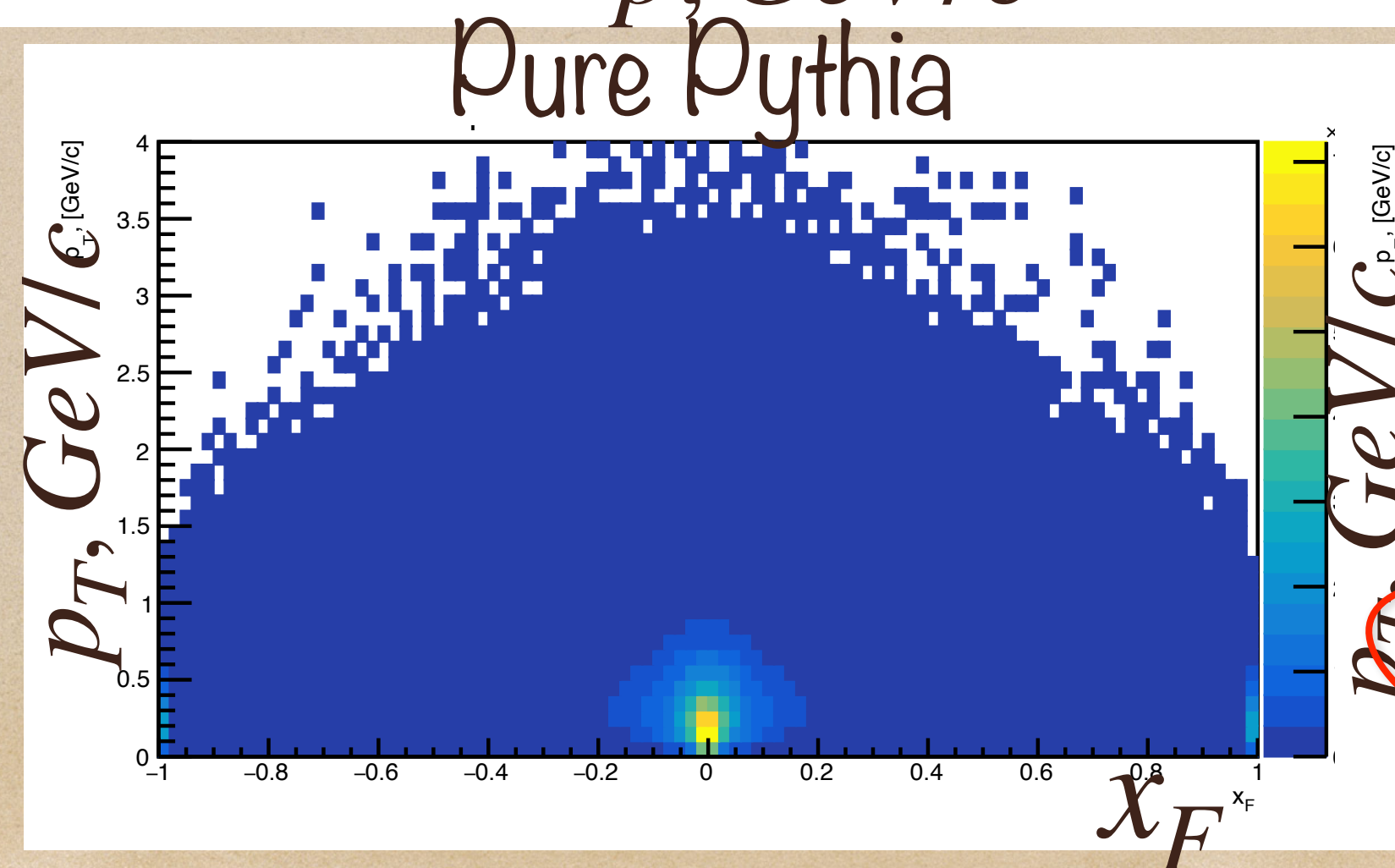
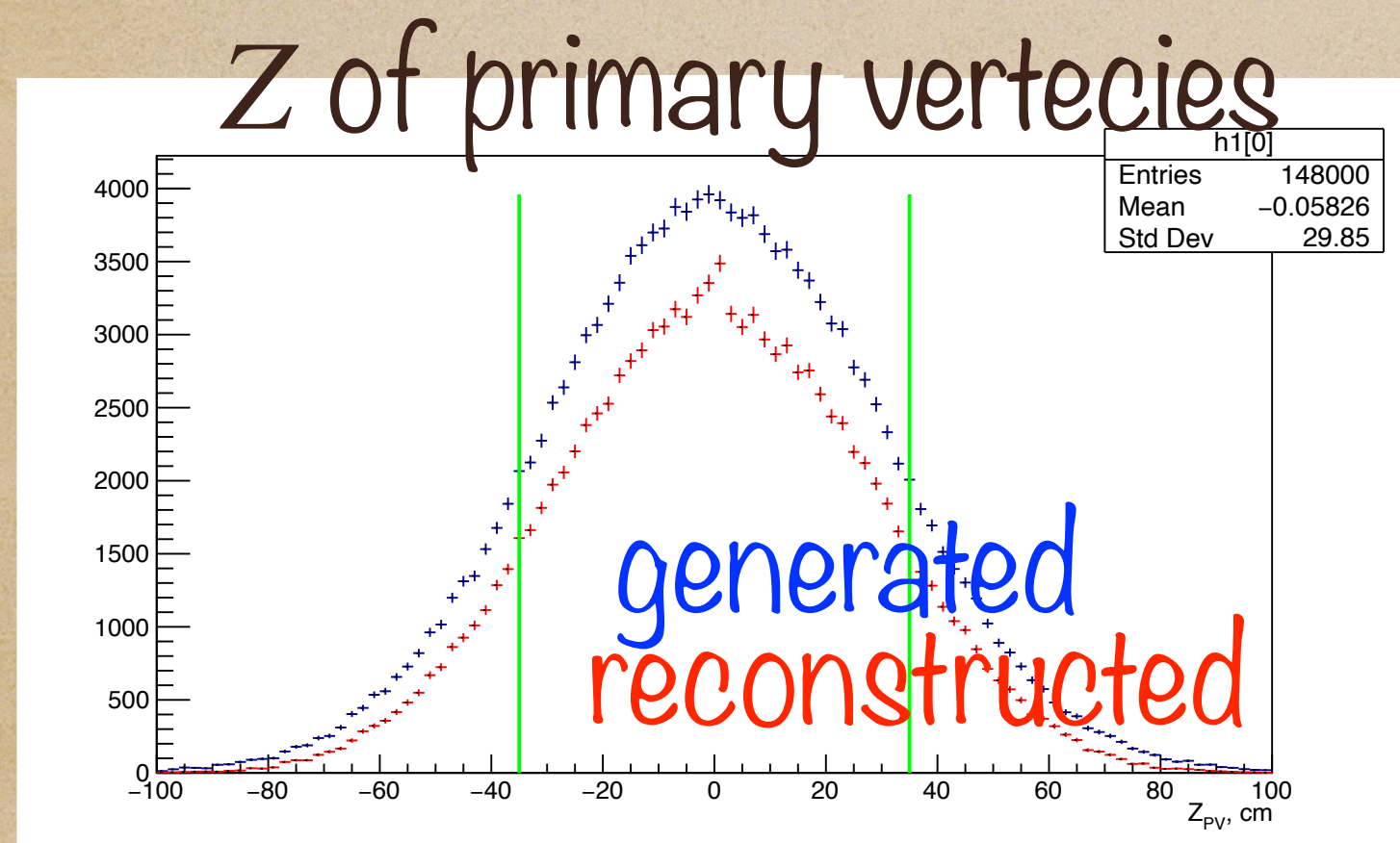
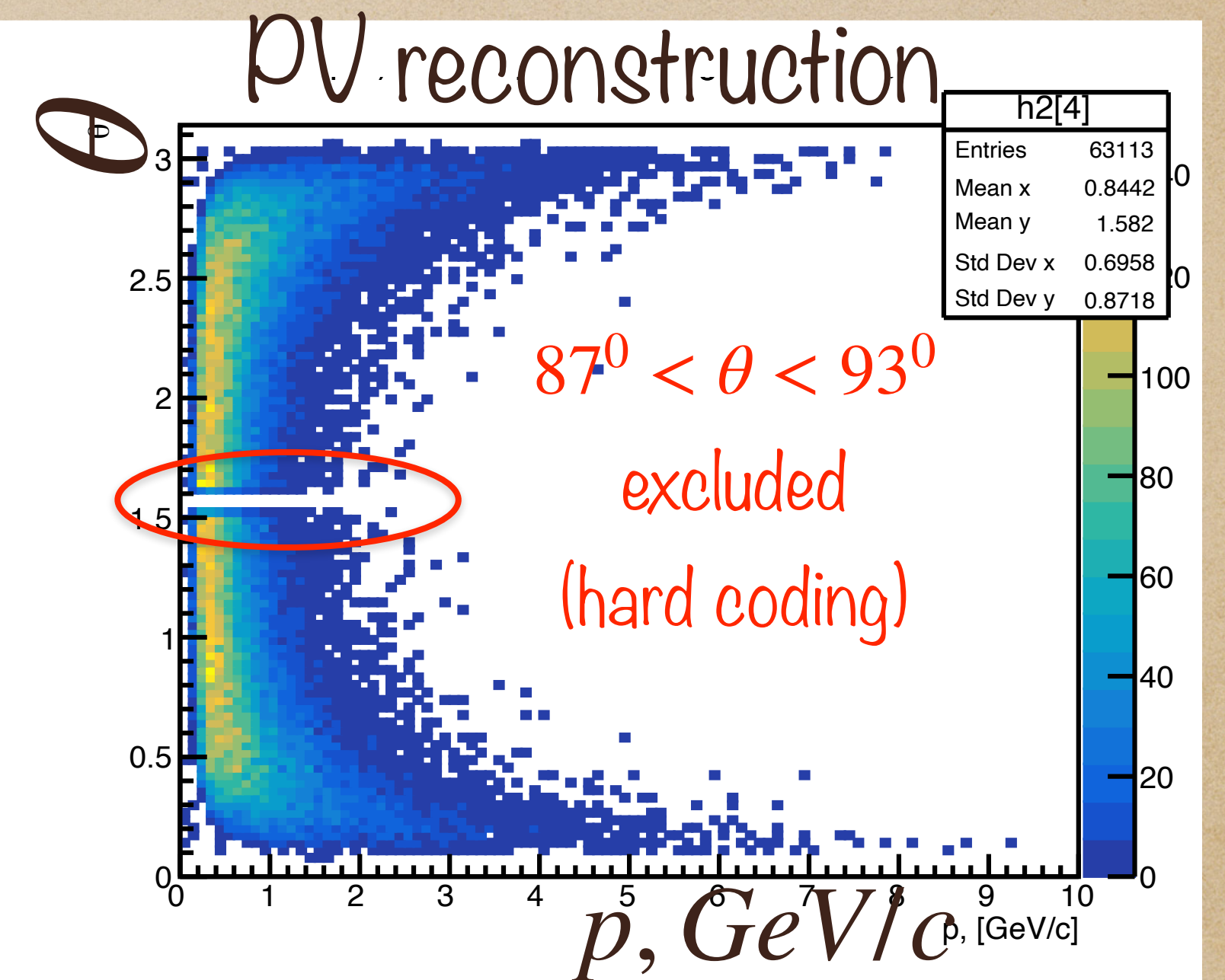
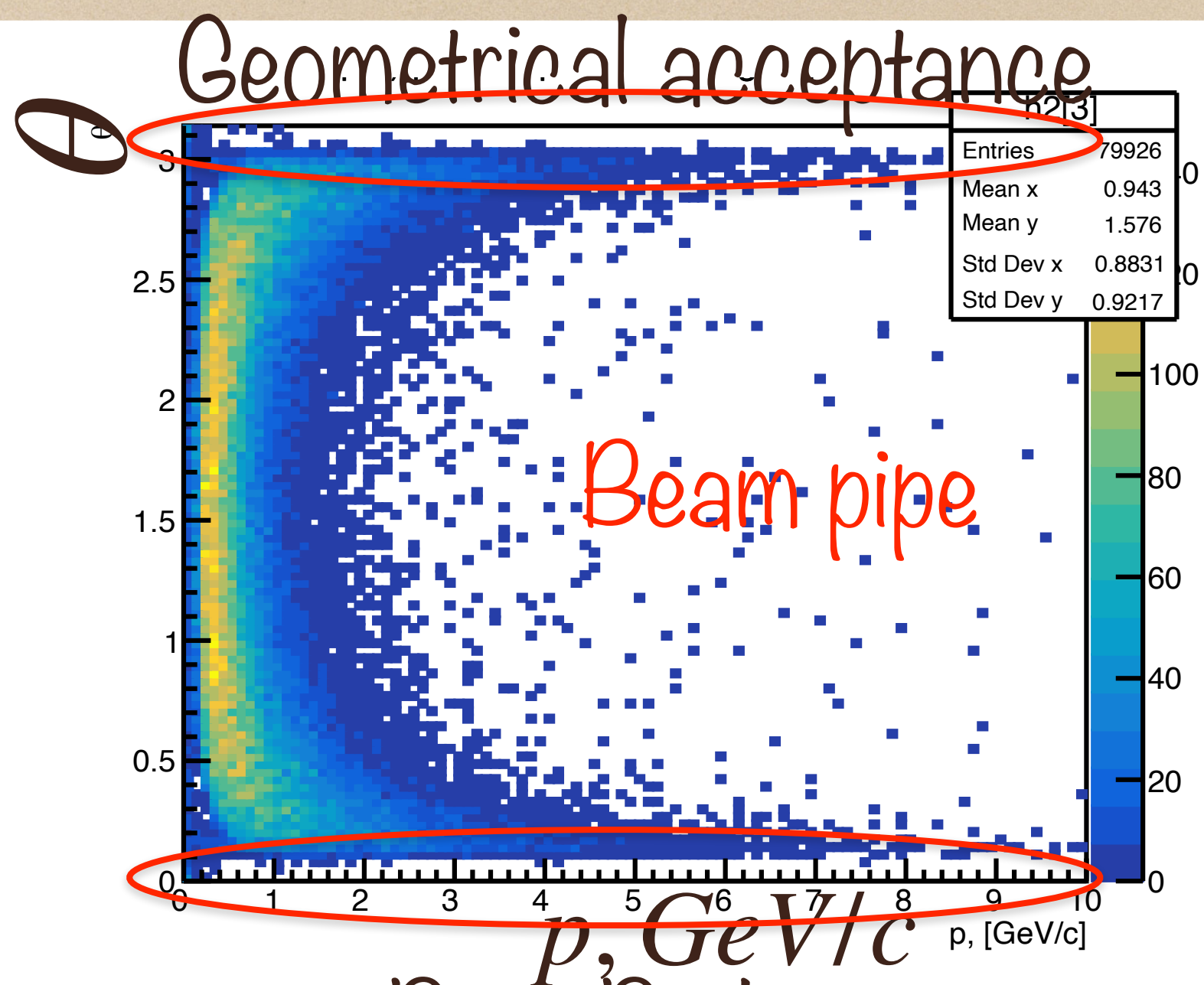
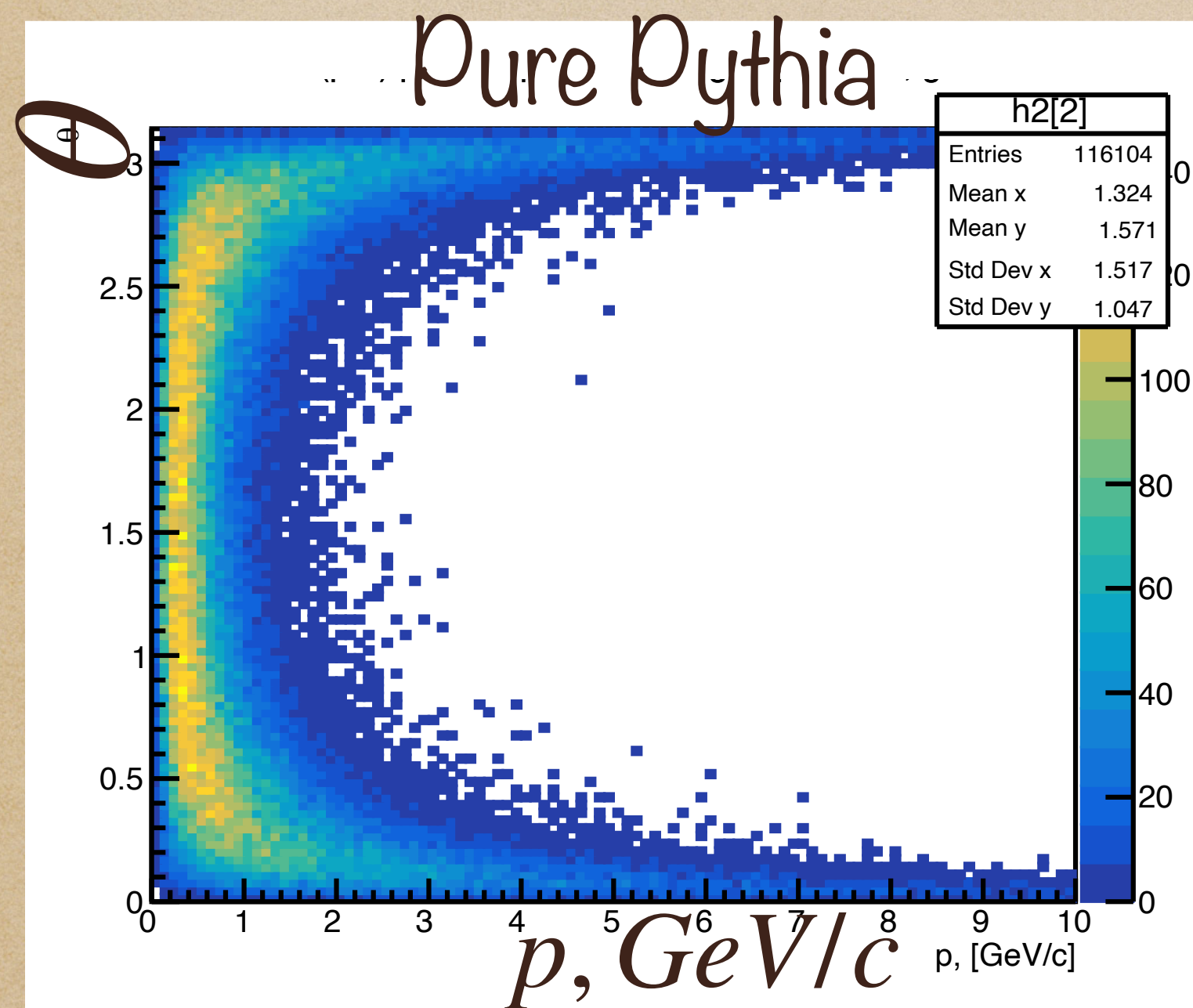
VI SPD Collaboration Meeting, Samara, 25.10.2023

