Preliminary results of proton/deuteron data

(July/October beamtimes, FADC readout)

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LI PANDA Collaboration Meeting

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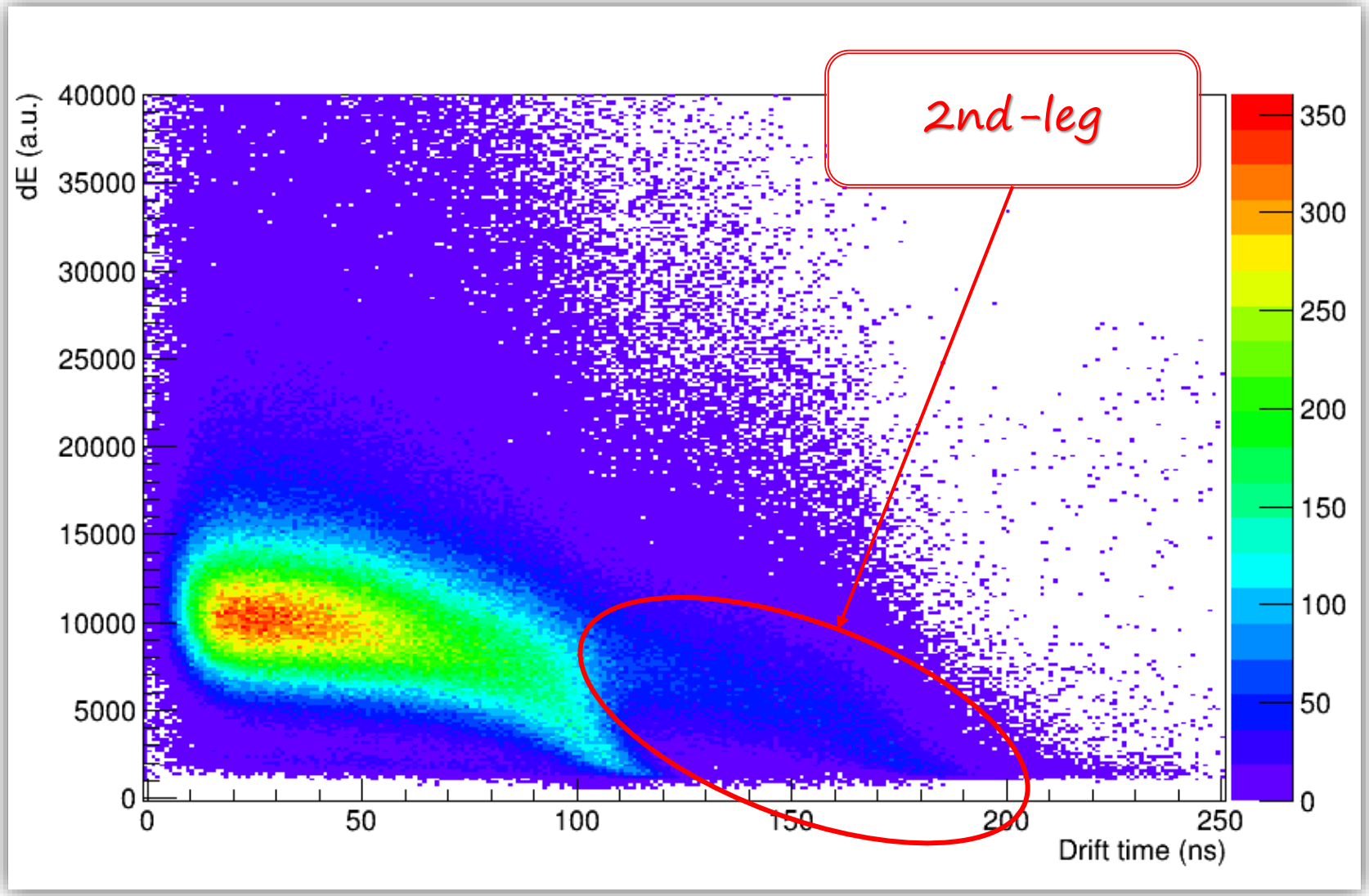
Overview

State of the art of the analysis of proton/deuteron data collected in July/October with the FADC readout

- 2nd-leg problem
- Possible solution
- Analysis results
  - Protons @ 3 GeV, low intensity
    - Only two straw layers used
  - Protons @ 600 and 800 MeV, low intensity
  - Deuterons @ 870 MeV
- Summary & Outlook

WARNING:
Results are preliminary!!!!

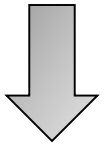
An unexpected guest



See P. Wintz's talk in this session

Looking for a «way out»

2nd leg ↔ track position wrt the tube wire



different drift time distributions for hits traversing the tubes above/below the wires

Software «way out»:

determination of the hit position wrt the tube wire from track reconstruction

(z_0, y_0) – wire position, (z, y) – hit position

$y|_{z_0} > y_0 \rightarrow$ ABOVE!

$y|_{z_0} < y_0 \rightarrow$ BELOW!

The «way out»

Determination of hit position:

(z_0, y_0) – wire position

(z, y) – hit position

$y|_{z_0} > y_0 \rightarrow$ ABOVE!

$y|_{z_0} < y_0 \rightarrow$ BELOW!

The «way out»

Track reconstruction

Determination of hit position:

(z_0, y_0) – wire position

(z, y) – hit position

$y|_{z_0} > y_0 \rightarrow$ ABOVE!

$y|_{z_0} < y_0 \rightarrow$ BELOW!

The «way out»

Input calibration for
drift time → isochrone radius

Track reconstruction

Determination of hit position:

(z_0, y_0) – wire position

(z, y) – hit position

$y|_{z_0} > y_0 \rightarrow$ ABOVE!

$y|_{z_0} < y_0 \rightarrow$ BELOW!

The «way out»

Input calibration for drift time → isochrone radius

Analysis of the experimental drift time distributions

Track reconstruction

Determination of hit position:

(z_0, y_0) – wire position

(z, y) – hit position

$y|_{z_0} > y_0 \rightarrow$ ABOVE!

$y|_{z_0} < y_0 \rightarrow$ BELOW!

The «way out»

Input calibration for drift time → isochrone radius

Analysis of the experimental drift time distributions

Track reconstruction

Determination of hit position:

(z_0, y_0) – wire position

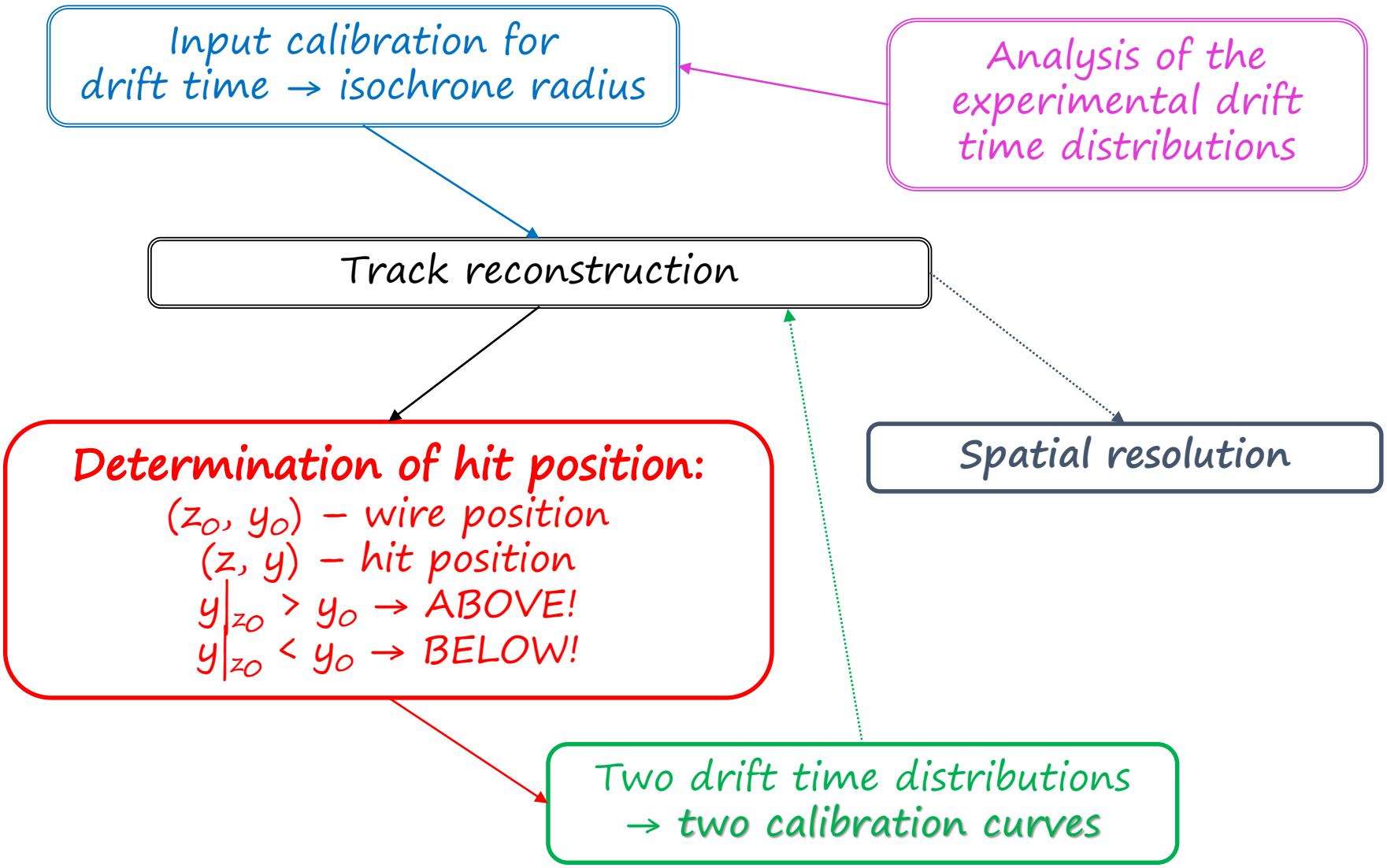
(z, y) – hit position

$y|_{z_0} > y_0$ → ABOVE!

