Status of FTS
CA Track Finder

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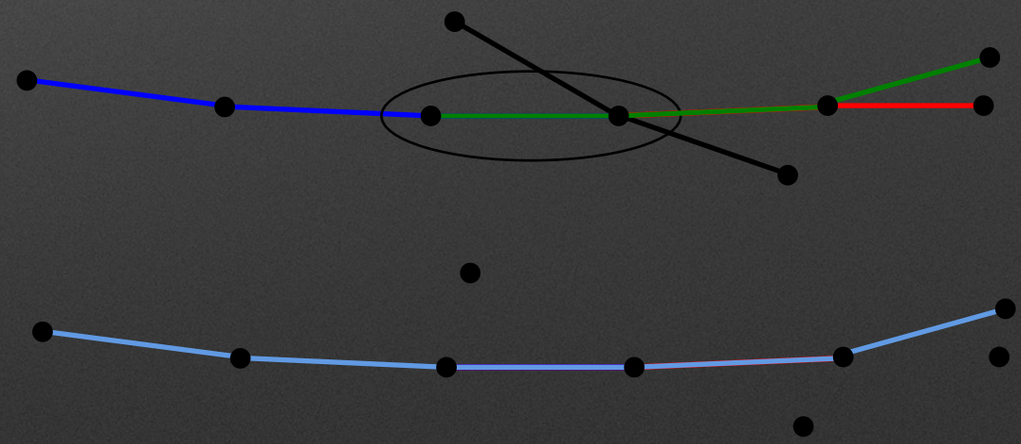
Outline

- Introduction
- Kalman filter track fit for Cellular Automaton Track Finder:
  - Magnetic Field Fit (Polynomial extrapolation)
  - Track extrapolation in non-homogeneous field regions
  - Kalman Filter update for FTS detector-specifics (tube measurements)
- Status & Results
- Summary

Cellular Automaton Track Finder

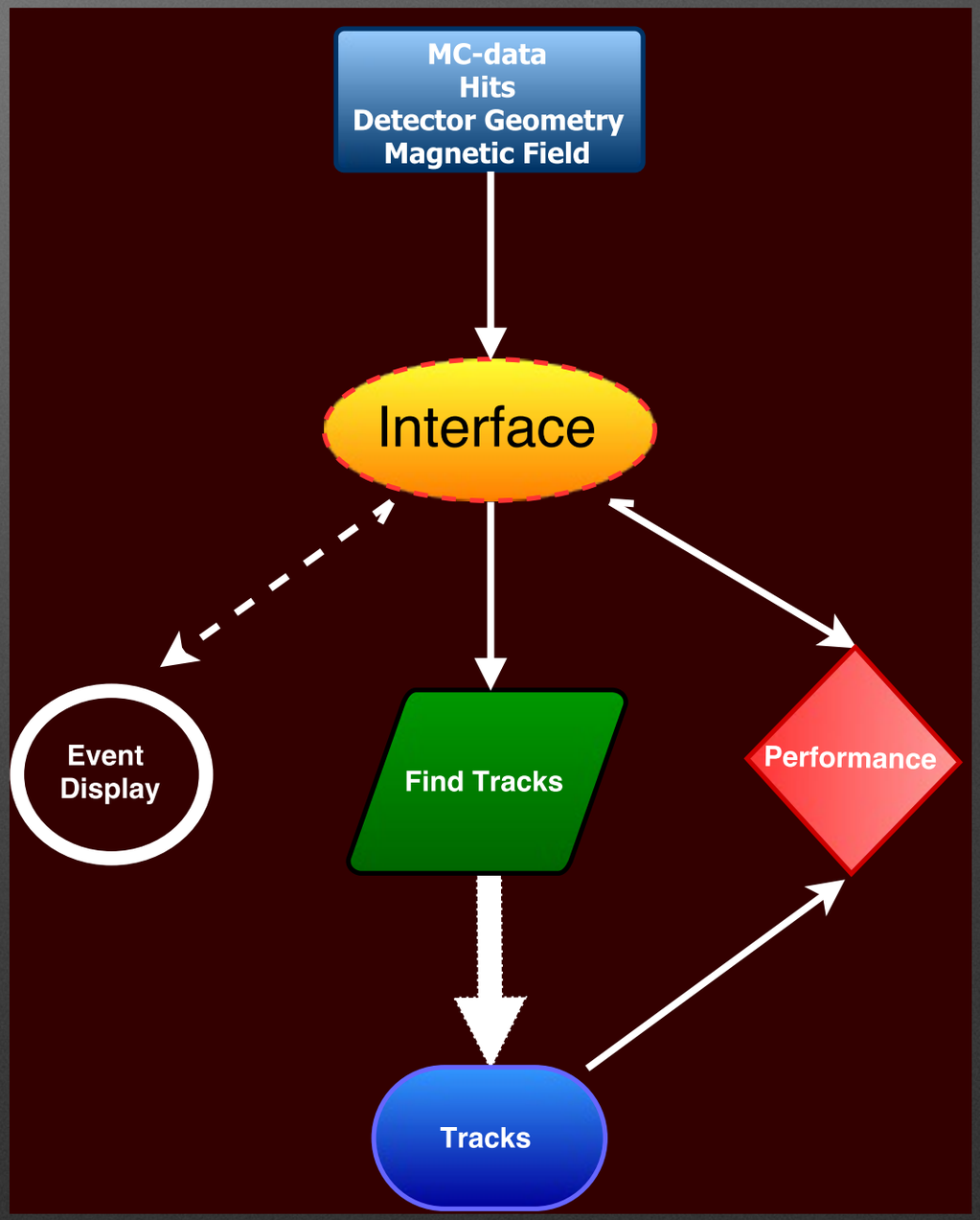
* **Input/Initialisation** (MC-info, hits, magnetic field, detector geometry etc.)
* **Track-segment construction**
  - Singlets
  - Doublets
  - Triplets
  - ...
  - N-plets
* **Evolution**
  - Neighbour Search
  - Track Construction
* **Performance evaluation**

* Estimation of Track Parameters
  - Kalman Filter
  - Extrapolation (to station position)
  - Update (using hit-measurement information)



