

Time calibrations

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Outlook

- A new code inside CGEMBOSS
- The fitting procedure
- Time-walk and time-reference
- Iteration test
- Preliminary results



A new code inside CGEMBOSS

A new package to measure the time calibrations is under development in a package inside CGEMBOSS

/CgemBossCvs/Cgem/CgemTimeCalibration

Starting from a run (or more runs) it can measure the time-walk and the time-reference values.

These corrections are data-driven. If the setup does not change, those corrections could be on other data-sets.



A new code inside CGEMBOSS

The code can operate through two main modes corresponding to the two **outputs**:

- a LUT for the time-reference
- a time-walk table

Despite the two modes, the code **shares** many **functions**:

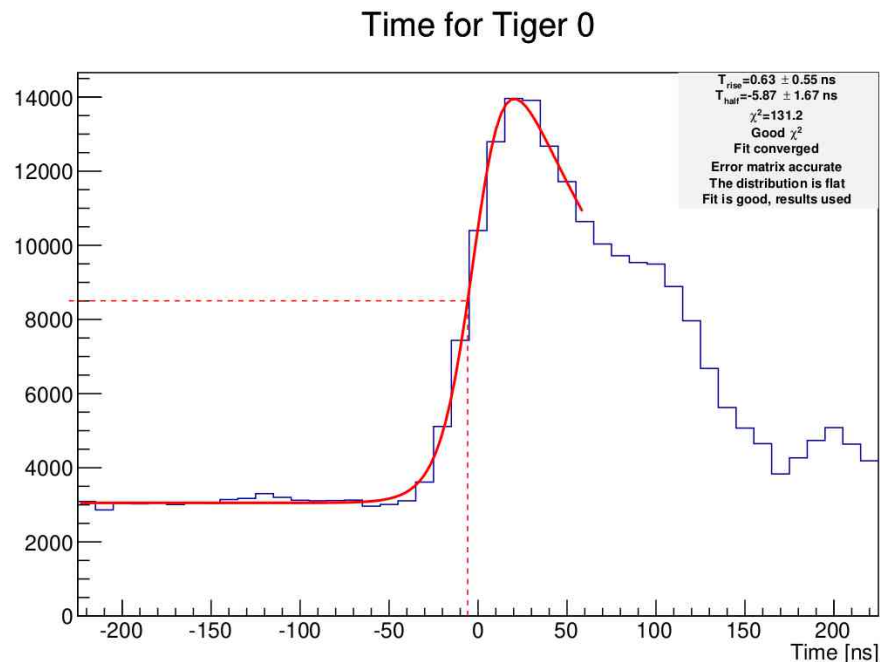
- retrieve the hit time and apply the time corrections
- fill an array for each sub-sample of hits, then an histogram (i.e. $1fC < \text{threshold} < 2fC$; $5fC < \text{charge} < 10fC$)
- time fit procedure and goodness evaluation



Fitting procedure: first analysis

At first the histogram is analyzed to extract the parameter of interest **without** a **fit**:

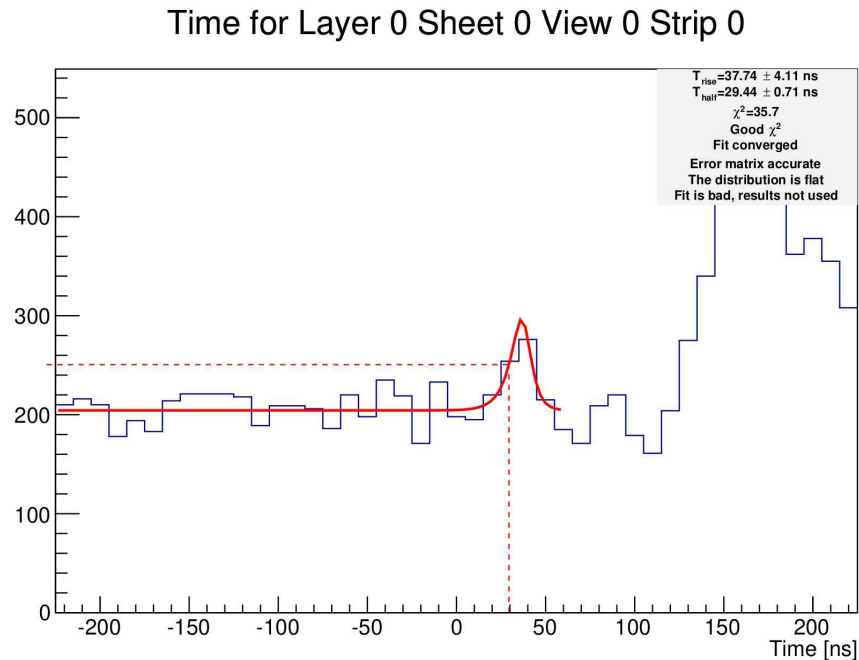
- time at maximum
- time at half maximum
- baseline in the time region [-225,-100] ns
- range fit for the function $[0] + [1] \cdot \text{TM} \exp(-[2] \cdot (x - [3])) / (1 + \text{TM} \exp(-(x - [4]) / [5]))$



