ToT & Spatial resolution study

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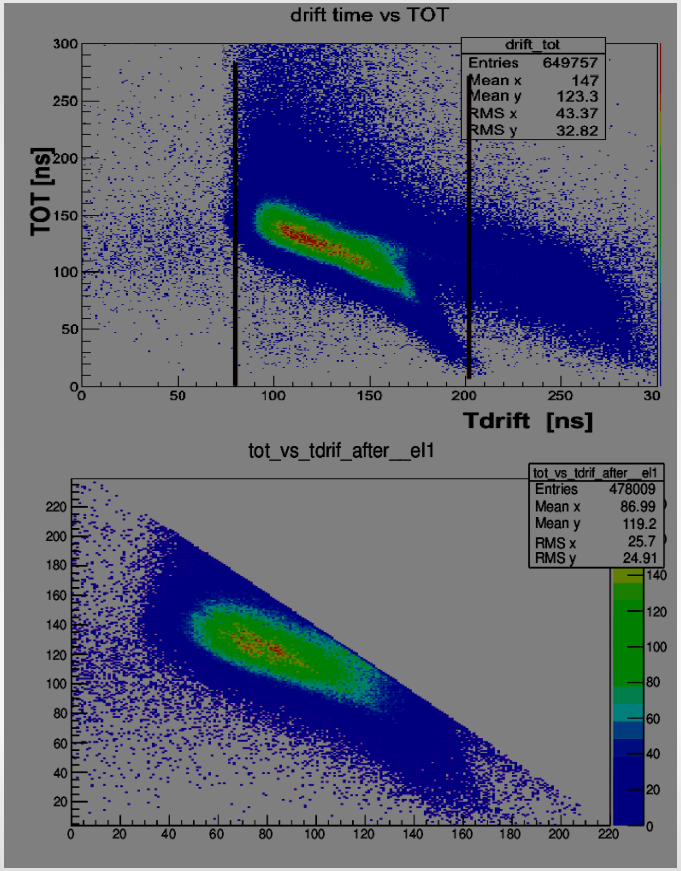
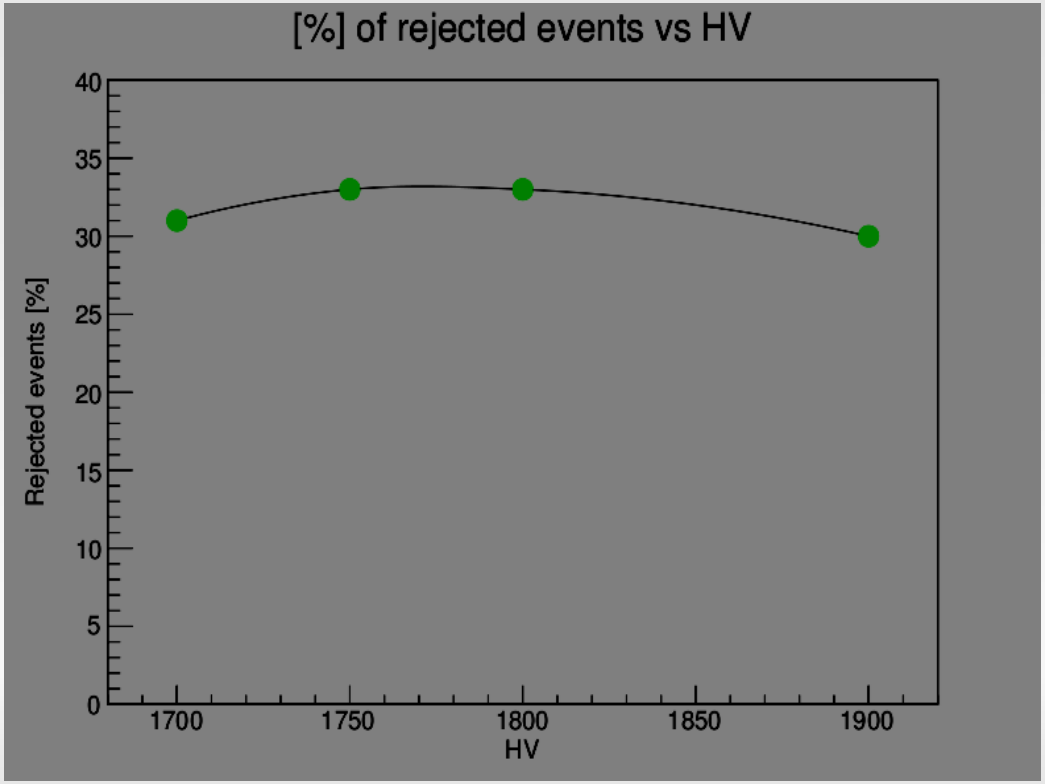
Time over threshold vs drif time