Package architecture

- Interfaces for CA track finder + QA within PandaRoot
- Event Display for debugging purposes and visualisation
- Vectorised code:
  - Suitable for fast analysis of big data streams

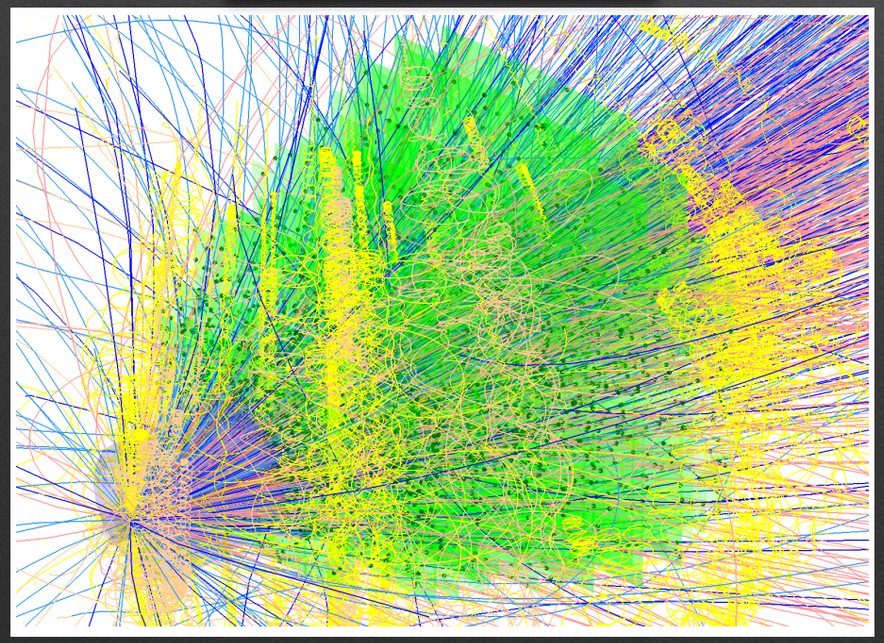


Track fit in inhomogeneous magnetic field

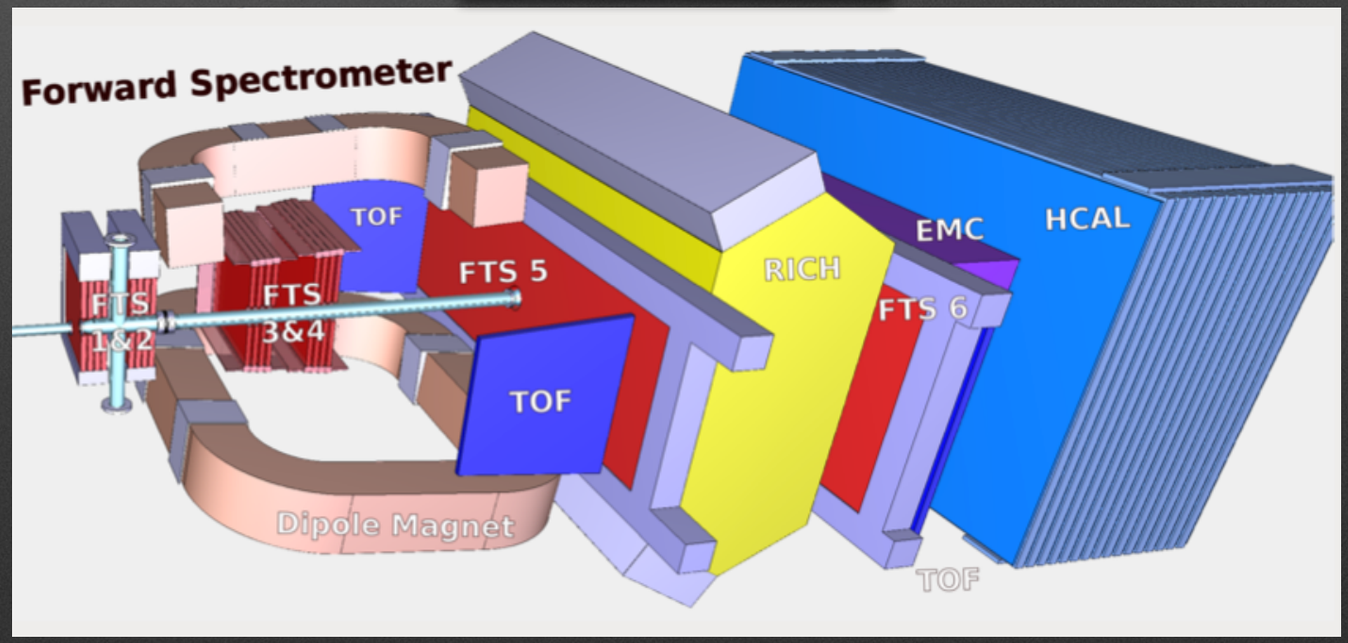
Track fit for PANDA FTS is similar to the STS CBM fit: dipole magnetic field, strip-like measurements, complex material structure. Fit from CBM STS is adapted for FTS:

- Magnetic field is approximated.
- Analytic formula based on the Taylor expansion is used for extrapolation.
- Each tube is added independently by the Kalman filter method.
- Fit is vectorised.

