ArgoNeuT Signals – data vs MC

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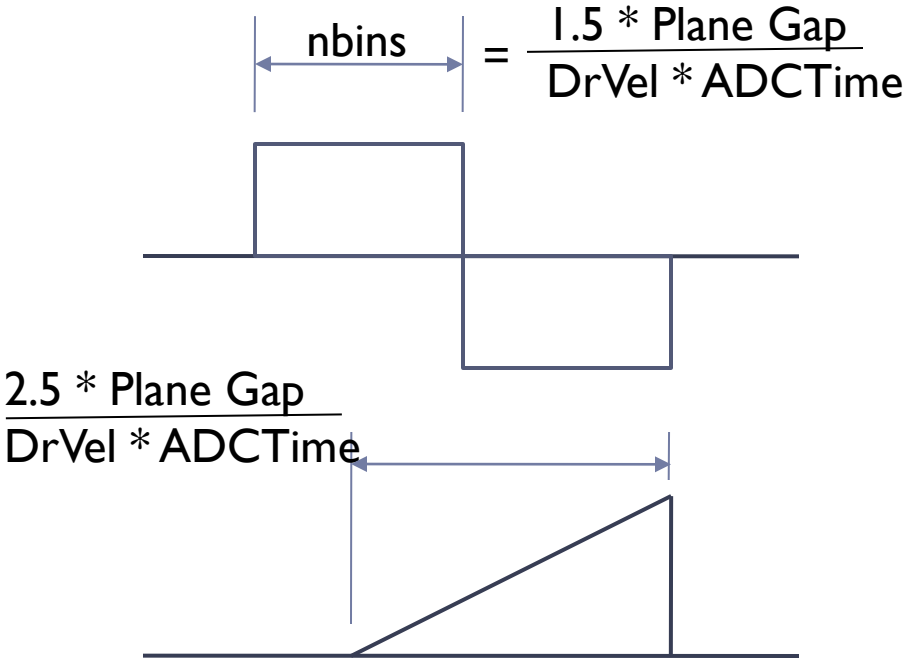
Goal & Method

- Goal 1: Gain familiarity with LArSoft
- Goal 2: Compare LArSoft implementation of simplified signal shape simulation written some time ago
  - MicroBooNE doc #369 – March 2009
    - Compare a single muon observed in the Bo test stand with a single simulated muon
    - Reproduced in the next 2 slides
- Method: Repeat this study with a single ArgoNeut muon

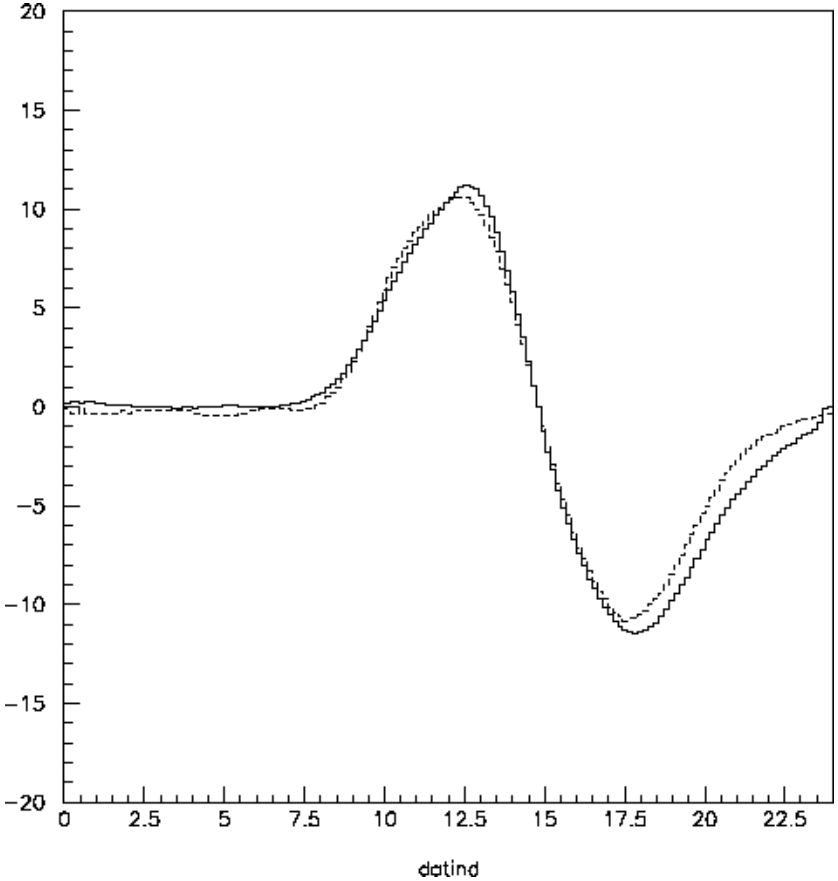
- Goal 3: Find the hit resolution
  - Will be needed to determine muon momentum via MCS

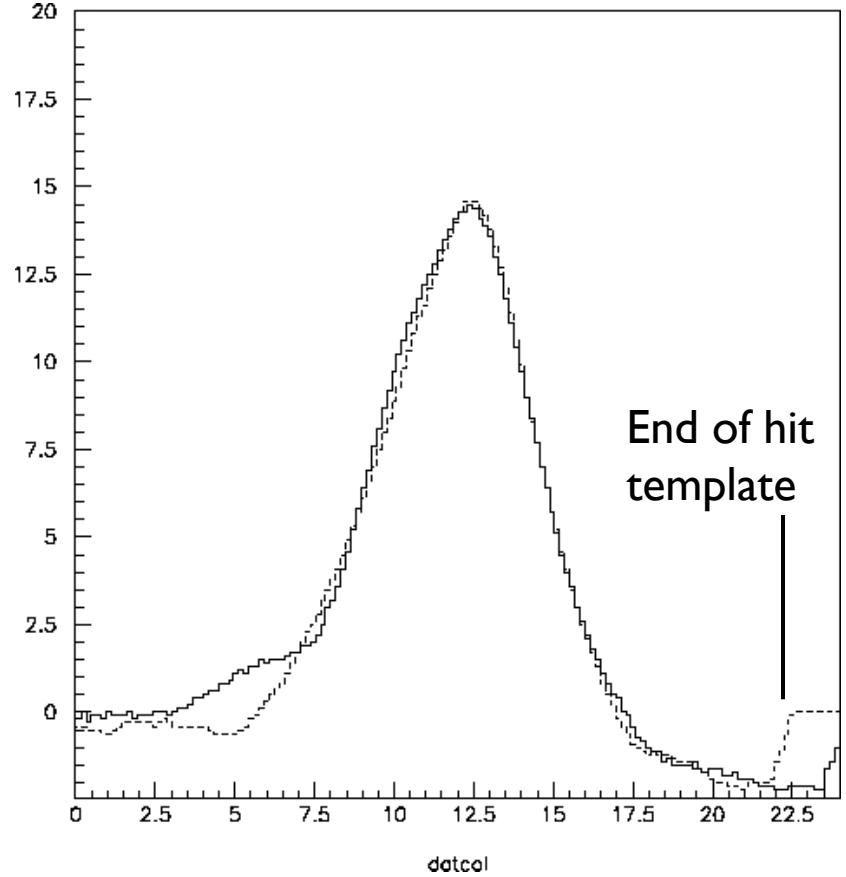
Simplified Simulation
From MicroBooNE doc 369

