# CGEM Software update

*I. Garzia, S. Spataro*

Who did the slides

Who is bothering you right now

March 5, 2021

# Announcement

用户，您好。

/workfs因硬件老旧，即将退役。请尽快将/workfs中的个人数据迁移到对应的/workfs2目录中，/workfs2的使用规则与/workfs的规则一致。

预计3月31日/workfs下线，不再提供访问。

如有问题，请联系我们。
Email: helpdesk@ihep.ac.cn; ihep_computing_service@ihep.ac.cn
电话：88236855

计算中心

==========

Dear user,

/workfs will be retired due to the old hardware.Please migrate your own data from /workfs as soon as possible!

The user needs to migrate personal data from /workfs to /workfs2. /workfs2 keeps the same quota rule as that of /workfs.

Please note you will NOT able to access to /workfs after 31st, March.

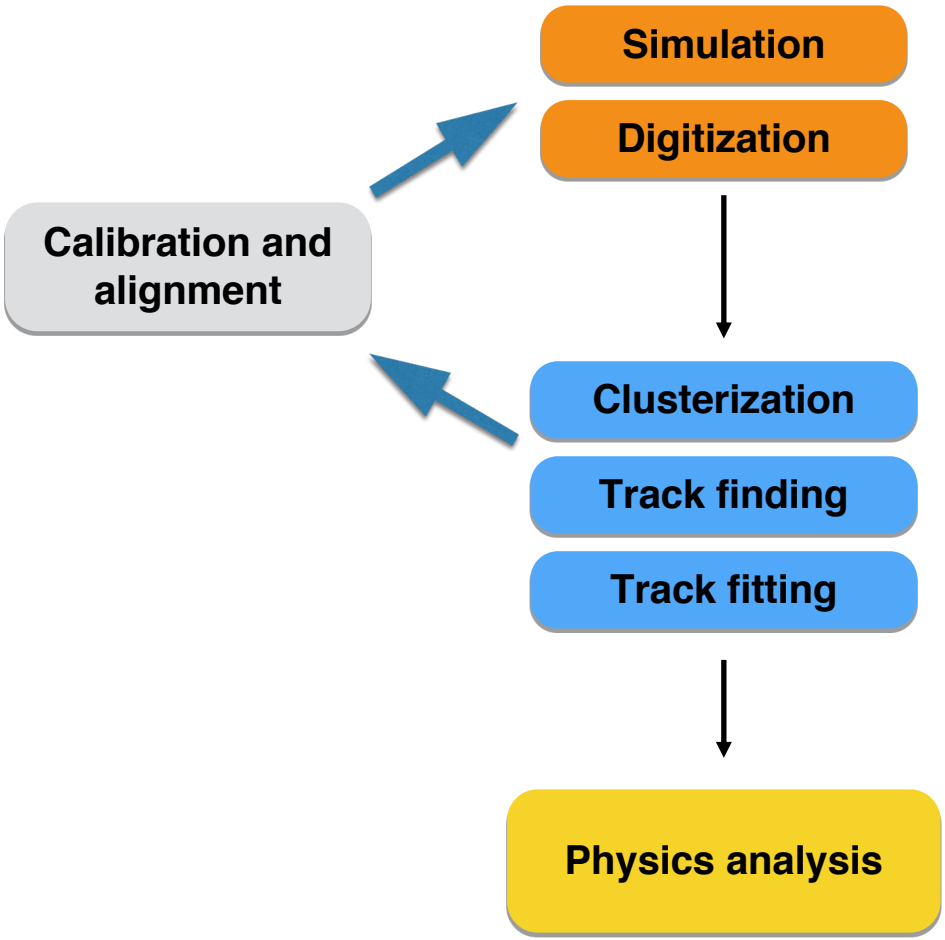
Any questions, please contact us.
Email: helpdesk@ihep.ac.cn; ihep_computing_service@ihep.ac.cn
Tel: 88236855

Computing Center

# Software status and activities

## Cgem BESIII Offline Software System (CgemBoss)

OFFICIAL RELEASE **CgemBoss665f**



# Software status and activities

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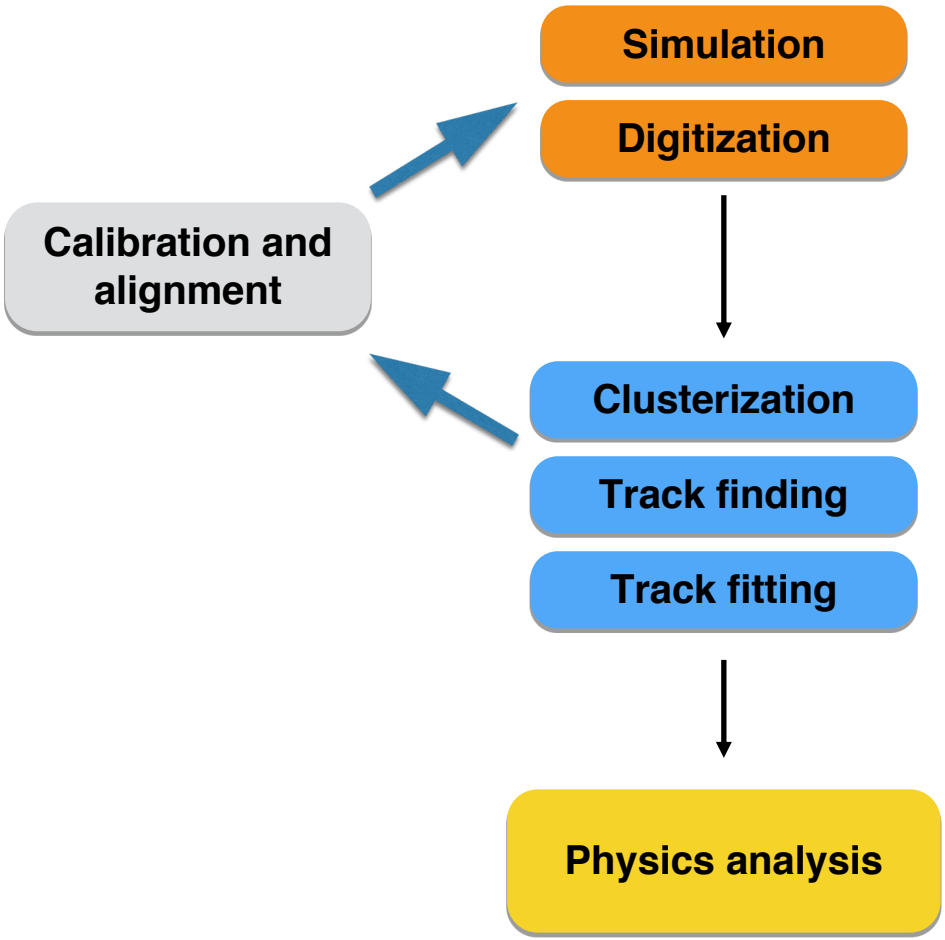



- Material effect studies (DONE)
- New L3 implementation (completed)
- Implementation of electronic details (ongoing)

- Improvement of global tracking algorithm (ongoing)

- Automatic time calibration (almost done)
- CGEM alignment (ongoing)

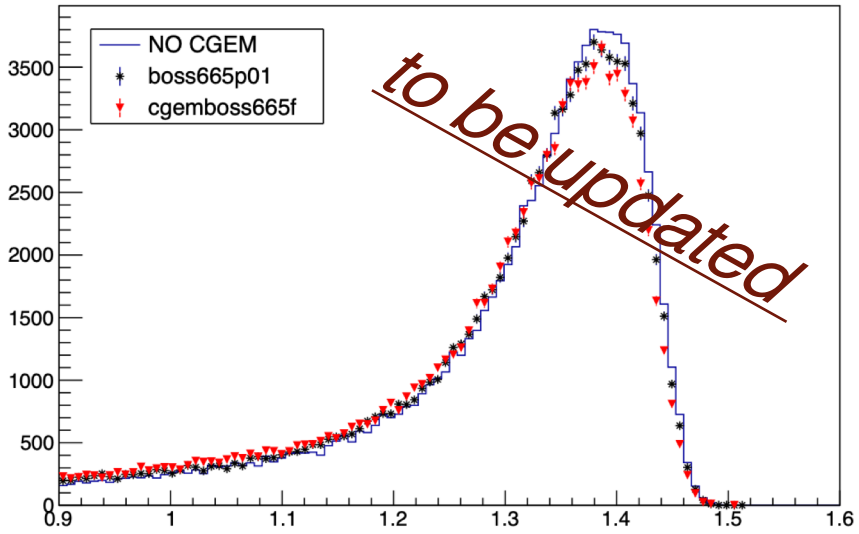
- **COSMIC RAY DATA VALIDATION with CgemBoss (ongoing)**

