

Photon Detection System Integration Information for ProtoDUNE

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ProtoDUNE PD System Information, Nov 2018

Outline

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1. Connecting to CERN network (from outside of CERN)

Connecting to Lxplus & NP04 server

1. Access Requirements

- a. [Click Here](#)

2. Log into lxplus

- a. `ssh -Y <username>@lxplus.cern.ch`
You are now in the CERN domain!

3. Log into NP04 server

(From lxplus machine)

- a. `ssh -Y <username>@np04-srv-XXX.cern.ch`
 - a. 024 -> Run Control
 - b. 012 -> SSP control
 - c. 023 -> Monet (OM) hist-file location

```
np04daq@np04-srv-024:~
ctnacias@ubuntu:~/Downloads$ ssh -Y cmacias@lxplus.cern.ch
Password:
* *****
* Welcome to lxplus082.cern.ch, SLC, 6.10
* Archive of news is available in /etc/motd-archive
* Reminder: you have agreed to the CERN
* computing rules, in particular OCS. CERN implements
* the measures necessary to ensure compliance.
* https://cern.ch/ComputingRules
* Puppet environment: production, Roger state: production
* Foreman hostgroup: lxplus/nodes/login
* Availability zone: cern-geneva-b
* LXPLUS Public Login Service - https://cern.ch/lxplusdoc
* LSF to be decommissioned on Jan 30th 2019. http://cern.ch/go/7Zmn
* *****
[cmacias@lxplus082 ~]$ ssh -Y np04daq@np04-srv-024.cern.ch
Last login: Mon Nov 26 18:33:57 2018 from lxplus028.cern.ch

Disk usage: 57% (1250GB remaining in /nfs/sw)

[np04daq@np04-srv-024 ~]$
```

View/Use Run Control

1. Log into np04-srv-024

(From lxplus machine)

a. `ssh -Y np04daq@np04-srv-024`

2. Open Run Control

a. Type "RC"

3. How to use RC

a. [Click Here](#)

The screenshot displays the NP04RC: FW_SYSTEM_OVERVIEW_TOOL interface. The top bar shows the system name and a user 'cmacias'. The main area is divided into several sections:

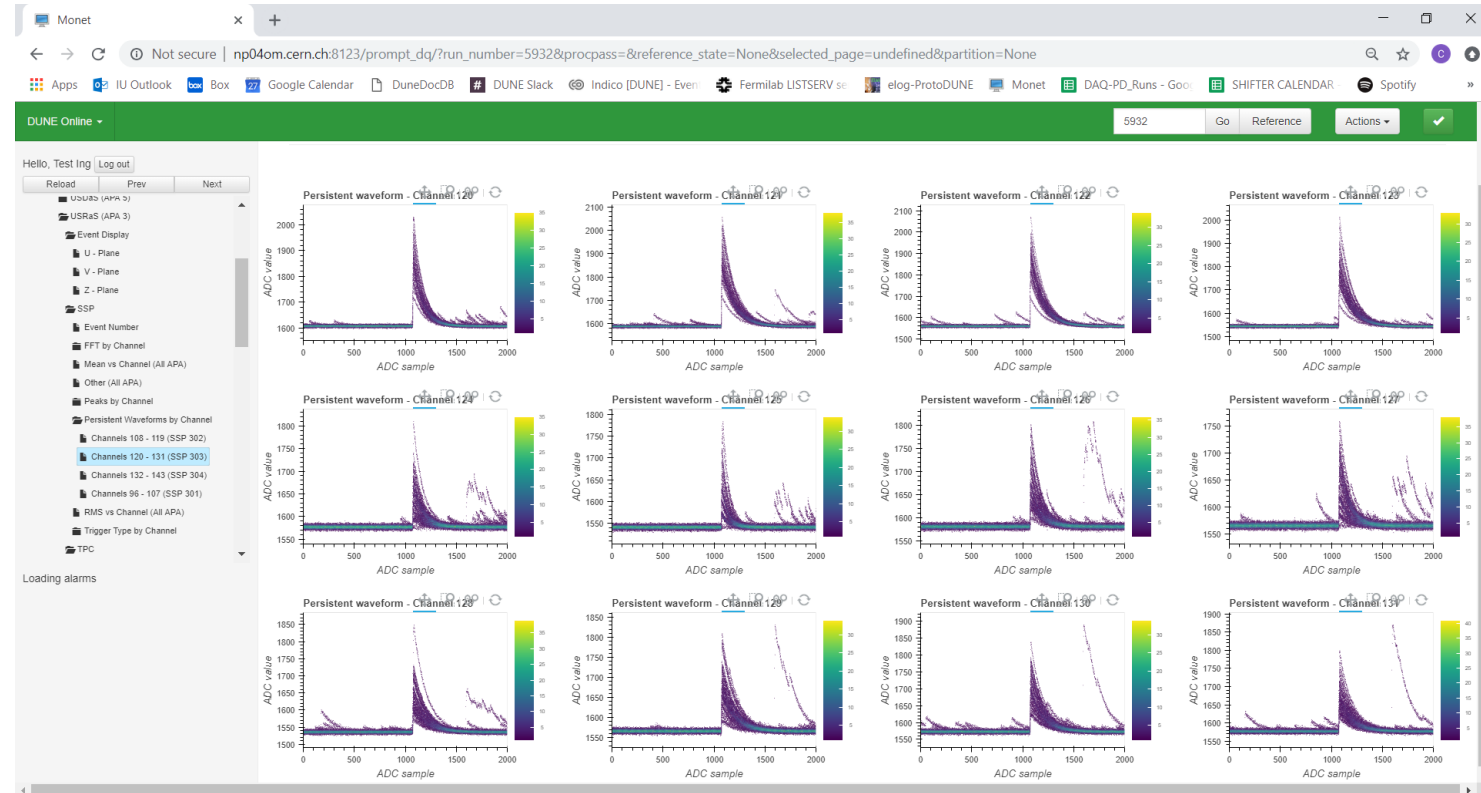
- System State:** Shows 'Partition_0' as 'RUNNING' with a green indicator.
- Sub-System State:** A table listing sub-systems and their states:

Sub-System	State
ProcessManager_0	RUNNING
BoardReaders_0	RUNNING
EventBuilders_0	RUNNING
Monitoring_0	RUNNING
InhibitMaster_0	RUNNING
RoutingMaster_0	RUNNING
- Run Control:** Includes a 'Run Number' field (5941) with a 'RUNNING 01:02:20' status, 'Fake Trigger Options' (Trigger rate: 2.00 Hz, Random checked), and an 'Inhibit Master' section with a green light indicator.
- Configuration:** Shows 'Run type: Test' and 'artdaq folder selection' set to '/mfs/sw/work_dirs/dune-artdaq_artdaq_v3_03_00_beta'.
- Run summary:** A scrollable text area containing details like 'Run number: 5941', 'Run type: Test', 'Partition Number: 0', 'User: stufanli', 'Start time: Tue 27 Nov 2018 01:57:47 PM CET', and a list of enabled devices and their ports.

A sidebar on the right contains various tool icons: Settings, Trends, Logs, RCE, FELIX, Tree, Logviewer, and Help.

Online Monitoring

1. Need to be connected to CERN network
2. Information on connecting to OM
 - a. [Click Here](#)
3. Quick way: create ssh tunnel
 - a. `ssh -N -D 8080 <username>@lxplus.cern.ch`
 - b. Tell Firefox to use the proxy on your machine (explained in link above)
4. View Runs on Monet
 - a. http://np04om.cern.ch:8123/prompt_dq/
5. Hist root files on Monet found:
 - a. `np04daq@np04-srv-023/OMoutput/OMoutput/`



