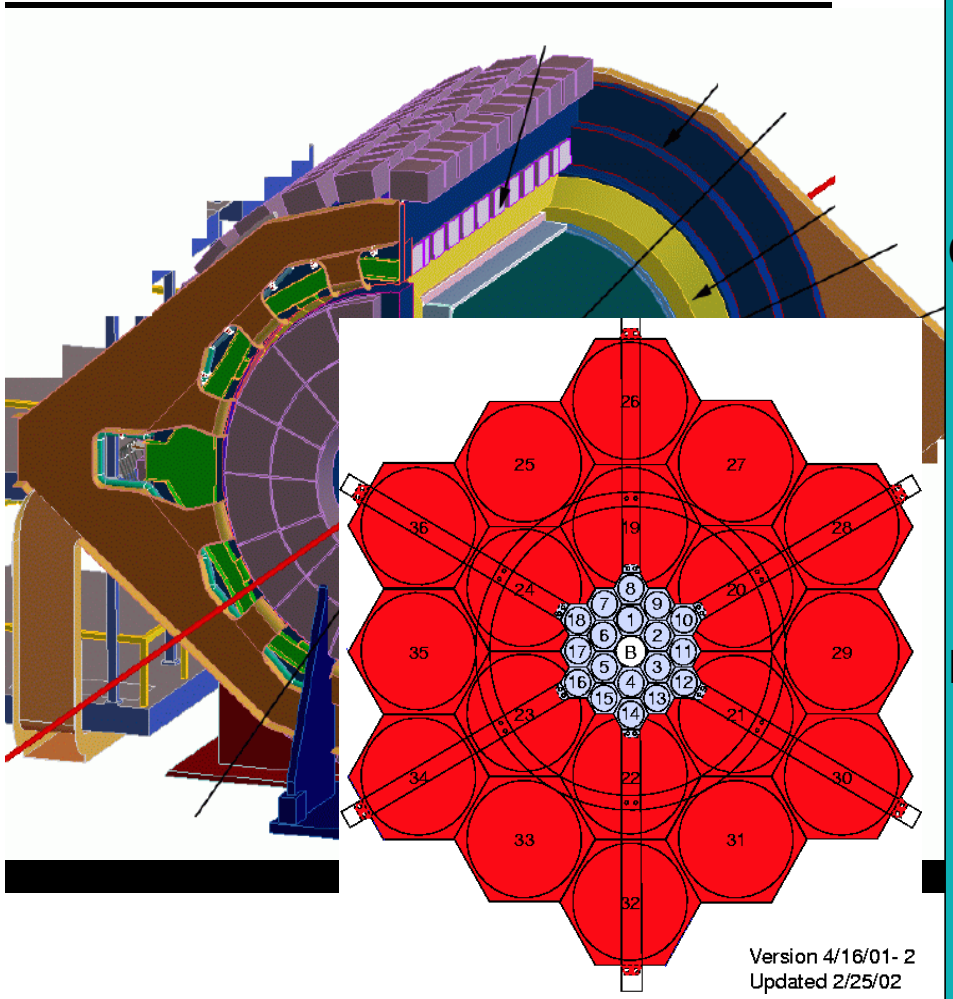
Vertex Finding and Pileup in the p+p data

Jon Gans
Yale University
STAR Collaboration

1) Detector Setup
2) Vertexing Bias – p+p and Au+Au
3) Influence of Bias on the Data
4) New Methodology to Remove Bias
   (Works for me, but probably not for you)
5. Remarks on pileup rejection
6. Contamination
7. Outlook



Time Projection Chamber:

2.1 meter drift over 40 μs

|η| < 1.5 , Full Azimuth

Central Trigger Barrel (Scintillator):

Trigger For Au+Au (not for p+p)

6° x 1 m – 240 Cover Entire Barrel

Sample 11 (Δt 110ns) times per trigger

Beam Beam Counters:

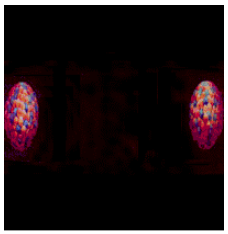
+/- 3meters , 3.5 < | η | < 5.5

Use for p+p Trigger (Coincidence)

70cm Vertex Resolution

Must Use TPC Tracks For Vertexing

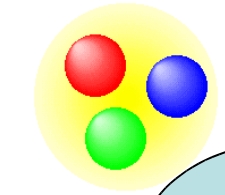
Vertex Efficiency with Embedding

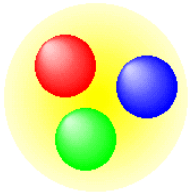


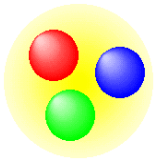
RECO

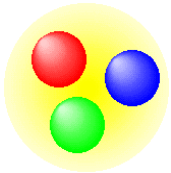
Vertex Efficiency

Empty Bunch Event







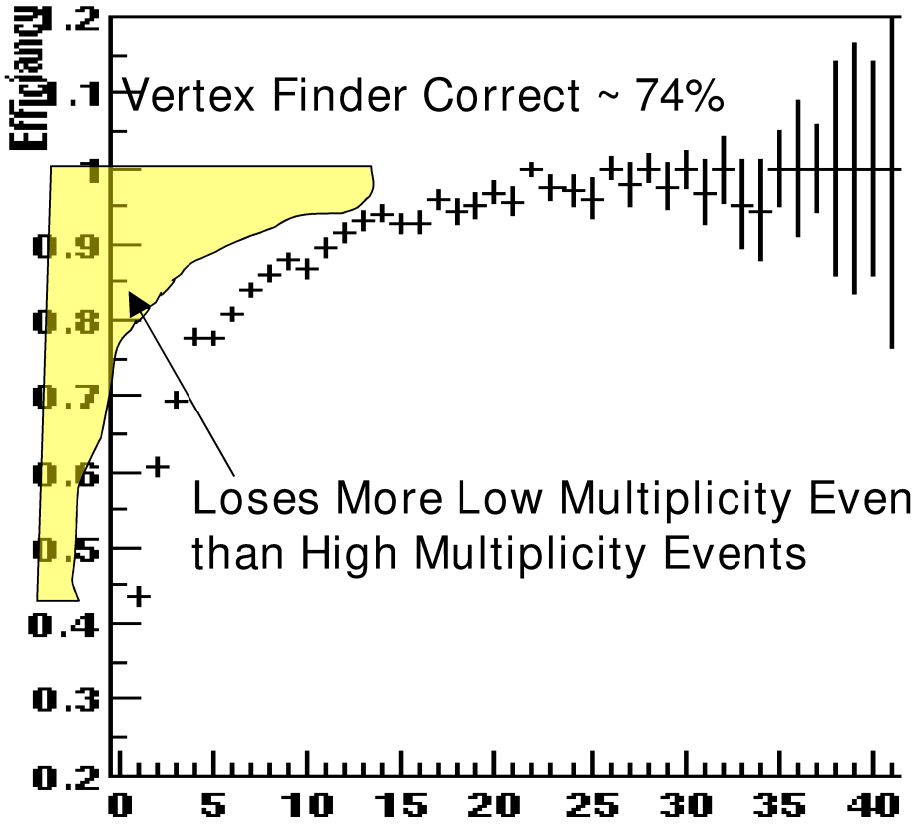


60 Total Bunches in Ring (I only show 5)
55 Are Filled With Protons
5 are empty
213 ns between each bunch

Since the empty bunches are only in the detector for short period of time, upstream, beam gas and pileup events are sampled.