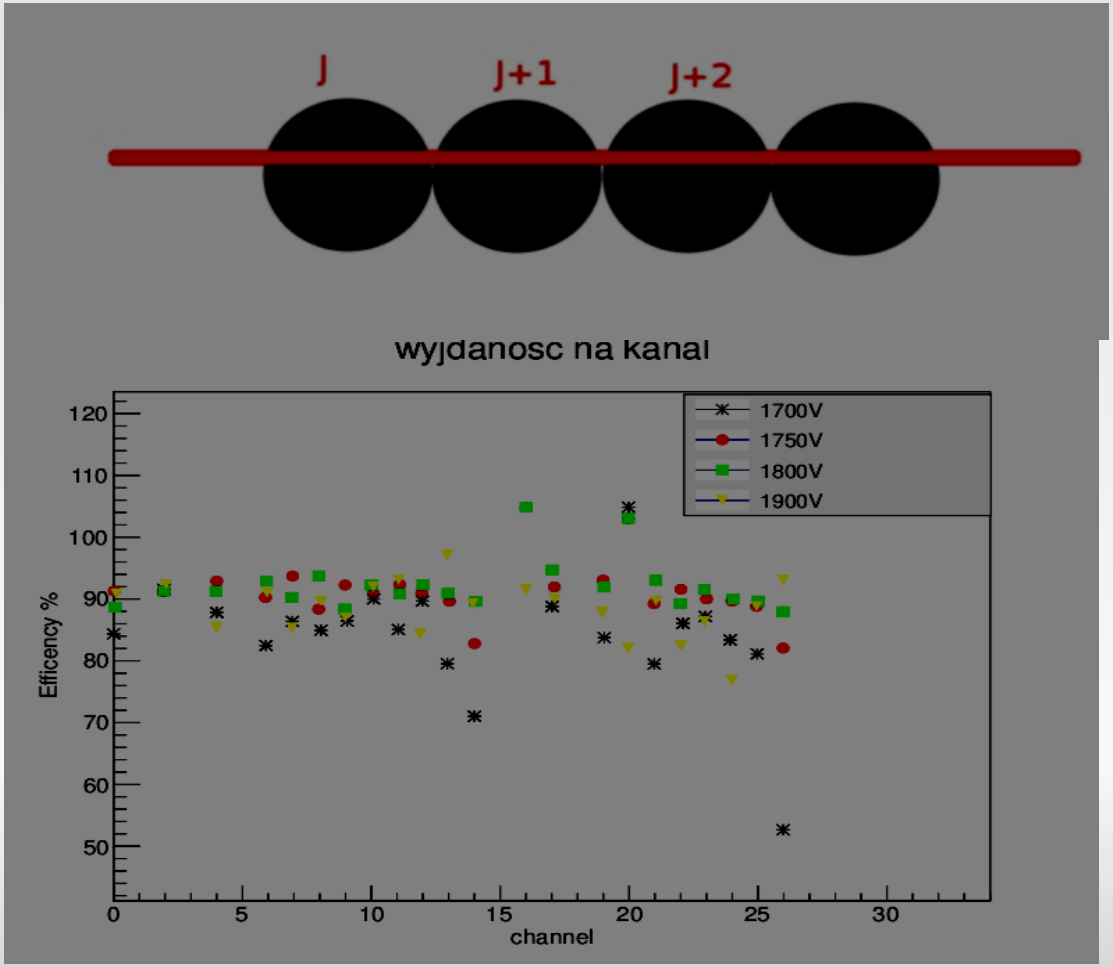
- A background structure is visible above ~ 120ns
- A cut was applied to remove the background
- 30% of events rejected, due to presence of emission form the cathode ?





Efficiency of the detector

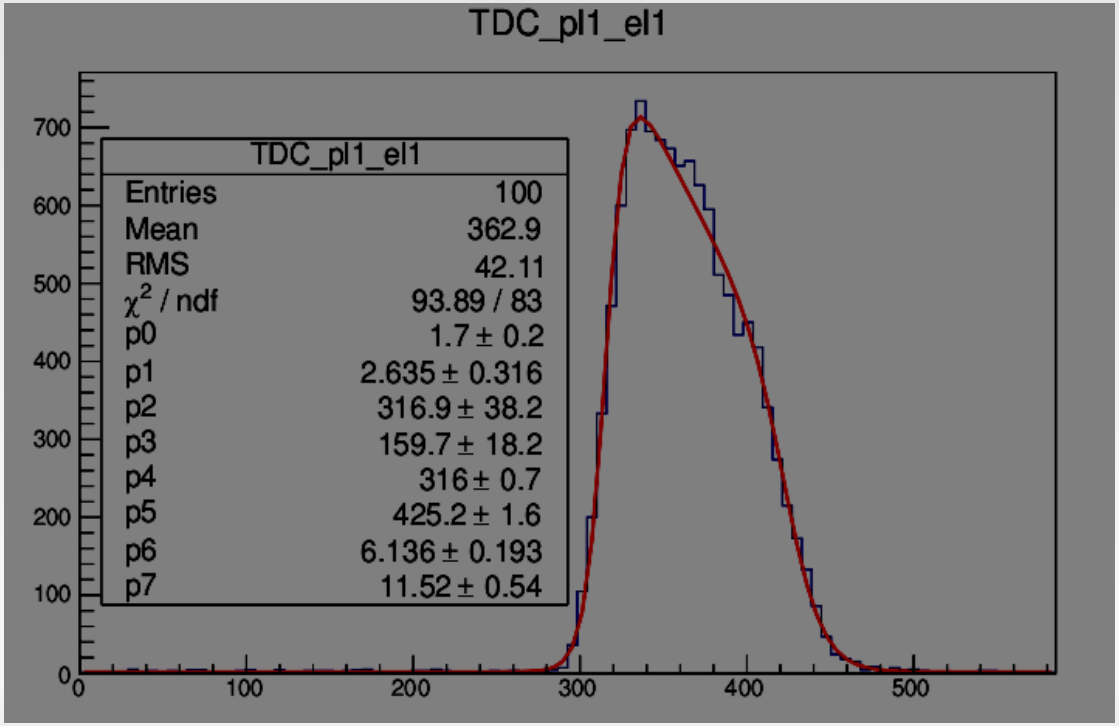
- ToT vs. Drift time spectra were made for j and j + 4 straws (the number of entries were obtained)
- The same was done for straw j + 2
- (Number of entries) [j + 2]/[j & j + 4] * 100%



The 8 param Fermi like function

$$\frac{\mathrm{d}n}{\mathrm{d}t} = P_1 + \frac{P_2\,[1 + P_3 \exp((P_5 - t)/P_4)]}{[1 + \exp((P_5 - t)/P_7)]\,[1 + \exp((t - P_6)/P_8)]},$$

- P1- noise
- P2- normalization factor
- P3-related to the shape
- P4- related to the shape
- P5- t0
- P6- t max
- P7- leading edge raise time
- P8- trail time



2nd step, preforming the D(t) calibration

- Each electron drift spectrum was fitted with a seven parameter function
- A D(t) curve was obtained using the uniform irradiation method using the formula below:

$$D(t) = R_{wire} + (R_{tube} - R_{wire}) \cdot \frac{\int_0^t n(t)dt}{\int_0^{T_{max}} n(t')dt'}$$

