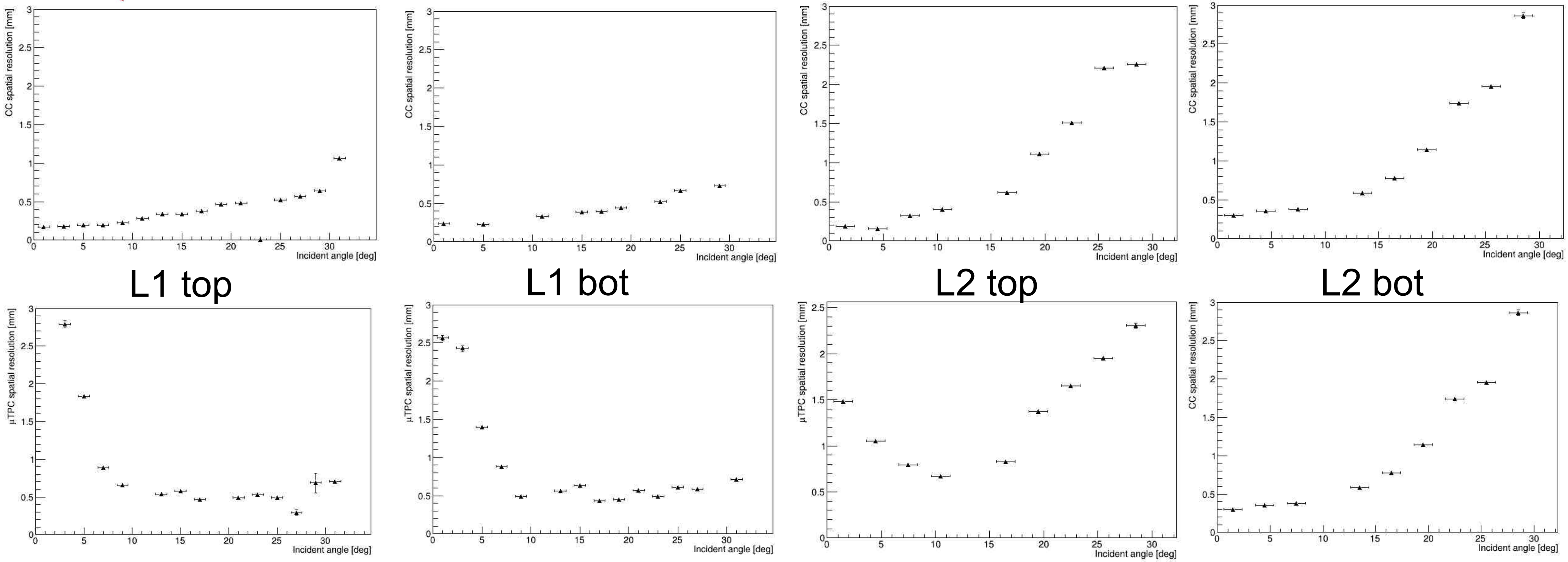
ANALYSIS UPDATES

CC & μTPC: incident angle



- L1 performs systematically better than L2, expecially if the beam incident angle is larger than 15°.
- μTPC behavior in L1 is flat between 10° and 30° while in L2 doesn't. Might it be due to the tracking system?
- No significant difference are evaluated between the top and the bottom part of L1 and L2.

What are the systematic to include in these results and why L2 is always worsen than L1?

TOY MC - COSMIC SETUP

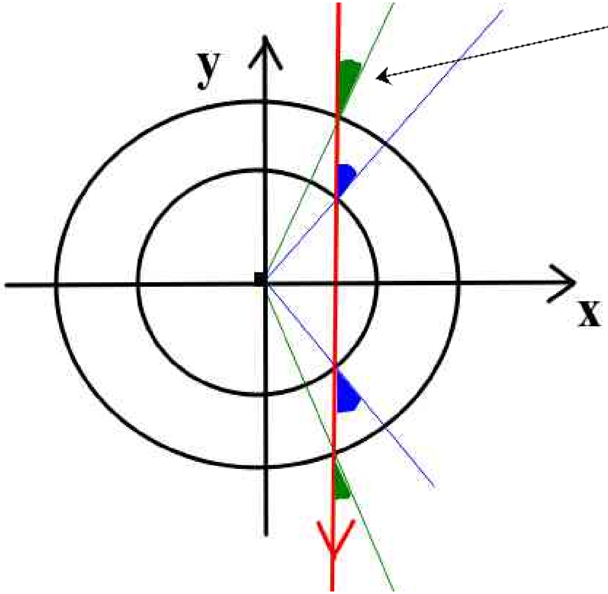
This is a simulation of the cosmic setup for L1 and L2. The purpose of this toy is to evaluate the contribution of the tracking system as a function of the incident angle.

Cosmic particle with a path orthogonal to the ground plane are shooted on L1 and L2. A shift is used to hit the setup with tracks having an incident angle w.r.t. the cylinder surface between 0 and 90° on L1 and between 0 and 40° on L2.

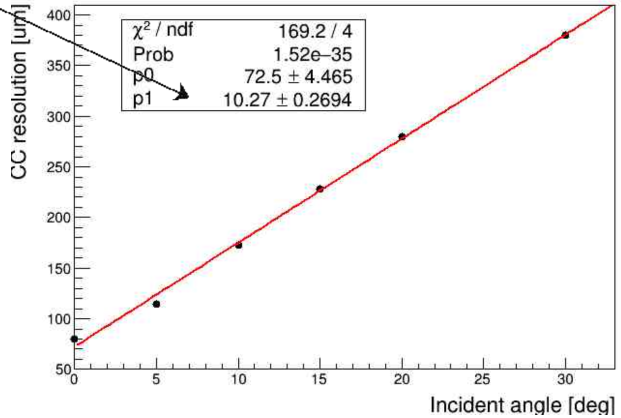
Up to now, only positive X positions are considered.

Position is evaluated with CC alogrithm only.

