Momentum dependence of STT resolutions for fADC readout

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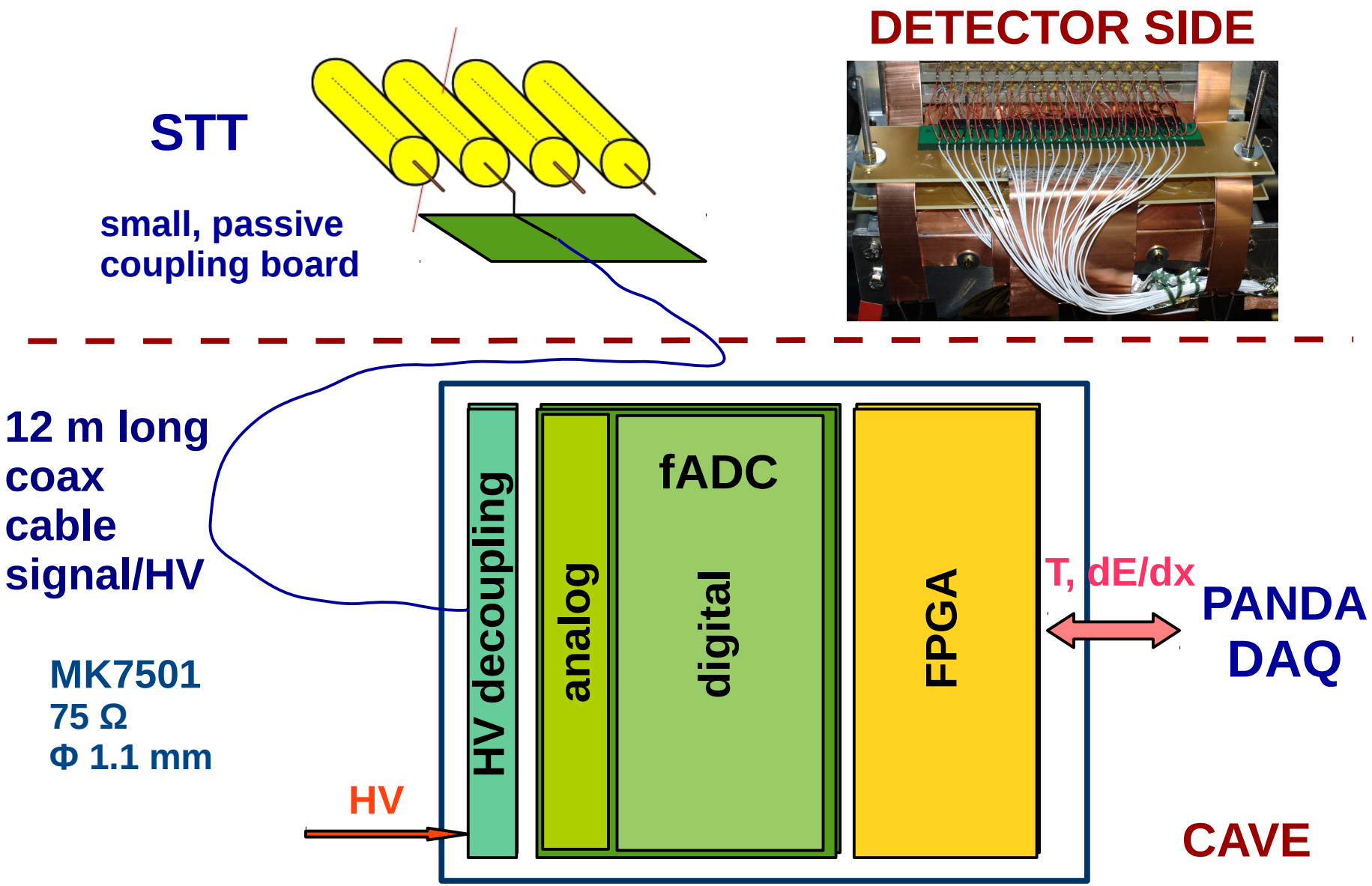
FEE-free readout system – final architecture



New flash ADC

In May '15 experiment first time the new flash ADC of the design optimized for PANDA experiment has been put into operation in the beam conditions.

16 channels were used. They were supplied from the fare-end preamplifier TIA04.

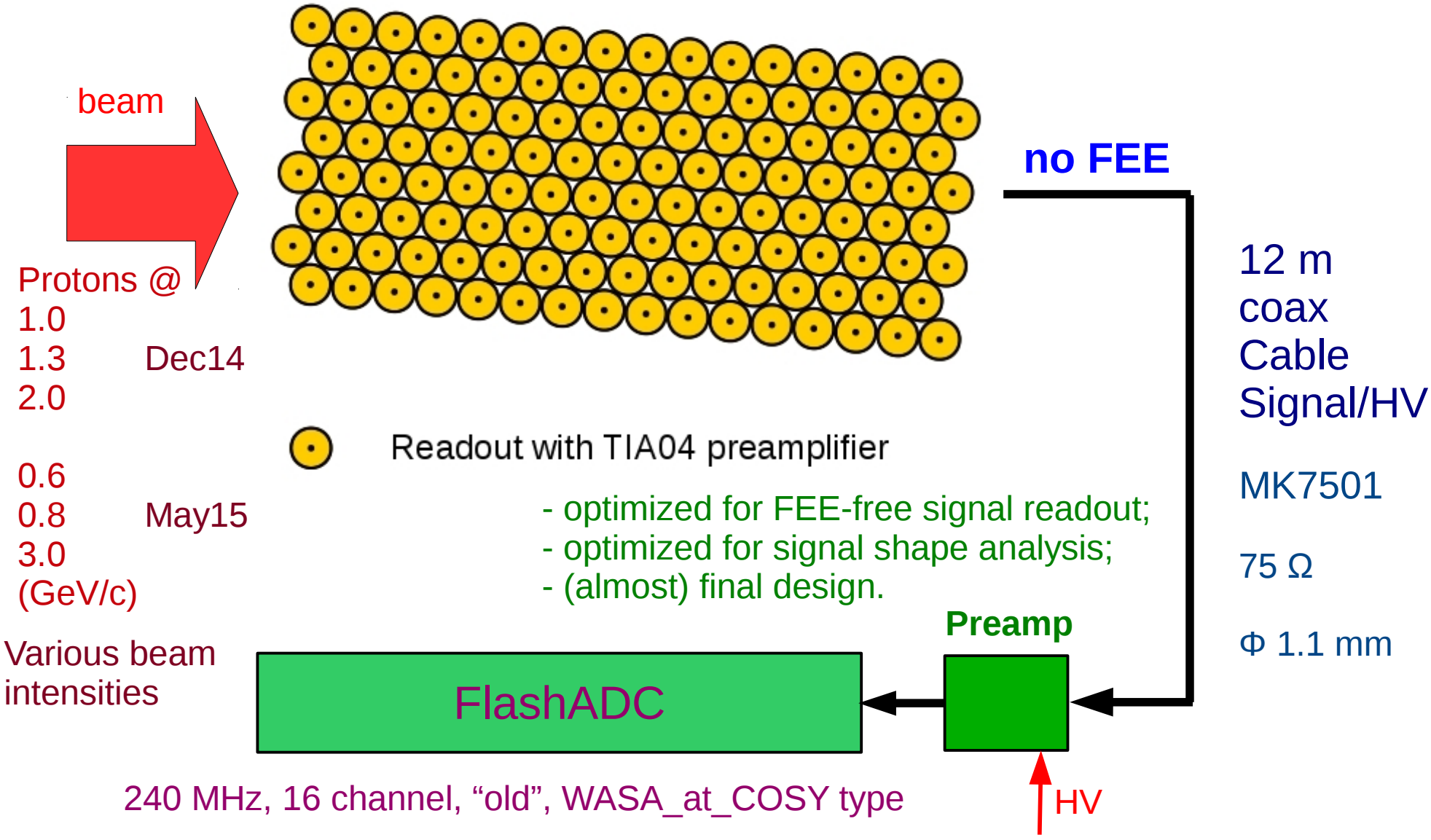
Data for different momenta were collected and are under analysis.

First observation are very promising !

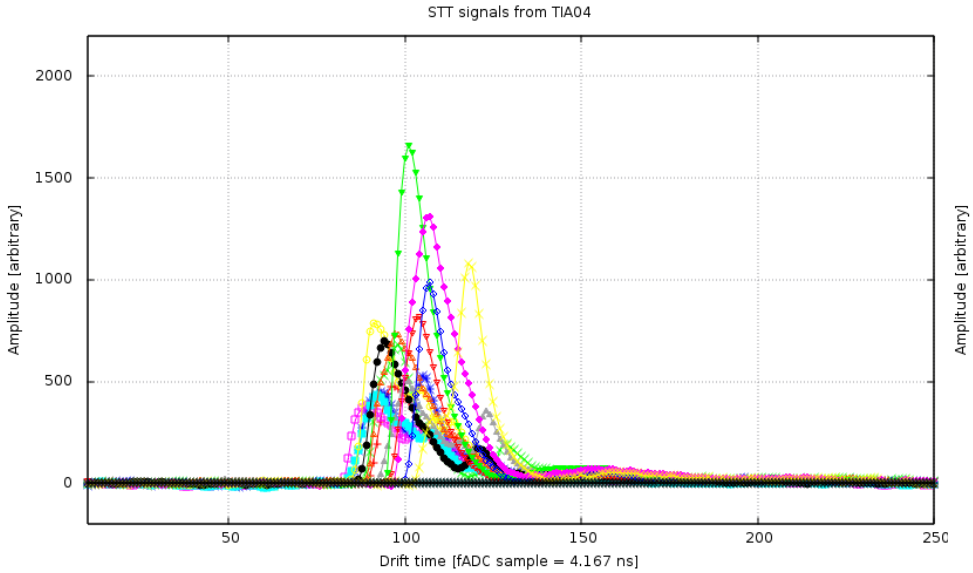
Further development and optimization is in progress.

