Event reconstruction and data analysis (ArgoNeuT test @ PAB)

Work in progress

Data taking

- Instrumented electronic channels: 48 on the Induction plane, 196 on the Collection plane

- **Bias voltages:**

  Cathode=-5kV, Shield=+100V, Induction=+158V, Collection=+233V;

  Fields:

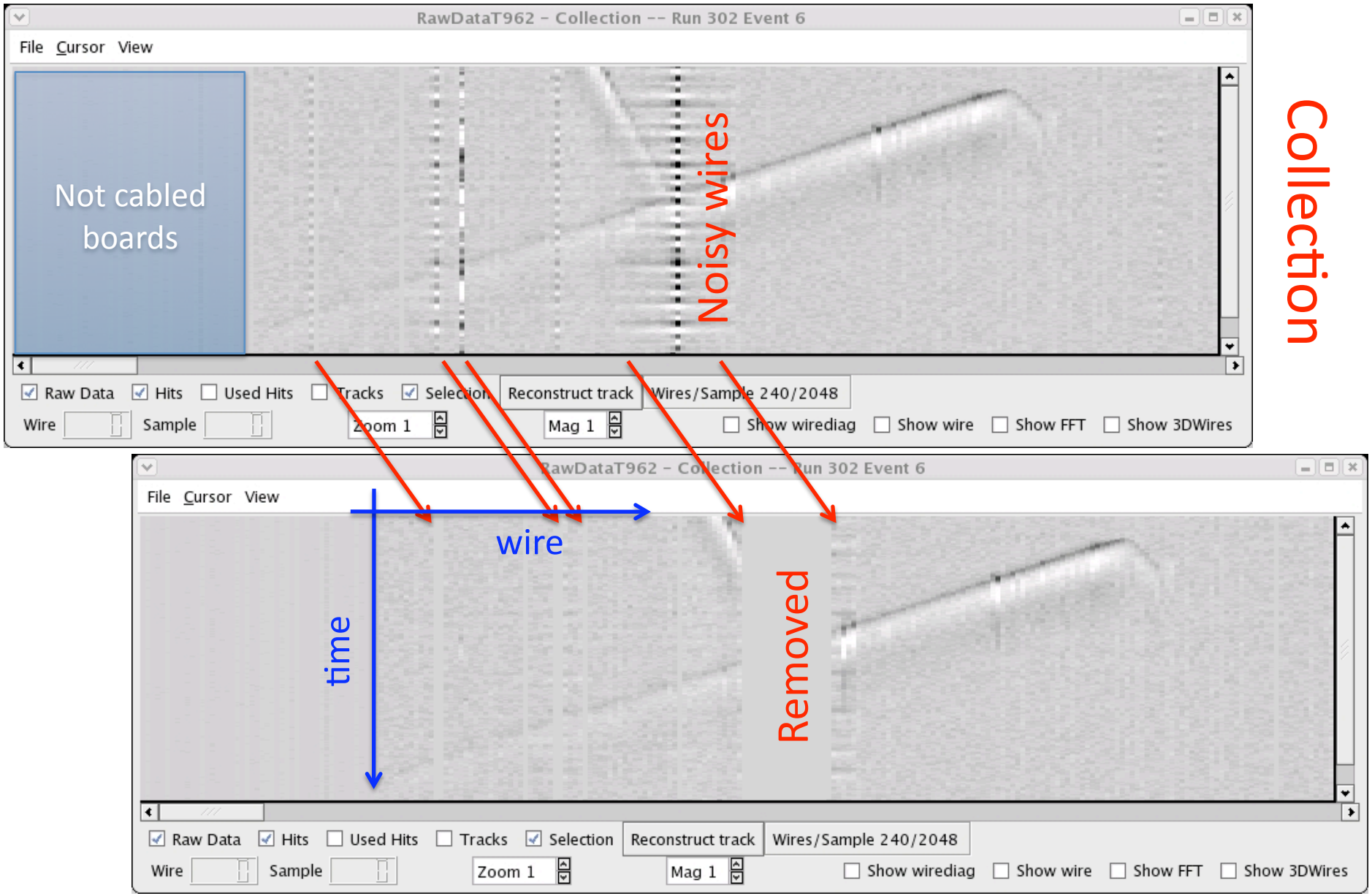
  E(drift) = 100V/cm (very low field, therefore 2048 samples x 198ns correspond to about half of the drift)
  E(shield-induction) = 146V/cm
  E(induction-collection) = 186 V/cm

- Data have been collected using the external trigger system (see Flavio presentation) since Aug. 12th. Adjustments to the trigger geometry have been made (Aug. 17th) in order to catch muons crossing, as much as possible, the whole part of the drift acquired within 2048 samples.

- Different cosmic ray signatures recorded: tracks of single muons crossing the active volume and more complicated multi-track topologies with muon bundles, electromagnetic and hadronic showers.

