

IoLS Updates

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CALCI Consortium Meeting

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HD Status

- Data taking is complete as of yesterday!
- Liquid transfer from NP04 to NP02 scheduled to begin tomorrow (Dec. 6th)

Shift focus to analysis of data collected in NP04

Slow Controls Interface

Connect and configure cib1 or cib2

- OPC UA SC client
 - Deployed, tested, and utilized
 - Able to configure and control serial devices
 - Laser, attenuator, power meter, external shutter, and the motors for periscope actuation
 - Access to higher level functions and the laser system state machine (e.g. warmup, pause, standby, shutdown)

The screenshot displays the Slow Controls Interface, divided into two main sections: a Command Terminal and an IoLS Monitoring dashboard.

Command Terminal: Shows the execution of various commands and their outputs. Key actions include connecting to 'cib1', configuring the laser system, setting the DAC, and performing a warmup. The terminal output shows successful connections and configurations.

IoLS Monitoring Dashboard: Provides a real-time overview of the system's status. It includes a 'Status Monitor' section with indicators for RNN800, LSTAGE, PM1, RNN600, A1, L1, and IoLS, all showing 'ready' or 'operating' states. The 'Device status' section shows 'Motor positions' (Motor: [-634042, 833999, 18200], CIB: [-634042, 834000, 18200]) and 'Attenuator position: -5000'. The 'Power Meter' shows energy at 2.5e-05 J. The 'Laser Timers' section shows warmup, standby, and pause timers. The 'Laser Part States' section shows indicators for ESH OPEN, LSH OPEN, FIRE, and QSWITCH.

Red arrows point from the 'Motor positions' and 'Attenuator position' labels to their respective values in the dashboard.

Nuno's IoLS-Manager running on np04-iols-srv-01 connected to Calibration Interface Board 1.

Slow Controls Interface continued

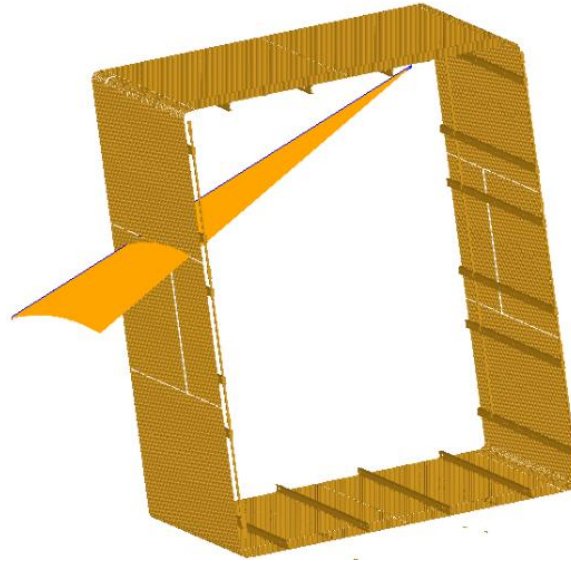
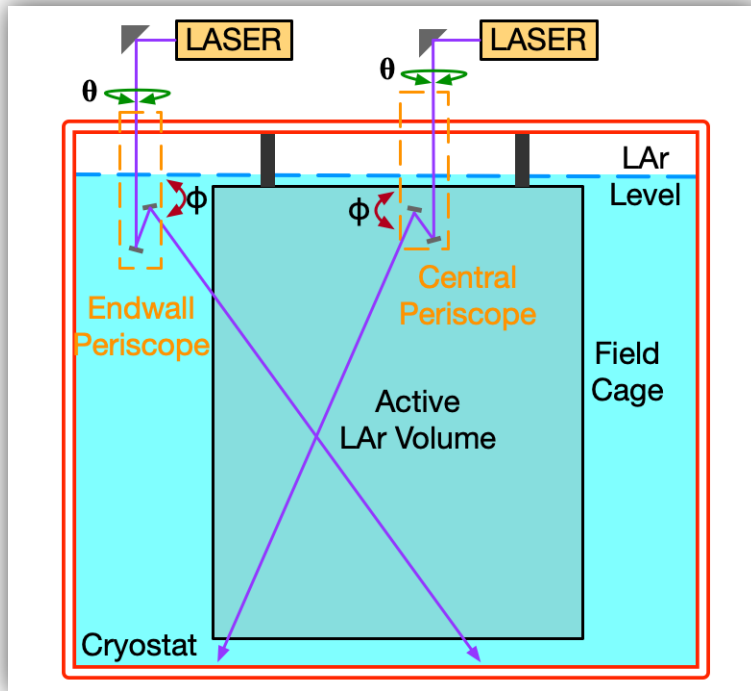
- Can execute laser functions of increasing complexity:
 - **fire_at_position** – move to a fixed position and fire <n> shots
 - **fire_segment** – fire the laser between two positions
 - **grid_scan** – 2D scan with a major and minor axis (motors)
 - **execute_scan** – accepts a json fragment containing a sequence of scan sub-segments
- Servers running on the CIBs listen for connections and instructions from either the manager or the newly-integrated geometry-based software (see [Francisco's](#) slides)

```
Command Terminal
INFO shutdown
INFO Shutdown the IoLS system
INFO config <location>
INFO Configure the IoLS system. Location points to the configuration file
INFO move_to_position <position> [approach]
INFO Move to a specified position. Approach is optional
INFO Example: move_to_position [155,256,367] uud
INFO warmup
INFO Start warmup of the laser. During this stage only motors can be moved.
INFO pause
INFO Pause the system. This will *keep* the laser firing, but shutter is closed.
INFO standby
INFO Pause the system. This will close the internal shutter and stop QSWITCH.
INFO resume
INFO Resume the system. This will open the shutters and start QSWITCH.
INFO stop
INFO Stop the system. This will stop the system (fire, qswitch, and return shutters to default position).
INFO fire_at_position <position> <approach> <num_shots>
INFO Fire at a specified position. Number of shots is optional.
INFO Example: fire_at_position [1,2,3] uud 10
INFO fire_segment <start_position> <end_position>
INFO Fire at a segment between two positions.
INFO Example: fire_segment [1,2,3] [4,5,6]
INFO execute_scan <run_plan>
INFO Execute a scan plan. The run plan should be a JSON object with a 'scan_plan' array.
INFO Example: execute_scan '{"scan_plan":[{"start":[1,2,3],"end":[4,5,6]}, {"start":[7,8,9],"end":[10,11,12]}]}'
INFO grid_scan <run_plan>
INFO Generate and execute a scan plan.
INFO Example: grid_scan '{"center":[1,2,3],"range":[0,1000,1000],"step":[0,100,1000],"approach":"uuu", "scan_axis"
:1}'
INFO read_var <variable>
INFO Read the value of a variable. Variable must be a fully qualified OPC-UA node
INFO set_pm_range <setting>
INFO Check the variable LS1.PM1.range_options for reference
INFO set_pm_threshold <setting>
INFO Threshold should be something above 100 (units of 0.01%)
INFO set_att_position <setting>
INFO Position should be a value in [-10000; 10000]
INFO set_dac <value>
INFO Value cannot be above 4095
INFO clear_error
INFO Clears IoLS error state, returning task messages
INFO exit
INFO Exit the program
>>
```

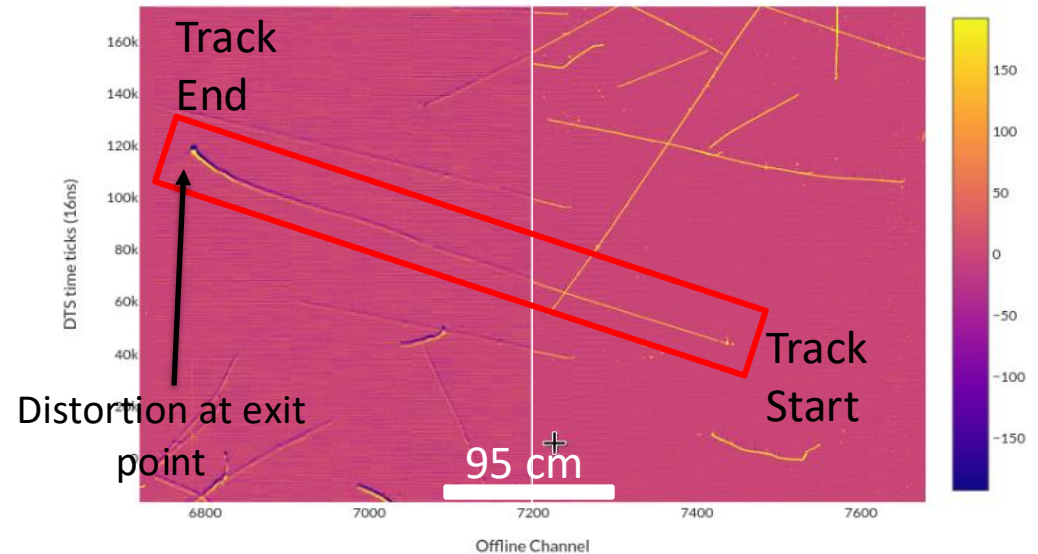
Help menu for the IoLS Manager

Upstream going laser track

- geoNavigator used to simulate/define various scans
- Planned scans with P1 and P2 to yield crossing tracks