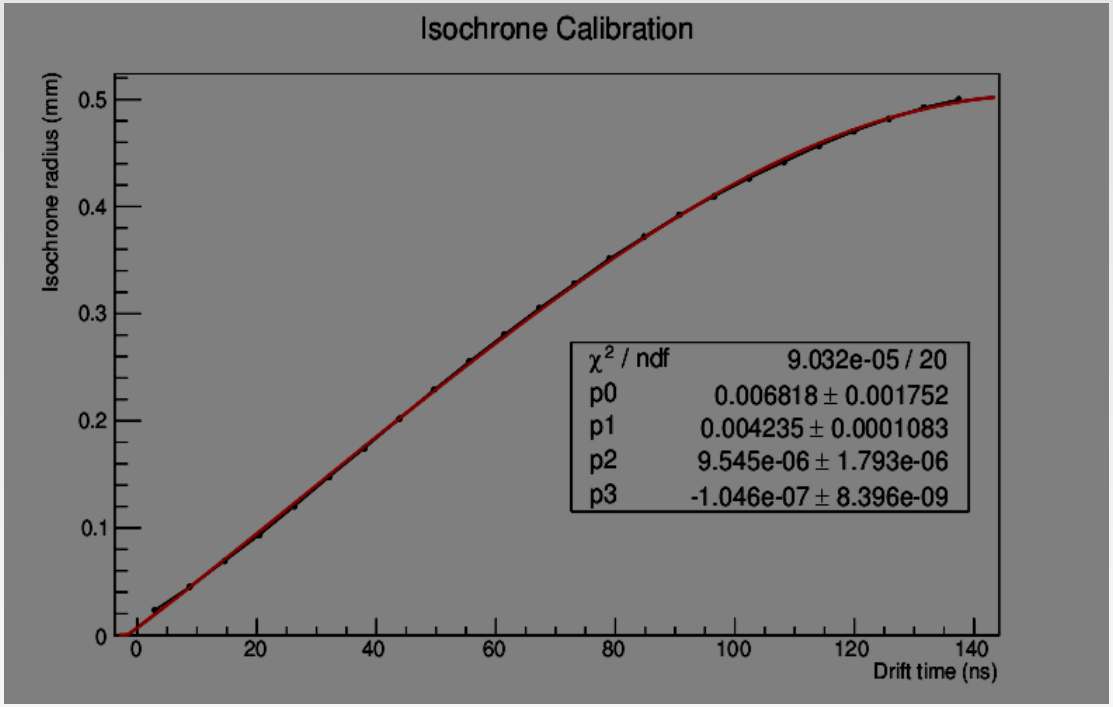
R_{wire} - anode diameter

R_{tube} – tube diameter.

t – time in with the spectrum was measured

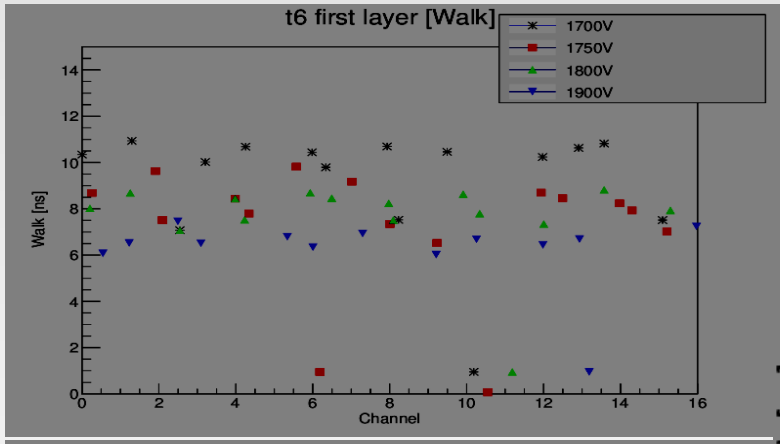
n(t) – number of events registered at time t.

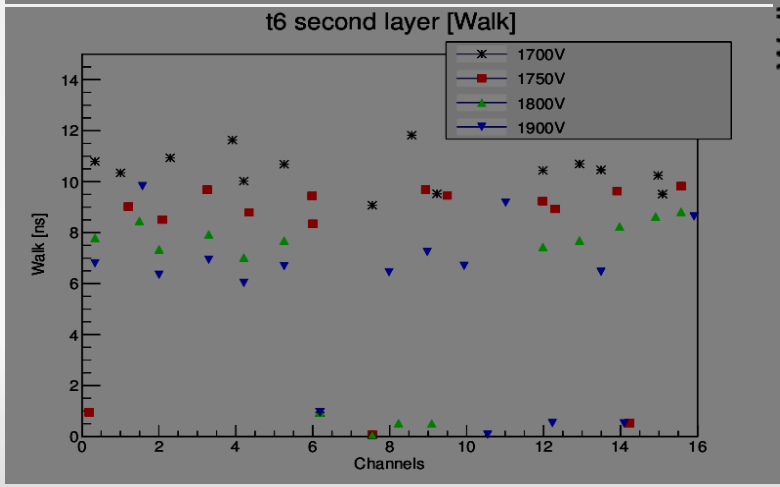
T_{max} – maximum drift time.

