Analysis of the MSD calibration runs

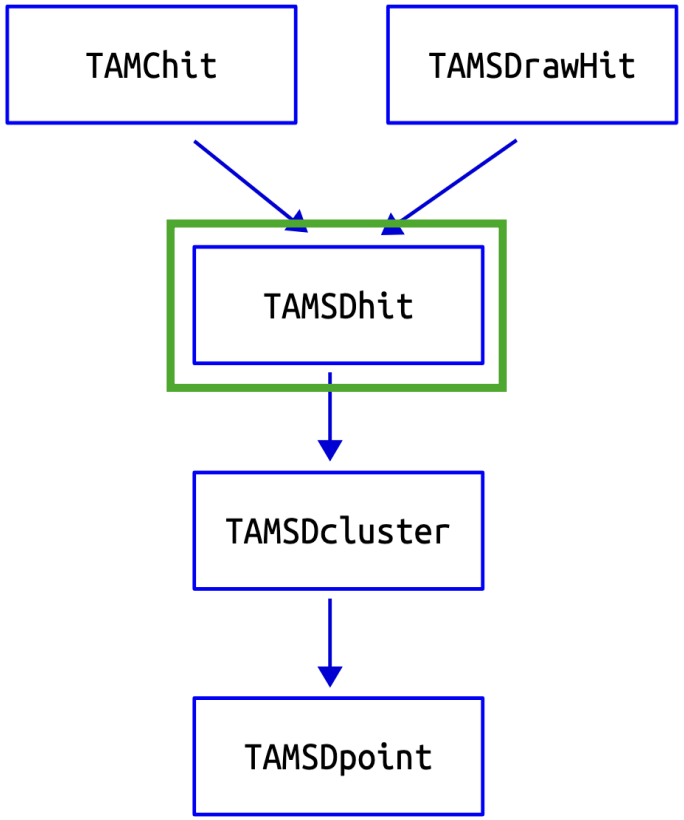
Sofia Mazzolani,
Ilaria Mattei,
Leonello Servoli

From R. Zarrella slides of FOOT XVI General Meeting

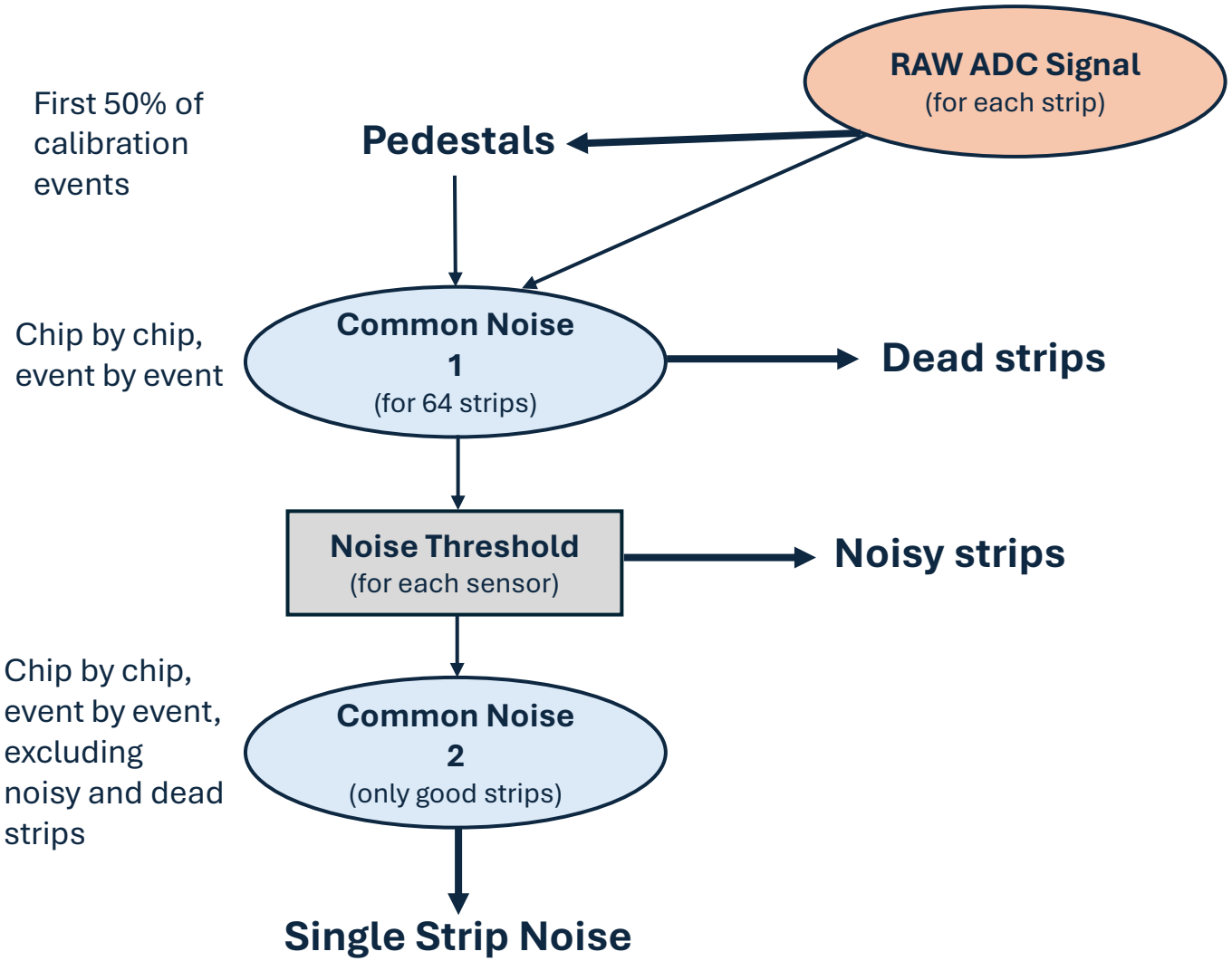
The MSD workflow

Step-by-step review of the MSD data processing!

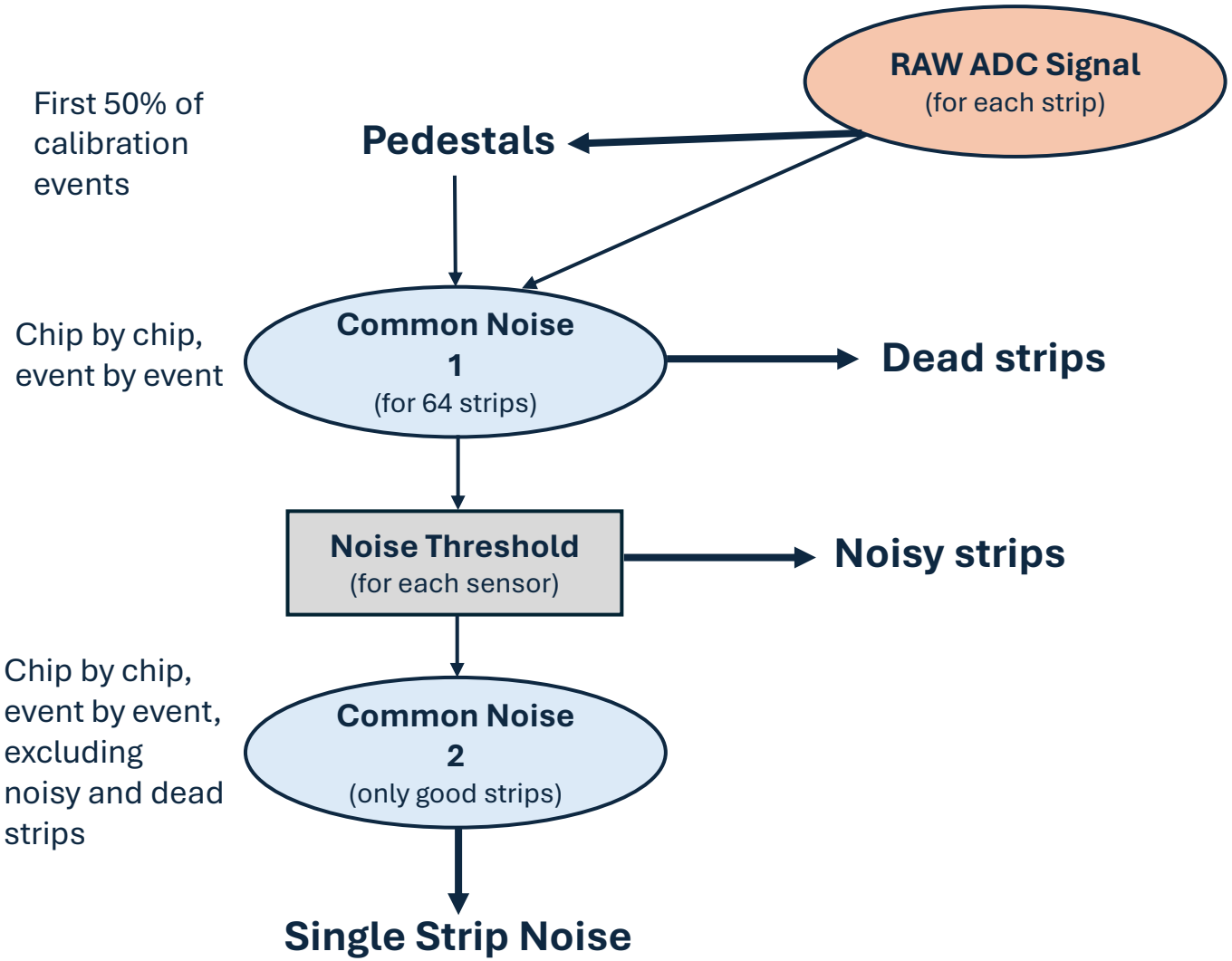
- **RawHit → Hit**
  - ➔ VA gain correction added
  - ➔ Correct flagging of noisy/dead strips
- **Hit → Cluster**
  - ➔ Clustering algorithm re-checked and updated
  - ➔ η-correction
- **MChit → Hit → Cluster**
  - ➔ Updated to match new containers



ComputeMsdPed.C → quality control of the 6 sensors in time (calibration runs)



ComputeMsdPed.C → quality control of the 6 sensors in time (calibration runs)

