TPC tracking report: Tracking Efficiency in current framework

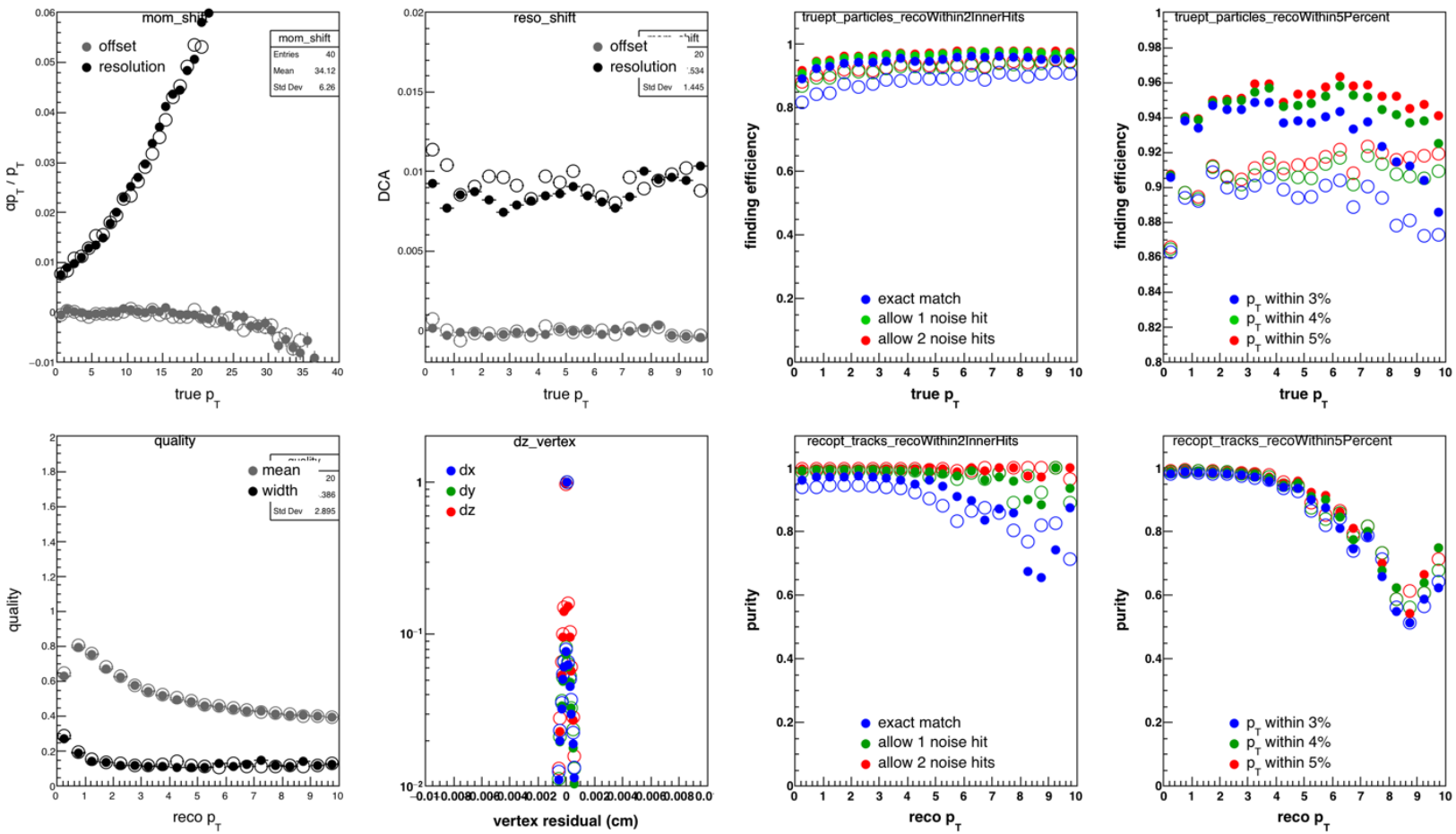
Carlos on behalf of

TPC Software working group

Tracking efficiency (1/2)

- Exercise to increase efficiency by exploring phase space of parameters was performed (backup: 11-17)
  - Only increases significantly when lowering number of required layers
  - Updated MIP thresholds in MAPS after Tony suggestion last Sim meeting. This also helps.

Tracking Performance

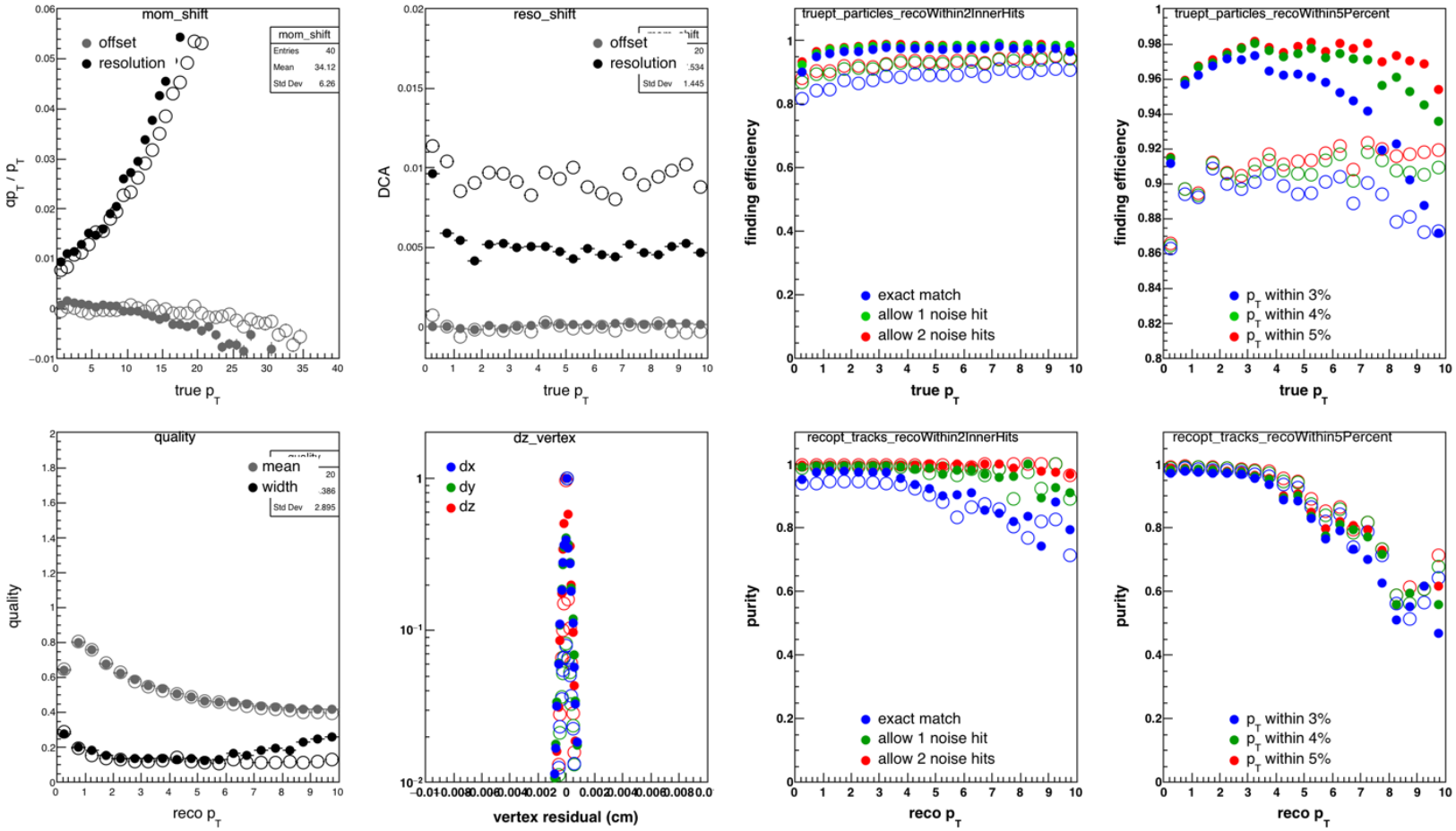


Performance of tracking after:

- Reducing NLayers required
- Increasing Chi2 cut

Efficiency increases by ~4% => 95%

Tracking Performance



Performance of tracking after:

