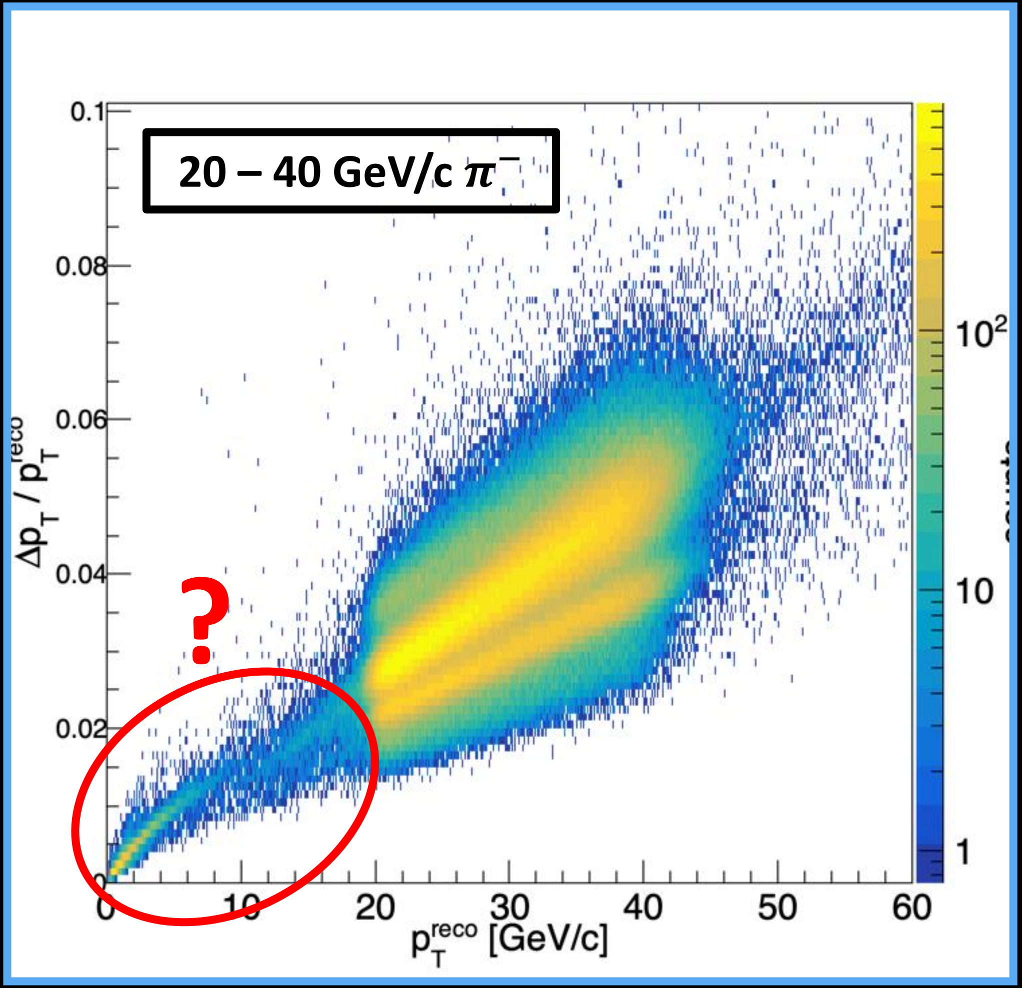
Track Cut Study: Follow-Up

sPHENIX Tracking Meeting

May 24th, 2023

Derek Anderson (ISU)

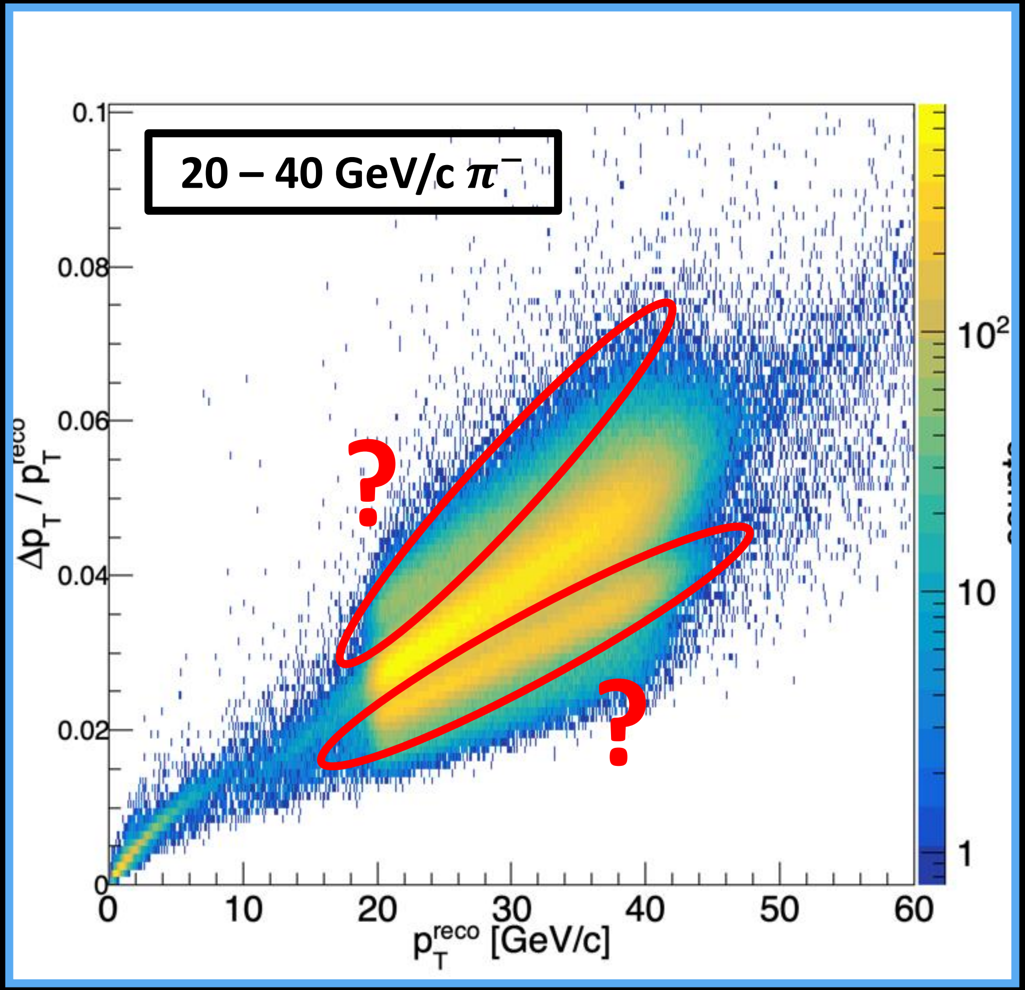
Summary | some observations (< 20 GeV/c tracks)



- Was looking at the percent error on p_T^{reco}* for tracks in events with 100 20 – 40 GeV/c π^-
  - ☞ **Noticed large population of tracks with $p_T^{reco} < 20$ GeV/c which survived the cuts listed on slide 4**
  - ☞ Noticed strange bands in tracks w/ $p_T^{reco} > 20$ GeV/c
  - * i.e. deltapt/pt from the evaluator

- After digging into the < 20 GeV/c tracks population, here are a few observations:
  1) < 20 GeV/c tracks made up of both primaries and secondaries **[slide 5]**
  2) Primaries clustered near $p_T^{reco} \sim 20$ GeV/c while secondaries near $p_T^{reco} \sim 0$ GeV/c **[slide 6 - 10]**
     - › As we would hope…
  3) Secondaries have significantly larger spread in reco vs. truth vertices than primaries **[slides 11 - 13]**
  4) There seem to be cases where secondaries are assigned INTT or MVTX hits when they shouldn't be **[slides 14 - 17]**

Summary | some observations (> 20 GeV/c tracks)

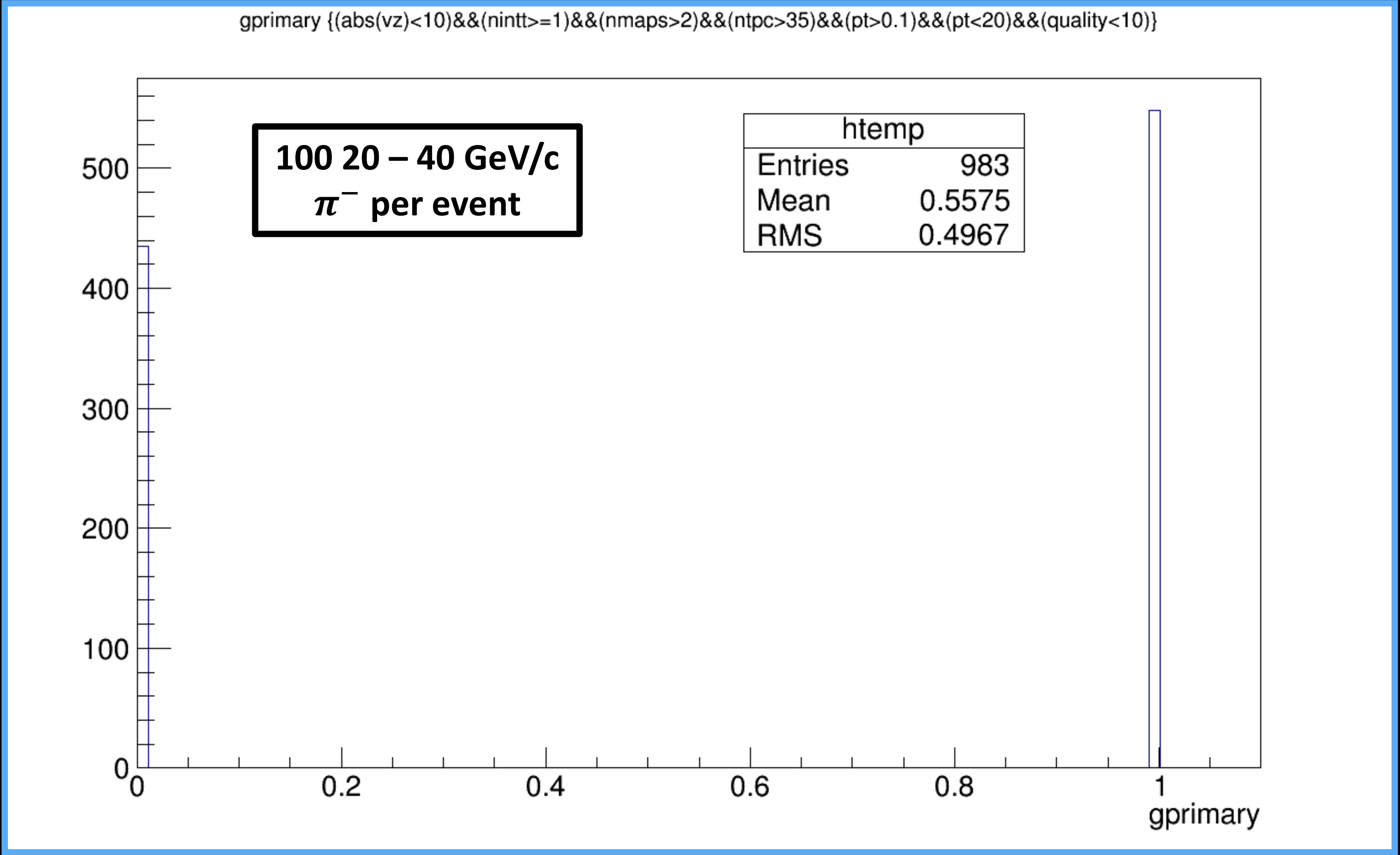


- Was looking at the percent error on p_T^{reco}* for tracks in events with 100 20 – 40 GeV/c π^-
  - ☞ Noticed large population of tracks with $p_T^{reco} < 20$ GeV/c which survived the cuts listed on slide 4
  - ☞ **Noticed strange bands in tracks w/ $p_T^{reco} > 20$ GeV/c**
  - * i.e. deltapt/pt from the evaluator
- A few observations for the > 20 GeV/c tracks:
  1) The bands weren't correlated with anything except pseudorapidity **[Slides 18, 19]**
     - The upper band is mostly tracks with large η (which makes sense: I would expect worse p_T^{reco} at large η)
     - The lower band is mostly tracks with $|\eta| \sim 0.5$, though…

Cuts Applied Here

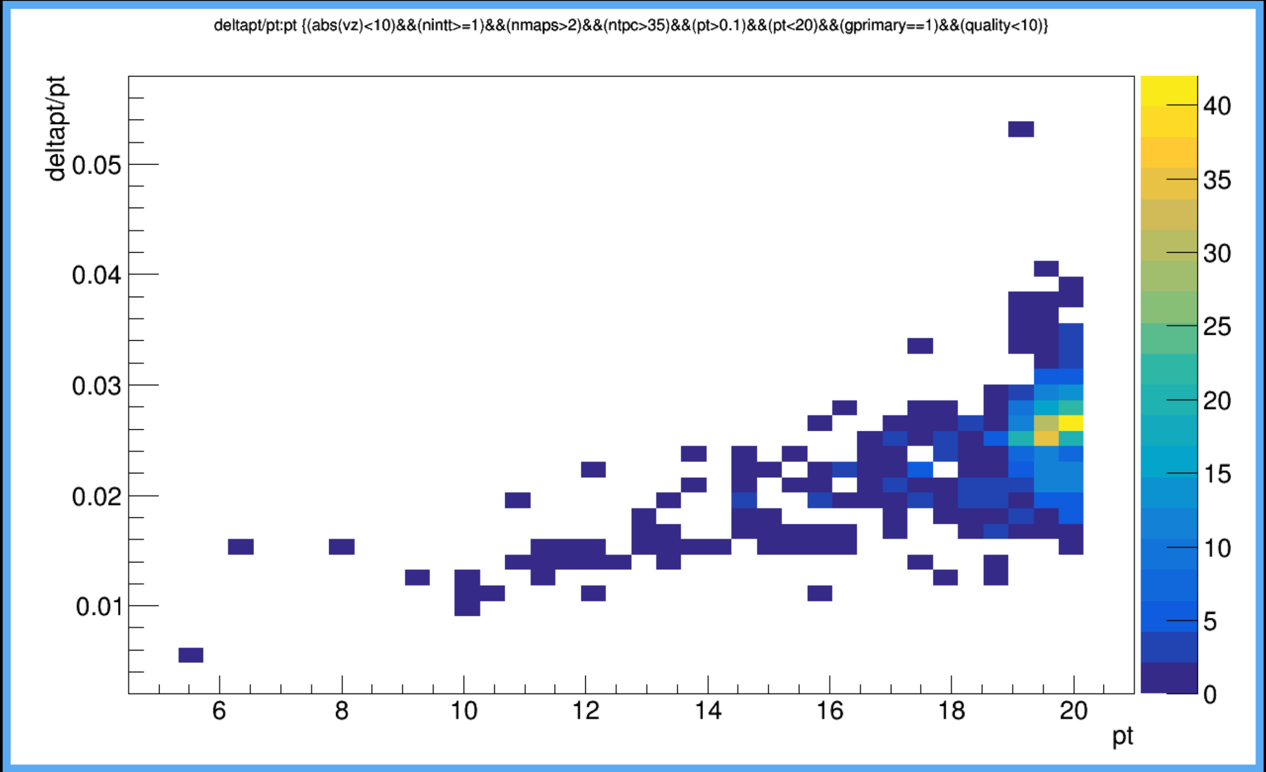
1) $|v_z| < 10$ cm
2) $N_{hits}^{intt} \geq 1$
3) $N_{hits}^{mvtx} > 2$
4) $N_{hits}^{tpc} > 35$ (24?)
5) $p_T^{reco} \in (0.1, 100)$ GeV/c
6) Quality < 10

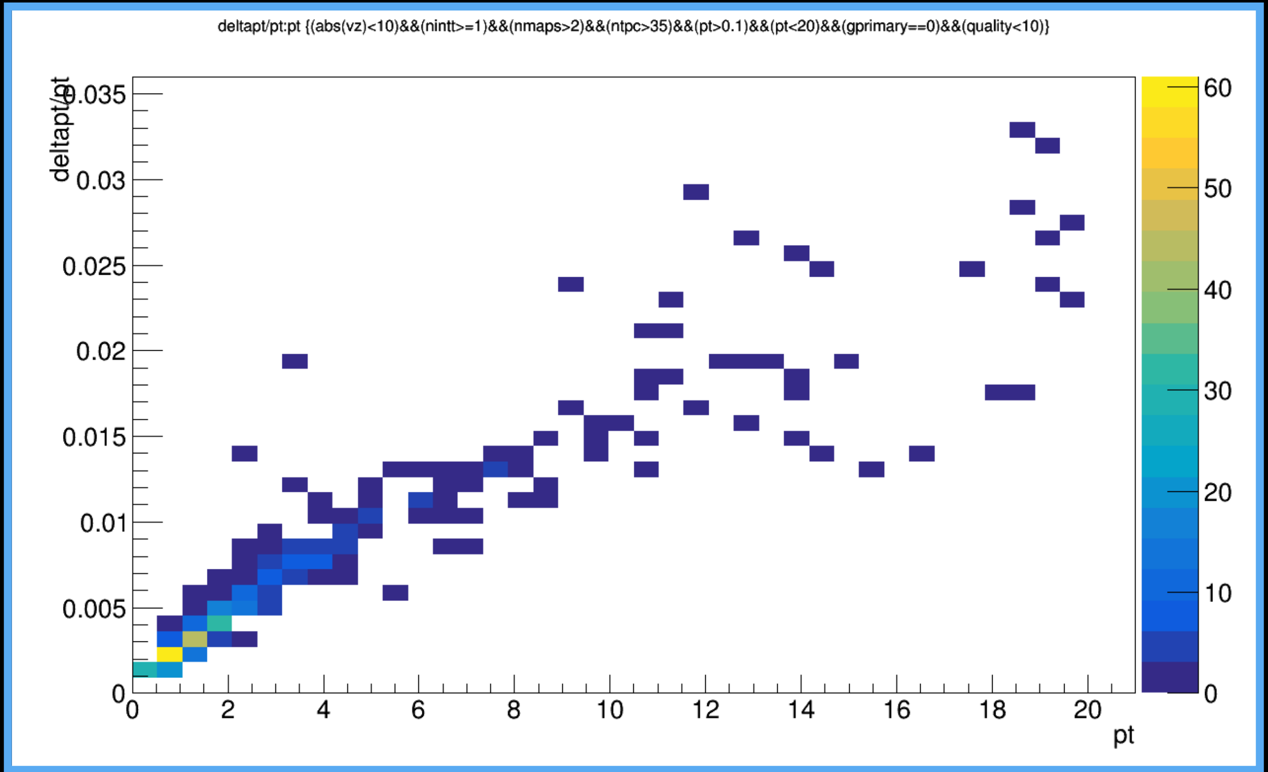
< 20 GeV/c Tracks | gprimary



< 20 GeV/c Tracks | deltapt/pt vs. pt

100 20 – 40 GeV/c
π^- per event



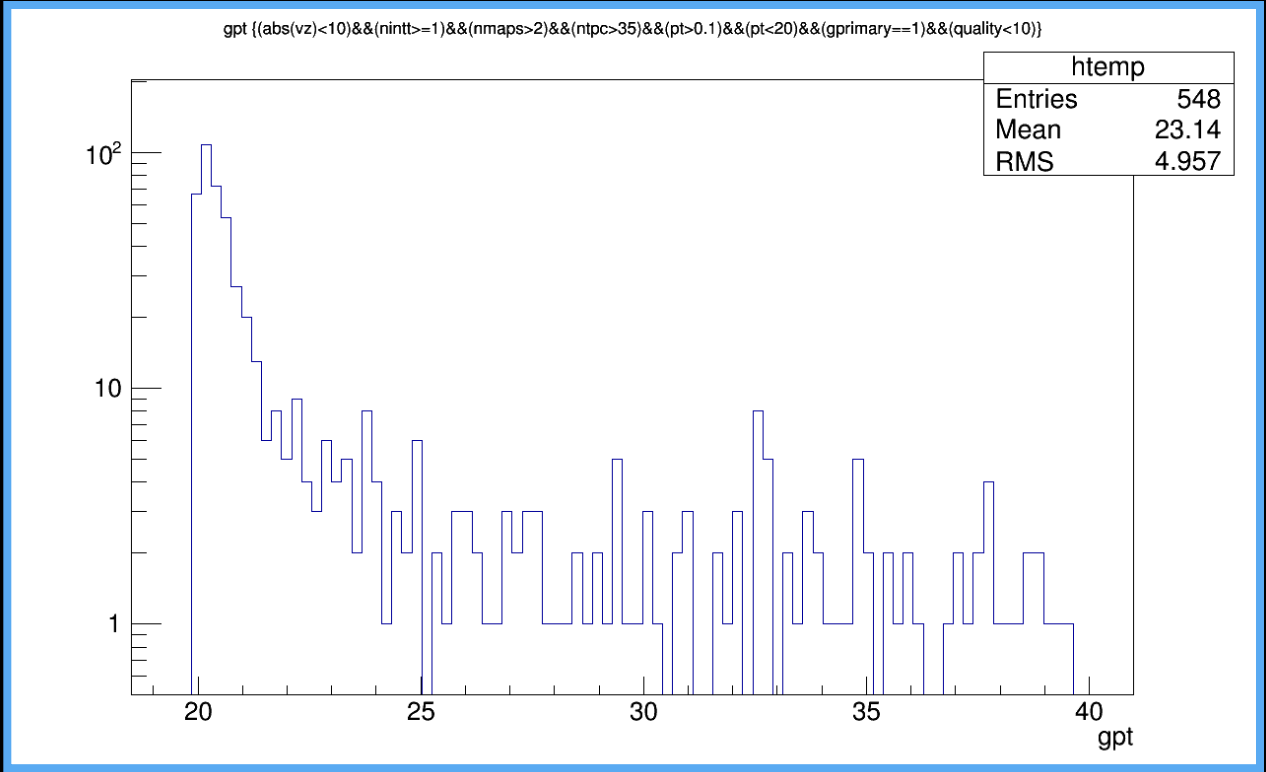


Primaries (gprimary = 1)

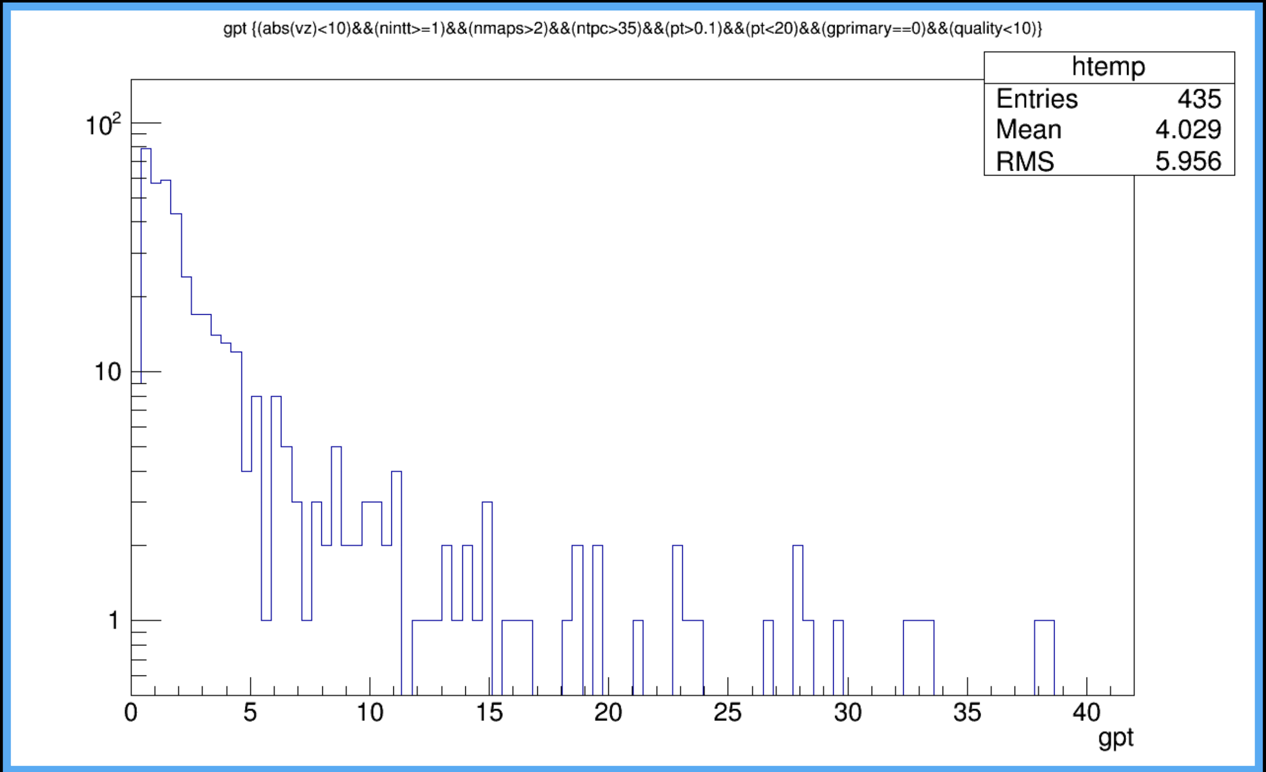
Secondaries (gprimary = 0)

< 20 GeV/c Tracks | gpt

100 20 – 40 GeV/c
π^- per event



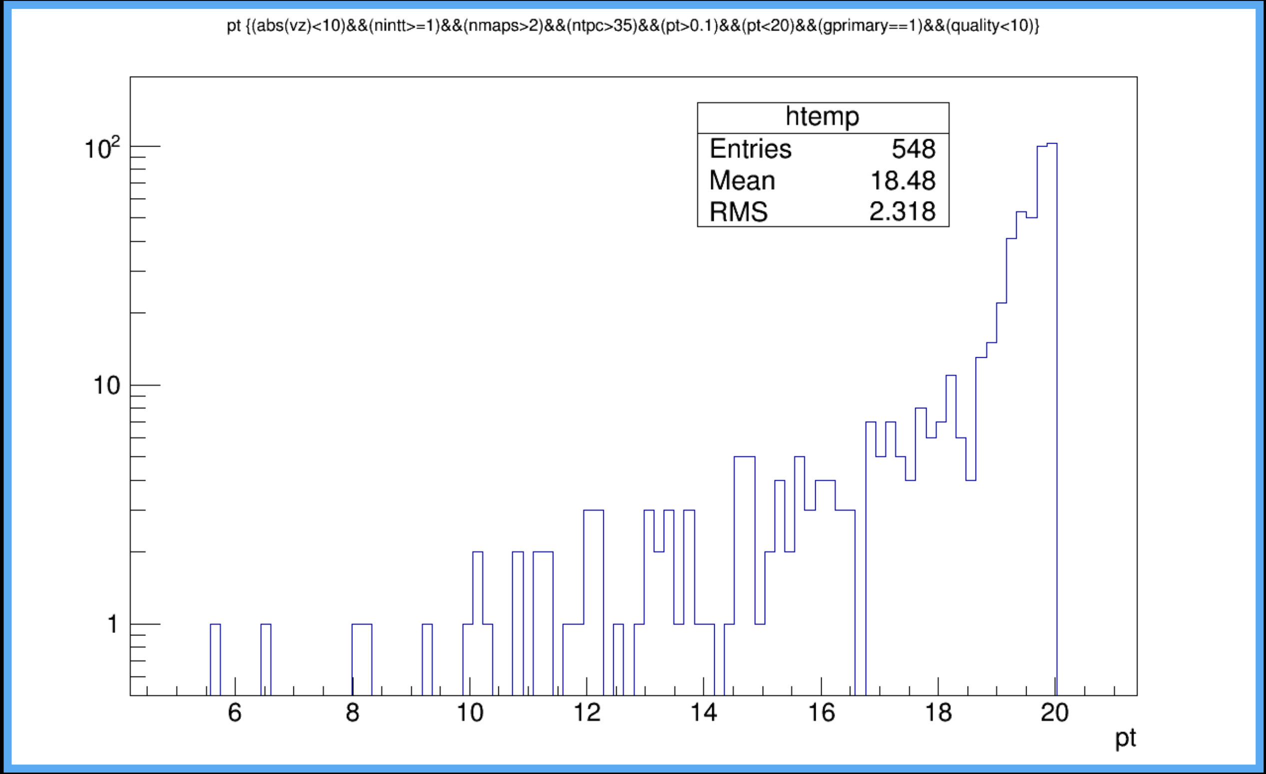
Primaries (gprimary = 1)

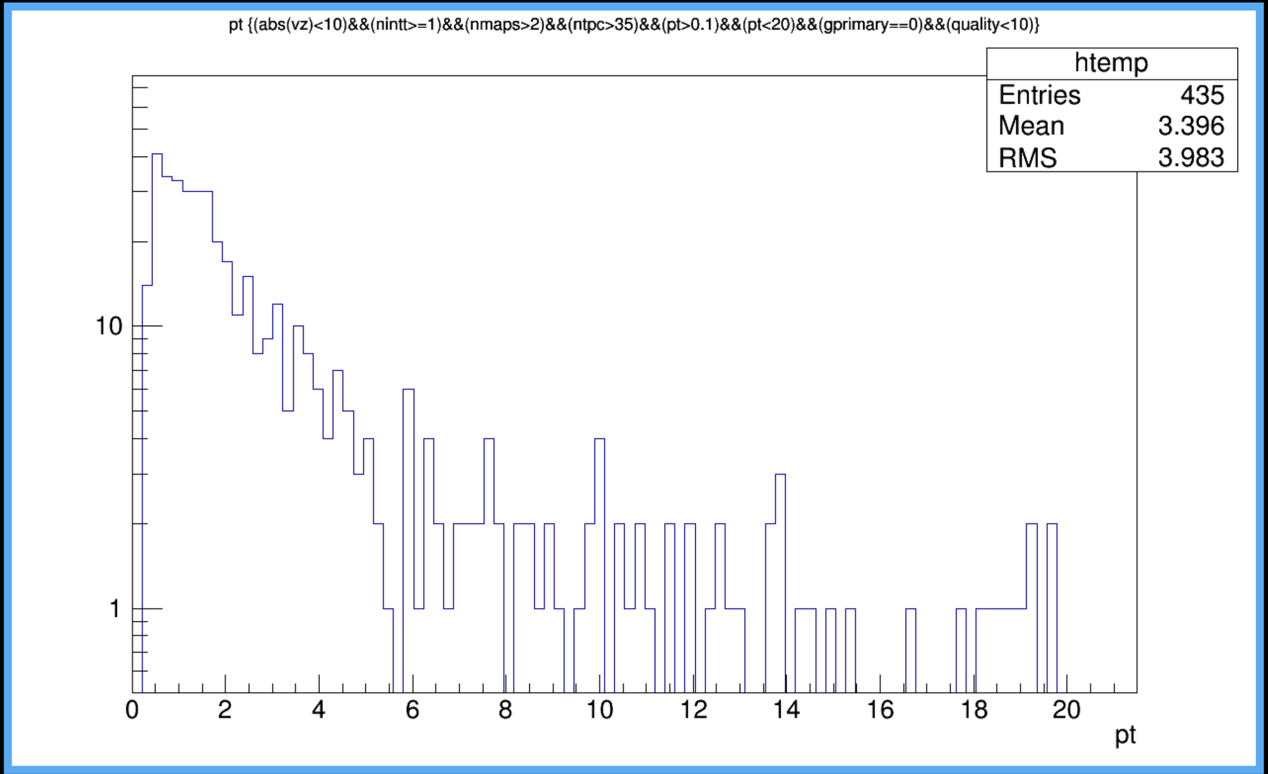


Secondaries (gprimary = 0)

< 20 GeV/c Tracks | pt

100 20 – 40 GeV/c
π^- per event



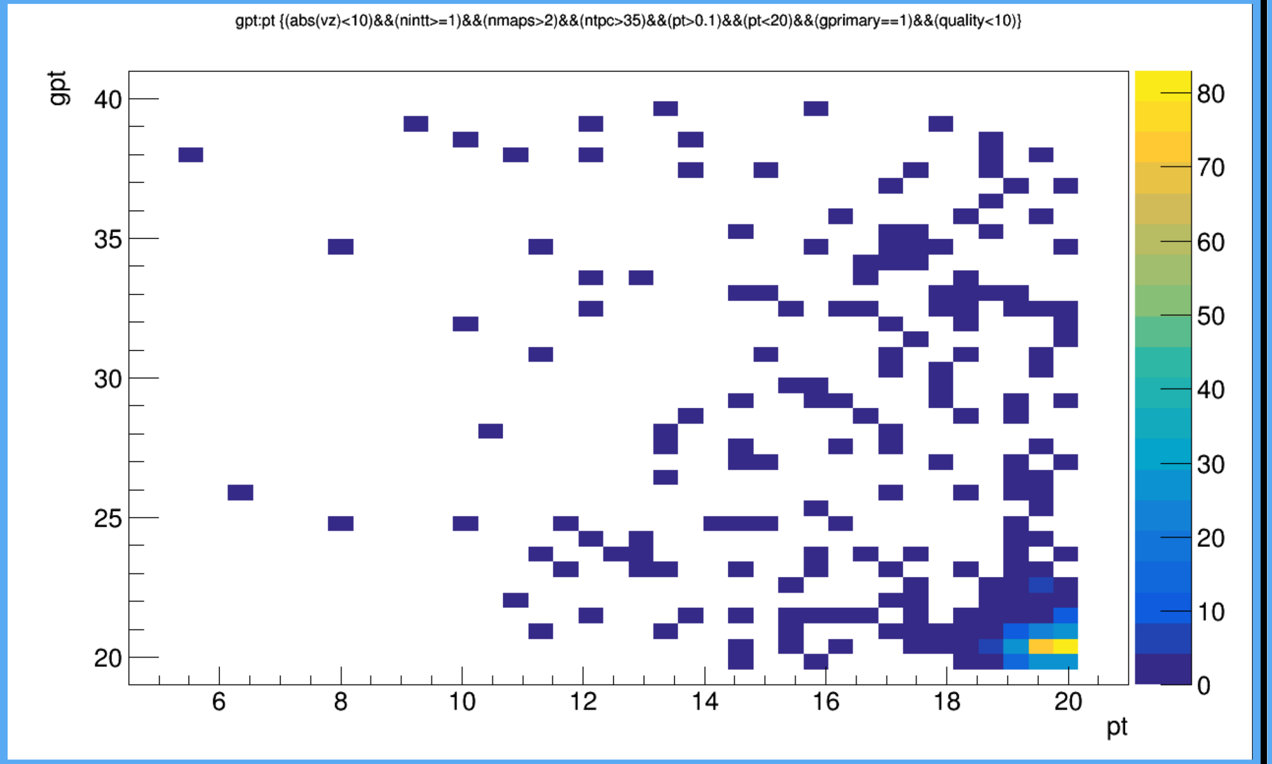


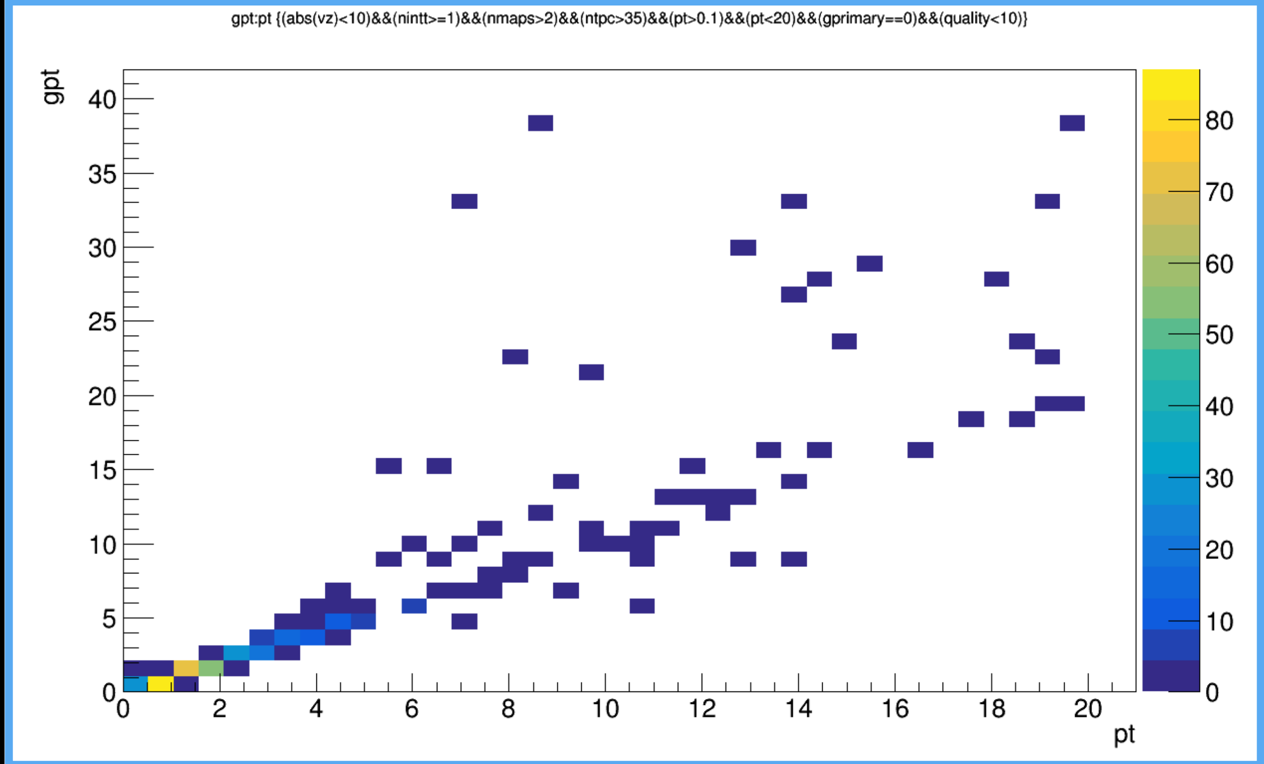
Primaries (gprimary = 1)

Secondaries (gprimary = 0)

< 20 GeV/c Tracks | gpt vs. pt

100 20 – 40 GeV/c
π^- per event



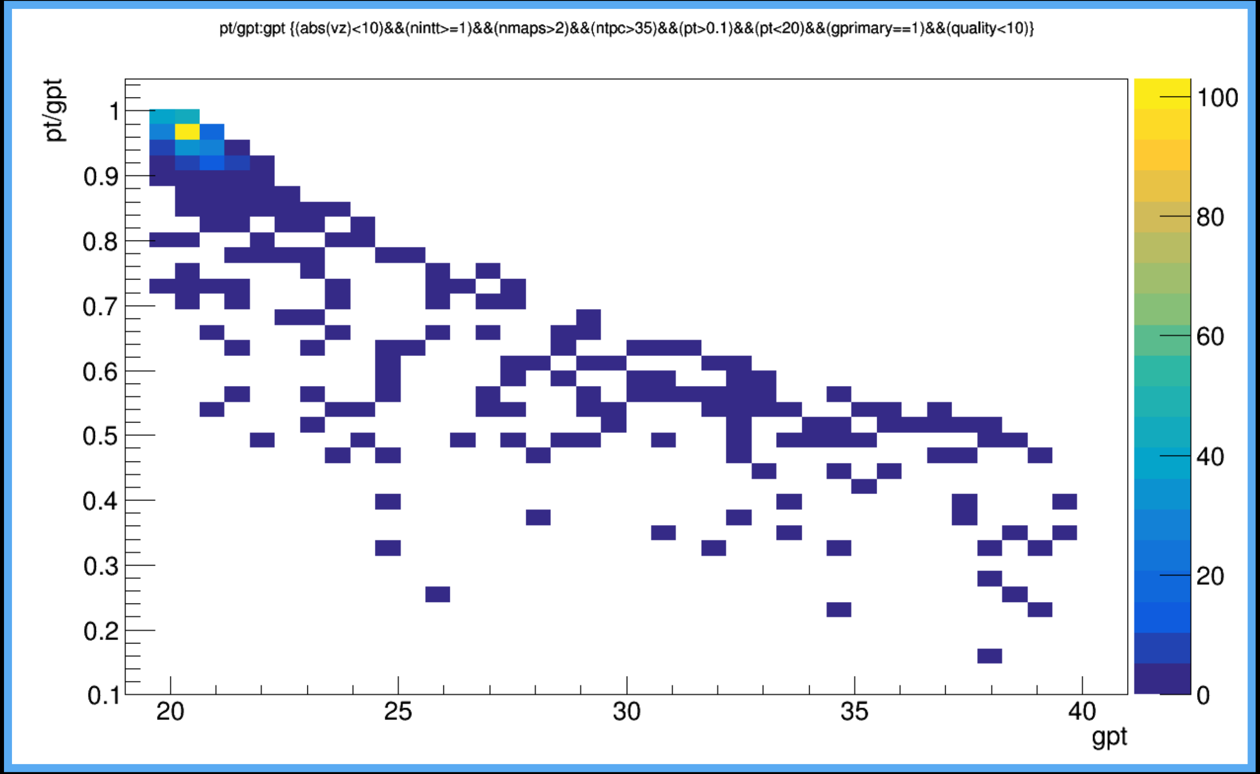


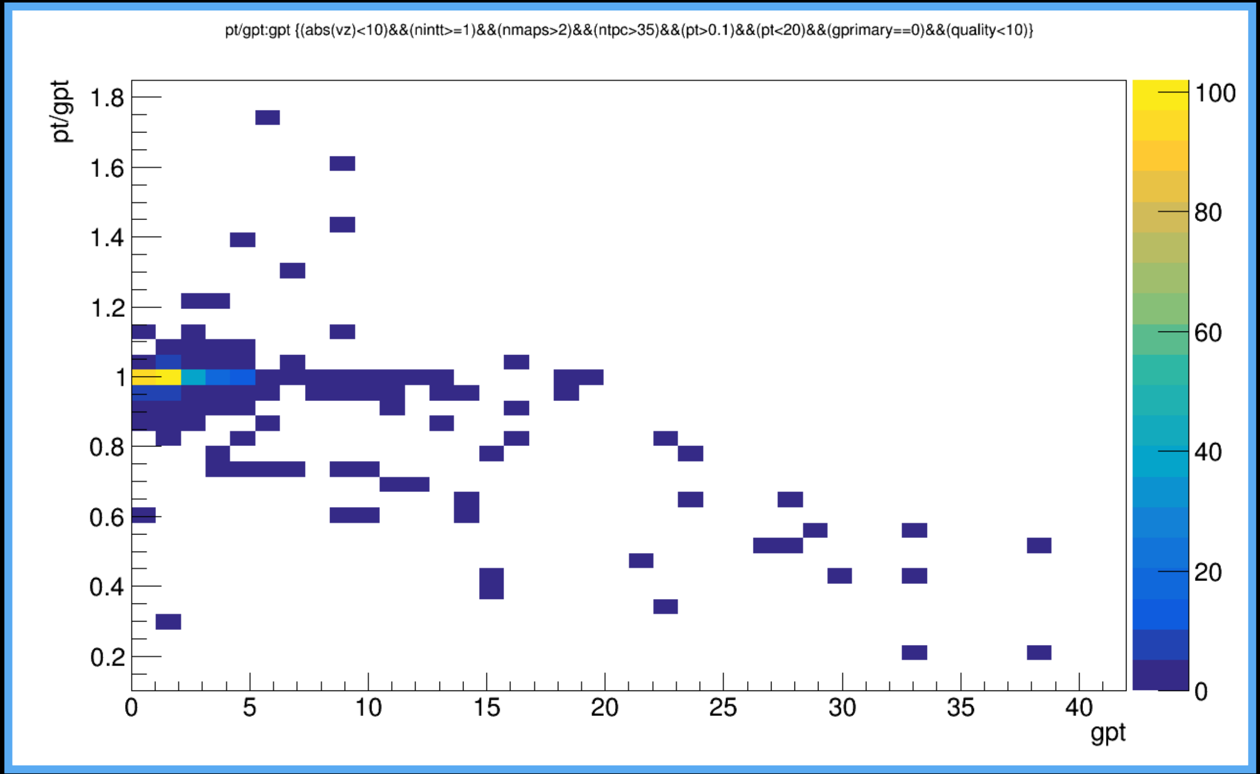
Primaries (gprimary = 1)

Secondaries (gprimary = 0)

< 20 GeV/c Tracks | pt/gpt vs. gpt

100 20 – 40 GeV/c
π^- per event



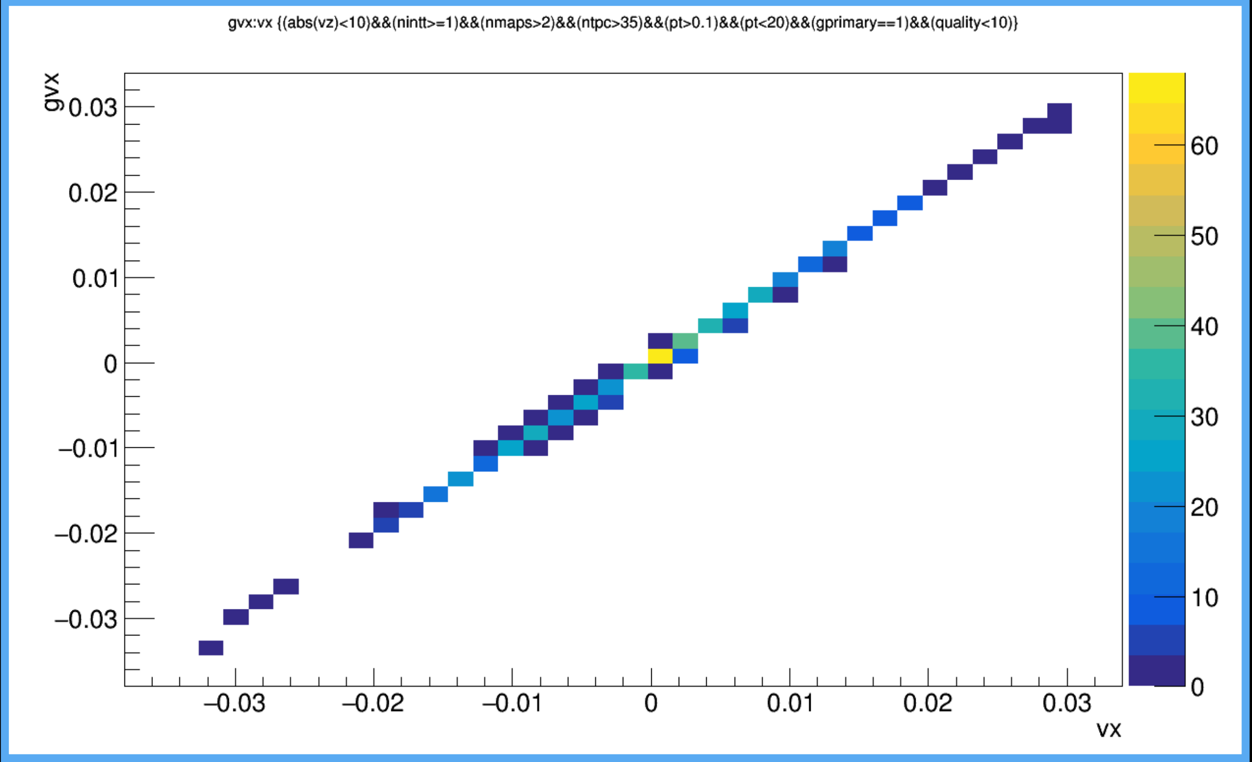


Primaries (gprimary = 1)

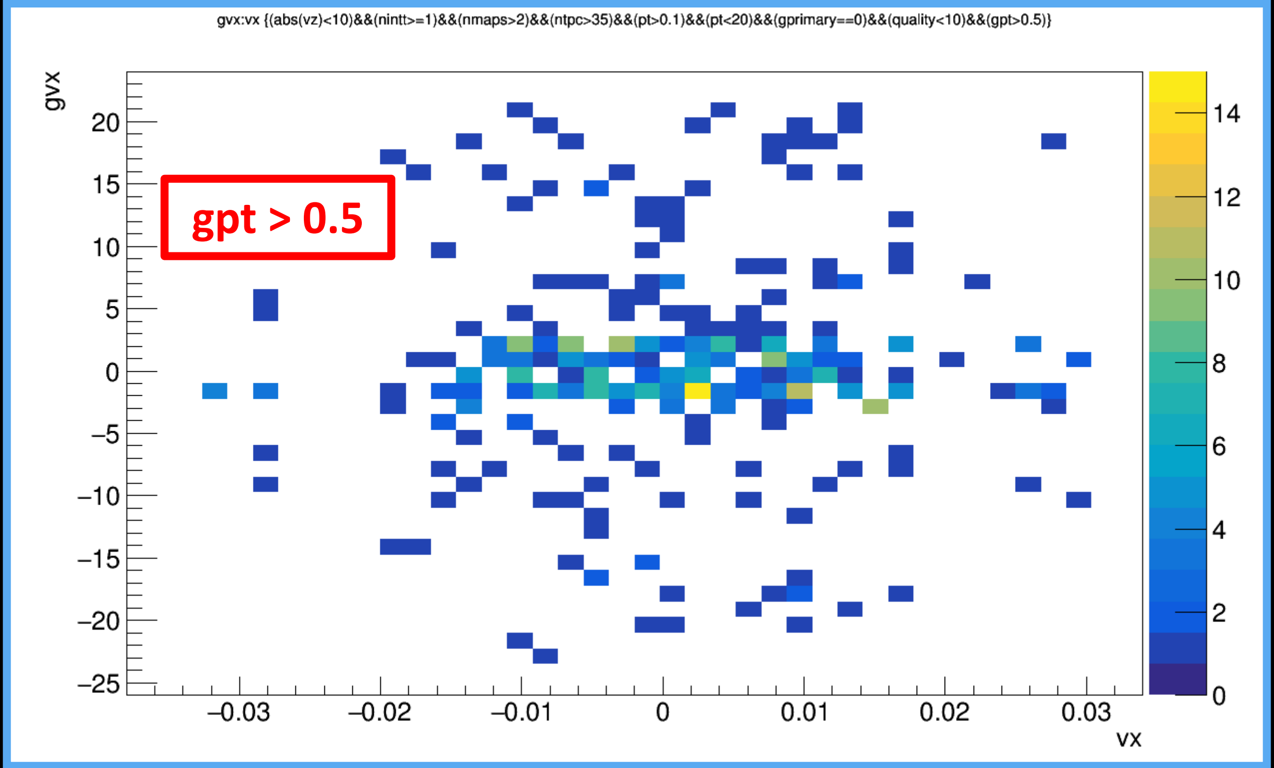
Secondaries (gprimary = 0)

< 20 GeV/c Tracks | gvx vs. vx

100 20 – 40 GeV/c π^- per event



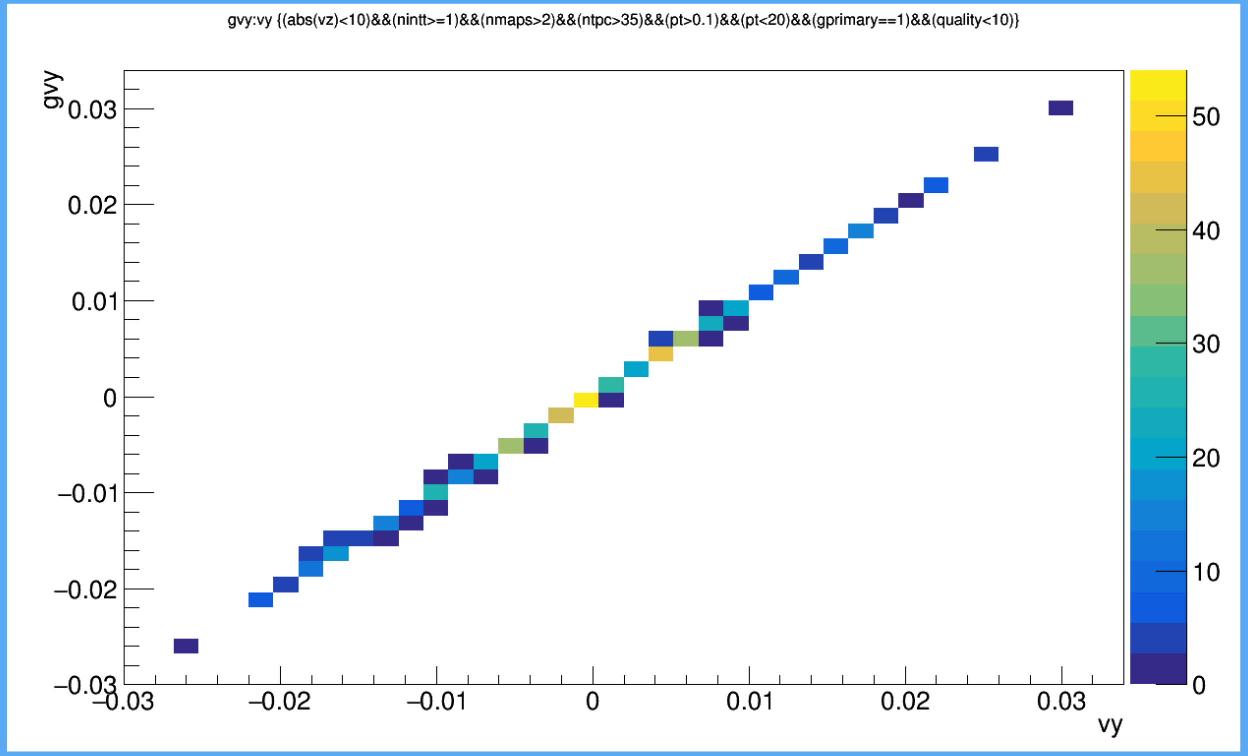
Primaries (gprimary = 1)

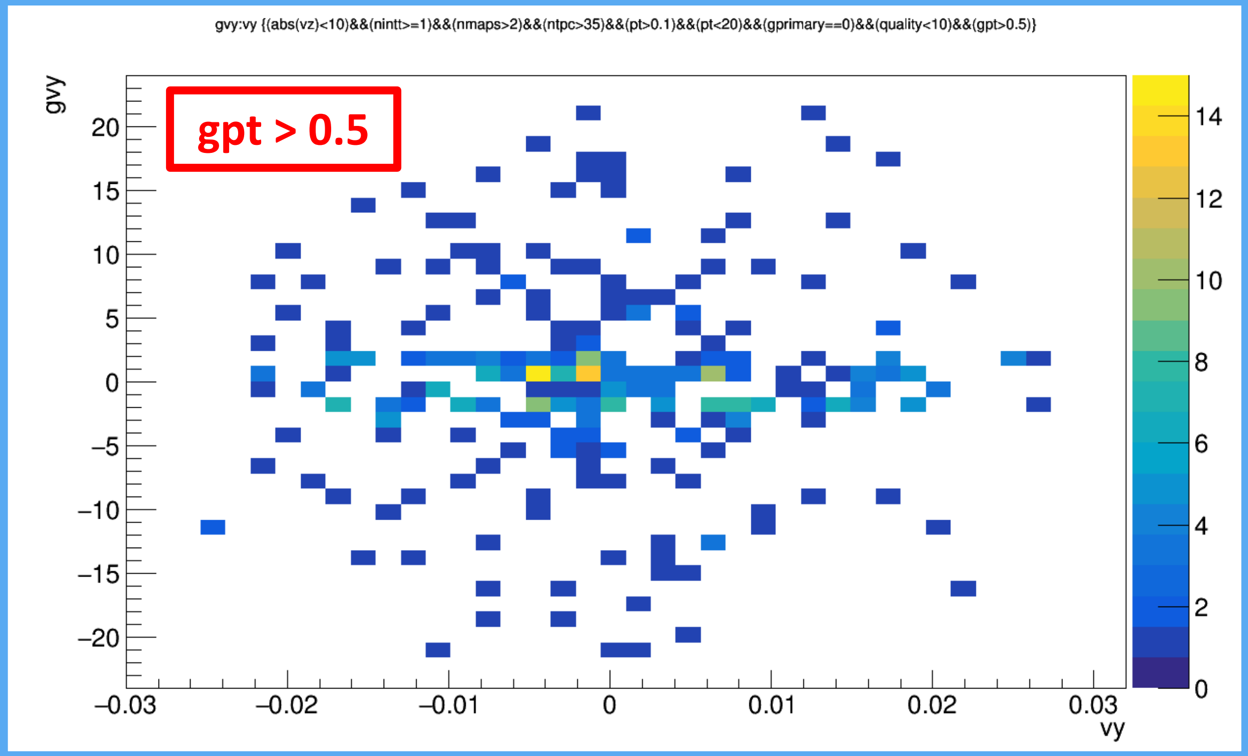


Secondaries (gprimary = 0)

< 20 GeV/c Tracks | gvy vs. vy

100 20 – 40 GeV/c
π^- per event



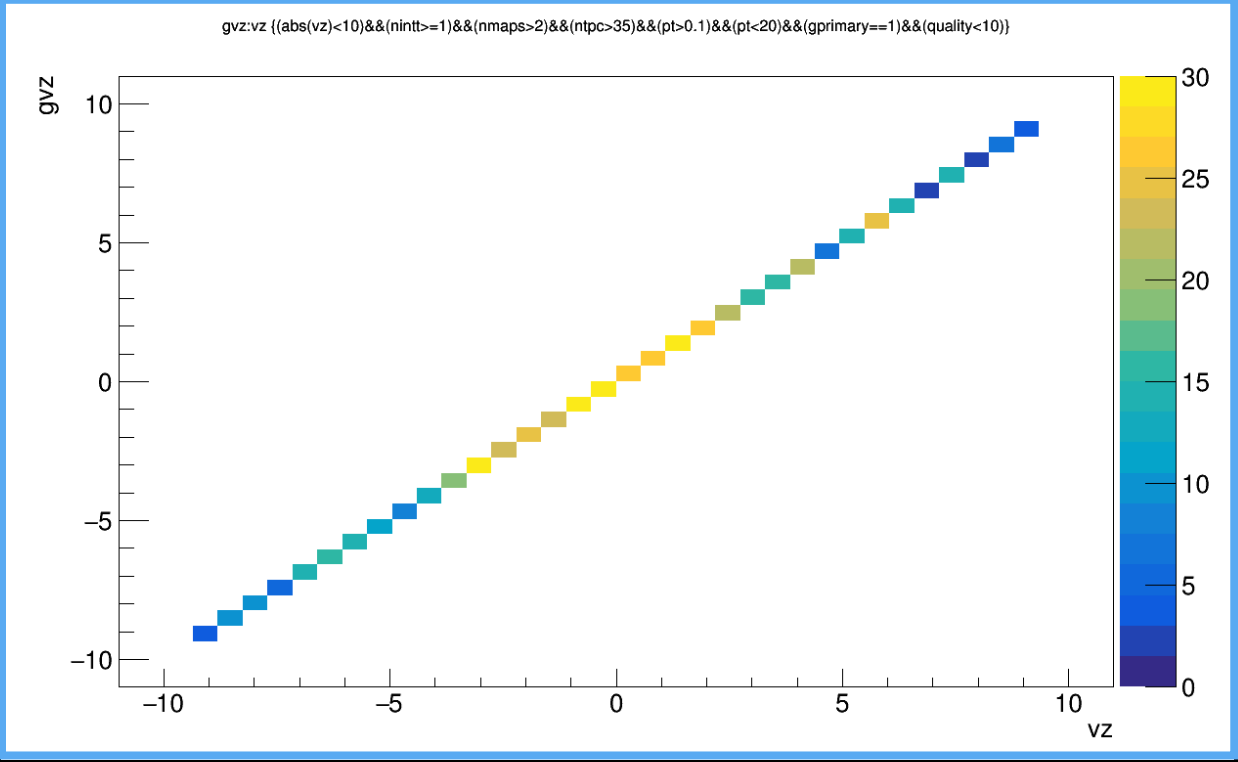


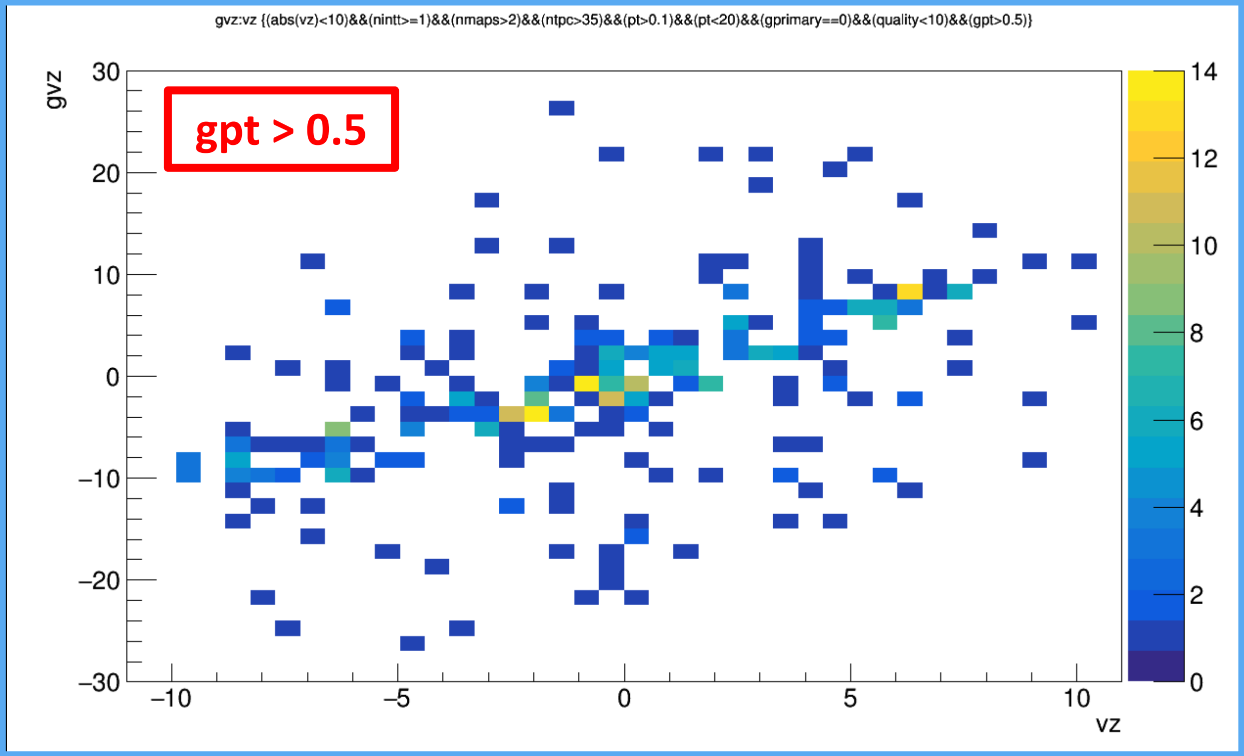
Primaries (gprimary = 1)

Secondaries (gprimary = 0)

< 20 GeV/c Tracks | gvz vs. vz

100 20 – 40 GeV/c
π^- per event



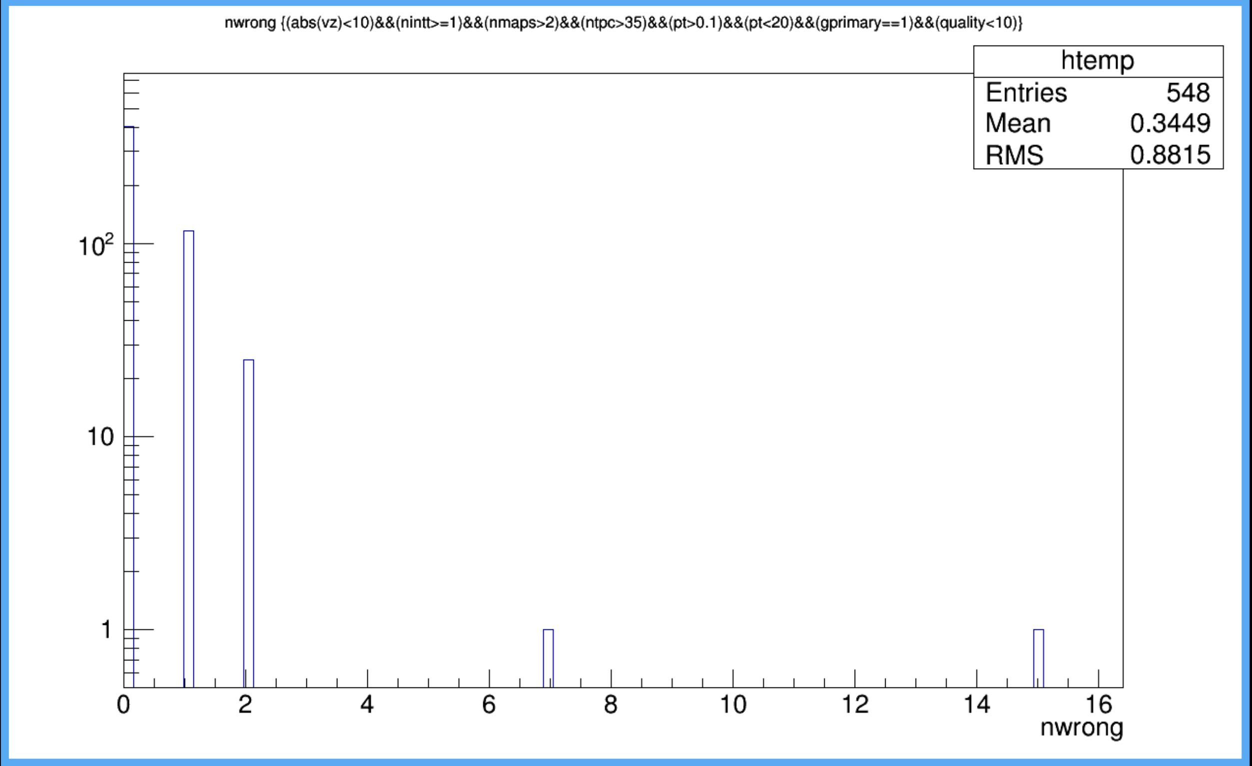


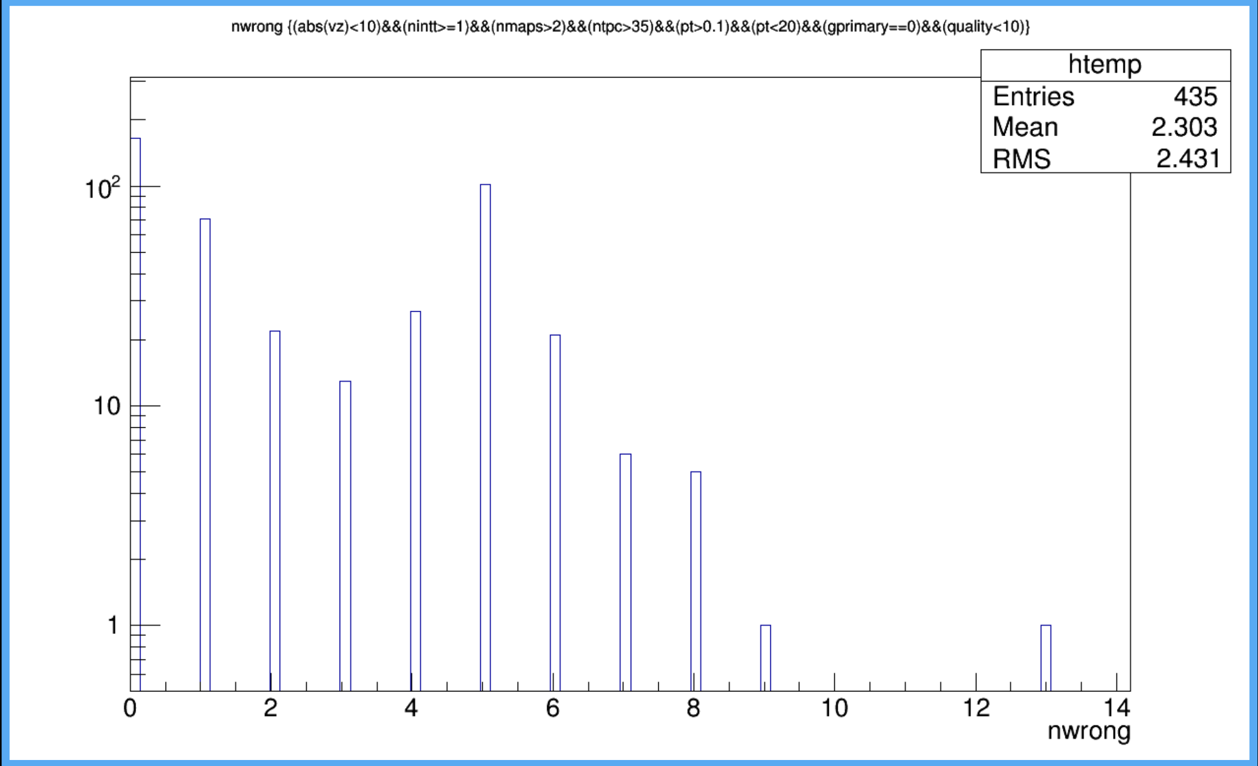
Primaries (gprimary = 1)

Secondaries (gprimary = 0)

< 20 GeV/c Tracks | nwrong

100 20 – 40 GeV/c
π^- per event





Primaries (gprimary = 1)

Secondaries (gprimary = 0)

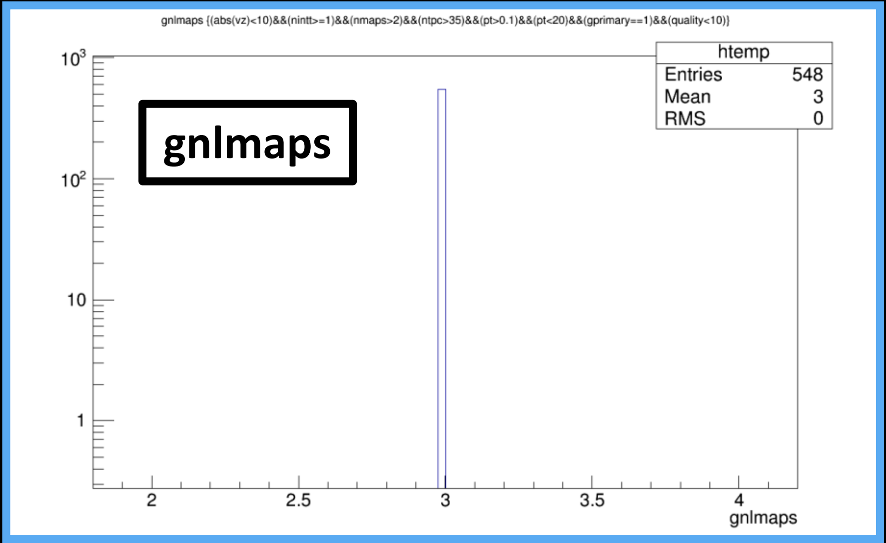
< 20 GeV/c Tracks | gnlmaps and nlmaps

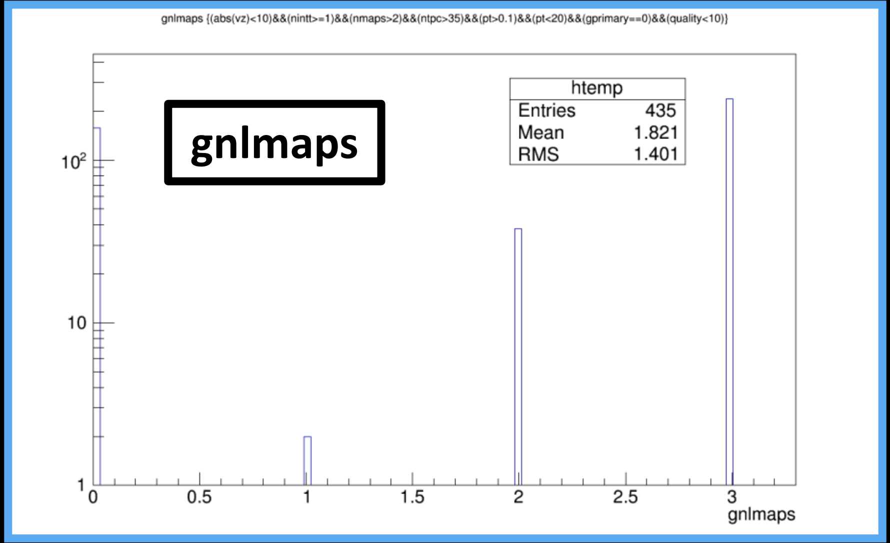
100 20 – 40 GeV/c π^- per event

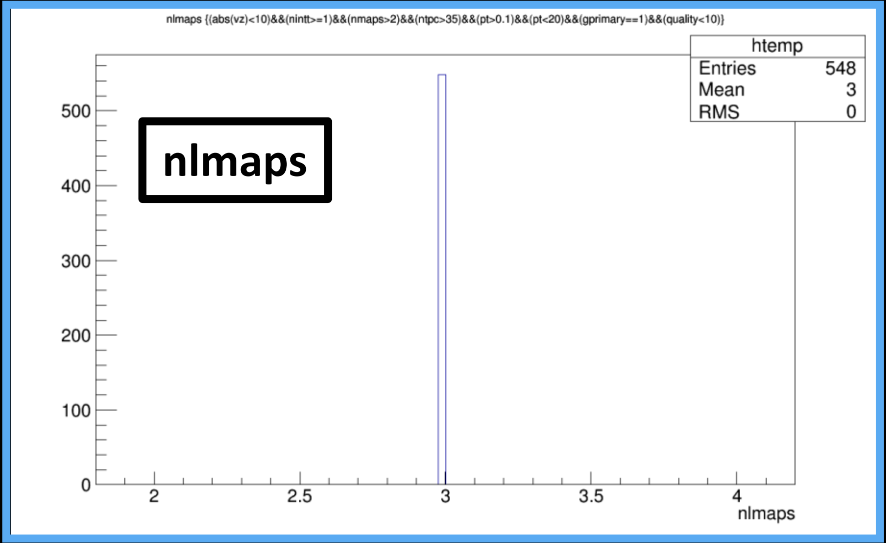
sPHENIX

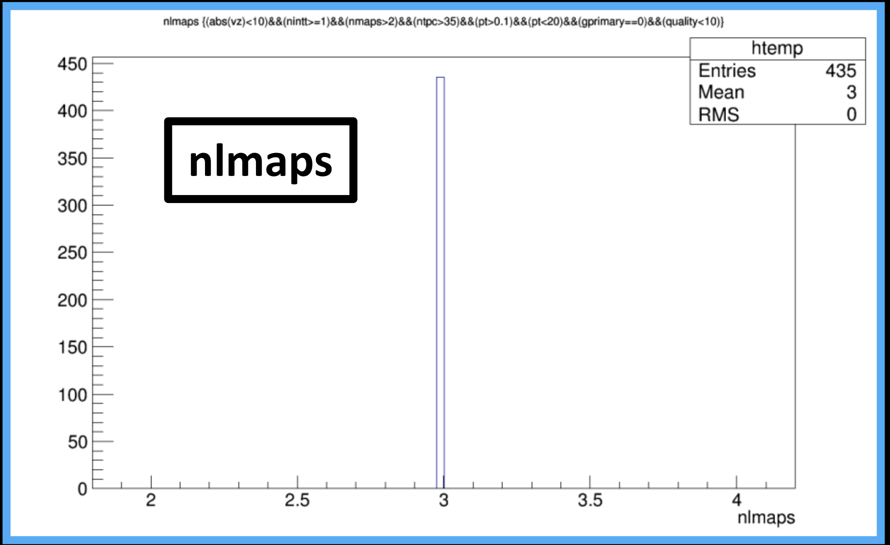
Primaries (gprimary = 1)

Secondaries (gprimary = 0)









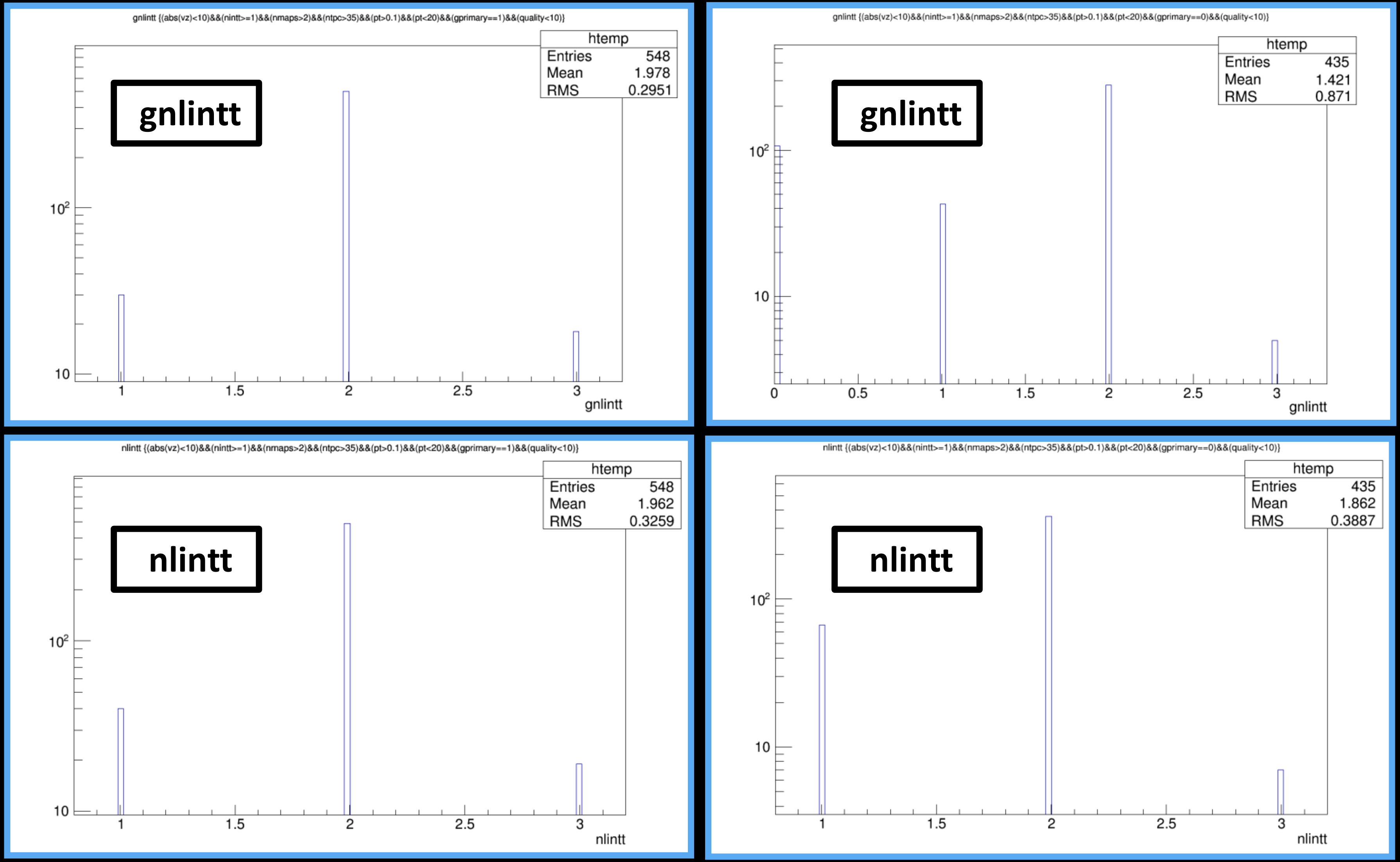
< 20 GeV/c Tracks | gnlintt and nlintt

100 20 – 40 GeV/c π^- per event

sPHENIX

Primaries (gprimary = 1)

Secondaries (gprimary = 0)

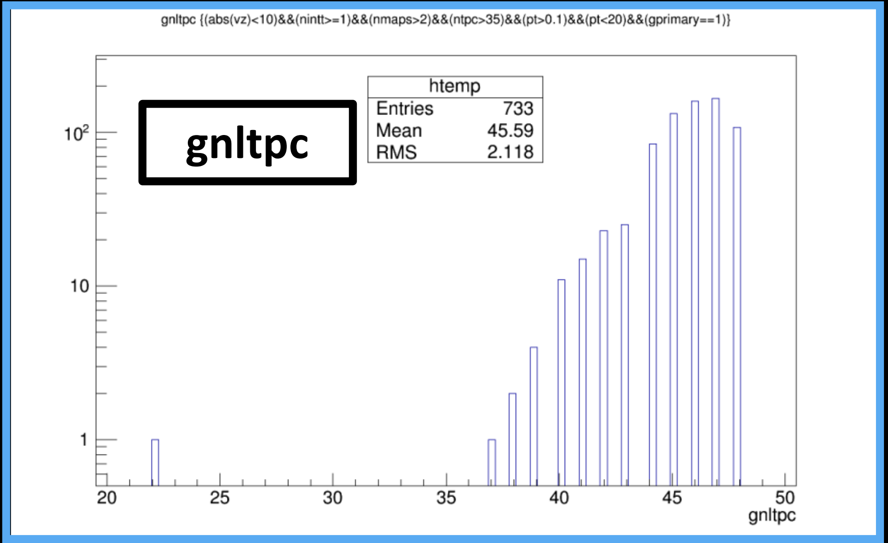


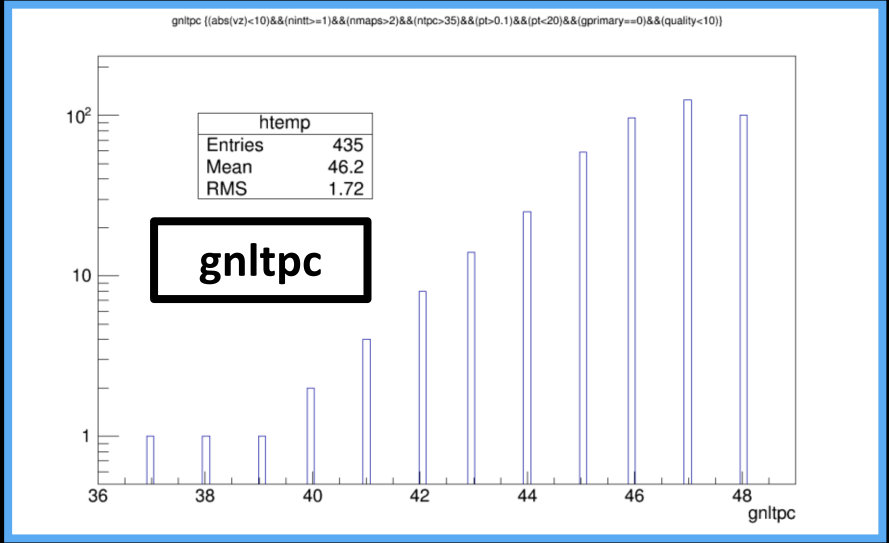
< 20 GeV/c Tracks | gnltpc and nltpc

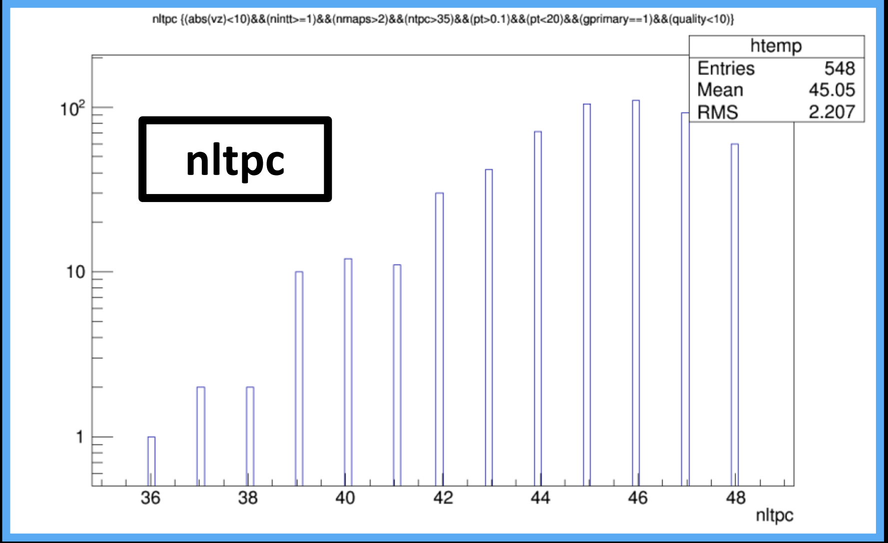
100 20 – 40 GeV/c π^- per event

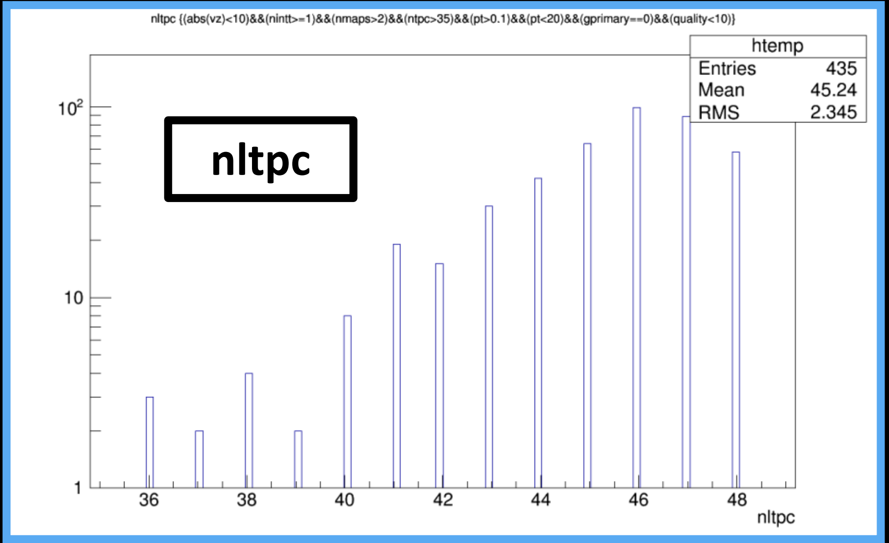
sPHENIX

Primaries (gprimary = 1)





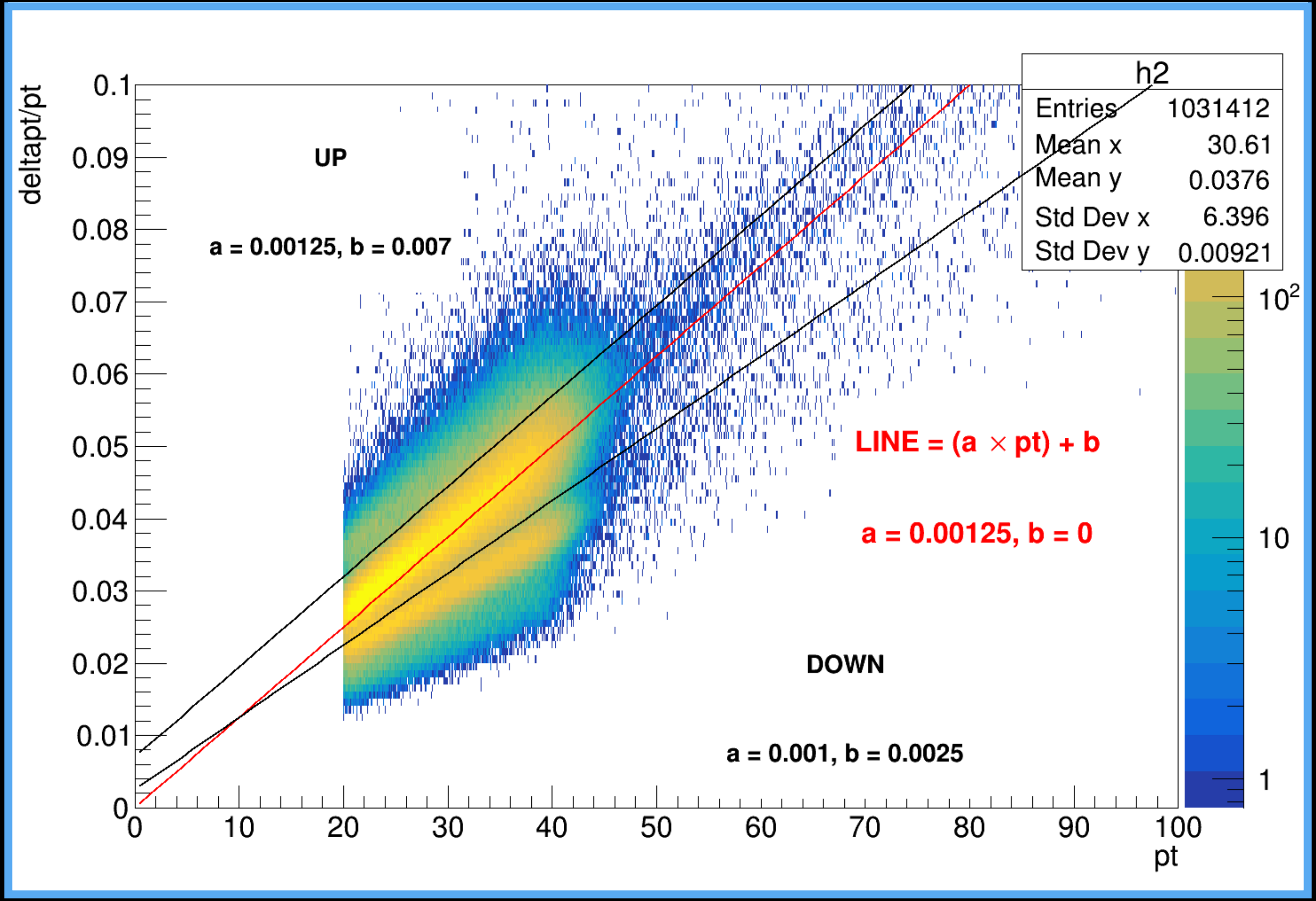




Secondaries (gprimary = 0)

> 20 GeV/c Tracks | looking into the bands

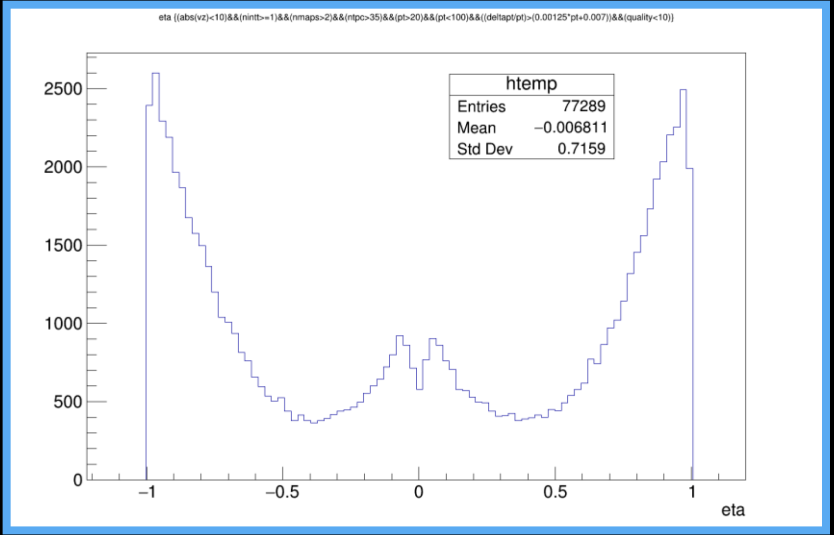
- To study the bands I guesstimated 2 lines which partitioned the > 20 GeV/c blob into 3 regions
  - **Up:** anything above the upper black line
  - **Down:** anything below the lower
  - **Center:** between the two lines
- **Note:** red line indicates (roughly) the slope of the main band