- Detailed structure of Garfield signal (slide 3) is unimportant
- Actual drift time thru wire plane is longer than 2D simulation predicts
- Inter-plane drift velocity is higher than in main volume
- Use simplified signal simulation
- Randomized cluster arrival time from diffusion only

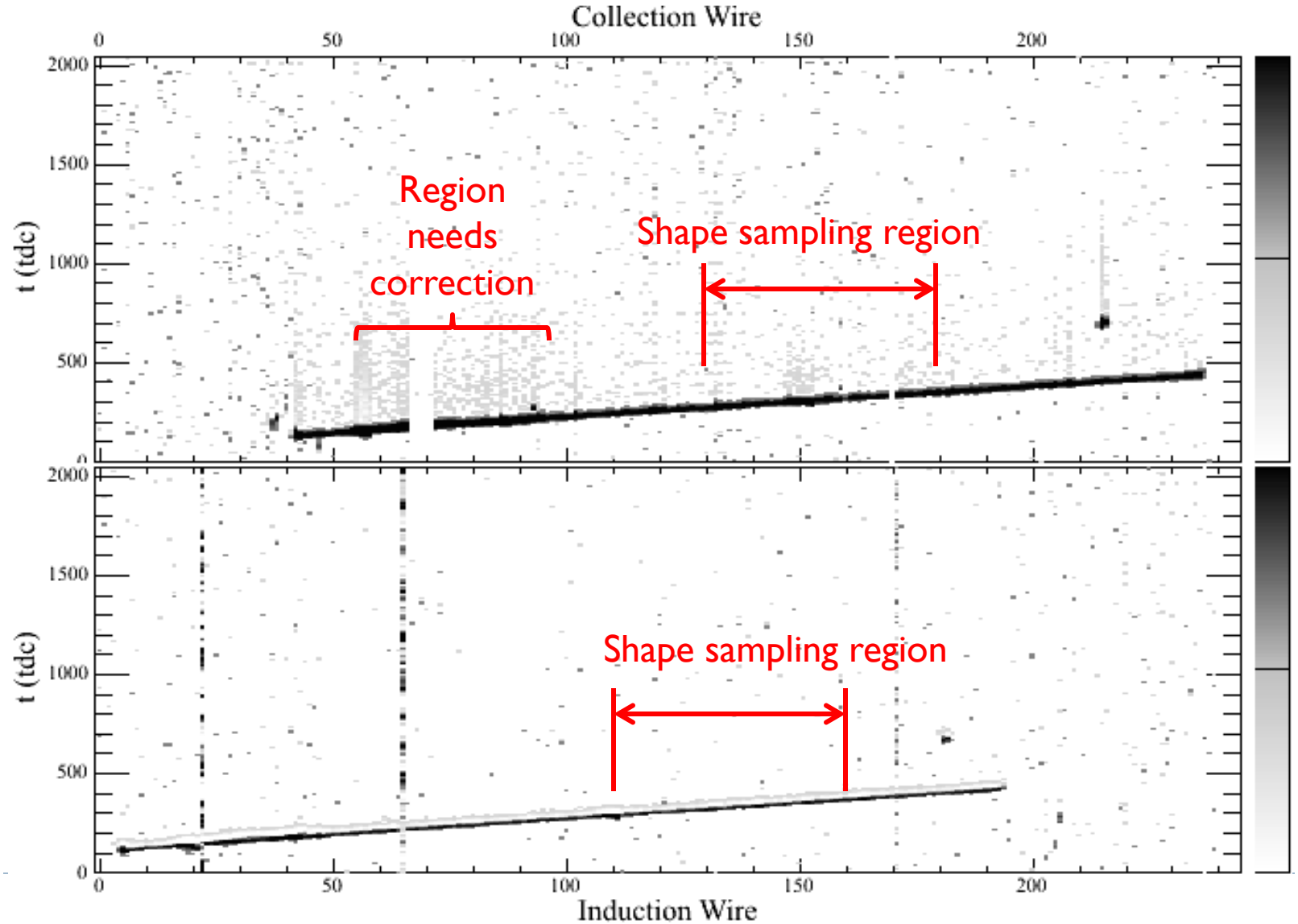


Simplified Simulation Results
From MicroBooNE doc 369

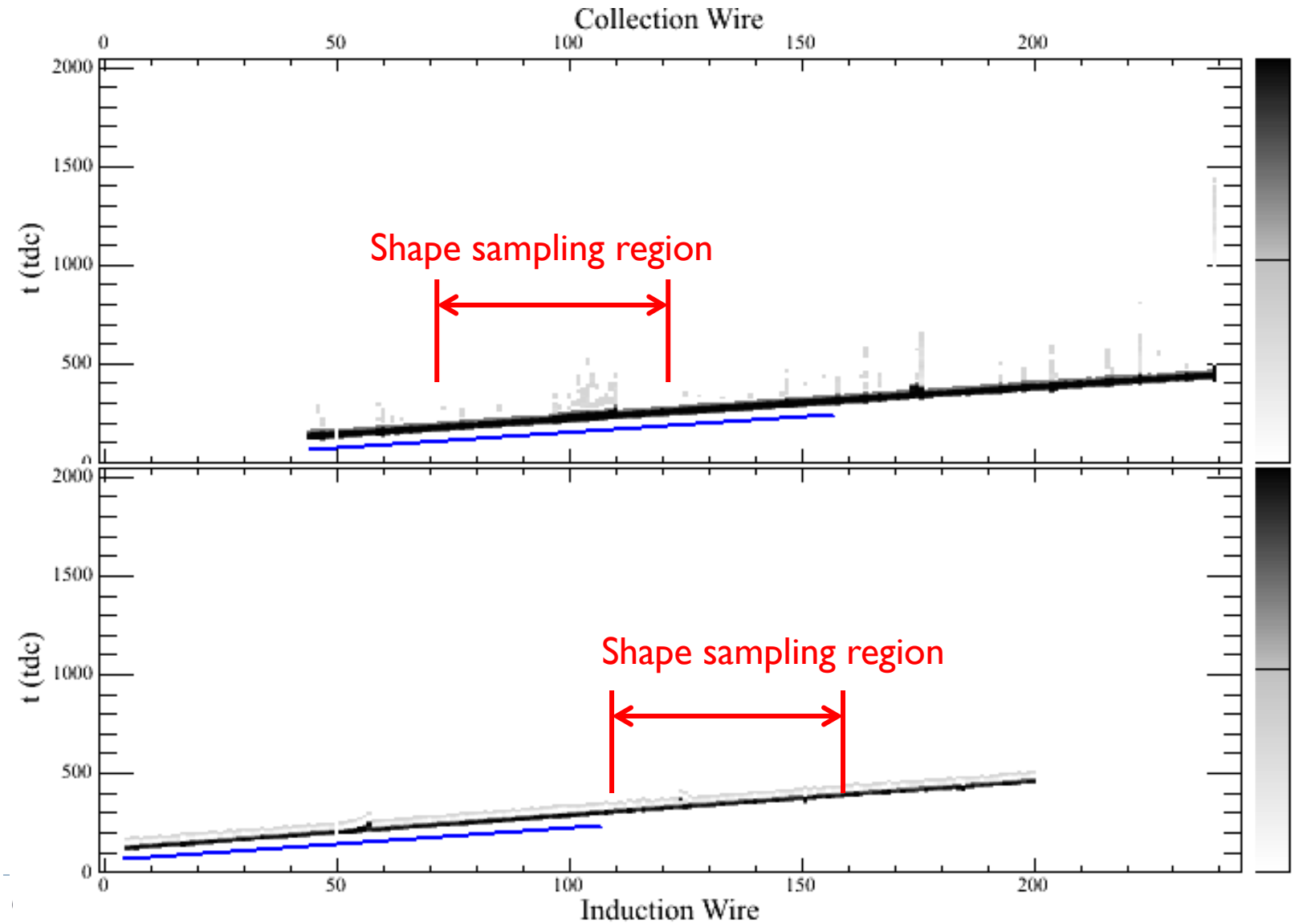




ArgoNeuT Muon
Run 649 Event 52



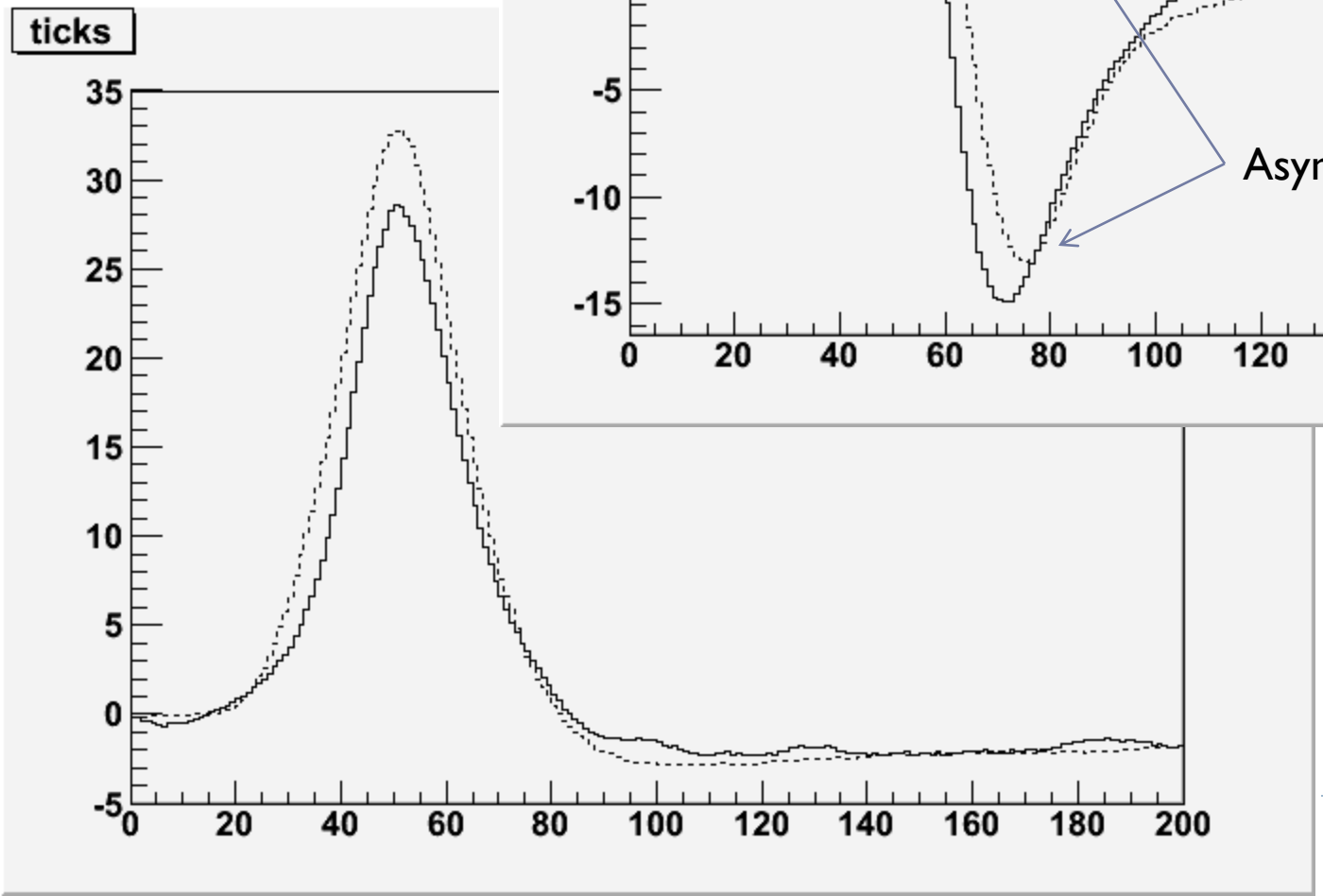
5 GeV MC muon at the same angle & position

