

# Distorted Seeds

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# Simulation Overview

- Ran 2 pion (one positive one negative) simulation only, no embedding
- Same random seed for three cases
  1. No distortions
  2. Static distortions
  3. Beam induced distortions
- Maps used shown here for archival purposes

```
G4TPC::ENABLE_STATIC_DISTORTIONS = true;
G4TPC::ENABLE_CORRECTIONS = true;
// Beam induced distortions
G4TPC::static_distortion_filename = distortion;
G4TPC::correction_filename = distortioncorrection;
//G4TPC::static_distortion_filename = "/phenix/u/hpereira/sphenix/work/g4simulations/
distortion_maps-new/average_minus_static_distortion_converted.root";
//G4TPC::correction_filename = "/phenix/u/hpereira/sphenix/work/g4simulations/distort
lon_maps-new/average_minus_static_distortion_inverted_4.root";

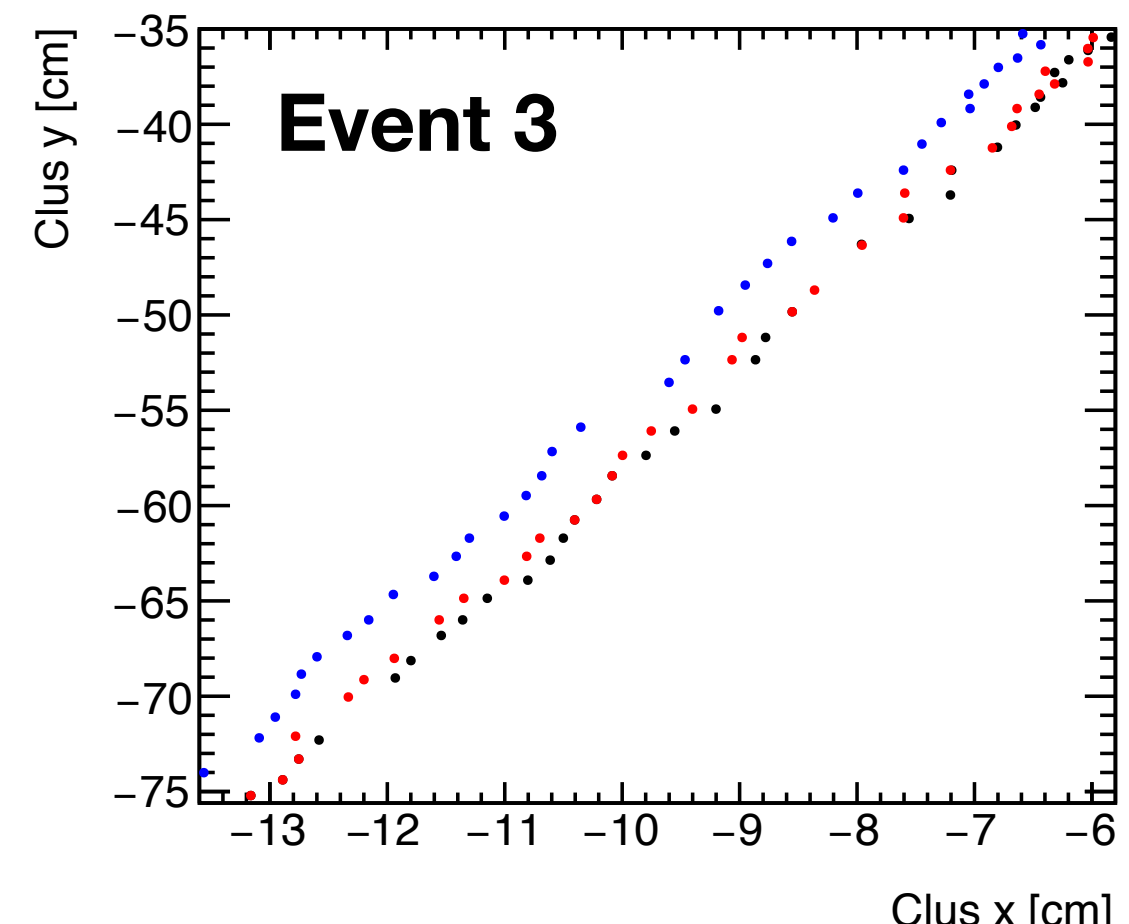
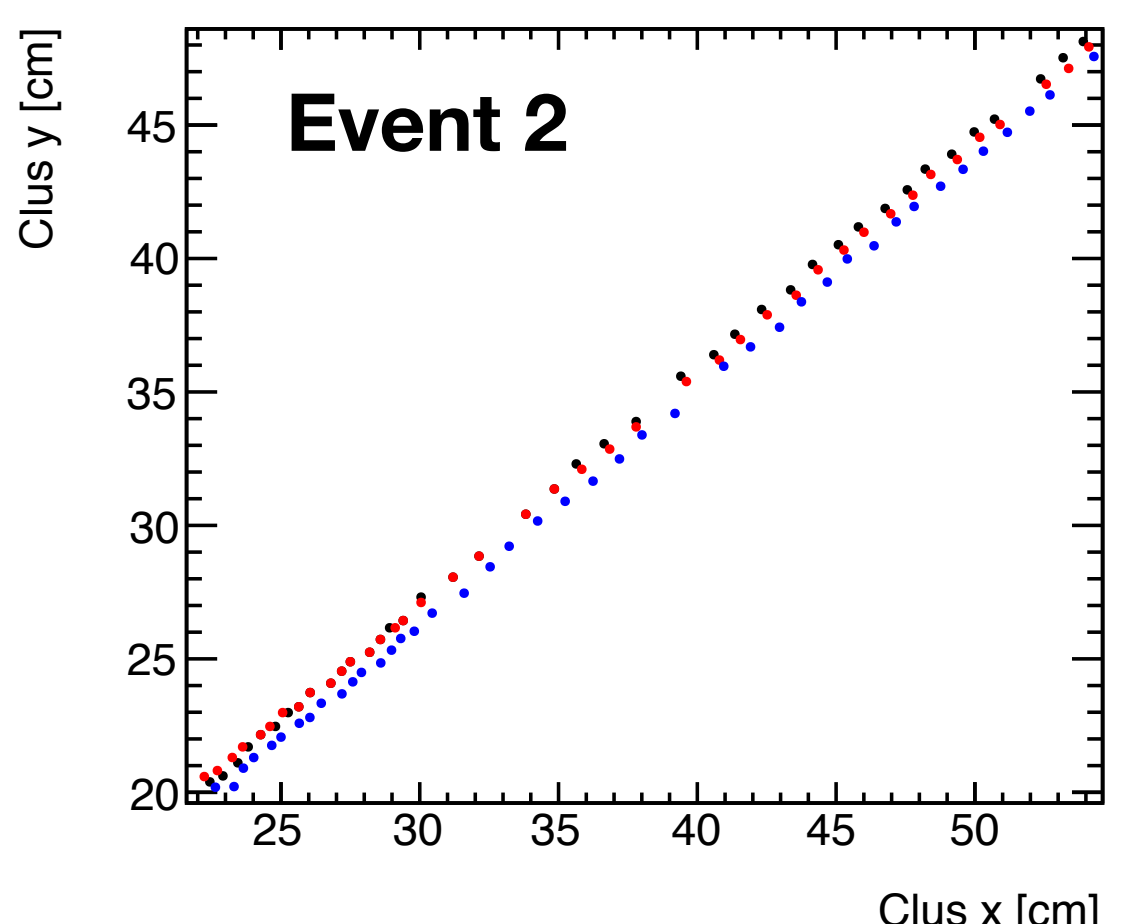
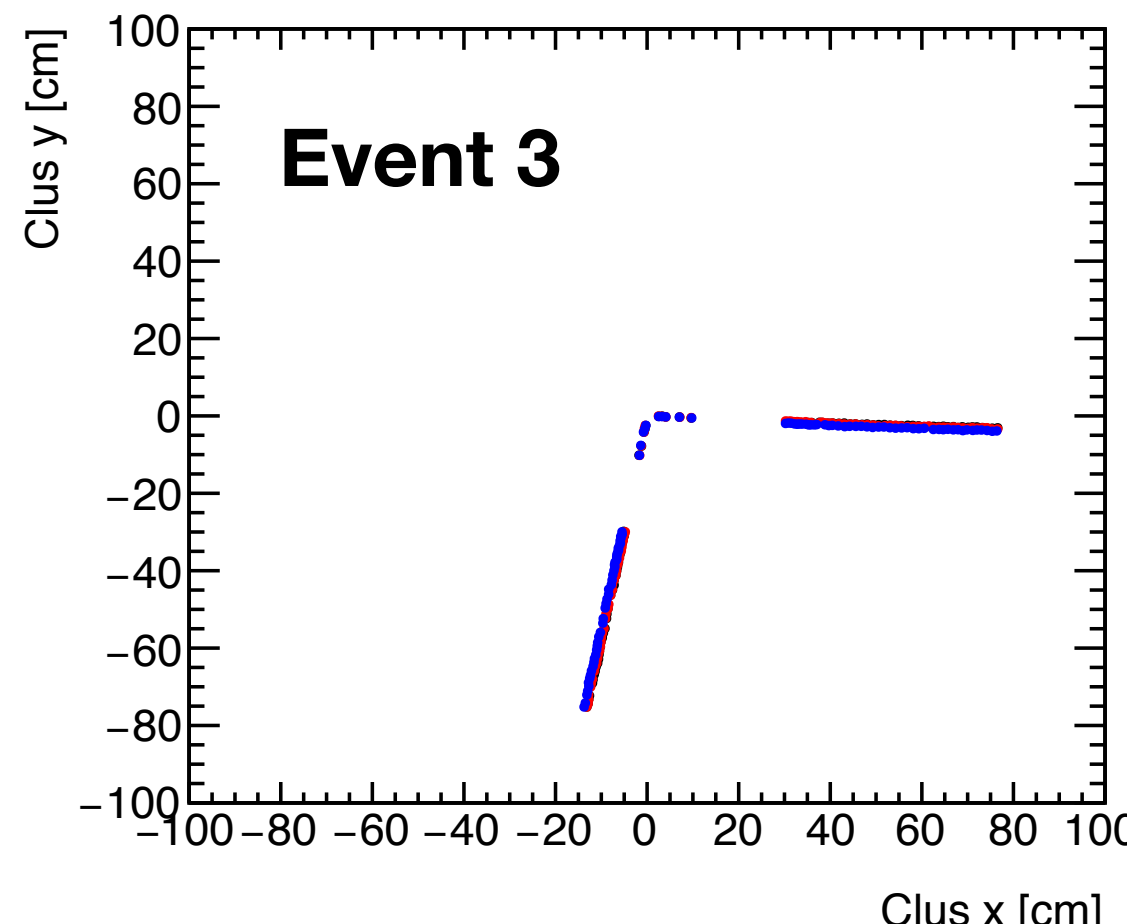
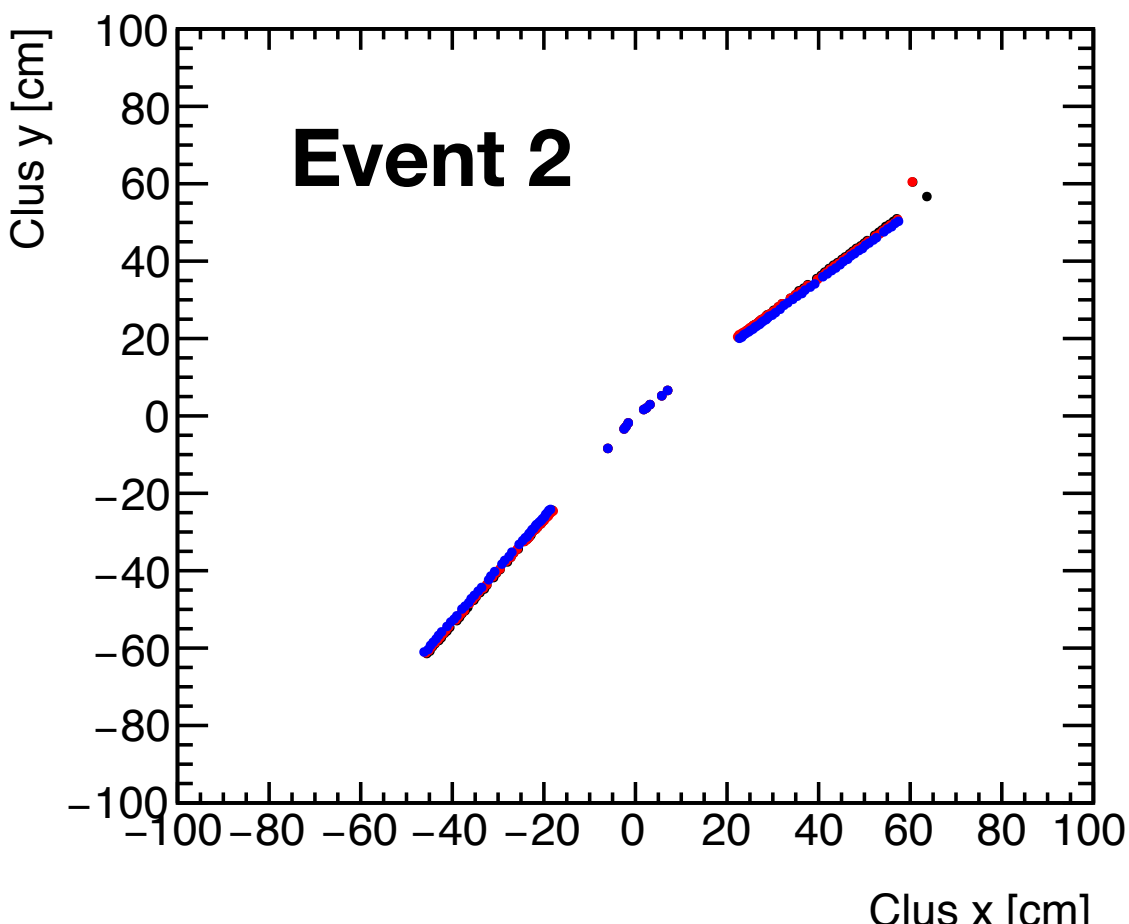
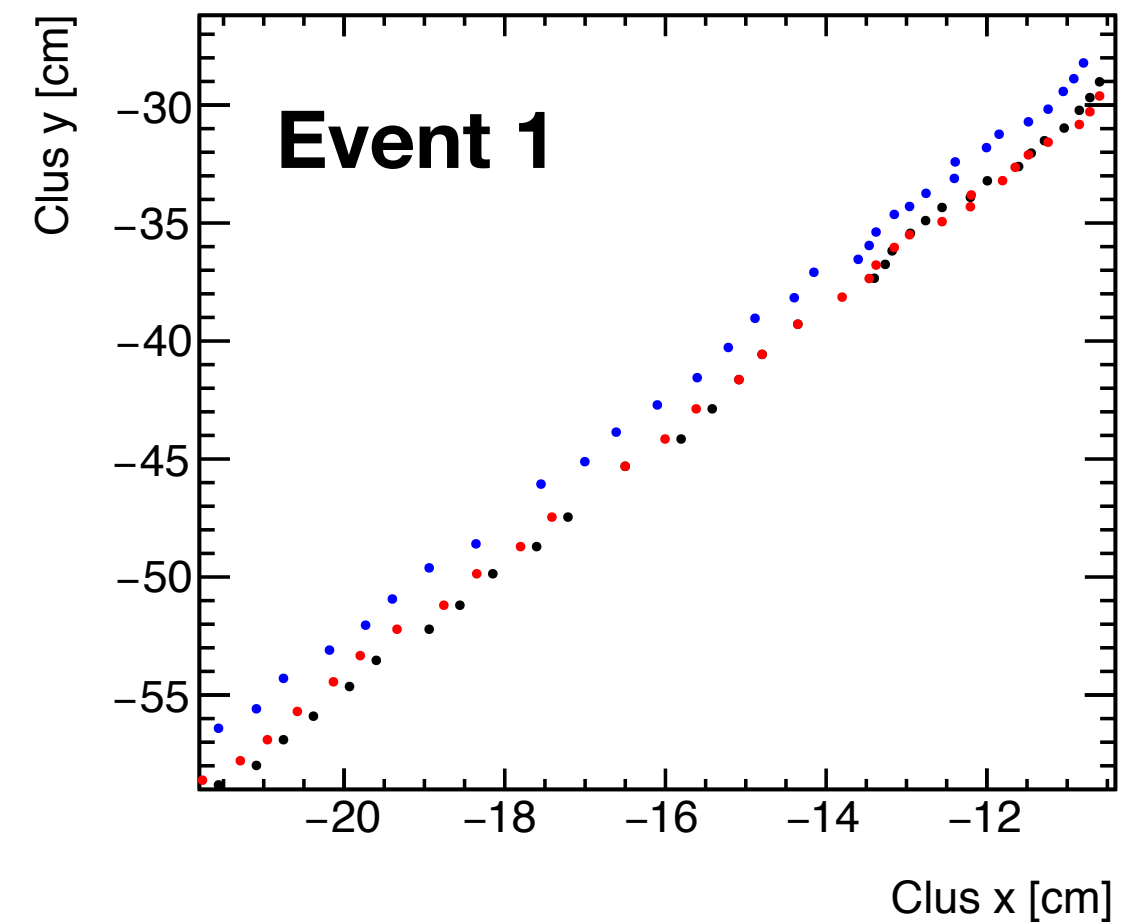
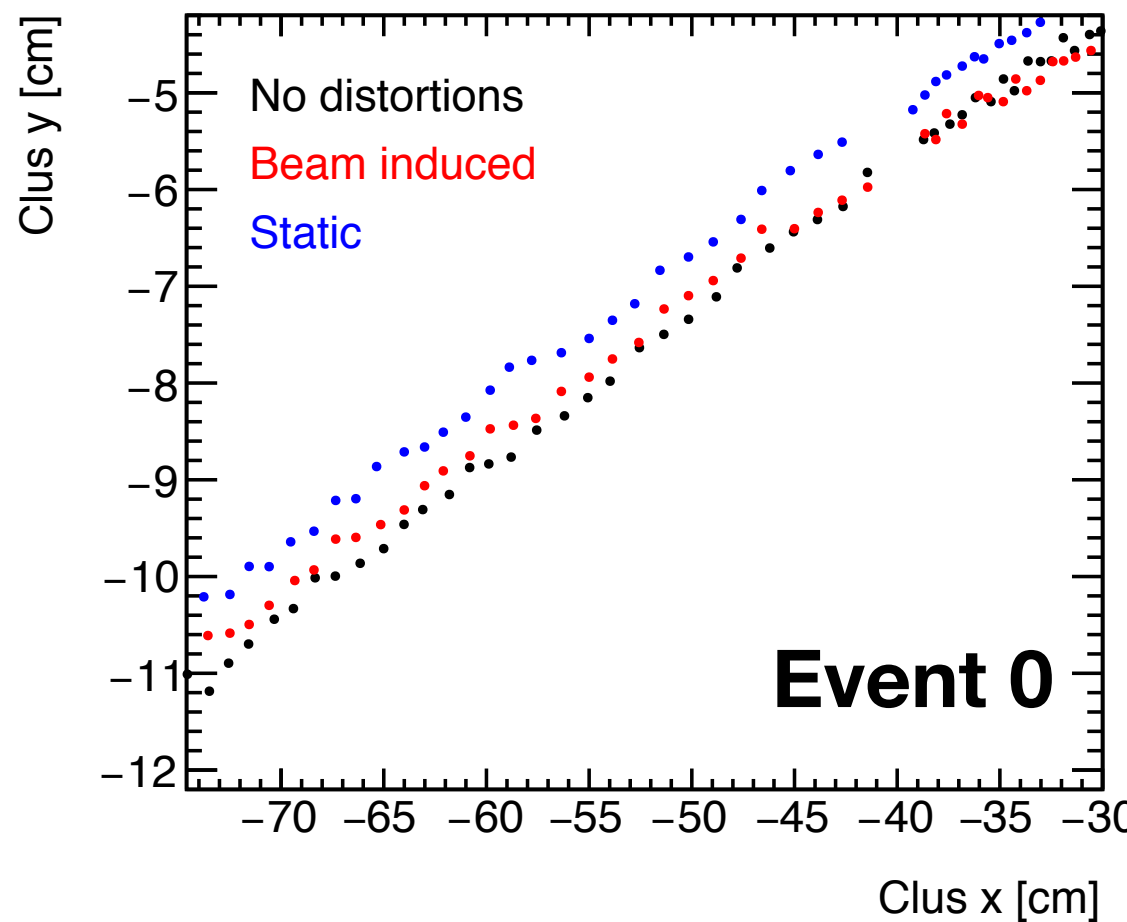
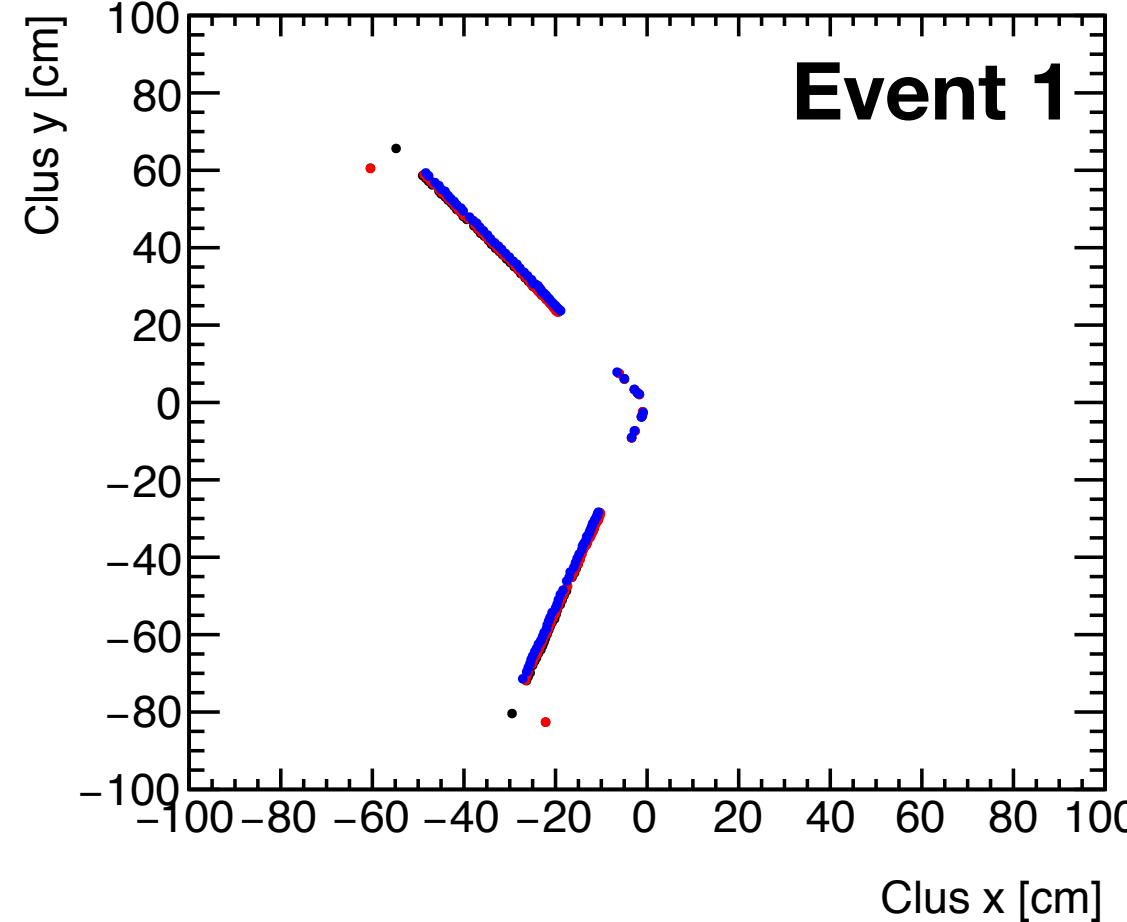
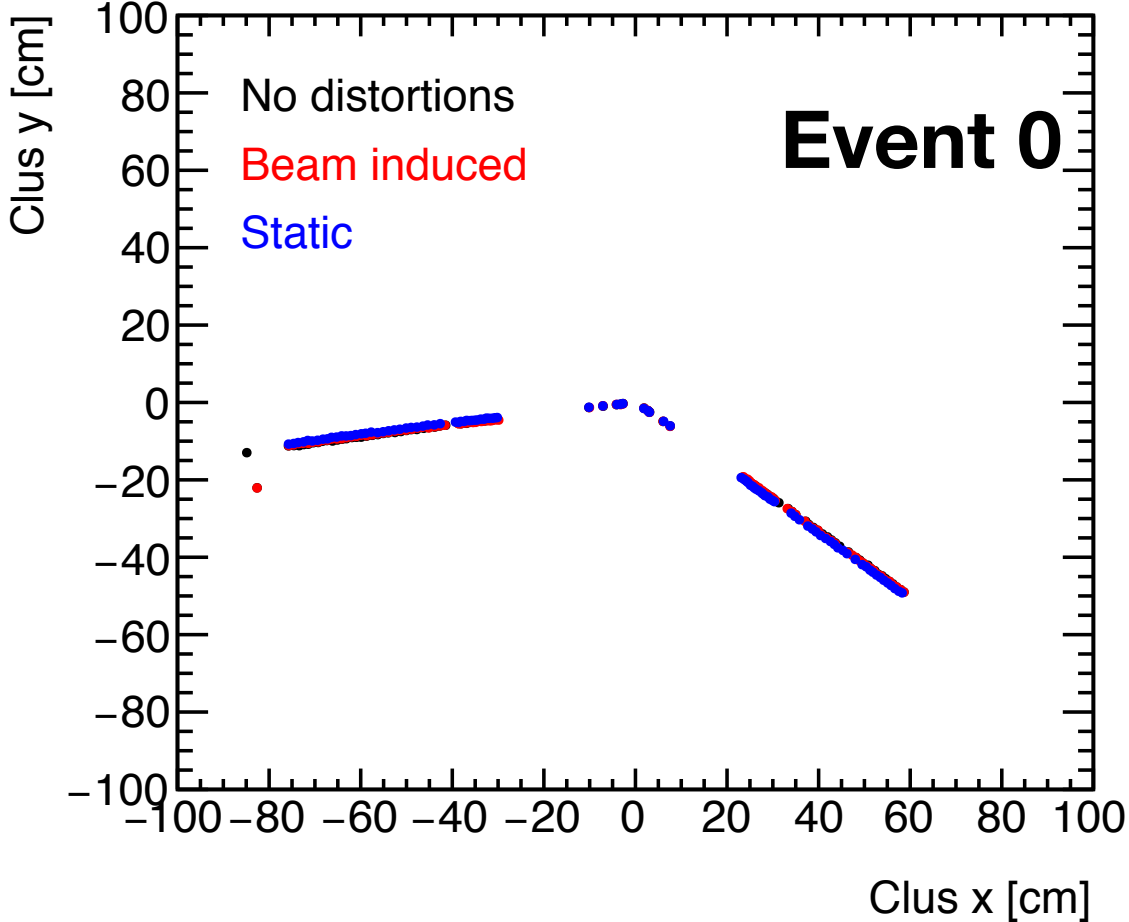
/// Static distortions
//G4TPC::static_distortion_filename = "/star/u/rcorliss/sphenix/trackingStudySampleNo
/2021/static_only.distortion_map.hist.root";
//G4TPC::correction_filename = "/phenix/u/hpereira/sphenix/work/g4simulations/distort
lon_maps-new/static_only_inverted_10-new.root";
```

# Example Tracks

- Next 7 slides show some example track seeds
- I put these together just so that I could see what the track seeds look like with and without the effect of the TPC cluster mover

