

μ TPC studies and Capacitive Corrections

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ASD

μ TPC reconstruction code:

Reconstruction/CgemClusterCreate/CgemClusterCreate-00-00-30

Some update to include the Cgem Time Calibrations from my code.

Submit an update of the package?

```
float CgemClusterCreate::get_Time(CgemDigiCol::iterator iDigiCol){  
    //Get digi time  
    float time = (*iDigiCol)->getTime_ns();  
    //Get rising time from calibration  
    float time_rising = get_TimeRising(iDigiCol);  
    //Get time-walk  
    float time_walk = get_TimeWalk(iDigiCol);  
    //Get time-reference  
    float time_reference = get_TimeReference(iDigiCol);  
    //  
    float time_shift_custom = -35;  
    time-=(time_rising+time_walk+time_reference+time_shift_custom);  
    return time;  
}
```

```
float get_Time(CgemDigiCol::iterator iDigiCol);  
float get_TimeWalk(CgemDigiCol::iterator iDigiCol);  
float get_TimeRising(CgemDigiCol::iterator iDigiCol);  
float get_TimeReference(CgemDigiCol::iterator iDigiCol);
```

μTPC reconstruction code:

Reconstruction/CgemClusterCreate/CgemClusterCreate-00-00-30

Some update to include the Cgem Time Calibrations from my code.