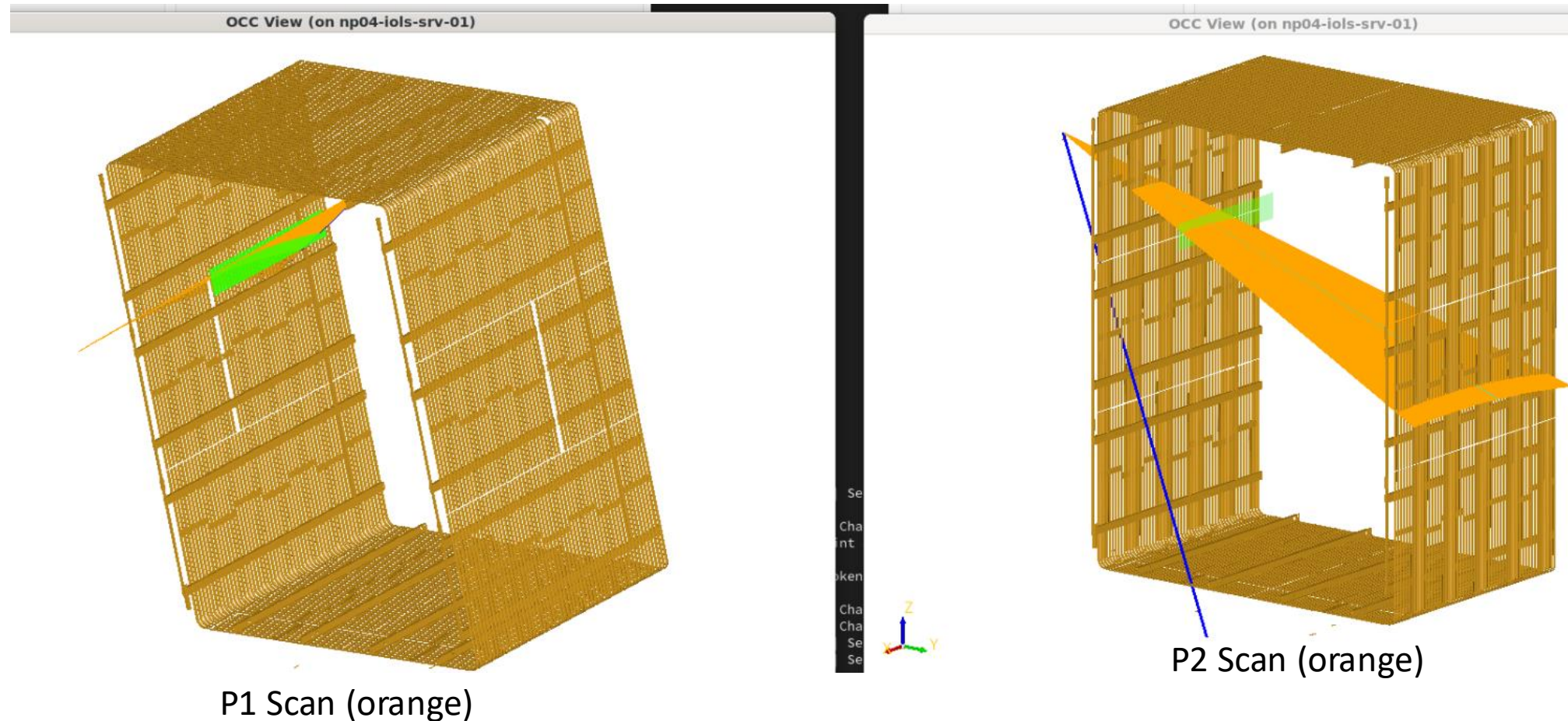


P1 scan of the rotary stage for a fixed position of the steerable mirror



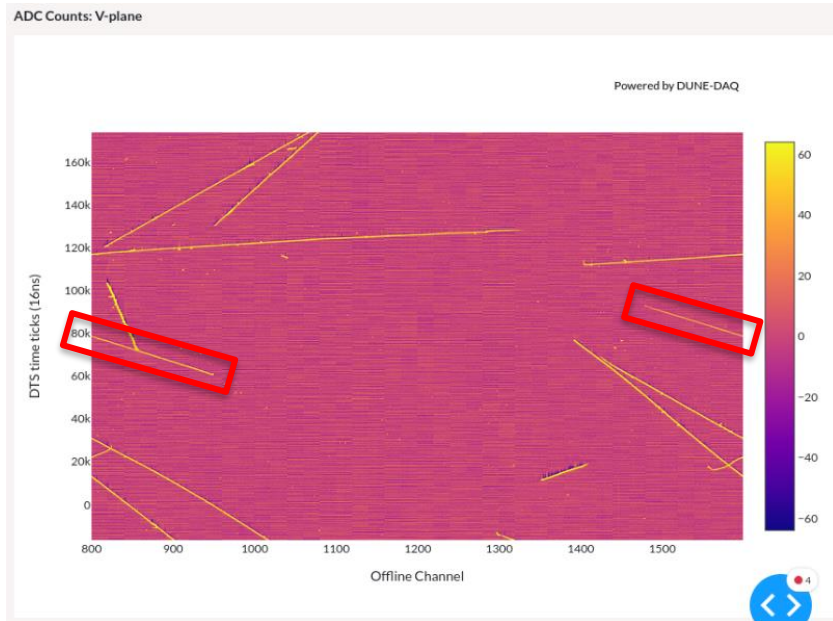
Crossing Track Region Example

- Crossing region shown in green for both periscopes

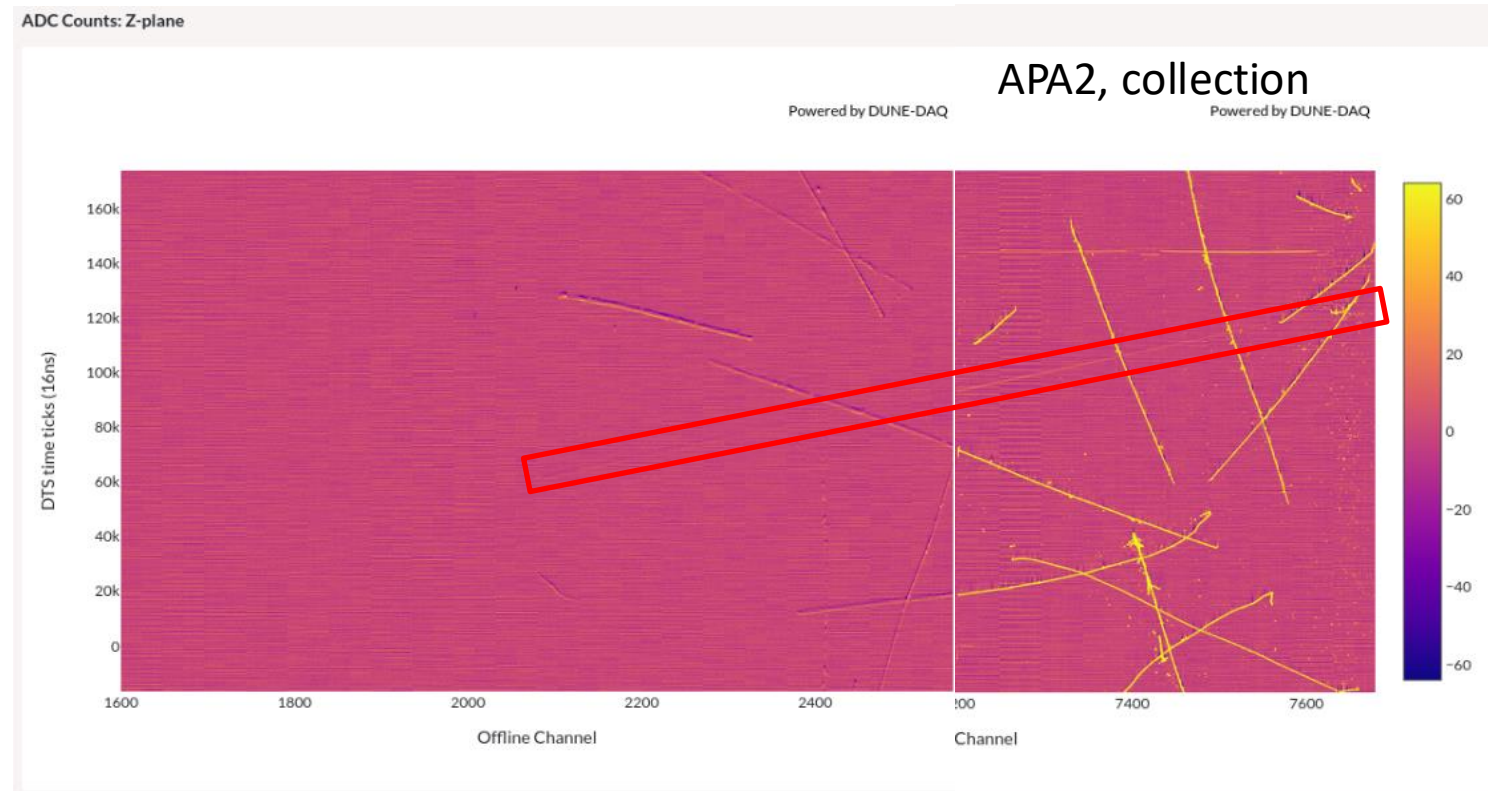


First P2 Downstream-Going Tracks

- Part of the scans defined for crossing-track candidates

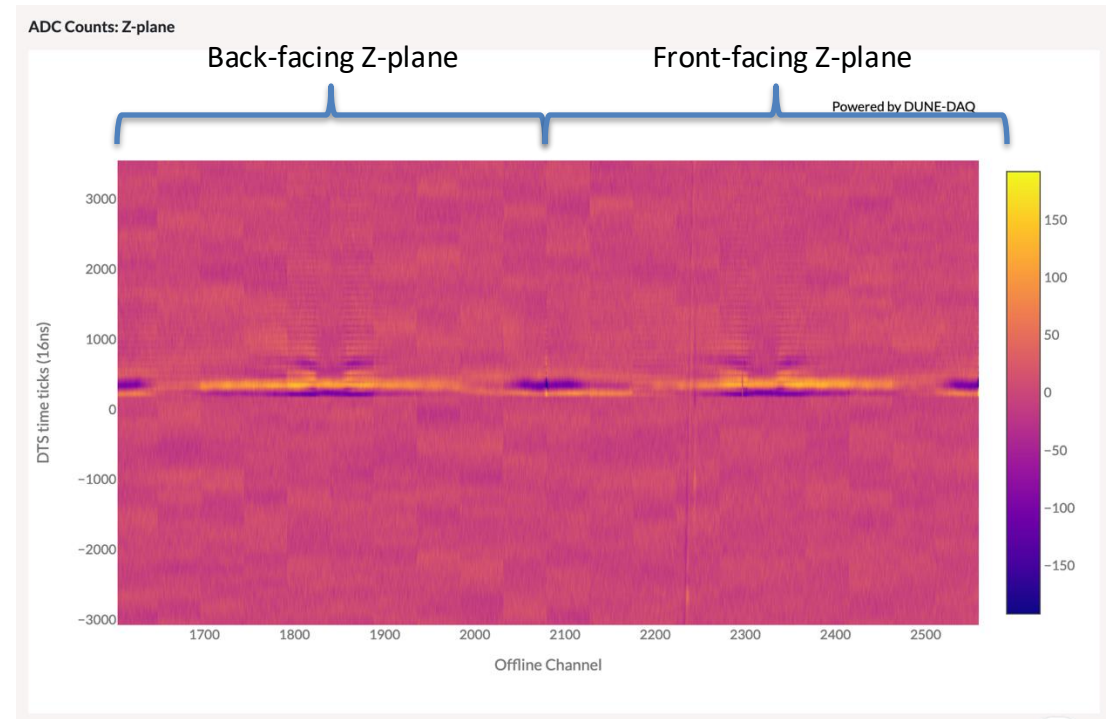


Collection on the v-plane for APA1

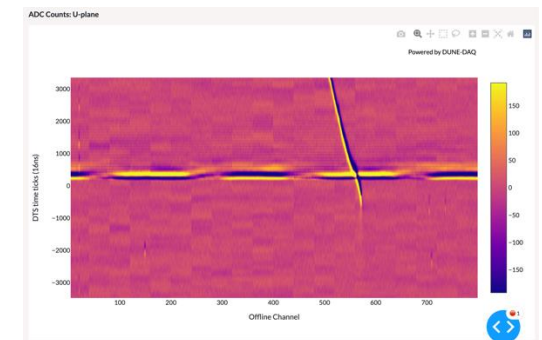
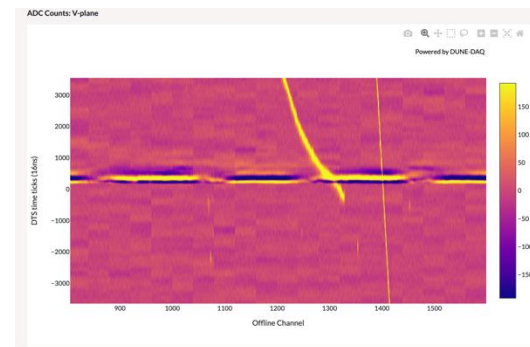


Laser artefact