Fitting procedure: first analysis

At first the histogram is analyzed to extract the parameter of interest without a fit:

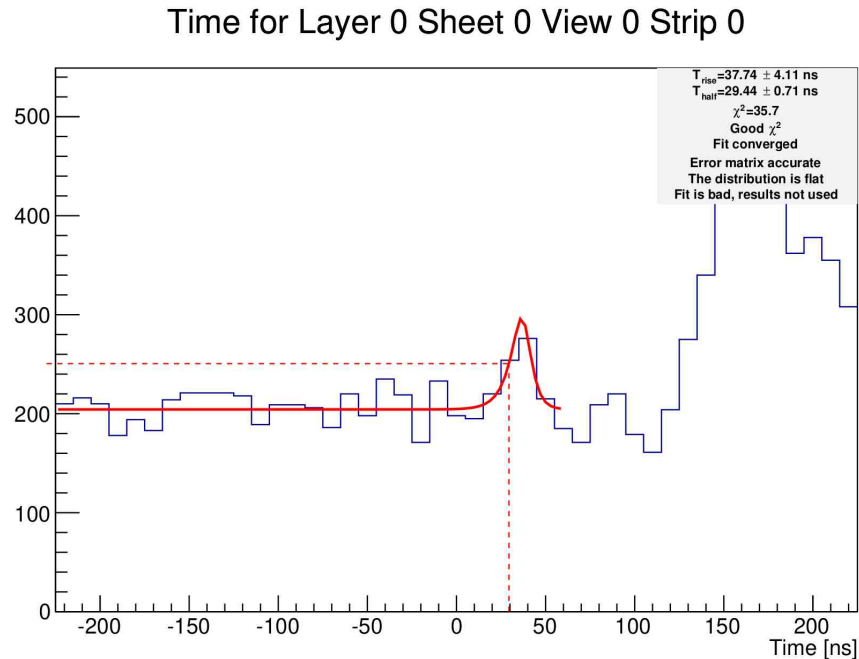
- time at maximum
- time at half maximum
- baseline in the time region [-225,-100] ns
- range fit for the function $[0]+[1]*\text{TMATH}::\text{Exp}(-[2]*(x-[3]))/(1+\text{TMATH}::\text{Exp}(-(x-[4])/[5]))$



Fitting procedure: removing flatness

Then a line is used to fit the time range [-225,50] ns.

The Chi2 is used to discriminate flat distributions to the proper ones.

