Bias on track fitting with $\log\left(\frac{Q_1}{Q_0}\right)$

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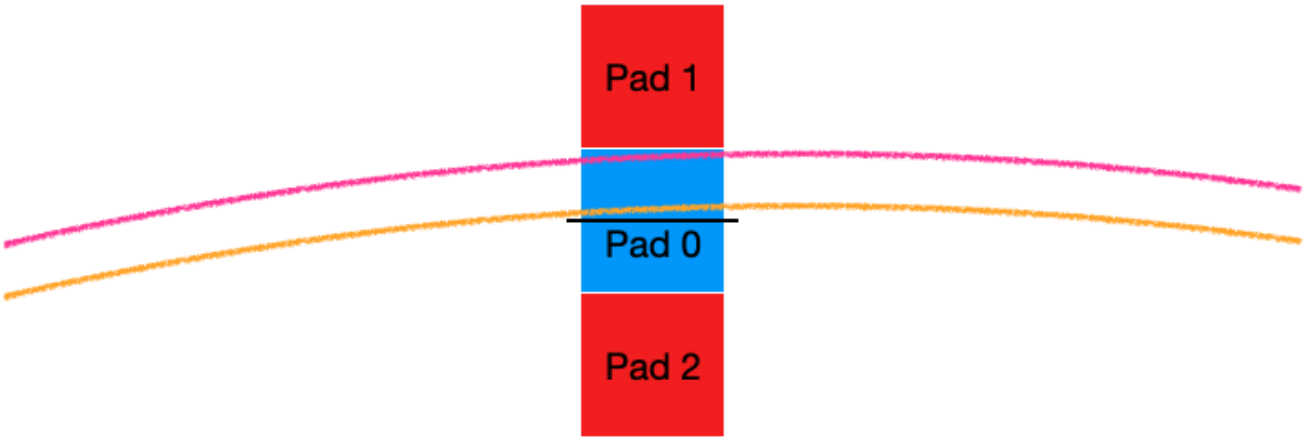
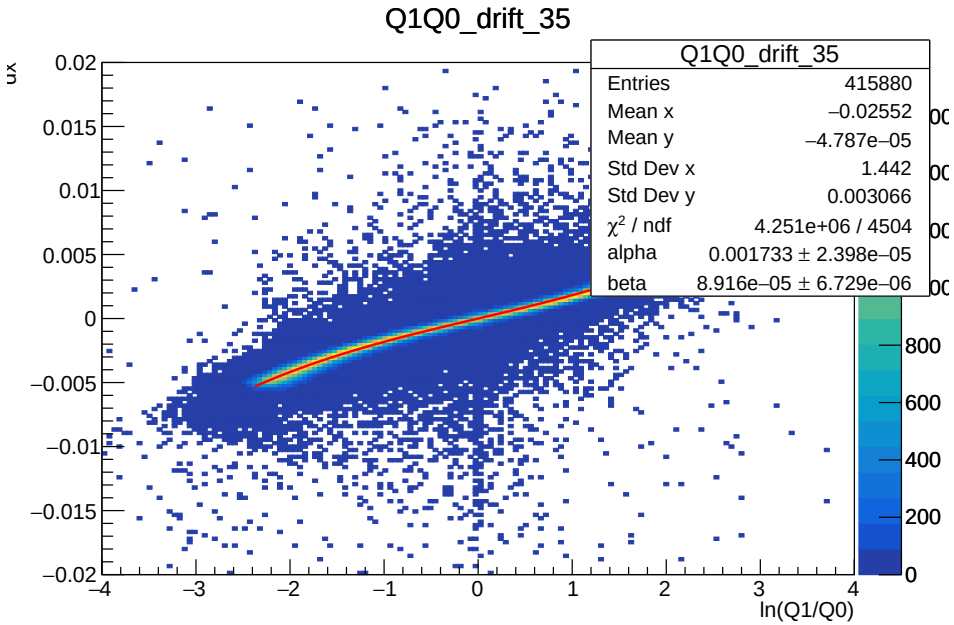
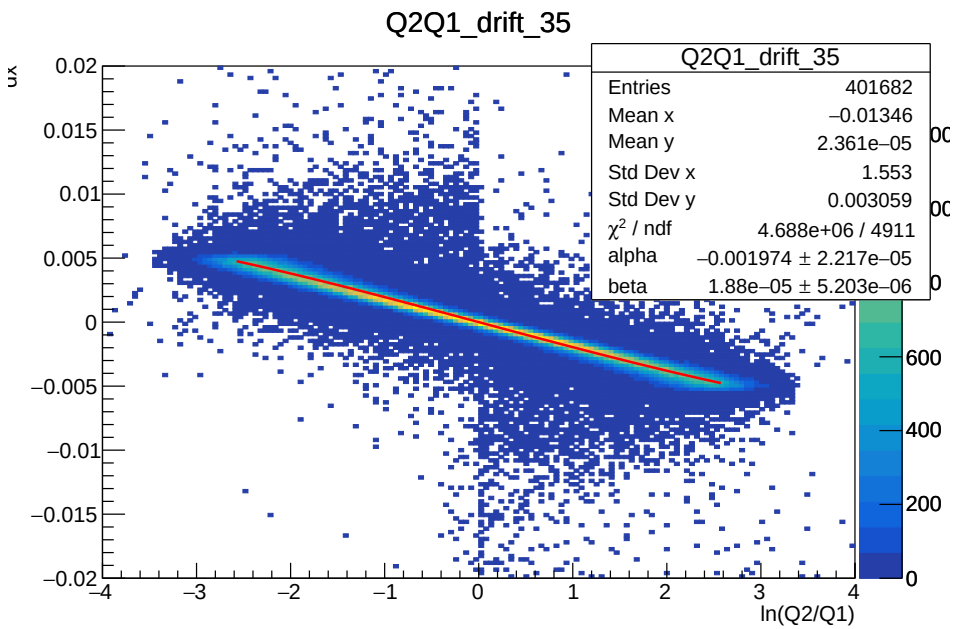
The Method

