Pool Timing Status

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Outline

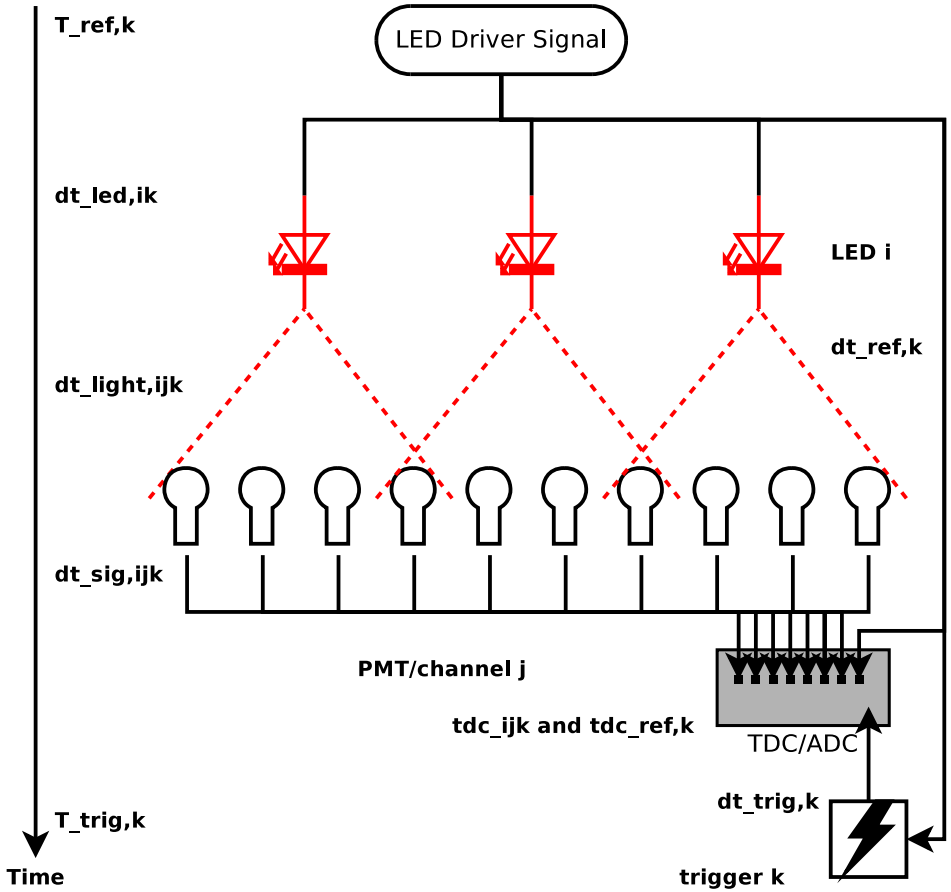
Method

Selection

Fitting

To Do and Reference

Method to measure LED/PMT delays



- Common signal flashes LED and trigger
- Compare the time each signal path takes
- Use geometry to subtract light's time-of-flight
- Only consider "unblocked" LED/PMT pairs

Data

LED calibration runs

- 300 Hz, 50 seconds per LED
- Both IWS/OWS triggered
- LED state scraped from DCS DB (thanks Elizabeth!)
  - Rely on precise DAQ/DCS time sync, (unchecked)

Focus on runs:

EH1 22155

EH2 22154

EH3 22153

Here, just look at EH3-IWS.

Selection

Trigger;

- Only consider IWS/OWS triggers (`DybAbortEventAlg`)
- Match trigger to LED blink
  - (can look at "wrong" det to check for light leaks)

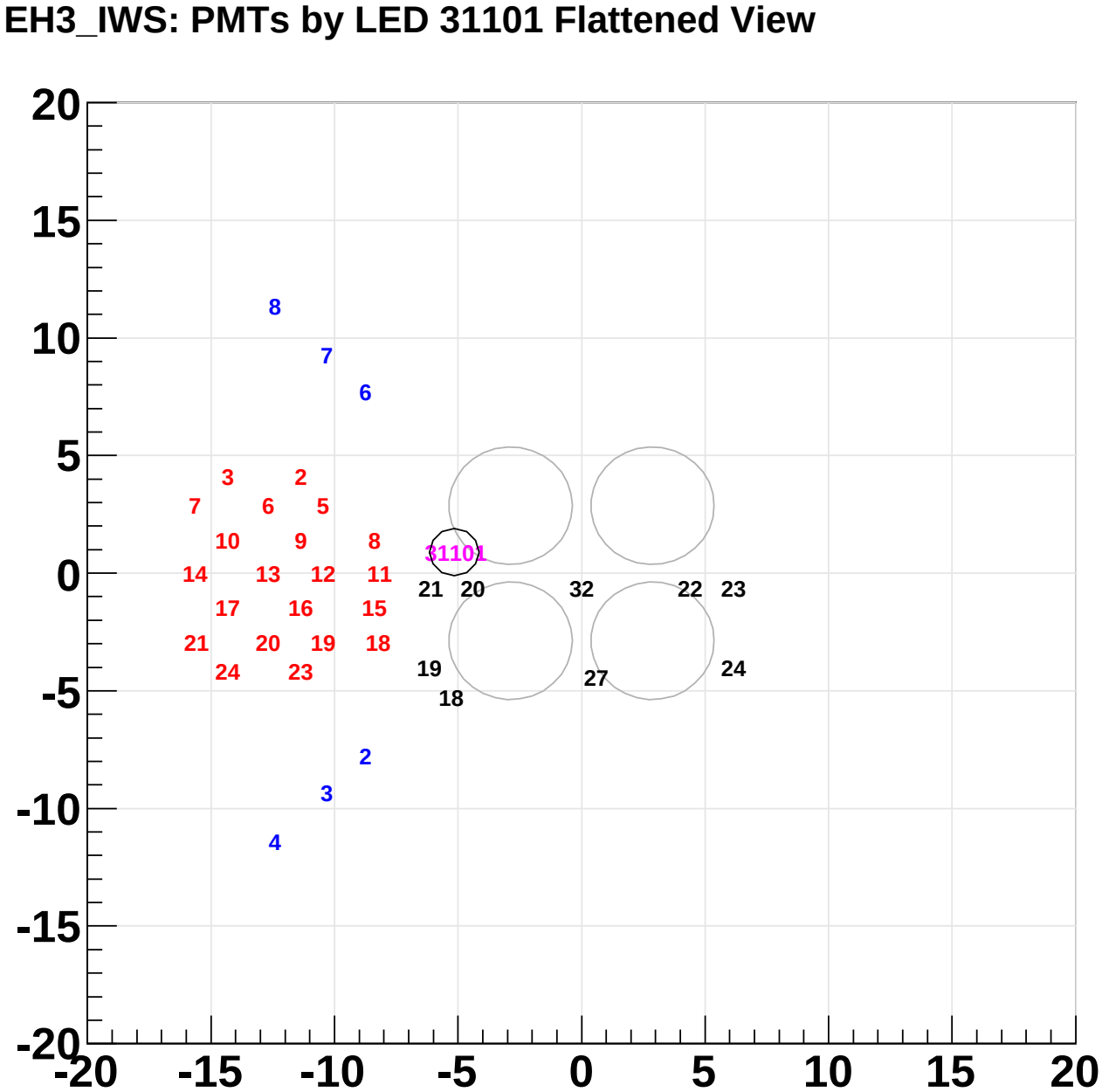
Hits:

- Unblocked LED/PMT view
- $Q_{PMT} > 50$ PE to reduce reflection
- $900 < TDC < 1100$ to reduce rare late light and early noise
- Apply time-of-flight subtraction

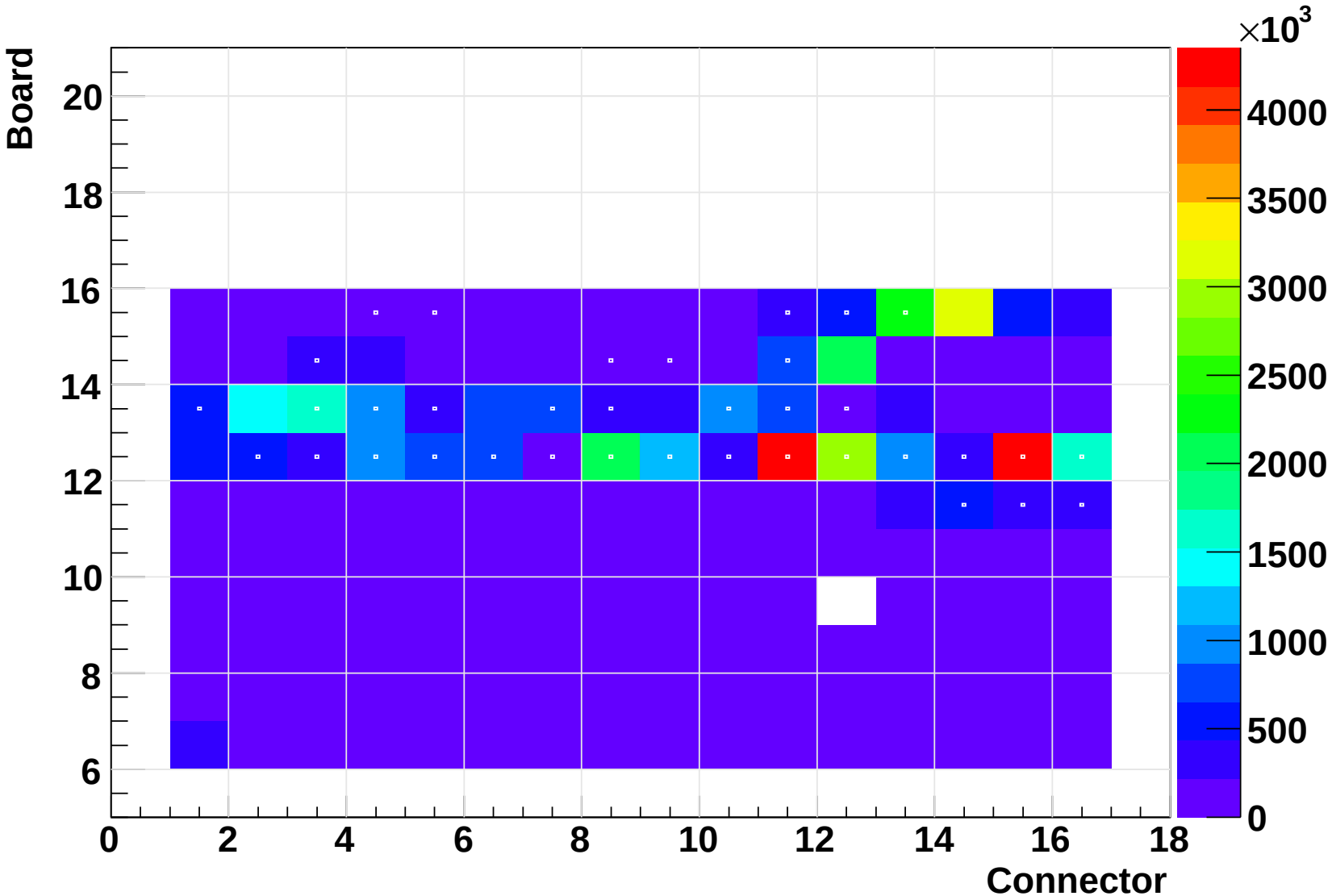
Blocking Matrix

- Thanks to Bob for this idea.
- Only look at LED/PMT pairs that "see" each other.
- Use nominal PMT positions from offline geometry and LED positions from Yue.
  - Uncovered lots of problems:
    - → Cable map, geometry, LED positions
- Uses 2-2-4 nominal AD deployment. Gaps not included

