

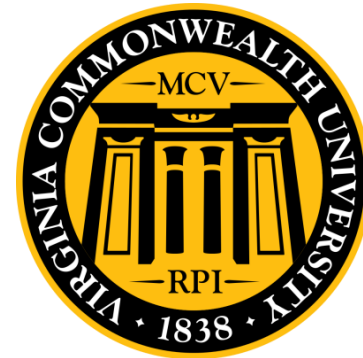


Primary Vertex and Pile-up Study

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INTRODUCTION



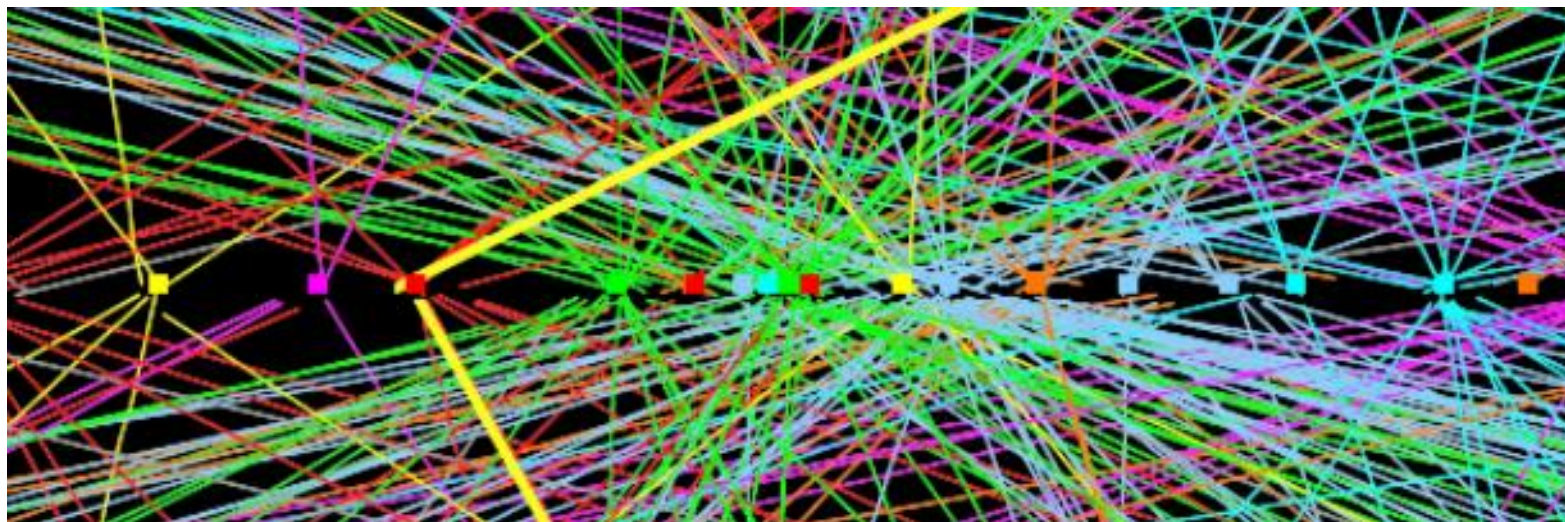
Long Term Goal

- Fast Tracking Trigger (FTK) *b*-tagging
 - Primary vertex needed to b-tag events
 - Pile-up vertices used to calculate background
 - $H \rightarrow b\bar{b} \rightarrow \sim 60\%$ for SM like Higgs
 - Search for di-Higgs or other interesting events
 - $HH \rightarrow b\bar{b} b\bar{b} \rightarrow \sim 33\%$ for SM like Higgs
- Algorithms to operate in the trigger
 - Location of the primary vertex
 - Number of the pile-up vertices
 - b-tag events to look for interesting physics



Project

- Work on algorithms to run in the trigger
 - Primary Vertex Finder
 - Main collision in the event
 - Can be used to b-tag events
 - Pile-up vertex counter
 - Used to determine size of background

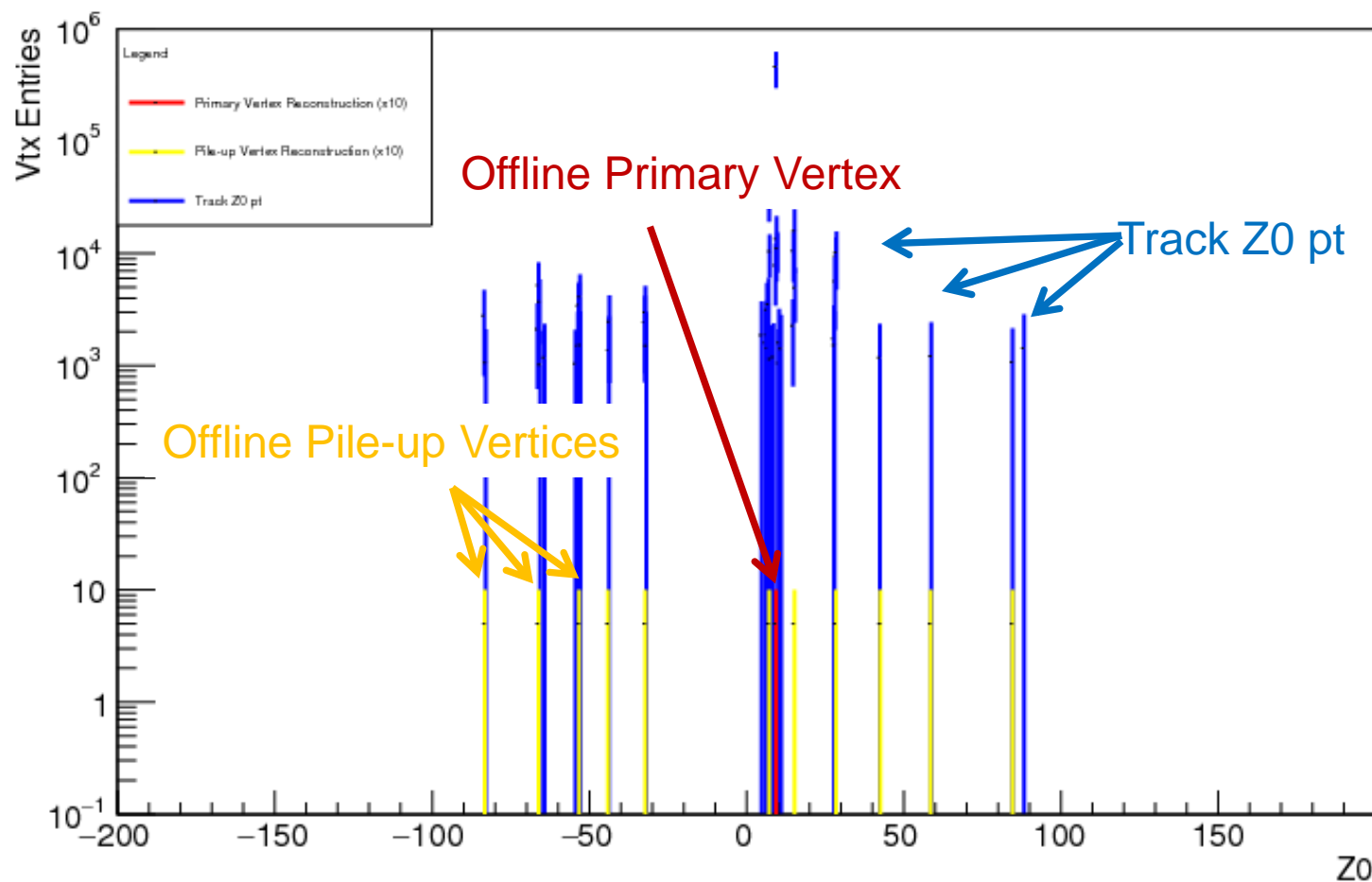




Event Display

- Primary vertex, Pile-up vertices, and Track p_T

Primary Vertex and Pile Up Study





Project Algorithms

- Primary Vertex Algorithms
 - Global maximum of sum track pt2 (GBL PT2 MAX)
 - Global maximum of sum track pt2 with ntrack cut (GBL MAX nCT)
- Pile-Up Vertex Algorithms
 - Local maximum sum track pt2 (LCL PT2 MAX)
 - Track multiplicity (TRK MULT)

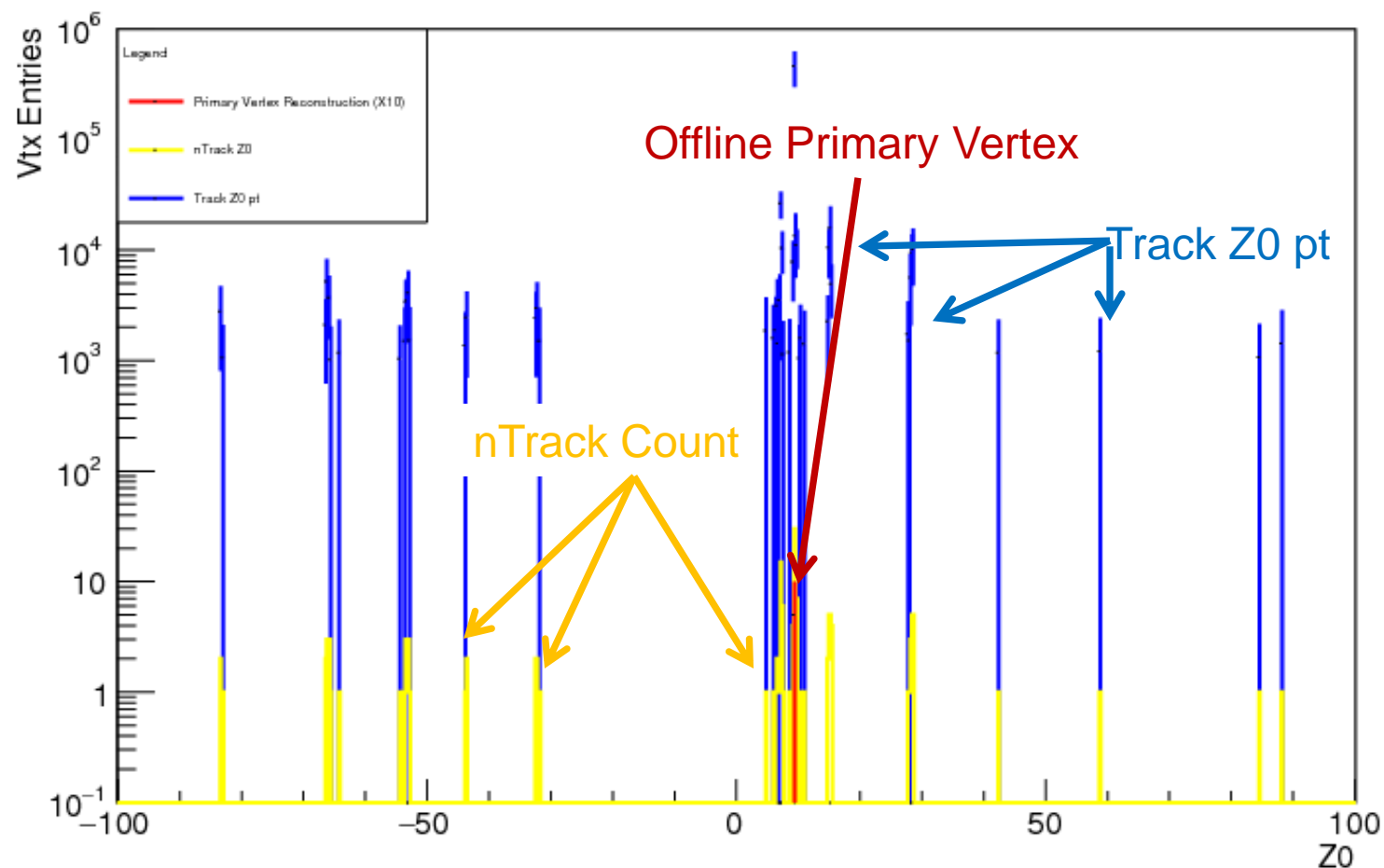


Primary Vertex – GLB PT2 MAX

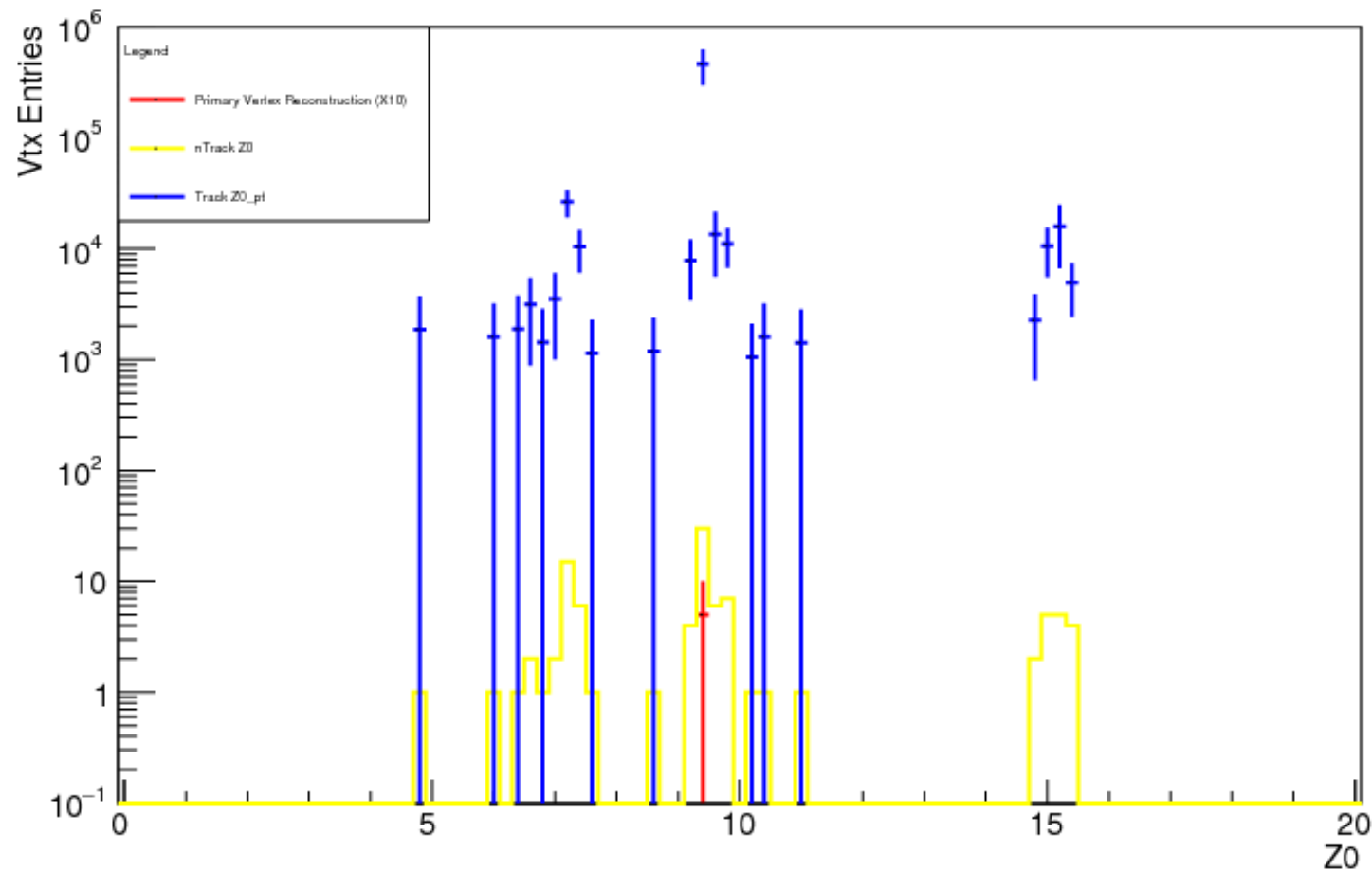
- Global maximum of sum track pt2 (GBL PT2 MAX)

