Research plan and current work with UMD

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Outline:

- Background
- Research plan*
- Current work with UMD:

  1. Latch and trigger peaks Monitoring
  2. Intensity Monitoring
  3. Signal characterization

- To do (soon)...

*Development of an estimator of the muonic component in AugerPrime by means of the cross-calibration with the underground AMIGA detectors

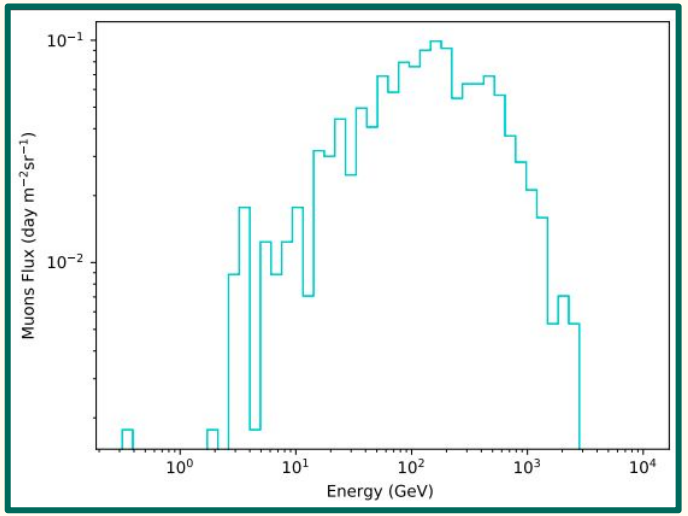
Background

Laboratorio 6 y 7 at LAGO:

- Preparing acquisition system for WCD “Neurus”
- Calibration with VEM signal of WCD “Pucho”

Licenciatura Thesis at ANDES:

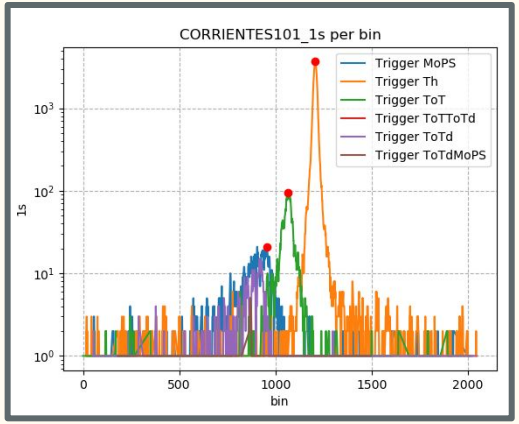
- Muon Flux estimation
- Paper in progress



Research plan:

TASK 1

Accurate determination of the number of muons by the UMD



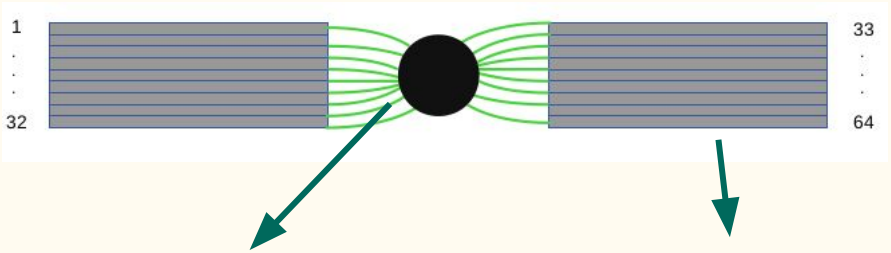
TASK 2

Systematic uncertainties in the indirect measurements of muons by the AugerPrime surface detectors (SSD+WCD)

TASK 3

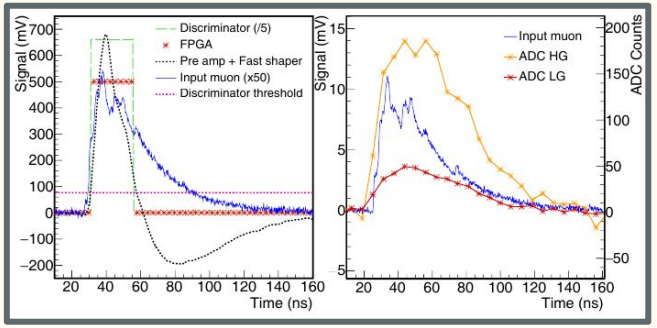
Determination of the number of muons obtained from new surface array of AugerPrime (i.e. the combination of SSD and WCD), through the cross-calibration with the UMD.