$y|_{z_0} < y_0$ → BELOW!

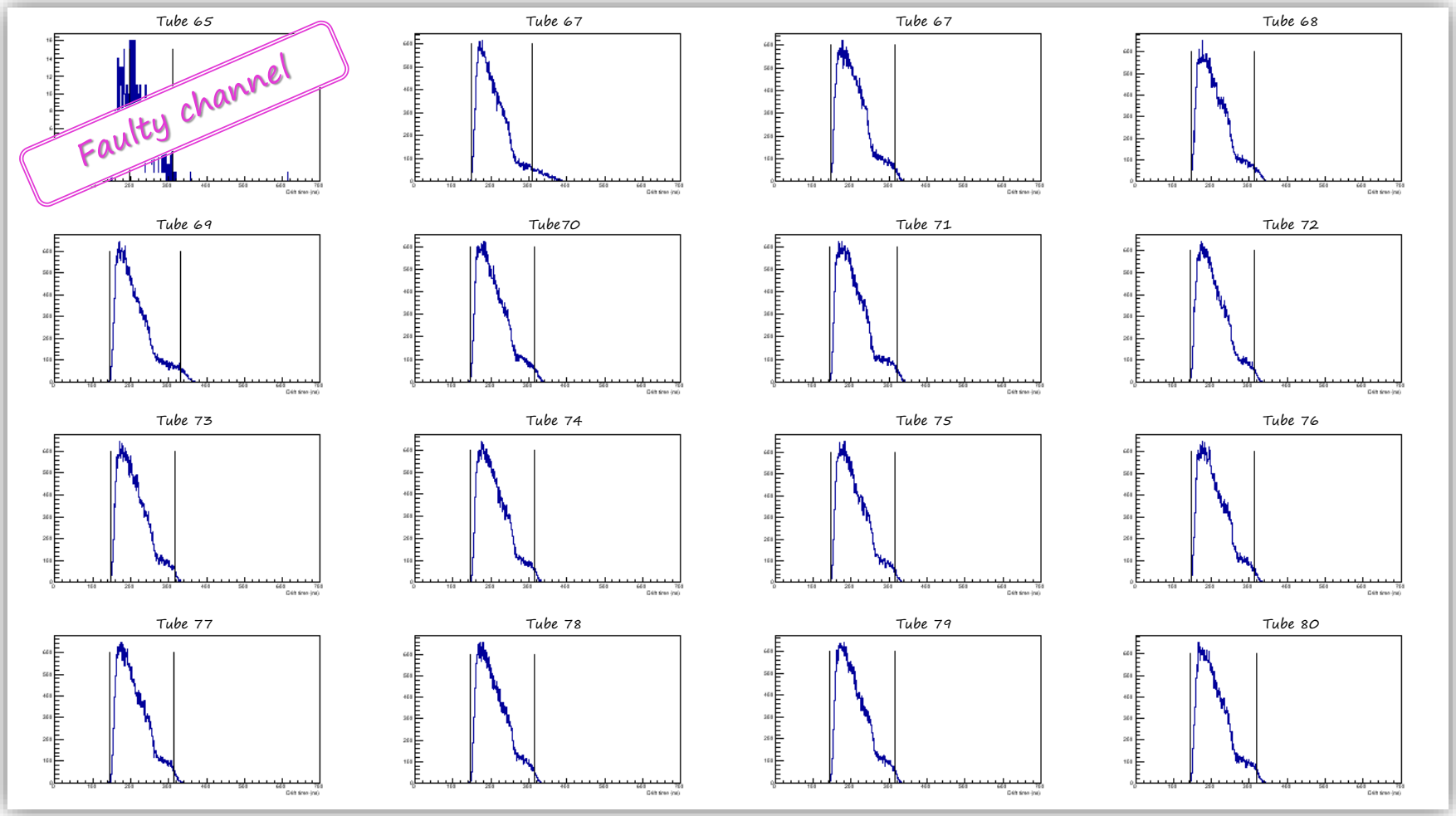
Two drift time distributions → **two calibration curves**

The «way out»


Input calibration for drift time → isochrone radius
Analysis of the experimental drift time distributions
Track reconstruction
Determination of hit position:
(z_0, y_0) – wire position
(z, y) – hit position
$y|_{z_0} > y_0$ → ABOVE!
$y|_{z_0} < y_0$ → BELOW!
Spatial resolution
Two drift time distributions
→ two calibration curves