Vertex Finding Efficiency

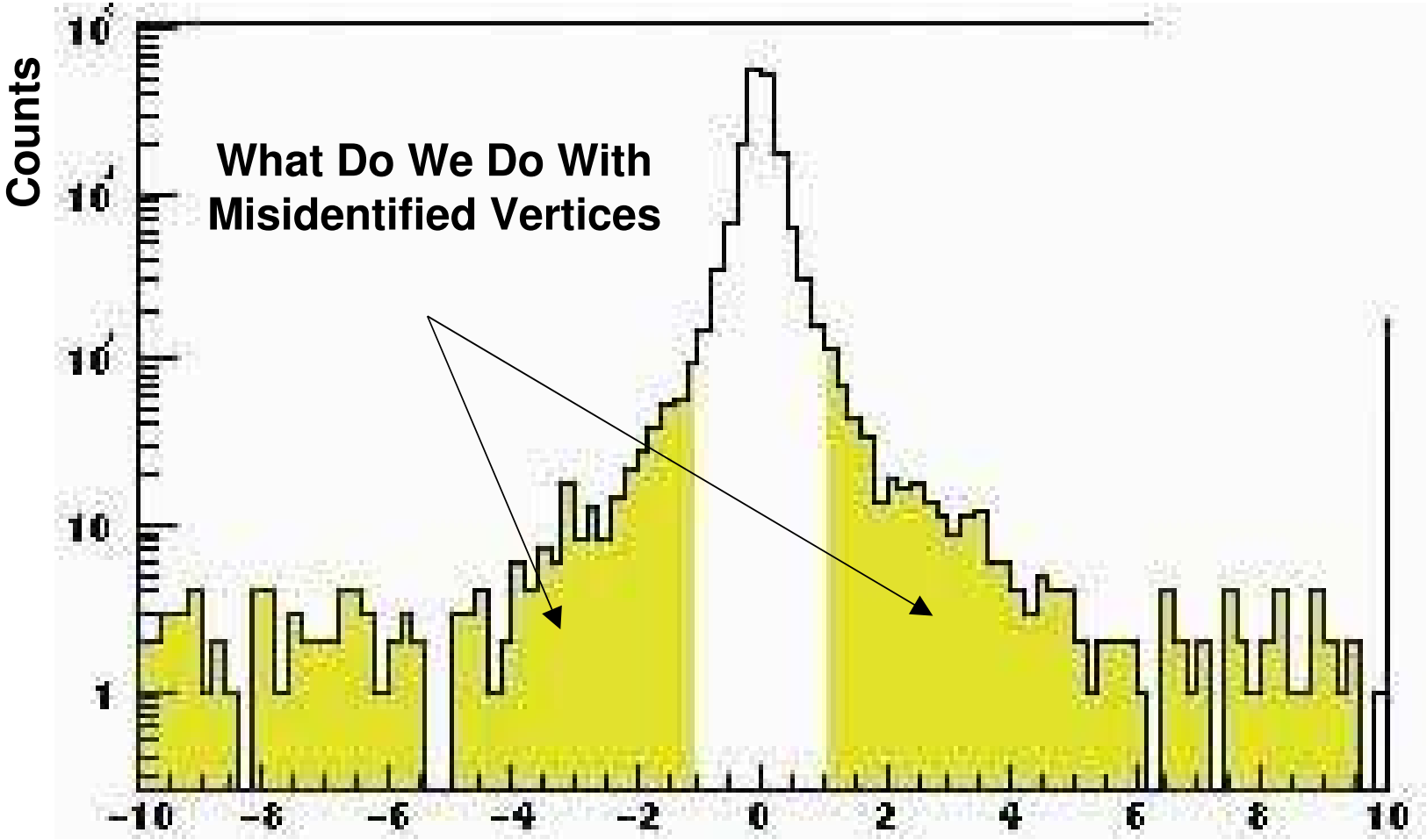
$$\text{Efficiency} = \frac{\text{Events with abs(ppLMVz ? mcz) < 1cm}}{\text{Total Number of Events}}$$



Why don?t we use these numbers to correct data?

