11th March 2021

- Extreme value of TBA (TBA > 50 or TBA < -50)
  - Check the RQ name for TBA
    - Calculated TBA from scratch, TBA = (T-B)/(T+B)
    - The output graph is exactly the same
  - The rate:
    - In total 14 + 18 = 32 out of 800,000 ~0.004% (1 LZap4.7.0 root file)
  - Event types:
    - Plot TBA vs Area for different conditions → **others**
  - Learned to use Event Viewer (pretty cool!)
    - Use event viewer to look at their pulses
    - From the raw root file:
      - Get **EventID**, **Run ID**
    - From the Lzap root file:
      - Get **PulseID**
  - Plot x vs. y positions of these events

Extreme TBA value

- $T - B > a\,(T + B)$
  - $T > 0 \rightarrow B < 0 \;\&\&\; |B| > T$
  - $T < 0 \rightarrow$
    - $B < 0$
    - $B > 0 \;\&\&\; |B| << |T|$ or $a >> 1$
  - $T = 0 \rightarrow B < 0$
  - $B = 0 \rightarrow T < 0$

- $T - B < -a\,(T + B)$

  $= B - T > a\,(T + B)$
  - $B > 0 \rightarrow T < 0 \;\&\&\; |T| > B$
  - $B < 0 \rightarrow$
    - $T < 0$
    - $T > 0 \;\&\&\; |T| << |B|$ or $a >> 1$
  - $T = 0 \rightarrow B < 0$
  - $B = 0 \rightarrow T < 0$

Pulse

PREM output:

```
TBA: 74.5369
/global/cfs/cdirs/lz/data/MDC3/background/BACCARAT-4.11.0_DER-8.5.13/20180401/lz_201804010002_000172_035738_raw.root,172,3873653,10
```

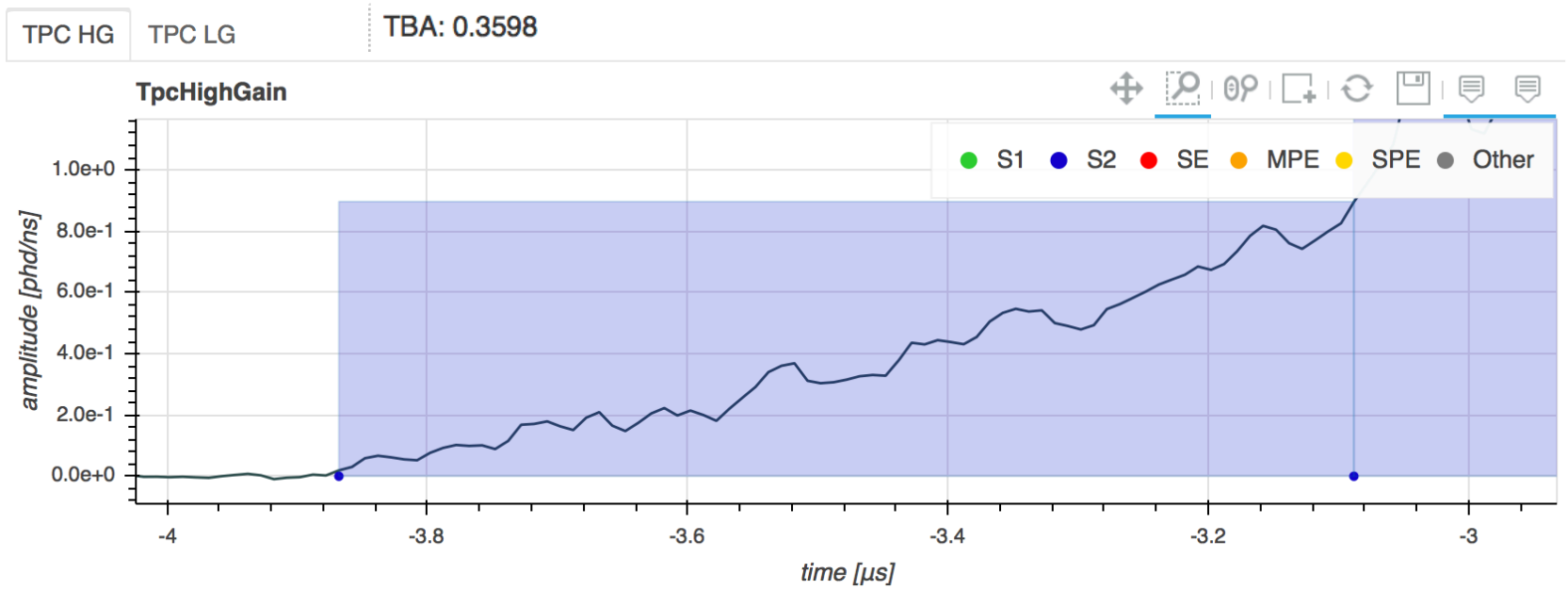
eventID

raw root file

runID

pulseID

Event Viewer output:



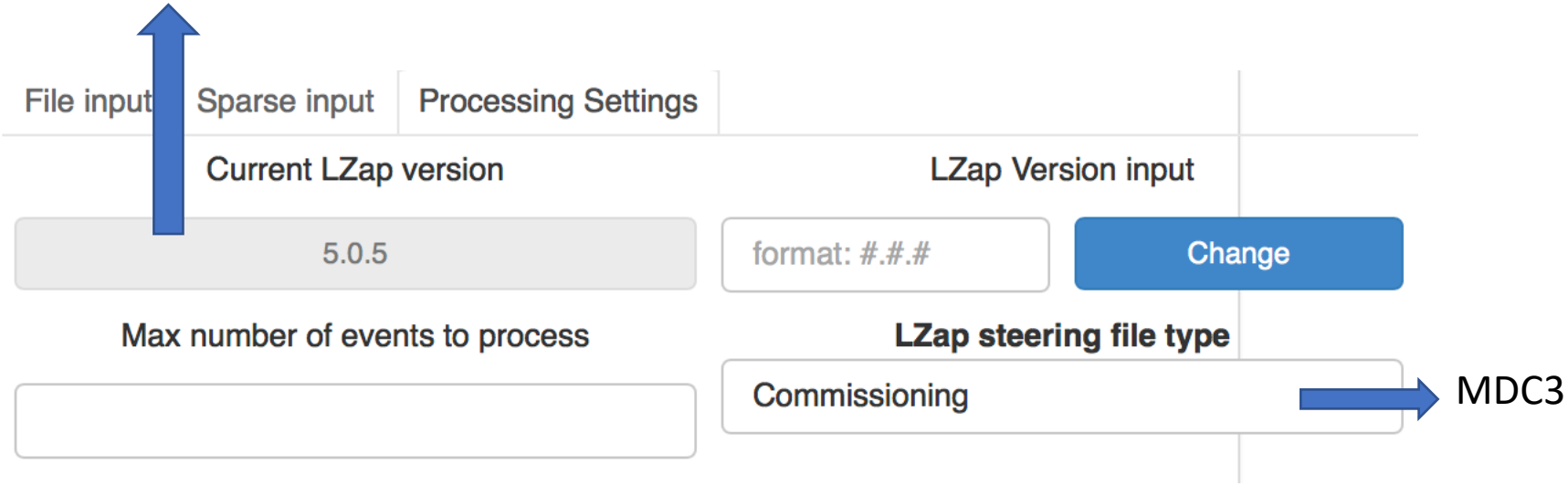
Does not match

1. Pulse type
2. TBA value

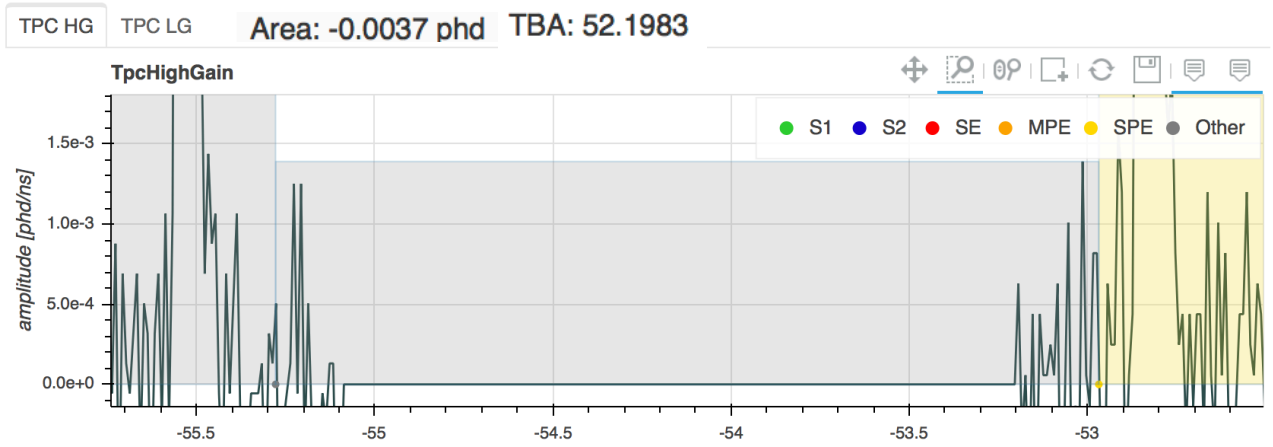
LZap 4.7.0

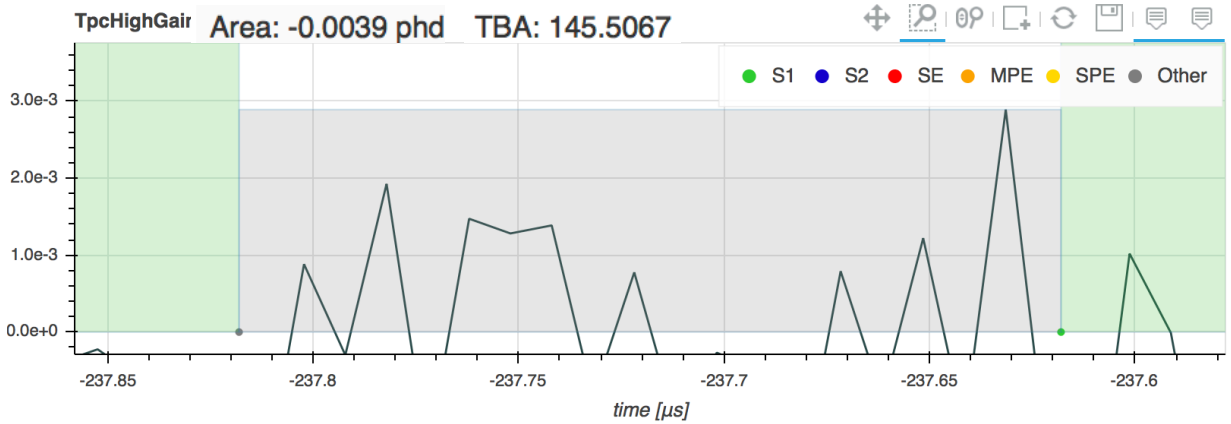
- Check the processing setting
- PREM input data file: using the root file from LZAP-4.7.0

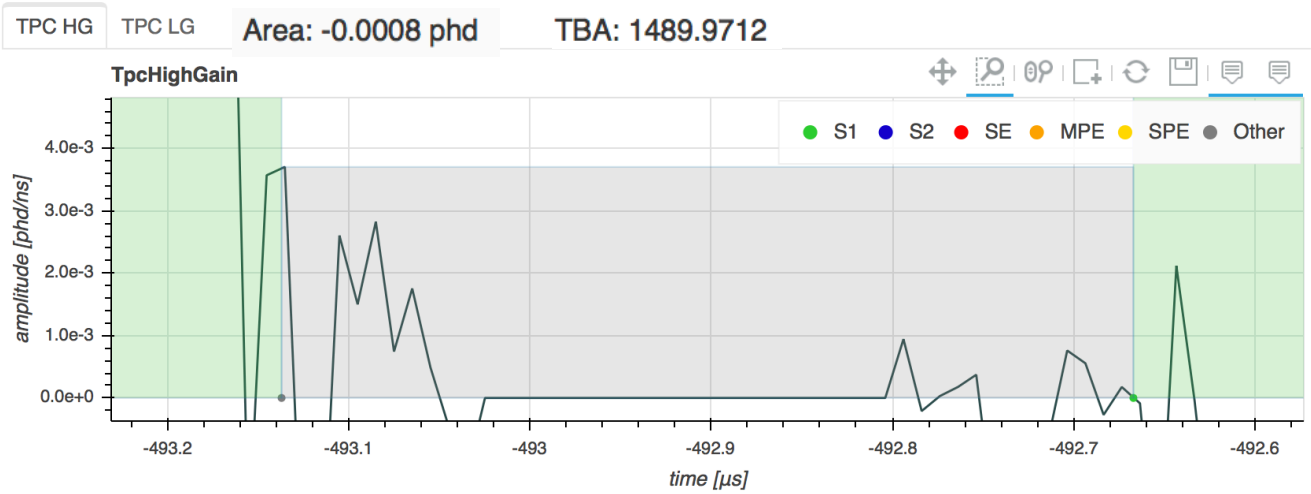
→ Default LZap version on Event Viewer: 5.0.5 → Event Viewer will process the raw root file with this LZap version
→ Change to 4.7.0

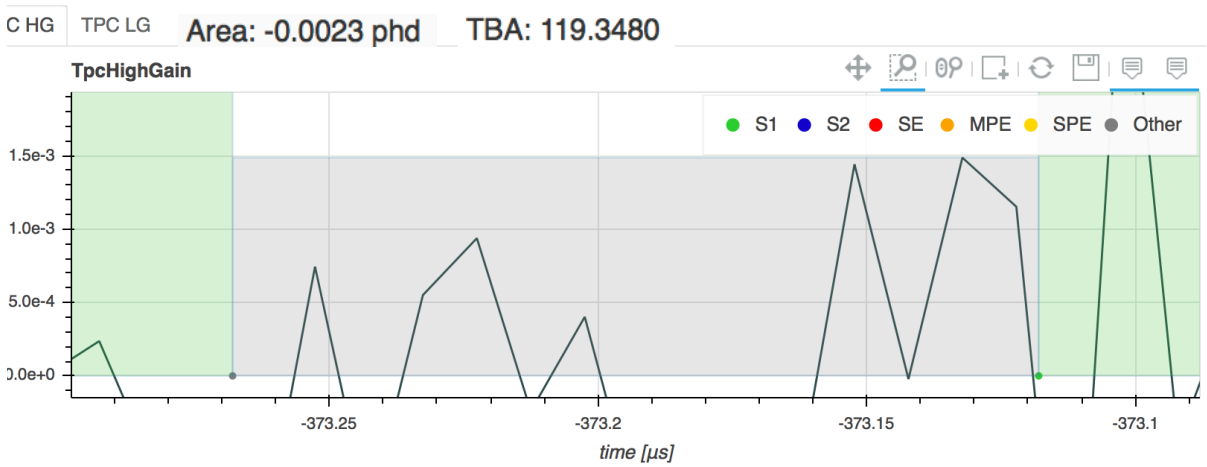


All the problems appear →







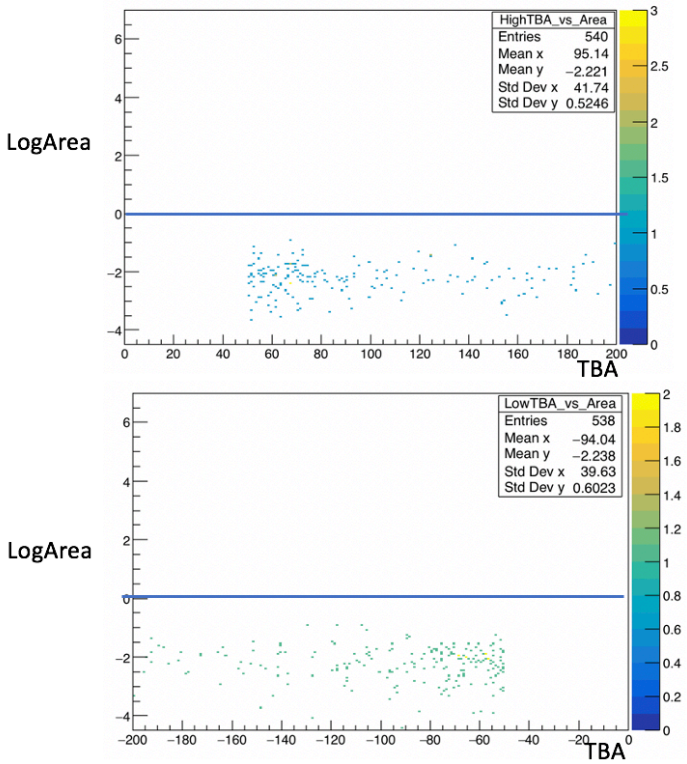


Problems with LZap version: 4.7.0

LZap 5.0.1

- Changed the input root data file to LZap 5.0.1, on the same date of root data file (20180401)
  - #Extreme TBA values decreased to 2+1 = 3 for 1 LZap data file