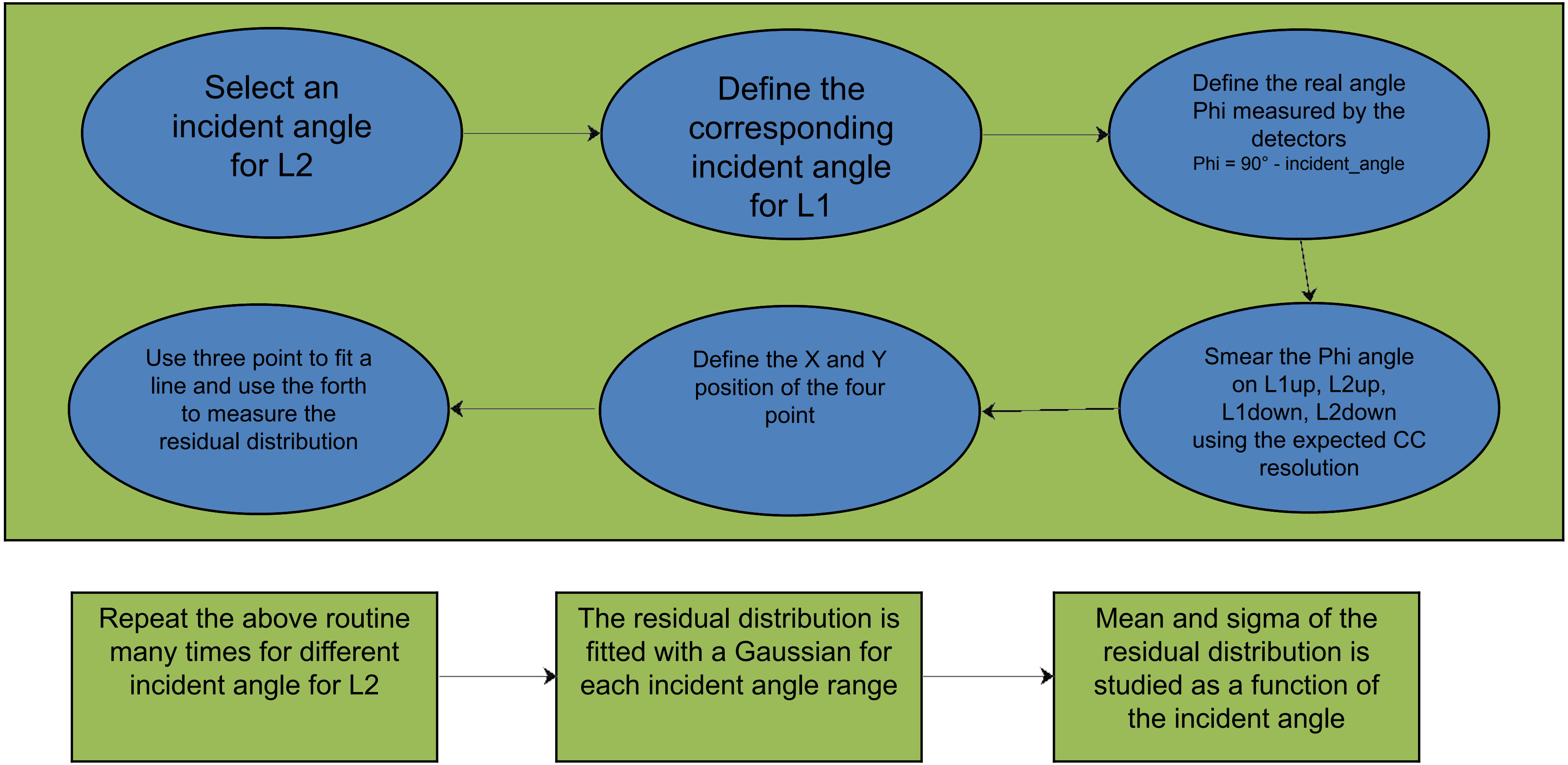
TOY MC - Cosmic setup



1. Generate a random number from 0° to 40° as the L2 incident angle
2. Evaluate the L1 incident angle from geometry: L1_angle = asin (R2/R1 * sin (L2_angle))
3. Smear the position on the L1up, L1down, L2up, L2down as a function of the expected performance from experimental data with planar triple-GEM
4. Choose 3 points and fit them with a line, then measure the residual of the forth point
5. Repeat action 1-4 for a large sample
6. Analyze the residual distrubution with a Gaussian fit
7. Plot the mean and the sigma as a function of the incident angle on the test detector
8. Evaluate the tracking contribution with a squared substraction of the expected resolution for each incident angle



TOY MC - Cosmic setup

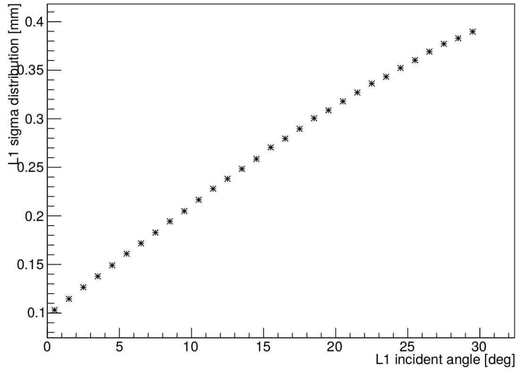


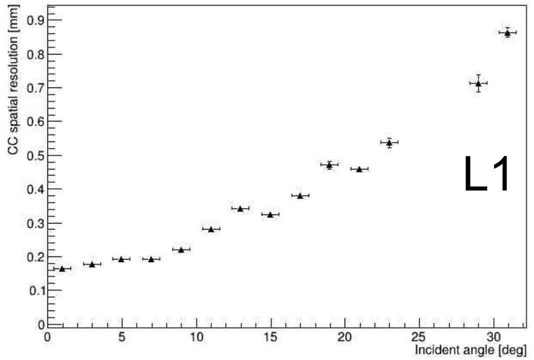
TOY MC - Sigma simulation vs experimental