Primary Vertex and Pile Up Study

Example Event

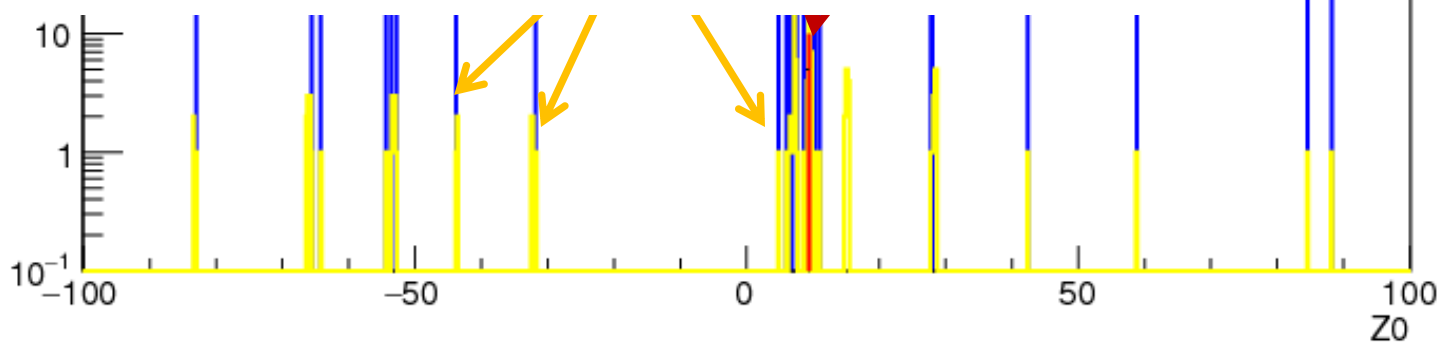


Primary Vertex and Pile Up Study

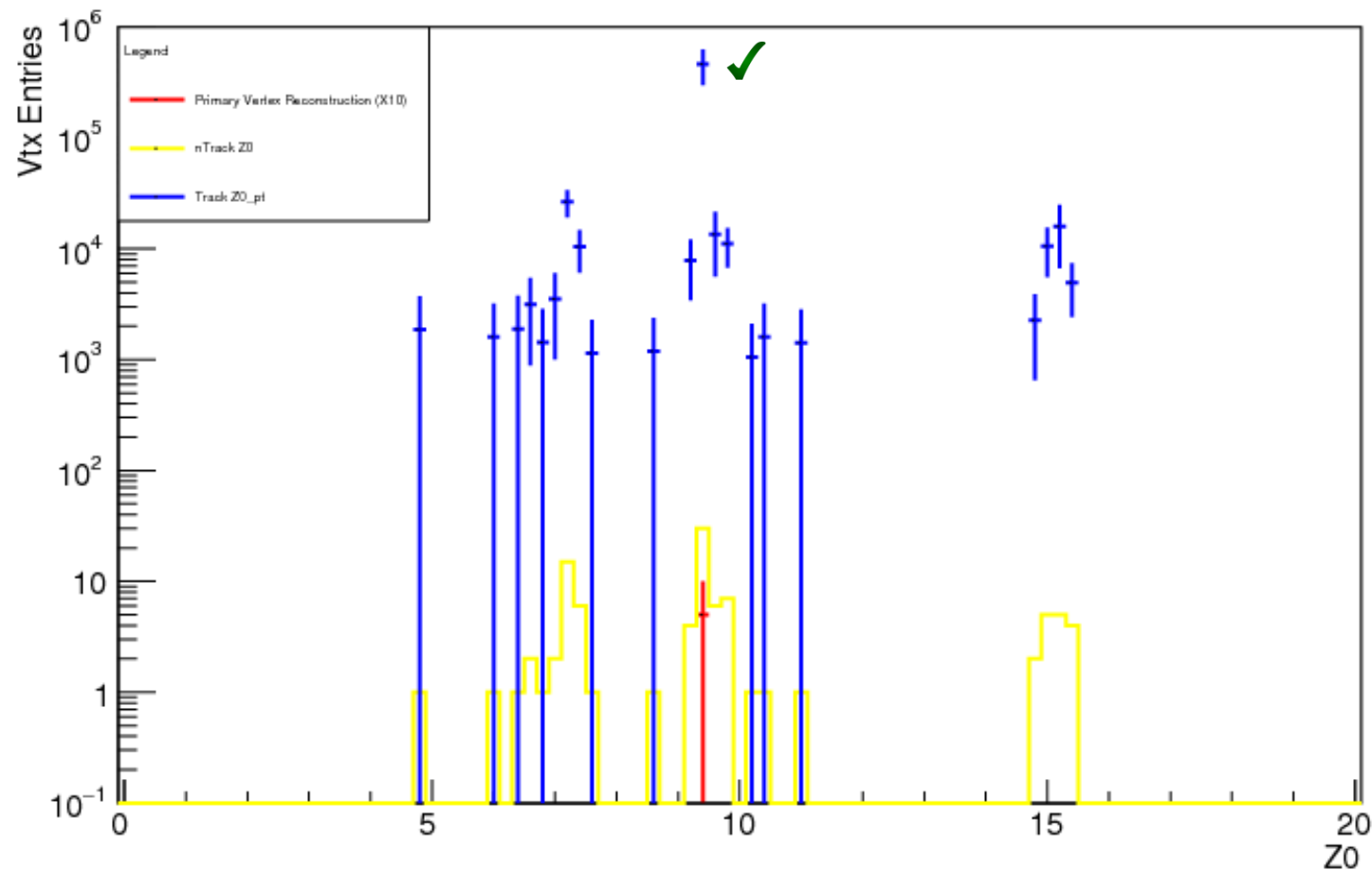


Example Event

< Z0 pt

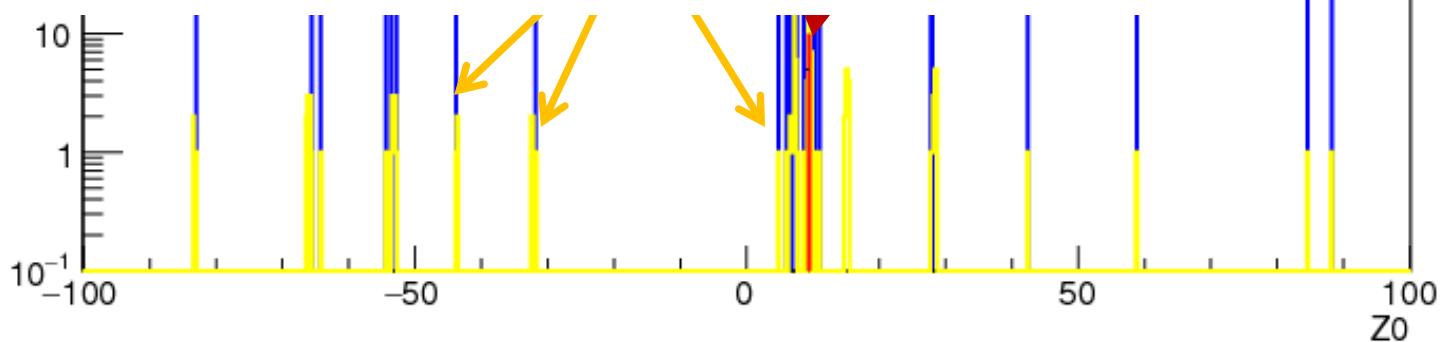


Primary Vertex and Pile Up Study



Example Event

< Z0 pt



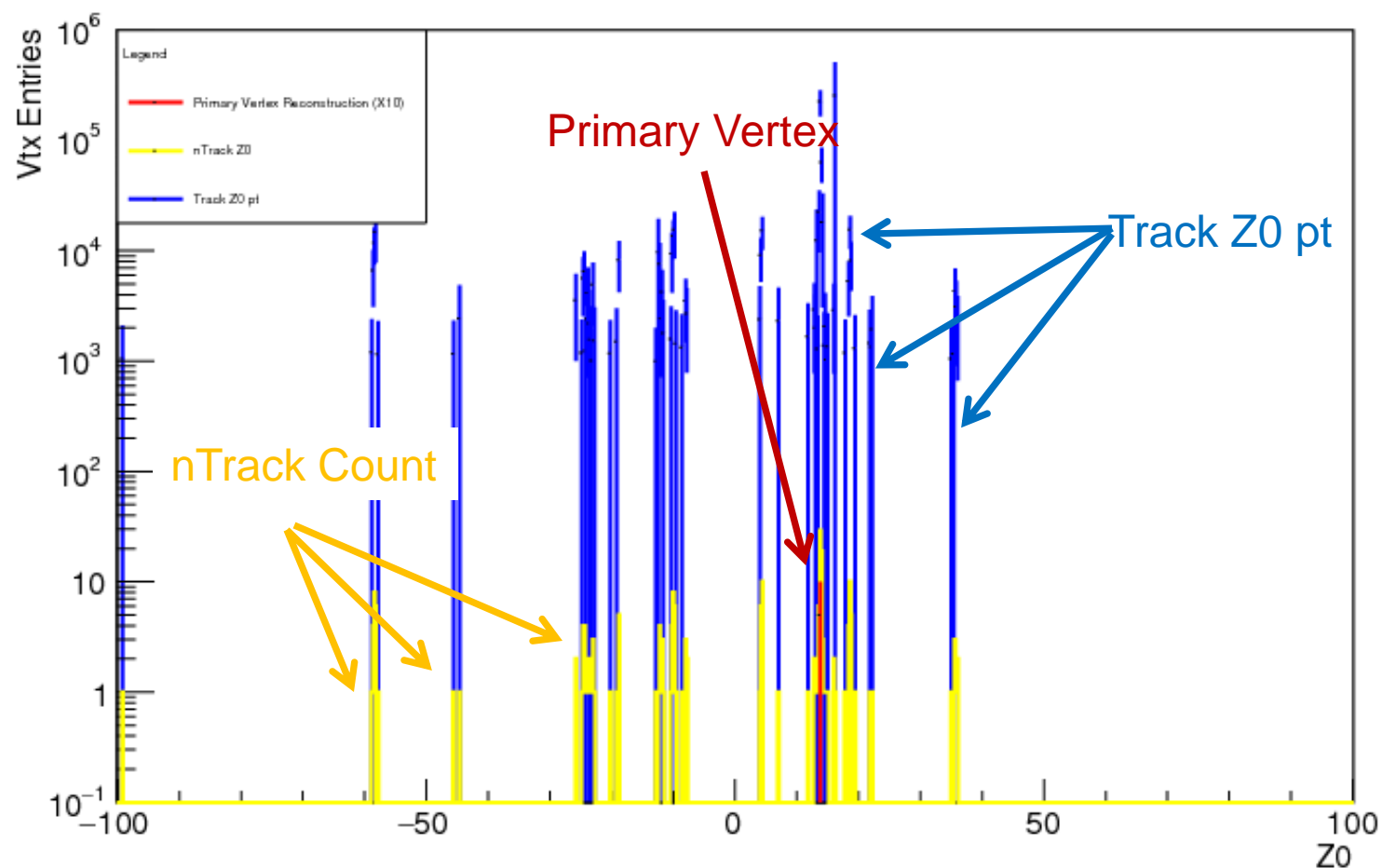


Primary Vertex – GLB MAX nCT

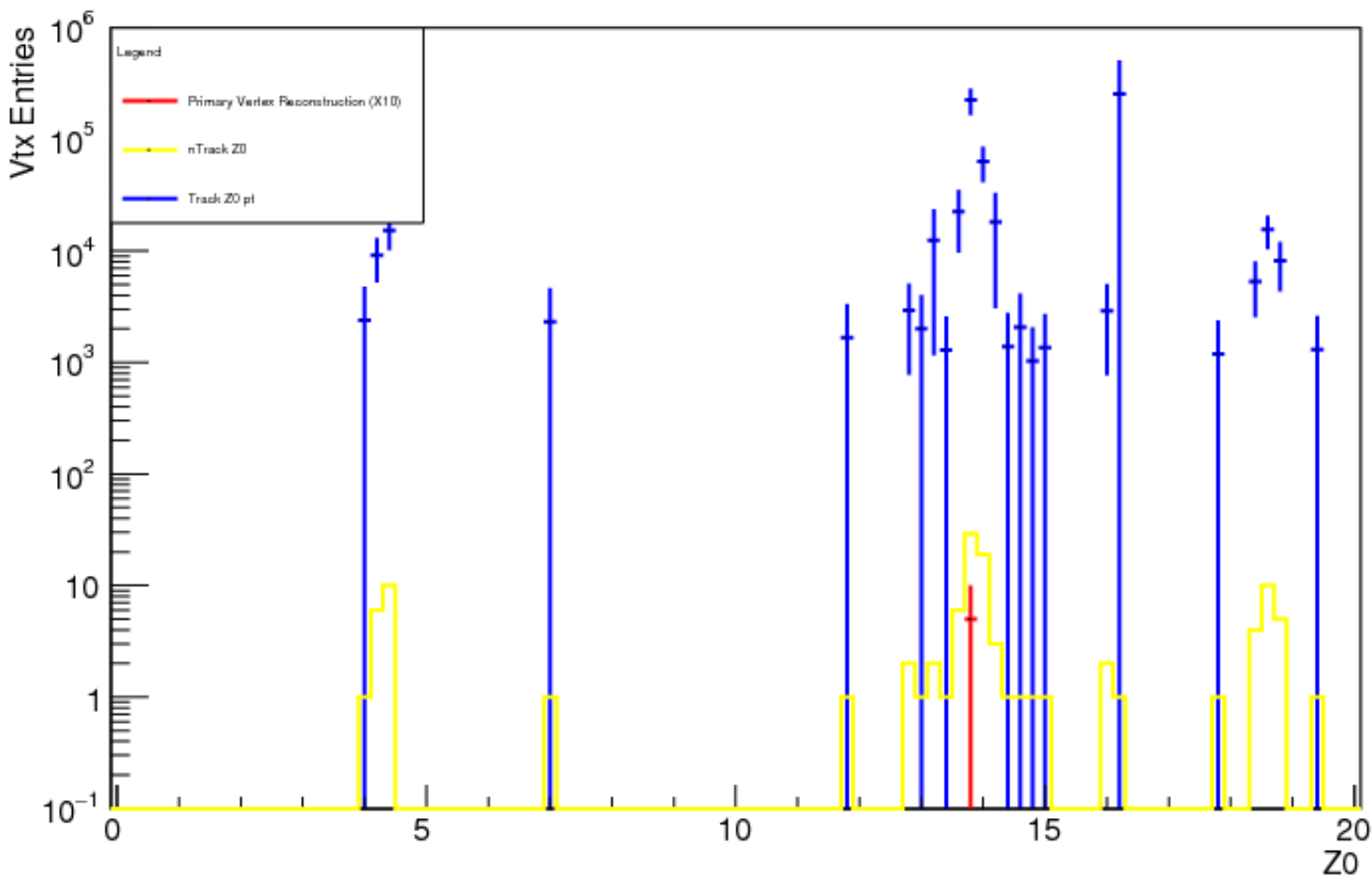
- Global maximum of sum track pt2 with ntrack cut (GLB MAX nCT)

Primary Vertex and Pile Up Study

Example Event 2



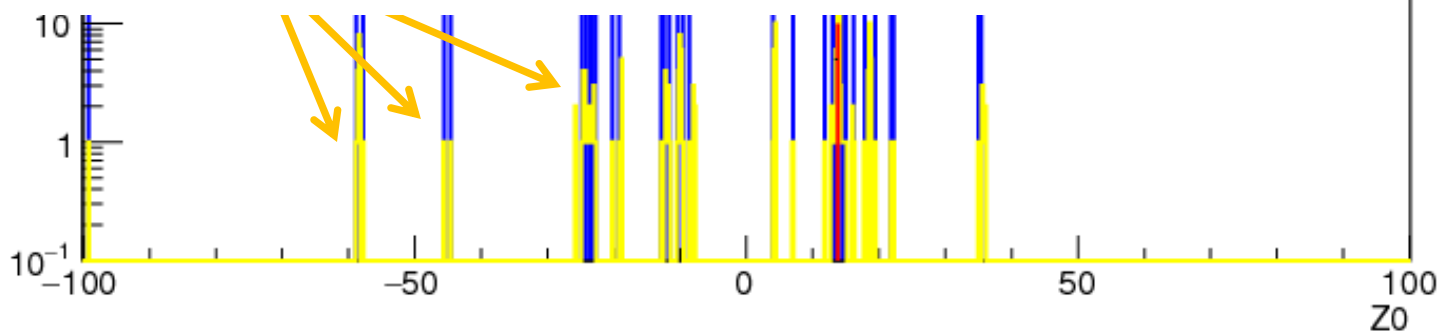
Primary Vertex and Pile Up Study



- MAX nCT)