UMD detectors



64 SiPM array

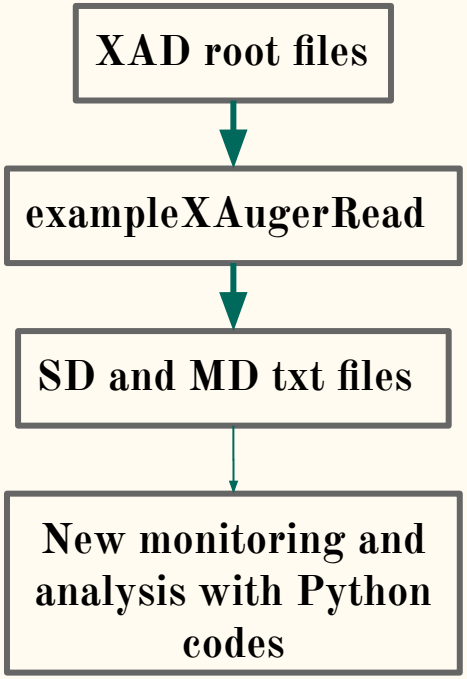
Scintillator Strips

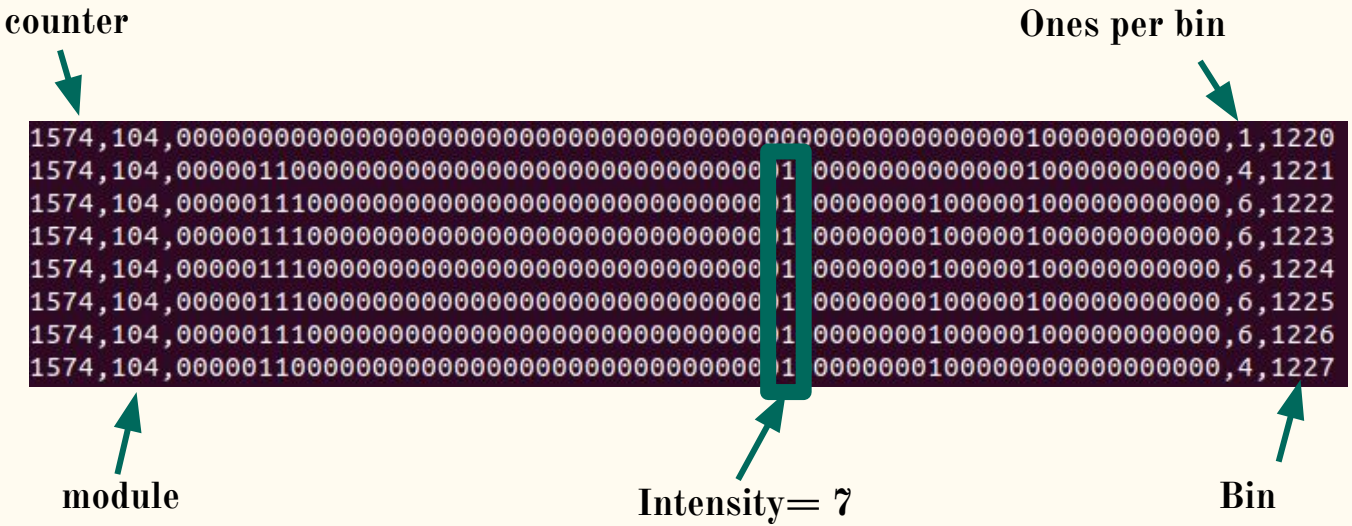


Botti A M., Determination of the chemical composition of cosmic rays in the energy region of 5 EeV with the AMIGA upgrade of the Pierre Auger Observatory - PhD Thesis

- Counter Mode: **Binary traces composed of FPGA samples @320 MHz ('1' means signal over THR).**
- Integrator Mode: Sum over the 64 SiPM signals. Gives a waveform as output.