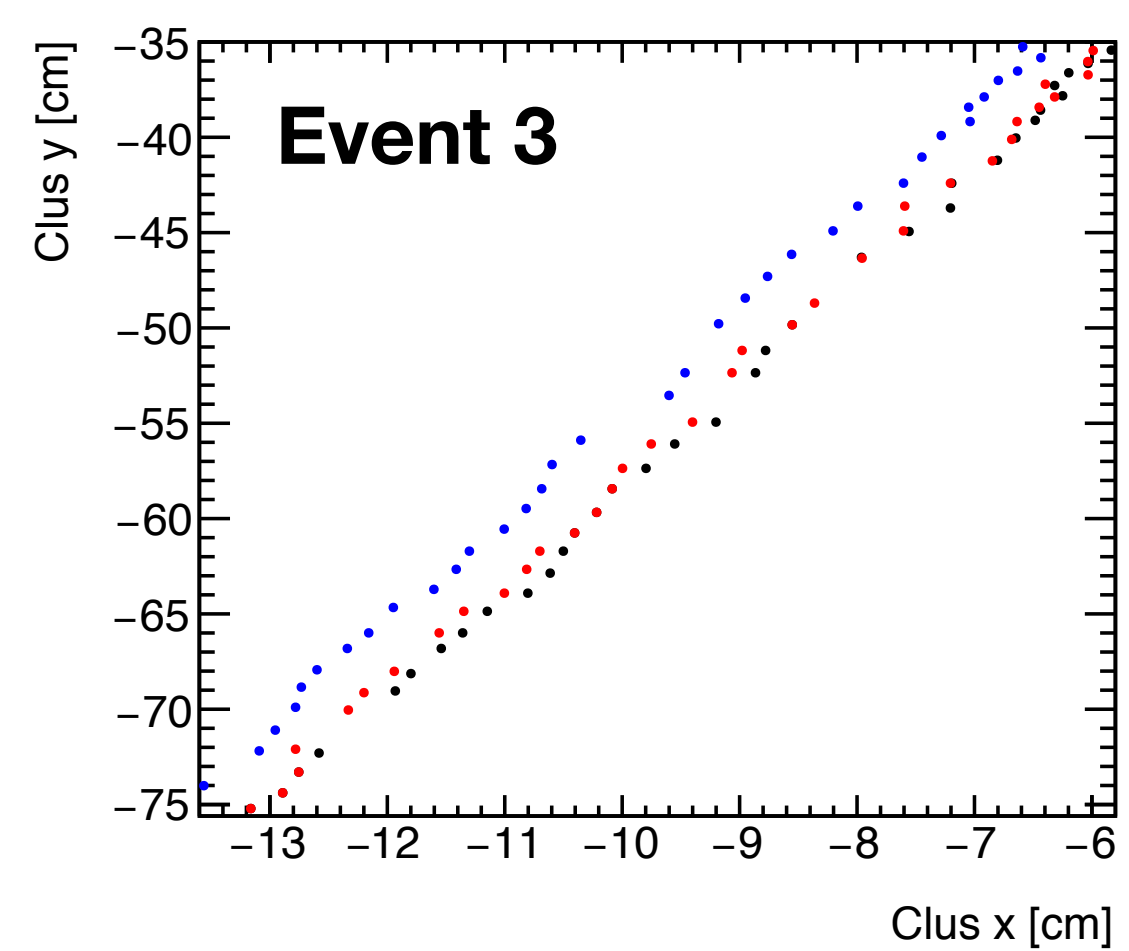
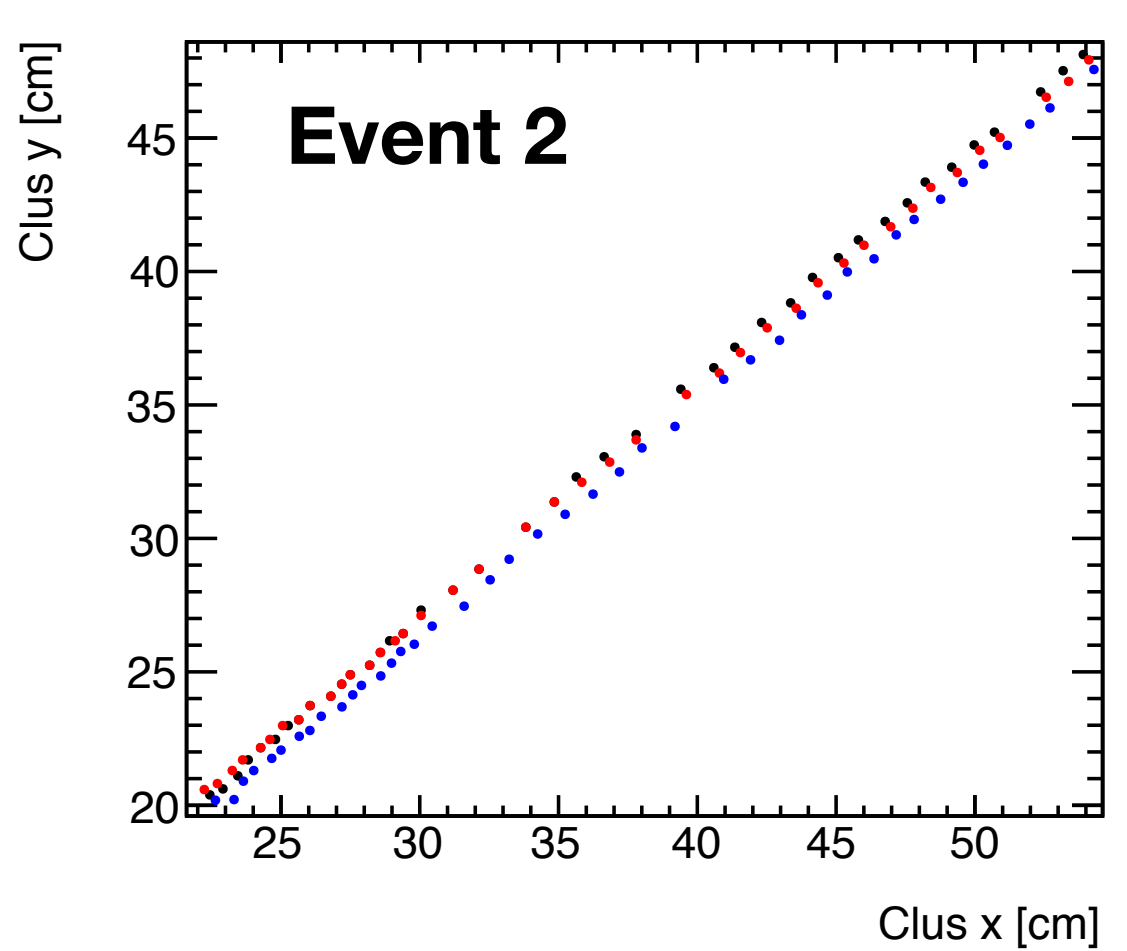
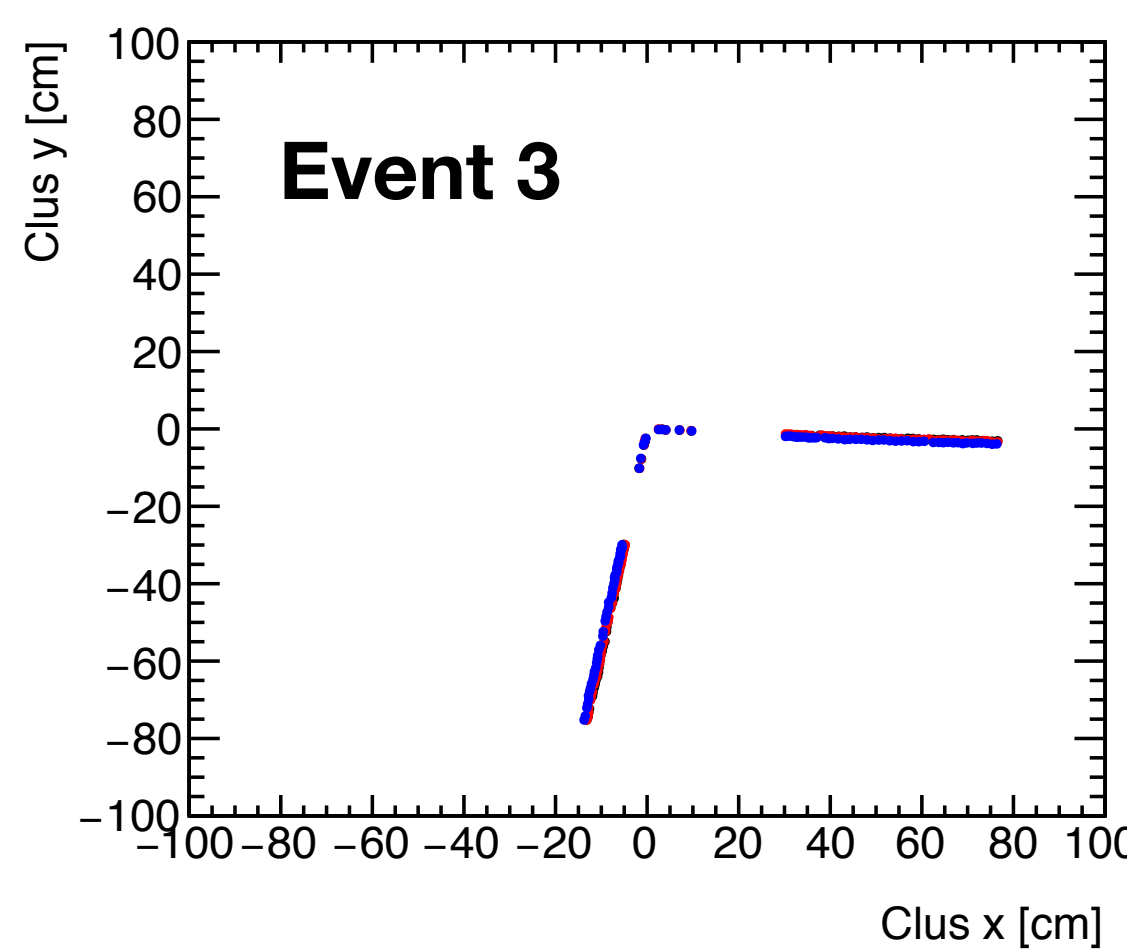
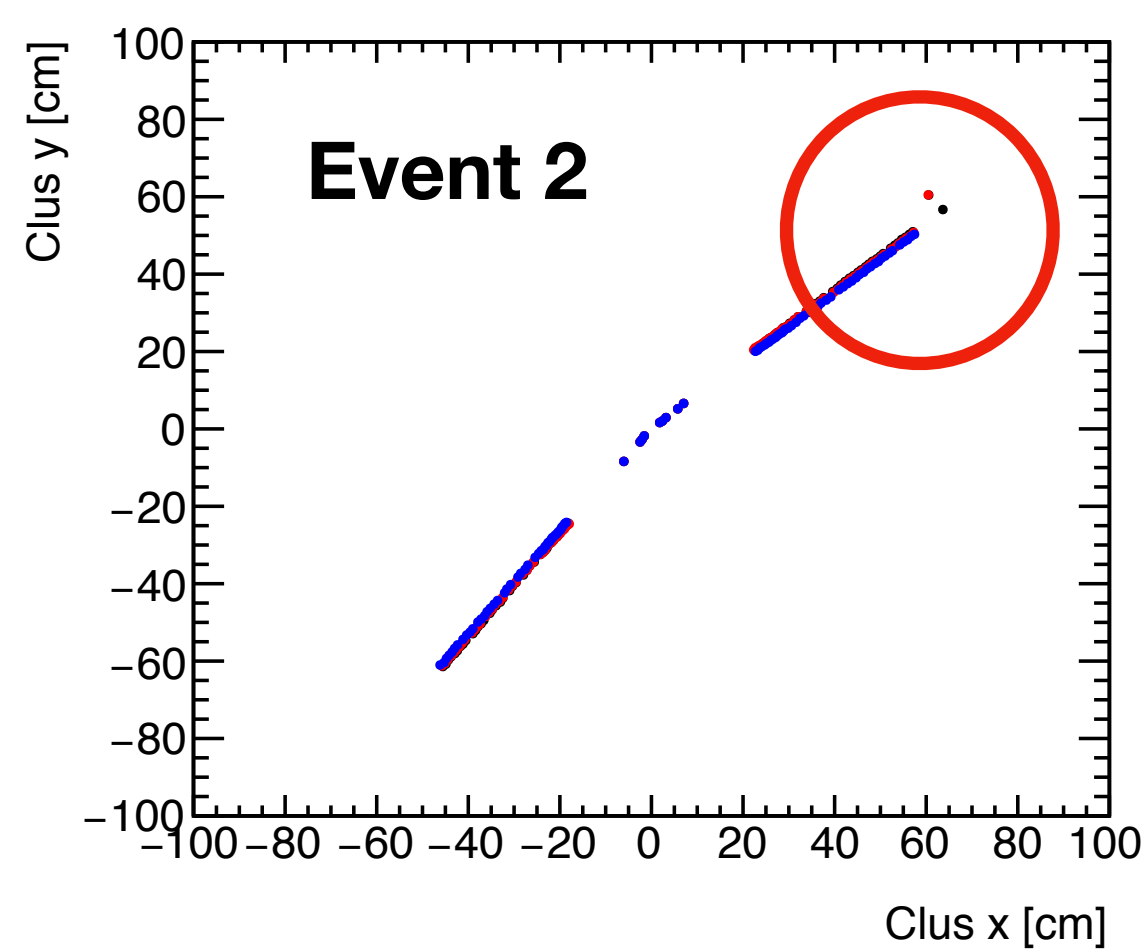
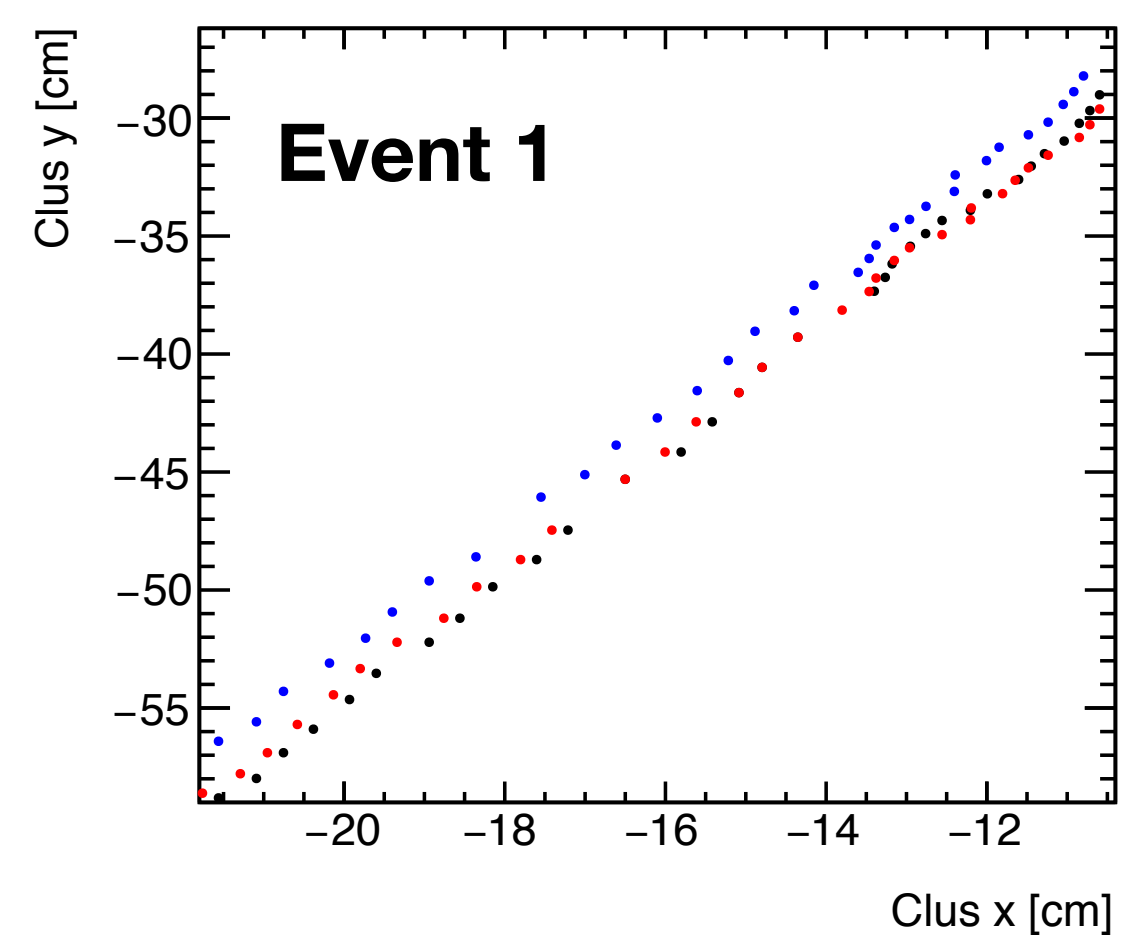
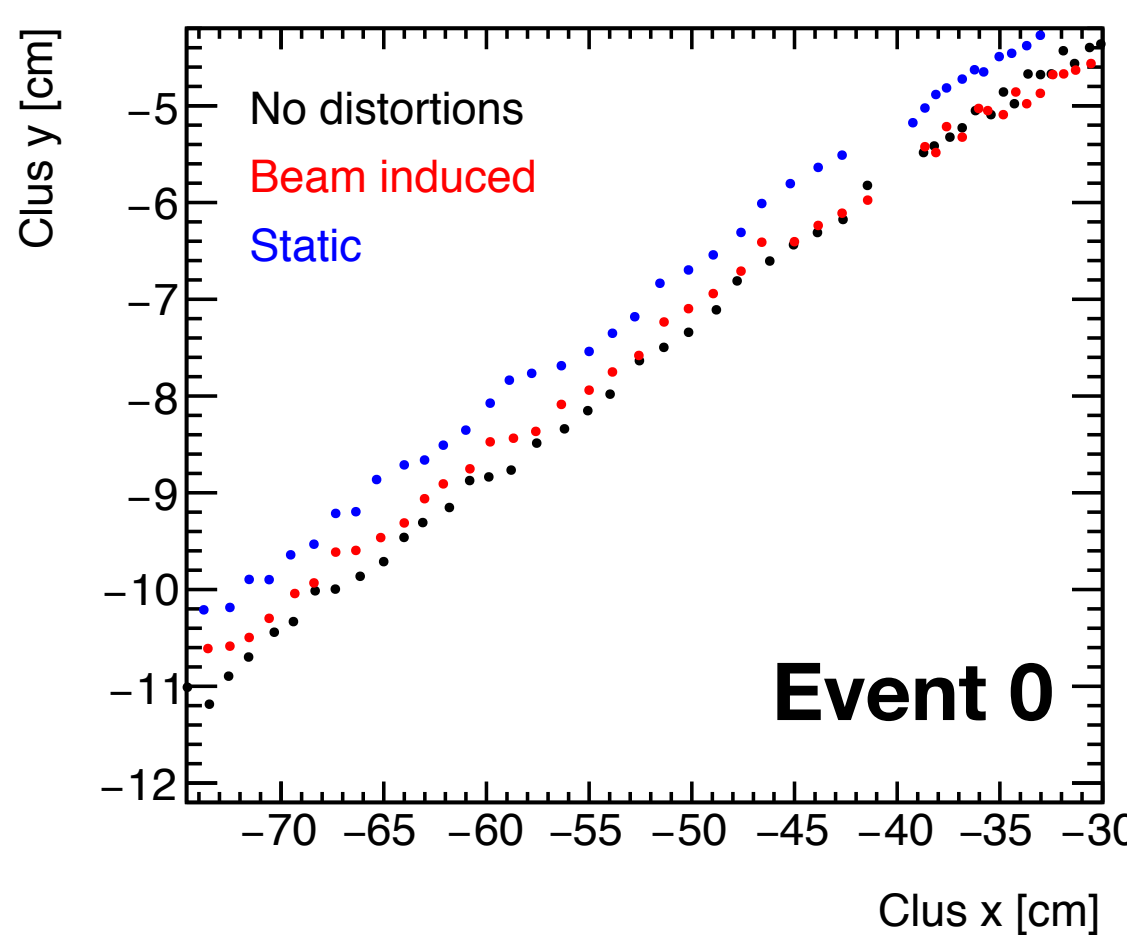
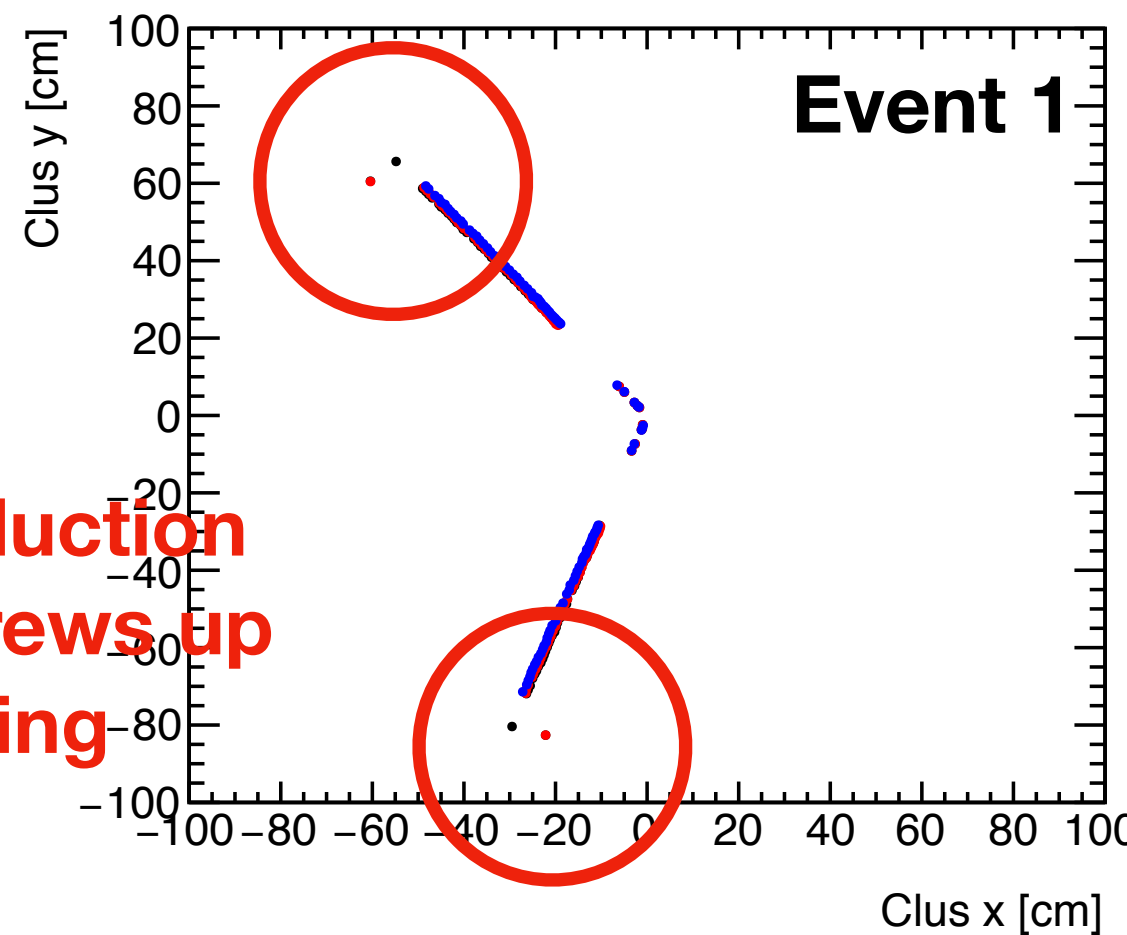
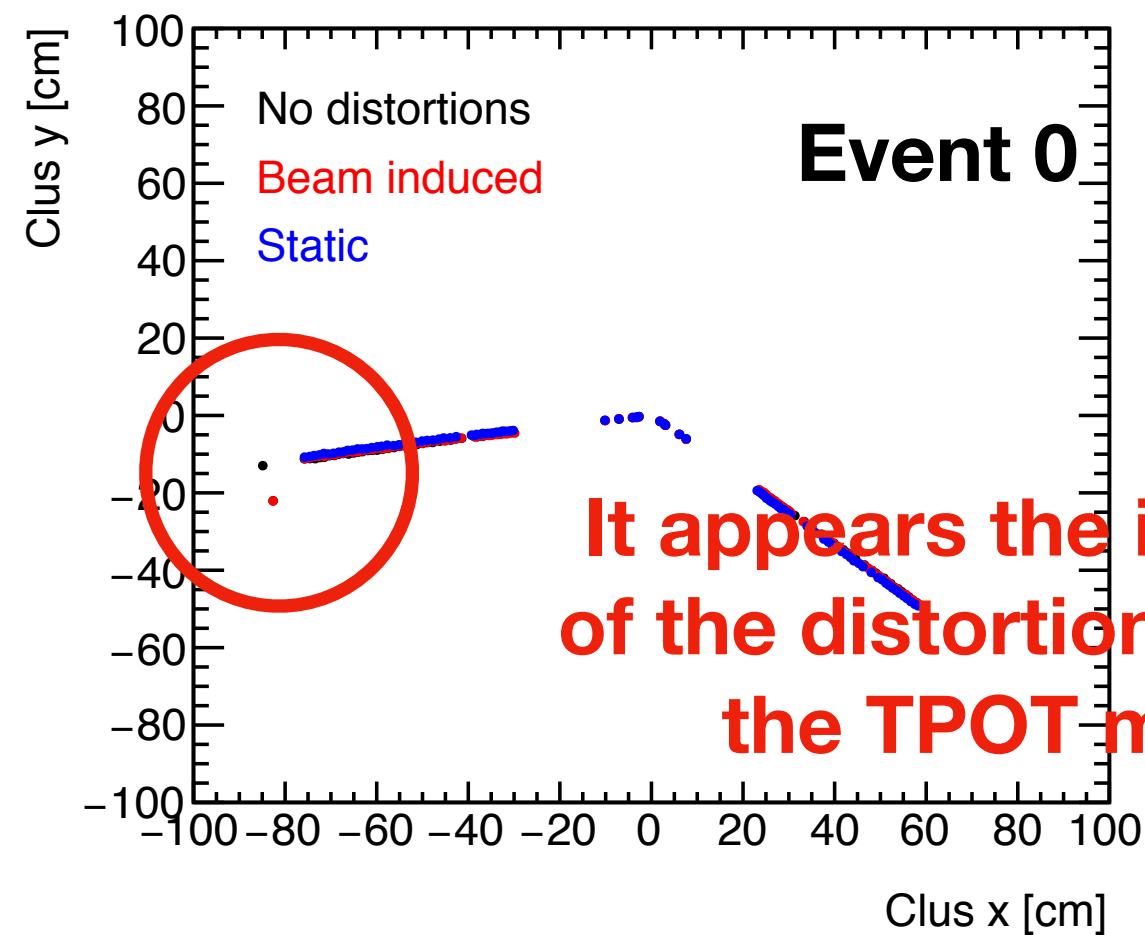
# Example Uncorrected Tracks y vs x

