2nd Update on VXD Tracking Studies

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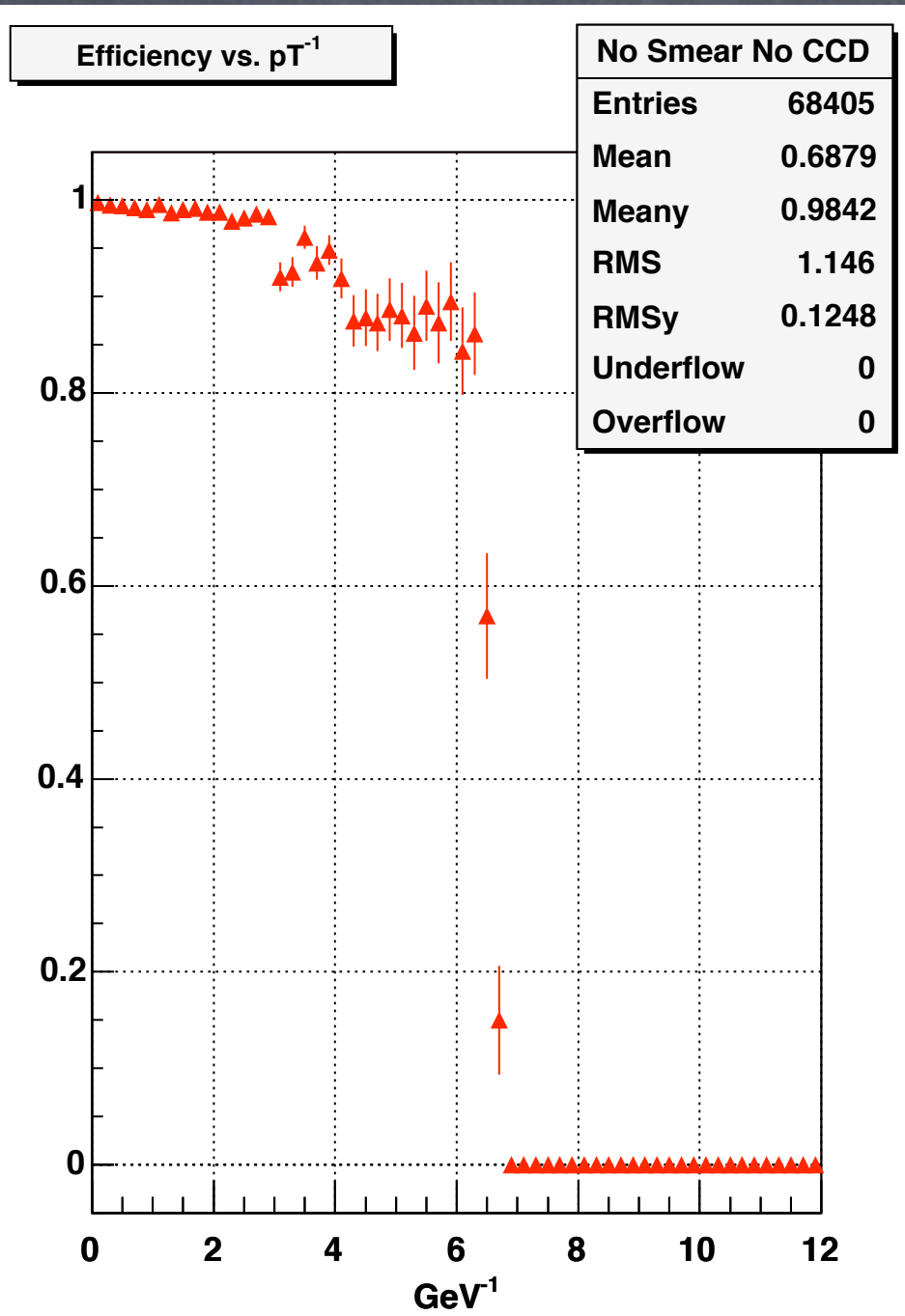
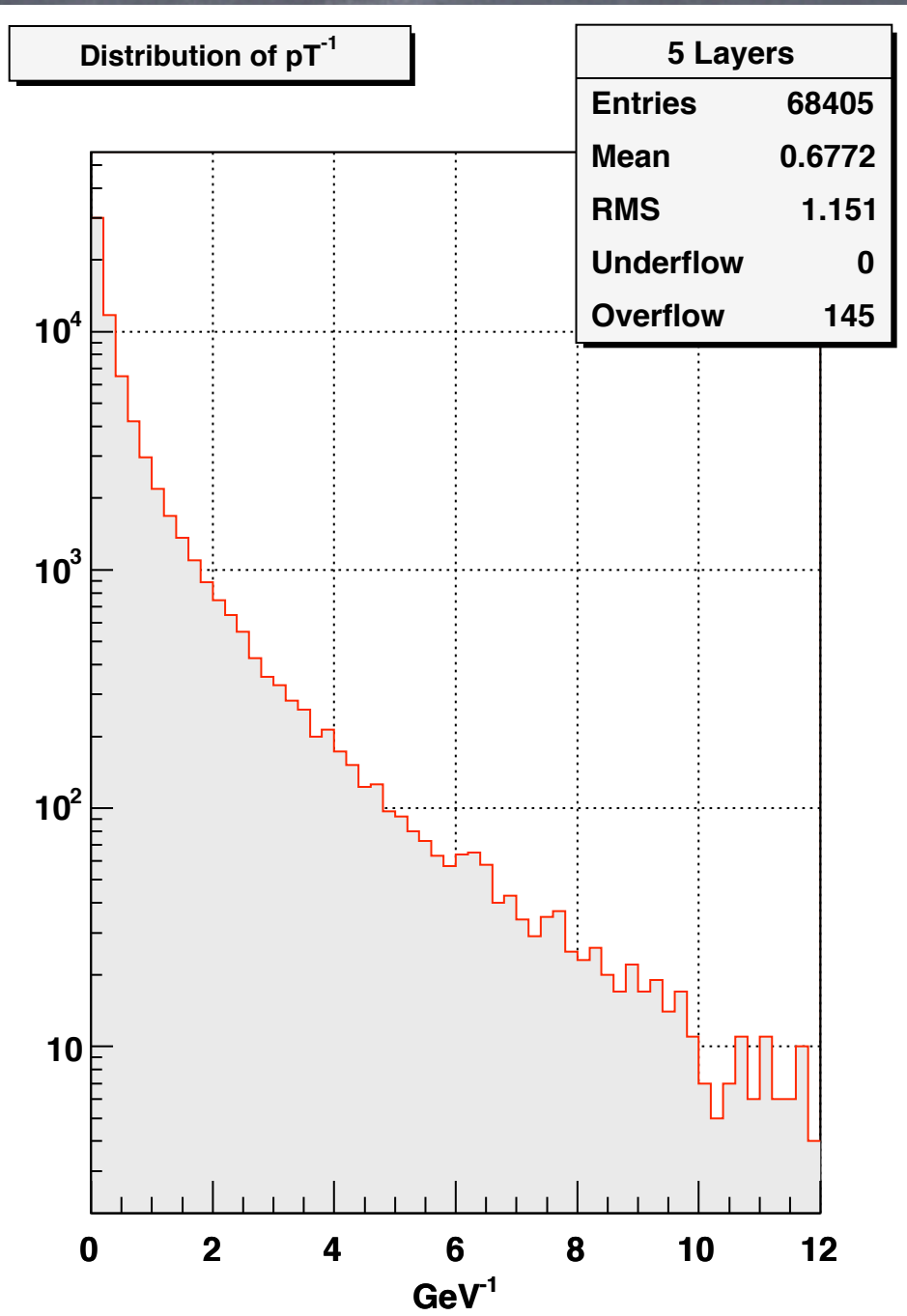
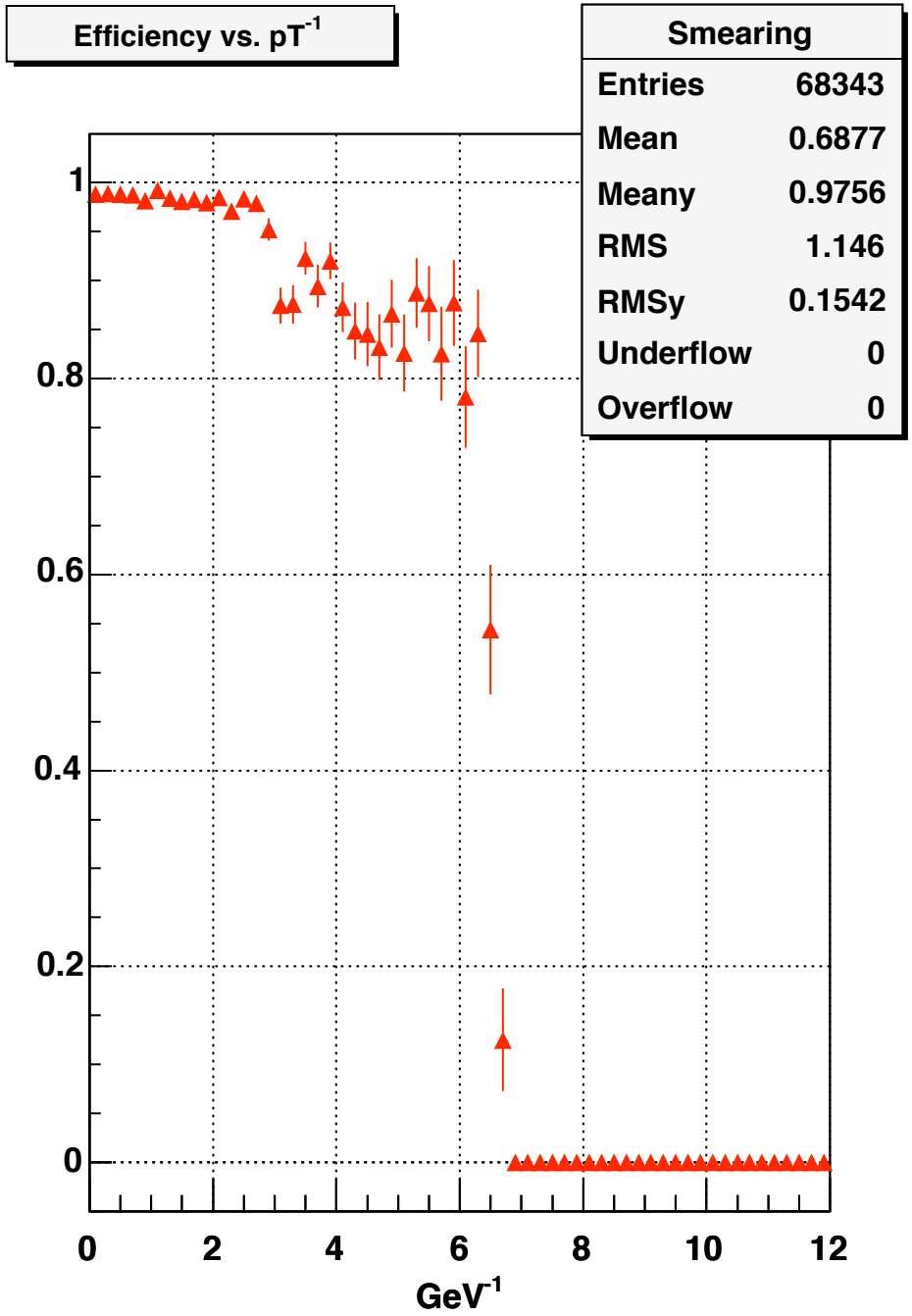
Quick Recap