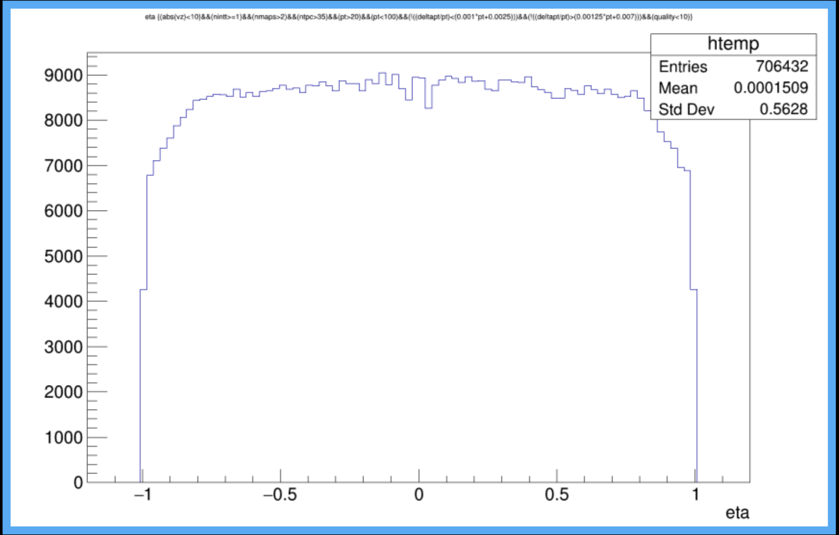
100 20 – 40 GeV/c π^- per event

> 20 GeV/c Tracks | looking into the bands

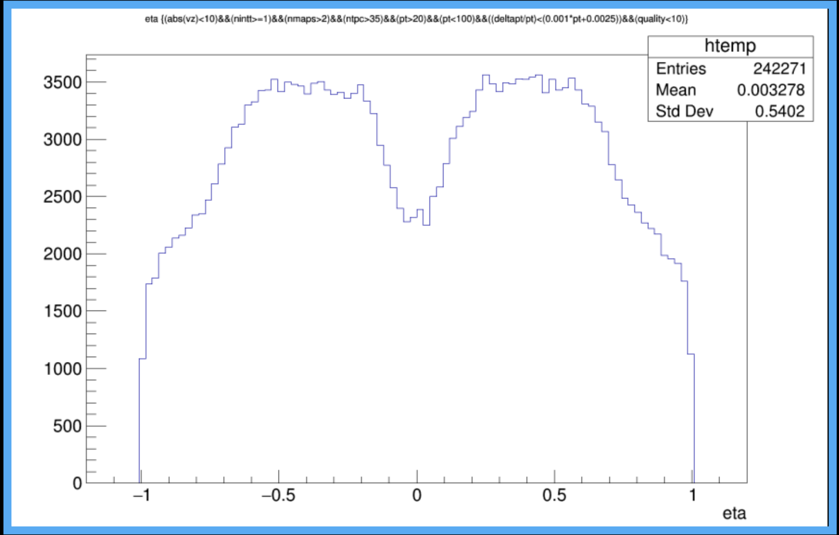
100 20 – 40 GeV/c π^- per event



Up

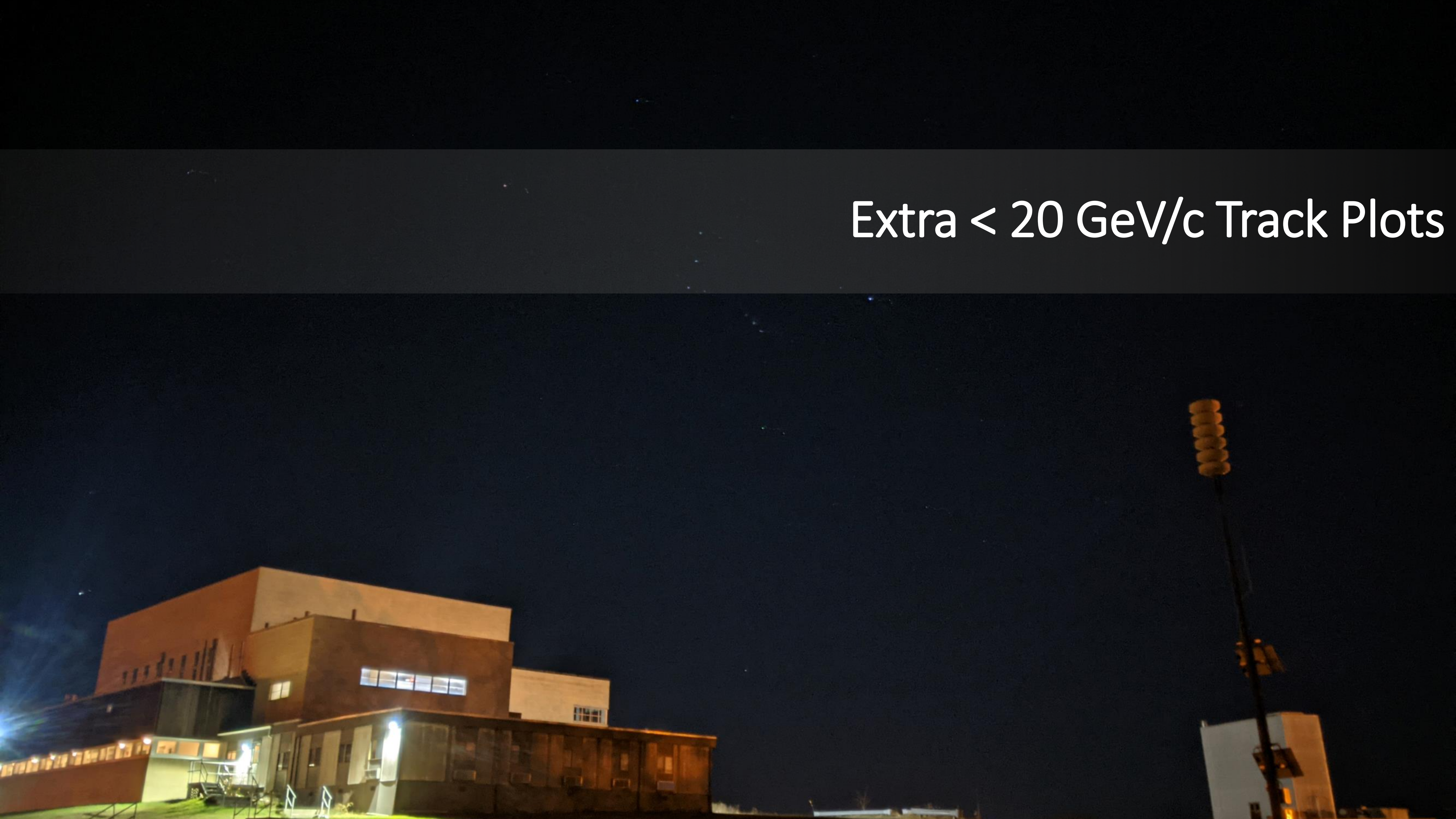


Center



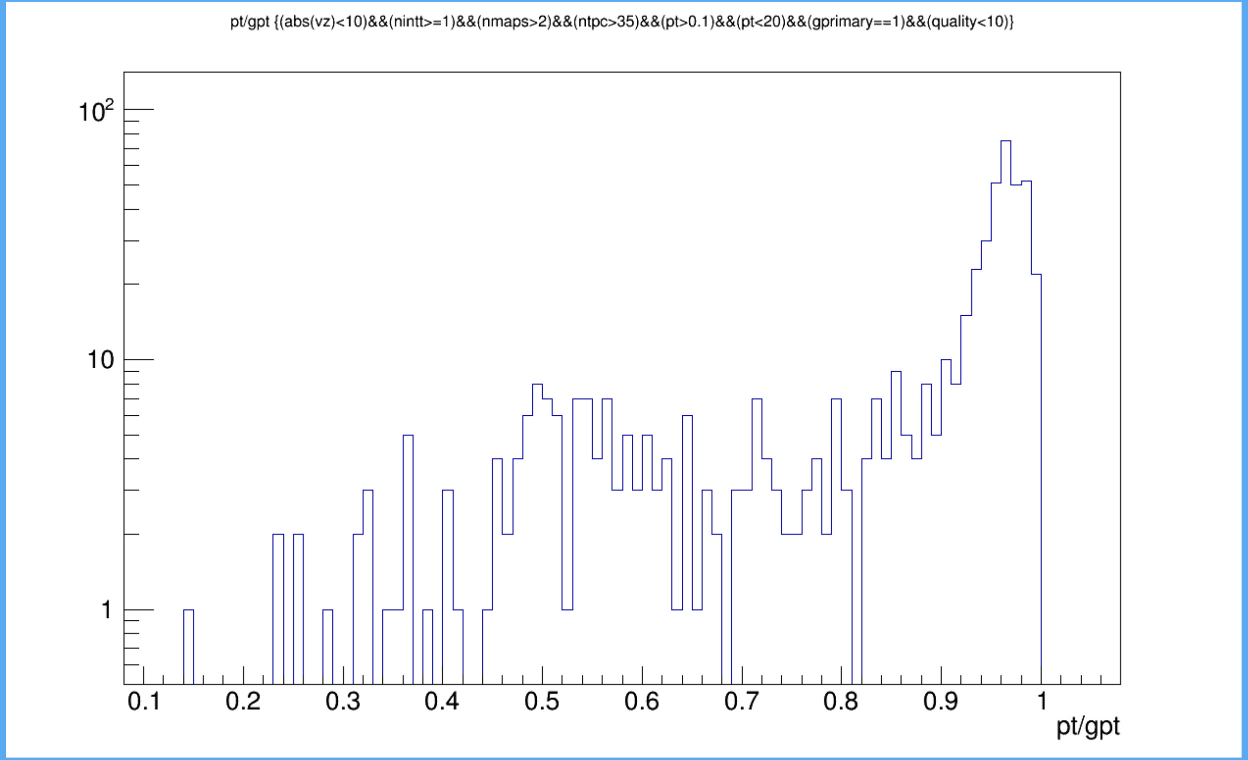
Down

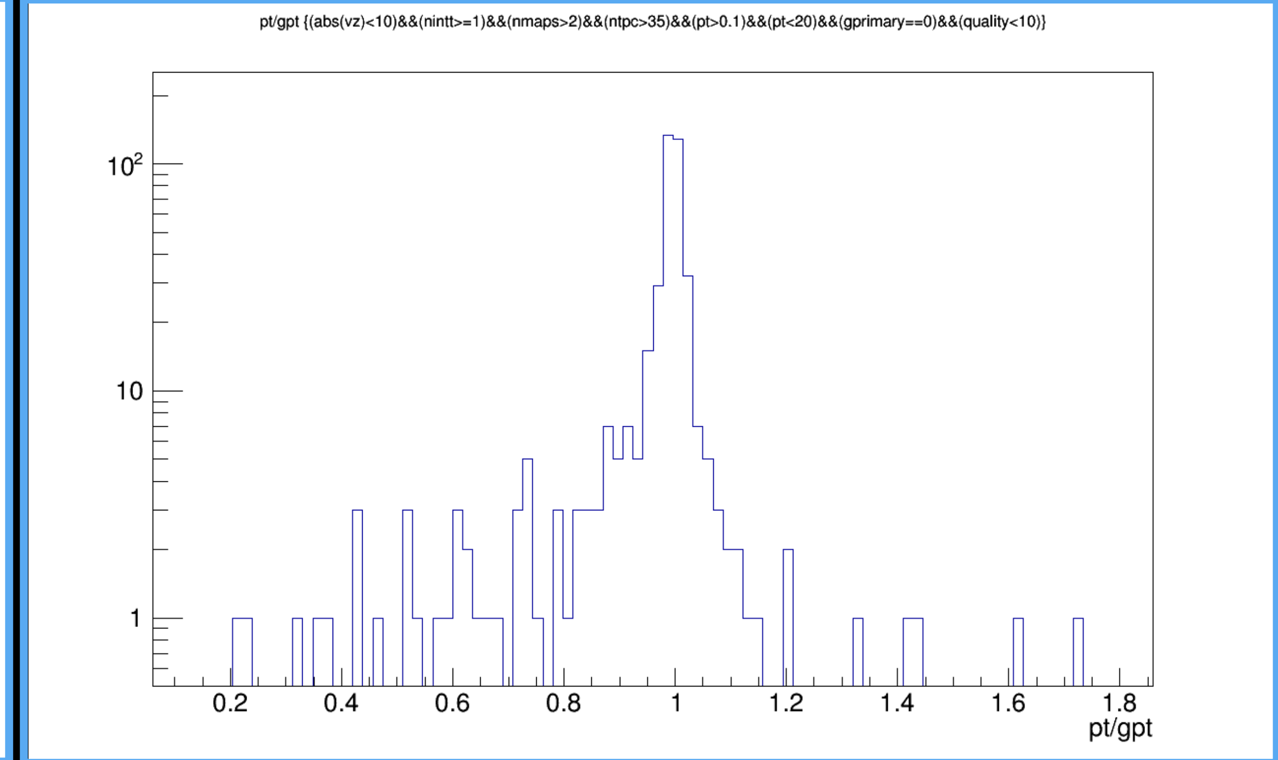
Extra < 20 GeV/c Track Plots



< 20 GeV/c Tracks | pt/gpt

100 20 – 40 GeV/c
π^- per event



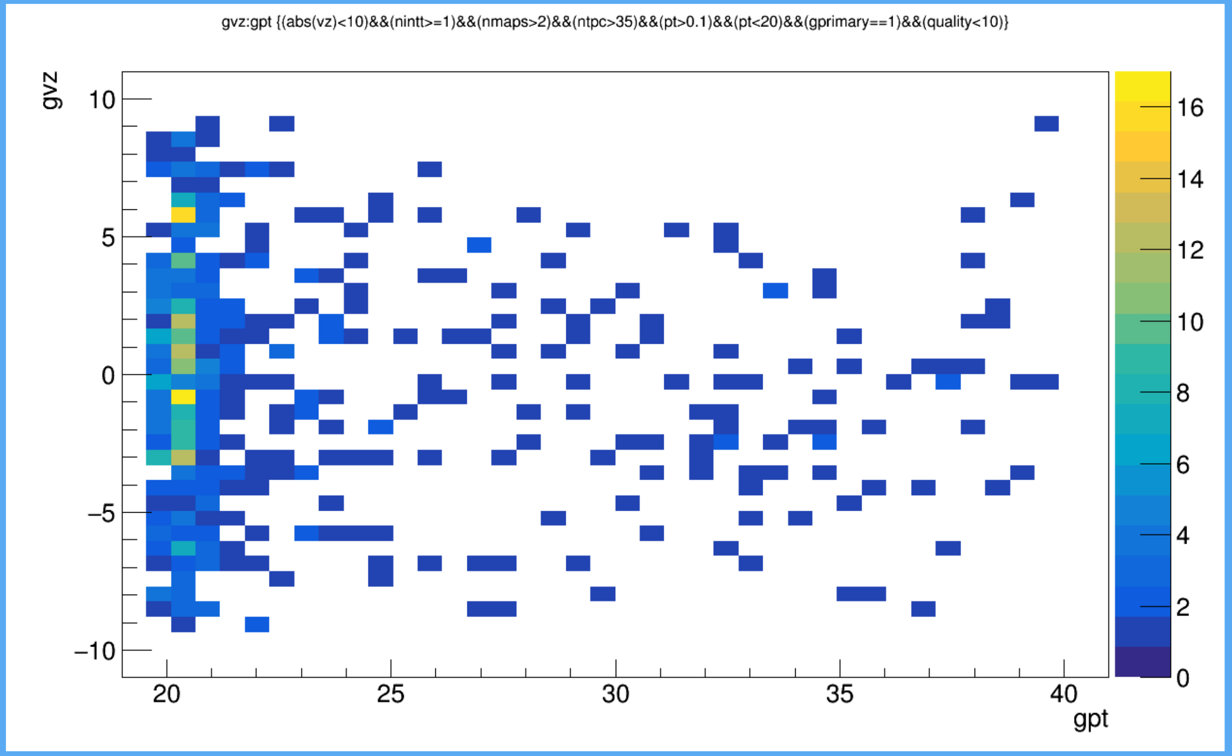


Primaries (gprimary = 1)

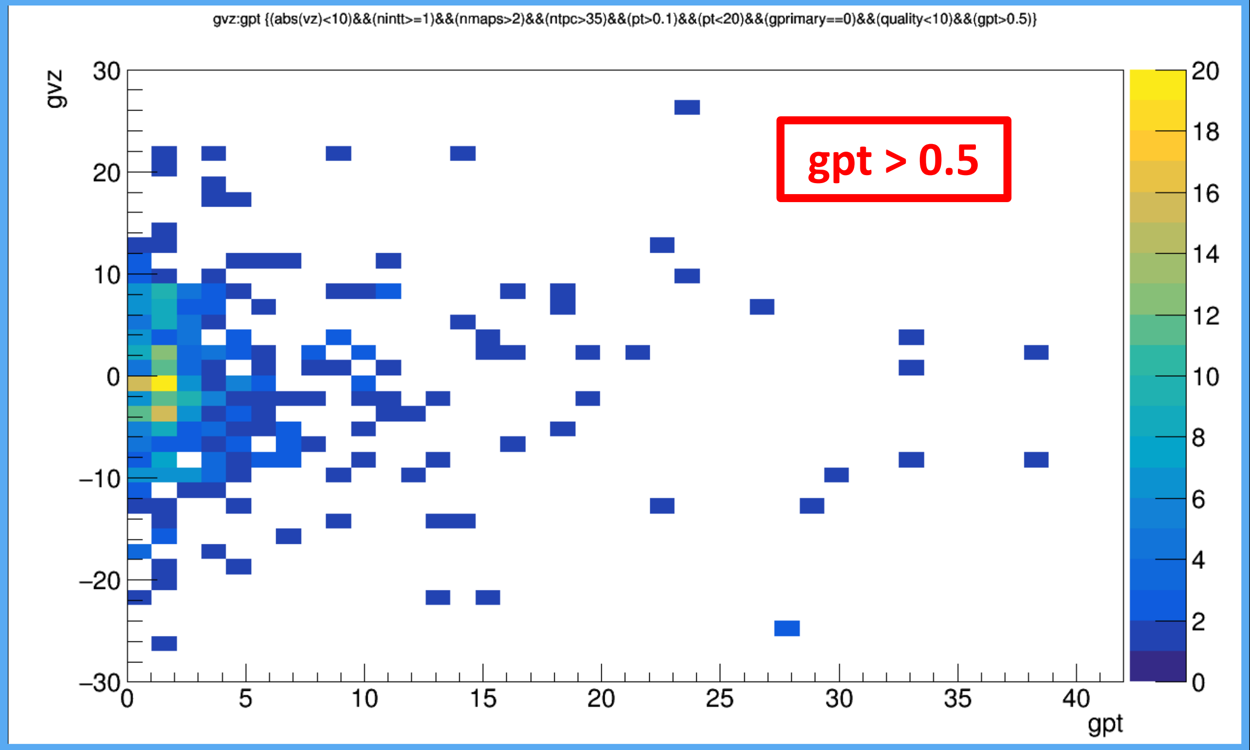
Secondaries (gprimary = 0)

< 20 GeV/c Tracks | gvz vs. pt

100 20 – 40 GeV/c
π^- per event



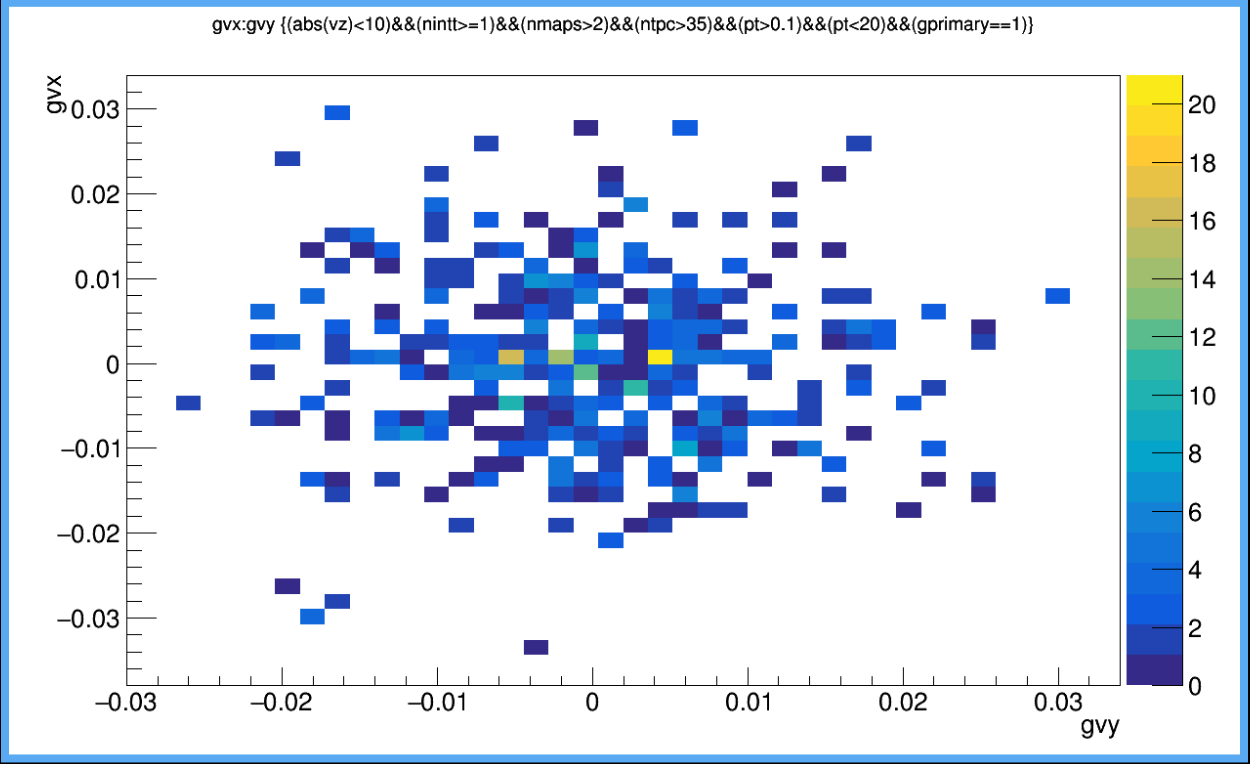
Primaries (gprimary = 1)

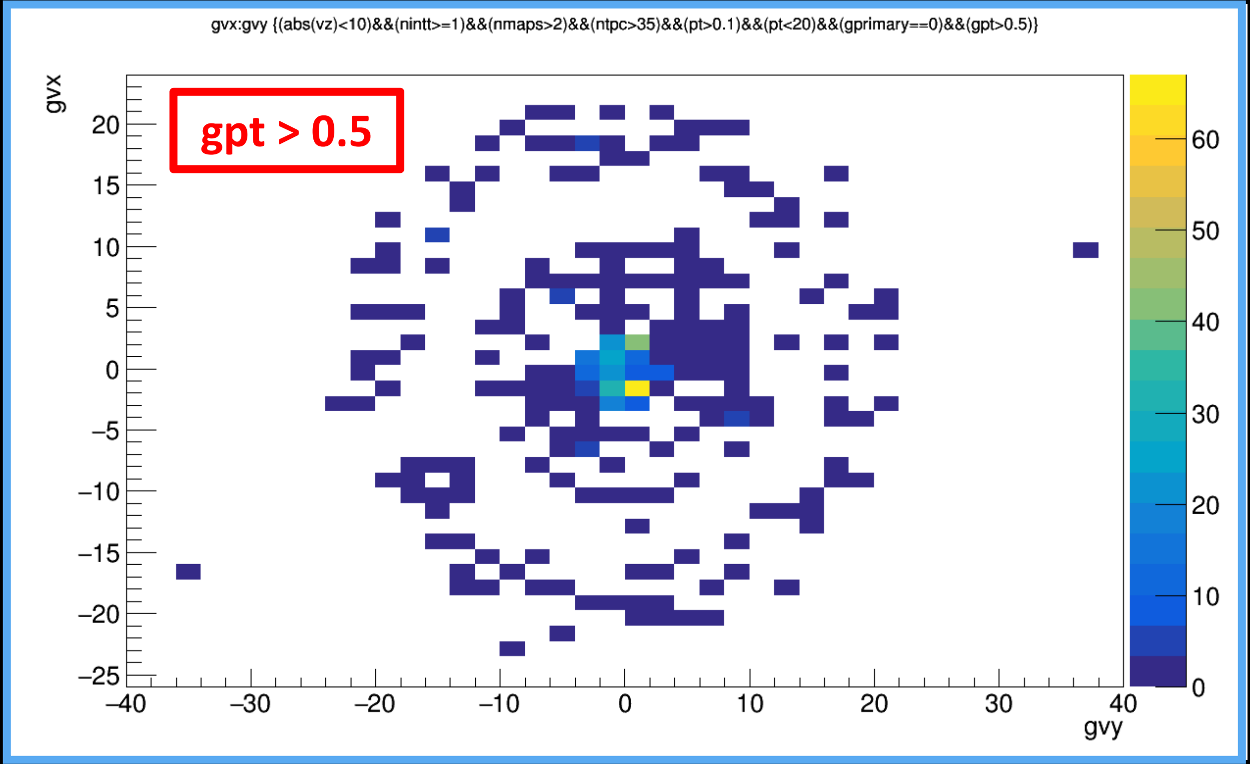


Secondaries (gprimary = 0)

< 20 GeV/c Tracks | gvx vs. gvy

100 20 – 40 GeV/c
π^- per event



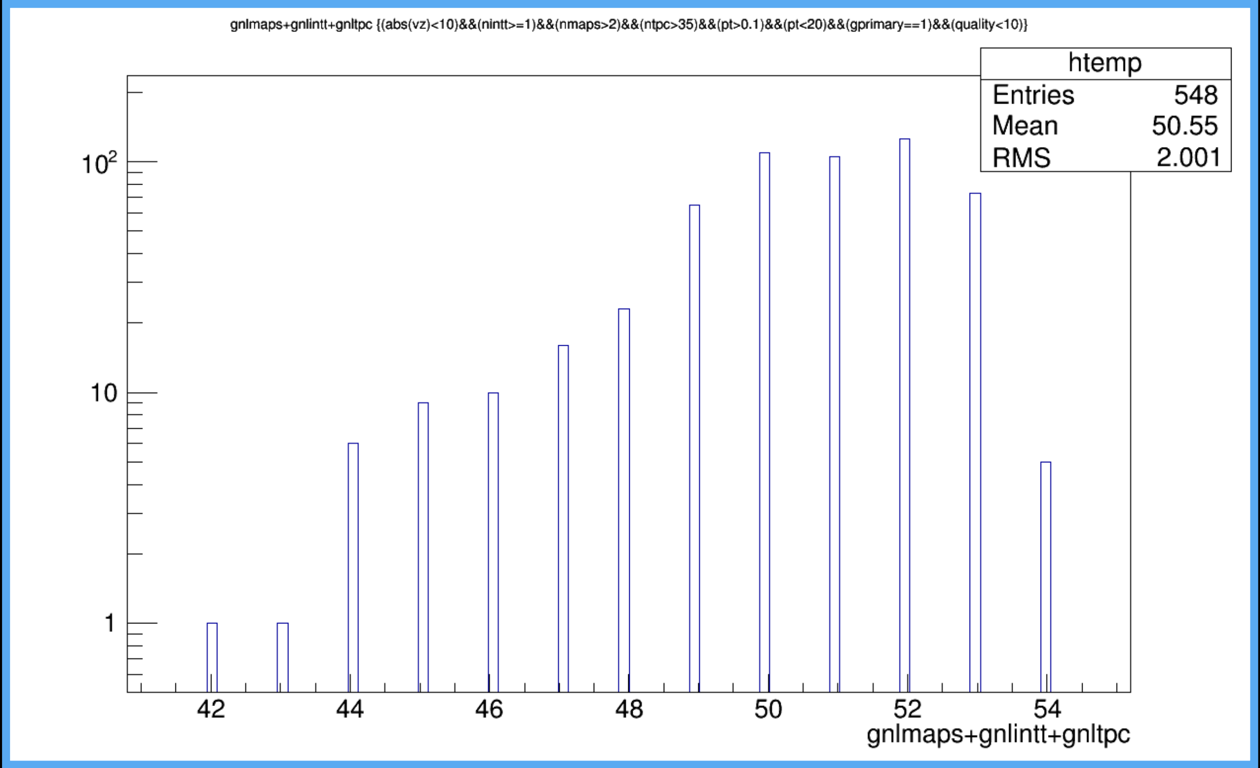


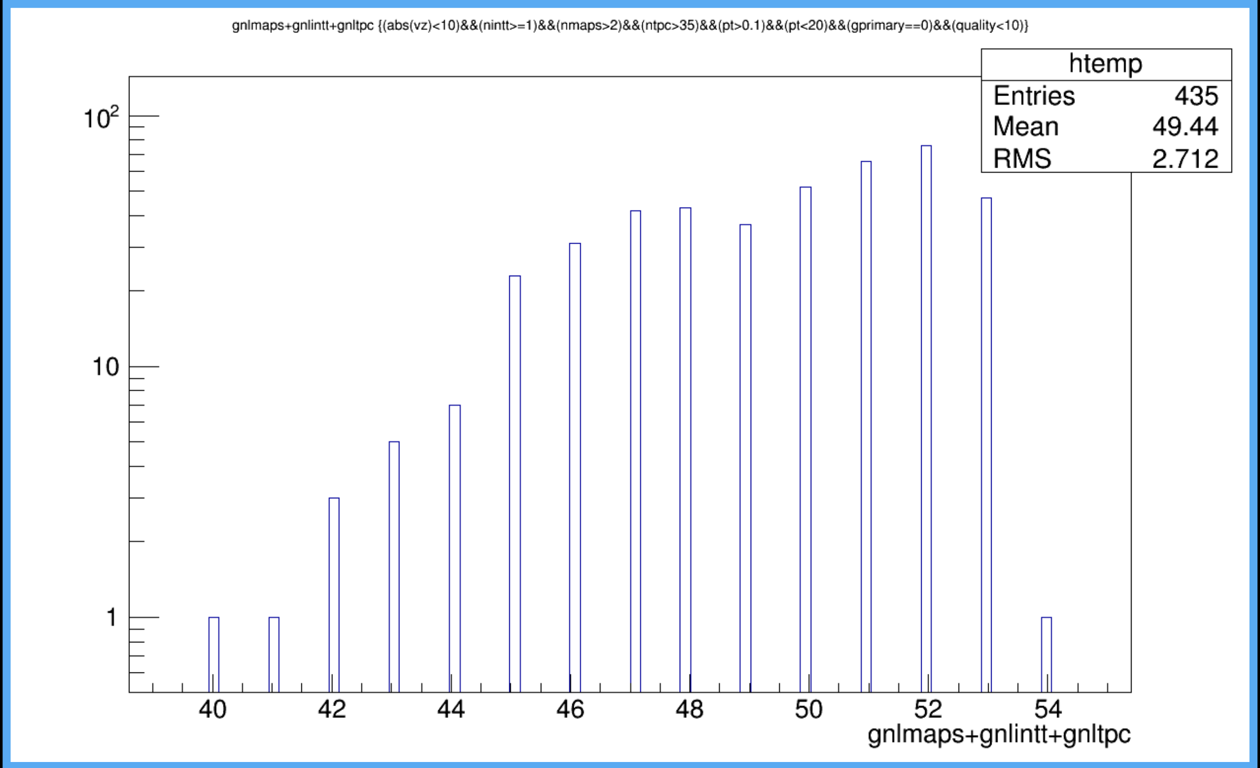
Primaries (gprimary = 1)

Secondaries (gprimary = 0)

< 20 GeV/c Tracks | gnltot = gnlmaps + gnlintt + gnltpc

100 20 – 40 GeV/c
π^- per event



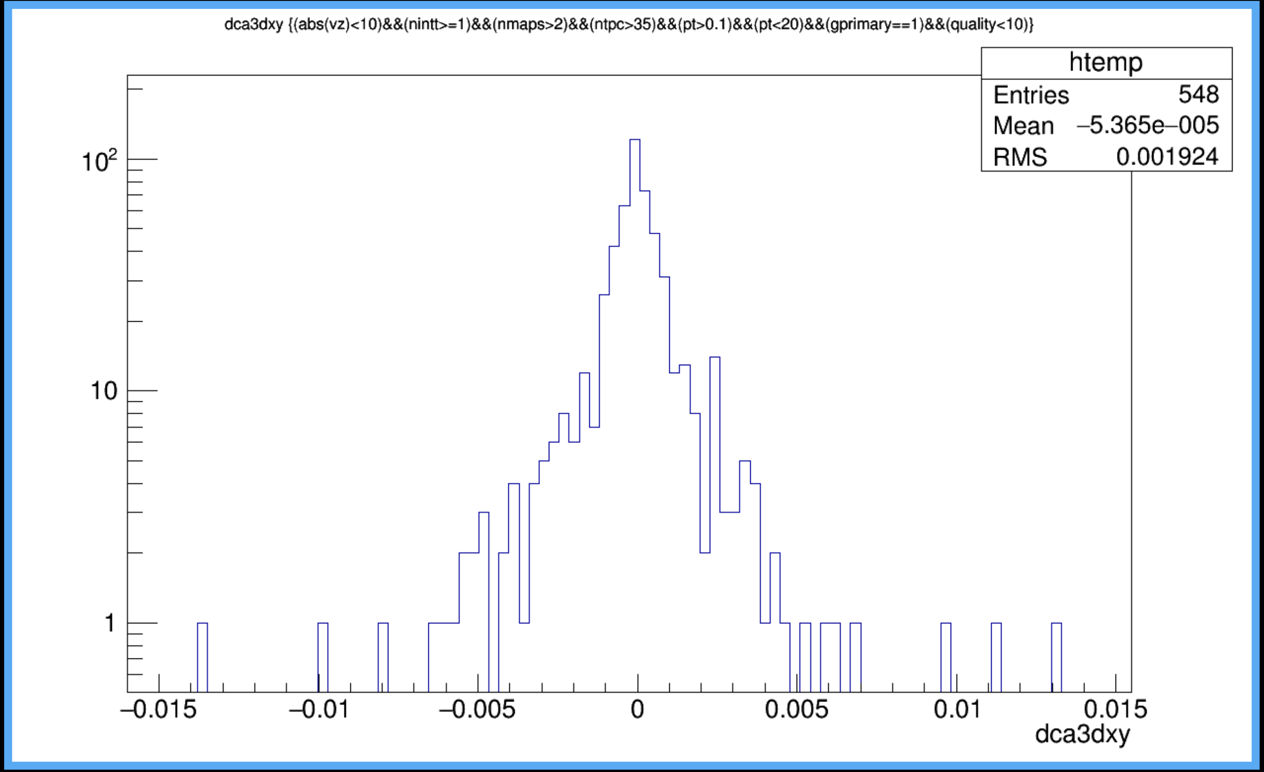


Primaries (gprimary = 1)

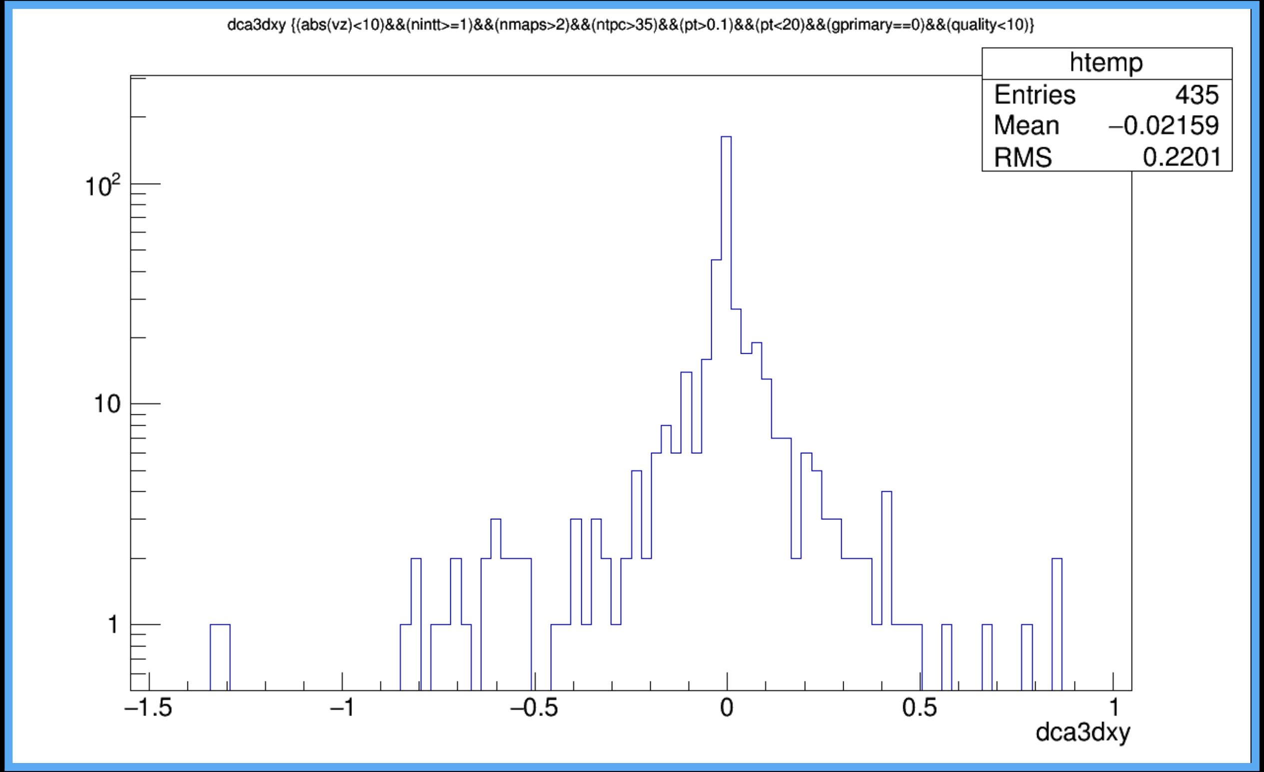
Secondaries (gprimary = 0)

< 20 GeV/c Tracks | dca3dxy

100 20 – 40 GeV/c
π^- per event



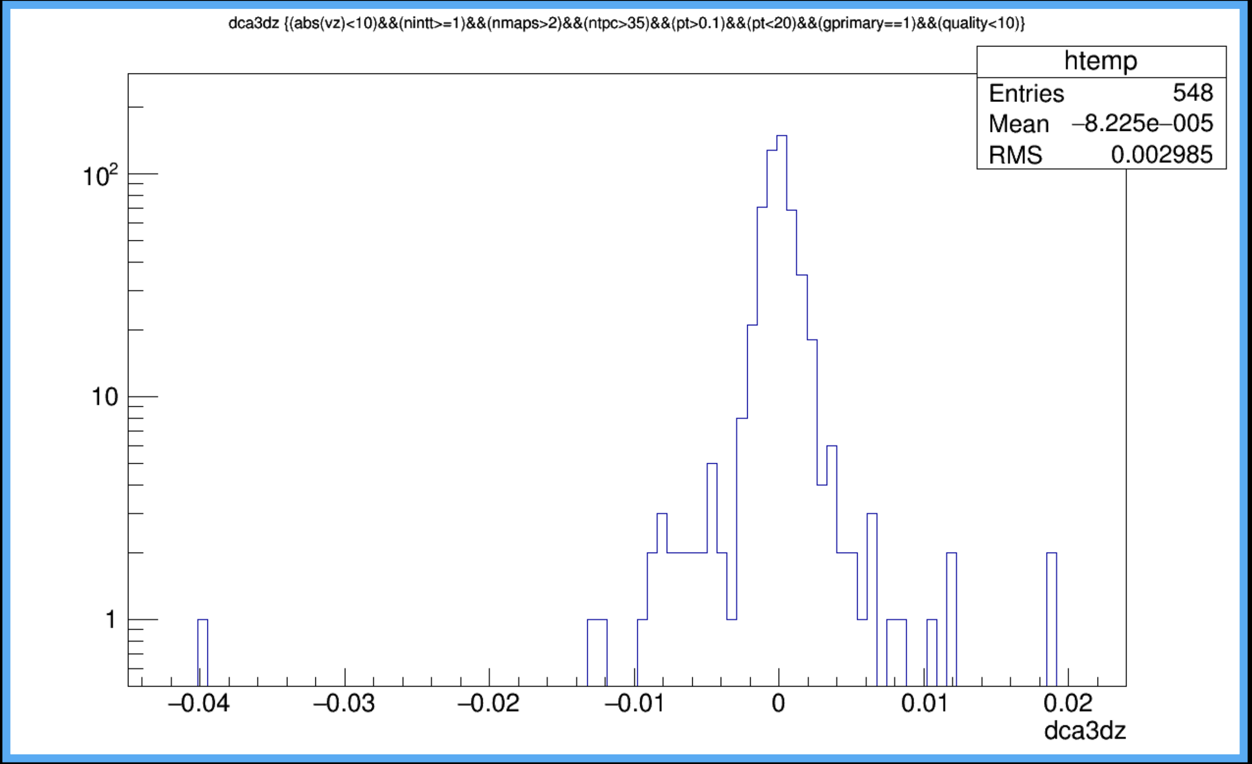
Primaries (gprimary = 1)

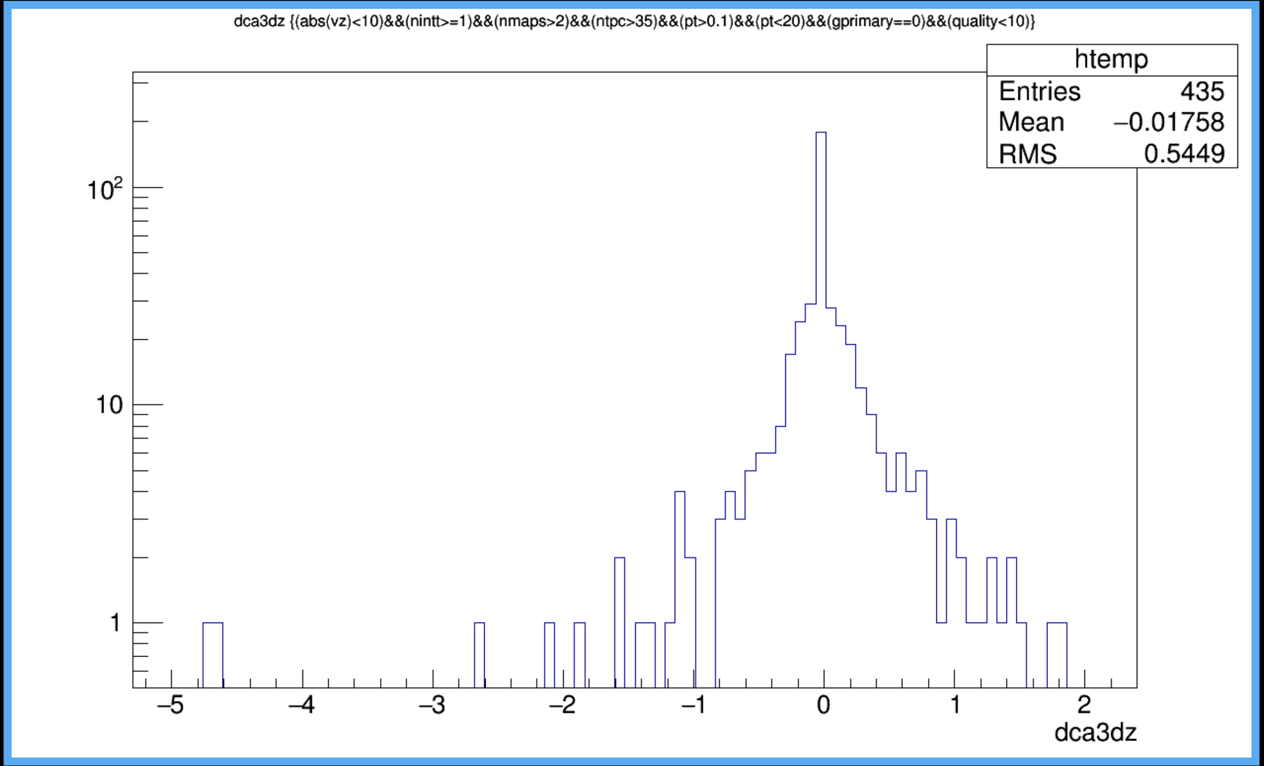


Secondaries (gprimary = 0)

< 20 GeV/c Tracks | dca3dz

100 20 – 40 GeV/c
π^- per event



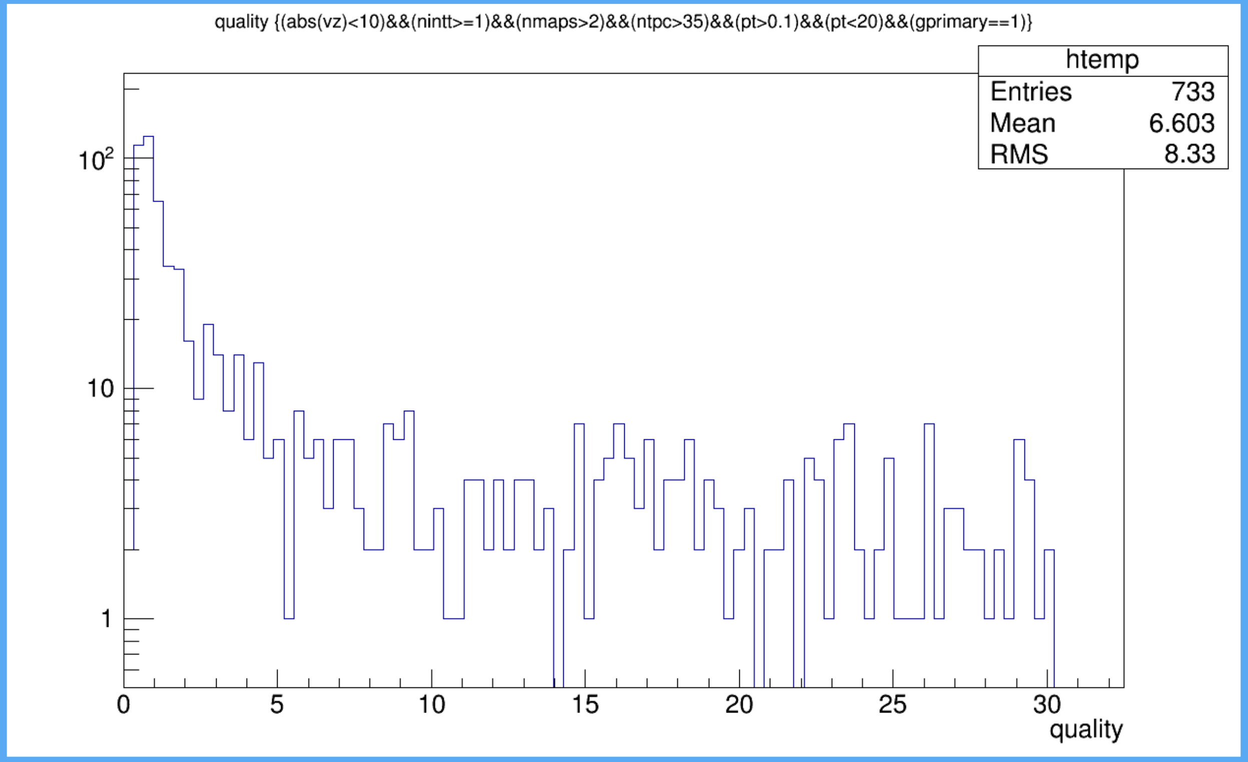


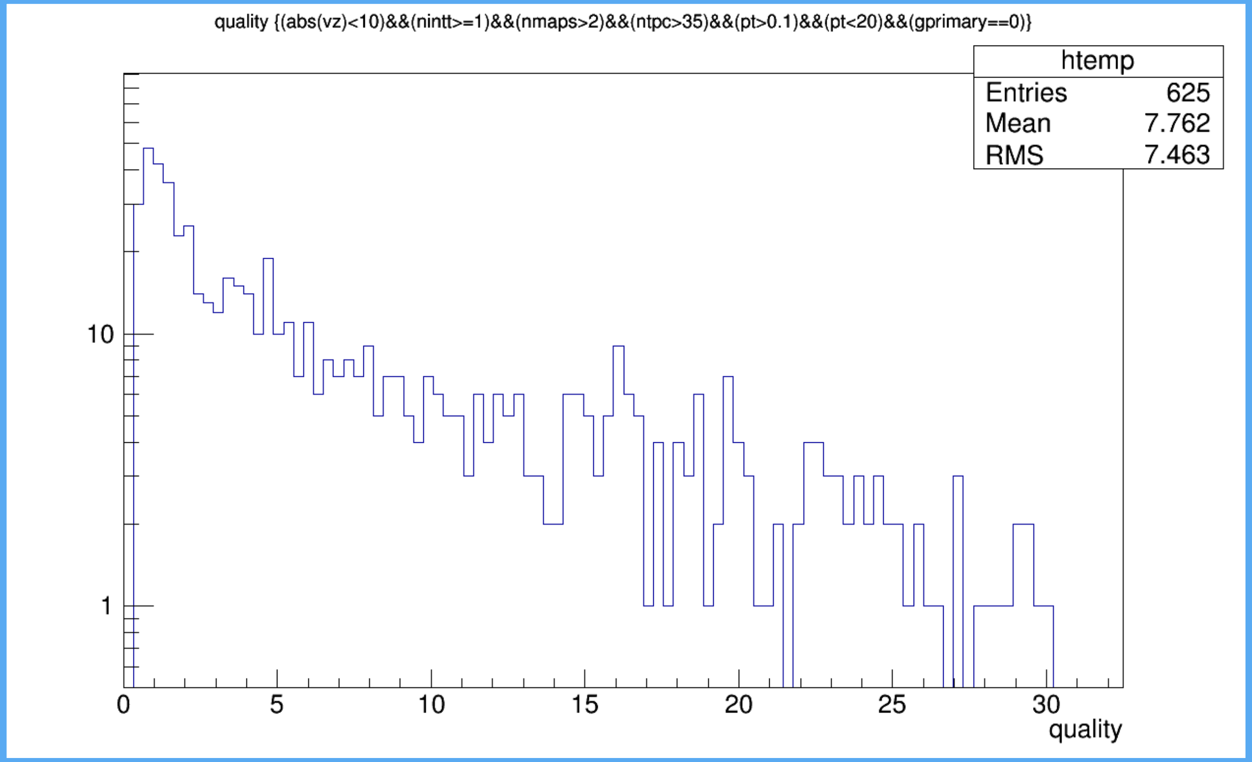
Primaries (gprimary = 1)

Secondaries (gprimary = 0)

< 20 GeV/c Tracks | quality

100 20 – 40 GeV/c
π^- per event



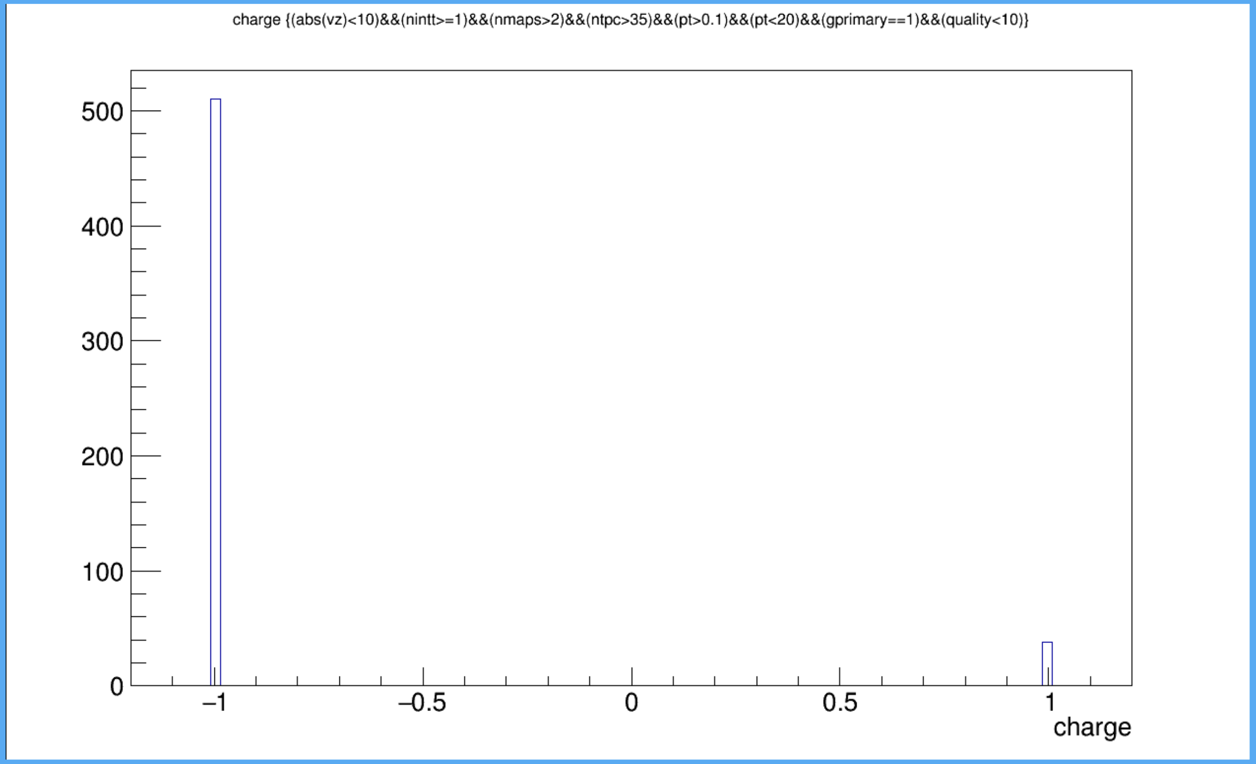


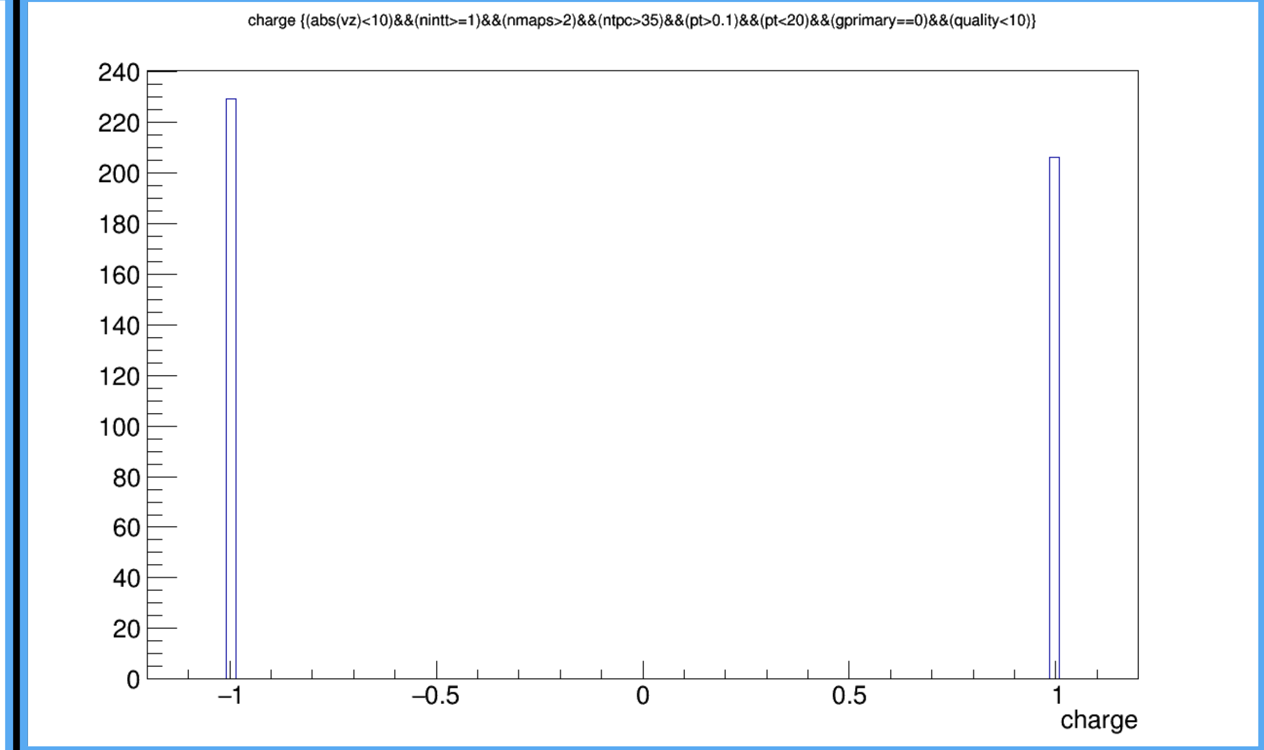
Primaries (gprimary = 1)

Secondaries (gprimary = 0)

< 20 GeV/c Tracks | charge

100 20 – 40 GeV/c π^- per event



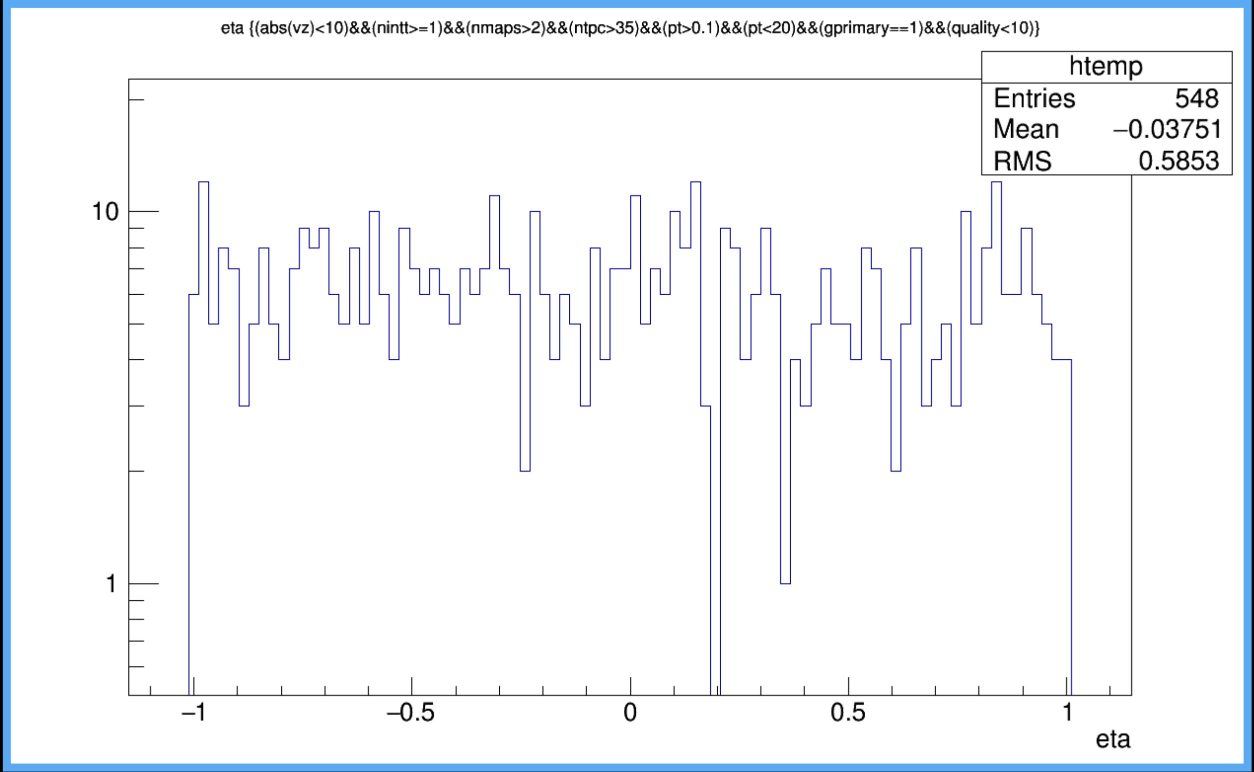


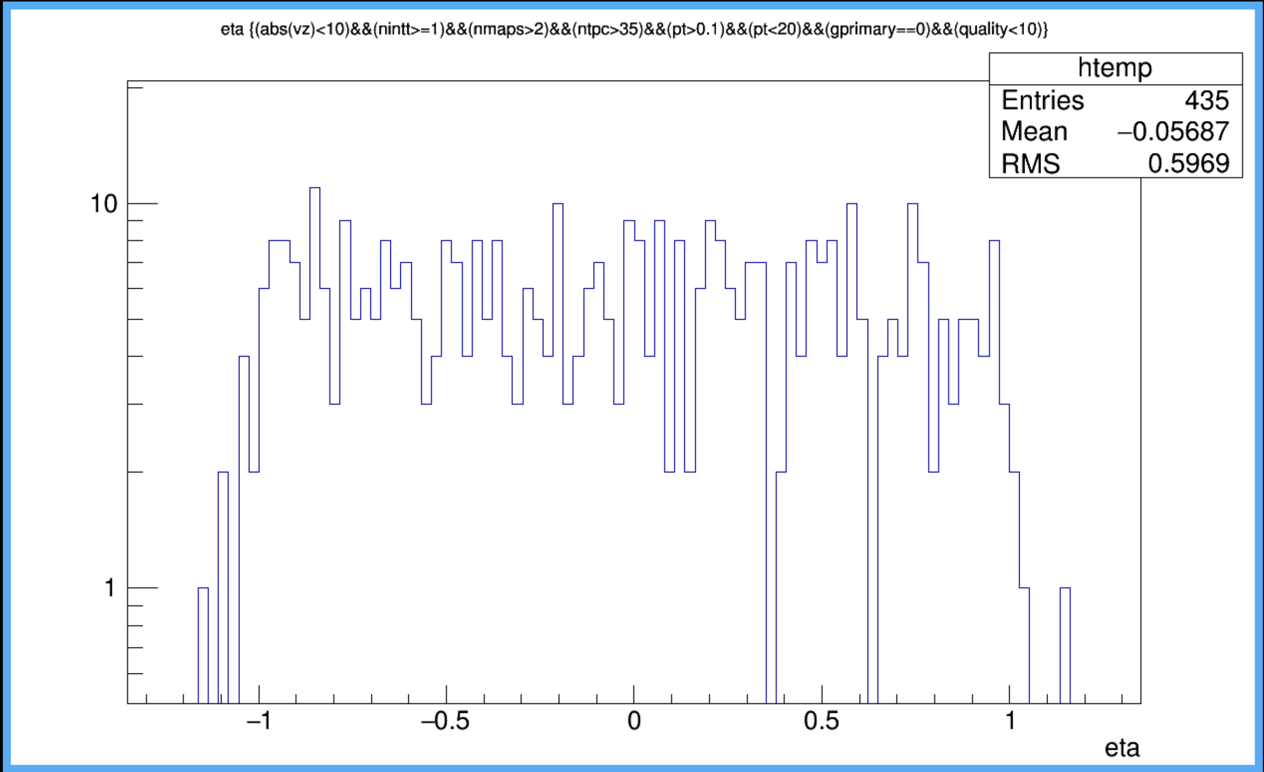
Primaries (gprimary = 1)

Secondaries (gprimary = 0)

< 20 GeV/c Tracks | eta

100 20 – 40 GeV/c π^- per event



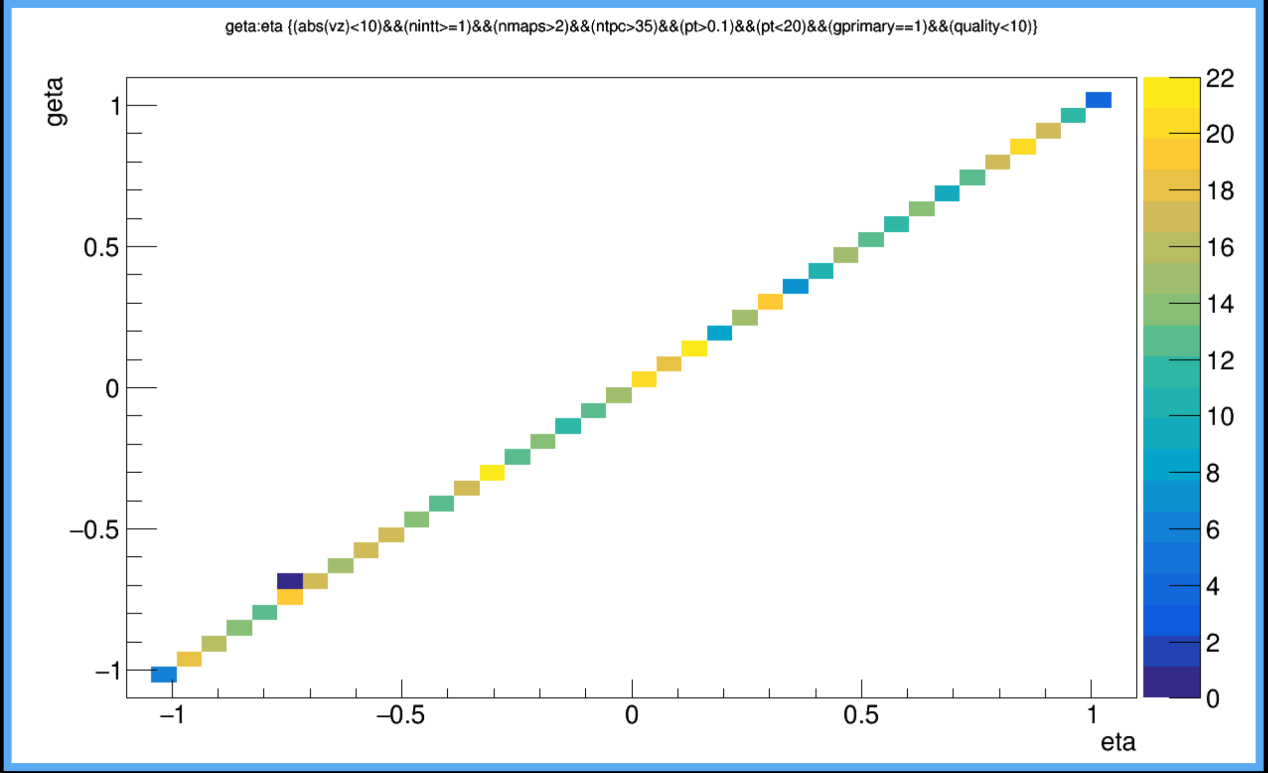


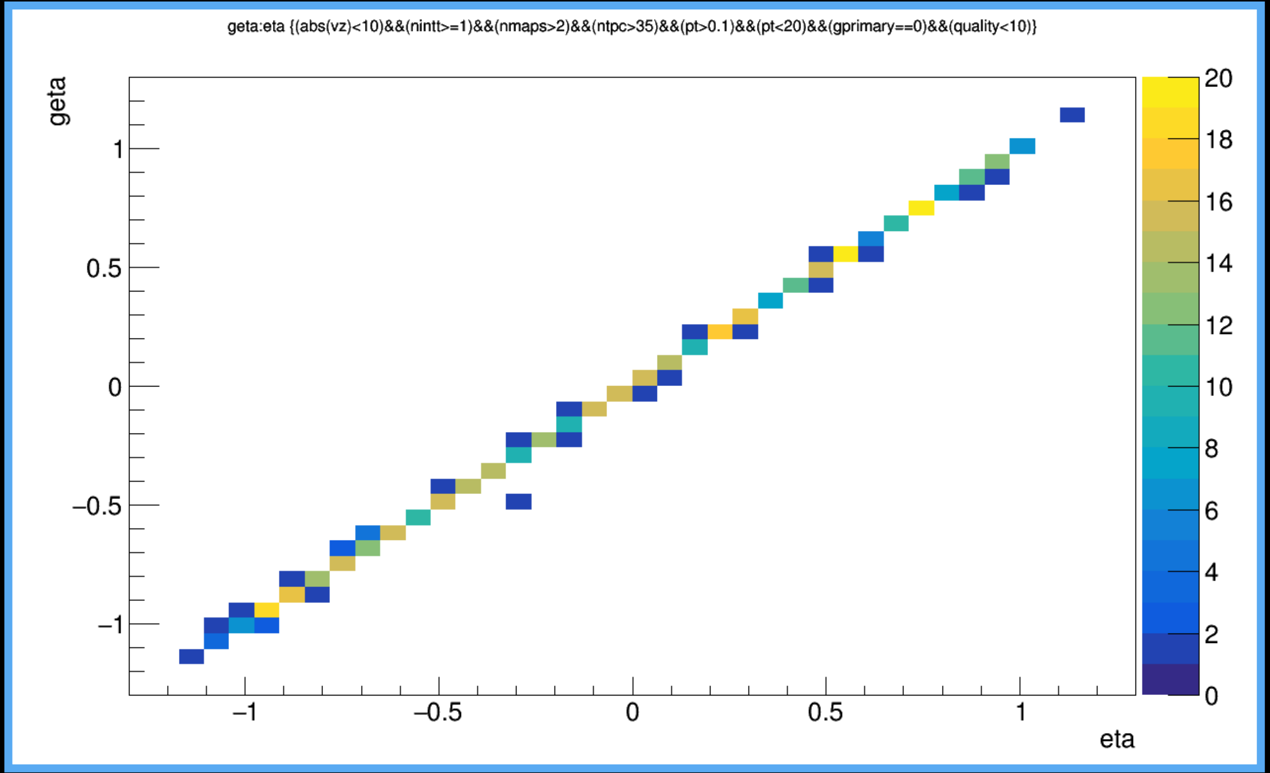
Primaries (gprimary = 1)

Secondaries (gprimary = 0)

< 20 GeV/c Tracks | geta vs. eta

100 20 – 40 GeV/c
π^- per event



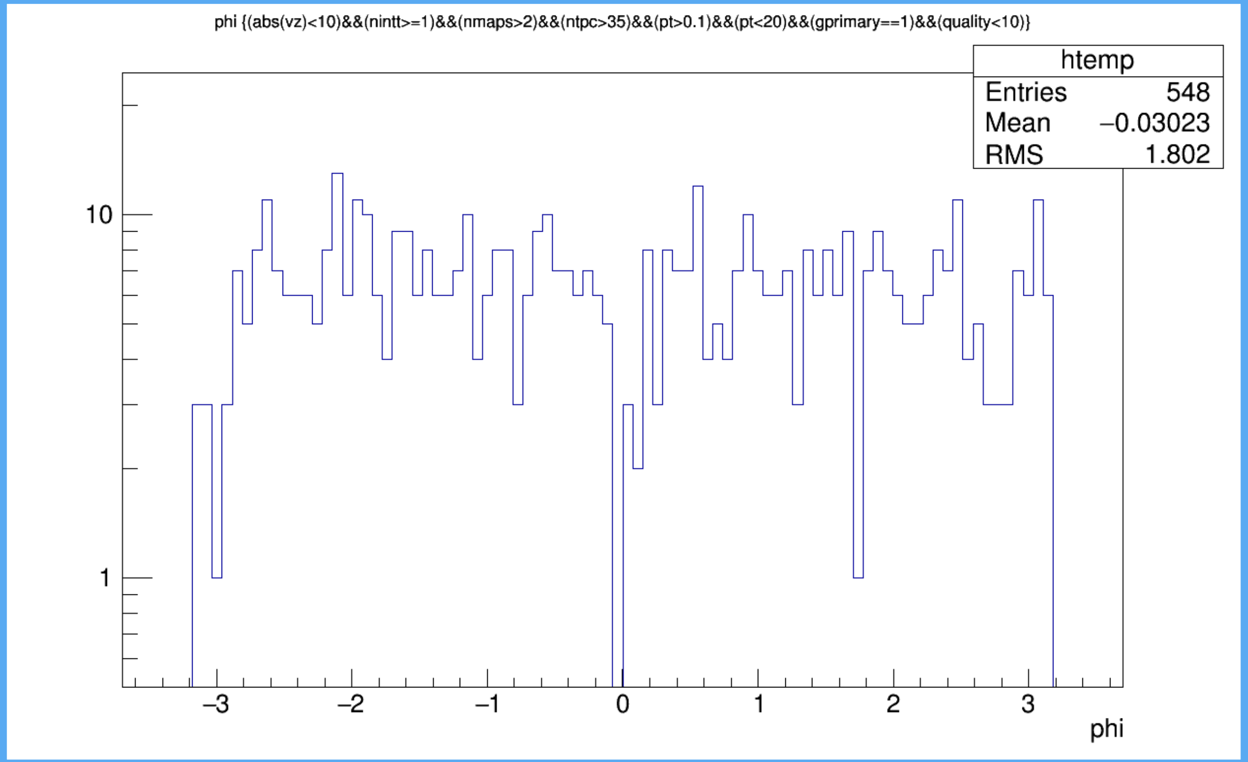


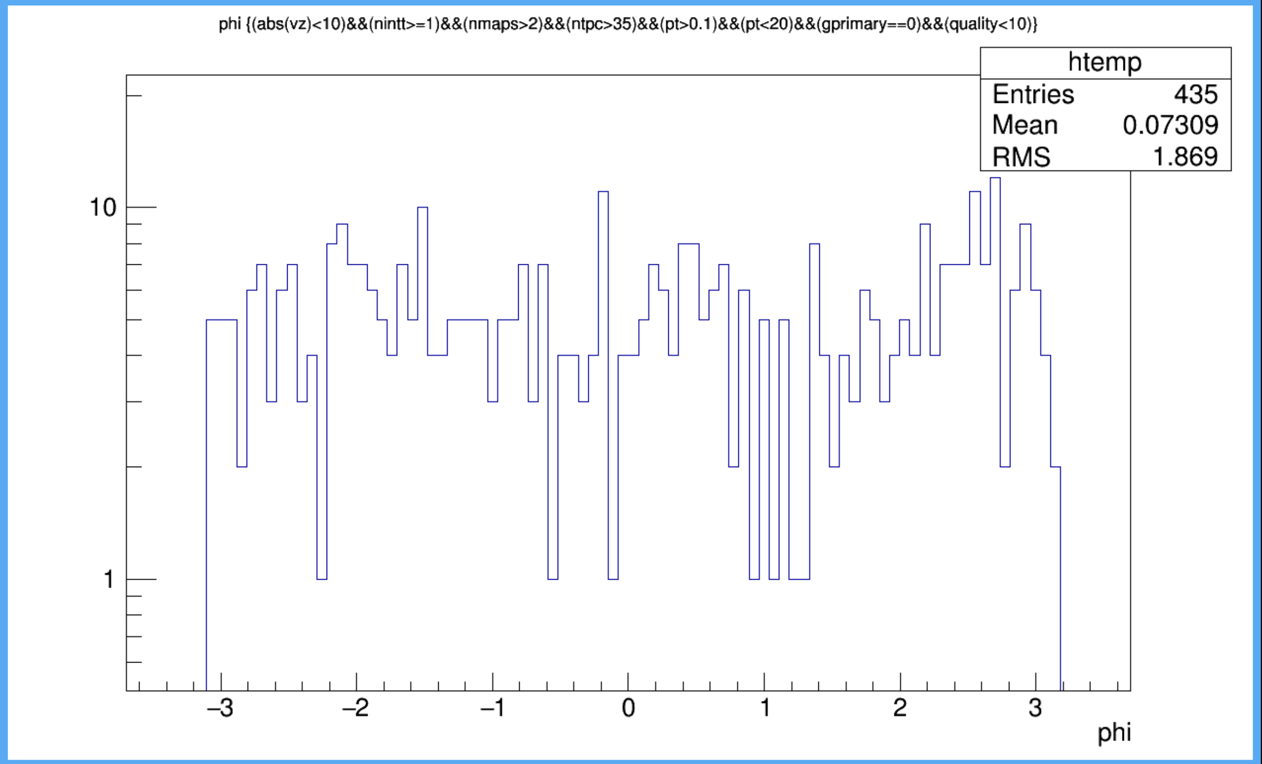
Primaries (gprimary = 1)

Secondaries (gprimary = 0)

< 20 GeV/c Tracks | phi

100 20 – 40 GeV/c
π^- per event



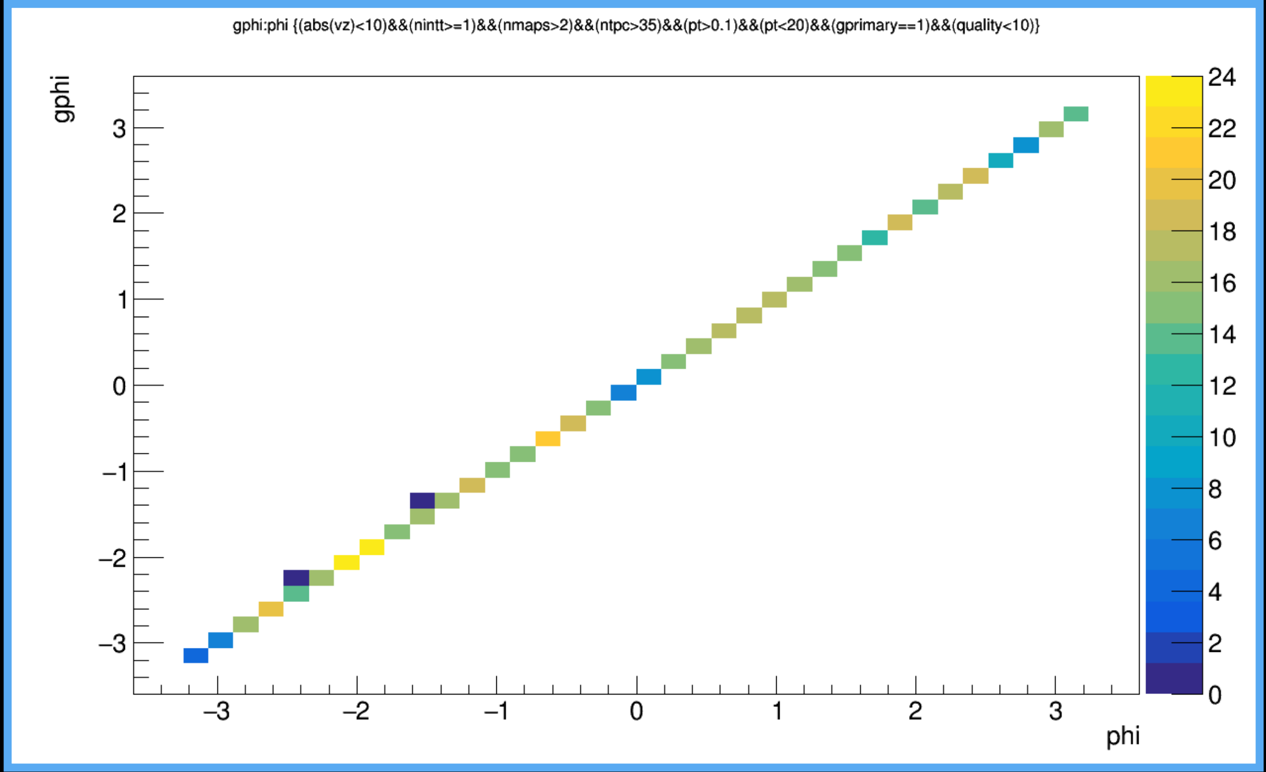


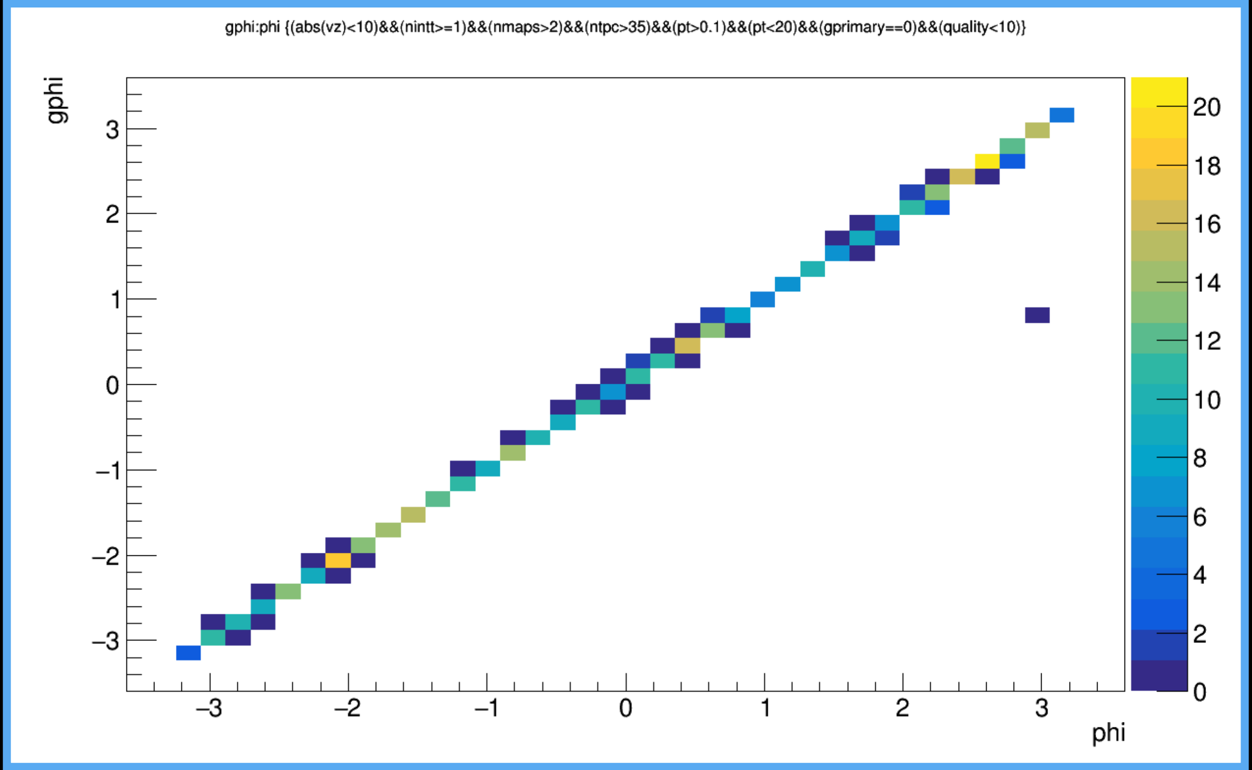
Primaries (gprimary = 1)

Secondaries (gprimary = 0)

< 20 GeV/c Tracks | gphi vs. phi

100 20 – 40 GeV/c
π^- per event



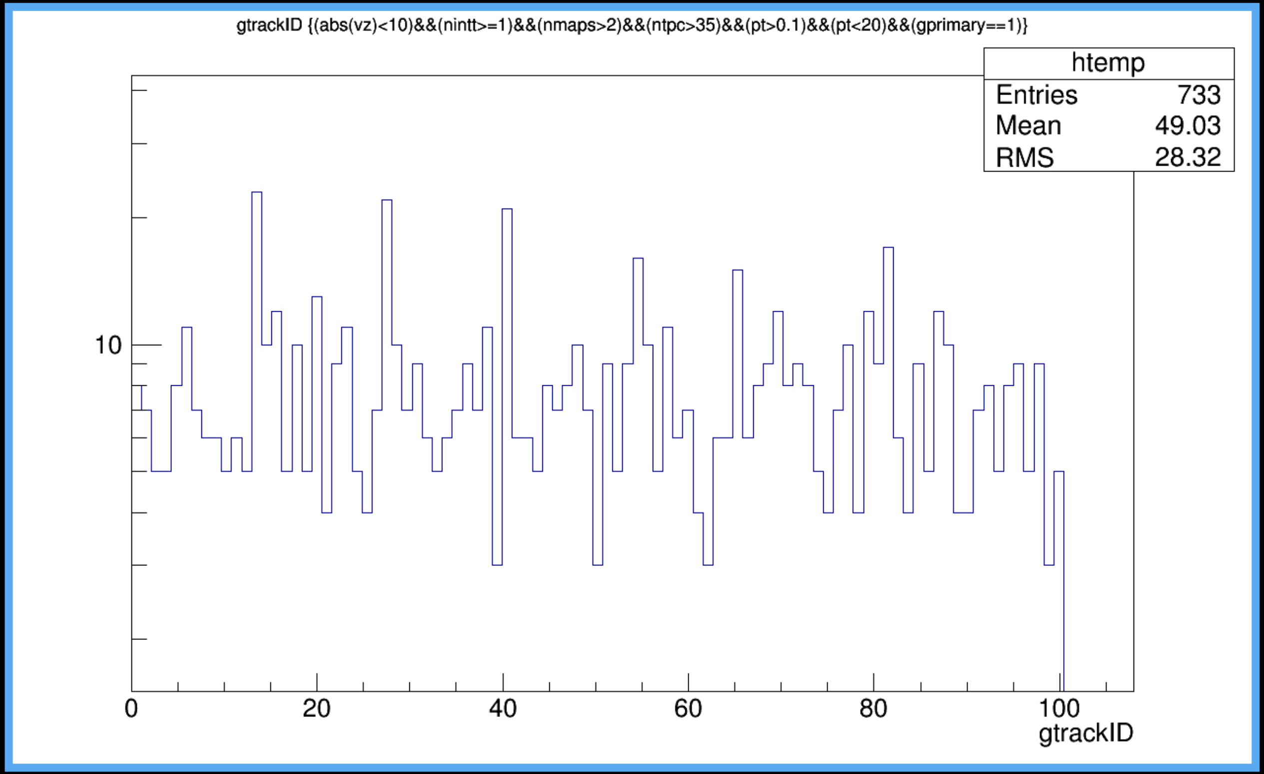


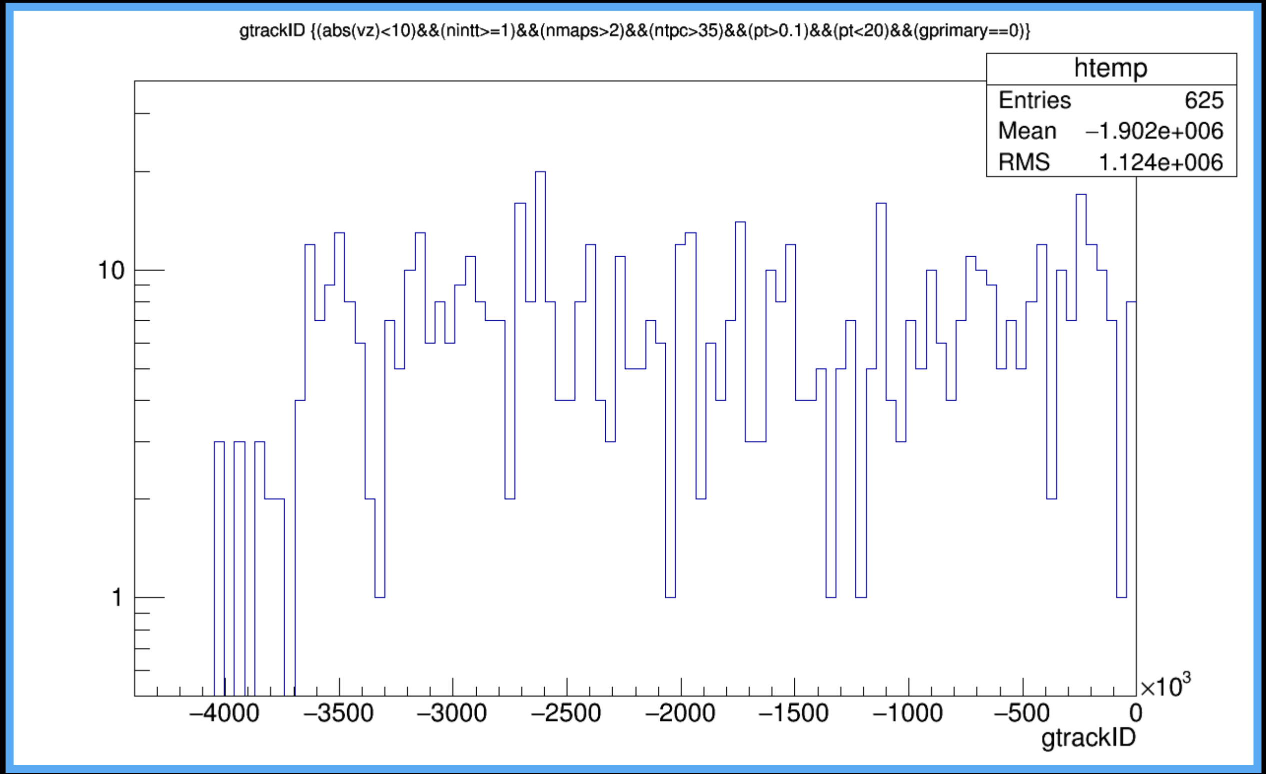
Primaries (gprimary = 1)

Secondaries (gprimary = 0)

< 20 GeV/c Tracks | gtrackid

100 20 – 40 GeV/c
π^- per event

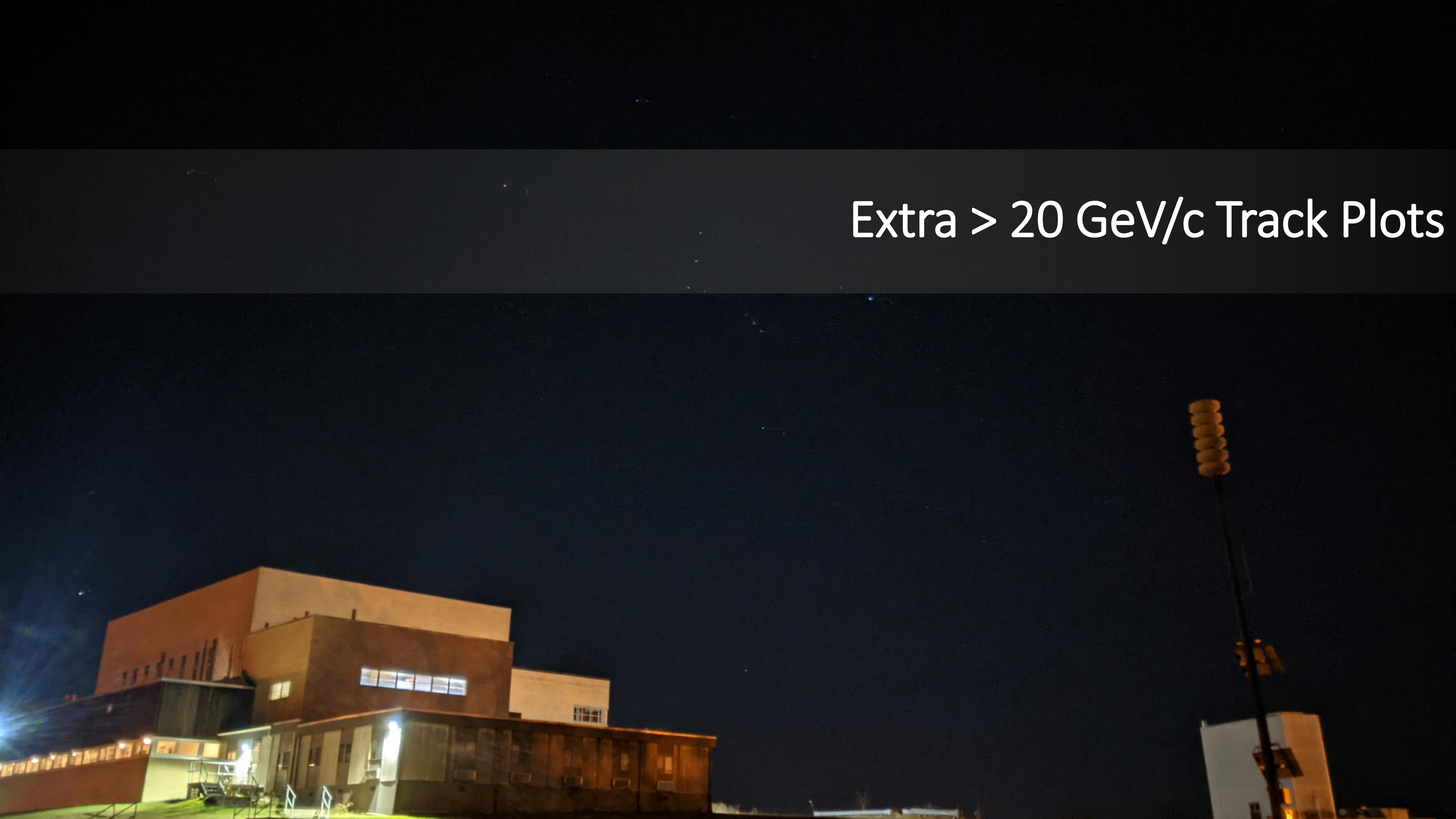




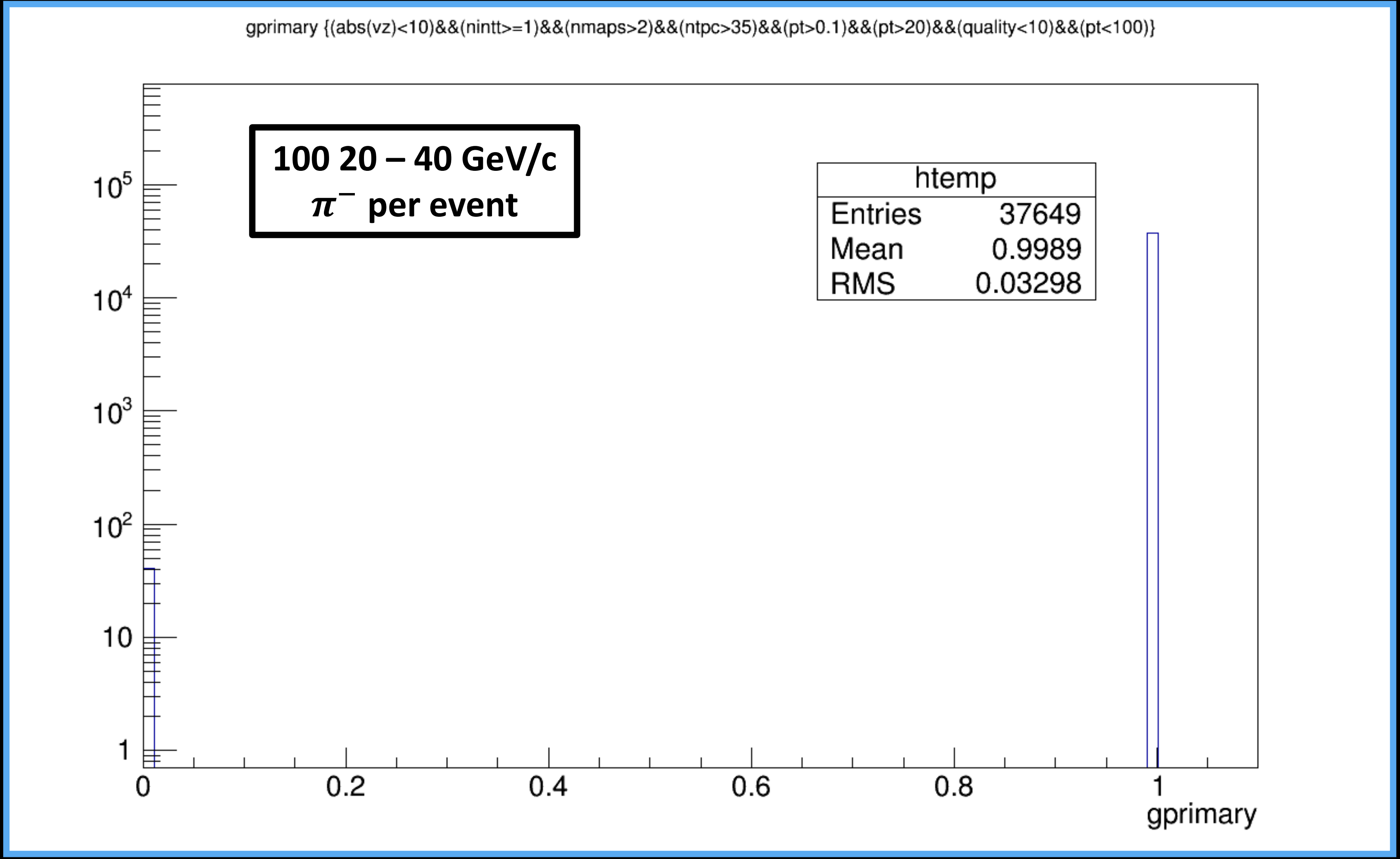
Primaries (gprimary = 1)

Secondaries (gprimary = 0)

Extra > 20 GeV/c Track Plots

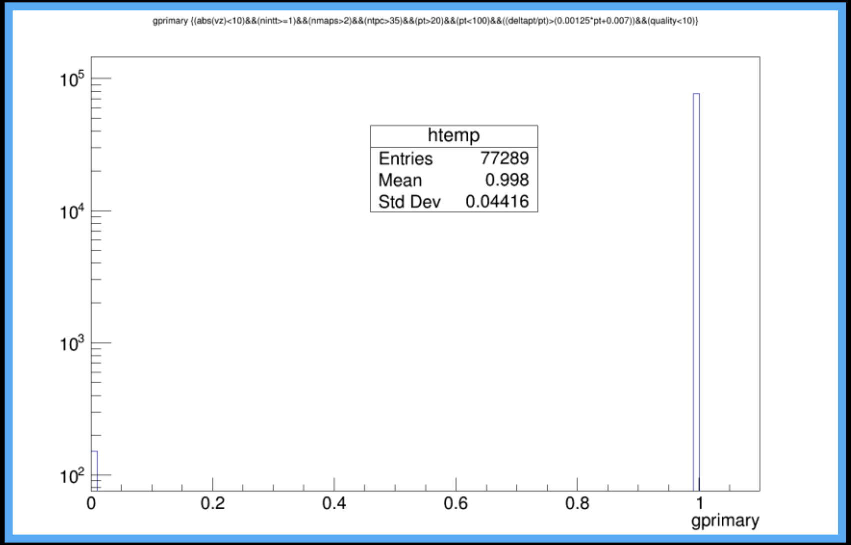


> 20 GeV/c Tracks | gprimary

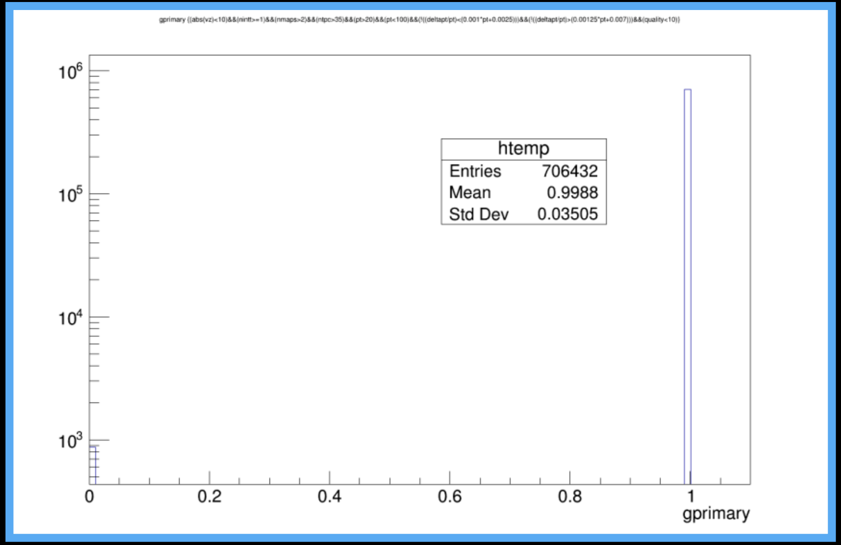


> 20 GeV/c Tracks | gprimary

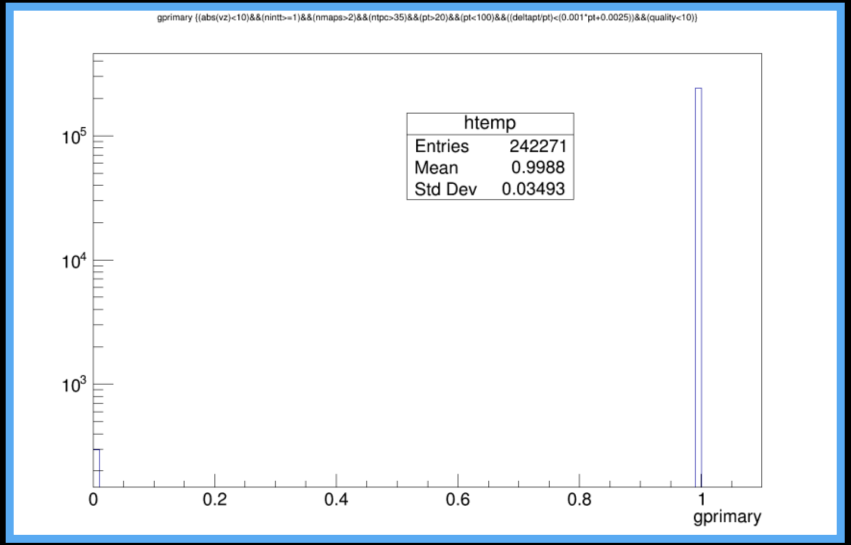
100 20 – 40 GeV/c π^- per event



Up



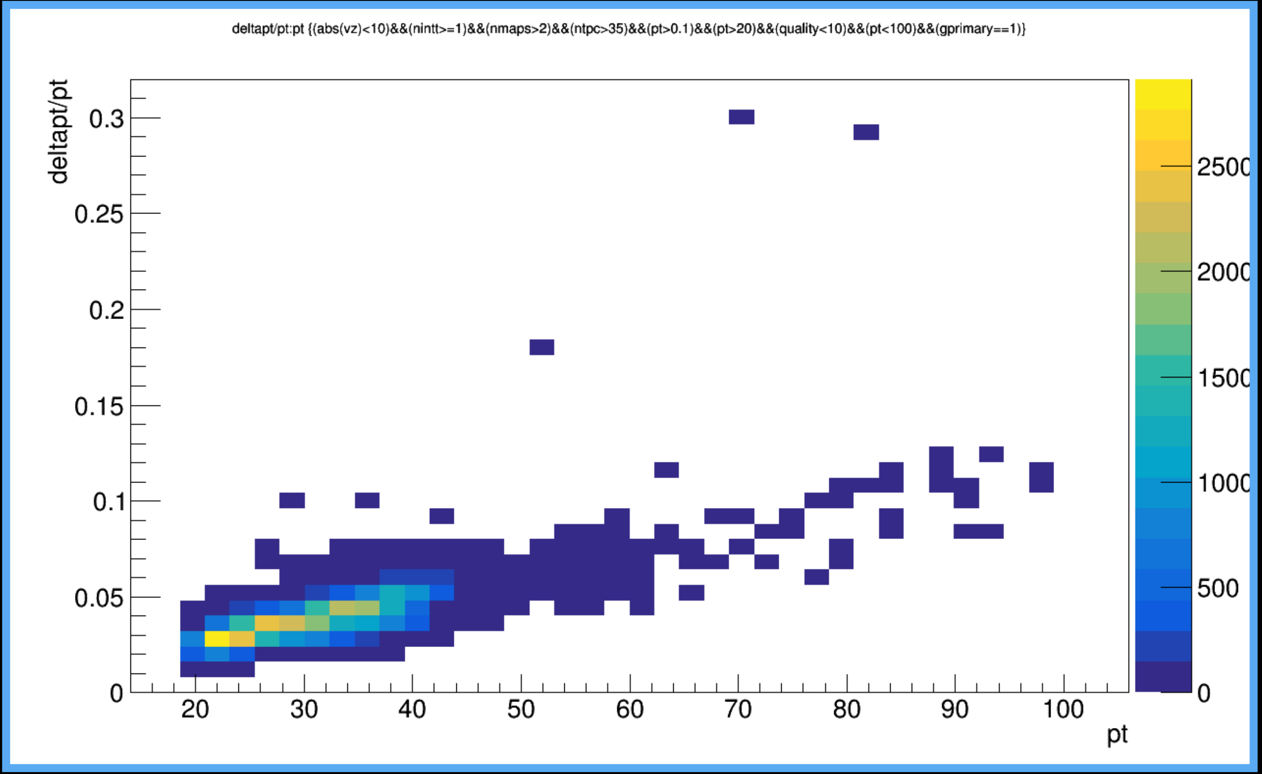
Center

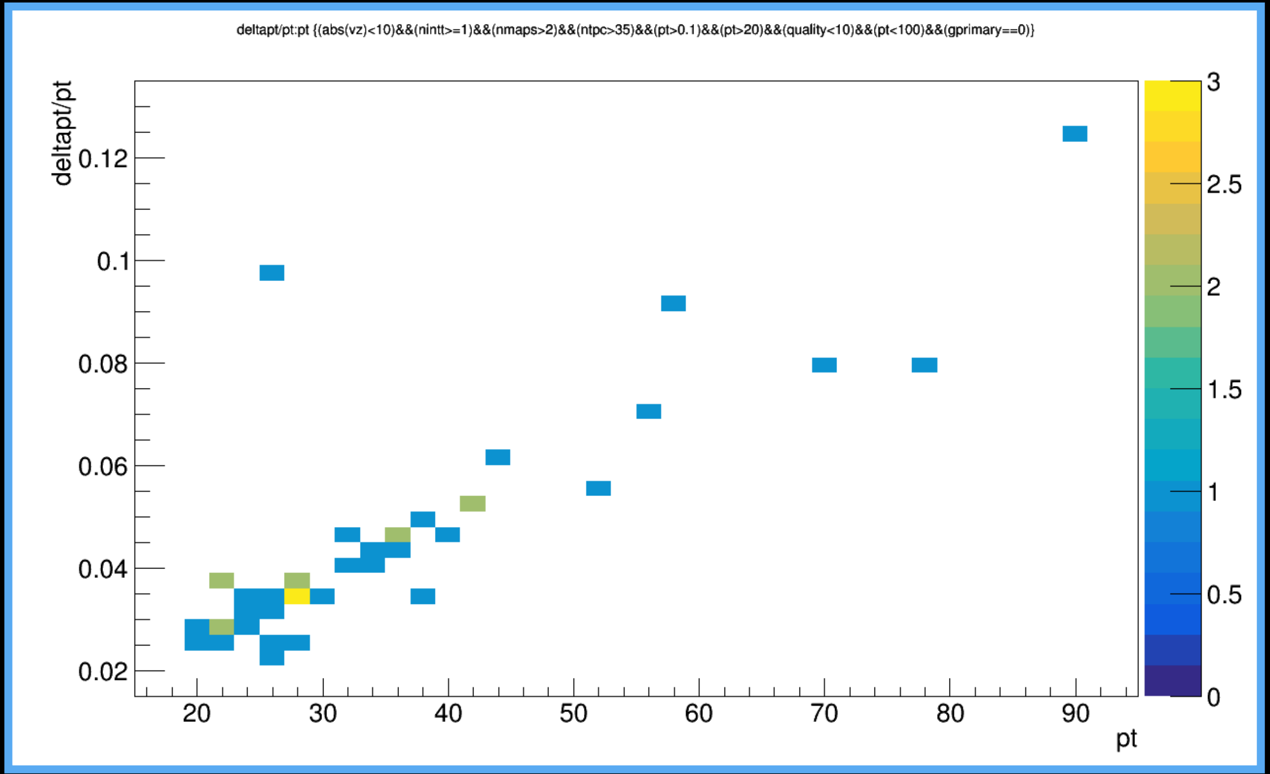


Down

> 20 GeV/c Tracks | deltapt/pt vs. pt

100 20 – 40 GeV/c
π^- per event



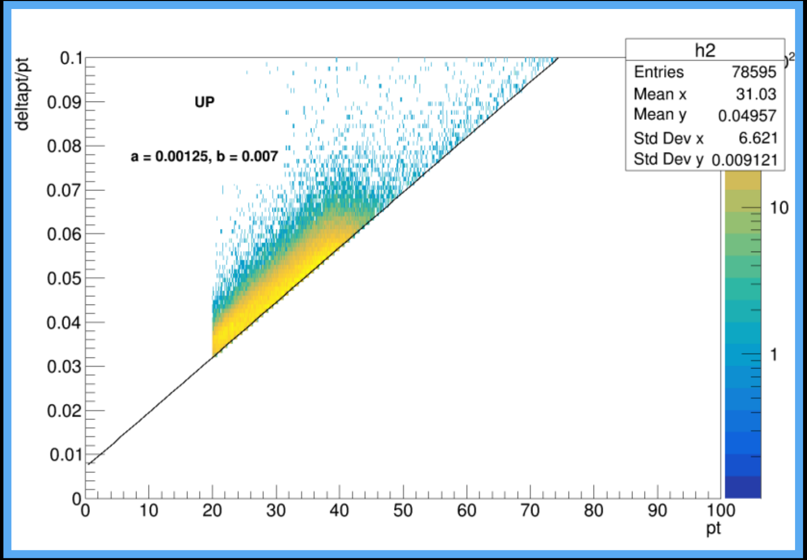


Primaries (gprimary = 1)