sigma in simulation

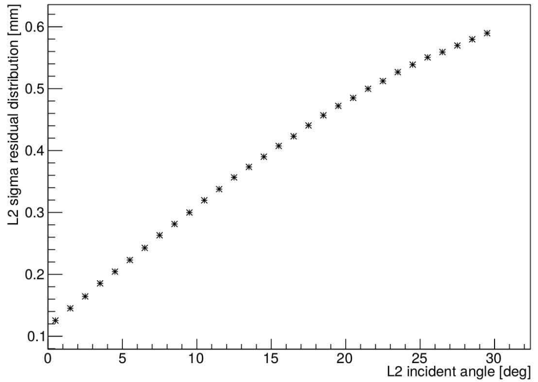
sigma in experimental data

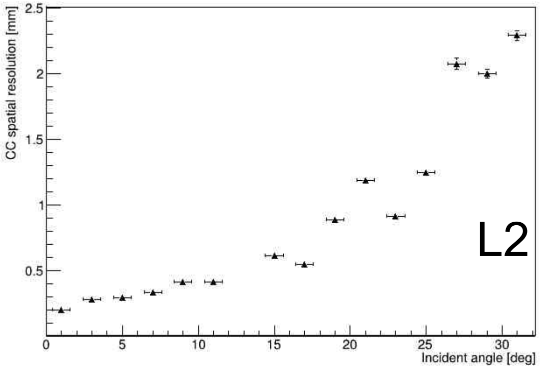
L1





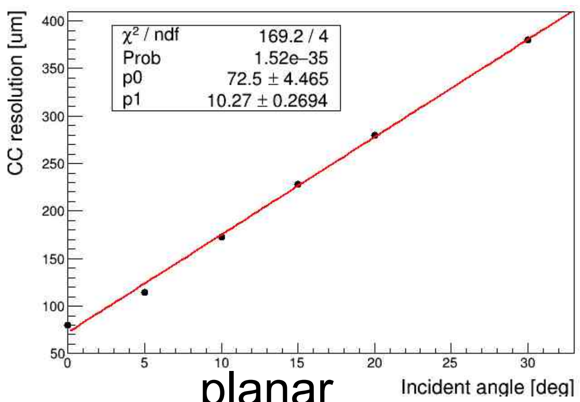
L2



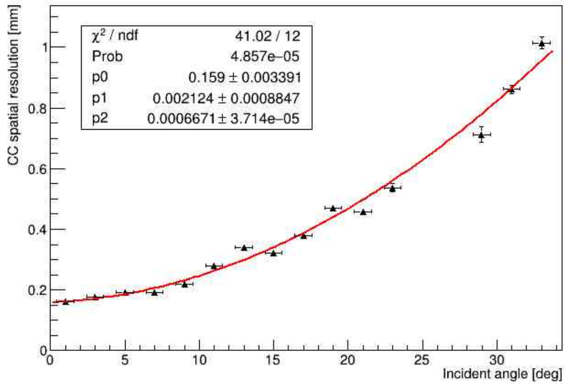


1. **The sigma measured contains the contribution of the tracking system and the detector itself**
2. Simulation underestimate the experimantal data, expecially on L2
3. The shape of the simulated and experimental data is different too
4. The resolution of the planar GEM is not the best one to simulate the CGEM

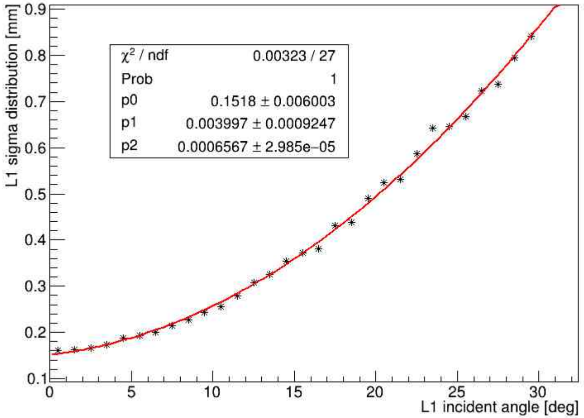
new TOY MC - CC resolution of CGEM



planar GEM



L1 data
sigma vs angle



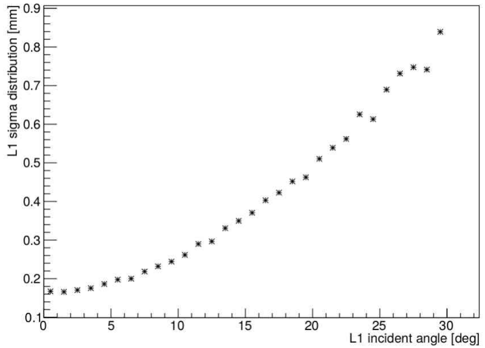
L1 sim
sigma vs angle

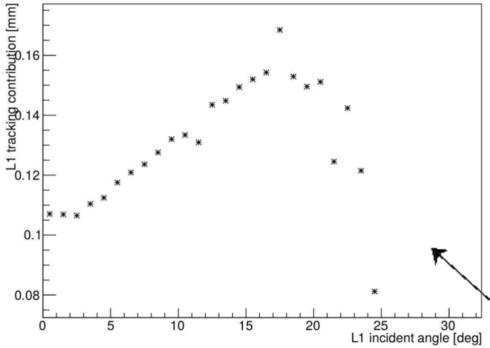
1. The performance of the CGEM is measured by real data is very different from the one measured by the cosmic setup
2. I try a differnet function to reproduce the resolution of the CC: a parabola instead of a line
3. The parabola for the simulation of the L1 resolution has been properly tuned to match the data of L1
4. The same values are used also for L2 and the simulated result (next slide) are in agreement with the experiement (previous slide)

new TOY MC - Tracking system contribution

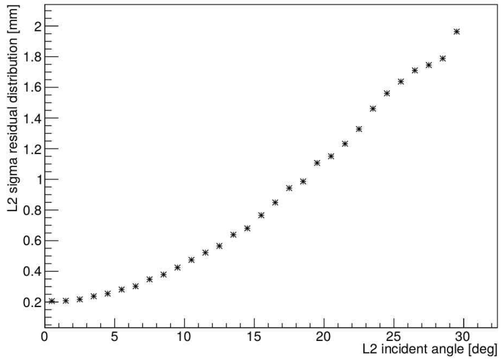
sigma in simulation

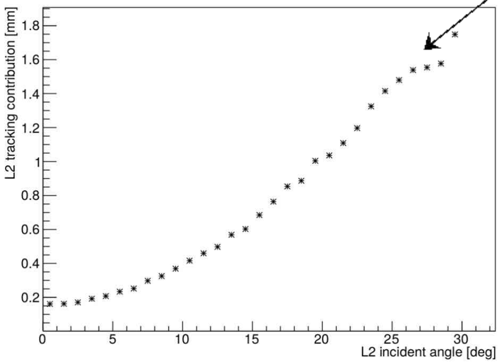
tracking contribution





L1





L2

1. Using the sigma value as a function of the incident angle measured in the previous slide, it is possible to measure the contribution of the tracking system.