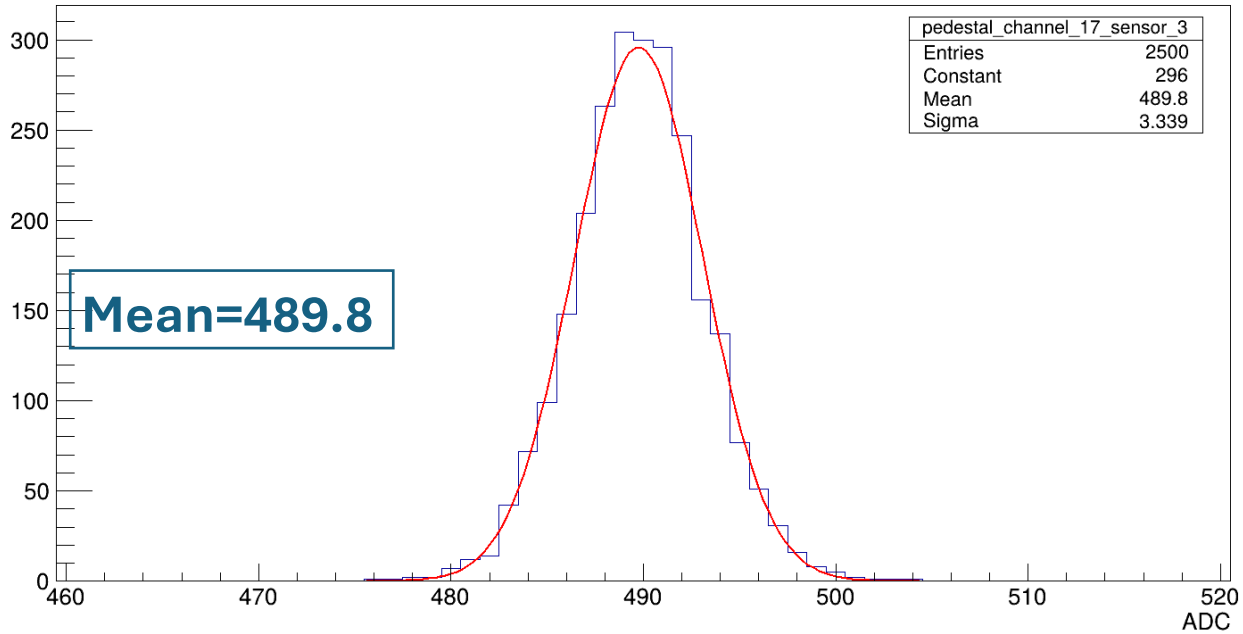


Output

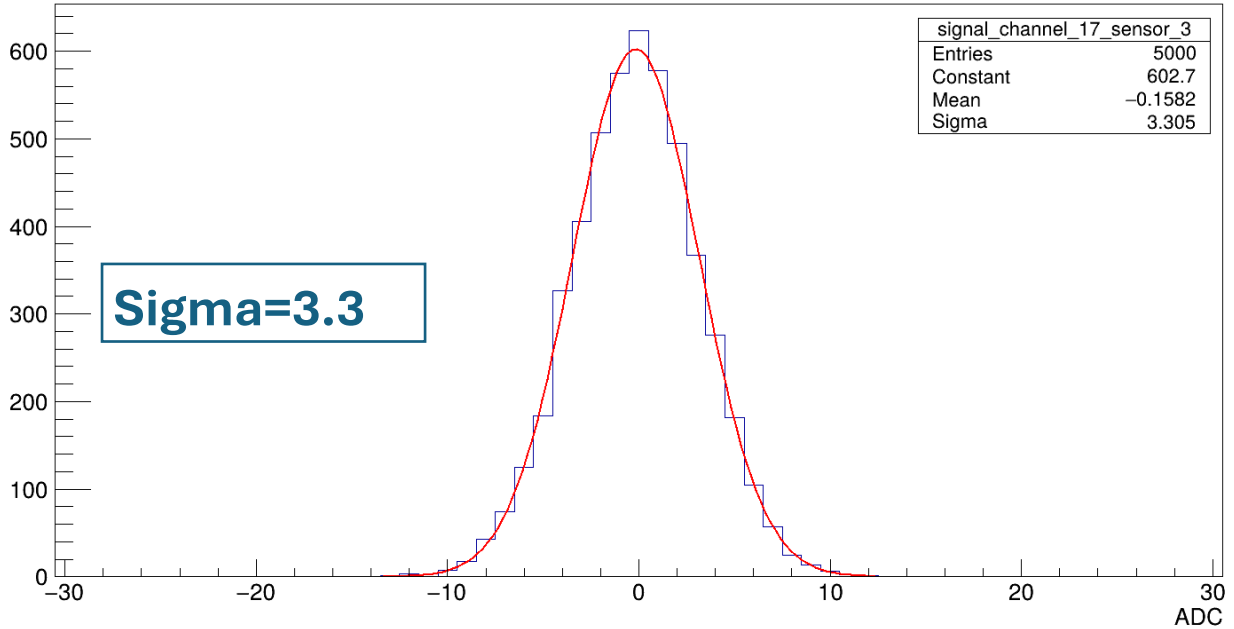
File . cal	-Pedestal -Single strip noise -Status of the strip
File .root	-Histograms
File .pdf	-Graphs

CNAO2024 run 7028
(5k events)

Pedestal



Signal - Pedestal



Sensor 3
Strip 17

Distribution centered around zero

Common Noise calculation

Self tuning method:

- Considering a chip of 64 strips (0-63).

-From them excluding the lateral ones: left with (8-55) strips.

To prevent different noise characteristics due to hardware or environment factors.

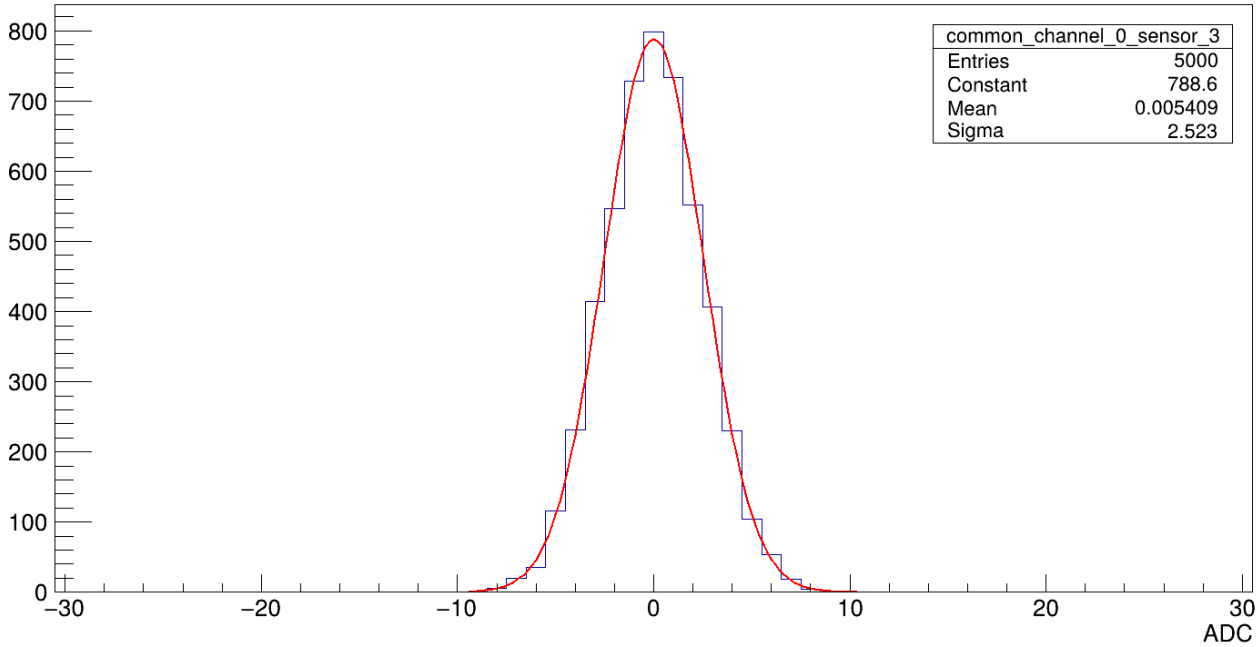
-Also excluding the ones with ADC > 1.5*MIP_ADC, with MIP_ADC=18 for a Minimun Ionizing Particle.

To avoid including strips that might contain real signals or very noisy strips.

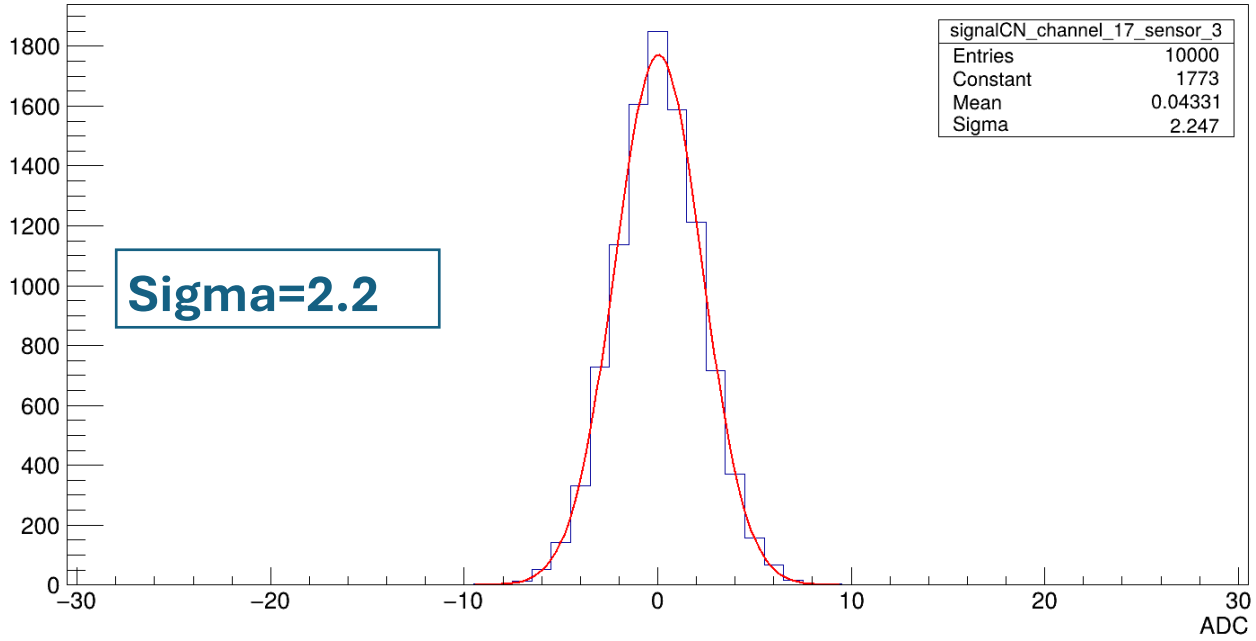
-Calculating the **baseline** on the (8-23) strips, minus the excluded, as the **mean_(Signal – Pedestal)**.

