PANDA LVI. Collaboration Meeting

PASTTREC tests in Krakow

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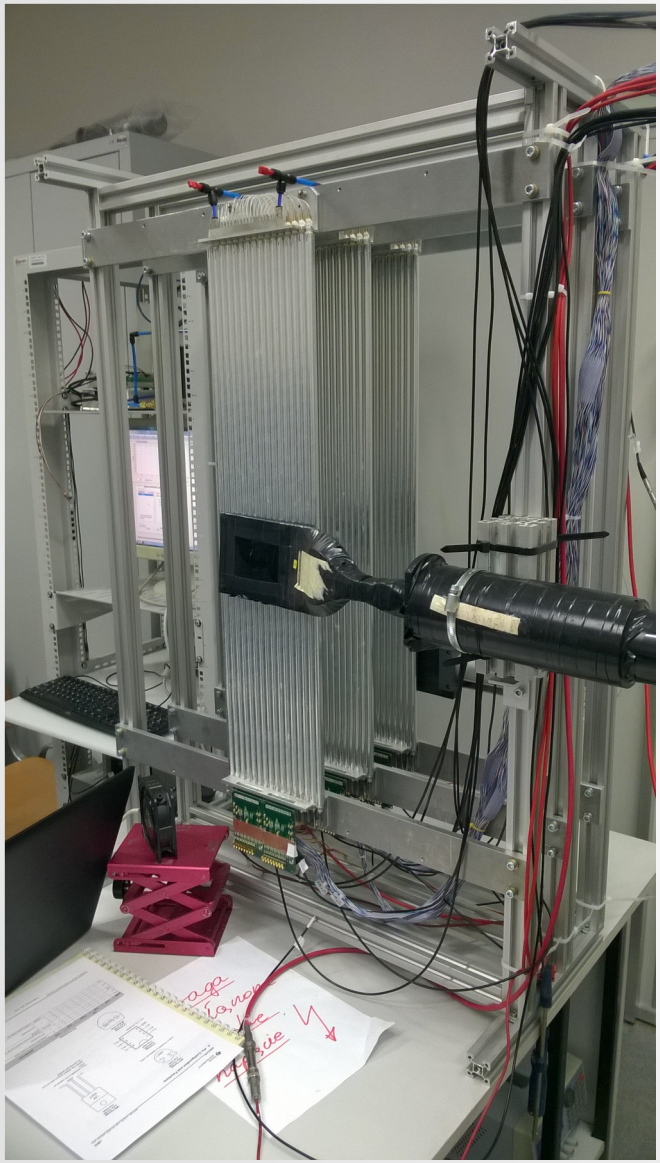
2 March 2016

Plan

1) FT prototype - reminder
2) FT prototype tests results in Krakow
   - efficiency
   - spatial resolution
   - ToT separation
3) Conclusion and outlook

Reminder/status



The set-up in Krakow

What we have:

- 30 front end electronic boards with PASTTRECv1 bonded
- 2 front end electronic boards with new PCB design
- Fully operational set-up in Krakow with 96 FT straws

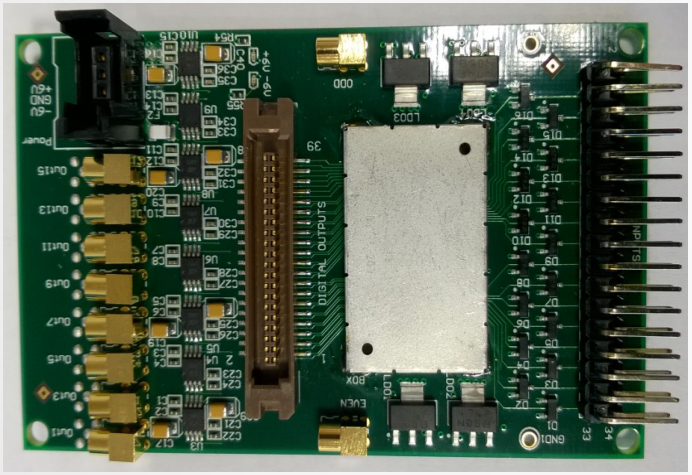
FEB with PASTTRECv1 properties:

- 2 PASTTREC ASIC on one PCB
- 2x8 digital and 2x8 analog channels
- Each FEB has 2 test inputs – odd and even channels
- +/- 6 V power supply (due to fast analog amplifiers which will be removed in final version of the FEE)
- Ribbon cable (10 pairs) to connect to TRB3 slow control and data transmission

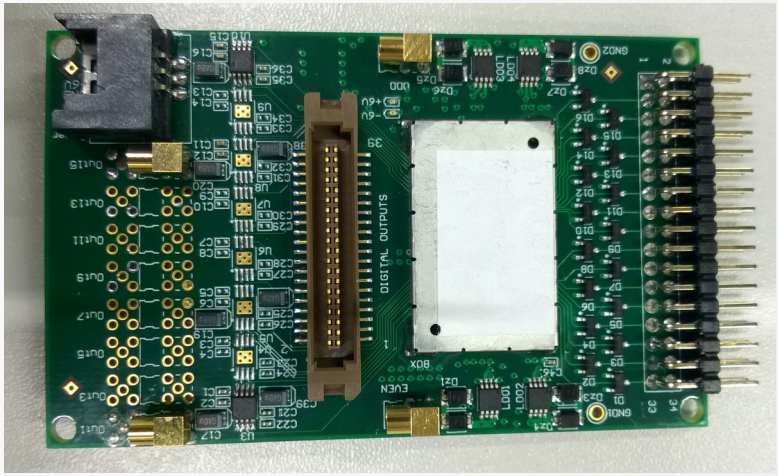
New FEB with PASTTRECv1

Main changes:

- Better low voltage regulators (6 → 3.3V).
- Less analog output drivers soldered (4 channels), less power consumption.
- Printed circuit board redesigned.



Old FEB

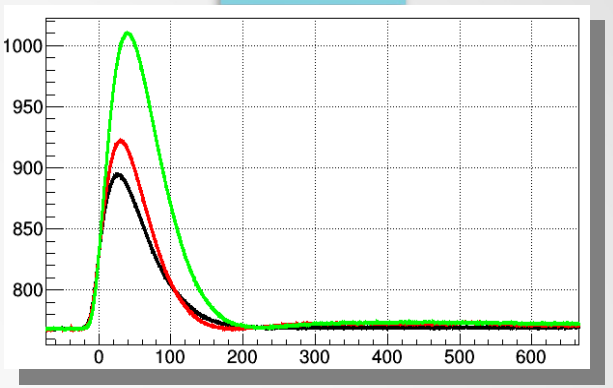


New FEB

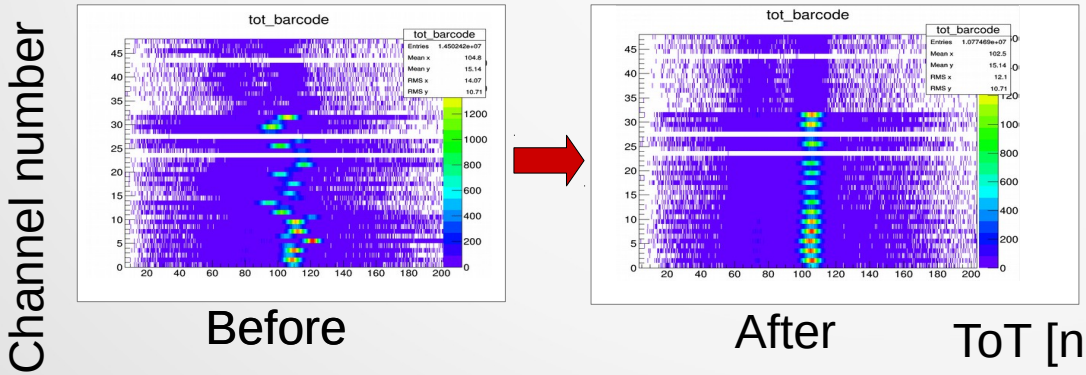
Low voltage	Old FEB (current [A])	New FEB (current [A])
+6 V	0.48	0.25
-6 V	0.25	0.06

Reminder

- The optimal tail cancellation settings have been found.
- The baselines for all 96 channels have been tuned.
- For cosmic rays data collection gain 1 and peaking time 20 ns has been selected. Data collection is triggered via two scintillators coincidence.

