



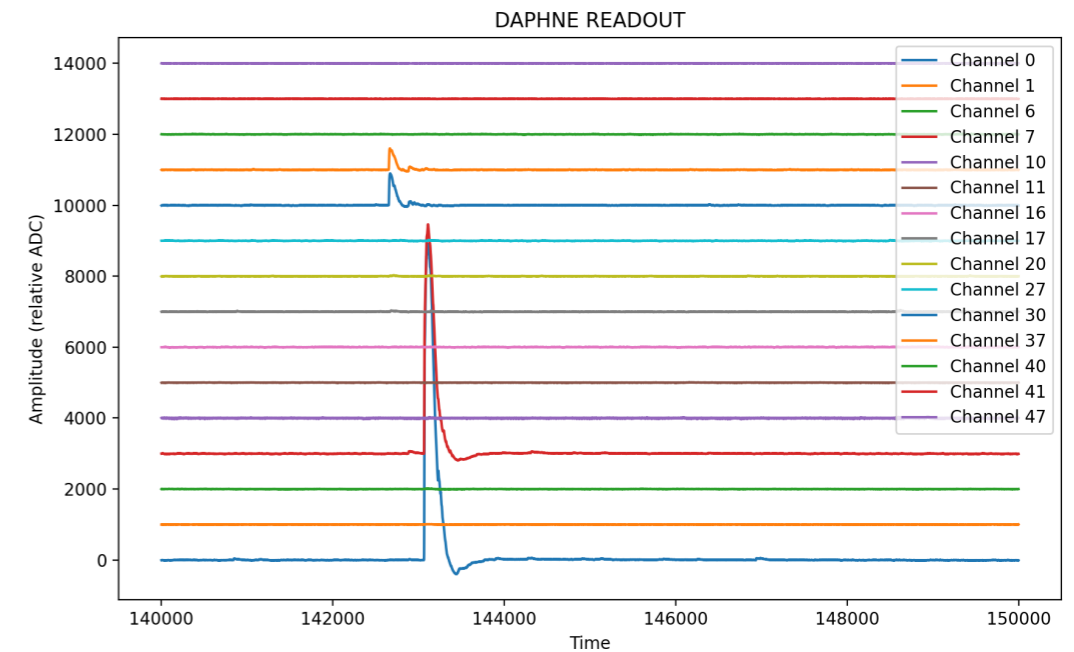
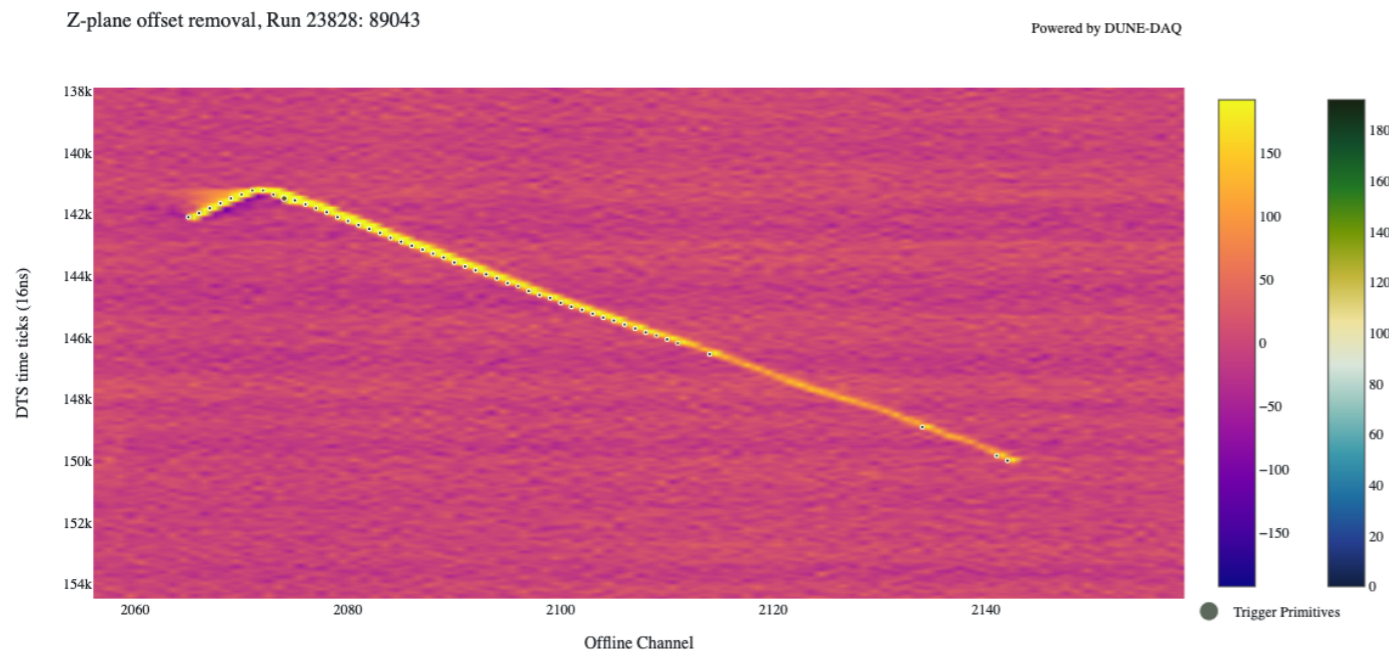
VD Coldbox data taking Jan 2024

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VD Coldbox run Jan 2024

- Joint PDS + TPC running from run 23822.
- PDS is running in streaming mode, some data is expected for each fragment.
- By the end of the run all PDS modules (cathode and membrane) included in the runs.
- A set of calibration runs performed during the run.
- From the DAQ side — smooth running.