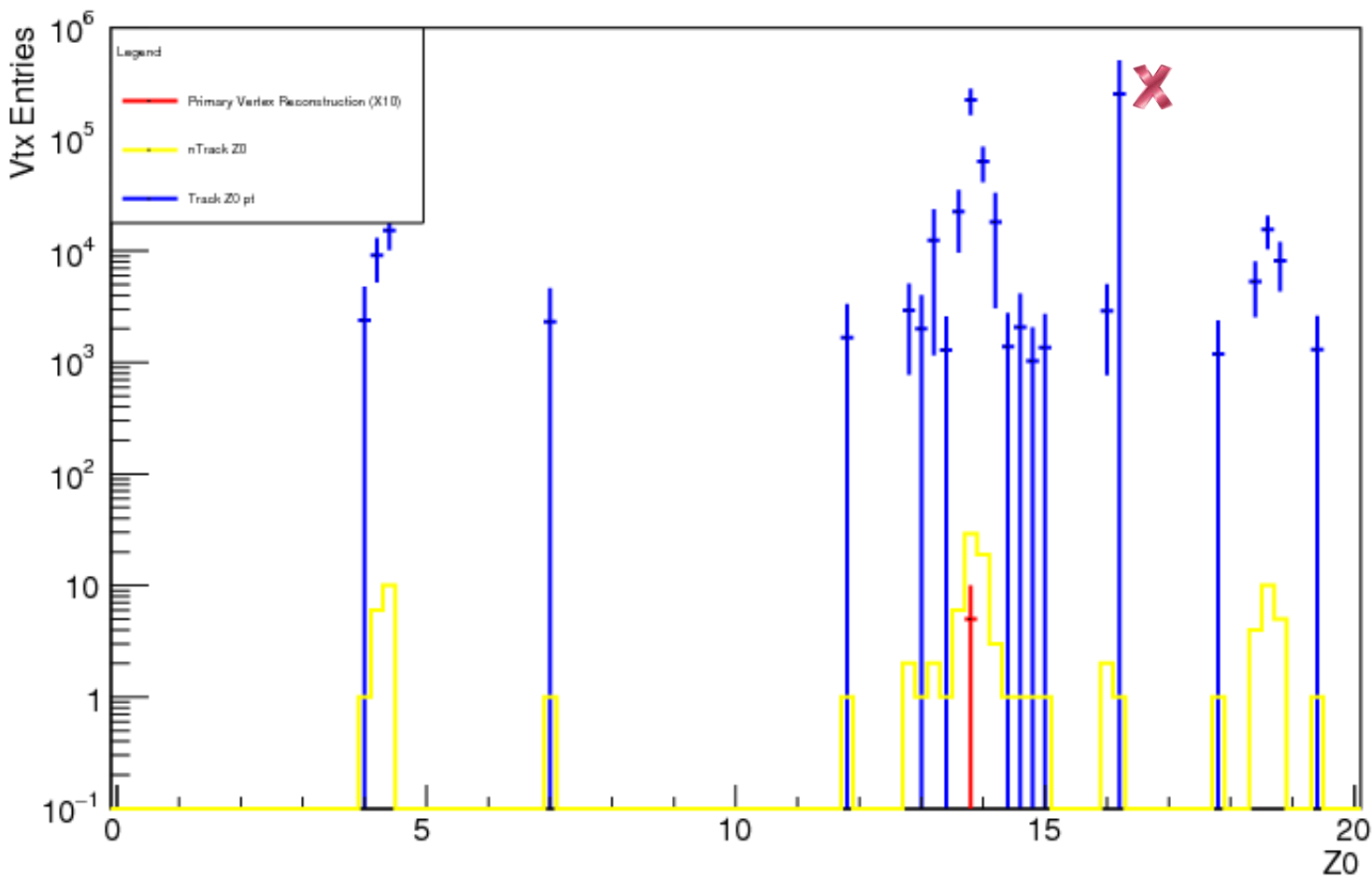
Example Event 2

< Z0 pt





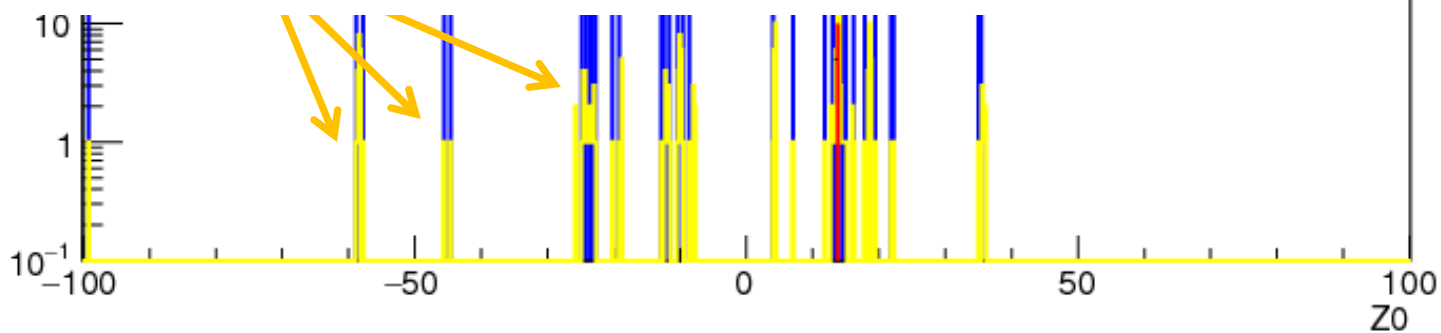
Primary Vertex and Pile Up Study



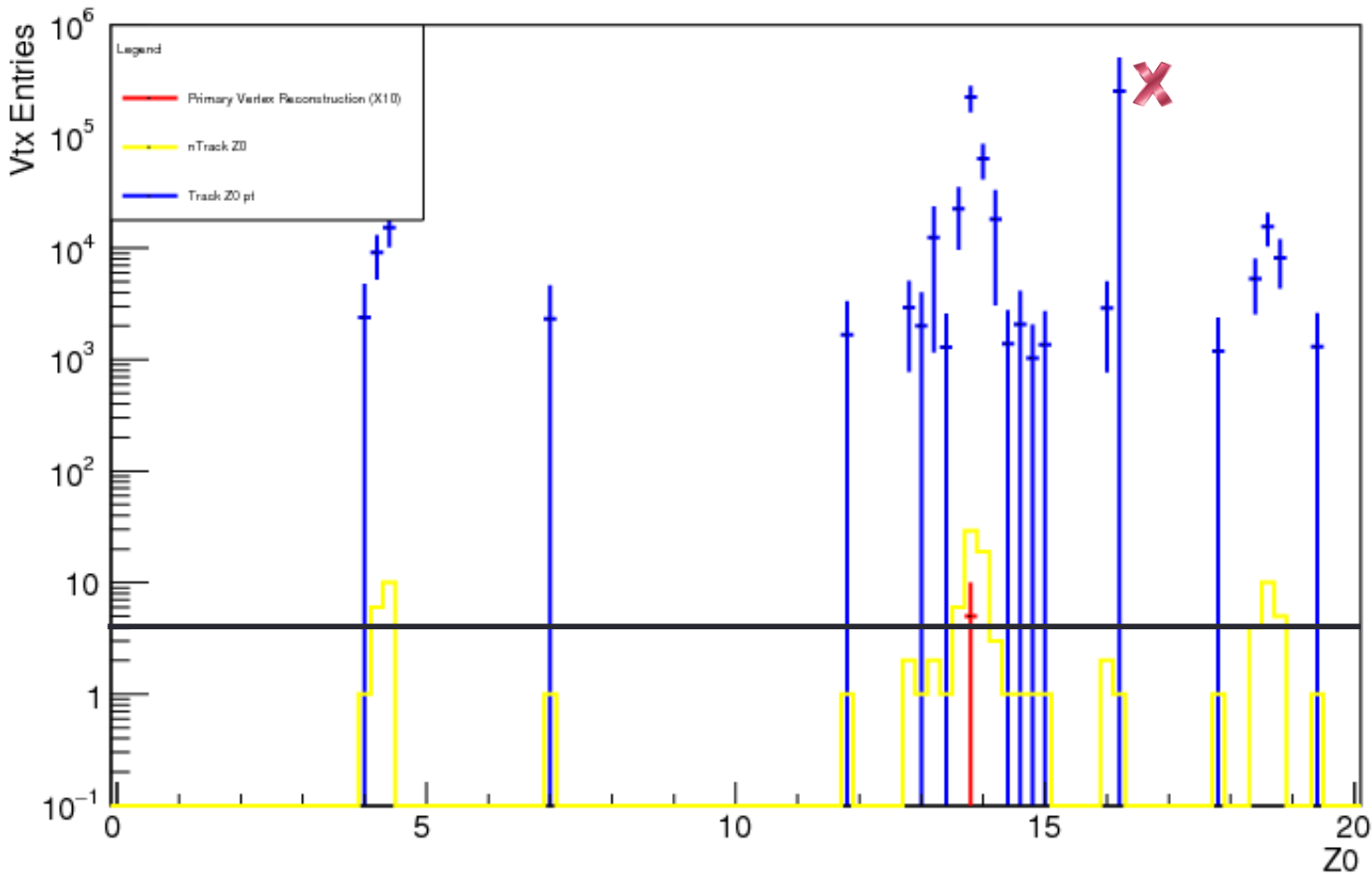
- MAX nCT)

Example Event 2

< Z0 pt



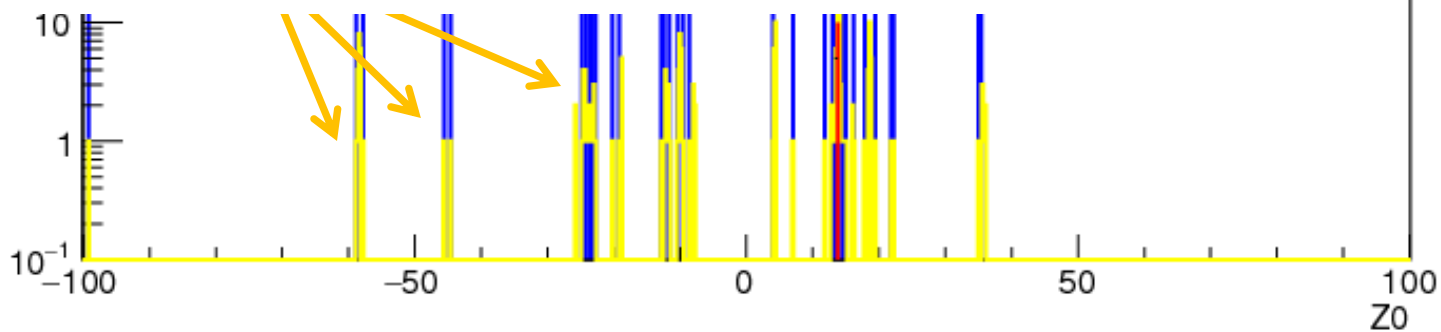
Primary Vertex and Pile Up Study



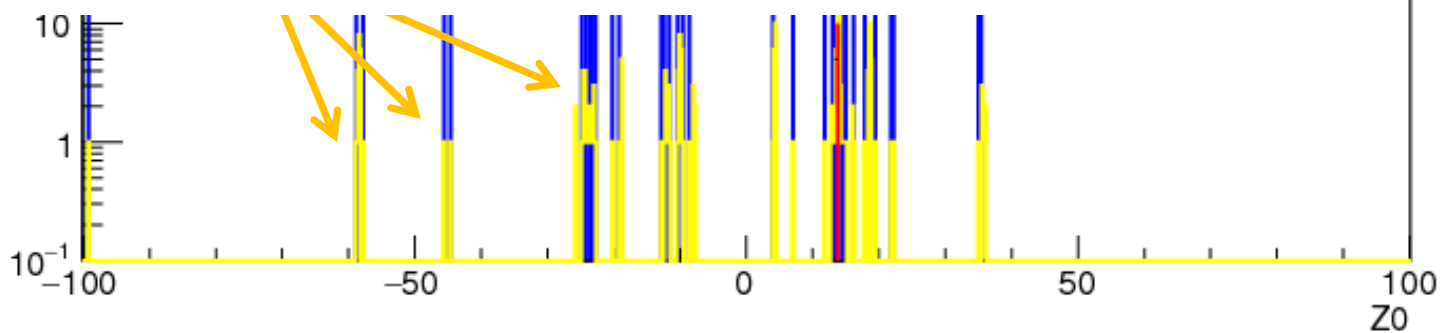
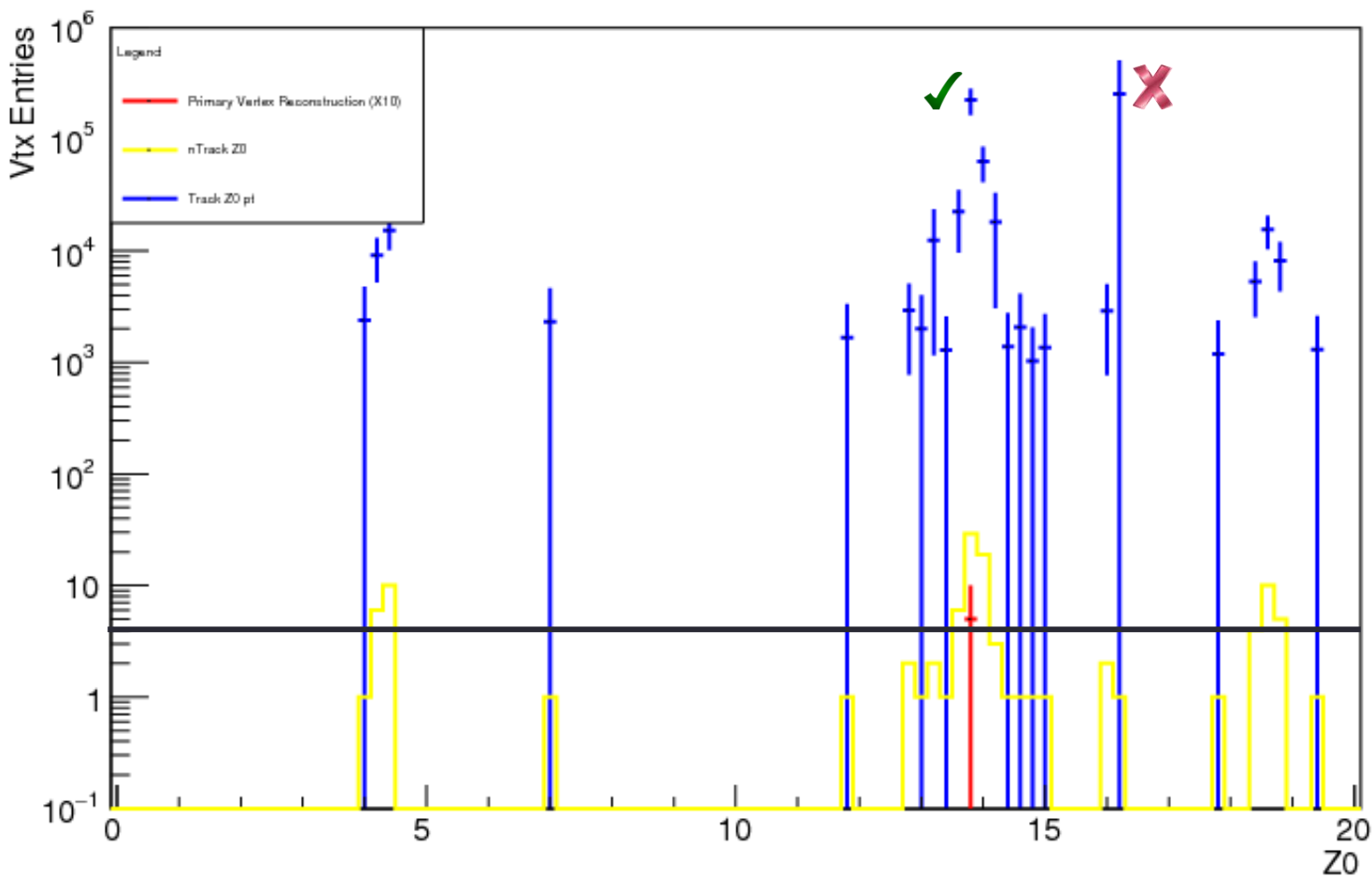
- MAX nCT)

Example Event 2

< Z0 pt



Primary Vertex and Pile Up Study





Project Algorithms

- Primary Vertex Algorithms
 - Global maximum of sum track pt2 (GBL PT2 MAX)
 - Global maximum of sum track pt2 with ntrack cut (GBL MAX nCT)
- Pile-Up Vertex Algorithms
 - Local maximum sum track pt2 (LCL PT2 MAX)
 - Track multiplicity (TRK MULT)