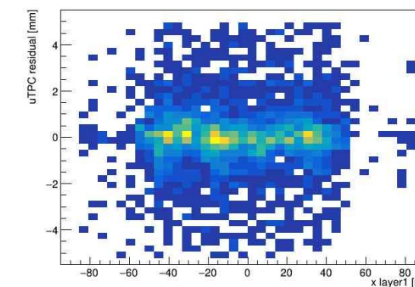
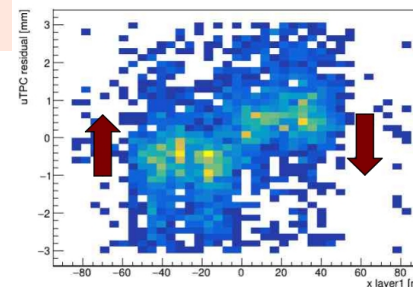
Submit an update of the package?

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float CgemClusterCreate::get_Time(CgemDigiCol::iterator iDigiCol){
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    float time = (*iDigiCol)->getTime_ns();
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    float time_rising = get_TimeRising(iDigiCol);
    //Get time-walk
    float time_walk = get_TimeWalk(iDigiCol);
    //Get time-reference
    float time_reference = get_TimeReference(iDigiCol);
    //
    float time_shift_custom = -35;
    time-=(time_rising+time_walk+time_reference+time_shift_custom);
    return time;
}
```

CgemCalibFunSvc.TimeFitFile="/bes3fs/cgemCosmic/data/timeFitCalibConst/timeFit_Run10.txt";

CgemCalibFunSvc.TimeWalkCalibFile = "TimeWalk.root";

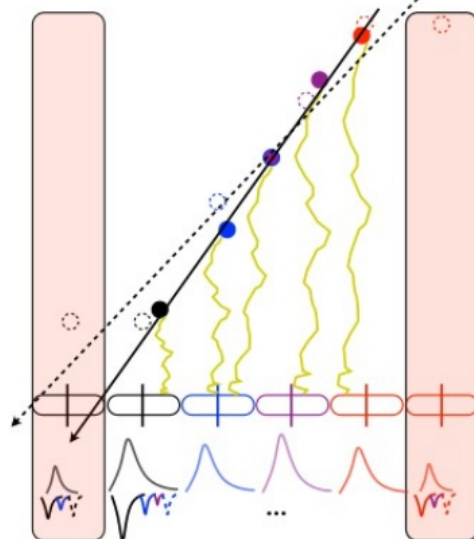
CgemCalibFunSvc.LUTfile = "TimeReference.root";
TestHit.LUTfile = "TimeReference.root";
CgemClusterCreate.LUTfile="TimeReference.roo";



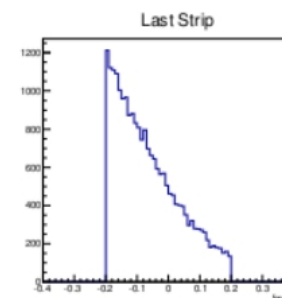
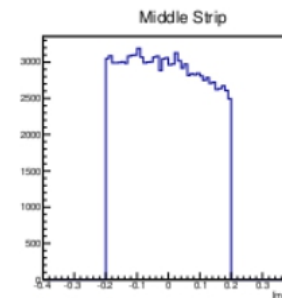
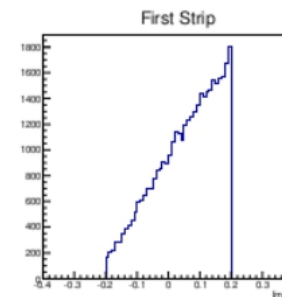
Bibliography of the effect

