Performance of the AugerPrime Surface Detector

2 November 2021

Alexander Streich
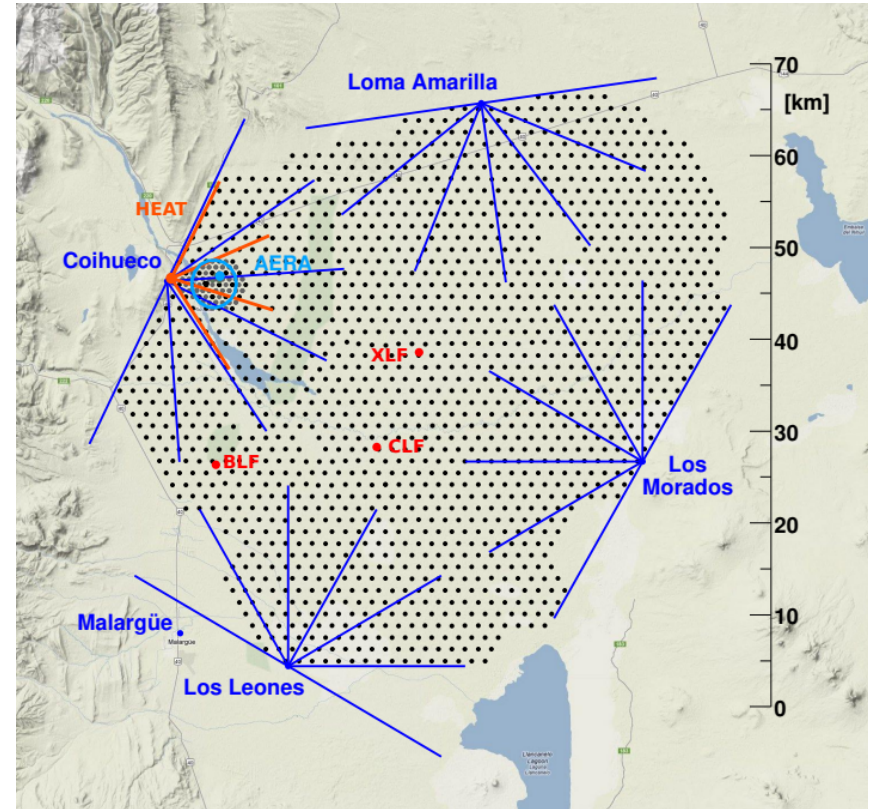
Pierre Auger Observatory

Fluorescence Detector (FD)
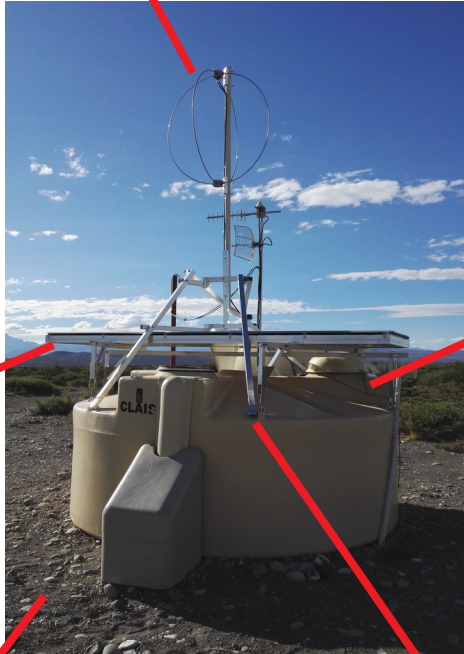with 27 telescopes

Surface Detector (SD)
with 1660 stations

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AugerPrime – Upgrade

Radio antenna (RD)
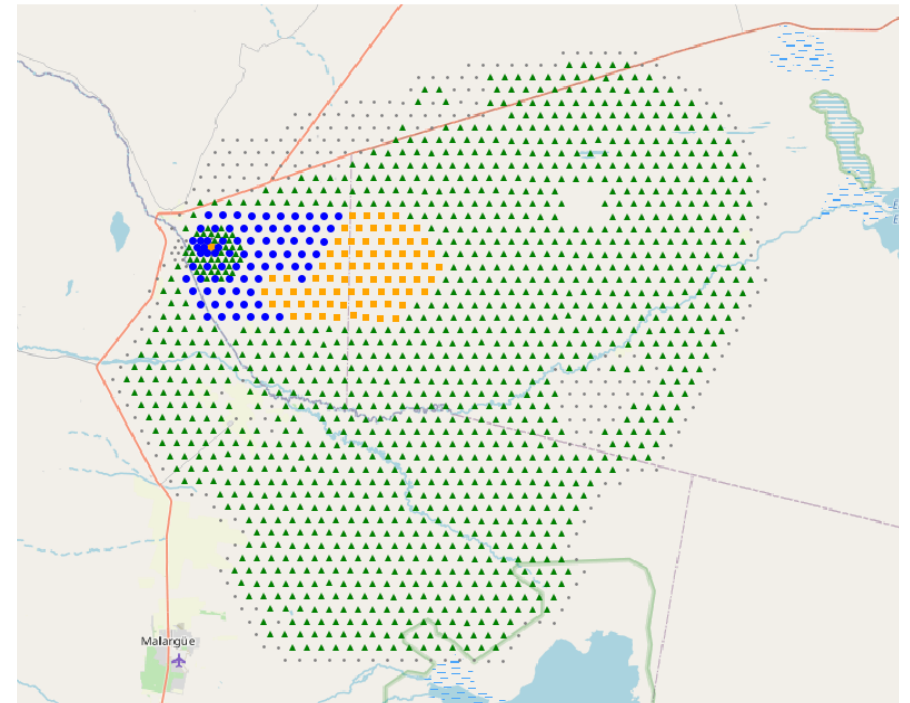
Electronics board (UUB)

Scintillation detector (SSD)