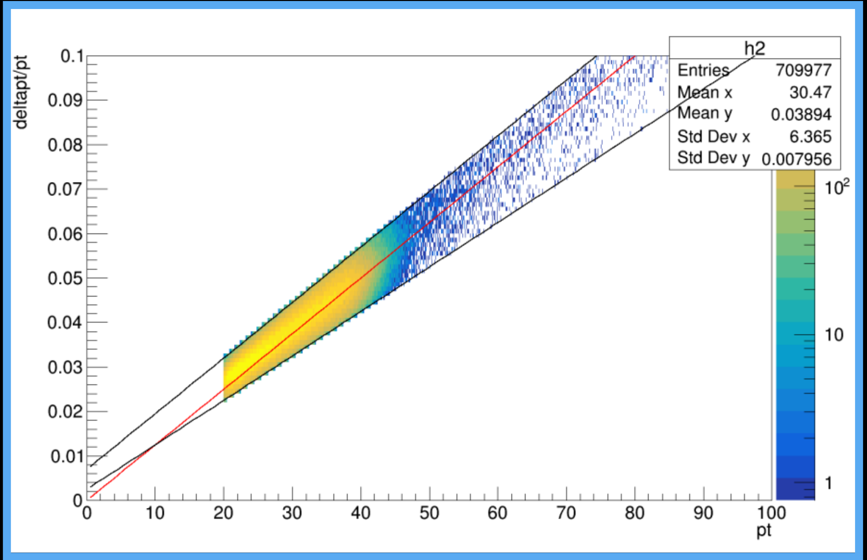
Secondaries (gprimary = 0)

> 20 GeV/c Tracks | deltapt/pt vs. pt

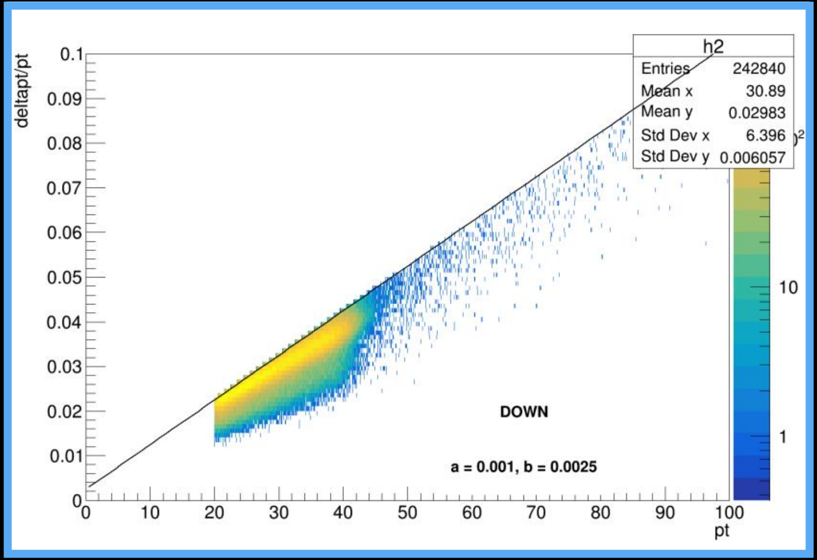
100 20 – 40 GeV/c π^- per event



Up



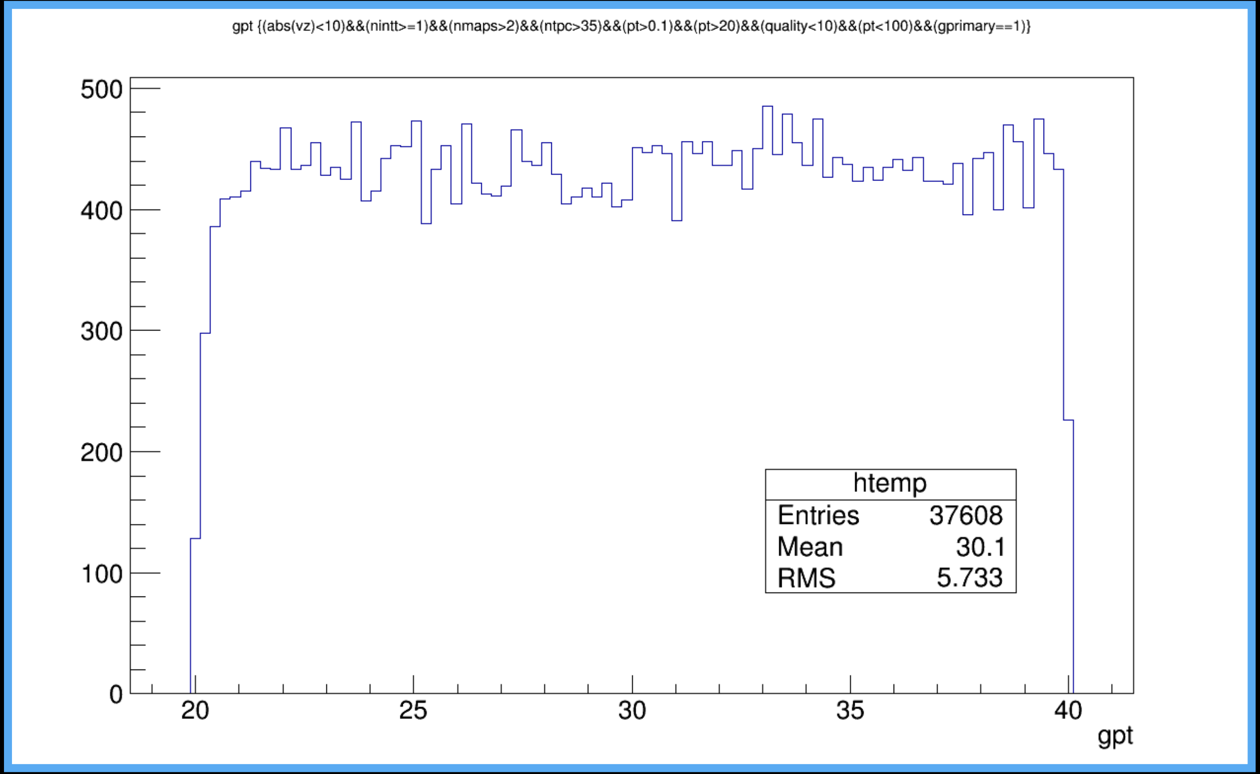
Center

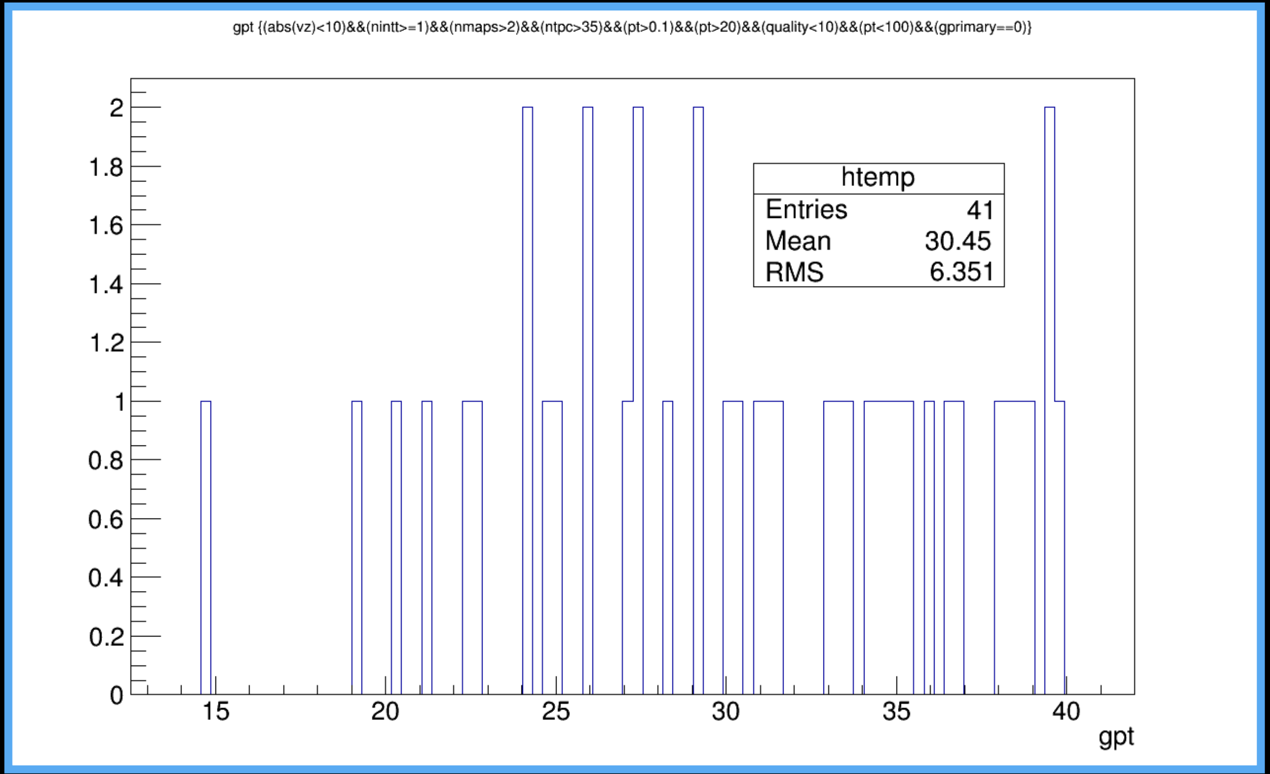


Down

> 20 GeV/c Tracks | gpt

100 20 – 40 GeV/c
π^- per event



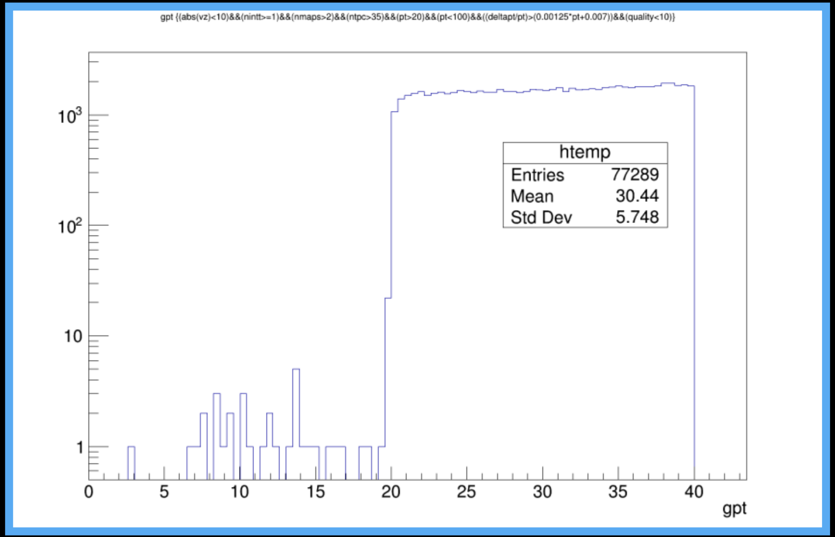


Primaries (gprimary = 1)

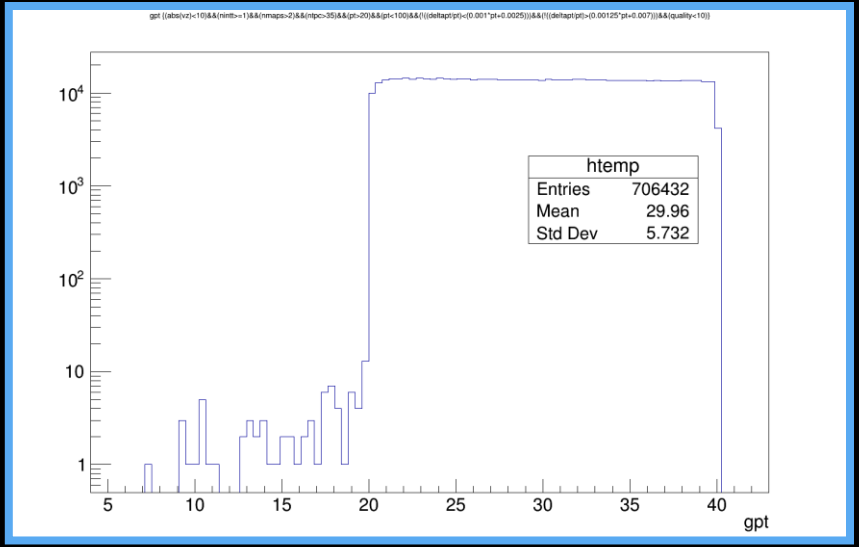
Secondaries (gprimary = 0)

> 20 GeV/c Tracks | gpt

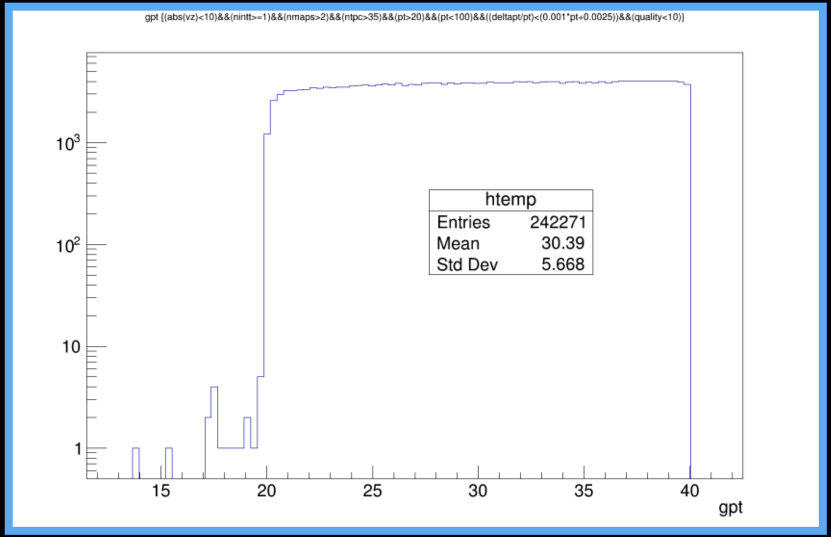
100 20 – 40 GeV/c π^- per event



Up



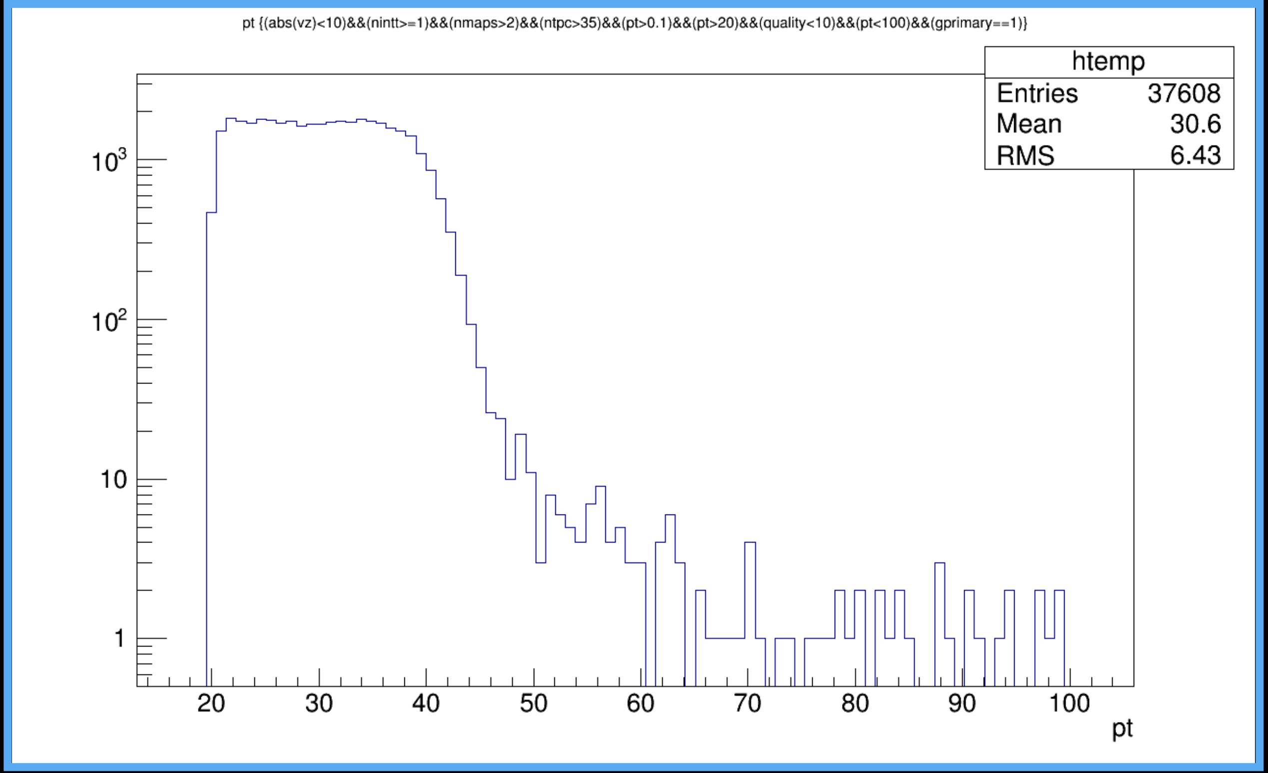
Center

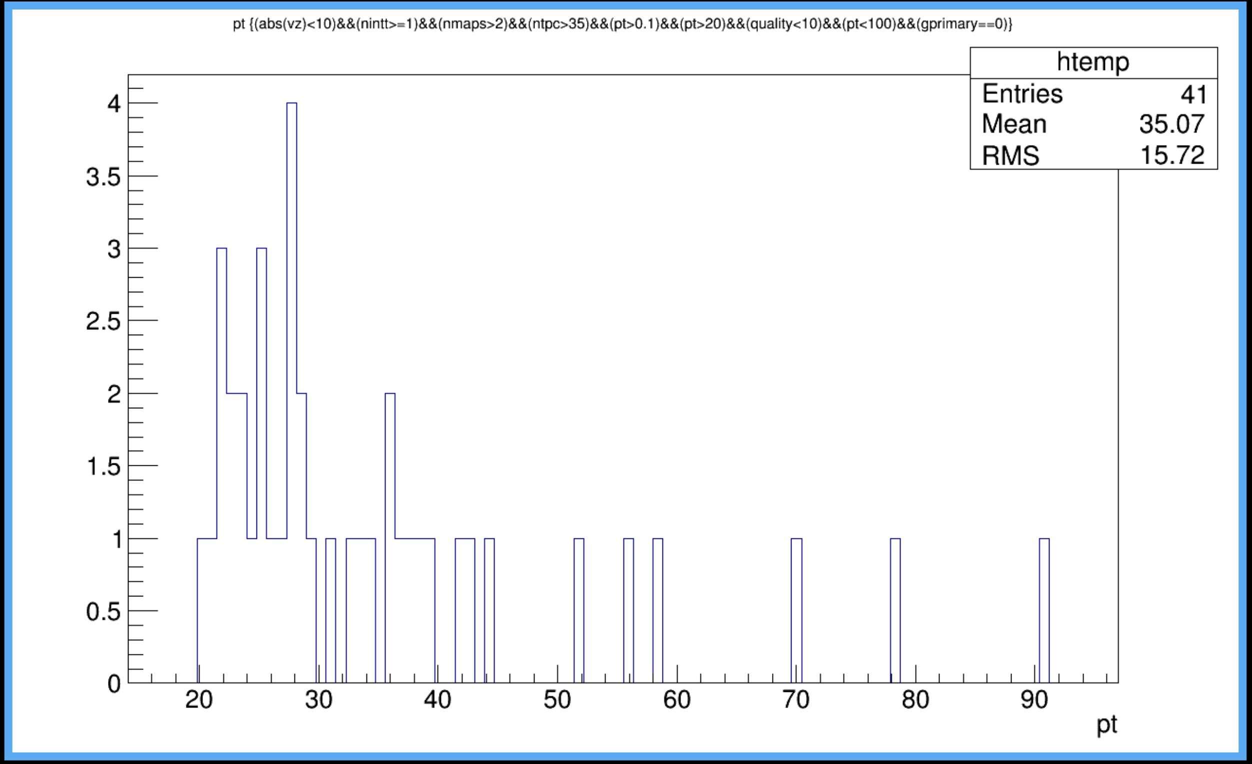


Down

> 20 GeV/c Tracks | pt

100 20 – 40 GeV/c π^- per event



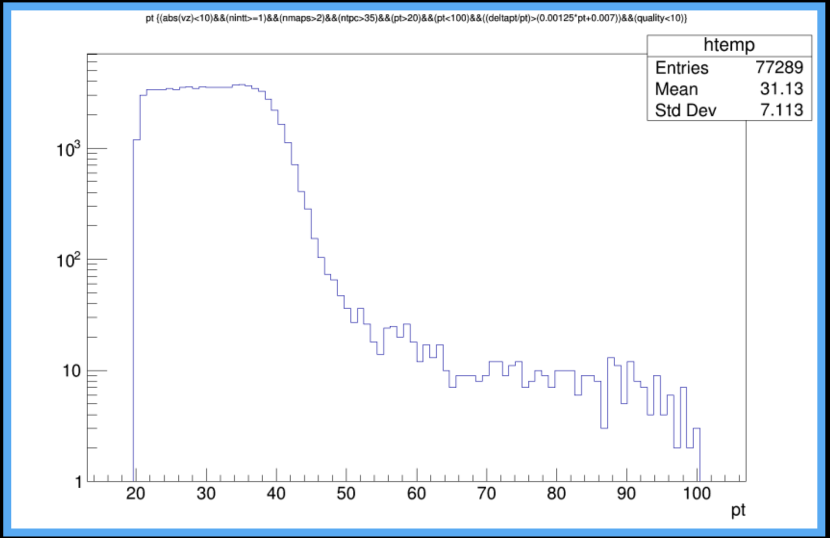


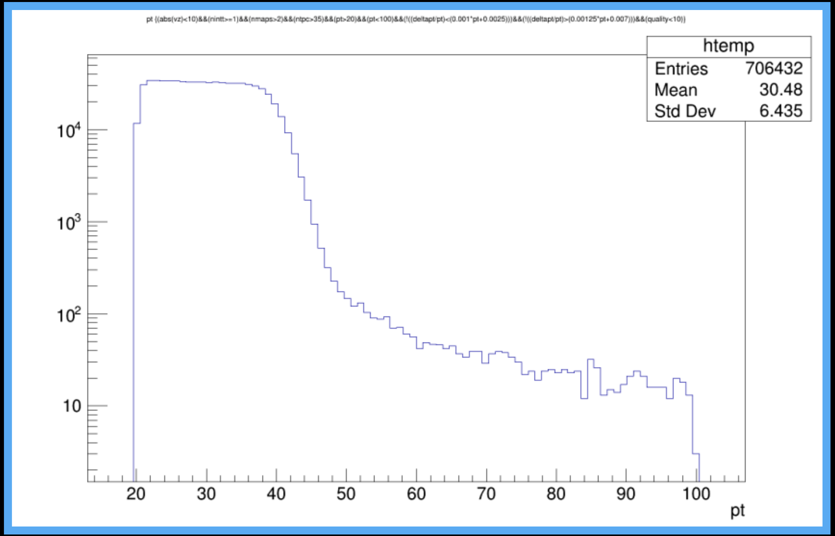
Primaries (gprimary = 1)

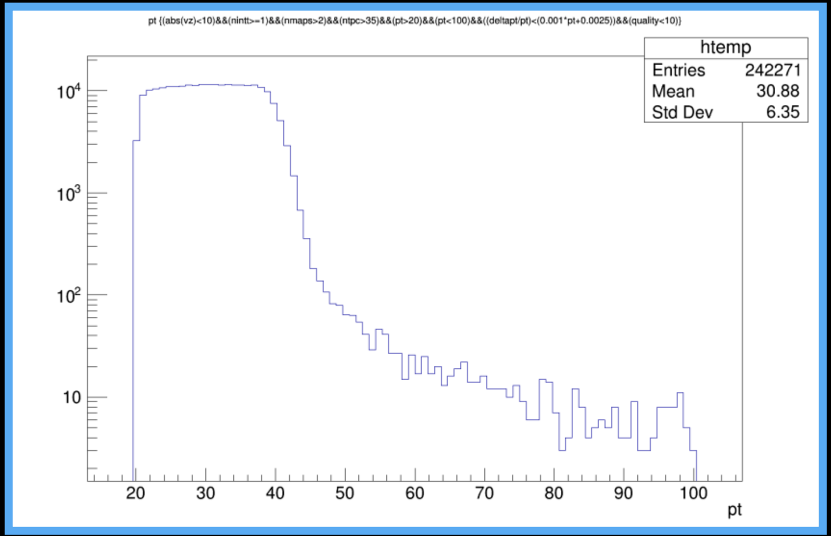
Secondaries (gprimary = 0)

> 20 GeV/c Tracks | pt

100 20 – 40 GeV/c π^- per event







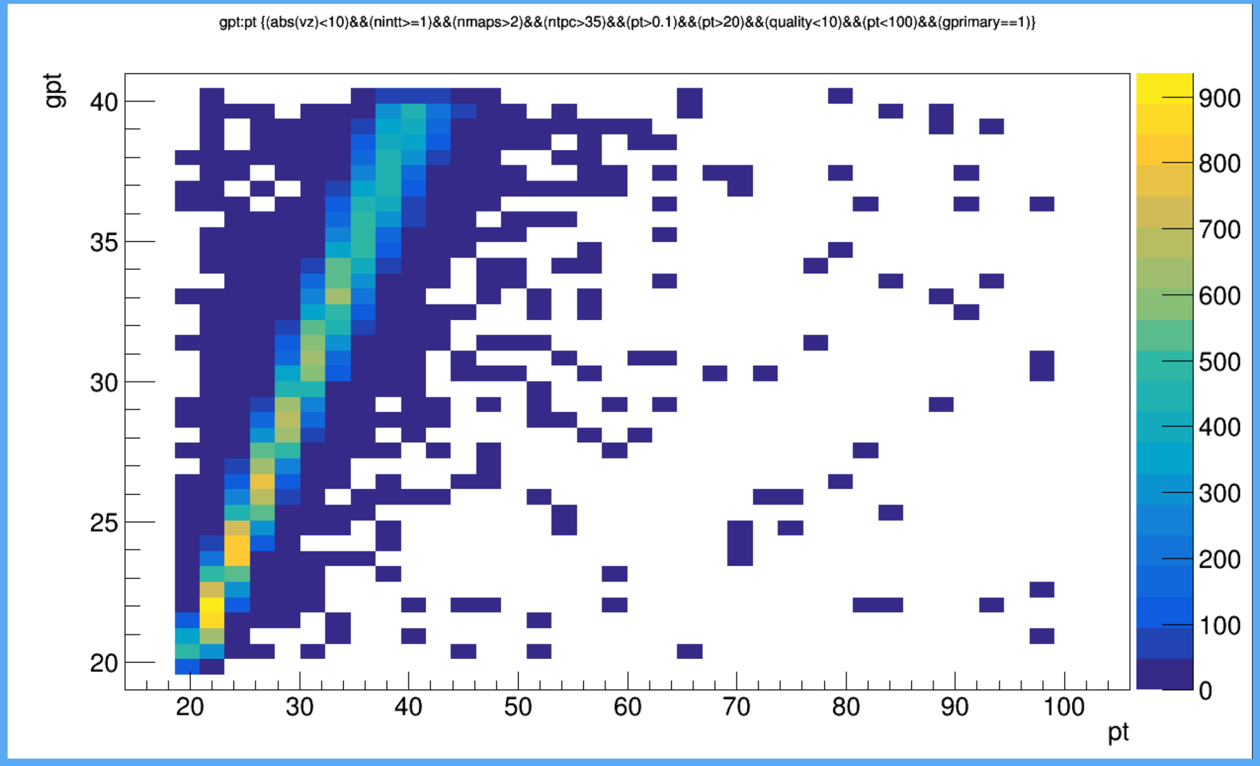
Up

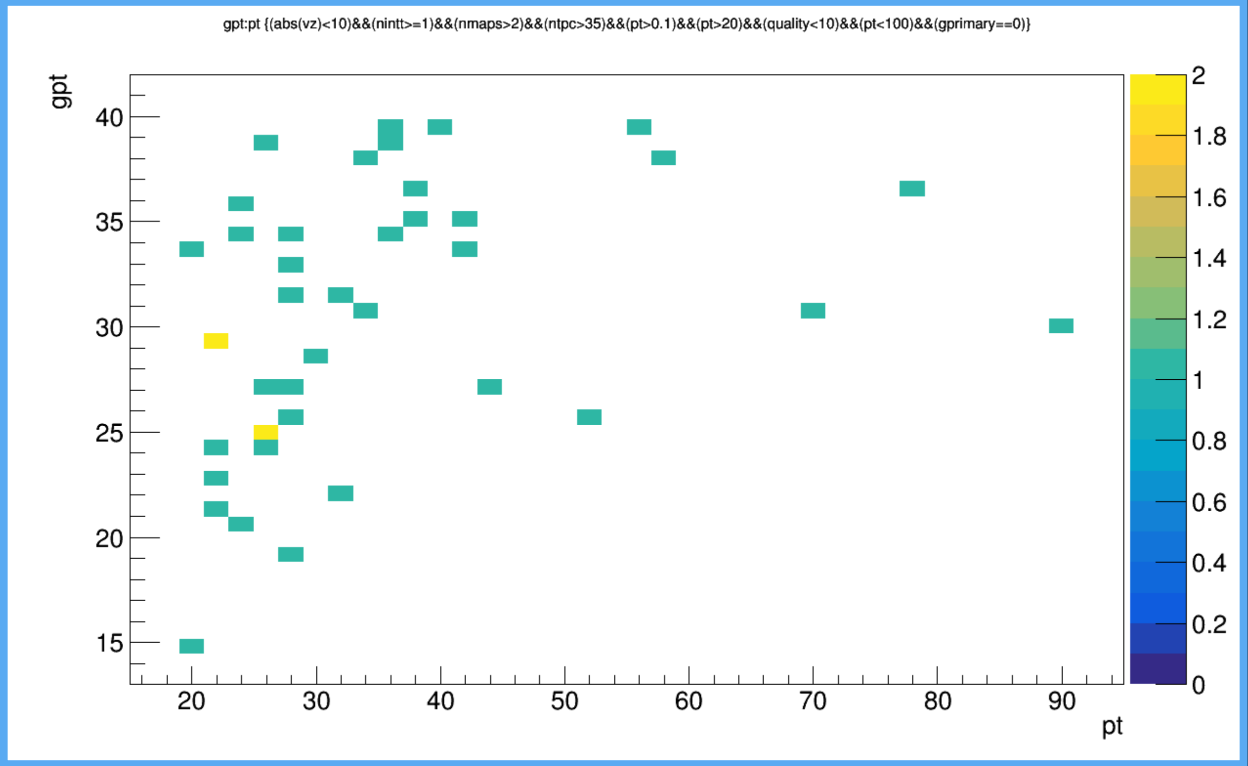
Center

Down

> 20 GeV/c Tracks | gpt vs. pt

100 20 – 40 GeV/c
π^- per event



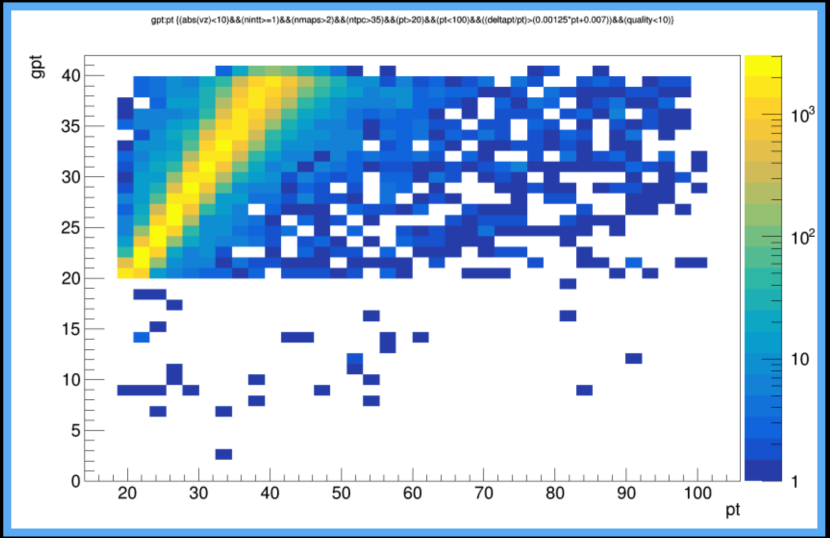


Primaries (gprimary = 1)

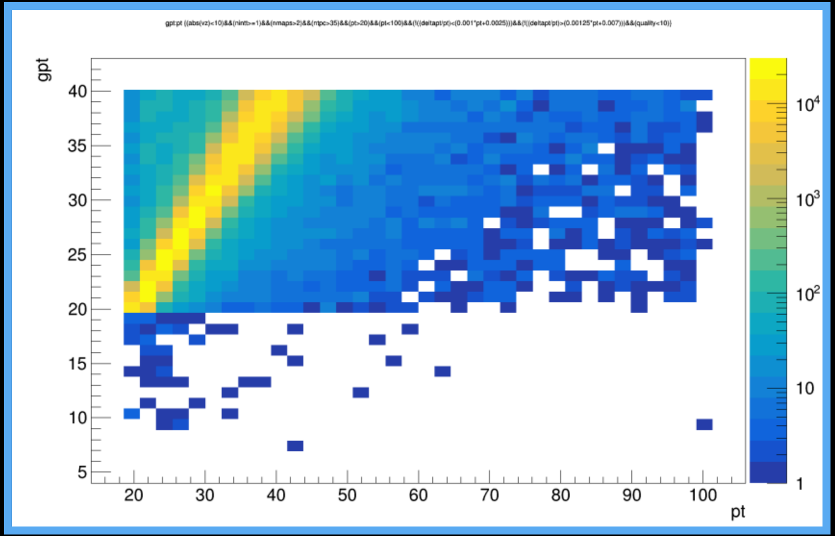
Secondaries (gprimary = 0)

> 20 GeV/c Tracks | gpt vs. pt (all tracks)

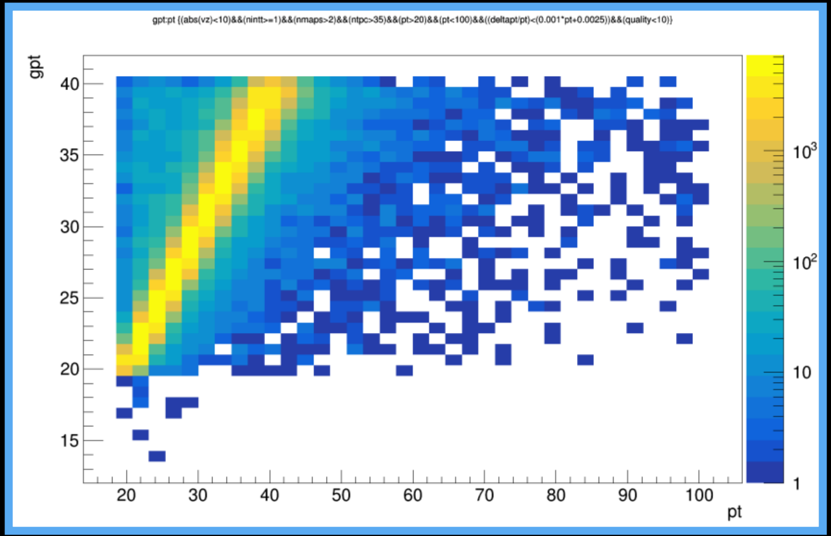
100 20 – 40 GeV/c π^- per event



Up



Center

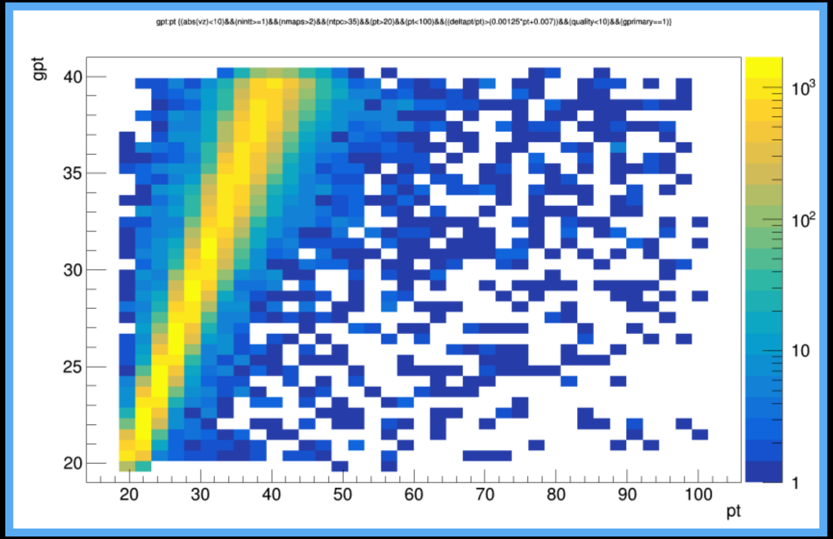


Down

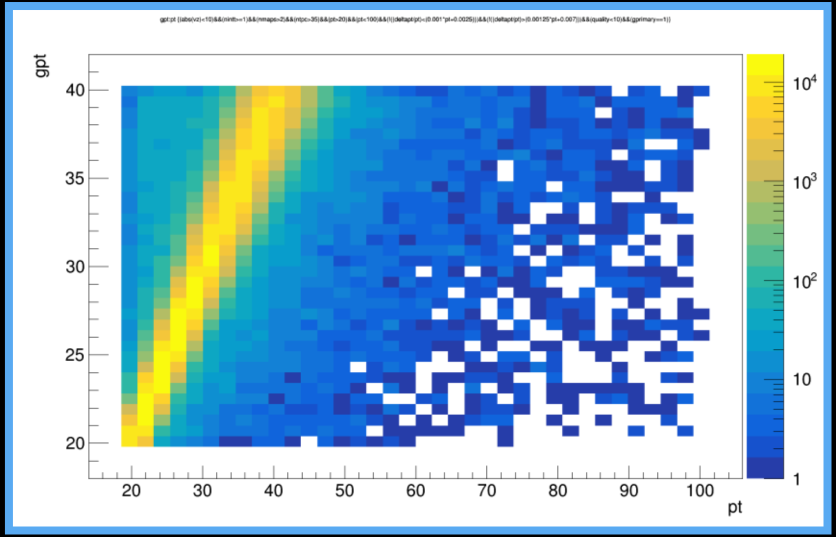
> 20 GeV/c Tracks | gpt vs. pt (only primaries)

Primaries (gprimary = 1)

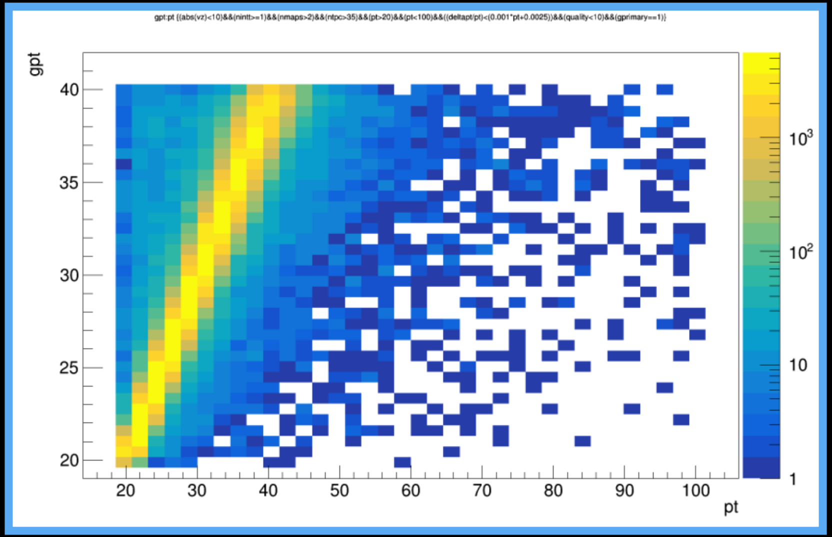
100 20 – 40 GeV/c π^- per event



Up



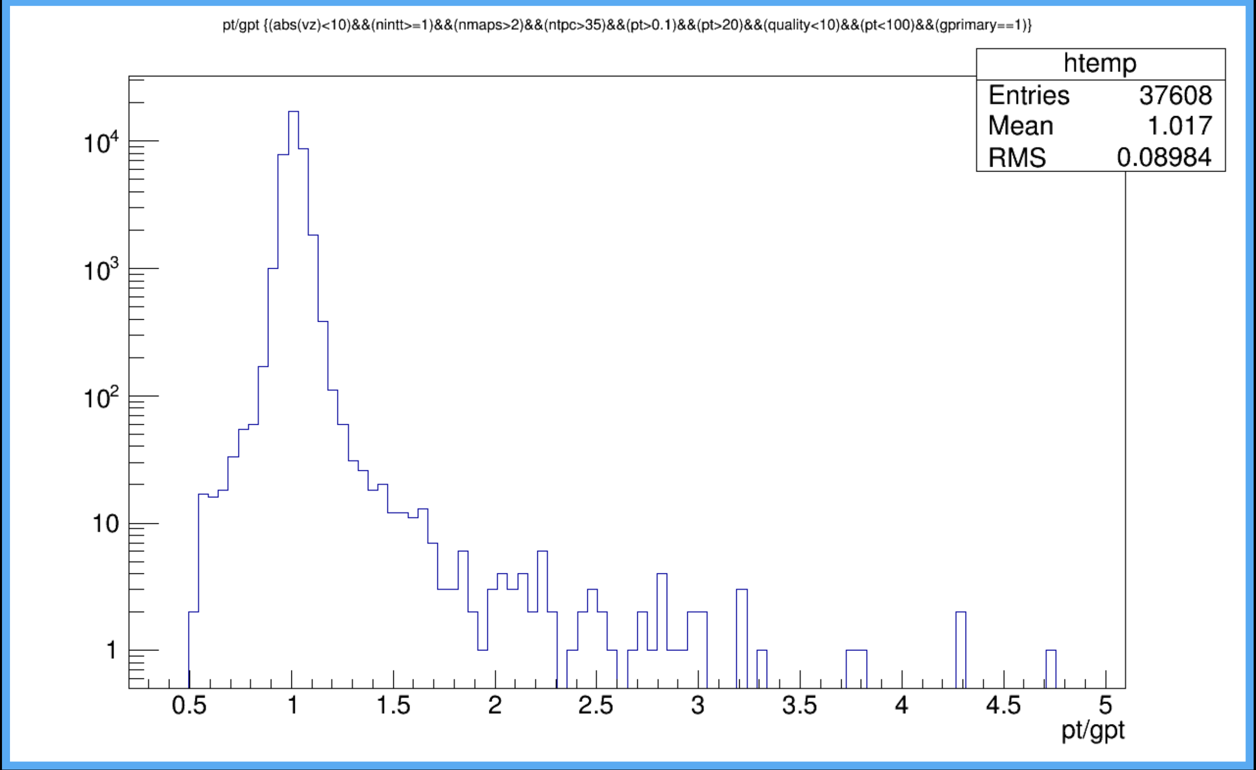
Center

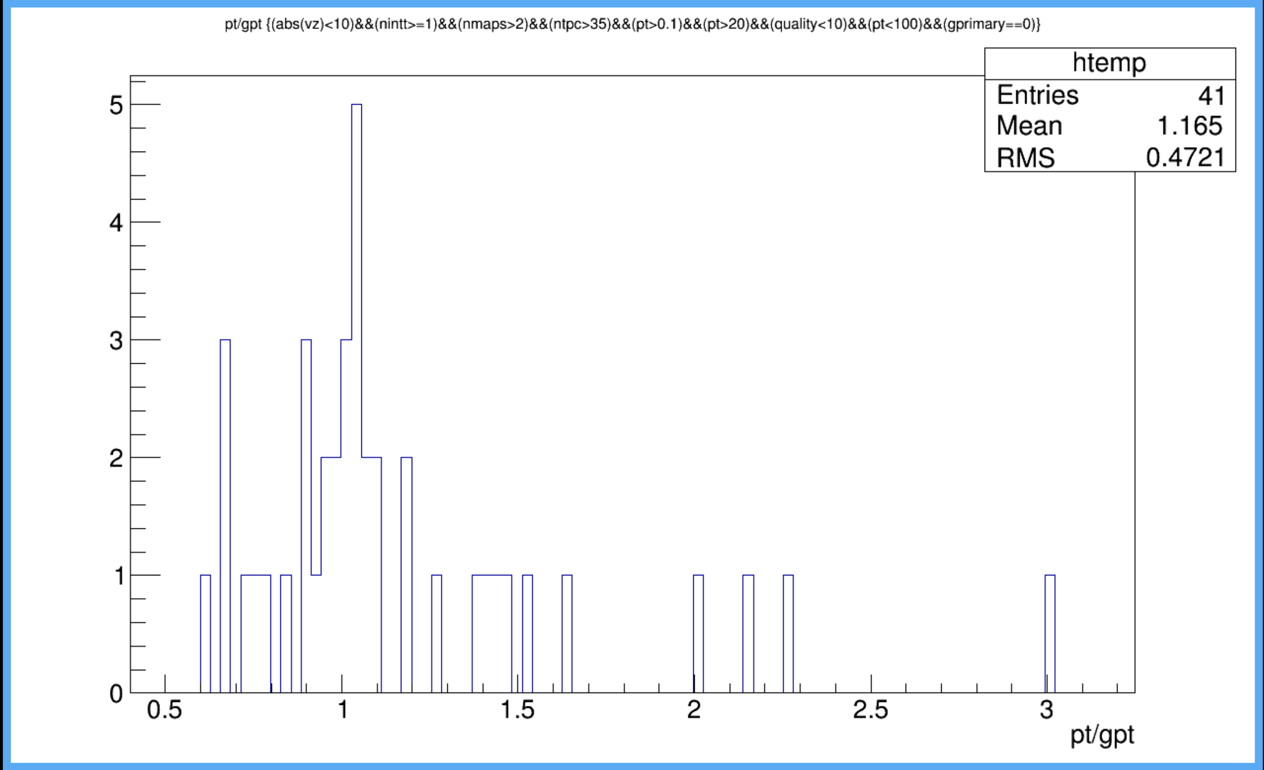


Down

> 20 GeV/c Tracks | pt/gpt

100 20 – 40 GeV/c π^- per event





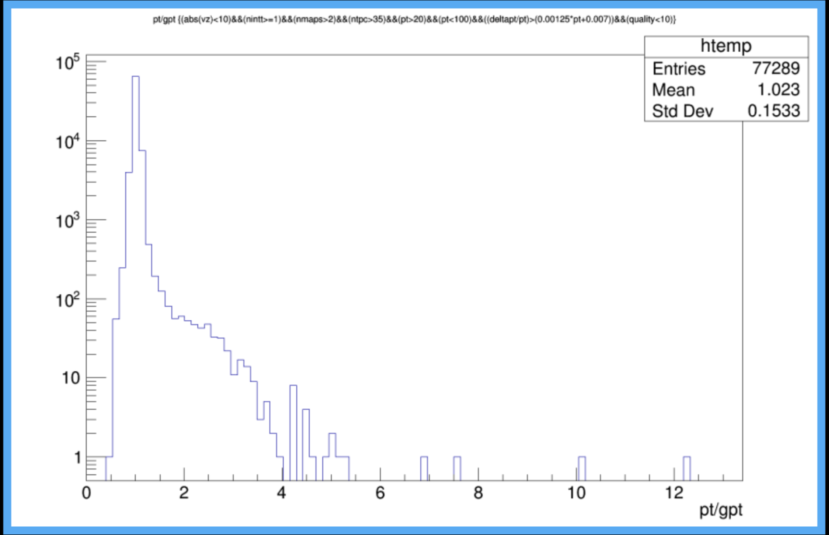
Primaries (gprimary = 1)

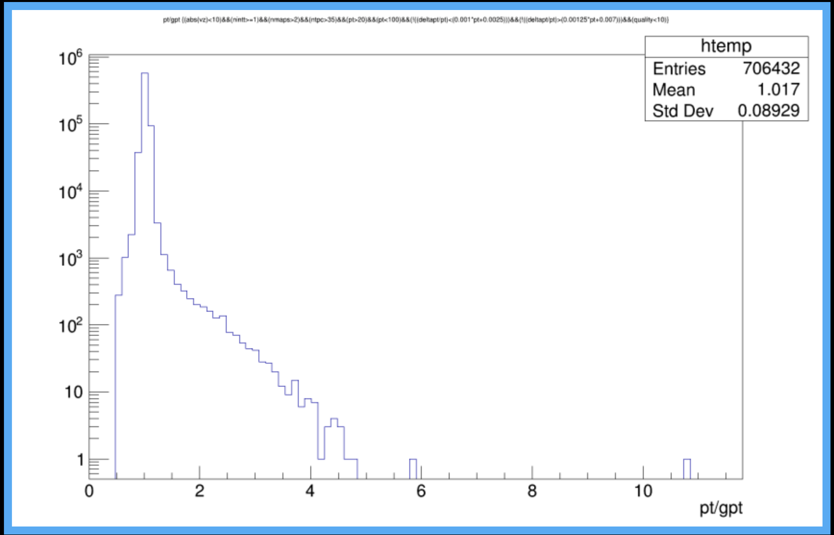
Secondaries (gprimary = 0)

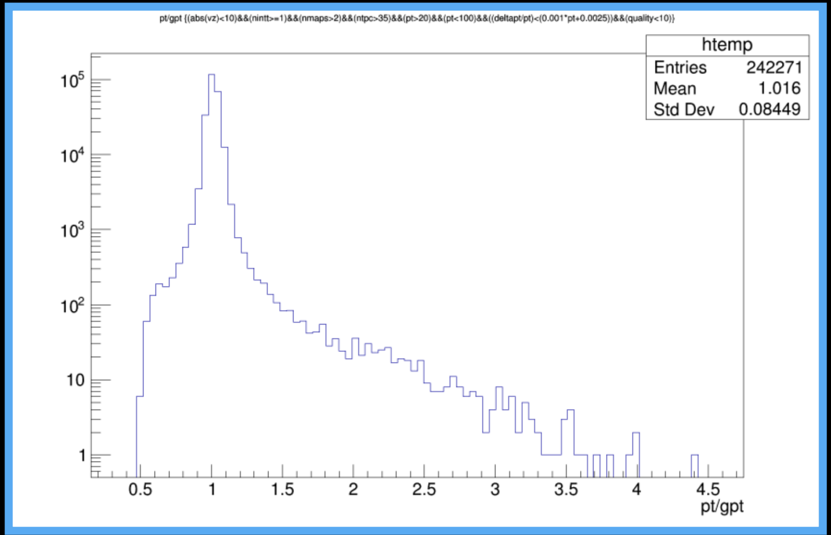
> 20 GeV/c Tracks | pt/gpt

sPHENIX

100 20 – 40 GeV/c π^- per event







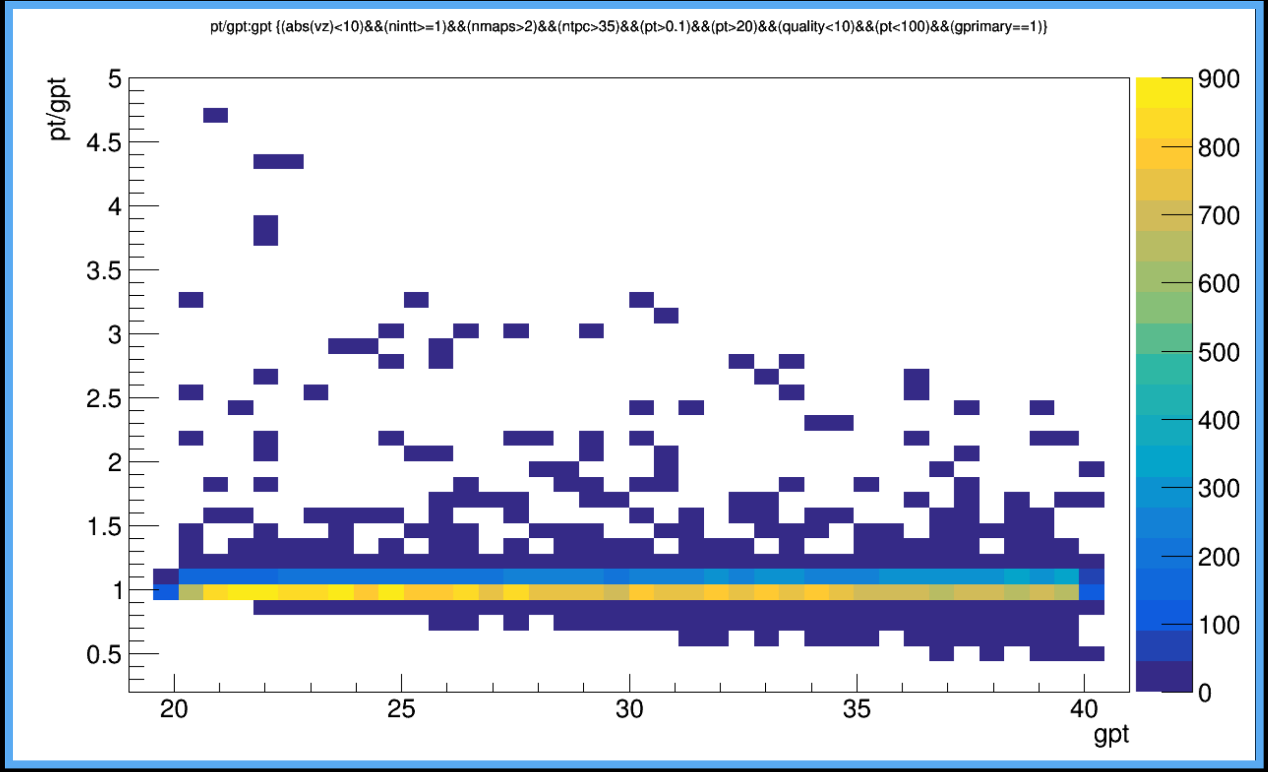
Up

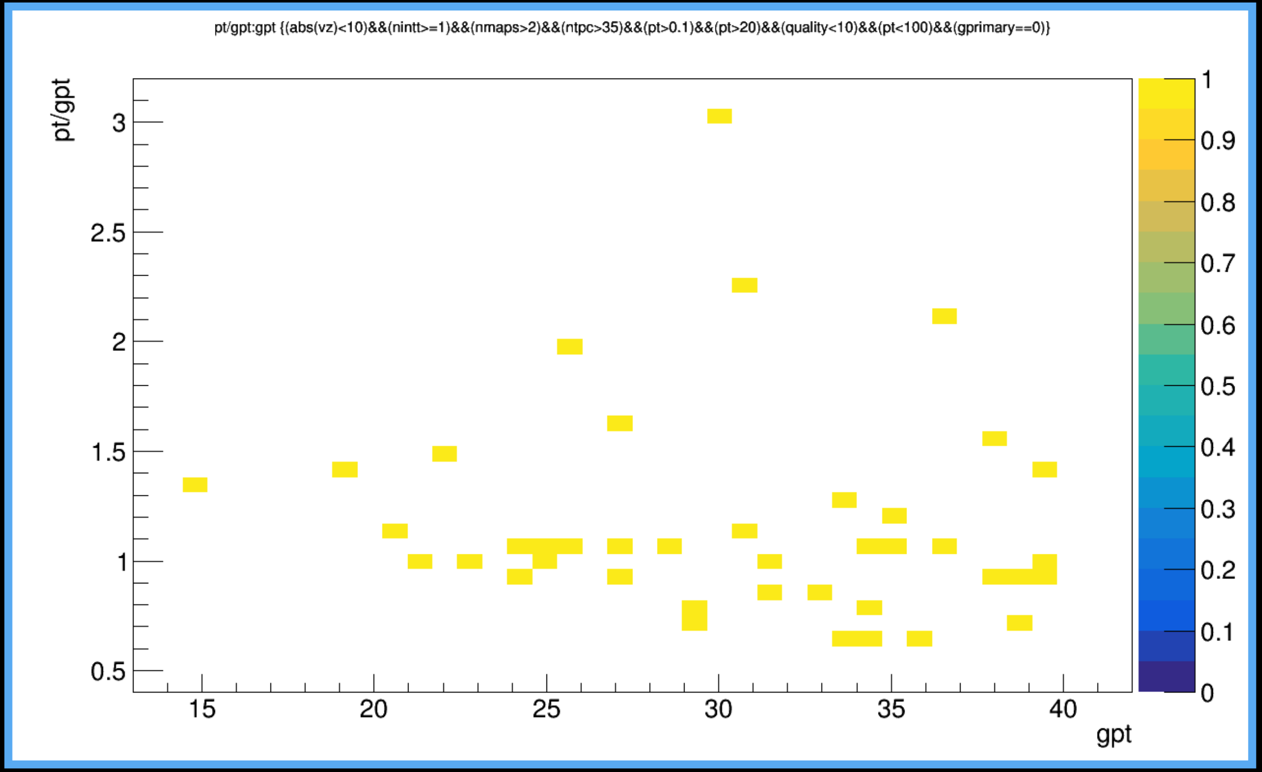
Center

Down

> 20 GeV/c Tracks | pt/gpt vs. gpt

100 20 – 40 GeV/c
π^- per event



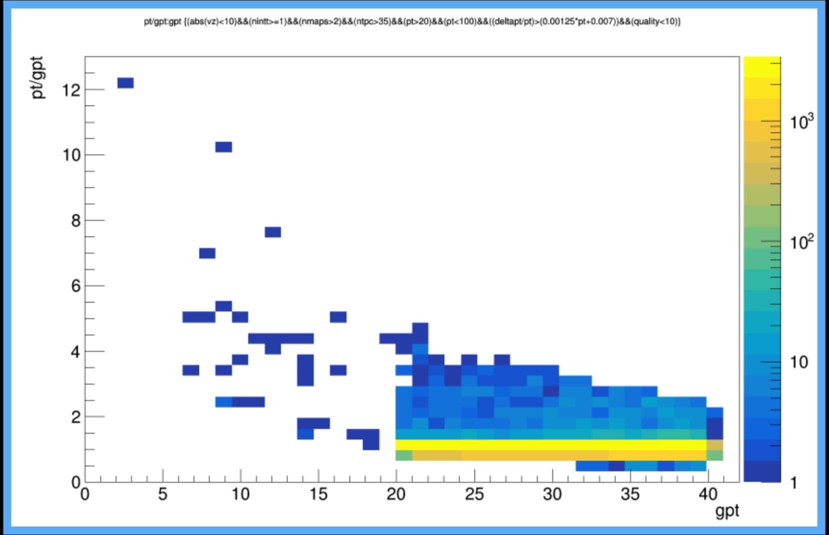


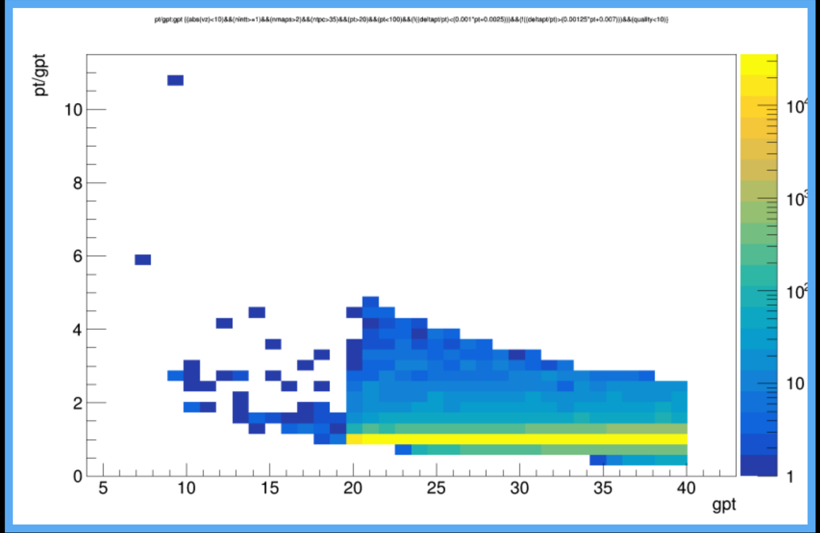
Primaries (gprimary = 1)

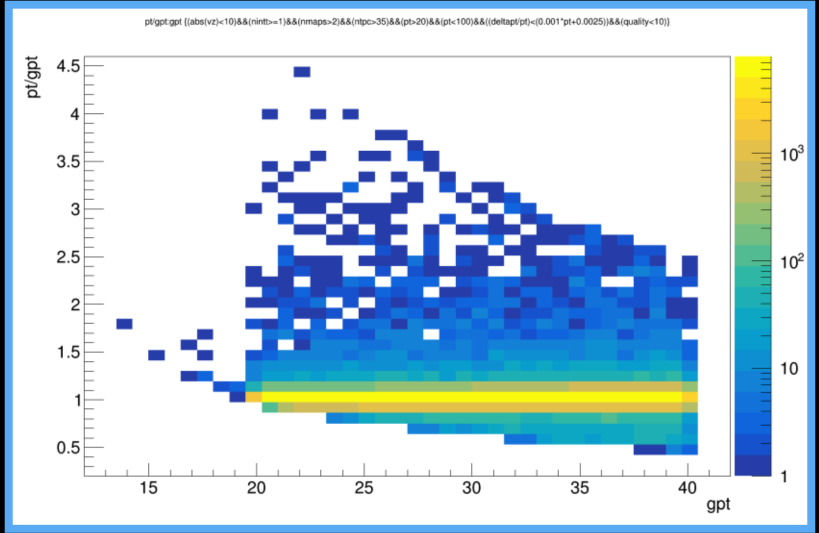
Secondaries (gprimary = 0)

> 20 GeV/c Tracks | pt/gpt vs. gpt

100 20 – 40 GeV/c π^- per event



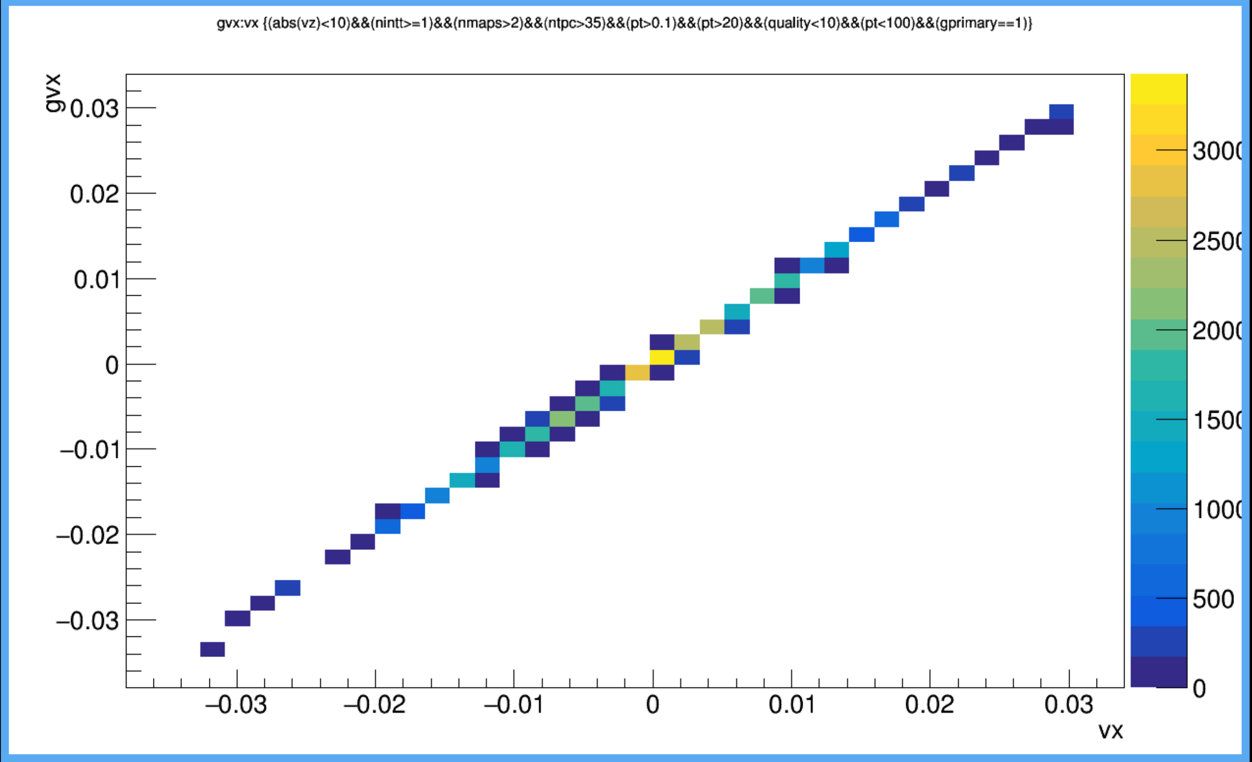


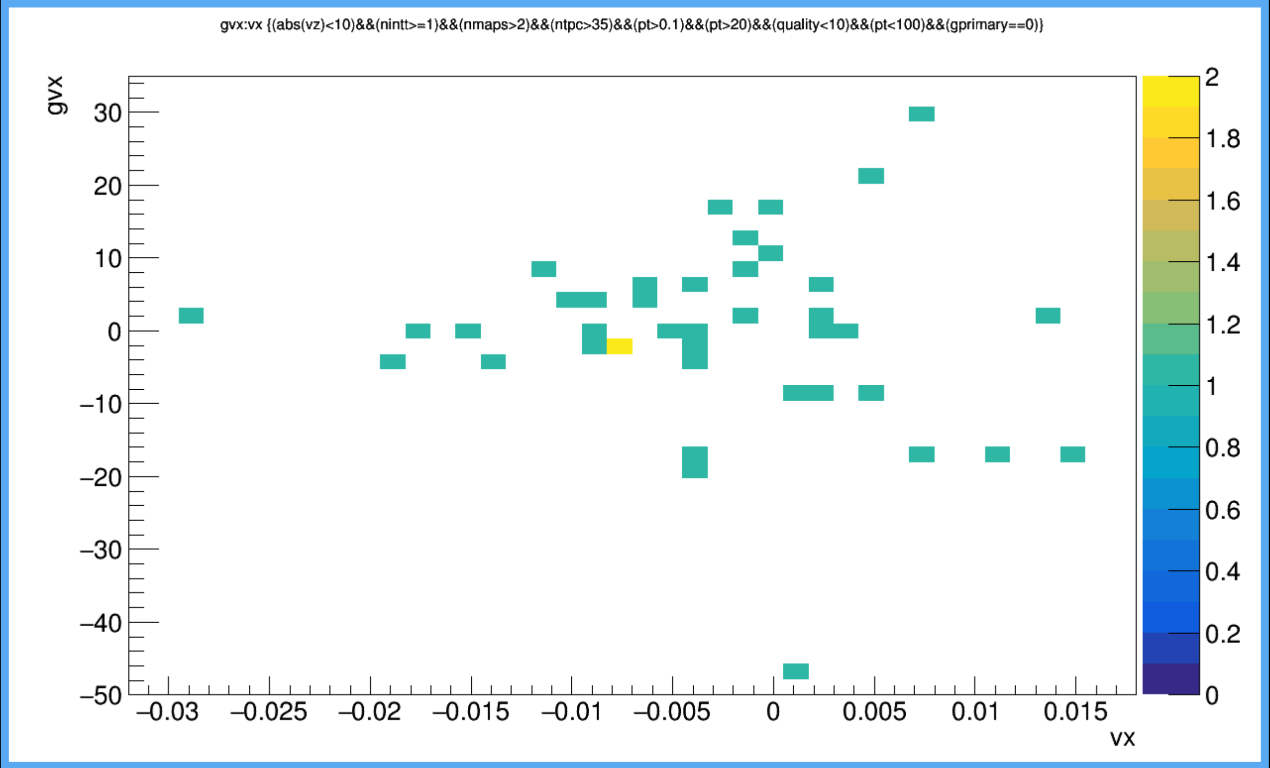


Up **Center** **Down**

> 20 GeV/c Tracks | gvx vs. vx

100 20 – 40 GeV/c
π^- per event



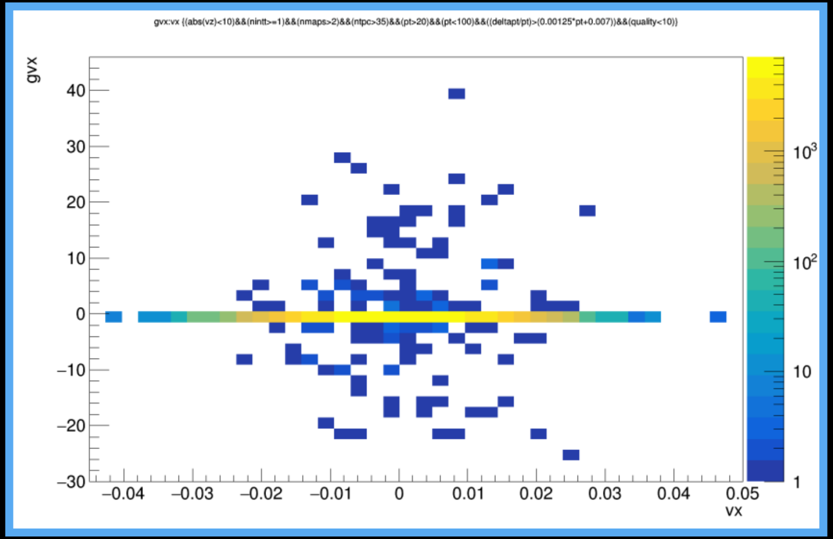


Primaries (gprimary = 1)

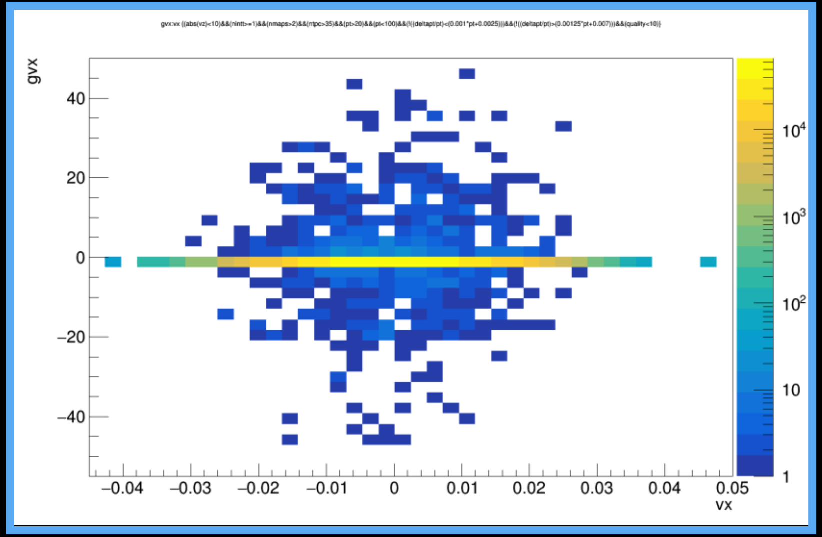
Secondaries (gprimary = 0)

> 20 GeV/c Tracks | gvx vs. vx (all tracks)

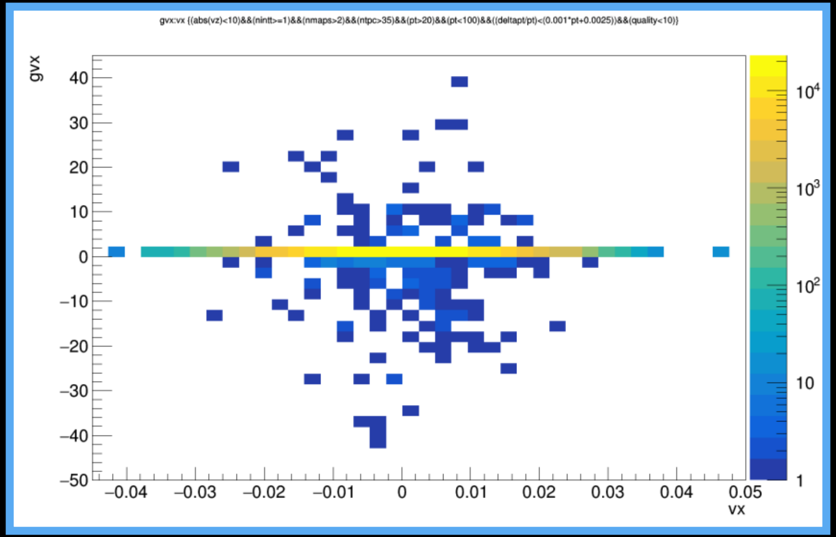
100 20 – 40 GeV/c π^- per event



Up



Center

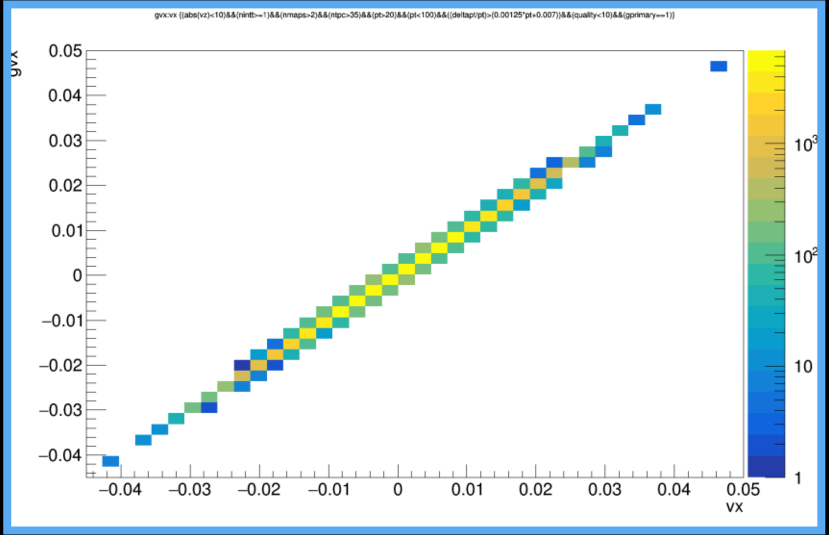


Down

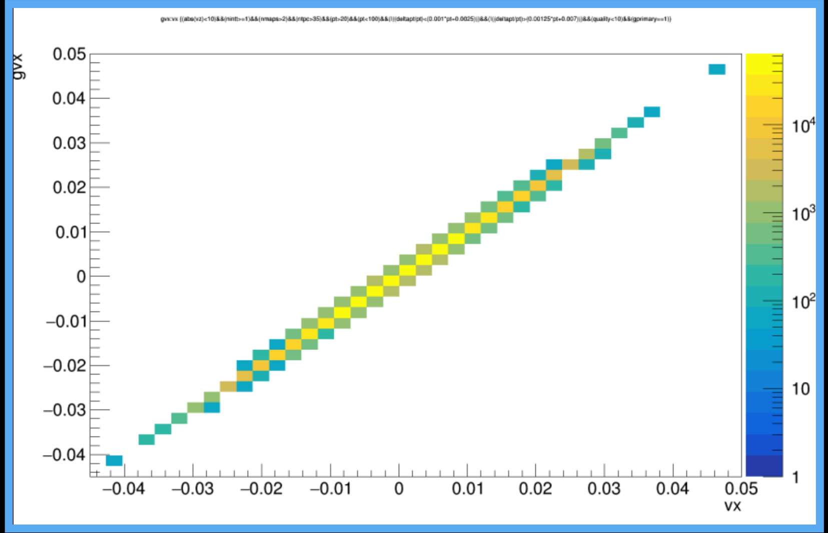
> 20 GeV/c Tracks | gvx vs. vx (only primaries)

Primaries (gprimary = 1)

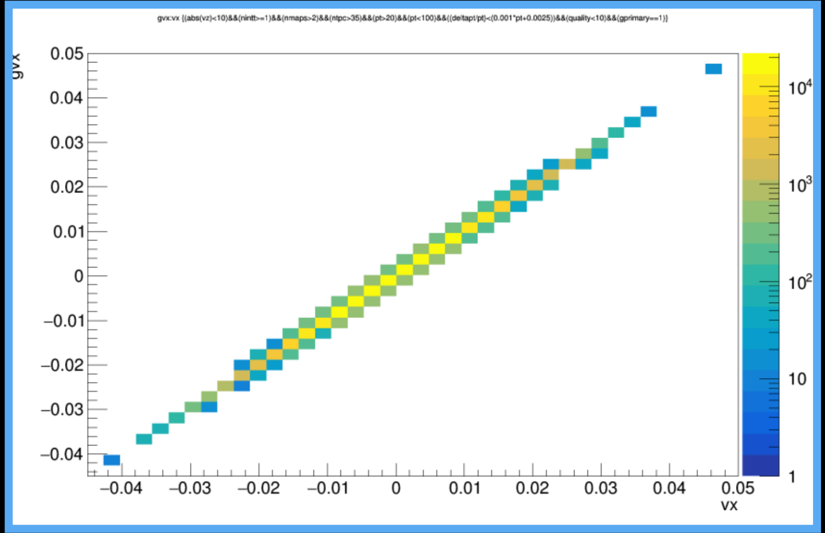
100 20 – 40 GeV/c π^- per event



Up



Center

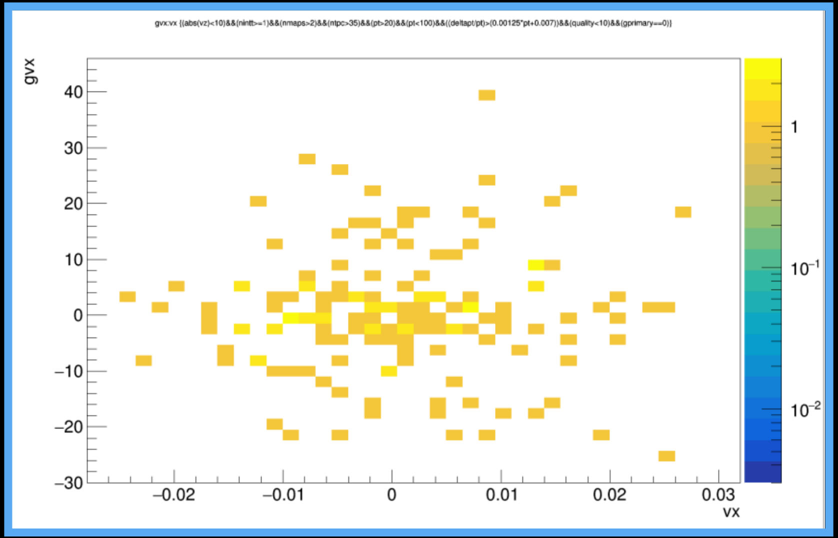


Down

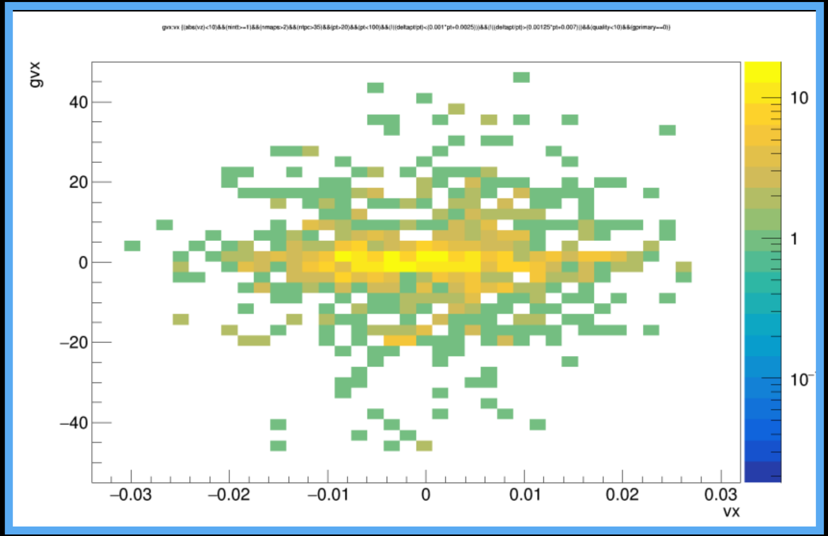
> 20 GeV/c Tracks | gvx vs. vx (only secondaries)

Secondaries (gprimary = 0)

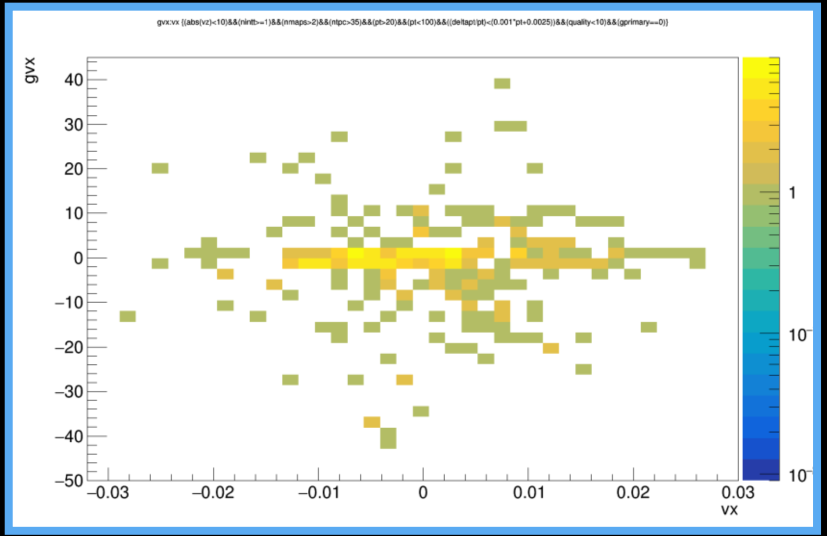
100 20 – 40 GeV/c π^- per event



Up



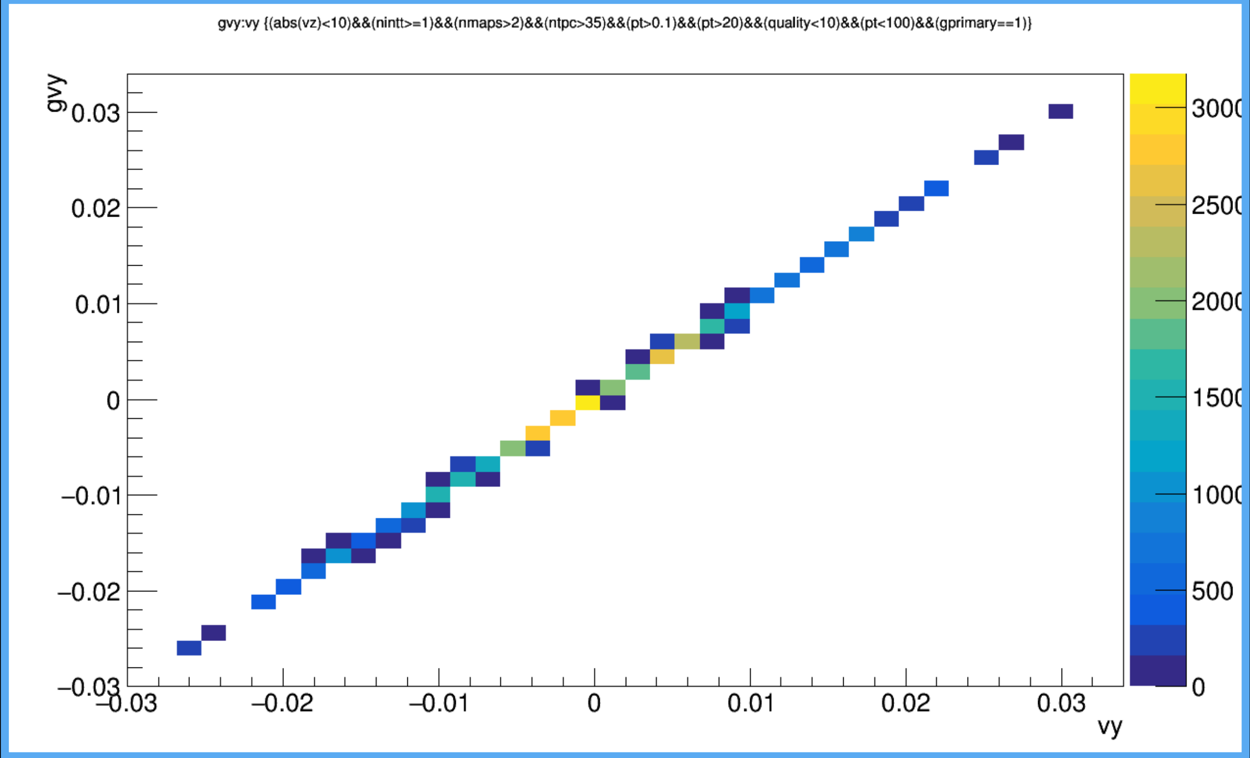
Center

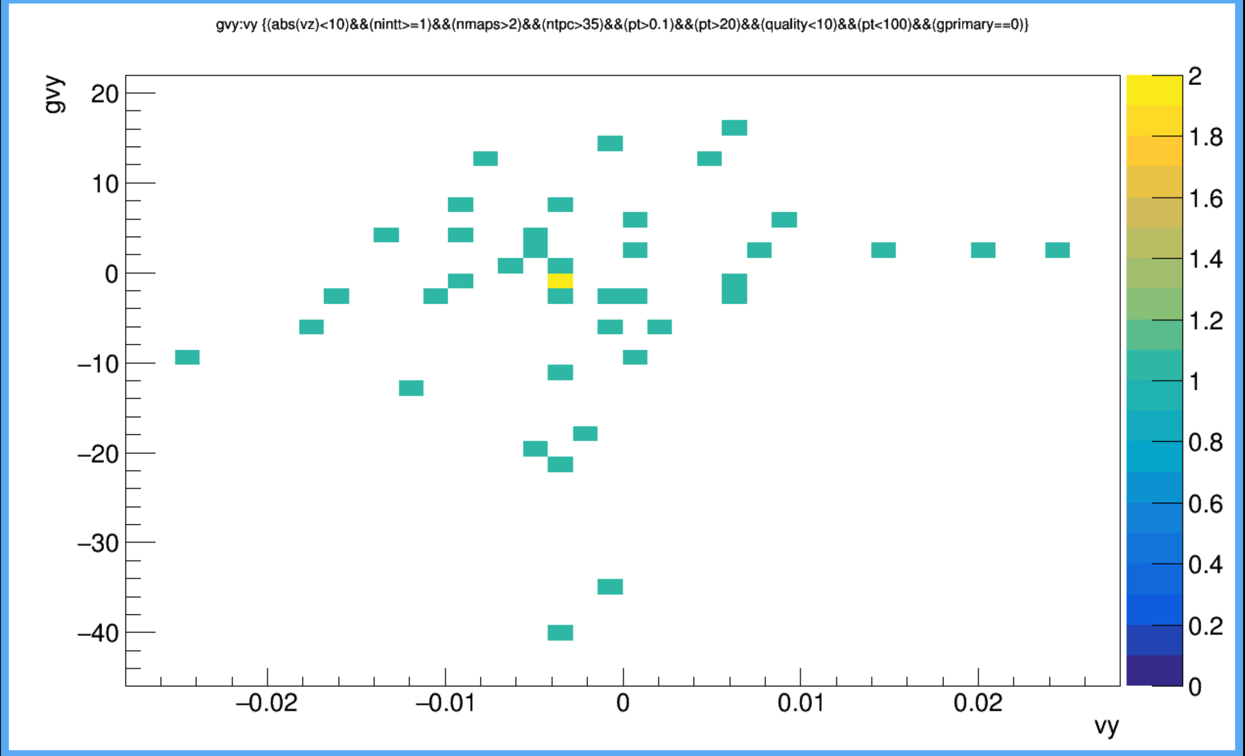


Down

> 20 GeV/c Tracks | gvy vs. vy

100 20 – 40 GeV/c
π^- per event



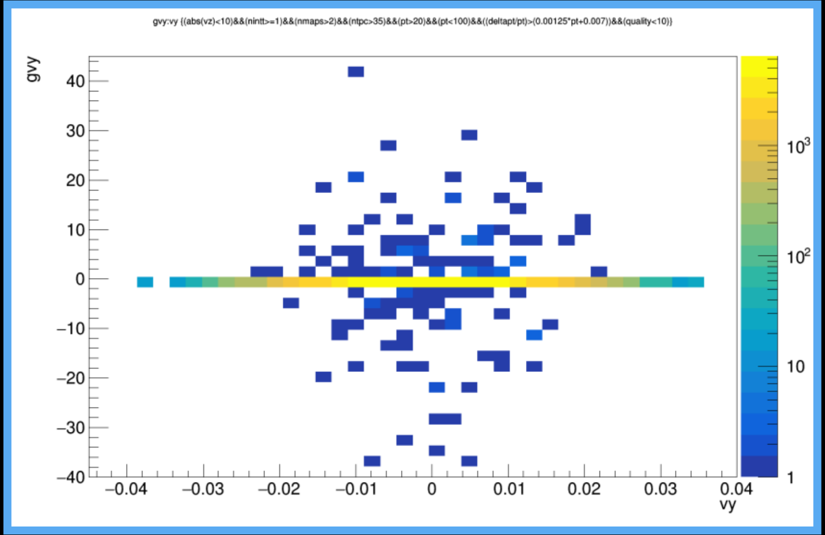


Primaries (gprimary = 1)

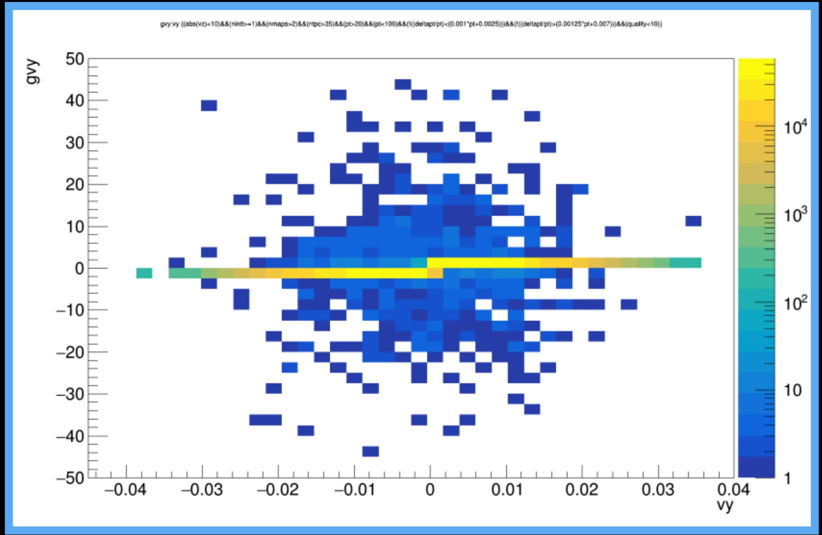
Secondaries (gprimary = 0)

> 20 GeV/c Tracks | gvy vs. vy (all tracks)

