

Track Cut Study: Update

sPHENIX Tracking Meeting

January 26th, 2023

Derek Anderson



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

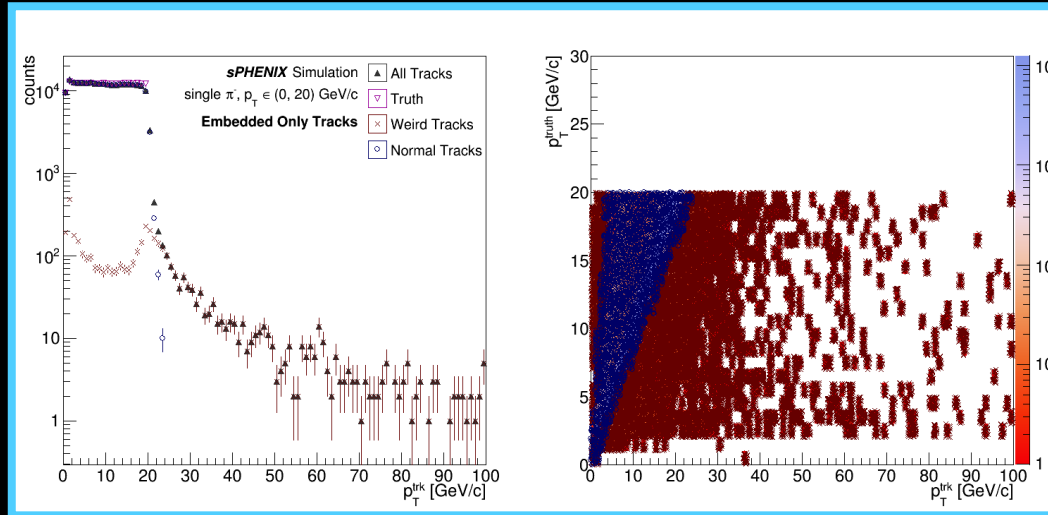
Weird Tracks w/o Silicon Seeds

- 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)

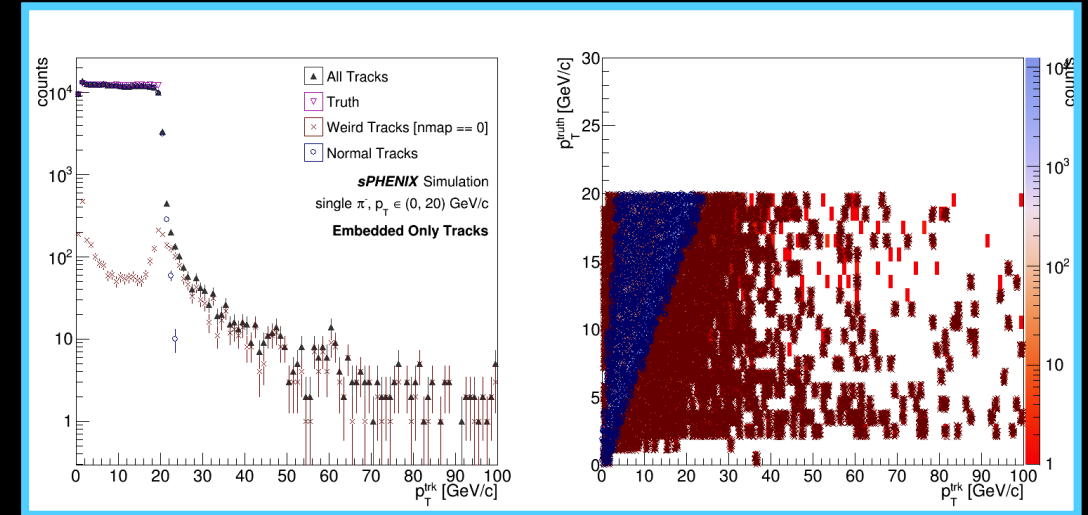
Weird Tracks w/ Silicon Seeds

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

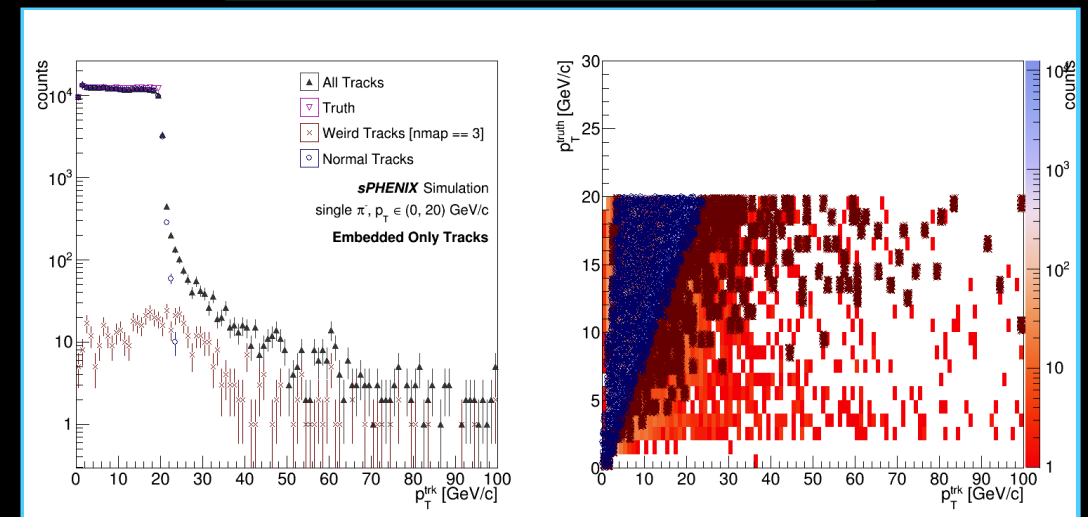
All Weird Tracks



Weird Tracks w/o Silicon Seeds



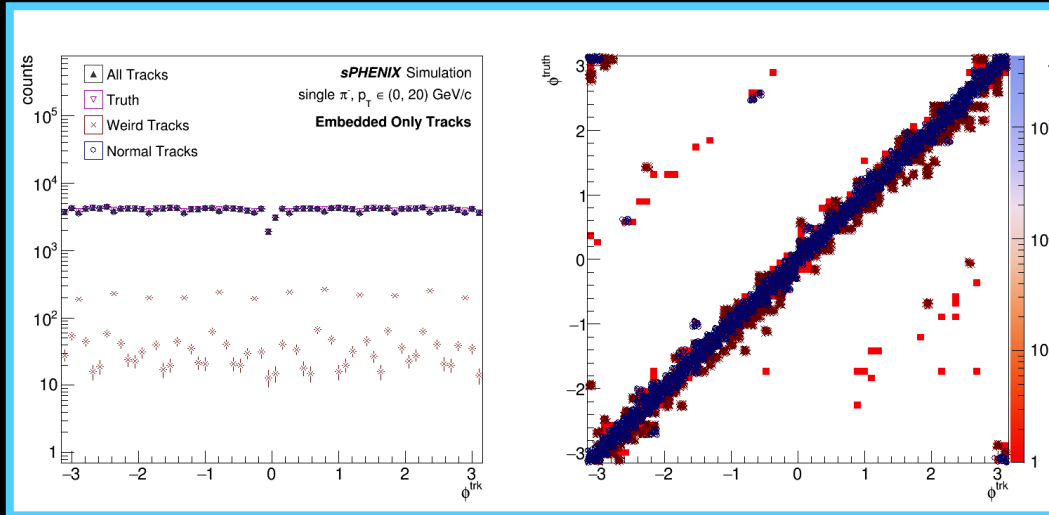
Weird Tracks w/ Silicon Seeds



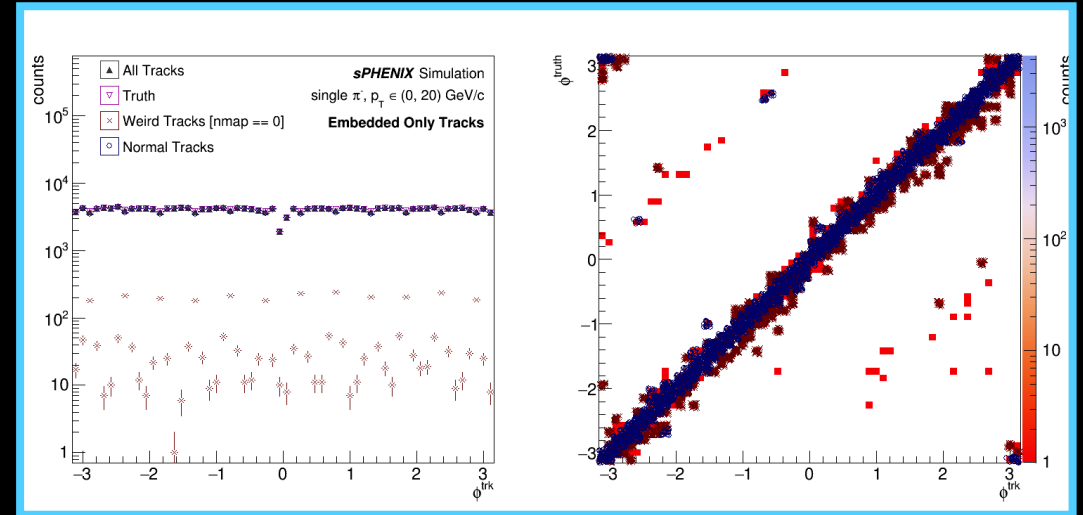
- Reconstructed and truth p_T
 - reco. p_T (left panels)
 - reco. vs. truth p_T (right panels)
 - **pt vs. gpt** leaves of ntp_track tuple
- **Note:** y-axes are **not** scaled
 - y-axis range changes between plots (apologies!)

Track Phi

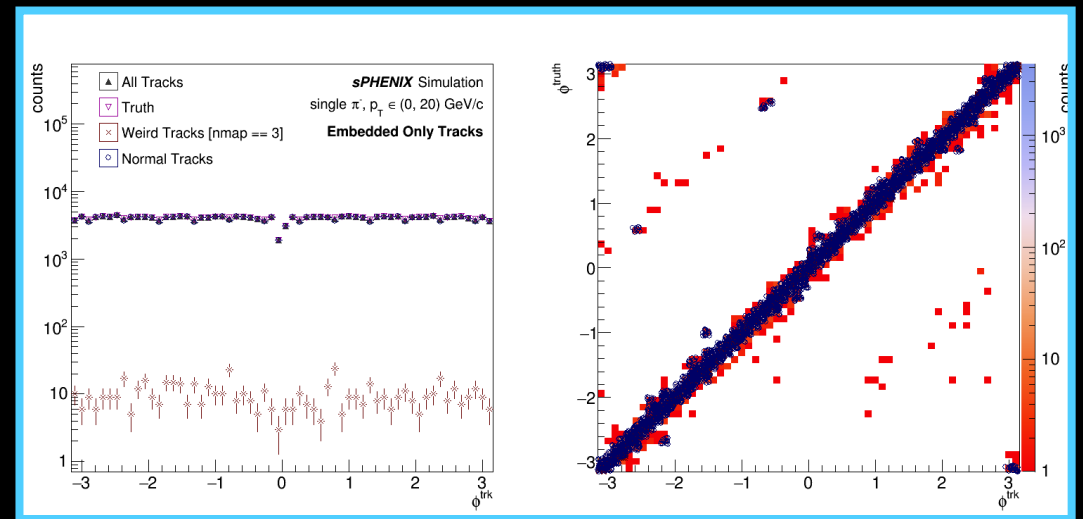
All Weird Tracks



Weird Tracks w/o Silicon Seeds

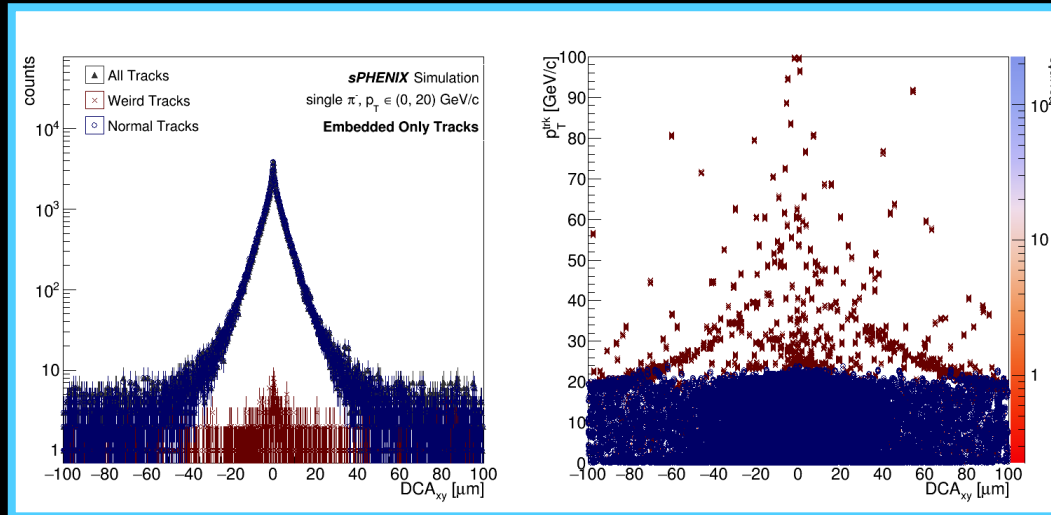


Weird Tracks w/ Silicon Seeds

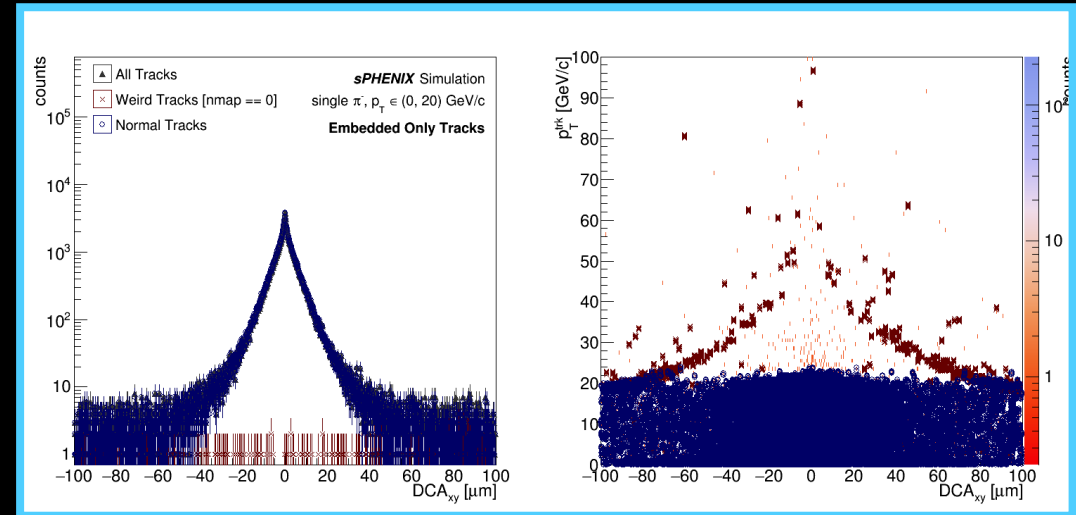


- Reconstructed and truth phi
 - reco. phi (left panels)
 - reco. vs. truth phi (right panels)
 - **phi vs. gphi** leaves of ntp_track tuple
- **Note:** y-axes are **not** scaled
 - y-axis range changes between plots (apologies!)

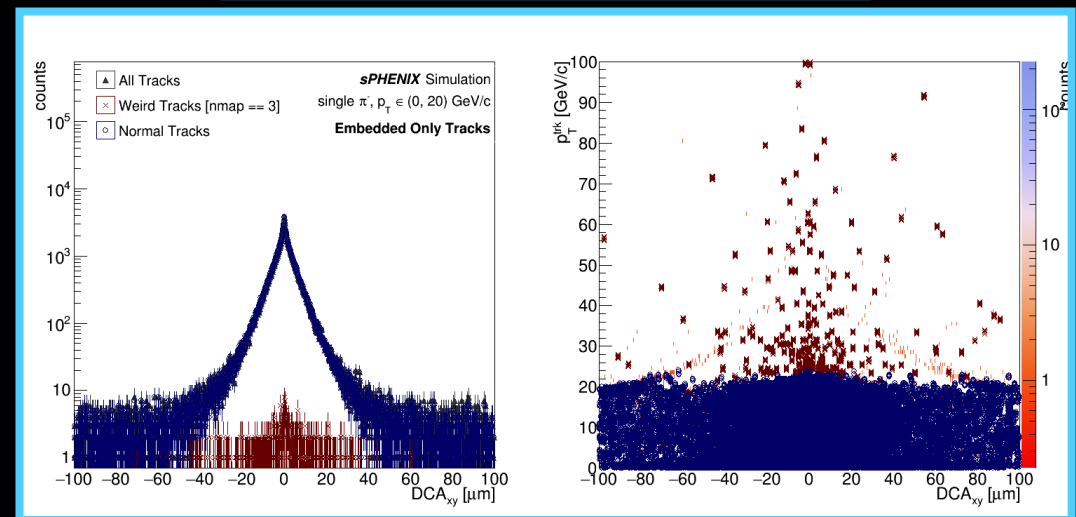
All Weird Tracks



Weird Tracks w/o Silicon Seeds

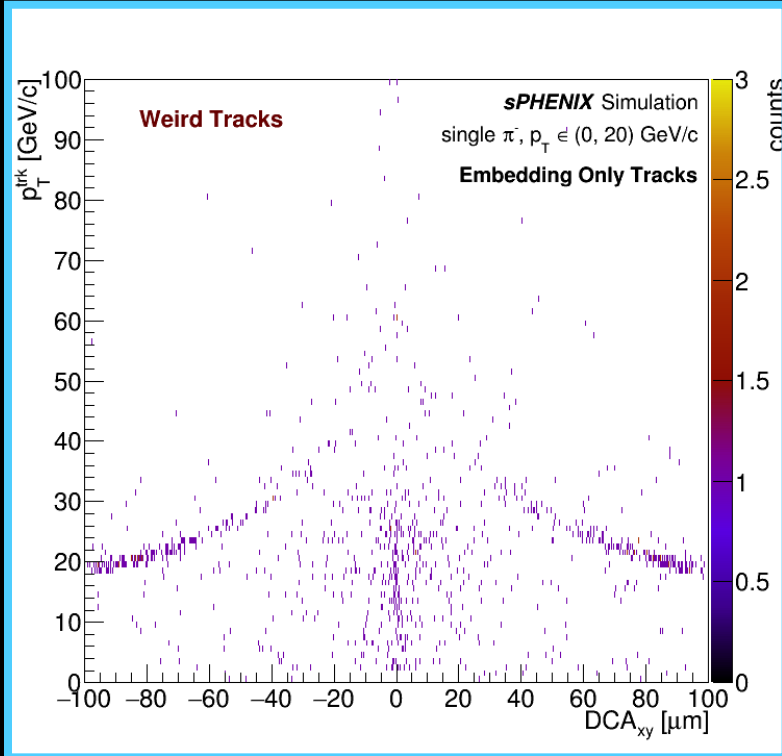


Weird Tracks w/ Silicon Seeds

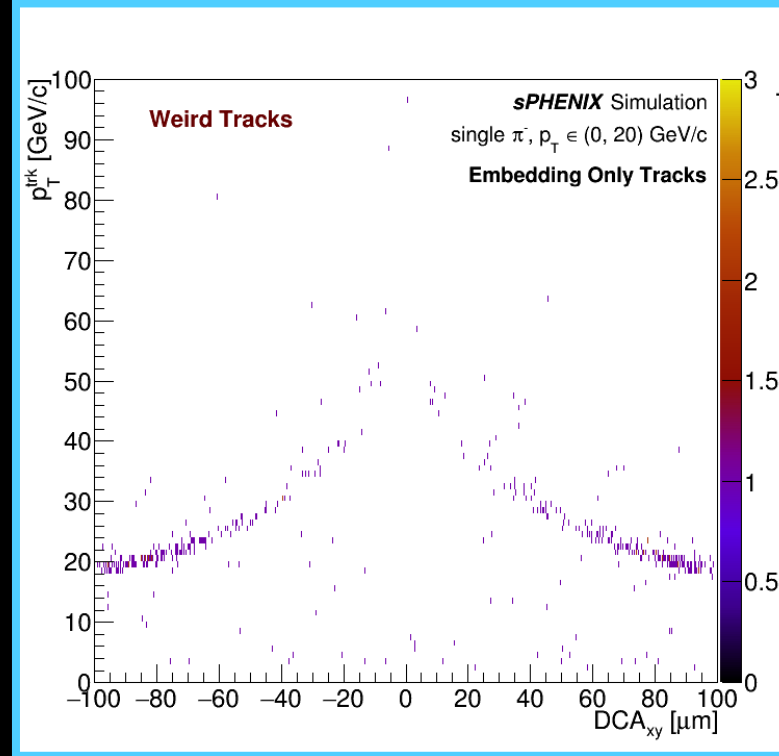


- Track DCAxy
 - Track DCAxy (left panels)
 - DCAxy vs. p_T^{trk} (right panels)
 - **dca3dxy vs. pt** leaves of ntp_track tuple
- **Note:** y-axes are **not** scaled
 - y-axis range changes between plots (apologies!)