Small photomultiplier tube (SPMT)
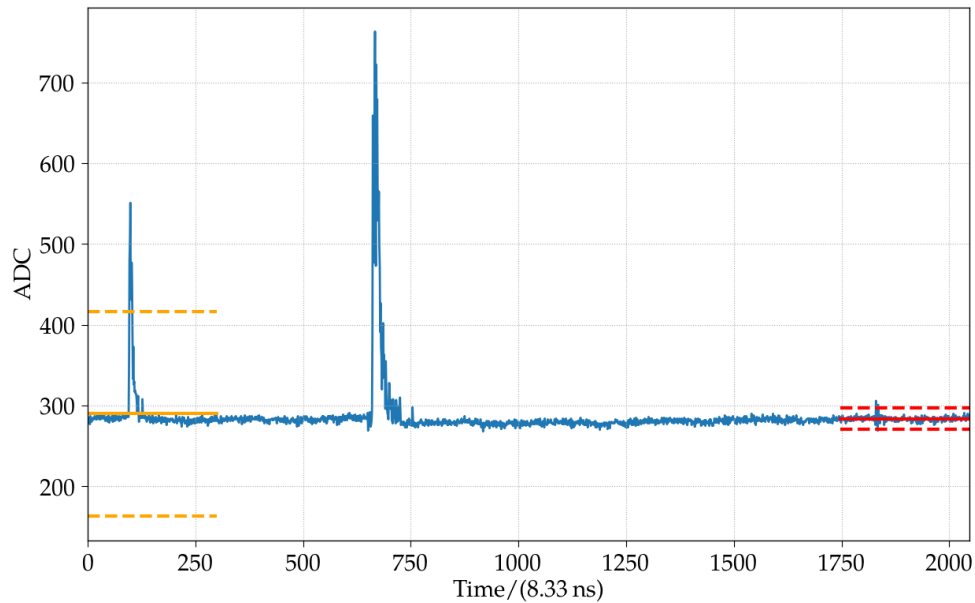
Underground detector (UMD)

Date: 01/11/2021
SSD deployed: 1377
• SD station

■ UUB pre-prod.: 79
● SSD pre-prod.: 76
▲ SSD w/o PMT: 1221

Upgraded Unified Board (UUB)

- Search for electrical transients

- Noise levels of input channels

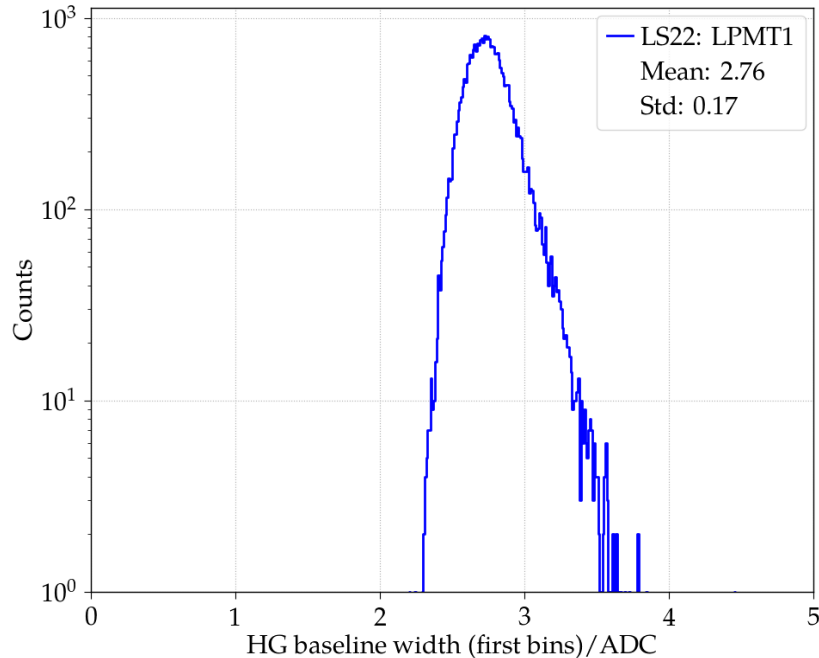- Amplification factors of input channels
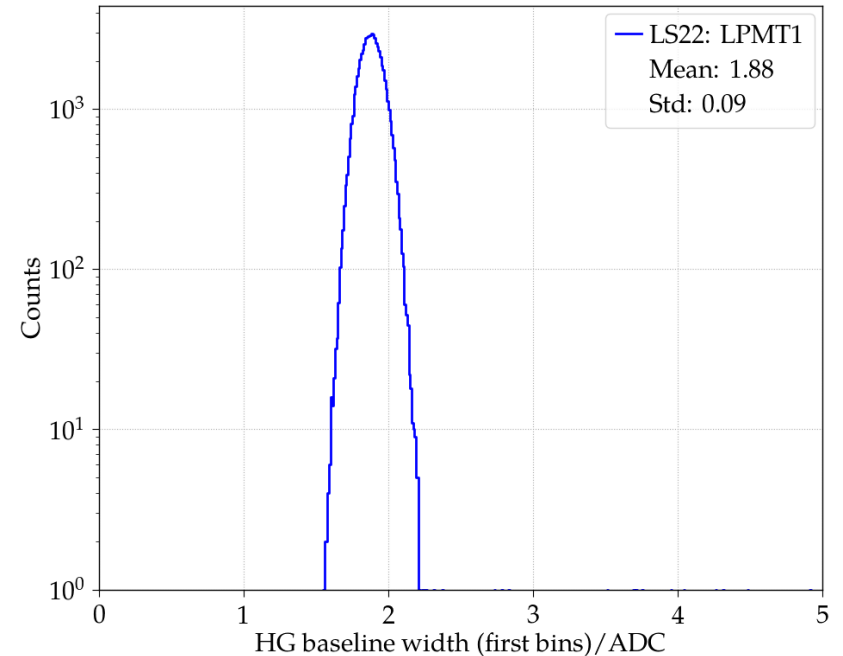
Pre-production version (2021)