Atlas has perform this study in 2014 and it has introduced a correction the the spatial and time position of the uTPC hits, most probably they use MC simulation with Ansys and/or Garfield

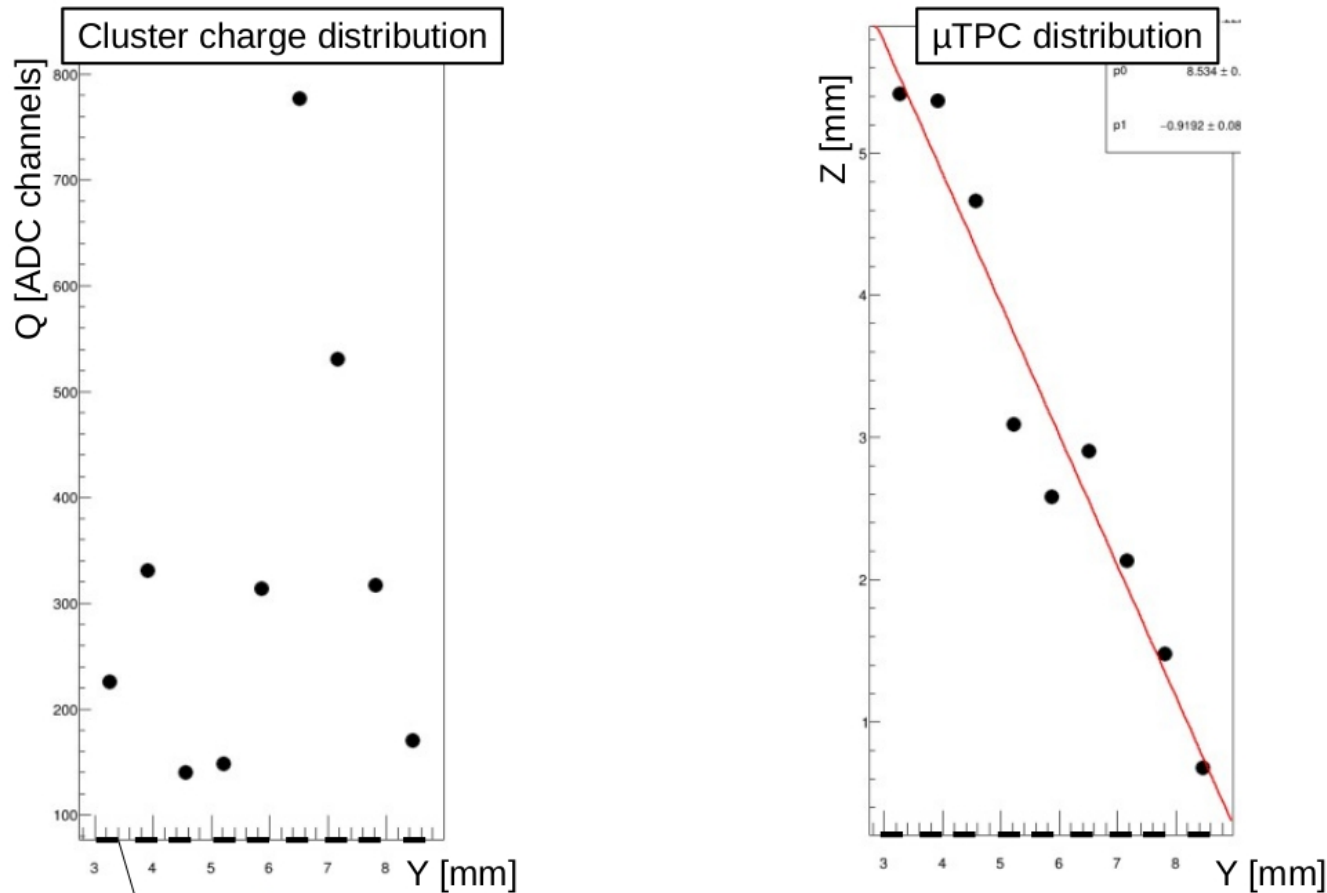
https://indico.cern.ch/event/284993/contribution/56/attachments/527483/727931/ntekas_mm_eesfye_2014.pdf



$$X_{\text{truth}} - X_{\text{pitch}/2}$$



The charge and μ TPC distributions



strips

μ TPC studies: Capacitive effects - Beijing - January, 2016

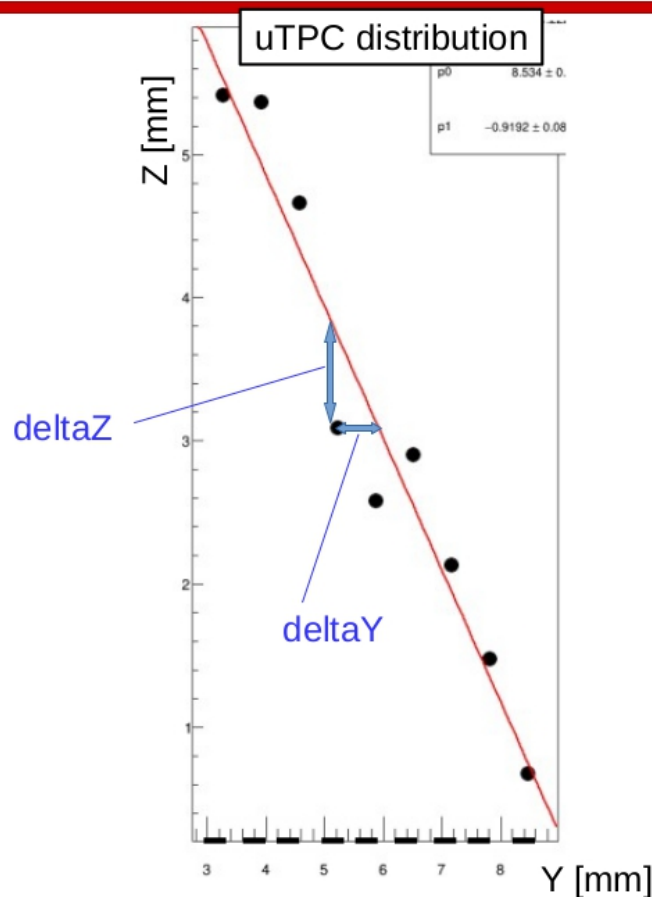
R.Farinelli



5

Quantities under study

We need to include in the n-tuple
those two variables for each Digi
“deltaZ” and “deltaY”



Let's study for each event the
good cluster used in the position
measurement of the tested
chamber.

In this study I used the chamber
with 5mm conversion gap (LNF or
plane 2) with ArIso gas mixture
and no magnetic field.
The incident angle between the
chamber and the beam is 45°

The distance between the point
and the line, deltaY and deltaZ,
has been studied.

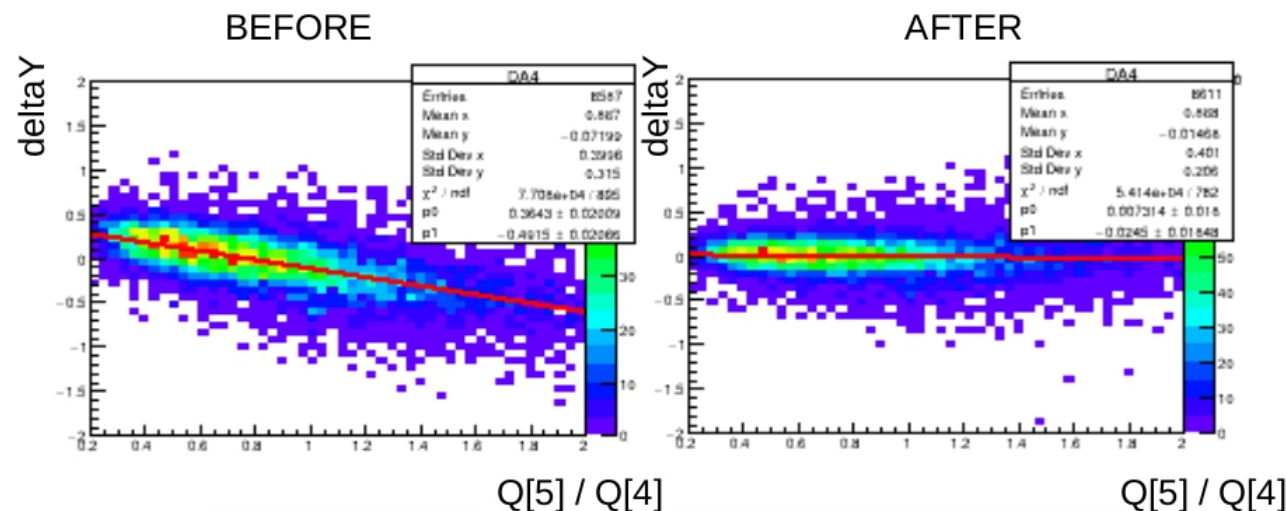
First correction

The values “m_corr” and “q_corr” change as a function of the cluster size but they are the same for each strip of the cluster.