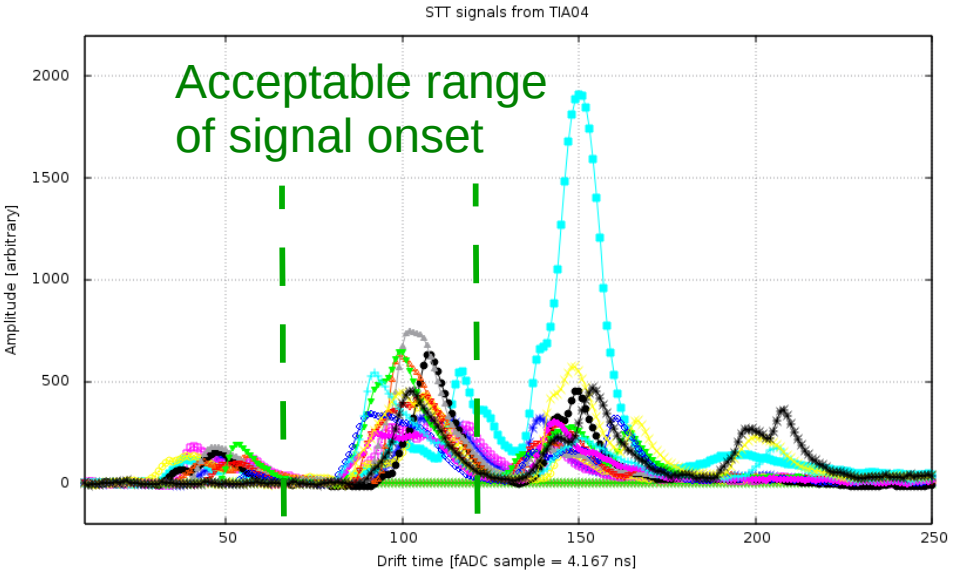
Congratulations for Lioubov Jokhovets & Andreas Erven !

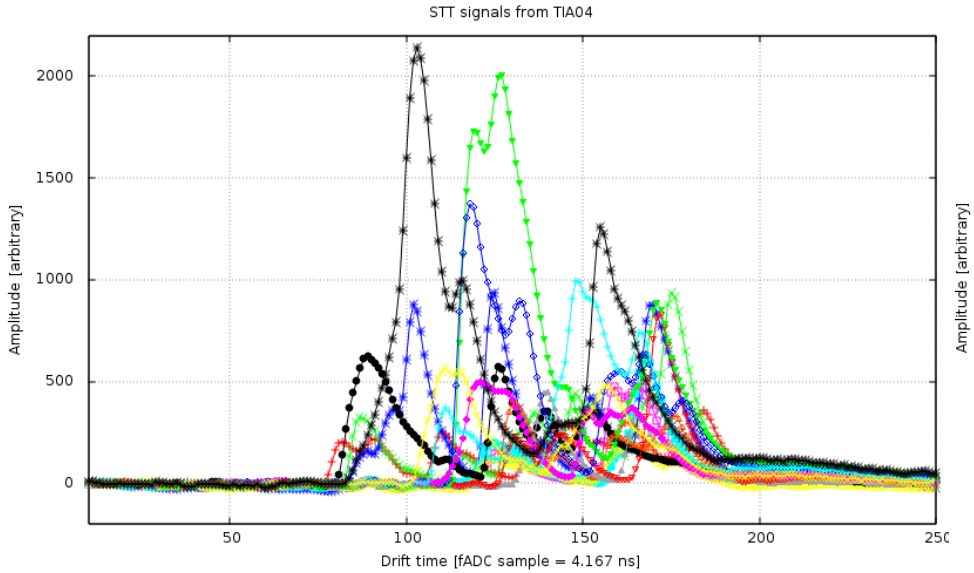
December '14 and May '15 beamtime

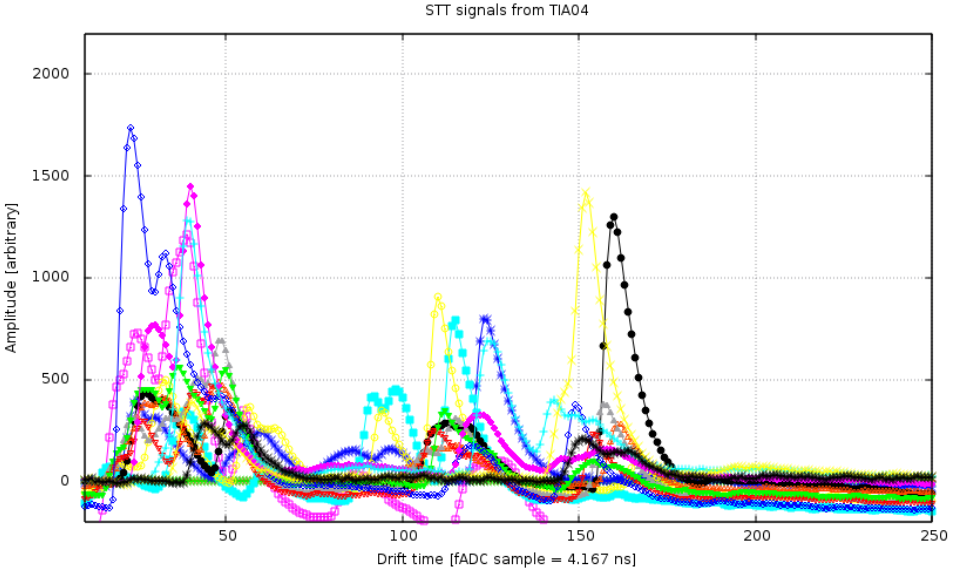


Signal selection

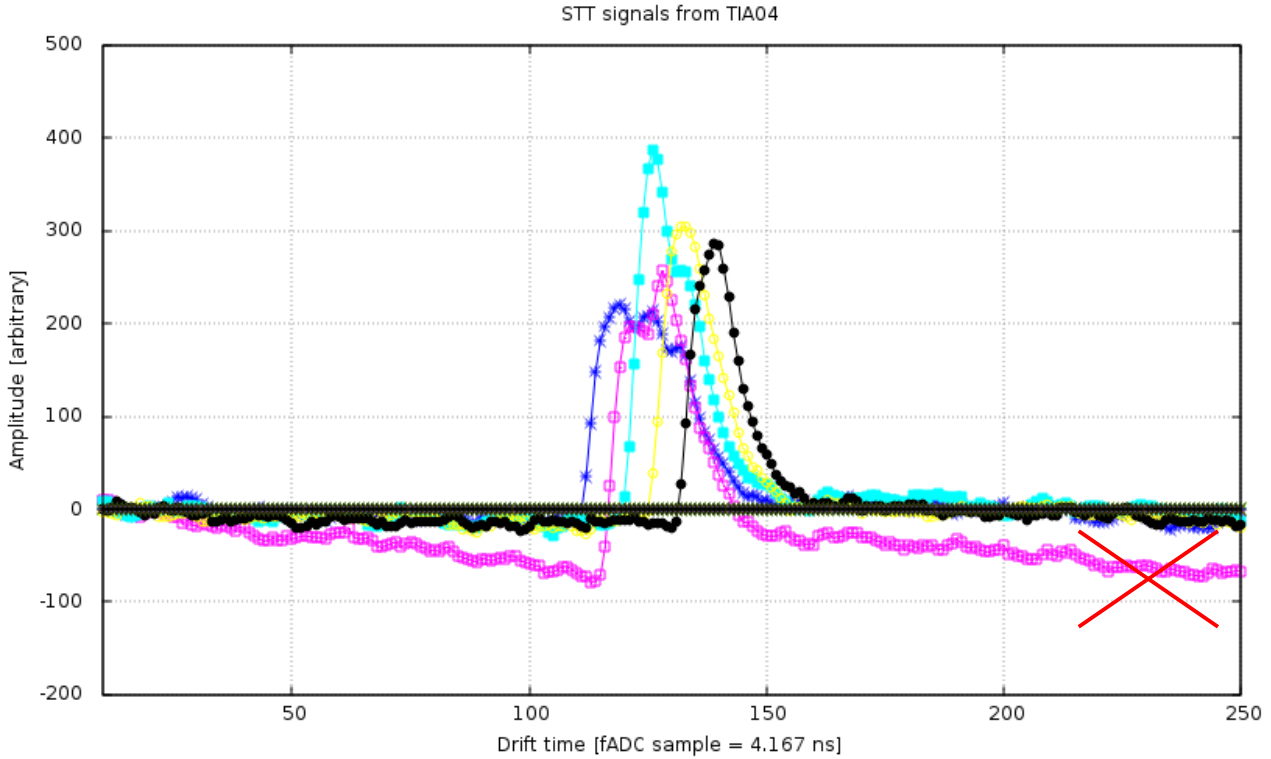








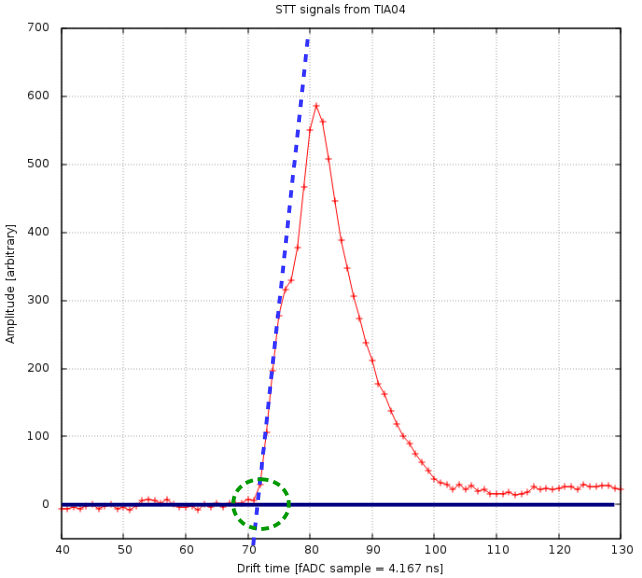
Signal selection



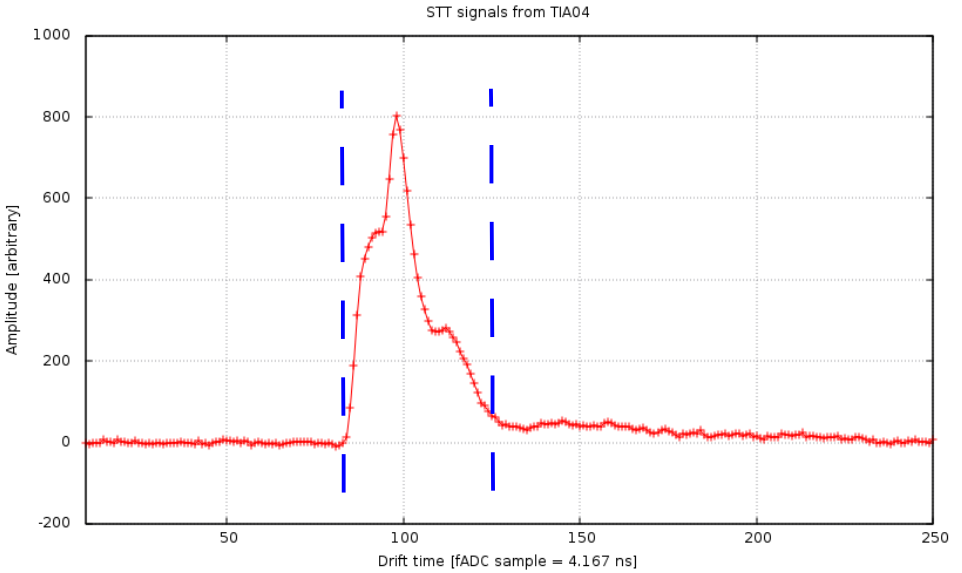
Baseline is always corrected.
But if baseline after correction is not flat
and at the onset of the signals is different by >20 from 0
then the signal is disregarded