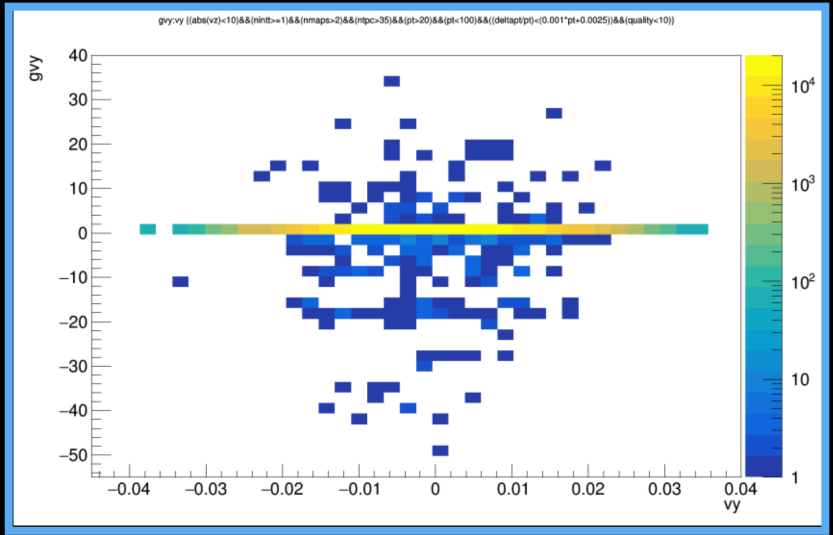
100 20 – 40 GeV/c π^- per event



Up



Center

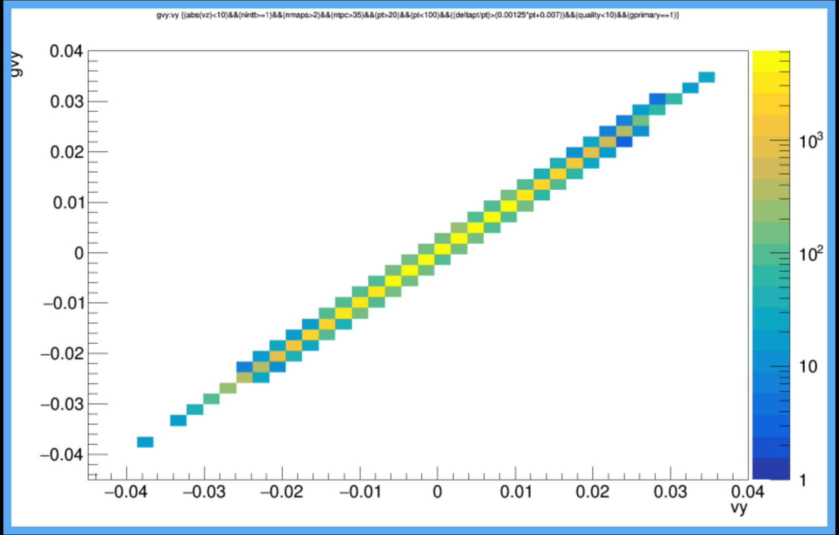


Down

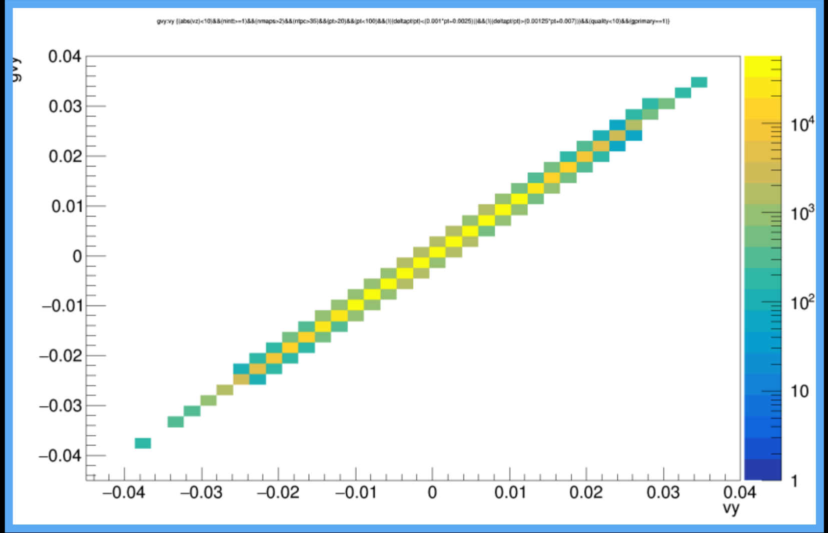
> 20 GeV/c Tracks | gvy vs. vy (only primaries)

Primaries (gprimary = 1)

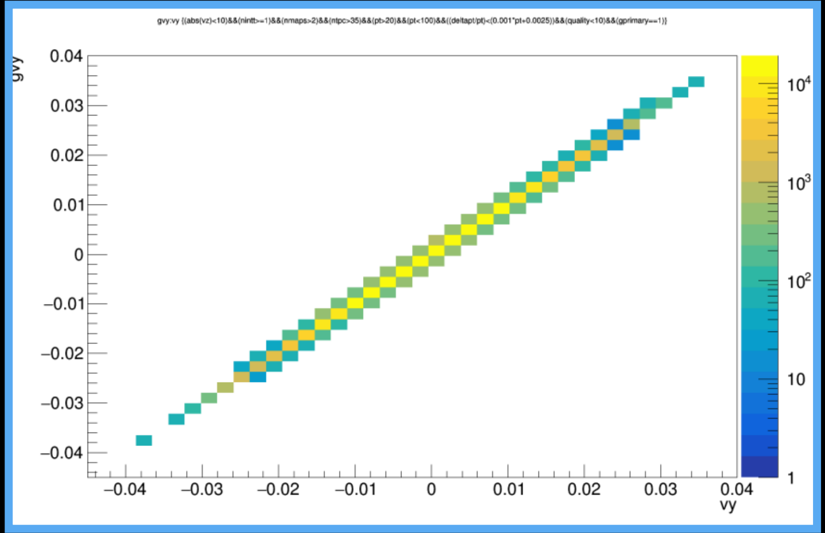
100 20 – 40 GeV/c π^- per event



Up



Center

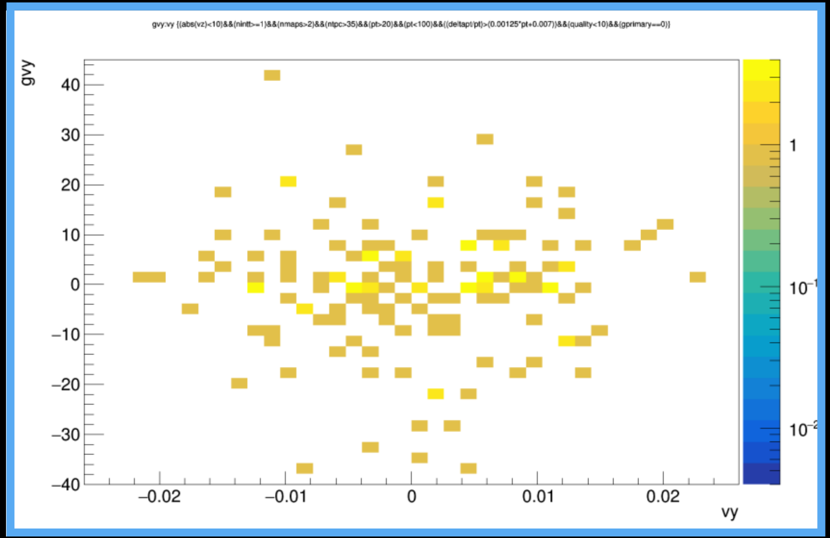


Down

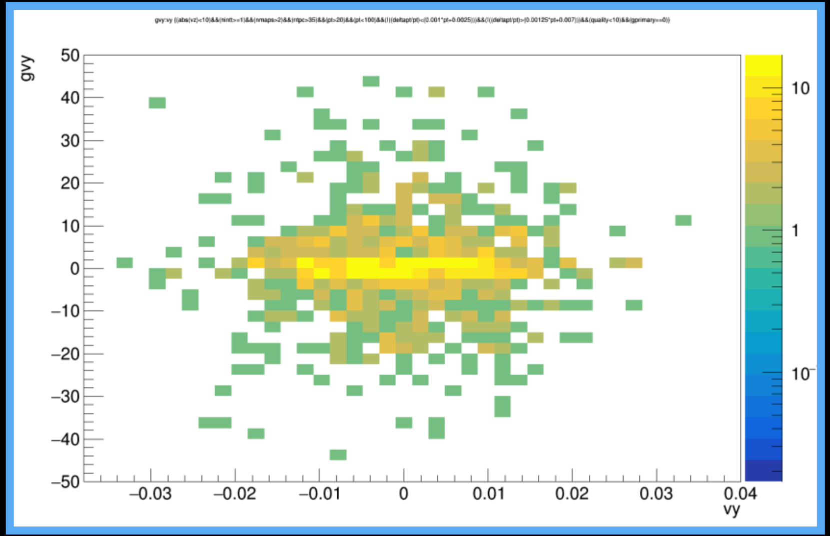
> 20 GeV/c Tracks | gvy vs. vy (only secondaries)

Secondaries (gprimary = 0)

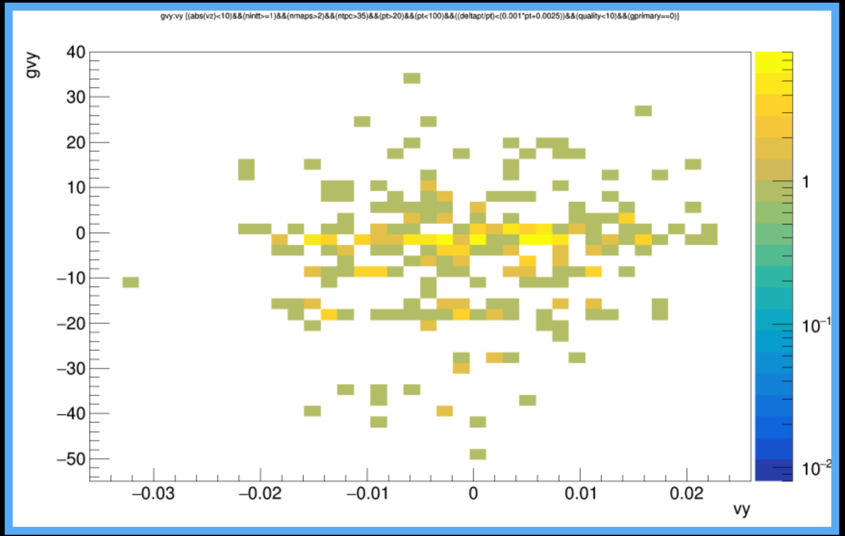
100 20 – 40 GeV/c π^- per event



Up



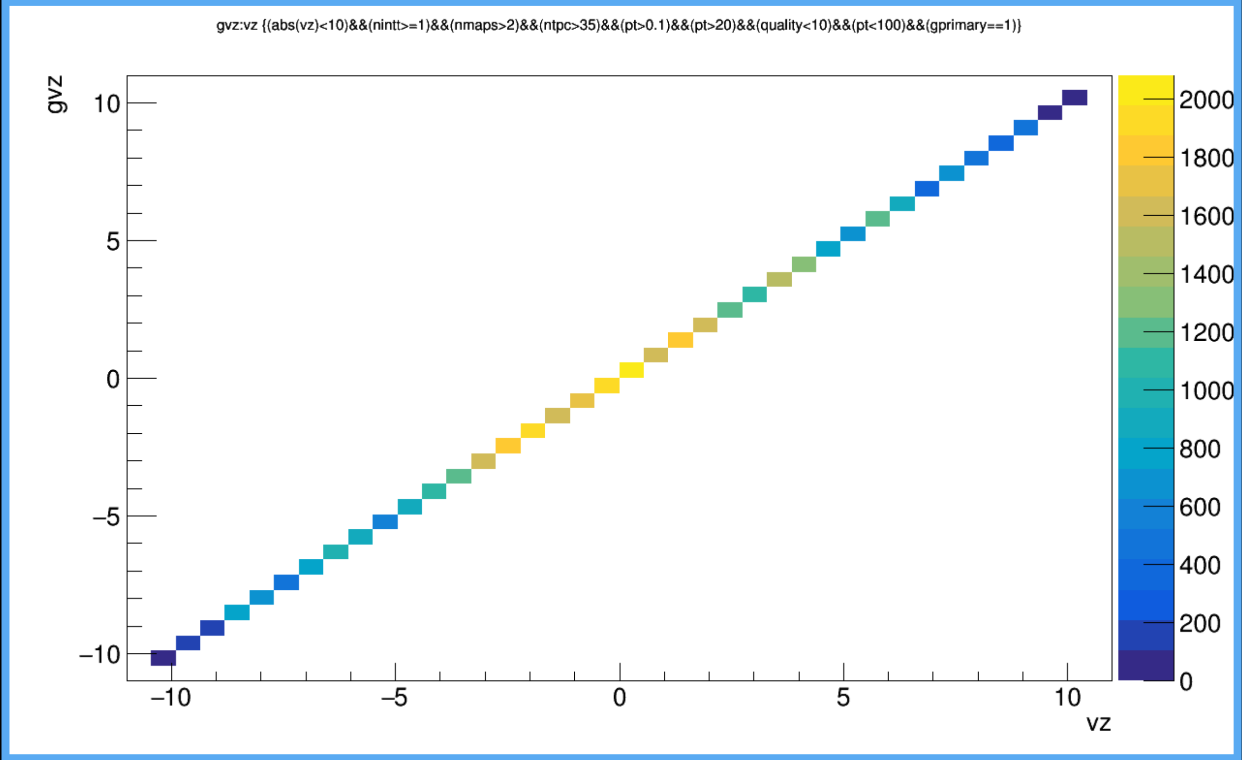
Center

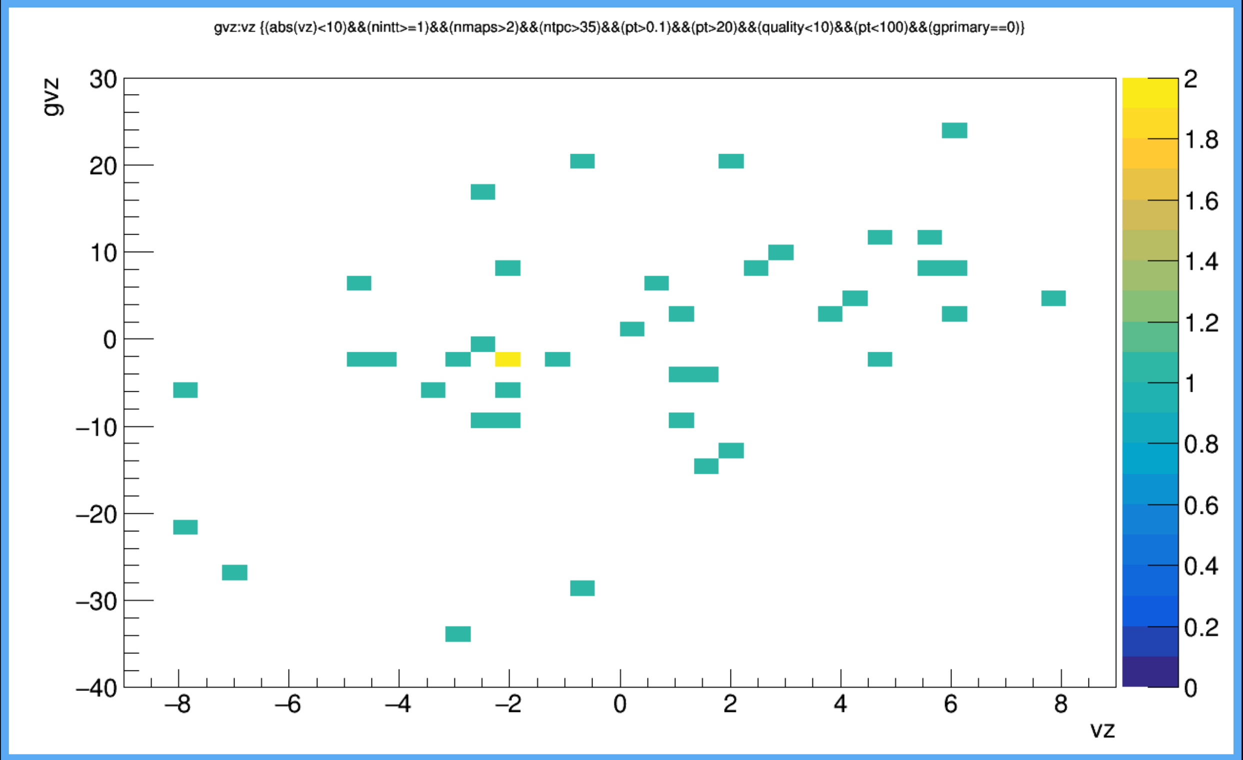


Down

> 20 GeV/c Tracks | gvz vs. vz

100 20 – 40 GeV/c π^- per event



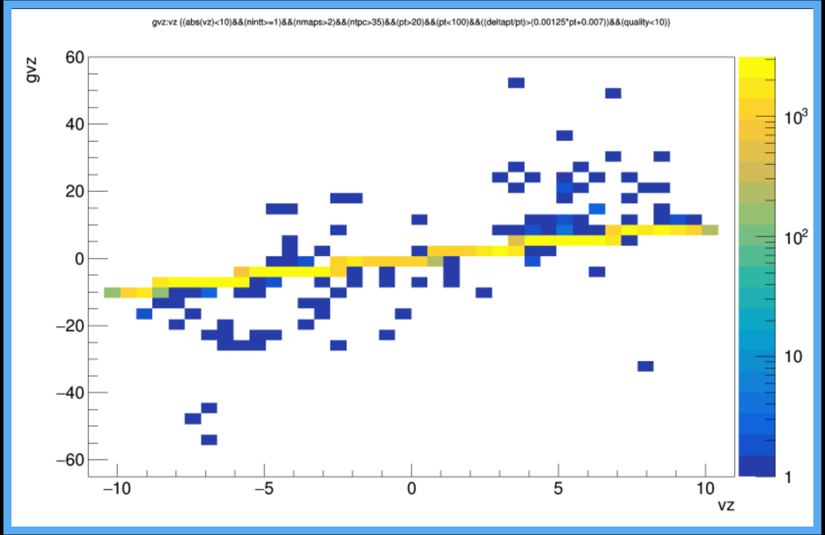


Primaries (gprimary = 1)

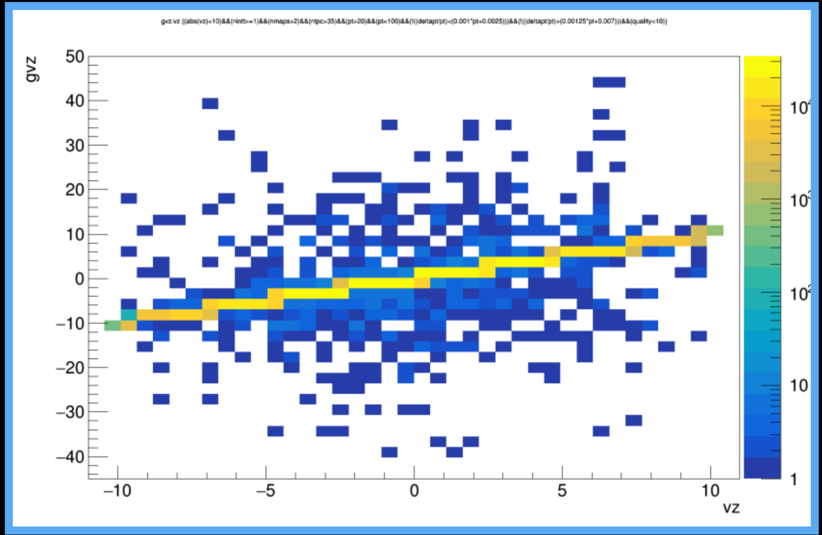
Secondaries (gprimary = 0)

> 20 GeV/c Tracks | gvz vs. vz (all tracks)

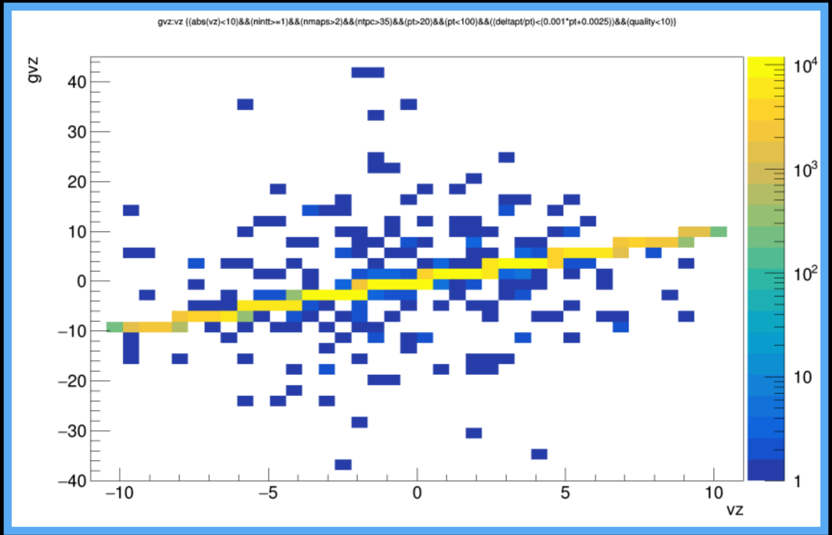
100 20 – 40 GeV/c π^- per event



Up



Center

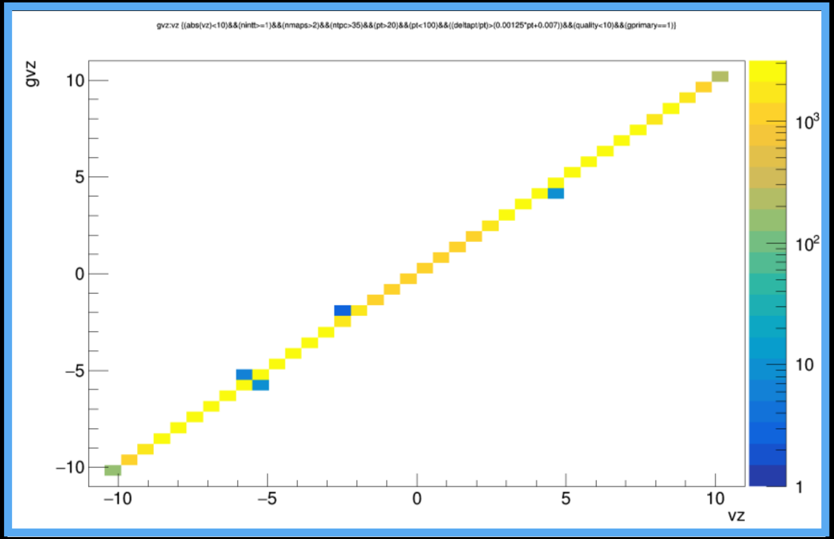


Down

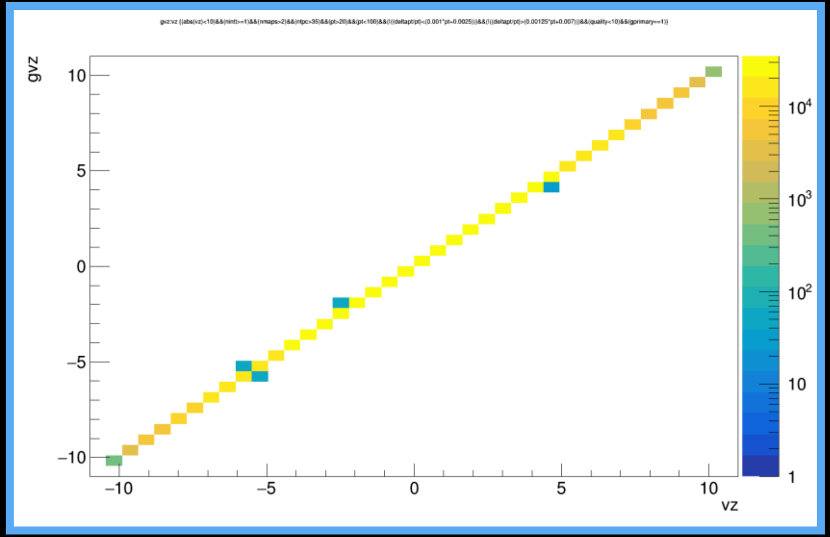
> 20 GeV/c Tracks | gvz vs. vz (only primaries)

Primaries (gprimary = 1)

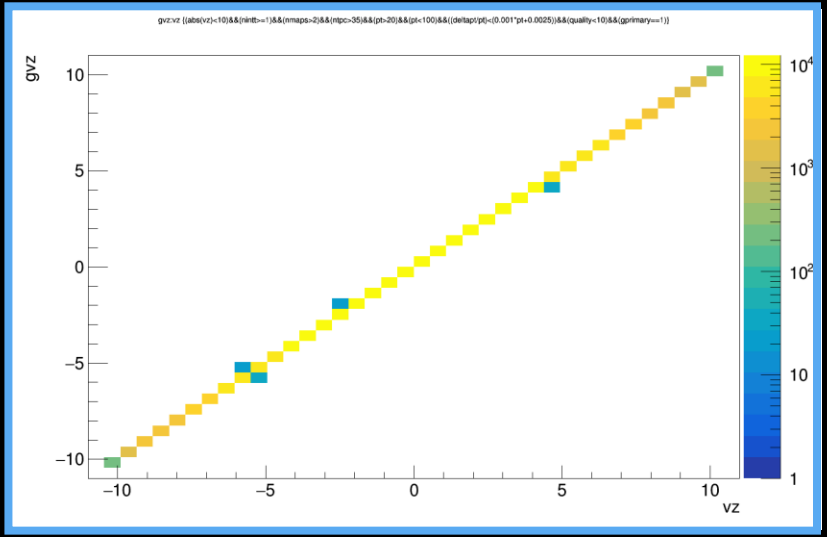
100 20 – 40 GeV/c π^- per event



Up



Center

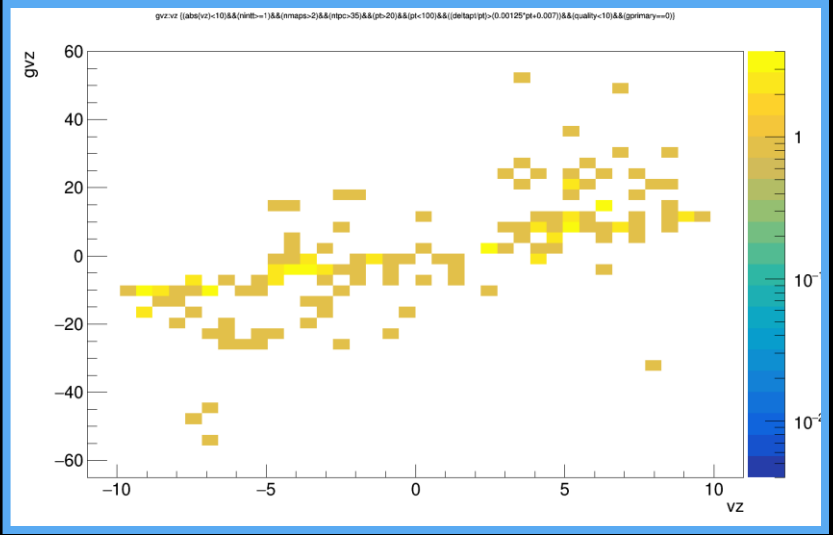


Down

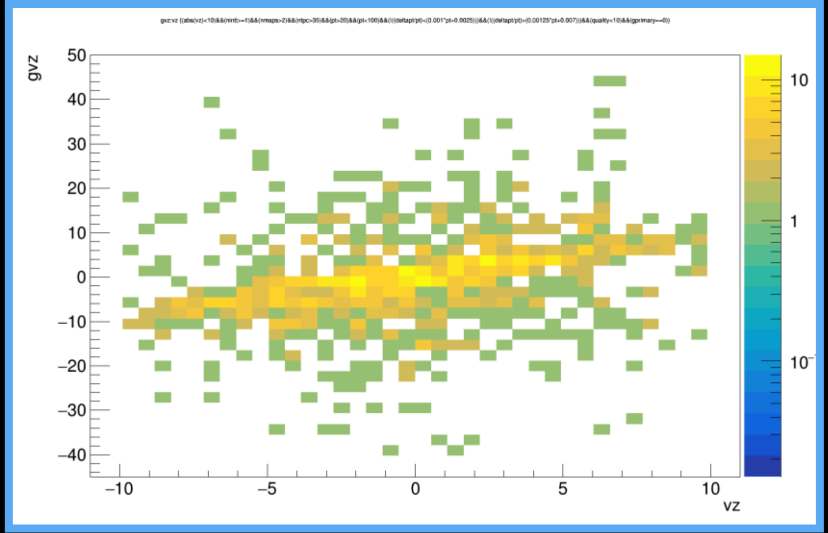
> 20 GeV/c Tracks | gvz vs. vz (only secondaries)

Secondaries (gprimary = 0)

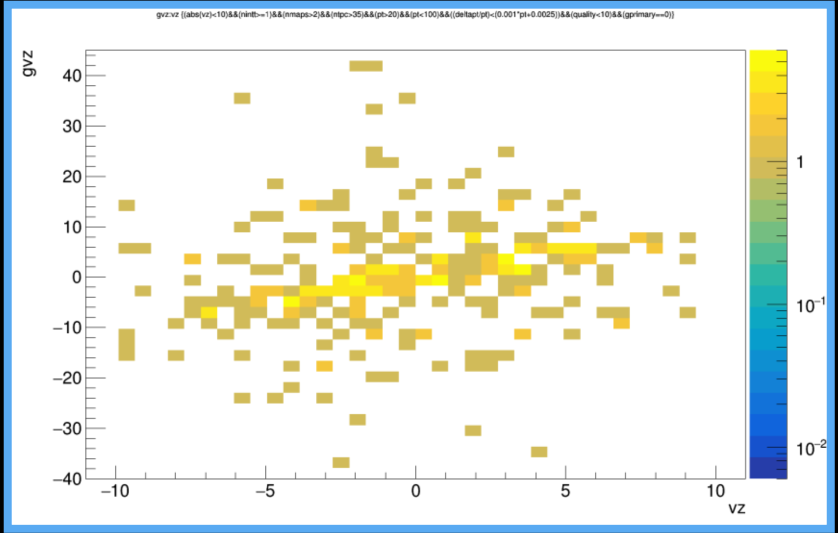
100 20 – 40 GeV/c π^- per event



Up



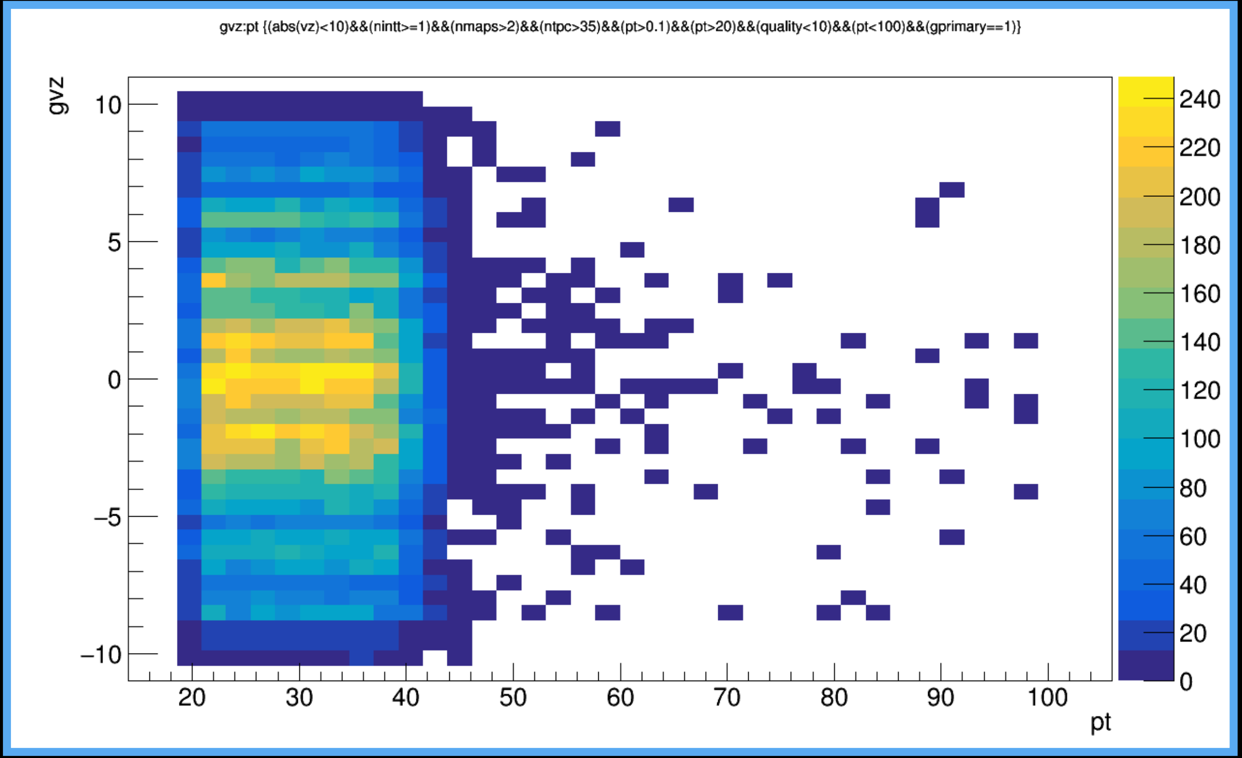
Center

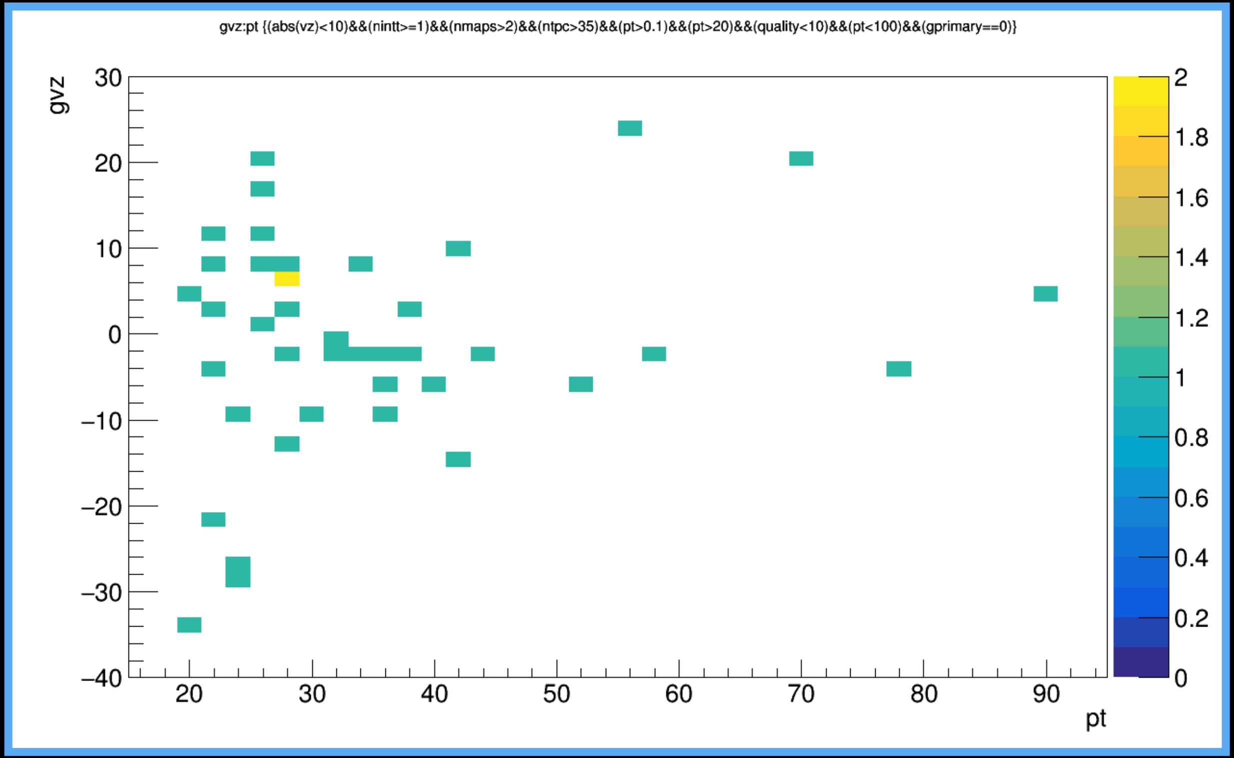


Down

> 20 GeV/c Tracks | gvz vs. pt

100 20 – 40 GeV/c
π^- per event



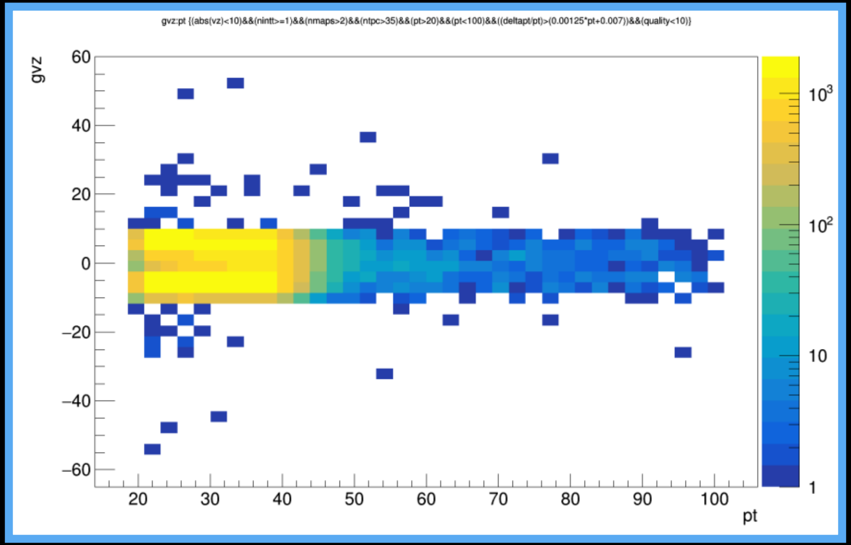


Primaries (gprimary = 1)

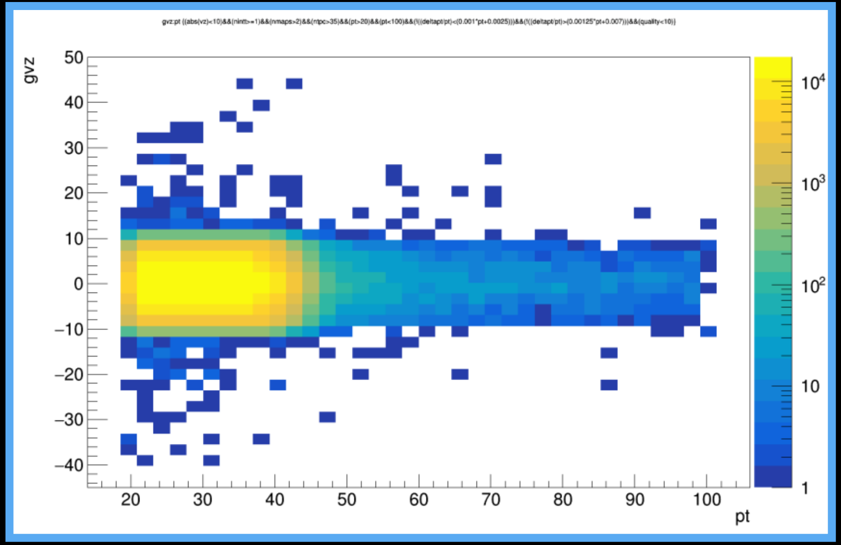
Secondaries (gprimary = 0)

> 20 GeV/c Tracks | gvz vs. pt

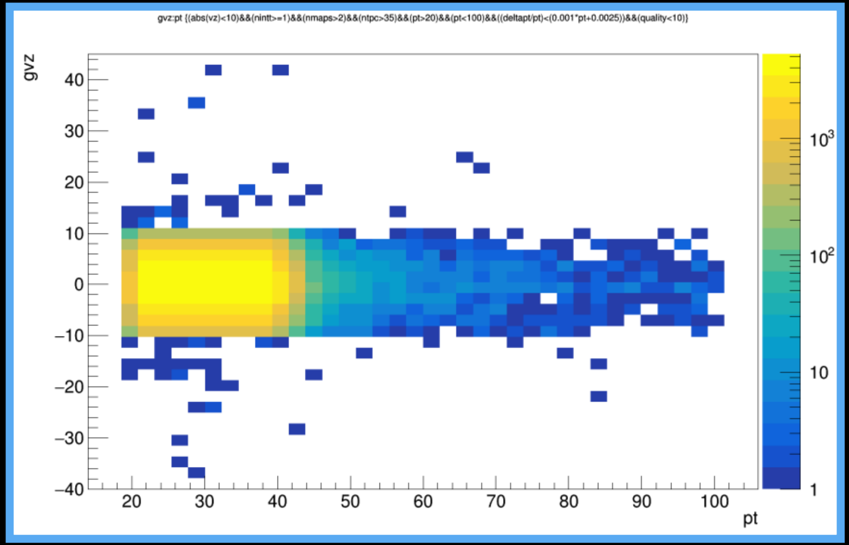
100 20 – 40 GeV/c π^- per event



Up



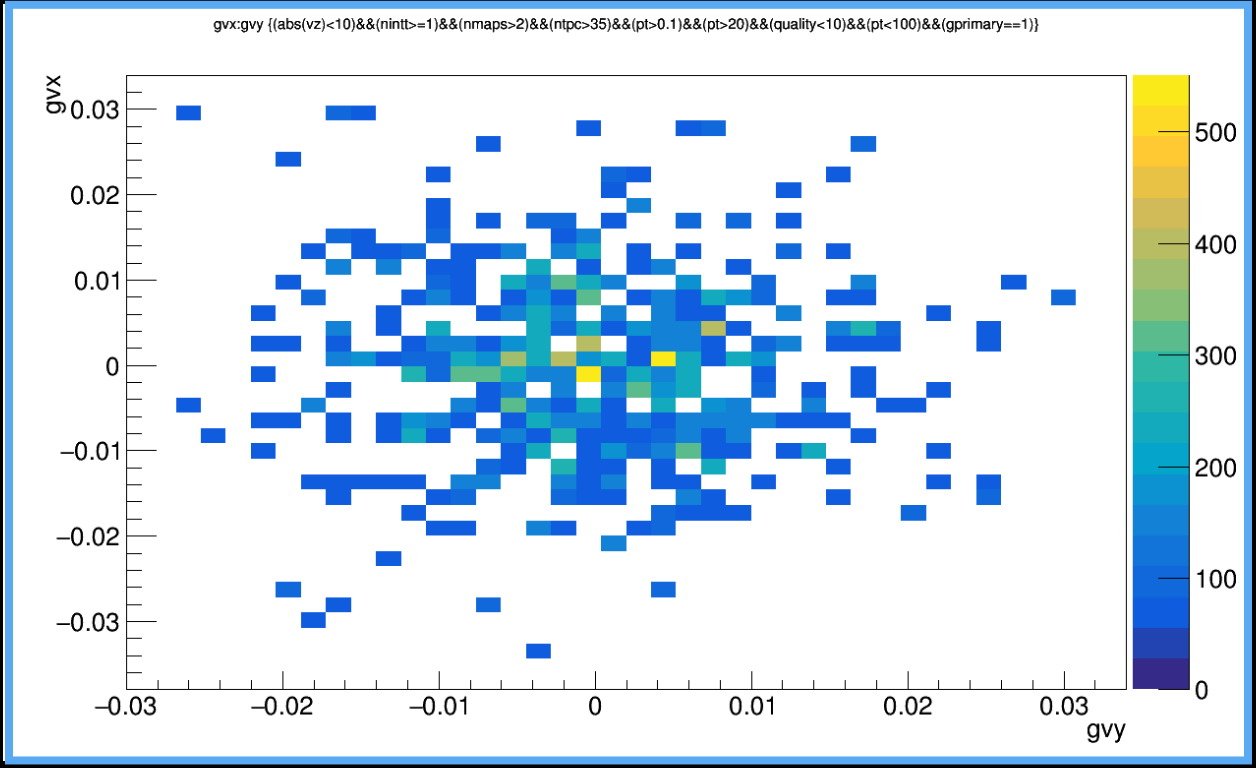
Center

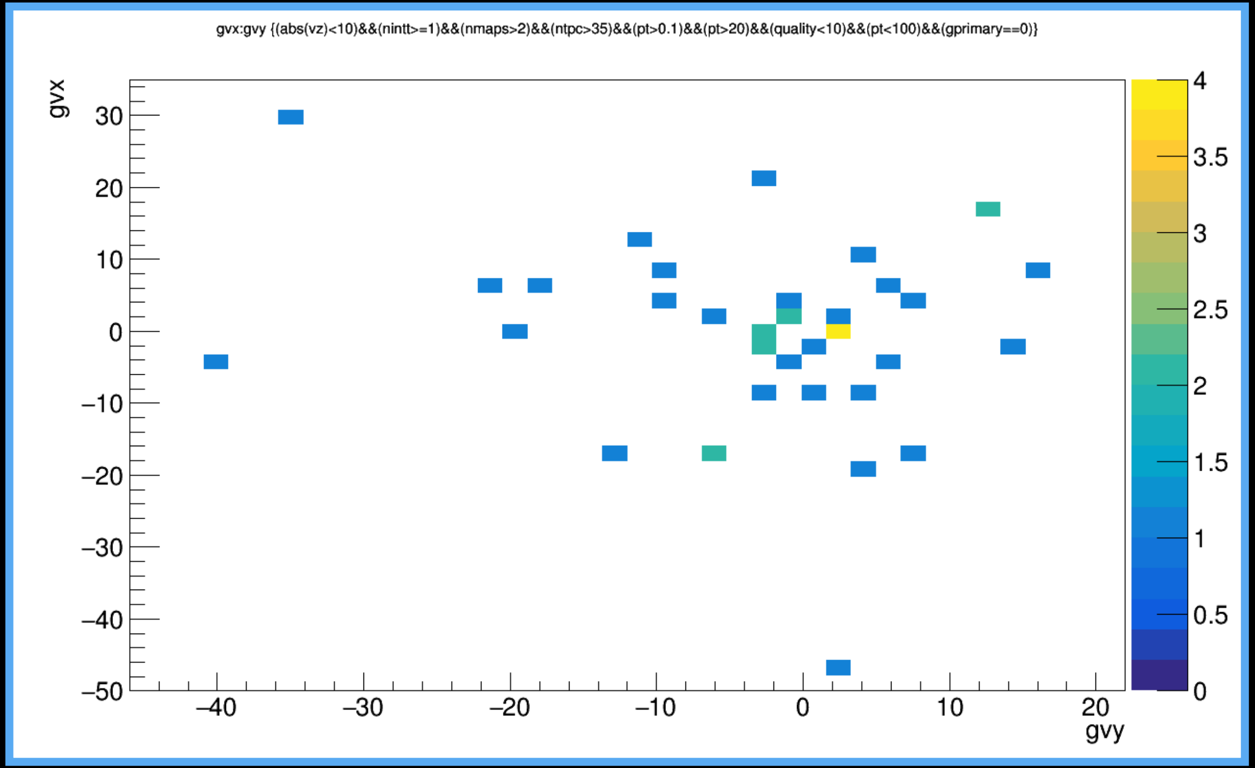


Down

> 20 GeV/c Tracks | gvx vs. gvy

100 20 – 40 GeV/c
π^- per event



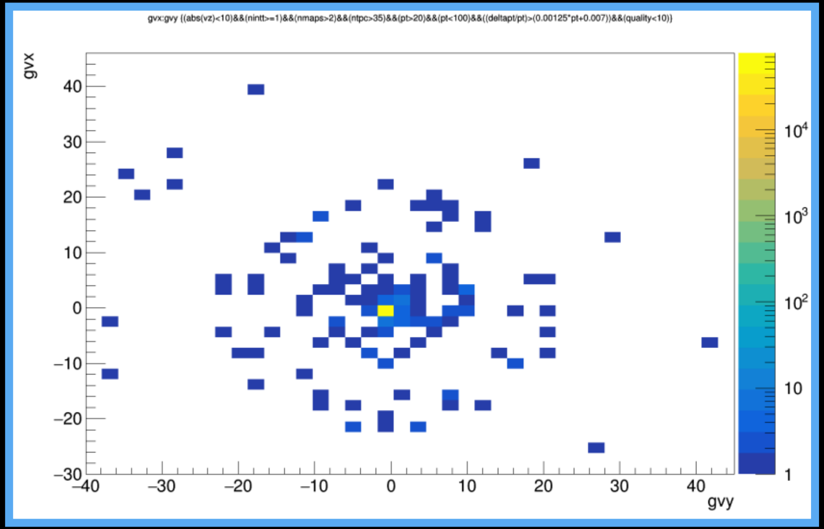


Primaries (gprimary = 1)

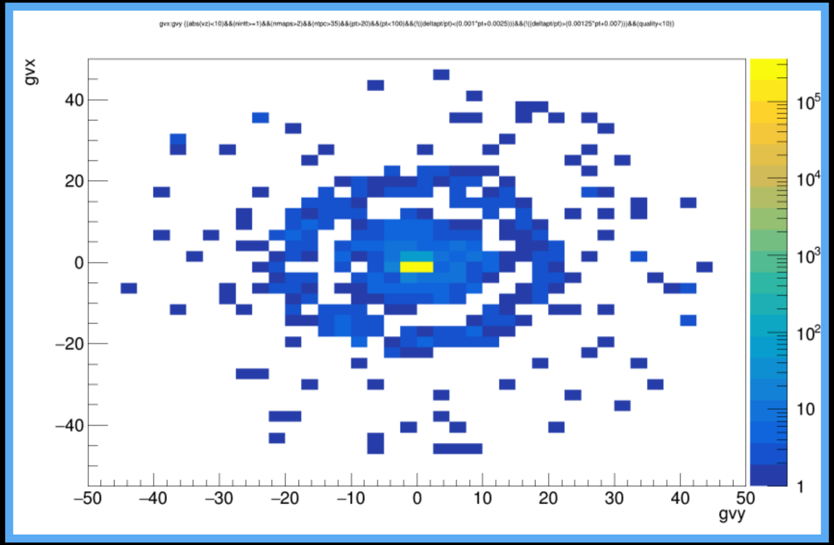
Secondaries (gprimary = 0)

> 20 GeV/c Tracks | gvx vs. gvy

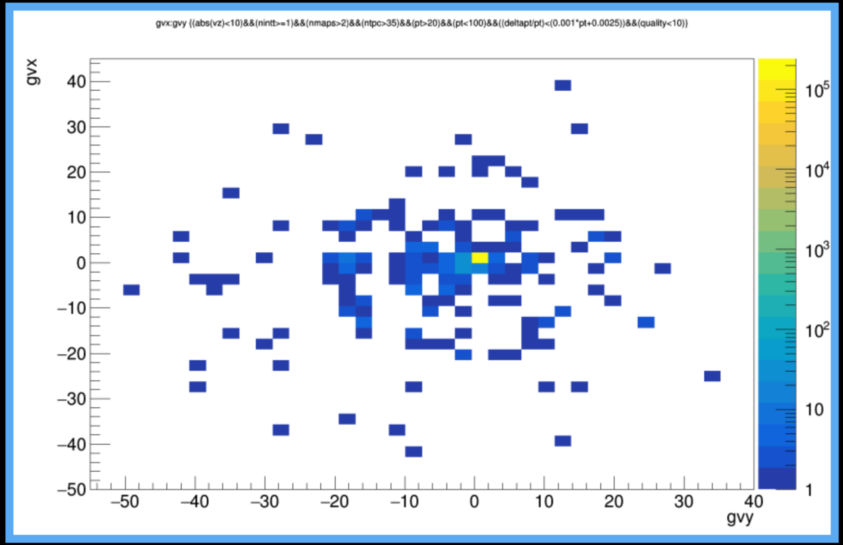
100 20 – 40 GeV/c π^- per event



Up



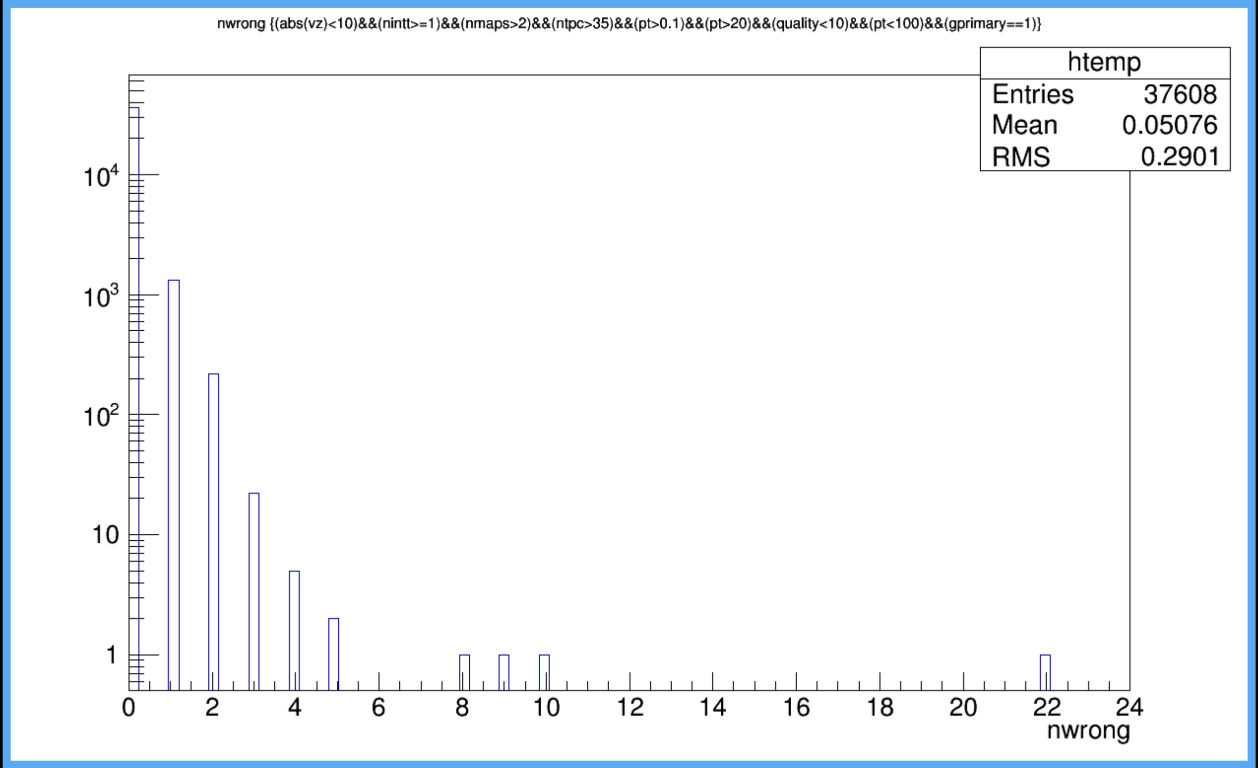
Center

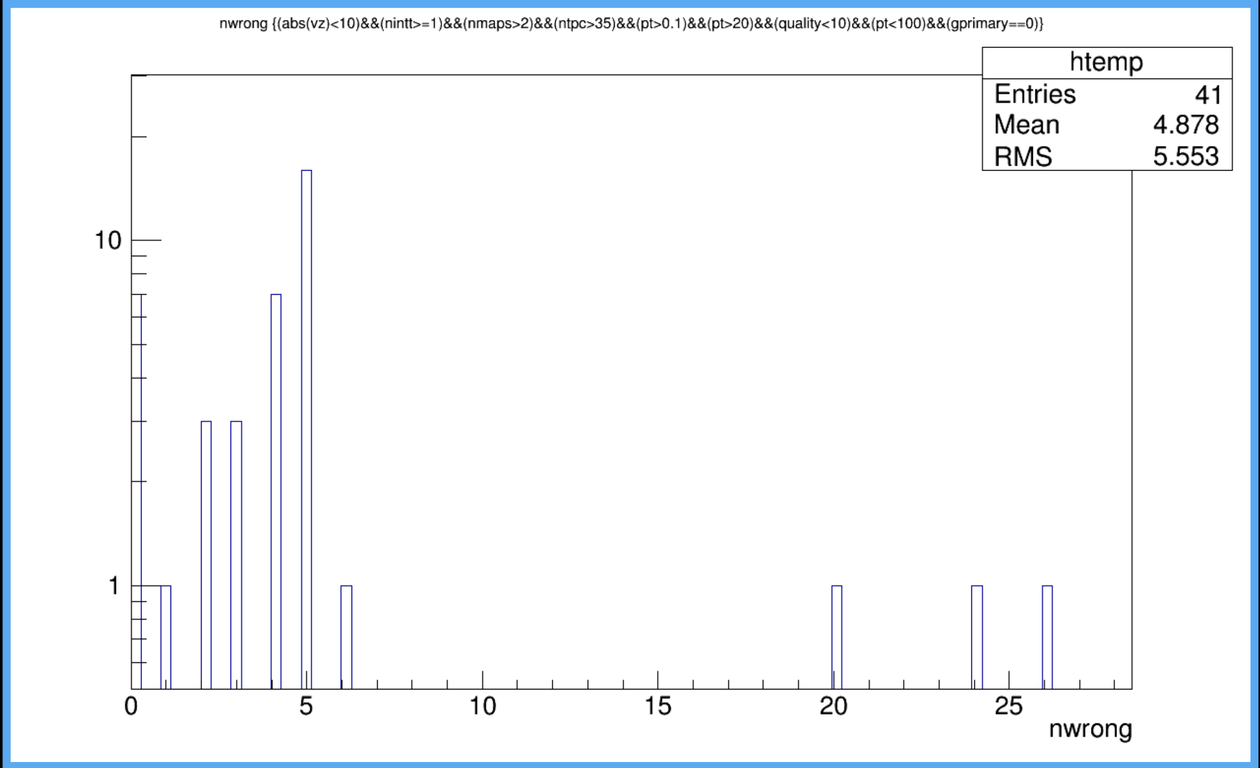


Down

> 20 GeV/c Tracks | nwrong

100 20 – 40 GeV/c
π^- per event



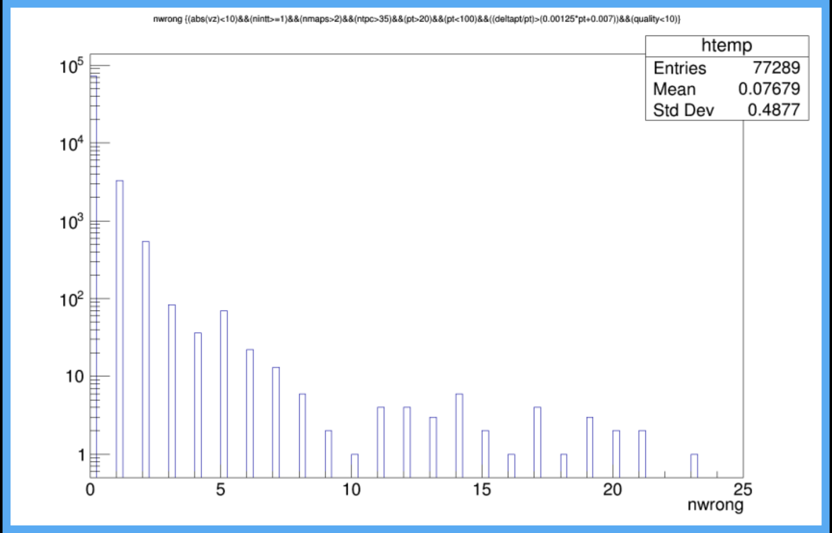


Primaries (gprimary = 1)

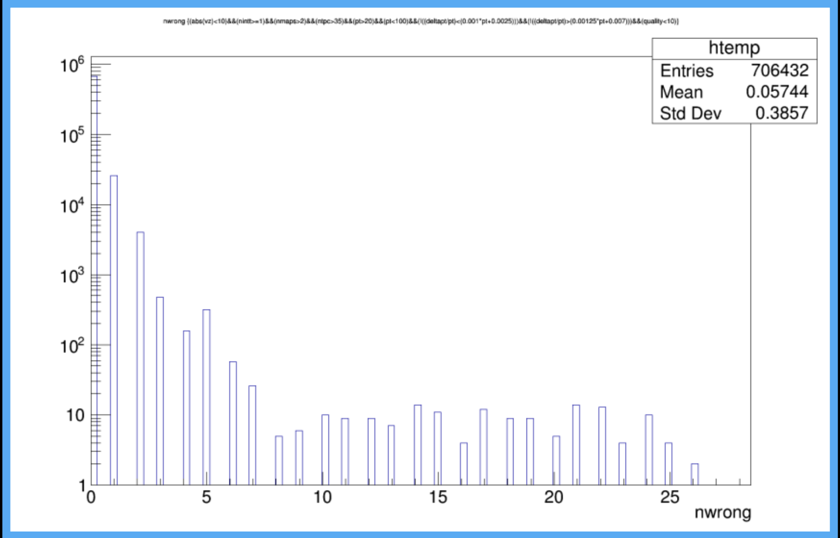
Secondaries (gprimary = 0)

> 20 GeV/c Tracks | nwrong

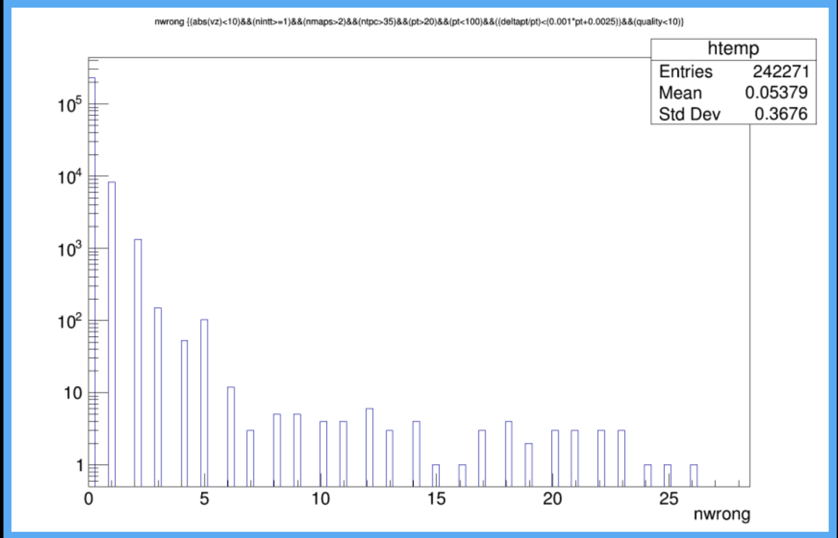
100 20 – 40 GeV/c π^- per event



Up



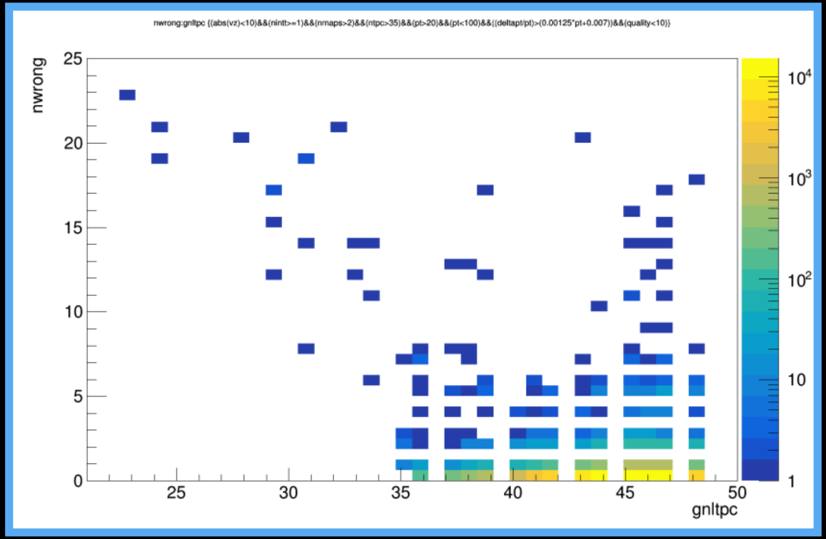
Center



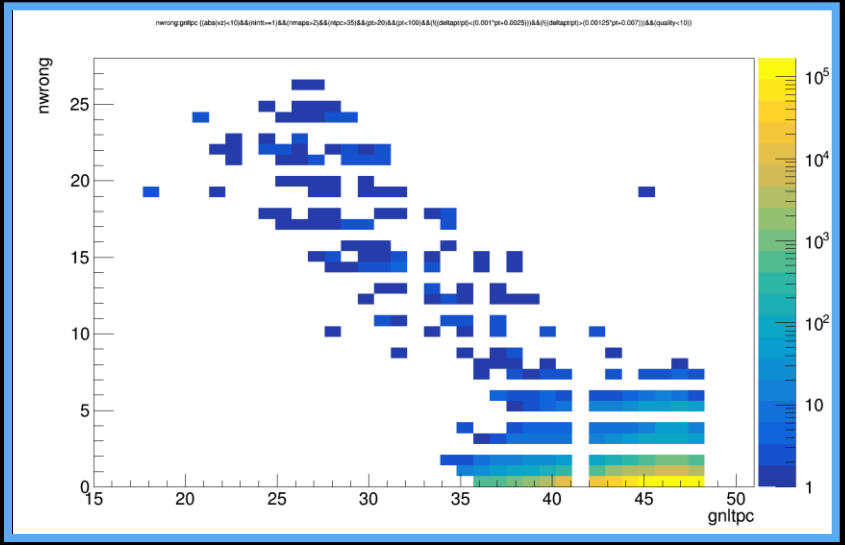
Down

> 20 GeV/c Tracks | nwrong vs. gnltpc

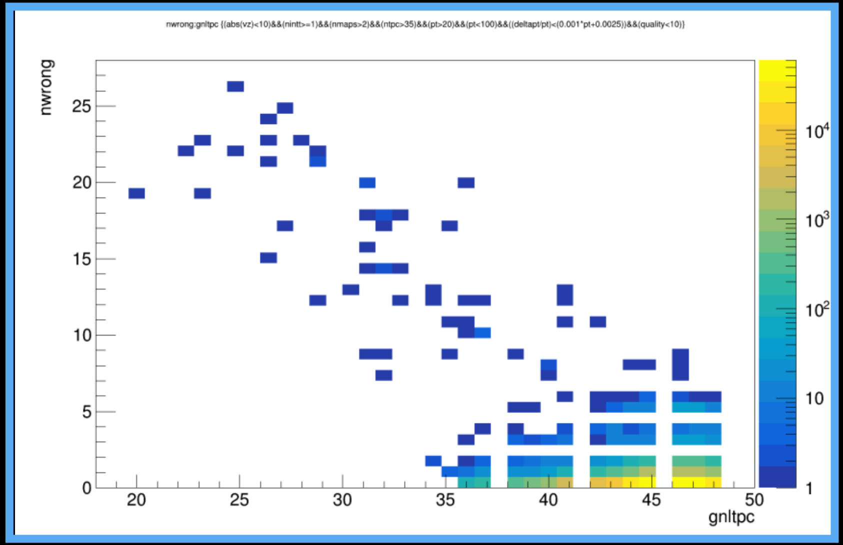
100 20 – 40 GeV/c π^- per event



Up



Center



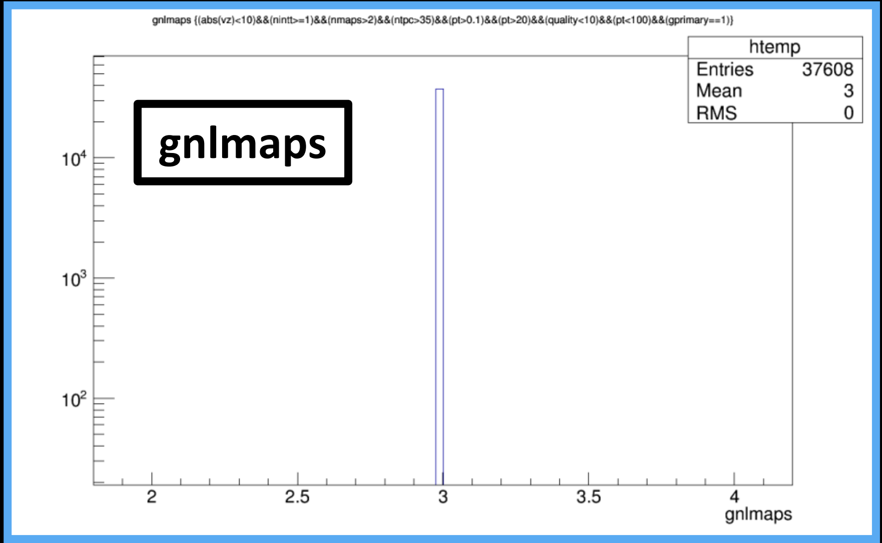
Down

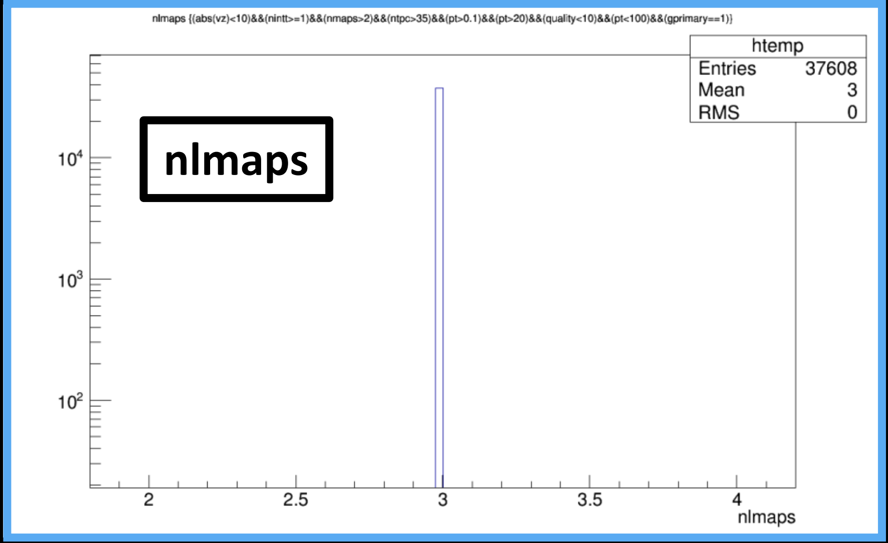
> 20 GeV/c Tracks | gnlmaps and nlmaps

100 20 – 40 GeV/c π^- per event

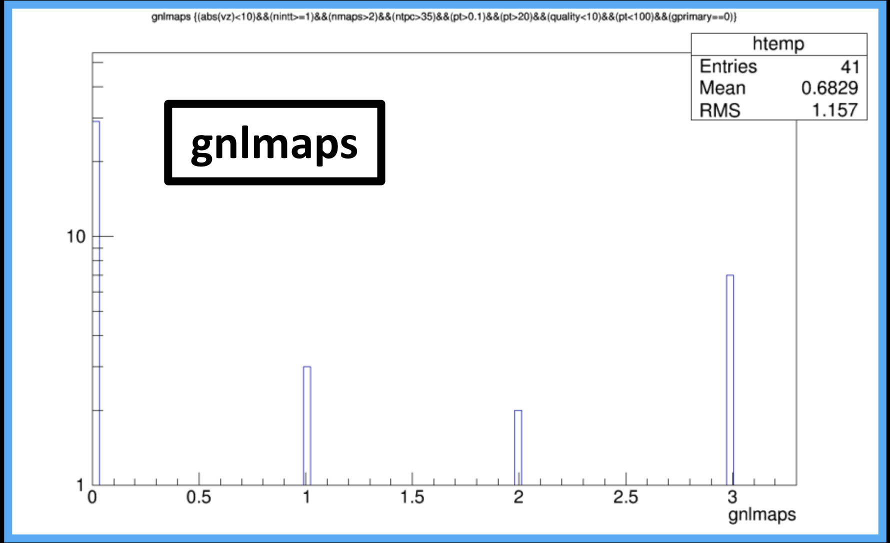
sPHENIX

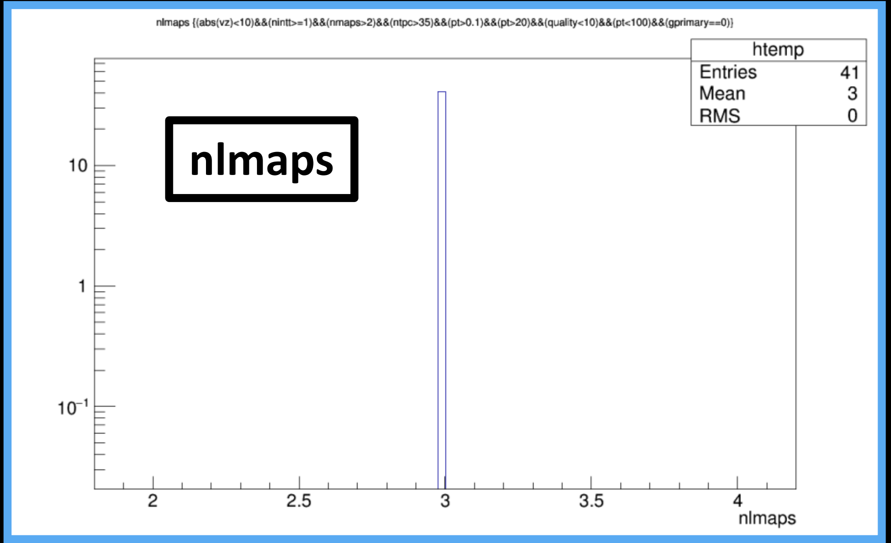
Primaries (gprimary = 1)





Secondaries (gprimary = 0)

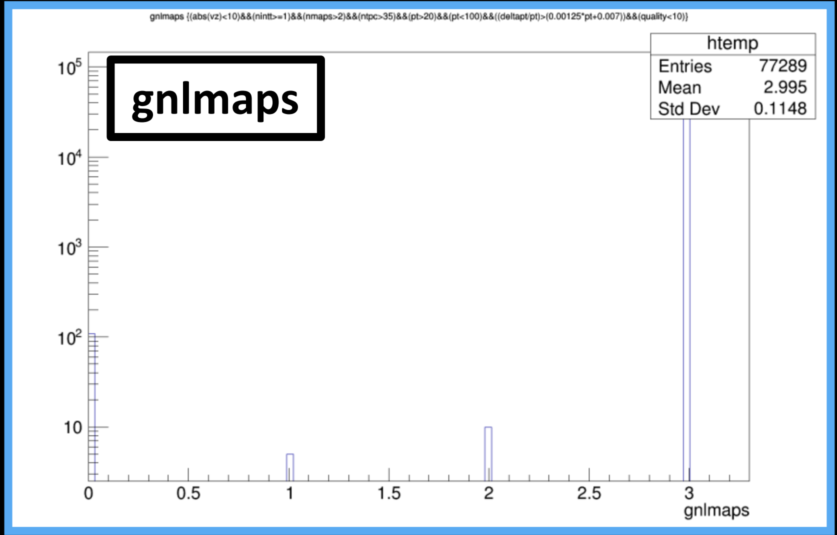


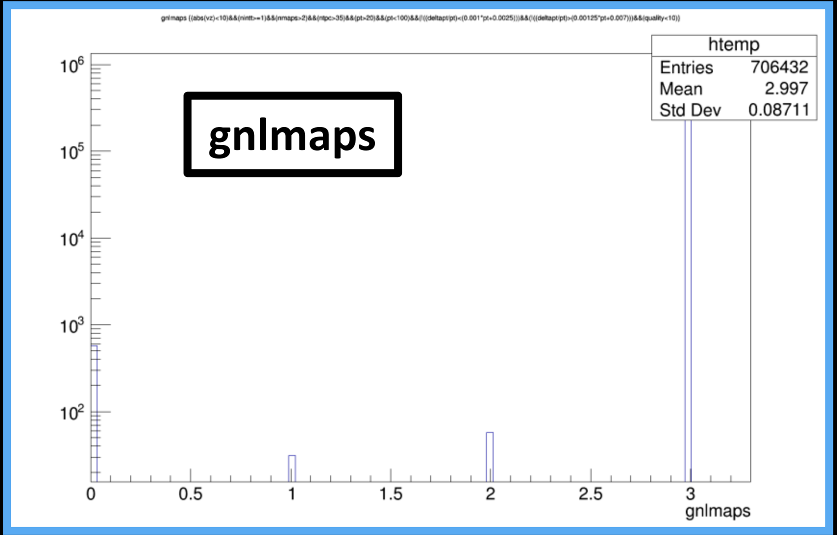


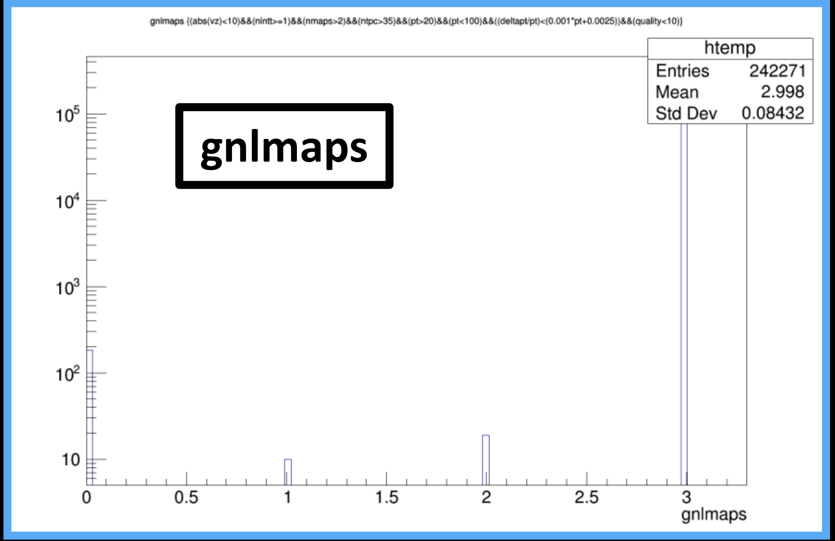
> 20 GeV/c Tracks | gnlmaps and nlmaps

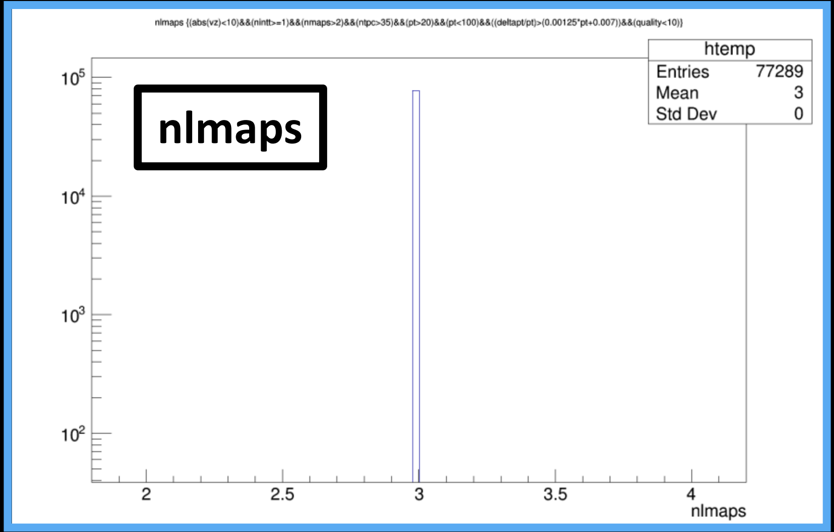
100 20 – 40 GeV/c π^- per event

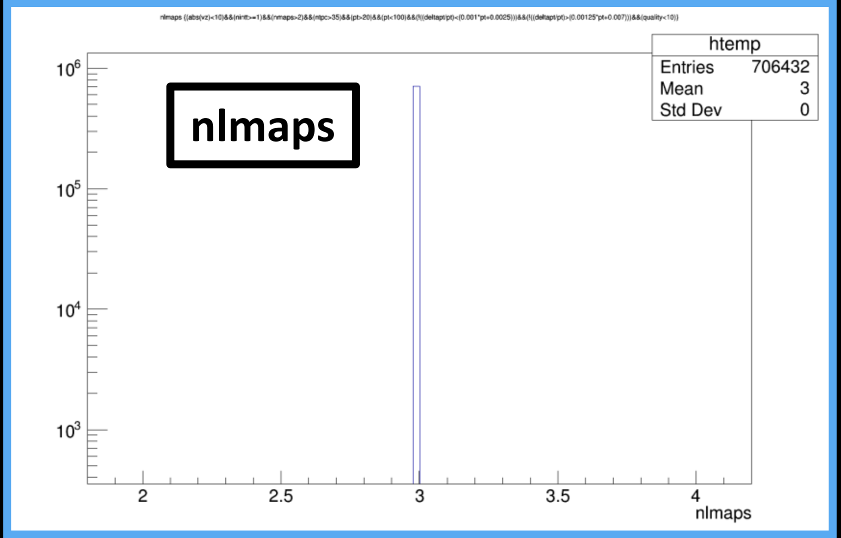
Up | **Center** | **Down**

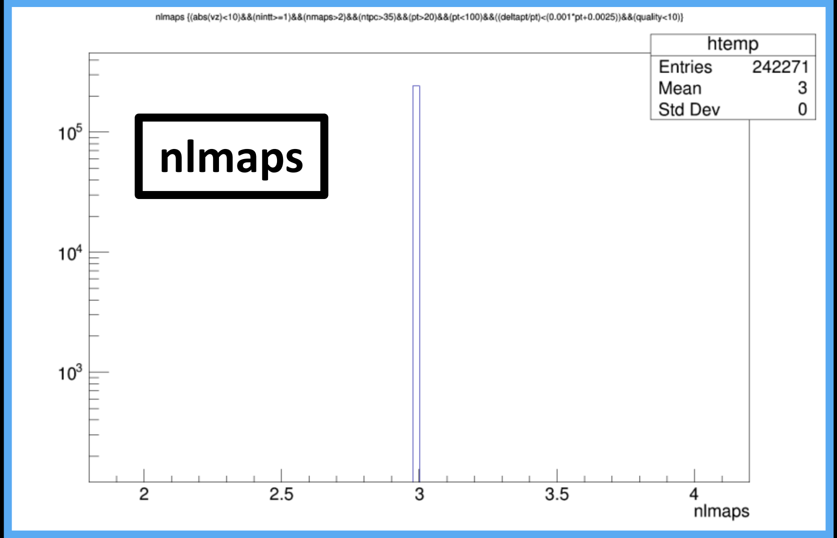








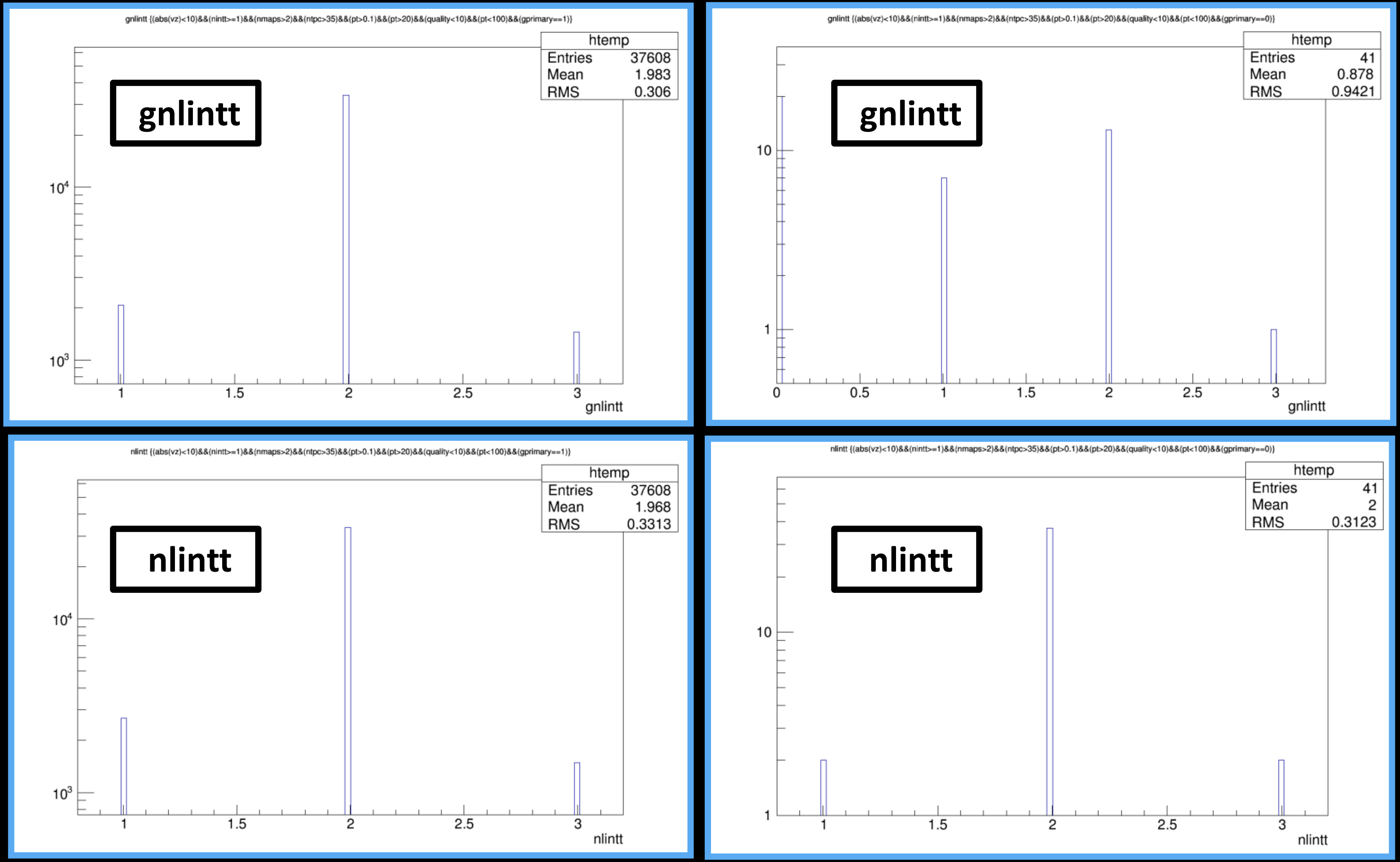




> 20 GeV/c Tracks | gnlintt and nlintt

100 20 – 40 GeV/c π^{-} per event

Primaries (gprimary = 1)



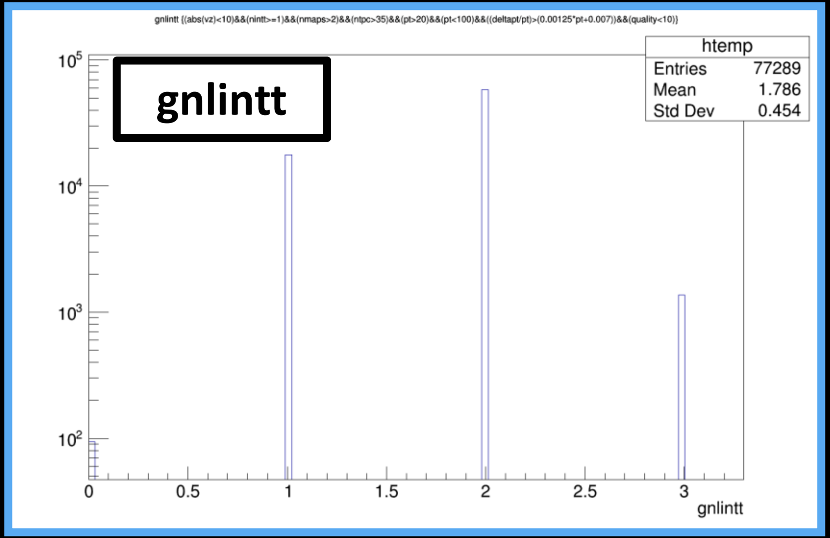
Secondaries (gprimary = 0)

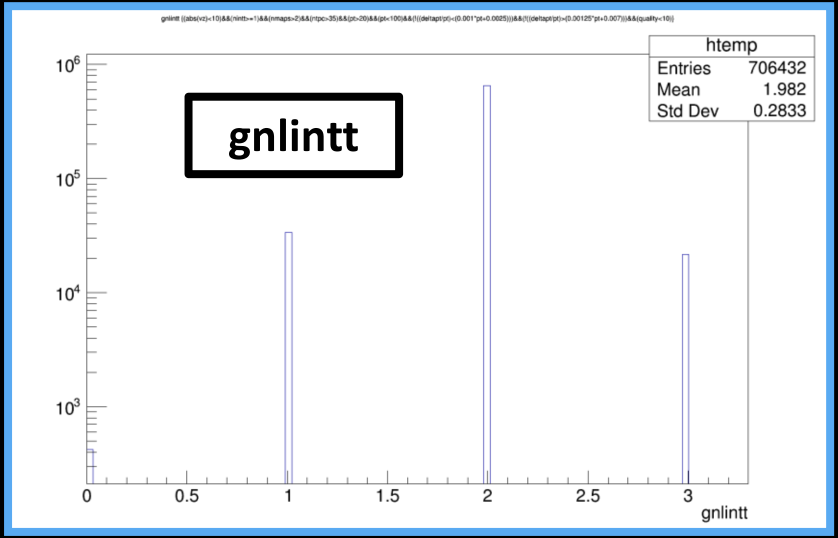
> 20 GeV/c Tracks | gnlintt and nlintt

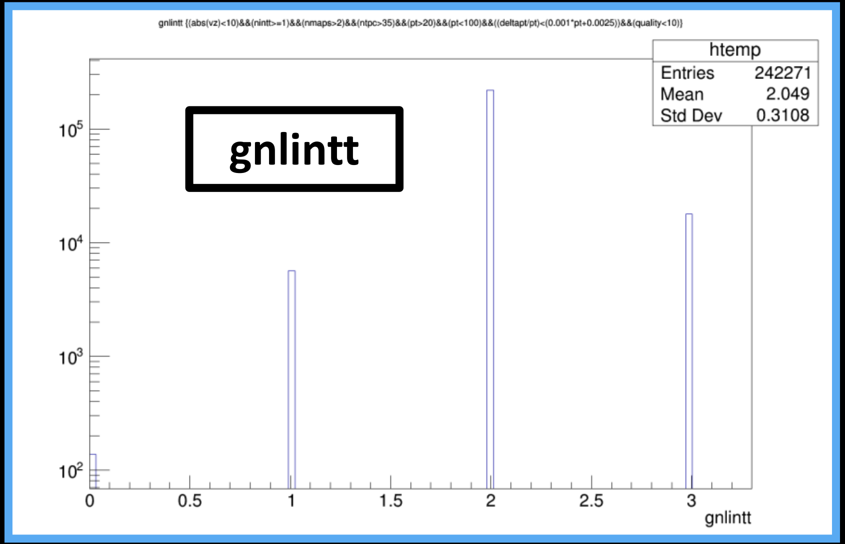
100 20 – 40 GeV/c π^- per event

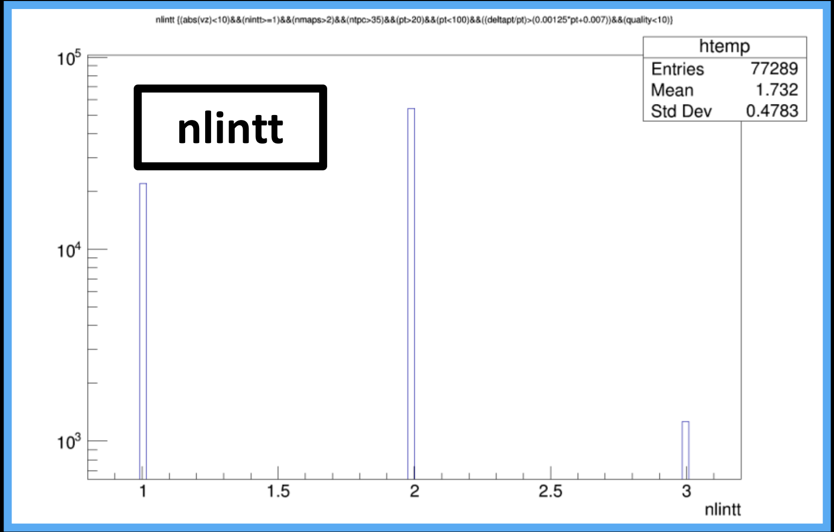
sPHENIX

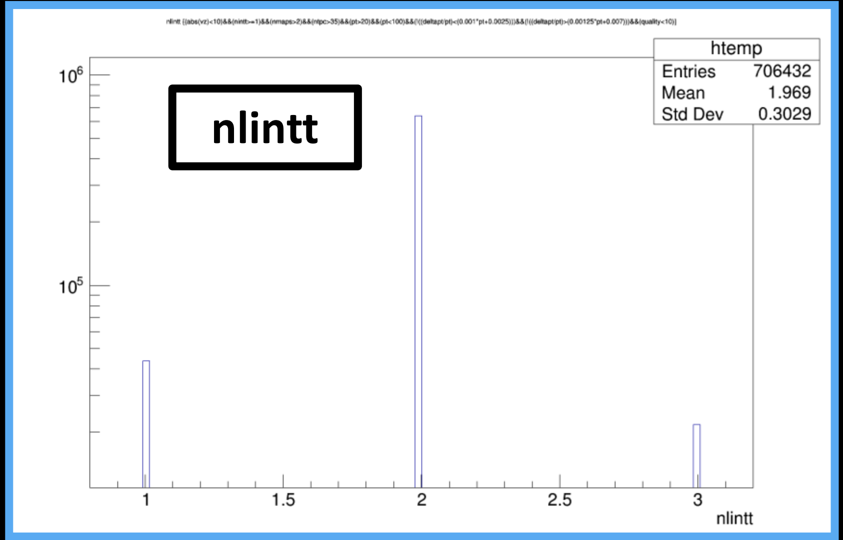
Up | **Center** | **Down**

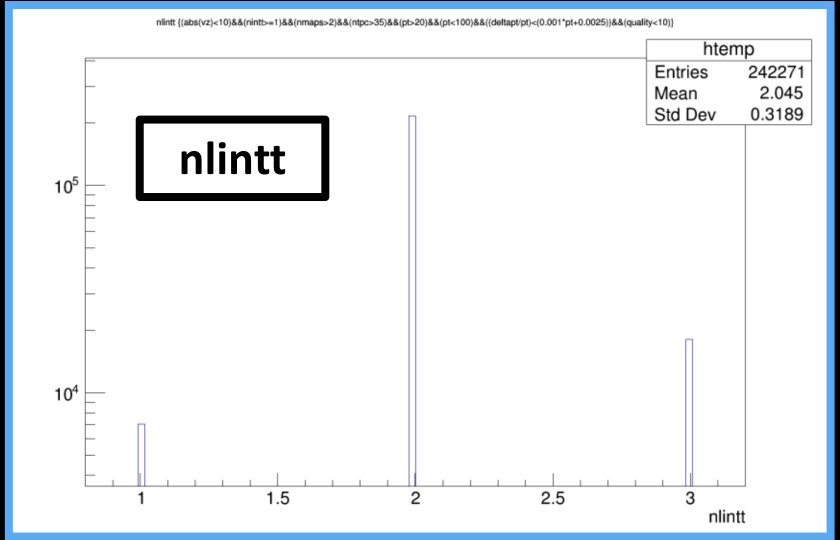










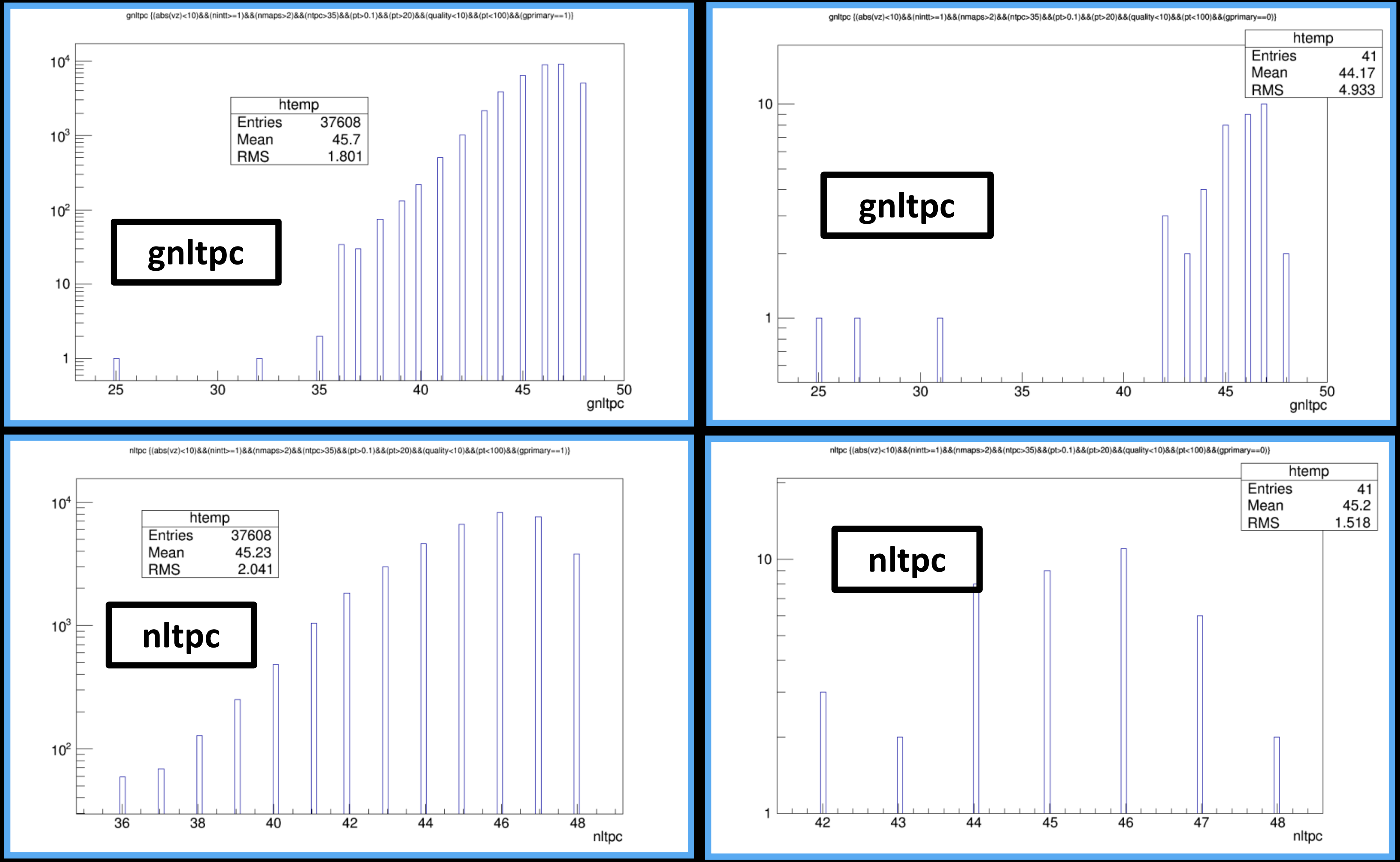


> 20 GeV/c Tracks | gnltpc and nltpc

100 20 – 40 GeV/c π^- per event

Primaries (gprimary = 1)