2. The sigma of the Guassian is determined by the intrinsic resolution of the detector and the contribution of the tracking system, then the effect of the tracking system can be extracted with a squared subtraction:

sqrt((residual sigma)^2 - (CC planar resolution)^2)

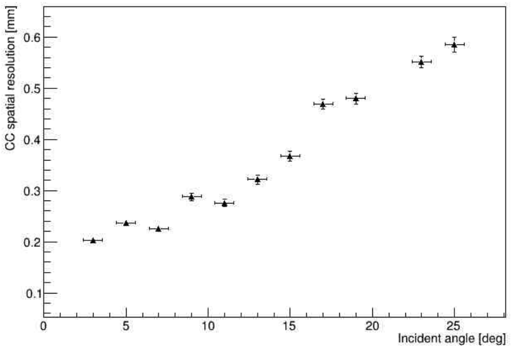
3. The result has to be understood. The contribution of the tracking system seems to be very small on L1. It is important to understand what is the role of the mean value of the residual and how it could worsen the tracking system.

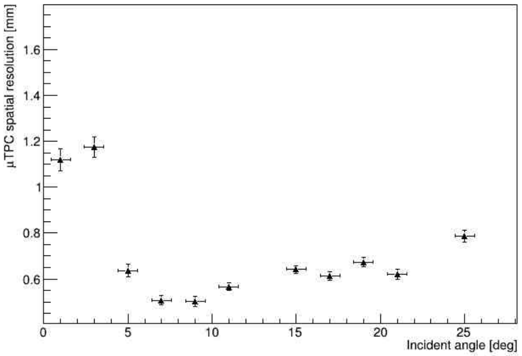
TOY MC - Conclusion

1. A contribution of the tracking system of about 100-150 μm for L1 and 200-1600 μm for L2 has been evaluated as a function of the incident angle
2. The CC resolution from the planar GEM is not enough to describe the data
3. A parabolic shape of the CC resolution vs incident angle seems to describe better the data
4. The resolution on L2 is systematically worsen thant L1

Ok, we can go back to the L1 performance

CC and TPC vs angle (L1top)





Until μTPC will to be better than CC, every merge studies is useless and they will not be implemented in CGEMBOSS

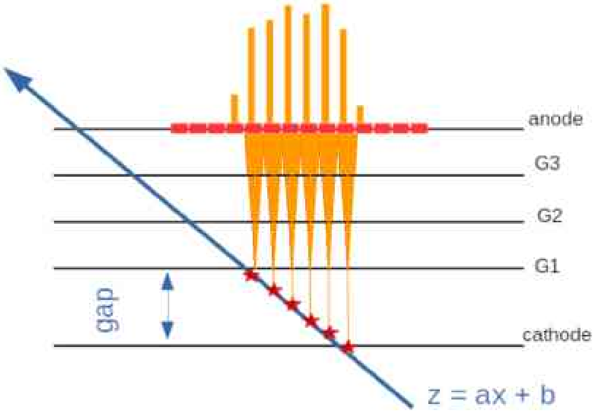
--> Let’s concentrate to the μTPC

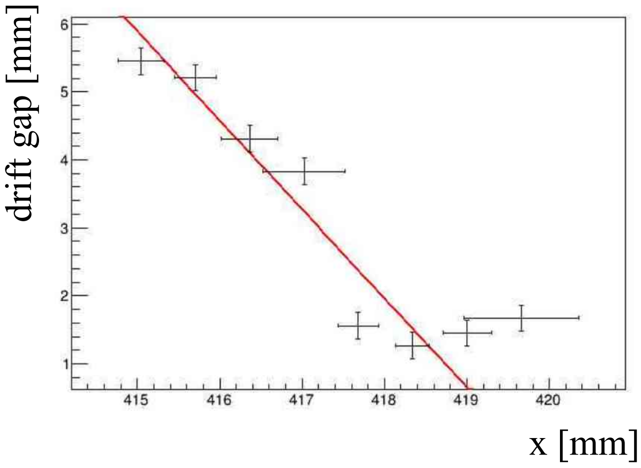
μTPC present status in CGEM-IT

$$t'_{hit} = t_{hit} - t_0$$

$$z_{hit} = t'_{hit} \cdot v_{drift}$$

$$x_{\mu TPC} = \frac{gap/2 - b}{a}$$





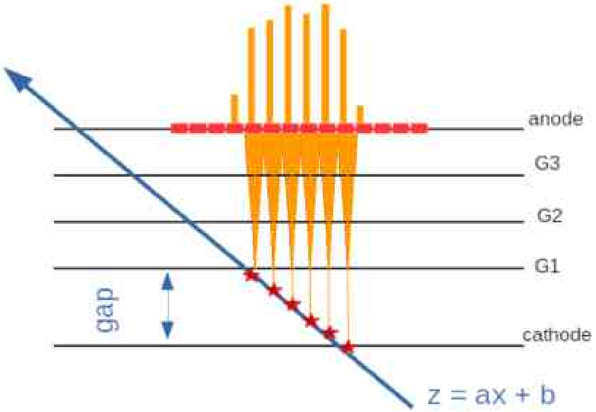
μTPC events are recostructed with error bars. Two methods are used in CGEMBOSS but in the present situation no differences show up.