Time and Energy Loss determination

Time:
Zero Crossing Time calculated for highest steepness of leading edge
(before derivative drops)



dE:
integration over 40 samples from the onset of the signal

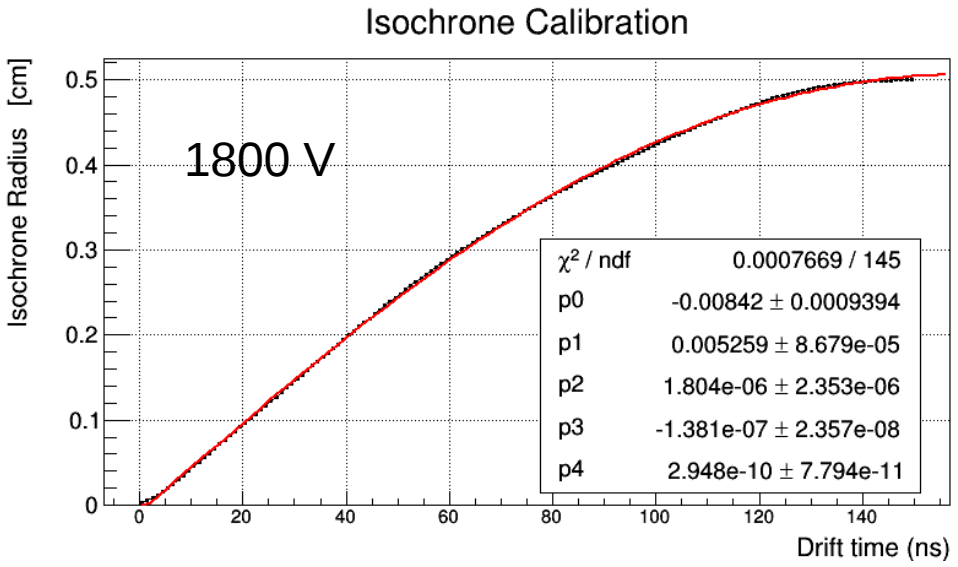


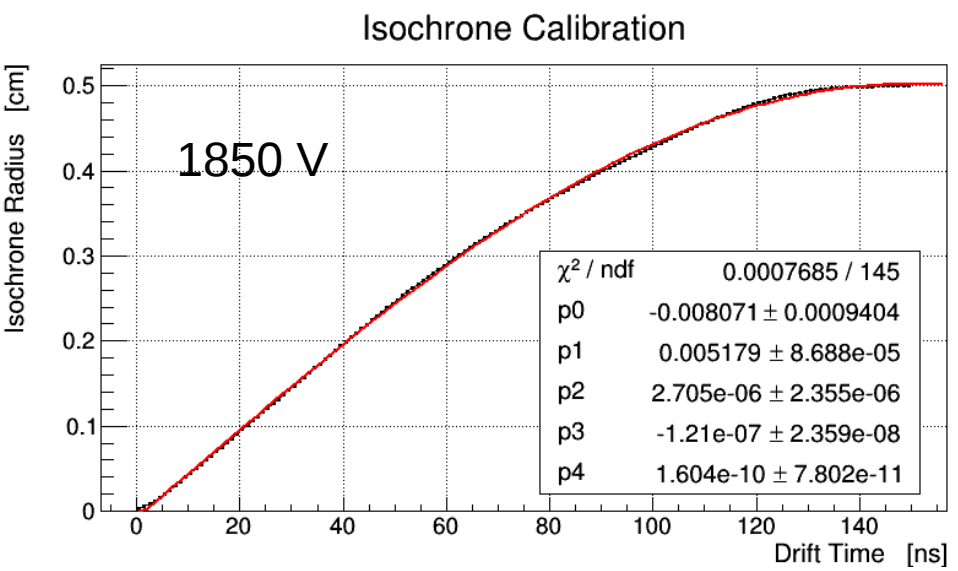
Isochrone calibration

May15 – very clean beam conditions – data taken at low intensities suitable for r-t calibration.

Equal samples of data collected at 0.6, 0.8 an 3.0 GeV/c added together and used for r-t calibration.

Obtained calibration curves used for analysis of May15 data and for re-analysis of Dec14 data





Reminder – Dec14 results

Results from two independent analysis of Dec14 data were presented in PANDA CM in Juelich - Dec '14 (K.P.)
and in PANDA CM in Giessen (Susanna Costanca). They are consistent.

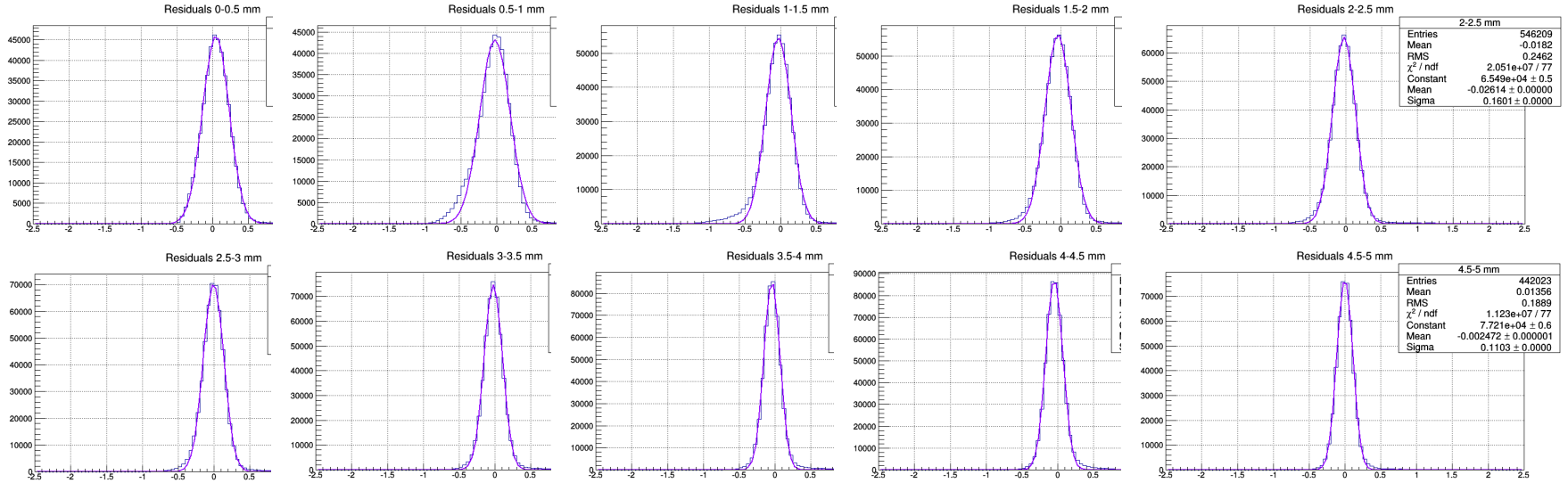
Results of re-analysis of these data with the calibration curves obtained from May15 data are in agreement with the earlier findings.

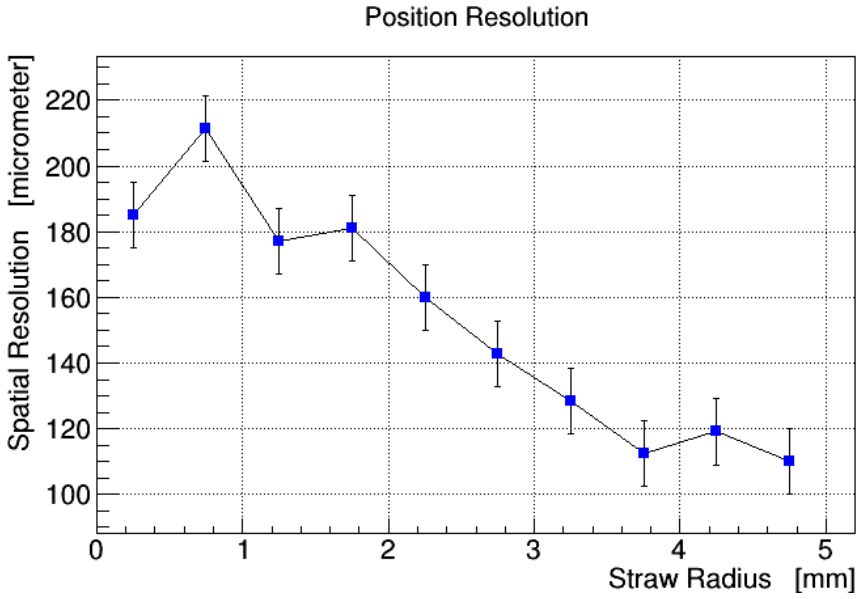
Results of Dec14 experiment

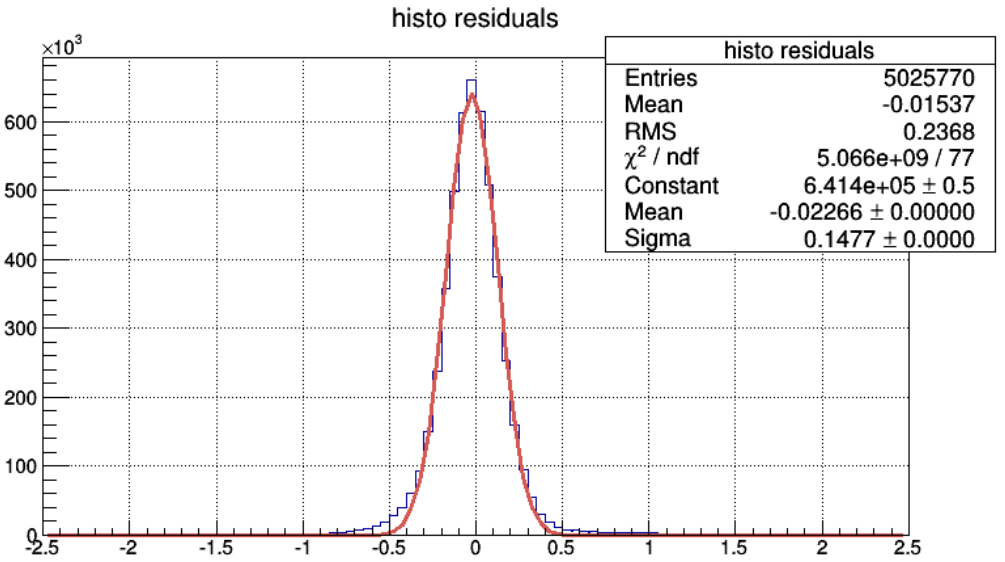
Only data collected at 1850 V working voltage were taken into account.

