Towards a new calibration algorithm for UUB?

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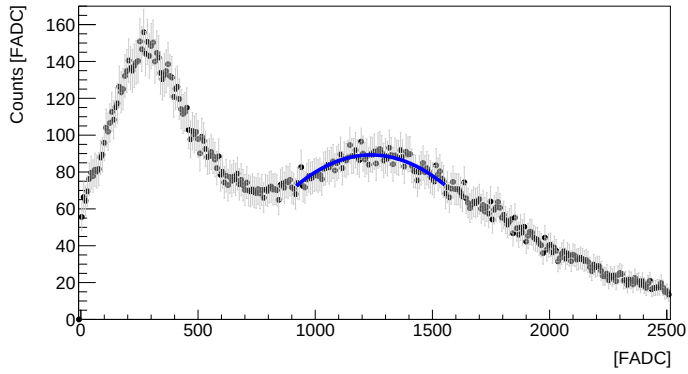
IIHE-ULB

September 7, 2021

The current algorithm (OffLine SdCalibrator Module)



Find "head-and-shoulder": from the right side of the histogram, search for local maximum (head), surrounded by drops (shoulders) with shoulder/head value ratio less than fChargeWindowShoulderHeadRatio (as default 0.75)

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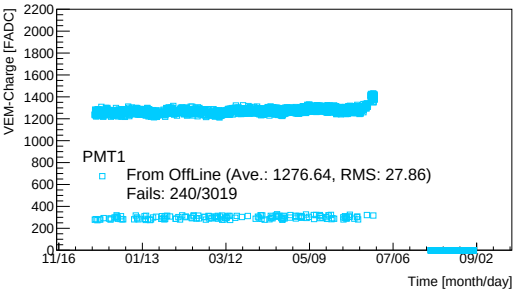

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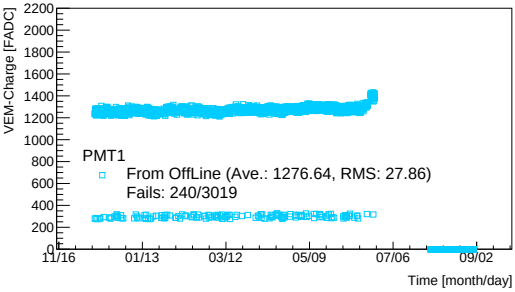

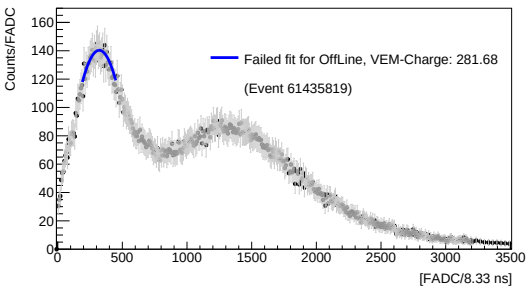

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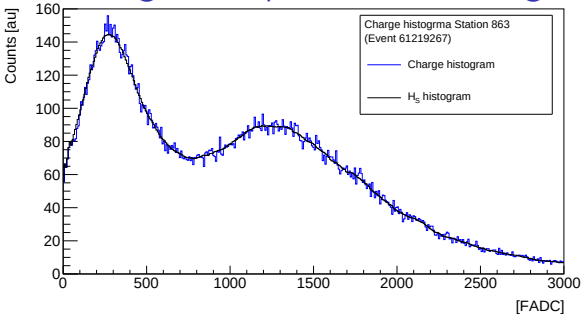
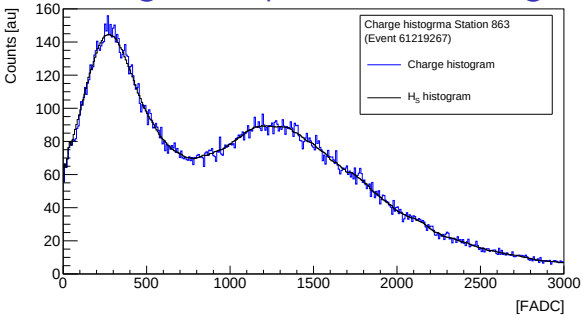
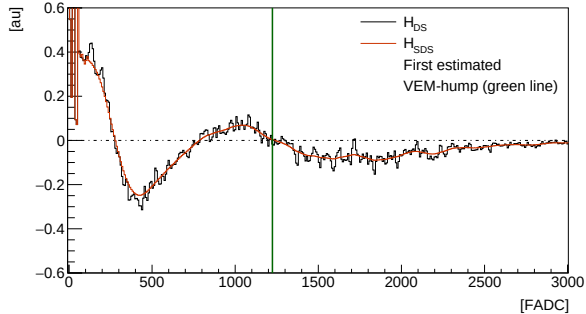
Obtaining initial parameters through derivatives