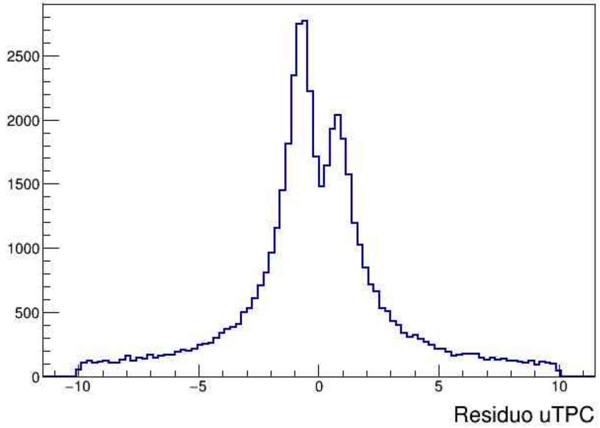
μTPC present status: time reference

$$t'_{hit} = t_{hit} - t_0$$

$$z_{hit} = t'_{hit} \cdot v_{drift}$$

$$x_{\mu TPC} = \frac{gap/2 - b}{a}$$





Double peak is observed in the μTPC residual distribution. This problem is due to the **time reference**.

μTPC present status: time reference

$$t'_{hit} = t_{hit} - t_0$$

$$z_{hit} = t'_{hit} \cdot v_{drift}$$

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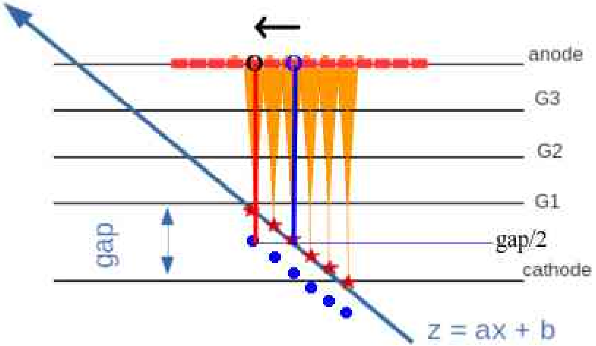
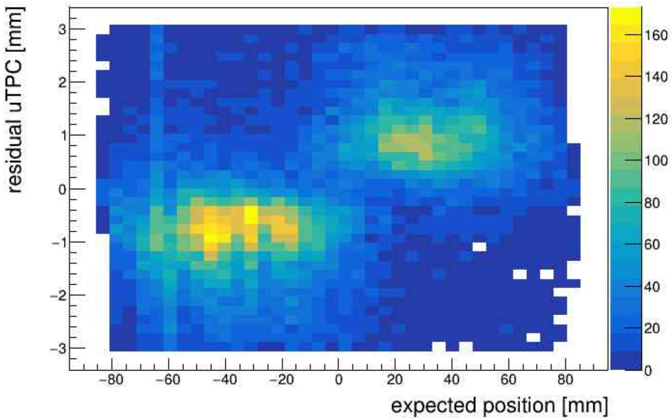




Double peak is observed in the μTPC residual distribution. This problem is due to the **time reference**.

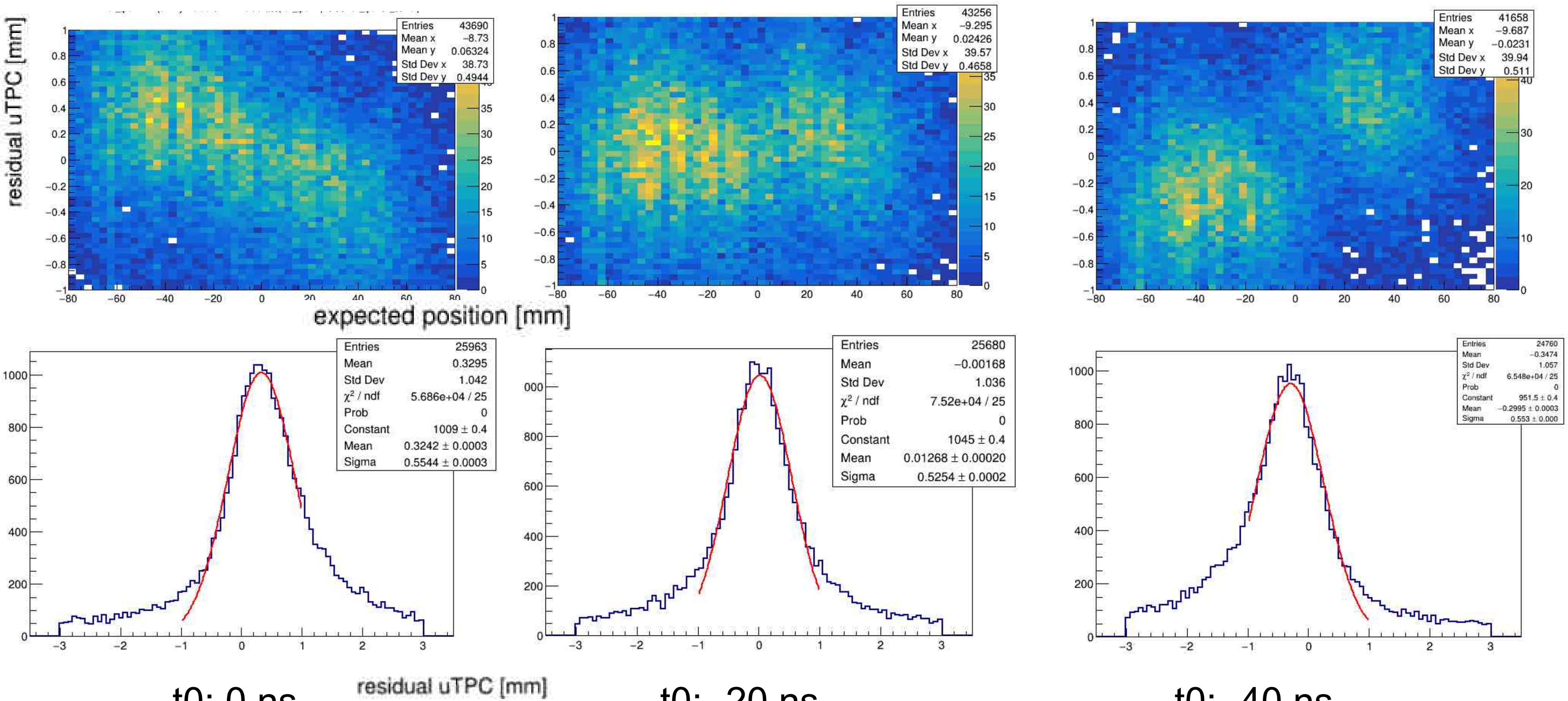
Positive position shift on one side and negative position to the opposite side.