Generation and Reconstruction

- ◆ 8 mln Soft QCD (w/o elastic) events with Pythia 8; pp at 27 GeV;
- ◆ SPDRoot v. 4.1.5.1; ITS: — MAPS 4 layers, no EndCap;
- ◆ Beam: `gRandom->SetSeed(seed);`

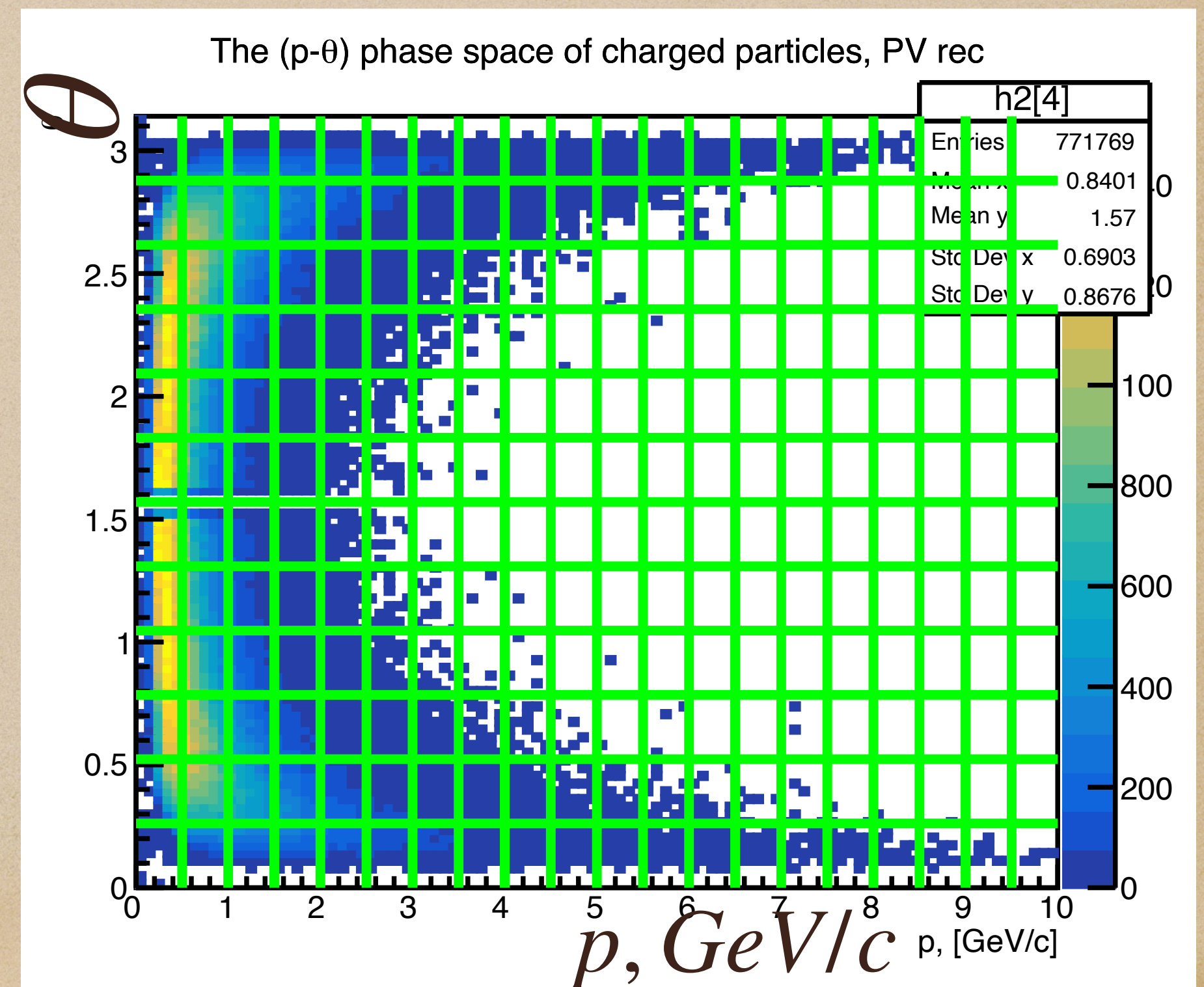
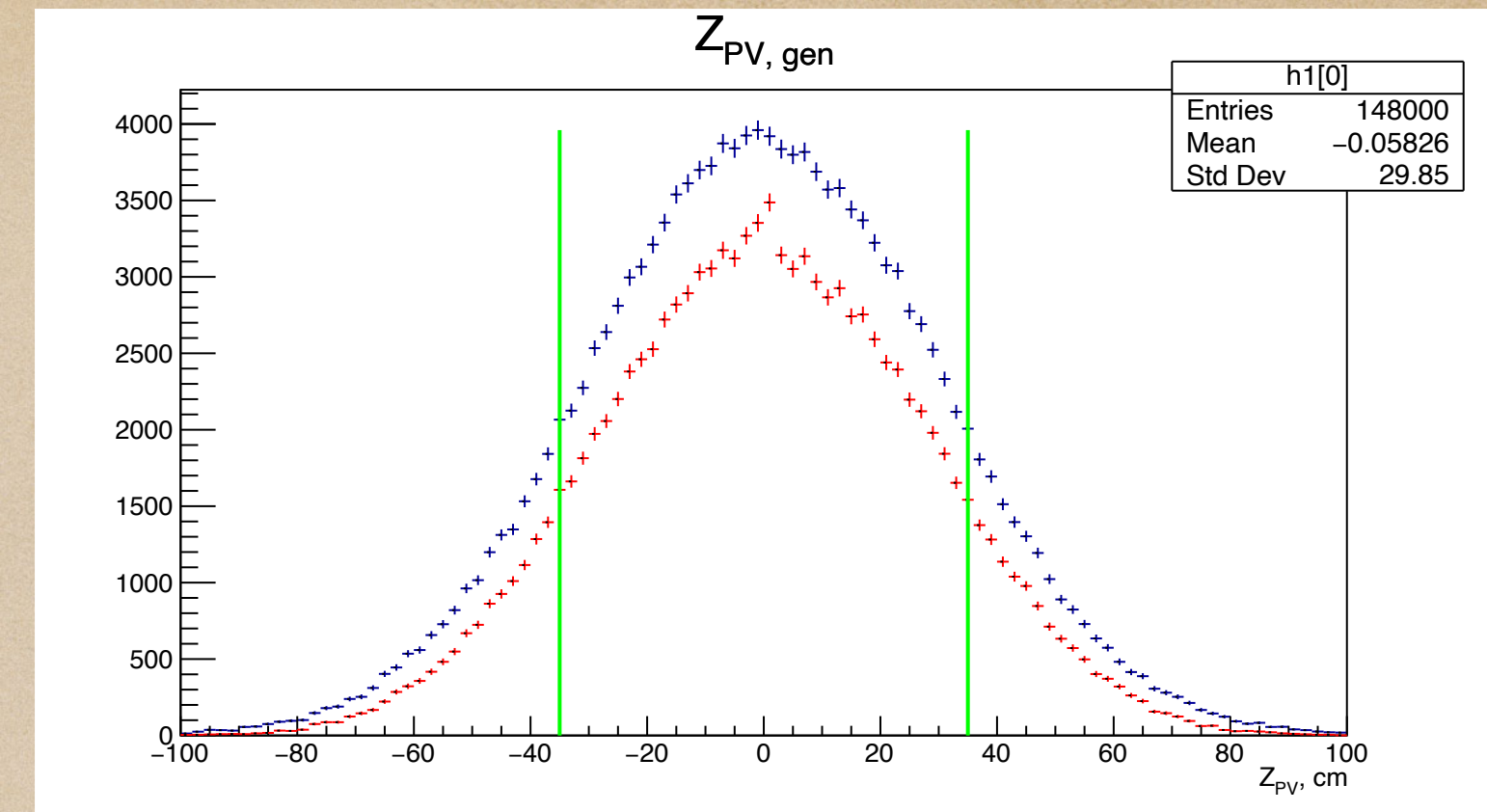
```
primGen->SetBeam(0., 0., 0.025, 0.025);//X0,Y0,Xwidth,Ywidth : 250 microns std. dev.  
primGen->SmearGausVertexXY(kTRUE);  
//Important : for uniform smearing or SmearVertexXY(kTRUE), give twice the width you want  
//uniform smearing is done from -width/2 to width/2  
//for Gaussian smearing or SmearGausVertexXY(kTRUE), give sigma or standard deviation you want  
  
primGen->SetTarget(0., 30.);//Z0,Zwidth, 30 cm std. dev.  
primGen->SmearGausVertexZ(kTRUE);  
//Important : for uniform smearing or SmearVertexZ(kTRUE), give twice the width you want  
//uniform smearing is done from -width/2 to width/2  
//for Gaussian smearing or SmearGausVertexZ(kTRUE), give sigma or standard deviation you want
```


Kinematic distributions



Selection

- ◆ Reconstructed Primary Vertex (RCVertex)
($-35 \text{ cm} < Z_{PV} < 35 \text{ cm}$)
- ◆ At least 1 hit in ITS and 8 or more hits in STRAW
- ◆ Track fit convergency $\neq 0$
- ◆ Particle identification in TOF m^2