- The charge collected in the pad 1 (pad 2) decreases (increases) when the track gets close to the center of the pad 0
- We hence have a better accuracy with $\log\left(\frac{Q_1}{Q_0}\right)$ ($\log\left(\frac{Q_2}{Q_1}\right)$) when the track is at the frontier (center) of the pad 0.



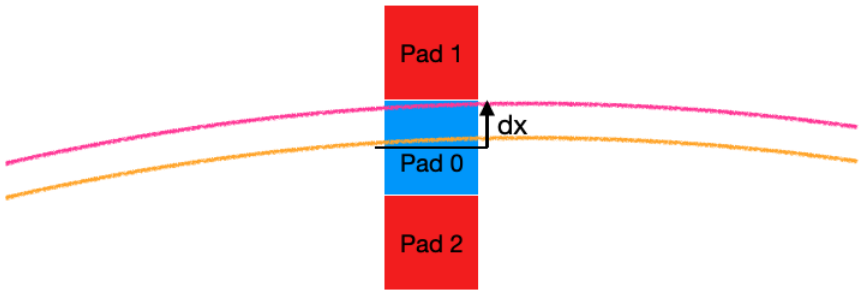
Parameterization with DESY test beam data



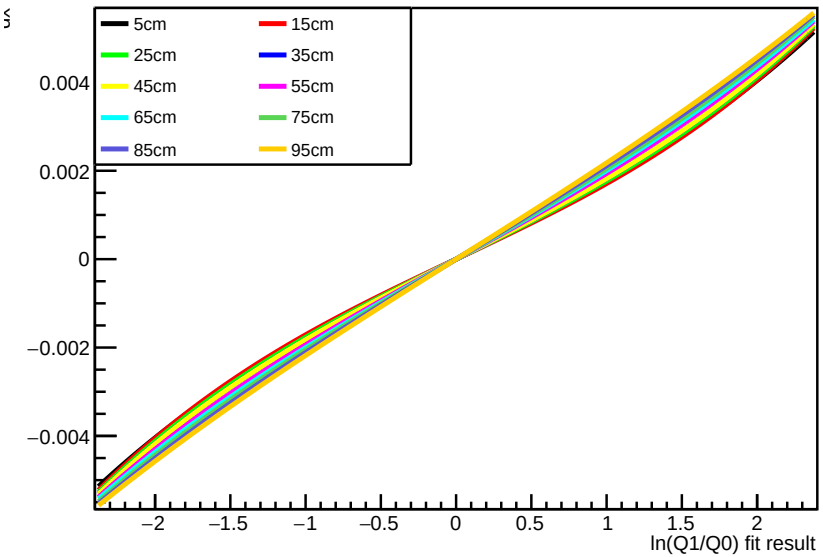


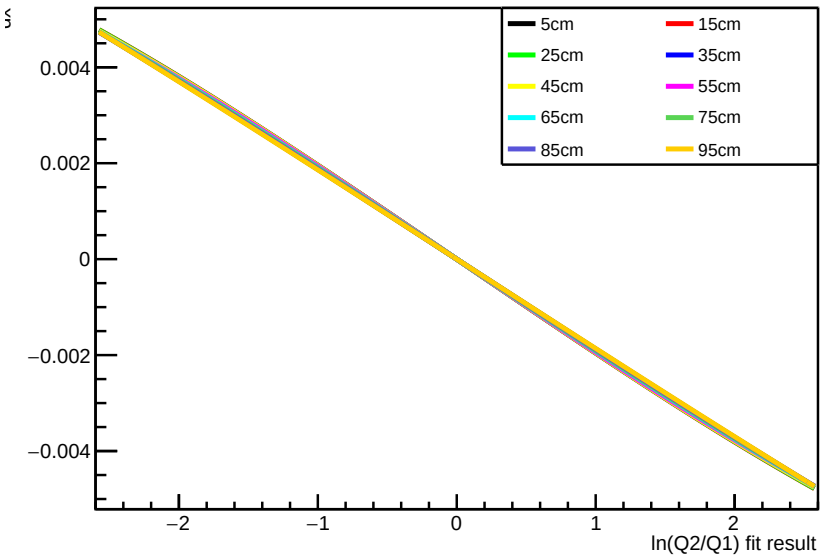
$$dx + \frac{\text{pad height}}{2} \times (pad_{y_1} - pad_{y_0}) = \alpha L_{10}^3 + \beta L_{10} \qquad dx = \alpha L_{21}^3 + \beta L_{21}$$

$$(\text{with } L_{ij} = \ln\left(\frac{Q_i}{Q_j}\right) \times (pad_{y_0} - pad_{y_1}))$$



Drift distance dependance of parameterization

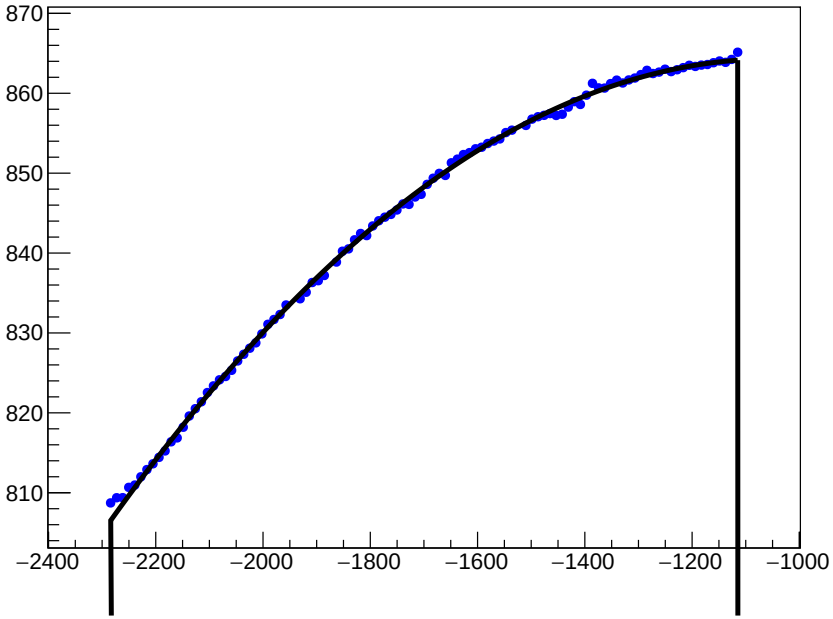




- By hand I've calculated a shift of $\approx 500\,\mu m$ ($\approx 125\,\mu m$) between the 2 extreme cases of $\ln(Q1/Q0)$ ($\ln(Q2/Q1)$).

