Single track simulation

- CGEMBoss software 6.6.5.b (first version released for Benchmark channel studies)
- fixpt generator used for the simulation:

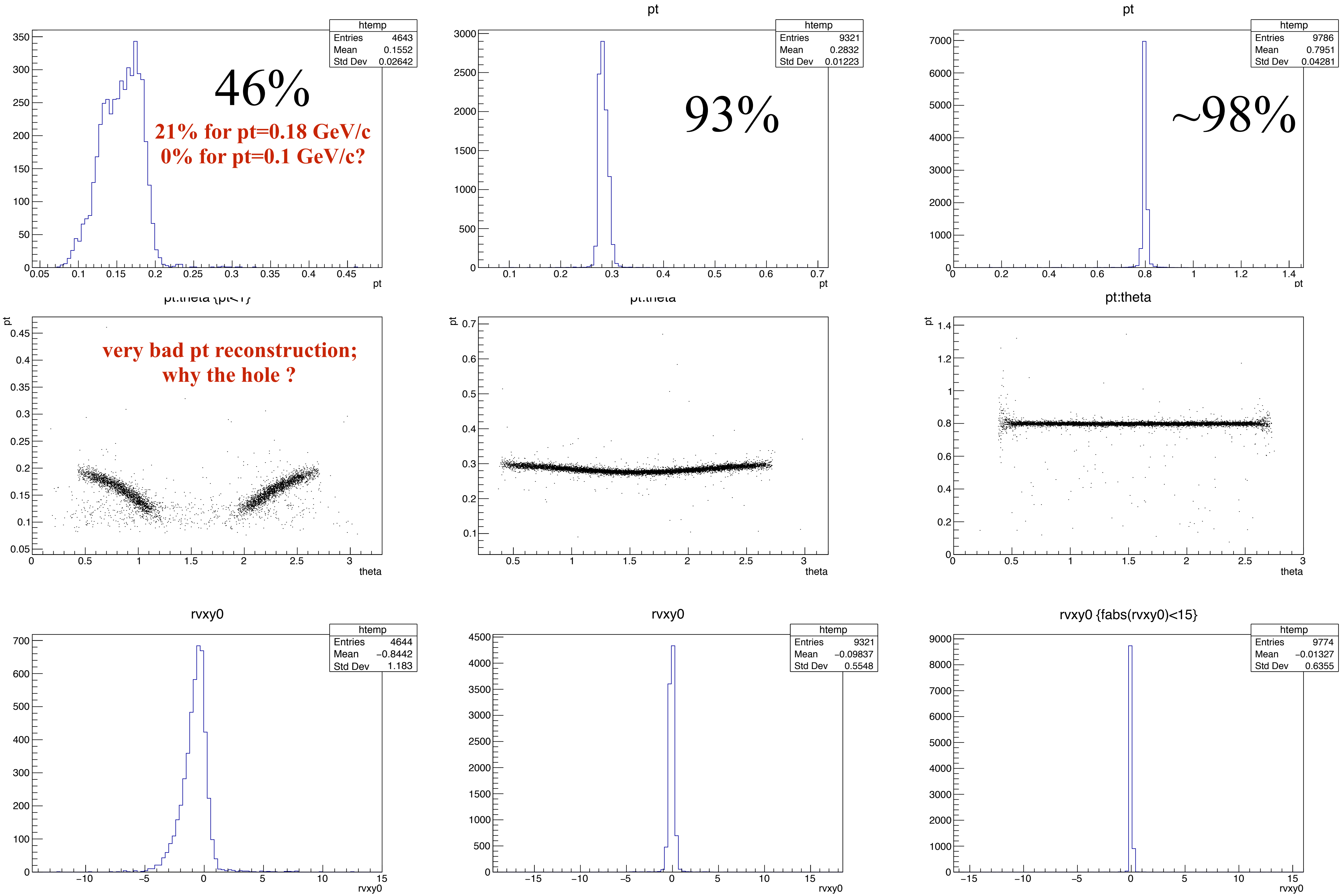
```
generator_name 'fixpt'

* if max_phi=0.0,   then  phi=0 to 2pi irrespective of min_phi;
* P = P +/- dP,  uniform distribution;
*        cos(theta) min    max    P  min_phi(rad) max_phi(rad) dP  Pt
fixpt_rpar        -0.93   0.93    0.       0.         0.    0.0  0.2
*             dumb  sober_pid    charge  particles     stable?(0=No)
fixpt_ipar   6        6           +1          1             1
```

- 10000 proton or pbar
  - proton: pt=0.2 GeV/c, 0.3 GeV/c and 0.8 GeV/c
  - pbar: pt=0.2 GeV/c, 0.3 GeV/c
  - -0.93<cos(theta)<0.93

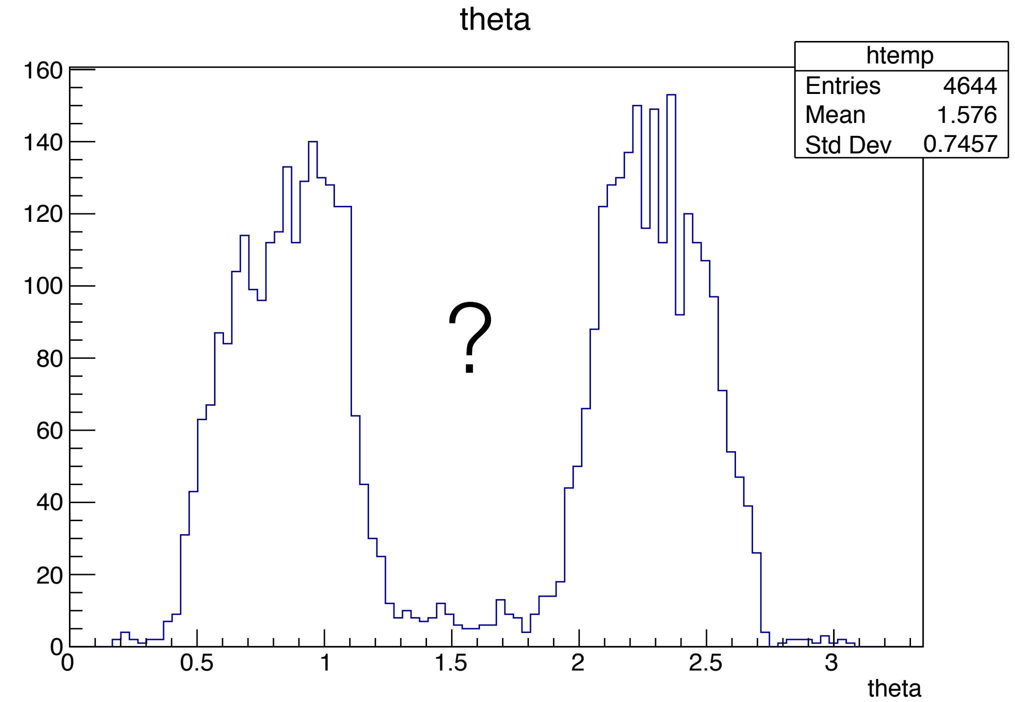
```
(1) RecMdcTrack *mdcTrk = (*itTrk)->mdcTrack();
      double pch=mdcTrk->p();
      double x0=mdcTrk->x();
      double y0=mdcTrk->y();
      double z0=mdcTrk->z();
      double thetaTrk=mdcTrk->theta();
```

```
(2) RecMdcKalTrack* mdcKalTrk = (*itTrk)->mdcKalTrack();
    RecMdcKalTrack::setPidType(RecMdcKalTrack::muon);
    m_ptkal=mdcKalTrk->pxy();
    m_thetakal=mdcKalTrk->theta();
    m_ptrkkal=mdcKalTrk->p();
    m_ngood=nGood;
```

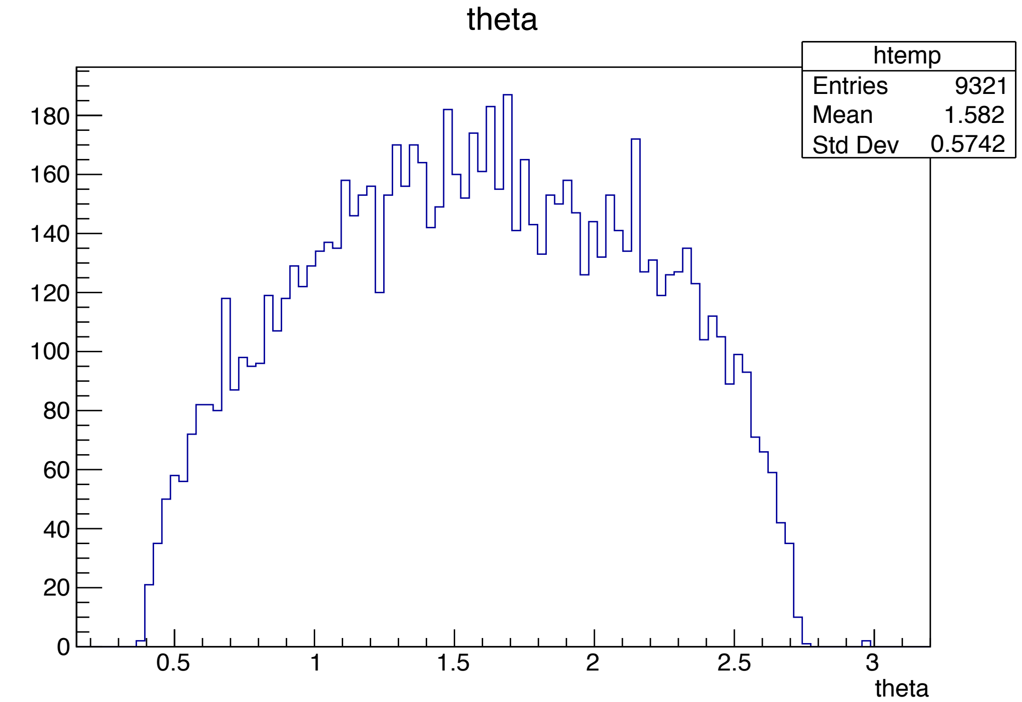
protons, pt=0.2 GeV/c   protons, pt=0.3 GeV/c   protons, pt=0.8 GeV/c