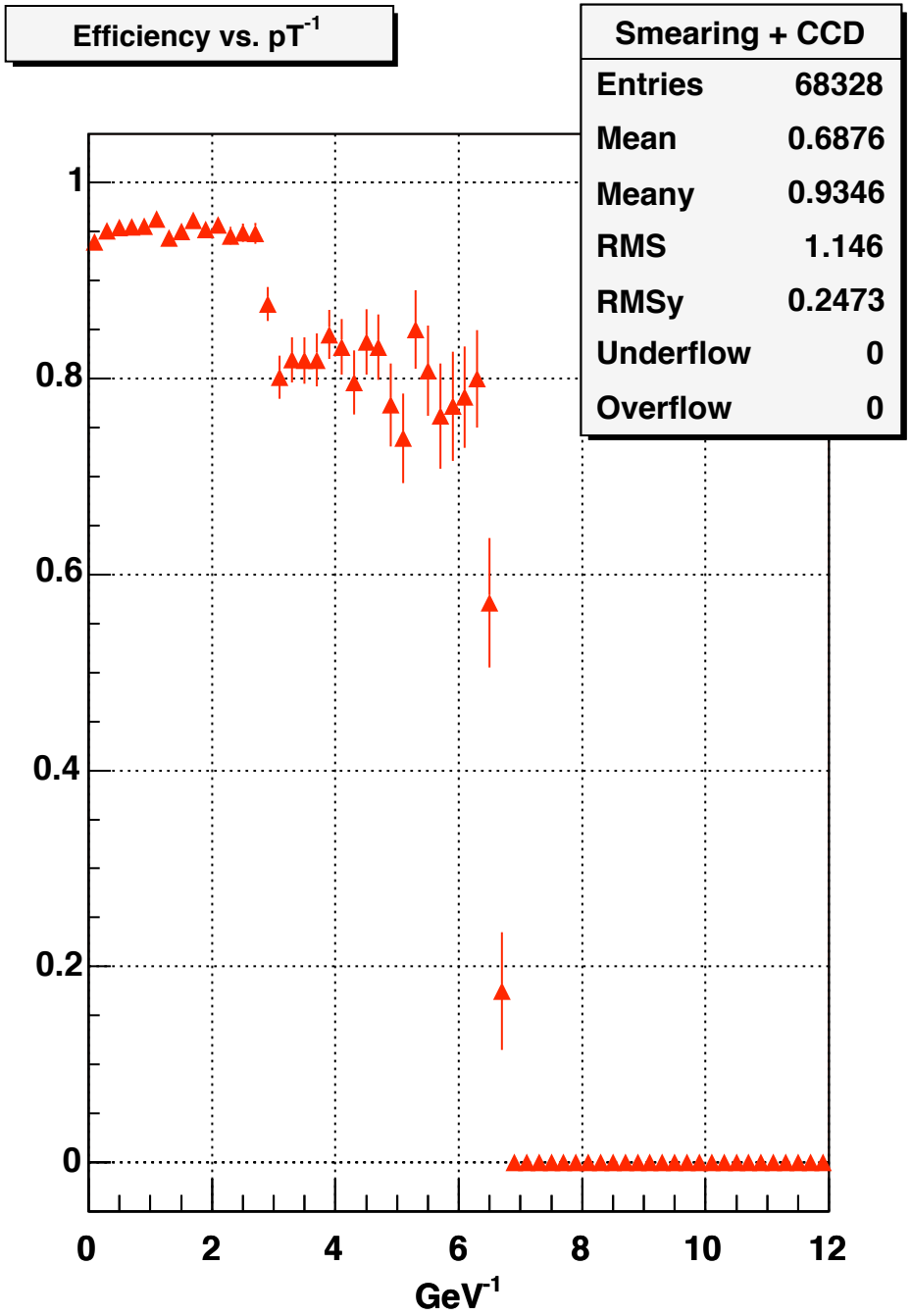
- 500 GeV E_{cm} qqbar events.
- MC truth limited to 2-jet events in the central region, originating within the VXD. Minimum pT = 0 GeV
- ~99.7% efficient* in the absence of gaussian hit smearing and realistic CCD simulation.
- Track fitter may not be entirely optimized.
- Lets look at qqbar efficiencies quickly: 1/pT and |α| (angle from jet thrust axis).