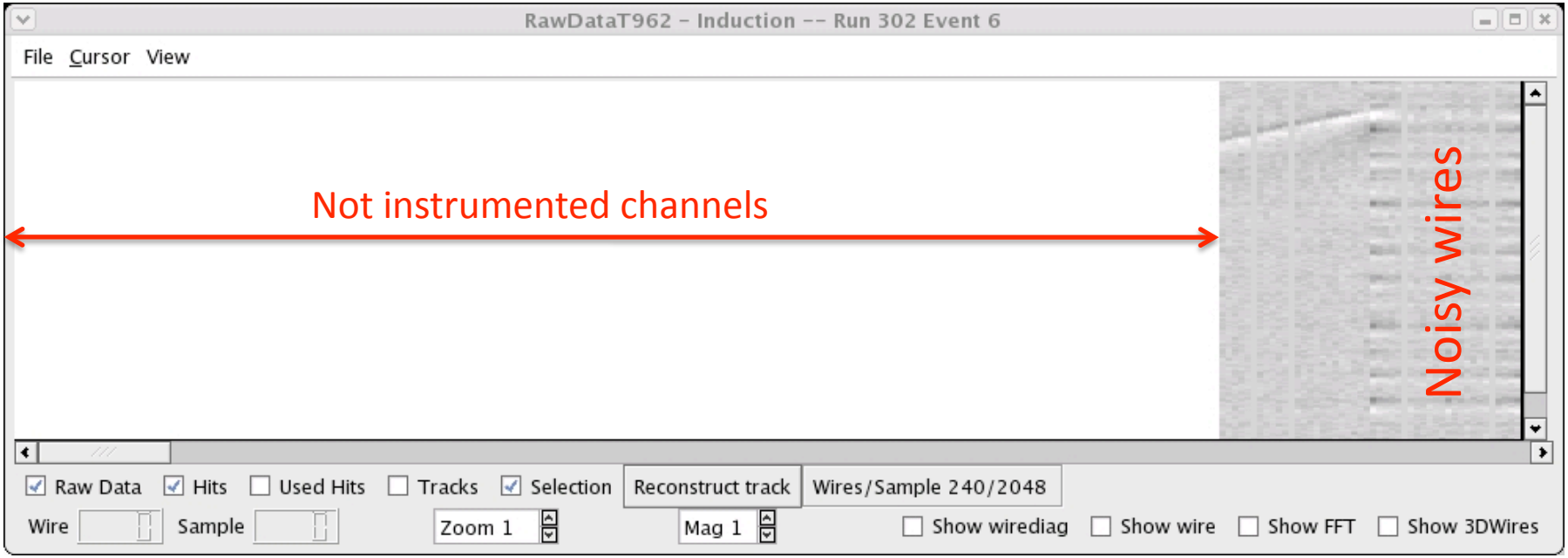
Crossing muon: raw data display

RUN 302 Event 6

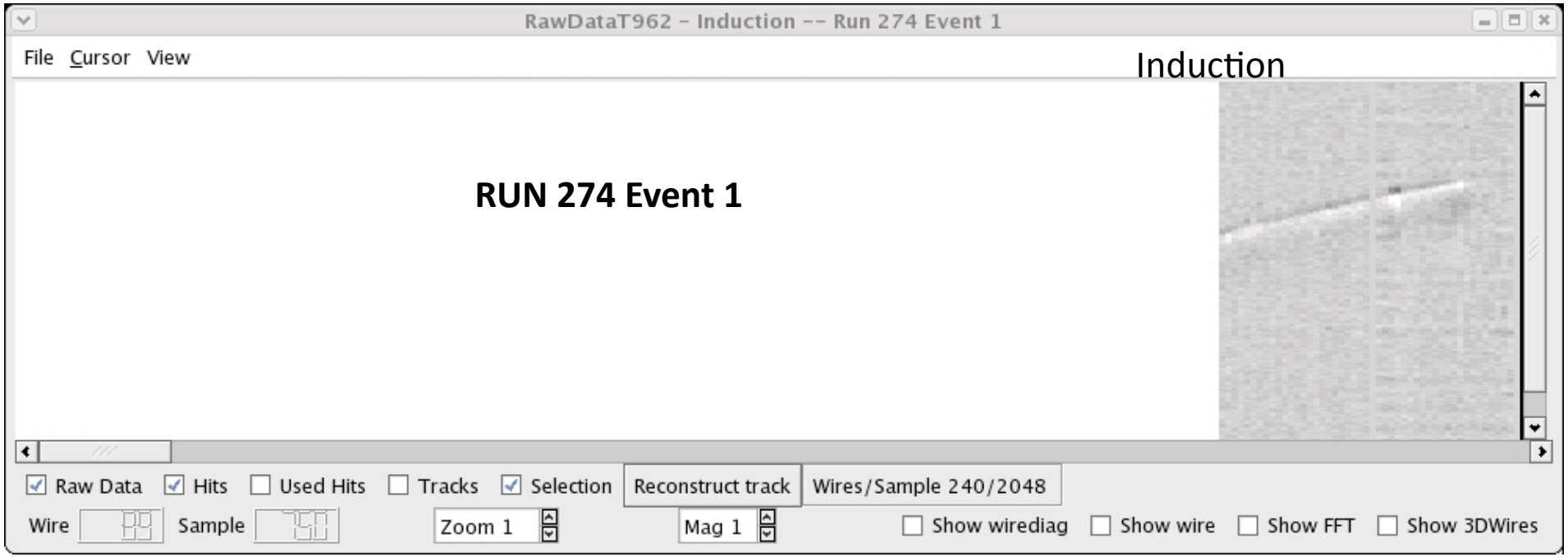


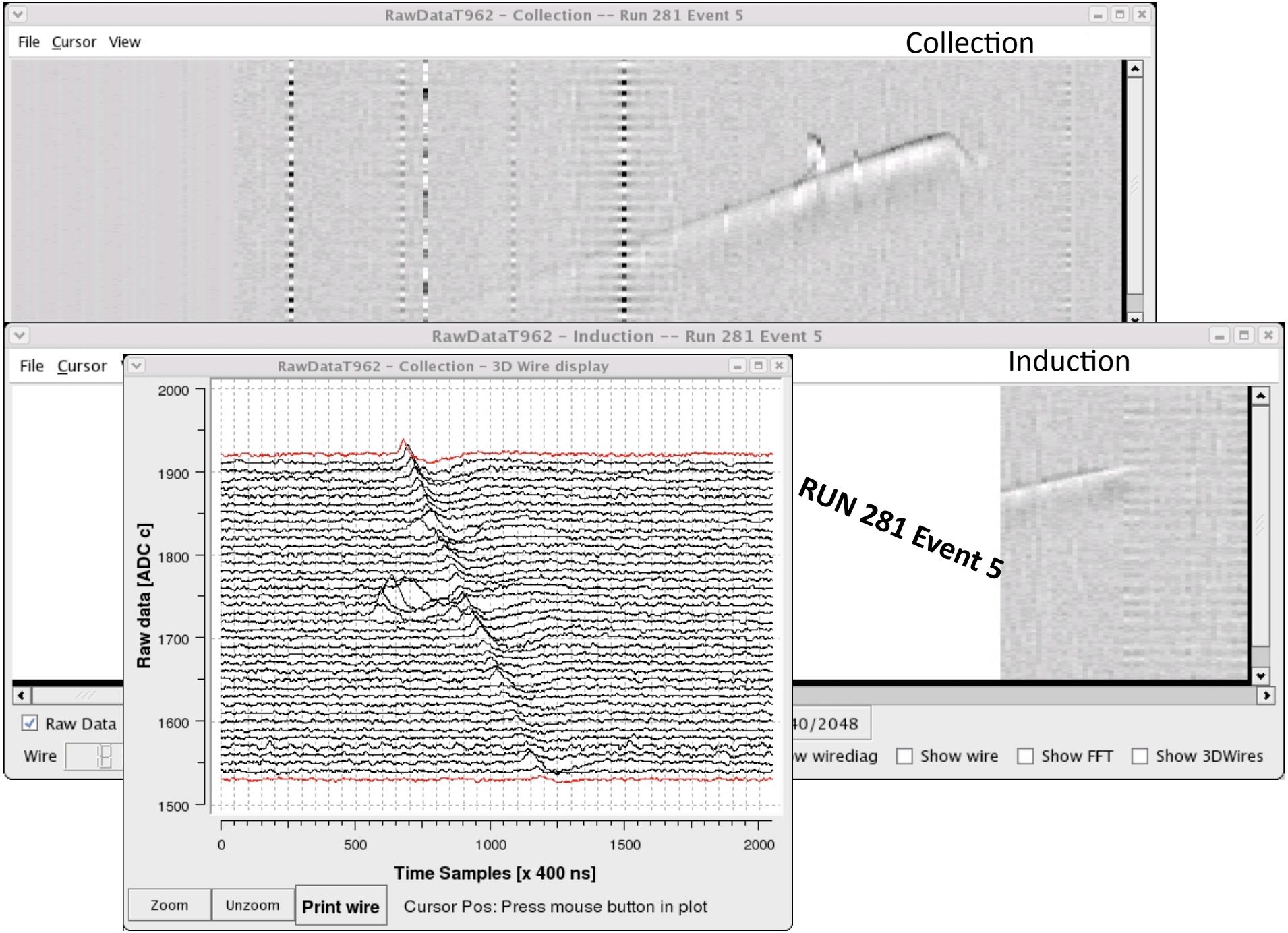
RUN 302 Event 6

Induction

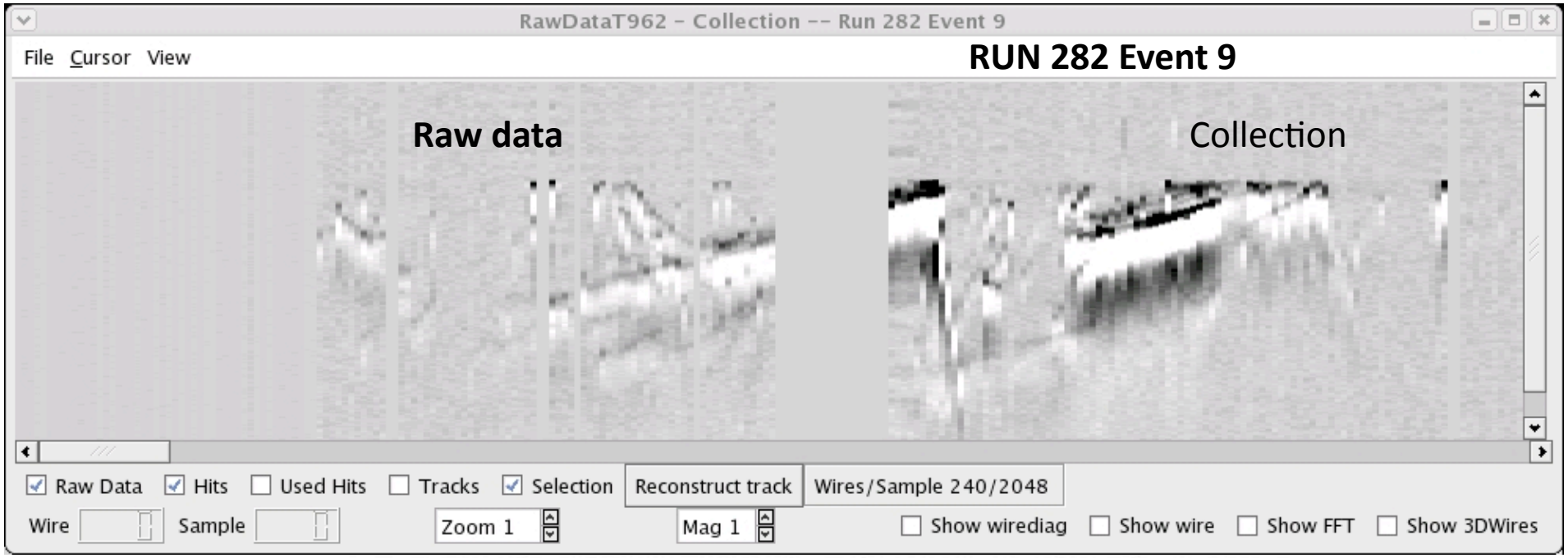


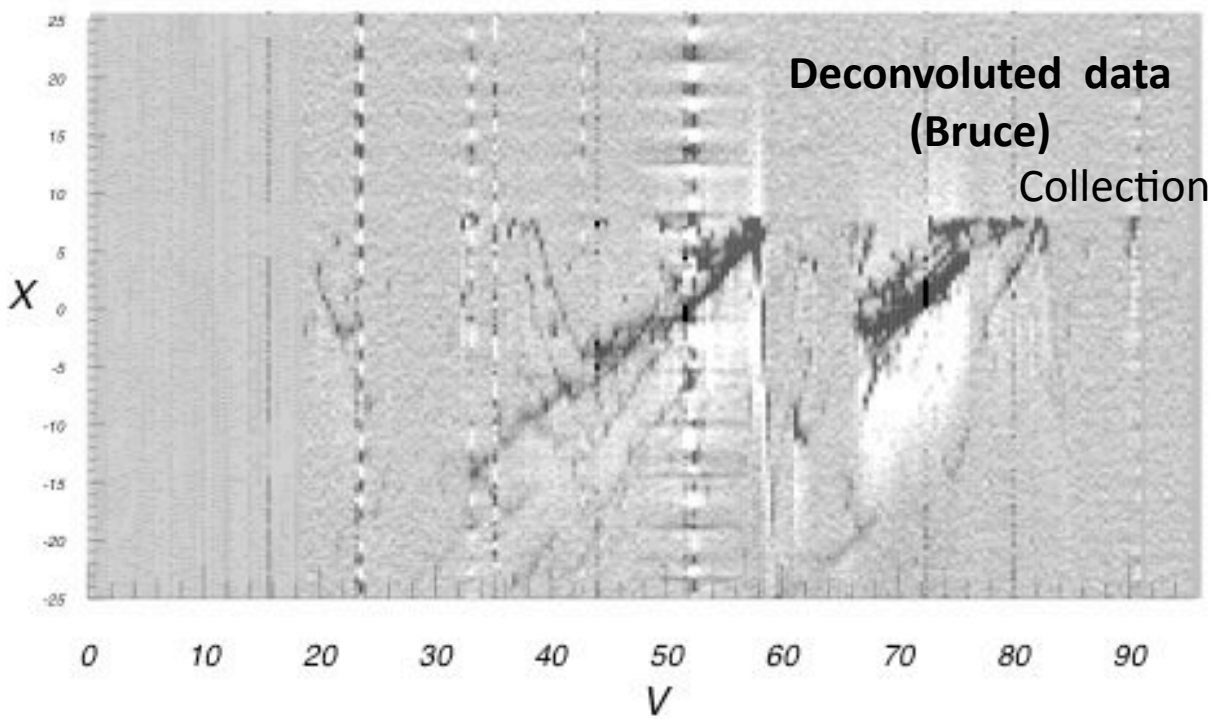
RawDataT962 - Collection -- Run 274 Event 1
File Cursor View
Collection
Raw Data
Hits
Used Hits
Tracks
Selection
Reconstruct track
Wires/Sample 240/2048
Wire
Sample
Zoom 1
Mag 1
Show wirediag
Show wire
Show FFT
Show 3DWires


RawDataT962 - Induction -- Run 274 Event 1
File Cursor View
Induction
RUN 274 Event 1
Raw Data
Hits
Used Hits
Tracks
Selection
Reconstruct track
Wires/Sample 240/2048
Wire
Sample
Zoom 1
Mag 1
Show wirediag
Show wire
Show FFT
Show 3DWires


RawDataT962 - Collection -- Run 281 Event 5
File Cursor View
Collection
RawDataT962 - Induction -- Run 281 Event 5
File Cursor
Induction