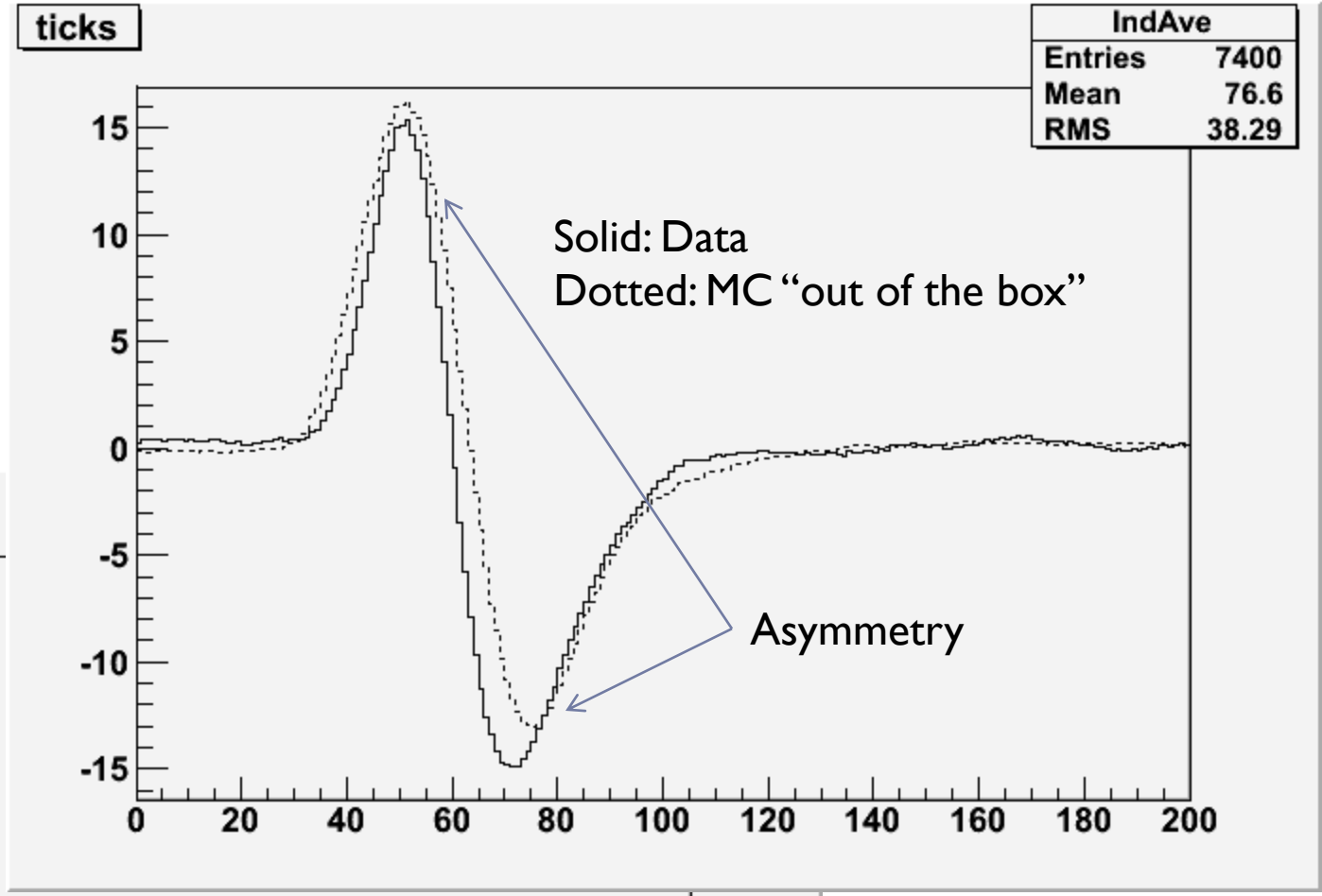


μ [5.0 GeV/c]