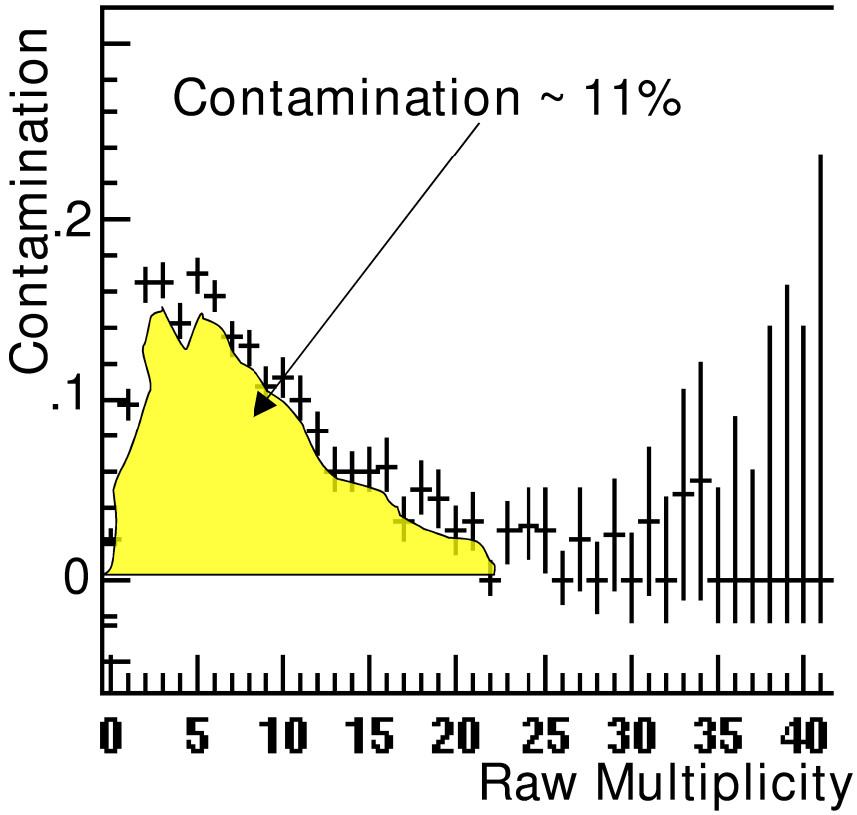
I Haven?t Told you the Whole Truth

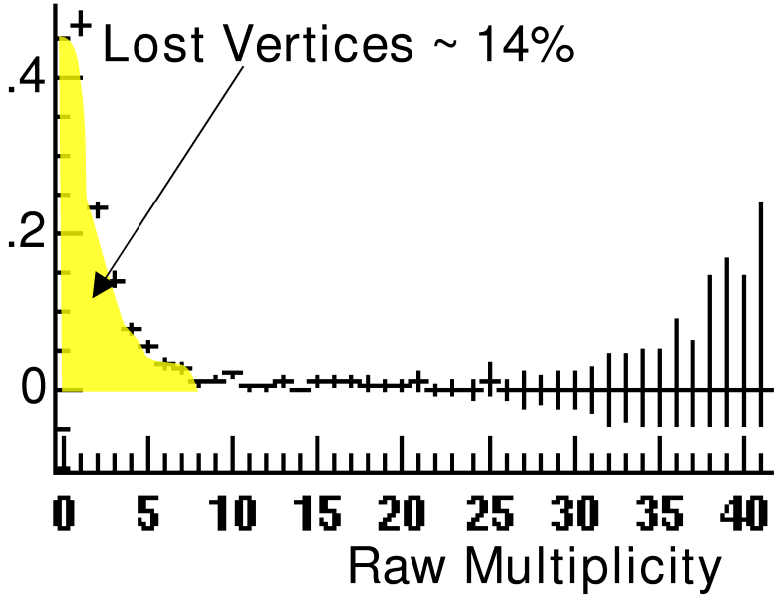
Vertex Finding Resolution



Vertex Finding Contamination

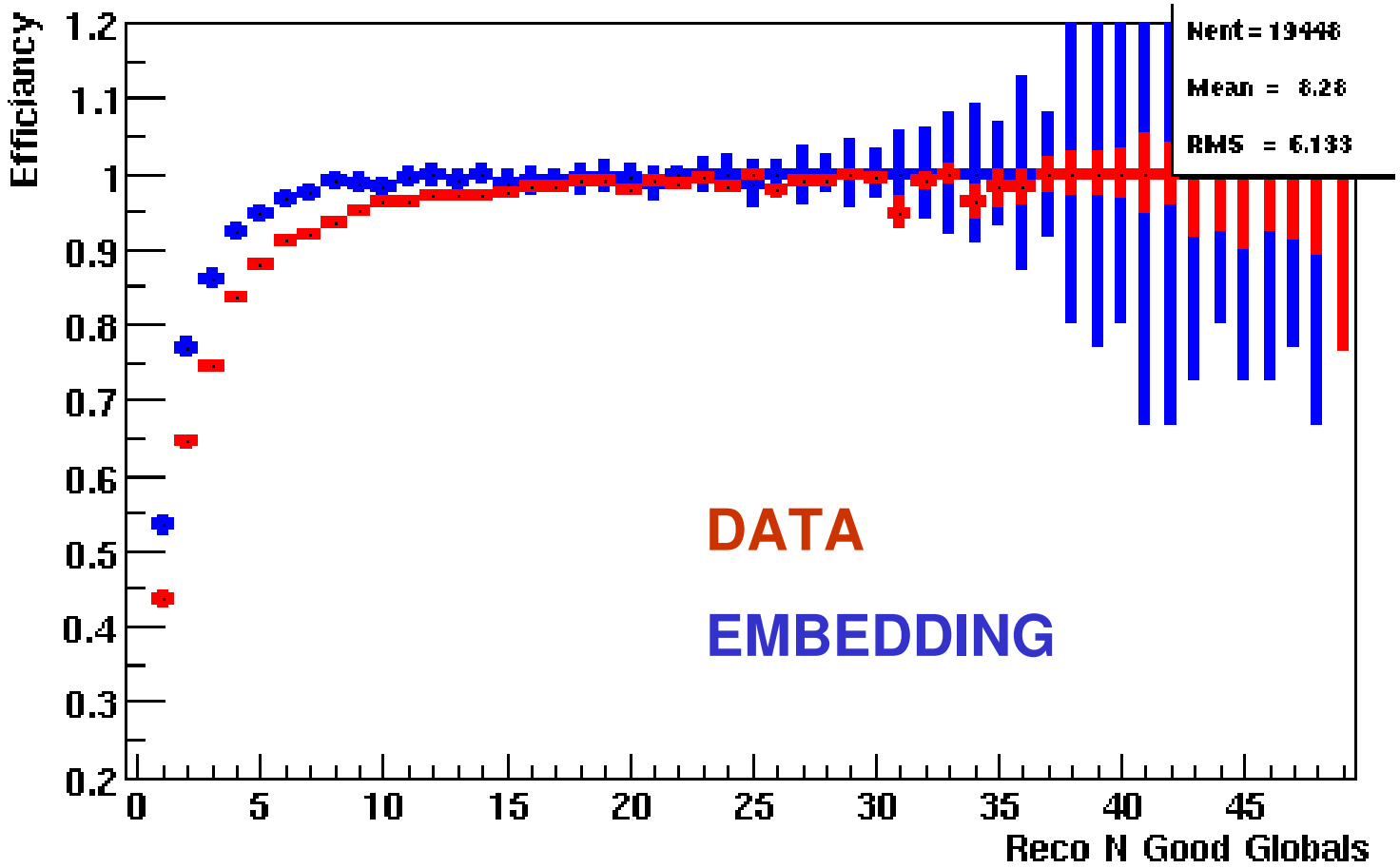
$$\text{Contamination} = \frac{\text{Events with abs(ppLMVz ? mcz) > 1cm}}{\text{Total Number of Events}}$$



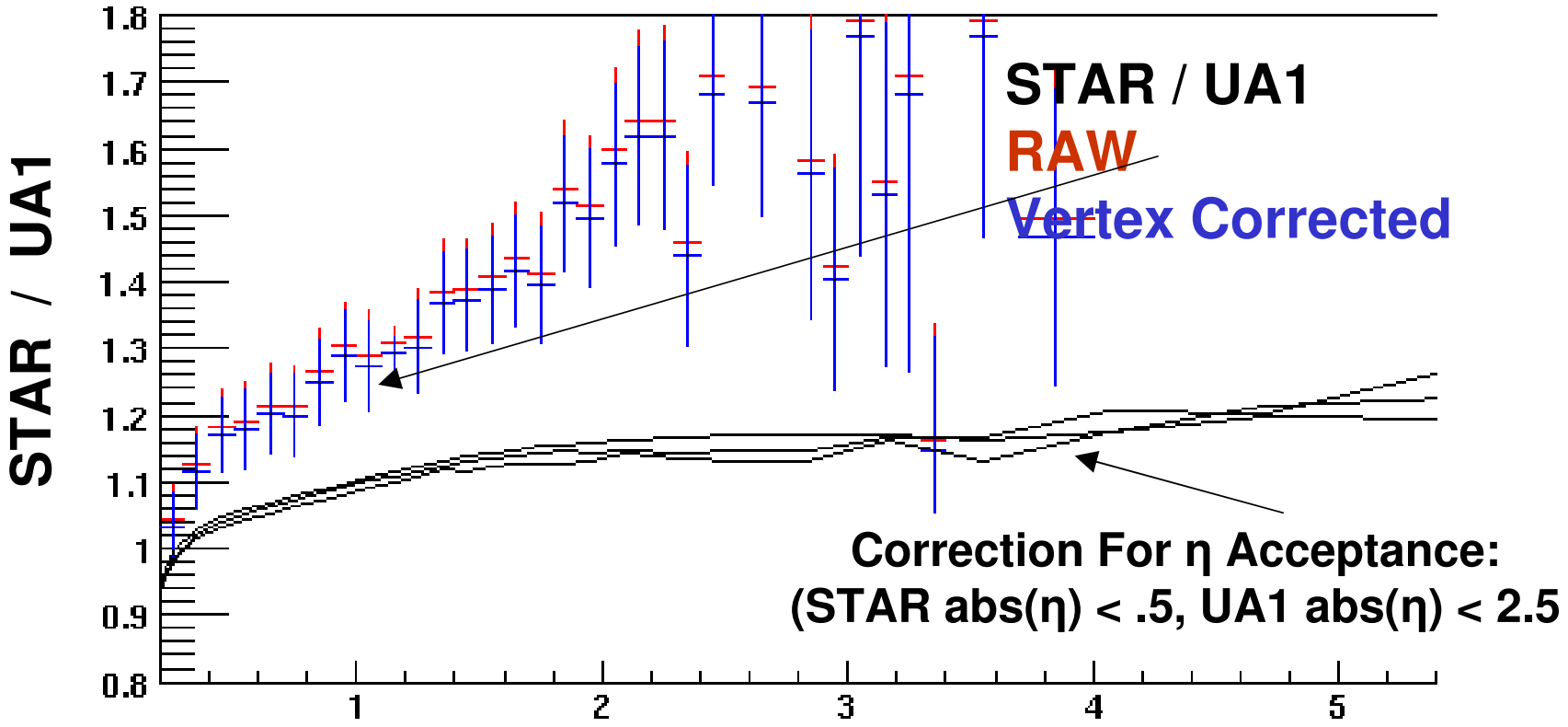


Does Embedding and Real Data Agree?