- Lowering MAPS thresholds
- Reducing NLayers required
- Increasing Chi2 cut

Efficiency increases an additional ~3% => 98%

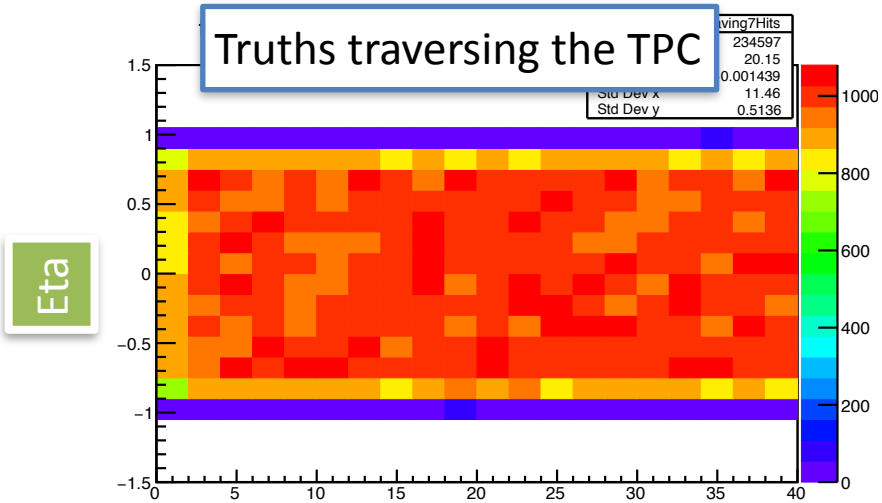
Pt-resolution worsens

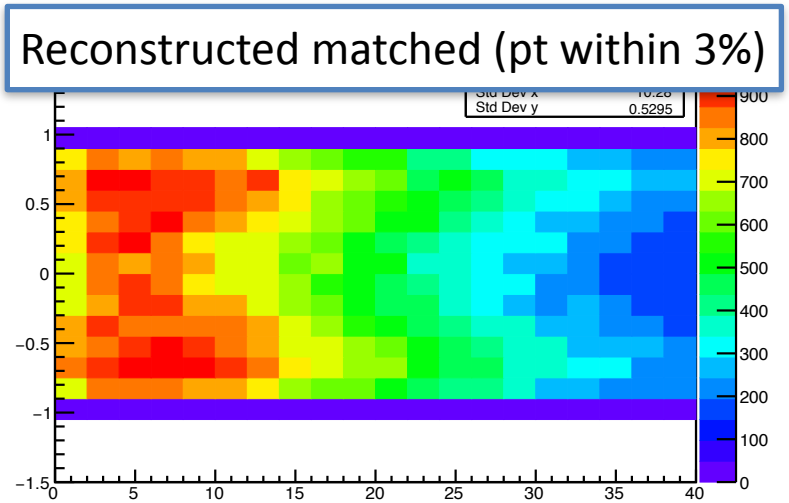
DCA reduces

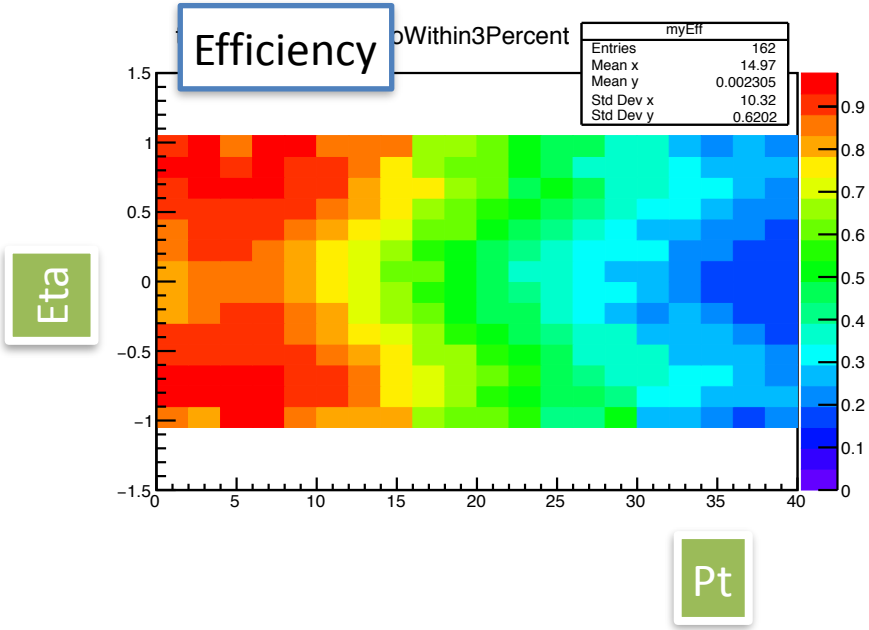
Tracking efficiency (2/2)

- Found a pseudo rapidity dependence on the efficiency (backup: 18-24)
  - At mid rapidity efficiency drops by ~10 percent (pt dependent)
  - Extends over all pt
  - Currently checking dp/p eta dependence

Eta dependence







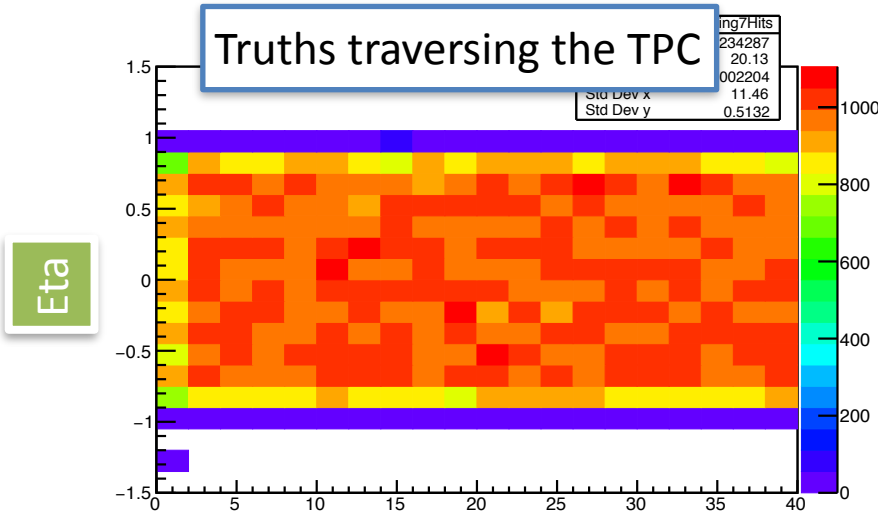
Using Nominal cuts

Efficiency drop for mid rapidity

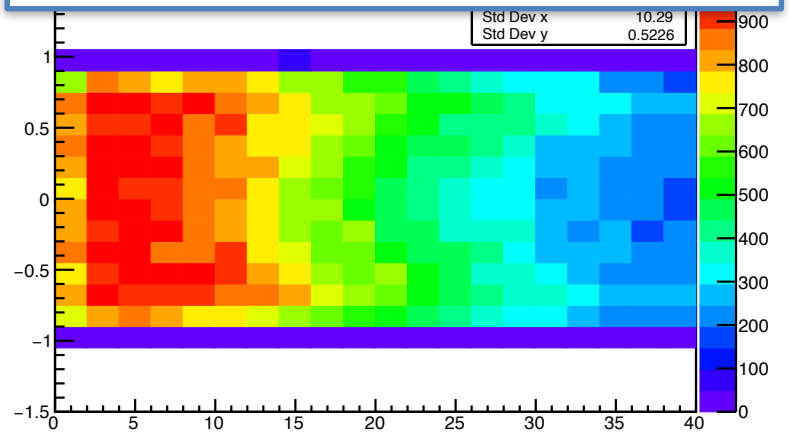
Plot from Jeff's analysis

Eta dependence

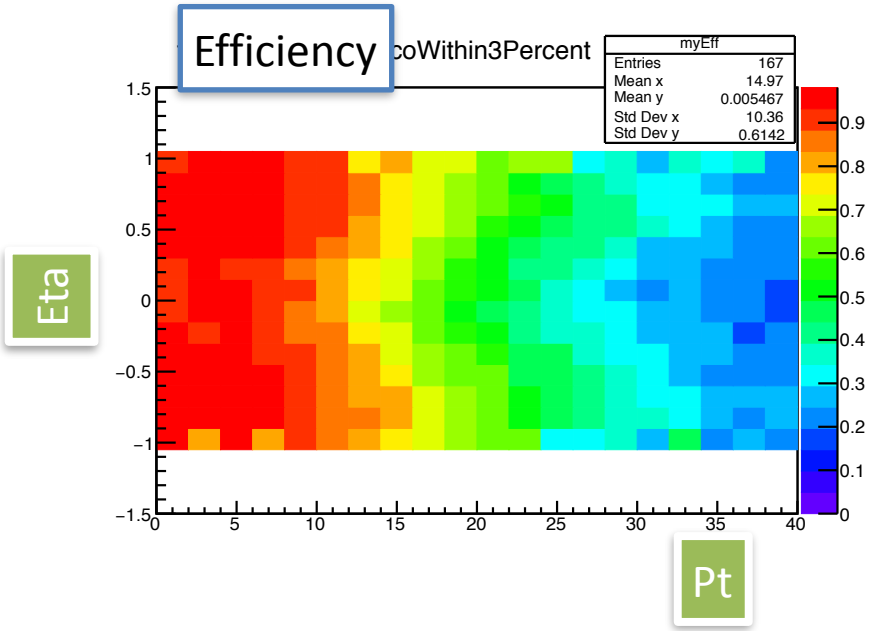
Truths traversing the TPC



Reconstructed matched (pt within 3%)



Efficiency



Lowering MAPS Thresholds

Eta dependence at low is gone

Plot from Jeff's analysis

Next steps

- Fakes: Working on procedure to reattach orphan clusters to short tracks
- Unified efficiency: Improving efficiency calculation at high pt

BACKUP SLIDES

TPC software: Current status

- Overall momentum resolution ~1% at 5 GeV/c
- Overall tracking efficiency above 90% (for pions embedded in most central Hijing events)
- Tracking specifications driven by T2K gas simulation
- SpaceCharge distortions impact is minimal when simulated using NeCO2 (much better ion mobility than T2K)

