CDC calibration for GCR 2017

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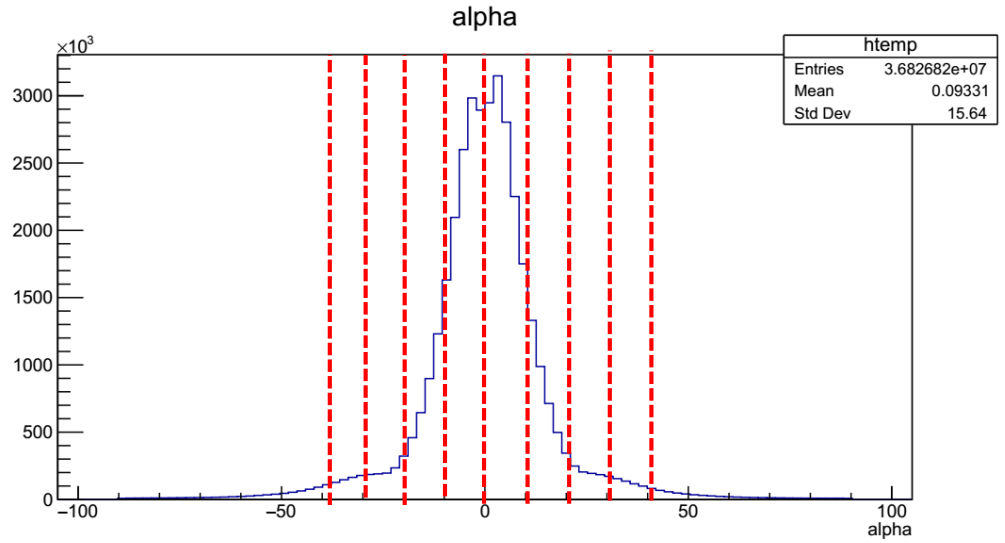
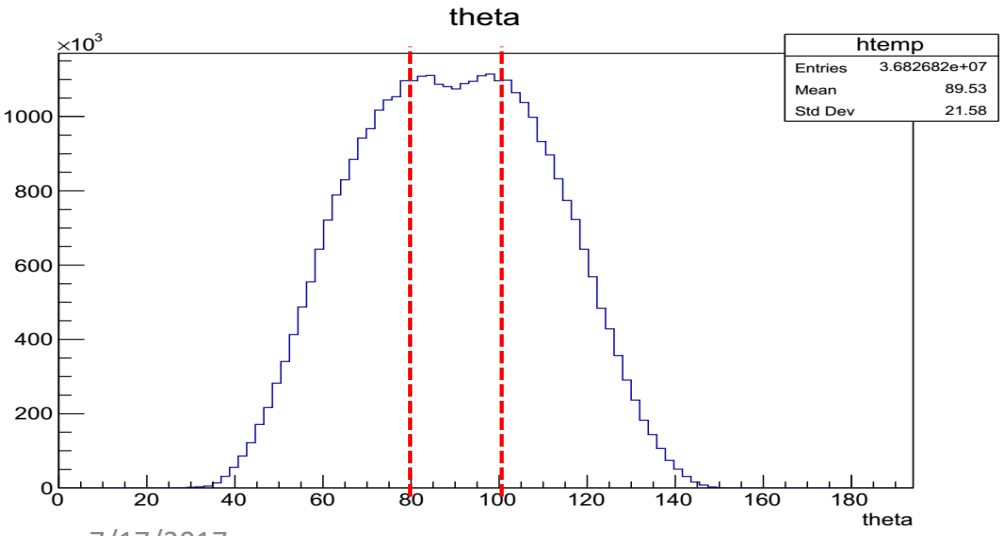
information

- Data used for calibration: run 3085 to run 3218.
  - 2M events.
  - Taken from 3rd ->7th, July. (1st week of GCR)
  - Trigger: TSF2 back-to-back & ECL timing.
- Data used for validation: run 3260-3370
  - ~1M events
  - Taken from 10th ->14th , July. (2nd week of GCR)
- Initial parameters:
  - Shift t0 from March data ~+100ns.
  - tw, alignment, sigma, from March data.
  - Xt_v3_Chebyshev.dat.gz
- Event selection for calibration:
  - Pt > 0.8Gev
  - Successfully extracted event T0.

Alpha, theta binning for xt

Xt = f(layer, left/right, alpha, theta)





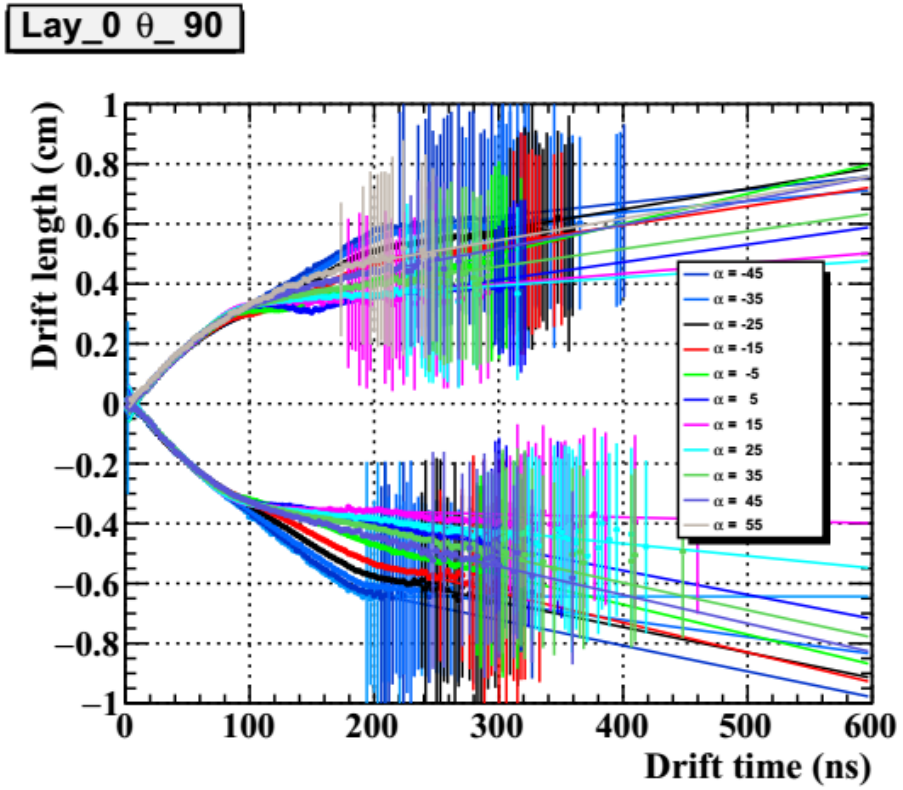
- Alpha (incident angle):
  - Every 10 deg.
  - Total 18 bins.
- Theta (polar angle): 3 bins
  1. [0;80] represented by 60
  2. [80;100] represented by 90
  3. [100;180] represented by 120

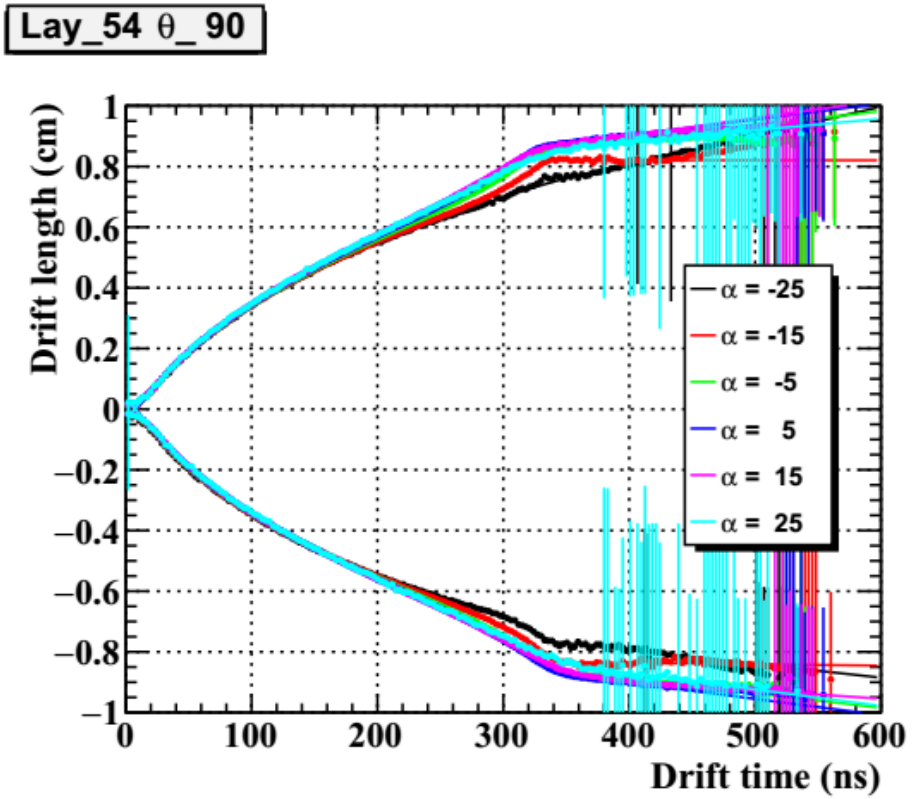
=> Total: 6048 xt functions

- Since TSF back-to-back worked well, so we don't have data for larger alpha. ~60% xt functions aren't calibrated.

Time to space (x-t) calibration

- 5th order Chebyshev polynomial(main region) + linear(boundary)
- Xt = f(layer, left/right, alpha, theta)



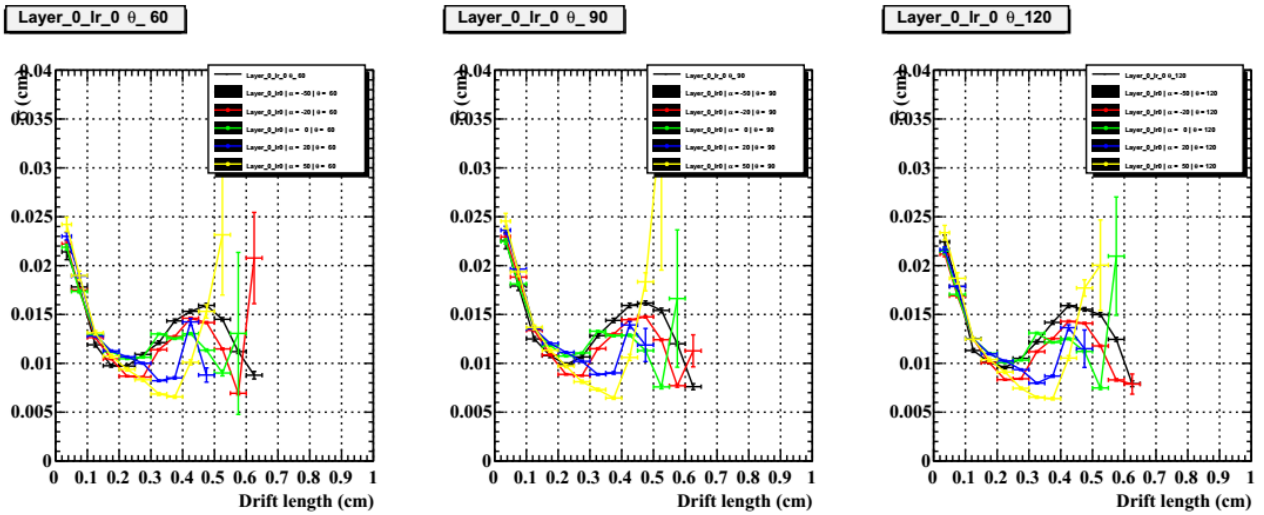


- Inner layer, xt function of ~11 alpha bins from [-45; 45] degree are calibrated for each layer.
- outer layers, xt function of 6 alpha bins are calibrated for each layers.