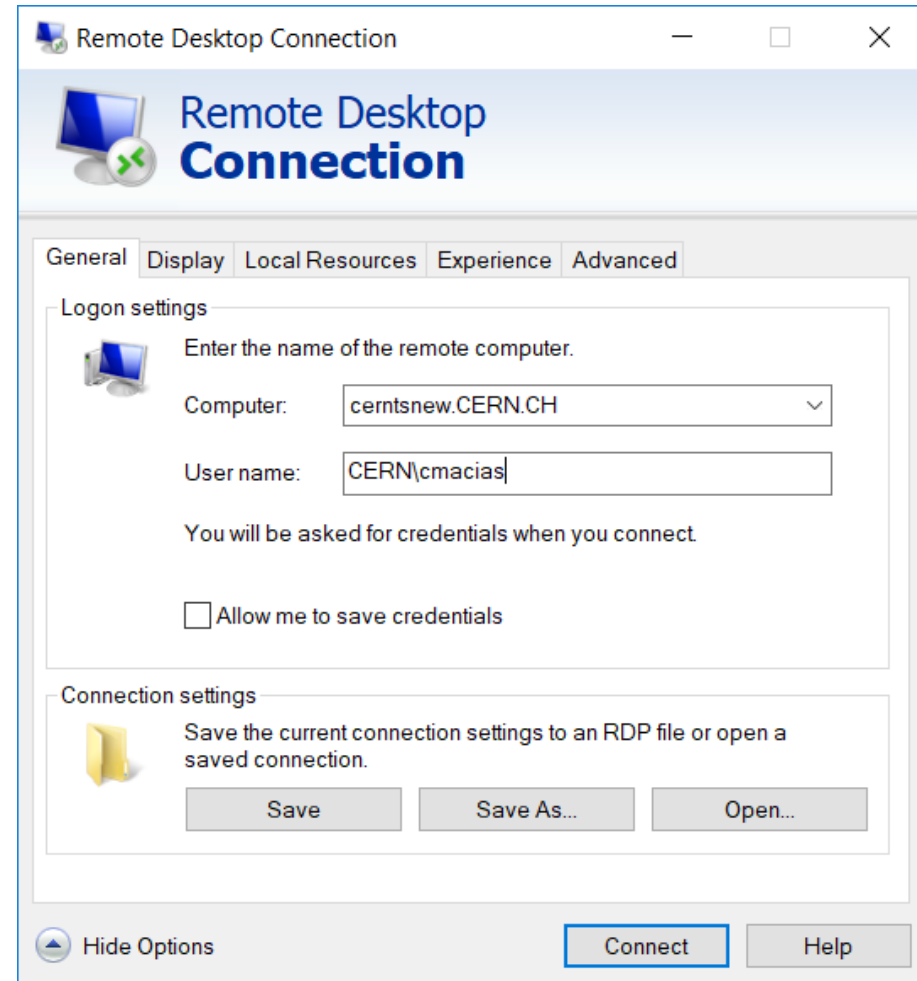
Connecting to Slow Control (DCS)

1. Connect to CERN network

- a. Via HOME Remote Desktop
 - Computer: *cerntsnew.CERN.CH*
 - Username: CERN*<username>*

2. Connect to DCS Network

- a. Via Remote Desktop
 - Computer: *cerntsice.CERN.CH*
 - *NOTE: different than above!*
 - Username: CERN*<username>*



Connecting to Slow Control (DCS)