protons, pt=0.2 GeV/c

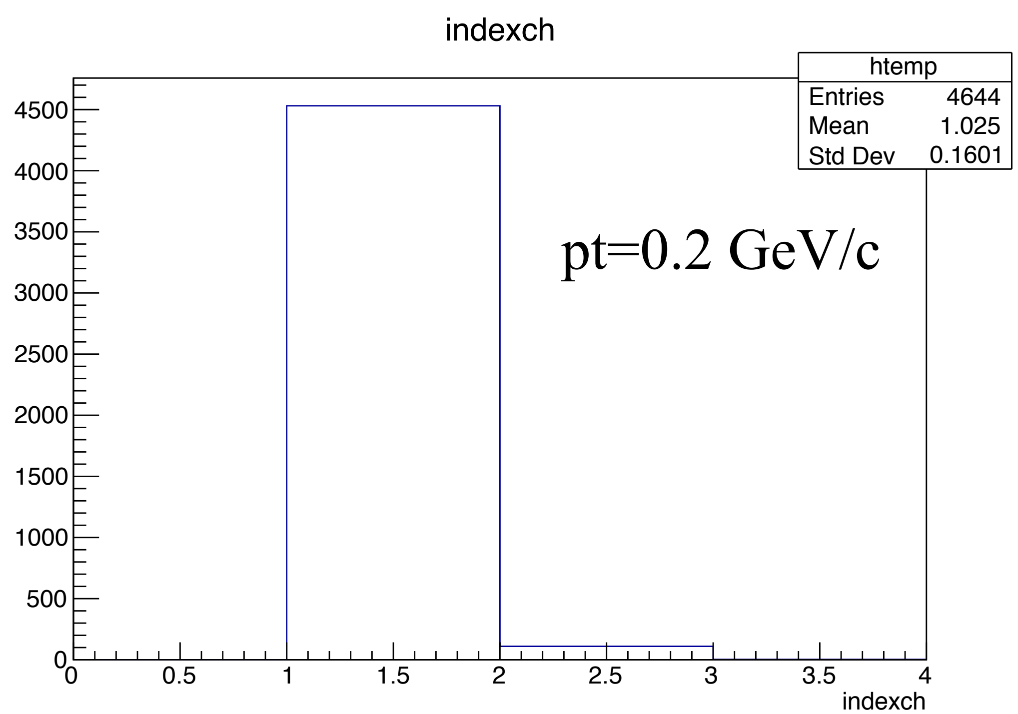


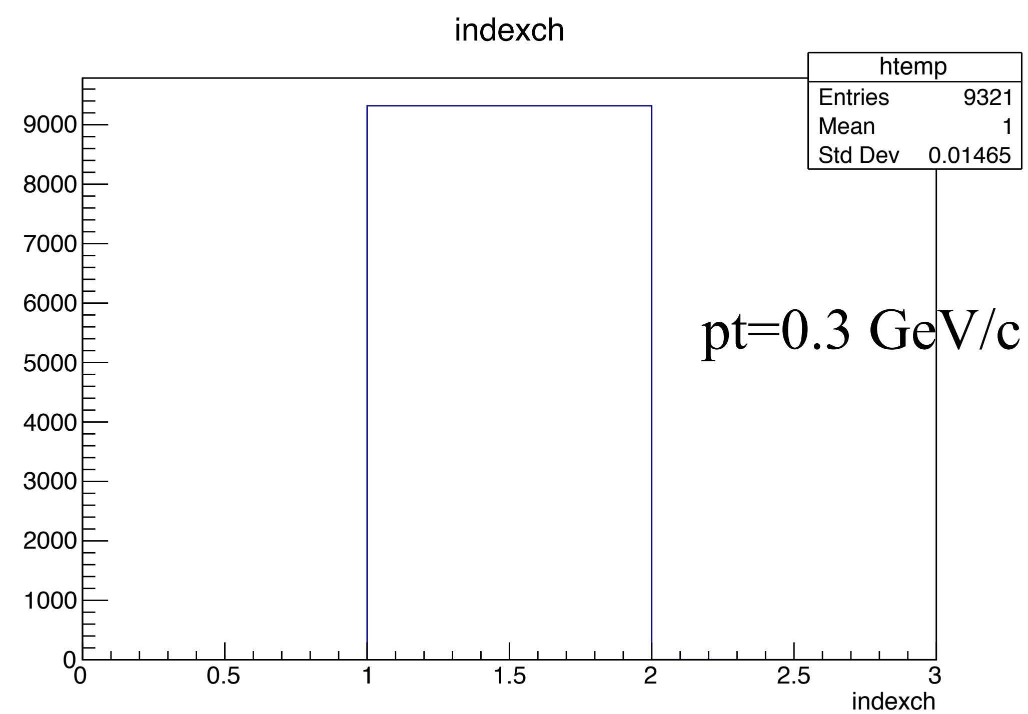
protons, pt=0.3 GeV/c
similar distribution for pt=0.8 GeV/c



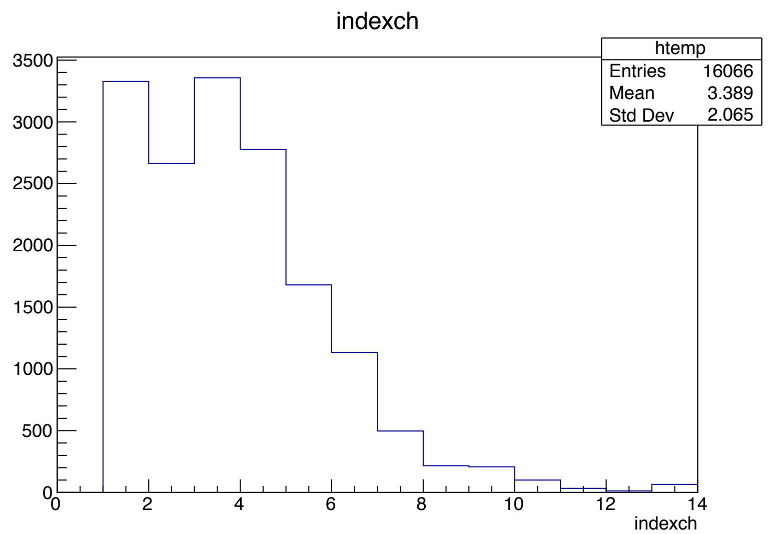
simulation with -0.93<cos(theta)<0.93

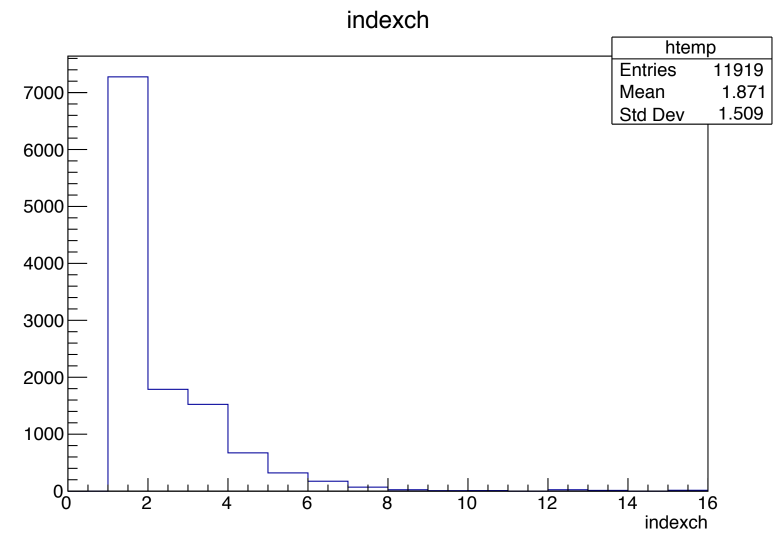
For each event, one charged track is reconstructed (two charged tracks are negligible):

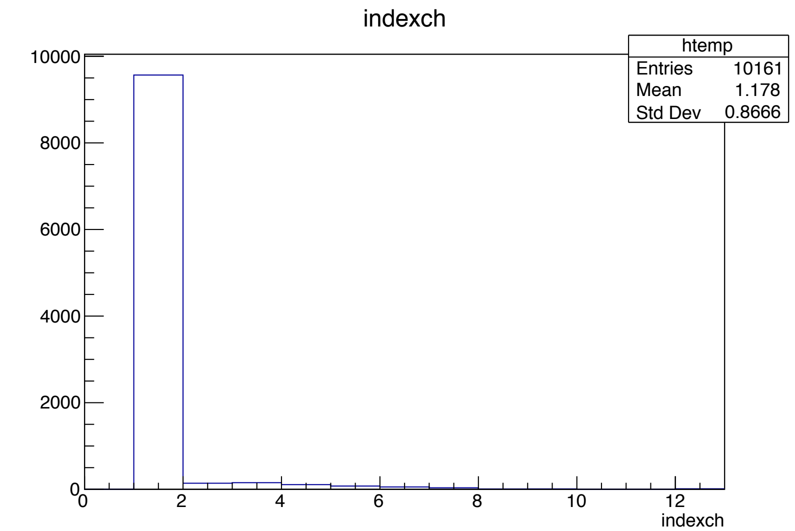




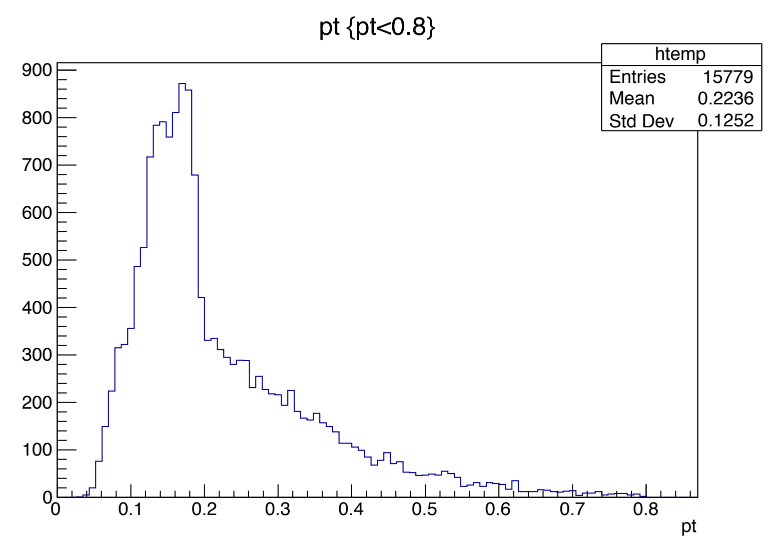
	Antiproton, pt=0.2 GeV/c	Antiproton, pt=0.3 GeV/c	Antiproton, pt=0.8 GeV/c
	~33%	~90%	~96%