-From the remaining (24-55) strips, using only the ones with a value around the baseline (**± 3 rms_(Signal – Pedestal)**) to compute Common Noise.
The rms il calculated on all the strips.

Common Noise 1



Signal – Pedestal – CN1

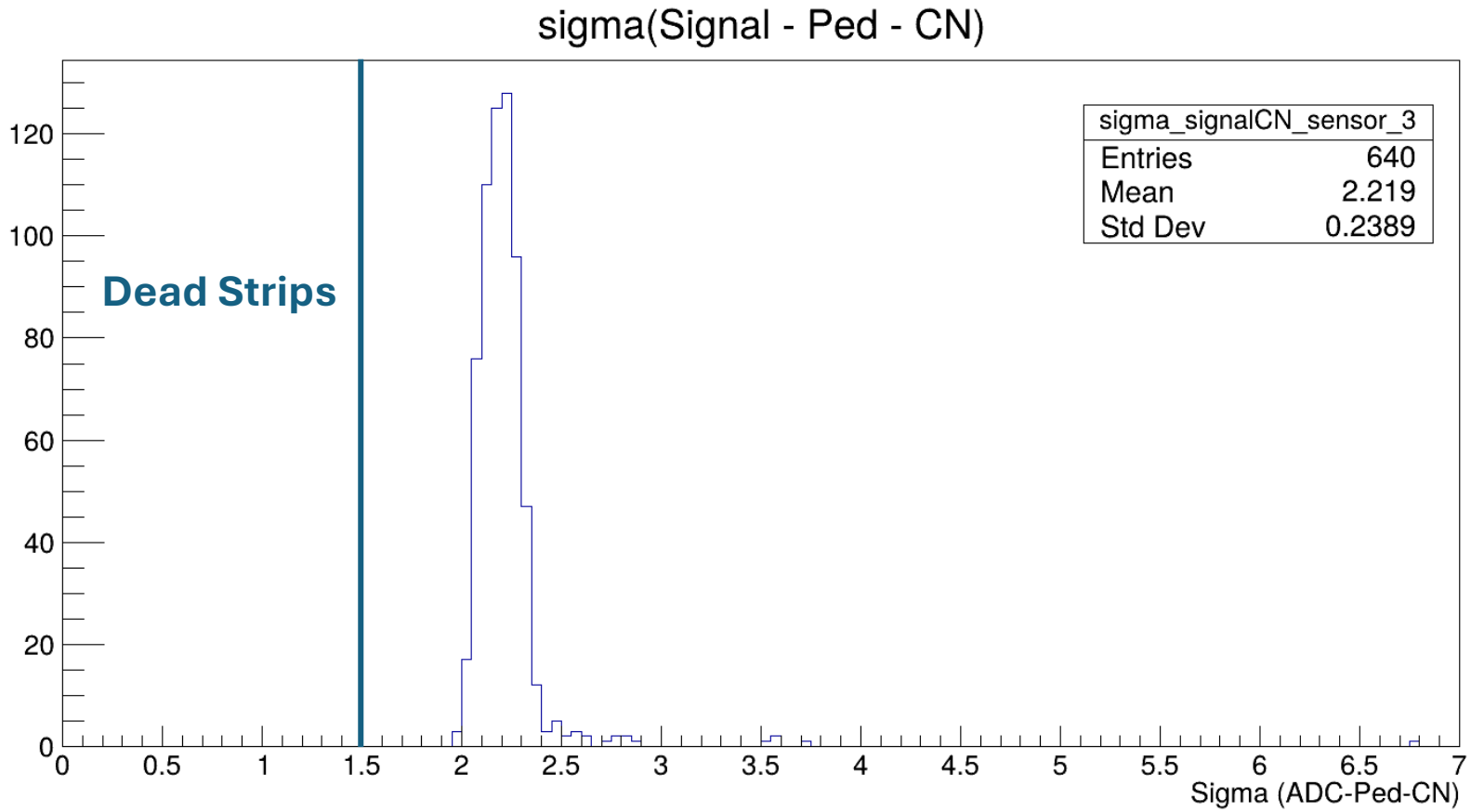


Sensor 3
Chip 0: strips (0-63)
Strip 17

Sigma decreases, narrower distribution

CNAO2024 run 7028
(5k events)
Sensor 3

Sigma(Signal – Ped – CN1) ⇨ Identification of Dead strips



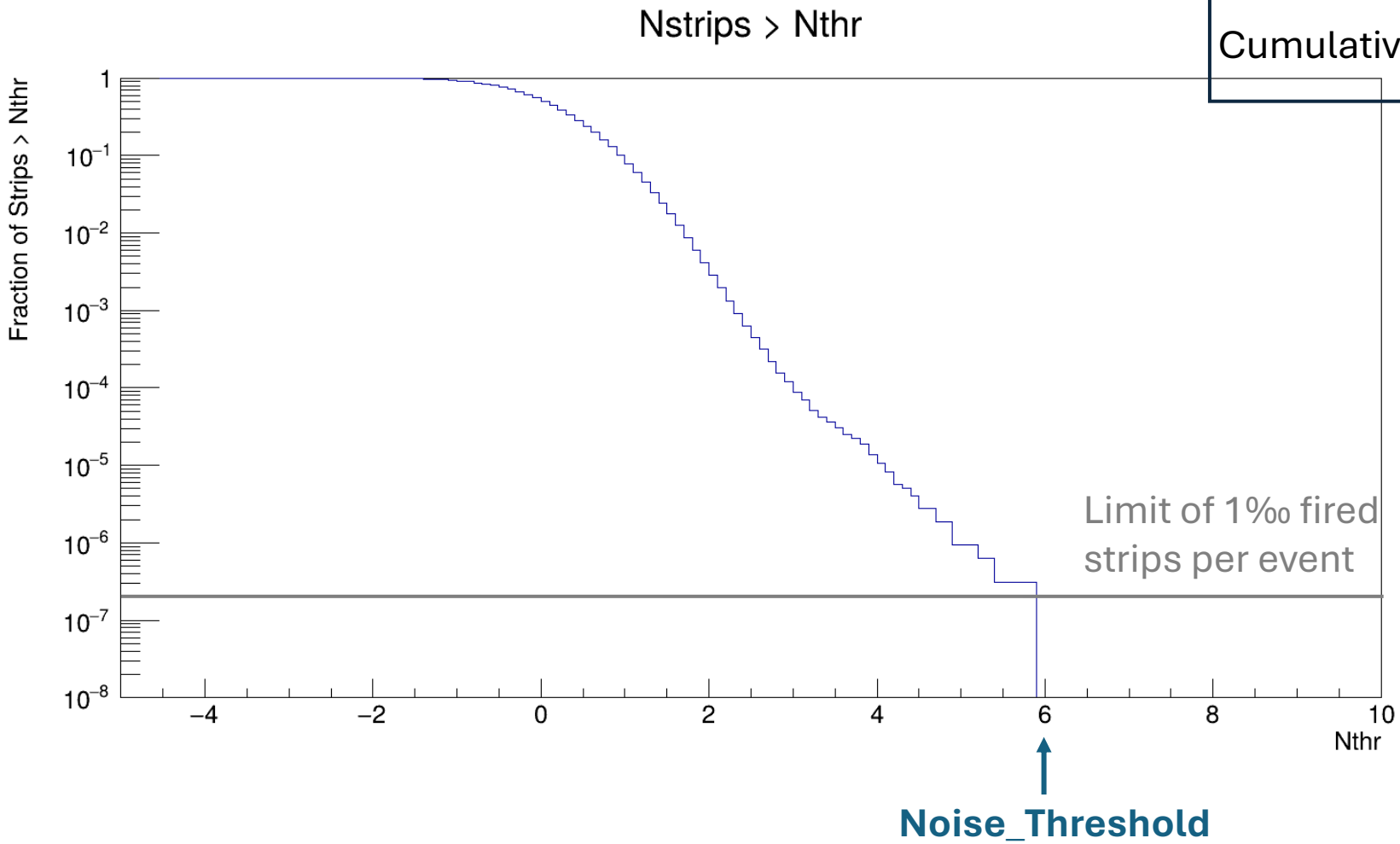
Dead if:

Sigma(ADC-Ped-CN1) < Mean – 3 Std Dev

Probably not connected to the read out.