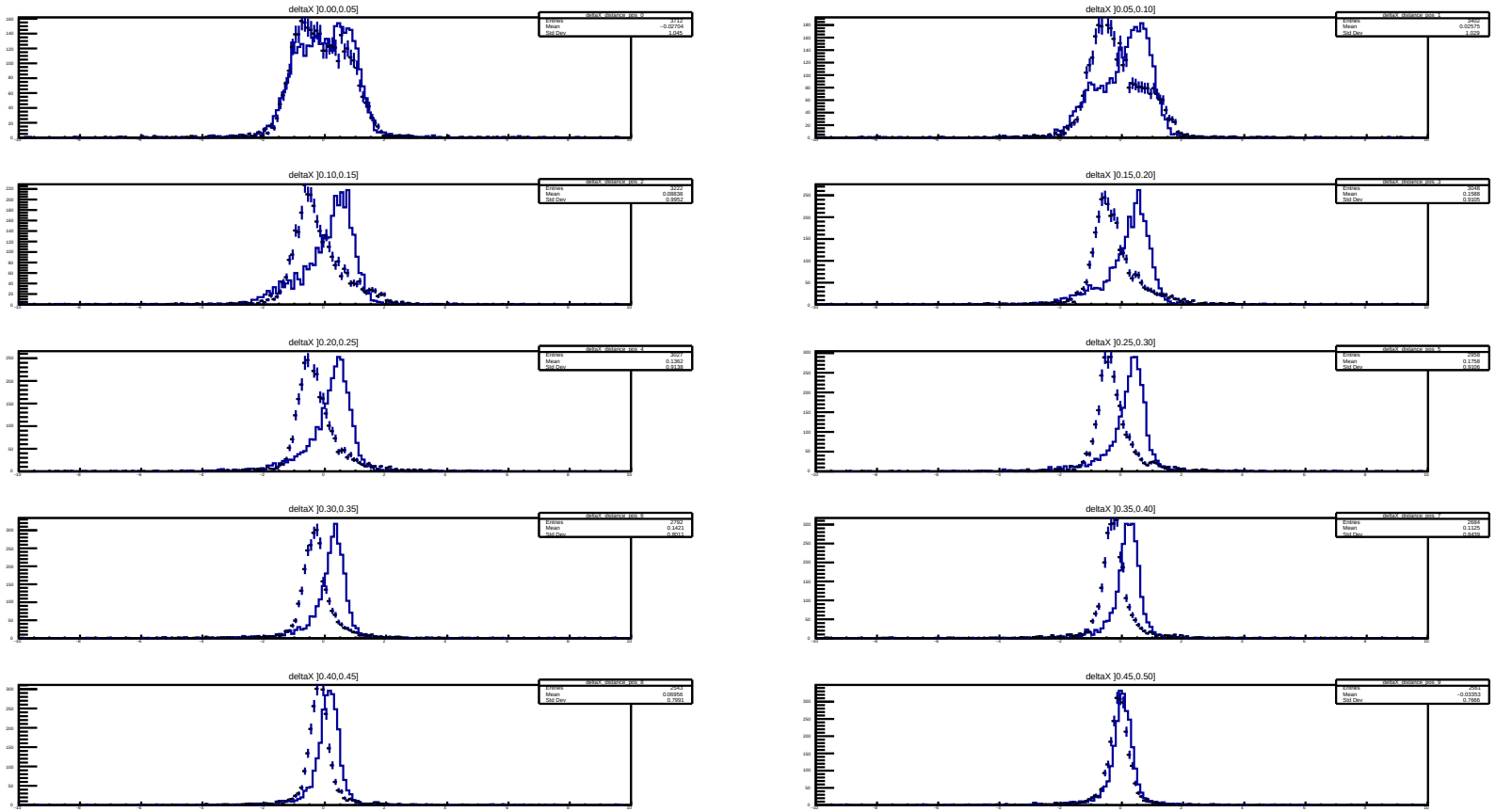
Impact of this shift on the spatial resolution with $\ln(Q1/Q0)$

