

LCTPC 2<sup>nd</sup> Topical Analysis Meeting  
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# Z resolution and event time

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With contributions from A. Bellerive, S. Ganjour, R. Mehdiyev  
(No recent work)

Z coordinate given by drift time \*  $v_{\text{drift}}$

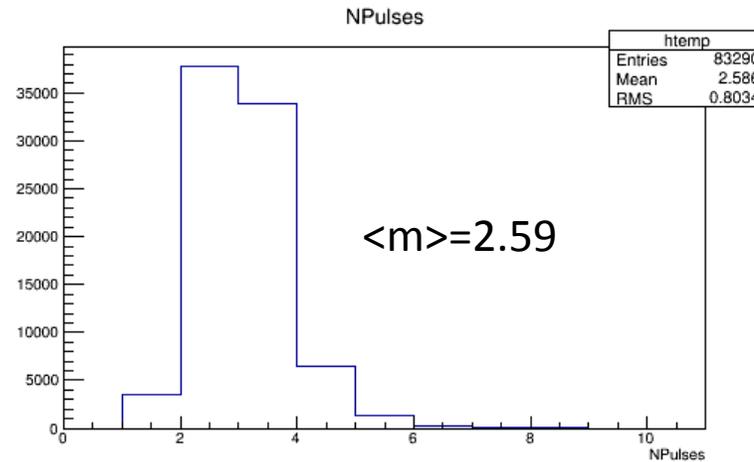
- Origin : t zero
- Every pad is connected to a sampler with a clock (25 MHz, 511 time bins, for tests at DESY with AFTER electronics)
- $V_{\text{drift}}$  can be measured by different methods, or taken from simulation. It slightly depends on the row. It is affected by pressure and temperature variations

# Hit time determination

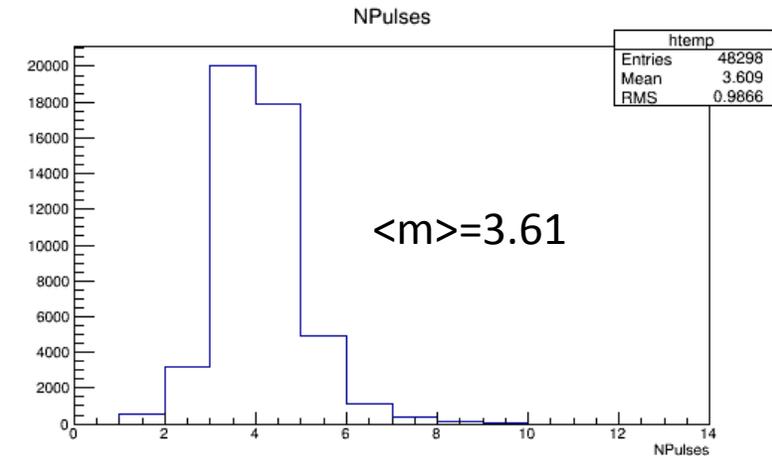
A hit is a cluster of several pads, each having a charge vs time information.

Multiplicity depends on RC per unit surface of the resistive-capacitive anode.

Here 2015 data, 100 ns shaping



**Carbon-loaded kapton**



**Diamond-Like Carbon (DLC)**

# Hit time determination

Several estimators of the hit time (implemented in Marlin, Rashid Mehdiyev)

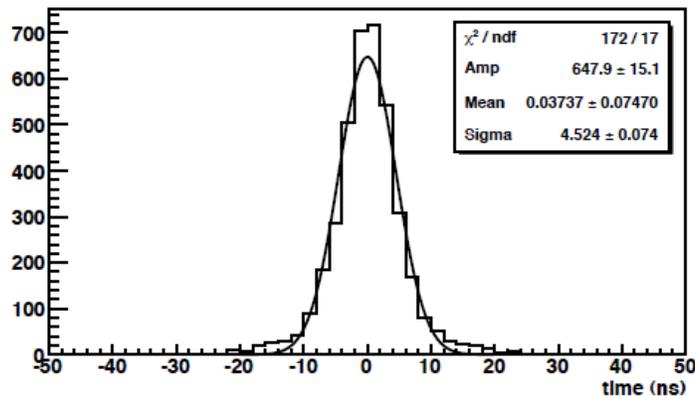
- Max bin (very crude)
- Max bin fitted
- Half-max bin
- Weighted mean
- Gaussian inflexion

$$Q(t) = \int I(t) dt \approx \frac{1}{\sigma_L \sqrt{2\pi}} \int_0^t \exp \left[ -\frac{1}{2} \left( \frac{t-t_0}{\sigma_L} \right)^2 \right] dt$$