Same 4 plots, zoomed in on random TPC seed

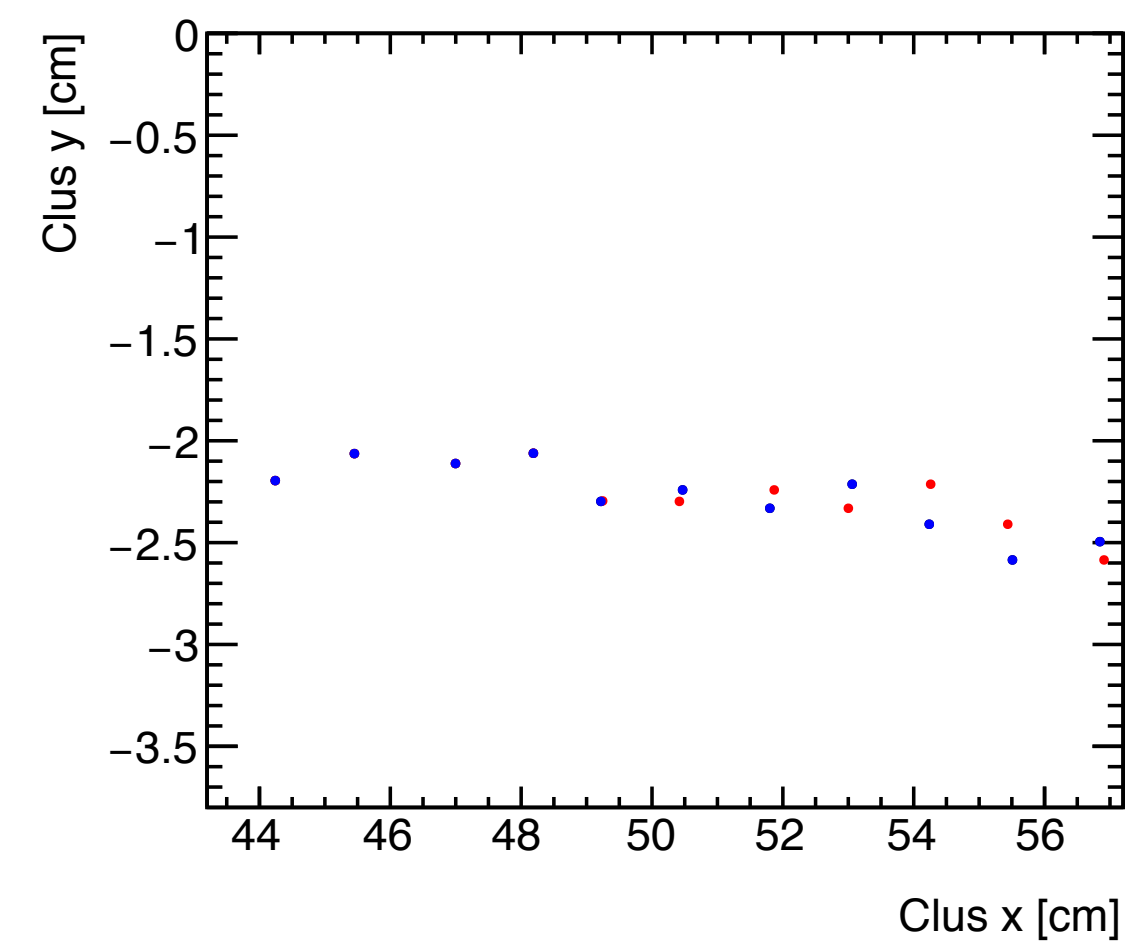
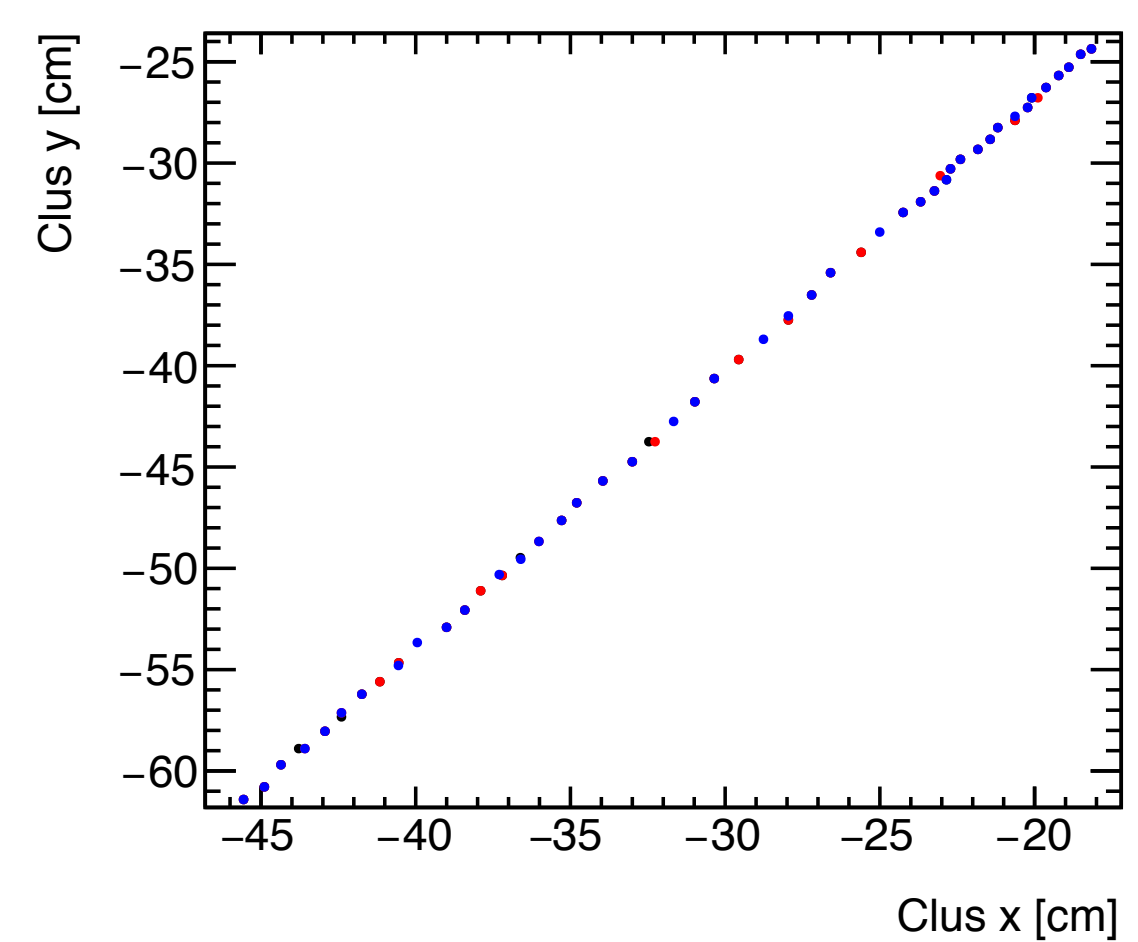
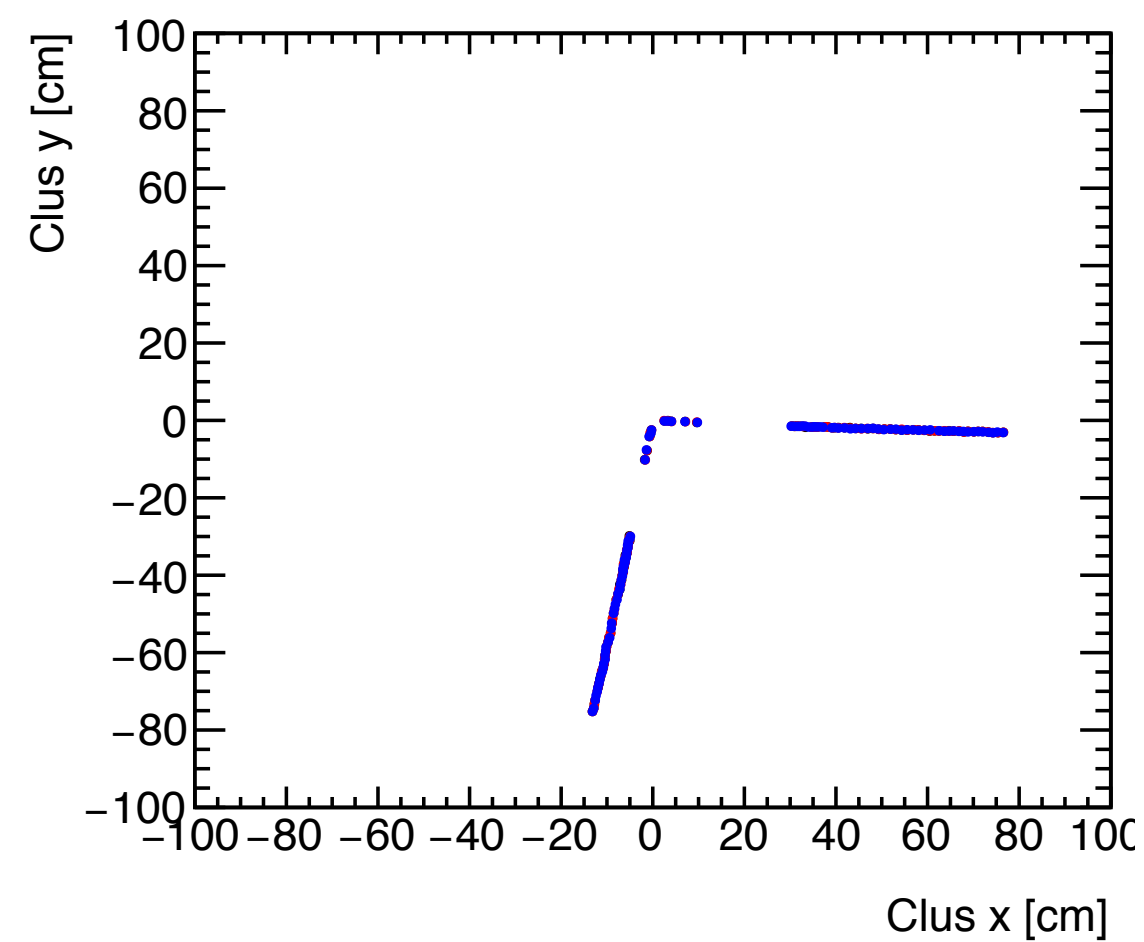
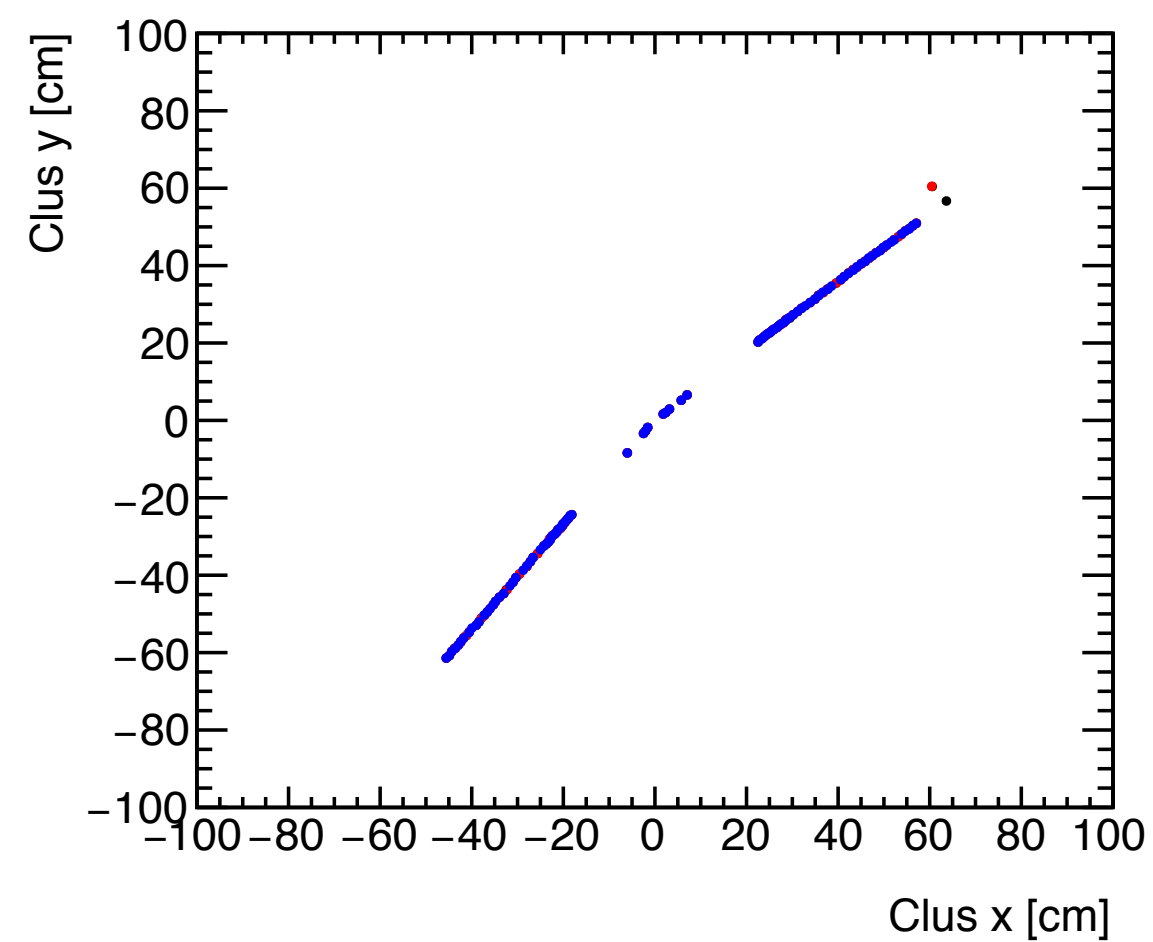
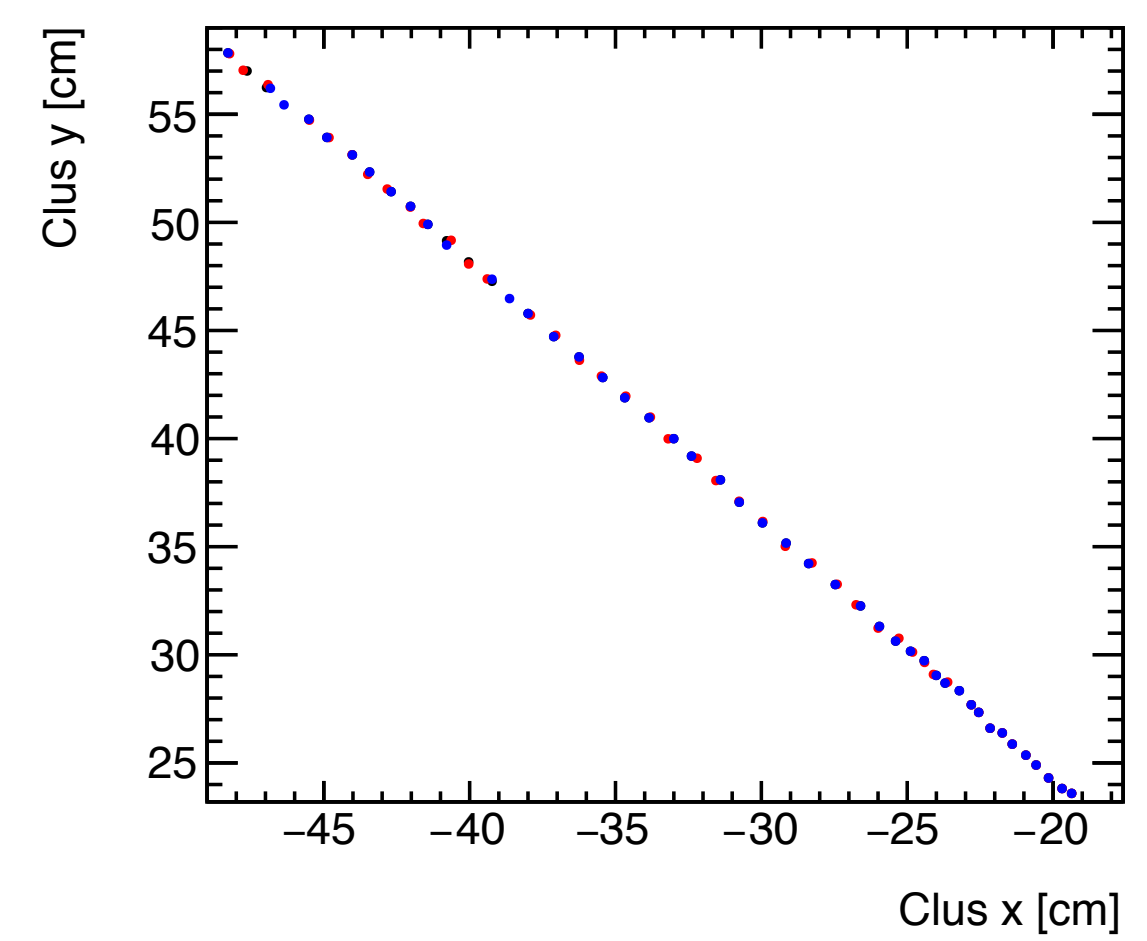
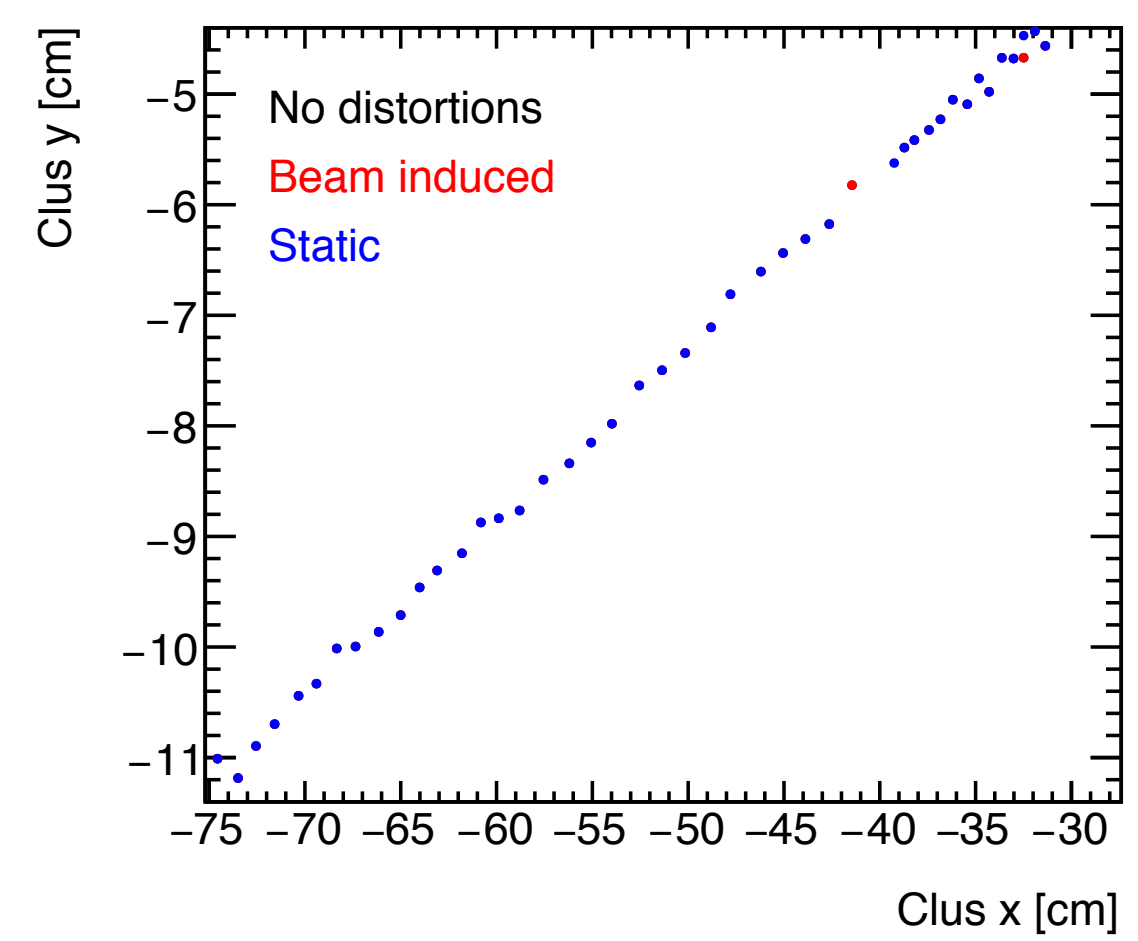
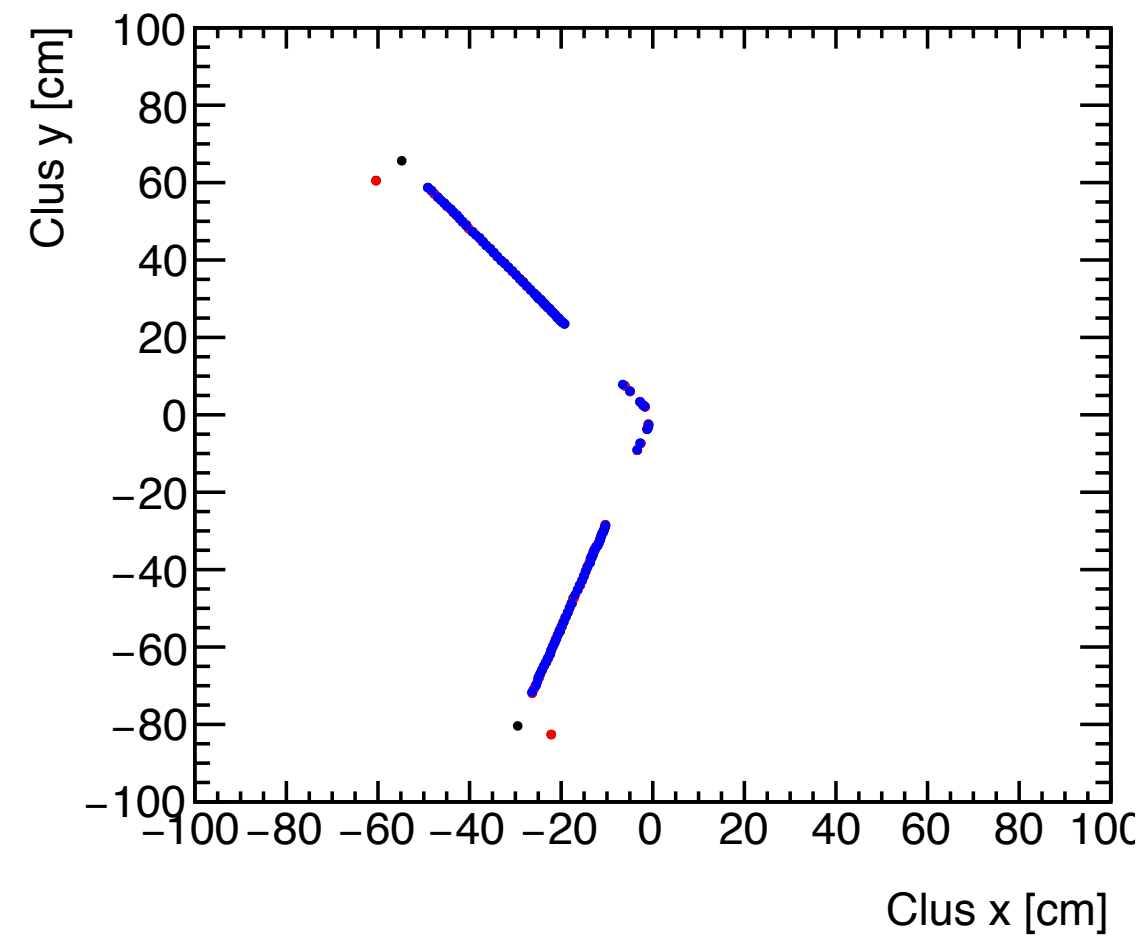
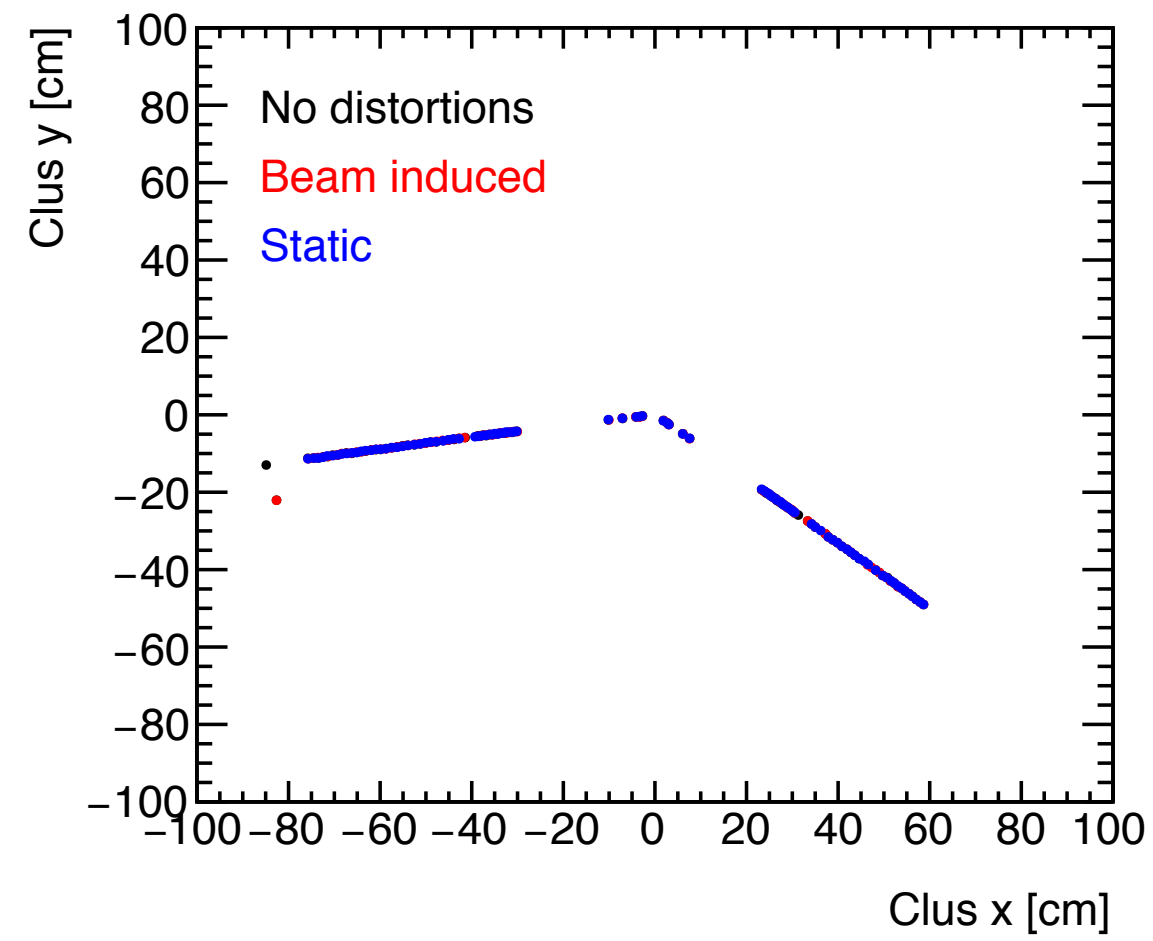


# Example Uncorrected Tracks y vs x

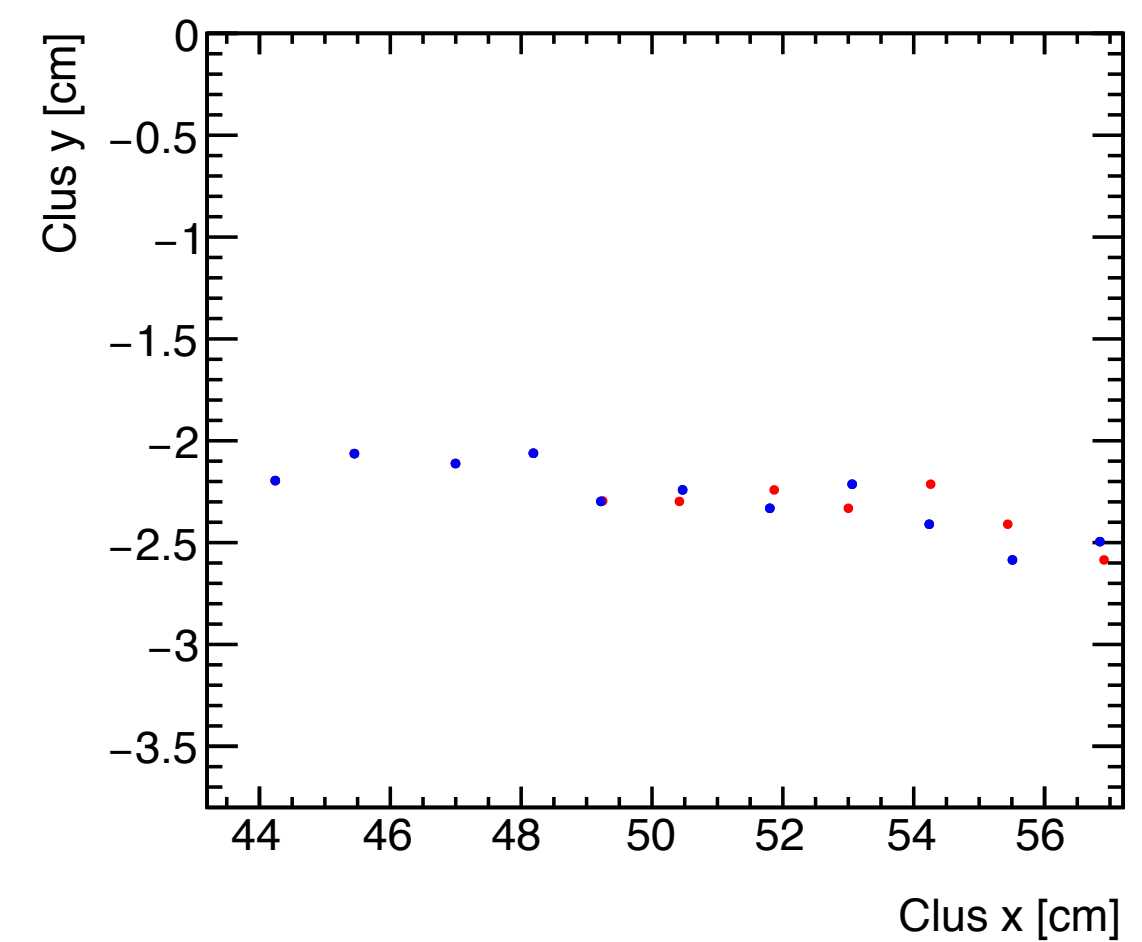
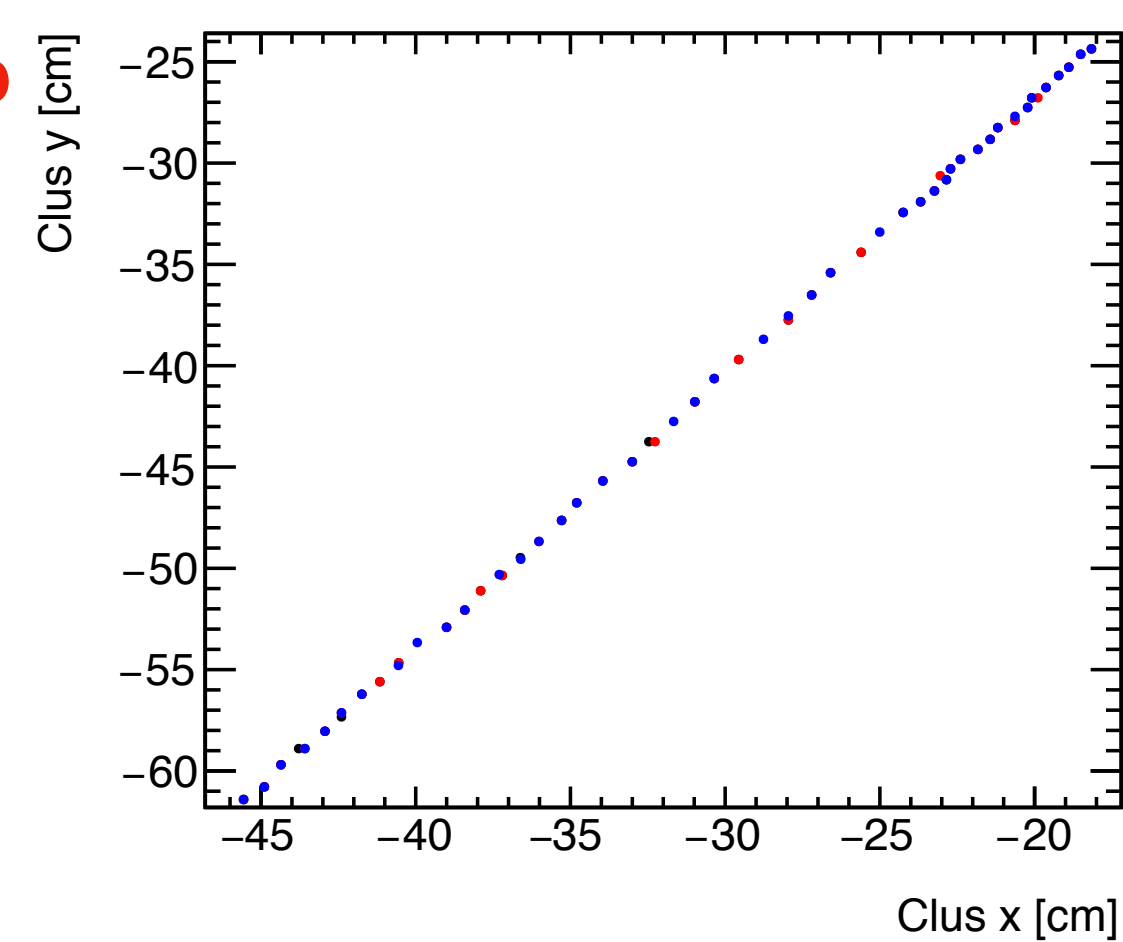
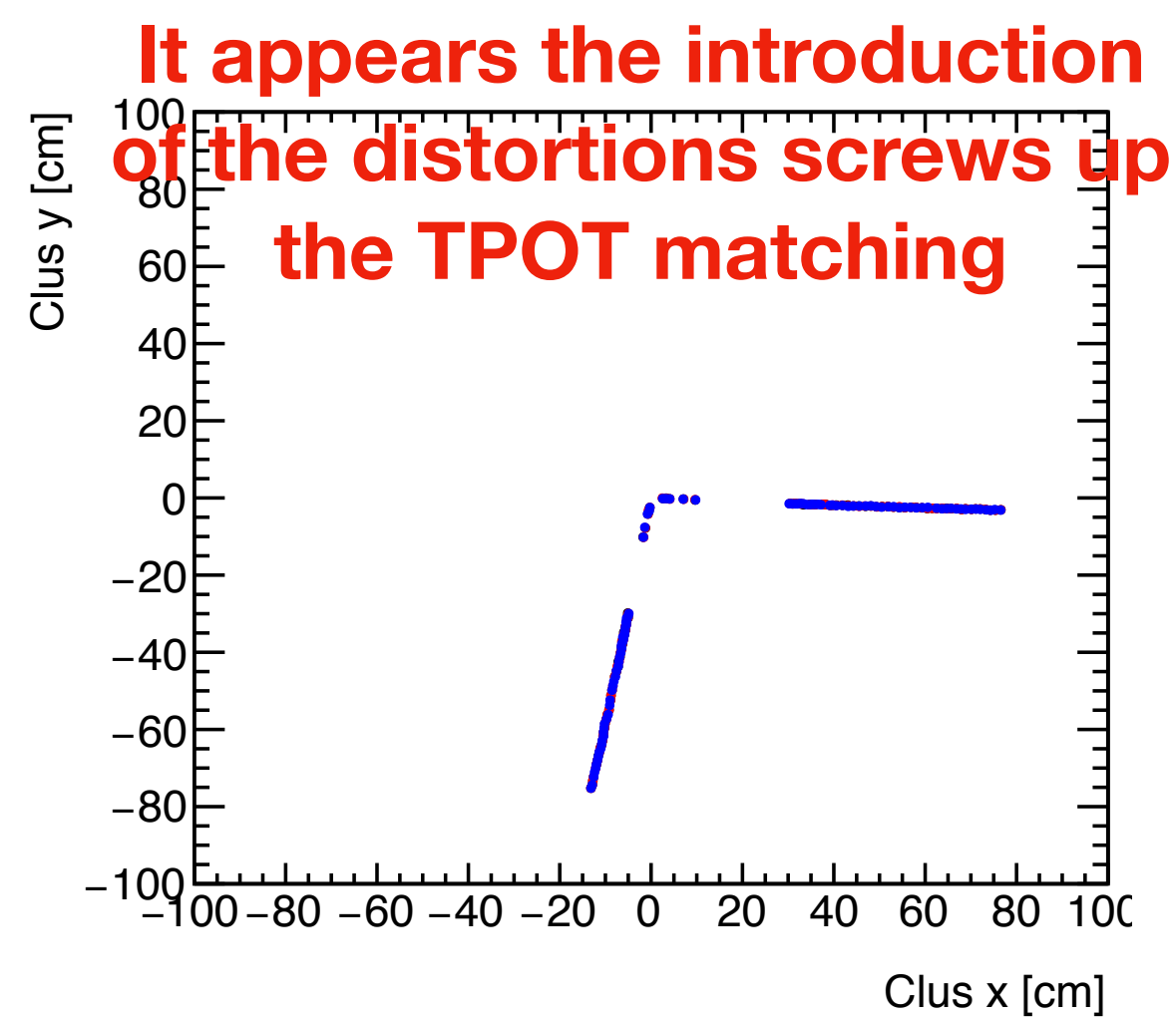
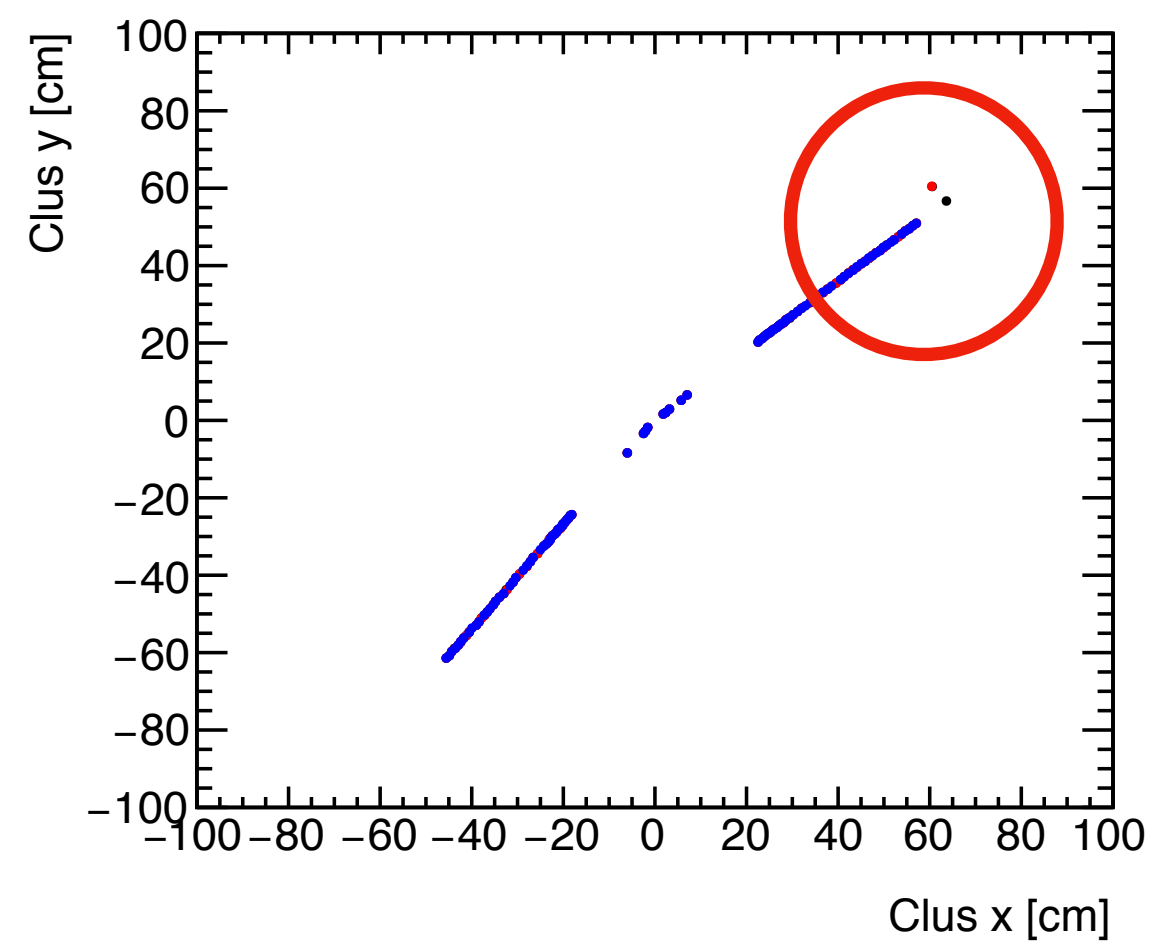
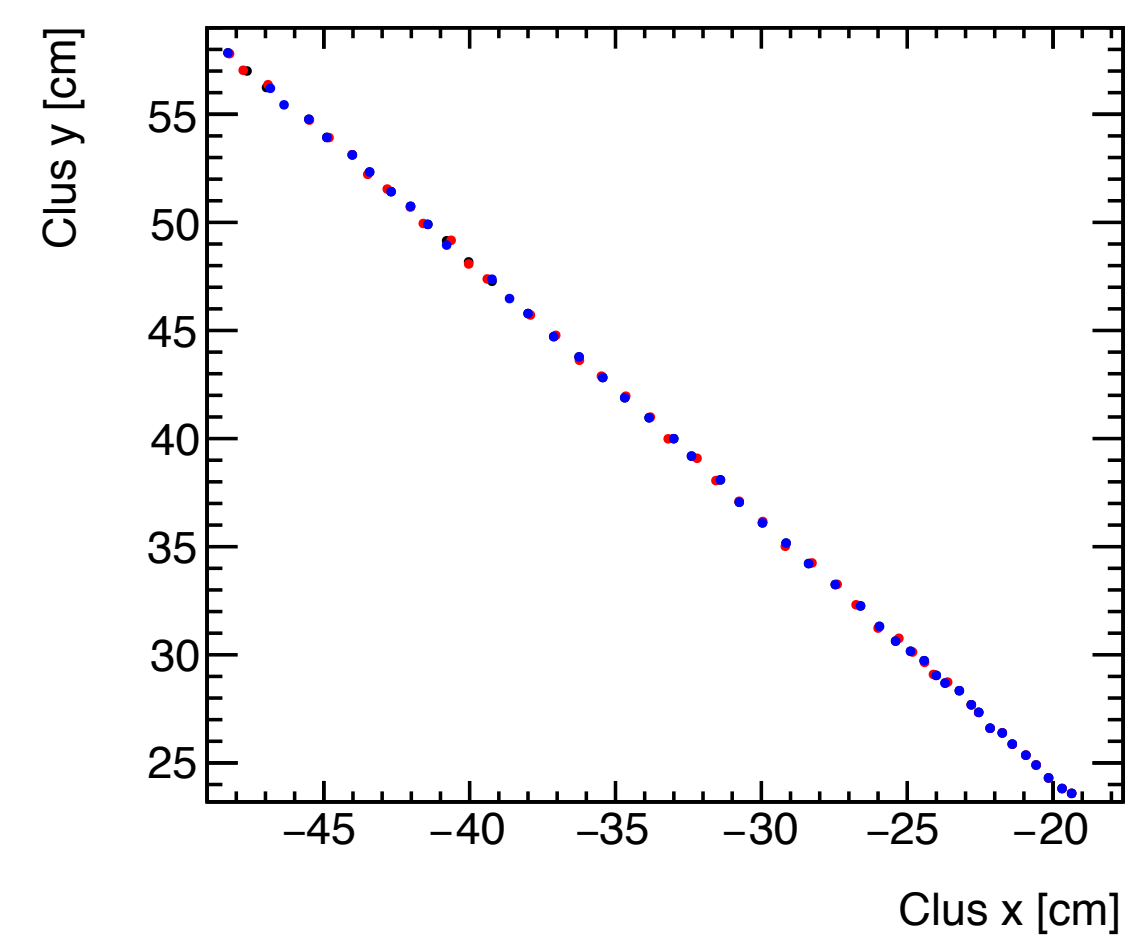
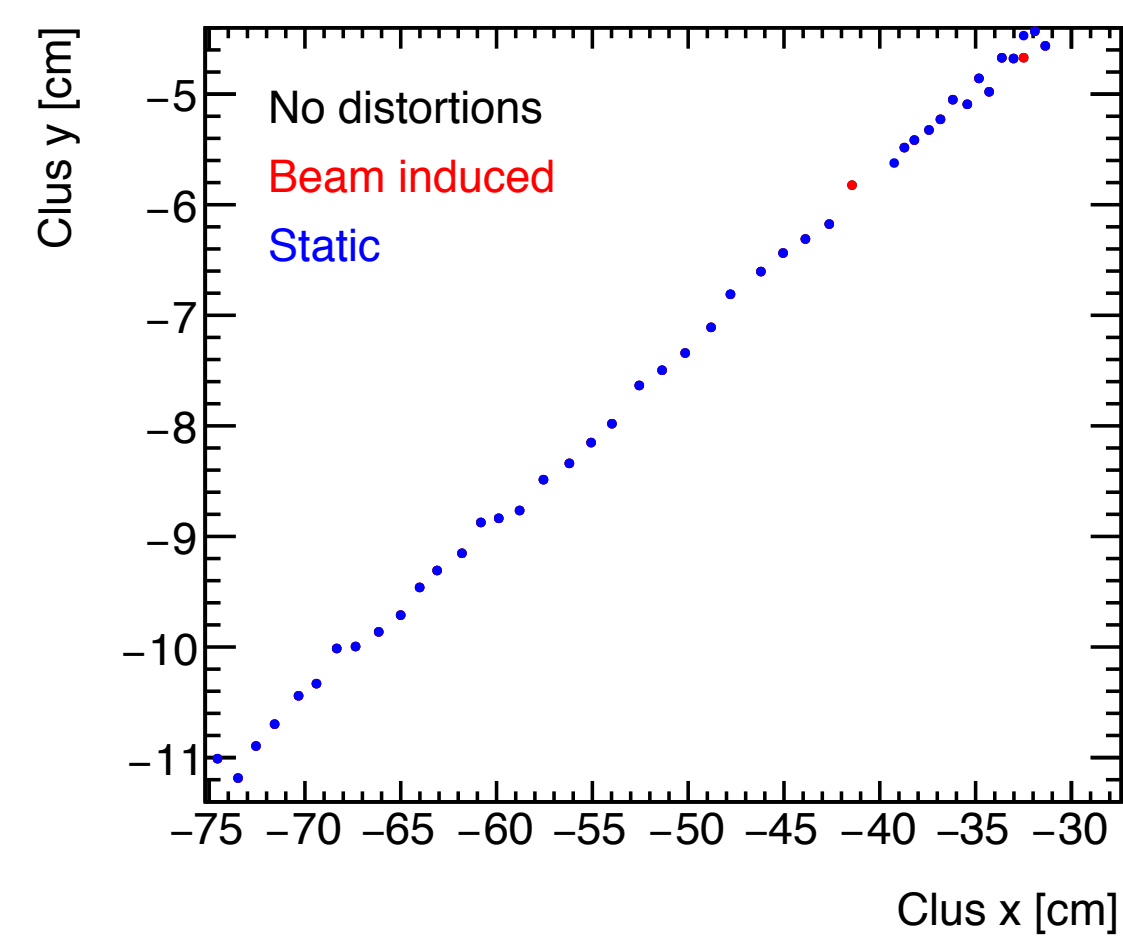
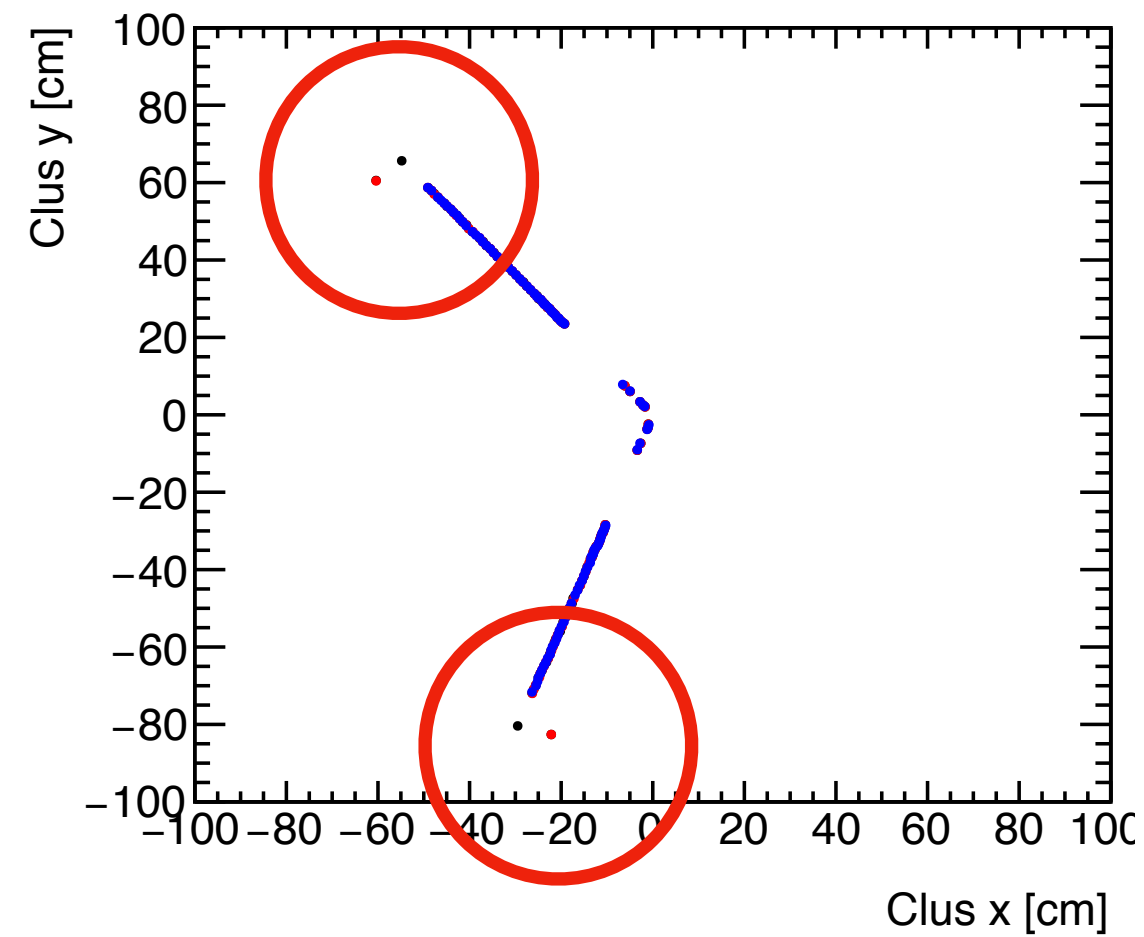
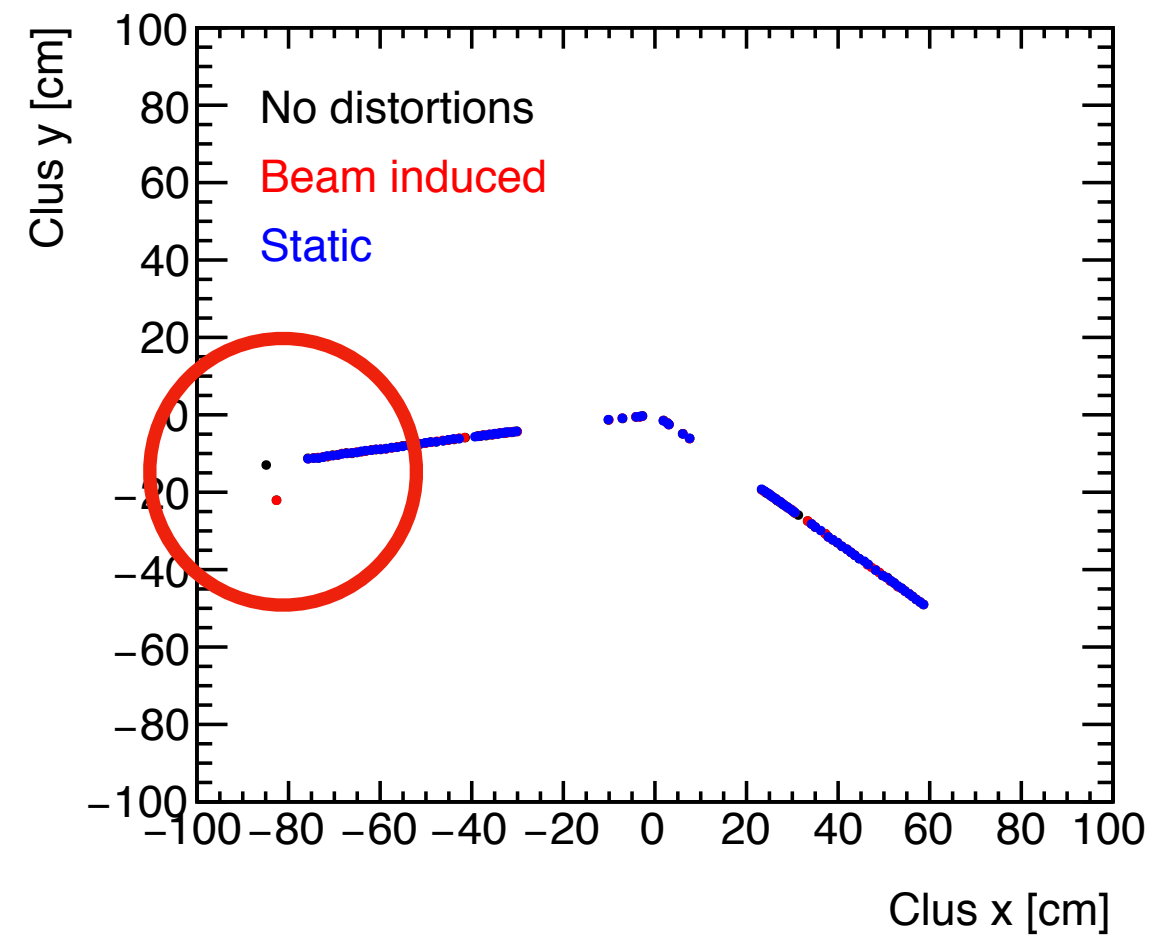
Same 4 plots, zoomed in on random TPC seed