$$\text{Efficiency} = \frac{\text{Events with Reconstructed Vertex(no residual cut)}}{\text{Total Number of Events}}$$



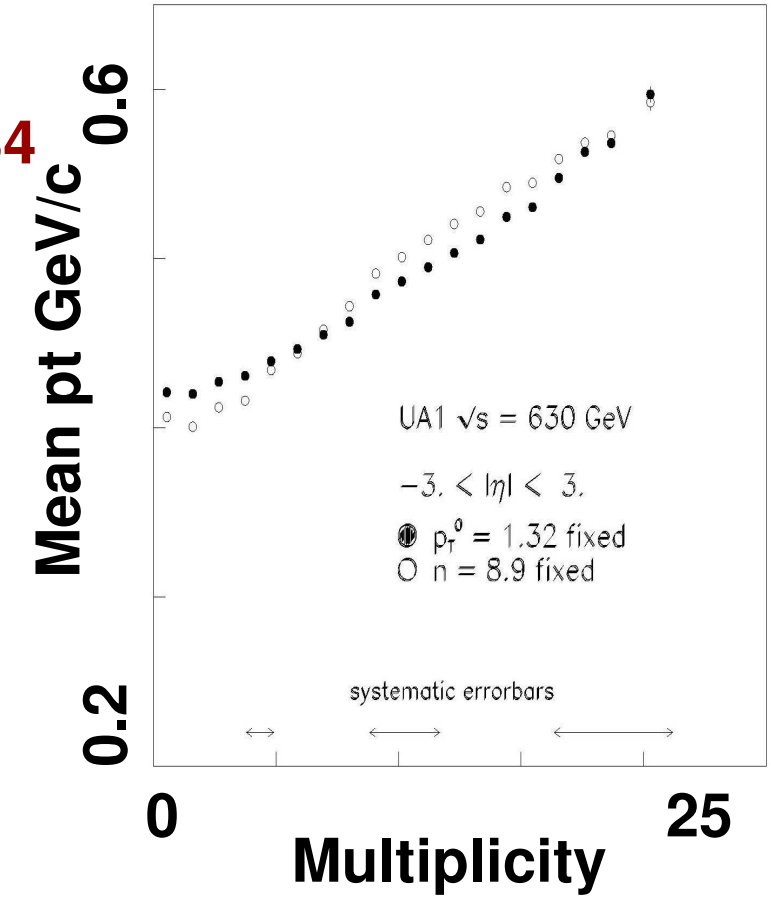
Spectra Using Primary Vertex Analysis Method



No Efficiency or Acceptance Corrections
(which would move spectra up anyways!)

Consequences of Multiplicity Bias

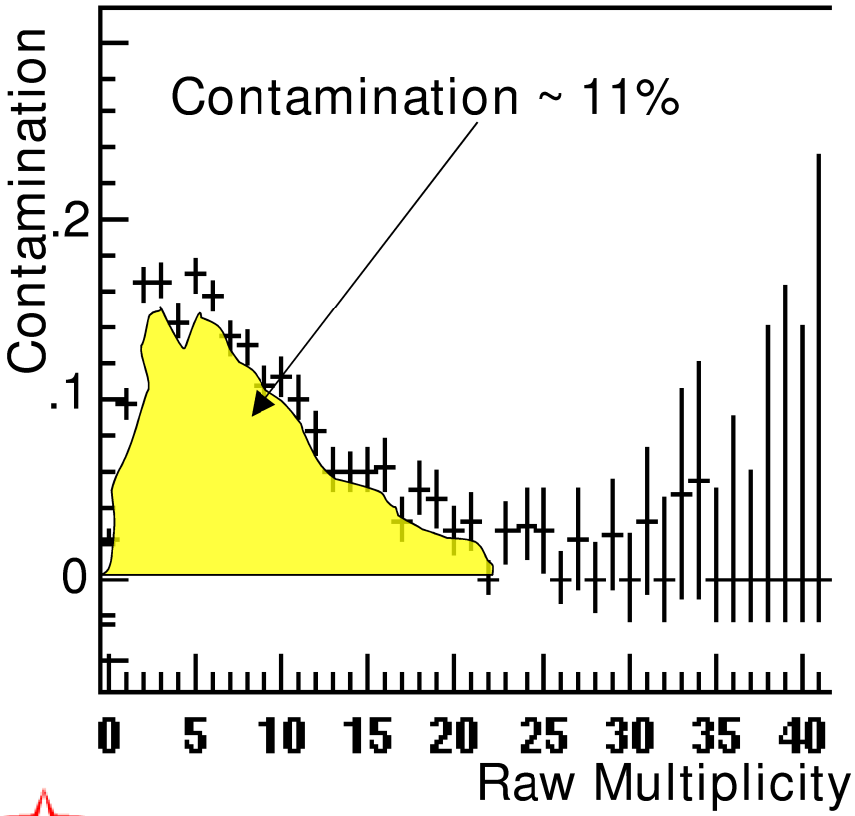
Mean pt scales with multiplicity
UA1 – *Phys Lett B* 366 (1996) 434

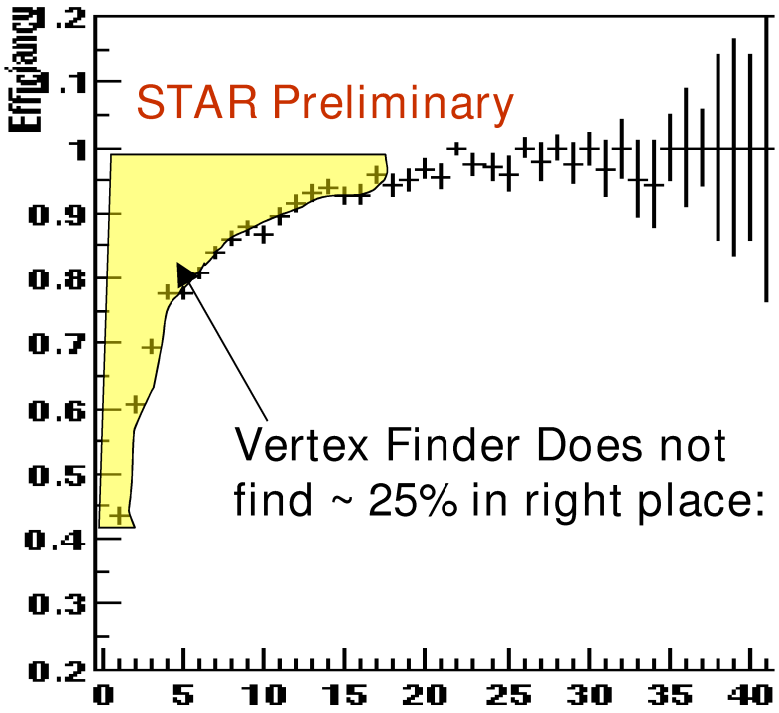


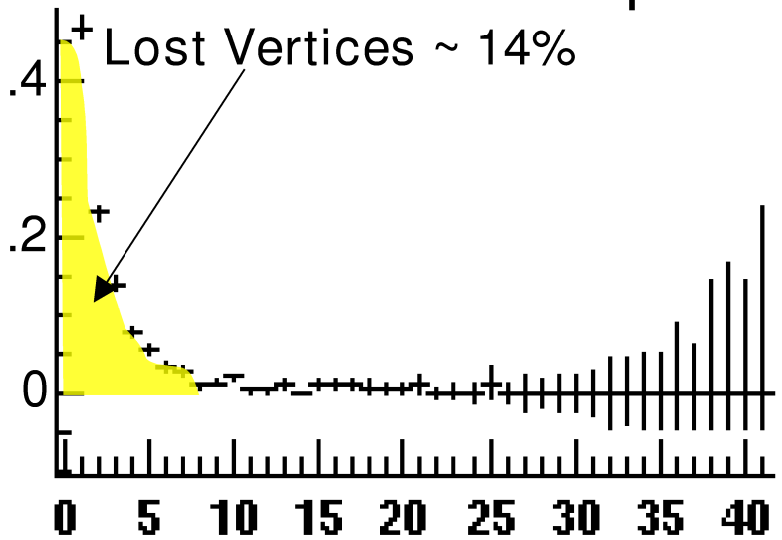
Momentum bias tied to vertex finding bias.