# CGEM Geometry: material effect studies

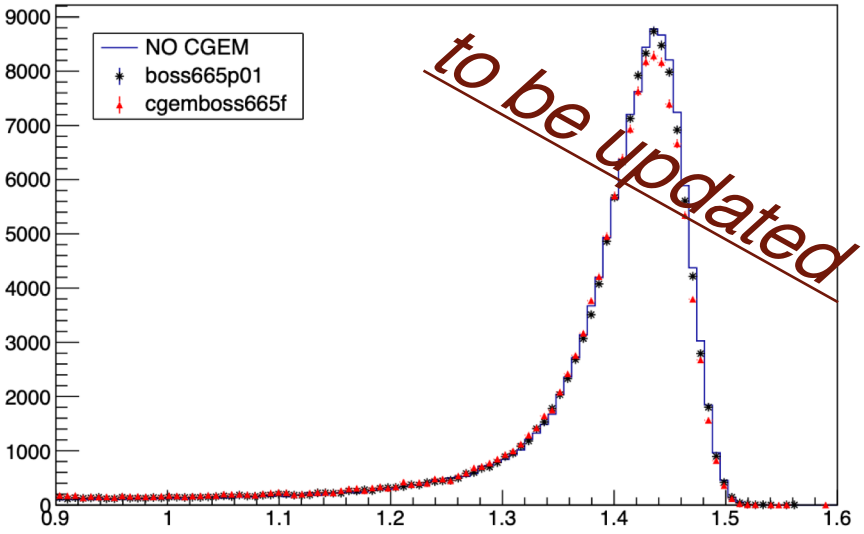
- "geantino" used to check the radiation length (simulated vs. expected)
- 100000 bhabha events

```
Babayaga.Ebeam=1.5485;            // Ecm = 2*Ebeam [GeV]
Babayaga.MinThetaAngle=16;        // minimum angle(deg.)
Babayaga.MaxThetaAngle=164;       //maximum angle(deg.)
Babayaga.MinimumEnergy=0.4;       //minimum energy  (GeV)
Babayaga.MaximumAcollinearity=10; //maximum acollinearity (deg.)
```