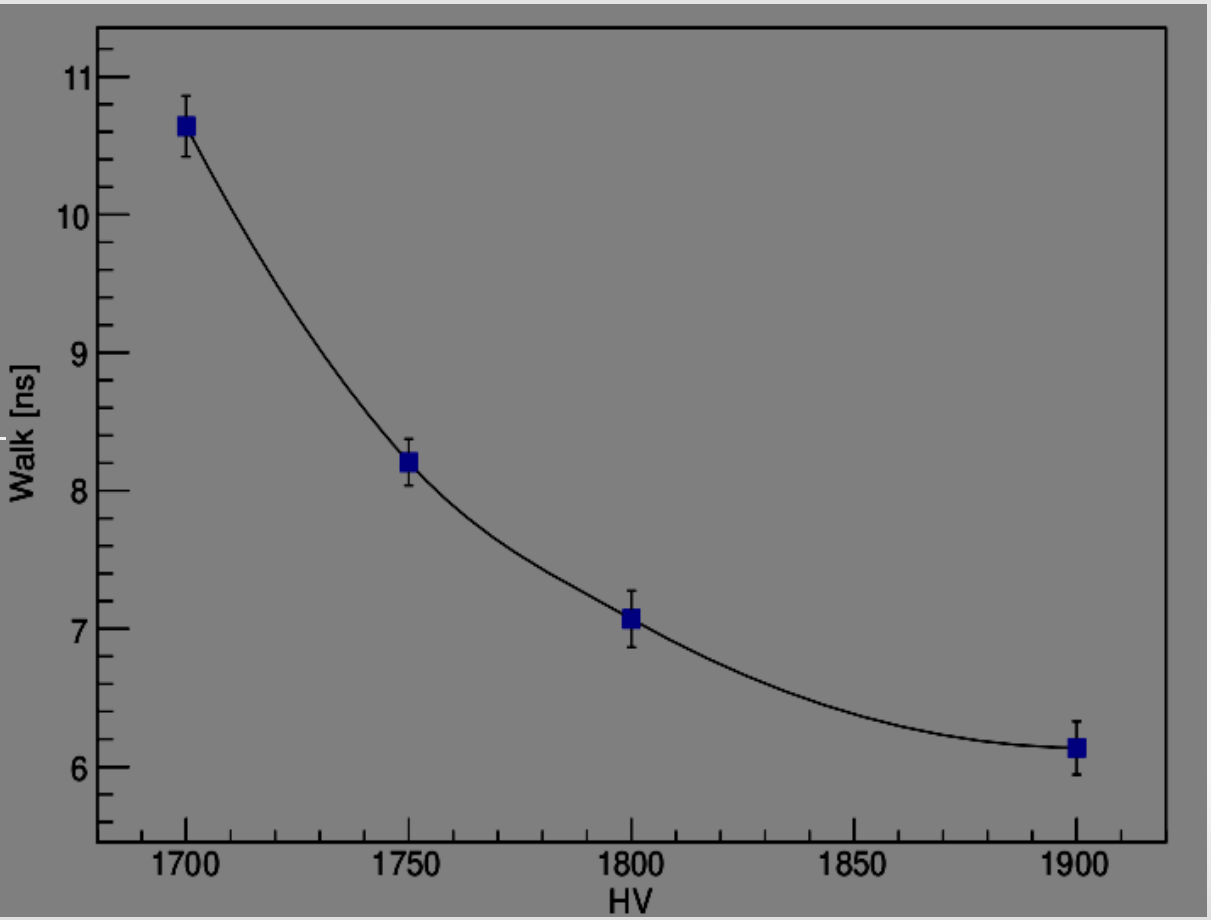


„Walk” vs High Voltage

- „Walk [t6]” was calculated for all HV settings
- This parameter affects the calibration, spatial resolution and the track reconstruction efficiency (tracks near the anode wire)

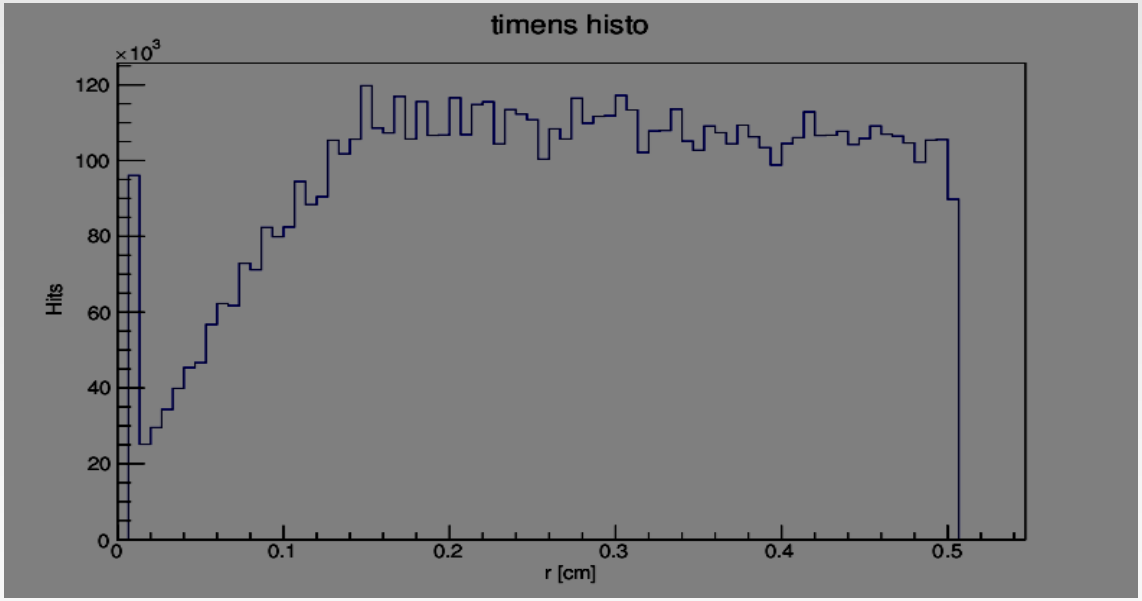






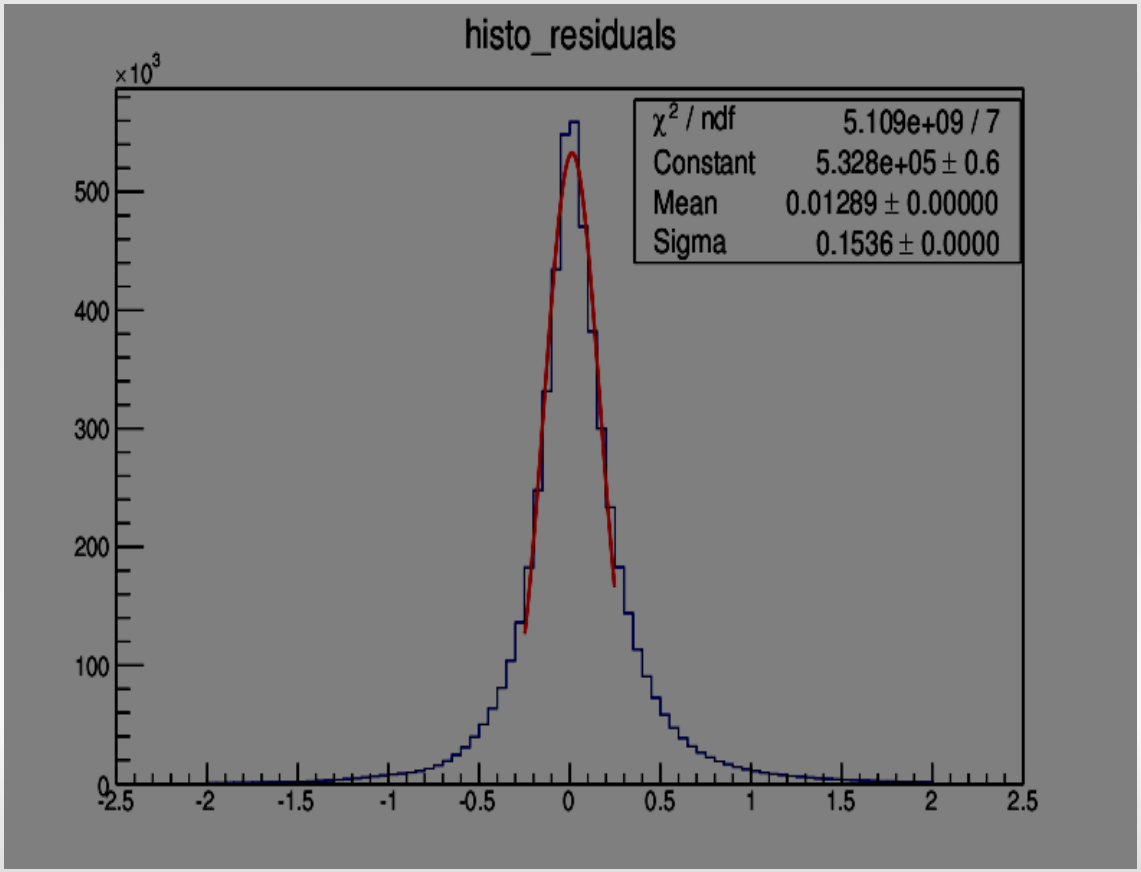
Hits in a function of distance form the anode wire