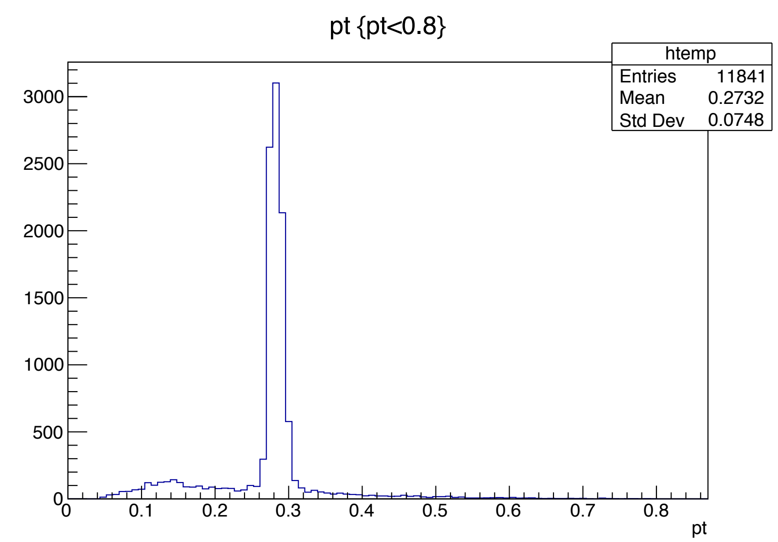


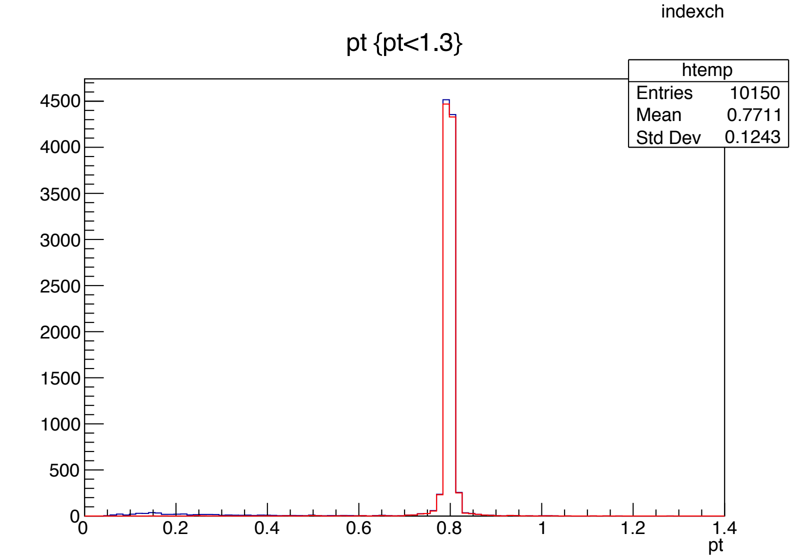




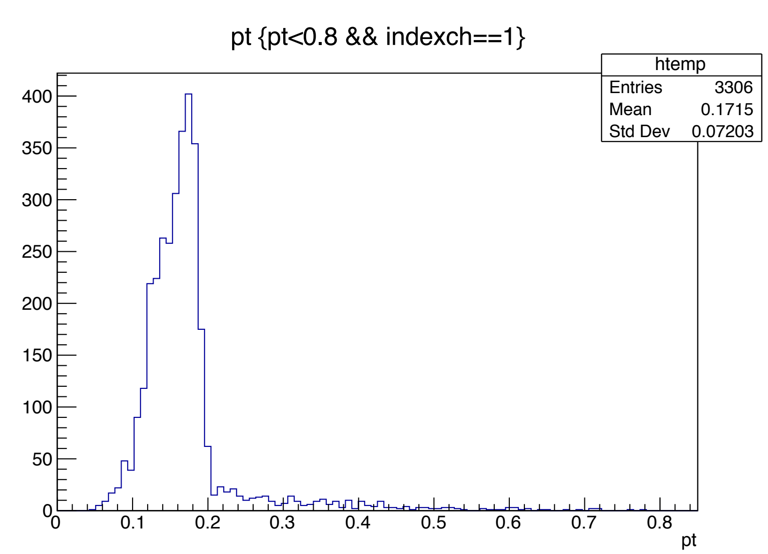
All events

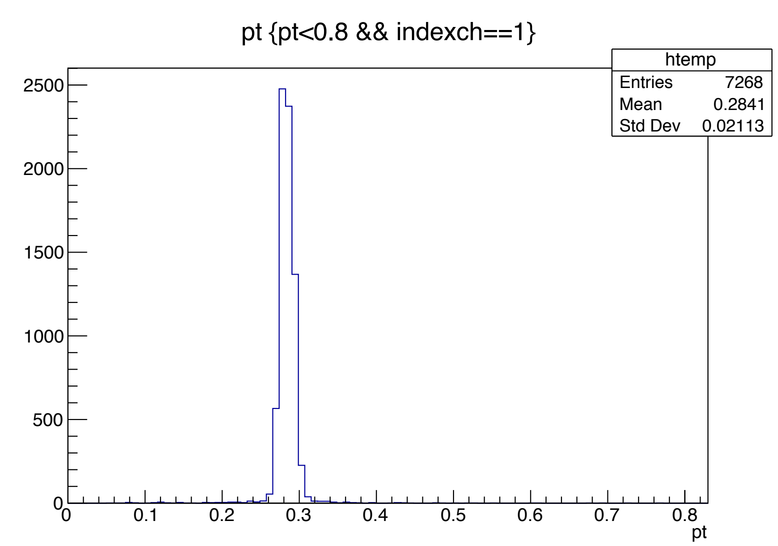






Selecting those events with only one charged track

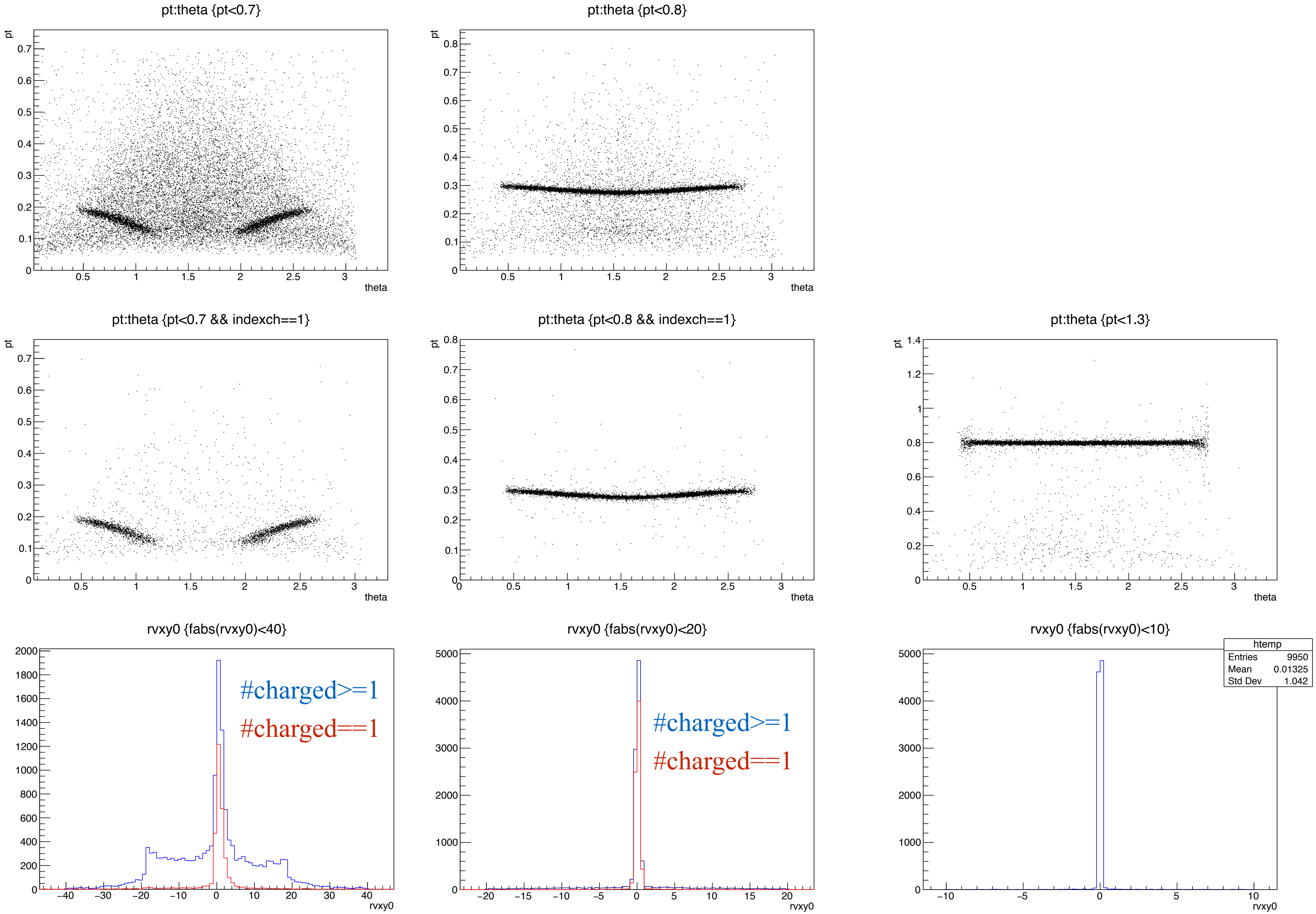




Antiproton, pt=0.2 GeV/c | Antiproton, pt=0.3 GeV/c | Antiproton, pt=0.8 GeV/c

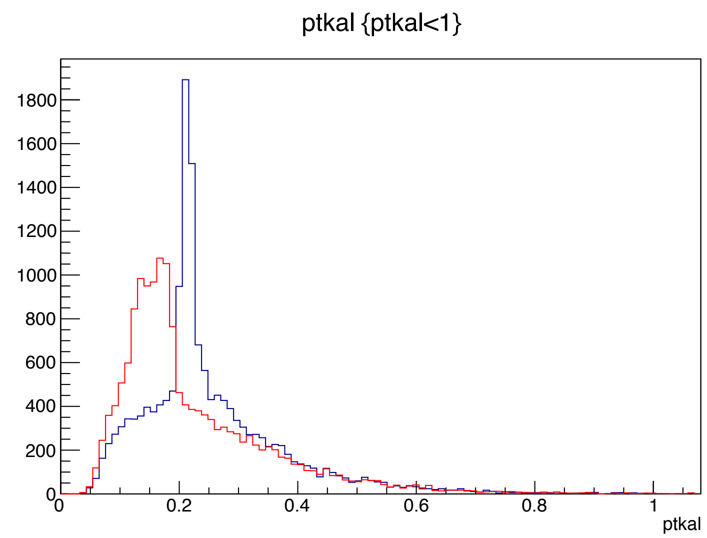
All events

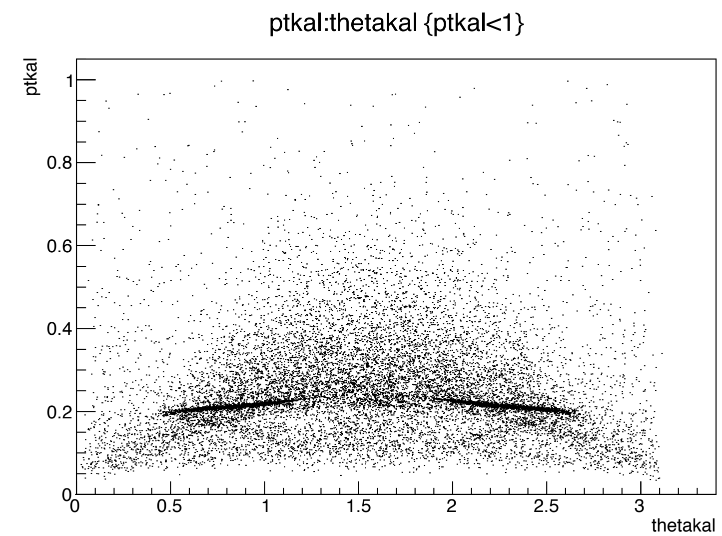
Selecting those events with only one charged track



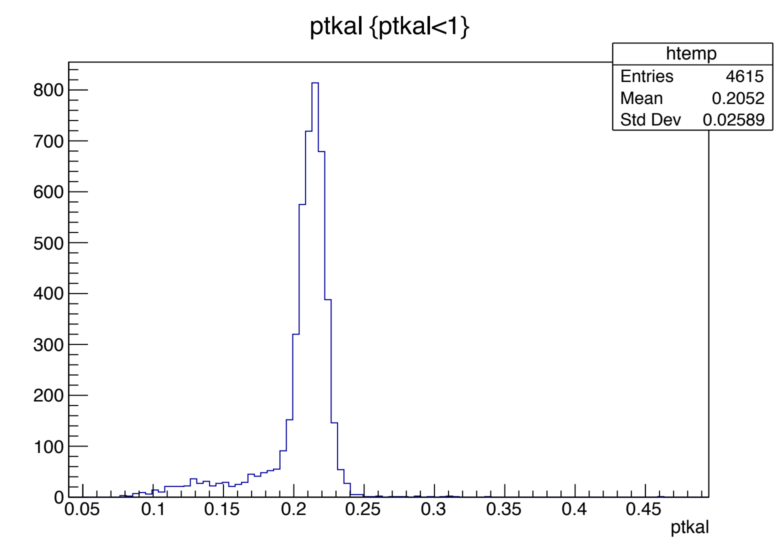
After Kalman:

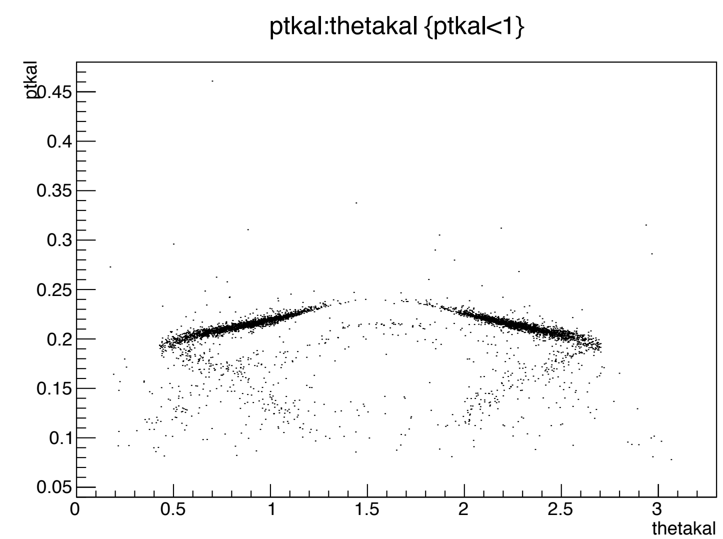
Antiproton, pt=0.2 GeV/c



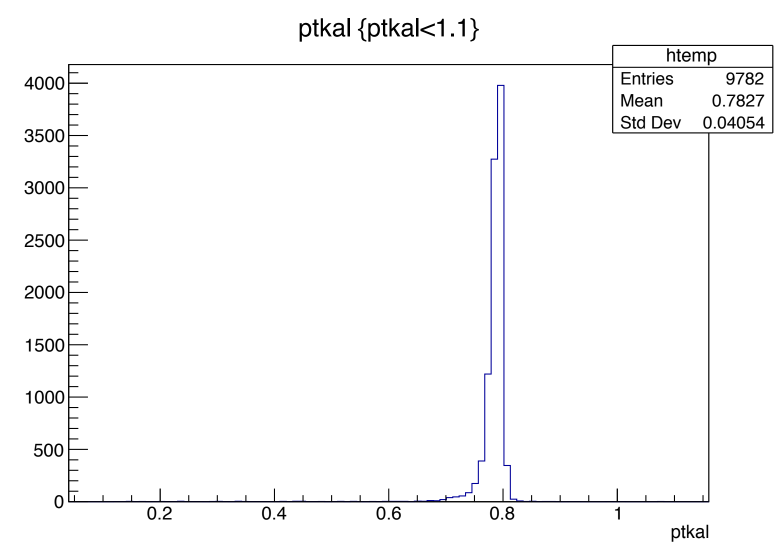


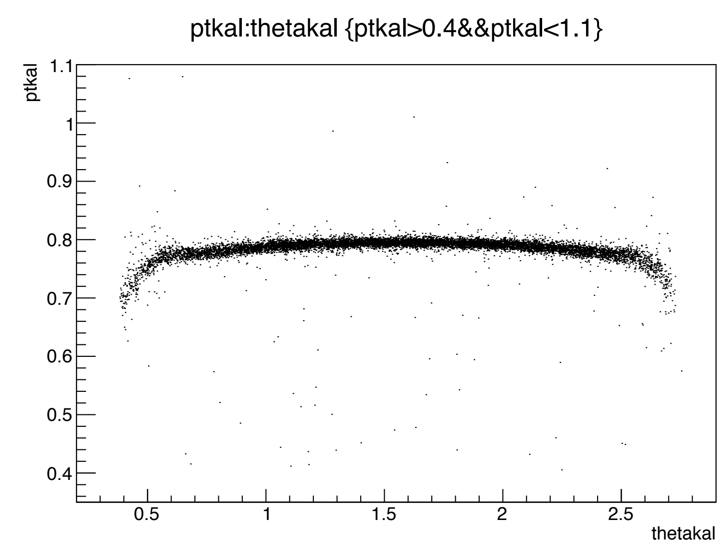
Proton, pt=0.2 GeV/c





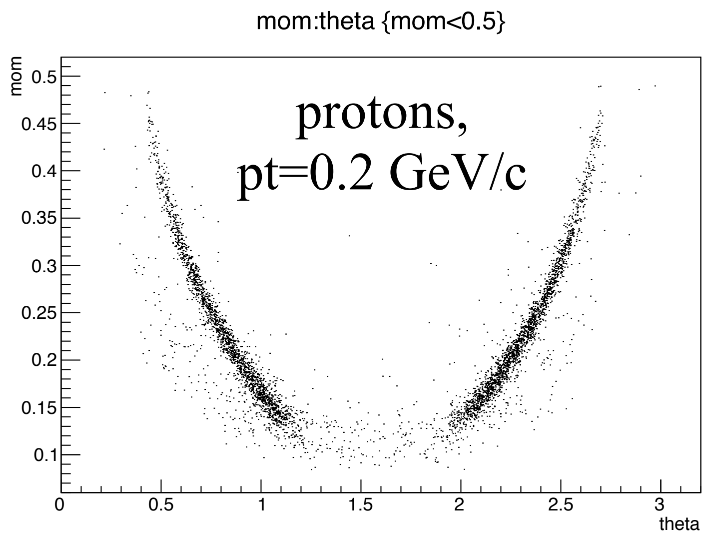
Proton, pt=0.8 GeV/c

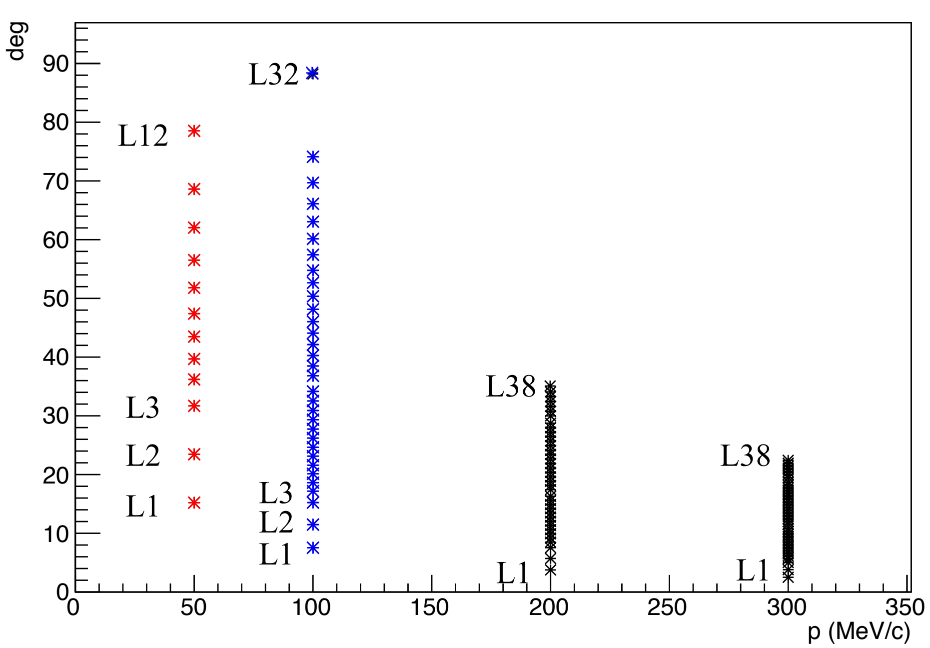




Conclusions from p and bar single track simulation

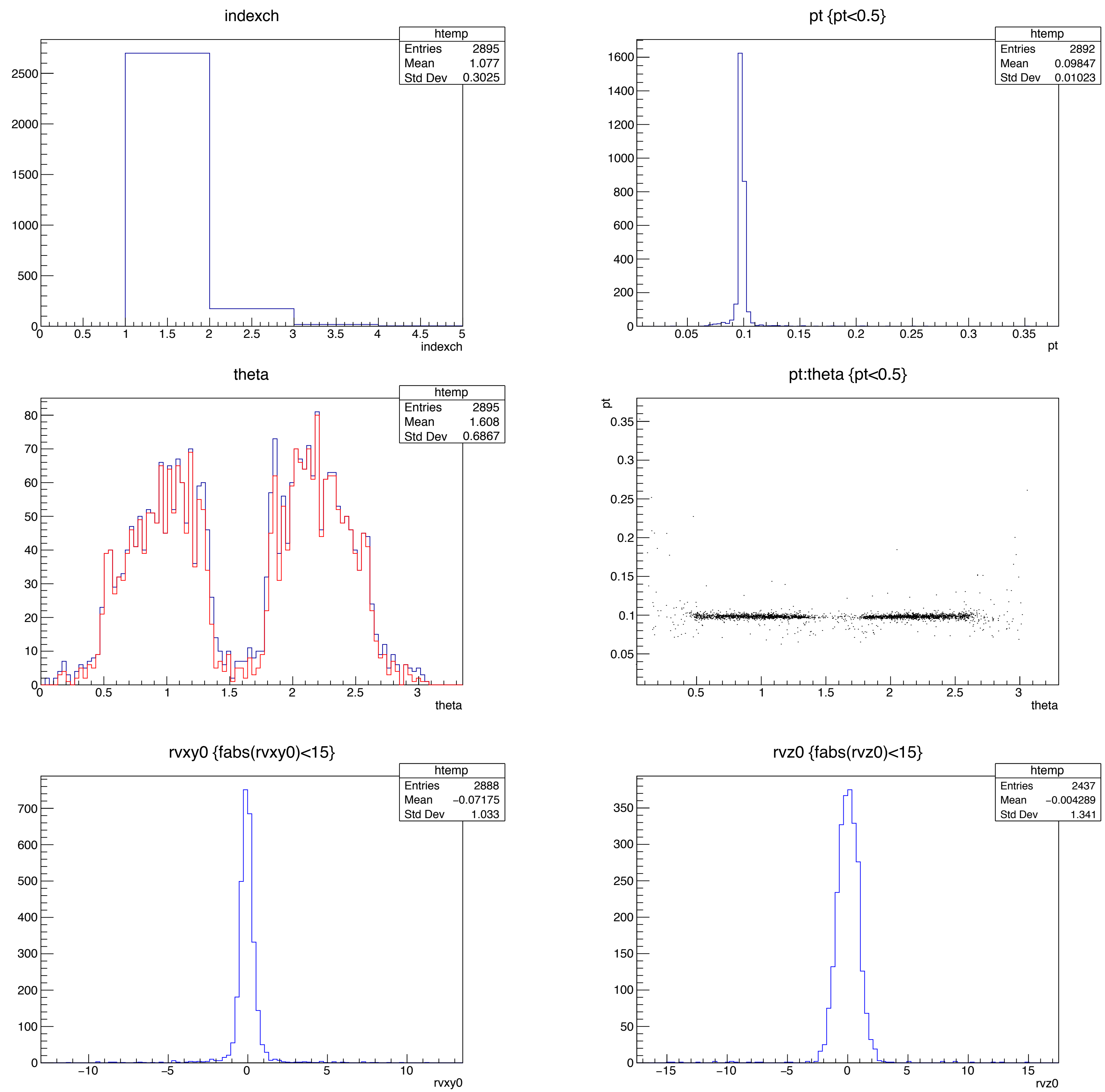
- One charged tracks is reconstructed when single track proton is simulated, while more charged tracks are reconstructed when we simulate single pbar track (independently from the transverse momentum pt) ….. **WHY?**
- Very BAD pt reconstruction for $pt \leq 0.2$ GeV/c for both p and pbar
- The bending is maximum when the track is emitted at 90 deg:
  - R_{cgem}(inner) ≈ 0.087 m
  - R_{ODC}(inner) ≈ 0.197 m (first layer)
  - R_{ODC}(stereo) ≈ 0.4 m (first stereo layer)
  - R_{ODC}(outer) ≈ 0.76 m (first stereo layer)
    - pt ≈ 0.2 GeV/c ==> R_{trk} = p [GeV/c] / (0.3*B [T]) = 0.67 m
    - pt ≈ 0.1 GeV/c ==> R_{trk} = p [GeV/c] / (0.3*B [T]) = ***0.33 m*** (31 layers over 38)
    - pt ≈ 0.5 GeV/c ==> R_{trk} = p [GeV/c] / (0.3*B [T]) = ***0.17 m*** (11 layers over 38)
- Reconstruction efficiency:
  - 21% for pt_{proton} = 0.18 GeV/c
  - 0.6% for pt_{proton} = 0.13 GeV/c
    - 2.64% restricting the polar angle range in the forward direction ($0.7<\cos\theta<0.93$)
  - no proton reconstructed for pt = 0.1 GeV/c