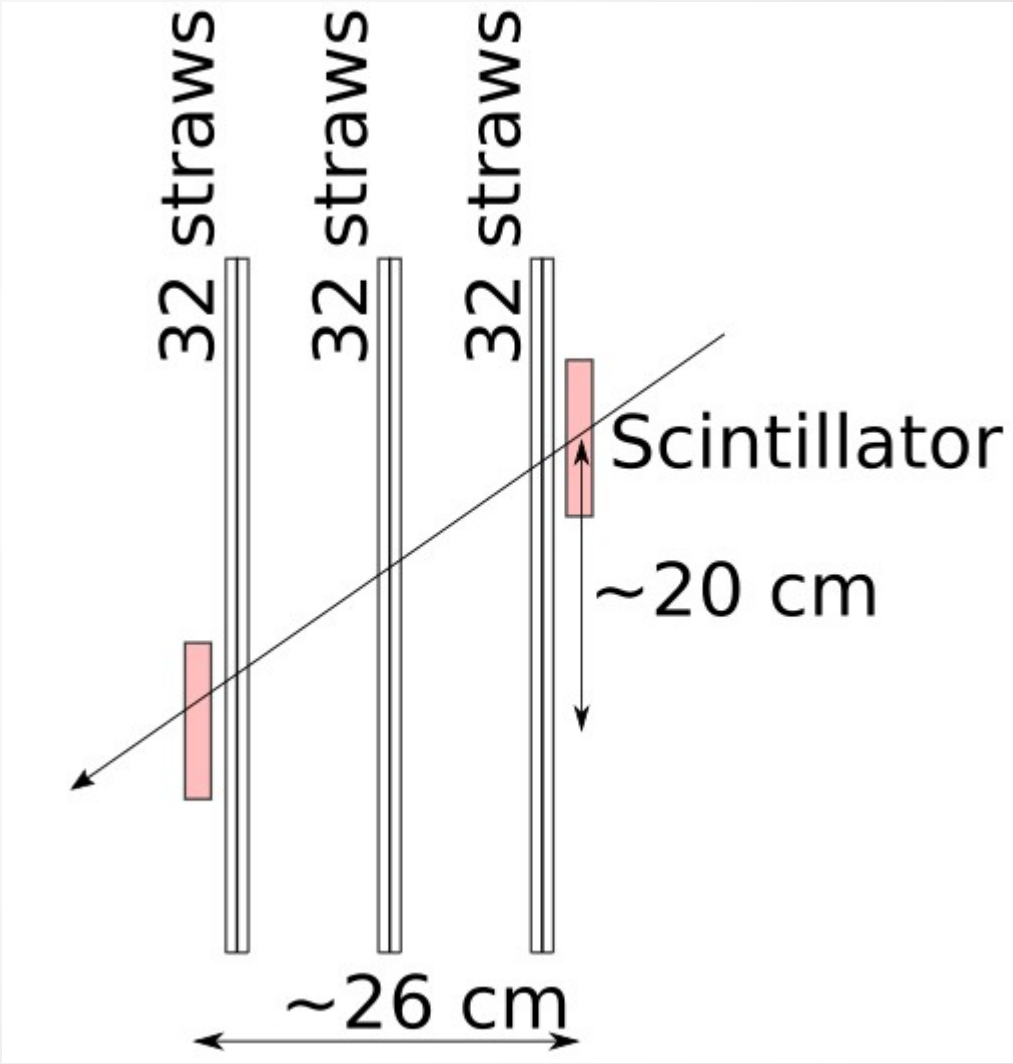


Analog pulses from ^{55}Fe presenting different tail cancellation settings. The settings of the black waveform was used for cosmic rays data acquisition.



Presentation of baseline tune procedure with iron source.

Set up configuration

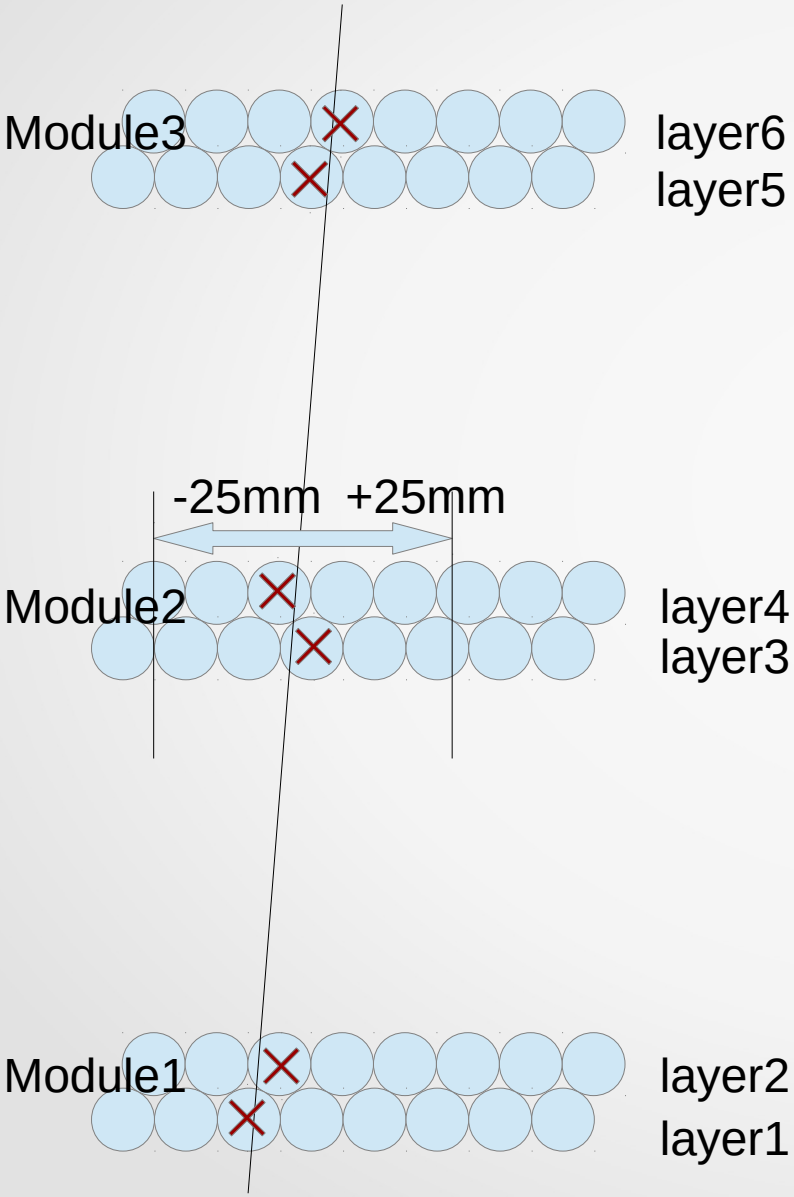


Data taken

High voltage	Threshold level	Triggers
1700 V	21 mV	30k
1800 V	21 mV	52k
1900 V	21 mV	46k
1700 V	5 mV	47k
1800 V	5 mV	48k
1900 V	5 mV	48k

The amount of data taken with cosmic rays.