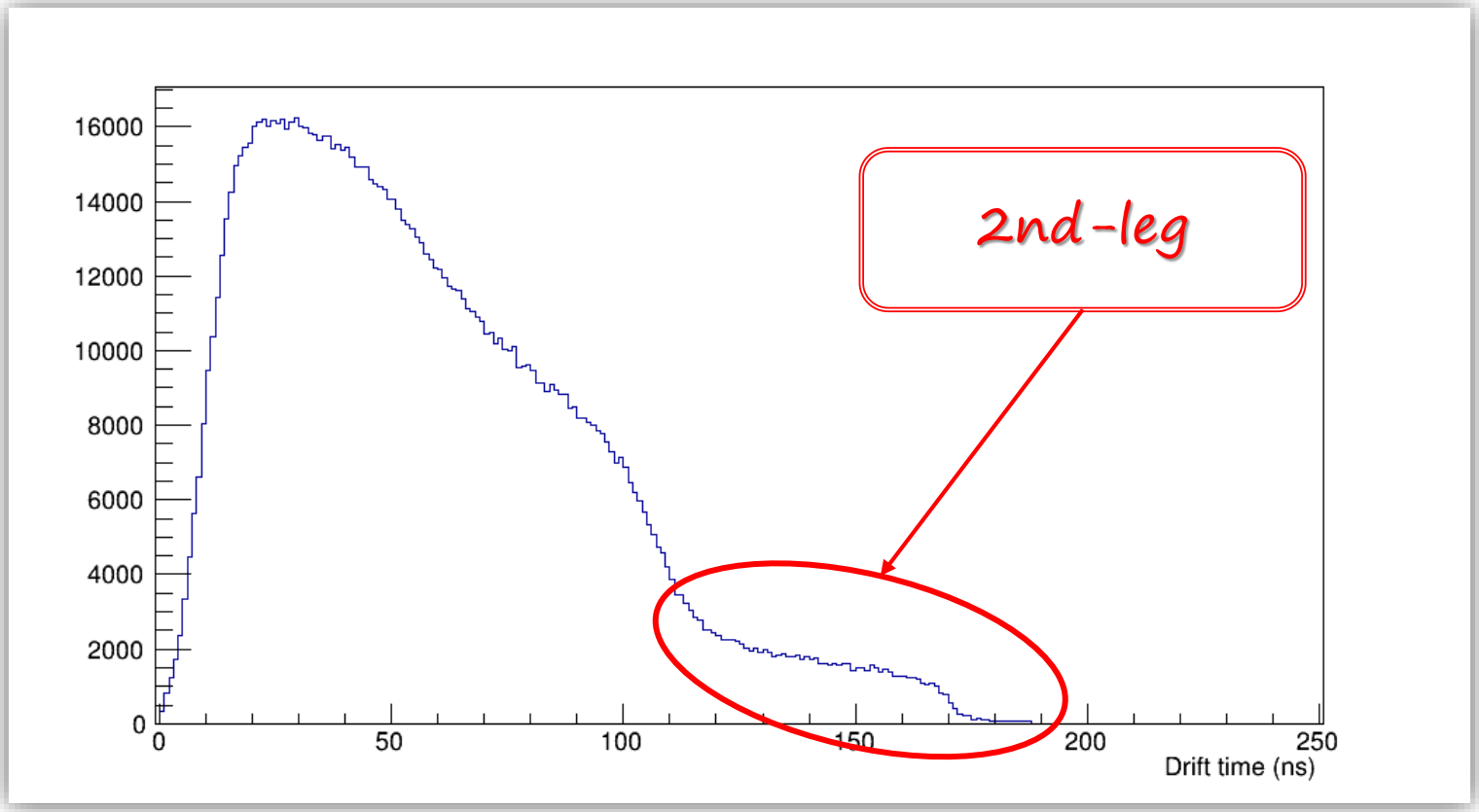
Drift time distributions

t_0 and t_{max} determination: 10% of the peak value



Proton data @ 3 GeV, 1 run @ low intensity, layer 5

Total drift time distribution

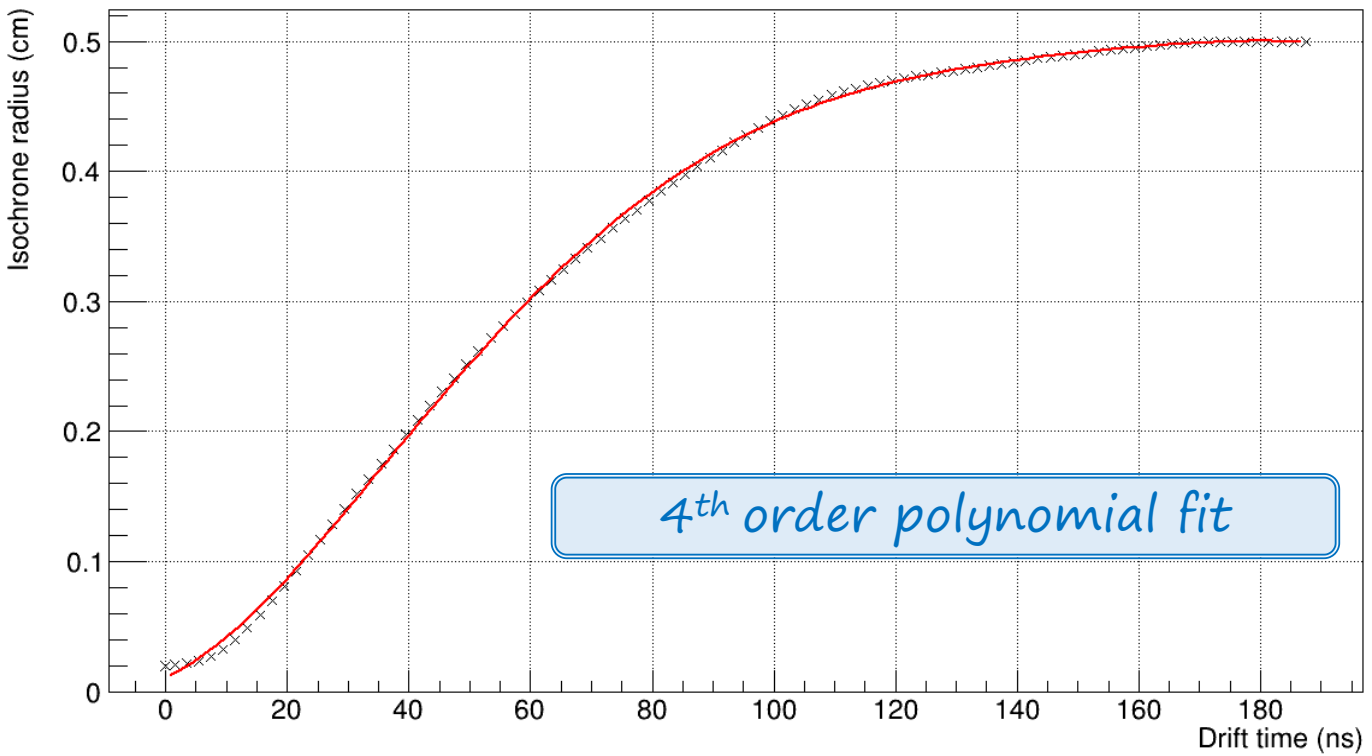


By its integration, we get isochrone curve- drift time relation:

$$r(t_i) = \frac{\sum_{i=1}^{i_t} N_i}{N_{tot}} \cdot (R_{tube} - R_{wire}) + R_{wire}$$

r(t) calibration

Input calibration curve for track reconstruction



Track reconstruction

«Ad hoc» algorithm for track reconstruction and dE/dx determination (in PandaROOT)

Algorithm steps:

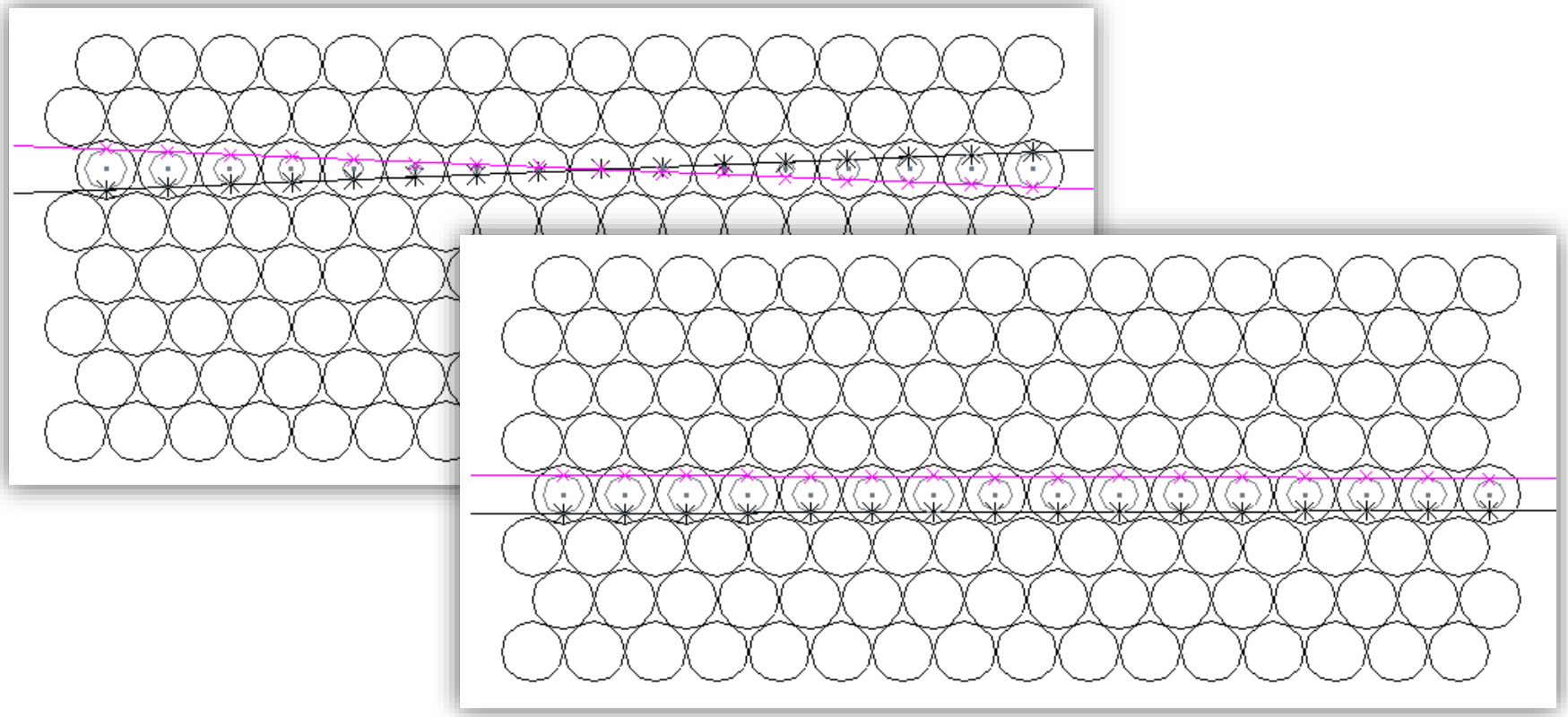
- «Hit producing»:
  - Drift time conversion into isochrone radius
- Track finding (pattern recognition)
  - Cluster formation
- Track fitting:
  - Prefit using points (centers of tubes)
  - Fit using isochrones
  - Fit using points (intersections on isochrones)
  - Refit

(see my talk @ June Tracking Session @ PANDA CM)

Note:
above/below ambiguity issue for tracks traversing a single layer

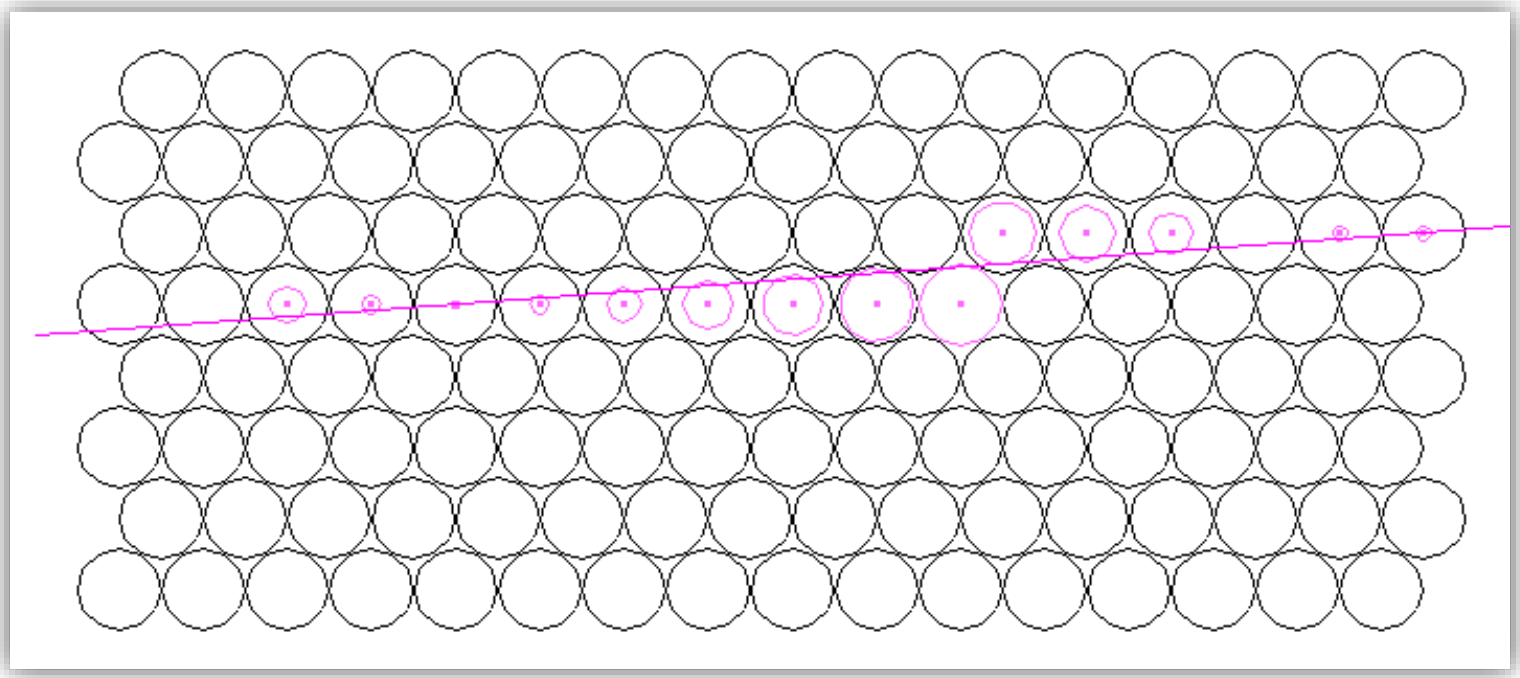
Above/below ambiguity

NO CHANCE to solve above/below ambiguity
for tracks traversing a single layer («in the middle»)