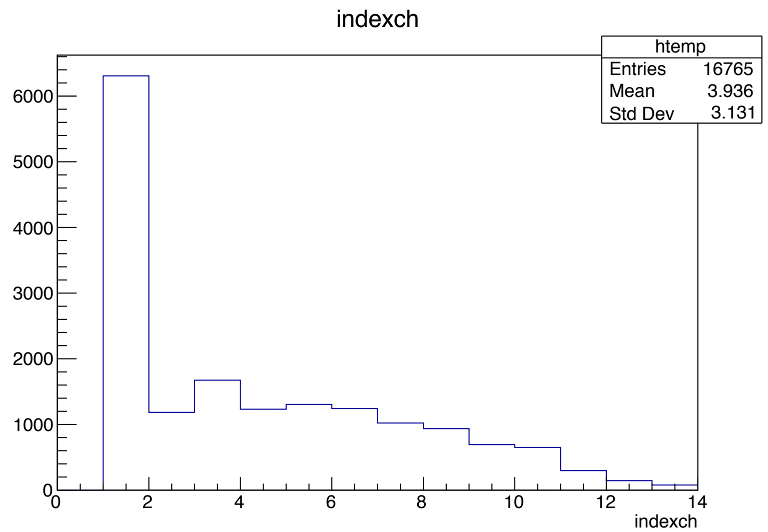


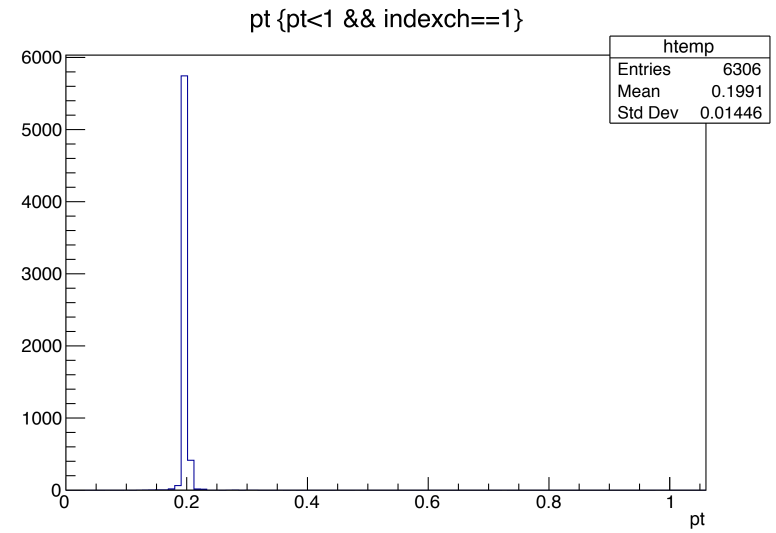
- After KALMAN fit
  - better pt determination for low track momenta ?

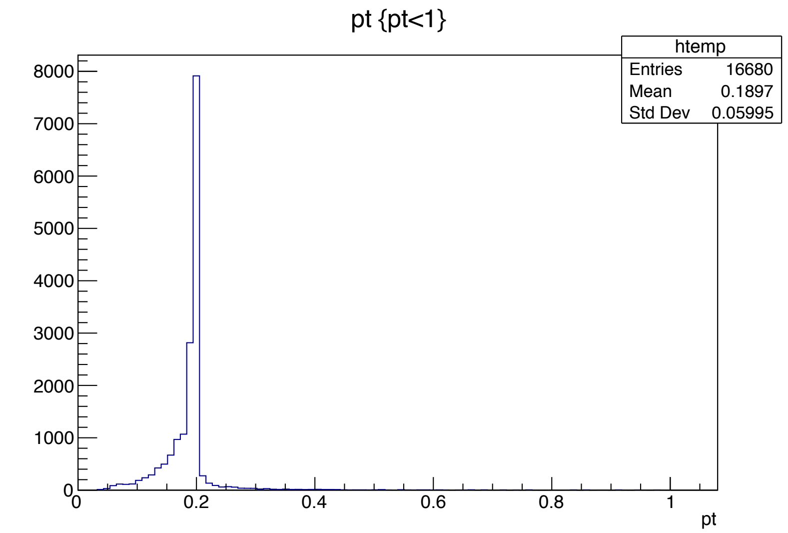
$\mu+$, pt=0.1 GeV/c

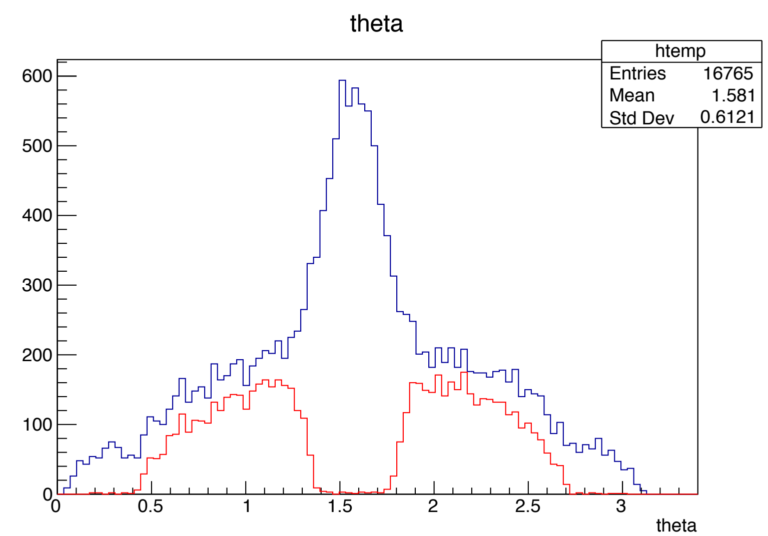

indexch
htemp
Entries 2895
Mean 1.077
Std Dev 0.3025
indexch
pt {pt<0.5}
htemp
Entries 2892
Mean 0.09847
Std Dev 0.01023
pt
theta
htemp
Entries 2895
Mean 1.608
Std Dev 0.6867
theta
pt:theta {pt<0.5}
pt
theta
rvxy0 {fabs(rvxy0)<15}
htemp
Entries 2888
Mean −0.07175
Std Dev 1.033
rvxy0
rvz0 {fabs(rvz0)<15}
htemp
Entries 2437
Mean −0.004289
Std Dev 1.341
rvz0