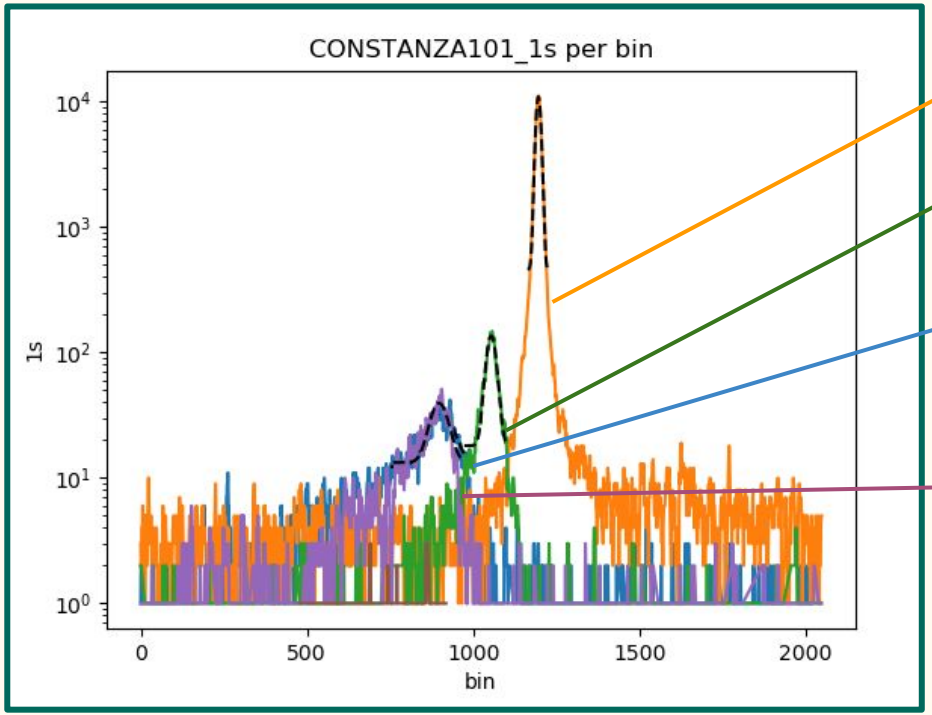
CDAS files treatment and selection of variables





N. Gonzalez et al, Data quality observables for the Underground Muon Detector of AMIGA

Latch and trigger peaks monitoring



Trigger Th

Trigger ToT

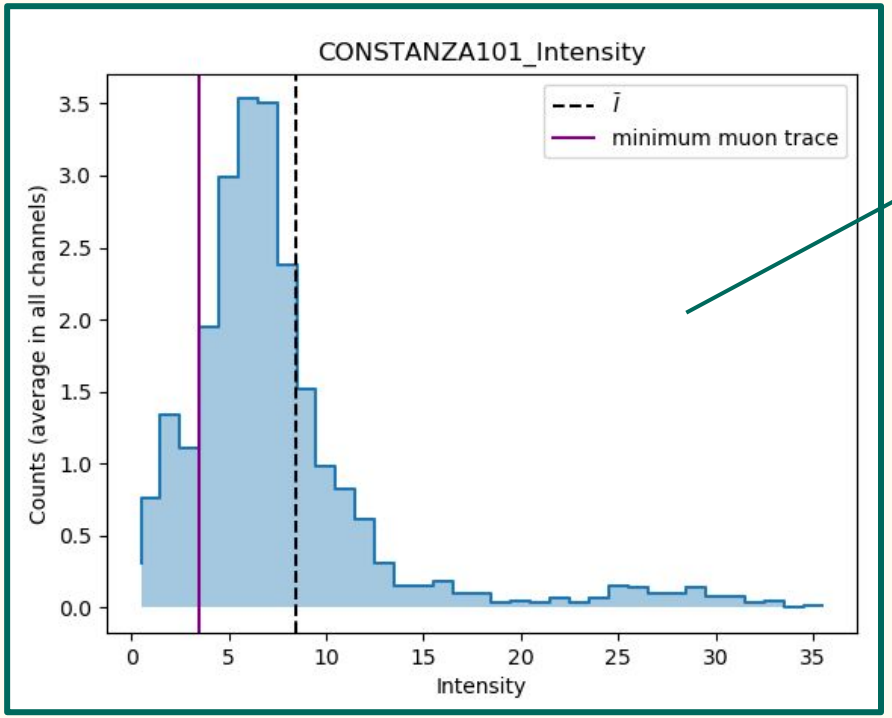
Trigger MoPS

Trigger ToTD

Latch bin: Th peak (1195)

```
[734, 101, 1195.724956, 10.4893, 1053.953895, 20.5448, 897.17833, 36.8422, 902.29481, 51.8384]
```