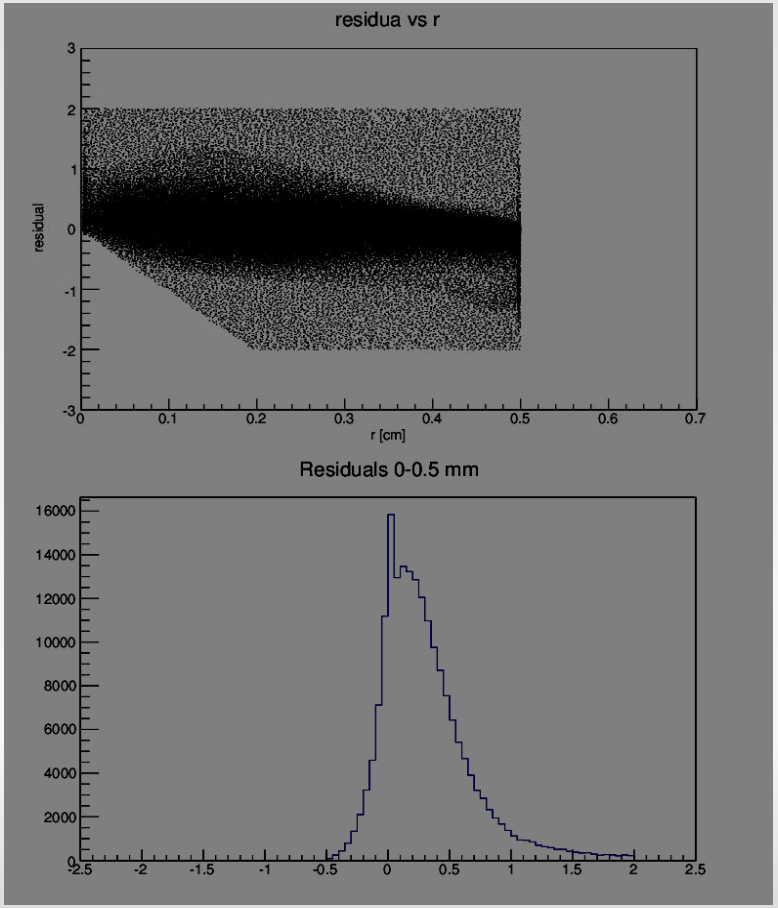
- Uniform irradiation method used



Spatial resolution study

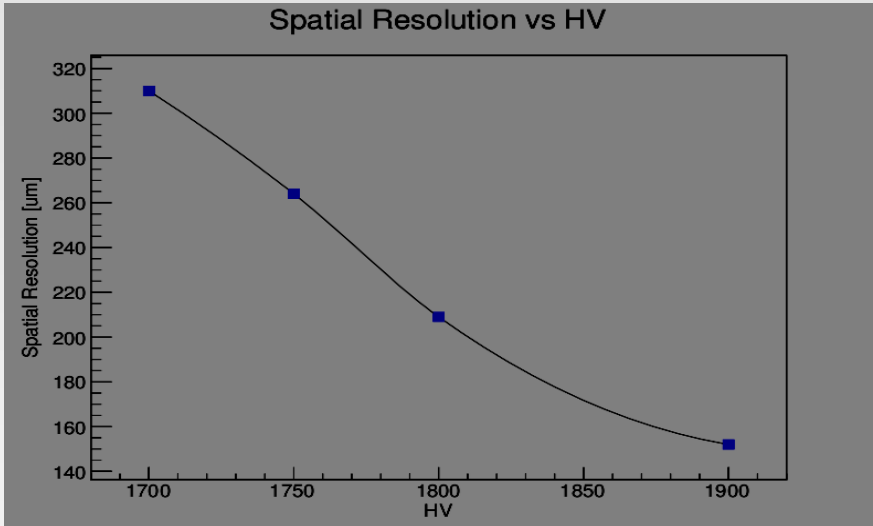
- A clear influence of „walk” visible in residual distributions
- Spatial resolution is between 150 um ~ 160 um
- Unsymmetrical structure of distributions visible for tracks near the anode wire