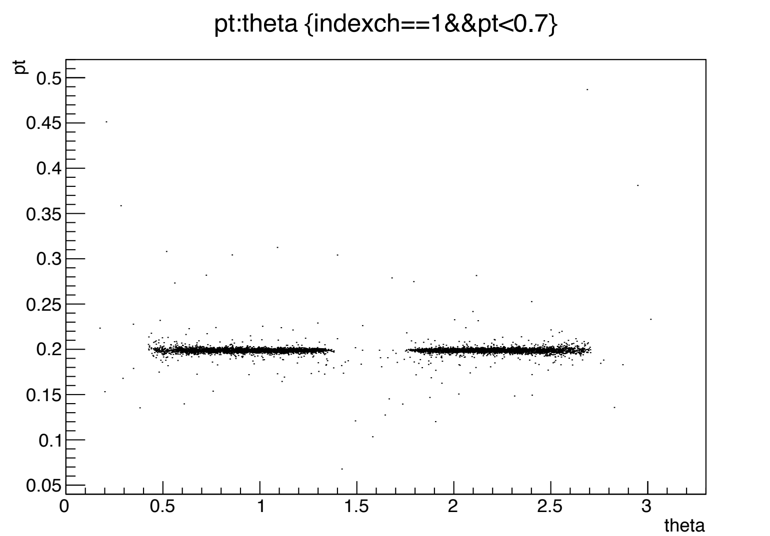
μ+, pt=0.2 GeV/c

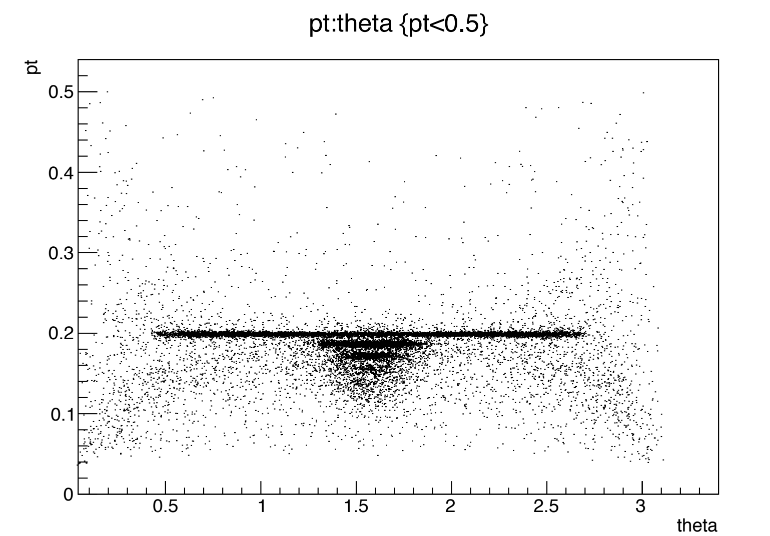


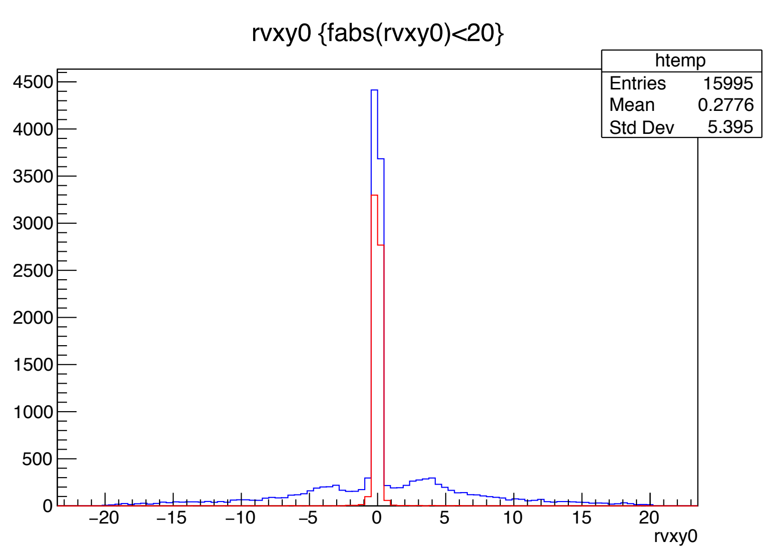


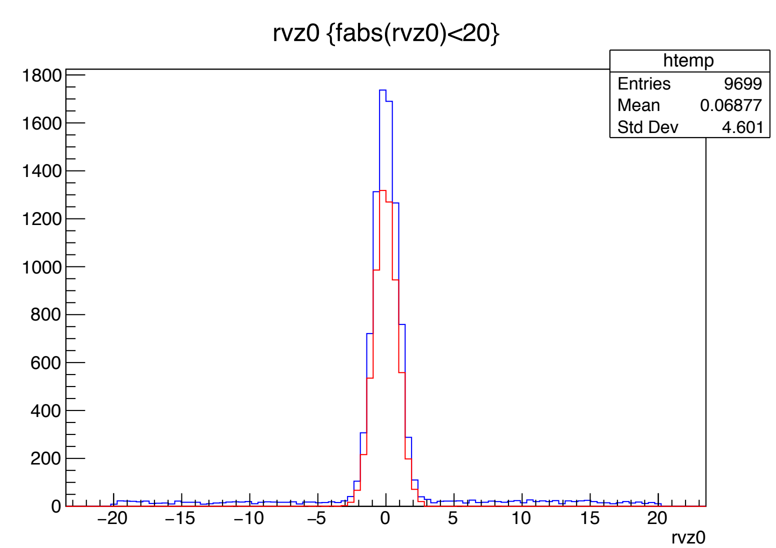






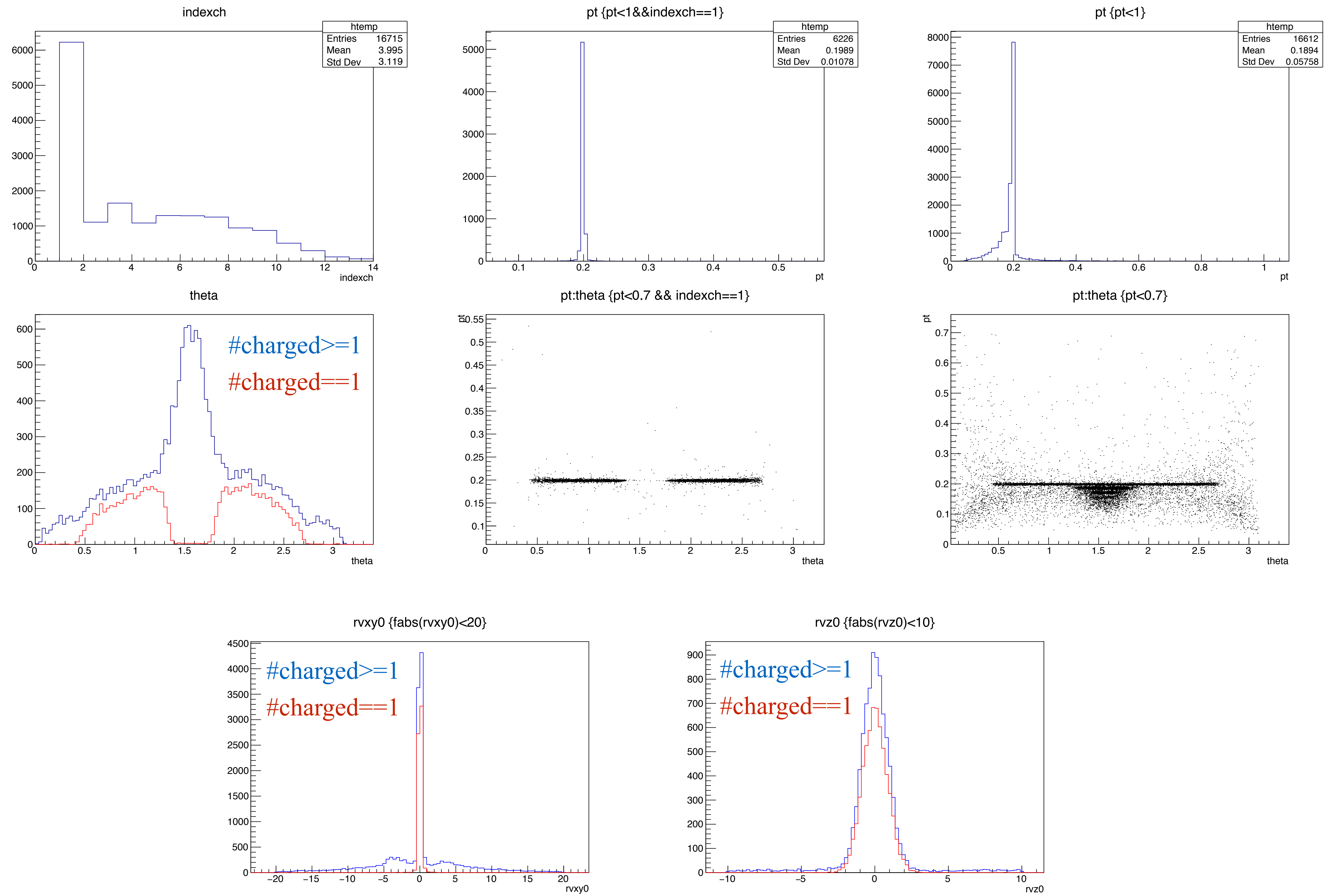




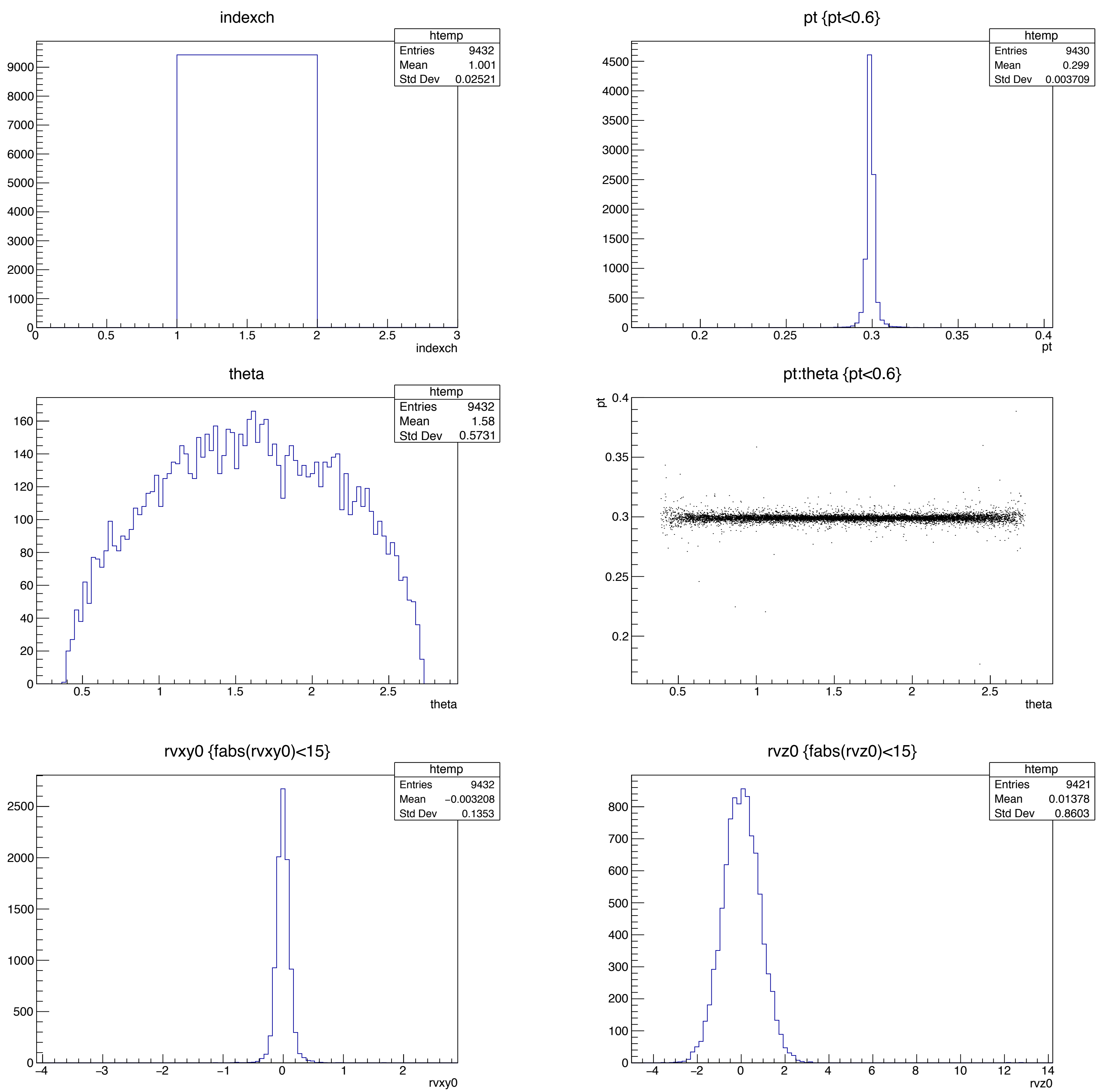


μ+ and μ- for pt = 0.2 GeV/c have similar behavior

μ−, pt=0.2 GeV/c

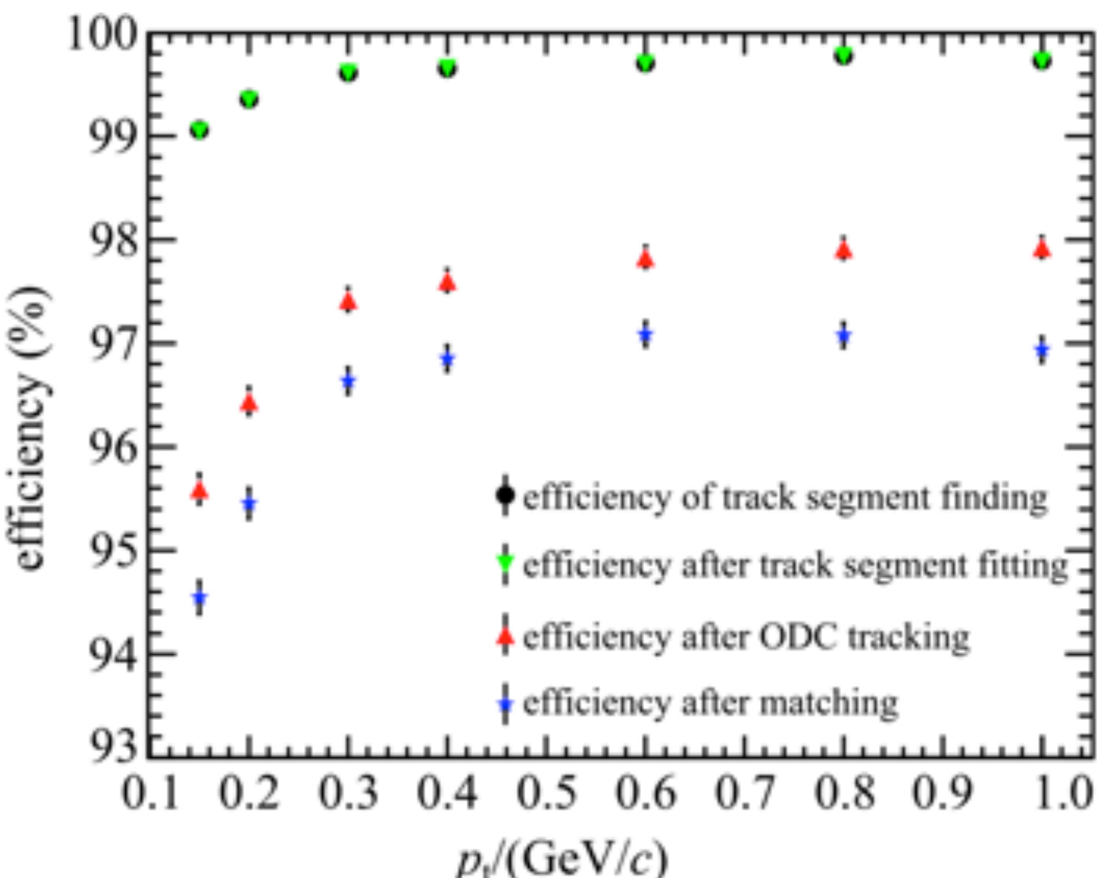

indexch
htemp
Entries 16715
Mean 3.995
Std Dev 3.119
pt {pt<1&&indexch==1}
htemp
Entries 6226
Mean 0.1989
Std Dev 0.01078
pt {pt<1}
htemp
Entries 16612
Mean 0.1894
Std Dev 0.05758
theta
#charged>=1
#charged==1
pt:theta {pt<0.7 && indexch==1}
pt:theta {pt<0.7}
rvxy0 {fabs(rvxy0)<20}
#charged>=1
#charged==1
rvz0 {fabs(rvz0)<10}
#charged>=1
#charged==1

