

$\pi^- + C$ analysis

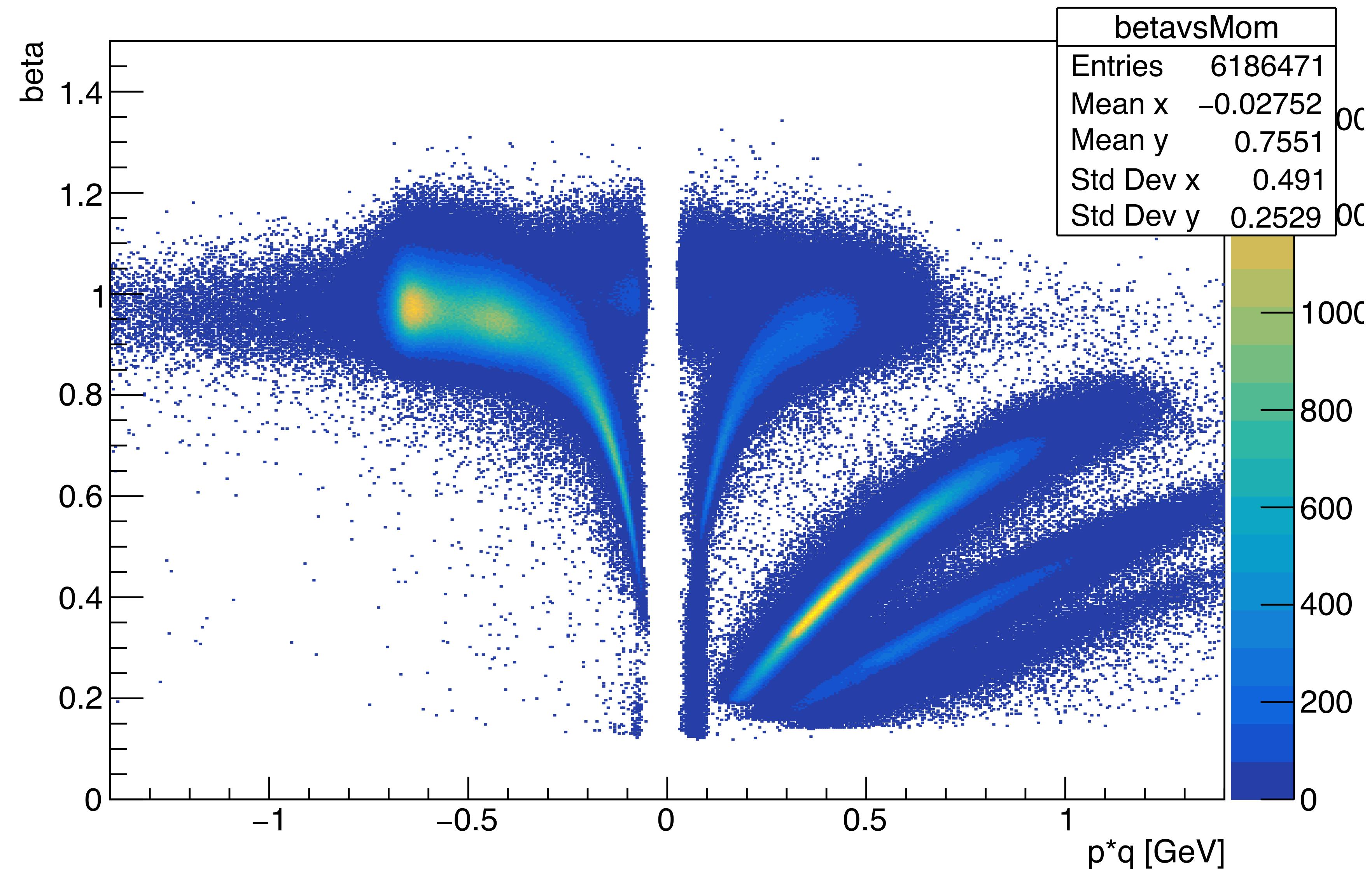
- secondary pion beam (from N + Be reaction) at 685 MeV/C
- proton, deuteron, π^- , π^+ production analysis from INCL
(θ vs p, θ , y , p, p_T , T spectra in 4pi and acceptance)
- differential cross-section T- θ
- mass cuts
- comparison of HADES experimental data with INCL

acceptance = full analysis chain:
INCL → HGEANT → DST(HYDRA)

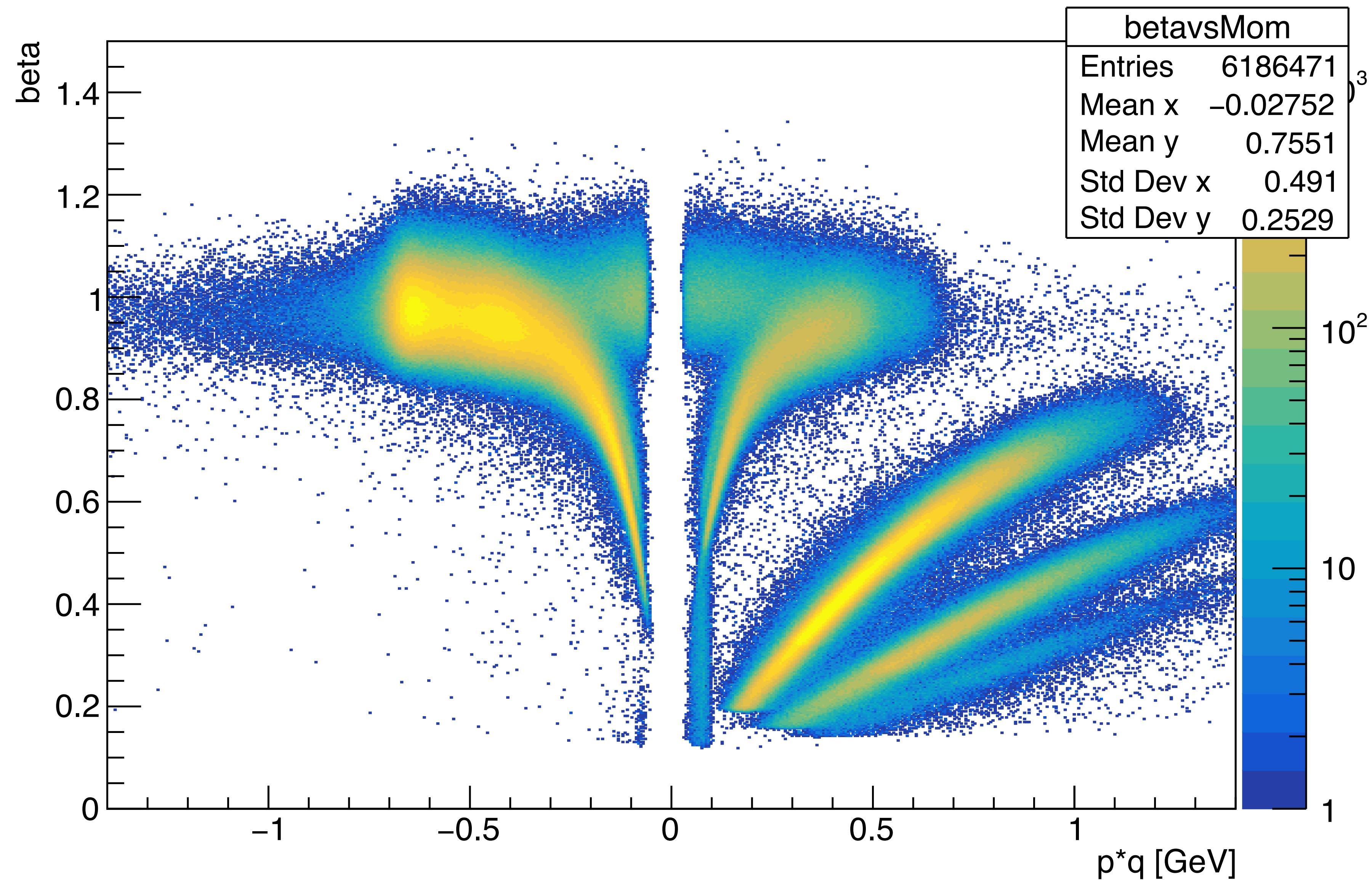
event selection criteria

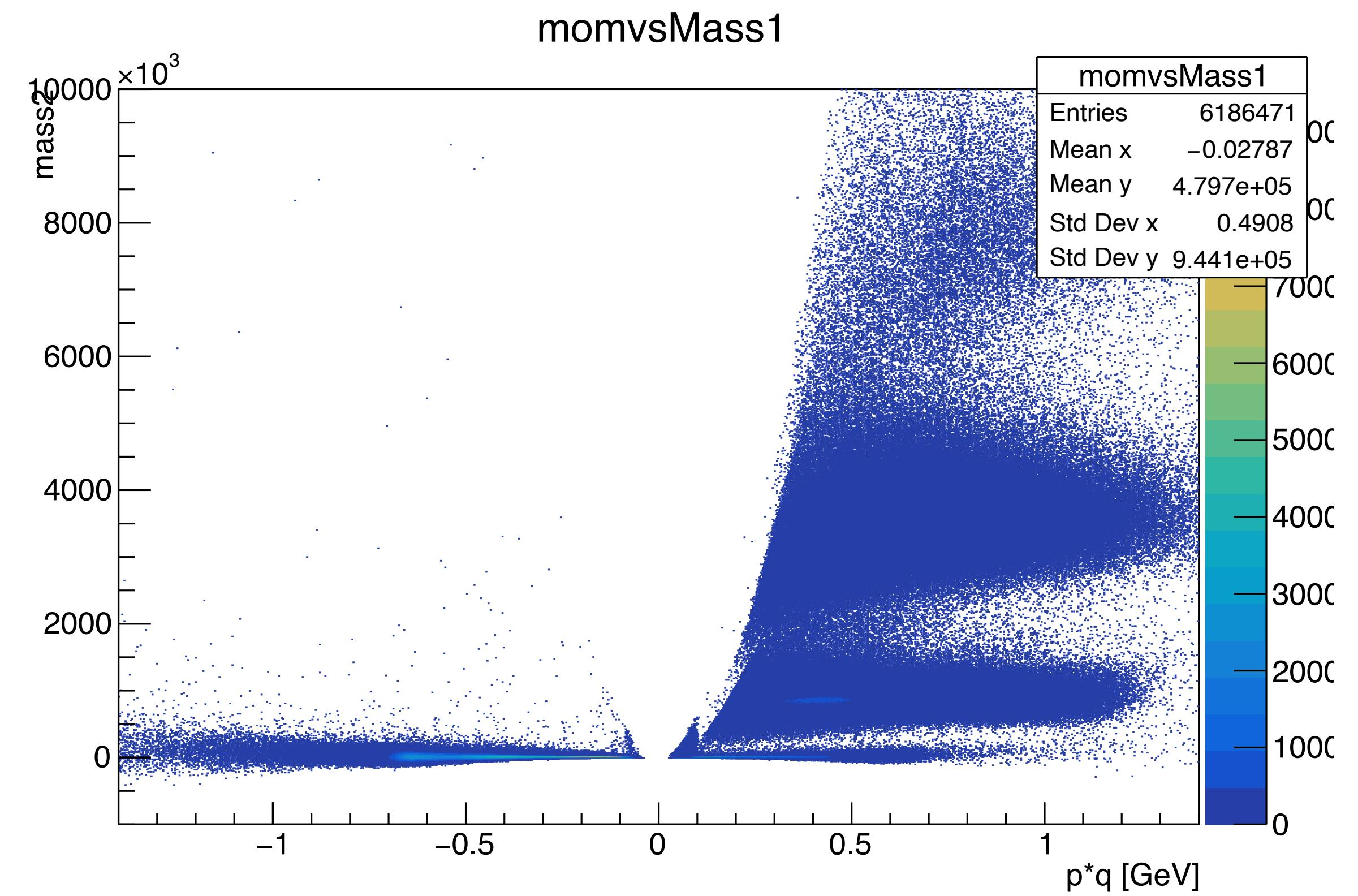
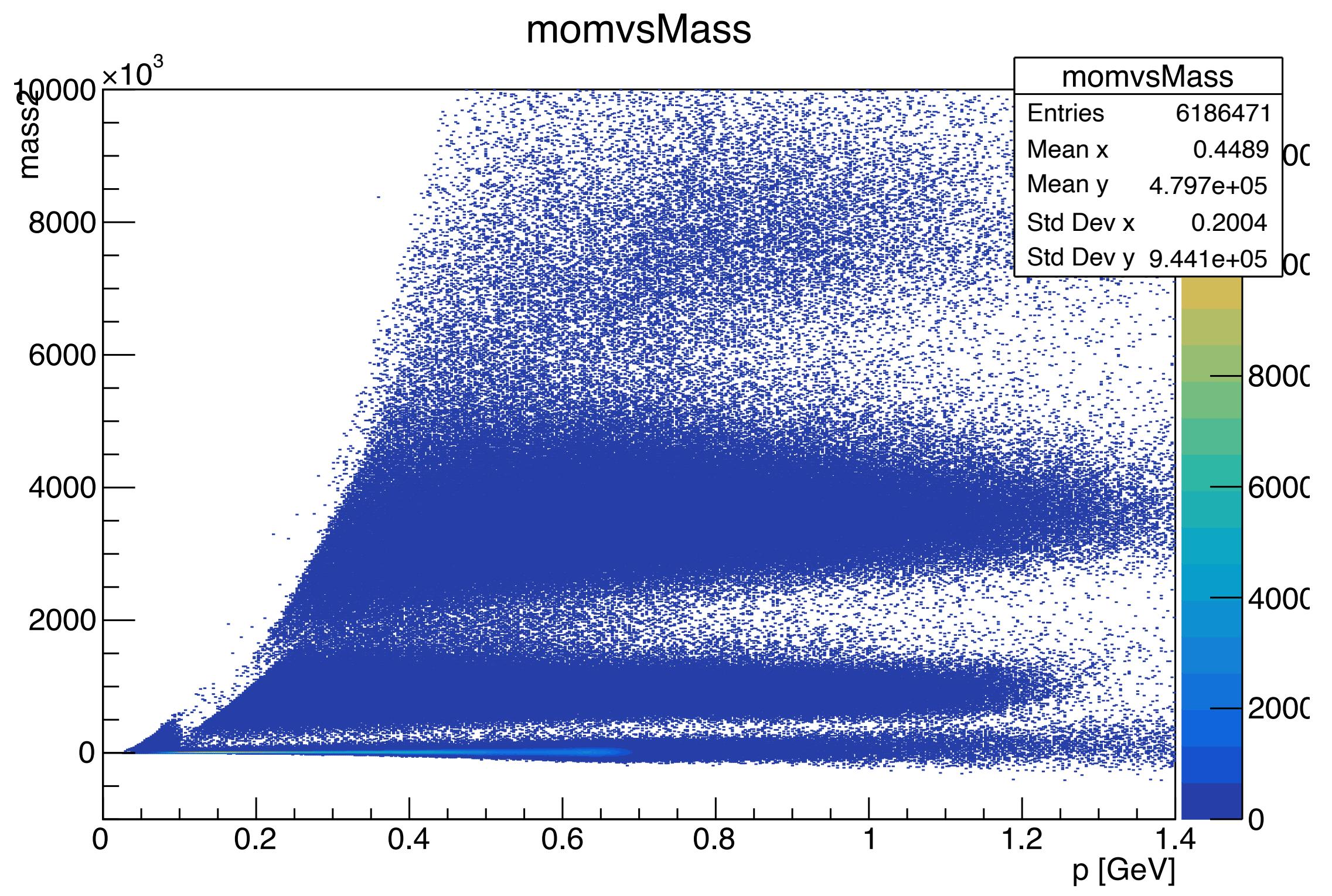
- acceptance: only well reconstructed trajectories (+ M2trigger):
 - `isFlagBit(kIsUsed)`
 - `VertexReco_z > -500`
 - GeantPID / mass cuts
- 4pi: only primary particles
 - `aMech == 0`

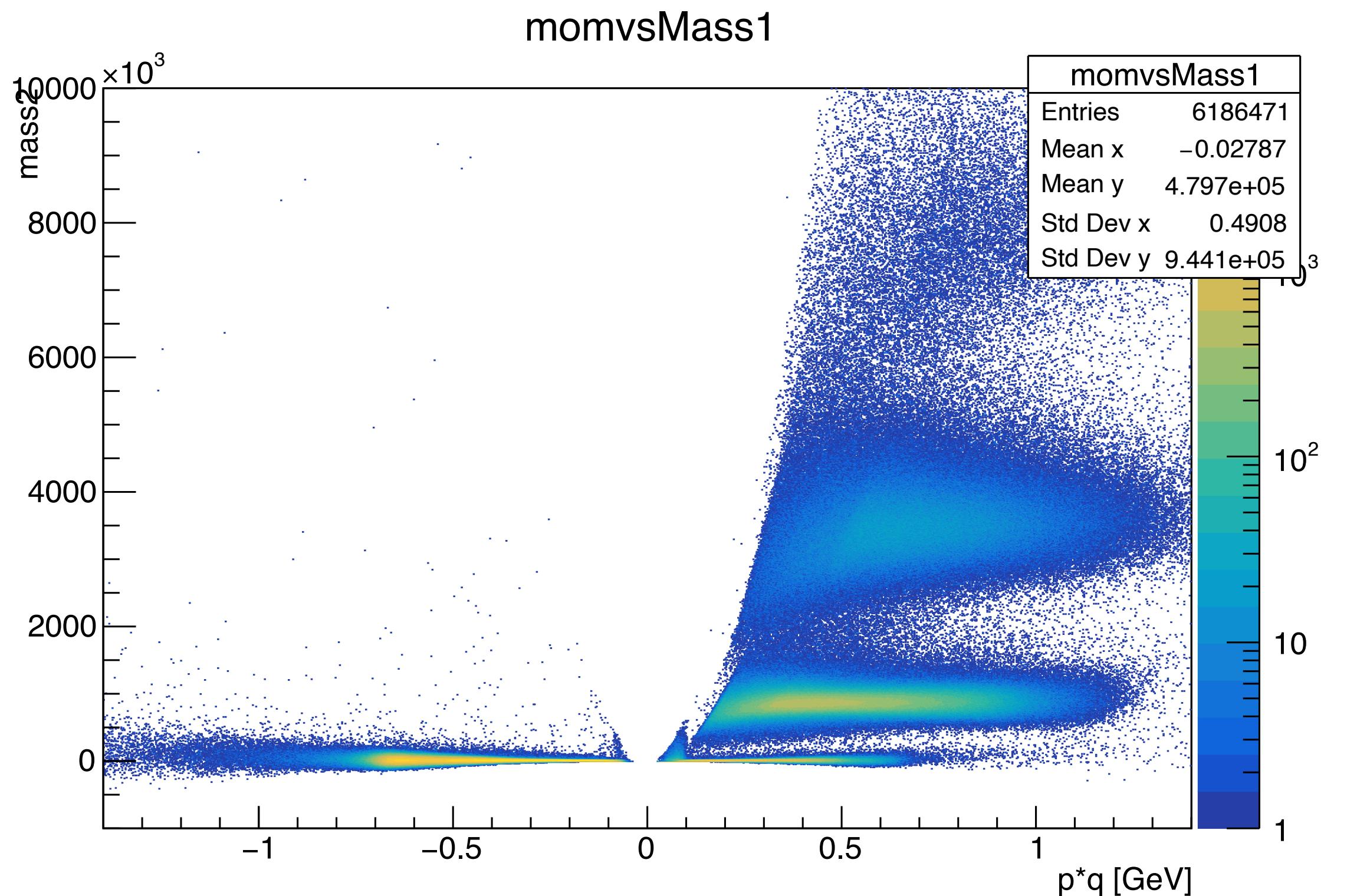
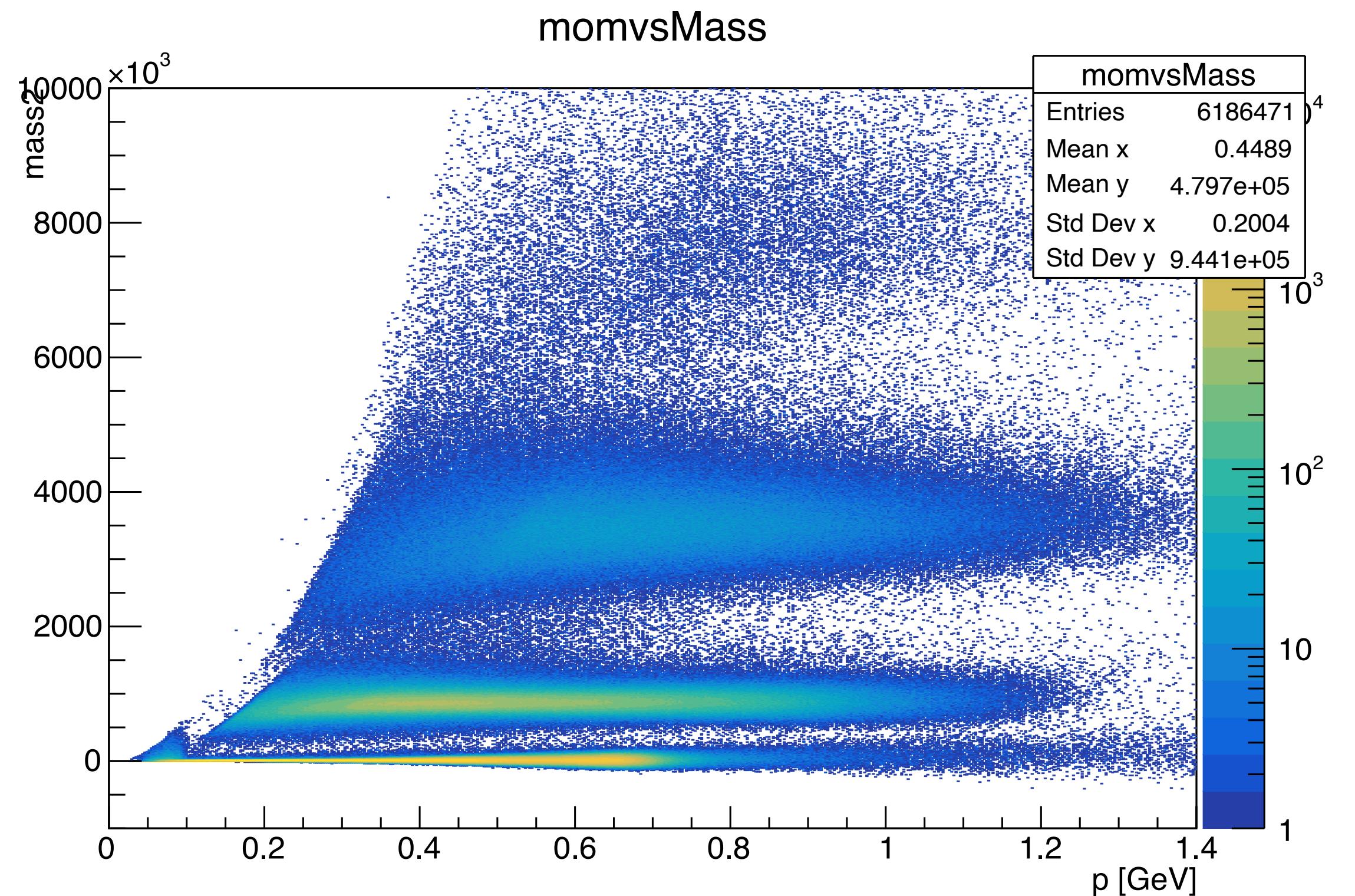
betavsMom



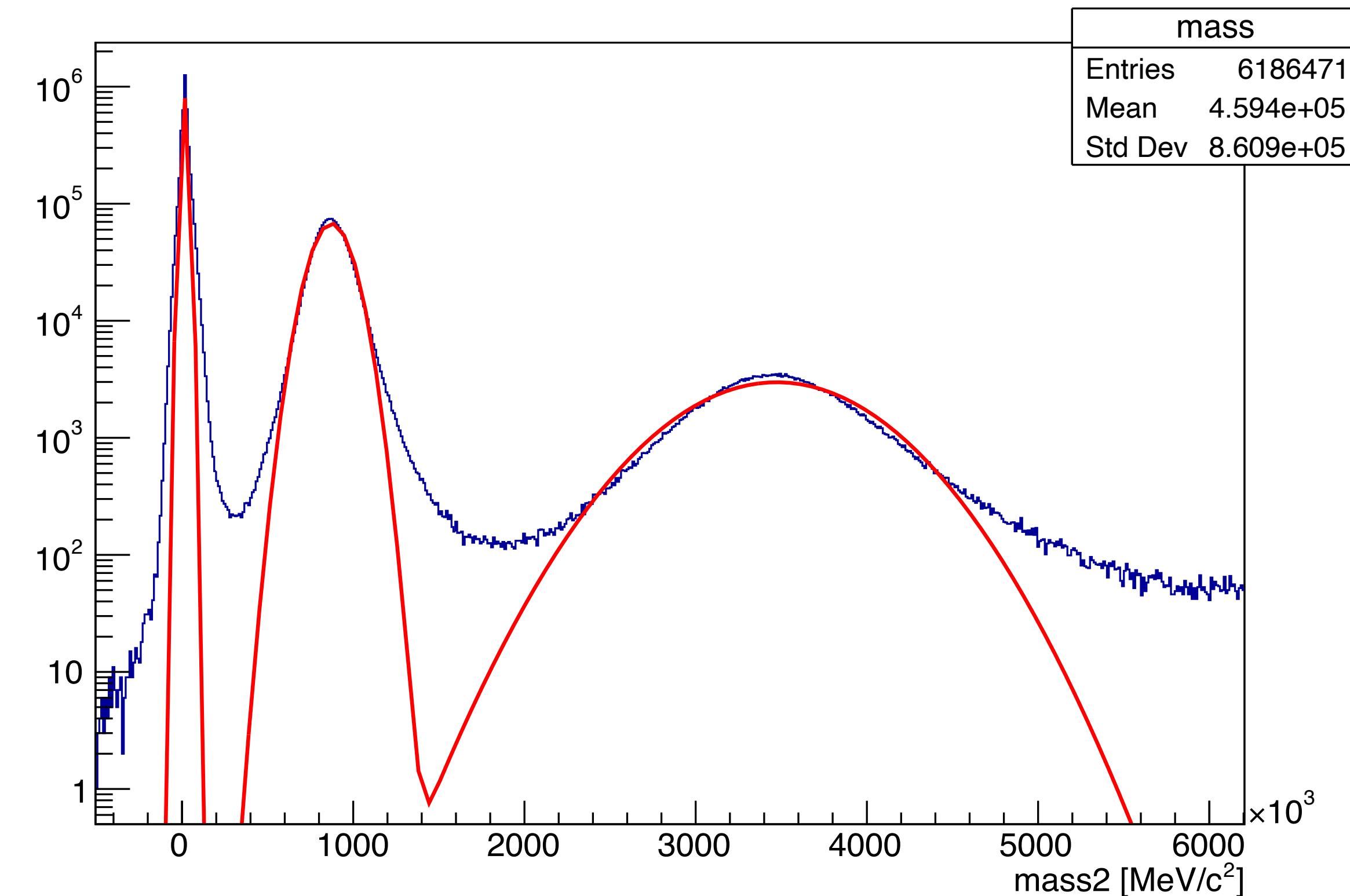
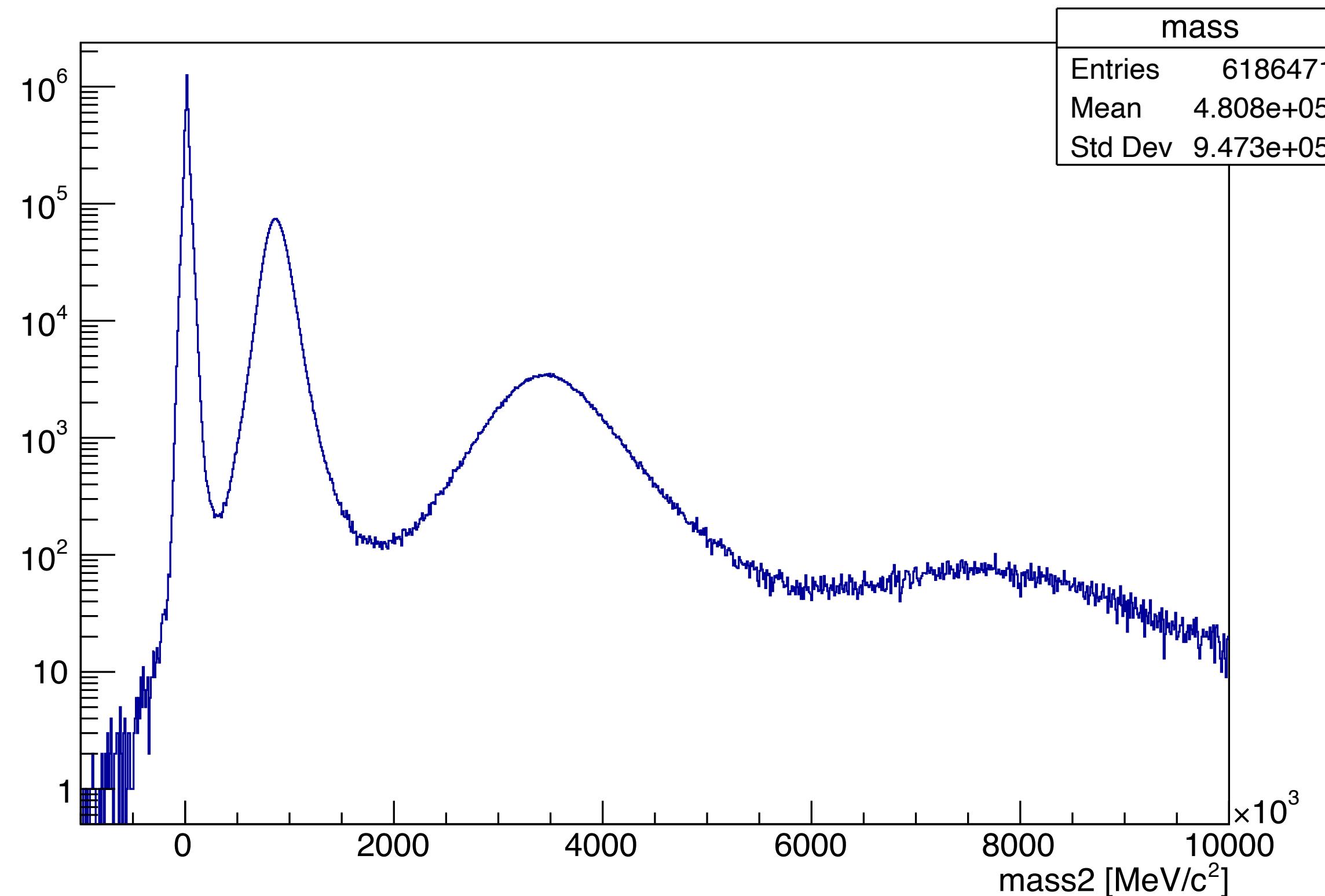
betavsMom







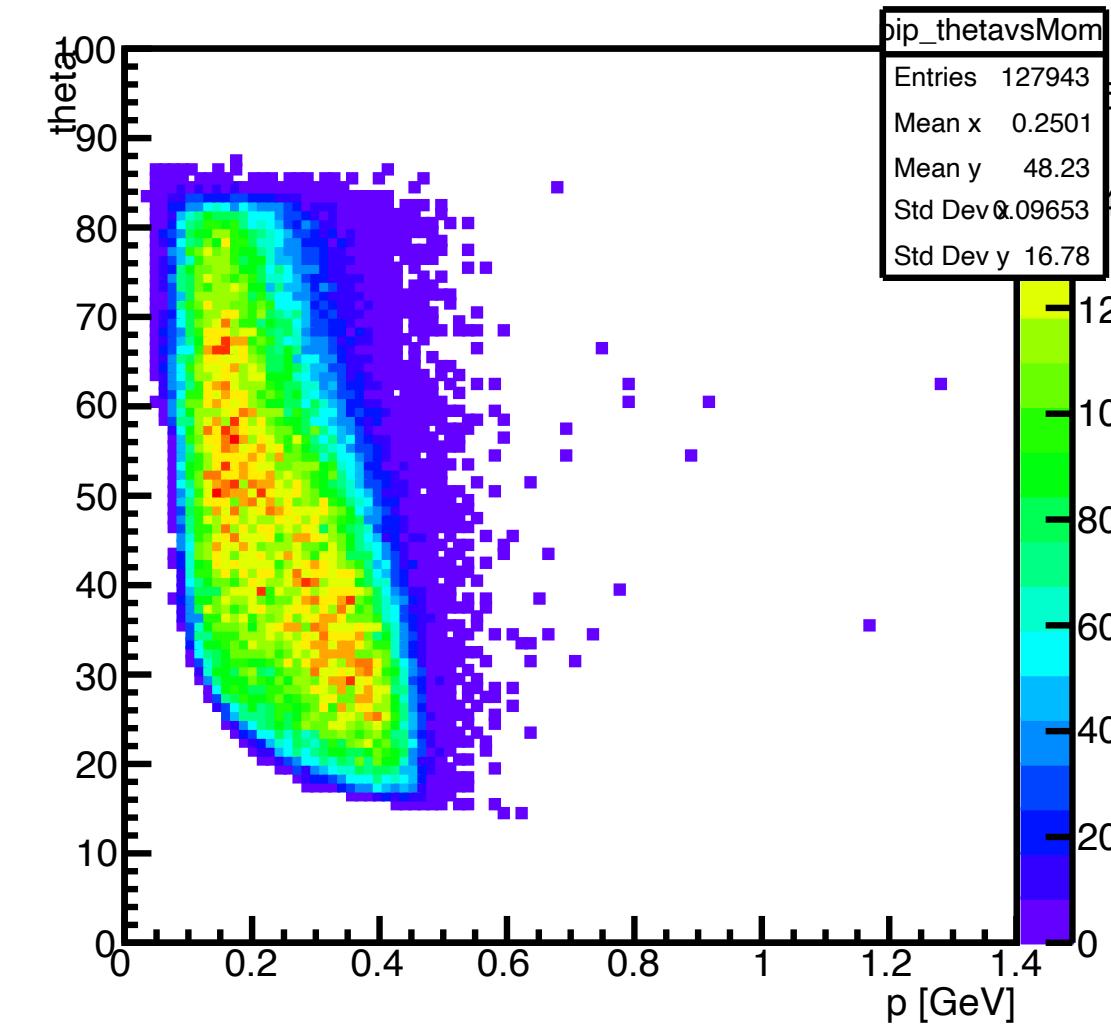
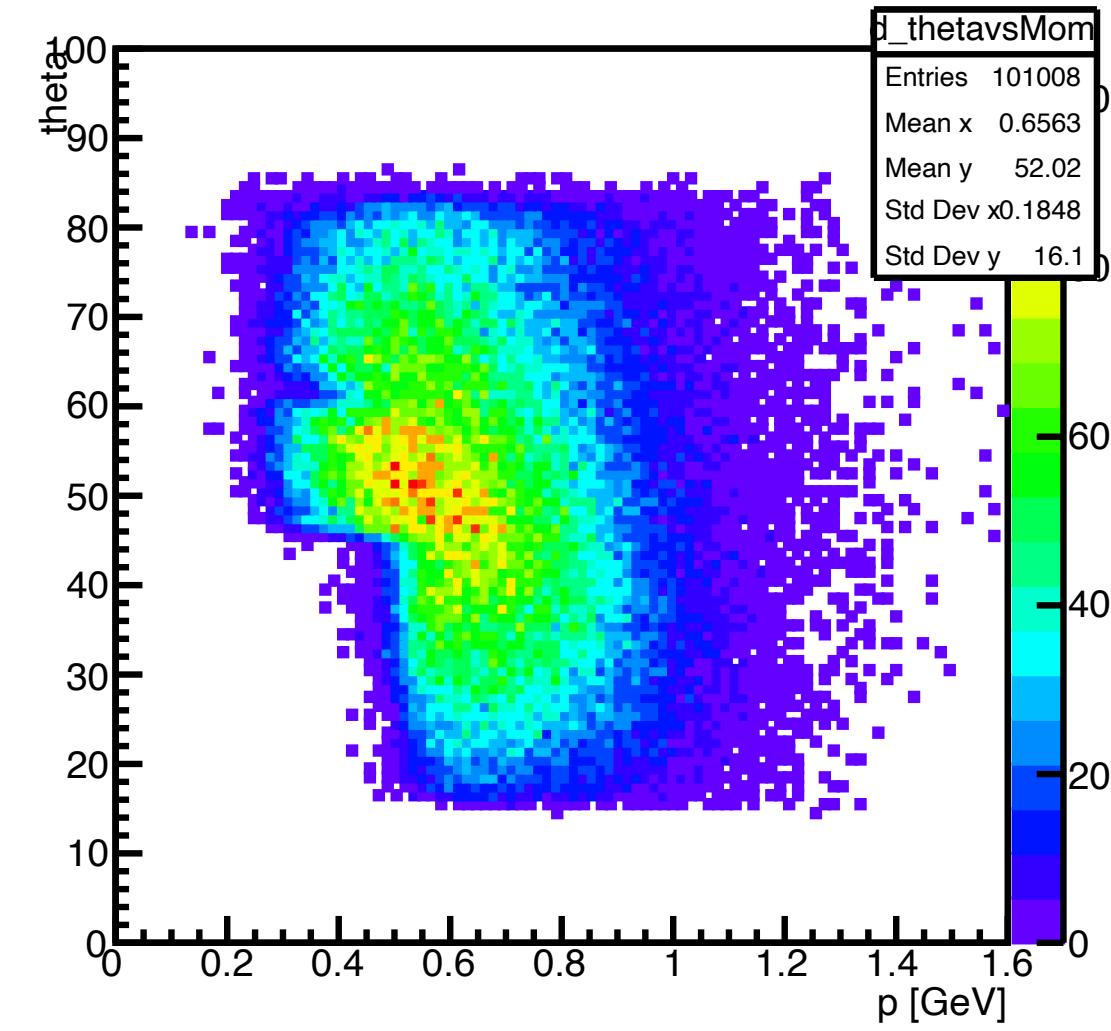
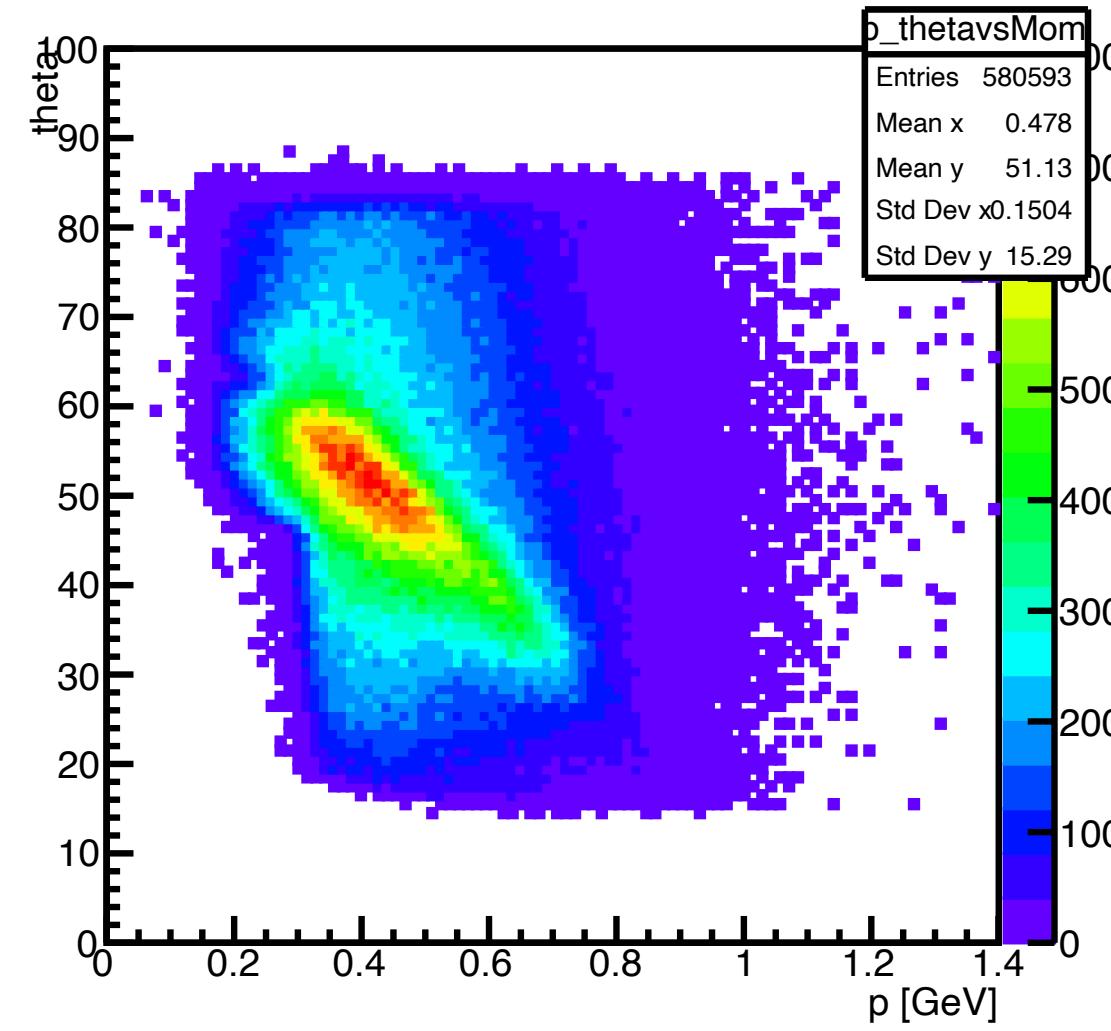
mass cuts



