Measurement of A_N^{h+} in pp @ 13 GeV in the SPD

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SPD Physics Weekly Meeting
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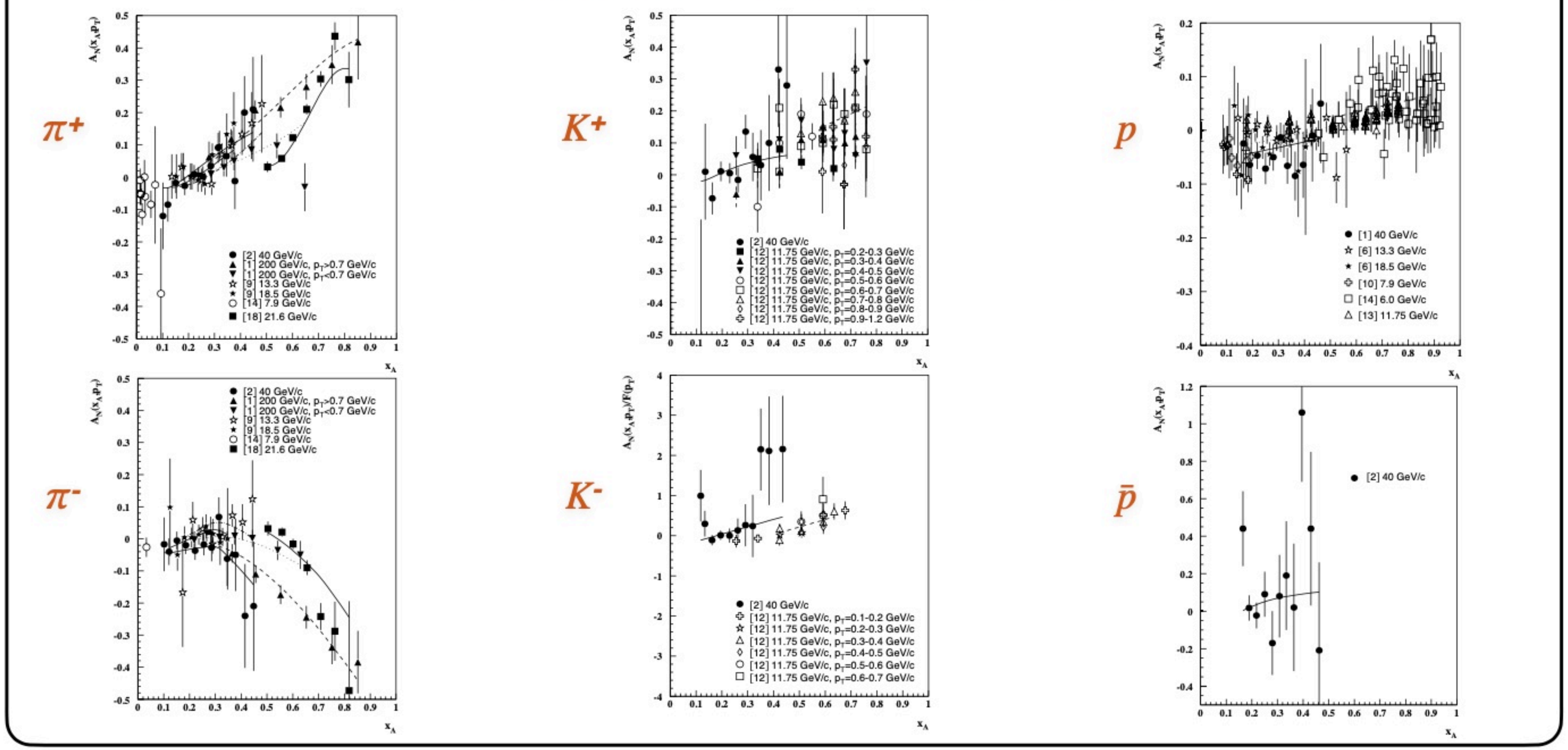
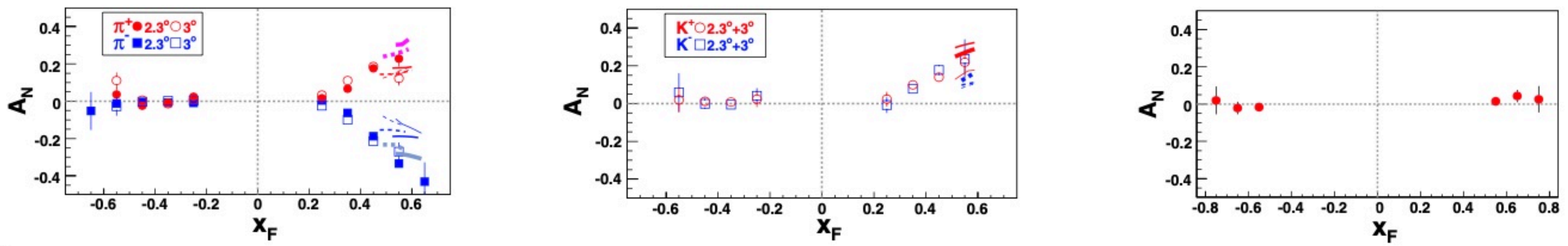
Fixed target experiments (Eur.Phys.J.C14(2000)427)



Collider experiment BRAHMS (Phys.Rev.Lett.101(2008)042001)



Generation and Reconstruction

- $10 \cdot 10^6$ soft QCD (w/o elastic) events with Pythia 8 in pp @ 13 GeV;
- SPDRoot v. 4.1.6; ITS: 1 layer Micromegas-based Central Tracker;
- 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
```

Micromegas-based Central Tracker description

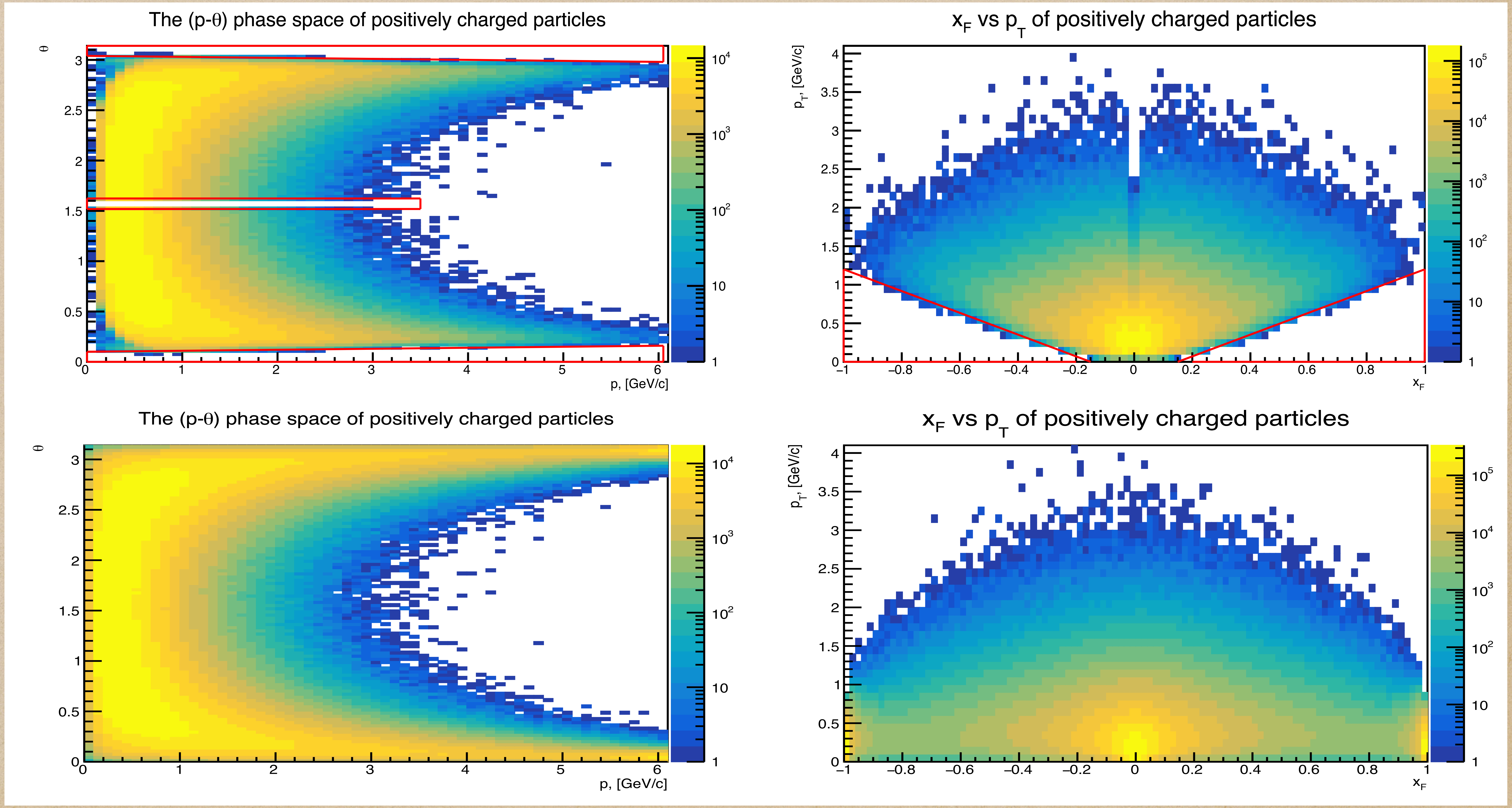
```
//________________________________________________________________________________
void CustomMvd(Int_t geo_type)
{
    if (geo_type < 1) return;

    SpdMvdGeoMapper* mapper = SpdMvdGeoMapper::Instance();
    if (geo_type == 1) { mapper->SetGeoType(1); return; }
    if (geo_type == 2) { mapper->SetGeoType(2); return; }
    mapper->SetGeoType(3);
    mapper->ClearGeometry();

    // here we can redefine active material (by default = "argon").