Tracking efficiency: Strategy for improvement

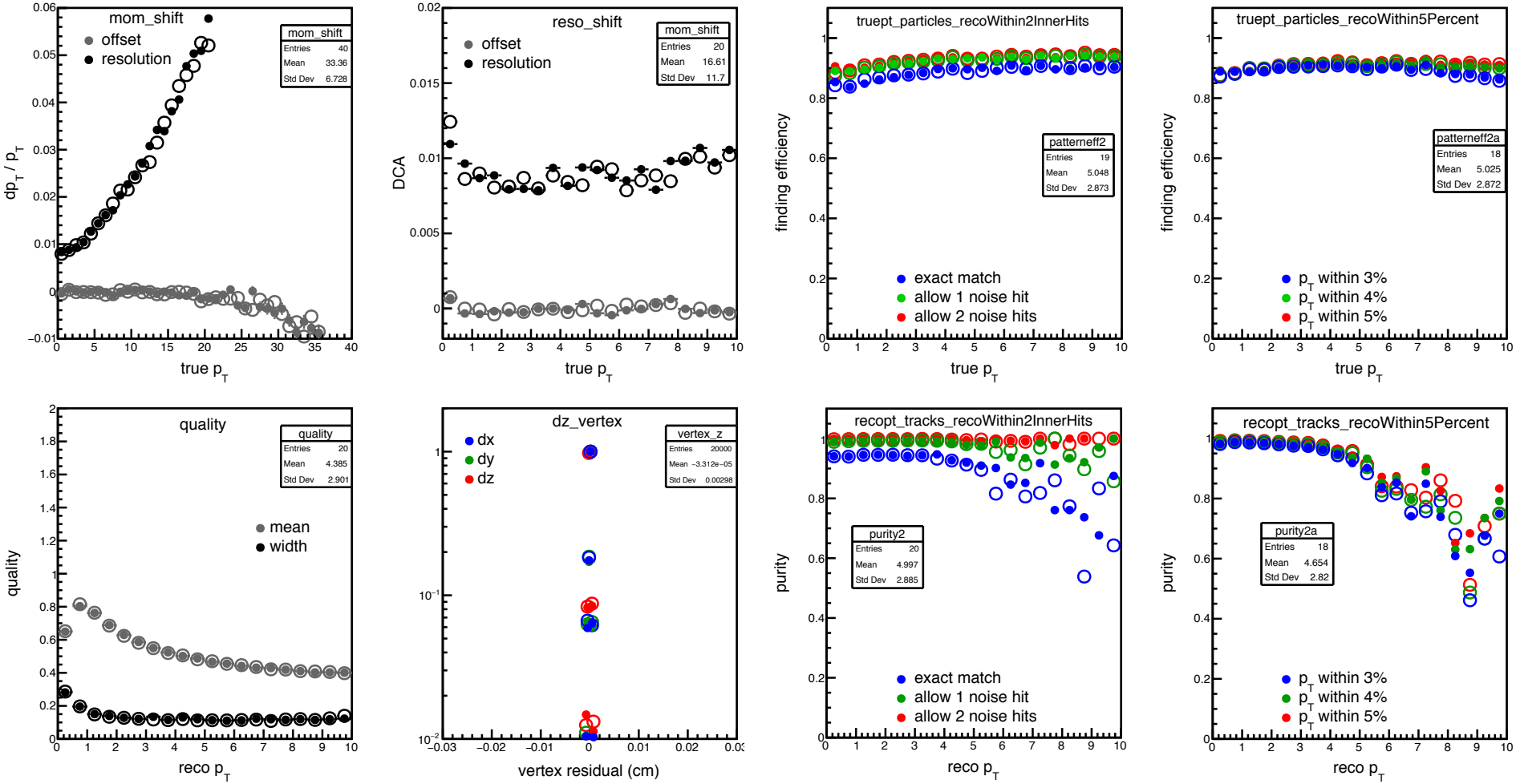
- Overall efficiency is limited by either clusterizer, hough selection or track finder algorithms.
  - Clusterizer: replace the current algorithm with geant truths and check the performance of the rest of the tracking
  - Track finder: twofolded. A) loosen the restrictions (increase efficiency) and develop a fake rejection layer on top to maintain the fakes under control. B) restrict the cuts (select track seeds) and develop and algorithm to reattach hits to seeded tracks.

Other improvements:

- Simulation of gas transport properties for “Ne2K” gas.
- PileUp, time occupancy and readout effects need to be added.

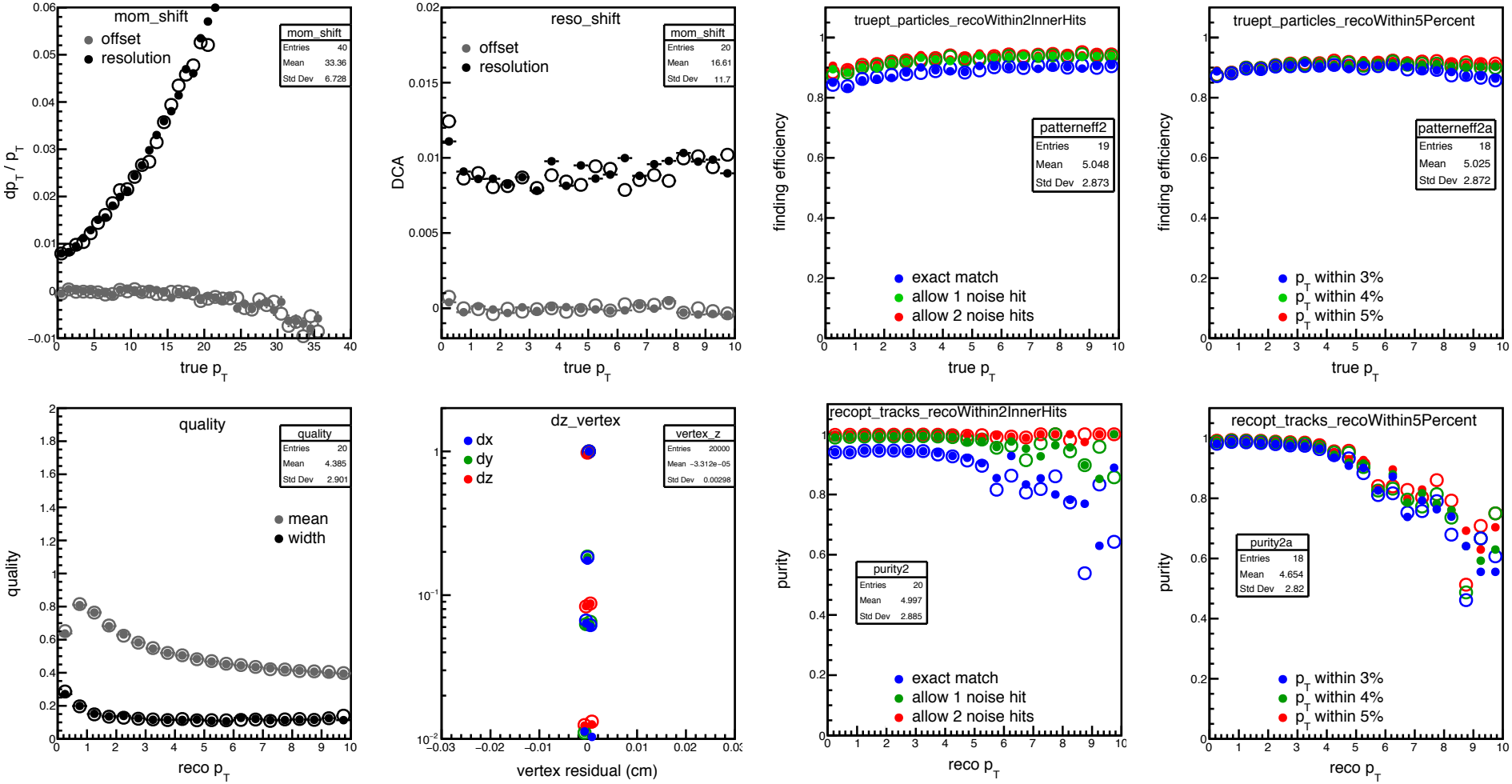
Jeff Spahn

Chi2 Cut Init = 5 (originally 2)



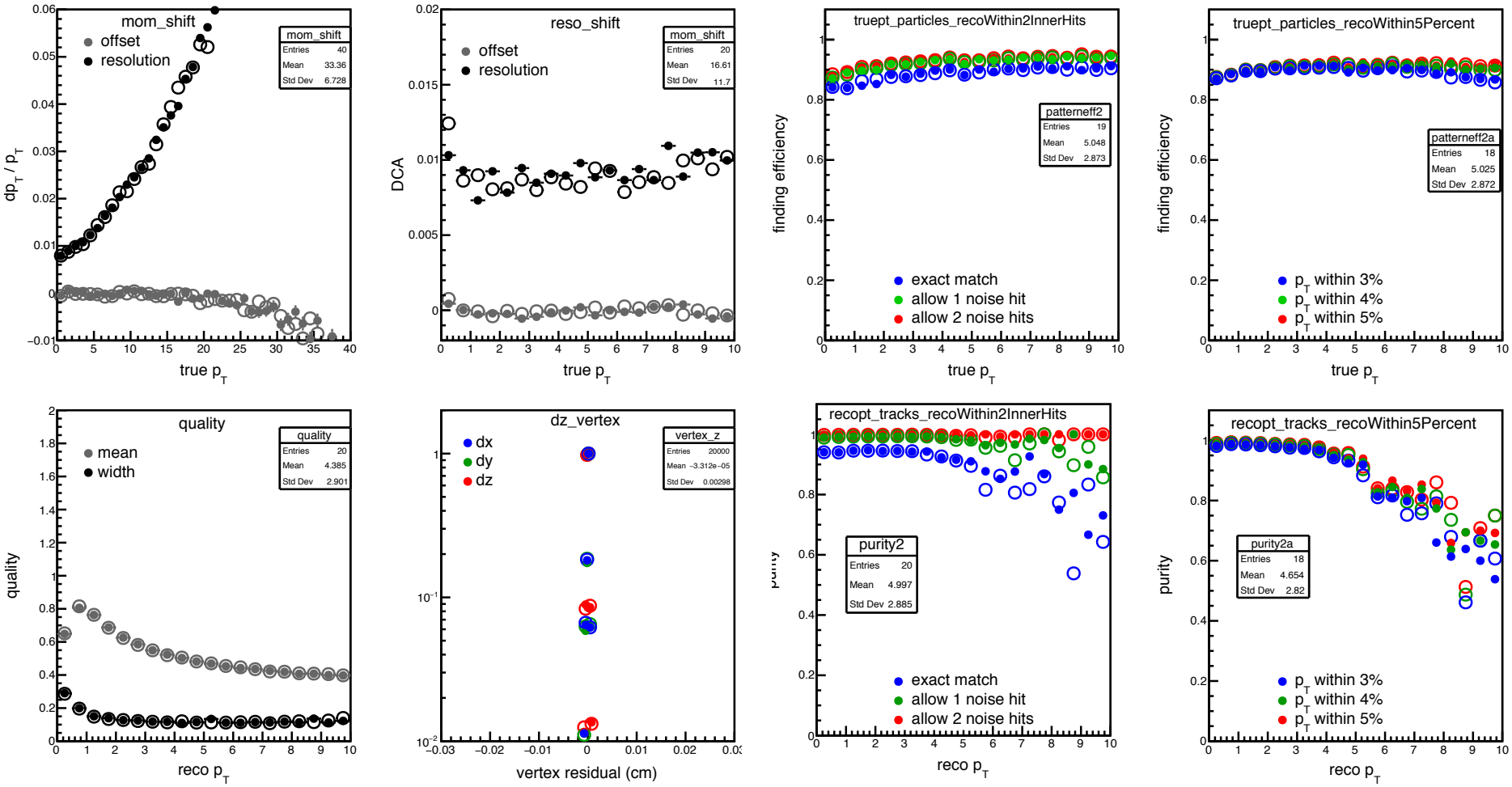
Jeff Spahn

Chi2 Cut Full = 5 (originally 2)