- Noticed a response of the cold electronics (all APAs) associated with the laser light entering the detector (near t_0)
 - *Not present* when the laser is flashing but blocked and not entering through the optical feedthrough into the detector
 - Observed with both P1 and P2 runs
 - Relatively insensitive to intensity of the laser being fired
- Full details can be found in [slides](#) presented at NP04 coordination meeting

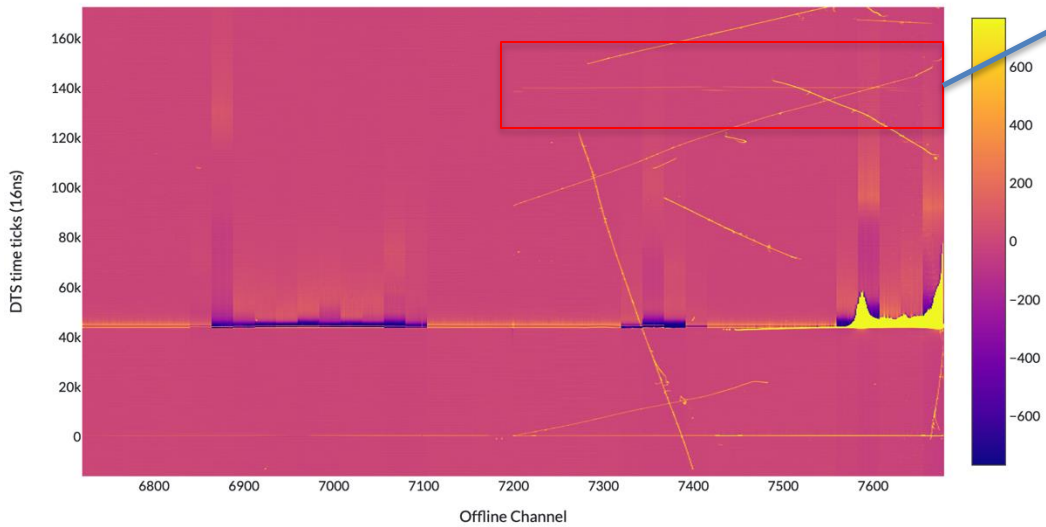


Run
32774,
APA1

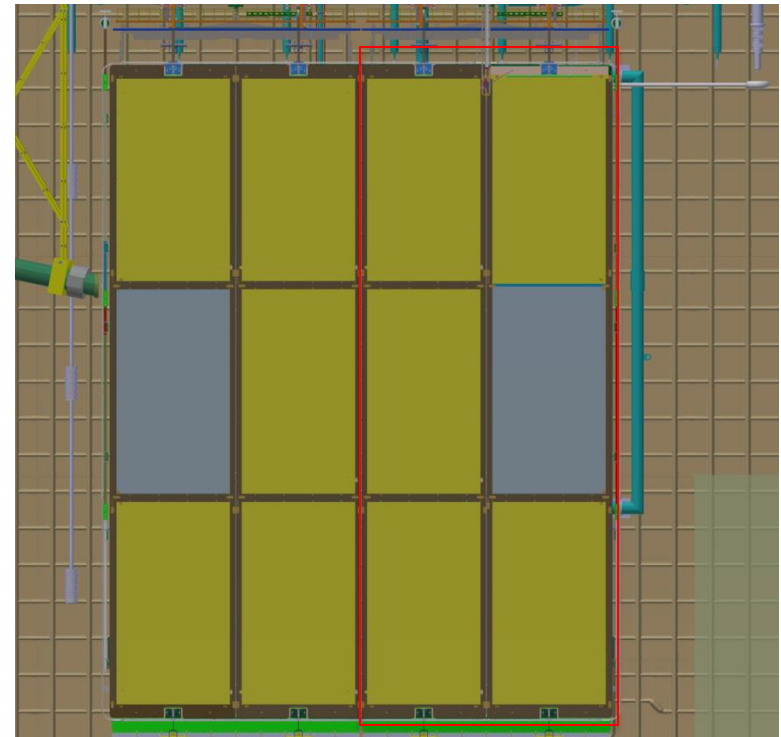
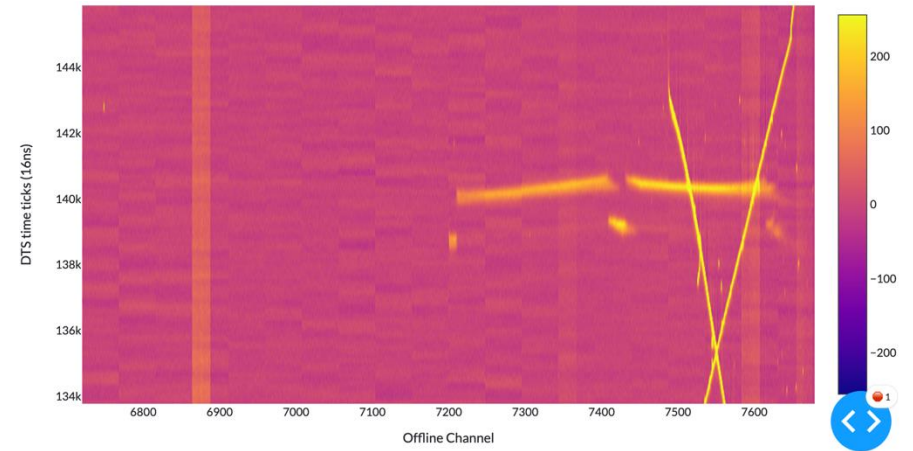


Induction planes (v on the left, and u on the right)