ENDCAPS




BARREL




Endcaps: |cos(theta)|<0.93 and |cos(theta)|>0.83

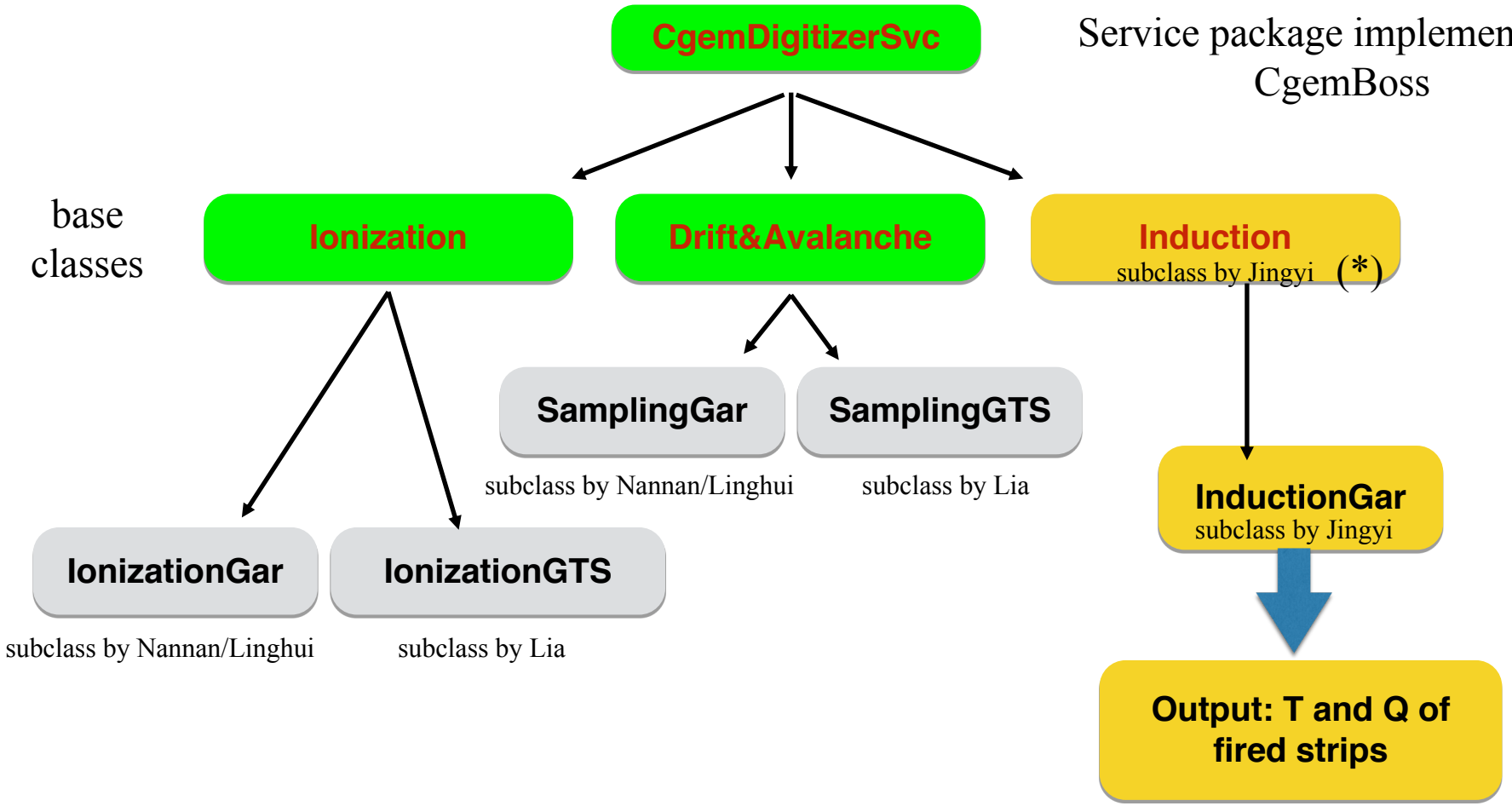
BARREL: |cos(theta)|<0.83



Isabella

# Digitization

*R. Farinelli, L. Lavezzi, N.N. Miao, L.H. Wu, J.Y. Zhao, L.L. Wang*

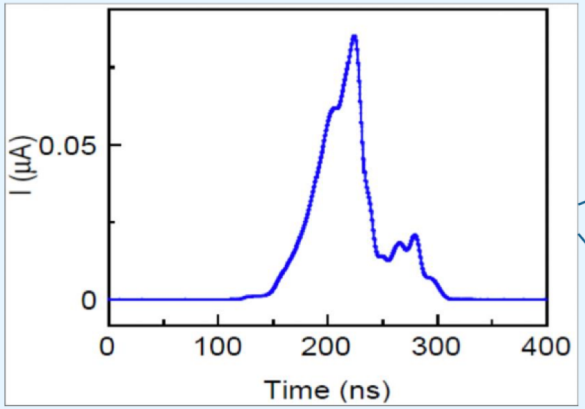


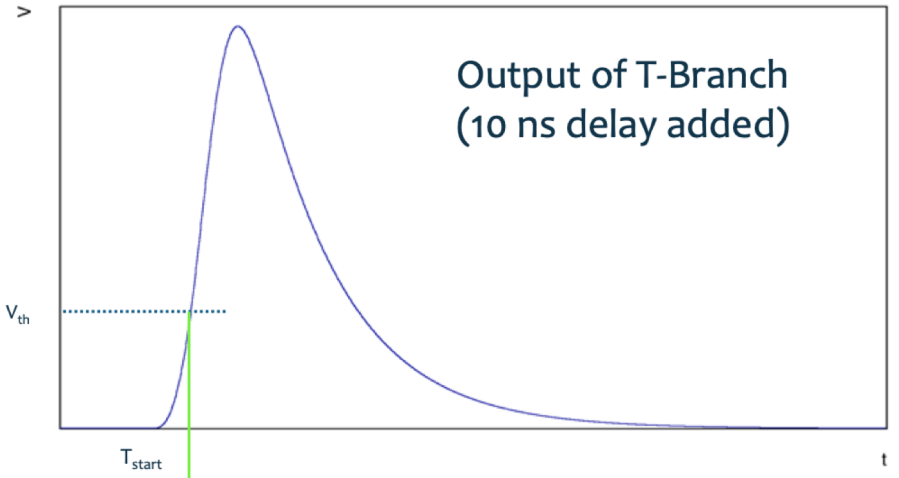

(*) subclass InductionGTS by Lia ready soon

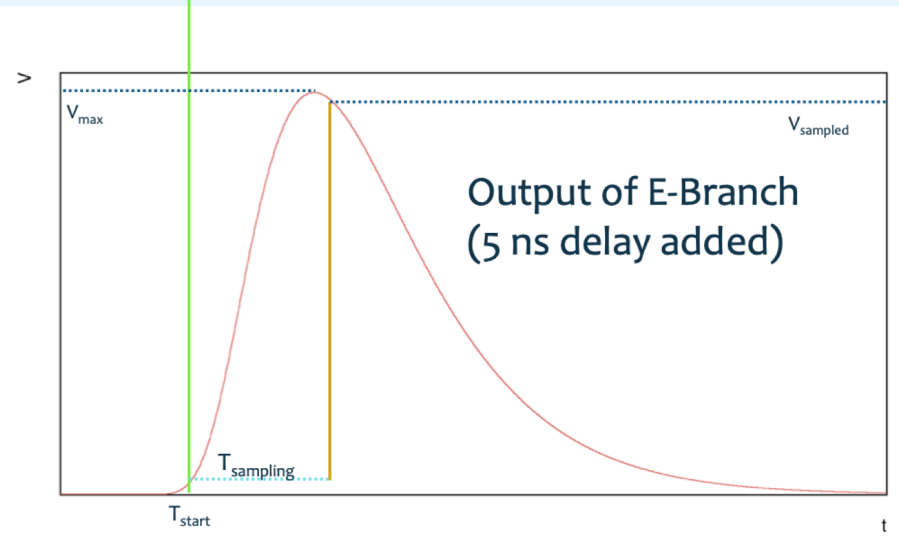
# Ditigization Activities restarted @ IHEP

## E-branch trigger

A typical input current



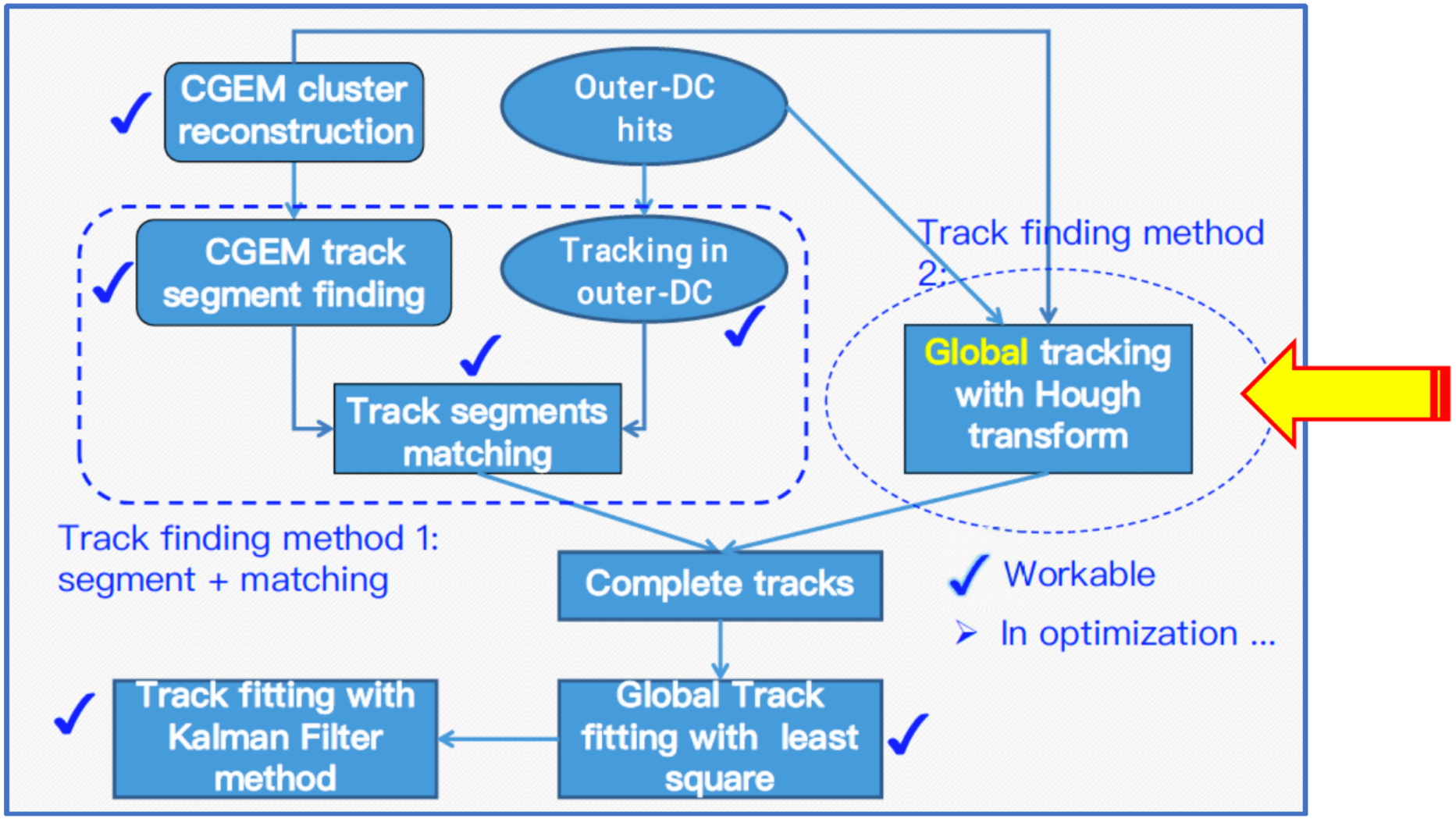




- Maximum voltage exceeds threshold
- Sampling start given by T-branch discriminator
- Sampling time is integer multiples of 25ns (default 175 ns same as in cosmic-ray data taking, 150 ns used in this talk)
- $V_{sampled}$ is close to $V_{max}$

Hang Zhou (USTC)