	Spatial resolution [μm] uncertainty: ~ 10	**Energy resolution** [%] uncertainty: ~ 1.0
2.0 GeV/c	160	9.2
1.3 GeV/c	157	9.1
1.0 GeV/c	154	9.0
Cosmics	154	

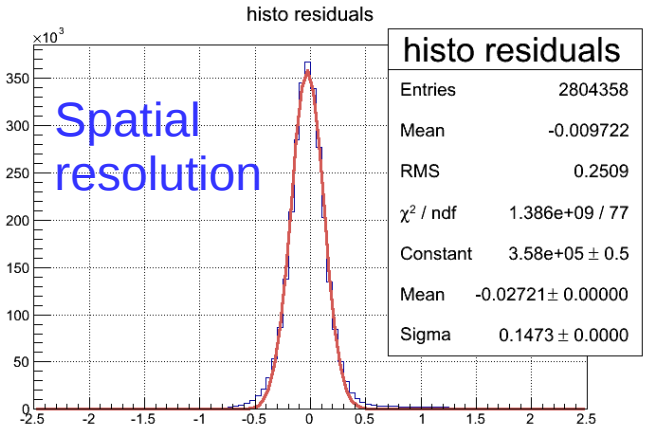
May 15: residua distributions example for 0.8 GeV/c (1800V)



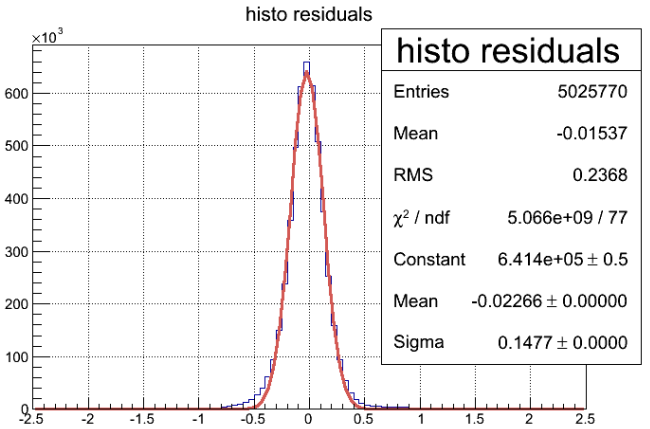


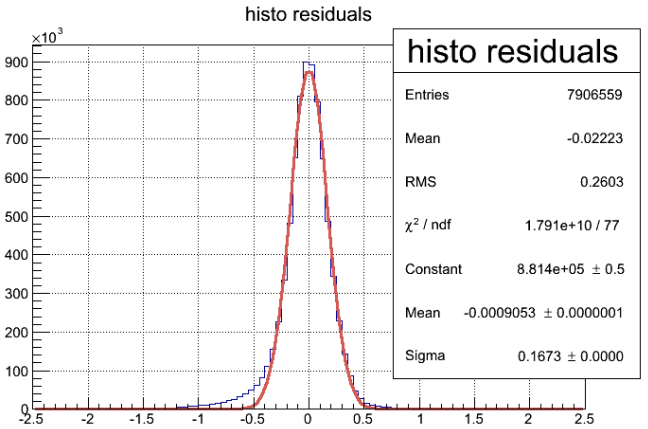


Preliminary results for May '14 data (only for HV = 1800 V)