FT efficiency estimation



The algorithm for efficiency estimation is as following: out of all events only events with exactly one hit per layer1,2,5,6 is selected (4 hits per event). There is a track fitted to the center of straws in module 1 and module 3. Then it is checked if on the way of the track there is one or two hits in the module 2 (the middle one). The hits in the middle layer distanced by less than 25 mm from reconstructed track are consider to belong to the track. If, with such a criteria, there is a hit in module 2 belonging to the track, then the detector is efficient otherwise it is inefficient.

Efficiency results

Threshold 21 mV

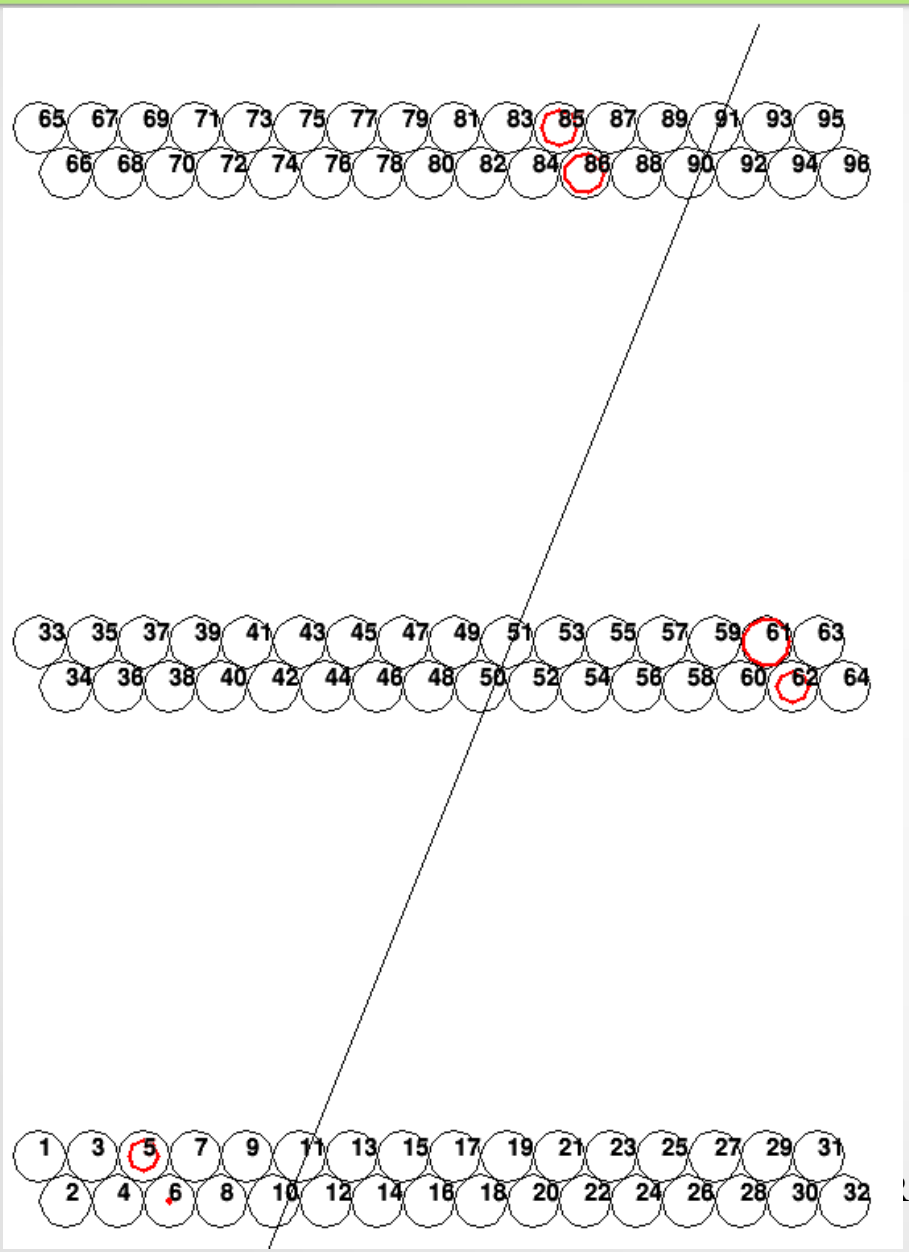
High voltage on the straws	1700 V	1800 V	1900 V
Efficiency if at least 1 straw fired in module 2	97.40	98.13	98.07
Efficiency if at least 2 straw fired in module 2	89.65	96.49	94.29

Threshold 5 mV

High voltage on the straws	1700 V	1800 V	1900 V
Efficiency if at least 1 straw fired in module 2	97.93	98.08	97.96
Efficiency if at least 2 straw fired in module 2	95.62	96.30	88.69

Lower efficiency due to noise?