Sneak peek



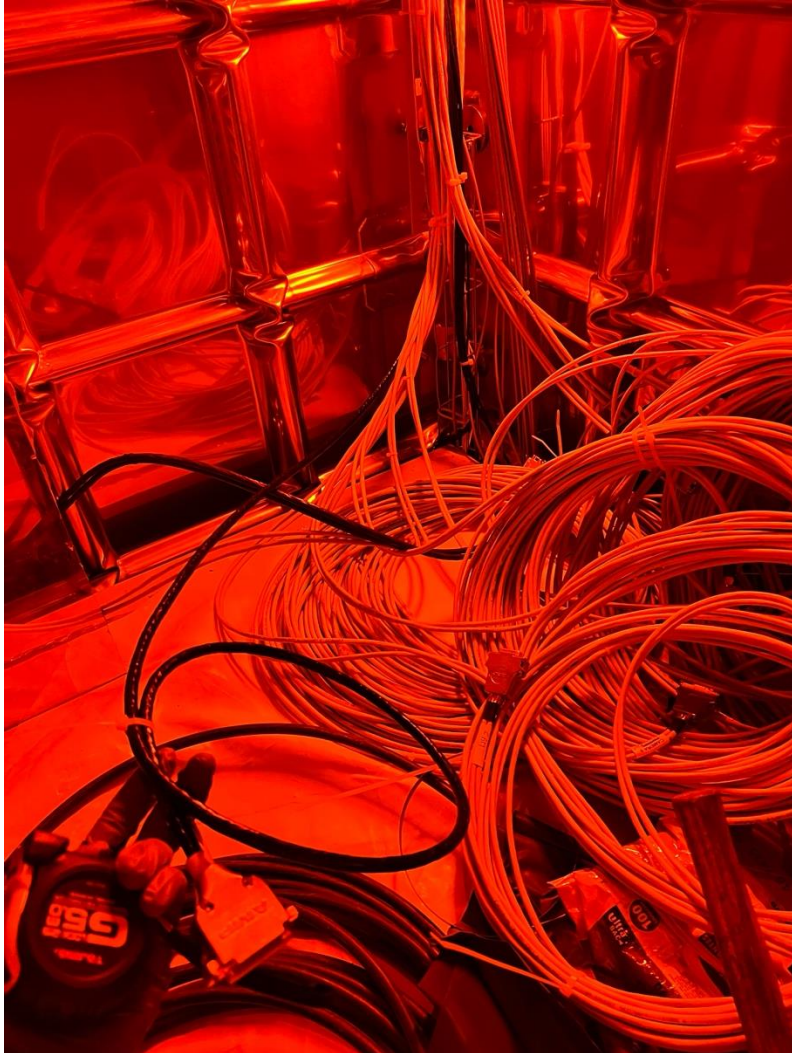
Run 32793, Trigger Record 628
APA2 collection, full view



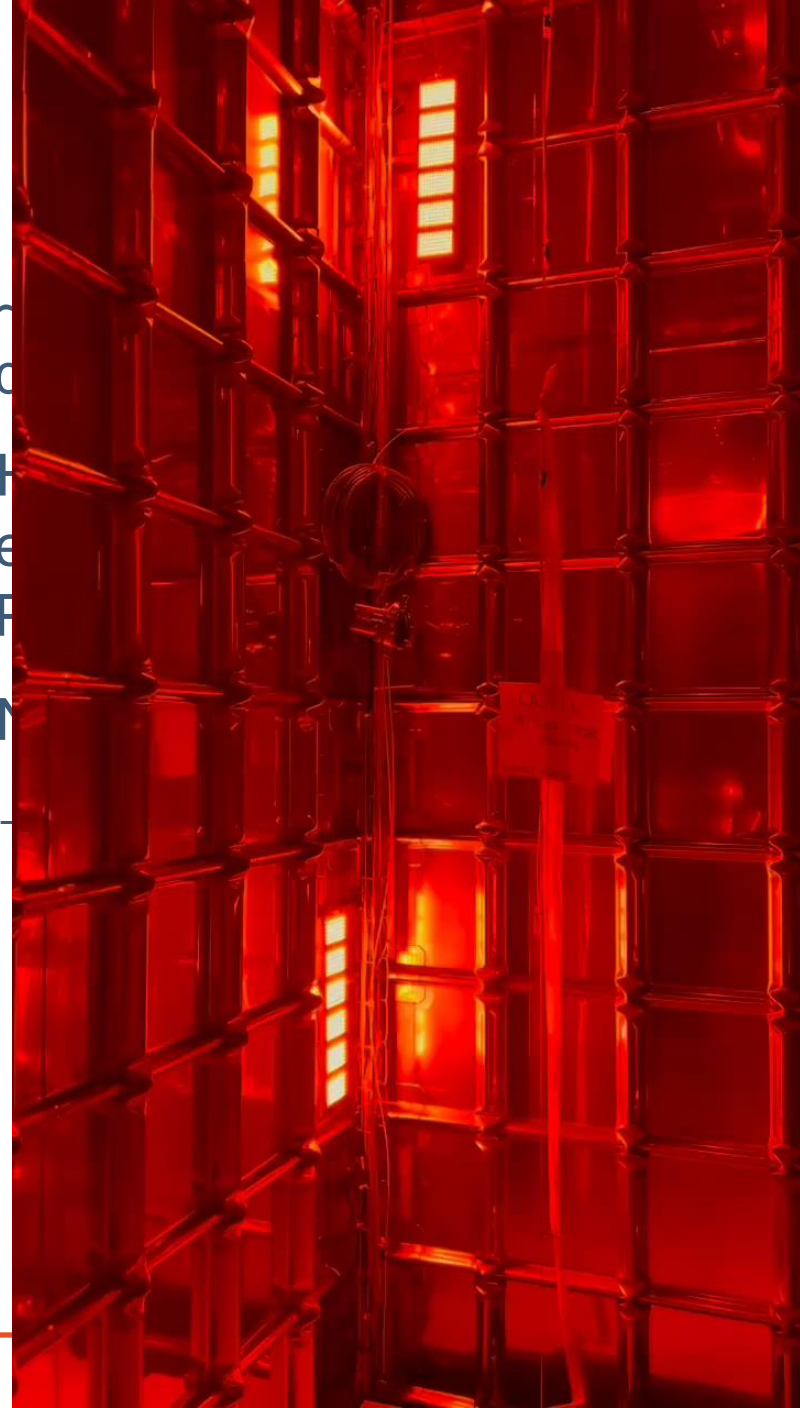
VD: Schedule updates

- PIN diode module installed – Sunday November 24th
- Laser feedthrough and periscope installation – Tuesday November 26th
- Laser stand installation scheduled for month of February
 - Shipments from LANL and LIP being prepared

PINdiode cable

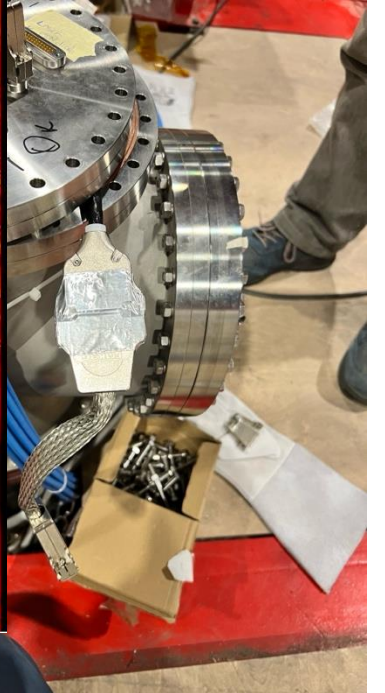


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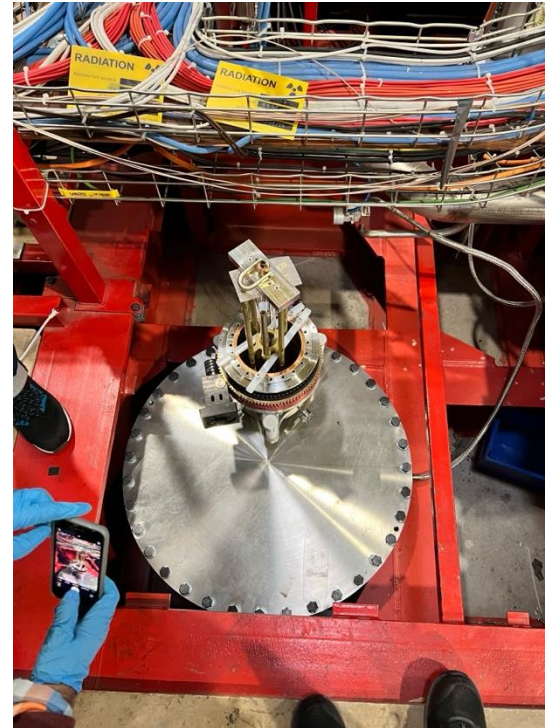
VD – PIN diodes

- Successful installation of the PIN diodes
 - November 24th
 - Verified that signals could be seen at the external flange extension
 - Used Class