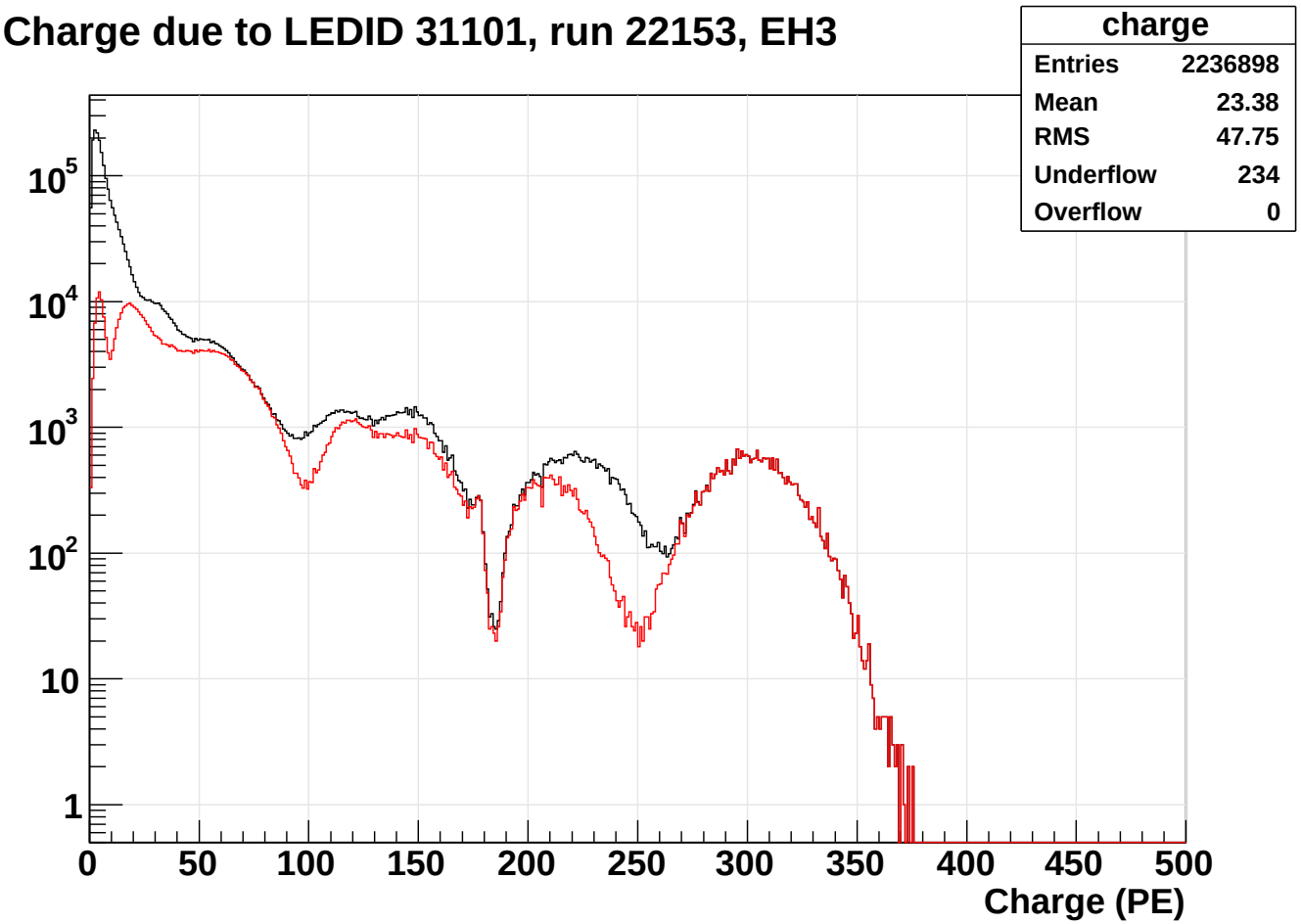
Focus on EH3 IWS LED 31101


EH3_IWS: PMTs by LED 31101 Flattened View
20
15
10
5
0
-5
-10
-15
-20
-20
-15
-10
-5
0
5
10
15
20
8
7
6
3
2
7
6
5
10
9
8
31101
14
13
12
11
21
20
32
22
23
17
16
15
21
20
19
18
19
24
24
23
27
18
2
3
4

Unblocked charge (marked by white squares)