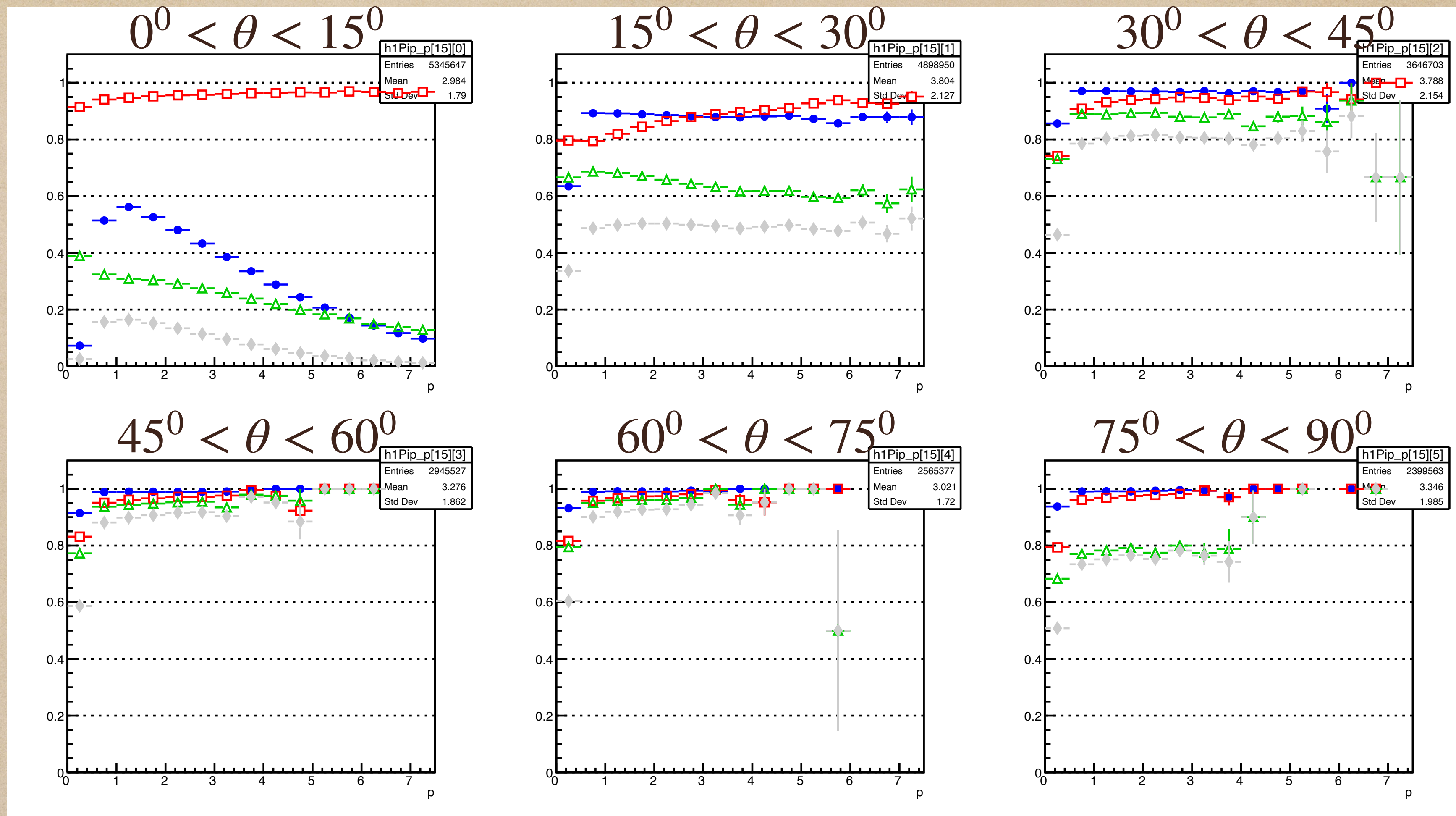


Factorisation of MC corrections

$$\pi^+ : C = C1 * C5 * C6 * C7, C1 = C2 * C3 * C4$$

- ◆ C2 — geometrical acceptance
- ◆ C3 — if track associated with TOF
- ◆ C4 — if track associated with a reconstructed primary vertex
- ◆ C5 — track has at least 1 hit in ITS
- ◆ C6 — at least 8 STRAW hits
- ◆ C7 — if fit converged or partially converged

$$\pi^+ : C1 = C2 * C3 * C4$$

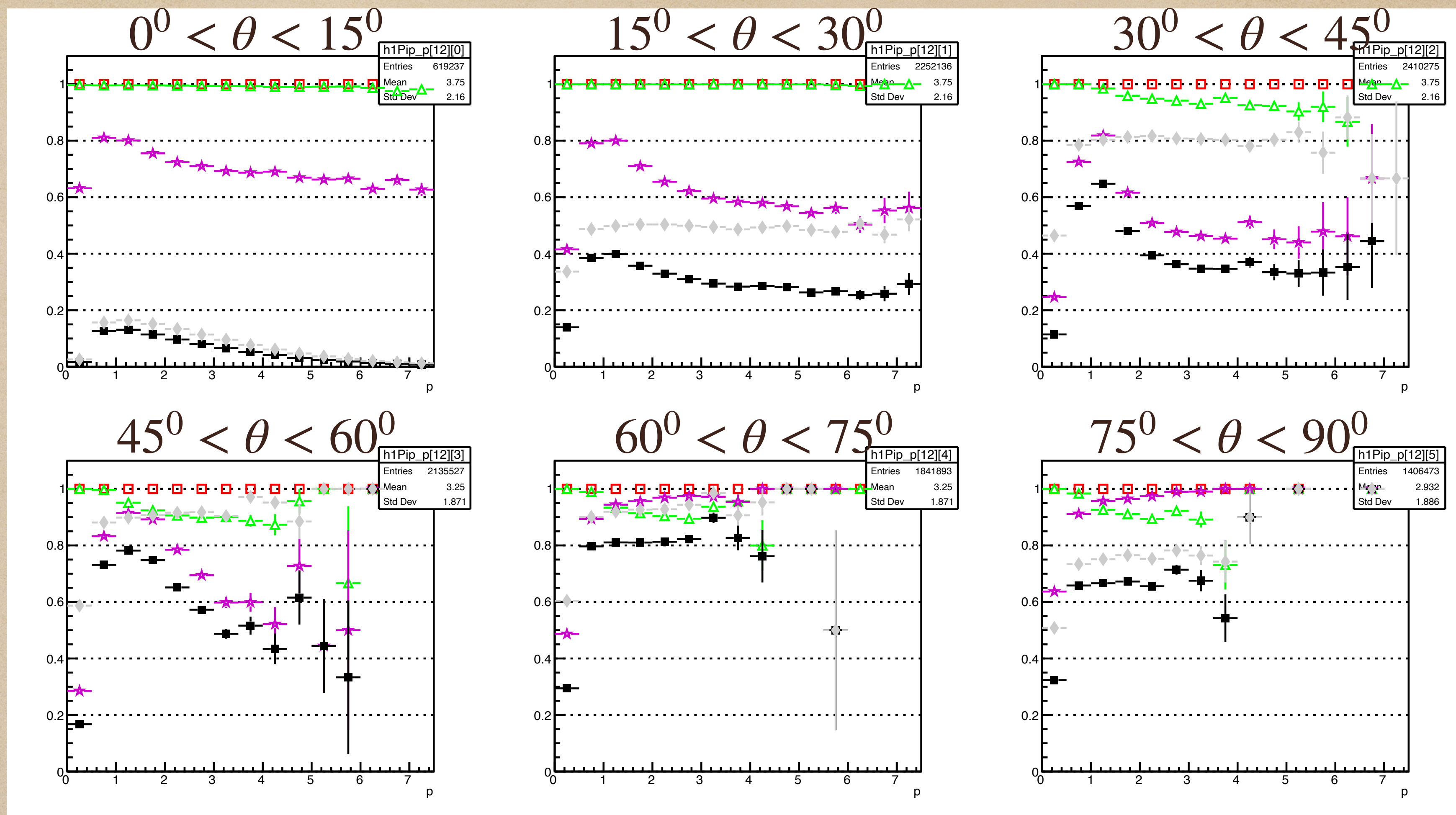


$C2 = N$ of tracks / N of particles

$C3 =$ association with TOF

$C4 =$ in a reconstructed primary vertex — $87^\circ < \theta < 93^\circ$ excluded (hard coding), track is fitted

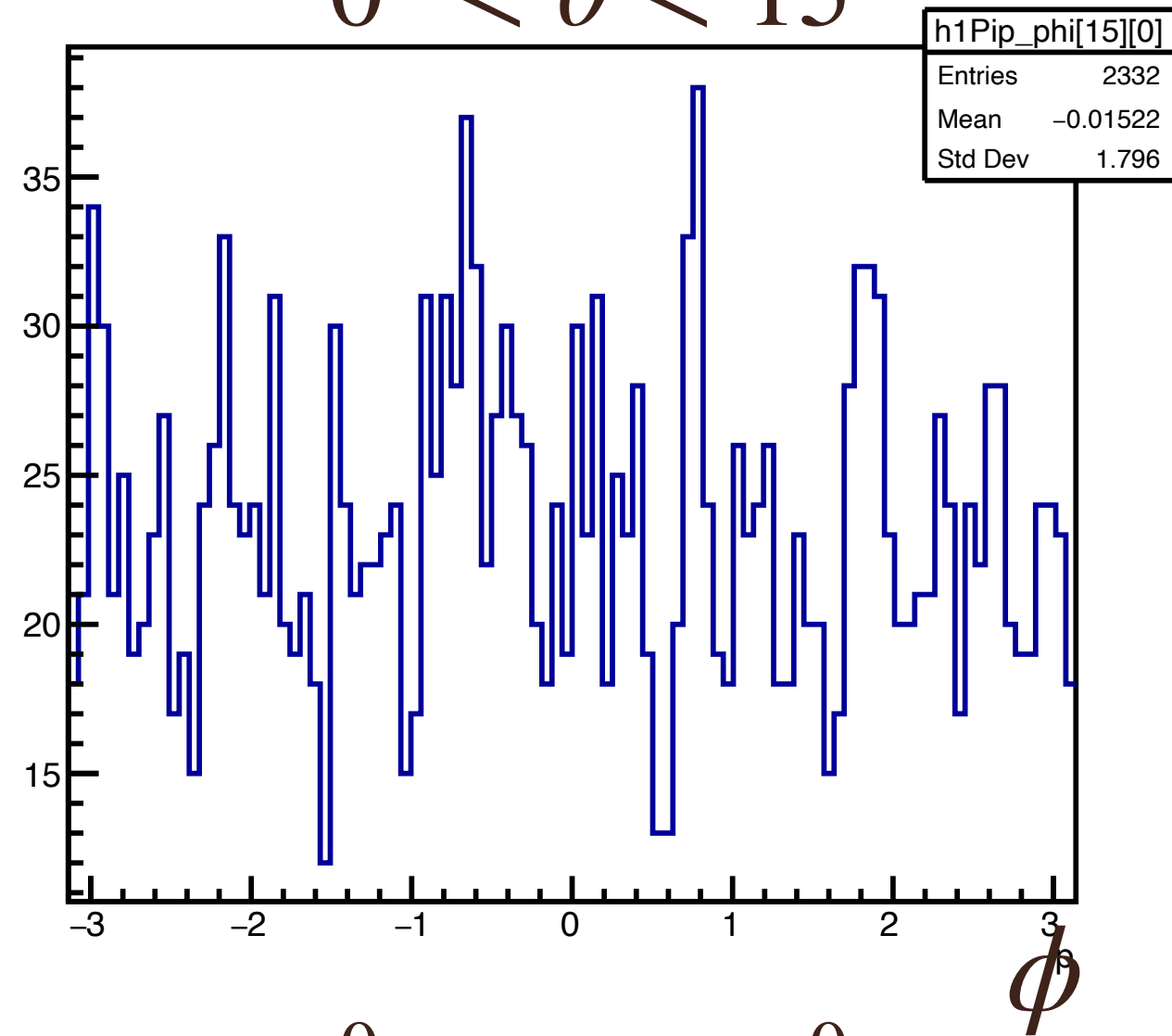
$$\pi^+ : C = C1 * C5 * C6 * C7$$



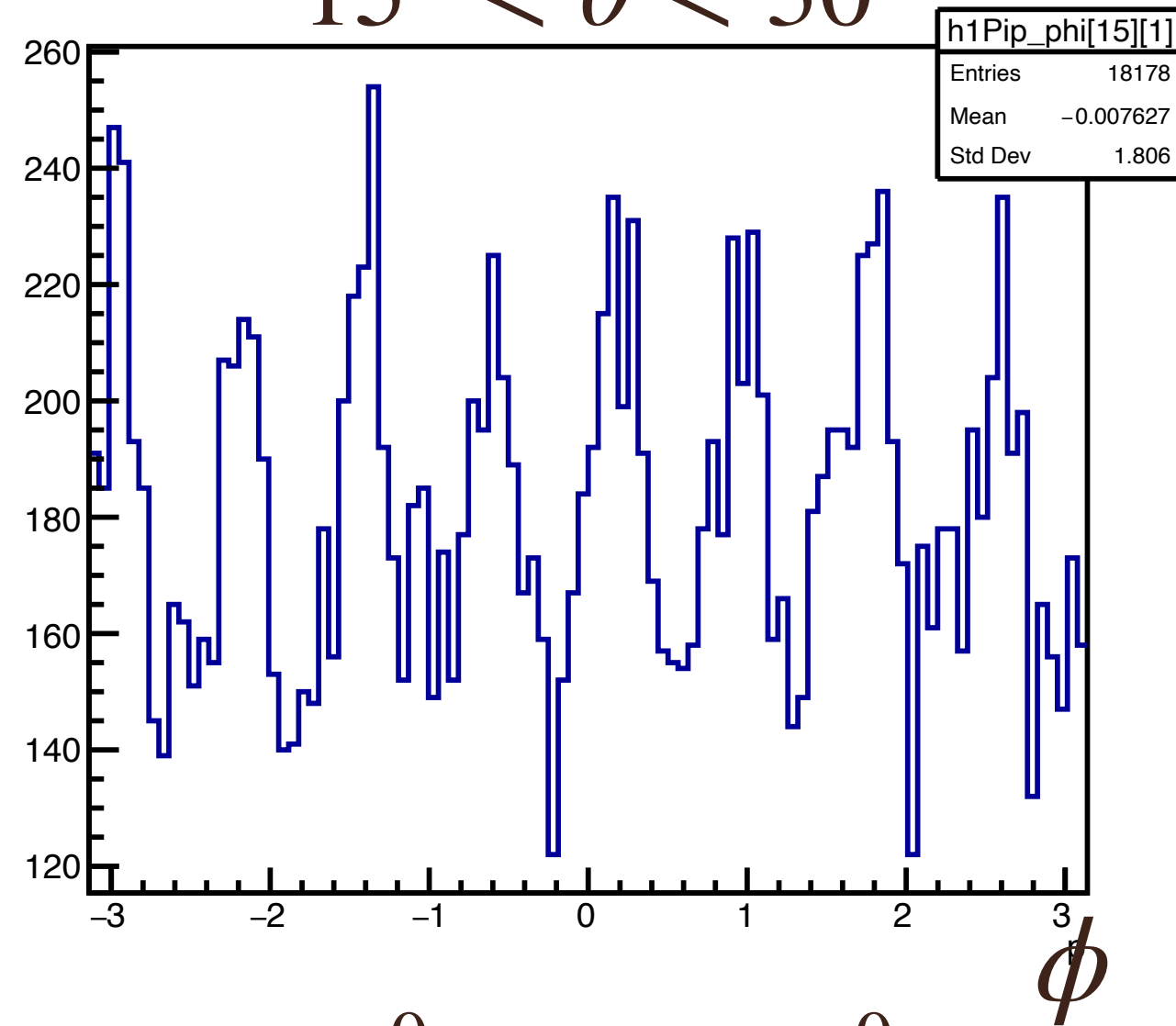
C1 = Total from previous page
 C5 = at least 1 hit in ITS — default reconstruction requirement
 C6 = at least 8 STRAW hits — gaps between octants (5 cm, corrected in the upcoming realisation)
 C7 = convergency cut — from 1 to 4 iterations (hard coding)