1. Smoothing the histogram by 15-bin sliding window, H_S

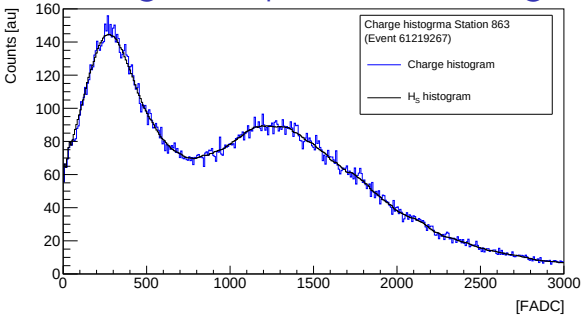
Obtaining initial parameters through derivatives

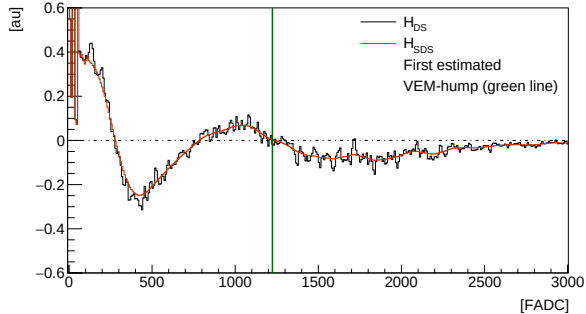




1. Smoothing the histogram by 15-bin sliding window, H_S
2. Obtain first derivative of the H_S ($\frac{f(x+1)-f(x-1)}{2h}$), H_{DS} (black line)

Obtaining initial parameters through derivatives





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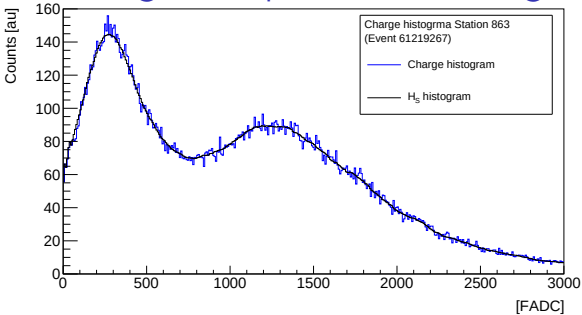
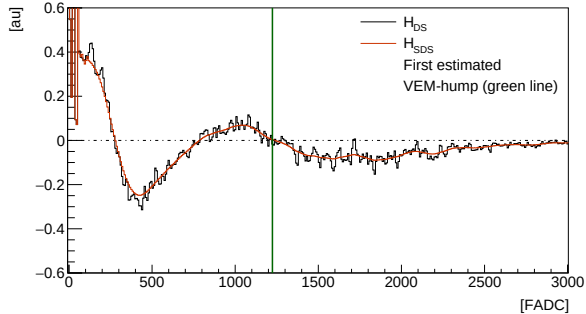
Obtaining initial parameters through derivatives





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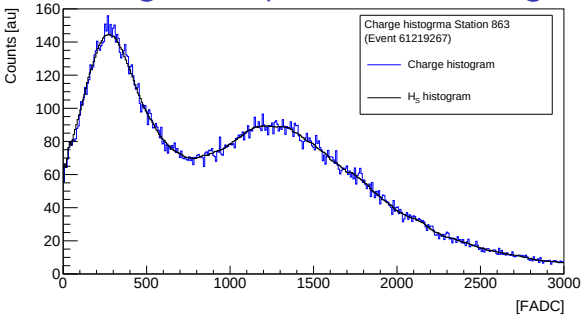
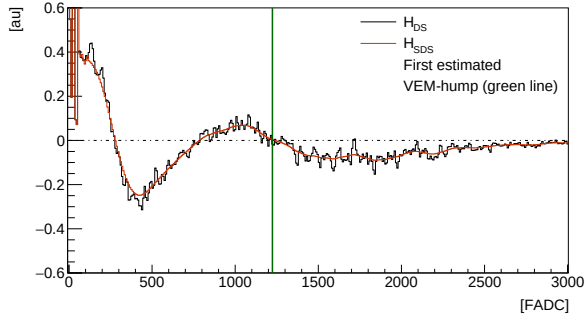
4. Searching for the VEM hump, i.e. first bin for H_{SDS} equal to zero; from right to left.