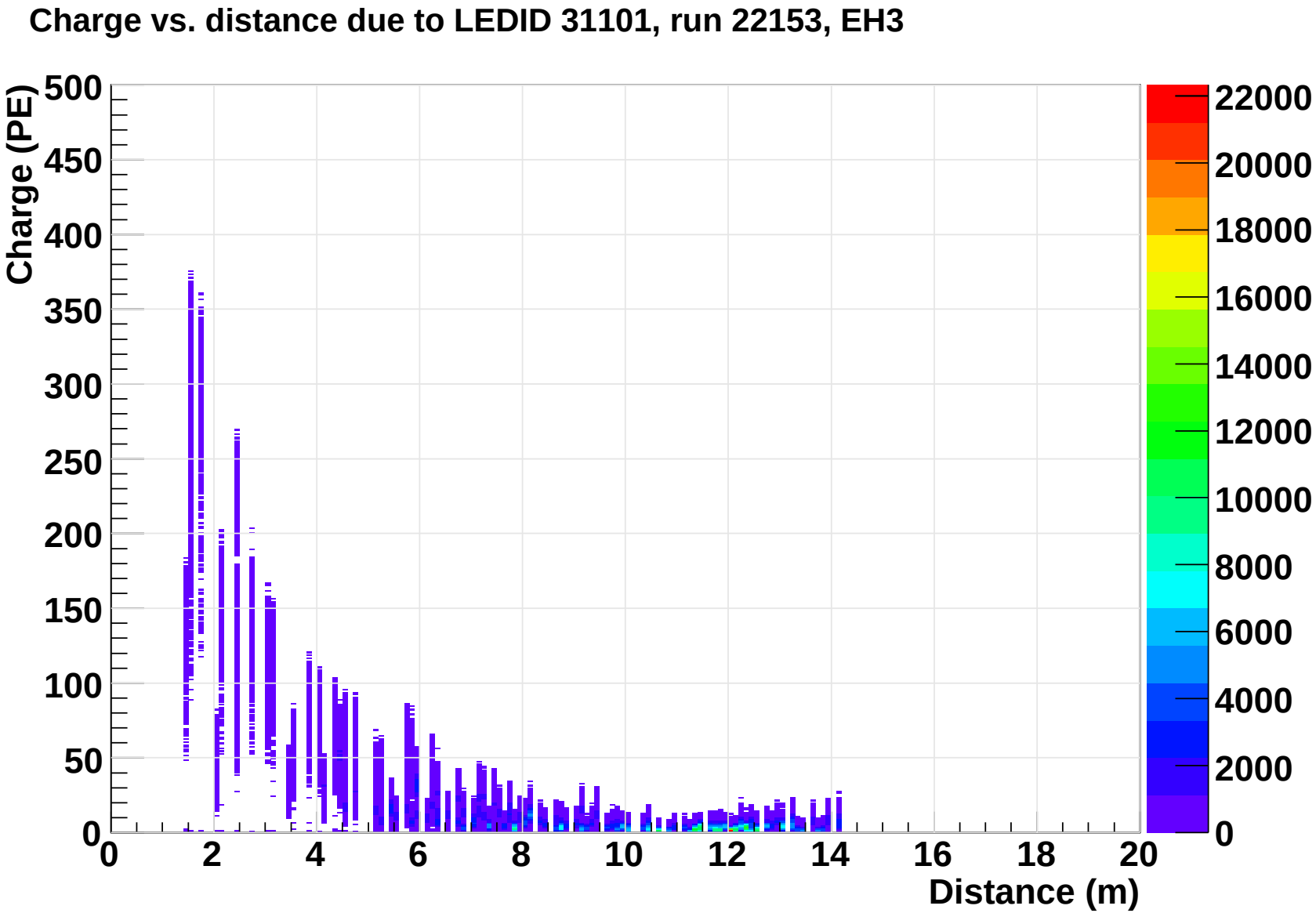


Blocking removes some PMTs with significant hits

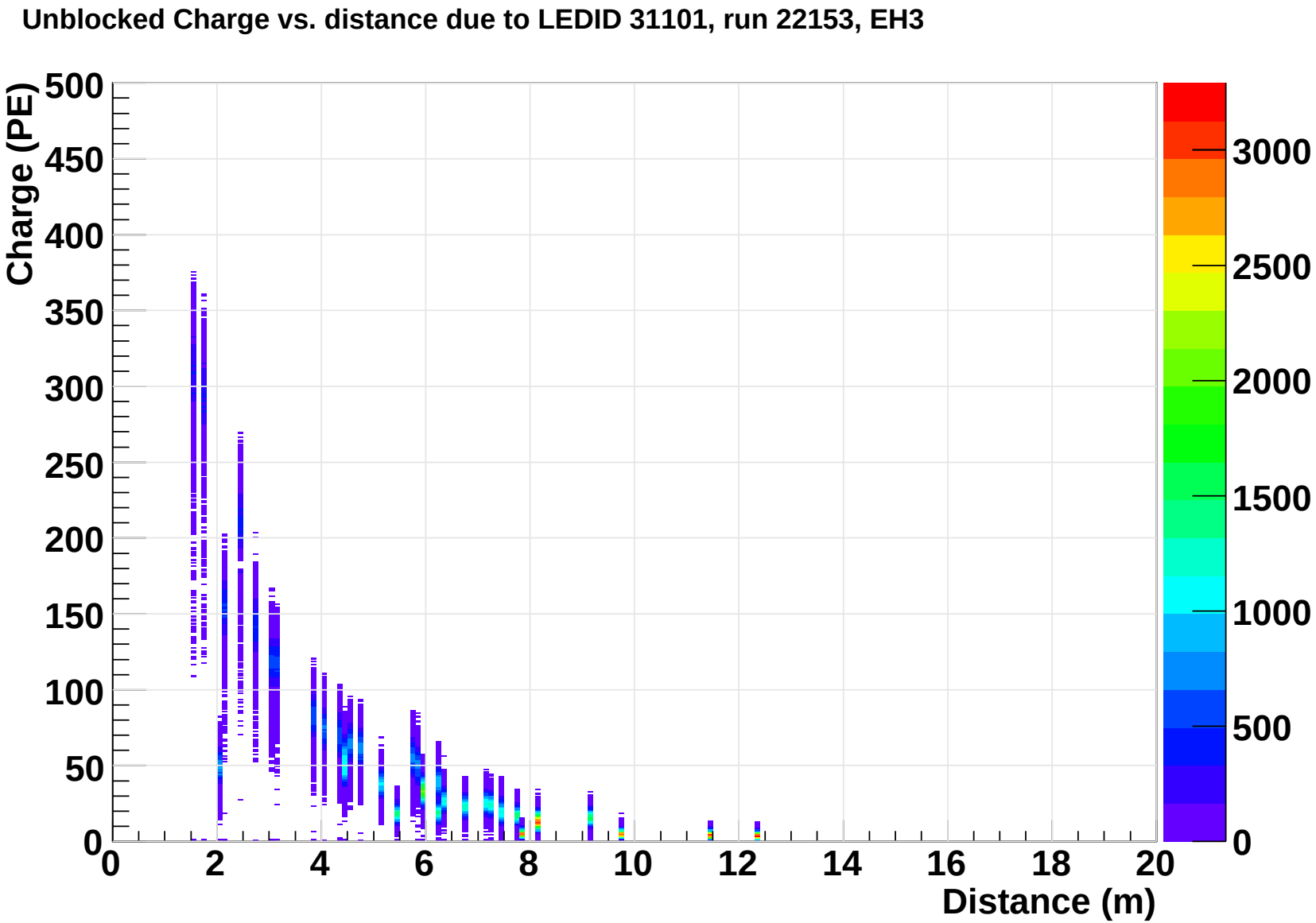


Example of **all charge** and unblocked charge for one LED.