Script for getting DAPHNE data

RAW data is recorded in **.hdf5* file format and then processed with LArSoft. Data processing and obtaining **.root* files takes time. A script developed for waveform quick analysis.

https://github.com/DUNE-DAQ/dqmtools/tree/vipopov/waveform_pds_ana

How to get PDS waveforms from hdf5 file

dqmtools package provides a script for dumping pds waveforms for further analysis (initially used to speed up the calibration process). `dump_dps_ana_info.py` takes two arguments -- input directory and run number, and has several options. For the list of available options try: `dump_pds_ana_info.py --help`. For each input file and each channel script will produce separate file containing 2-dimensional numpy array with waveforms.

Most general usage example:

```
dump_pds_ana_info.py /data3/ 24100
```



which will process all files/all records/all channels in the run. In case there is need for a quick look on the waveform quality and only part of channels are of interest

```
dump_pds_ana_info.py /data3/ 24100 -nr 2 -nf 1 --cathode
```



this will process only 2 records in 1 file and only channels in the cathode PDS modules.

Vast of the calibration data converted to **.npy* files and could be found here:

https://cernbox.cern.ch/files/spaces/eos/user/v/vipopov/LED_data_VDColdbox



Lost DAPHNE fragments

100 records in the fragment header VS 3 records with actual data

```
frh
run trigger sequence src_id trigger_timestamp_dts window_begin_dts window_end_dts det_id ... data_size_bytes trigger_time window_begin_time window_end_time
23845 1186 0 3 106627731986442347 106627731986409579 106627731986475115 2 ... 0 2024-01-23 21:01:51+00:00 2024-01-23 21:01:51+00:00 2024-01-23 21:01:51+00:00
4 106627731986442347 106627731986409579 106627731986475115 2 ... 0 2024-01-23 21:01:51+00:00 2024-01-23 21:01:51+00:00 2024-01-23 21:01:51+00:00
1 106627731986442347 106627731986409579 106627731986475115 2 ... 0 2024-01-23 21:01:51+00:00 2024-01-23 21:01:51+00:00 2024-01-23 21:01:51+00:00
2 106627731986442347 106627731986409579 106627731986475115 2 ... 0 2024-01-23 21:01:51+00:00 2024-01-23 21:01:51+00:00 2024-01-23 21:01:51+00:00
1187 0 2 106627732014870347 106627732014837579 106627732014903115 2 ... 0 2024-01-23 21:01:52+00:00 2024-01-23 21:01:52+00:00 2024-01-23 21:01:52+00:00
...
1284 0 1 106627739144132395 106627739144099627 106627739144165163 2 ... 0 2024-01-23 21:03:46+00:00 2024-01-23 21:03:46+00:00 2024-01-23 21:03:46+00:00
1285 0 4 106627739148523467 106627739148490699 106627739148556235 2 ... 0 2024-01-23 21:03:46+00:00 2024-01-23 21:03:46+00:00 2024-01-23 21:03:46+00:00
3 106627739148523467 106627739148490699 106627739148556235 2 ... 0 2024-01-23 21:03:46+00:00 2024-01-23 21:03:46+00:00 2024-01-23 21:03:46+00:00
2 106627739148523467 106627739148490699 106627739148556235 2 ... 0 2024-01-23 21:03:46+00:00 2024-01-23 21:03:46+00:00 2024-01-23 21:03:46+00:00
1 106627739148523467 106627739148490699 106627739148556235 2 ... 0 2024-01-23 21:03:46+00:00 2024-01-23 21:03:46+00:00 2024-01-23 21:03:46+00:00

[400 rows x 11 columns]
daqh
run trigger sequence src_id n_obj daq_header_version det_data_version det_id crate_id slot_id stream_id timestamp_first_dts timestamp_first_time
23845 1189 0 3 1025 1 0 2 2 6 2 106627732148179680 2024-01-23 21:01:54+00:00
1193 0 4 1025 1 0 2 2 6 3 106627732216247136 2024-01-23 21:01:55+00:00
2 1025 1 0 2 2 6 1 106627732216247136 2024-01-23 21:01:55+00:00
3 1025 1 0 2 2 6 2 106627732216247136 2024-01-23 21:01:55+00:00
1 1025 1 0 2 2 6 0 106627732216247136 2024-01-23 21:01:55+00:00
1250 0 2 1025 1 0 2 2 6 1 106627736139694880 2024-01-23 21:02:58+00:00
4 1025 1 0 2 2 6 3 106627736139694880 2024-01-23 21:02:58+00:00
3 1025 1 0 2 2 6 2 106627736139694880 2024-01-23 21:02:58+00:00
1 1025 1 0 2 2 6 0 106627736139694880 2024-01-23 21:02:58+00:00

deth_kHD_PDS_kDAPHNEstream
run trigger sequence src_id n_channels sampling_period ts_diffs_vals ts_diffs_counts
23845 1189 0 3 4 1 [1] [65599]
1193 0 4 4 1 [1] [65599]
2 4 1 [1] [65599]
3 4 1 [1] [65599]
1 4 1 [1] [65599]
1250 0 2 4 1 [1] [65599]
4 4 1 [1] [65599]
3 4 1 [1] [65599]
1 4 1 [1] [65599]

deth_kHD_PDS_kDAPHNEstream
run trigger sequence src_id channel daphne_chan adc_mean adc_rms adc_max adc_min adc_median
23845 1189 0 3 20 3316.386037 180.283476 7600 2920 3308.0
27 2669.577393 349.835727 11963 2209 2656.0
30 2102.874909 18.484137 2657 2057 2102.0
37 2175.187729 14.812779 2674 2138 2174.0
1193 0 4 40 609.190137 2.194462 618 600 609.0
47 2245.187317 1.832865 2253 2237 2245.0
40 609.190137 2.194462 618 600 609.0
41 1226.292957 2.126516 1236 1217 1226.0
2 10 4418.979345 487.866634 16383 3797 4404.0
11 3730.021997 2.007567 3757 3713 3730.0
16 16 3201.493003 8.732717 3471 3180 3201.0
17 3337.398902 502.399364 16383 2711 3321.0
3 20 3314.973354 201.561730 7414 3039 3295.0
27 2674.671524 419.451687 10688 2360 2646.0
30 2091.663979 13.077464 2444 2054 2091.0
37 2161.611707 8.837330 2366 2139 2161.0
```