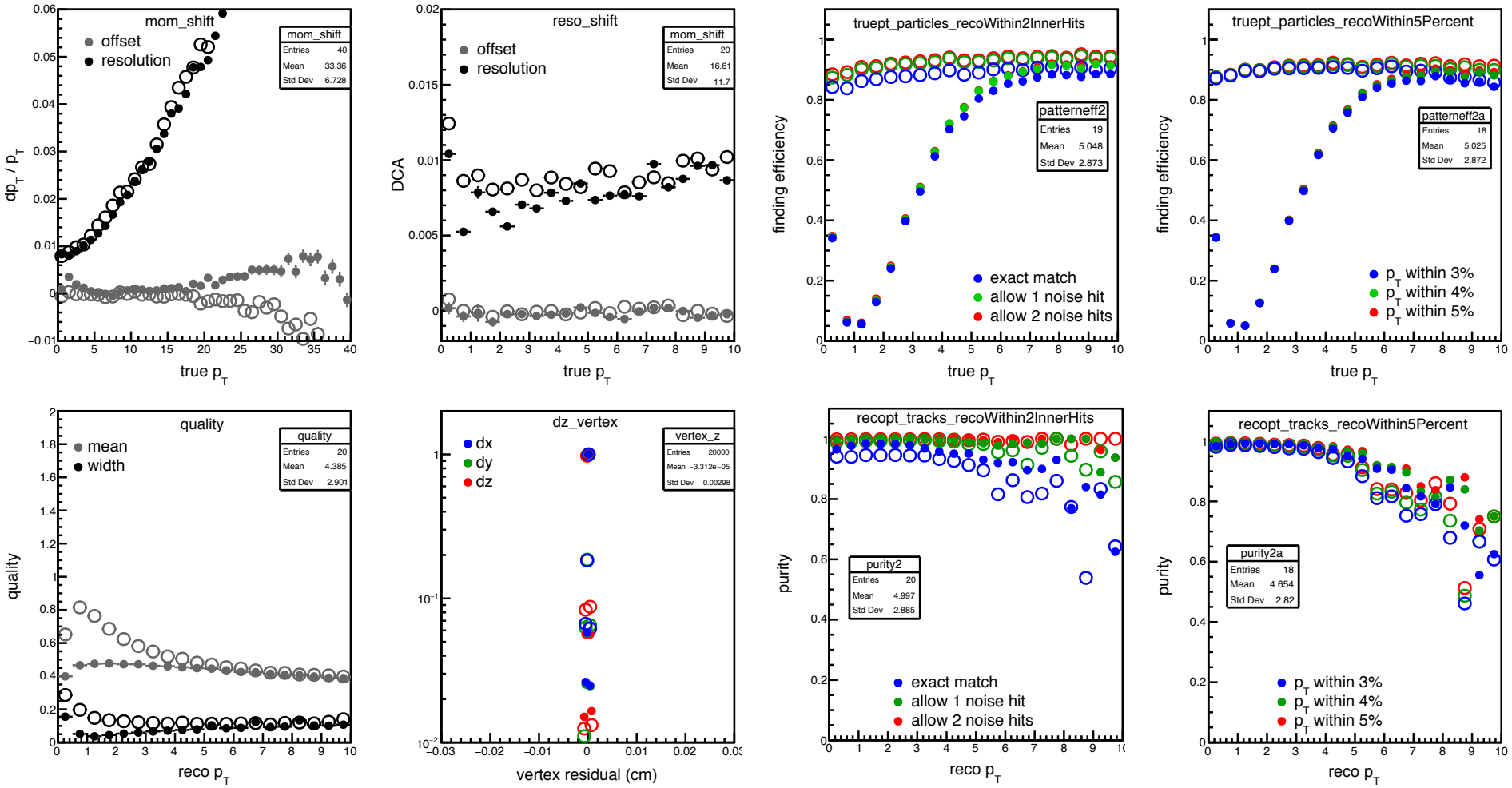
Jeff Spahn

Chi2 Cut Full = 5
Chi2 Cut Init = 5
(Both Originally 2)



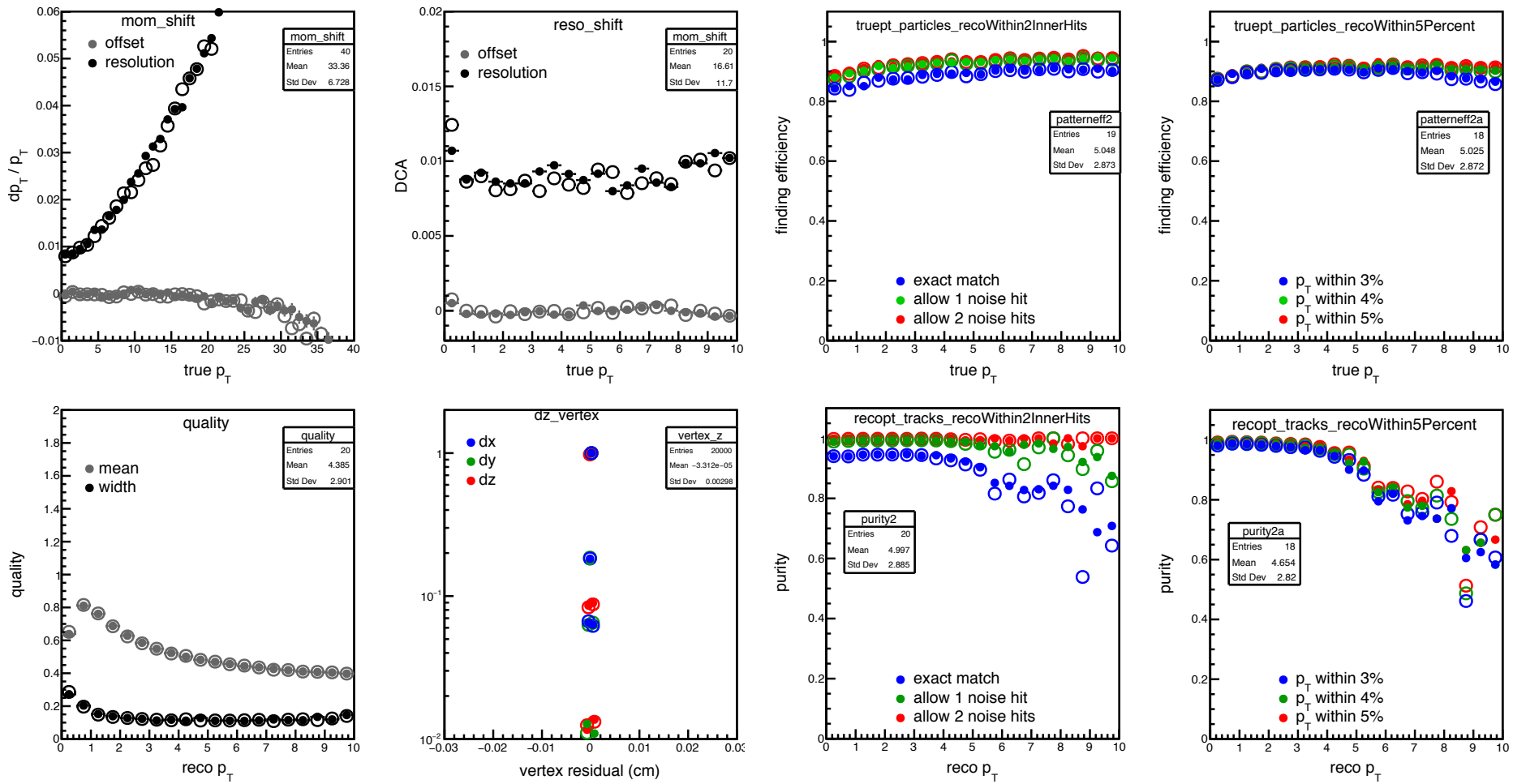
Jeff Spahn

Chi2 Cut Full = 0.5
Chi2 Cut Init = 0.5
(Both Originally 2)



