TOF wall status update

TW group

XIII FOOT Collaboration Meeting

TW status

Several data are available now for calibration and for monitoring the TW performance and stability over the time.

- CNAO 2021
  - Dedicated runs for TW, but problems with high rates in the central bars
- HIT 2022
  - Several He energies at the center of the detectors, acquired with a different gain
- CNAO 2022
  - Whole detector irradiation with Carbons and protons

Questions?

- Is the TW calibration reproducible over time (at least after one year)?
- Is the TW performance reproducible over time?

Detector Calibration

CNAO Data 2021

At CNAO 2021 we investigated energy and time resolution with 4 different energies of carbon ions.

We obtained a set of calibration curves for the bars (not every bar because the beam was fixed at the center of the TW)

Energy and time resolution were similar to what was obtained in past measurements.

Table 1
Energy resolution σ_E and time resolution between the two layers σ_{TW}, obtained for one bar of the detector with carbon ions at the four different energies.

Carbon energy	σ_E/E(%)	σ_{TW} (ps)
400 MeV/u	6.3 ± 0.3	62 ± 2
300 MeV/u	6.4 ± 0.3	49 ± 2
200 MeV/u	6.1 ± 0.2	47 ± 1
150 MeV/u	6.1 ± 0.1	42 ± 1

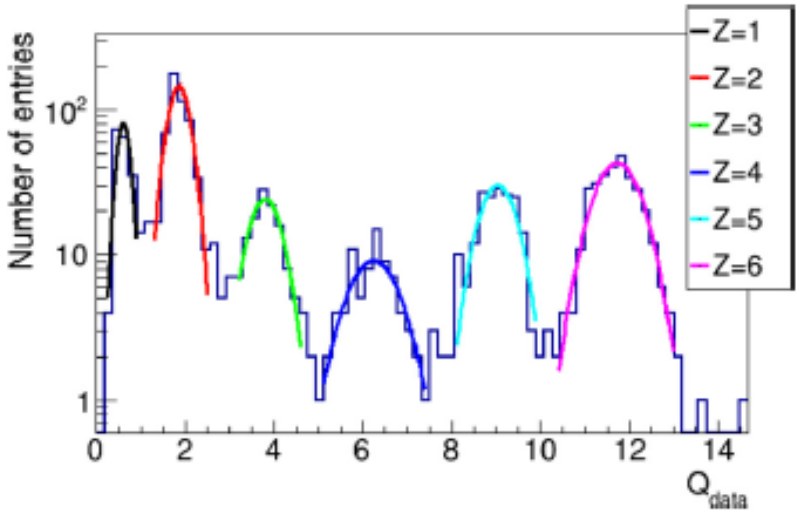
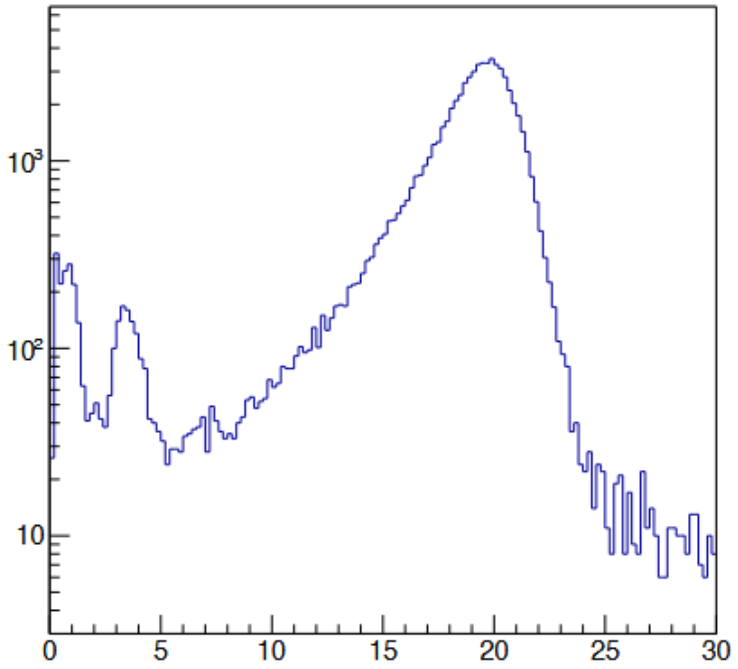


Fig. 3. Charge collected in the analyzed bar for the 300 MeV/u carbon beam on graphite target.