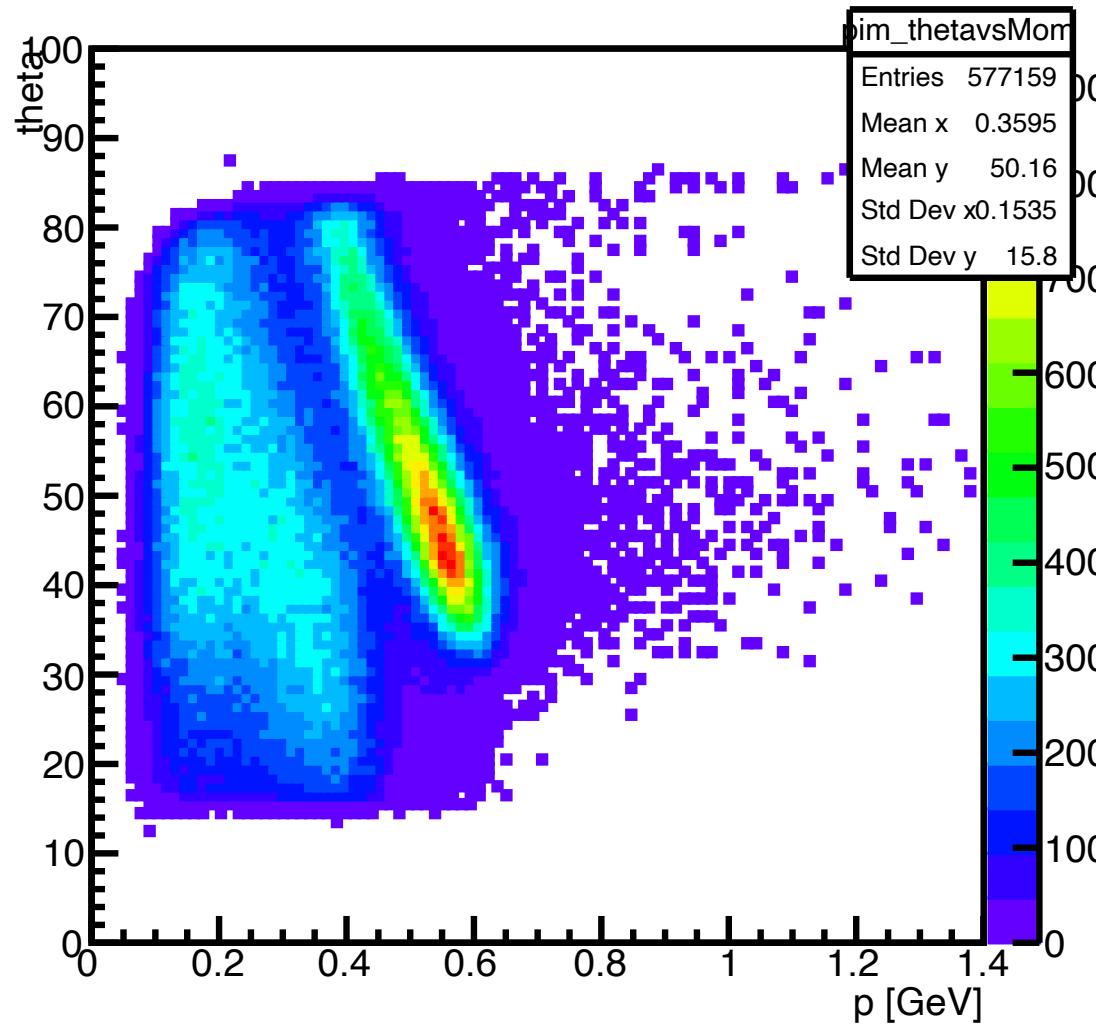
	π^+/π^-	p	d
mean	16 790	872 541	3 473 960
std dev	19 972	107 807	494 141
cut	π^+ : (-20 000 34 000) π^- : (-20 000, 60 000)	(200 000, 1 900 000)	(1 900 000, 6 100 000)

θ vs momentum

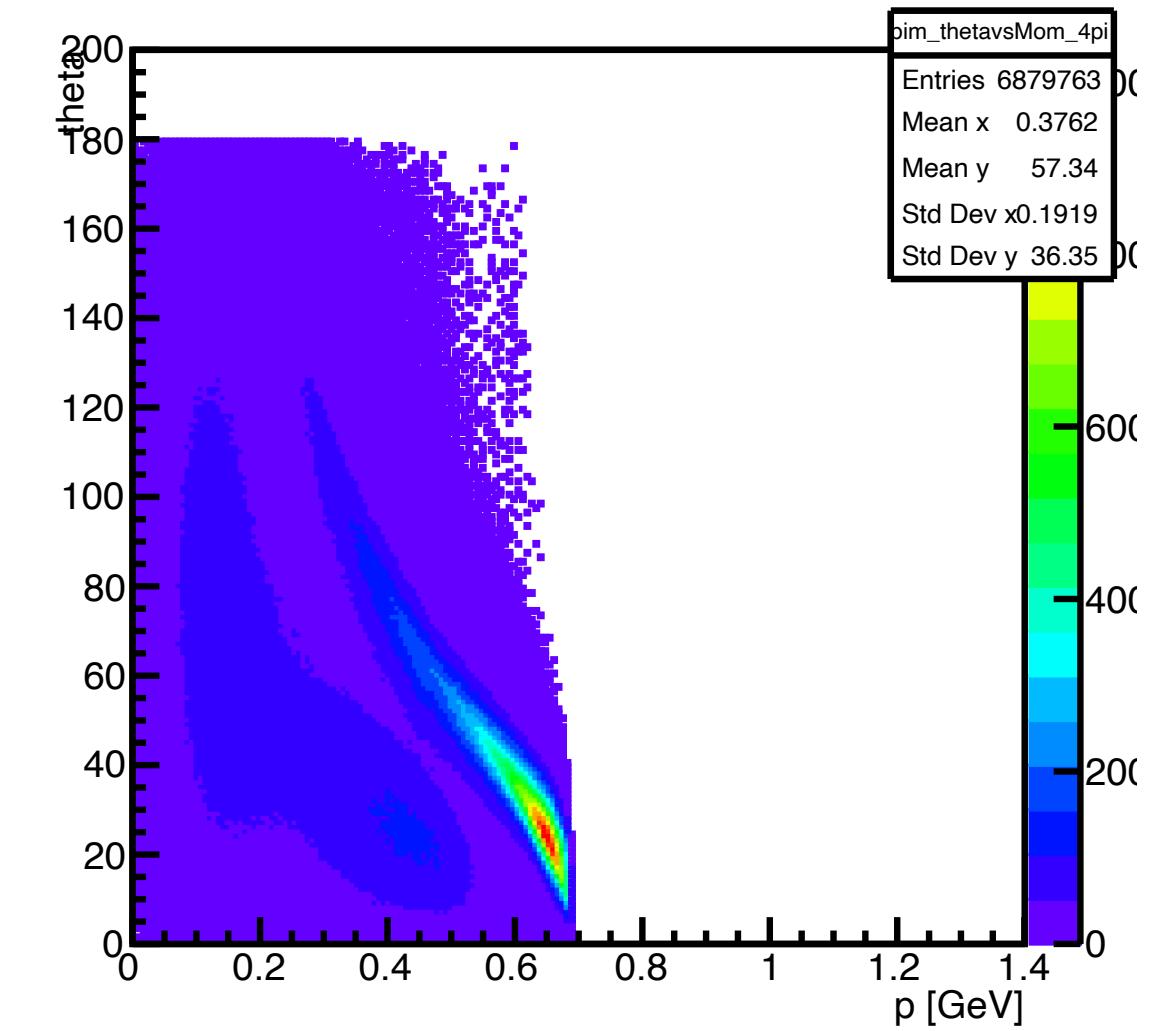
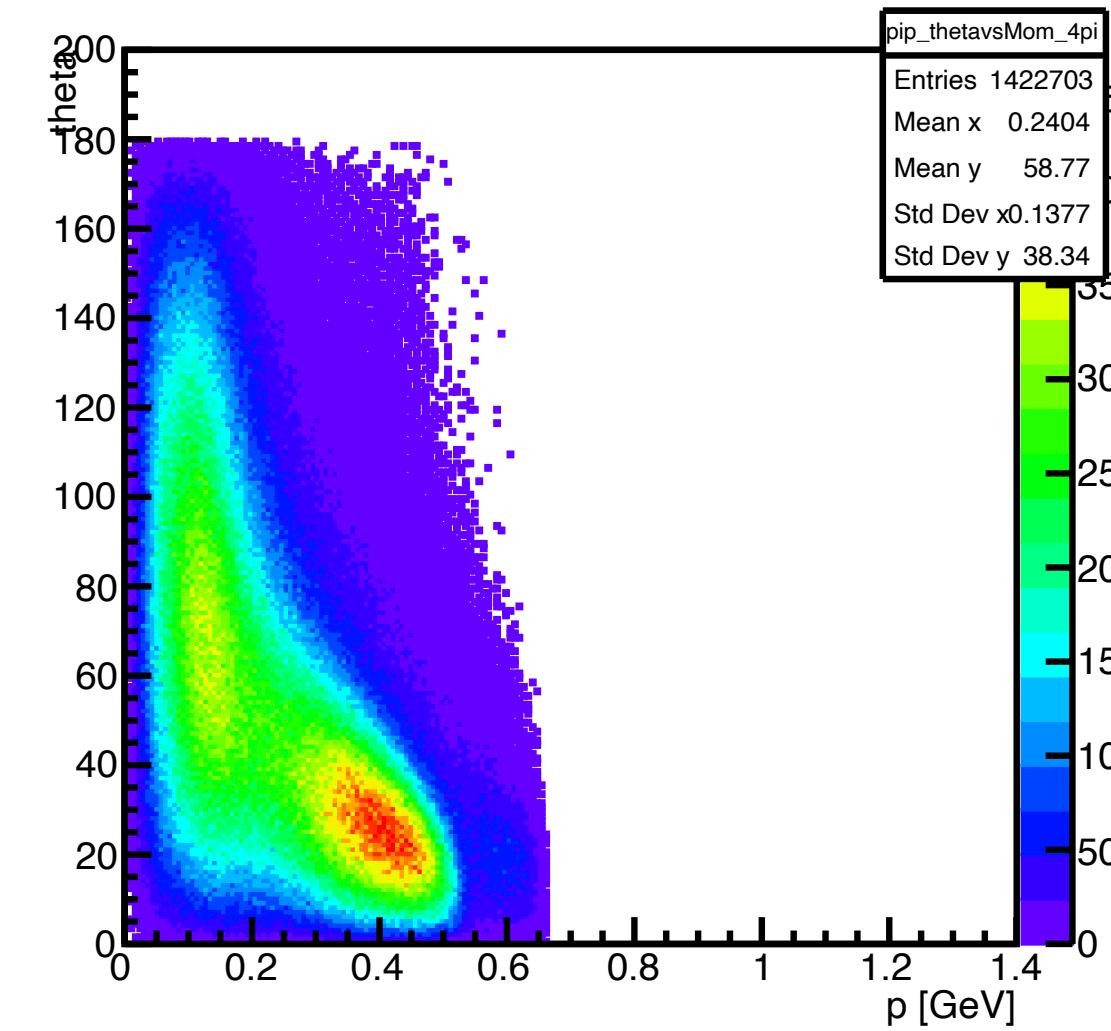
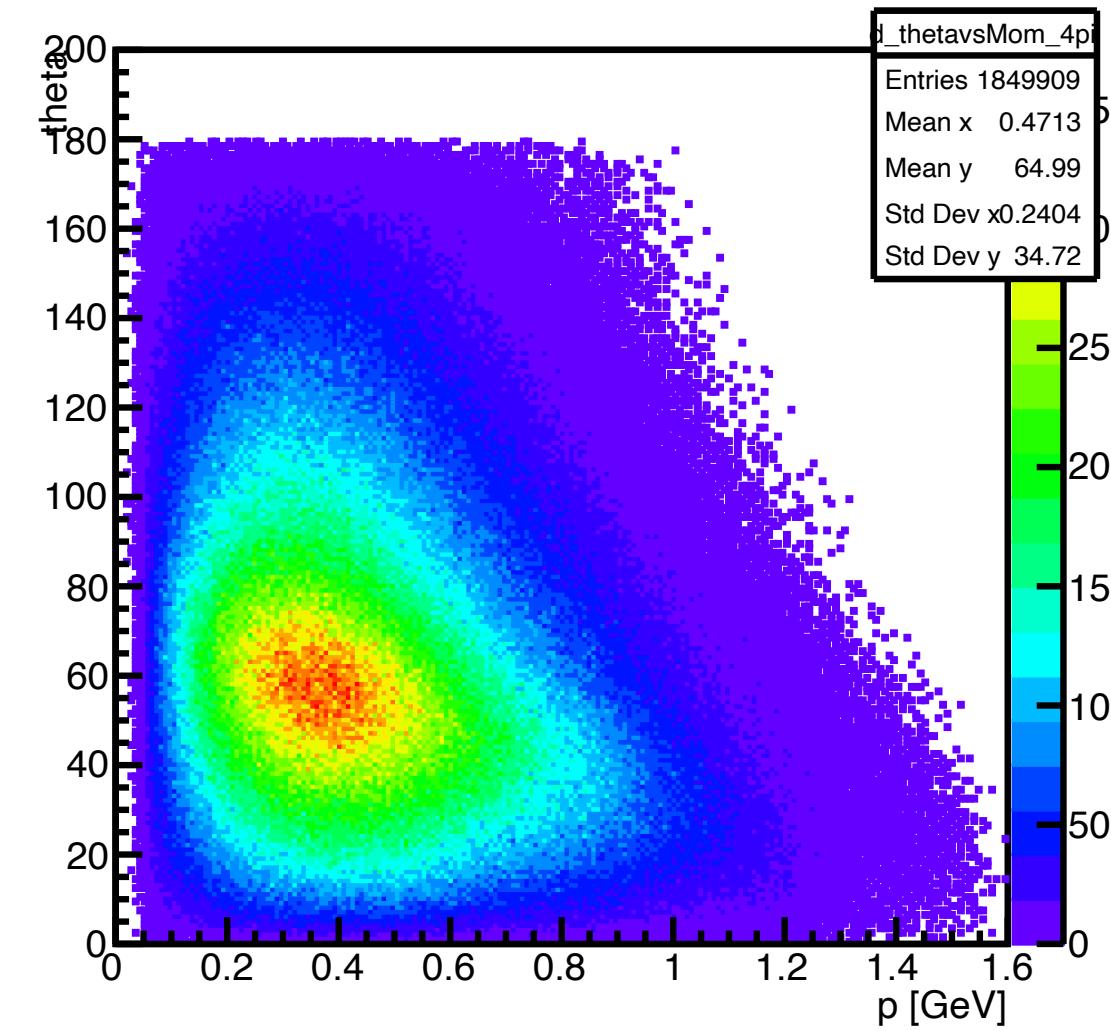
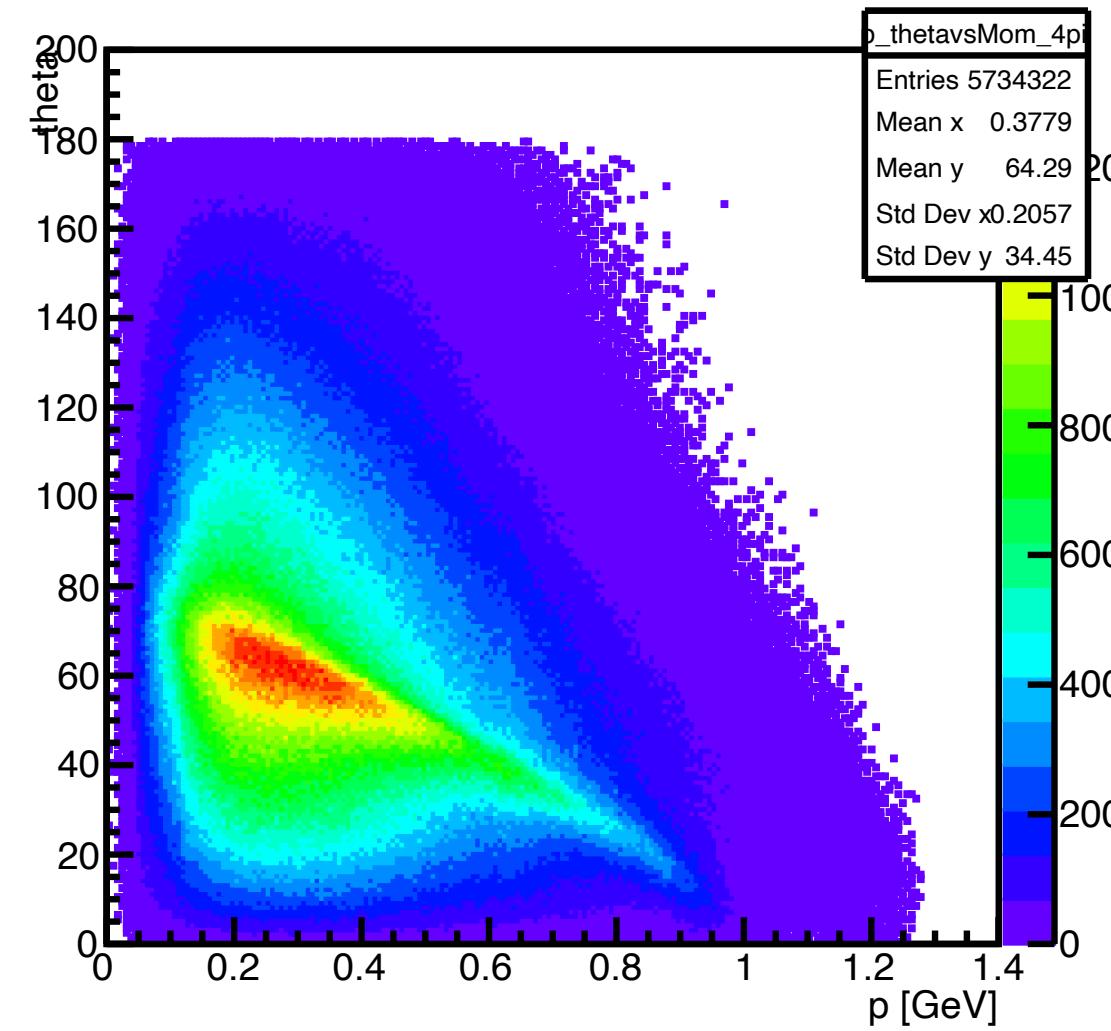
full analysis chain



GeantPID used to identify particles



4pi



p

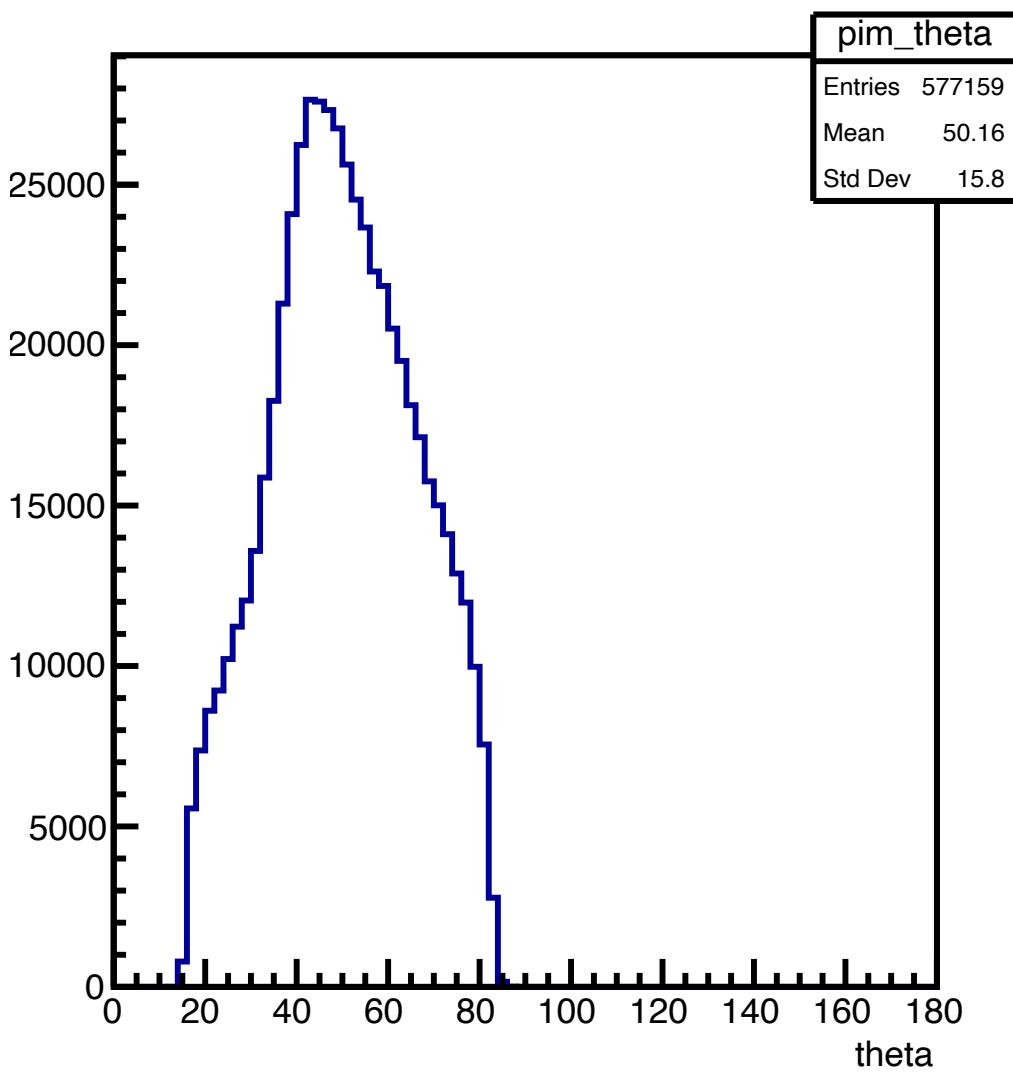
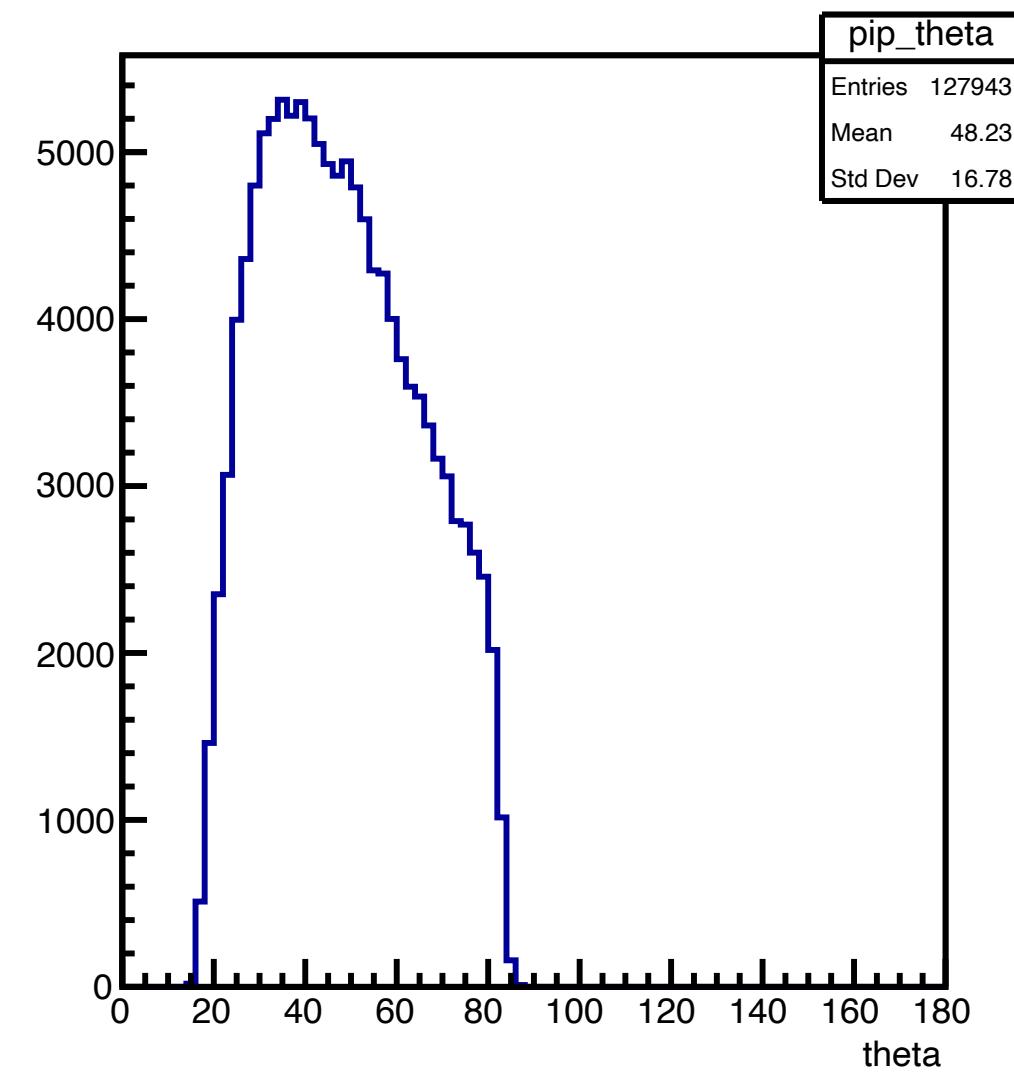
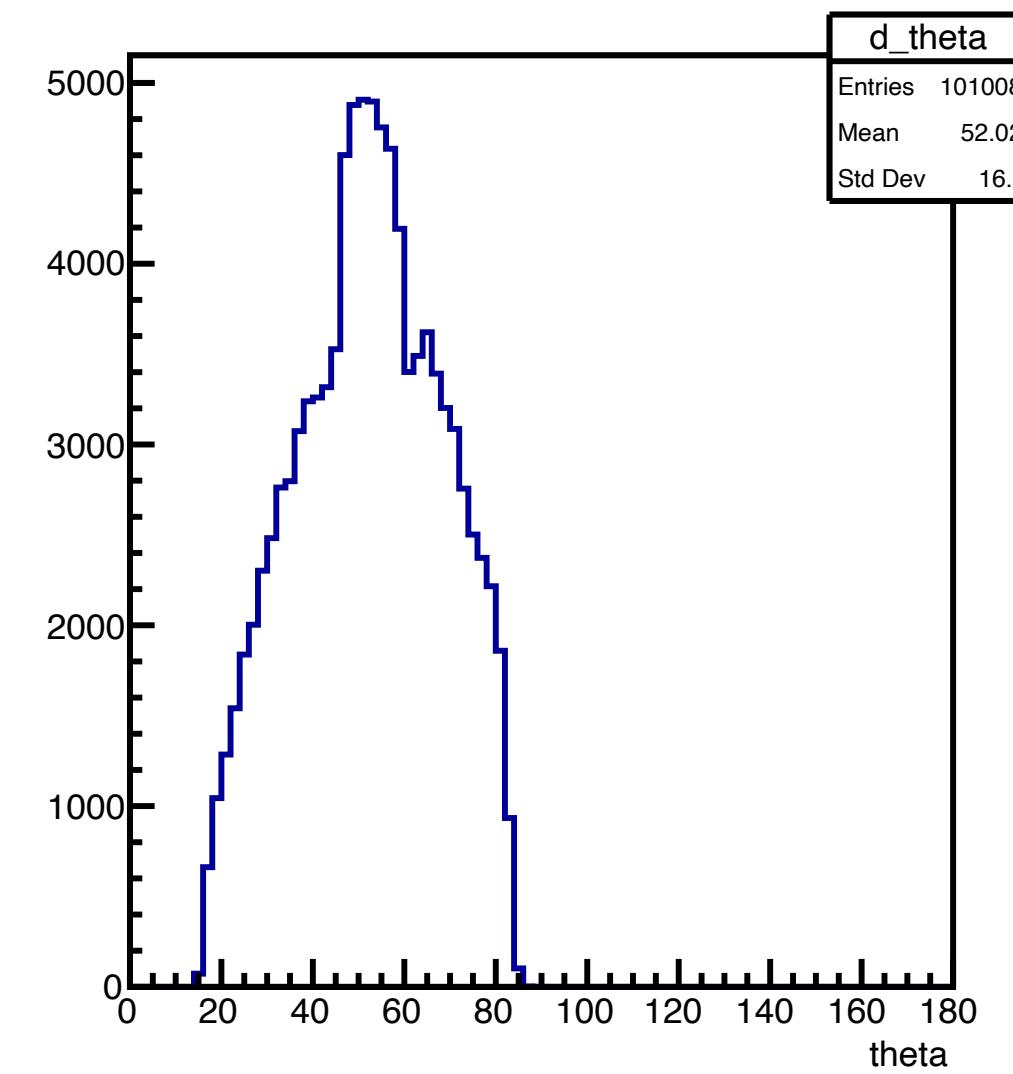
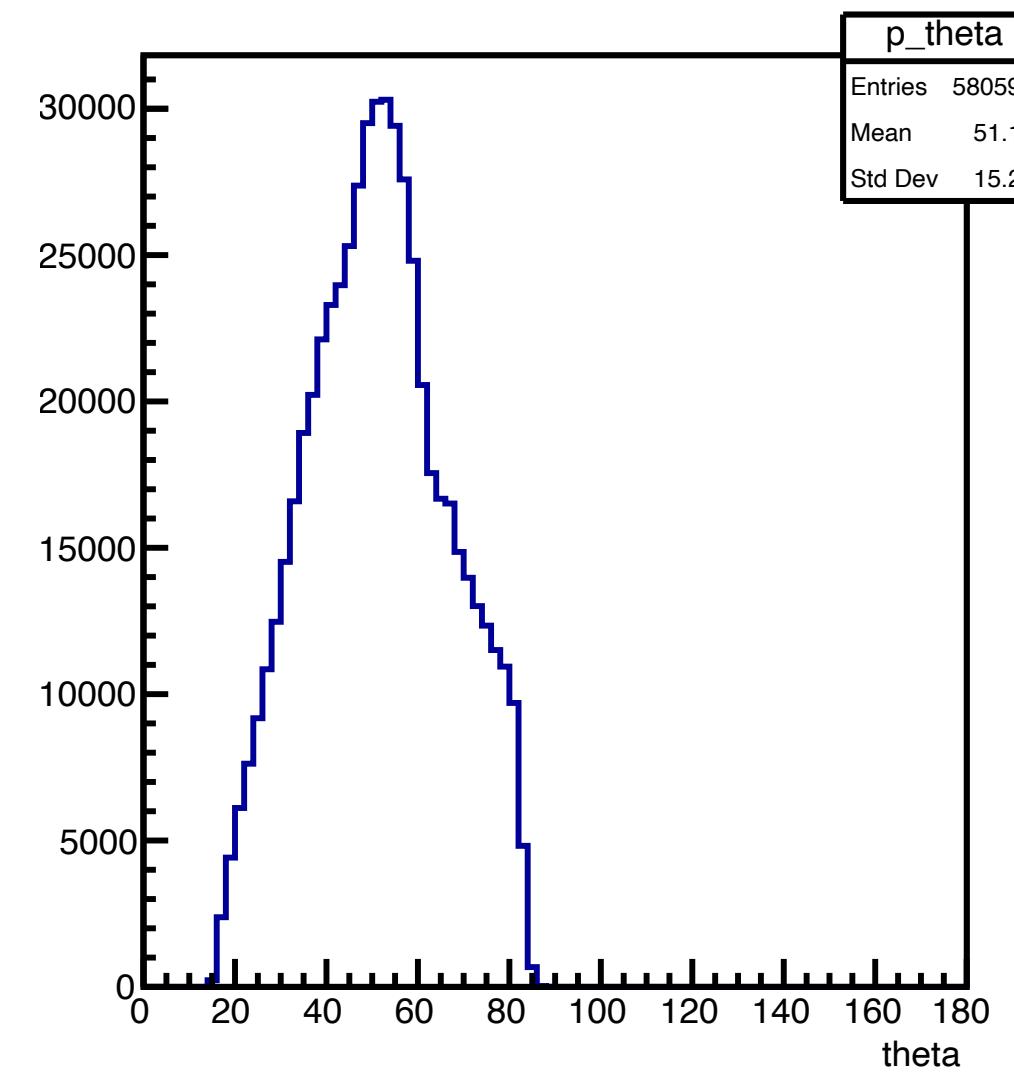
d

π^+

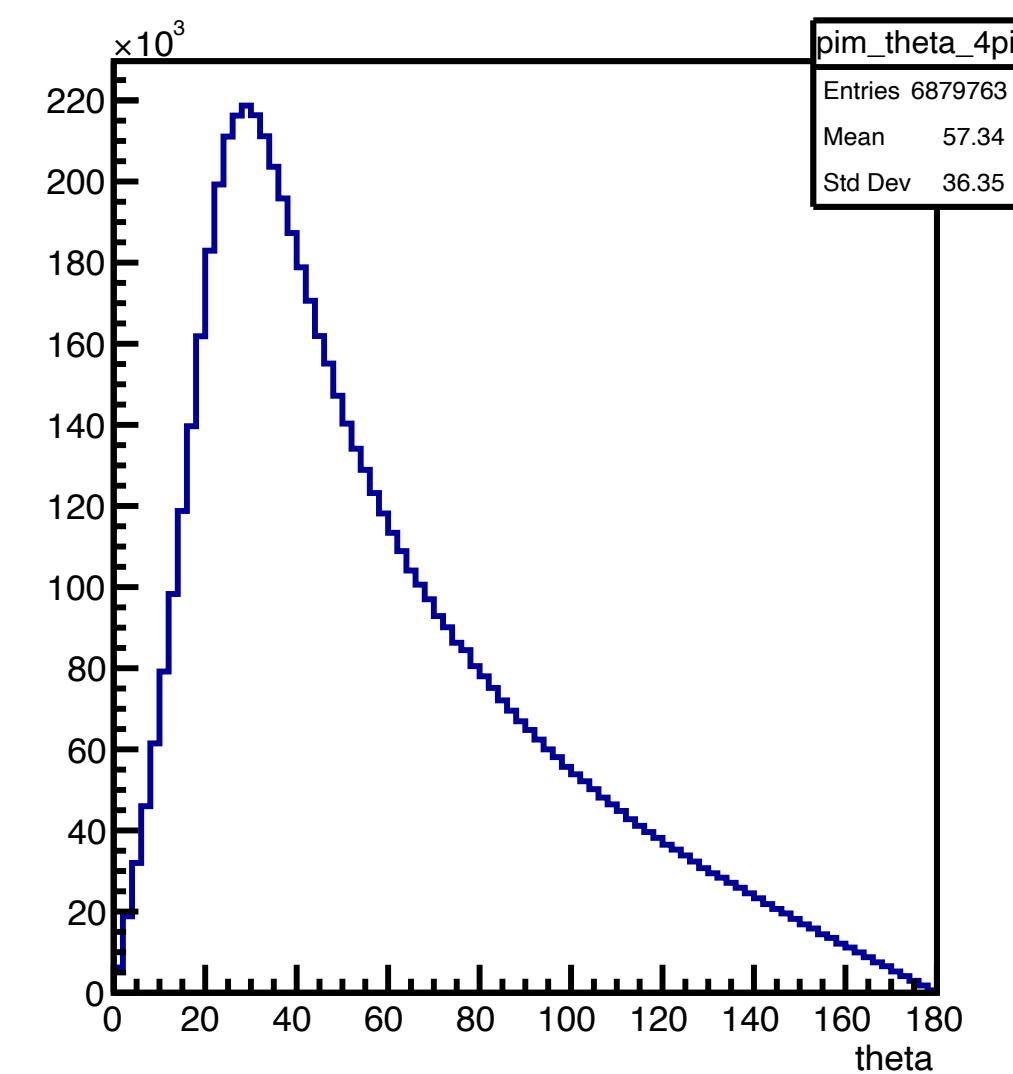
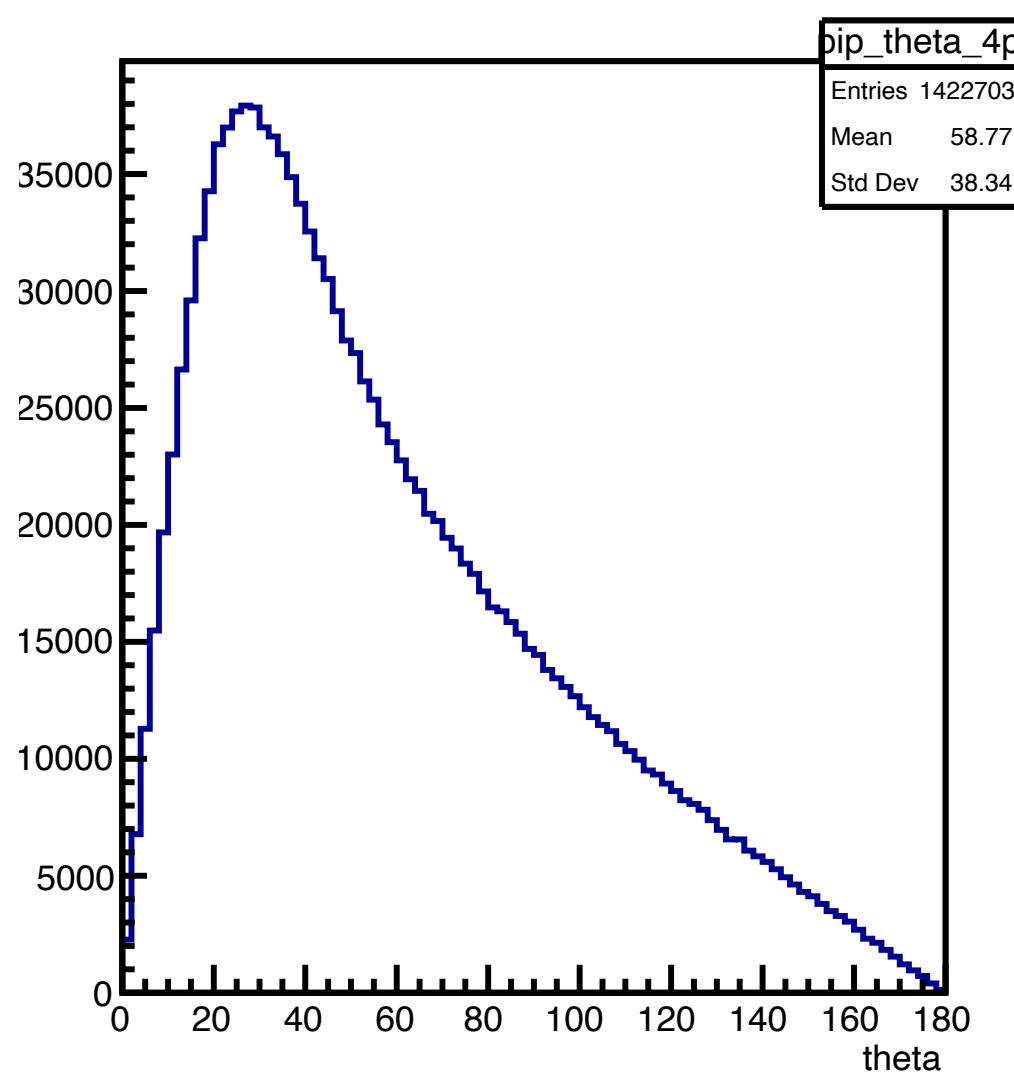
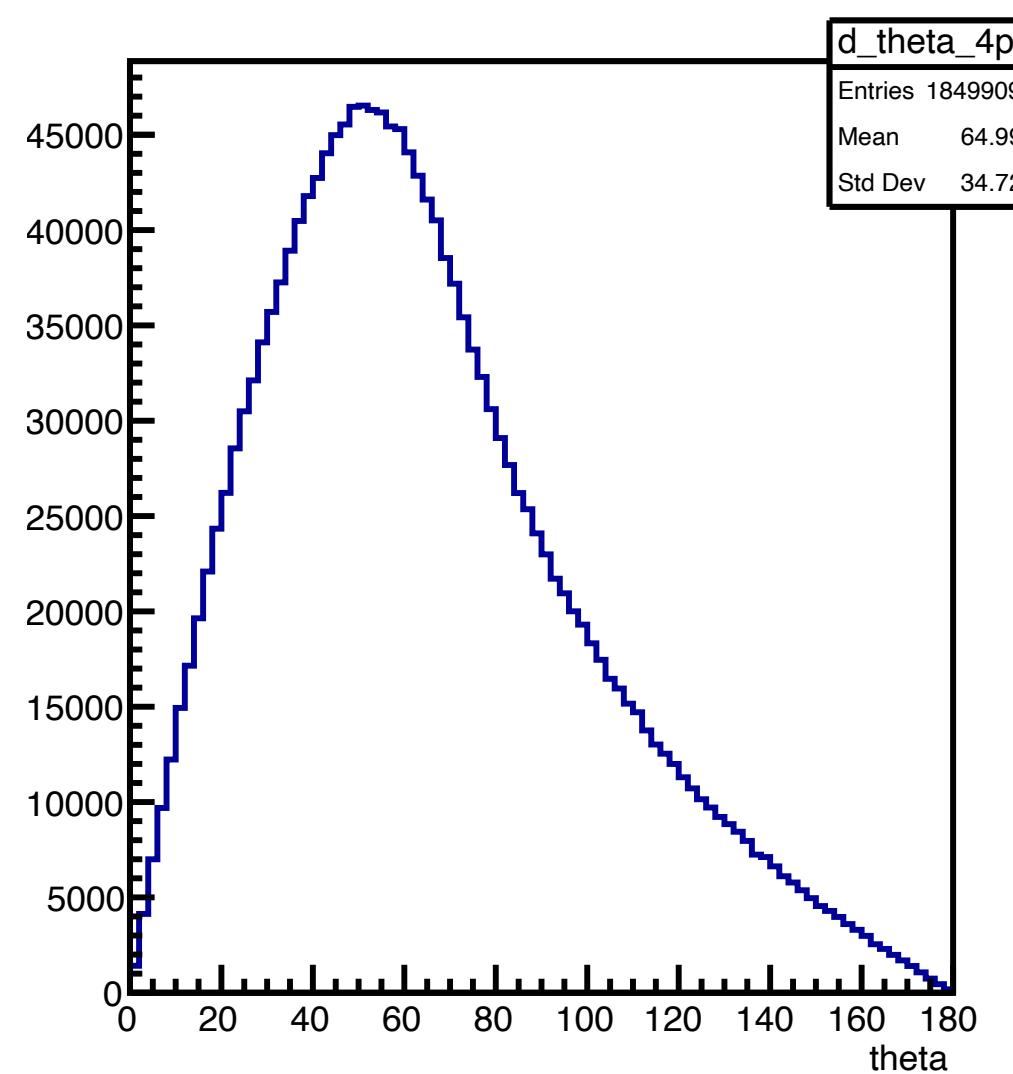
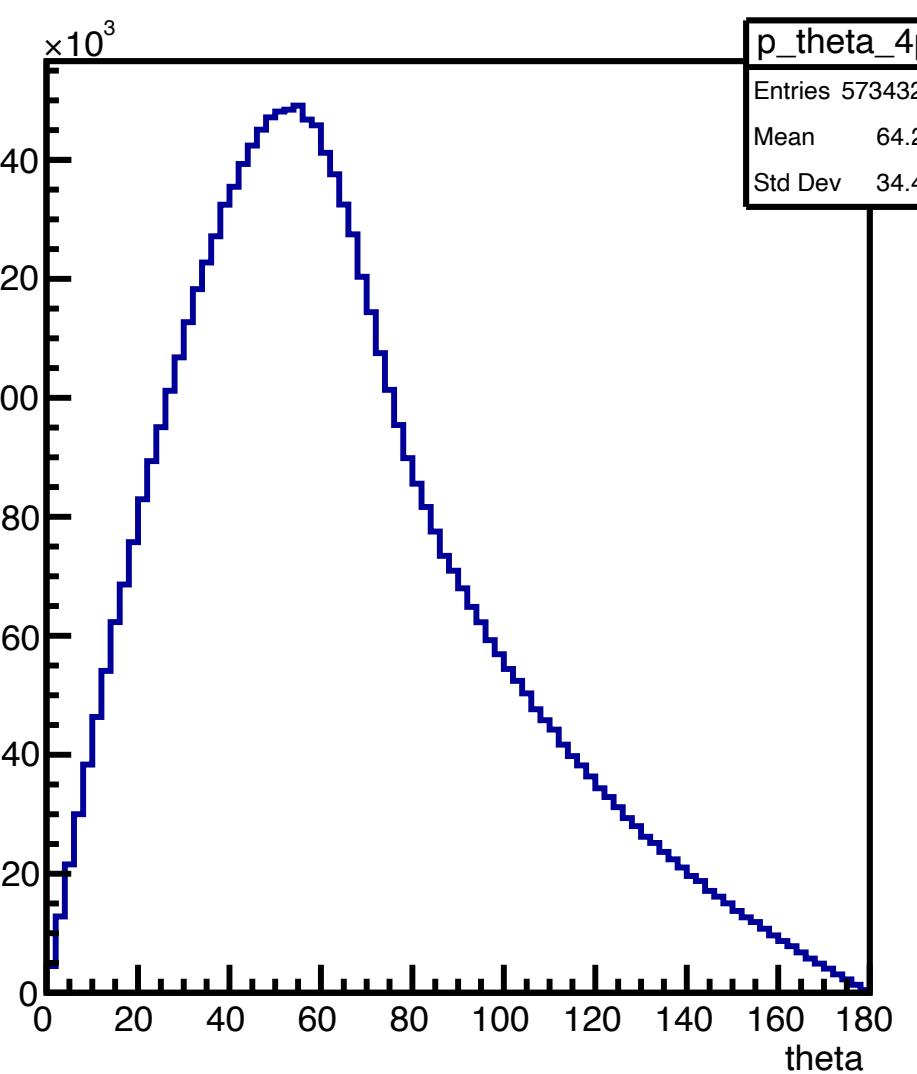
π^-