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Upgraded Unified Board (UUB)

- Noise levels of input channels:
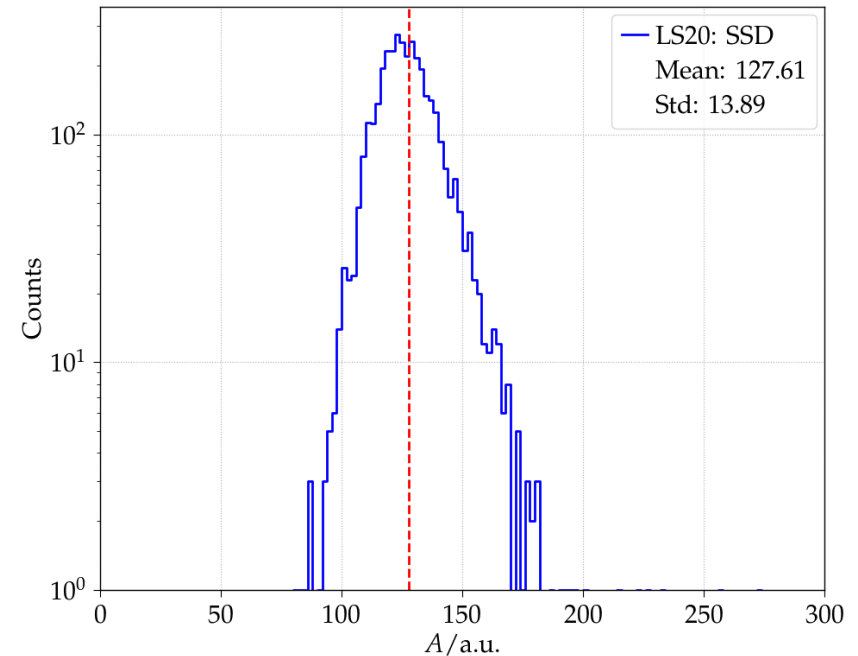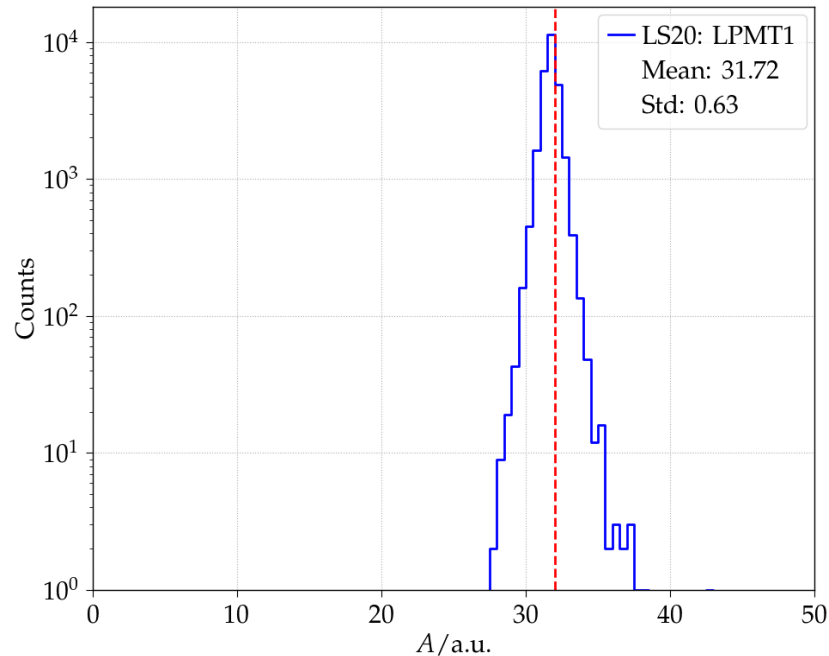

Prototype V1 (2016) → Pre-production version (2021)

→ Similar noise levels for original UB

Upgraded Unified Board (UUB)

- Amplification factors of input channels:

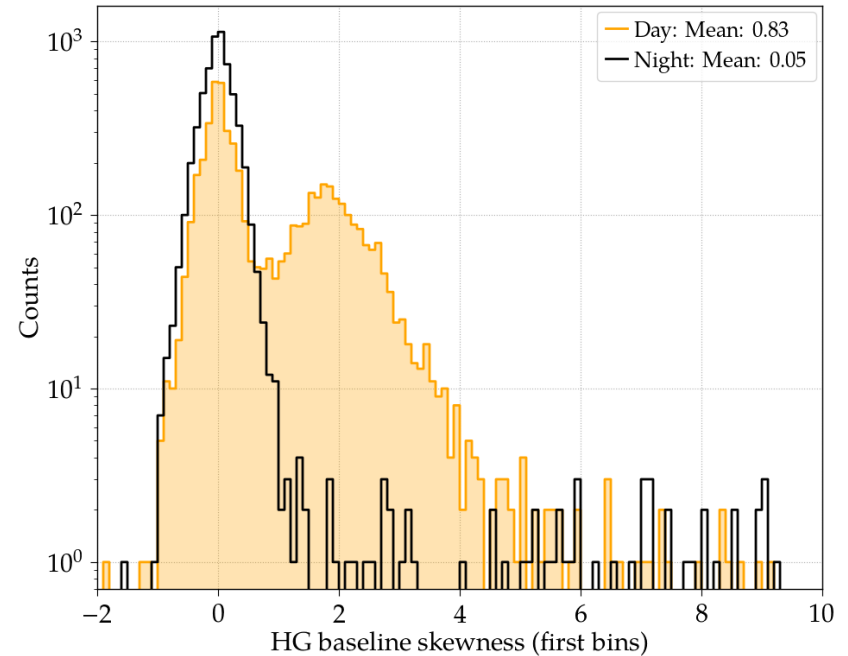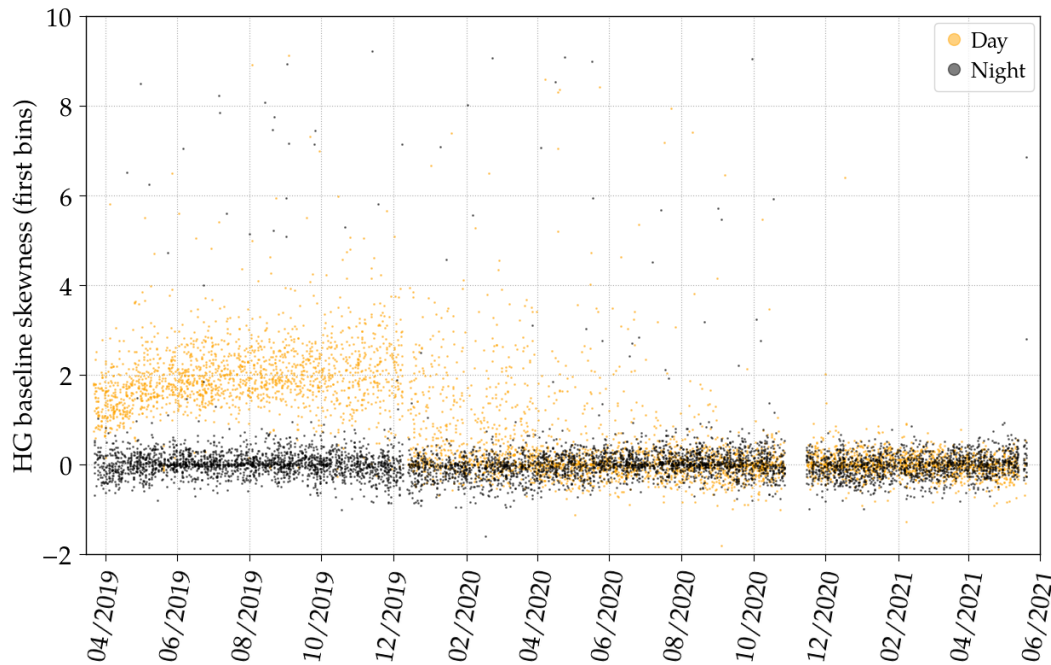Signal: $S = \sum_{t_{\text{start}}}^{t_{\text{stop}}} (s(t)) - N\bar{b}$

Amplification factor: $A = \dfrac{S_{\text{HG}}}{S_{\text{LG}}}$

LS20: LPMT1
Mean: 31.72
Std: 0.63

LS20: SSD
Mean: 127.61
Std: 13.89

Surface Scintillator Detector (SSD)

- Light tightness tests:

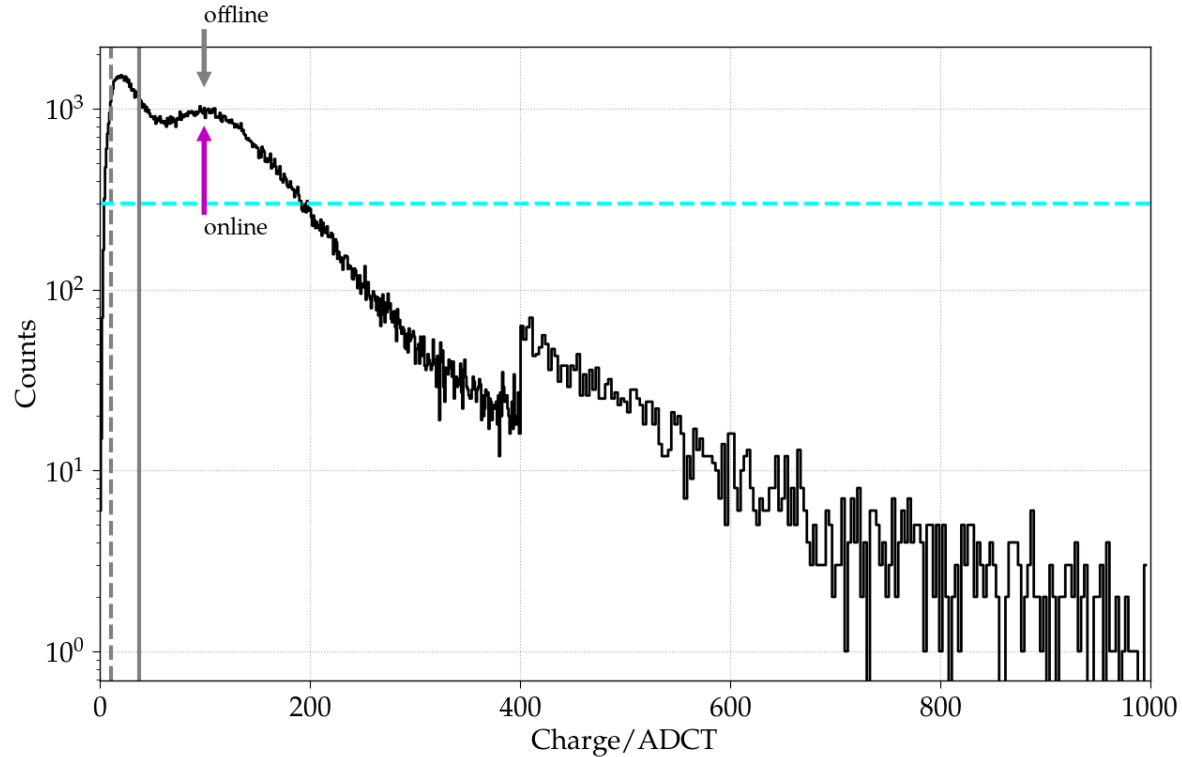$$\text{Skewness:} \quad Sk = \frac{\frac{1}{N}\sum (b(t) - b)^3}{\sigma_b^3}$$