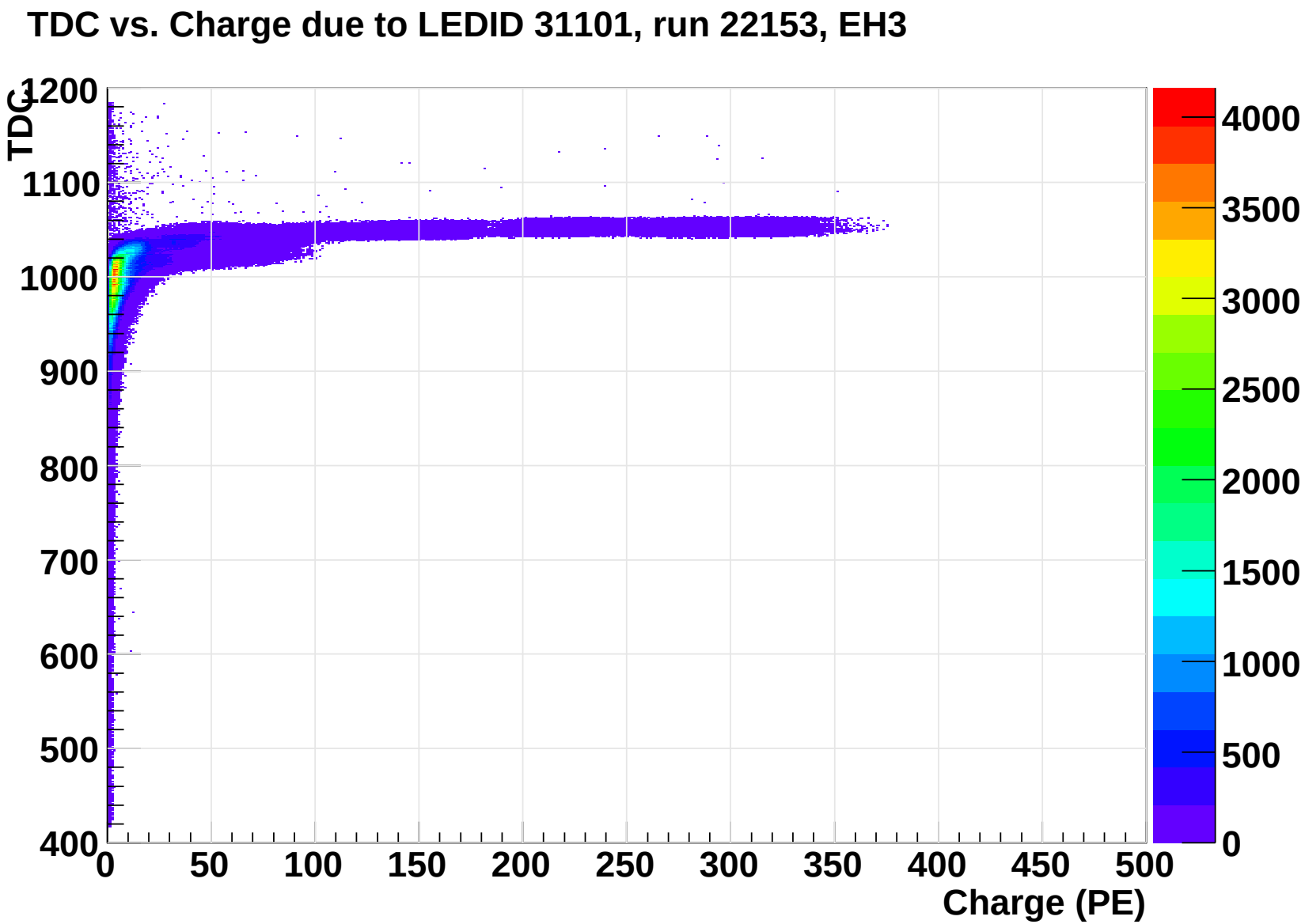
All charge vs. Distance for an LED



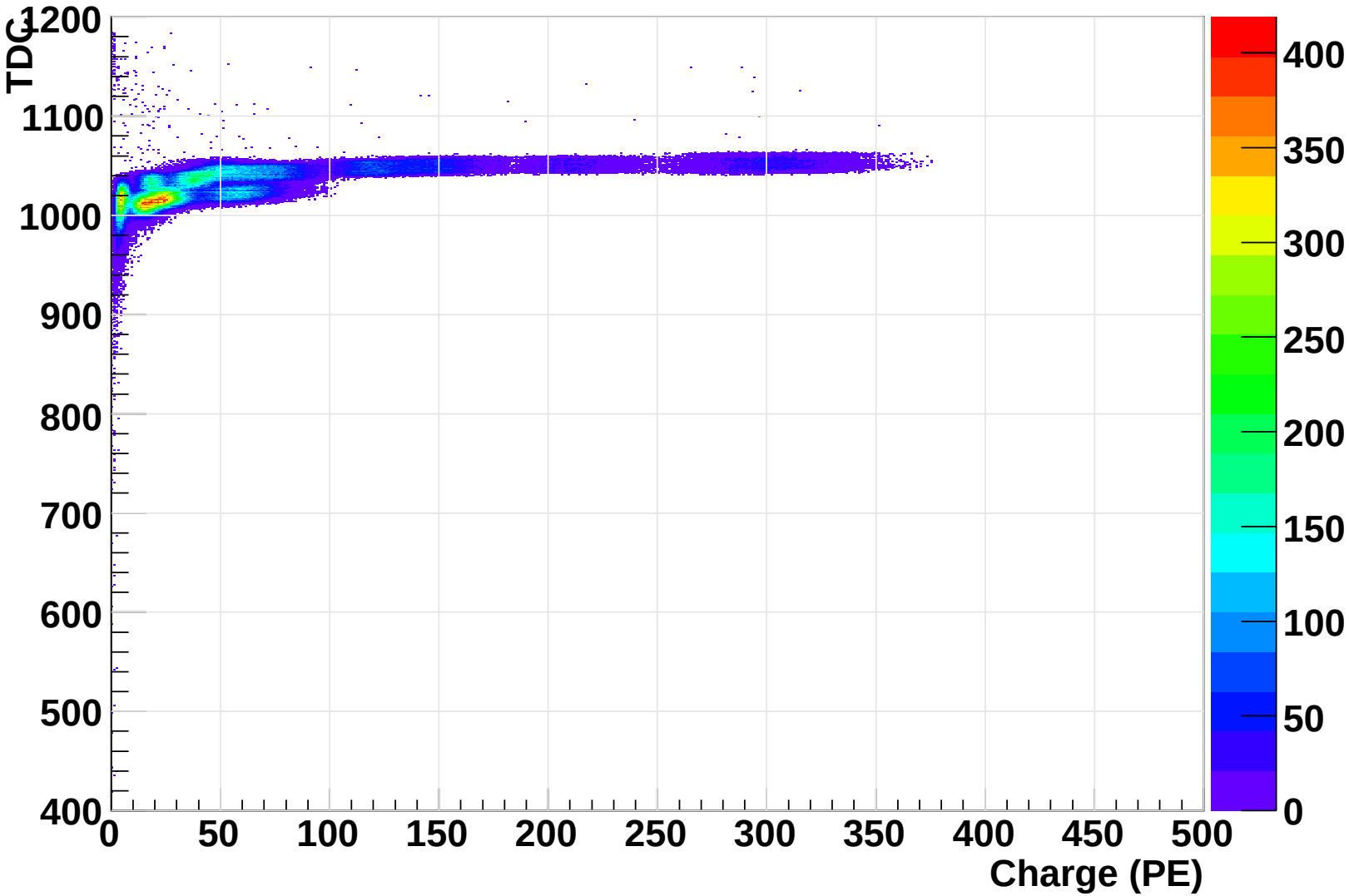
Unblocked charge vs. Distance for an LED