Positive pions: no hits in STRAW but 1 hit in ToF

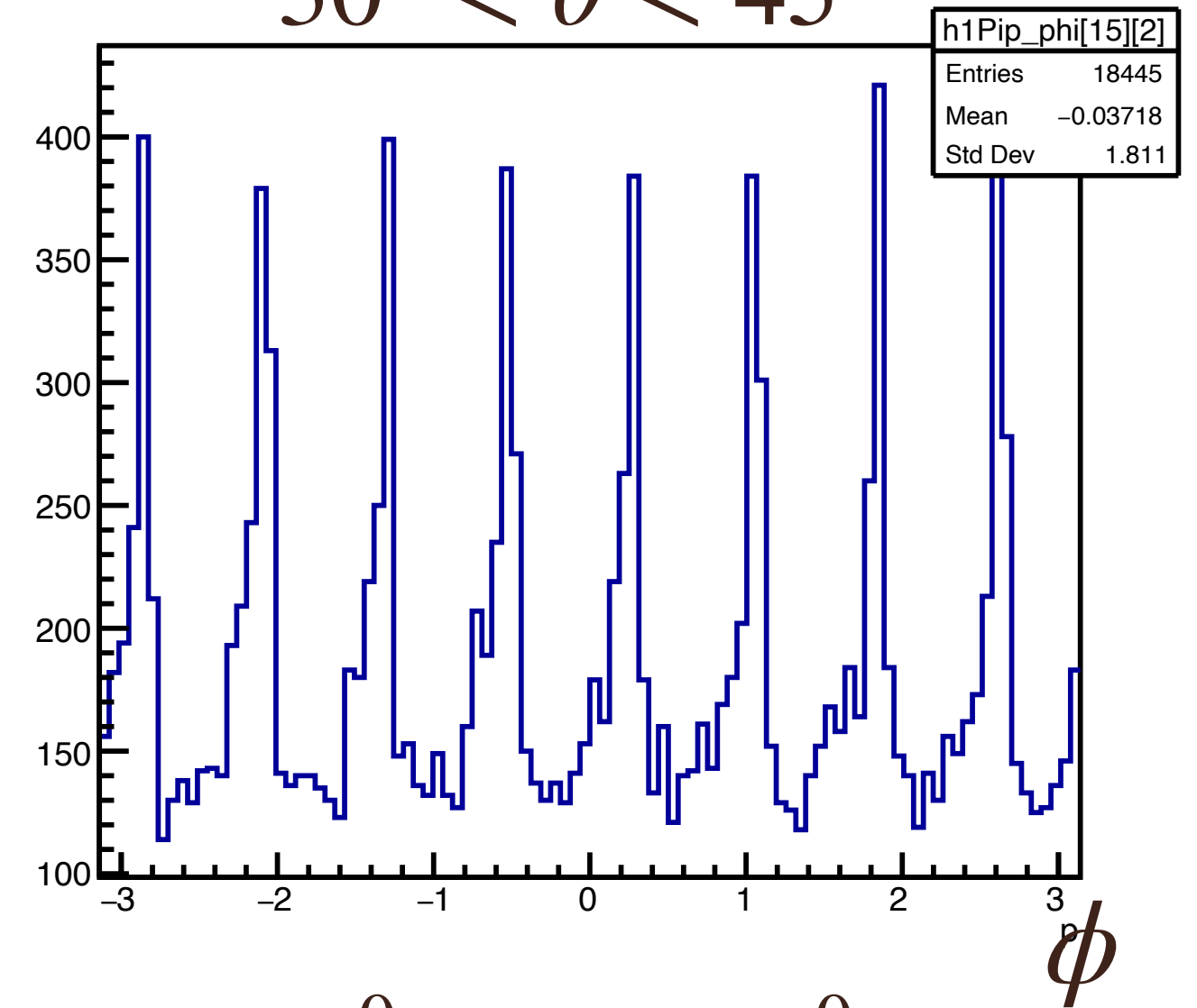
$0^{\circ} < \theta < 15^{\circ}$



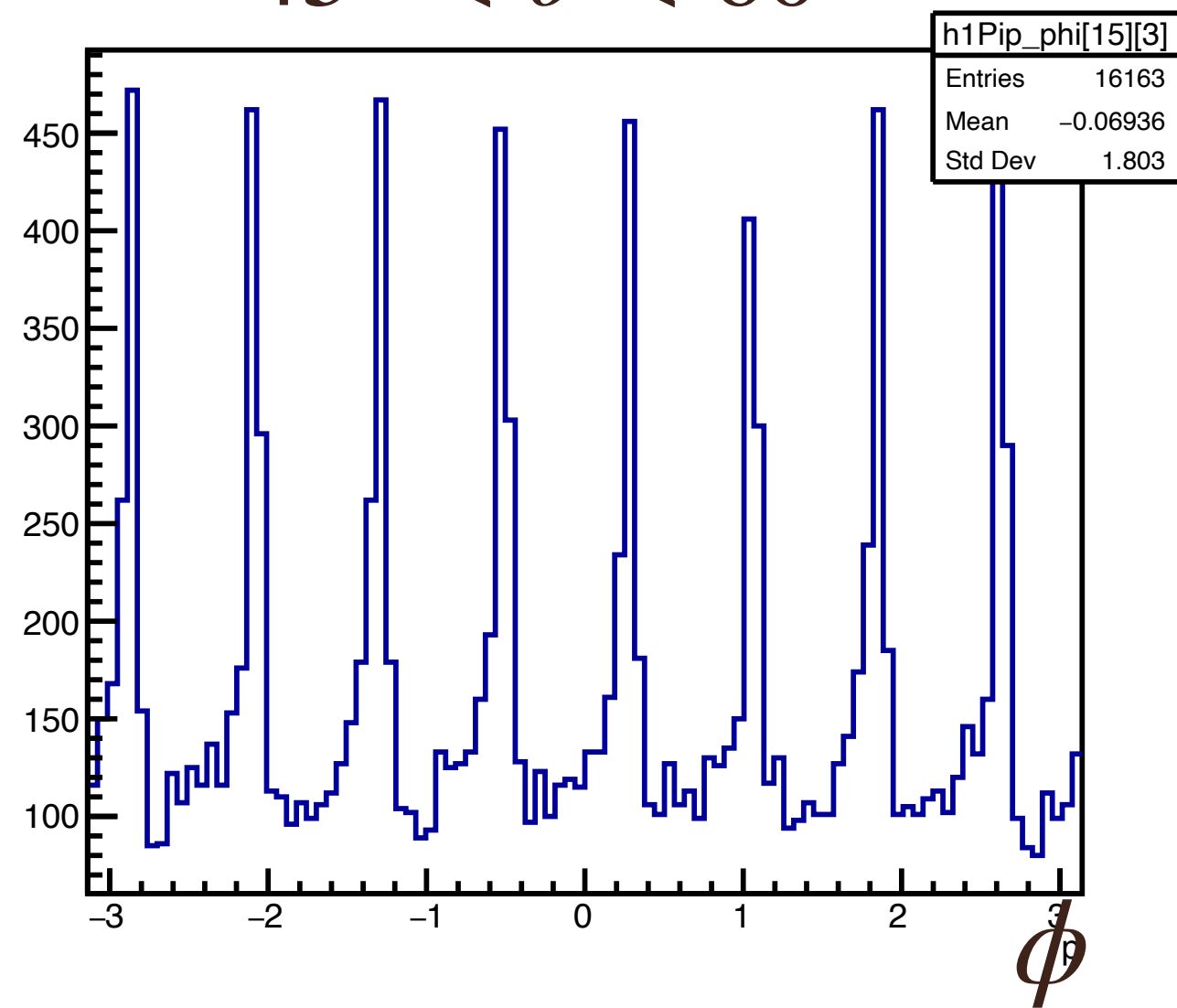
$15^{\circ} < \theta < 30^{\circ}$



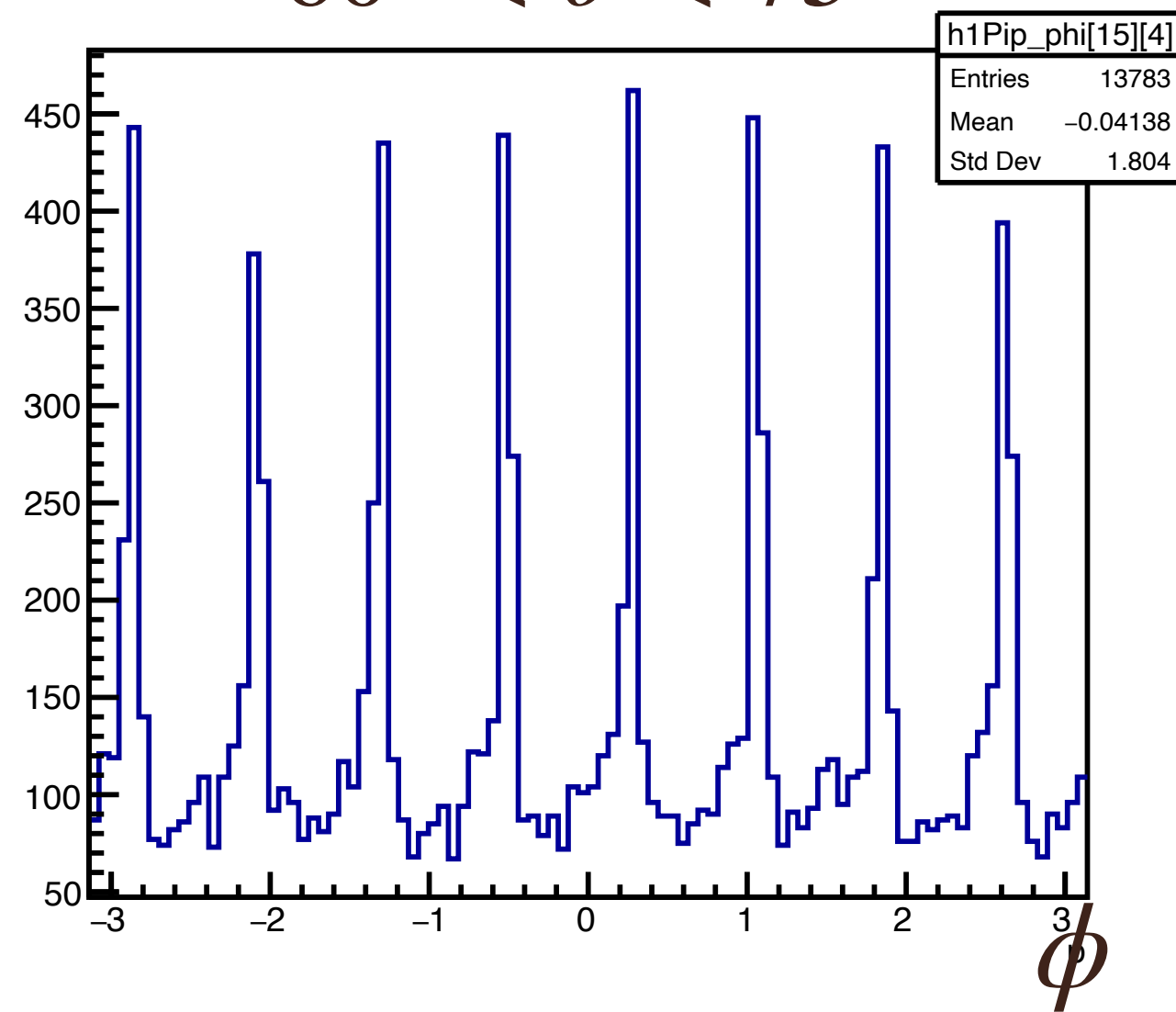
$30^{\circ} < \theta < 45^{\circ}$