full analysis chain

θ



4pi

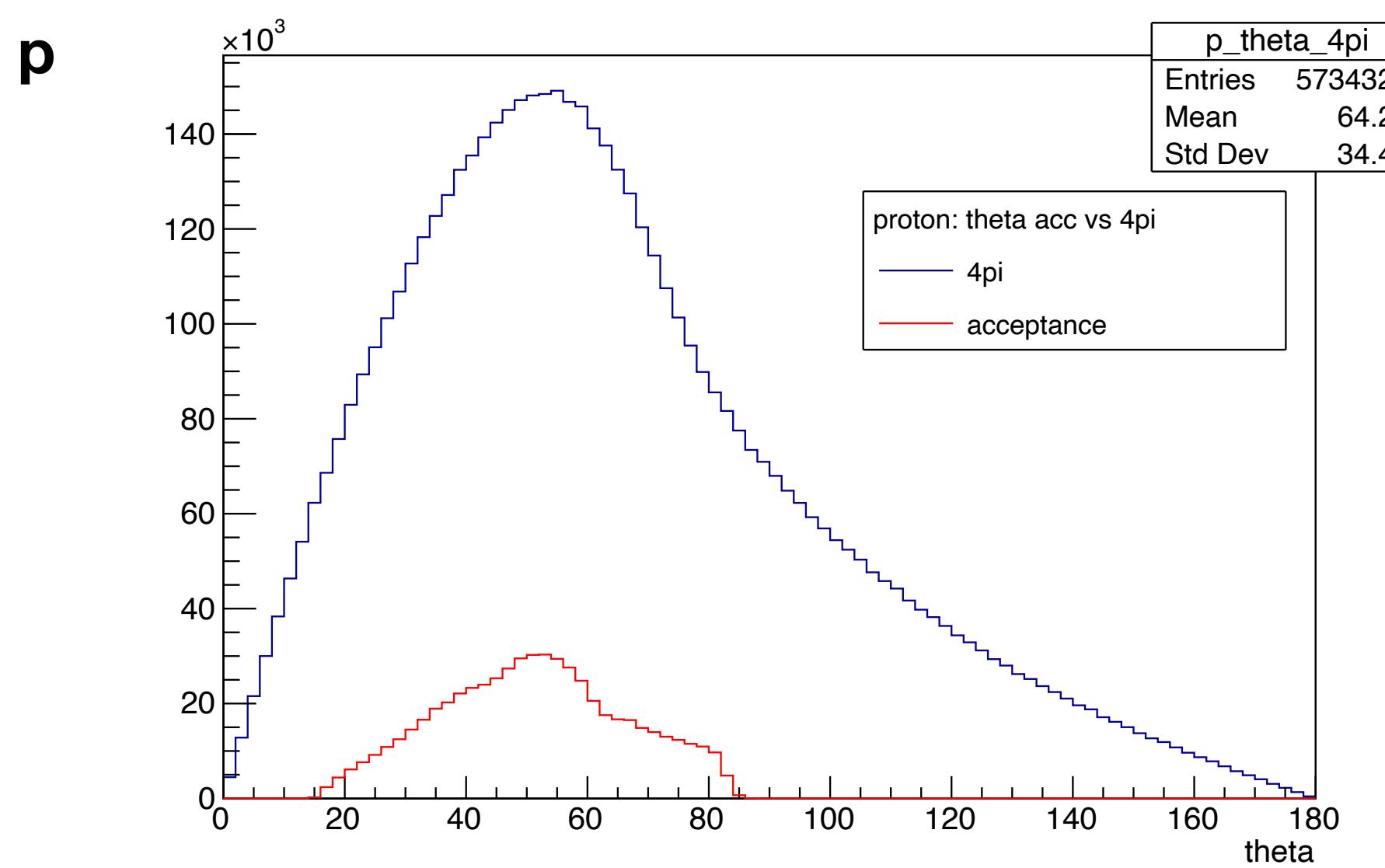


p

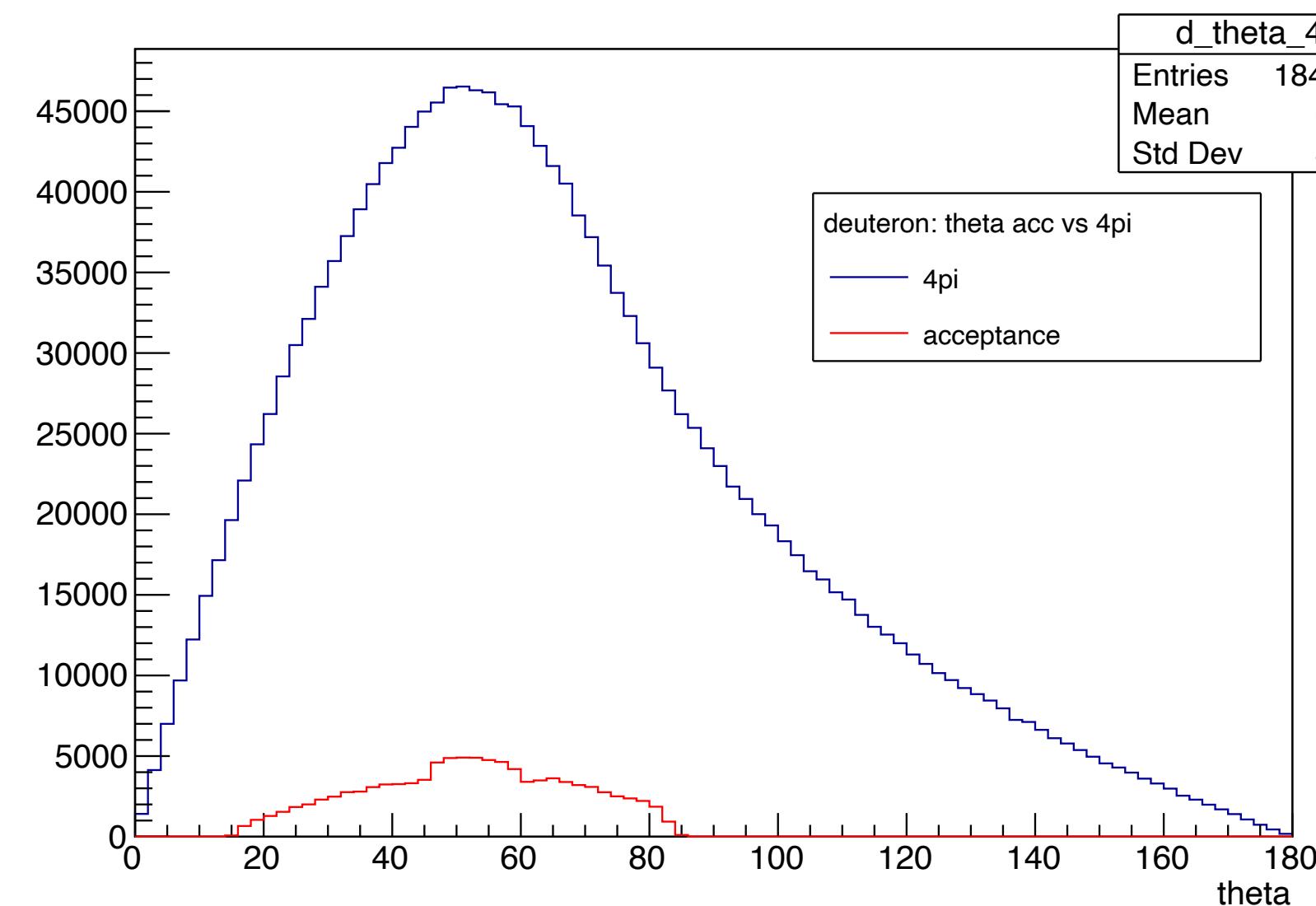
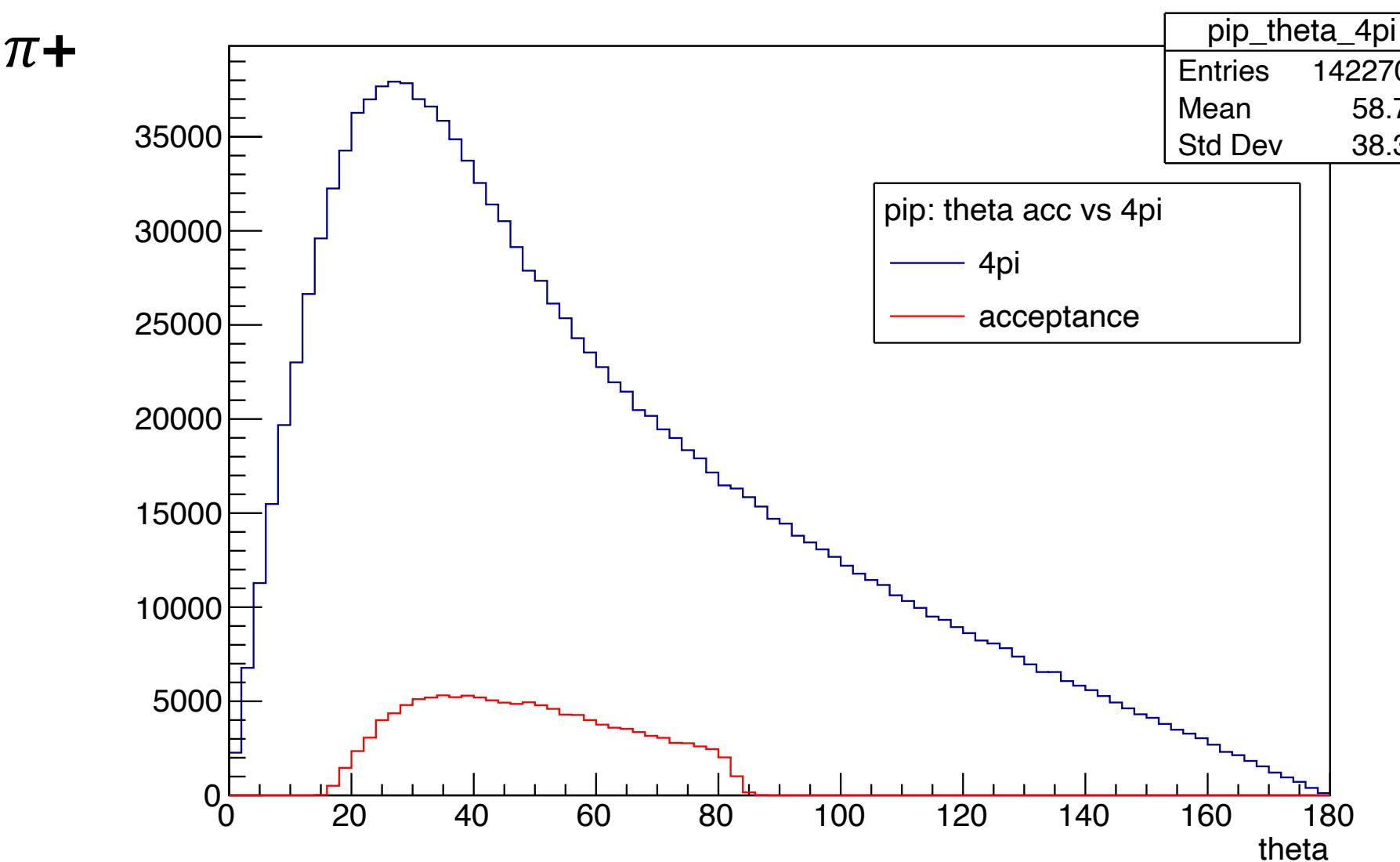
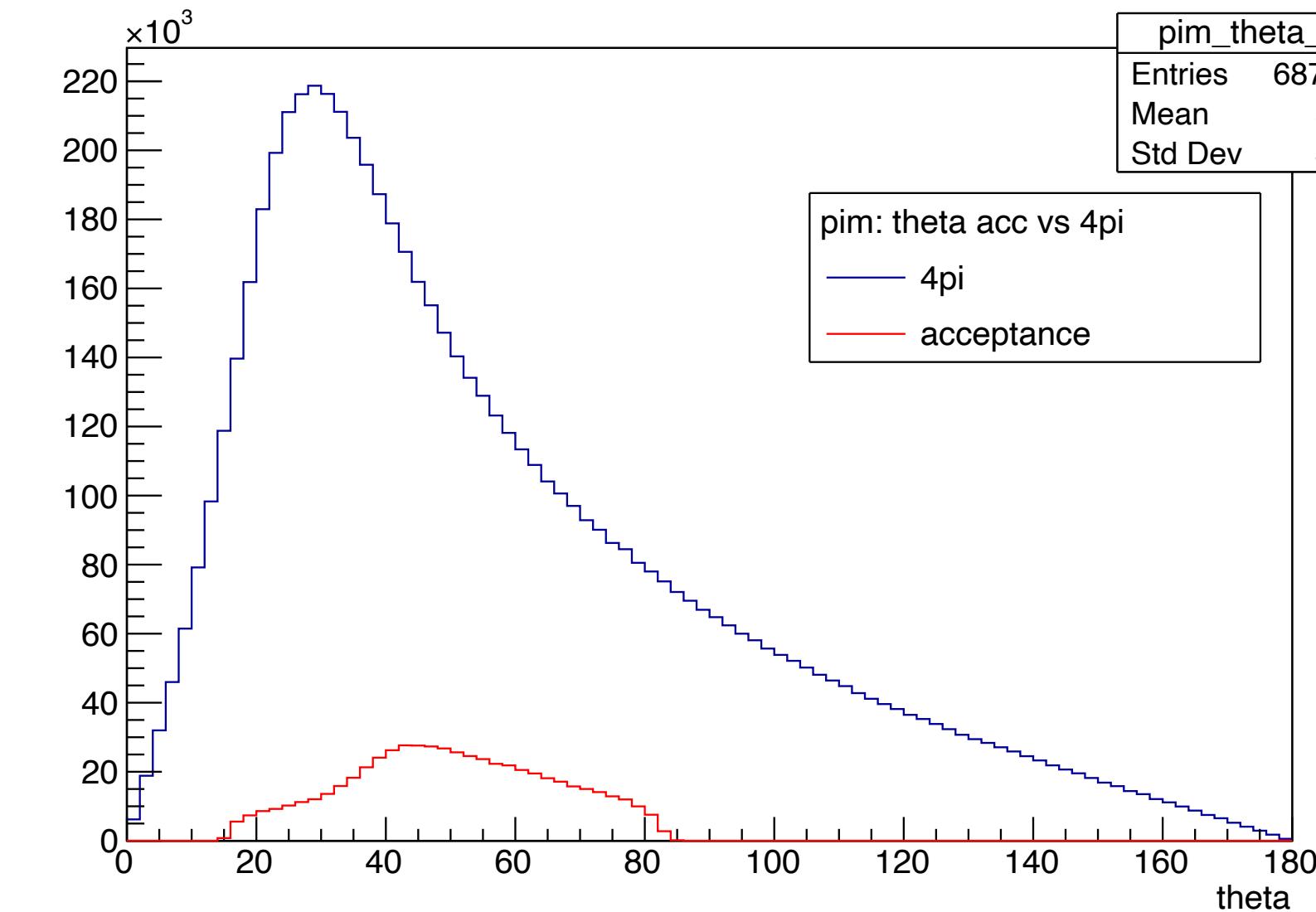
d