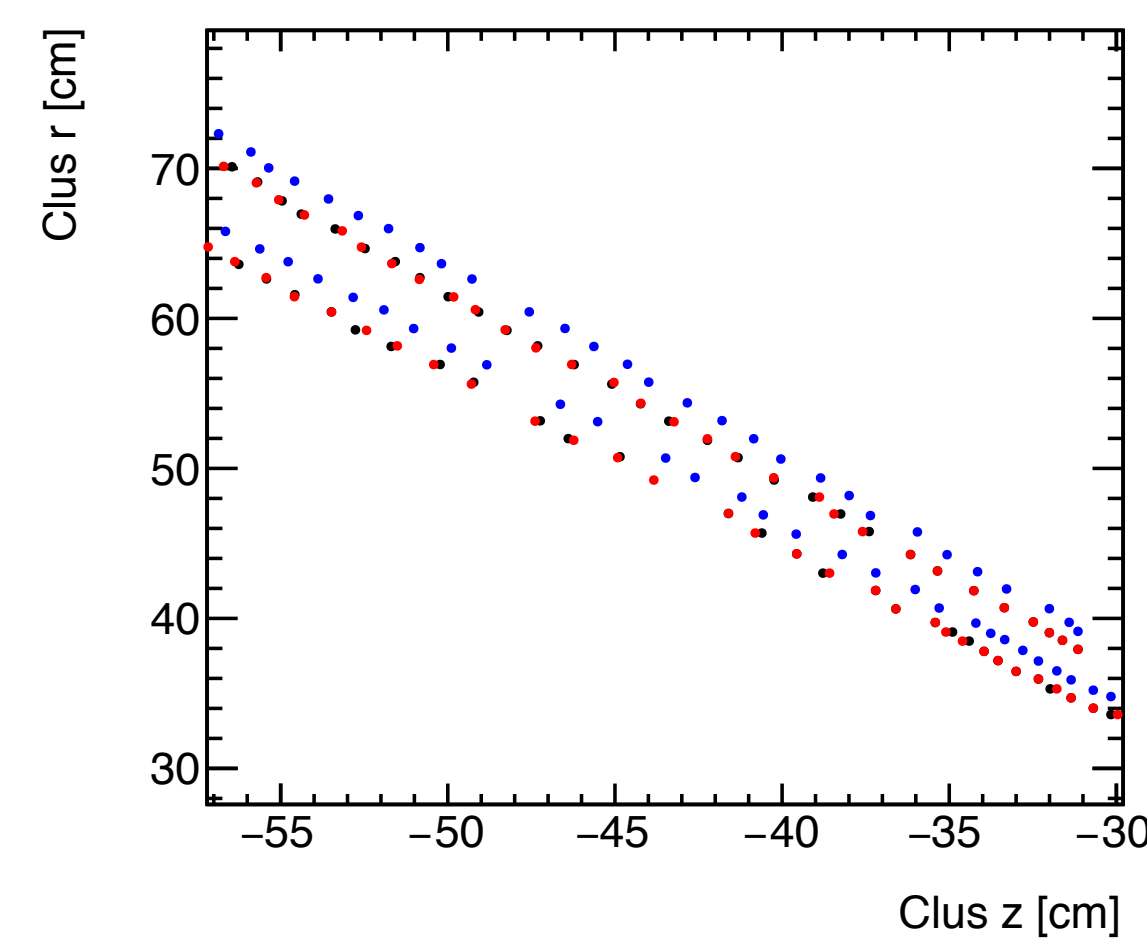
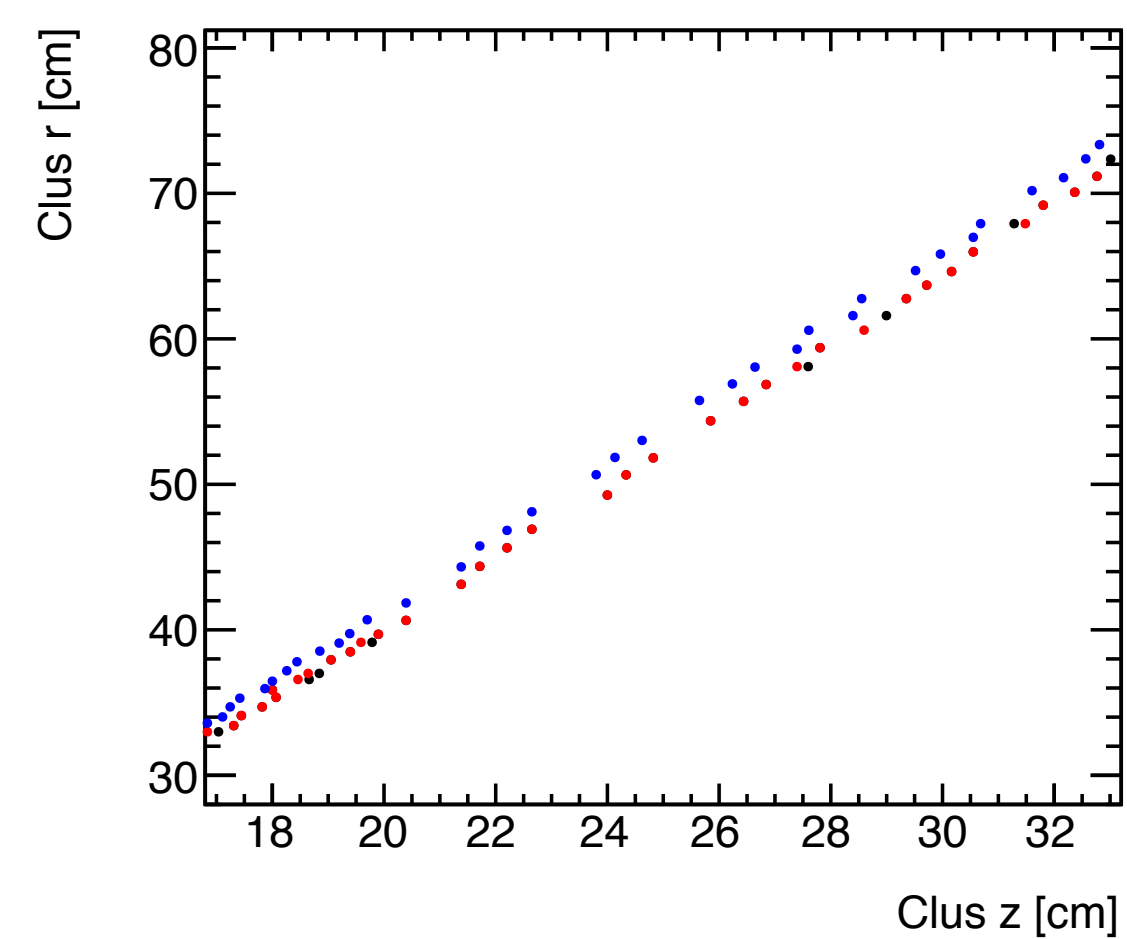
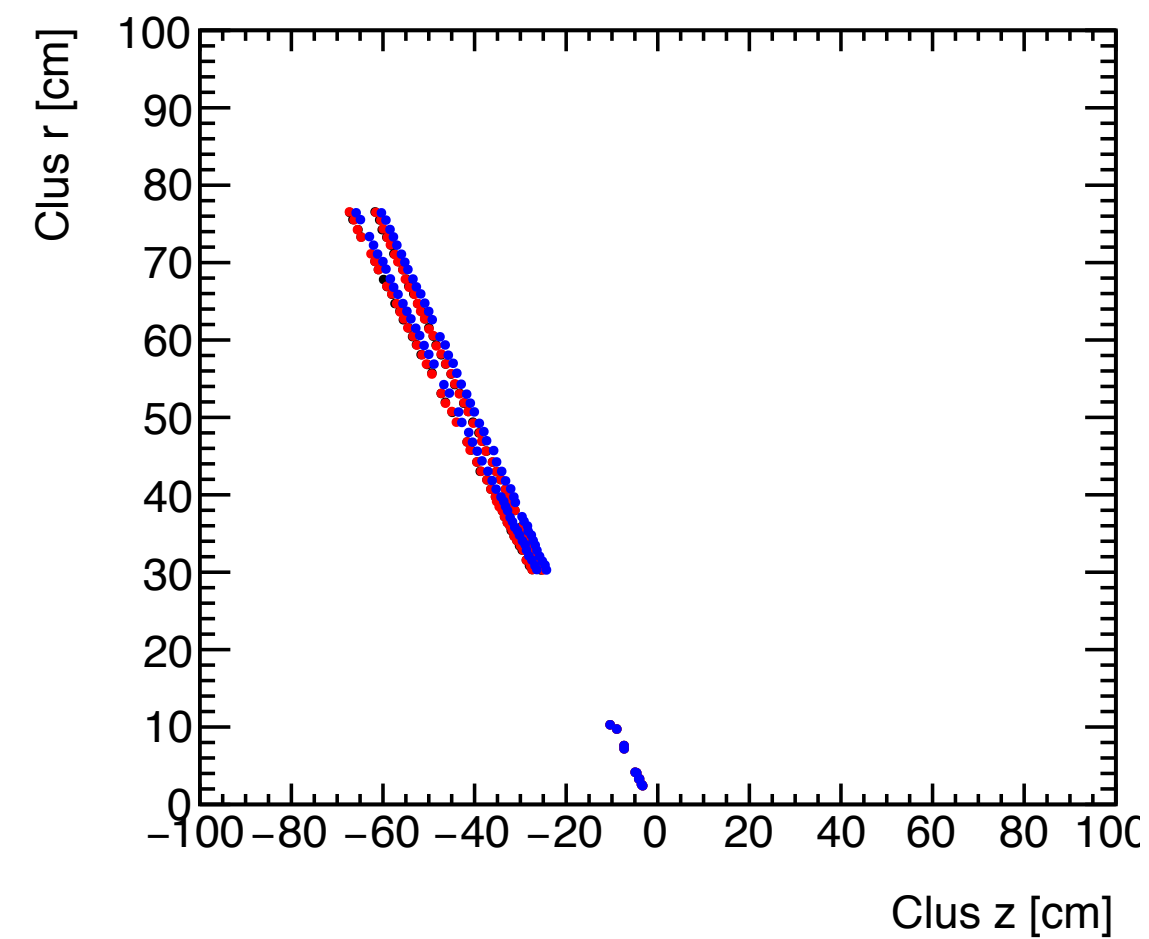
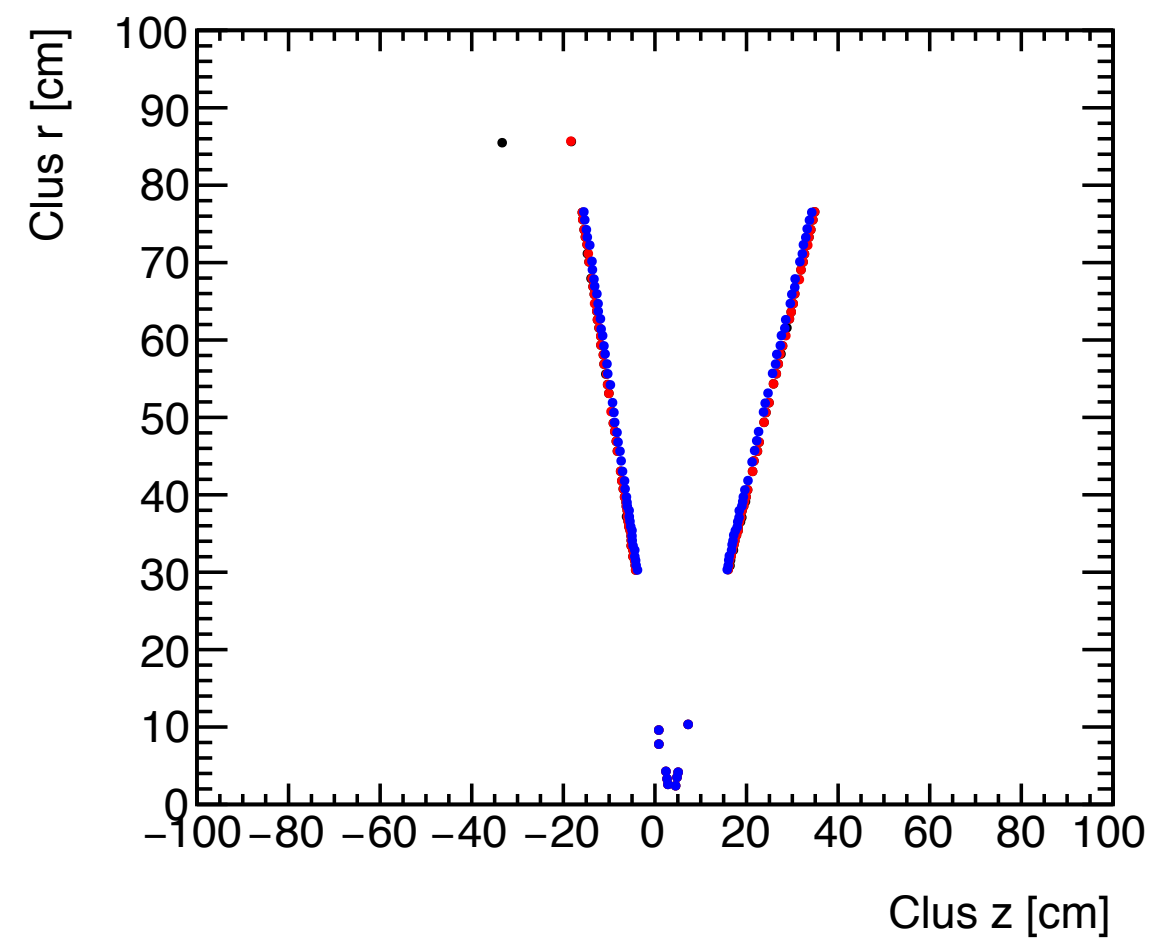
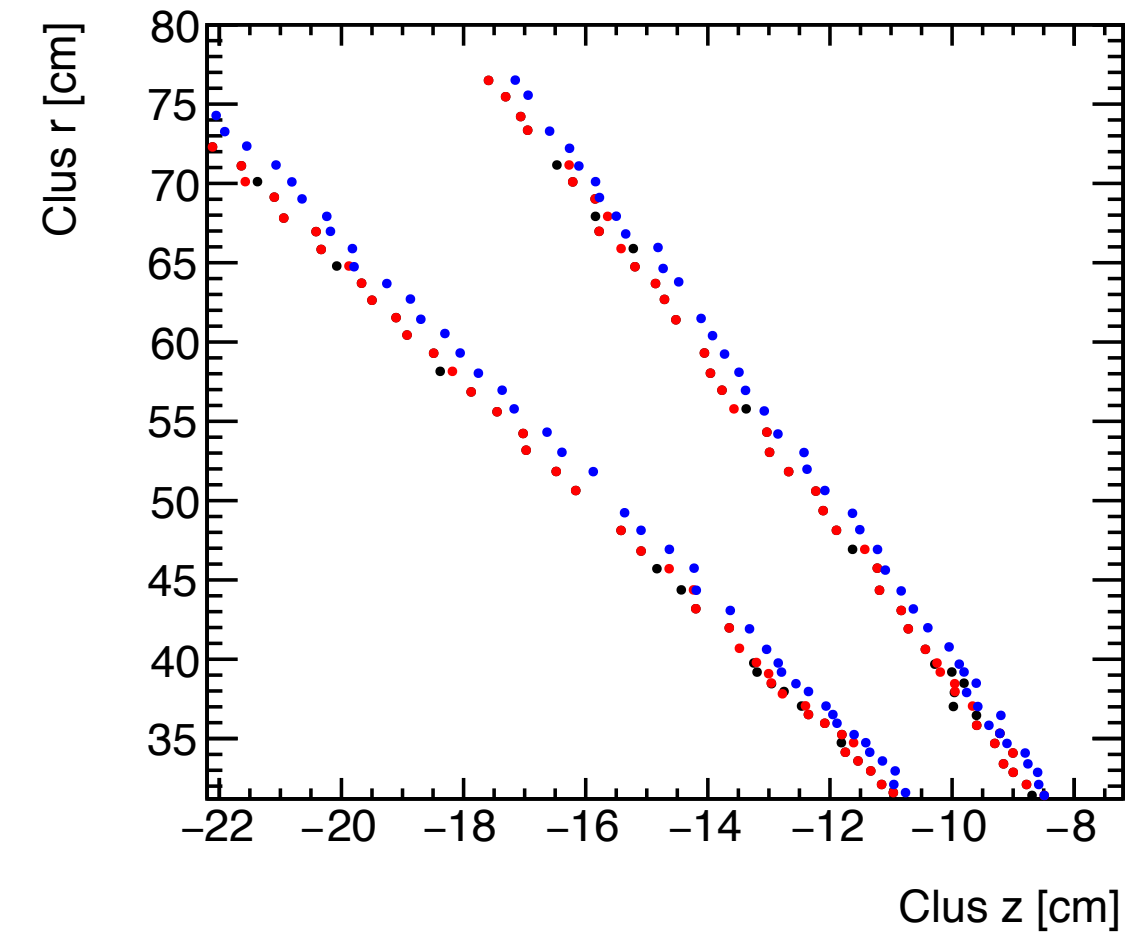
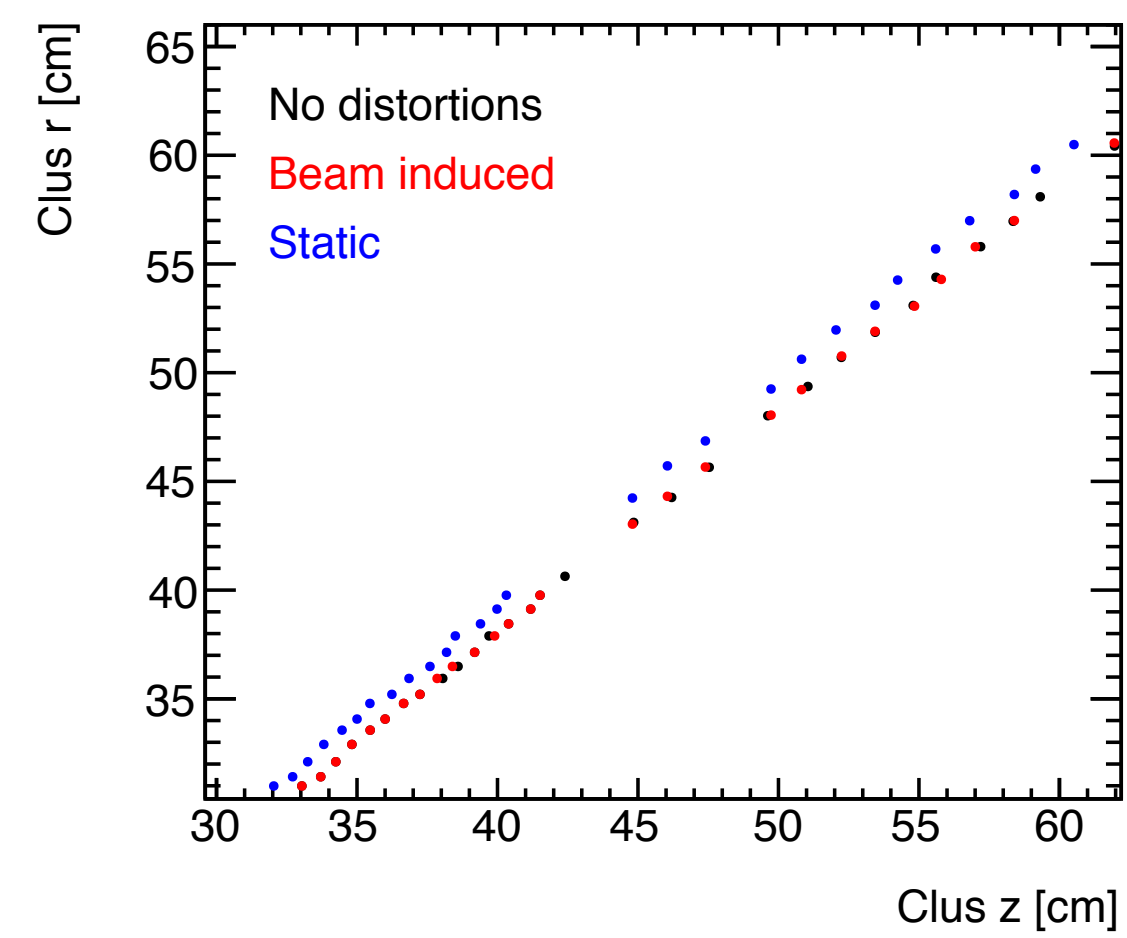
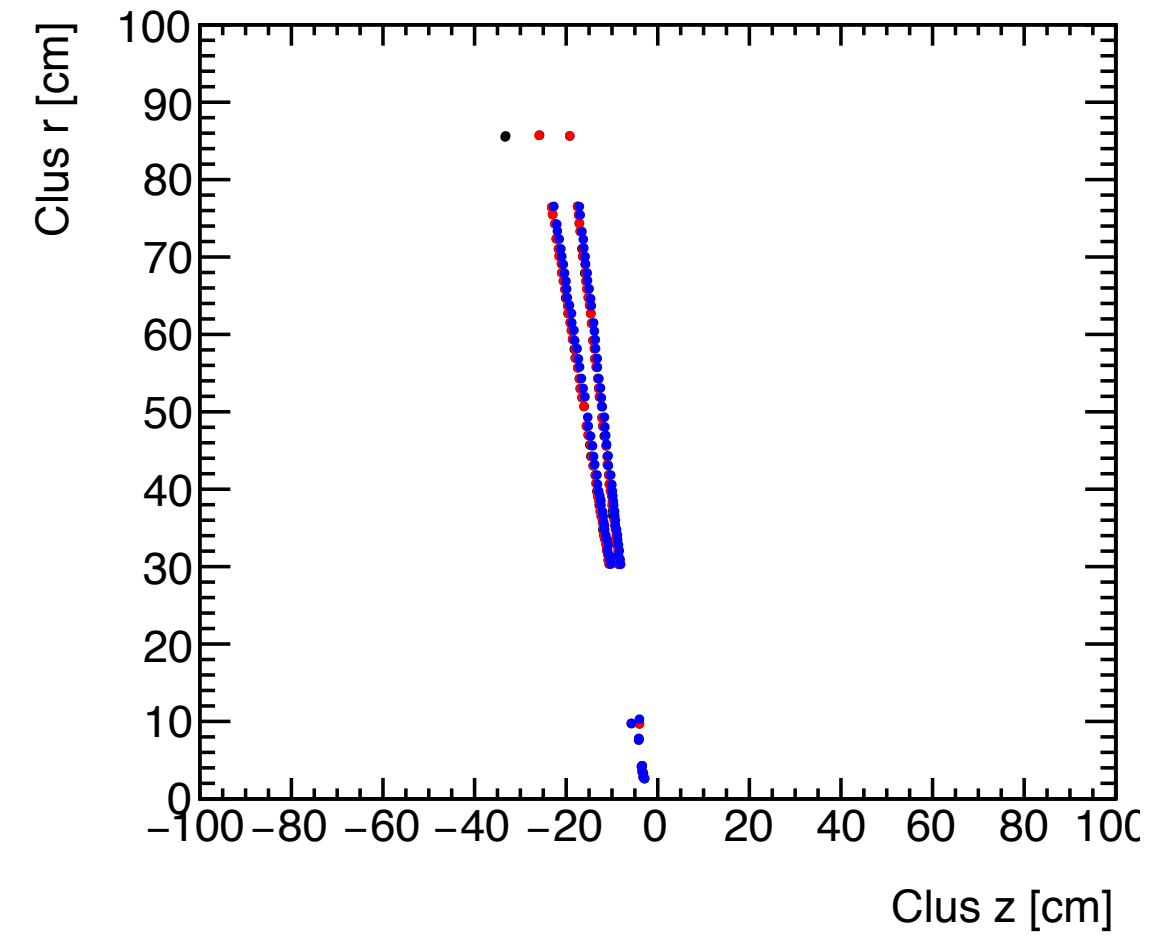
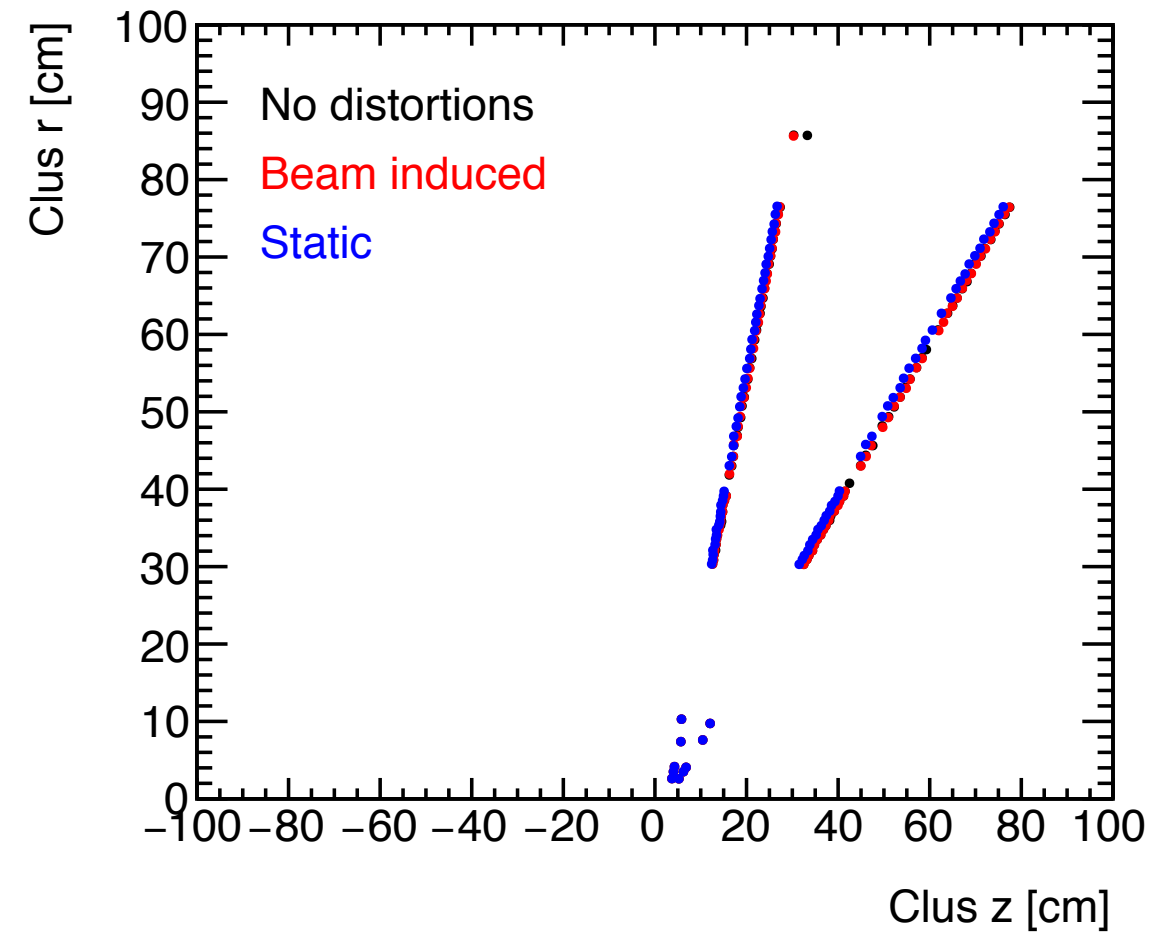
# Example Corrected Tracks y vs x