RawDataT962 - Collection - 3D Wire display
Raw data [ADC c]
2000
1900
1800
1700
1600
1500
0
500
1000
1500
2000
Time Samples [x 400 ns]
Zoom
Unzoom
Print wire
Cursor Pos: Press mouse button in plot
RUN 281 Event 5
Raw Data
Wire
40/2048
w wirediag
Show wire
Show FFT
Show 3DWires

C. R. shower


RawDataT962 - Collection -- Run 282 Event 9
File Cursor View
RUN 282 Event 9
Raw data
Collection
Raw Data
Hits
Used Hits
Tracks
Selection
Reconstruct track
Wires/Sample 240/2048
Wire
Sample
Zoom 1
Mag 1
Show wirediag
Show wire
Show FFT
Show 3DWires

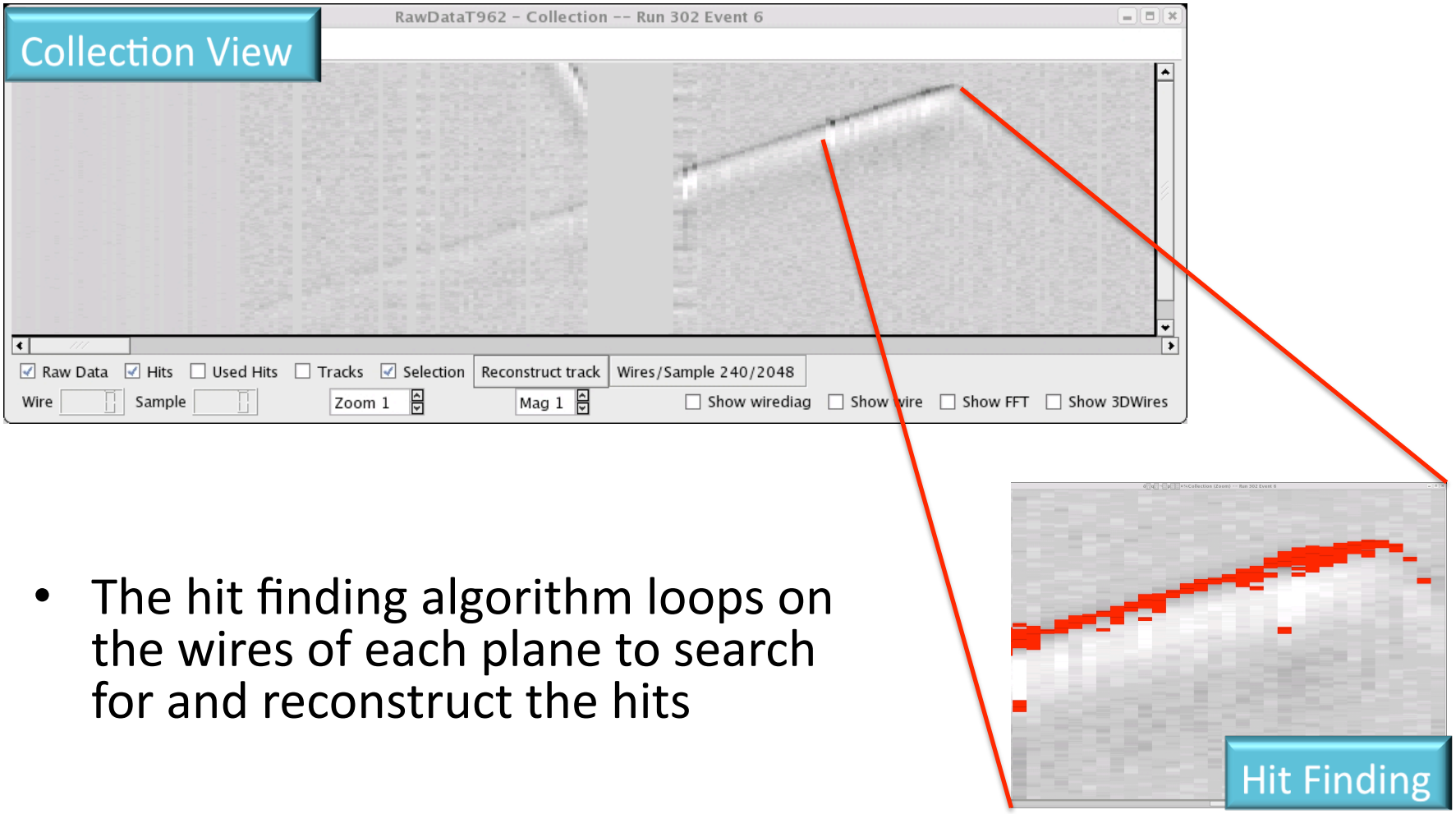

Deconvoluted data
(Bruce)
Collection
X
V
25
20
15
10
5
0
-5
-10
-15
-20
-25
0
10
20
30
40
50
60
70
80
90

Off-line software

- Single track events have been selected by visual scanning for the present off-line analysis.
- ICARUS off-line software has been so far used for display and event reconstruction.