    //mapper->SetActiveMaterial("copper");

    //-----------------------------------------
    // BUILD LAYERS

    Int_t l0, l1;
    l0 = mapper->DefineLayer(5.0,80.0);
    mapper->SetLayerActivity(l0,true);
    mapper->AddSublayer(l0,0.01750,"FR4");
    mapper->AddSublayer(l0,0.00190,"copper");
    mapper->AddSublayer(l0,0.01350,"kapton2");
    mapper->AddSublayer(l0,0.40000,"argon");
    mapper->AddSublayer(l0,0.00055,"copper");
    mapper->AddSublayer(l0,0.02400,"kapton2");

    l1 = mapper->DefineLayerCopy(l0,5.5);
    l1 = mapper->DefineLayerCopy(l0,6.0);

//   l1 = mapper->DefineLayerCopy(l0,12.0);
//mapper->SetLayerActivity(l1,true);
//   l1 = mapper->DefineLayerCopy(l0,12.5);

//   l1 = mapper->DefineLayerCopy2(l0,19.0,160.0);   mapper->SetLayerActivity(l1,true);
//   l1 = mapper->DefineLayerCopy2(l0,19.5,160.0);
}
```

- CustomMvd(3); — 1 layer
- track_fitter->SetFitterMaxIterations(20); — convergency and PV RC

Charged Hadrons: 2D distributions

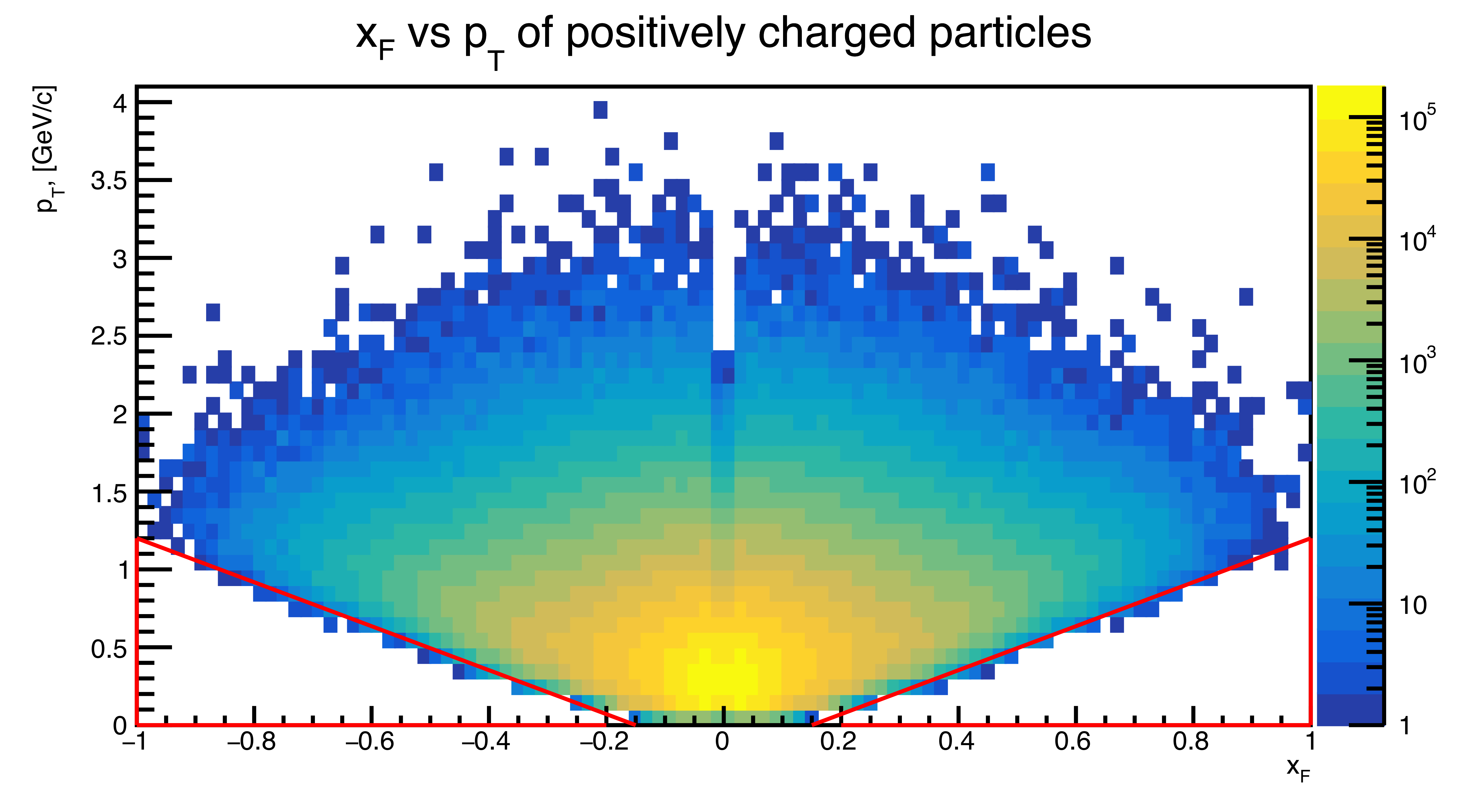
Reconstructed in SPDRoot