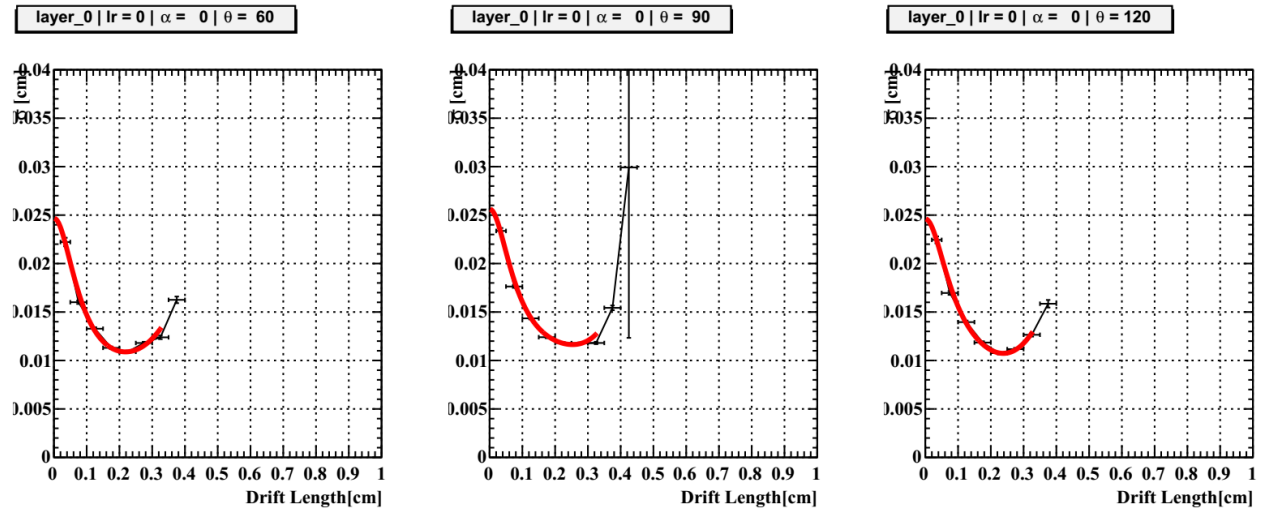
Position resolution

- σ =f(layer, lr, α, θ)
- Position resolution of GCR2017 seem better than data without B-field at some incident angels.

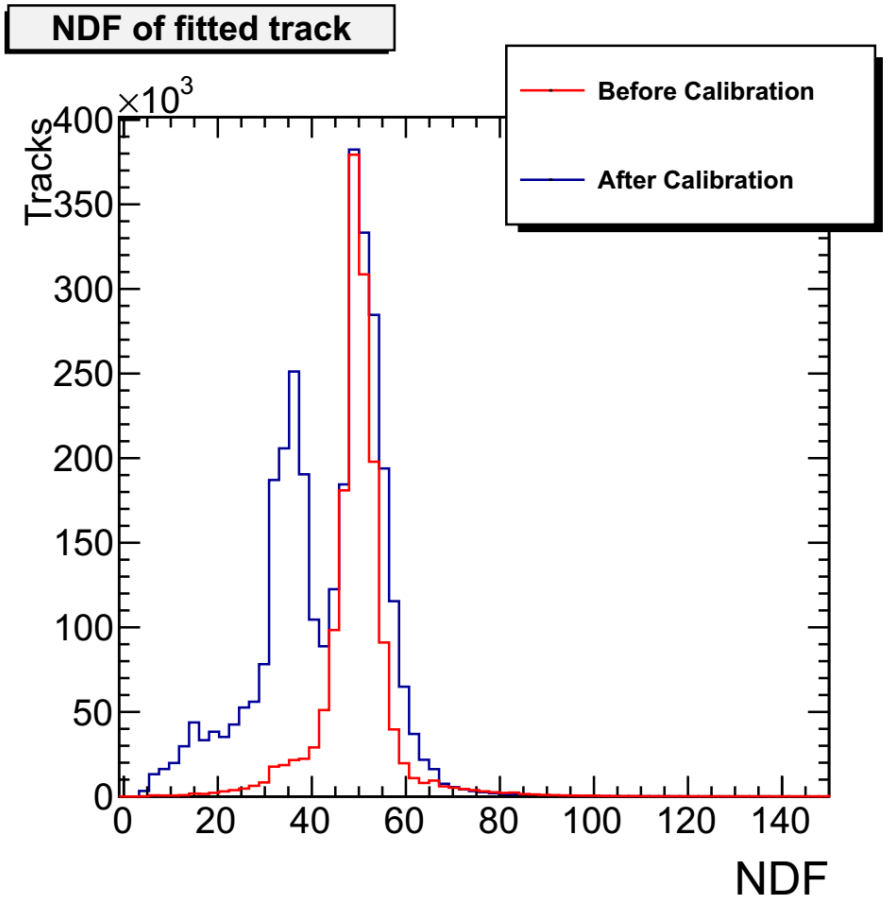
GCR 2017, With B field

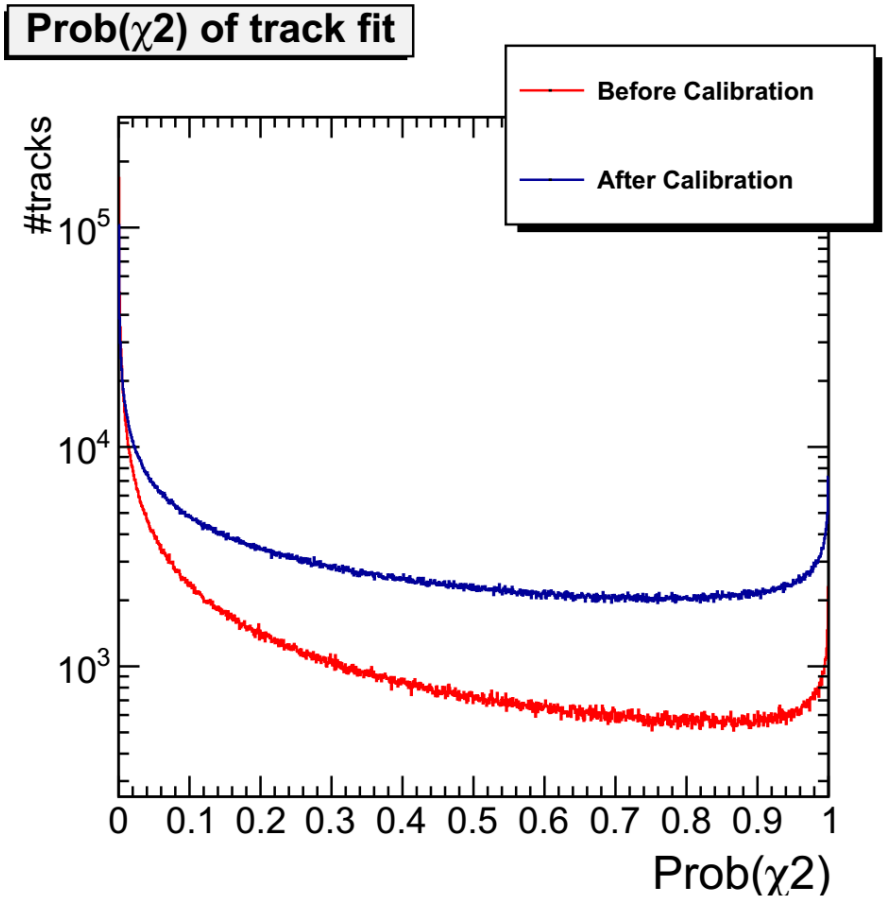


Sigma without B field. (default sigma for CDC simulation)



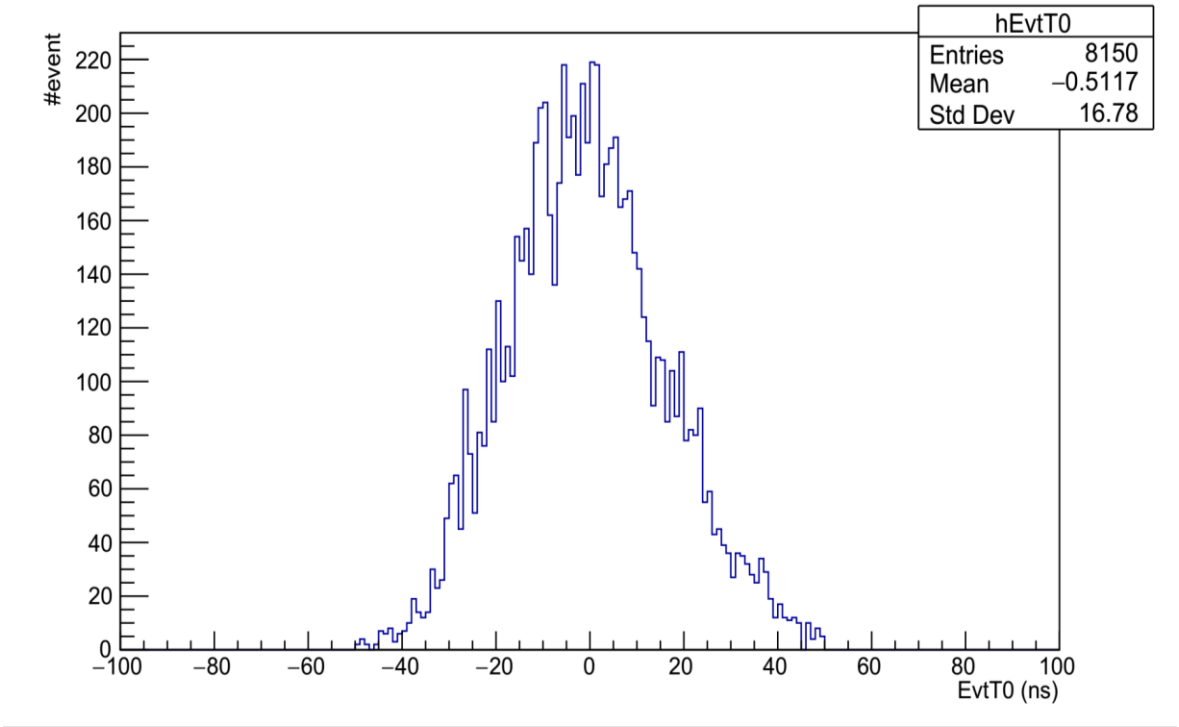
Results of calibration





- After calibration, tracking efficiency increase significantly. P-value is almost flat