  Currently only the raw data display is adapted for ArgoNeuT. Reconstruction algorithms (Hit Finding, Clustering, 2D Track reconstruction and 3D track reconstruction) are optimized for the ICARUS T600 detector.

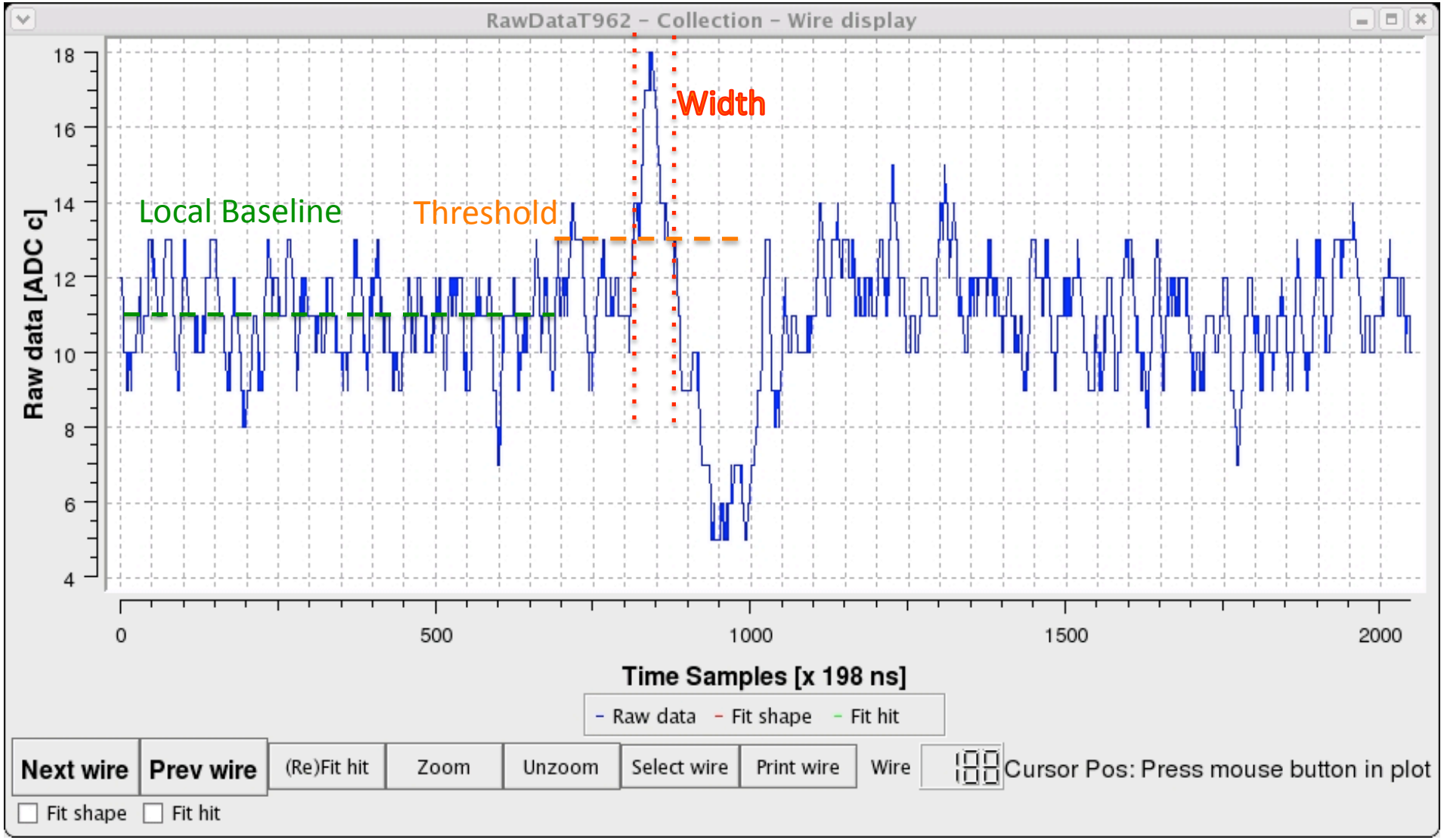
Hit Finding



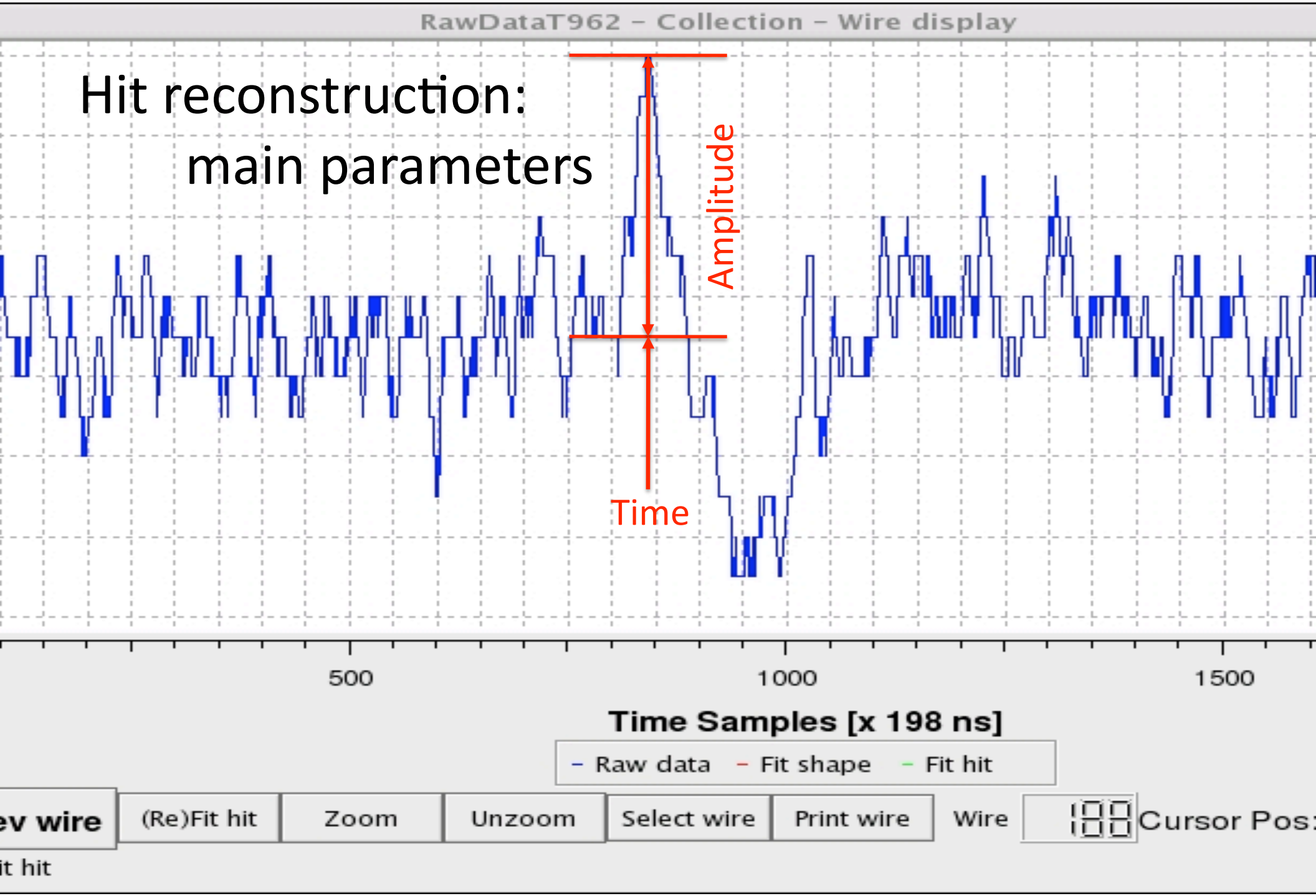
- The hit finding algorithm loops on the wires of each plane to search for and reconstruct the hits