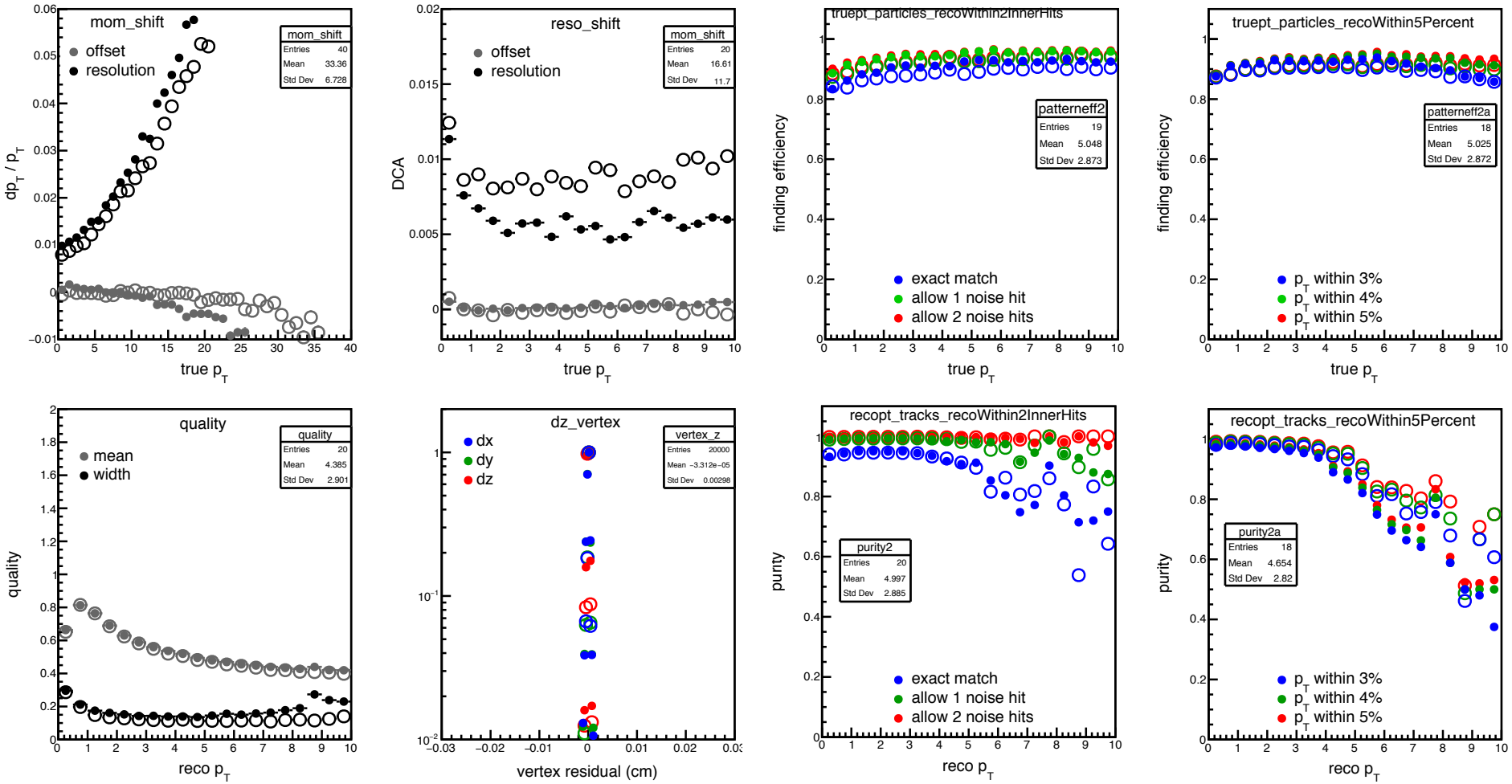
Jeff Spahn

set_use_vertex(false)



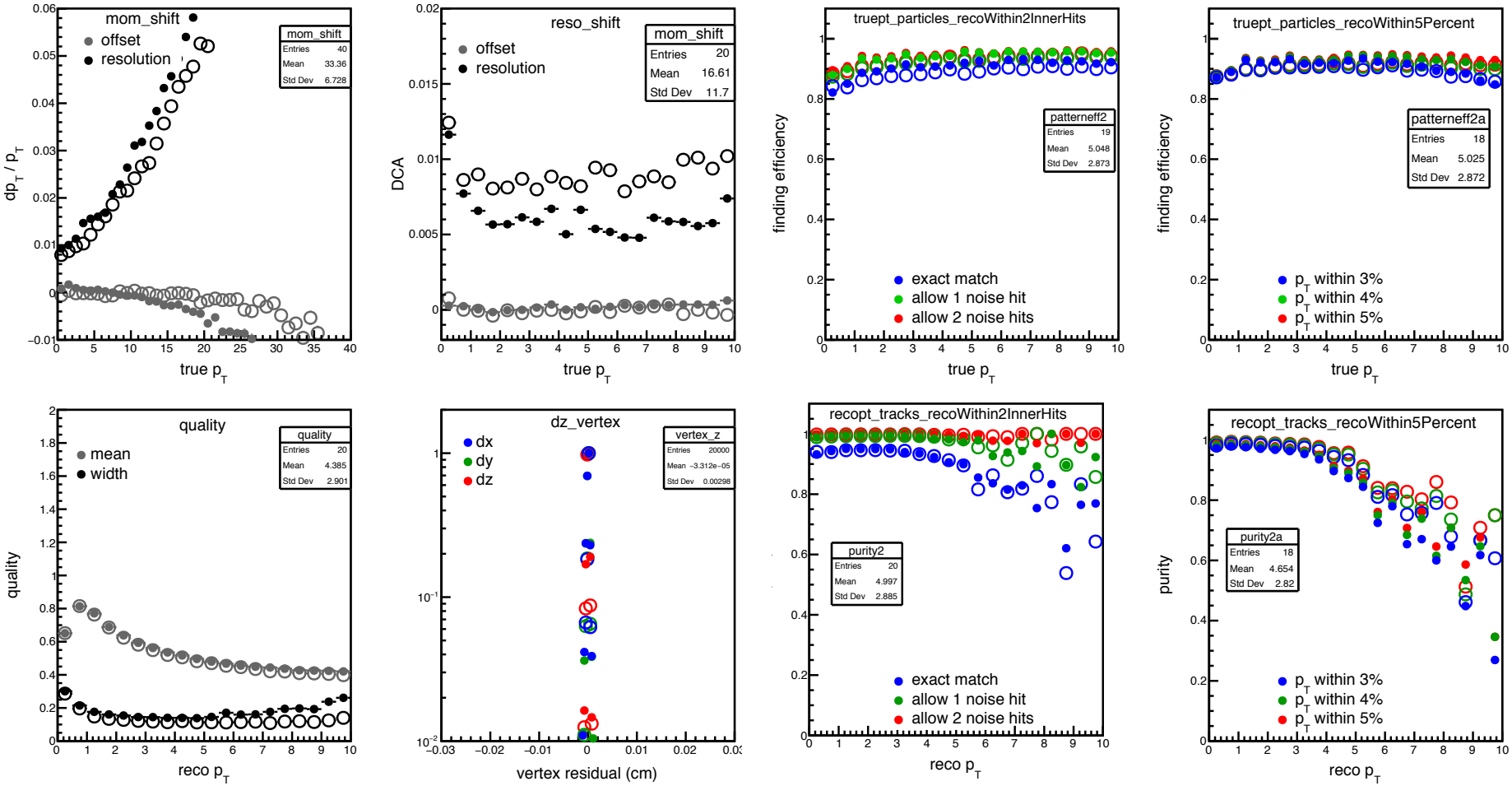
Jeff Spahn

Hough Transform Required Seed = Max_si_layer - 20 (Originally Max_si_layer - 6)



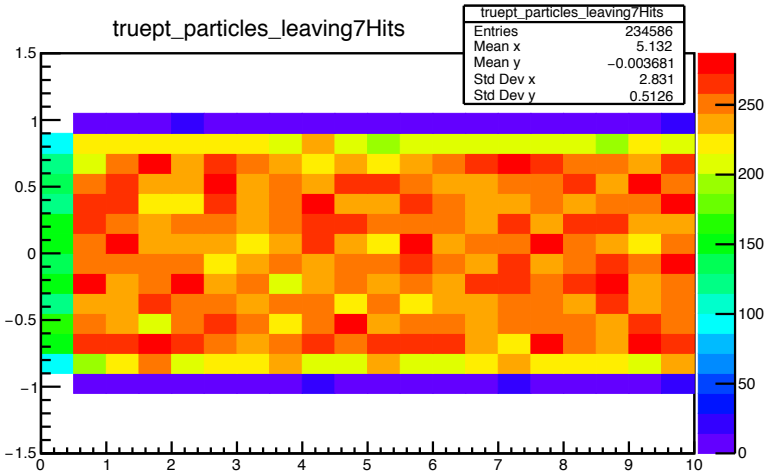
Jeff Spahn

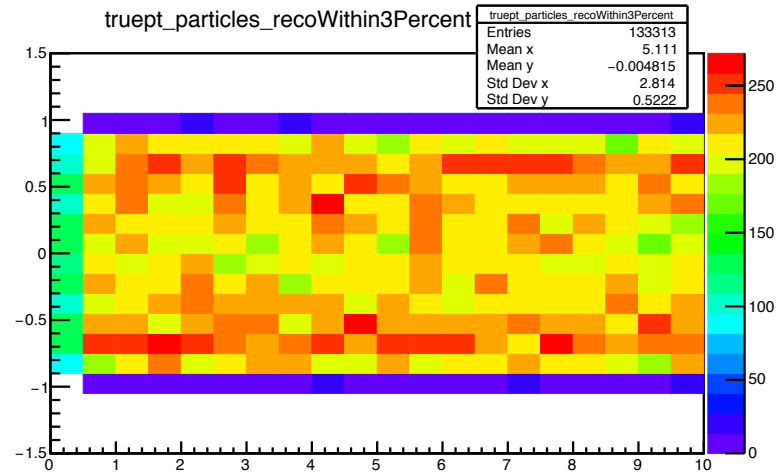
set_use_vertex(false)
Hough Transform Required Seed = Max_si_layer - 20