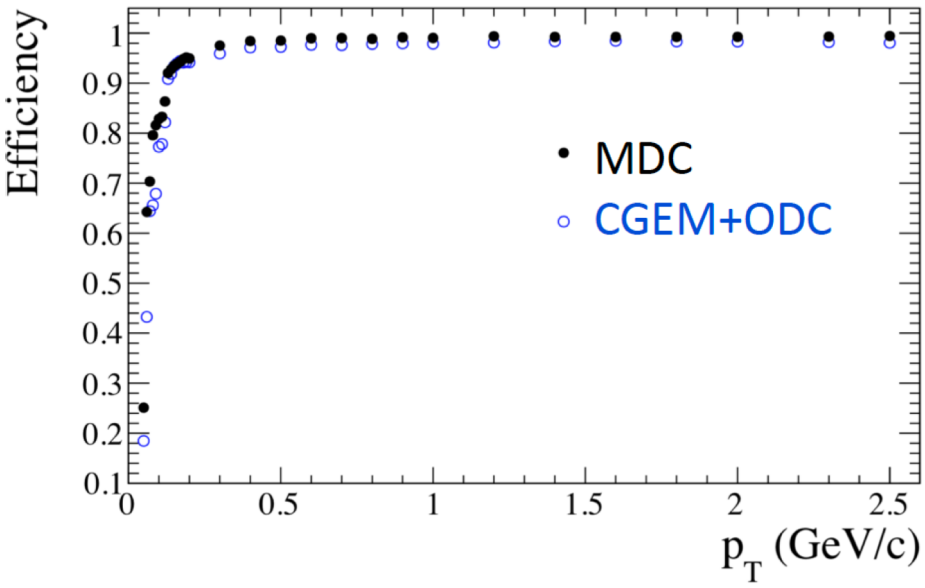
# Global reconstruction

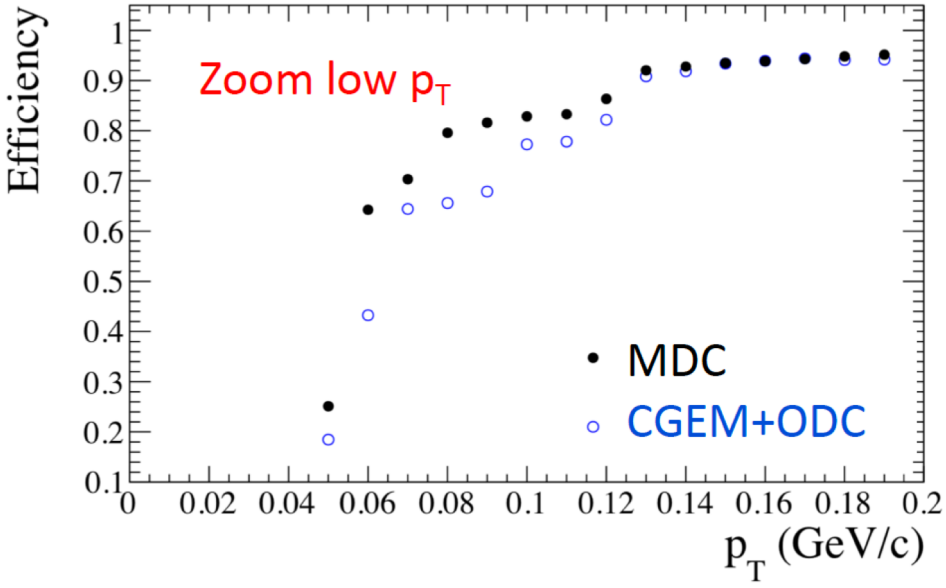


# Global Tracking Characterisation

- From previous update in September (shown by Stefano Spataro)

## Single pion Efficiency



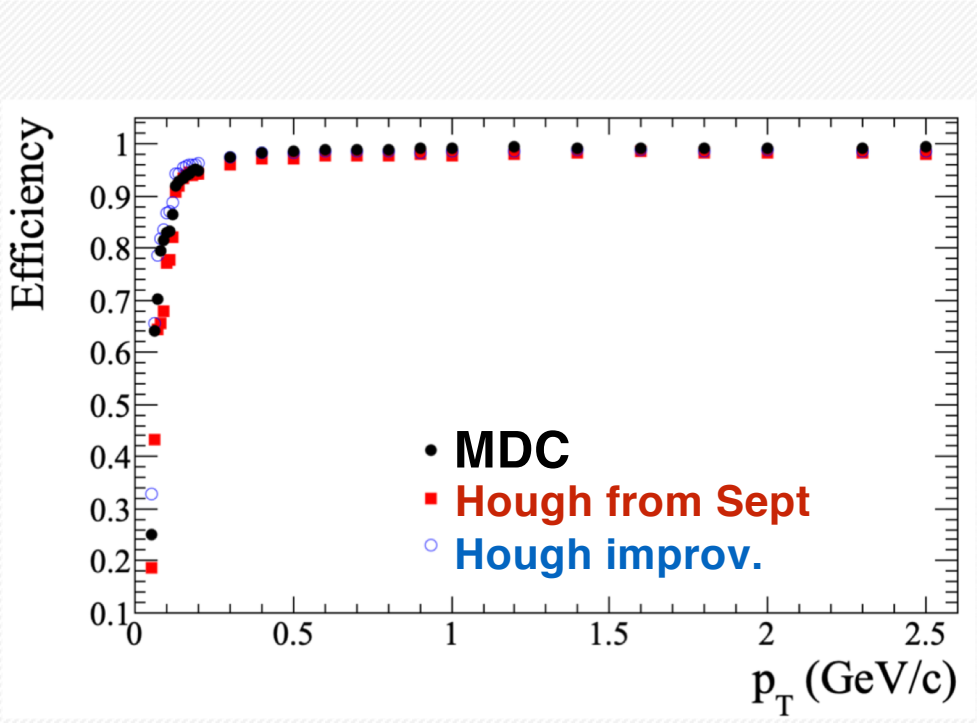

Efficiency comparable to MDC case, a bit lower at low $p_T$, there is room for improvements