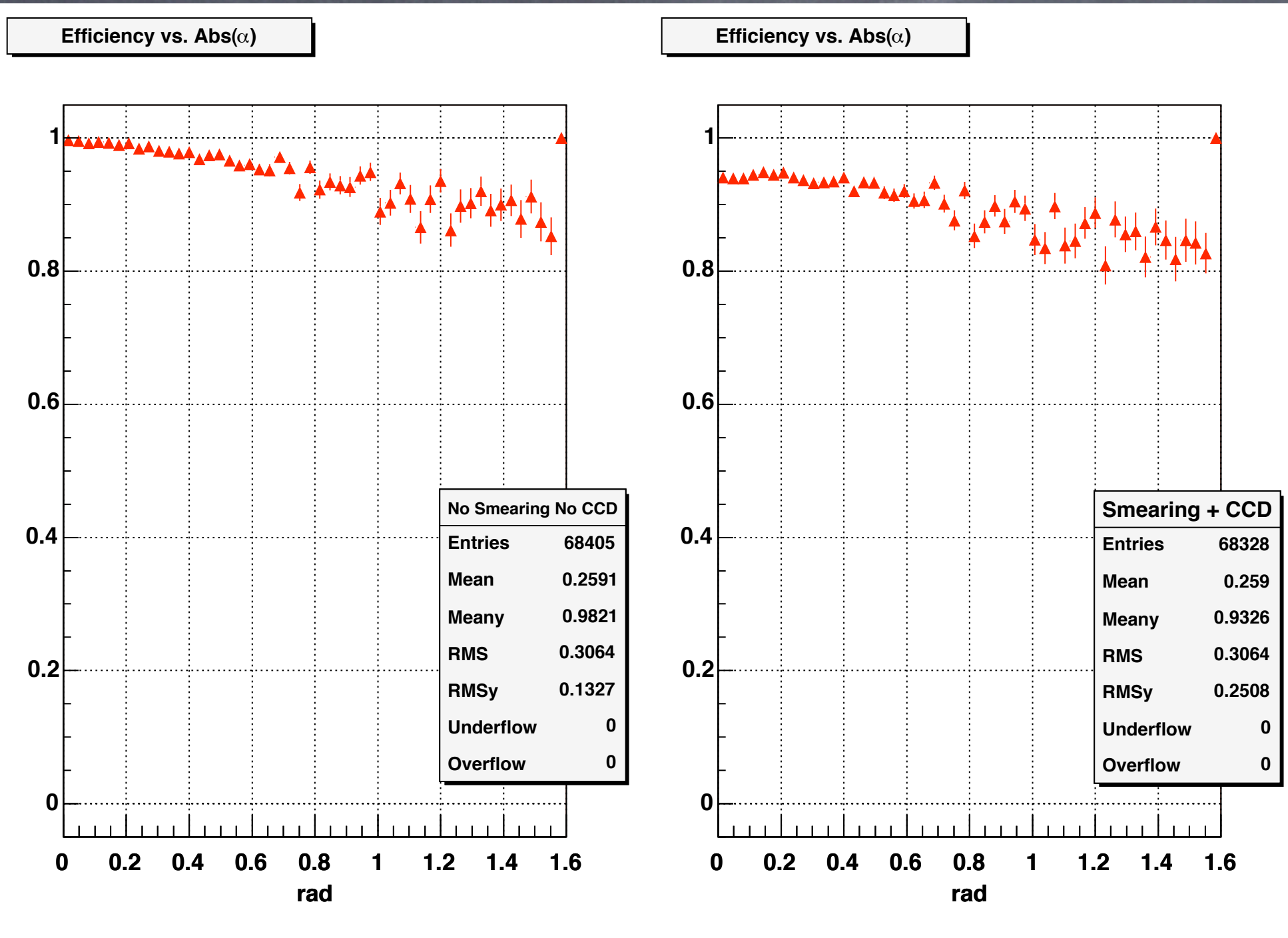
*Except at low pT


Efficiency vs. pT-1
No Smear No CCD
Entries 68405
Mean 0.6879
Meany 0.9842
RMS 1.146
RMSy 0.1248
Underflow 0
Overflow 0
1
0.8
0.6
0.4
0.2
0
0 2 4 6 8 10 12
GeV-1


Distribution of pT-1
5 Layers
Entries 68405
Mean 0.6772
RMS 1.151
Underflow 0
Overflow 145
10^4
10^3
10^2
10
0 2 4 6 8 10 12
GeV-1

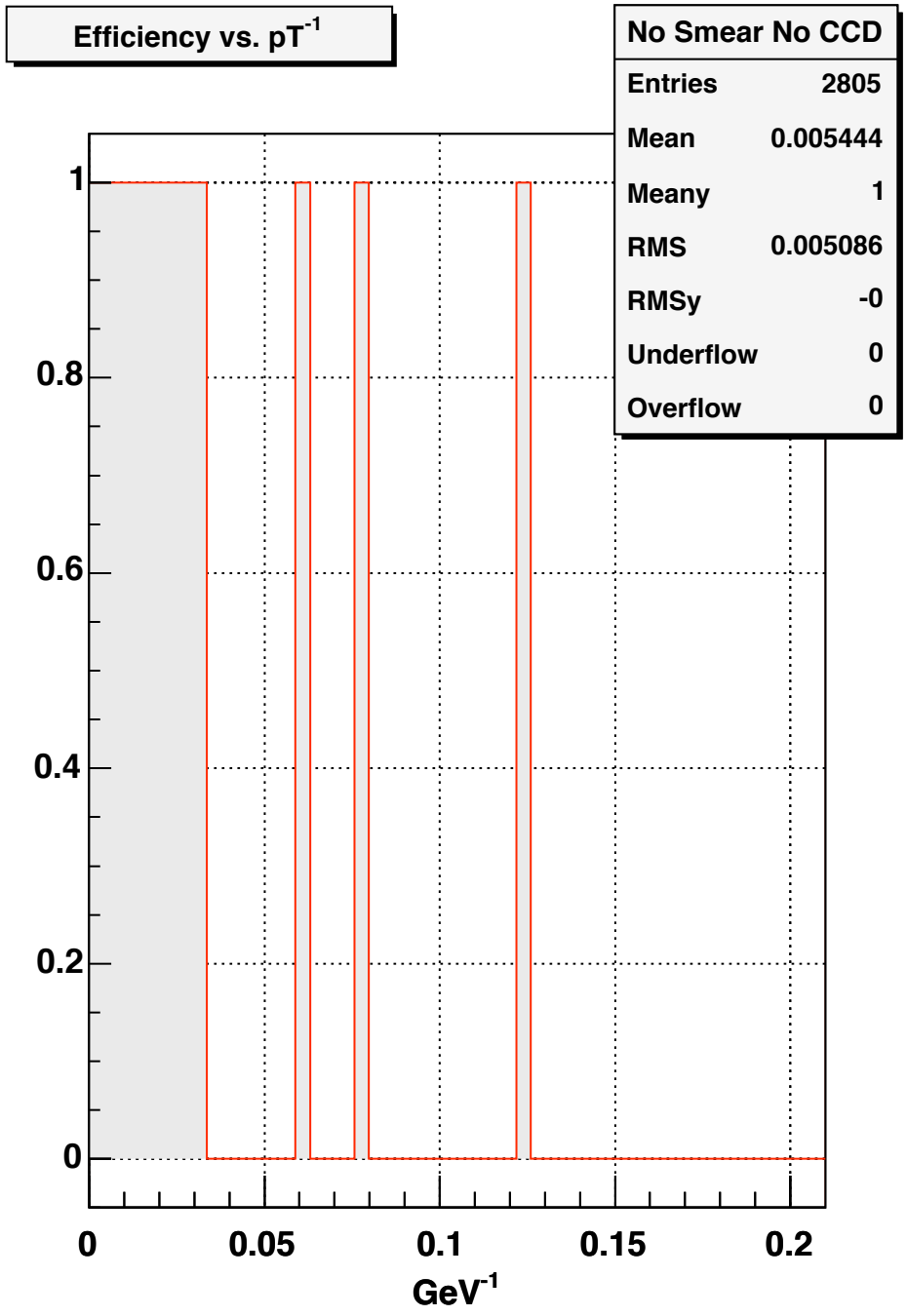

Efficiency vs. pT^-1
Smearing
Entries 68343
Mean 0.6877
Meany 0.9756
RMS 1.146
RMSy 0.1542
Underflow 0
Overflow 0
1
0.8
0.6
0.4
0.2
0
0 2 4 6 8 10 12
GeV^-1