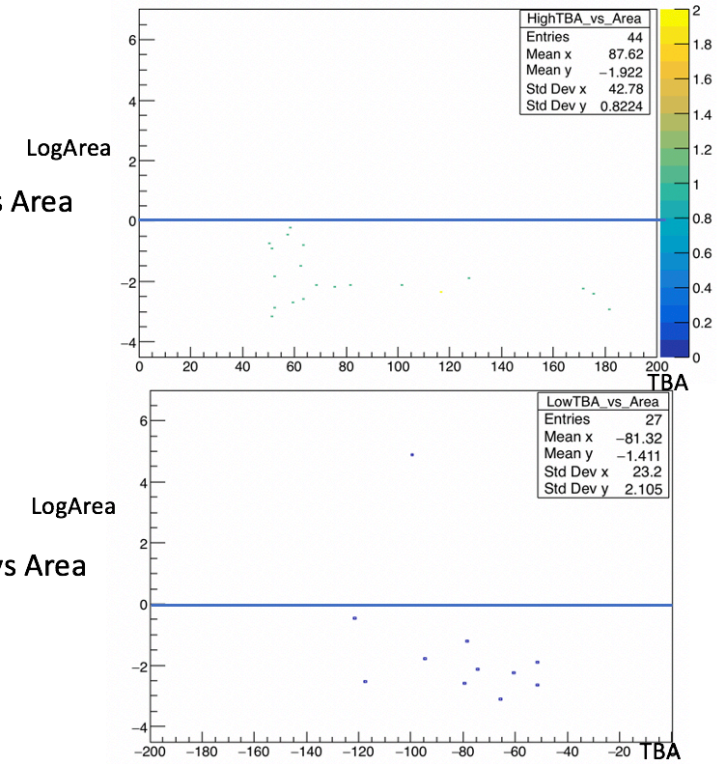
LZap 4.7.0



TBA > 50 vs Area

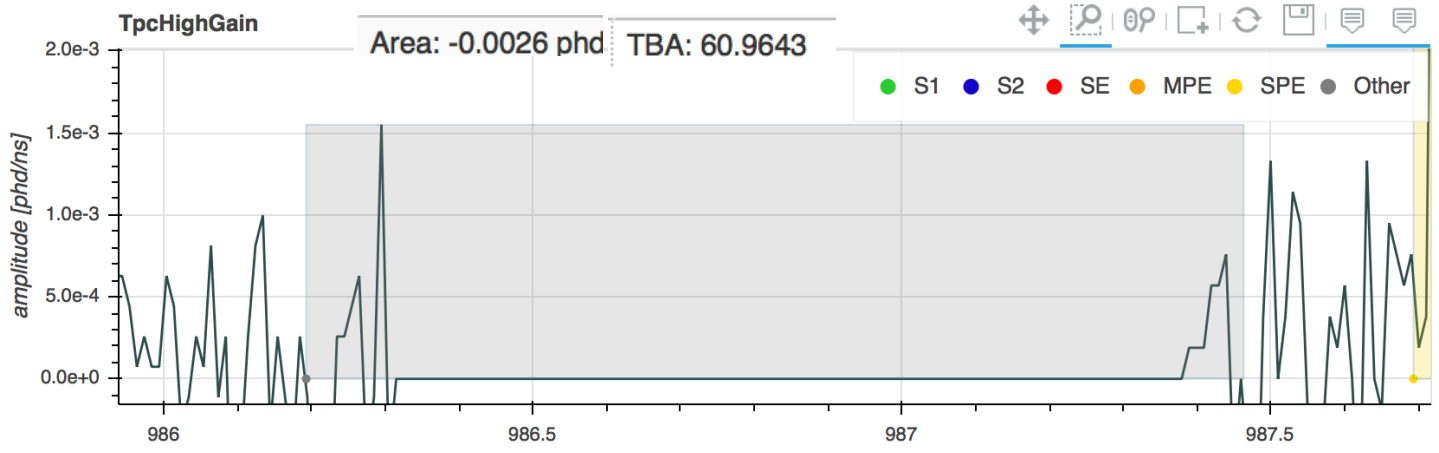
TBA < -50 vs Area

LZap 5.1.0

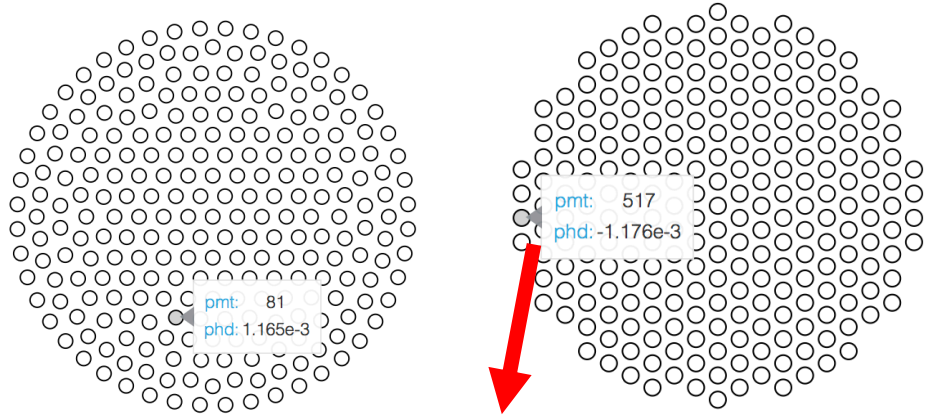


1. 8h data
2. A fraction of pulse area, < 1

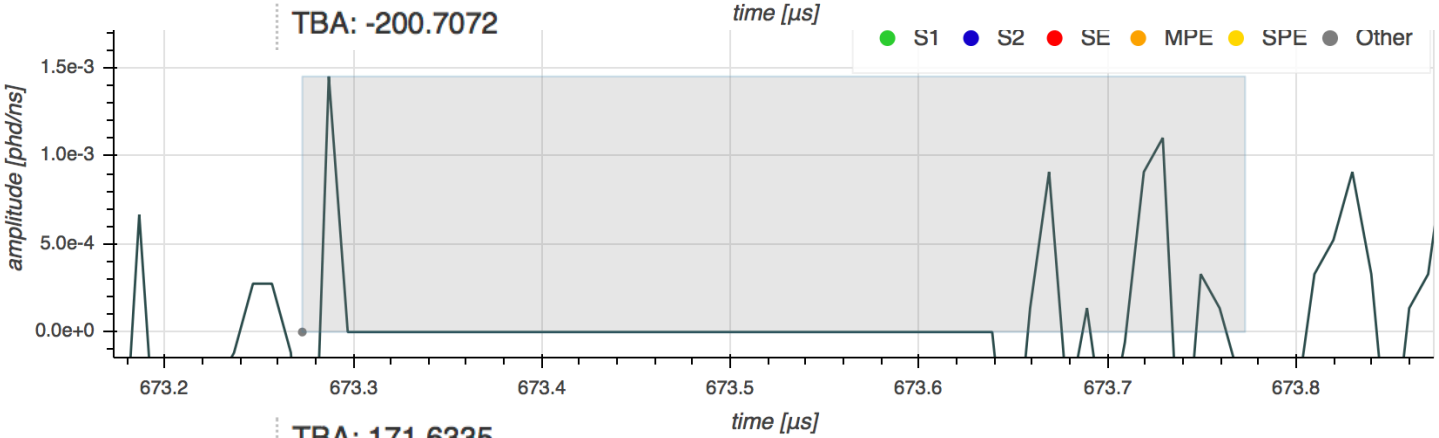
Just out of curiosity……



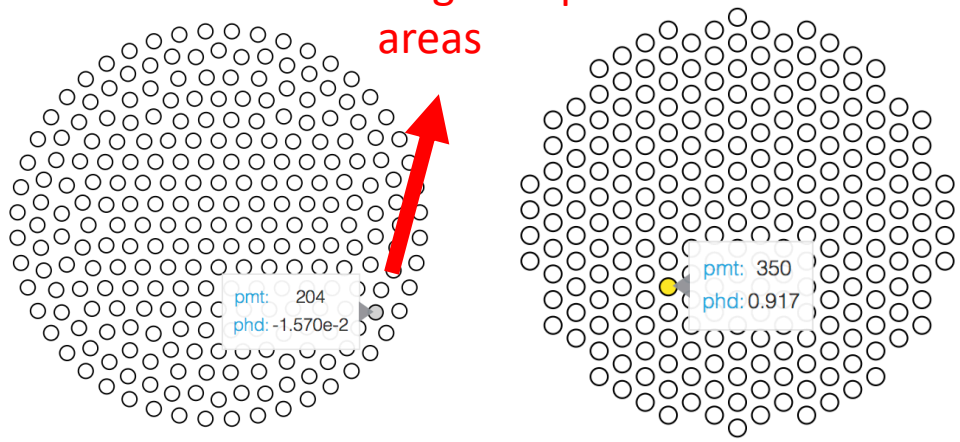
97

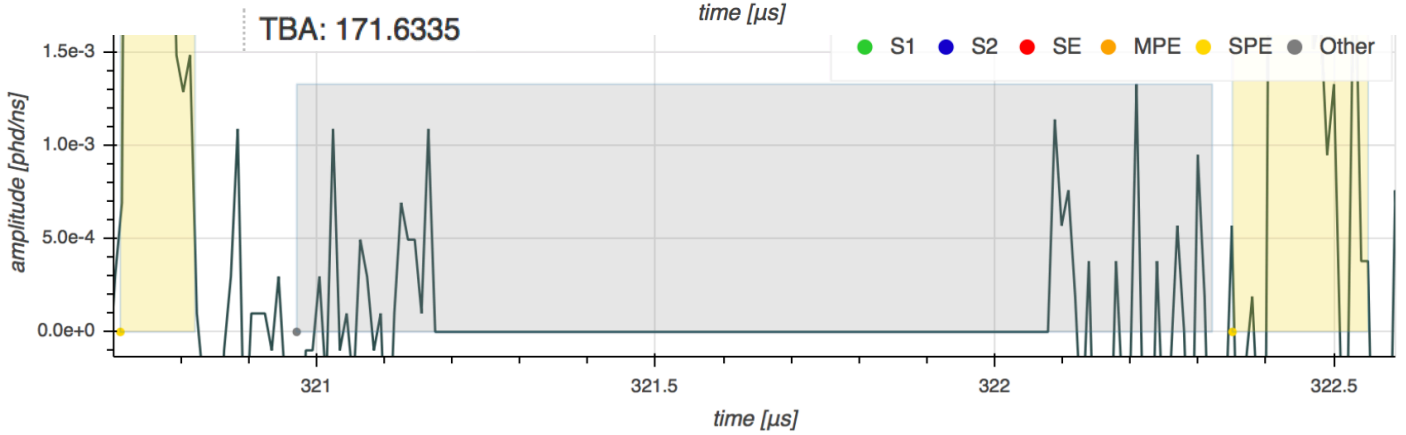


Negative pulse areas

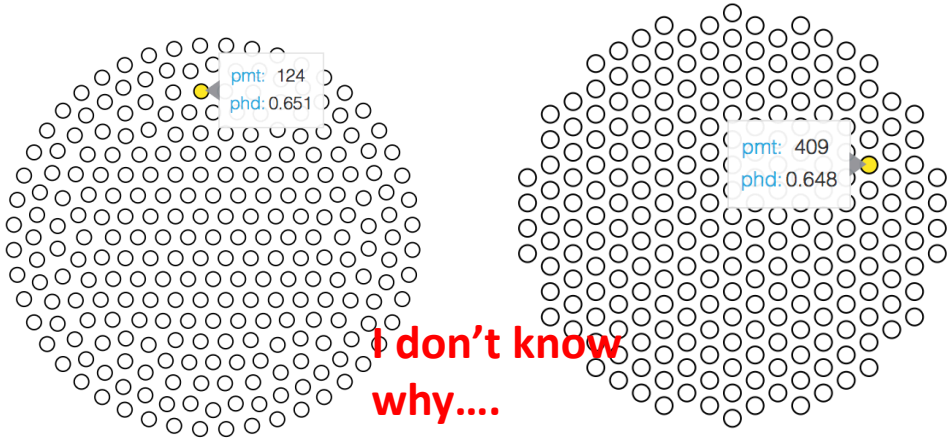


37

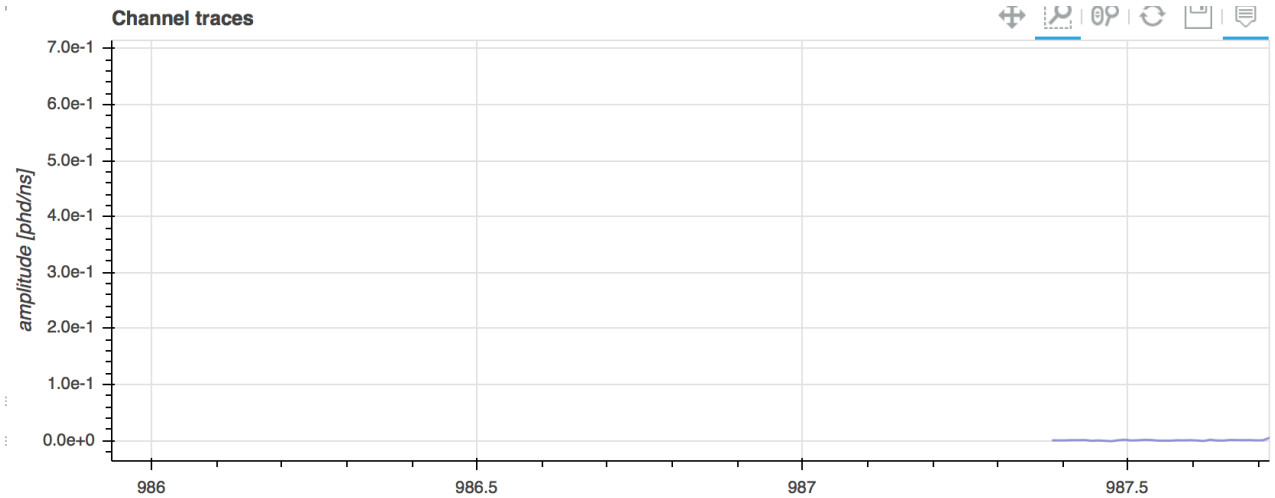




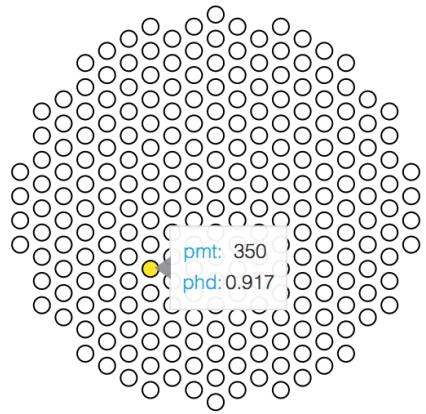
25

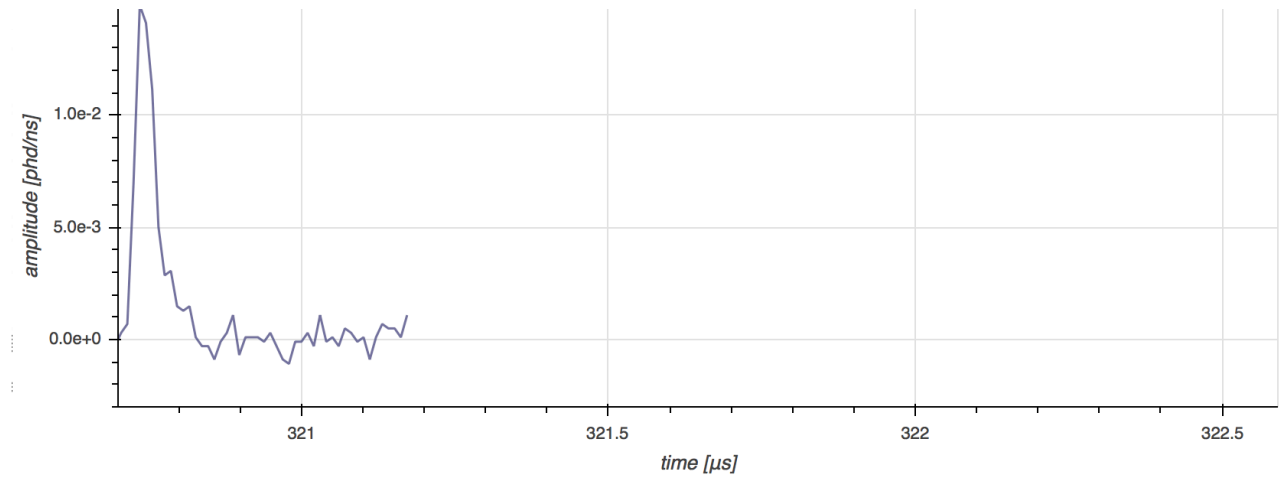


I don't know why….

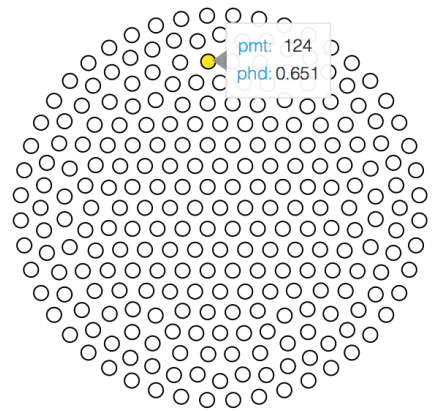

Channel traces
7.0e-1
6.0e-1
5.0e-1
4.0e-1
3.0e-1
2.0e-1
1.0e-1
0.0e+0
amplitude [phd/ns]
986
986.5
987
987.5

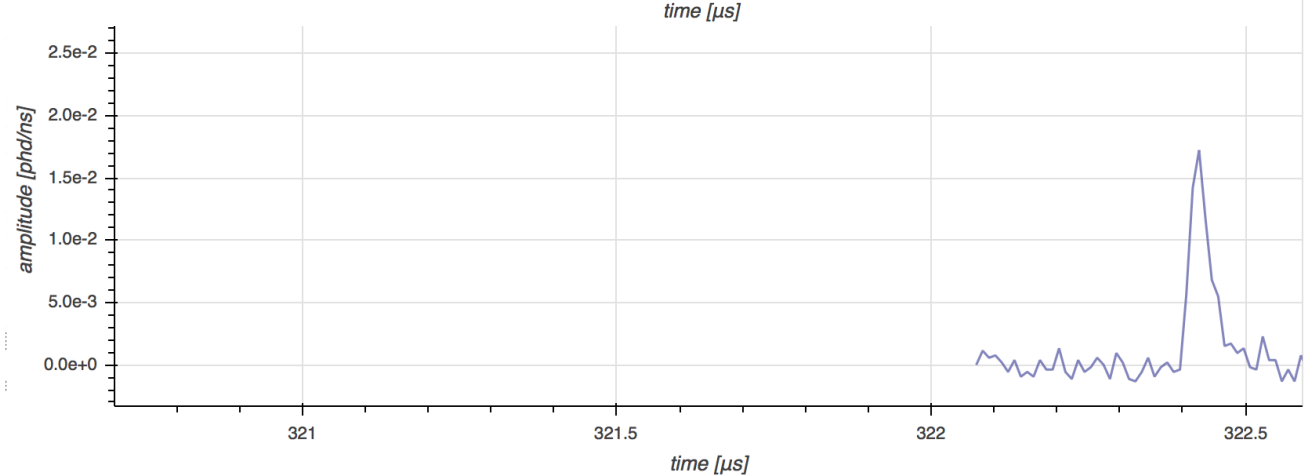
37 B


pmt: 350
phd: 0.917

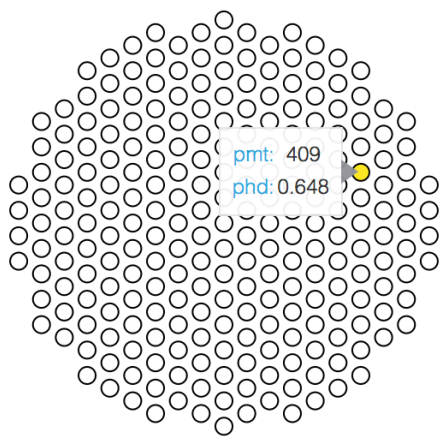

1.0e-2
5.0e-3
0.0e+0
amplitude [phd/ns]
321
321.5
322
322.5
time [μs]

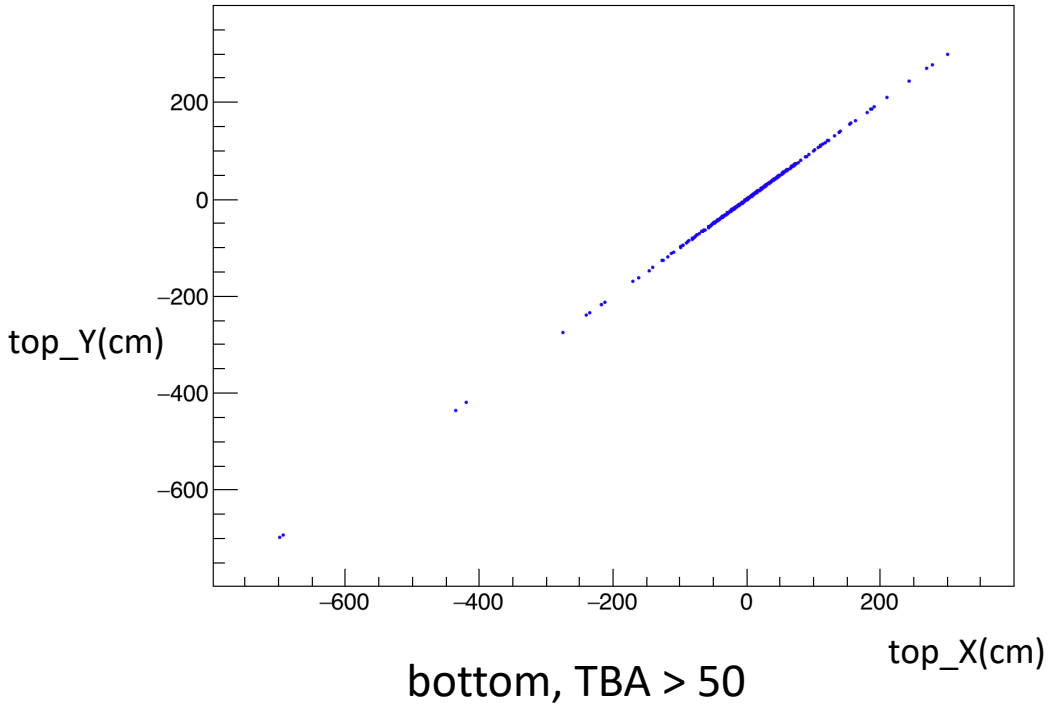
25 T


pmt: 124
phd: 0.651

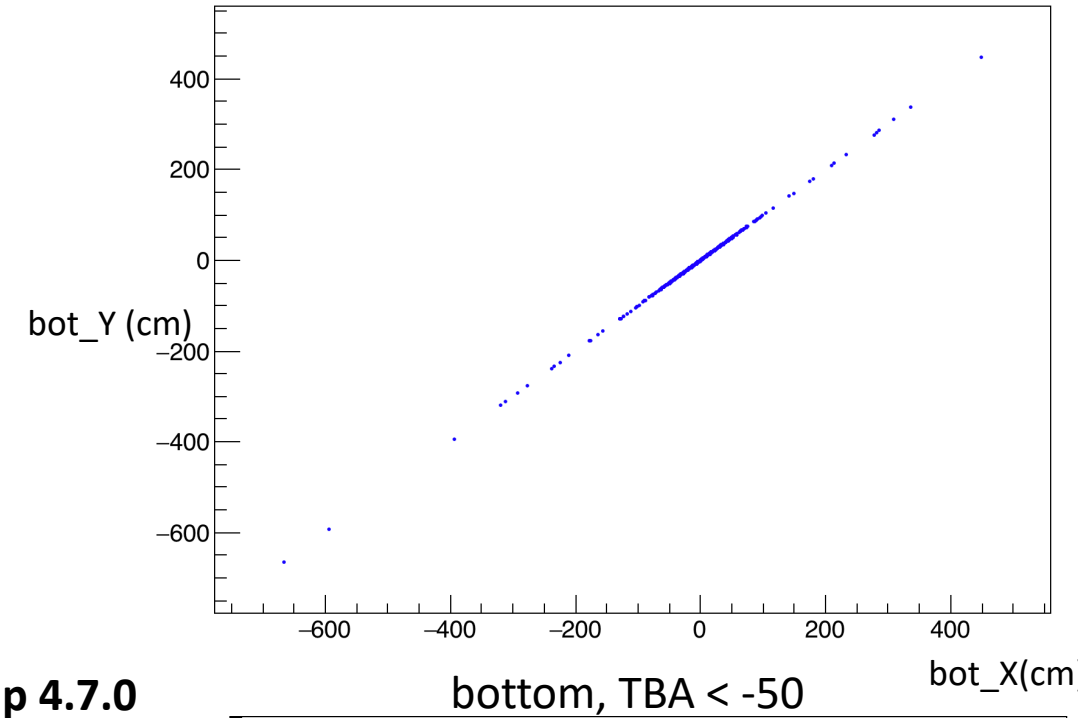

2.5e-2
2.0e-2
1.5e-2
1.0e-2
5.0e-3
0.0e+0
amplitude [phd/ns]
321
321.5
322
322.5
time [μs]