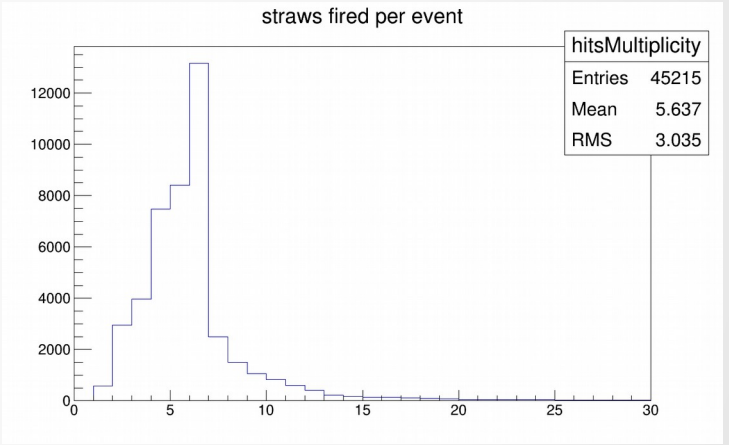
Inefficiency justification



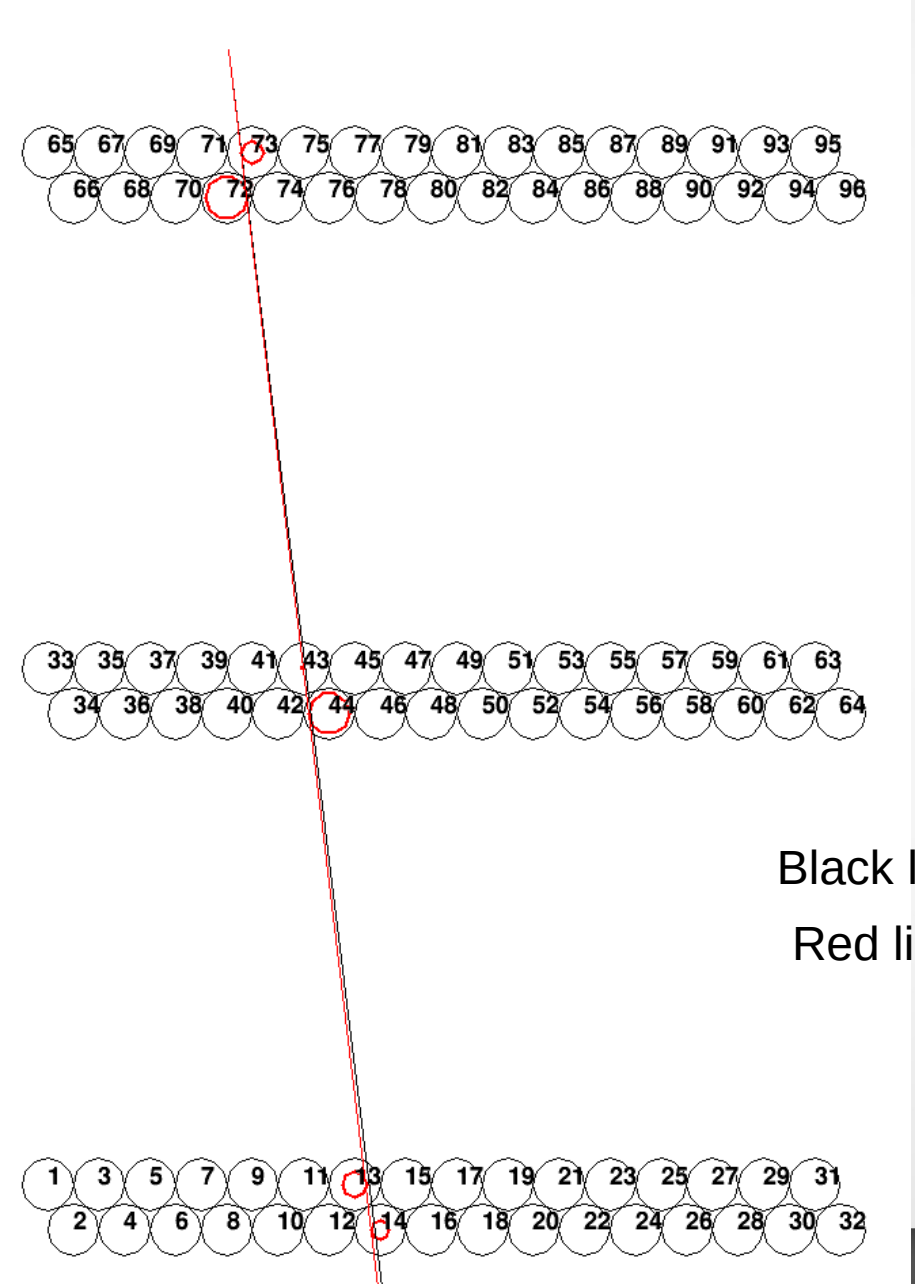
Example of an event contributing to the detector inefficiency.

Data analysis - preparation

- Drift time to radius calibration with uniform illumination method
- Drift time offsets elimination (different cable length compensation)
- Data filtration (events with exactly one hit per layer selected – 6 hits per events) resulting in 5-8kEvents.
- Track finding:
  - Prefit to the center of straws using TlinearFitter
  - Fit to the drift radius using TMinuit



Event display

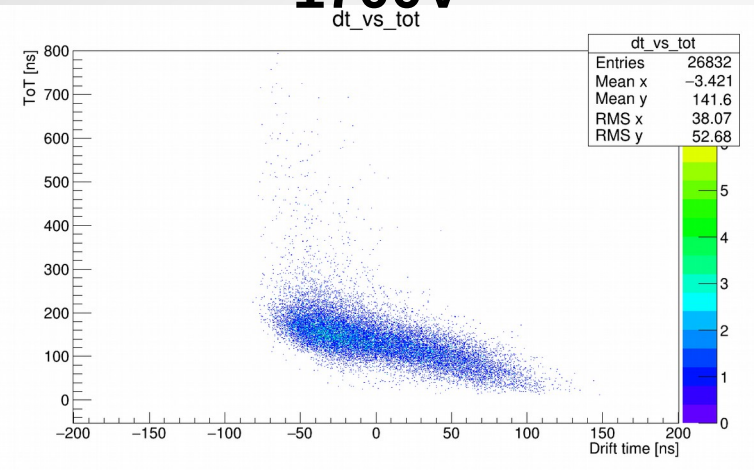


Black line represents prefit.

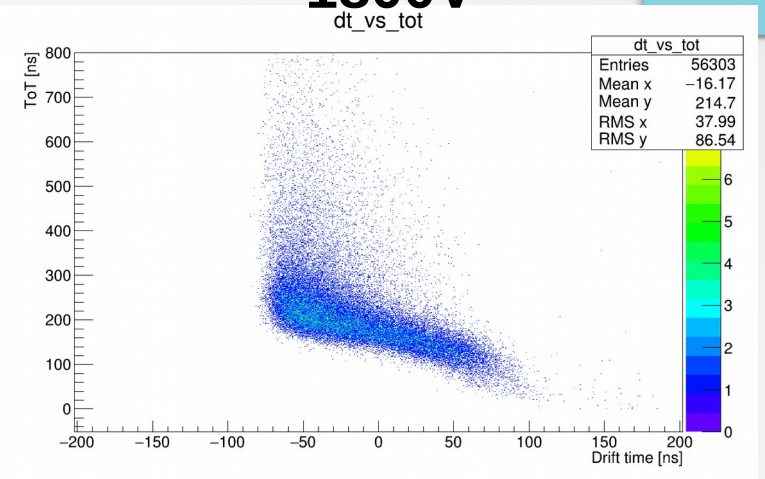
Red line represents Minuit fit.

Drift time and ToT (21 mV)