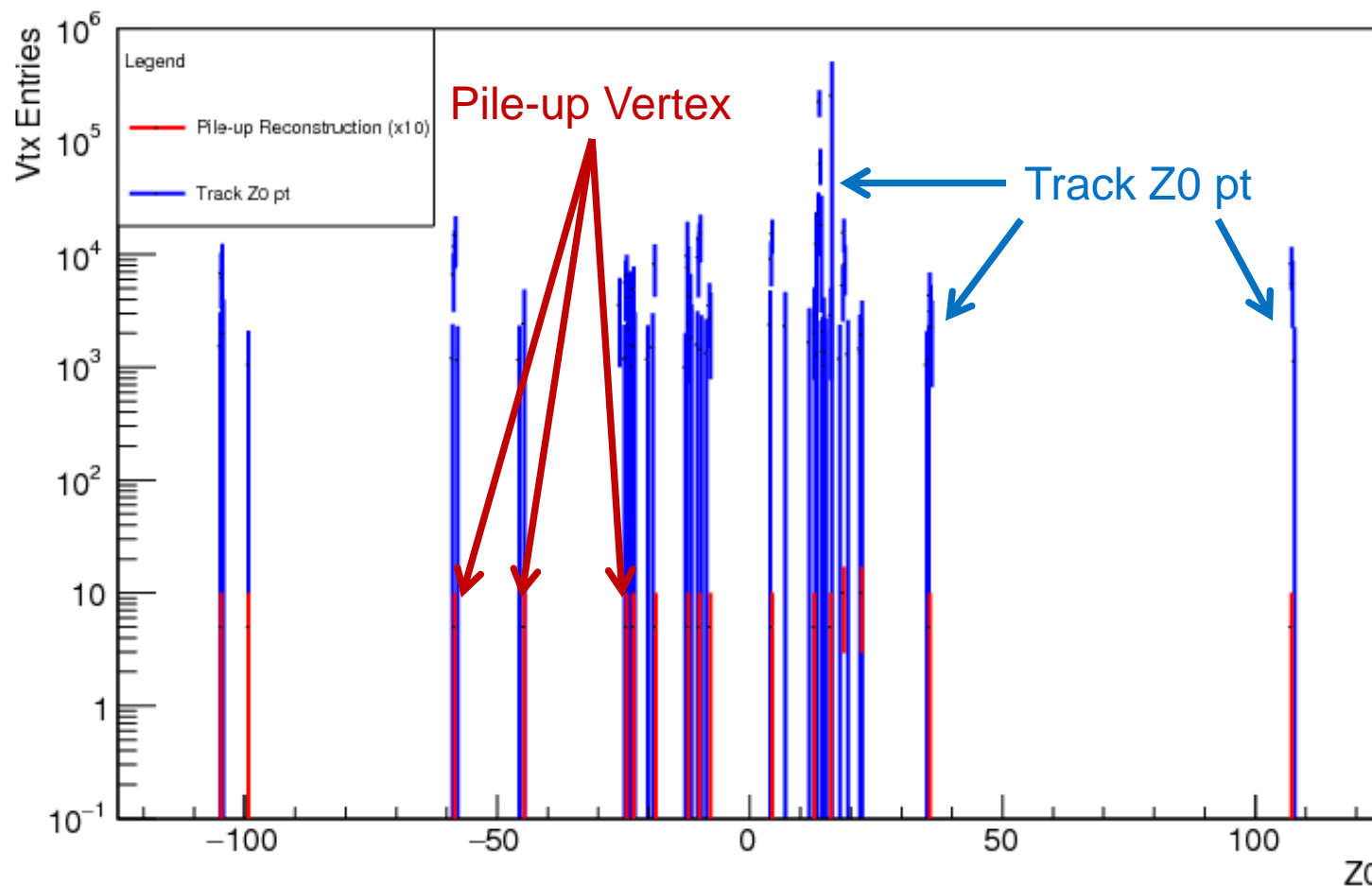


Pile-up Vertex – LCL PT2 MAX

- Local maximum sum track pt2 (LCL PT2 MAX)

Primary Vertex and Pile Up Study

Example Event 3



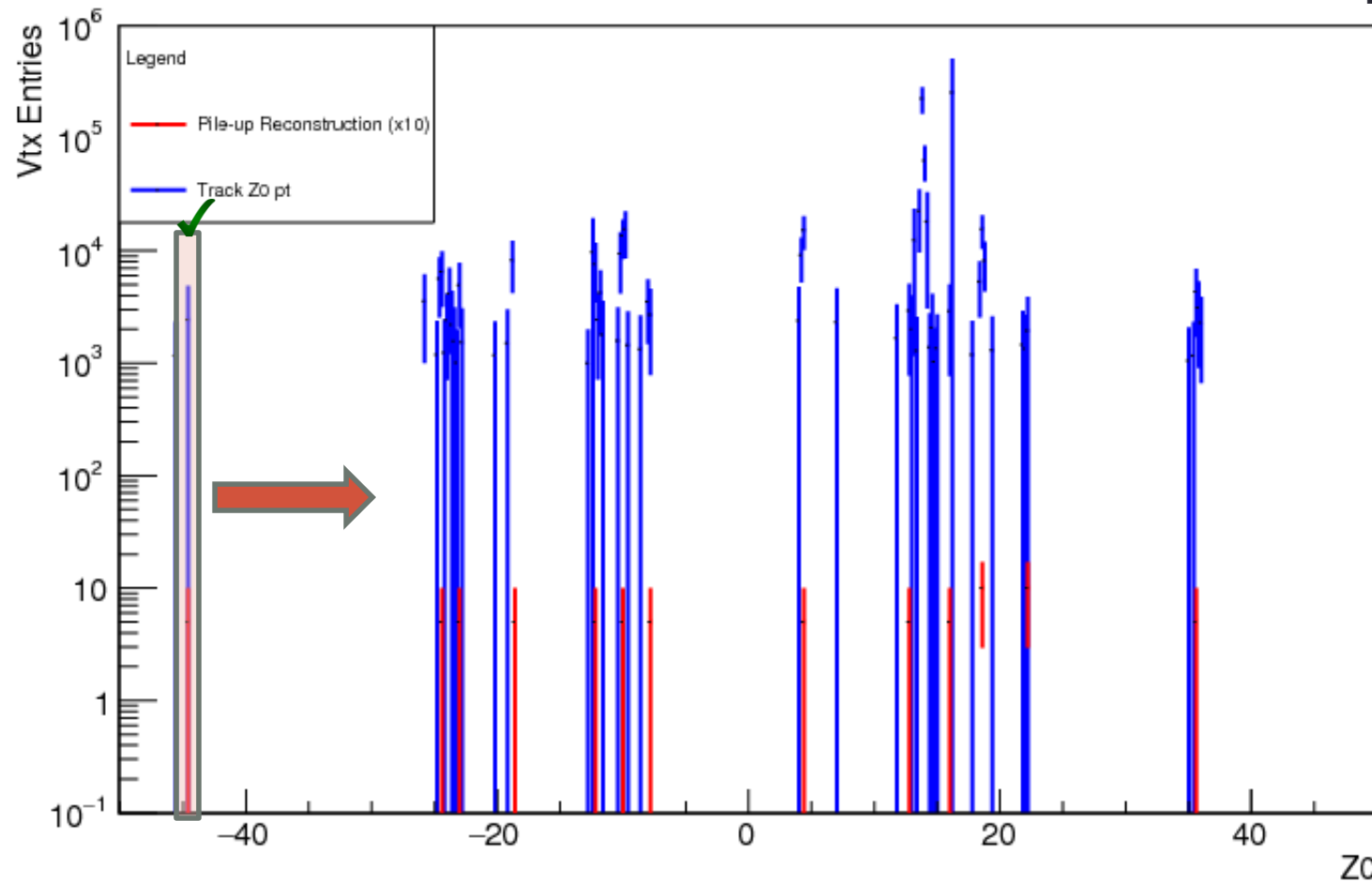


Pile-up Vertex – LCL PT2 MAX

- Local maximum sum track pt2 (LCL PT2 MAX)

Primary Vertex and Pile Up Study

Example Event 3



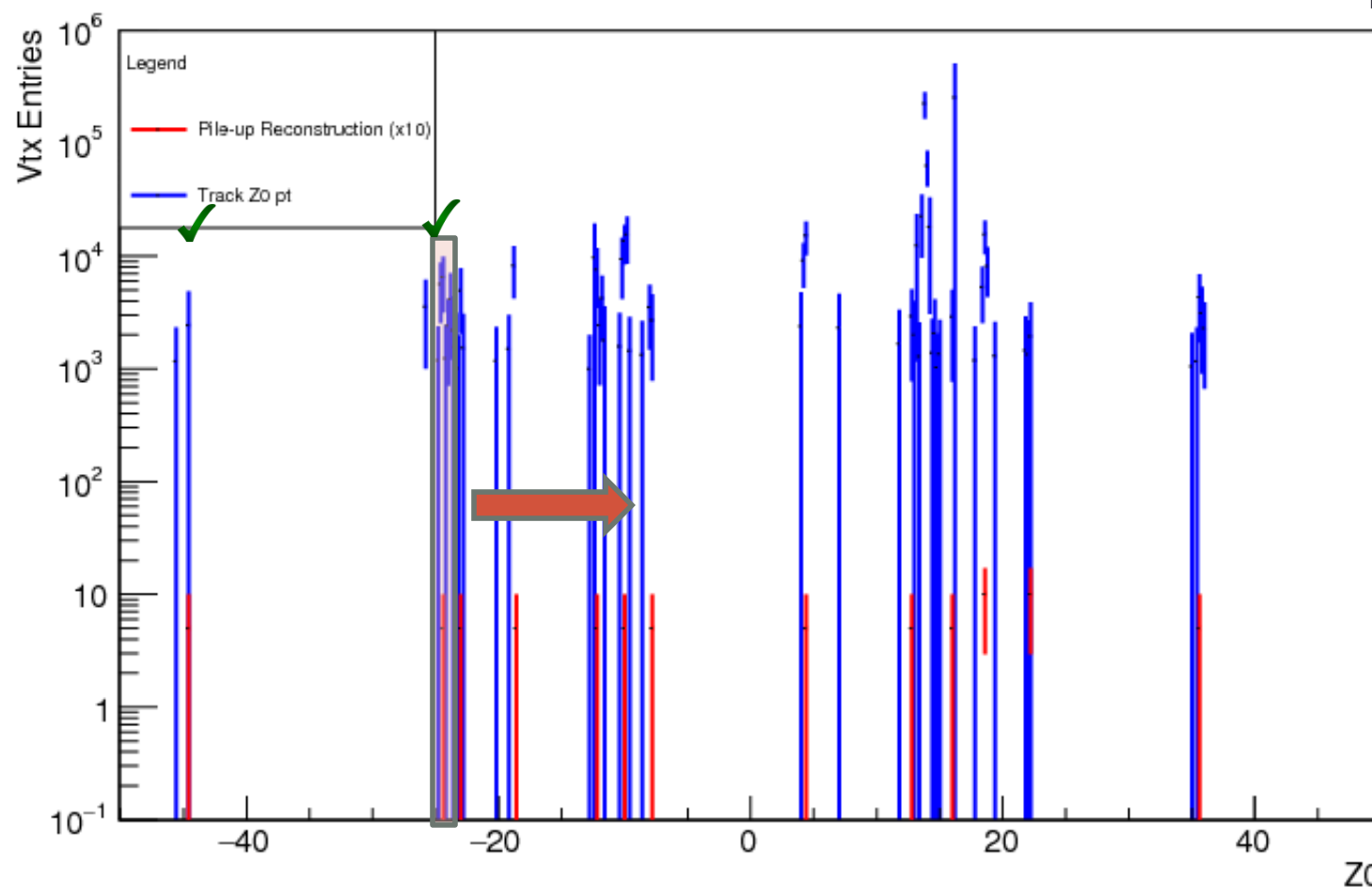


Pile-up Vertex – LCL PT2 MAX

- Local maximum sum track pt2 (LCL PT2 MAX)

Primary Vertex and Pile Up Study

Example Event 3



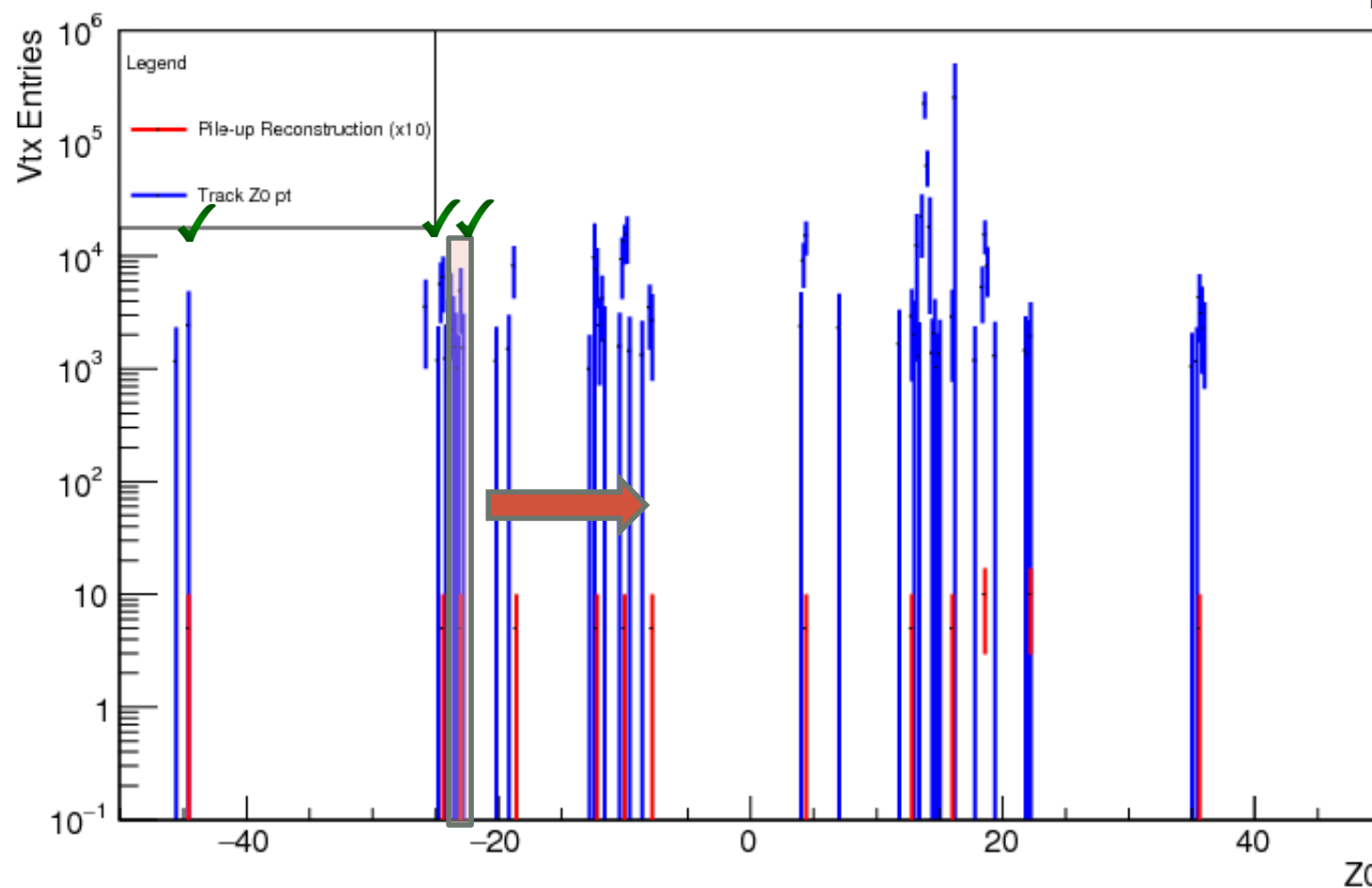


Pile-up Vertex – LCL PT2 MAX

- Local maximum sum track pt2 (LCL PT2 MAX)