pure Pythia8

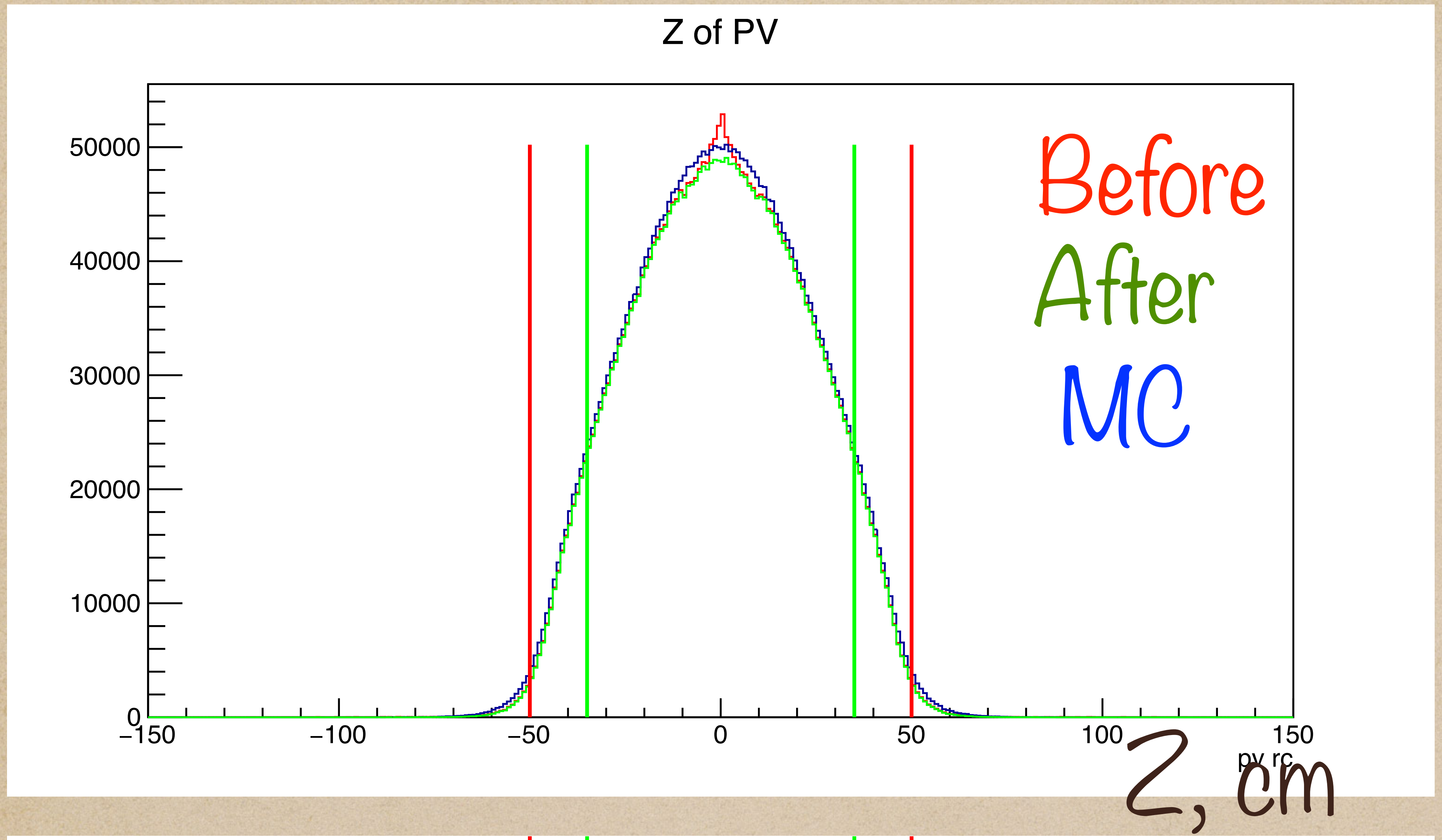


Selection

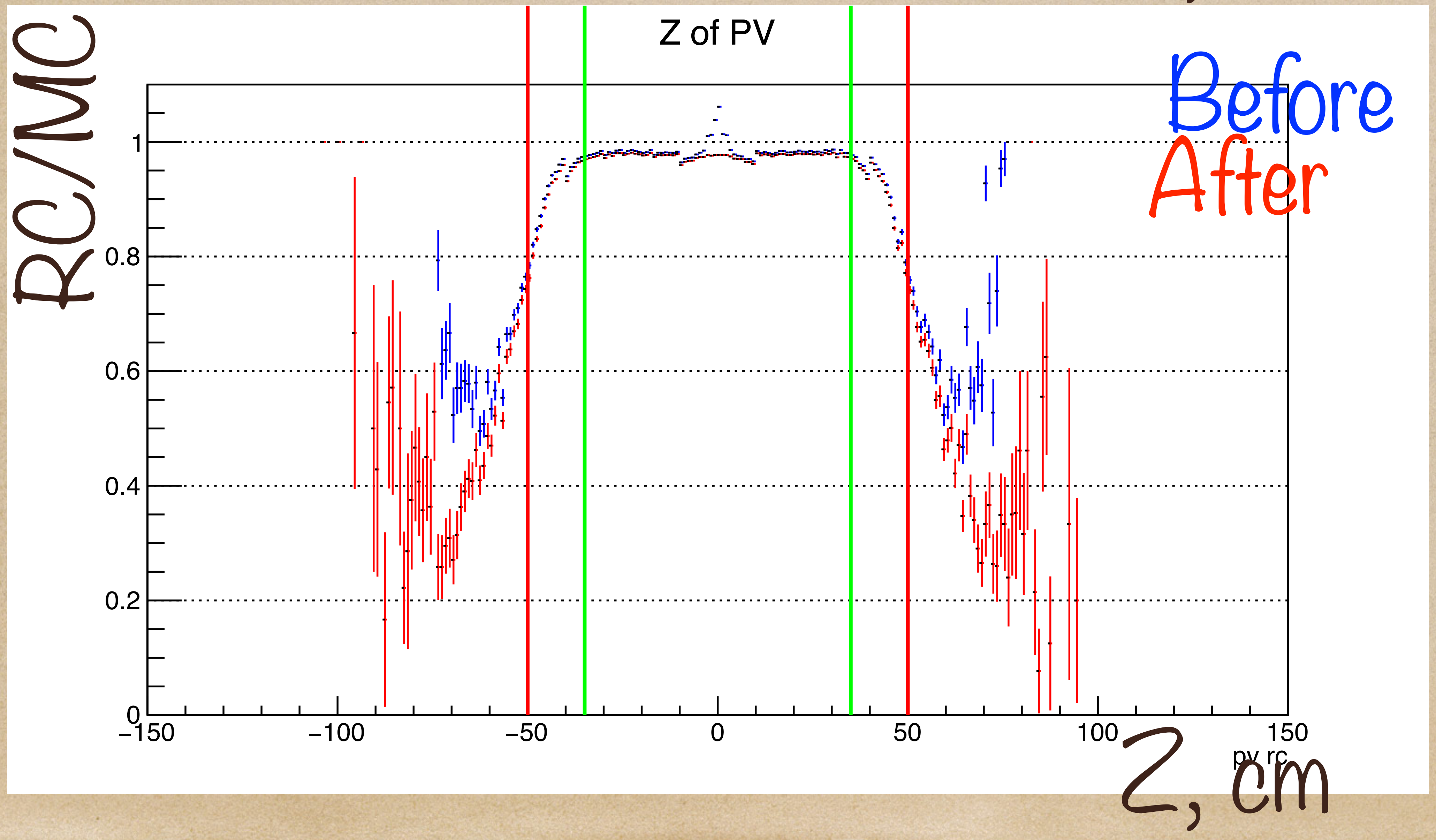
- Reconstructed Primary Vertex (RCVertex)
- $-35\ cm < Z_{PV} < 35\ cm$
- $\sigma_Z < 4\ cm$
- At least 8 hits in STRAW
- Track fit convergency != 0
- $\sigma_p/p < 0.1$
- $p_T > 0.5\ GeV/c$



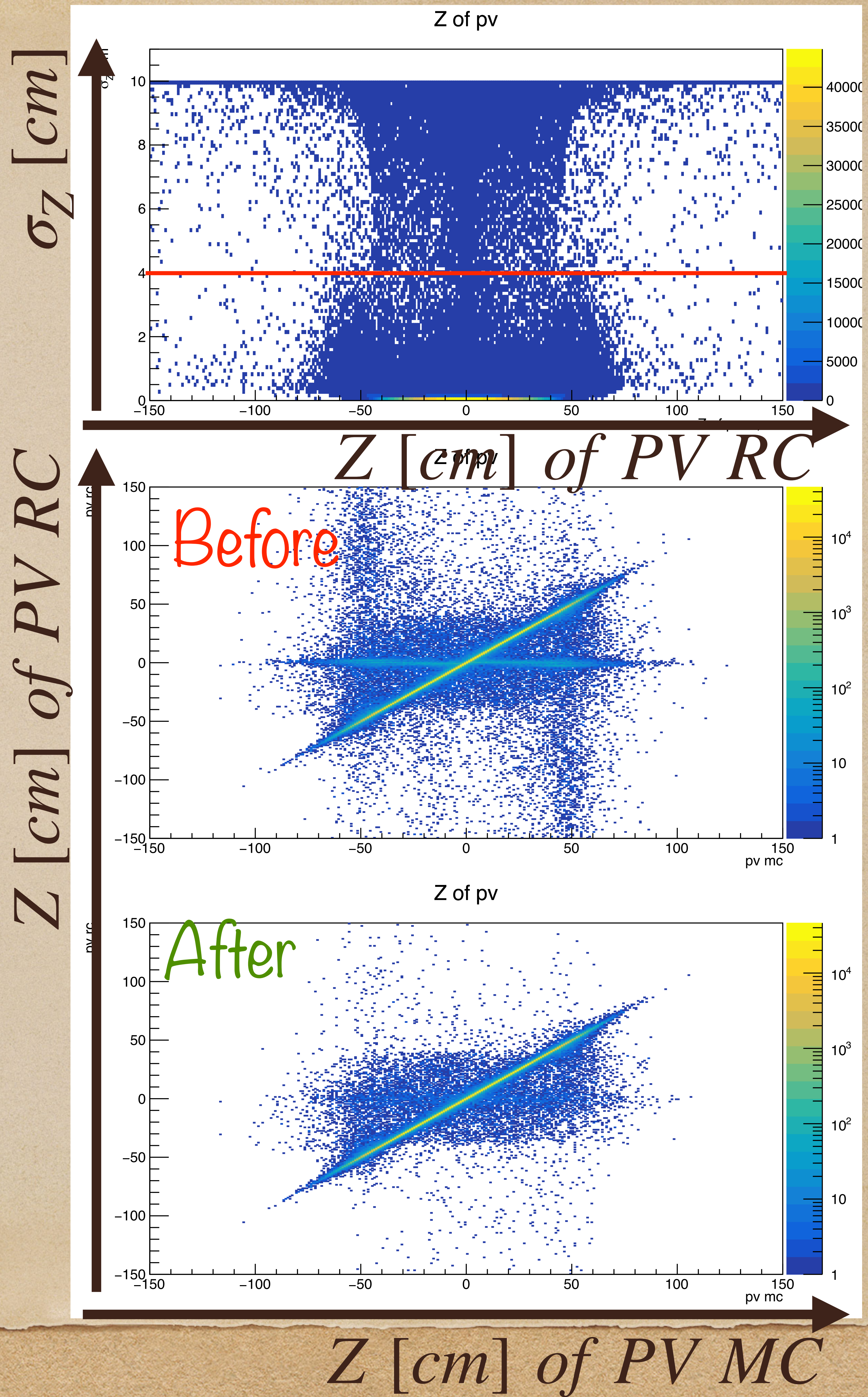
$\sigma_Z < 4\ cm$



Z of PV
Before
After
MC
pv rc
Z, cm

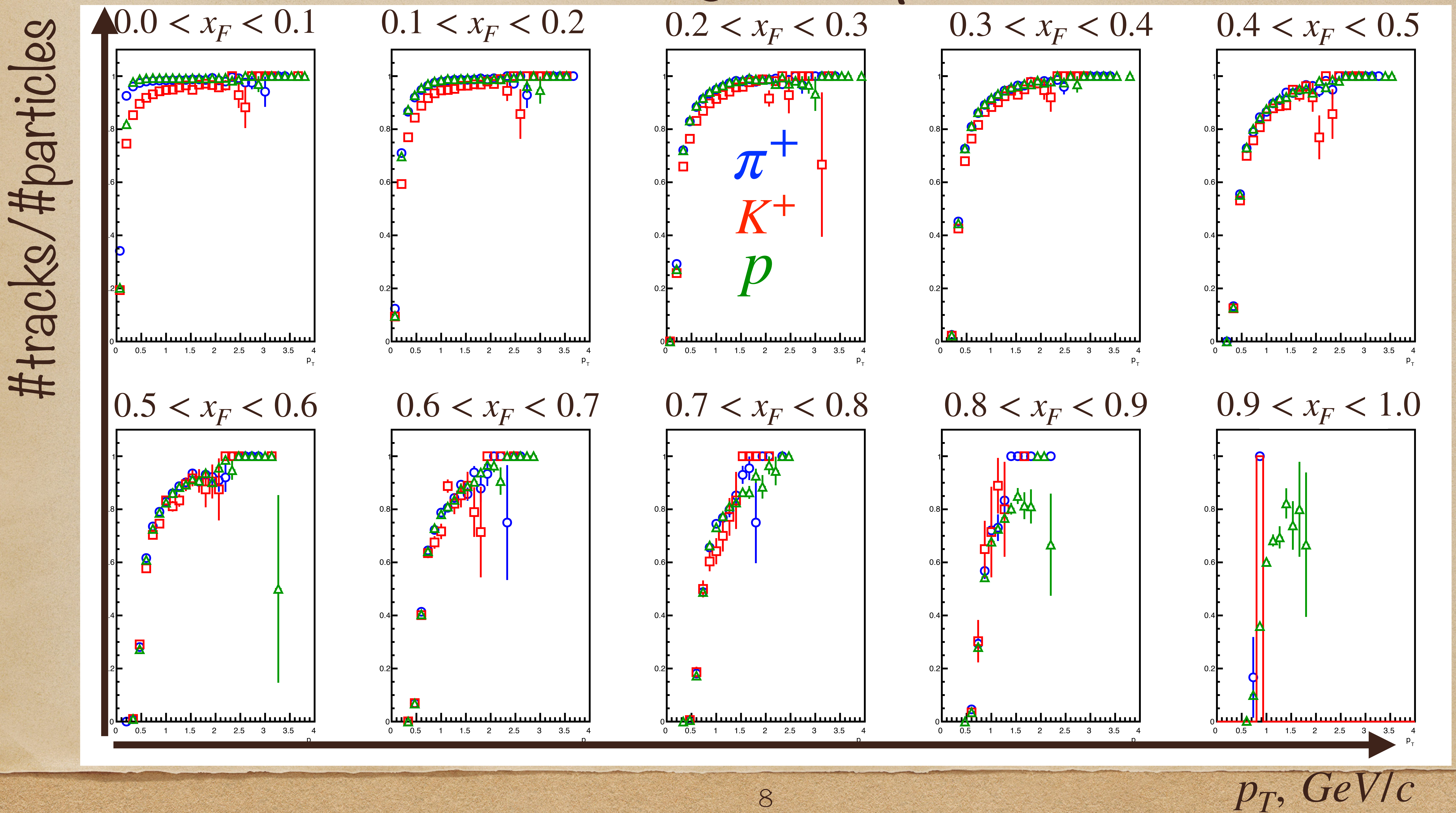


Z of PV
RC/MC
Before
After
pv rc
Z, cm