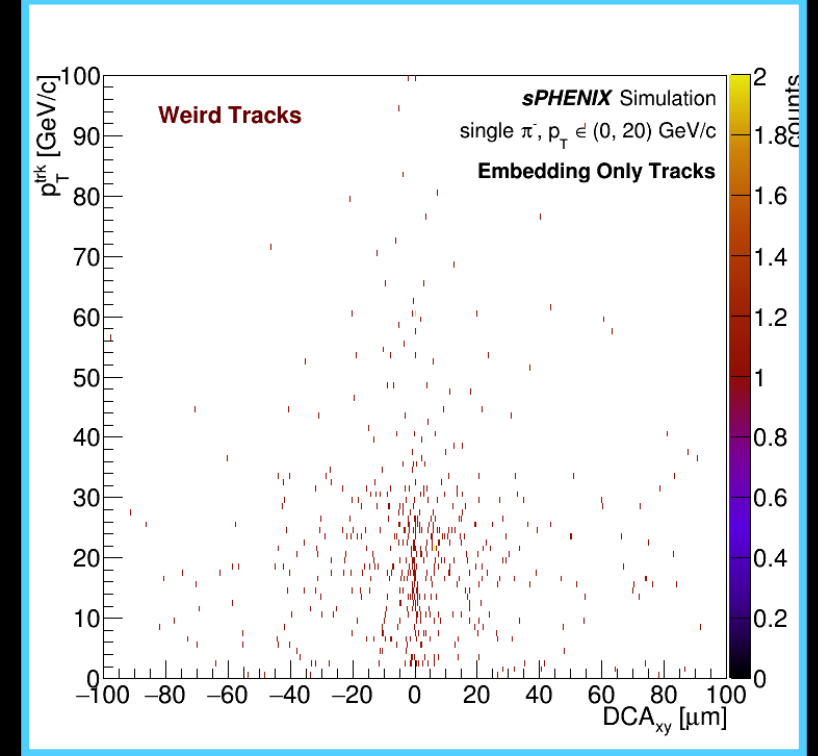
Weird Track DCAxy



All Weird Tracks



Weird Tracks w/o Silicon Seeds

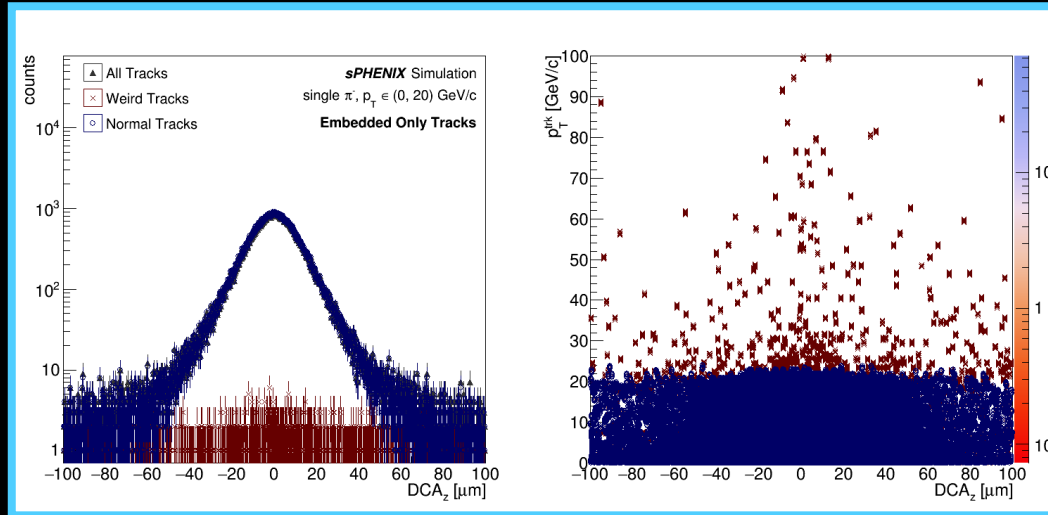


Weird Tracks w/ Silicon Seeds

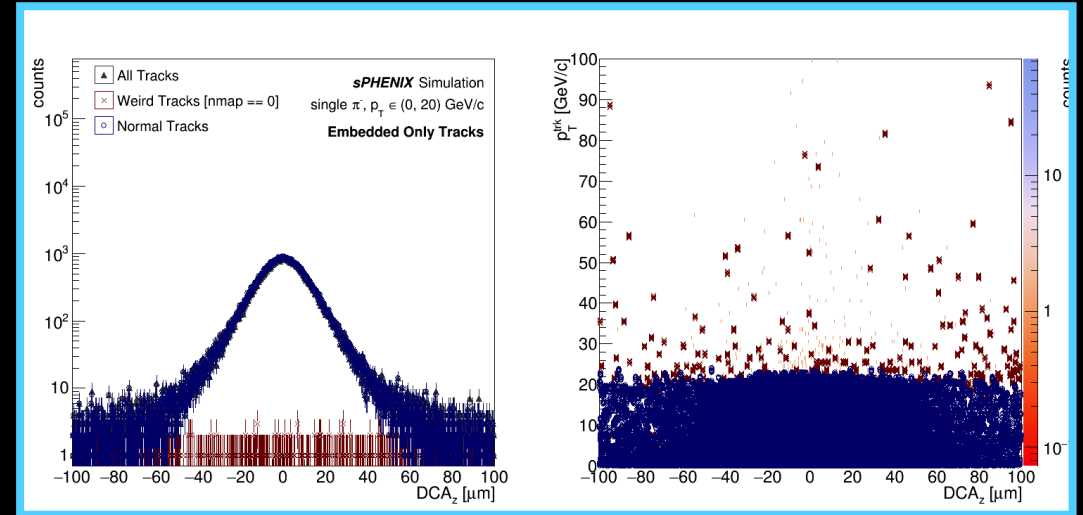
- Weird track DCAxy
 - `dca3dxy` leaf of `ntp_track` tuple for only weird tracks

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

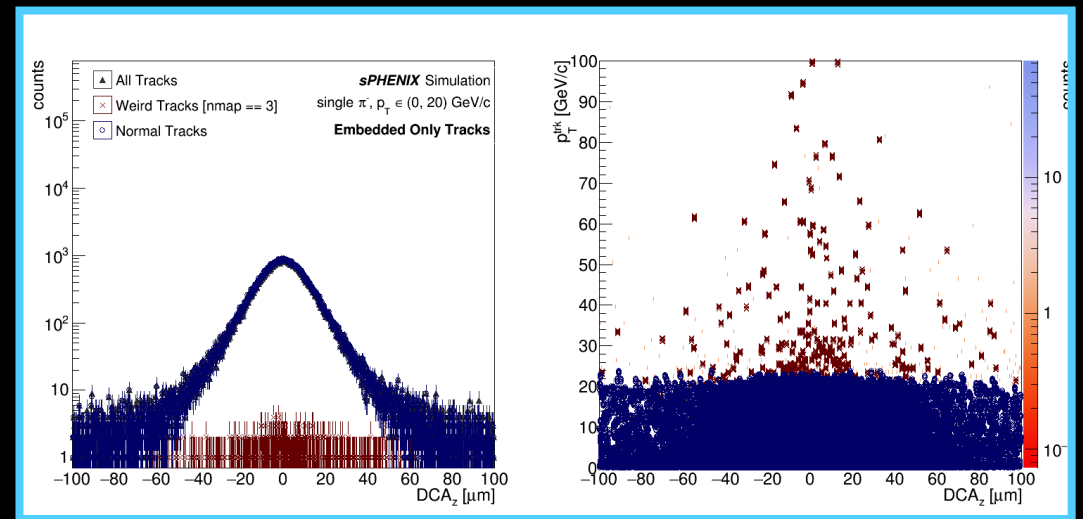
All Weird Tracks



Weird Tracks w/o Silicon Seeds

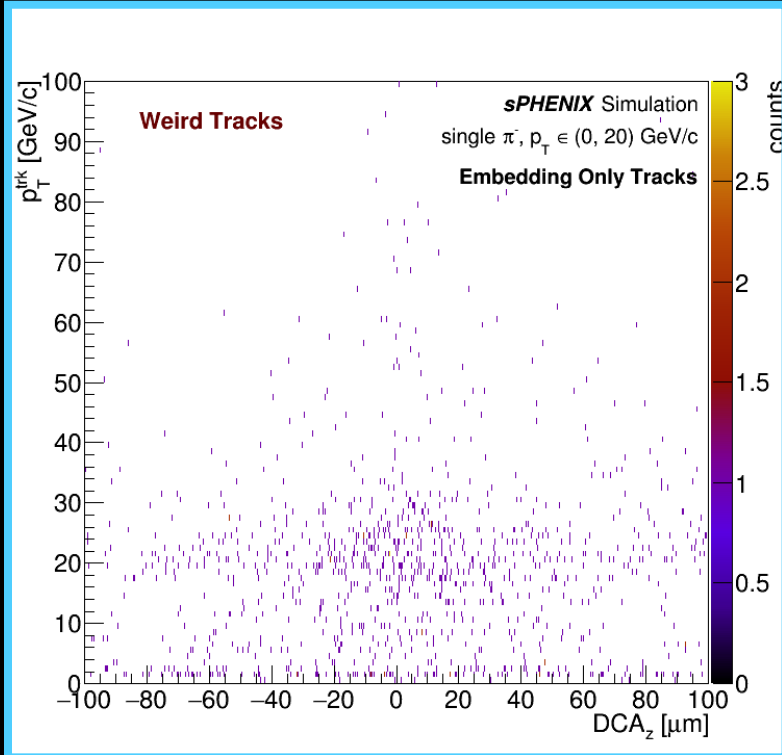


Weird Tracks w/ Silicon Seeds

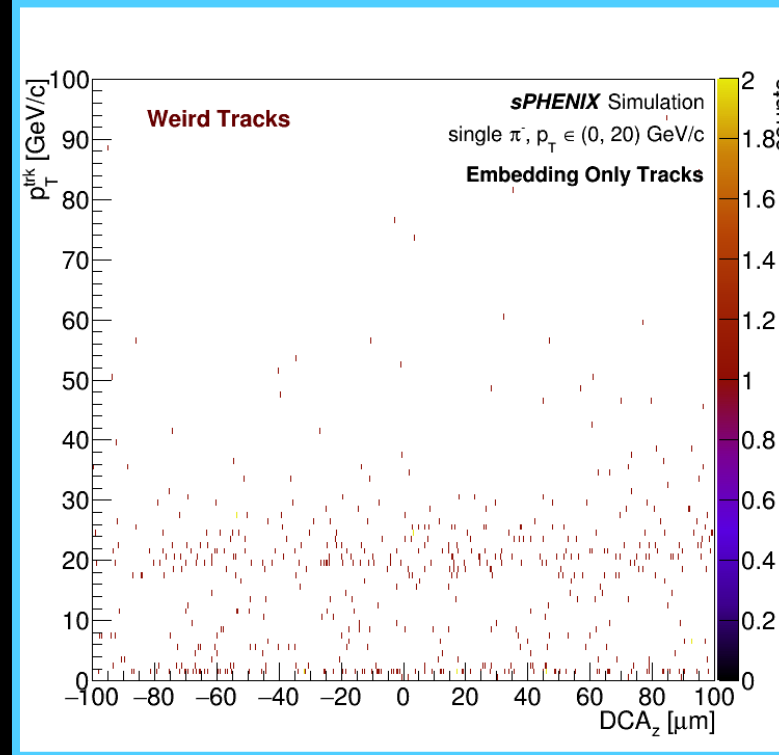


- Track DCAz
 - Track DCAz (left panels)
 - DCAz vs. p_T^{trk} (right panels)
 - **dca3dz vs. pt** leaves of ntp_track tuple
- **Note:** y-axes are **not** scaled
 - y-axis range changes between plots (apologies!)

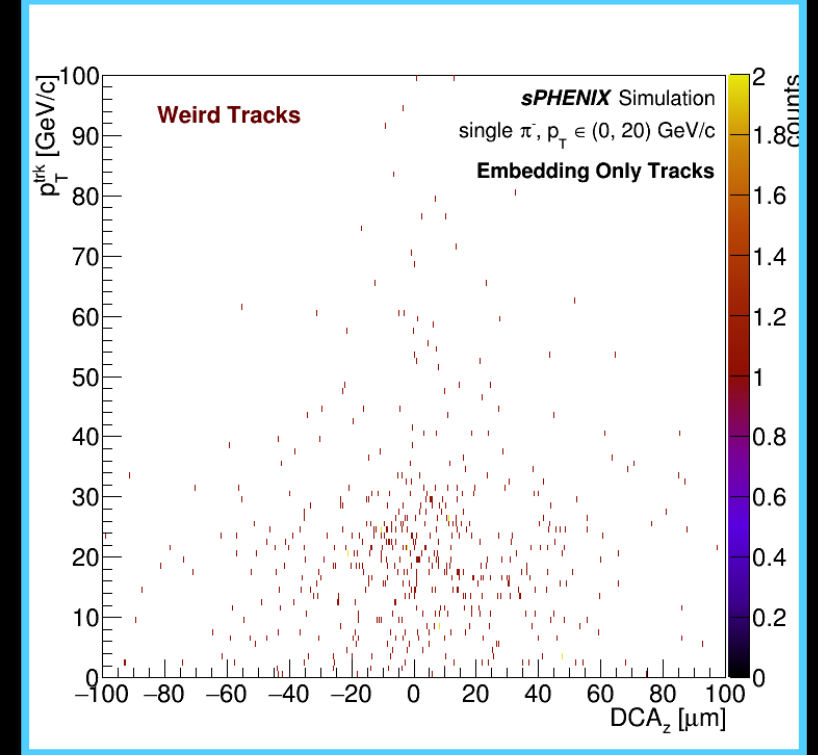
Weird Track DCAz



All Weird Tracks



Weird Tracks w/o Silicon Seeds



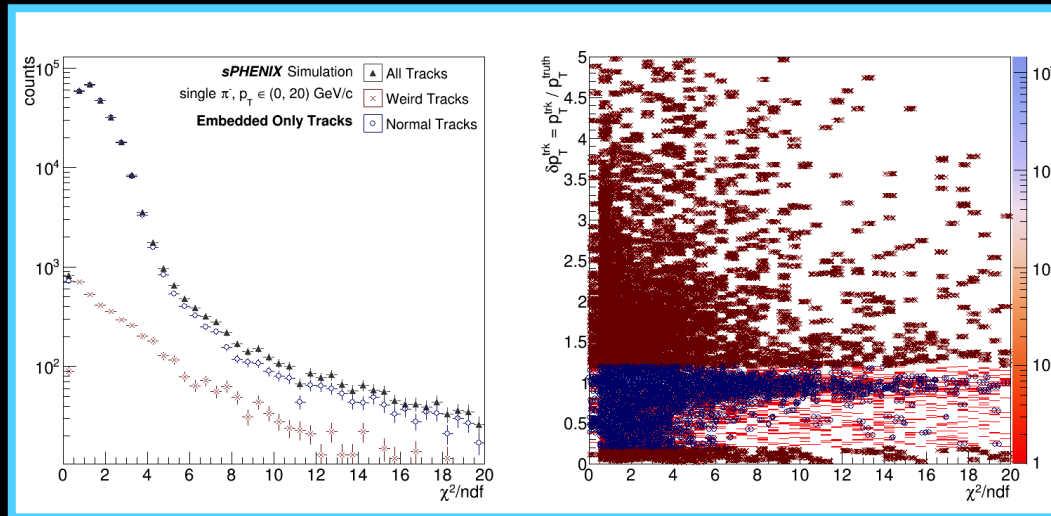
Weird Tracks w/ Silicon Seeds

- Weird track DCAz
 - `dca3dz` leaf of `ntp_track` tuple for only weird tracks

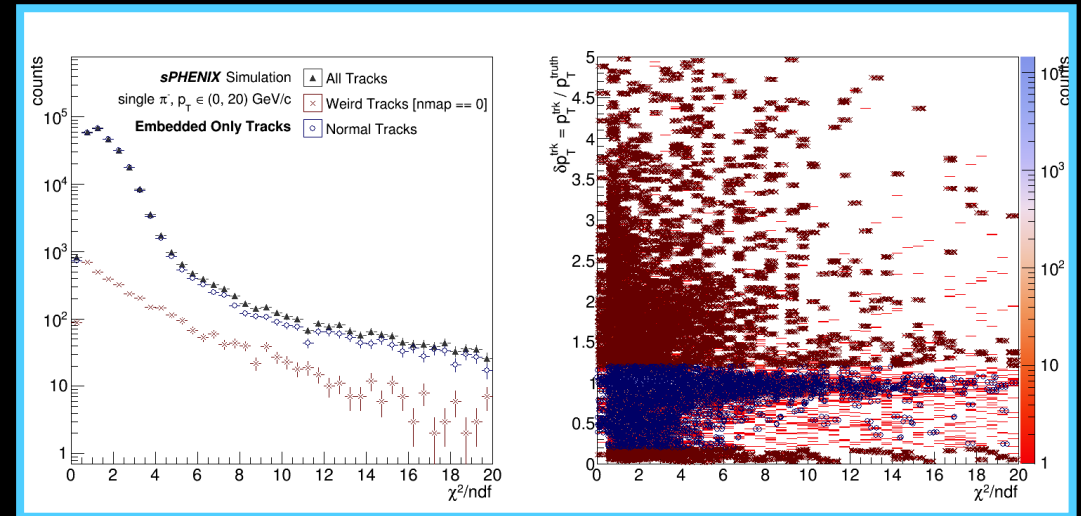
- **Note:** z-axes are **not** scaled
 - z-axis range changes between plots (apologies!)

Track Quality

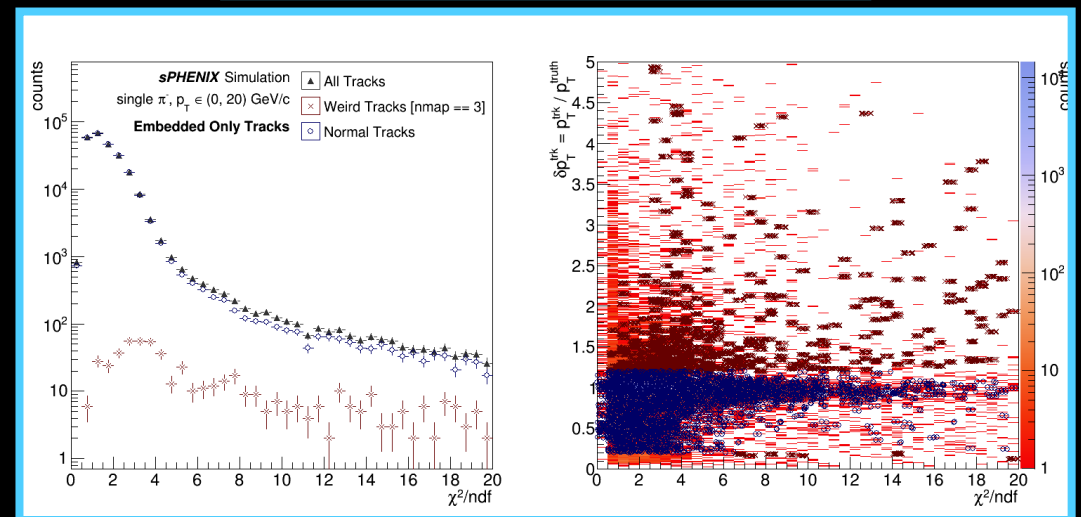
All Weird Tracks



Weird Tracks w/o Silicon Seeds



Weird Tracks w/ Silicon Seeds

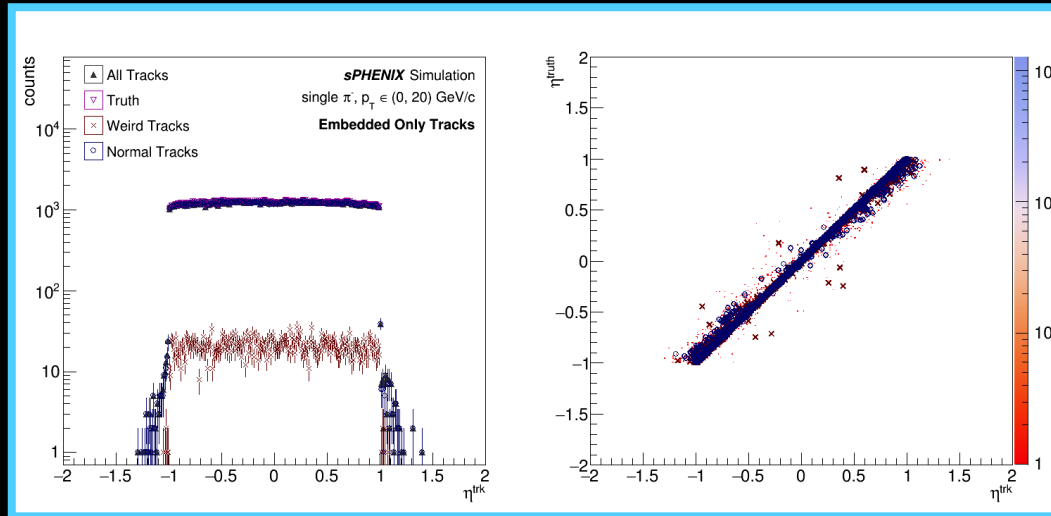


- Track χ^2/ndf
 - Track χ^2/ndf (left panels)
 - χ^2/ndf vs. $p_T^{\text{trk}} / p_T^{\text{true}}$ (right panels)
 - **quality vs. pt/gpt** leaves of ntp_track tuple
- **Note:** y-axes are **not** scaled
 - y-axis range changes between plots (apologies!)

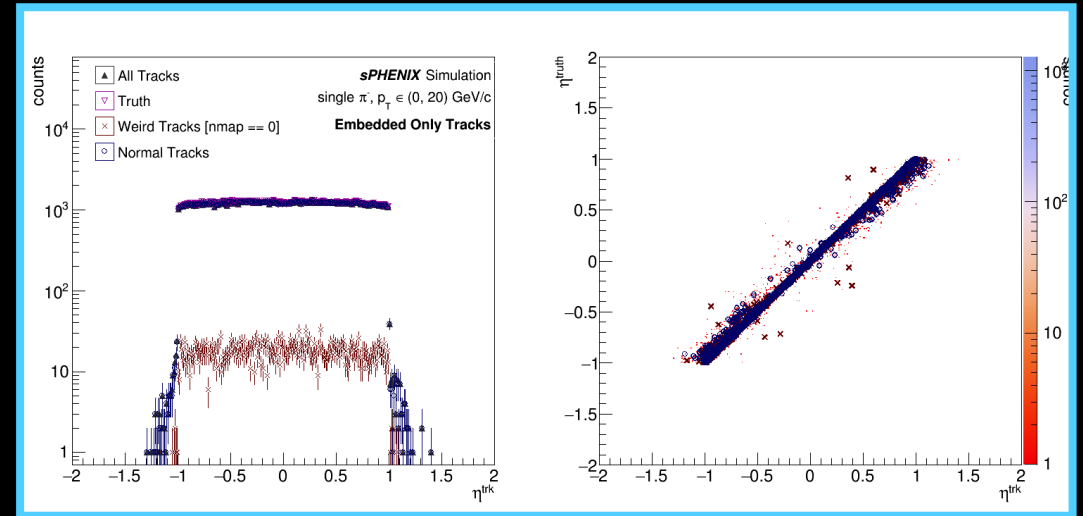
Extra Slides



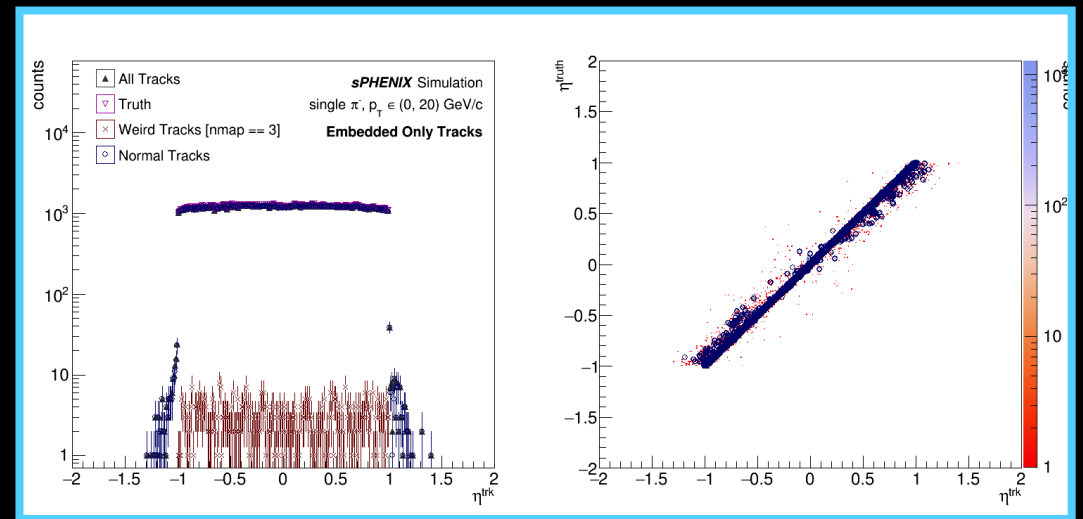
All Weird Tracks



Weird Tracks w/o Silicon Seeds

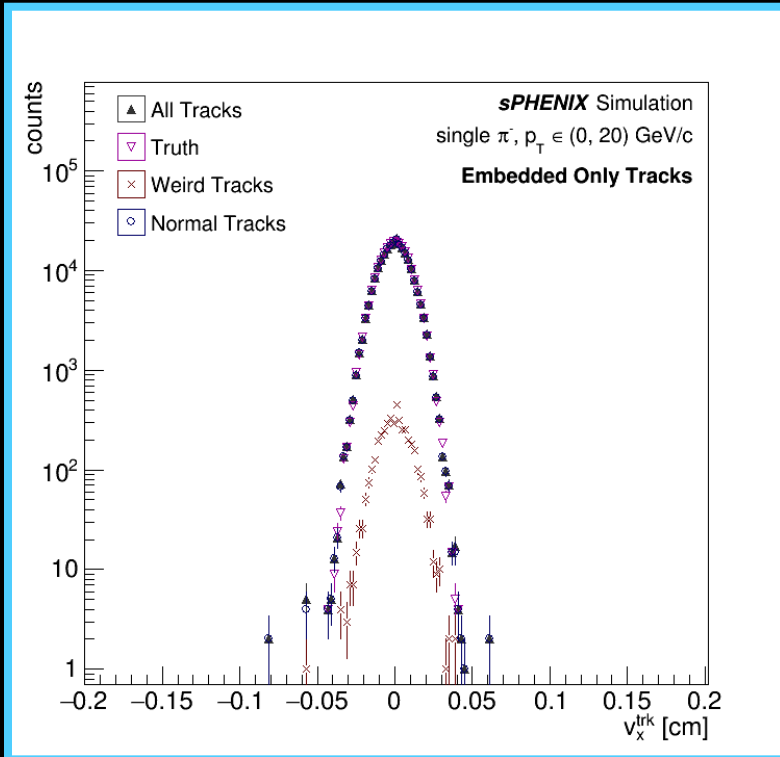


Weird Tracks w/ Silicon Seeds

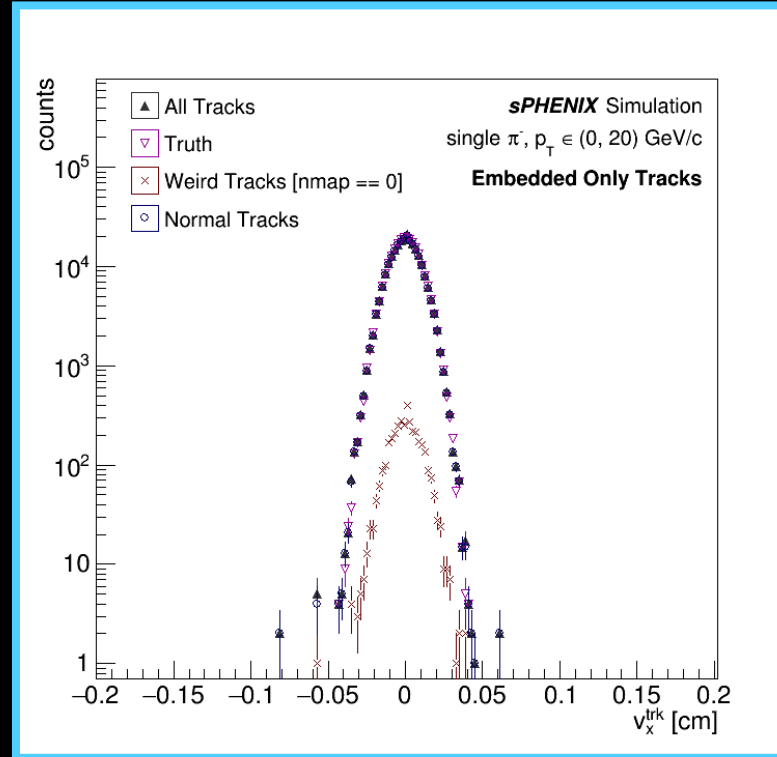


- Reconstructed and truth eta
 - reco. eta (left panels)
 - reco. vs. truth eta (right panels)
 - **eta vs. geta** leaves of ntp_track tuple
- **Note:** y-axes are **not** scaled
 - y-axis range changes between plots (apologies!)