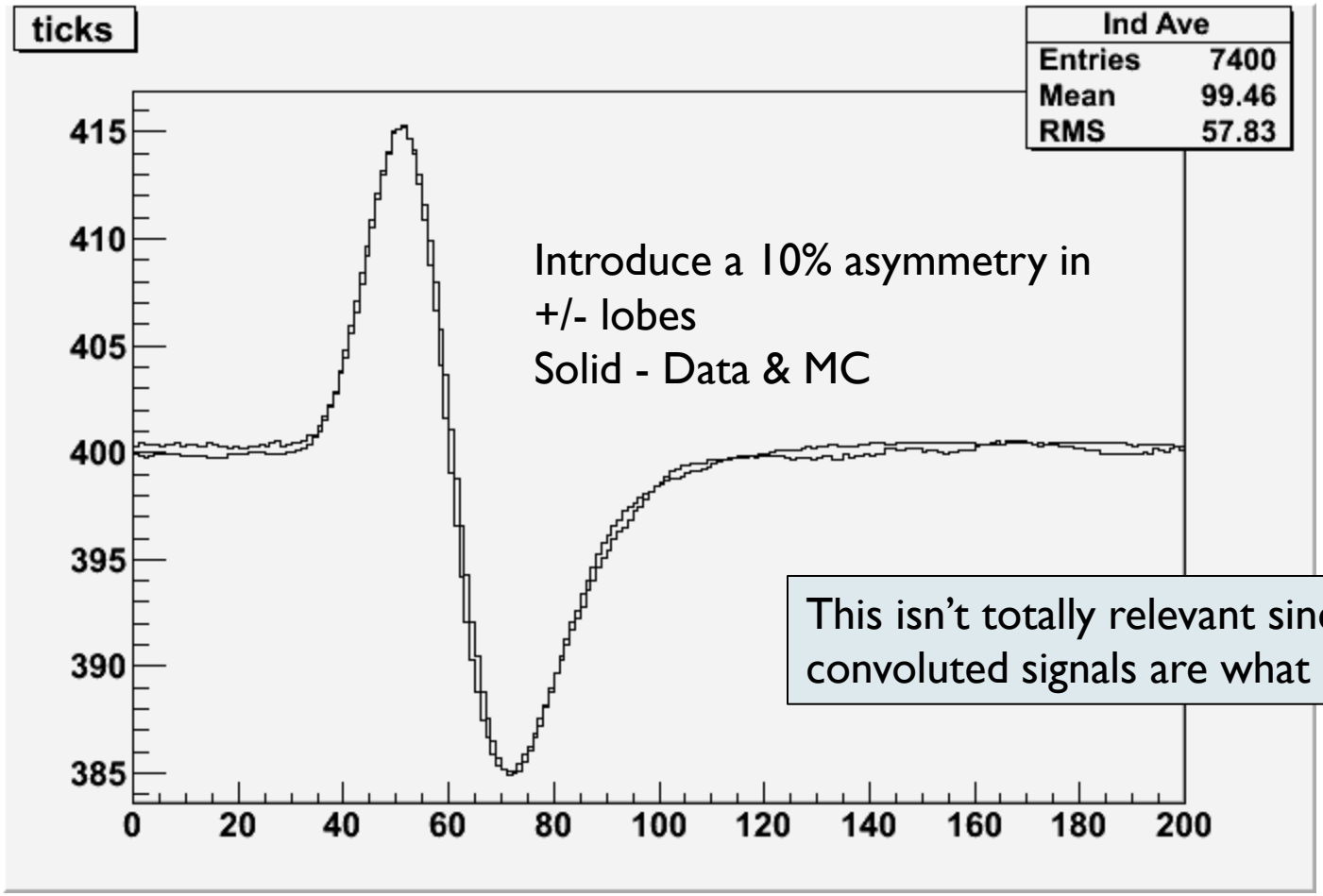
Shape Sampling

- Find maximum +ve ADC value for 0 < ticks < 500
  - Average 3 adjacent time bins
- Histogram max ADC values
- Cut to remove max ADC values inconsistent with MIP
  - Delta rays
  - Forgot to save the histograms…
- Use ~20 channels to generate the average shape
- Shift ADC array by the time bin of the max ADC value
- Fill histogram
- Normalize histogram by the number of channels used


ticks
35
30
25
20
15
10
5
0
-5
0
20
40
60
80
100
120
140
160
180
200

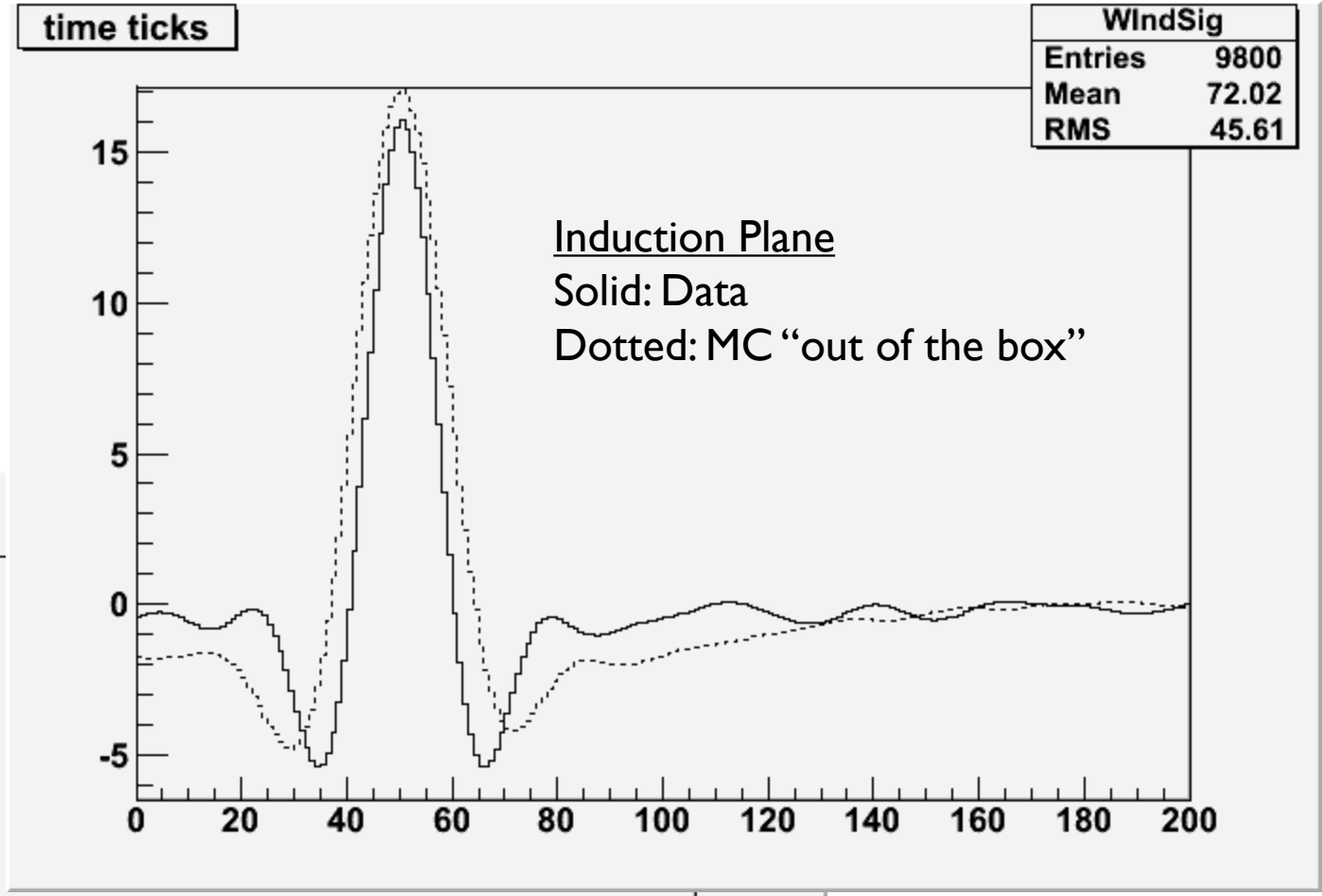

ticks
IndAve
Entries 7400
Mean 76.6
RMS 38.29
15
10
5
0
-5
-10
-15
0
20
40
60
80
100
120
140
160
180
200
Solid: Data
Dotted: MC "out of the box"
Asymmetry