- The parameterization gives the shift wrt to the center of the main pad as a function of $\ln(Q1/Q0)$ (For this study, I forced hatRecon to use only this ratio)
- The track shift wrt the center of the main pad is under-(over-)estimated if the drift distance is higher (lower) than the one expected by the parameterization



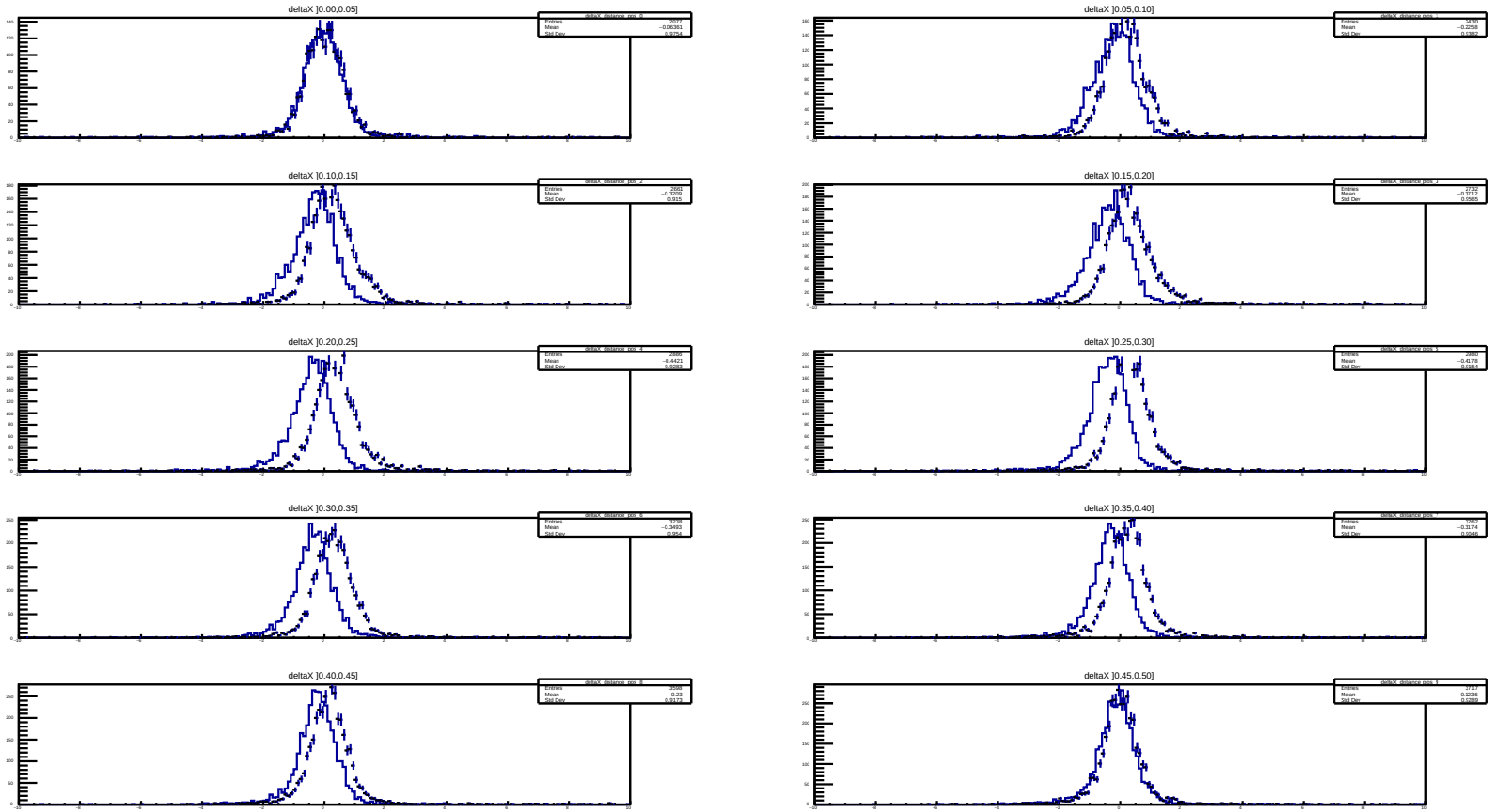
- $y_{reco} - y_{fit}$ shifted on one side or the other depending on track position wrt center of the main pad