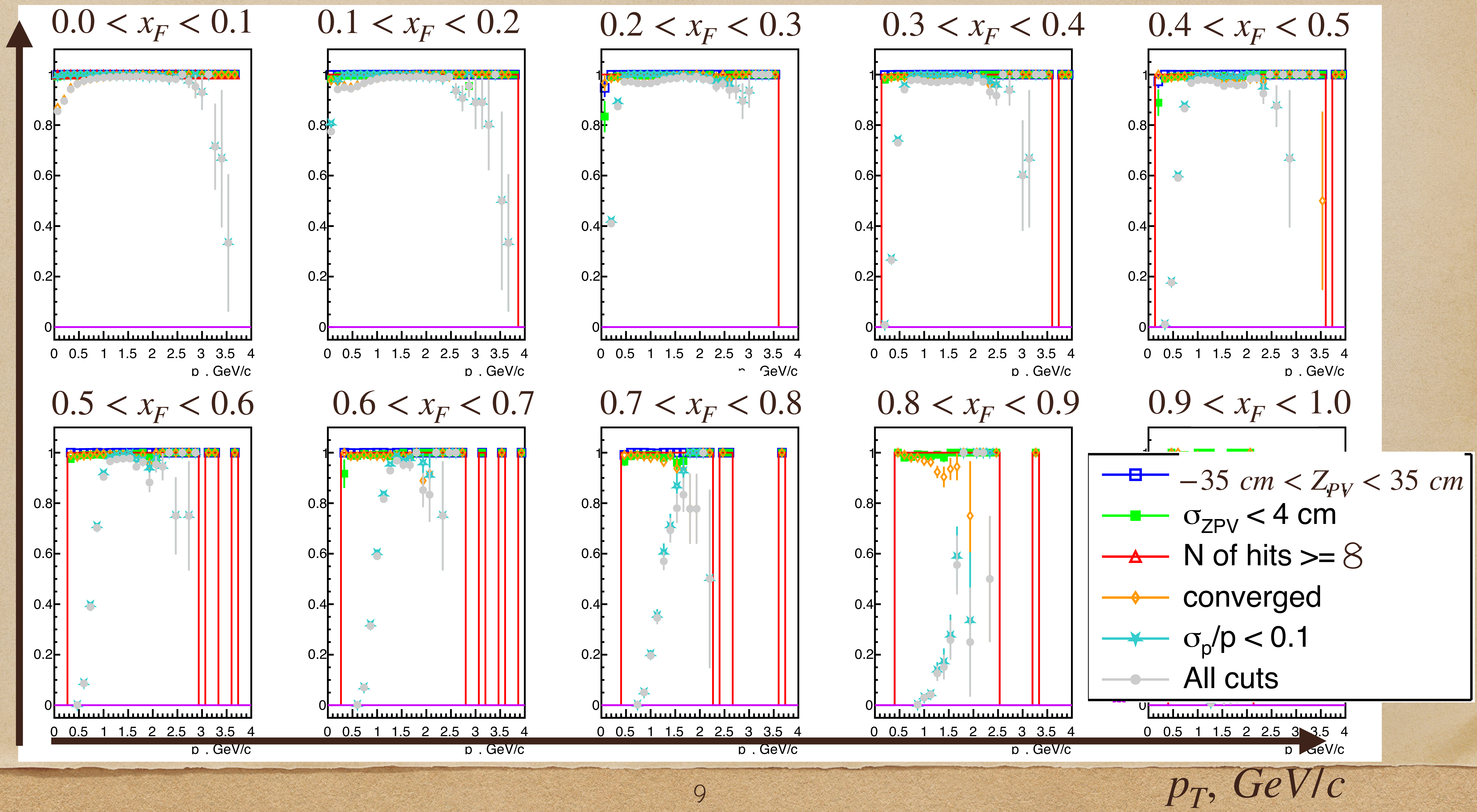


Z of pv
σ_Z [cm]
Z [cm] of PV RC
Before
After
pv mc
Z [cm] of PV MC

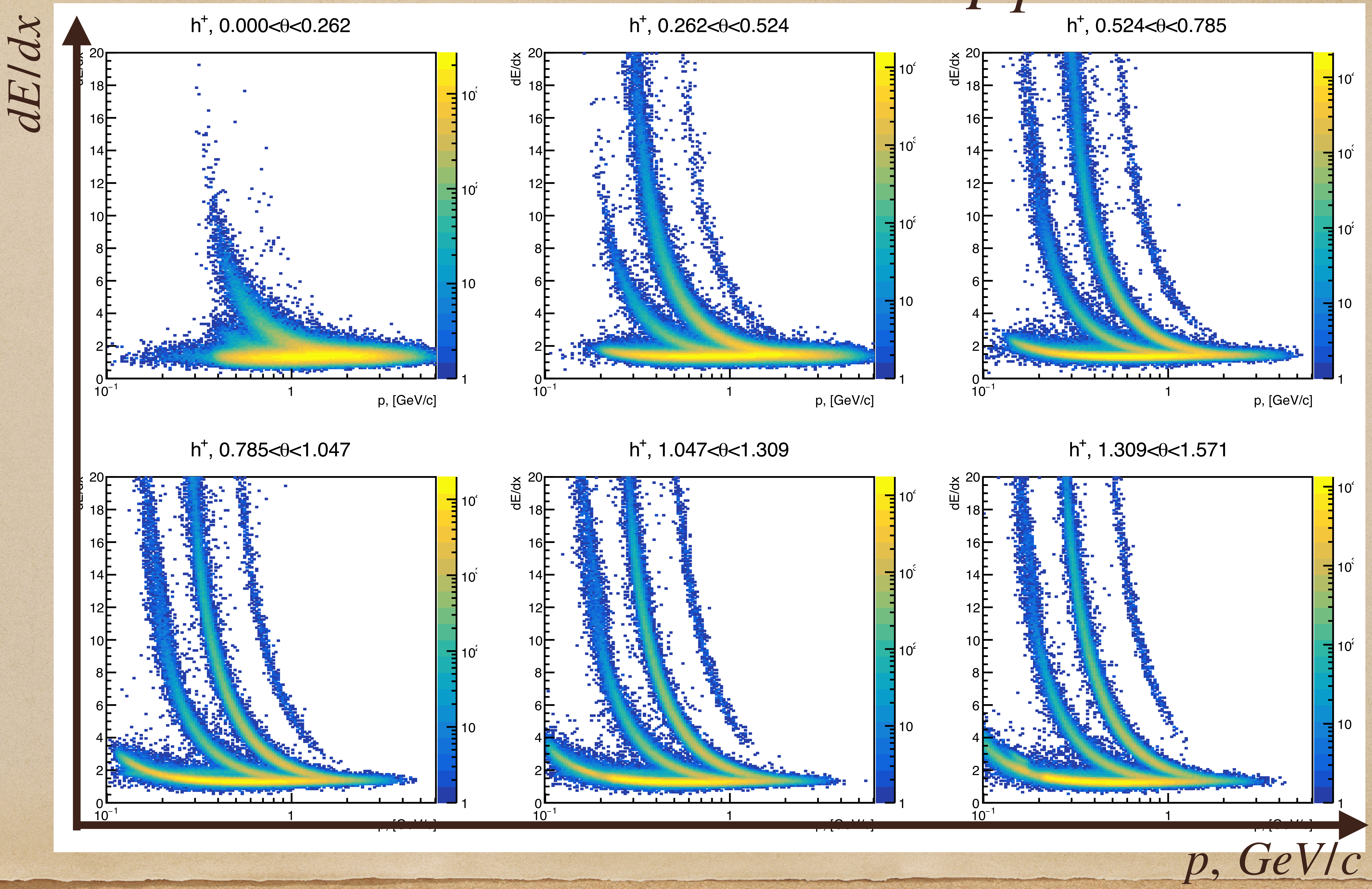
Geometry acceptance



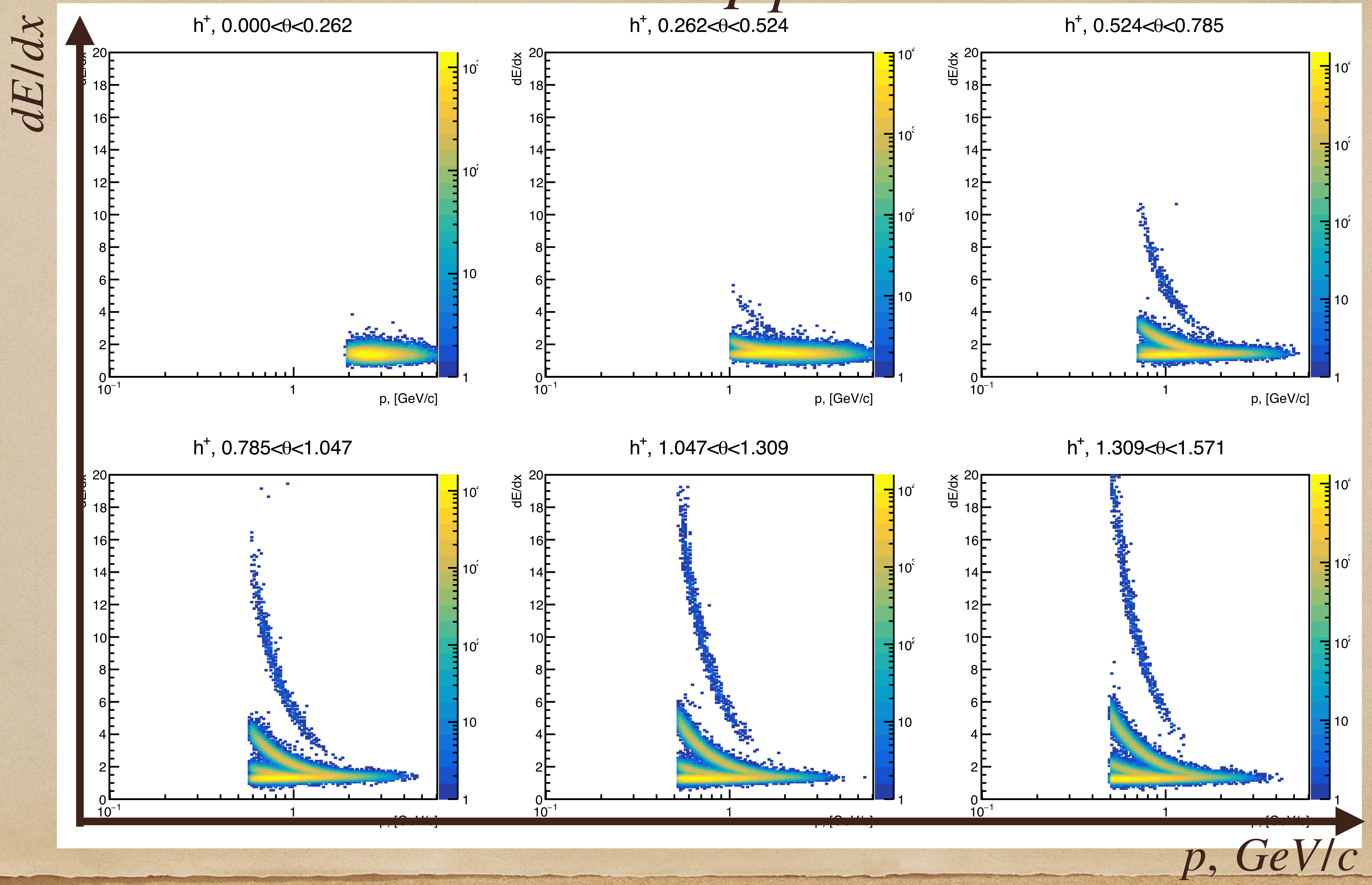
Selection criteria and feed down corrections



PID with STRAW (all p_T)



PID with STRAW ($p_T > 0.5\ GeV/c$)



Extraction of A_N

$p^{\uparrow} + p \rightarrow \boldsymbol{\pi^0} + X$ $\qquad \phi = 2\pi$

The cross section of hadron production in polarized $p^{\uparrow} + p$ collisions, is modified in azimuth.