CNAO2024 run 7028
(5k events)
Sensor 3

Noise Threshold for a sensor ⇨ Identification of Noisy strips



Cumulative of strips when $\frac{\text{ADC-Ped-CN1}}{\text{sigma(Ped)}}$ > Nthr

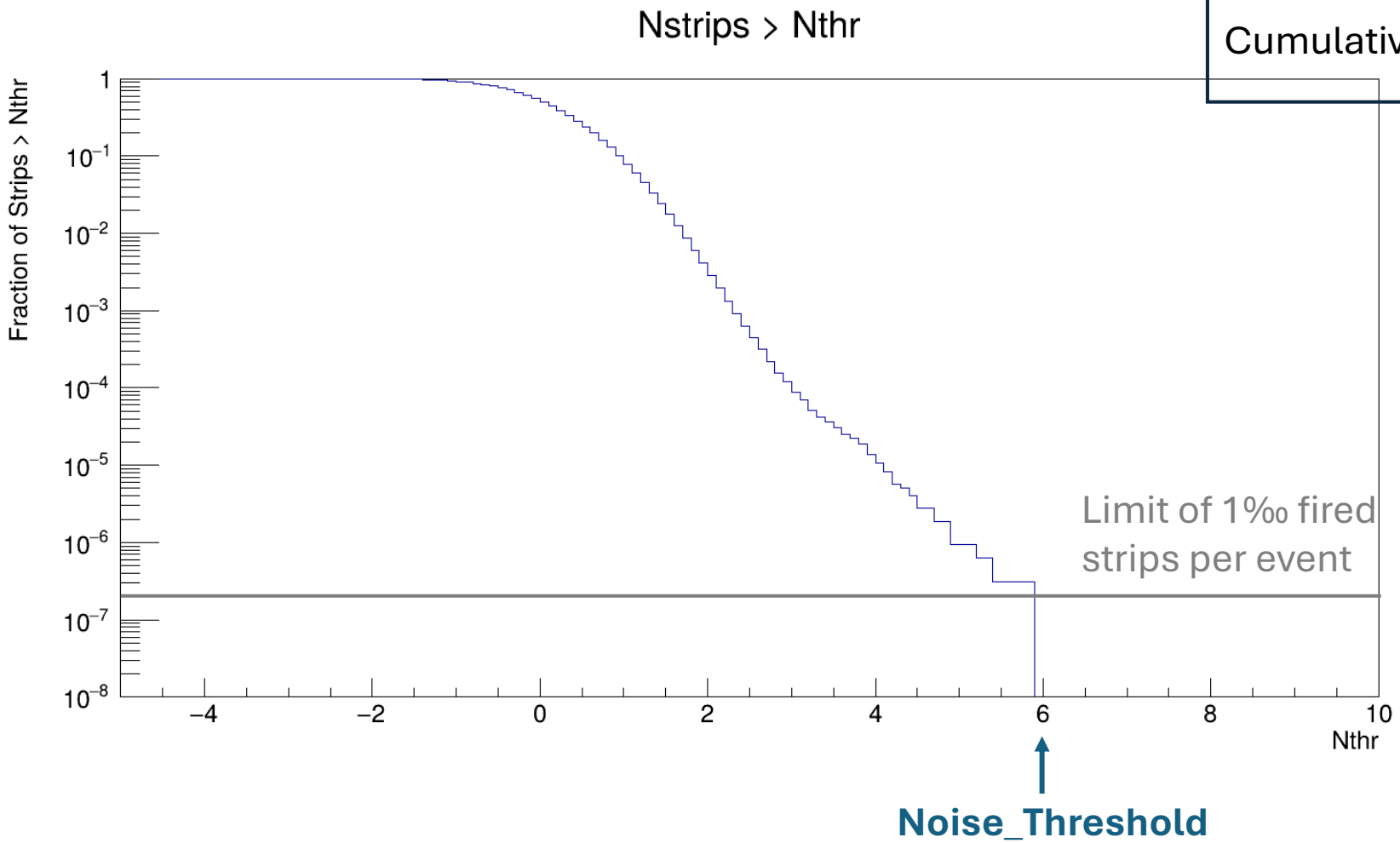
Normalized to
640 strips x 5000 events

Noisy if :

Sigma(ADC-Ped-CN1) >
(Mean+ Noise_Threshold x Std Dev)

CNAO2024 run 7028
(5k events)
Sensor 3

Noise Threshold for a sensor ⇨ Identification of Noisy strips



Cumulative of strips when $\frac{\text{ADC-Ped-CN1}}{\text{sigma(Ped)}}$ > Nthr

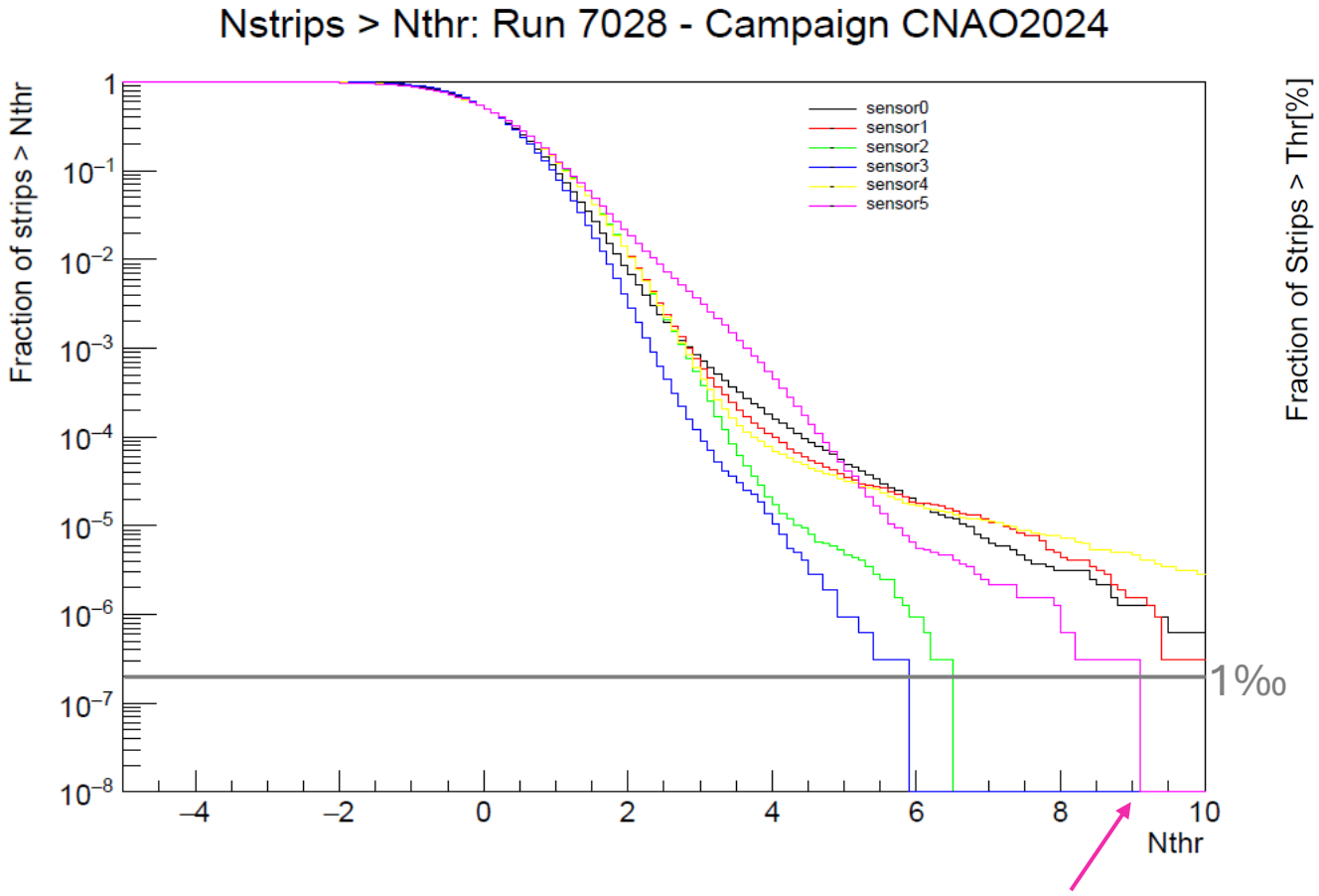
Normalized to
640 strips x 5000 events

Noisy if :

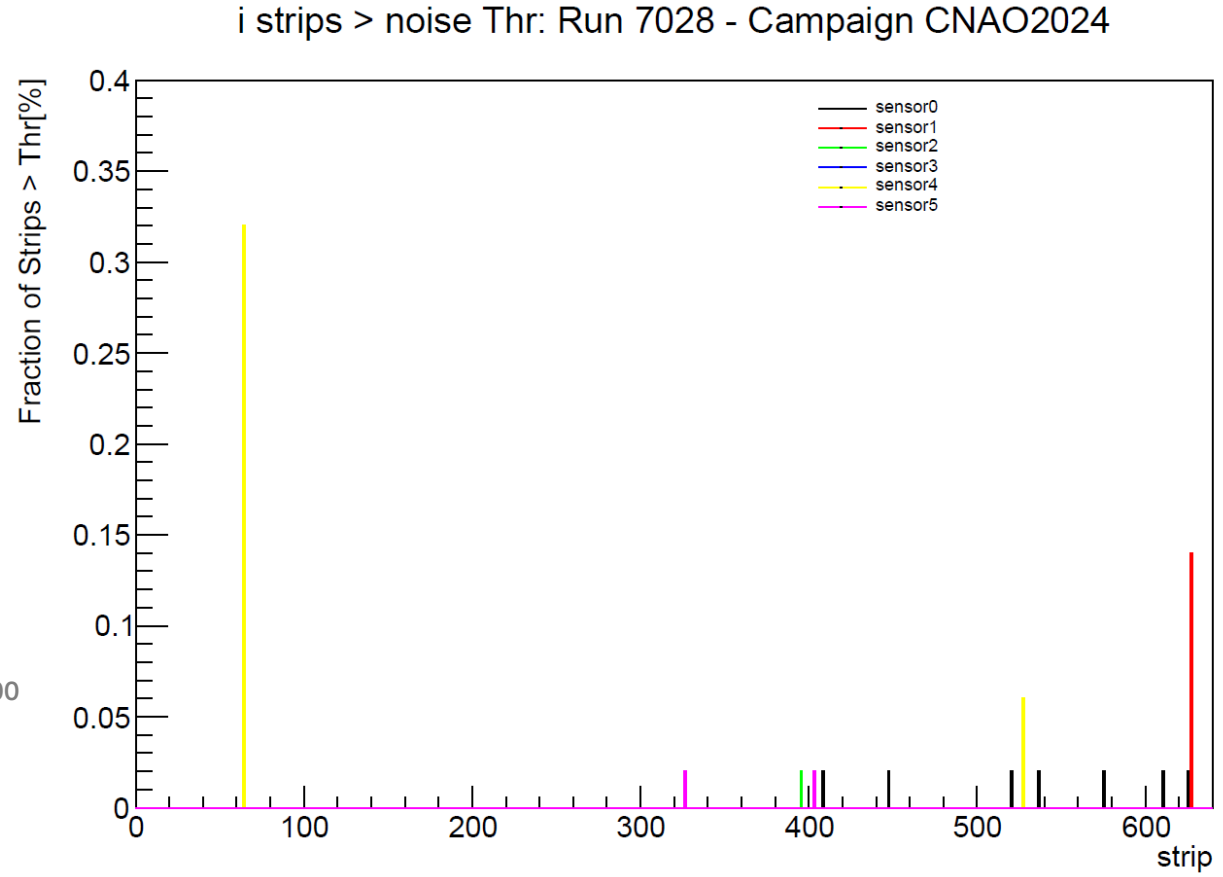
Sigma(ADC-Ped-CN1) >
(Mean+ Noise_Threshold x Std Dev)

Common Noise 2
(without dead and noisy strips)