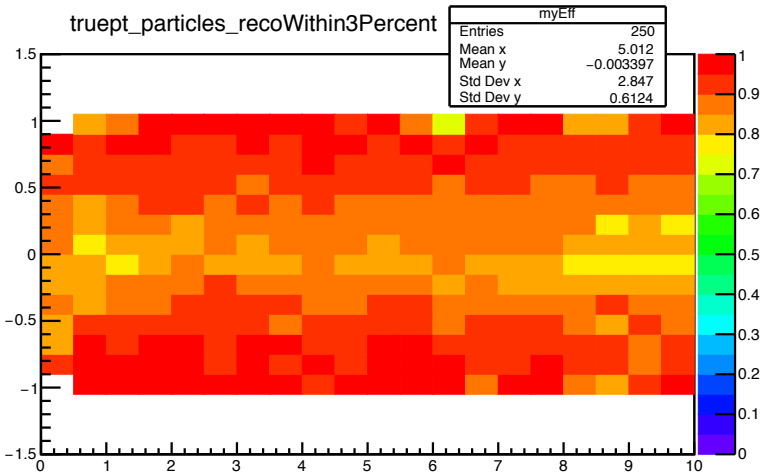


Jeff Spahn

Efficiency with respect to Eta and pT







2000 Machines (20 Events each)

Required layers = si_layers - 6

Chi Squared = 2.0

Maps Cell Threshold = 0.25

Maps Clusterizer Threshold = 0.5

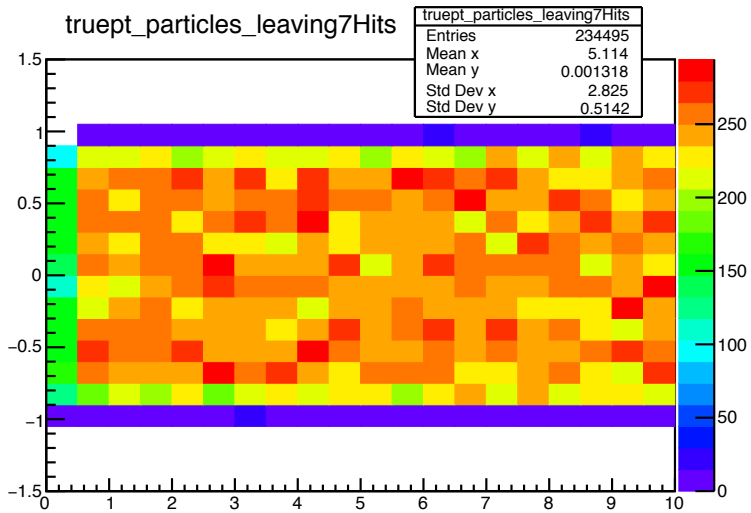
X-Axis: pT Range 0-10

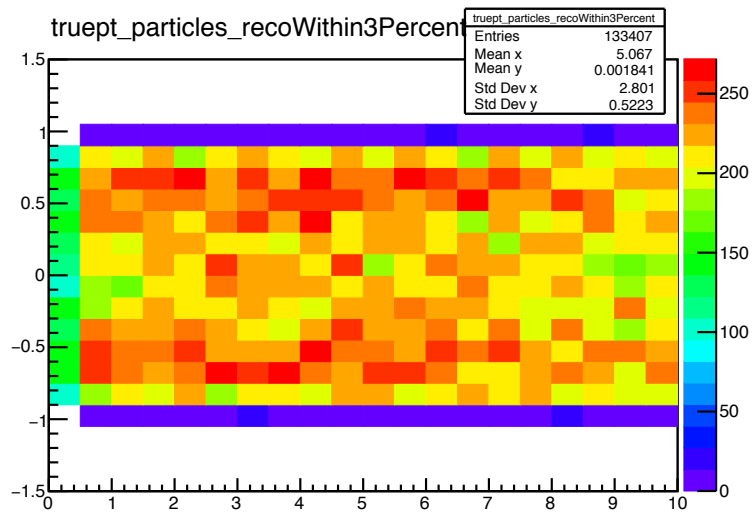
Y-Axis: η (Pseudo rapidity)

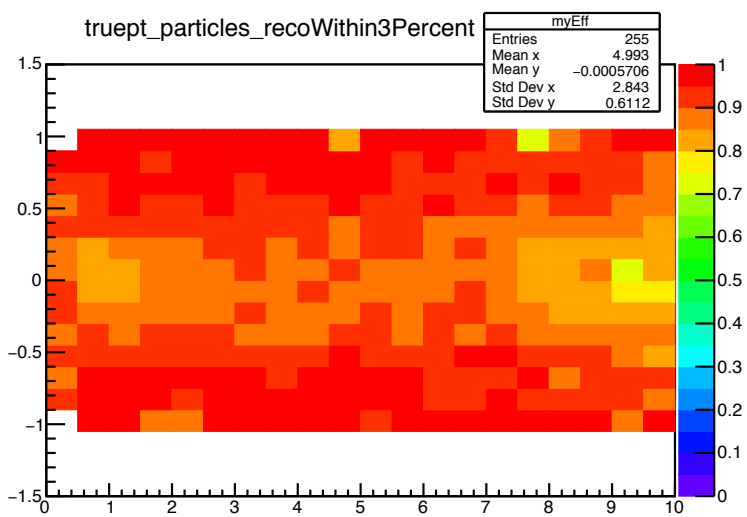
Z-Axis: Number of Hits / Efficiency

Jeff Spahn

Required Layers Reduced







2000 Machines (20 Events each)

Required layers = **si_layers - 20**

Chi Squared = 2.0

Maps Cell Threshold = 0.25

Maps Clusterizer Threshold = 0.5

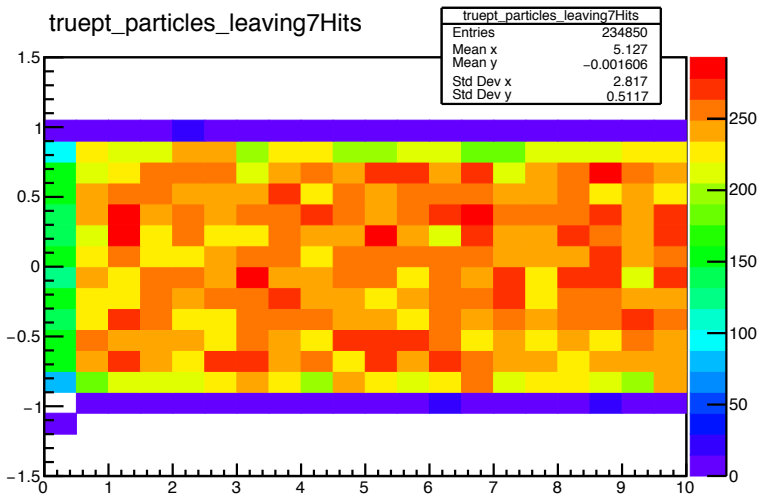
X-Axis: pT Range 0-10

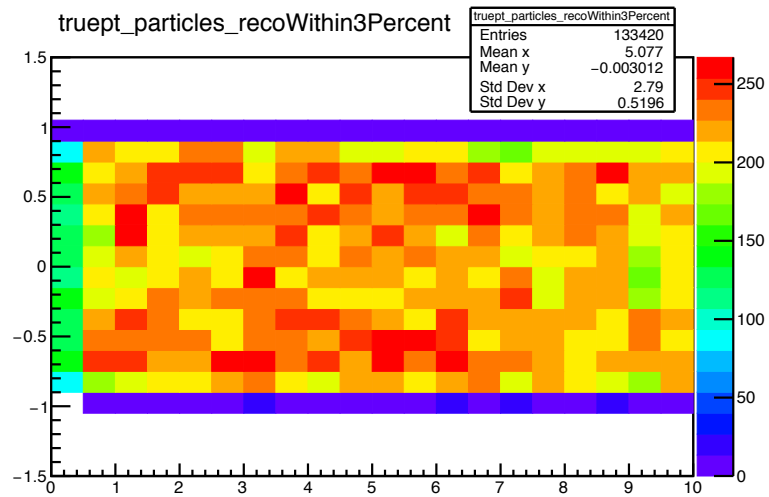
Y-Axis: η (Pseudo rapidity)