π^+

π^-

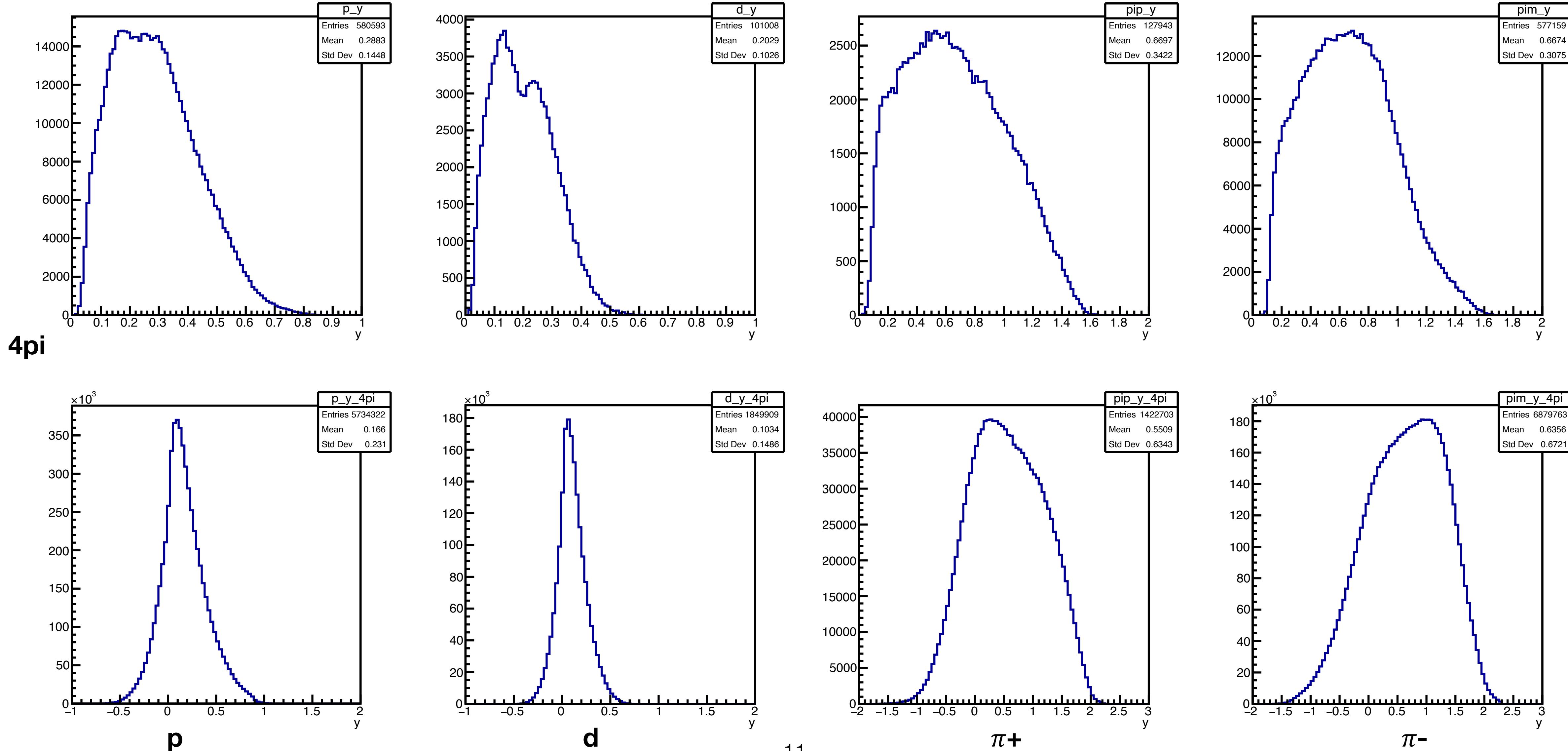
θ 

#entries in acceptance / #entries in 4pi

d π^+  π^- 

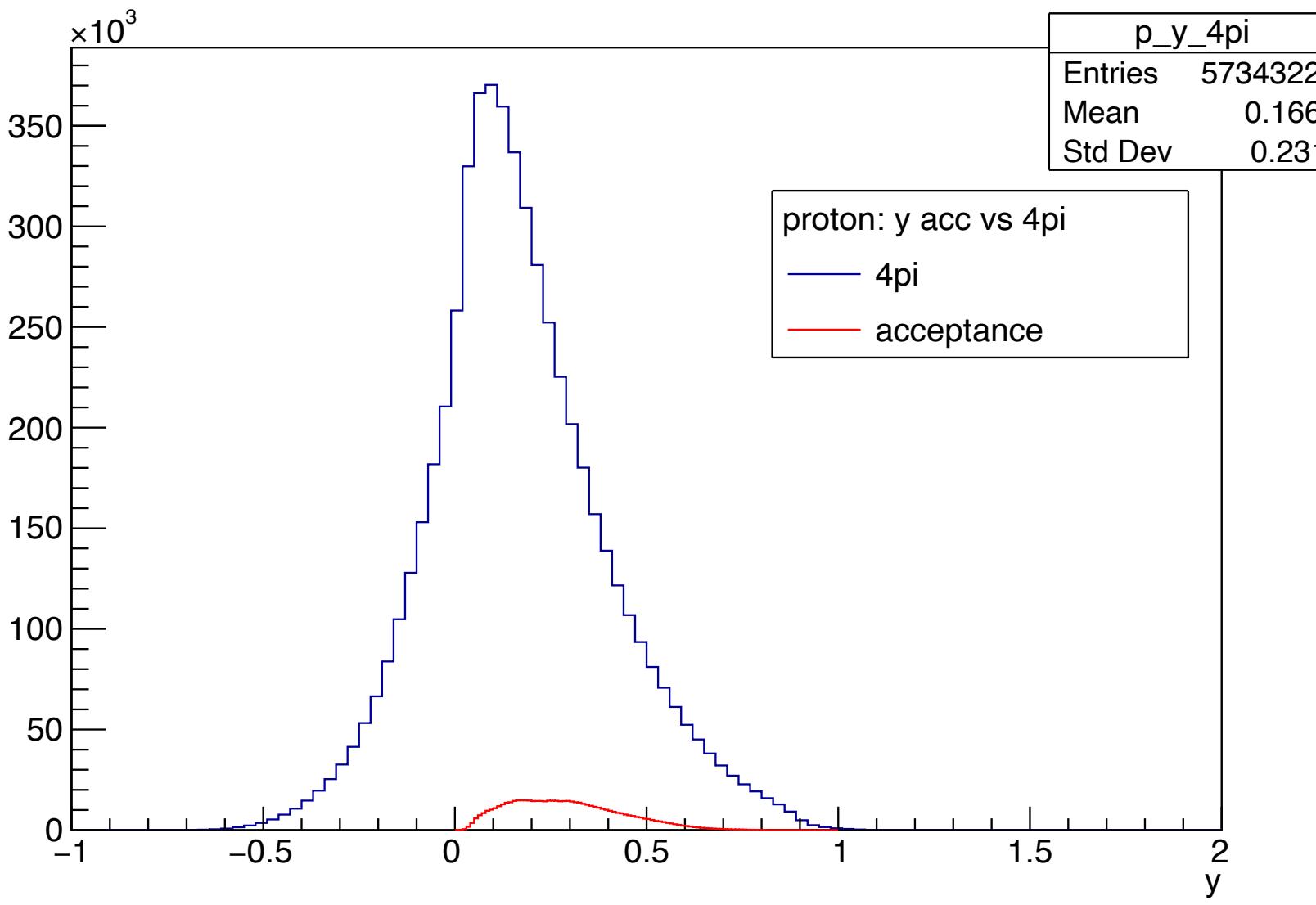
rapidity

full analysis chain



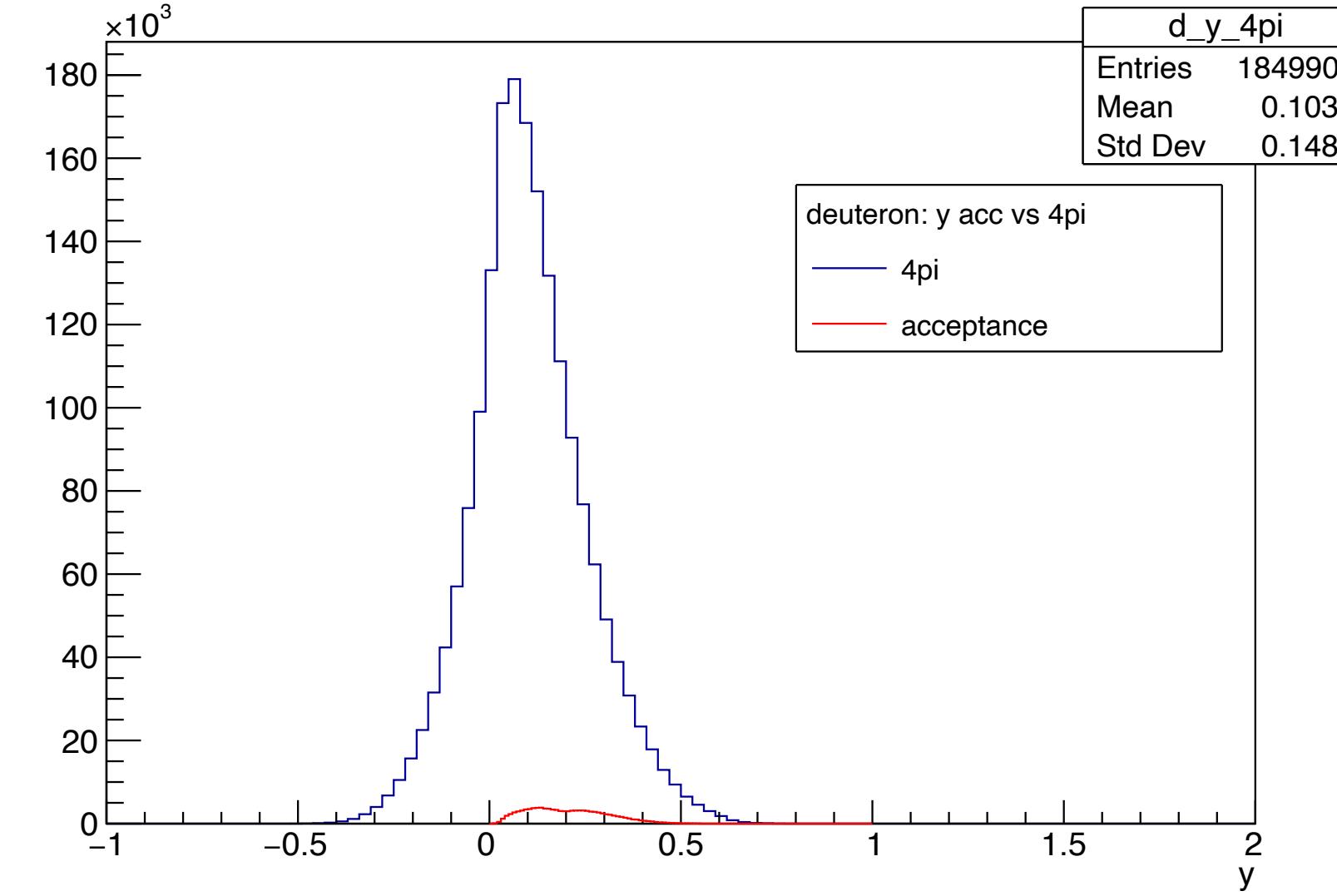
rapidity

p



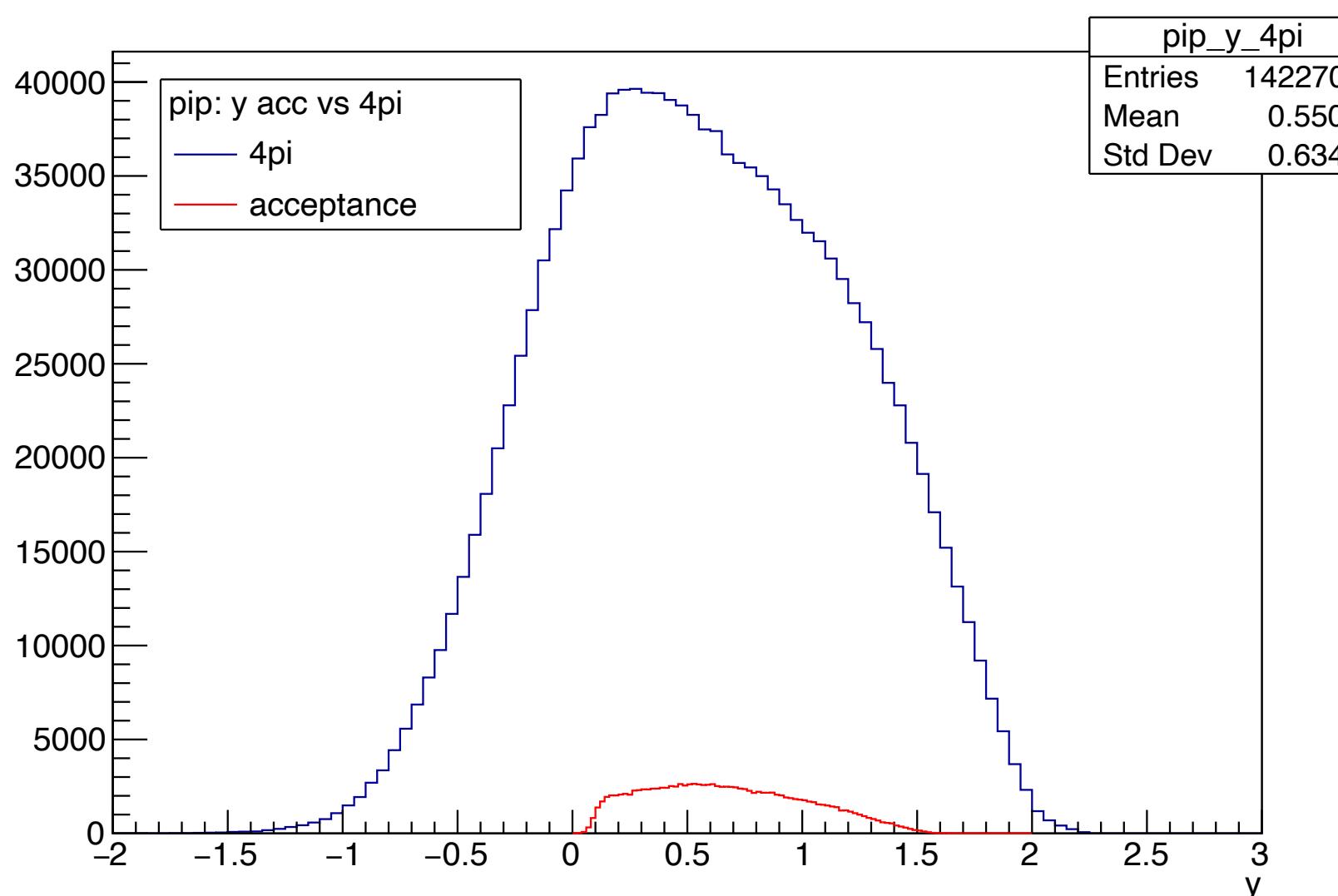
10.12%

d



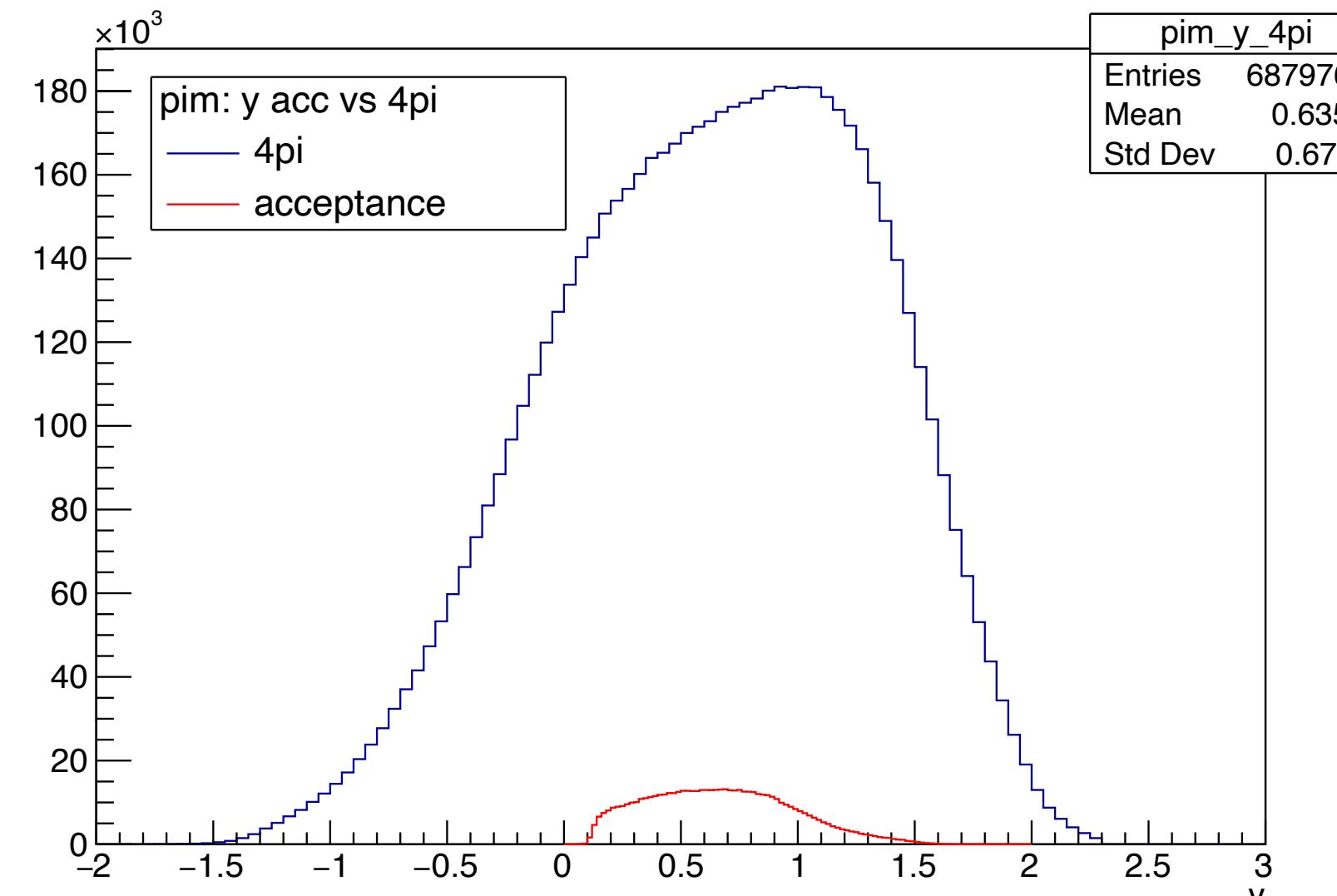
5.46%

π^+



8.99%

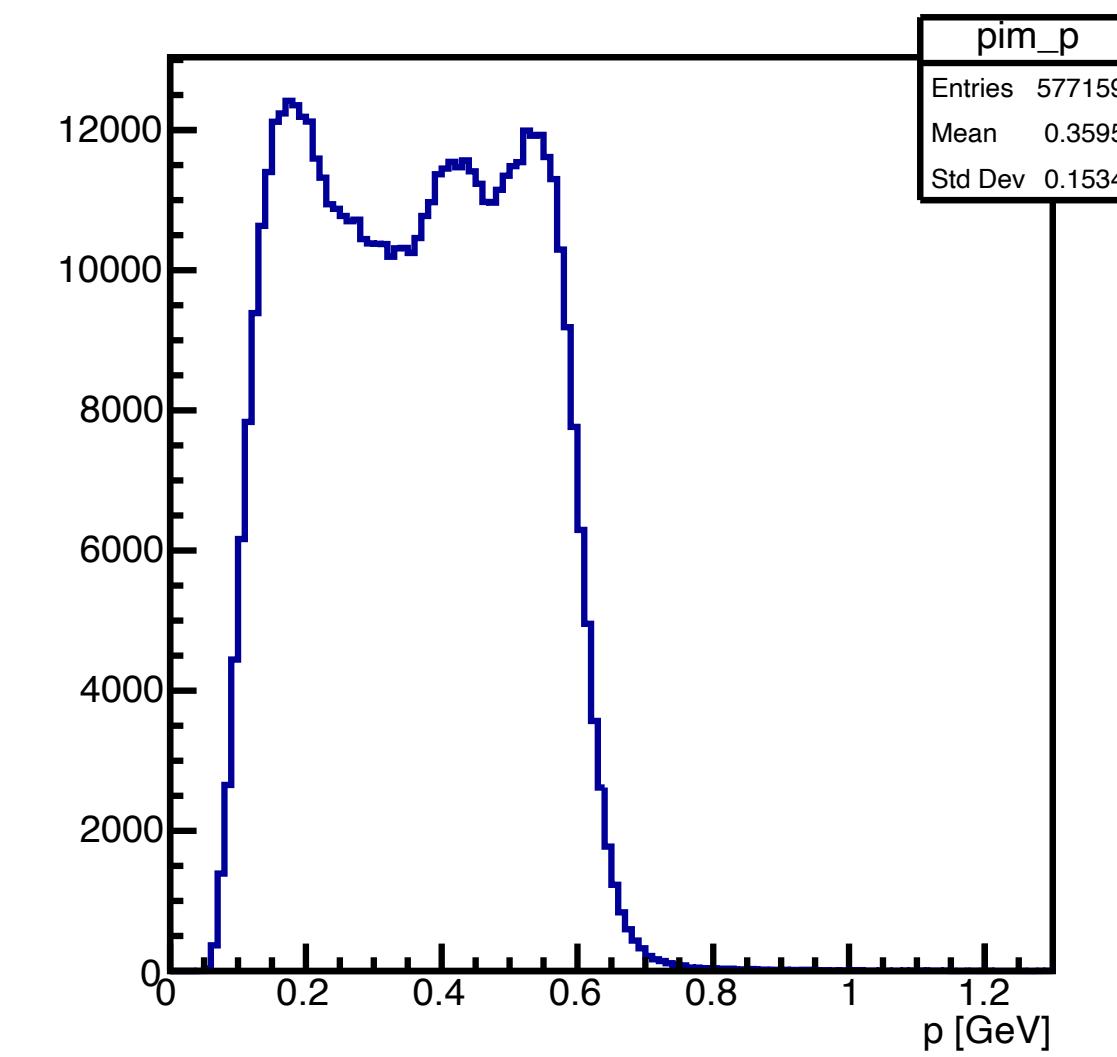
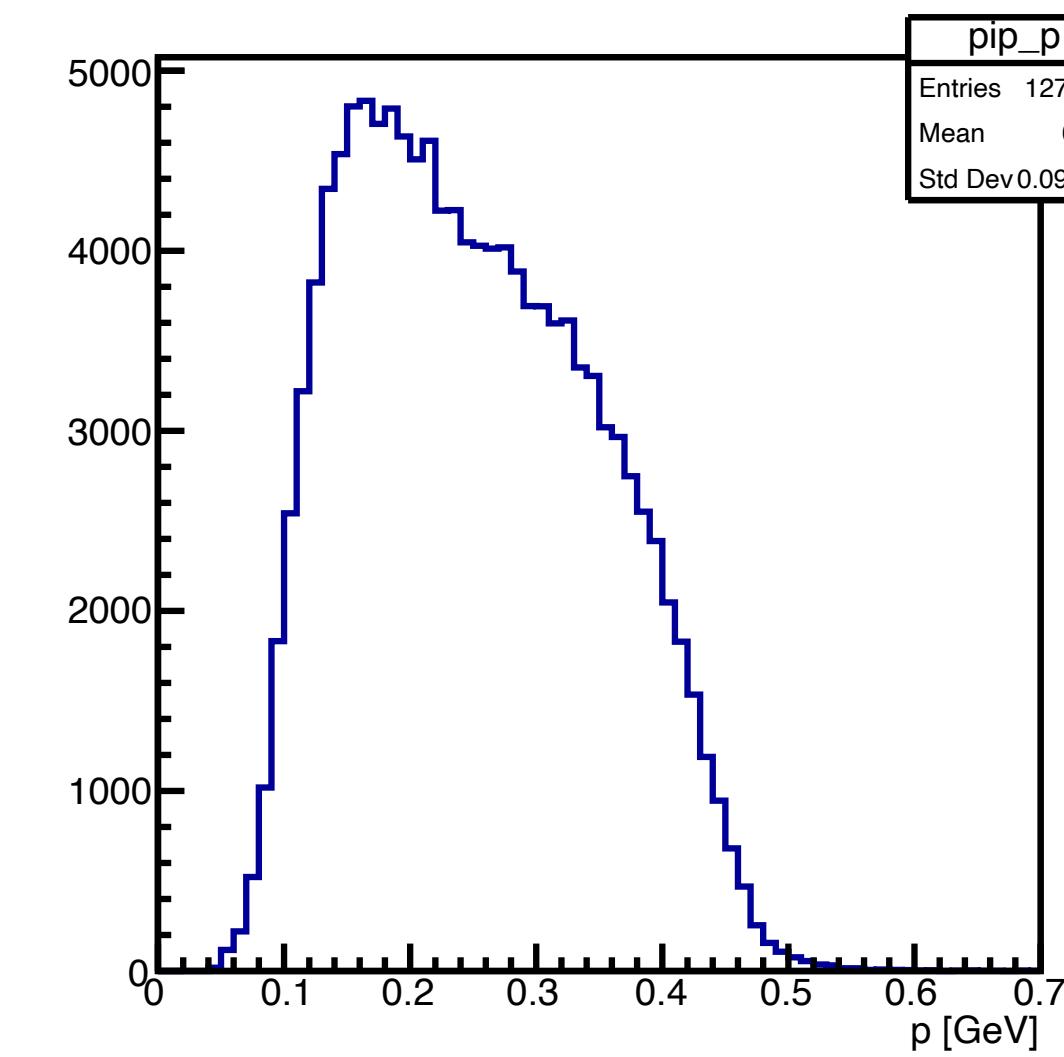
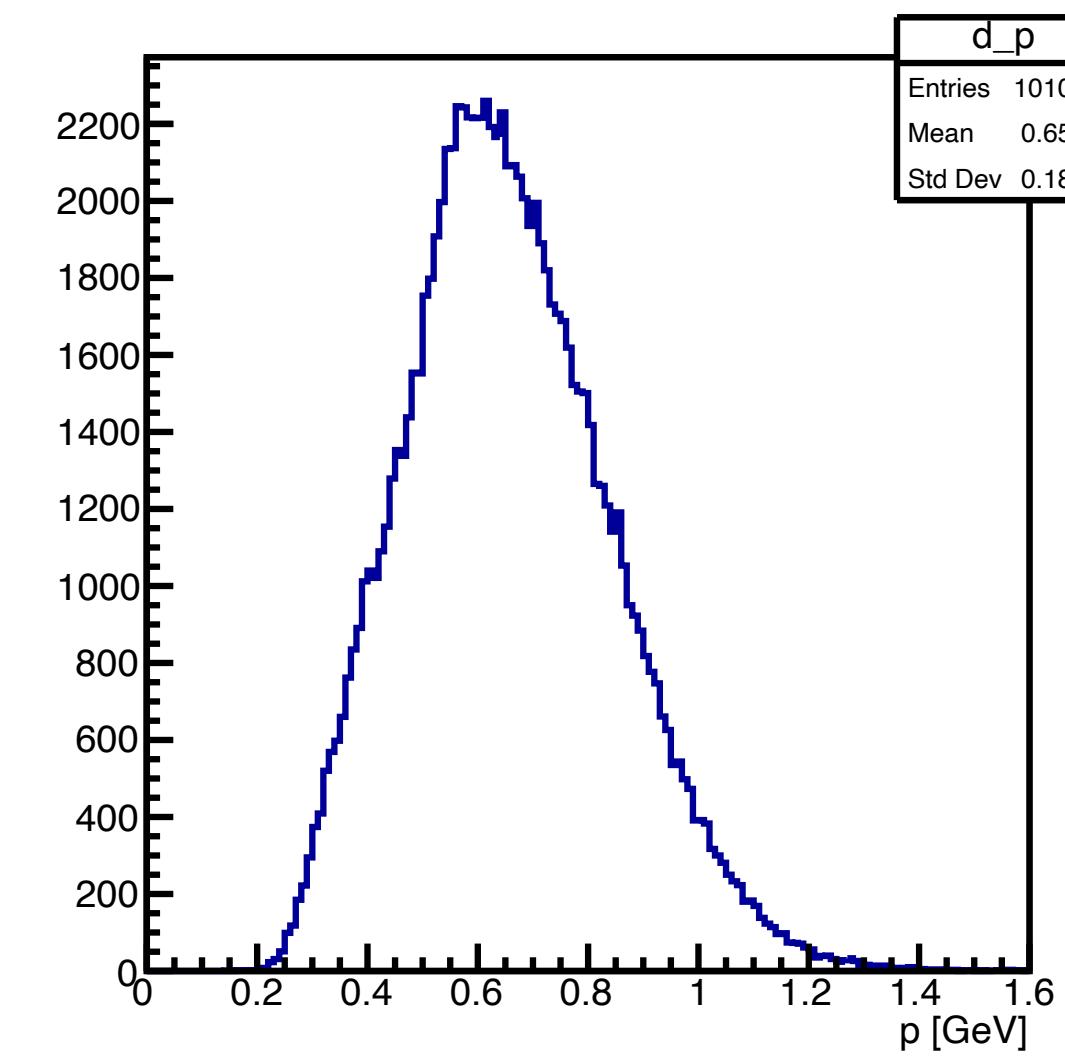
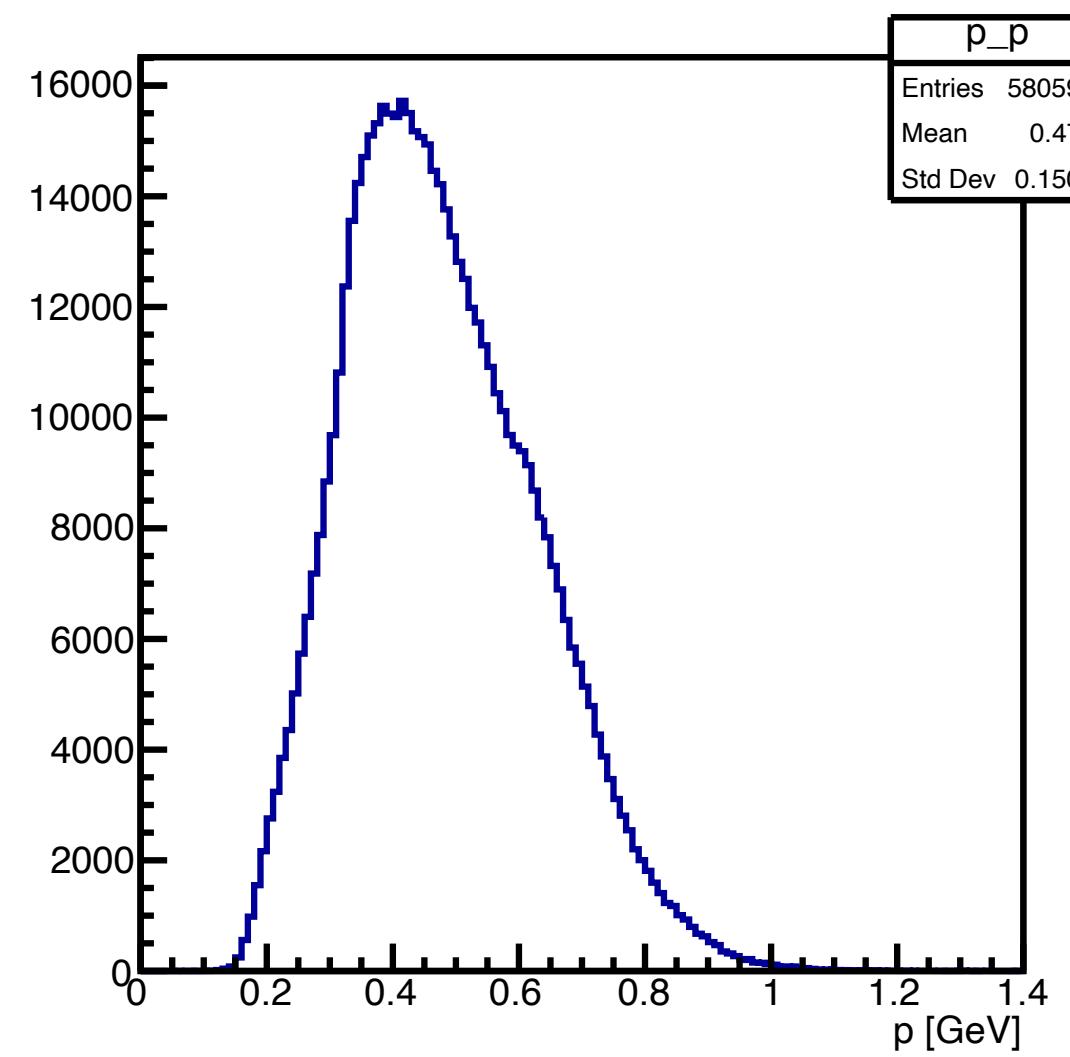
π^-



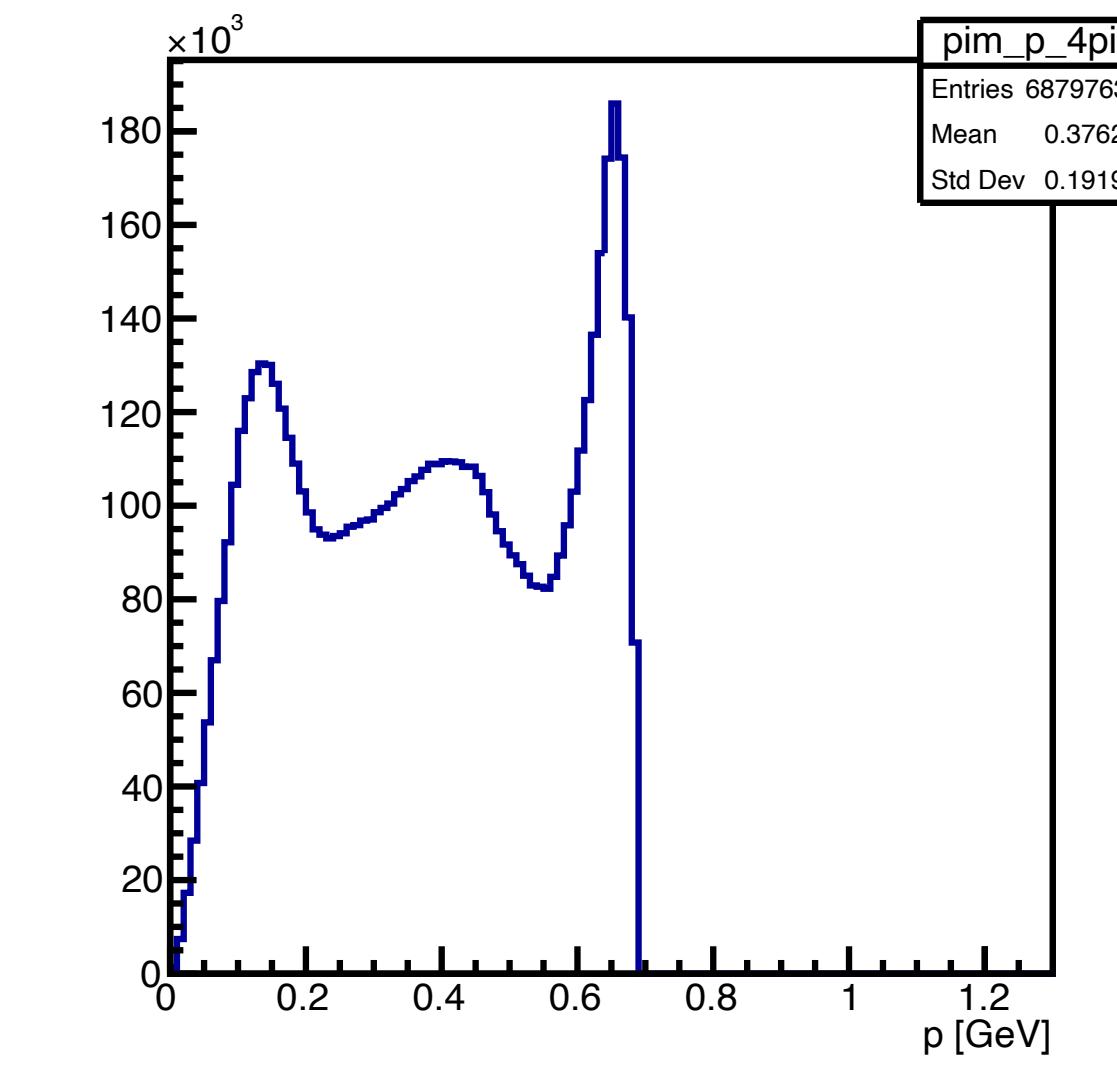
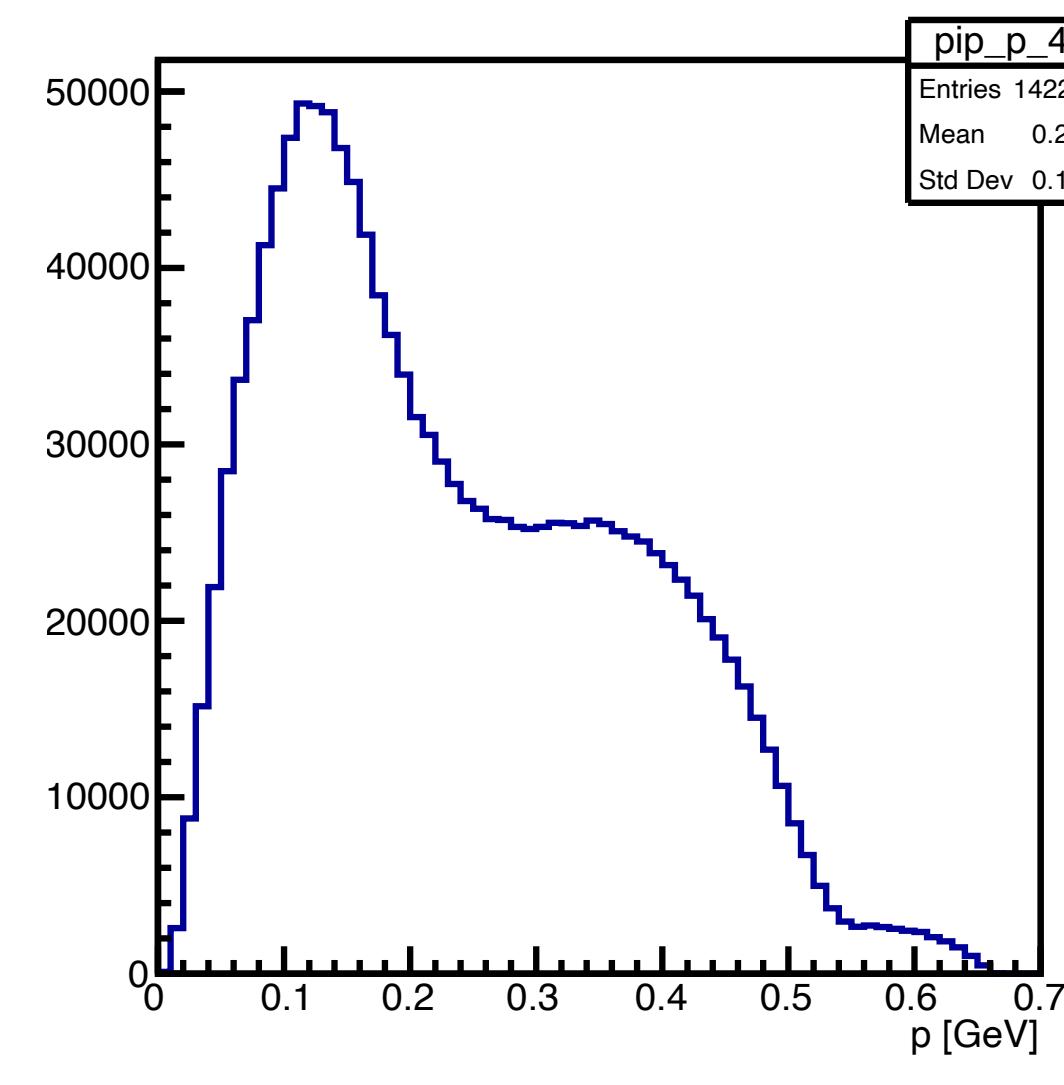
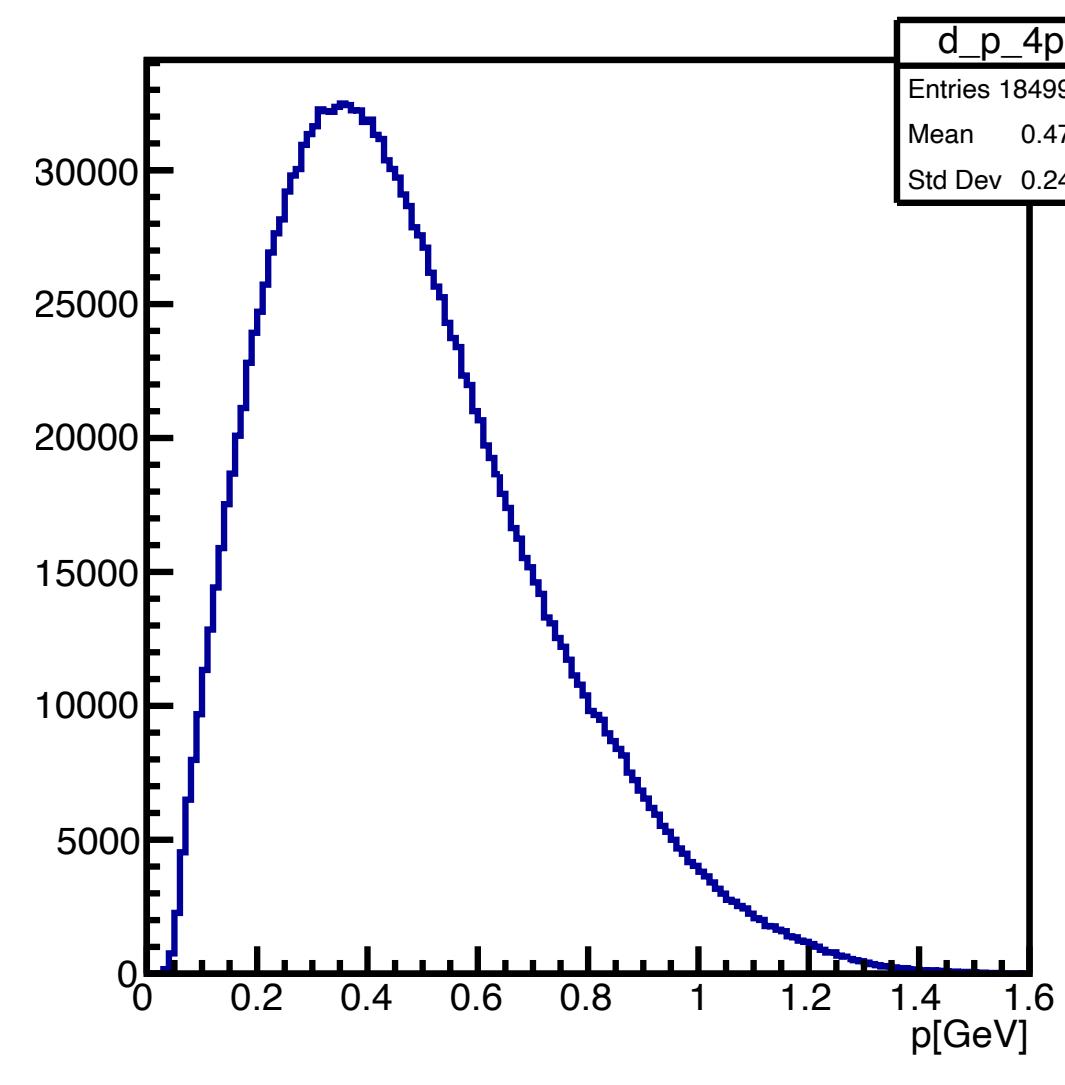
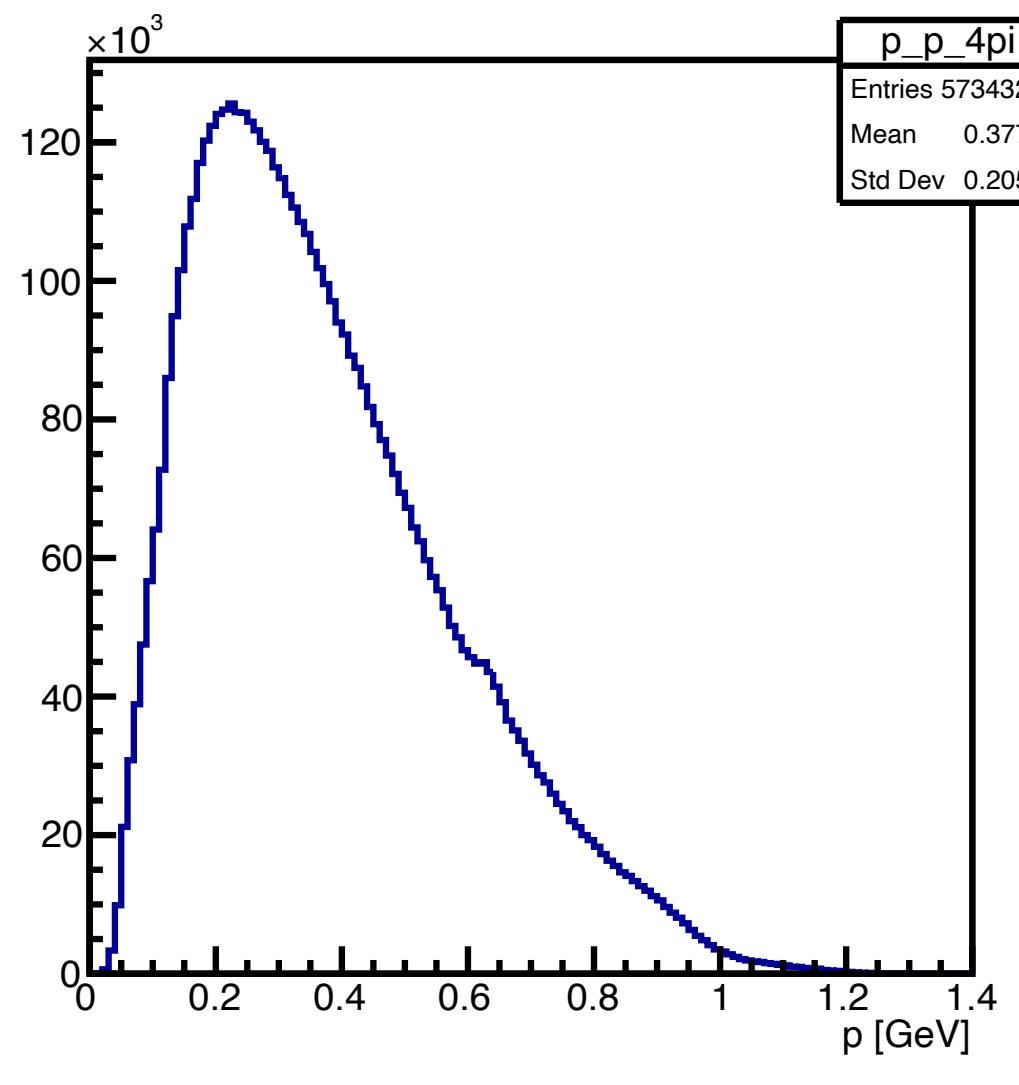
8.39%