Lost DAPHNE fragments

Each fragment has field *data size bytes* that should not be 0 for actual data. Quite a lot of runs in the middle of data taking have ~90% of lost DAPNE fragments.

Another point is *window begin/ window end* values. Those are set via daq configuration file and should be stable over run. However for problematic runs they vary.

Caused be **enabling the TP** for PDS which is not actually implemented at the moment.

As far as I know LArSoft process the data with missing fragments without raising any Warnings/Errors.

Statistics of lost fragments is in the table

| Run | file | Fragment header data | | |
|-------|------|------------------------|-------|------------------------------------|
| | | "data_size_bytes == 0" | Total | unique [window_end - window_begin] |
| 23822 | 0 | 0 | 328 | [262144] |
| 23822 | 1 | 0 | 328 | [262144] |
| 23822 | 2 | 0 | 328 | [262144] |
| 23823 | 0 | 0 | 328 | [262144] |
| 23823 | 1 | 0 | 328 | [262144] |
| 23823 | 2 | 0 | 328 | [262144] |
| 23824 | 0 | 0 | 328 | [262144] |
| 23824 | 1 | 0 | 328 | [262144] |
| 23826 | 0 | 0 | 328 | [262144] |
| 23827 | 0 | 0 | 328 | [262144] |
| 23827 | 299 | 4 | 332 | [64 262144] |
| 23828 | 1 | 0 | 328 | [262144] |
| 23844 | 0 | 1479 | 1552 | [65536 75552] |
| 23844 | 1 | 1458 | 1524 | [65536 75552] |
| 23844 | 2 | 1460 | 1528 | [65536 75552] |
| 23845 | 0 | 2253 | 2276 | [65536] |
| 23845 | 1 | 2444 | 2464 | [65536 95584 106912] |
| 23845 | 2 | 2427 | 2456 | [65536 75552] |
| 23845 | 18 | 2457 | 2492 | [65536 75552 85568] |
| 23846 | 0 | 2420 | 2440 | [65536 75552 95584] |
| 23846 | 1 | 598 | 608 | [65536] |
| 23847 | 0 | 2492 | 2504 | [65536 75552] |
| 23847 | 1 | 319 | 324 | [65536] |
| 23849 | 0 | 2854 | 2868 | [65536 76096] |
| 23849 | 1 | 2364 | 2376 | [65536 75552] |
| 23849 | 2 | 2506 | 2540 | [65536] |
| 23865 | 0 | 4650 | 4664 | [65536 75552 76480 82592 82688] |
| 23865 | 1 | 4808 | 4824 | [65536 75552 85568 105664] |
| 23865 | 2 | 5034 | 5056 | [65536 75552 79136] |
| 23868 | 0 | 0 | 328 | [262144] |
| 23868 | 1 | 0 | 328 | [262144] |
| 23868 | 2 | 0 | 328 | [262144] |
| 23875 | 0 | 4 | 332 | [320 262144] |
| 23875 | 1 | 0 | 328 | [262144] |
| 23875 | 2 | 0 | 52 | [262144] |
| 23888 | 0 | 0 | 328 | [262144] |
| 23888 | 1 | 0 | 328 | [262144] |
| 23888 | 2 | 0 | 328 | [262144] |



Calibration runs

Calibration – All good!