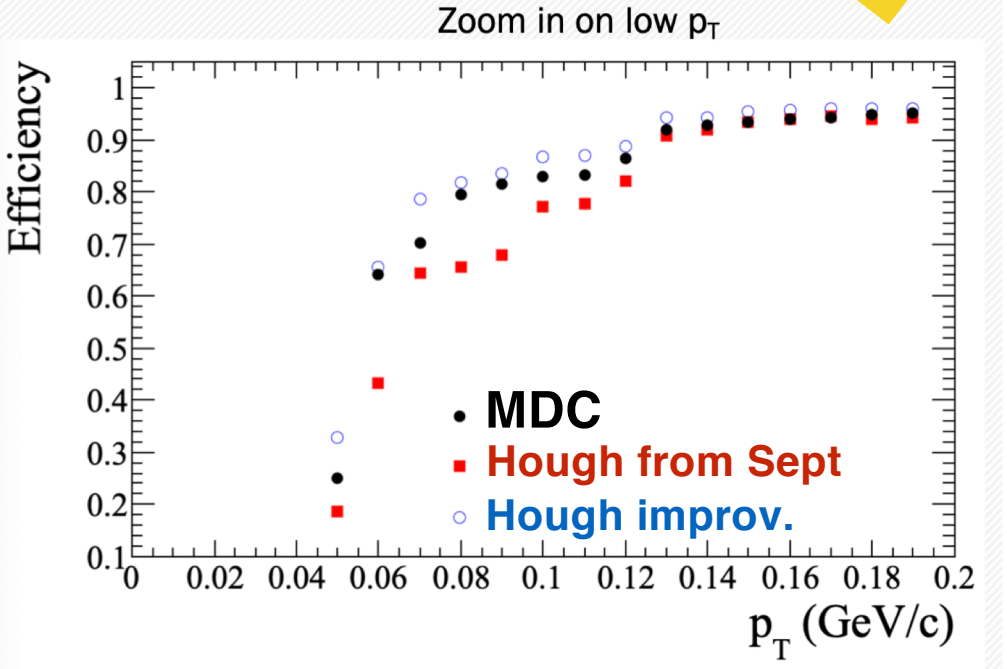
*LL Wang*

# Global Tracking Characterisation

## Single Pion Efficiency

NEW



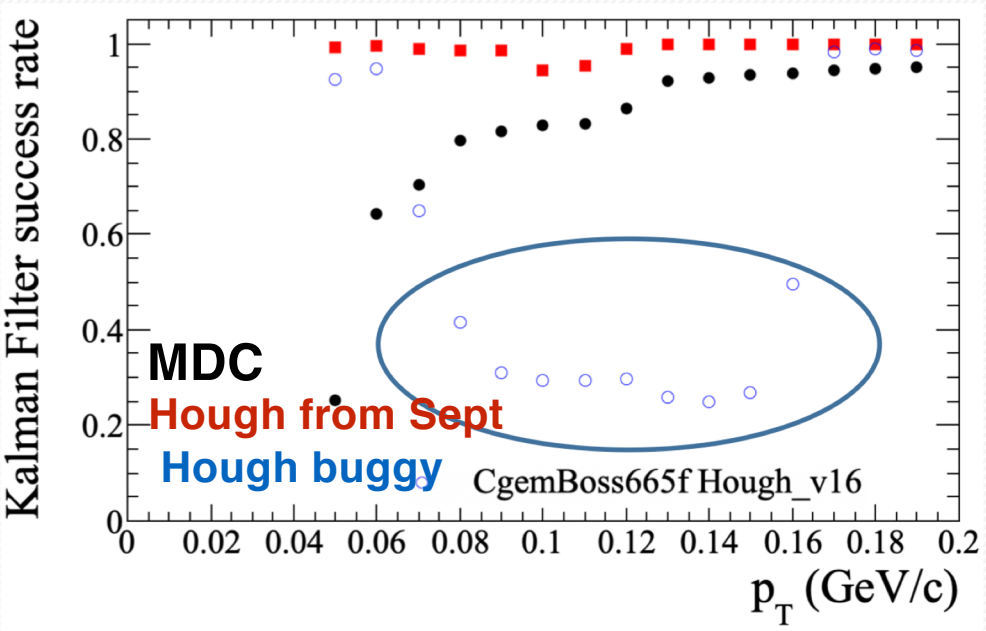



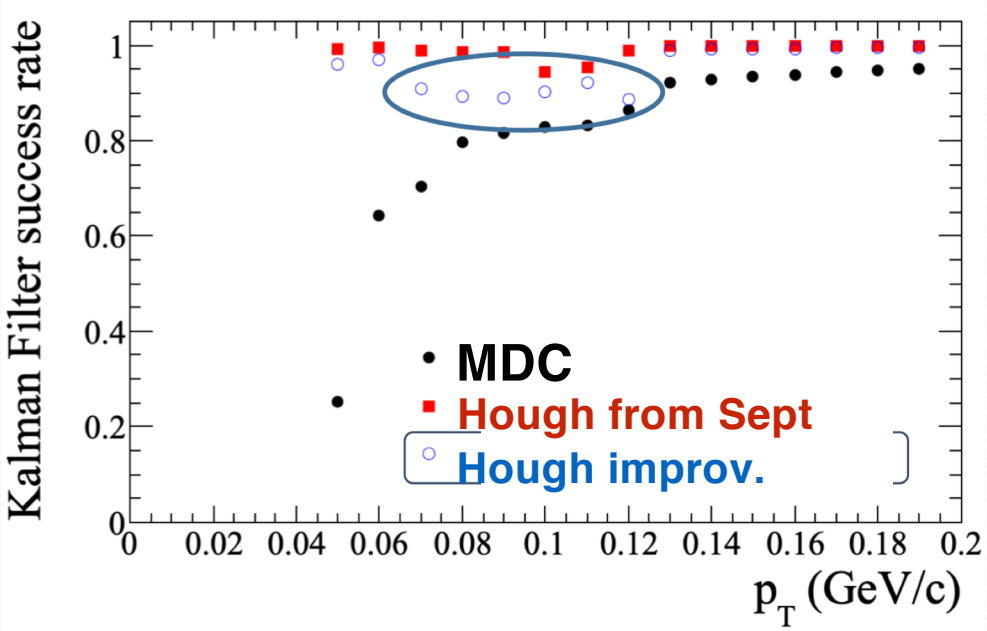

*LL Wang*

# Global Tracking Characterisation

## Kalman filter success rate for good $\pi^-$ track

Zoom in on low $p_T$



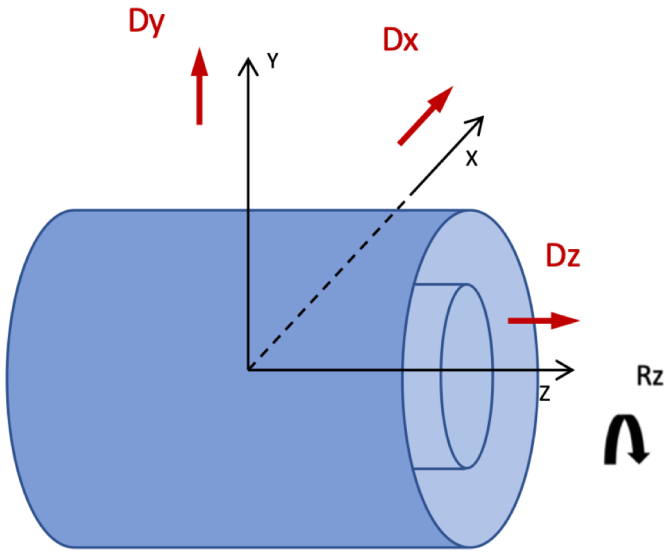

Success rate = $N_{success}/N_{good}$

*LL Wang*

# Alignment

- Mis-alignment information extracted by fitting the track with least-square method
- Select four cluster combinations with the best 3D line fit as good cosmic ray candidates

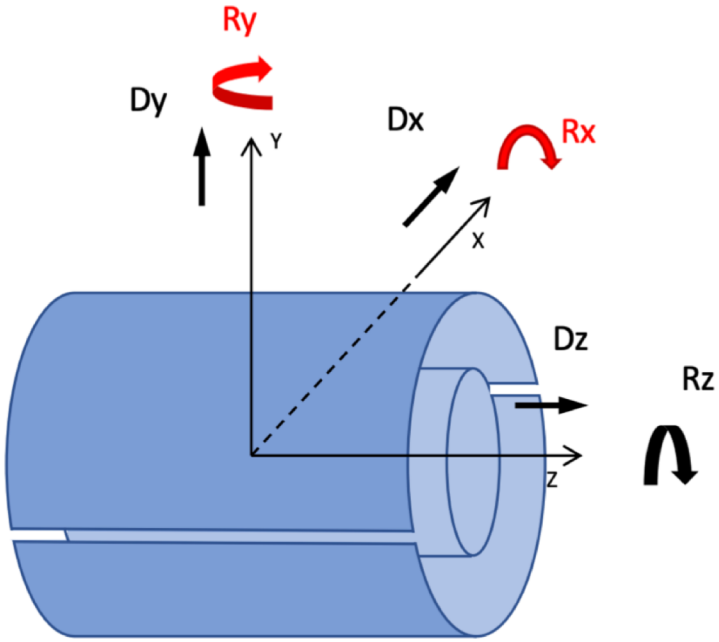
- 4 parameters
- one sheet for L2




OLD

V.S.

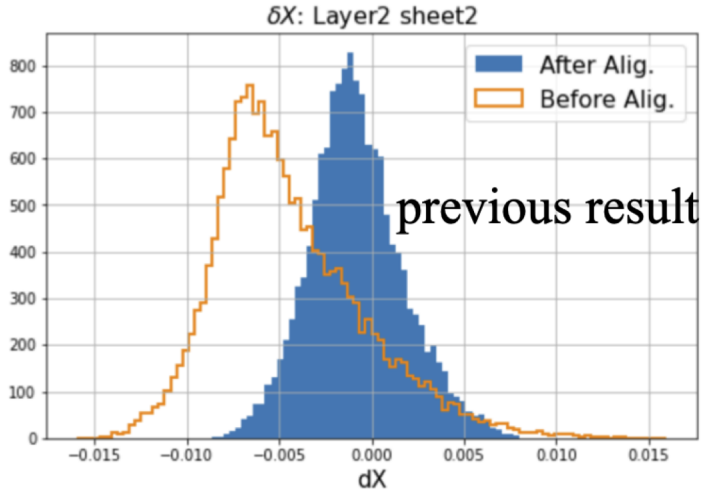
- 6 parameters (Dy fixed)
- two sheet for L2