25 B


pmt: 409
phd: 0.648

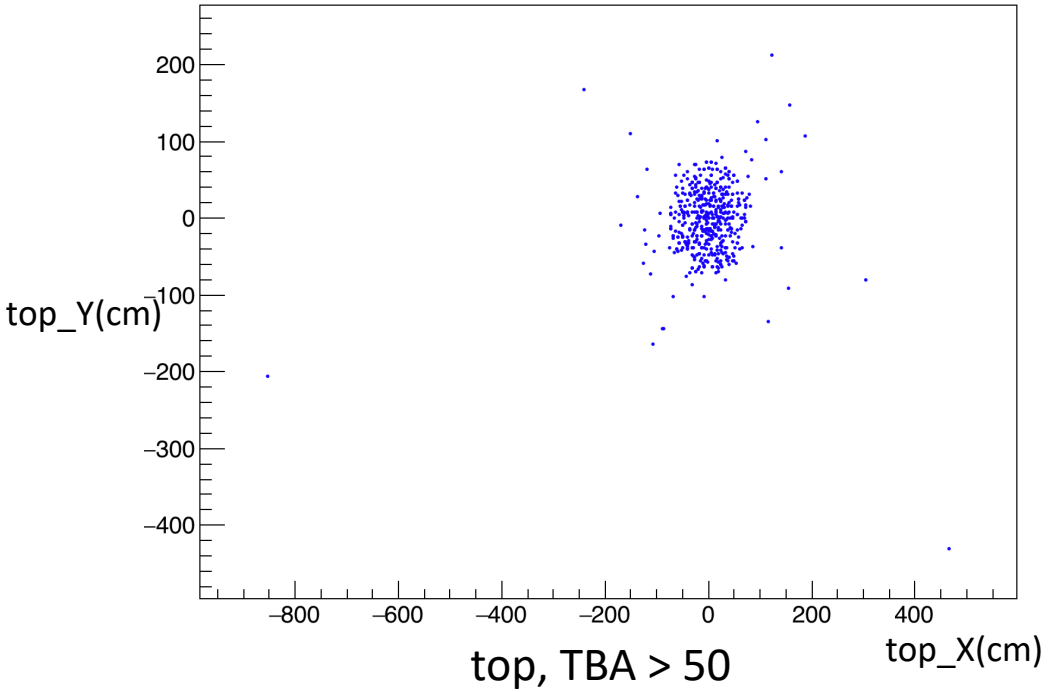


bottom, TBA > 50

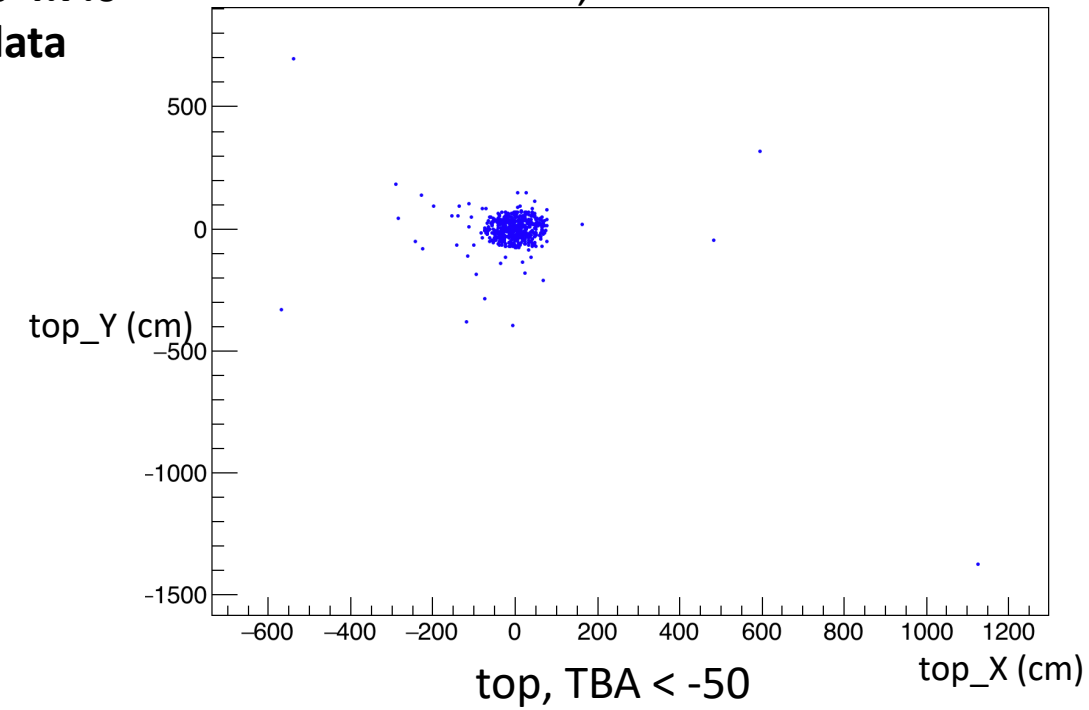


bottom, TBA < -50

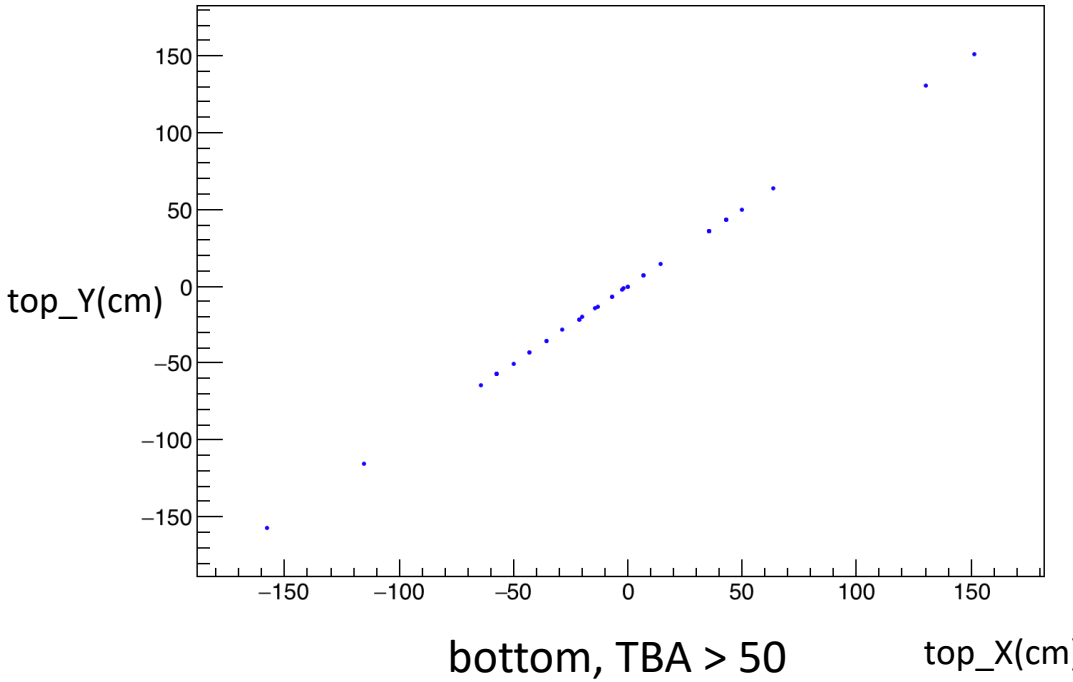
LZap 4.7.0
8h data



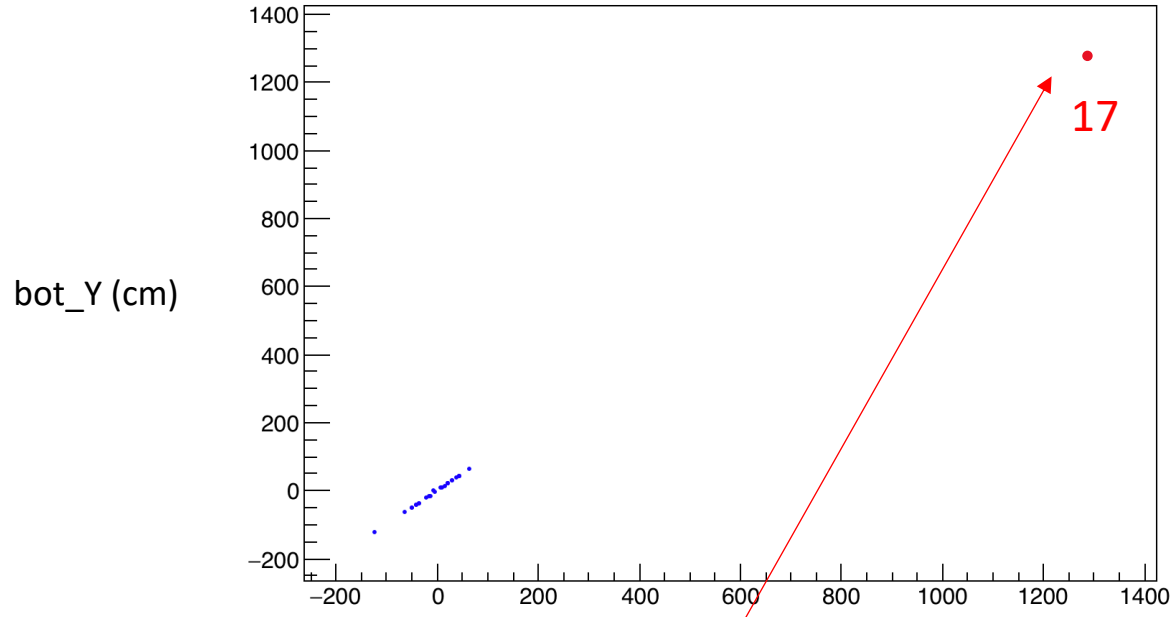
top, TBA > 50



top, TBA < -50

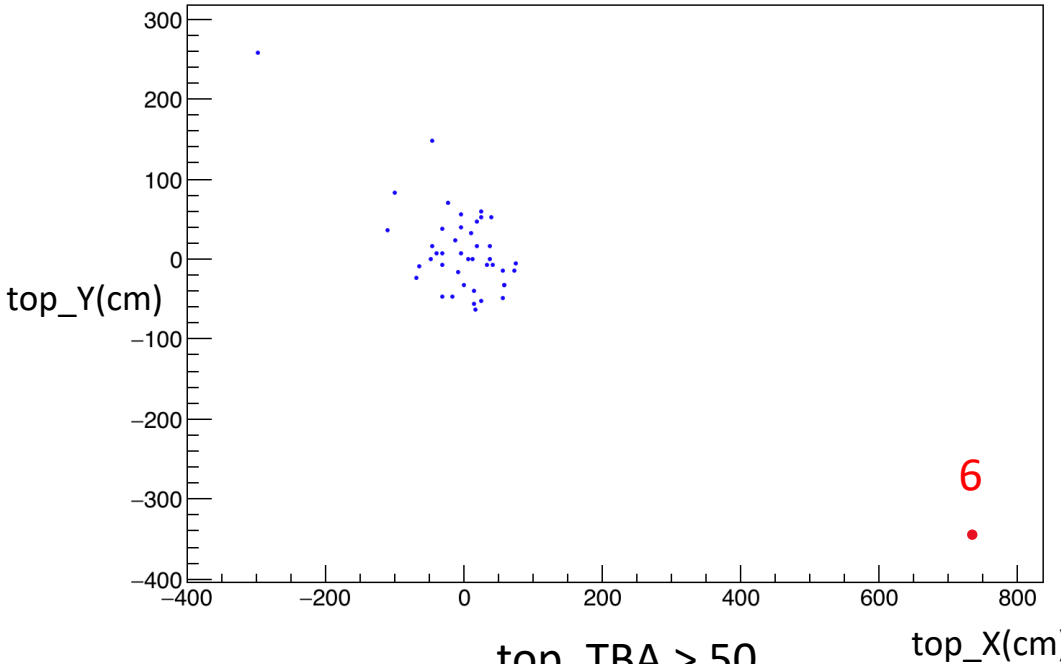


bottom, TBA > 50

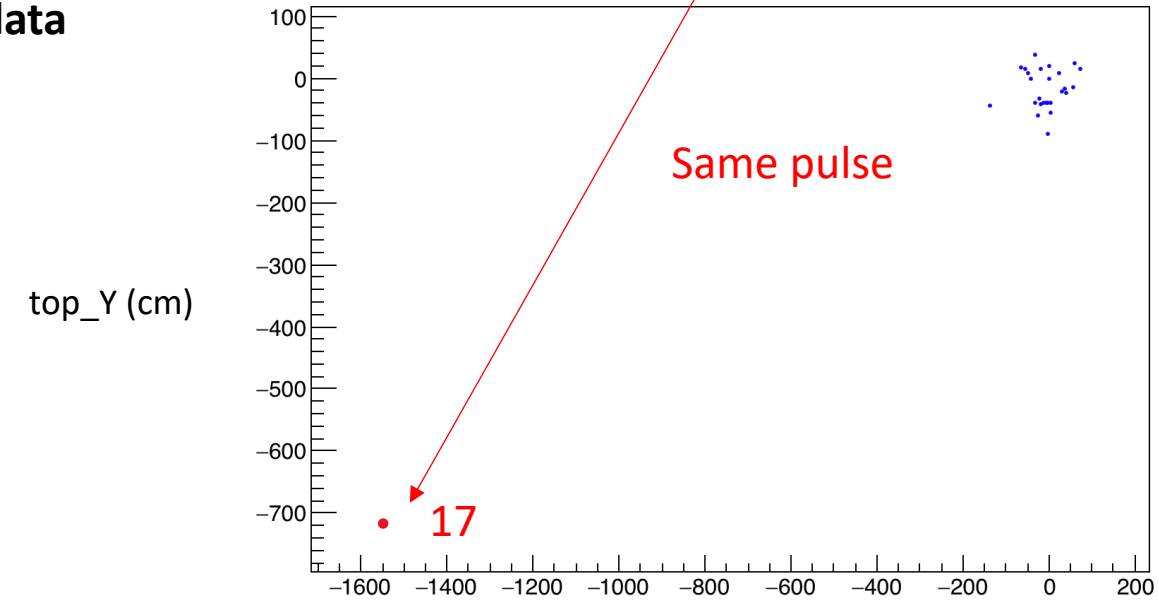


bottom, TBA < -50

LZap 5.0.1
8h data

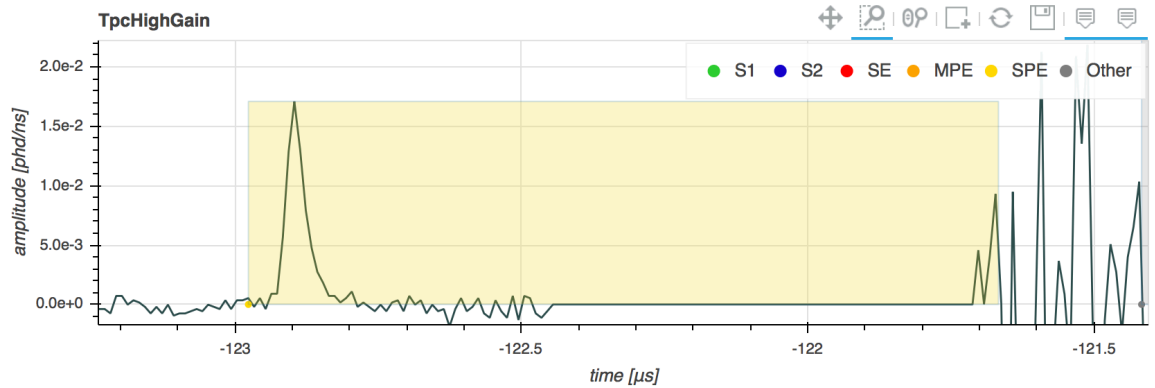


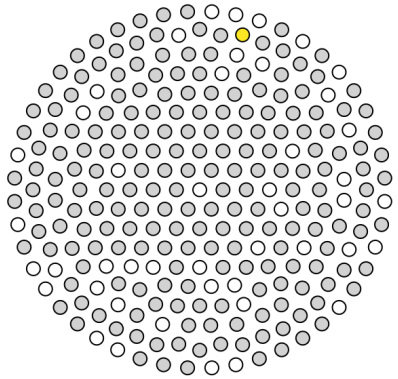
top, TBA > 50

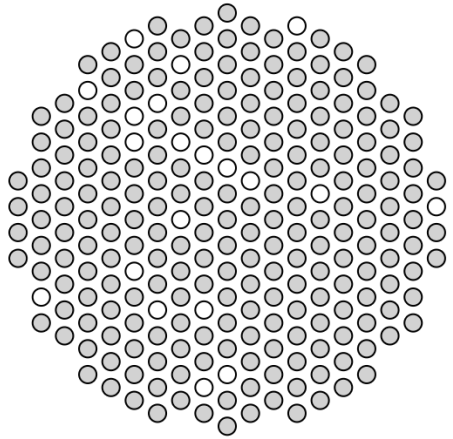


top, TBA < -50

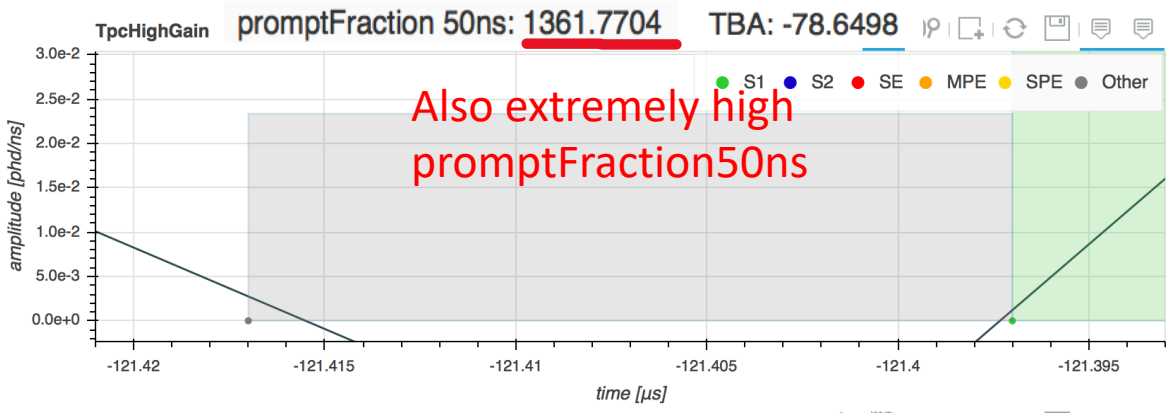
16



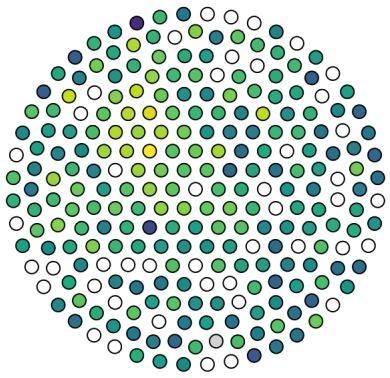


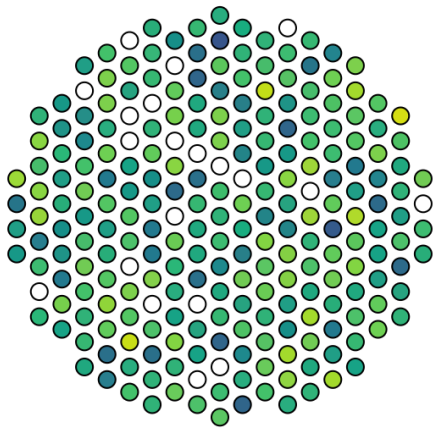


17

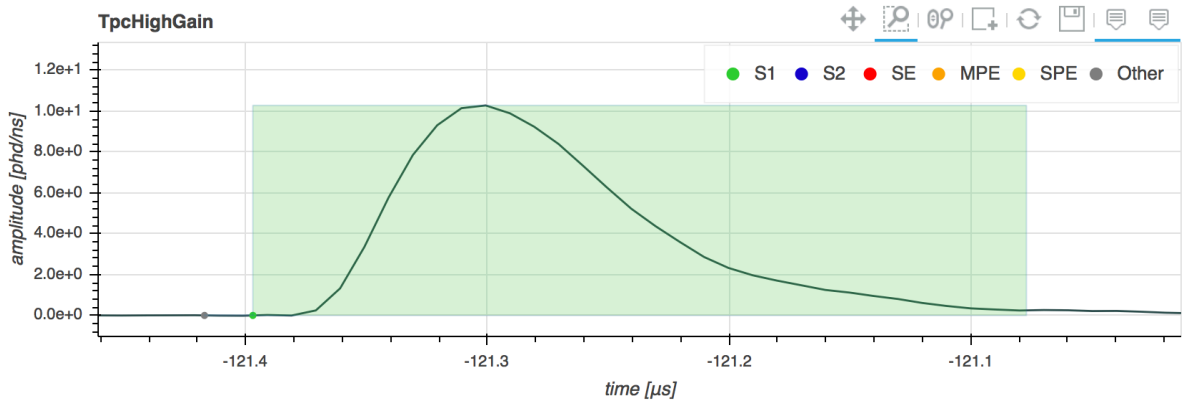


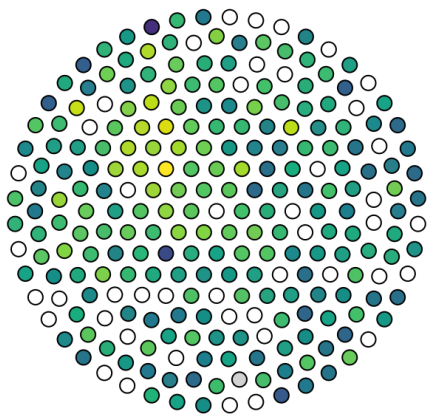
Also extremely high promptFraction50ns

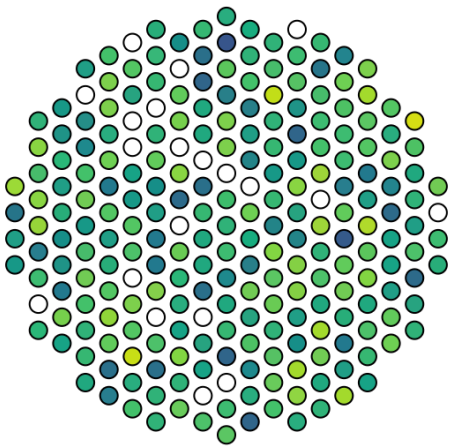


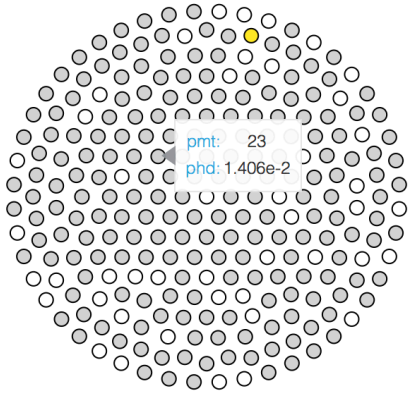


18

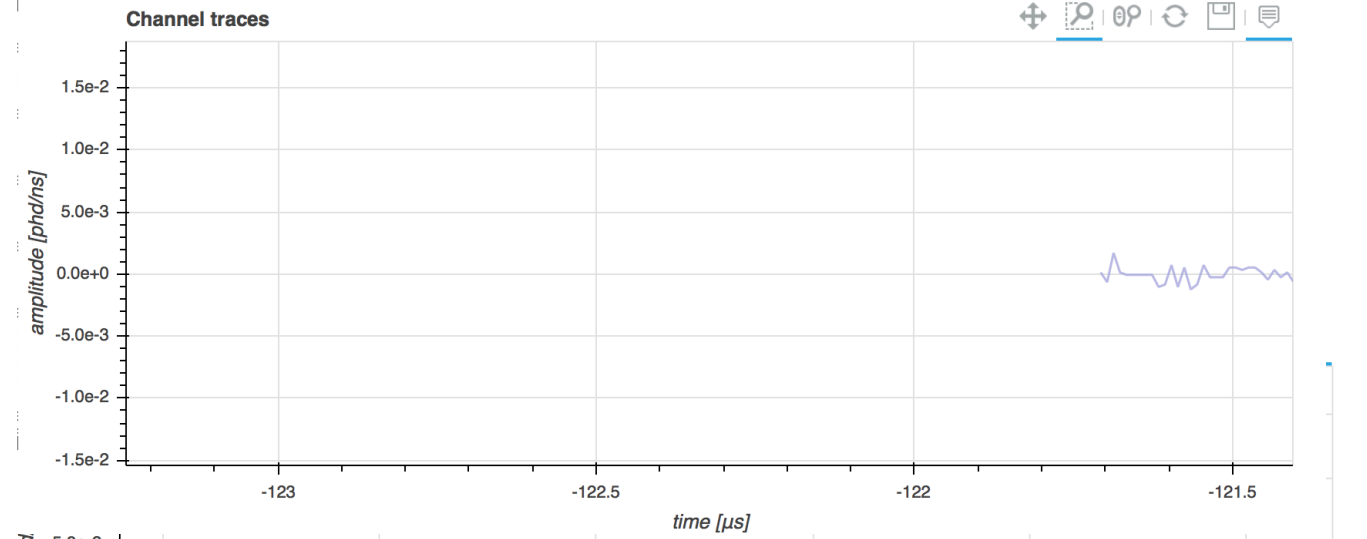




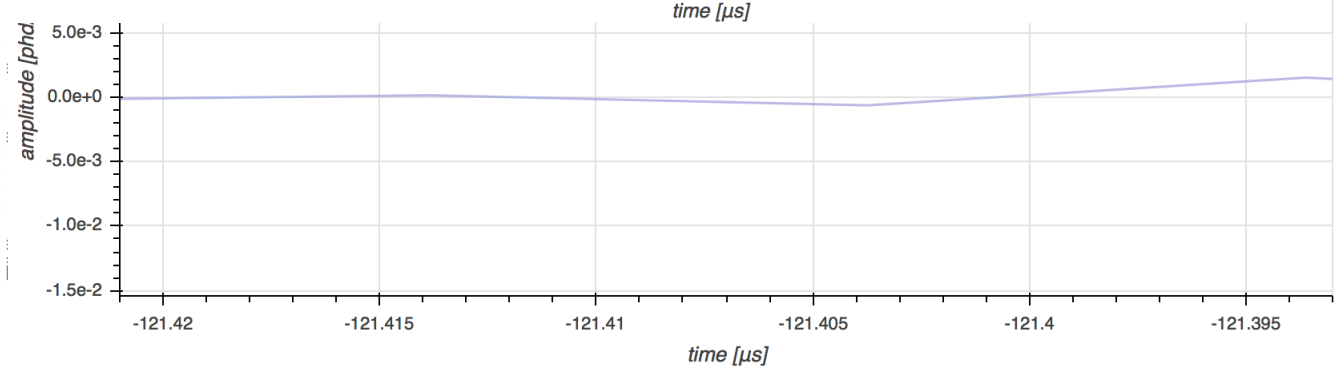


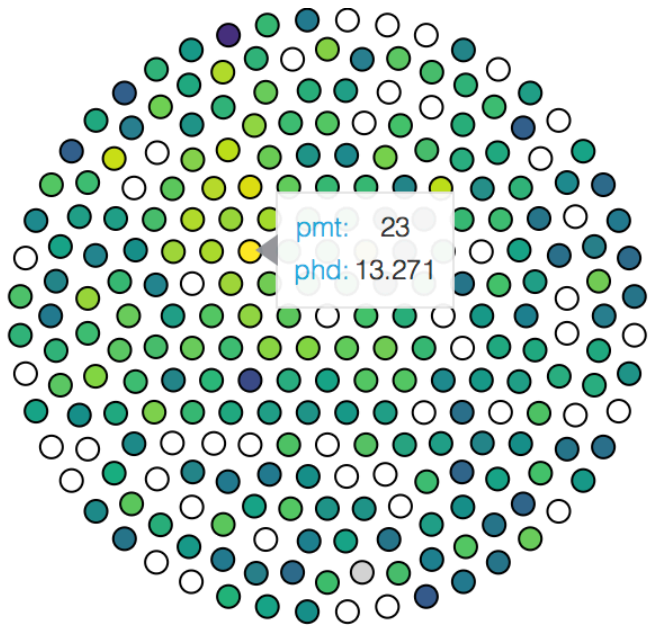

pmt: 23
phd: 1.406e-2

16

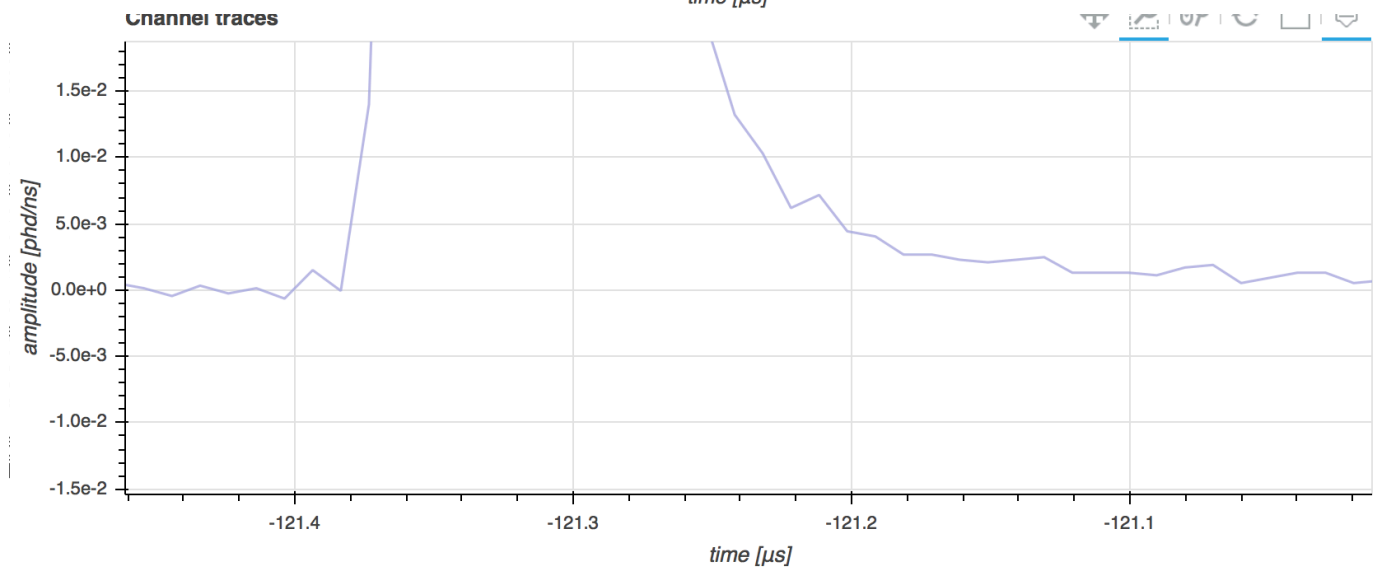

Channel traces
1.5e-2
1.0e-2
5.0e-3
0.0e+0
-5.0e-3
-1.0e-2
-1.5e-2
amplitude [phd/ns]
-123
-122.5
-122
-121.5
time [μs]

17

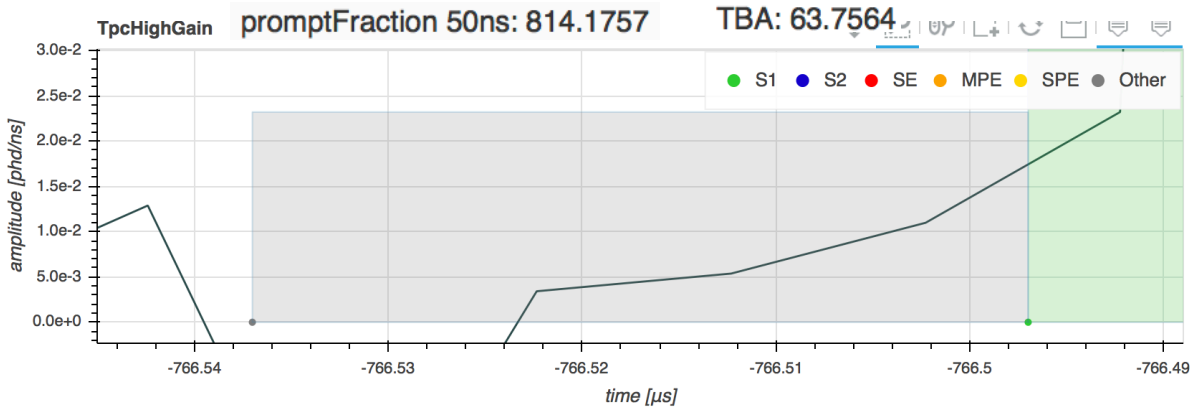

5.0e-3
0.0e+0
-5.0e-3
-1.0e-2
-1.5e-2
amplitude [phd
-121.42
-121.415
-121.41
-121.405
-121.4
-121.395
time [μs]

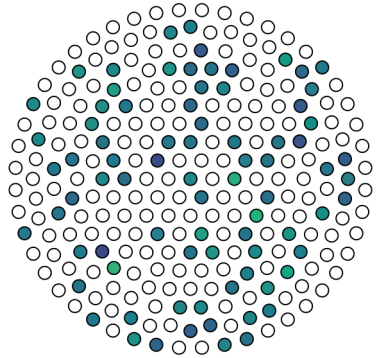

pmt: 23
phd: 13.271

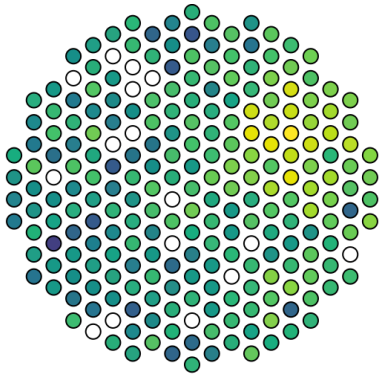
18


Channel traces
1.5e-2
1.0e-2
5.0e-3
0.0e+0
-5.0e-3
-1.0e-2
-1.5e-2
amplitude [phd/ns]
-121.4
-121.3
-121.2
-121.1
time [μs]

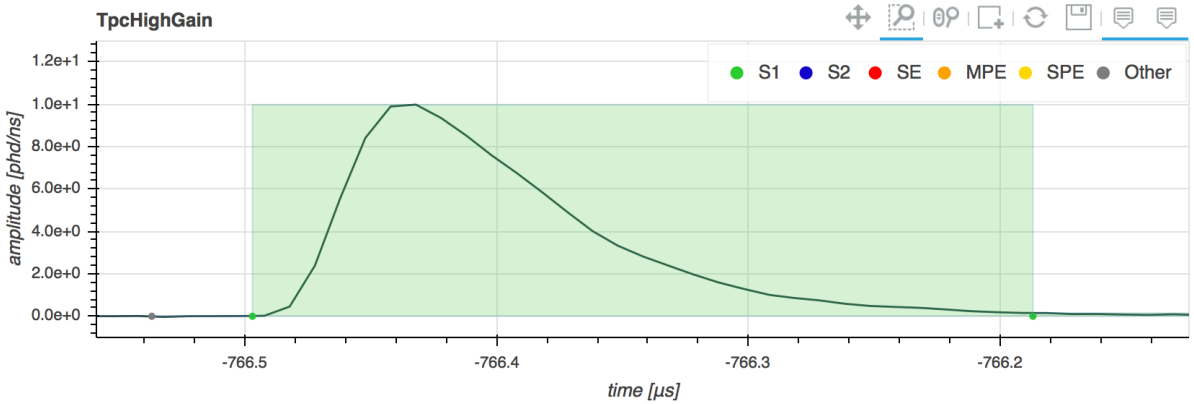
6

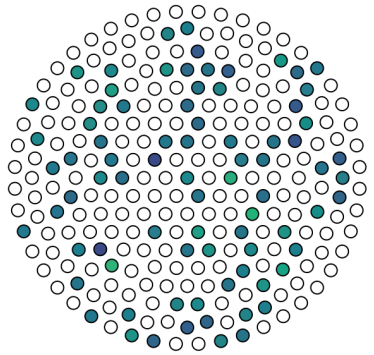

TpcHighGain
promptFraction 50ns: 814.1757
TBA: 63.7564
S1 S2 SE MPE SPE Other
amplitude [phd/ns]
3.0e-2
2.5e-2
2.0e-2
1.5e-2
1.0e-2
5.0e-3
0.0e+0
-766.54
-766.53
-766.52
-766.51
-766.5
-766.49
time [µs]