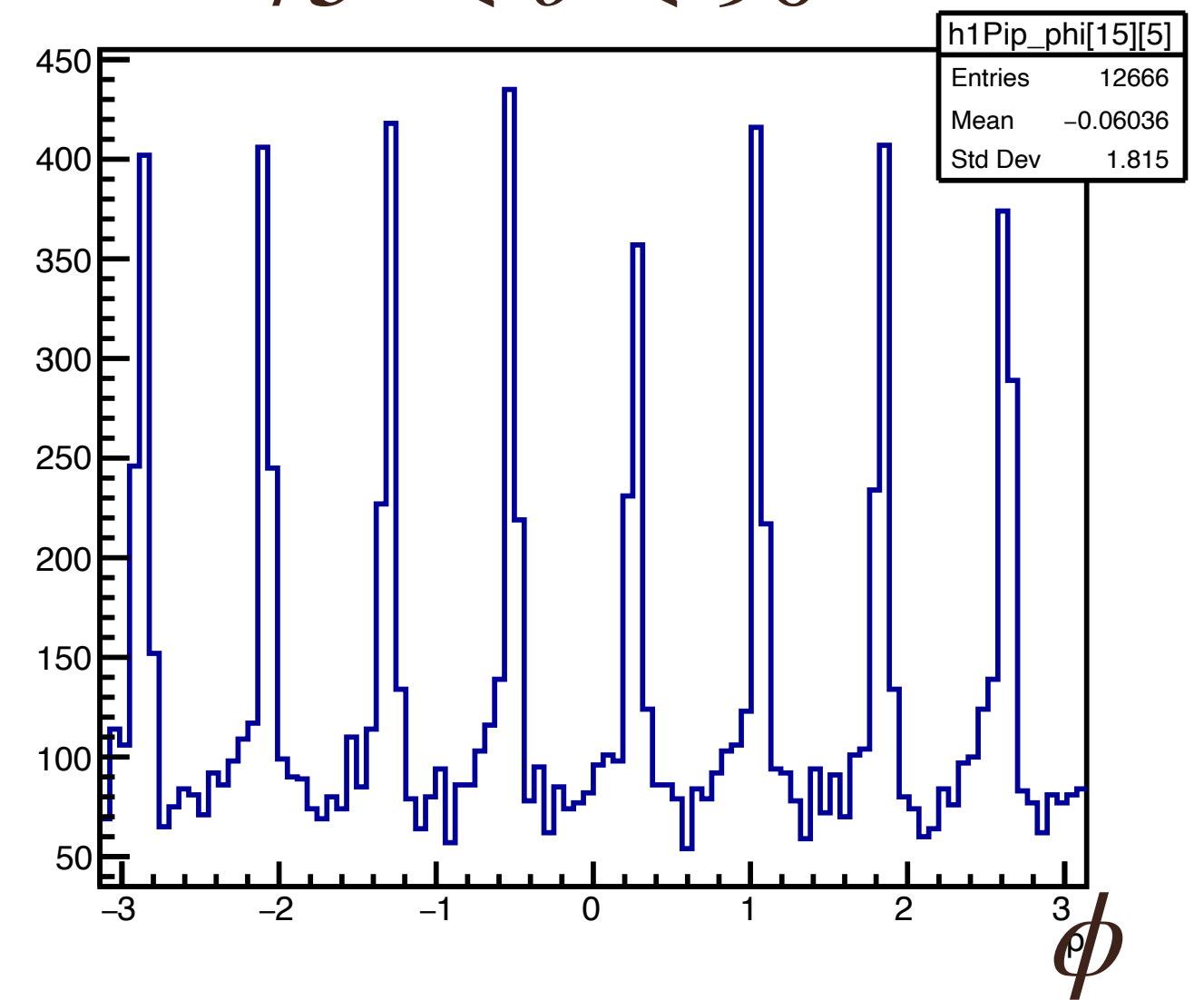
$45^{\circ} < \theta < 60^{\circ}$



$60^{\circ} < \theta < 75^{\circ}$



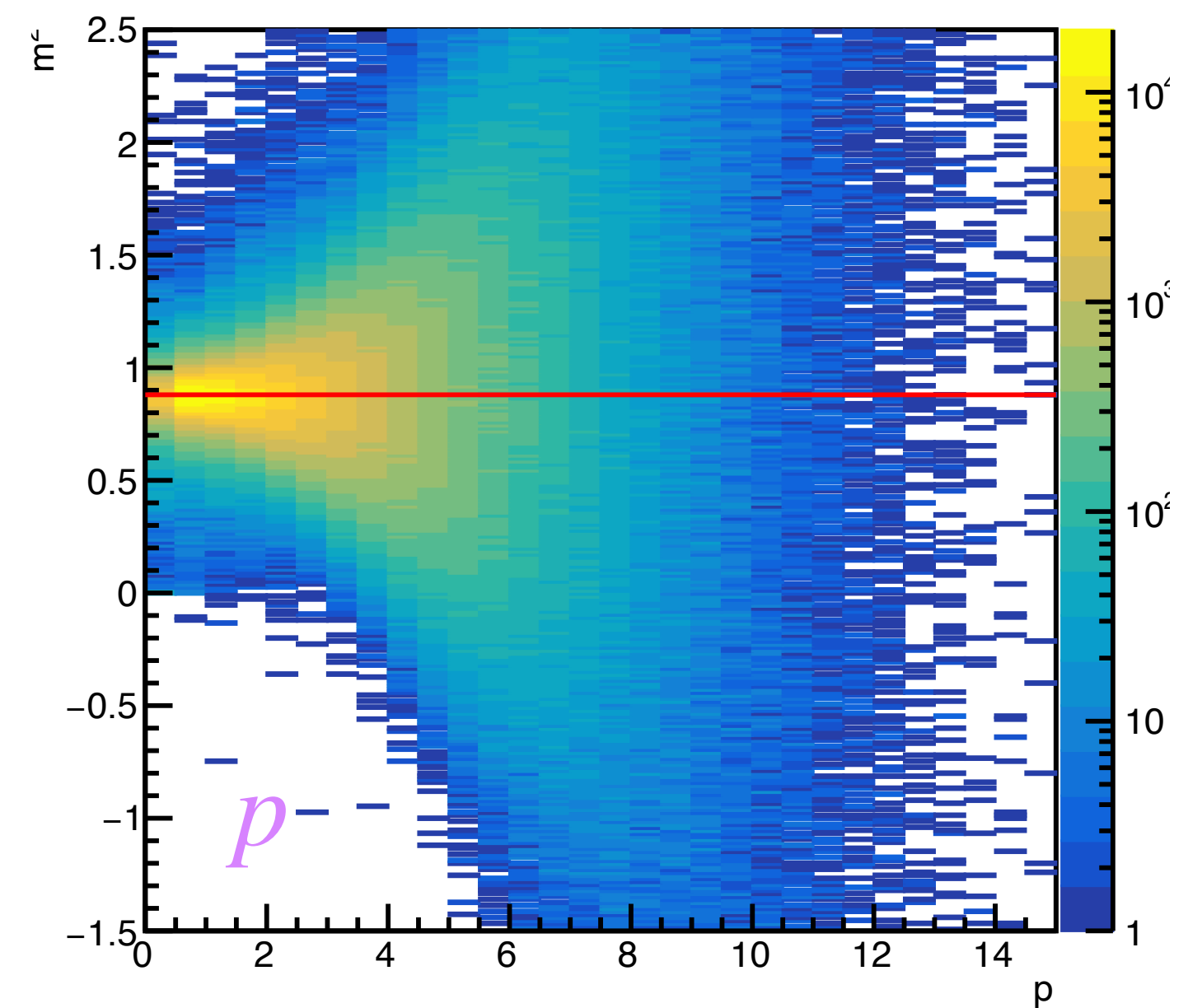
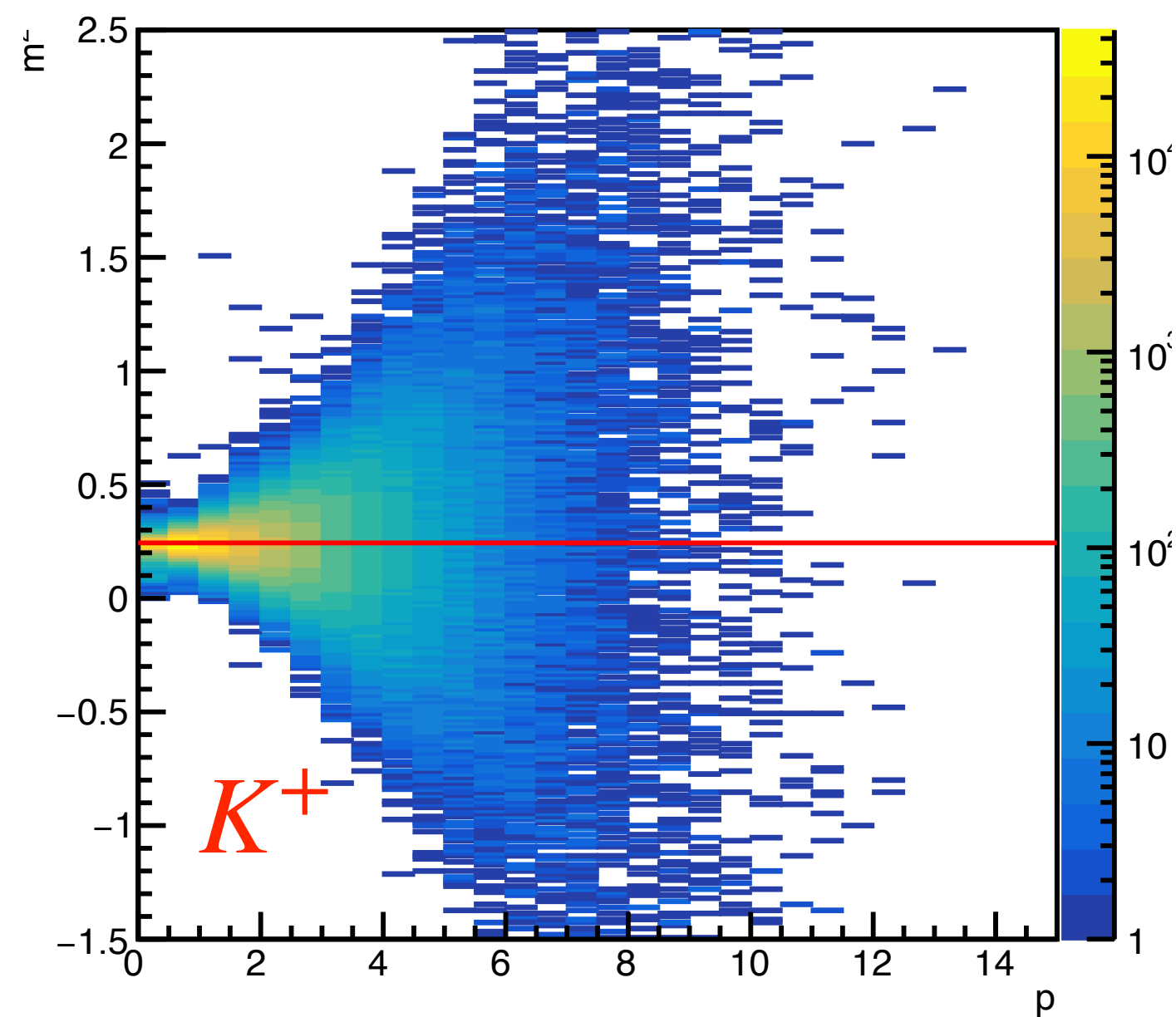
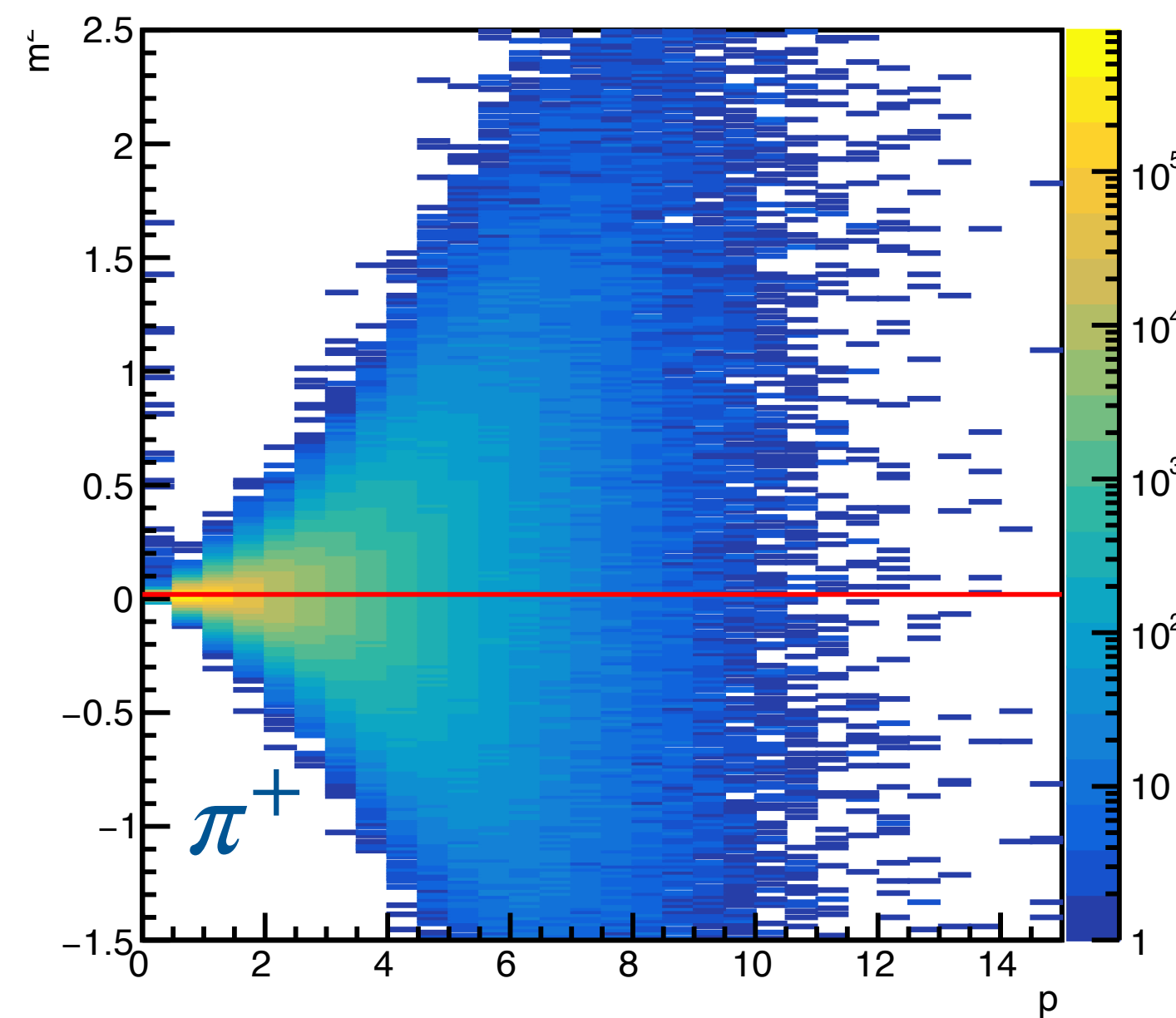
$75^{\circ} < \theta < 90^{\circ}$