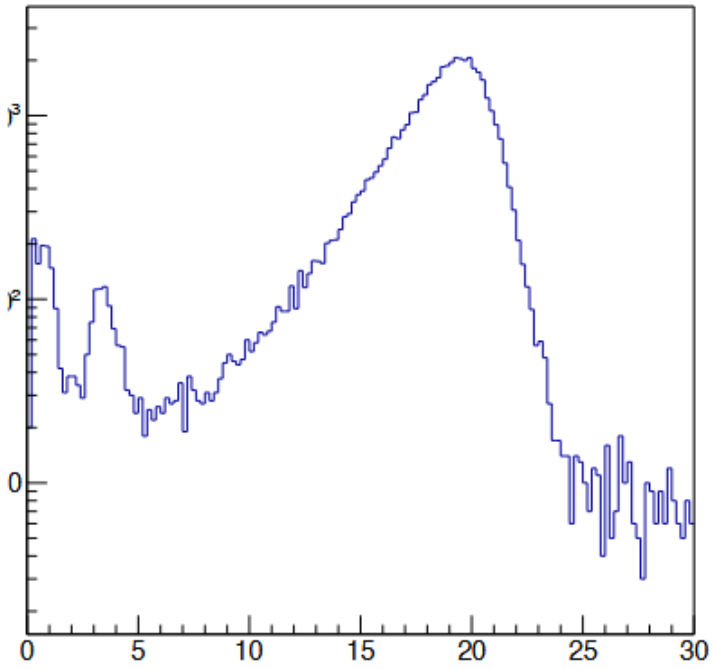
Detector Calibration

CNAO Data 2021 – Beam Rate Issues

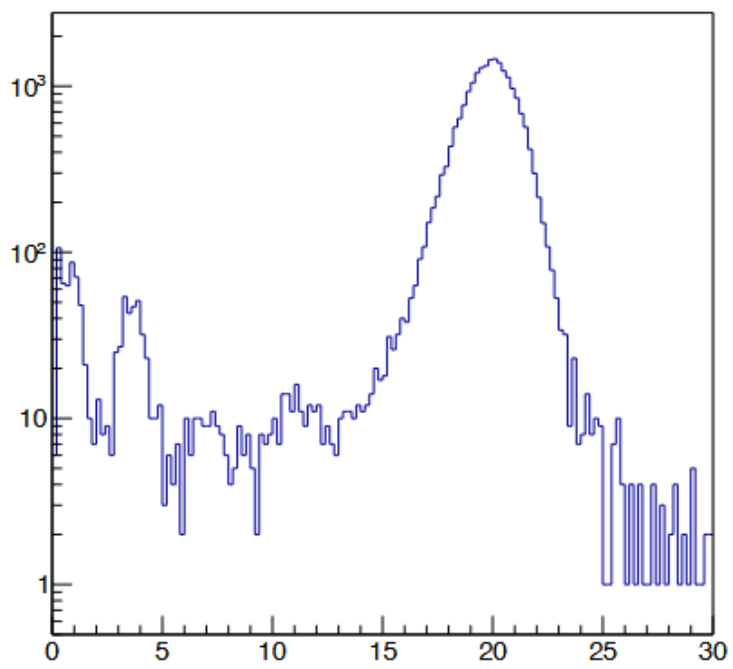
Bar 8
E=150 MeV/u
No cut on beam rate



Bar 8
E=150 MeV/u
BeamRate>5000

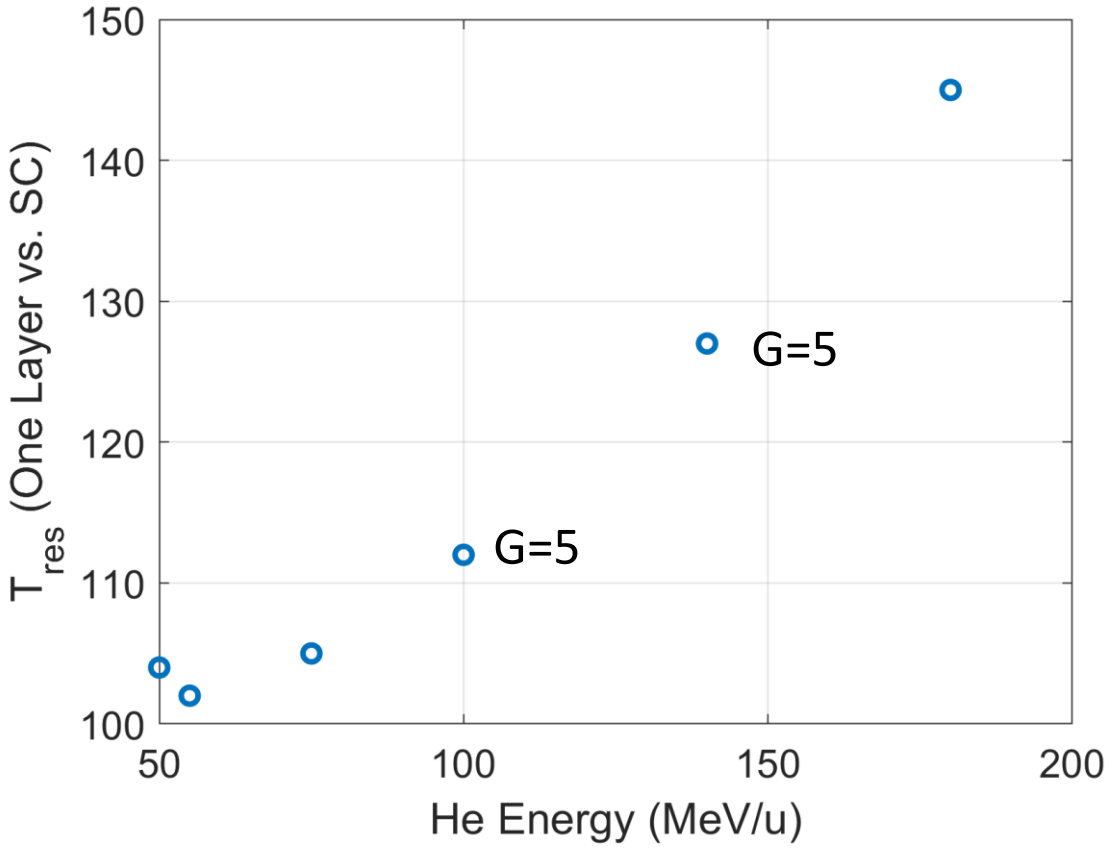


Bar 8
E=150 MeV/u
BeamRate<5000



HIT Campaign

TW performance



Unless stated otherwise, TW gain was set to 2.5.

The standard deviation between the two layers of the TW was measured for 200 MeV/u He beam obtaining 124 ps, corresponding to a TW contribution to the TOF resolution of about 62 ps at 200 MeV/u.

The study of the TW time resolution as a function of the Helium energy is currently ongoing.

CNAO Campaign

Problems

- The height of the beam was different from the nominal one at the TW position (about 2 cm more than expected). To be kept in mind for the further data taking.

- The differential switch of the 380 V power source in the XPR room has a compliance too strict for the TW motion system. TW could not be moved for both data takings. The increase of the current compliance is not a minor change and would require specific authorizations, so, changes to the motion system must be made.
  - It is not a problem of power requirement, but of noise filtering and/or power-up.
  - Replacement of the current filters?

- We found a way to scan the whole detector using the magnets, but the capability to move the TW would be important for an easy and quick alignment of the detector.

CNAO Campaign

TW performance

Comparison of the response of the bar between CNAO2022 (run 5469 Carbon Target at 200 MeV/u) and CNAO2021 (same beam energy but the amount of material on the beamline is slightly different) – by Aafke
Plot legend:

- CNAO2021
- CNAO2022

Remember that the central bars in the CNAO2021 data taking have problems related to the high data rate, so differences on these bars are expected.

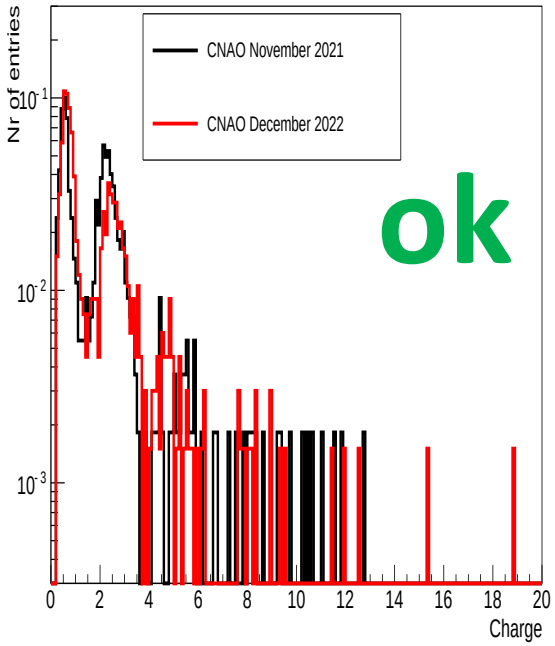
Data were analyzed using shoe, 250kevents were used.

thanks to Yun for the decoded root file!

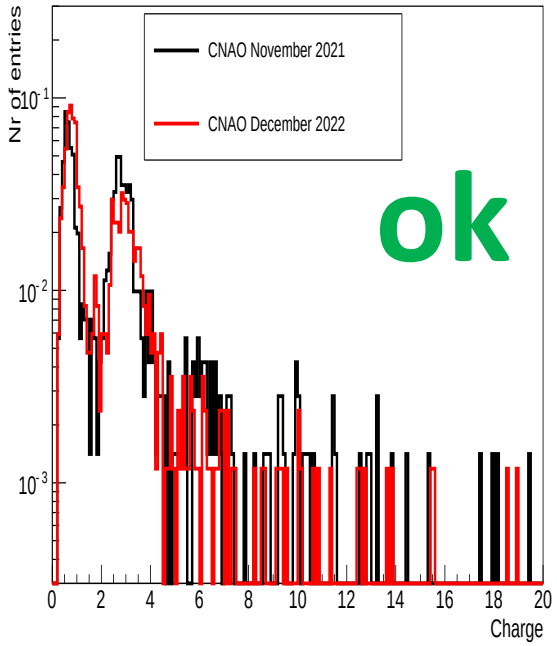
CNAO Campaign

TW performance

Bar 0



Bar 1



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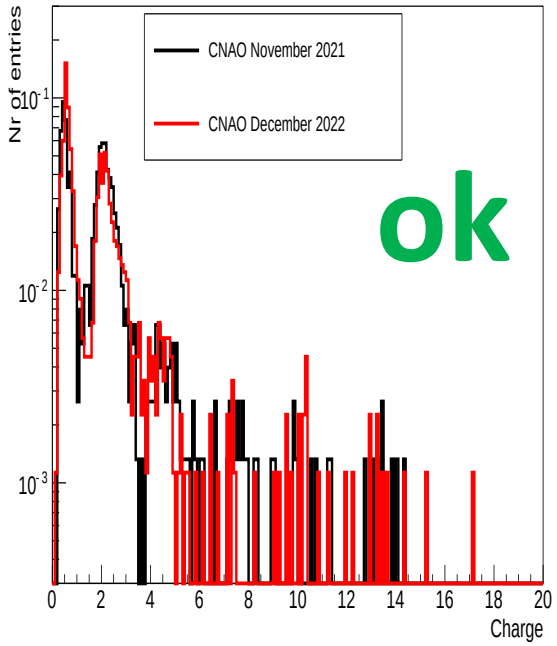