Such tracks will be discarded in the following…

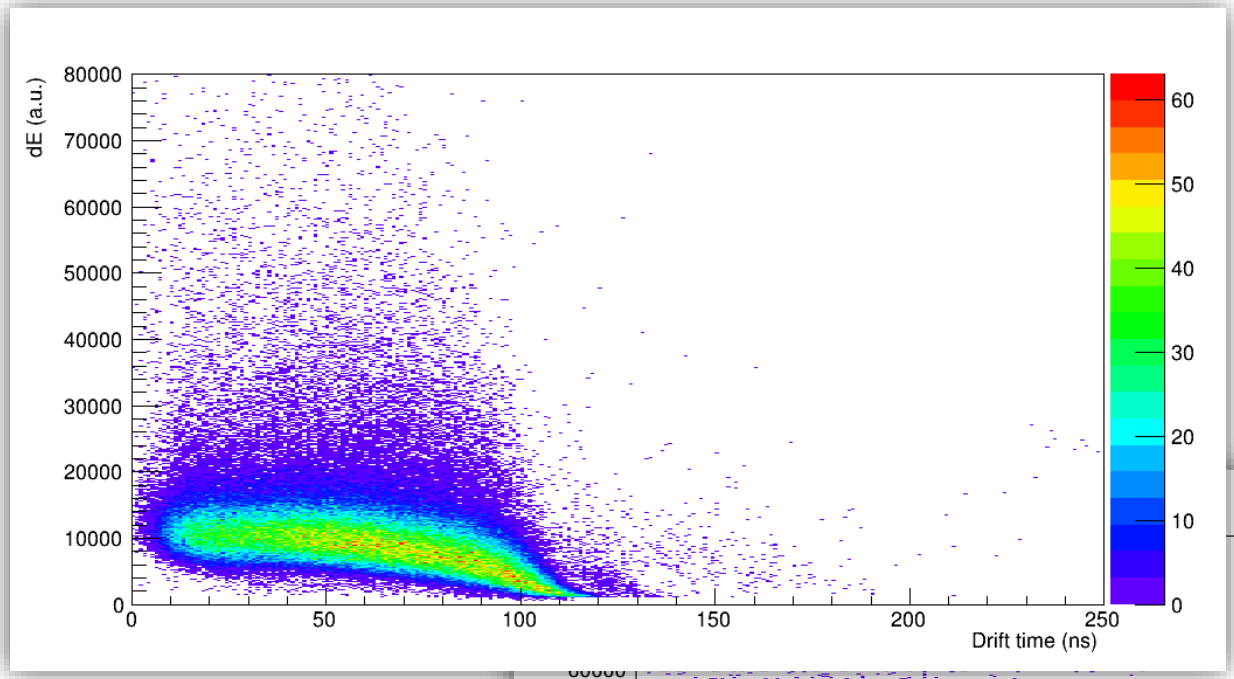
Above/below hit separation



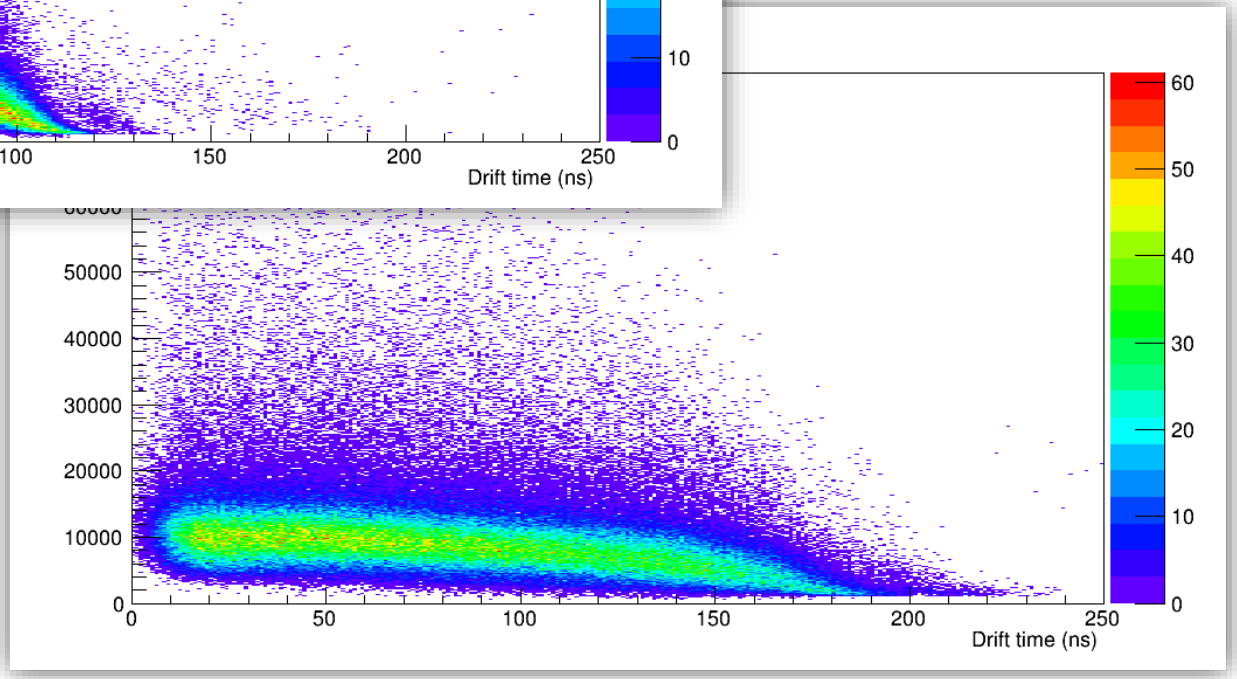
After track reconstruction, each hit is «tagged» as above/below