1. Connect to CERN network

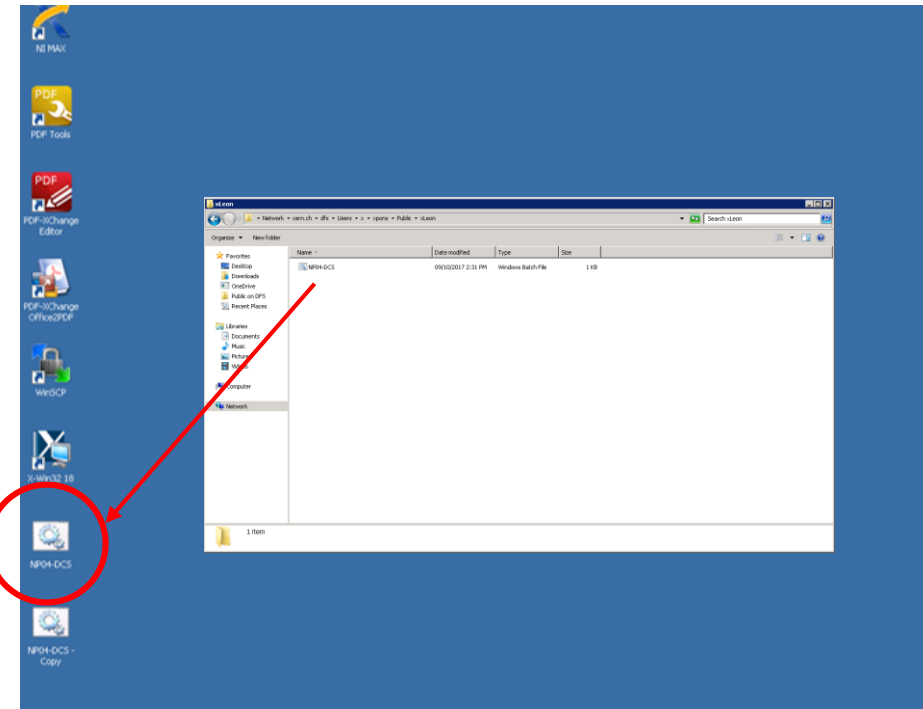
- a. Via HOME Remote Desktop
 - Computer: *cerntsnew.CERN.CH*
 - Username: CERN*<username>*

2. Connect to DCS Network

- a. Via Remote Desktop
 - Computer: *cerntsice.CERN.CH*
 - Note: May need to be added to list*
 - Username: CERN*<username>*