Hit Identification

Hits are independently searched for in every wire as signal regions of a certain width above the baseline value

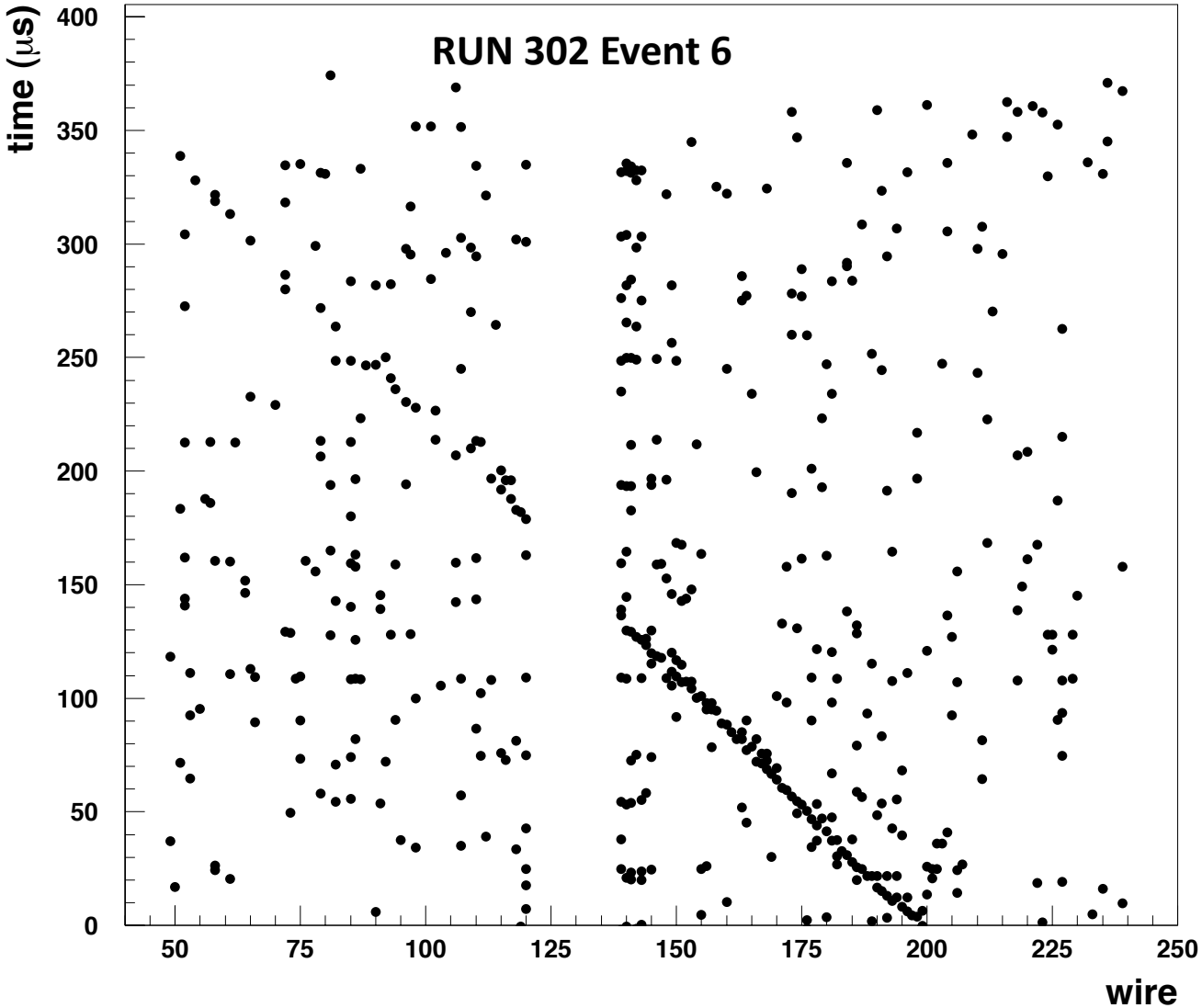


Hit reconstruction: main parameters

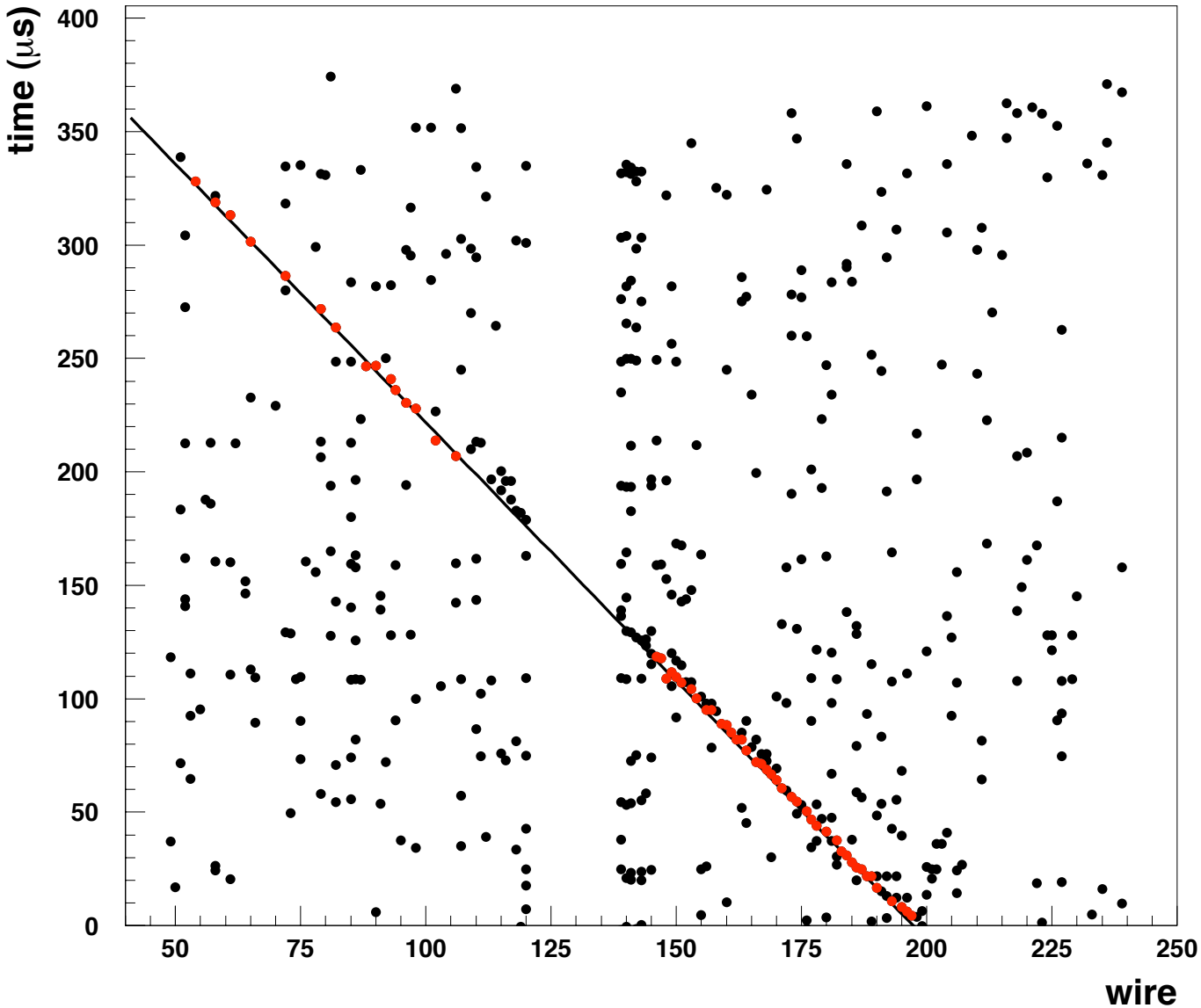


e-lifetime measurement (I)