Vertex Finder looses low multiplicity events

=> Spectra is shifted to higher pt


Contamination
Contamination ~ 11%
0
.1
.2
0 5 10 15 20 25 30 35 40
Raw Multiplicity

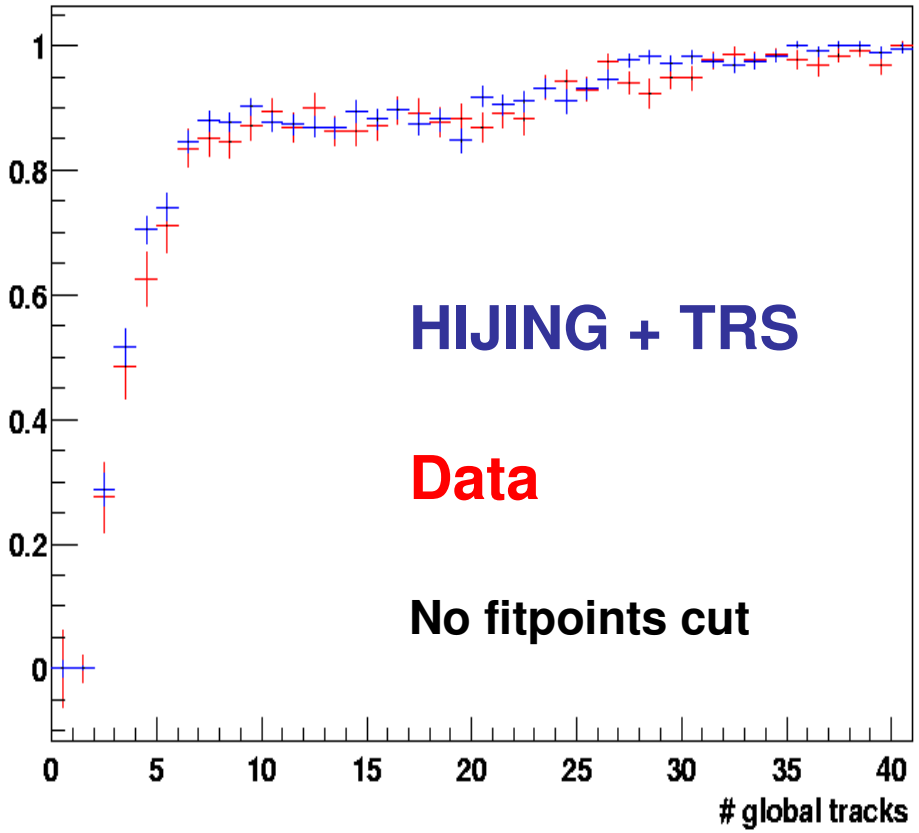

Efficiency
STAR Preliminary
Vertex Finder Does not
find ~ 25% in right place:
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
.1
.2
0 5 10 15 20 25 30 35 40
Raw Multiplicity

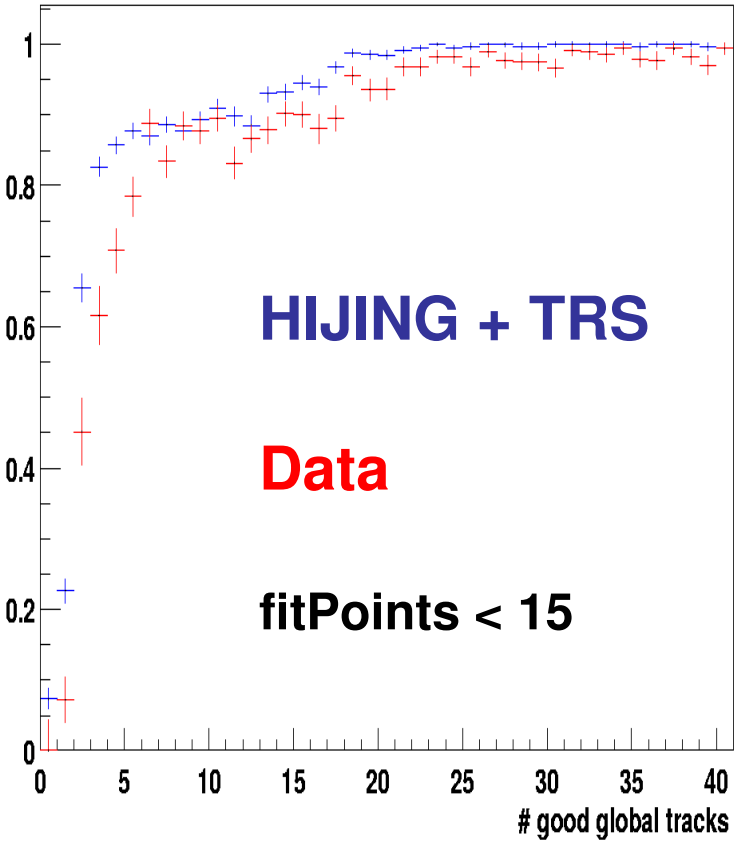

Lost Vertices ~ 14%
0
.2
.4
0 5 10 15 20 25 30 35 40
Raw Multiplicity

What about Au+Au data?

Thanks to P. Fachini

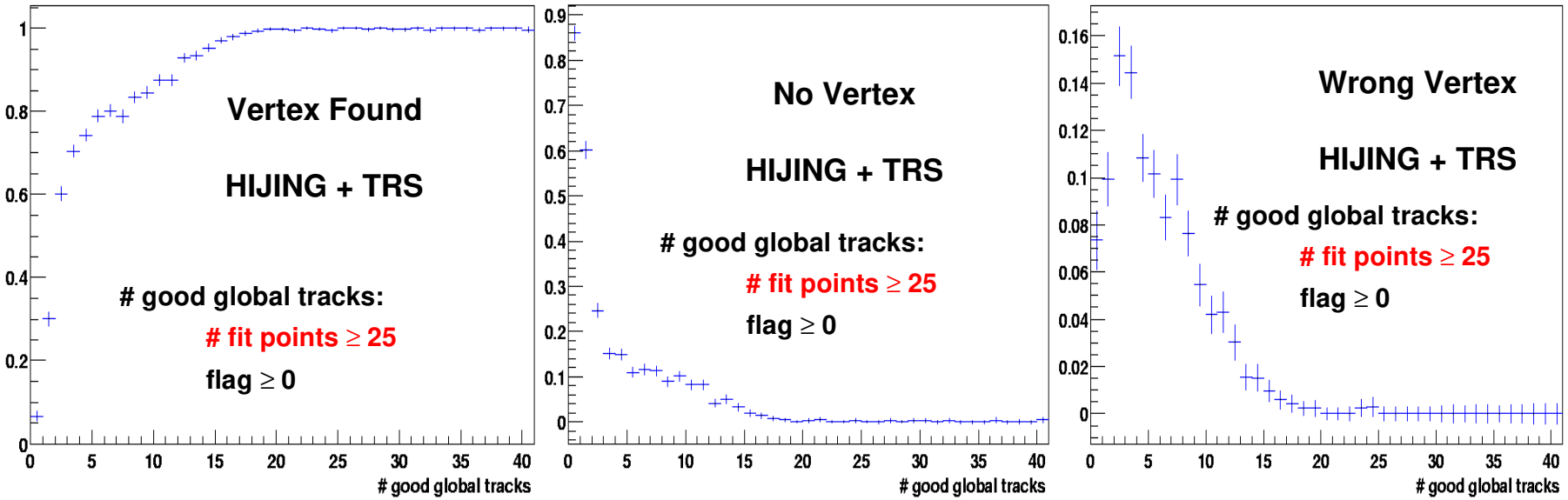
$$\text{Efficiency} = \frac{\text{Events with Reconstructed Vertex(no residual cut)}}{\text{Total Number of Events}}$$