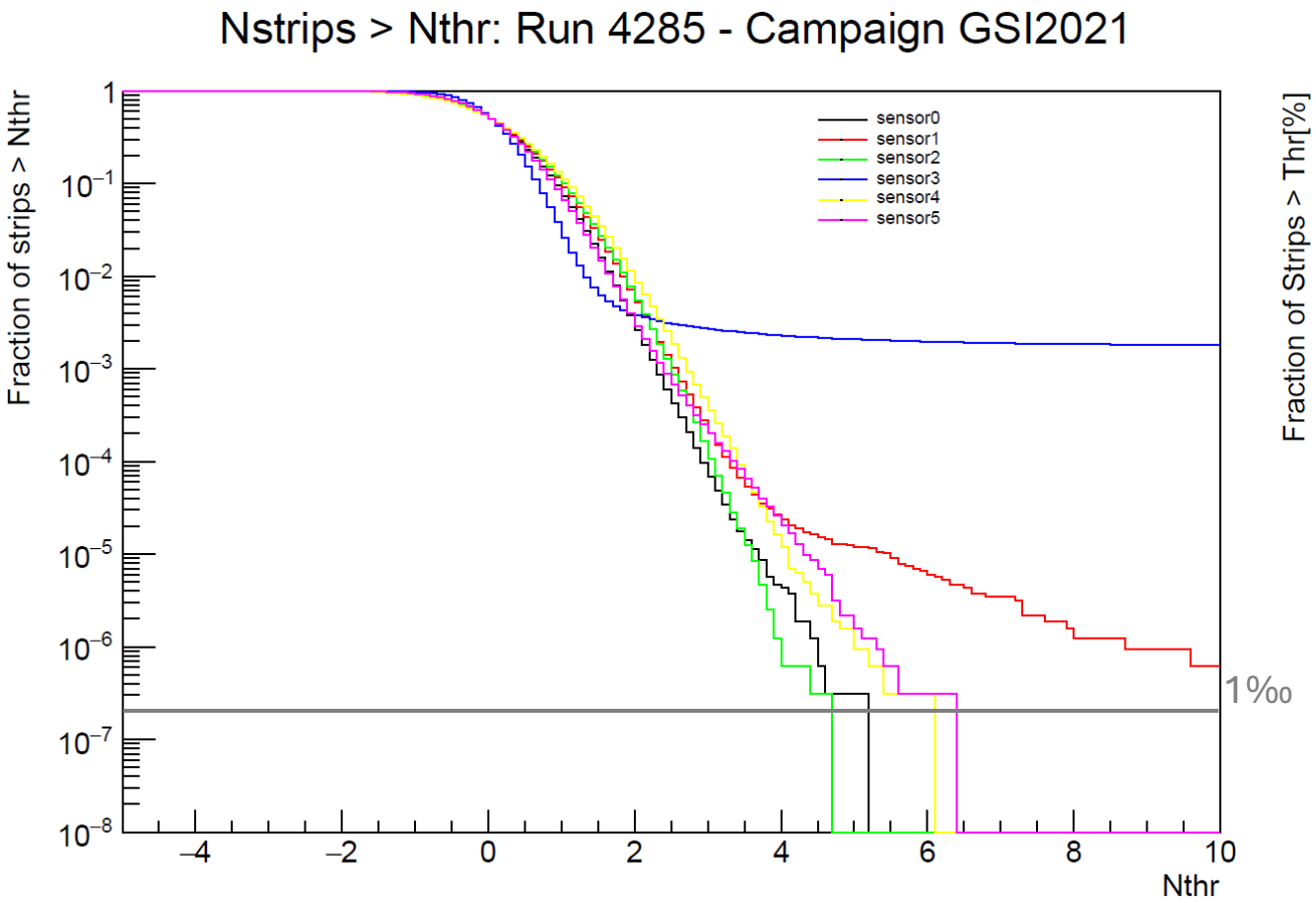
CNAO2024 – run 7028 (5k events)

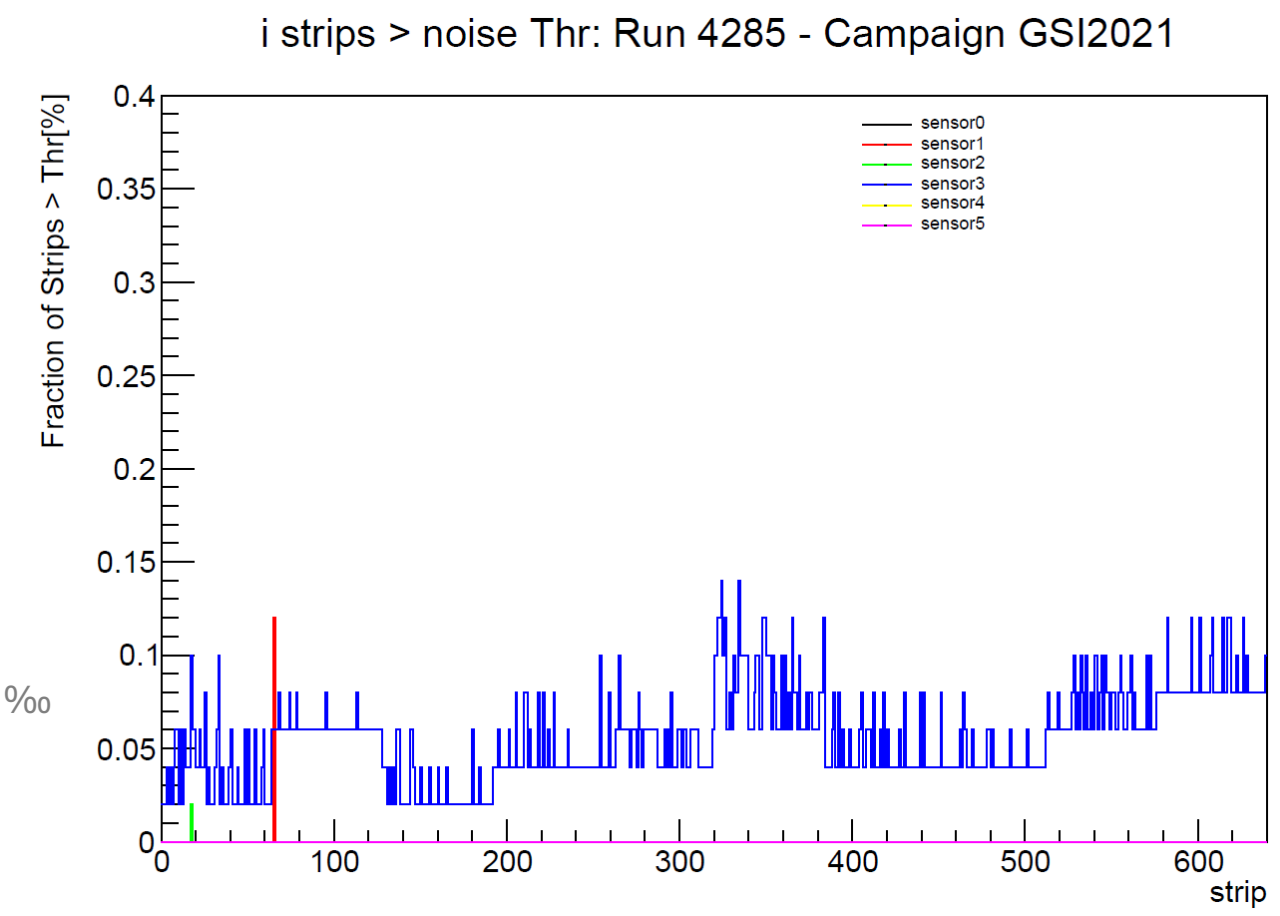


Final Threshold Noise: Thr=9.2



GSI2021 – run 4285 (5k events)





Sensor 3 noisy in GSI2021

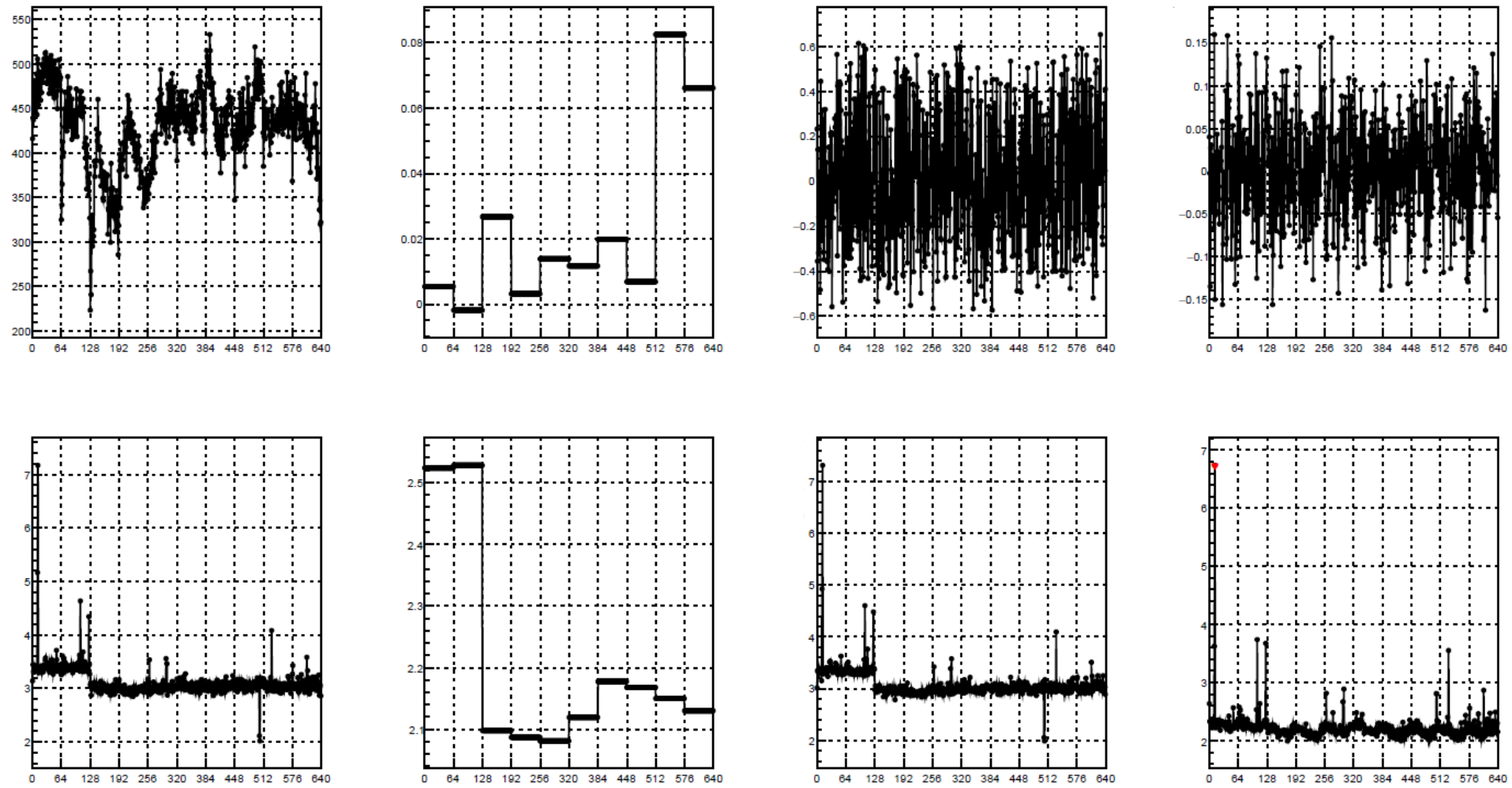
Graphs in file.pdf → For each sensor in each run:

CNAO2024 run 7028
(5k events)
Sensor 3

ADC
Channel (Strip)

Means →
Sigmas →

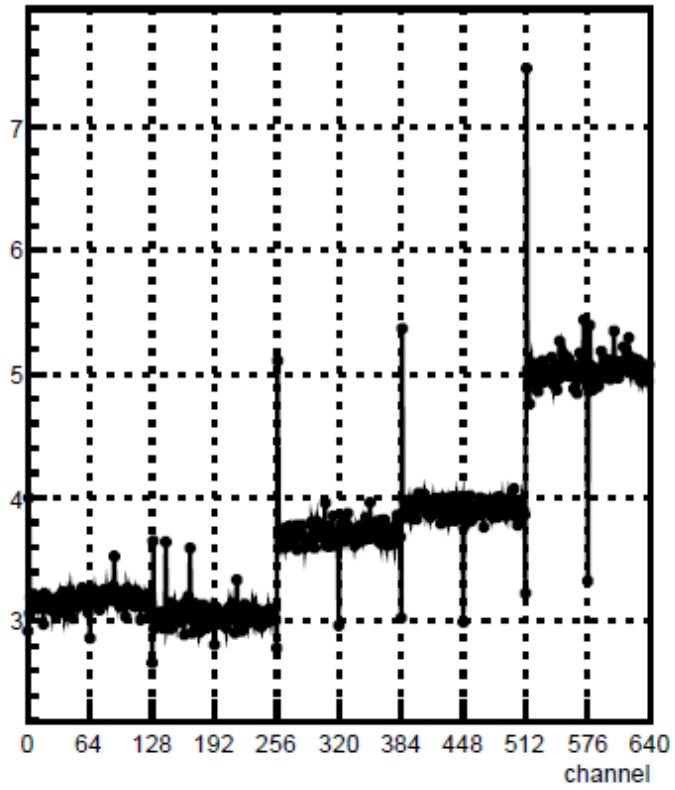
Pedestals | Common Noise 2 | Signal-Ped | Signal-Ped-CN2



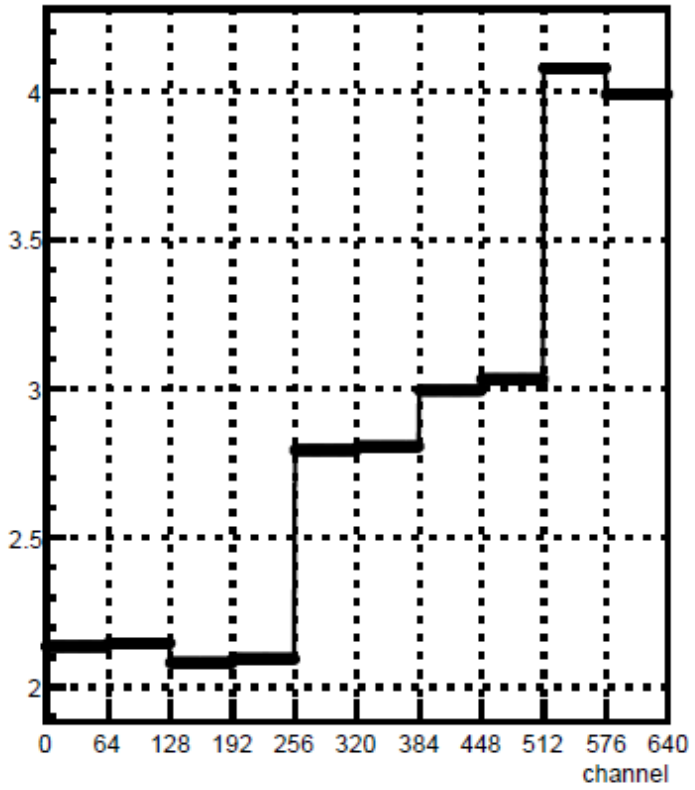
GSI2021 – run 4285

Sensor 5

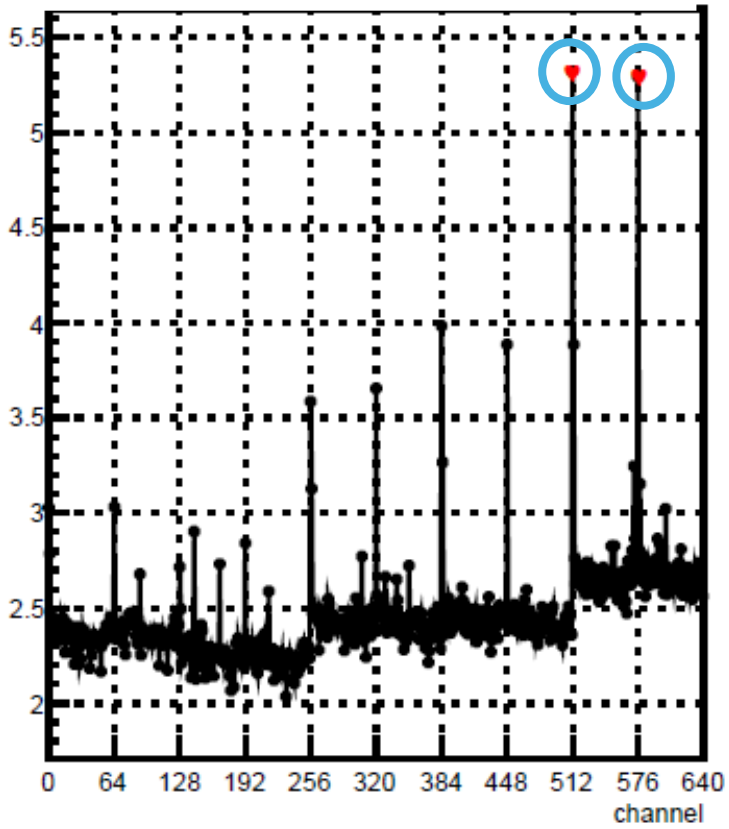
Sigma(Ped)

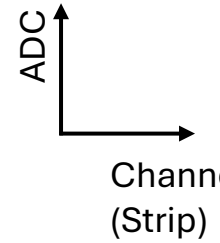


Sigma(CN2) [2 ADC scale]



Sigma(Signal-Ped-CN2)