Intensity monitoring

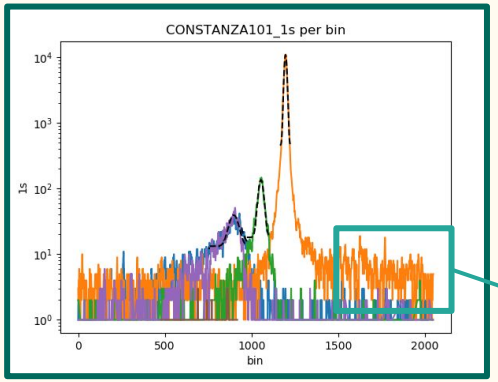


$$\bar{I} = 8.49$$
$$\sigma = 5.36$$

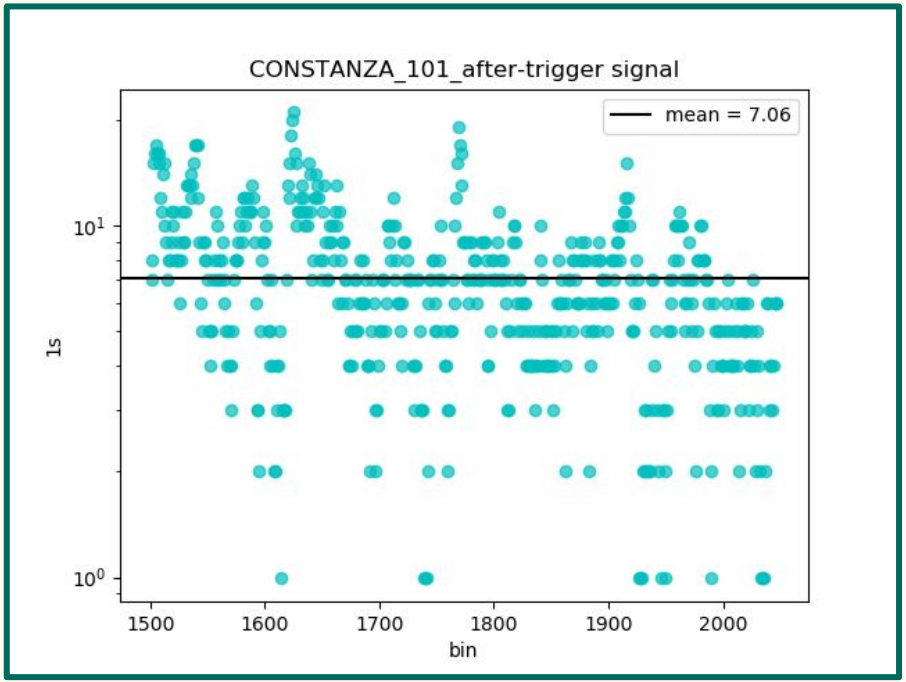
Average muon trace measured in laboratory:

$$\bar{I}_\mu = 7.8, \sigma_\mu = 1.5$$

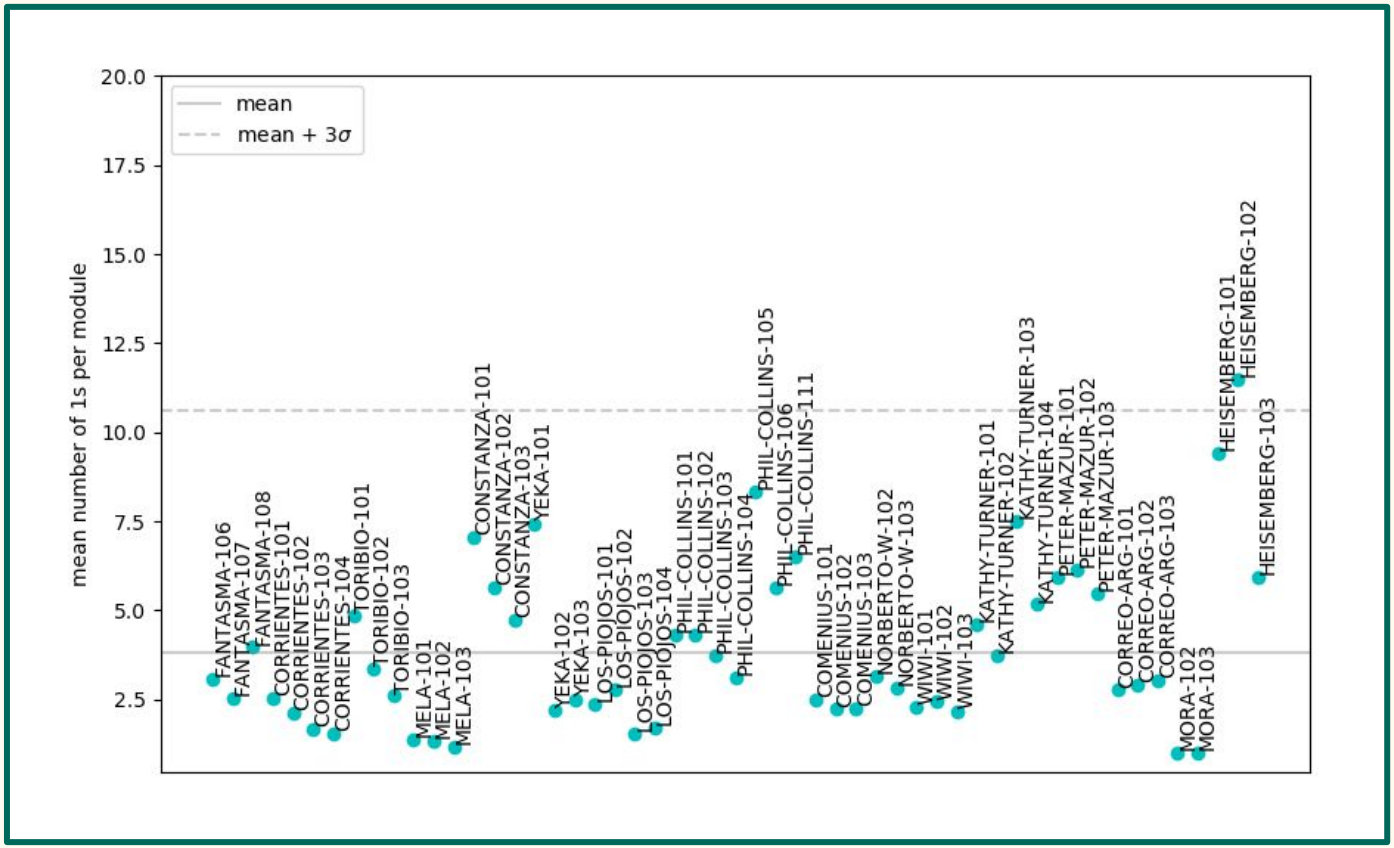
Signal characterization



RoI: Traces after trigger peaks (between bin 1500 and 2048) generated from dark rate, spontaneous emission and afterpulsing.



After-trigger number of 1s



Summary

- Proposal of observing the following variables for monitoring:

1. Latch bin and characteristic bin per trigger type
2. Intensity of signal (average over channels) per module
3. Mean rate in the after-trigger region

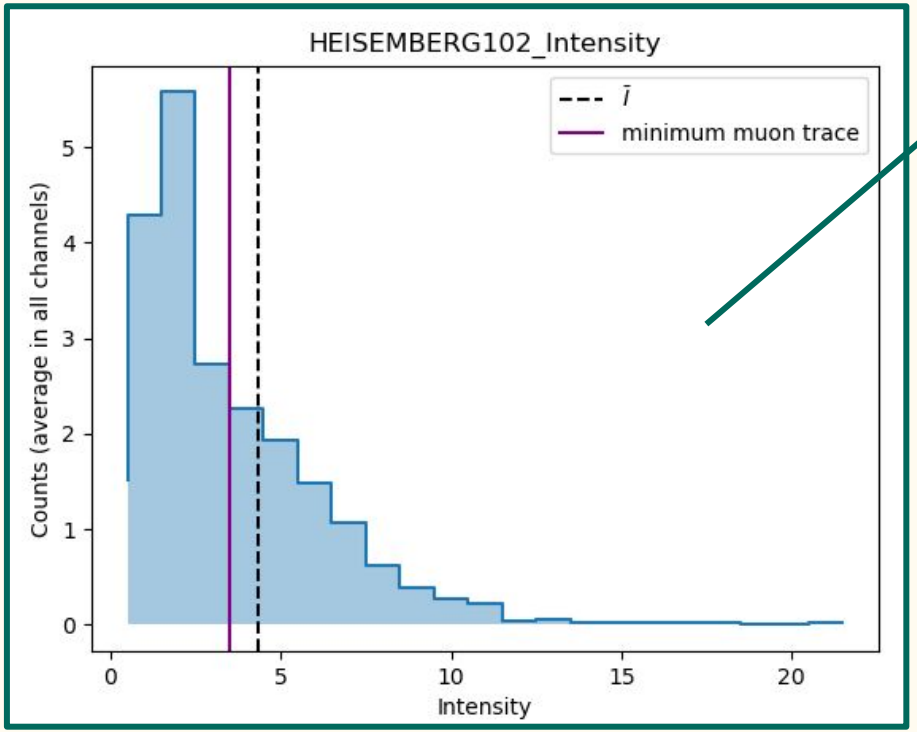
- New tool for detection of bad periods
- Starting study of background signals

To do (soon)...

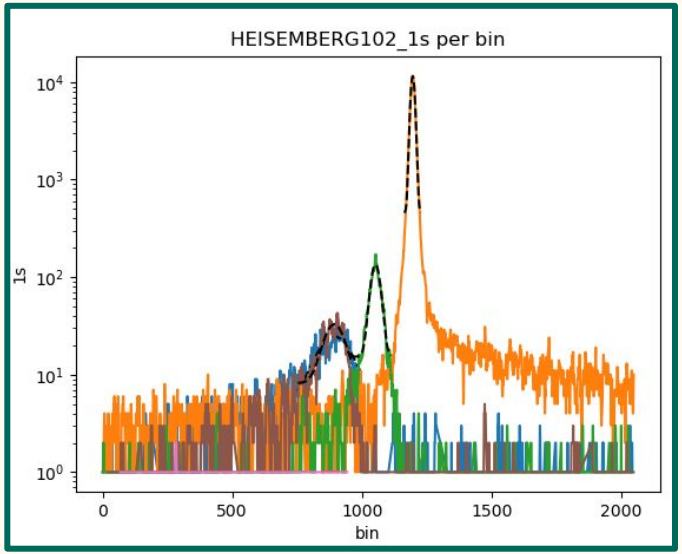
- Characterization of the complete signal
- Study of stability in time of variables
- Incorporation of Integrator mode