Spatial resolution

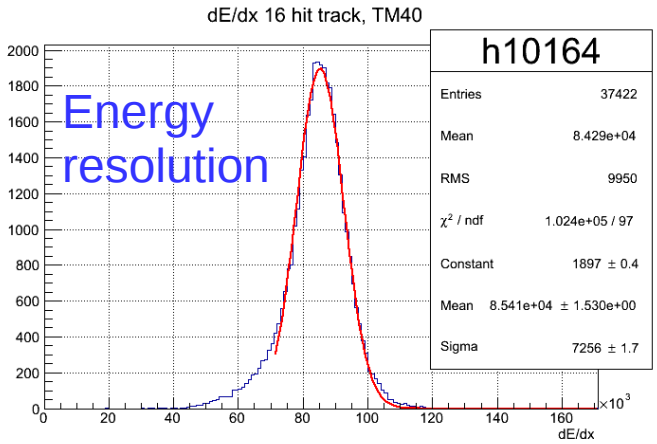




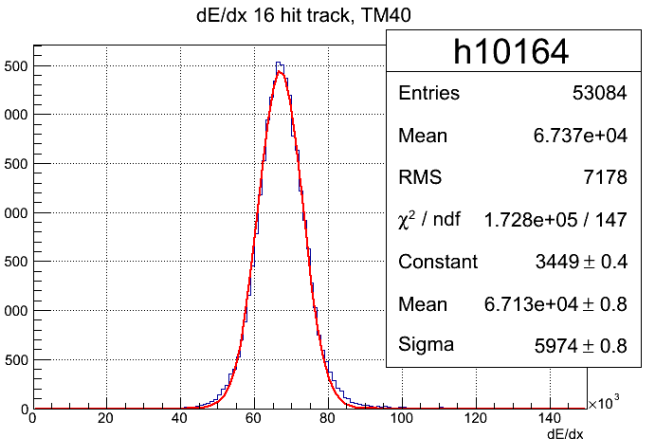
0.6 GeV/c

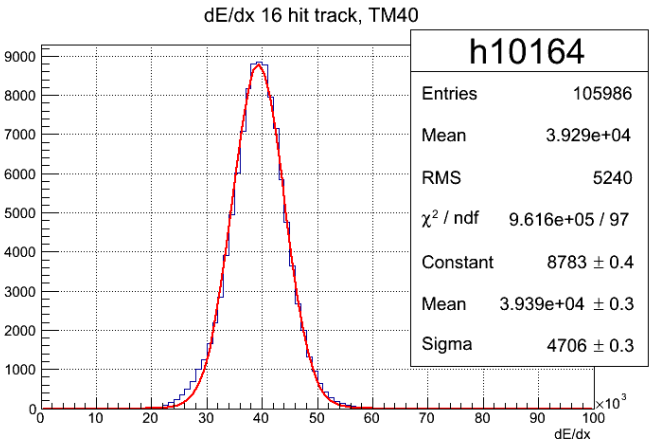
0.8 GeV/c

3.0 GeV/c



Energy resolution

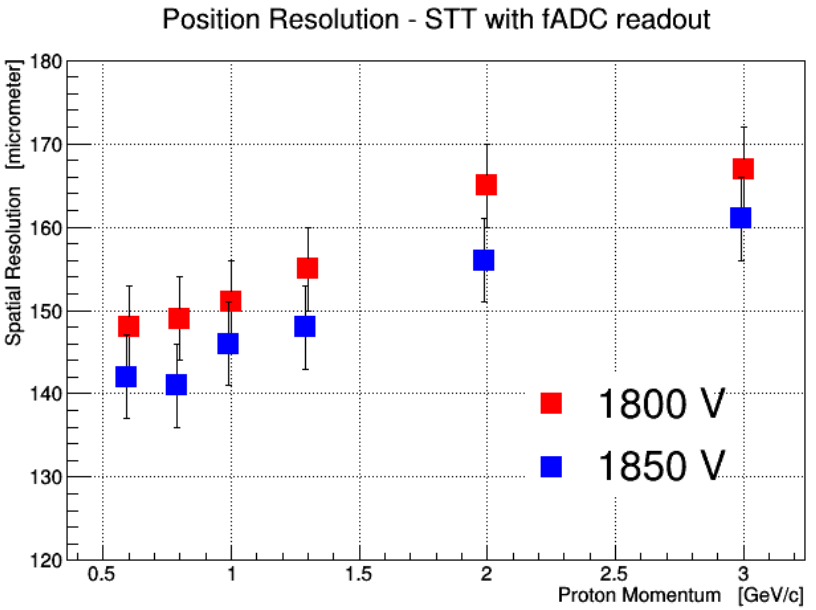


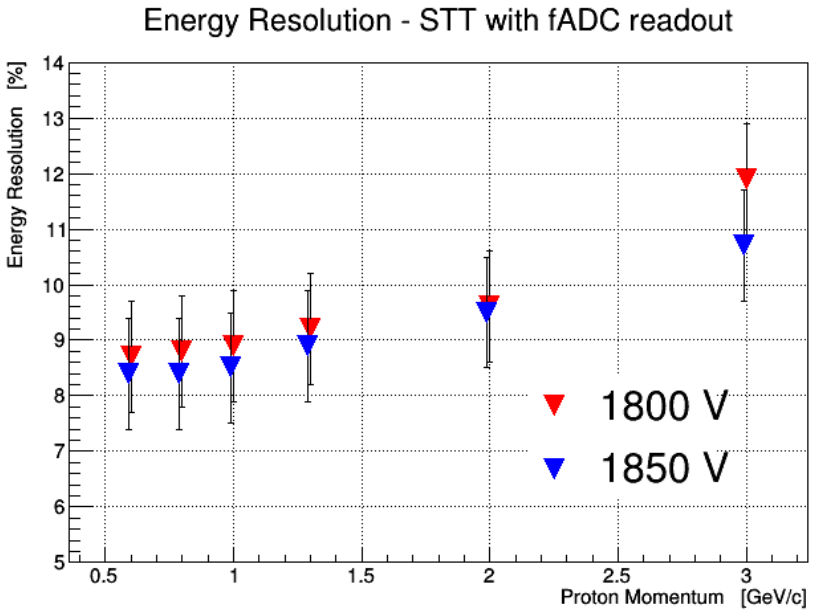


Summary of current results

All beam momenta

Presented results are only for reconstructed tracks of 16 hits



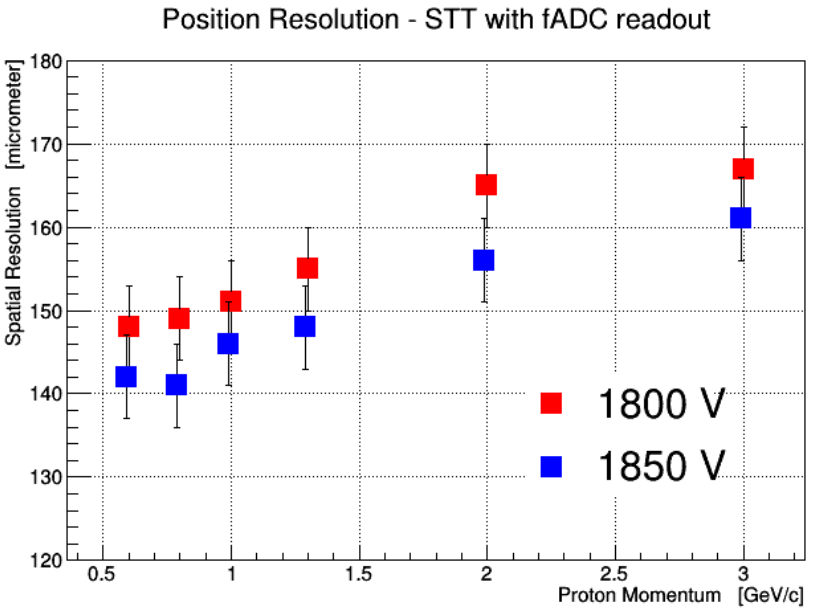


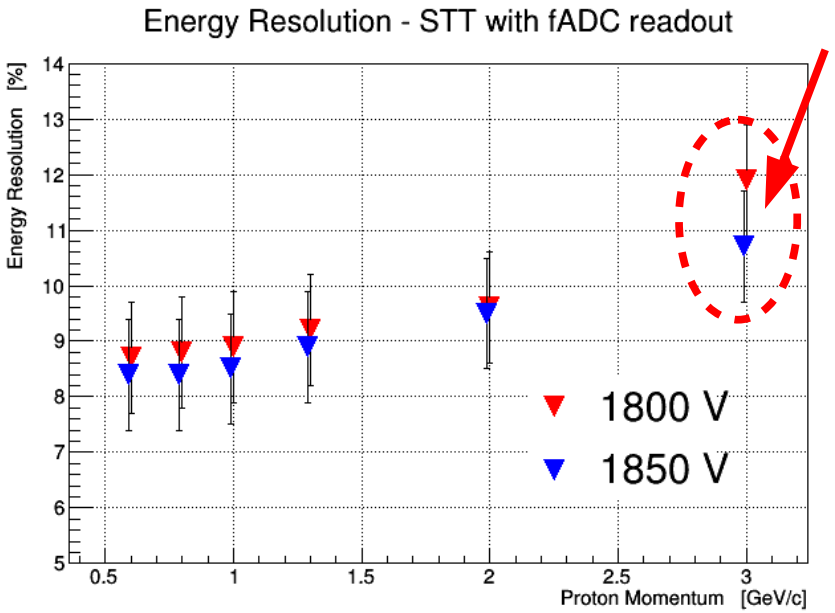
For the energy resolution the Truncation Mean of 40 % applied to initial dE/dx distributions

Summary of current results

All beam momenta

Presented results are only for reconstructed tracks of 16 hits



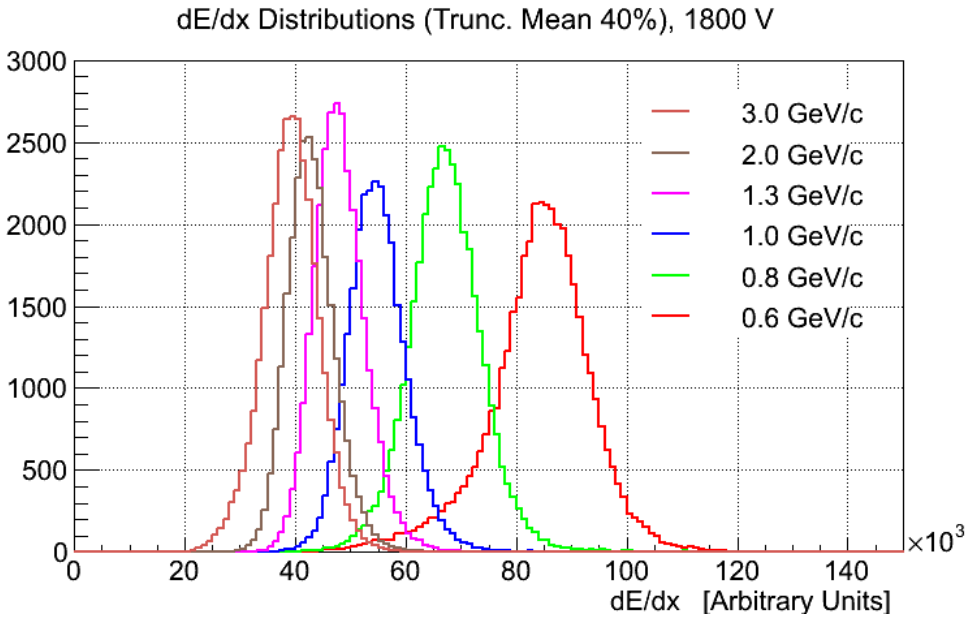


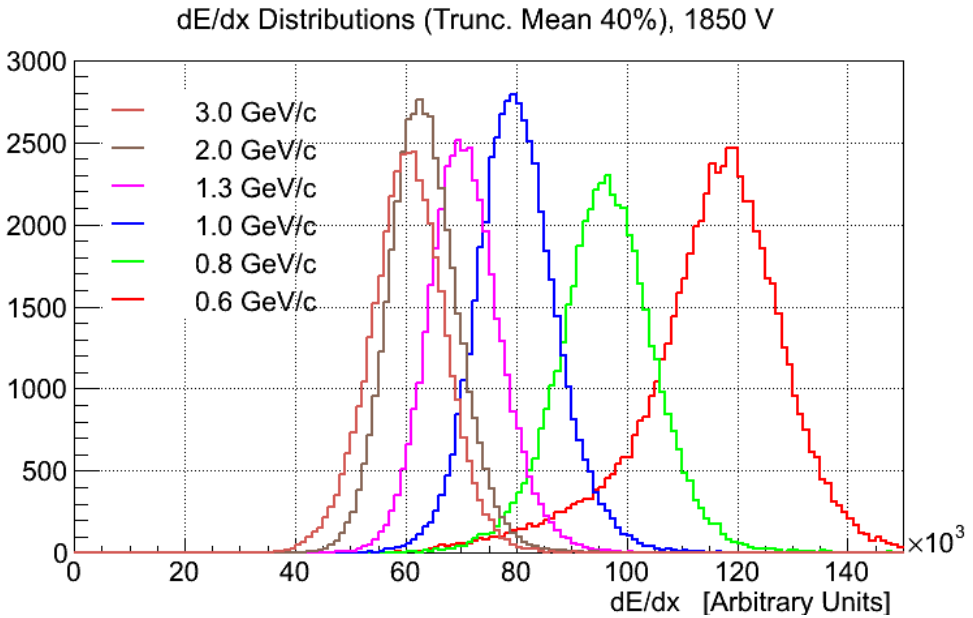
For the energy resolution the Truncation Mean of 40 % applied to initial dE/dx distributions

Gain of the preamplifier has to be increased -

Optimization for the dynamic range of the final fADC

Summary of current results
dE/dx distributions





Summary

- In the Dec '14 and May '15 beam tests the whole applicability range of STT prototype has been checked;
- The data were collected both for the minimum ionizing as well as for the highly ionizing particles of low momenta;
- The feasibility of the FEE-free readout of PANDA STT based on TIA04 amplifier and 12 m long signal transmission cable is confirmed;
- Both the obtained spatial resolution as well the energy resolution for the whole momentum range of interest are comprised in the demanded range;
- The observed deterioration of the energy resolution of the highest momenta has origin in insufficient gain of preamplifier and will be corrected in the final design;
- The architecture of the readout system is fixed;
- Analog part of the readout chain can be considered as established.

Outlook

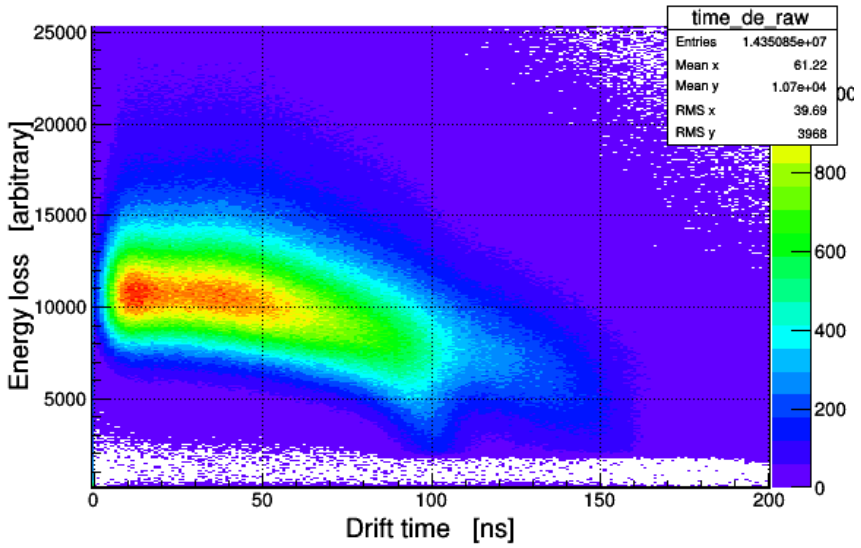
- We are happy with the analog part of the readout chain. Demanded adjustment of the final parameters of the amplifier will be done only when the dynamic range of the final fADC will be known.
- Integration of the preamplifier into fADC circuitry is an issue and we would like to go on as soon as possible.
- The same concern the mechanical design and the integration of the HV decoupling into the analog stage of the new readout device.
- The signal selection and shape analysis procedures are developed and checked. Nevertheless they need implementation and optimization for the new FPGA system.
- In order to assure a real progress in the readout system development we need at least 64 channels of the new fADC with at least raw data output prior to the next beamtime.