This is the first correction.

- A dependence of the deltaY as function of the ratio between the charge the strip and its neighbor has been found for each strip except the last one
- Here an example of the correction effect of the 4 strip of the cluster
- The same correction is done in each strip (except the last one):

$$XYV_tpc[i] -= (Q_hit[i+1]/Q_hit[i]) * (m_corr) + q_corr$$

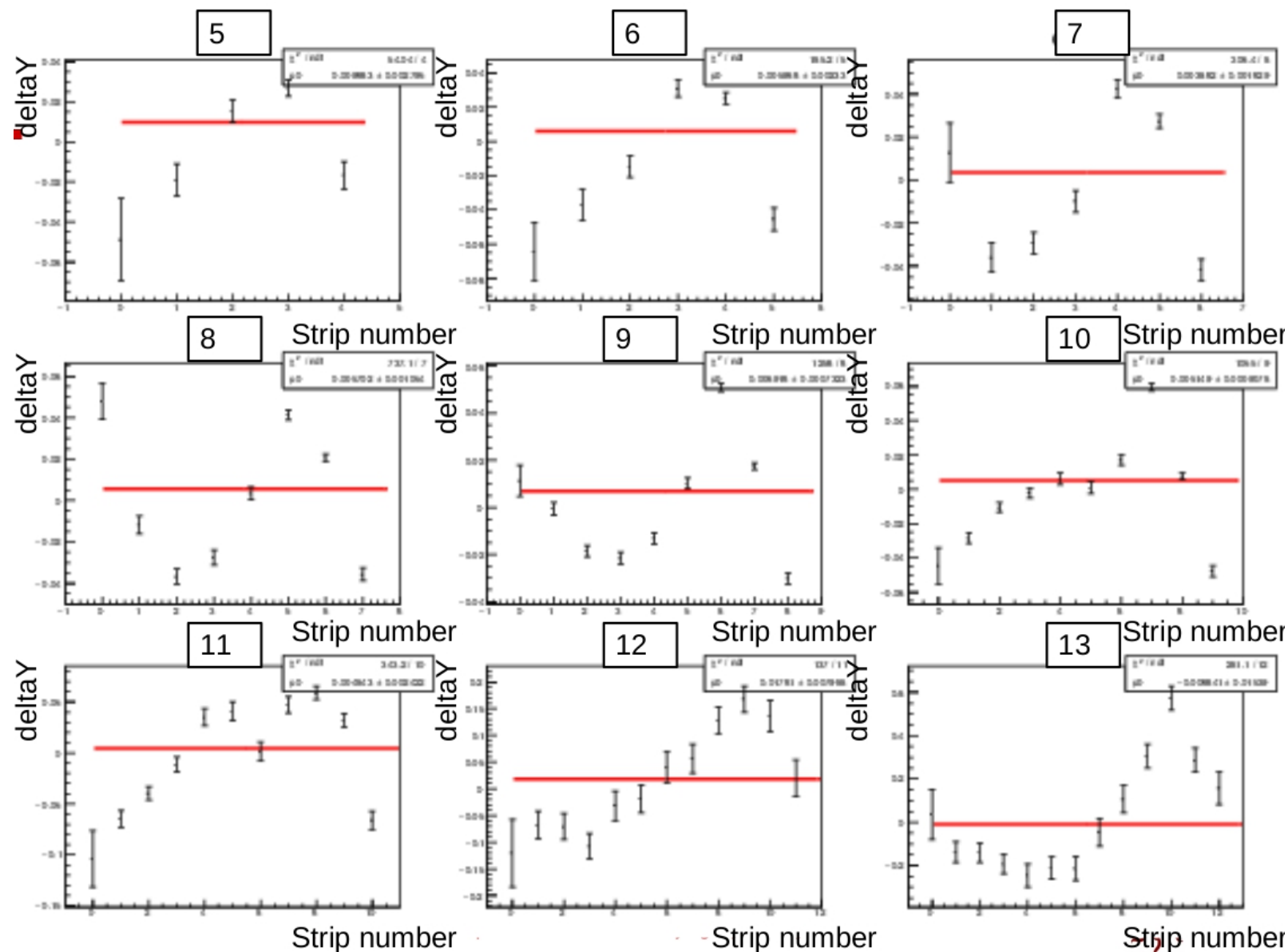


Capacitive corrections

Data from planars
testbeam

This slide shows the ΔY as a function of the strip in the cluster as function of the cluster size (from 5 to 13).