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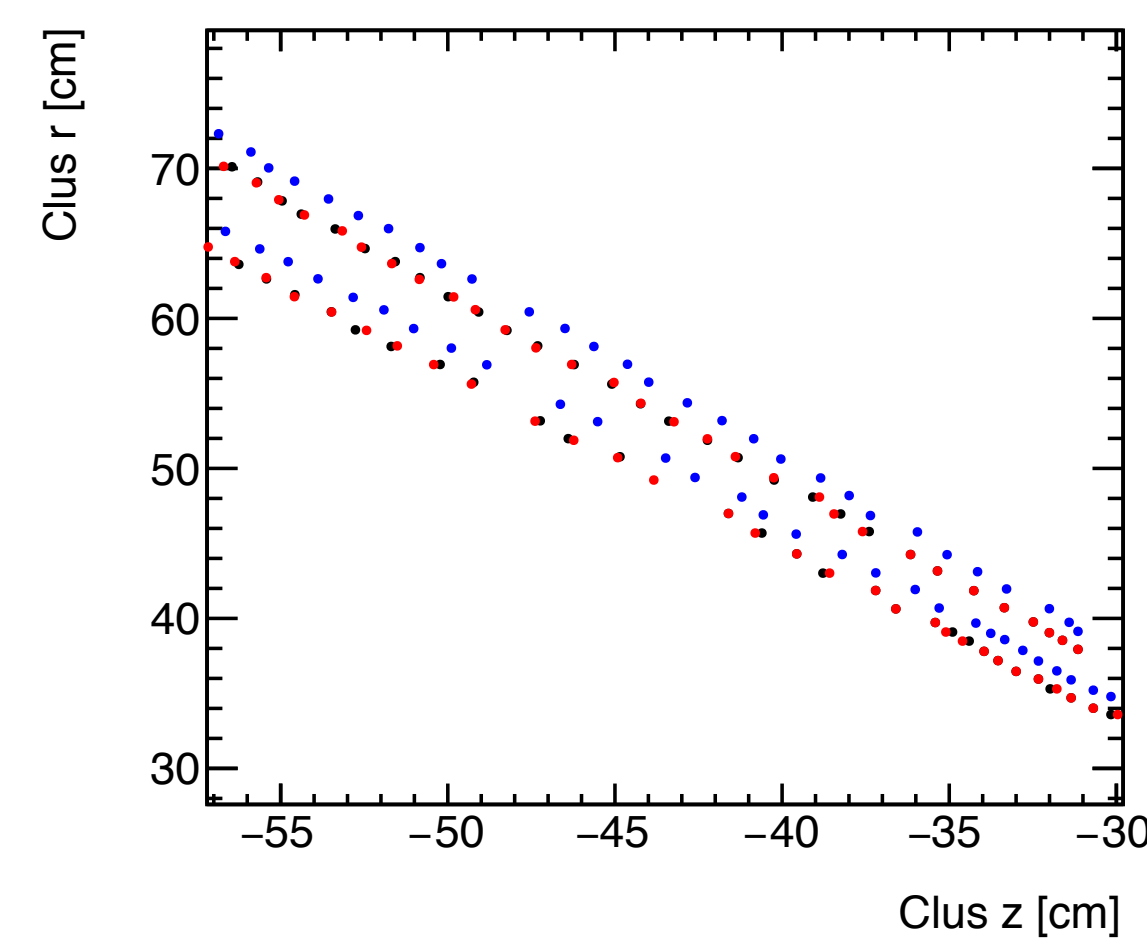
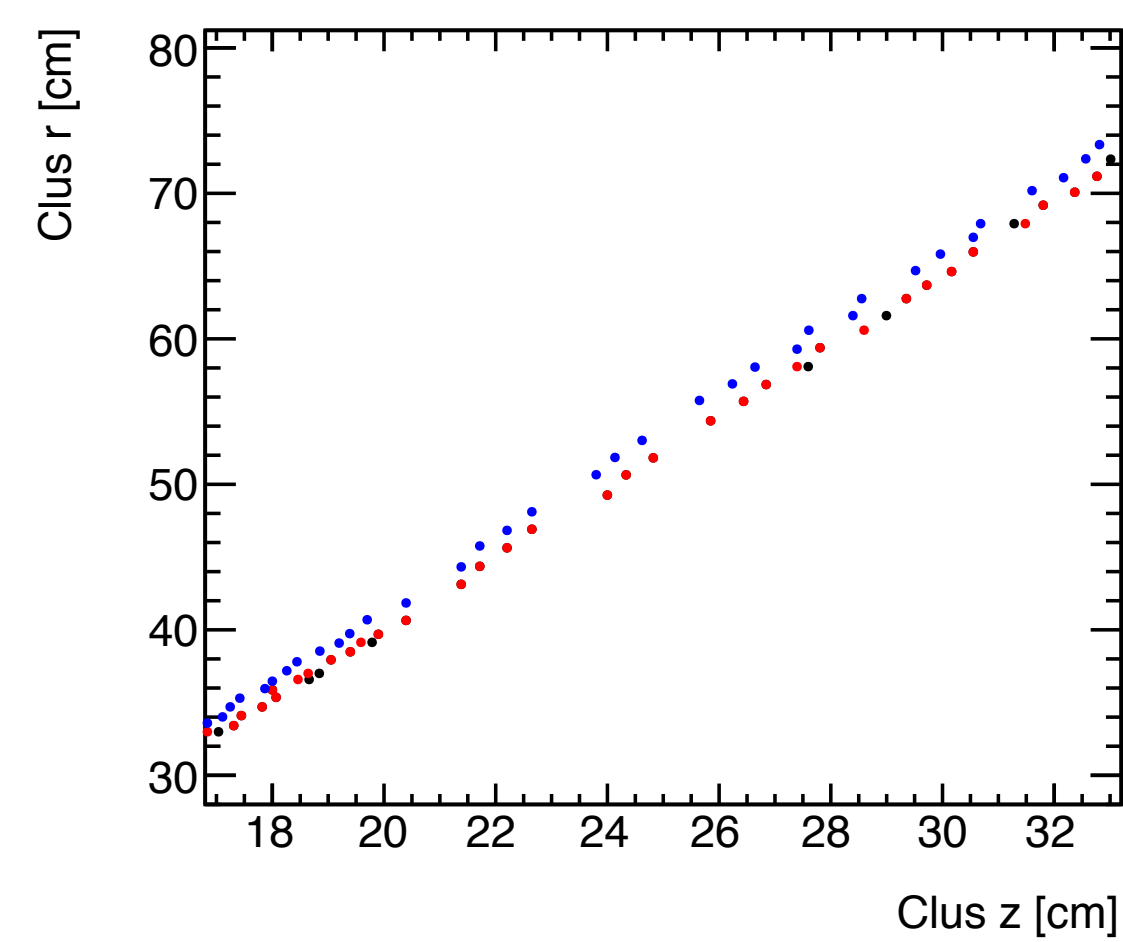
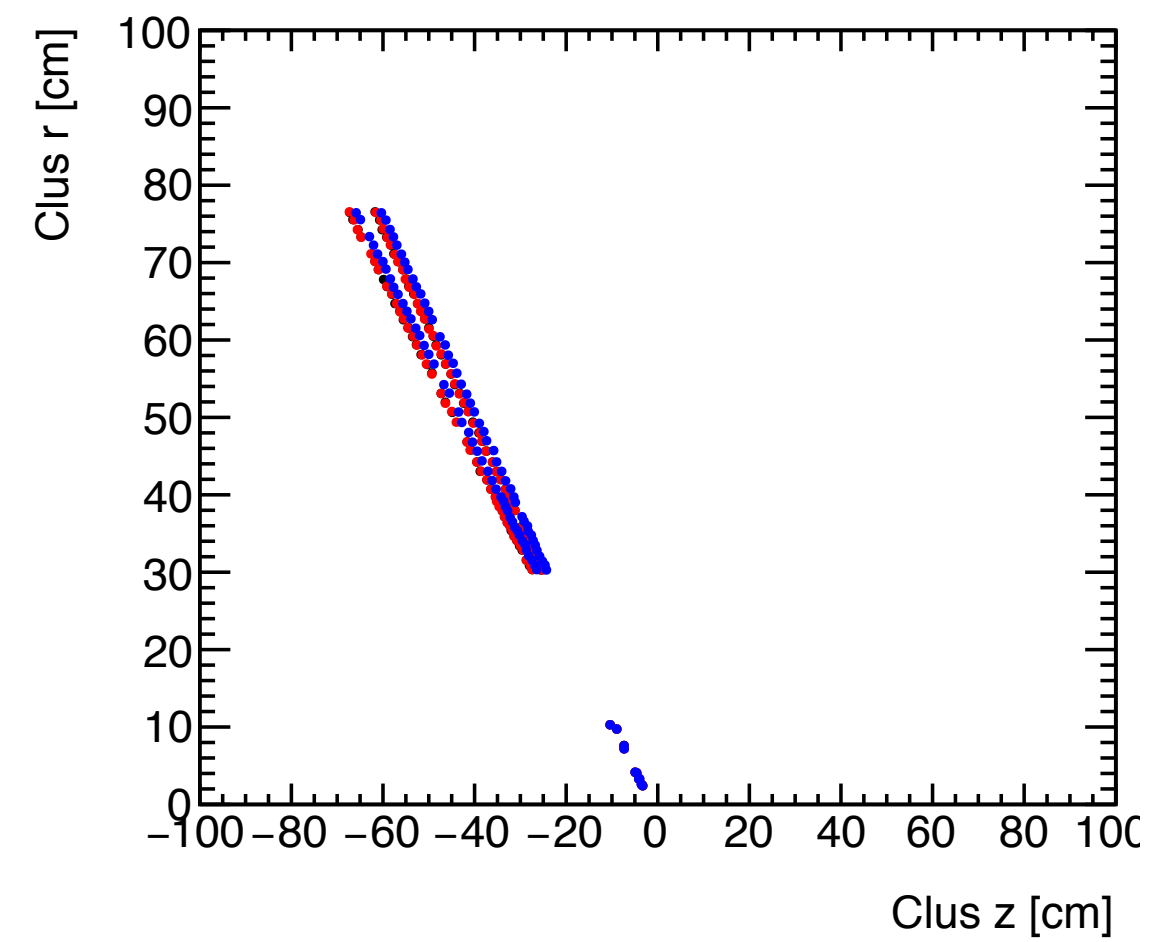
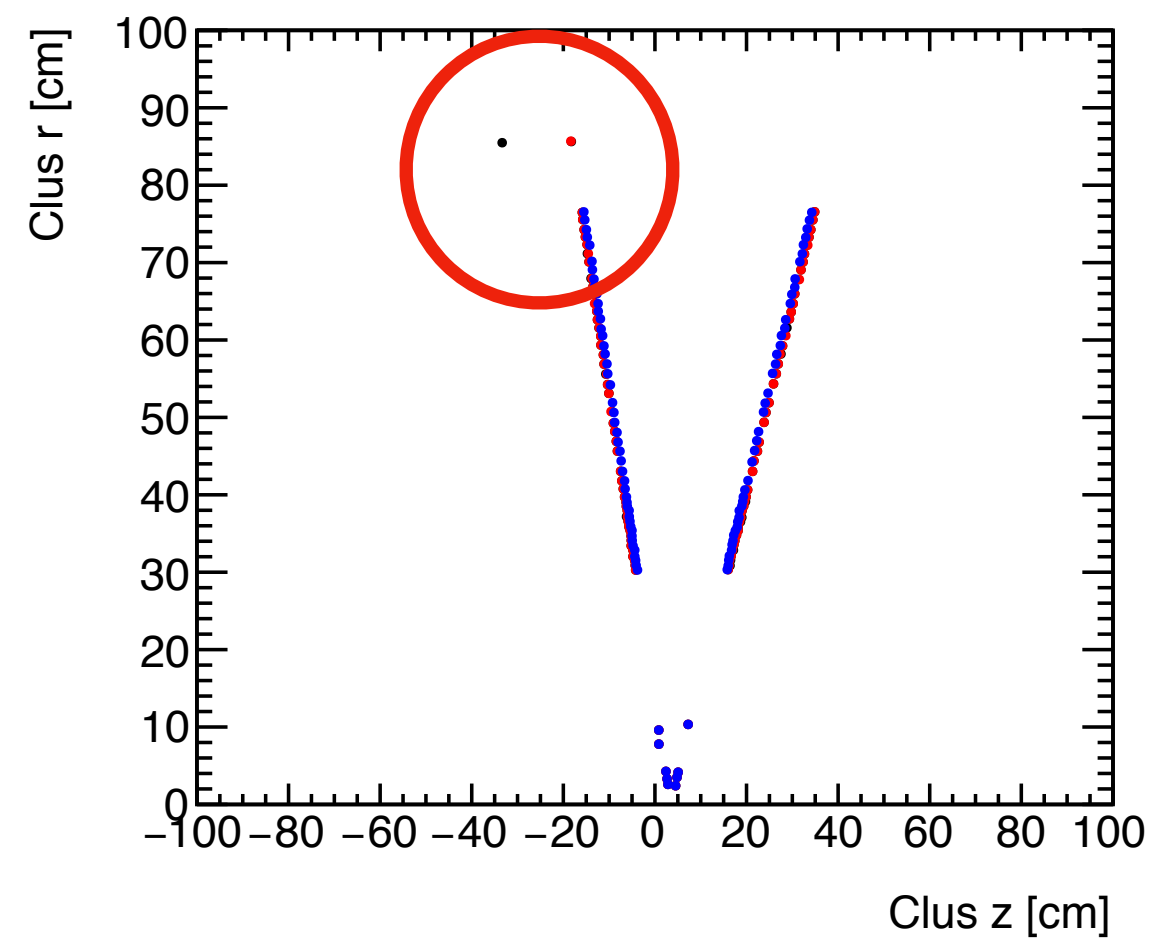
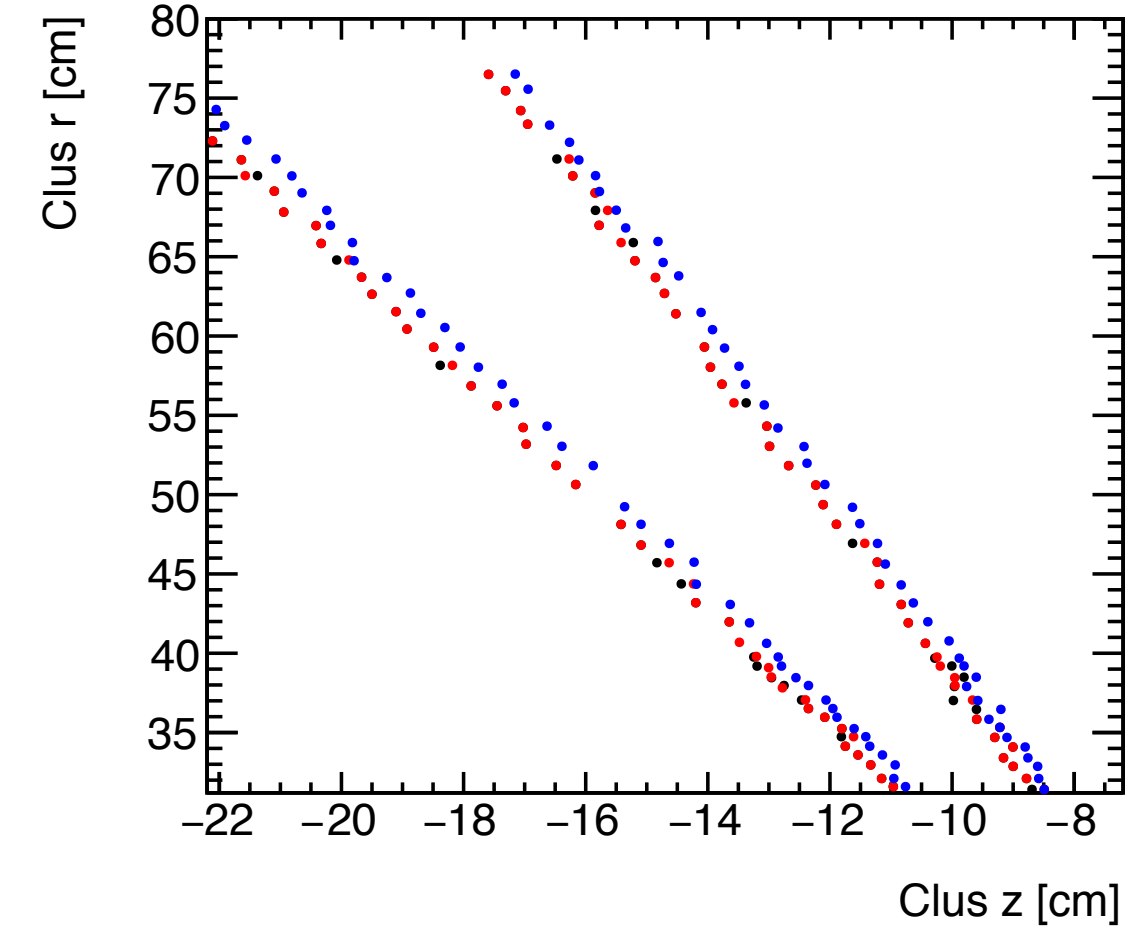
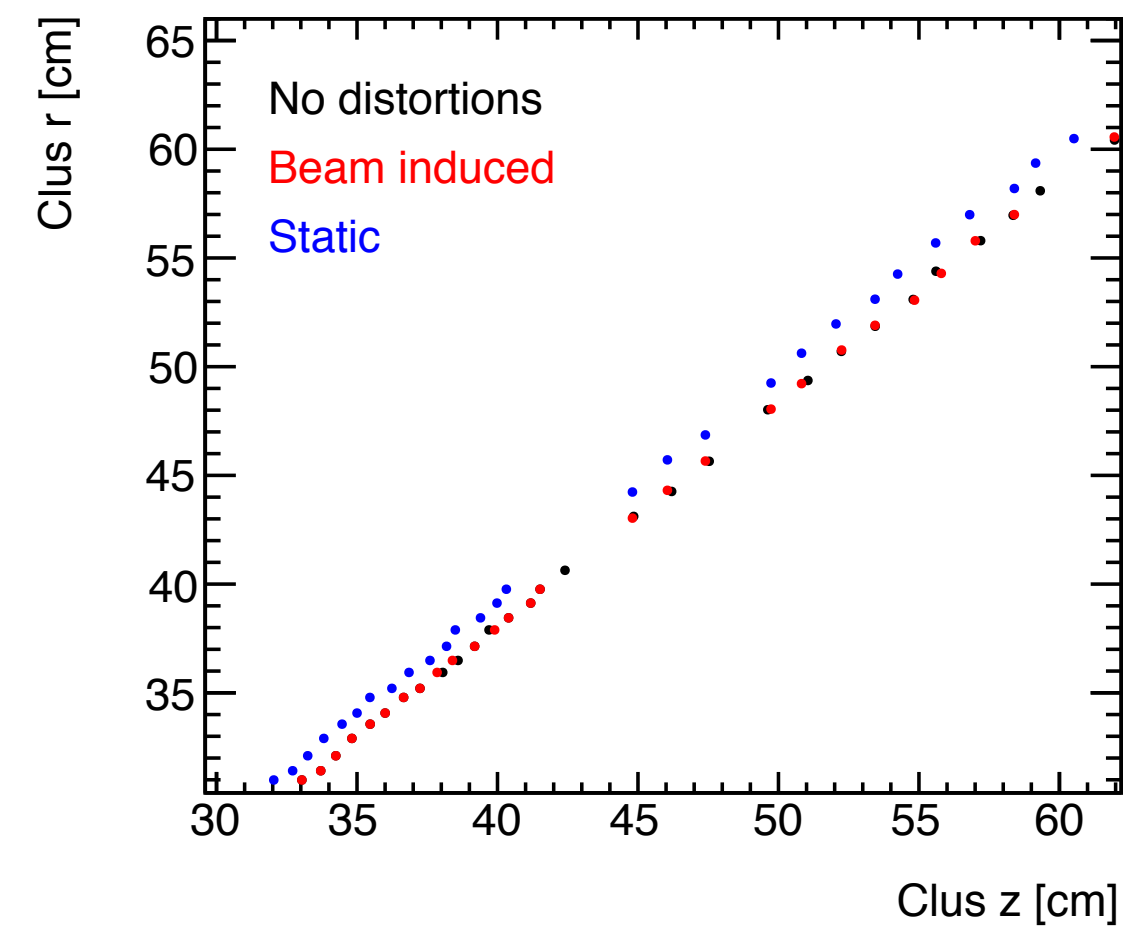
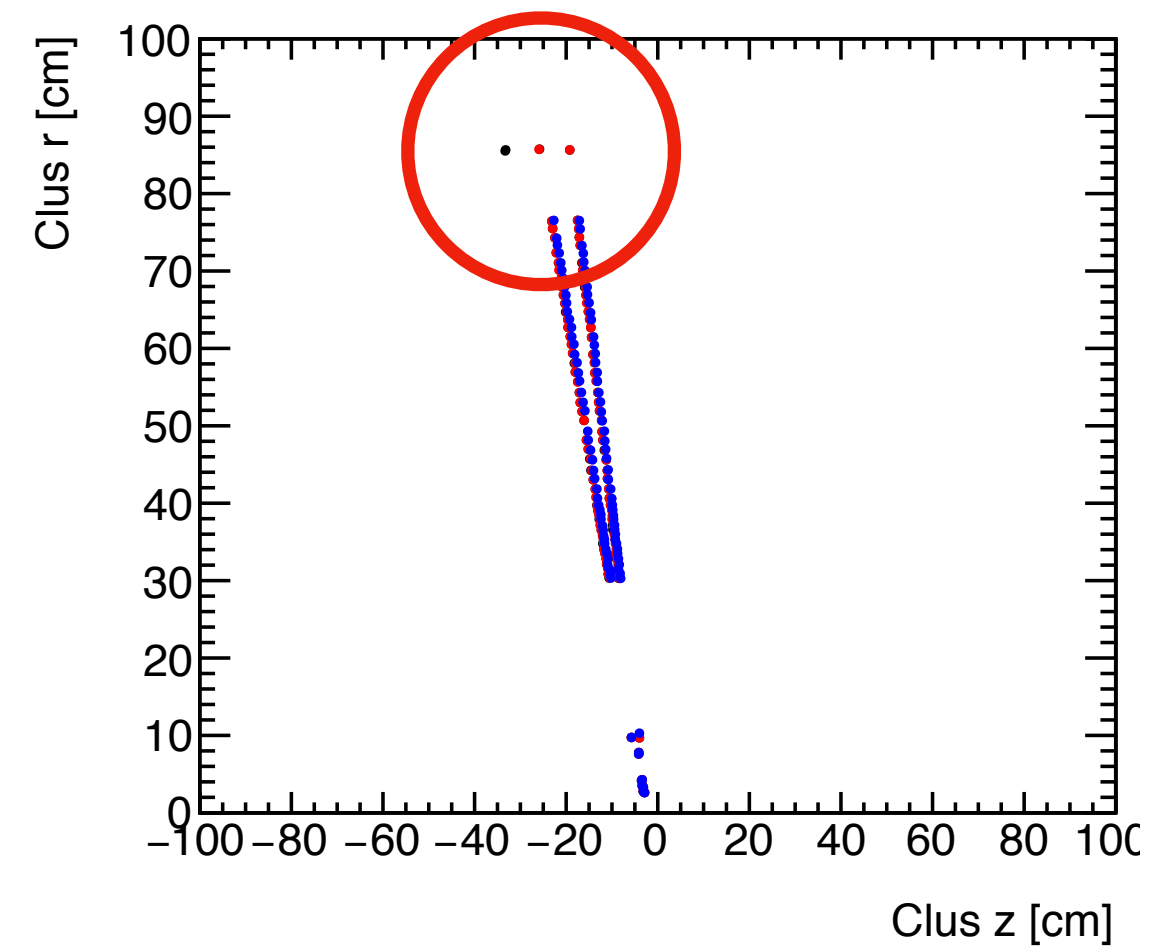
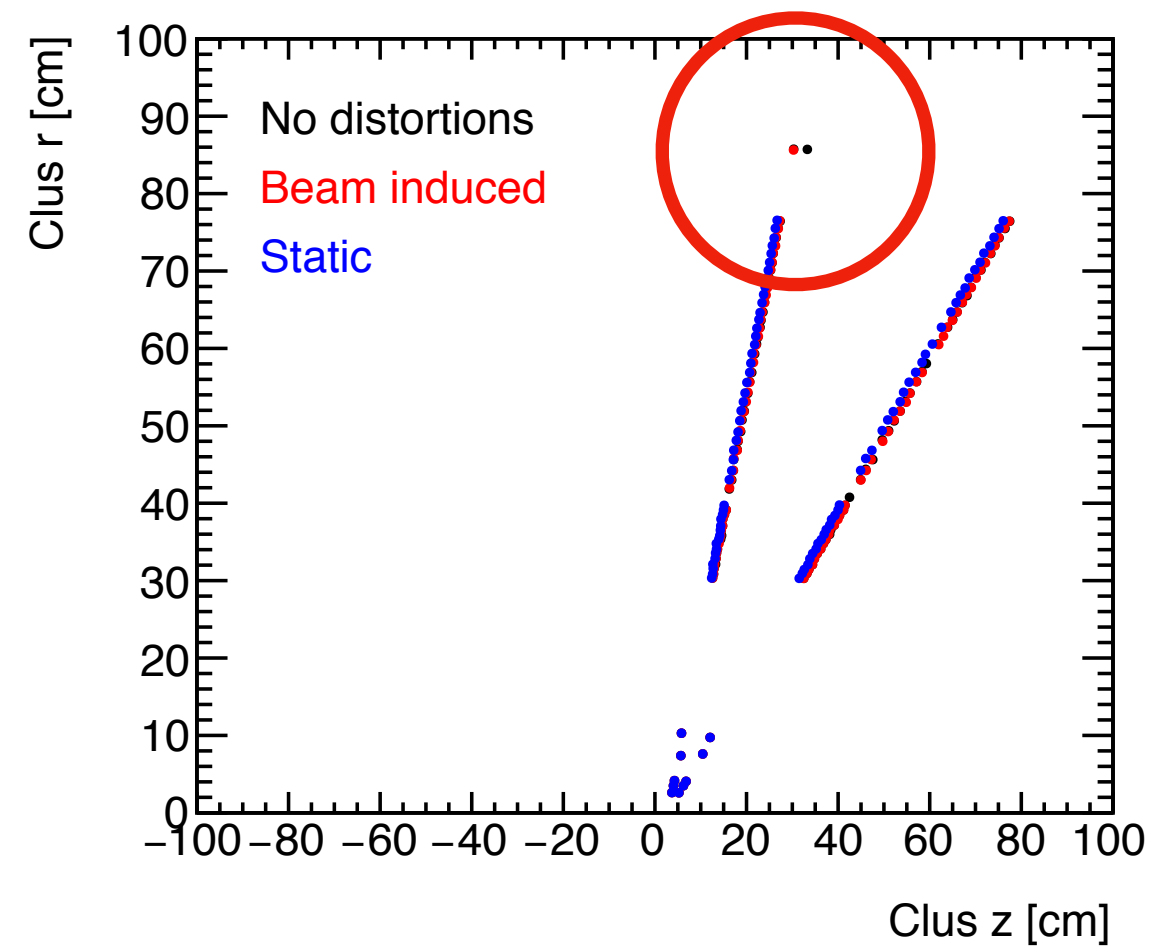