Obtaining initial parameters through derivatives





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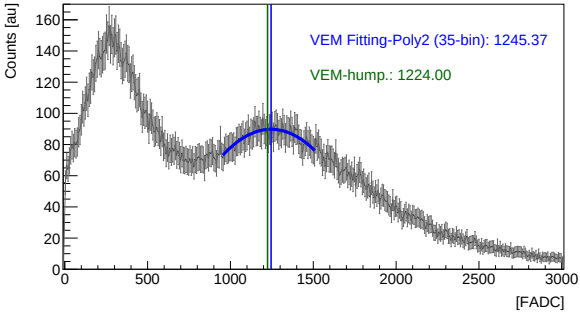
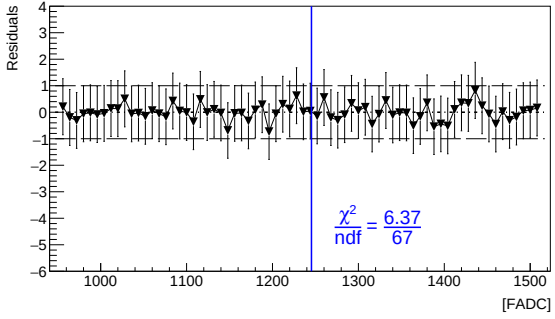
3. Smoothing H_{DS}, obtaining H_{SDS} (red line)
4. Searching for the VEM hump, i.e. first bin for H_{SDS} equal to zero; from right to left.
5. Fixing the fitting range using n-bin leftward and n-bin rightward from VEM hump.

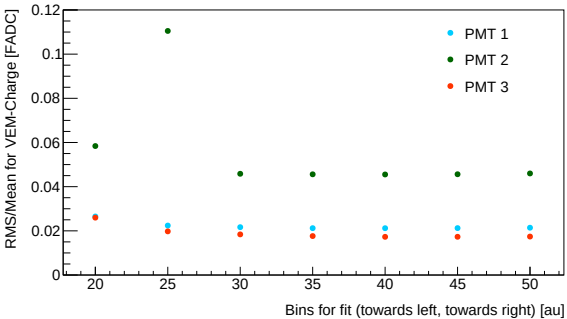
Describing the muon hump with a second polynomial

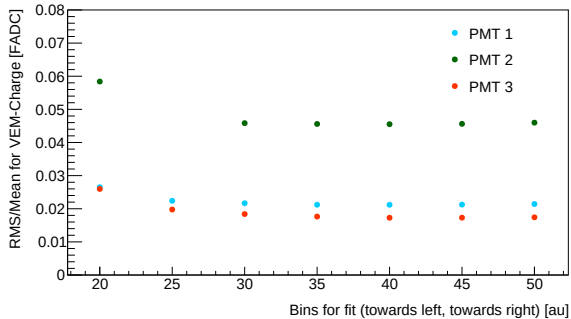




Choosing the number of bins

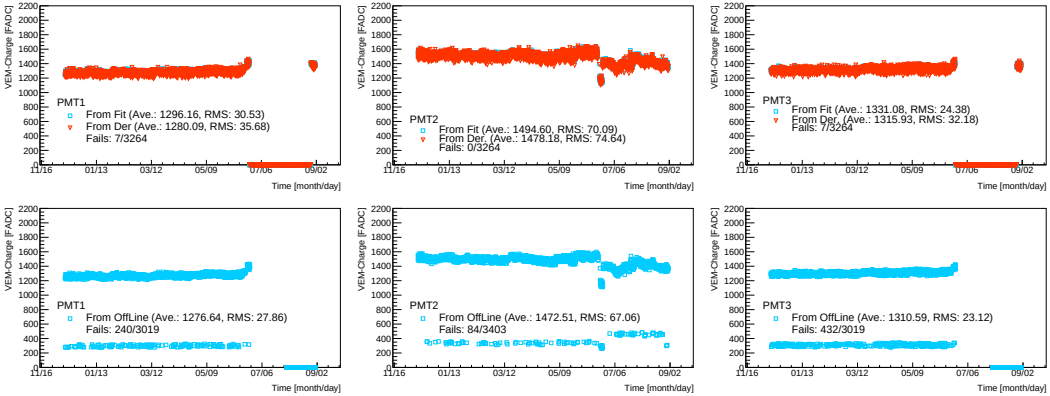
1. Using the hump value from the derivative as initial parameter
2. Fixing the number of bins to the left and right with an extra condition of not reaching the valley
3. Checking the spread of the VEM values versus number of used n-bin





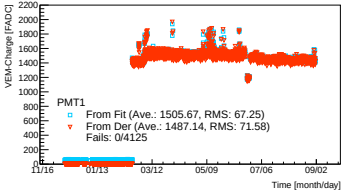
$\Rightarrow$ A number of about 35 bins is sufficient