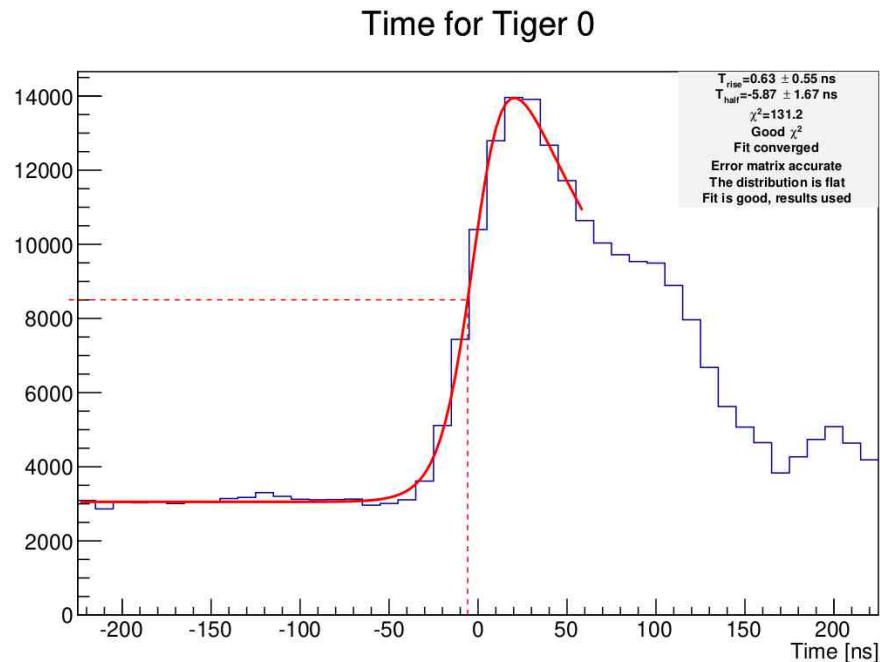


Fitting procedure: Chi2 and error matrix

The plot is fitted without any parameter limits with using Minos fitting algorithm.

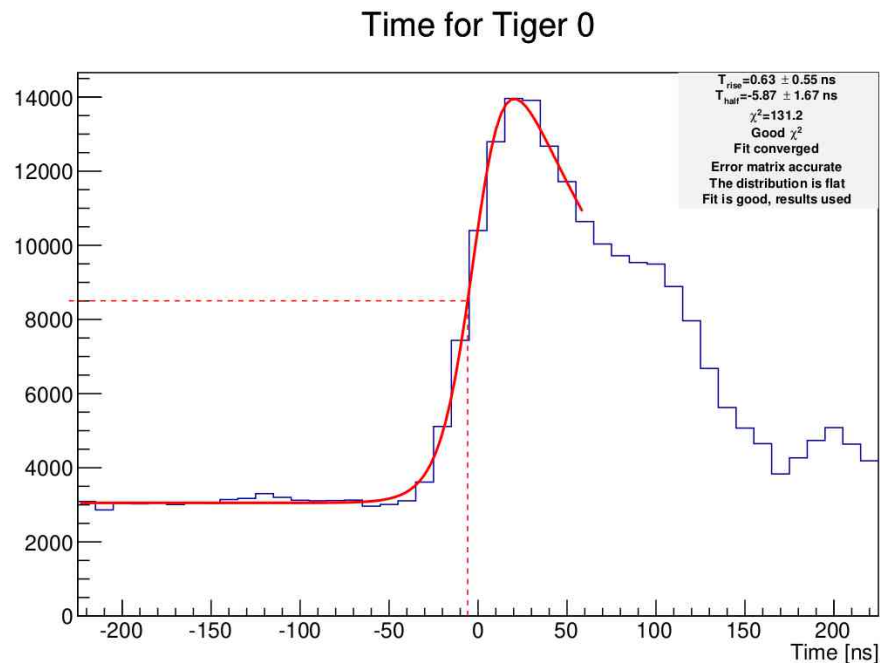
Fits with a **Chi2** larger than 1000 are rejected.

Fits without errors (i.e. **convergence**) and with an accurate **matrix** error are used for the corrections.



Fitting procedure: time value

The used time value is the one measured at the half maximum.



Time-Walk and Time-Reference

Several loops are used to fill the array concerning those corrections:

- time-walk --> loop on T_branch threshold and hit charge
- time-reference --> loop on the tiger
- time-reference --> loop on the channels
- time-reference --> loop on the channels/tigers with $Q_{\text{hits}} > 30fC$



Fit goodness and success rate

Time-walk:

N time-walk fit : 48

N time-walk good : 35 --> 0.729

Time-reference:

N timeref-channel fit : 5438

N timeref-channel good: 2082 --> 0.382

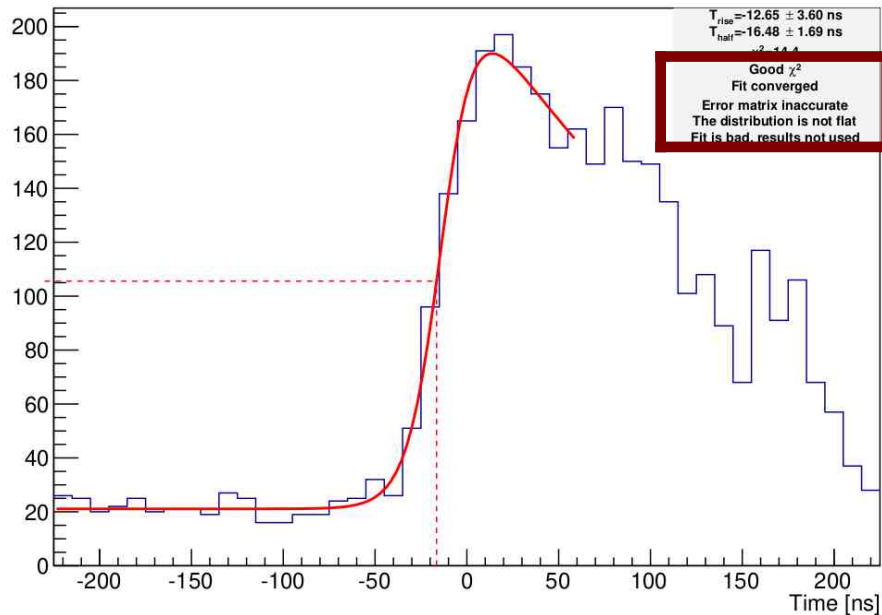
N timeref-tiger fit : 88

N timeref-tiger good : 55 --> 0.625

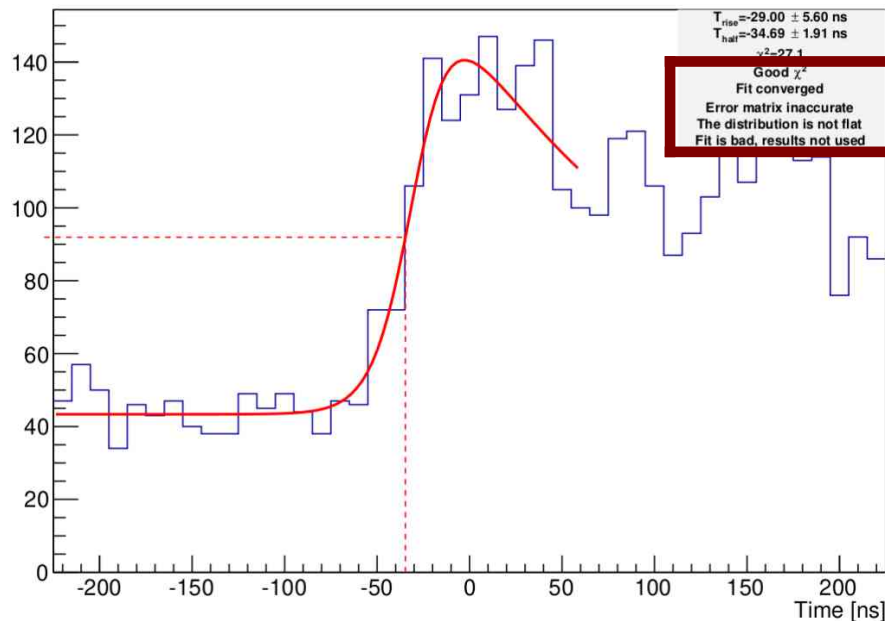


Fit goodness and success rate