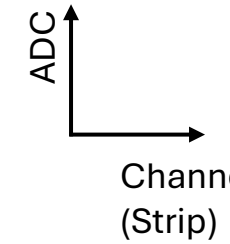


-Jump of the signal every 128 strips

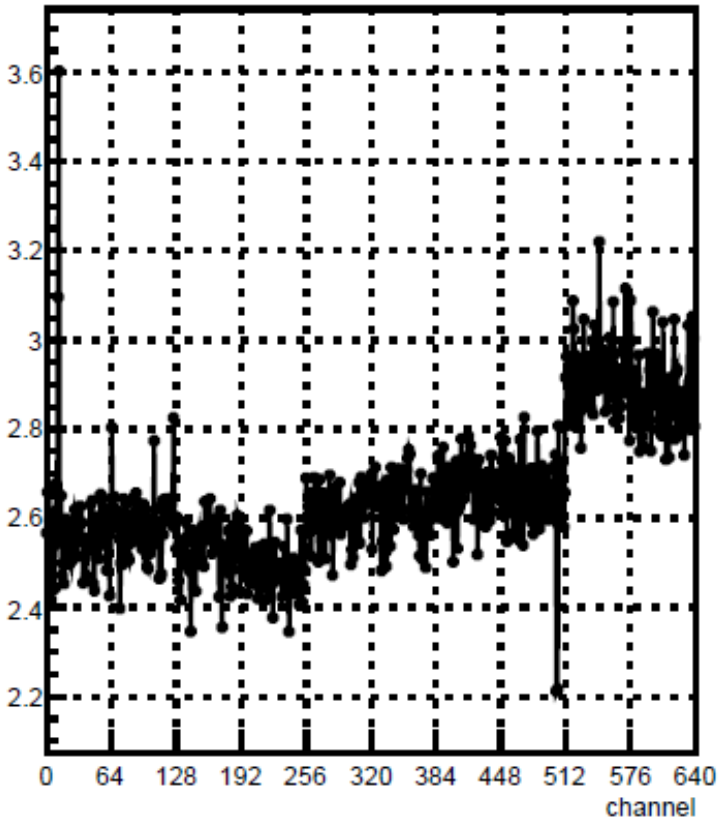
-Firmware problem

HIT2022 – run 4850

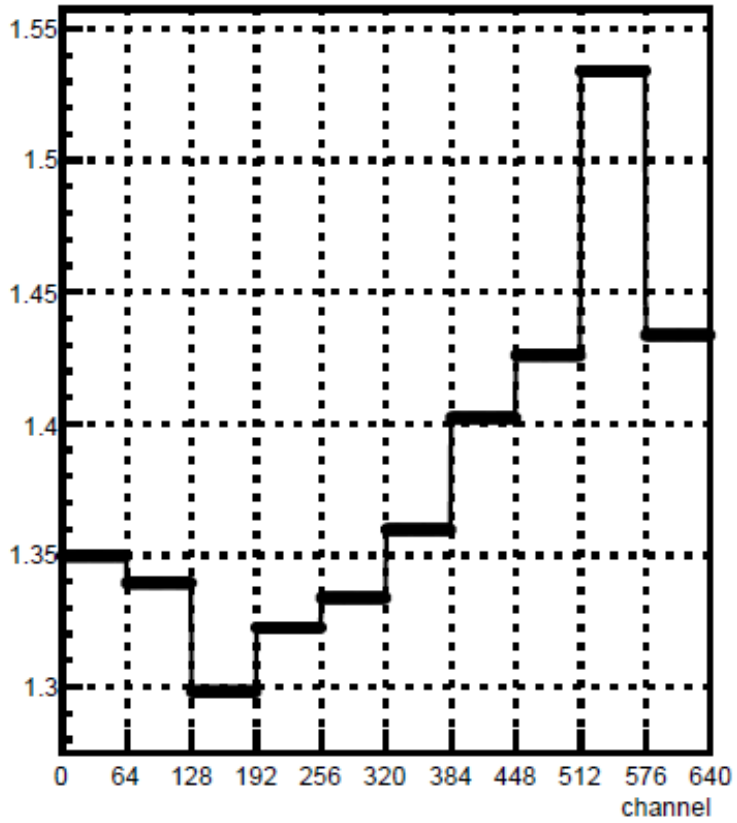
Sensor 5



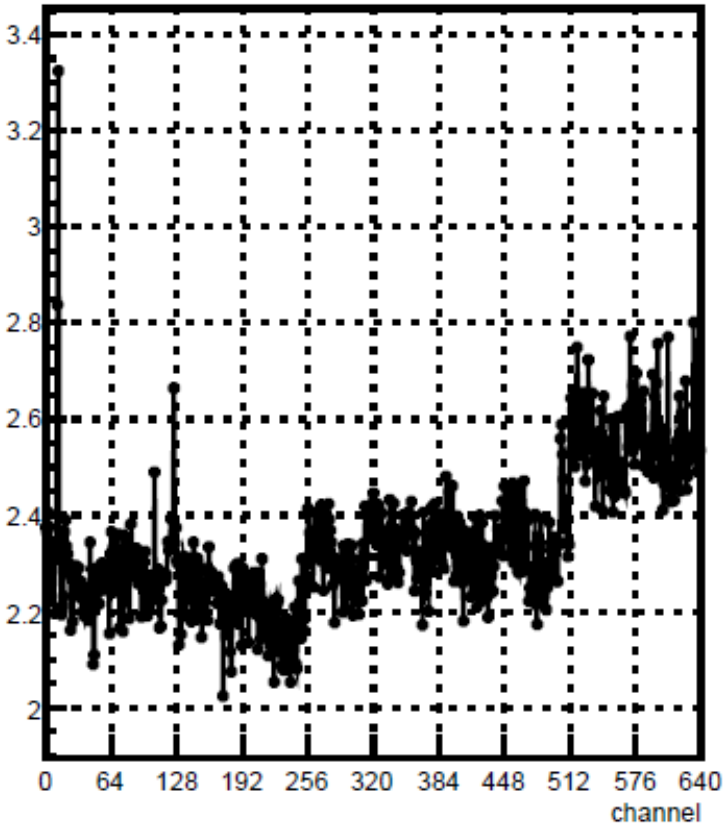
Sigma(Ped)



Sigma(CN2) [0.3 ADC scale]



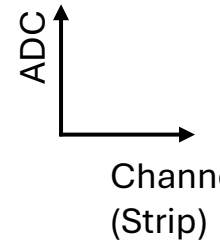
Sigma(Signal-Ped-CN2)



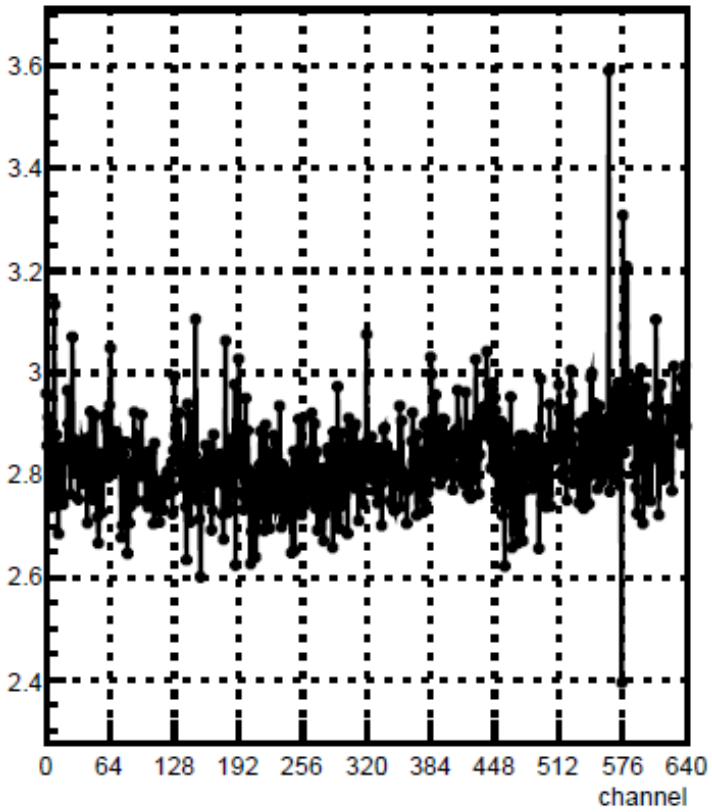
Problems: solved

CNAO2023 – run 5497

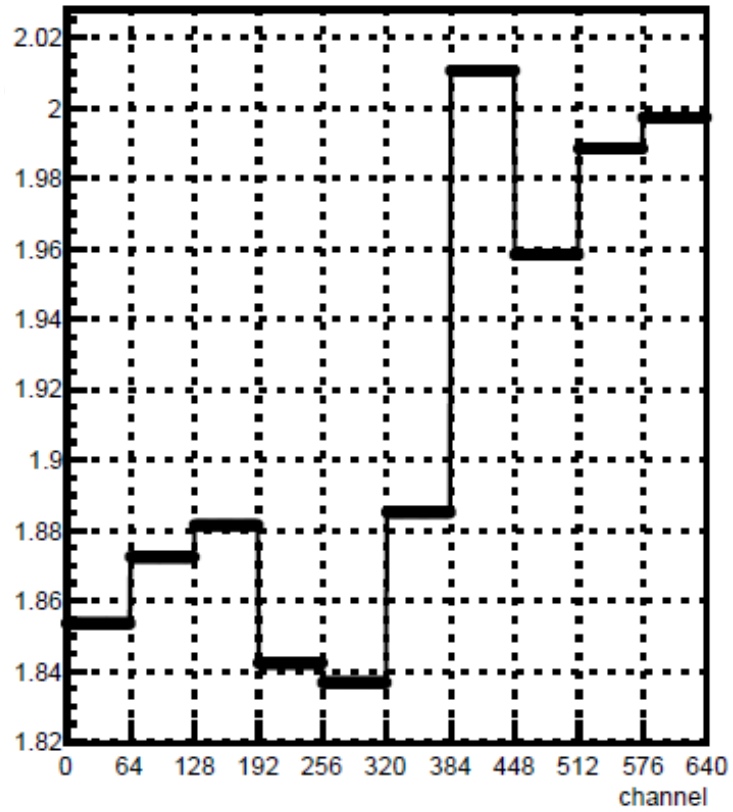
Sensor 5



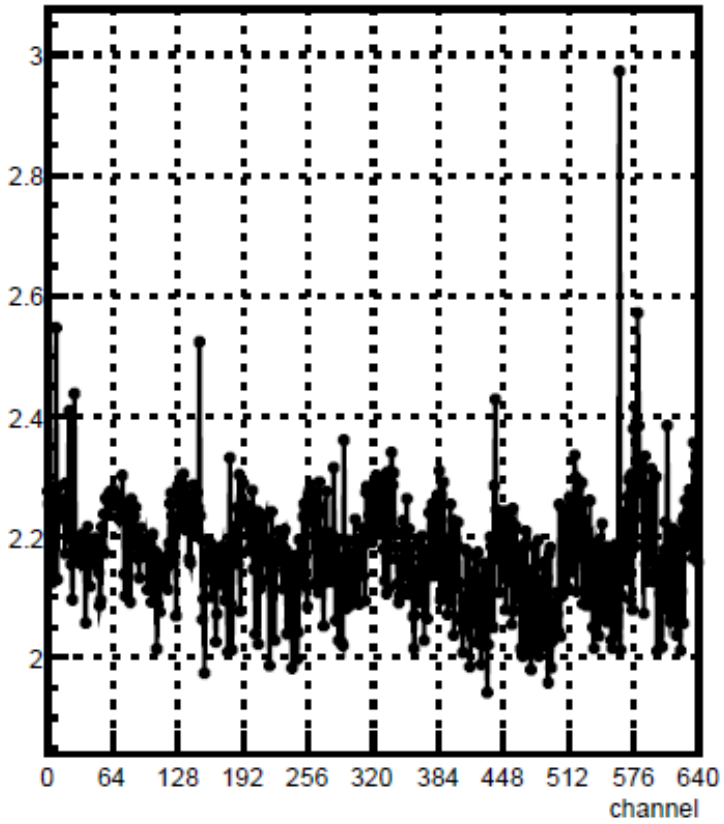
Sigma(Ped)



Sigma(CN2) [0.2 ADC scale]



Sigma(Signal-Ped-CN2)

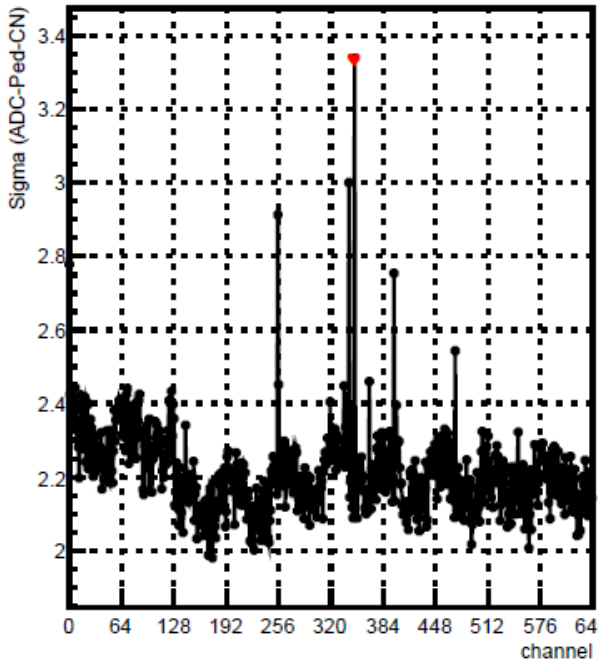


Problem: solved (constant CN)

CNAO2023 – run 6202

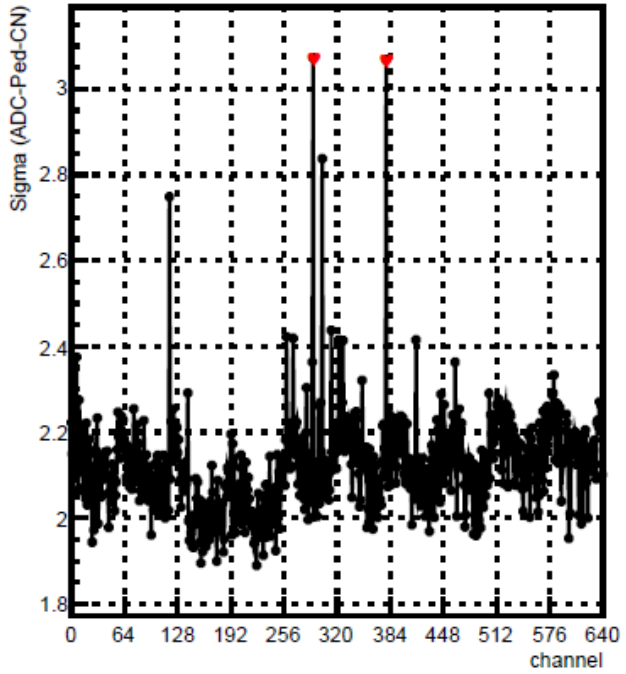
Sensor 0

Sigma(Signal-Ped-CN2)