momentum

full analysis chain



4pi



p

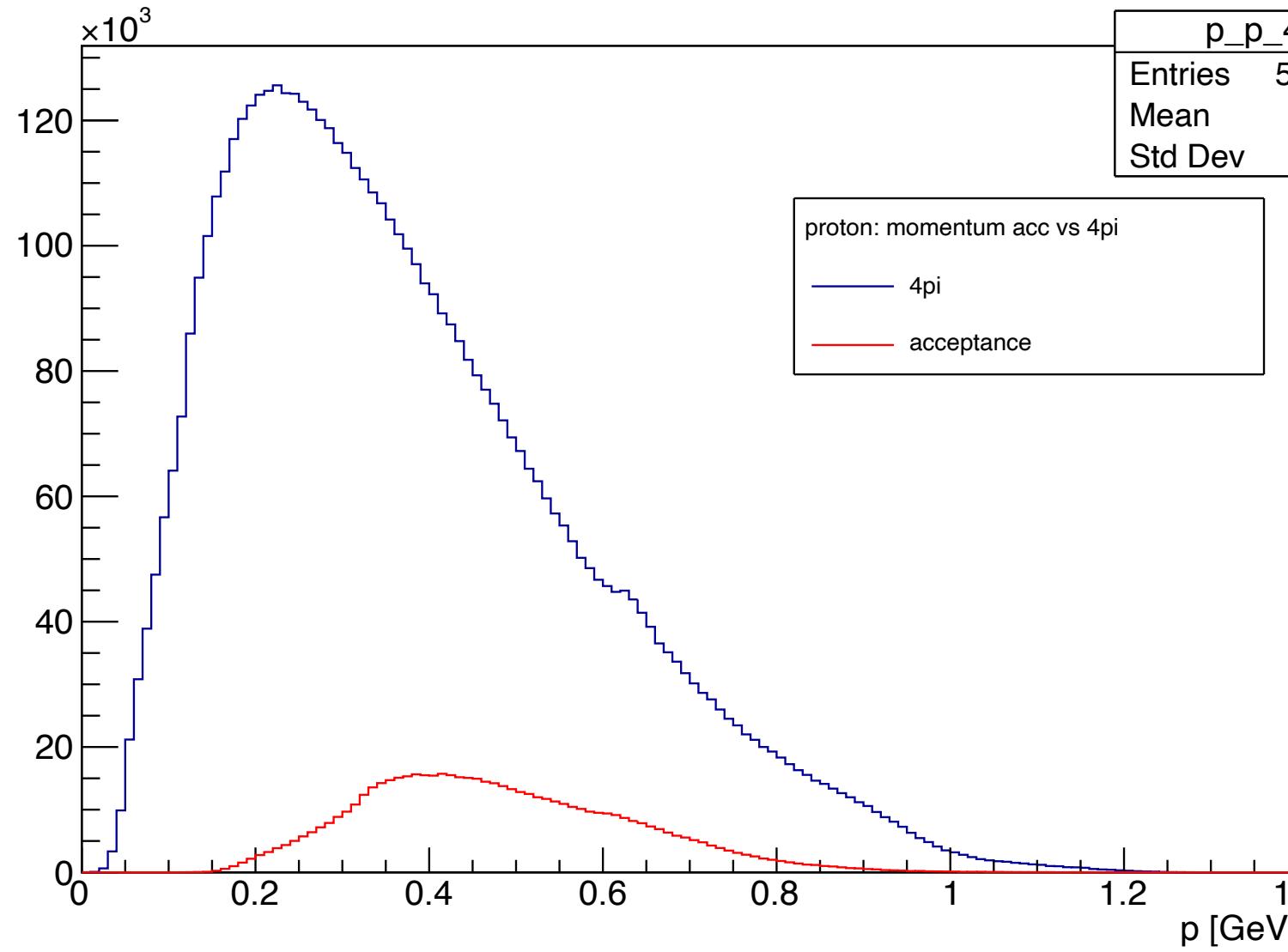
d

π^+

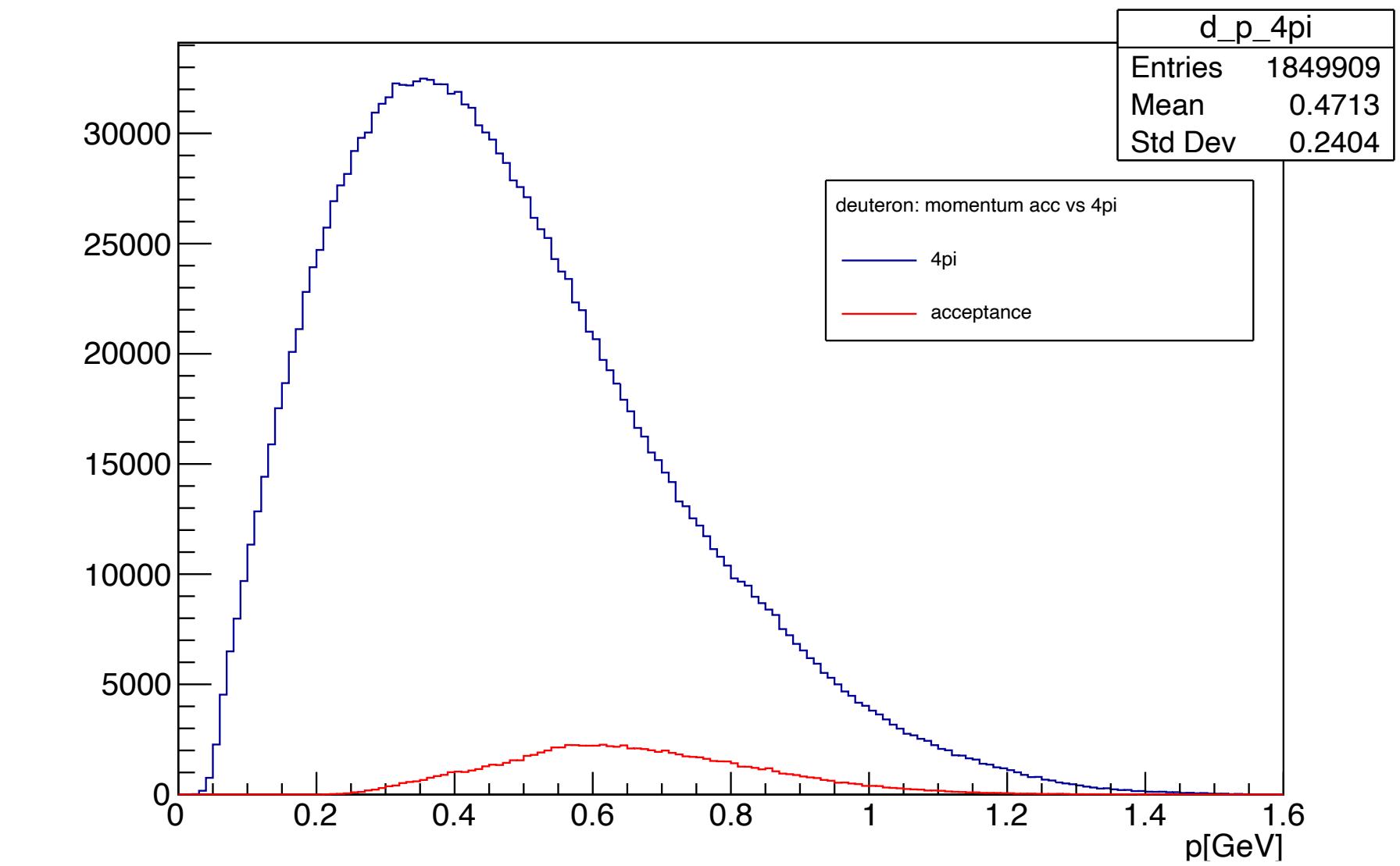
π^-

momentum

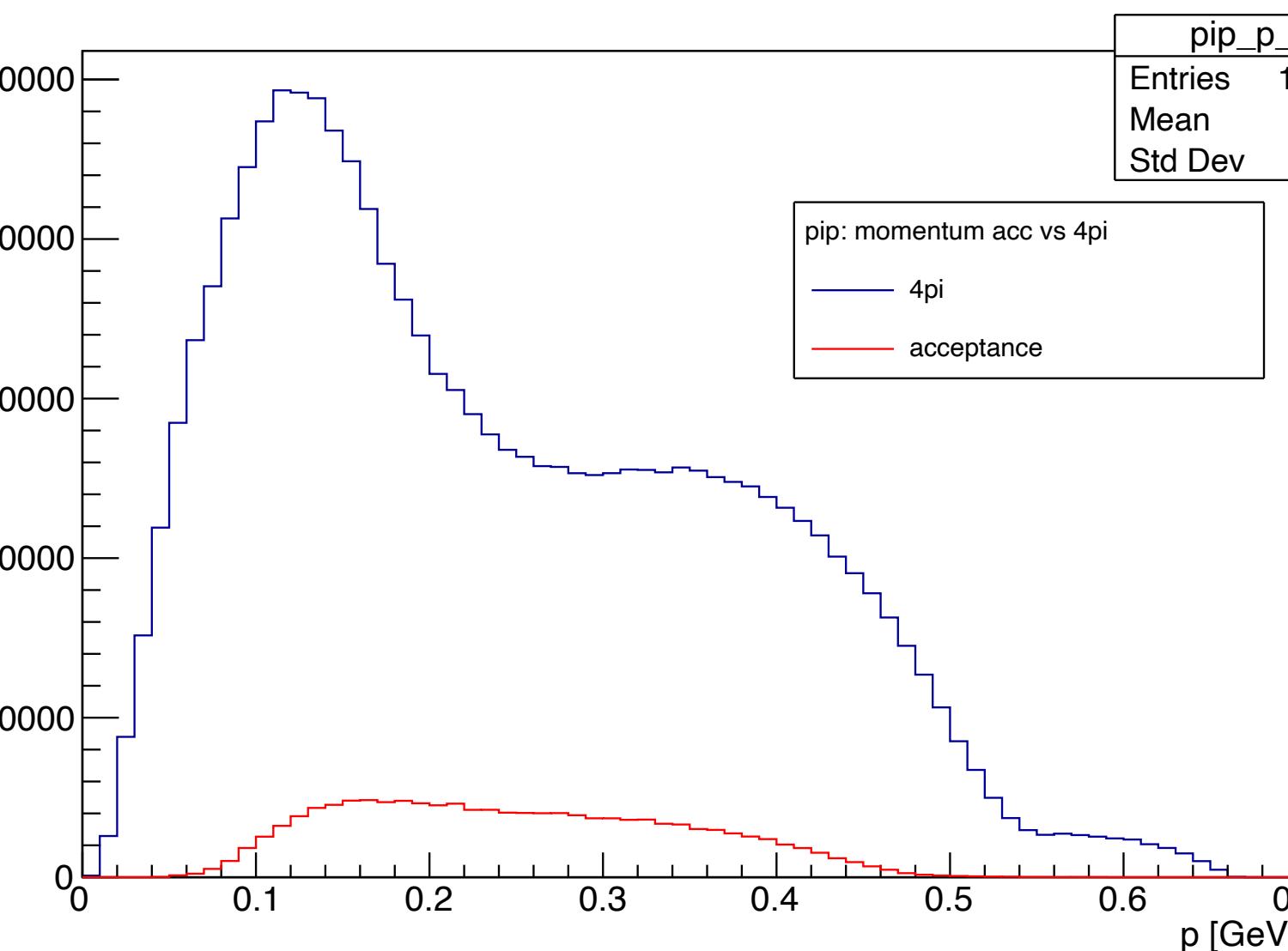
p



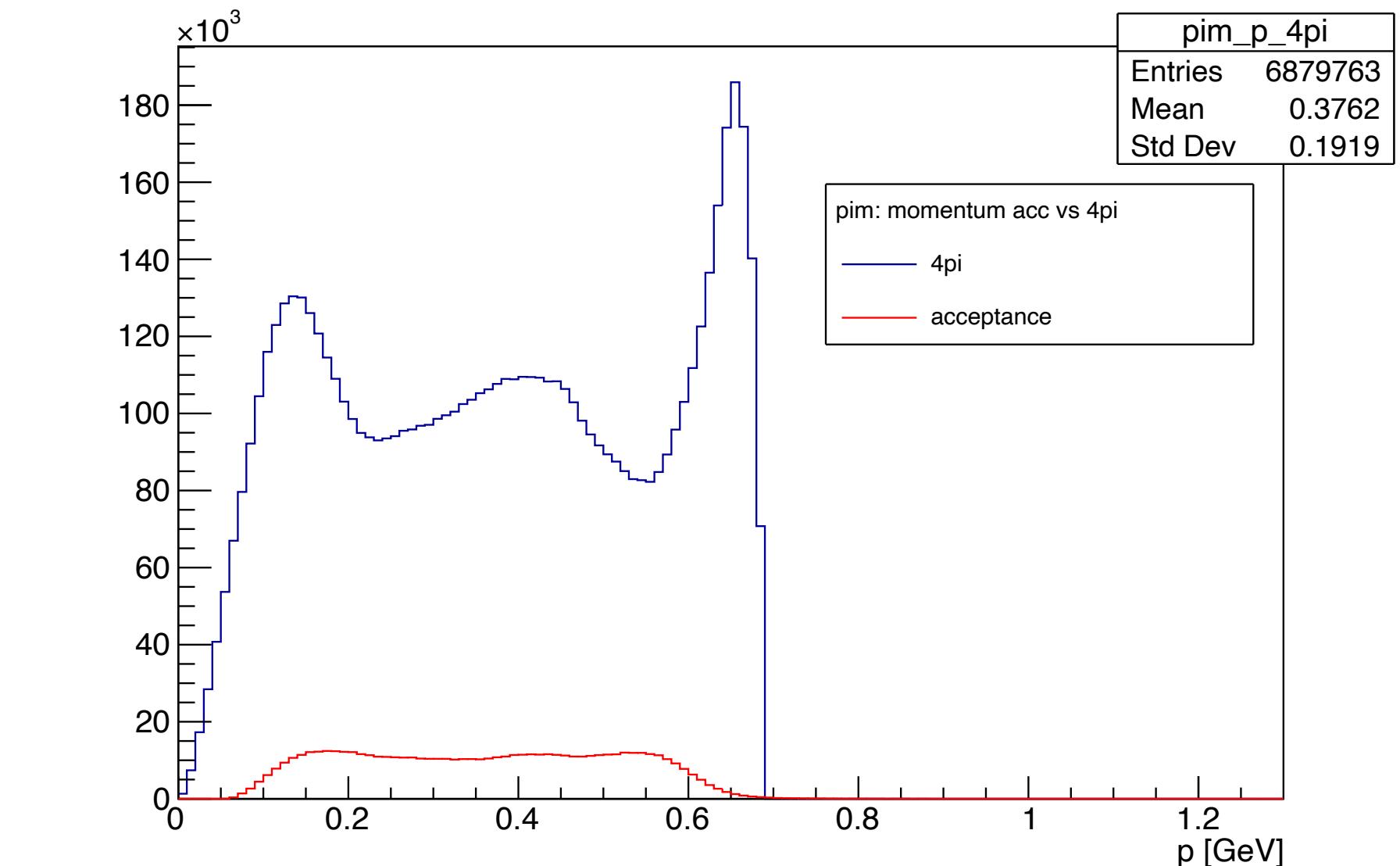
d



π^+

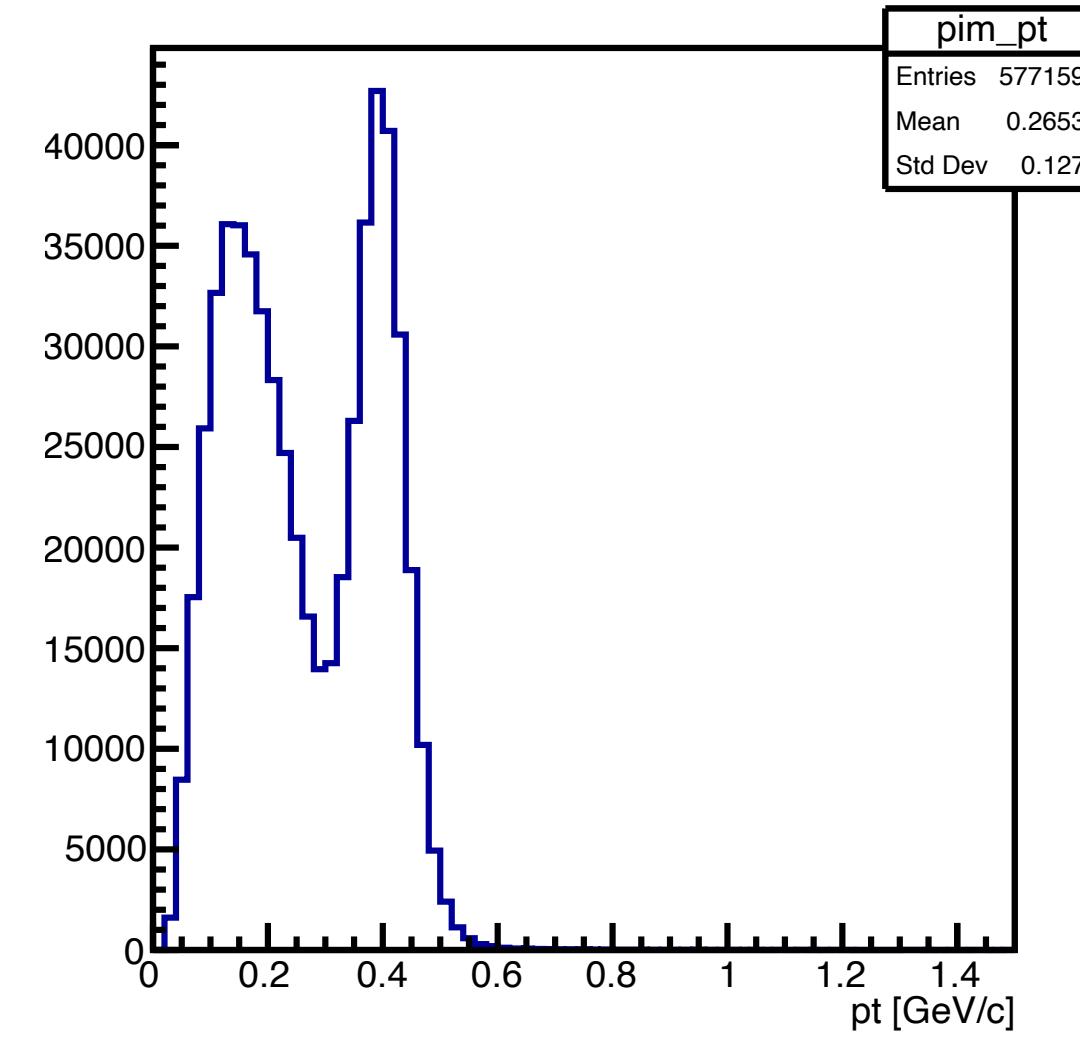
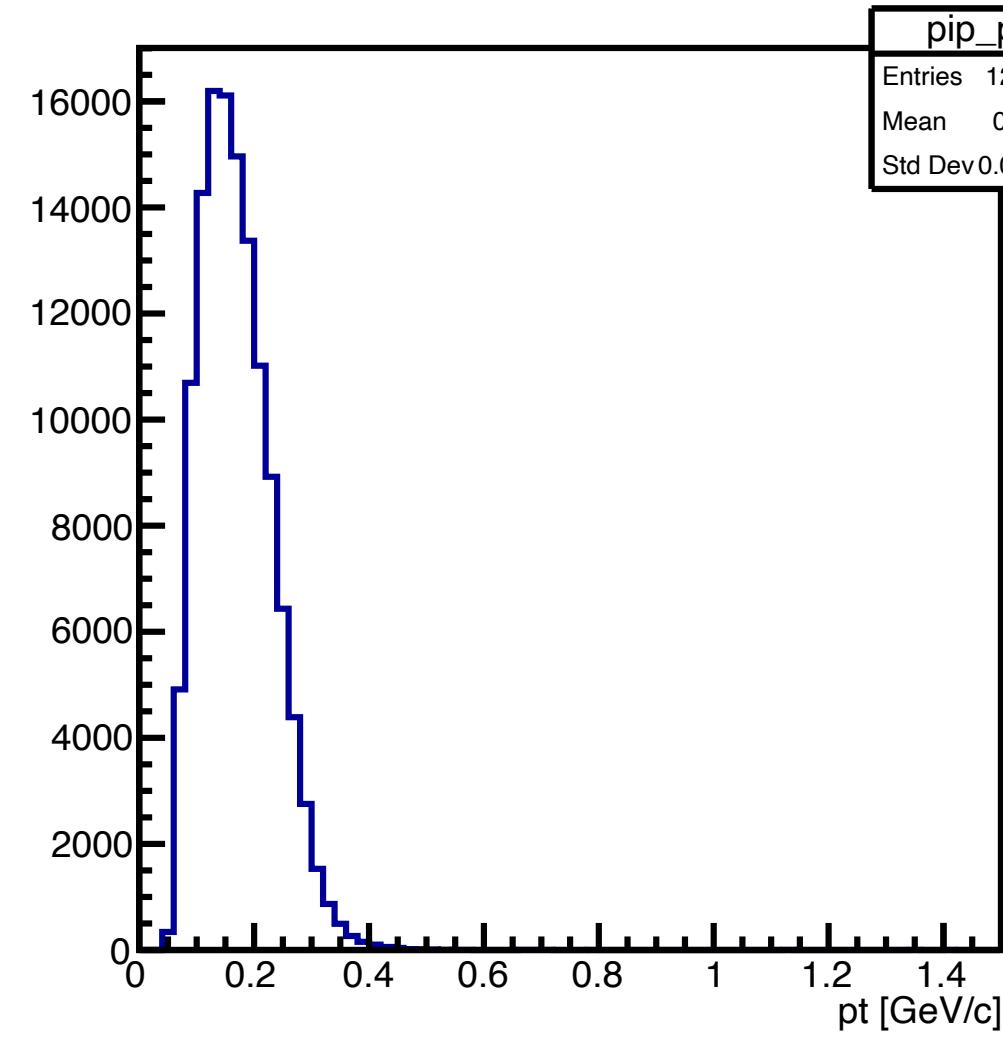
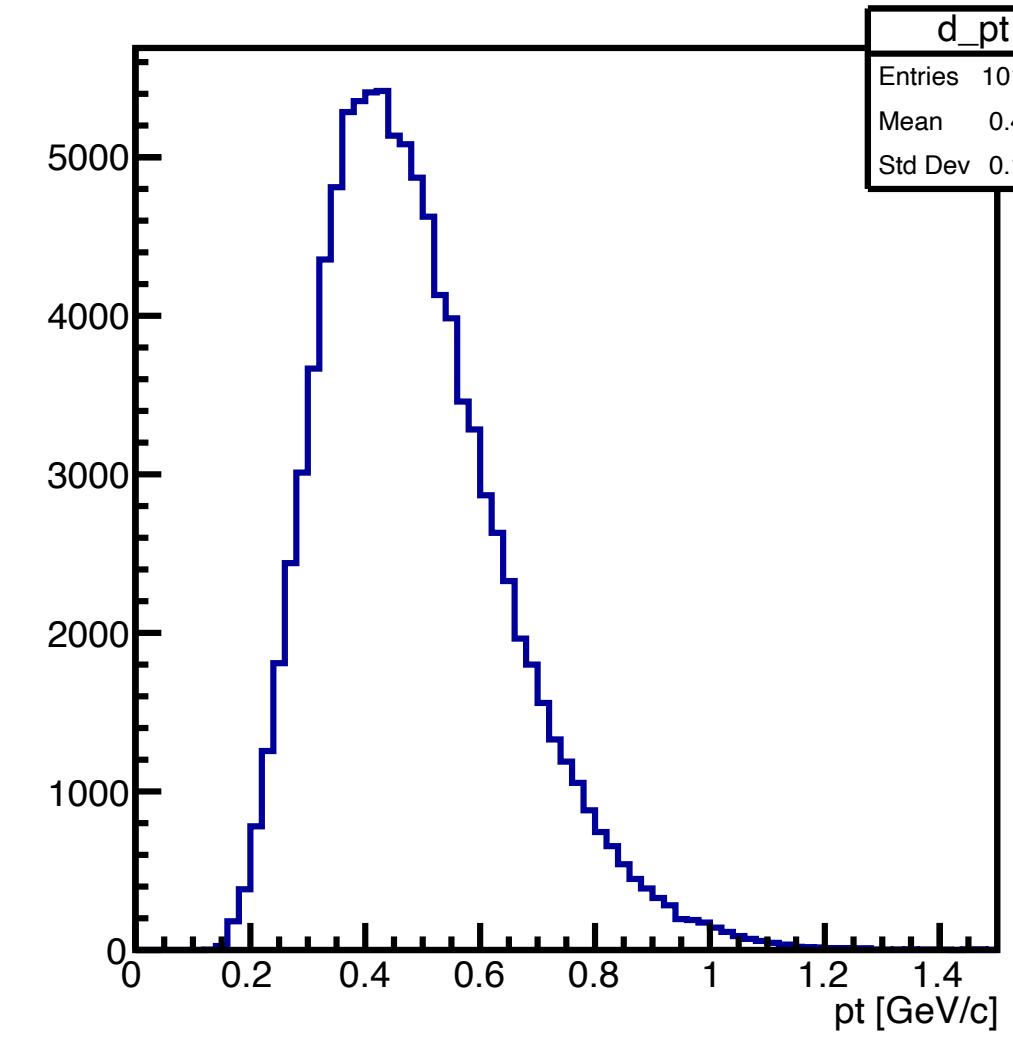
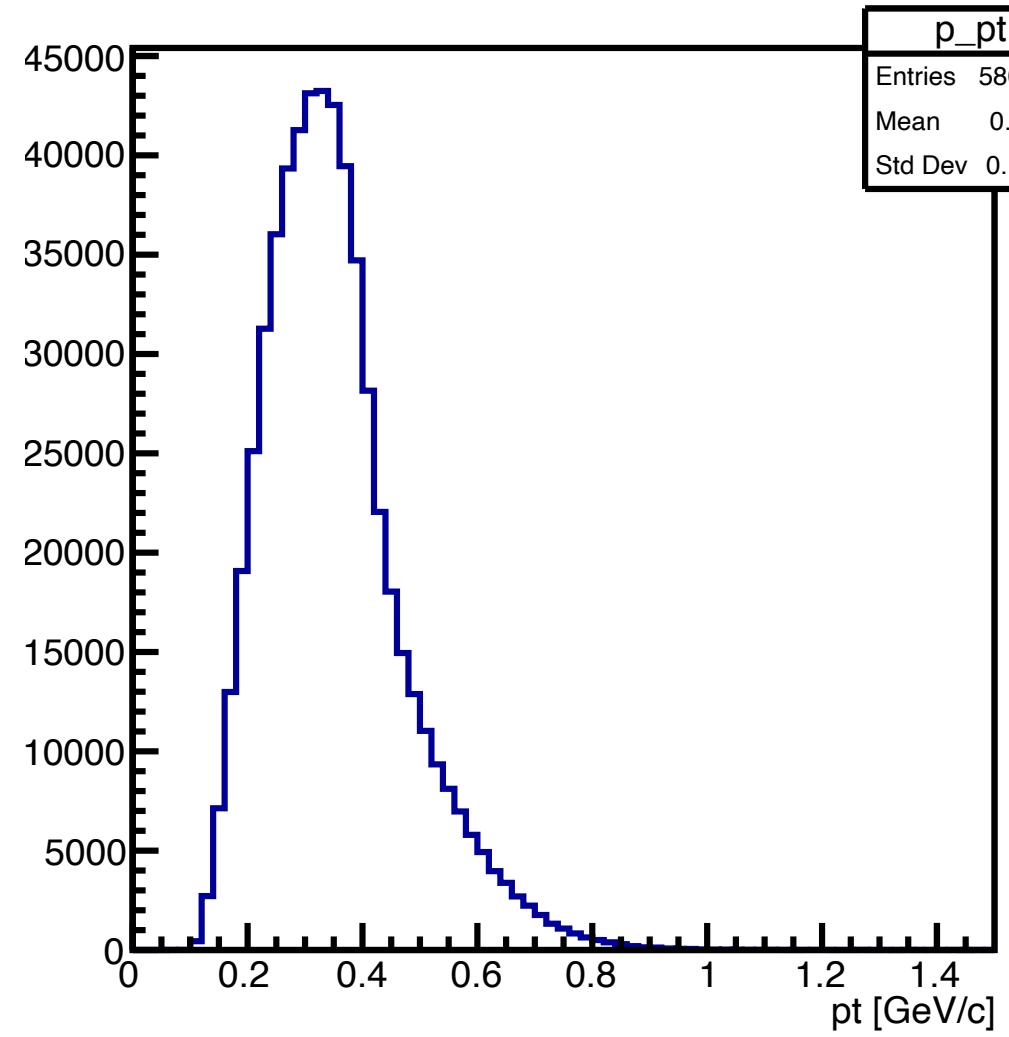


π^-

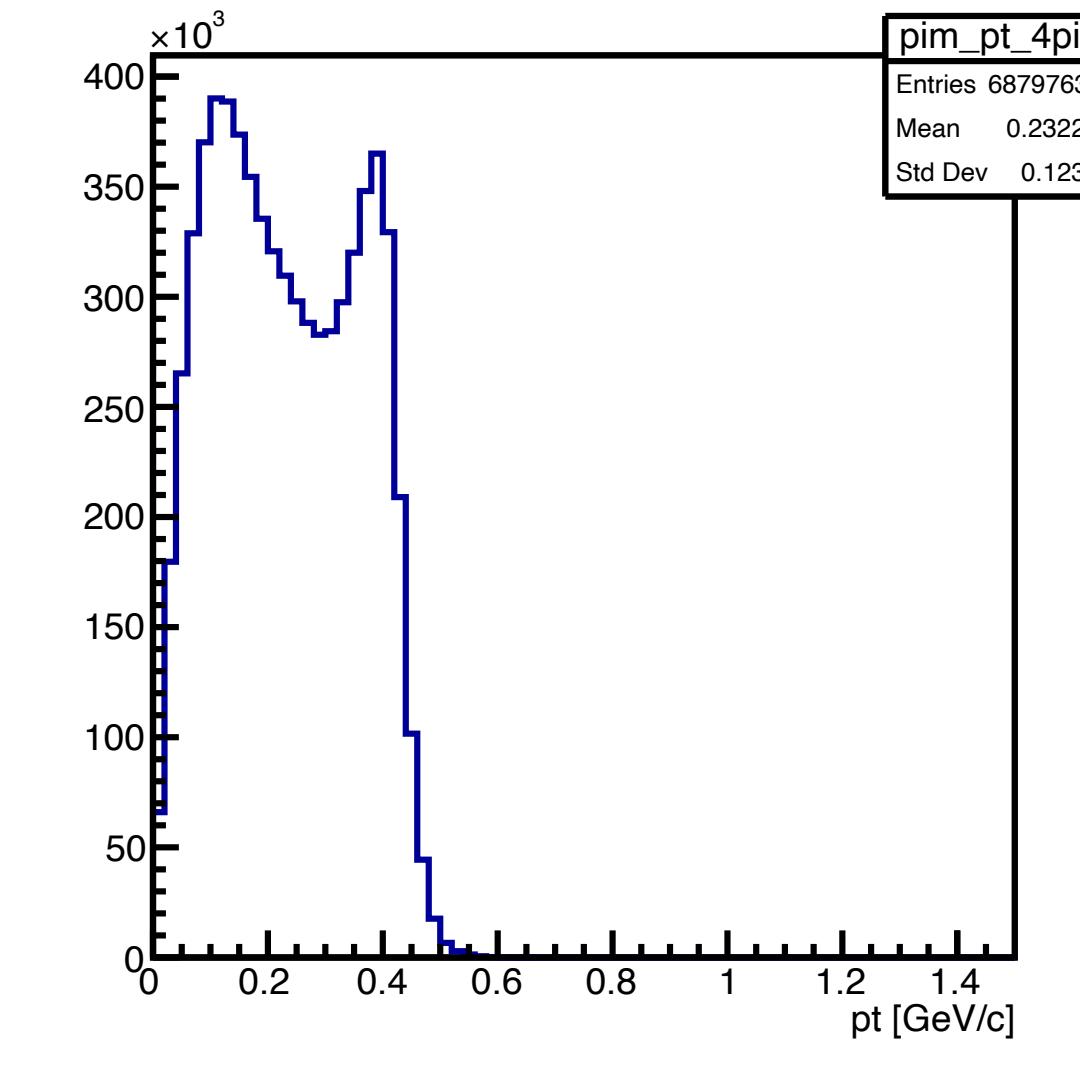
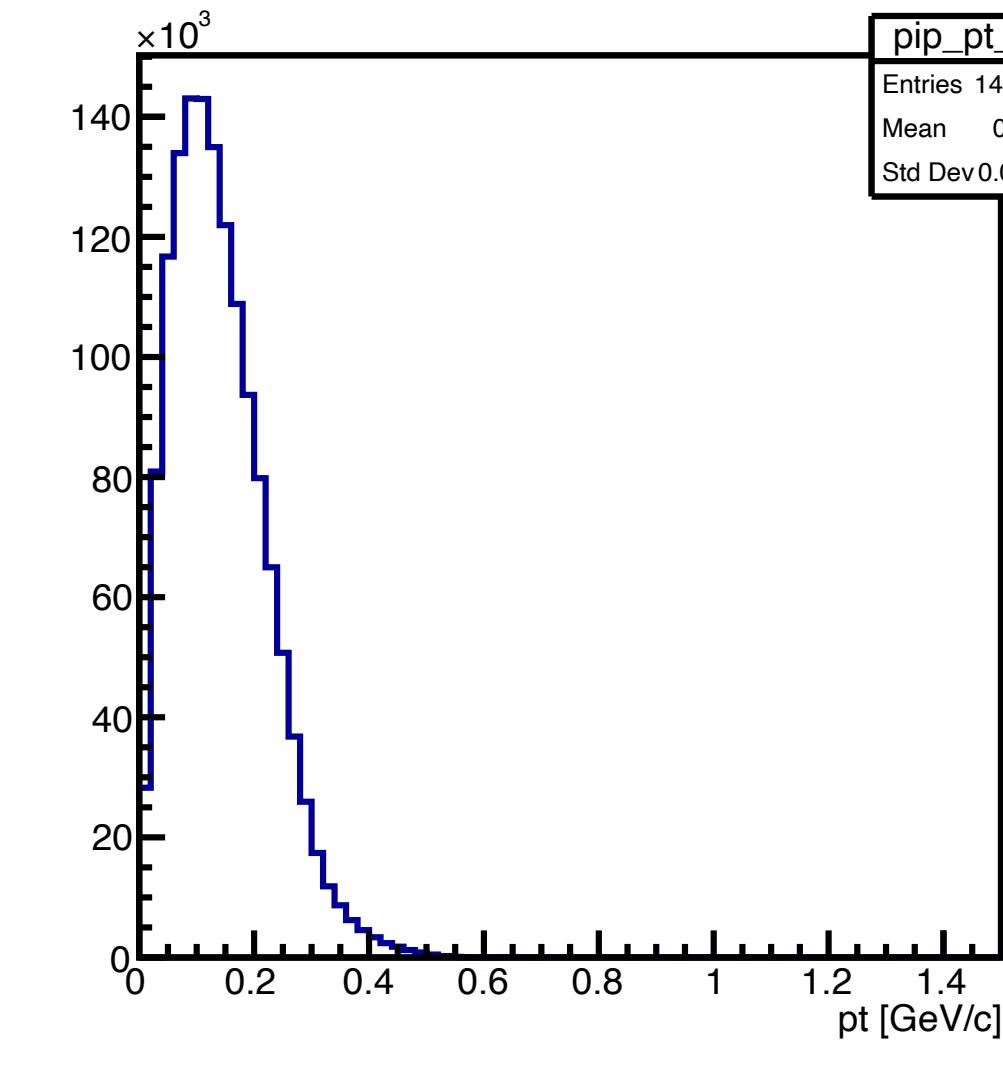
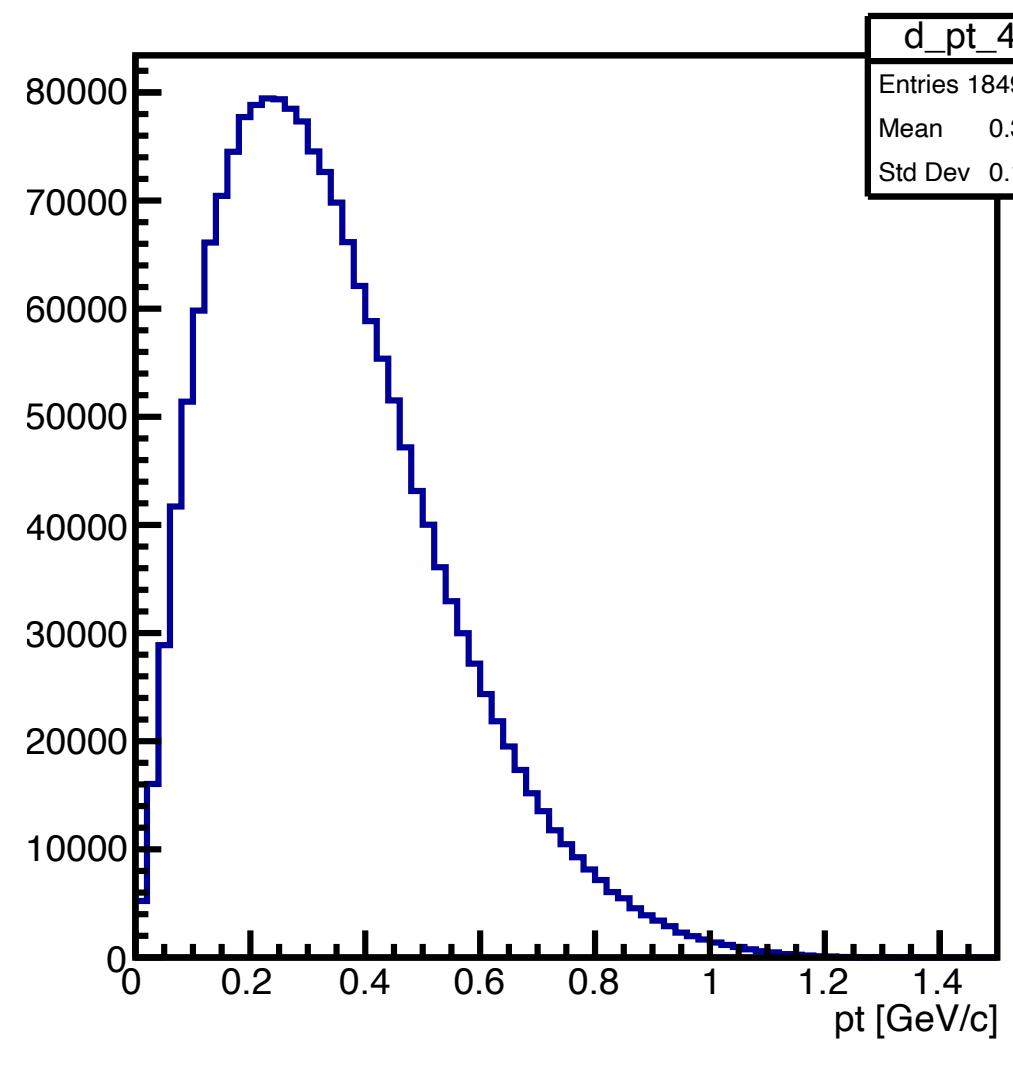
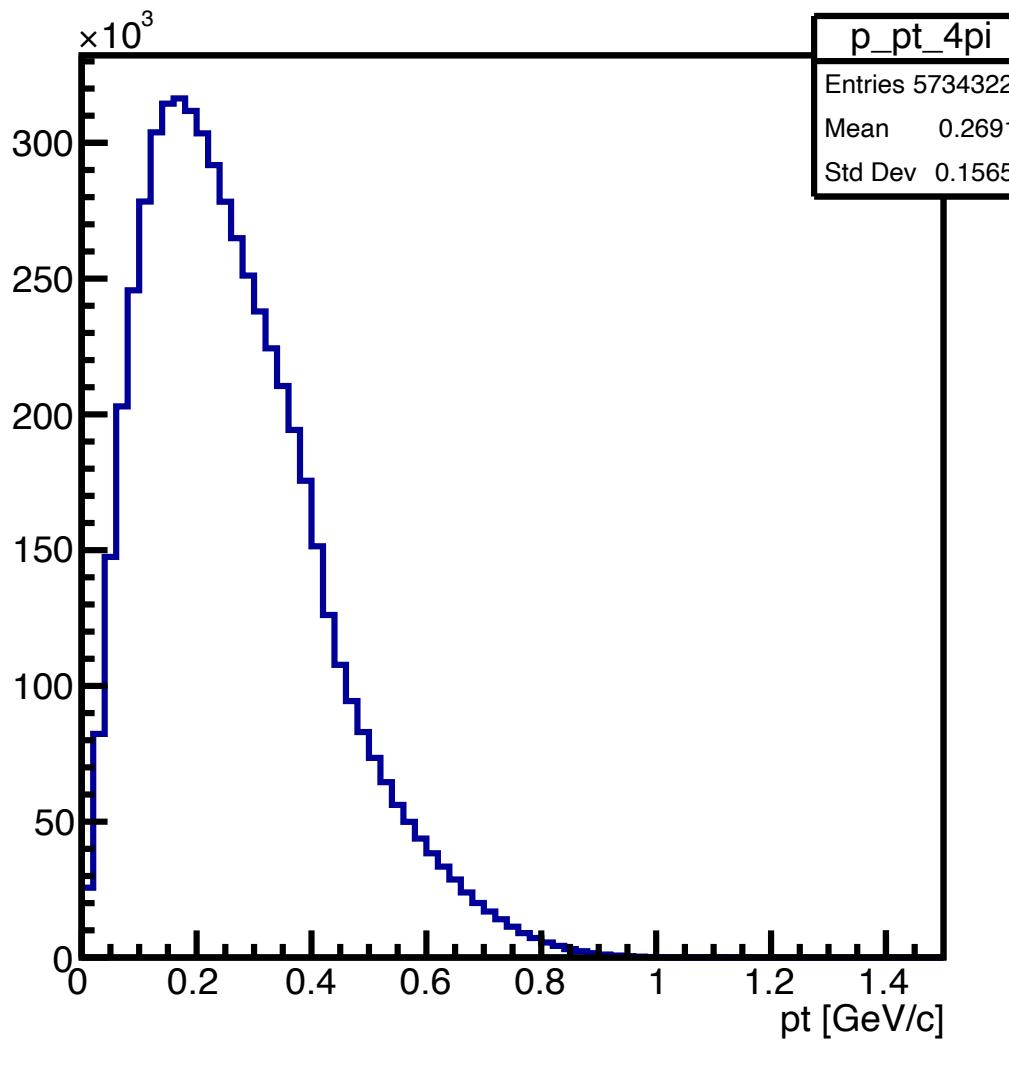


transverse momentum

full analysis chain



4pi



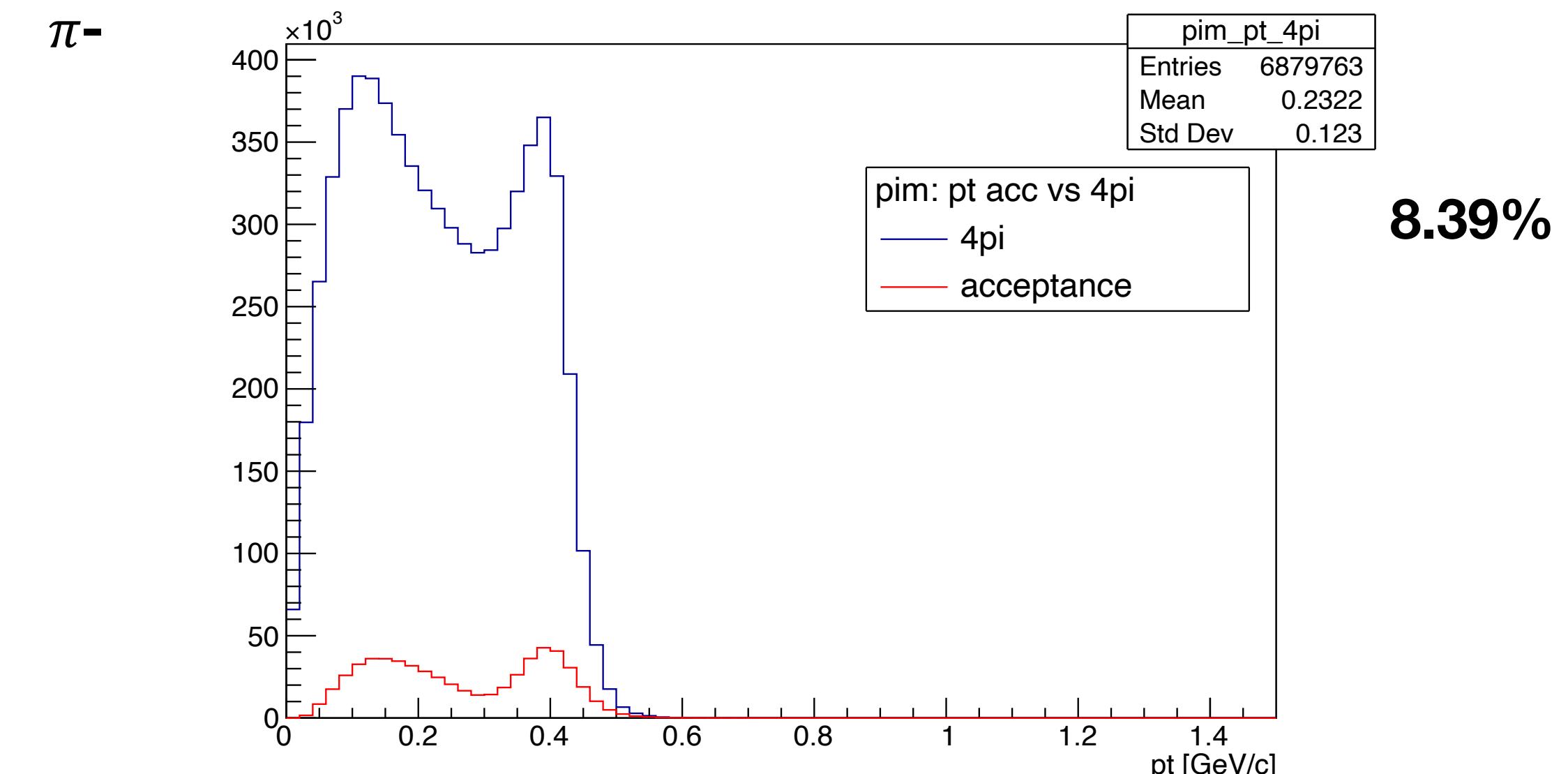
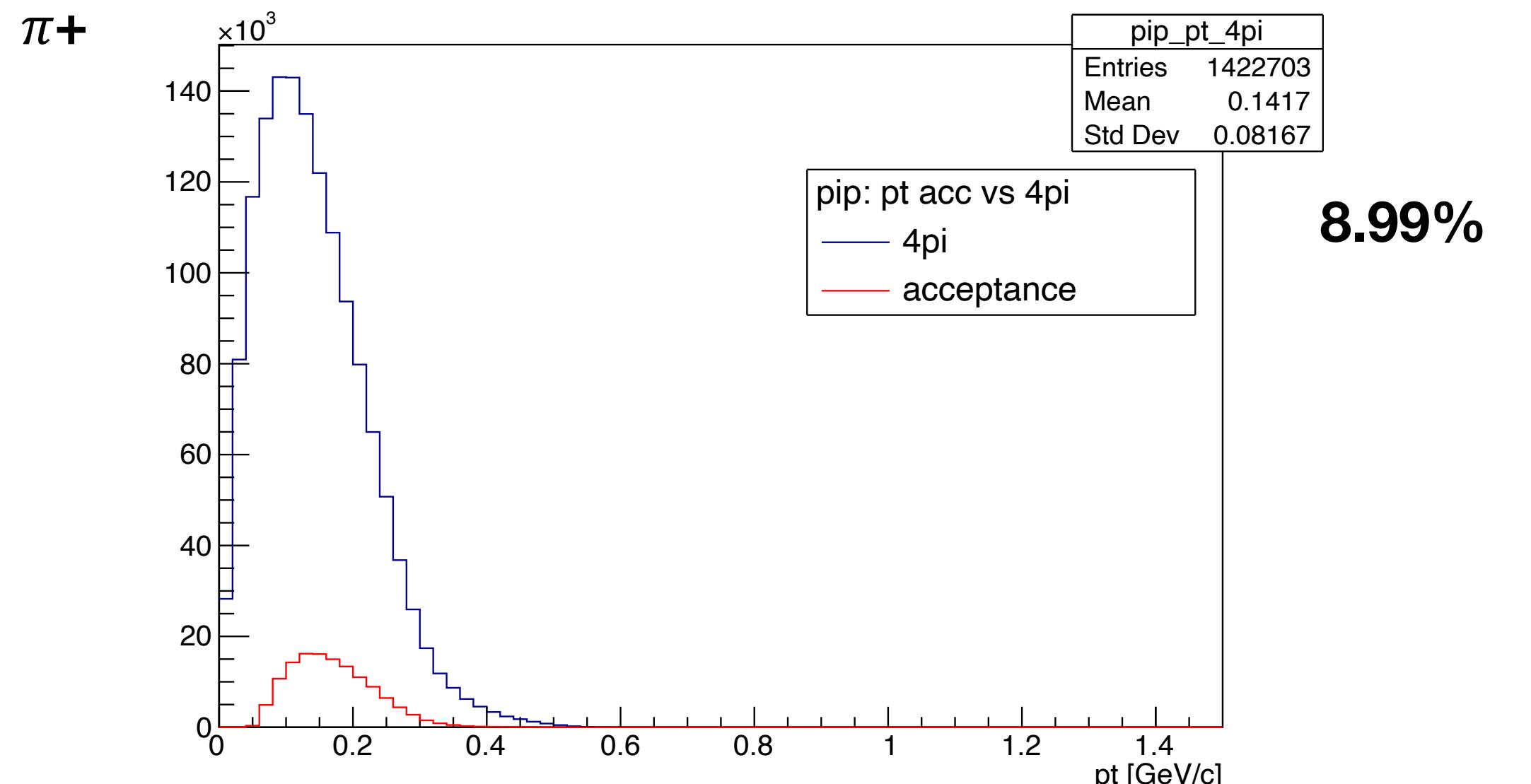
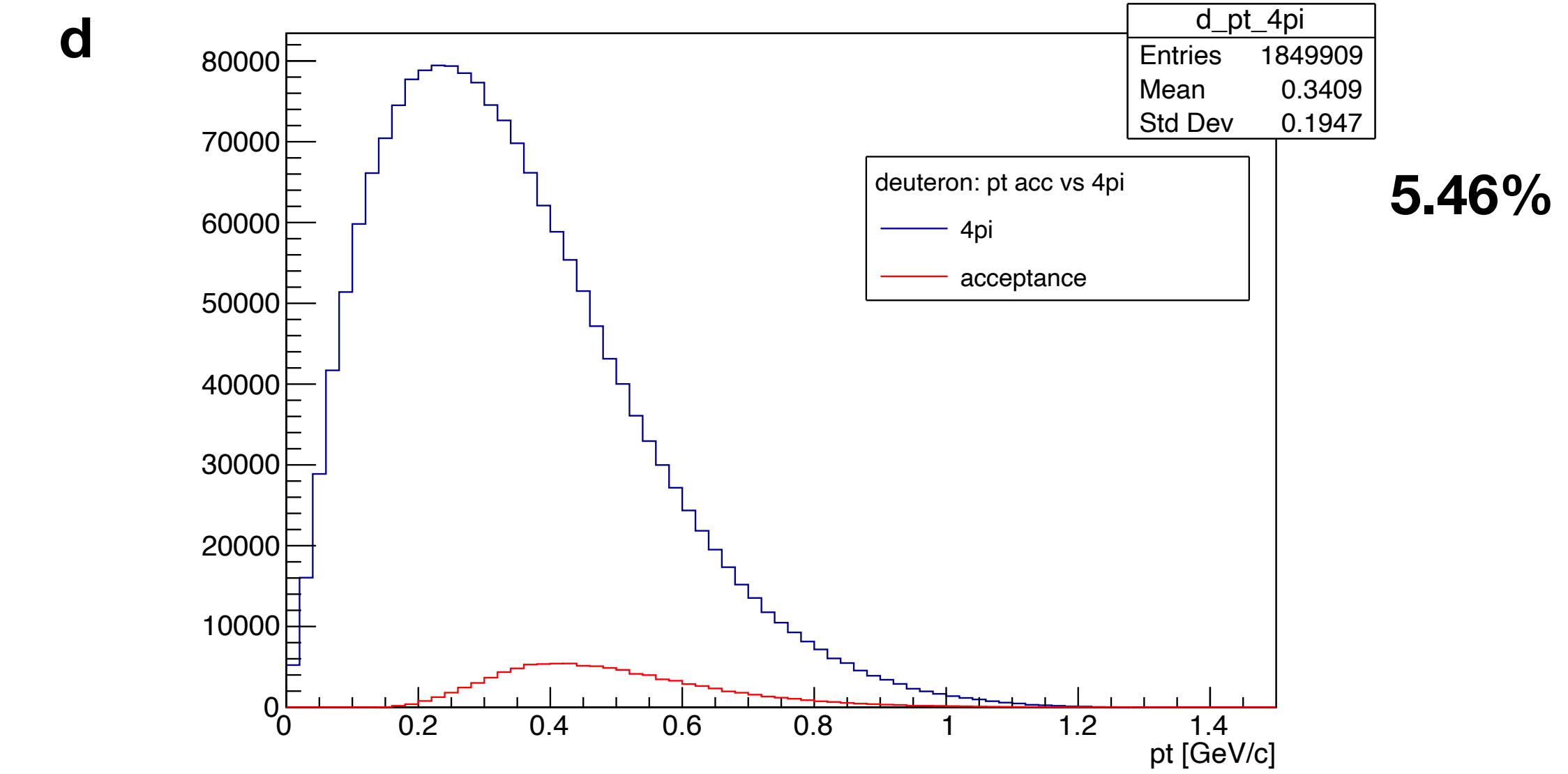
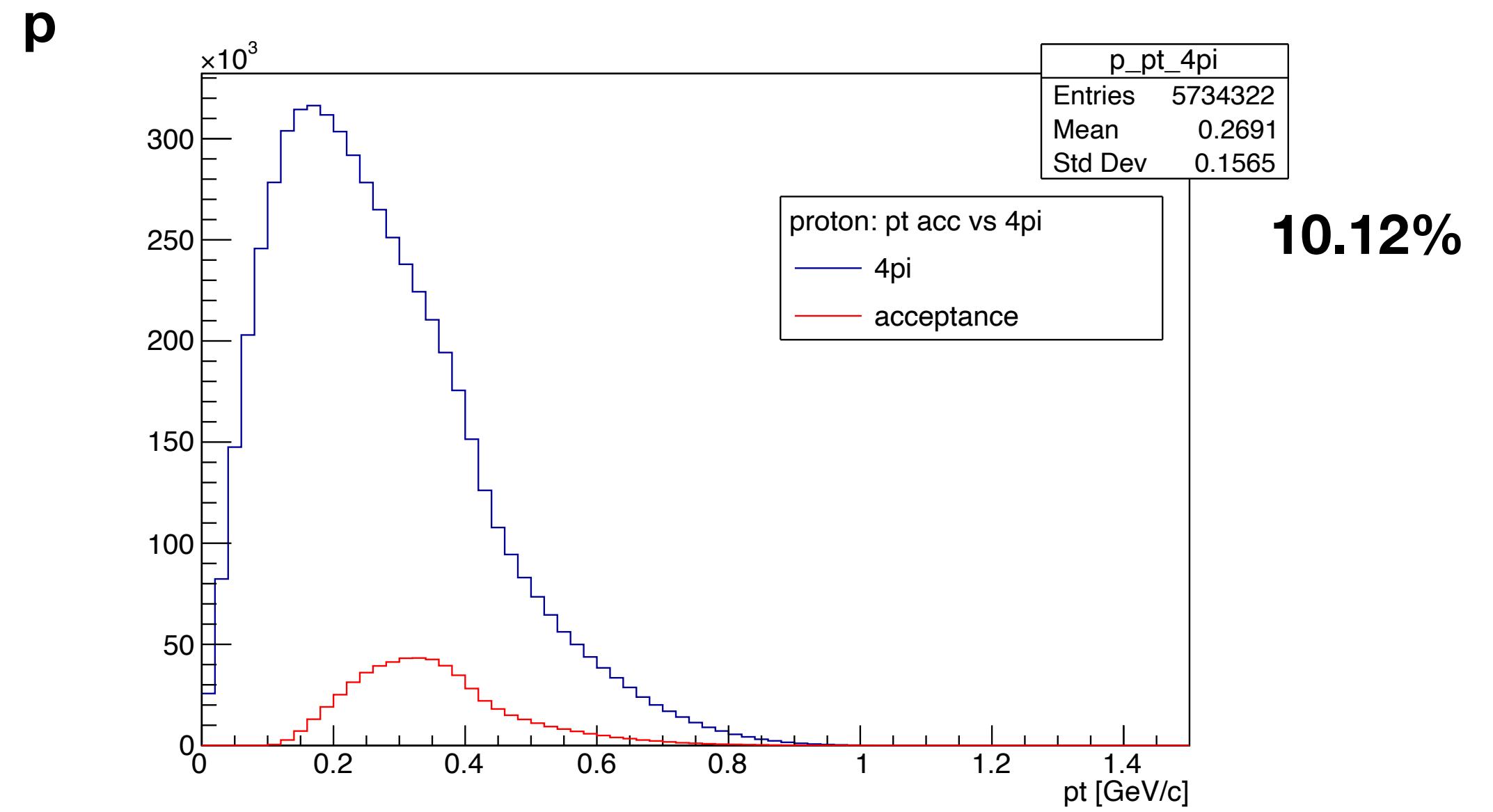
p