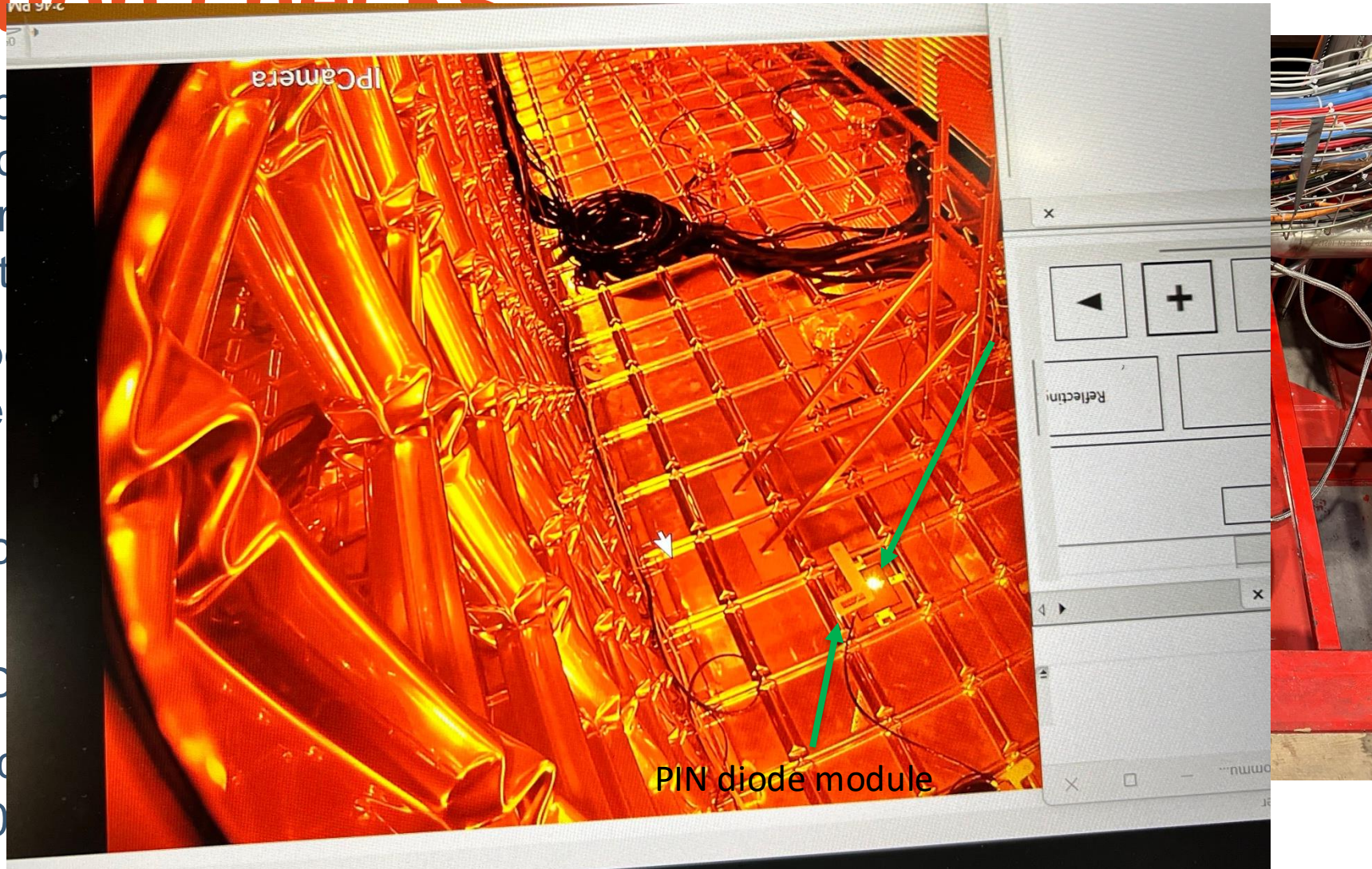
Successful Periscope installation

- Tuesday, November 26th



Installation checks

- Completed a pre-cleanroom prep Class 3B laser camera mounting
- Installed the pre-roughly pointed module
- Checked the camera - VERY GOOD
- Still need to add for the RNN60



VD

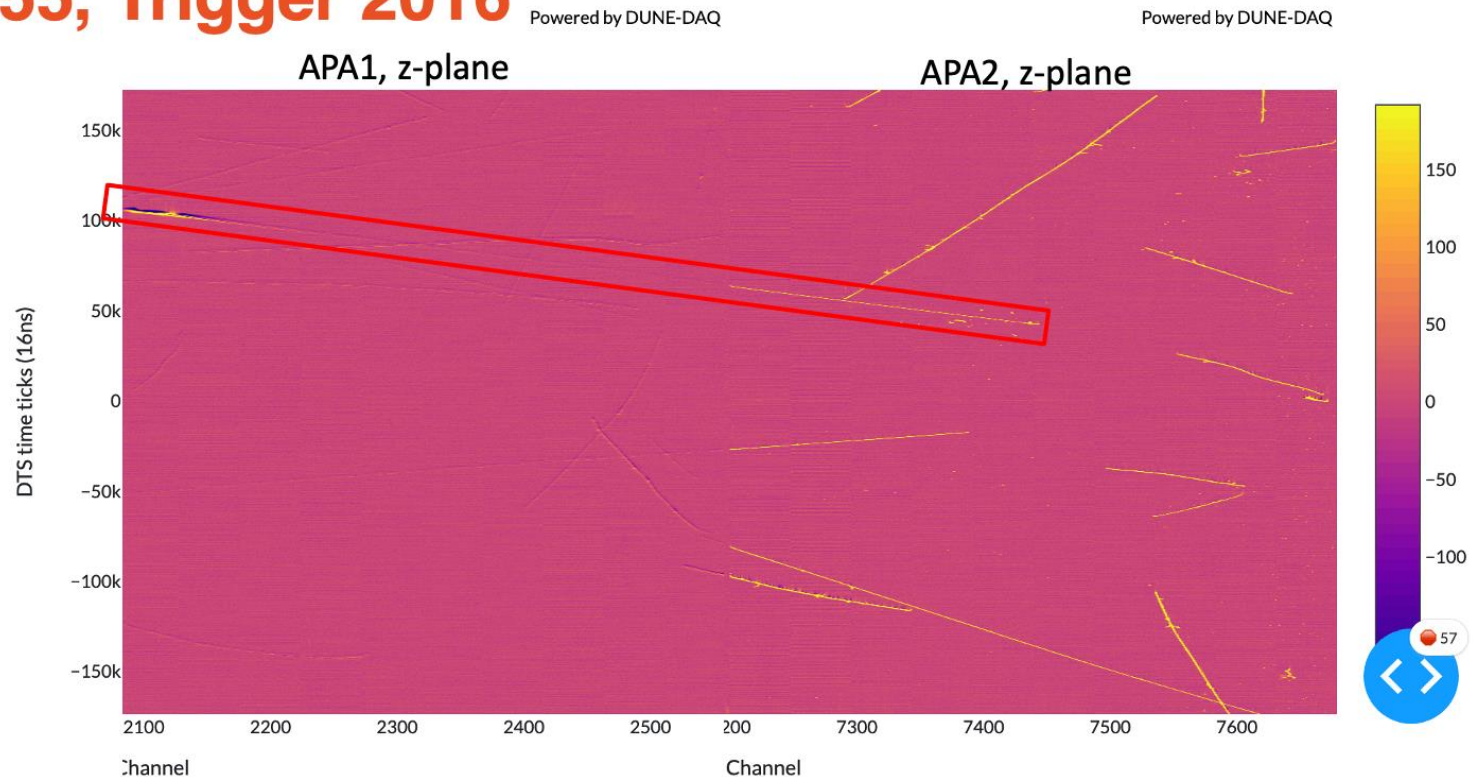
- Status of the VD roof:



P1 Upstream-Going Tracks

- P1 aimed towards upstream end of NP04
- ~25 degrees w.r.t. APA

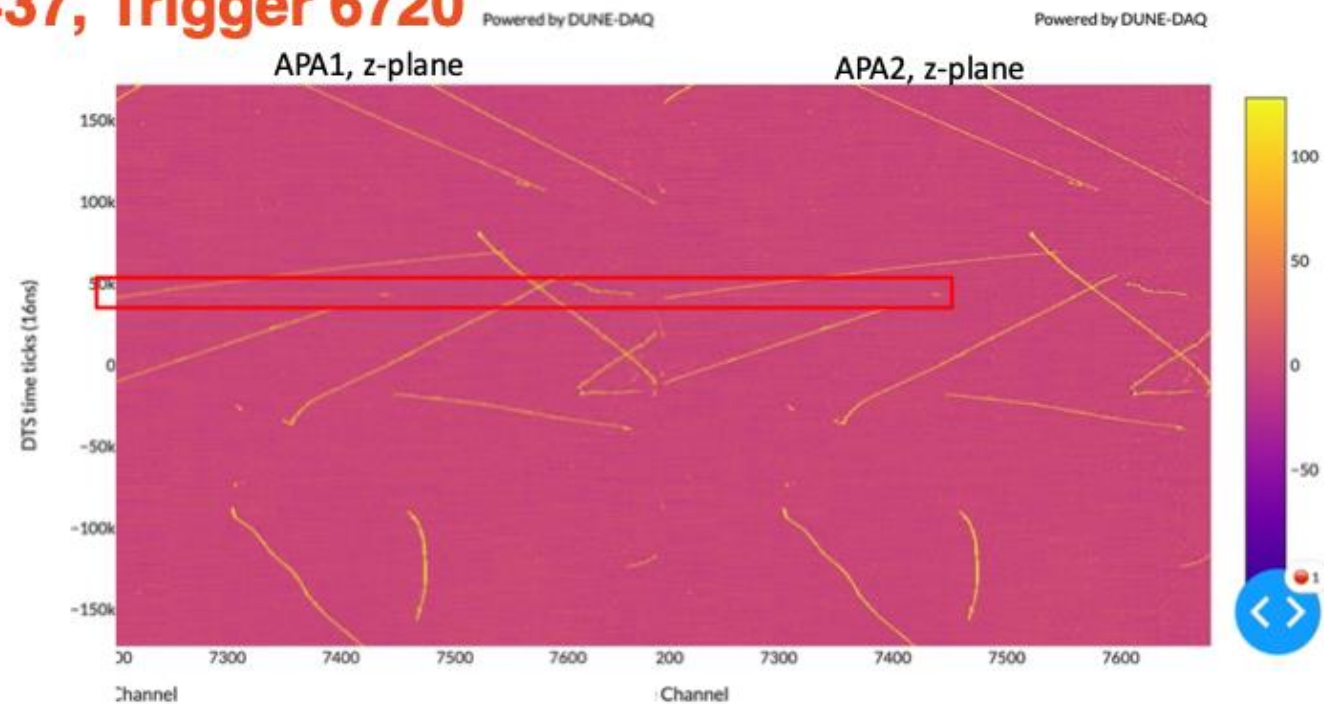
Run31355, Trigger 2016



P1-Parallel APA tracks (Oct. 23)