A wrong time reference can shift the μTPC points (from red stards to blue dots) then a shift in the μTPC positions.

Positive angle shift on one side, negative angle to the other one.

Let's select only negative expected position

μTPC: time reference studies - L1top

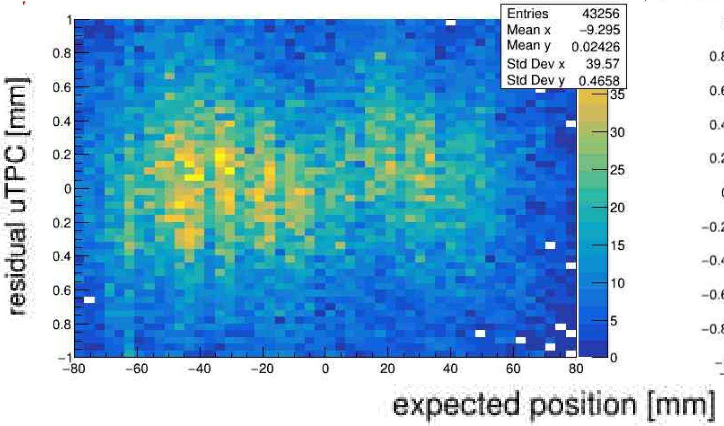


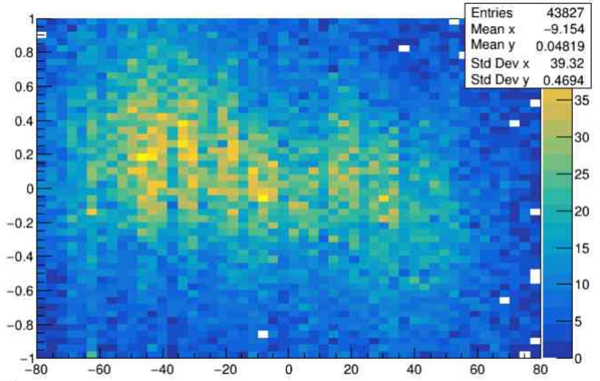
t0: 0 ns

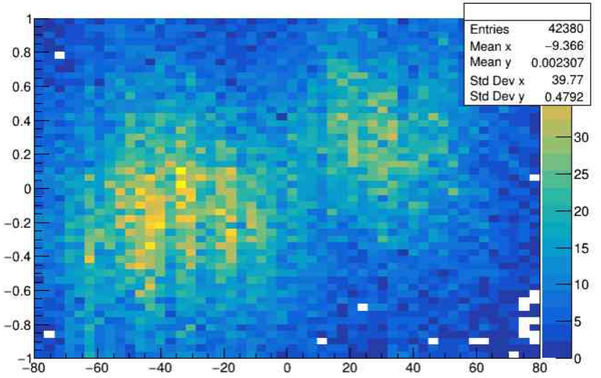
t0: -20 ns

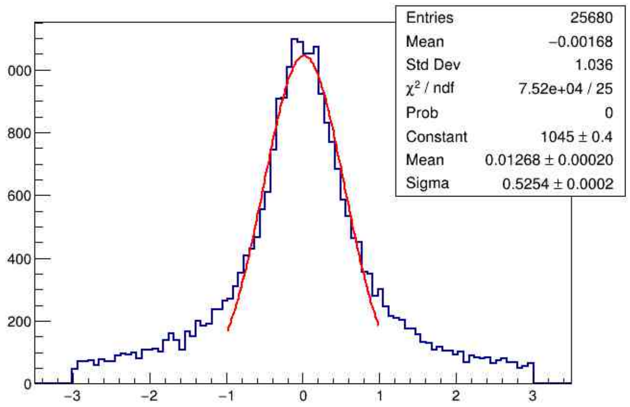
t0: -40 ns

μTPC: time width studies - L1top



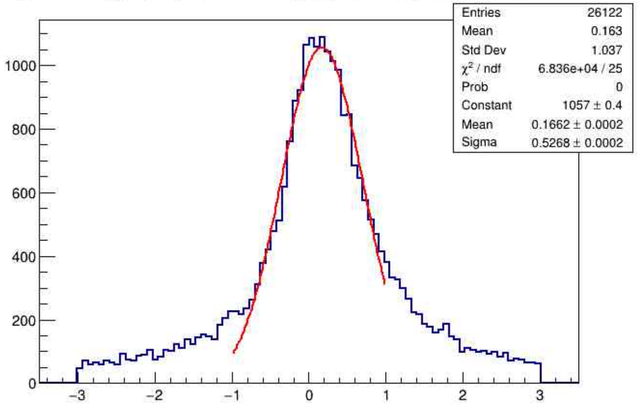






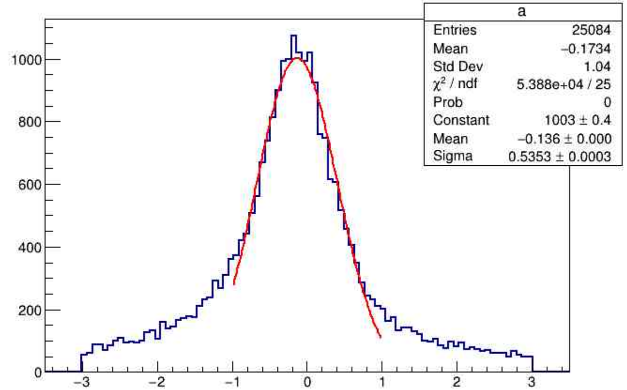
tF: +0 ns

d.v. = 37 um/ns



tF: +20 ns

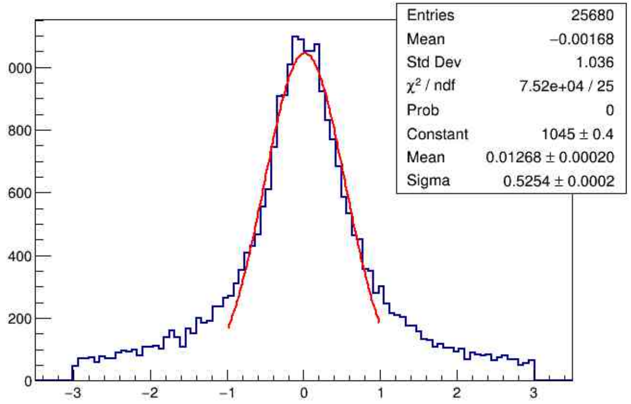