$$\frac{d\sigma}{d\phi} = \frac{d\sigma}{d\phi_0}(1 + \underbrace{P \cdot A_{\mathrm{N}} \cdot \cos\phi}_{\text{Azimuthal cosine modulation}})$$

$$N_{\boldsymbol{\pi}^0}(\phi) = A(1 + B\cos\phi)$$

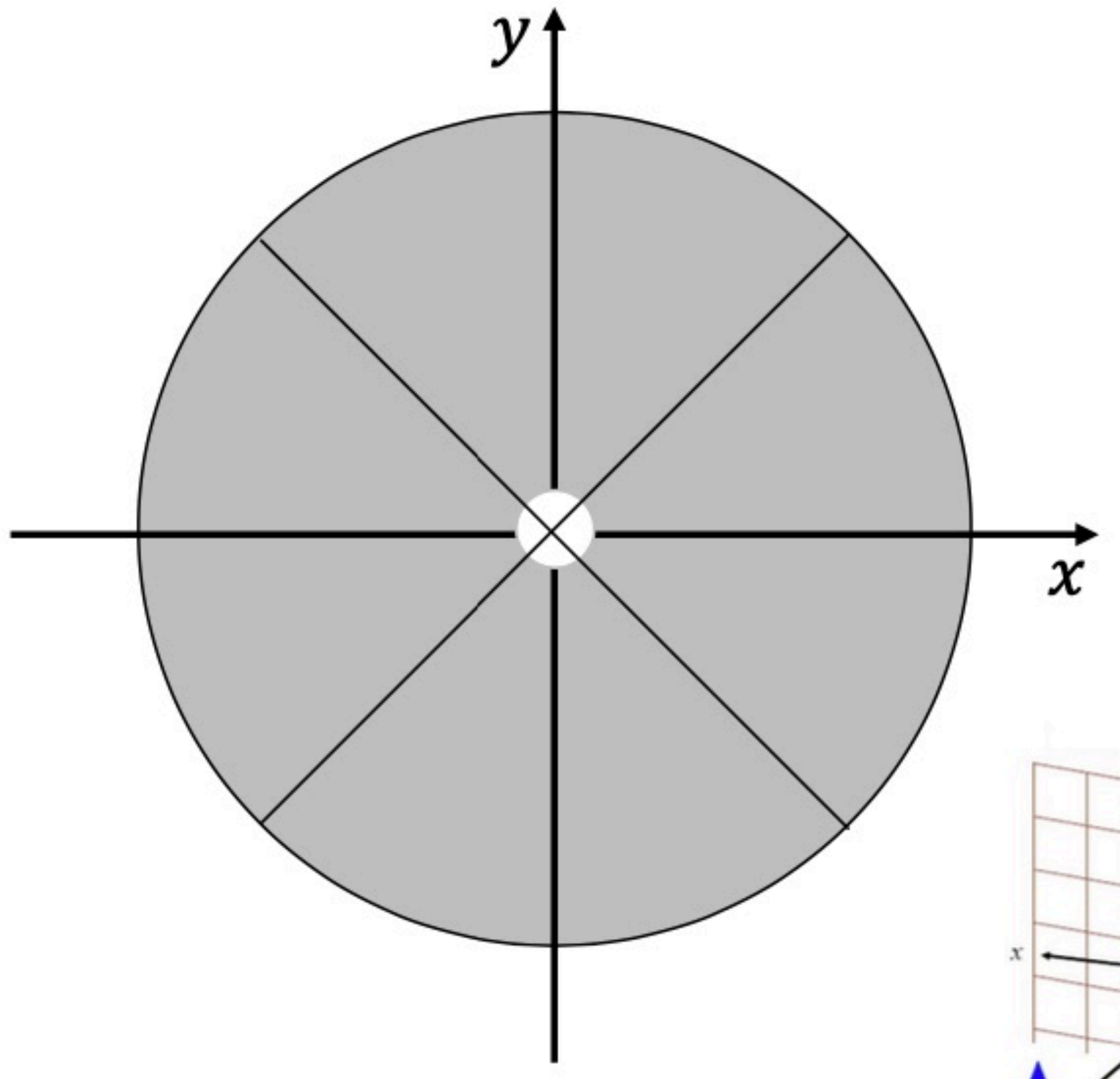
$$A_N = \frac{B}{P}$$

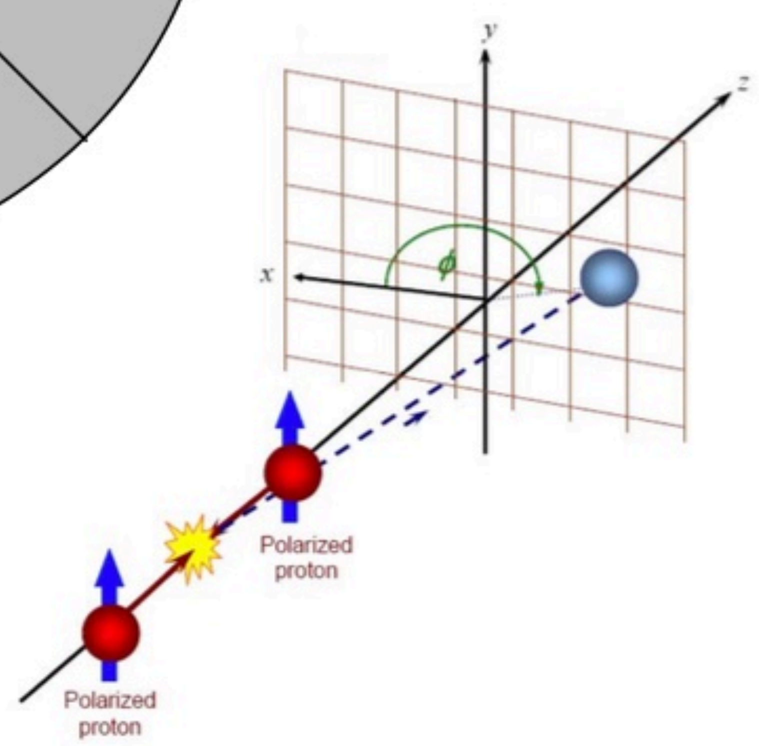
$N_{\boldsymbol{\pi}^0}(\phi)$: Yield of π^0

P: Beam polarization

- P ~ 0.7 was assumed

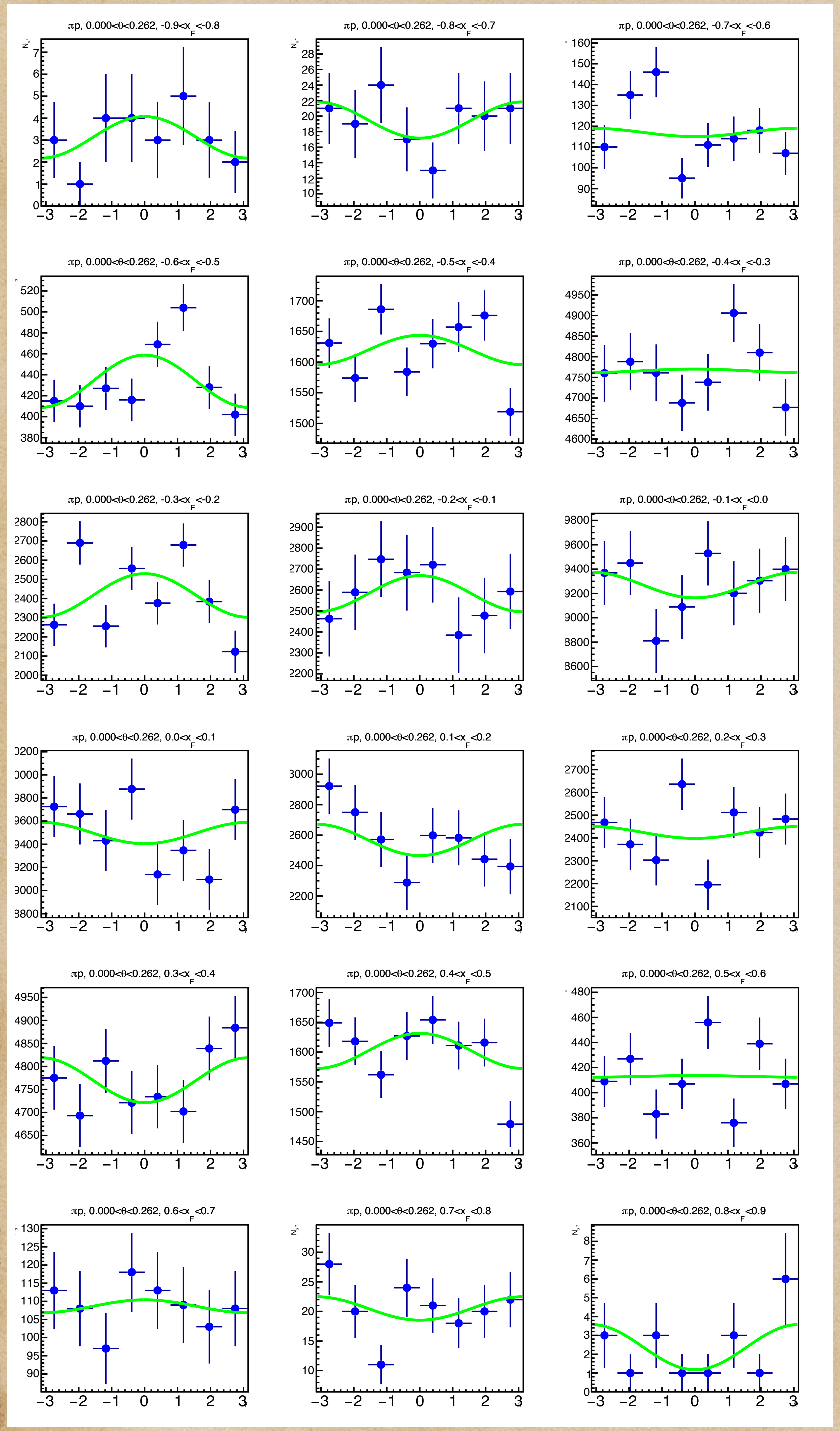
8 azimuthal bins

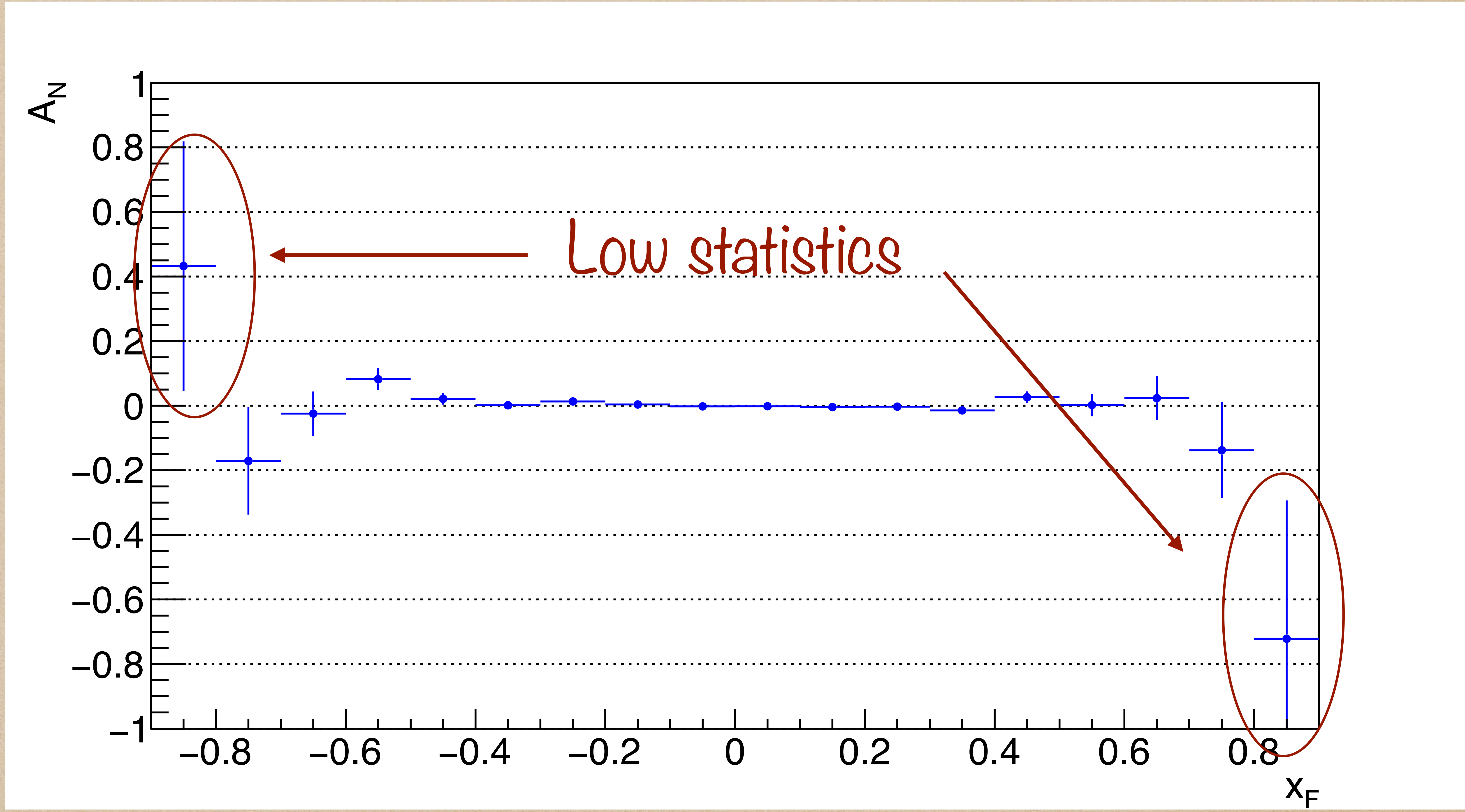