Tuning the Induction Plane Simulation

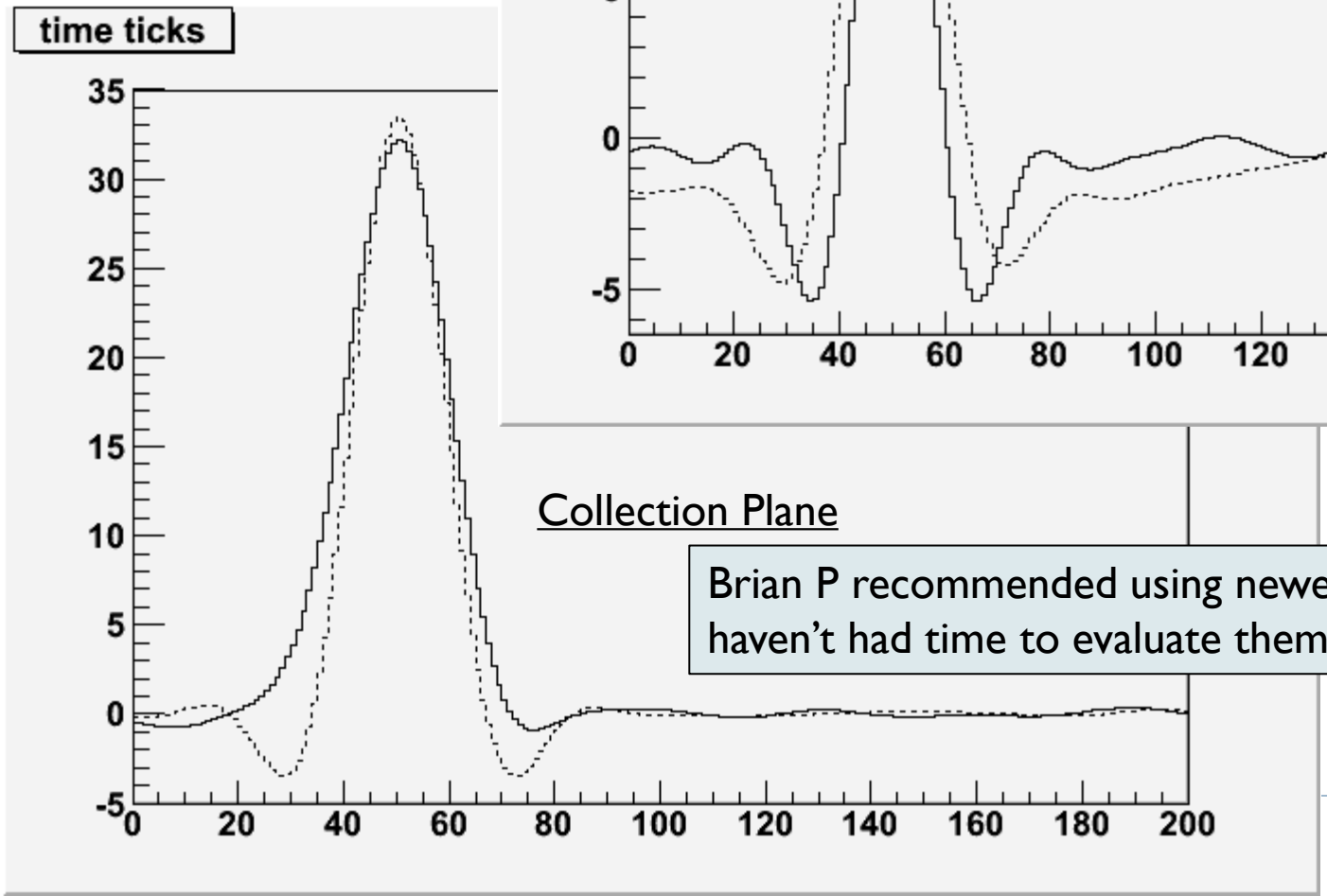


This isn't totally relevant since de-convoluted signals are what matters

De-convoluted wire signals



Induction Plane
Solid: Data
Dotted: MC "out of the box"



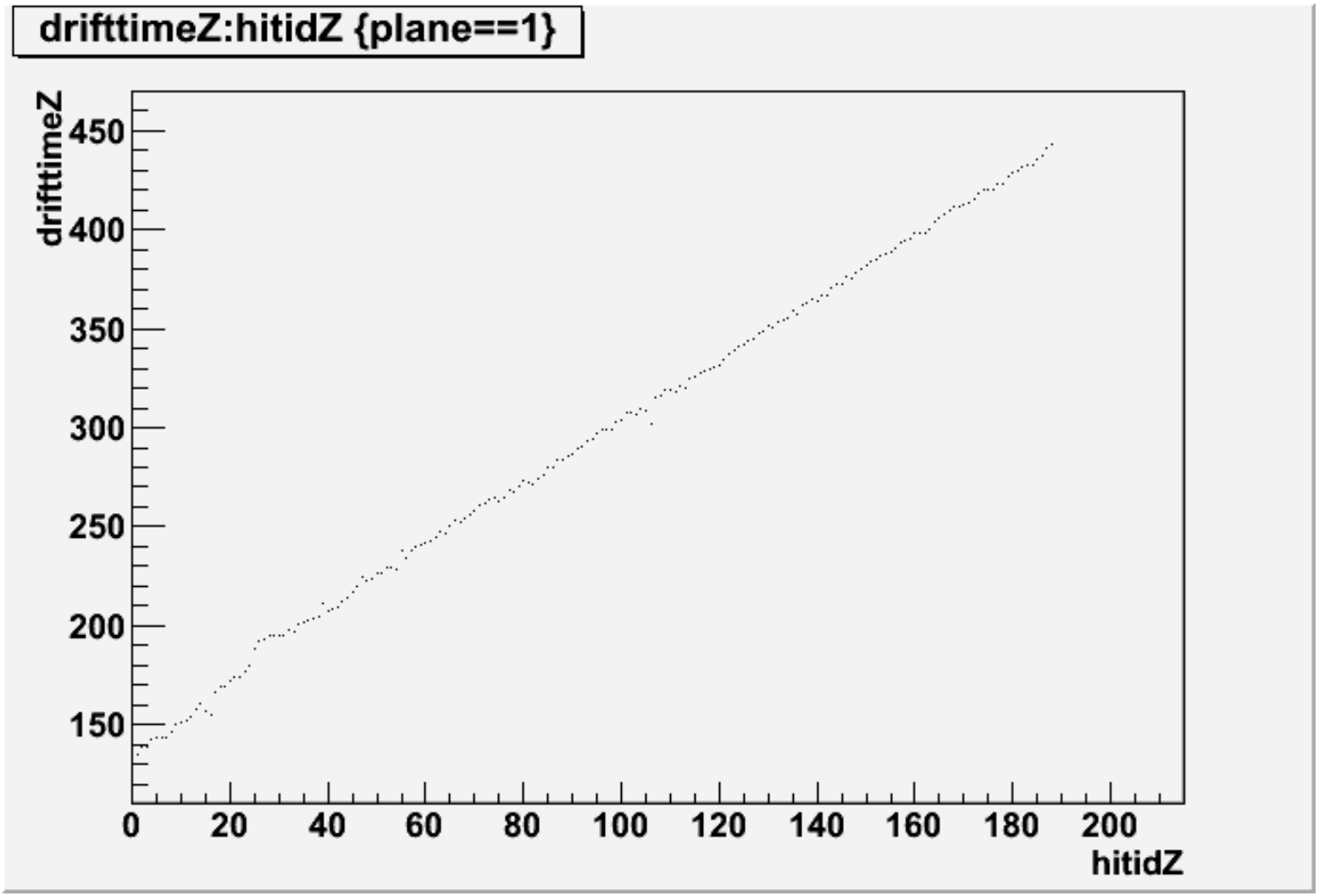
Collection Plane

Brian P recommended using newer response files but I haven't had time to evaluate them