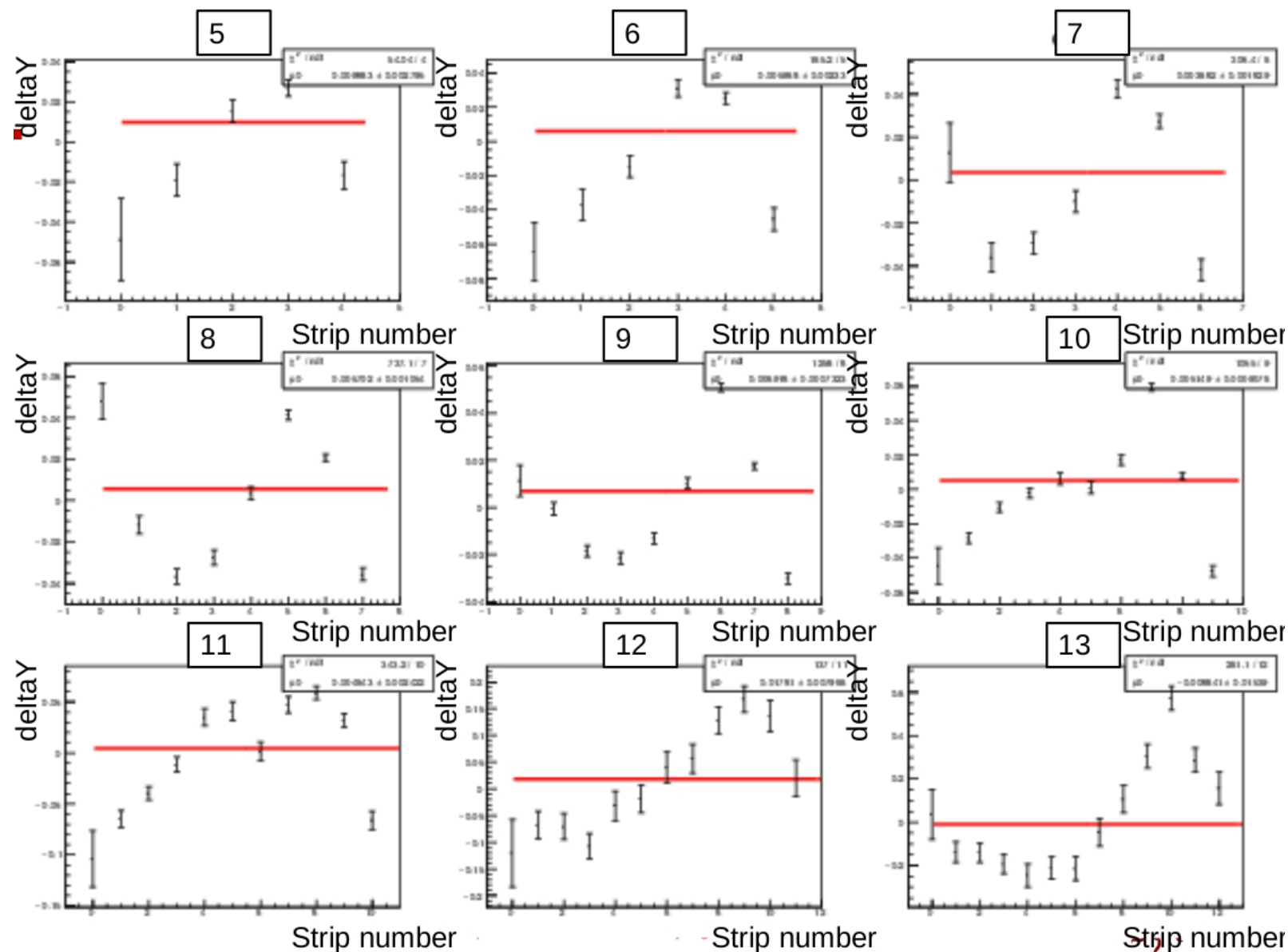
The red line shows the mean value of the “global_ΔY” for each cluster size. It’s mean value has to be zero.