| Run | file | Fragment header data | | |
|-------|------|------------------------|-------|------------------------------------|
| | | “data_size_bytes == 0” | Total | unique [window_end - window_begin] |
| 24040 | 0 | 0 | 11624 | [50000] |
| 24040 | 1 | 0 | 6684 | [50000] |
| 24042 | 0 | 0 | 11624 | [50000] |
| 24042 | 1 | 0 | 11624 | [50000] |
| 24042 | 2 | 0 | 4948 | [50000] |
| 24043 | 0 | 0 | 11624 | [50000] |
| 24043 | 1 | 0 | 11624 | [50000] |
| 24043 | 2 | 0 | 10324 | [50000] |
| 24047 | 0 | 0 | 11624 | [50000] |
| 24047 | 1 | 0 | 2796 | [50000] |
| 24049 | 0 | 0 | 11624 | [50000] |
| 24049 | 1 | 0 | 7868 | [50000] |
| 24090 | 0 | 0 | 11624 | [50000] |
| 24090 | 1 | 0 | 8700 | [50000] |
| 24091 | 0 | 0 | 11624 | [50000] |
| 24091 | 1 | 0 | 11624 | [50000] |
| 24091 | 2 | 0 | 288 | [50000] |
| 24093 | 0 | 0 | 11624 | [50000] |
| 24093 | 1 | 0 | 7592 | [50000] |

As far as I know LArSoft process the data with missing fragments without raising any Warnings/Errors.

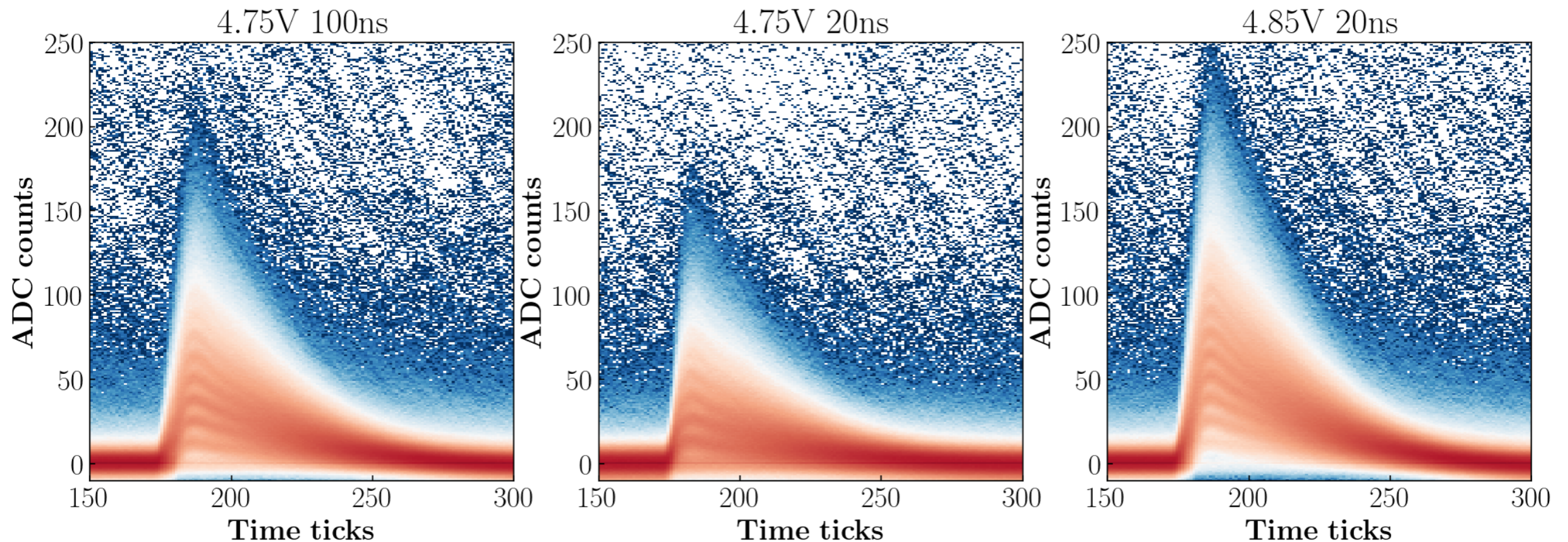


PDS calibration runs

Several sets of calibration data were acquired: 24037 — 24062; 24088 — 24100; LED frequency 20kHz. DAQ trigger frequency 50Hz and window — 50000tt ($800 \mu s$)

Varied parameters:

- LED intensity (HV);
- SiPM bias voltage;
- Pulse width;
- (Attenuation)