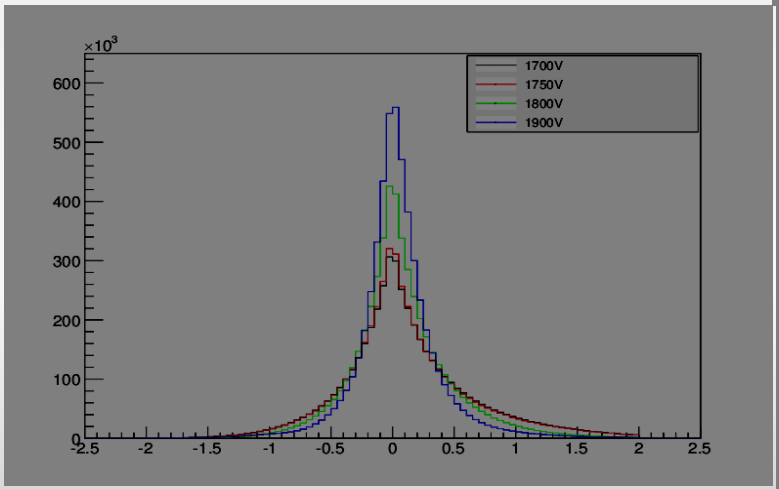


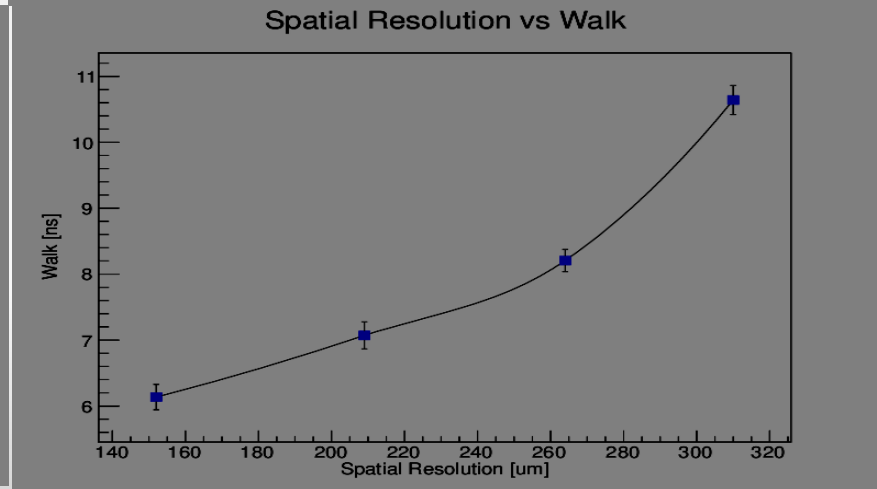


Spatial resolutions for different HV

- Spatial resolution is better for higher HV [expected]
- Poor spatial resolution for low HV [1700 – 1750]
- Spatial resolution related to so called „walk” effect [expected]





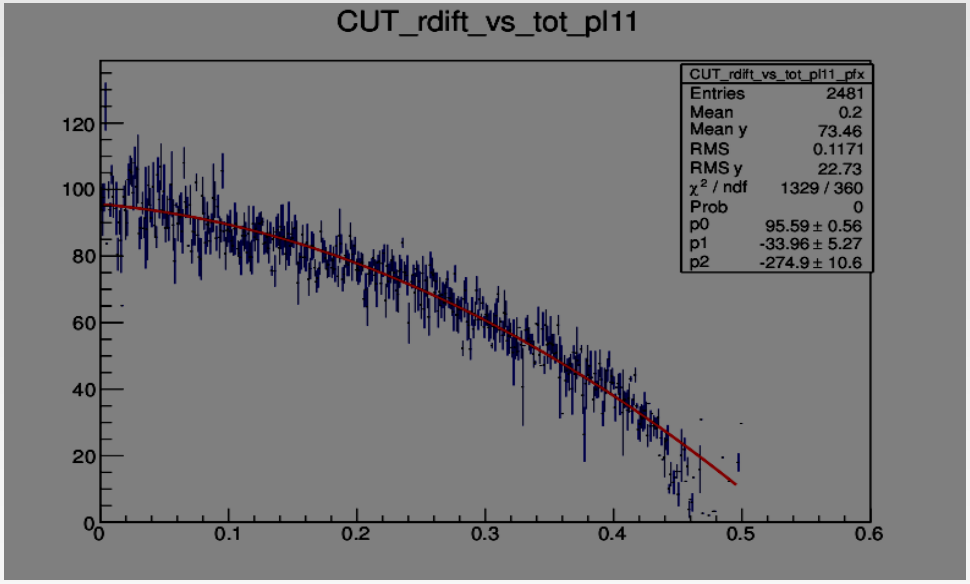


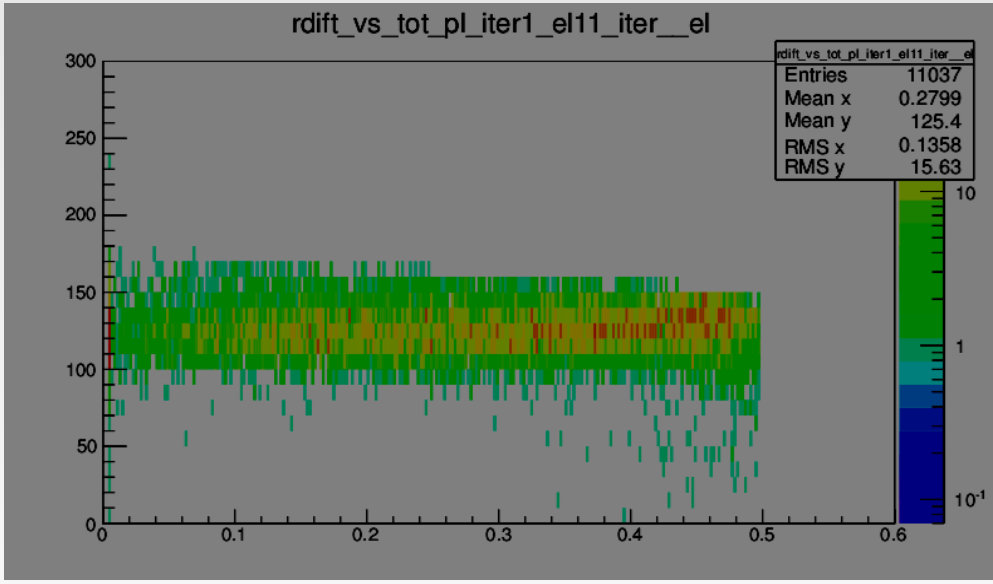
Tracking results

- 76 % of track were reconstructed (10 straw track taken in to consideration)
- A new calibration improved the spatial resolution ~150 um
- 6 ns walk (for 1900 V) affected the spatial resolution and tracking efficiency for tracks near the anode wire (tracking efficiency expected above (90%)