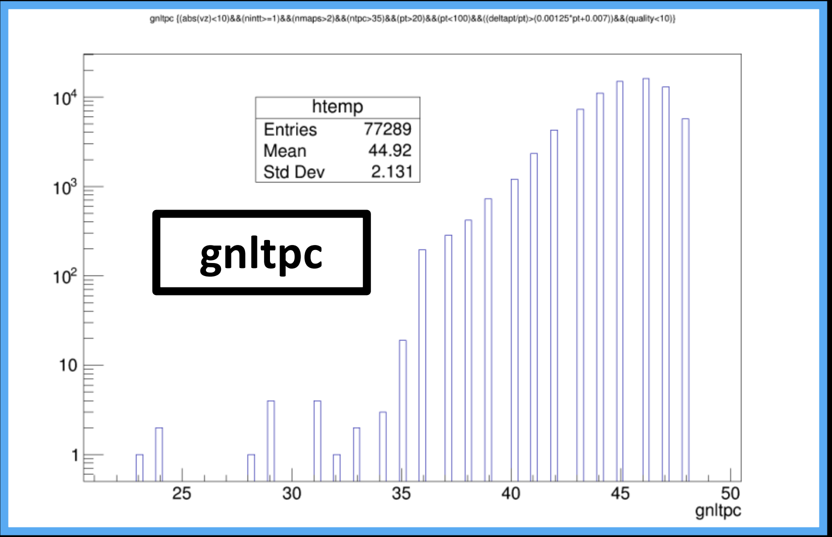
Secondaries (gprimary = 0)

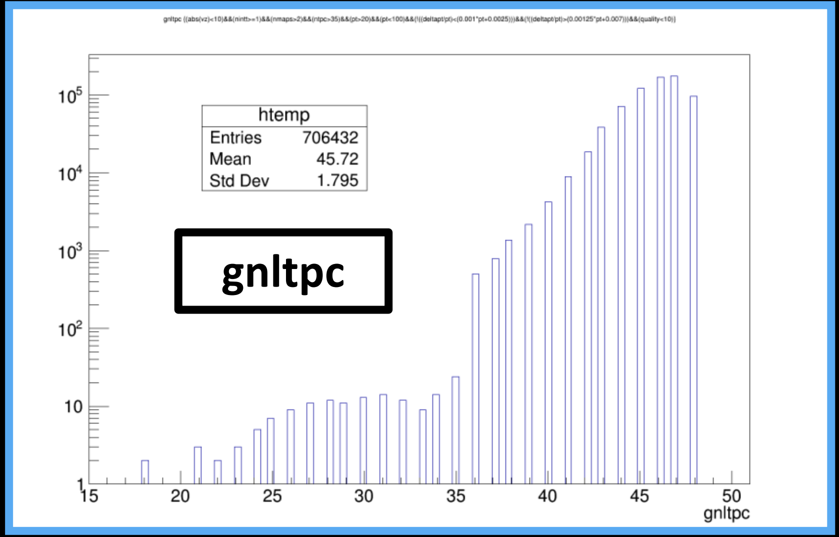


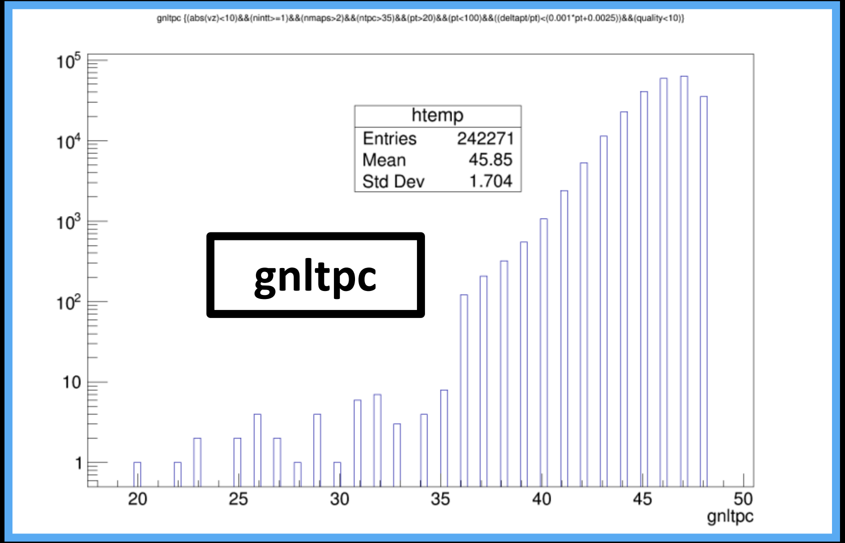
> 20 GeV/c Tracks | gnltpc and nltpc

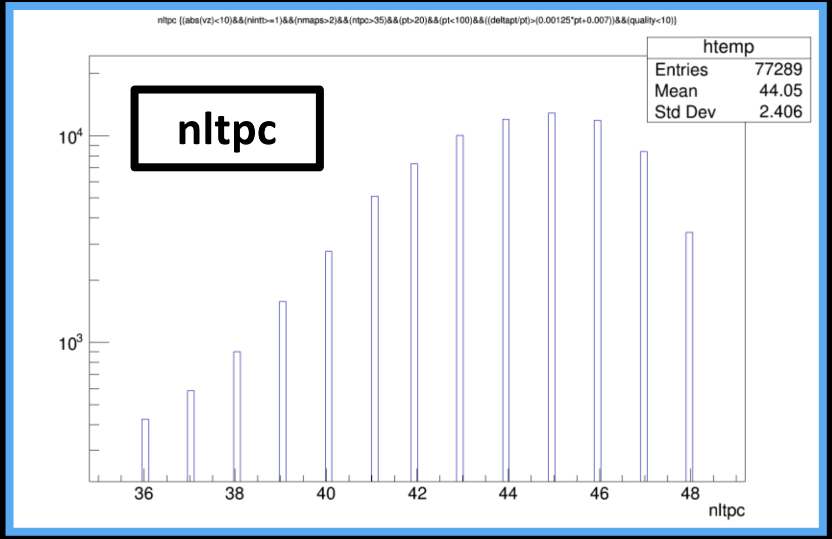
100 20 – 40 GeV/c π^- per event

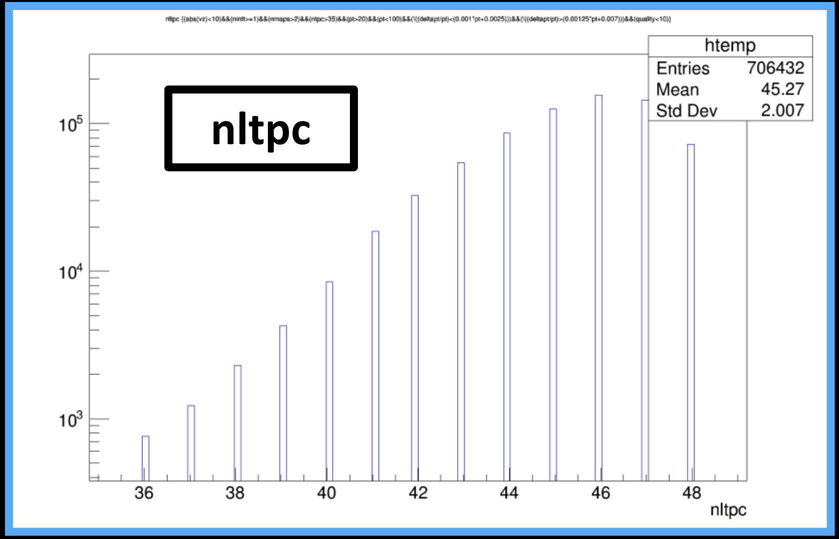
Up | **Center** | **Down**

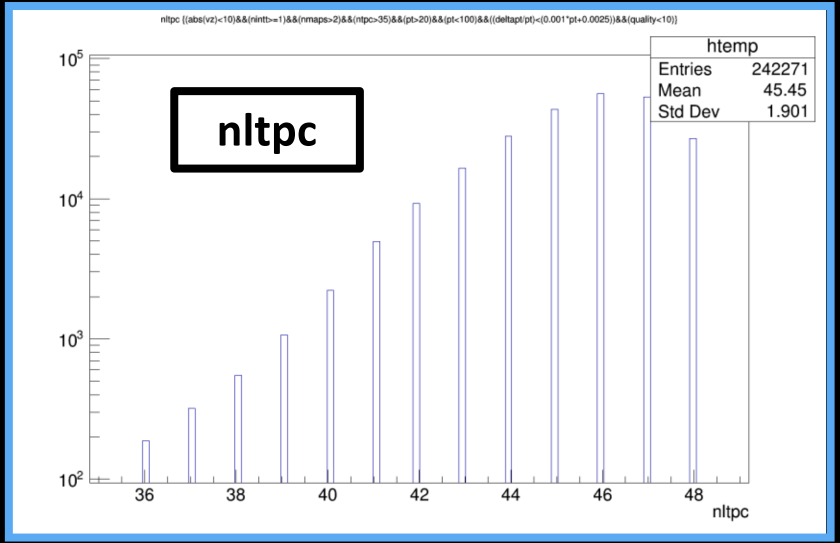






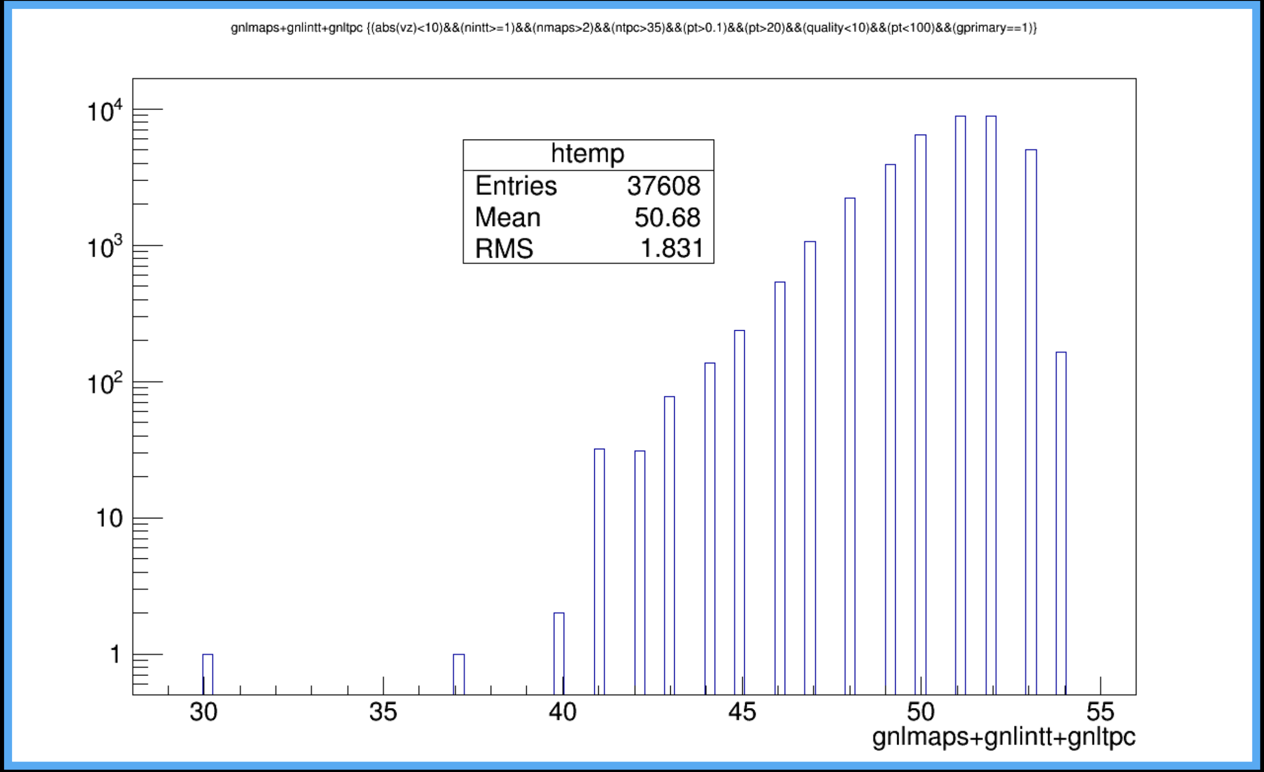


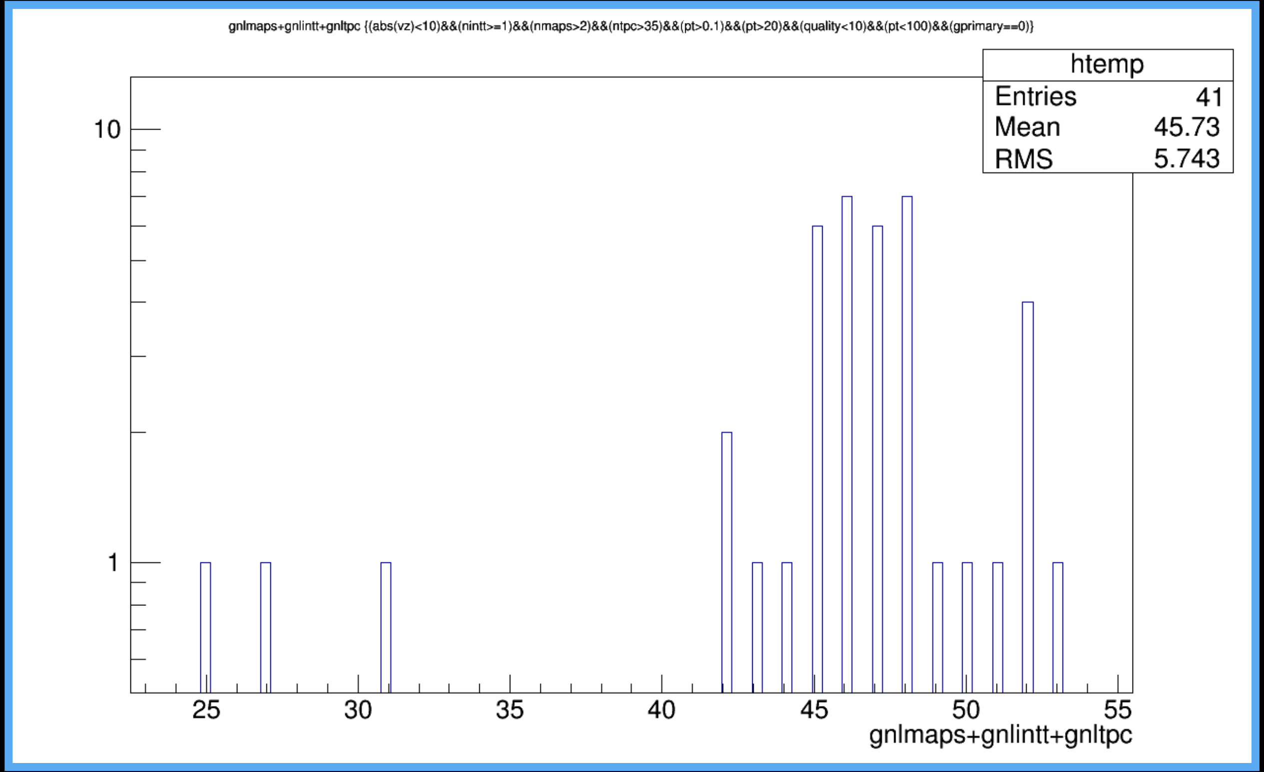




> 20 GeV/c Tracks | gnltot = gnlmaps + gnlintt + gnltpc

100 20 – 40 GeV/c π^- per event



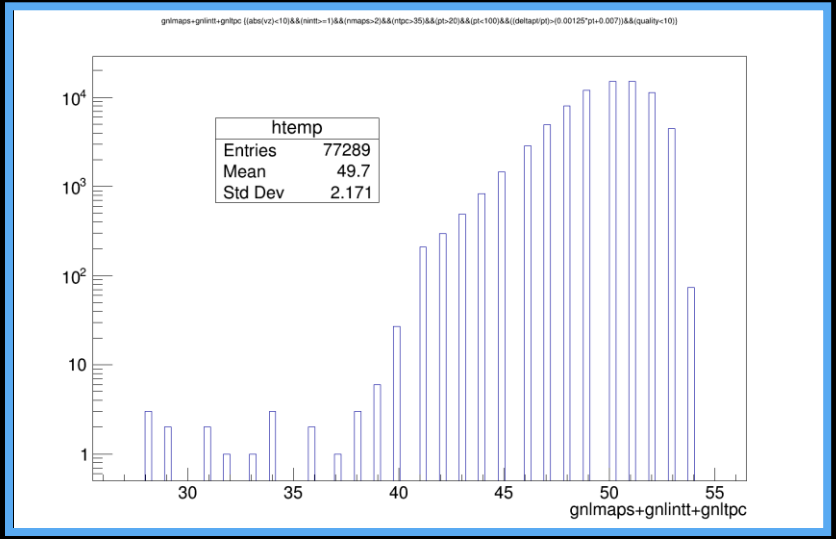


Primaries (gprimary = 1)

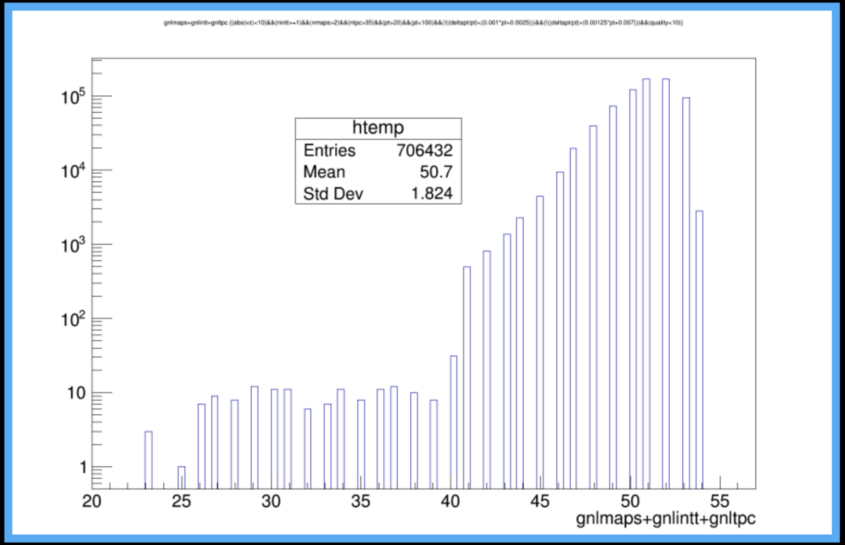
Secondaries (gprimary = 0)

> 20 GeV/c Tracks | gnltot = gnlmaps + gnlintt + gnltpc

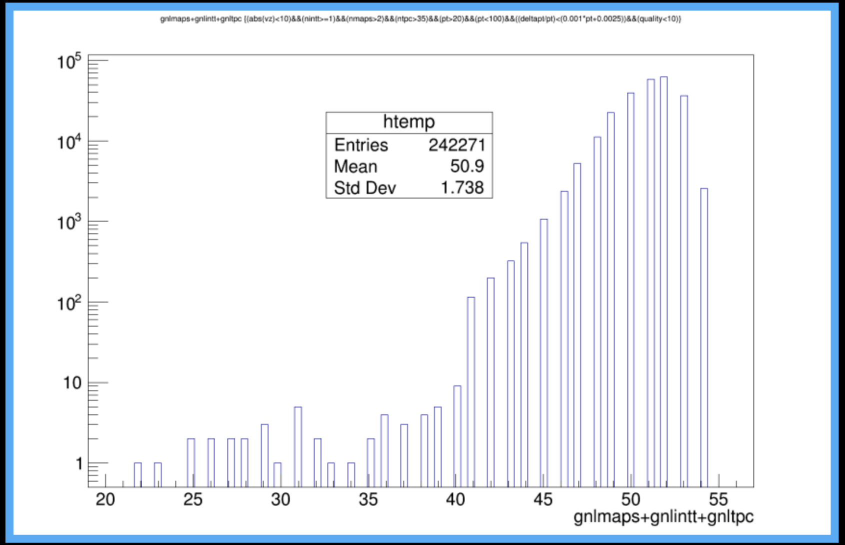
100 20 – 40 GeV/c π^- per event



Up



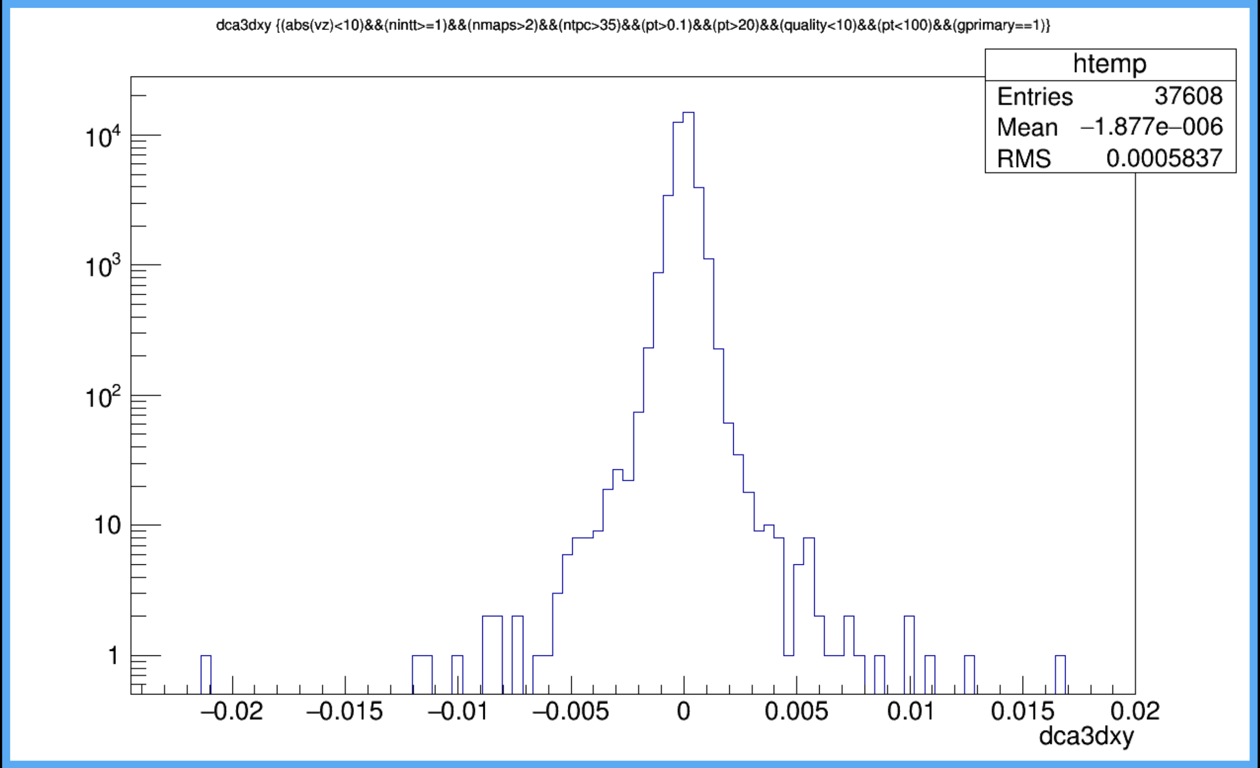
Center

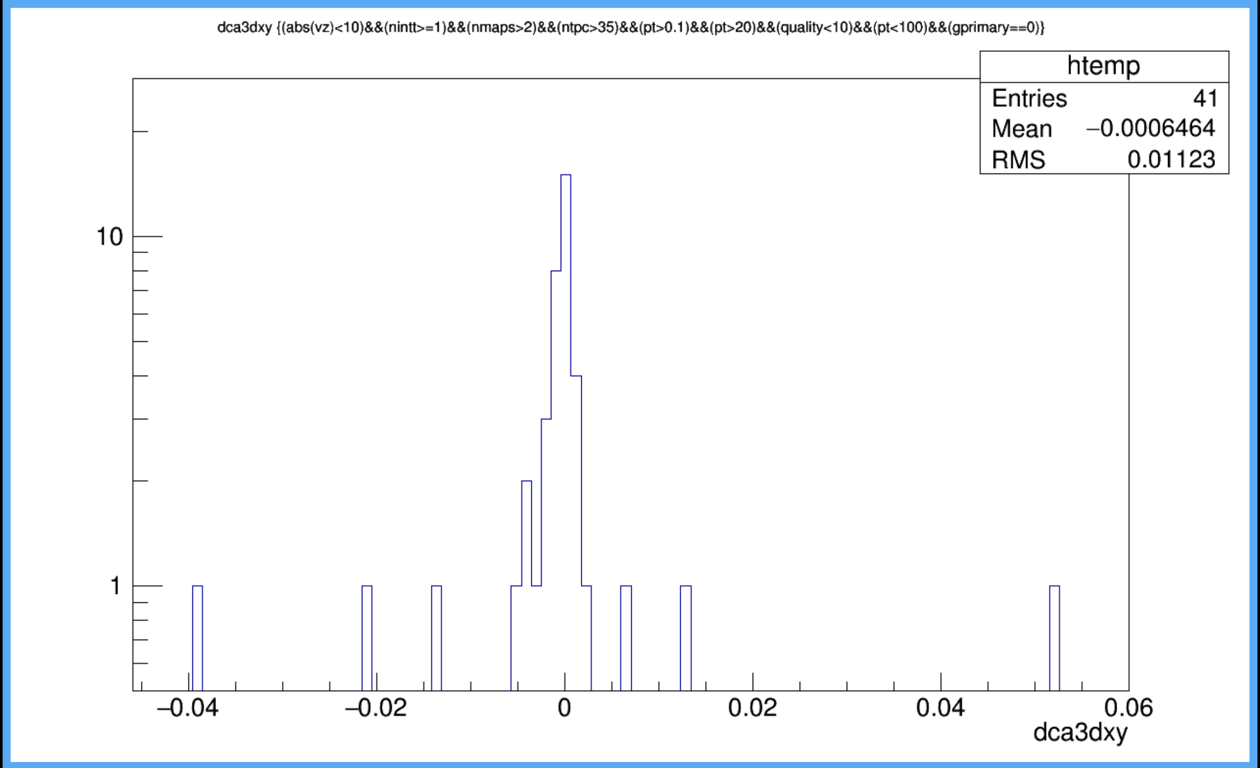


Down

> 20 GeV/c Tracks | dca3dxy

100 20 – 40 GeV/c
π^- per event



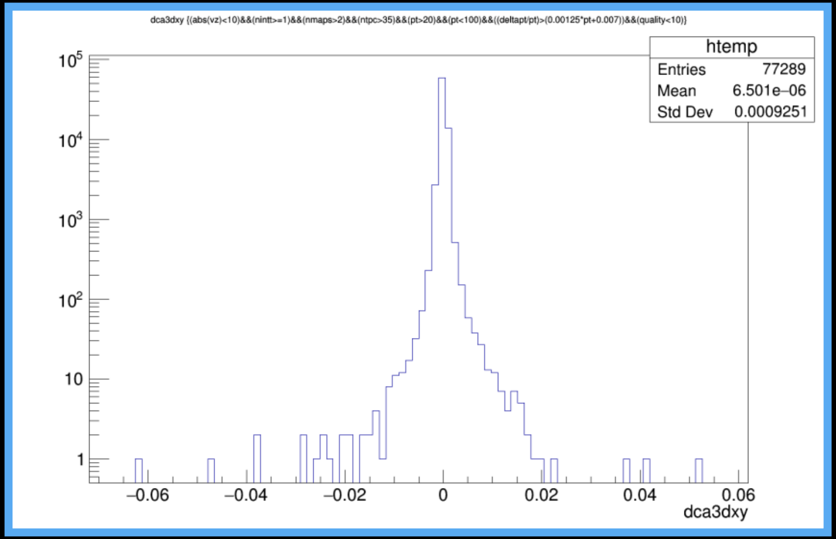


Primaries (gprimary = 1)

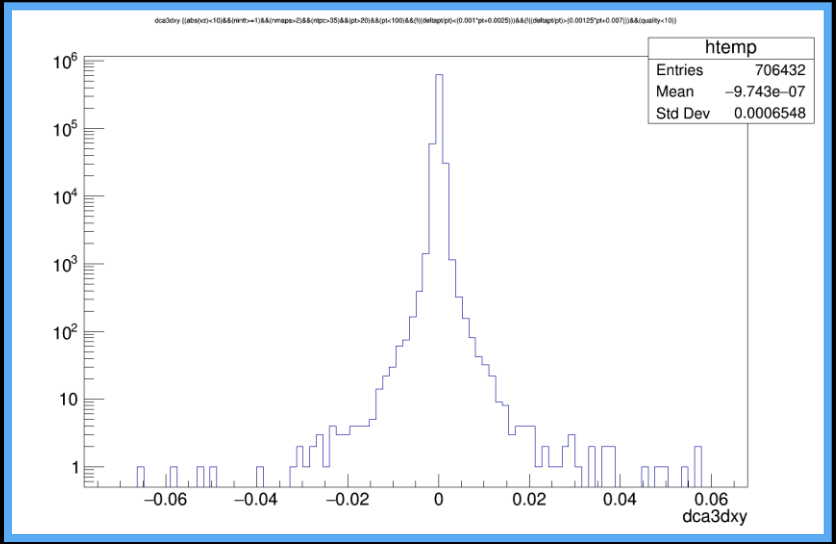
Secondaries (gprimary = 0)

> 20 GeV/c Tracks | dca3dxy

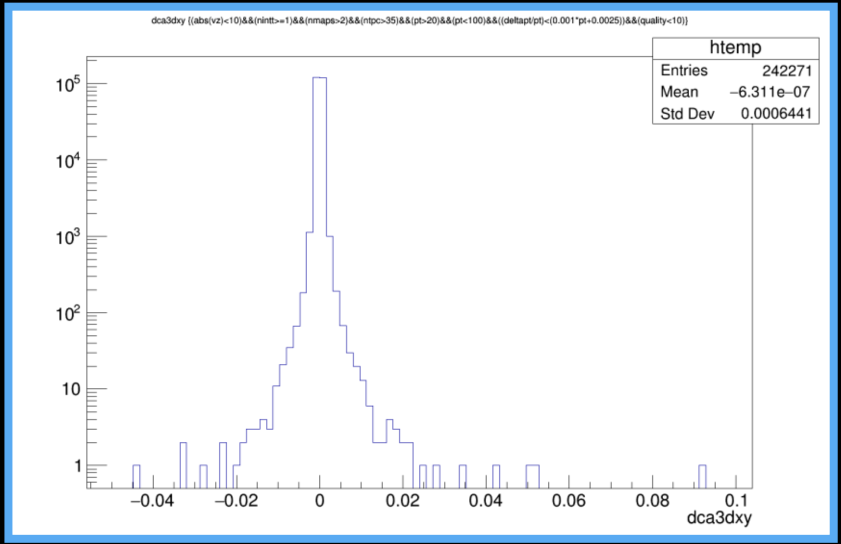
100 20 – 40 GeV/c π^- per event



Up



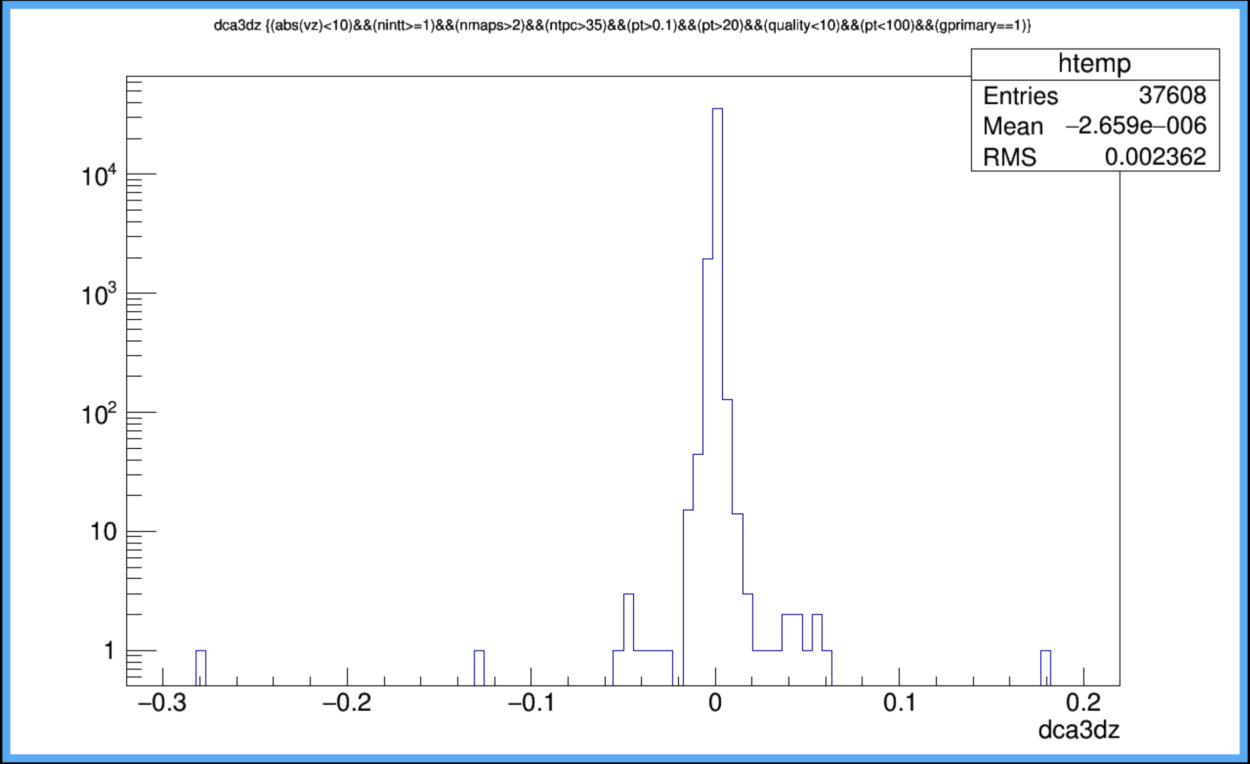
Center

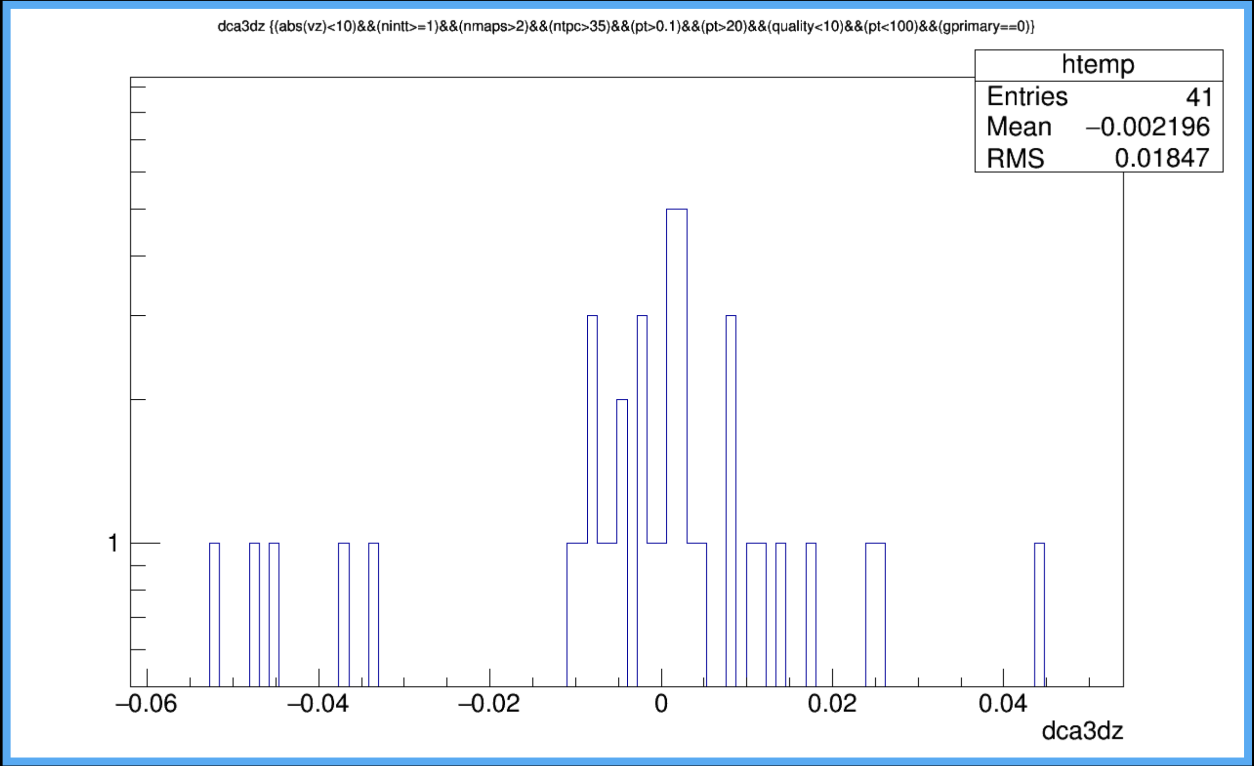


Down

> 20 GeV/c Tracks | dca3dz

100 20 – 40 GeV/c π^- per event



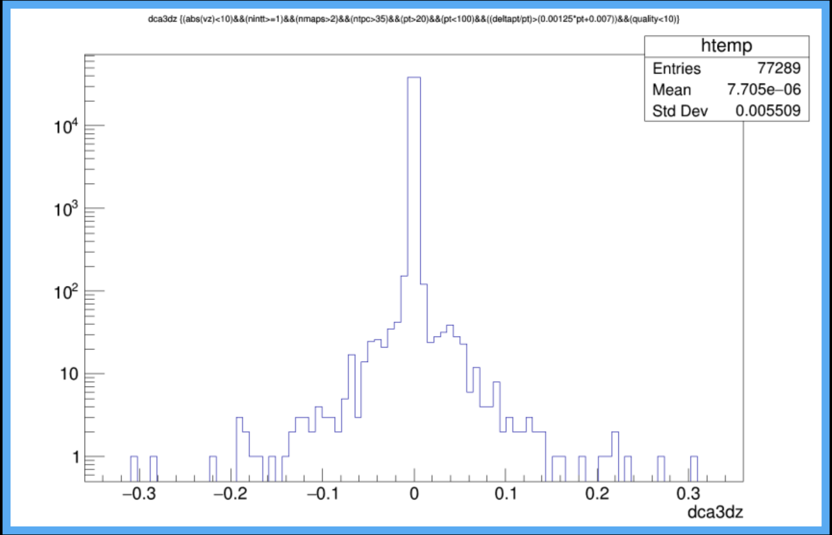


Primaries (gprimary = 1)

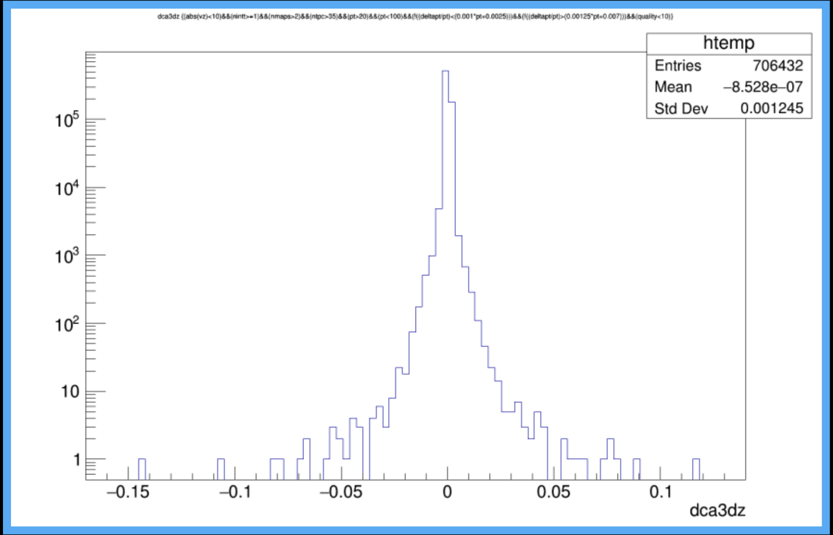
Secondaries (gprimary = 0)

> 20 GeV/c Tracks | dca3dz

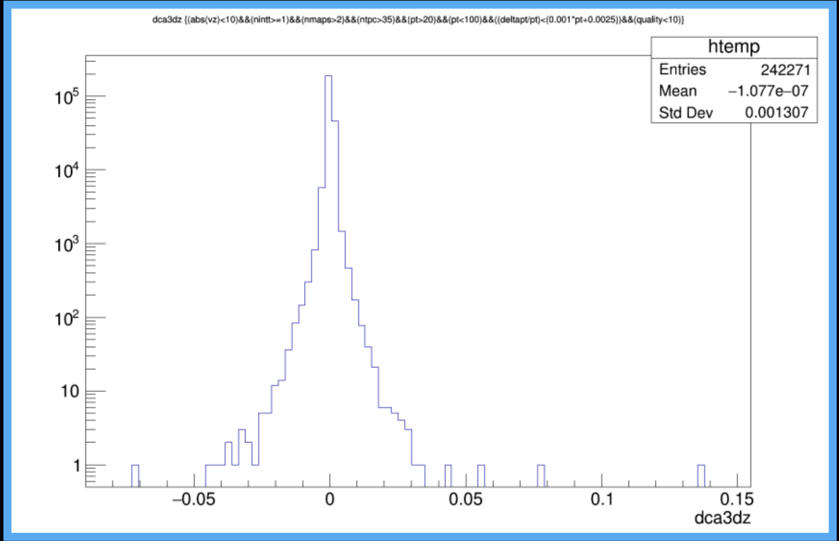
100 20 – 40 GeV/c π^- per event



Up



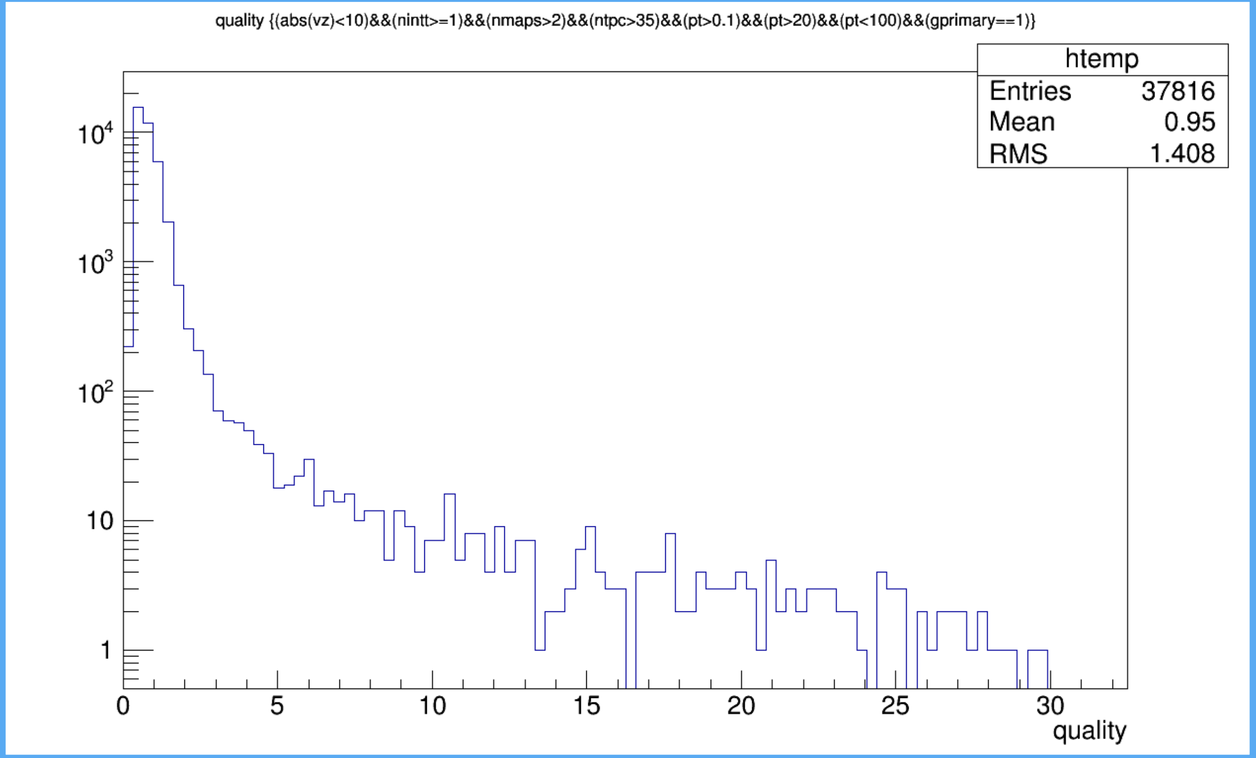
Center

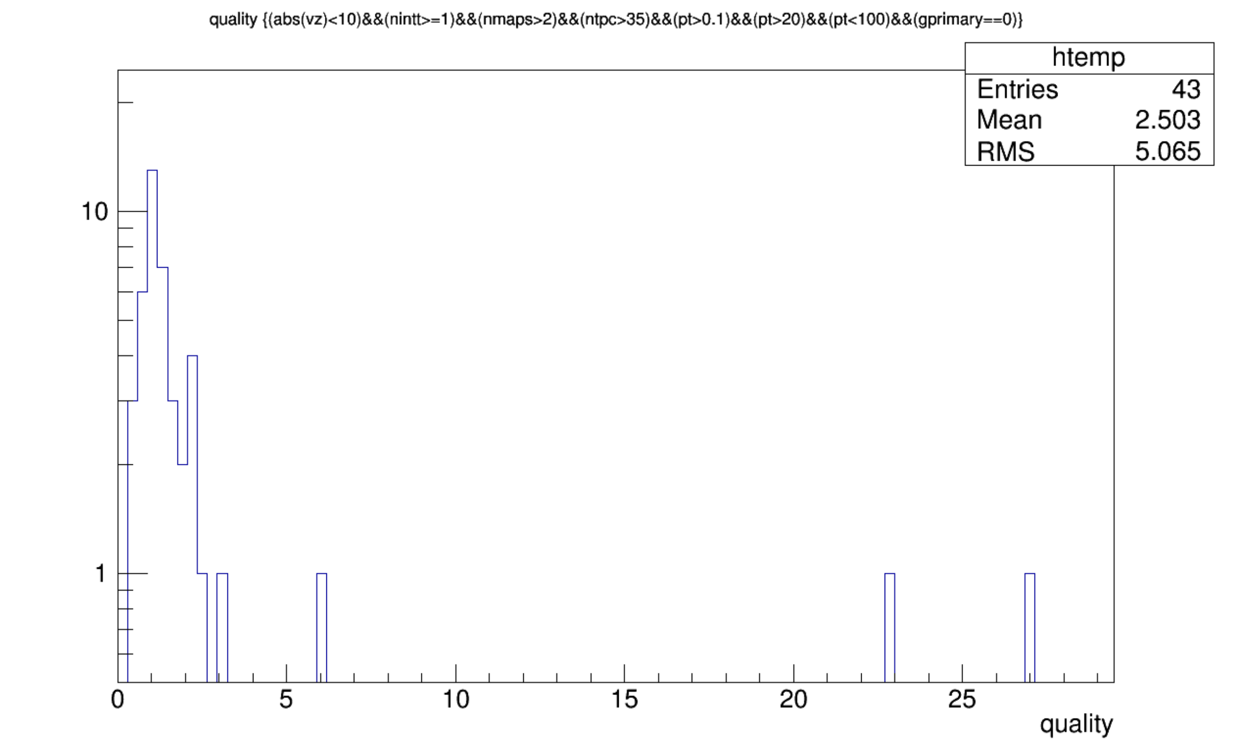


Down

> 20 GeV/c Tracks | quality

100 20 – 40 GeV/c π^- per event



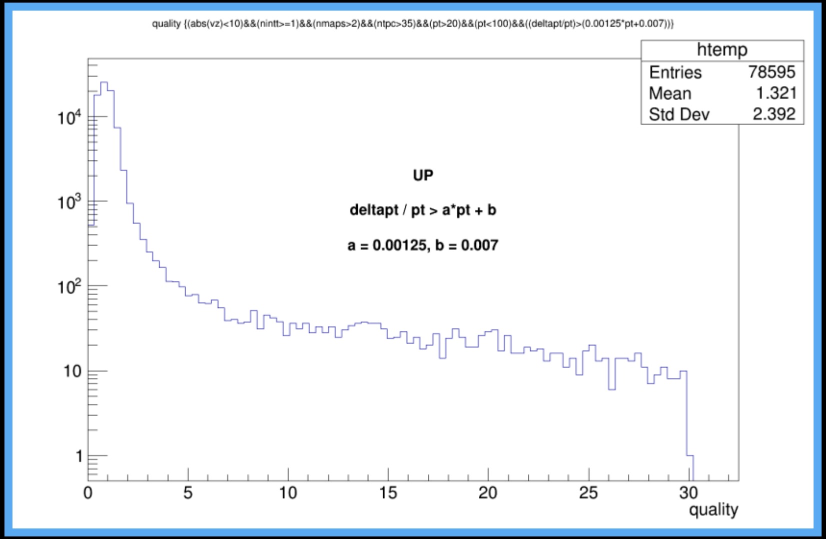


Primaries (gprimary = 1)

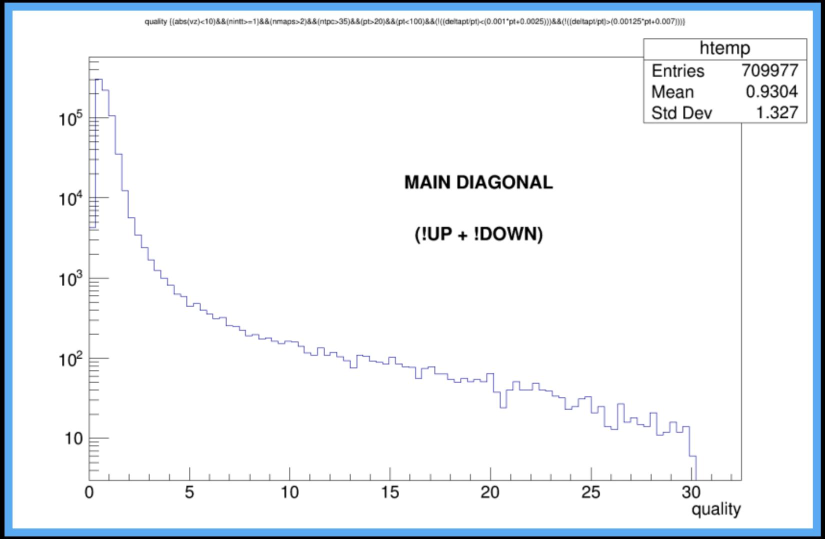
Secondaries (gprimary = 0)

> 20 GeV/c Tracks | quality

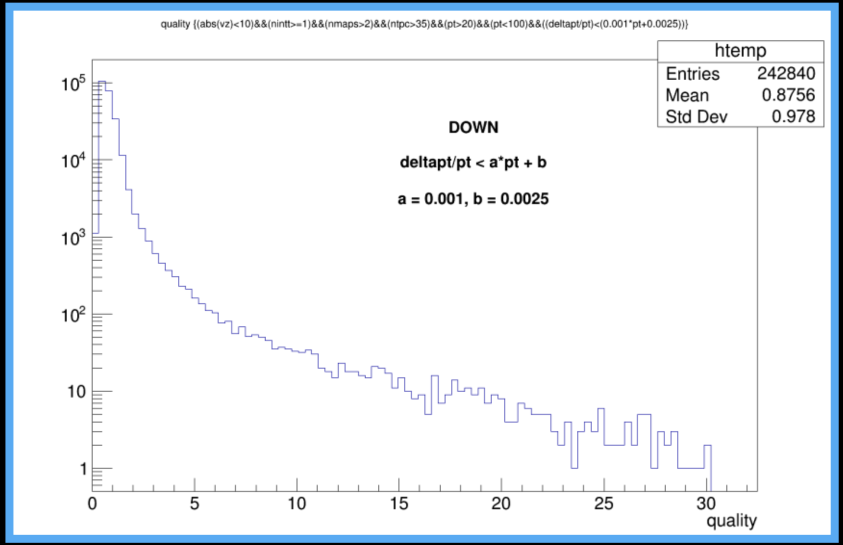
100 20 – 40 GeV/c π^- per event



Up



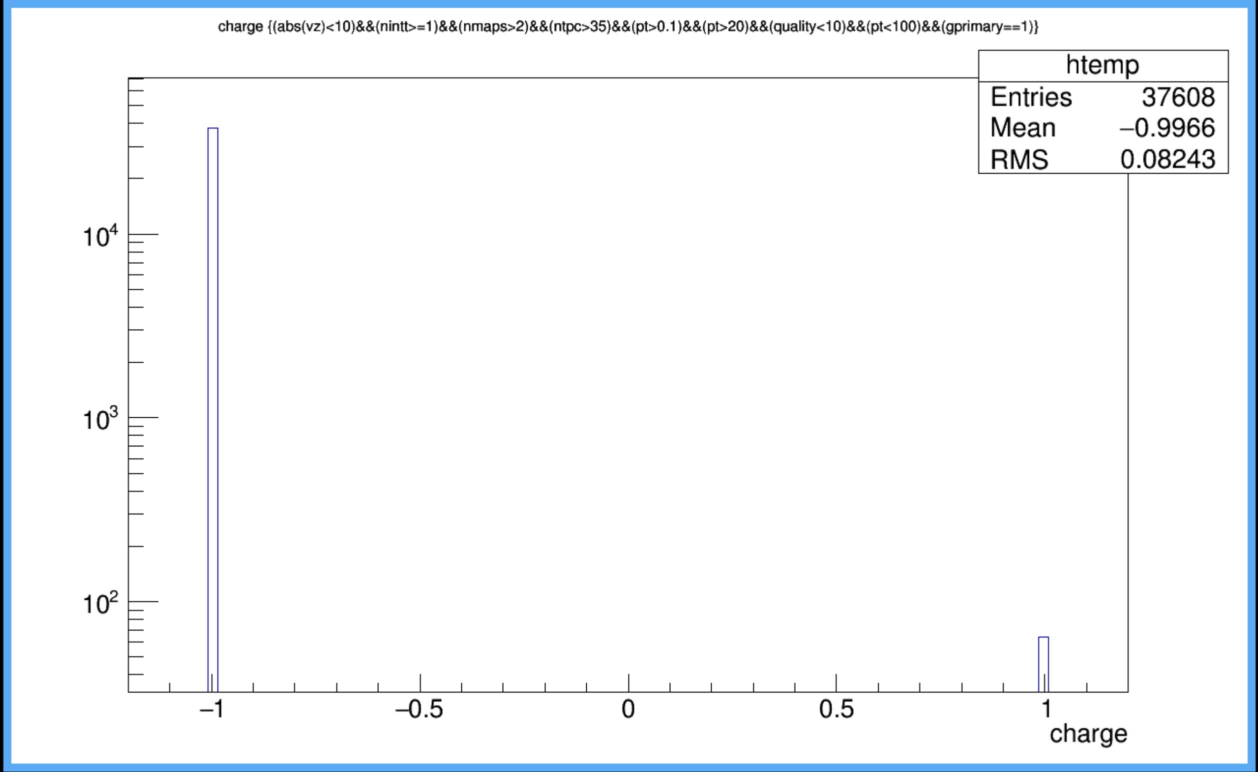
Center

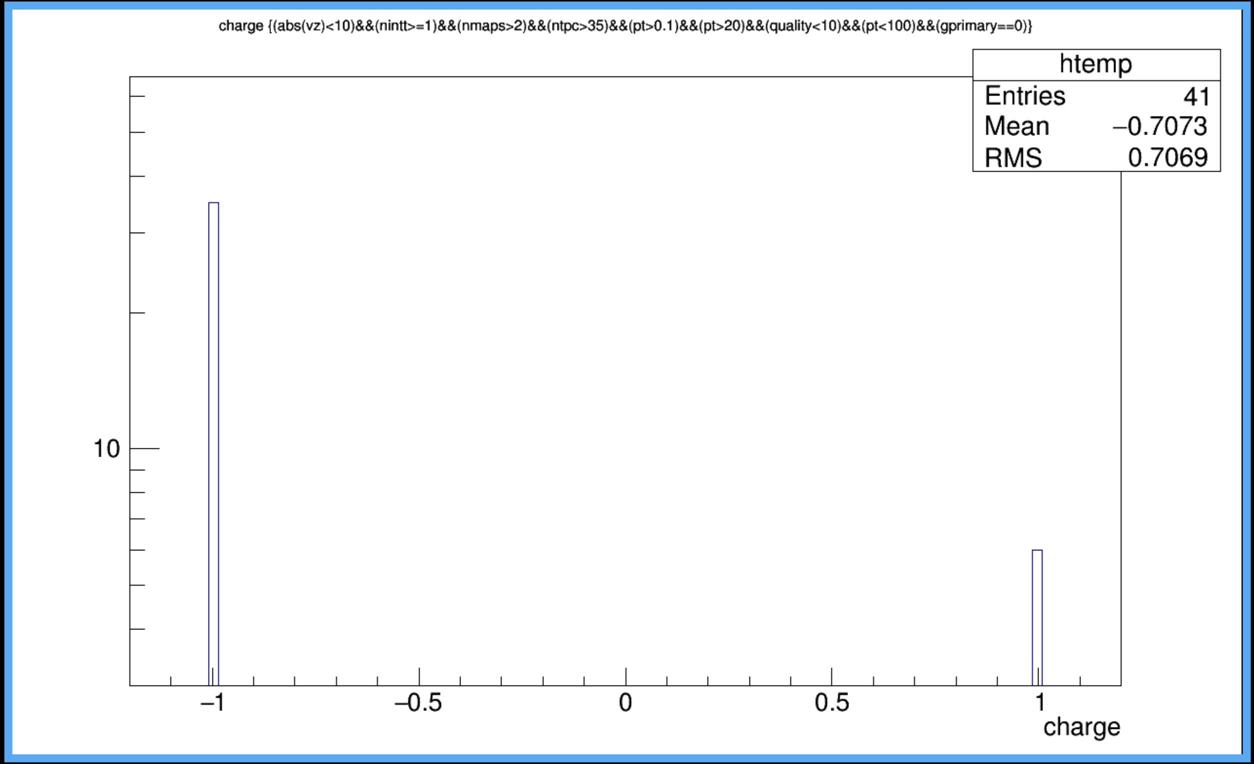


Down

> 20 GeV/c Tracks | charge

100 20 – 40 GeV/c π^- per event



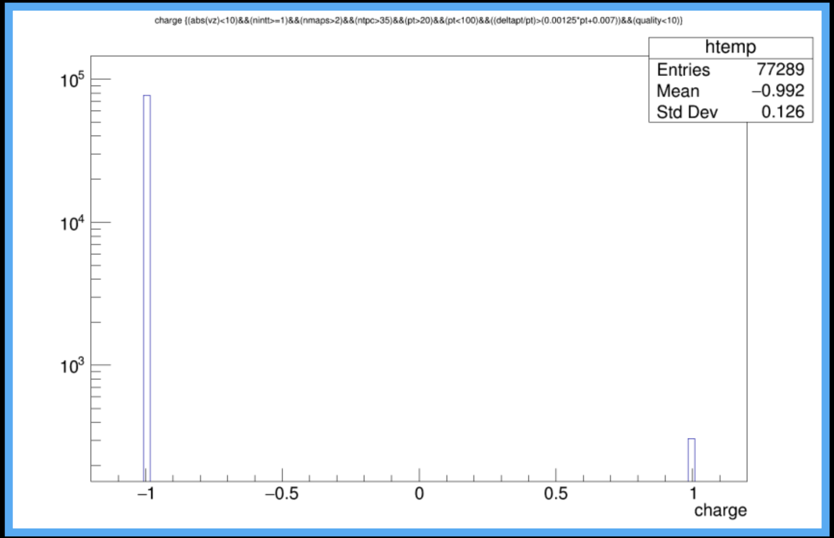


Primaries (gprimary = 1)

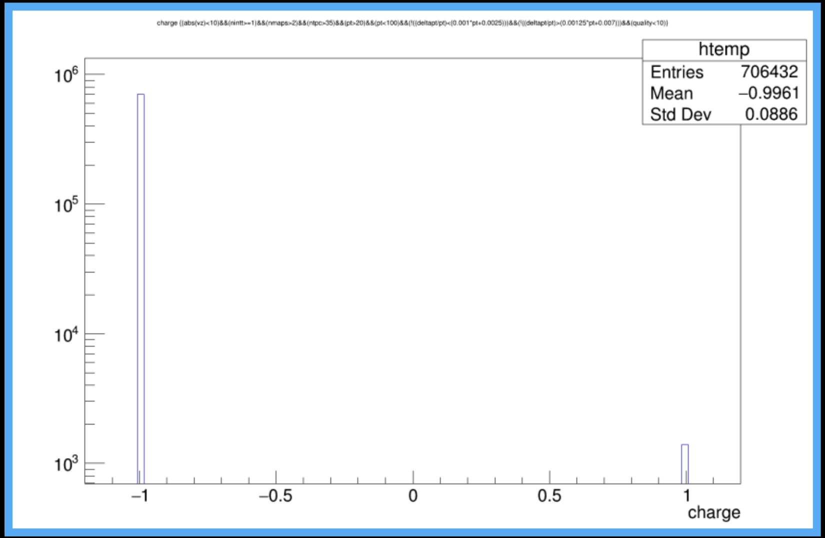
Secondaries (gprimary = 0)

> 20 GeV/c Tracks | charge

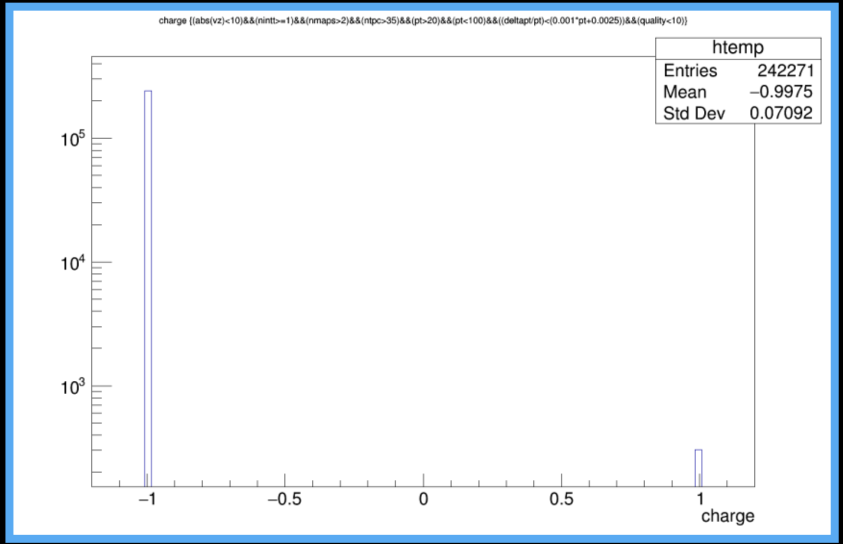
100 20 – 40 GeV/c π^- per event



Up



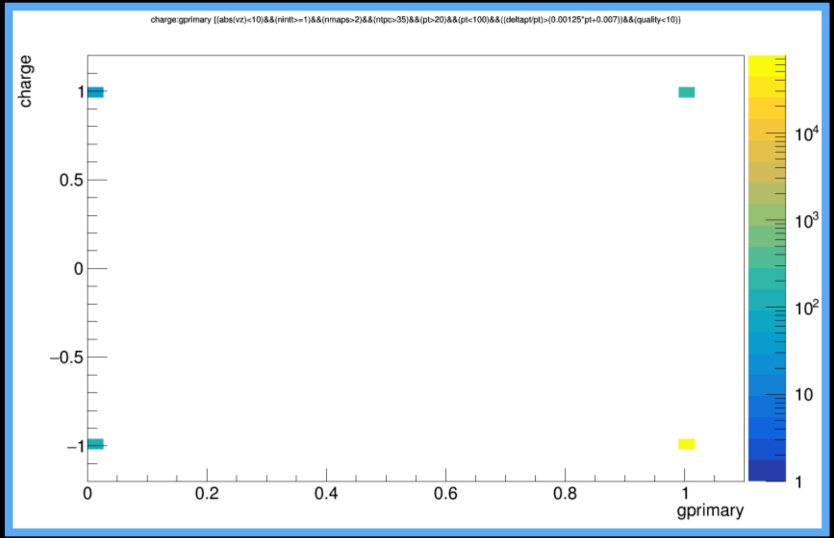
Center



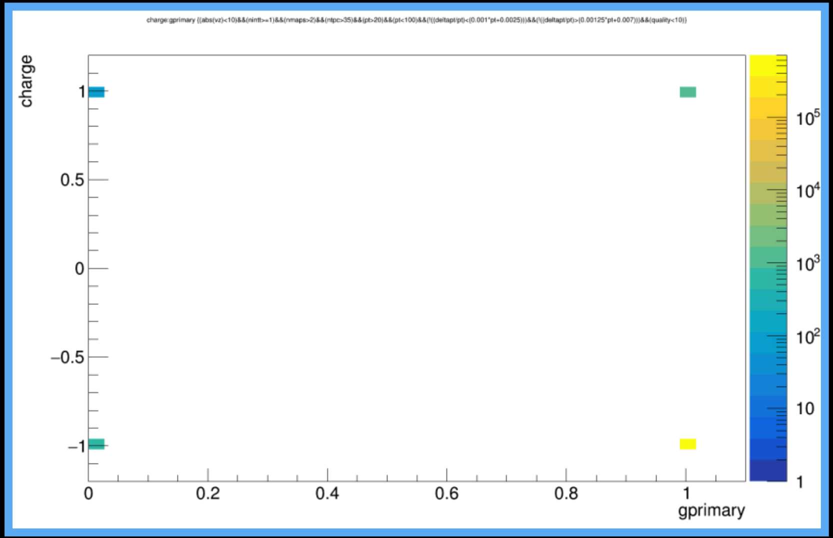
Down

> 20 GeV/c Tracks | charge vs. gprimary

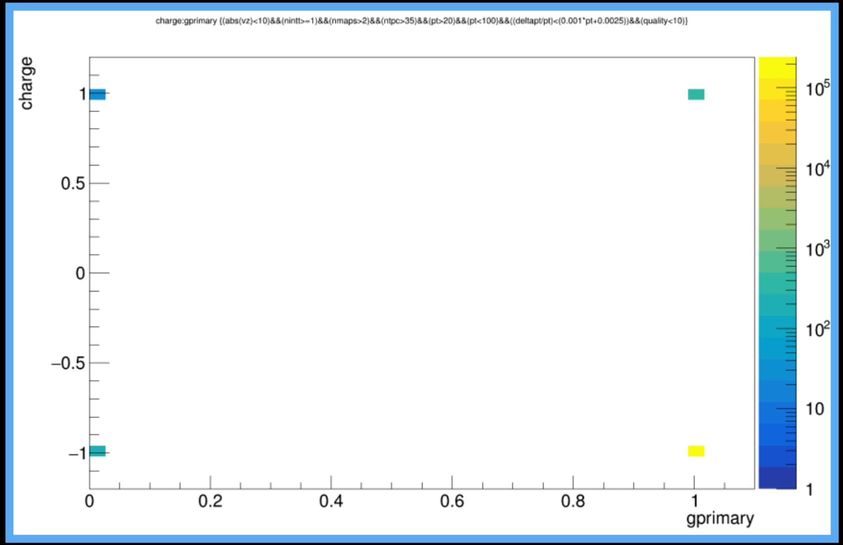
100 20 – 40 GeV/c π^- per event



Up



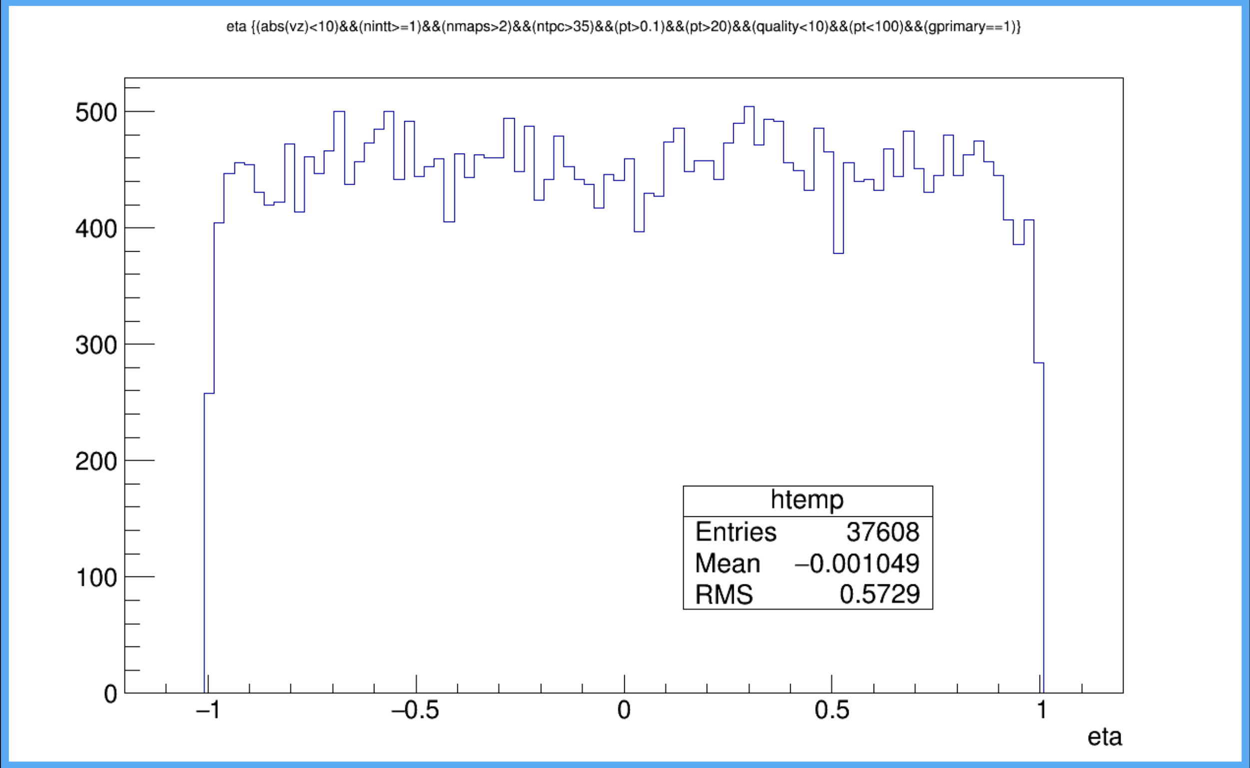
Center



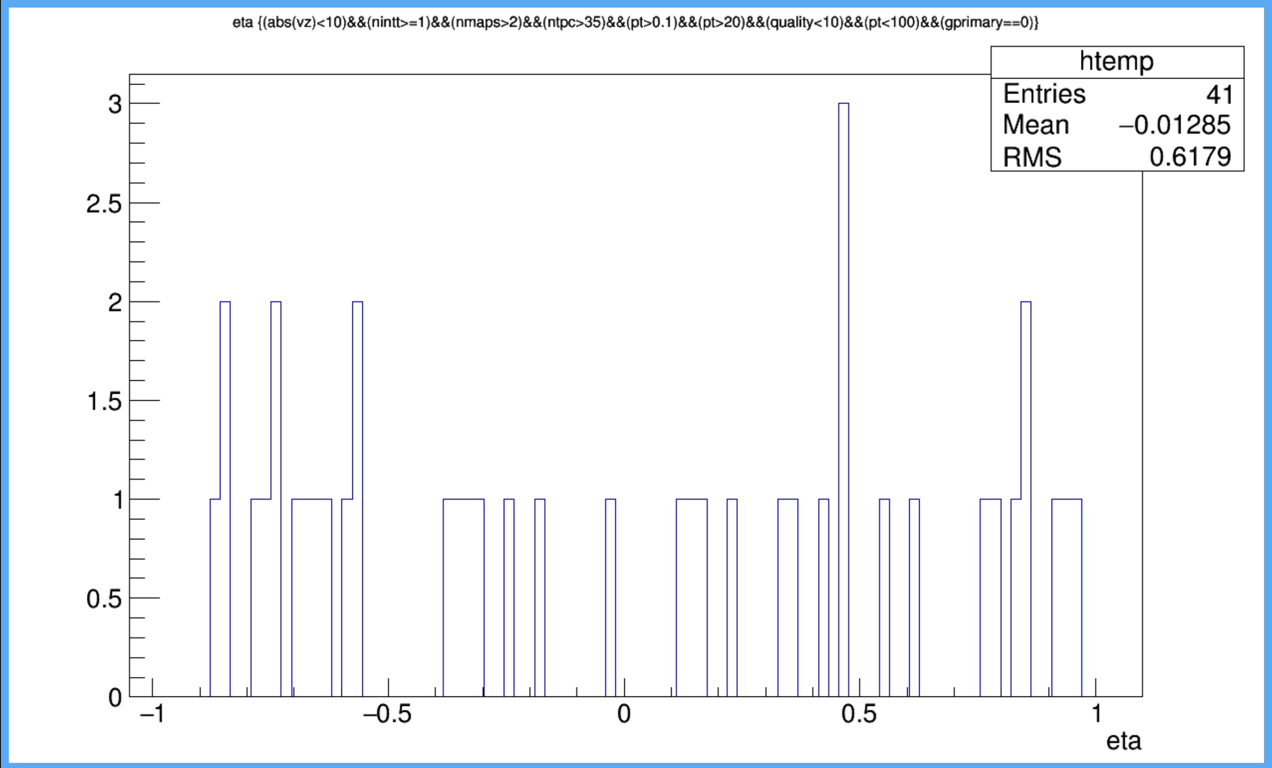
Down

> 20 GeV/c Tracks | eta

100 20 – 40 GeV/c π^- per event



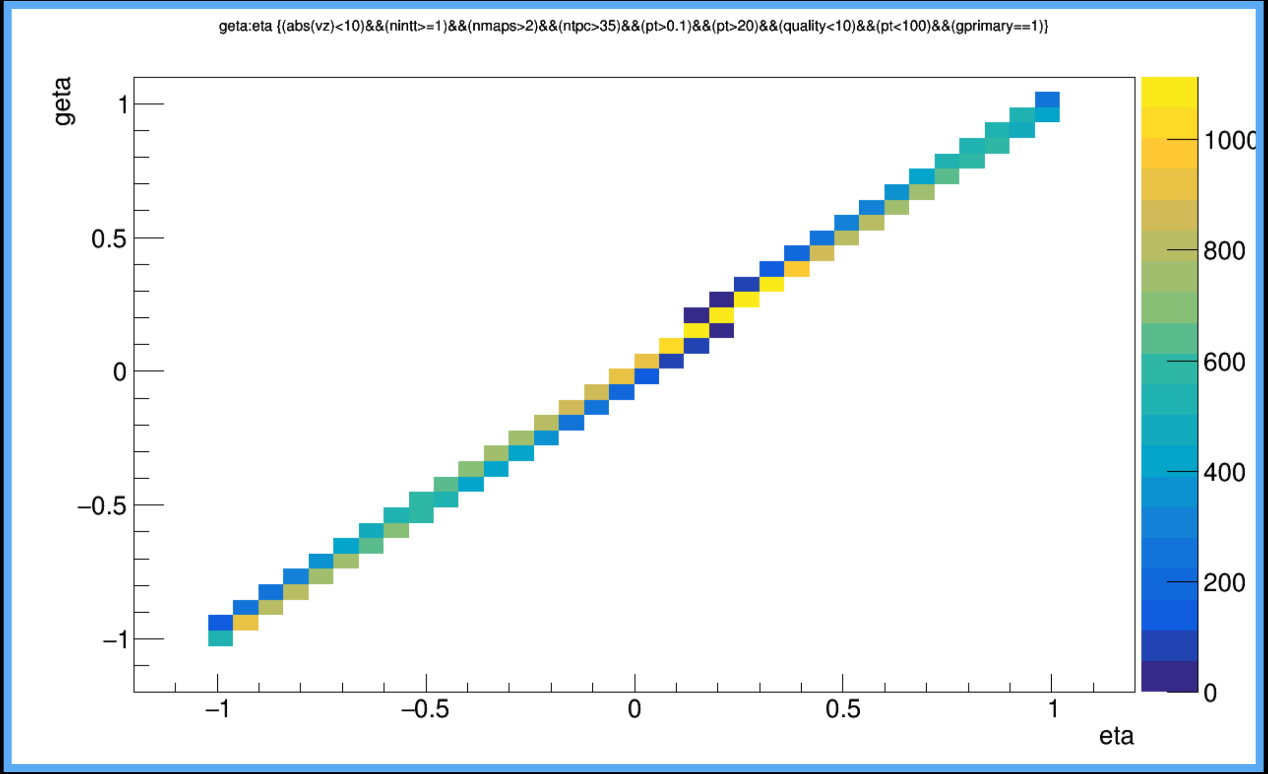
Primaries (gprimary = 1)

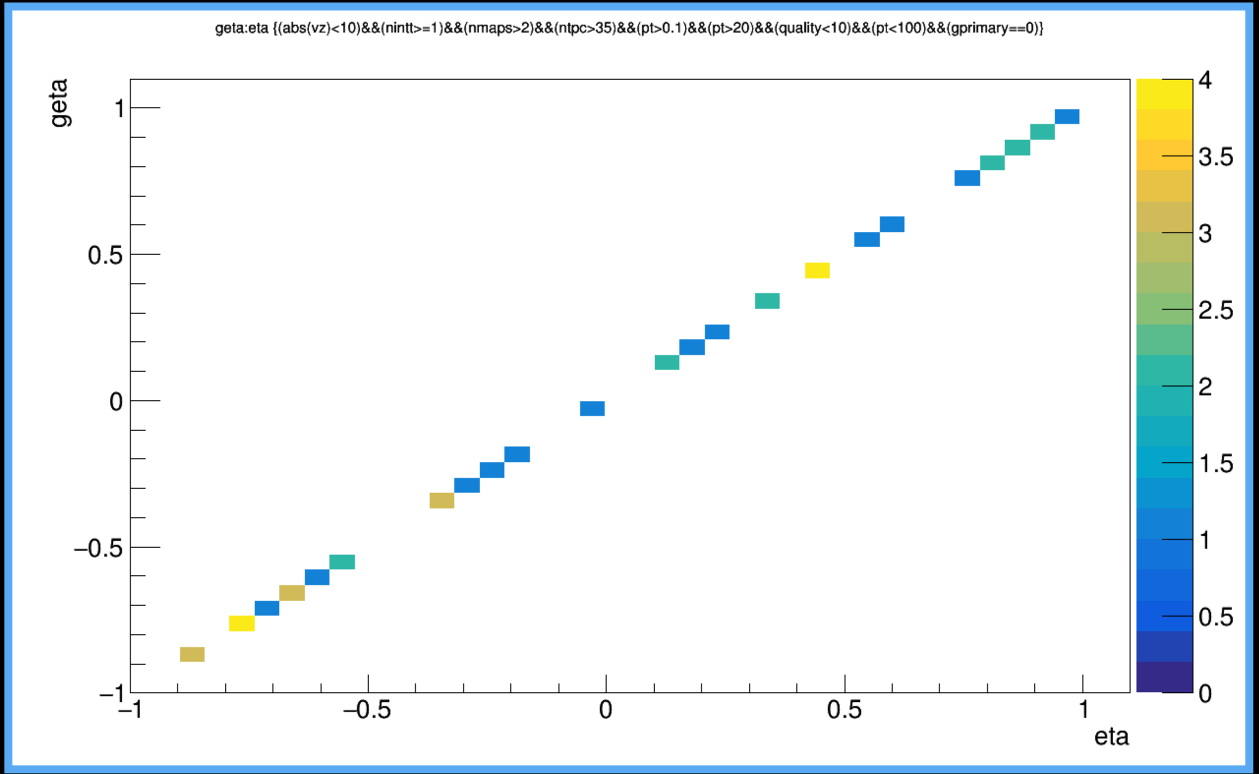


Secondaries (gprimary = 0)

> 20 GeV/c Tracks | geta vs. eta

100 20 – 40 GeV/c
π^- per event



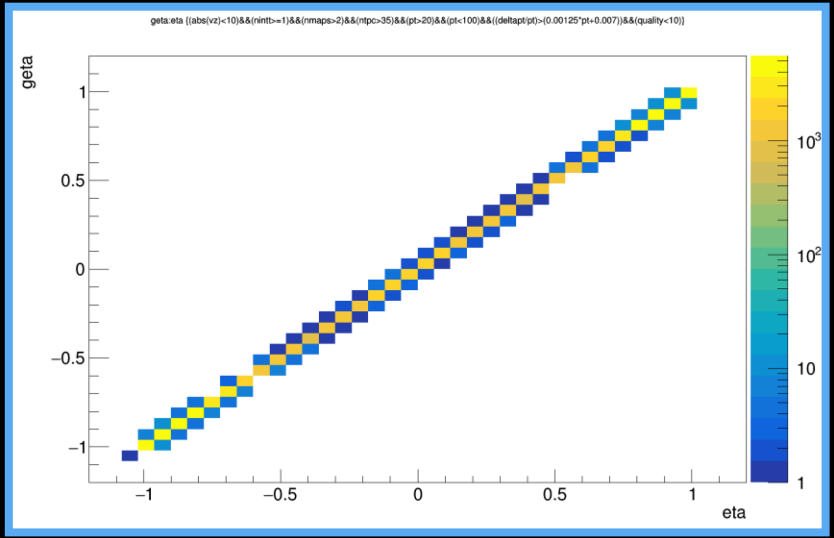


Primaries (gprimary = 1)

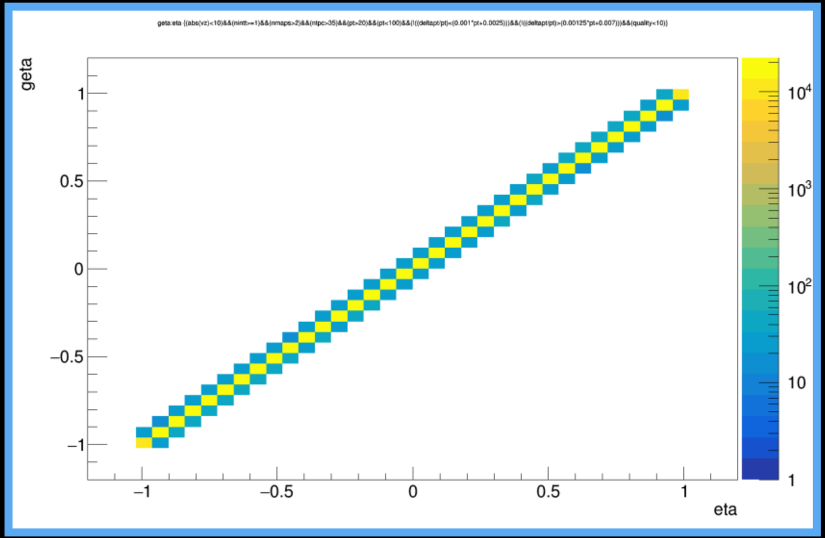
Secondaries (gprimary = 0)

> 20 GeV/c Tracks | geta vs. eta

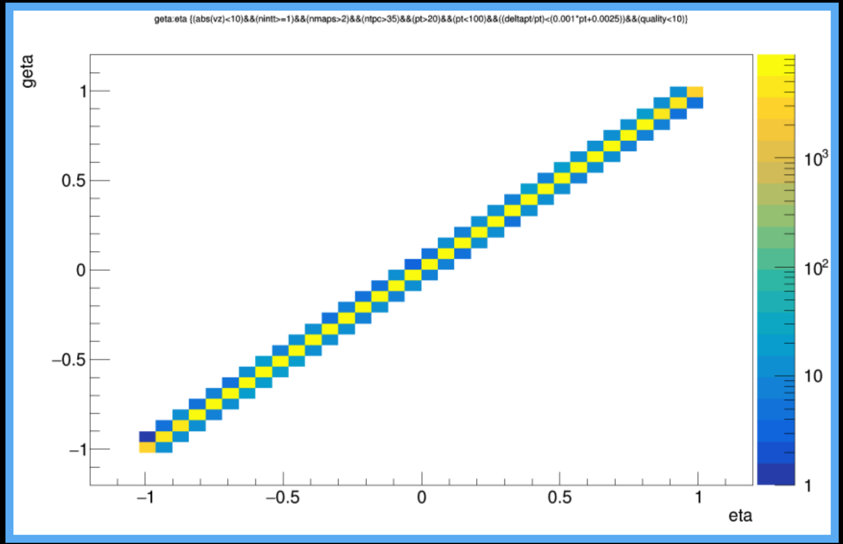
100 20 – 40 GeV/c π^- per event



Up



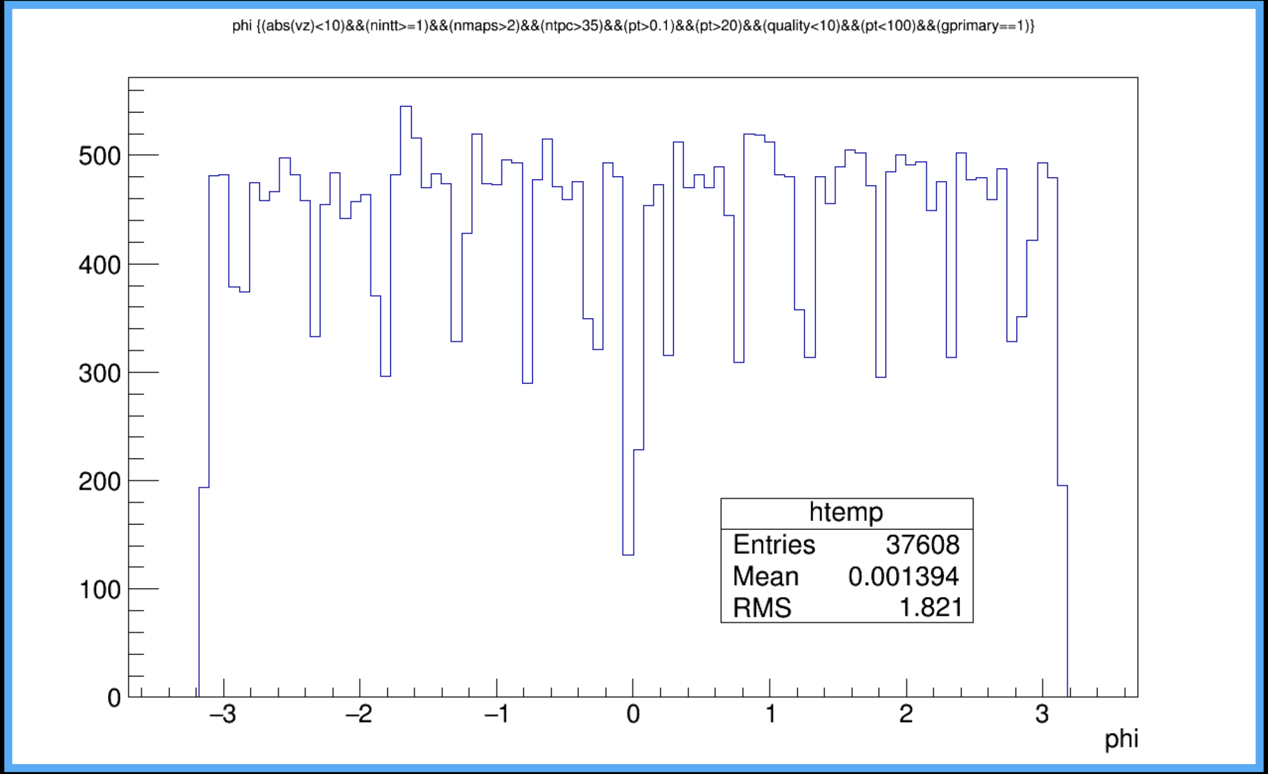
Center

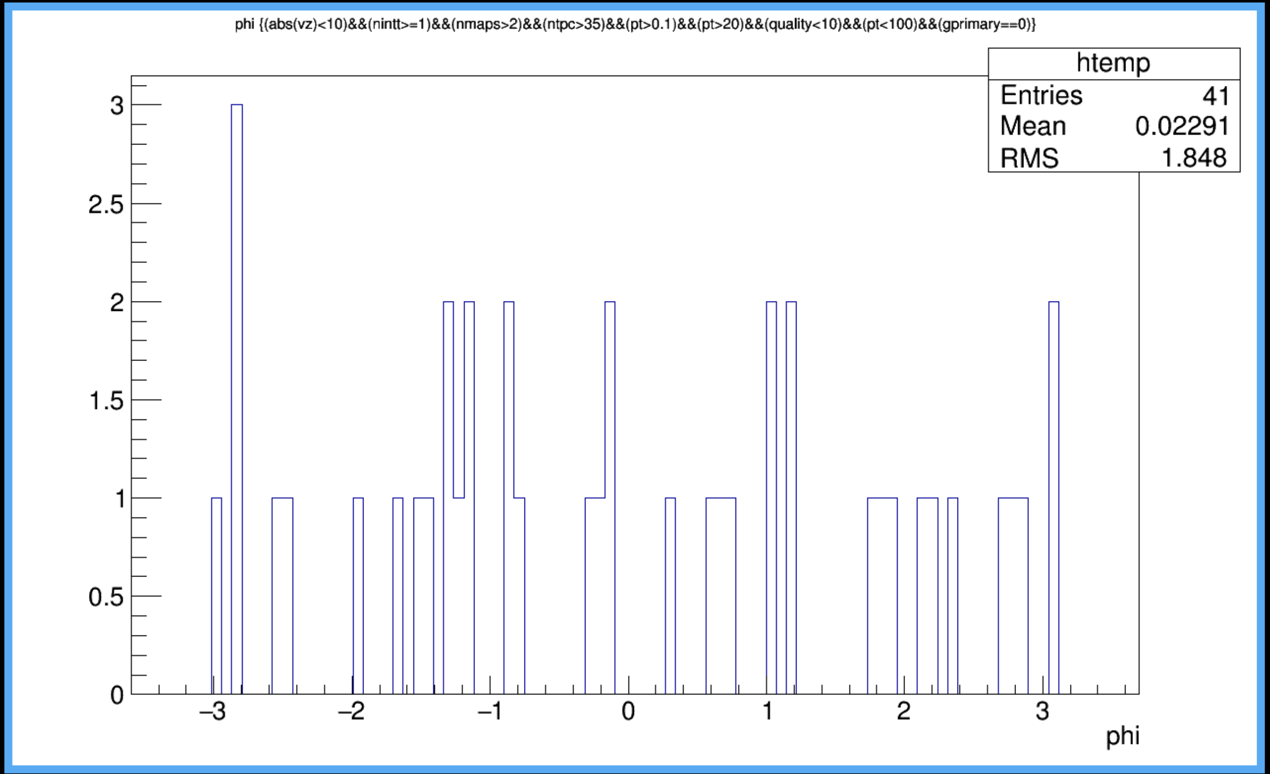


Down

> 20 GeV/c Tracks | phi

100 20 – 40 GeV/c π^- per event



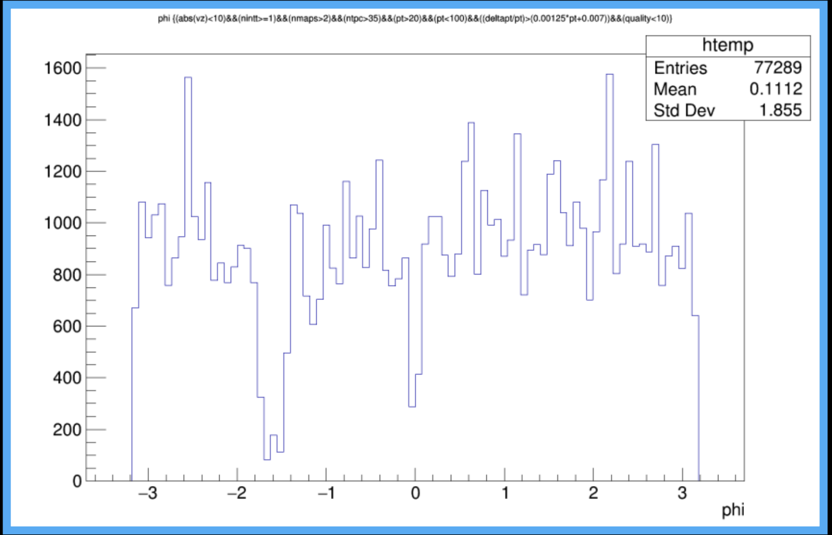


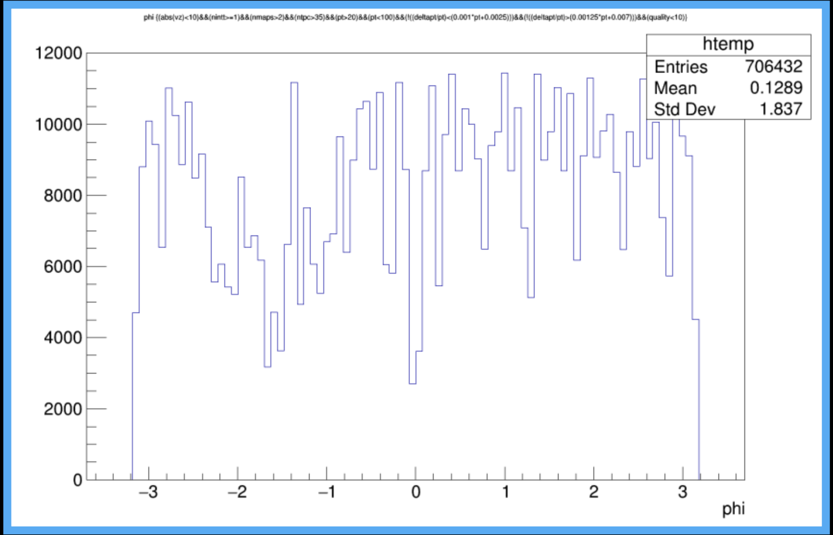
Primaries (gprimary = 1)

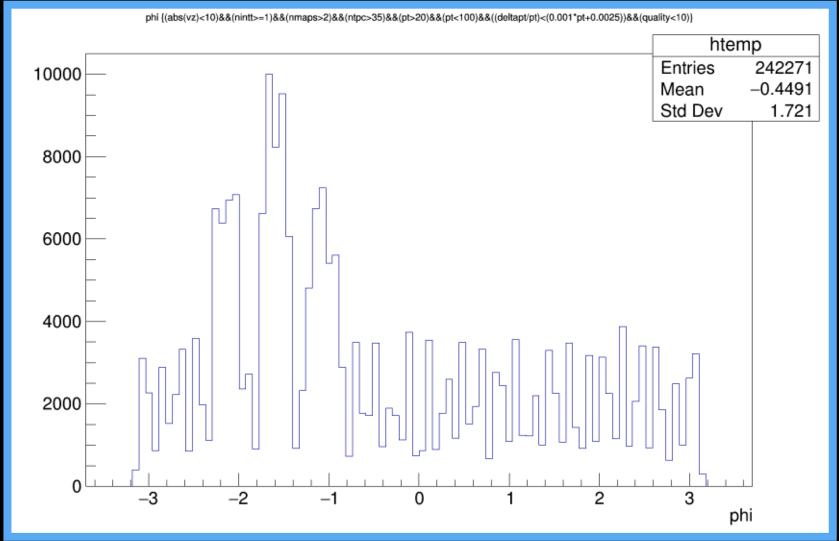
Secondaries (gprimary = 0)