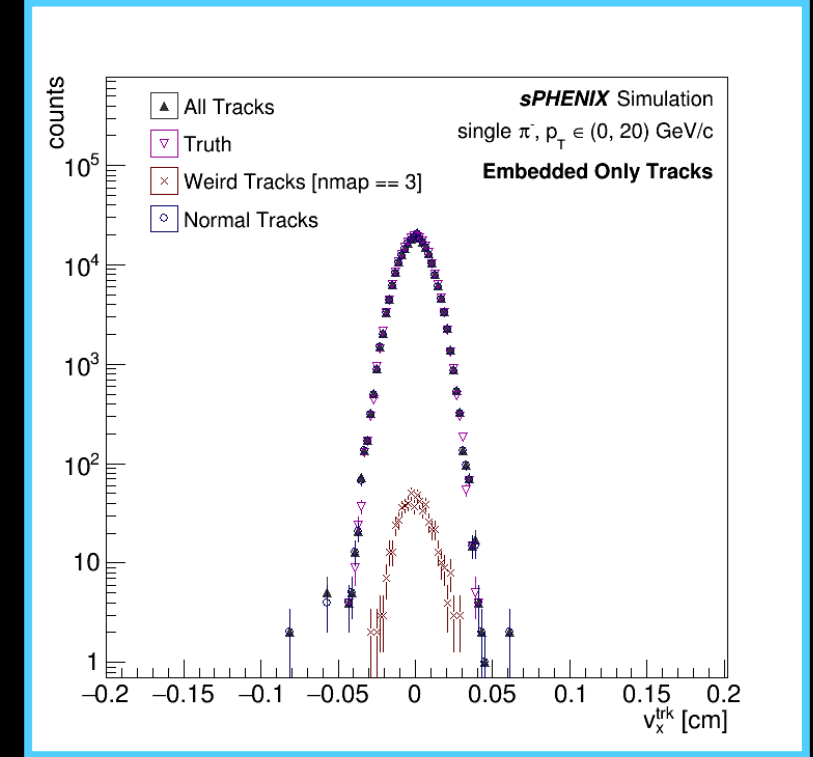
Track X-Vertex



All Weird Tracks



Weird Tracks w/o Silicon Seeds

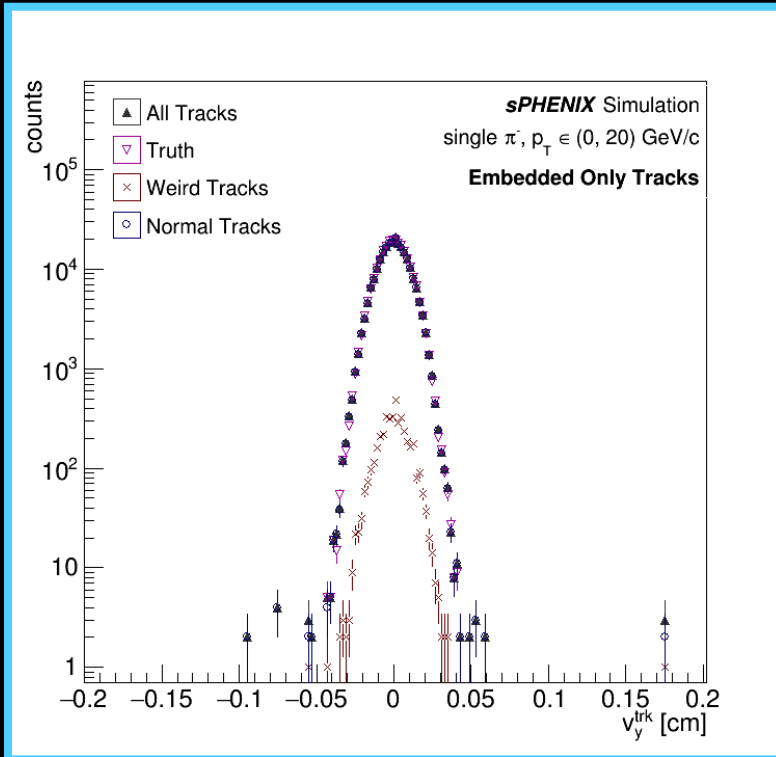


Weird Tracks w/ Silicon Seeds

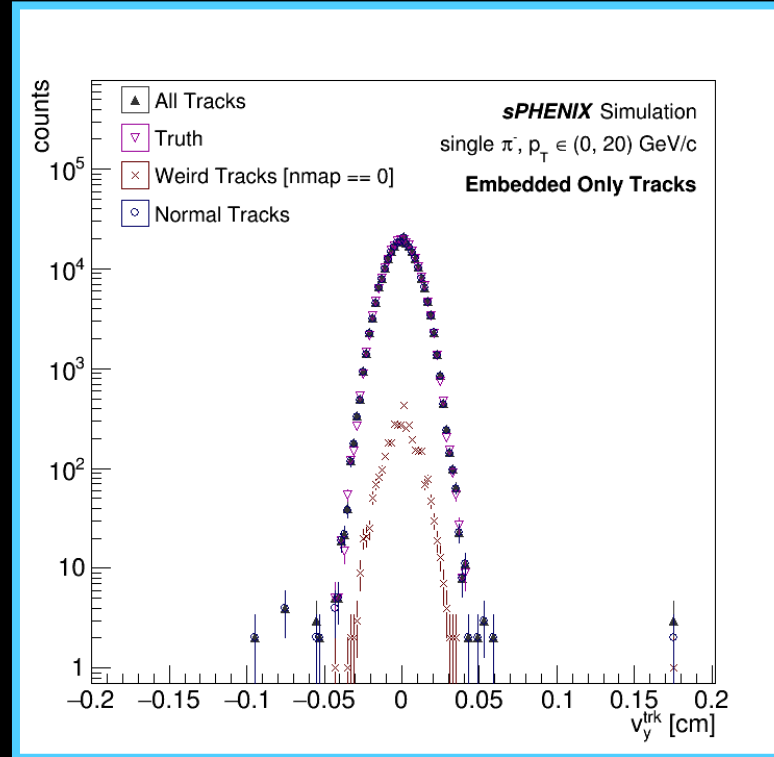
- X-component of reconstructed vertex
 - v_x leaf of `ntp_track` tuple

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

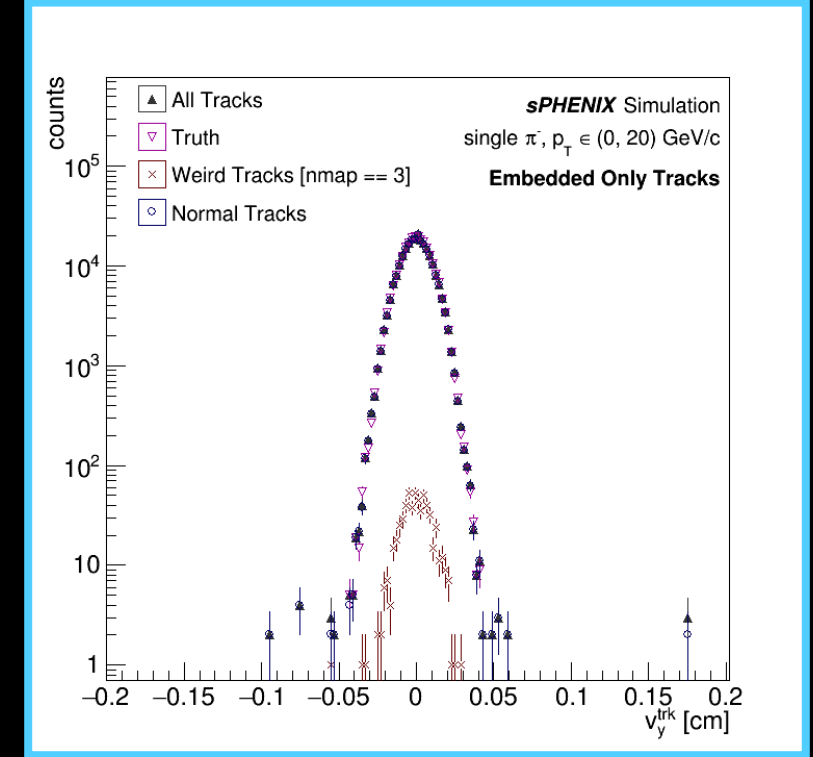
Track Y-Vertex



All Weird Tracks



Weird Tracks w/o Silicon Seeds



Weird Tracks w/ Silicon Seeds

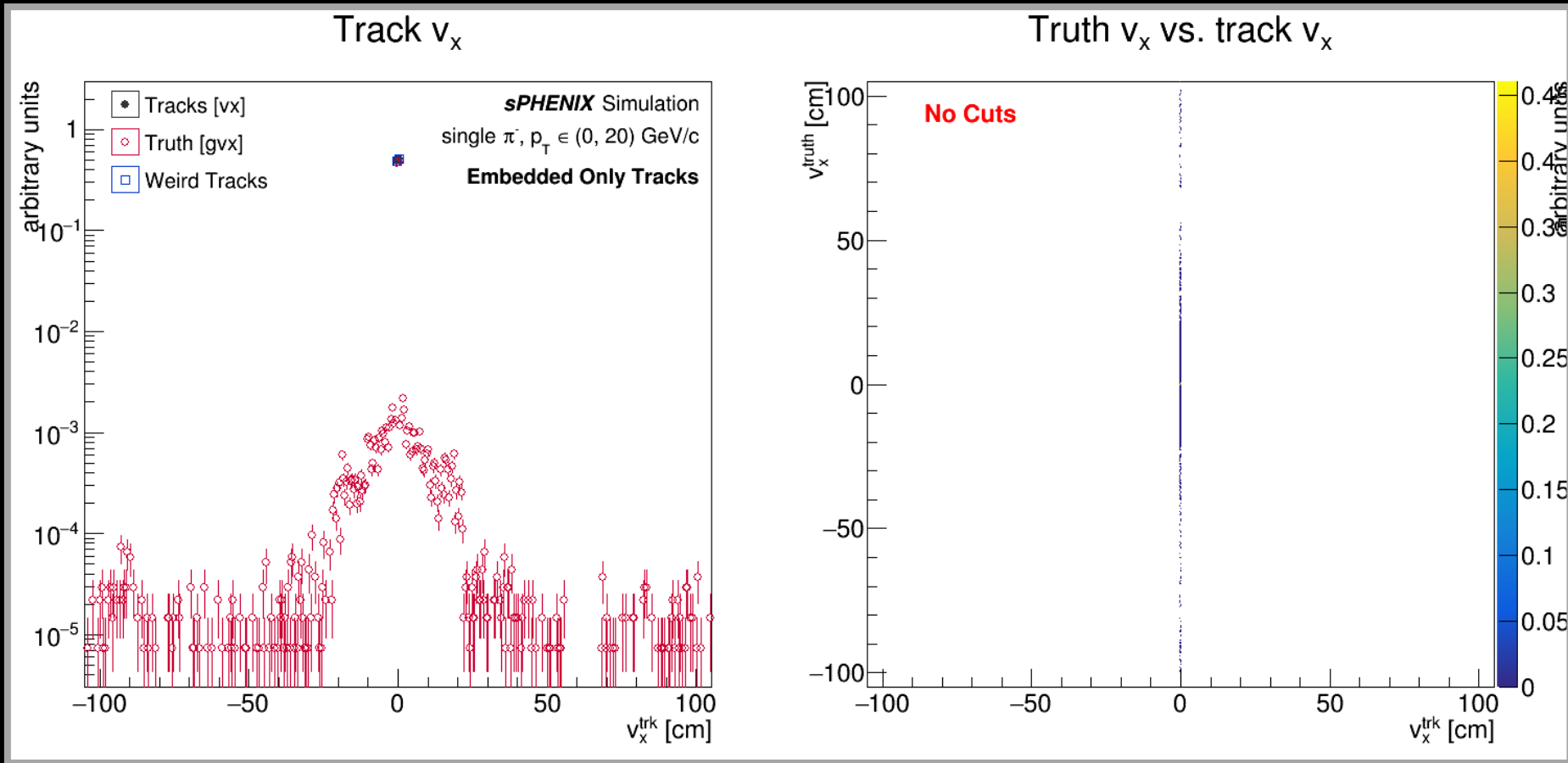
- Y-component of reconstructed vertex
 - **vy** leaf of ntp_track tuple

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

Previous Slides



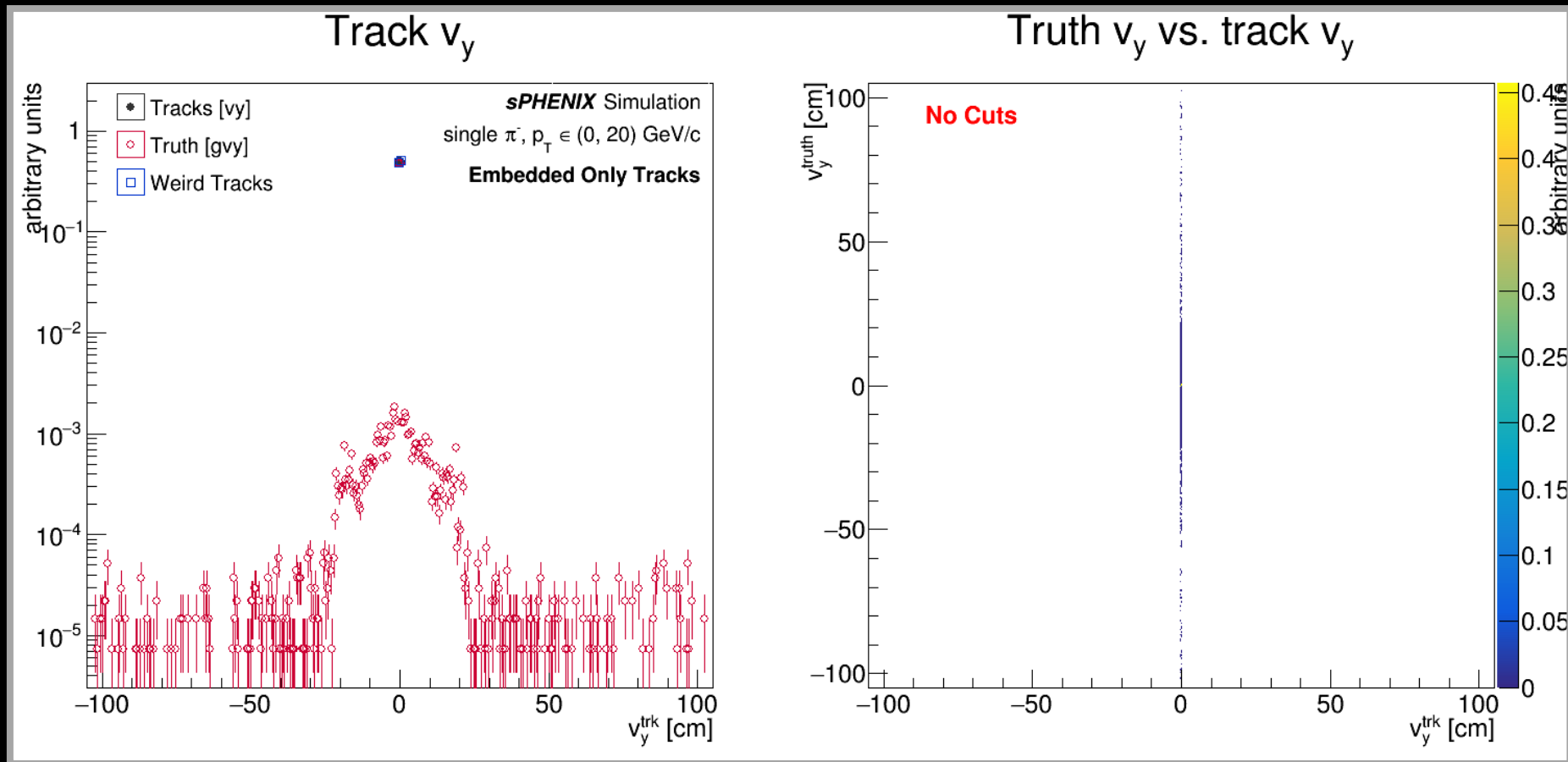
Workfest Follow-Up | Reco. vs. Truth v_x



- Only cuts applied are to select “weird tracks”
 $\Rightarrow p_T^{reco} / p_T^{truth} \notin (0.2, 1.2)$

- **Note:** distributions scaled by integral

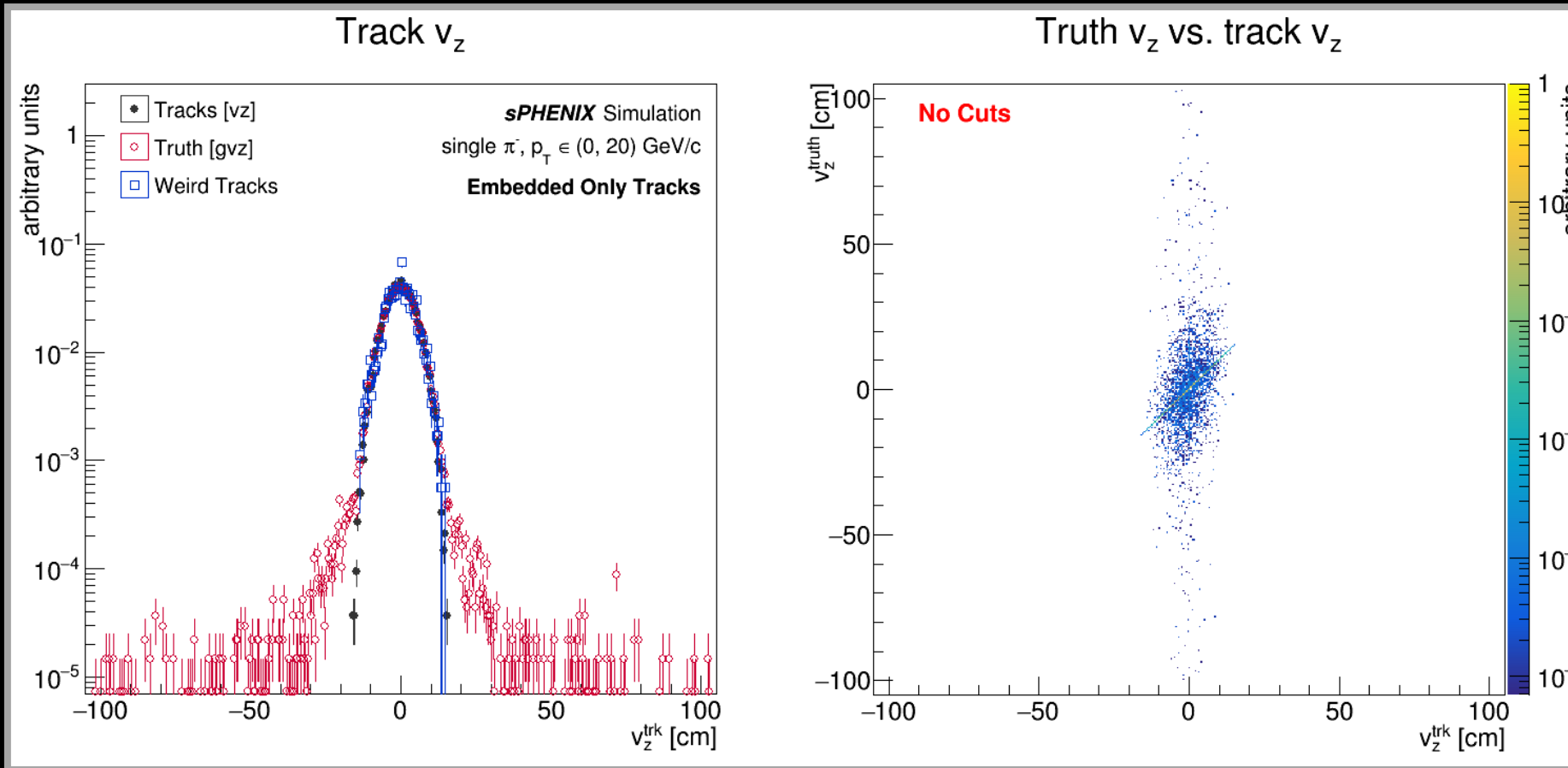
Workfest Follow-Up | Reco. vs. Truth v_y



- Only cuts applied are to select “weird tracks”
 $\Rightarrow p_T^{\text{reco}} / p_T^{\text{truth}} \notin (0.2, 1.2)$

- **Note:** distributions scaled by integral

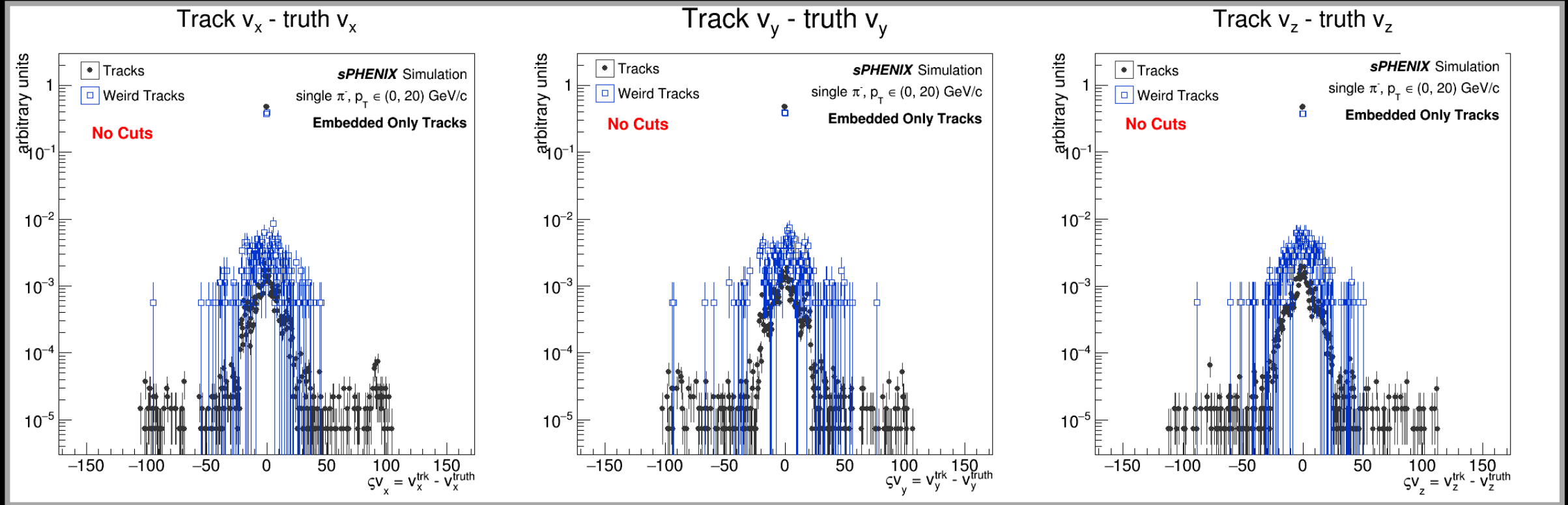
Workfest Follow-Up | Reco. vs. Truth v_z



- Only cuts applied are to select “weird tracks”
 $\Rightarrow p_T^{\text{reco}} / p_T^{\text{truth}} \notin (0.2, 1.2)$