ToT calibration

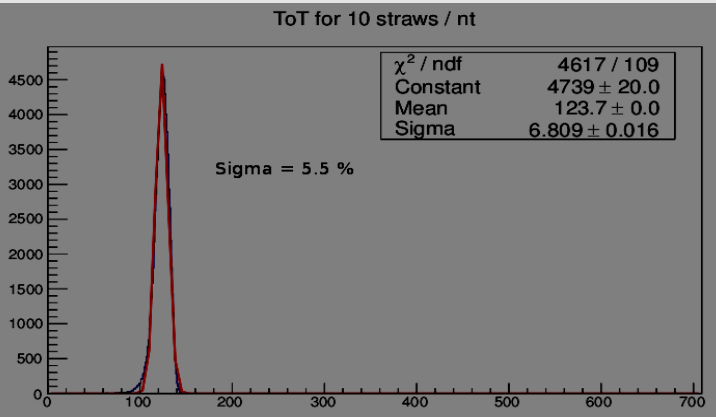
- 2nd degree poly was fitted to the ToT vs. rdrift plot
- The function was used to calibrate the ToT

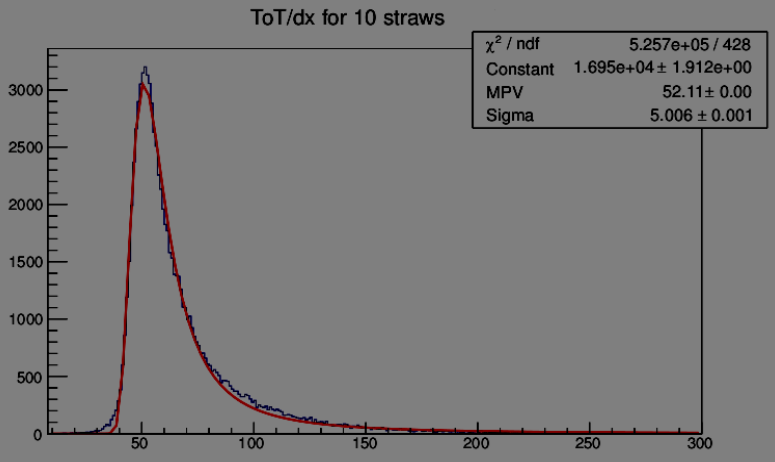


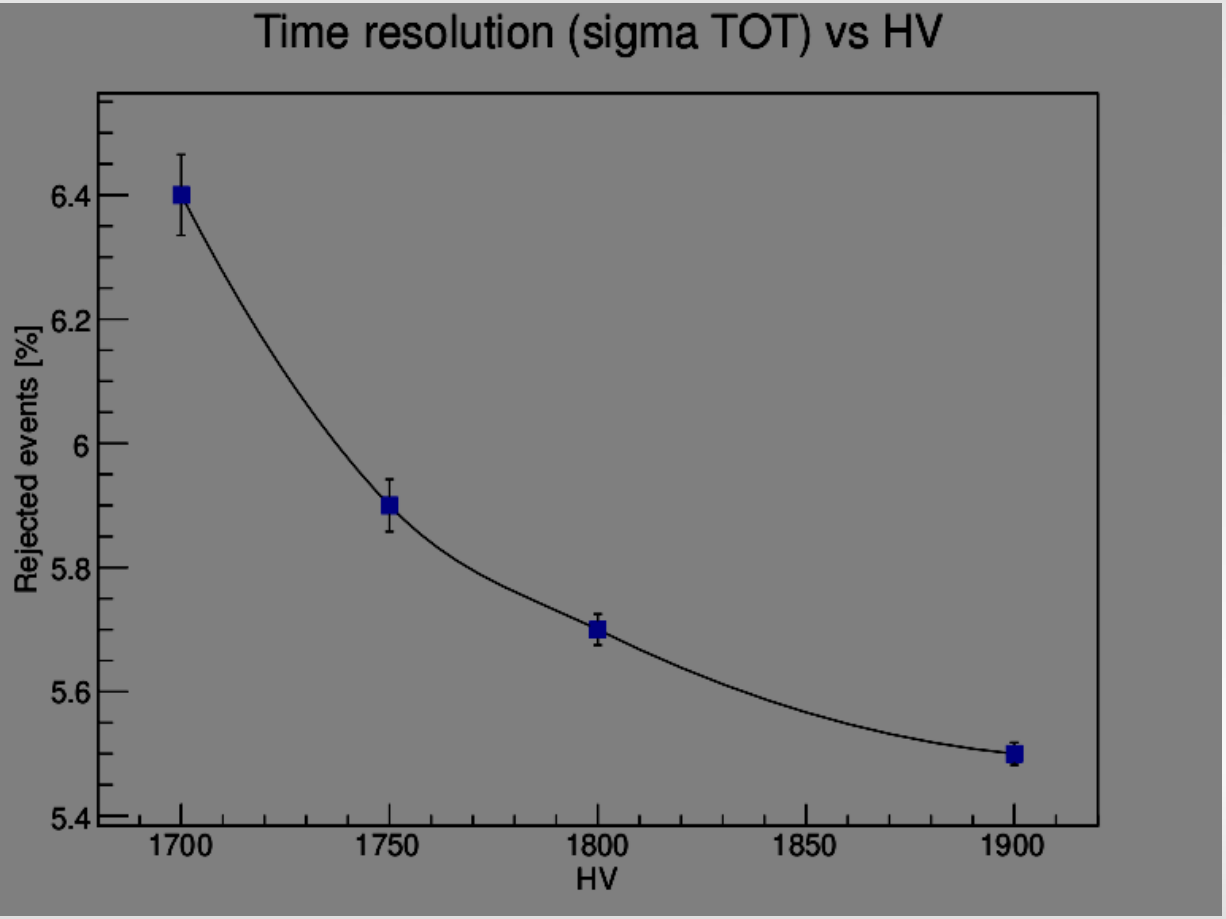


ToT study

- Spectra for 10 straw tracks were calculated
- ToT/dx and ToT distributions were made
- Landau like shape of ToT/dx (expected) shows that dx is calculated as it should be