> 20 GeV/c Tracks | phi

100 20 – 40 GeV/c π^- per event







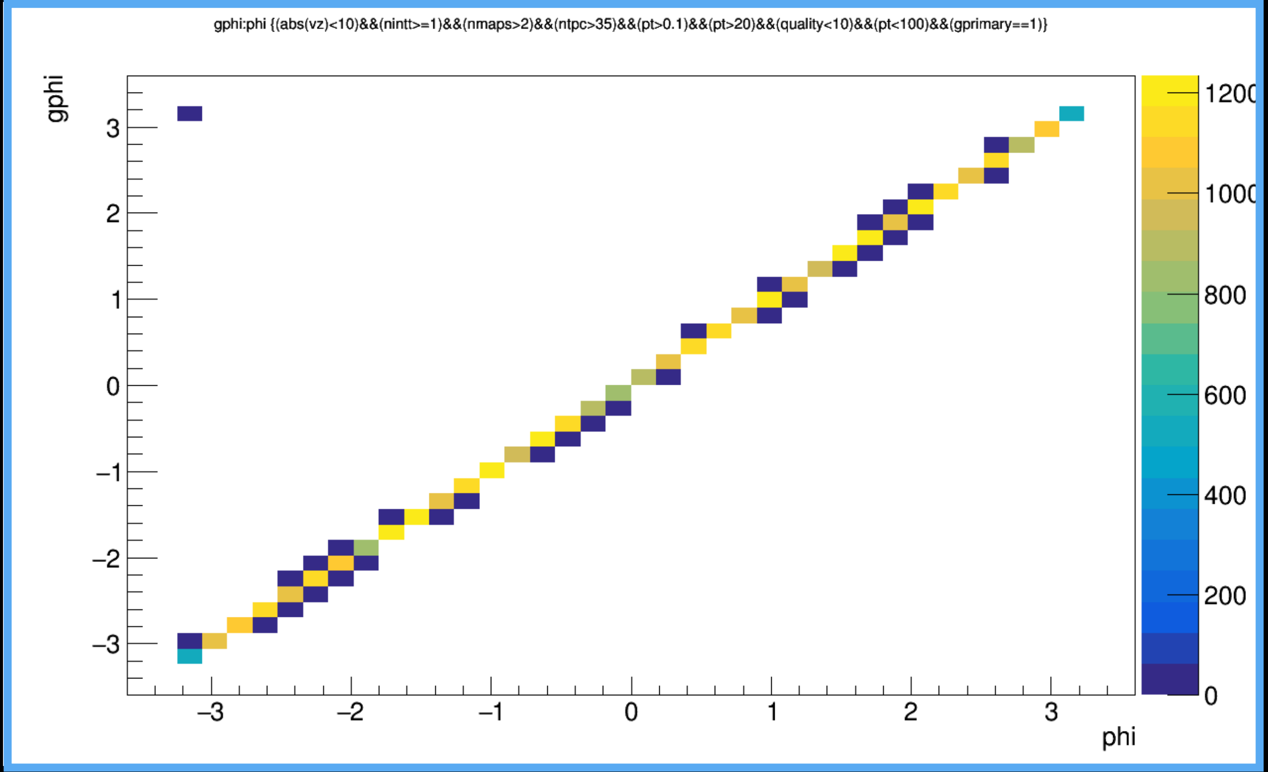
Up

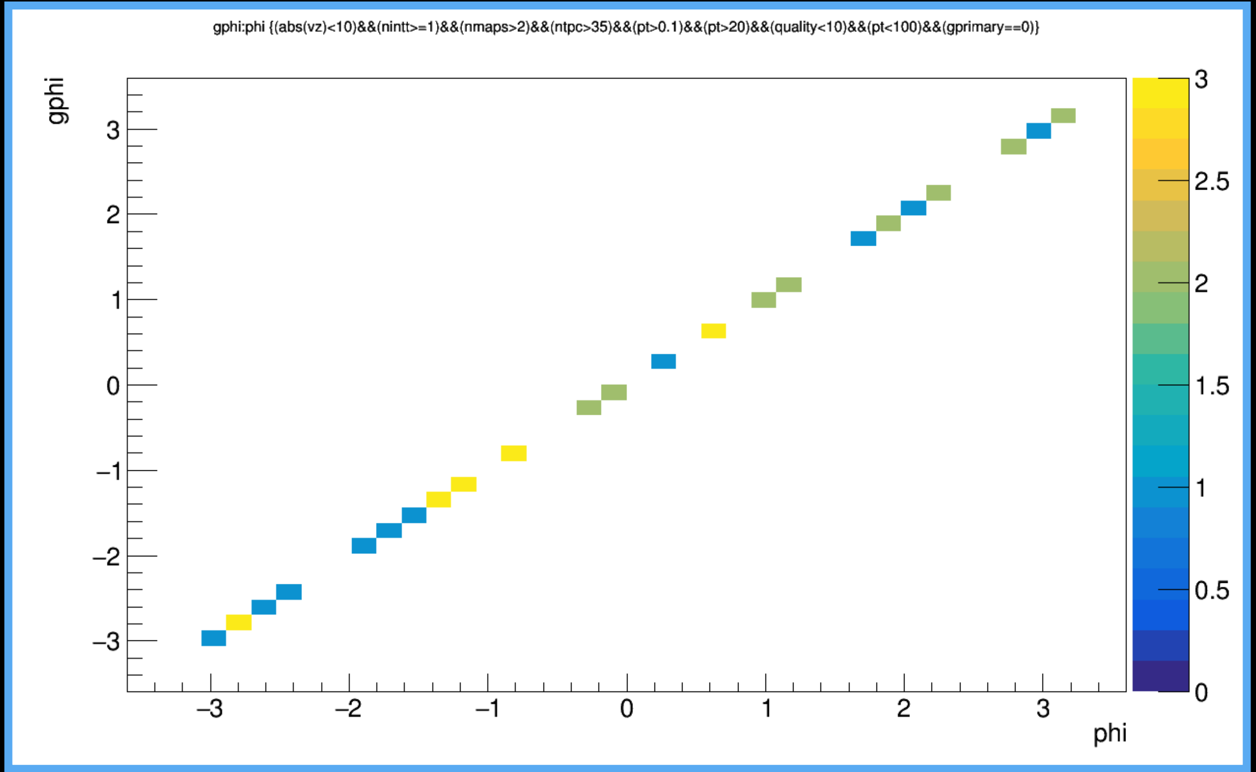
Center

Down

> 20 GeV/c Tracks | gphi vs. phi

100 20 – 40 GeV/c
π^- per event



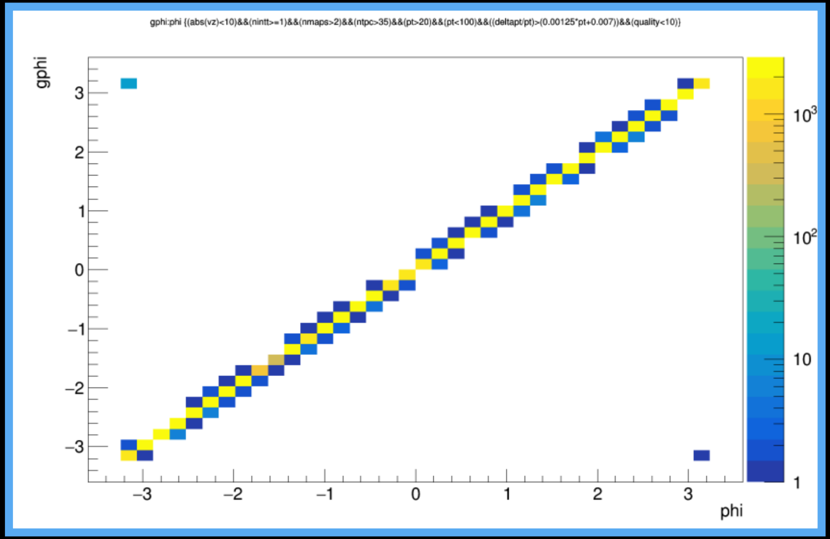


Primaries (gprimary = 1)

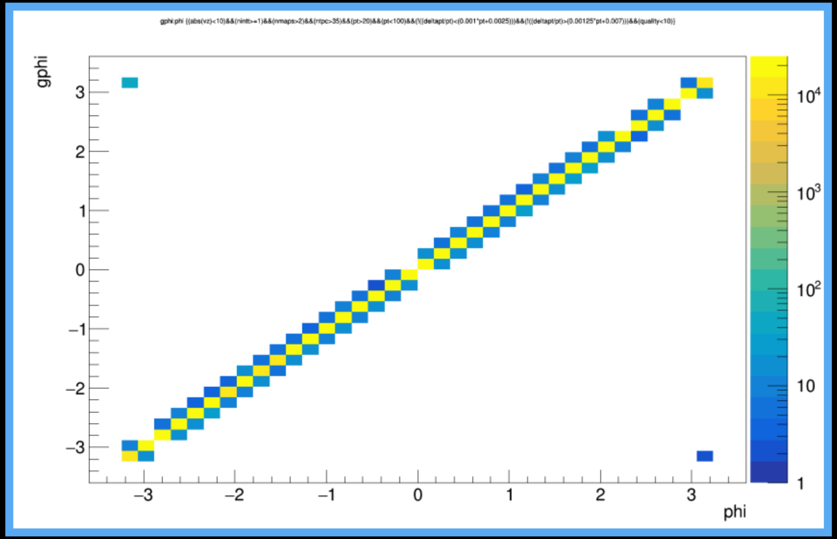
Secondaries (gprimary = 0)

> 20 GeV/c Tracks | gphi vs. phi

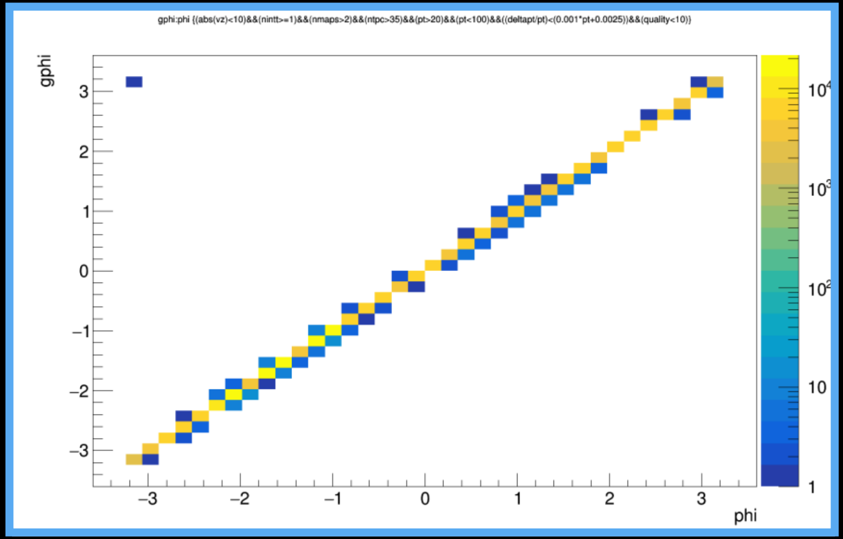
100 20 – 40 GeV/c π^- per event



Up



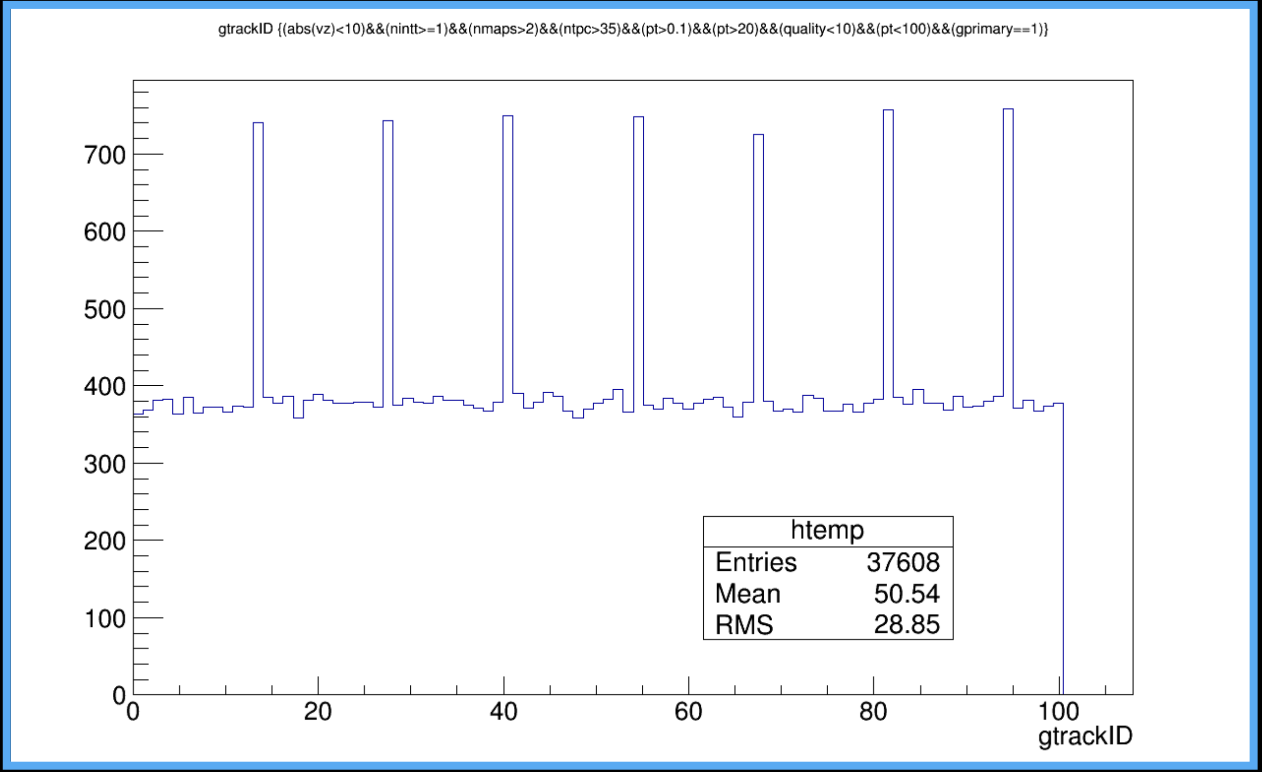
Center

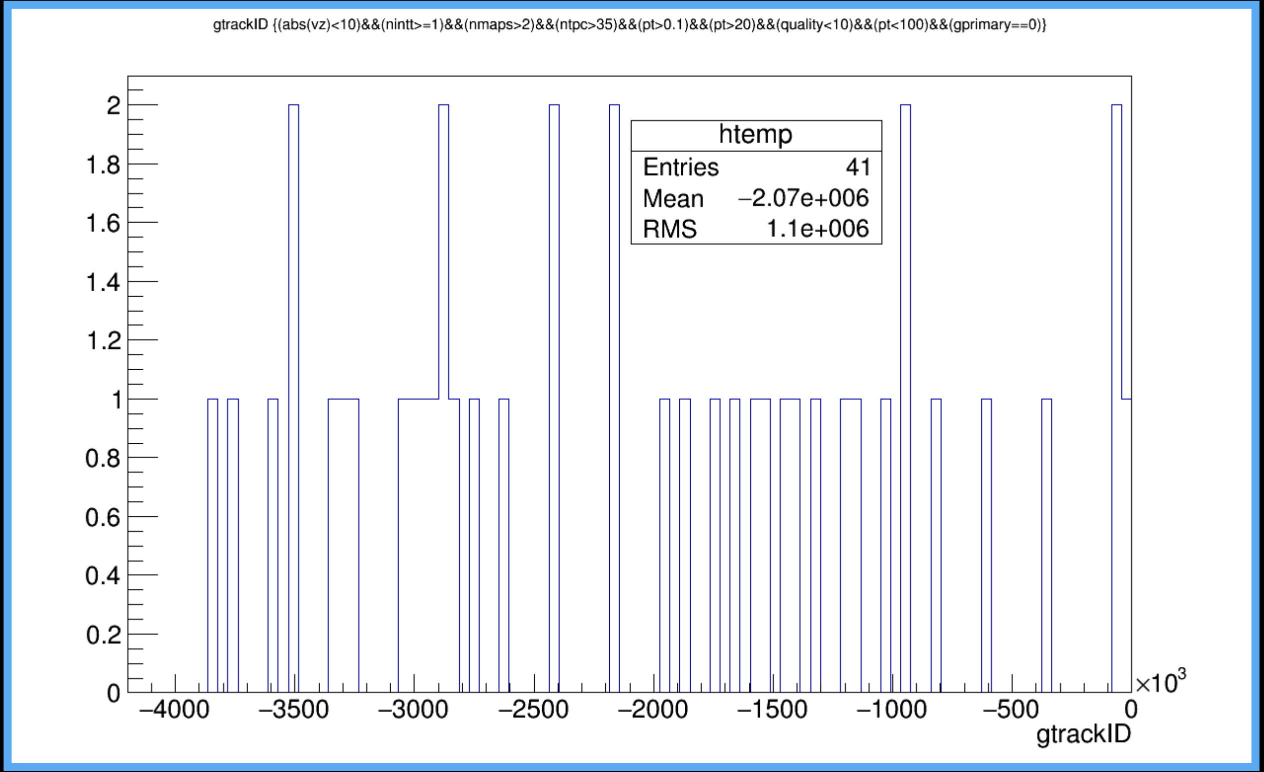


Down

> 20 GeV/c Tracks | gtrackid

100 20 – 40 GeV/c
π^- per event



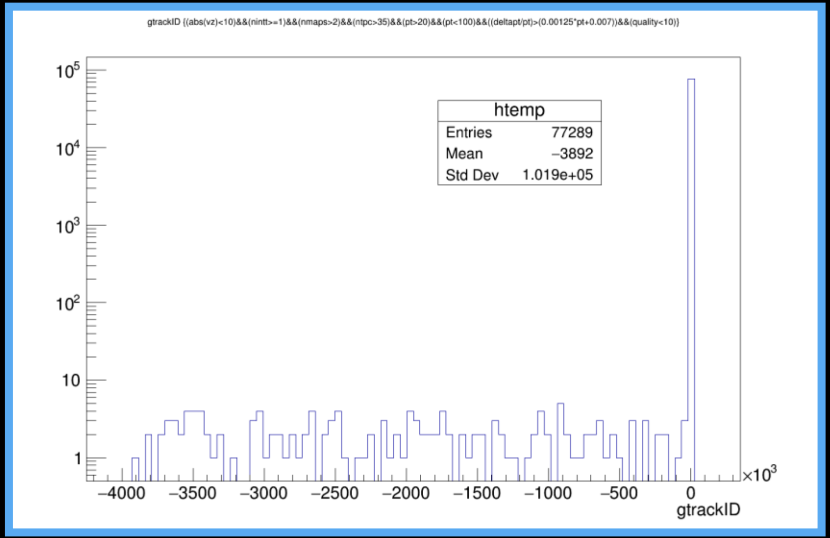


Primaries (gprimary = 1)

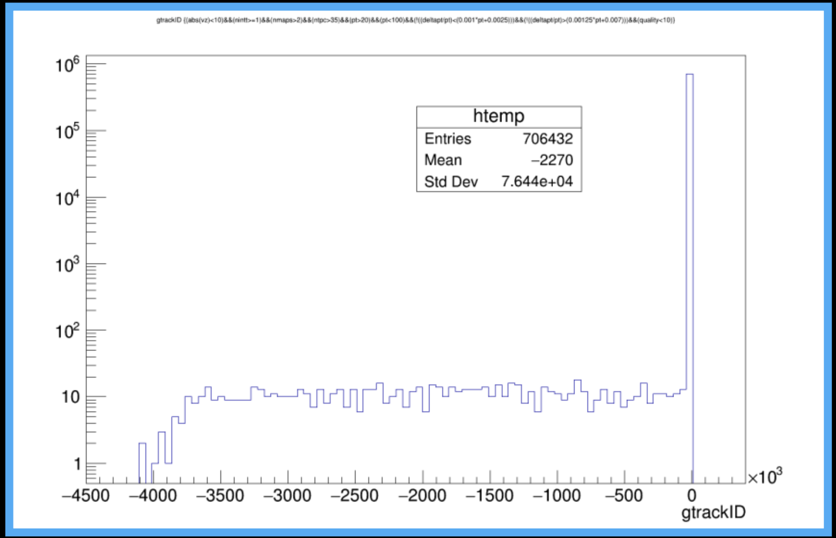
Secondaries (gprimary = 0)

> 20 GeV/c Tracks | gtrackid

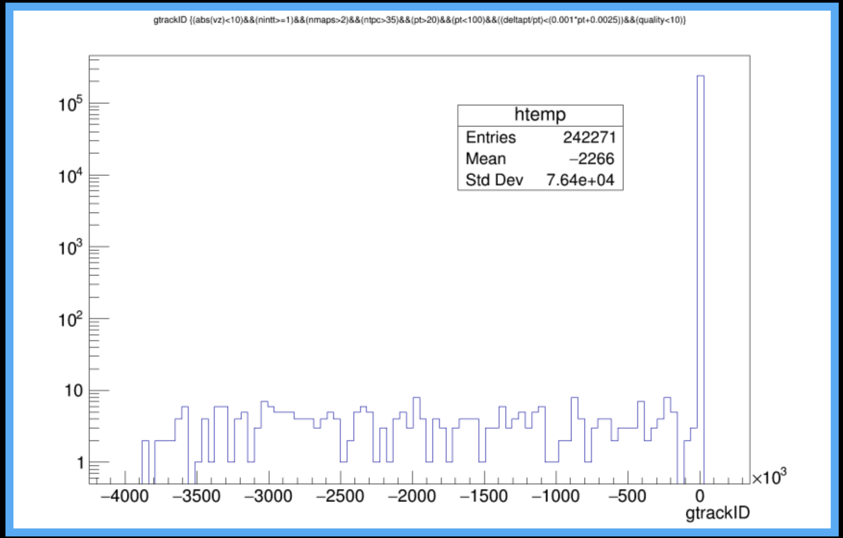
100 20 – 40 GeV/c π^- per event



Up

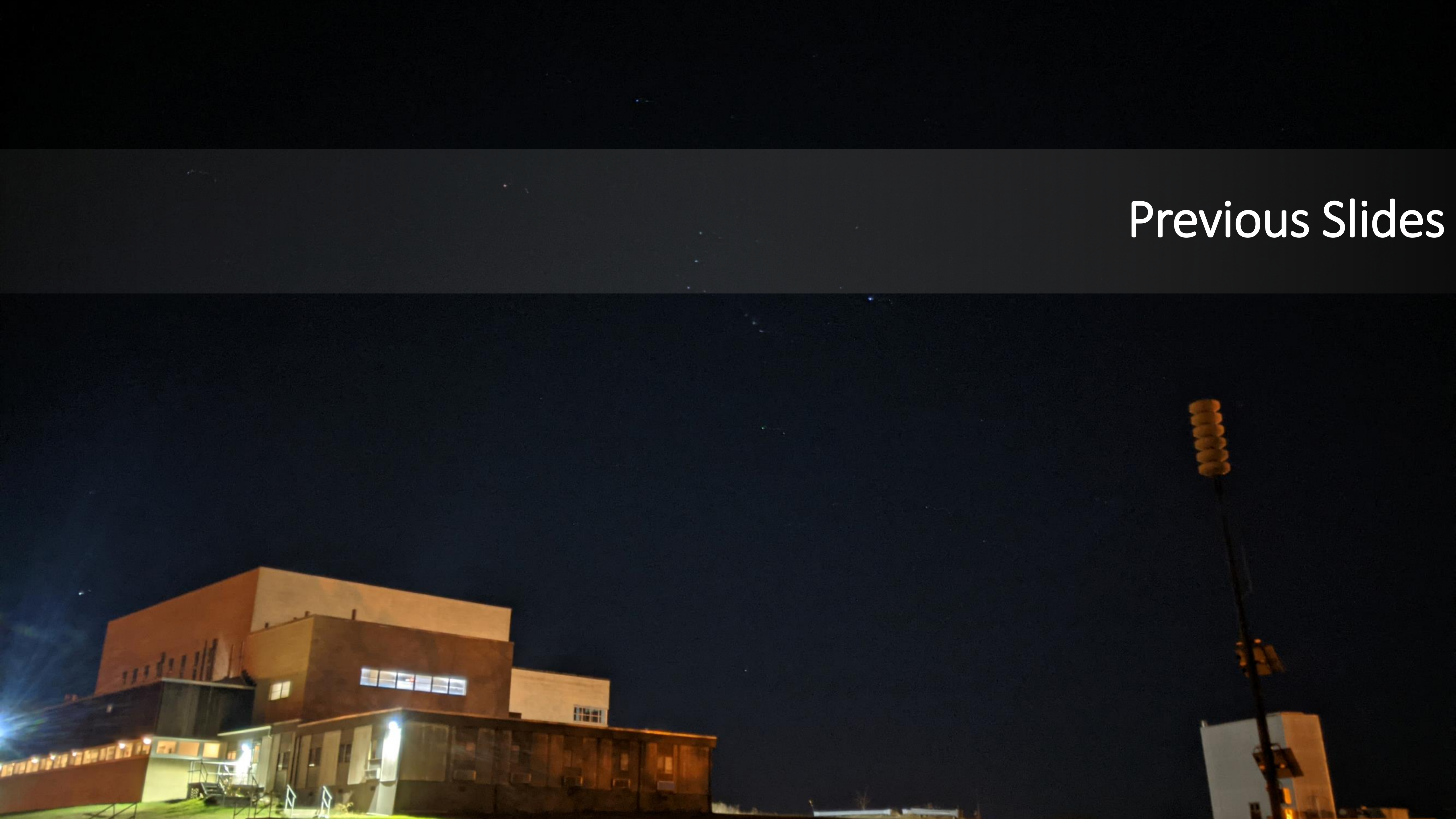


Center



Down

Previous Slides



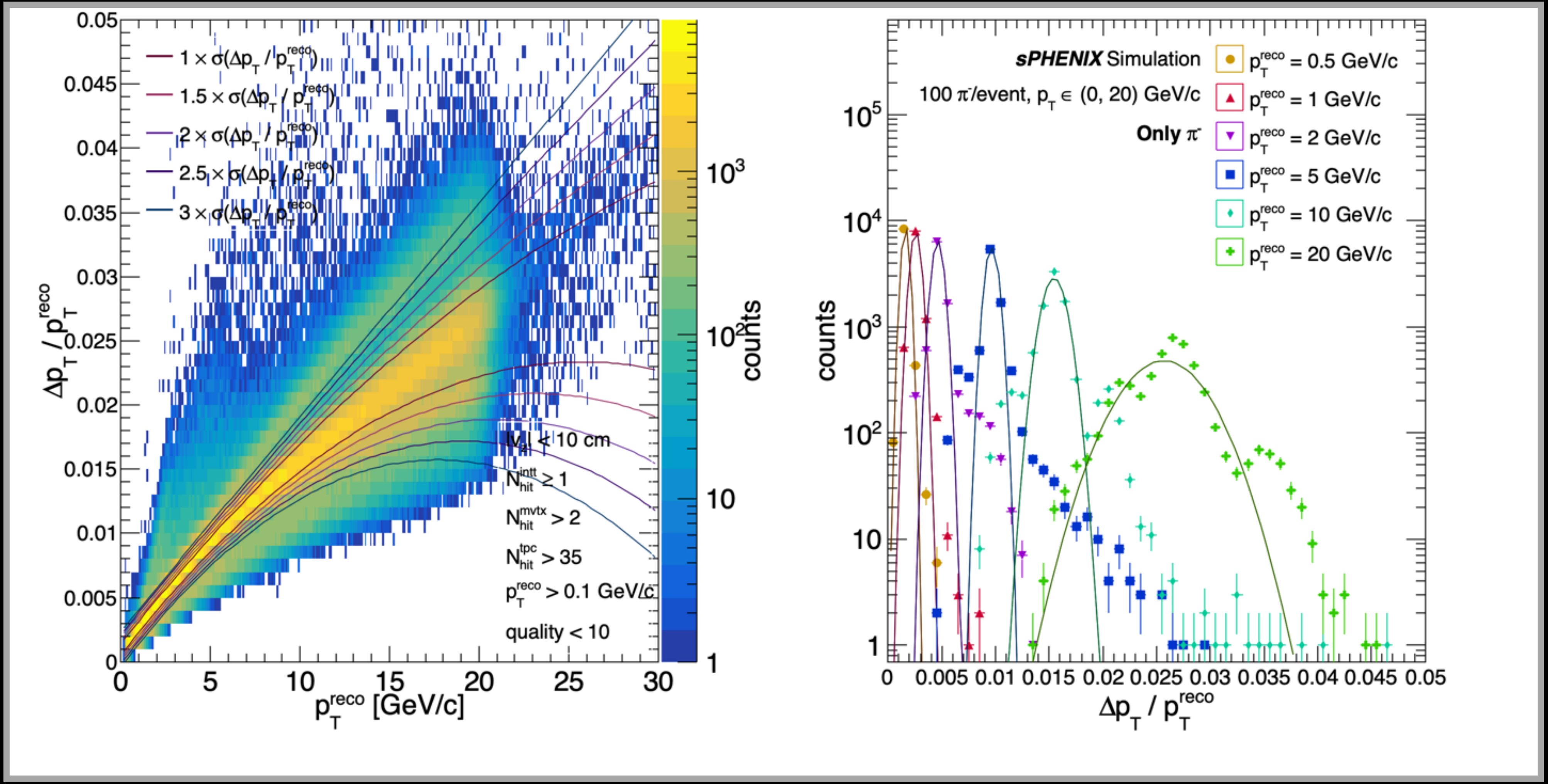
Performance Cut Strawman

1) $|v_z| < 10$ cm
2) $N_{hits}^{intt} \geq 1$
3) $N_{hits}^{mvtx} > 2$
4) $N_{hits}^{tpc} > 35$ (24?)
5) $p_T^{reco} > 0.1$ GeV/c
6) $\Delta p_T / p_T^{reco} \in ?$ **
7) $(\sigma(DCA_\star)/DCA_\star < ?)$ *

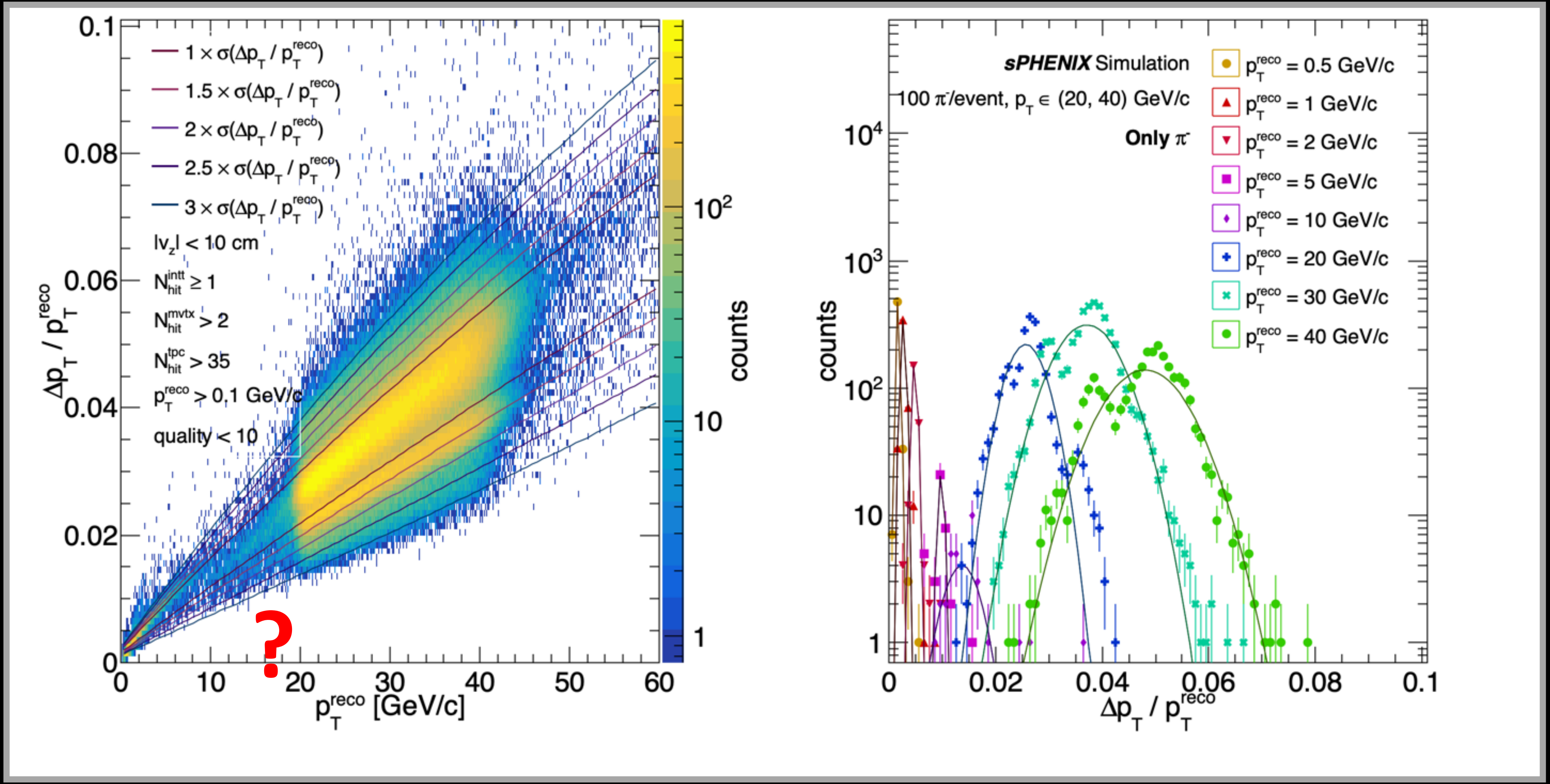
* Need to explore in heavy-ion environments first…

** Looking into now…

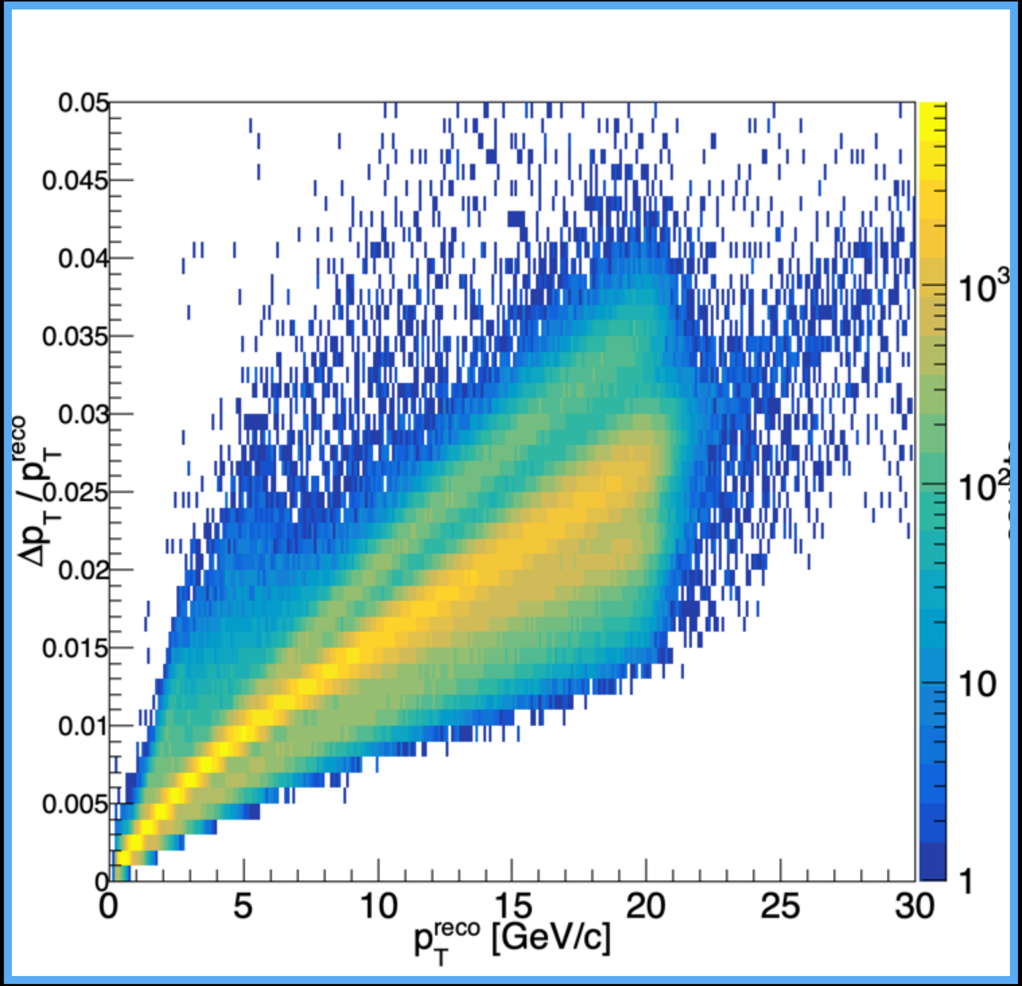
Percent Error over p_T^{reco} | 0 – 20 GeV/c

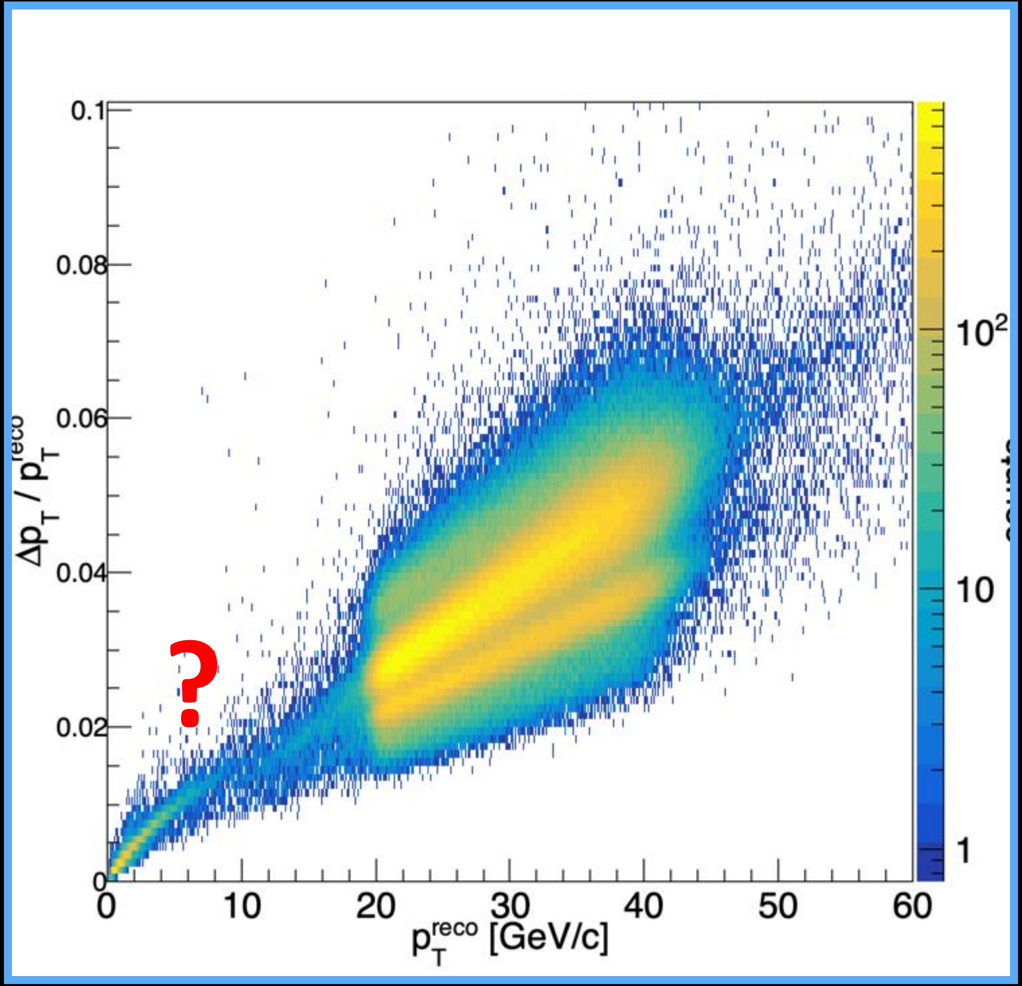


Percent Error over p_T^{reco} | 20 – 40 GeV/c



Percent Error over p_T^{reco} | 0 – 20 vs. 20 – 40 GeV/c

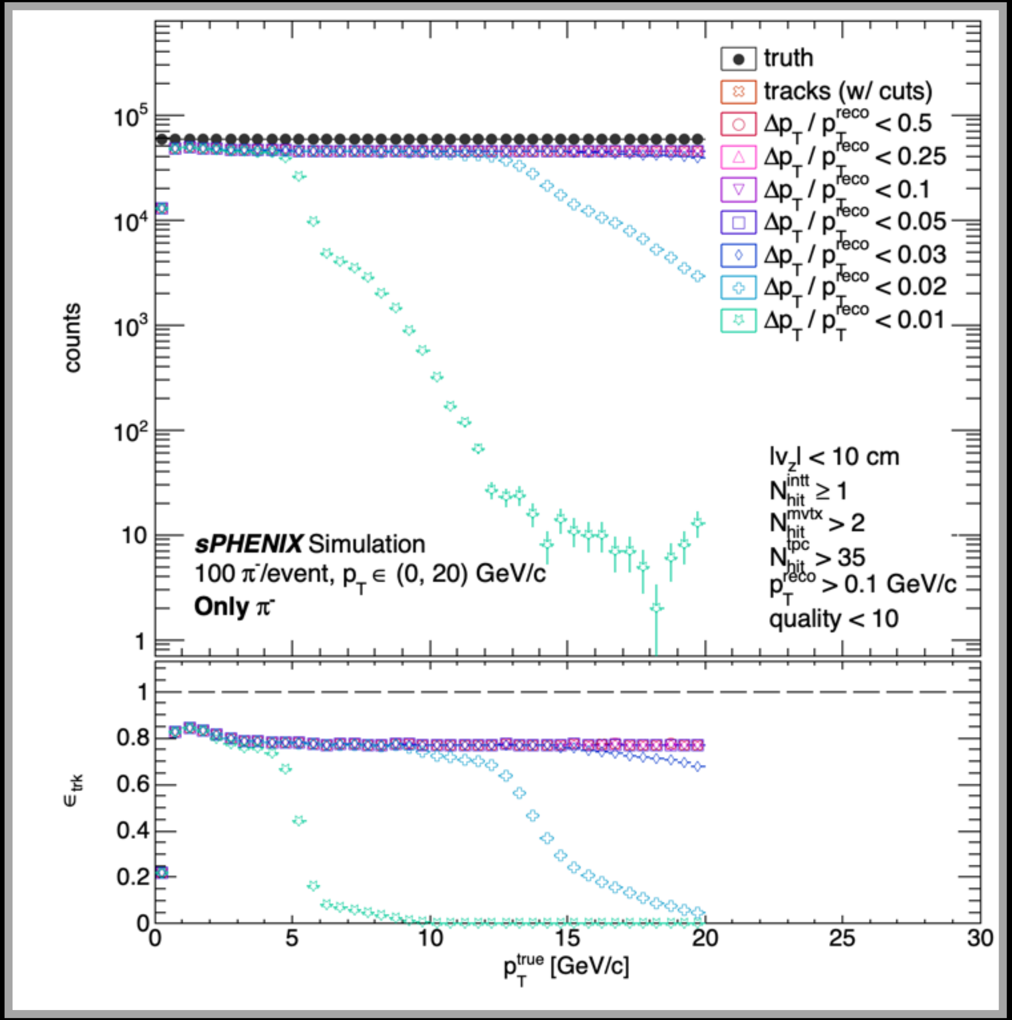




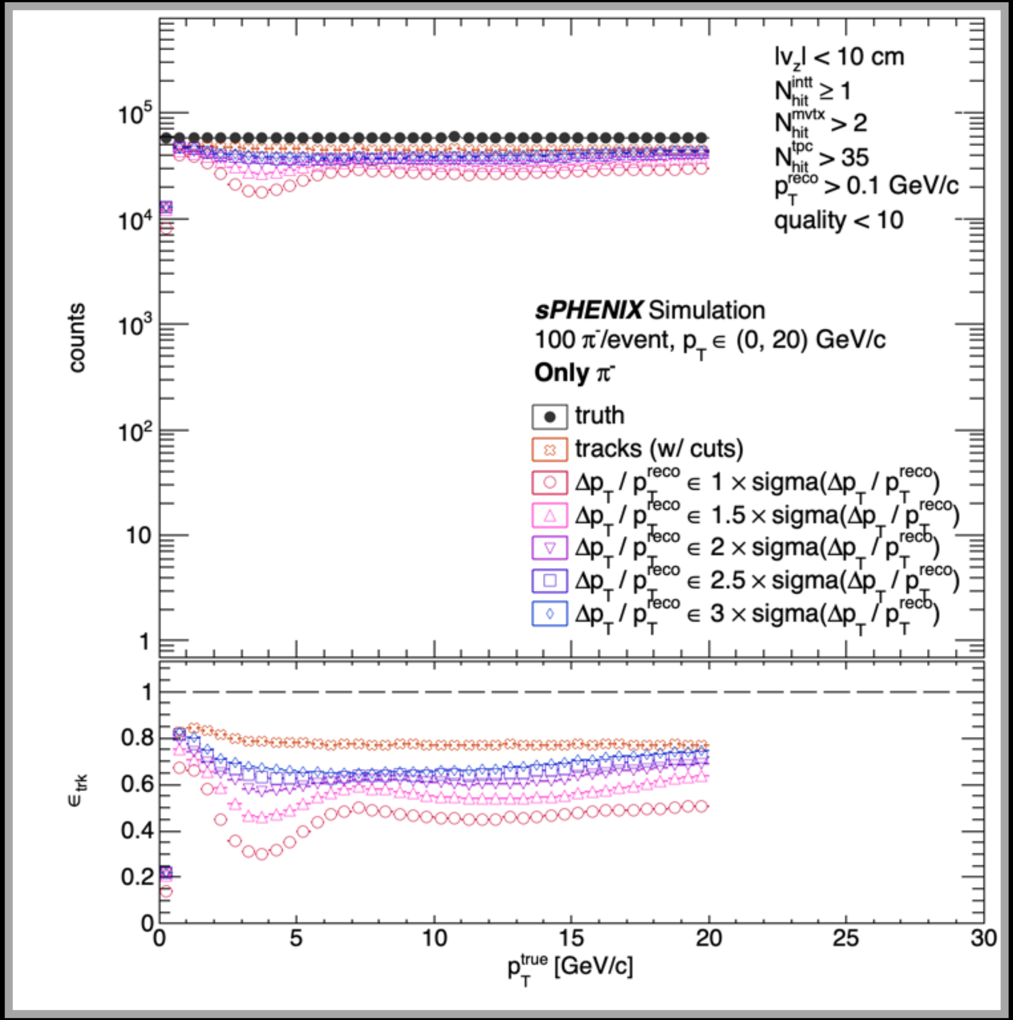
0 – 20 GeV/c

20 – 40 GeV/c

p_T^{reco}-Dependent Cut | efficiencies (0 – 20 GeV/c)

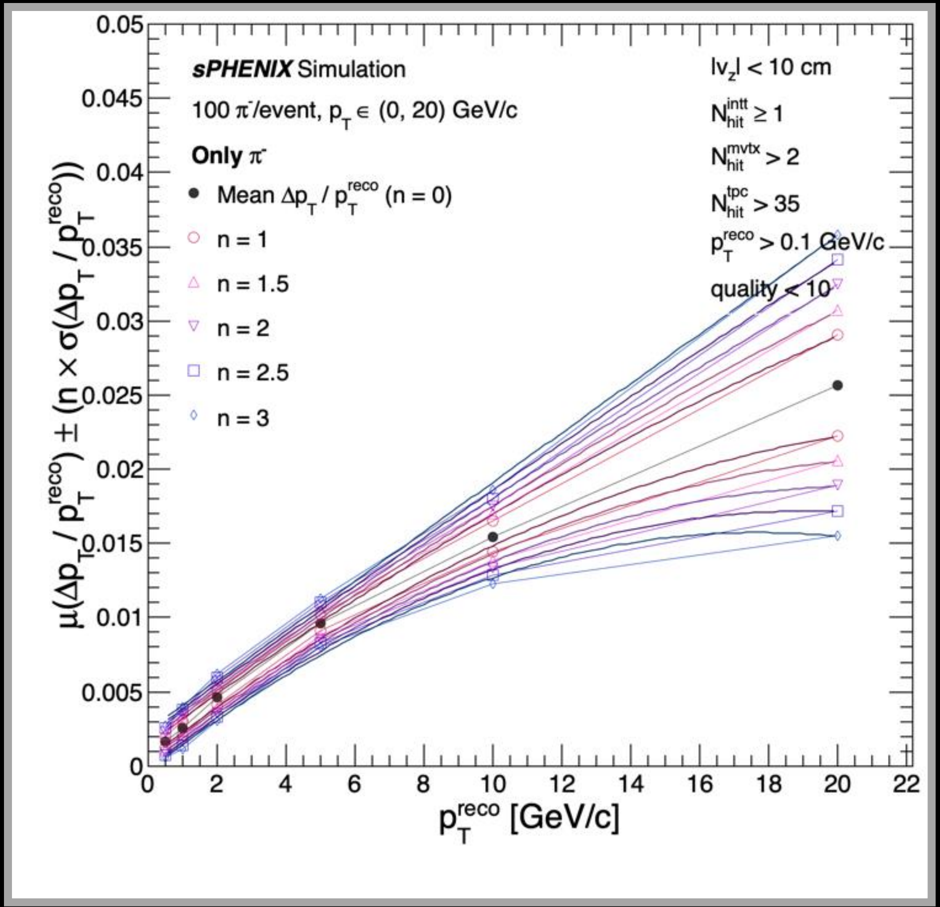


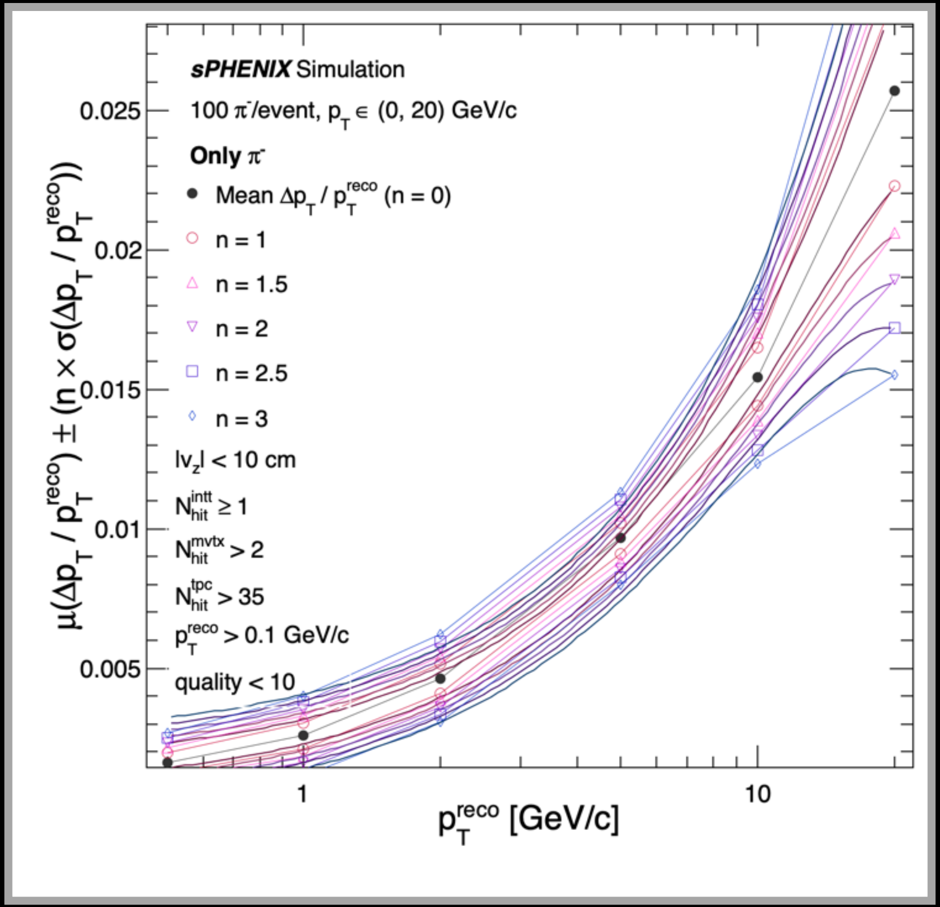
Flat Cuts



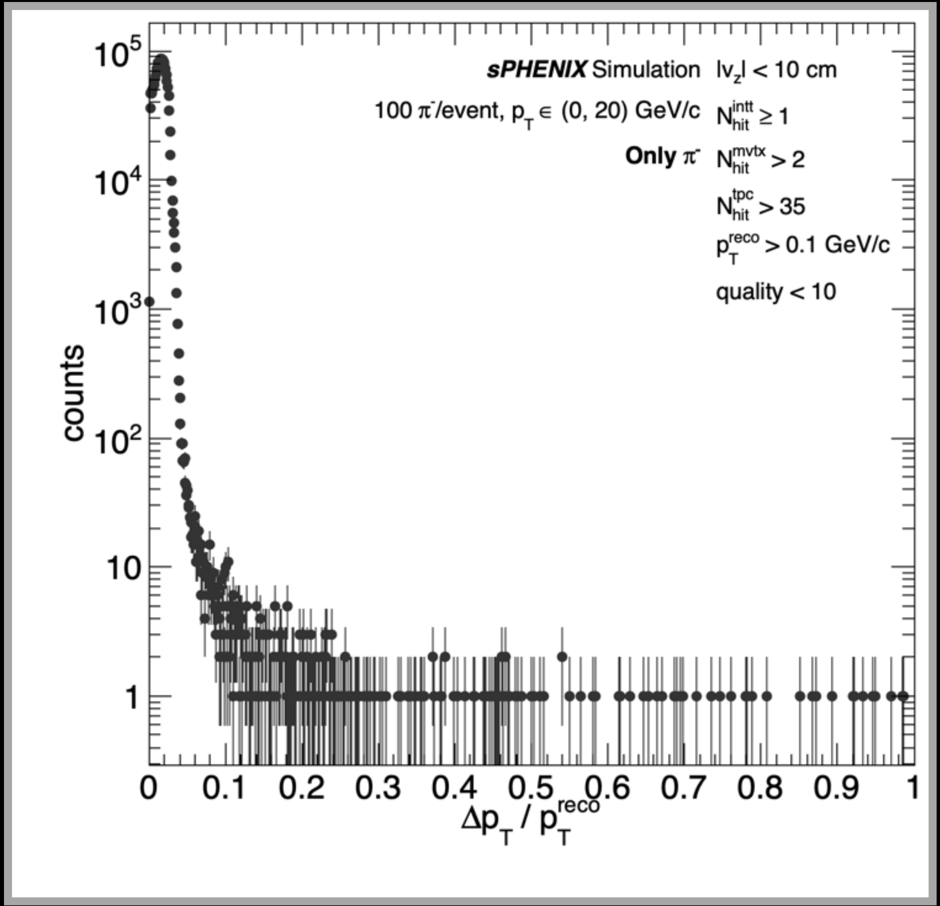
pT-Depdendent Cut

p_T^{reco}-Dependent Cut | extracted $\mu \pm n\sigma$ $(0-20\ \text{GeV/c})$

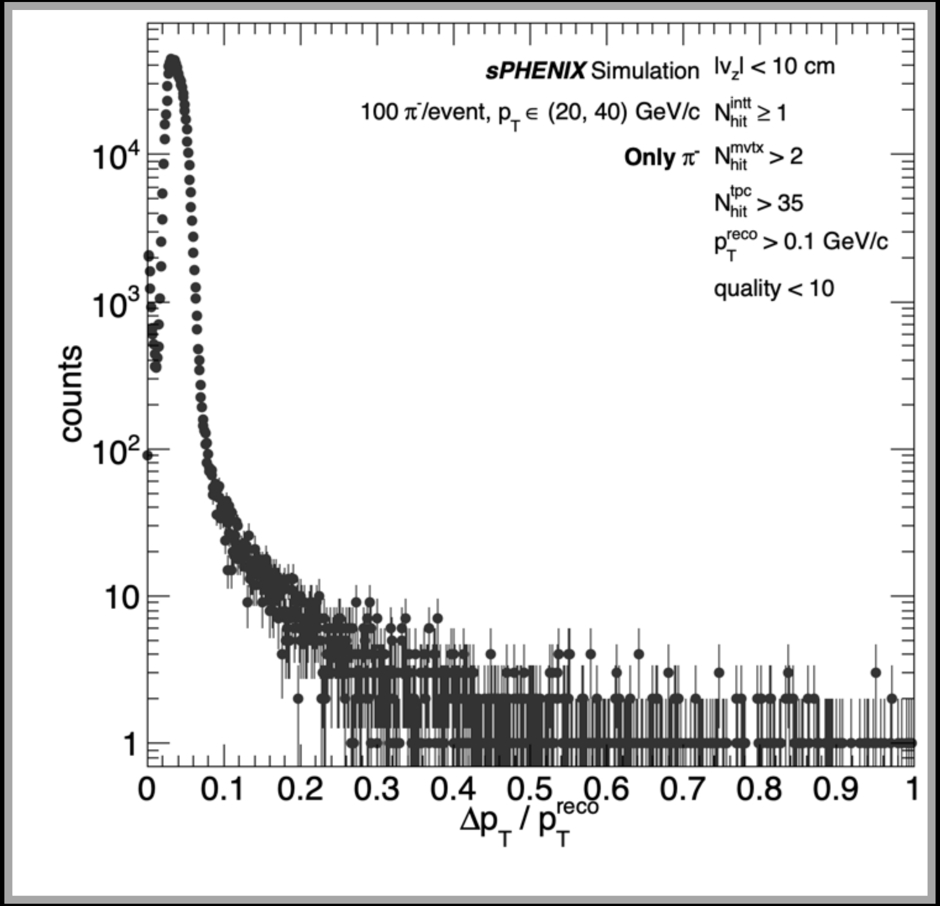




Backup | 1D Percent Error over p_T^{reco}



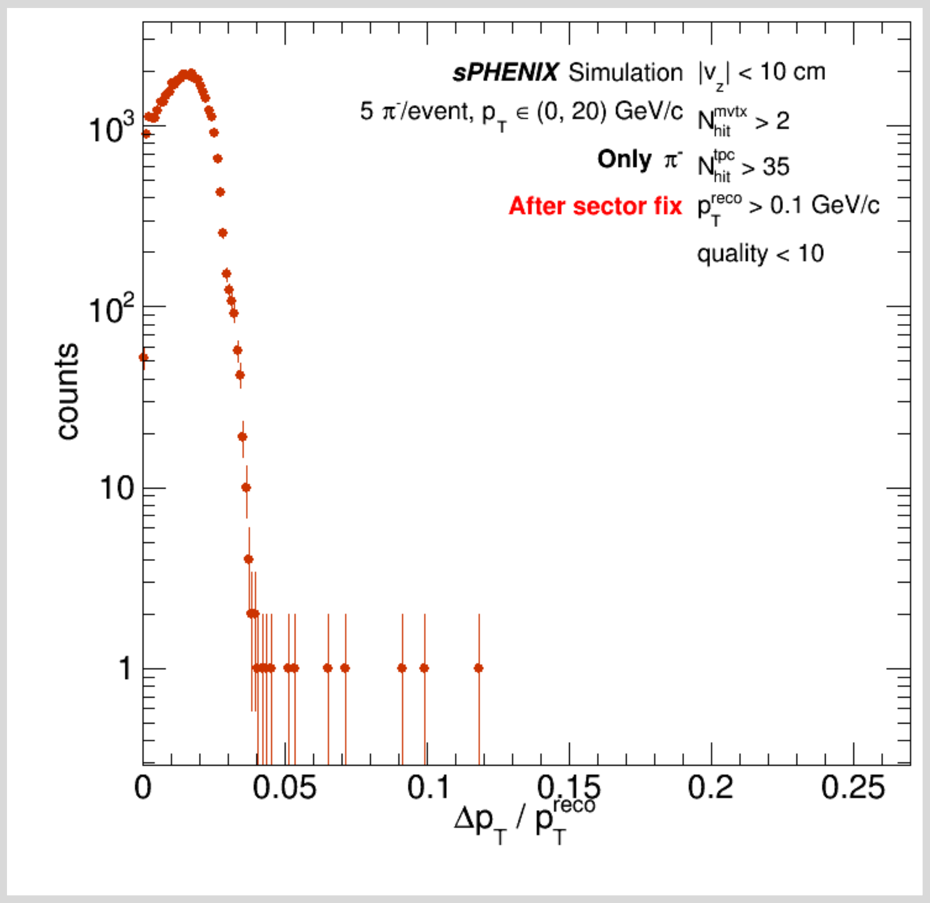
0 – 20 GeV/c

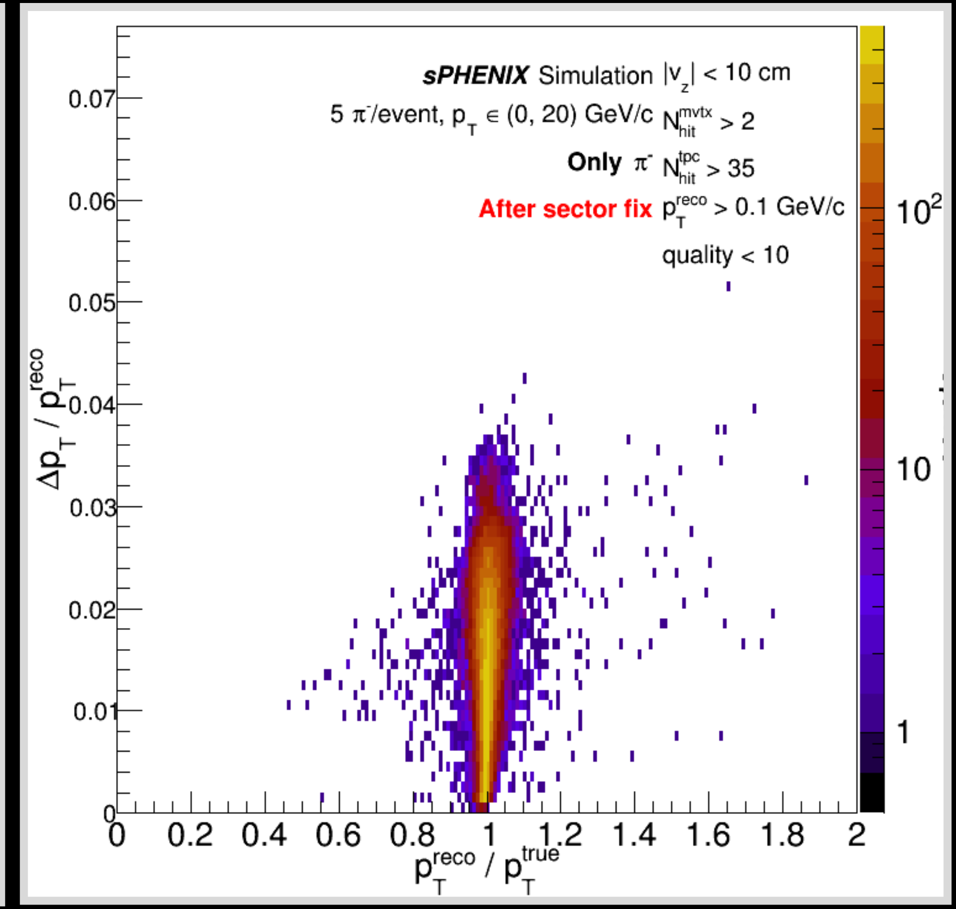


20 – 40 GeV/c

Track Percent Errors

W/ SECTOR FIX

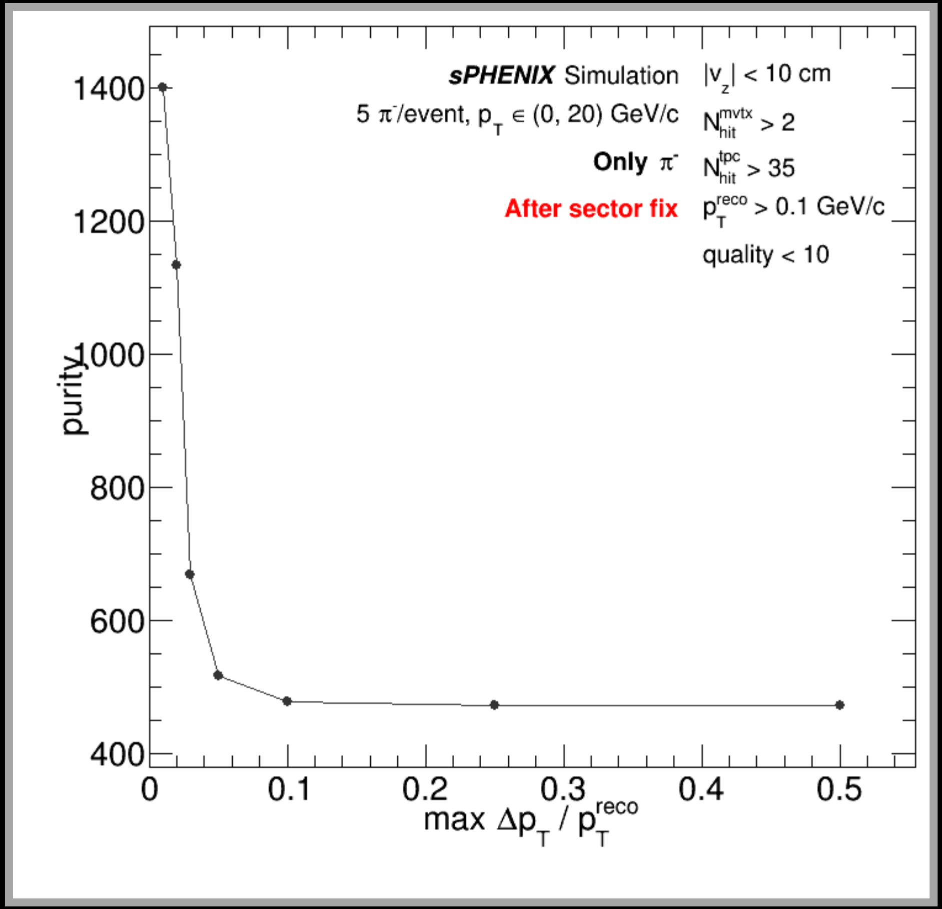


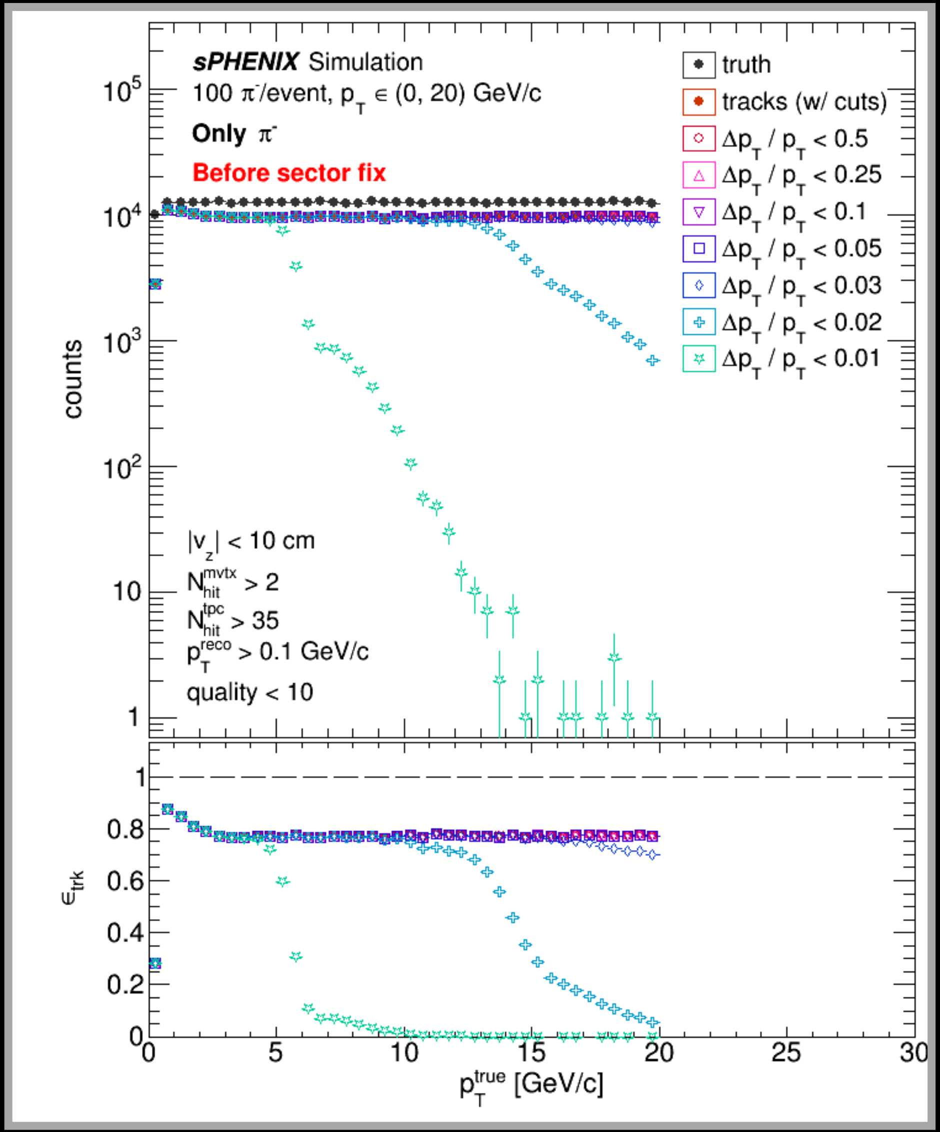


- **Shown:** %-errors on track p_T
  - 1D distribution (left) and Vs. p_T^{reco}/p_T^{true} (right)
  - For $N_\pi = 5$ events

Track Efficiency and Purity

W/ SECTOR FIX

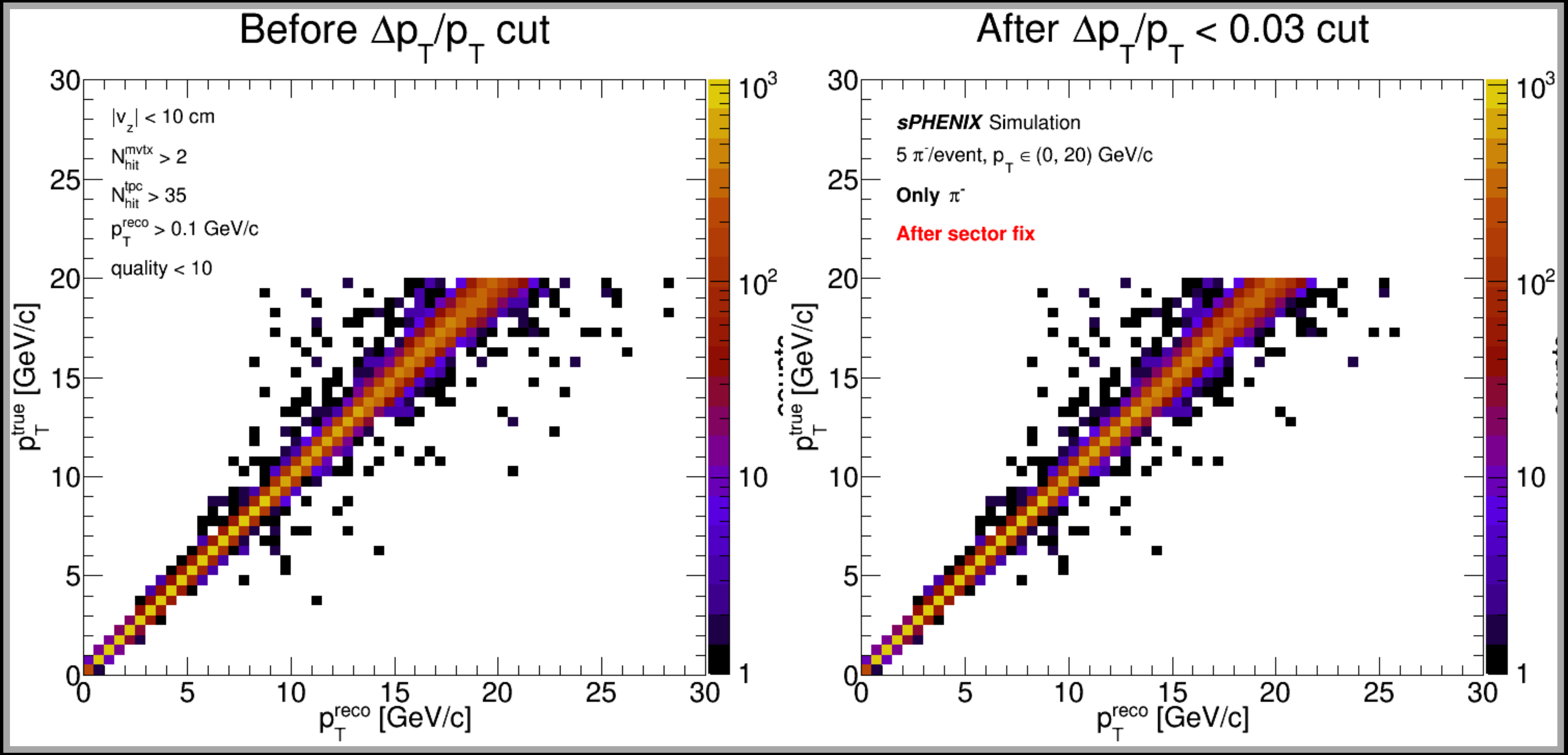




- **Shown:** purity (left) and efficiency right) vs. $\Delta p_T / p_T^{reco}$ cuts
  - For $N_\pi = 5$ events

Track vs. Truth p_T Before and After Δp_T Cuts

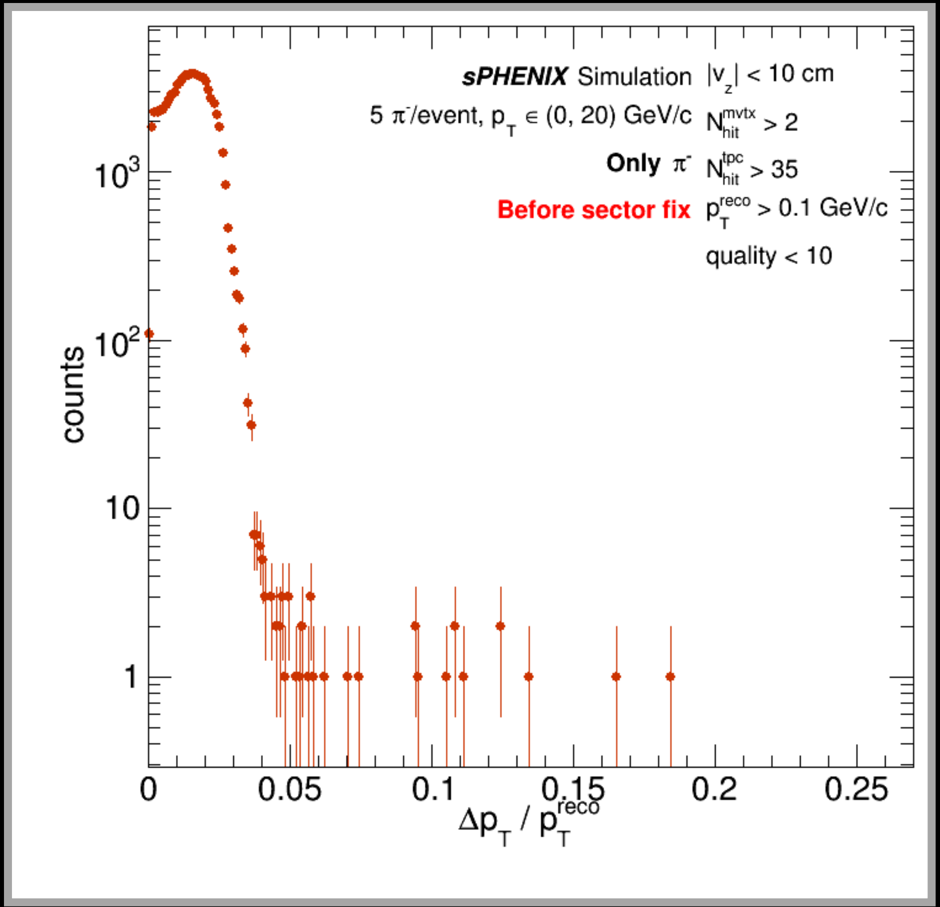
W/ SECTOR FIX

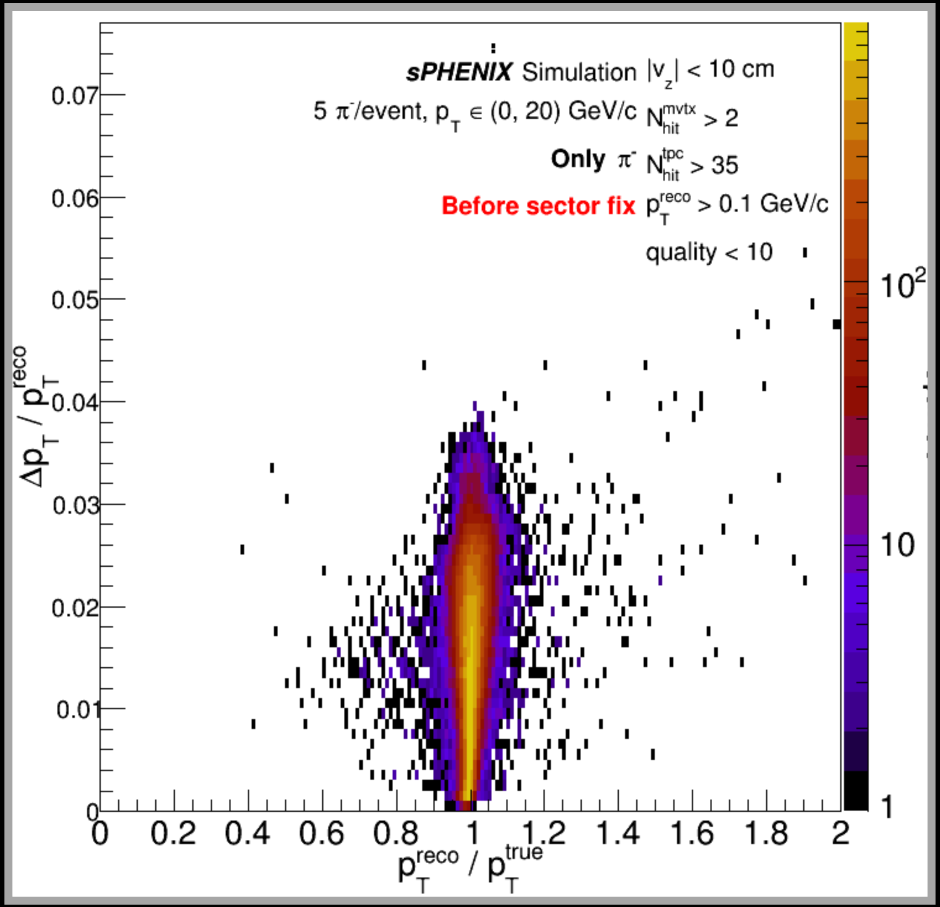


- **Shown:** 2D distribution of truth vs. reconstructed p_T
  - No Δp_T cut (left) and w/ Δp_T (right)
  - For $N_\pi = 5$ events

Backup | Track Percent Errors (Before Fix, $N_\pi = 5$)

NO SECTOR FIX

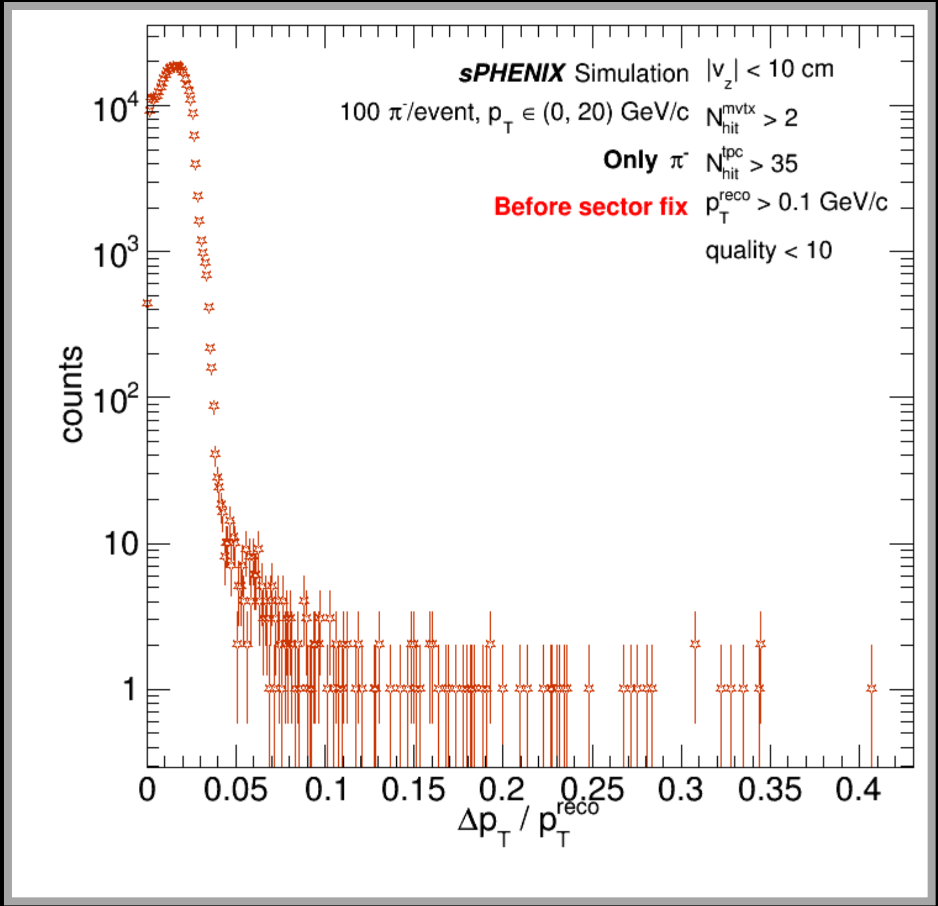


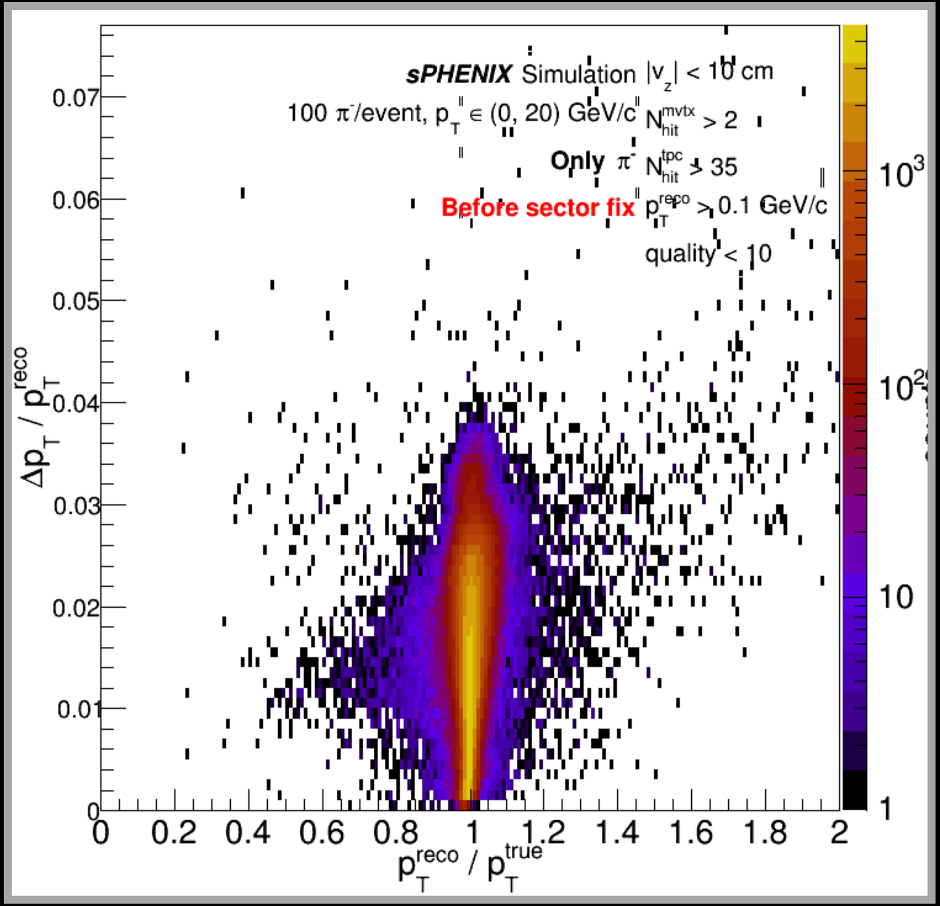


- **Shown:** %-errors on track p_T
  - 1D distribution (left) and Vs. p_T^{reco}/p_T^{true} (right)
  - For $N_\pi = 5$ events

Backup | Track Percent Errors (Before Fix, $N_\pi = 100$)

NO SECTOR FIX

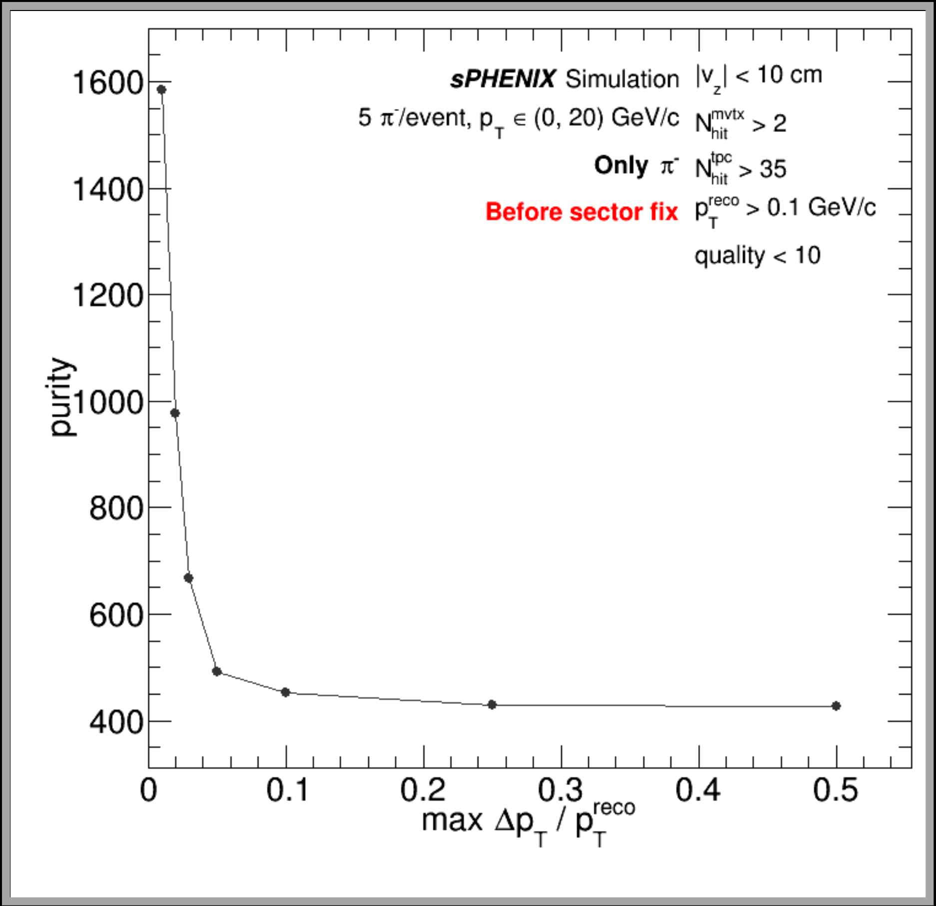


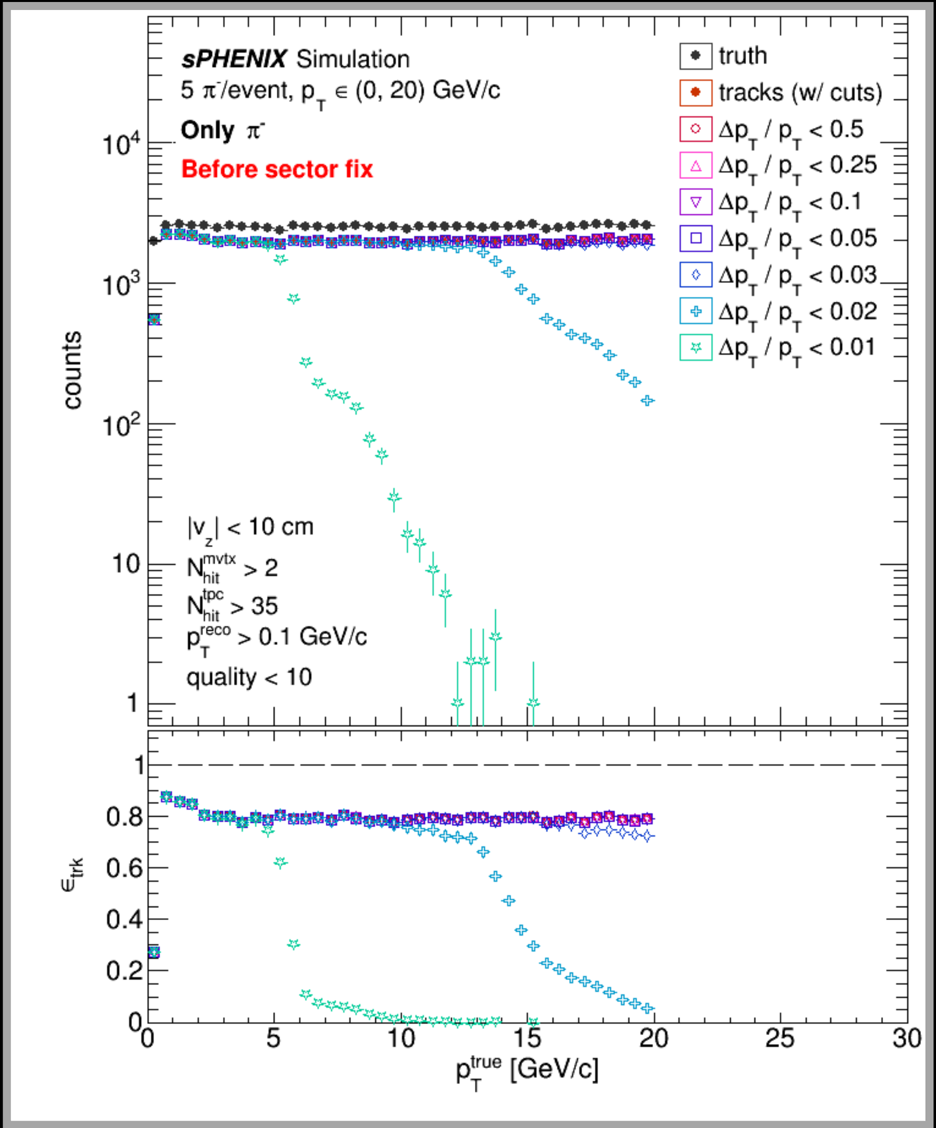


- **Shown:** %-errors on track p_T
  - 1D distribution (left) and Vs. p_T^{reco}/p_T^{true} (right)
  - For $N_\pi = 100$ events

Backup | Track Efficiency and Purity (Before Fix, $N_\pi = 5$)

NO SECTOR FIX

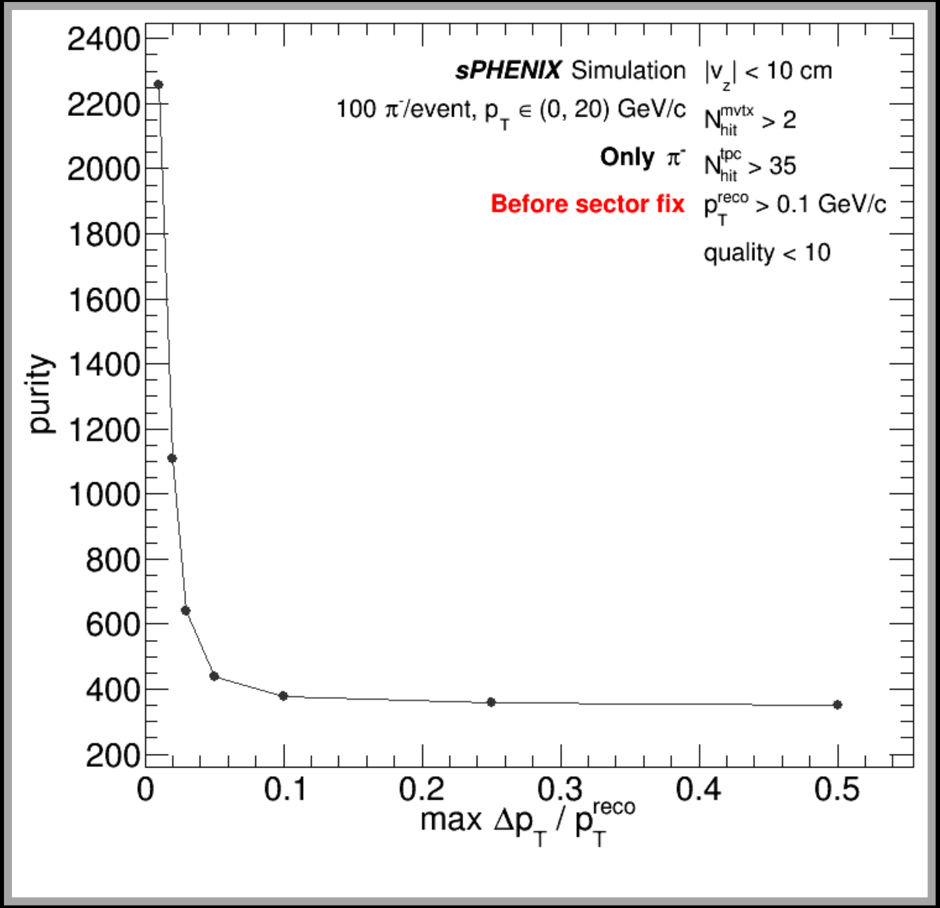


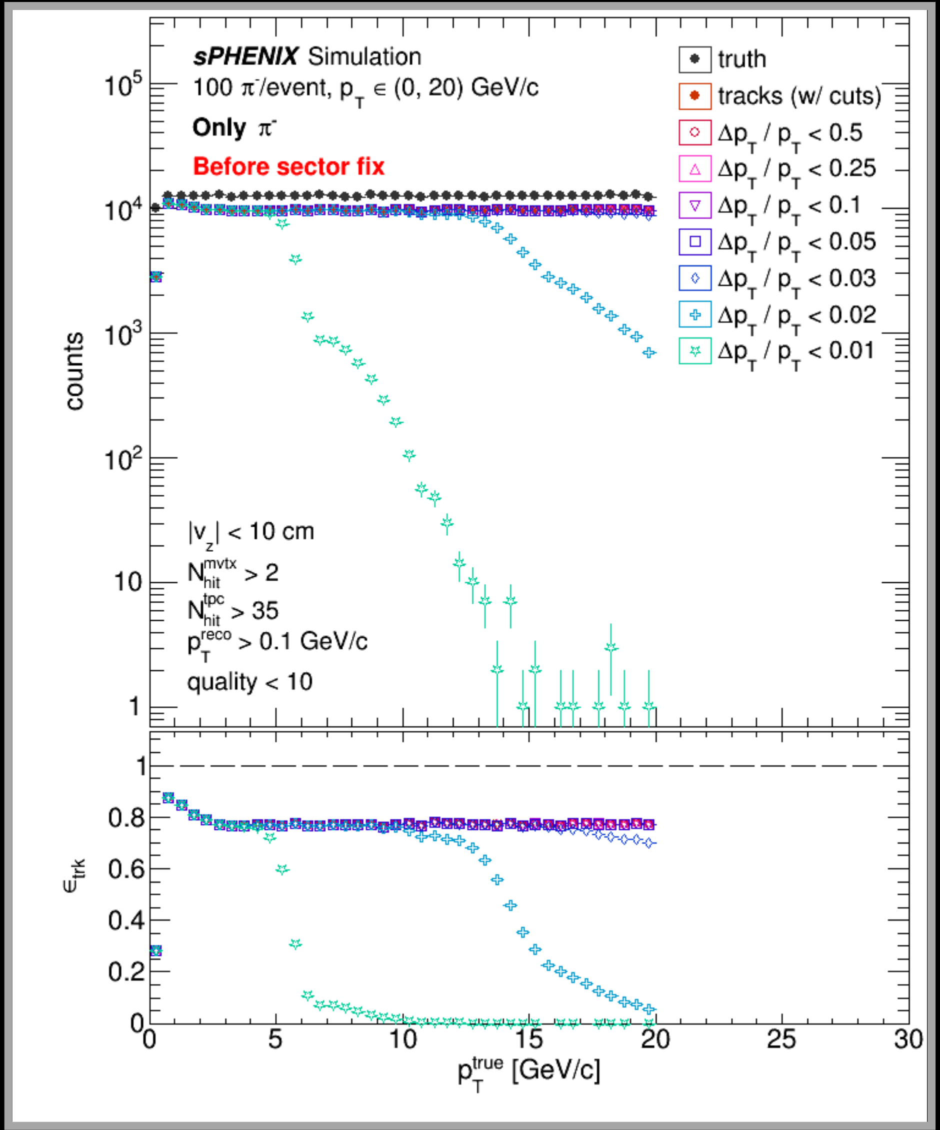


- **Shown:** purity (left) and efficiency right) vs. $\Delta p_T / p_T^{reco}$ cuts
  - For $N_\pi = 5$ events

