

SiPM analysis - Cobalt run

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Cobalt run - deconvolved data

```
/eos/experiment/dune/solar/data/SoLAr_v2/Light/root/46v_12db_th950_deco_cobalt
```

```
-r--r--r--. 1 guffantd np-comp 28G Sep 30 2025 deco_v6_0cd913fa_20230706_170930.data.root
-r--r--r--. 1 guffantd np-comp 6.8G Sep 29 2025 deco_v6_0cd913fa_20230706_172114.data.root
-r--r--r--. 1 guffantd np-comp 17G Sep 30 2025 deco_v6_0cd8d631_20230706_172619.data.root
-r--r--r--. 1 guffantd np-comp 7.8G Sep 30 2025 deco_v6_0cd8d631_20230706_173712.data.root
-r--r--r--. 1 guffantd np-comp 8.5G Sep 29 2025 deco_v6_0cd8d631_20230706_174714.data.root
-r--r--r--. 1 guffantd np-comp 18G Sep 30 2025 deco_v6_0cd913fa_20230706_175855.data.root
-r--r--r--. 1 guffantd np-comp 16G Sep 30 2025 deco_v6_0cd9414a_20230706_181038.data.root
-r--r--r--. 1 guffantd np-comp 18G Sep 30 2025 deco_v6_0cd9414a_20230706_182121.data.root
-r--r--r--. 1 guffantd np-comp 15G Sep 30 2025 deco_v6_0cd913fa_20230706_183343.data.root
-r--r--r--. 1 guffantd np-comp 14G Sep 30 2025 deco_v6_0cd8d631_20230706_184345.data.root
-r--r--r--. 1 guffantd np-comp 14G Sep 30 2025 deco_v6_0cd913fa_20230706_185346.data.root
-r--r--r--. 1 guffantd np-comp 7.0G Sep 30 2025 deco_v6_0cd8d631_20230706_190348.data.root
-r--r--r--. 1 guffantd np-comp 33G Sep 30 2025 deco_v6_0cd8d631_20230706_212204.data.root
-r--r--r--. 1 guffantd np-comp 40G Oct 1 2025 deco_v6_0cd9414a_20230706_214206.data.root
-r--r--r--. 1 guffantd np-comp 32G Sep 30 2025 deco_v6_0cd8d631_20230706_215208.data.root
-r--r--r--. 1 guffantd np-comp 20G Sep 30 2025 deco_v6_0cd9414a_20230706_220426.data.root
-r--r--r--. 1 guffantd np-comp 26G Sep 30 2025 deco_v6_0cd9414a_20230706_221211.data.root
-r--r--r--. 1 guffantd np-comp 24G Sep 30 2025 deco_v6_0cd8d631_20230706_223214.data.root
```

Contain timestamp information and deconvolved waveforms

- 18 runs
- 345 Gb of data
- 327,666,432 entries

```
OBJ: TObjArray TObjArray An array of objects : 0
OBJ: TBranch event event/i : 0 at: 0x557ddb52f9f0
OBJ: TBranch sn sn/i : 0 at: 0x557ddcd67ec0
OBJ: TBranch ch ch/i : 0 at: 0x557ddcd6e900
OBJ: TBranch ntp_ms ntp_ms/l : 0 at: 0x557ddcd753b0
OBJ: TBranch tai_ns tai_ns/l : 0 at: 0x557ddcd7e3e0
OBJ: TBranch tslpps_ns tslpps_ns/l : 0 at: 0x557ddcd84dd0
OBJ: TBranch decwfm decwfm[998]/S : 0 at: 0x557ddcd8b8d0
OBJ: TBranch rwf_status rwf_status/i : 0 at: 0x557ddcda1100
```