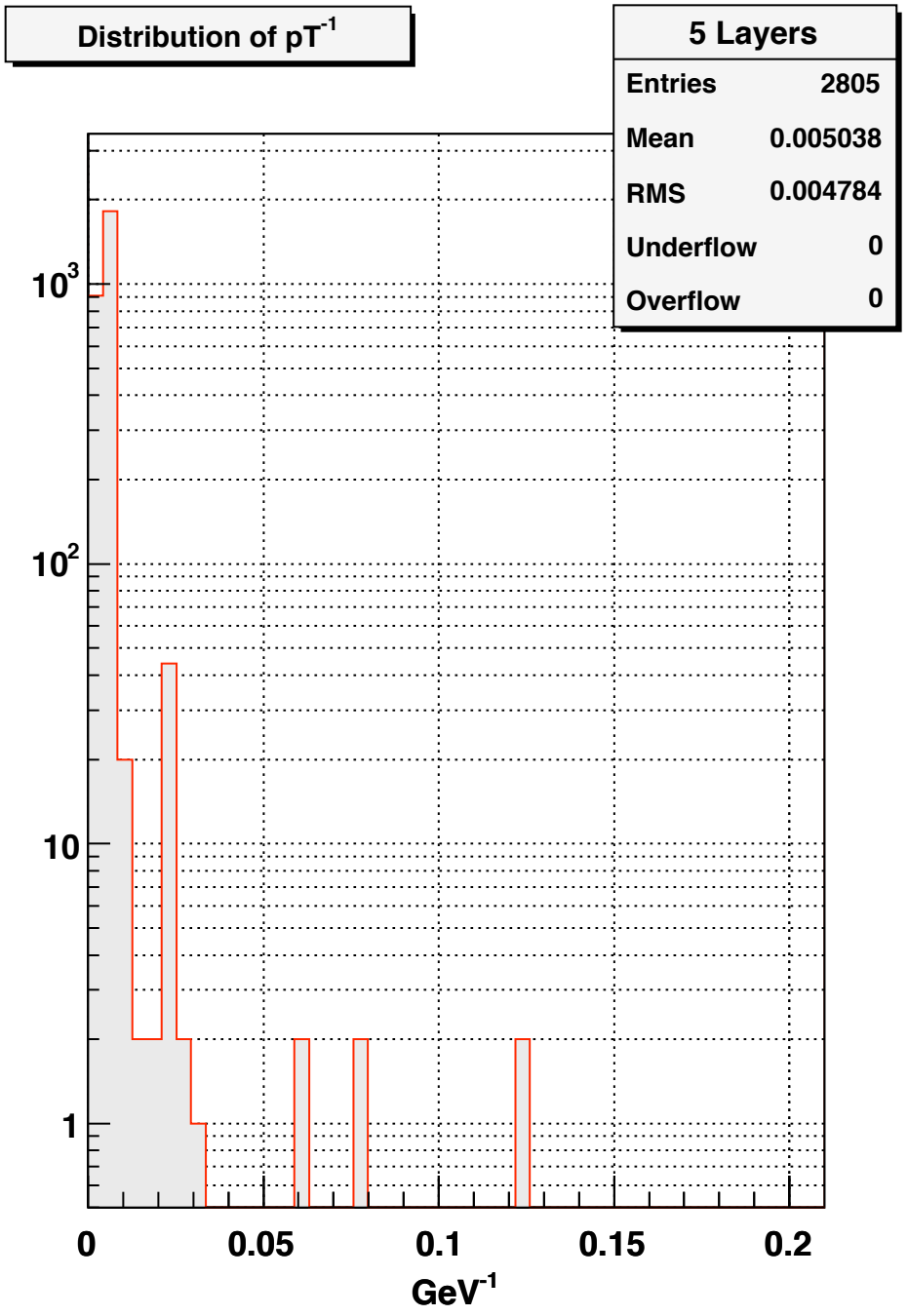

Efficiency vs. pT^-1
Smearing + CCD
Entries 68328
Mean 0.6876
Meany 0.9346
RMS 1.146
RMSy 0.2473
Underflow 0
Overflow 0
1
0.8
0.6
0.4
0.2
0
0 2 4 6 8 10 12
GeV^-1

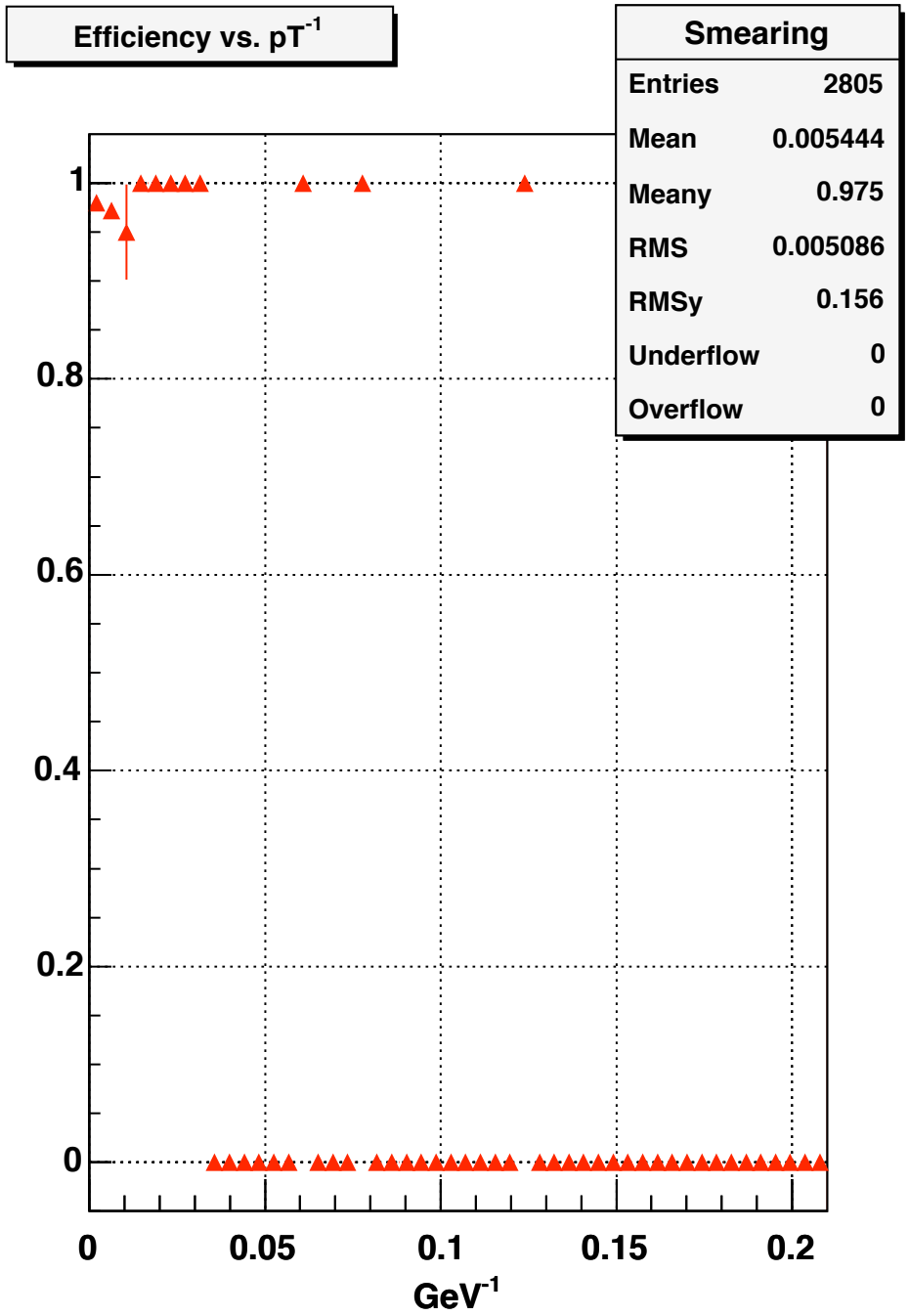

Efficiency vs. Abs(α)
1
0.8
0.6
0.4
0.2
0
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
rad
No Smearing No CCD
Entries 68405
Mean 0.2591
Meany 0.9821
RMS 0.3064
RMSy 0.1327
Underflow 0
Overflow 0
Efficiency vs. Abs(α)
1
0.8
0.6
0.4
0.2
0
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
rad
Smearing + CCD
Entries 68328
Mean 0.259
Meany 0.9326
RMS 0.3064
RMSy 0.2508
Underflow 0
Overflow 0