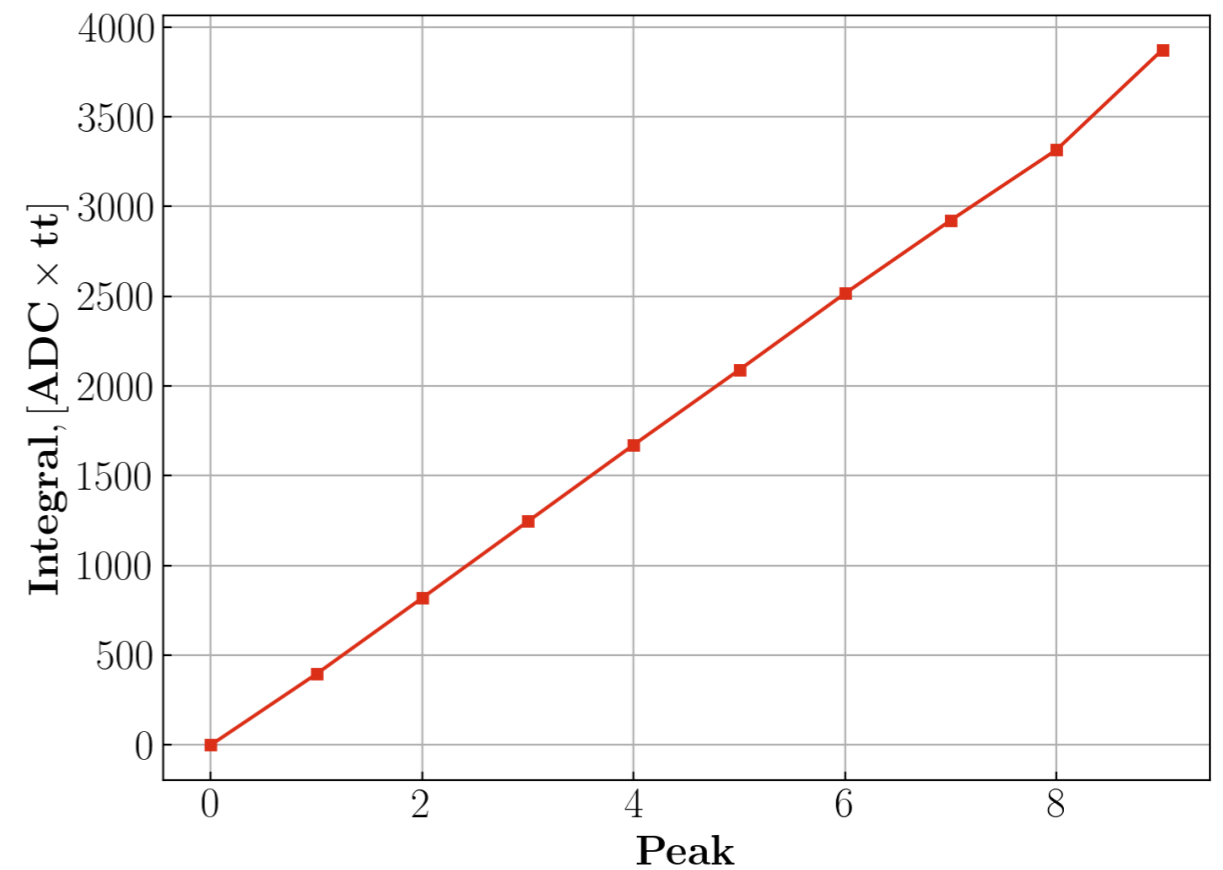
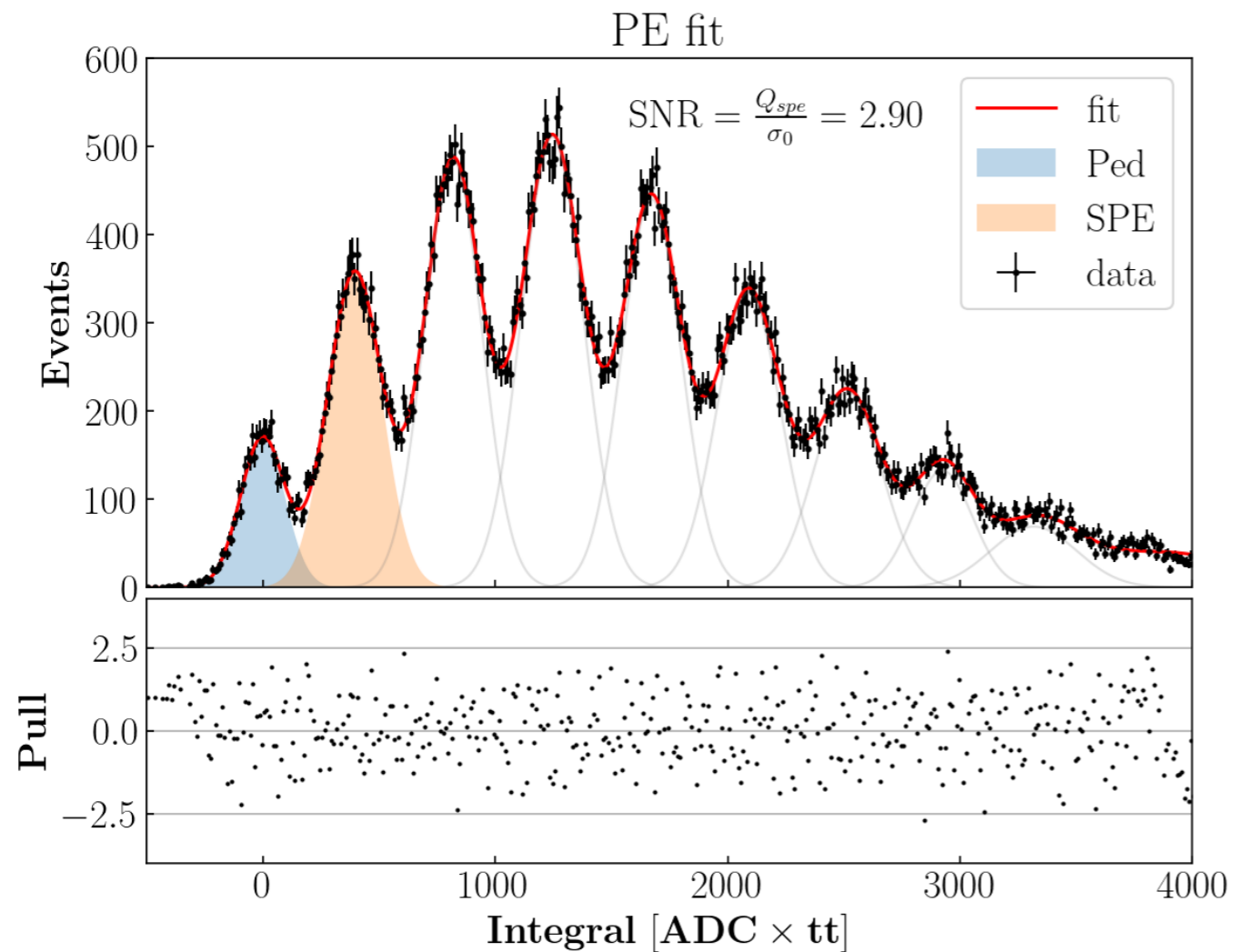