Cobalt run - (photons) hits data

```
/eos/experiment/dune/solar/data/Solar_v2/Light/root/46v_12db_th950_deco_cobalt
```

```
-r--r--r--. 1 guffantd np-comp 201M Sep 30 2025 hits_v7_0cd913fa_20230706_170930.data.root
-r--r--r--. 1 guffantd np-comp 54M Sep 29 2025 hits_v7_0cd913fa_20230706_172114.data.root
-r--r--r--. 1 guffantd np-comp 129M Sep 30 2025 hits_v7_0cd8d631_20230706_172619.data.root
-r--r--r--. 1 guffantd np-comp 73M Sep 30 2025 hits_v7_0cd8d631_20230706_173712.data.root
-rw-r--r--. 1 guffantd np-comp 82M Jul 9 11:14 hits_v7_0cd8d631_20230706_174714.data.root
-r--r--r--. 1 guffantd np-comp 131M Sep 30 2025 hits_v7_0cd913fa_20230706_175855.data.root
-r--r--r--. 1 guffantd np-comp 125M Sep 30 2025 hits_v7_0cd9414a_20230706_181038.data.root
-r--r--r--. 1 guffantd np-comp 140M Sep 30 2025 hits_v7_0cd9414a_20230706_182121.data.root
-r--r--r--. 1 guffantd np-comp 108M Sep 30 2025 hits_v7_0cd8d631_20230706_184345.data.root
-r--r--r--. 1 guffantd np-comp 108M Sep 30 2025 hits_v7_0cd913fa_20230706_185346.data.root
-r--r--r--. 1 guffantd np-comp 72M Sep 30 2025 hits_v7_0cd8d631_20230706_190348.data.root
-rw-r--r--. 1 guffantd np-comp 234M Jul 9 13:06 hits_v7_0cd8d631_20230706_212204.data.root
-r--r--r--. 1 guffantd np-comp 294M Oct 1 2025 hits_v7_0cd9414a_20230706_214206.data.root
-r--r--r--. 1 guffantd np-comp 227M Sep 30 2025 hits_v7_0cd8d631_20230706_215208.data.root
-r--r--r--. 1 guffantd np-comp 152M Sep 30 2025 hits_v7_0cd9414a_20230706_220426.data.root
-r--r--r--. 1 guffantd np-comp 181M Sep 30 2025 hits_v7_0cd8d631_20230706_223214.data.root
```

Contain timestamp and computed hits (height, integral, time, etc.)

- 16 runs*
- 2.3 Gb of data
- 288,717,056 entries

```
OBJ: TObjArray TObjArray An array of objects : 0
OBJ: TBranch event event/i : 0 at: 0x560725defbb0
OBJ: TBranch sn sn/i : 0 at: 0x560725dae220
OBJ: TBranch ch ch/i : 0 at: 0x560725dd06e0
OBJ: TBranch ntp_ms ntp_ms/l : 0 at: 0x560725781d80
OBJ: TBranch tai_ns tai_ns/l : 0 at: 0x5607253e6a20
OBJ: TBranch tslpps_ns tslpps_ns/l : 0 at: 0x560726aa5ce0
OBJ: TBranch wfm_status wfm_status/i : 0 at: 0x560726aaaec0
OBJ: TBranch n_hits n_hits/S : 0 at: 0x560726aada80
OBJ: TBranchElement hits hits_ : 0 at: 0x560726ab1b30
```