- **Note:** distributions scaled by integral

Workfest Follow-Up | Difference Between Reco. vs. Truth Vtx

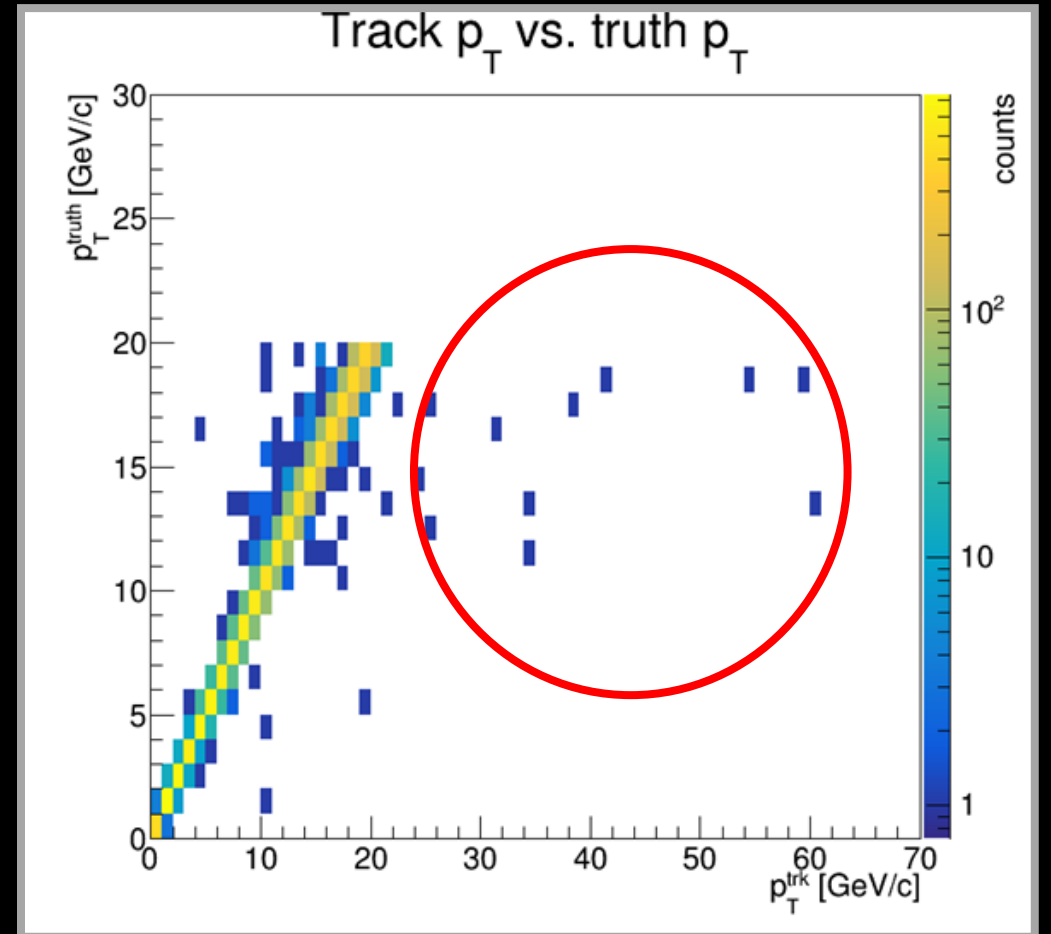


- Only cuts applied are to select “weird tracks”
 $\Rightarrow p_T^{\text{reco}} / p_T^{\text{truth}} \notin (0.2, 1.2)$

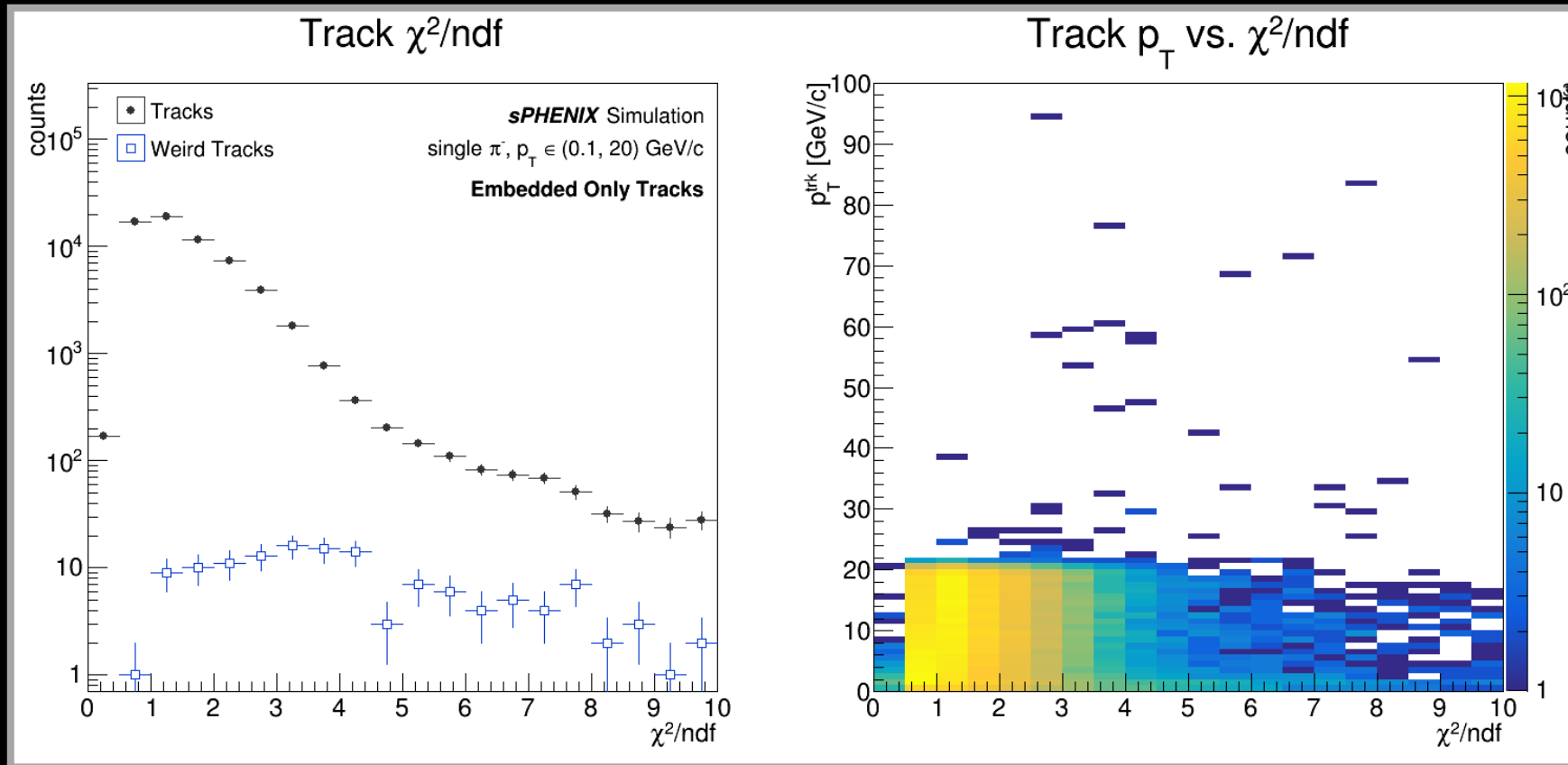
- **Note:** distributions scaled by integral

What Did I do?

- **Task:** characterize outlier tracks
 - **Result:** Made progress and have a lead (see next slide)...
- **Note:** Also would like to determine cuts to remove pileup tracks
 - Made progress along this front as well:
 - 👍 Figured out how to embed in hijing: now successfully running jobs
 - 👍 Made necessary edits to code to characterize pileup tracks



A Possible Lead



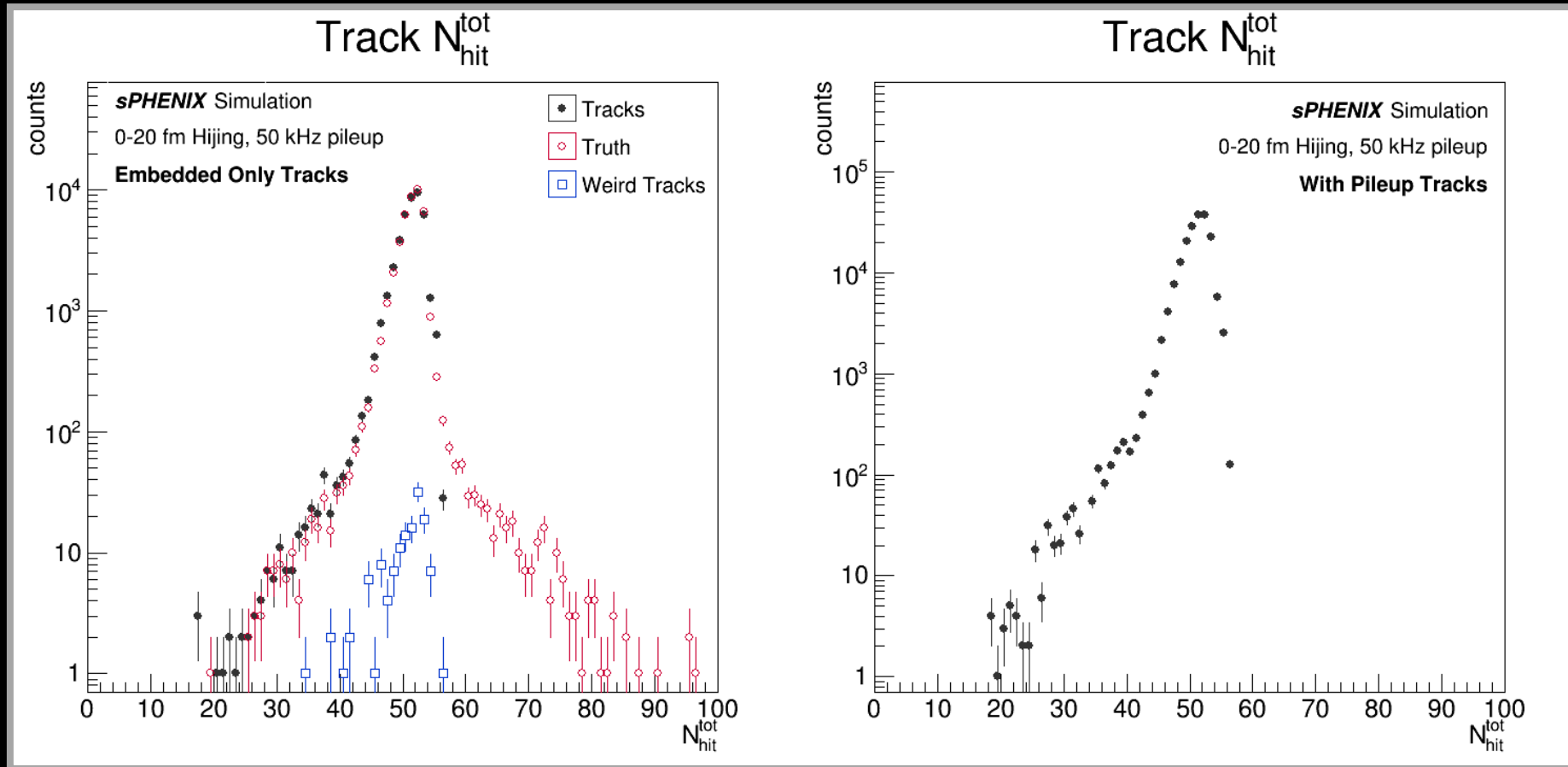
- Outlier tracks generally look similar to normal tracks...
 - ☞ **Except:** The chi2/ndf of the track fit...
 - ☞ Will be following up at tracking meeting at on Tuesday

Update Details

- Currently running over larger sample
 - 0 – 20 fm Hijing (**type = 4**)
 - 50 kHz pileup (**pileup = 1**)
 - ☞ **41700 embedded tracks shown here**
(12868 last time)
- **Pileup tracks included this time:**
 - Plotted all entries from ntp_gtrk
(excluded NAN entries)
 - ☞ **Should I be looking at only entries with
gprimary = 0?**

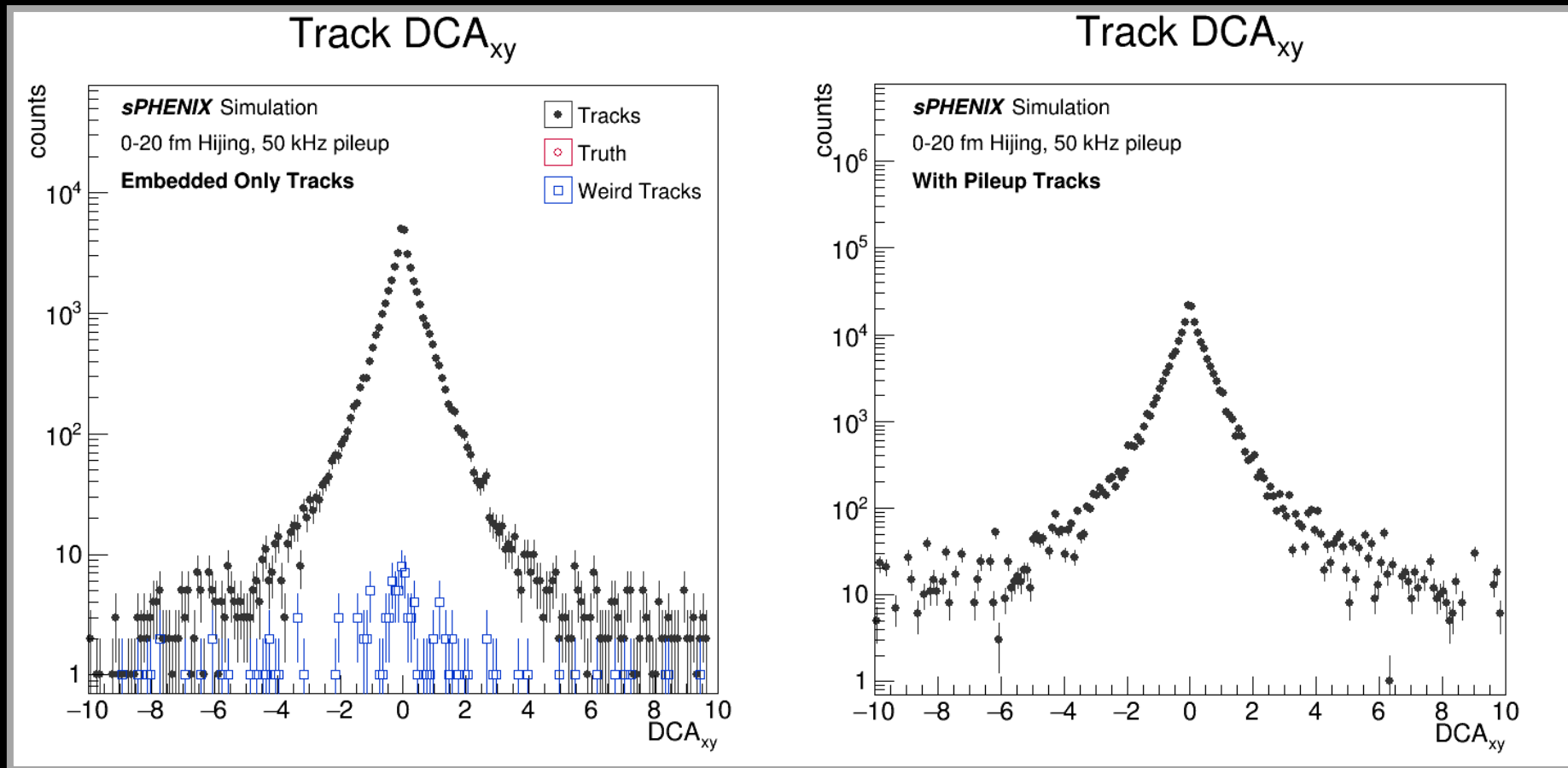
- **Plots shown here:**
 - Nhits, DCAxy, DCAz, η , ϕ , and p_T for reco., truth, “weird”, and pileup tracks
 - The %-errors on DCAxy, DCAz, η , ϕ , and p_T
- **“Weird Tracks:”** tracks w/ unusually large or small p_T^{trk} / p_T^{true}
 - ☞ **< 0.2 or > 1.2**

Embed Only vs. With Pileup | Track NHits



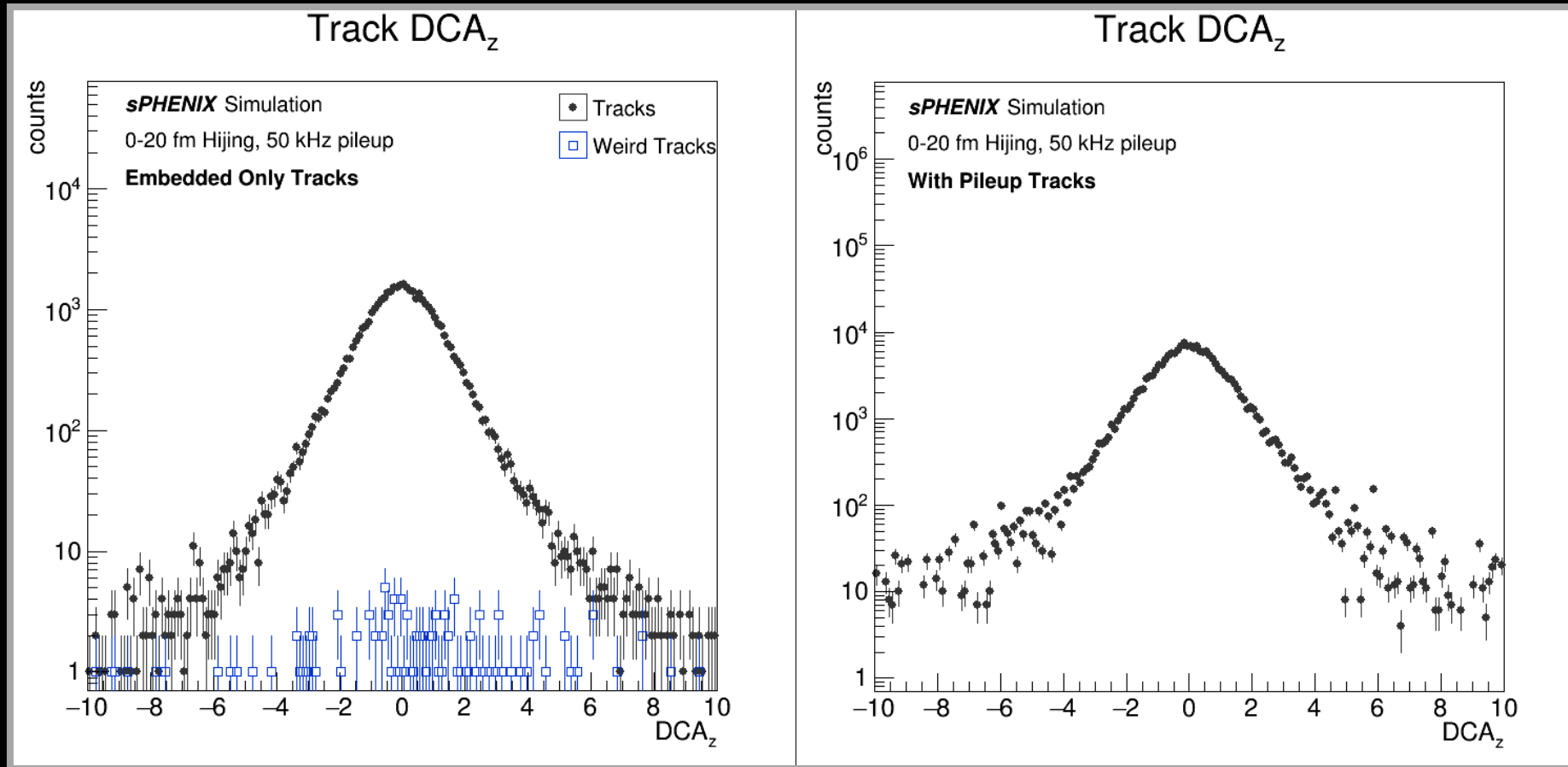
- **Note:** y-axis scale changes b/n left and right
 - Will fix next time..

Embed Only vs. With Pileup | Track DCA_{xy}



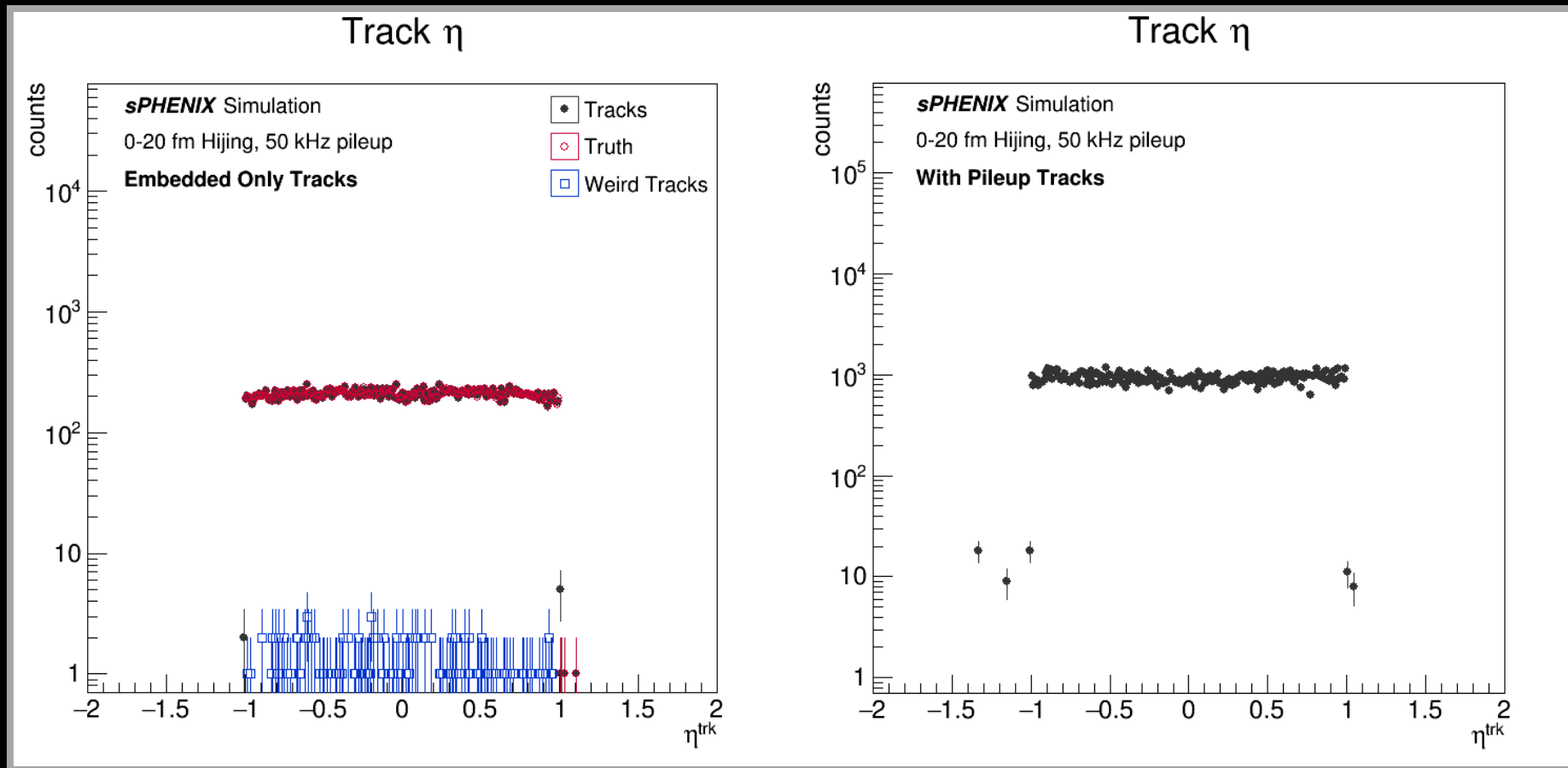
- **Note:** y-axis scale changes b/n left and right
 - Will fix next time..