Sensor 5

Sigma(Signal-Ped-CN2)

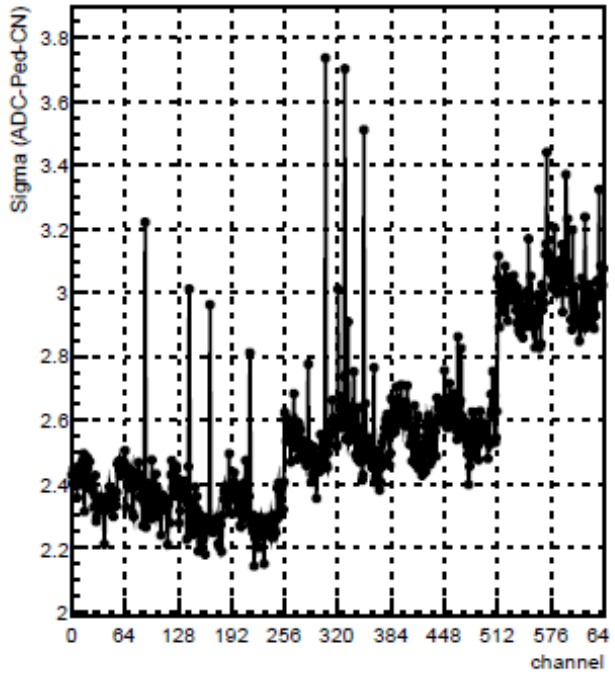


-No changes in the sigmas

CNAO2024 – run 7028

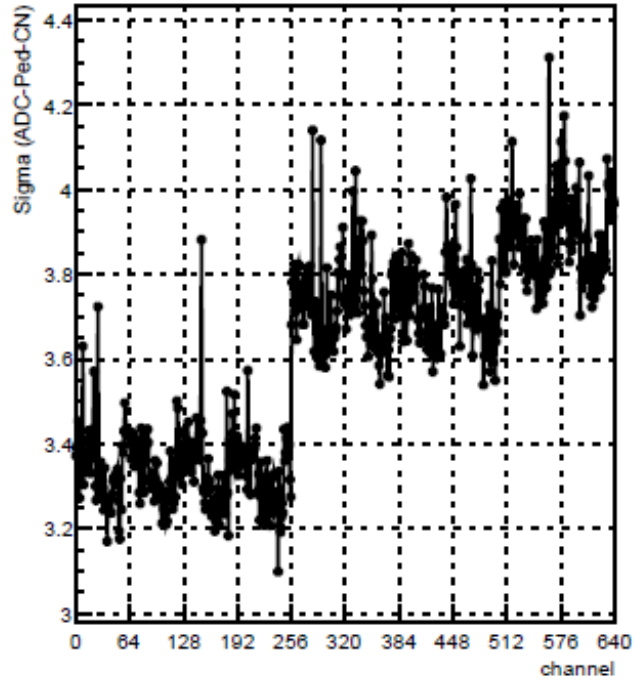
Sensor 0

Sigma(Signal-Ped-CN2)



Sensor 5

Sigma(Signal-Ped-CN2)

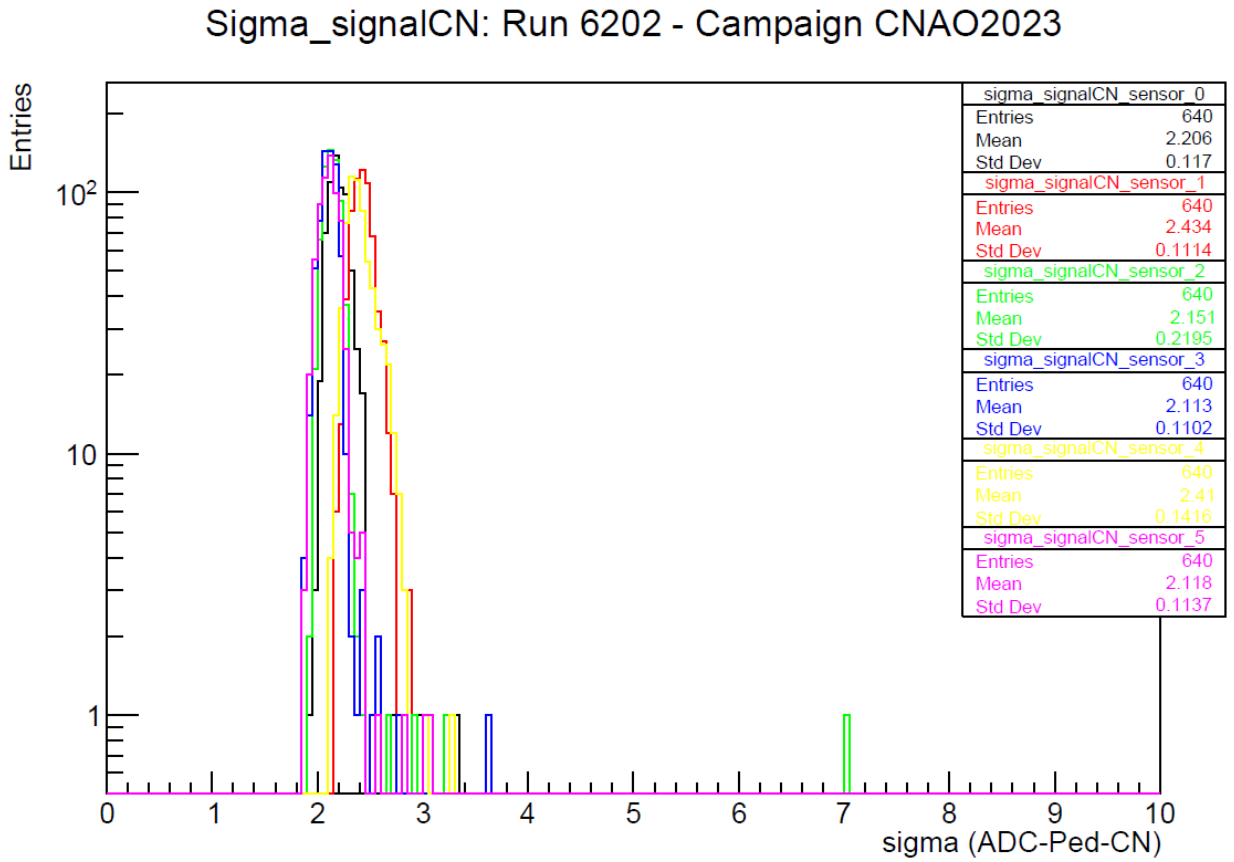


-Higher sigmas
-Changes in the sigmas

<u>Light on sensors</u> due to the change of the mechanic set up

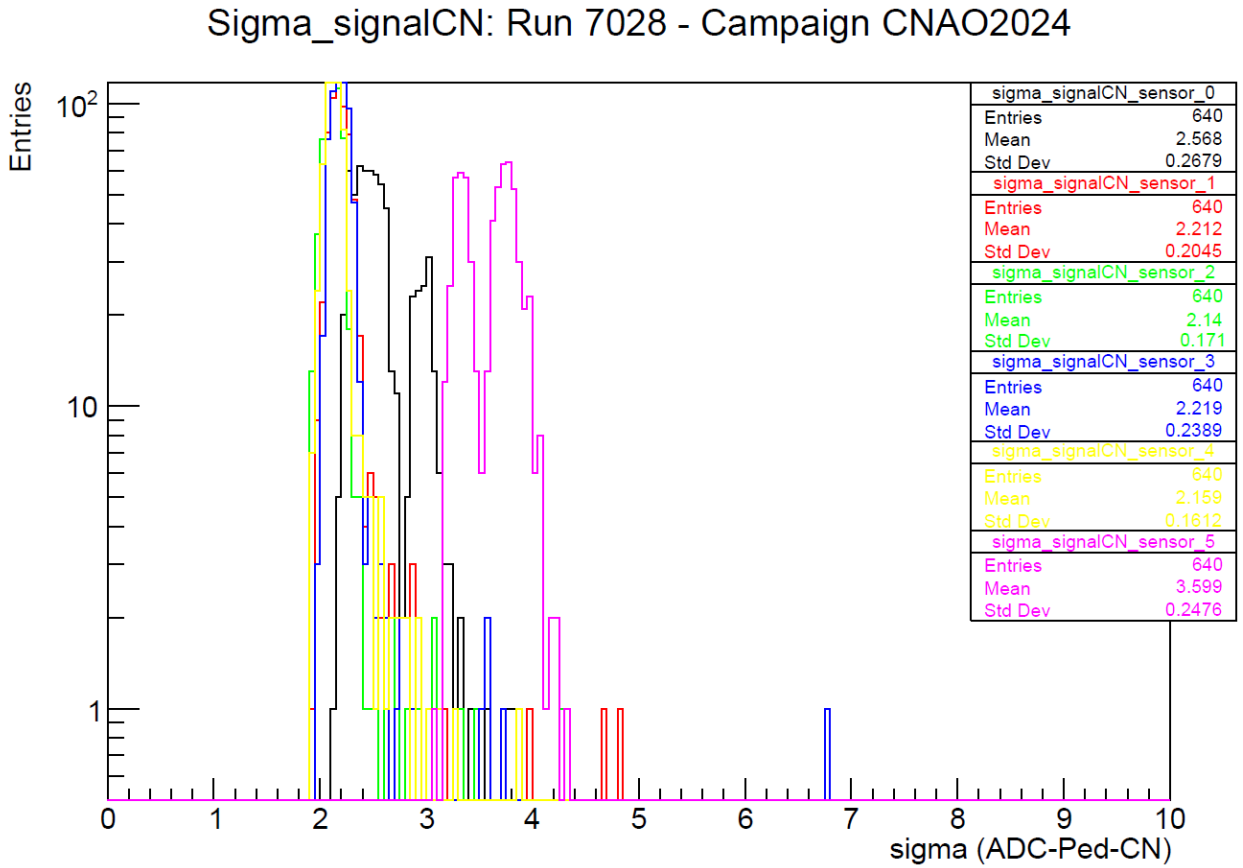
Make it more hermetic

CNAO2023 – run 6202



-Coincident distributions

CNAO2024 – run 7028



-Spread out distributions
-Double peaks for the external sensors

-Internal sensors keep being stable

Conclusion

-ComputeMsdPed.C is an efficient macro for the study of calibration runs

-MSD detector seems to behave consistently through each data taking campaign analyzed up to now

Next work

-List of good calibration runs for each campaign

-Start working on clusters (physics runs)

-Make the support apparatus more hermetic for the next data taking

Thank you for listening!