Particle identification in TOF

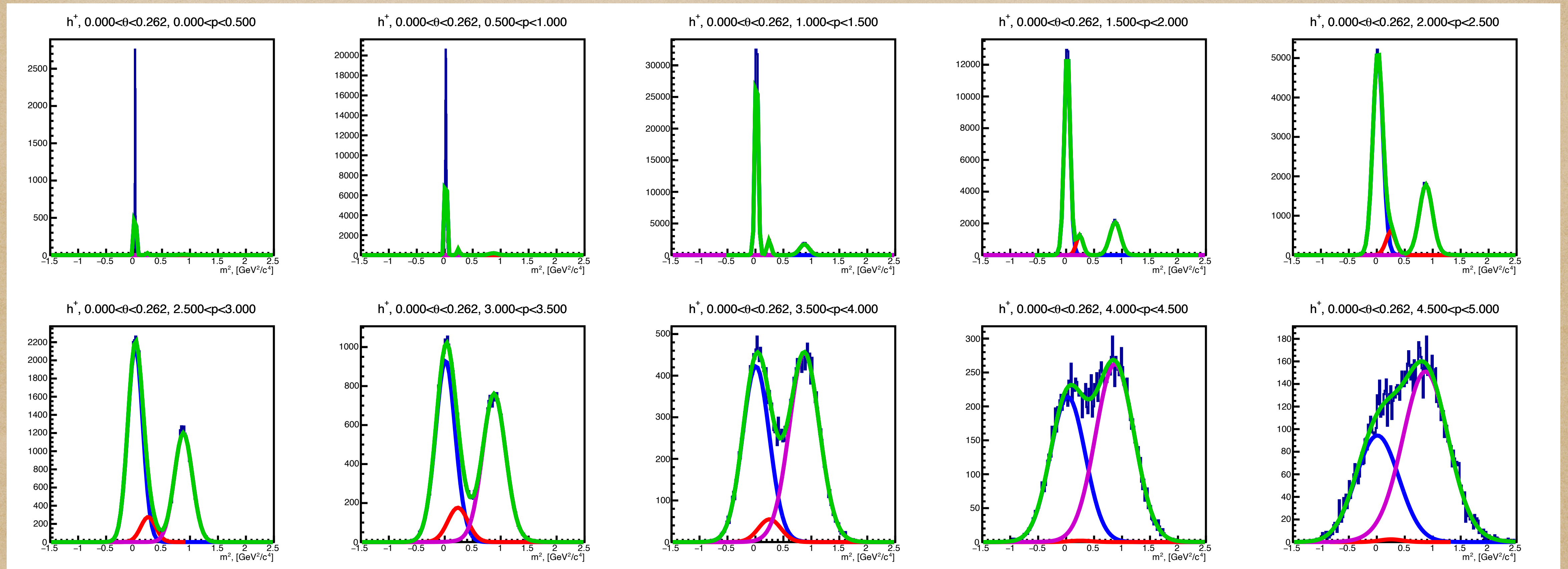
m^2

Positive hadrons



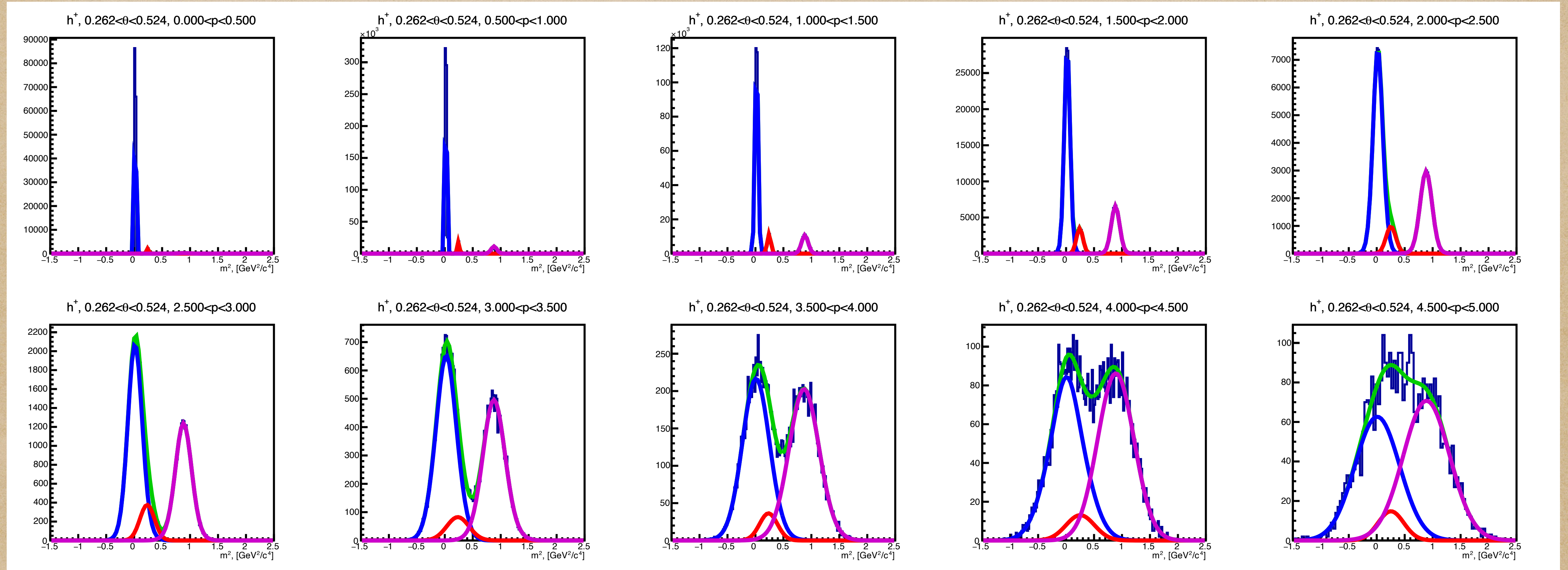
$p, \text{ GeV}/c$

$0^{\circ} < \theta < 15^{\circ} : \text{ToF } m^2, [\text{GeV}^2/c^4]$



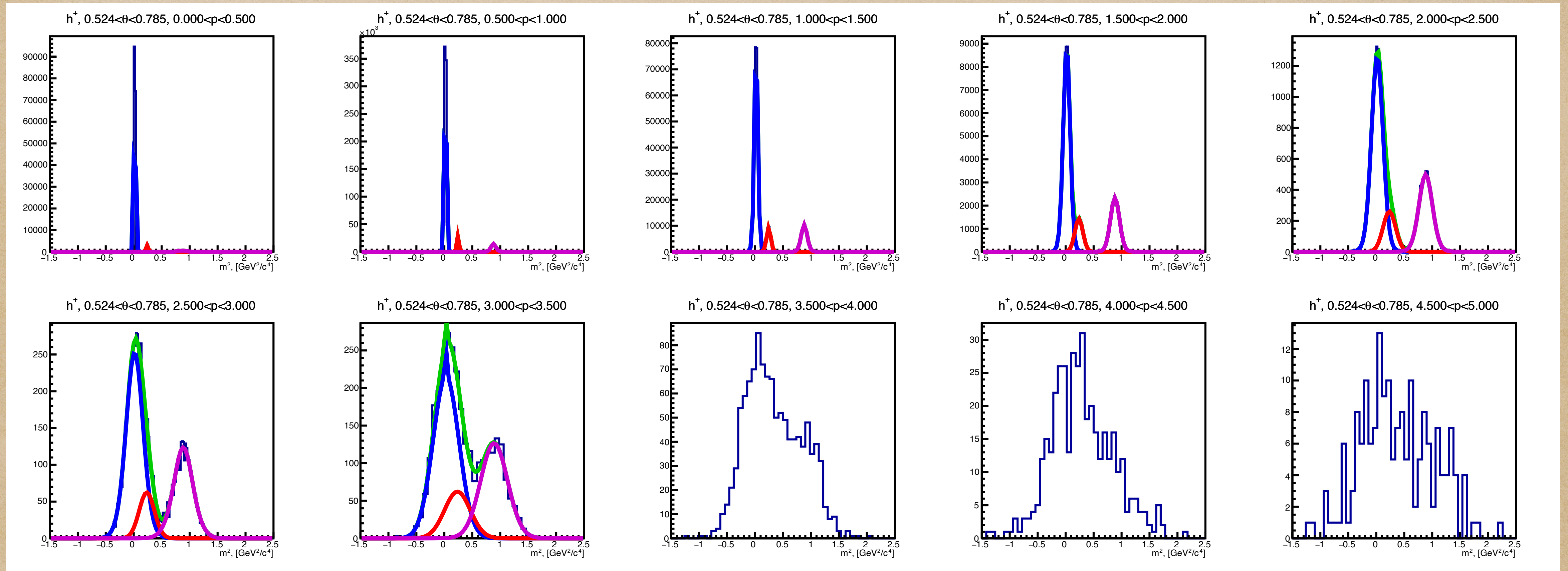
Fit by 3 double gaussians: π^+ , K^+ and p

$15^\circ < \theta < 30^\circ : \text{ToF } m^2, [\text{GeV}^2/c^4]$



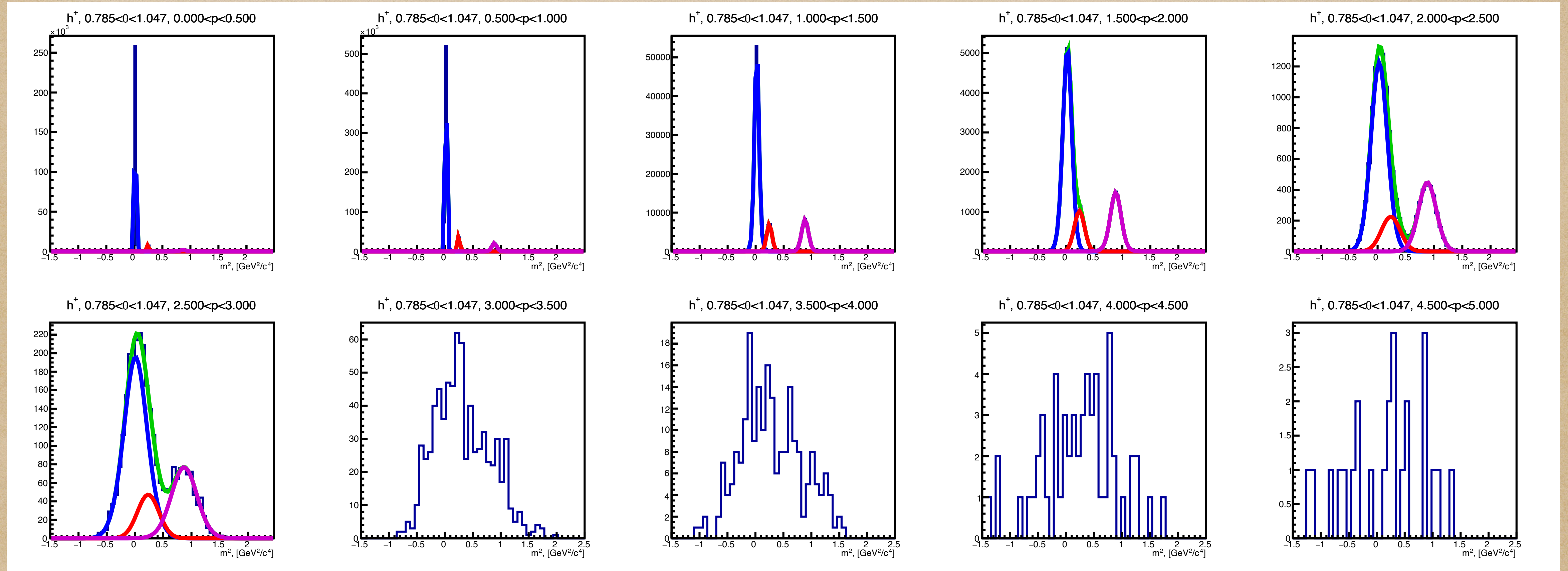
Fit by 3 double gaussians: π^+ , K^+ and p

$30^\circ < \theta < 45^\circ$: ToF m^2 , [GeV^2/c^4]



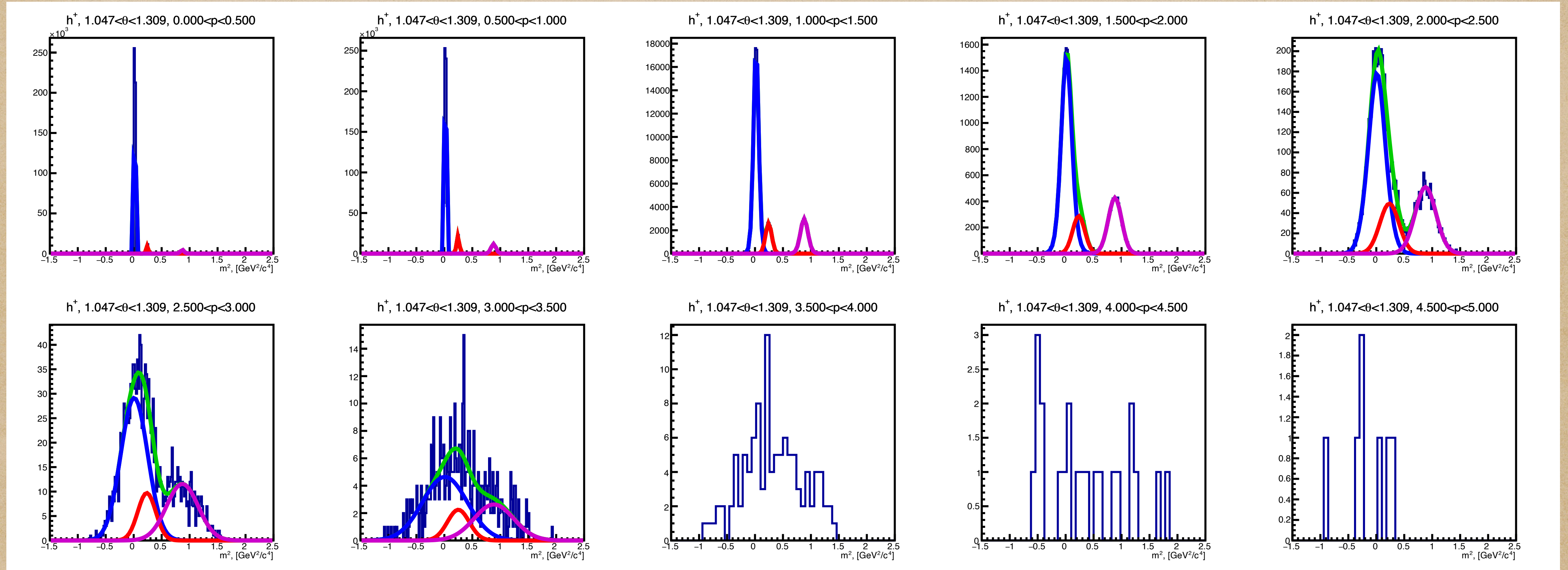
Fit by 3 double gaussians: π^+ , K^+ and p

$45^\circ < \theta < 60^\circ$: ToF m^2 , [GeV^2/c^4]



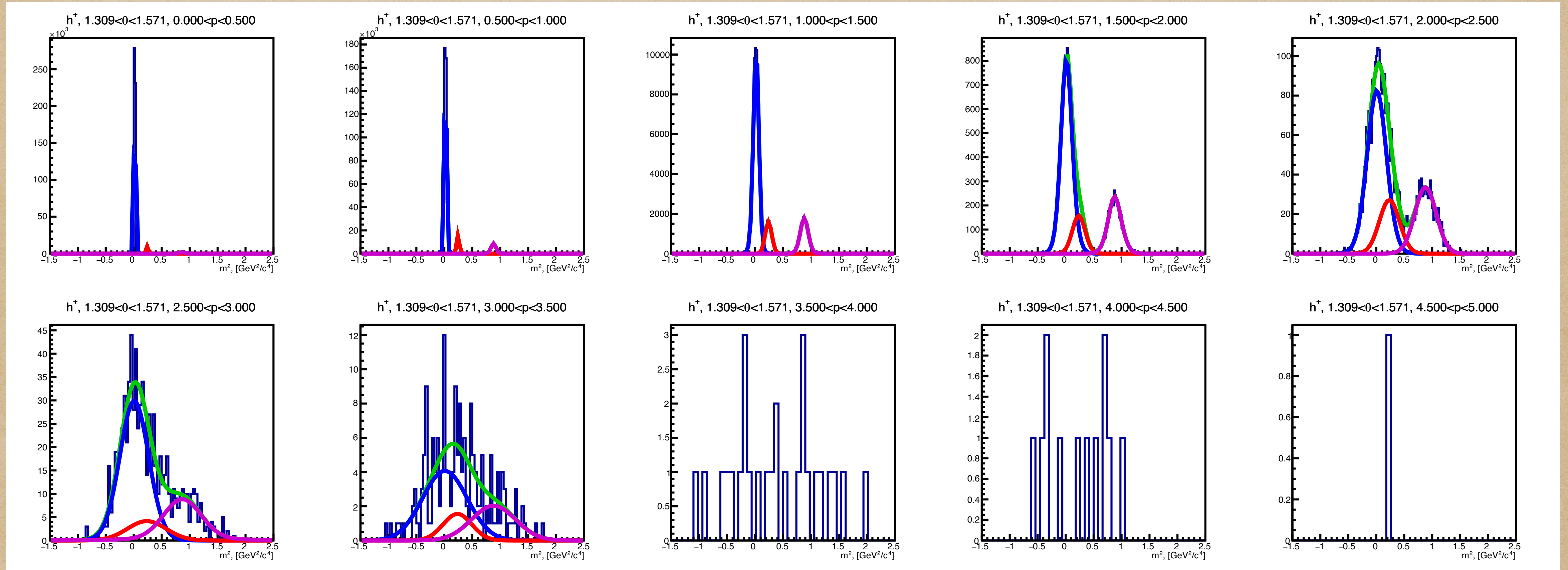
Fit by 3 double gaussians: π^+ , K^+ and p