3. Open NP04-DCS

- a. Located:
<\\cern.ch\dfs\Users\x\xpons\Public\xLeon> *



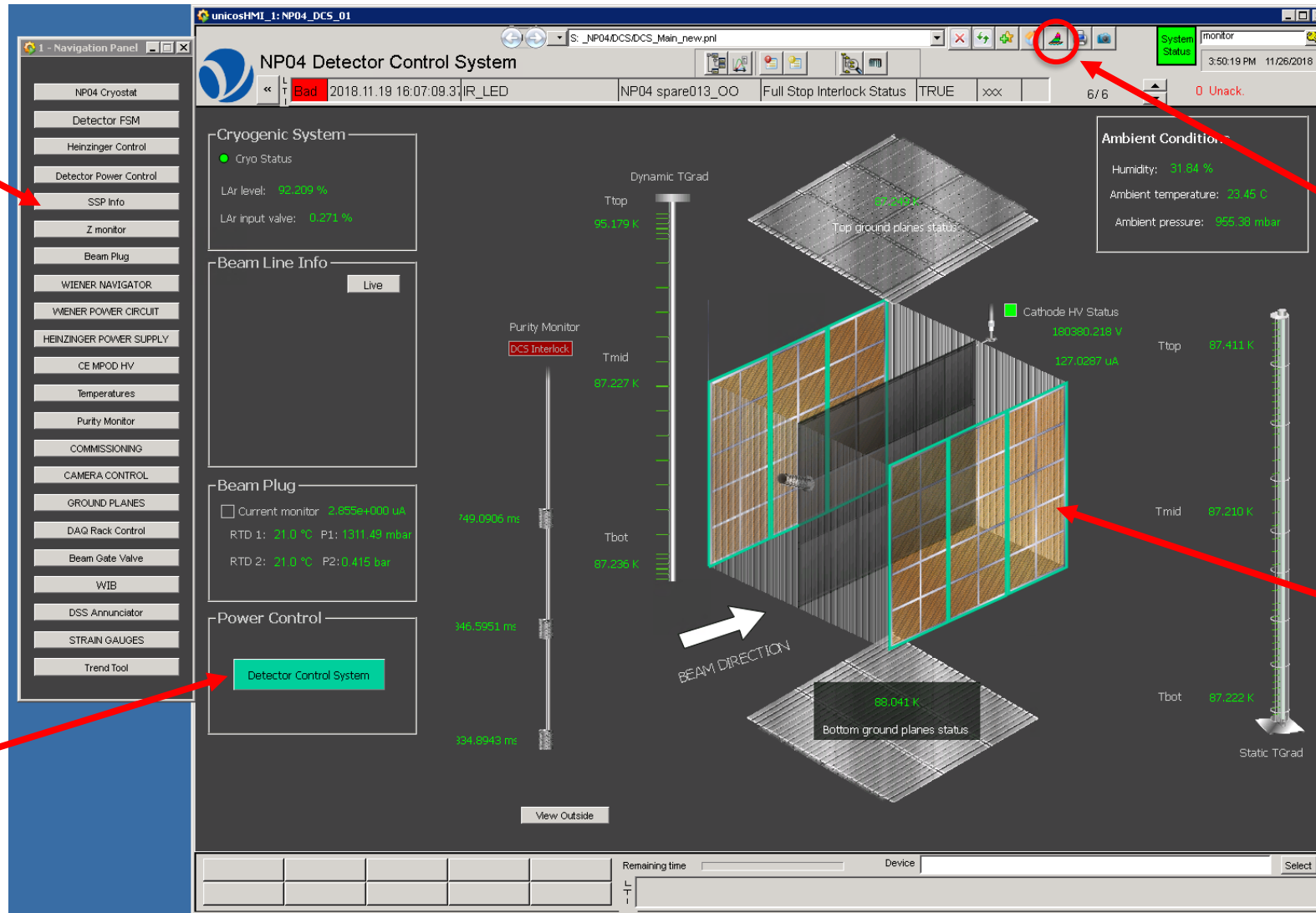
*Contact Xavier.Pons@cern.ch for additional help

2. Navigating Through Slow Control (DCS)

Slow Control (DCS) Home Page

Navigation to SSP Info Panel

For Easy Detector Control



Access to Navigation panel

SSP Control per APA

Turning On/Off Individual SSP Power Supplies

DS-RaS: TOP

Mon 26-Nov-2018 16:15:12

monitor

DS-RaS

System State

APA DS-RaS READY

Photon Detectors READY

PD Power READY

Slot	State	VOLTAGE	CURRENT
Slot_A	READY	22.007 V	1.726 A
Slot_B	READY	22.004 V	1.742 A
Slot_C	READY	22.007 V	1.729 A
Slot_D	READY	21.995 V	1.733 A

PD Bias READY

Slot	State	VOLTAGE	CURRENT
Slot_A	READY	29.996 V	0.089 A
Slot_B	READY	30.240 V	0.088 A
Slot_C	READY	29.998 V	0.084 A
Slot_D	READY	29.998 V	0.040 A

SSP Status

Messages

26-Nov-2018 16:14:56 - *** WARNING - Access Control: User monitor Can Not Operate Detector_Control_System ***

Close

Control SSP- LV

Control SSP- HV

Turning On/Off Entire APA SSP Power Supplies

The screenshot displays the NP04 Detector Control System interface. At the top, the title bar reads "DetectorControlSystem: TOP" and the main title is "NP04 Detector Control System". The system status is "READY". The interface is divided into two main sections: "DaS" (Detector Assembly System) on the left and "RaS" (Readout Assembly System) on the right. Each section contains three sub-sections: "APA DS", "APA MS", and "APA US". Each sub-section has a "READY" status indicator and a list of power supply components: "Photon Detectors", "CE High Voltage", and "CE Low Voltage". A central diagram shows the detector layout with colored lines connecting the power supply components to their respective locations. A red circle highlights the "READY" status of the "Photon Detectors" in the "APA DS-RaS" section, with a red arrow pointing to it from the text "Control LV & HV for ALL SSPs/APA".