Primary Vertex and Pile Up Study

Example Event 3



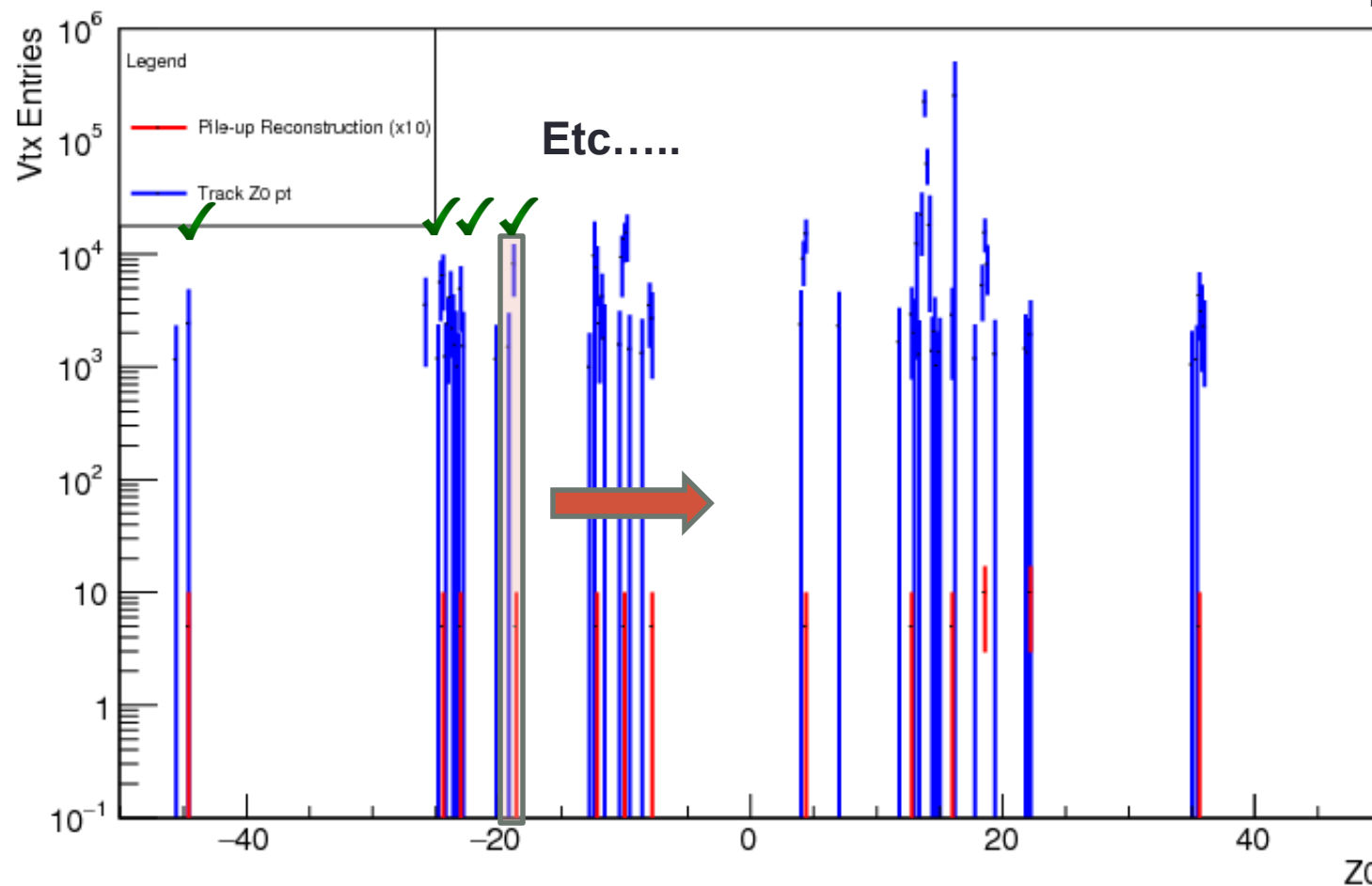


Pile-up Vertex – LCL PT2 MAX

- Local maximum sum track pt2 (LCL PT2 MAX)

Primary Vertex and Pile Up Study

Example Event 3



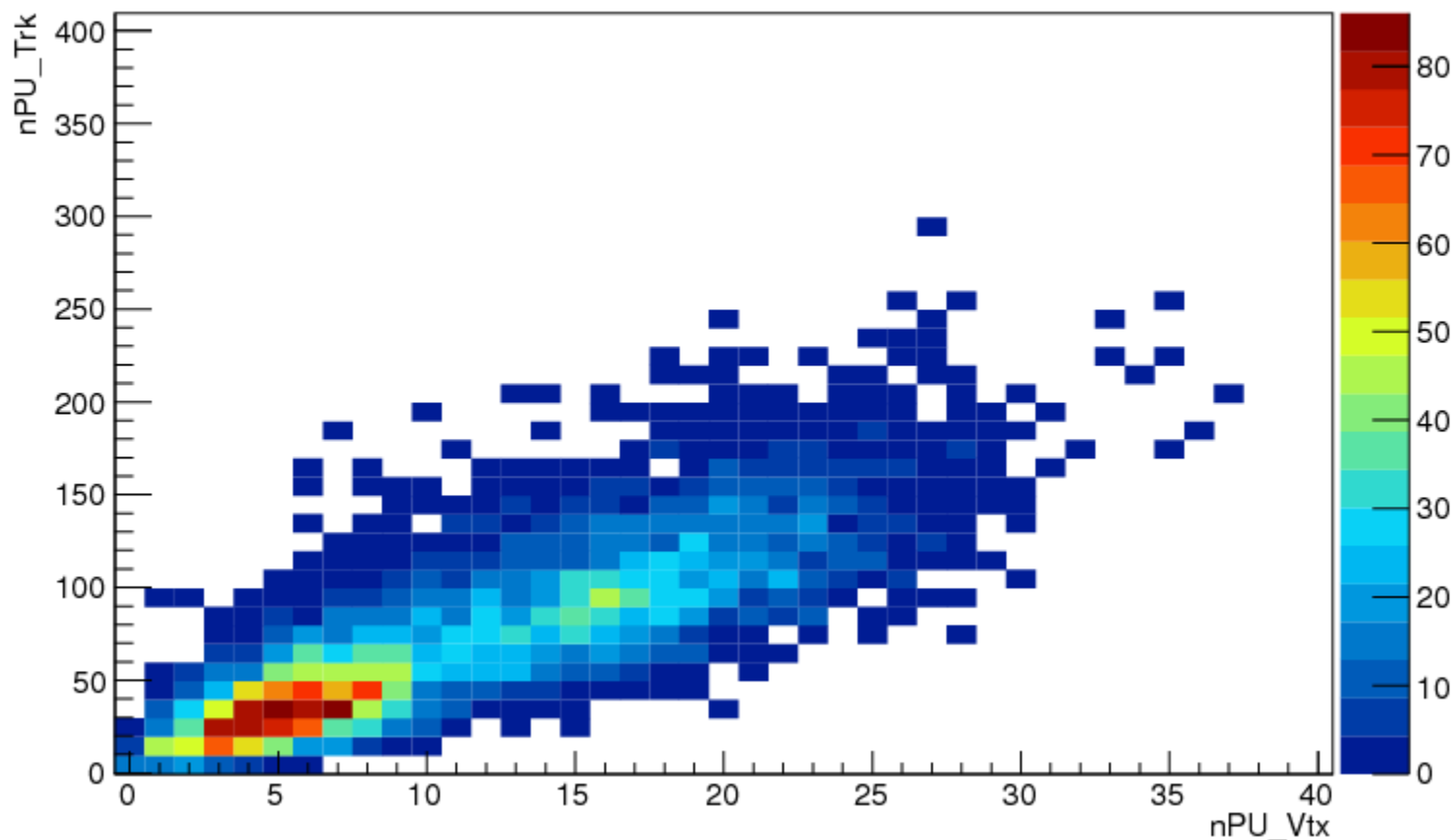


Pile-up Vertex – TRK MULT

- Track multiplicity (TRK MULT)

Example Sample

Pile-up Study Vertex Scatter Plot Trk_pt_cut=1 GeV



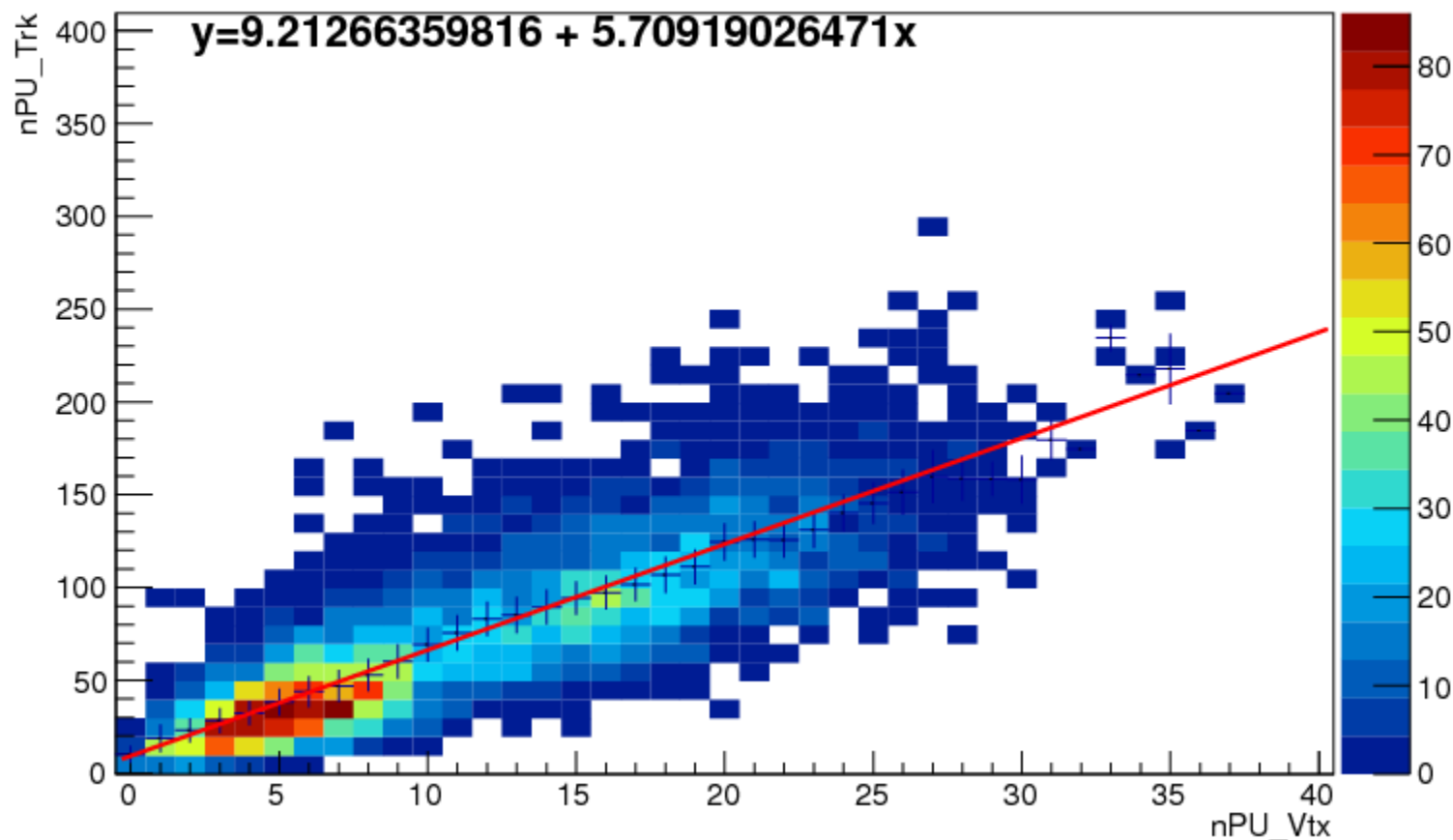


Pile-up Vertex – TRK MULT

- Track multiplicity (TRK MULT)

Example Sample

Pile-up Study Vertex Scatter Plot Trk_pt_cut=1 GeV



ADJUSTMENTS



Algorithm Adjustments

- $t\bar{t}$ samples did not run as well as di-jet sample
 - Changed sum pt to sum pt²
 - Weights higher pt tracks more
 - Changed Primary Vertex GBL MAX nCT
 - Changed from complex track cut to simple cut
 - Adjusted the bin size (0.1mm \rightarrow 0.5mm)