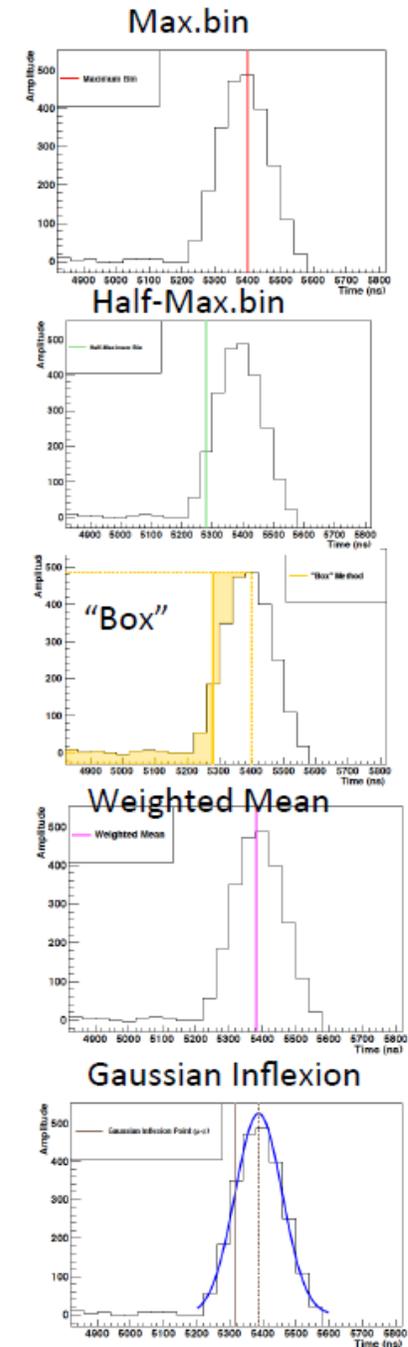
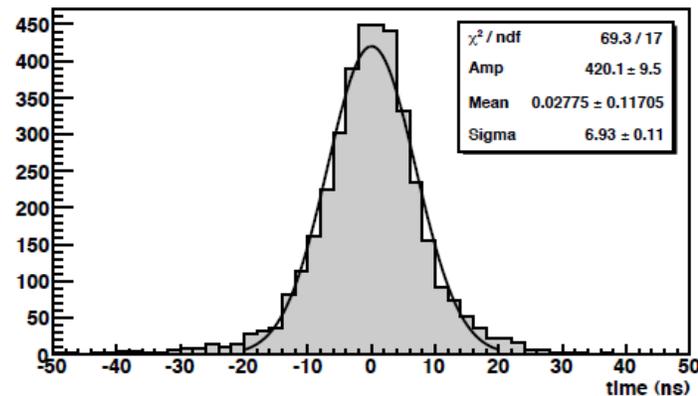
Fit an helix through the hits

Calculate z-residuals of the hits to the helix

Sigma of the residuals is your z resolution (geometric mean between inclusive and exclusive residuals)