Its drift time is used to fill the corresponding drift time distribution

Two drift time distributions

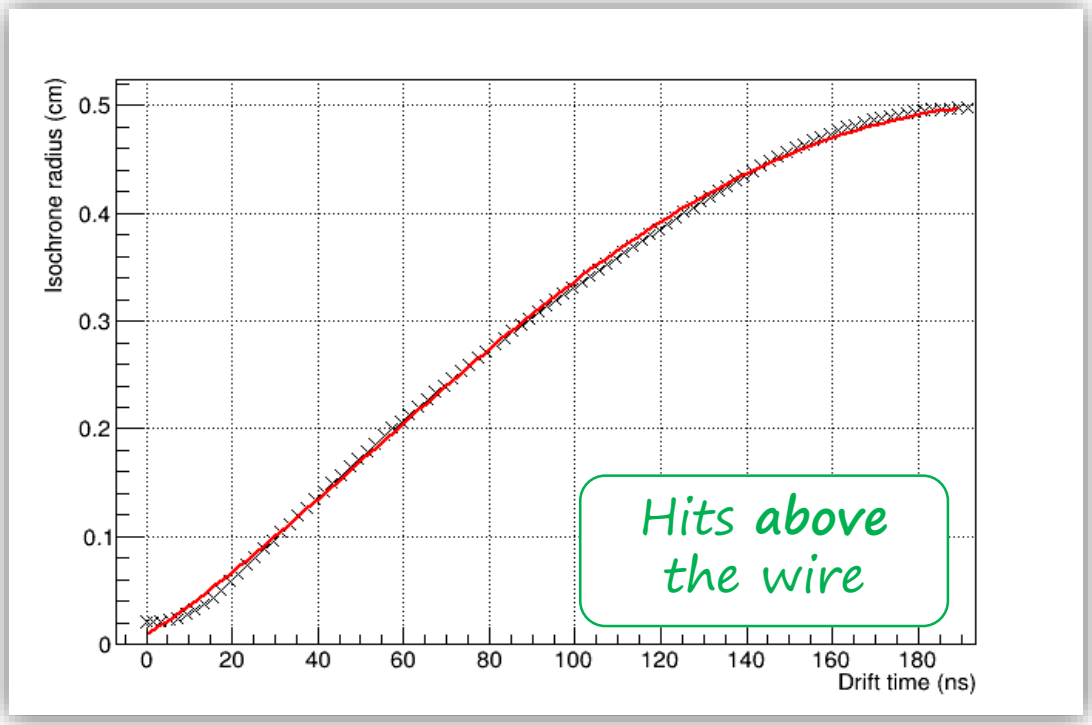


Hits below the wire



Hits above the wire

Two new r(t) calibration curves



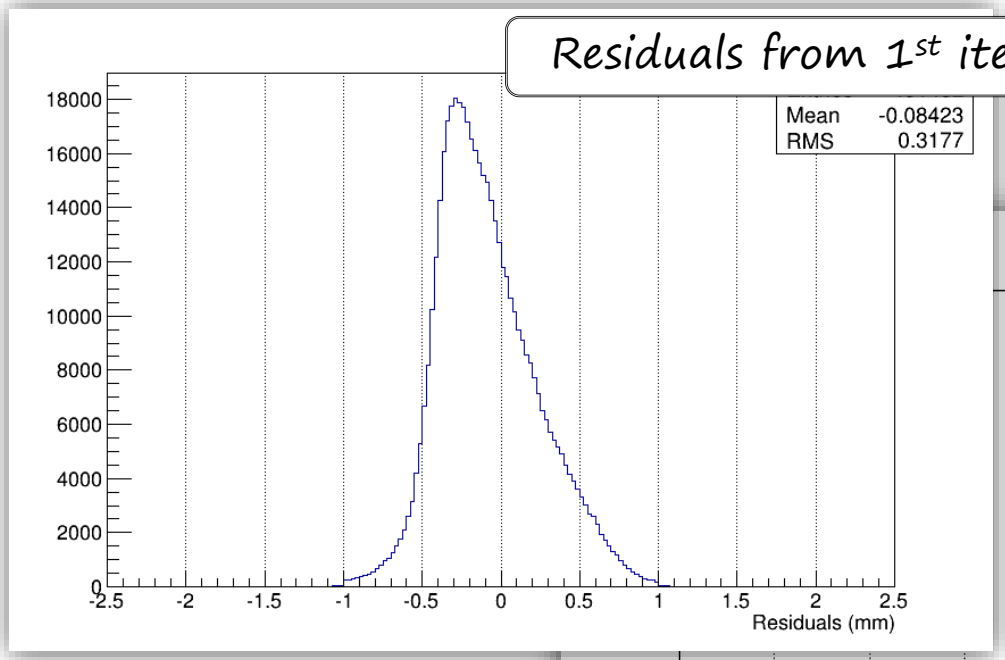
For each hit, depending on where it passed inside the tube, a new isochrone radius is calculated

Track reconstruction: 2nd iteration with corrected r values

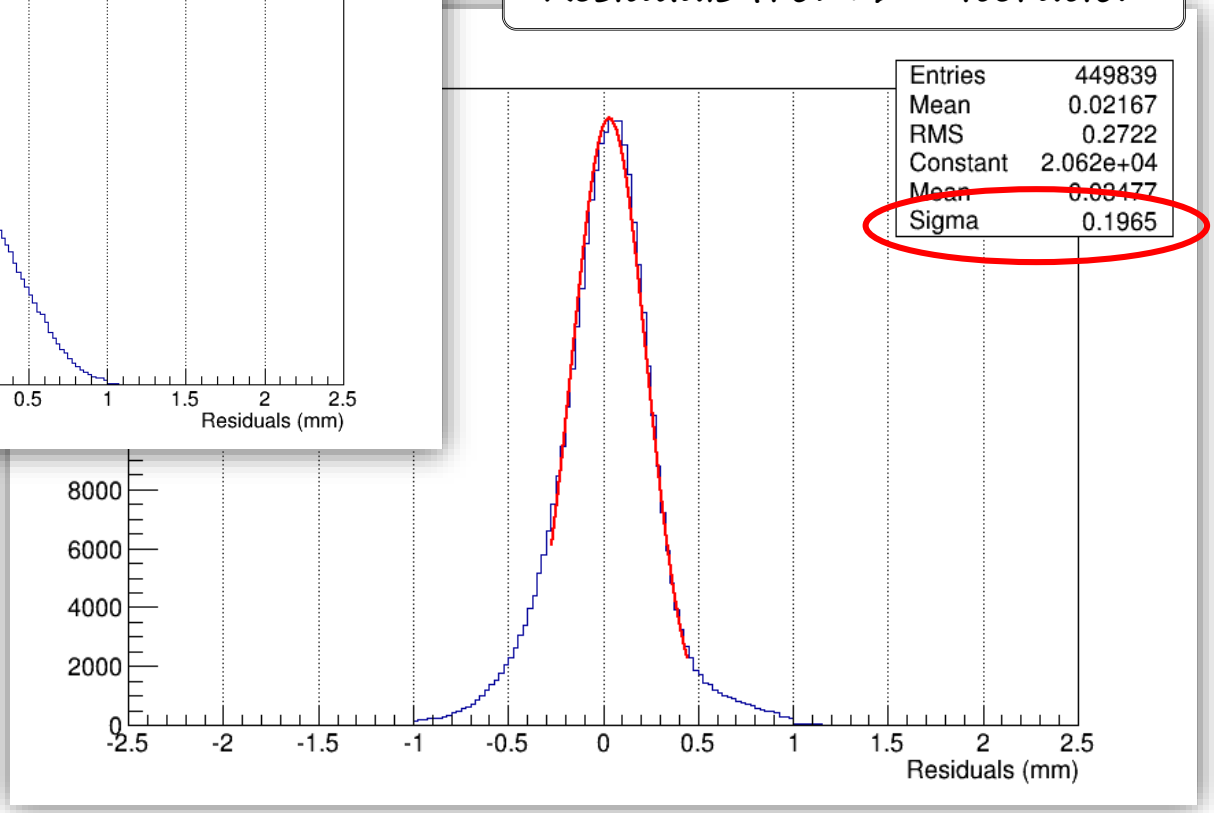
Residuals distributions

$$\Delta r = r_{fit}(a,b) - r_{raw}$$

Residuals from 1st iteration

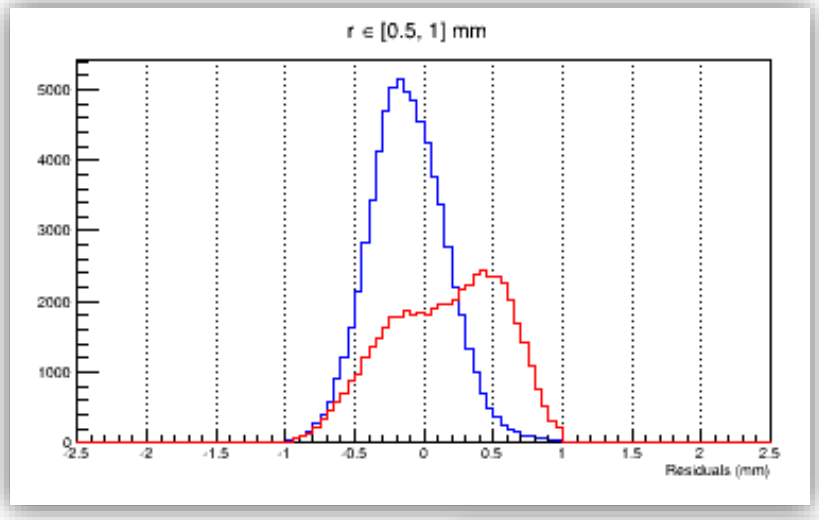


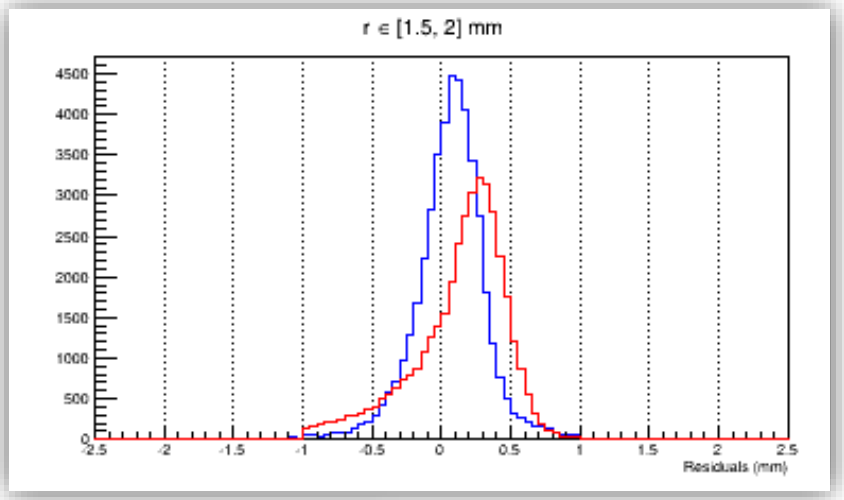
Residuals from 2nd iteration

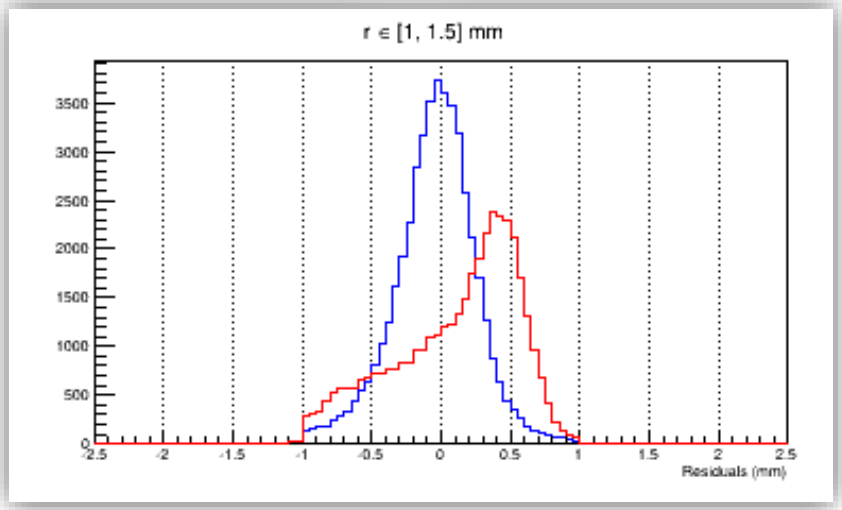


Residuals distributions (II)