Embed Only vs. With Pileup | Track DCA_z



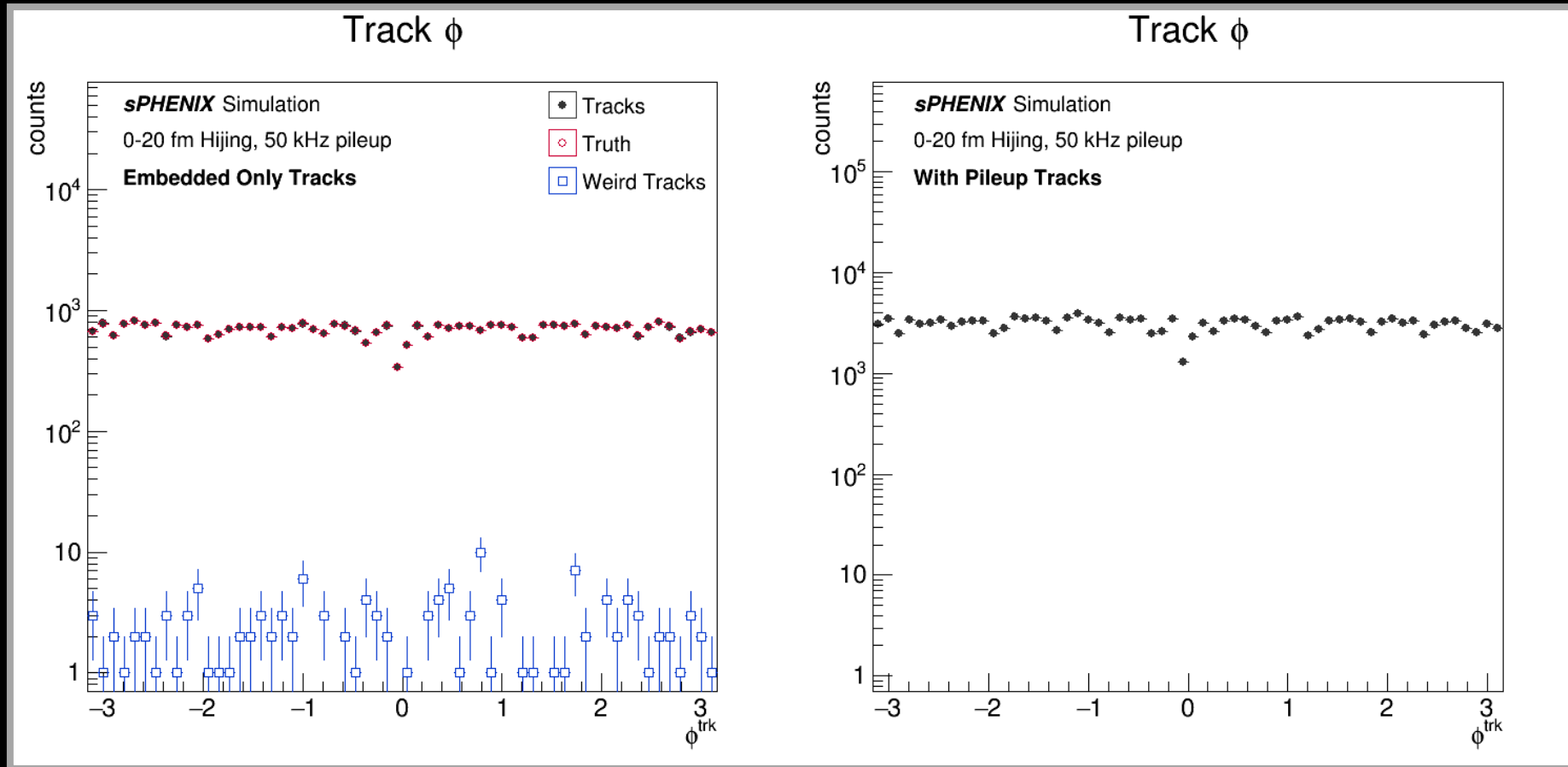
- **Note:** y-axis scale changes b/n left and right
 - Will fix next time..

Embed Only vs. With Pileup | Track η



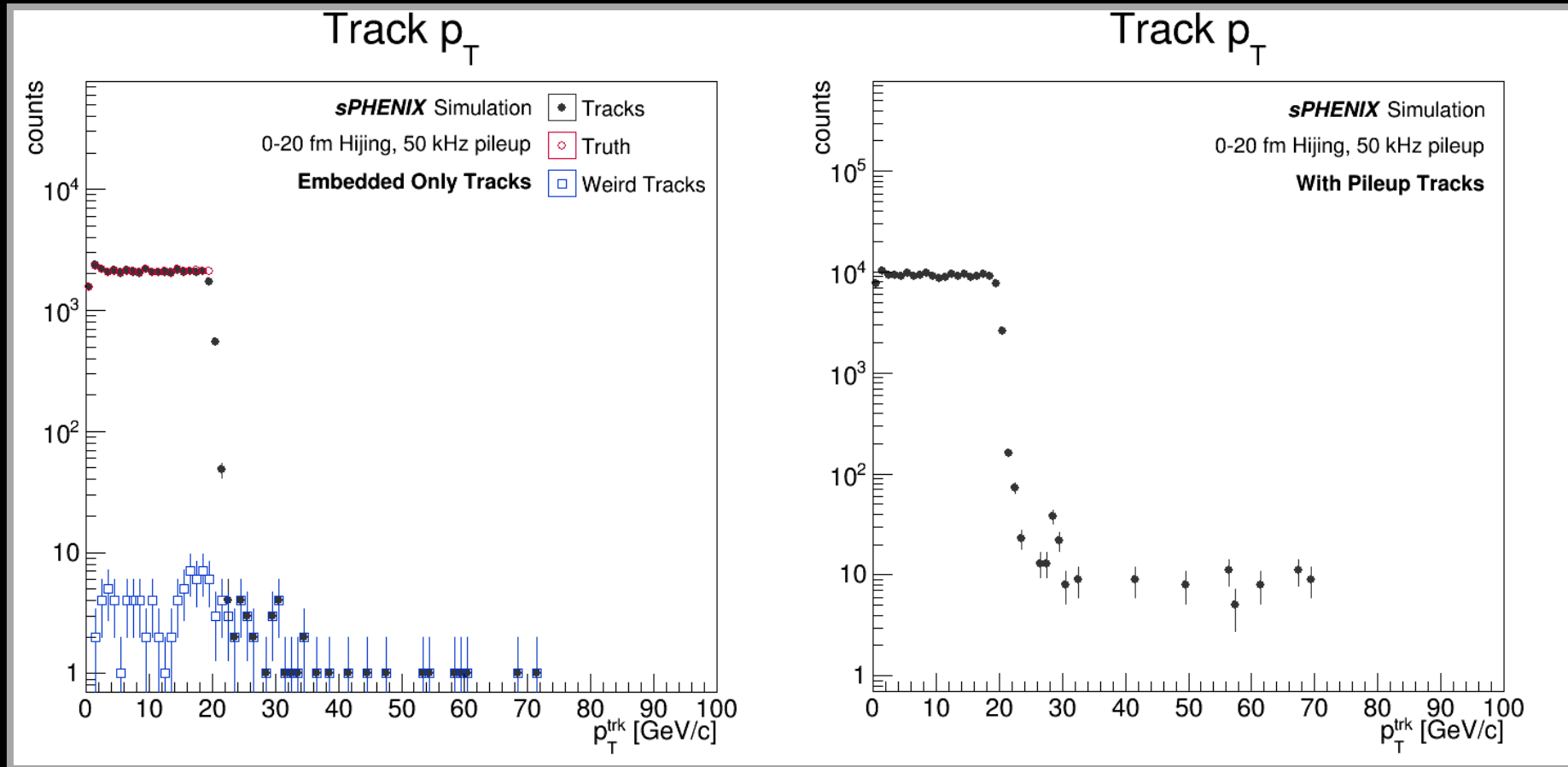
- **Note:** y-axis scale changes b/n left and right
 - Will fix next time..

Embed Only vs. With Pileup | Track ϕ



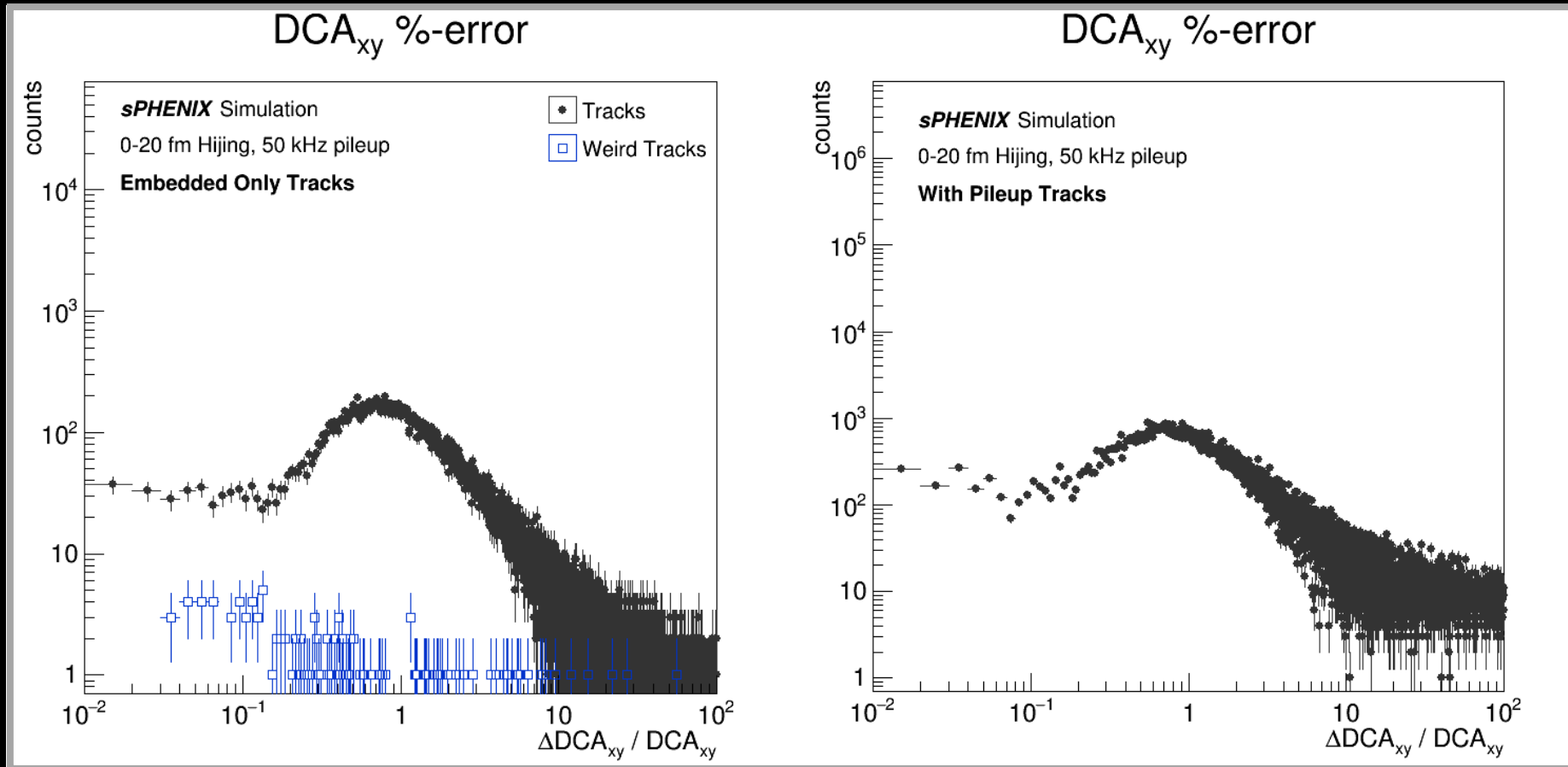
- **Note:** y-axis scale changes b/n left and right
 - Will fix next time..

Embed Only vs. With Pileup | Track p_T



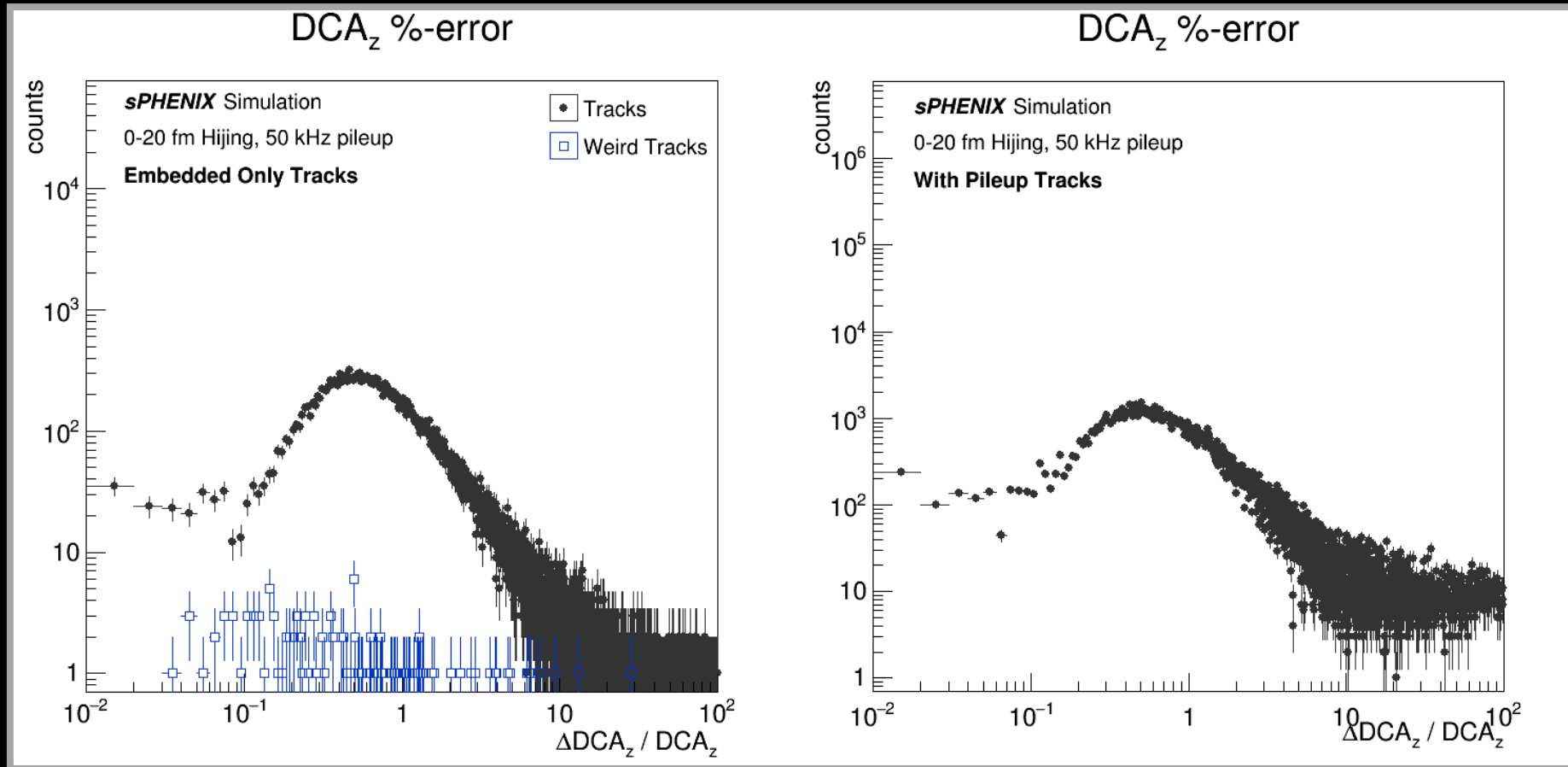
- **Note:** y-axis scale changes b/n left and right
 - Will fix next time..

Embed Only vs. With Pileup %-Error | Track DCA_{xy}



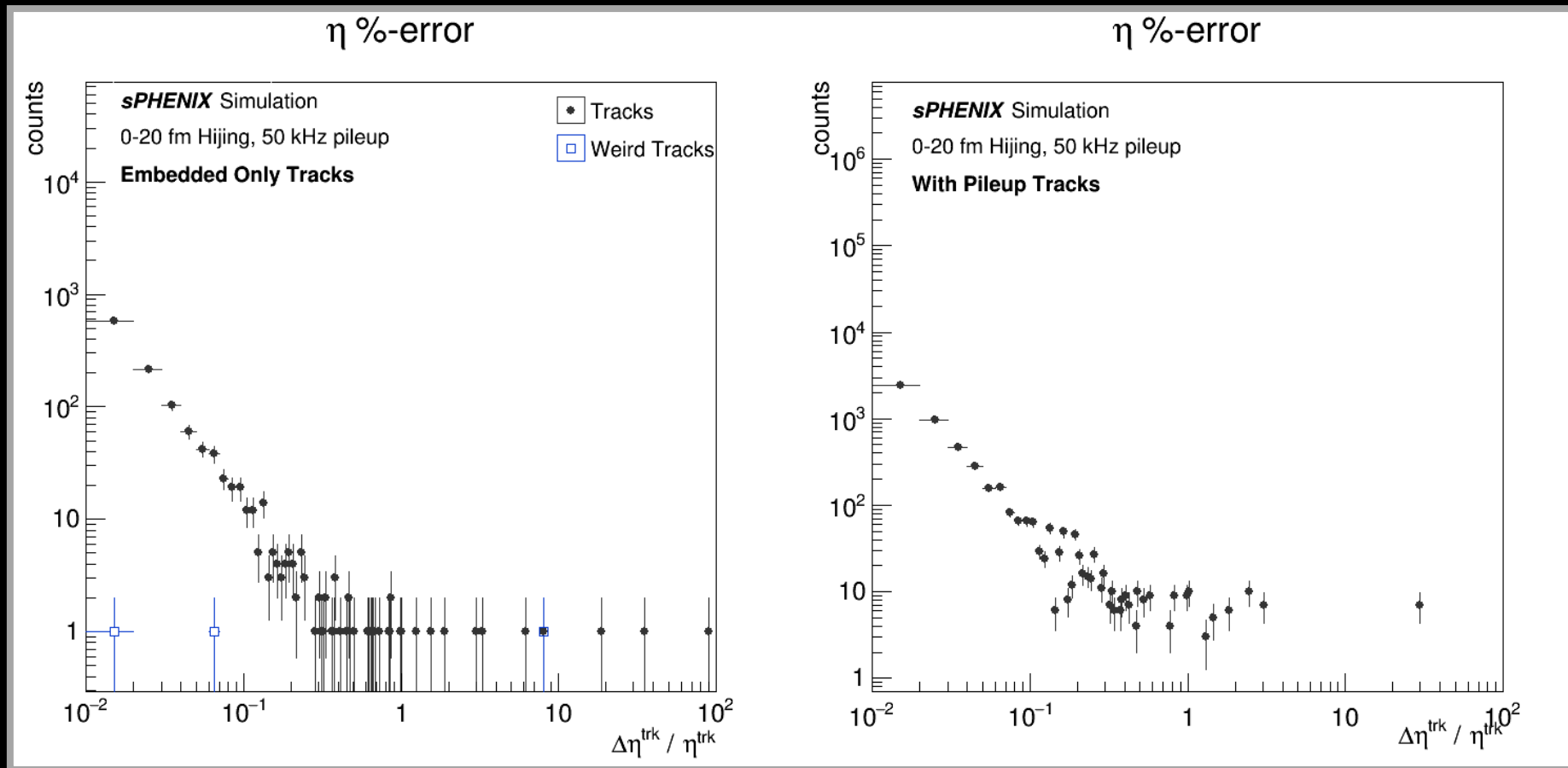
- **Note:** y-axis scale changes b/n left and right
 - Will fix next time..

Embed Only vs. With Pileup %-Error | Track DCAz



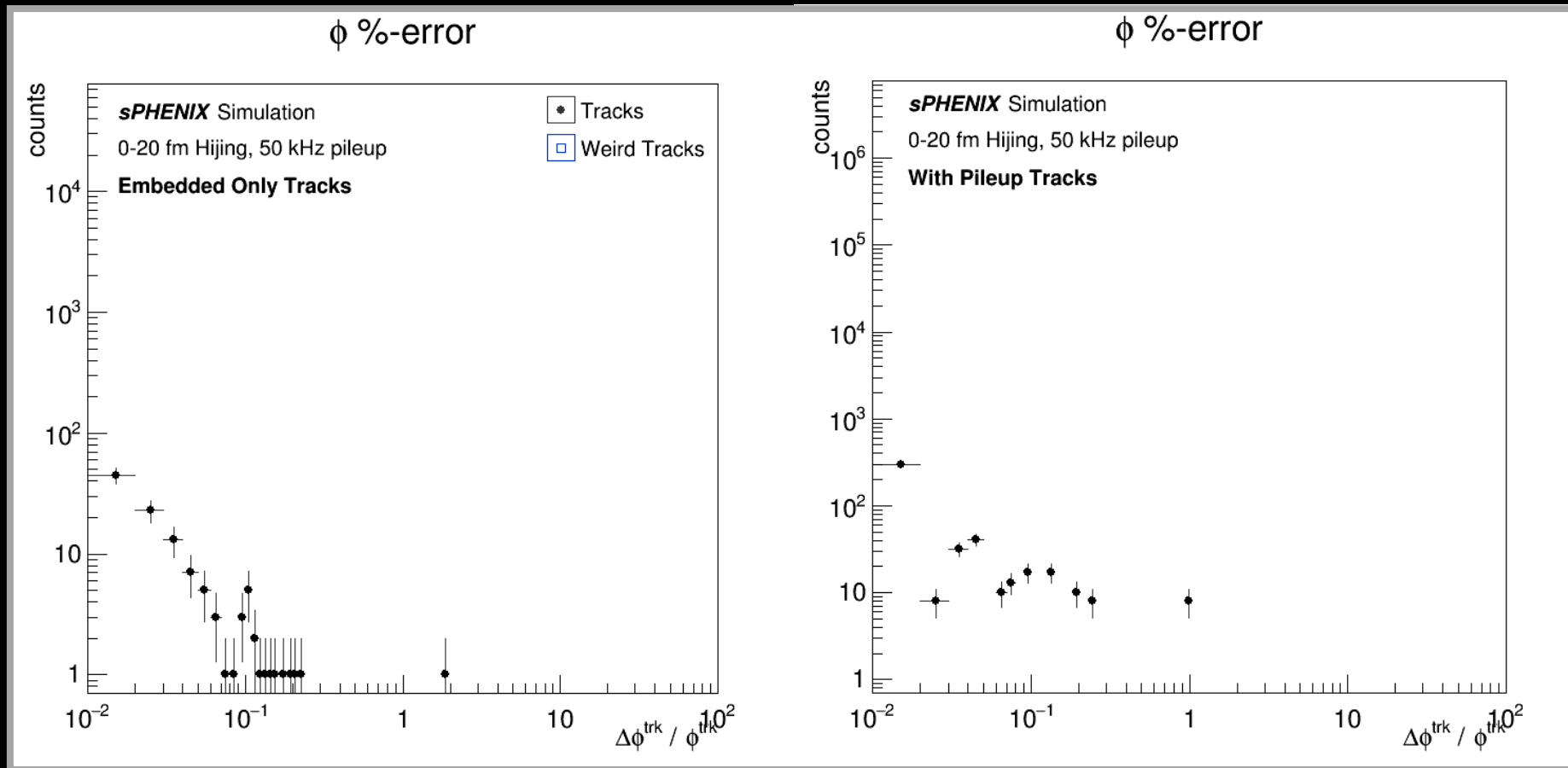
- **Note:** y-axis scale changes b/n left and right
 - Will fix next time..