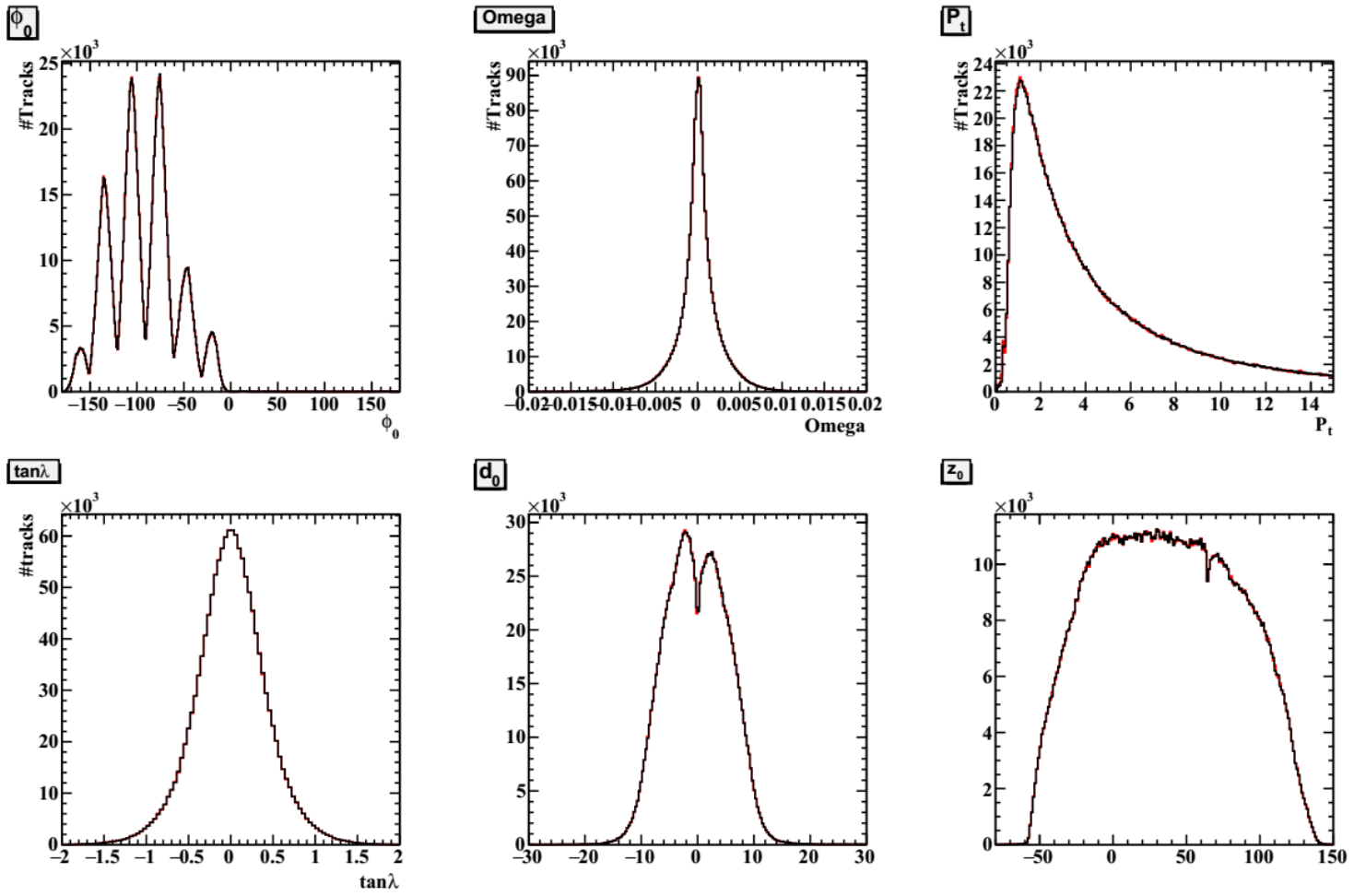
Event T0 distribution



- Search range during calibration: [-50,50]ns, event which is failure to extract t0 didn’t use in calibration.
- To reduce consuming time, analysis can set the range [-40,40]ns, We lost small amount of events out side this range, but speed will be increase.

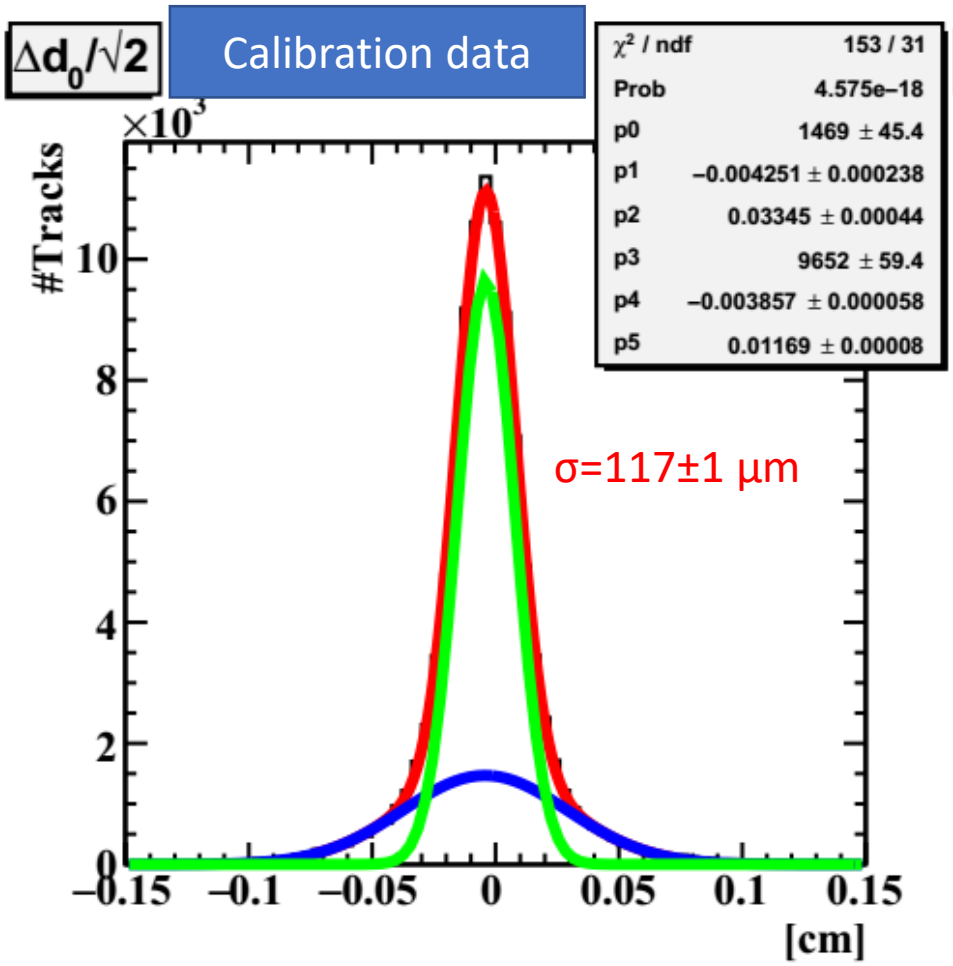
Track parameters

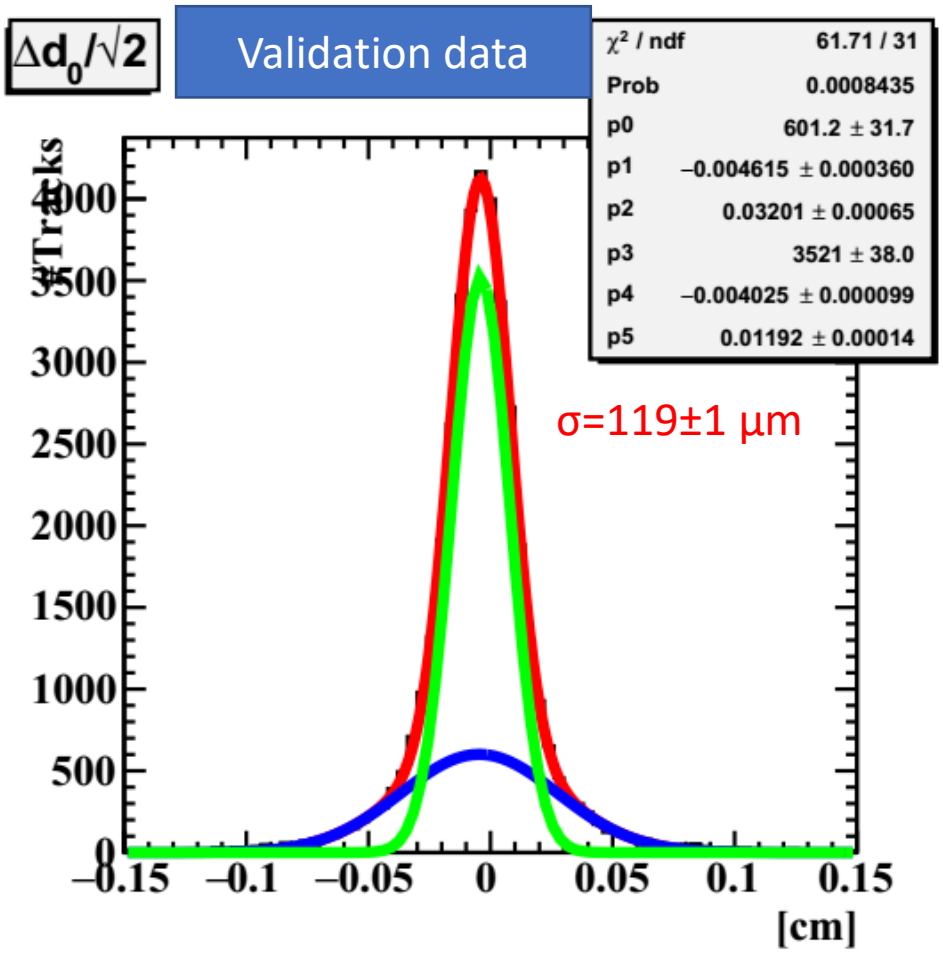
- Rejected events which are opposite direction at perigee point



Performance study (d_0,z0,Pt,ϕ_0,tanλ resolution), long tracks around IP region are selected: Ndf>25 && $|d_0|$<5 && $|z_0|$<10;