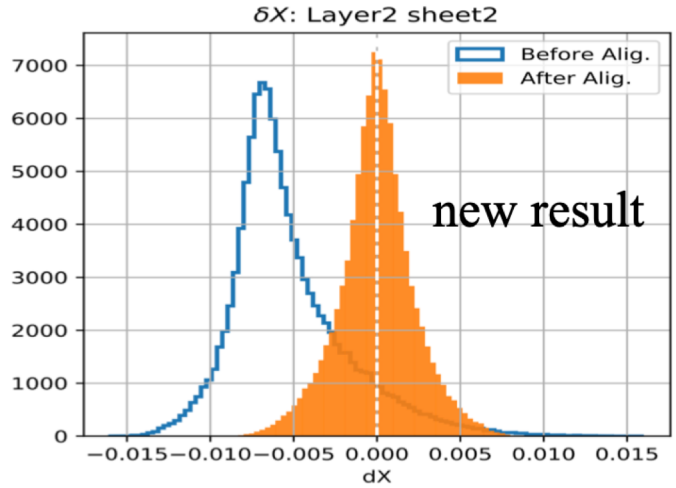



NEW

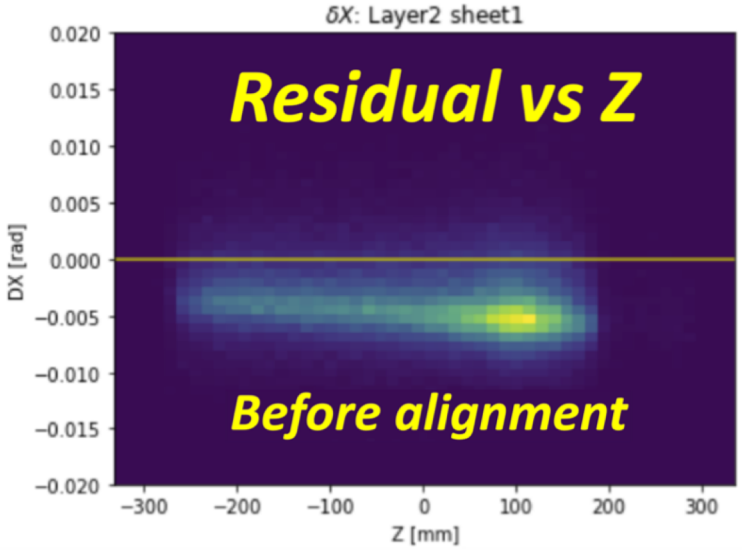
# Alignment

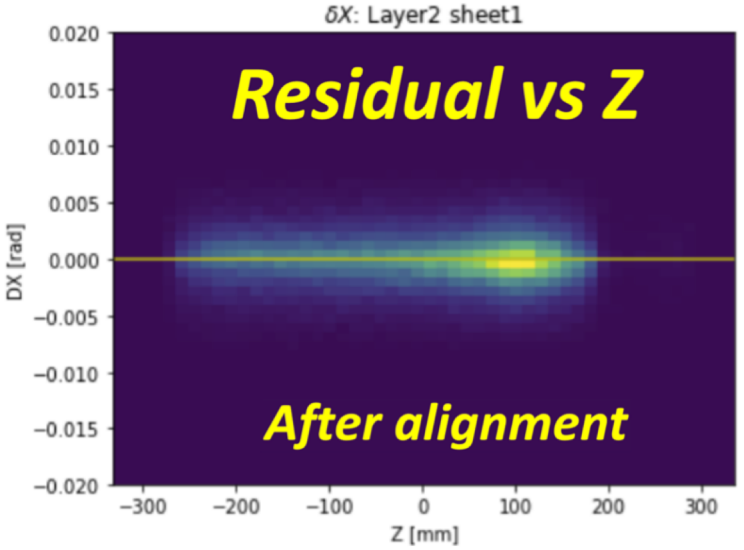
- Improvements in residuals which did not all peak well at 0 before => necessary of separating the two sheets of layer 2




- Improvements in residuals along z => necessary of introducing rotations along x/y axis