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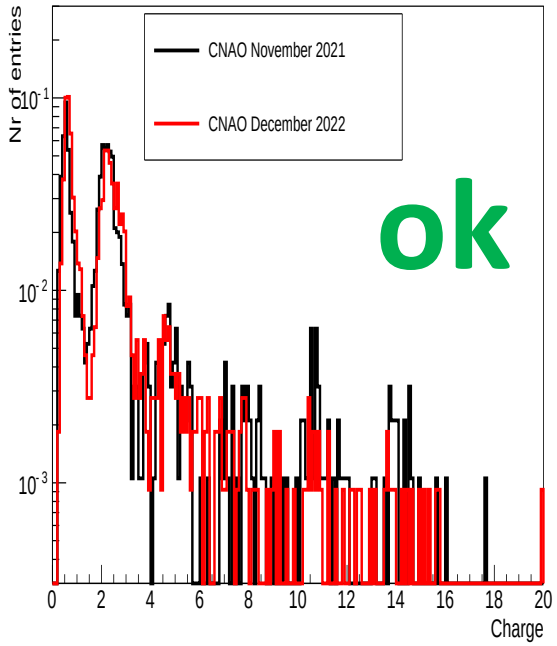
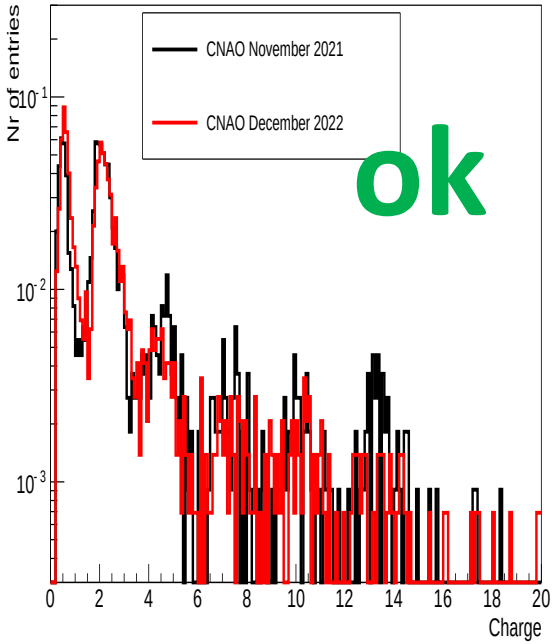


CNAO Campaign

TW performance

Bar 4



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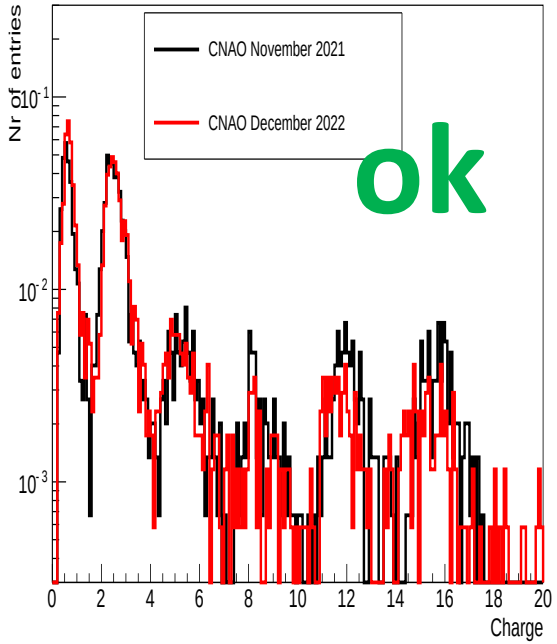

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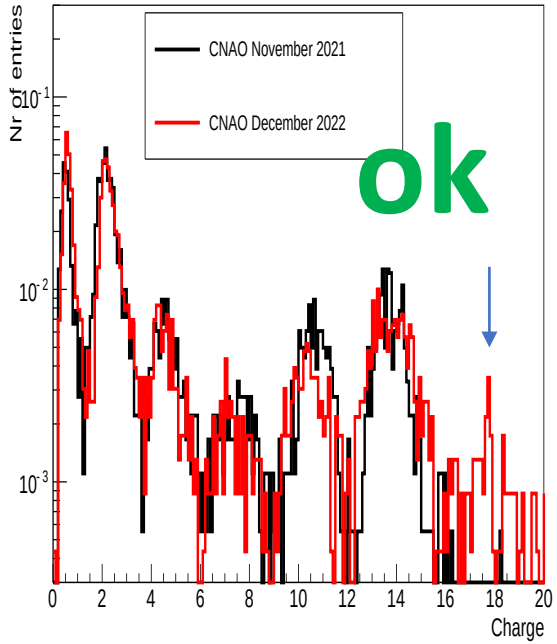

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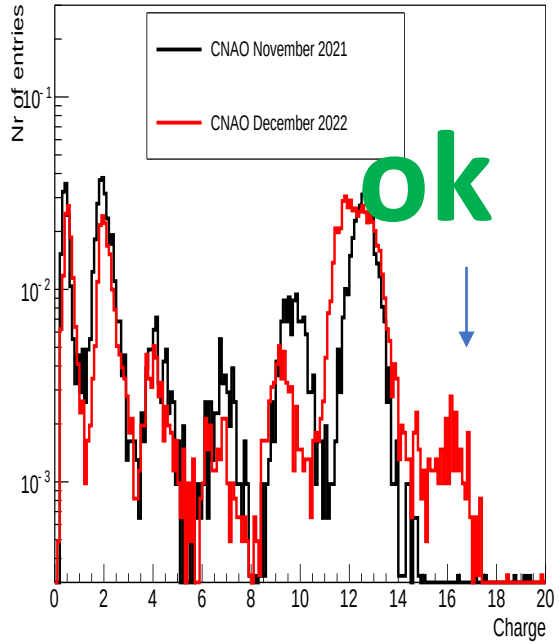
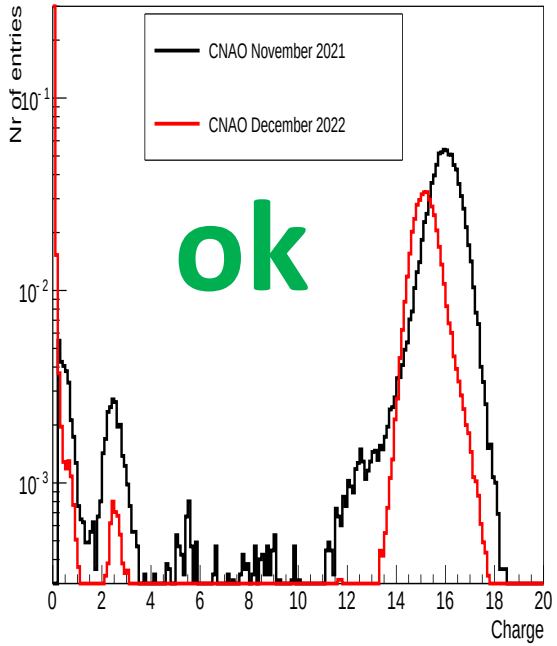


CNAO Campaign

TW performance

Bar 8



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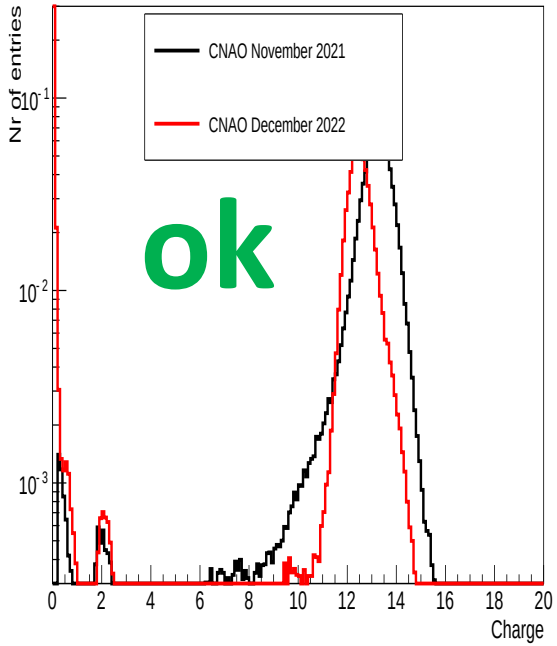

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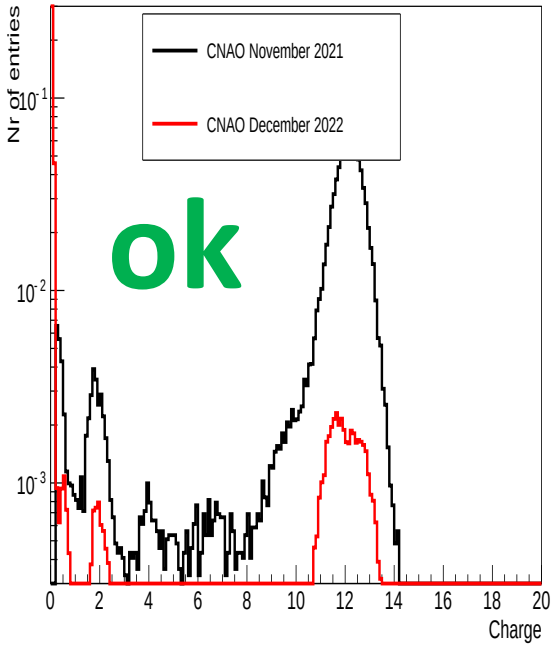