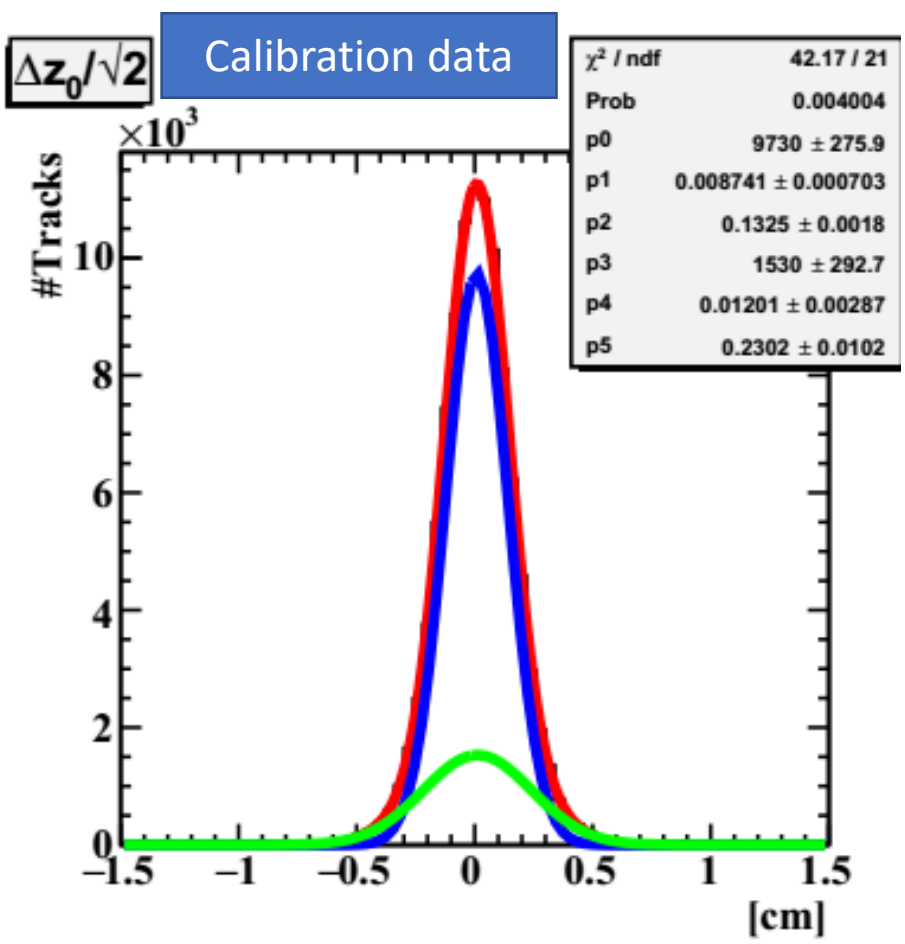
d_0 resolution



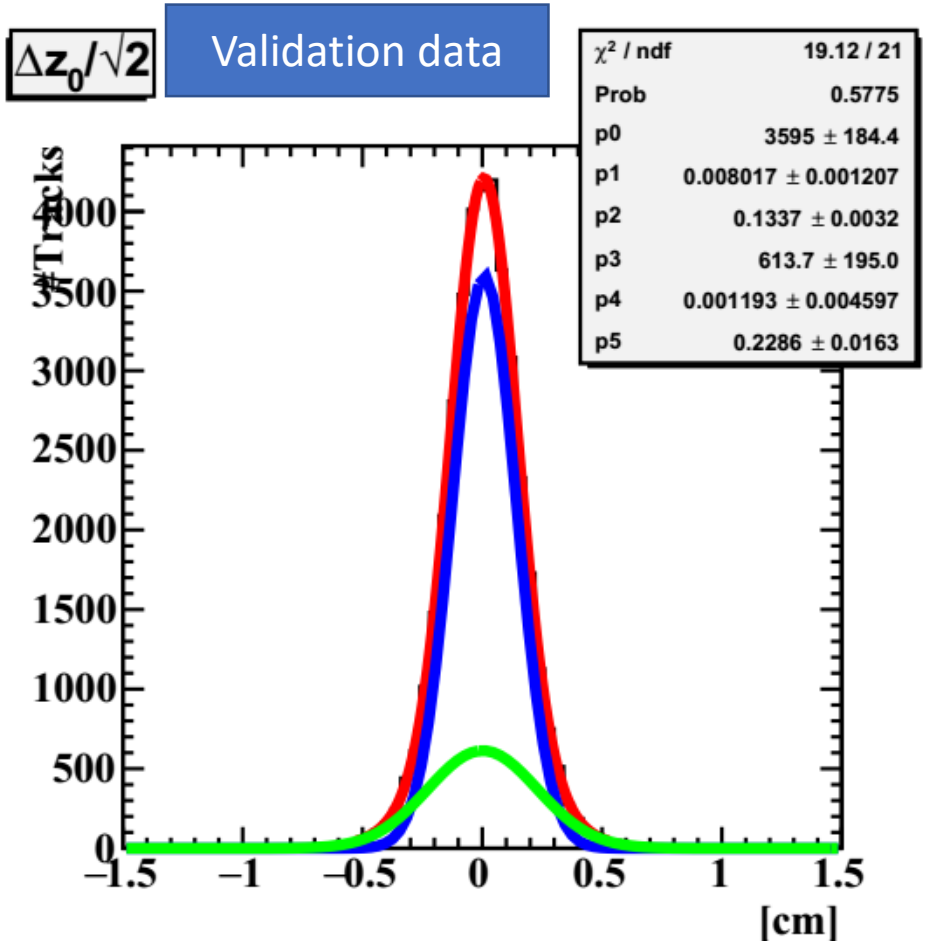


- D0 resolutions are the same between data used for calibration and other data.