- Parallel tracks easy w/ P1
 - Rotated 25 degrees in opposite direction from previous run

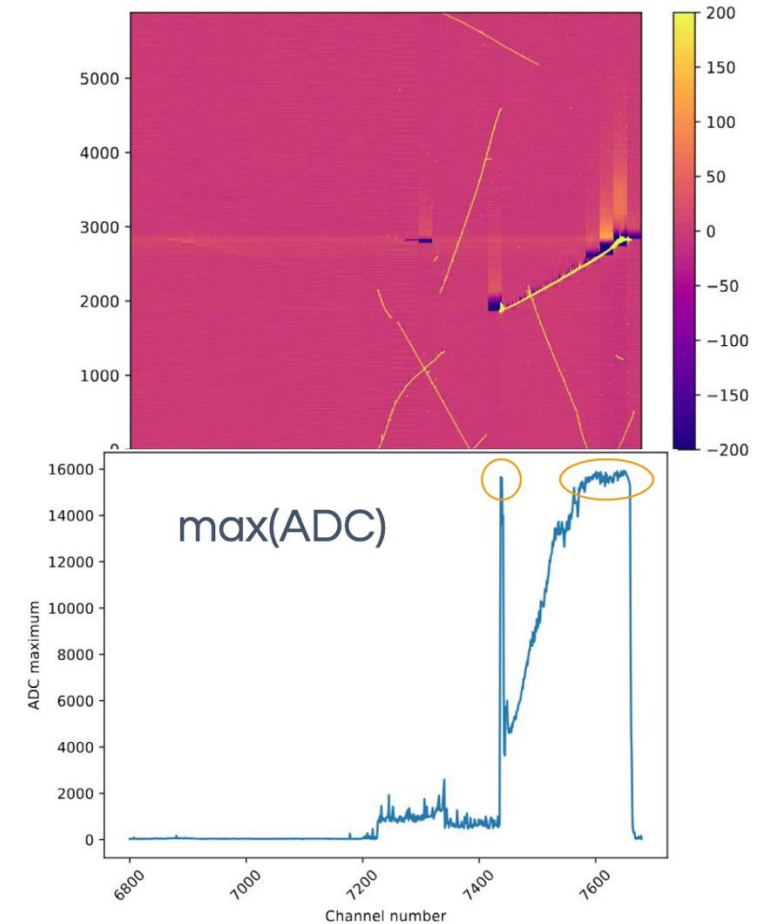
Run31437, Trigger 6720



Analysis

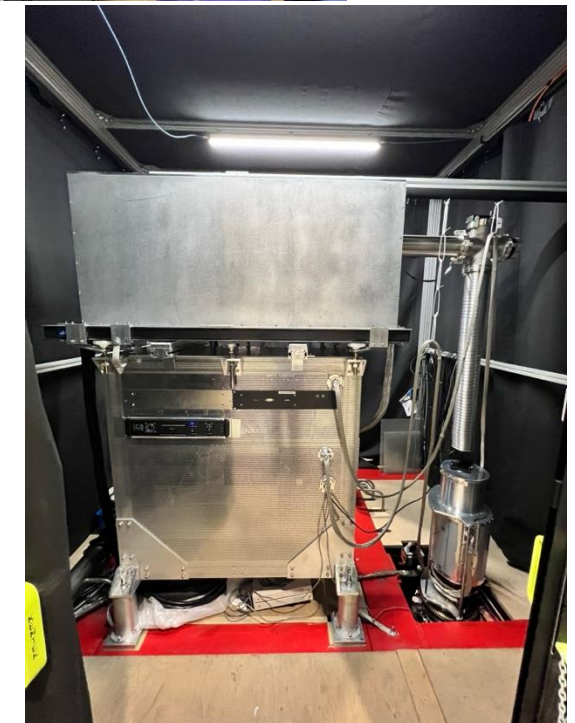
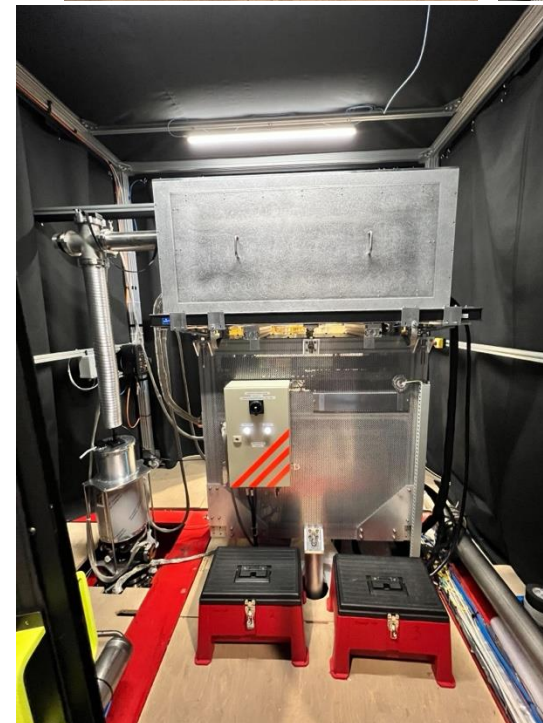
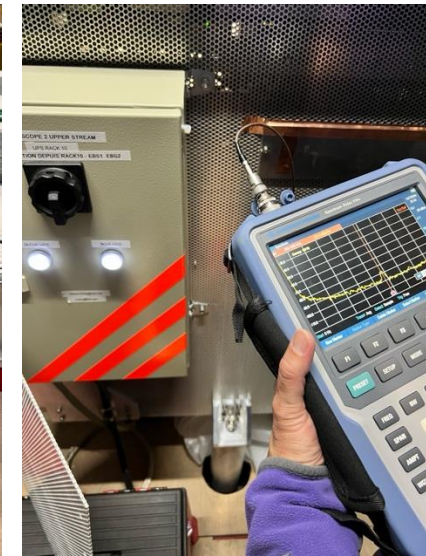
- Ramping up on the analysis
 - [Raw data studies](#) by W. Campanelli and C. Vilela @LIP
- MC Reco analysis being taken up by C. Palacios (SULI student @LANL) and new member of the team

TPC saturation



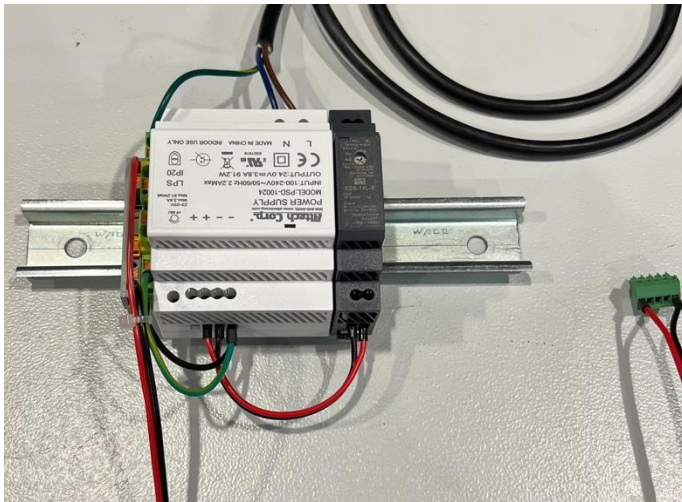
Electrical review

- Second grounding review by Terri & Linda in late September
 - No noticeable change in the noise found while searching w/ antenna and spectrum analyzer
 - (Not even with the fans running at full blast!)
 - Redid some of the grounding to lower the impedances and cleaned up existing grounding using wide, Aluminum tape



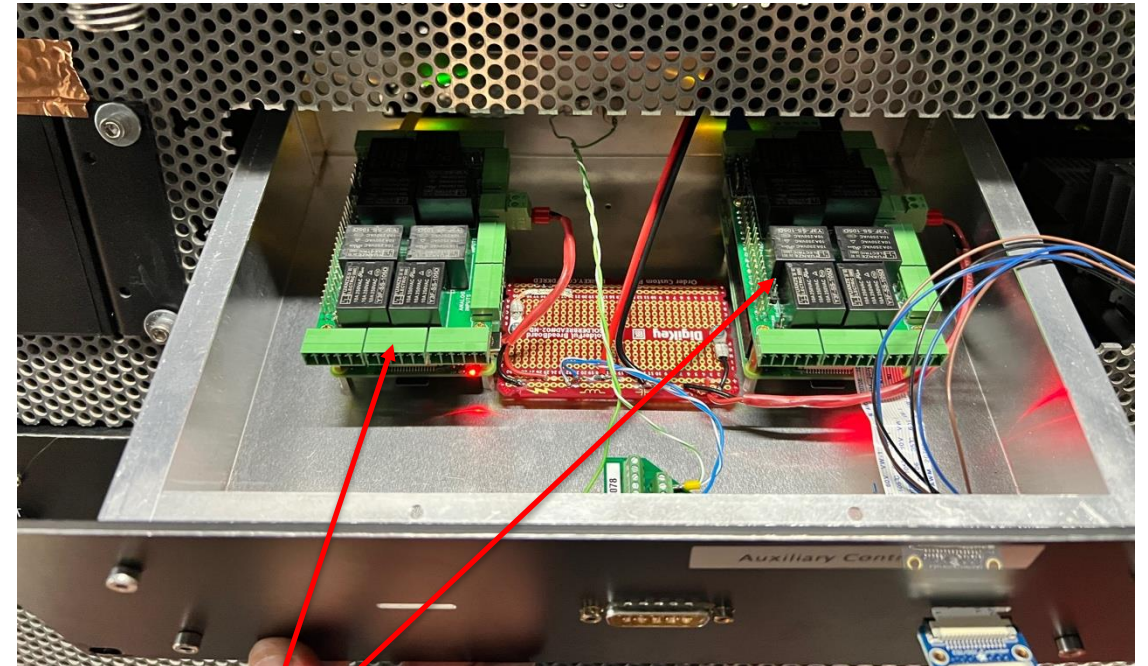
Miscellaneous

- Finished RPi Auxiliary Controls Box
 - Fans mounted inside the laser stand can be controlled remotely via Rpi and relay board
- Cleanroom re-organized and cleaned in preparation for arrival of P3