PDS calibration runs

Example of PE fitting results (for good channel).

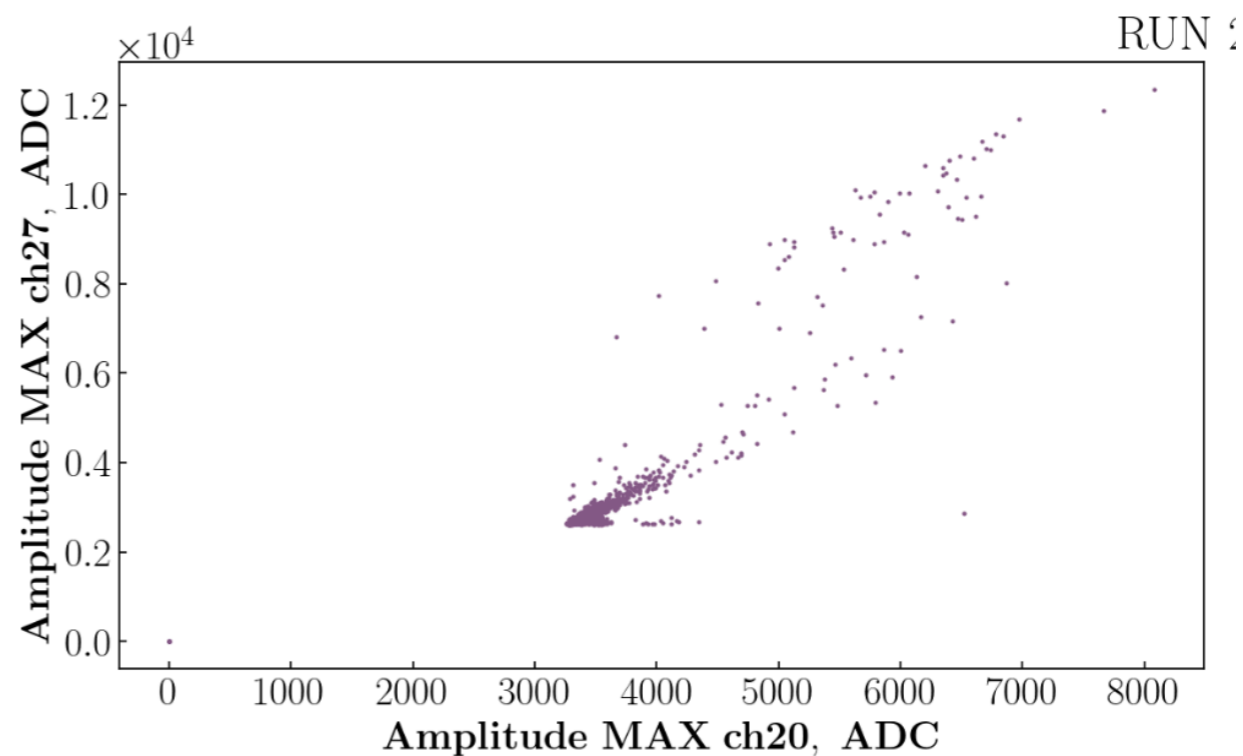
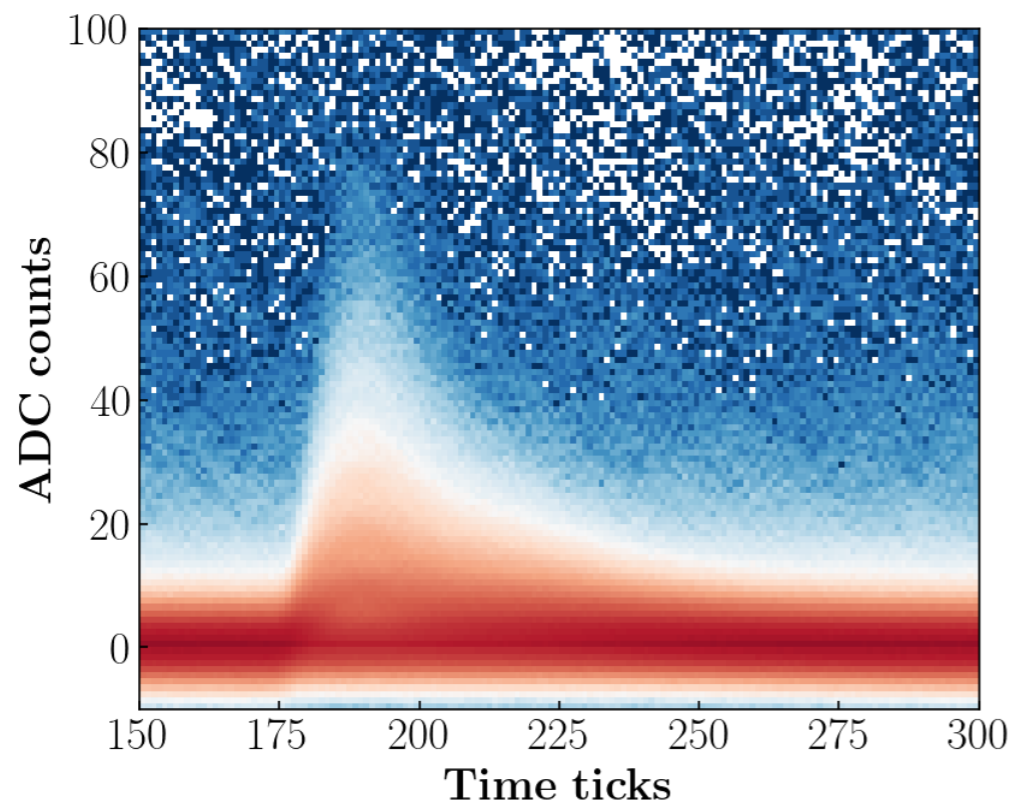
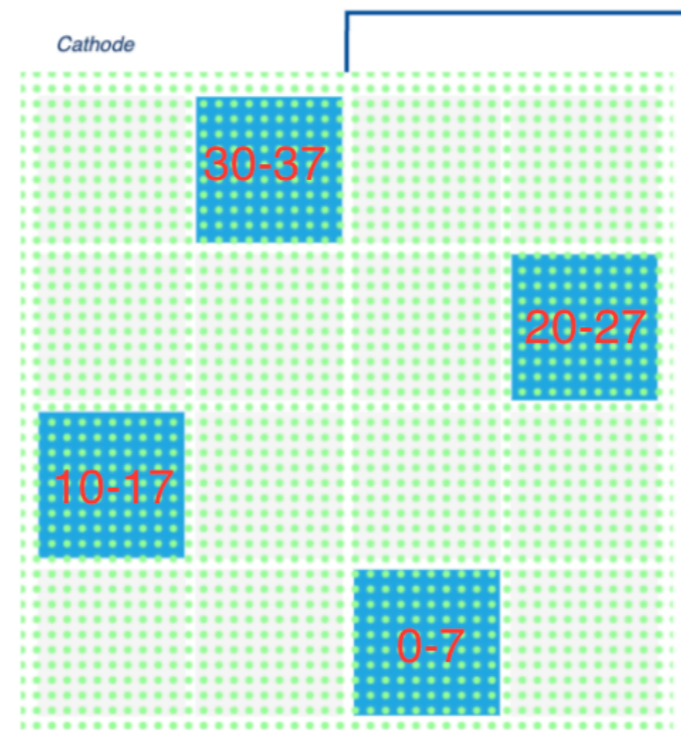
Signal to Noise ratio estimation and peak separation plot.