Z_0 resolution

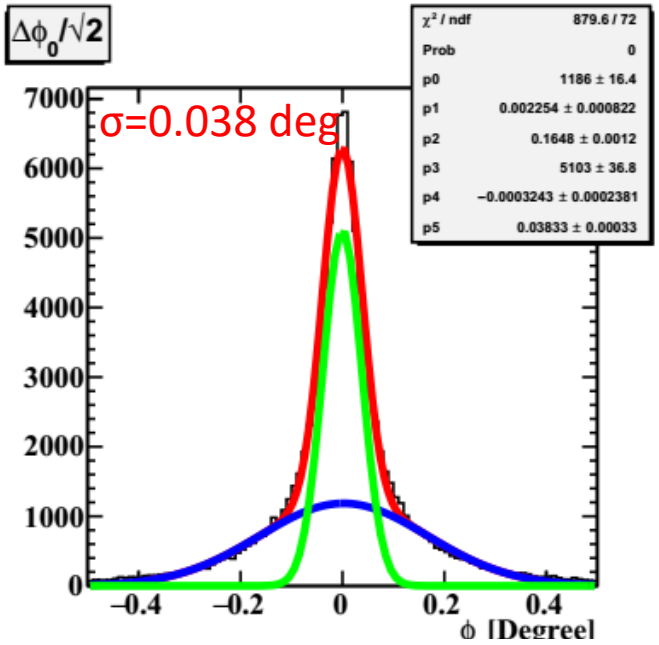


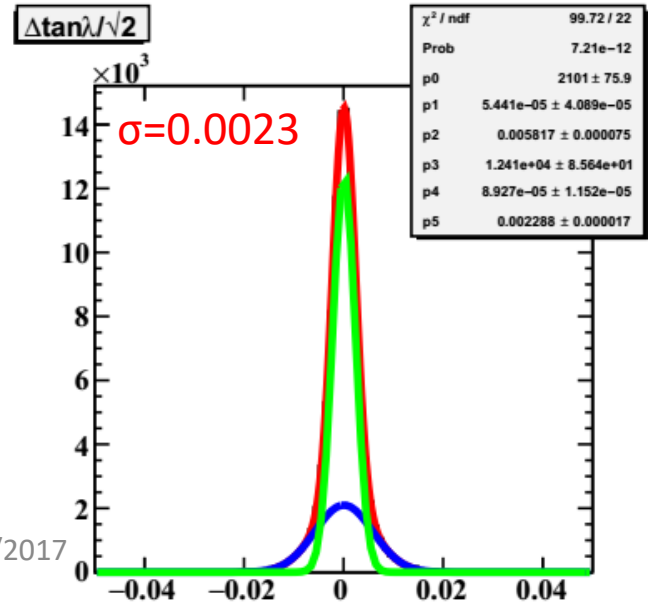
σ=1.33±0.02 mm



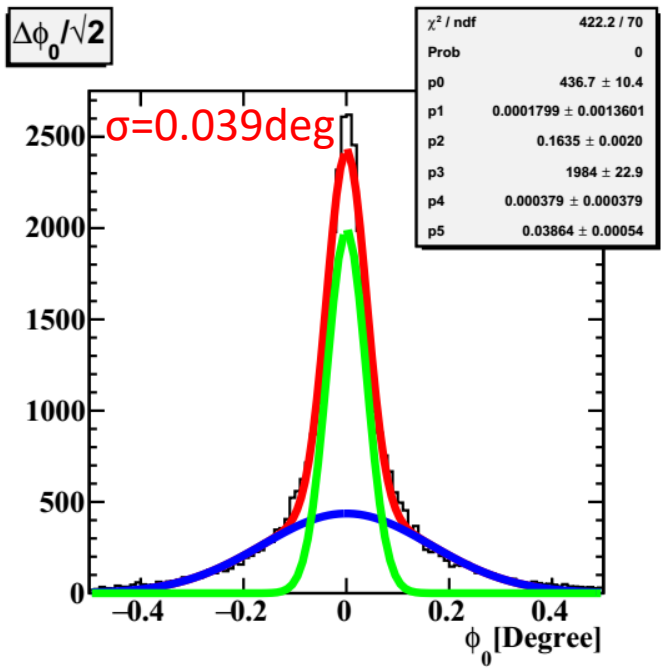
σ=1.33±0.03 mm

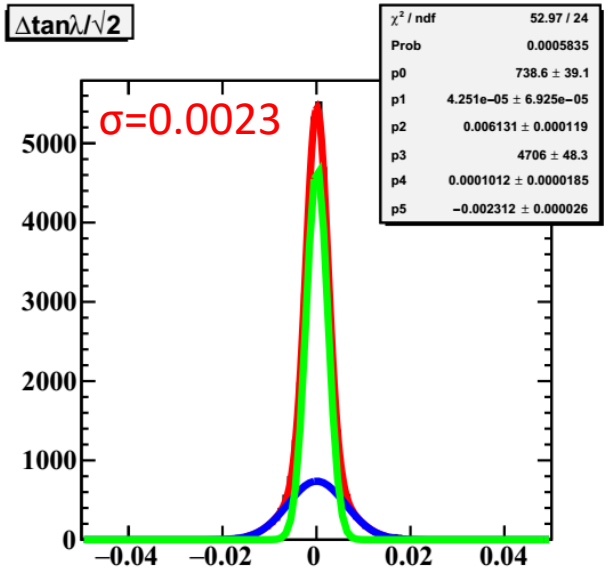
Calibration data





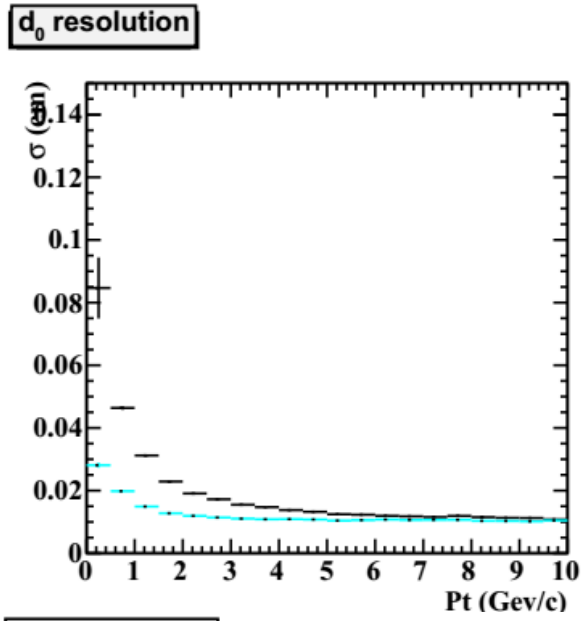
Validation data

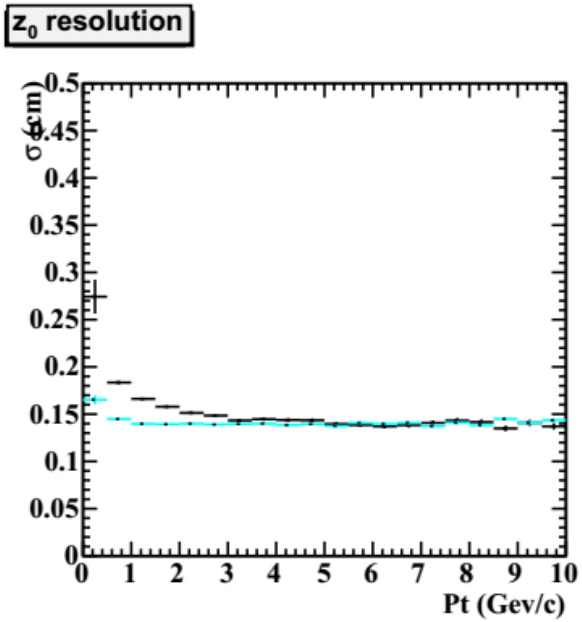


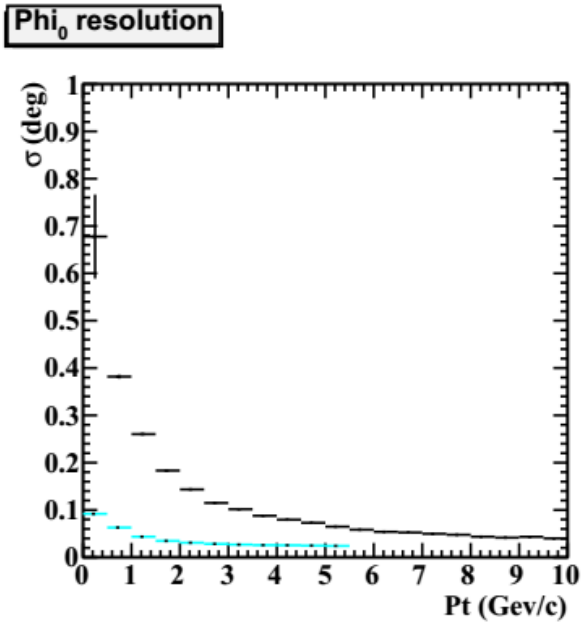


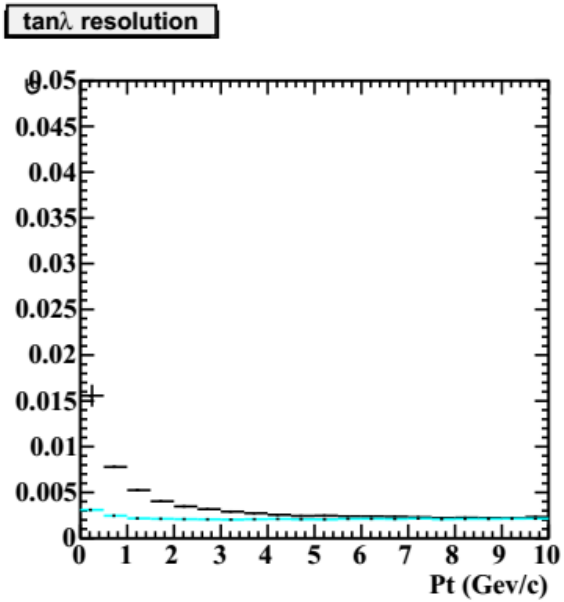
Track parameters resolution as function of Pt.

Black: real data.
Cyan: simulation (default sigma)



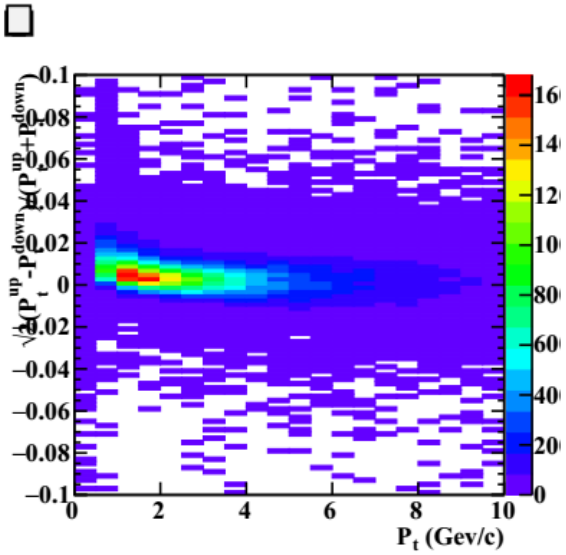


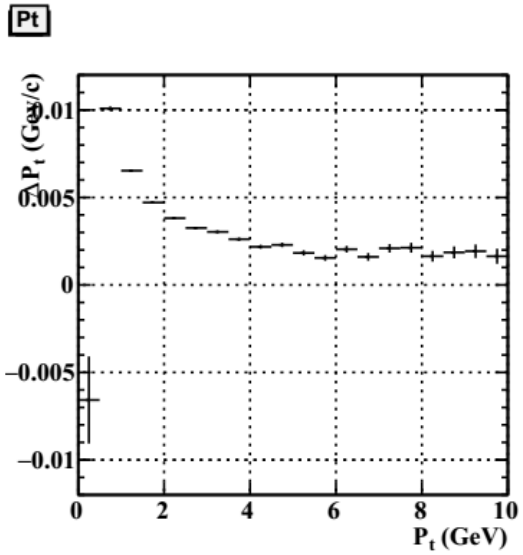


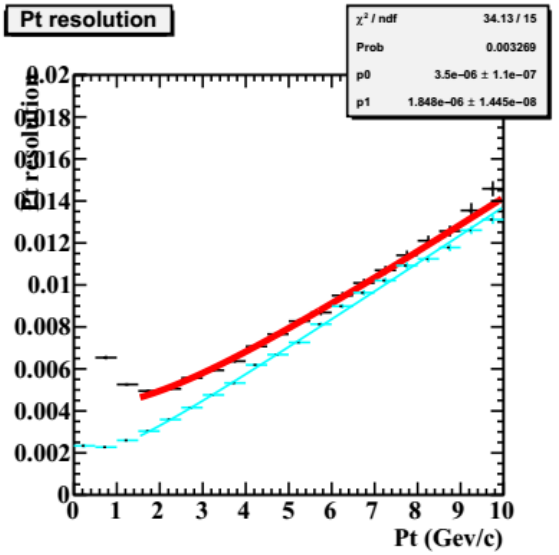


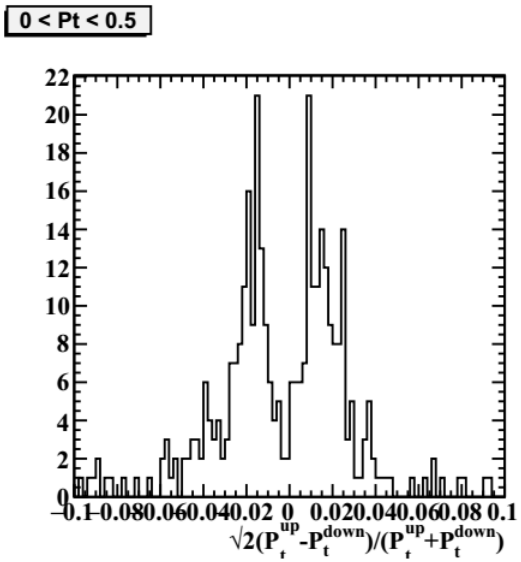
- At high Pt region, real data and simulation are almost same, except ϕ_0.

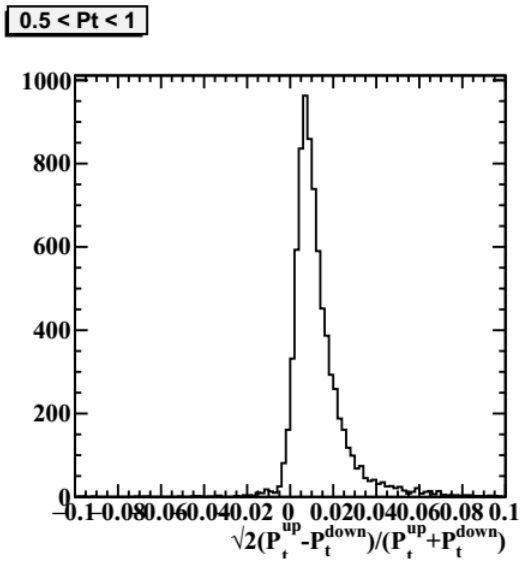
Pt resolution

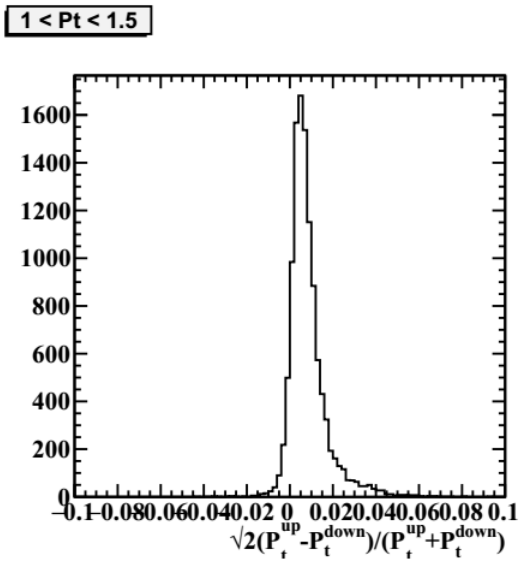






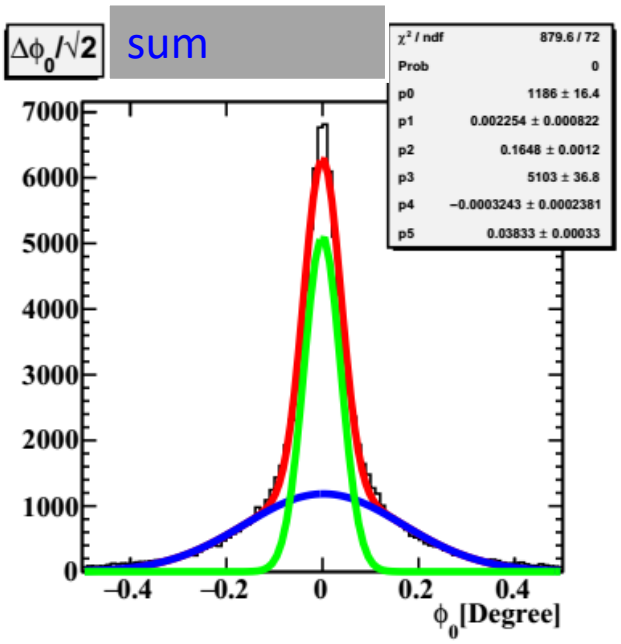


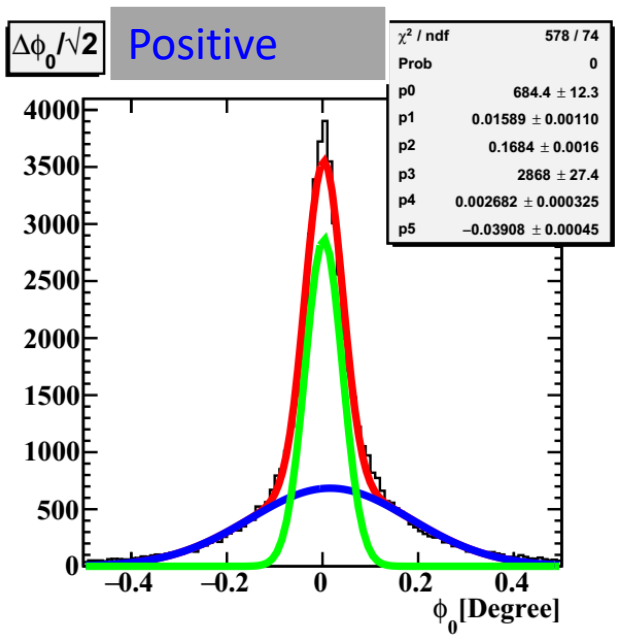


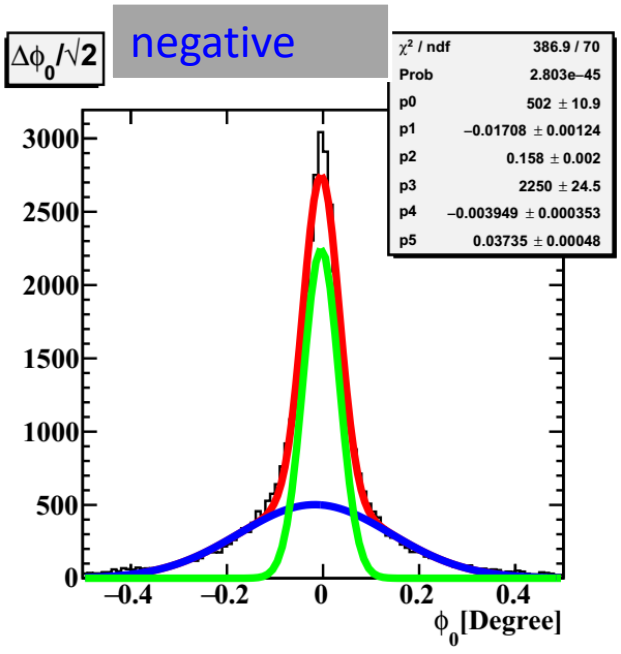


ΔPt is not gaussian, long tail at positive side??