All information about hits

*processing

Process light event

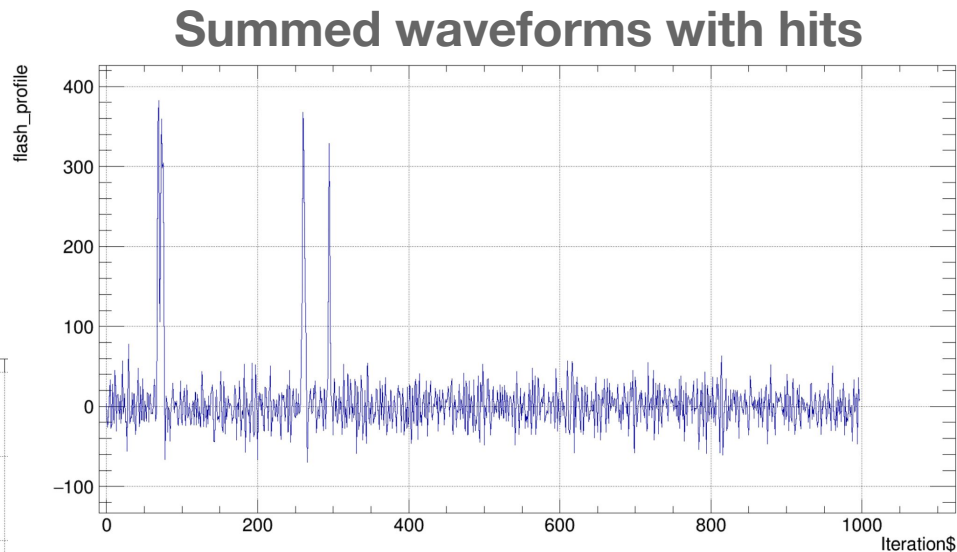
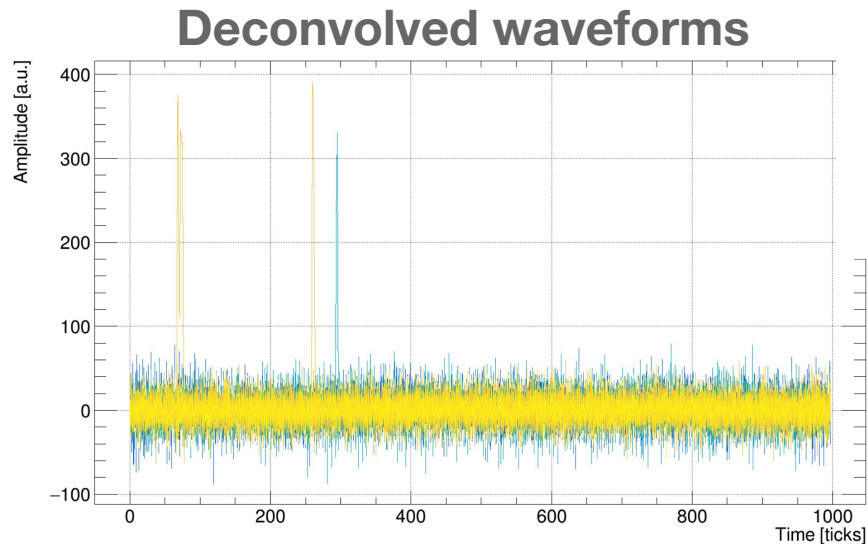
[SoLAr-decowave/script/process_filtered_waveforms.cc](#)

Daniele's code to process create “light events”: analyzing all 64 SiPMs hits for the same event

- The two SiPM boards doesn't match perfectly in timestamp and are not aligned in order as entry.
 - The new code create groups by sorting timestamp and getting events that are close by max 500 ticks (i.e., 500 ns).

```
process_light_event \  
--decoinput /eos/experiment/dune/solar/data/SoLAr_v2/Light/root/46v_12db_th950_deco_cobalt/deco_v6_0cd913fa_20230706_172114.data.root \  
--hitsinput /eos/experiment/dune/solar/data/SoLAr_v2/Light/root/46v_12db_th950_deco_cobalt/hits_v7_0cd913fa_20230706_172114.data.root \  
--hits_tree hit_finder_0_00_b1 \  
--calibration /eos/experiment/dune/solar/data/SoLAr_v2/Light/calib/24db/46v/deconv_gains/deconv_gain.root \  
--output pippo.root
```

Processed events



```
root [4] flash_tree->Show(1000)
=====> EVENT:1000
event
  = 1001,
  1001
ntp_ms
  = 0
tai_ns
  = 1688675576407654400
tslpps_ns
  = 1688675576407654400
total_q
  = 6.45872
total_nhits
  = 4
tail2total
  = 0.428918
flash_profile
  = 3,
  -26, -19, -8, 20, 33, -27, -22, 28, -13, -21,
  45, 20, -31, 14, 15, 6, -16, 14, -21
flash_bl_stdev
  = 15.9943
sipm_charge
  = 0,
  0, 0, 0, 0, 0,
  0, 0, 0, 0, 0,
  0, 0, 0, 0, 0,
  0, 0, 0, 0
sipm_status
  = 0,
  0, 0, 0, 0, 0, 0, 0, 0, 0,
  0, 0, 0, 0, 0, 0, 0, 0
```