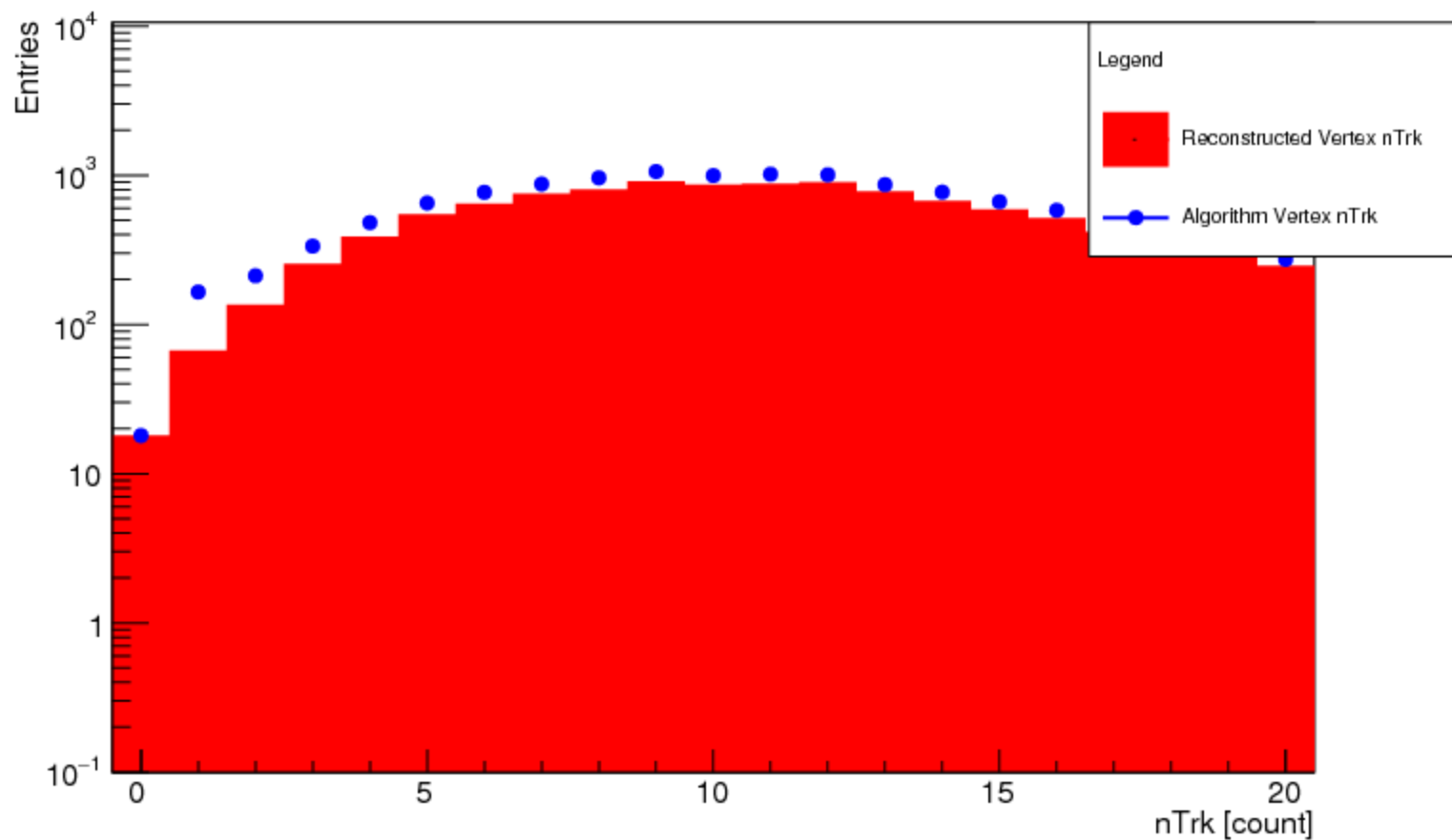


BIN SIZE 0.1MM



Bin Size 0.1mm

Track Info: nTrk



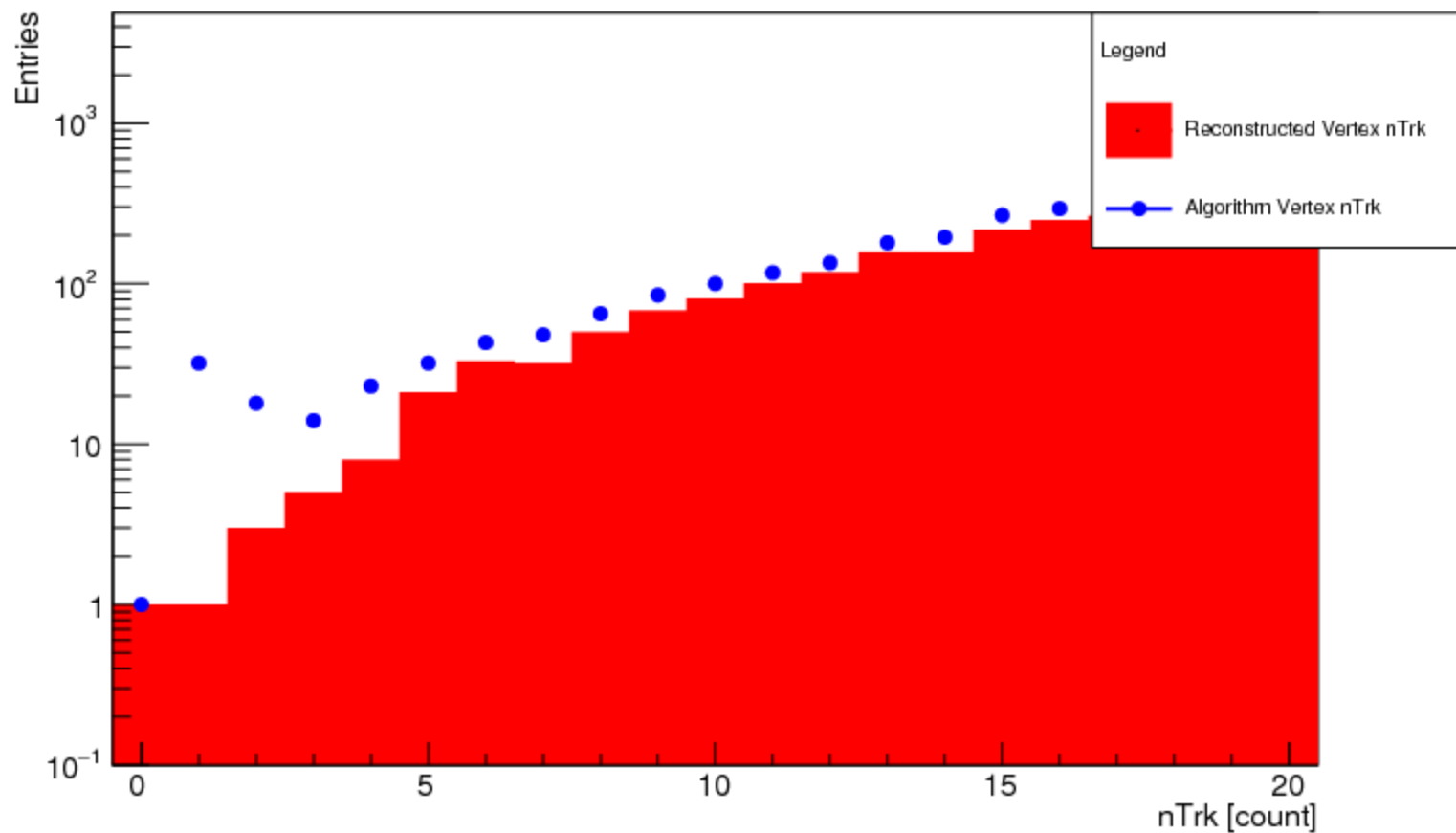


BIN SIZE 0.5MM



Bin Size 0.5mm

Track Info: nTrk



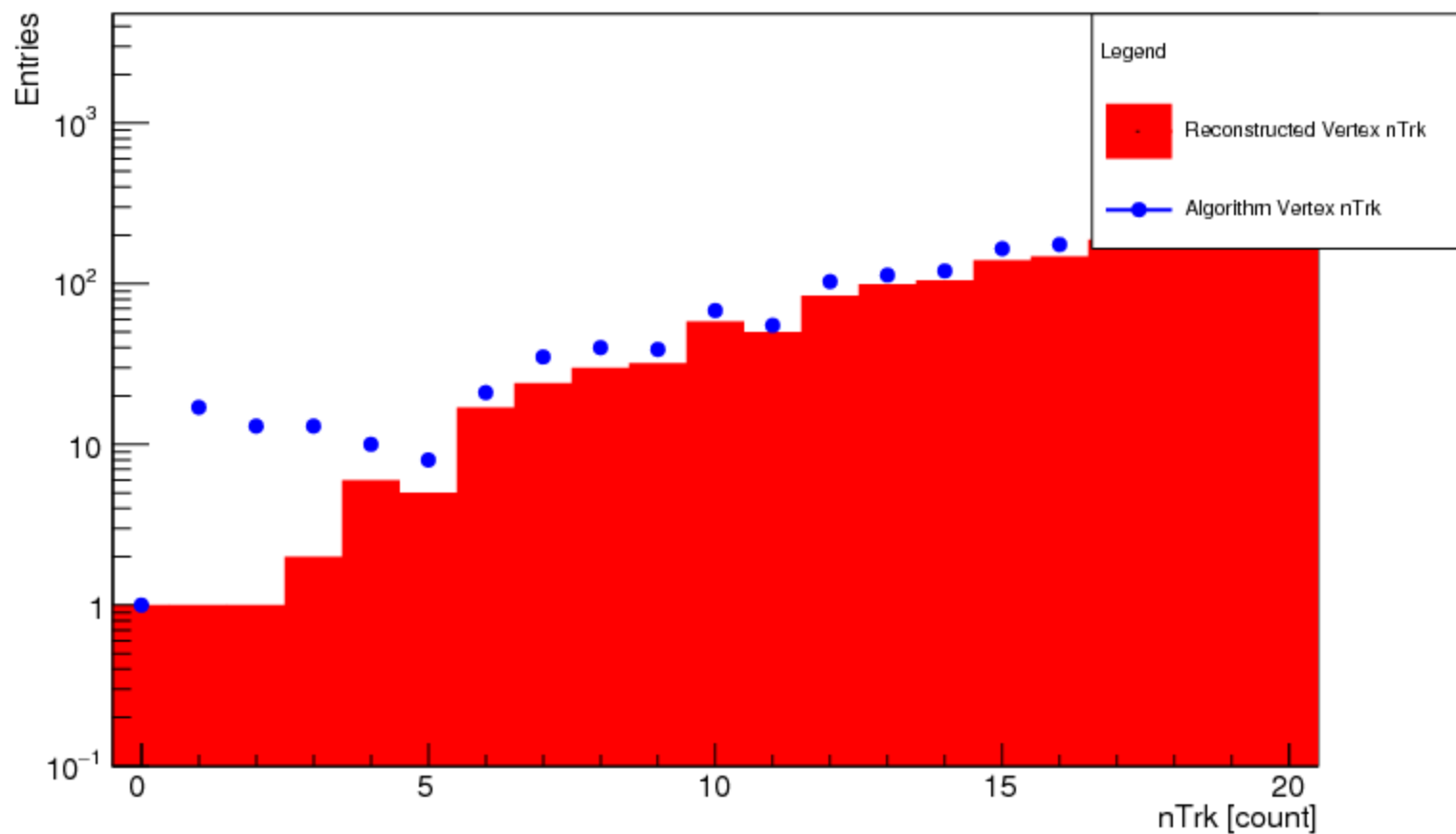


BIN SIZE 0.9MM



Bin Size 0.9mm

Track Info: nTrk



RESULTS



PRIMARY VERTEX STUDY

[12000 EVENTS]

Global maximum of sum track pt2 (GBL PT2 MAX)

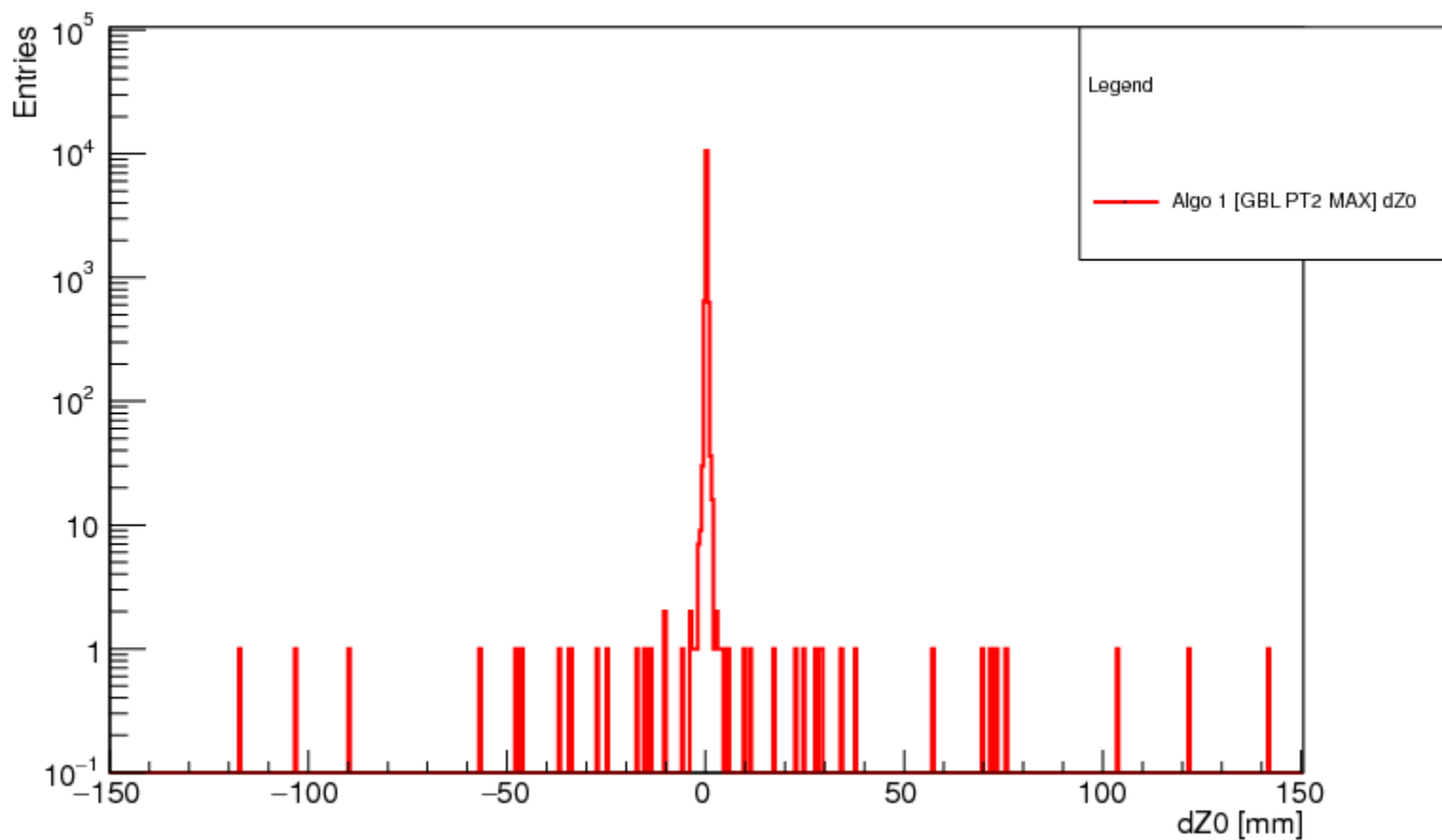
Global maximum of sum track pt2 with ntrack cut (GBL MAX nCT)



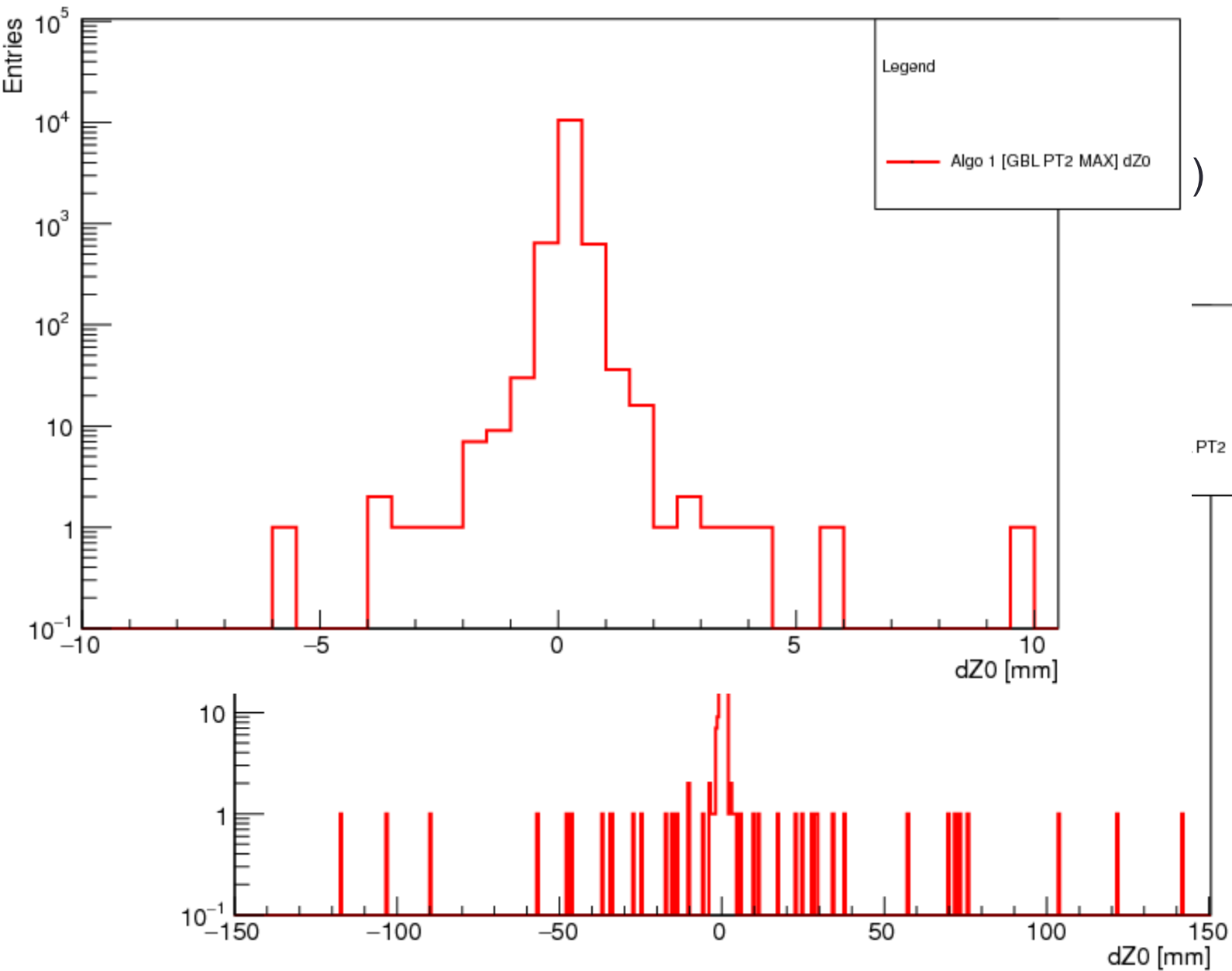
Primary Vertex GBL PT2 MAX dZ0

- Distance between GBL PT2 MAX and Reconstruction (dZ0)

Track Info: Algo 1 [GBL PT2 MAX] dZ0



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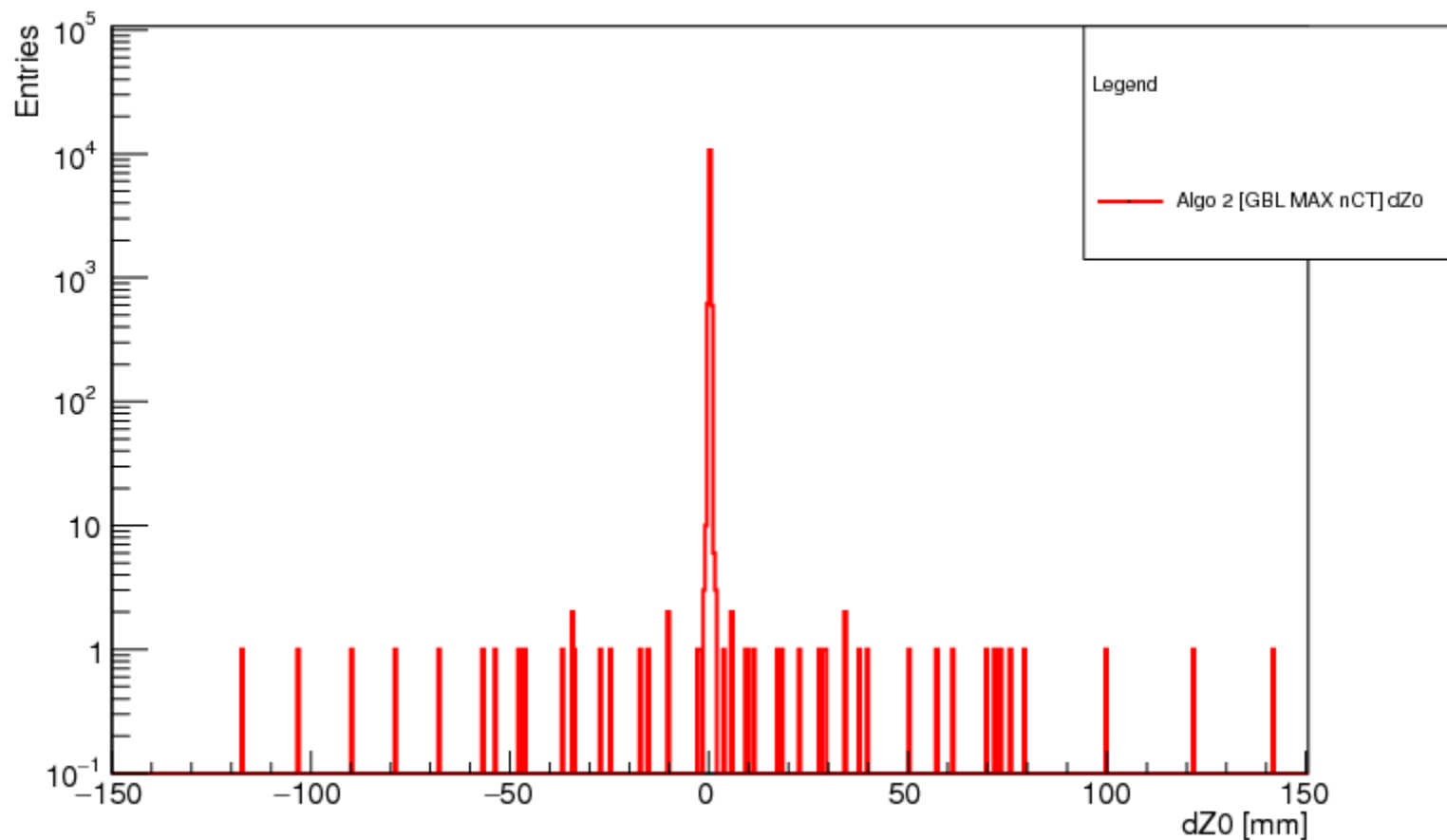