Backup Slides

Track reconstruction

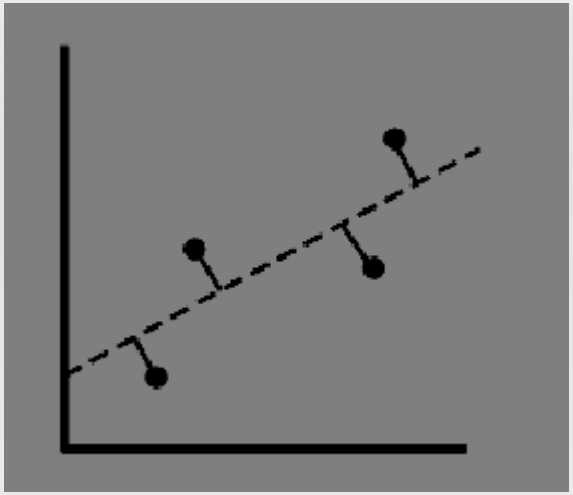
- Pre-prefit
- Prefit
- Intersection finder
- Refit

Pre-prefit

- Finding the first track hypothesis

$$R_{\perp} = \sum_{i=1}^{N} d_i$$

$$d_i = \frac{|y_i - (a + bx_i)|}{\sqrt{1 + b^2}}.$$



- Where ”d” is the distance from the center of the
- firing tube to the fitted line
- The obtained a and b are used to call Minuit class and preform the prefit
- If the mean value of ”d” is above 0.5 cm the procedure is repeated

Prefit

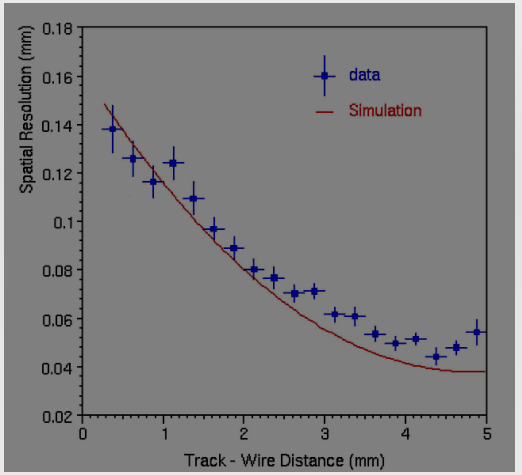
- A ROOT Minuit class is called to preform a prefit
- The next function witch is going to optimized:

$$\chi^2 = \frac{1}{N-2}\sum_{i=1}^{N}\left(\frac{\Delta r_i(a,b)}{\sigma_{r_{i,raw}}}\right)^2,$$

- $\sigma_{ri,raw-}$ is obtained by fitting a six degree polynomial
- First set of residuals is being calculated.

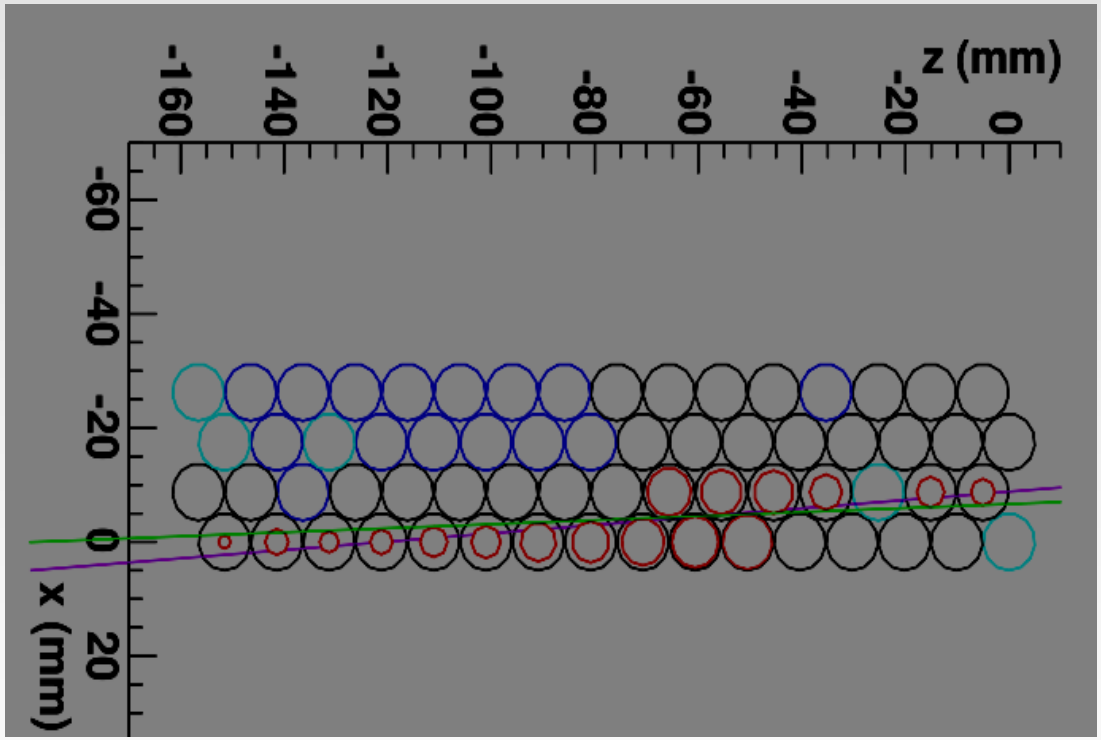
$$\Delta r_i = r_{i,fit}(a,b) - r_{i,raw} = \frac{|y_i - (a+bx_i)|}{\sqrt{1+b^2}} - r_{i,raw}$$

- $\Delta_{ri} > 0.2$ cm the track is rejected



Intersection finder

- Finding the intersections between the obtained track and the calculated drift circles



Refit

- The procedure starts with using Minuit calls and minimalizing the function below:

$$\chi^2 = \sum_{i=1}^{N_{hits}} \frac{d_i^2}{\sigma_{d_i,tot}^2}, \quad d_i^2 = \left[\frac{y_i - (a + bx_i)}{\sqrt{1+b^2}}\right]^2$$

- Where the sigma is related to (x,y) witch are the coordinates of the intersection with the drift circle:

$$\sigma_{d_i,tot}^2 = \frac{\sigma_{i,y}^2}{1+b^2} + \frac{b^2\sigma_{i,x}^2}{1+b^2}.$$

- Another set of residuals is calculated (same way as in prefit) and a cut is applied (above 0.2 cm) to eliminate the influence form delta electrons

The finale track (blue line)