Power rail for fans and RPIs

Auxiliary Controls Box



Relay boards

Rpi camera extender board

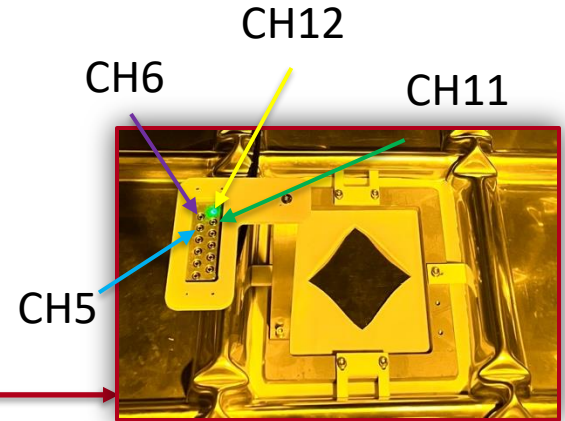
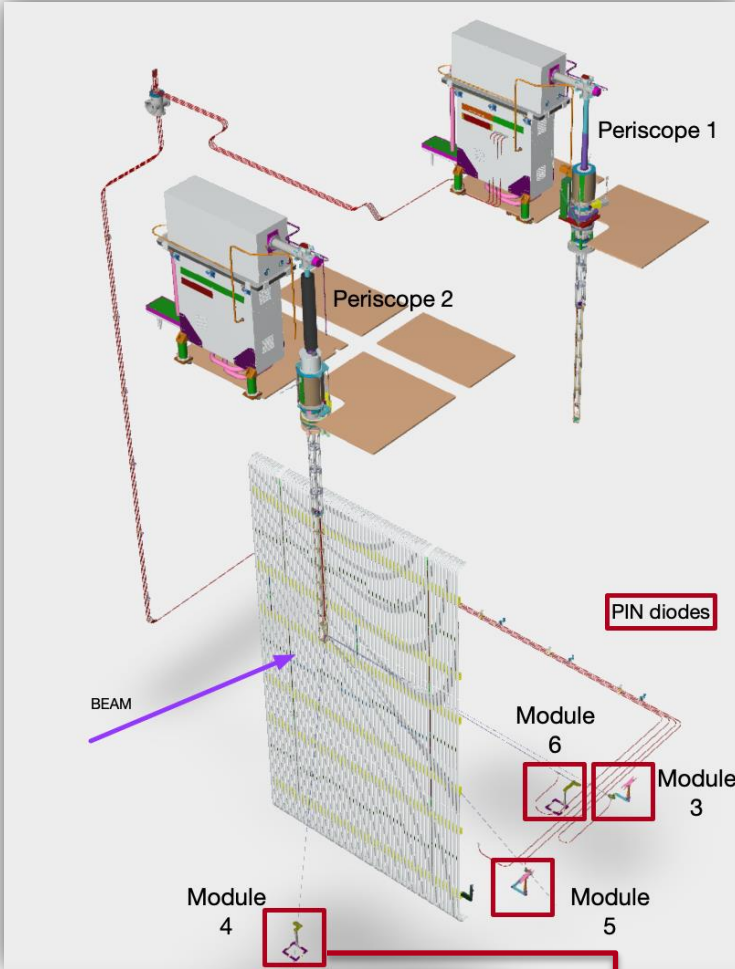
Laser Periscope 2 (P2) Updates

#	Server	Node Id	Display Name
1	open62541...	NS2[String]LS1.PM1.average_options	average_options
2	open62541...	NS2[String]LS1.PM1.average_options	average_options
3	open62541...	NS2[String]LS1.PM1.average_reading	average_reading
4	open62541...	NS2[String]LS1.PM1.average_window	average_window
5	open62541...	NS2[String]LS1.PM1.baud_rate	baud_rate
6	open62541...	NS2[String]LS1.PM1.id	id
7	open62541...	NS2[String]LS1.PM1.measurement_mode	measurement_mode
8	open62541...	NS2[String]LS1.PM1.measurement_options	measurement_options
9	open62541...	NS2[String]LS1.PM1.port	port
10	open62541...	NS2[String]LS1.PM1.pulse_length_options	pulse_length_options
11	open62541...	NS2[String]LS1.PM1.pulse_width	pulse_width
12	open62541...	NS2[String]LS1.PM1.range_options	range_options
13	open62541...	NS2[String]LS1.PM1.range_selected	range_selected
14	open62541...	NS2[String]LS1.PM1.serial_number	serial_number
15	open62541...	NS2[String]LS1.PM1.state	state
16	open62541...	NS2[String]LS1.PM1.trigger_threshold	trigger_threshold
17	open62541...	NS2[String]LS1.PM1.wavelength	wavelength
18	open62541...	NS2[String]LS1.A1.acceleration	acceleration
19	open62541...	NS2[String]LS1.A1.baud_rate	baud_rate
20	open62541...	NS2[String]LS1.A1.deceleration	deceleration
21	open62541...	NS2[String]LS1.A1.device_port	device_port
22	open62541...	NS2[String]LS1.A1.id	id
23	open62541...	NS2[String]LS1.A1.idle_current_setting	idle_current_setting
24	open62541...	NS2[String]LS1.A1.max_speed	max_speed
25	open62541...	NS2[String]LS1.A1.motor_state_options	motor_state_options
26	open62541...	NS2[String]LS1.A1.moving_current_setting	moving_current_setting
27	open62541...	NS2[String]LS1.A1.offset	offset
28	open62541...	NS2[String]LS1.A1.resolution_options	resolution_options
29	open62541...	NS2[String]LS1.A1.resolution_setting	resolution_setting
30	open62541...	NS2[String]LS1.A1.serial_number	serial_number
31	open62541...	NS2[String]LS1.A1.state	state
32	open62541...	NS2[String]LS1.A1.transmission	transmission
33	open62541...	NS2[String]LS1.A1.position	position

Major progress in commissioning activities for the Ionization Laser System:

- EndWall periscope design working stably
- Successfully aimed and hit PIN diodes channels using Class IV UV laser
- Calibration Interface Board (CIB) successfully used to trigger on laser shots → DAQ readout for P2 events
- Slow Controls (SC) integration of the Laser Systems progressing and nearly complete