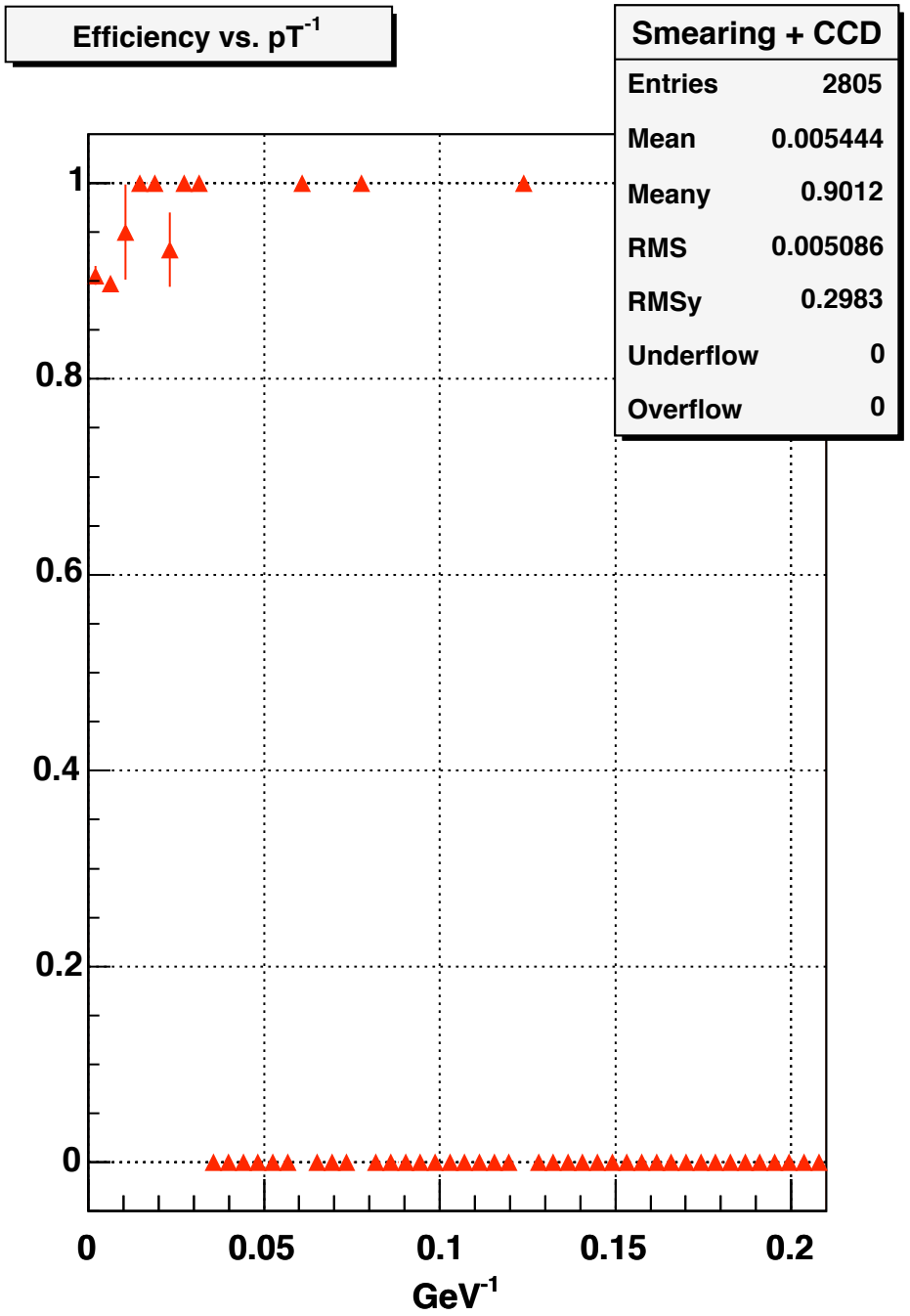
$\mu\mu$ Efficiency Comparison

- Why is efficiency for qqbar dropping so much when we add gaussian hit smearing, and realistic vertex (CCD) simulation smearing?
- We now consider $\mu\mu$ events at the same center of mass energy (500 GeV), in the same detector (SDJan03), subject to the same fiducial constraints.


Efficiency vs. pT^-1
No Smear No CCD
Entries 2805
Mean 0.005444
Meany 1
RMS 0.005086
RMSy -0
Underflow 0
Overflow 0
1
0.8
0.6
0.4
0.2
0
0
0.05
0.1
0.15
0.2
GeV^-1


Distribution of pT^-1
5 Layers
Entries 2805
Mean 0.005038
RMS 0.004784
Underflow 0
Overflow 0
10^3
10^2
10
1
0
0.05
0.1
0.15
0.2
GeV^-1

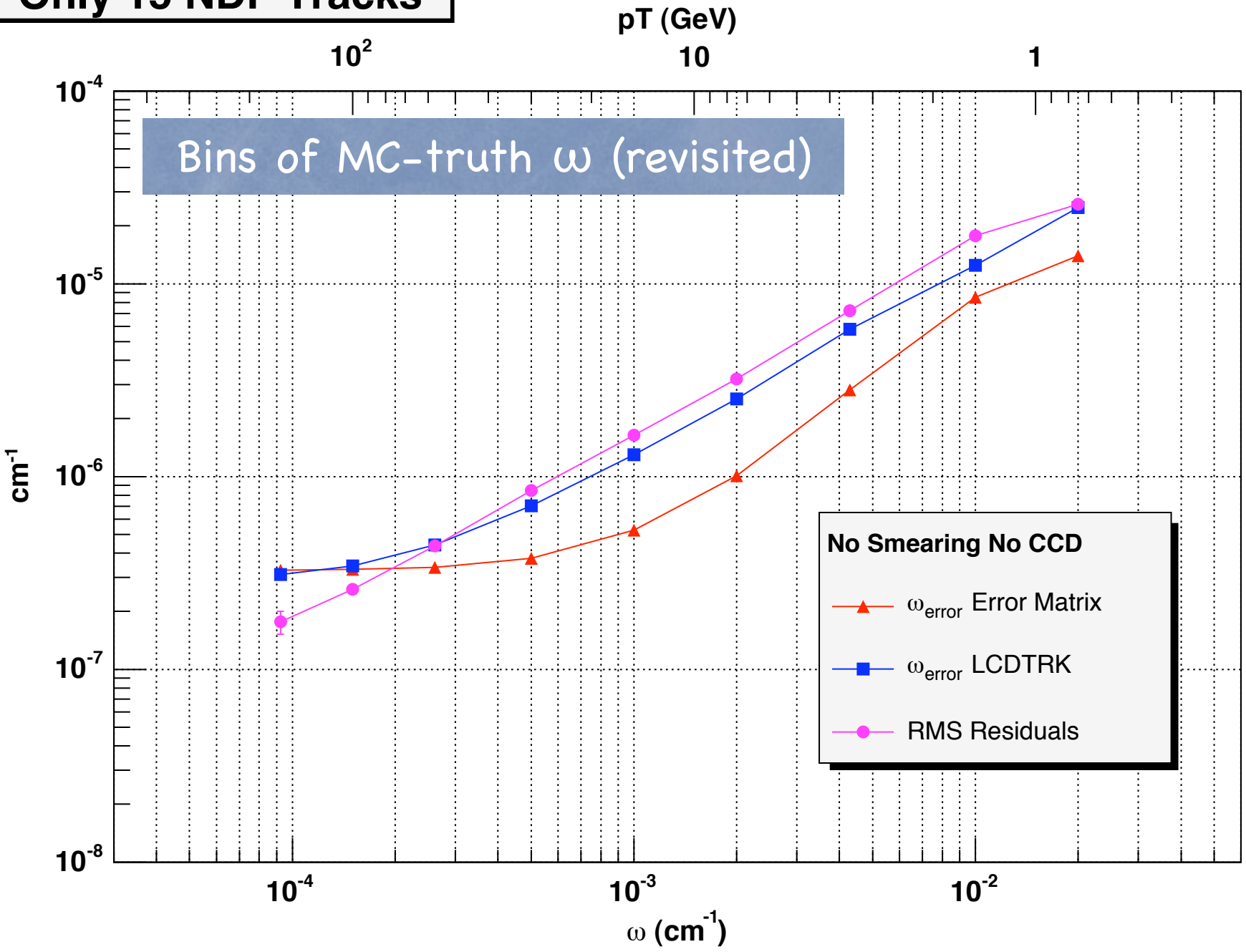

Efficiency vs. pT-1
Smearing
Entries 2805
Mean 0.005444
Meany 0.975
RMS 0.005086
RMSy 0.156
Underflow 0
Overflow 0
1
0.8
0.6
0.4
0.2
0
0
0.05
0.1
0.15
0.2
GeV-1