## Example of COSMO data

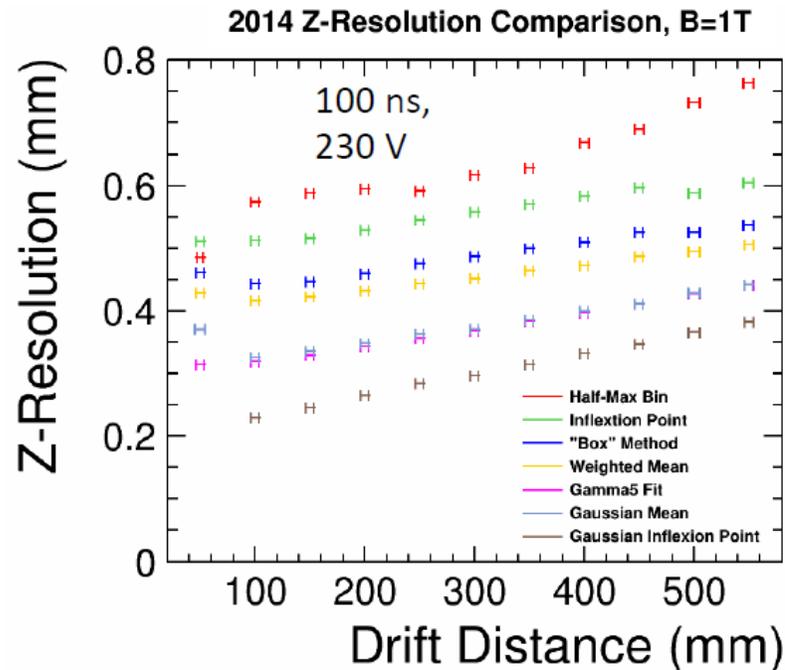
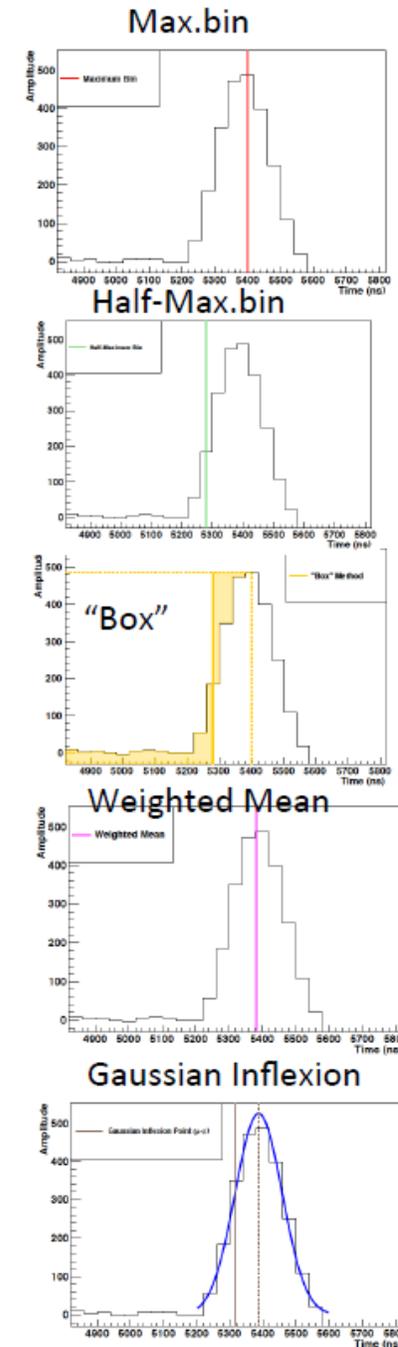


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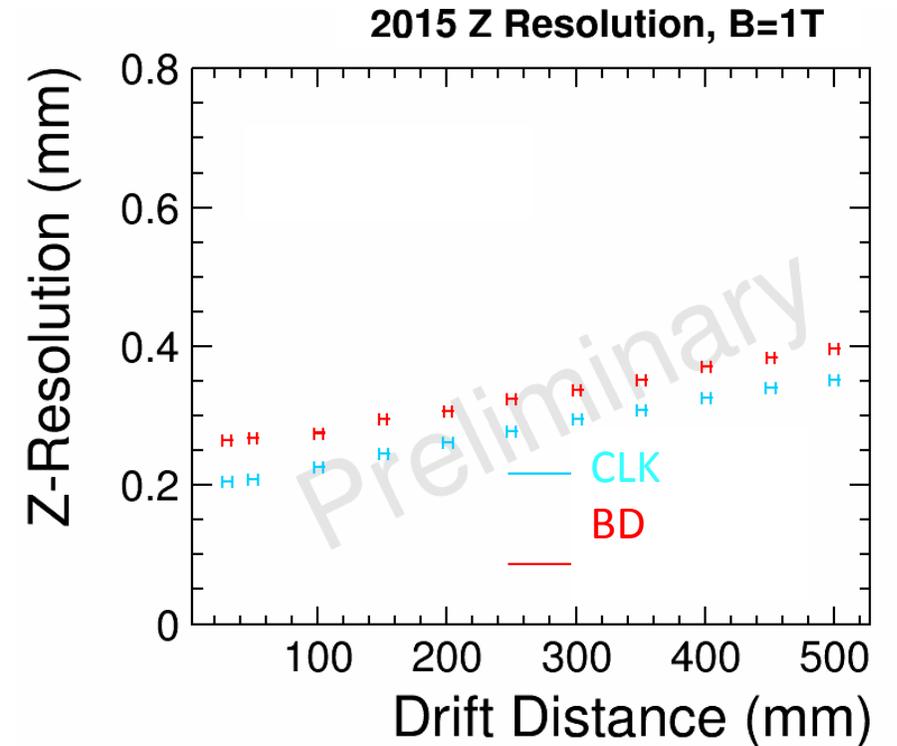


# Results

z resolution is better for CLK than for DLC ('Black Diamond')  
(CLK : 200  $\mu\text{m}$  ; BD: 250  $\mu\text{m}$  – at zero drift distance)  
This corresponds to a time resolution of 2.9 ns per hit

DLC is found to spread more the charge than CLK, so it has a lower RC.