μ+, pt=0.3 GeV/c


indexch
htemp
Entries 9432
Mean 1.001
Std Dev 0.02521
indexch
pt {pt<0.6}
htemp
Entries 9430
Mean 0.299
Std Dev 0.003709
pt
theta
htemp
Entries 9432
Mean 1.58
Std Dev 0.5731
theta
pt:theta {pt<0.6}
pt
theta
rvxy0 {fabs(rvxy0)<15}
htemp
Entries 9432
Mean −0.003208
Std Dev 0.1353
rvxy0
rvz0 {fabs(rvz0)<15}
htemp
Entries 9421
Mean 0.01378
Std Dev 0.8603
rvz0

Conclusions from muon simulation

- Similar behavior for μ− and μ+
- Tracking efficiency lower than expected
- Why so many tracks reconstructed for pt ~ 0.2 GeV/c ?
- pt well reconstructed up to 0.1 GeV/c
- As for proton and antiproton, hole around 90 deg fro low momentum tracks (pt<0.2 GeV/c)
- No substantial difference after Kalman fit

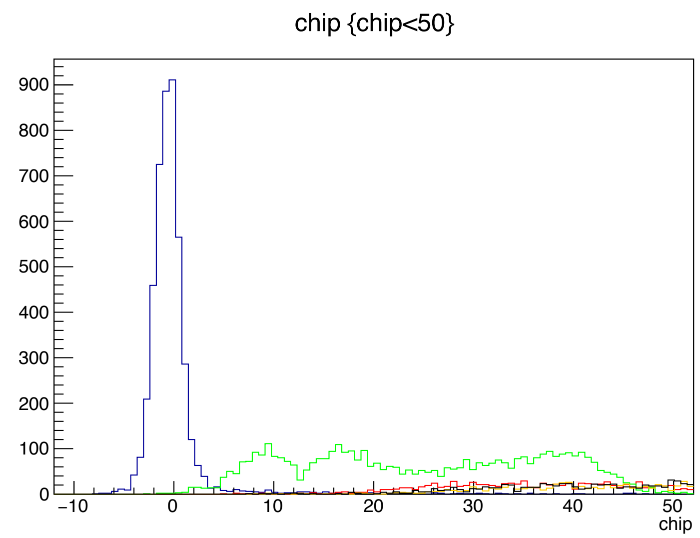


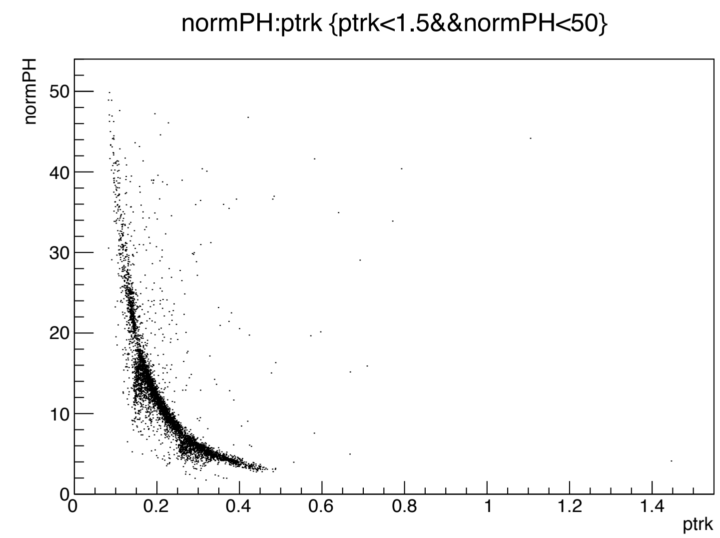
- 0.3 GeV/c: ~ 95 %
- 0.2 GeV/c: ~ 63%
  (87% taking into account also the events with more than 1 charged track reconstructed)
- 0.1 GeV/c: ~ 25%