$$\Delta r = r_{fit}(a,b) - r_{raw}$$





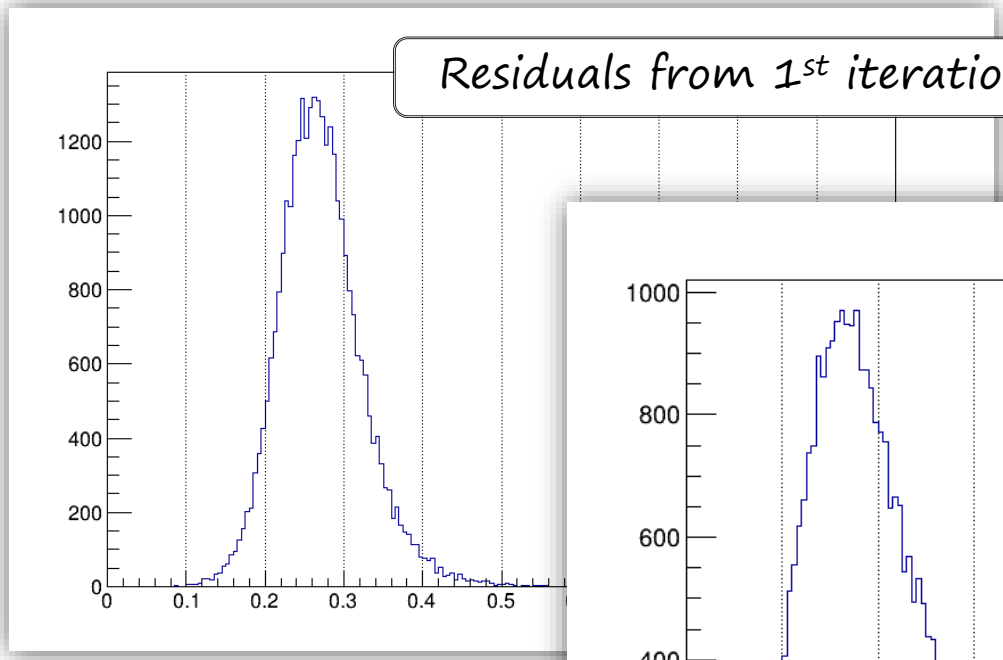


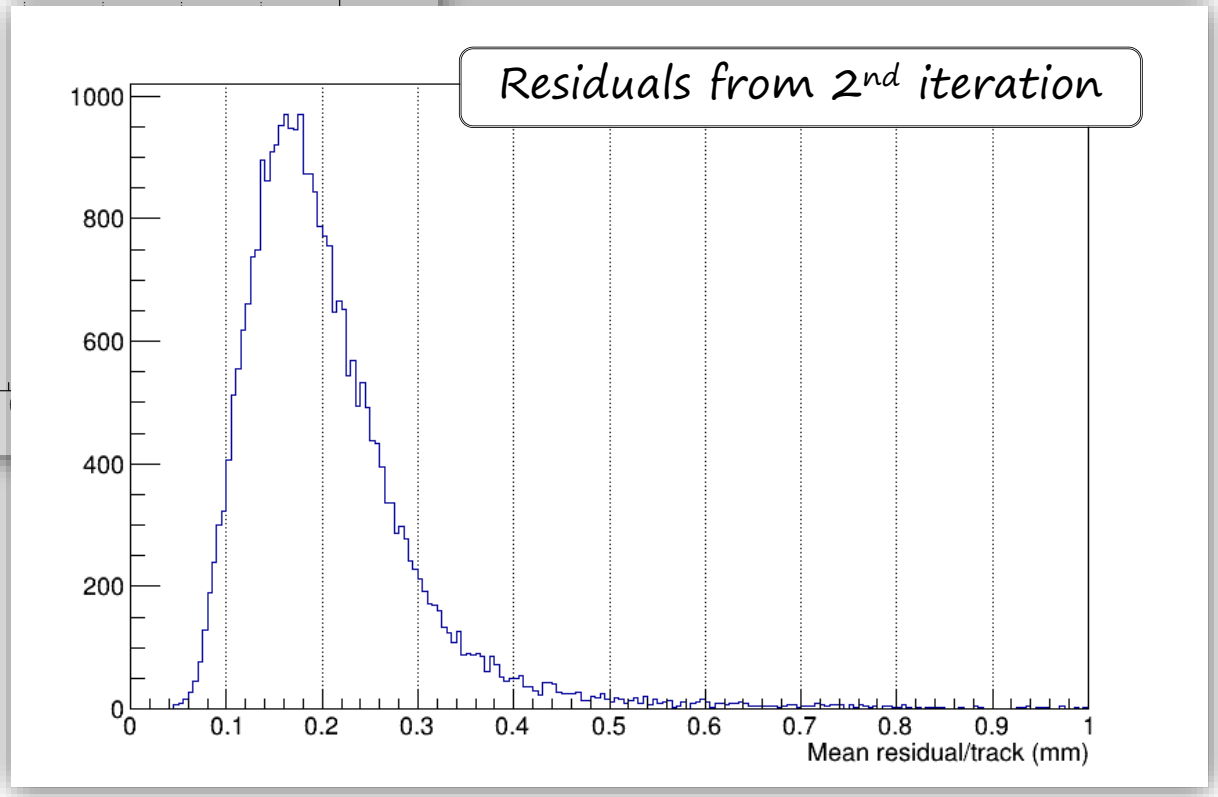
1st iteration

2nd iteration

Mean residuals/track

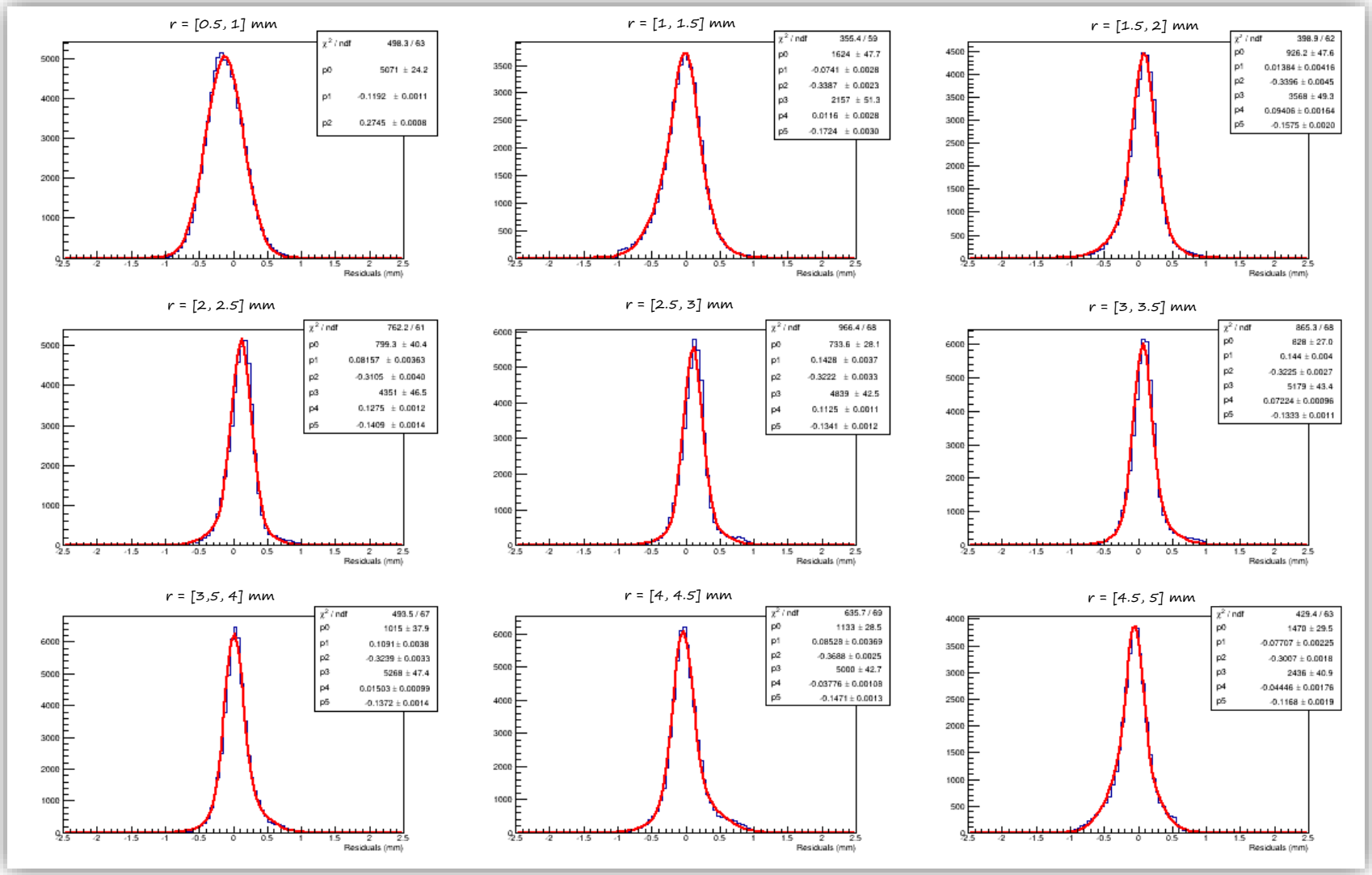
$$\Delta r_{mean} = \Sigma r_{hit}(a,b) \,/\, (\#hits/trk)$$