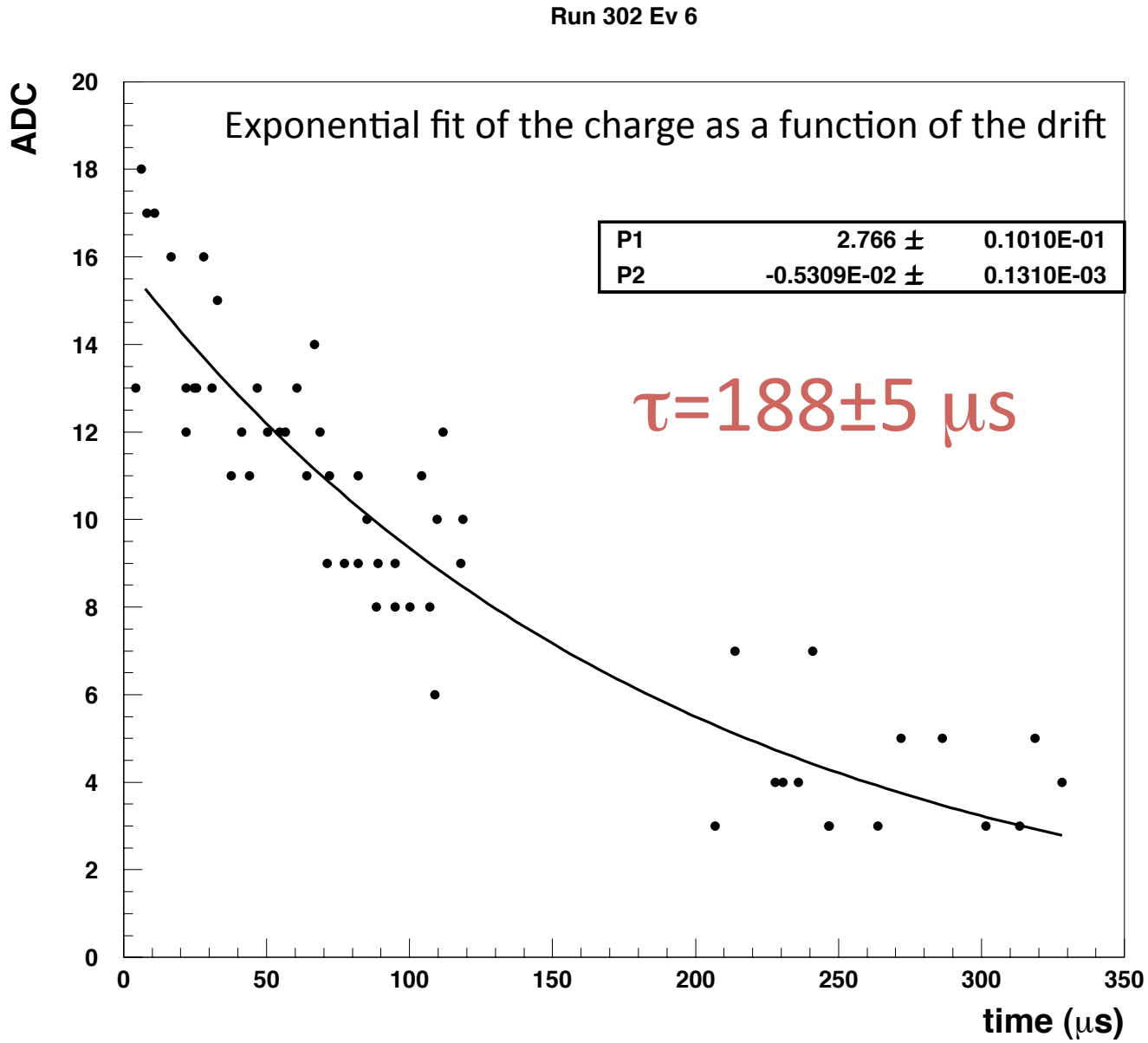
Reconstructed hits (with low threshold)



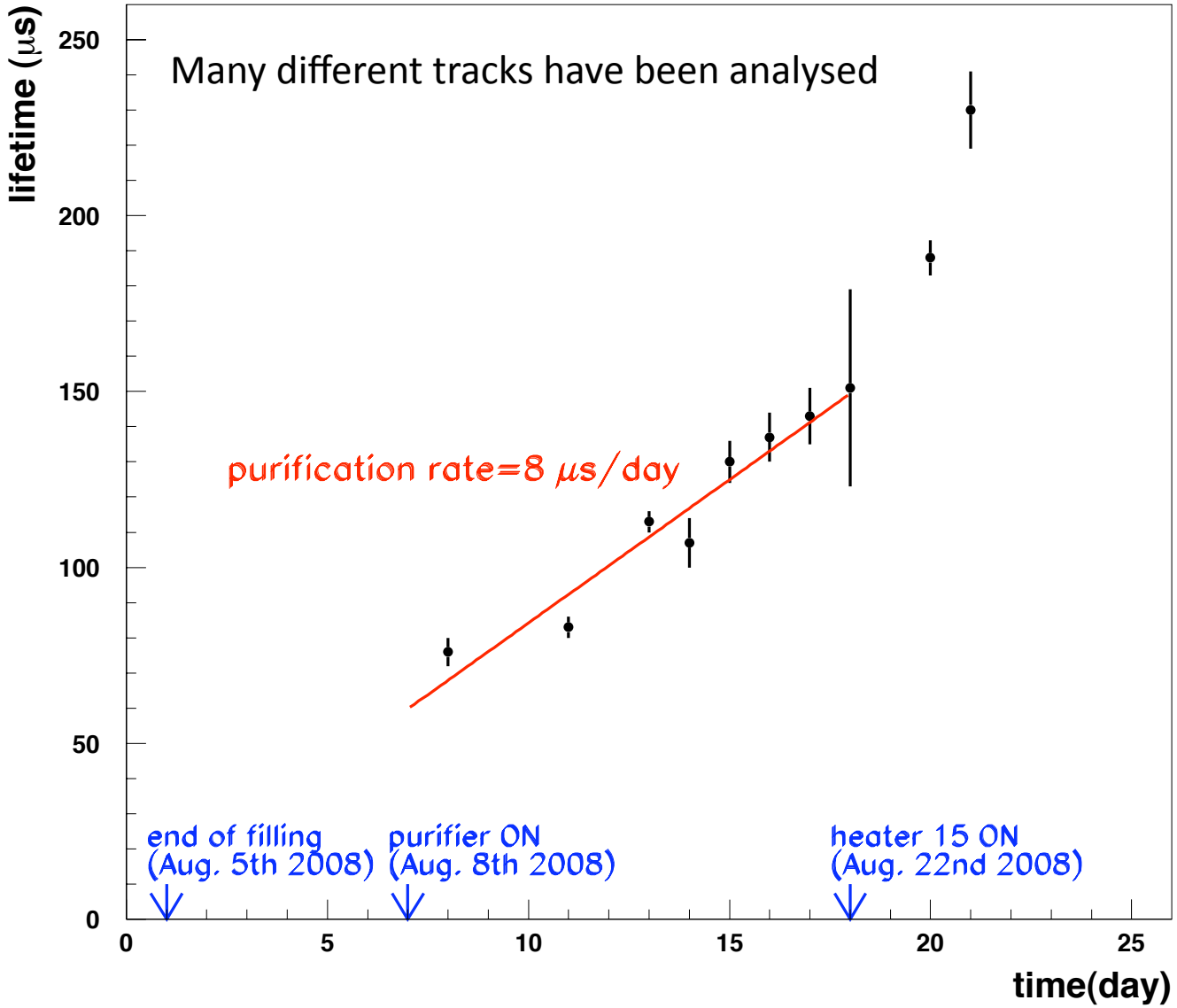
e-lifetime measurement (II)