# Example Uncorrected Tracks r vs z

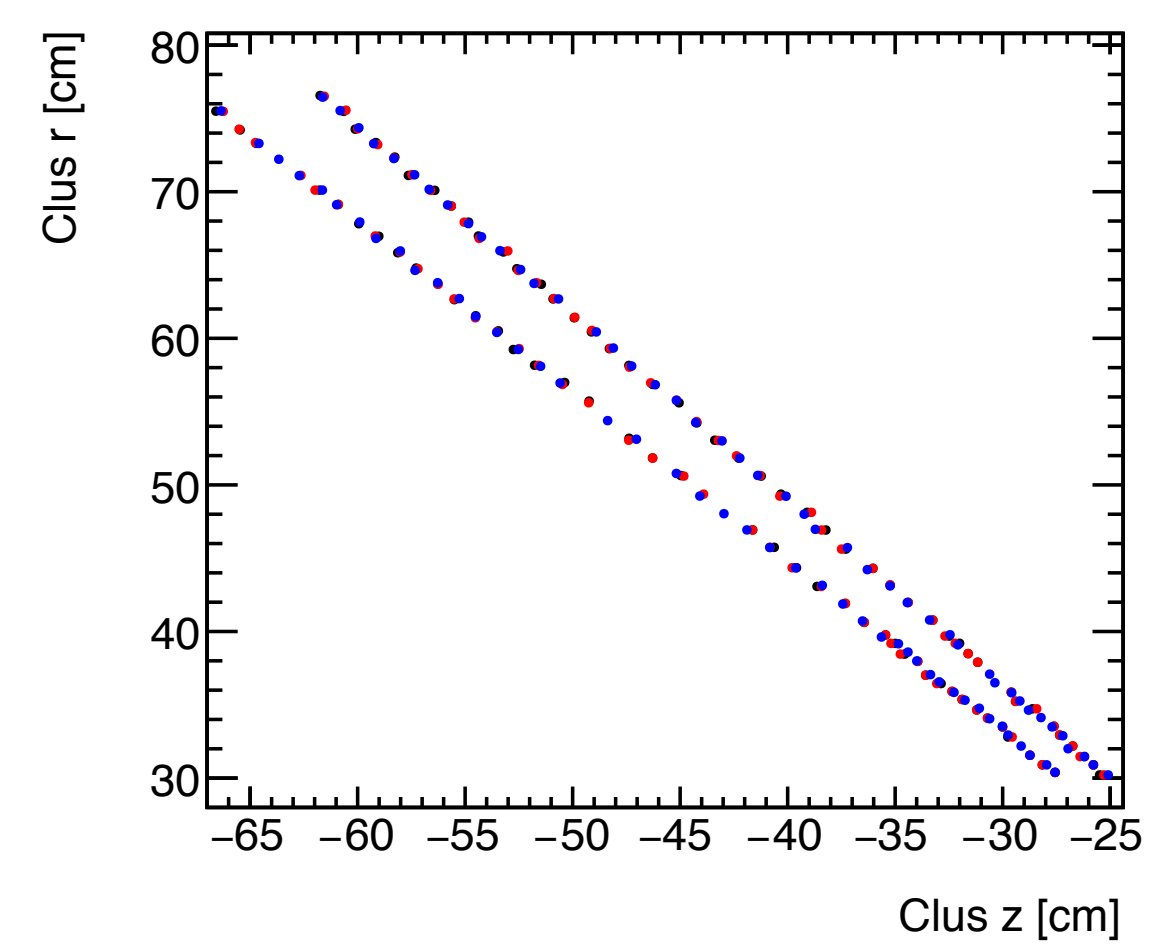
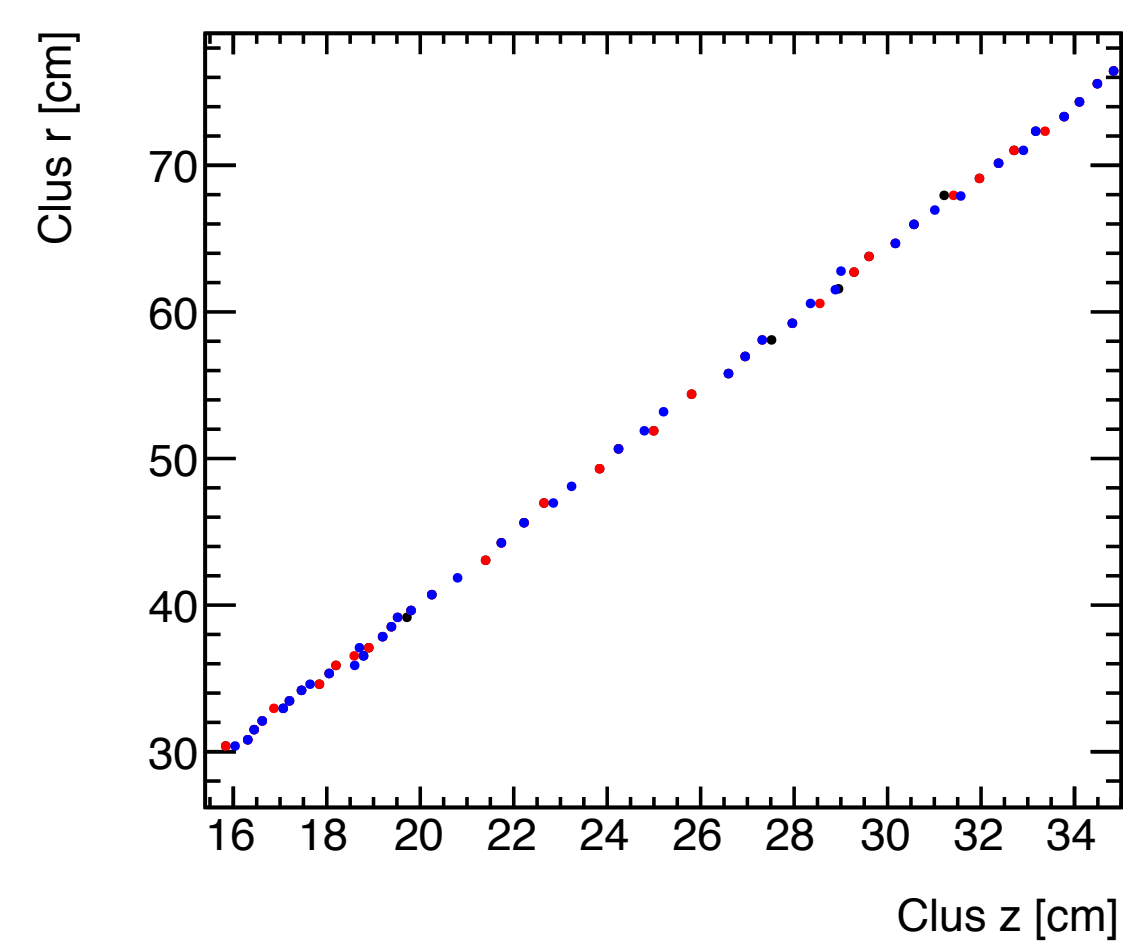
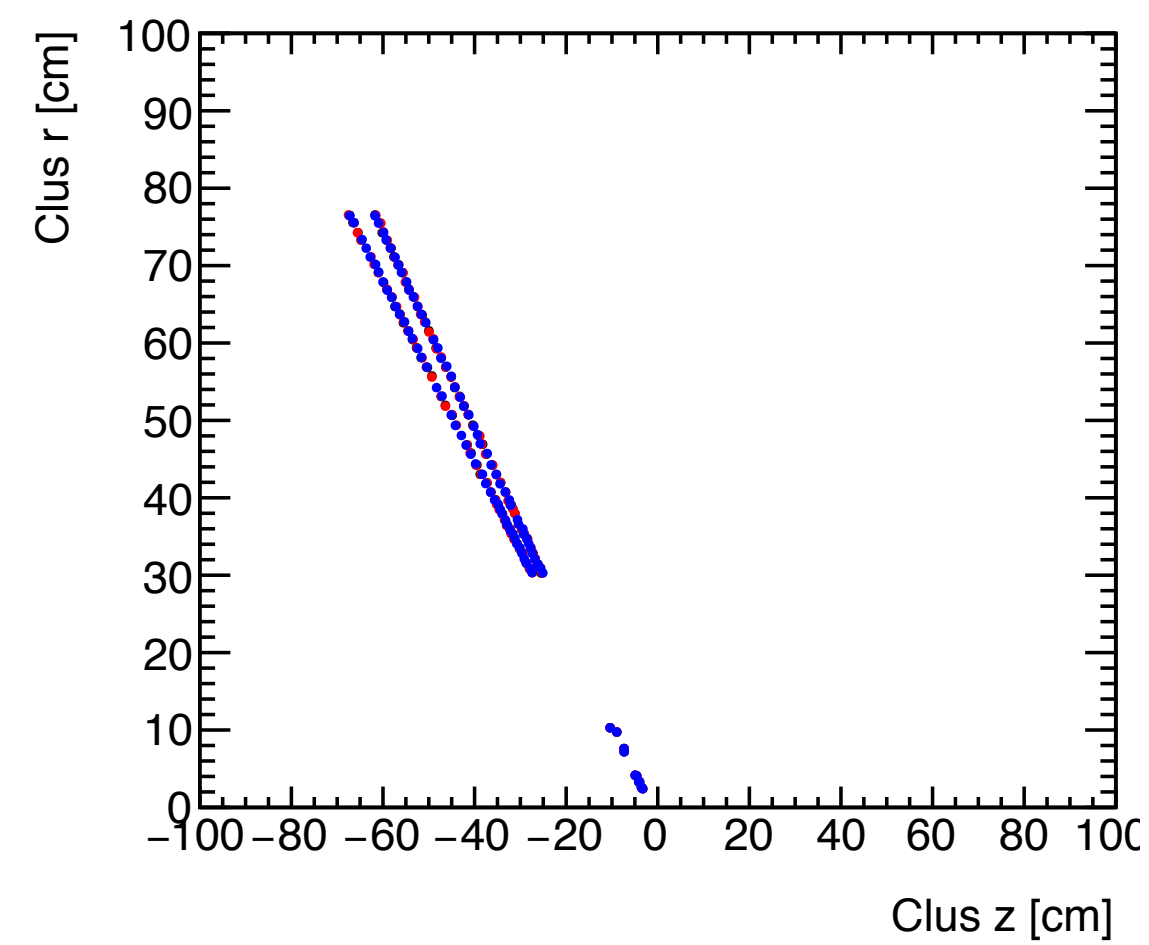
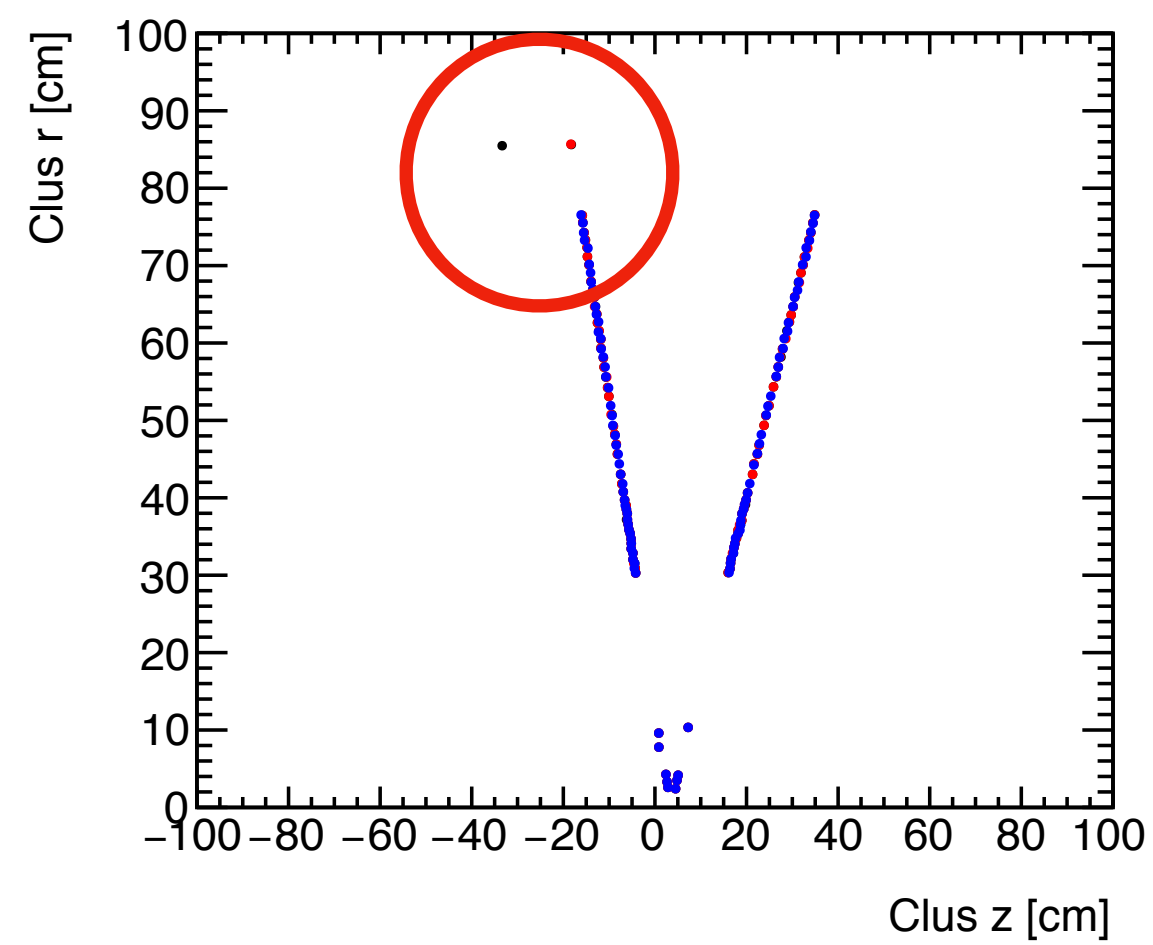
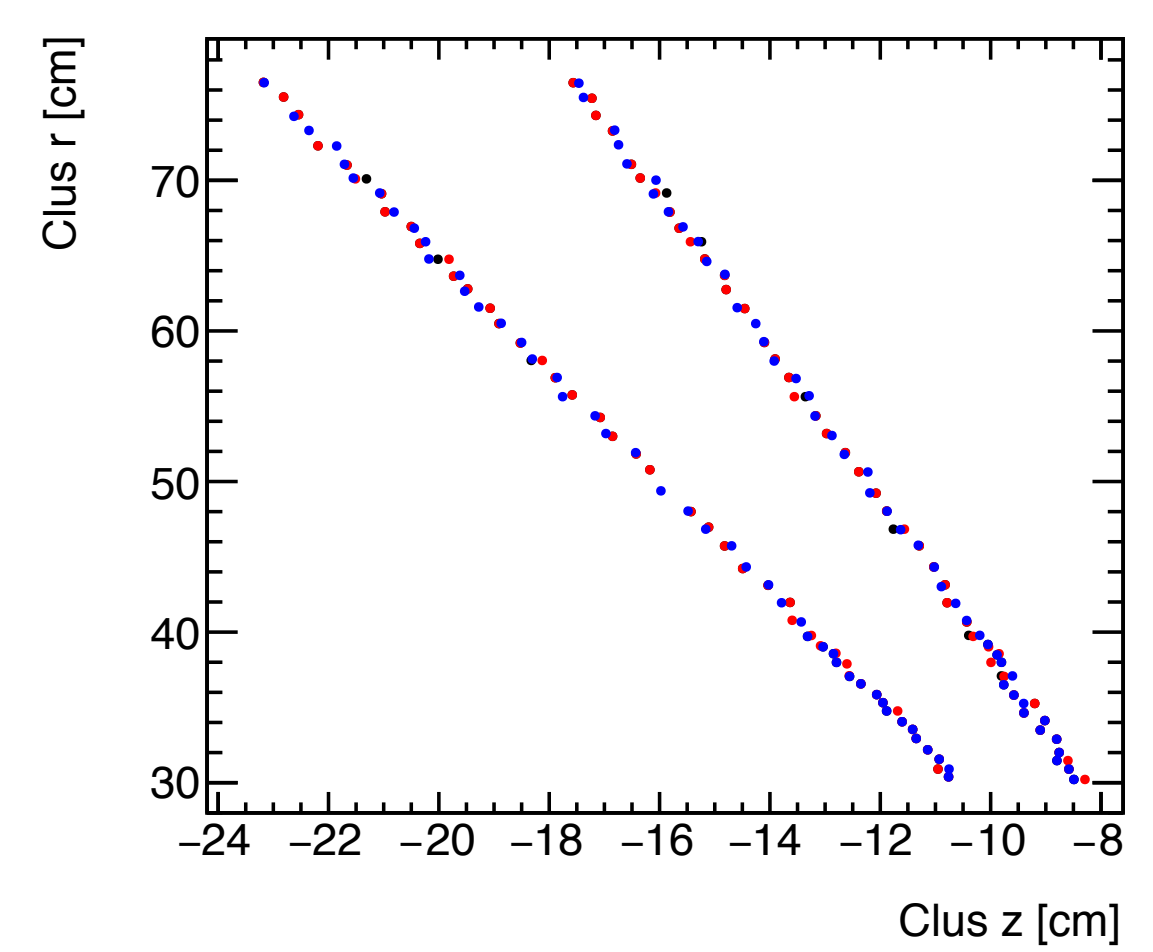
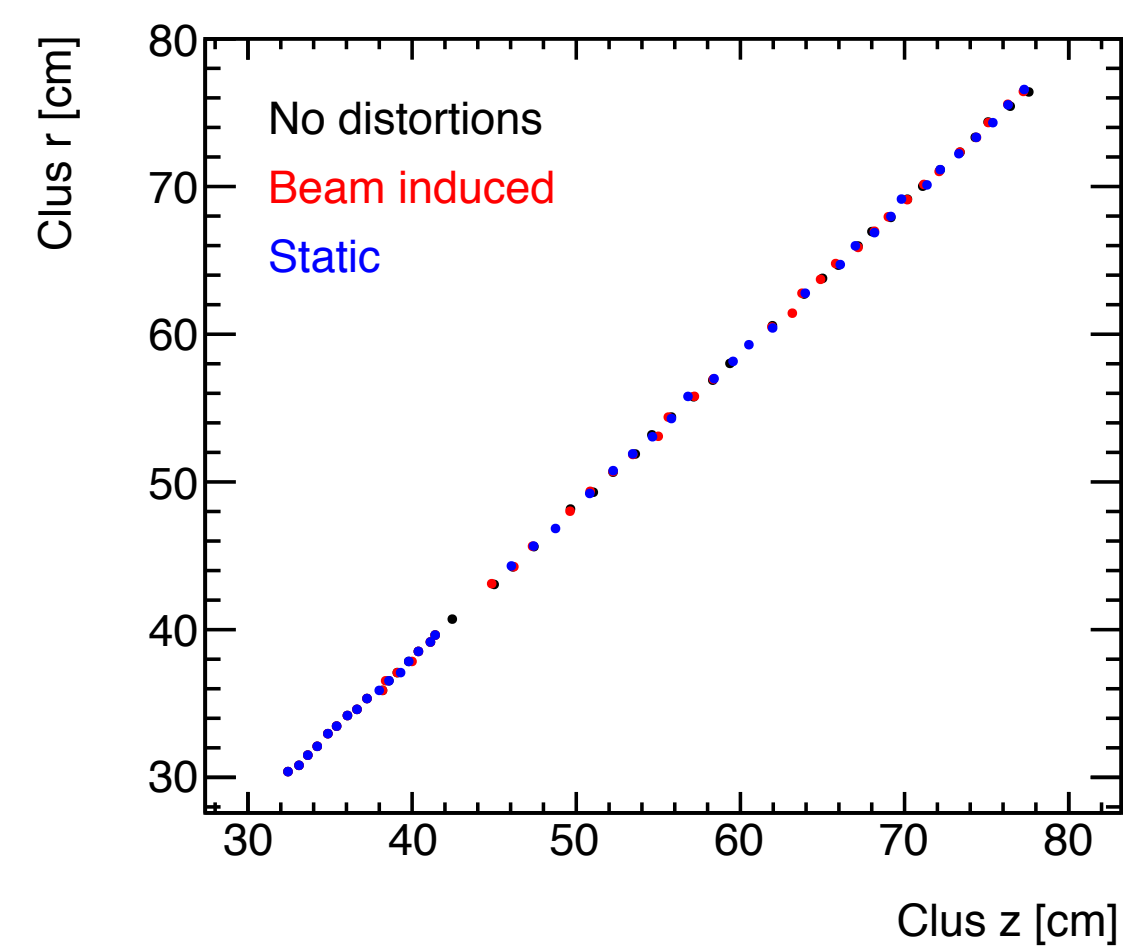
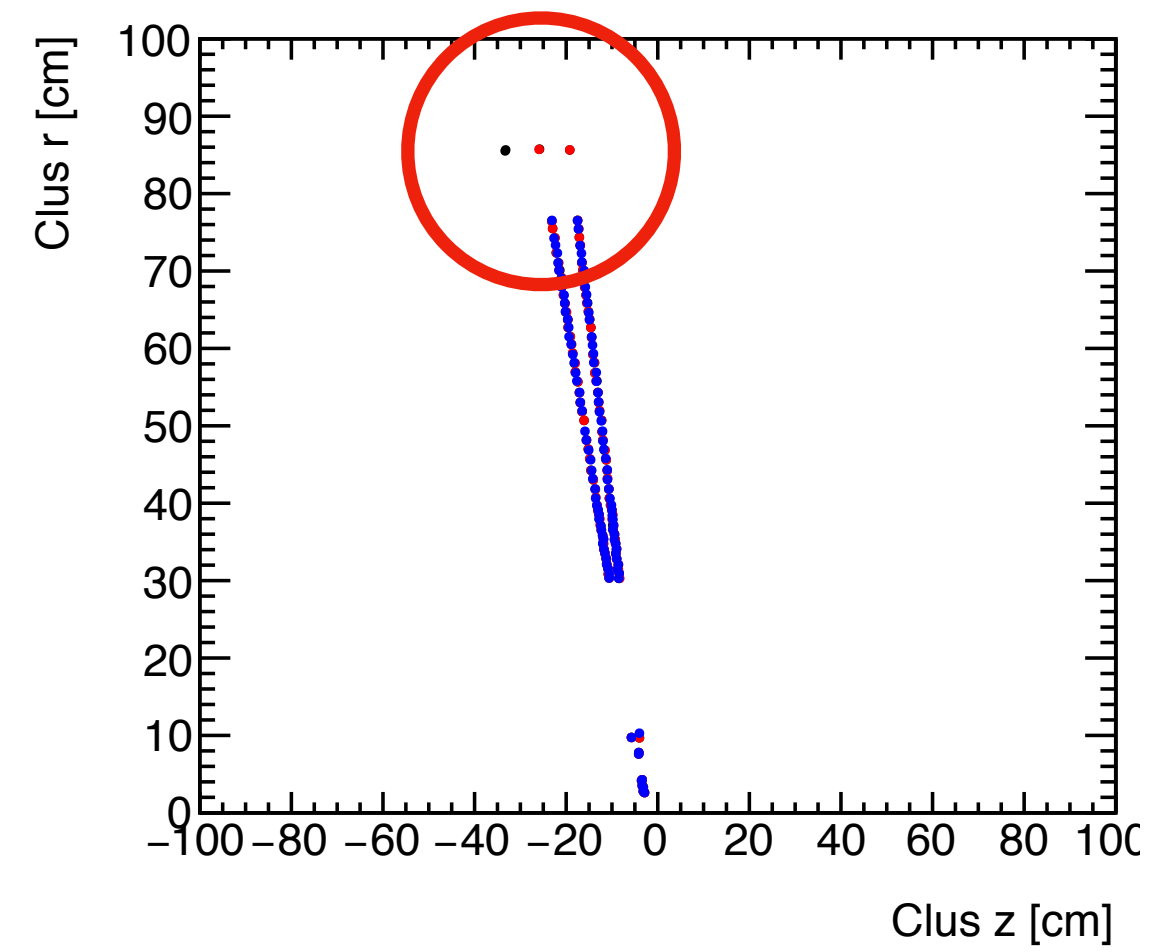
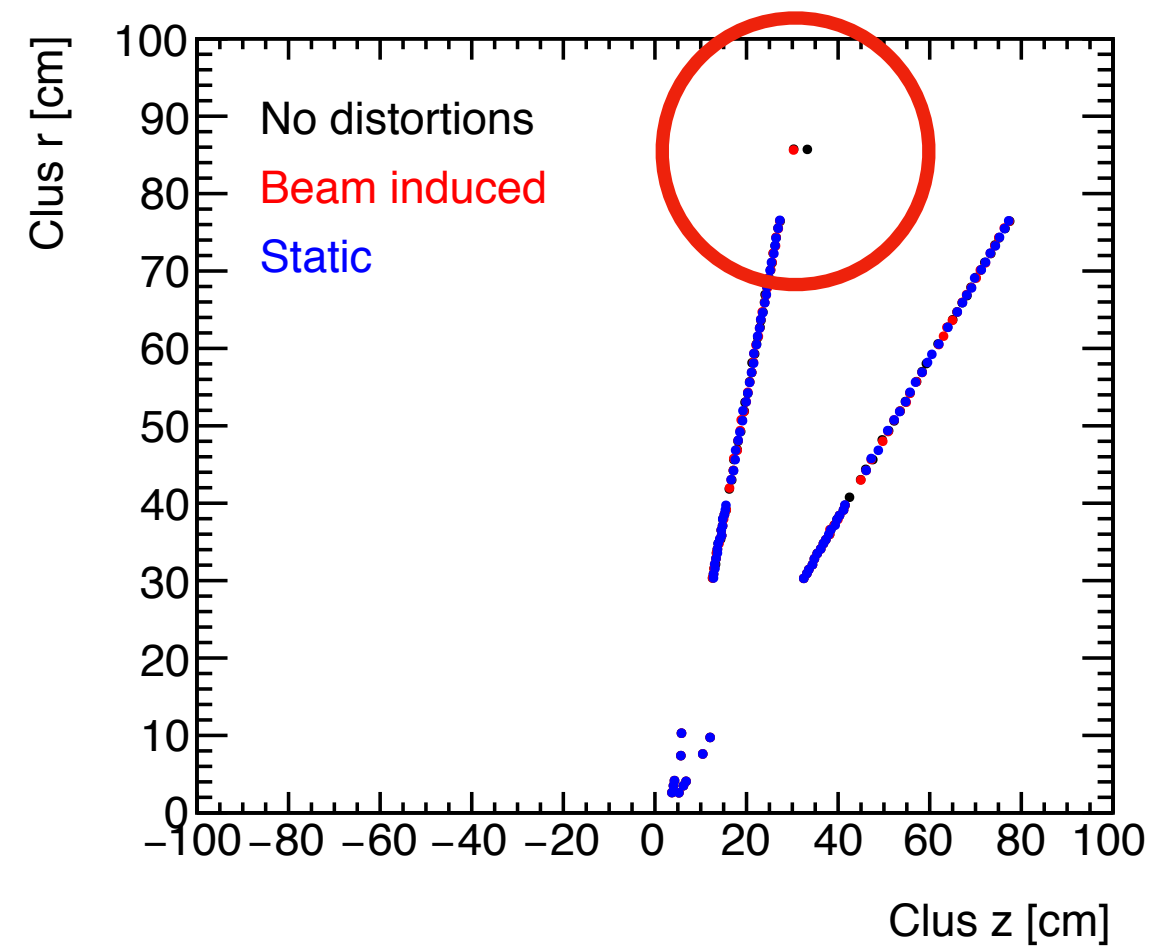




# Example Uncorrected Tracks r vs z



# Example Corrected Tracks r vs z

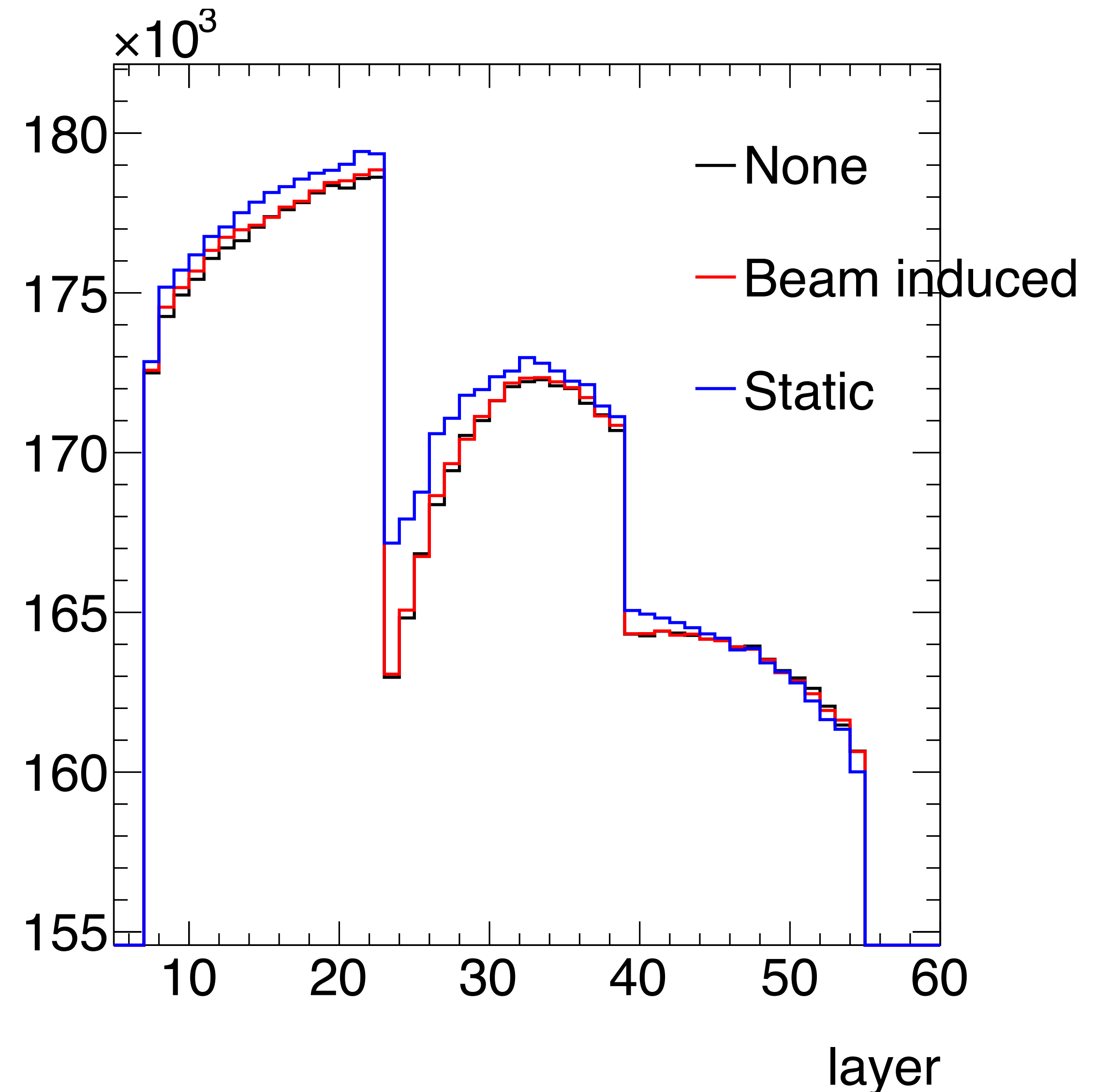


# All cluster analysis

**i.e. with ntp\_cluster**

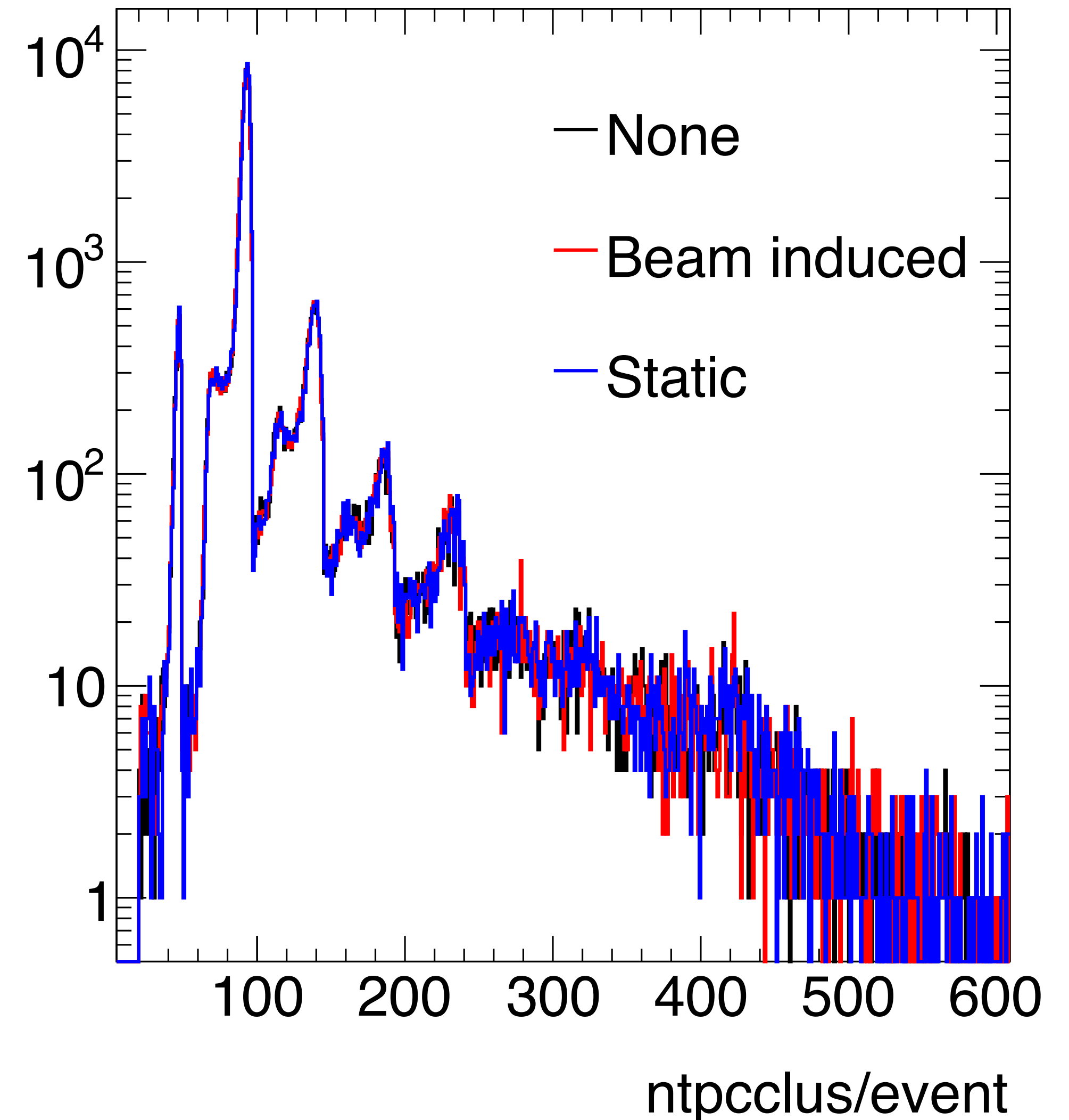
# Clusters Per Layer

- Tend to have more reconstructed clusters per layer in static distorted events
- Beam induced very similar to no distortion case
- Most pronounced difference in middle TPC layers
- Less apparent in outer TPC layers, some difference in innermost layers



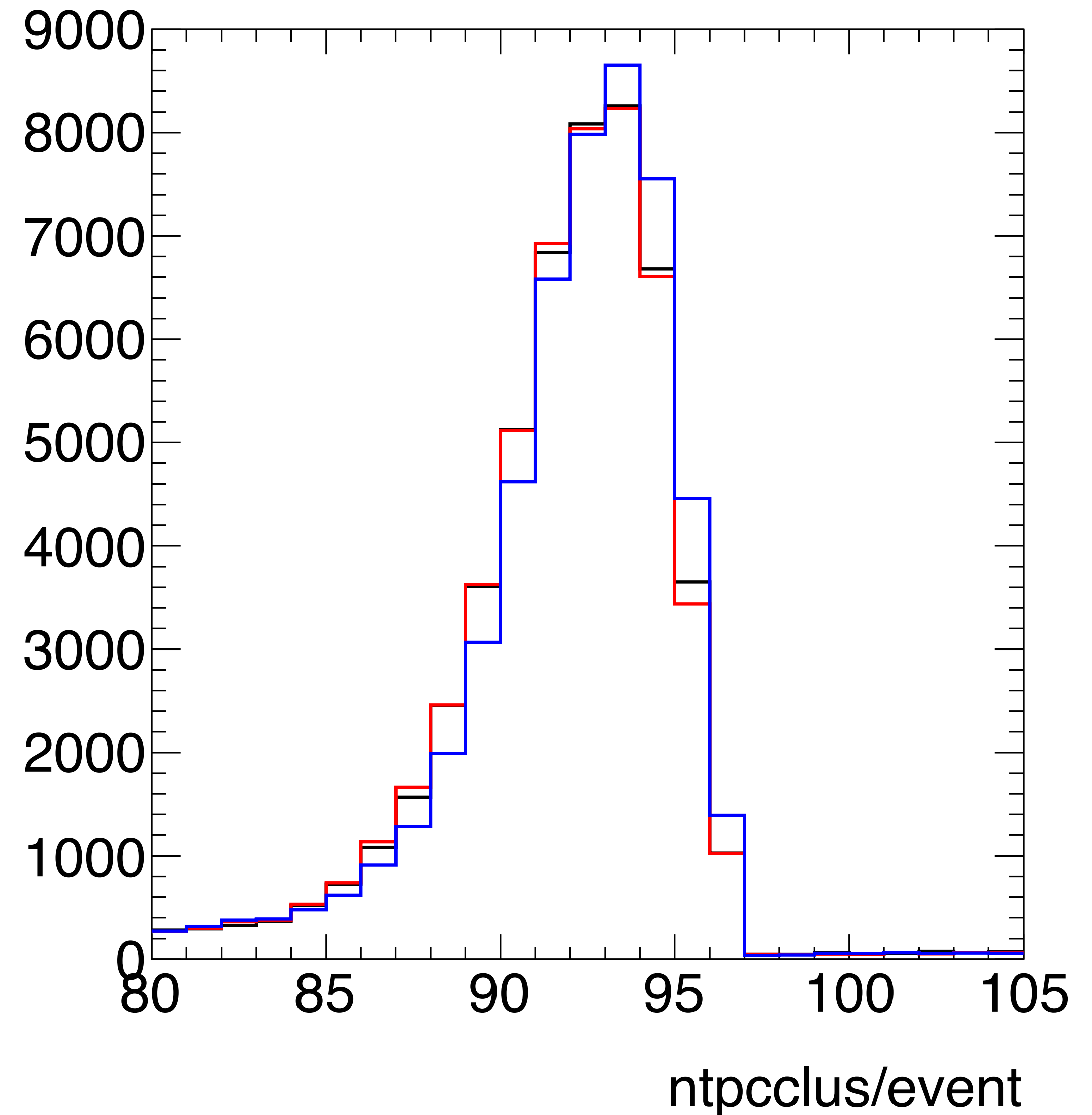
# NTPC Clusters

- At a global glance the number of TPC clusters per event seems relatively stable for each case
- However zooming in to the predominant 2 particle peak (i.e. ~94 clusters per event, 47 per track) shows they are weighted higher for the static distortion case