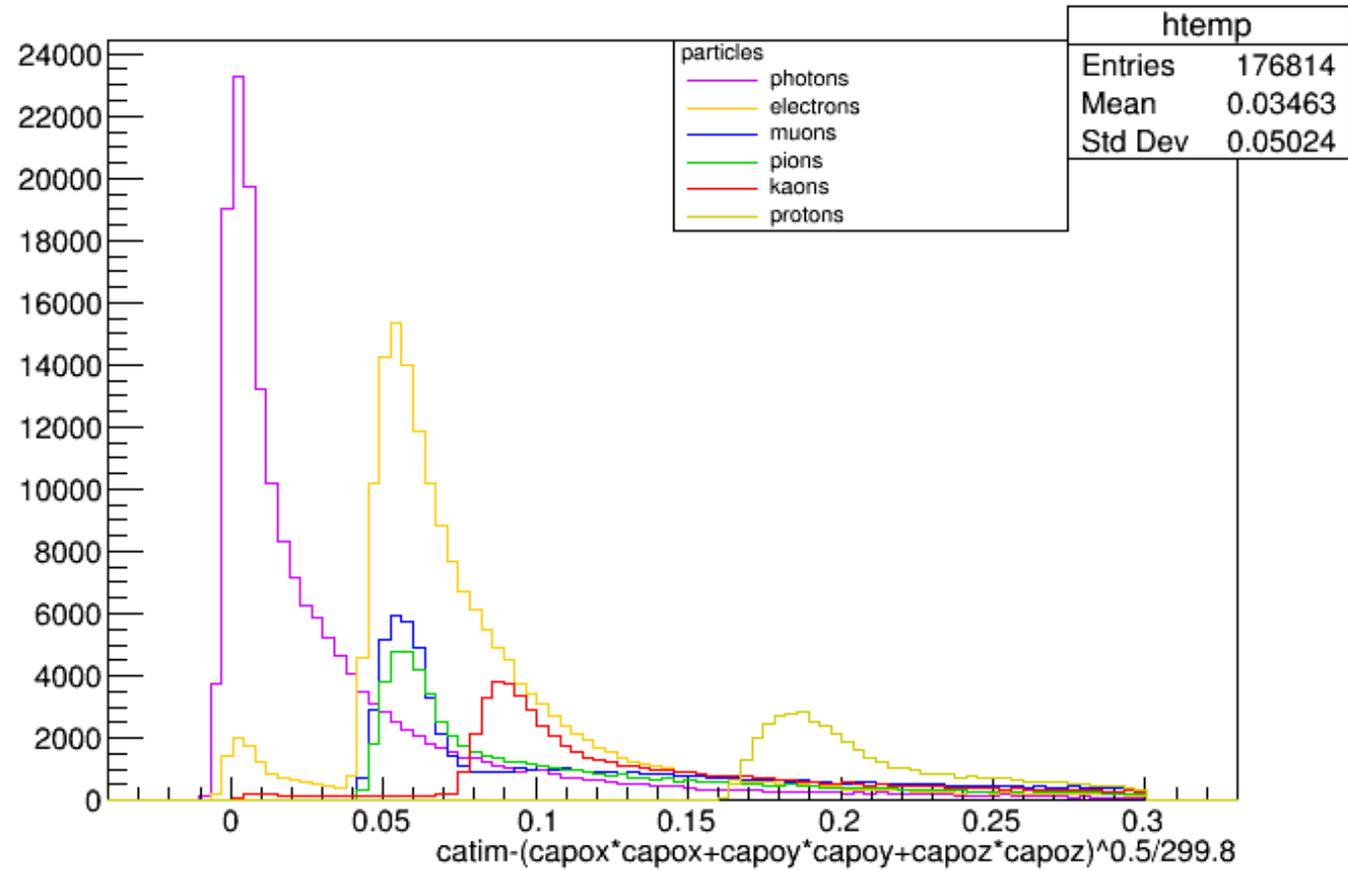
Effective number of electrons is rather low (9 instead of 35 as obtained from  $r$   $\phi$  resolution vs  $z$ ). Not clearly understood



# EVENT TIME

- Assuming independent hits, the resolution on the time of a track of 200 hits is 0.2 ns : not enough to distinguish various particle, but very useful for matching with silicon hits (SET especially) and thus get a TPC event time.

F. Gaede, calorimetric hit time from MC truth



# Conclusion

- Z-coordinate resolution can be as good as 200  $\mu\text{m}$  (much better than requirement)
- If the 200 hits on a track are independent, the track time resolution is  $3\text{ns}/\sqrt{200}$ , that is 0.2 ns, offering interesting possibilities