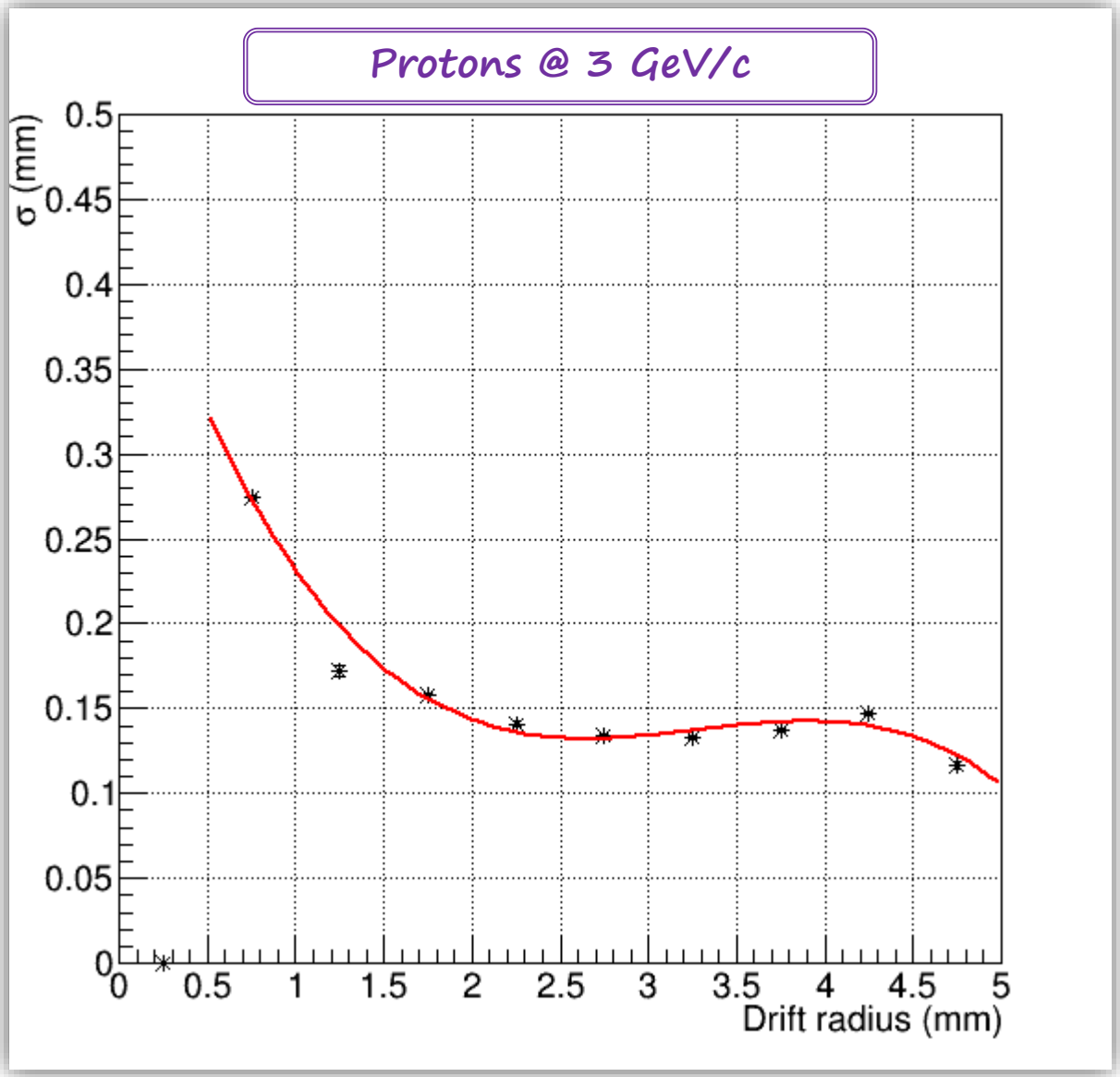


Residuals distributions (III)