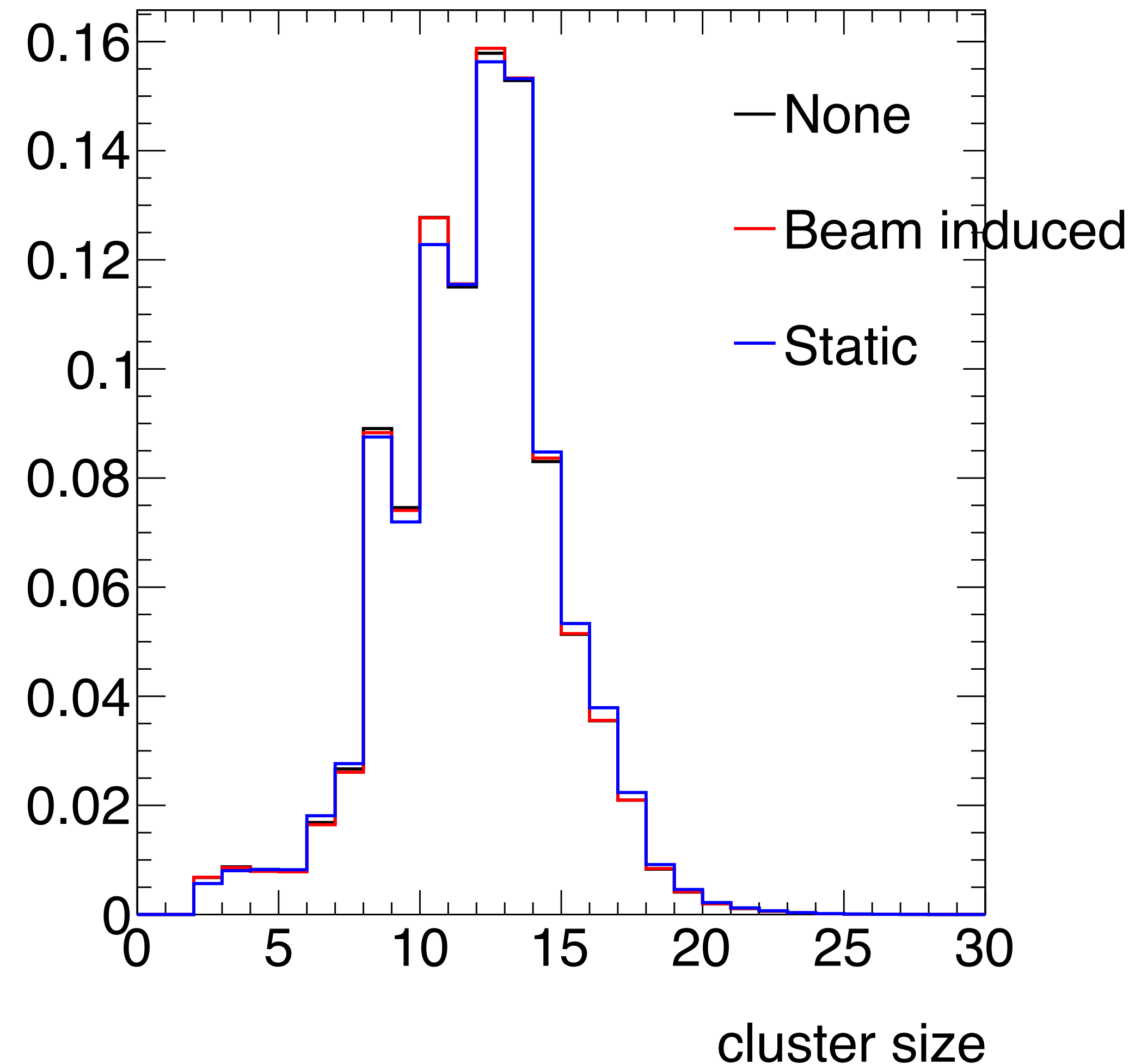
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# Cluster Sizes

- Cluster size distribution slightly broadened in static distorted case
- Note - these findings are only in reconstructed cluster case.
- Truth cluster (ntp\_g4cluster) distributions look the same across no, beam induced, and static distortion cases

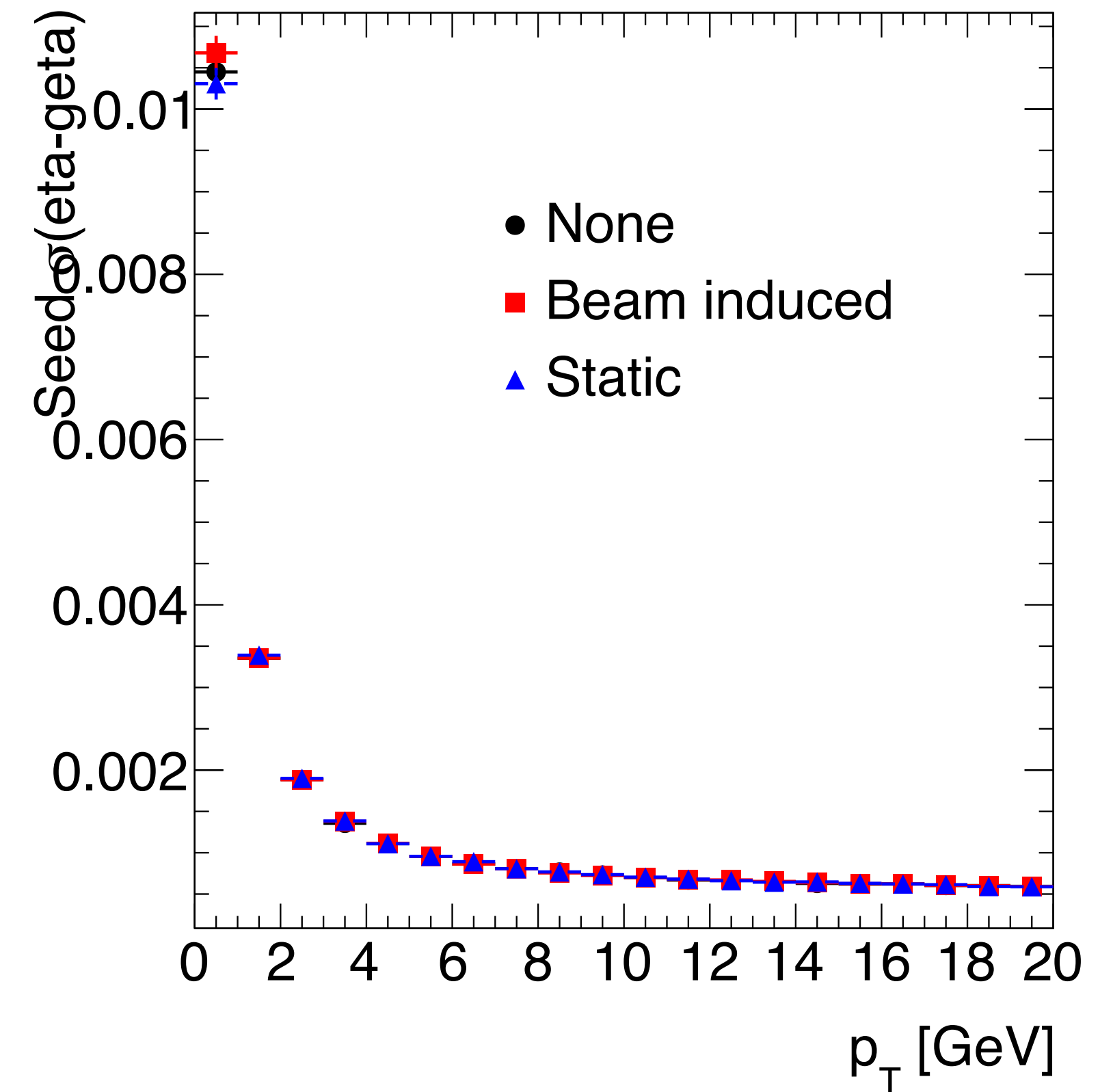
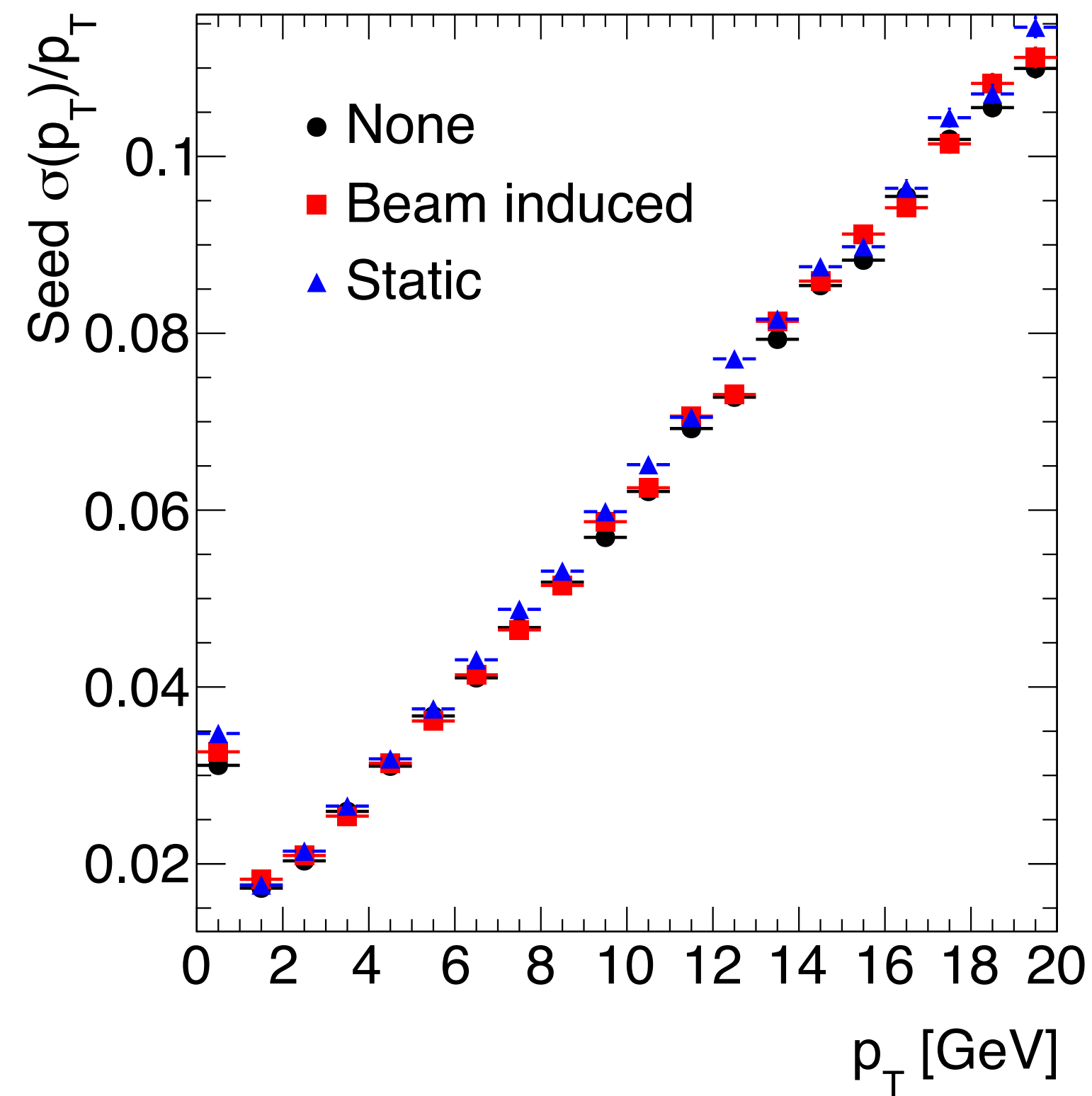
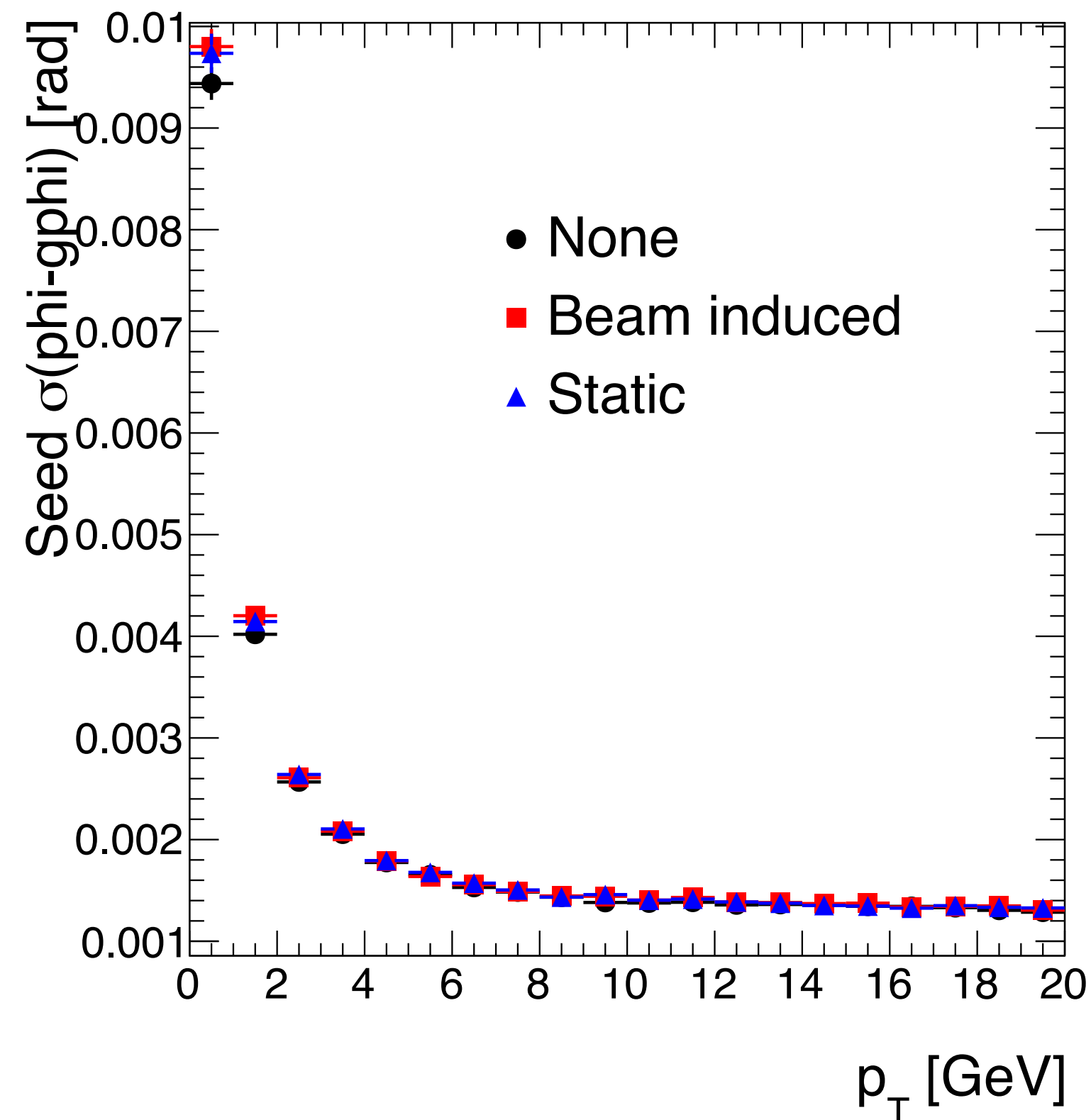


# Track seed analysis

i.e. with `ntp_gtrack`



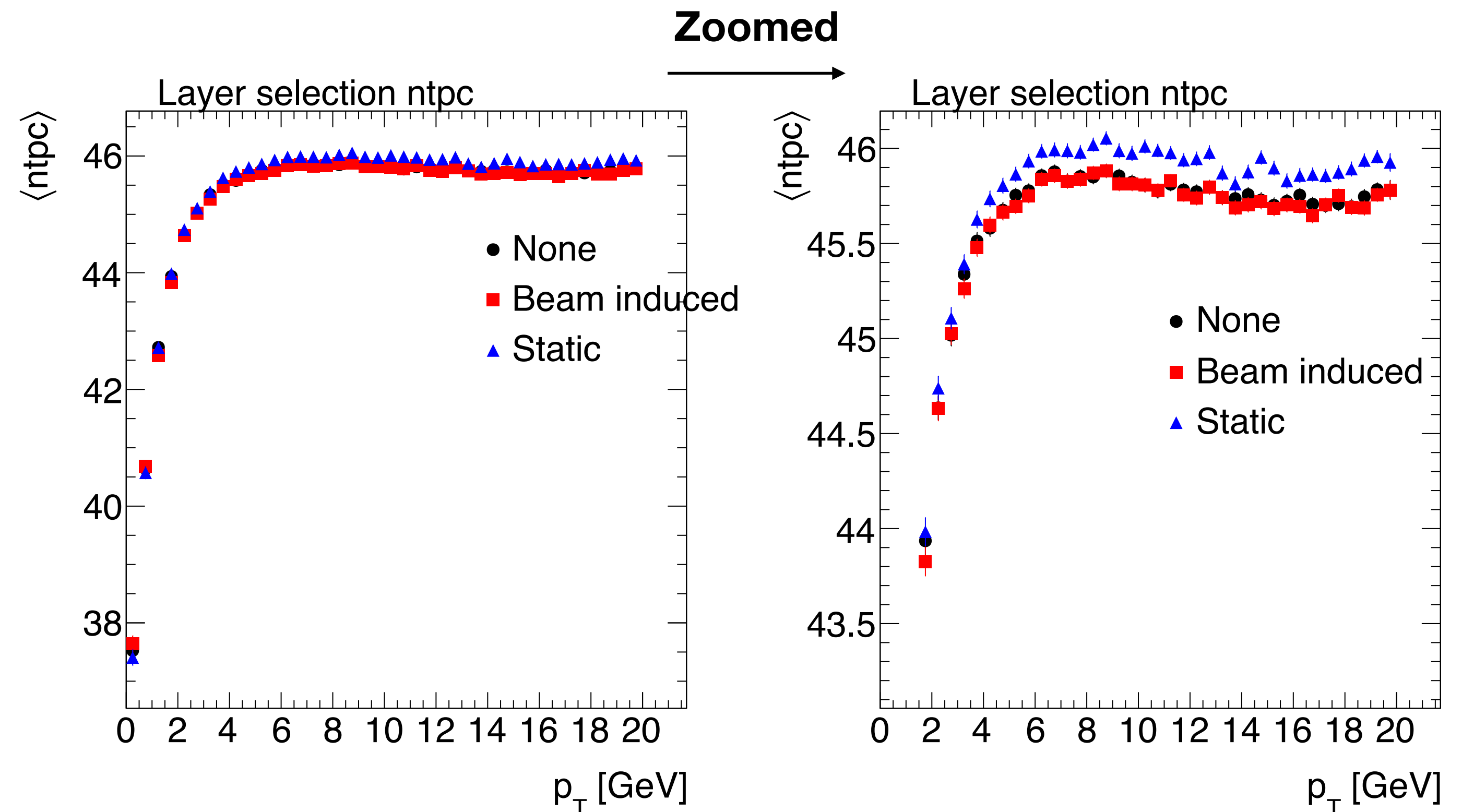
# Seed Track Parameters



- Seed track parameters look similar amongst all cases

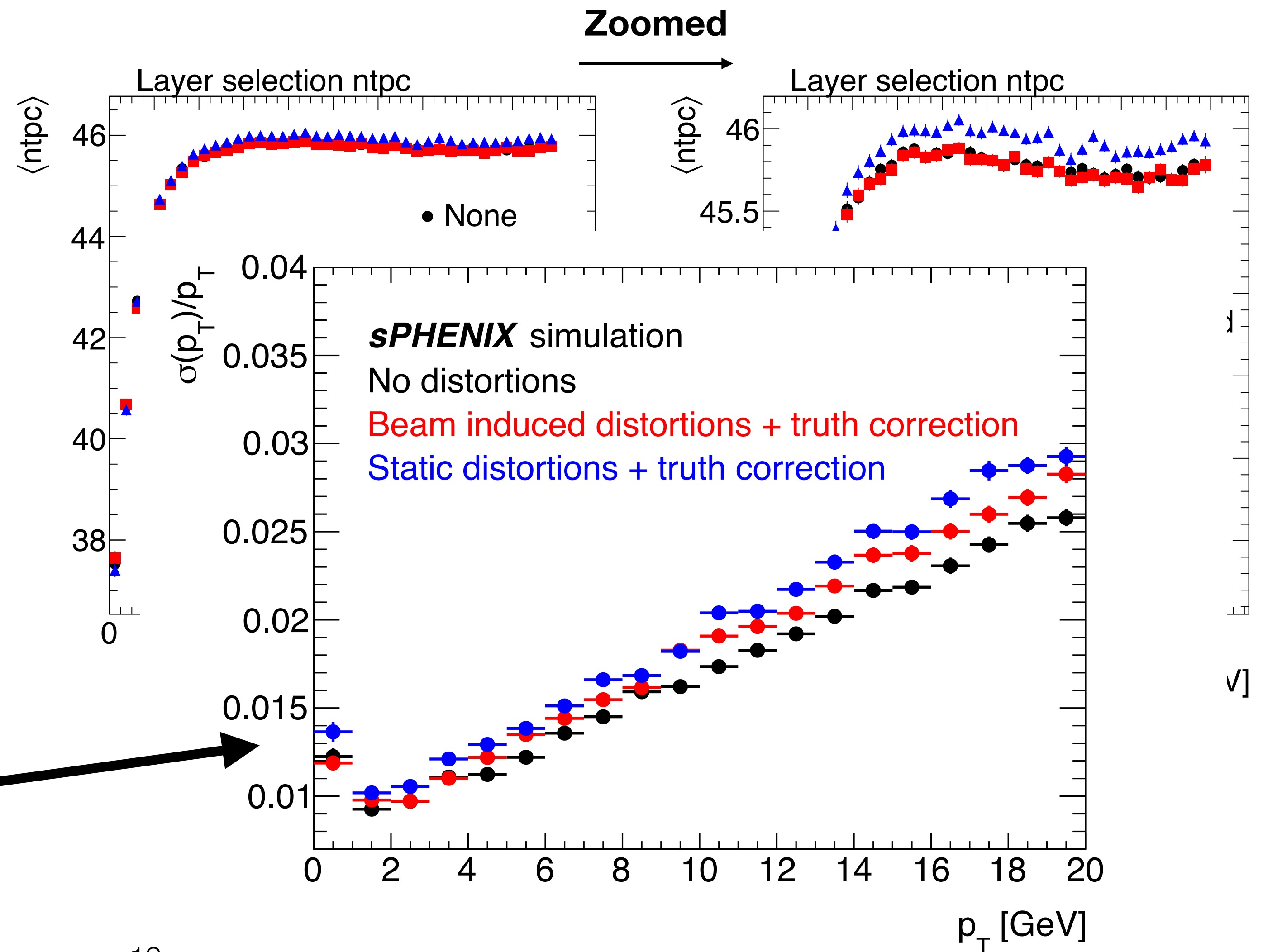
# Layer Selections

- Following histograms are filled with the following procedure:
  - Fill (e.g.) “ntpc:gpt” TH2
  - Project each bin to y axis and get mean and mean error of TH1 histogram
  - Plot these mean+mean errors as a function of  $p_T$
- Static distorted seeds typically have larger number of TPC layers found
- At low  $p_T$  there does not appear to be a systematic difference
  - Probably why the  $p_T$  resolution “spreads” out at higher  $p_T$

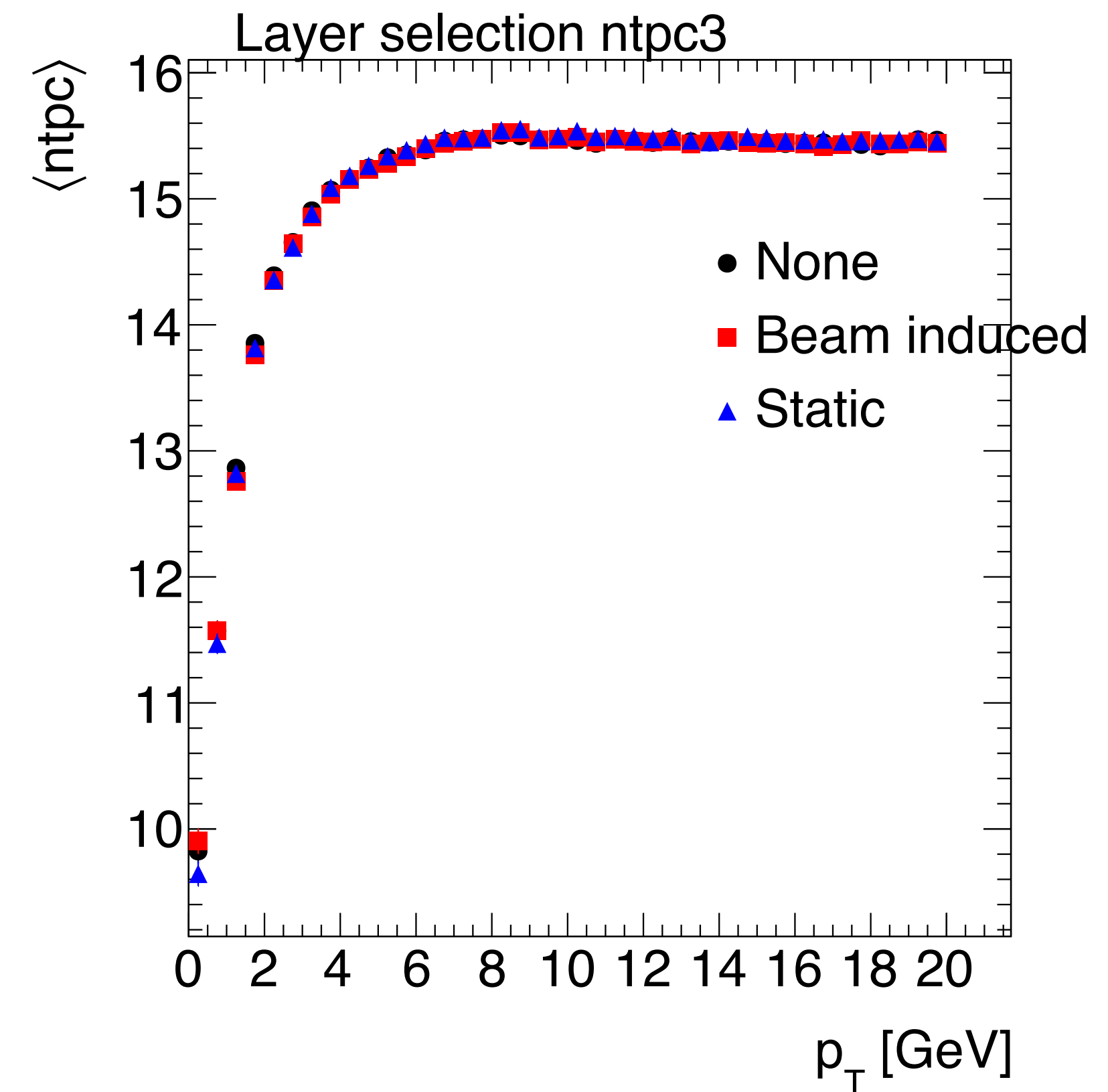
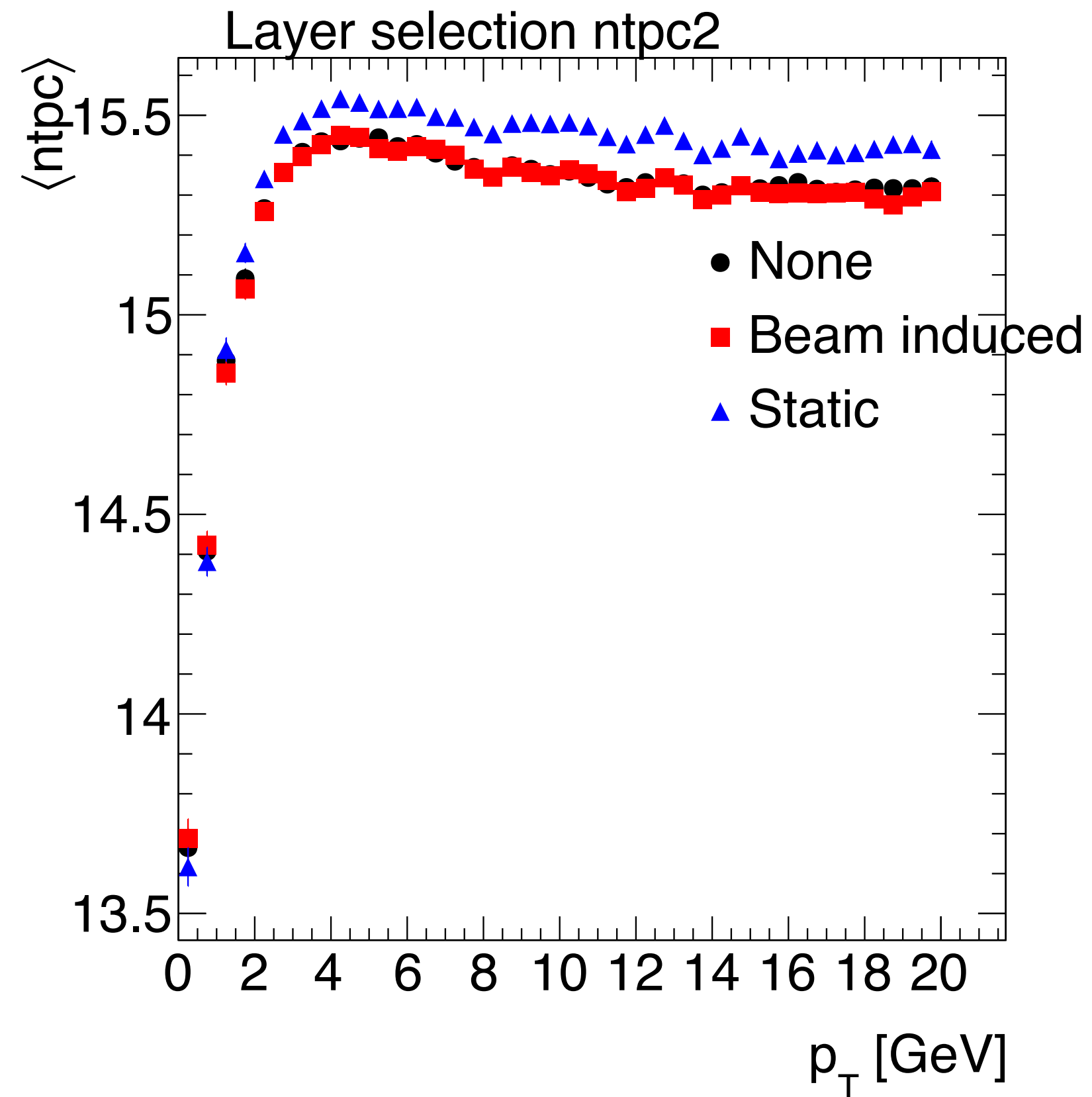
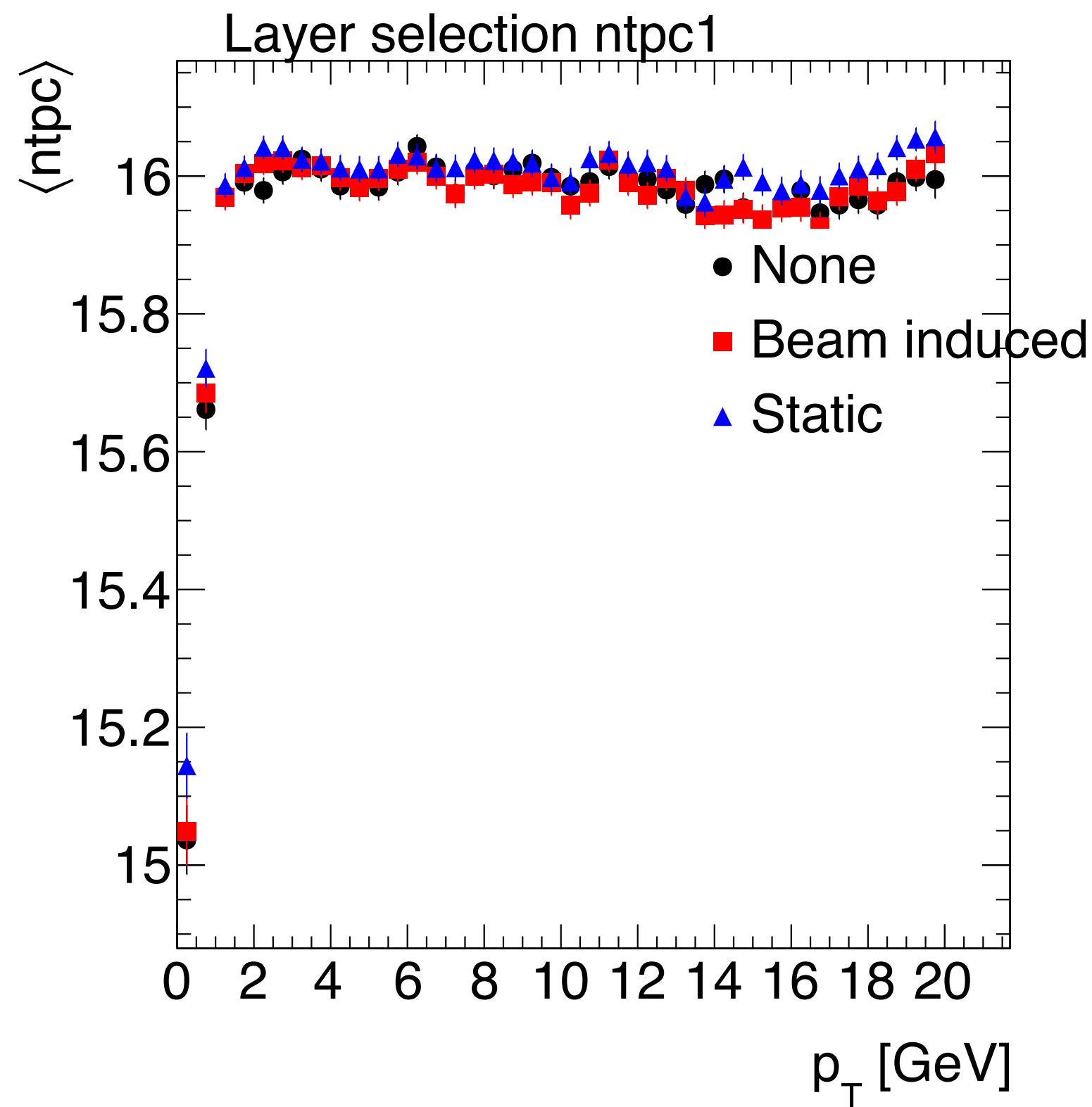