Different between positive and negative charge.





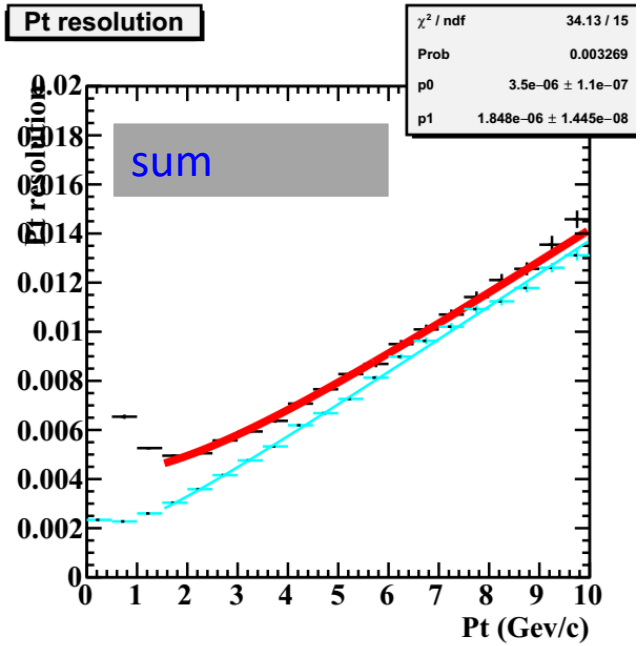


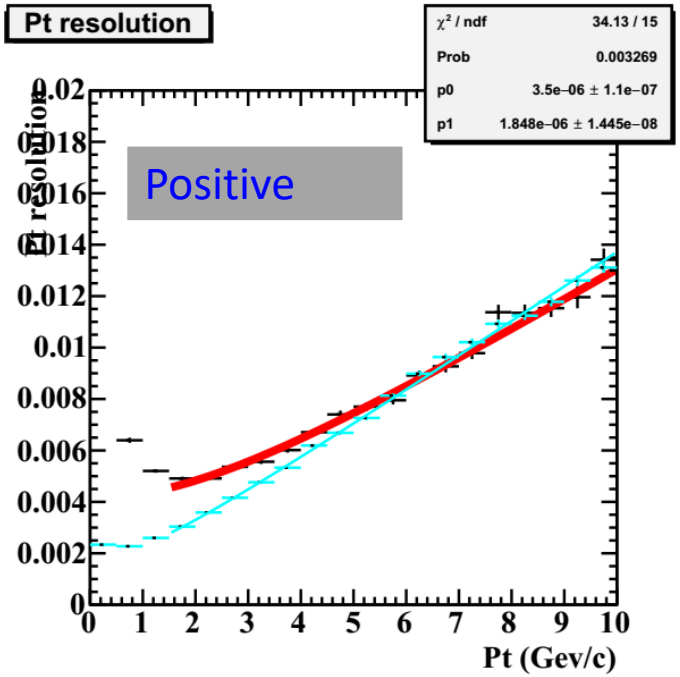
	Sum	Positive	Negative
Mean	0.00032	0.00268	-0.00394
Sigma	0.03833	0.03908	0.03735
		Positive shift	Negative shift

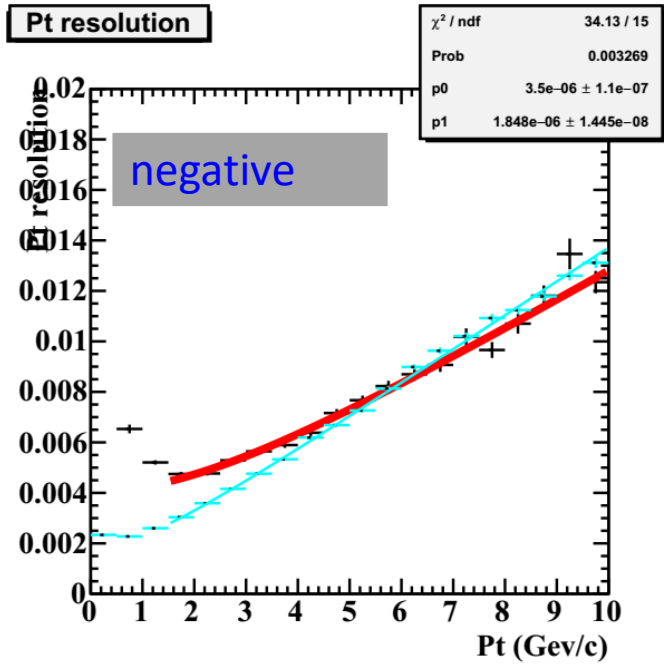
Small shift, but it's opposite, is this due to energy loss in mapper?

Pt resolution

- Separate charge, Pt resolution improved.