d

π^+

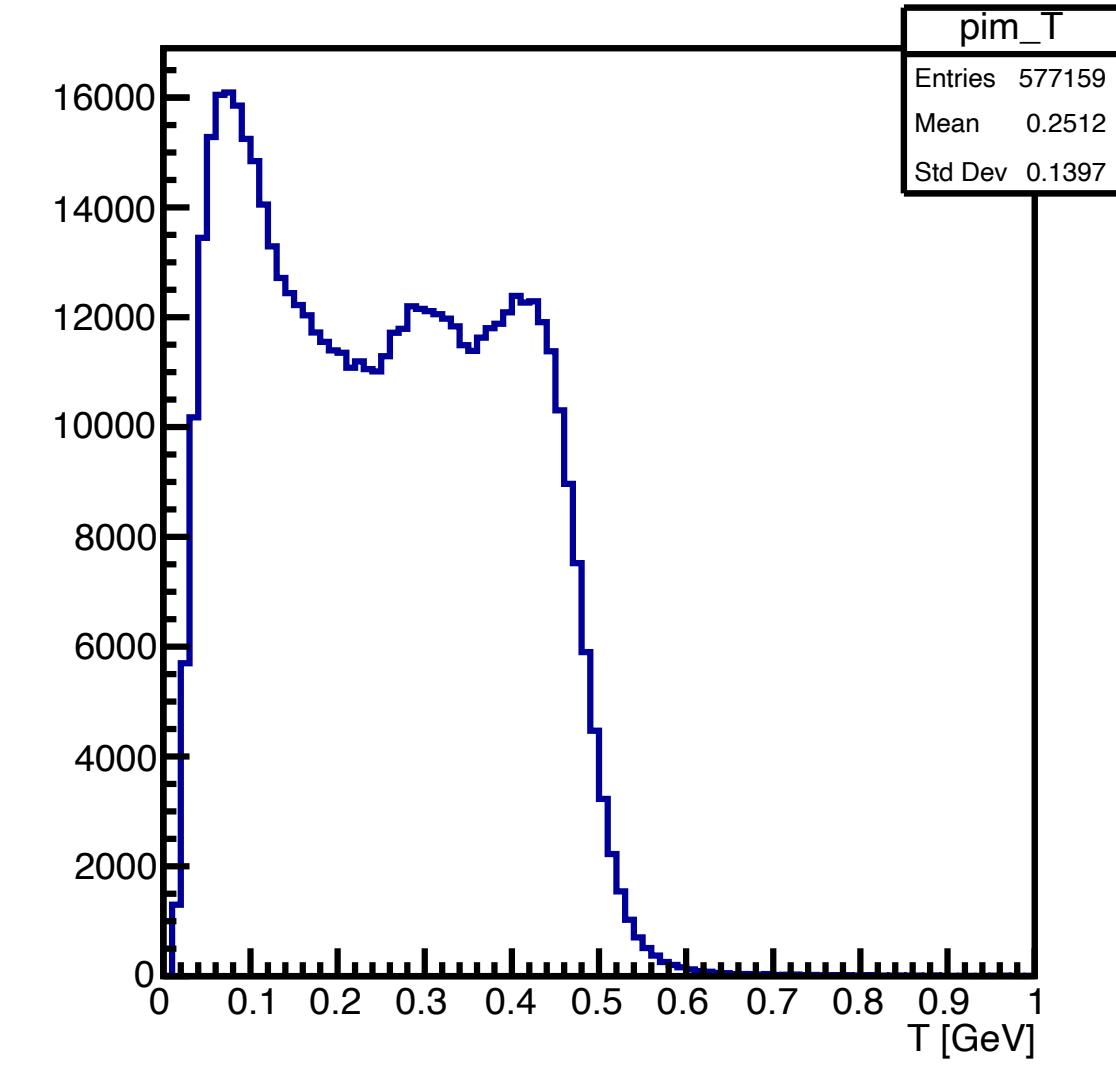
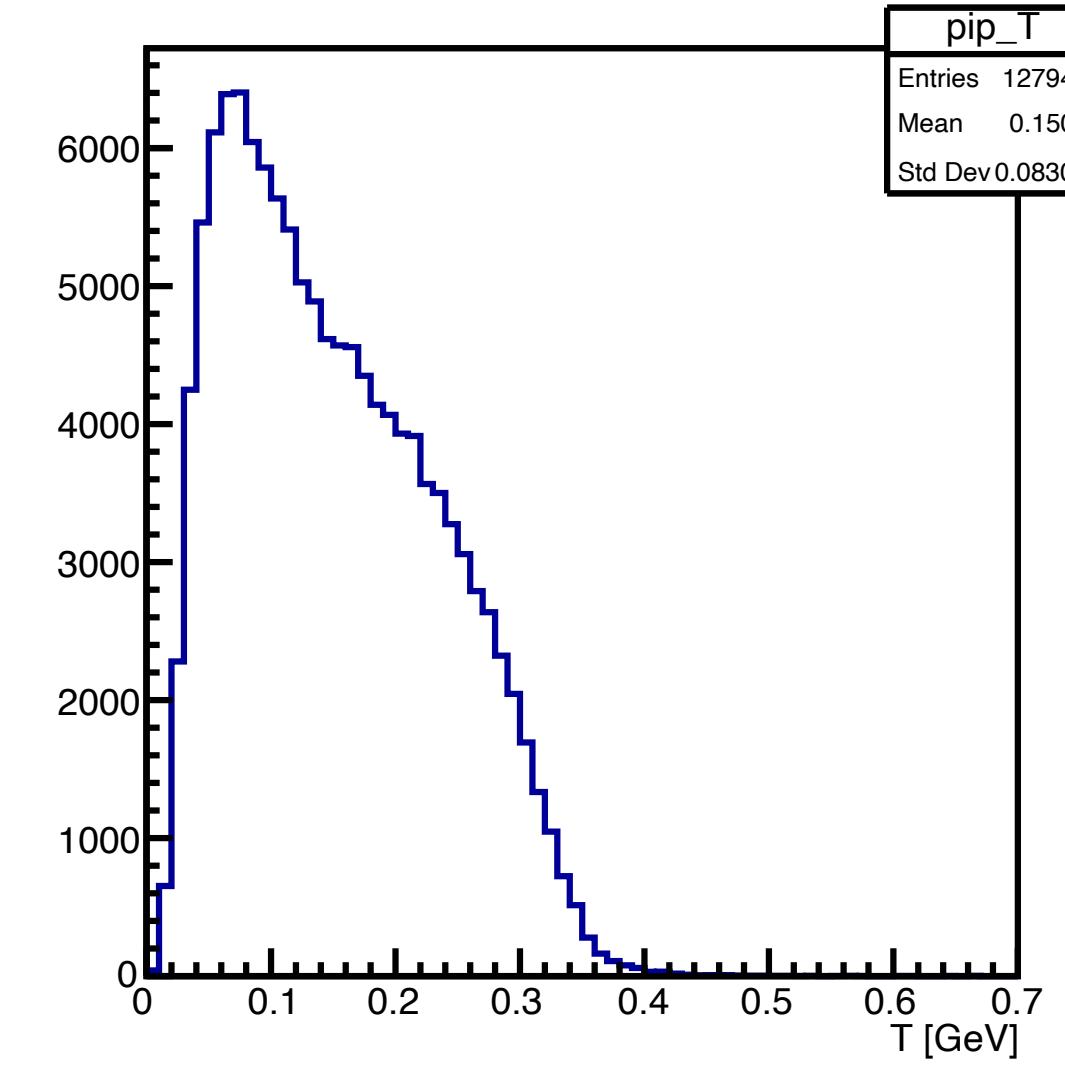
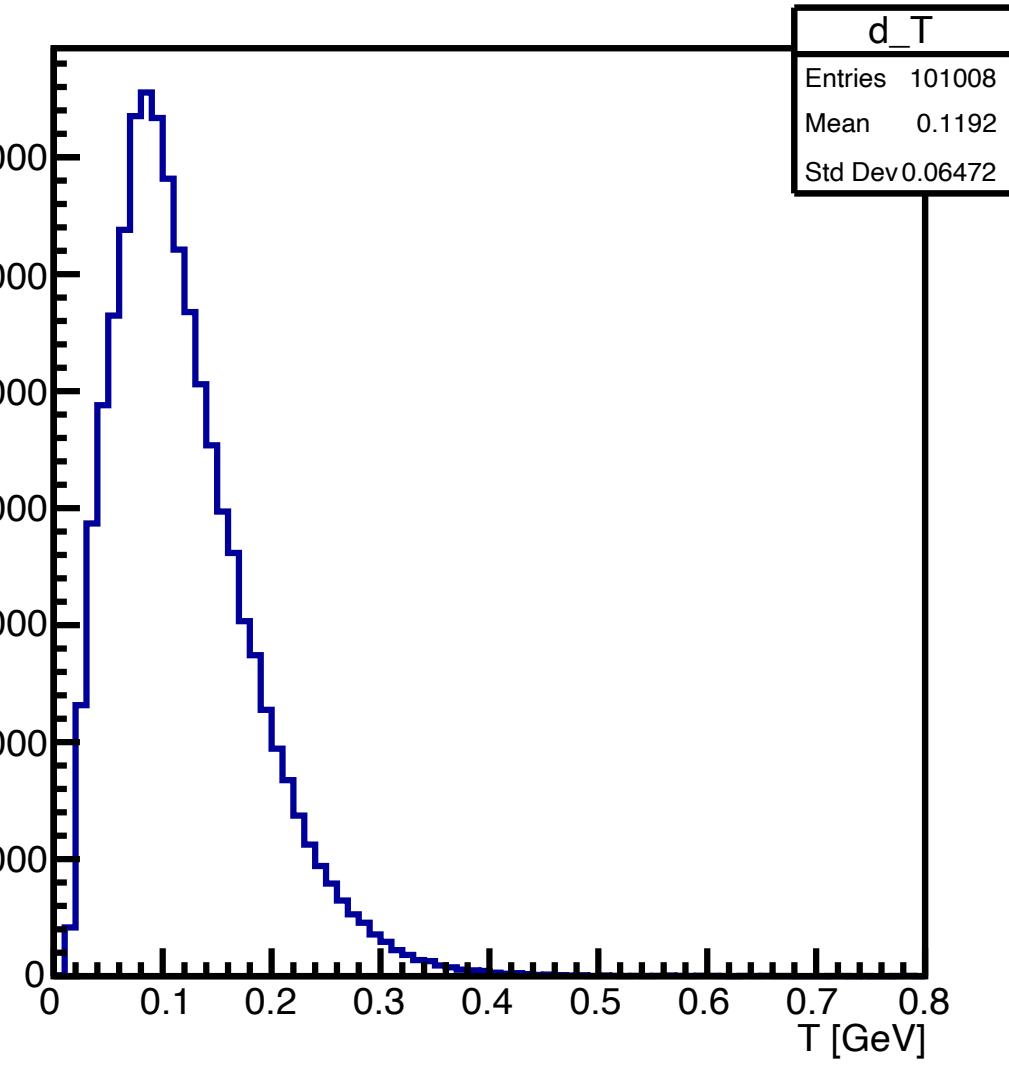
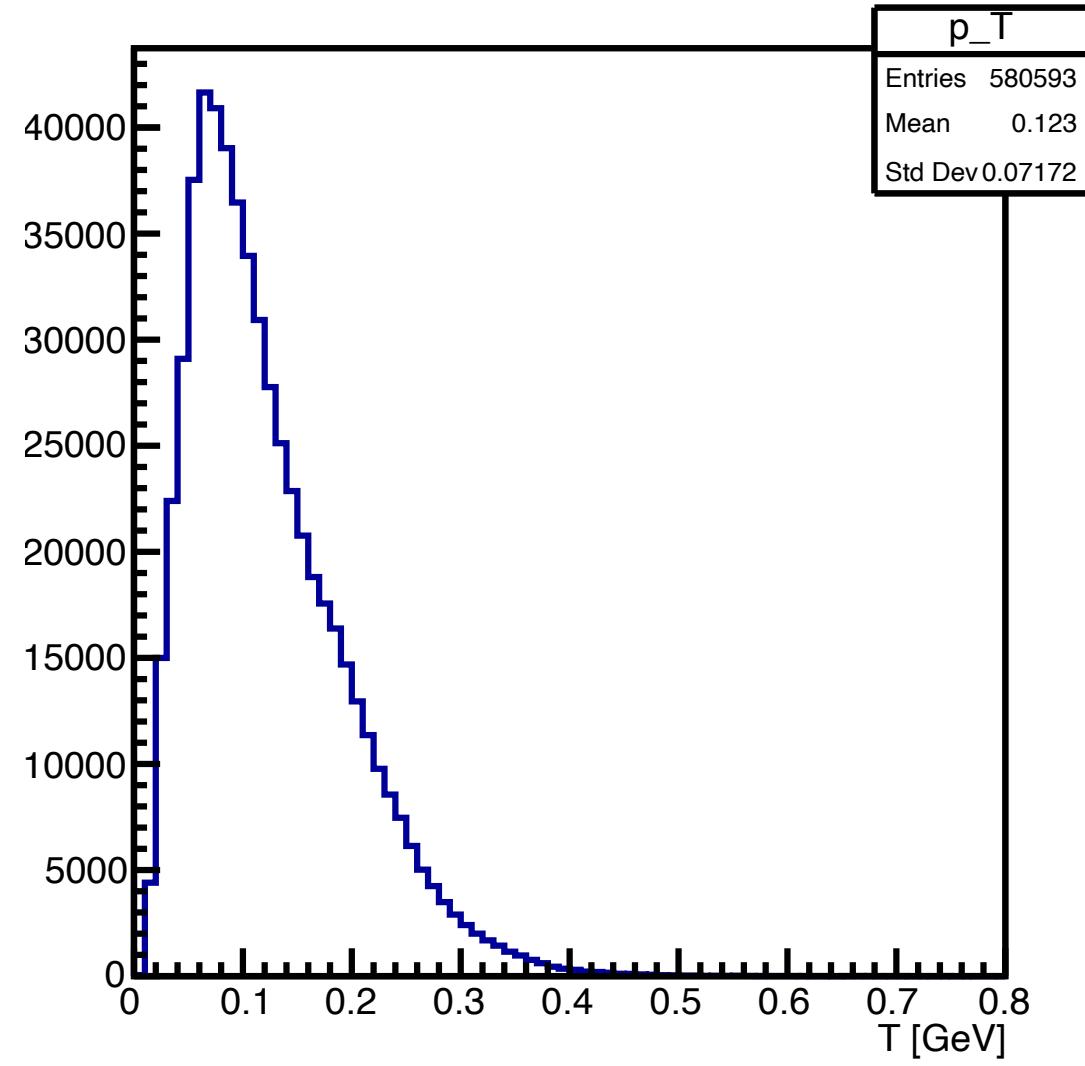
π^-

transverse momentum

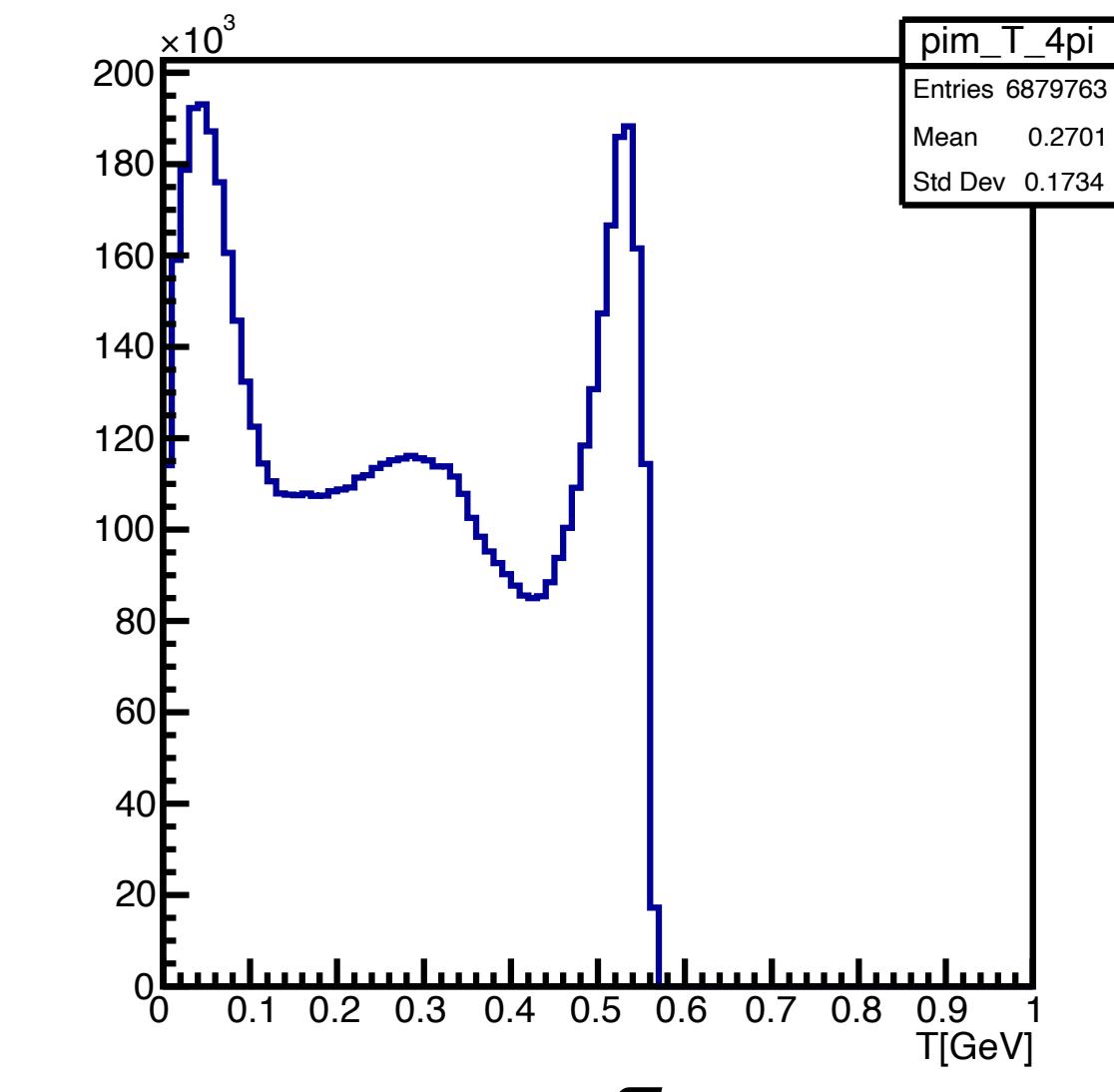
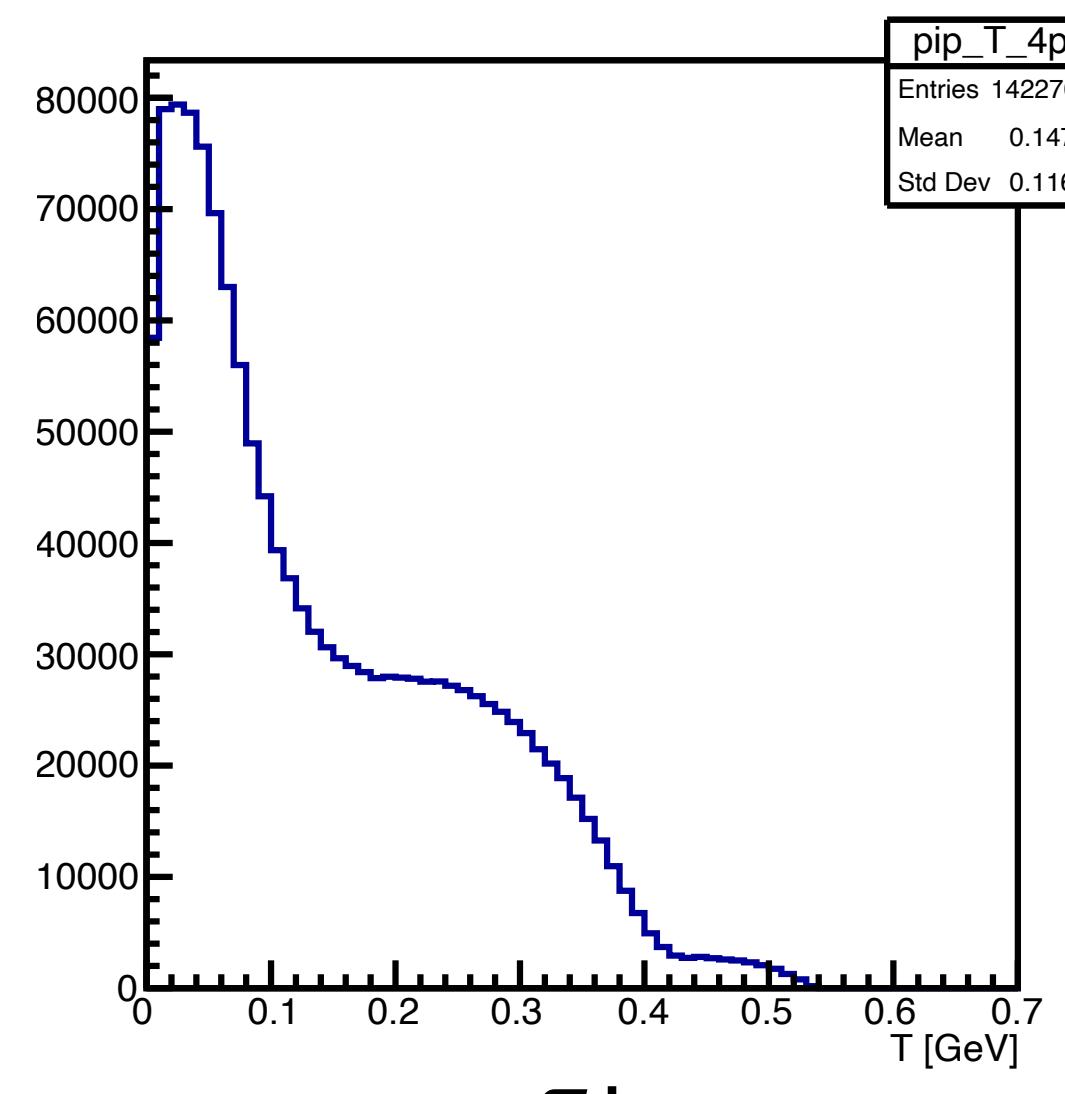
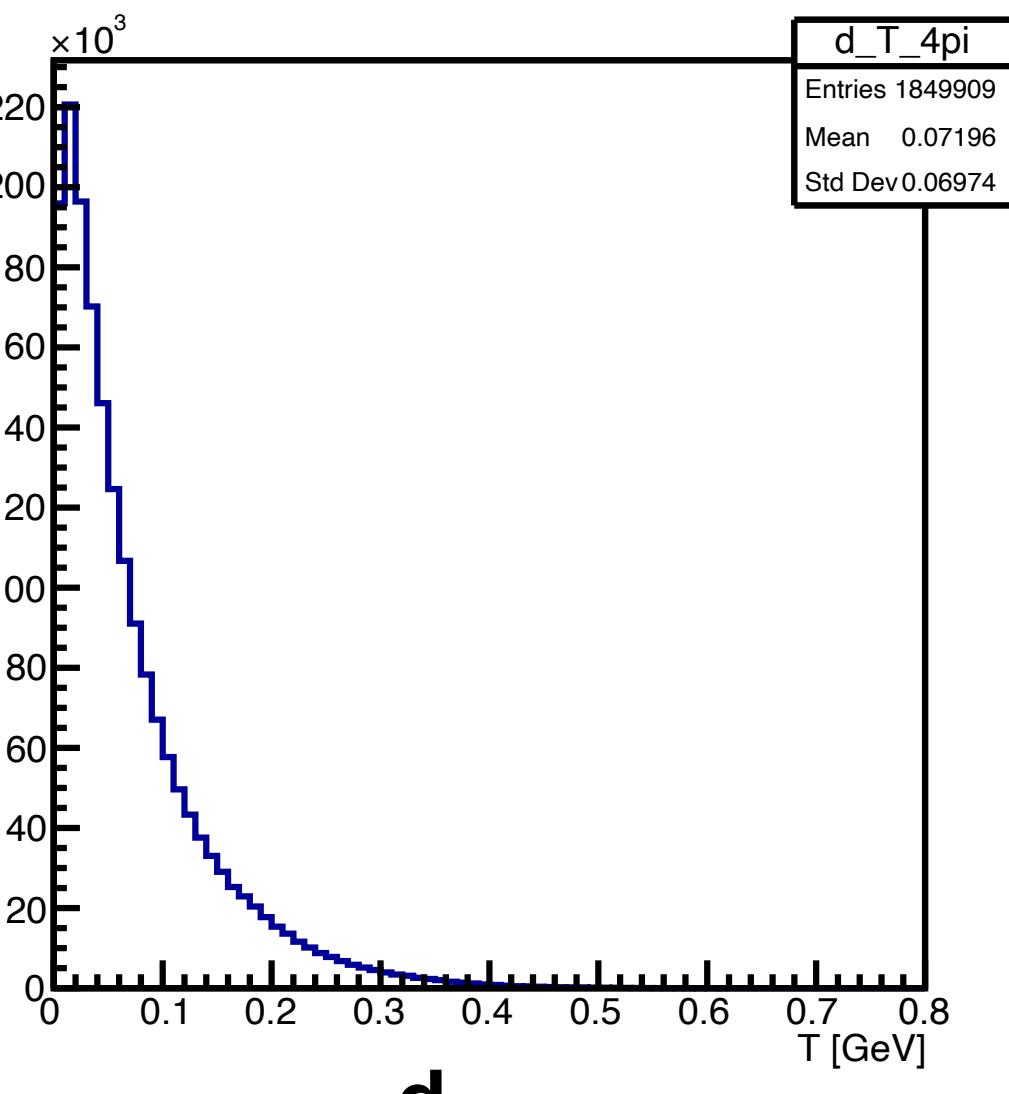
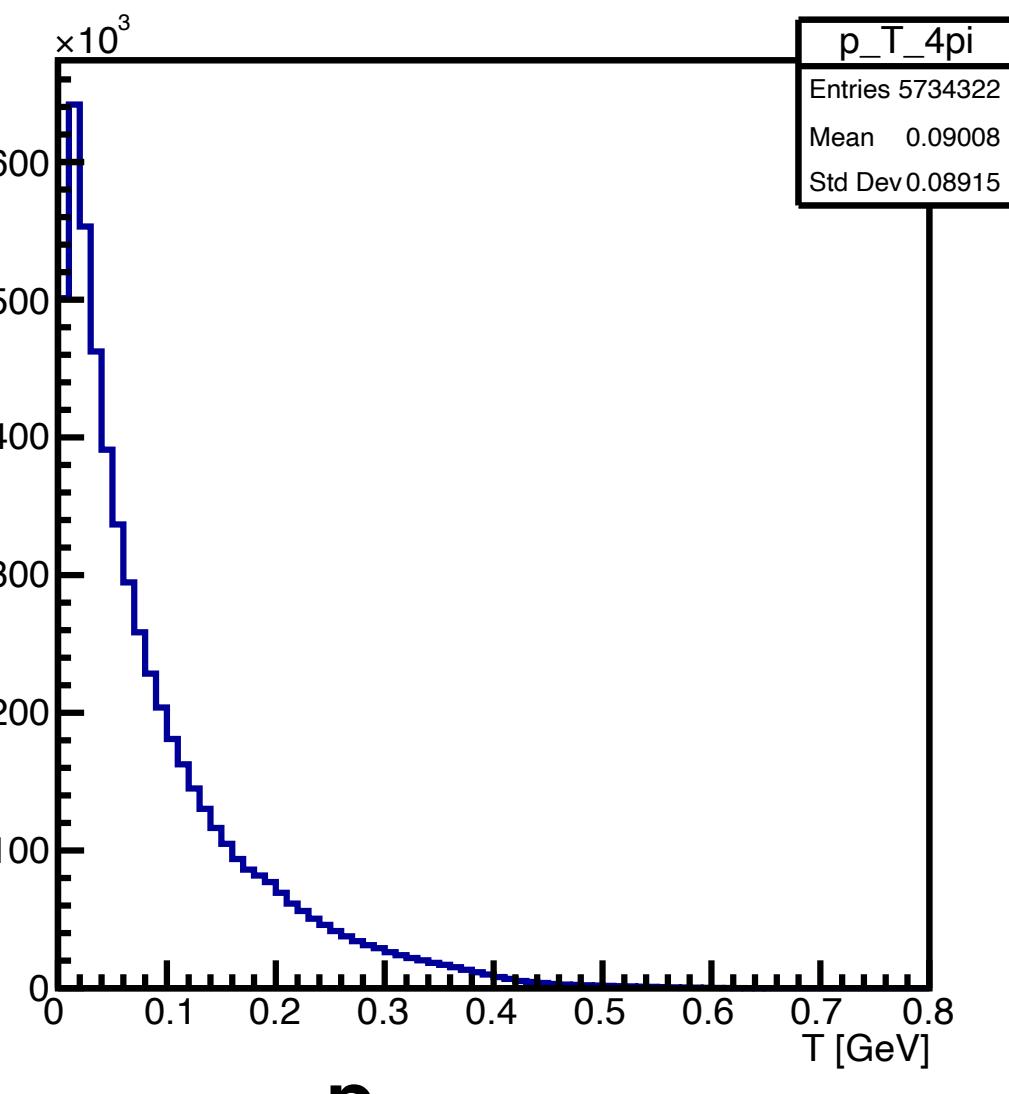


kinetic energy

full analysis chain



4pi



p

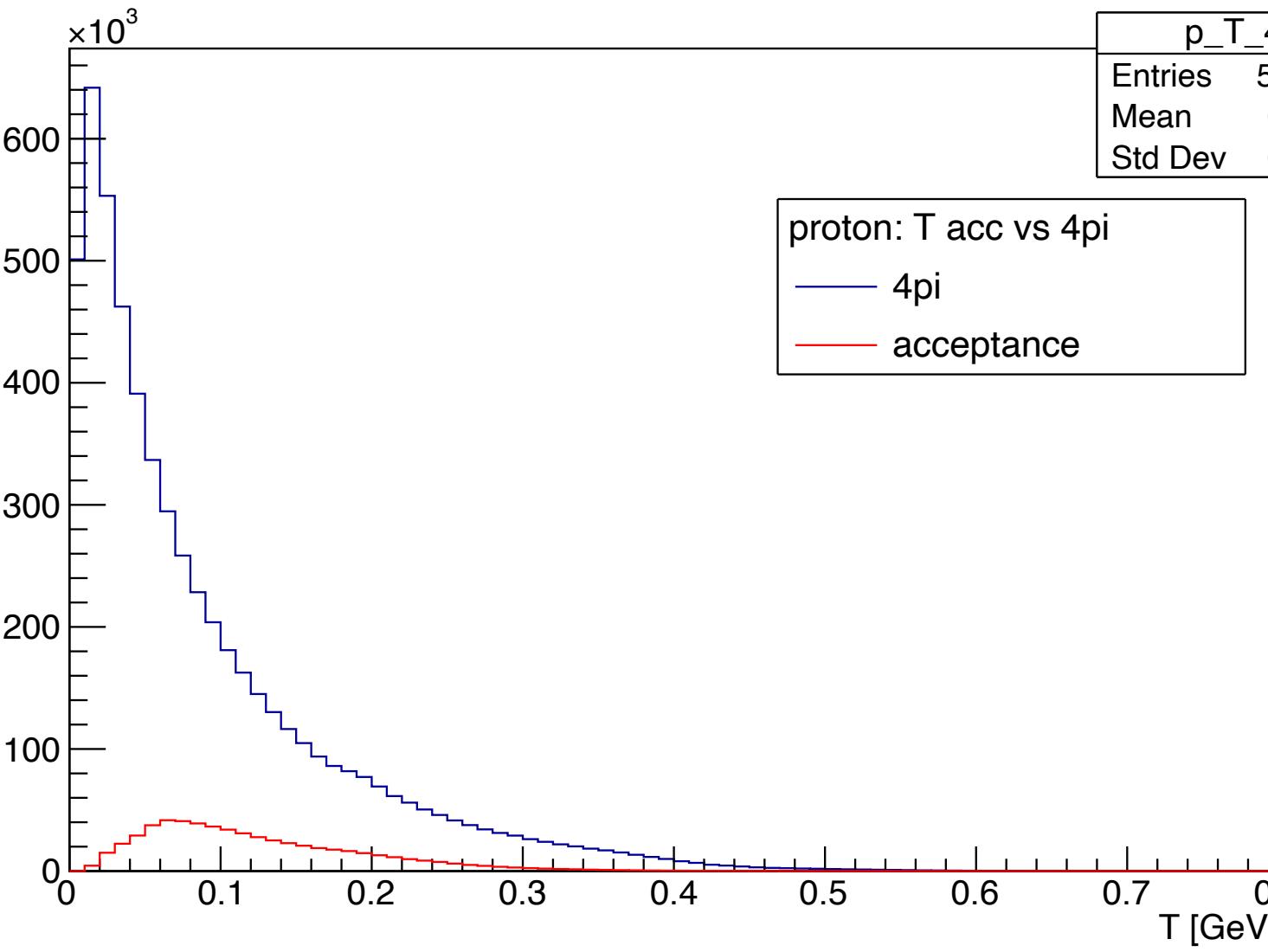
d

π^+

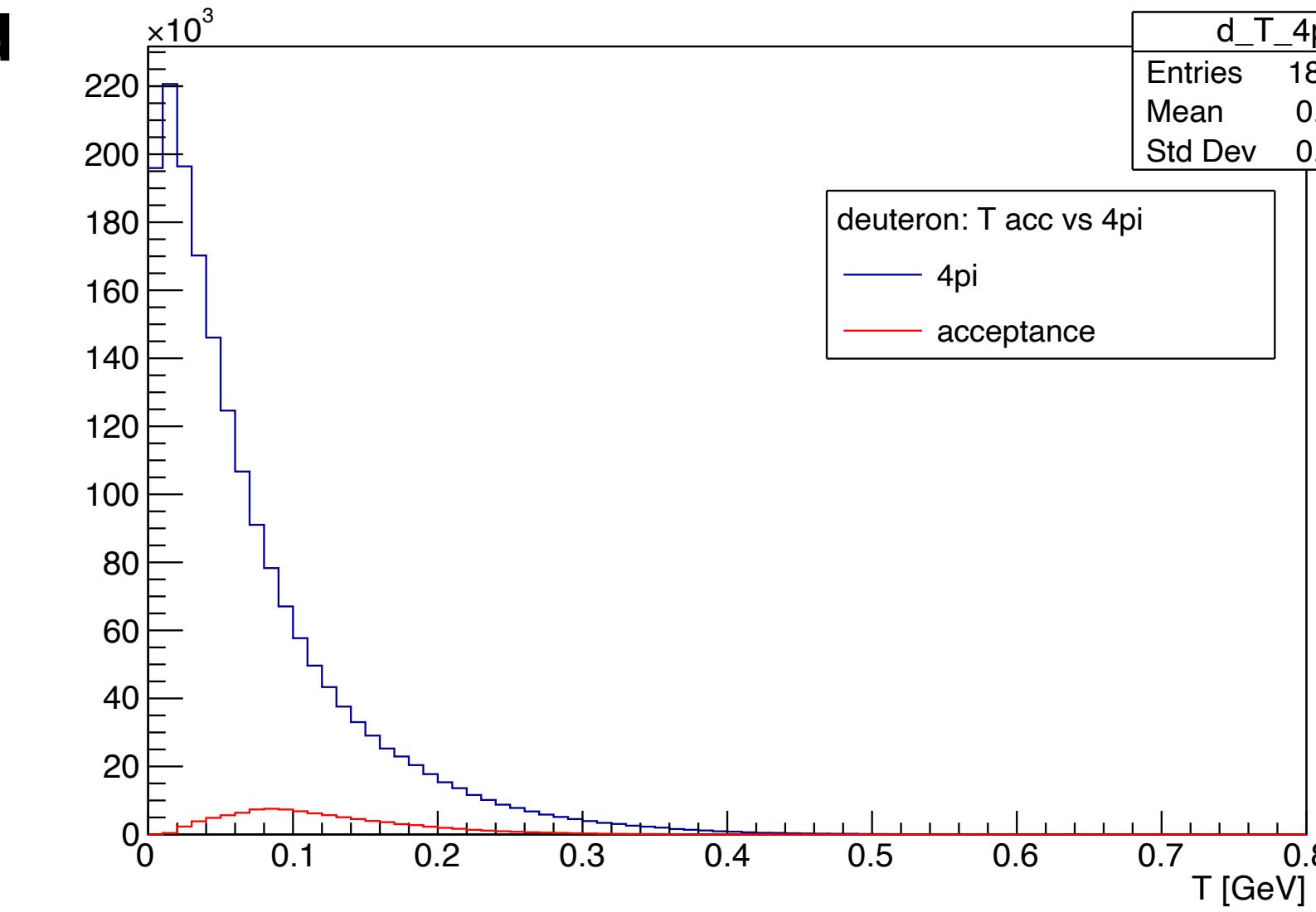
π^-

kinetic energy

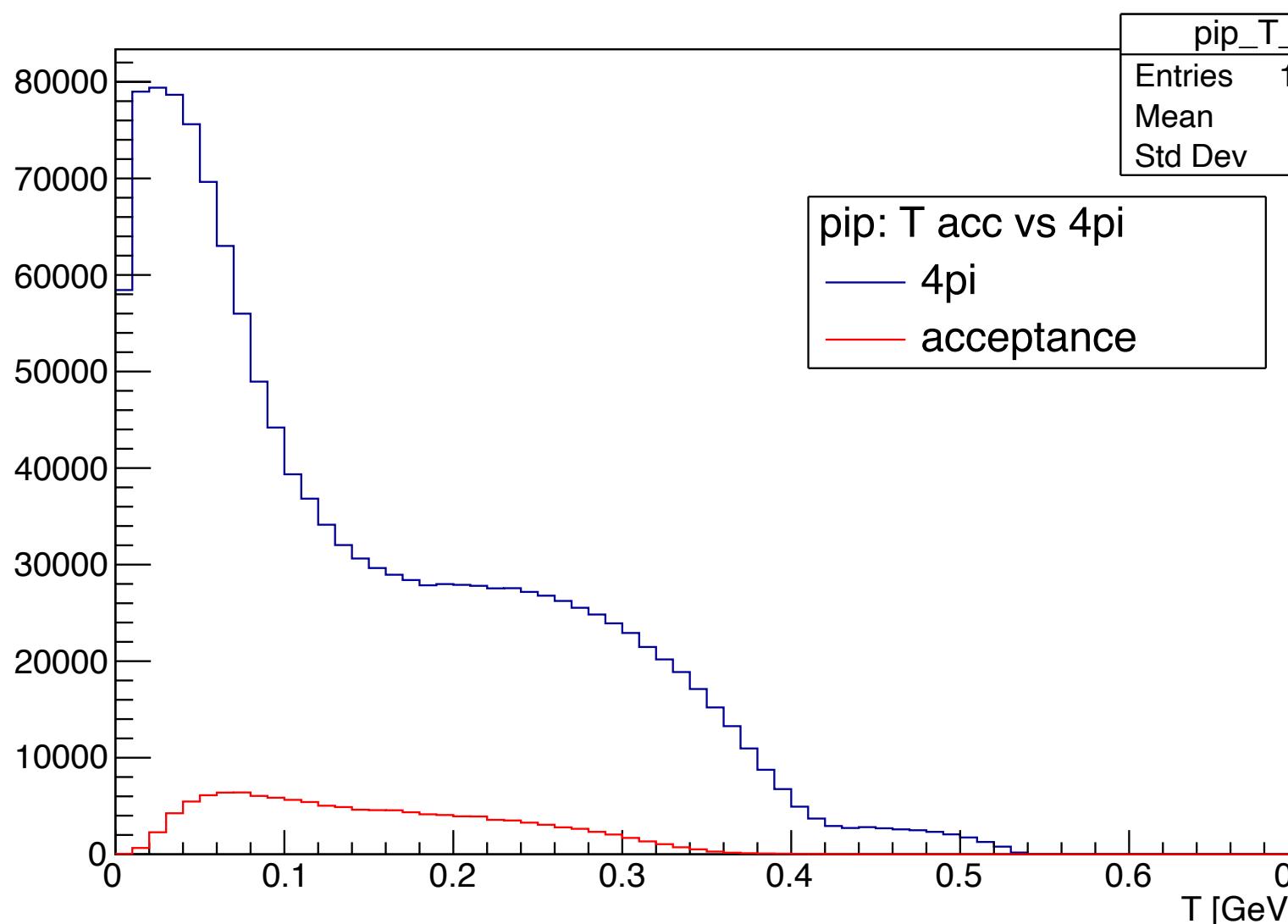
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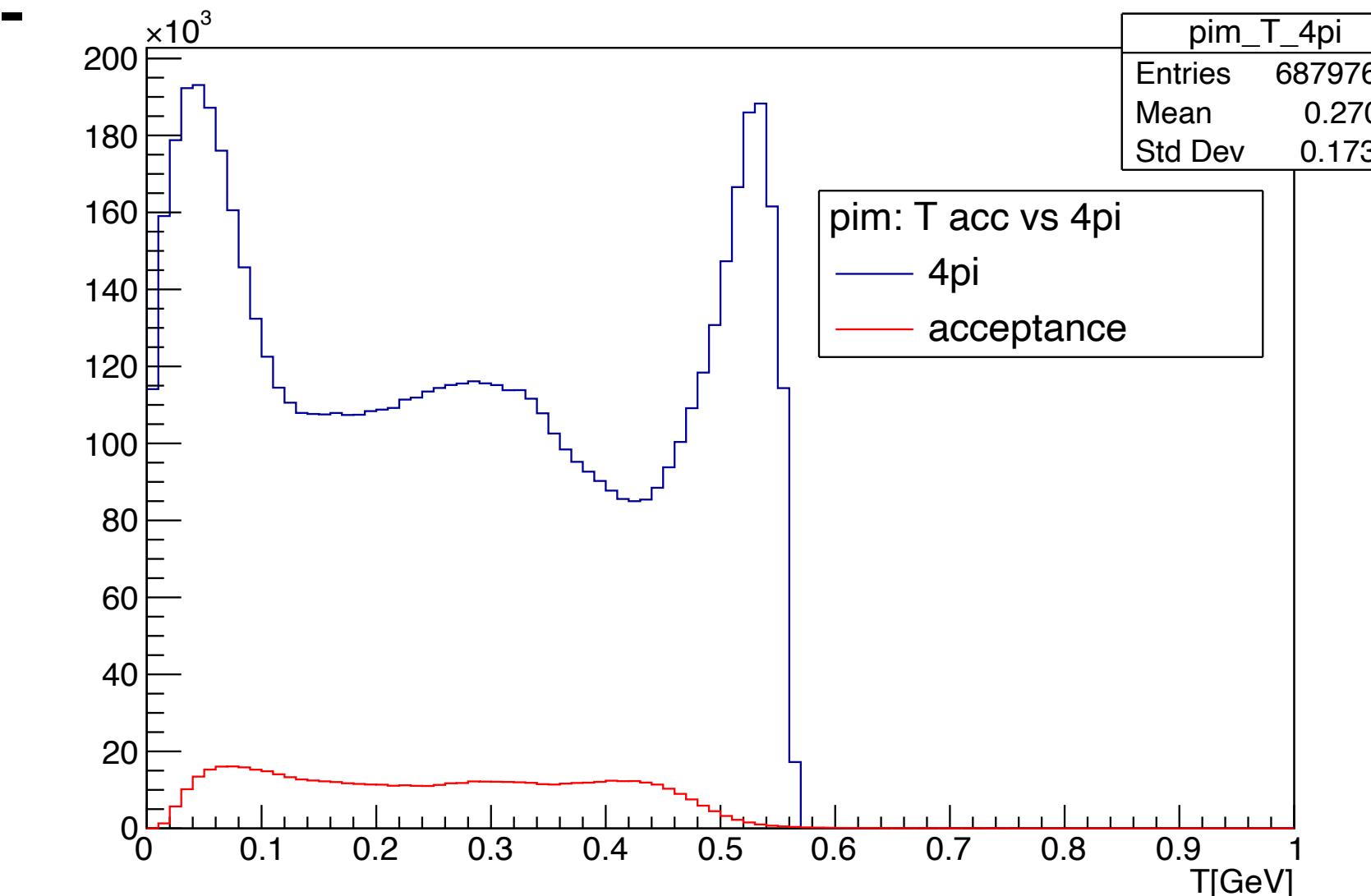
d