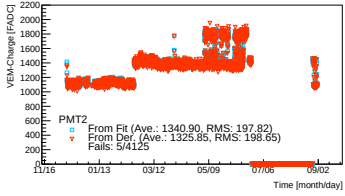
863 Station

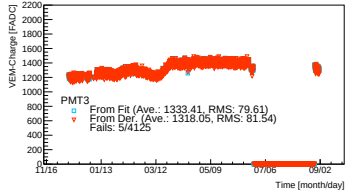


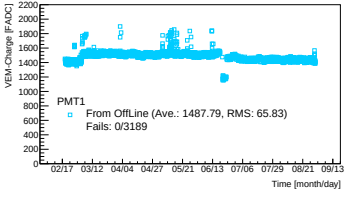
From December 2020, this method fit properly all histograms, including the ones for which OffLine-SdCalibrator algorithm fails.

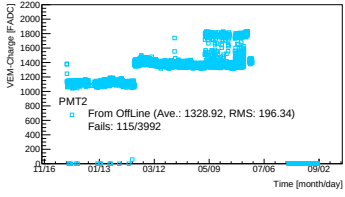
Station 1740

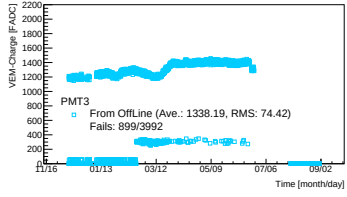




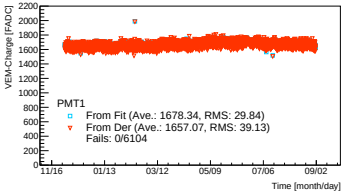


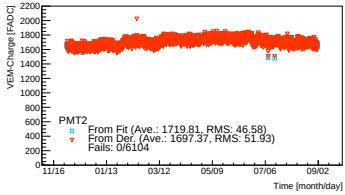


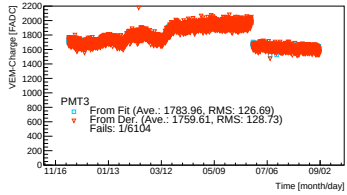


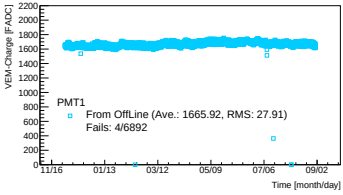


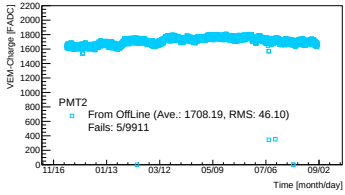
Station 1729

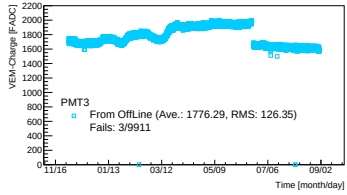




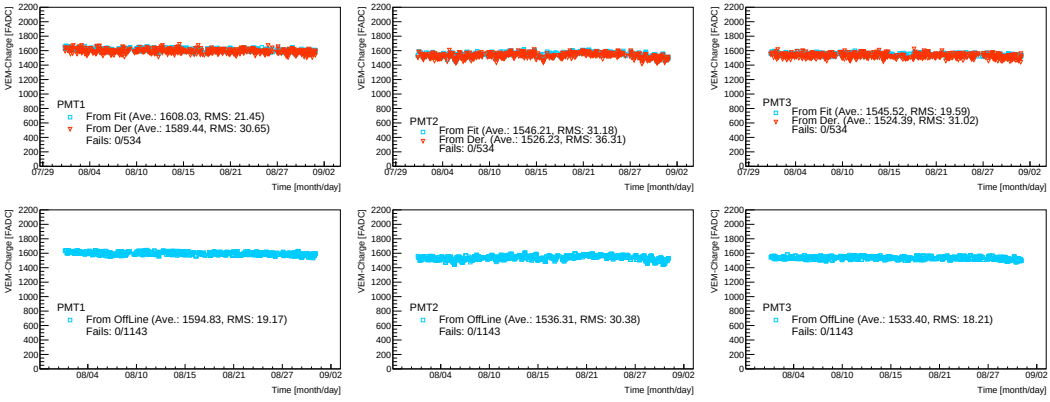








Station 1221



Full August.

Conclusions and outlook

Towards a fix of the Offline VEM-calibration

- The OffLine algorithm fails to find for all the calibration histograms the second peak
- Based on the first derivative of the histograms we can correctly identify the muon hump in all cases (18 stations*)
- The new algorithm works on smoothed histograms and the obtained hump values can be used as initial parameters in to obtain the VEM-charge values
- The new algorithm is user-independent
- Implementation in Offline?