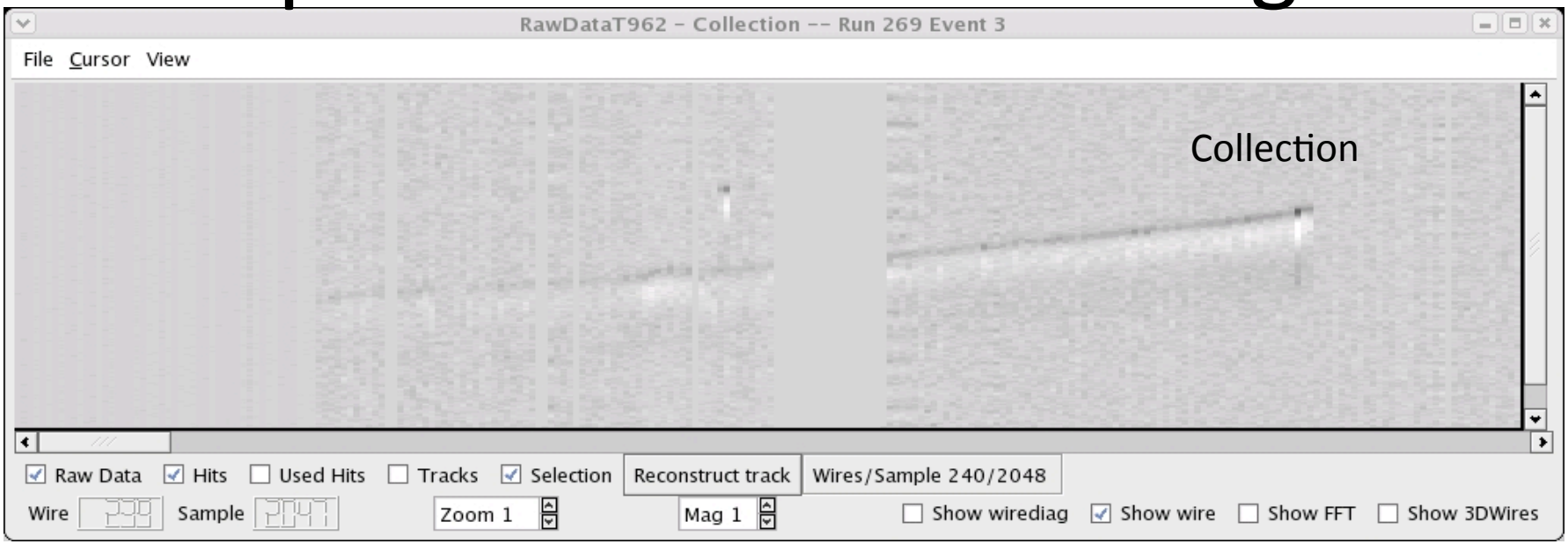
e-lifetime measurement

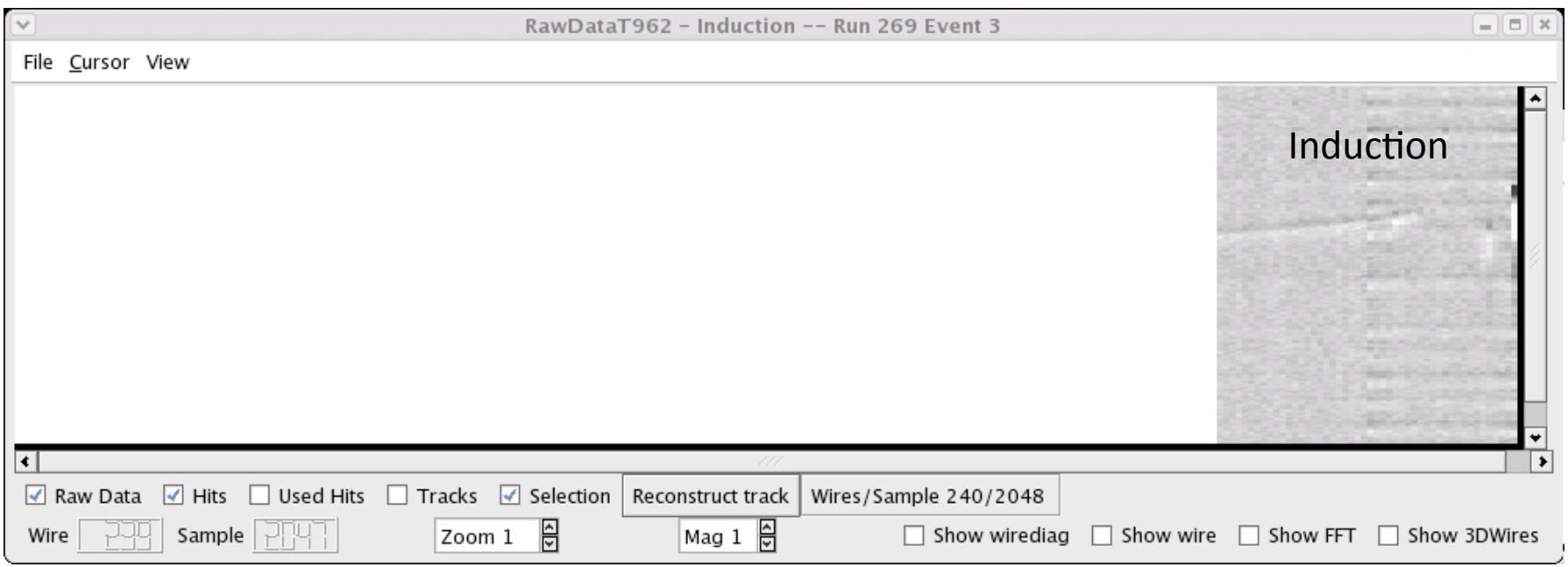


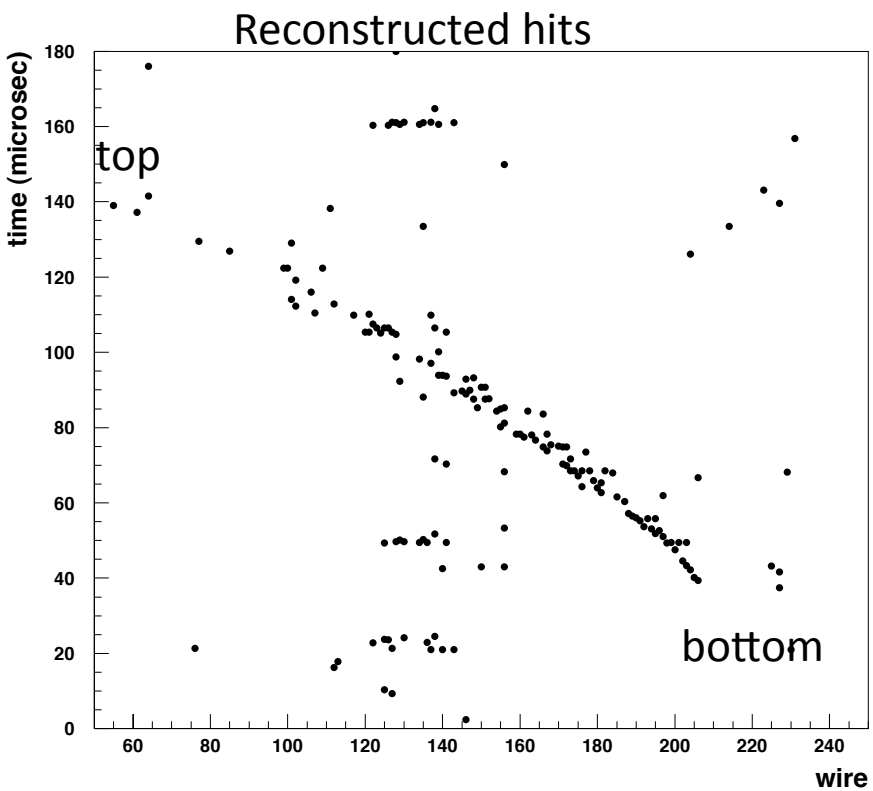
Evolution of the e-lifetime



A problem: Track "Bending"