d.v. = 43 um/ns



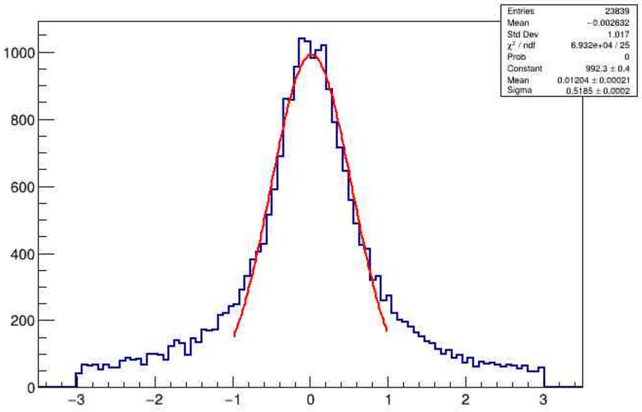
tF: -20 ns

d.v. = 32 um/ns

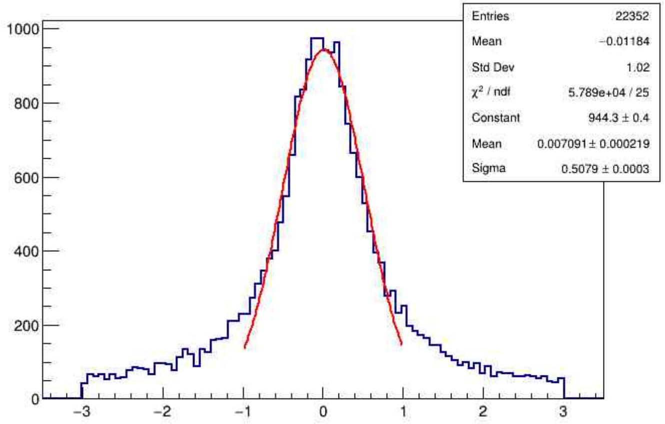
μTPC: time error studies - L1top



2 ns err

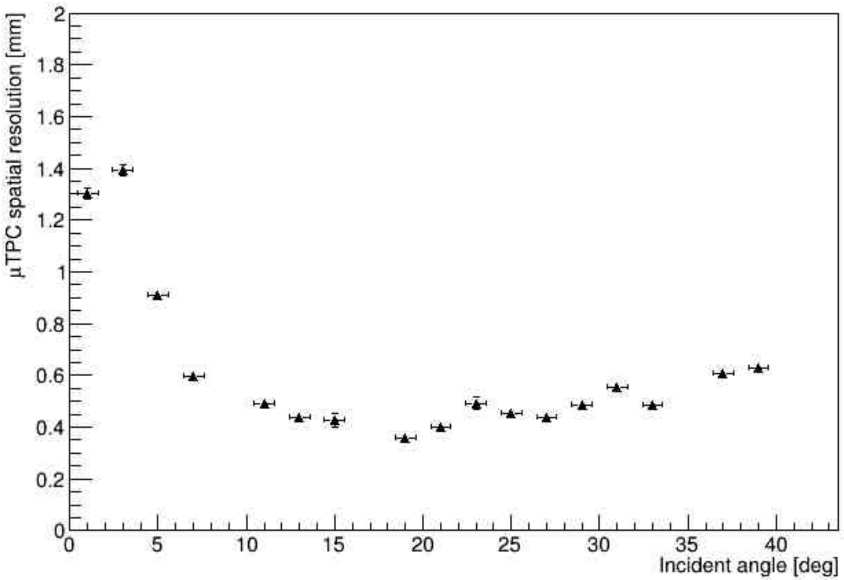


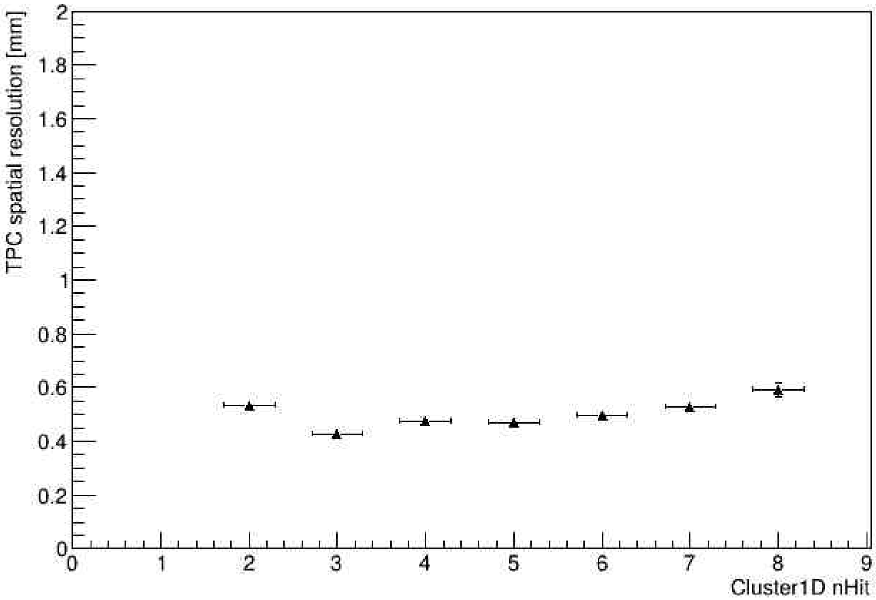
5 ns err



10 ns err

μTPC studies





This is the behavior as a function of the incident angle and cluster size

μTPC conclusion

1. Optimization of the μTPC variables are needed
2. Preliminary studies on the time reference shows important effects
3. Minor effects are observed in the drift velocity scan and in the error size scan
4. More studies will be needed because the actual results could not improve the μTPC below 500μm