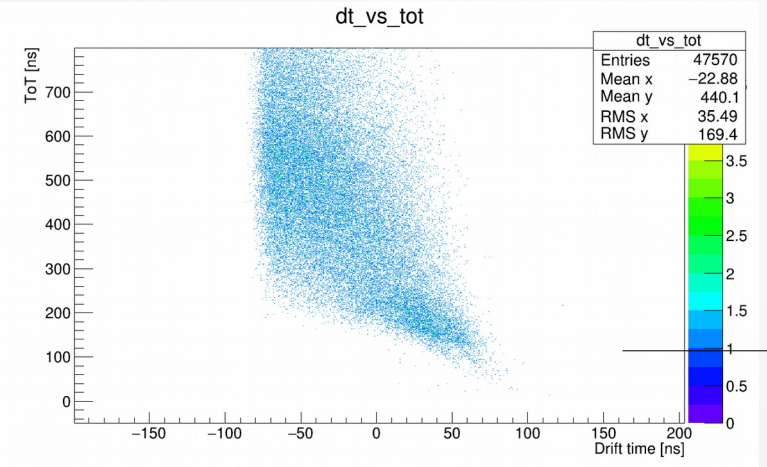
1700V

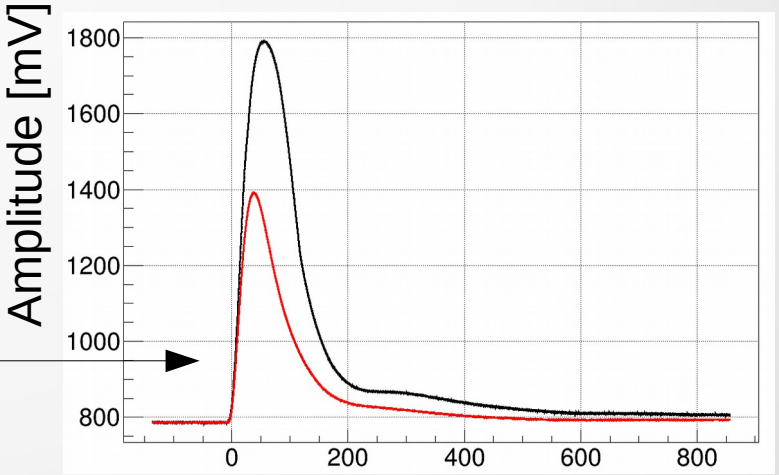


1800V



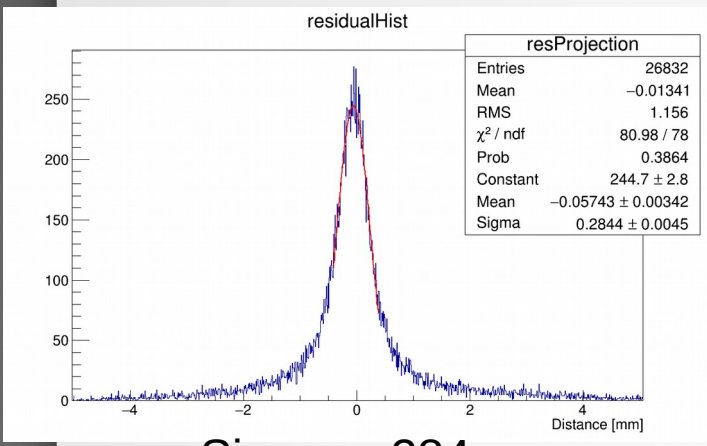
1900V





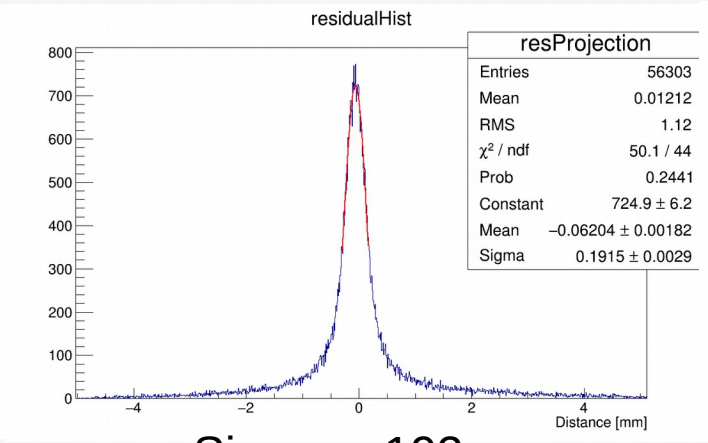
Residuals distribution (21 mV)