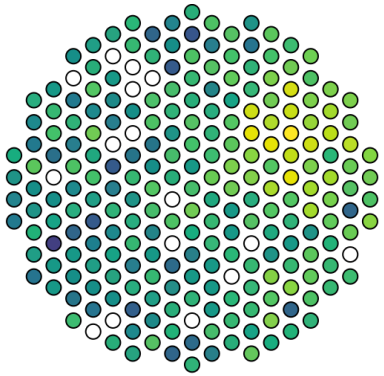




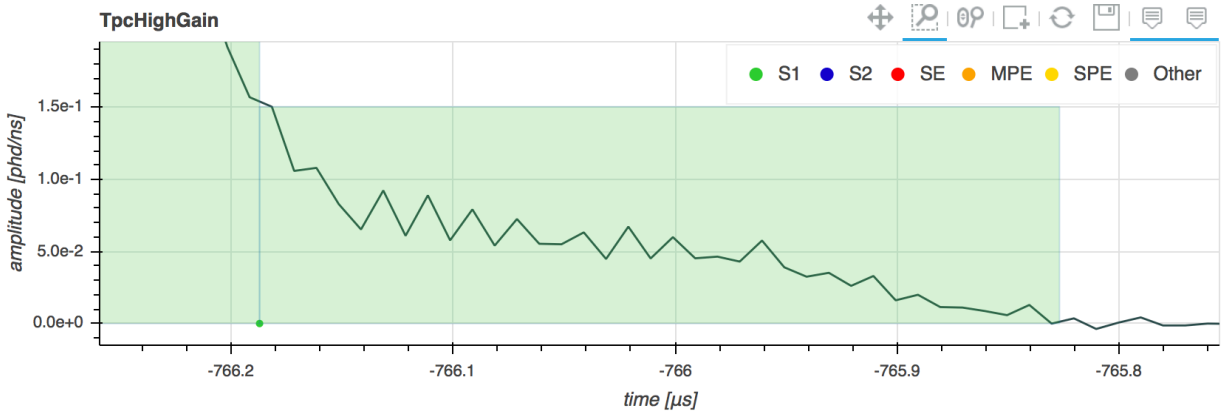
7

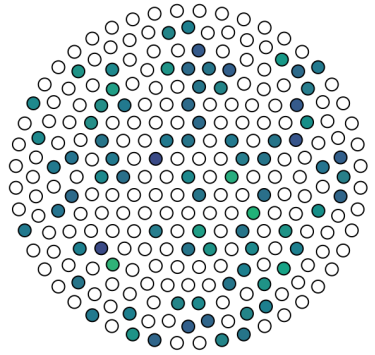

TpcHighGain
S1 S2 SE MPE SPE Other
amplitude [phd/ns]
1.2e+1
1.0e+1
8.0e+0
6.0e+0
4.0e+0
2.0e+0
0.0e+0
-766.5
-766.4
-766.3
-766.2
time [µs]

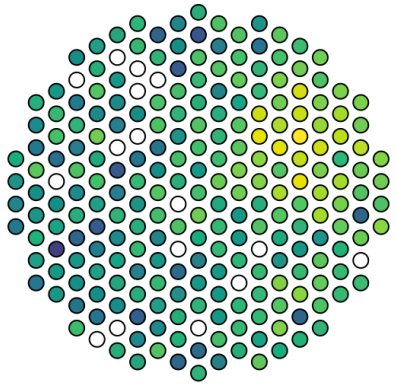


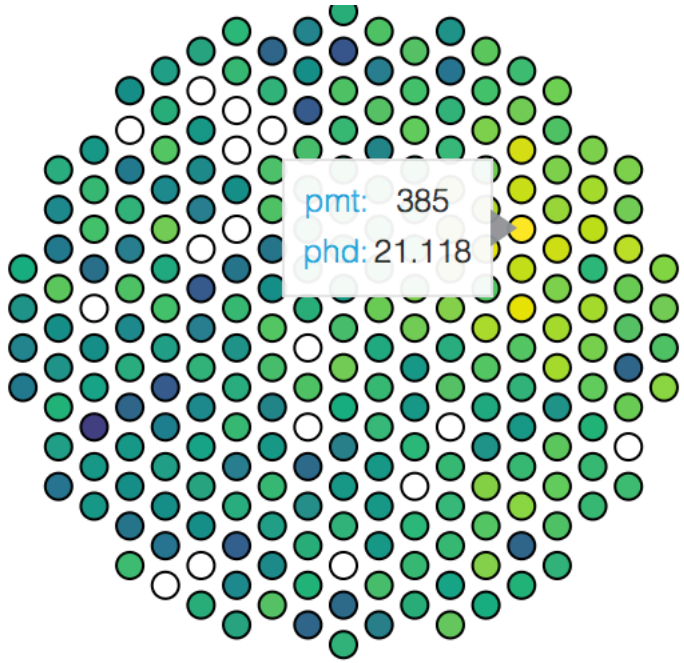


8

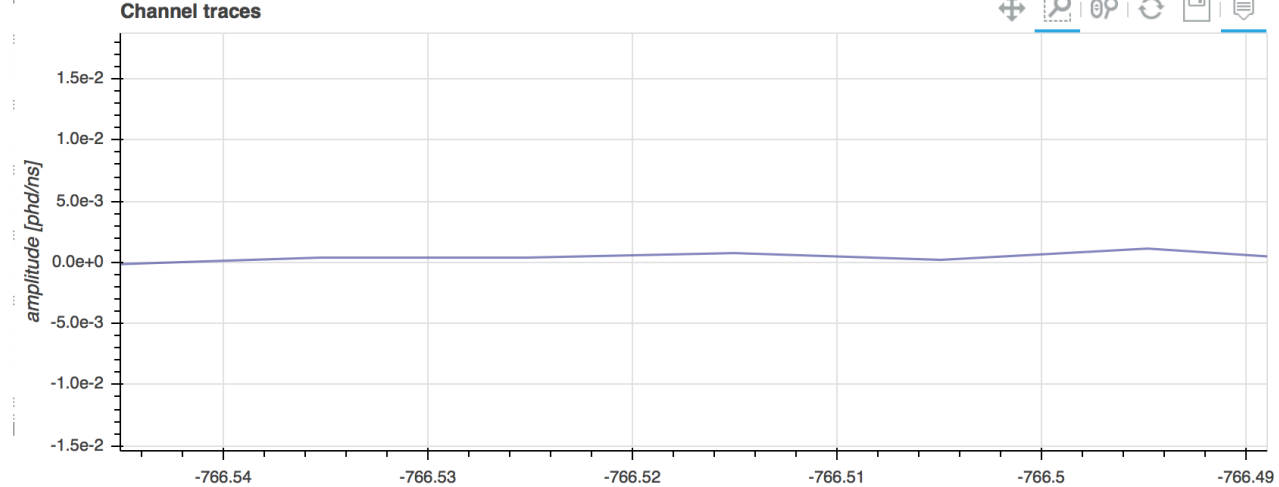

TpcHighGain
S1 S2 SE MPE SPE Other
amplitude [phd/ns]
1.5e-1
1.0e-1
5.0e-2
0.0e+0
-766.2
-766.1
-766
-765.9
-765.8
time [µs]



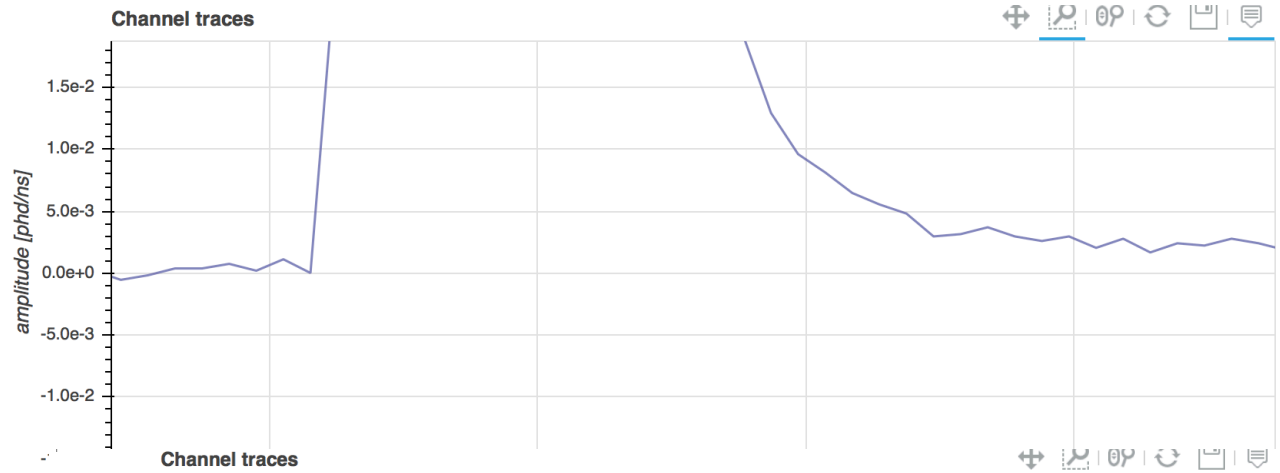



pmt: 385
phd: 21.118

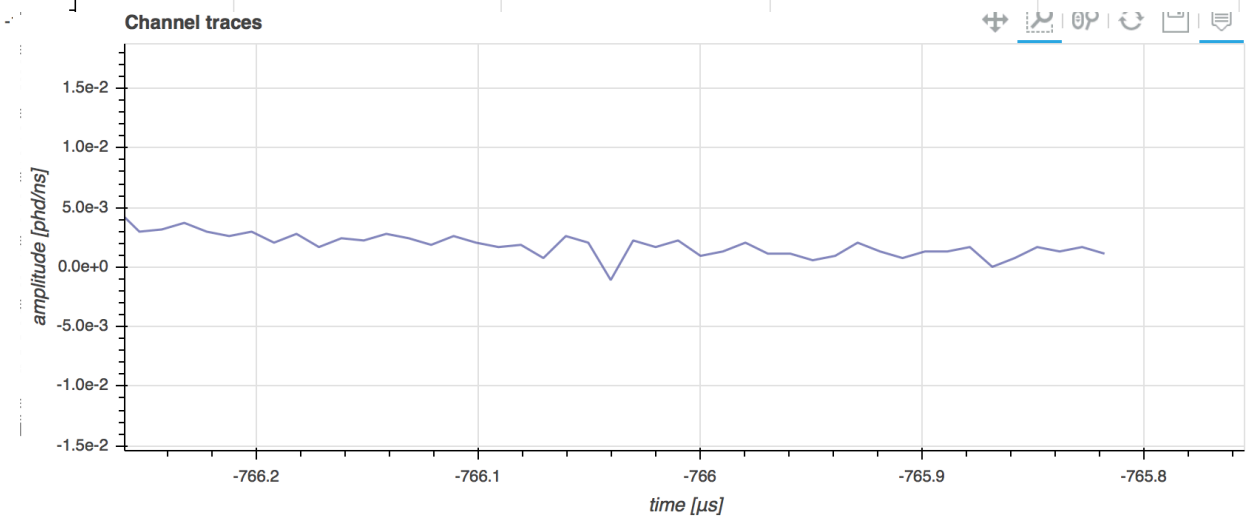
6


Channel traces
amplitude [phd/ns]
1.5e-2
1.0e-2
5.0e-3
0.0e+0
-5.0e-3
-1.0e-2
-1.5e-2
-766.54
-766.53
-766.52
-766.51
-766.5
-766.49

7


Channel traces
amplitude [phd/ns]
1.5e-2
1.0e-2
5.0e-3
0.0e+0
-5.0e-3
-1.0e-2

8

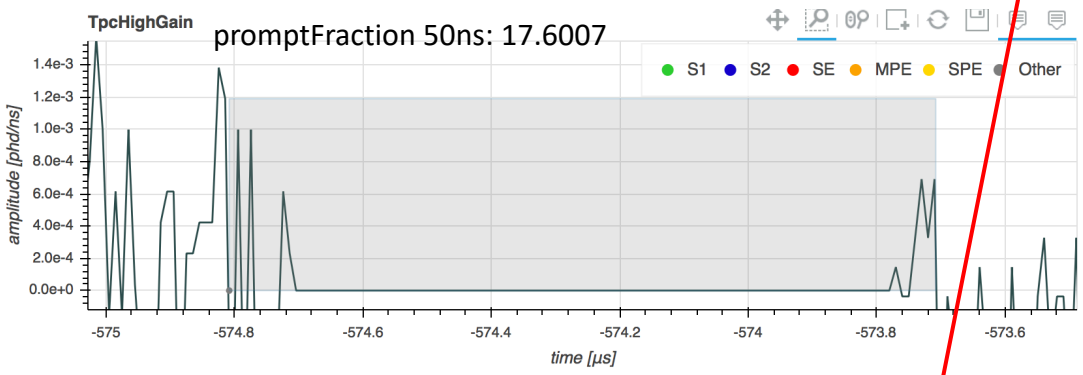

Channel traces
amplitude [phd/ns]
1.5e-2
1.0e-2
5.0e-3
0.0e+0
-5.0e-3
-1.0e-2
-1.5e-2
-766.2
-766.1
-766
-765.9
-765.8
time [μs]

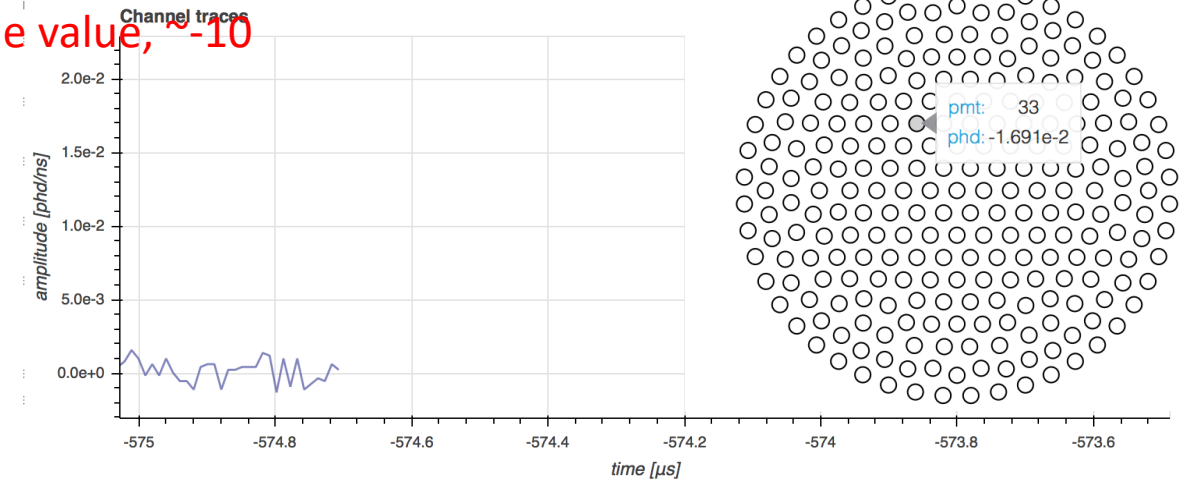
Extremely extreme TBA value

- TBA = 2130 (in LZAP 5.0.1)

Same pFraction50ns, but TBA changed to a reasonable value, ~ -10

Process with Lzap 5.0.1

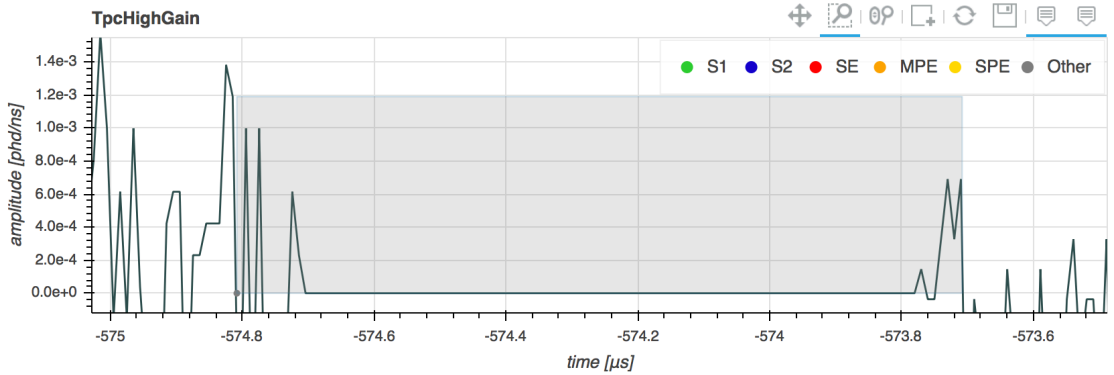


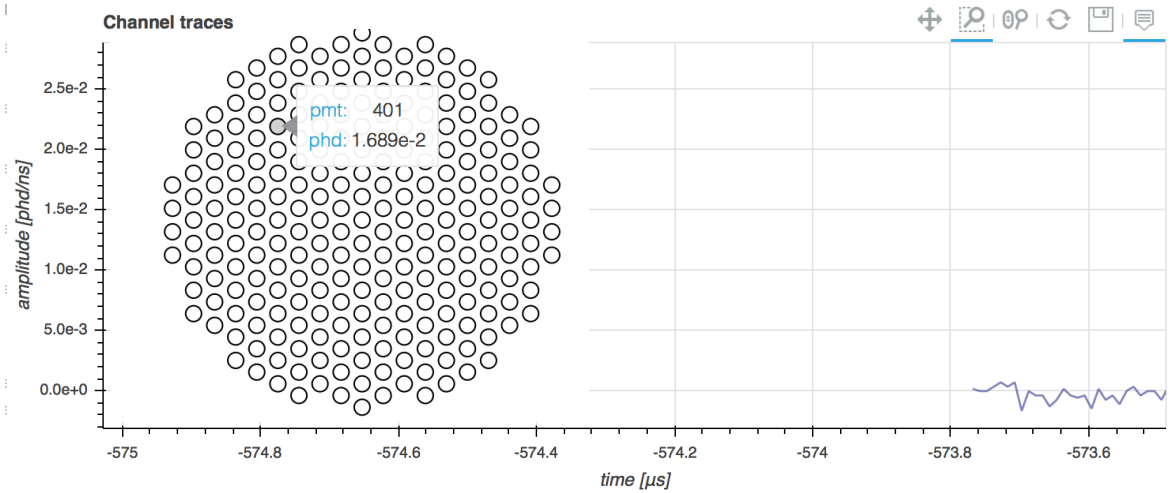


Process with Lzap 5.0.5

promptFraction 50ns: 17.6007

TBA: -10.8432





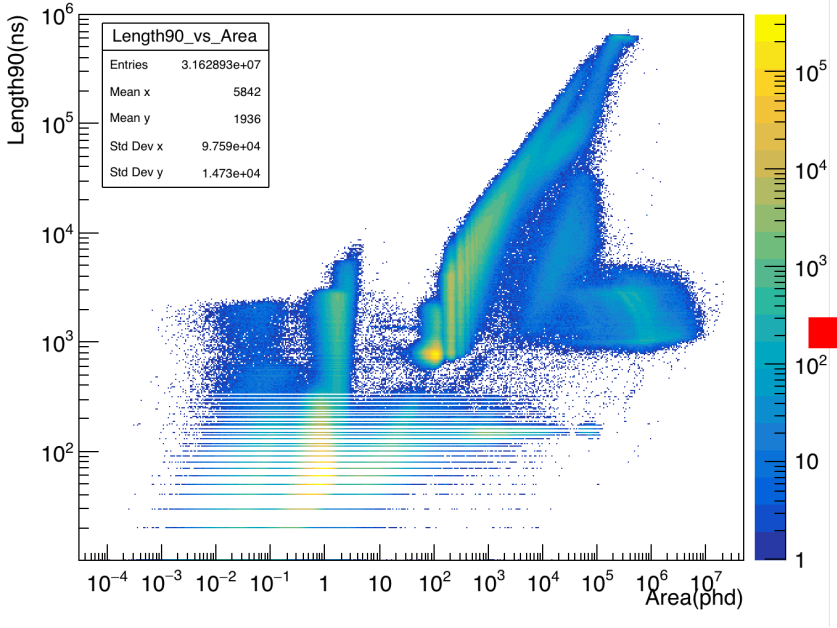
LZAP 5.0.5

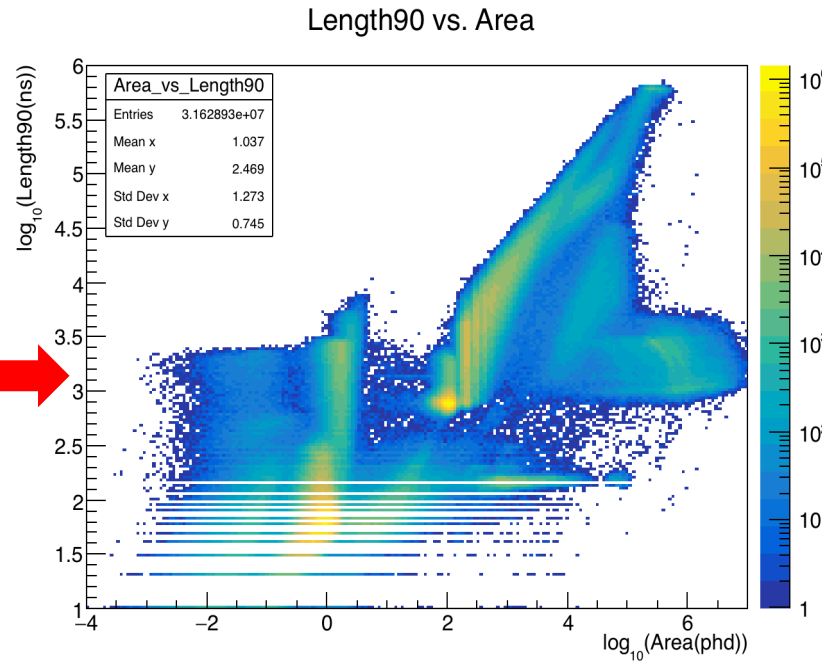
- Checked for the two with weird x, y positions:
  - 6: TBA: 63.75 → -0.2737
  - 17: TBA: -78 → 0.1623
  - Still same problems with PMTs and pFraction50ns
- The newest: Lzap 5.2.x

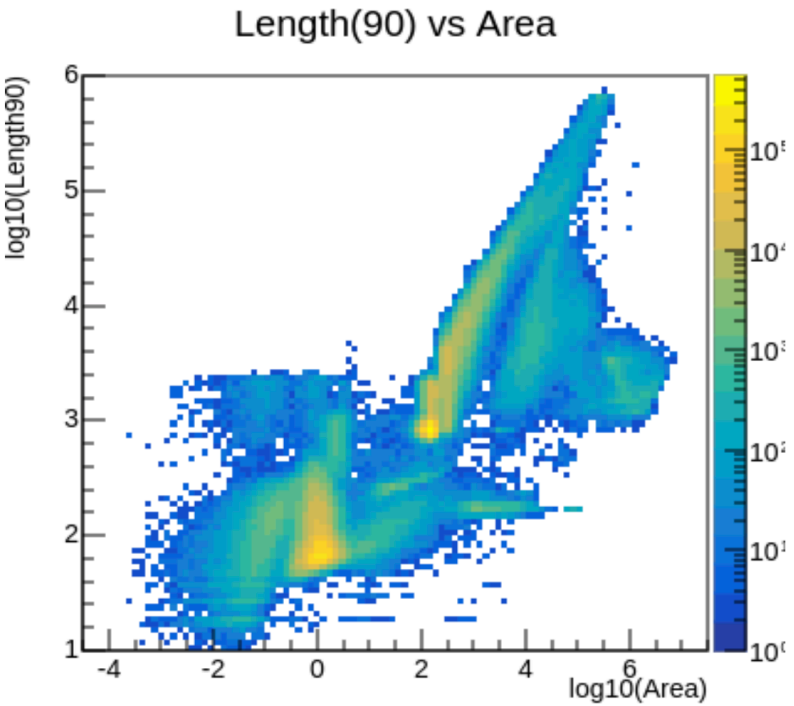
3rd March 2021

- Pulse Classification's Parameter Space:
  - Changed the scale for the PREM plot
  - Play with pFraction100
    - Sent Chico message on Slack
- Next module: Noise