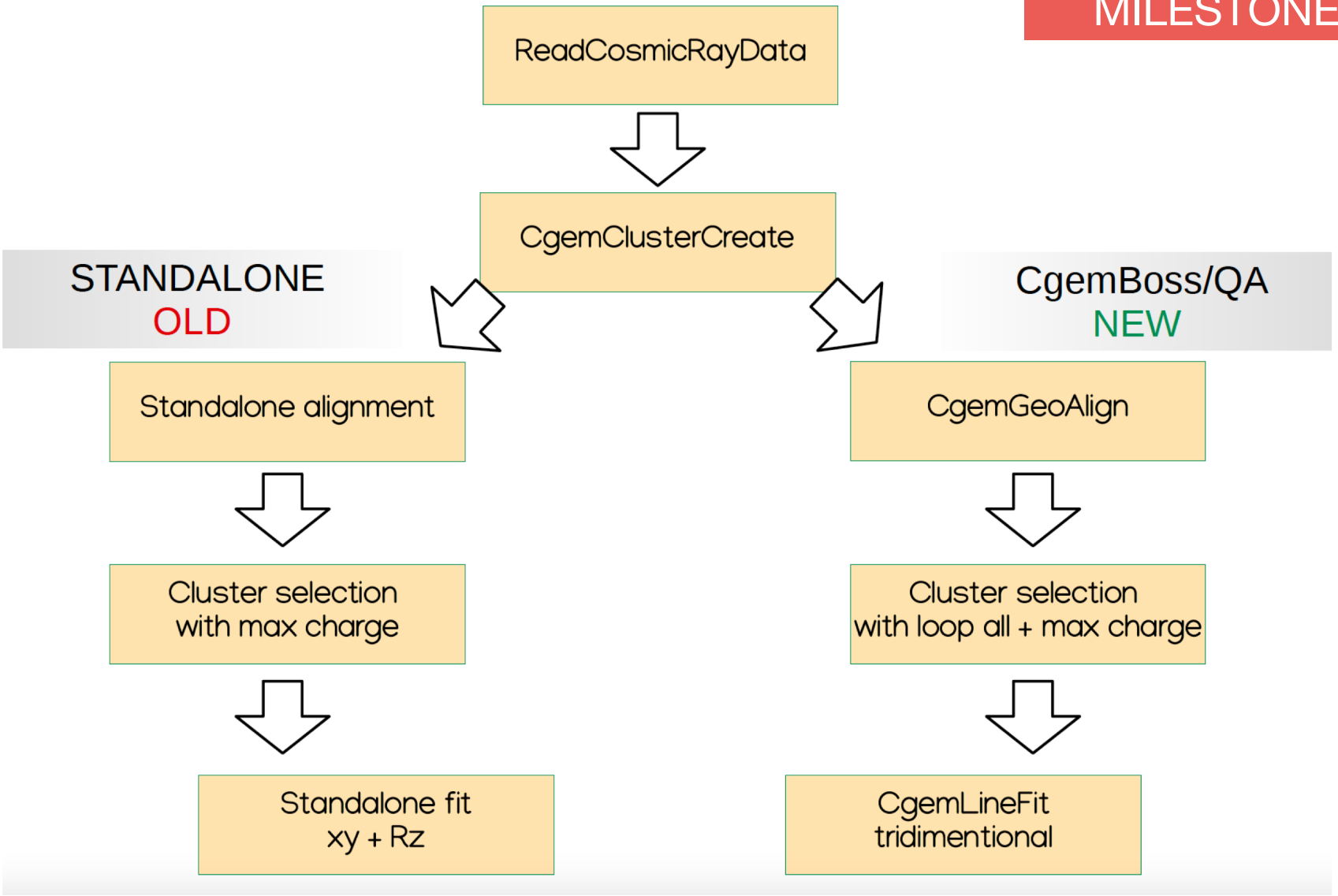



Aiqiang

# Cosmic ray data validation and performances studies

Goal: automatise the performances studies

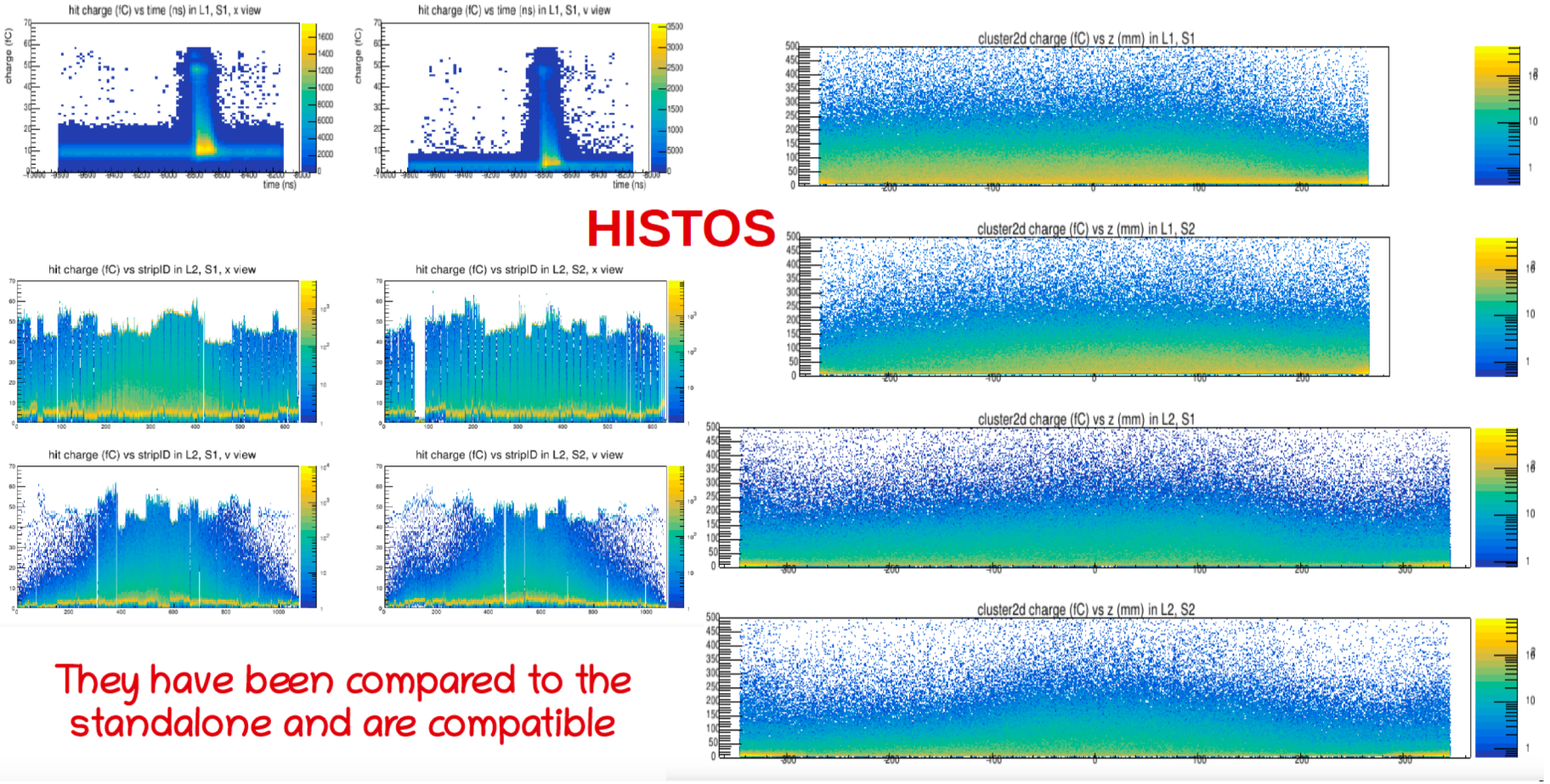
SOFTWARE MILESTONE!



# New QA in CgemBoss

**Two packages:**

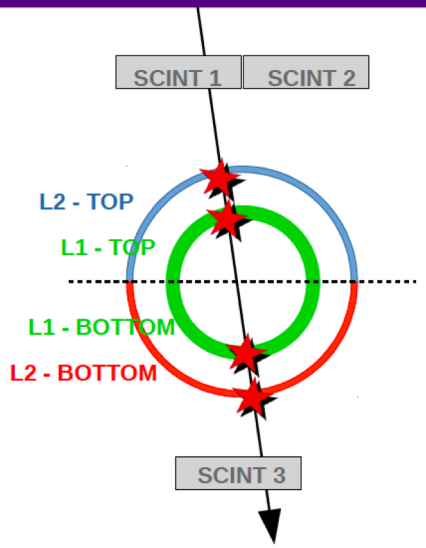
- **TestTrack**: all the *hit + cluster 1D + cluster 2D + fitted track* are saved to a TTree (ROOT file)
- **CgemCosmicRayQA** reads the TTree and fills all the histograms




They have been compared to the standalone and are compatible

*L Lavezzi*

# Validation with run 17




Usual analysis procedure:
- Three out of four planes as trackers
- Tests the fourth plane
- Trigger from the coincidence of scintillators

***Using the same cuts, good agreement between the standalone code and CgemBoss***

Comparison of the standalone (old) and the CgemBoss (new) analysis results

**STANDALONE**

Selection (on trackers):
- Three trackers fired
- Total cluster charge

L1, x view, $Q_{CLUSTER}$ > 20 fC
L2, x view, $Q_{CLUSTER}$ > 15 fC

L1, v view, $Q_{CLUSTER}$ > 10 fC
L2, v view, $Q_{CLUSTER}$ > 10 fC

- No cut on cluster size
- Fit in two steps:

1) xy plane
2) Rz plane

**CgemBoss**

Selection (on trackers):
- Three trackers fired
- No cut on charge
- No cut on cluster size
- Loop all + max Q

The **Loop all + max Q** method loops on all combinations of highest charged clusters to find the usable ones.
- The fit is three-dimensional

# CGEM QA: Cosmic ray data validation

CHECKs to evaluate the level of goodness

1) peak height in time distribution
2) percentage of hits in time window
3) signal level [Hz]
4) noise level [Hz]
5) saturation peak over base ratio
6) saturation charge [fC]
7) nof blind strips (NOT USED NOW)
8) mean charge of selected cluster1D
9) mean cl. size of selected cluster1D
10) mean charge of selected cluster2D