1700V



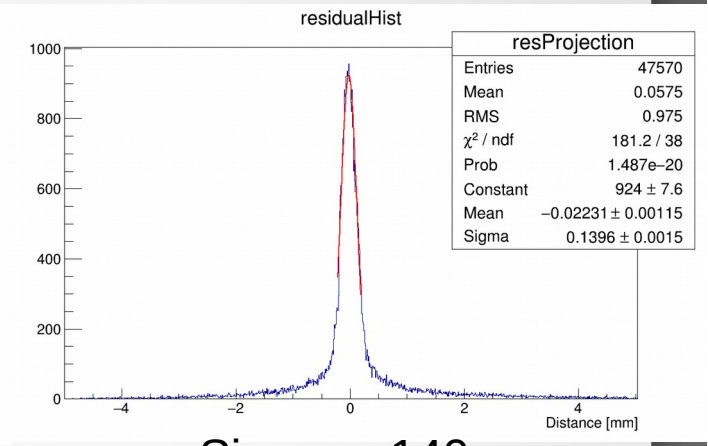
Sigma = 284µm

1800V

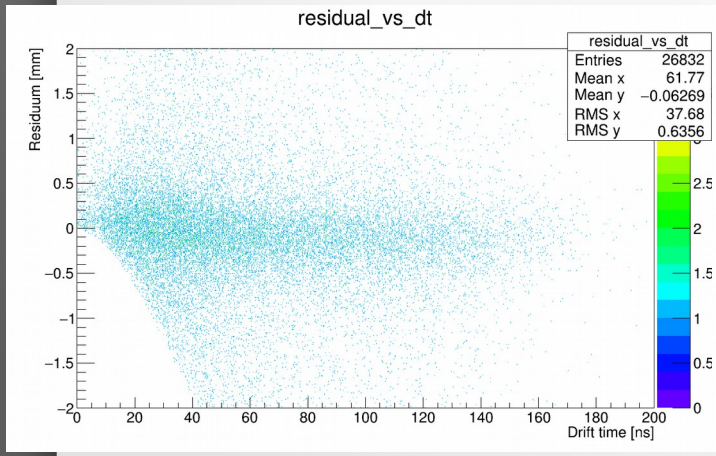


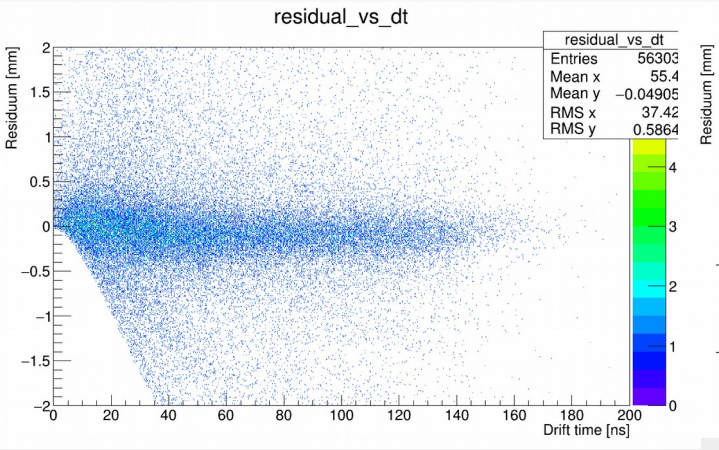
Sigma = 192µm

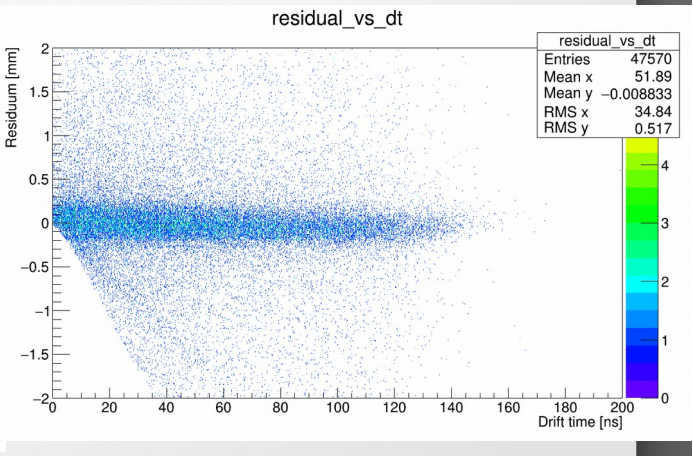
1900V



Sigma = 140µm

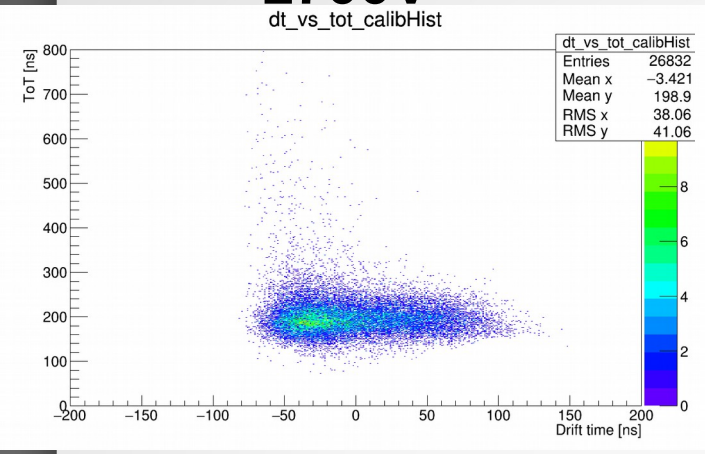




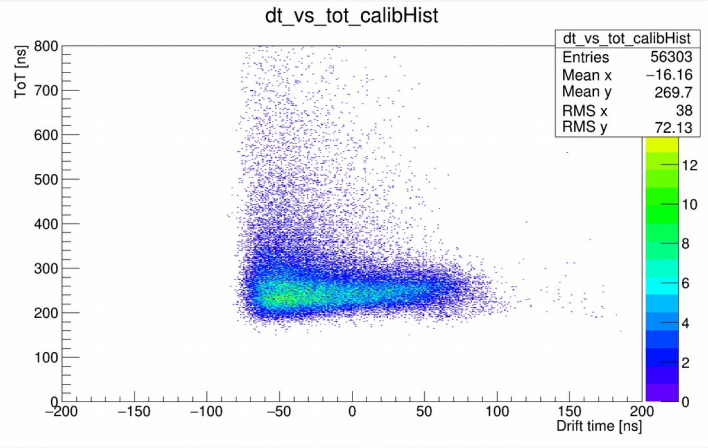


ToT calibrated (21 mV)

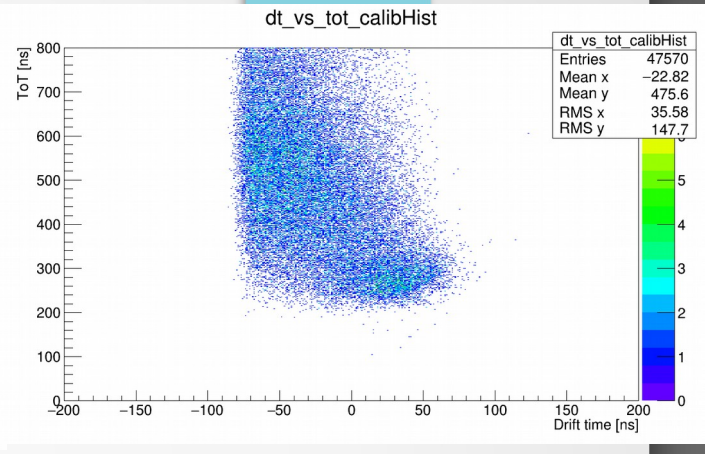
1700V

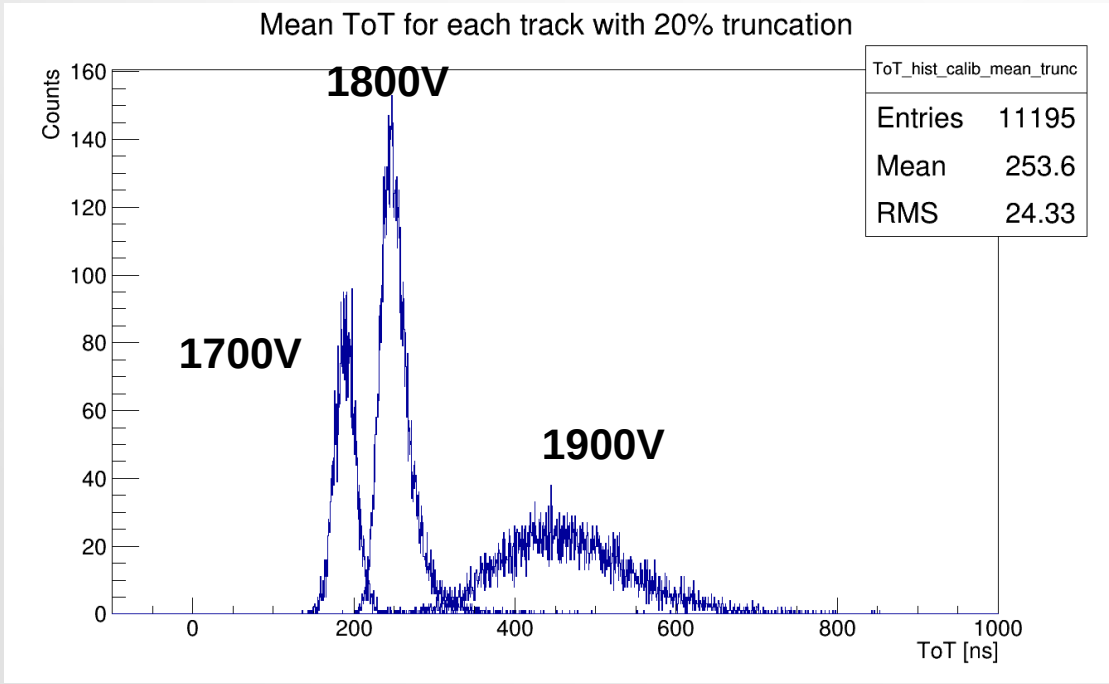


1800V



1900V





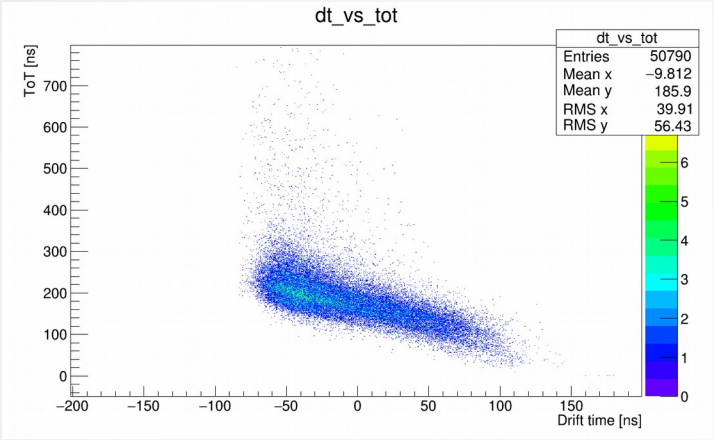
$$sep = \frac{ToT\,1 - ToT\,2}{\Delta ToT\,1 + \Delta ToT\,2}$$