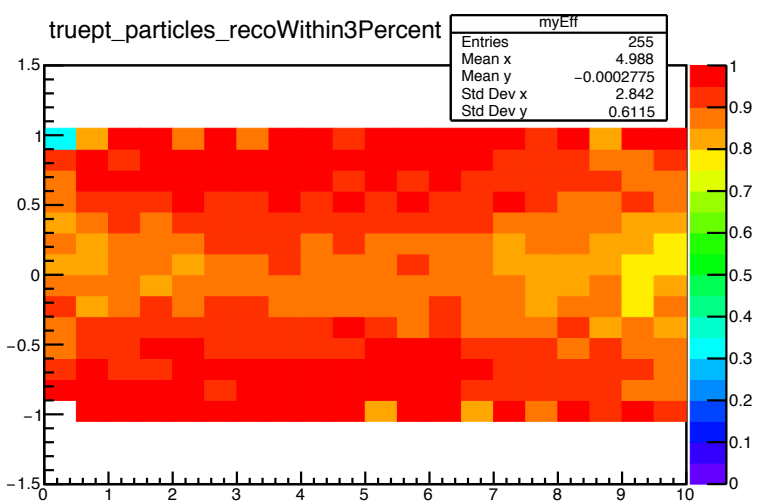
Z-Axis: Number of Hits / Efficiency

Jeff Spahn

Increased Events







2000 Machines (**40** Events each)

Required layers = si_layers - 6

Chi squared = 2.0

Maps Cell Threshold = 0.25

Maps Clusterizer Threshold = 0.5

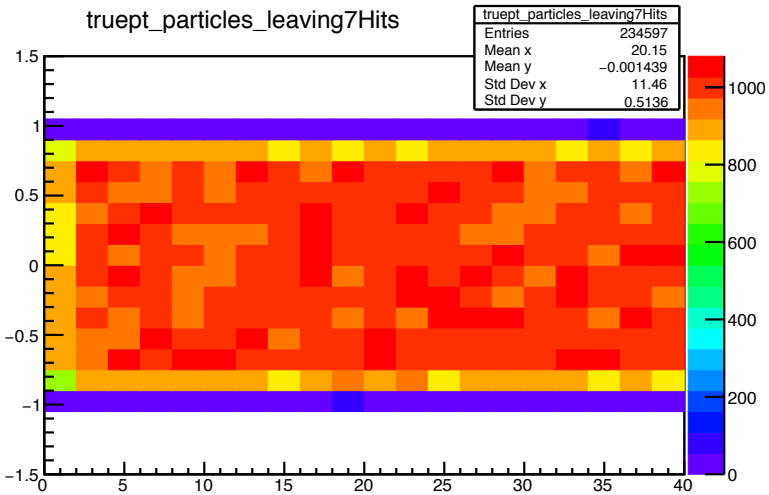
X-Axis: pT Range 0-10

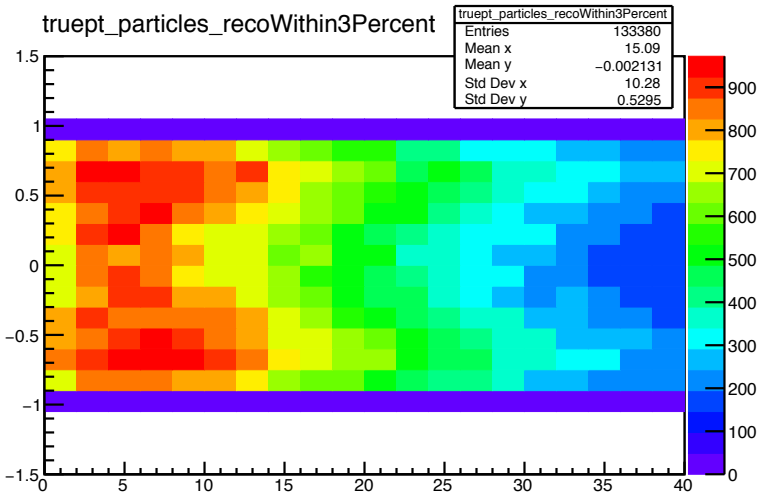
Y-Axis: η (Pseudo rapidity)

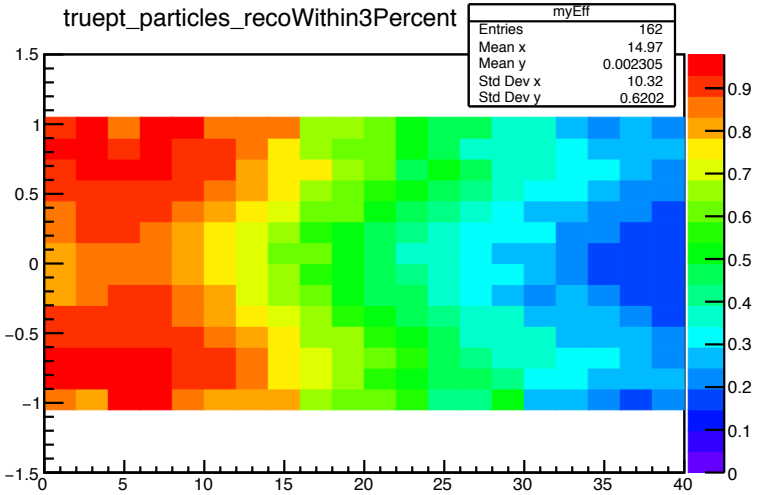
Z-Axis: Number of Hits / Efficiency

Jeff Spahn

Increased Events and pT Range







2000 Machines (**40** Events each)

Required layers = si_layers - 6

Chi squared = 2.0

Maps Cell Threshold = 0.25

Maps Clusterizer Threshold = 0.5

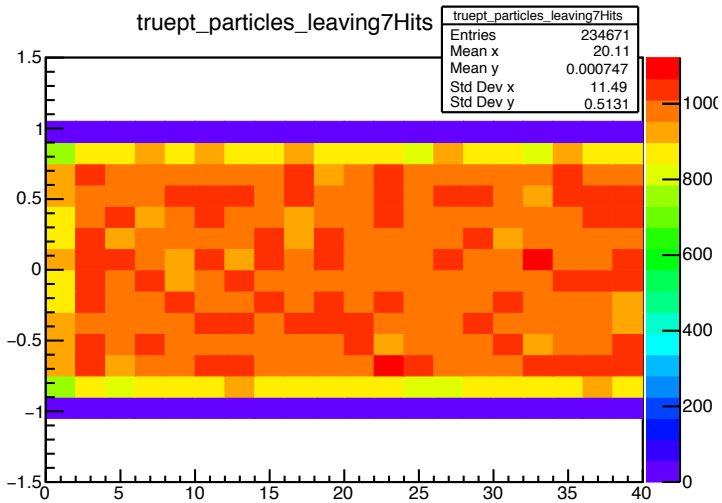
X-Axis: pT Range 0-**40**

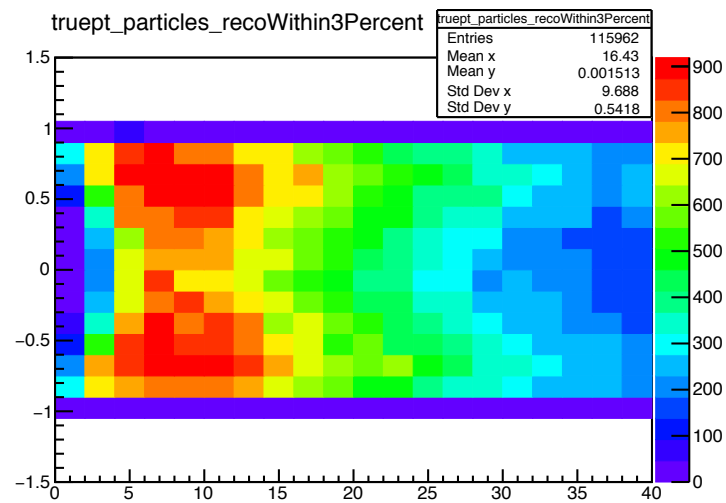
Y-Axis: η (Pseudo rapidity)

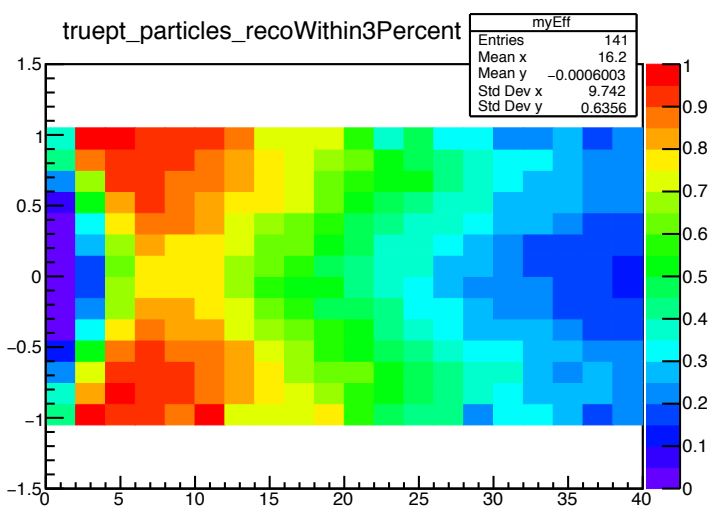
Z-Axis: Number of Hits / Efficiency

Jeff Spahn

Reduced Chi Squared







2000 Machines (**40** Events each)

Required layers = si_layers - 6

Chi squared = **0.5**

Maps Cell Threshold = 0.25

Maps Clusterizer Threshold = 0.5

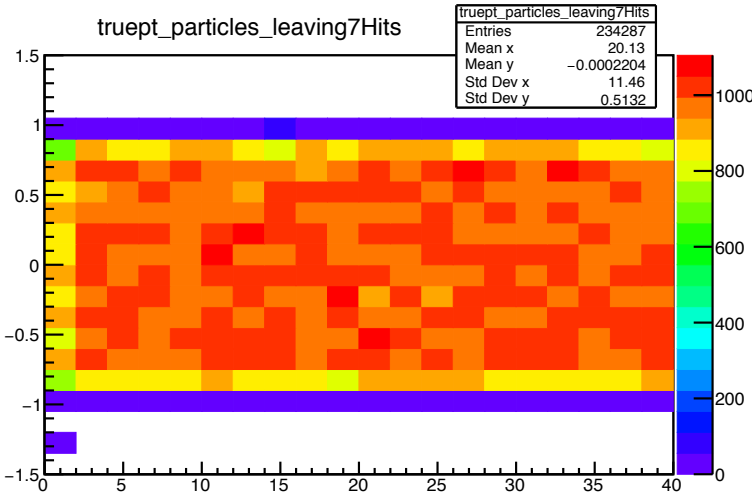
X-Axis: pT Range 0-**40**

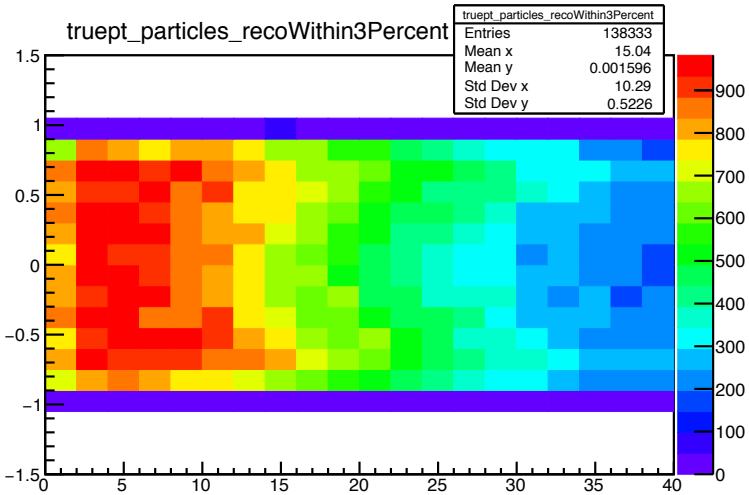
Y-Axis: η (Pseudo rapidity)