CBM STS

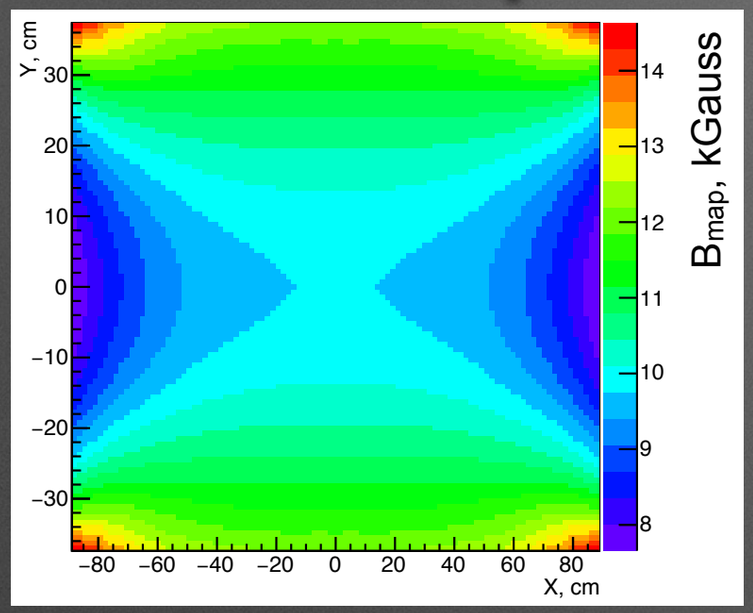


PANDA FTS

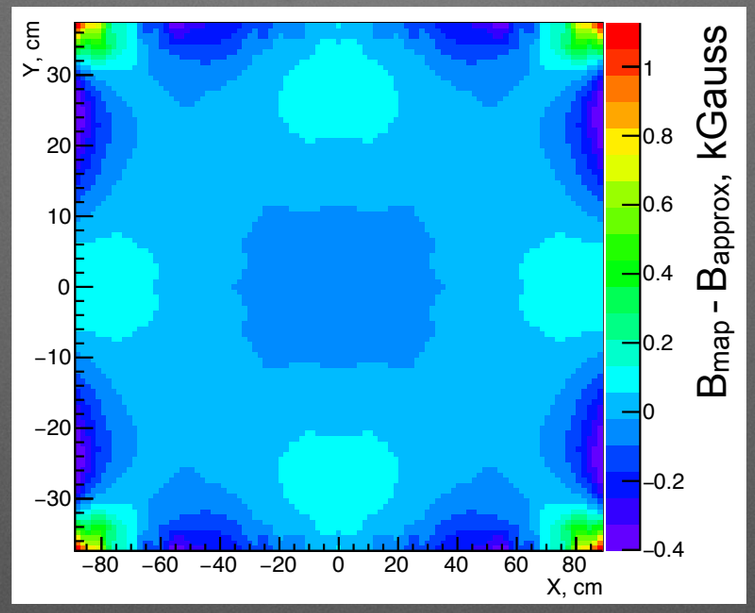


Magnetic Field Approximation

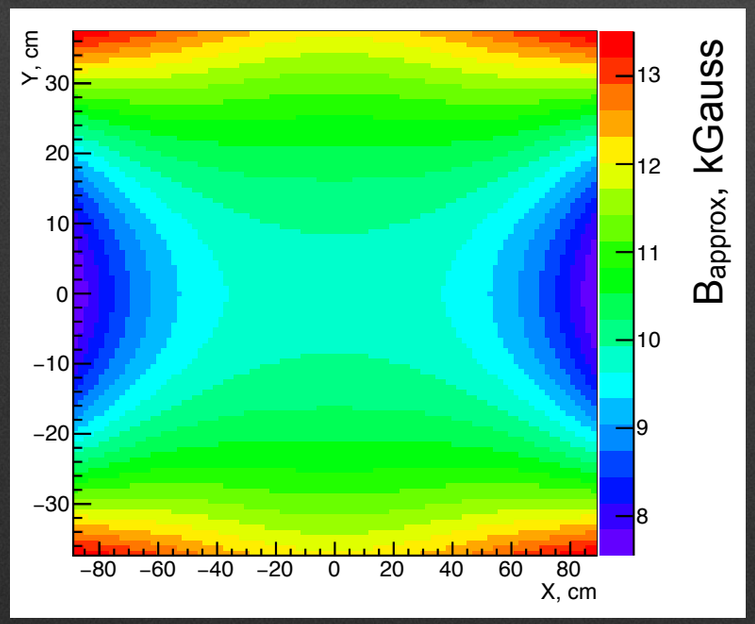
Field Map



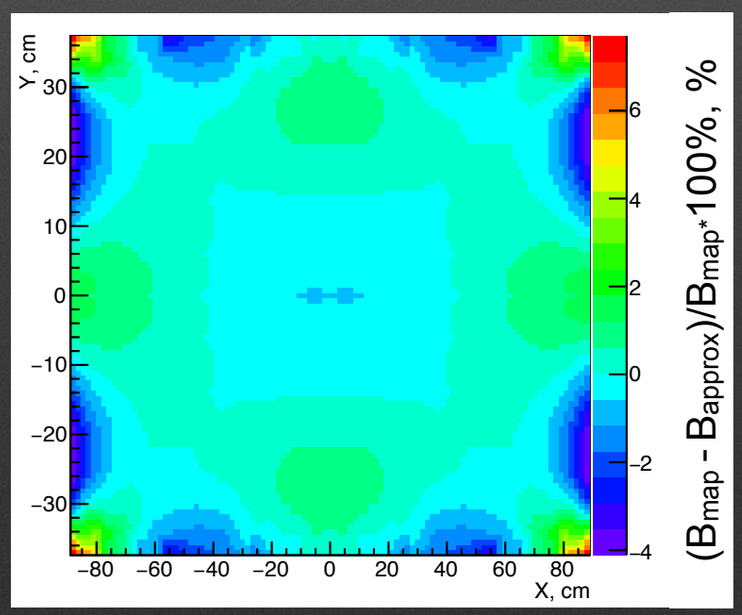
ΔB, kGauss



Approximation (5th order polynomial)