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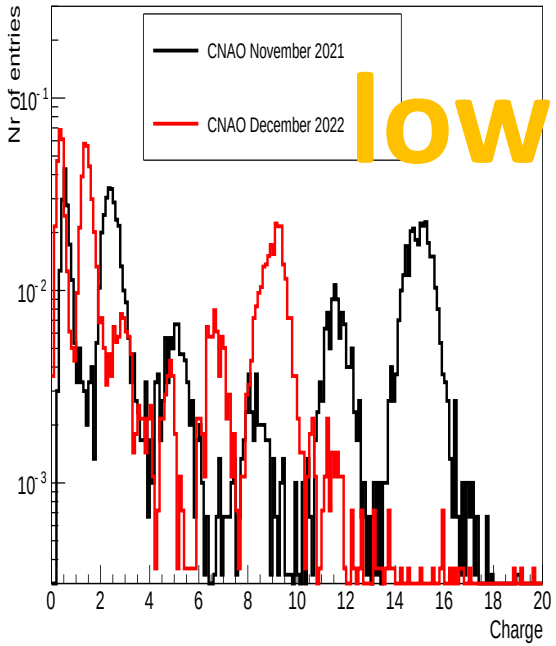
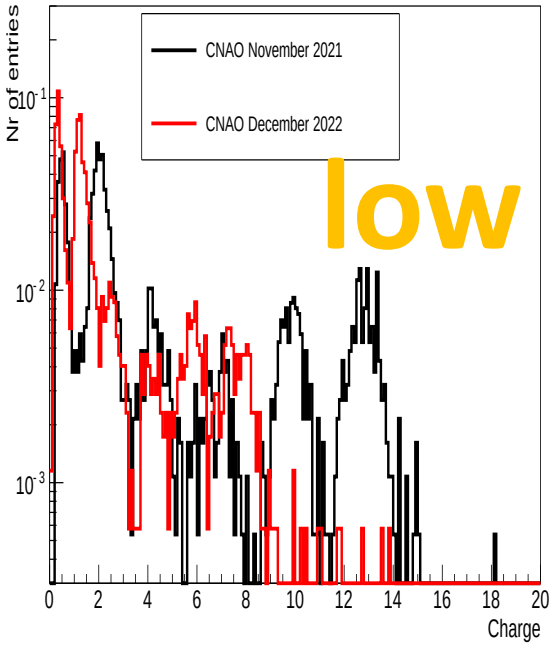


CNAO Campaign

TW performance

Bar 12



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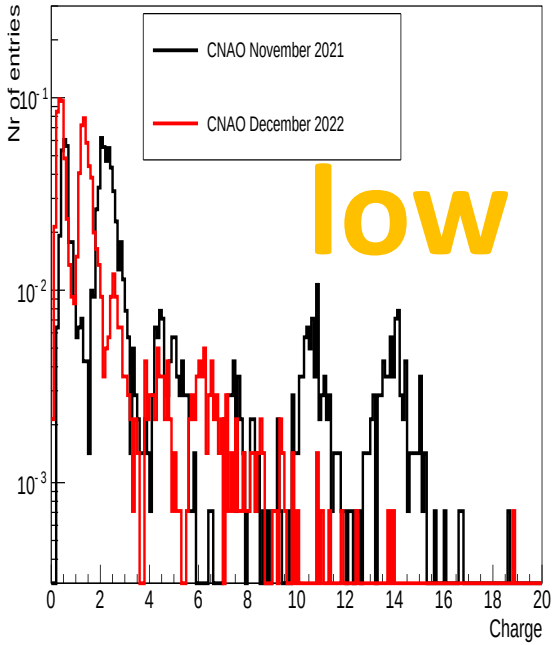

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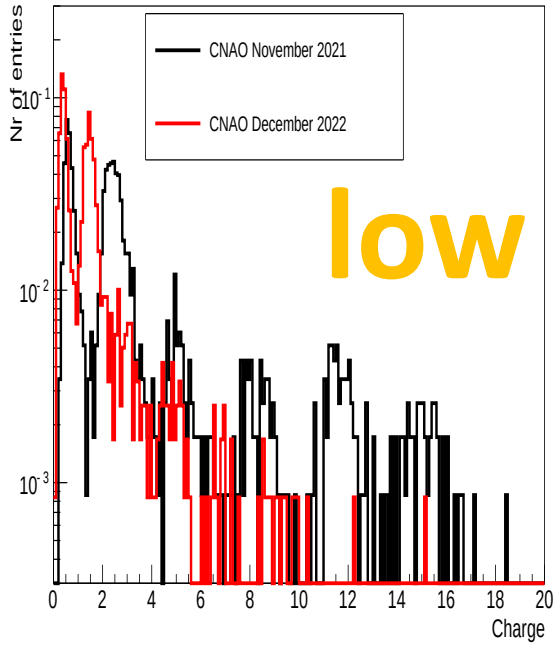

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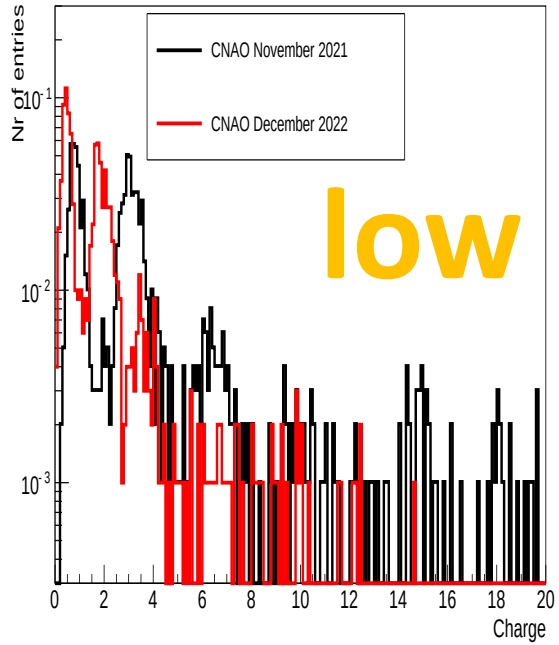
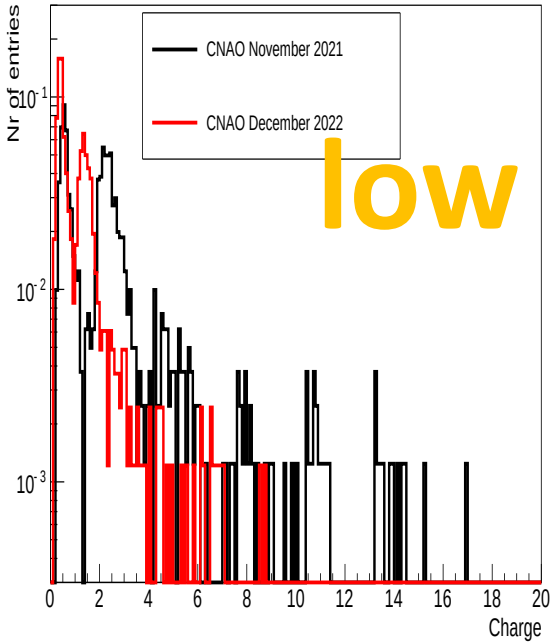


CNAO Campaign

TW performance

Bar 16



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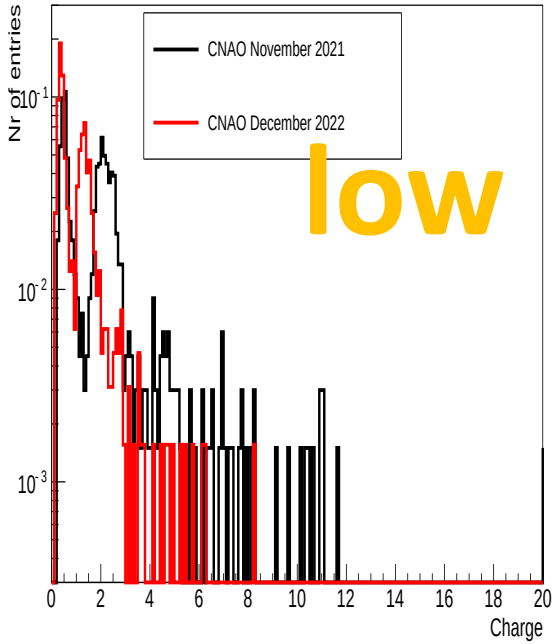