Detector Control System: TOP

Mon 26-Nov-2018 16:05:58

monitor

NP04 Detector Control System

Detector Control System **READY**

DaS

APA DS-DaS **READY**

Photon Detectors	READY	✓
CE High Voltage	READY	✓
CE Low Voltage	READY	✓

APA MS-DaS **READY**

Photon Detectors	READY	✓
CE High Voltage	READY	✓
CE Low Voltage	READY	✓

APA US-DaS **READY**

Photon Detectors	READY	✓
CE High Voltage	READY	✓
CE Low Voltage	READY	✓

RaS

APA DS-RaS **READY**

Photon Detectors	READY	✓
CE High Voltage	READY	✓
CE Low Voltage	READY	✓

APA MS-RaS **READY**

Photon Detectors	READY	✓
CE High Voltage	READY	✓
CE Low Voltage	READY	✓

APA US-RaS **READY**

Photon Detectors	READY	✓
CE High Voltage	READY	✓
CE Low Voltage	READY	✓

Messages

26-Nov-2018 16:05:39 - *** WARNING - Access Control: User monitor Can Not Operate Detector_Control_System ***

Close

Control LV & HV
for ALL SSPs/APA

SSP Panel

1 - SSP Info

cmacias

SIPM Control

Turn all channels to nominal bias → ON Bias

Turn all channels to ~1/2 nominal bias → OFF Bias

Load a different config file → Load from file

Set ALL channels to specified voltage → mV Set to All

View ALL channels in THREE different ways

				Target Voltage (mV)											
DIM	SSP	PDTS Status	Free Event Memory	CH 0	CH 1	CH 2	CH 3	CH 4	CH 5	CH 6	CH 7	CH 8	CH 9	CH 10	CH 11
	ssp101	14C8	251658240	26000	26000	26000	26000	26000	26000	26000	26000	26000	26000	26000	26000
	ssp102	1428	251658240	26000	26000	26000	26000	26000	26000	26000	26000	26000	26000	26000	26000
	ssp103	14B8	251658240	26000	0	26000	26000	26000	26000	26000	26000	26000	26000	26000	26000
	ssp104	1428	251658240	0	26000	26000	26000	0	0	0	0	0	0	0	0
	ssp201	14E8	251658240	26000	26000	26000	26000	26000	26000	26000	26000	26000	26000	0	26000
	ssp202	1418	251658240	26000	26000	0	26000	26000	0	26000	26000	26000	26000	26000	26000
	ssp203	14A8	251658240	26000	26000	26000	26000	26000	26000	26000	26000	26000	26000	0	26000
	ssp204	1448	251658240	26000	26000	26000	26000	0	0	0	0	0	0	0	0
	ssp301	14A8	251658240	26000	26000	26000	26000	26000	26000	26000	26000	26000	26000	26000	26000
	ssp302	1448	251658240	26000	26000	0	26000	26000	26000	26000	26000	26000	26000	26000	0
	ssp303	1458	251658240	26000	26000	26000	26000	26000	26000	26000	26000	26000	26000	26000	26000
	ssp304	14F8	251658240	48000	48000	48000	48000	48000	48000	48000	48000	48000	48000	48000	48000
	ssp401	1448	251658240	26000	26000	26000	26000	26000	26000	26000	26000	26000	26000	26000	26000
	ssp402	14F8	251658240	26000	26000	26000	26000	26000	26000	26000	26000	26000	26000	26000	26000
	ssp403	1408	251658240	26000	26000	26000	26000	26000	26000	26000	26000	26000	26000	26000	26000
	ssp404	1448	251658240	26000	26000	26000	26000	0	0	0	0	0	0	0	0
	ssp501	14E8	251658240	26000	26000	26000	26000	26000	26000	26000	26000	26000	26000	26000	26000
	ssp502	1418	251658240	26000	26000	26000	26000	0	0	0	0	0	0	0	0
	ssp503	14F8	251658240	46240	46240	46240	46240	46240	46240	46240	46240	46240	46240	46240	46240
	ssp504	1478	251658240	48000	48000	48000	48000	48000	48000	48000	48000	48000	48000	48000	48000
	ssp601	1458	251658240	48000	48000	48000	48000	48000	48000	48000	48000	48000	48000	48000	48000
	ssp602	1458	251658240	48000	48000	48000	48000	48000	48000	48000	48000	48000	48000	48000	48000
	ssp603	1468	251658240	48000	48000	48000	48000	48000	48000	48000	48000	48000	48000	48000	48000
	ssp604	1418	251658240	48000	48000	48000	48000	48000	48000	48000	48000	48000	48000	48000	48000