Thank you for your attention

After-trigger intensity



$$\bar{I} = 4.34$$
$$\sigma = 2.67$$

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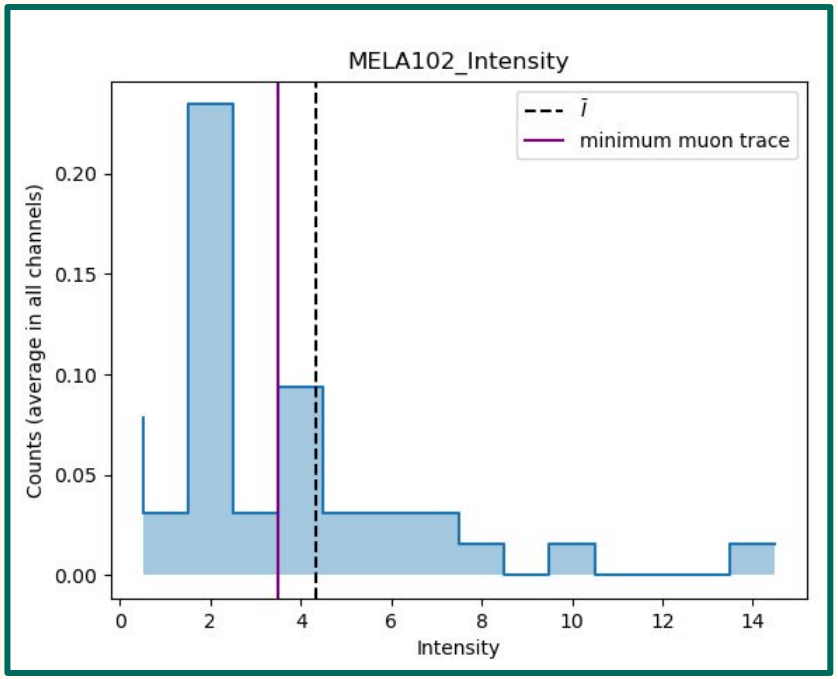
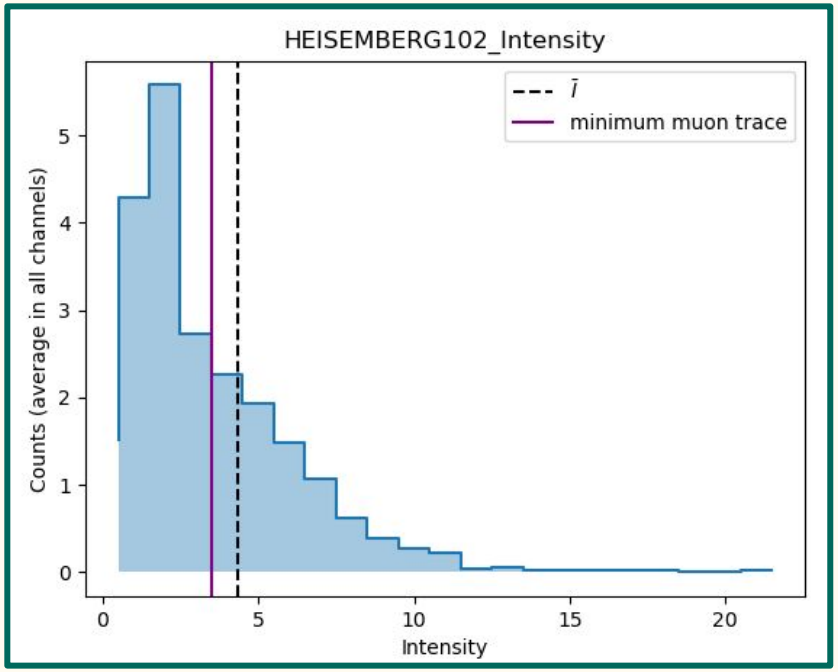
[734, 101, 1195.5061, 11.463, 1051.819561, 24.9267, 893.06525, 53.9969, 893.36242, 89.1533]
```

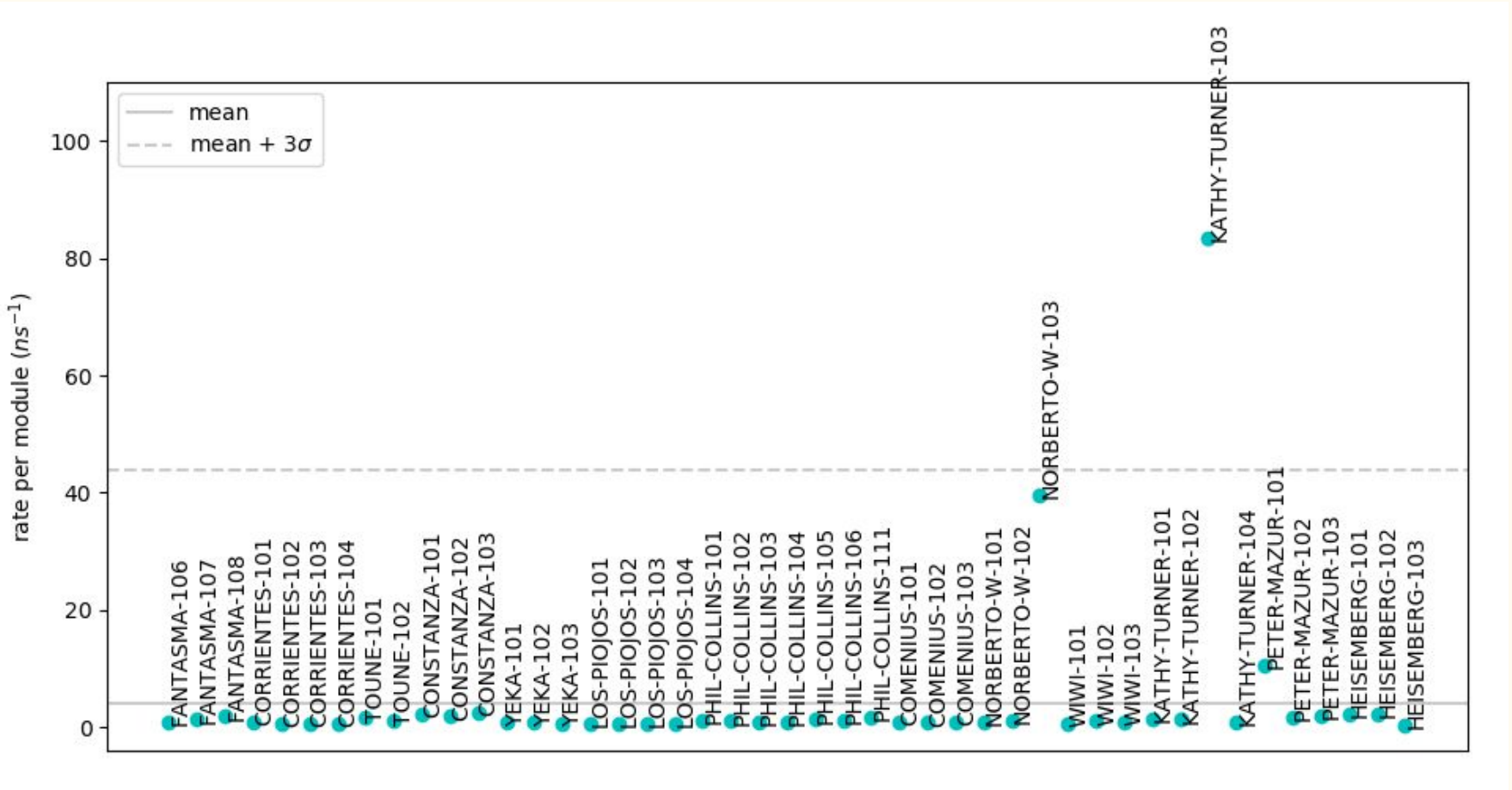
Intensity

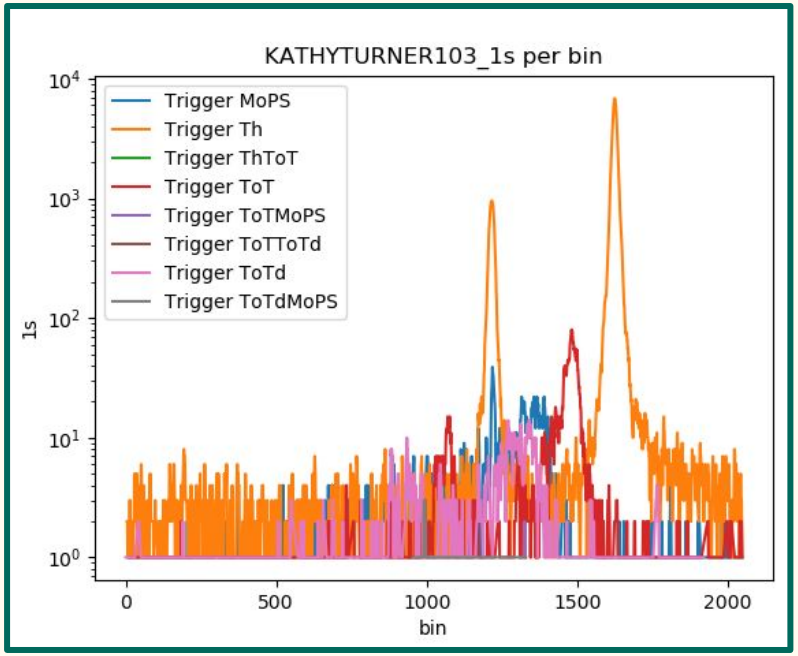


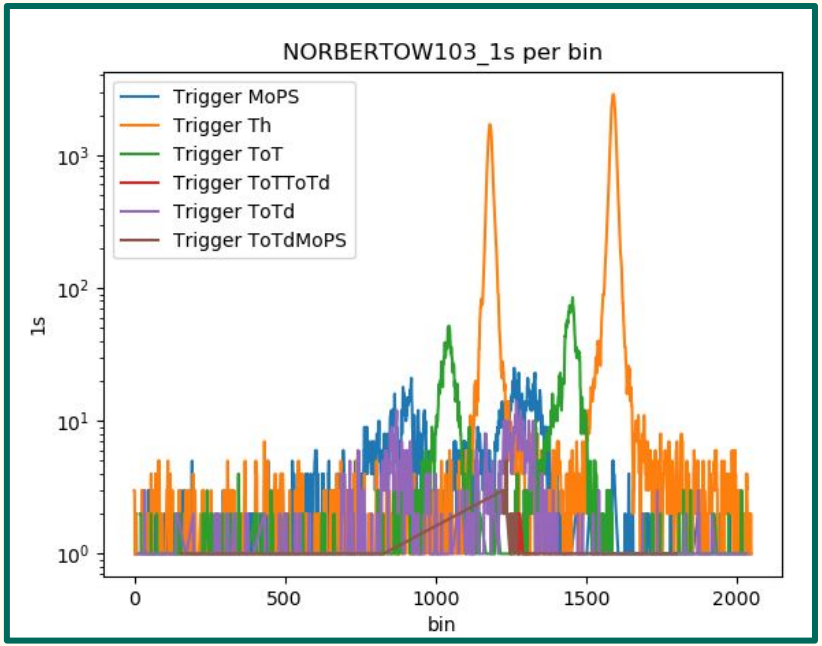
$$\bar{I} = 4.33$$
$$\sigma = 2.88$$



$$\bar{I} = 4.34$$