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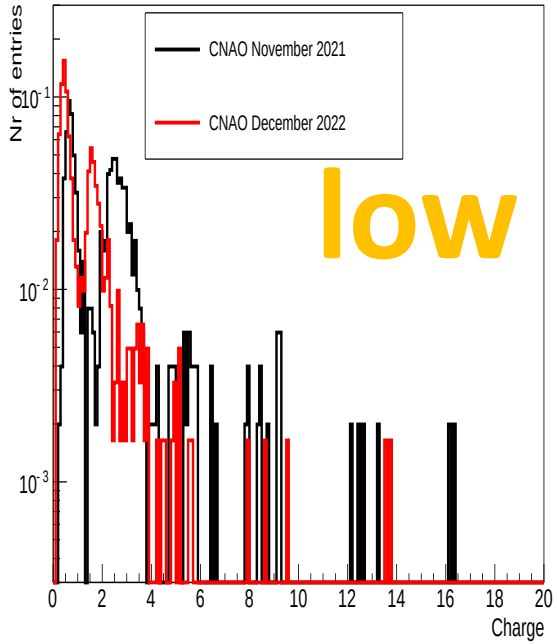

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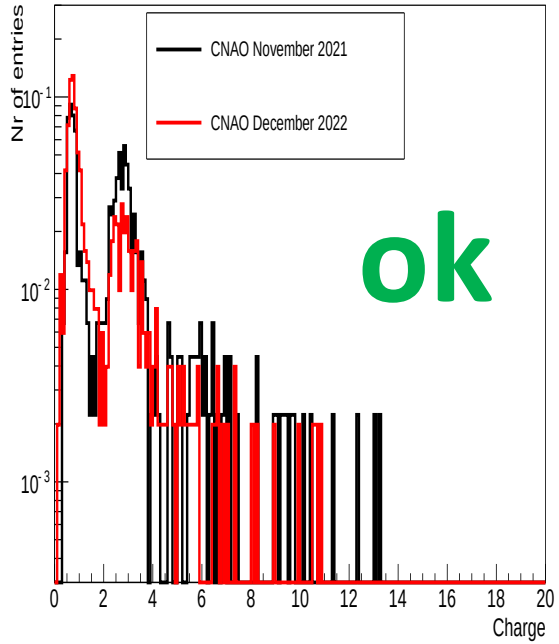
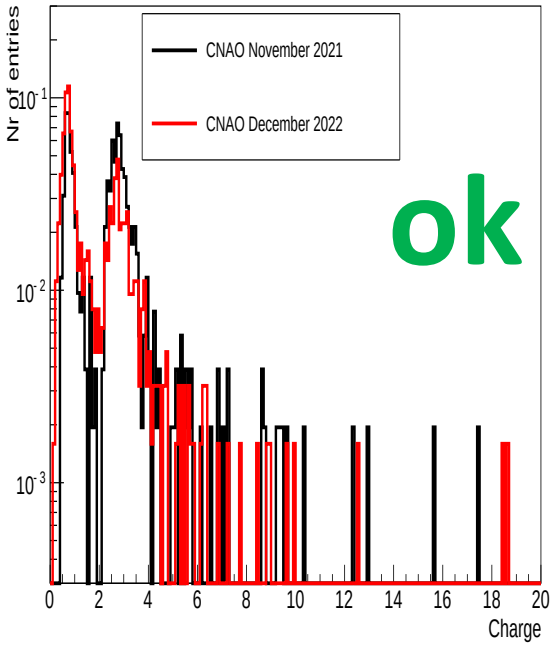


CNAO Campaign

TW performance

Bar 20



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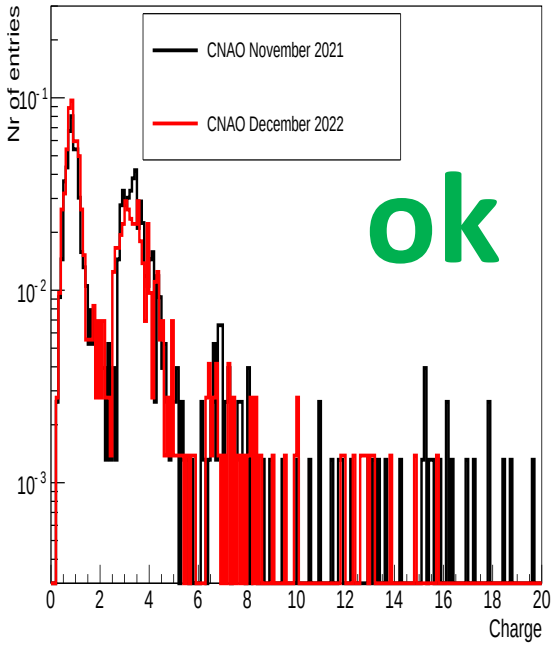

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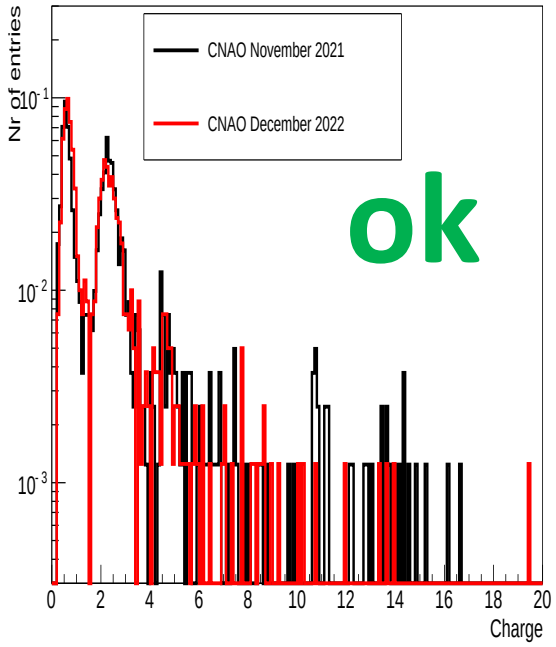

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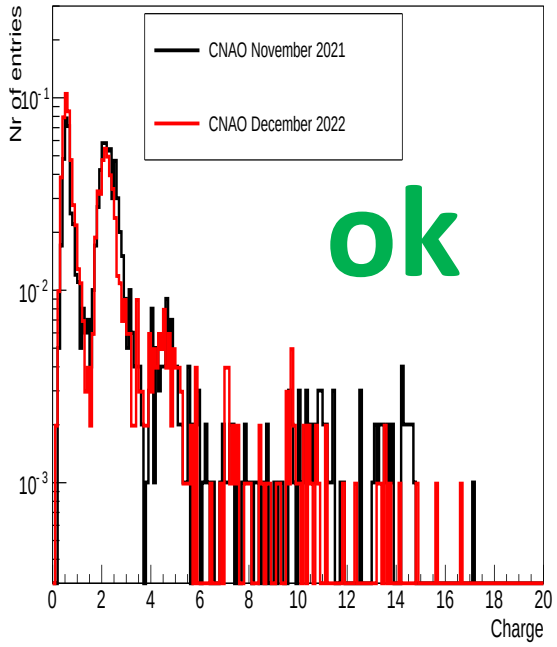
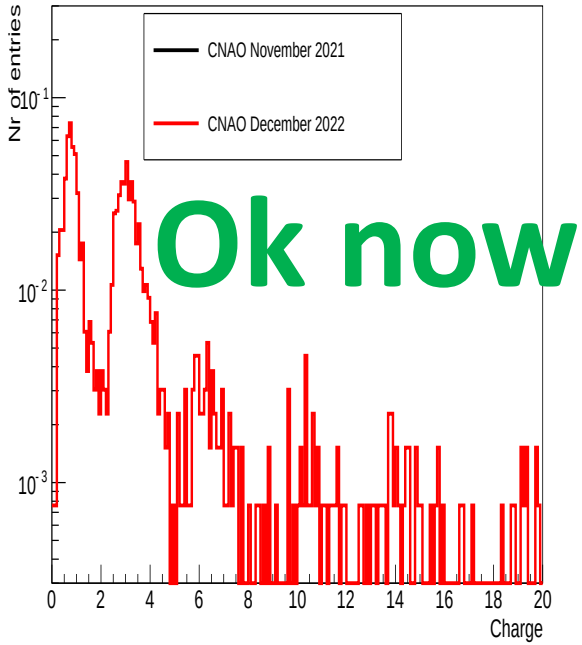