Efficiency vs. pT-1
Smearing + CCD
Entries 2805
Mean 0.005444
Meany 0.9012
RMS 0.005086
RMSy 0.2983
Underflow 0
Overflow 0
1
0.8
0.6
0.4
0.2
0
0
0.05
0.1
0.15
0.2
GeV-1

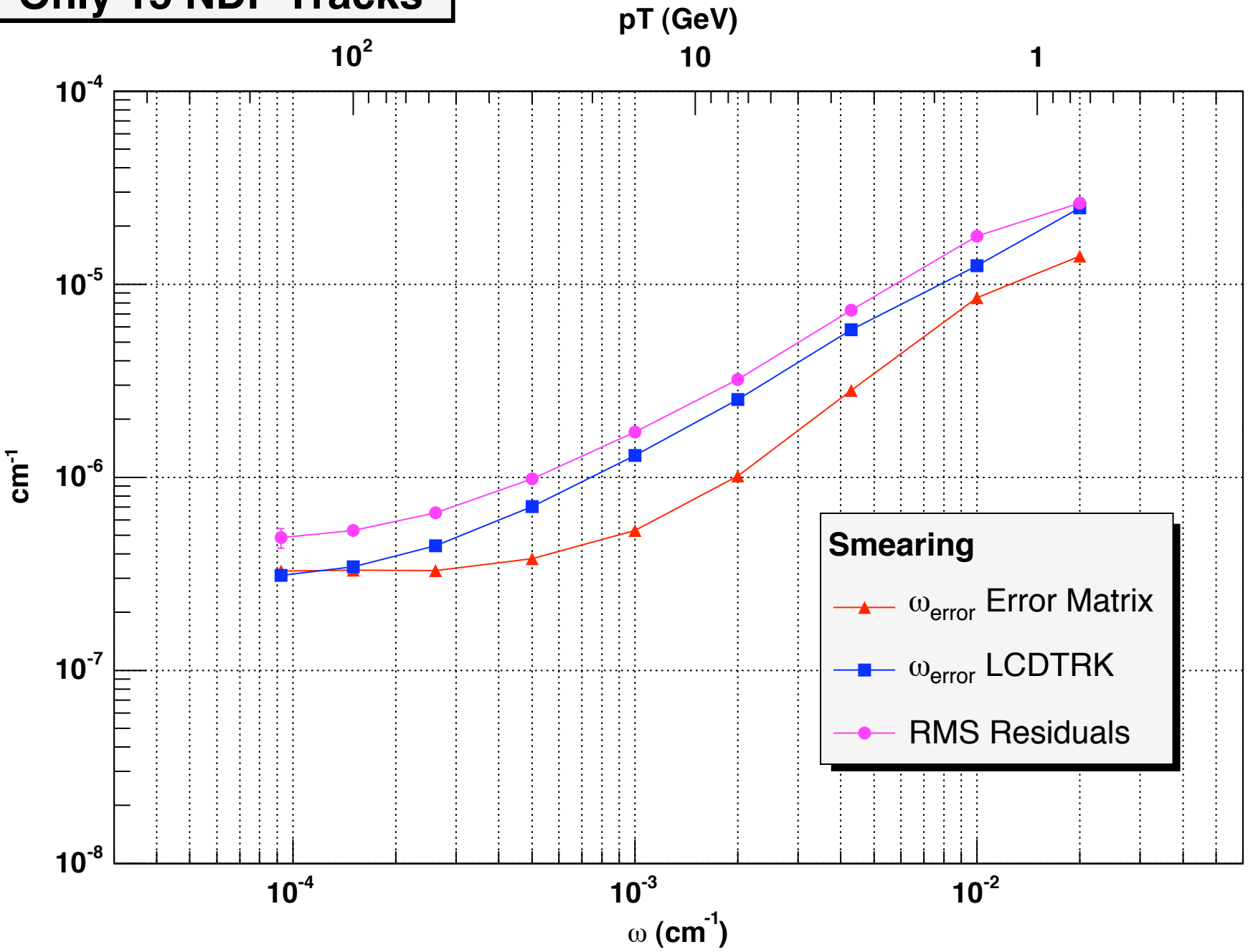
Measuring the error in ω

- Plot the square-root of the curvature matrix element along with the RMS of the curvature residual, and the predicted error from LCDTRK (B. Schumm) as a function of curvature.
  - Require hits on all layers (15 NDF)
  - Residual fitting done in bins of curvature corresponding to pT ranging from 0.5 to 200 GeV
  - LCDTRK values averaged over $\cos(\theta) = 0$ to 0.5
  - Consider cases with and without hit smearing, and full CCD simulation