- The spin dependent π^0 yields for each bin are extracted from the invariant mass spectra in different x_{F} sub-ranges for each ϕ bin.
- The invariant mass was fitted with a **polynomial** function for the background and a **normalized Gaussian** distribution representing the signal peak.

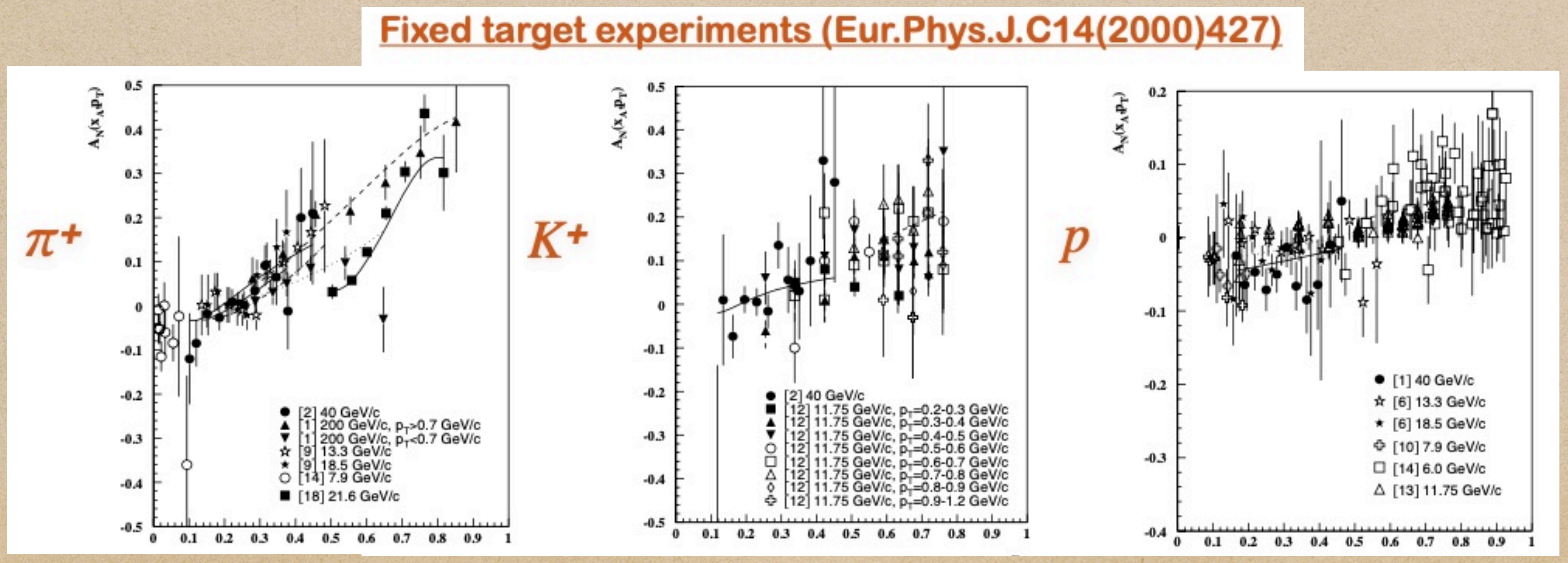
$A_N\left(\pi^+, p_T > 0.5\ GeV/c, P_{beam} = 0.7\right)$

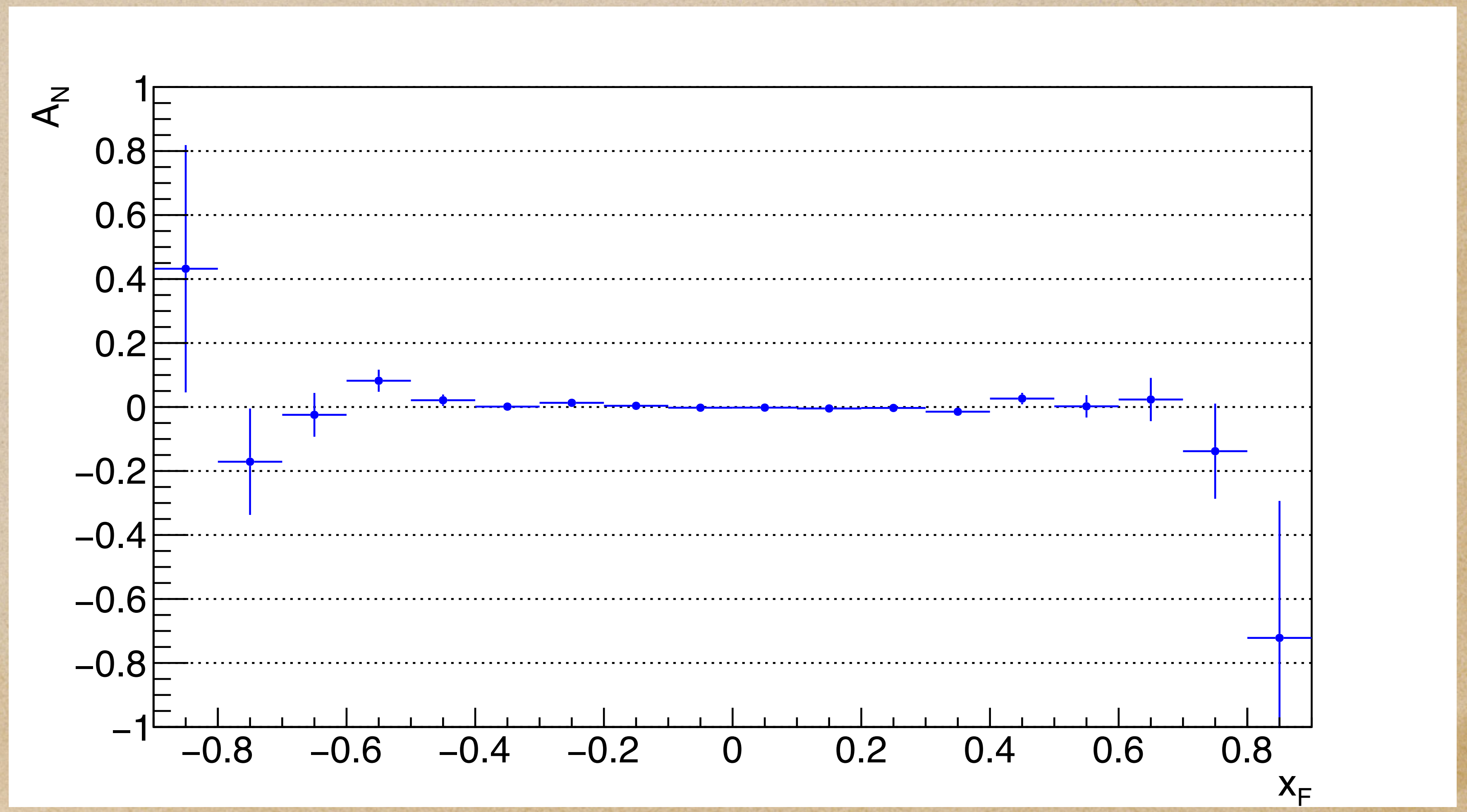




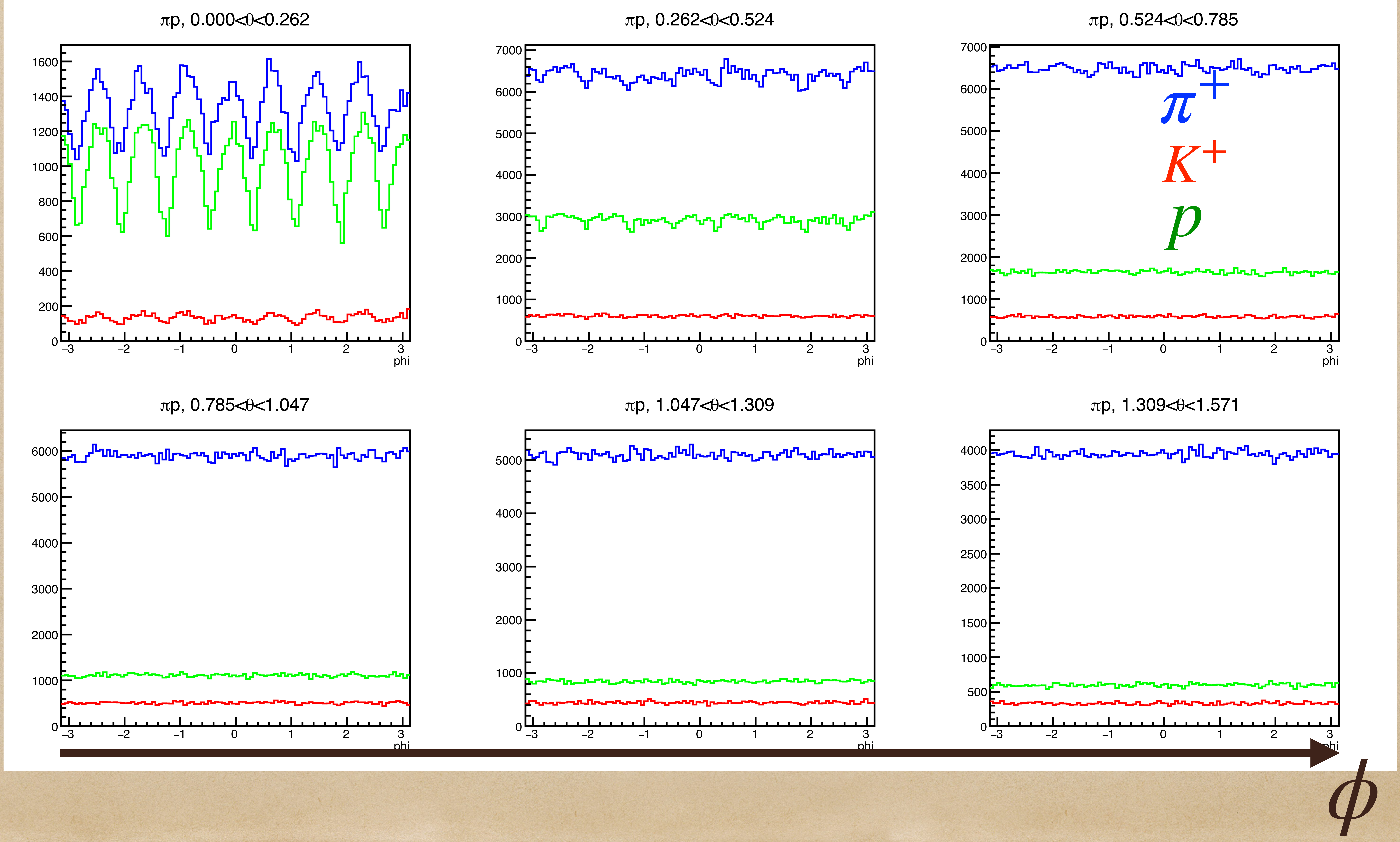