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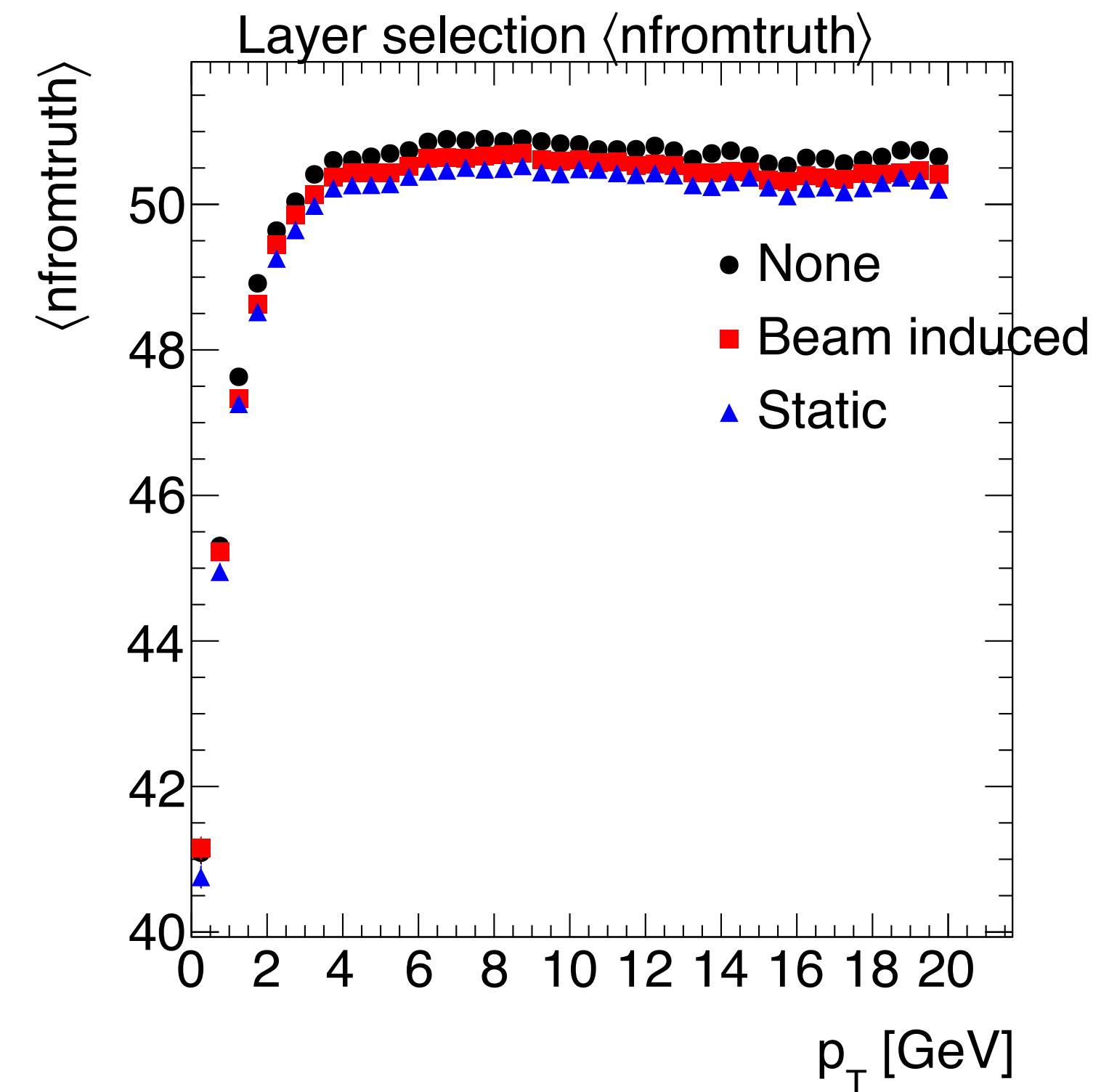
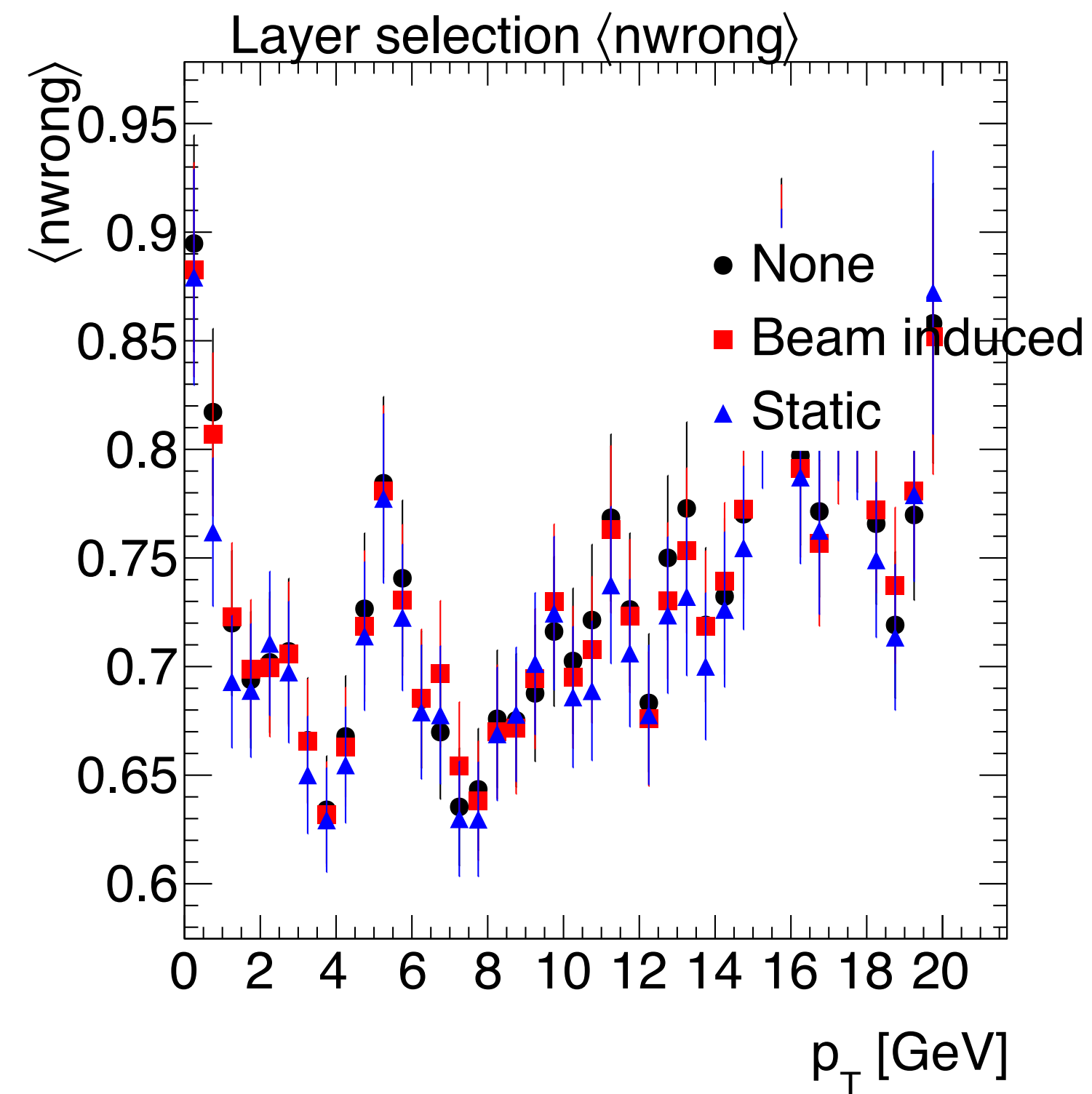


# Layer Selections



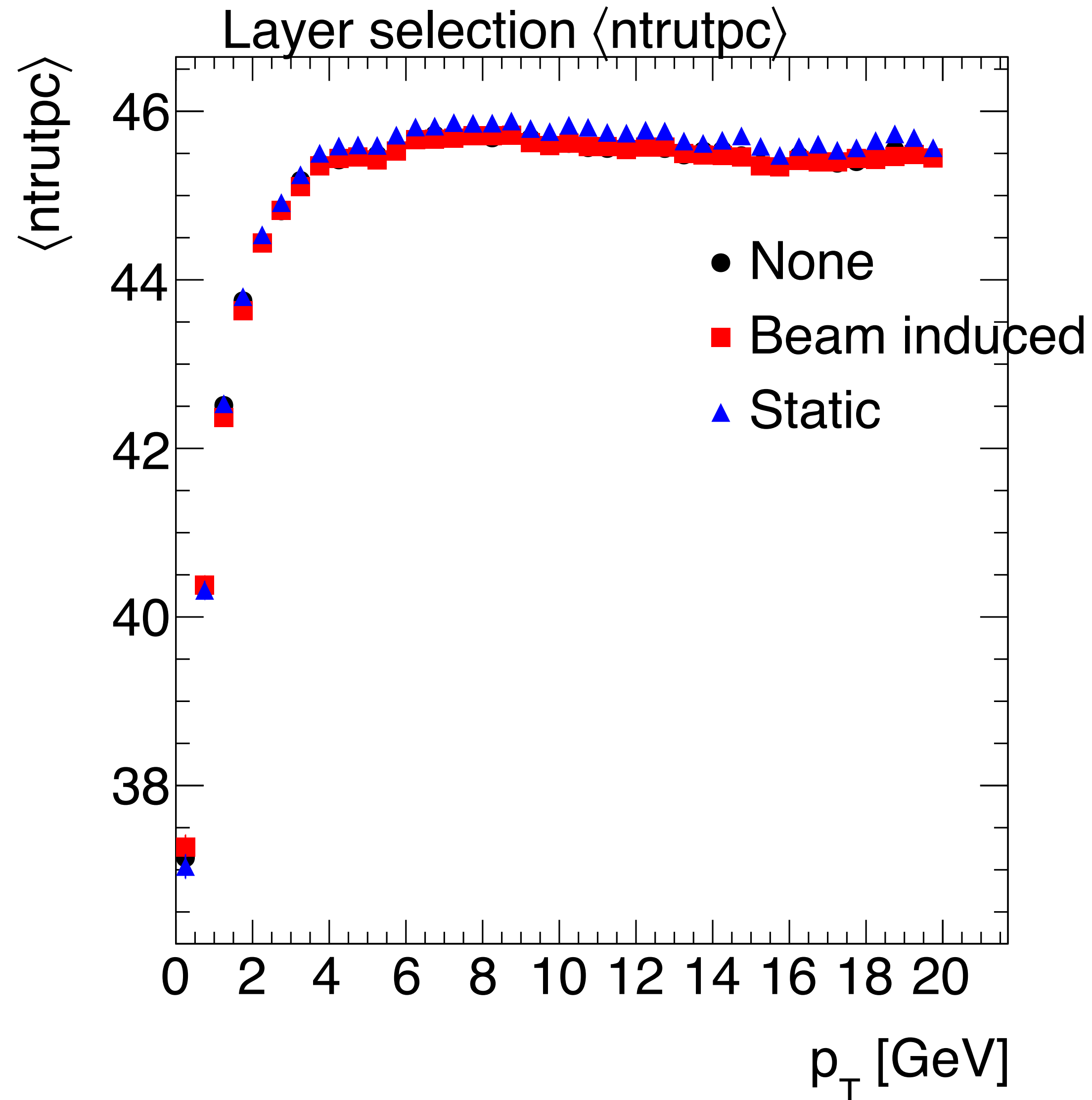
- Looking at layers 0-16 (left), 16-32 (middle), 32-48 (right) indicates typically more clusters found in layers 16-32

# Track-Cluster Evaluation



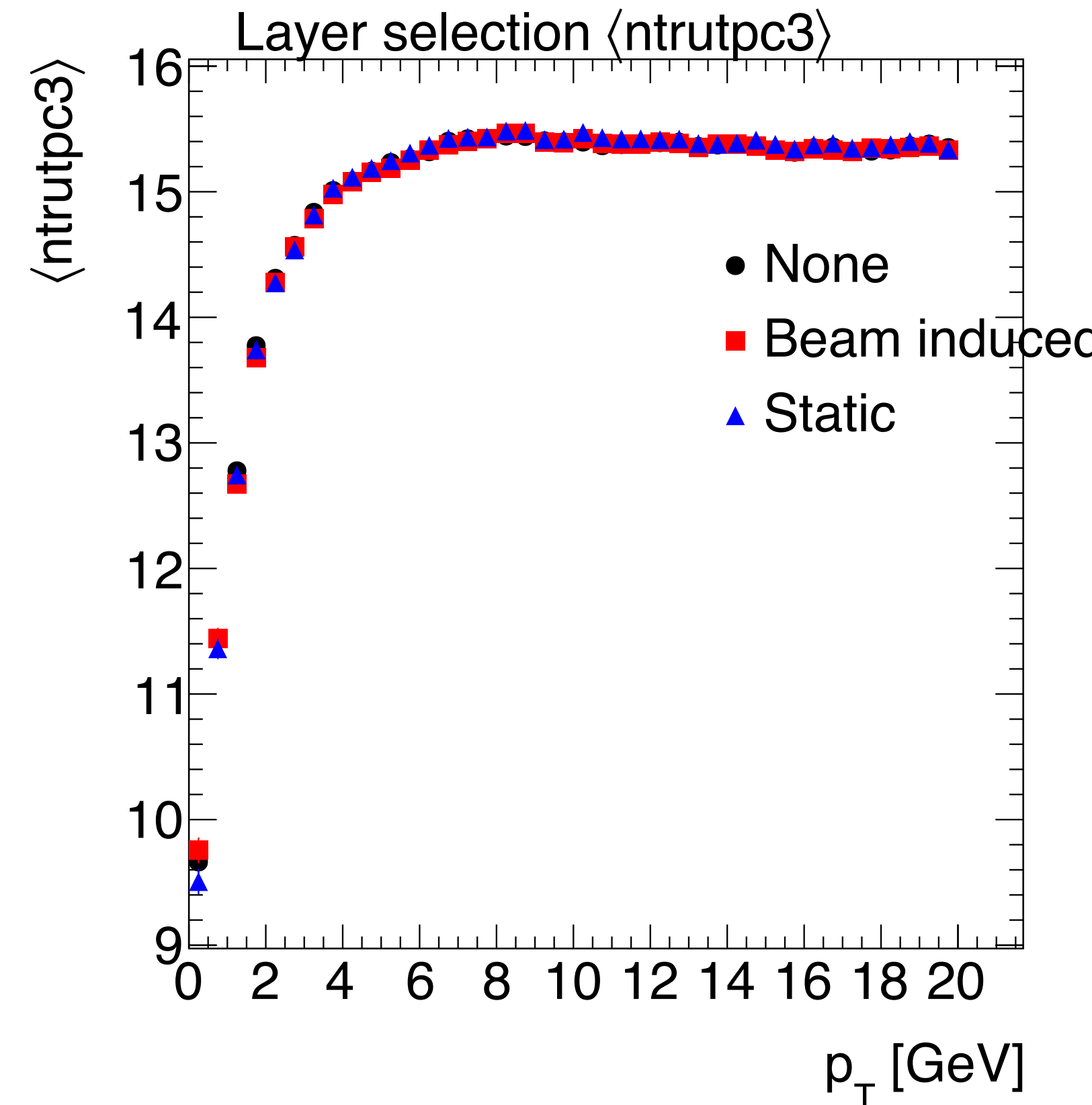
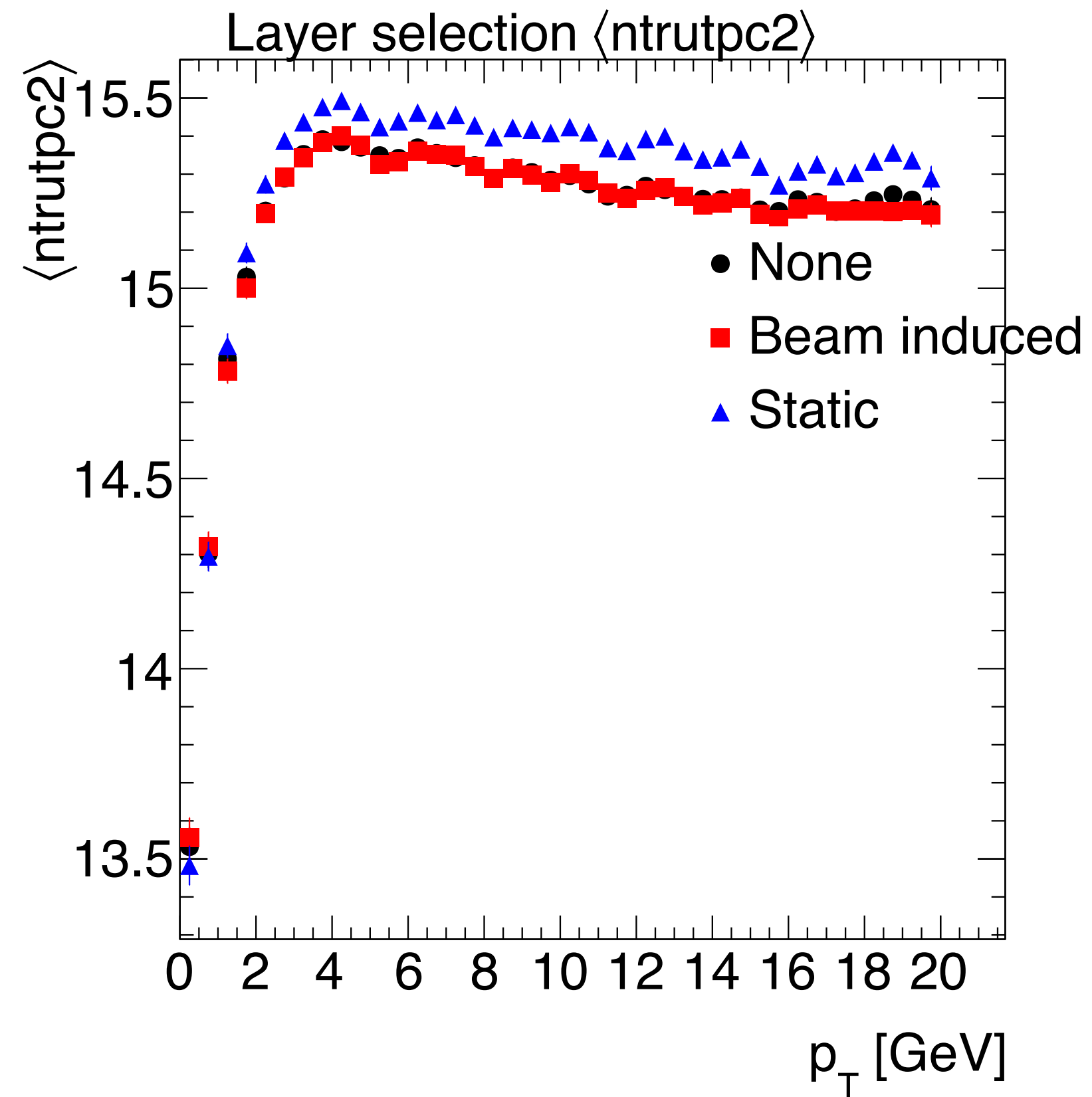
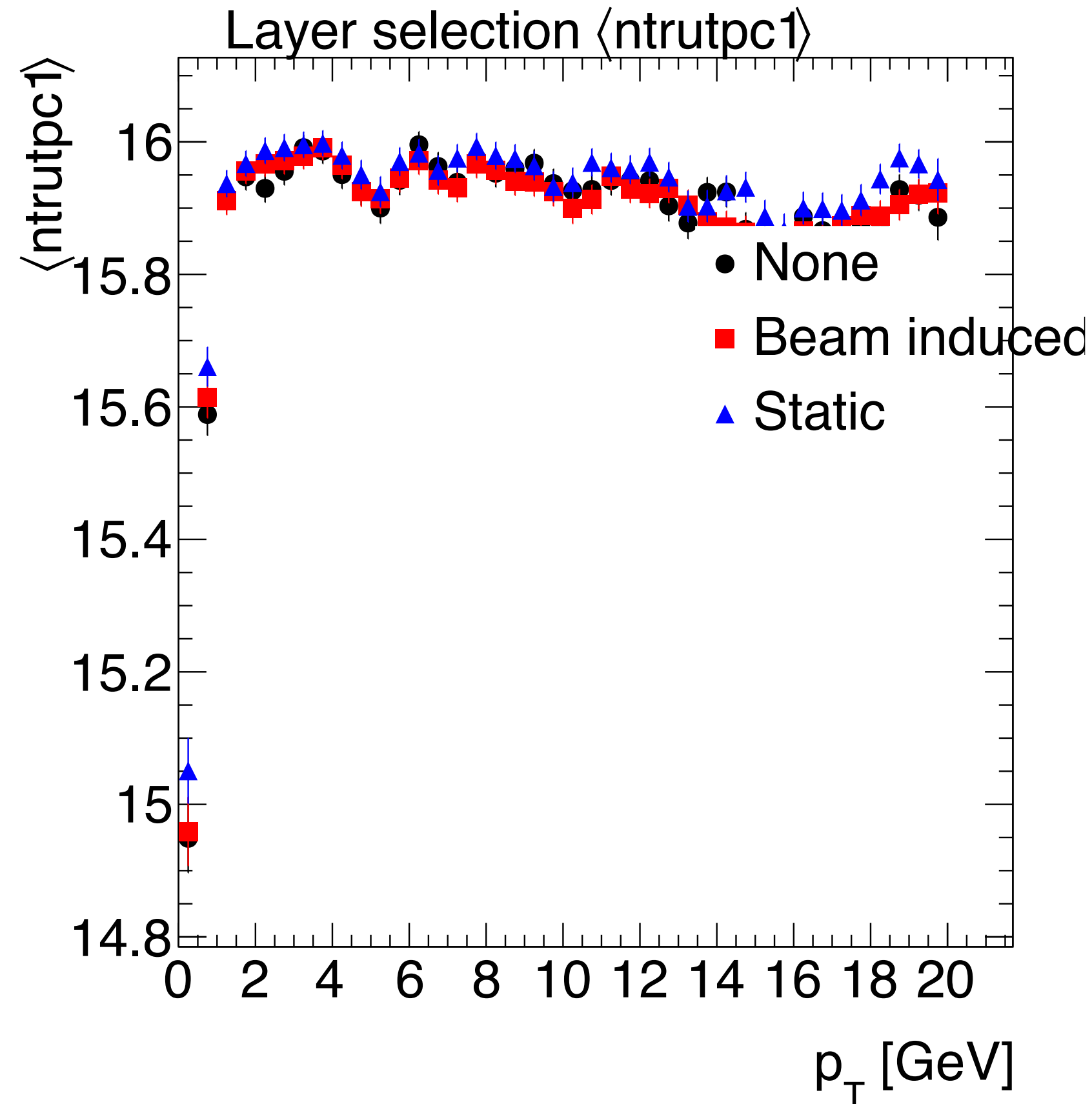
- No indication of any increase/decrease of the number of wrong clusters associated to tracks
- There is a systematic decrease in the number of true clusters associated to the tracks going from no  $\rightarrow$  beam induced  $\rightarrow$  static distortions
- This suggests the decrease in the  $p_T$  resolution is not from the larger number of clusters per event in static distorted case, but the seeding missing actual clusters that belong to the track

# TPC Layer Evaluation



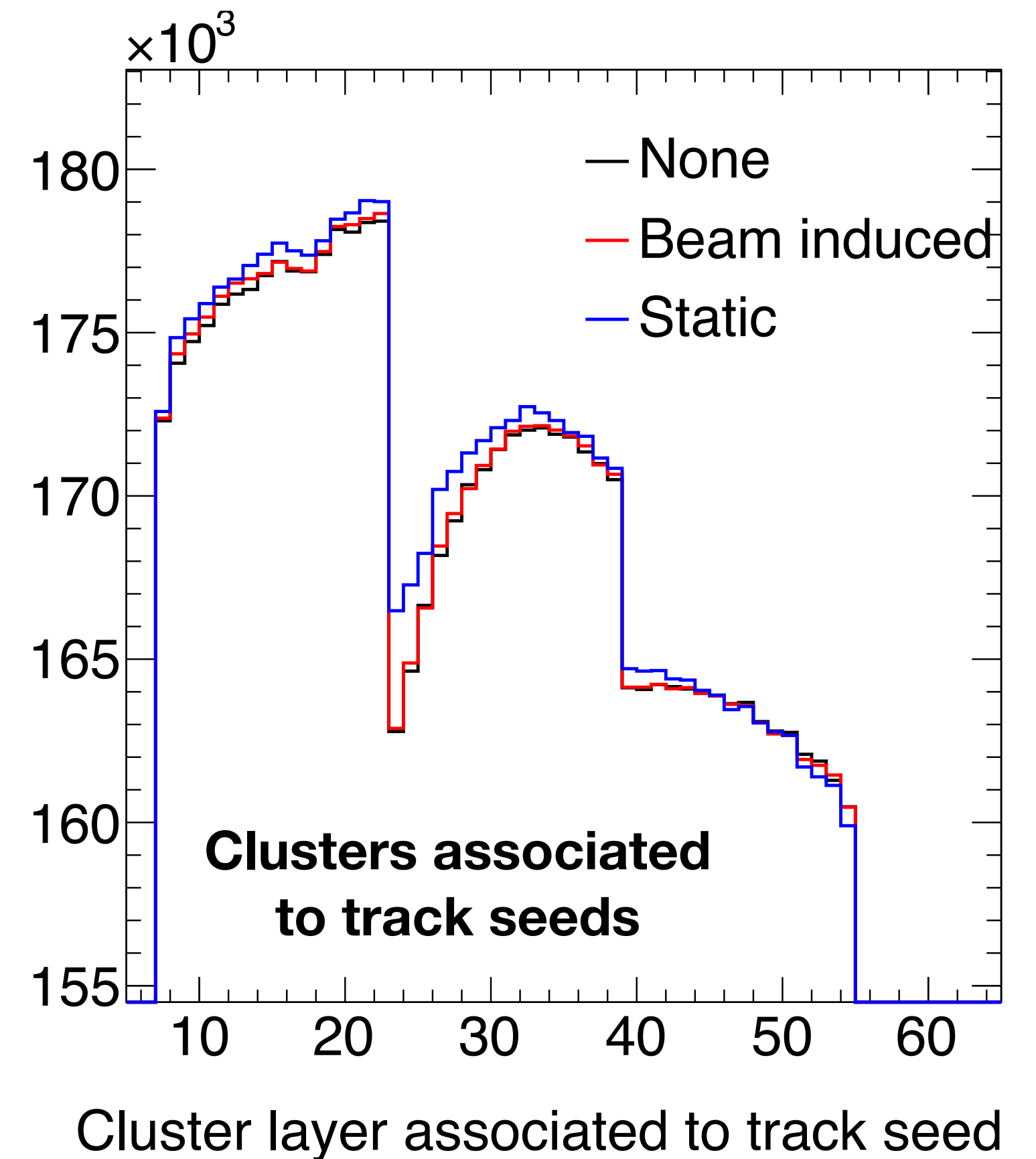
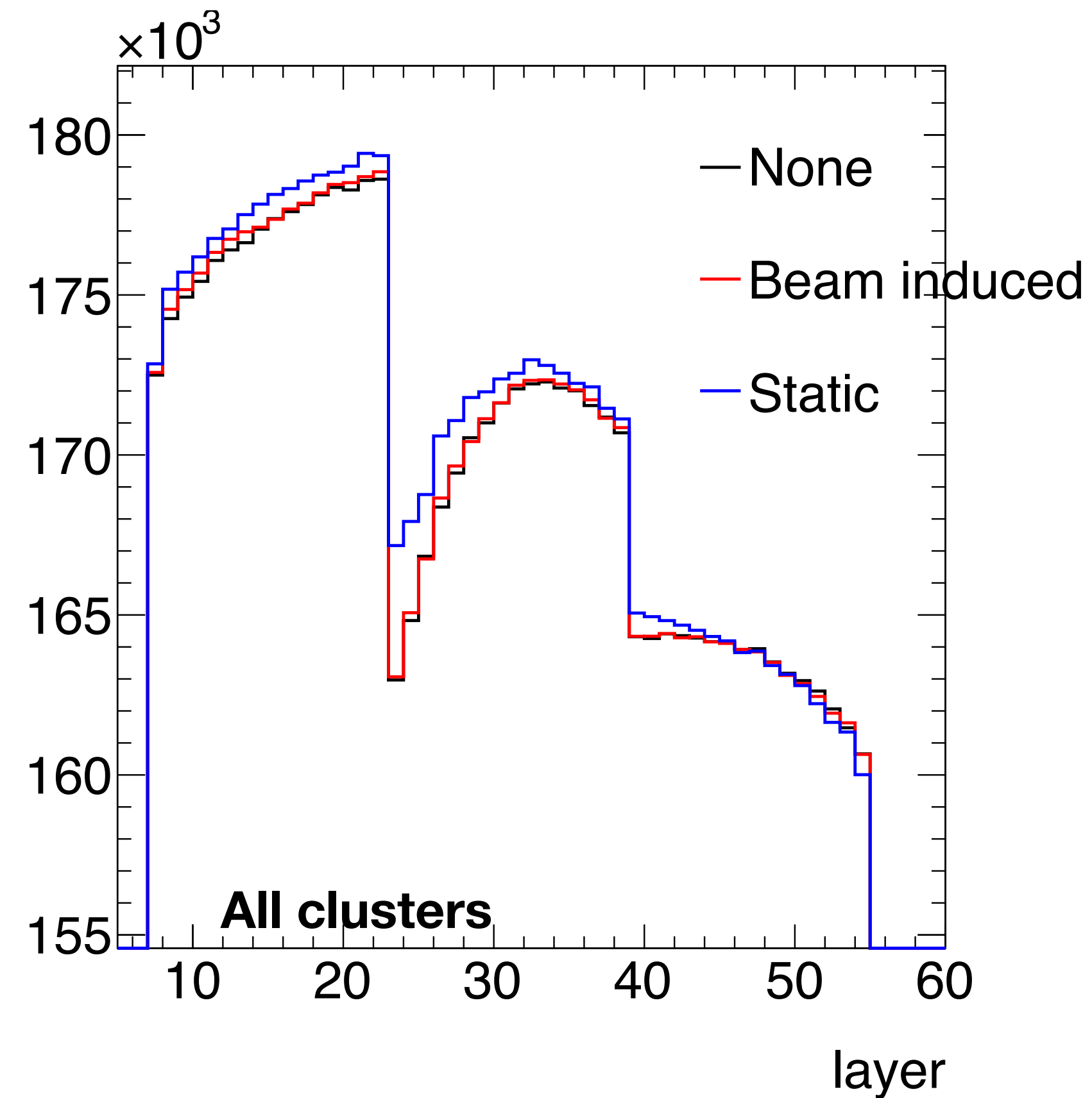
- TPC layer evaluation shows similar story to nTPC clusters
- Makes sense since these are two pion events, there will not be extraneous clusters

# TPC Layer Evaluation



- For completeness,  $n_{trutpc}\langle n \rangle$  show similar results to  $n_{tpc}\langle n \rangle$

# Clusters Associated to Tracks



- Clusters associated to track seeds look similar to all clusters
- Unsurprising given these are 2 track events



# Conclusions

- Cluster finding with distortions
  - Beam induced distortions don't appear to create a significant number of additional clusters
  - Static distortions create a nontrivial number of additional clusters in TPC. Changes the shape of clusters as a function of layer
- Track finding with distortions
  - Most likely candidate for momentum degradation is loss of a few clusters in track seeding. See page 21
    - So seems to be an issue in the way the CA seeder handles the distortions
    - Next step is to understand if there is systematic behavior in which cluster(s) are lost