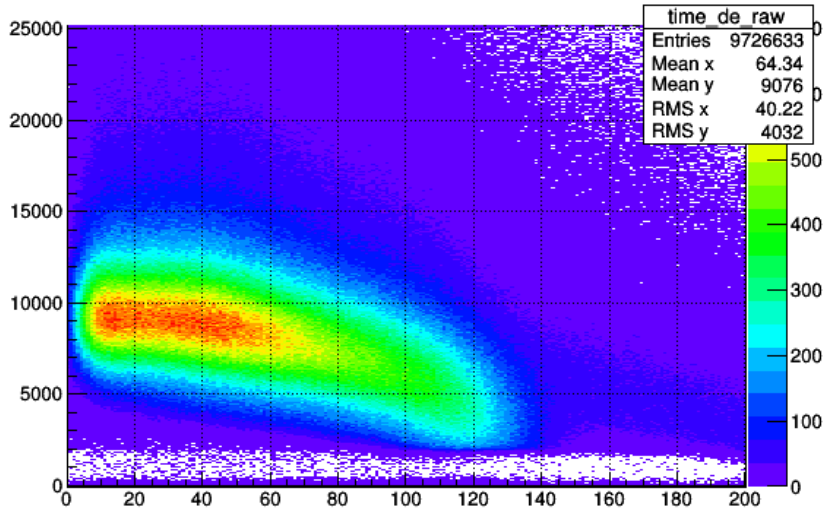
Thank you !

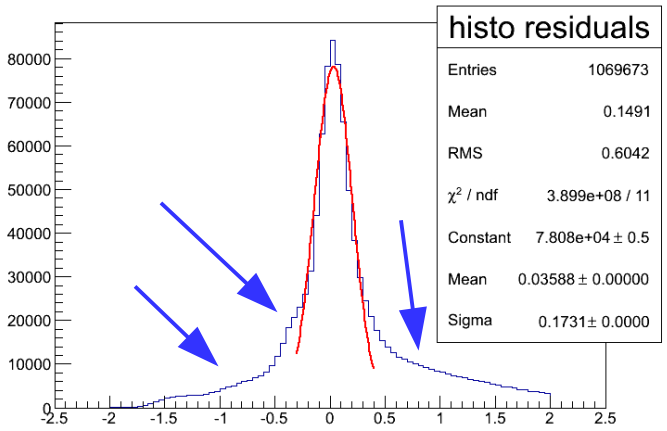
Backup slides

Improvement of STT1 geometry

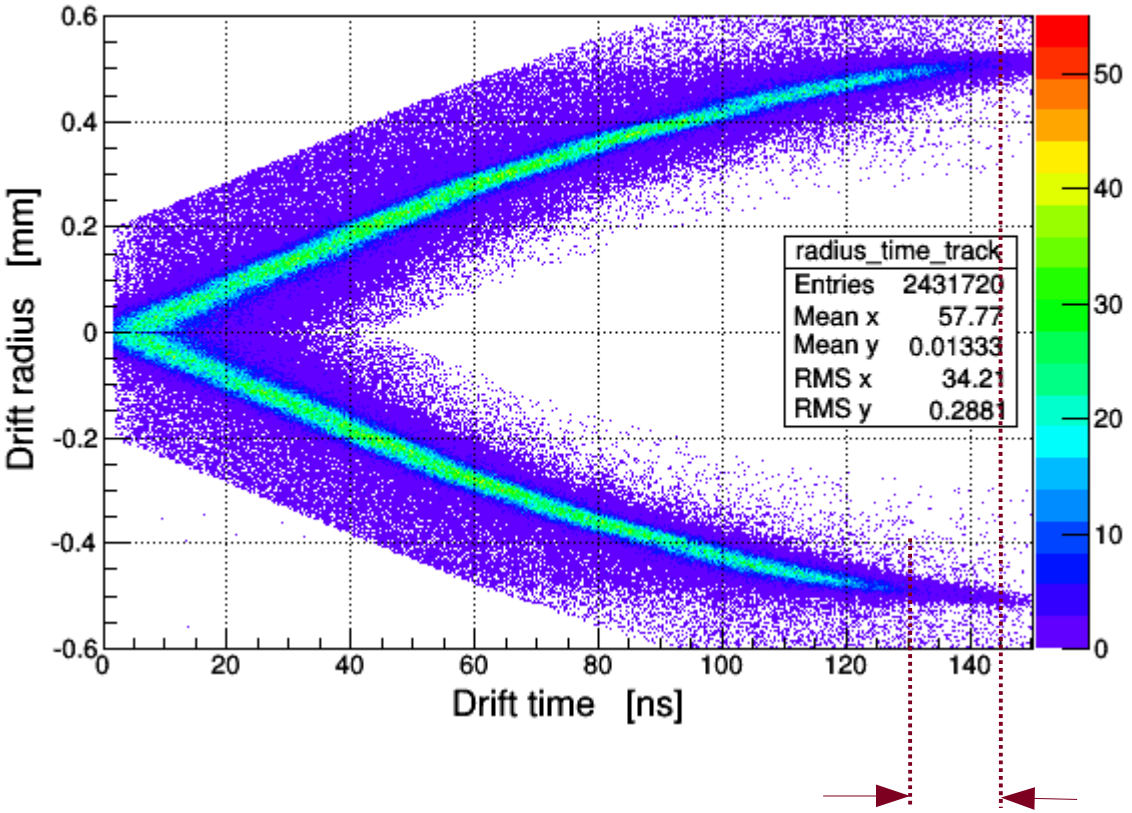
Small deformation of STT1 prototype due to fixation of the straw ends identified and corrected.







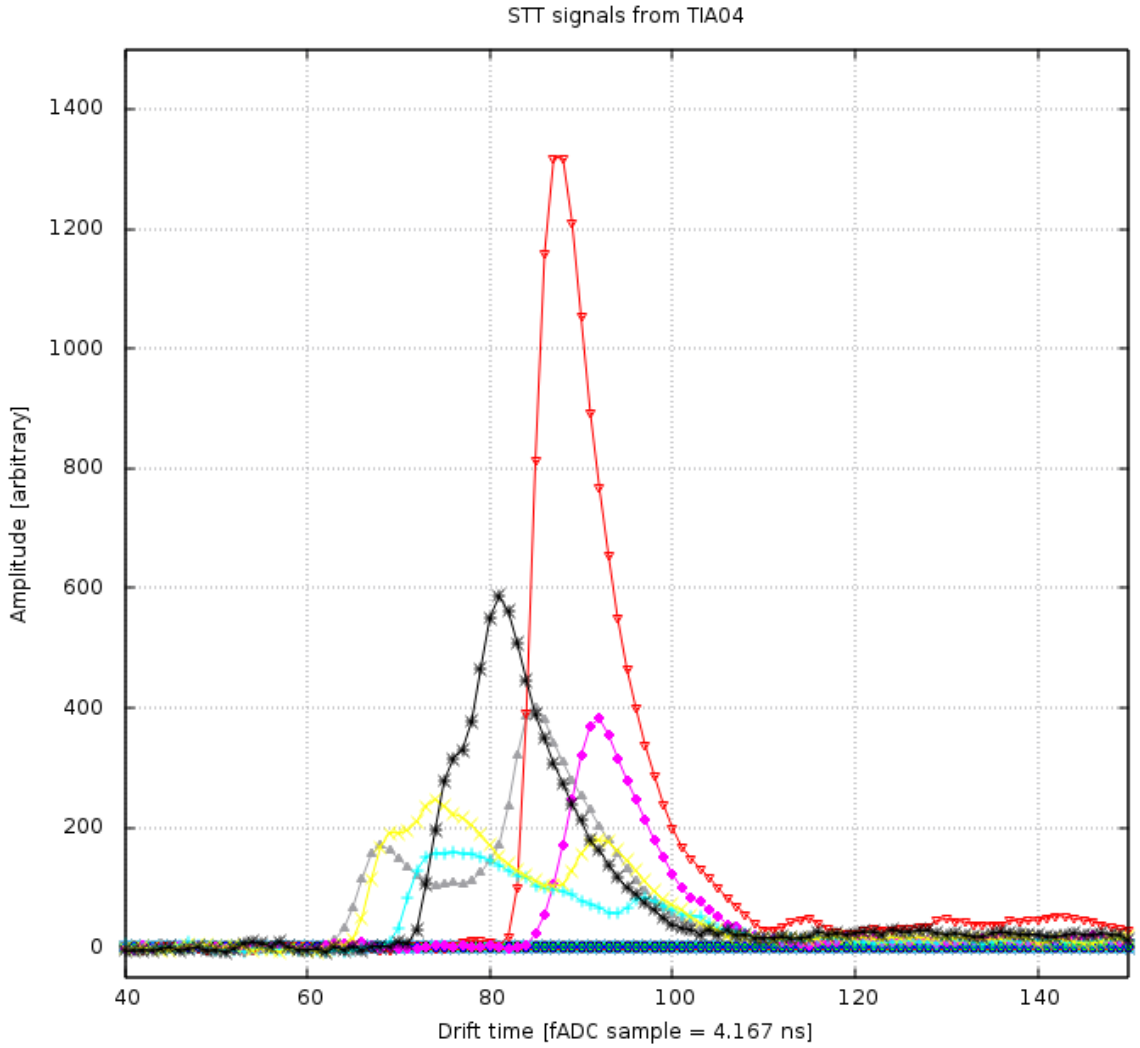
Current geometry of STT1



Still tiny displacement of the wires down resulting in the difference in up/down drift times ranges of ~ 15 ns