Primary Vertex GBL MAX nCT dZ0

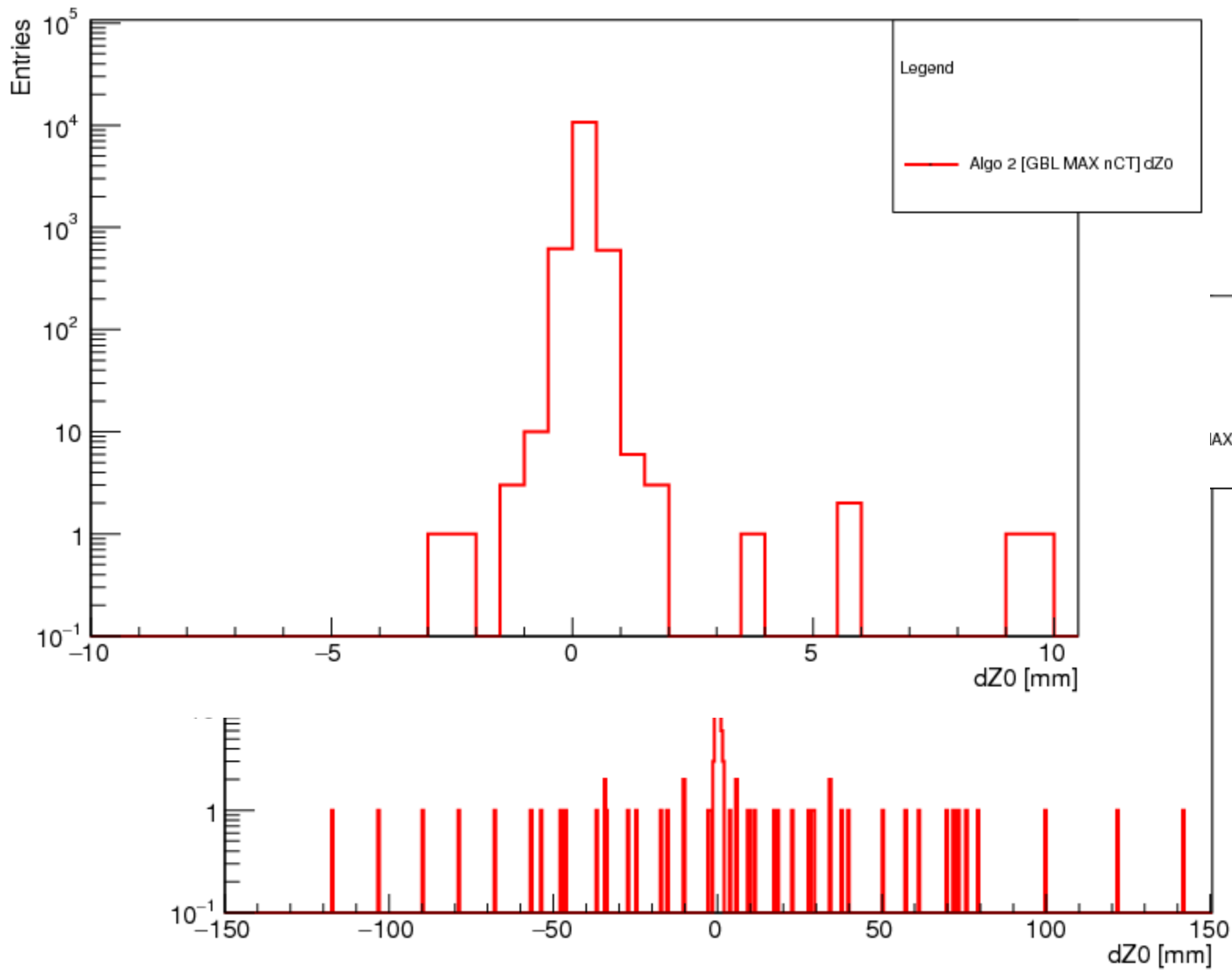
- Distance between GBL MAX nCT and Reconstruction (dZ0)

Track Info: Algo 2 [GBL MAX nCT] dZ0



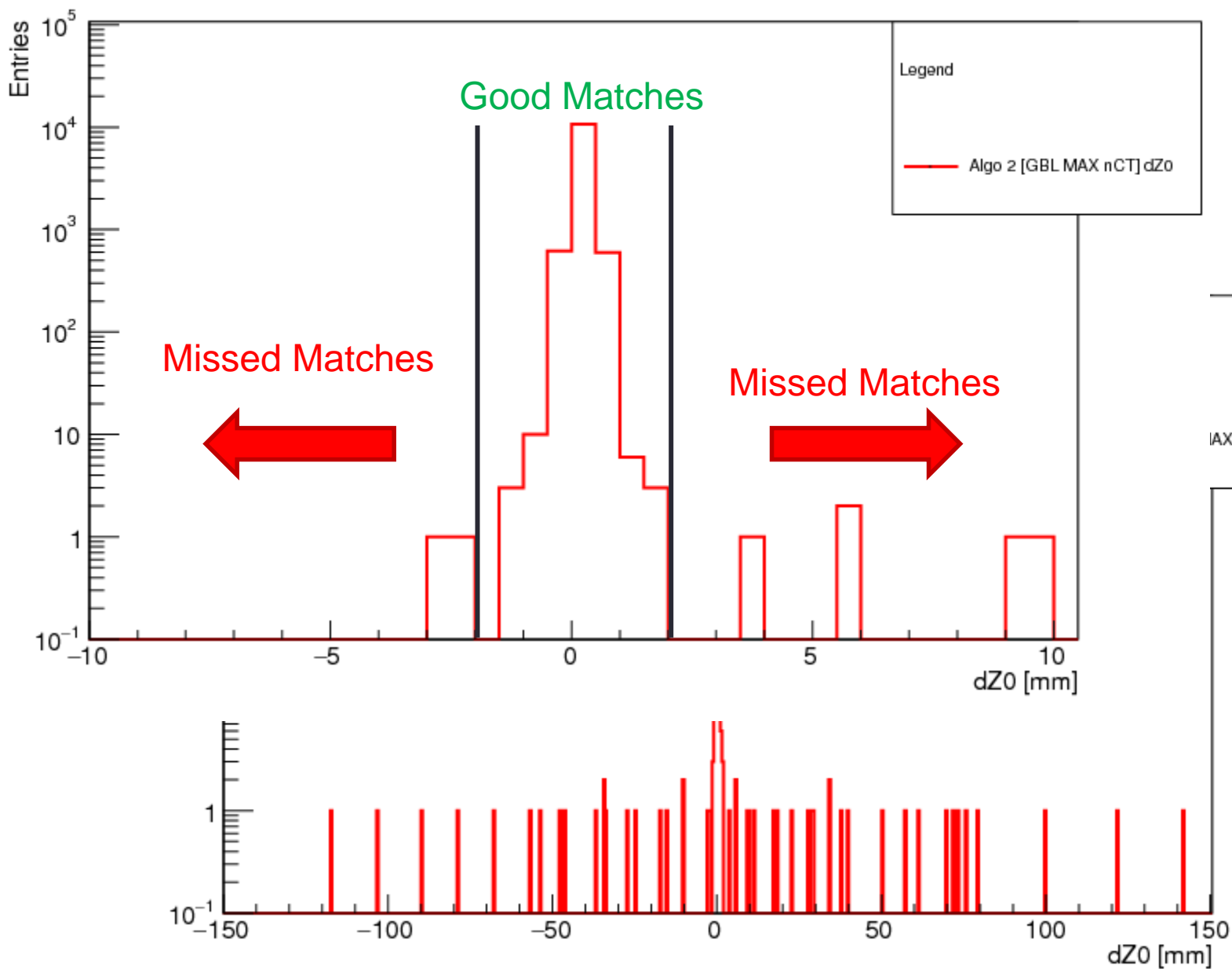


Track Info: Algo 2 [GBL MAX nCT] dZ0





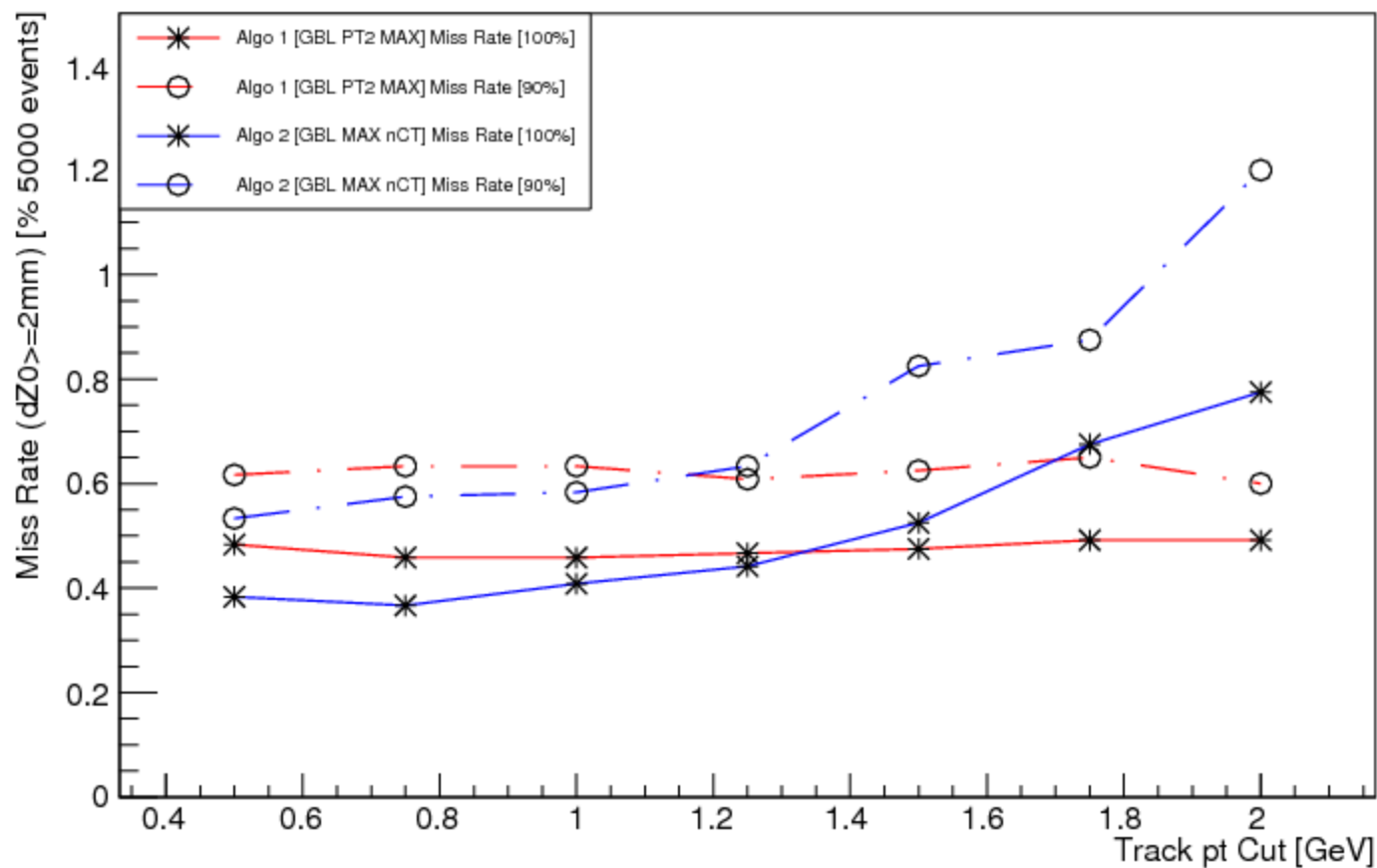
Track Info: Algo 2 [GBL MAX nCT] dZ0





Primary Vertex Miss Rate

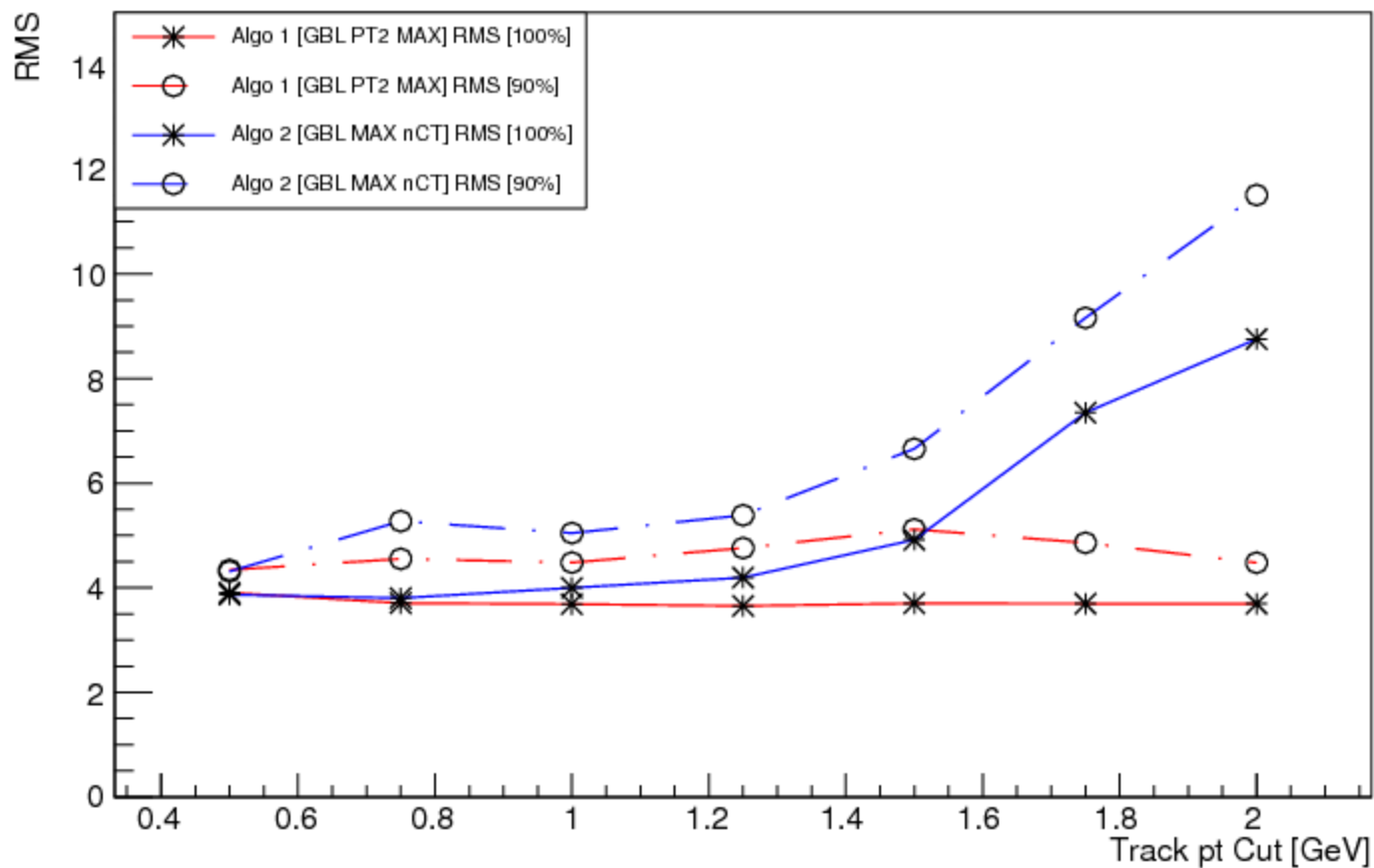
Primary Vertex Miss Rate





Primary Vertex RMS

Primary Vertex RMS





PILE-UP STUDY [12000 EVENTS]