Time for Layer 0 Sheet 0 View 0 Strip 328



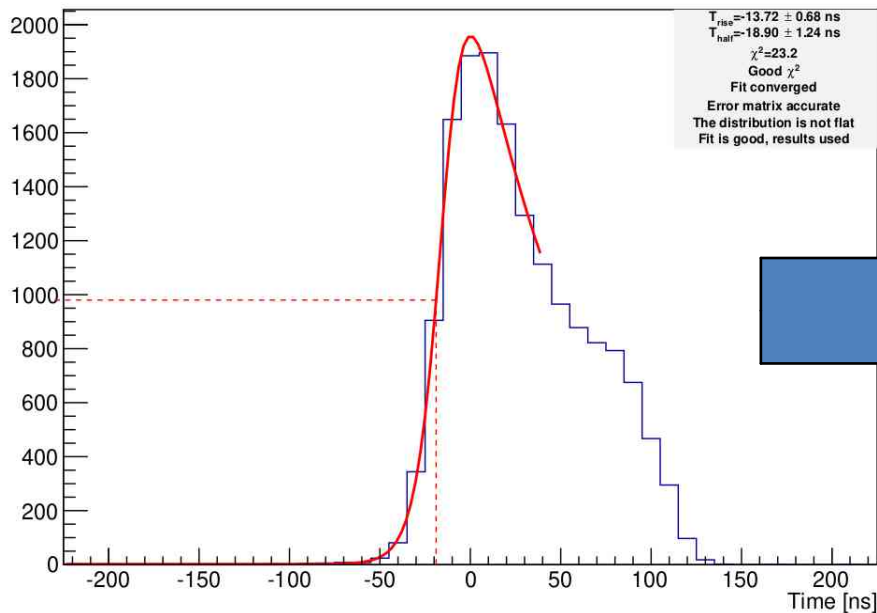
Time for Layer 0 Sheet 0 View 0 Strip 5



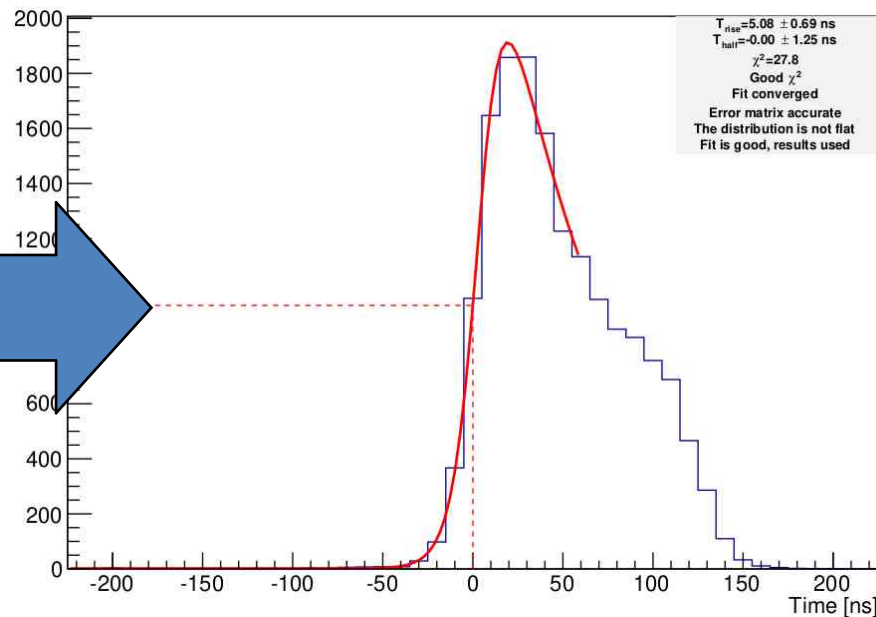
Even if the fits seem good, they are **rejected**. More investigation will occur