$60^\circ < \theta < 75^\circ : \text{ToF } m^2, [\text{GeV}^2/c^4]$



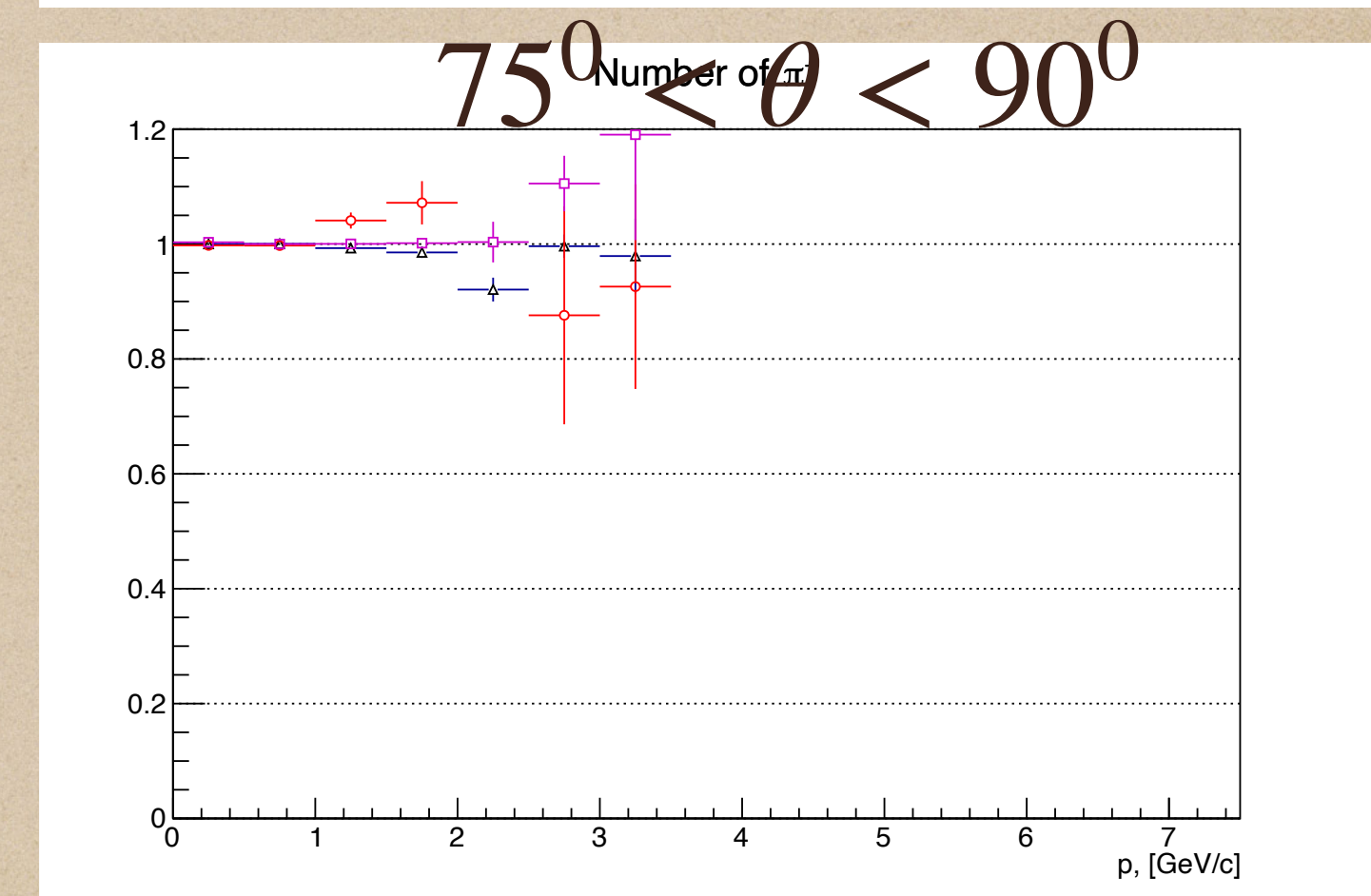
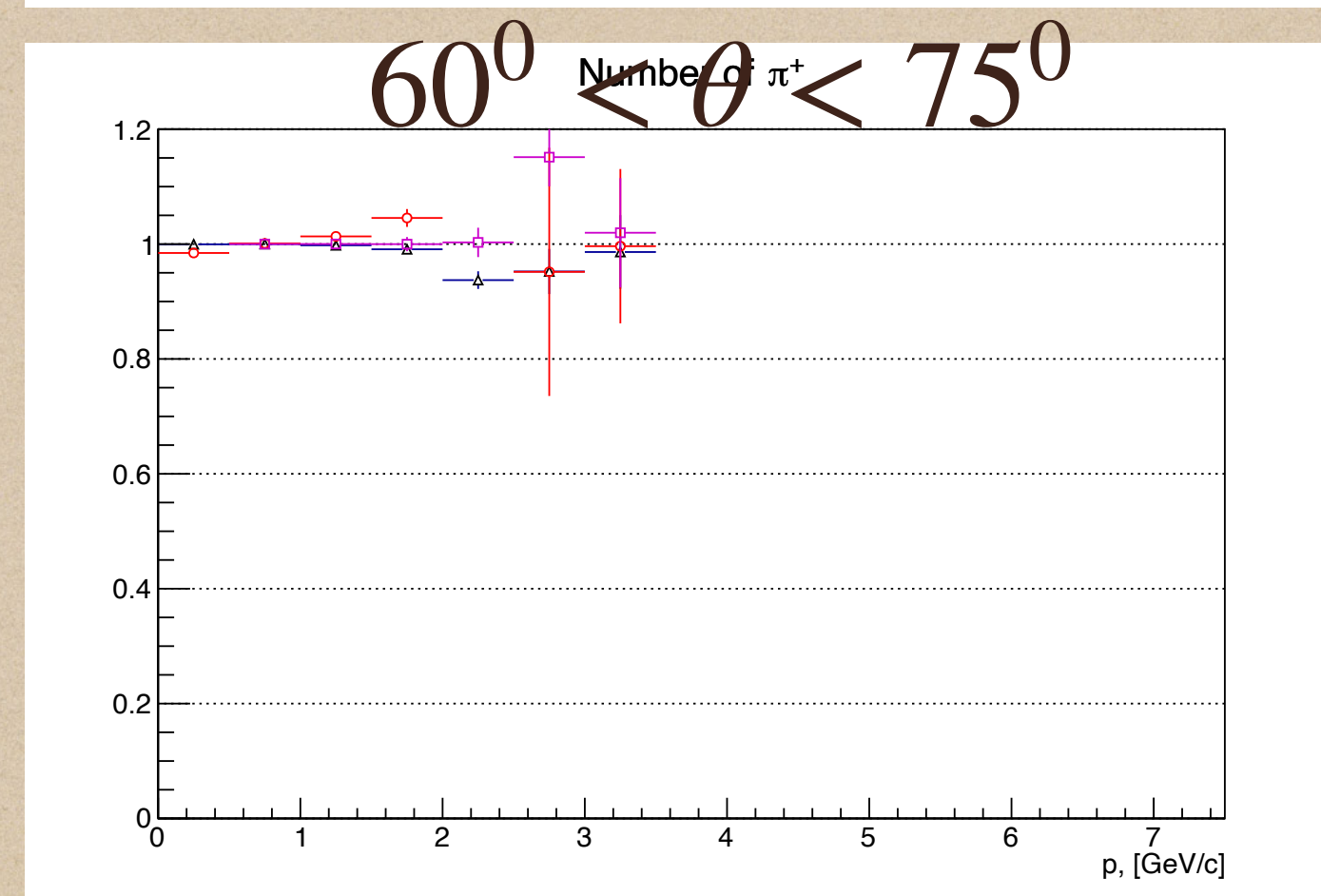
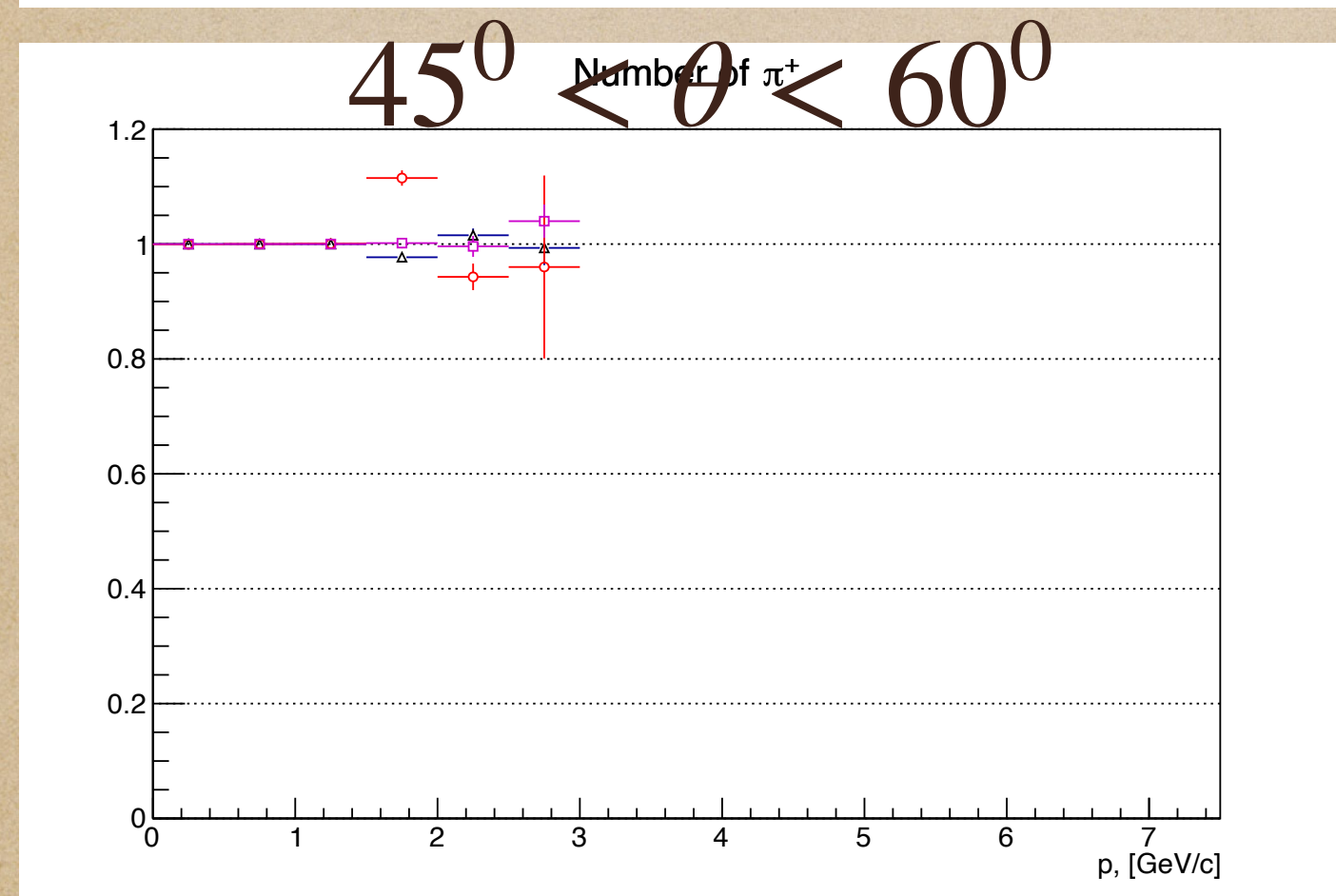
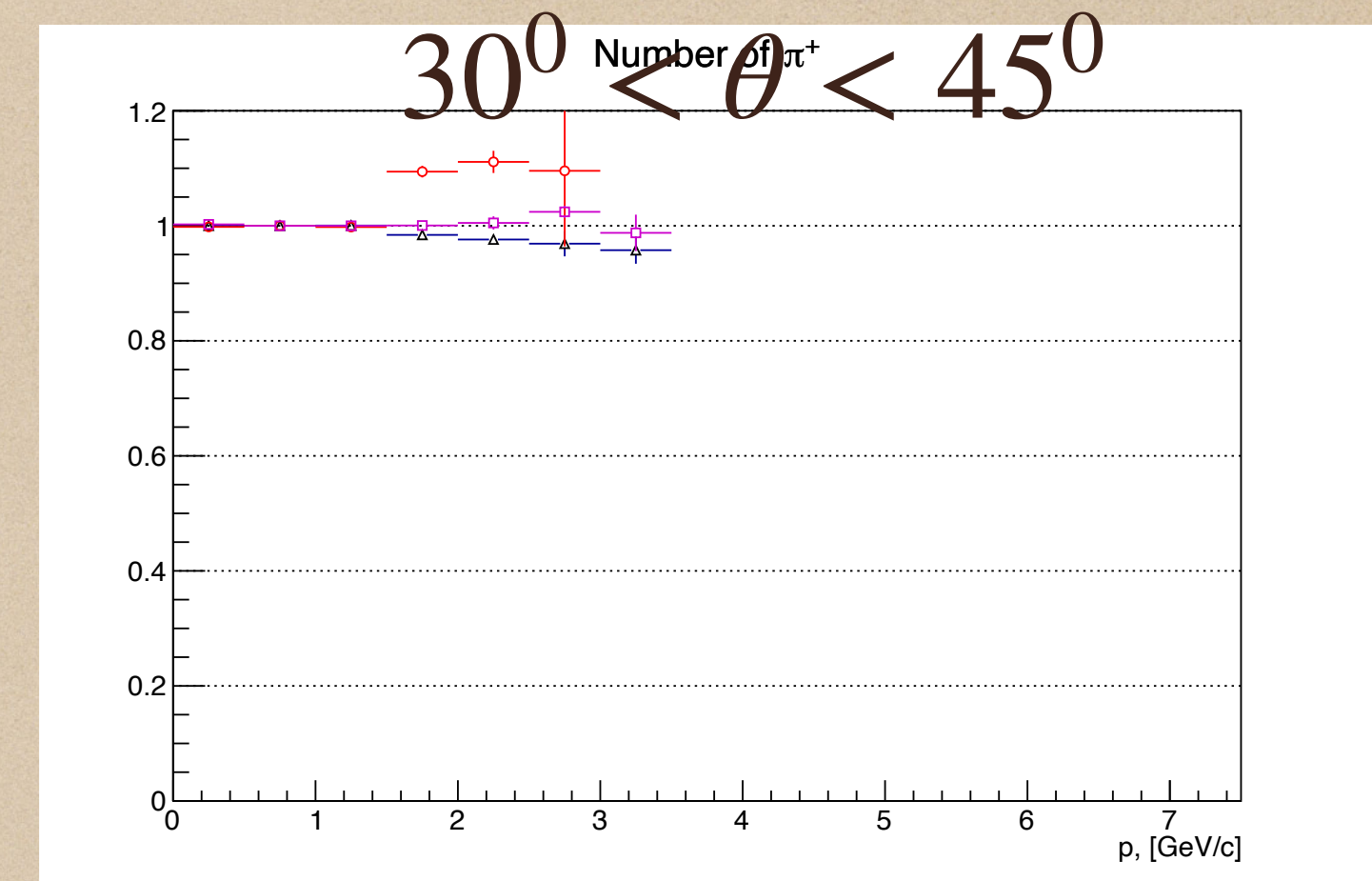
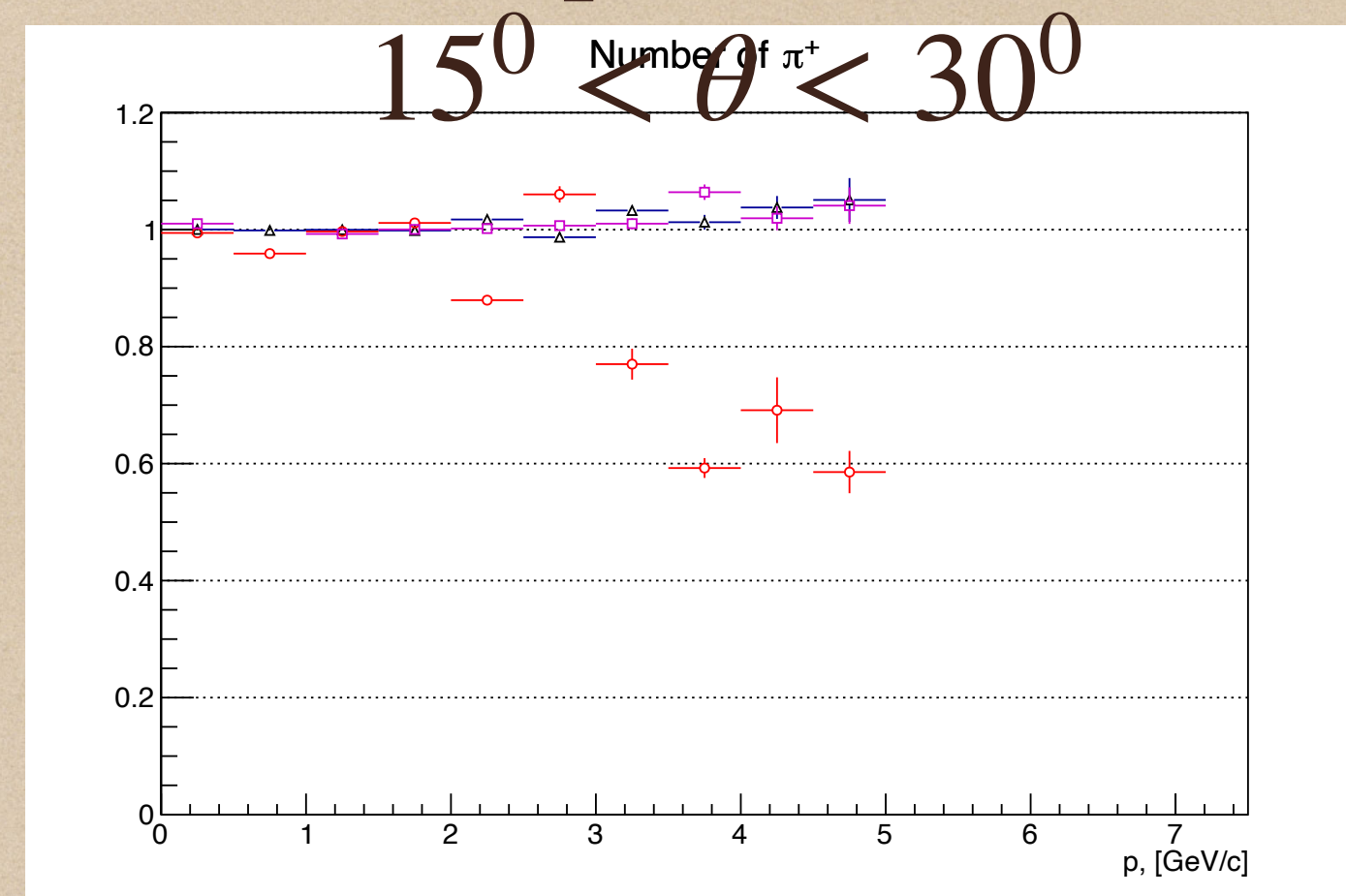
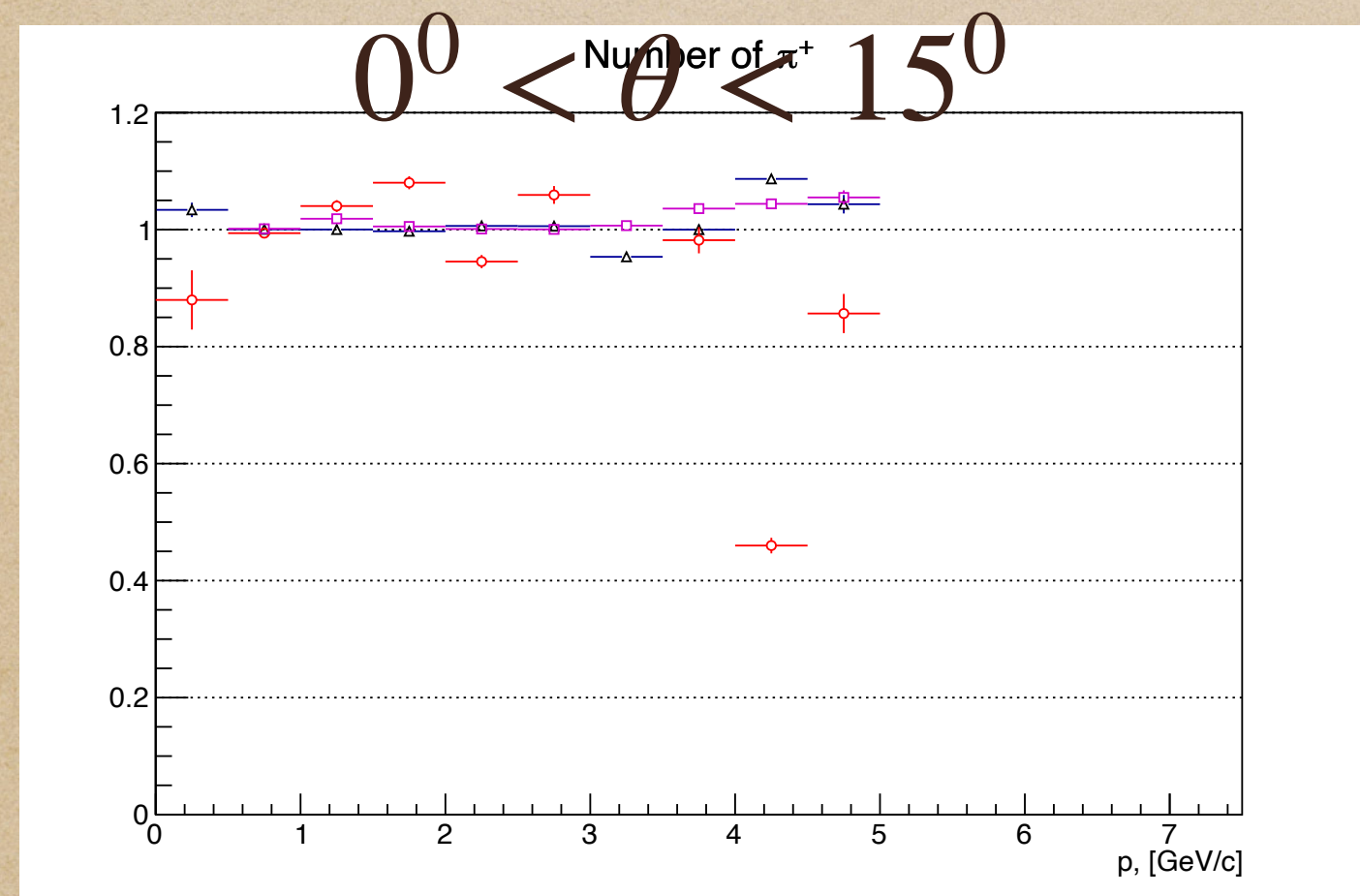
Fit by 3 double gaussians: π^+ , K^+ and p