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Calibration Procedure

- Optimization of algorithm + adaptations for AugerPrime stations

Non-upgraded UB stations

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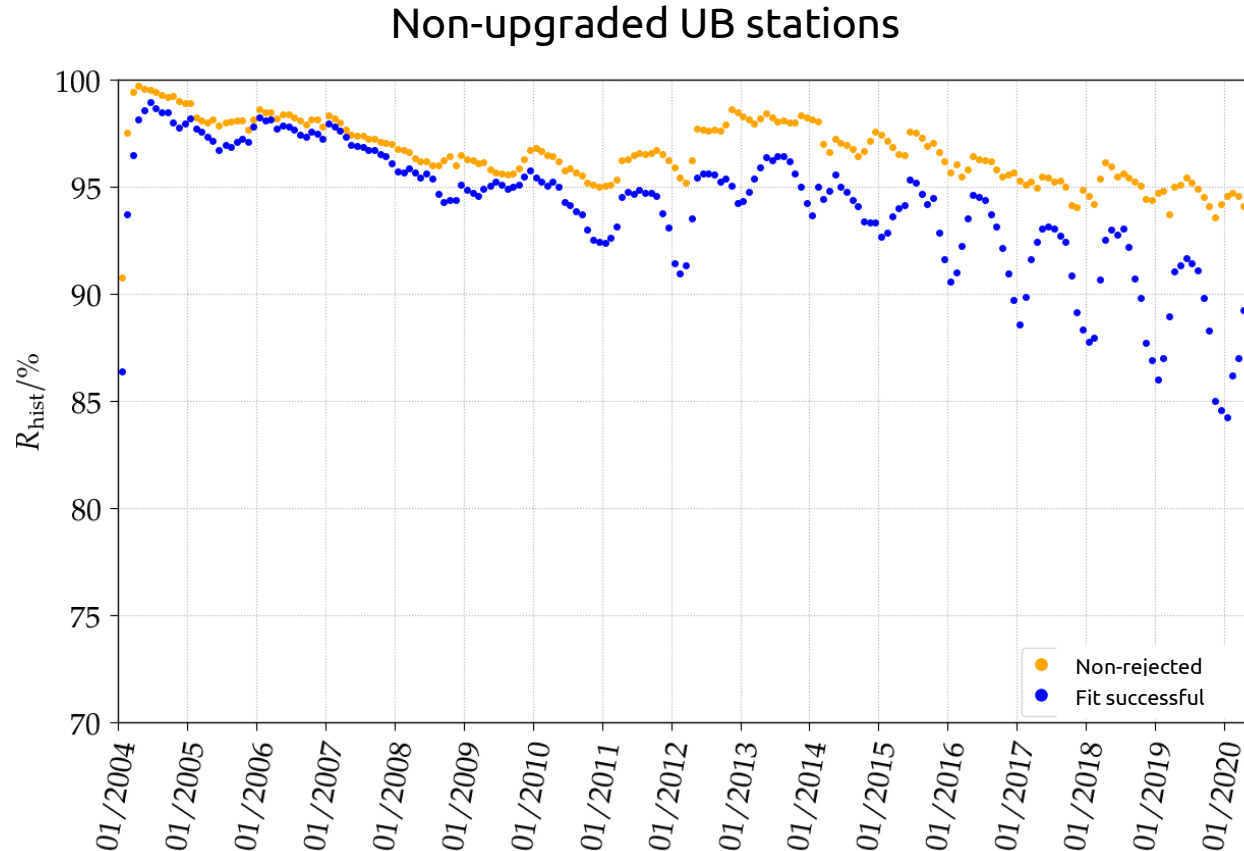
Calibration Procedure

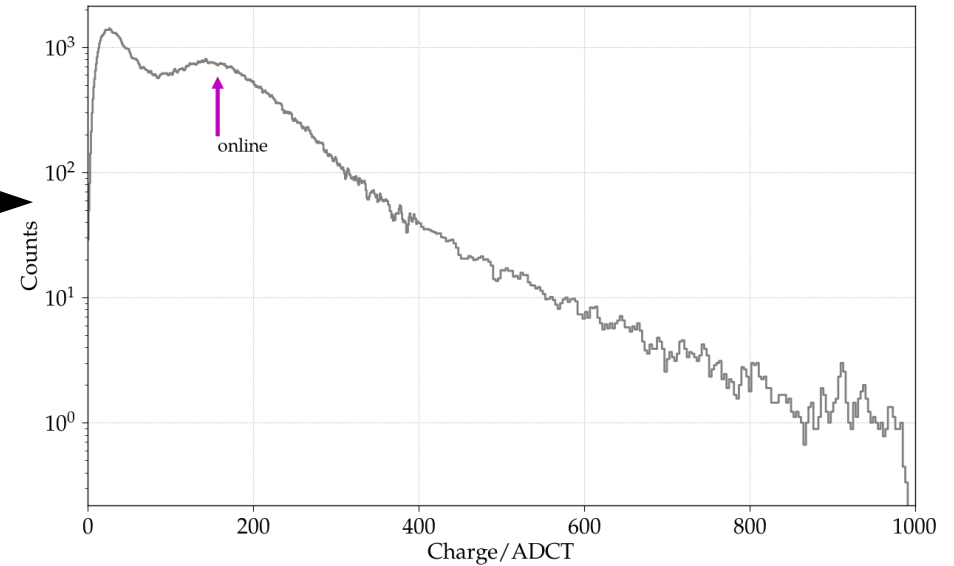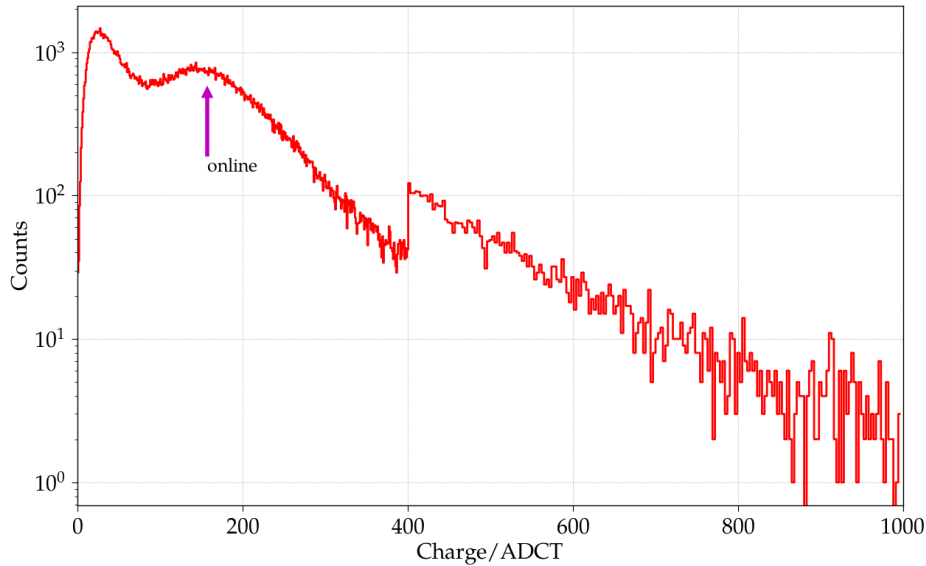- Failing current fit procedure:

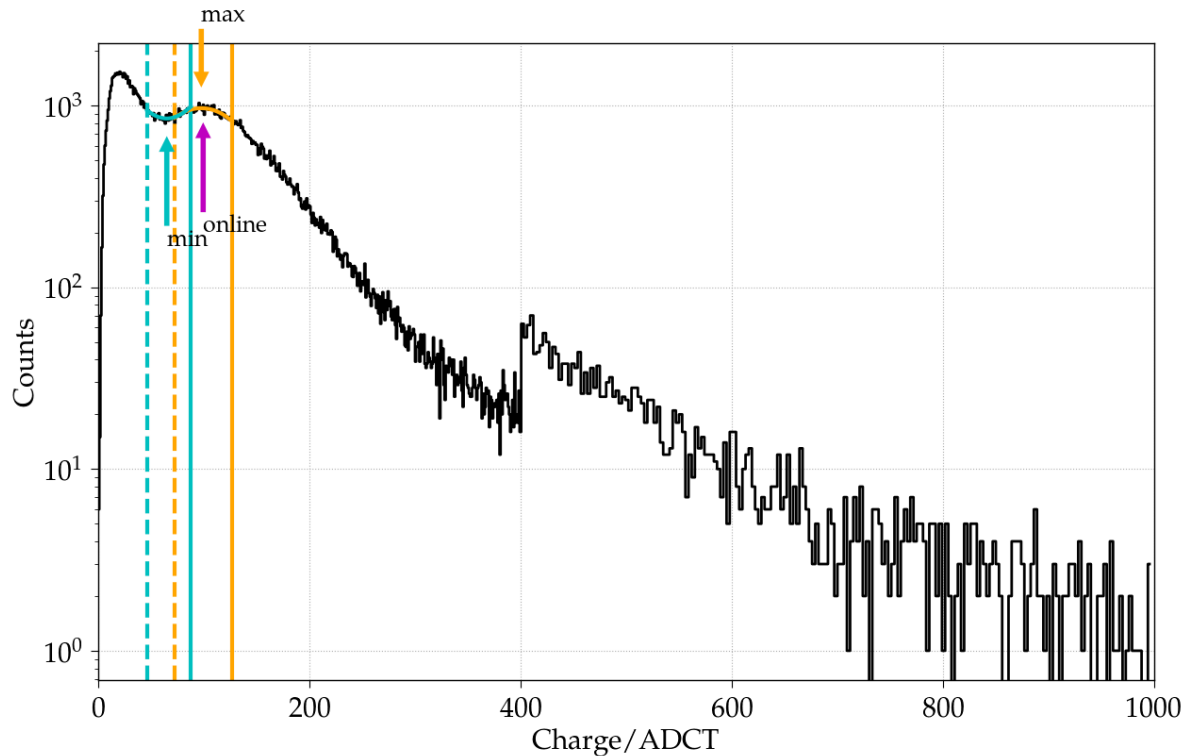# Calibration Procedure

- Modified fit procedure:

$$c_i$$

$$d_i = \frac{1}{3}\left(\frac{c_{i-1}}{\Delta_{i-1}} + \frac{c_i}{\Delta_i} + \frac{c_{i+1}}{\Delta_{i+1}} \right)$$