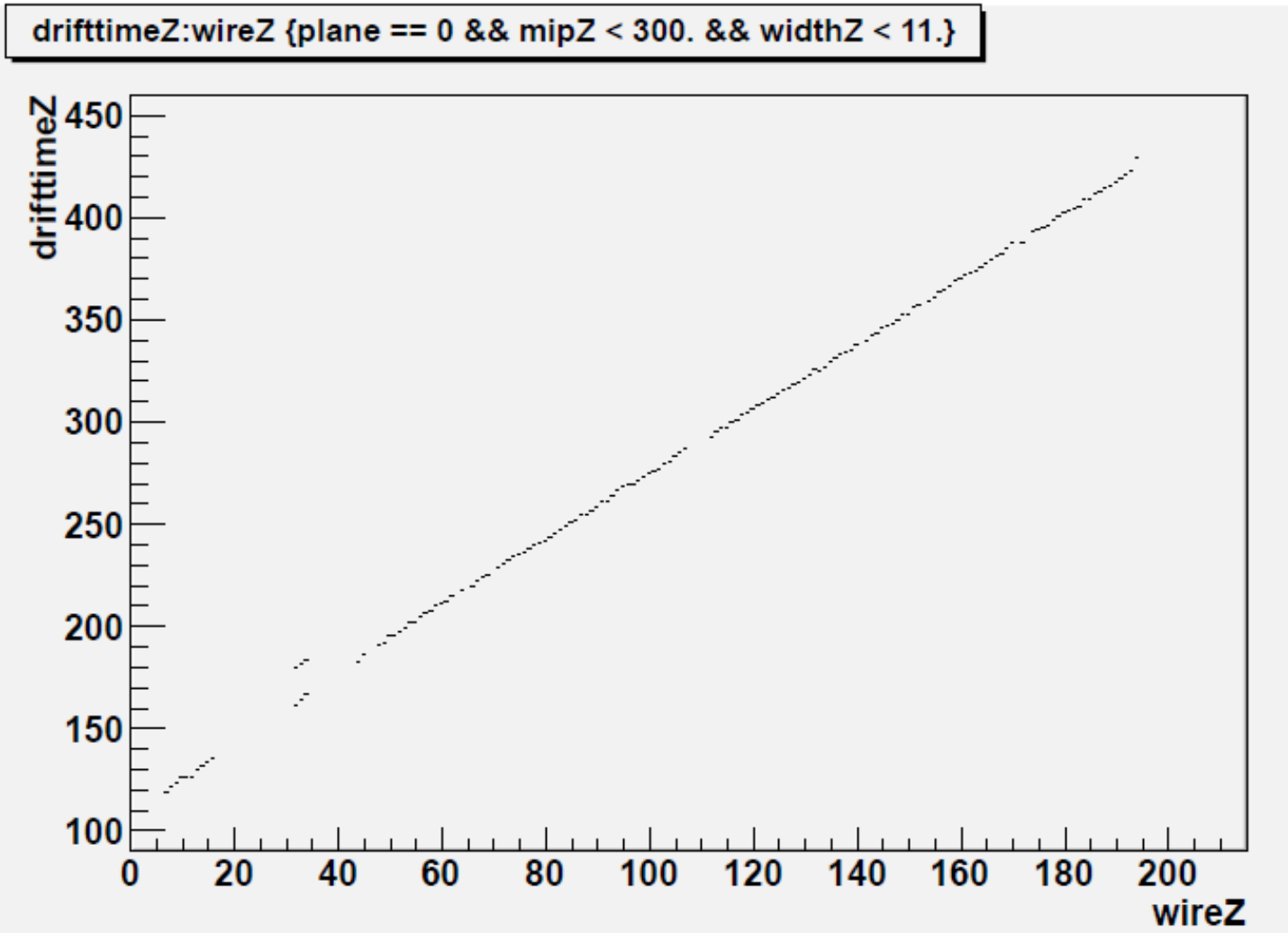
Hit Resolution

- Don't need a track fit
- Apply HoughLineFinder to the real muon hits
- Modify HoughLineFinderAna TTree to include hit residual in the drift direction
- Find Hit wire (w) for each hit in the cluster
- Hit residual = $t_w - 0.5 \times (t_{w-1} - t_{w+1})$ where t = drift time (ticks)
  - Hit residual is calculated only if there are hits on both adjacent wires
- Histogram hit residual → histogram σ ~ hit resolution