Channels 20 and 27 (c3 module)

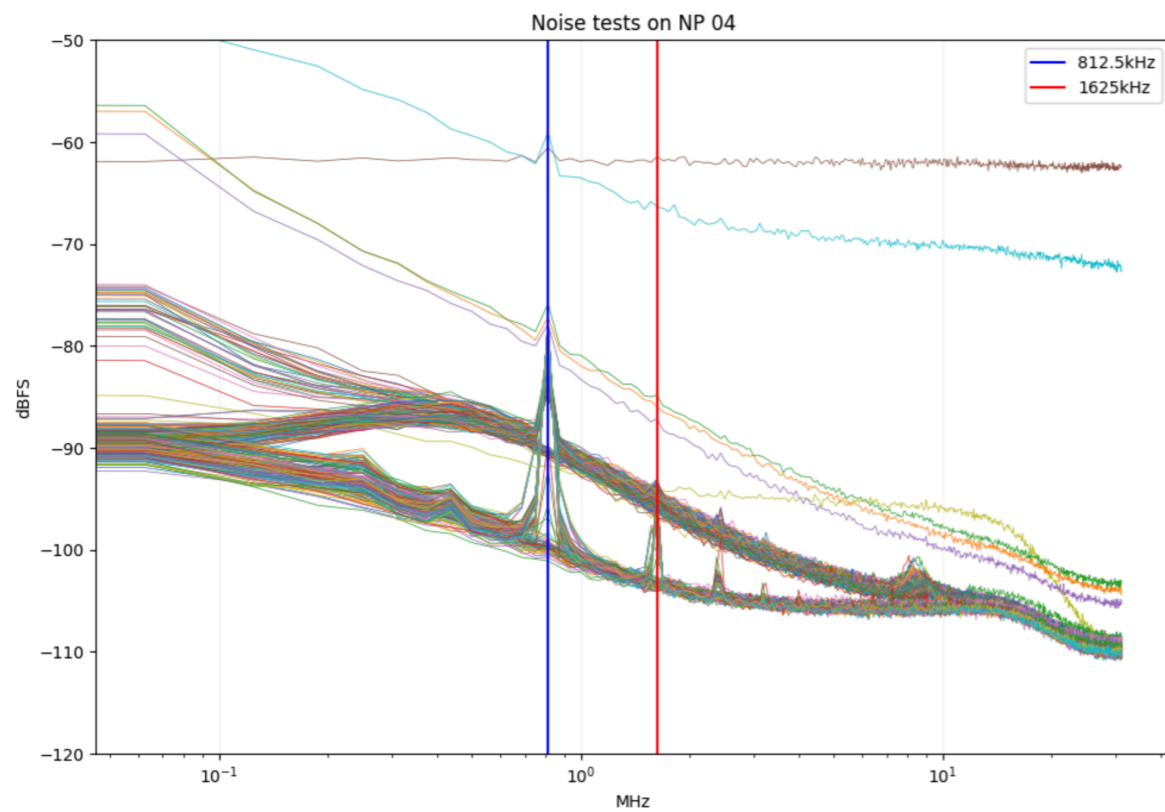
Following the discussion of DD generator positioning, I would like to note that not all channels perform equally well. And channels 20 & 27 in module 3 are the worst.