Backup | Track Efficiency and Purity (Before Fix, $N_\pi = 100$)

NO SECTOR FIX

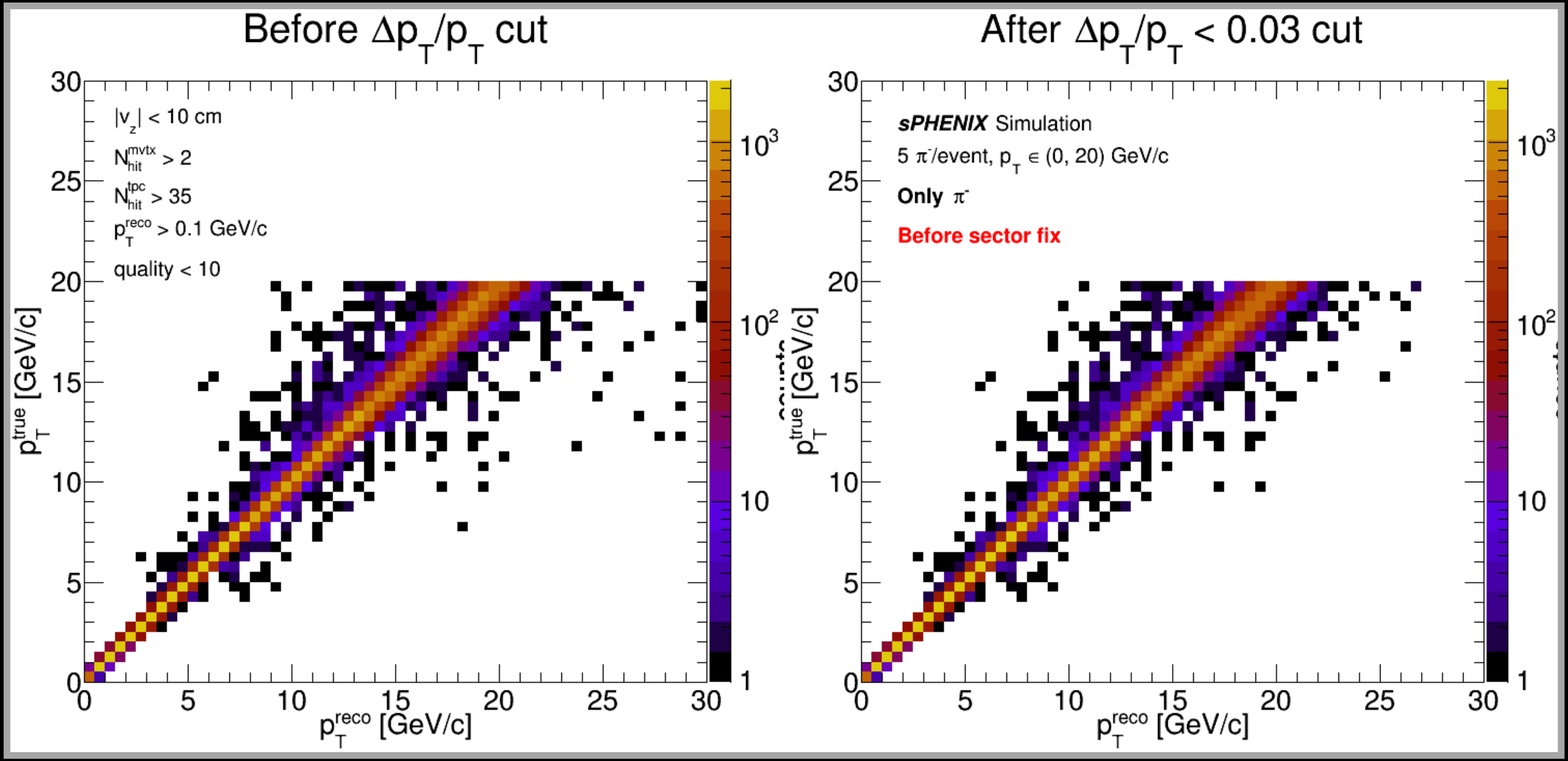




- **Shown:** purity (left) and efficiency right) vs. $\Delta p_T / p_T^{reco}$ cuts
  - For $N_\pi = 100$ events

Backup | Track vs. Truth p_T (Before Fix, $N_\pi = 5$)

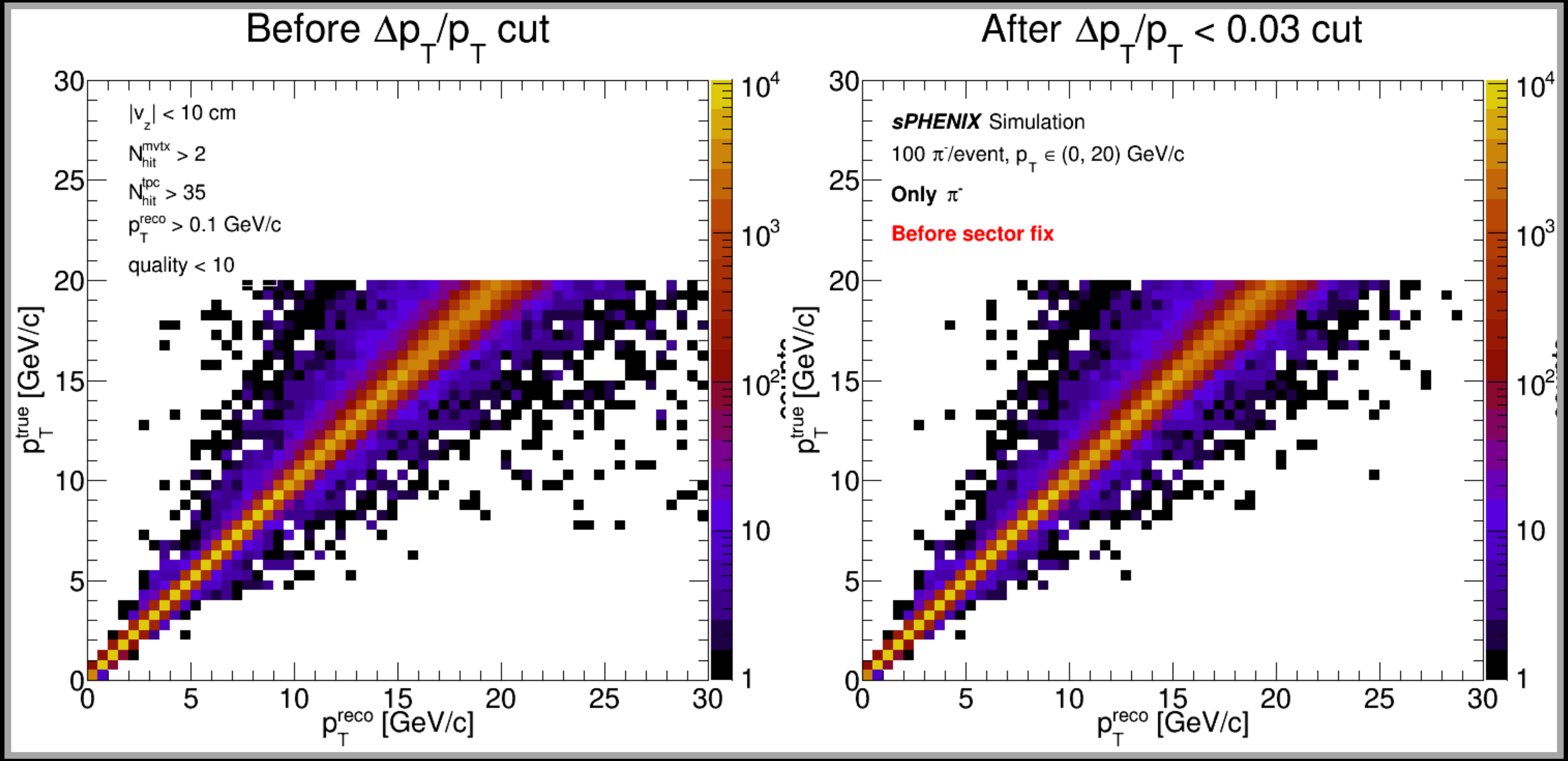
NO SECTOR FIX



- **Shown:** 2D distribution of truth vs. reconstructed p_T
  - No Δp_T cut (left) and w/ Δp_T (right)
  - For $N_\pi = 5$ events

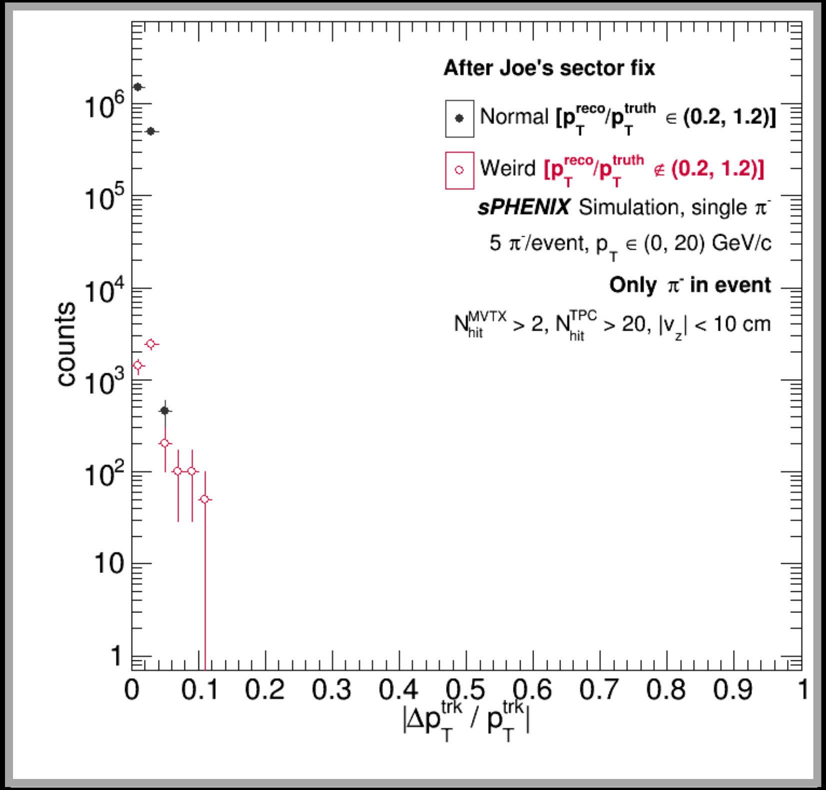
Backup | Track vs. Truth p_T (Before Fix, $N_\pi = 100$)

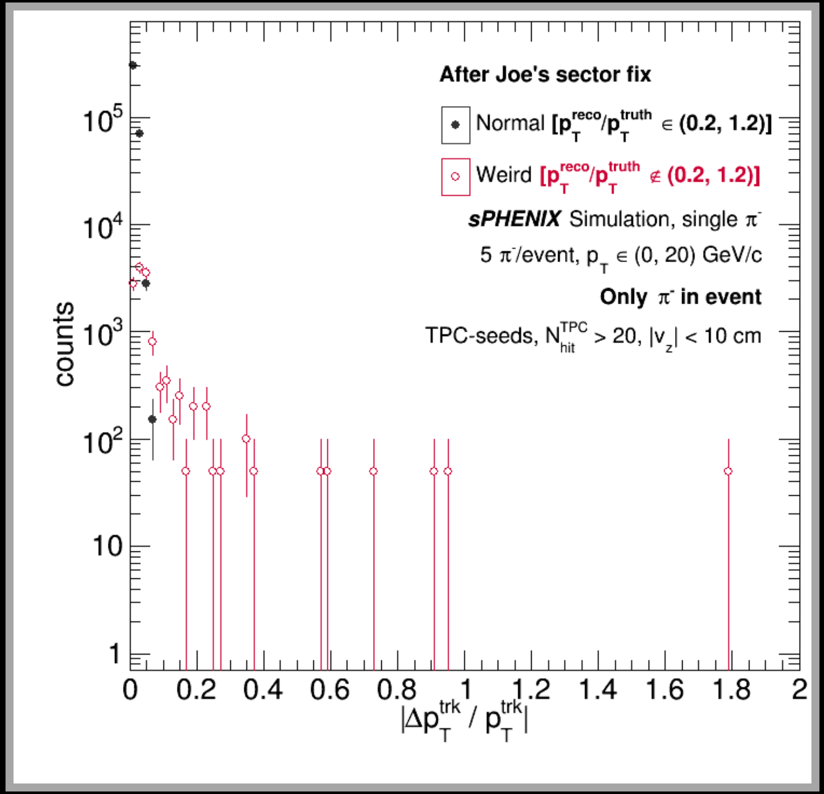
NO SECTOR FIX



- **Shown:** 2D distribution of truth vs. reconstructed p_T
  - No Δp_T cut (left) and w/ Δp_T (right)
  - For $N_\pi = 100$ events

Track Percent Errors | TPC-Seed vs. w/ MVTX After Sector Fix

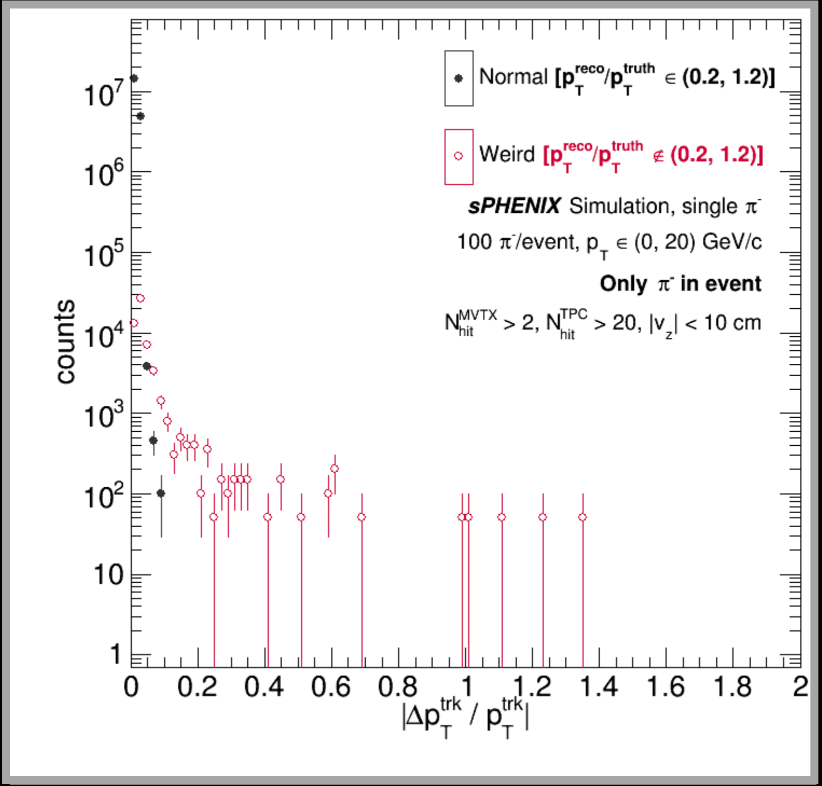


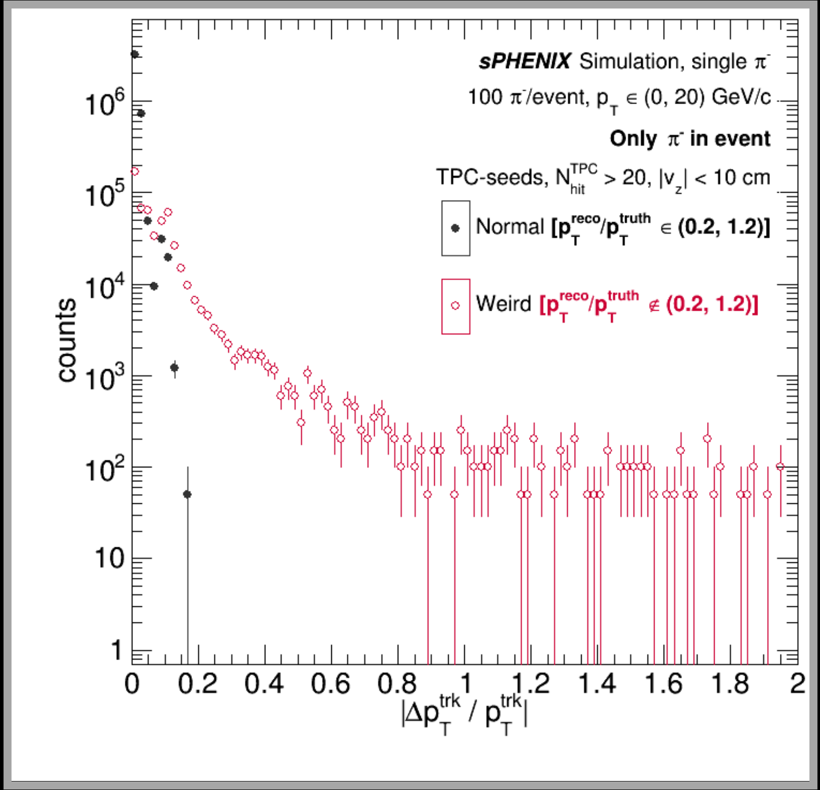


W/ SECTOR FIX

- **Shown:** %-errors on track p_T
  - W/ MVTX hits (left) vs. TPC-Seeds (right)
  - For $N_\pi = 5$ events

Track Percent Errors | TPC-Seed vs. w/ MVTX



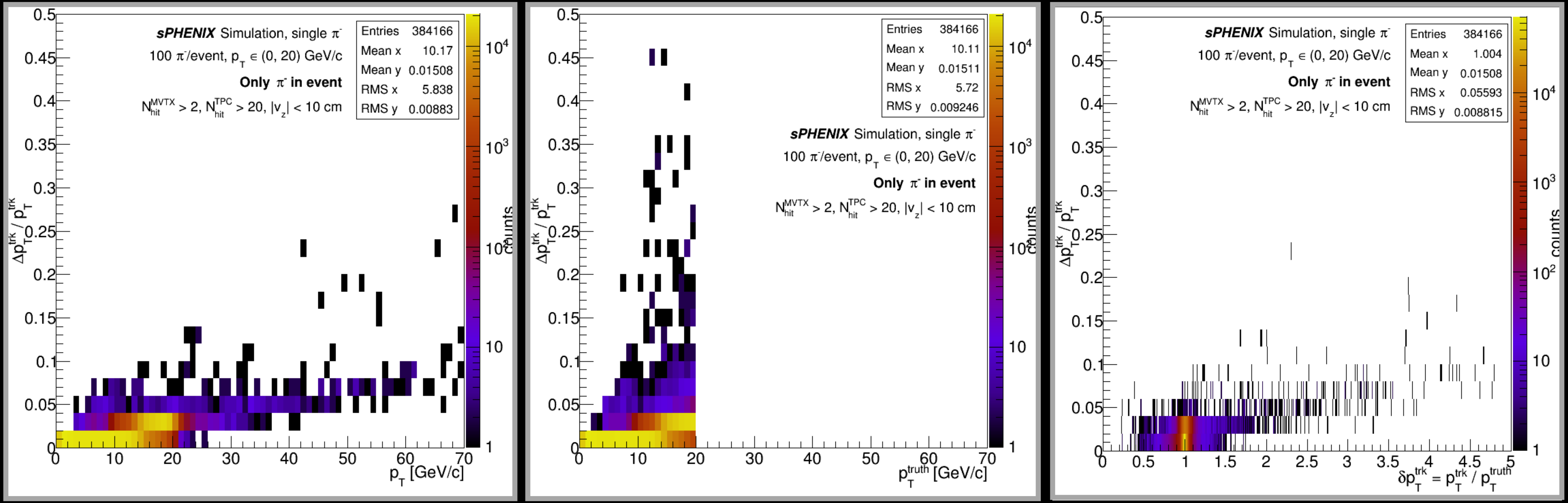


NO SECTOR FIX

- **Shown:** %-errors on track p_T
  - W/ MVTX hits (left) vs. TPC-Seeds (right)
  - For $N_\pi = 100$ events

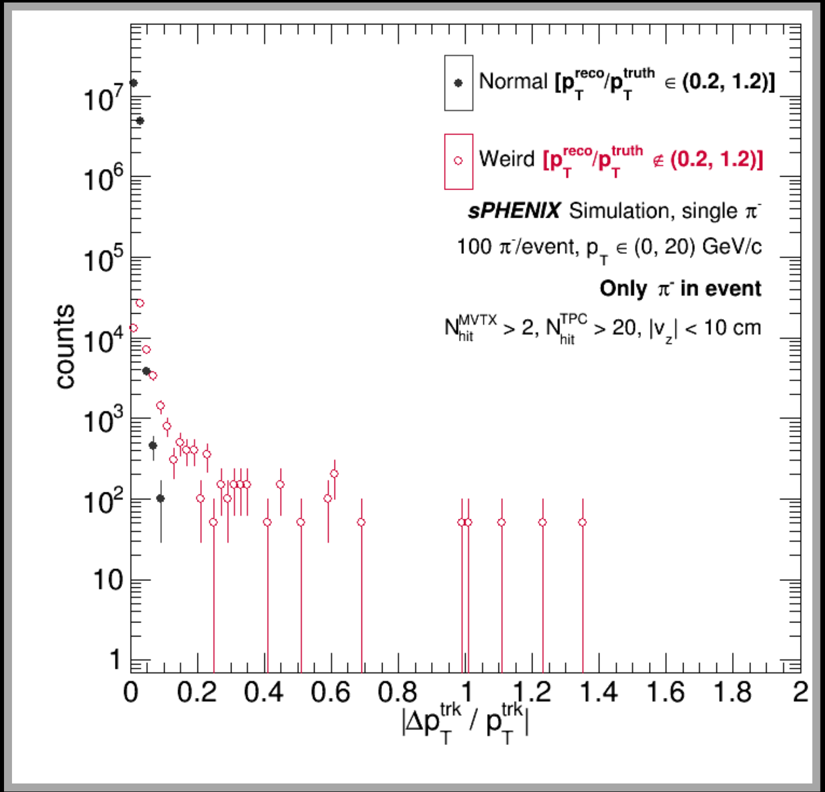
Track Percent Errors | Percent-error vs. p_T

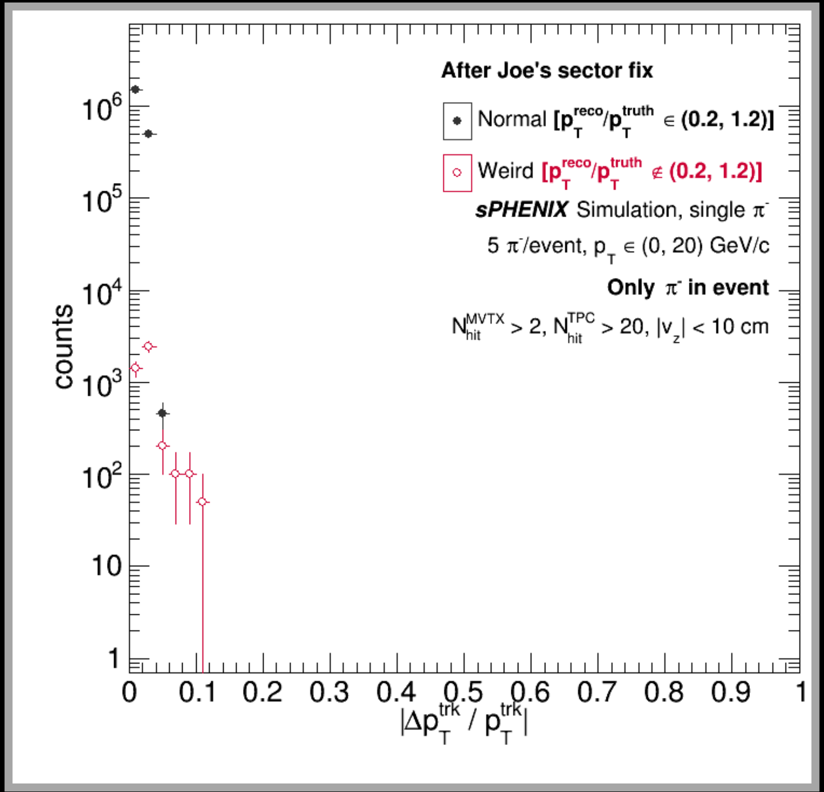
NO SECTOR FIX



- **Shown:** %-errors on track p_T vs. reco (right), truth (center), and fractional (left) p_T
  - W/ MVTX hits
  - For $N_\pi = 100$ events

Track Percent Errors | Before vs. After Sector Fix





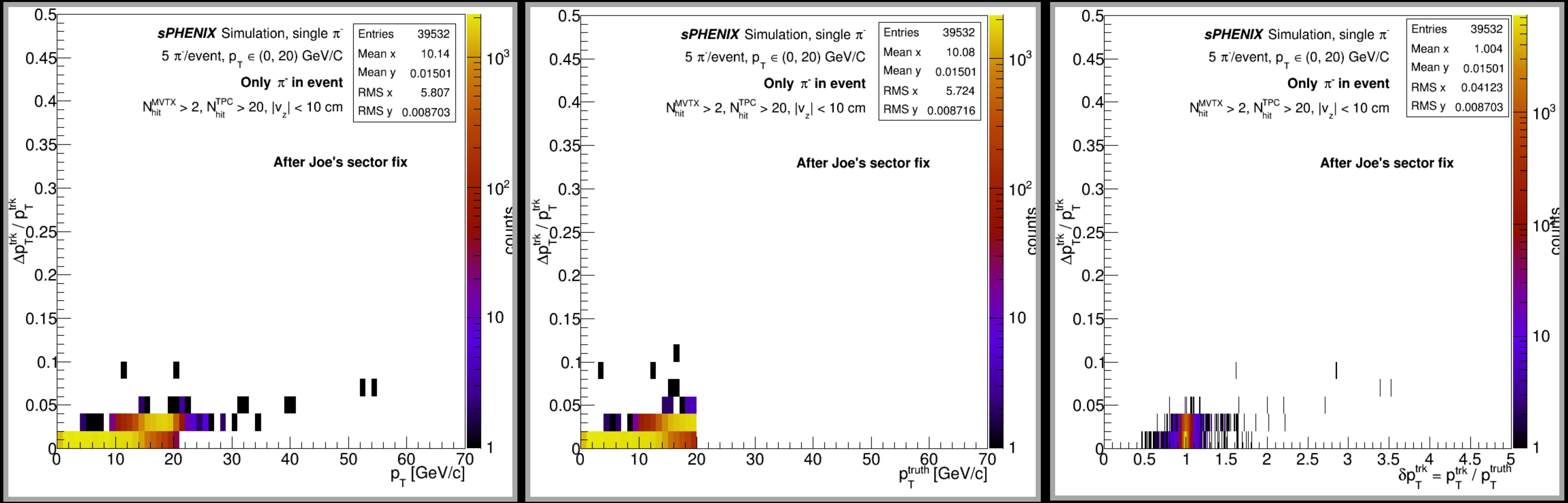
NO SECTOR FIX

W/ SECTOR FIX

- **Shown:** %-errors on track p_T
  - W/ MVTX hits
  - For $N_\pi = 100$ (left) and 5 (right) events

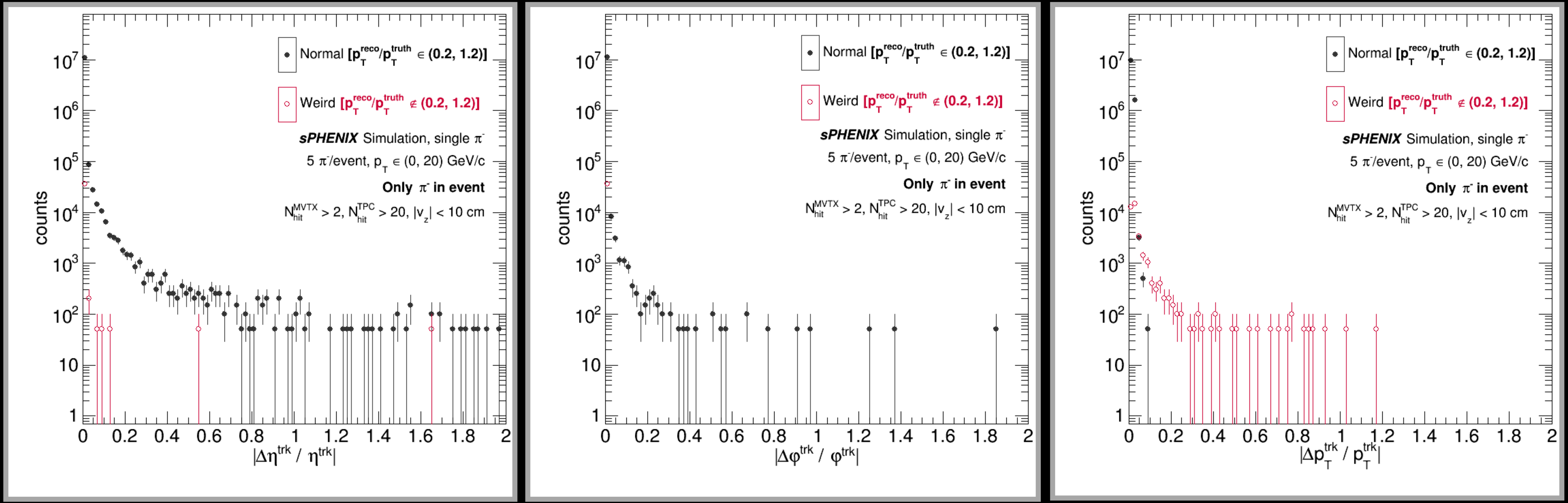
Track Percent Errors | Percent-error vs. p_T

W/ SECTOR FIX



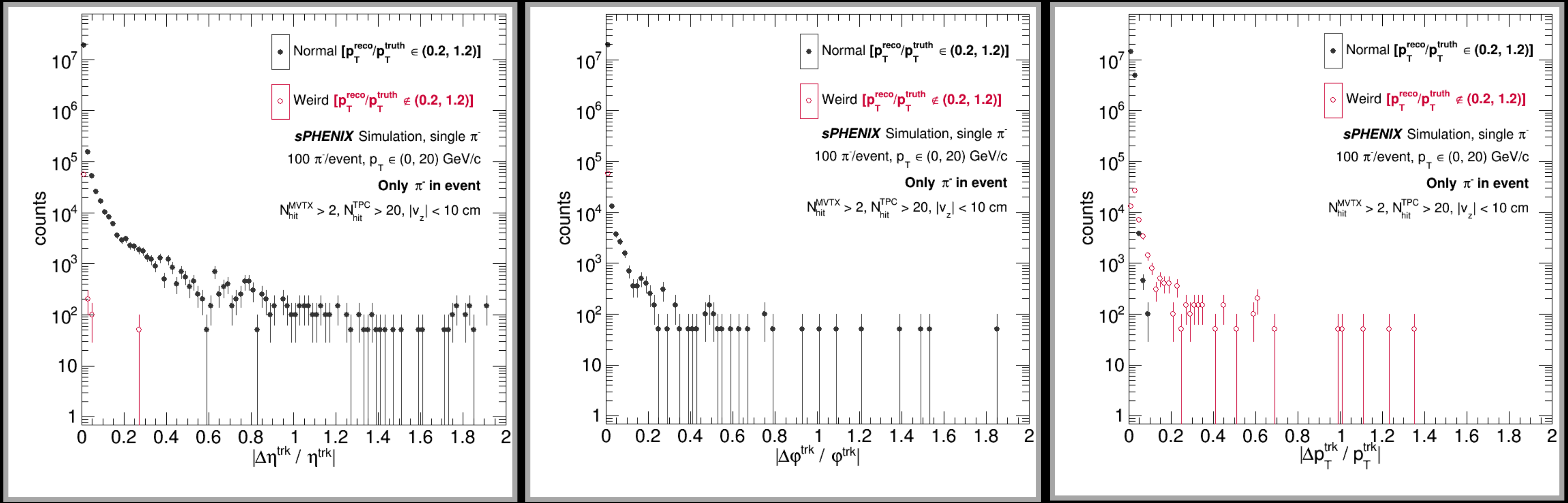
- **Shown:** %-errors on track p_T vs. reco (right), truth (center), and fractional (left) p_T
  - W/ MVTX hits
  - For $N_\pi = 5$ events

Track Percent Errors | $N_\pi = 5$



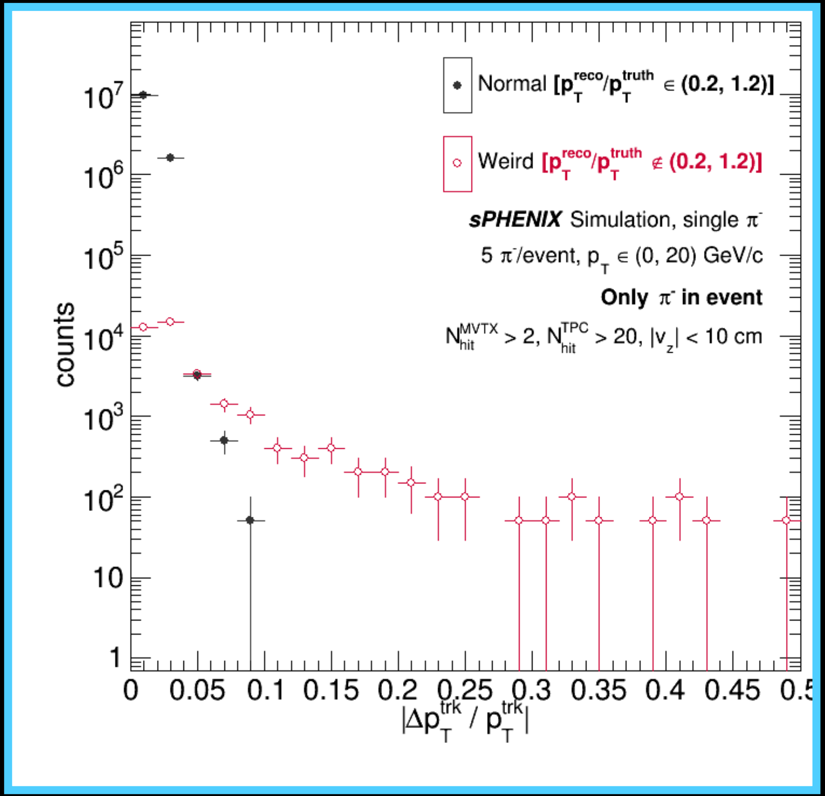
- **Shown:** %-errors on track η **(left)**, φ **(center)**, and p_T **(right)**
  - For $N_\pi = 5$ events

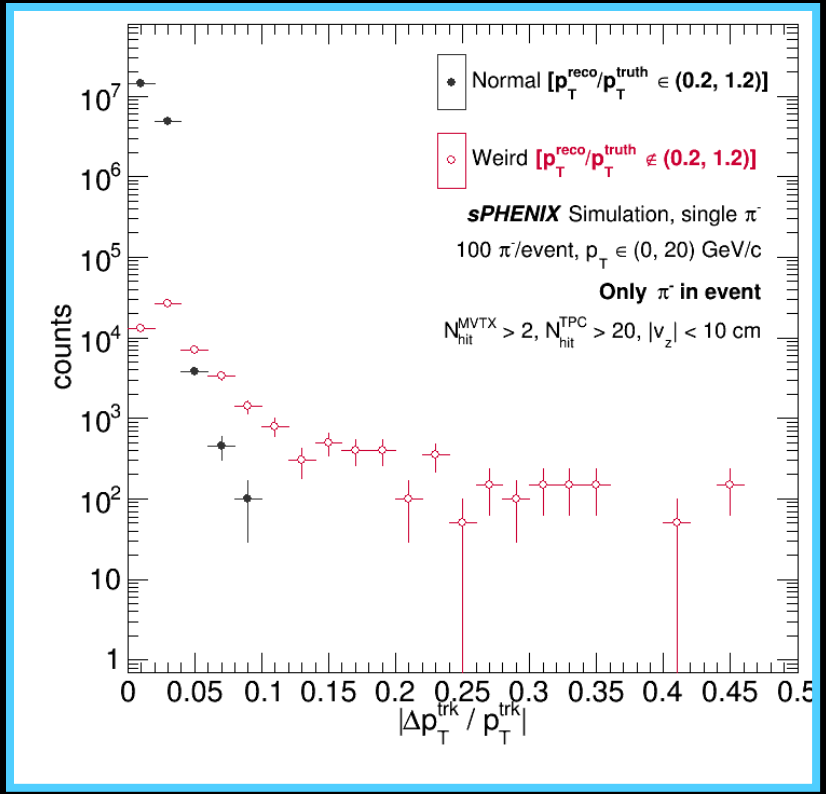
Track Percent Errors | $N_\pi = 100$



- **Shown:** %-errors on track η **(left)**, φ **(center)**, and p_T **(right)**
  - For $N_\pi = 100$ events

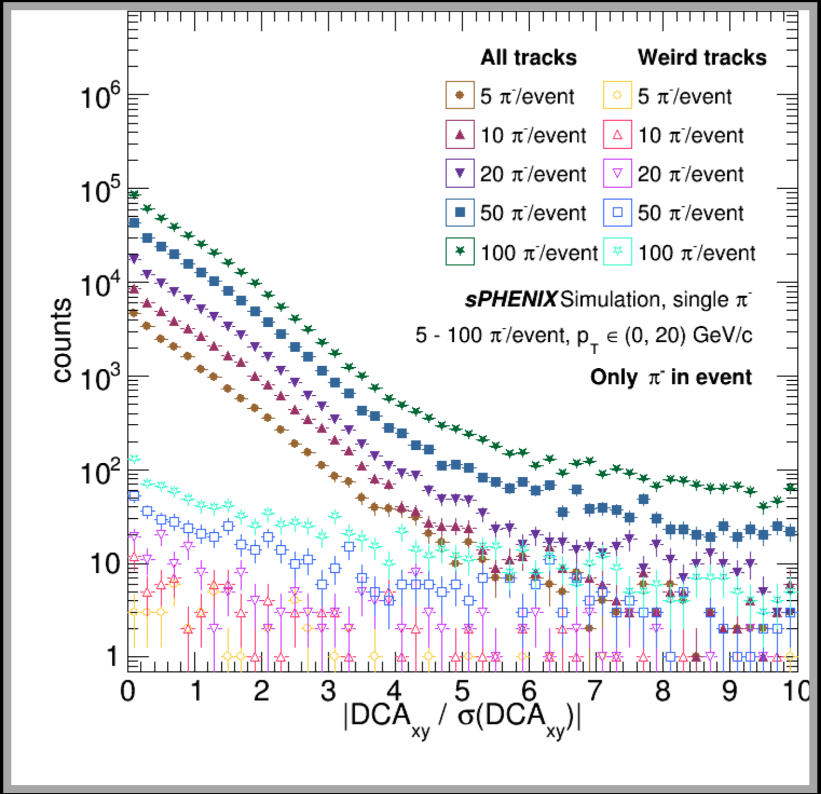
Track Percent Errors | zoomed-in on x-axis

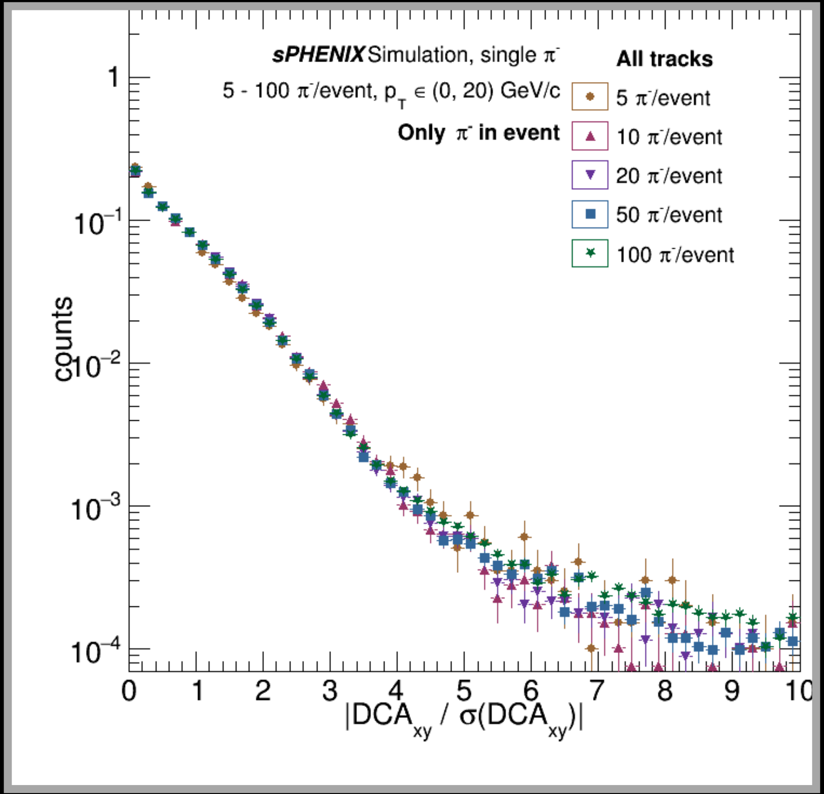


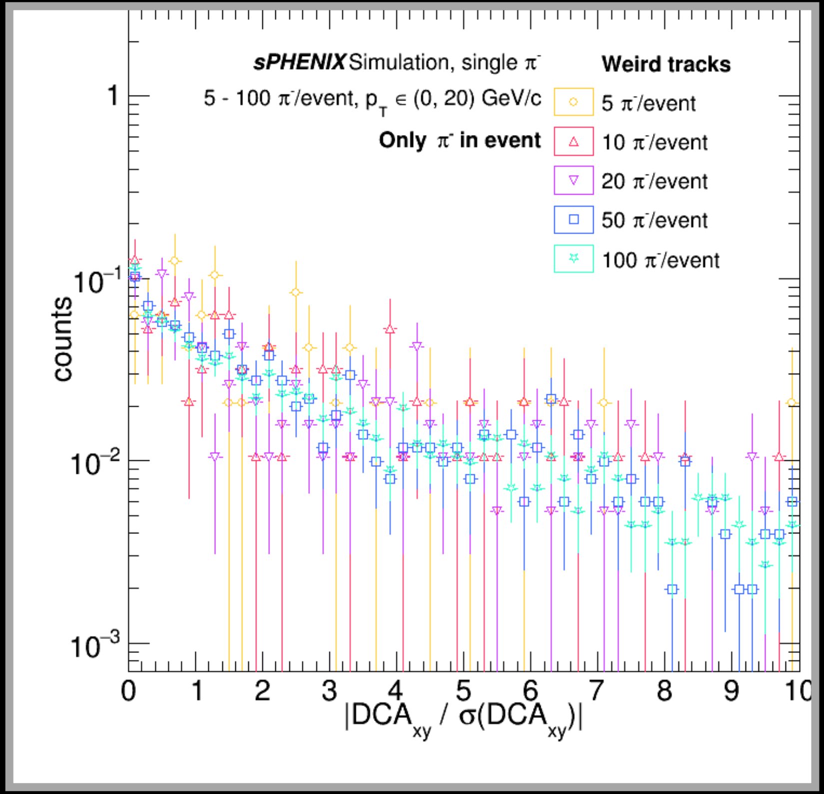


- **Shown:** %-errors on track p_T
  - For $N_\pi = 5$ (left) and 100 (right) events

DCAxy/σ(DCAxy) vs. N_π

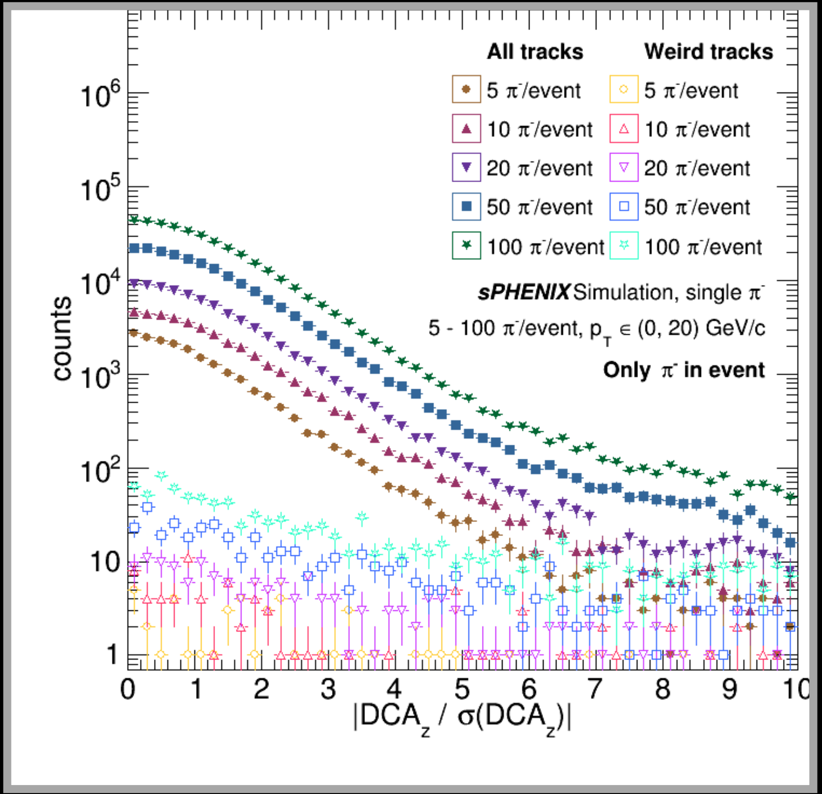


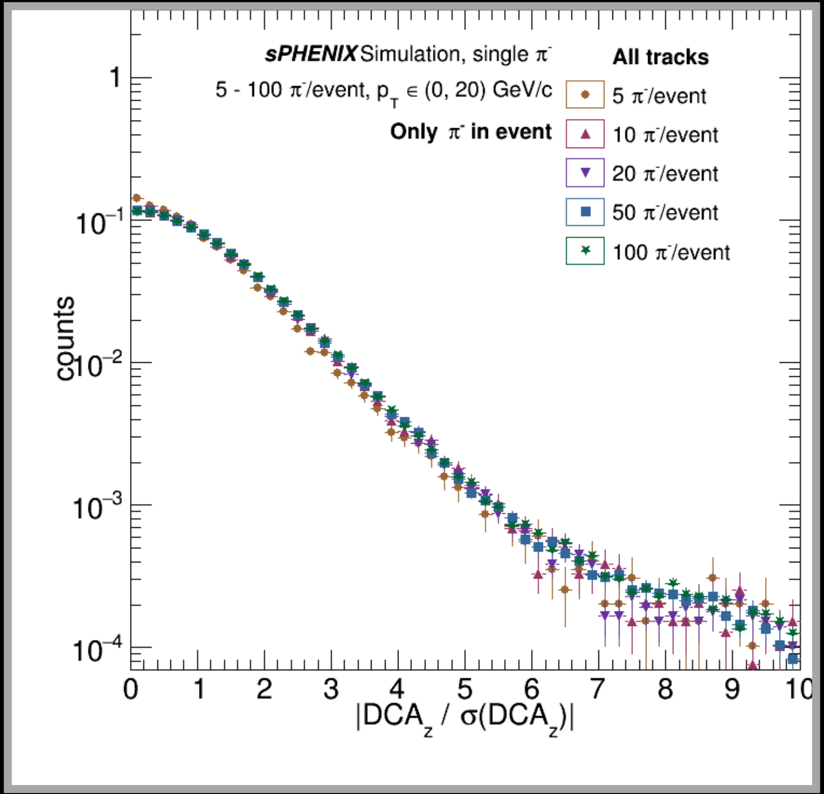


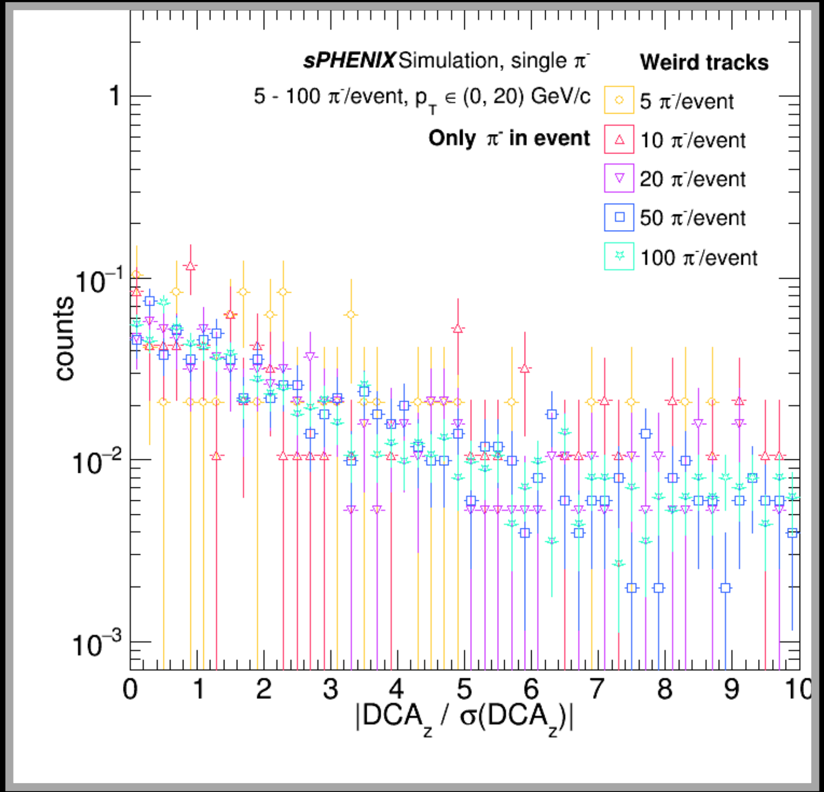


- **Shown:** DCAxy/σ(DCAxy)
  - Unnormalized **(left)** , all tracks **(normalized, center)** , and weird tracks **(normalized, right)**
  - For $N_\pi = 5$ **(orange)**, $N_\pi = 10$ **(red)**, $N_\pi = 20$ **(purple)**, $N_\pi = 50$ **(blue)**, and $N_\pi = 100$ **(green)** events

DCAz/σ(DCAz) vs. N_π

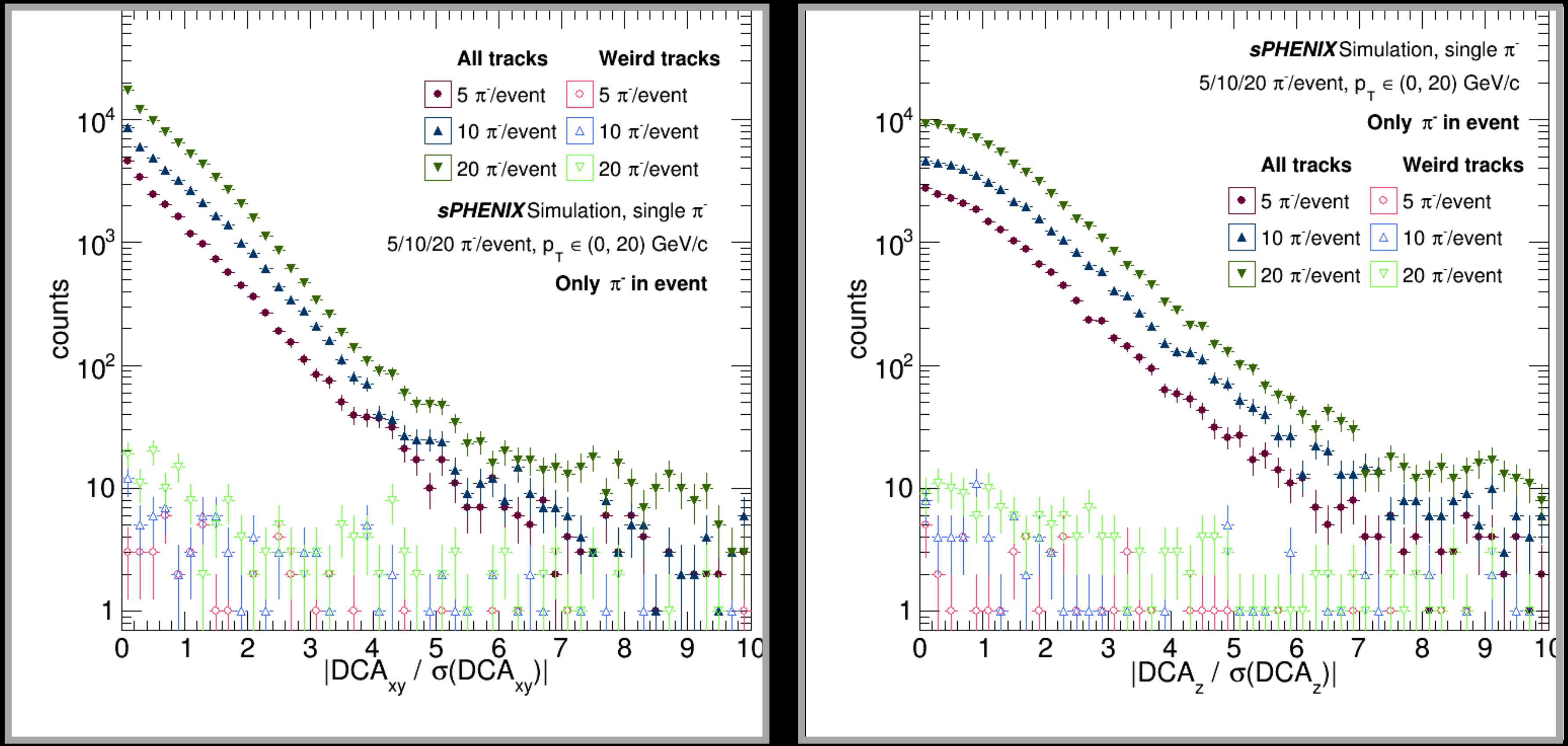






- **Shown:** DCAz/σ(DCAz)
  - Unnormalized **(left)** , all tracks **(normalized, center)** , and weird tracks **(normalized, right)**
  - For $N_\pi = 5$ **(orange)**, $N_\pi = 10$ **(red)**, $N_\pi = 20$ **(purple)**, $N_\pi = 50$ **(blue)**, and $N_\pi = 100$ **(green)** events

How does DCA/σ(DCA) look?

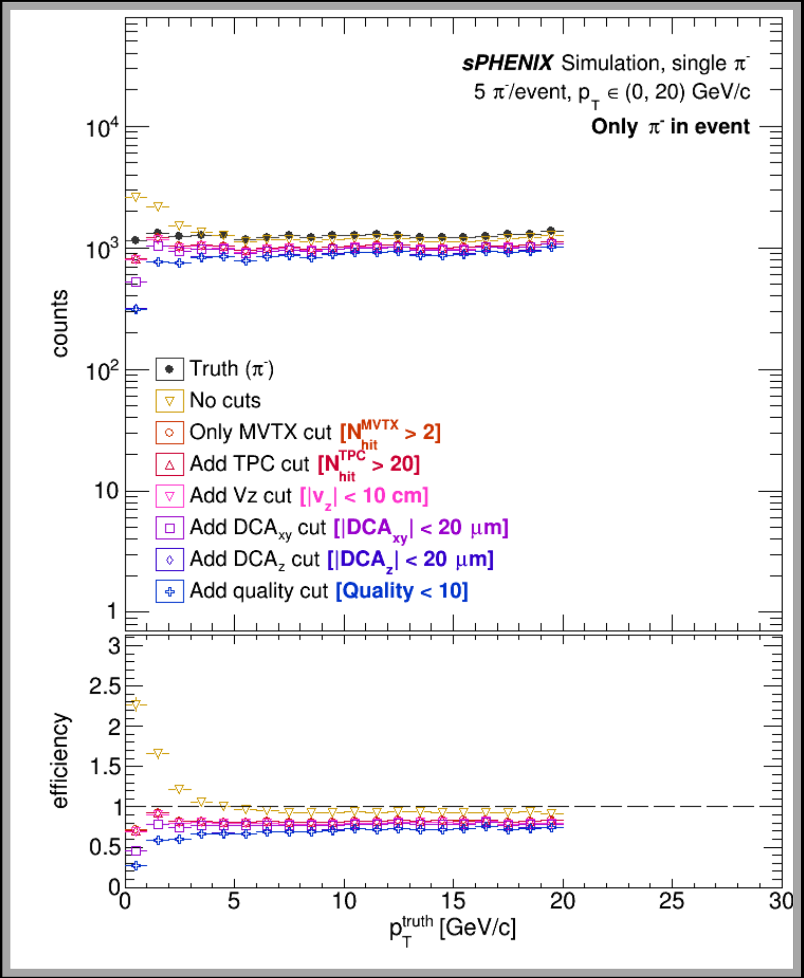


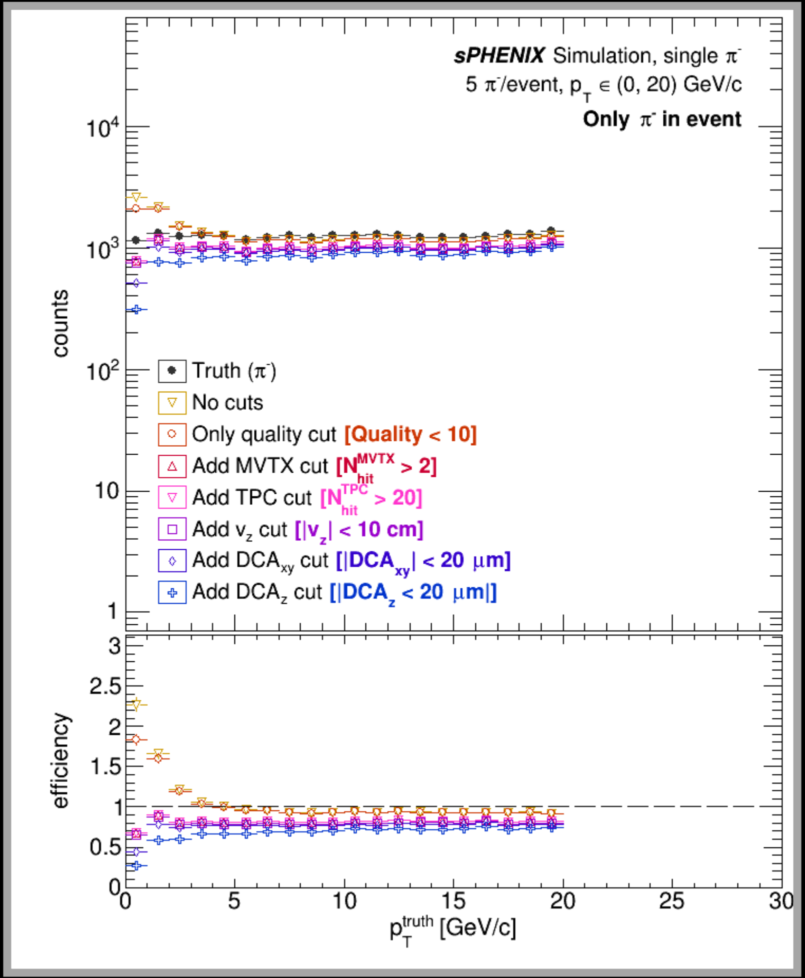
- **Shown:** DCA/σ(DCA) for DCAxy (right) and DCAz (left)
  - Shown for $N_\pi = 5$ (red), $N_\pi = 10$ (blue), and $N_\pi = 20$ (green) events
  - ($N_\pi = 50$ and $N_\pi = 100$ events in progress…)

How does changing cut hierarchy affect efficiency?

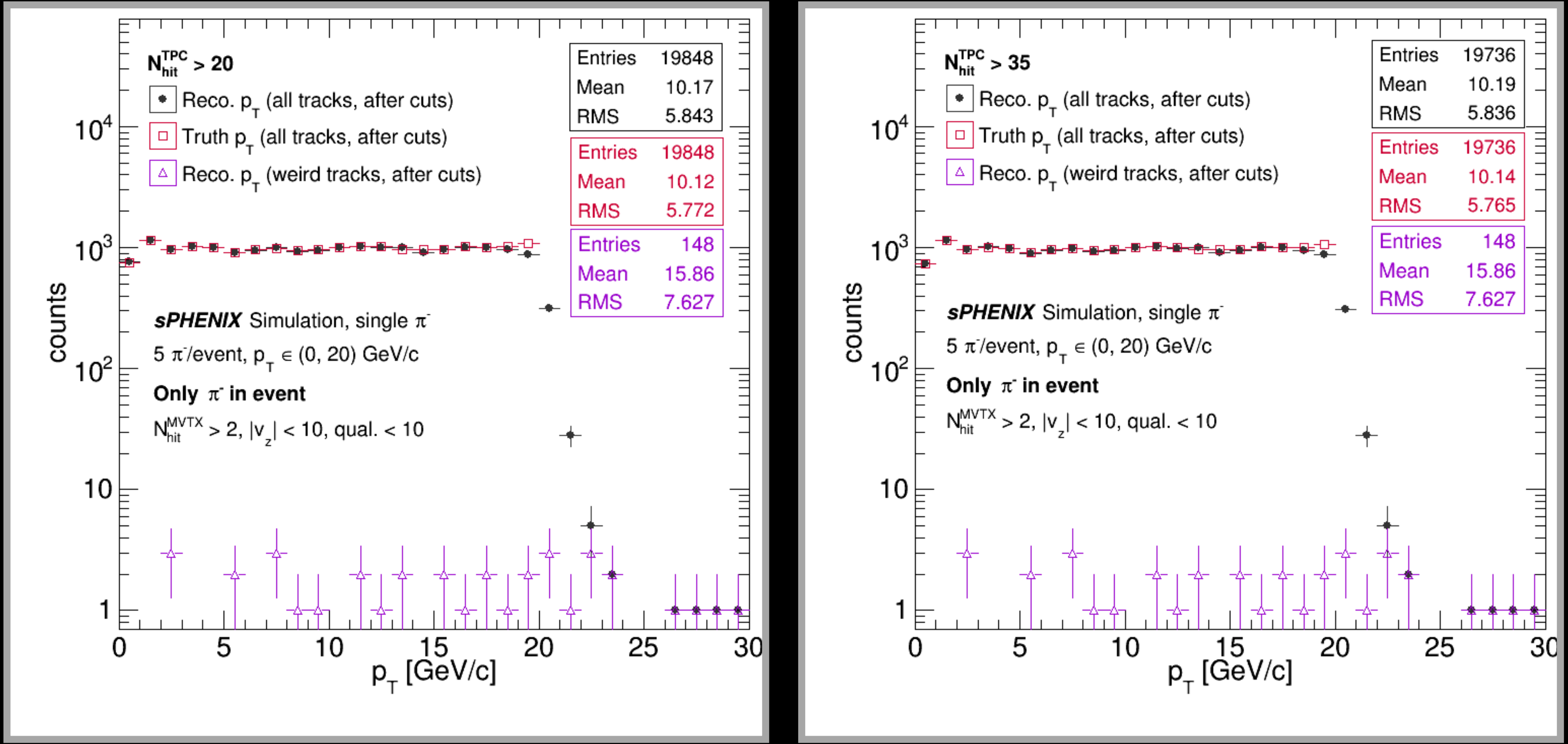
sPHENIX

- **Shown:** How reco. efficiency evolves as cuts are added
  - **Left:** quality cut applied last
  - **Right:** quality cut applied first
  - ☞ Quality cut (< 10) on its own doesn't remove many tracks
- For π^--only events
  - Only 5 π^-/event
  - (20 π^-/events in backup)





What happens when N_{hit}^{TPC} is varied?

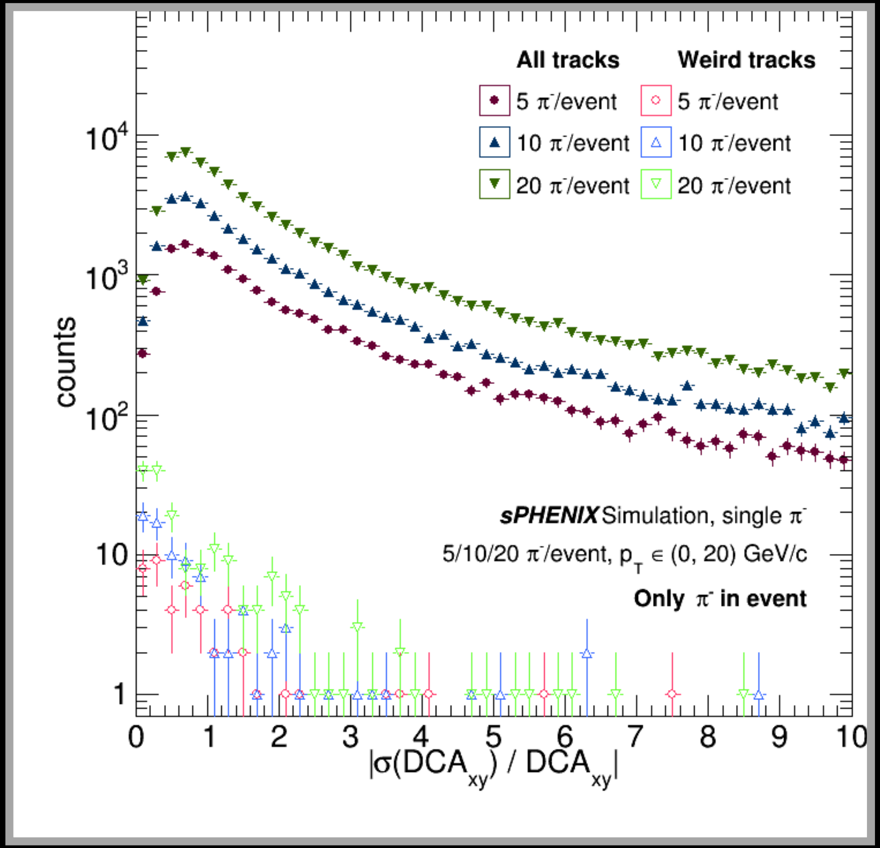


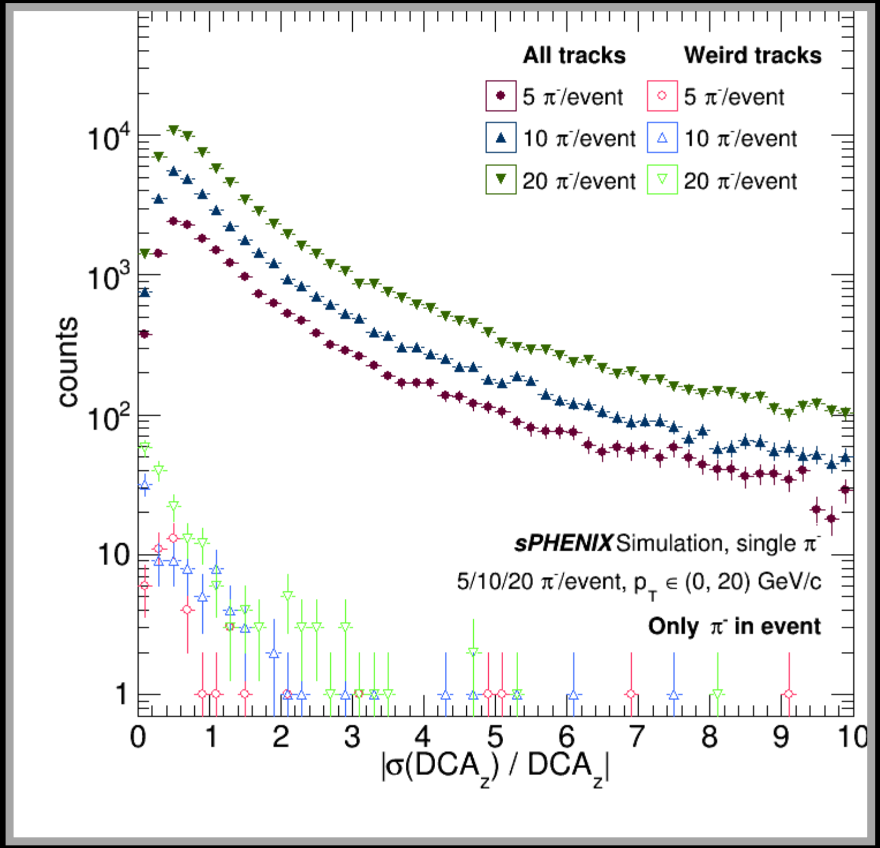
- **Shown:** Reconstructed (**black** and **purple**) p_T vs. true p_T **(red)**
  - Left: $N_{hit}^{TPC} > 20$ cut applied
  - Right: $N_{hit}^{TPC} > 35$ cut applied
- **Varying N_{hit}^{TPC} cut makes little impact**

- **Note:** cuts on N_{hit}^{MVTX}, v_z, and quality also applied

- Only 5 π^-/events
  - (10, 20 π^-/events in backup)

σ(DCA)/DCA vs. N_π



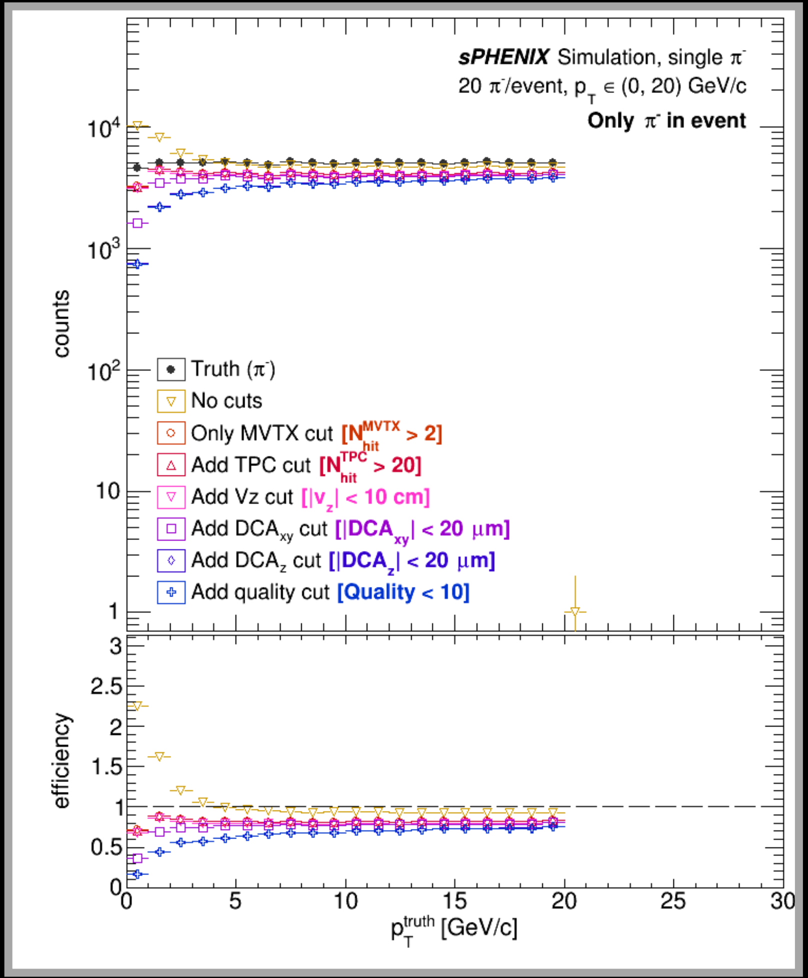


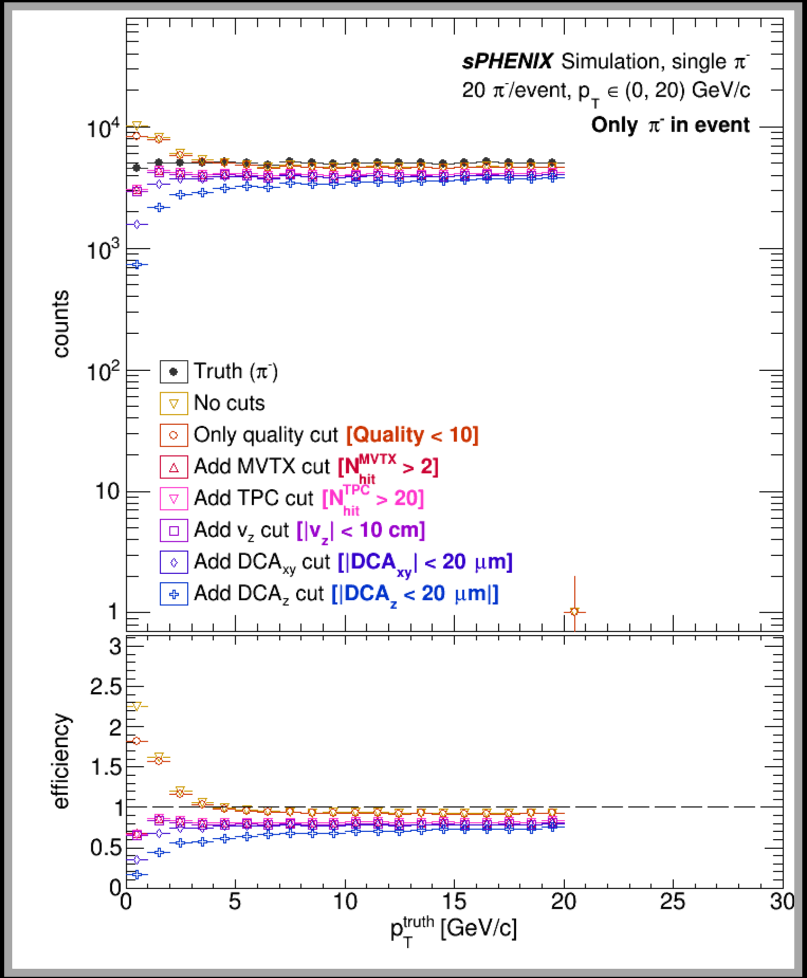
- **Shown:** σ(DCA)/DCA for DCAxy (right) and DCAz (left)
  - Shown for $N_\pi = 5$ **(red)**, $N_\pi = 10$ **(blue)**, and $N_\pi = 20$ **(green)** events

Cuts vs. efficiency for 20 π^-/event

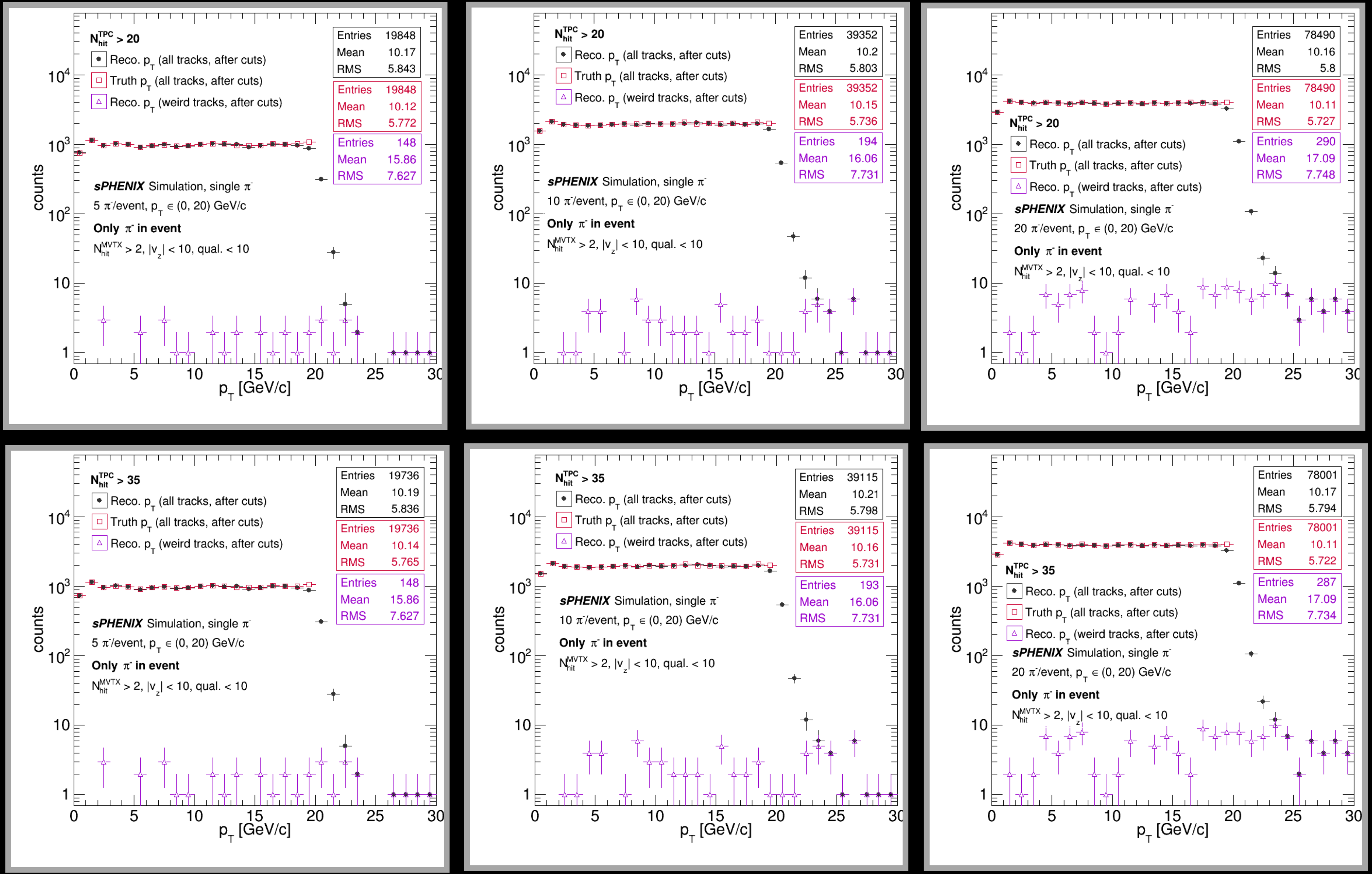
- **Shown:** How reco. efficiency evolves as cuts are added
  - **Left:** quality cut applied last
  - **Right:** quality cut applied first
  - ☞ Quality cut (< 10) on its own doesn't remove many tracks

- For π^--only events
  - 20 π^-/event

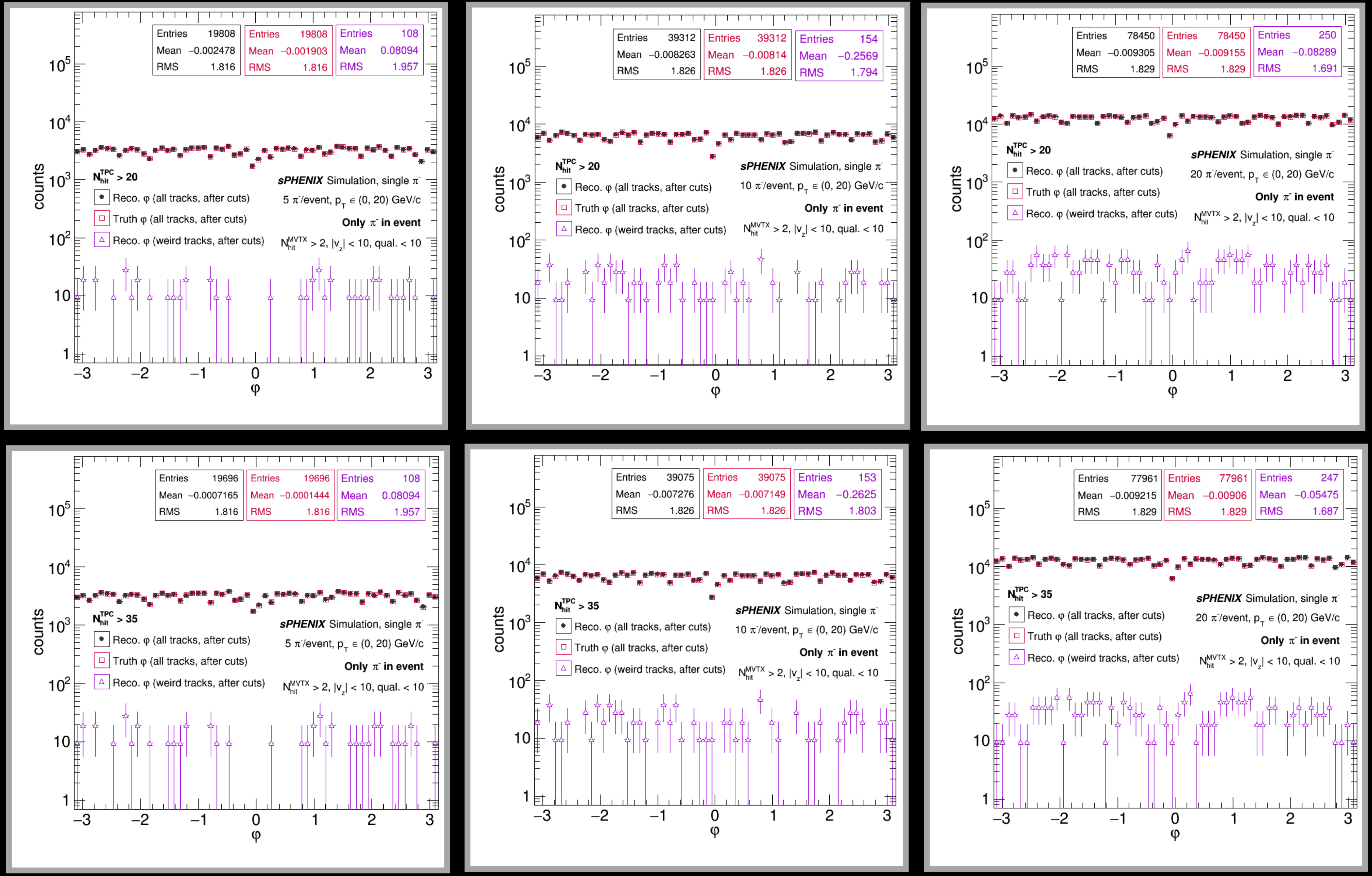




Varying N_{π} and N_{hit}^{TPC}

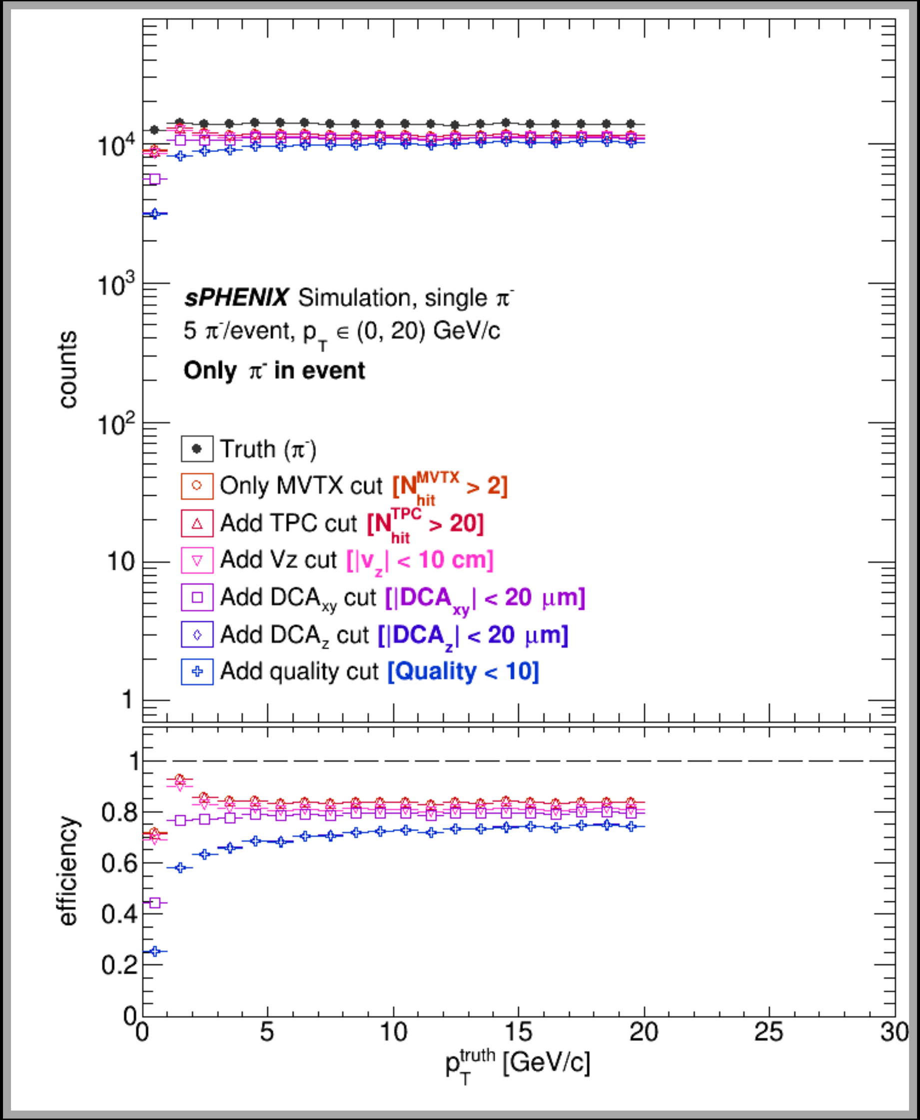


Varying N_{π} and N_{hit}^{TPC}

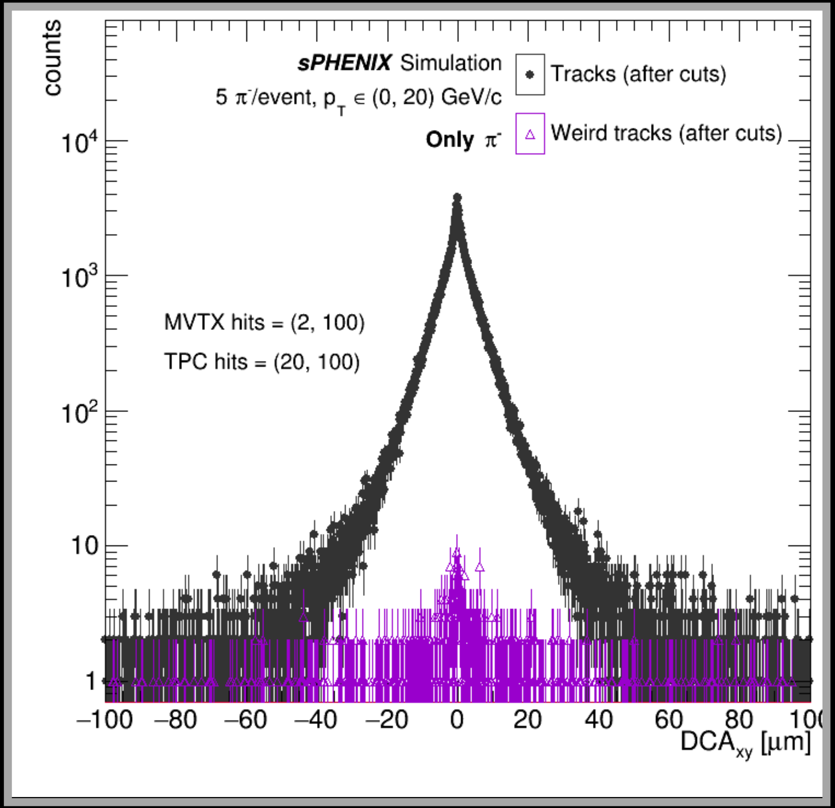


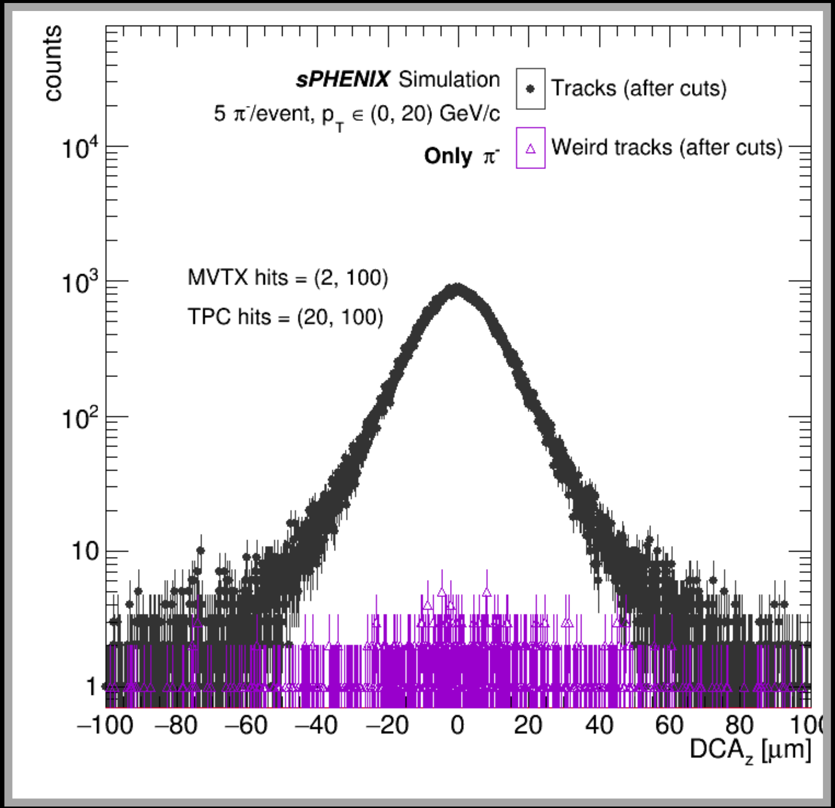
Tracking Efficiency vs. Cuts

- **Shown:** How reco. efficiency evolves as cuts are added
  - Biggest effects are due to DCA…
  - **Note:** “Add quality cut” and “Add DcaZ cut” points are on top of each other
- For π^--only events
  - Only 5 π^-/event
  - ☞ Now working on events with more π^-



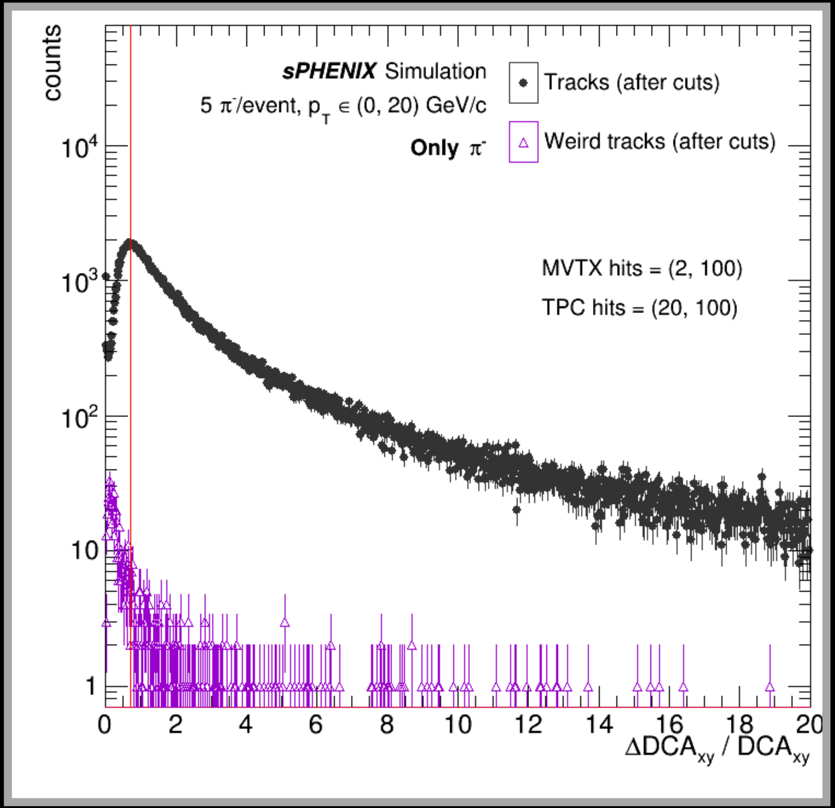
Track DCA Distributions

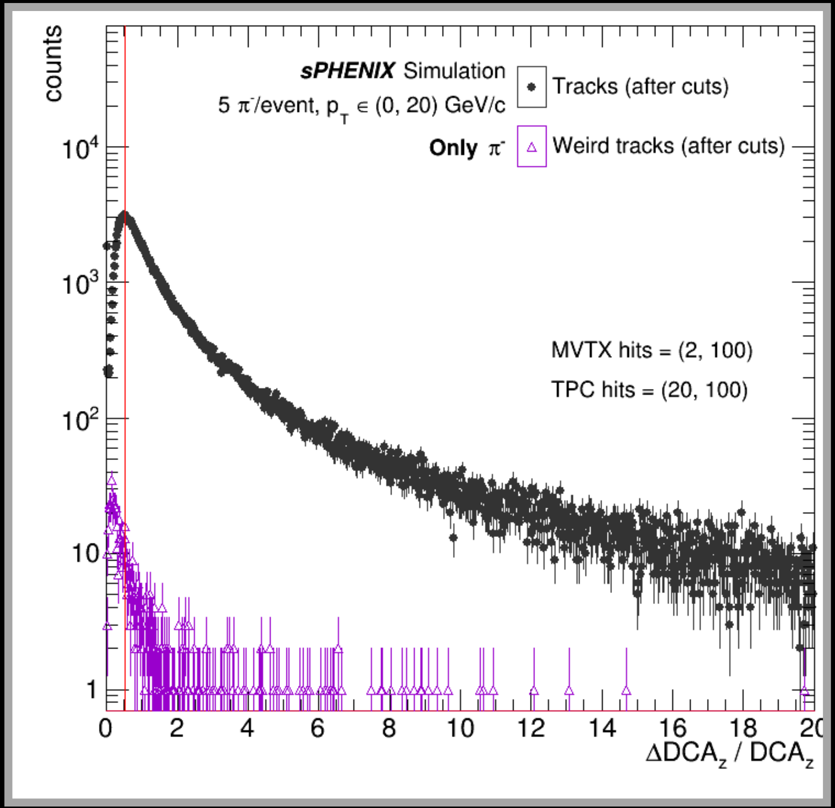




- **Left:** track DCAxy distribution
  Right: track DCAz distribution
  - ☞ Only for 5 π^{-}/event
- **Black** points are all tracks, **purple** points are weird tracks