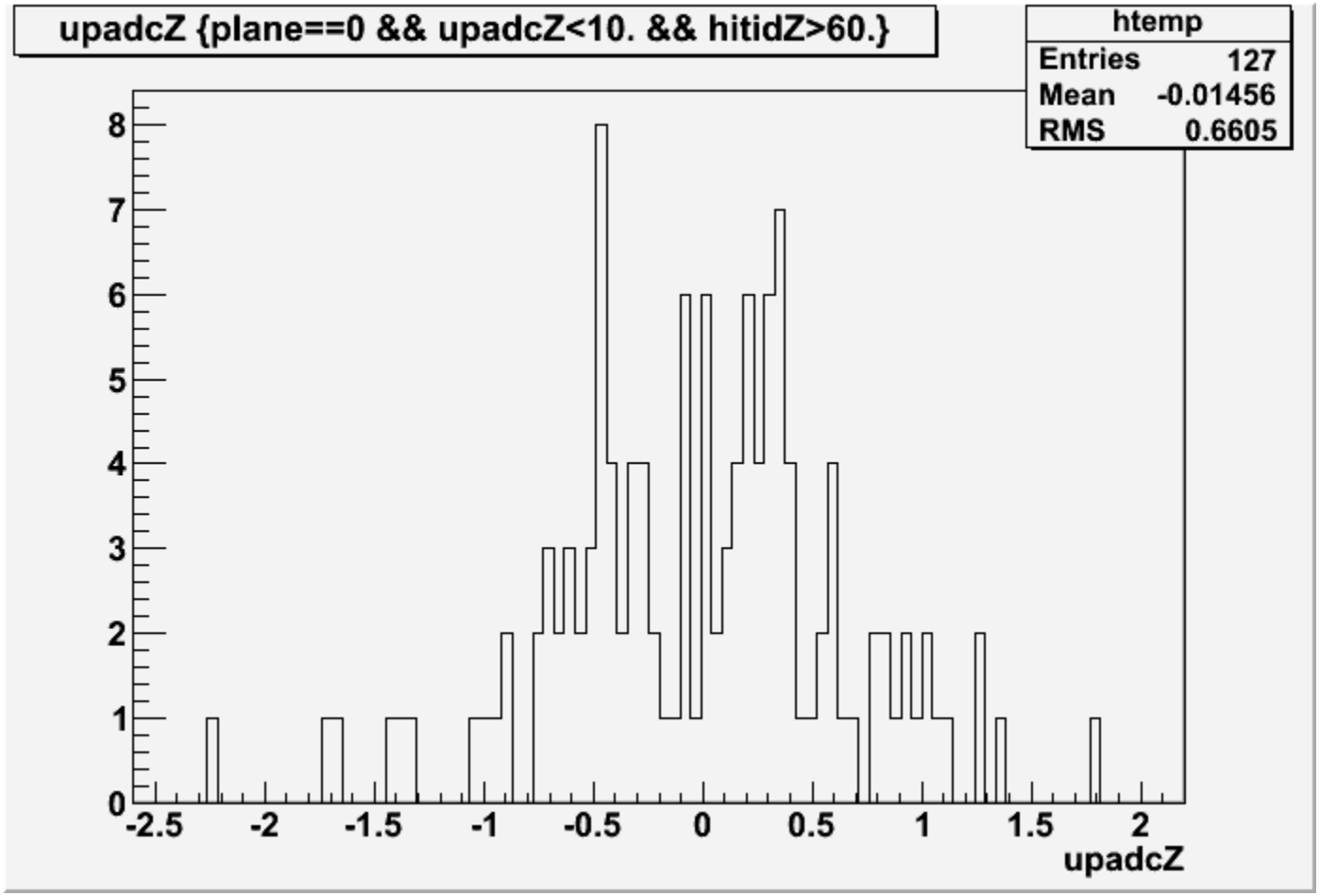
Drift Time vs wire – Collection Plane ArgoNeuT Run 649 Event 52



Drift Time vs wire – Induction Plane ArgoNeuT Run 649 Event 52

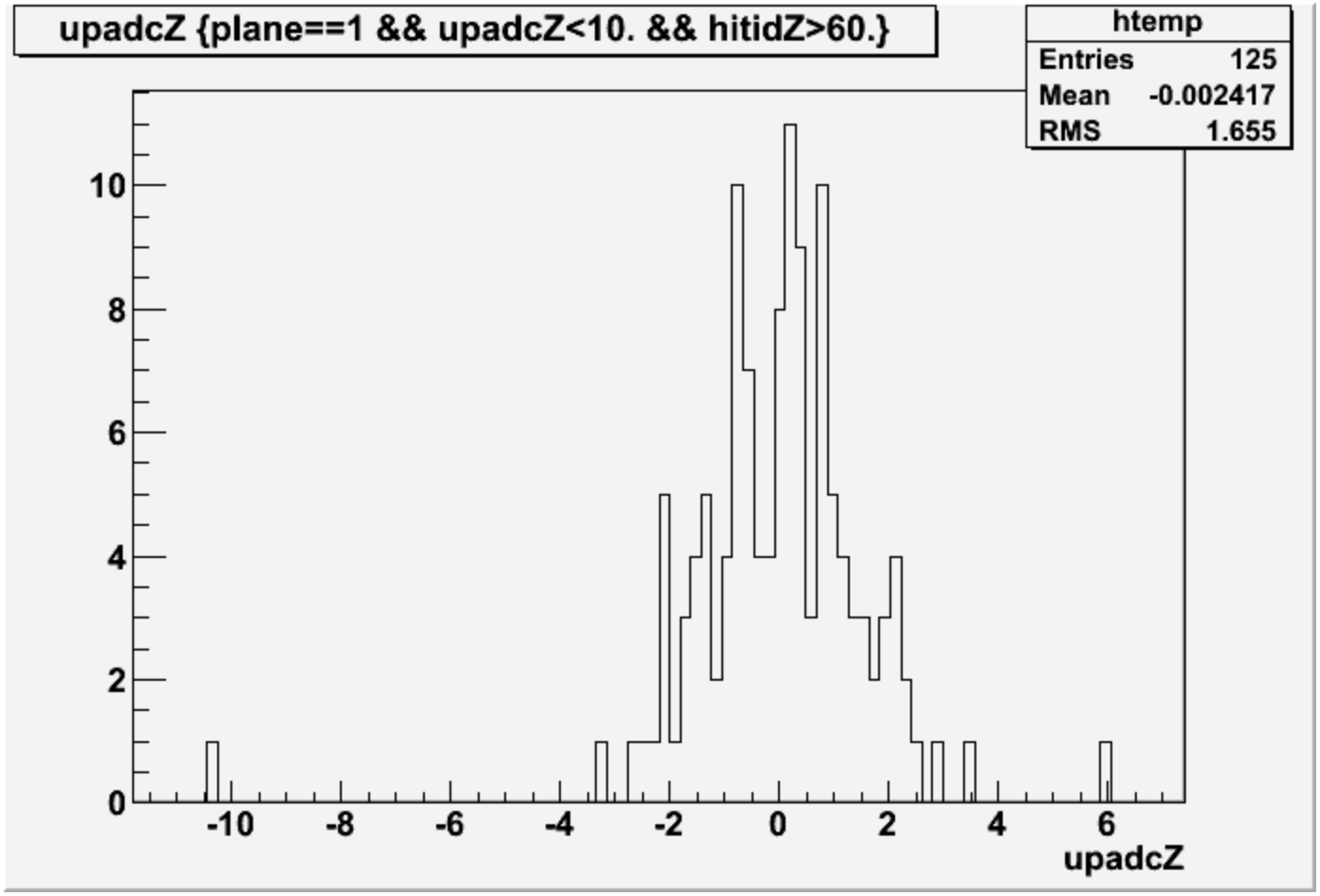


Hit Residual Histogram (w cuts) Induction Plane



Hit Resolution = 0.66 ticks x 0.2 μs/tick x 1.6 mm/μs = 210 μm

Hit Residual Histogram
Collection Plane



Hit Resolution = 1.66 ticks x 0.2 μs/tick x 1.6 mm/μs = 530 μm