CNAO Campaign

TW performance

Bar 24



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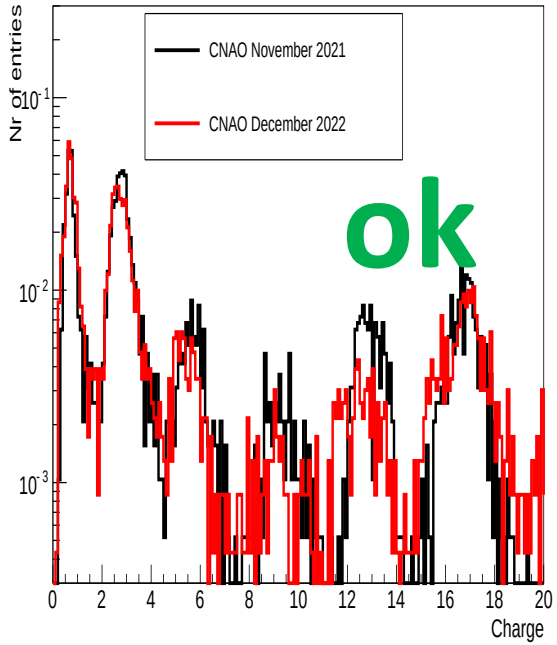

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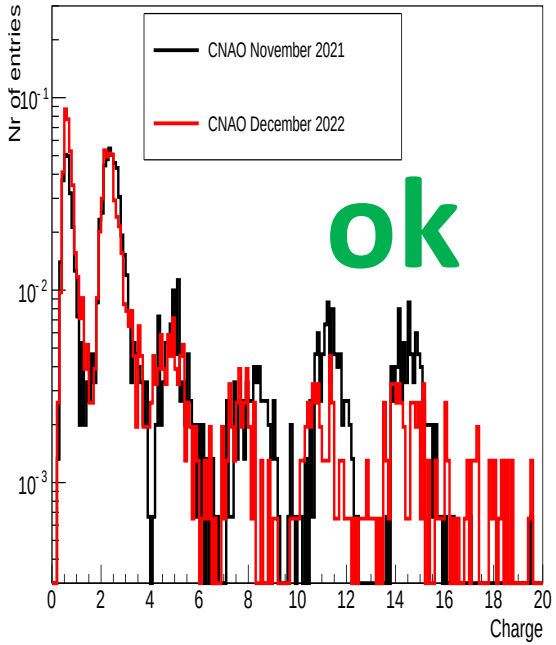

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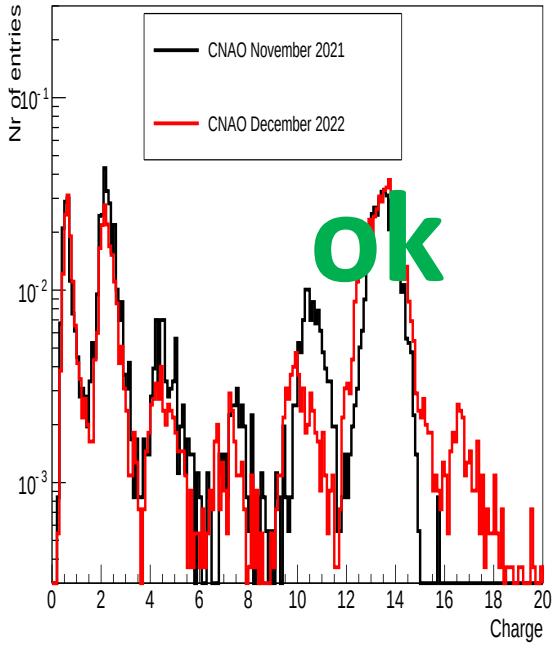
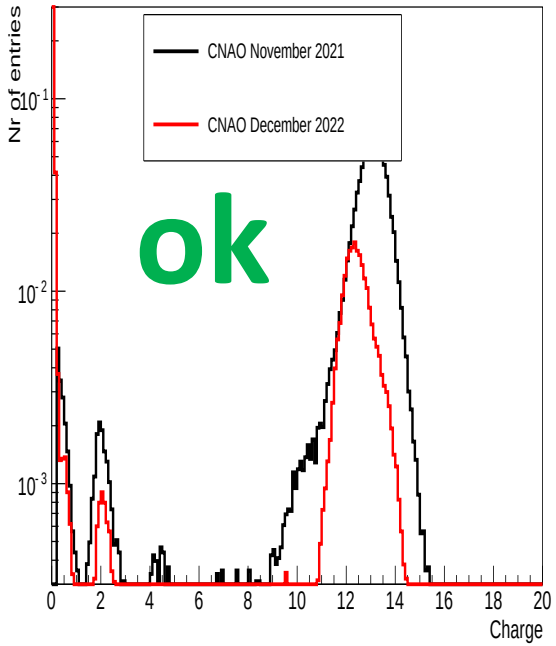


CNAO Campaign

TW performance

Bar 28



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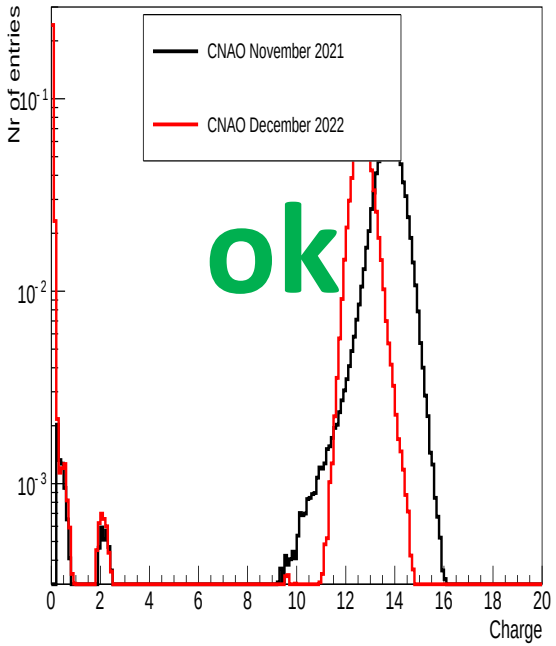

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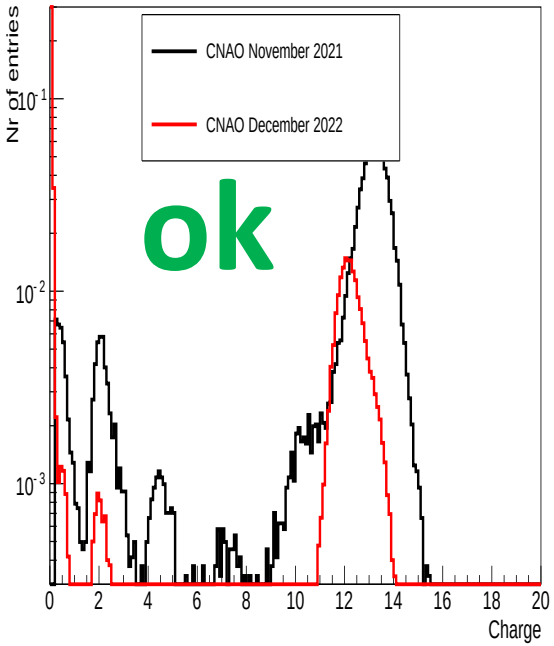