More on Au+Au HIJING Studies

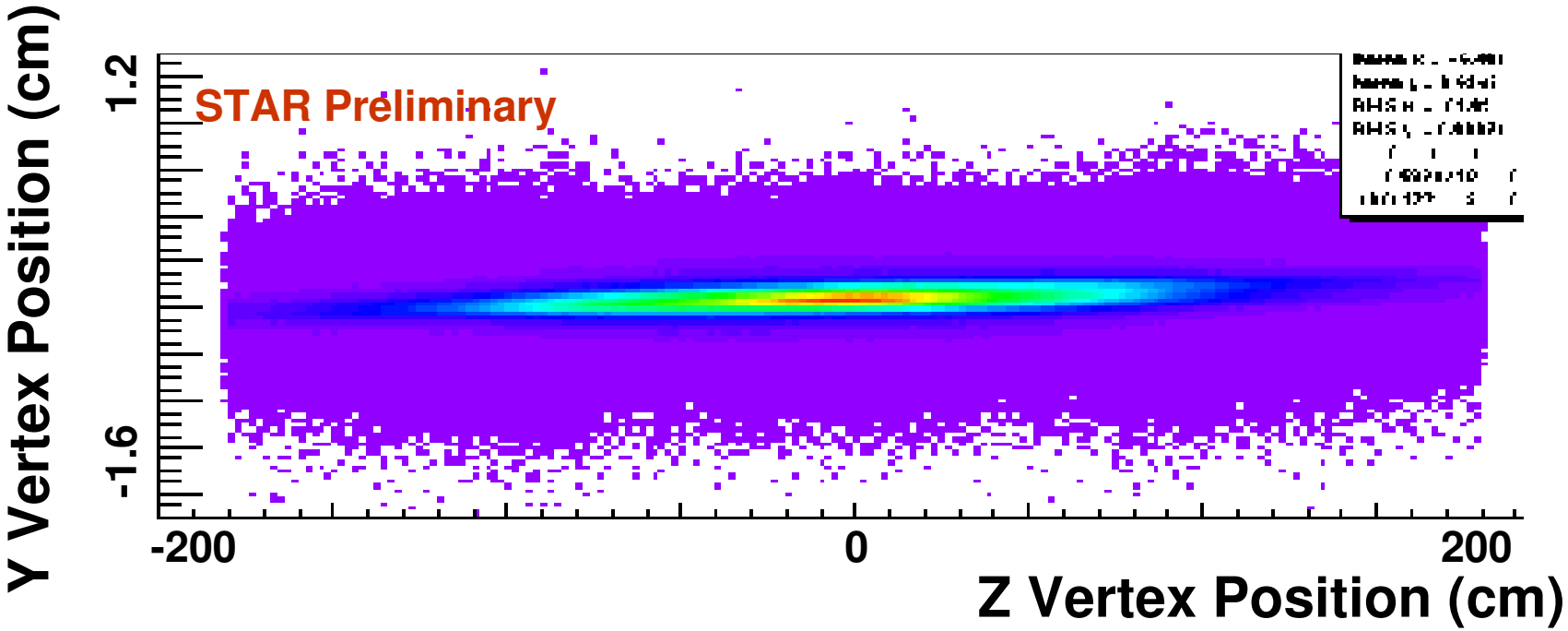
Thanks to P. Fachini



Shapes Similar to proton+proton Embedding

Determining Spectra Without Vertexing

Beamline position is well known in STAR.
For events with a found Vertex: Parameterize X and Y position of Vertex versus Z

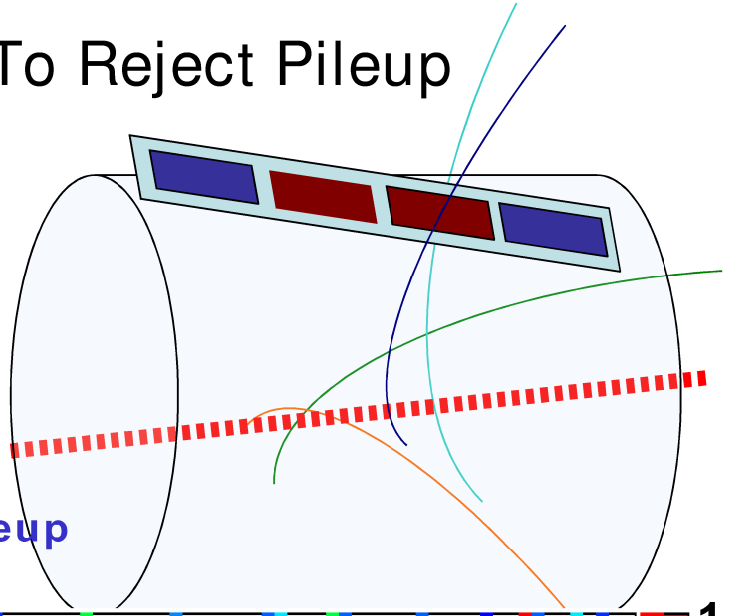


$x(z) = -0.304233 \text{ cm} + -0.00065732 * z$
$y(z) = 0.407226 \text{ cm} + 0.00012396 * z$