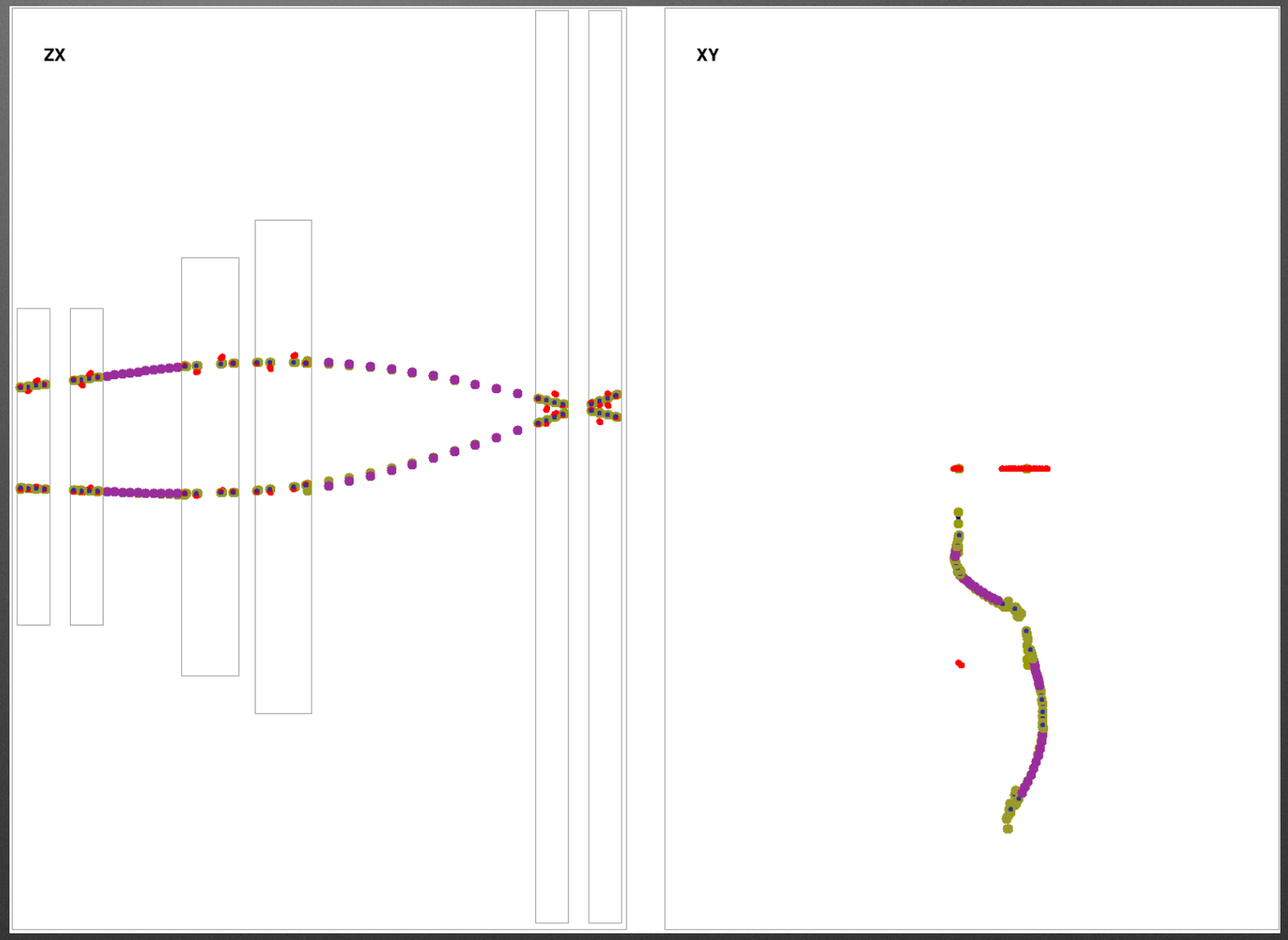
ΔB, %



- Magnetic field is approximated at each station in the XY-plane
- Approximation allows to reduce the required data volume to fit the cache size.
- Allows to vectorise code efficiently, thus providing additional speedup of the code.

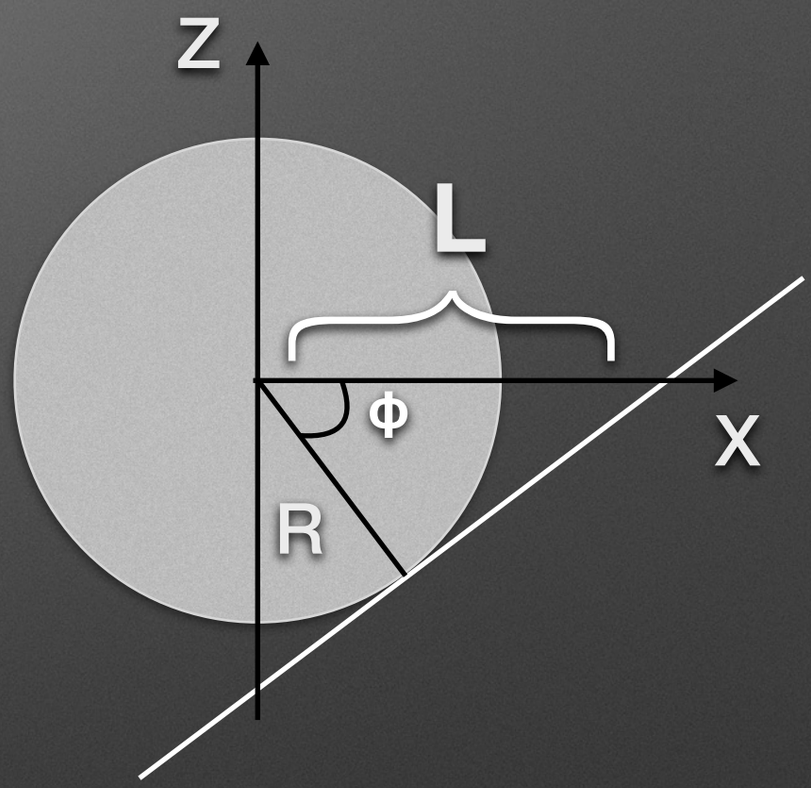
Field approximation along track

- Between stations each component of the magnetic field is approximated with a parabola alongside the track by 3 nearest hits.
- For precise extrapolation of tracks in the regions with highly inhomogeneous field (before and after magnet) array of 10 planes each are created and used.