Length90 vs Area





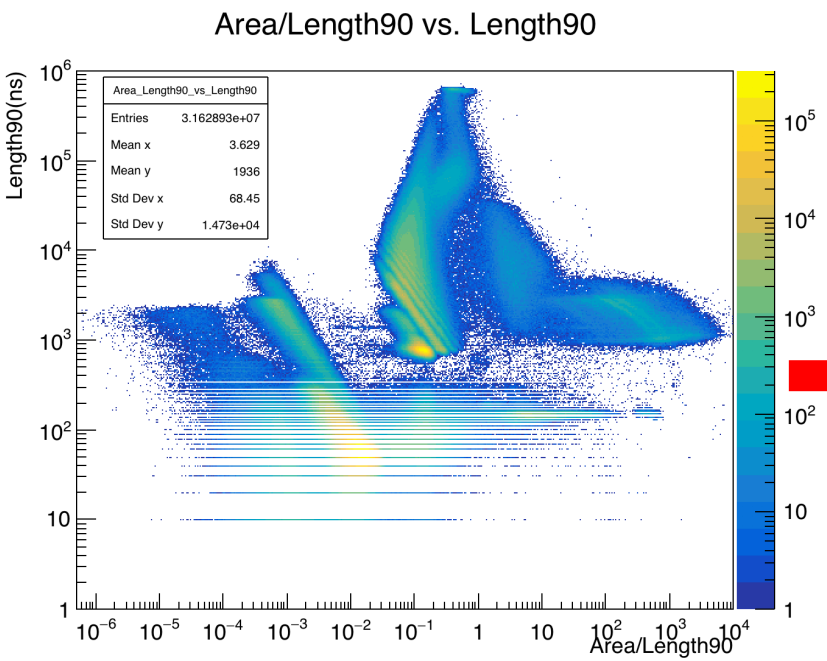


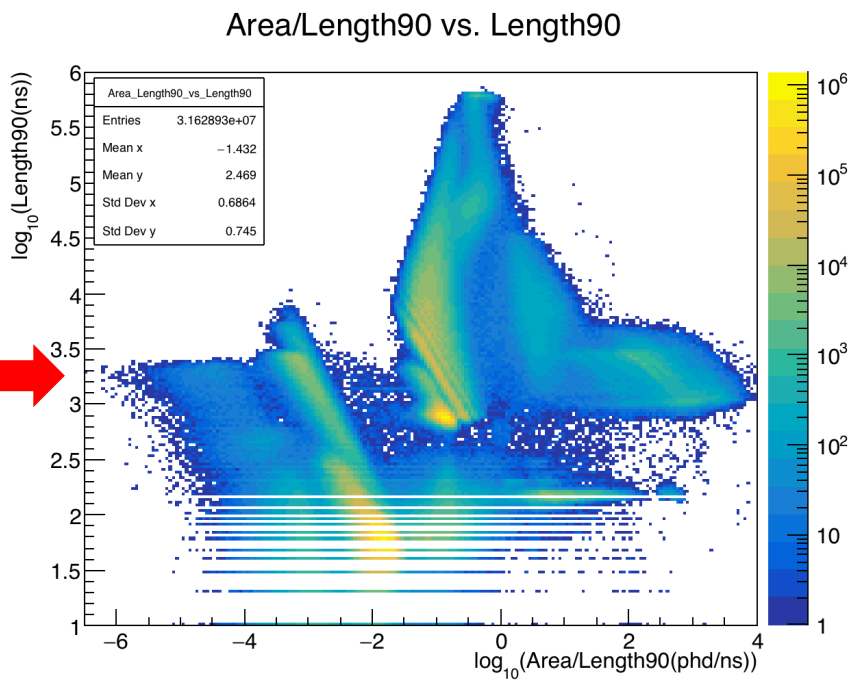
PREM

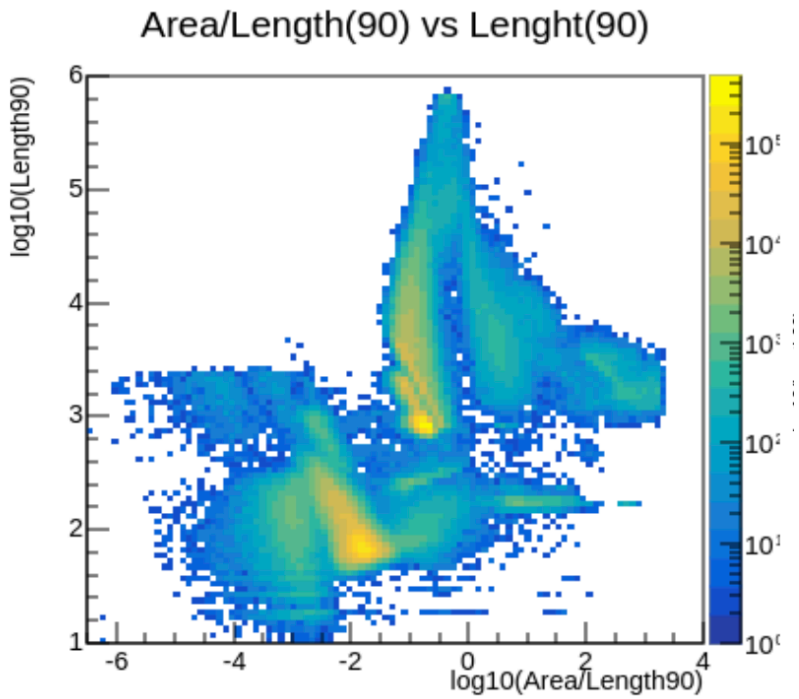
1. Change the log scale axis
2. Reduce the bin number
3. Will change the interval from 0.1 to 0.2 further reduce the stripe?

UPM

Area/Length90 vs Length90



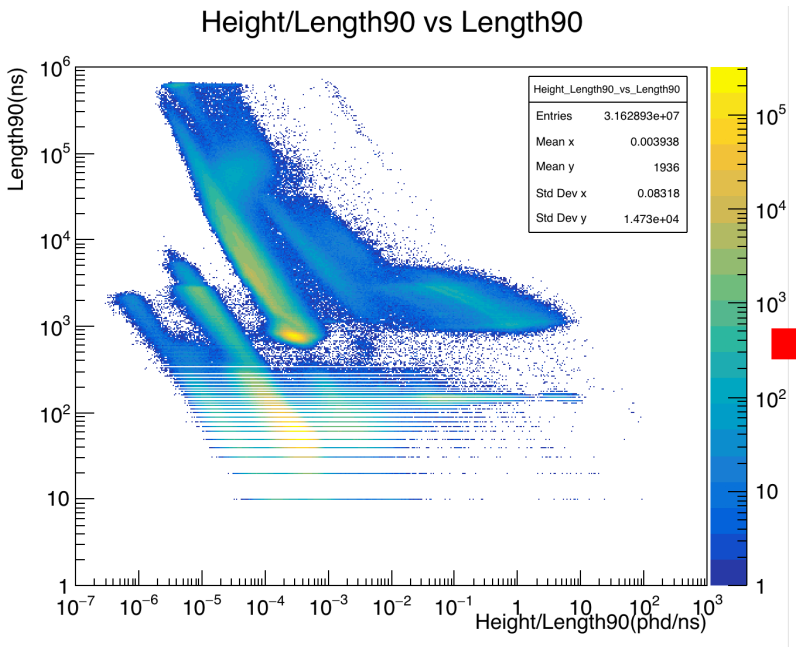


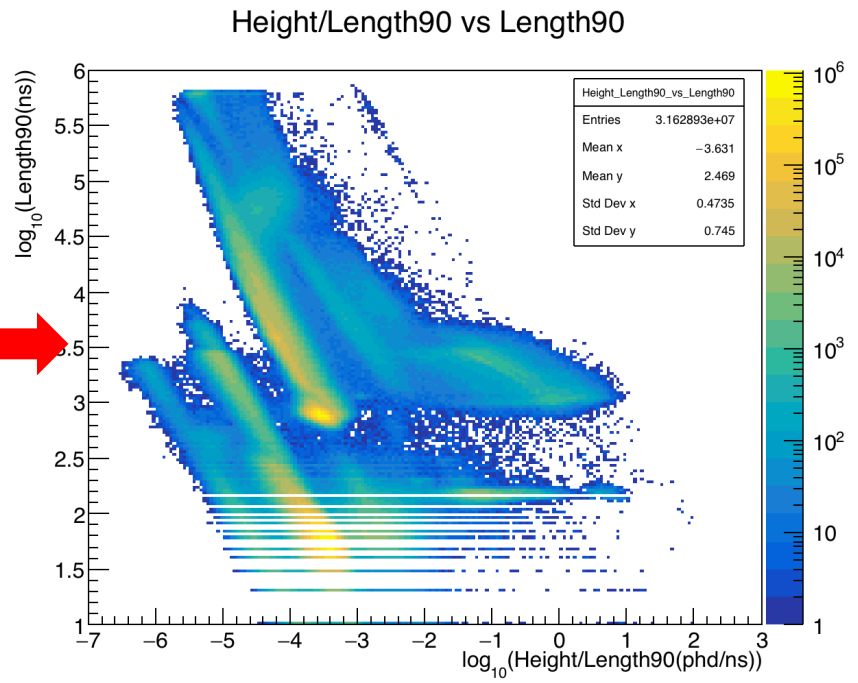


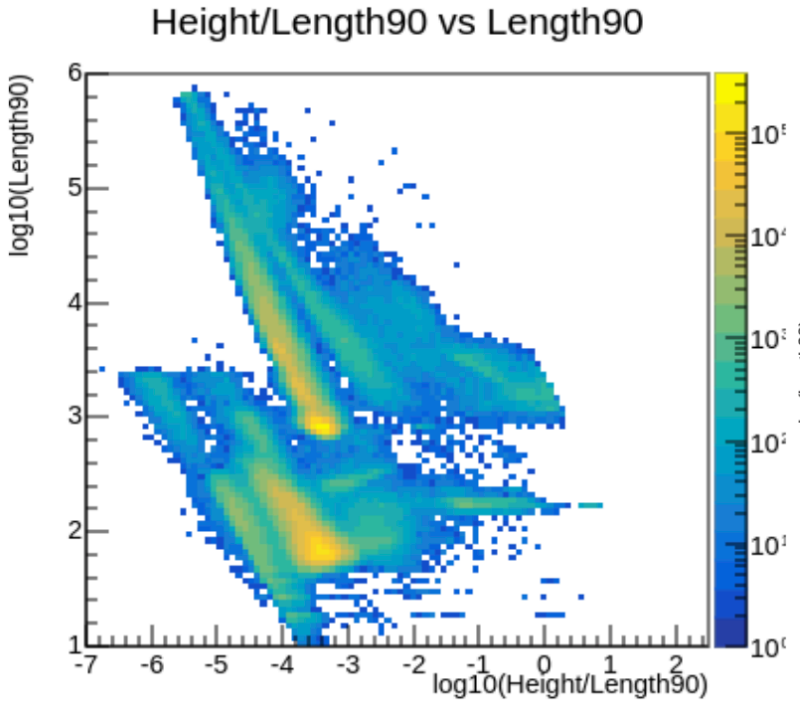
PREM

UPM

Area/Length90 vs Length90



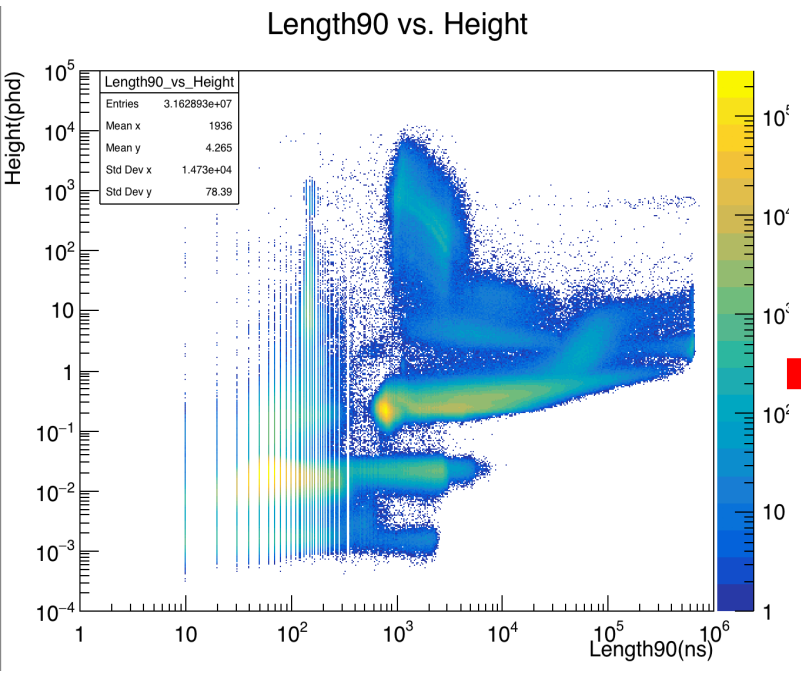


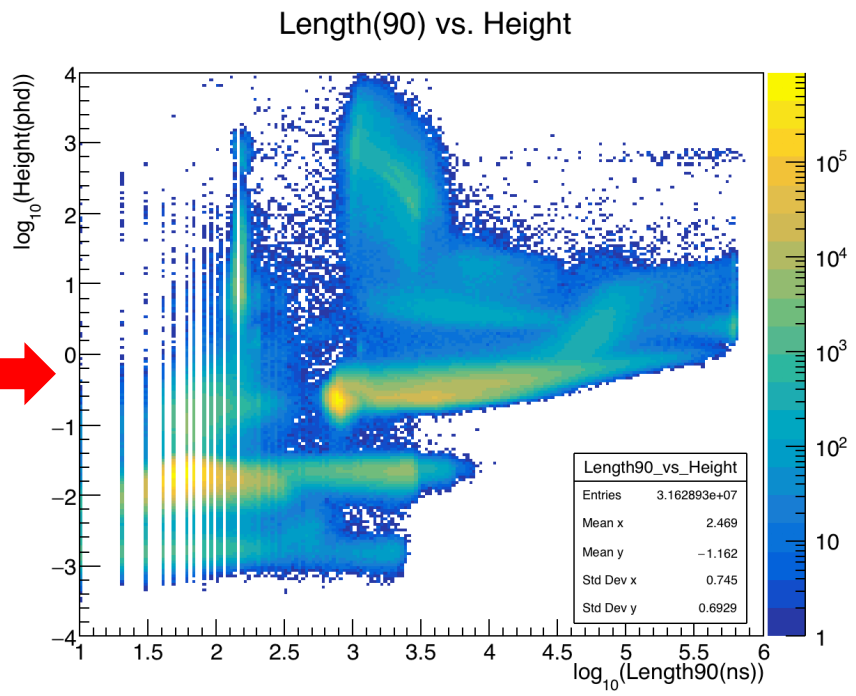


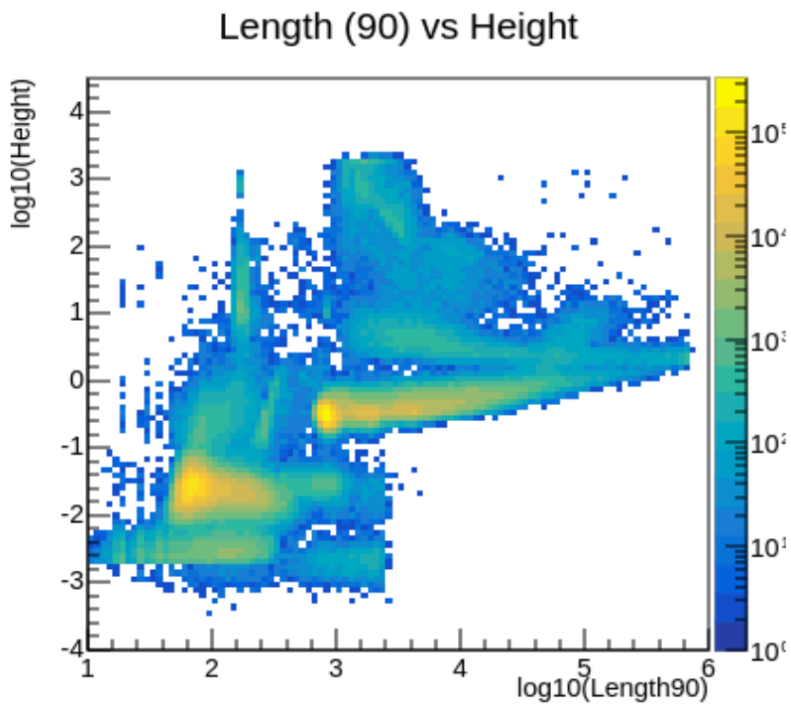
PREM

UPM

Length 90 vs Height



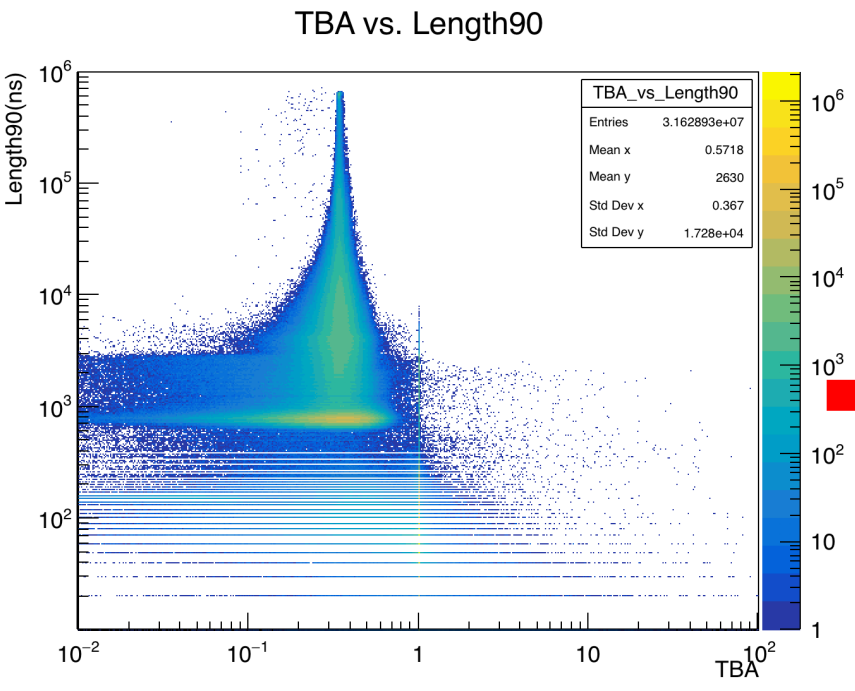


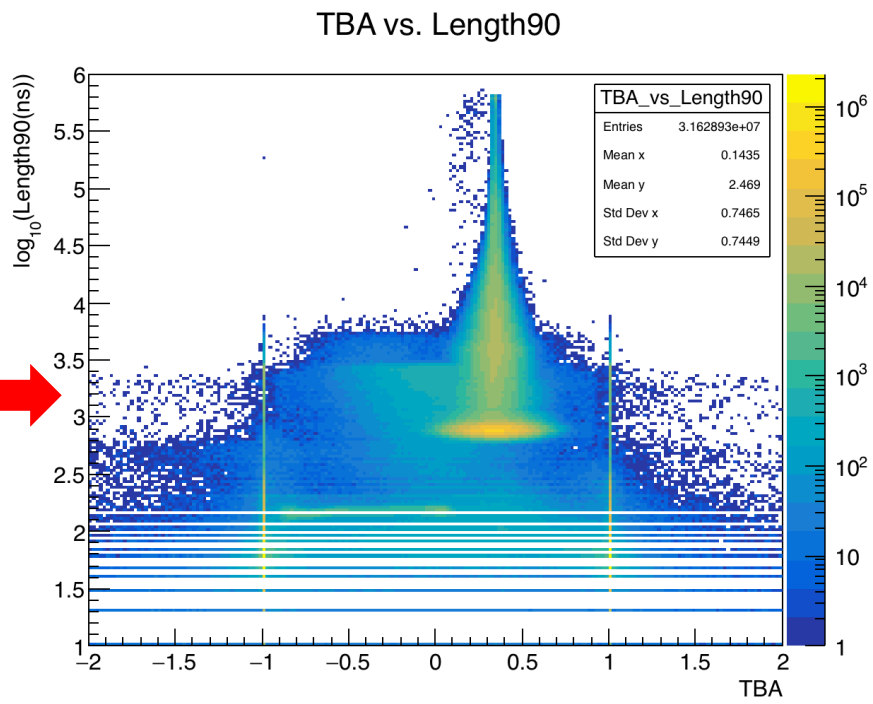


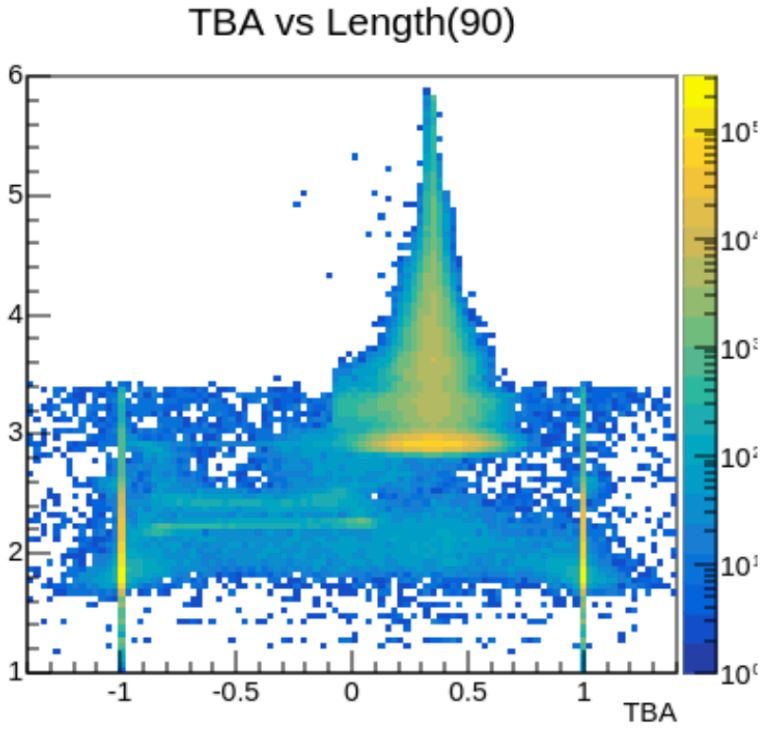
PREM

UPM

TBA vs Length90



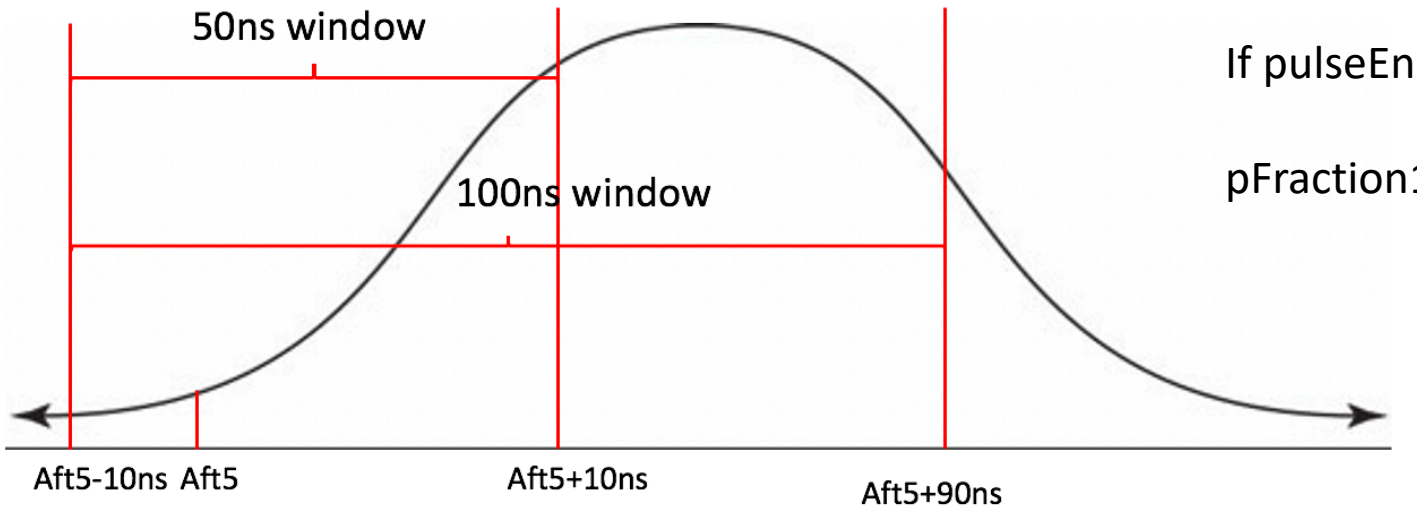




PREM

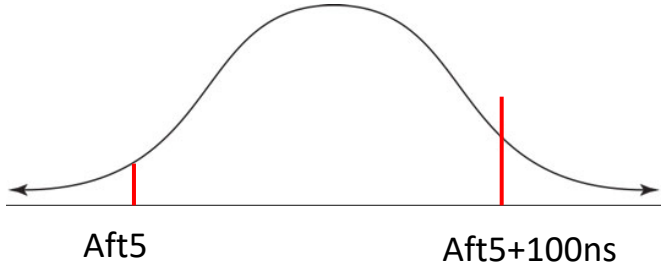
UPM

Guess on the pFraction100

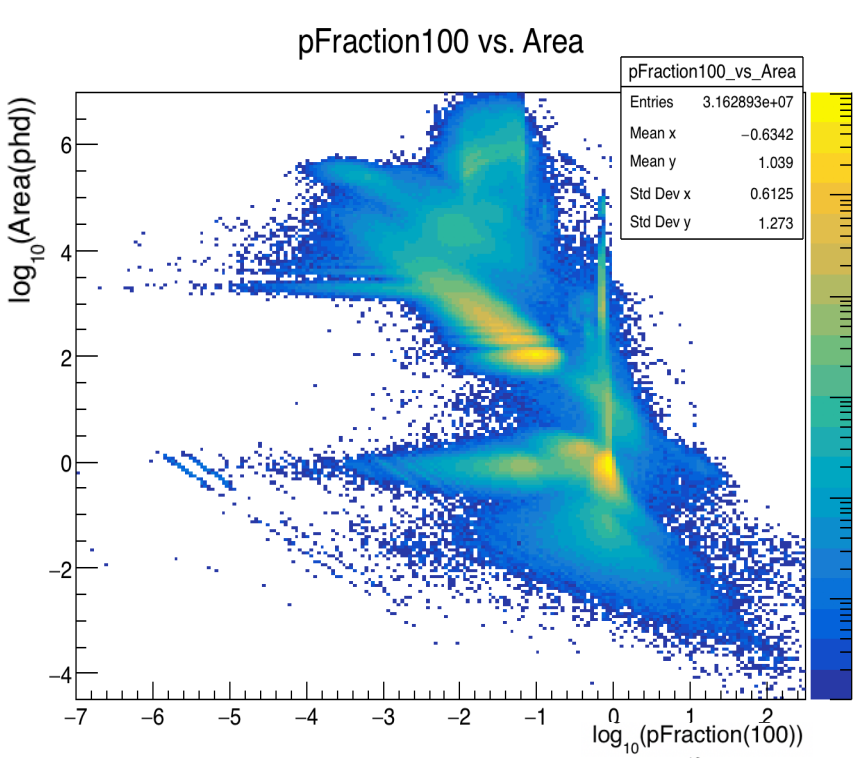


If pulseEndTime_ns = aft5 – 10ns:
get area_initial
If pulseEndTime_ns = aft5+90ns:
get area_final
pFraction100 = (area_final-area_initial)/total_area