1) Project Track To Beam Line Check for 1cm DCA or less

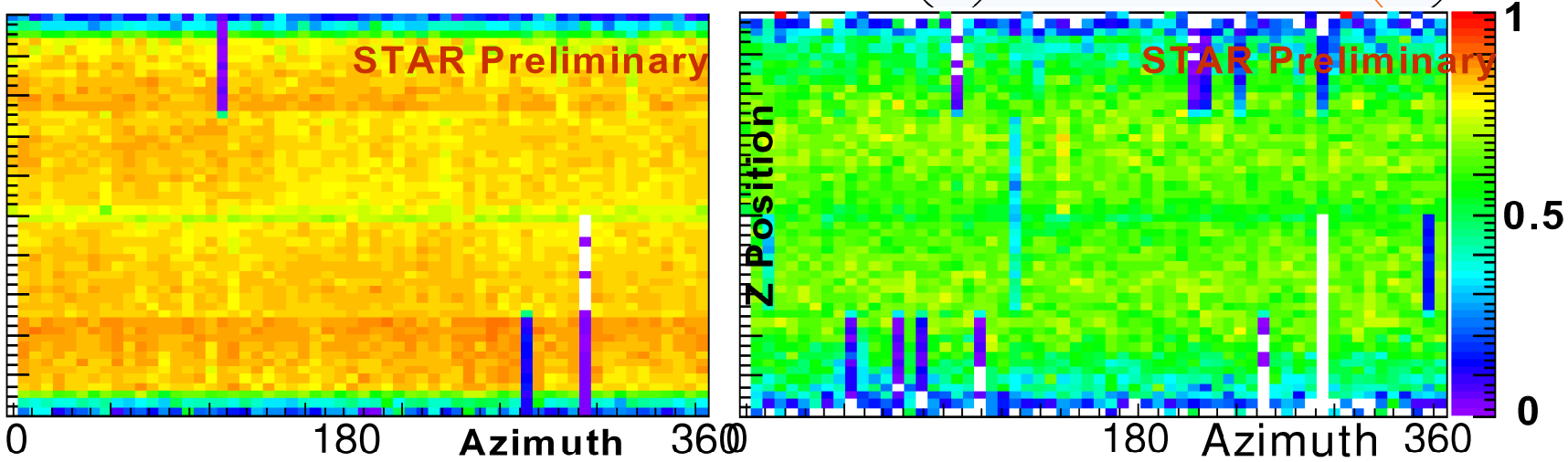
Match Track To CTB To Reject Pileup

$$\text{CTB Match Eff.} = \frac{\text{Track Matches CTB Hit}}{\text{Track Projects To CTB}}$$



Good Measure Of Pileup

Lower Matching Efficiency => Higher Pileup



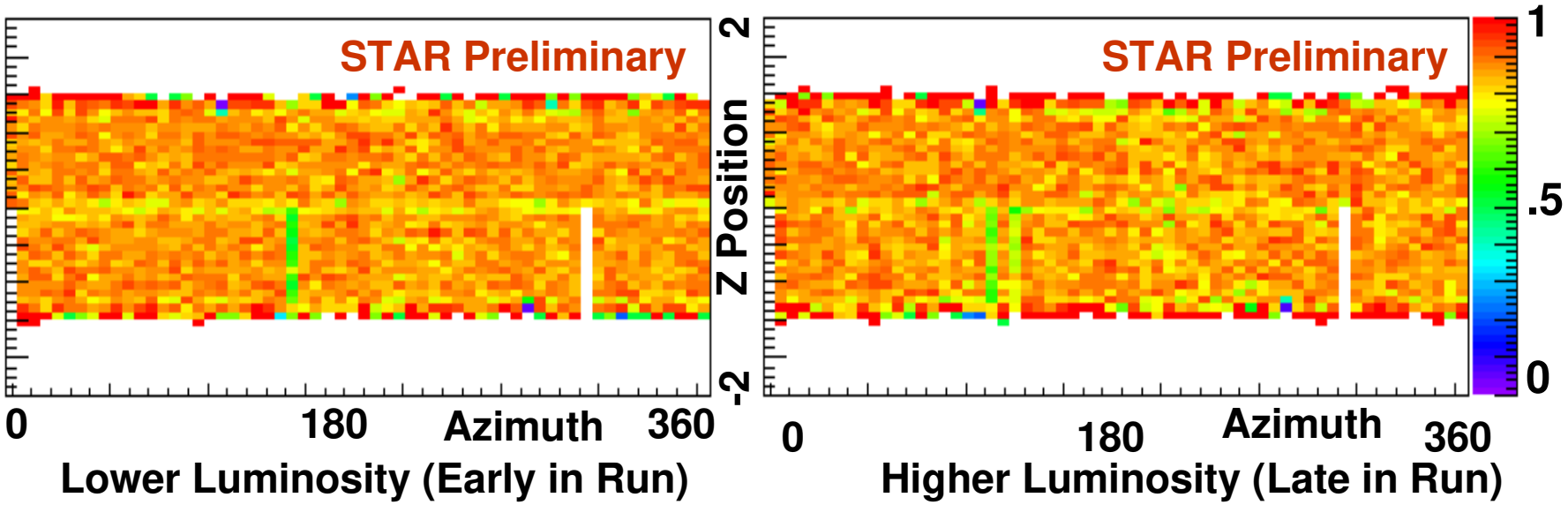
Lower Luminosity (Early in Run)

Higher Luminosity (Late in Run)

Note: 5-10% Matching Rate When CTBs Rotated by 90 degrees

Same Studies with SVT Matched Tracks

Lower Matching Efficiency => Higher Pileup



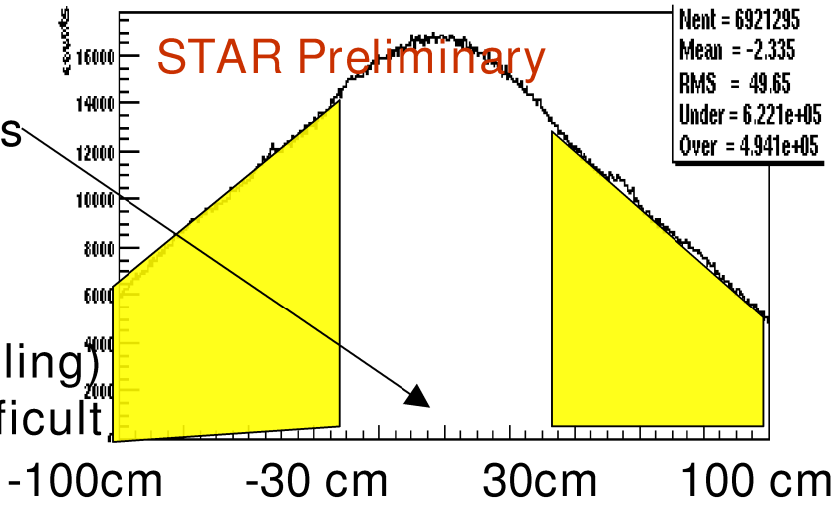
Note: 5-10% Matching Rate When CTBs Rotated by 90 degrees

Appears that SVT Matched Tracks Suffer Less Pileup!!
Can we use the SVT for pilup rejection?
Very Preliminary Result, needs more attention.