Local maximum sum track pt2 (LCL PT2 MAX)

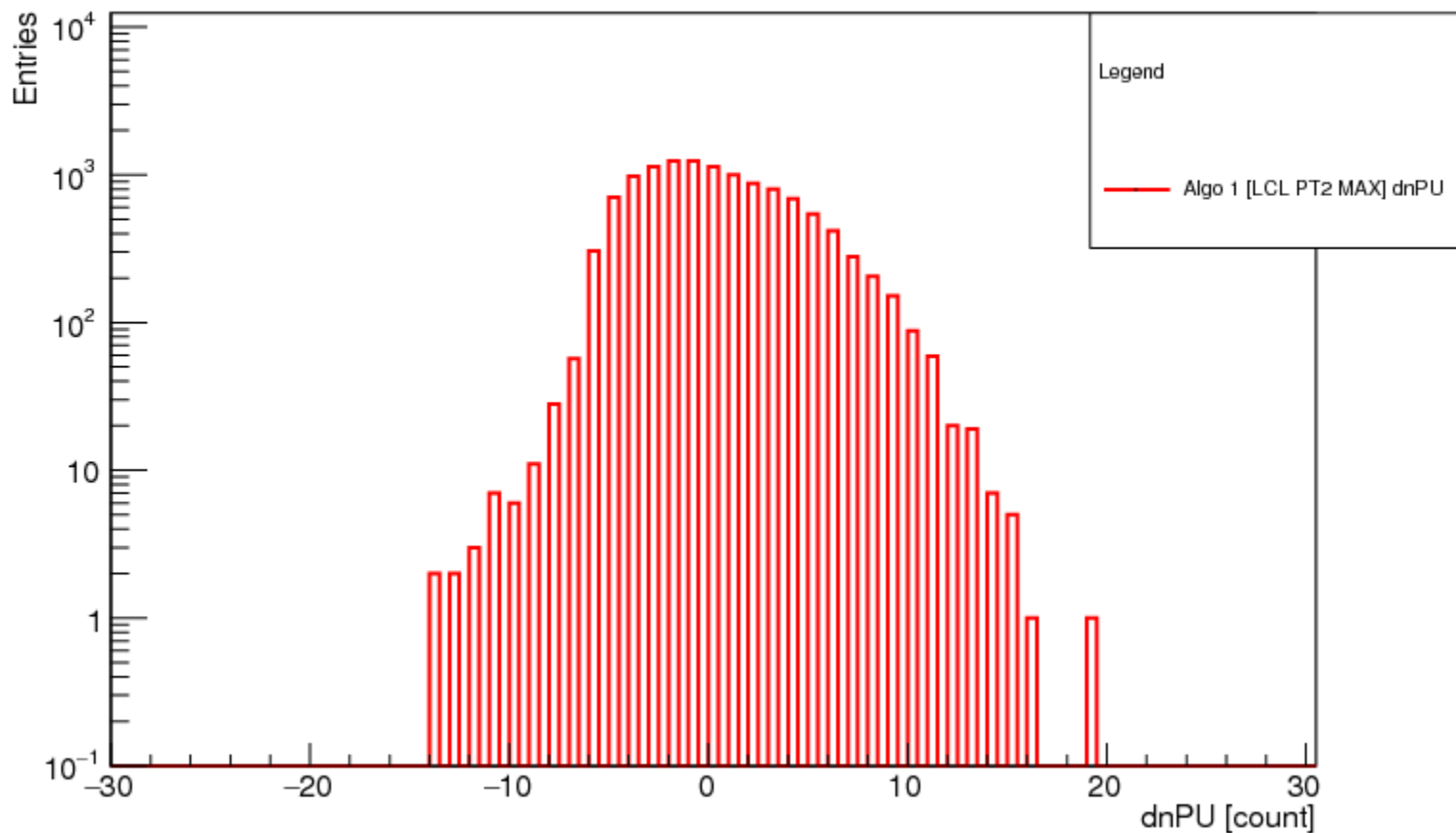
Track Multiplicity (TRK MULT)



Pile-up Vertex LCL PT2 MAX dnVtx

- Difference between pile-up count for LCL PT2 MAX and reconstructed

Track Info: Algo 1 [LCL PT2 MAX] dnPU

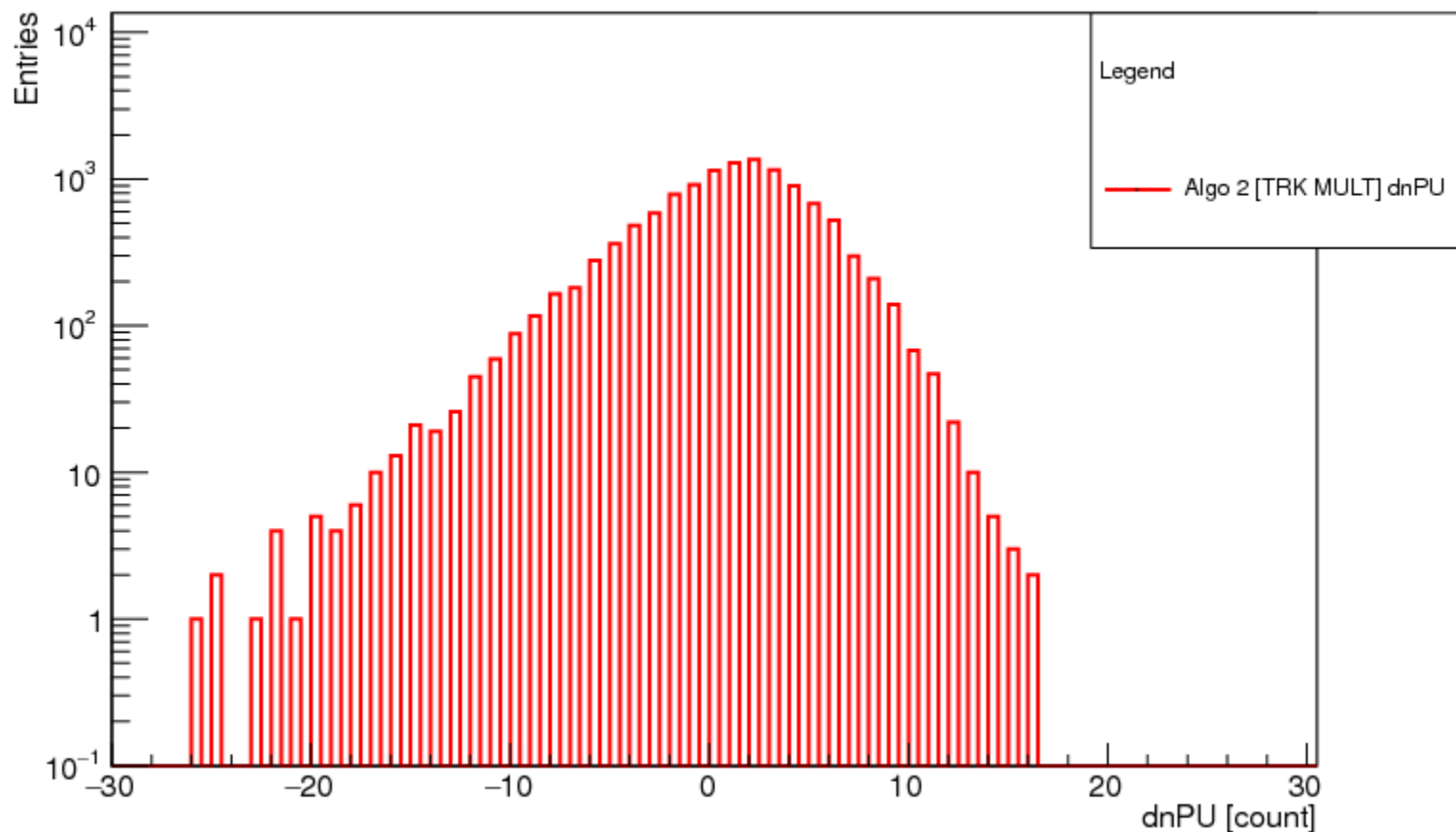




Pile-up Vertex TRK MULT dnVtx

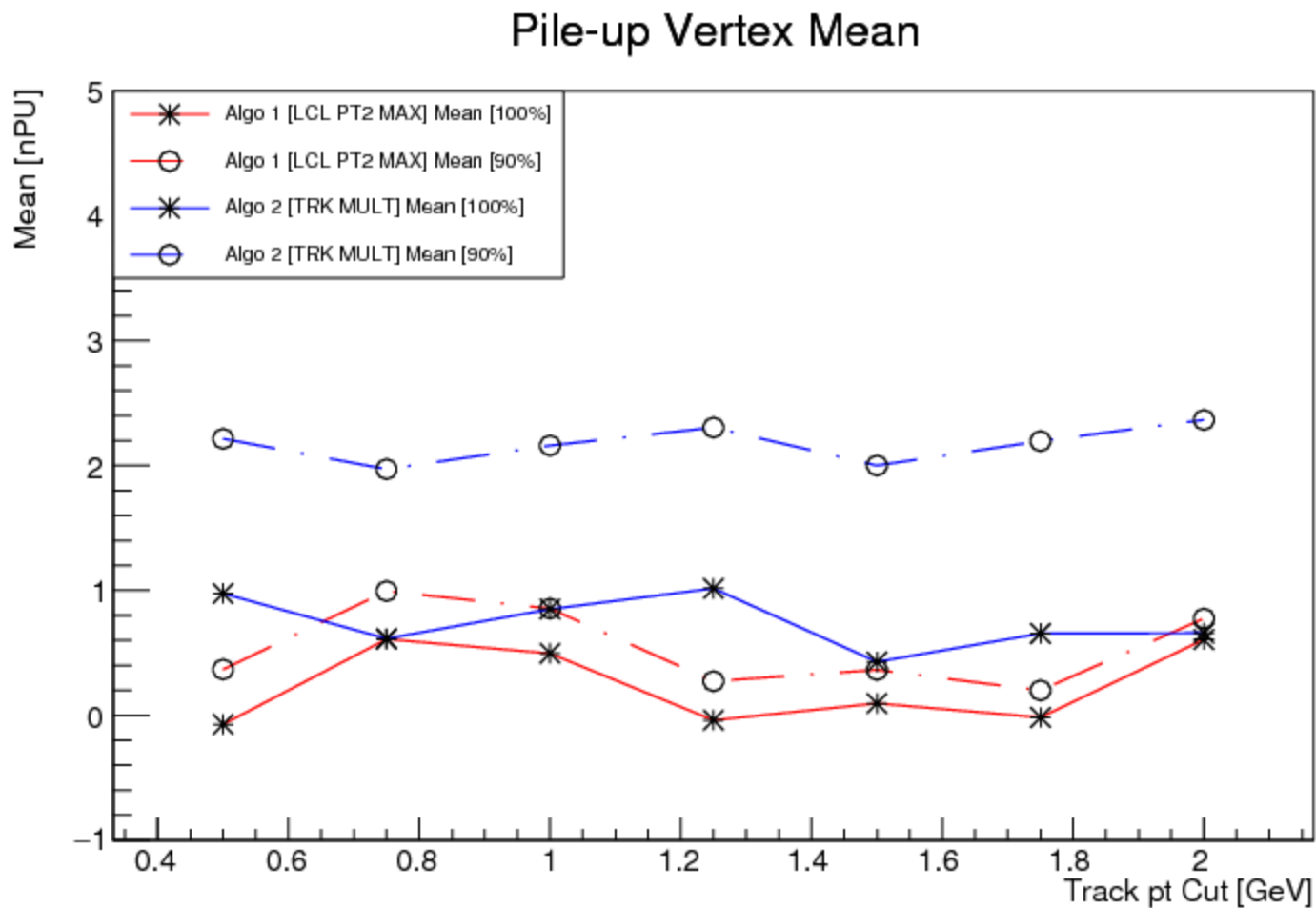
- Difference between pile-up count for TRK MULT and reconstructed

Track Info: Algo 2 [TRK MULT] dnPU





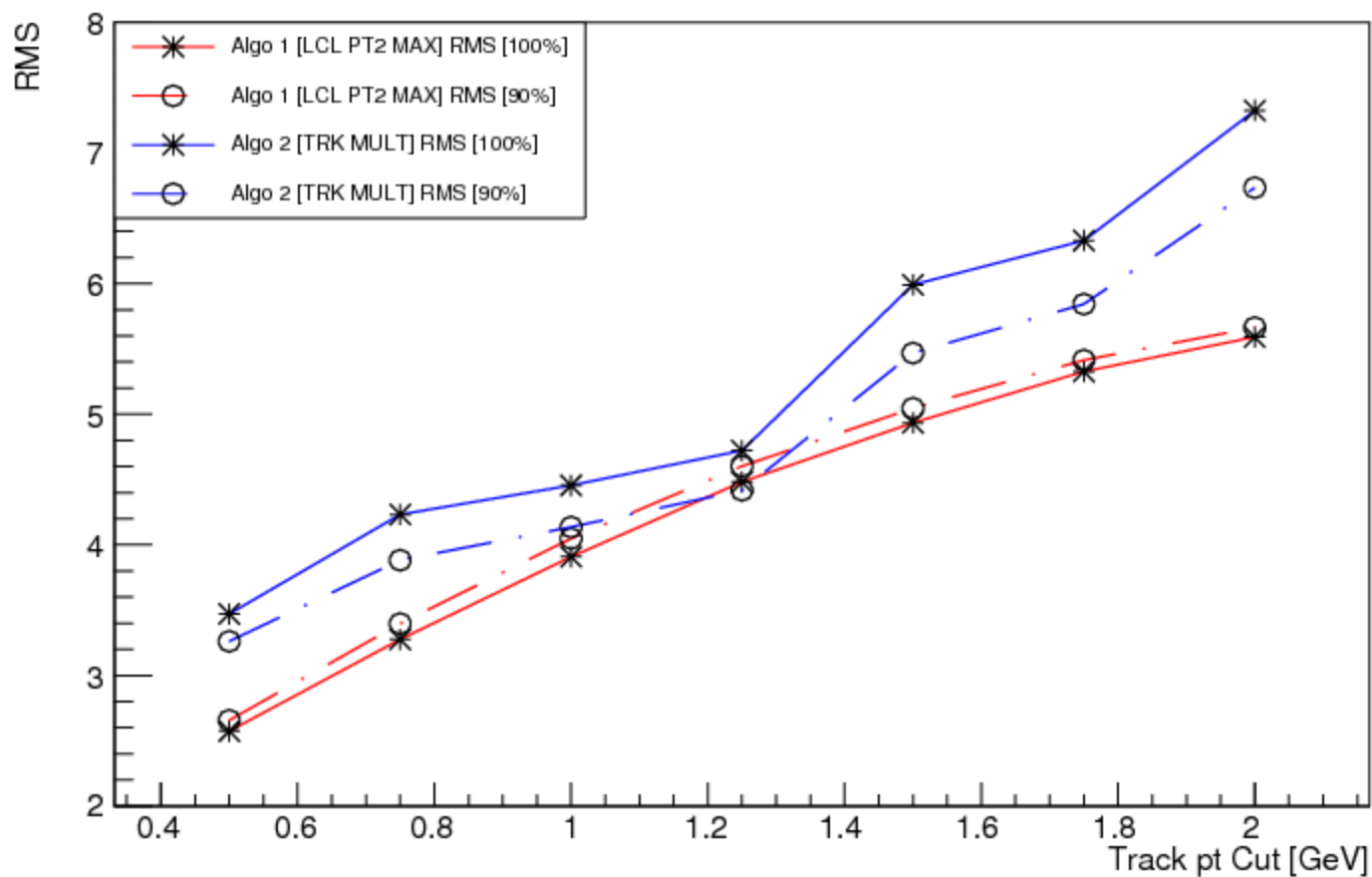
Pile-up Vertex Mean





Pile-up Vertex RMS

Pile-up Vertex RMS





Conclusion

- Result and method write-up
- Get FTK tracks
 - Compare the results of FTK tracks (<100% tracks)
- Use other vertex finders
 - Compare results with other trigger algorithms