π^+

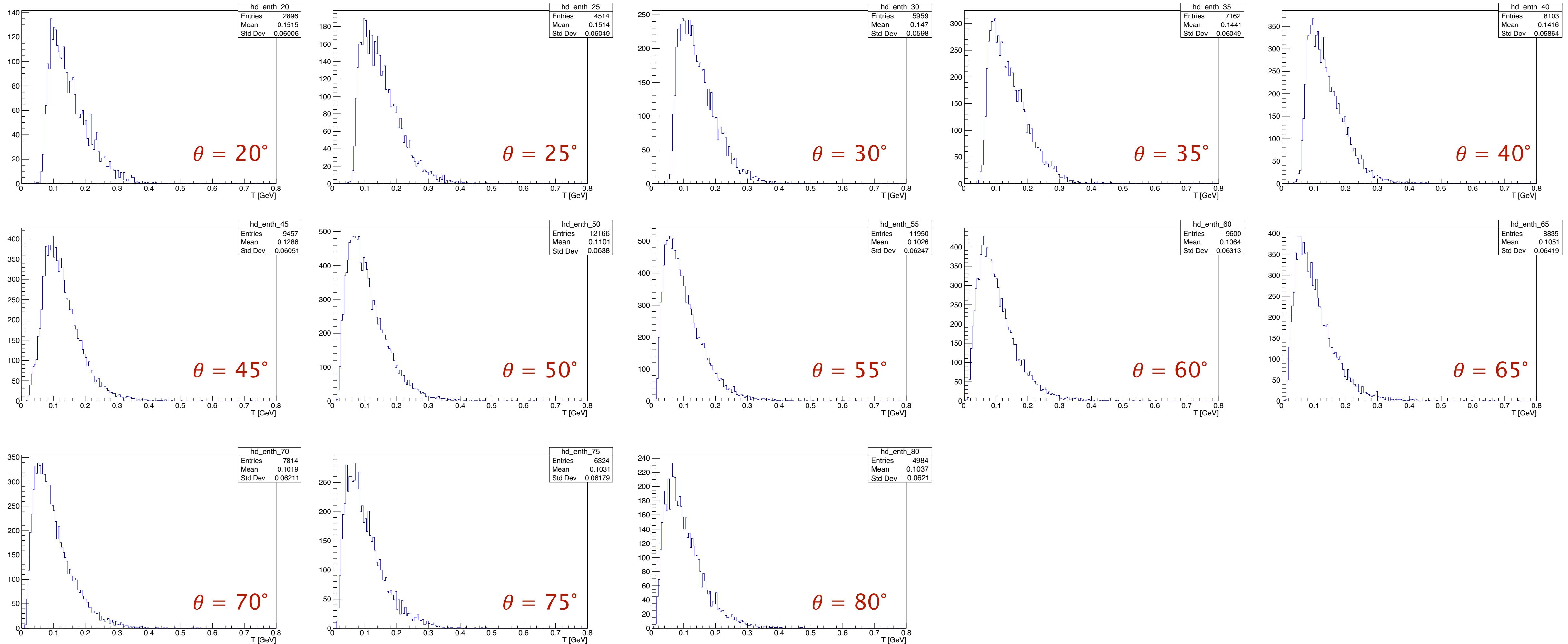


π^-



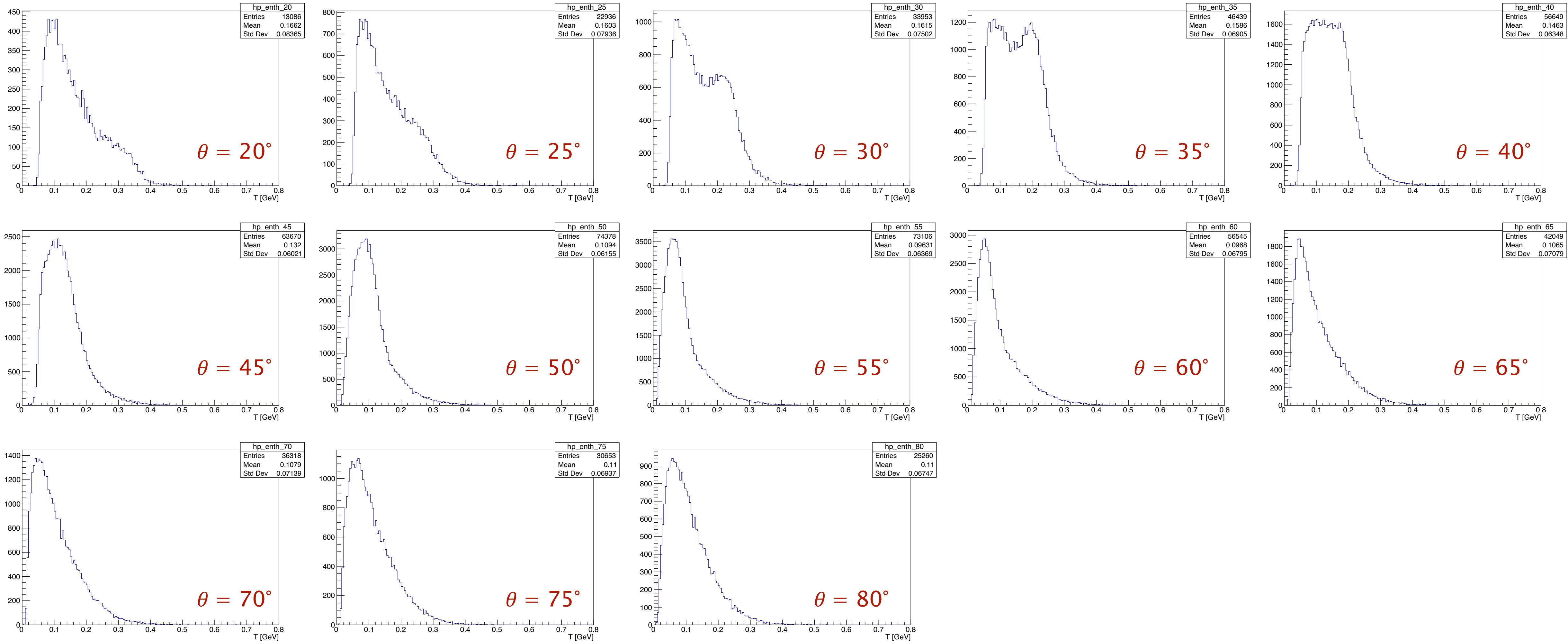
T-θ distributions: d

θ from 20° to 80°
 $\Delta\theta = 5^\circ$



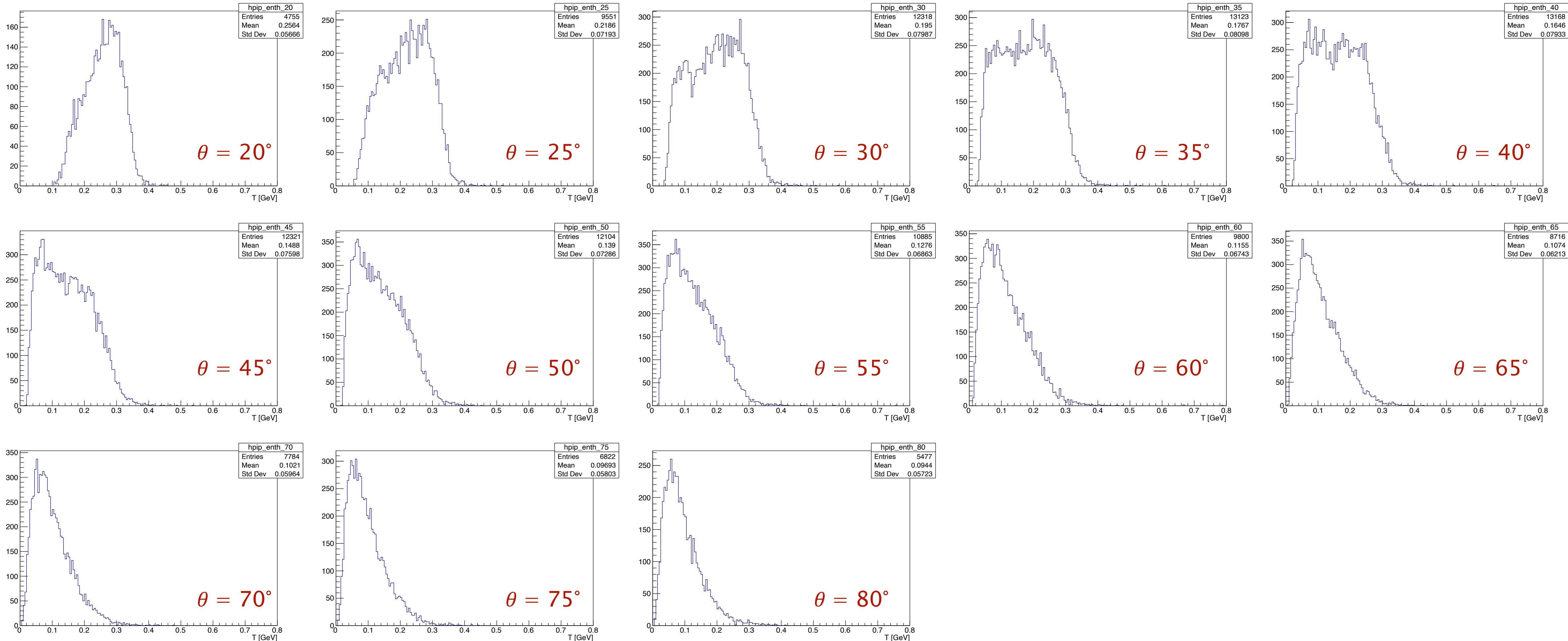
T-θ distributions: p

θ from 20° to 80°
 $\Delta\theta = 5^\circ$



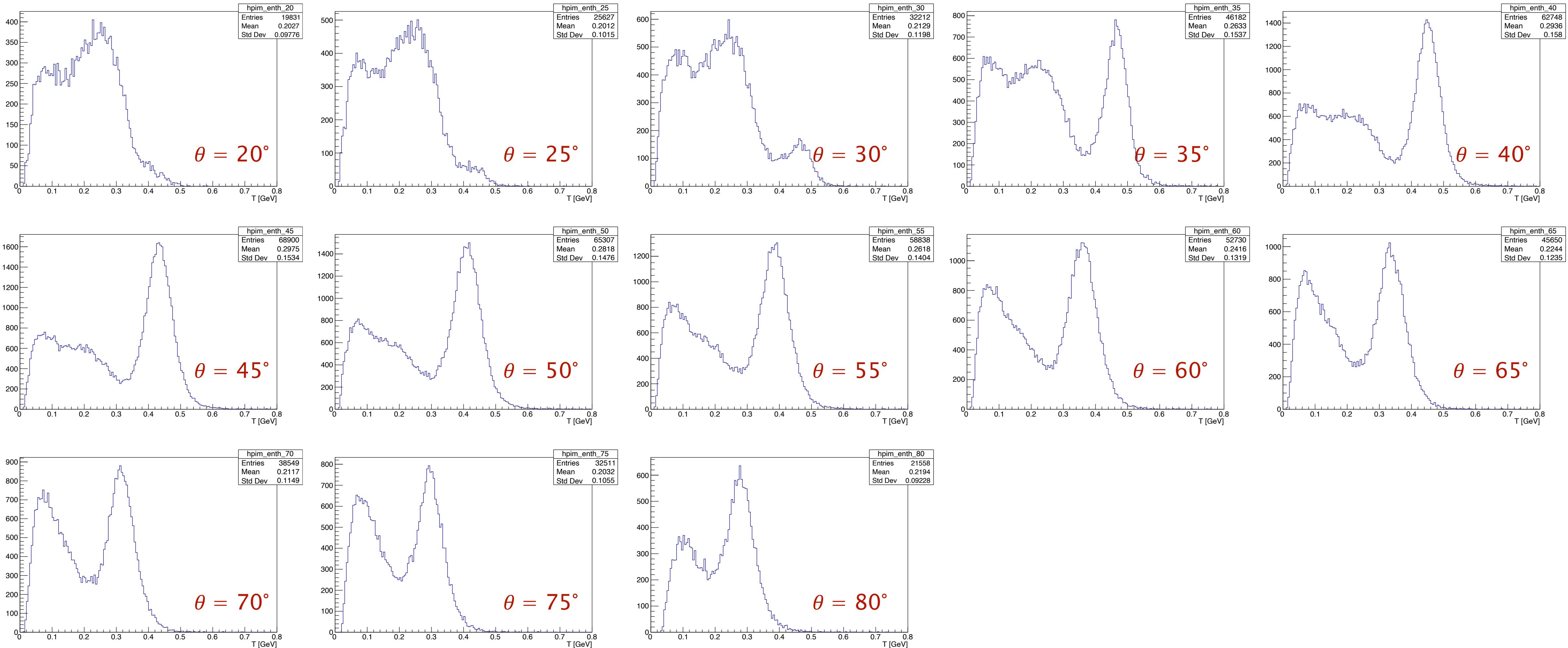
T - θ distributions: π^+

θ from 20° to 80°
 $\Delta\theta = 5^\circ$

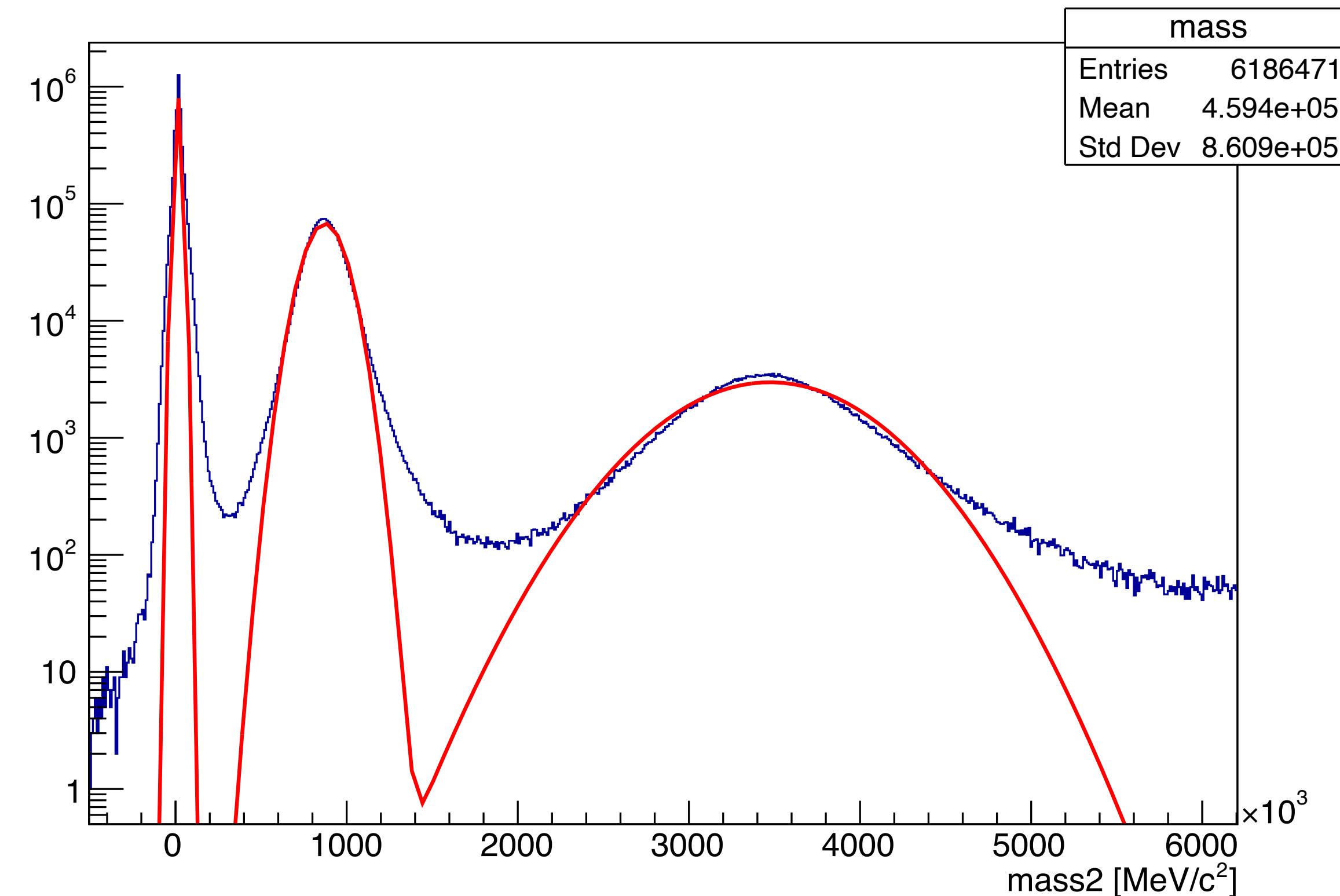
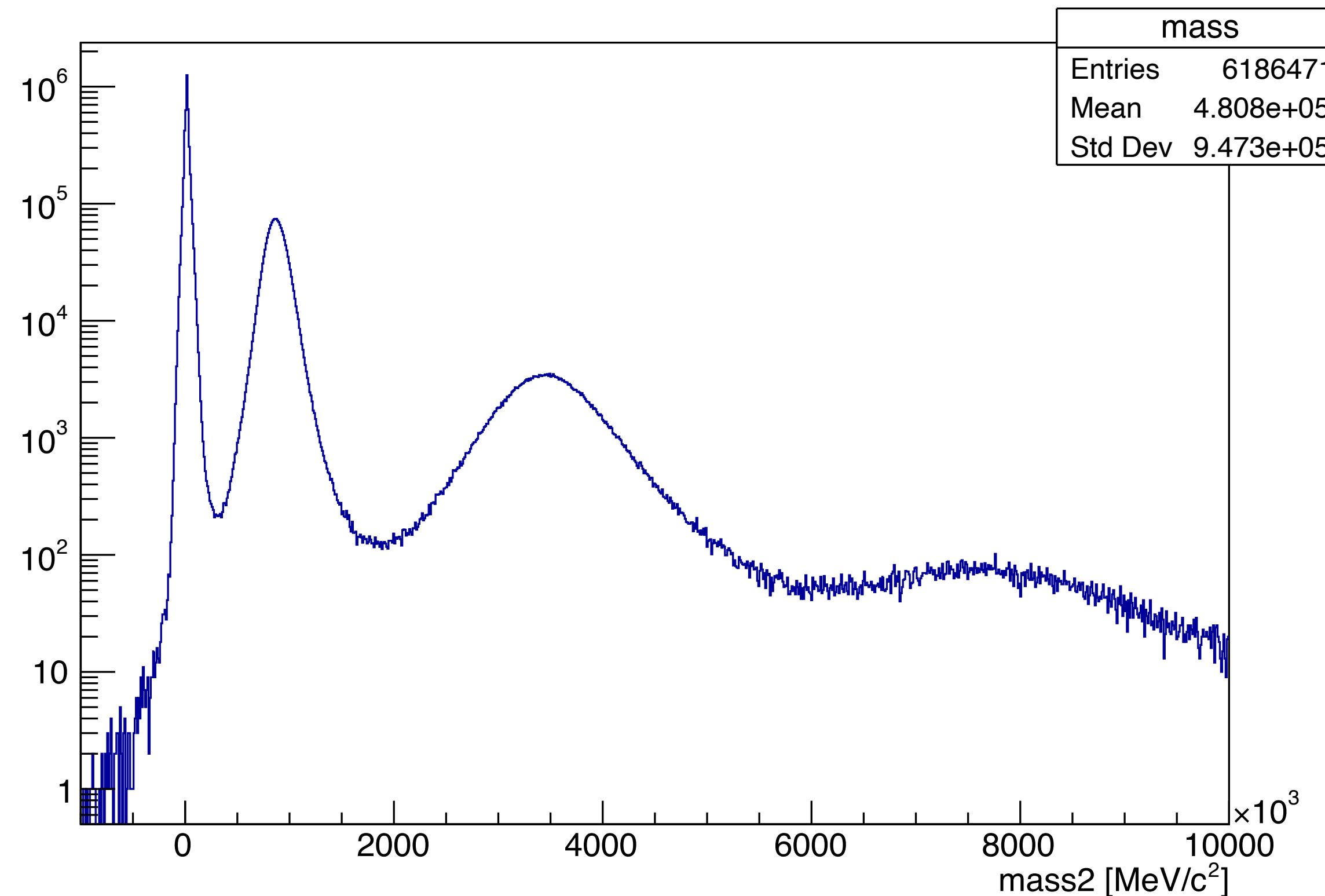


T - θ distributions: π^-

θ from 20° to 80°
 $\Delta\theta = 5^\circ$



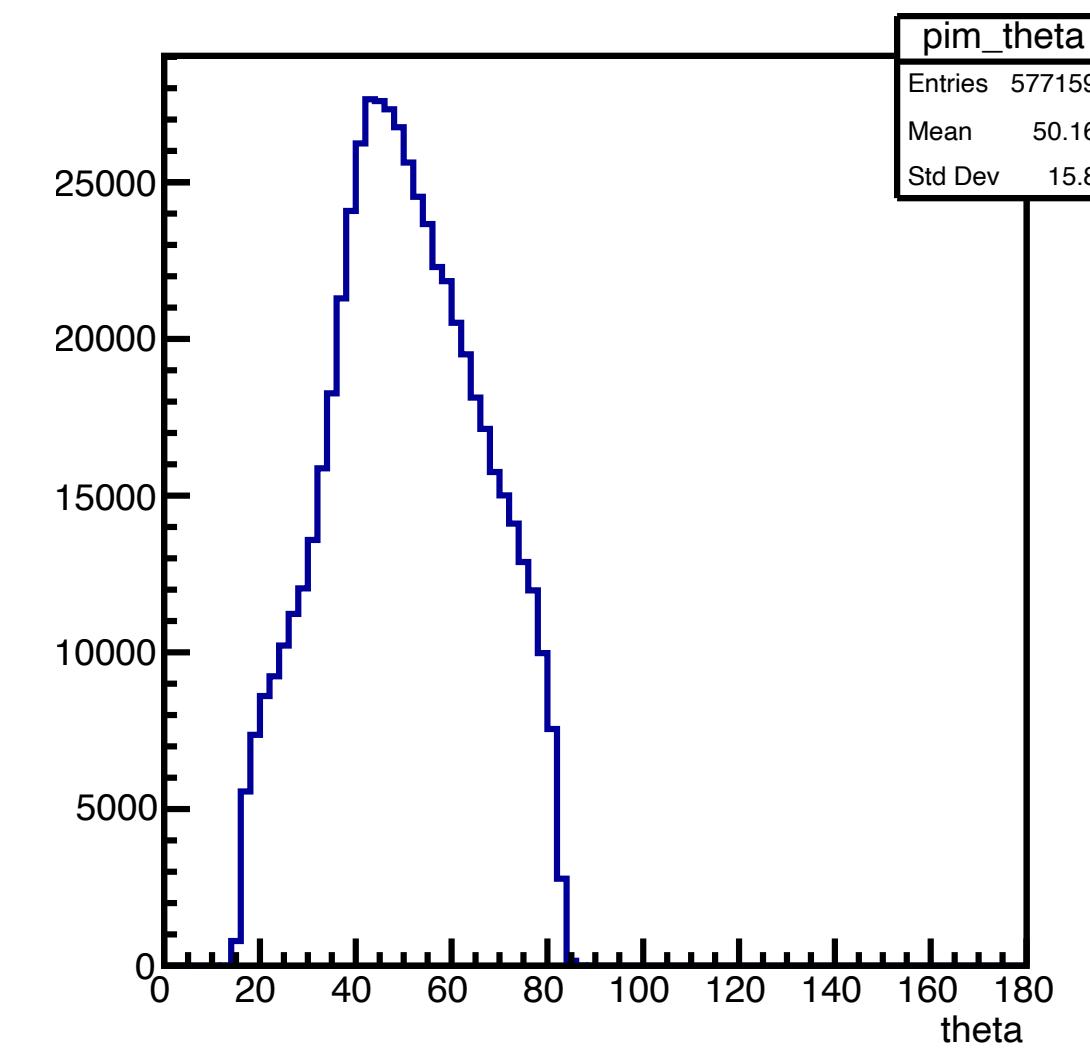
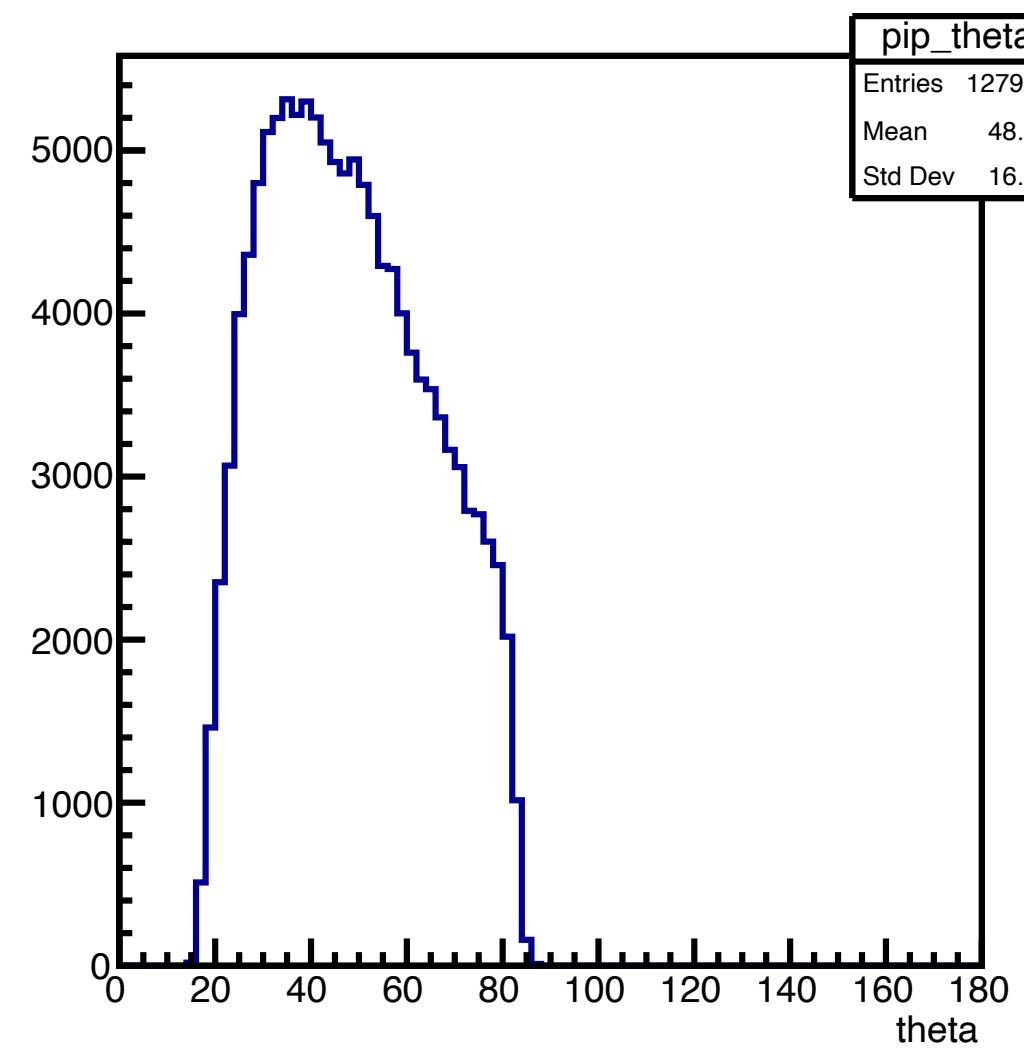
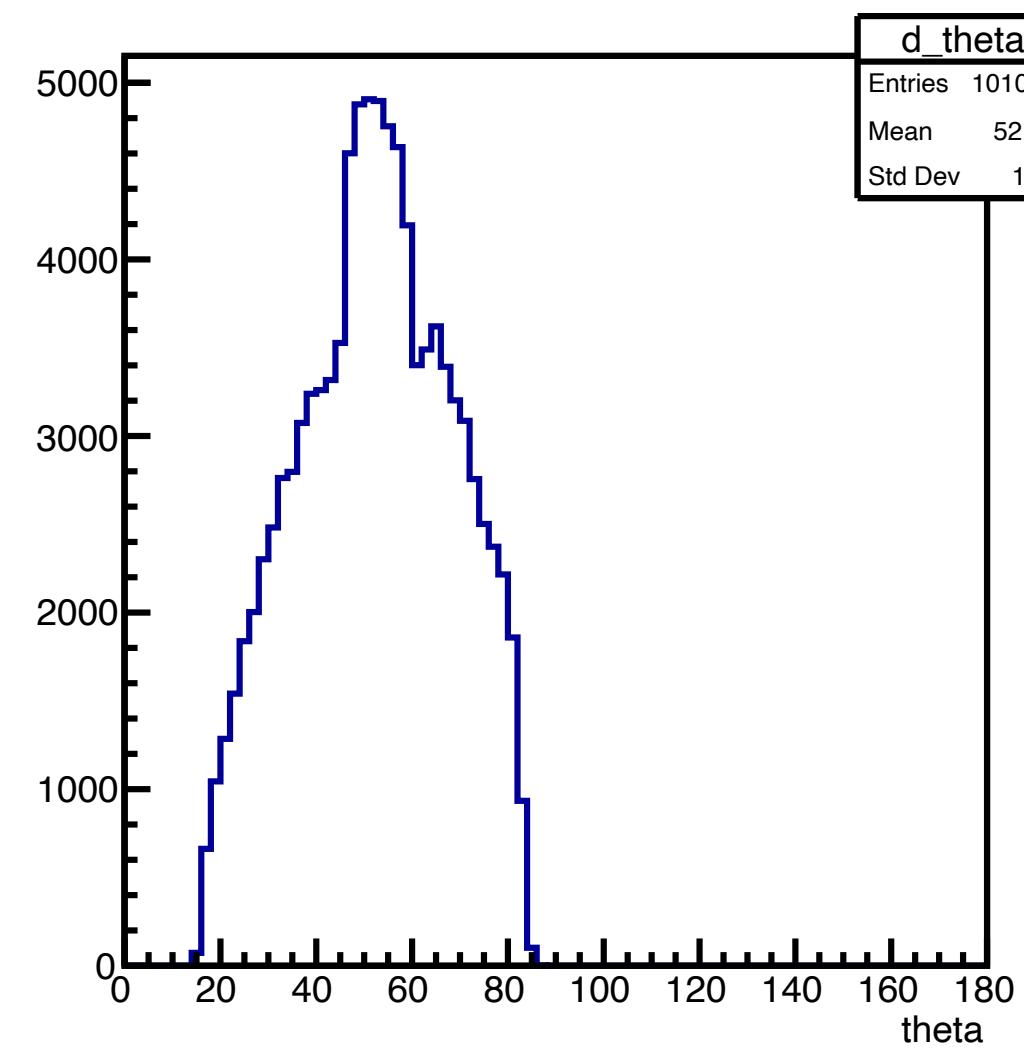
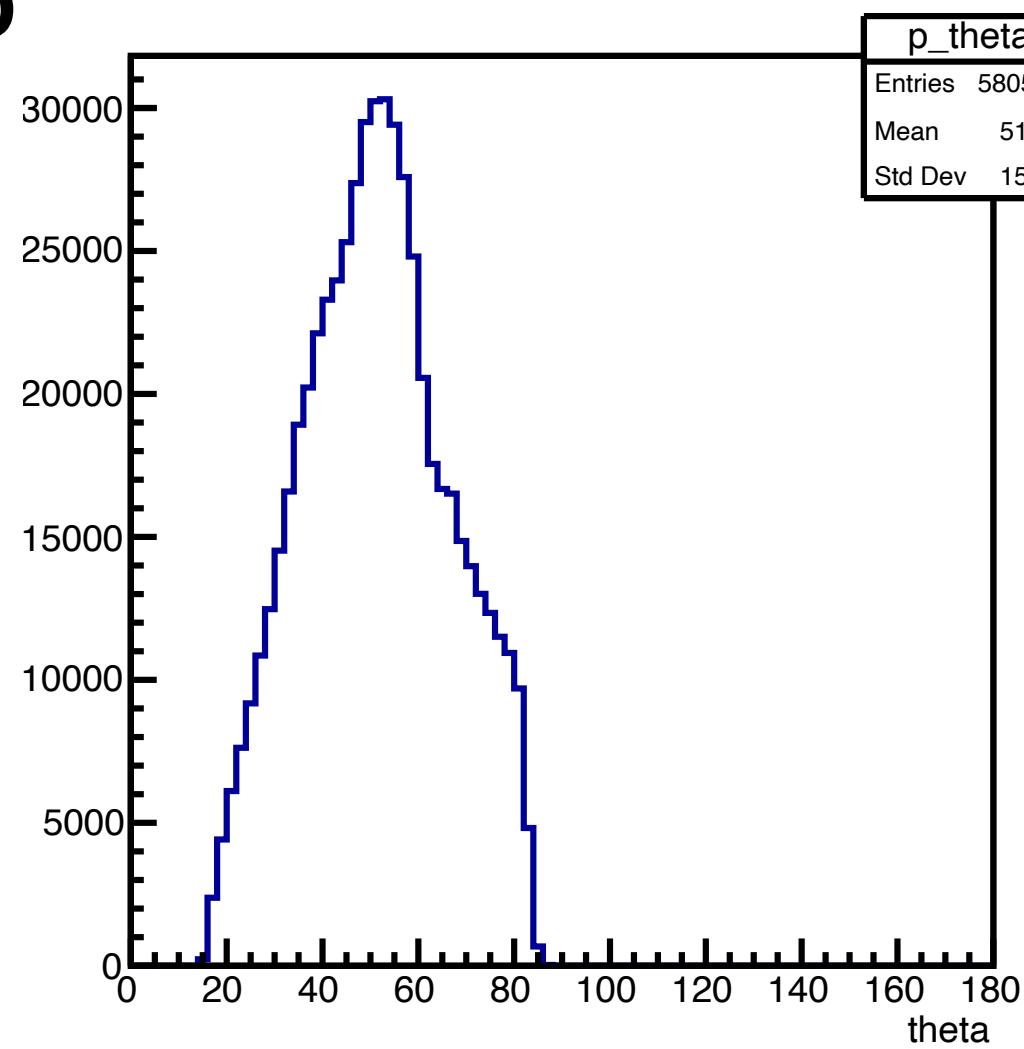
mass cuts