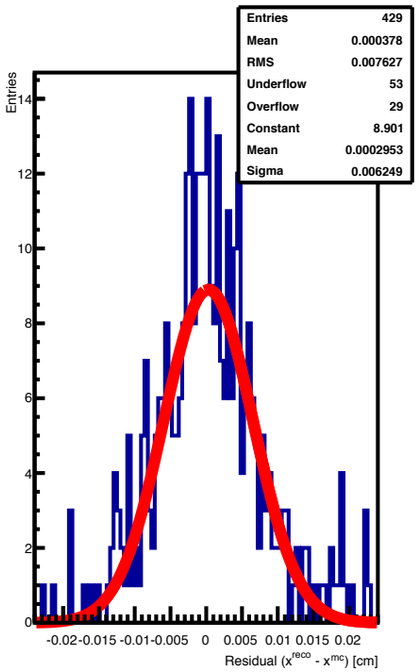


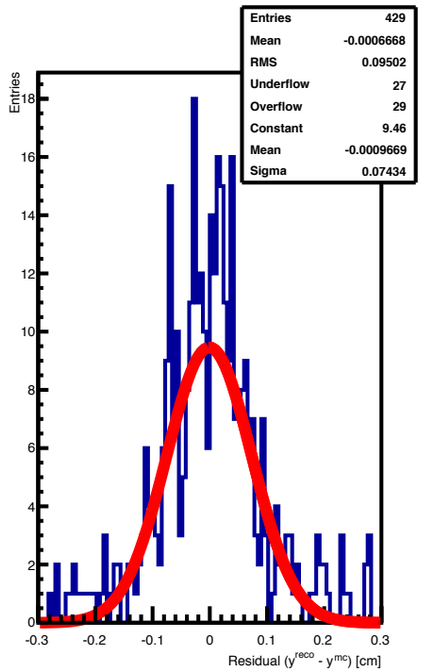
Kalman Filter with tube measurements

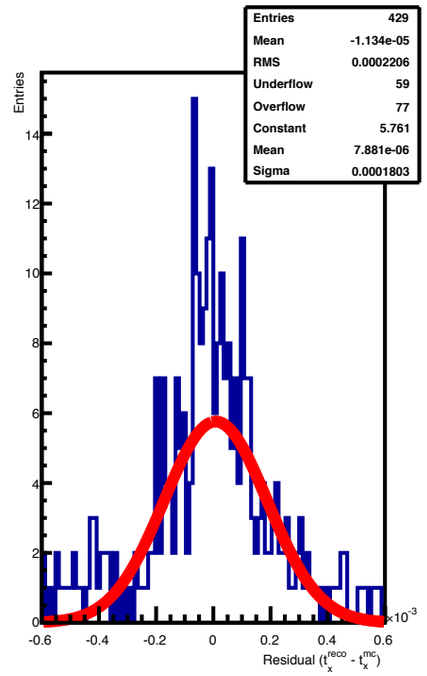
- The Measurement model for strip-like measurements: H = {cos a, sin a, 0, 0, 0} (a - angle between tube and OY). Each tube is filtered independently.
- Track parameters should be obtained at the position of the measurement.
- Since track parameters are obtained not at the position of the measurement but at the z-position of the tube centre, measurement (r) should be corrected: L=R/cos(ϕ)