Processed events

```
/eos/experiment/dune/solar/data/Solar_v2/Light/root/46v_12db_th950_deco_cobalt
```

```
-r--r--r--. 1 guffantd np-comp 416M Jul 3 16:36 lightevent_v11_calib_0cd8d631_20230706_172619.data.root
-r--r--r--. 1 guffantd np-comp 205M Jul 3 15:41 lightevent_v11_calib_0cd8d631_20230706_173712.data.root
-rw-r--r--. 1 guffantd np-comp 221M Jul 9 15:01 lightevent_v11_calib_0cd8d631_20230706_174714.data.root
-r--r--r--. 1 guffantd np-comp 355M Jul 3 15:45 lightevent_v11_calib_0cd8d631_20230706_184345.data.root
-r--r--r--. 1 guffantd np-comp 185M Jul 3 16:09 lightevent_v11_calib_0cd8d631_20230706_190348.data.root
-rw-r--r--. 1 guffantd np-comp 819M Jul 9 00:00 lightevent_v11_calib_0cd8d631_20230706_215208.data.root
-r--r--r--. 1 guffantd np-comp 609M Jul 3 19:51 lightevent_v11_calib_0cd8d631_20230706_223214.data.root
-rw-r--r--. 1 guffantd np-comp 700M Jul 9 05:18 lightevent_v11_calib_0cd913fa_20230706_170930.data.root
-r--r--r--. 1 guffantd np-comp 176M Jul 3 15:50 lightevent_v11_calib_0cd913fa_20230706_172114.data.root
-r--r--r--. 1 guffantd np-comp 448M Jul 3 16:56 lightevent_v11_calib_0cd913fa_20230706_175855.data.root
-r--r--r--. 1 guffantd np-comp 342M Jul 3 17:18 lightevent_v11_calib_0cd913fa_20230706_185346.data.root
-r--r--r--. 1 guffantd np-comp 409M Jul 3 16:27 lightevent_v11_calib_0cd9414a_20230706_181038.data.root
-r--r--r--. 1 guffantd np-comp 458M Jul 3 16:15 lightevent_v11_calib_0cd9414a_20230706_182121.data.root
-rw-r--r--. 1 guffantd np-comp 1022M Jul 9 06:45 lightevent_v11_calib_0cd9414a_20230706_214206.data.root
-r--r--r--. 1 guffantd np-comp 522M Jul 3 18:10 lightevent_v11_calib_0cd9414a_20230706_220426.data.root
```

Contain event base information

- Timestamp
- Total charge
- Individual SiPM charge & status
- Summed (hit) SiPMs' waveform

- 15 runs*
- 6.8 Gb of data
- 4,016,734 events

*processing

```
OBJ: TObjArray TObjArray An array of objects : 0
OBJ: TBranch event event[2]/i : 0 at: 0x556374b62460
OBJ: TBranch ntp_ms ntp_ms/l : 0 at: 0x55637482e8e0
OBJ: TBranch tai_ns tai_ns/l : 0 at: 0x556374cc4640
OBJ: TBranch tslpps_ns tslpps_ns/l : 0 at: 0x556374b8f150
OBJ: TBranch total_q total_q/F : 0 at: 0x556374807520
OBJ: TBranch total_nhits total_nhits/s : 0 at: 0x556375e0e340
OBJ: TBranch tail2total tail2total/F : 0 at: 0x556375e1d490
OBJ: TBranch flash_profile flash_profile[998]/I : 0 at: 0x556375e2a300
OBJ: TBranch flash_bl_stdev flash_bl_stdev/F : 0 at: 0x556375e3c190
OBJ: TBranch sipm_charge sipm_charge[64]/F : 0 at: 0x556375e49360
OBJ: TBranch sipm_status sipm_status[64]/S : 0 at: 0x556375e4ad10
```

Charge spectrum

Total charge (all 64 SiPMs) shows nicely 1 to 4 PEs structure