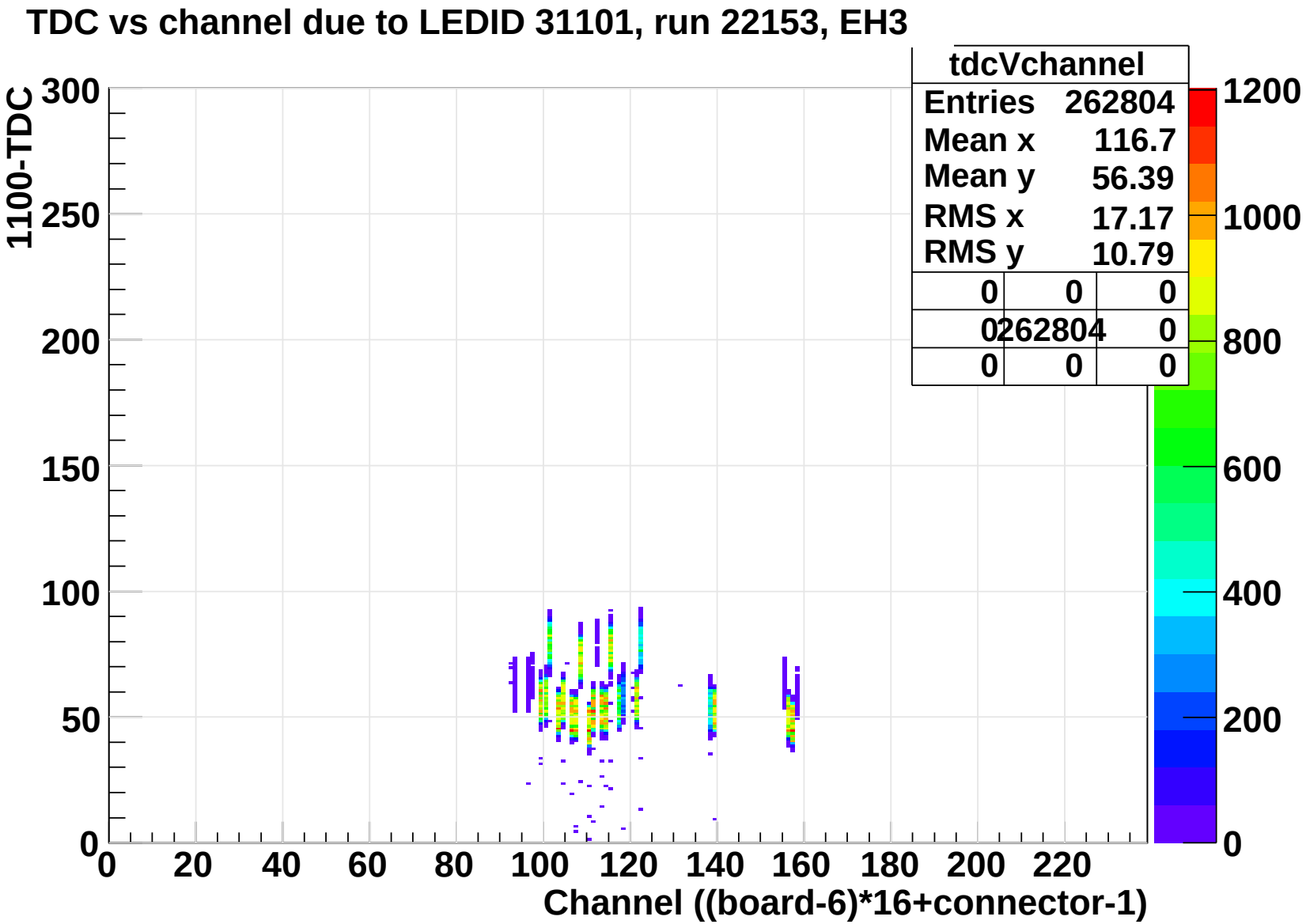
TDC vs. Charge, all hits from an LED



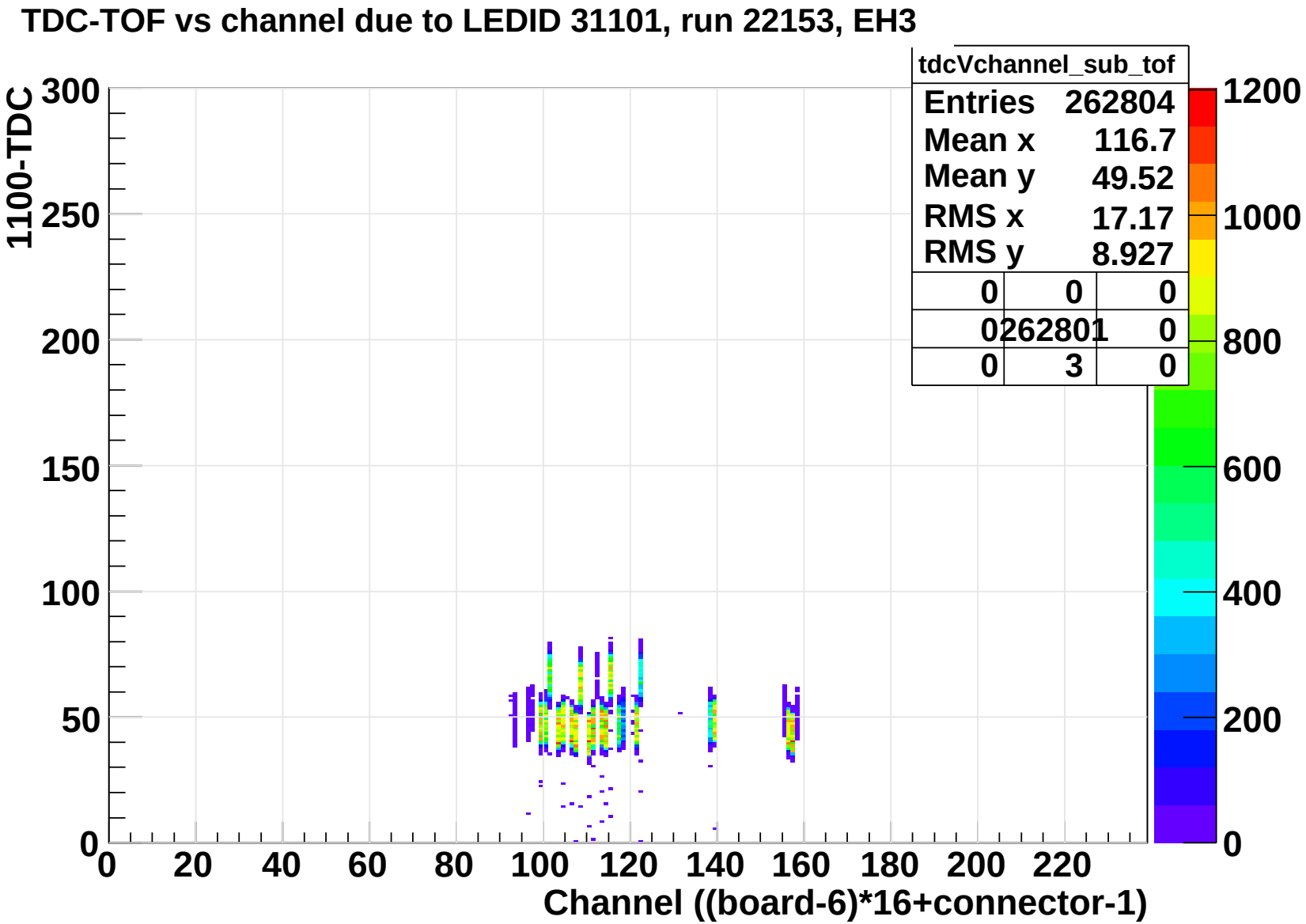
TDC vs. Charge, unblocked hits from an LED