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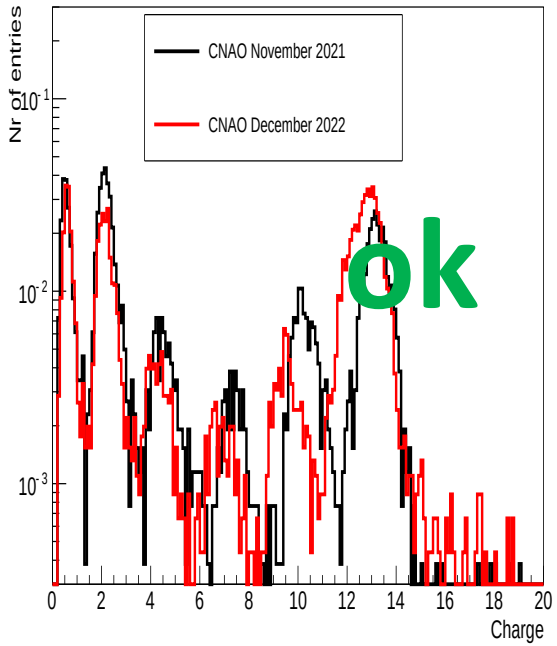
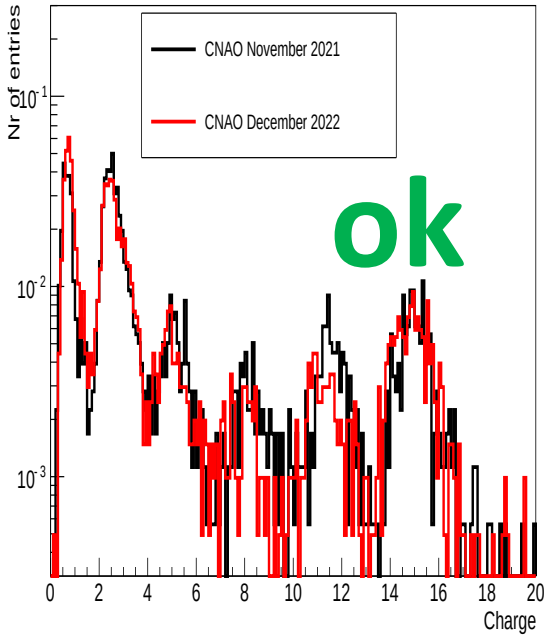


CNAO Campaign

TW performance

Bar 32



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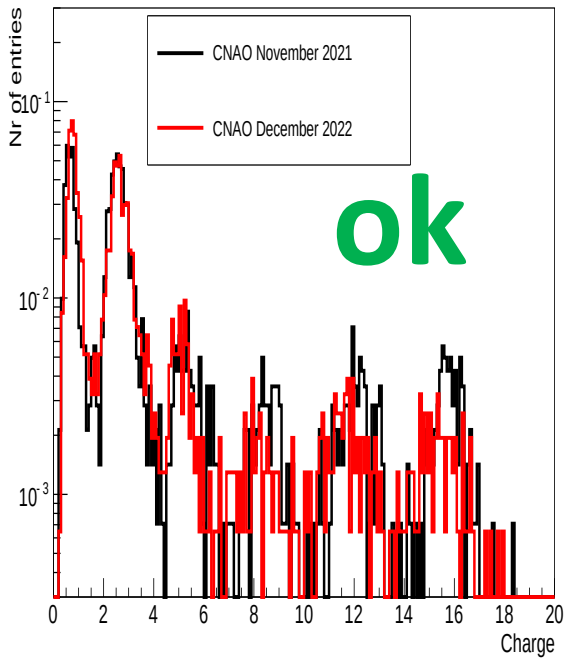

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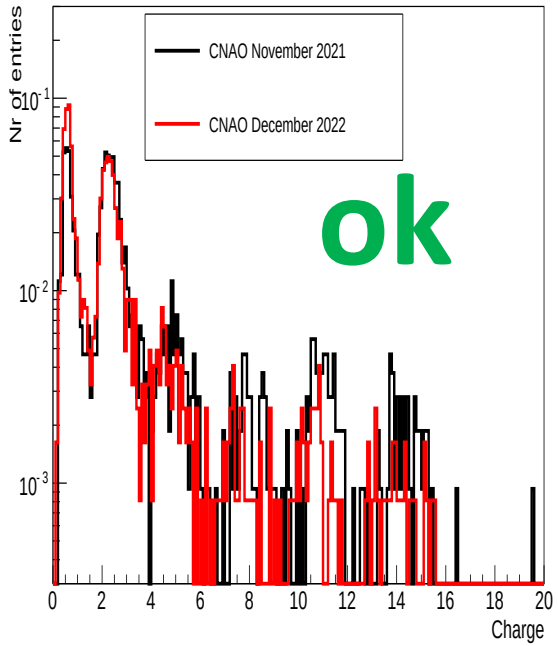

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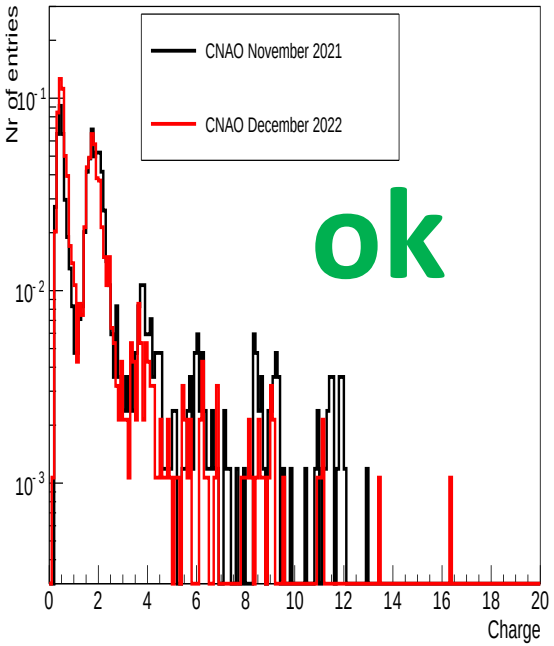
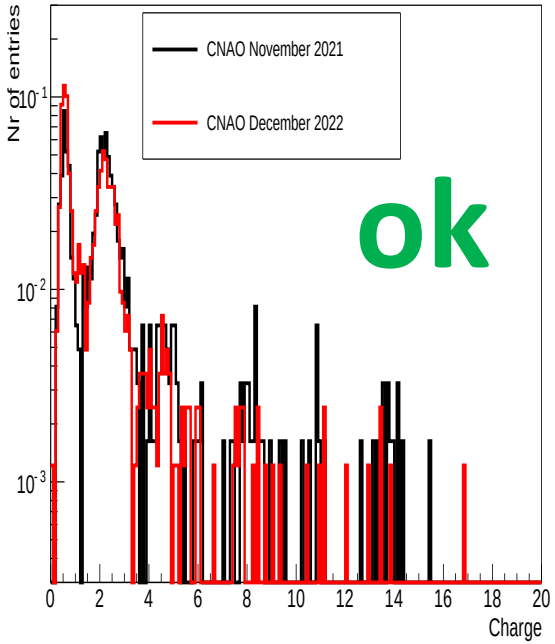


CNAO Campaign

TW performance

Bar 36



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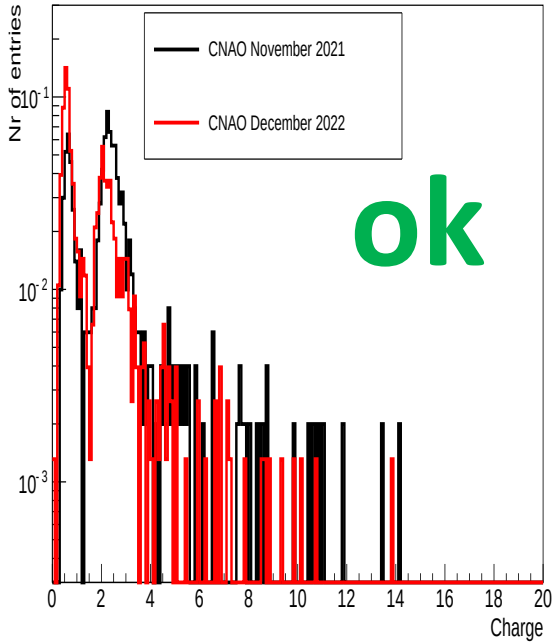