LUT results

LUT: results

The variables list is:

GENERAL SETTING
runs
high voltage values
energy mode

GEOMETRY
ROC id, FEB id, TIGER id
strip, side, layer

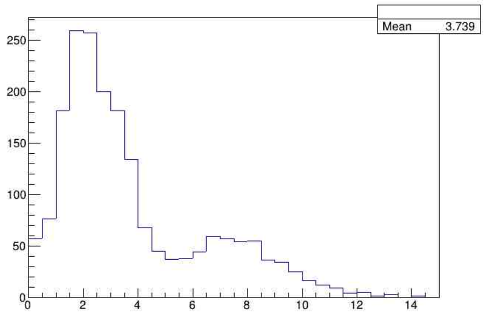
CALIBRATION
qdc slope, constant and saturation value

THRESHOLD
voltage thr. E and T branches
voltage baseline E and T branches
charge cut (fC) E and T branches
effective charge cut (fC) on the channel

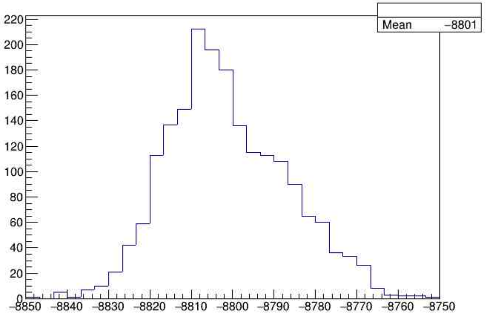
NOISE (out of time)
rate (Hz) , mean charge (fC)

SIGNAL (in-time)
rate (Hz), mean chare (fC), max charge (fC)
leading and falling time (ns)
quality

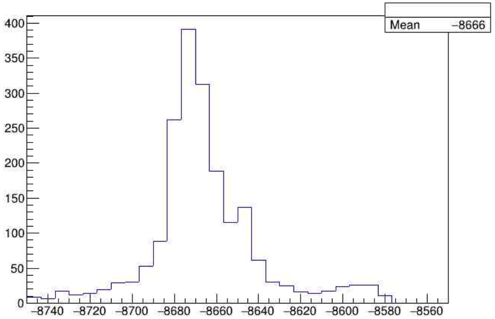
--> New package to extract the variables: ReadCosmicRayData-00-00-21



threshold [fC]

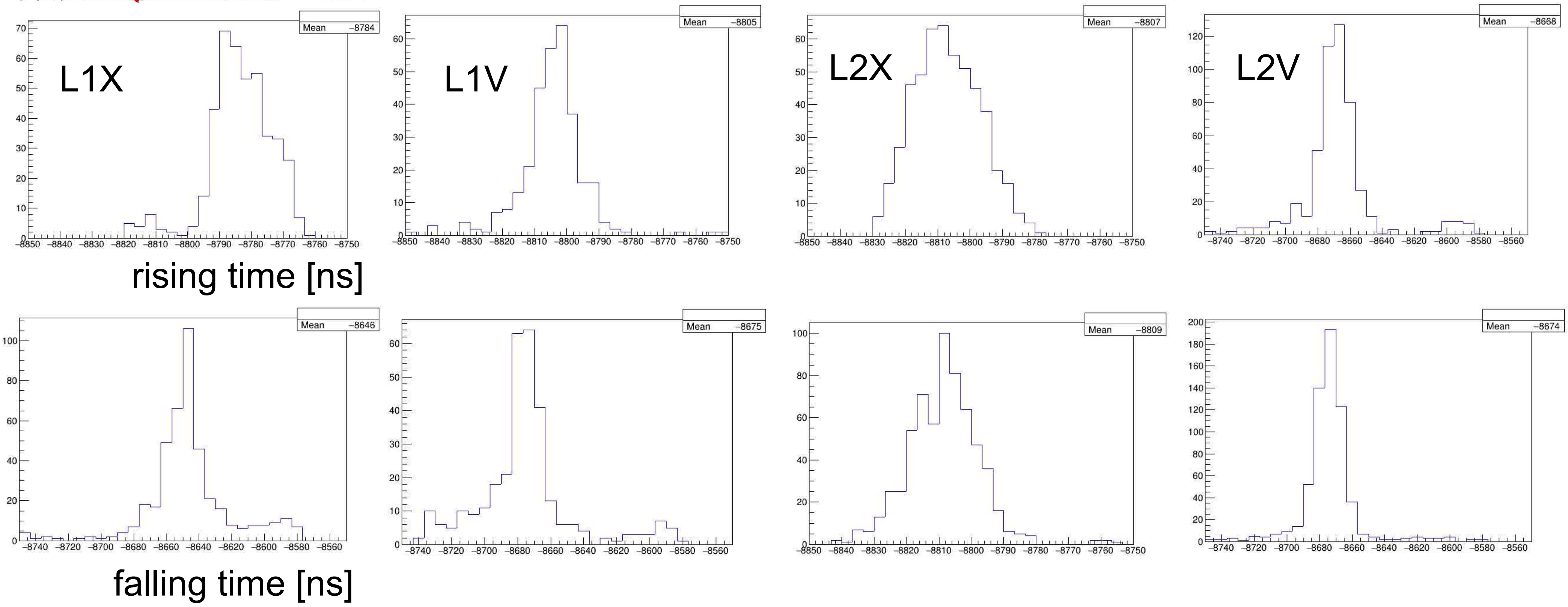


rising time [ns]



falling time [ns]

LUT: Time reference



Differences of several tens of ns are present between on L1 and L2, but also between channels of the same layer

LUT - Conclusion

1. Information channel by channel can be used to improve the resolution of the detector such us the time-walk effect
2. Moreover other information such us time reference could be used for futher studies
3. Is the calibration team available to develope the corrections channel by channel?

All - Conclusion

1. L1 detector is the one with the smaller contribution of the tracking system
2. uTPC optimization is feasible but now we need to implement it chip by chip or channel by channel
3. LUT can provide threshold value and it could be used to perform the time-walk correction