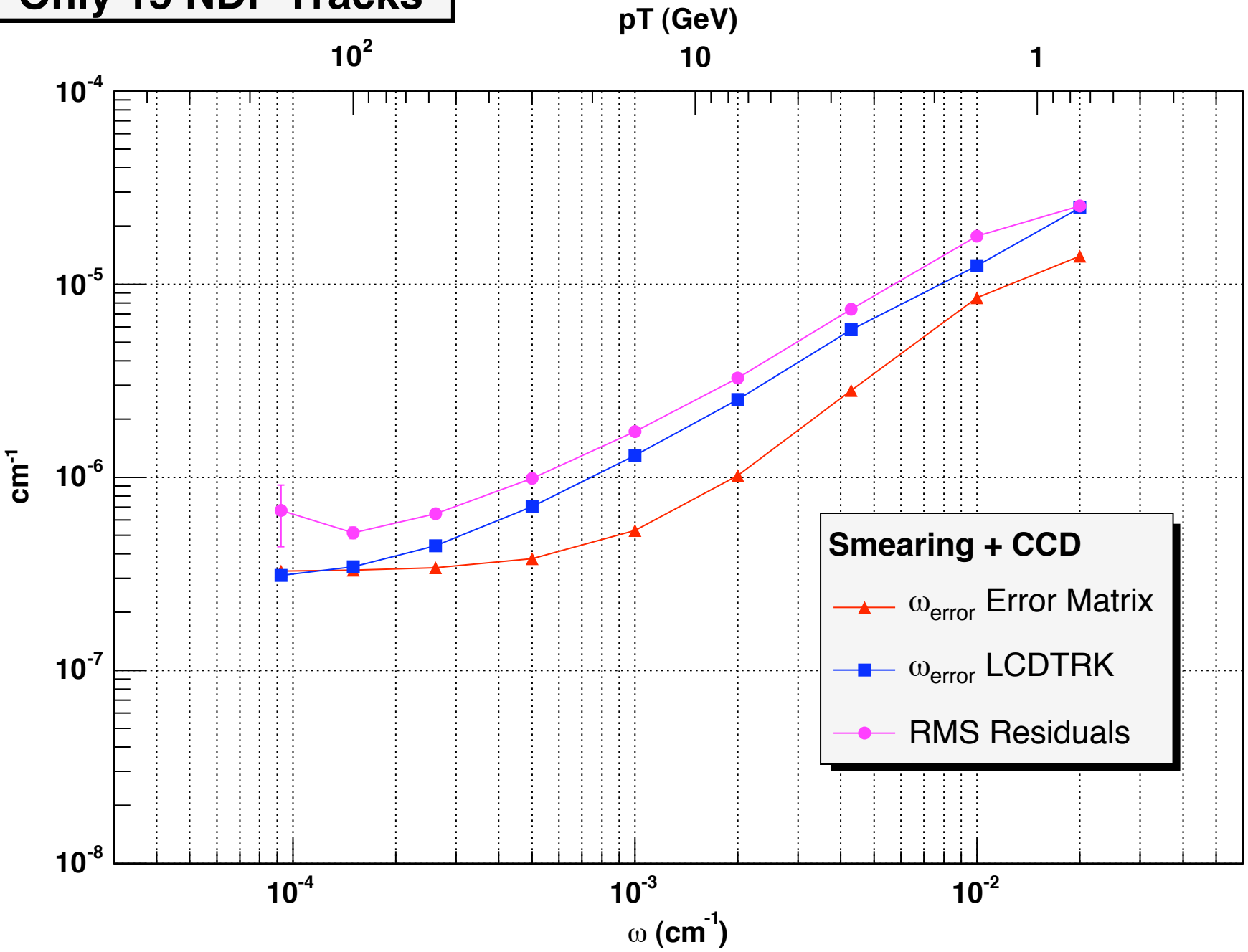
Only 15 NDF Tracks



Only 15 NDF Tracks



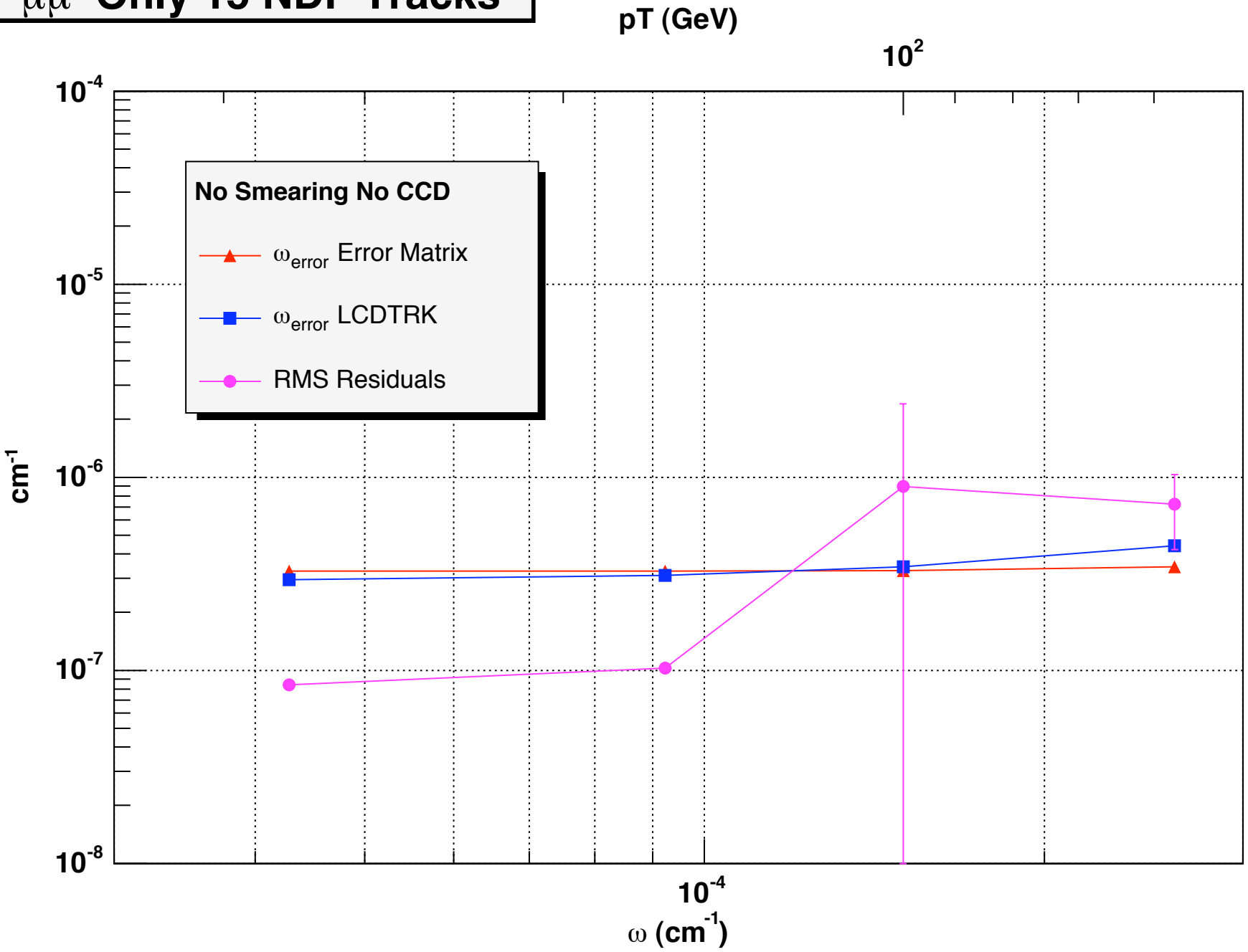
Only 15 NDF Tracks



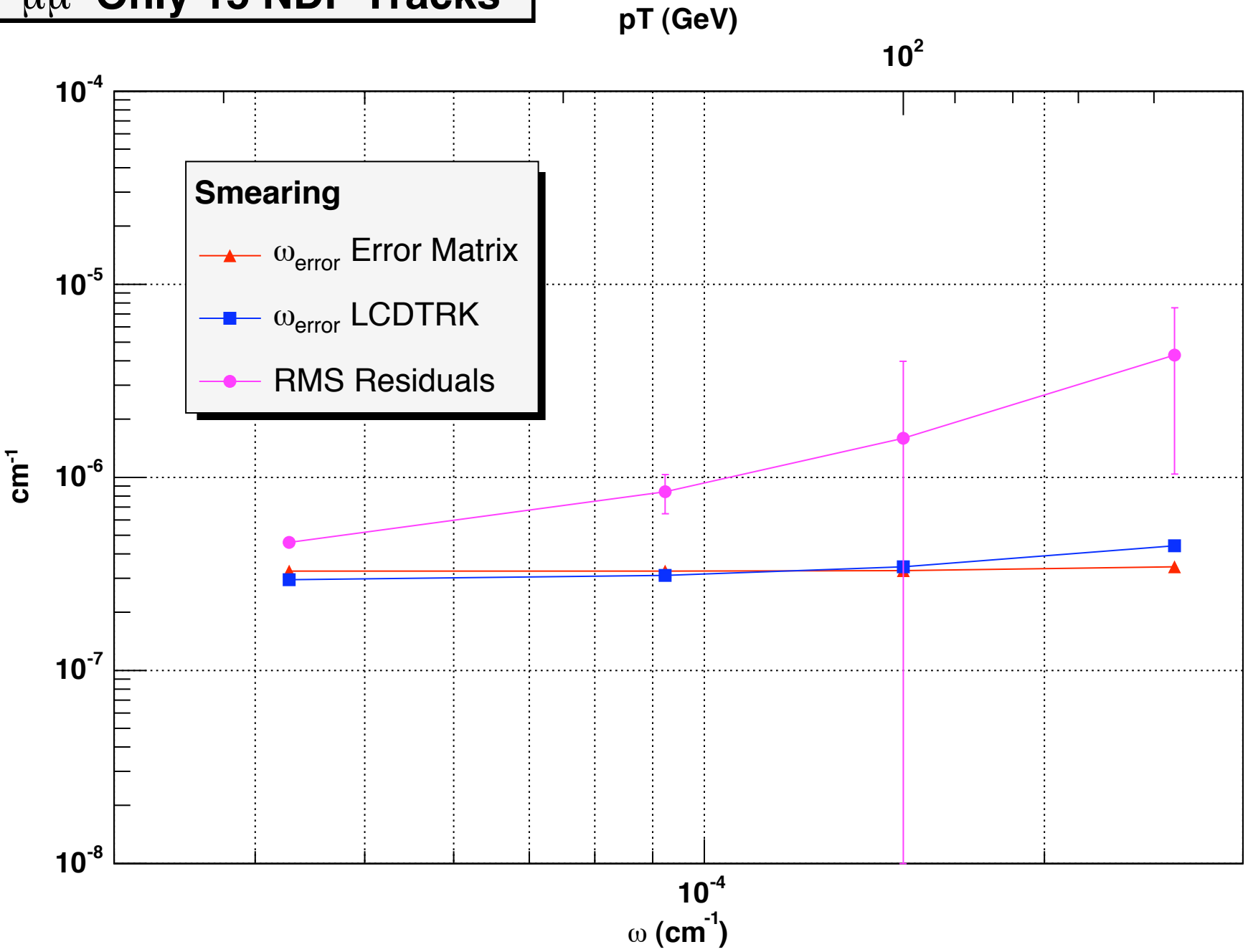
$\mu\mu$ Curvature Comparison

- Armed with what we have seen in the qqbar cases, we now perform the same analysis on the $\mu\mu$ events: same energy, detector, fiducial volume, and NDF cuts.
- The "well known" curvature minus sign error within JAS/LCD is apparently *not* present for the $\mu\mu$ event file...
- Only the 1st two (highest pT) bins in the following are particularly trustworthy