→ needs to be further investigated

Signals



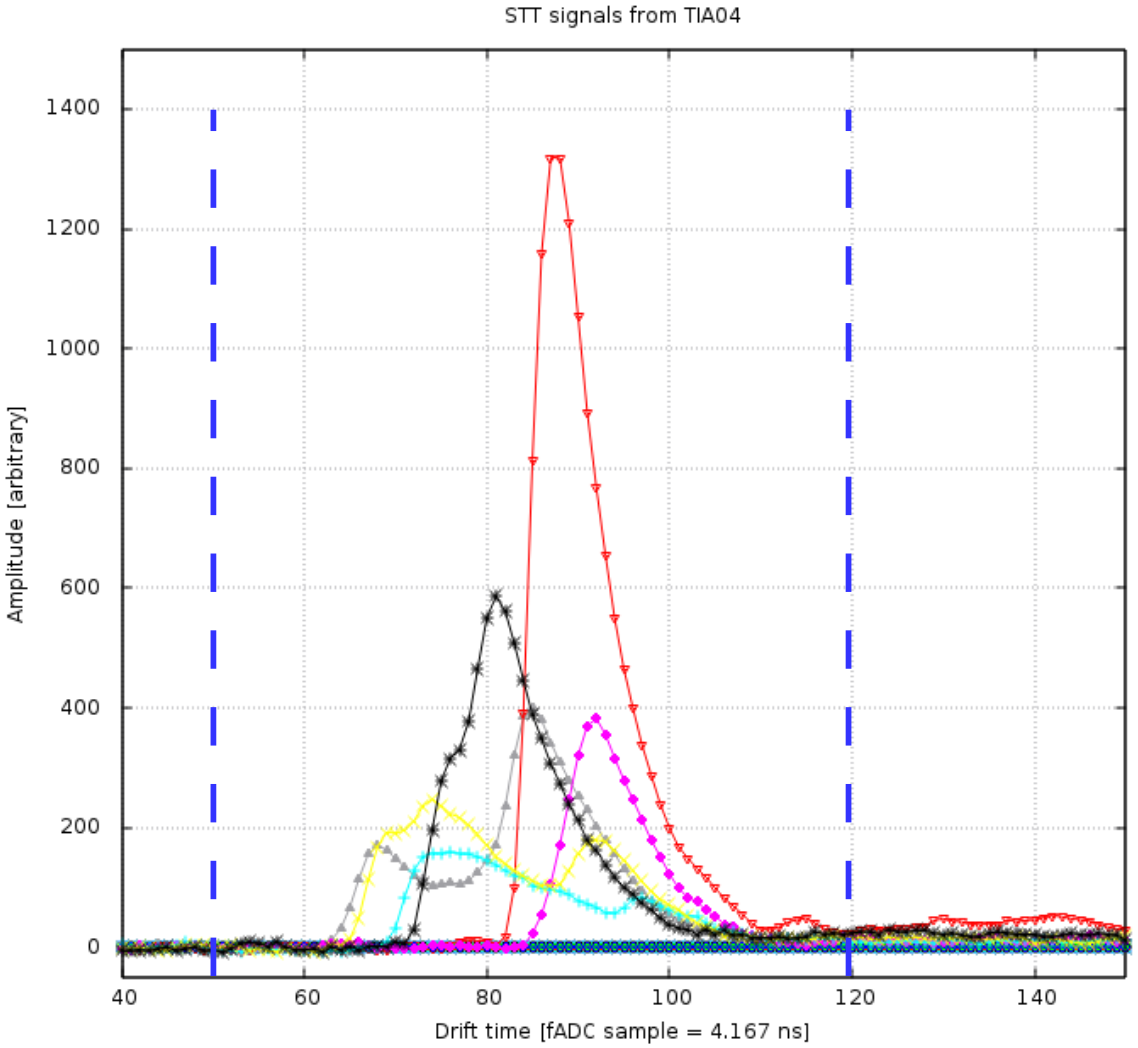
- very low noise level (< 3 mV),

- rising edge with low curvature,

- 5 - 7 samples before maximum,

- trailing edge tail
  (due to a chain of capacitors
  in the current coupling
  to fashADC - will be avoided
  in target system).

Energy loss estimation



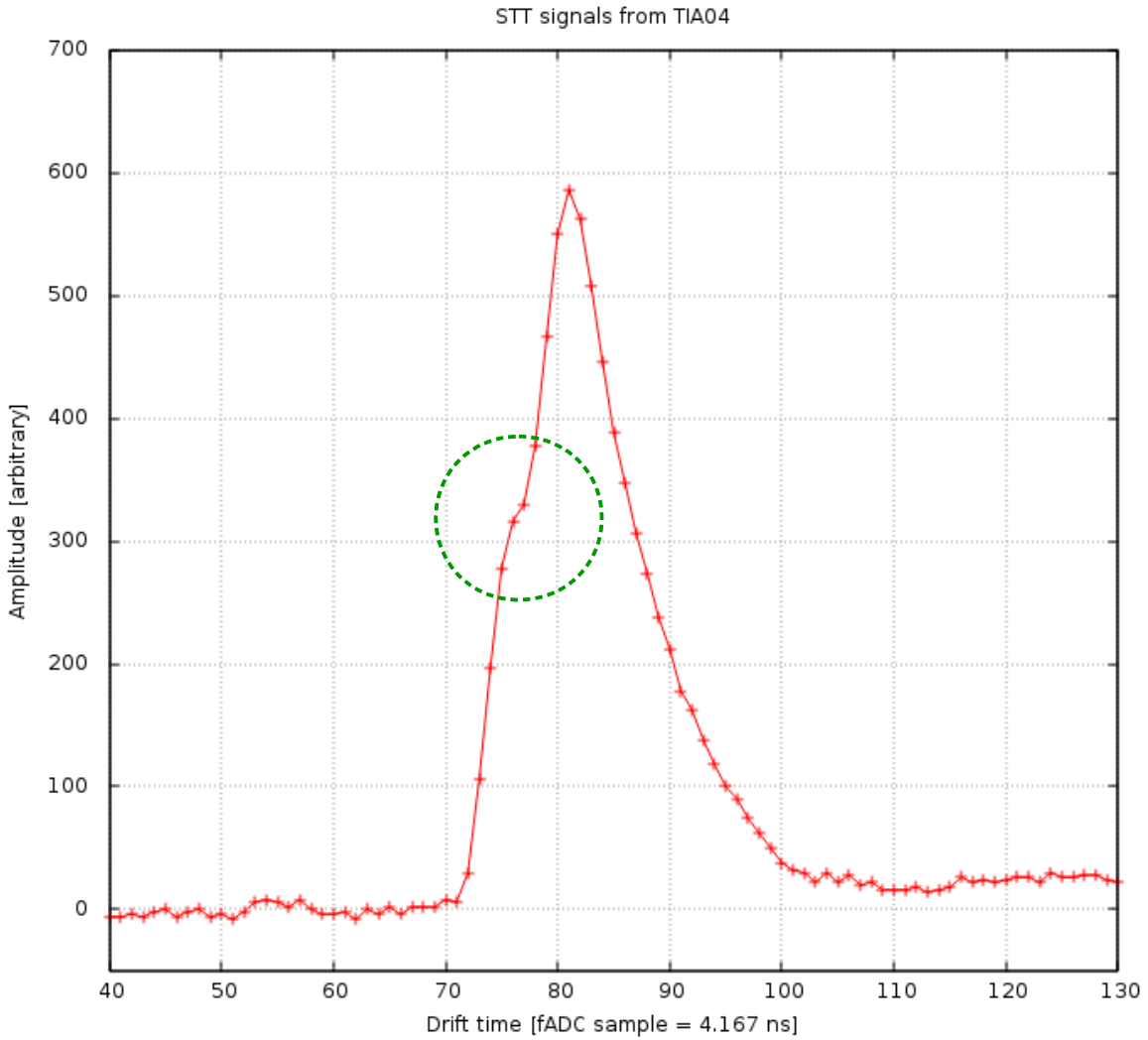
Preliminary analysis:

- **integration** between sample **50** and sample **120**
  → **dE**

- **normalization to path length**

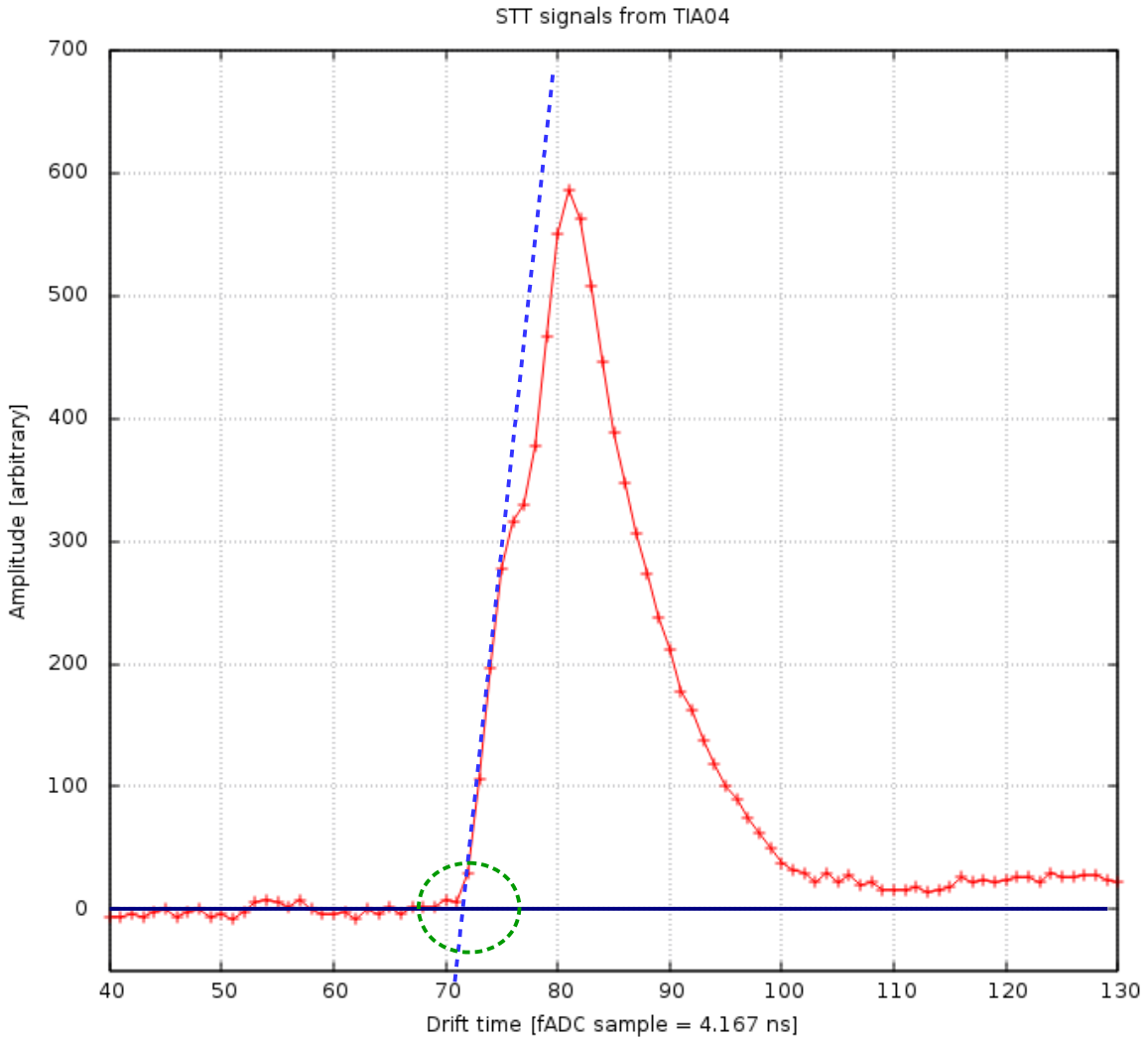
- **truncation mean**

Time estimation – Zero Crossing Time



On the leading edge derivative checked until it starts to decrease

Time estimation – Zero Crossing Time



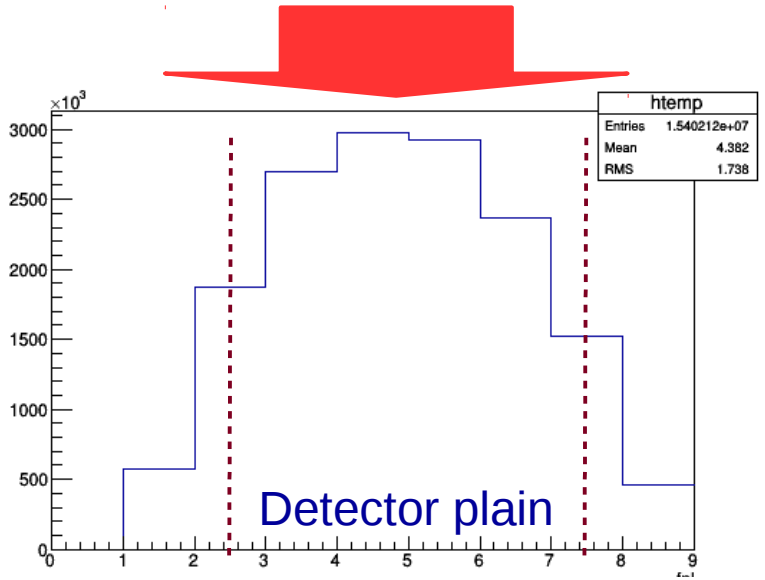
On the leading edge derivative checked until it starts to decrease

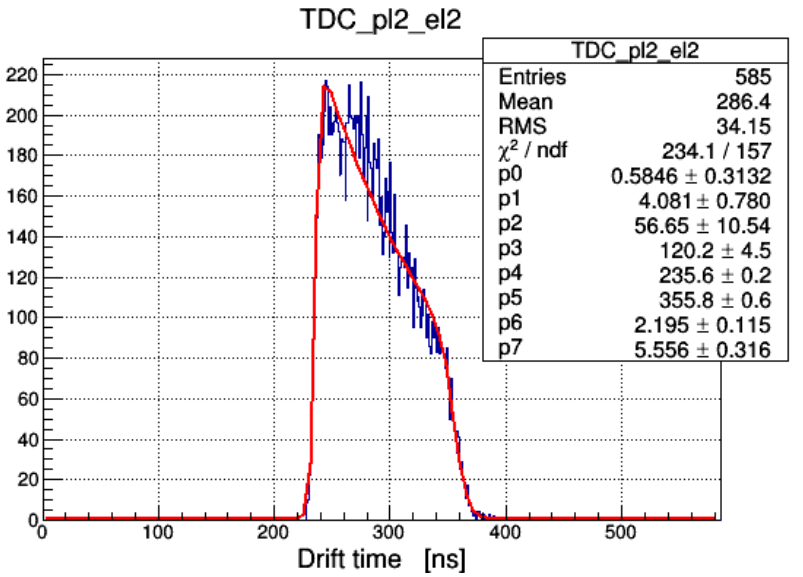
then

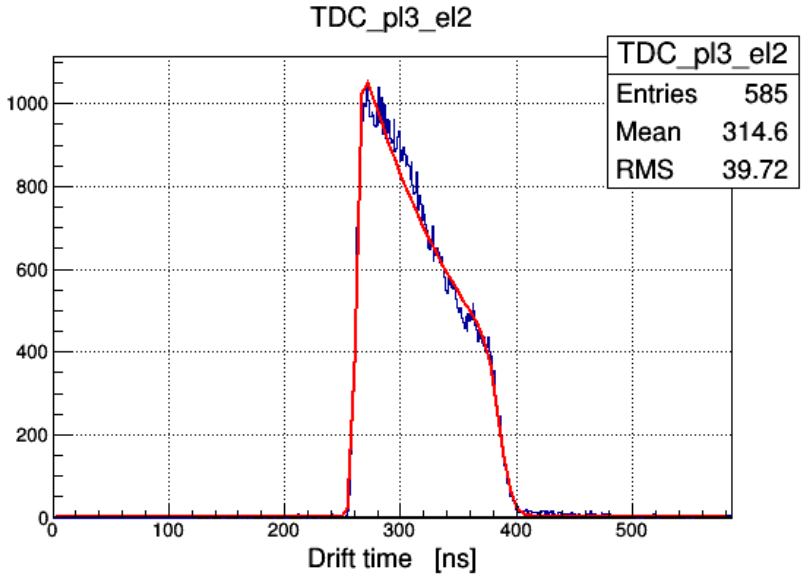
at the highest steepness of leading edge straight line fit

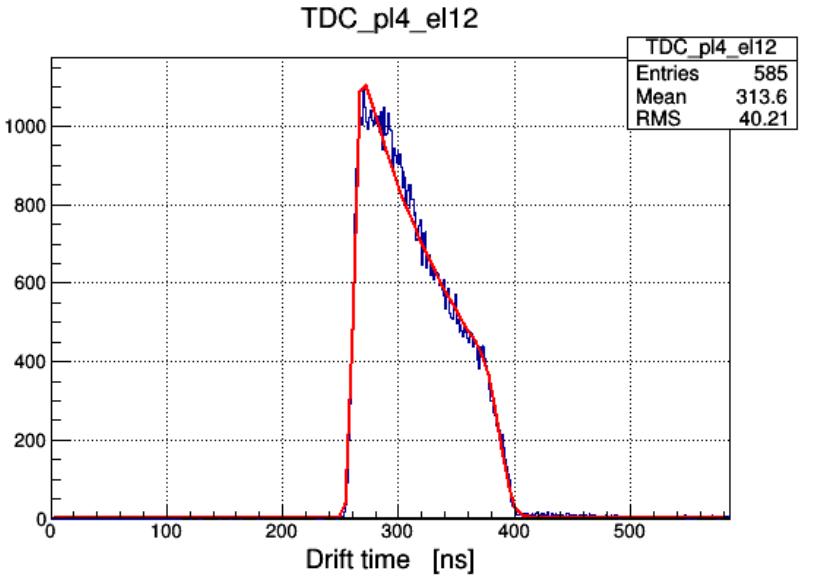
→ **Zero Crossing Time**

Drift time spectra









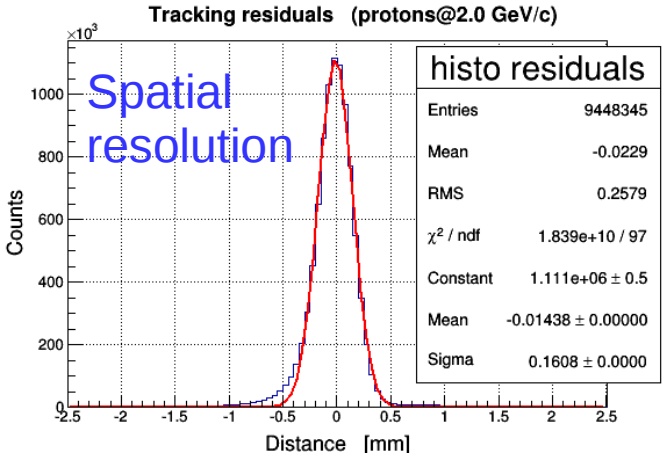
Preliminary results

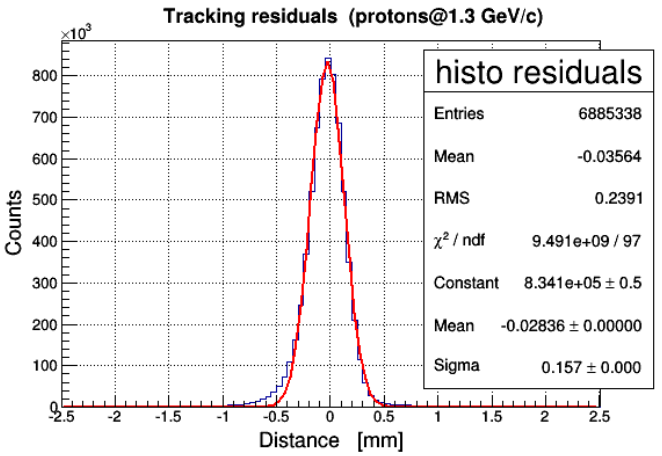
2.0 GeV/c

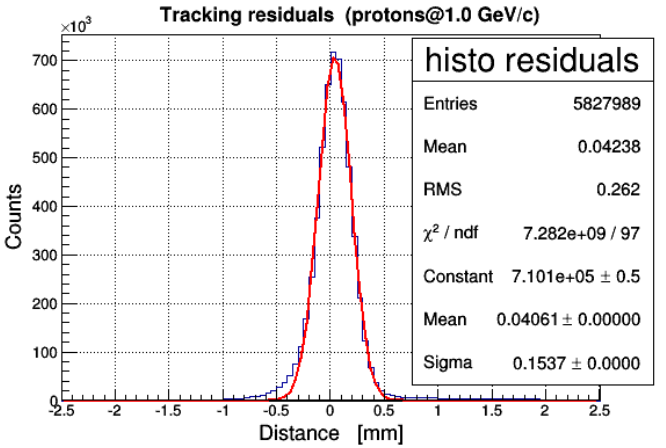
1.3 GeV/c

1.0 GeV/c

Spatial resolution







Energy resolution