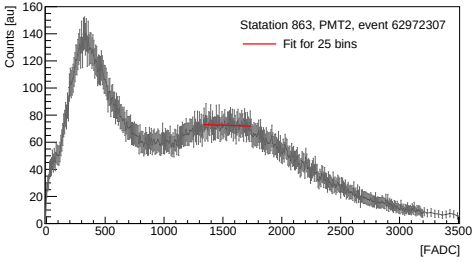
Statistics for August (see also Alex's and Corinne's analysis)

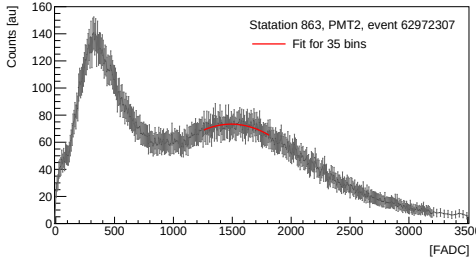
- 6/18 stations do not have calibration histograms from August 1st to 27th.
- 0 stations have bad calibration histograms.

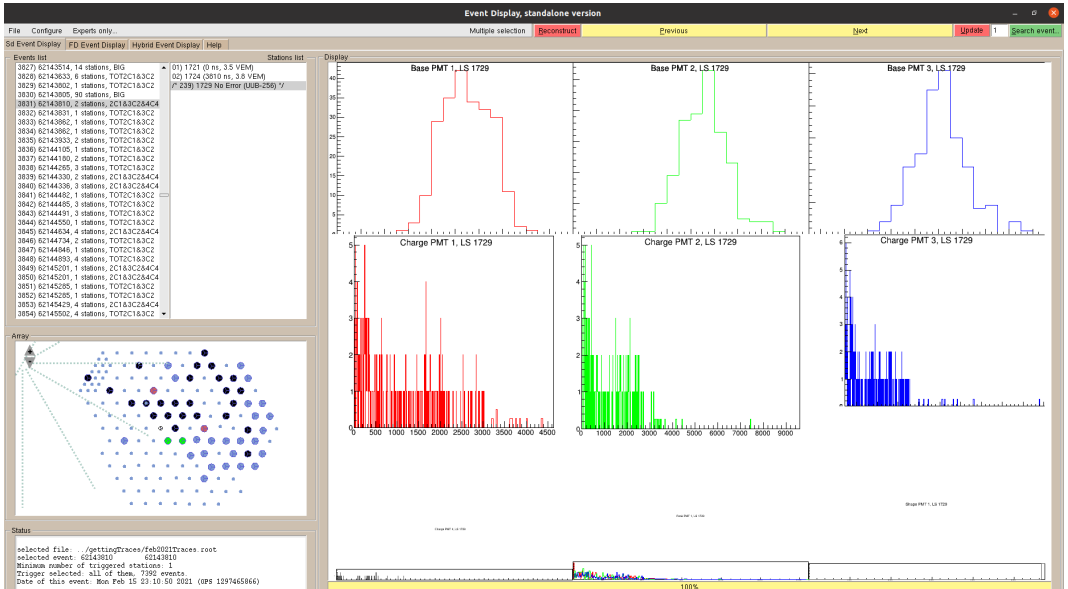
*Station studied: 863 1222 1219 1211 1740 1743 1221 1217 1747 1741 1745 1818 1851 1729 1735 1746 1819 1791