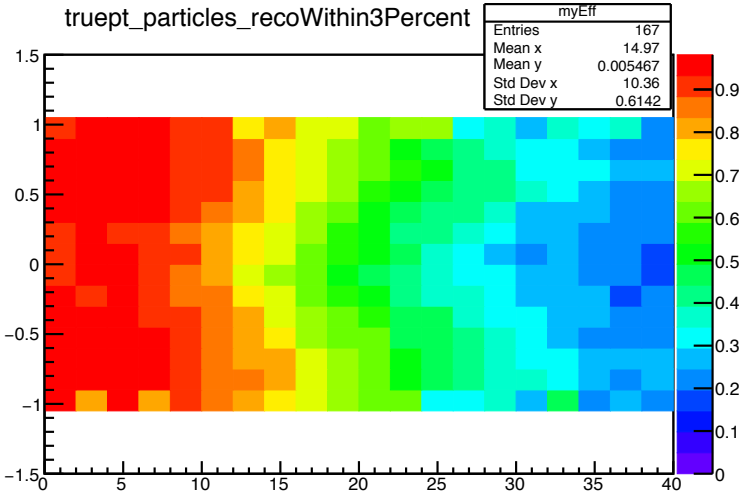
Z-Axis: Number of Hits / Efficiency

Jeff Spahn

Decreased Cell + Clusterizer Thresholds







2000 Machines (**40** Events each)

Required layers = si_layers - 6

Chi squared = 2.0

Maps Cell Threshold = **0.1**

Maps Clusterizer Threshold = **0.1**

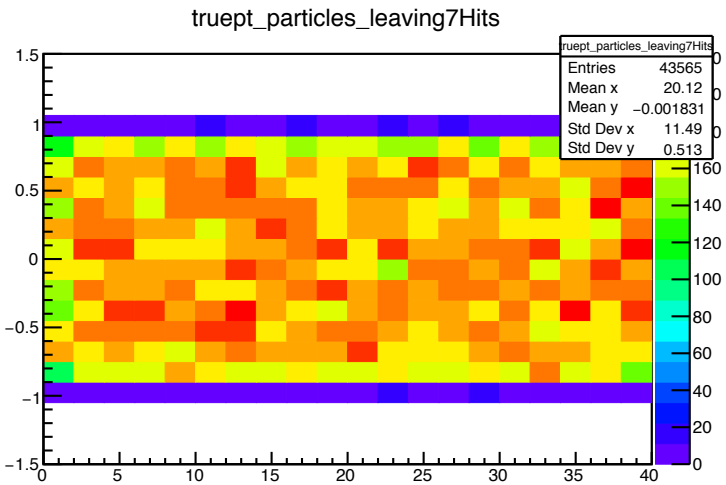
X-Axis: pT Range 0-**40**

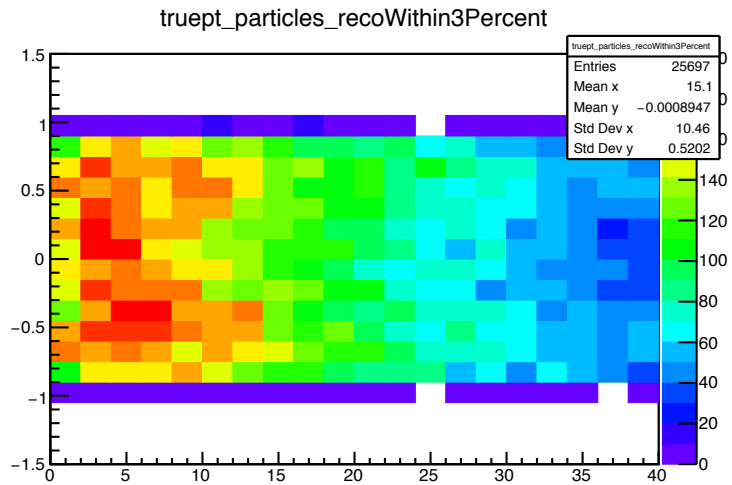
Y-Axis: η (Pseudo rapidity)

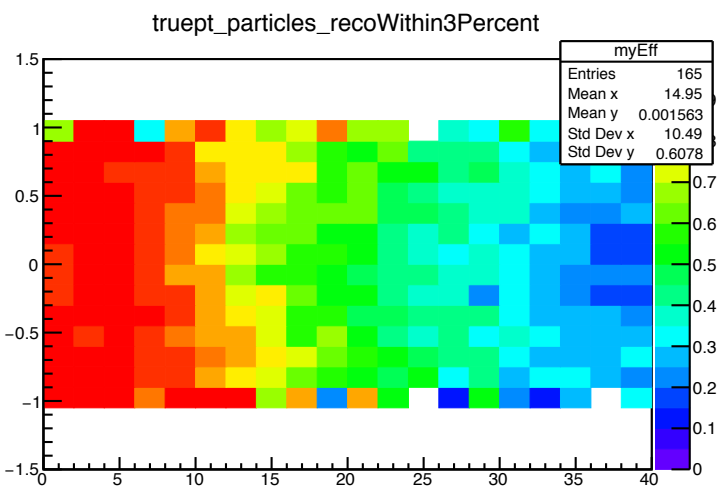
Z-Axis: Number of Hits / Efficiency

Jeff Spahn

Decreased Thresholds Reduced Required Layers







2000 Machines (**40** Events each)

Required layers = si_layers - **30**

Chi squared = 2.0

Maps Cell Threshold = **0.1**

Maps Clusterizer Threshold = **0.1**

X-Axis: pT Range 0-**40**

Y-Axis: η (Pseudo rapidity)

Z-Axis: Number of Hits / Efficiency

Average Resolution Parametrization

```
In[327]:= Res1[pt_] := 0.01 Exp[-pt / 10];
          Res2[pt_] := -0.004 + 0.003 * pt;
          Res[pt_] := Sqrt[Res1[pt] * Res1[pt] + Res2[pt] * Res2[pt]];
          Show[Plot[Res1[x], {x, 0.2, 40}, PlotStyle → Orange],
           Plot[Res2[x], {x, 0.2, 40}, PlotStyle → Magenta],
           Plot[Res[x], {x, 0.2, 40}, PlotStyle → Black],
           PlotRange → {{0.2, 40}, {0, 0.12}}]
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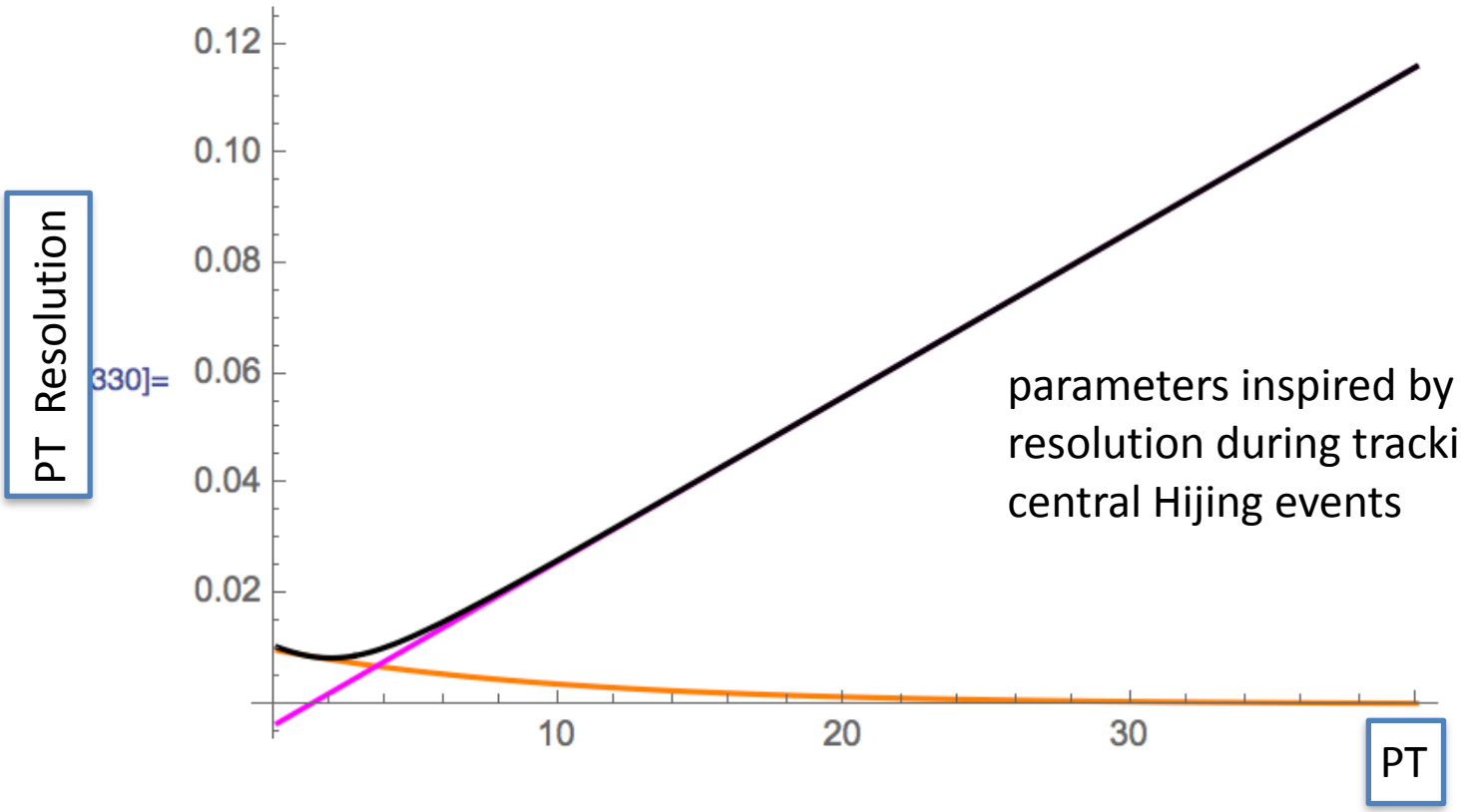
Out[330]=



parameters inspired by obtained resolution during tracking of most central Hijing events