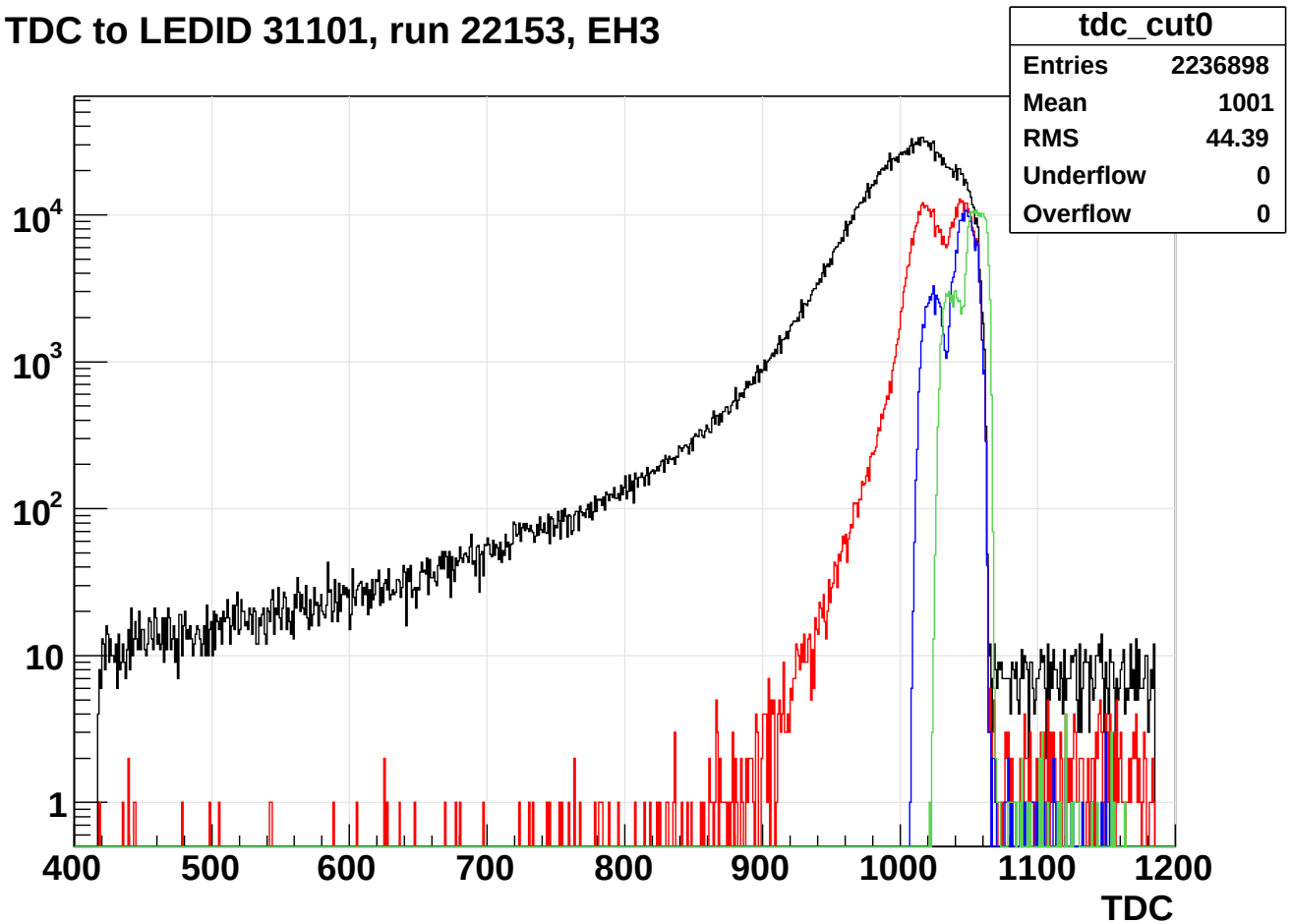
Before ToF subtraction



After ToF subtraction



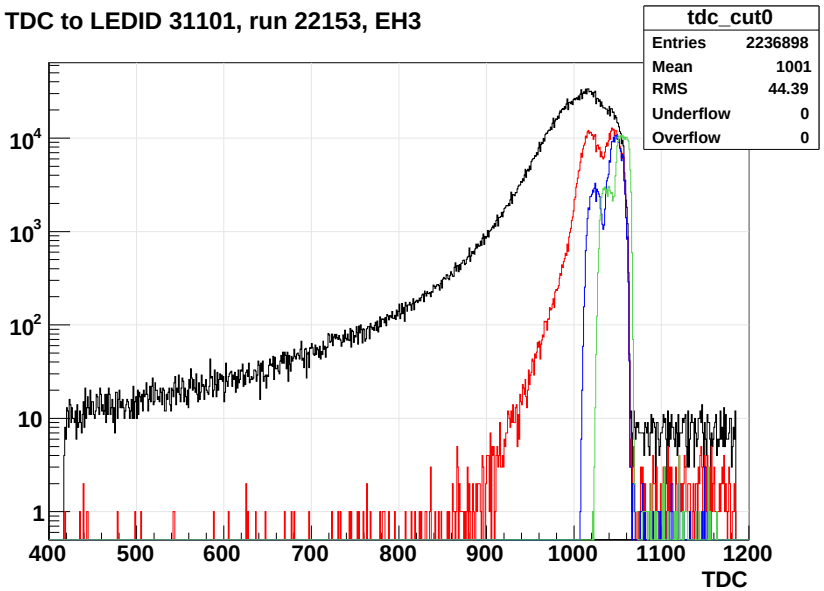
Hit selection results for one LED

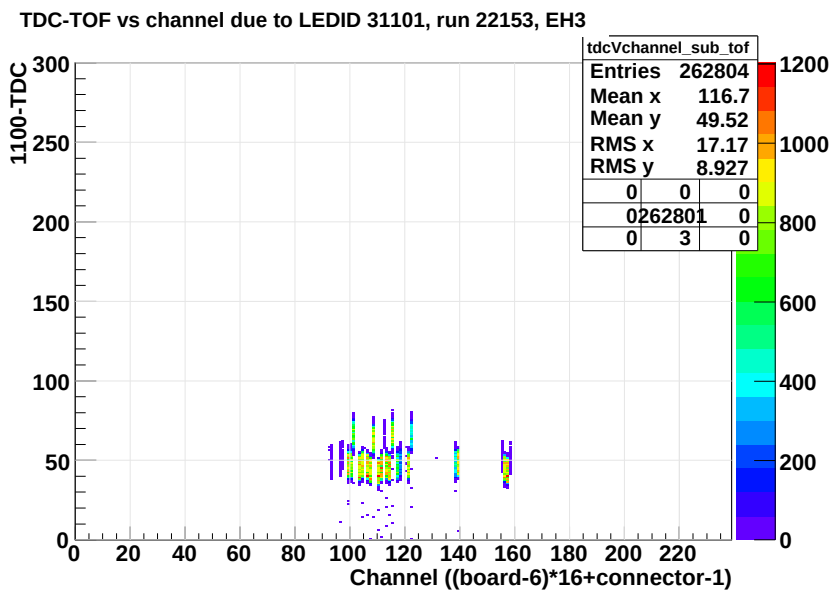


all, unblocked, $Q > 50$ PE, ToF subtracted.

Fitting

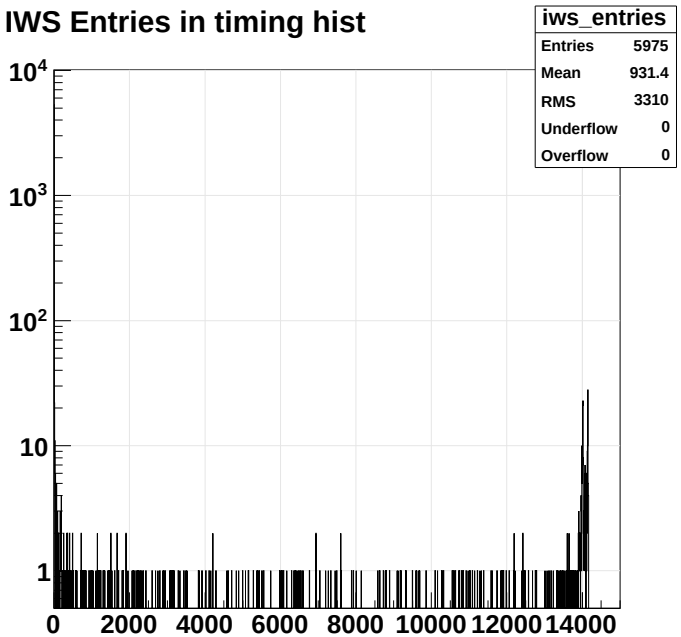
Timing Edge

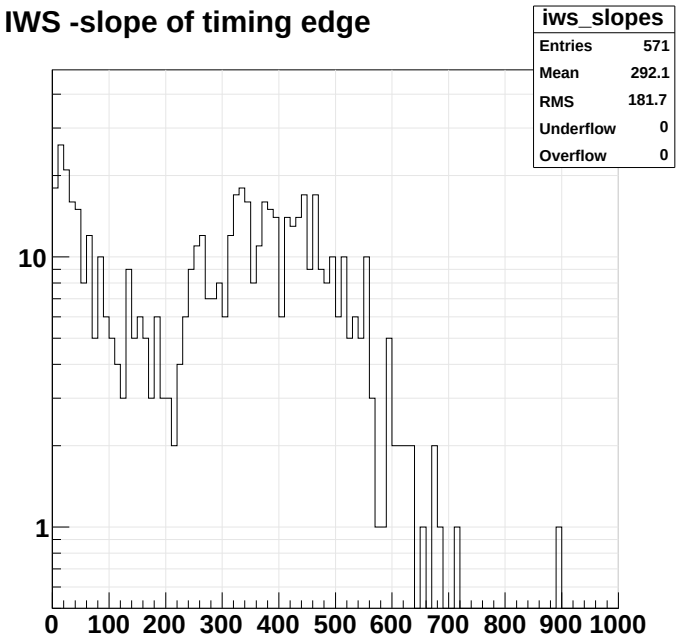




Use rising edge of TDC-ToF for each channel. Edge is where bin-to-bin change is greatest.