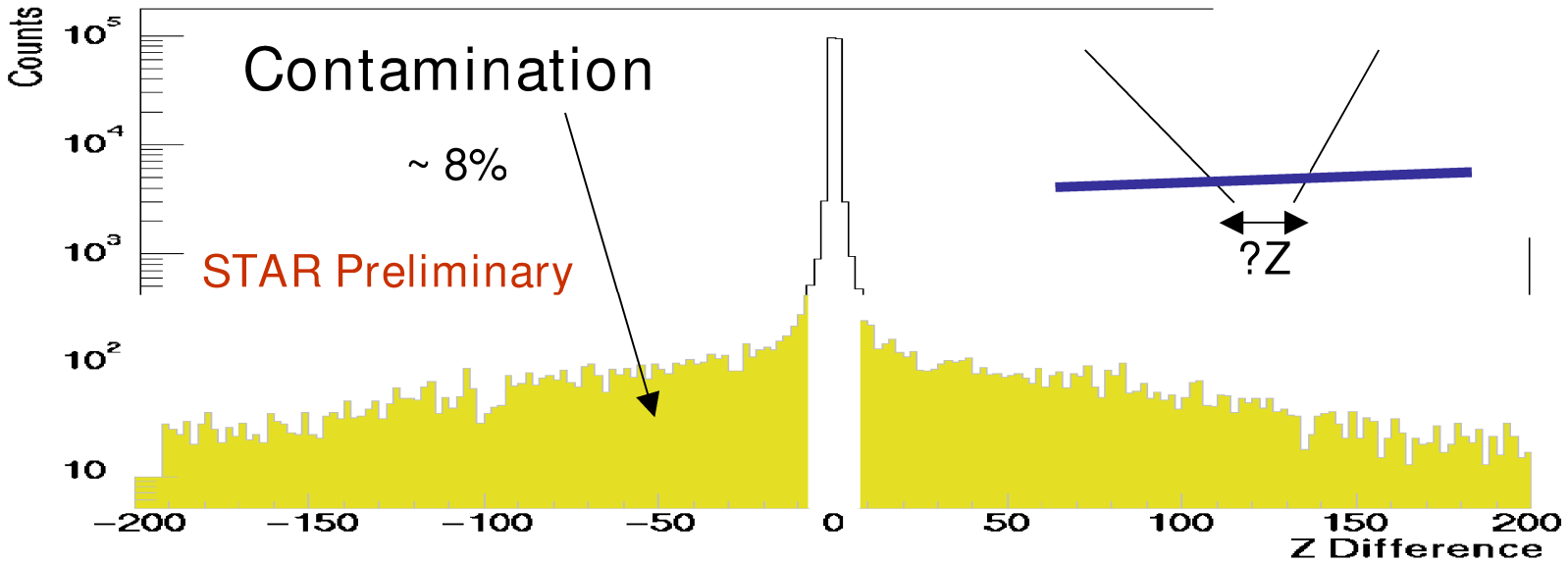
Drawbacks to No Vertex Method

Z position of vertex unknown

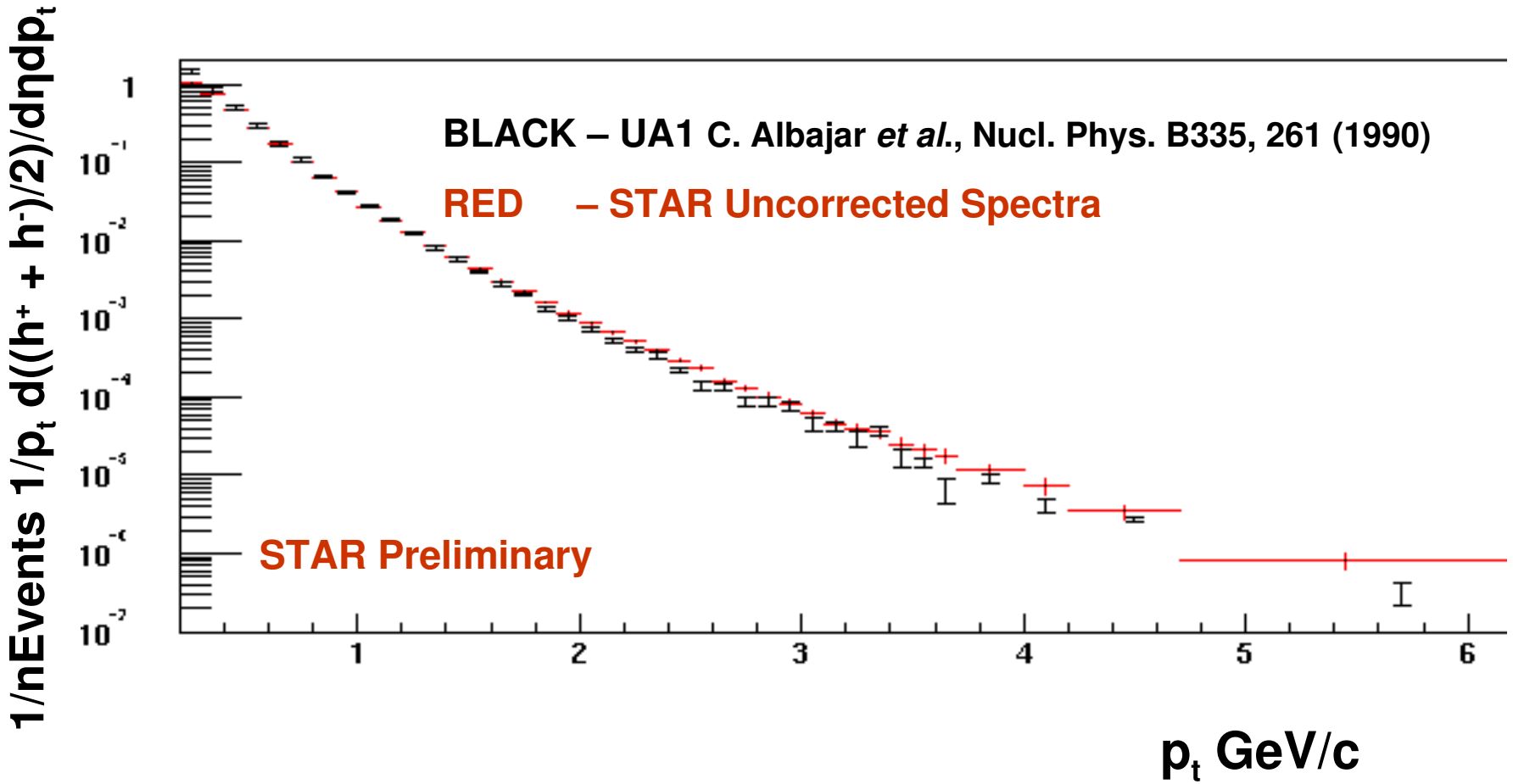
From Higher Multiplicity Events Get Z pos



Due To Added Material outside +/- 30 cm
(Inner Vertex Detector Electronics and Cooling)
Acceptance and Efficiency Corrections Difficult



UNCORRECTED Spectra

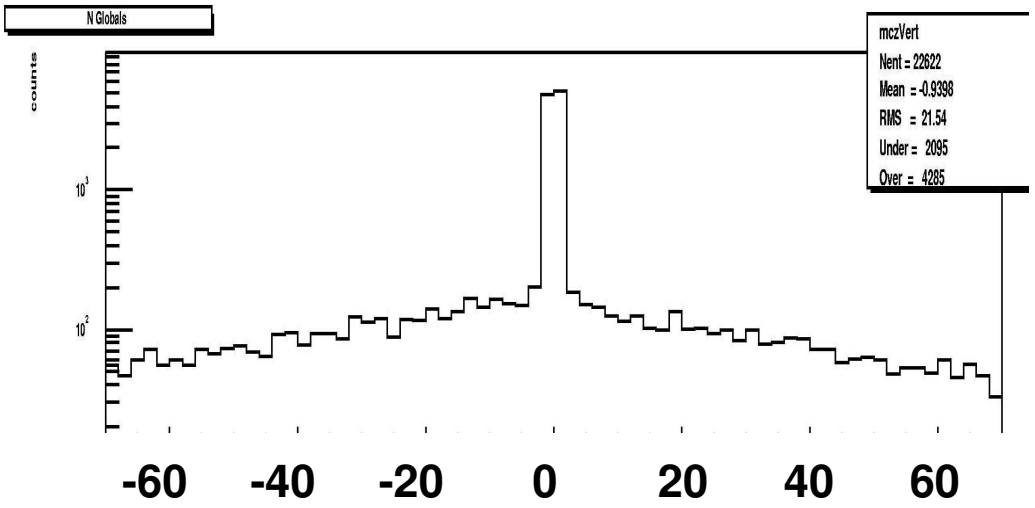


NEVER Trust A Log Plot

Future and Outlook

Investigating methods to constrain Z Vertex Position.

JG and P. Fachini investigating methods to accomplish this.



Mean z Projection - mcVertz

Efficiency and Acceptance Corrections currently being studied in pp

ITTF Vertex Finder