Lower drift than expected



Comparison of $x_{reco} - x_{fit}$ for vertical tracks on the right (histogram) or on the left (dots with error bars) side of the main pad $\rightarrow$ shift is overestimated because drift distance is lower than the one expected by the parameterization

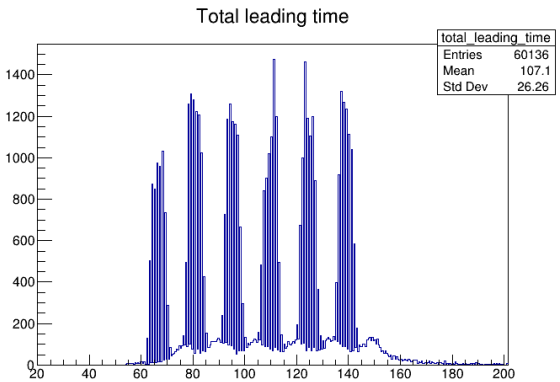
Higher drift than expected

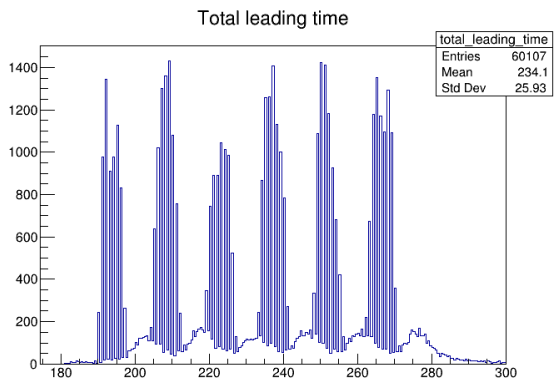


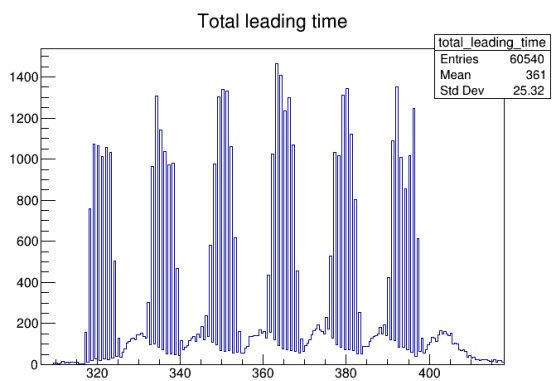
Opposed effect for higher drift

t_{max} as an estimator of the drift distance

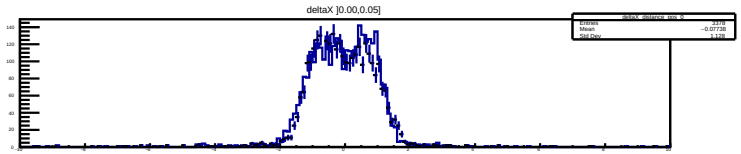
- The t_{max} time corresponding to the maximum of the waveform in the main pad is positively correlated with the drift distance
- But neutrinos are produced in series of bunches and the time reference is the beginning of the first bunch
- Therefore, without the precise time which will be given by the SuperFGD, we can only have a $\approx$ 600ns time window
- We can nevertheless obtain 3 well separated drift distance ranges