Laser system SC parameters

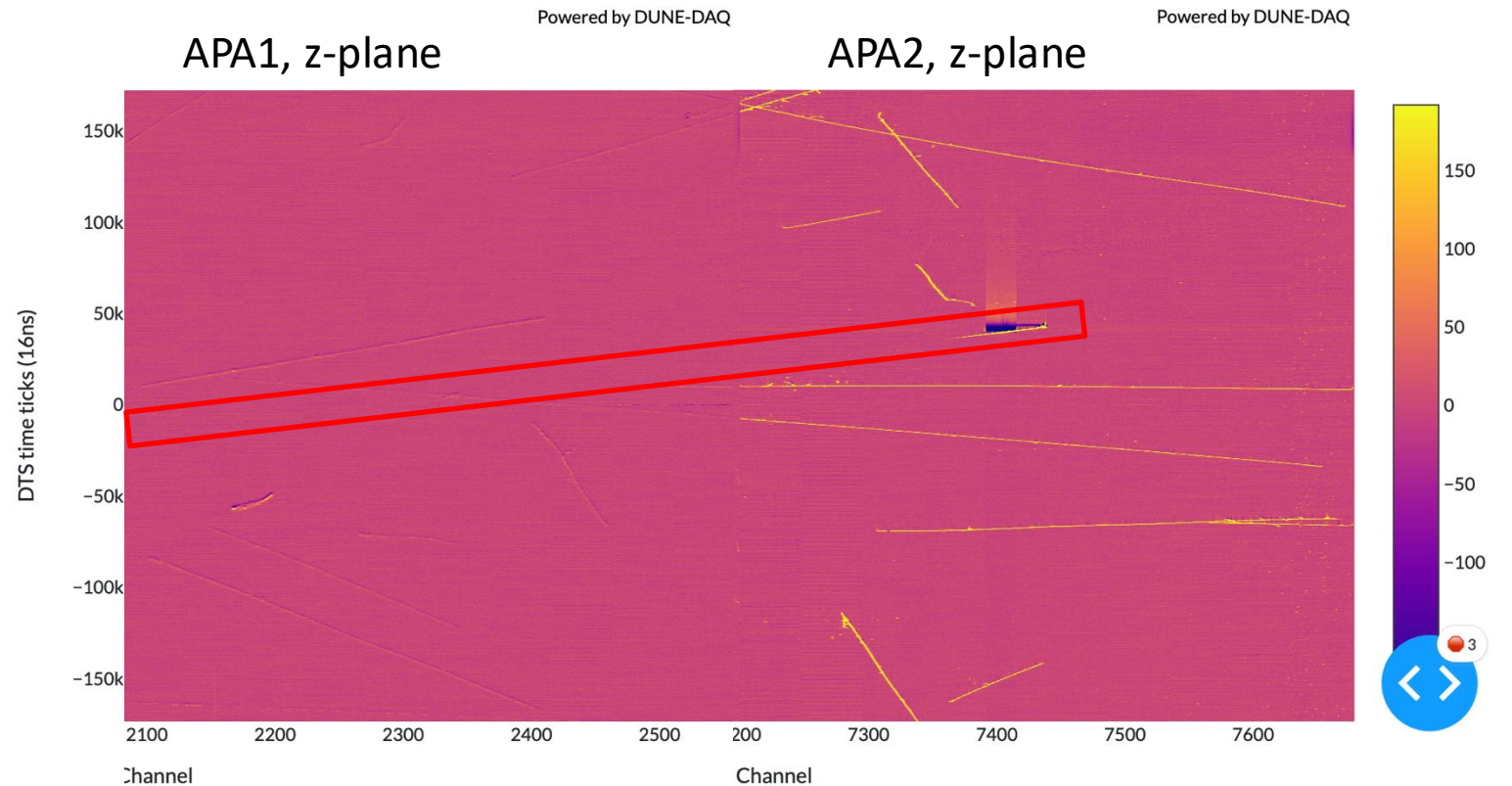


PIN diode CH12 and nearest neighbor response to UV in LAr from a direct hit to CH12

P1 PIN diode tracks (Oct. 24)

Run319, Trigger 6720

- Used the geoNavigator to generate the coordinates for any PINdiodes visible to P1
- Partial track and large signal observed in the right channel

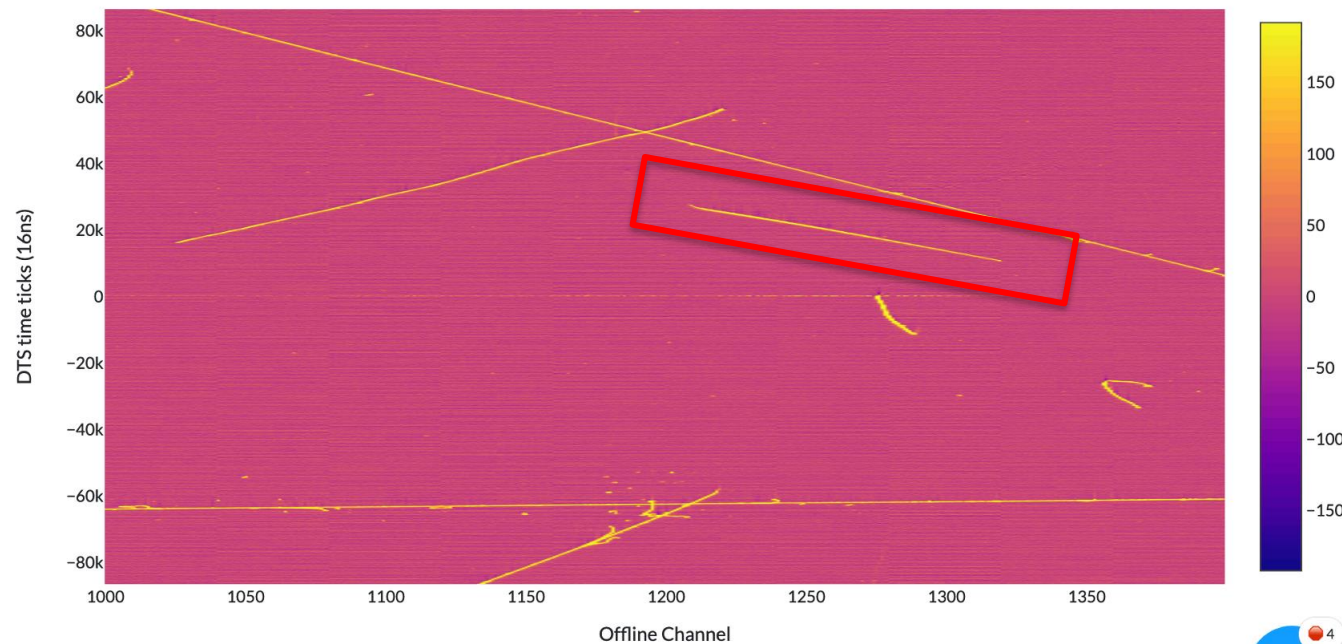


First Confirmed P2 Laser track events

ADC Counts: V-plane

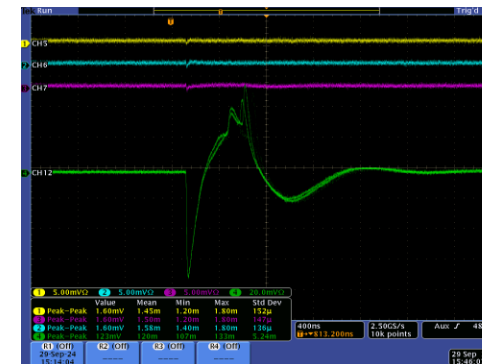
Run 29390 Trigger 1120, APA1

Powered by DUNE-DAQ



Event display for events triggered by P2 while aimed at PIN diode Module 5, CH12.

- P2 aimed at PIN diode Module 5, CH12
- Module is mounted onto bottom-end of the APA1 frame and sits beneath the field cage
 - Two field cage gaps must be crossed to hit
- Energy ramped up from 100 μJ \rightarrow 14 mJ
- Laser track entering the field cage and exiting the field cage captured in run 29390

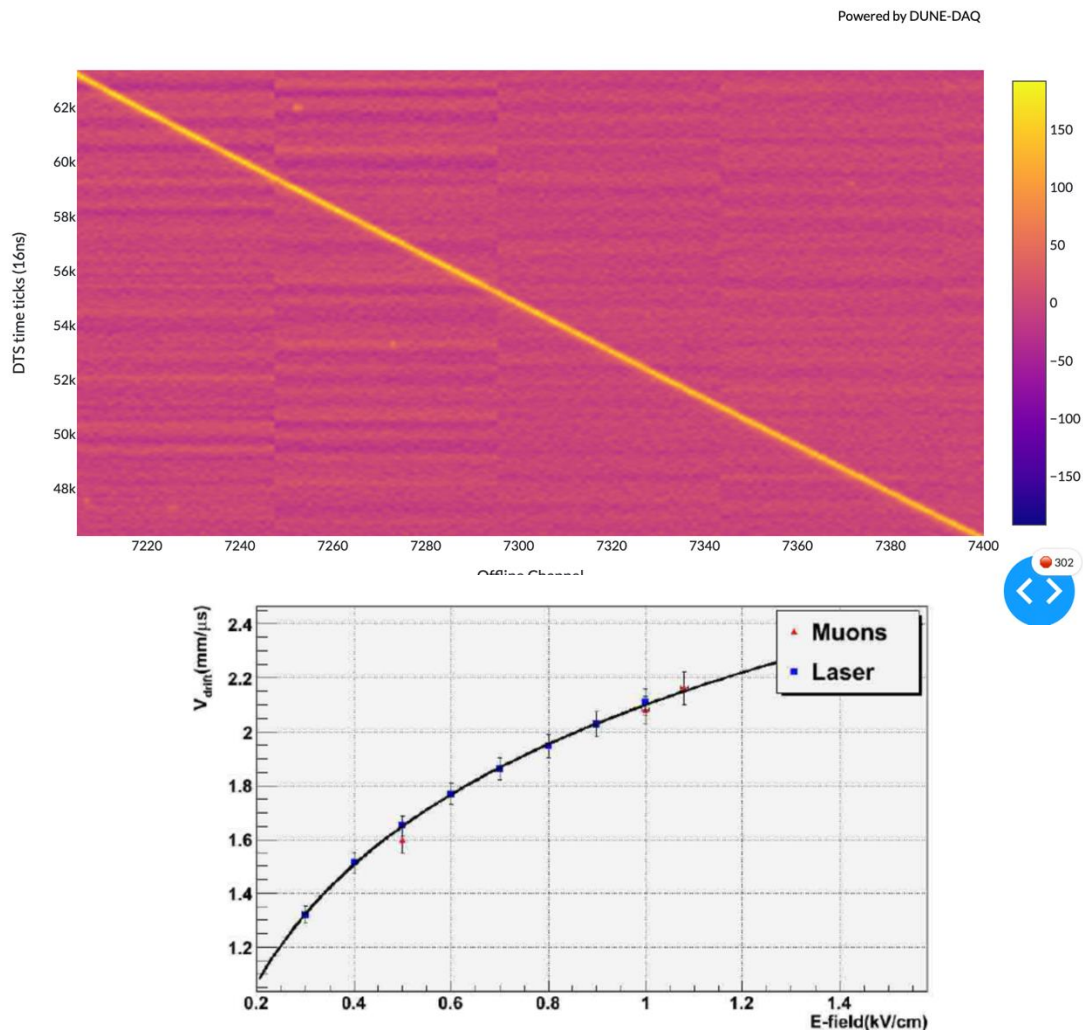


Response from PIN diode CH12 (green) to 100 μJ of UV



Response from PIN diode CH12 (green) to 14 mJ of UV

Back-of-the-envelope calculation



- Track angle
 - 897.5 mm
- 200 collection channels (4.875 mm wire pitch)
 - 17 kticks (16 ns) = 272 μ s
 - 1.65 mm/ μ s drift velocity at 500 V/cm
 - 448.8 mm
- $\text{Atan}(448.8/897.5) = 26$ degrees