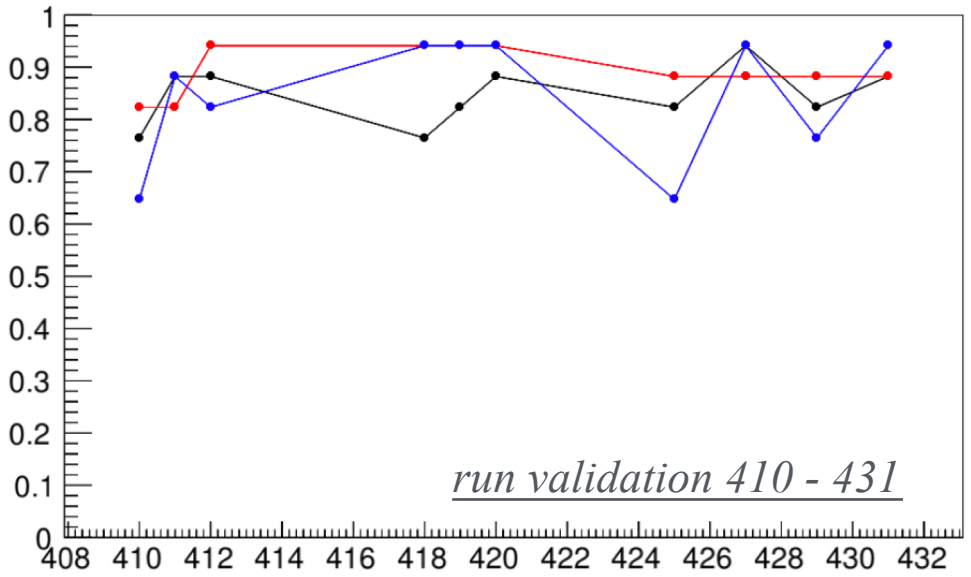
For each:
- Layer
- Sheet
- View

For each:
- Layer
- Sheet

17 checks for each sheet

Goodness level = #passed checks/#total

Layer 1
Layer 2 - Sheet 1
Layer 2 - Sheet 2



# QA procedure

@ Beijing

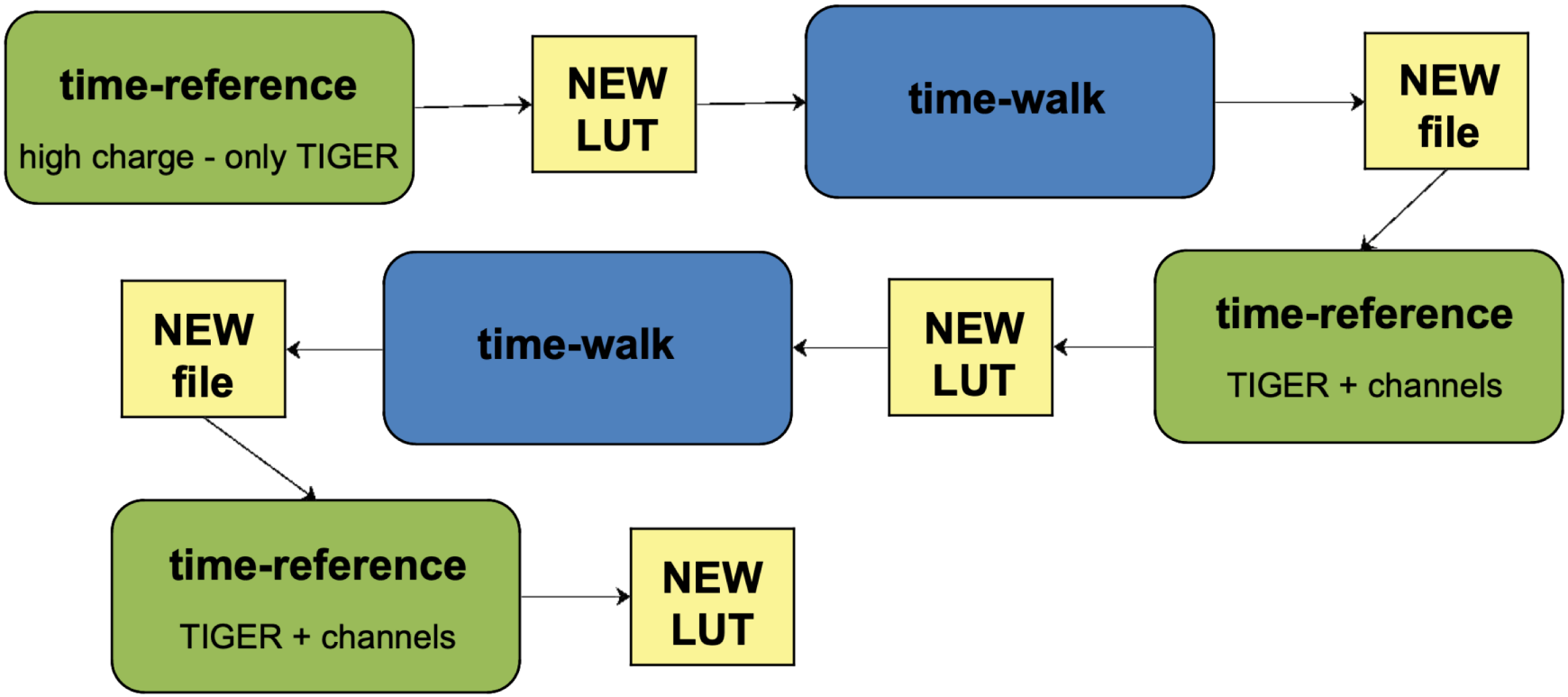

1) Data taking
2) **Copy** to Ferrara server
3) First step of QA with TER-GRAAL
4) Conversion for CgemBoss
5) **Copy** to lxslc7 machines
6) Second step of QA with CgemBoss
7) **Copy** results to Ferrara server
8) Definition of Level of Goodness

We would like to automatize all the points

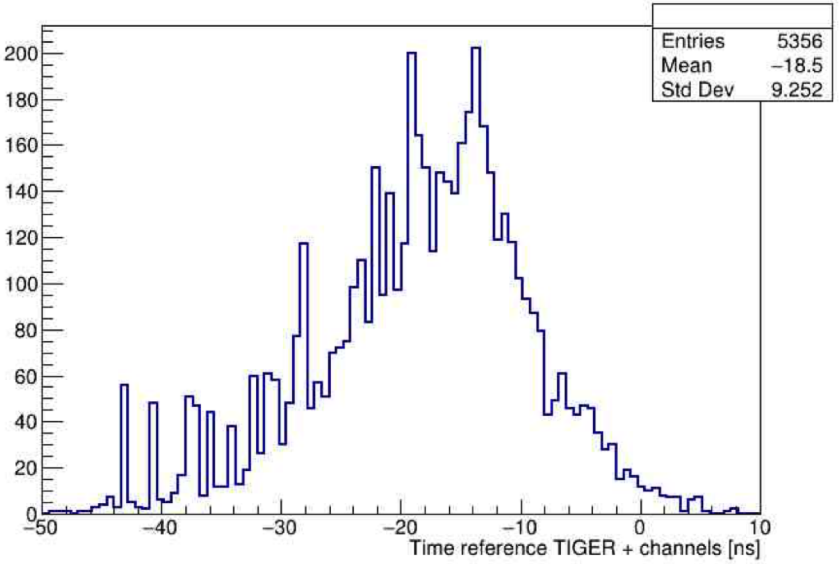
How to copy data?

Lia

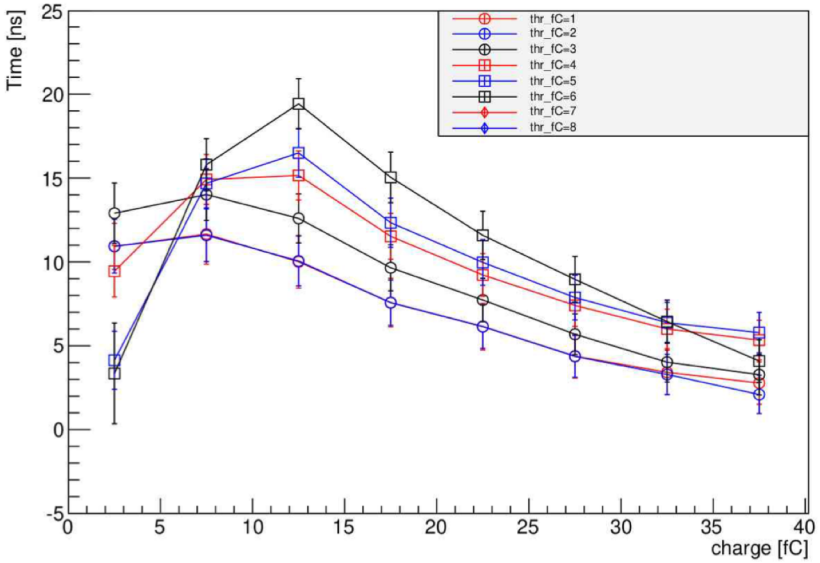
# Time walk - time reference



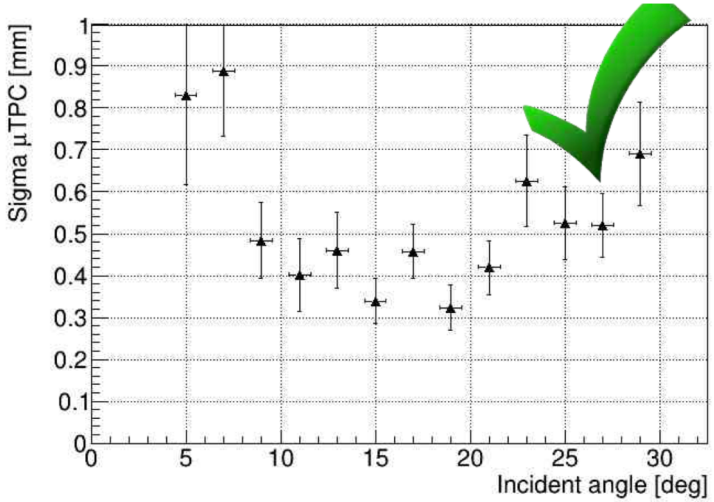

# Time walk - time reference




time-reference




time-walk




new time corrections

- Automatic procedure for each run in CgemBoss (done)
- Missing time propagation (ongoing)
- Missing capacitive correction (to be studied)

# Conclusions

- **Global tracking code under testing and characterization**
- **Time calibration: automatic procedure implemented in CgemBoss. Additional checks ongoing**
- **Alignment for cosmic ray data analysis finalized**
- **Automatic Offline Quality Assurance in a very good shape**