*Yellow means modified SSP

SSP Detailed Panel

SIPM Control

ON Bias

OFF Bias

Details

Load from file

mV Set to All

Bias Target | **Bias Measur** | **SSP_Status: _NP04\DC5\SSP_Status.pnl**

DIM	SSP
	ssp101
	ssp102
	ssp103
	ssp104
	ssp201
	ssp202
	ssp203
	ssp204
	ssp301
	ssp302
	ssp303
	ssp304
	ssp401
	ssp402
	ssp403
	ssp404
	ssp501
	ssp502
	ssp503
	ssp504
	ssp601
	ssp602
	ssp603
	ssp604

*Yellow near

SSP 101

SET VOLTAGE

Voltage supply and Temperature

Bias Supply Rail Voltage: 29.529 V

Voltage of chage injection: 4.022 V

Voltage at Voltage Monitor: 5.080 V

Voltage at Current Monitor: 5.080 V

Temp. at Voltage Monitor: 36.394 °C

Temp. at Current Monitor: 40.196 °C

Clock and memory

Data processor clock status register: 0x11111101

PDTS status register: 0x1448 ✓

Free Event Memory: 251658240 M

Total number of commands received:

332357	0	6708	6709
22	20	0	0
1274952	0	0	0
0	21805	0	0

Channel	Bias			Rate monitoring			
	Target (mV)	Bias Voltage (V)	Bias Current (A)	Disc Rate	Ahit Rate	Accepted Event	Dropped Event
Channel 0	26000	26.009	8.505e-008	25	25	0	0
Channel 1	26000	26.029	6.504e-008	25	25	0	0
Channel 2	26000	26.050	9.005e-008	25	25	0	0
Channel 3	26000	26.036	8.505e-008	25	25	0	0
Channel 4	26000	26.006	3.002e-008	25	25	0	0
Channel 5	26000	26.036	3.502e-008	25	25	0	0
Channel 6	26000	26.031	1.501e-008	25	25	0	0
Channel 7	26000	26.045	2.001e-008	25	25	0	0
Channel 8	26000	26.012	1.501e-008	25	25	0	0
Channel 9	26000	26.054	3.002e-008	25	25	0	0
Channel 10	26000	26.018	1.501e-008	25	25	0	0
Channel 11	26000	26.020	3.002e-008	25	25	0	0

	CH 10	CH 11
000	26000	26000
000	26000	26000
000	26000	26000
0	0	0
000	0	26000
000	26000	26000
000	0	26000
0	0	0
000	26000	26000
000	26000	0
000	26000	26000
000	26000	26000
000	48000	48000
000	26000	26000
000	26000	26000
000	26000	26000
0	0	0
000	26000	26000
0	0	0
240	46240	46240
000	48000	48000
000	48000	48000
000	48000	48000
000	48000	48000
000	48000	48000