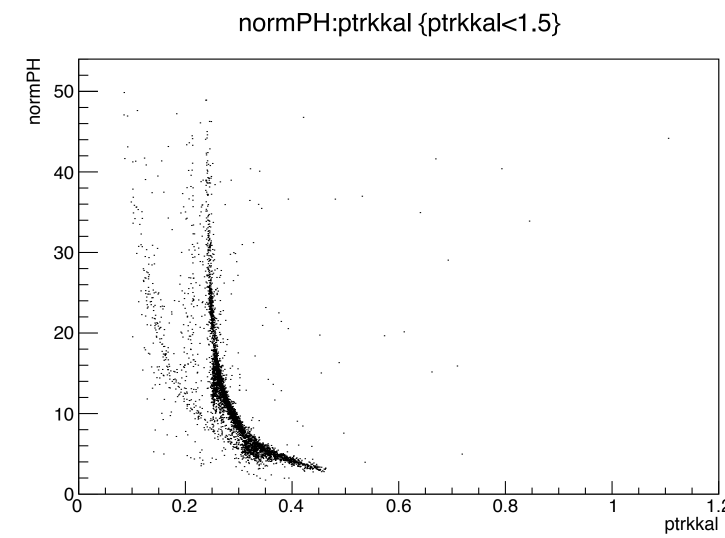
https://arxiv.org/pdf/1604.03102v1.pdf

dE/dx

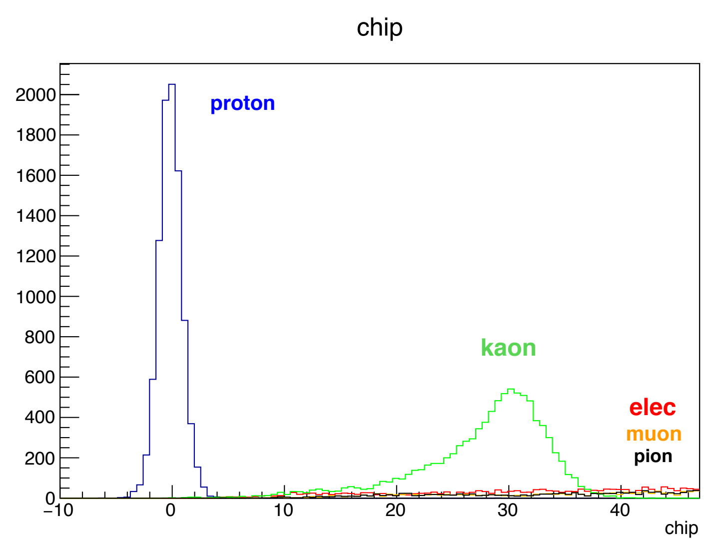
protons,
pt=0.2 GeV/c

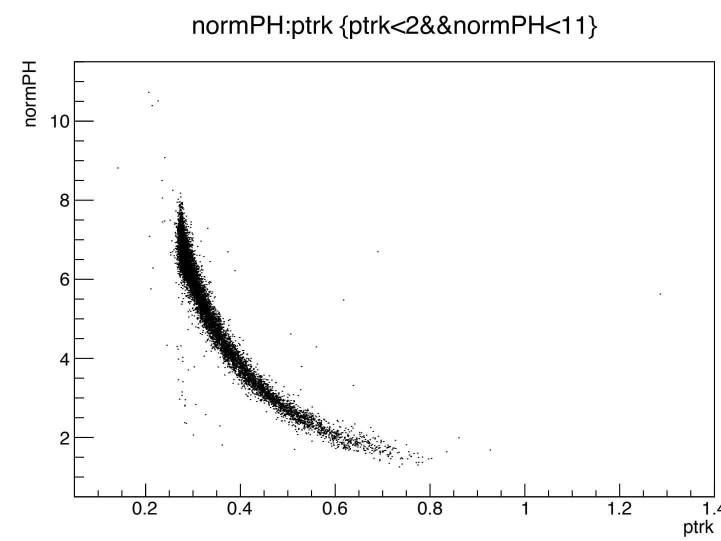


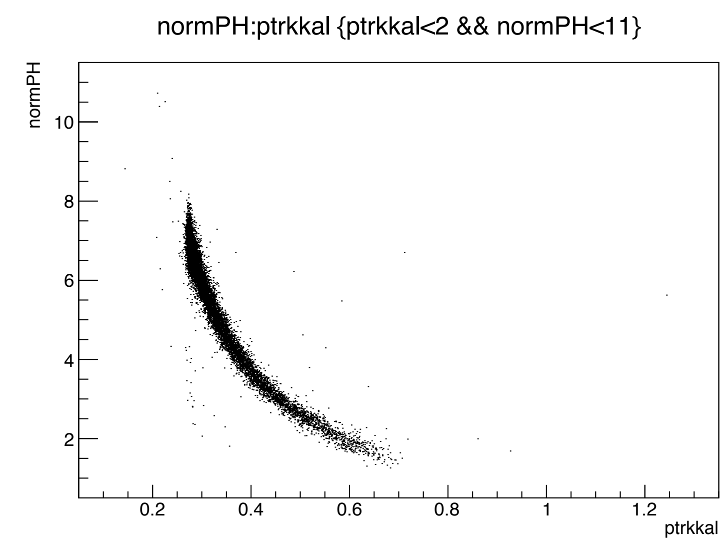




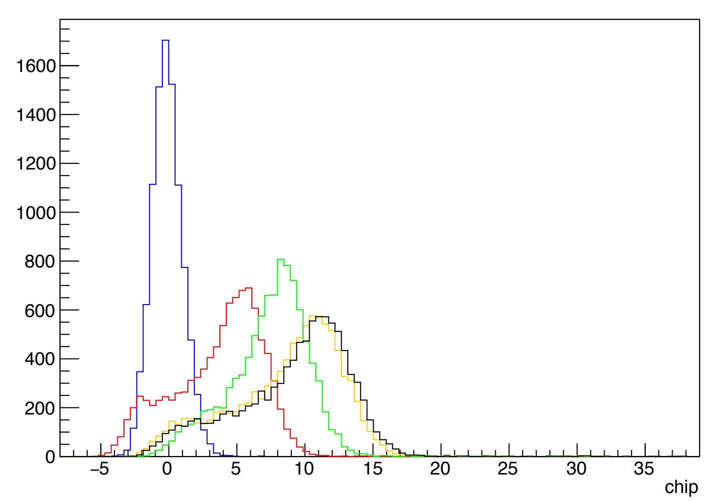
protons,
pt=0.3 GeV/c

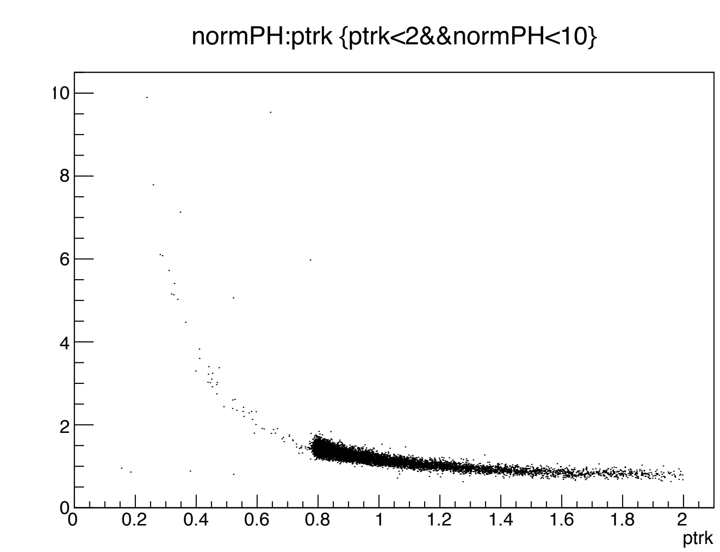


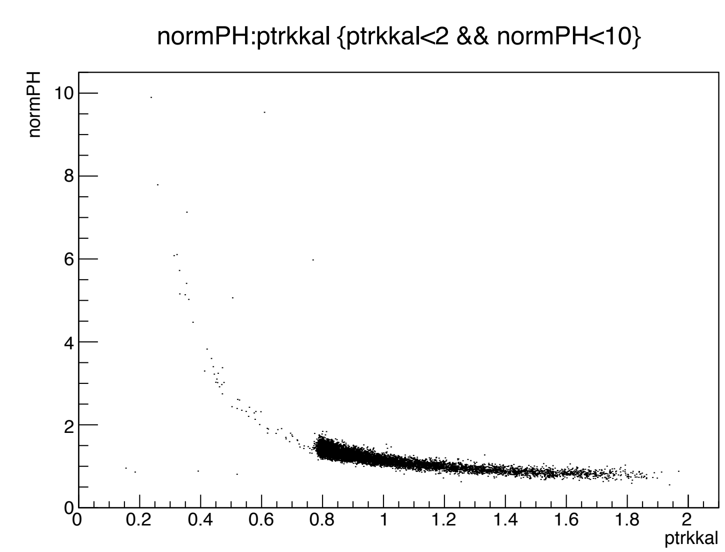




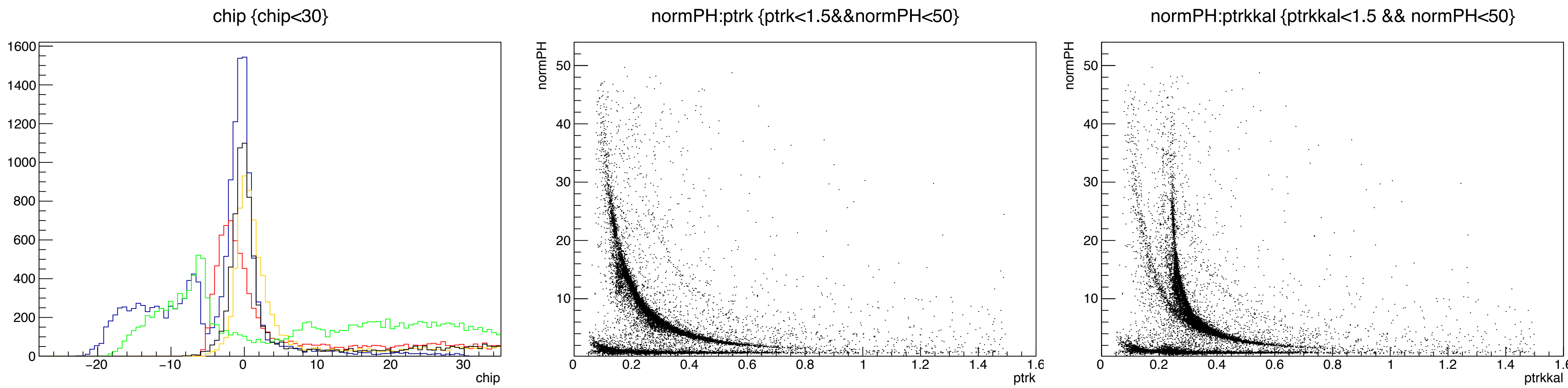
protons,
pt=0.8 GeV/c



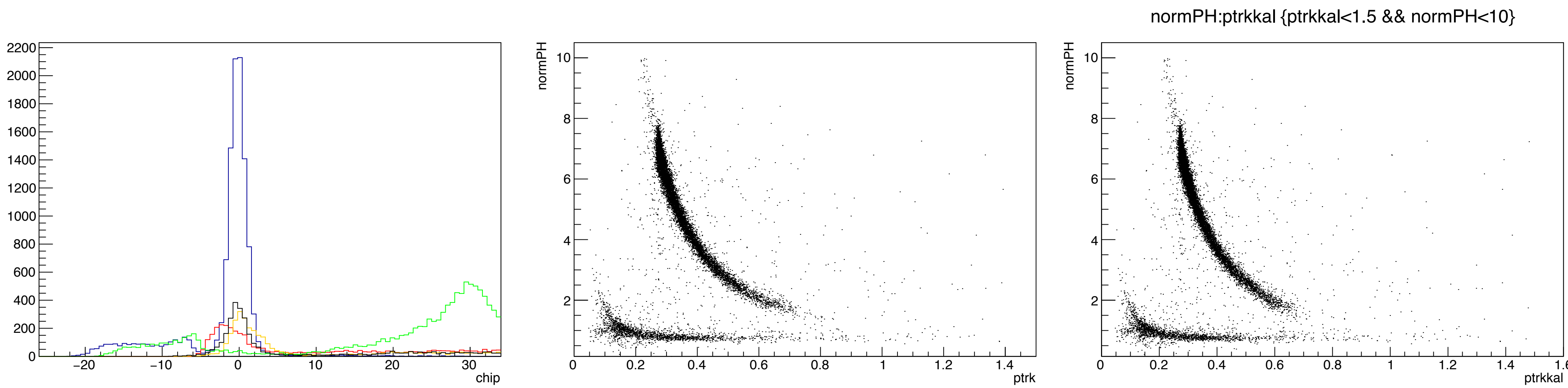




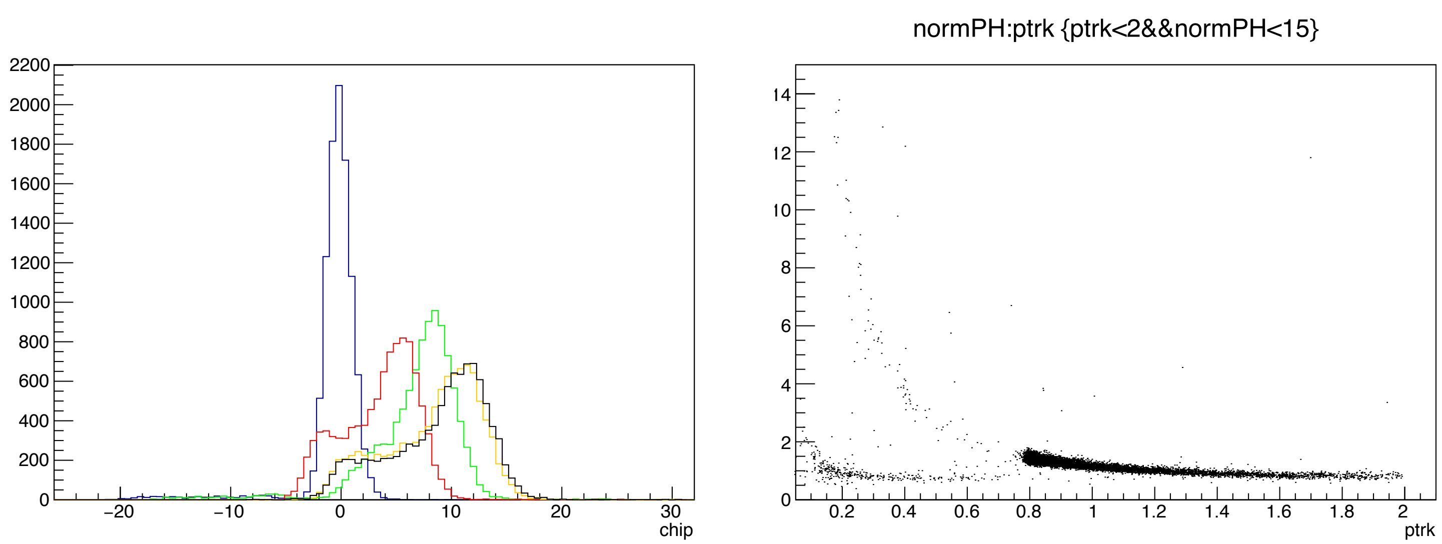
pbar,
pt=0.2 GeV/c



pbar,
pt=0.3 GeV/c



pbar,
pt=0.8 GeV/c

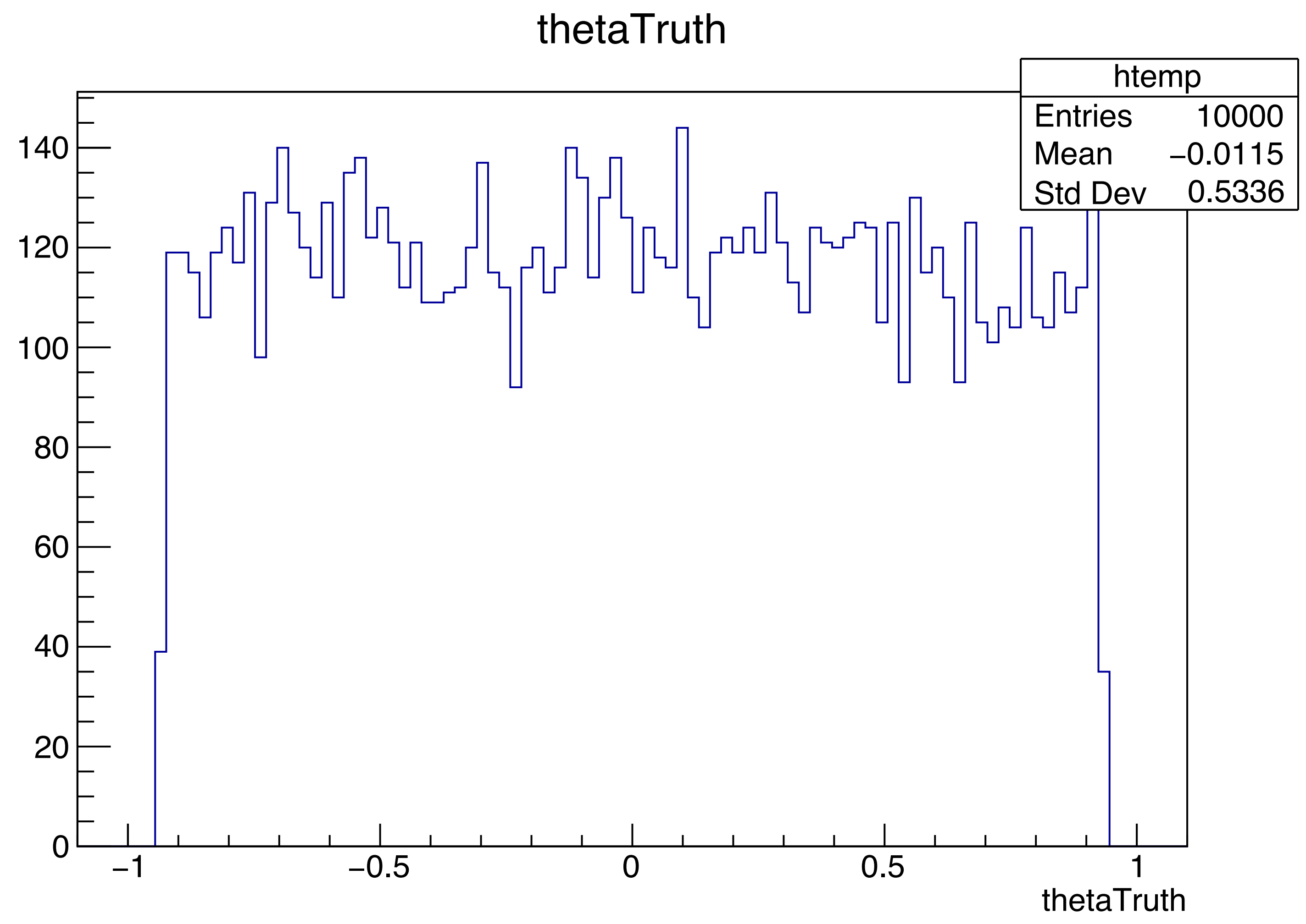


Next to do

I’m checking to the standard Boss results

…..

spares


thetaTruth
htemp
Entries 10000
Mean −0.0115
Std Dev 0.5336
140
120
100
80
60
40
20
0
−1
−0.5
0
0.5
1
thetaTruth