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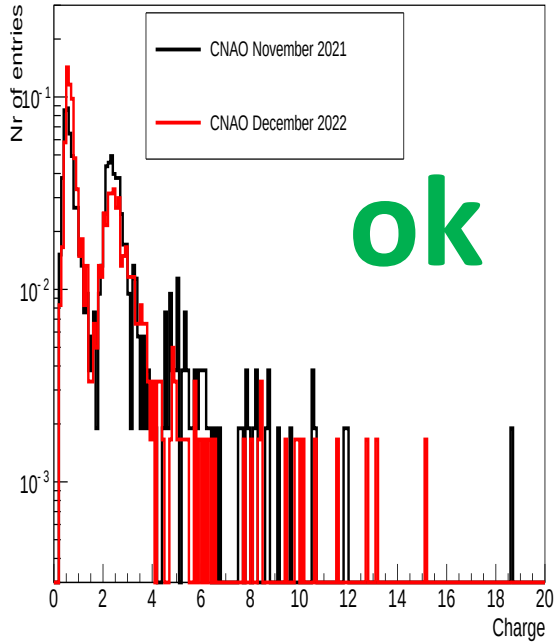

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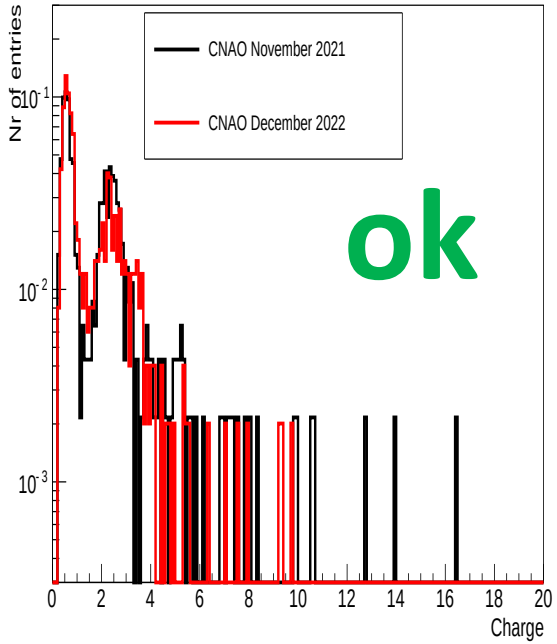
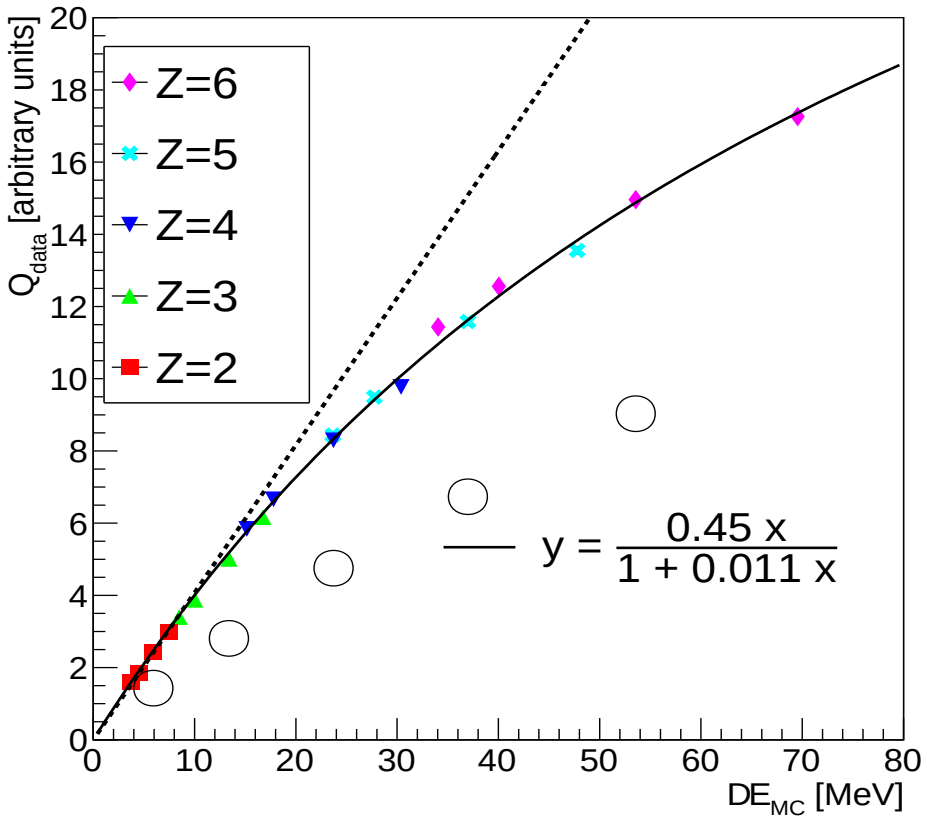


CNAO Campaign

TW performance

Bar 11



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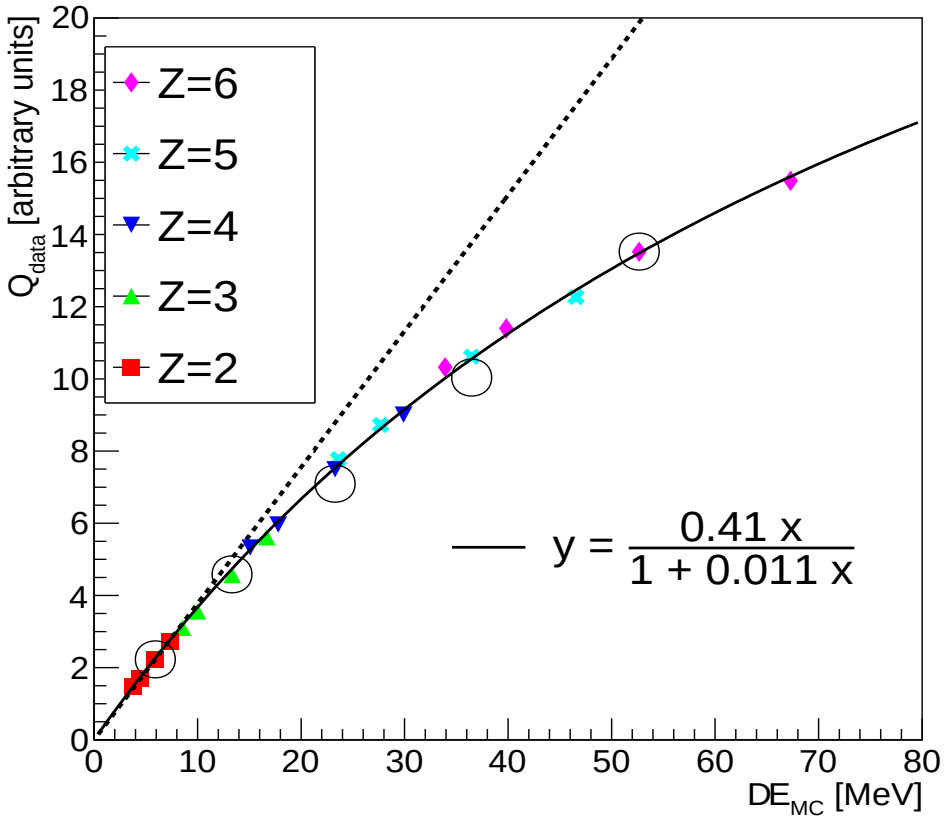

CNAO Campaign

Data Available for TW studies

- Rear
  - 0-7: ok (bar 7 with slightly lower charge and some events at larger charge…)
  - 8,9,10: ok, no problem as in cnao 2021! (good!)
  - 11-18: lower charge by a factor 0.65
  - 19: ok
  - On some bars we see a peak at charge higher than carbon… under investigation
- Front
  - 20-39: ok
    - On most bars somewhat lower charge but it's not a problem
    - On some bars we see a peak at charge higher than carbon… under investigation

Lots of data available for TW studies and cross-calibration!
On the last night we collected data irradiating (almost) the whole detector with 3 different C energies (115, 200 and 300) and with 230 MeV protons. NO SC data available, but energy can be recalibrated in the board with different behavior compared to CNAO2021.

Further work…

Analysis

- Investigate if the behavior of the low-gain board is constant in all the runs of CNAO2022 and compare the configuration files
- Investigate in detail the time resolution with Helium at HIT
- Understand in detail the exact correction to be applied on each bar to use CNAO2021 calibration in CNAO2022 data elaboration.

Hardware

- Modify the motion controller to be compliant with the CNAO restrictions
  - New tests have to be carried out at CNAO since the problem can be due to the specific room noise to be filtered by the controllers.
- Modify the table according to the actual height of the experimental room
- Investigate in detail the behaviour of the board in laboratory