for different isochrone radius ranges

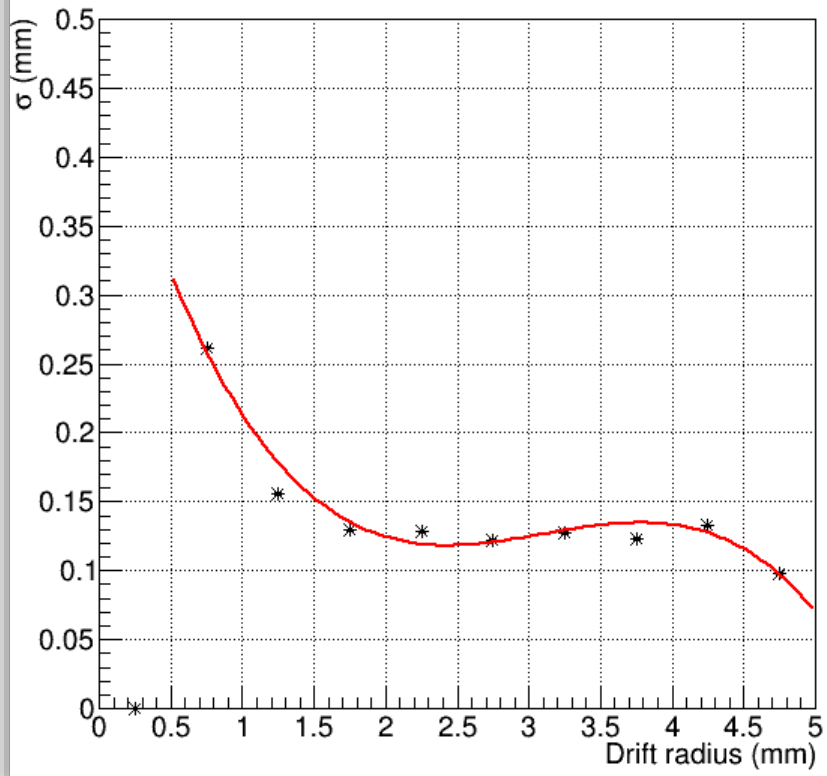


Spatial resolution

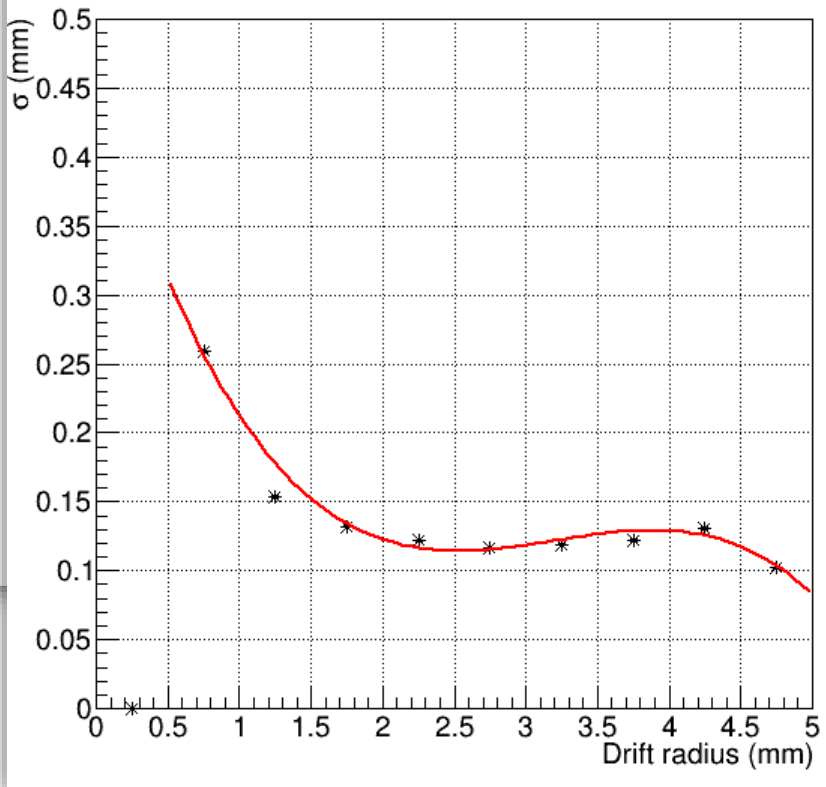


Spatial resolution

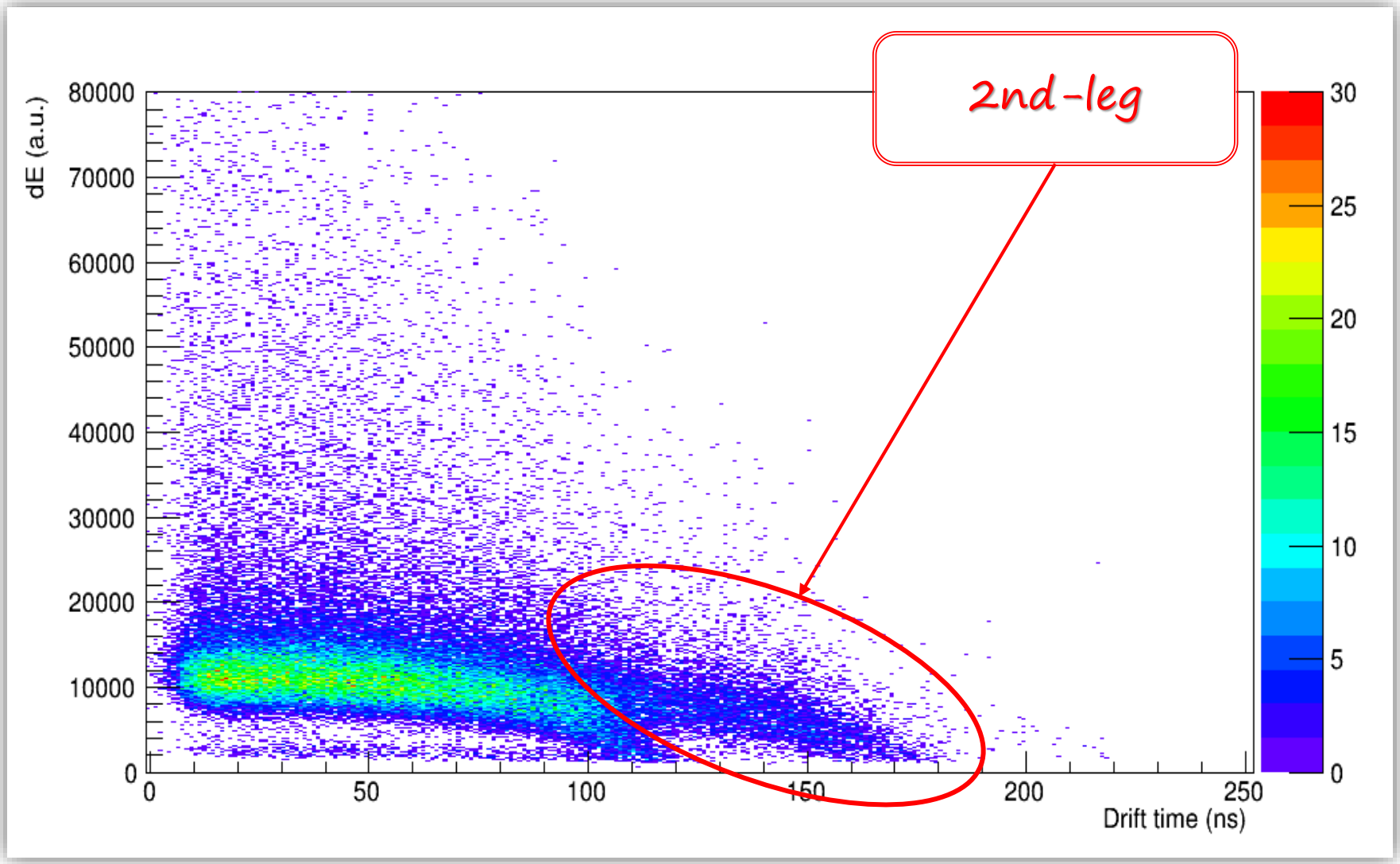
Protons @ 600 MeV/c



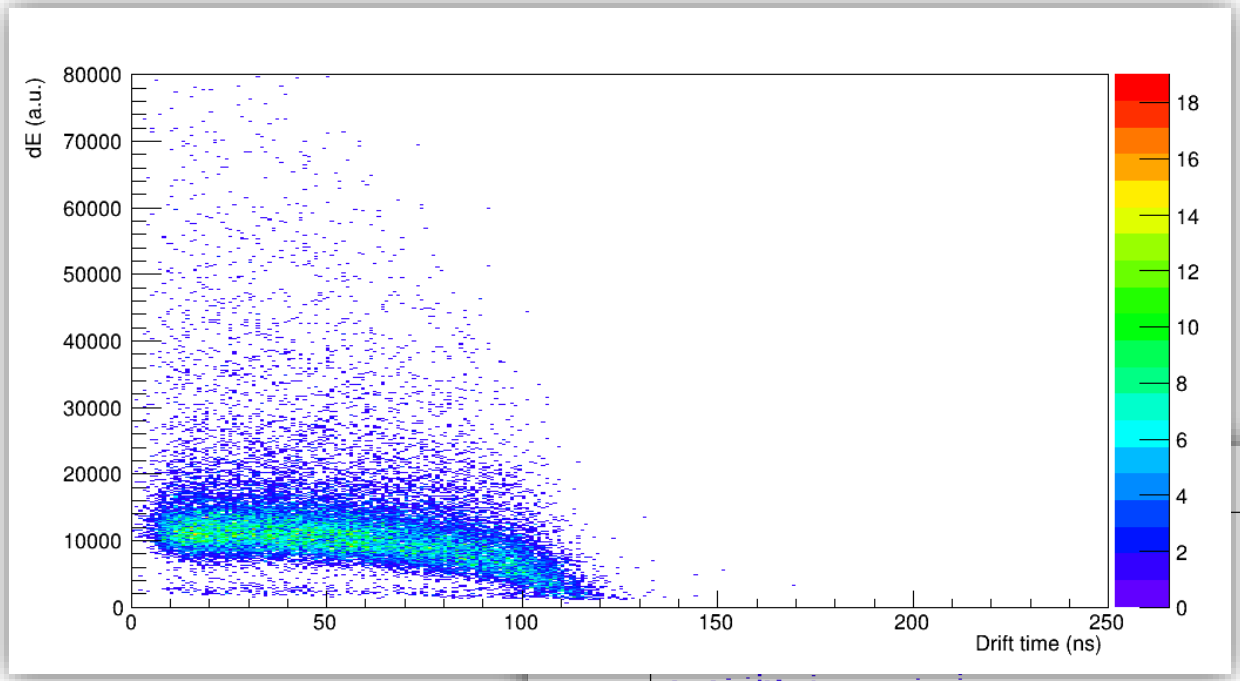
Protons @ 800 MeV/c



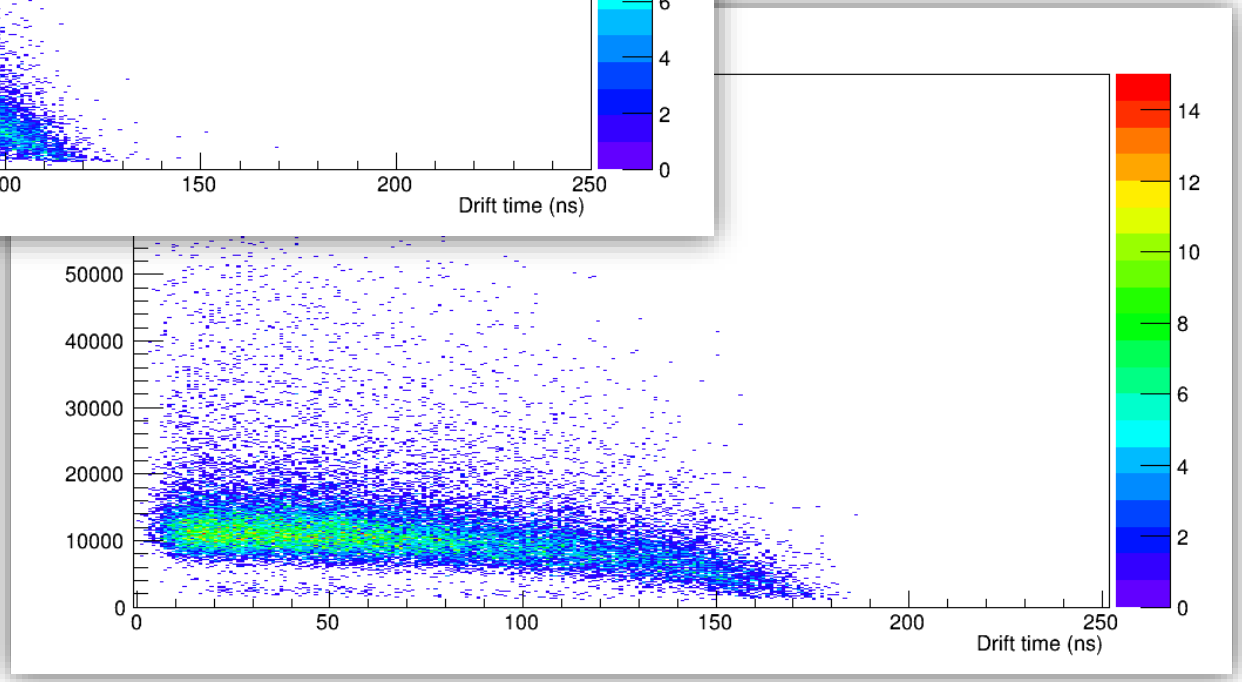
2nd-leg for deuterons (870 MeV)



Two drift time distributions



Hits below the wire



Hits above the wire

Summary & Outlook

- The 2nd-leg source has been identified and corrected for the last beamtime
- A software correction has been implemented in the reconstruction code and tested with July/October data, affected by this problem
- An improvement in the residuals distribution and spatial resolution is evident
- A test can be performed with more iterations, since results are promising
- Data affected by the 2nd-leg issue can still be used!!


Thank you!