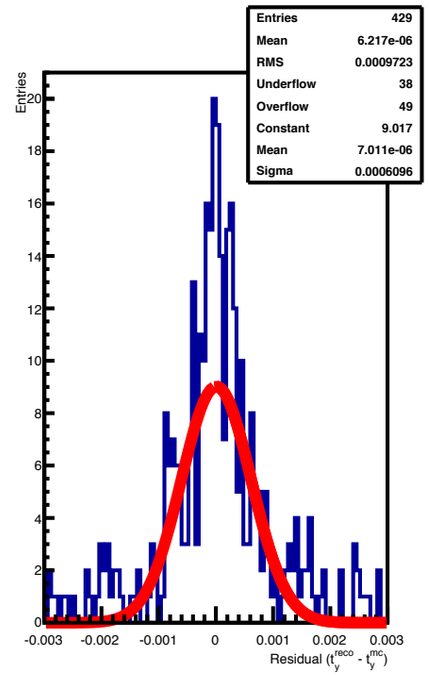


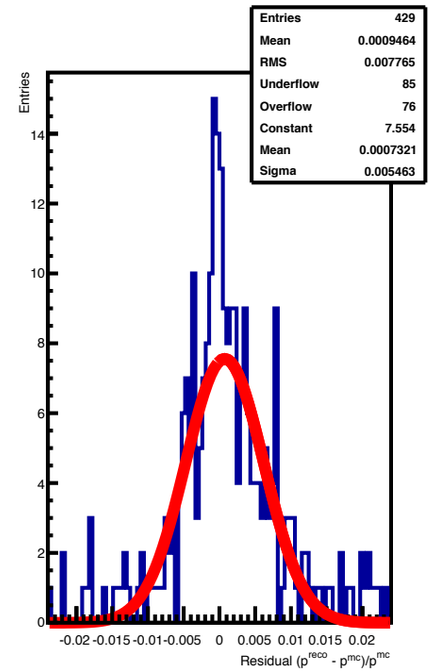
Residuals & Pulls for Standalone

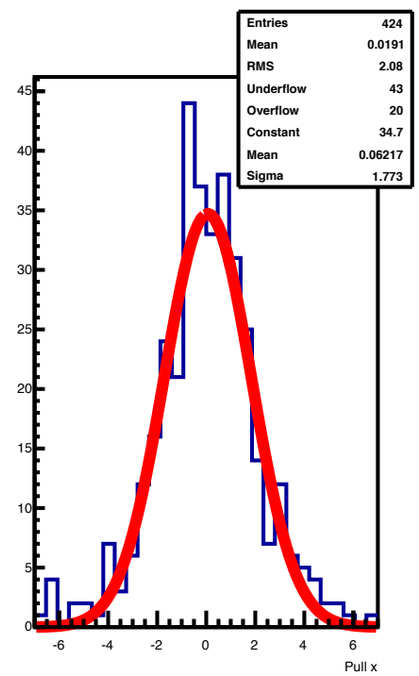


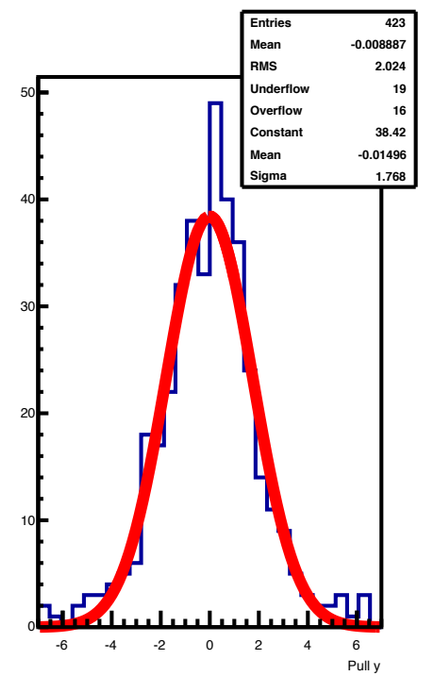


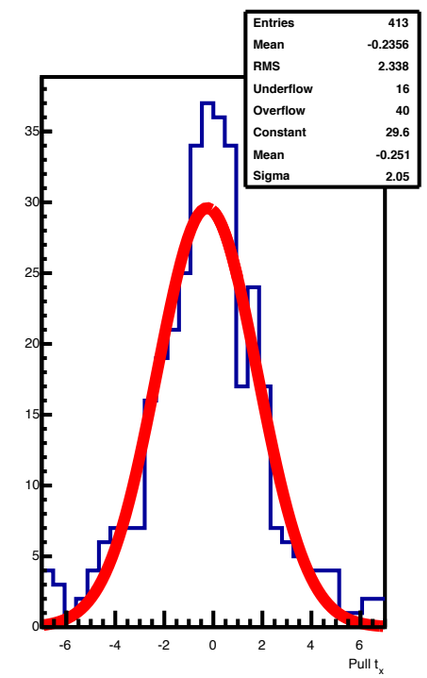


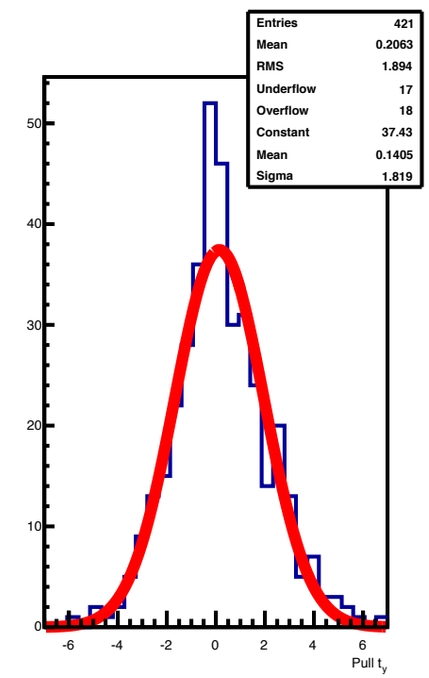


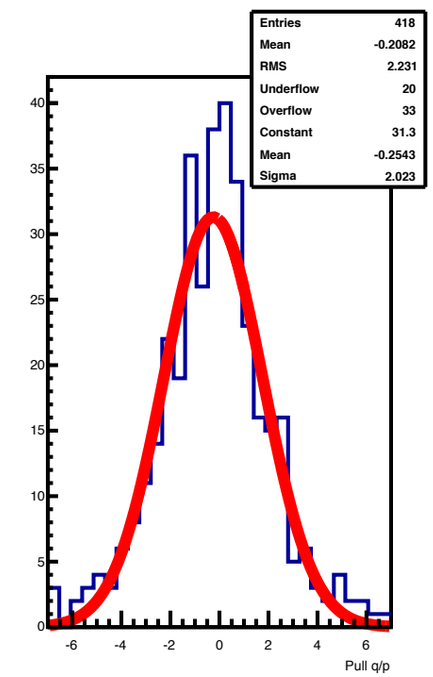




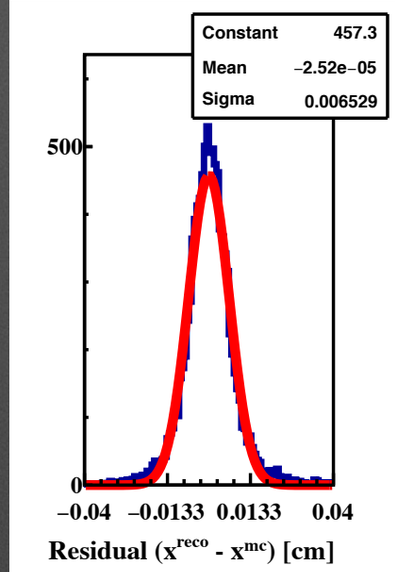


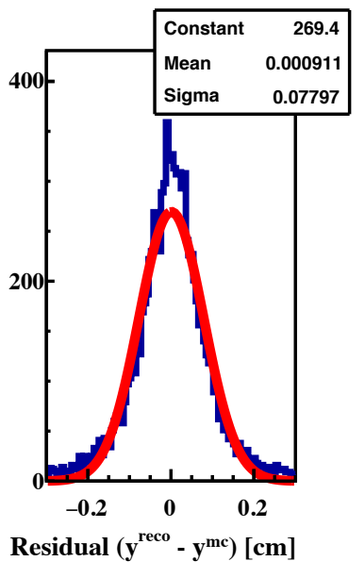


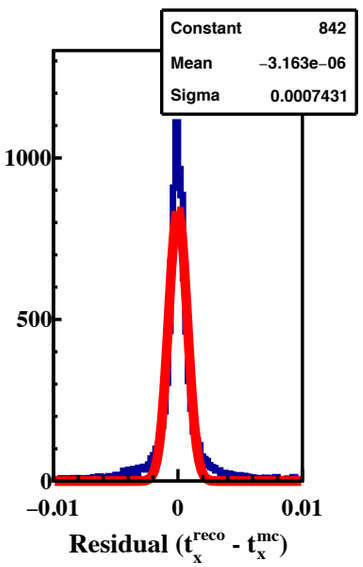


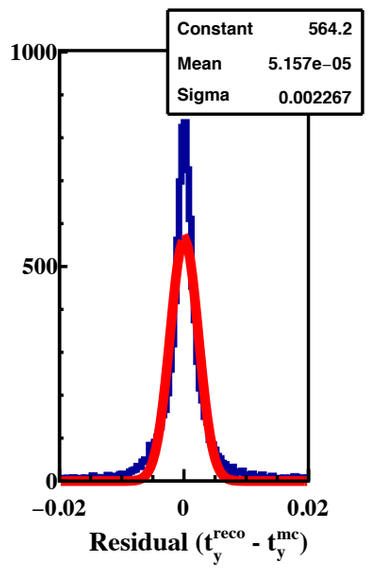


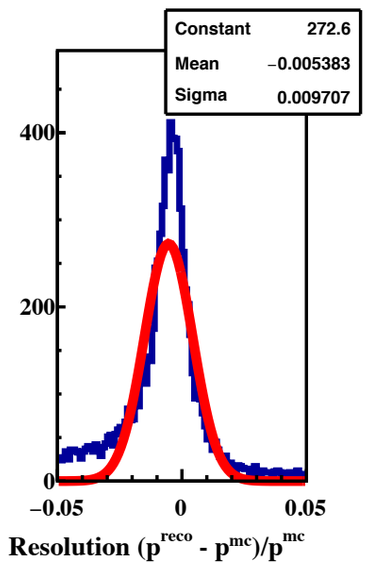
Residuals & Pulls for FTS Track Finder (PandaRoot)