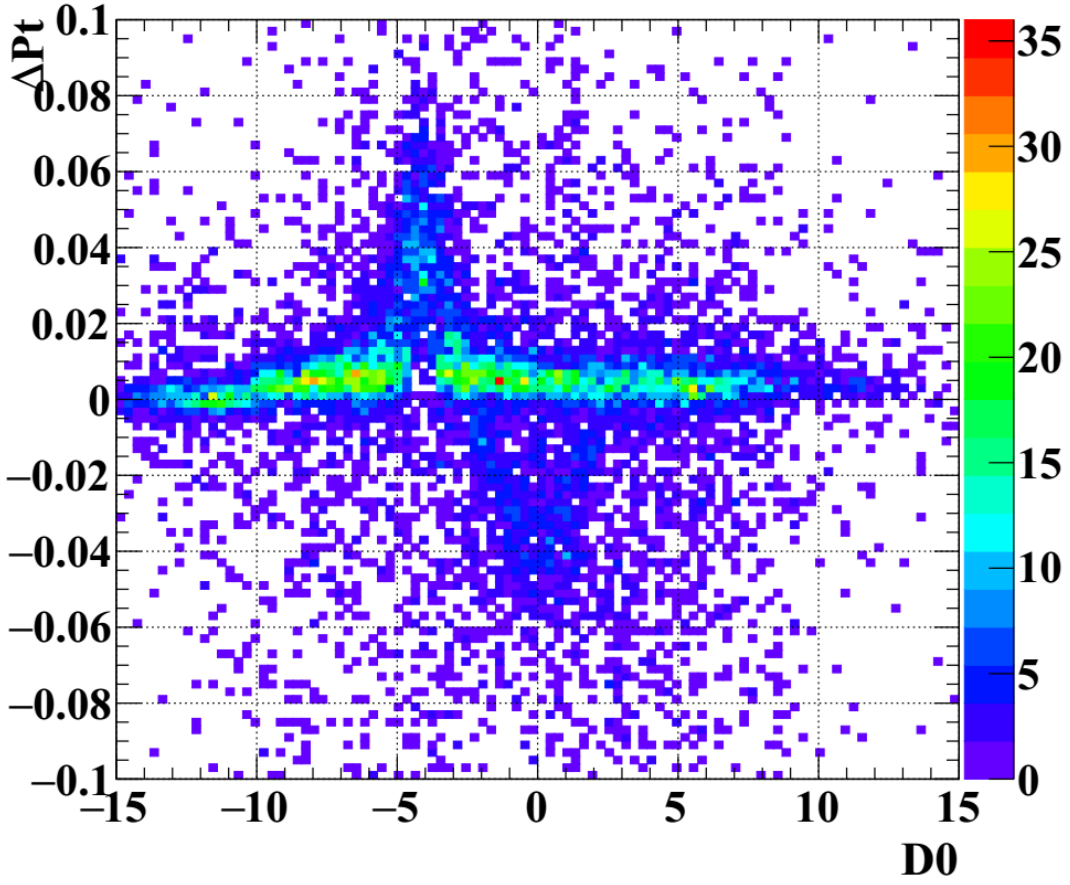






Effect of mapper

- $-110<\phi_0<-100$
- $0.5<Pt<1.5$

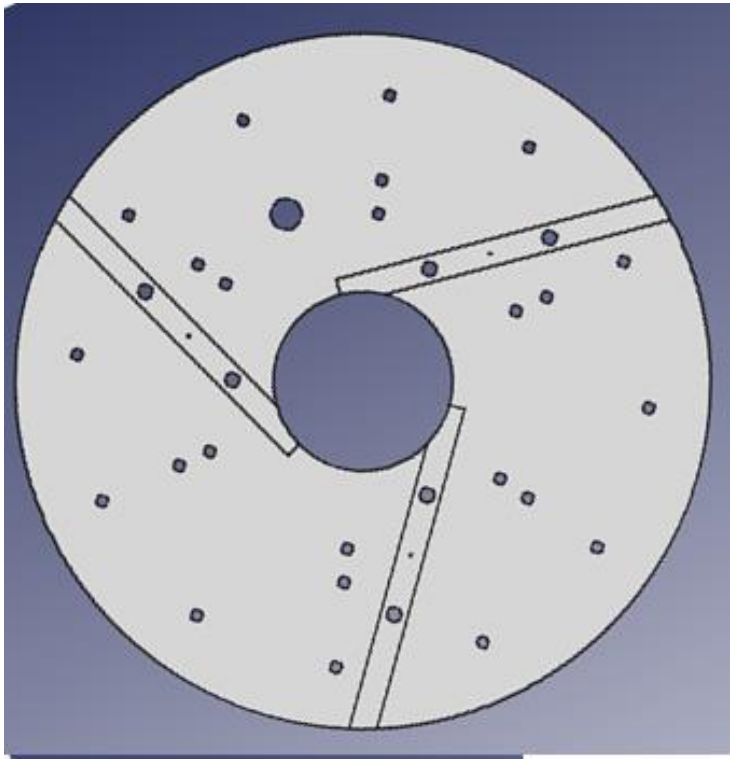


Summary

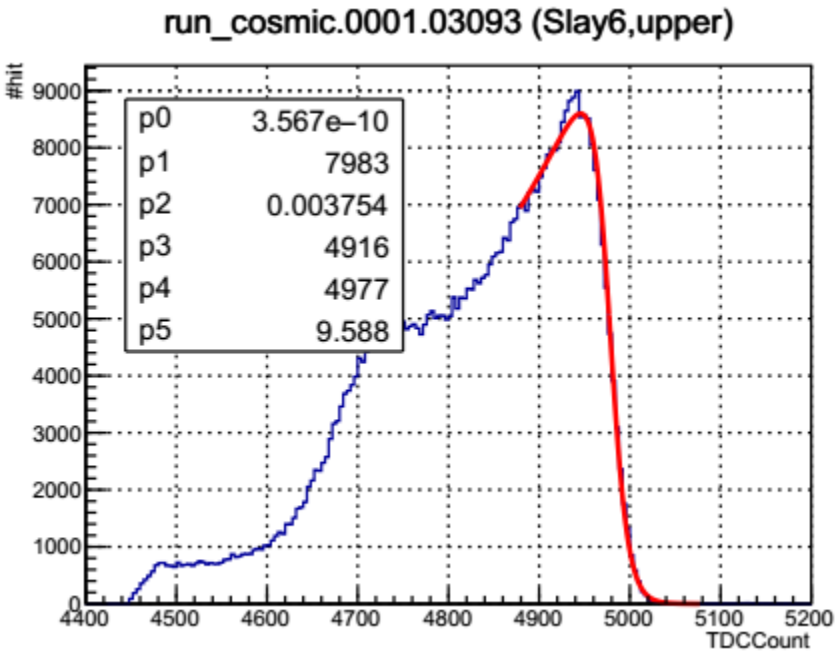
- CDC was calibrated for GCR2017.
  - Xt relation: 40% of 6048 xt functions are calibrated.
  - Position resolution around 100um at the middle of cell. It is better then sigma of previous data (no B Field)
  - d_0 and z_0 resolution are 117μm and 1.33mm, respectively.
  - ϕ_0 and tanλ resolution are 0.038deg and 0.0023.
  - At high Pt region those resolution are the same as simulation results.
  - Pt resolution as function of Pt larger than simulation ~0.2% at Pt around 2GeV and 0.1 at high Pt region.
- Effect of mapper seem larger, simulation to confirm the effect is necessary.

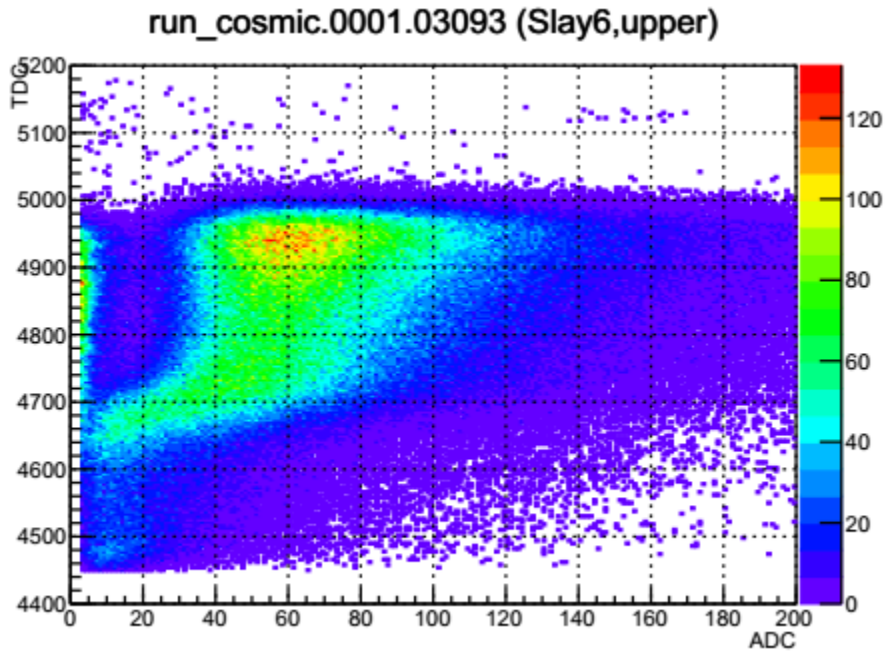
Backup

mapper



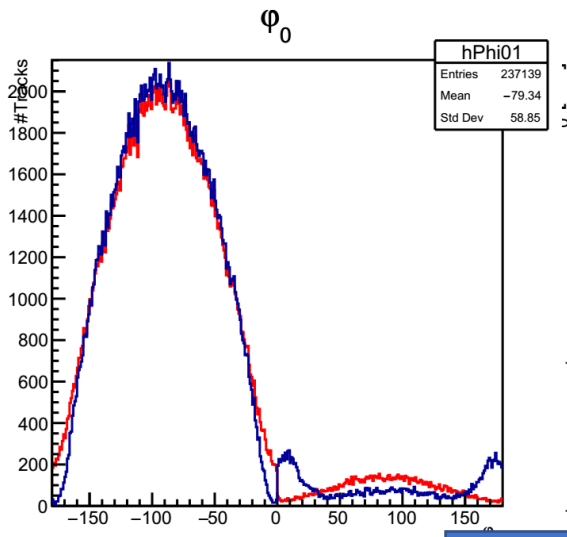
ADC TDC distribution

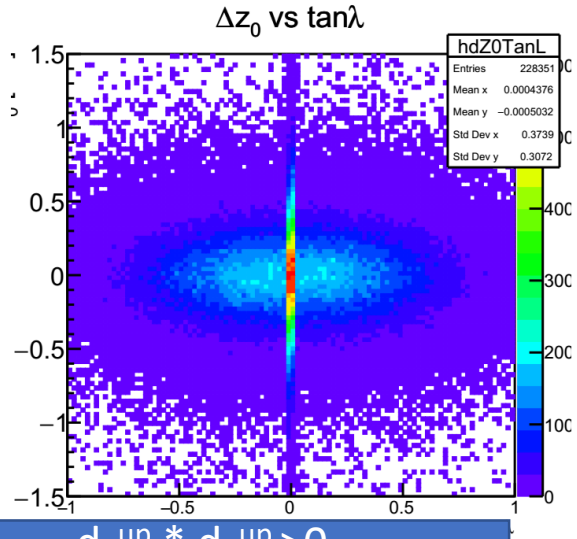


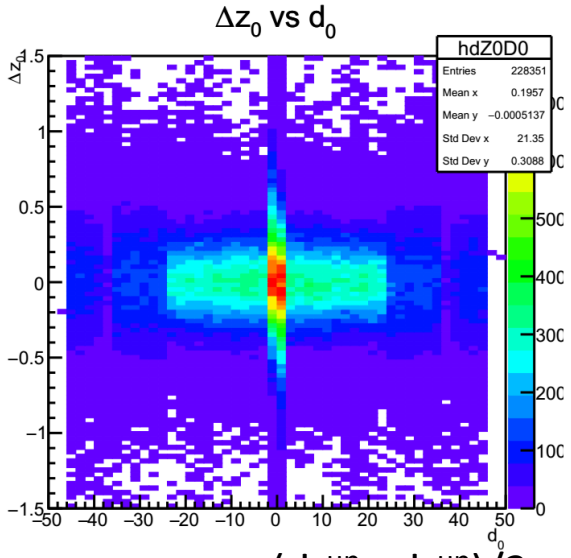


- Plots show ADC and TDC of SL6 of GCR2017. run 3093.
- Since GDL changed sometime, so please check your data before do analysis, constants from central db cannot use if GDL is changed.

Mis-identify direction of track

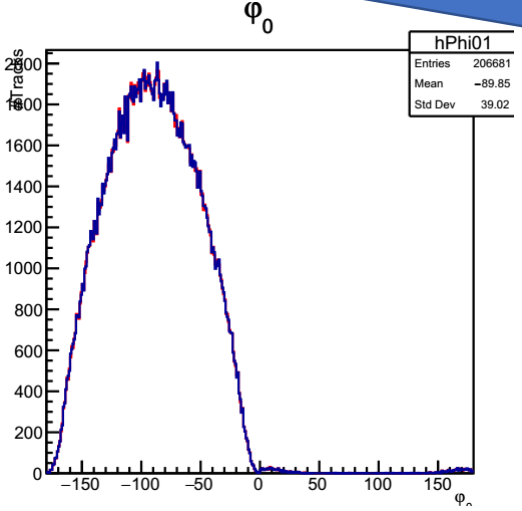


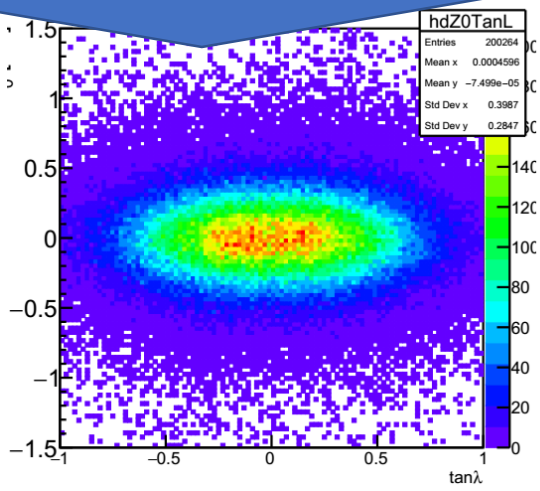


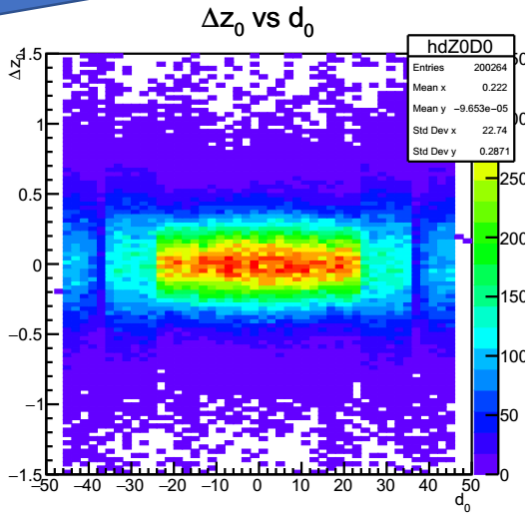


$(d_0^{up}+ d_0^{up})/2$

$d_0^{up} * d_0^{up} > 0$
This cut might reject many low pt tracks





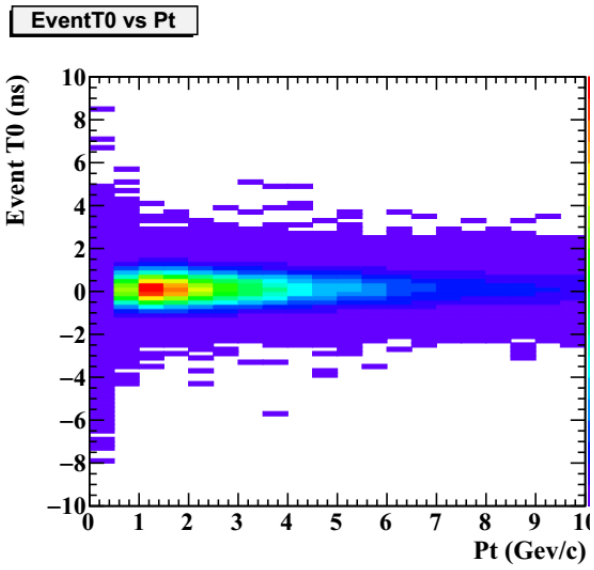


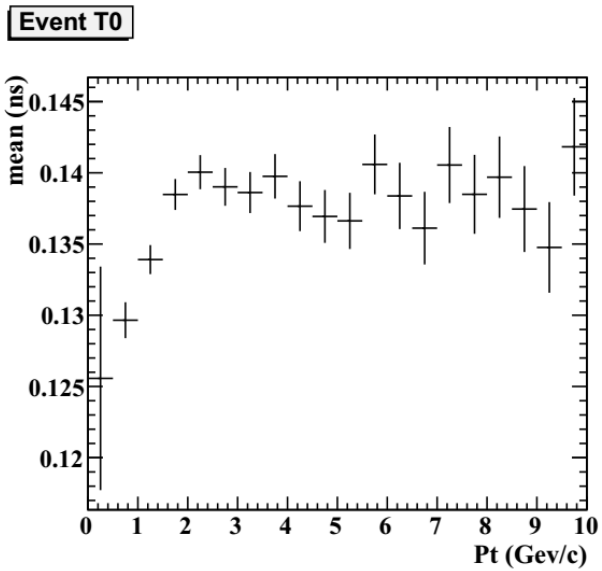
$(\tan\lambda^{up}+ \tan\lambda^{up})/2$