Calibration Procedure
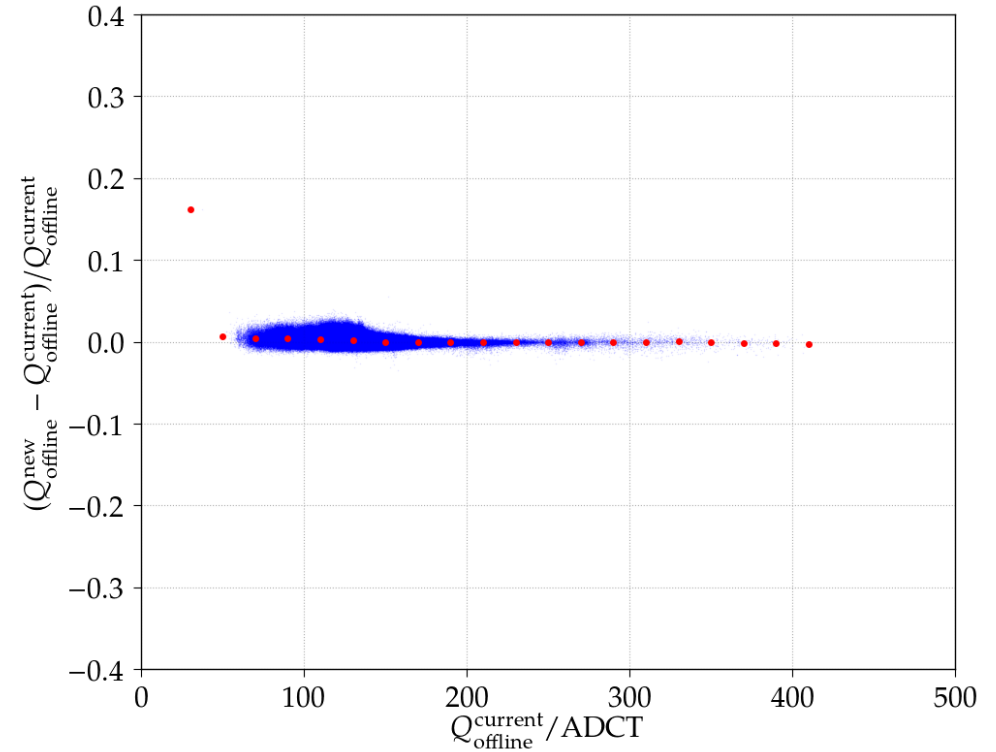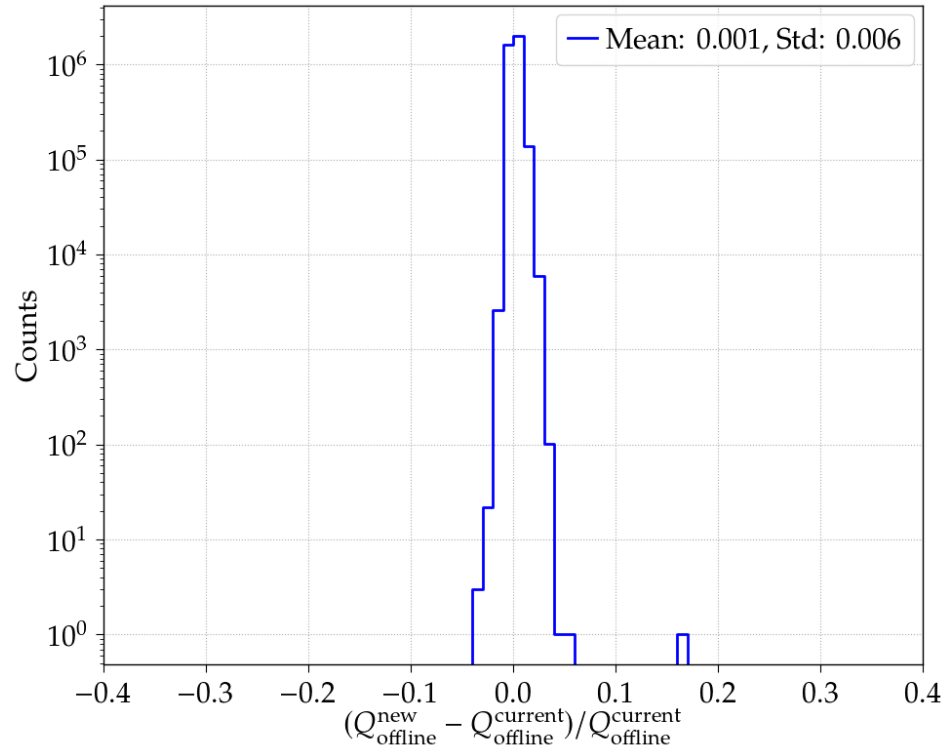
- Successful modified fit procedure:

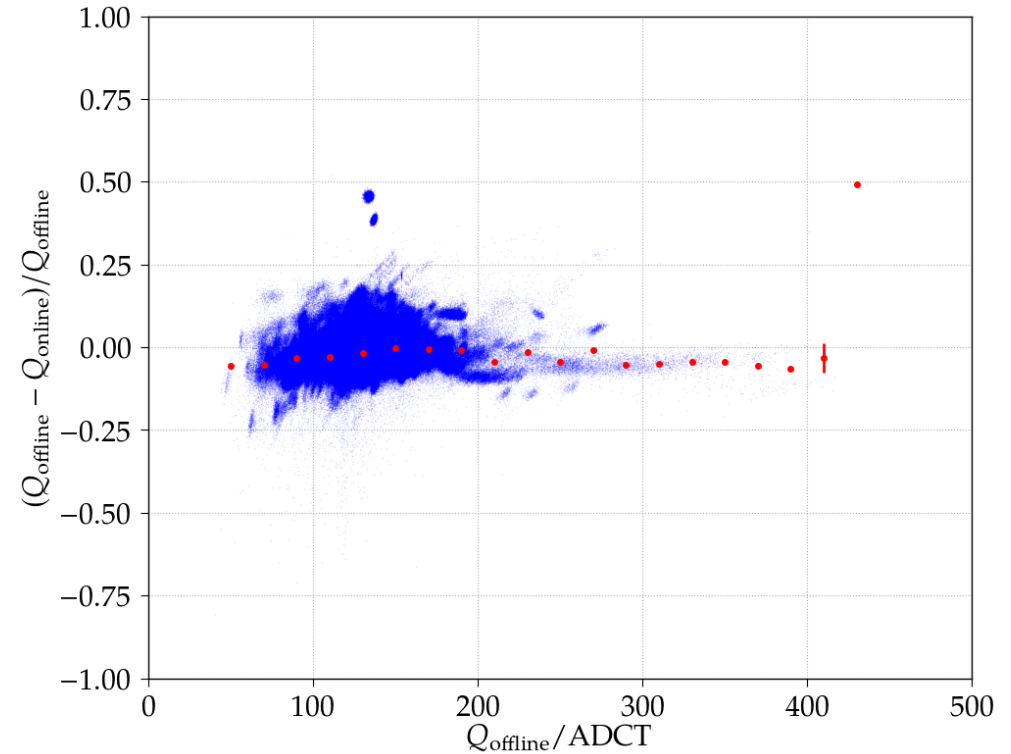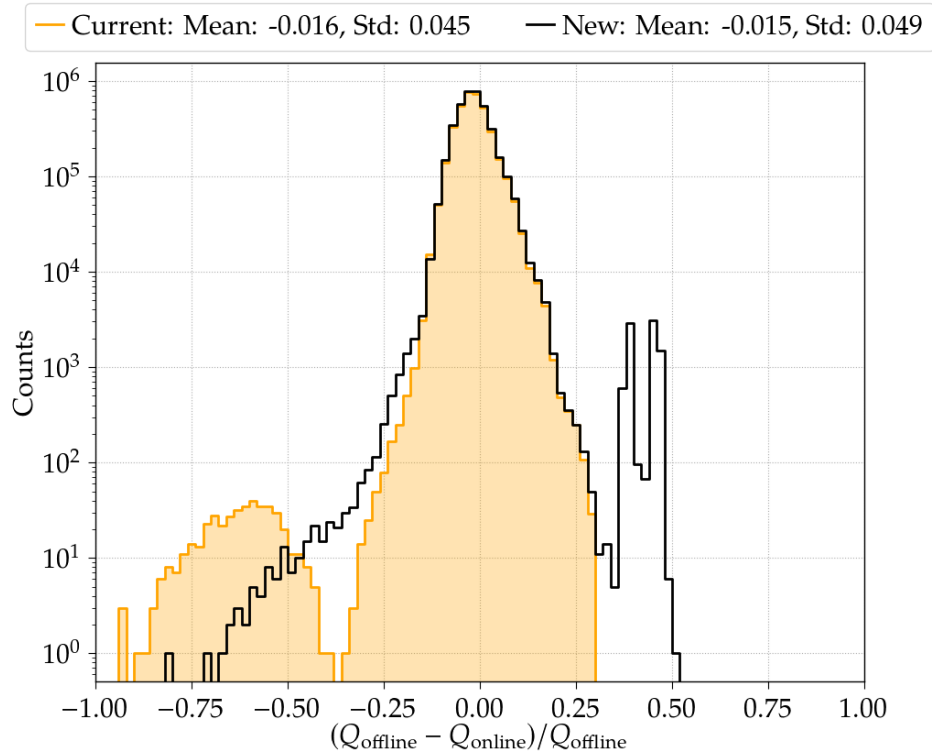August 2021:

Current: 94.83 %
New: 99.66 %

Calibration Procedure

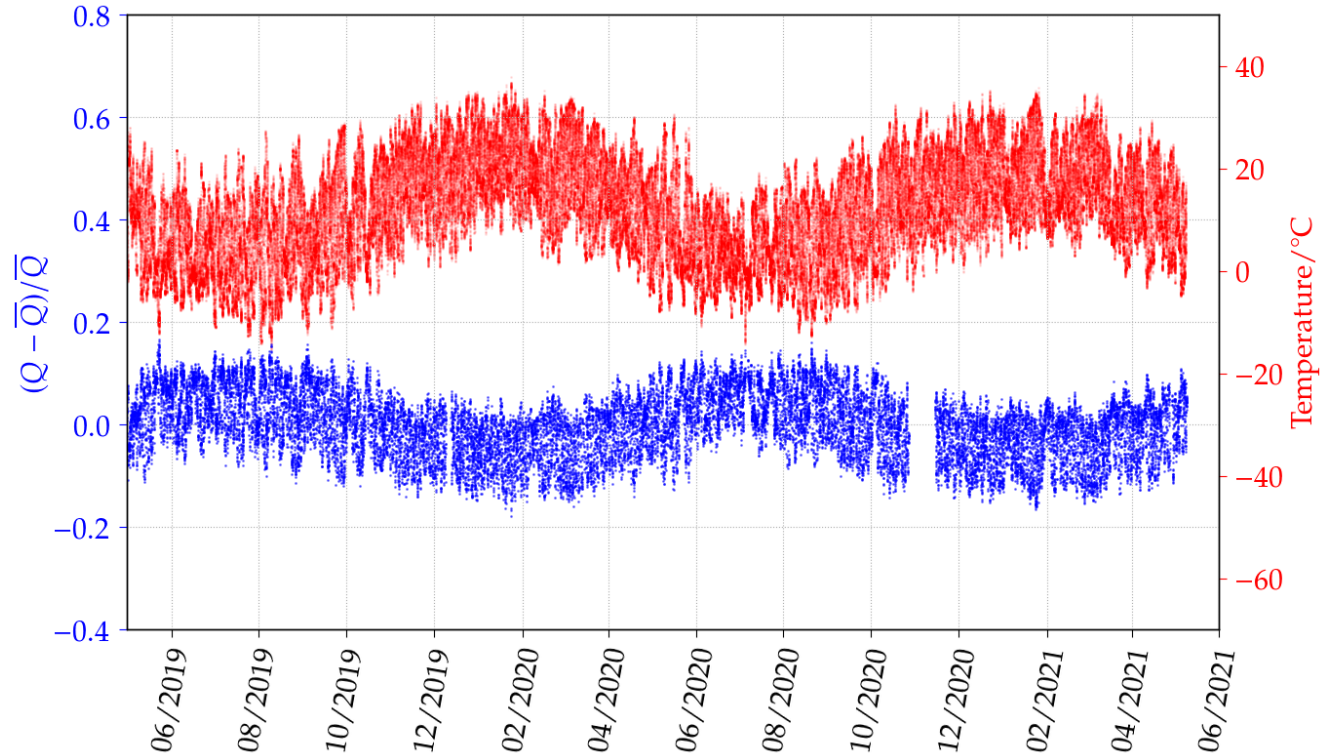- Comparison current to modified (data from August 2021):

Calibration Procedure

- Comparison online estimate to modified:

Calibration Procedure

- MIP charge stability:

Summary

- Electronics board properties match requirements ✓

- **1377** out of **1518** SSD units deployed: stable long-term performance ✓

- Single SSD with mechanical failure

- Modified calibration procedure with improved stability and flexibility ✓

Thank You!

Backup

- Rejected PMTs:

Non-upgraded UB stations