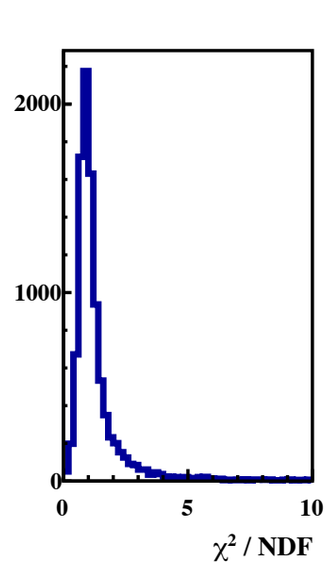


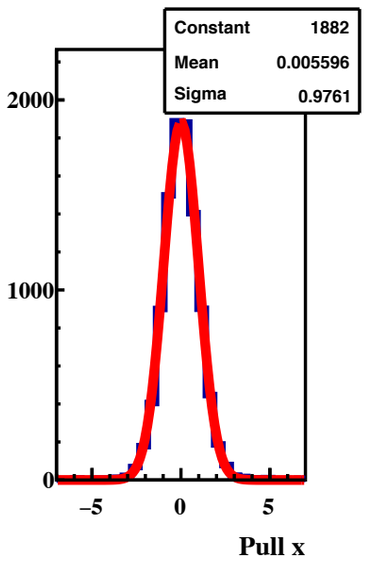


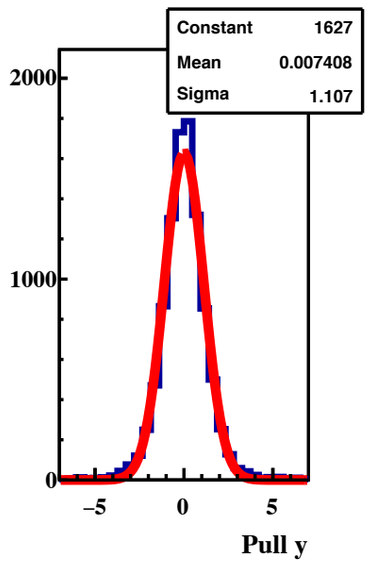


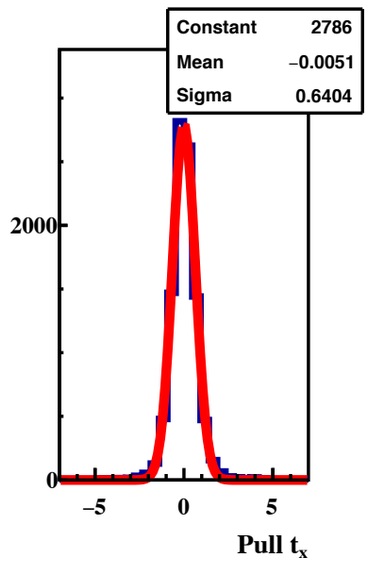


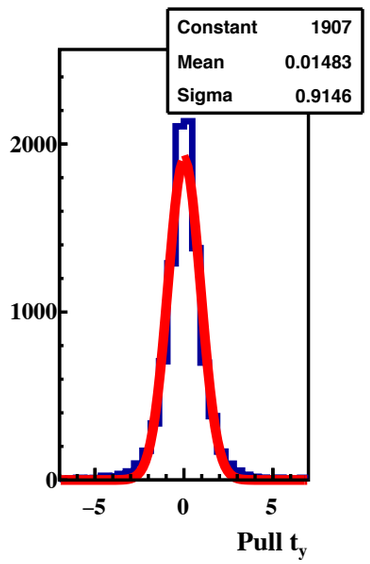


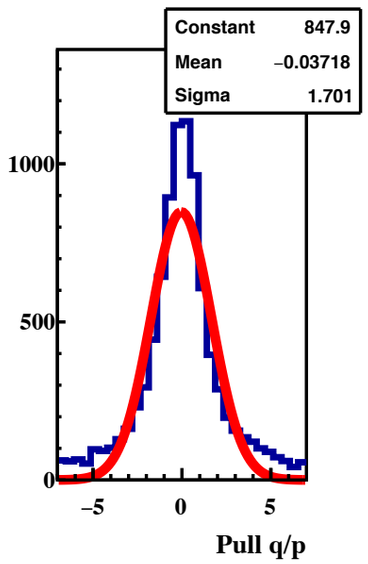


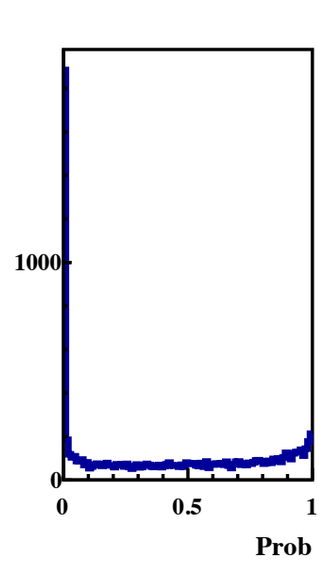










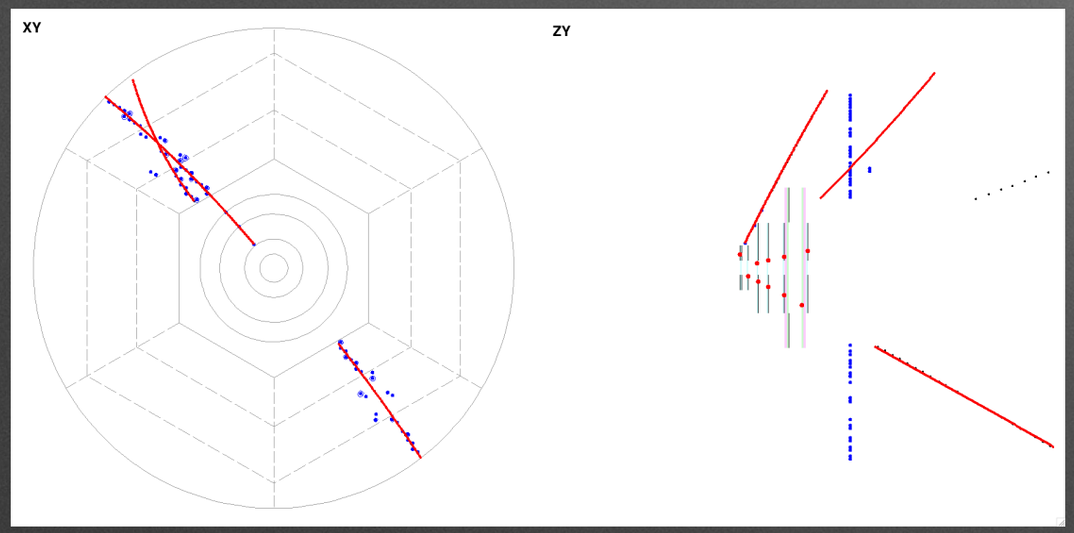


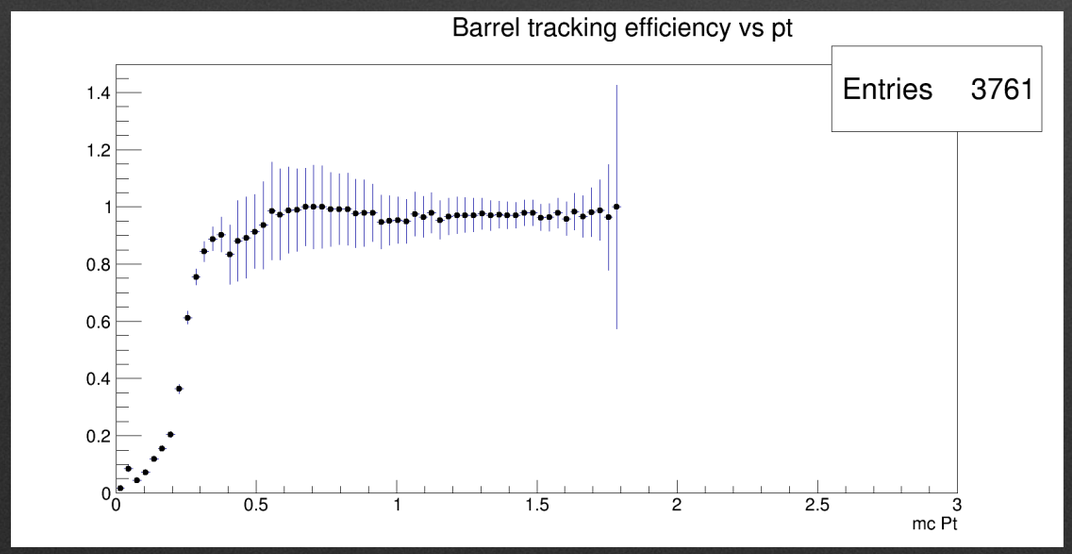
- Correct pulls and χ2 distribution.
- Pulls are not ideal and peak at 0 in prob due to the approximate material budget.

Plans for CA Track Finder

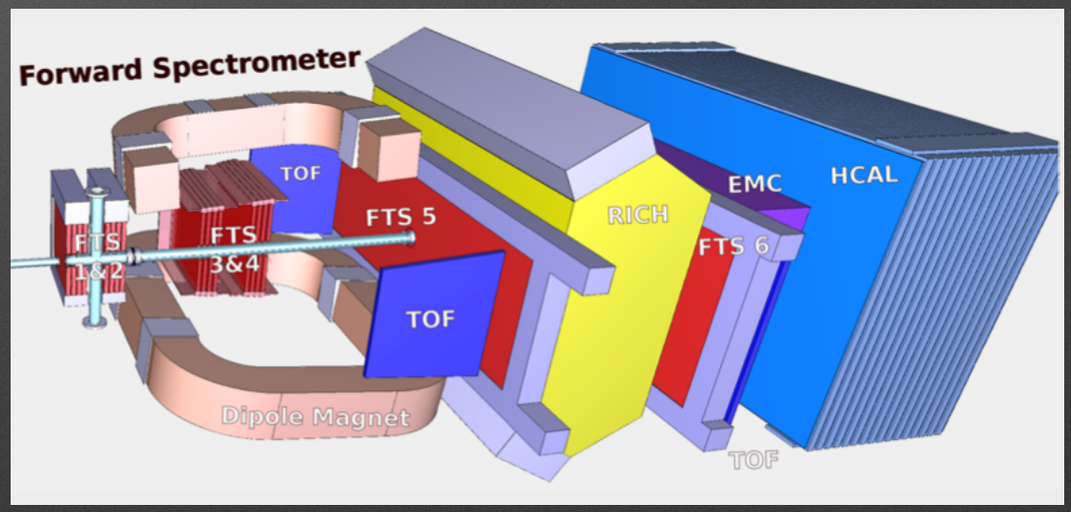
- With improved track fit the CA method can be further developed.
- FTS measurements are similar to STT: STT CA track finder can be applied to FTS

Barrel part





Forward part



Current Status

Functionality	Standalone	PandaRoot
Interface	+	+
Event display	+	+
Performance analysis	+	+
Fit (inhomogeneous field)	+	+
Reconstructed tracks	+	in progress

Summary

- The FTS standalone track finder was adapted to the PandaRoot framework.
- Interfaces to run the integrated into PandaRoot CA package + QA are developed & debugged.
- Kalman filter based track fitter is implemented for the inhomogeneous magnetic field and shows correct results.
- Track finder for the forward part is in progress.