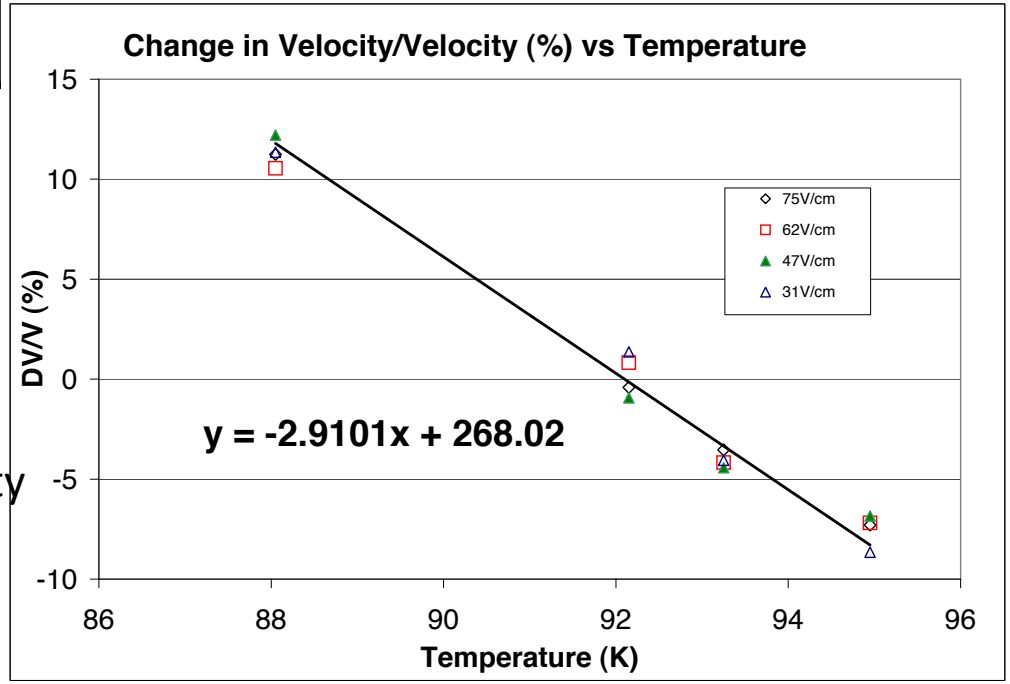


Track "Bending":

- due to temperature up-down gradient inside the LAr volume

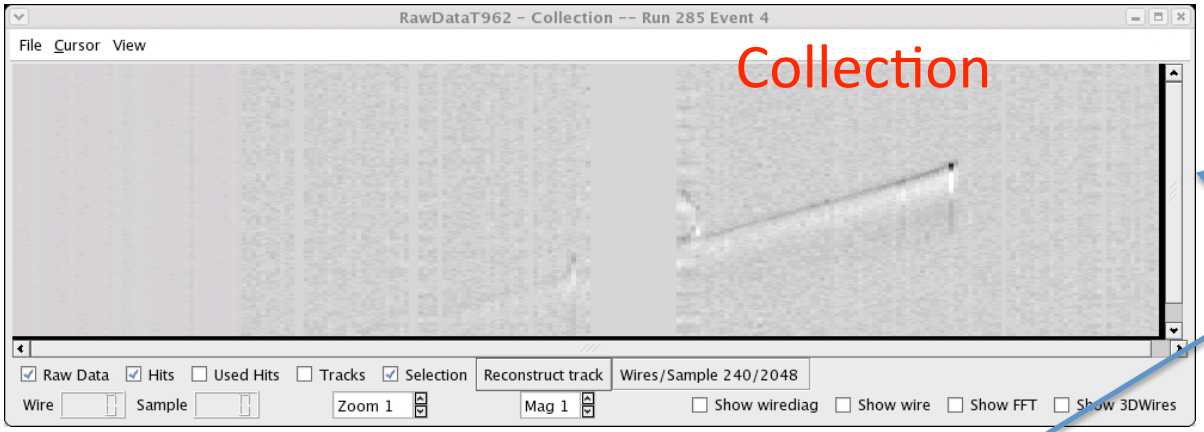
→ Drift velocity variation?

- due to electric field non-uniformity (enhanced by low EF setting)?



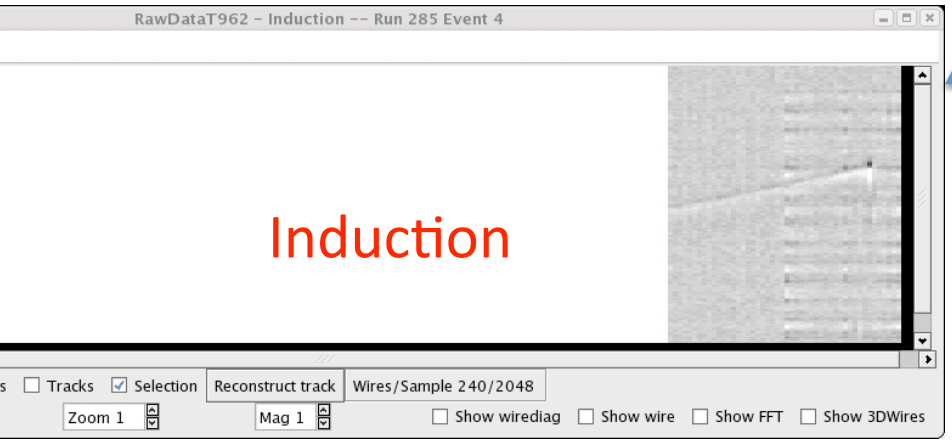
3D reconstruction

[the 3D reconstruction is necessary to apply corrections to the signal amplitudes due to the geometry of the track and to the e-lifetime when measuring the energy released]

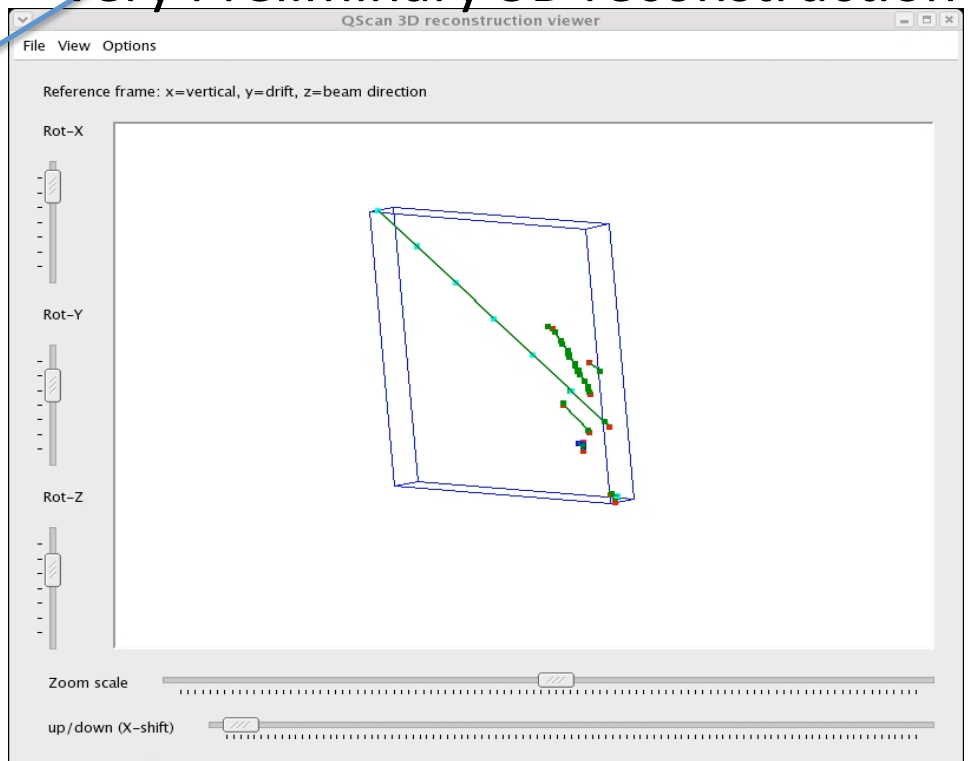


RUN 285 Event 4

2D projections



Very Preliminary 3D reconstruction



Clustering, 2D and 3D track reconstruction

- Cluster (group of adjacent hits) reconstruction: Hits are grouped into common charge deposition distribution based on their position in the wire/ drift coordinate plane.
- 2D track reconstruction: clusters are linked together to reconstruct 2D tracks on each view
- 3D track reconstruction: 2D tracks from different views are matched to reconstruct the 3D event

To be done
(for detector characterization)

- Continue the measurement of the evolution of the e-lifetime during the data taking;
- Electron drift velocity measurement;
- 3D reconstruction for:

  - dE/dx measurement (calibration factor to convert ADC→ charge needed)