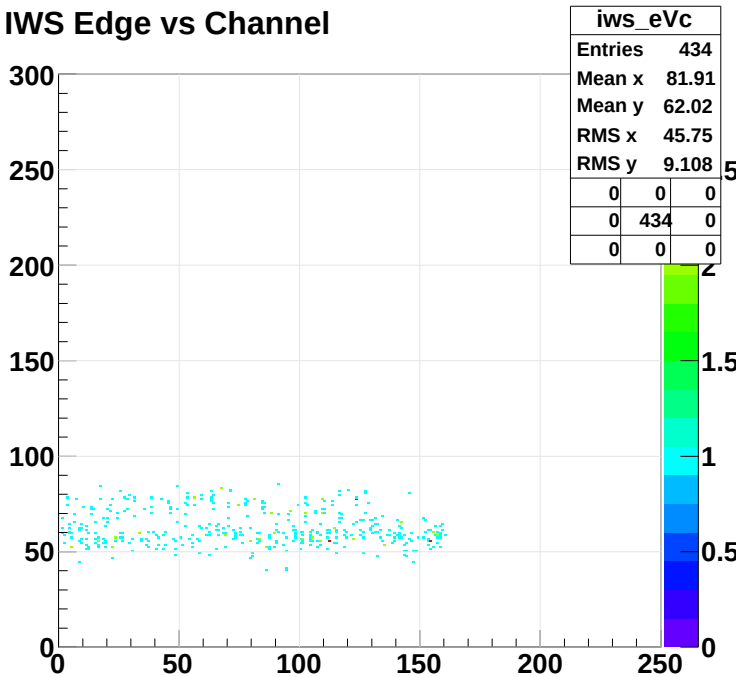
Selected PMT/LED pairs



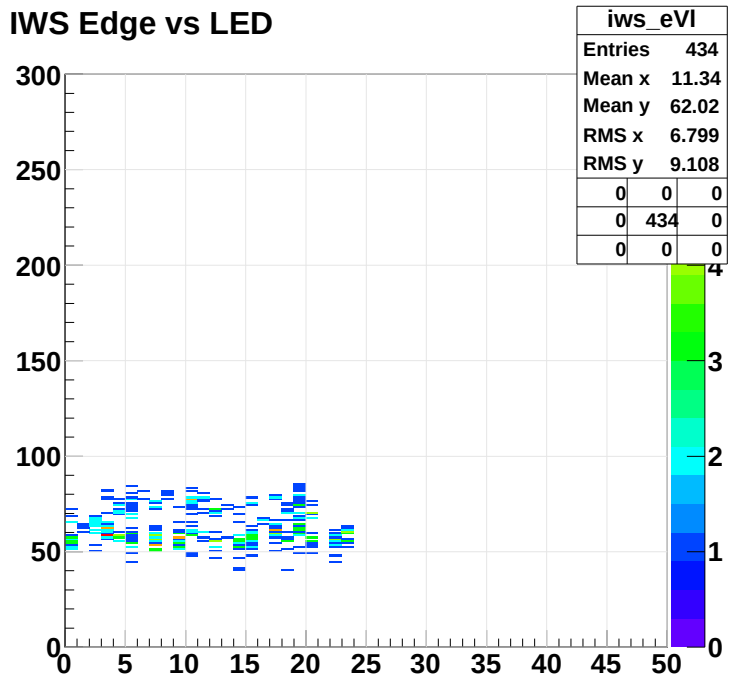


- Some LEDs produce little or no measured PMT charge
  - Must measure > 100 flashes in a PMT.
  - Edge must be "sharp" change of > 100 flashes per timing bin.

Fit input

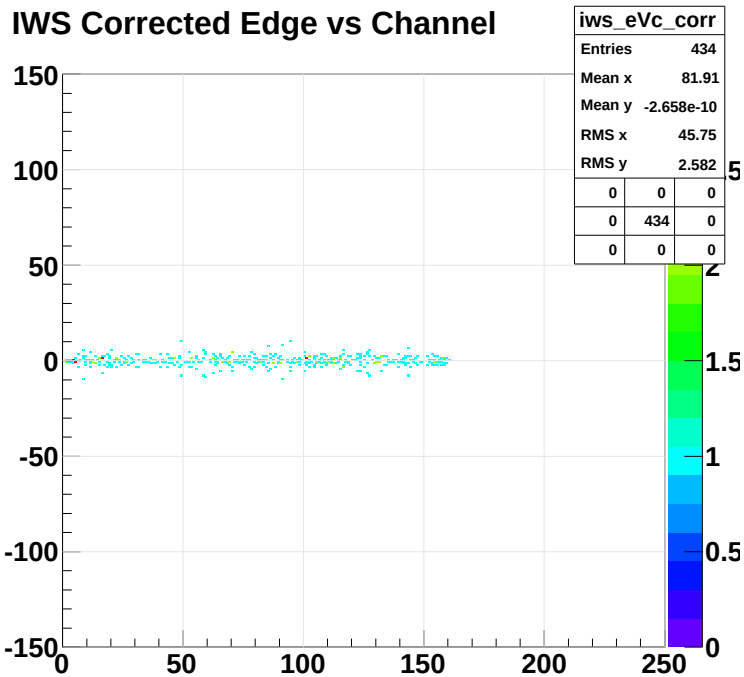


Edge times vs Channel

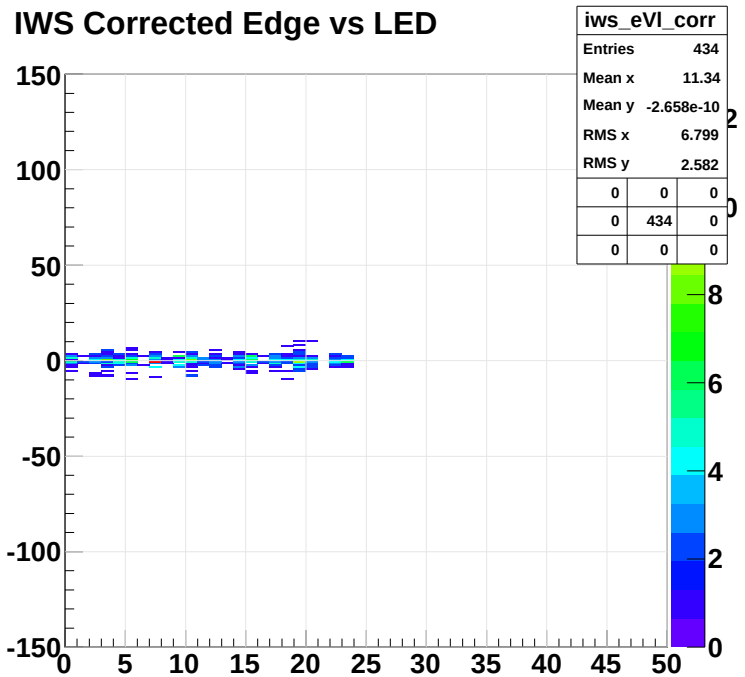


Edge times vs LED

Apply fit results



Edge times vs Channel



Edge times vs LED

To Do

To Do

- Run on the rest of the pools for the given time.
- Refactor code to be less chaotic
  - Need ROOT upgrade for Python access to TFitter
- Run on all LED files
  - Change with time? Power cycles? LED death rate?
- Hook into NuWa calibration, offline DB
- Automate for on-going running.
- Refine methods

I hope some of these things can be taken over by someone else!

DocDB

Non exhaustive list of relevant DocDB entries:

- 6851 Muon Calibration run list, Y. Meng
- 7159 Muon PMT Installation/Spot-number/Position maps, B. Hackenburg
- 7519 Pool LED position, Y. Meng
- 7550 Yue's method
- 7566 Daya Bay Local Coordinate Systems, B. Hackenburg
- 7597 What PMTs see what LEDs, B. Viren

Code

Most everything is in SVN at `people/bv/muons/MissedBus`.
Current procedure is very painful:

1. Make analysis tree

```
nuwa.py -m MissedBus.lovepool -m Quickstart.Calibrate \
        -m 'MissedBus.calibflashfiller out.root' in.root
```

2. Apply event selection and make LED/PMT histograms

```
selection.py wpled-eh3-22153-32???.root selection.ps
```

3. Generate fit inputs (`to_fit*.txt`) and plots

```
prefit.py selection-hists.root
```

4. Do fit, generate `fit.py`

```
rfit.py to_fit_iws.txt
```

5. Apply fits in plots

```
prefit.py selection-hists.root
```

- Python scripts under `MissedBus/python/MissedBus/plots/`
- Requires recent NuWa trunk and an upgraded root (v5.32.02 used)