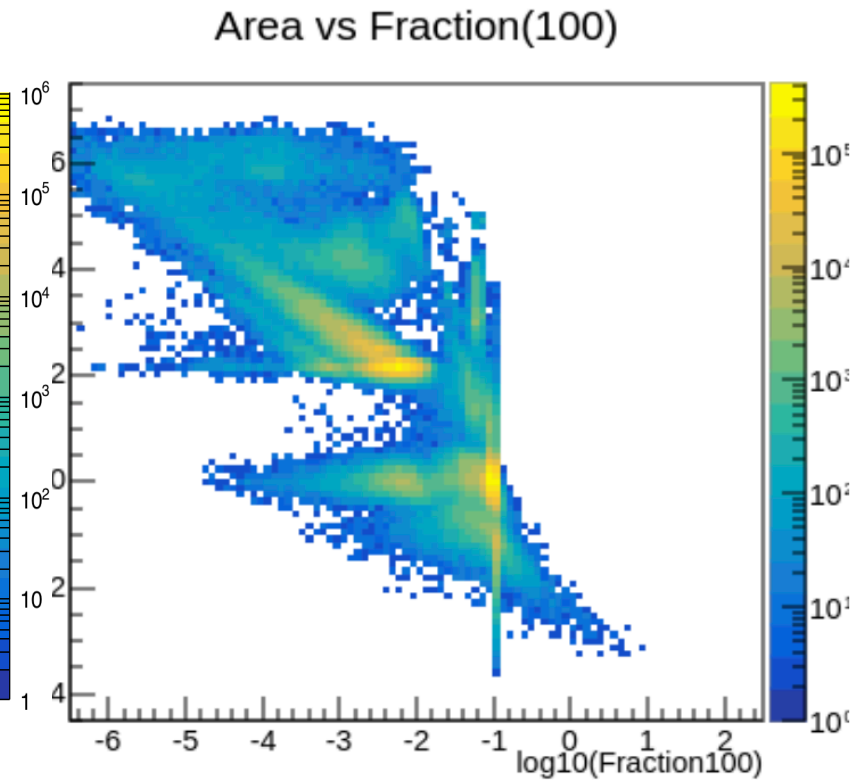
- pFraction100:
  - 1. `pulseArea100ns_phd` / `pulseArea_phd`
  - 2. `promptFraction50`



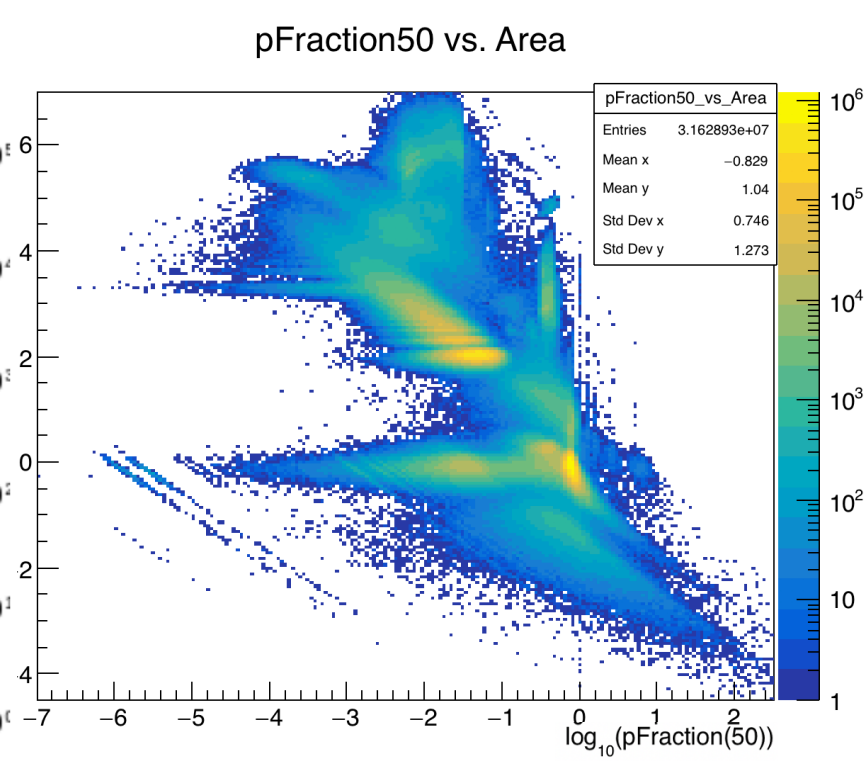
Area vs Fraction100



PREM



UPM



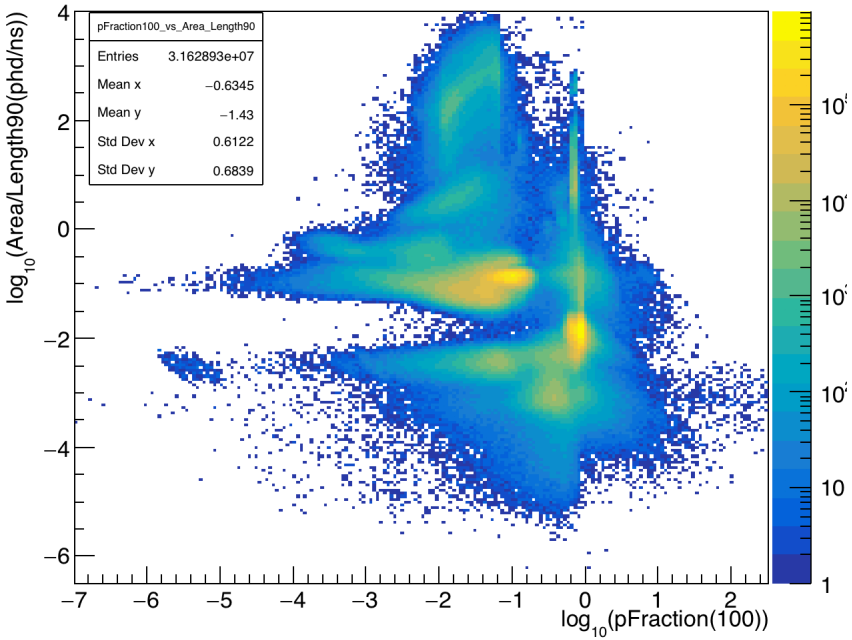
PREM

`pulseArea100ns_phd` / `pulseArea_phd`

`promptFraction50`

pFraction90 vs Area/Length90

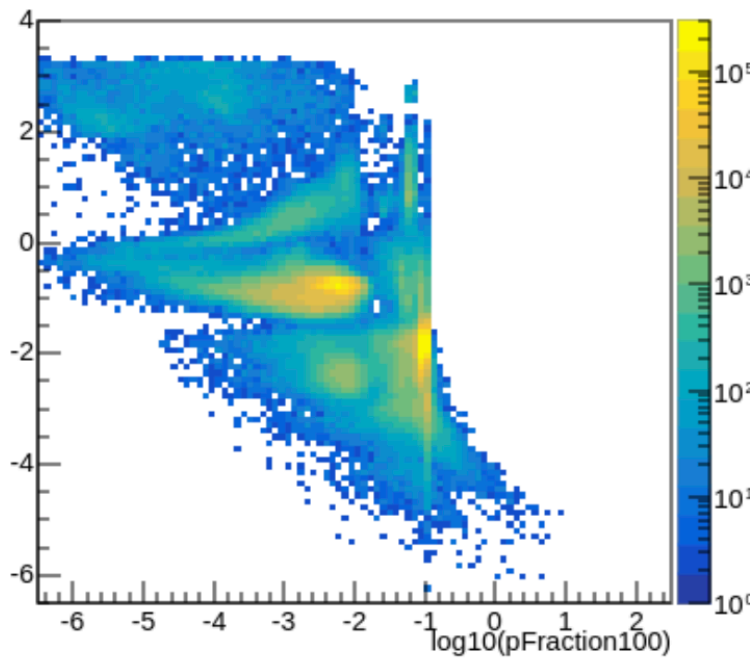
pFraction100 vs Area/Length90



PREM

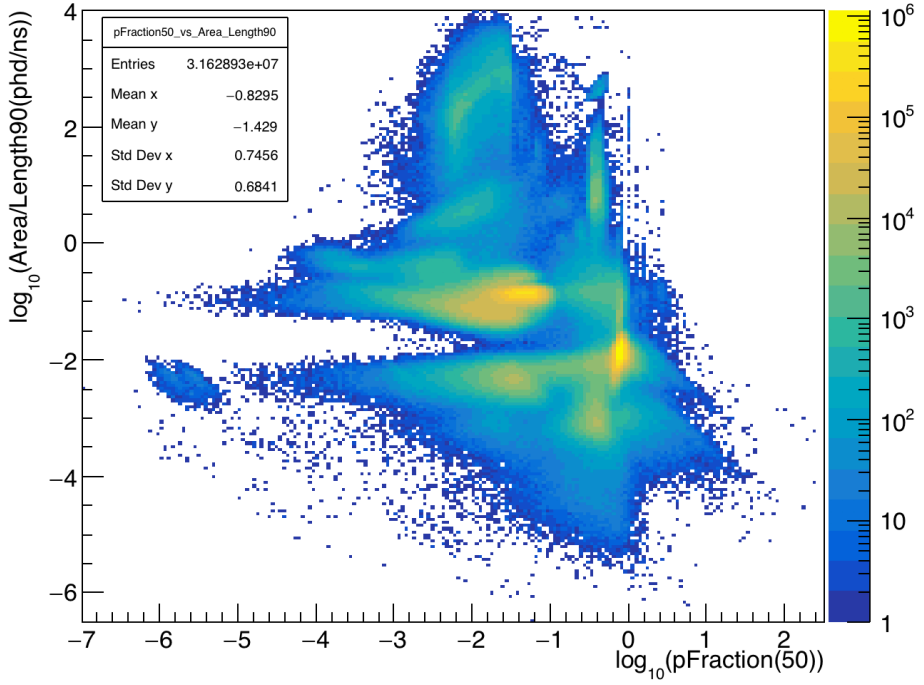
`pulseArea100ns_phd` / `pulseArea_phd`

pFraction(90) vs Area/Lenght(90)



UPM

pFraction50 vs. Area/Length90



PREM

`promptFraction50`

To do

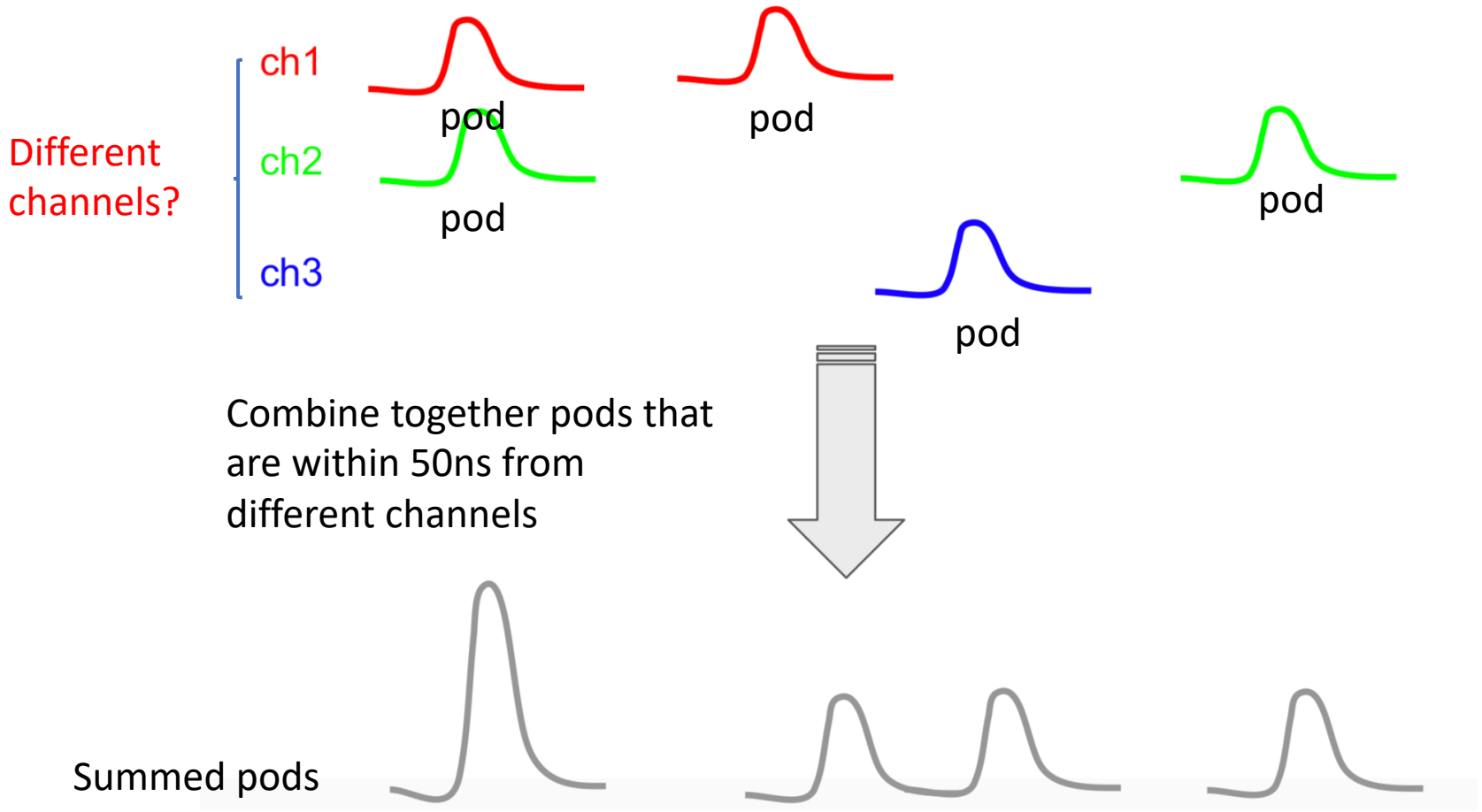
- Noise module, which category of RQ?

25th Feb. 2021

- **P**hysics **RE**adiness **M**onitor (**PREM**):
  - Uses the reduced quantities (RQs) to automatically generate plots from the data
  - Has shifters looking through the plots to look for the problem in the detector
  - **Input data:** fully processed data after LZAP ~after 8 hours
  - **My goal:**
    - Working on PREM_TPC module-> produce PREM plots and add them to PREM website:
      - **Pulse Classification's Parameter Space** (UPM module on Twiki); **input:** ~8h MDC3 data; all events pulse
        - Area vs Length90
        - Area vs pFraction100
        - Length90 vs Height
        - TBA vs Area
        - TBA vs Length90
        - Height/Length90 vs Area
        - Height/Length90 vs Length90
        - Area/Height vs Area
        - Area/Height vs Area/Length90
        - Area/Length90 vs Length90
        - pFraction90 vs Area/Length90
    - Understand the physics process behind t
    - Develop the proper algorithm for the pl

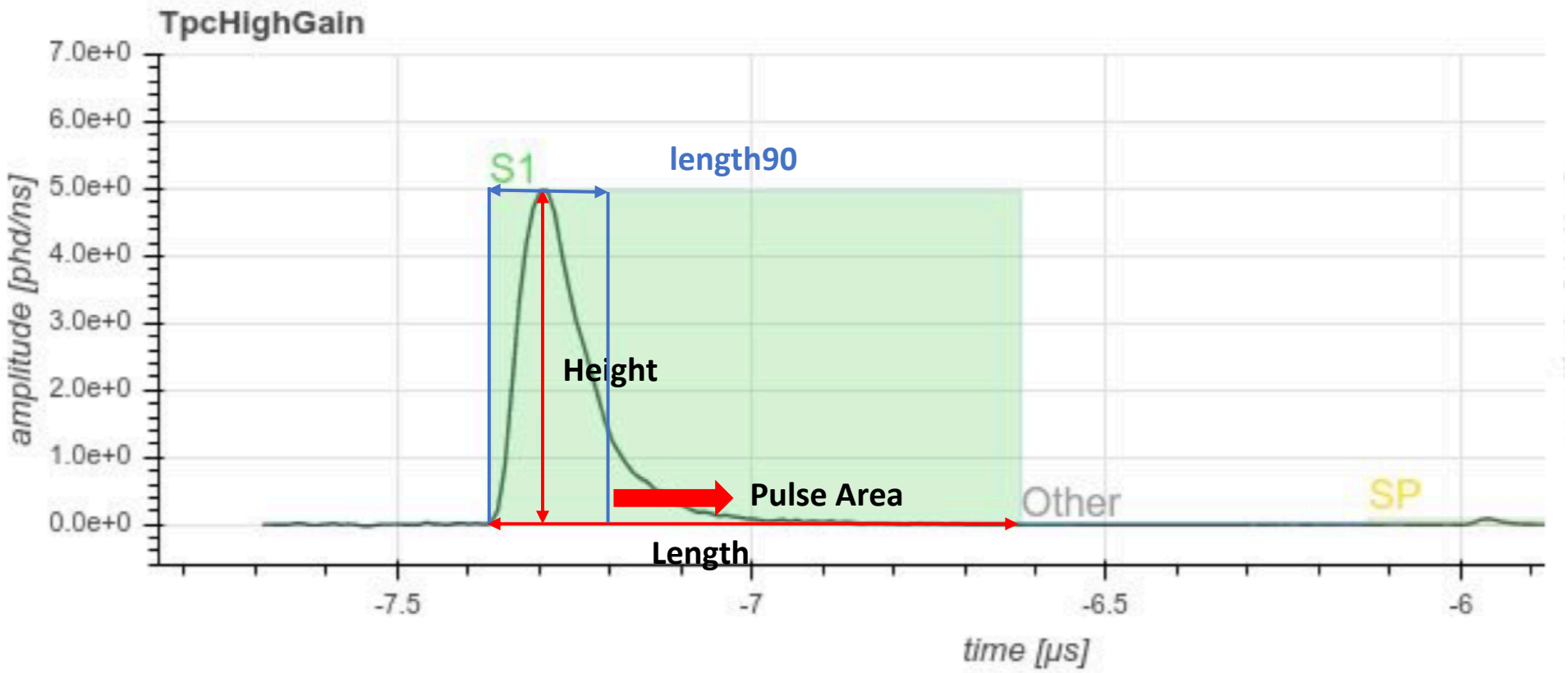
POD

http://teacher.pas.rochester.edu:8080/pub/Lz/MDC1KickOff20170720/20170721_LzCollabMtg_LZapOverview.pdf



http://teacher.pas.rochester.edu:8080/pub/Lz/AnalysisDocDB000035/Pulse_Classifier_HADES_Overview_20200706.pdf

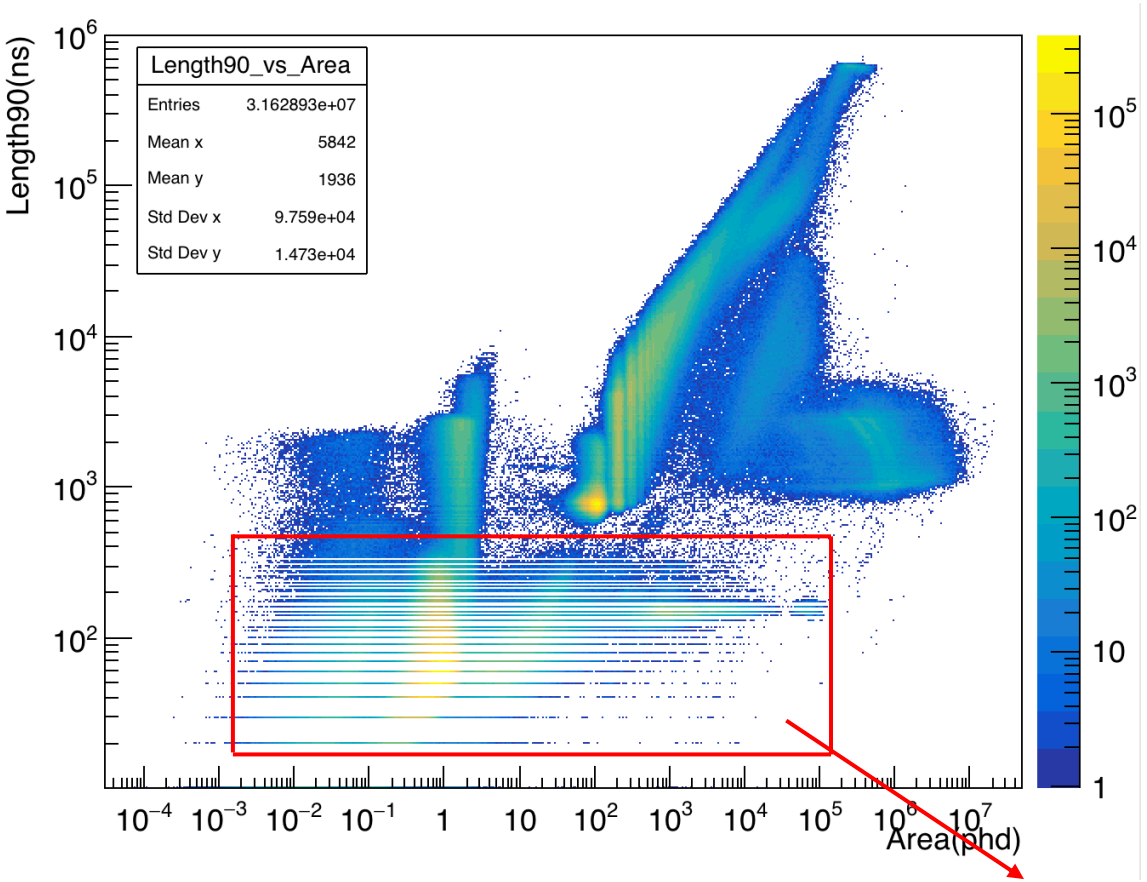
Pulse



Area vs Length90

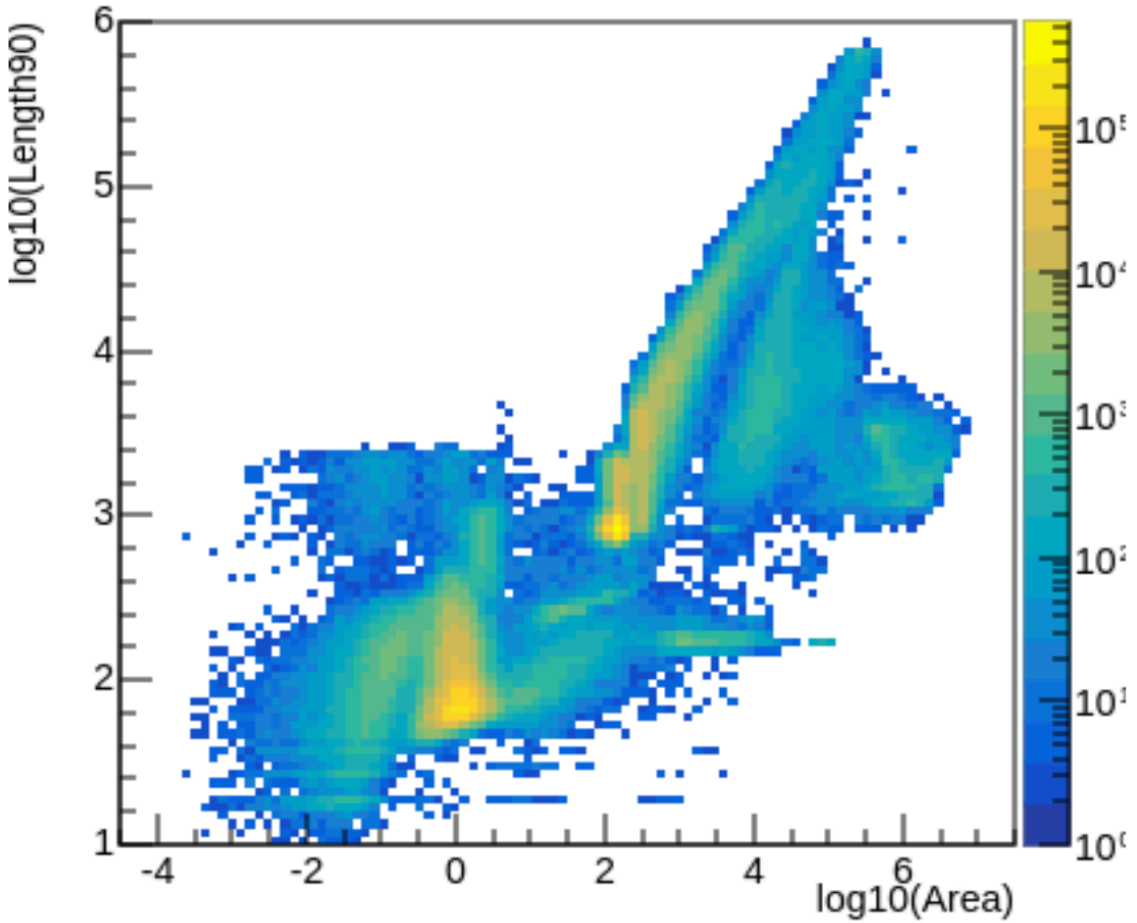
Length90: Time at which summed pod reaches 90% of total area