Summary

- We can not identify π^+ @ $p_T > 0.5\ GeV/c$ using STRAW detector alone, but
- Since $A_N^{\pi^+}$, $A_N^{K^+}$, and A_N^p are positive $\Rightarrow A_N^{h^+}$ should be positive @ $x_F > 0.2$
- $A_N^{h^+}$ can be a first test of polarised measurements at SPD

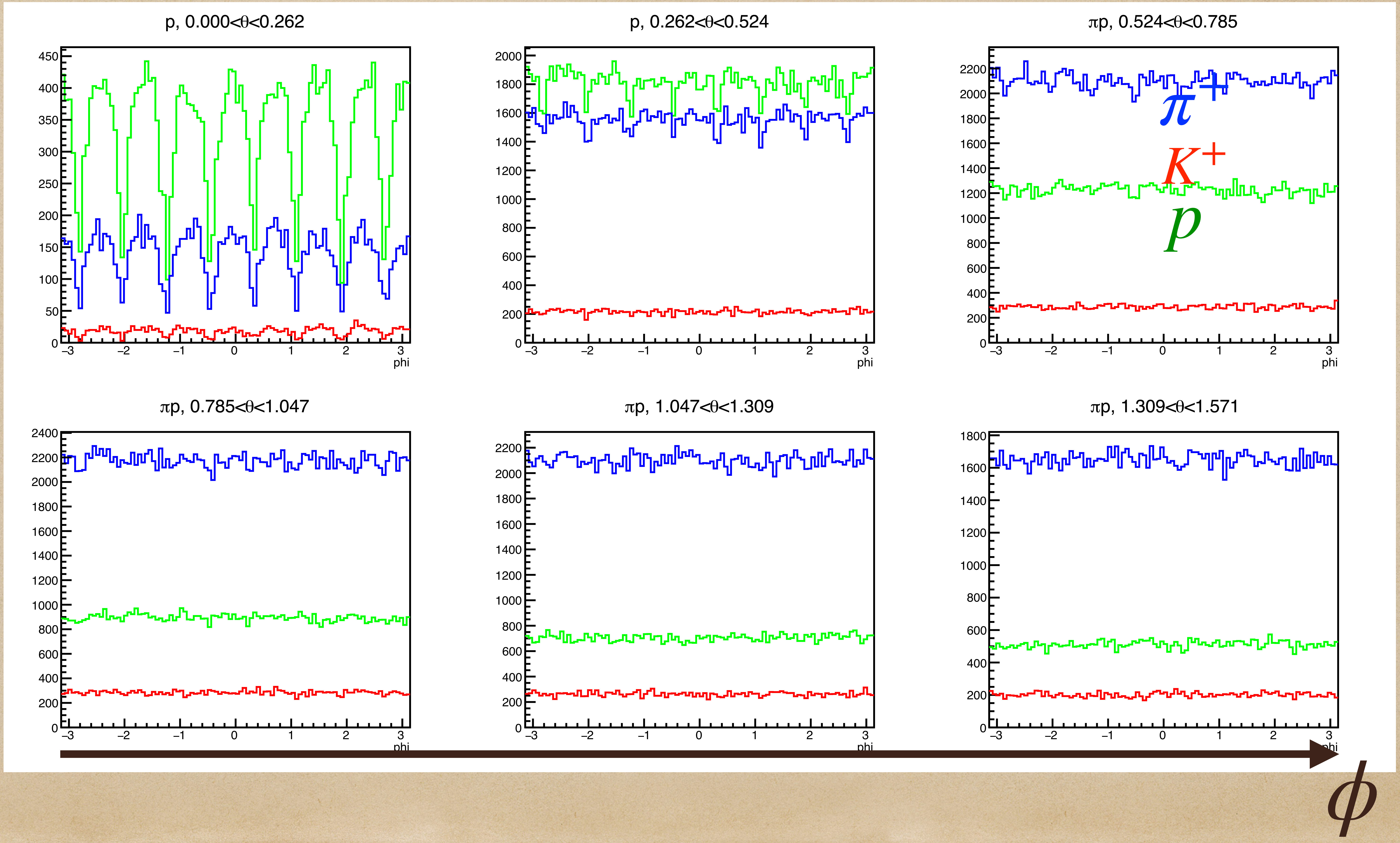




Azimuthal angle ϕ distribution (All p_T)



Azimuthal angle ϕ distribution ($p_T > 0.5\ GeV/c$)



PID with STRAW ($p_T > 0.5\ GeV/c$), pp@27GeV