The third correction starts from the plot on shown there (I did find a proper slide).

It performs a linear fit from these plots: ΔY vs strip_position_in_the_cluster then it evaluates the linear parameter (m and q) as a function of the cluster size.

This is the third correction.



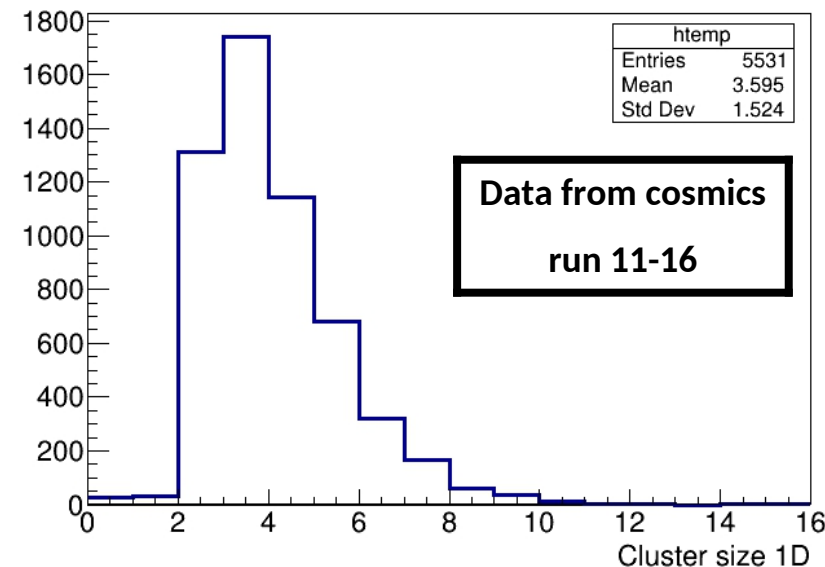
Do we need to fix the time calibration to start this study?

Do we need to update my code in CgemClusterCreate?

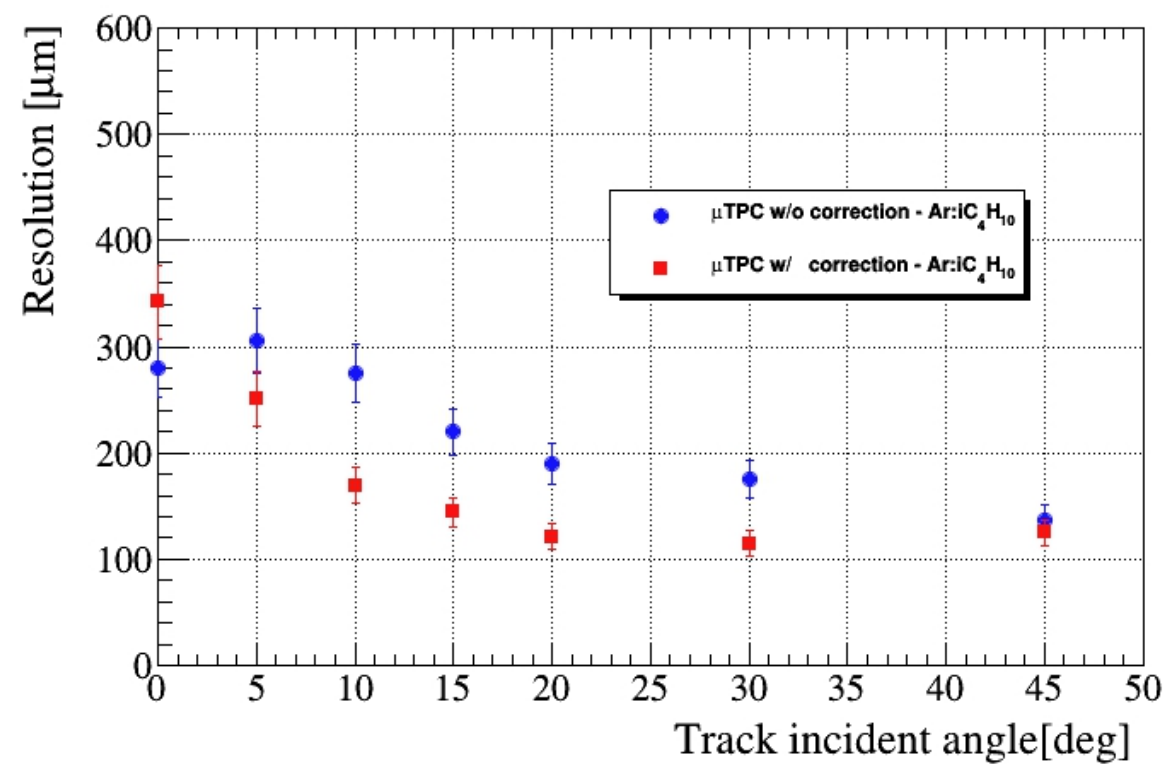
To start these studies we need to implement some variables in the CgemDigi Collection or something similar.