BACKUP

BACKUP Station 863. PMT 2, failed reco. for 25 bins






Event Display, standalone version
File
Configure
Experts only...
Multiple selection
Reconstruct
Previous
Next
Update
1
Search event...
Sd Event Display
FD Event Display
Hybrid Event Display
Help
Events list
Stations list
3827) 62143514, 14 stations, BIG
3828) 62143633, 6 stations, TOTZC1&3C2
3829) 62143802, 1 stations, TOTZC1&3C2
3830) 62143805, 90 stations, BIG
3831) 62143810, 2 stations, ZC1&3C2&4C4
3832) 62143831, 1 stations, TOTZC1&3C2
3833) 62143862, 1 stations, TOTZC1&3C2
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3835) 62143933, 2 stations, TOTZC1&3C2
3836) 62144105, 1 stations, TOTZC1&3C2
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3838) 62144265, 3 stations, TOTZC1&3C2
3839) 62144330, 2 stations, ZC1&3C2&4C4
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3841) 62144482, 1 stations, TOTZC1&3C2
3842) 62144485, 3 stations, ZC1&3C2&4C4
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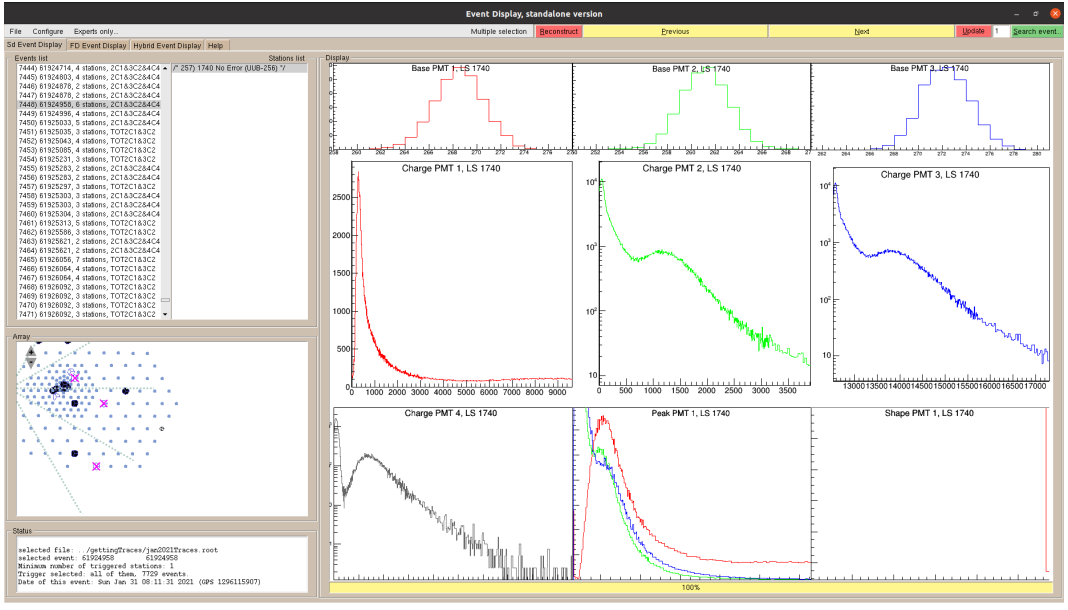
3852) 62145285, 1 stations, TOTZC1&3C2
3853) 62145429, 4 stations, ZC1&3C2&4C4
3854) 62145502, 4 stations, TOTZC1&3C2
01) 1721 (0 ns, 3.5 VEM)
02) 1724 (3810 ns, 3.8 VEM)
/* 239) 1729 No Error (UUB-256) */
Array
Status
selected file: .../gettingTraces/feb2021Traces.root
selected event: 62143810 62143810
Minimum number of triggered stations: 1
Trigger selected: all of them. 7392 events
Date of this event: Mon Feb 15 23:10:50 2021 (GPS 1297465866)
Display
Base PMT 1, LS 1729
Base PMT 2, LS 1729
Base PMT 3, LS 1729
Charge PMT 1, LS 1729
Charge PMT 2, LS 1729
Charge PMT 3, LS 1729
100%