Embed Only vs. With Pileup %-Error | Track η



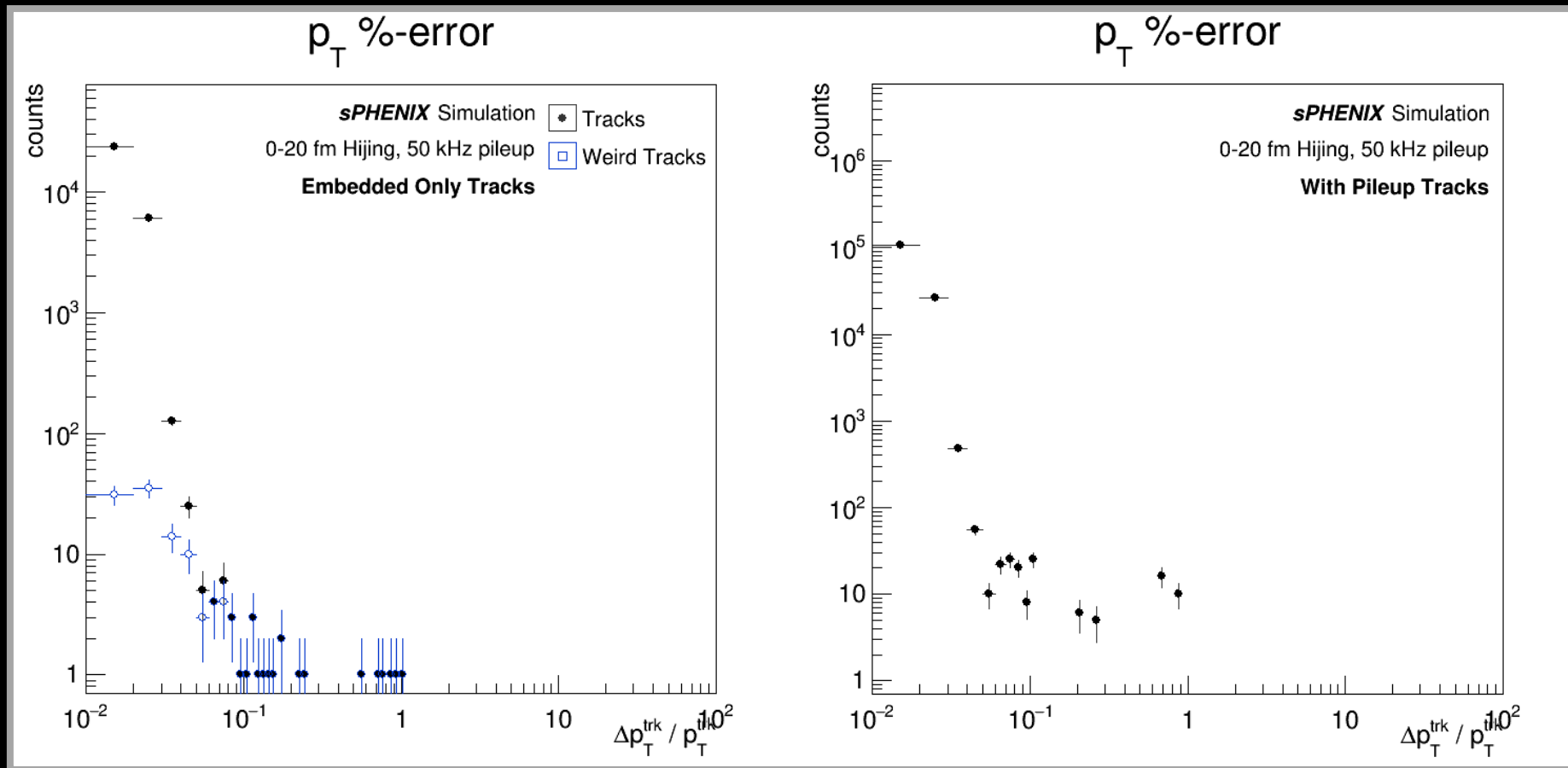
- **Note:** y-axis scale changes b/n left and right
 - Will fix next time..

Embed Only vs. With Pileup %-Error | Track ϕ



- **Note:** y-axis scale changes b/n left and right
 - Will fix next time..

Embed Only vs. With Pileup %-Error | Track p_T



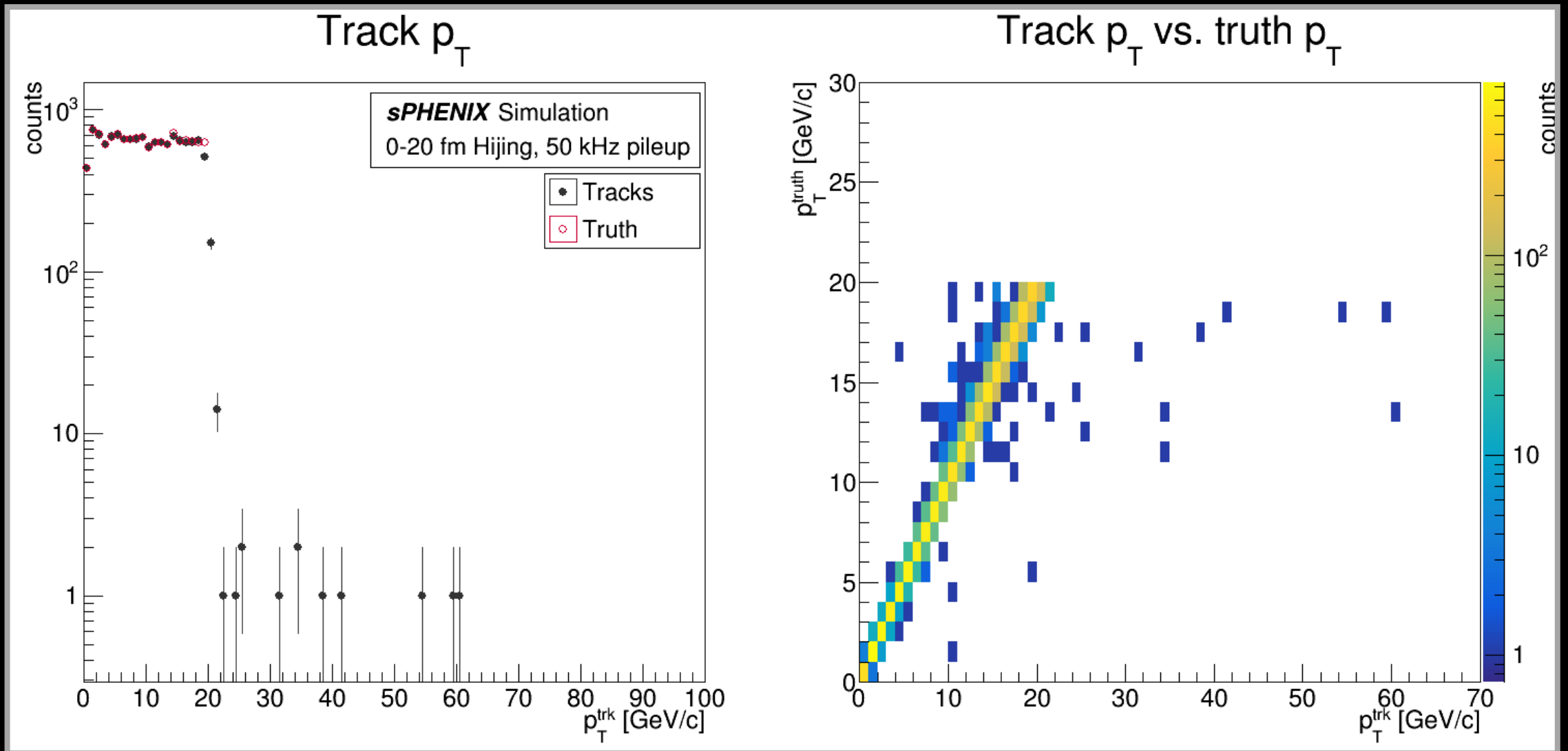
- **Note:** y-axis scale changes b/n left and right
 - Will fix next time..

Update Details

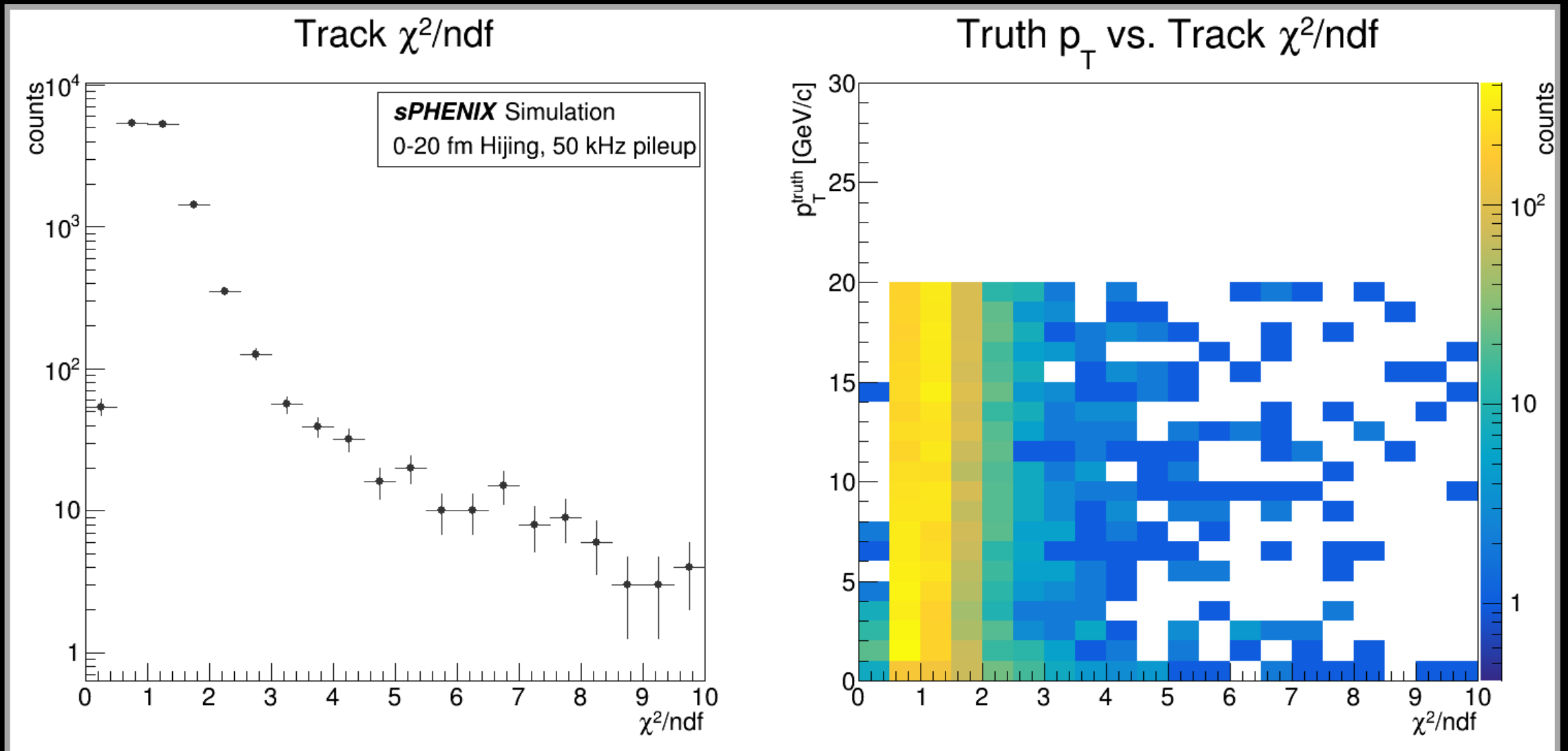
- Currently running over larger sample
 - 0 – 20 fm Hijing (**type = 4**)
 - 50 kHz pileup (**pileup = 1**)
 - ☞ **12868 tracks shown here** (4257 last time)
- **Tracks shown are embedded only**
 - Wanted to look at pileup tracks as well, but forgot to run sample
 - Will look at next week...

- **Plots shown here:**
 - Plots from last time w/ more stats, and compared against true p_T
 - A few new quantities ($\eta, \phi...$)
 - Plots of “scaled” quantities, e.g.
$$p_T / \Delta p_T$$
- **Will look closer at tracks w/ unusually large (or small) p_T^{trk} / p_T^{true} next week**