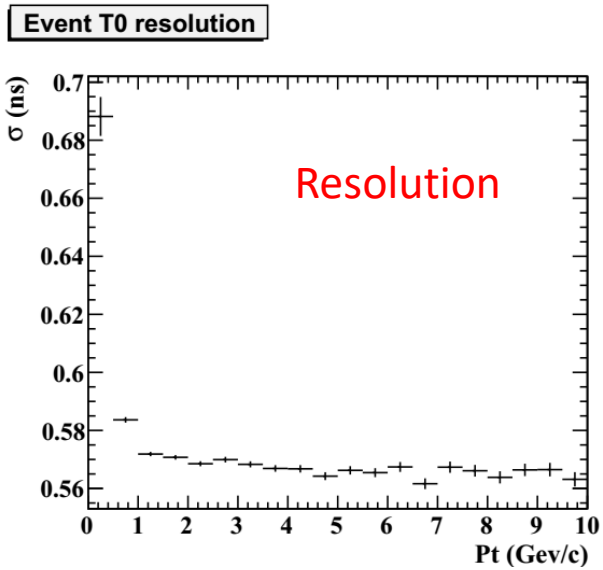
$(d_0^{up}+ d_0^{up})/2$

Event T0

- The performance of event t0 module was checked by simulation.
- CDCSimHits were reset after simulation, production time exactly set =0 at y=0.

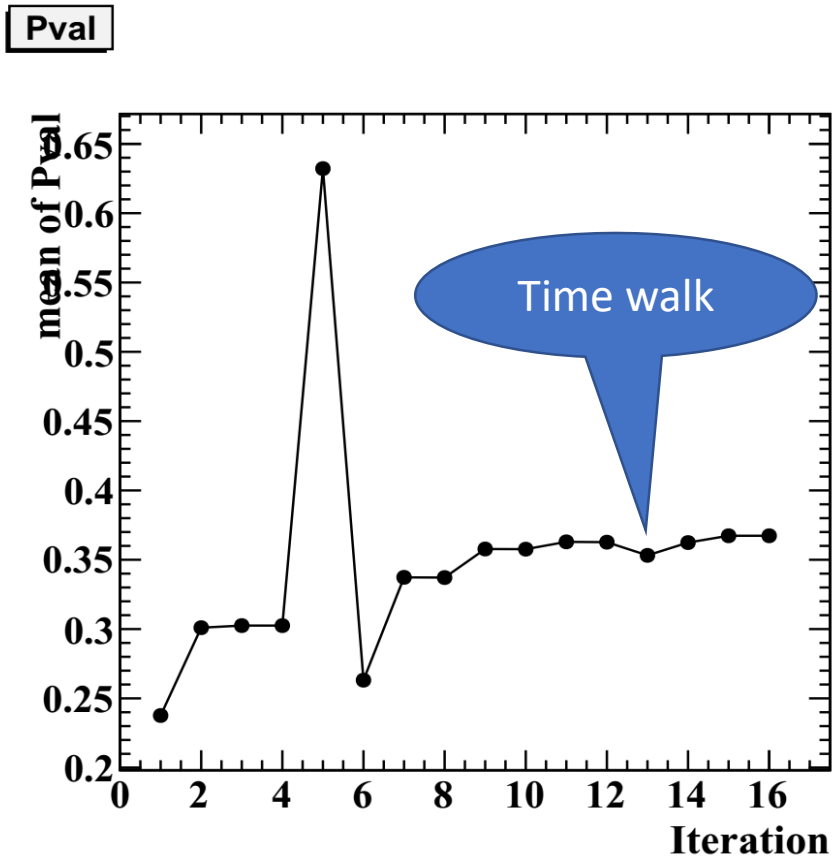


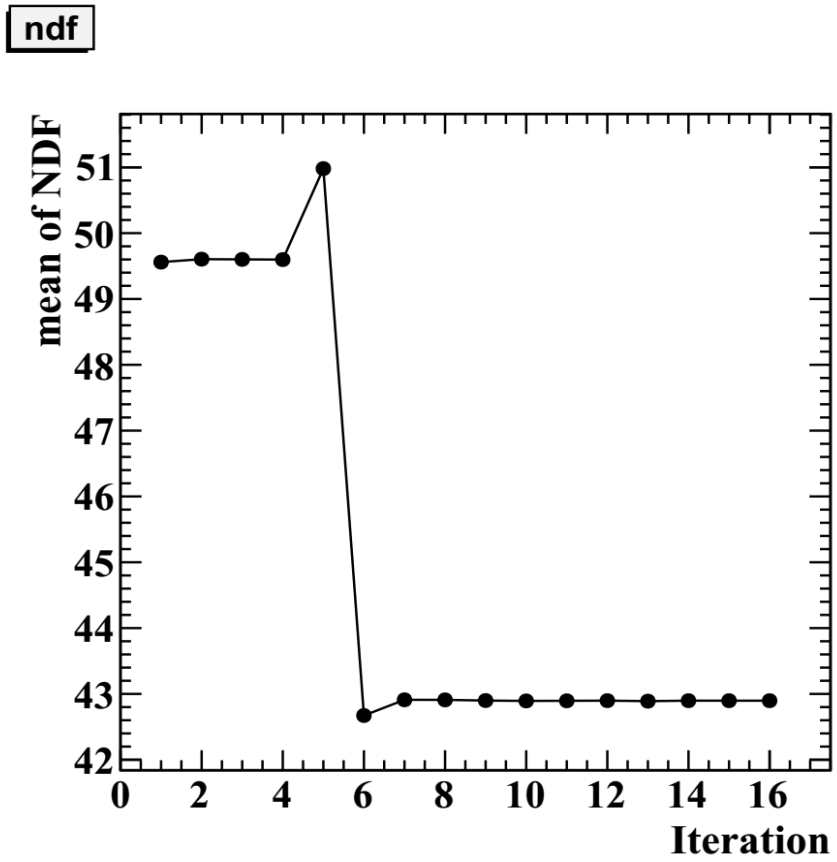




Event T0 module work well for cosmic

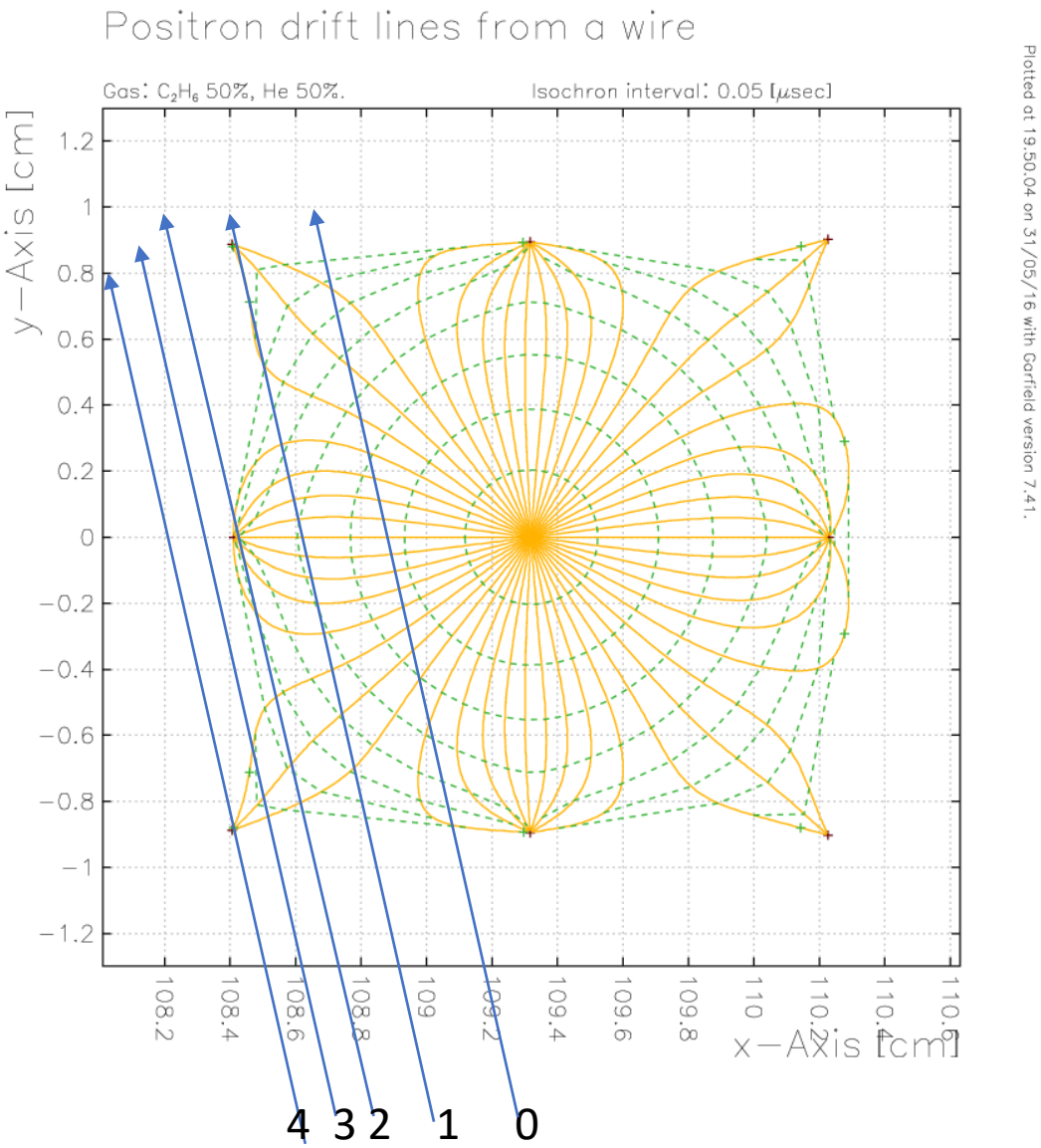
NDF and P-value vs Iteration#





- Calibration converged after 16 iterations.

Drift line


Positron drift lines from a wire
Gas: C_2H_6 50%, He 50%.
Isochron interval: 0.05 [μsec]
y−Axis [cm]
x−Axis [cm]
Plotted at 19.50.04 on 31/05/16 with Garfield version 7.41.
4 3 2 1 0