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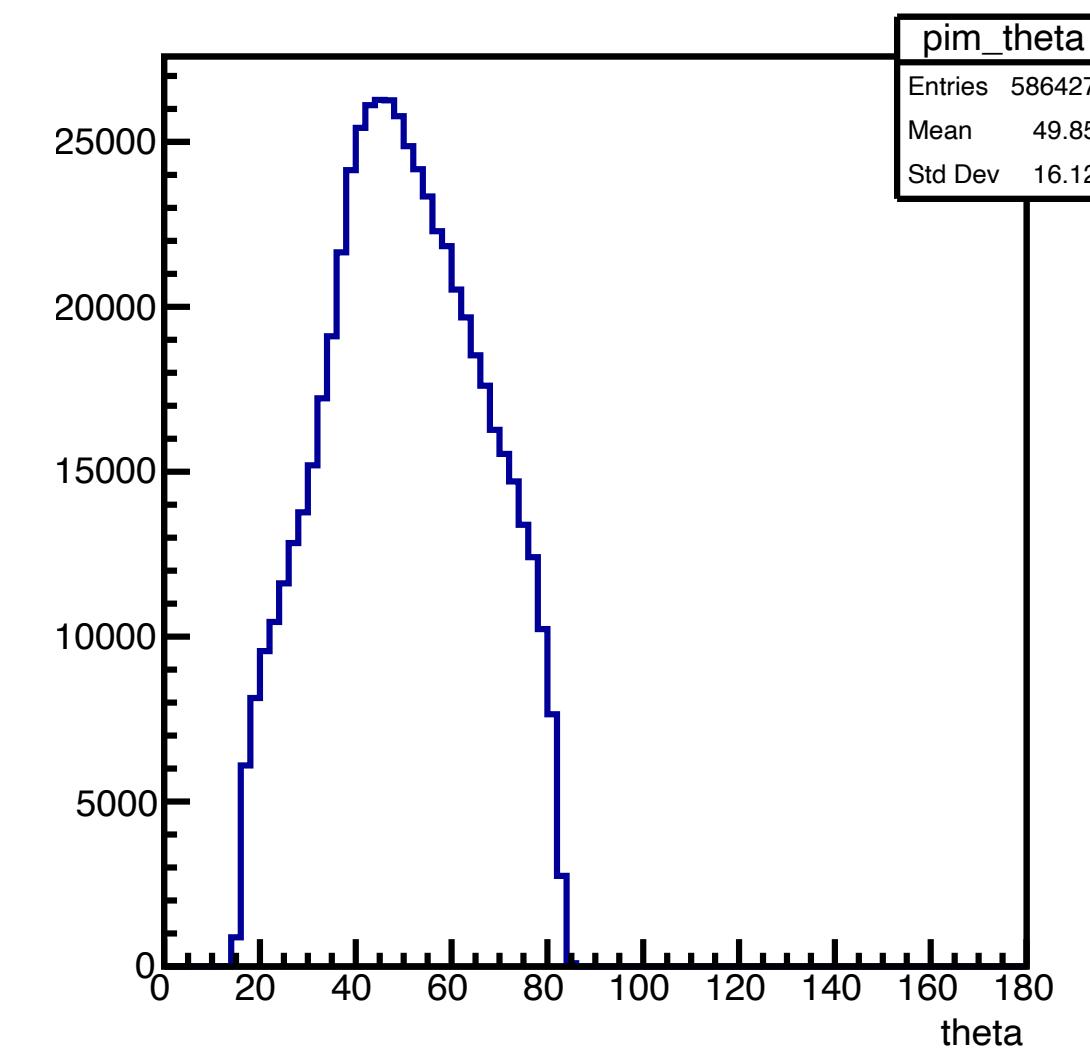
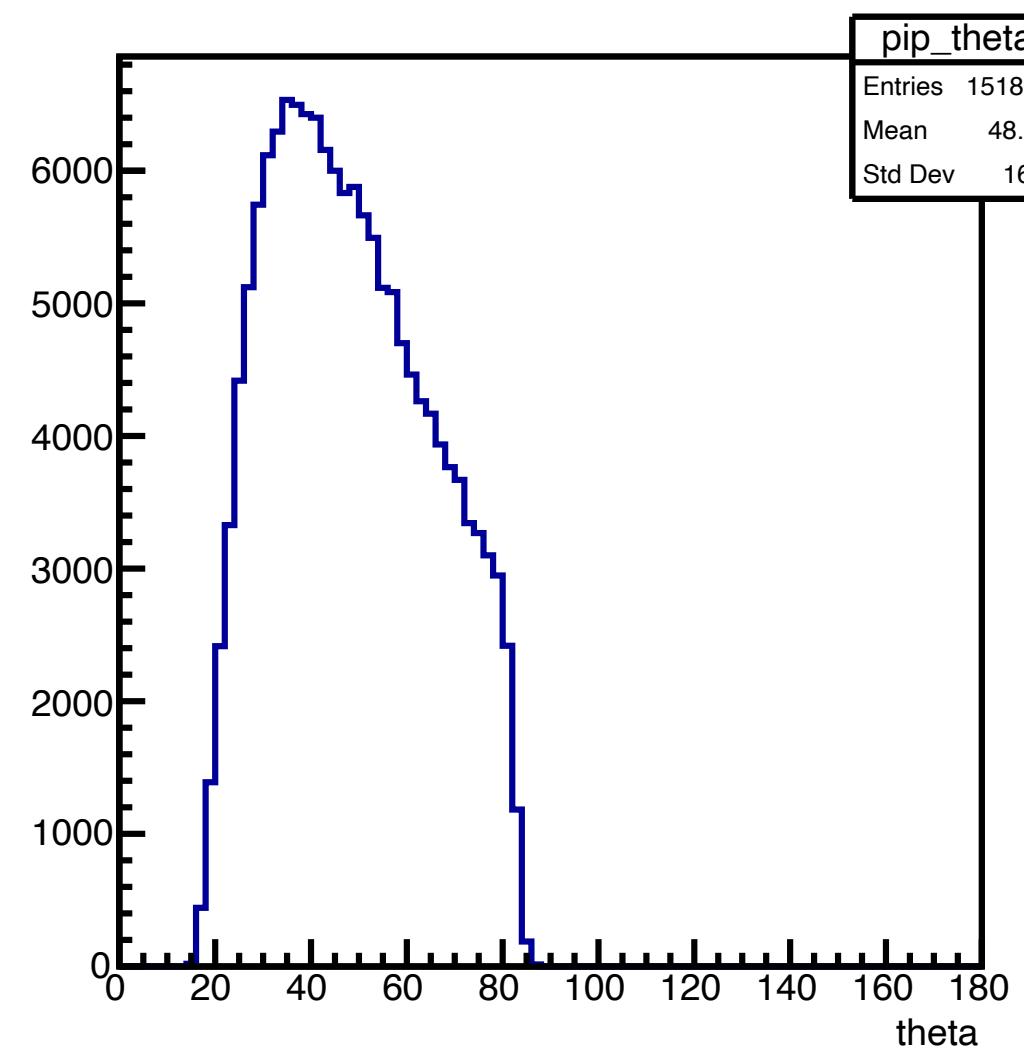
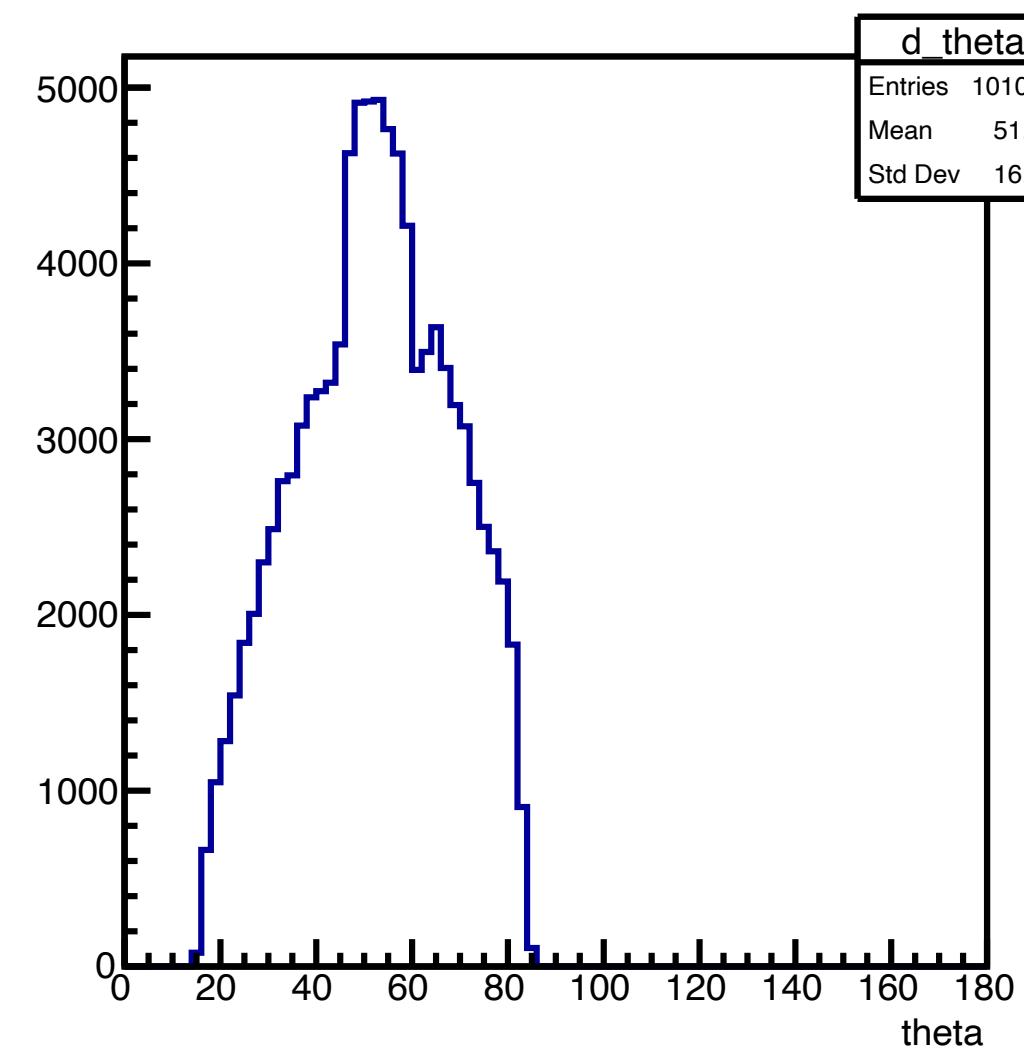
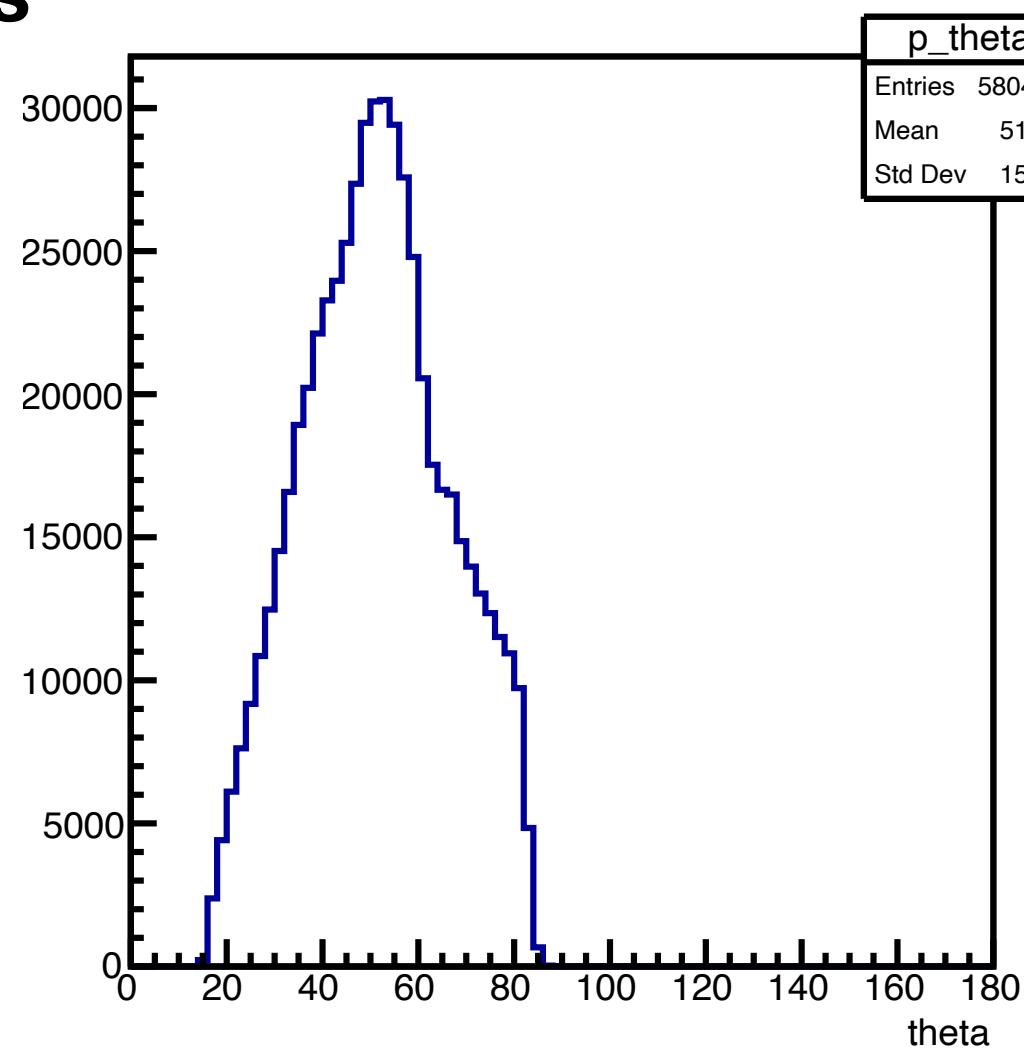
mass cuts vs GeantPID comparison

PID



< 1%

cuts



19% extra

2% extra

experimental data vs INCL

- experimental data compared to INCL simulation in acceptance
- both are normalized in two ways:
 - A **counts -> mb / unit**
 - INCL: -> $\text{Scale}(1.462 \times 10^{-5})$ total cross-section [mb] / # of simulated events
(1462.32mb / 100 000 000)
 - data: -> $\text{Scale}(10.165 \times 10^{-7})$ derived from elastic pim-p and rescaled to pim+12C
(Fatima presentation)
 - B
 - -> $\text{Scale}(1/\text{Integral}())$

III. NORMALISATION

counts -> mb/unit

Data :

$$F_{Norm} = 2 \times \frac{\sigma_{el}}{N_{el}} \times F_{C/CH2}.$$

- Normalisation for pi+p cross section CH2 target (all statistics): $\frac{\sigma_{el}}{N_{el}} 1.107 \times 10^{-7}$
 - σ_{el} - known cross-section of elastic scattering in full solid angle.
 - N_{el} - number of elastic scattering events in full solid angle
 - N_R - number of collisions of the reaction of interest.
- relative normalisation C (all stat.)/CH2 (all stat.) = $F_{C/CH2} = 1./0.2178$.

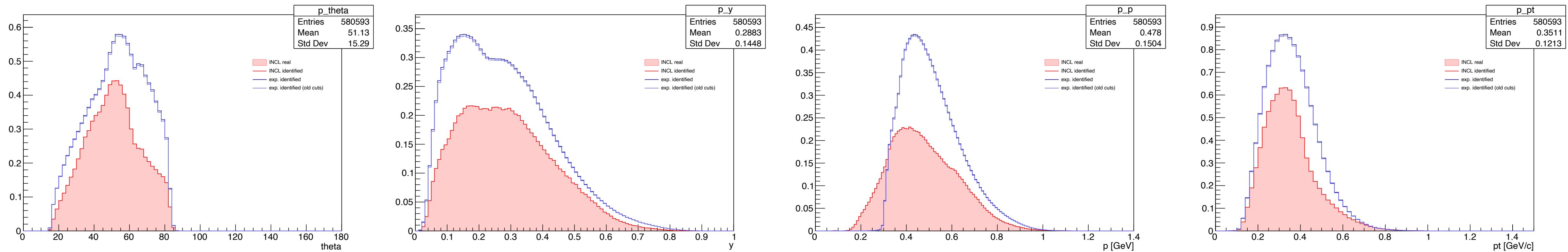
INCL :

$$F_{Norm} = \frac{\sigma_{reaction}}{\text{Number of shots}}$$

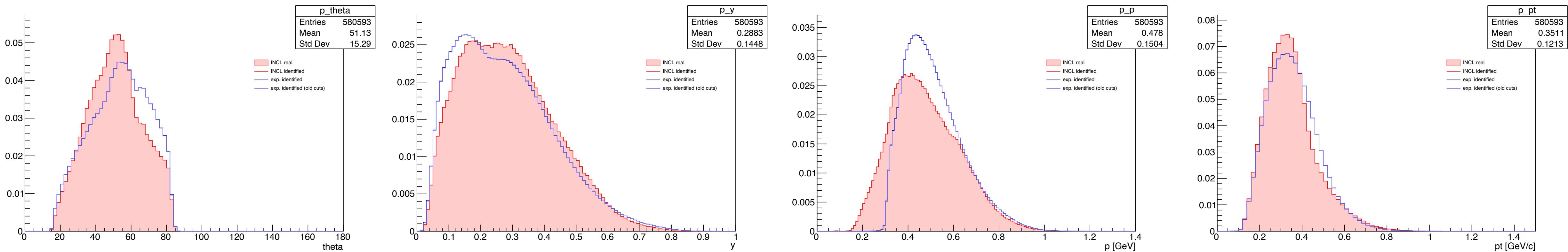
- $\sigma_{reaction} = 1462.32$ mb.
- Number of shots = 100 000 000.

experimental data vs INCL: p

A

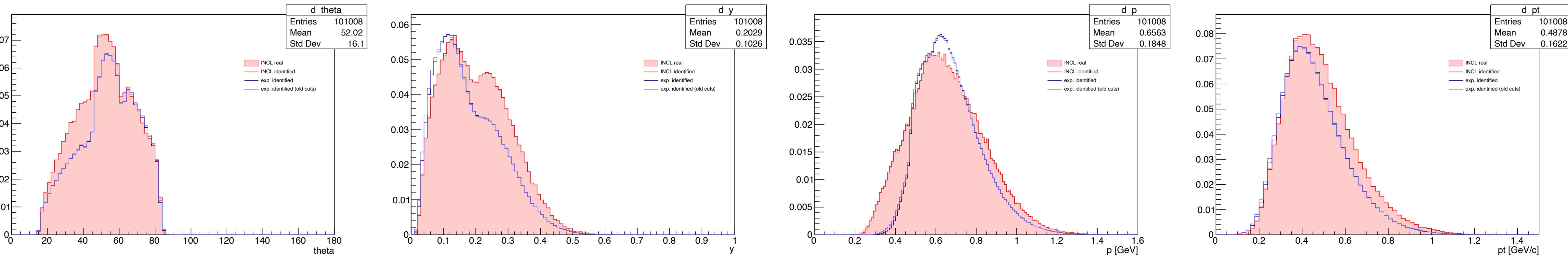


B

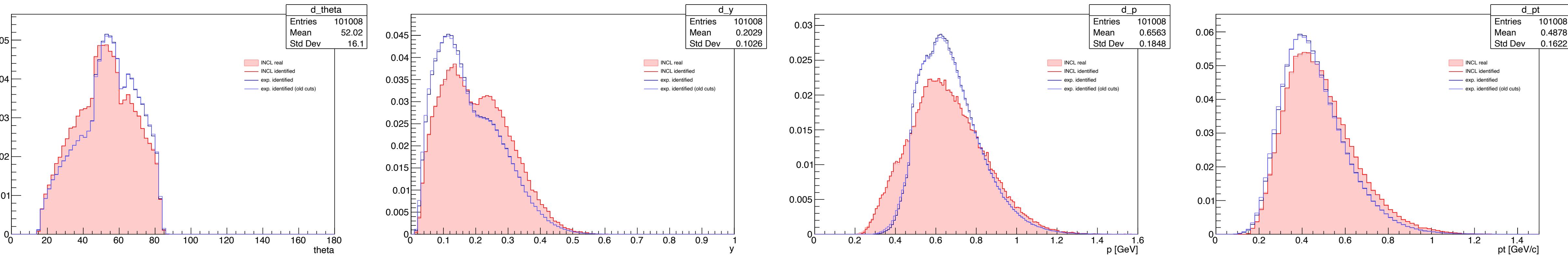


experimental data vs INCL: d

A

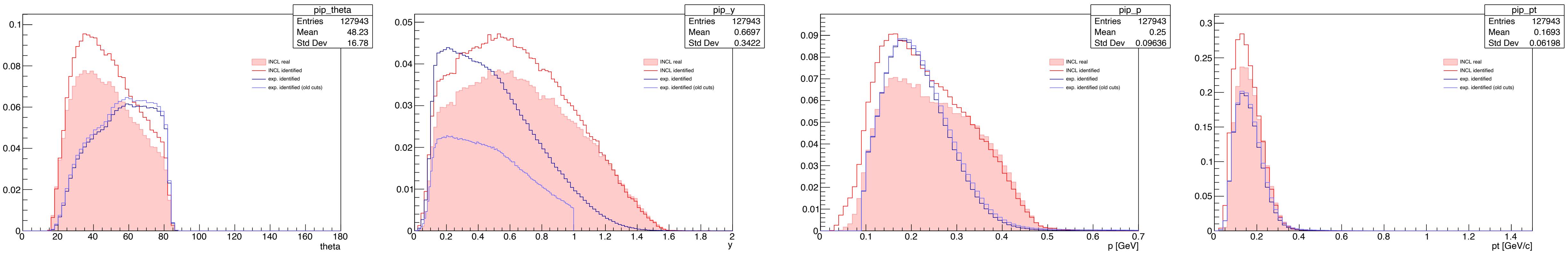


B

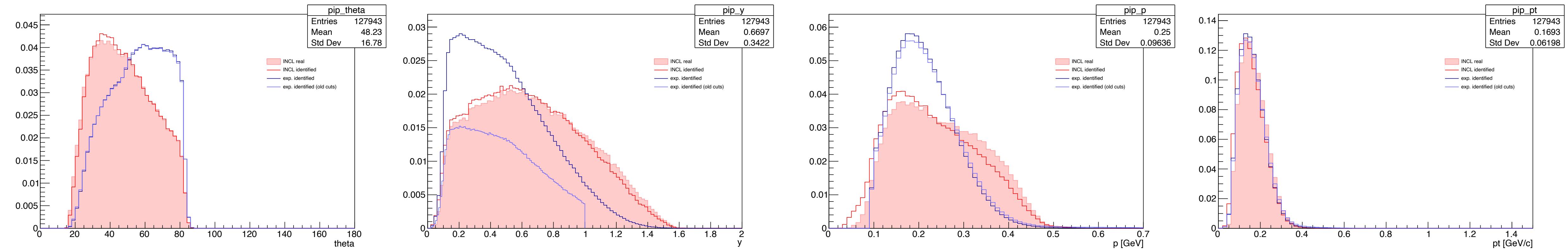


experimental data vs INCL: π^+

A

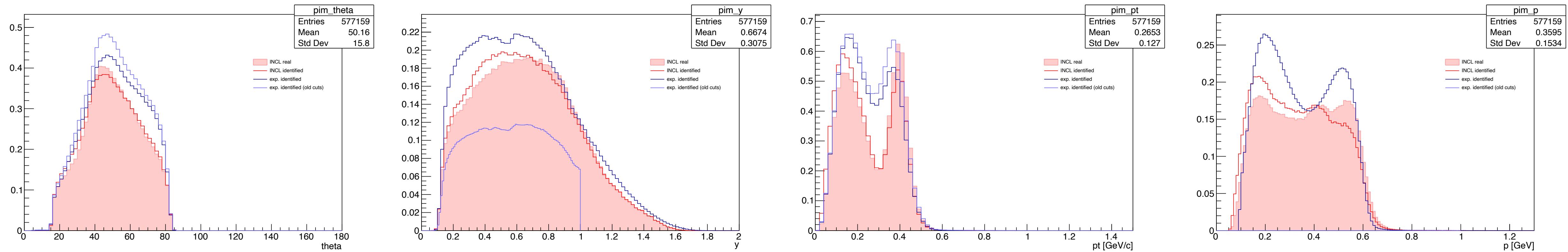


B

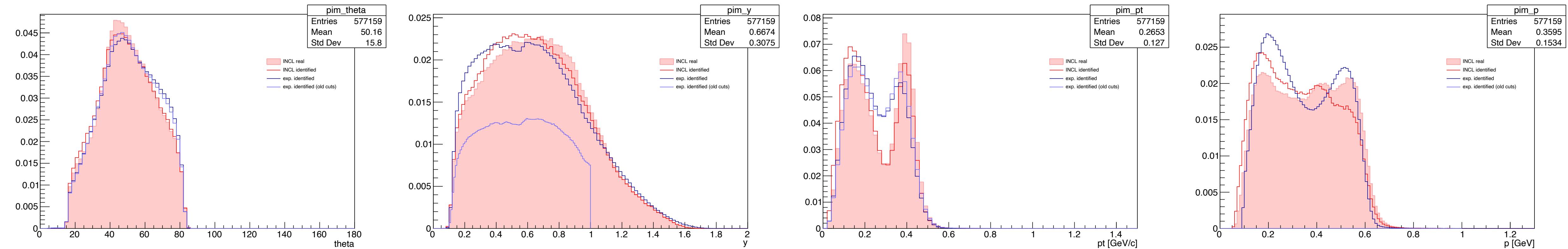


experimental data vs INCL: π^-

A



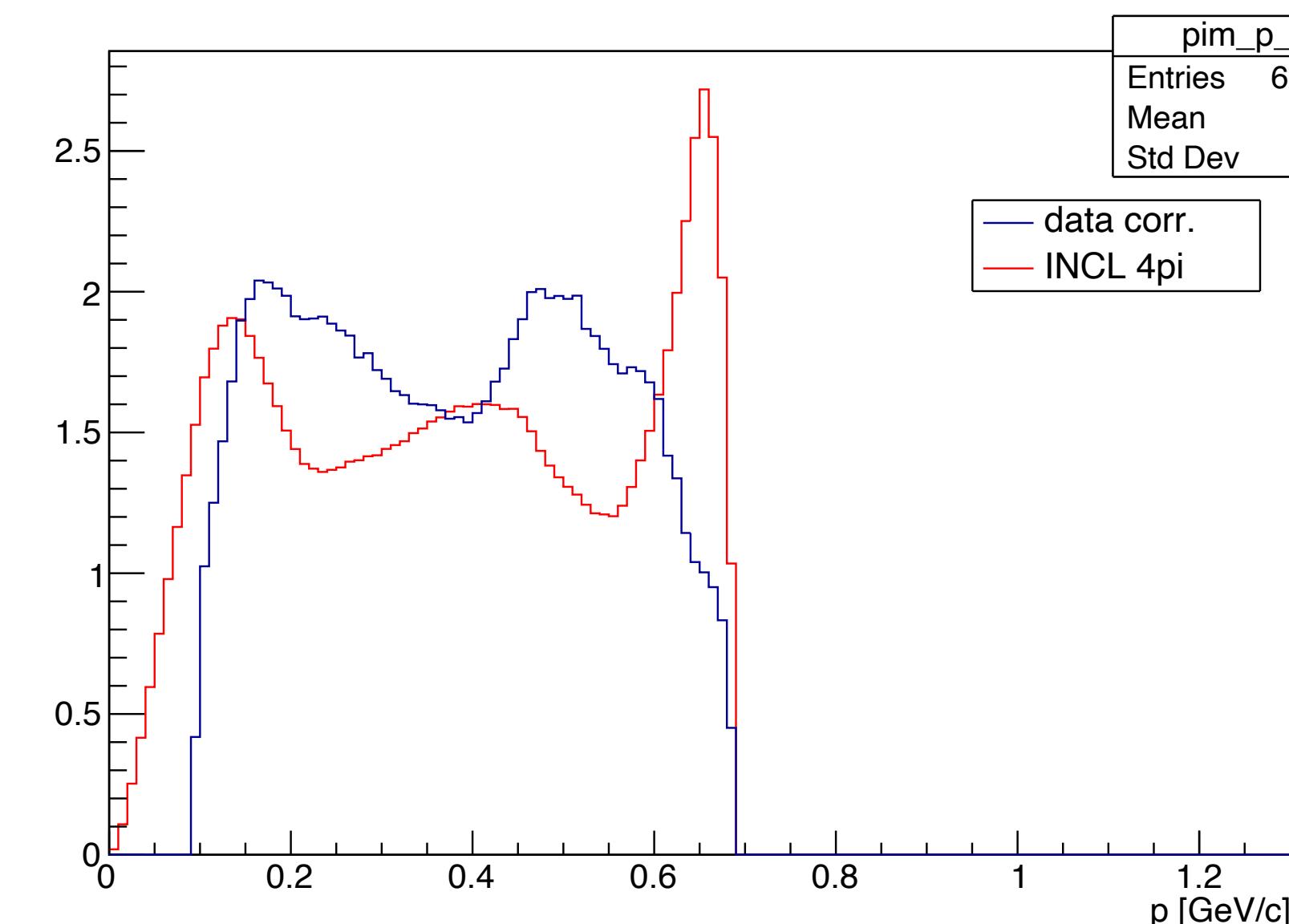
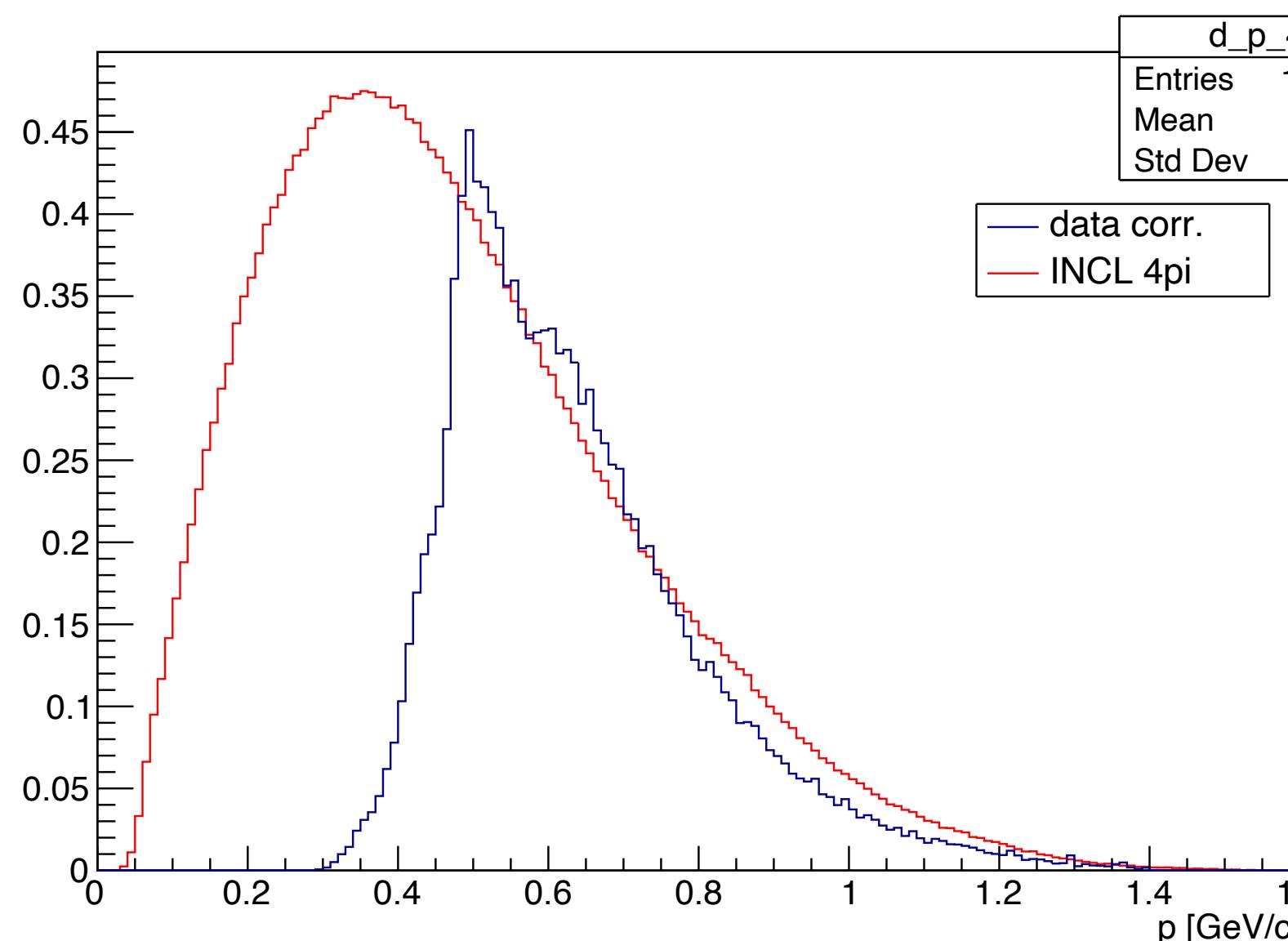
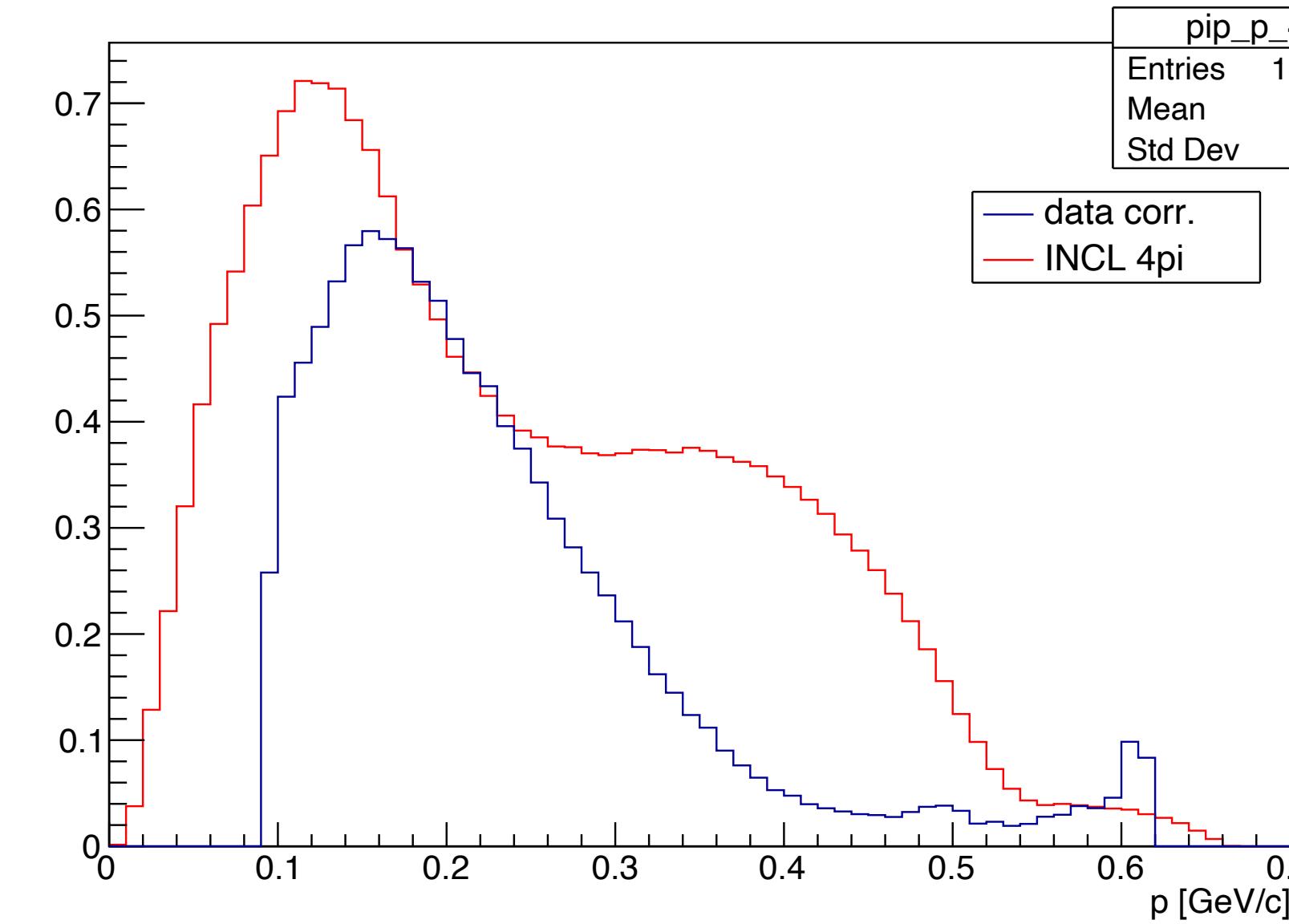
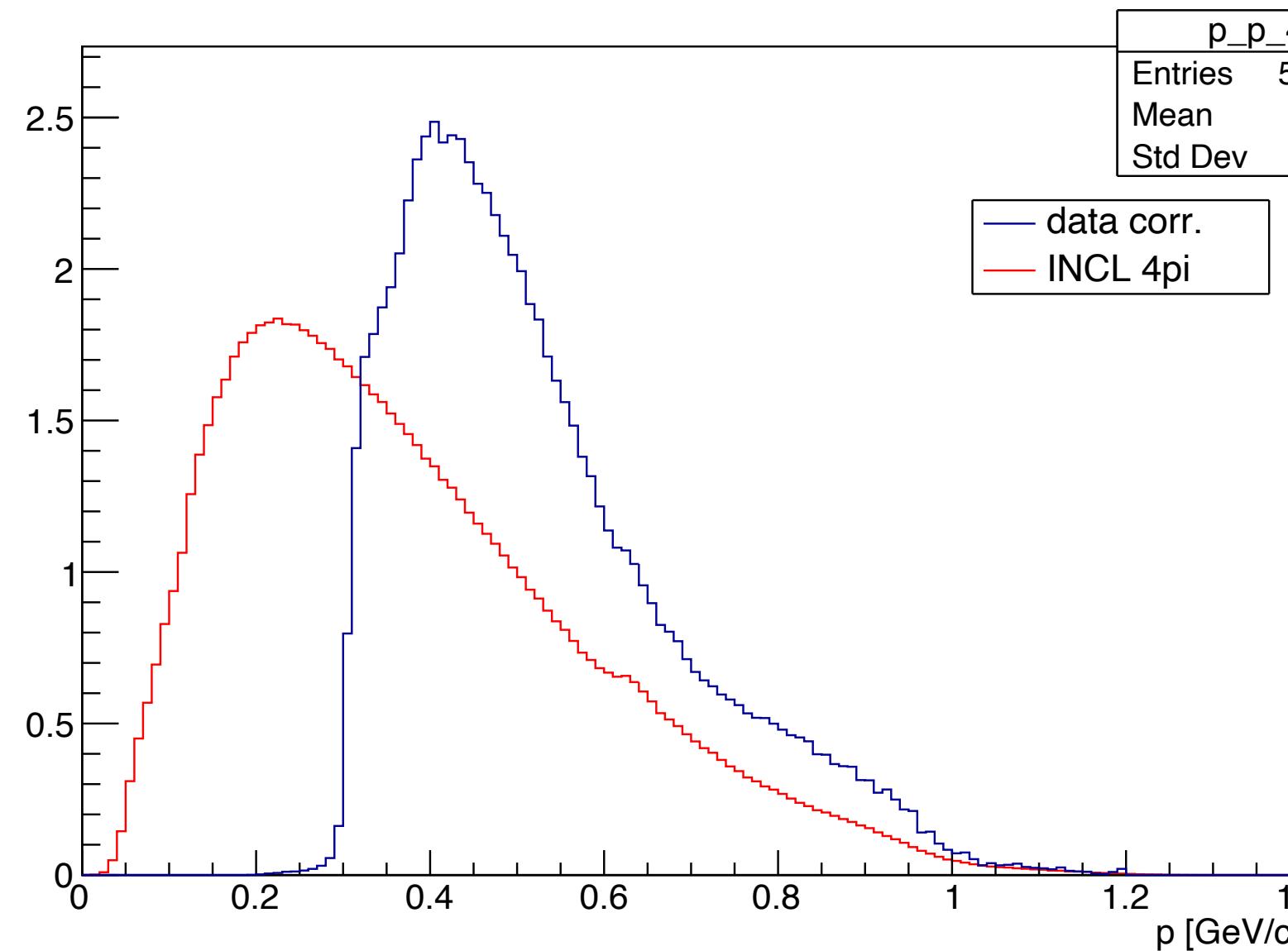
B



conclusion + what's next?

- what next?
 - M2 trigger problem
 - compare experimental data with INCL in 4 pi
(tried 1D acceptance*efficiency correction, need to check if 2D/3D correction is needed)
 - improve pip cuts?

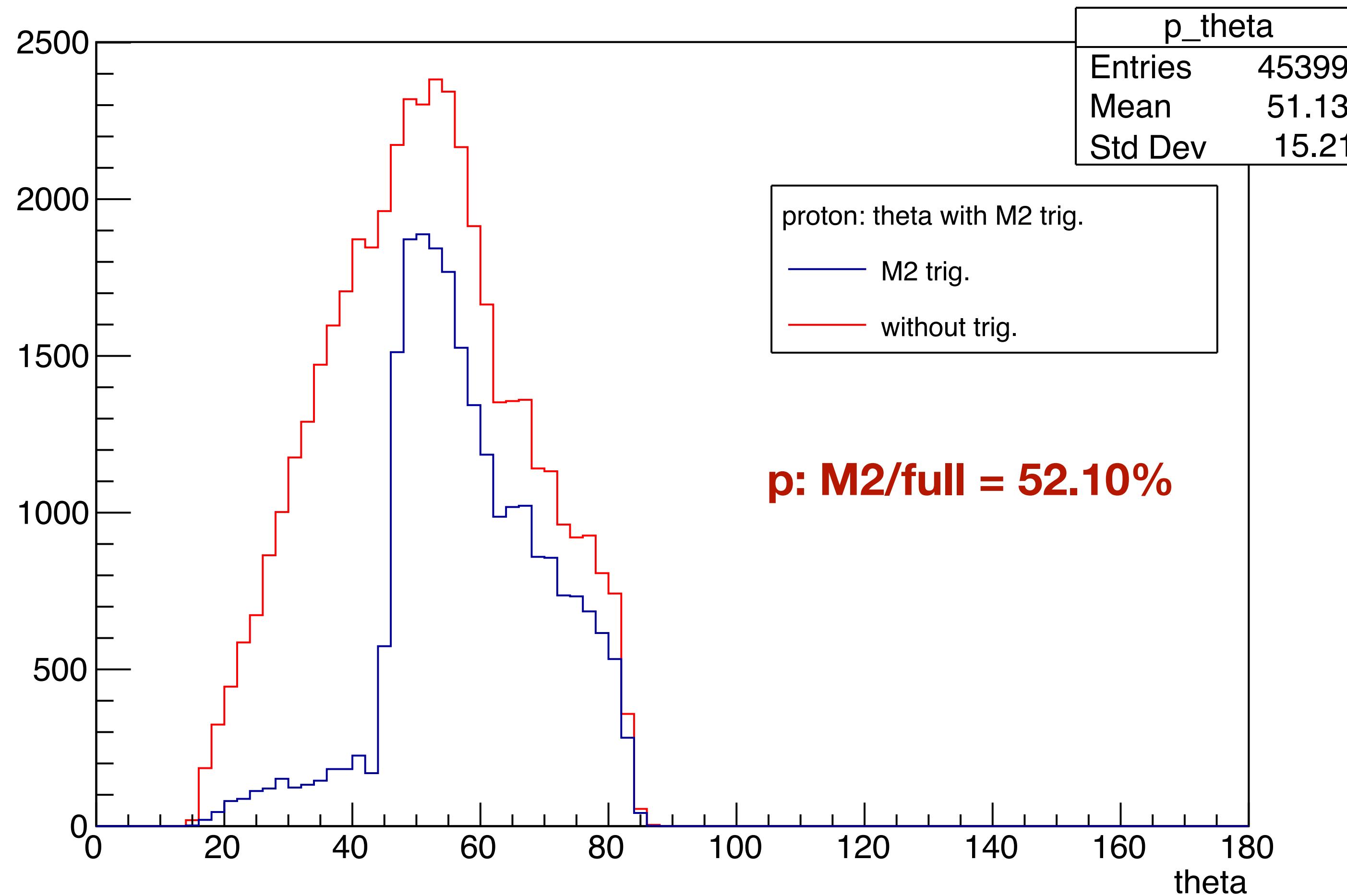
experimental data vs INCL (4pi)



- data and INCL scaled accordingly
- experimental data corrected for acceptance and efficiency effects (1D)

maybe 2D/3D correction would be better?

M2 trigger



- problem with M2 emulation in HYDRA (already reported)

- code: [https://github.com/pauczy/pimC analysis](https://github.com/pauczy/pimC_analysis)
- complete report: <https://www.overleaf.com/read/gytzcjxvjchj>