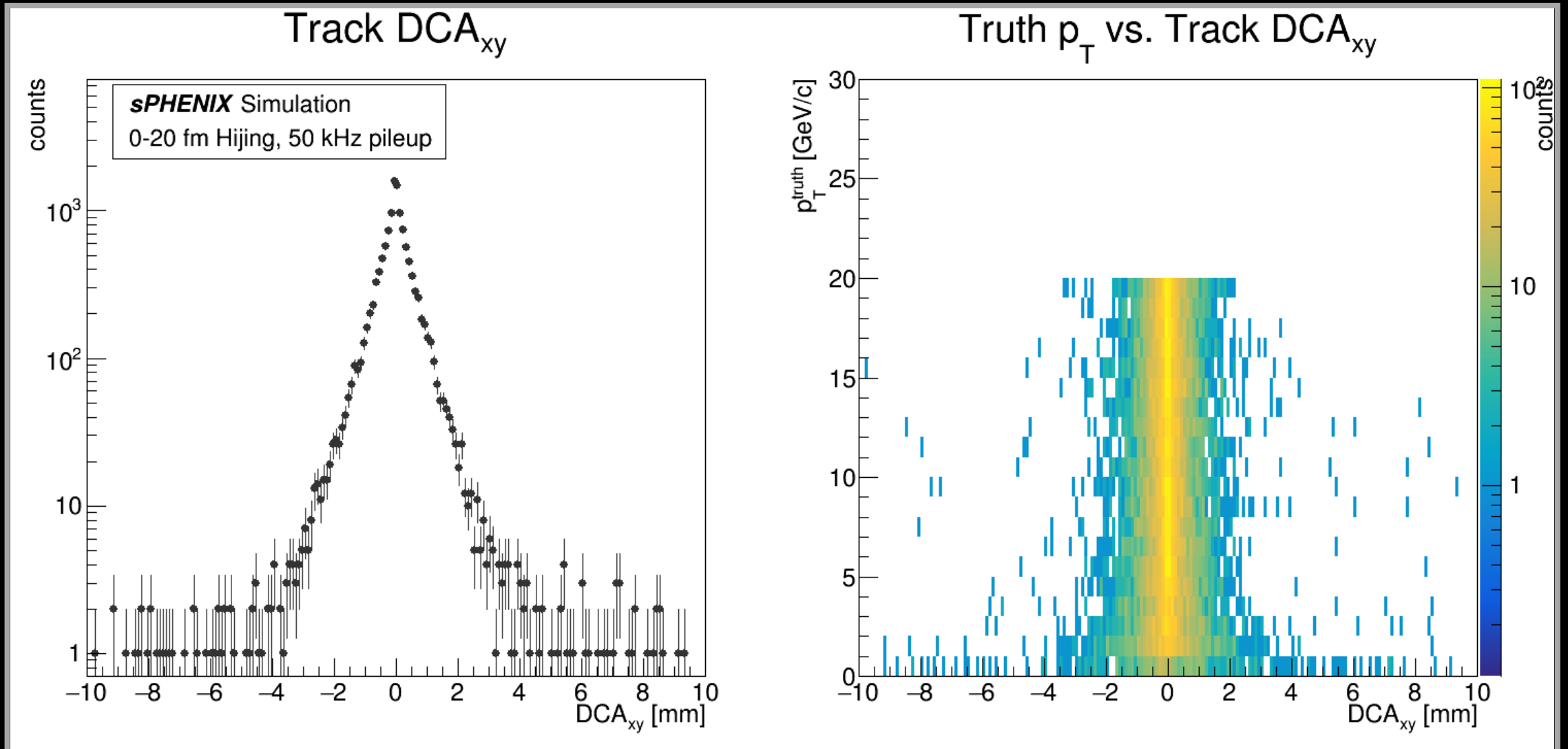
Updated Plots | Track vs. True p_T



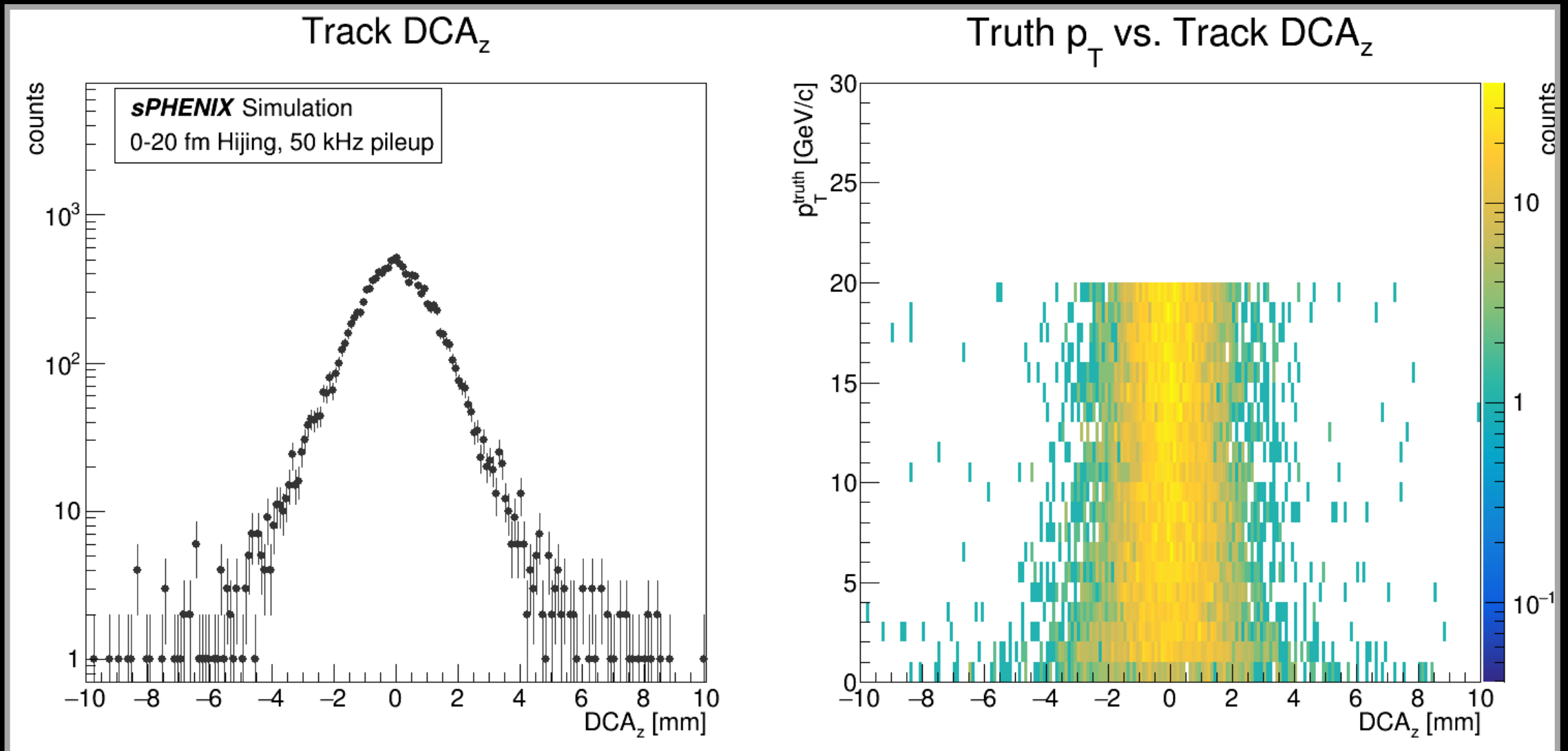
Updated Plots | Track Quality



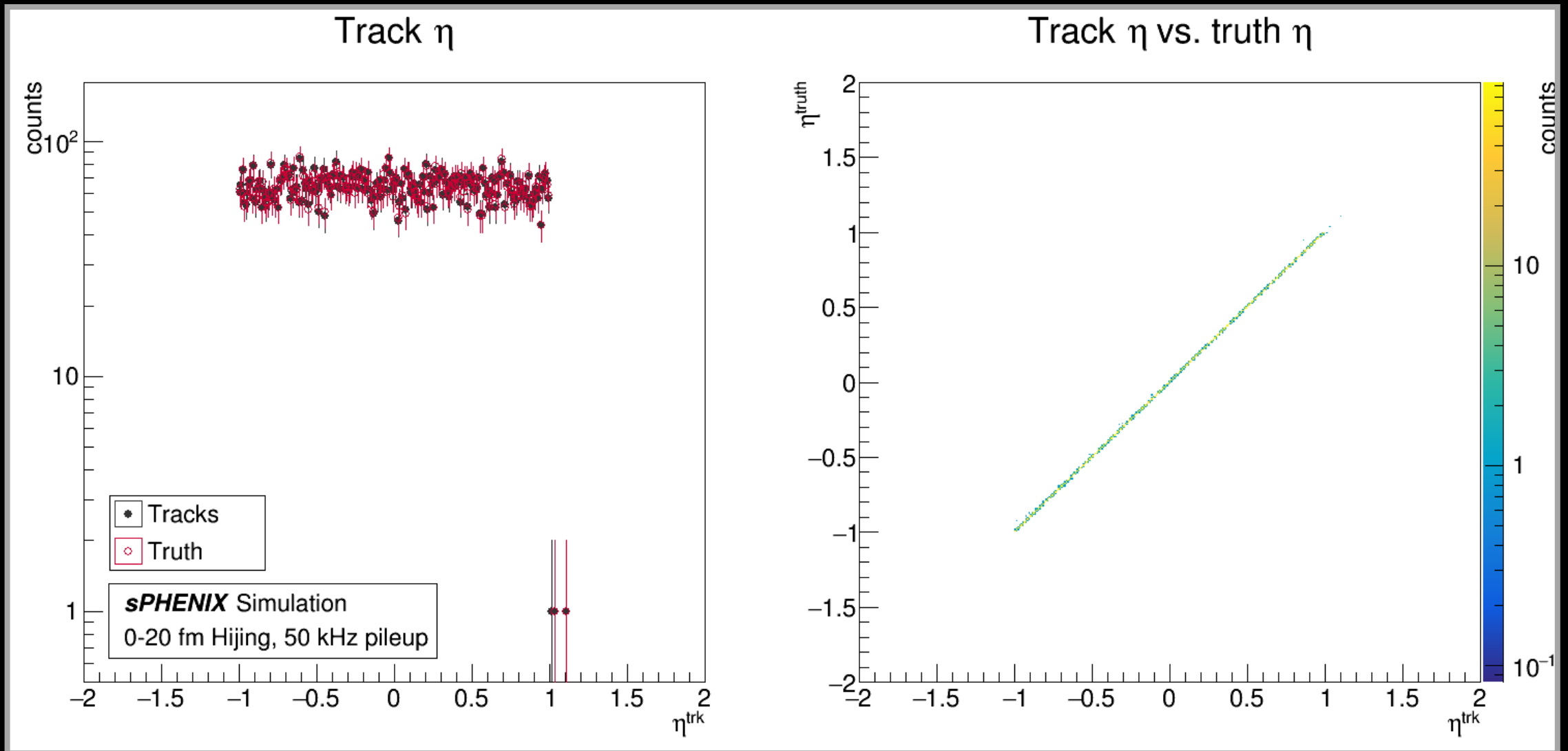
Updated Plots | Track DCA_{xy}



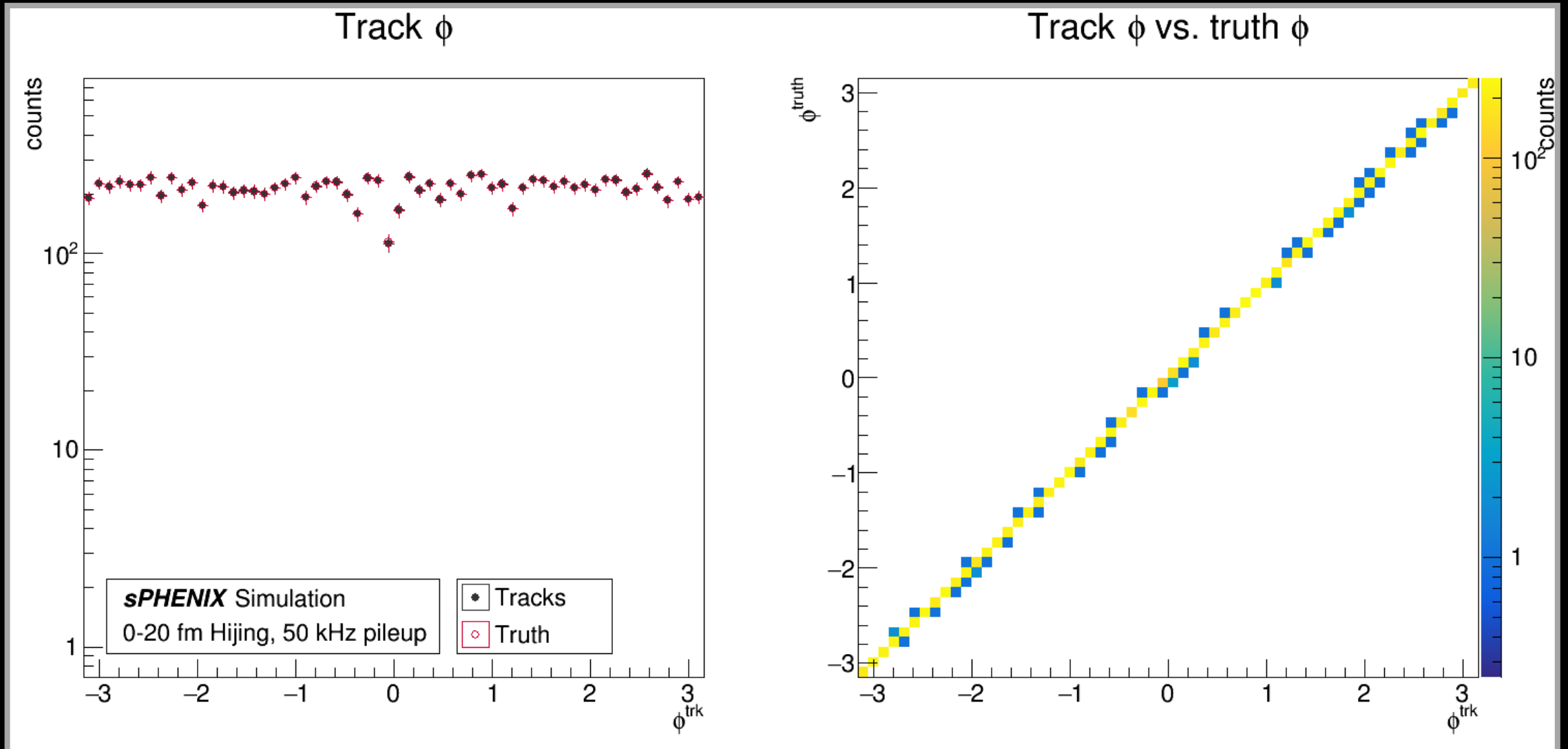
Updated Plots | Track DCA_z



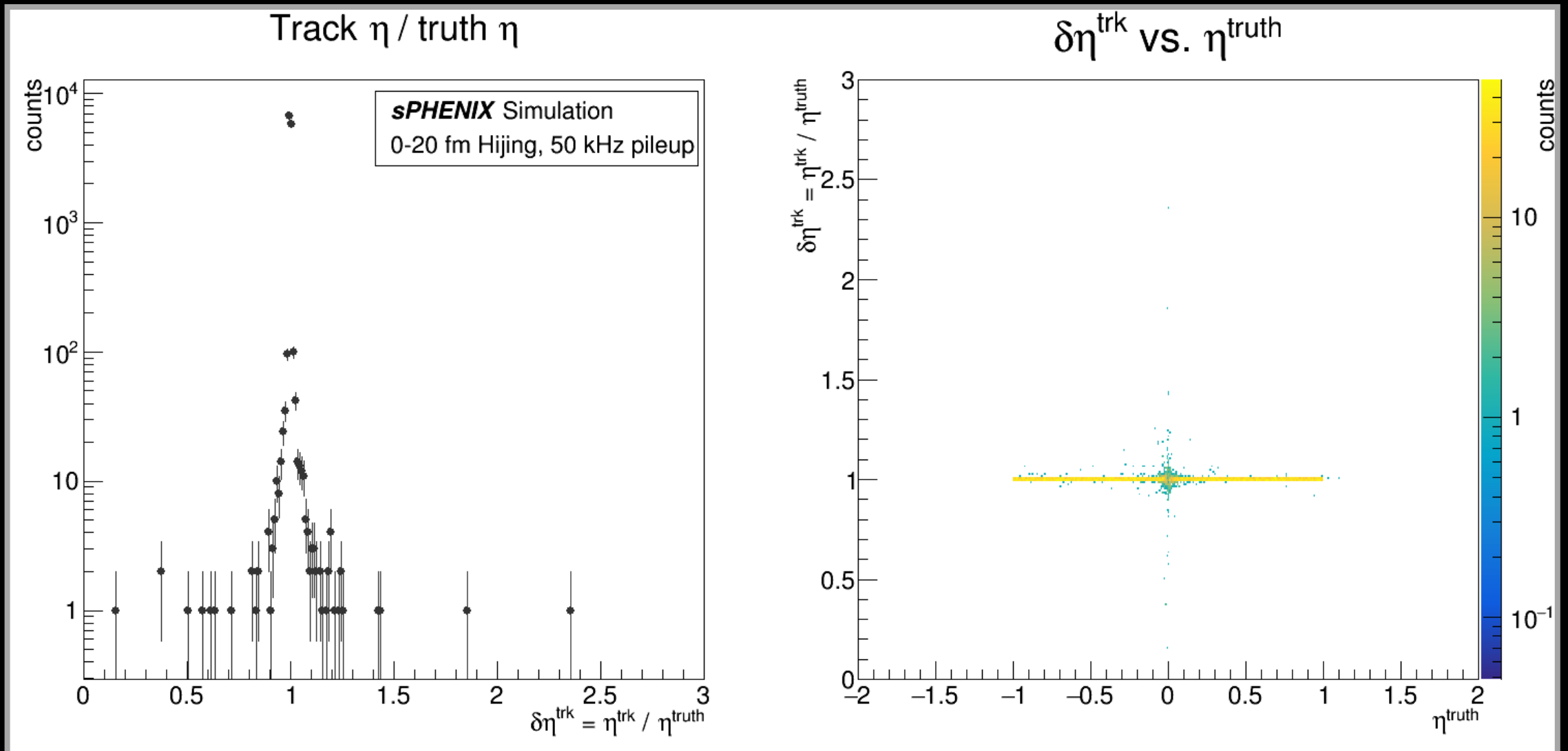
New Quantities | Track vs. True η



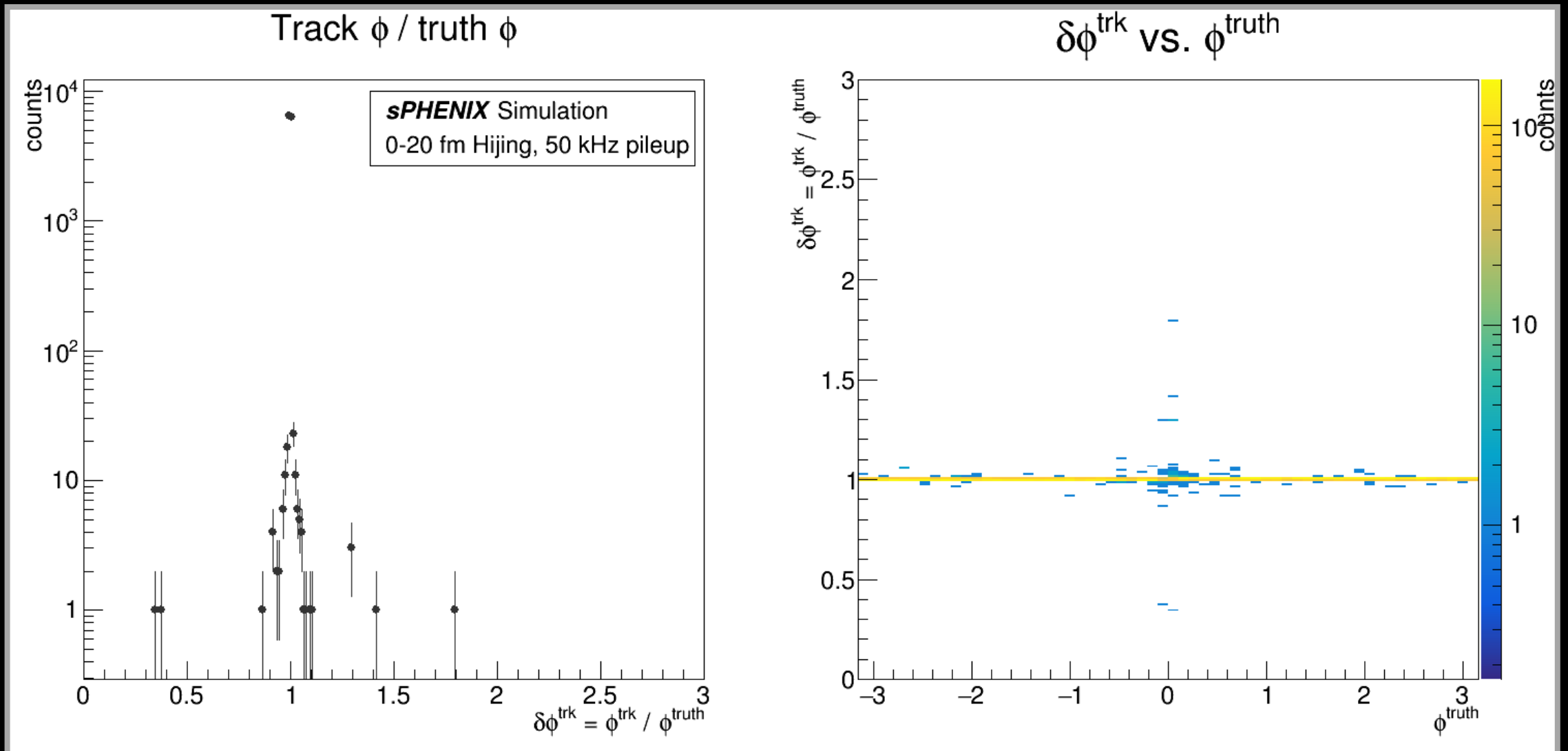
New Quantities | Track vs. True ϕ



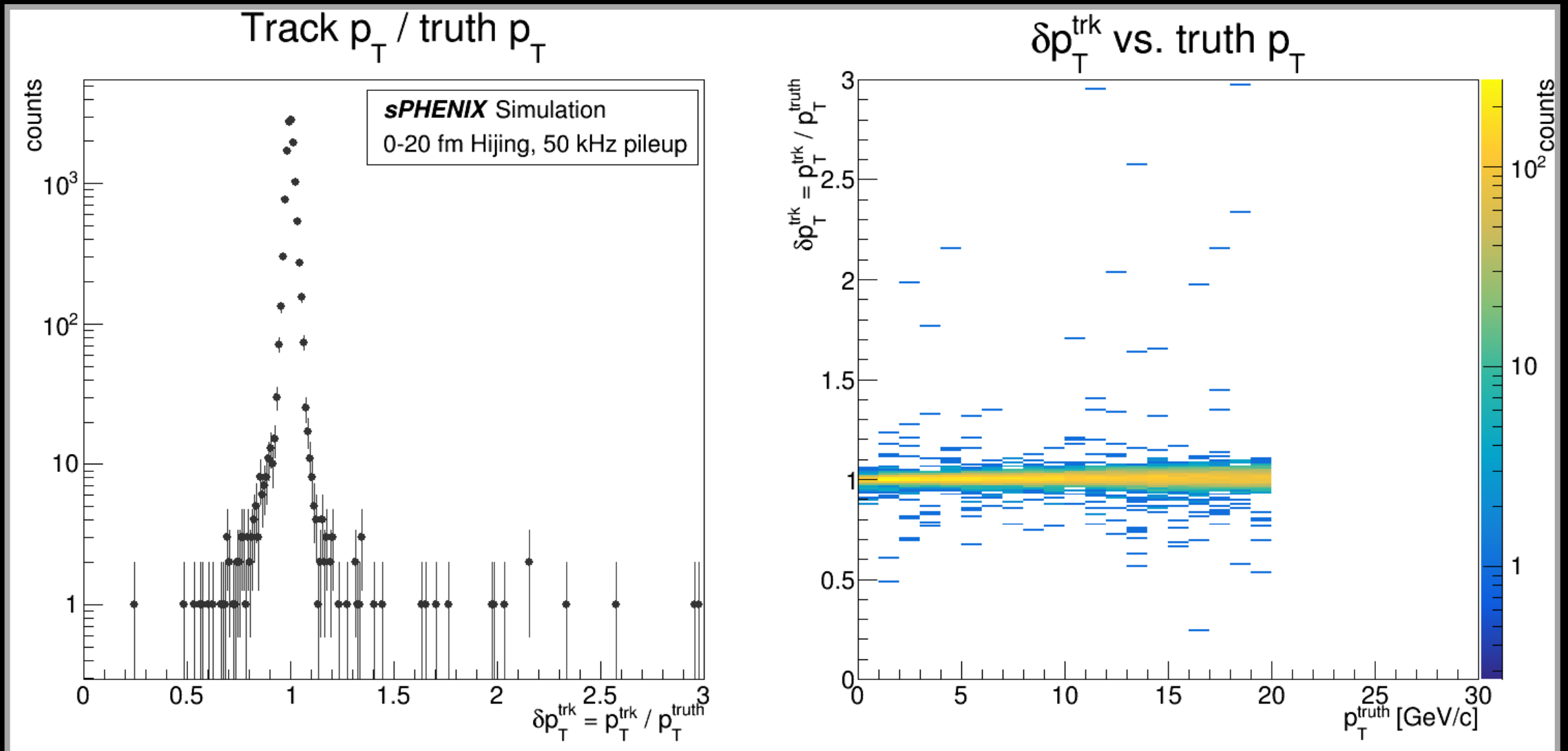
New Quantities | Fractional vs. True η



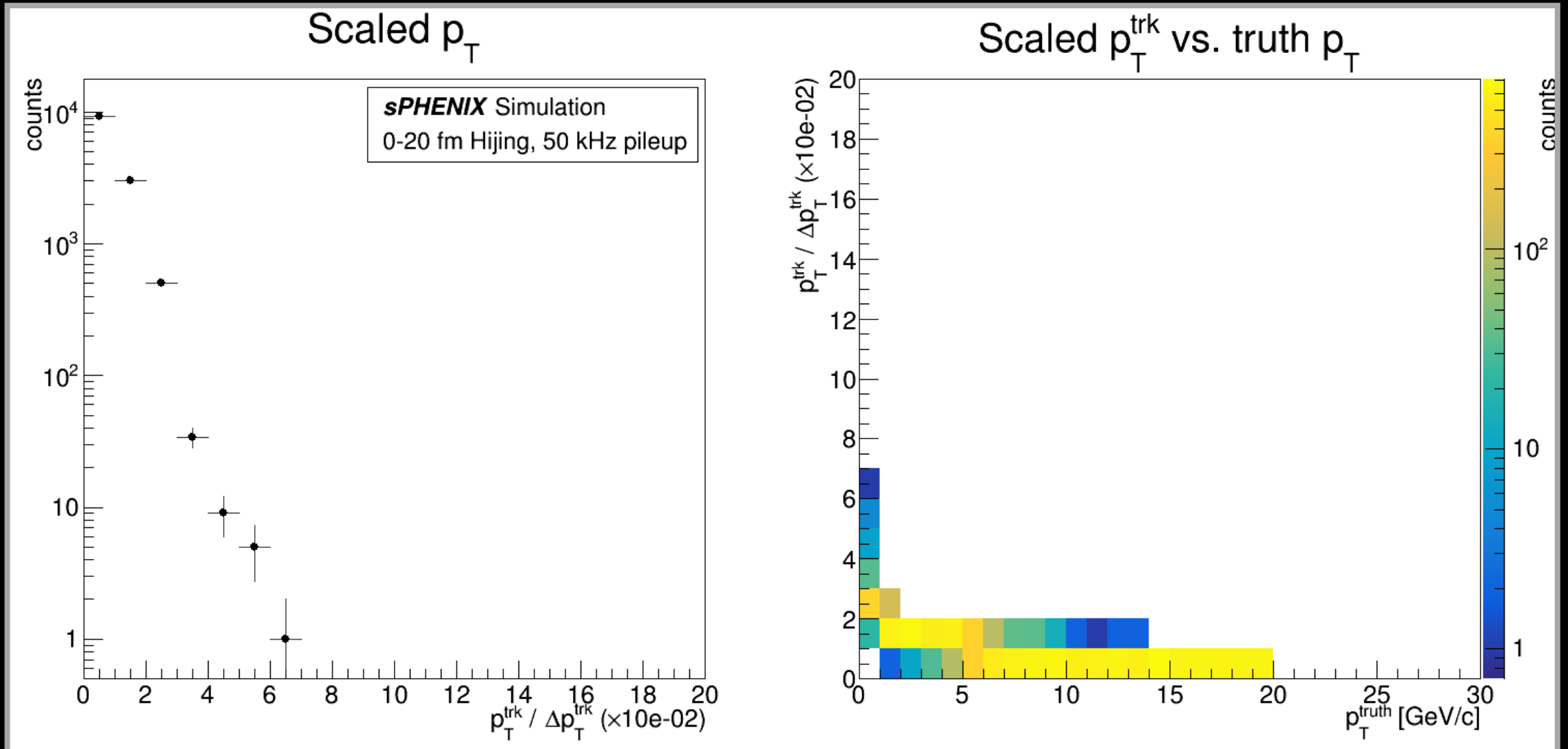
New Quantities | Fractional vs. True ϕ



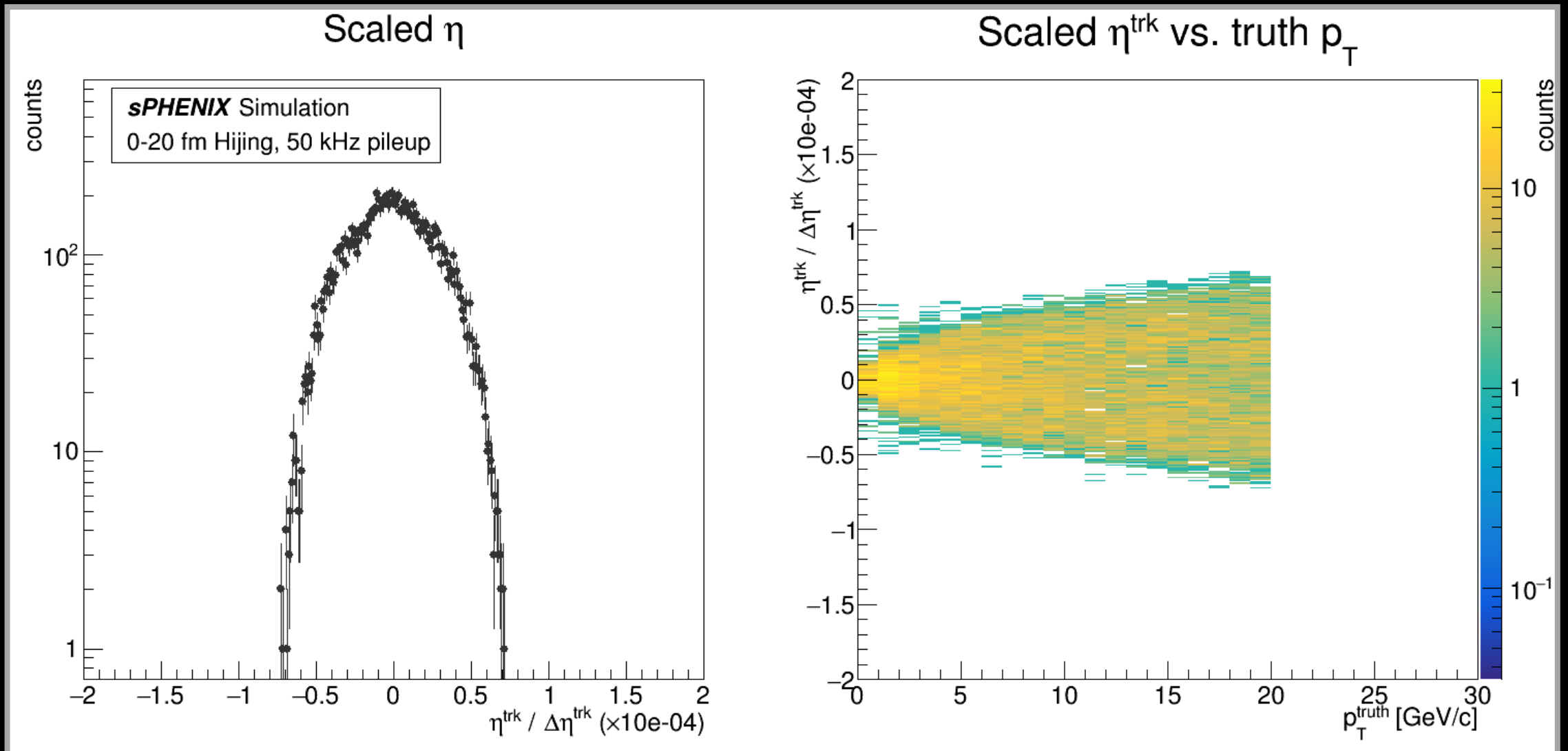
New Quantities | Fractional vs. True p_T