Area vs Length90



PREM

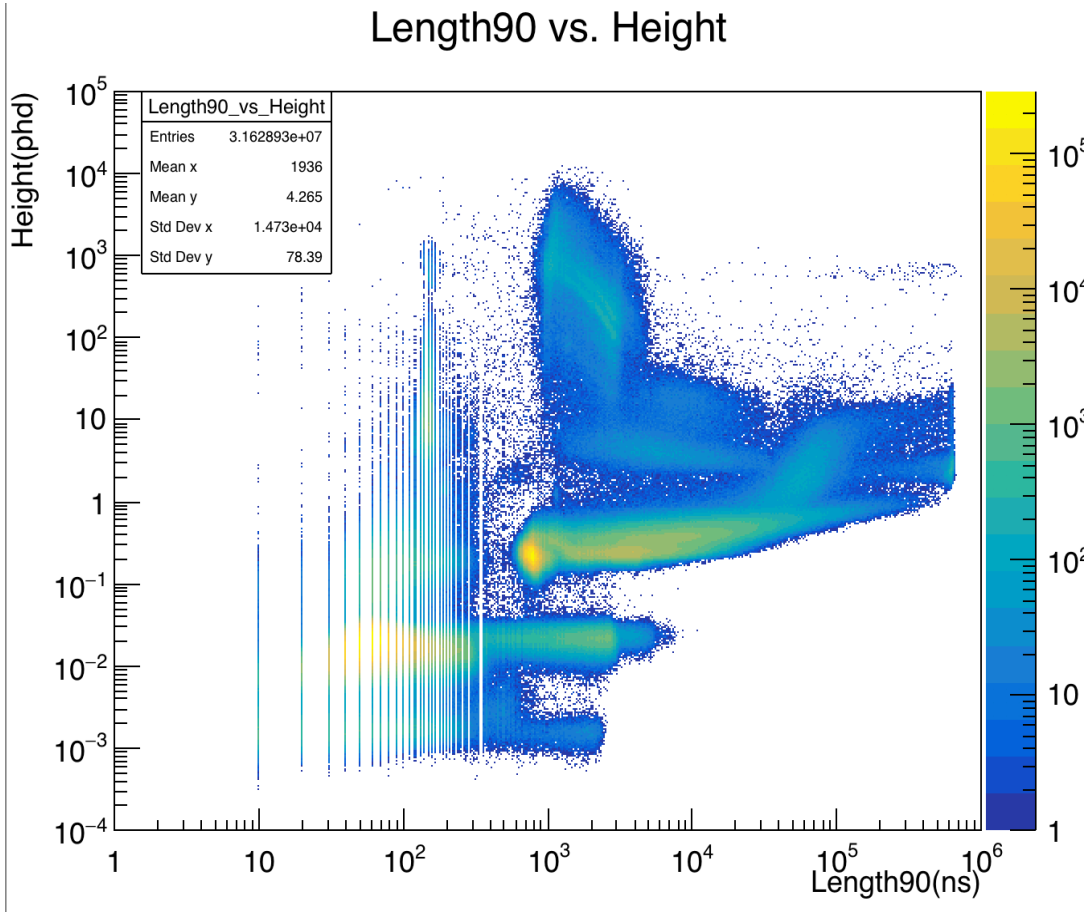
Length(90) vs Area



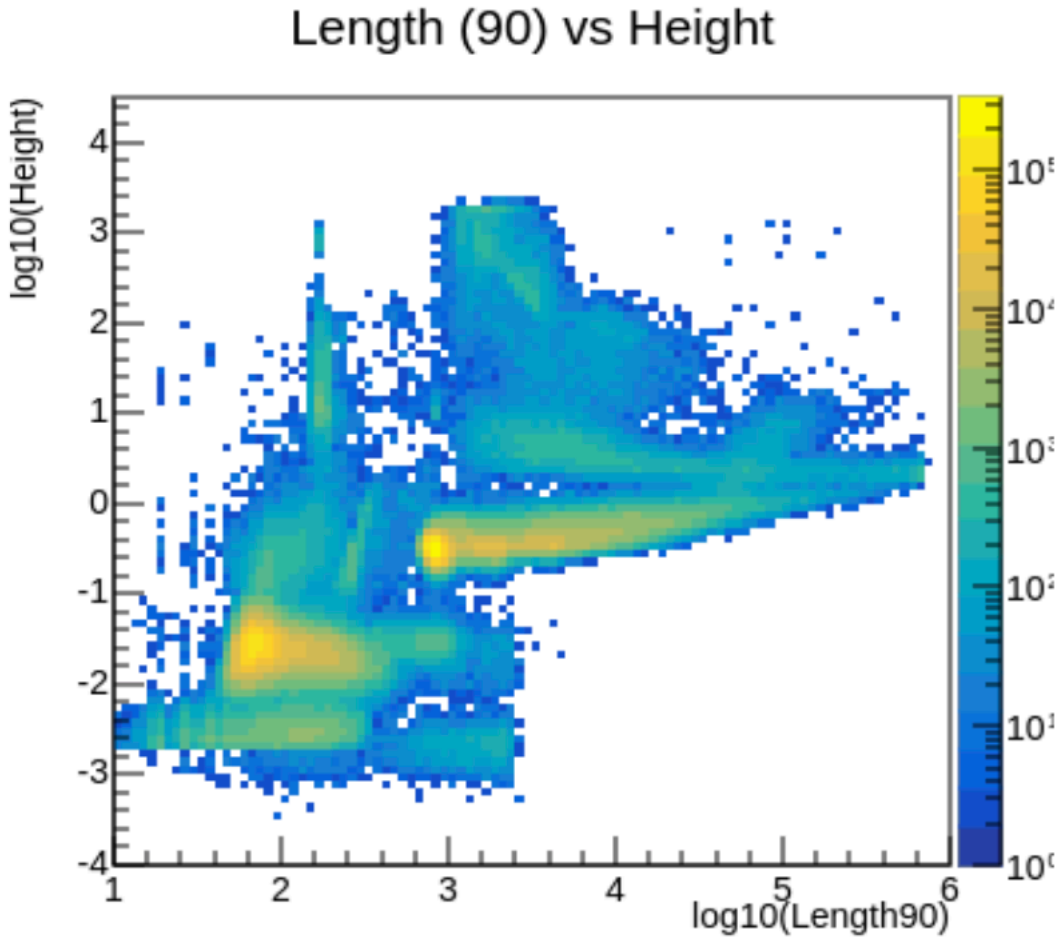
UPM

The smallest data sample interval = 10ns

Length 90 vs Height



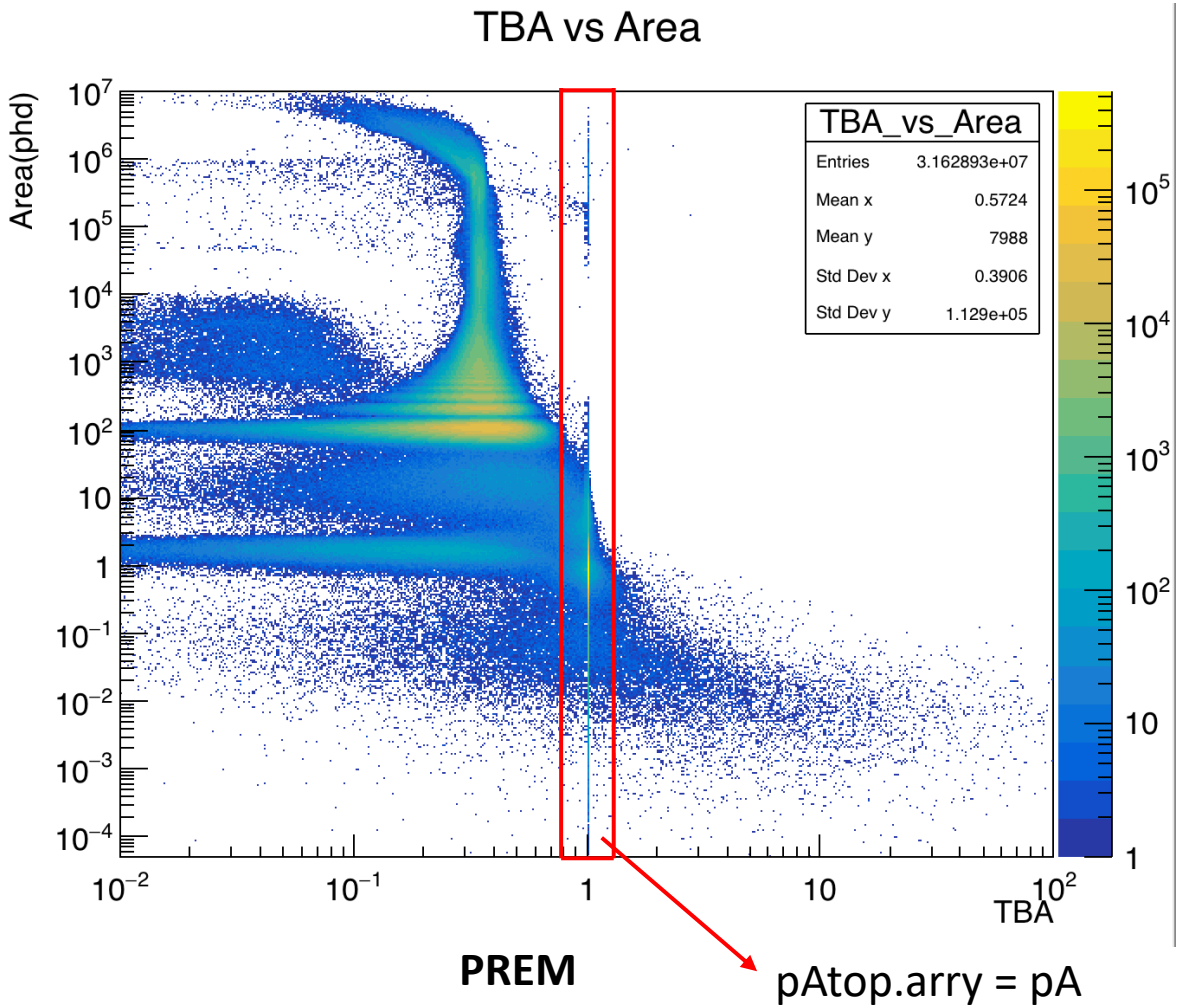
PREM



UPM

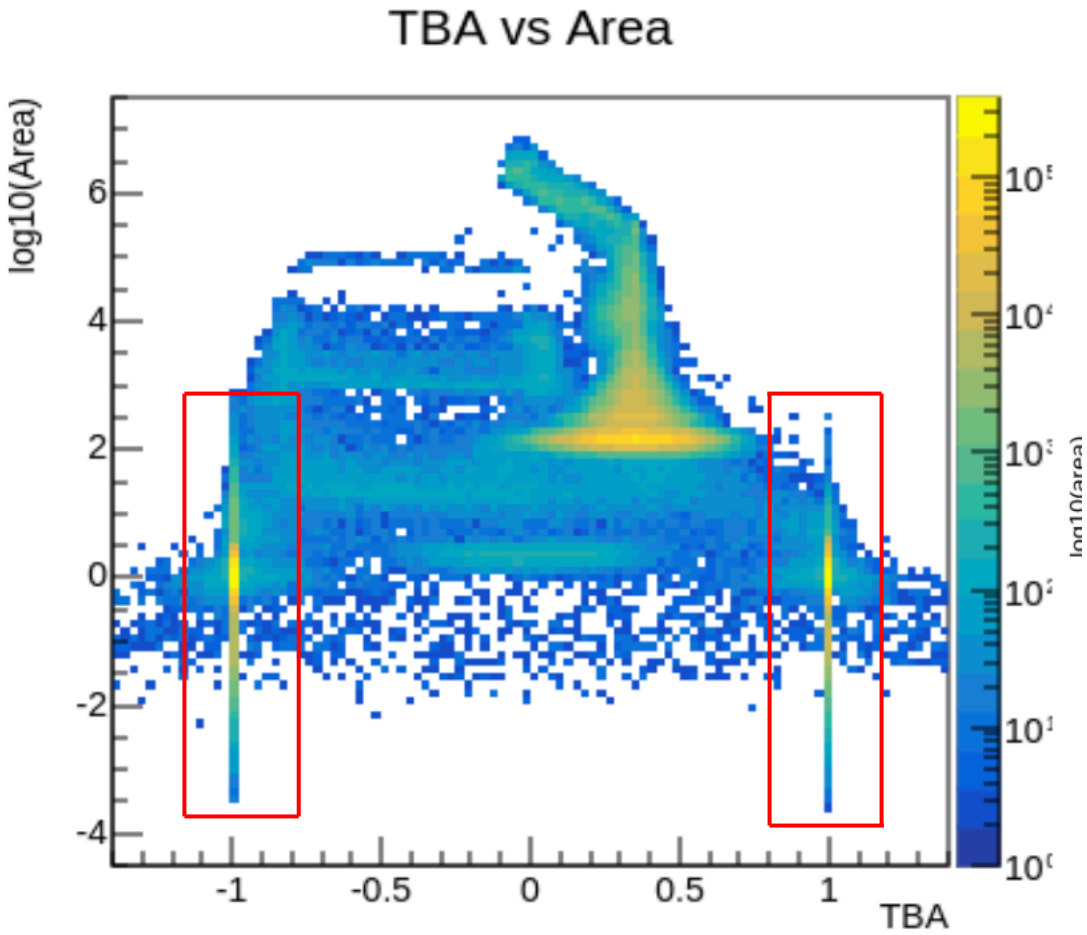
TBA vs Area

Top-bottom asymmetry (TBA) = (pAtop.array-pAbot.array)/pA



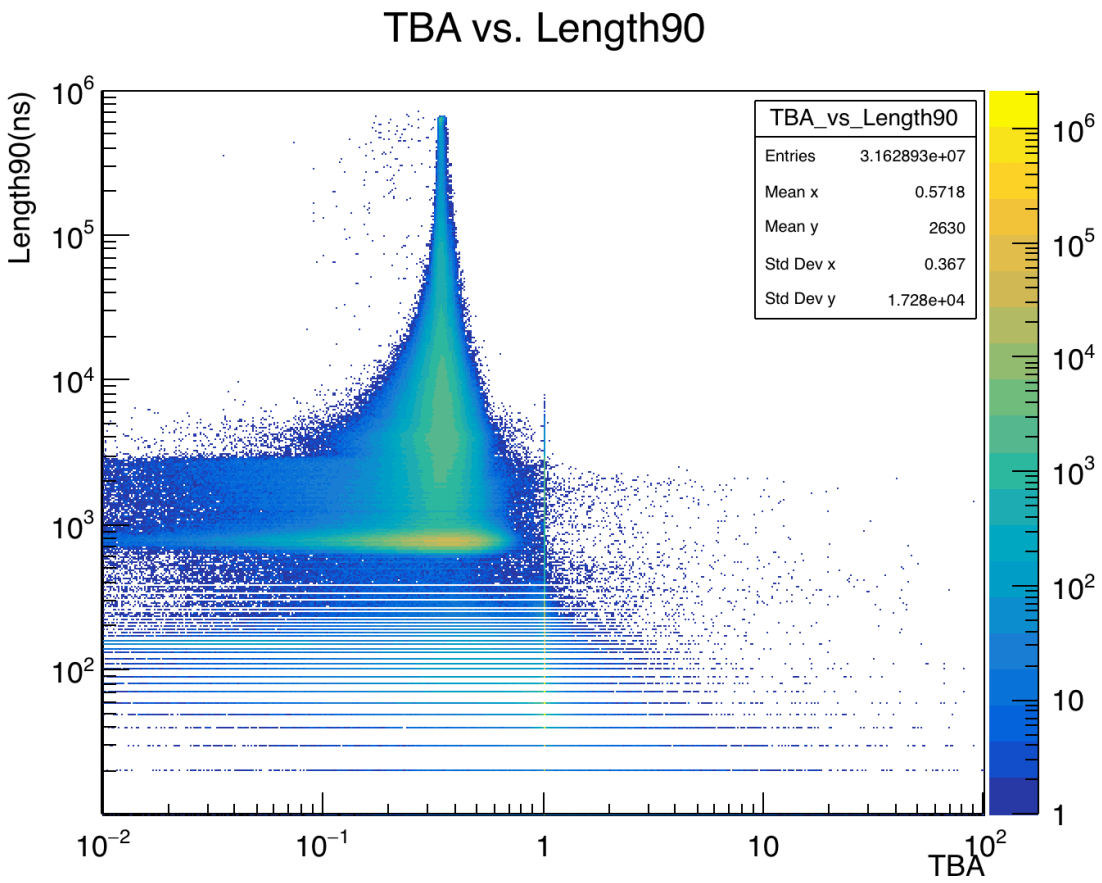
PREM

pAtop.arry = pA

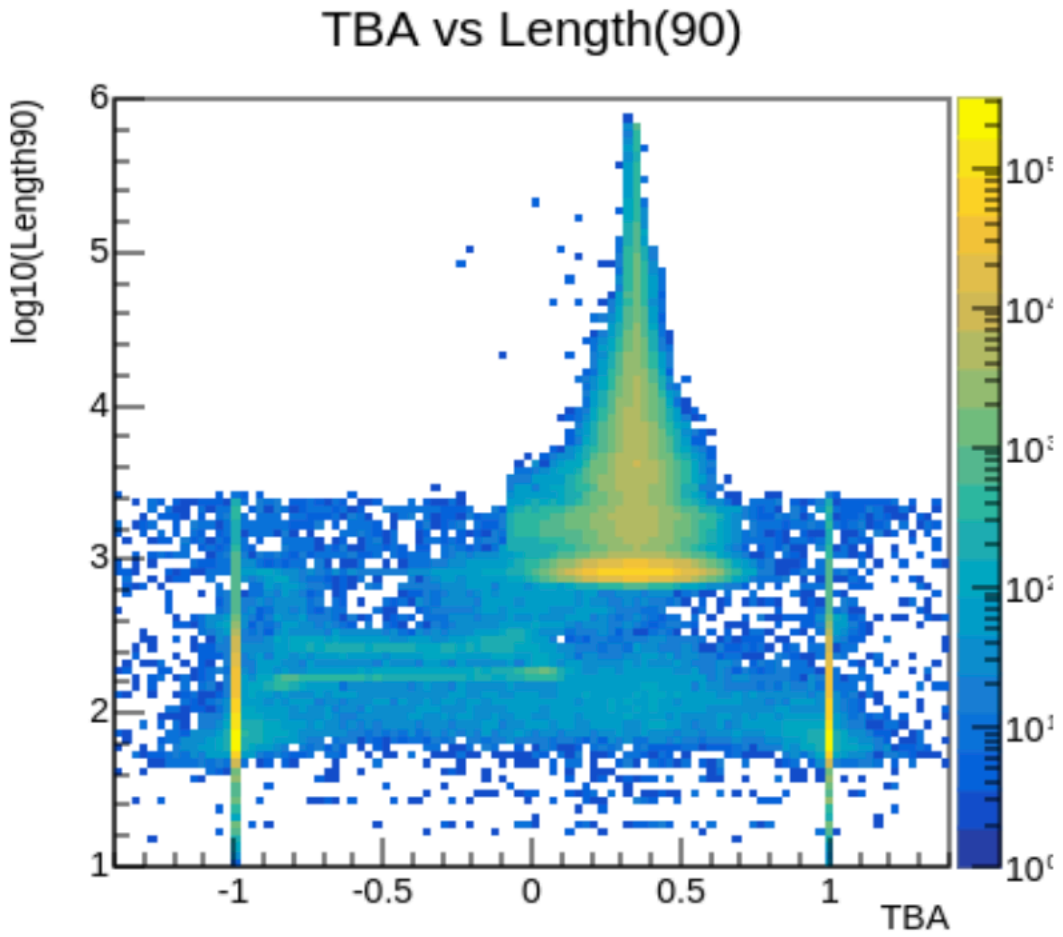


UPM

TBA vs Length90

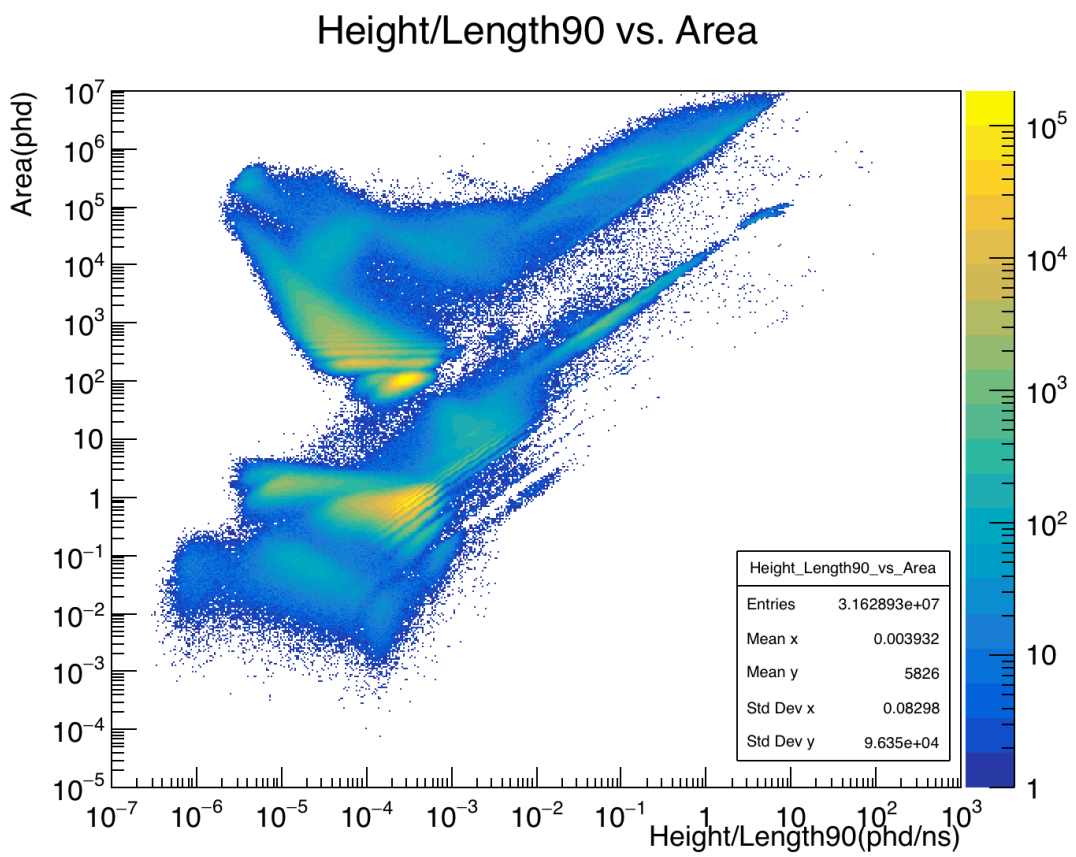


PREM

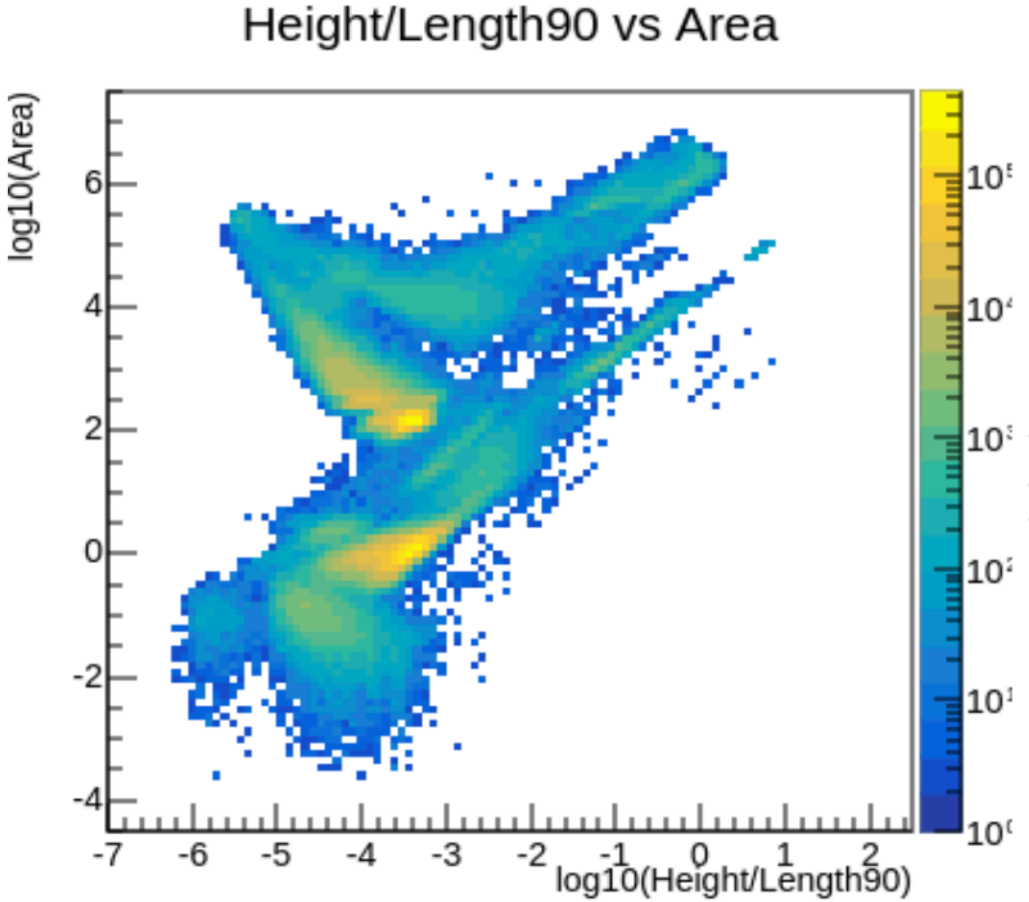


UPM

Height/Length90 vs Area

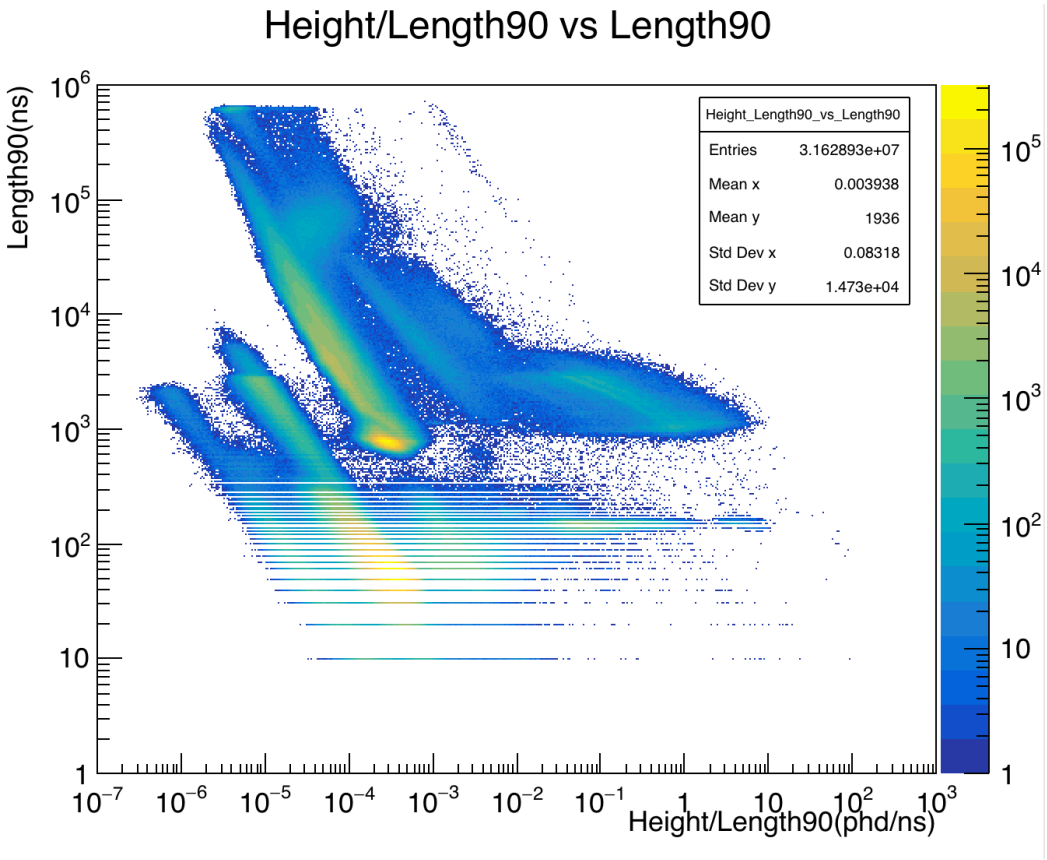


PREM

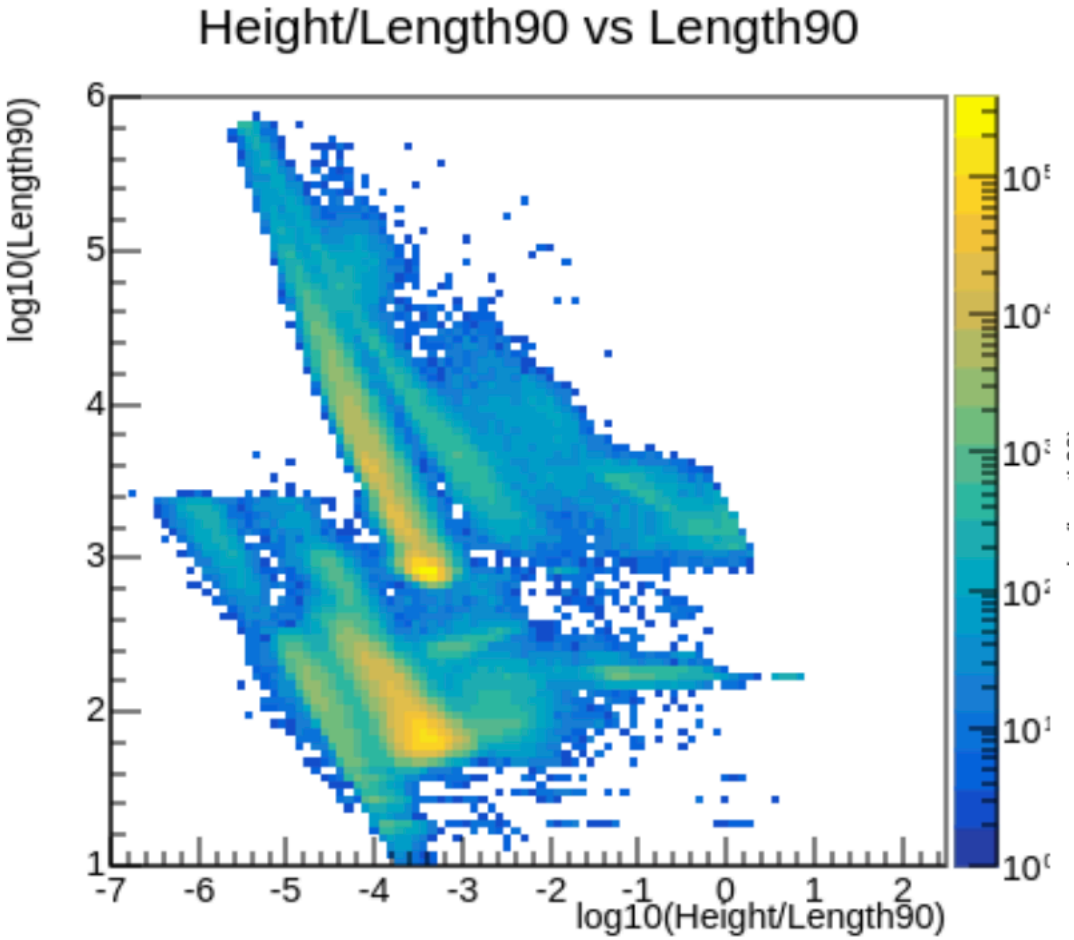


UPM

Height/Length90 vs Length90

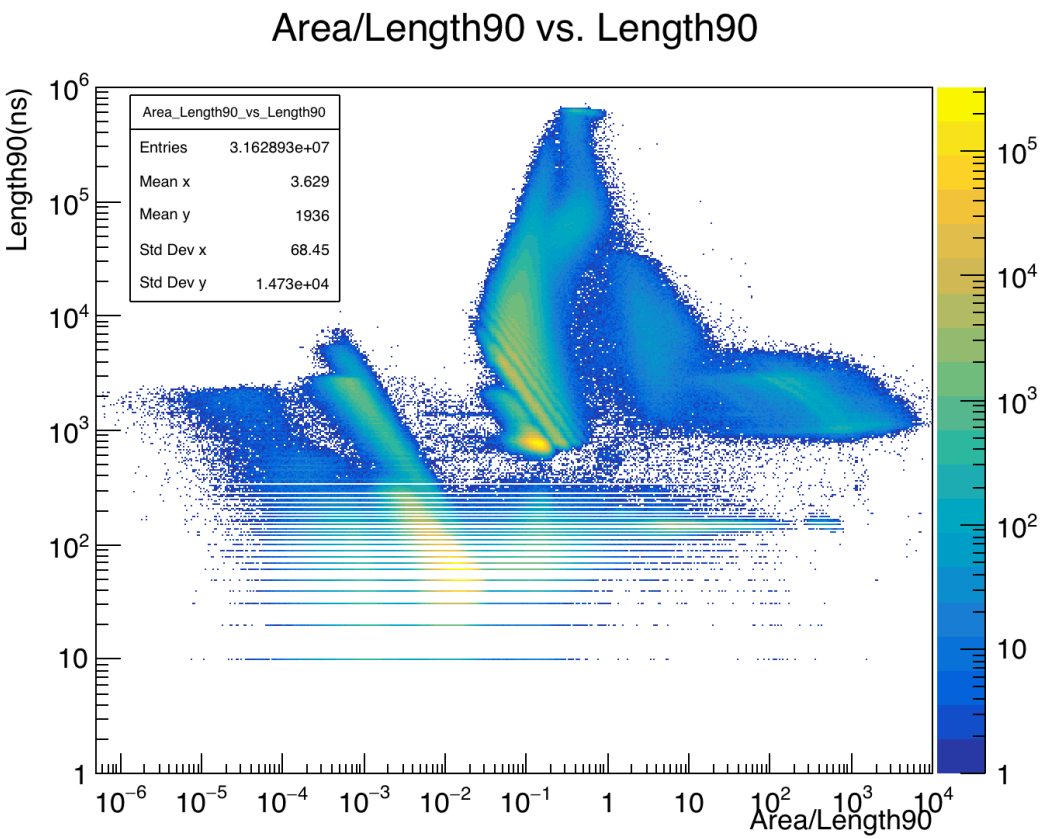


PREM

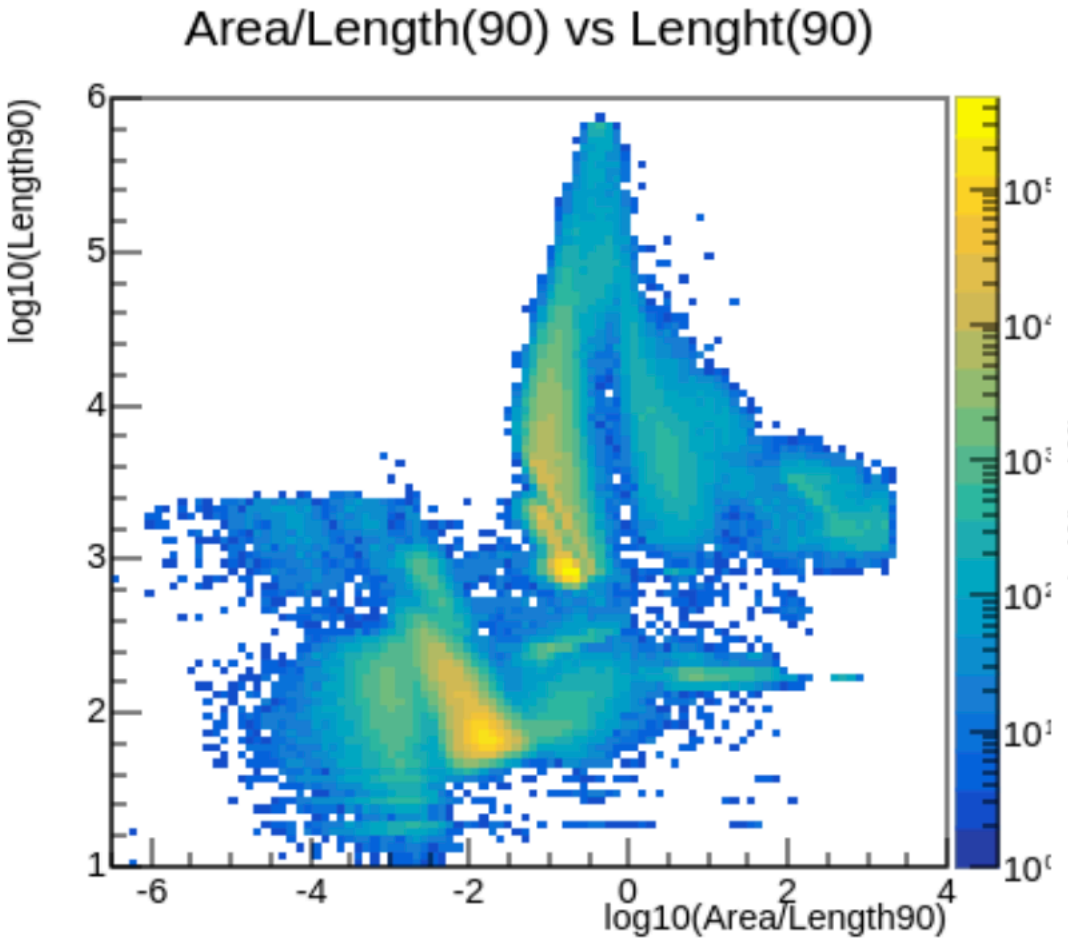


UPM

Area/Length90 vs Length90

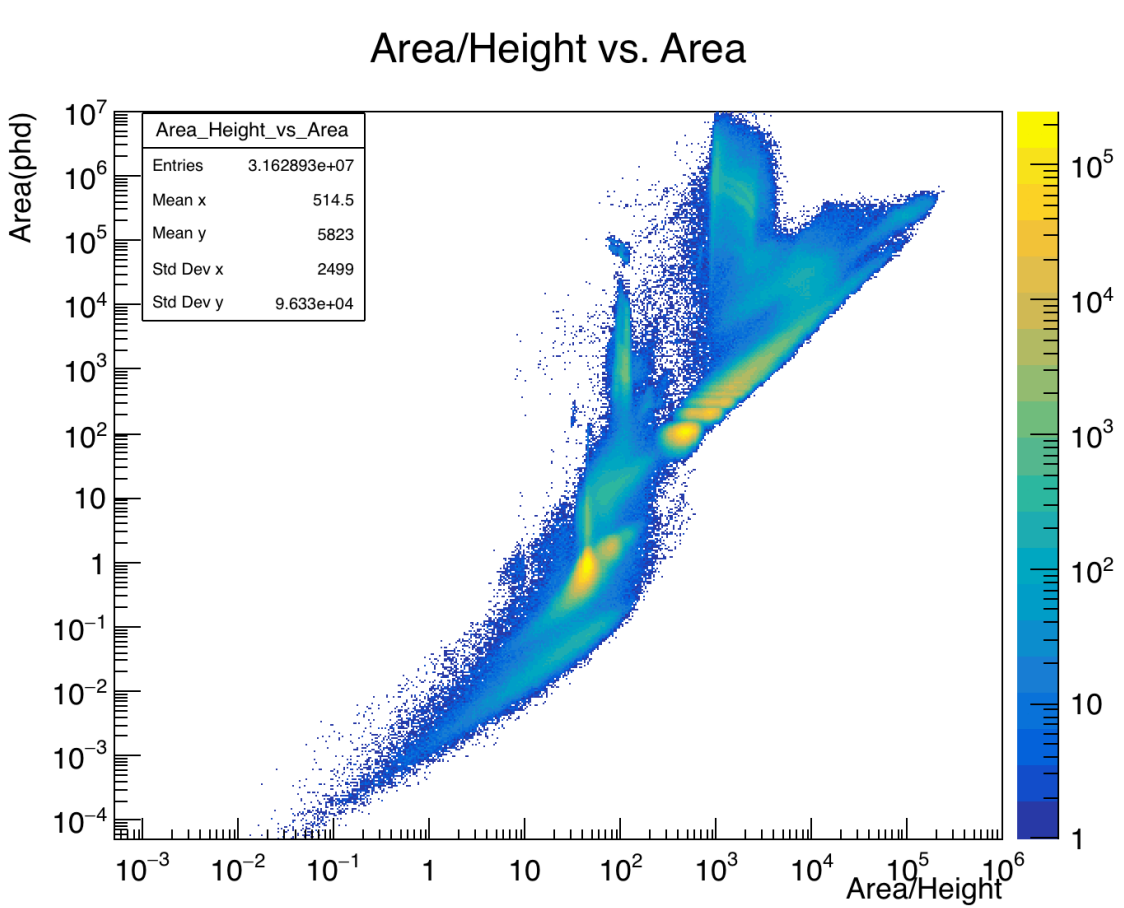


PREM

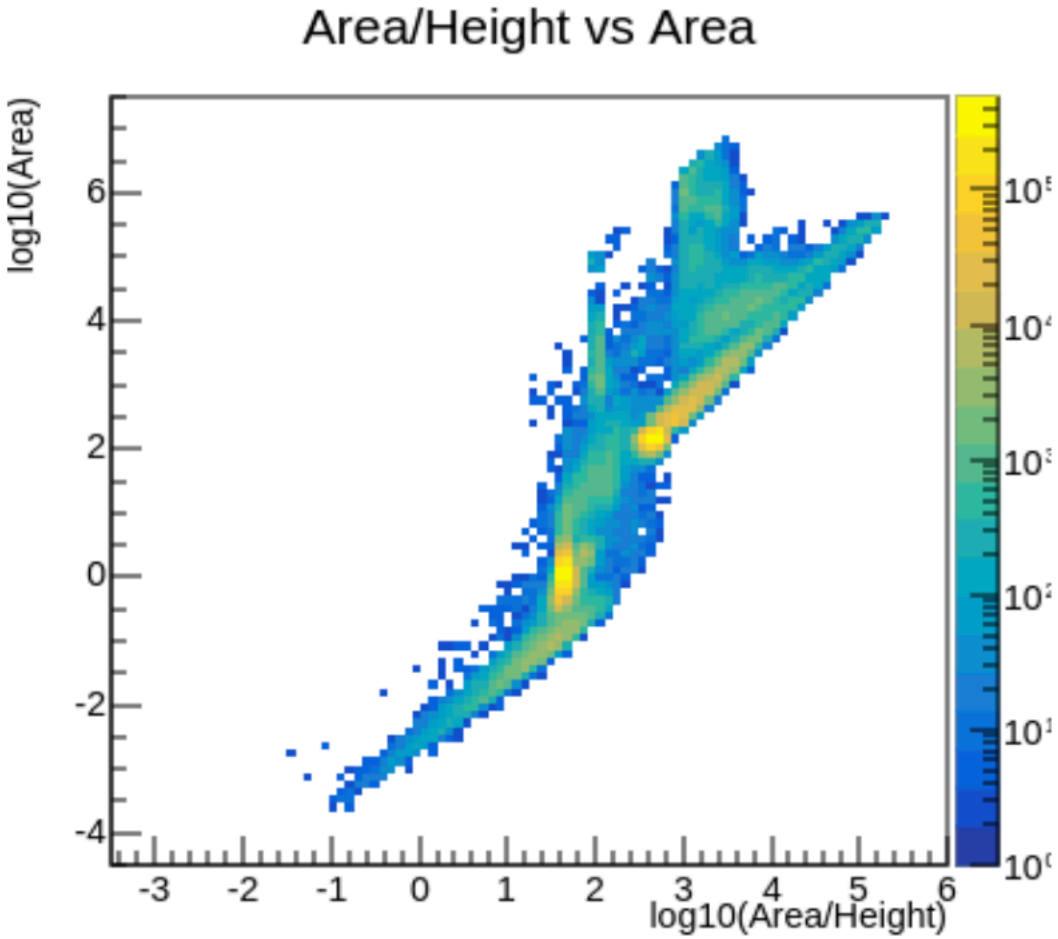


UPM

Area/Height vs Area

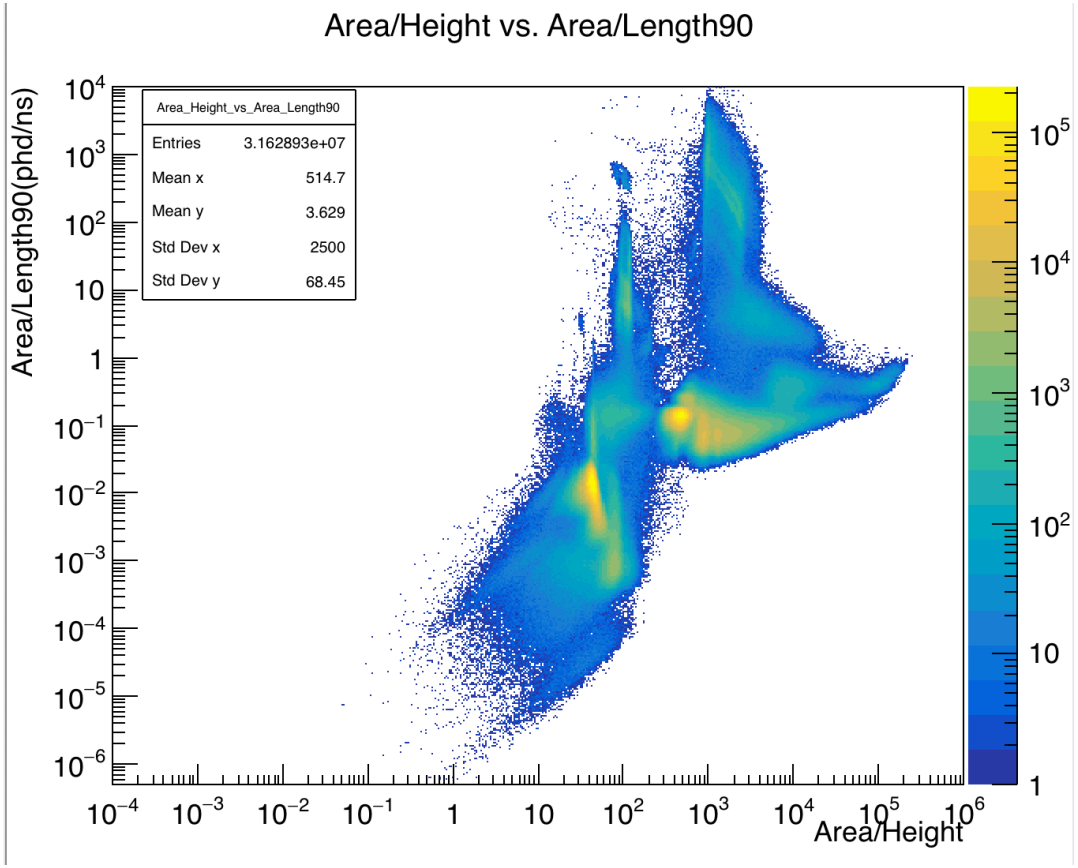


PREM

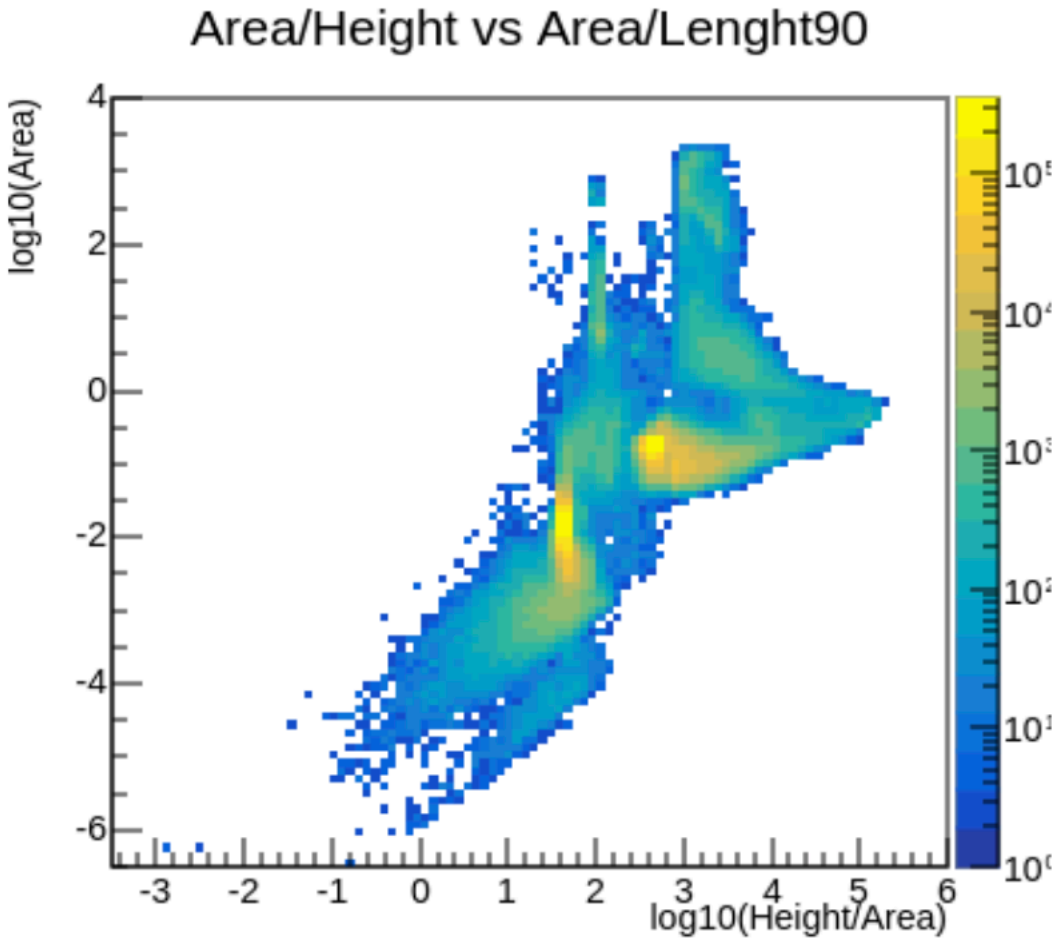


UPM

Area/Height vs Area/Length90



PREM



UPM

To do

- Clarify the RQ name of the variable pFraction100