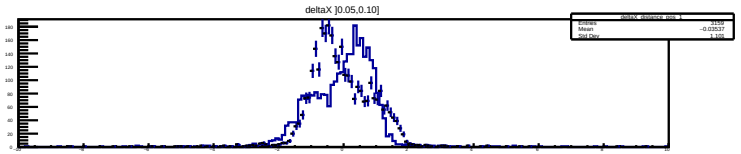


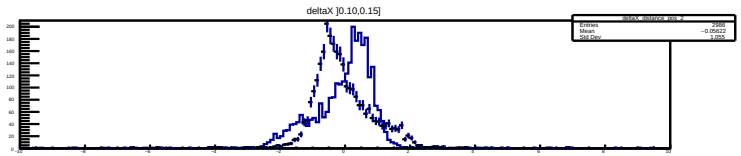


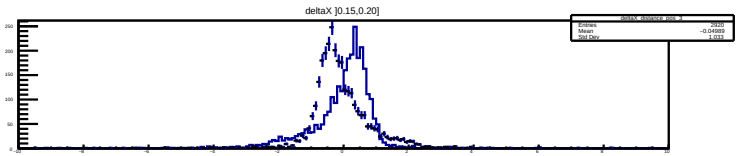


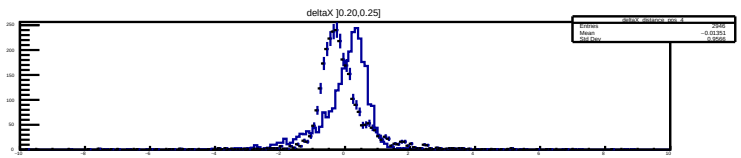
Results obtained with parameters adapted to low drift distance