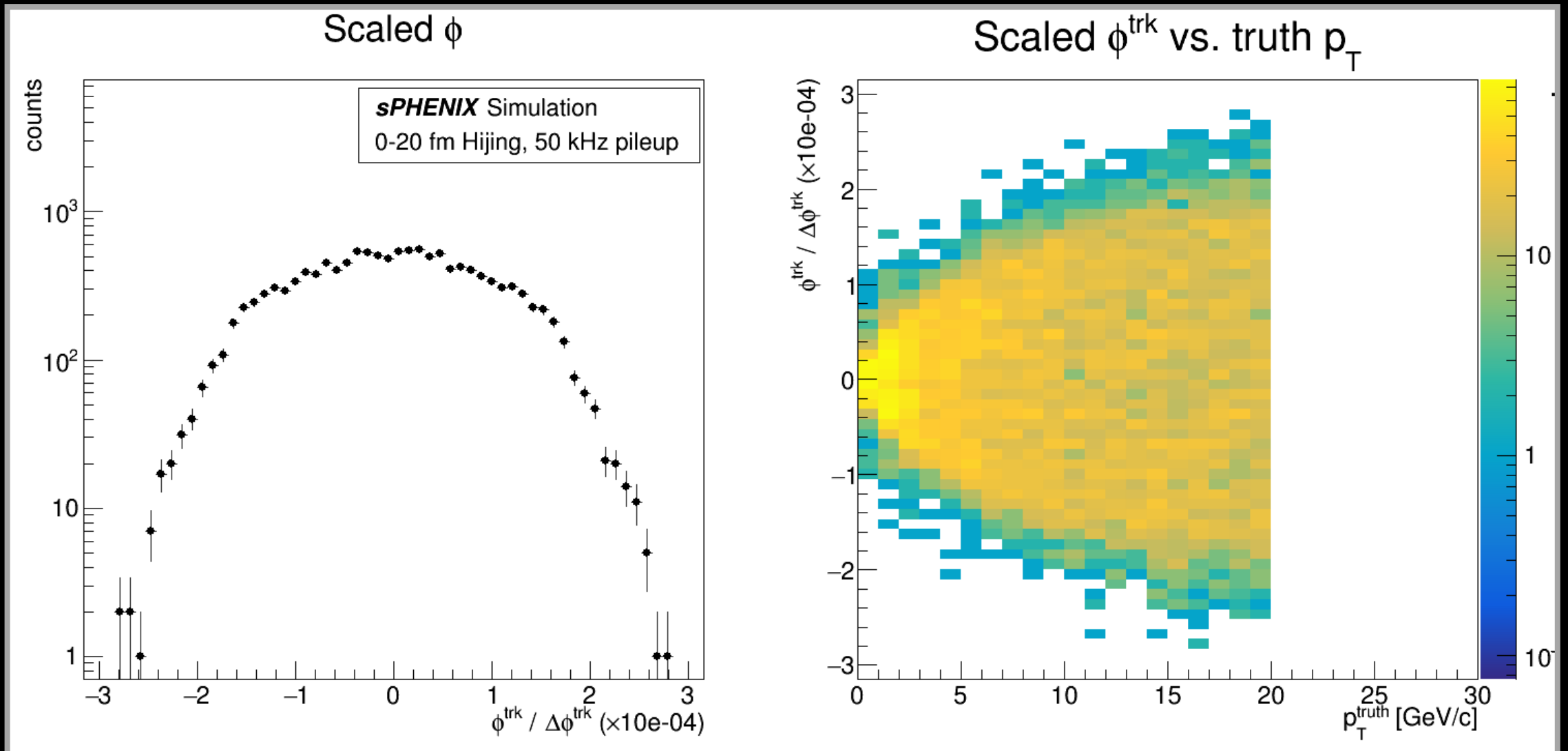
Scaled Quantities | Track p_T



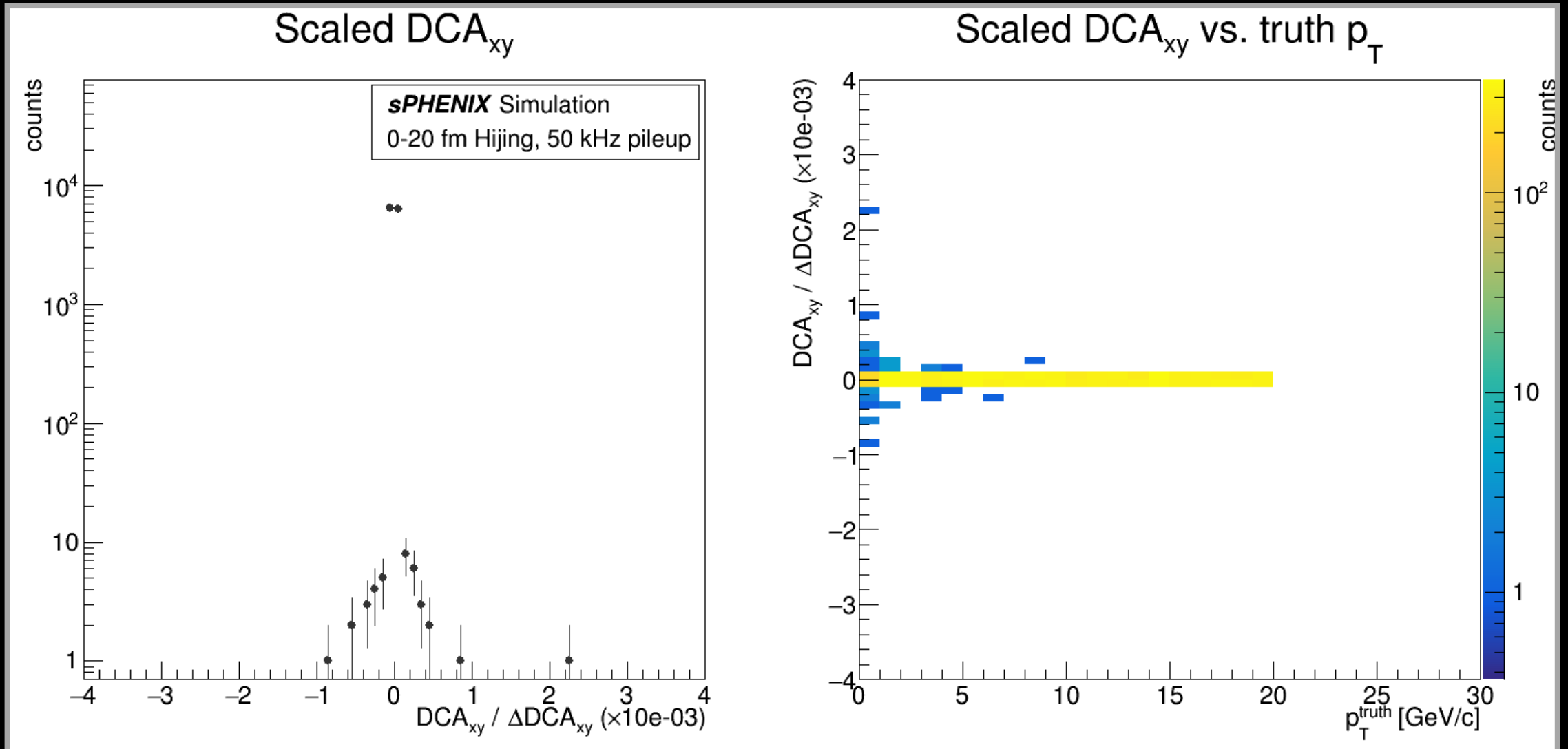
Scaled Quantities | Track η



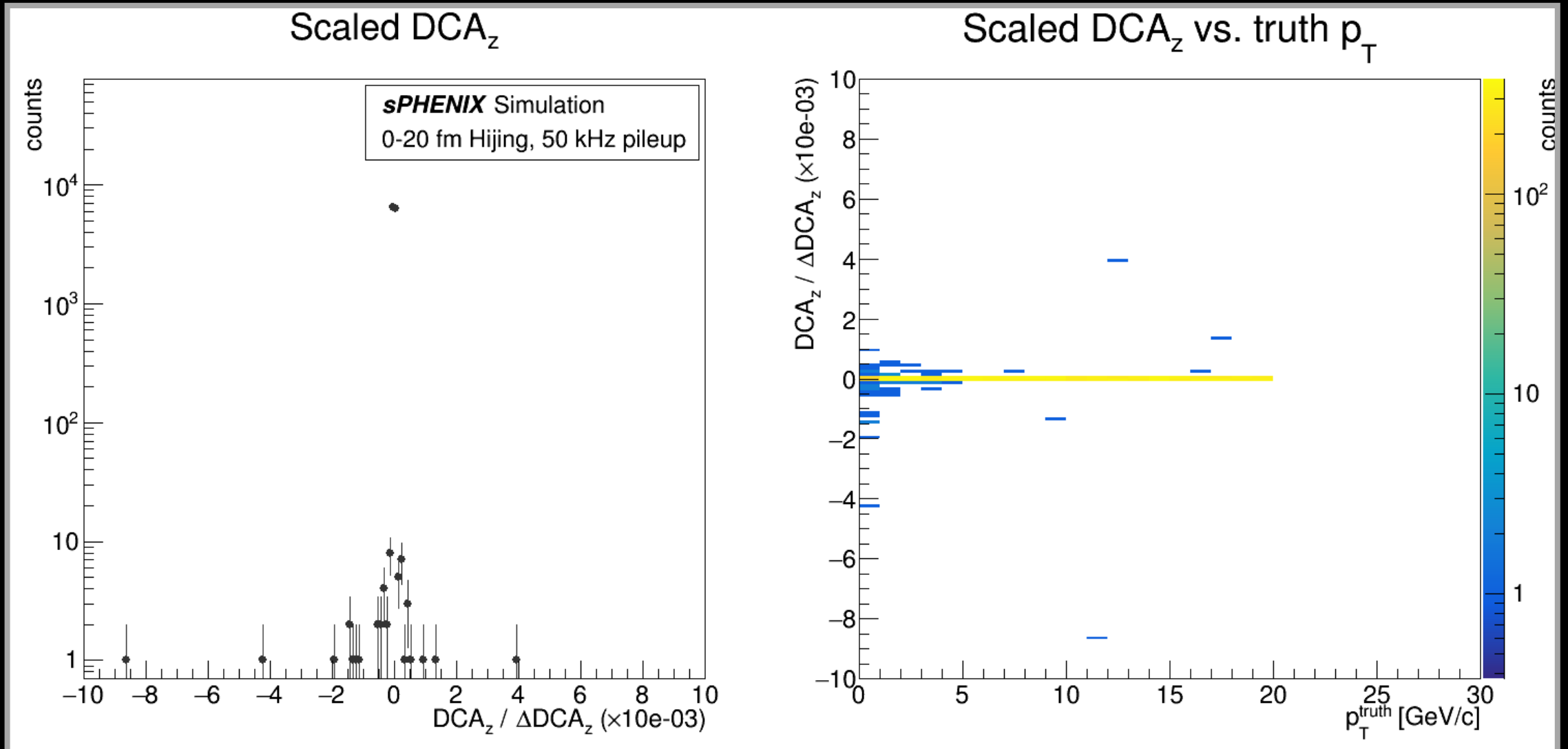
Scaled Quantities | Track ϕ



Scaled Quantities | Track DCA_{xy}



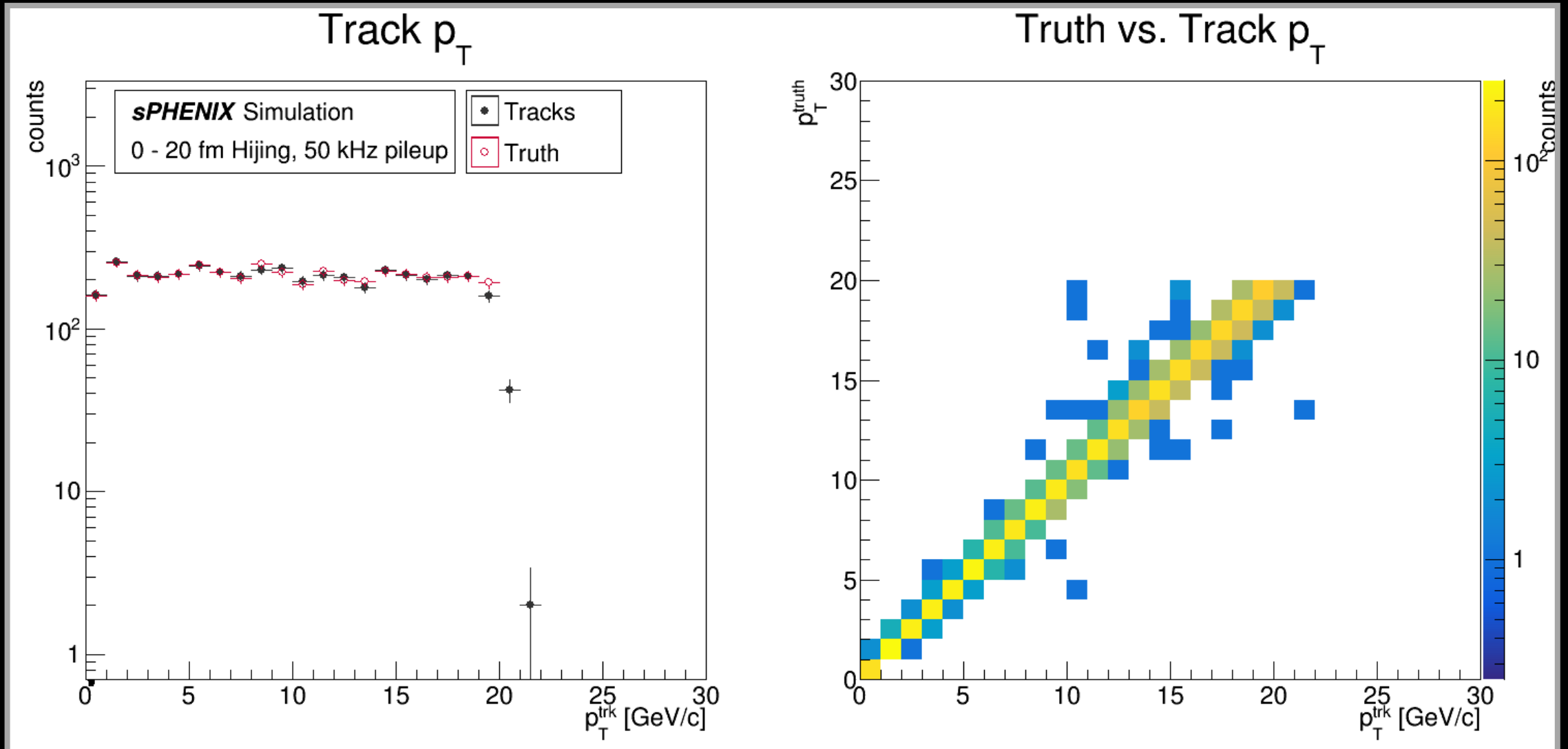
Scaled Quantities | Track DCAz



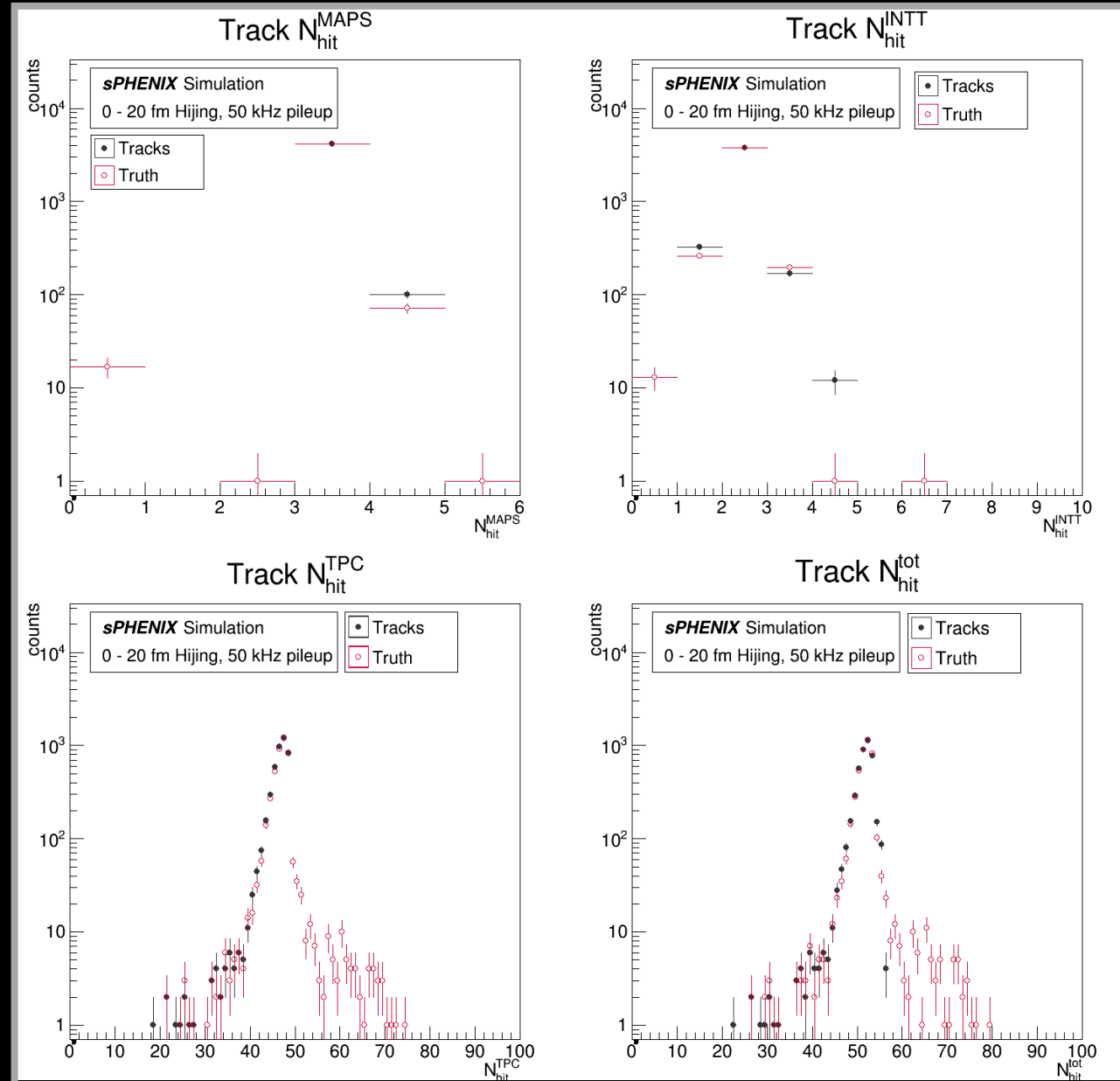
Study Details

- Ran default Fun4All macro over small set of files to test:
 - 0 – 20 fm Hijing (**type = 4**)
 - 50 kHz pileup (**pileup = 1**)
 - ☞ Next will run over larger sample
- **These slides:** looked at a handful of quantities
 - ☞ This update is mostly to correct any conceptual errors...

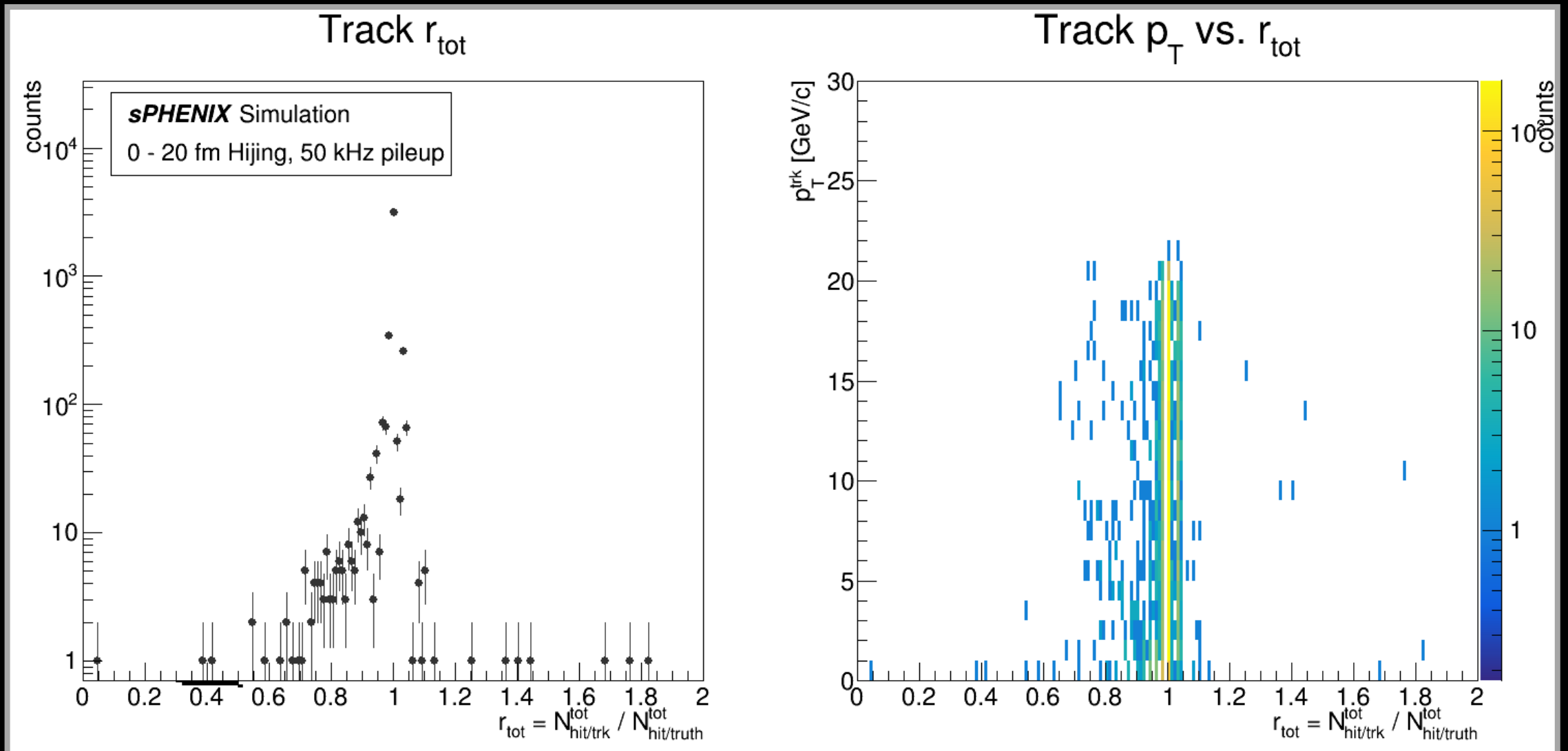
Track vs. True Pt



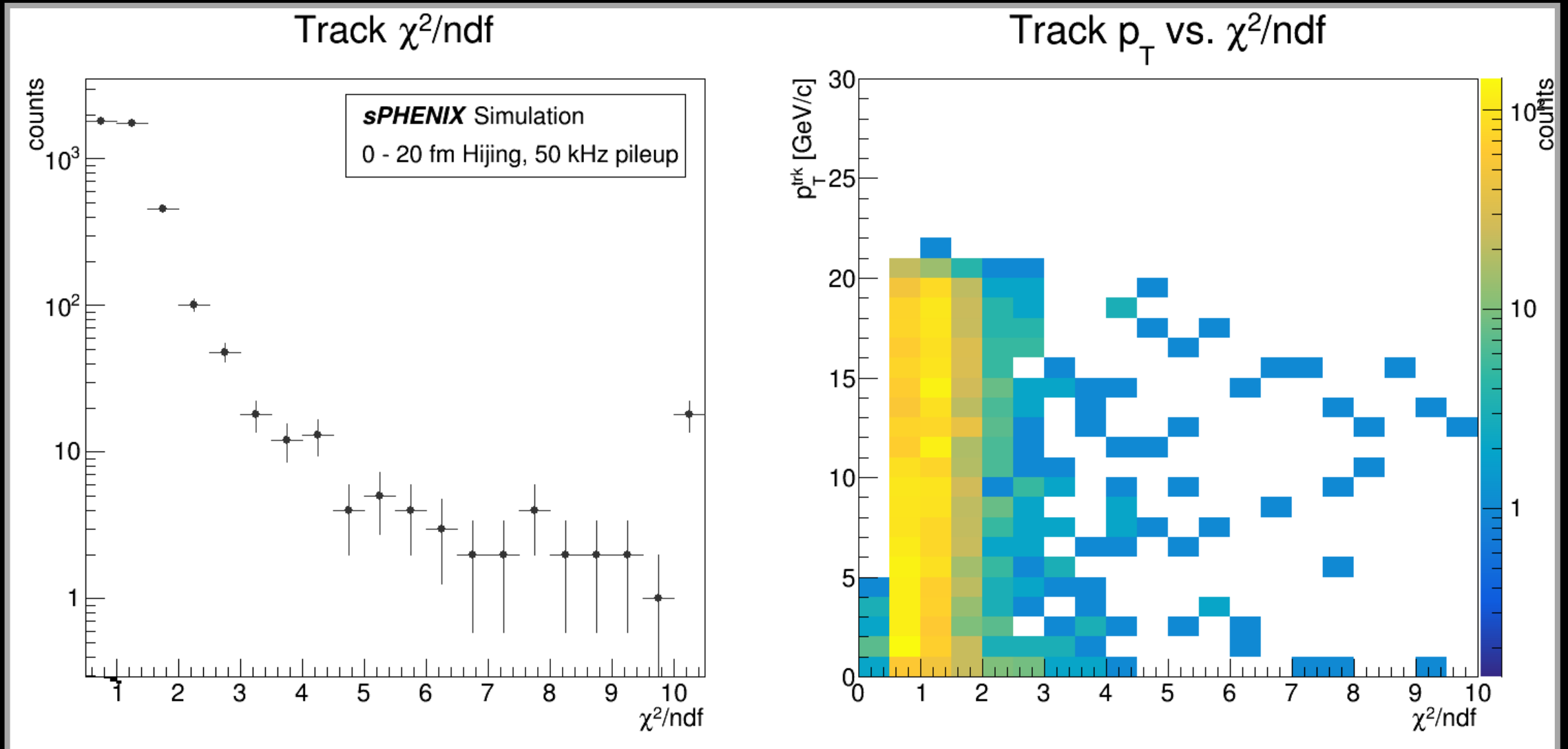
Track vs. Truth Nhits



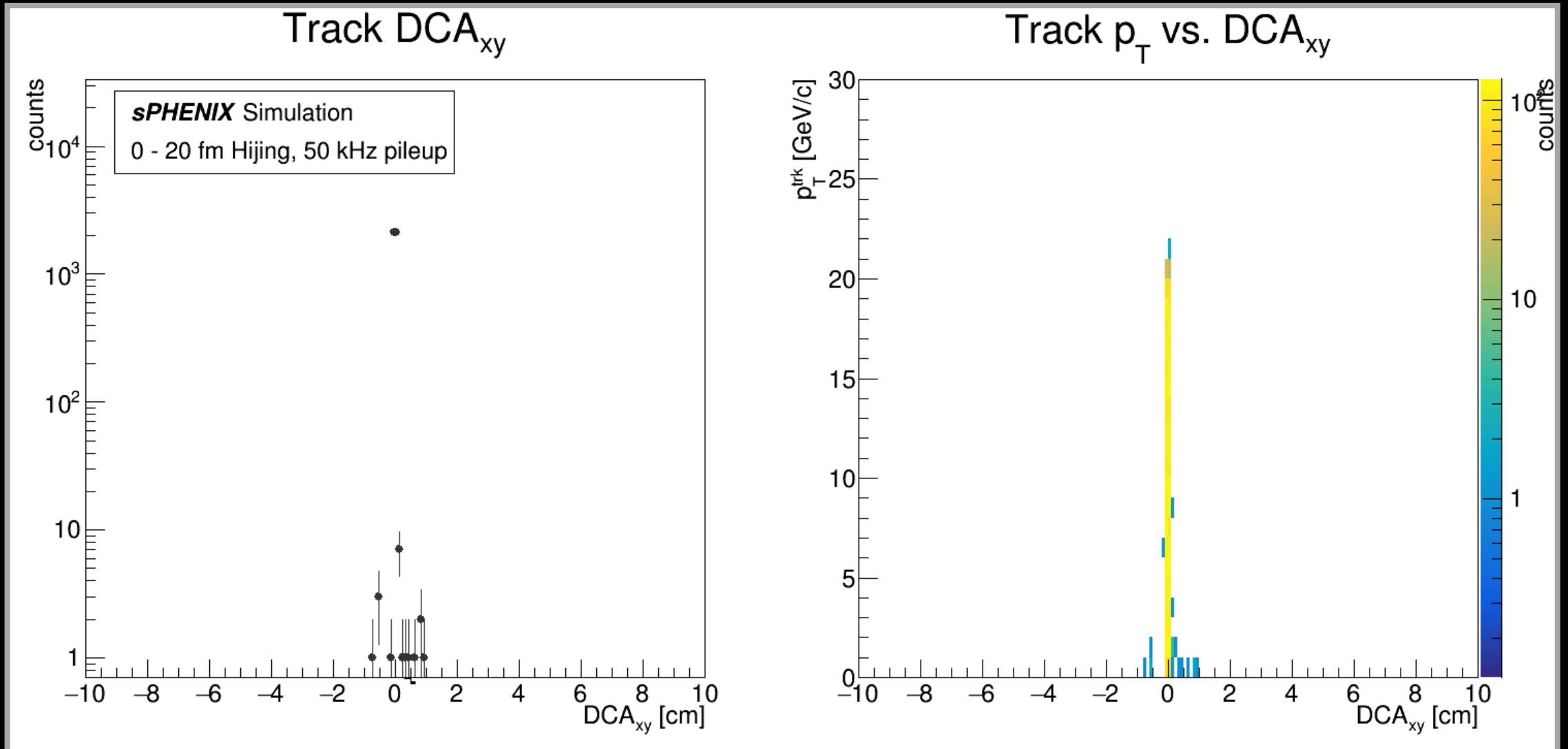
Track/True Nhits



Track Quality



Track DCA_{xy}



Track DCA_z