Convergence test: time-reference & high charge

Time for Tiger 2

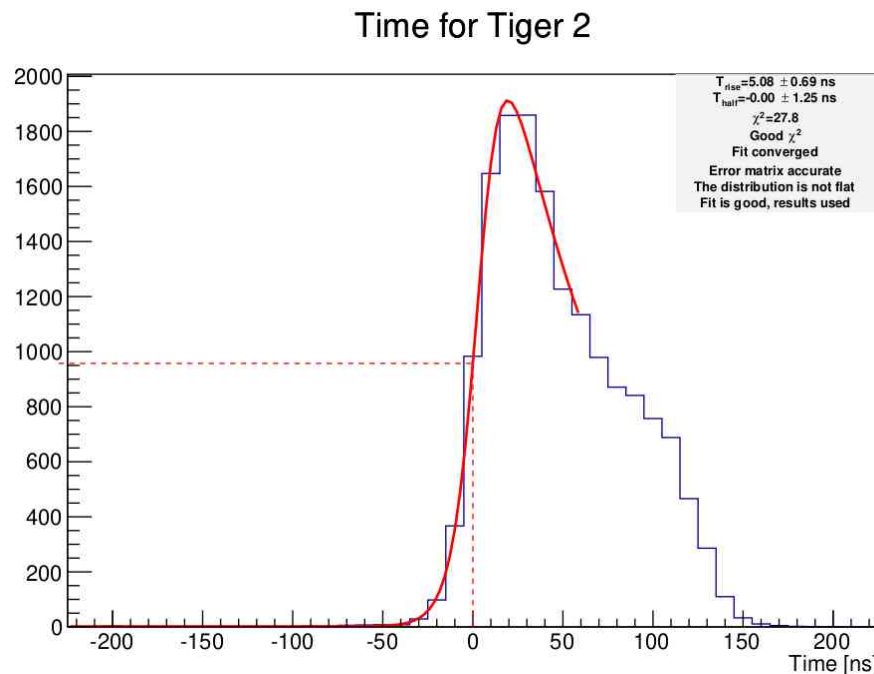


Time for Tiger 2



Convergence test: time-reference & high charge

If the fit of the plot is good in each iteration then the time correction to apply in each round goes to zero and the time at half maximum goes to zero too.



Convergence test: other tests

The following tests have been performed:

- time-walk --> not converge
- time-reference on tiger --> partially converge
- time-reference on channel --> partially converge

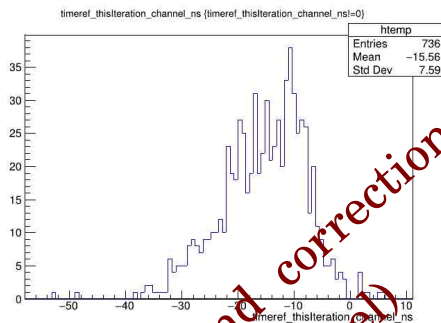
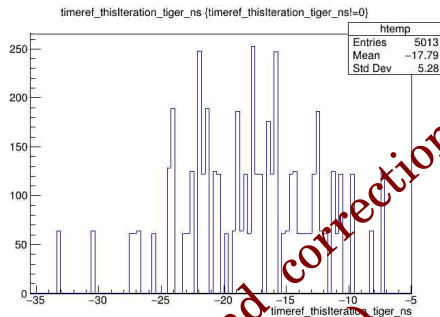
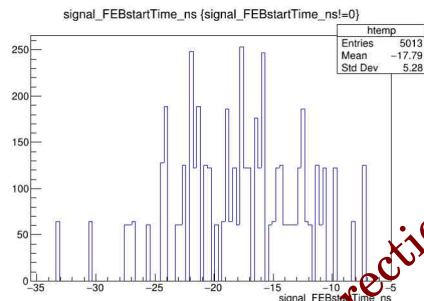
The histograms with a convergent correction need **only 2 iterations**.

The convergence has been tested up to 20 iterations for each case.

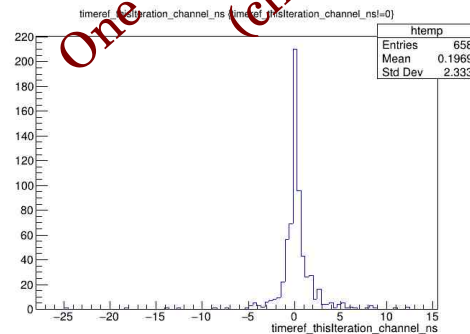
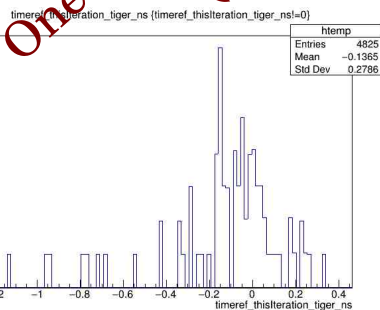
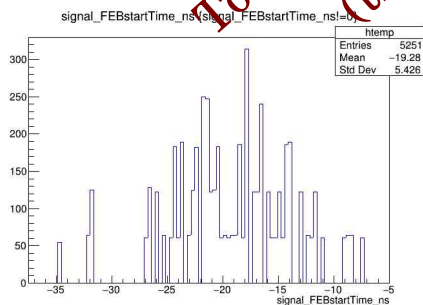


Preliminary results: time-ref & high charge

First round



Second round



Conclusion

A new code to measure the time correction for each run of our data-sets is under development inside CGEMBOSS.

The algorithm take care about time-reference and time-walk. The time-propagation will be investigated in a second time.

The number of fits to perform is large then a very nice fitting procedure and goodness evaluation is needed.

Now the success rate of the fit is not optimal and only partial results can be achieved.

The next task will be addressed to improve the success rate and to test the convergence for each case under needed for the time corrections.

Then the impact on the μ TPC resolution will be evaluated.



Thanks