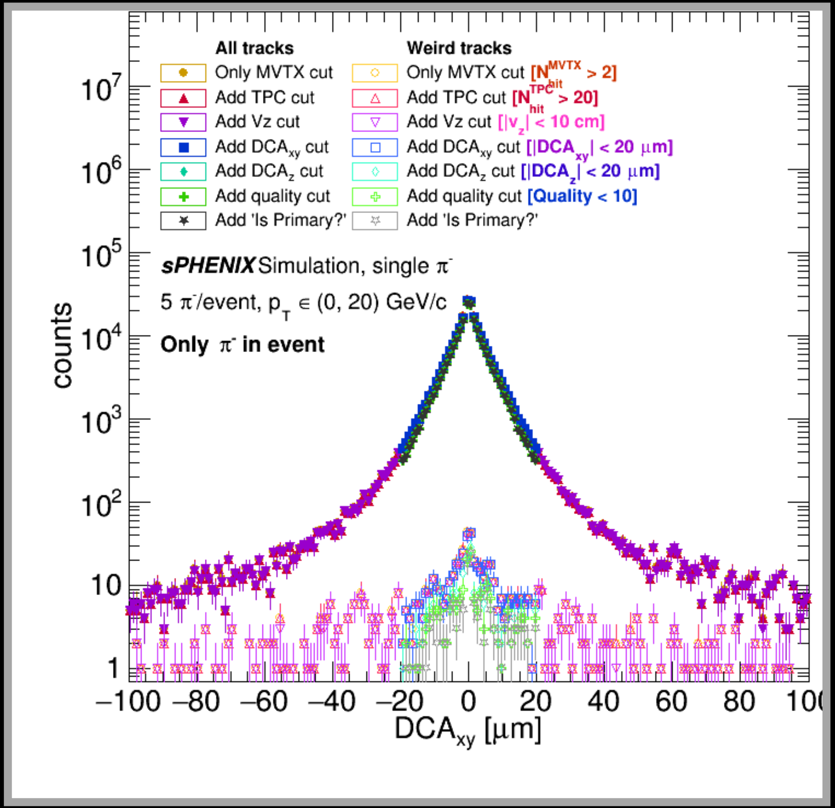
Track σ_{DCA}/DCA Distributions

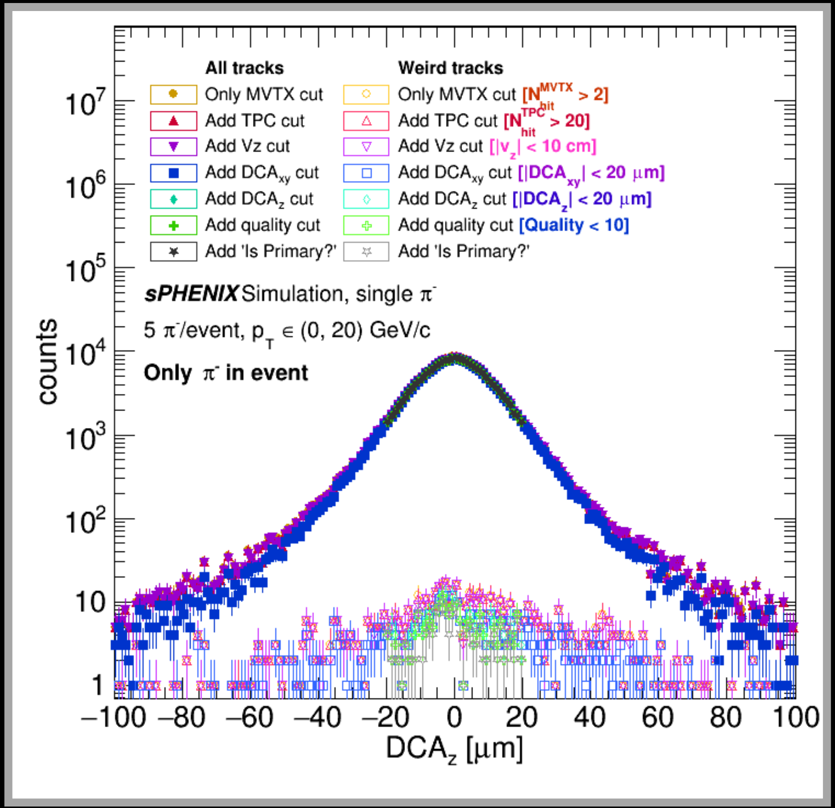




- **Left:** track DCAxy distribution
  Right: track DCAz distribution
  - ☞ Only for 5 π^{-}/event
- **Black** points are all tracks, **purple** points are weird tracks
- **Red** lines indicate maxima of distribution for all tracks

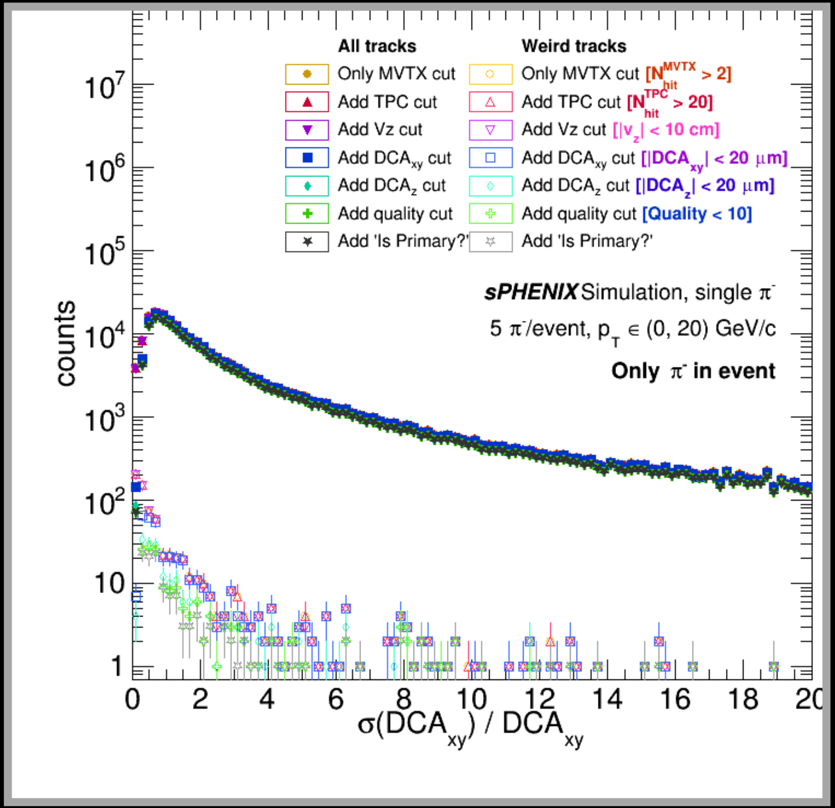
Track DCA vs. Successive Cuts

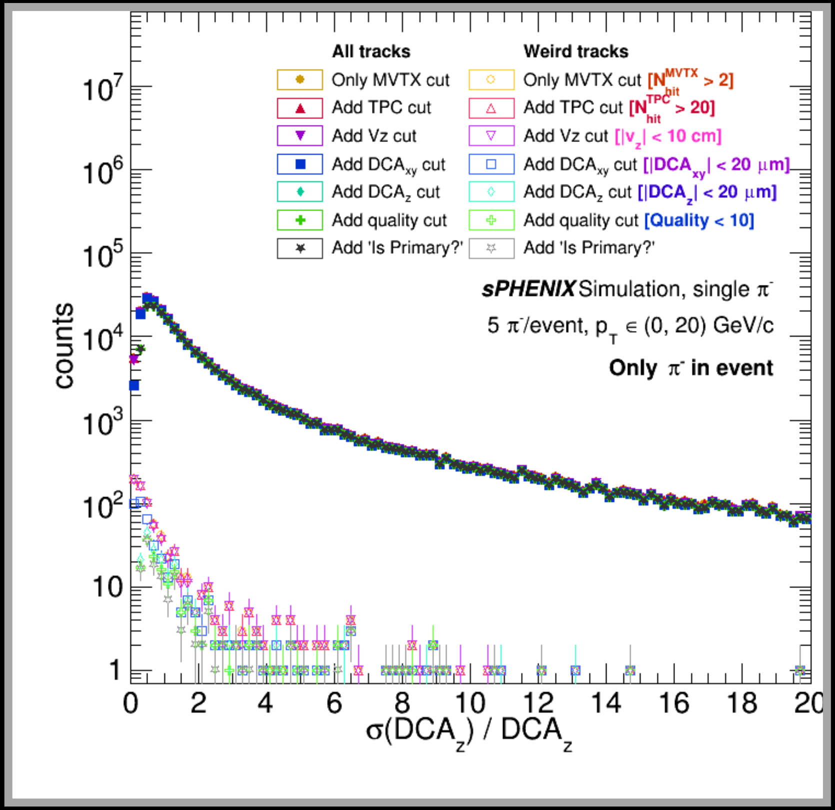




- **Left:** track DCAxy distribution
  Right: track DCAz distribution
  ☞ Only for 5 π^-/event
- **Closed Markers:** all tracks
  Open Markers: weird tracks

Track σ_{DCA}/DCA vs. Successive Cuts



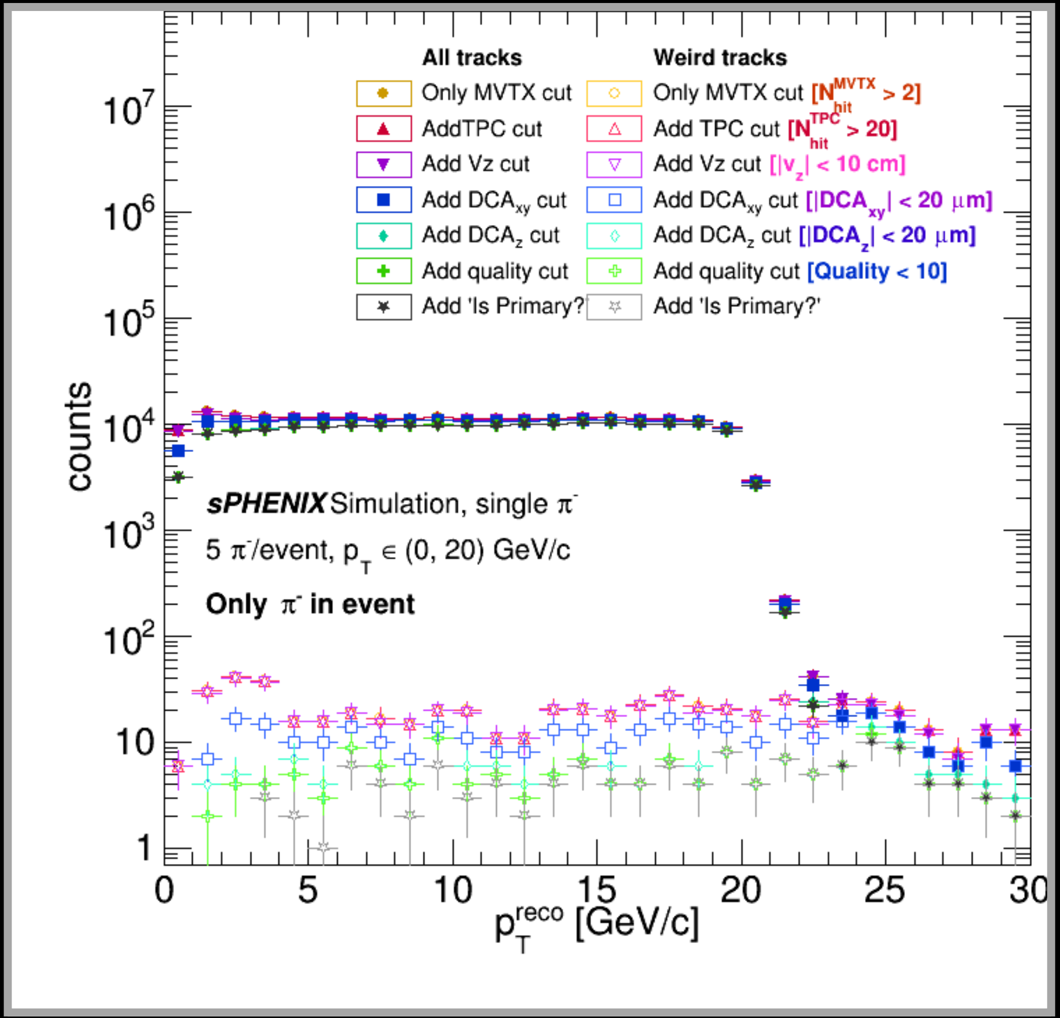


- **Left:** track DCAxy distribution
  Right: track DCAz distribution
  ☞ Only for 5 π^-/event

- **Closed Markers:** all tracks
  Open Markers: weird tracks

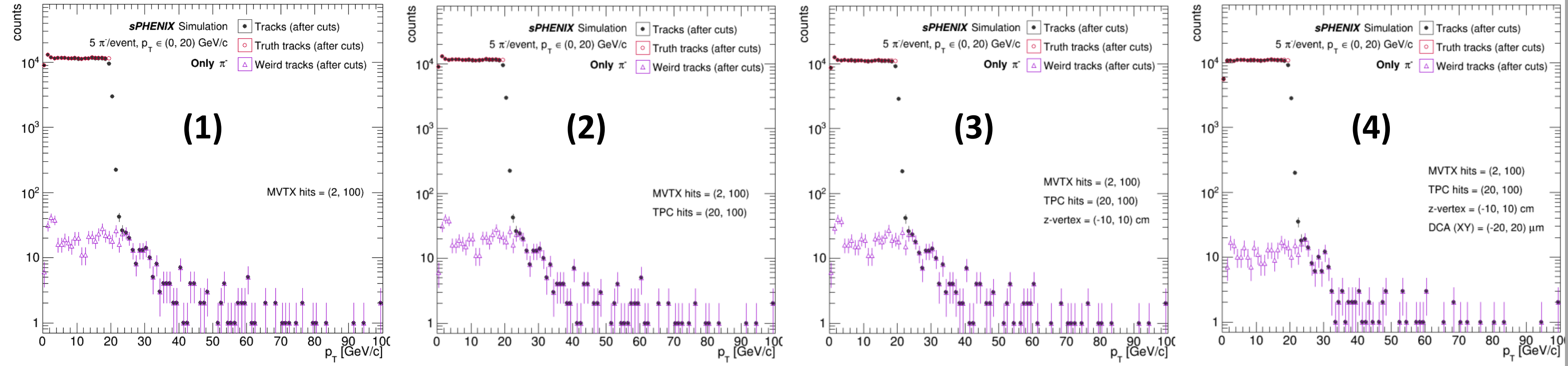
Track p_T vs. Successive Cuts | 1 panel

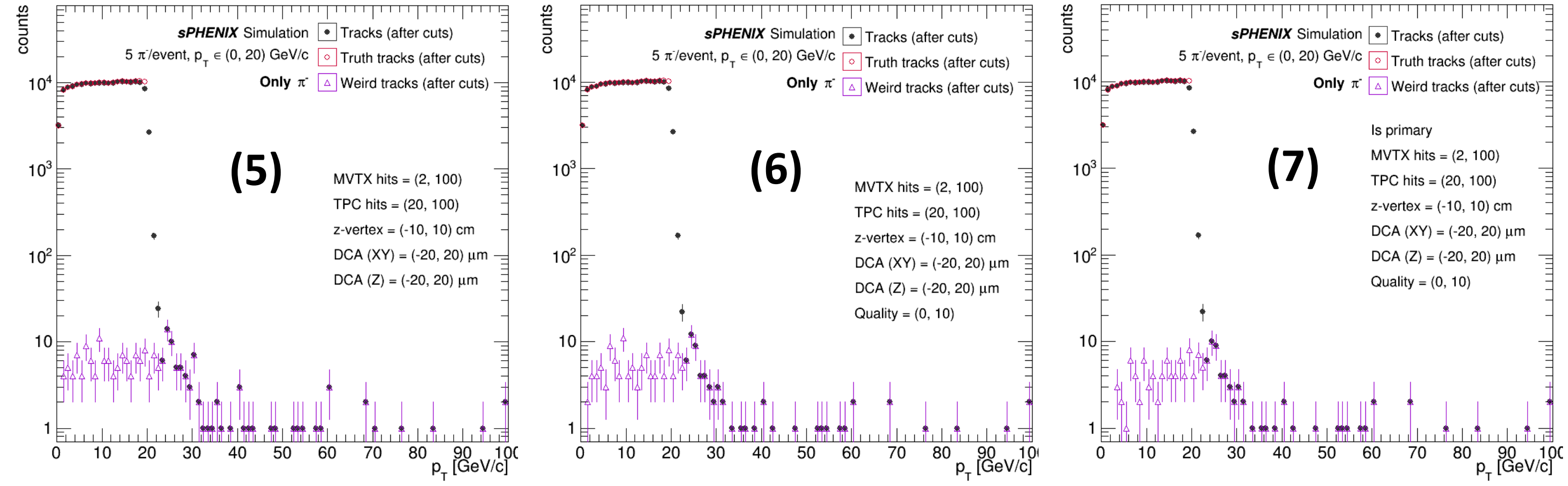
- **Left:** track DCAxy distribution
  Right: track DCAz distribution
  - ☞ Only for 5 π^-/event
- **Closed Markers:** all tracks
  Open Markers: weird tracks



Track p_T vs. Successive Cuts | 7 panels

sPHENIX

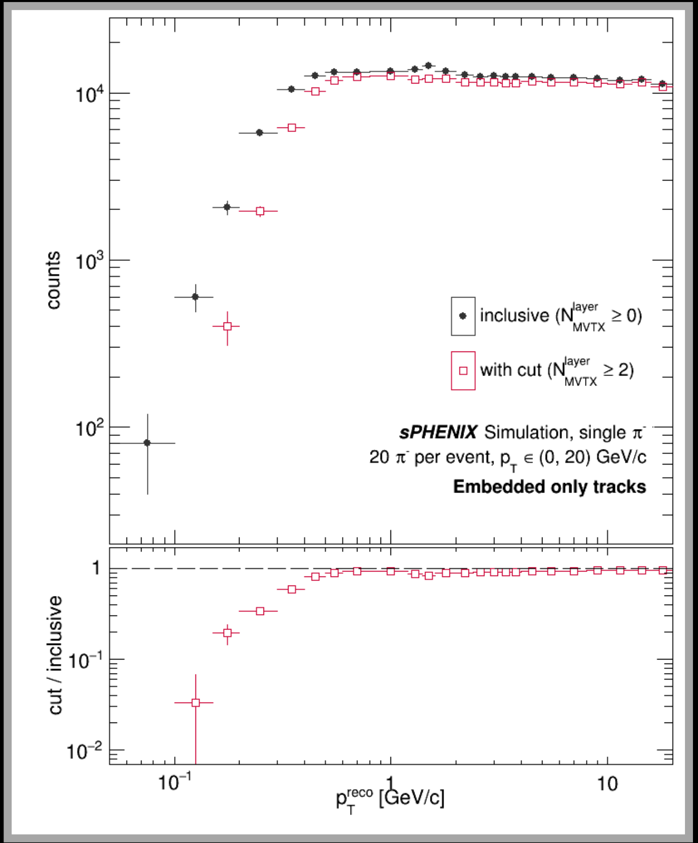


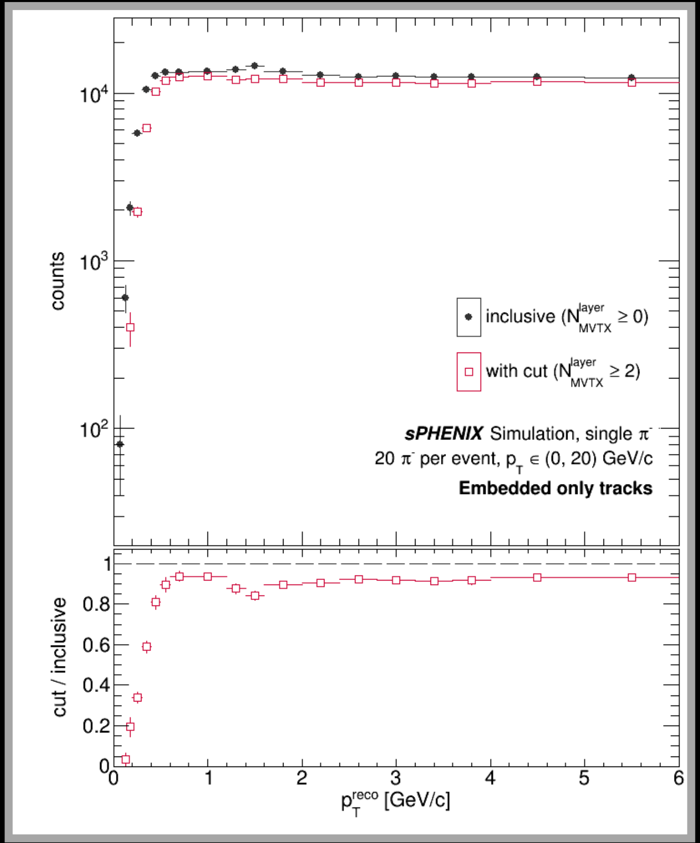


- **Black** points are all tracks, **purple** points are weird tracks
  - ☞ Only for 5 π^{-}/event

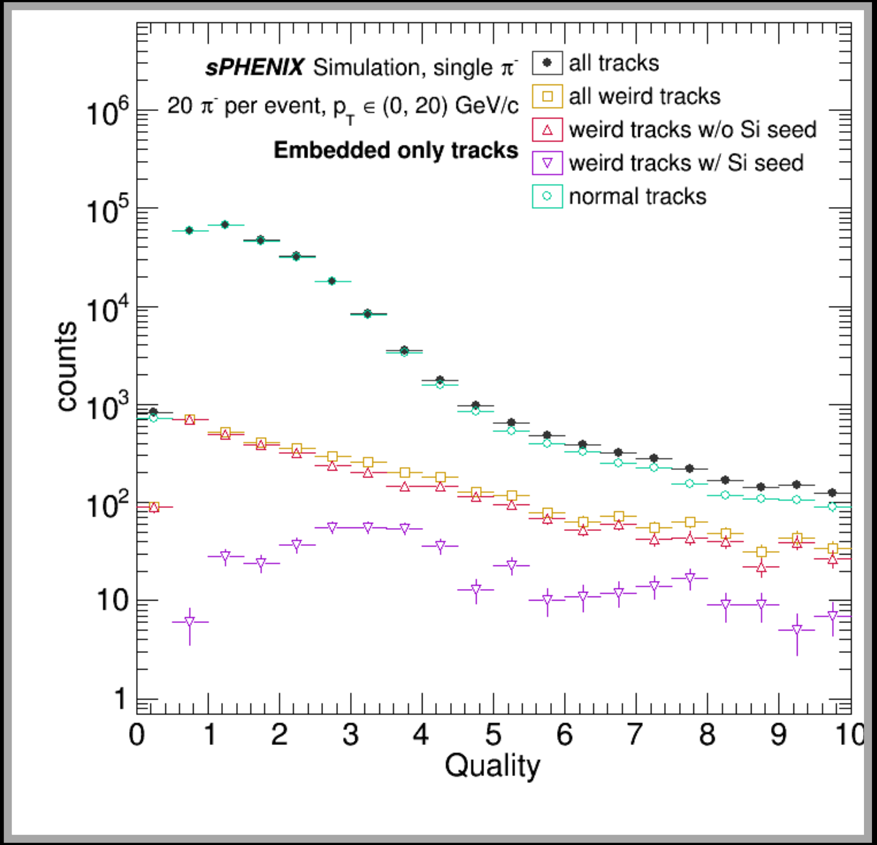
MVTX Hits >= 2 vs. Inclusive

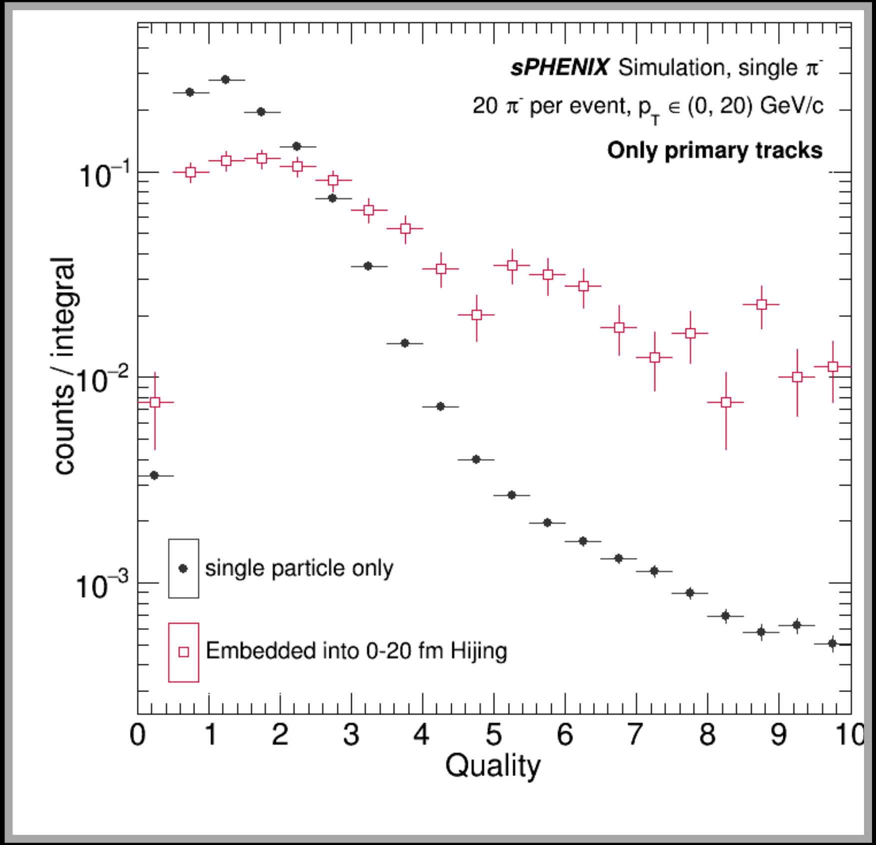
- Reconstructed track p_T of primary tracks w/
  - $N_{MVTX}^{layer} \geq 2$ **(red)** vs.
  - Inclusive **(black)**
- Rebinned left figure on slide 5 to accentuate low-pT region
  - **Left:** log x-axis
  - **Right:** linear x-axis





Track Quality in Hijing

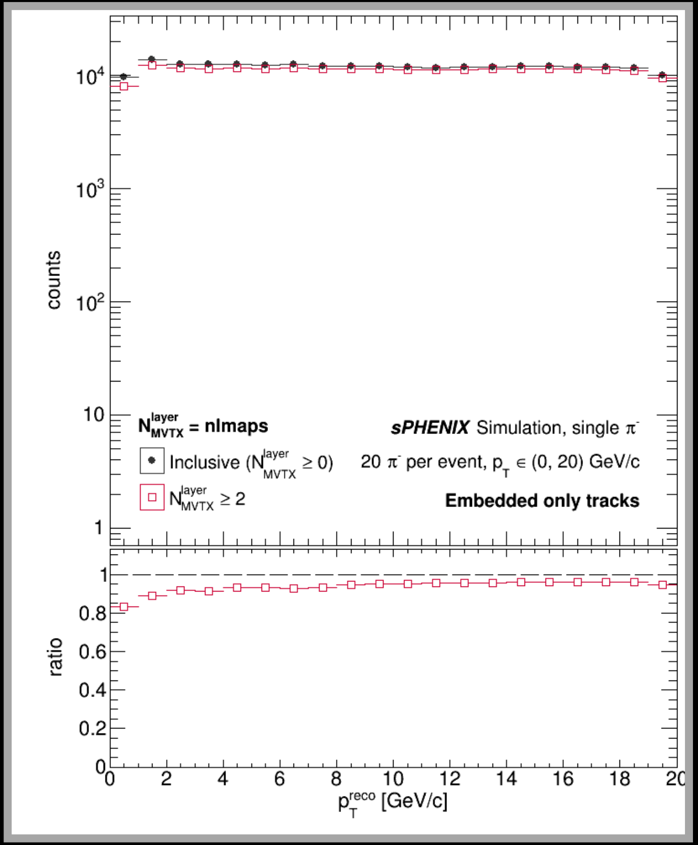


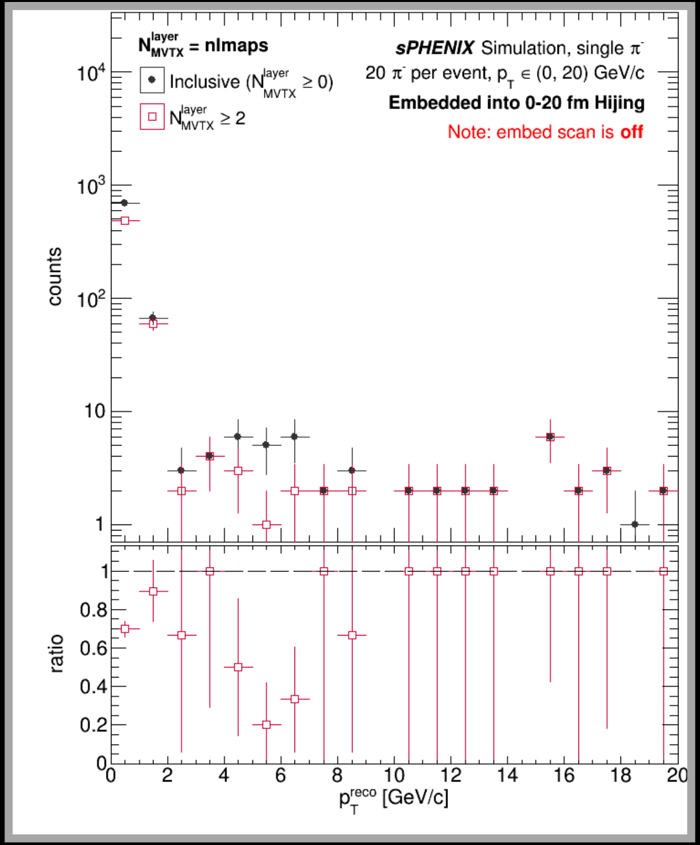


- Ratio of weird/normal (primary) tracks to all (primary) tracks as a function of quality
  - **Left:** single particle only
  - **Right:** single particle vs. embedded into Hijing
- **Reminder:**
  - Weird $\Rightarrow p_T^{reco}/p_T^{true} \notin (0.2,1.20)$
  - Normal $\Rightarrow p_T^{reco}/p_T^{true} \in (0.2,1.20)$

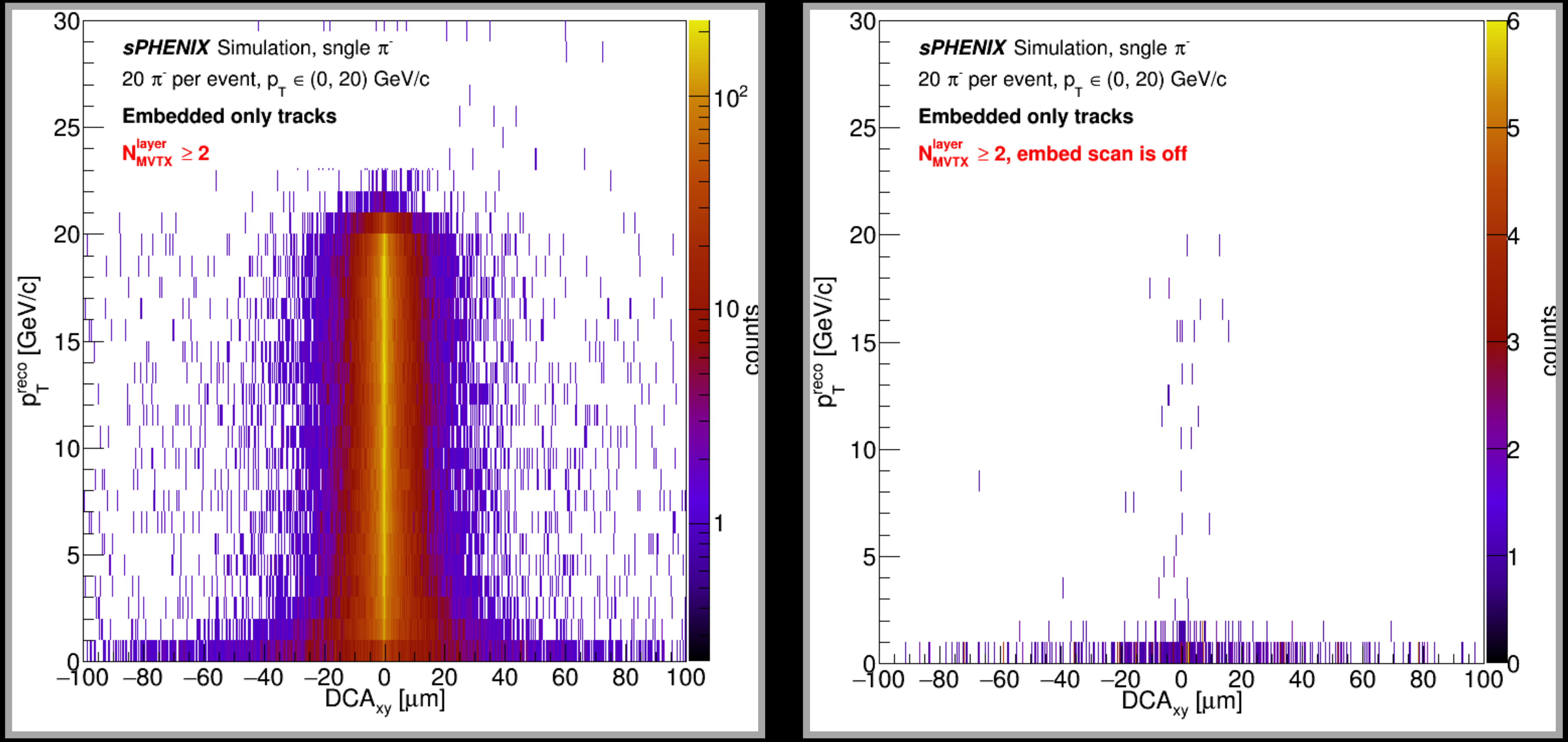
MVTX Hits >= 2 vs. Inclusive | track pT

- Reconstructed track p_T of primary tracks w/
  - $N_{MVTX}^{layer} \geq 2$ **(red)** vs.
  - Inclusive **(black)**
- **Left:** single particle only
  Right: single particles embedded into Hijing
  ⇒ Not enough stats for embedded tracks!





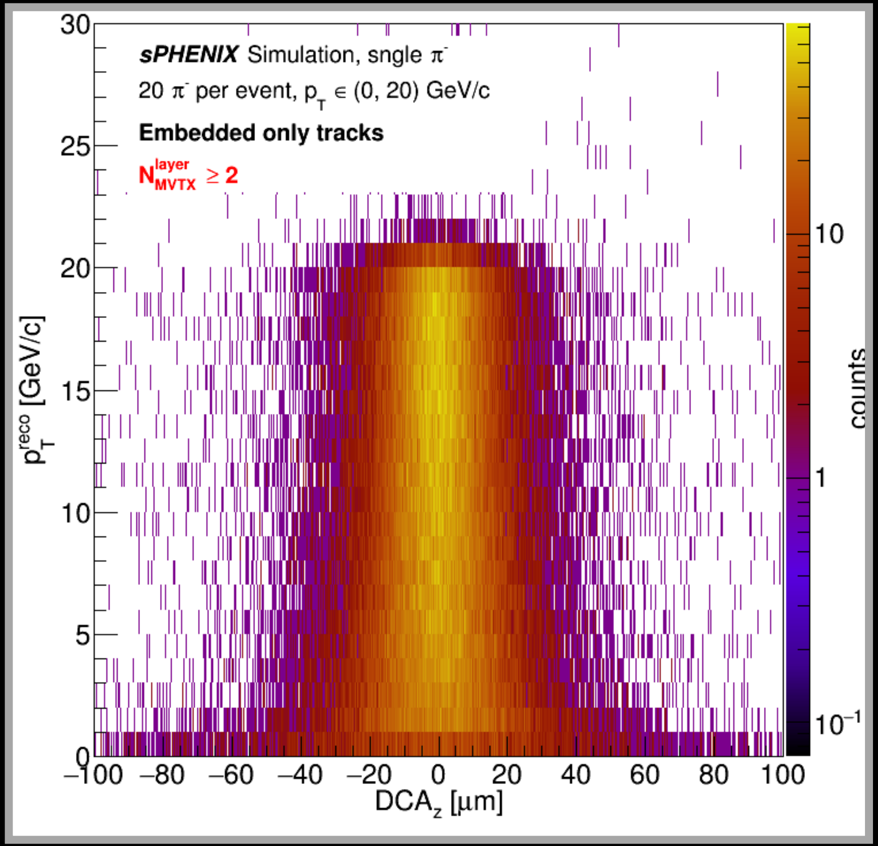
MVTX Hits >= 2 | track DCAxy

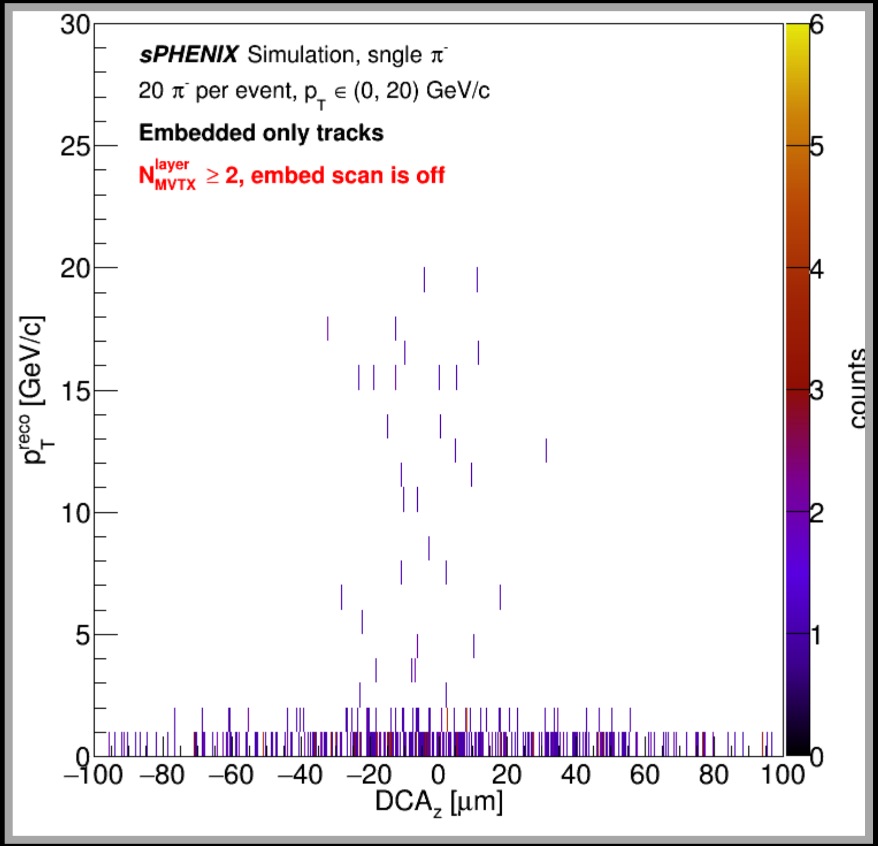


- Primary track DCAxy for primary tracks w/ $N_{MVTX}^{layer} \geq 2$

- **Left:** single particle only
  Right: single particles embedded into Hijing
  ⇒ Not enough stats for embedded tracks!

MVTX Hits >= 2 | track DCAz





- Primary track DCAxy for primary tracks w/ $N^{layer}_{MVTX} \geq 2$

- **Left:** single particle only
  Right: single particles embedded into Hijing
  ⇒ Not enough stats for embedded tracks!

For Next Time

Plots to Make:

- Quality (and other track quantities) vs. N_{TPC}^{hit}
- Average cluster size for weird tracks vs. normal tracks
  - ☞ Do we have access to that in the evaluator?

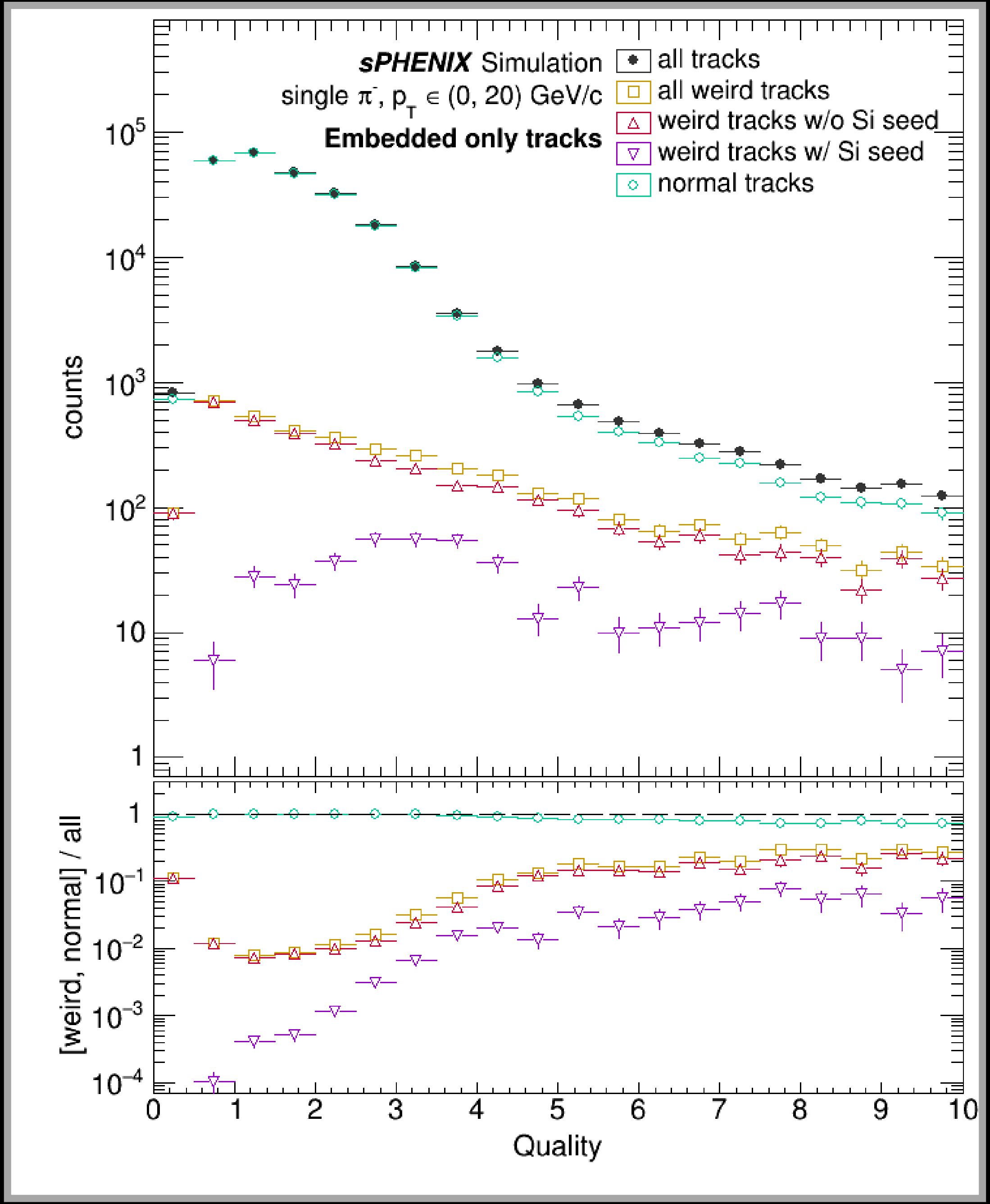
To Take Care Of:

- Finish refactoring code
  - › Did not set it up intelligently 😅
  - › Became unmanageable as the no. of different populations to look at grew
- Generate more embedded stats

Ratio of Weird/Normal Tracks to All

- Ratio of weird/normal (primary) tracks to all (primary) tracks as a function of quality

- **Reminder:**
  - Weird $\Rightarrow p_T^{reco}/p_T^{true} \notin (0.2,1.20)$
  - Normal $\Rightarrow p_T^{reco}/p_T^{true} \in (0.2,1.20)$



Details

- **Weird Tracks:** tracks with $p_T^{trk}/p_T^{true} \notin (0.2, 1.2)$
  - Split weird track population into 2 samples:
    - W/o Silicon Seeds: **nmaps == 0**
    - W/ Silicon Seeds: **nmaps == 3**
- **Normal Tracks:** tracks with $p_T^{trk}/p_T^{true} \in (0.2, 1.2)$

- Color scheme:
  - **Black triangles =** primary tracks
  - **Magenta triangles =** truth
  - **Red X's =** weird primary tracks
  - **Blue circles =** normal primary tracks
- In 2D plots:
  - **Color maps =** all primary tracks
  - **Red X scatter plots =** weird primary tracks
  - **Blue circle scatter plots =** normal primary tracks

- Simulated sample of single π^-
  - 20 π^- per event
  - $p_T^{true} \in (0, 20)$ GeV/c
  - Ran w/ scan_for_embed on

- Using larger sample than in previous updates:
  - No. of primary tracks: **244015**
  - No. of weird tracks: **4175**
    - No. w/o silicon seeds: **3582**
    - No. w/ silicon seeds: **578**
    - **15** weird tracks had nmaps == 4
  - No. of normal tracks: **239840**
- Cuts Applied:
  - **gprimary == 1** (select only primary tracks)
  - Cuts to select weird & normal tracks

Some Observations

Weird Tracks w/o Silicon Seeds

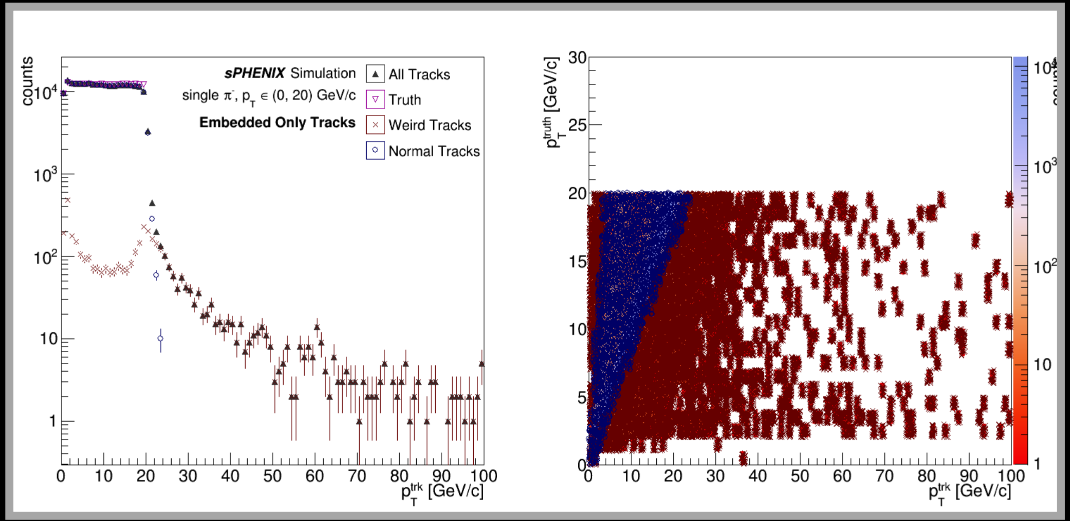
- p_T^{trk} distribution is bimodal (slide 4)
- Majority seem to lie at sector boundaries in phi (slide 5)
- Majority have large DCAxy values (slides 6 and 7)
  - Show no correlation in DCAz (slides 8 and 9)
- χ^2/ndf distribution is falling (slide 10)

Weird Tracks w/ Silicon Seeds

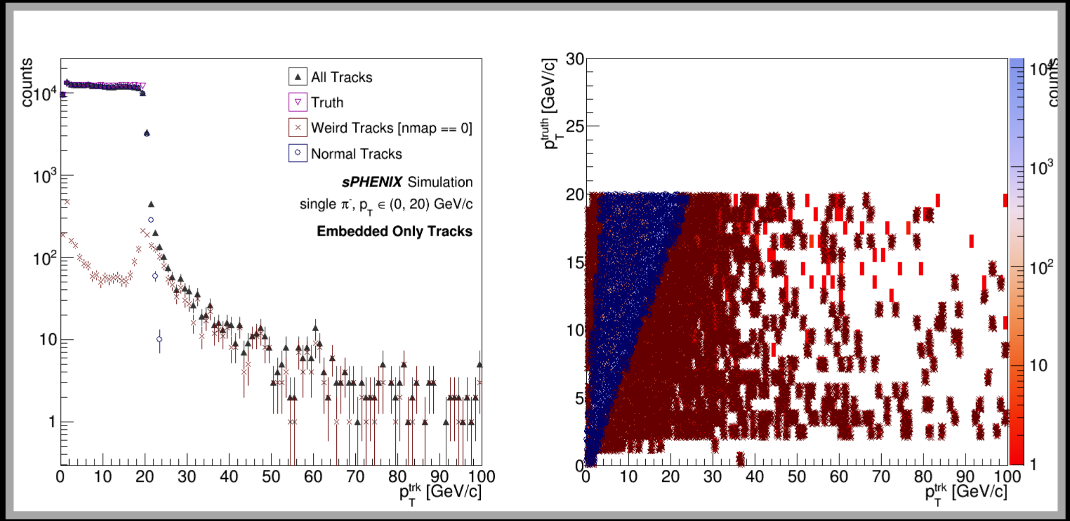
- p_T^{trk} distribution is unimodal (slide 4)
- No correlation in phi (slide 5)
- χ^2/ndf distribution is roughly flat (slide 10)

Track Pt

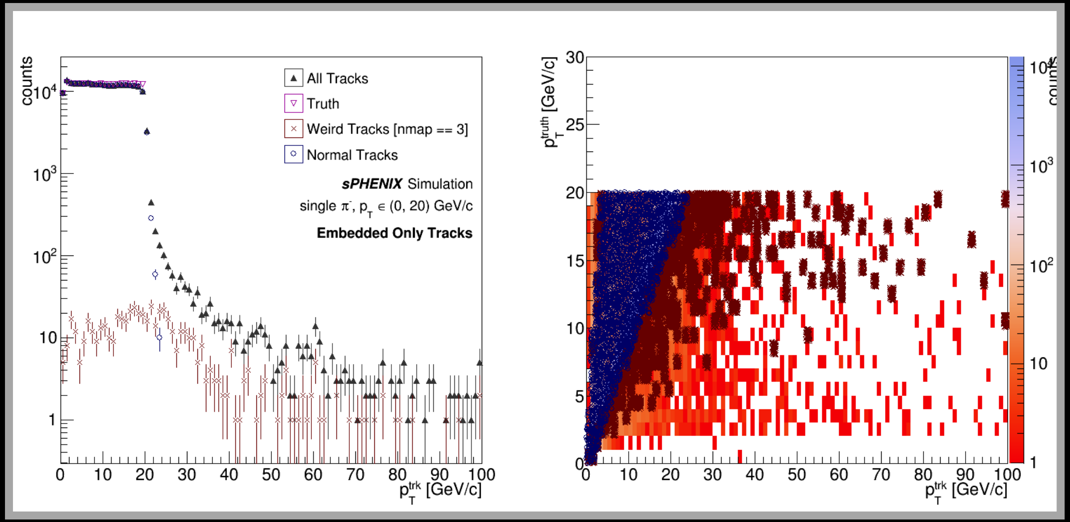
All Weird Tracks



Weird Tracks w/o Silicon Seeds



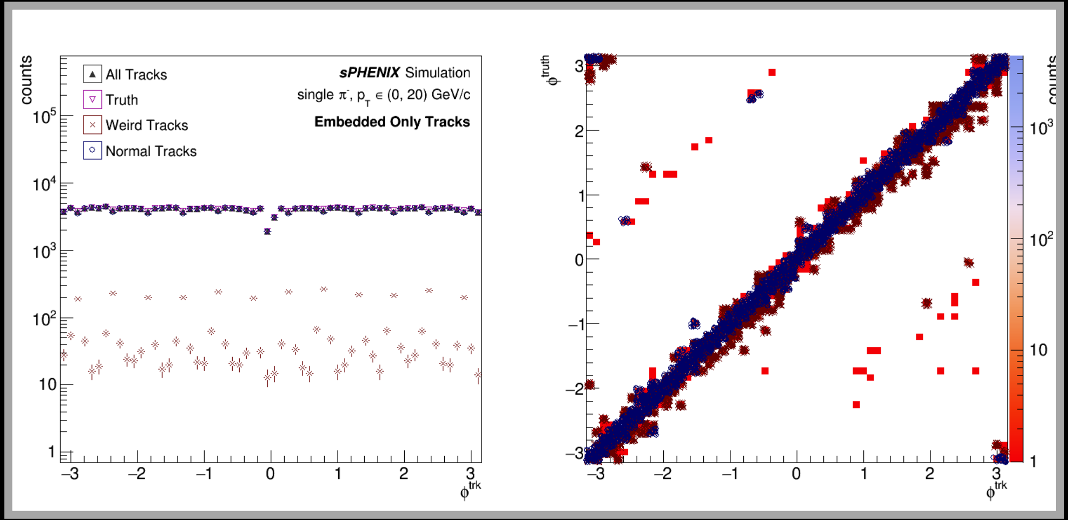
Weird Tracks w/ Silicon Seeds



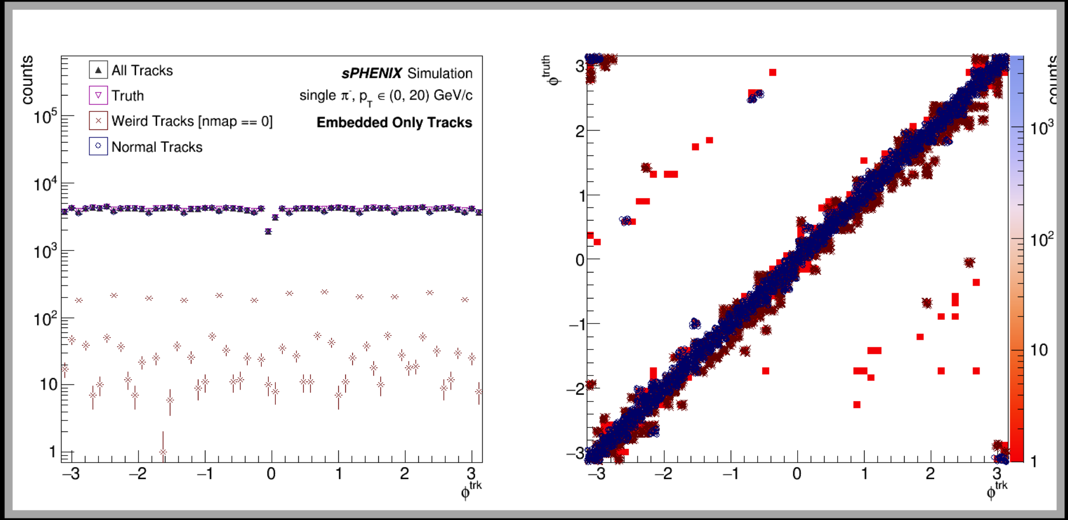
- Reconstructed and truth p_T
  - reco. p_T (left panels)
  - reco. vs. truth p_T (right panels)
  - **pt vs. gpt** leaves of ntp_track tuple
- **Note:** y-axes are **not** scaled
  - y-axis range changes between plots (apologies!)

Track Phi

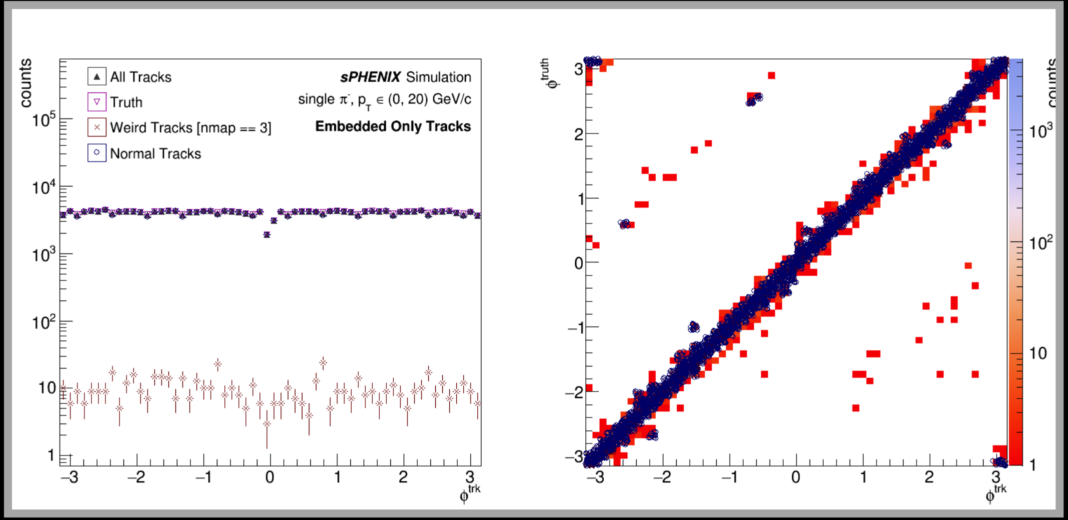
All Weird Tracks



Weird Tracks w/o Silicon Seeds



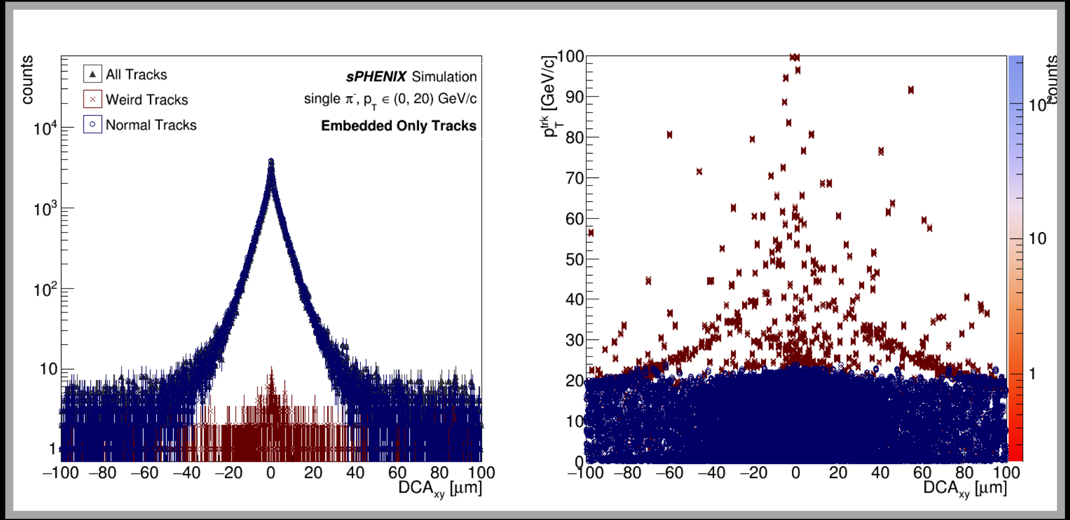
Weird Tracks w/ Silicon Seeds



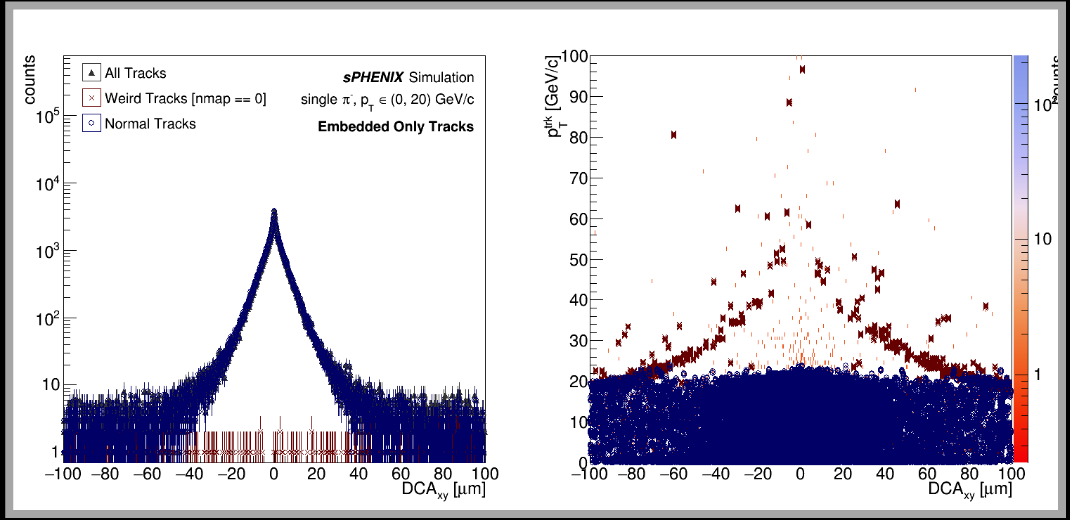
- Reconstructed and truth phi
  - reco. phi (left panels)
  - reco. vs. truth phi (right panels)
  - **phi vs. gphi** leaves of ntp_track tuple
- **Note:** y-axes are **not** scaled
  - y-axis range changes between plots (apologies!)

Track DCAxy

All Weird Tracks



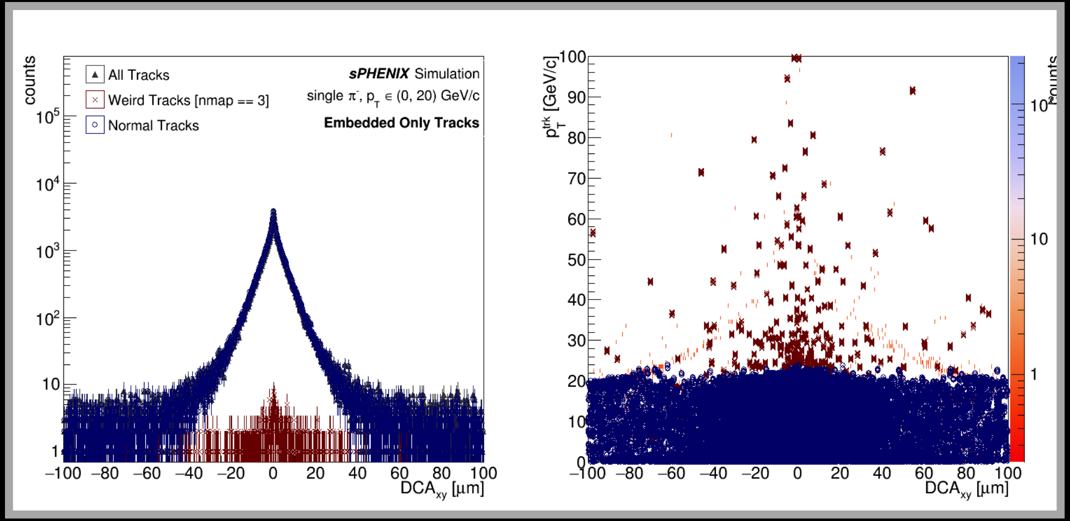
Weird Tracks w/o Silicon Seeds



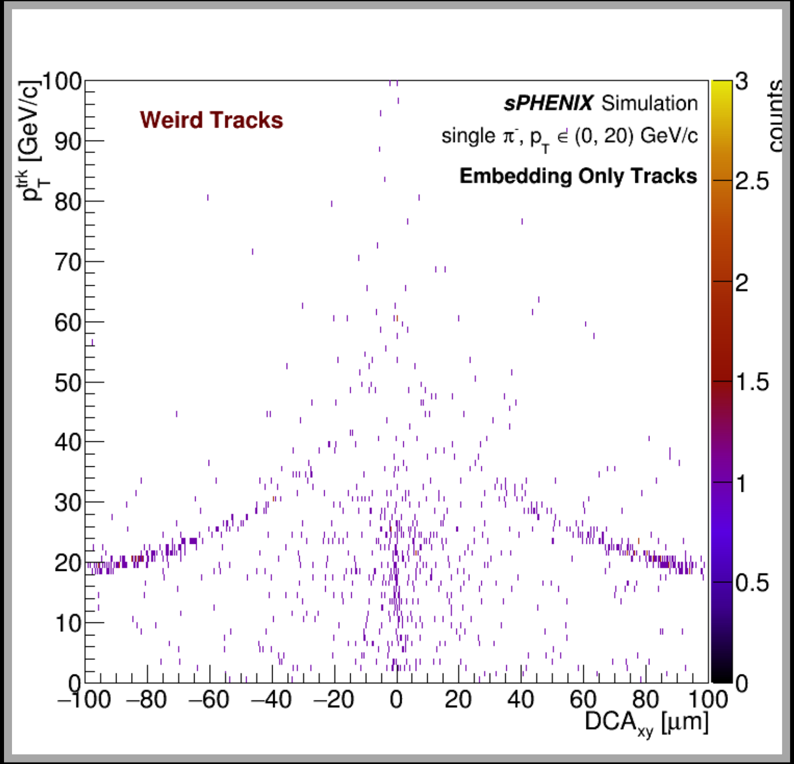
- Track DCAxy
  - Track DCAxy (left panels)
  - DCAxy vs. p_T^{trk} (right panels)
  - **dca3dxy vs. pt** leaves of ntp_track tuple

- **Note:** y-axes are **not** scaled
  - y-axis range changes between plots (apologies!)

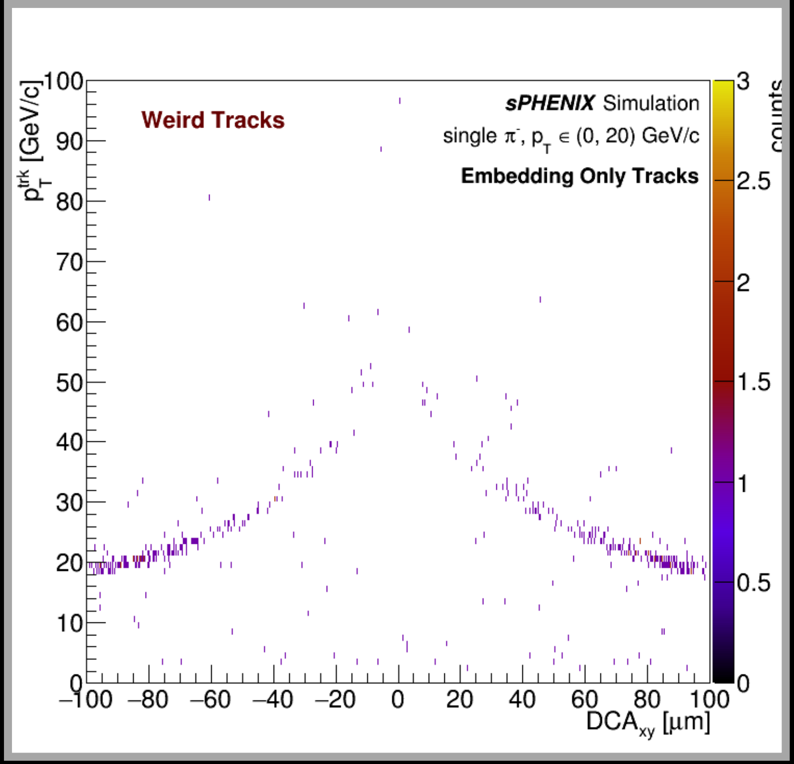
Weird Tracks w/ Silicon Seeds



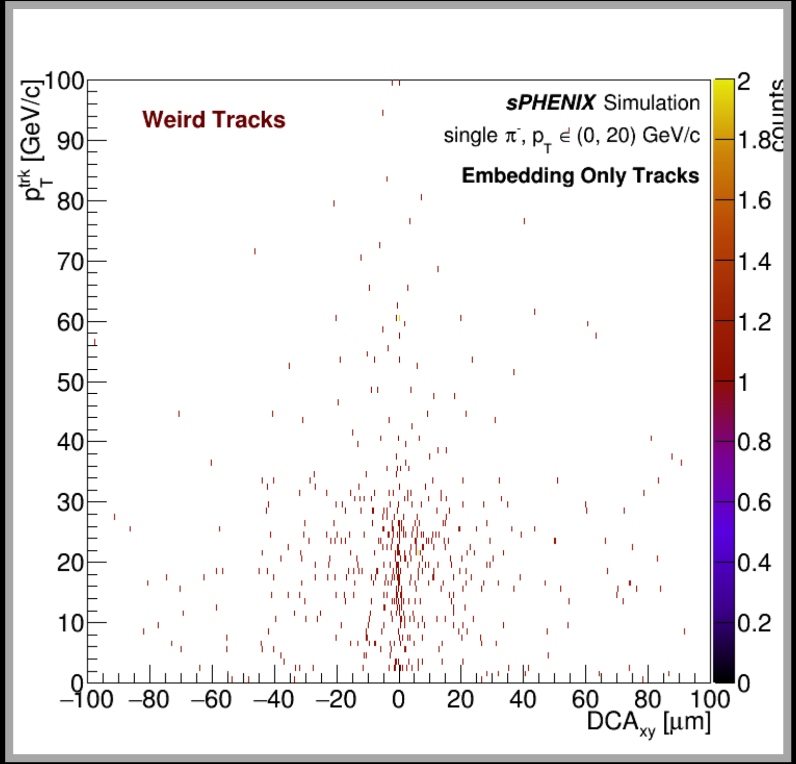
Weird Track DCAxy



All Weird Tracks



Weird Tracks w/o Silicon Seeds

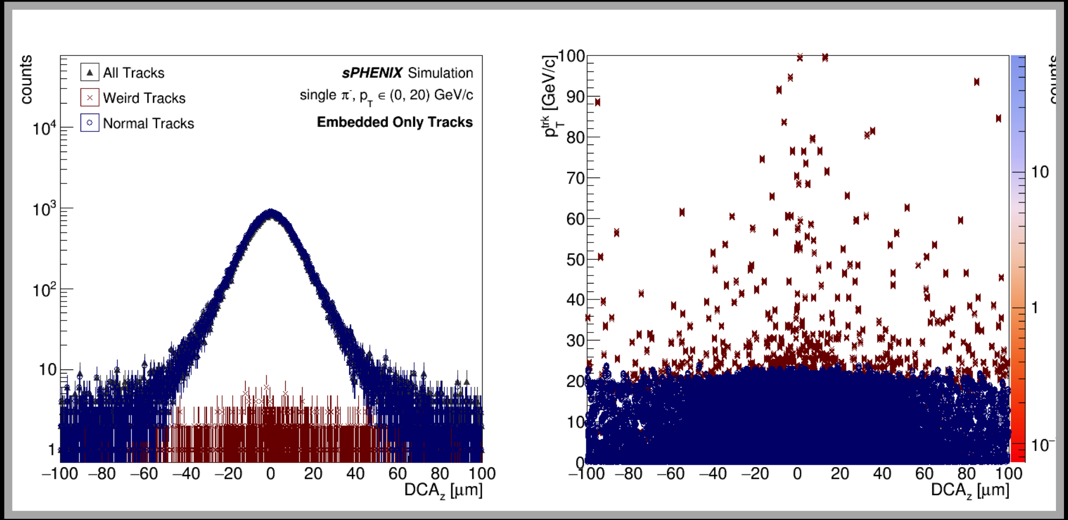


Weird Tracks w/ Silicon Seeds

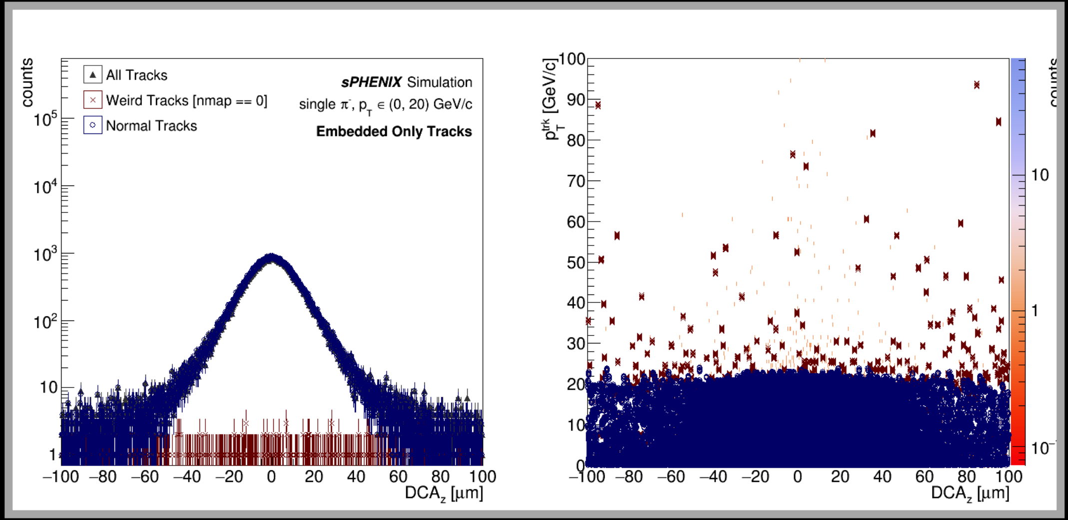
- Weird track DCAxy
  - **dca3dxy** leaf of ntp_track tuple for only weird tracks
- **Note:** z-axes are **not** scaled
  - z-axis range changes between plots (apologies!)

Track DCAz

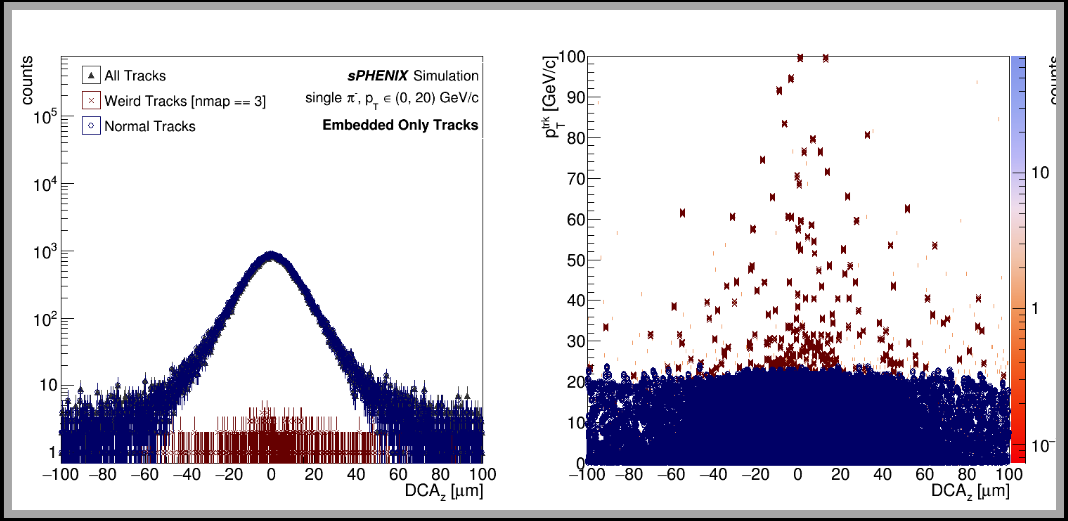
All Weird Tracks



Weird Tracks w/o Silicon Seeds



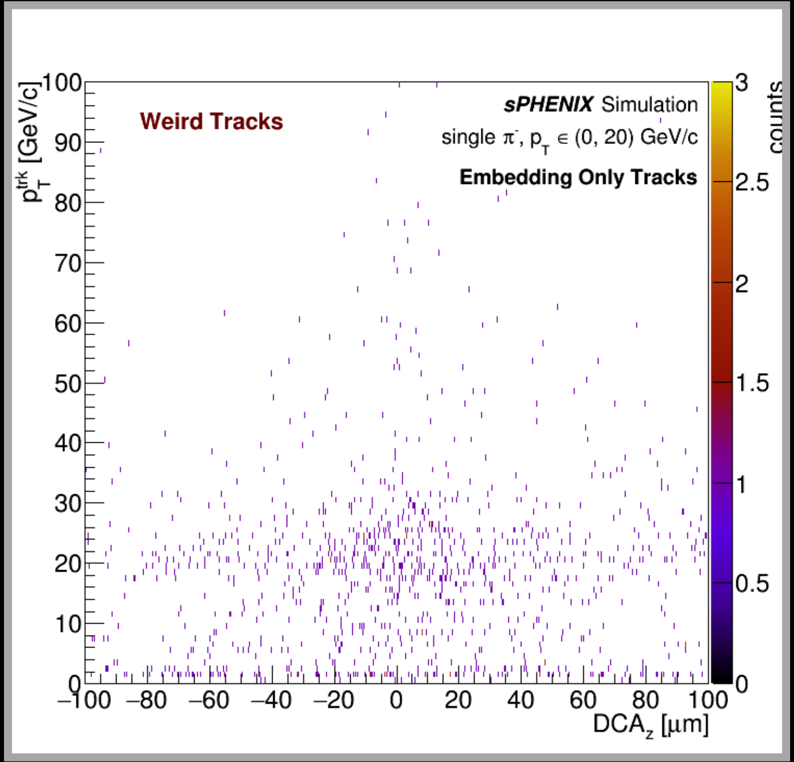
Weird Tracks w/ Silicon Seeds

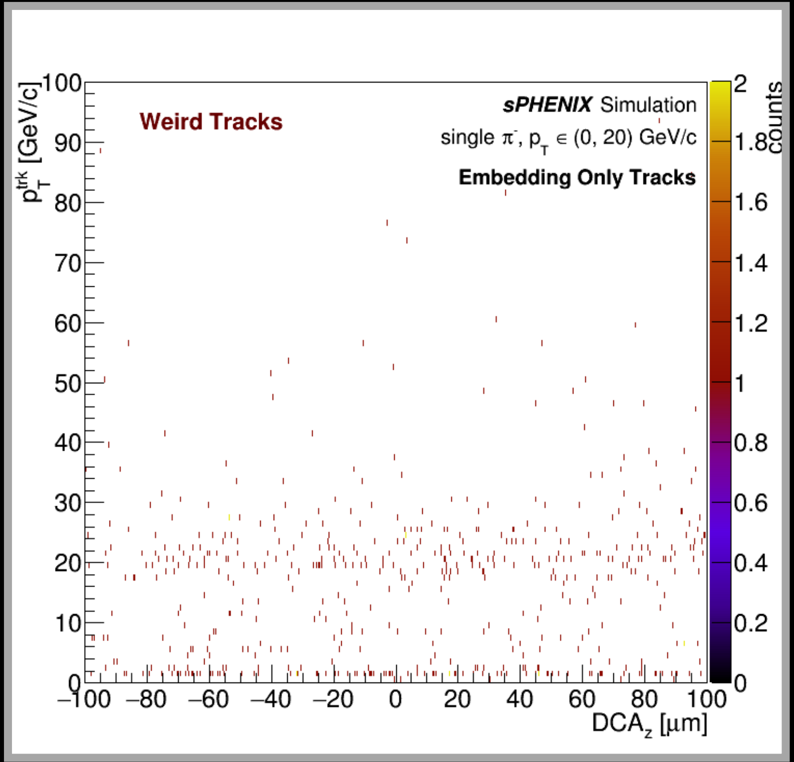


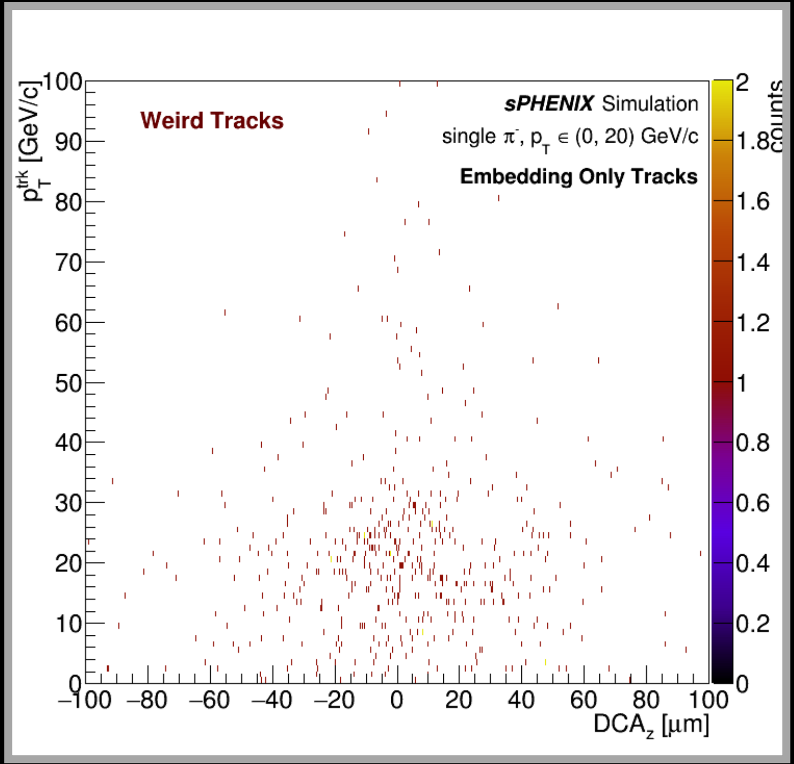
- Track DCAz
  - Track DCAz (left panels)
  - DCAz vs. p_T^{trk} (right panels)
  - **dca3dz vs. pt** leaves of ntp_track tuple

- **Note:** y-axes are **not** scaled
  - y-axis range changes between plots (apologies!)

Weird Track DCAz





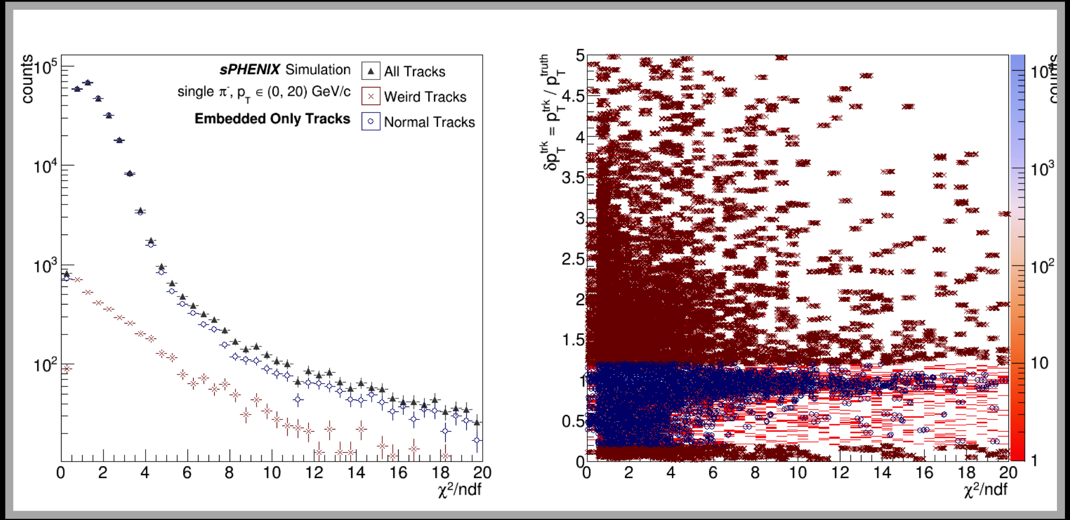


All Weird Tracks | **Weird Tracks w/o Silicon Seeds** | **Weird Tracks w/ Silicon Seeds**

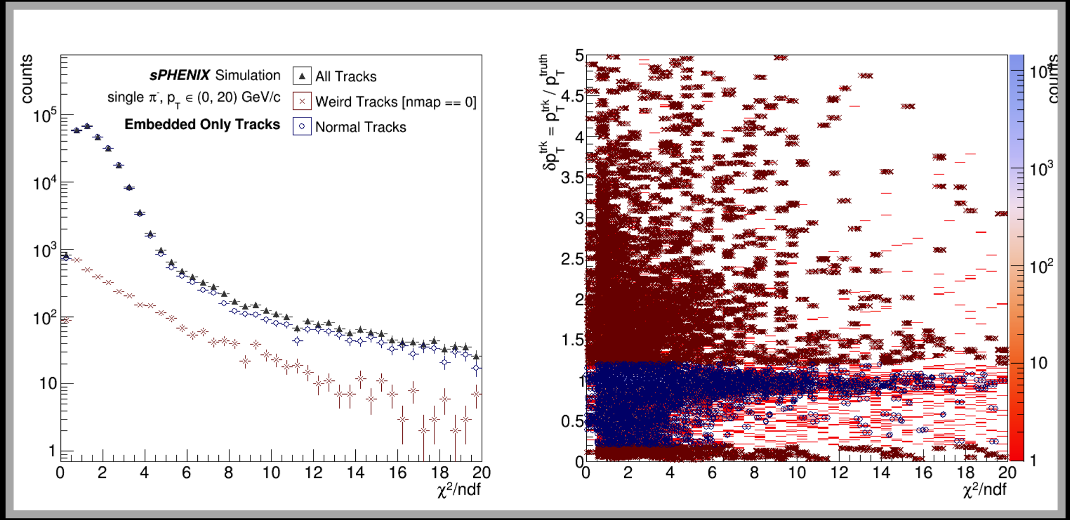
- Weird track DCAz
  - **dca3dz** leaf of ntp_track tuple for only weird tracks
- **Note:** z-axes are **not** scaled
  - z-axis range changes between plots (apologies!)

Track Quality

All Weird Tracks

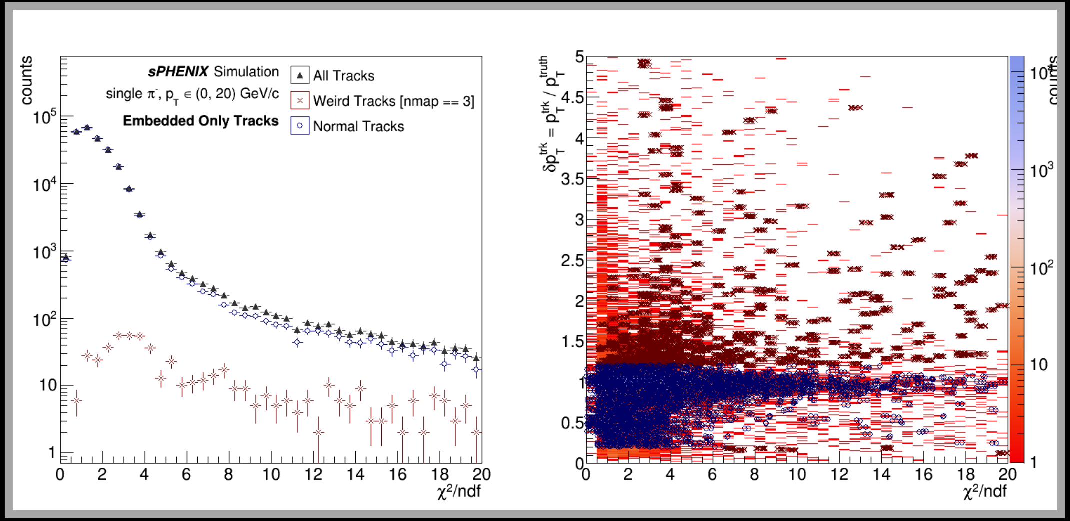


Weird Tracks w/o Silicon Seeds



- Track χ^2/ndf
  - Track χ^2/ndf (left panels)
  - χ^2/ndf vs. p_T^{trk}/p_T^{true} (right panels)
  - **quality vs. pt/gpt** leaves of ntp_track tuple

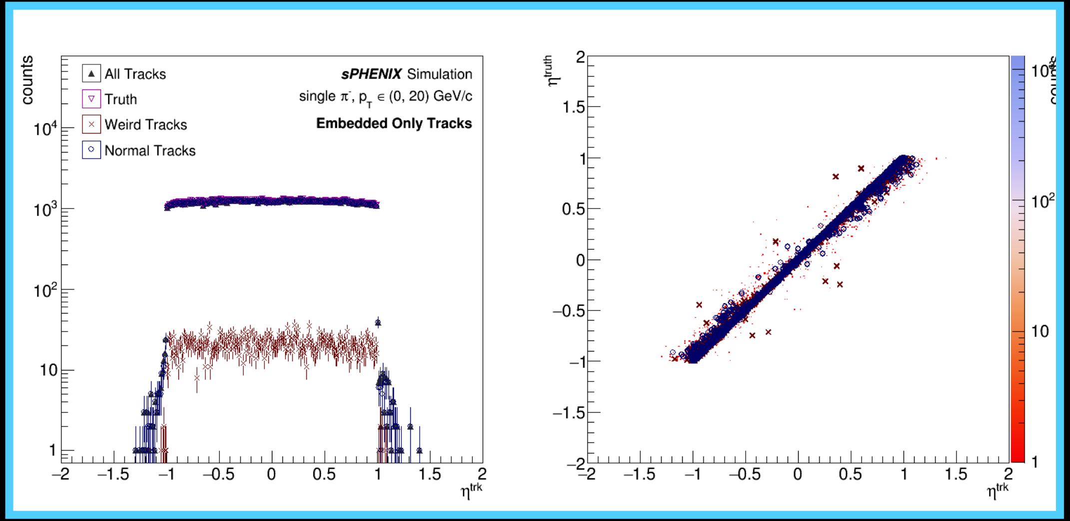
Weird Tracks w/ Silicon Seeds



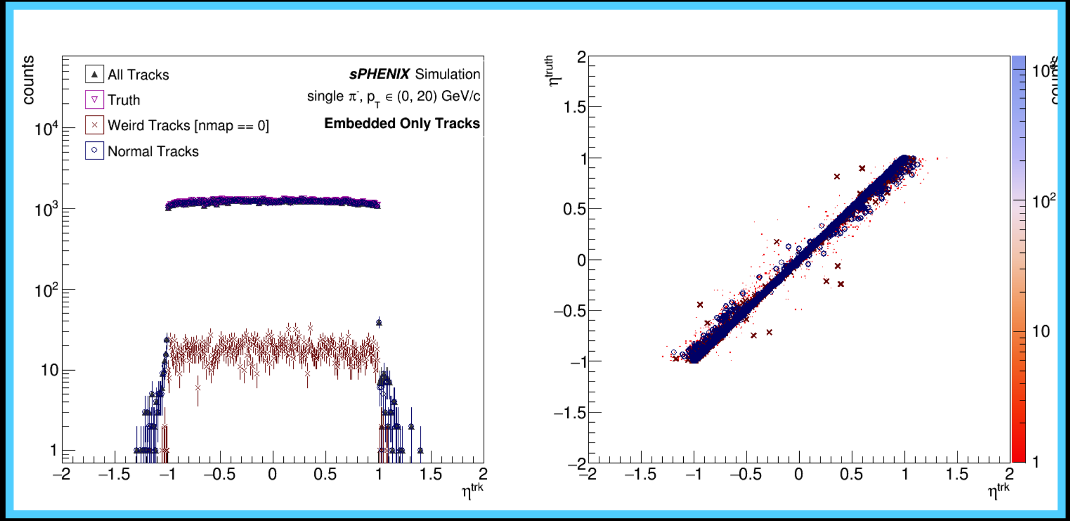
- **Note:** y-axes are **not** scaled
  - y-axis range changes between plots (apologies!)

Track Eta

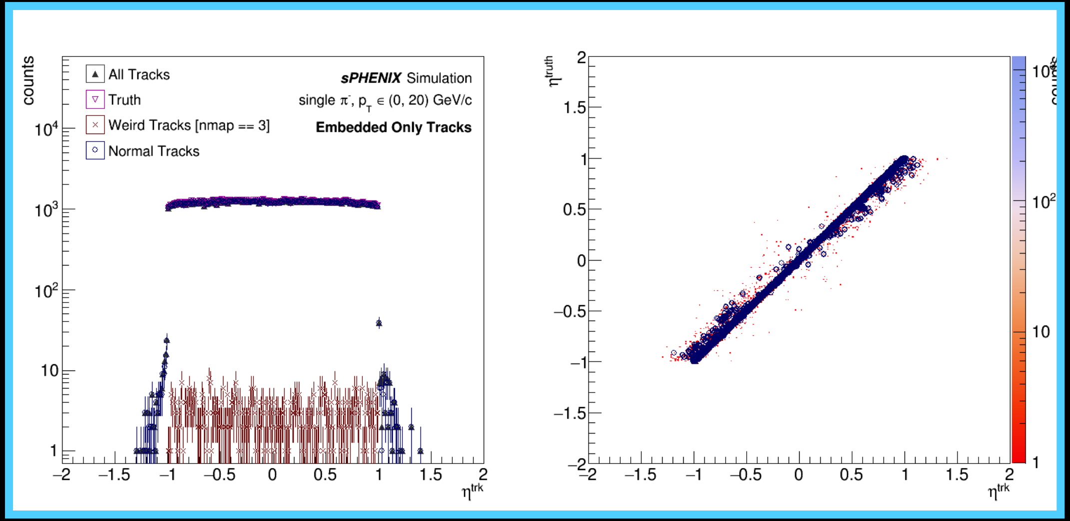
All Weird Tracks



Weird Tracks w/o Silicon Seeds

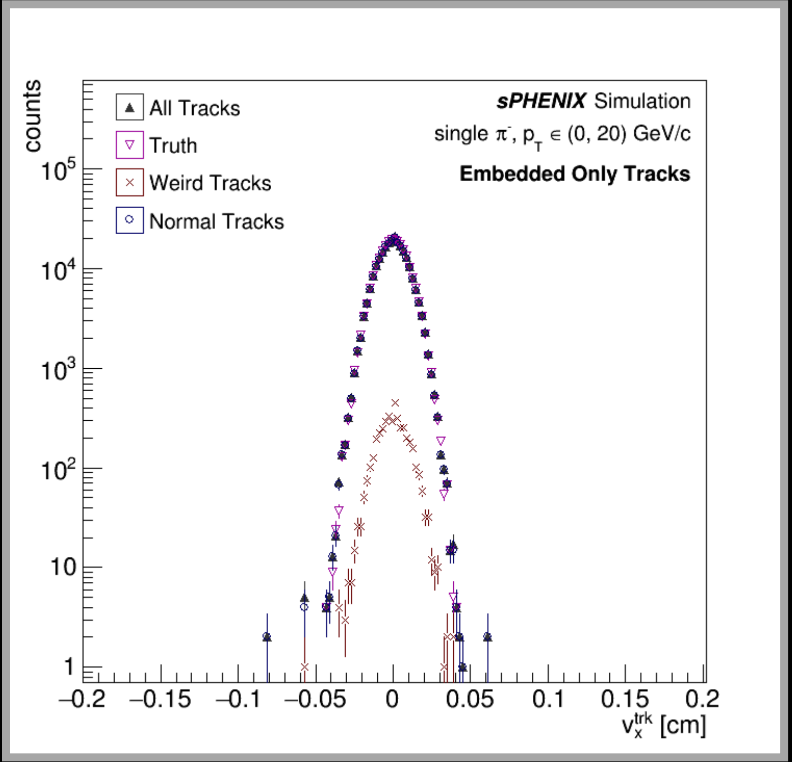


Weird Tracks w/ Silicon Seeds

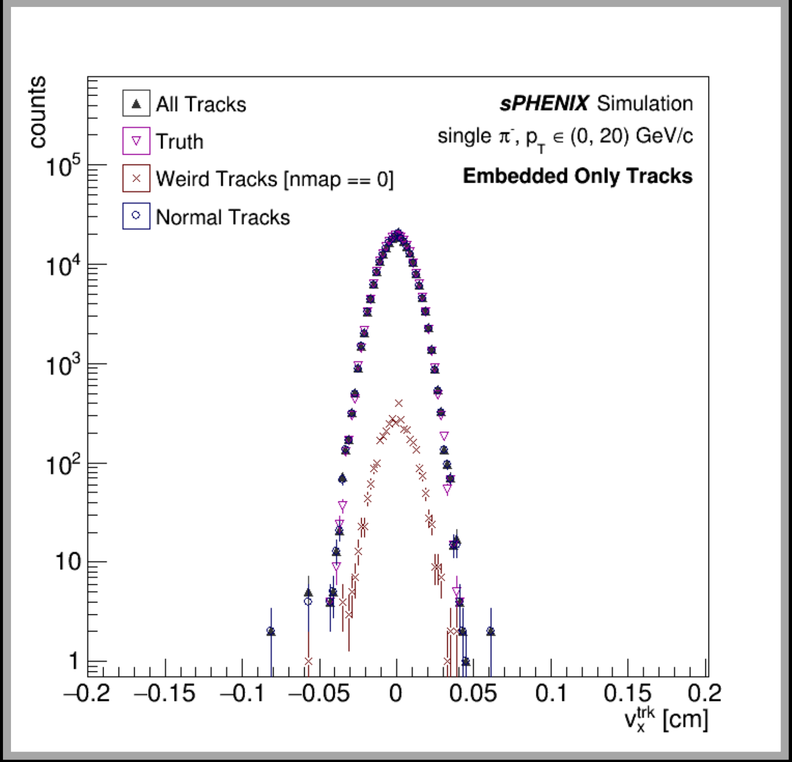


- Reconstructed and truth eta
  - reco. eta (left panels)
  - reco. vs. truth eta (right panels)
  - **eta vs. geta** leaves of ntp_track tuple
- **Note:** y-axes are **not** scaled
  - y-axis range changes between plots (apologies!)

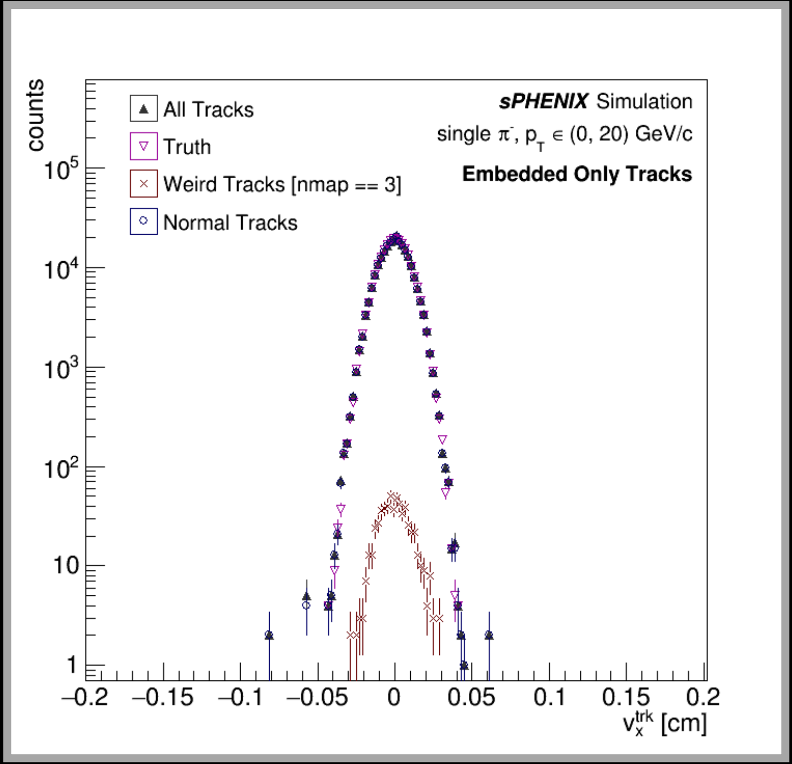
Track X-Vertex



All Weird Tracks



Weird Tracks w/o Silicon Seeds



Weird Tracks w/ Silicon Seeds

- X-component of reconstructed vertex
  - **vx** leaf of ntp_track tuple
- **Note:** y-axes are **not** scaled
  - y-axis range changes between plots (apologies!)