Event Display, standalone version
File
Configure
Experts only...
Multiple selection
Reconstruct
Previous
Next
Update
Search event...
Sd Event Display
FD Event Display
Hybrid Event Display
Help
Events list
Stations list
7444) 61924714, 4 stations, 2C163C284C4
7445) 61924803, 4 stations, 2C163C284C4
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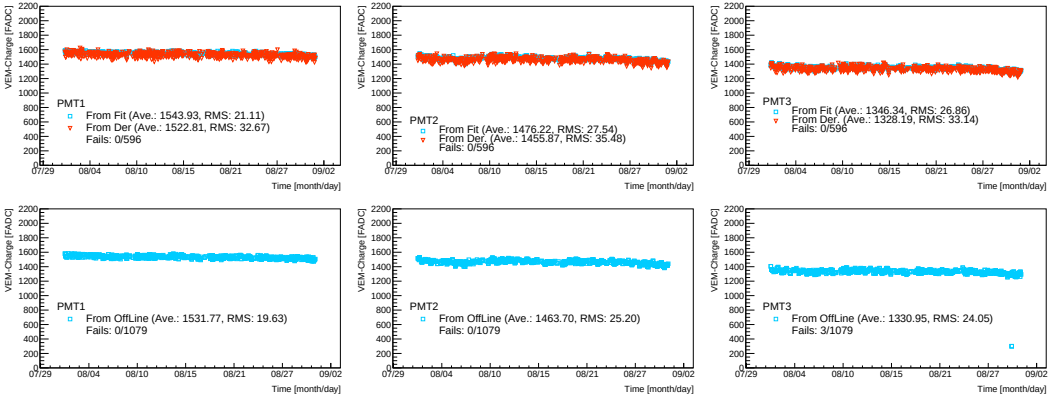
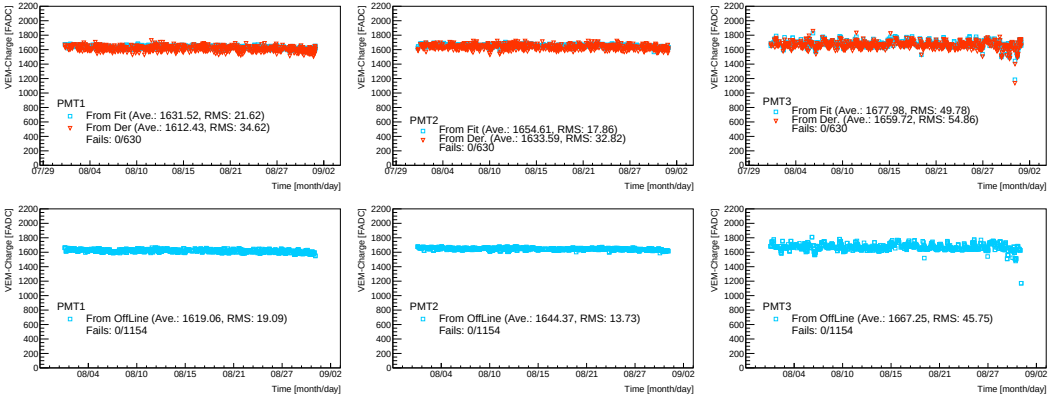
7469) 61926092, 3 stations, TOTZC163C2
7470) 61926092, 3 stations, TOTZC163C2
7471) 61926092, 3 stations, TOTZC163C2
/* 257) 1740 No Error (UUB-256) */
Array
Status
selected file: ../gettingTraces/jan2021Traces.root
selected event: 61924958 61924958
Minimum number of triggered stations: 1
Trigger selected: all of them. 7729 events
Date of this event: Sun Jan 31 08:11:31 2021 (GPS 1296115907)
Display
Base PMT 1, LS 1740
Base PMT 2, LS 1740
Base PMT 3, LS 1740
Charge PMT 1, LS 1740
Charge PMT 2, LS 1740
Charge PMT 3, LS 1740
Charge PMT 4, LS 1740
Peak PMT 1, LS 1740
Shape PMT 1, LS 1740
100%

Station 1222



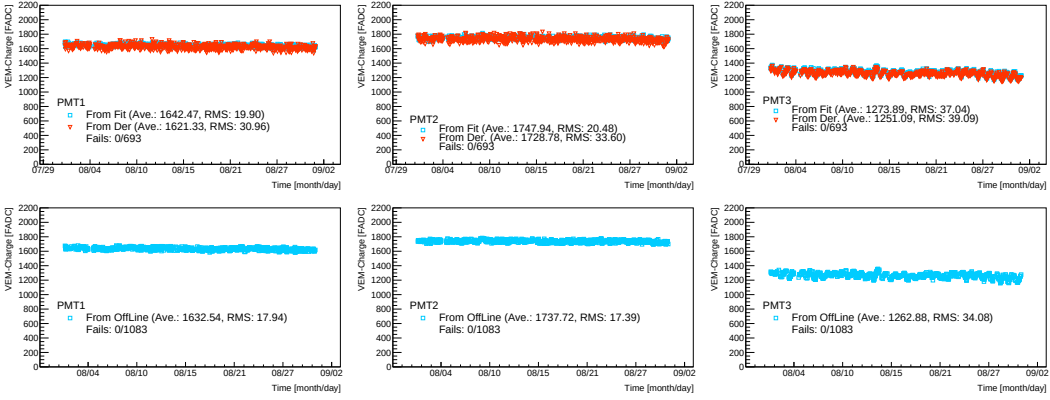
Full August.

Station 1219



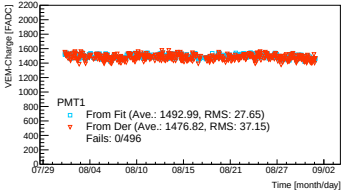
Full August.

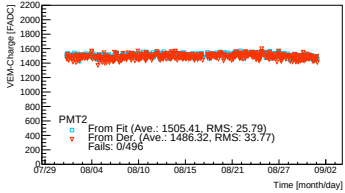
Station 1211

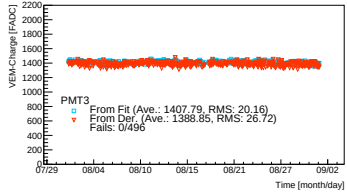


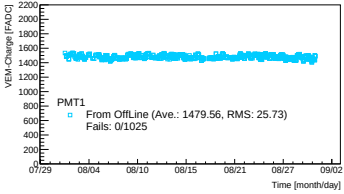
Full August.