Separation$^{1700\text{-}1800}$ = 2.12

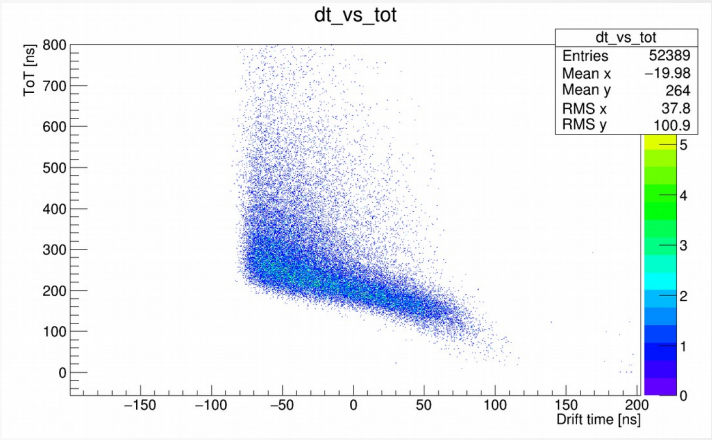
Separation$^{1800\text{-}1900}$ = 3.54

Drift time and ToT (5 mV)

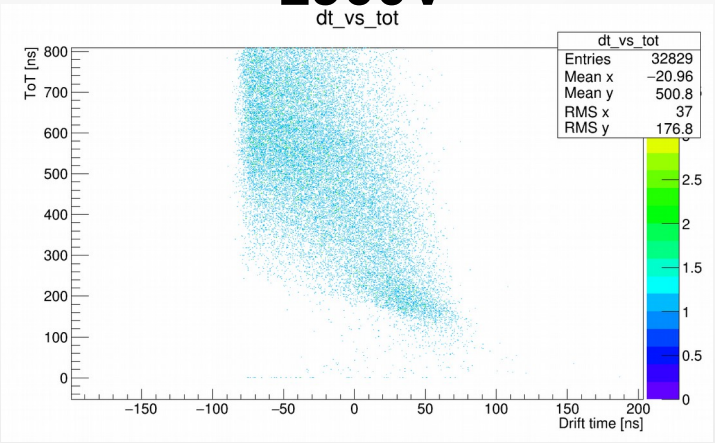
1700V



1800V

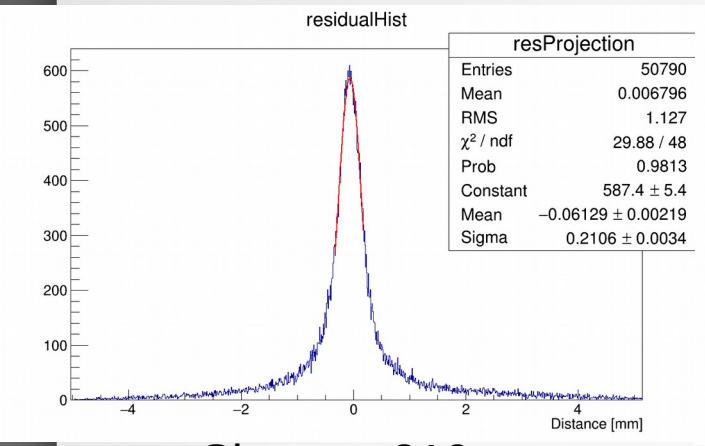


1900V

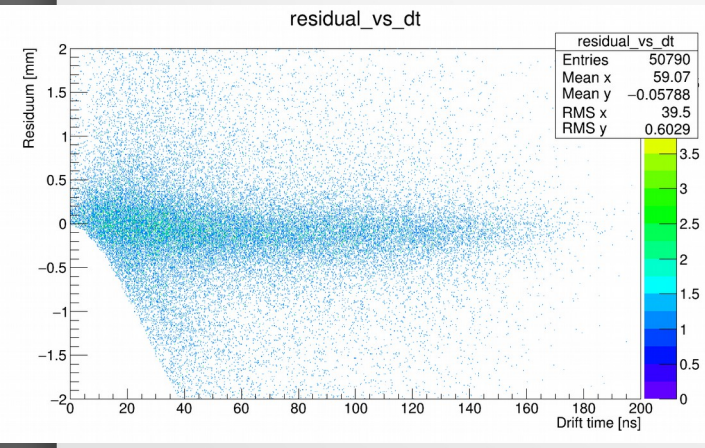


Residuals distribution (5 mV)