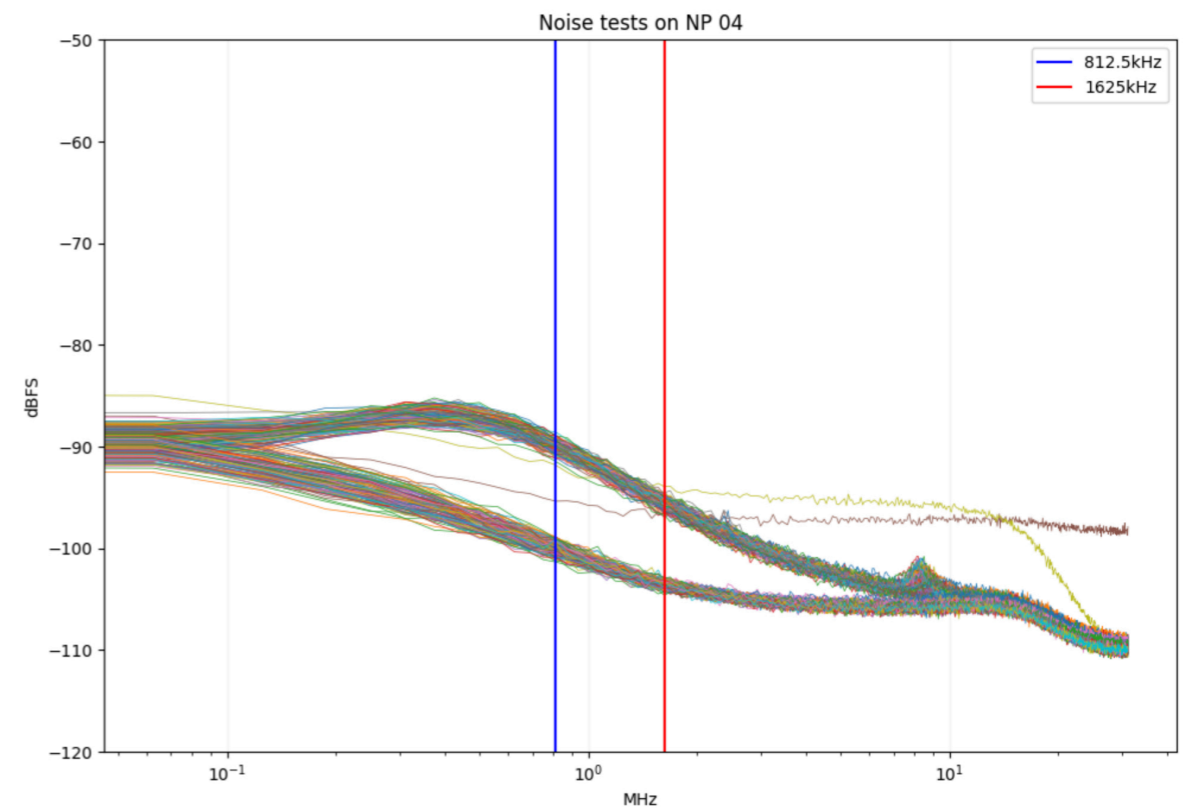


Grounding progress (from Manuel Arroyave)

Before grounding the detector



After grounding the detector





Summary

- DAQ for the VD Coldbox is stable and with DAPHNE only could run up to 50Hz with ~ 1 ms waveforms;
- TP for DAPHNE should be disabled for the sake of PDS data (not sure if it matters for the large signals, still something to take into consideration);
- During the January runs calibration was performed, it showed however that some of the channels are much noisier than others;
- Script for PDS waveform extraction developed and pushed to gitHub. Further “quick analysis” tools are under development.