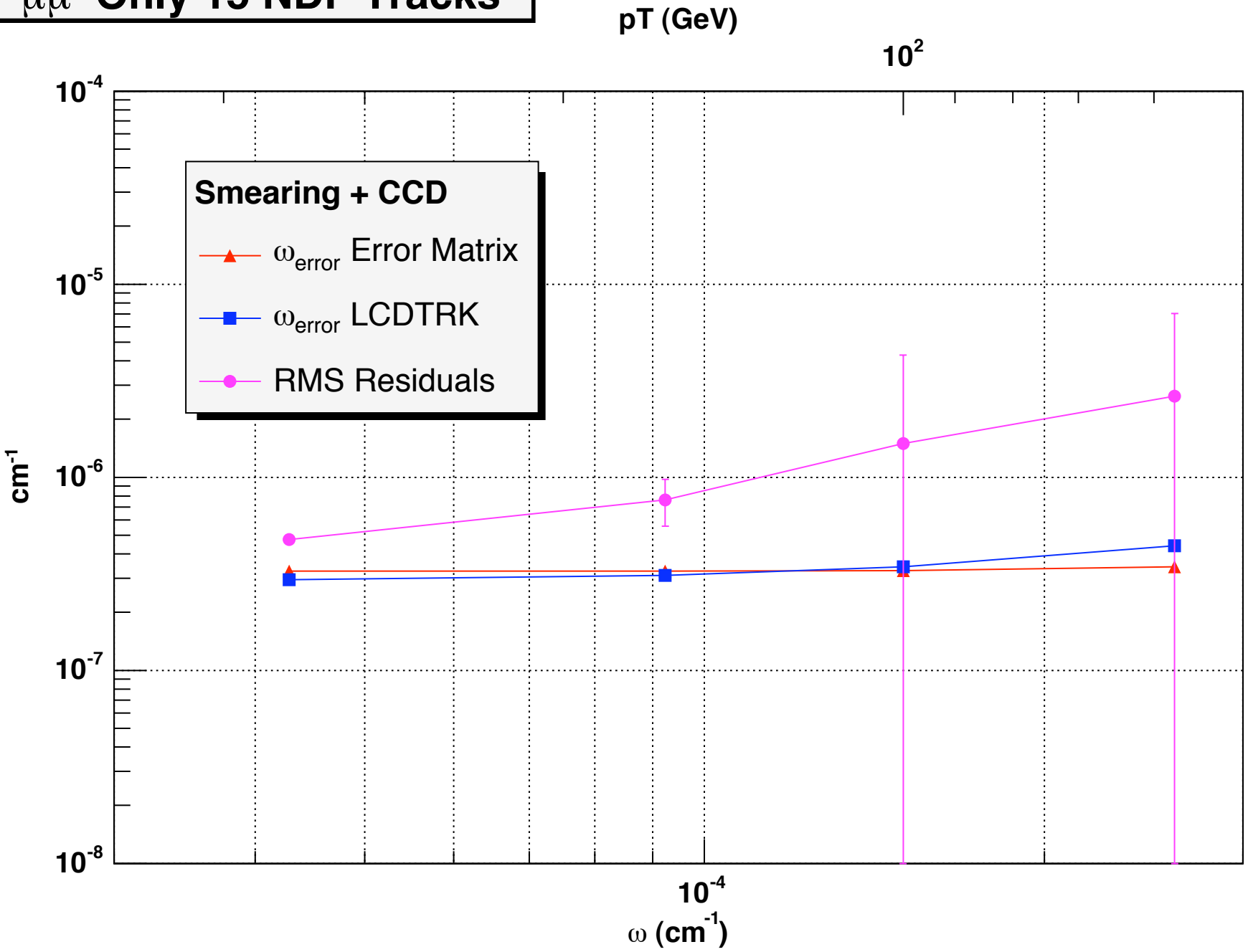
μμ Only 15 NDF Tracks



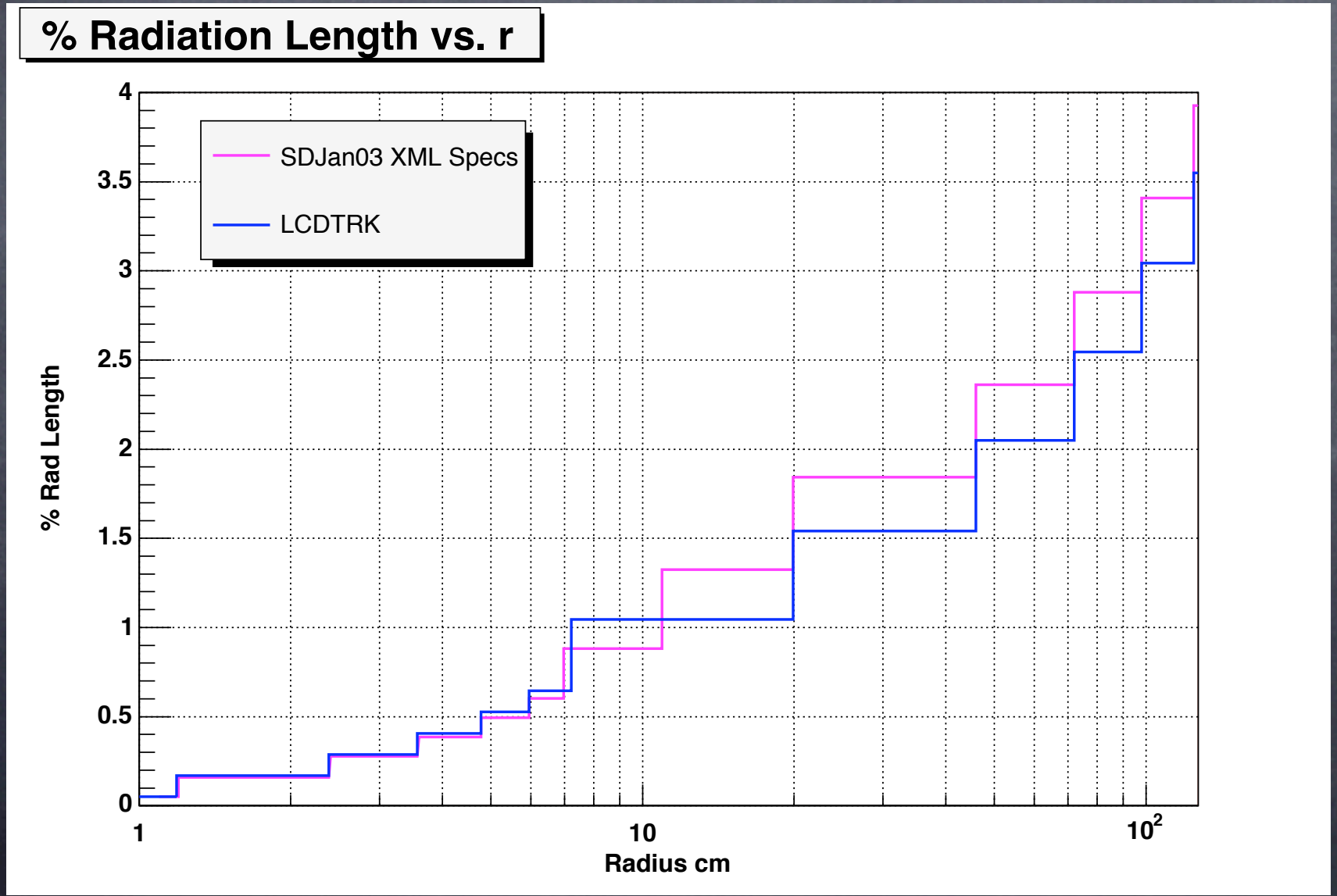
μμ Only 15 NDF Tracks



μμ Only 15 NDF Tracks



What about Detector Materials?



Conclusions

- Efficiency
  - There are efficiency losses when smearing is included. The effect worsens when including CCD simulation.
  - Not just confusion near the jet core - this effect is present for $\mu\mu$ events as well.

- Fitting
  - Incorporation of material in error matrix in the fitter seems incorrect.
  - We need to make material in LCDTRK match the SDJan03 specifications to make a comparison between expectations and observations in multiple Coulomb scattering dominated regions.*
  - High pT: error matrix and LCDTRK agree, but the residuals are worse than expectations. This is also true for $\mu\mu$ - fitter is not optimal; multiple scattering isn't to blame.

*Will do this very soon!

LATE BREAKING NEWS!

- We looked at $\mu\mu$ event displays with gaussian smearing only - and found if the z-smearing (based on 2 out of 2 missed tracks) is large in the first central tracking layer, the muon is not reconstructed.