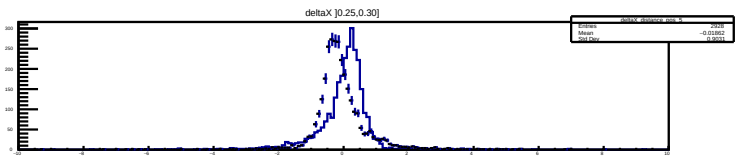


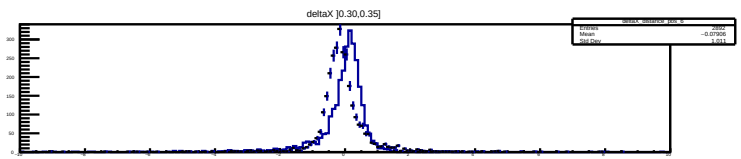


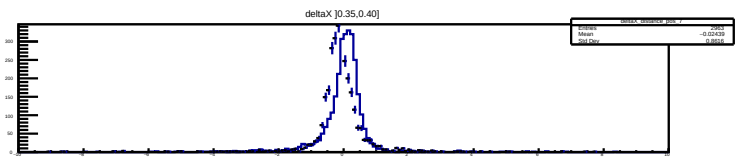


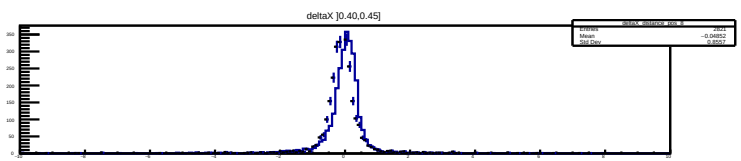


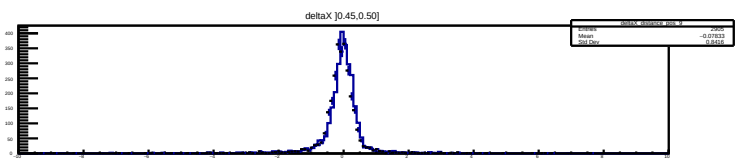




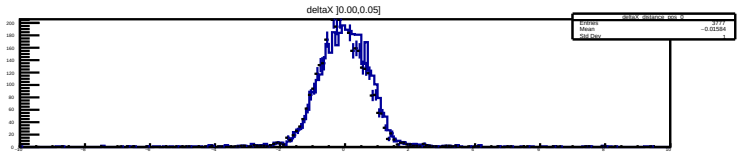


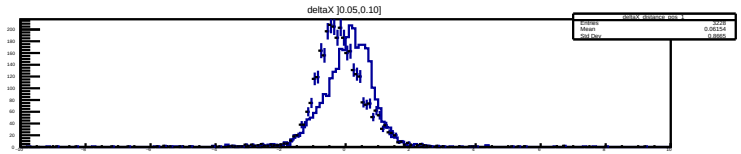


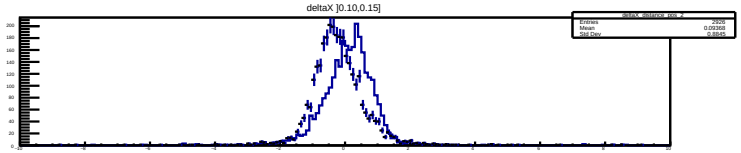


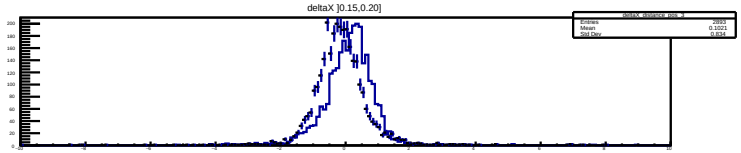


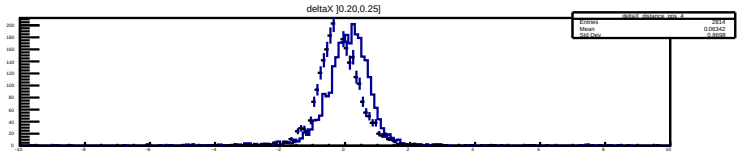
Results obtained with parameters adapted to large drift distance

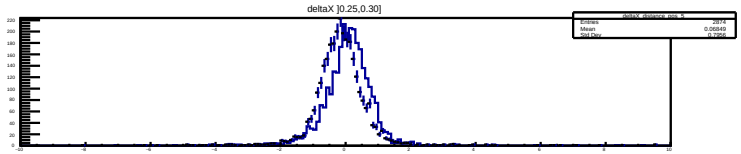


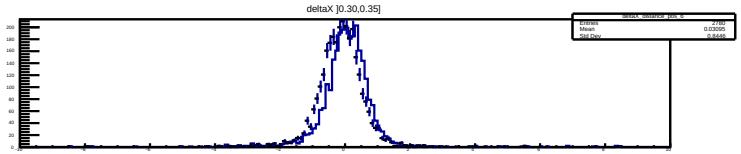


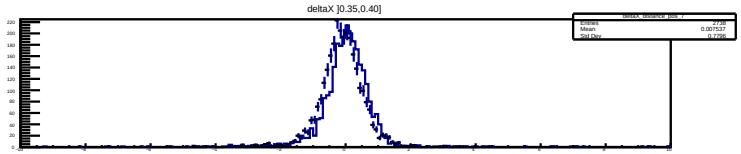


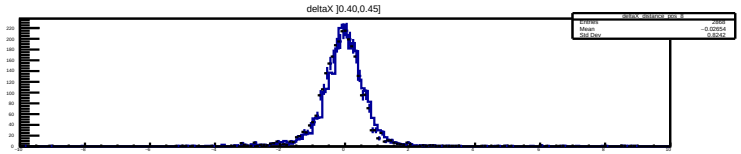


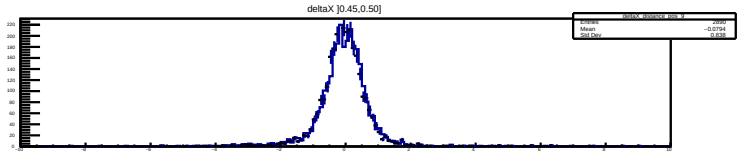












Conclusions/perspectives

- Bias due to not knowing the drift distance
- Possible to distinguish three drift distance regions thanks to t_max
- Bias slightly reduced, especially in the frontier of the pad which is the region of interest when we use $Q1/Q0$
  - For horizontal and vertical tracks we mostly use $Q2/Q1$ when we are at the center of main pad, but for diagonal tracks the cluster multiplicity in not sufficient
  - Currently studying the evolution of the bias and spatial resolution as a function of drift distance and track angle
- Still not perfect but should improve thanks to the precise time information given by SuperFGD

– Thank you ! –

– Backup –