$$\sigma = 2.67$$


mean
mean + 3σ
rate per module (ns^{-1})
0
20
40
60
80
100
FANTASMA-106
FANTASMA-107
FANTASMA-108
CORRIENTES-101
CORRIENTES-102
CORRIENTES-103
CORRIENTES-104
TOUNE-101
TOUNE-102
CONSTANZA-101
CONSTANZA-102
CONSTANZA-103
YEKA-101
YEKA-102
YEKA-103
LOS-PIOJOS-101
LOS-PIOJOS-102
LOS-PIOJOS-103
LOS-PIOJOS-104
PHIL-COLLINS-101
PHIL-COLLINS-102
PHIL-COLLINS-103
PHIL-COLLINS-104
PHIL-COLLINS-105
PHIL-COLLINS-106
PHIL-COLLINS-111
COMENIUS-101
COMENIUS-102
COMENIUS-103
NORBERTO-W-101
NORBERTO-W-102
NORBERTO-W-103
WIWI-101
WIWI-102
WIWI-103
KATHY-TURNER-101
KATHY-TURNER-102
KATHY-TURNER-103
KATHY-TURNER-104
PETER-MAZUR-101
PETER-MAZUR-102
PETER-MAZUR-103
HEISEMBERG-101
HEISEMBERG-102
HEISEMBERG-103


KATHYTURNER103_1s per bin
Trigger MoPS
Trigger Th
Trigger ThToT
Trigger ToT
Trigger ToTMoPS
Trigger ToTToTd
Trigger ToTd
Trigger ToTdMoPS
1s
bin
0
500
1000
1500
2000


NORBERTOW103_1s per bin
Trigger MoPS
Trigger Th
Trigger ToT
Trigger ToTToTd
Trigger ToTd
Trigger ToTdMoPS
1s
bin
0
500
1000
1500
2000