- Think about the binning for Length90

18th Feb. 2021

- 1. **Account:**
  - LZ account: ☑
  - NERSC: ☑
- 2. **Code:**
  - Set up cori account
  - Installed Alpaca & PREM module
- 3. **To do:**
  - Add PREM module to Alpaca for running (environment not setting up properply?)
  - Look at the Twiki page to choose a part to work on

Cori setup

- 1. Set up NERSC account and two-factor authentication (OTP) on website
- 2. Log into Cori account on terminal: *ssh user_name@cori.nersc.gov,* with password+OTP
- 3. Create a folder at: */global/project/projectdirs/lz/users/your_username*
- 4. Set up shifter environment:
  - Write the .bashrc.ext file: https://luxzeplin.gitlab.io/docs/softwaredocs/computing/usdc/shifter.html#some-magic
  - source .bashrc.ext
  - shifterCOS7 bash
- 5. To use git command:
  - Generate a key on cori: https://docs.gitlab.com/ee/ssh/
  - Add it to GitLab: https://gitlab.com/-/profile/keys

10th Feb. 2021

- 1. **Account:**
  - LZ account: ☑
  - NERSC: in progress
- 2. **Code:**
  - Installed ALPACA & PREM modules
  - Walked through PREM modules with Rachel
- 3. **To do:**
  - Get the NERSC account
  - Run the code locally