Is it possible to perform those studies in a data-driven way?

- > The statistic and the cluster size range is small
- > we need to define the calibration to merge different runs

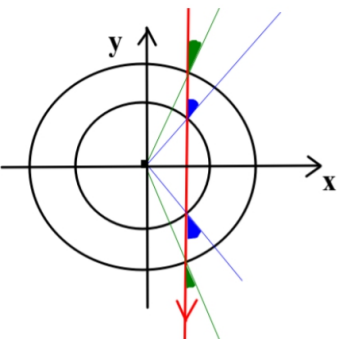


ASD



Thanks

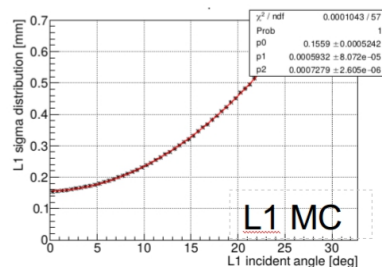
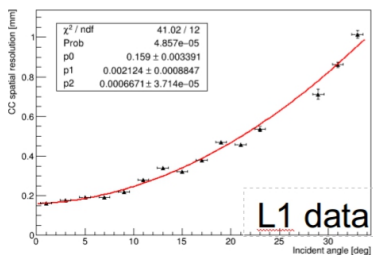
Toy simulation



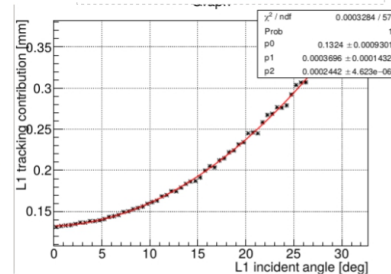
1. Randomize the position of the cosmic ray [0, R_L1]
2. Smear the track incident angle of 0.36 deg (from Marco's calculation) for L1down and L2down
3. Evaluate the expected CC resolution at the impact point using the function

$$CC_res = 80 \mu m + 3.0 \mu m/deg * angle + 0.65 \mu m/deg^2 * angle^2$$
4. Smear the four point on the X direction and extract the corresponding Y
5. Use three point to reconstruct the track and measure the residual distribution and the contribution of the tracking system = $\sqrt{\sigma_{recon}^2 - \sigma_{true}^2}$

The function used to evaluate the CC_res has been calculated in order to match the reconstructed CC_res in the MC data with the experimental data below 20μm



Contribution of the tracking system on L1



Toy results

1. The thrend of the contribution of the tracking system now is reasonable with respect to the one shown on April 8
2. This results is important to understand the behavior of the μTPC once the incident angle is larger than 15° but it does not explain the difference between μTPC resolution of the CGEM and the planar GEM. (See next slide.)
3. The MC resolution for L1 matches the experimental data but the MC resolution of L2 does not. L2 seems to be different from L1 or the systematic are not measured properly. A different function could be used to estimate the CC resolution as a function of the angle for L2. (Compare the plot of the previous slide with the one in the next.)
4. The CGEM CC resolution has a parabolic behavior as a function of the angle while in the planar GEM it has a linear behavior. This is not understood.