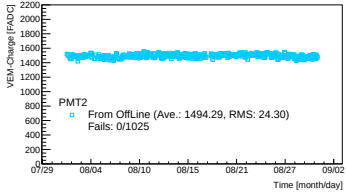
Station 1743

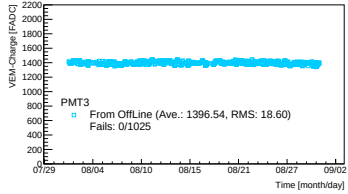






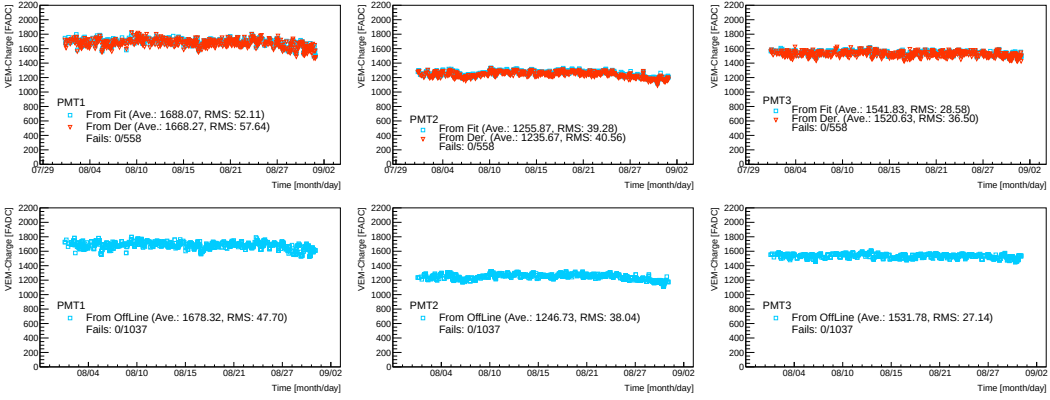






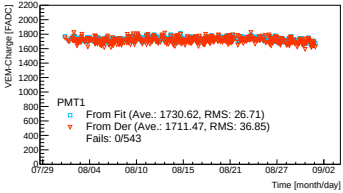
Full August.

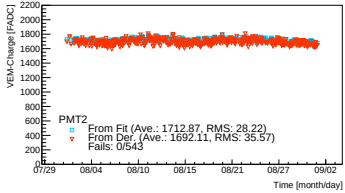
Station 1217

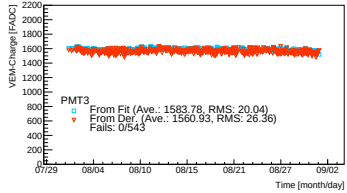


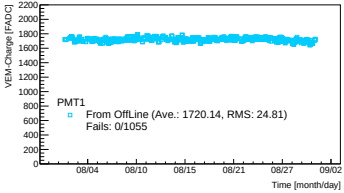
Full August.

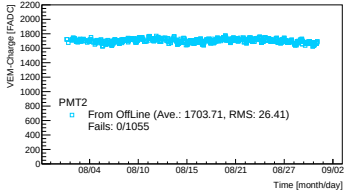
Station 1747

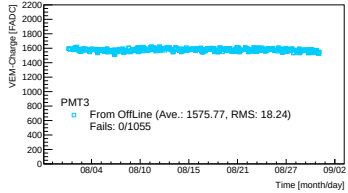






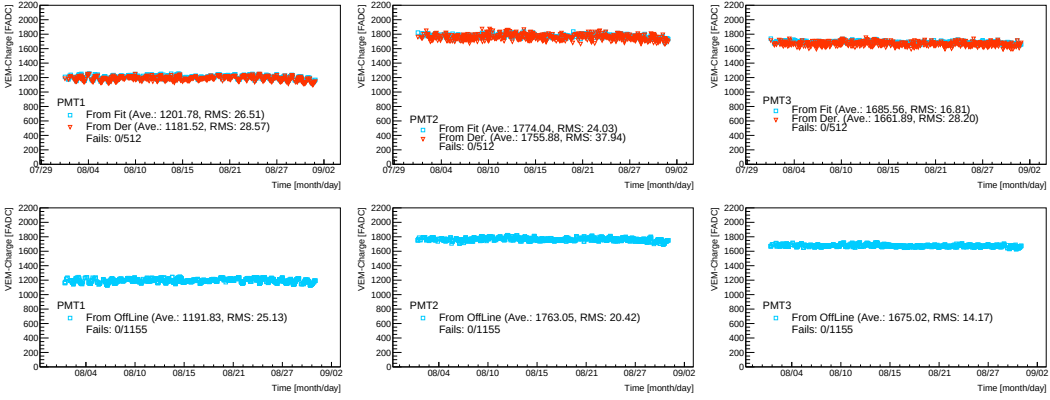






Full August.

Station 1741



Full August.