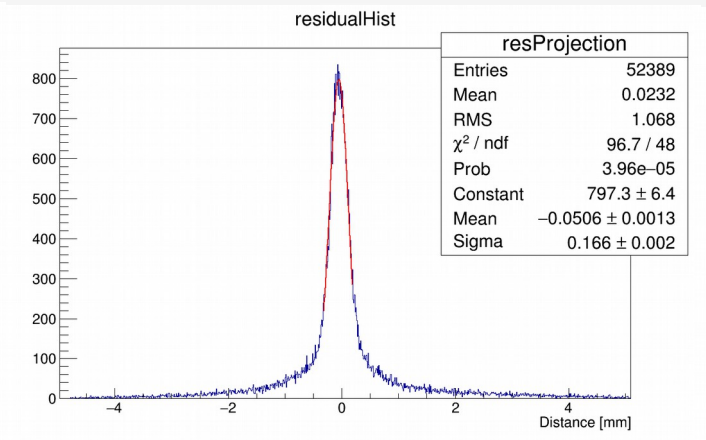
1700V



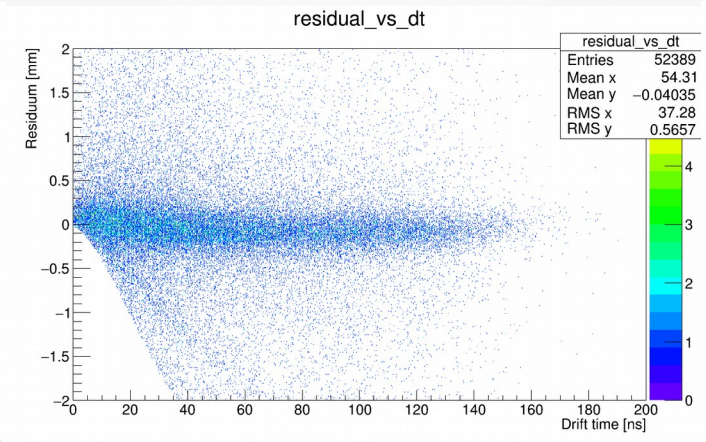
Sigma = 210µm



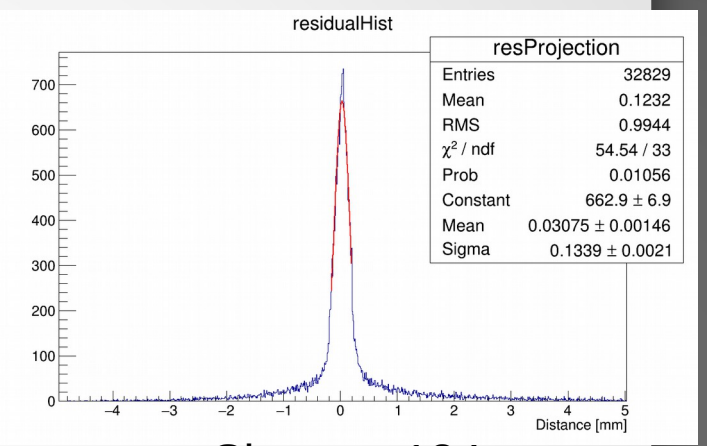
1800V



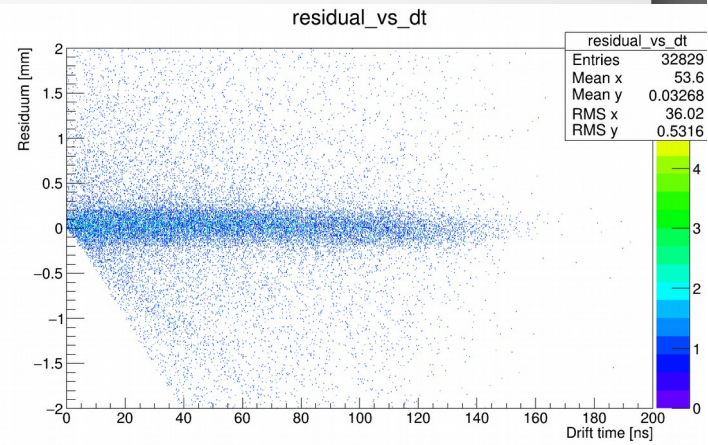
Sigma = 166µm



1900V

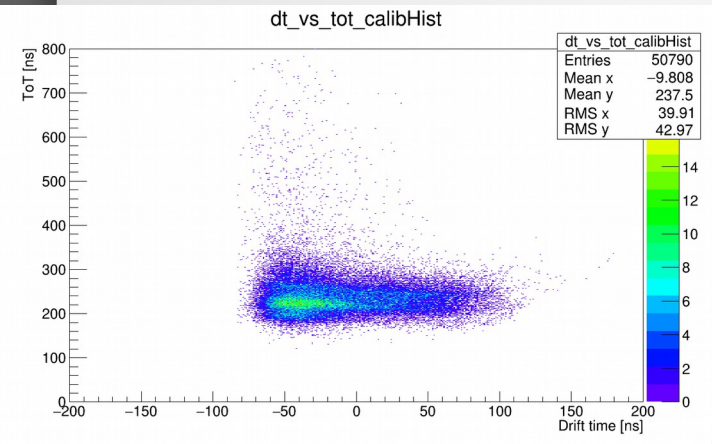


Sigma = 134µm

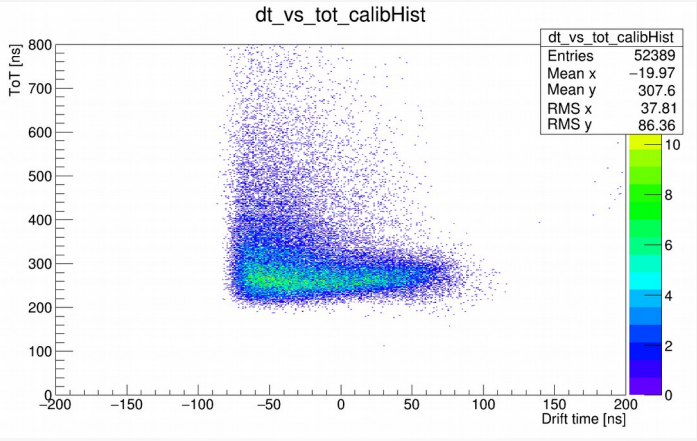


ToT calibrated (5 mV)

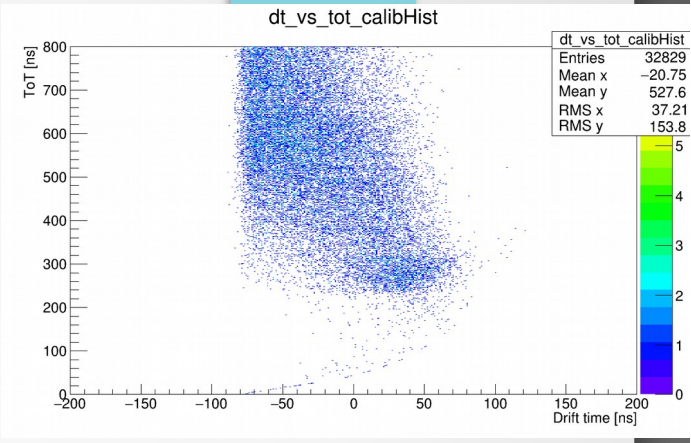
1700V

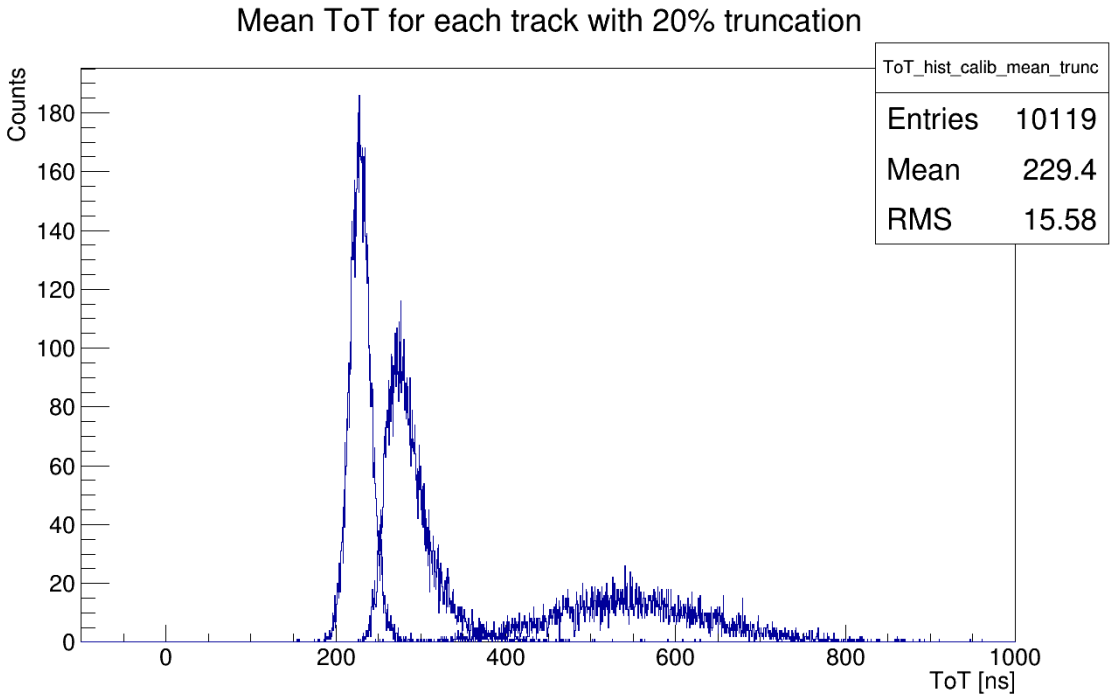


1800V



1900V





$$sep = \frac{ToT\,1 - ToT\,2}{\Delta ToT\,1 + \Delta ToT\,2}$$

Separation$^{1700\text{-}1800}$ = 1.66

Separation$^{1800\text{-}1900}$ = 2.40

Conclusions and outlook

- Lower threshold improves spatial resolution but worsen ToT separation,
- There is still room form improvement by adding more straw layers,
- Continue with cosmic ray measurement in Krakow (faster shaping – 15 ns)
- Preparation set-up in Juelich (cosmic rays and later beam)
- Preparation for the beam test (22.04.-02.05.2016)
  - Measuring at different beam momenta (STT: single TRB 176 channels, FT: single TRB 96 channels)
  - Measuring with different thresholds (STT: single TRB 176 channels, FT: single TRB 96 channels)
  - Checking different PASTTREC settings (STT: single TRB 176 channels, FT: single TRB 96 channels)

Thank you for your attention!

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Acknowledgments:
Project is supported by NCN [DEC-2013/09/N/ST2/02180]