$75^\circ < \theta < 90^\circ$: ToF m^2 , [GeV^2/c^4]



Fit by 3 double gaussians: π^+ , K^+ and p

$$N_{fit}/N_{MC\ pid} : \pi^+, K^+, p$$



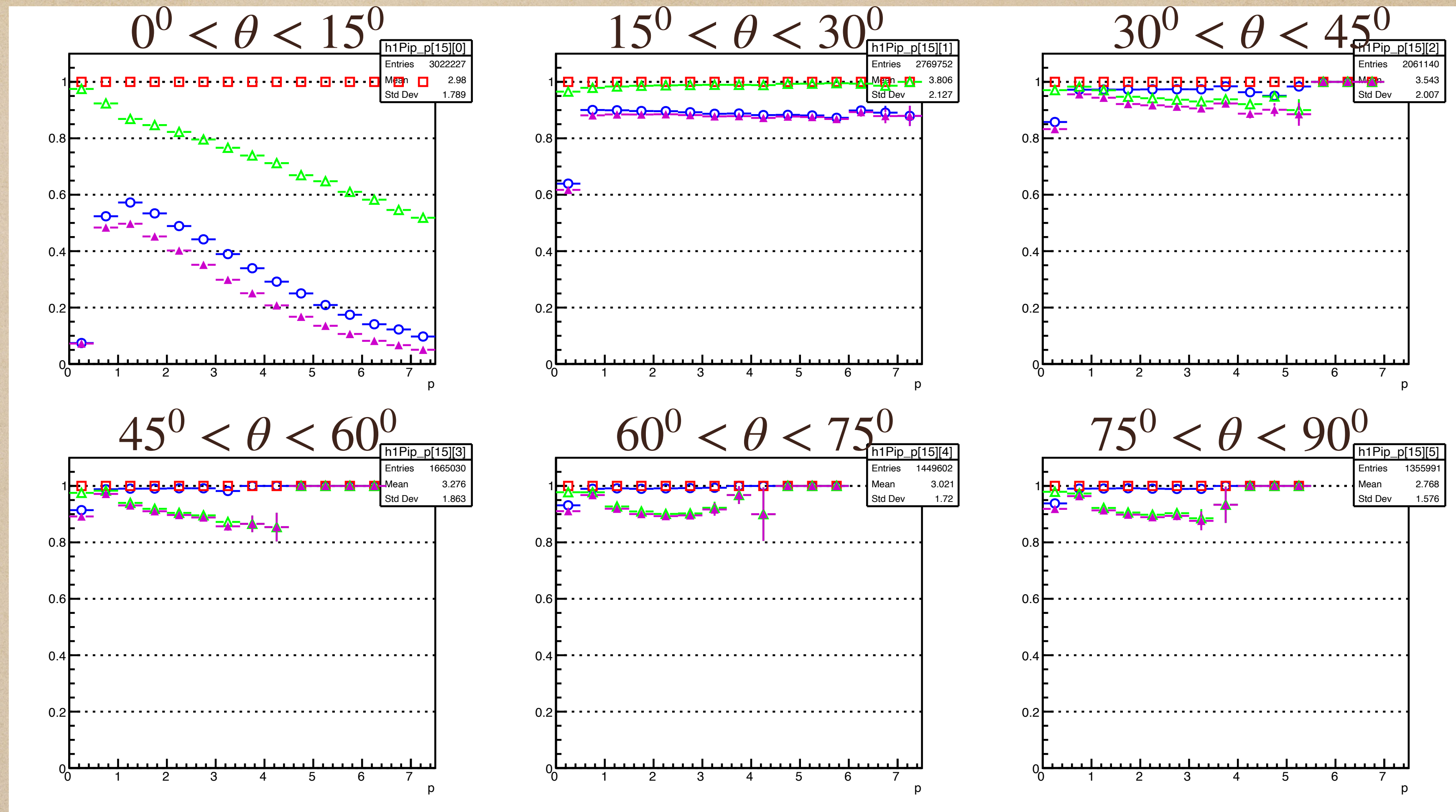
- ◆ Using TOF information we are able to get correct numbers for identified π^+ and p even with free parameters
- ◆ K^+ is fitted up to 1.5 GeV/c

Summary

- ◆ Analysis is performed in 6 bins of θ and 10 momentum bins (from 0 to 5 GeV/c)
- ◆ MC correction has been factorised
- ◆ Track reconstruction and primary vertex reconstruction should be fixed
- ◆ Using TOF information we are able to get correct numbers for identified π^+ and p even with free parameters in the fitting function
- ◆ For K^+ fit tuning is needed
- ◆ Feed-down corrections to be estimated

Backup slides

$$\pi^+ : C1 = C2 * C3 * C4$$

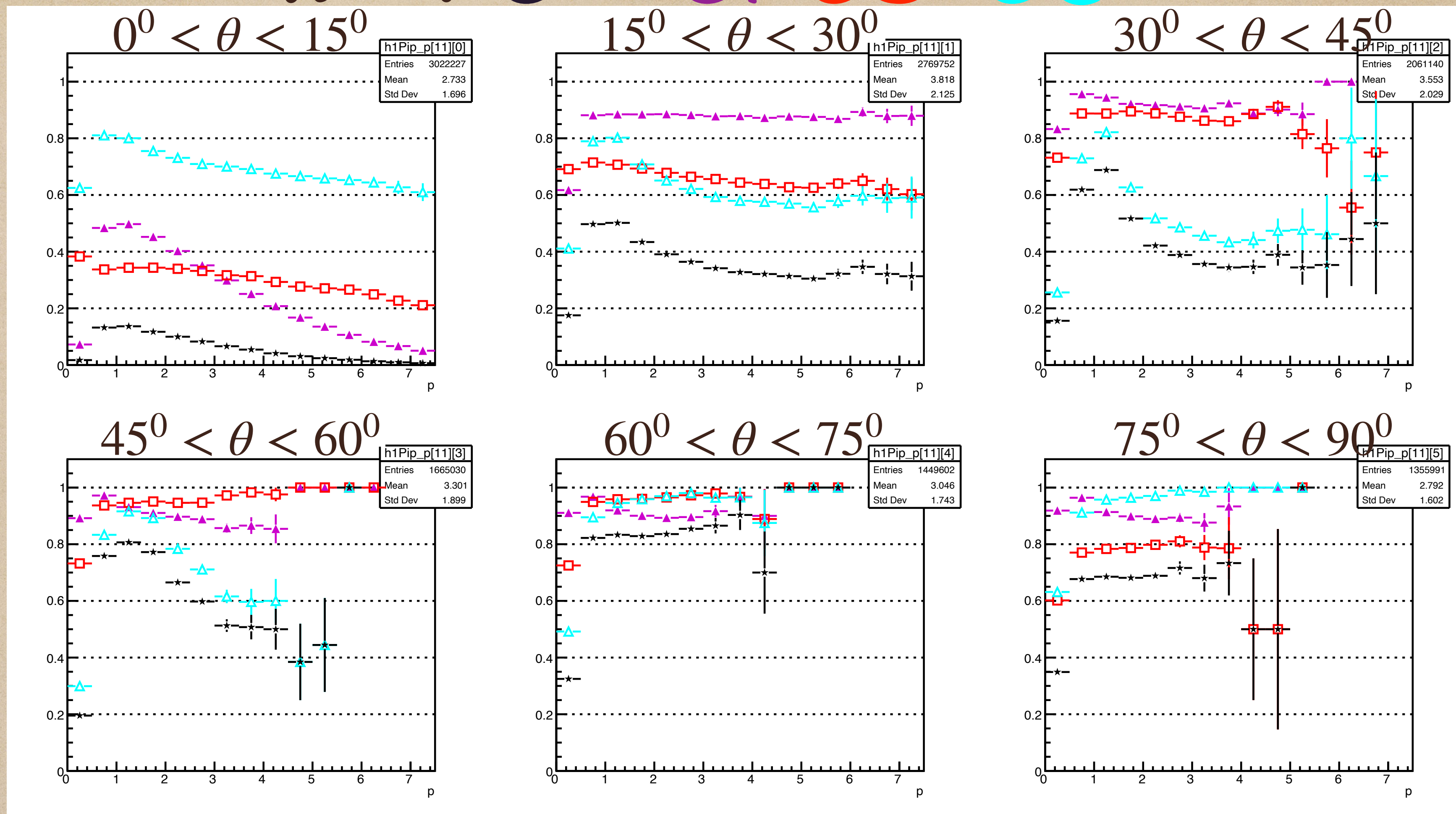


$C2 = N$ of tracks / N of particles

$C3 =$ at least 1 hit in ITS — default reconstruction requirement

$C4 =$ at least 8 STRAW hits — gaps between octants (5 cm)

$$\pi^+ : C = C1 * C5 * C6$$



$C1$ = Total from previous page
 $C5$ = reconstructed PV — $87^\circ < \theta < 93^\circ$ excluded (hard coding), track is fitted
 $C6$ = convergency cut — from 1 to 4 iterations (hard coding)