Double click to open in a new window

View more details/SSP

Set bias to individual channels

3. PD Hardware Setup

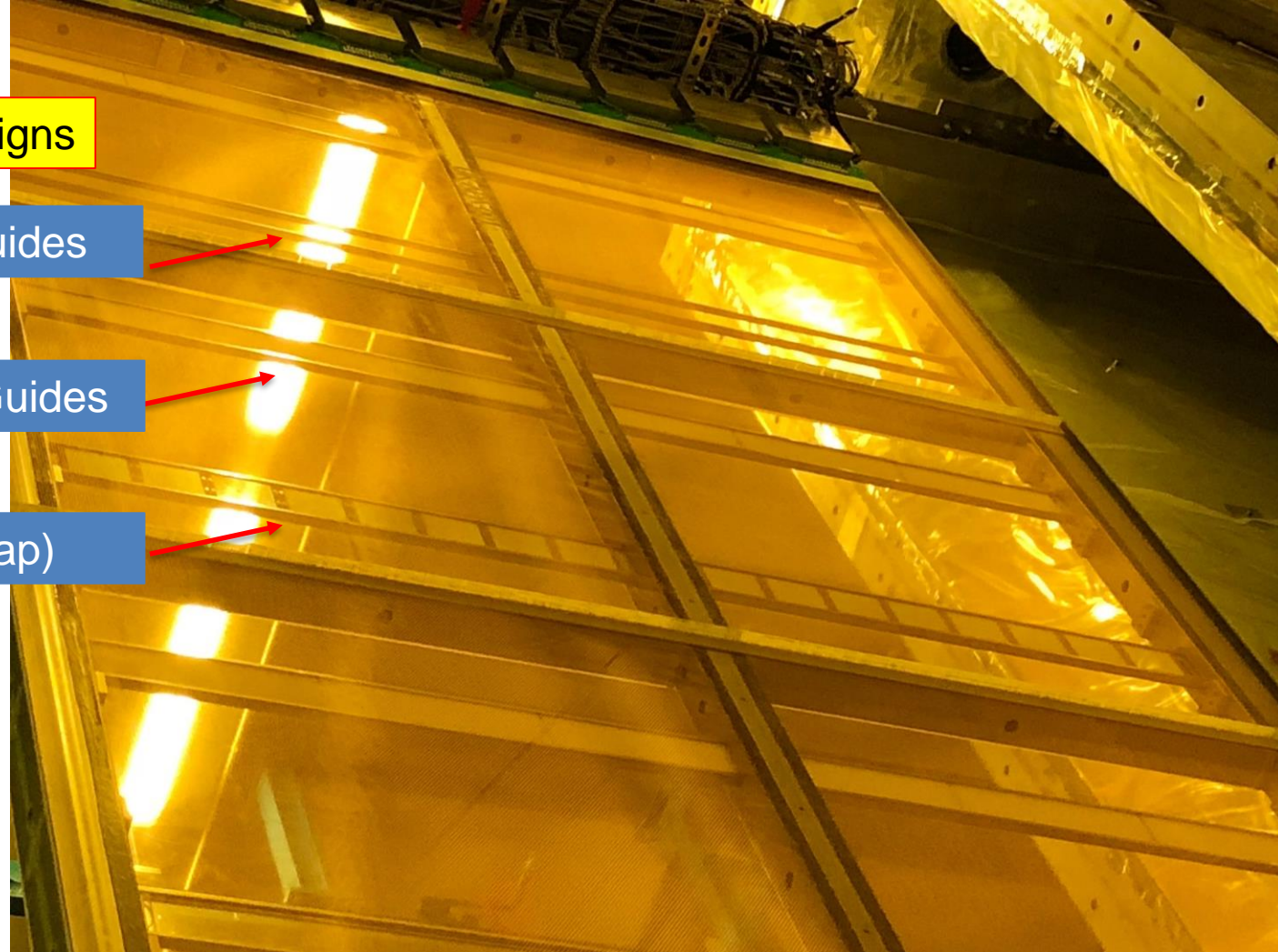
Photon Detector Module Layout

PD Module Designs

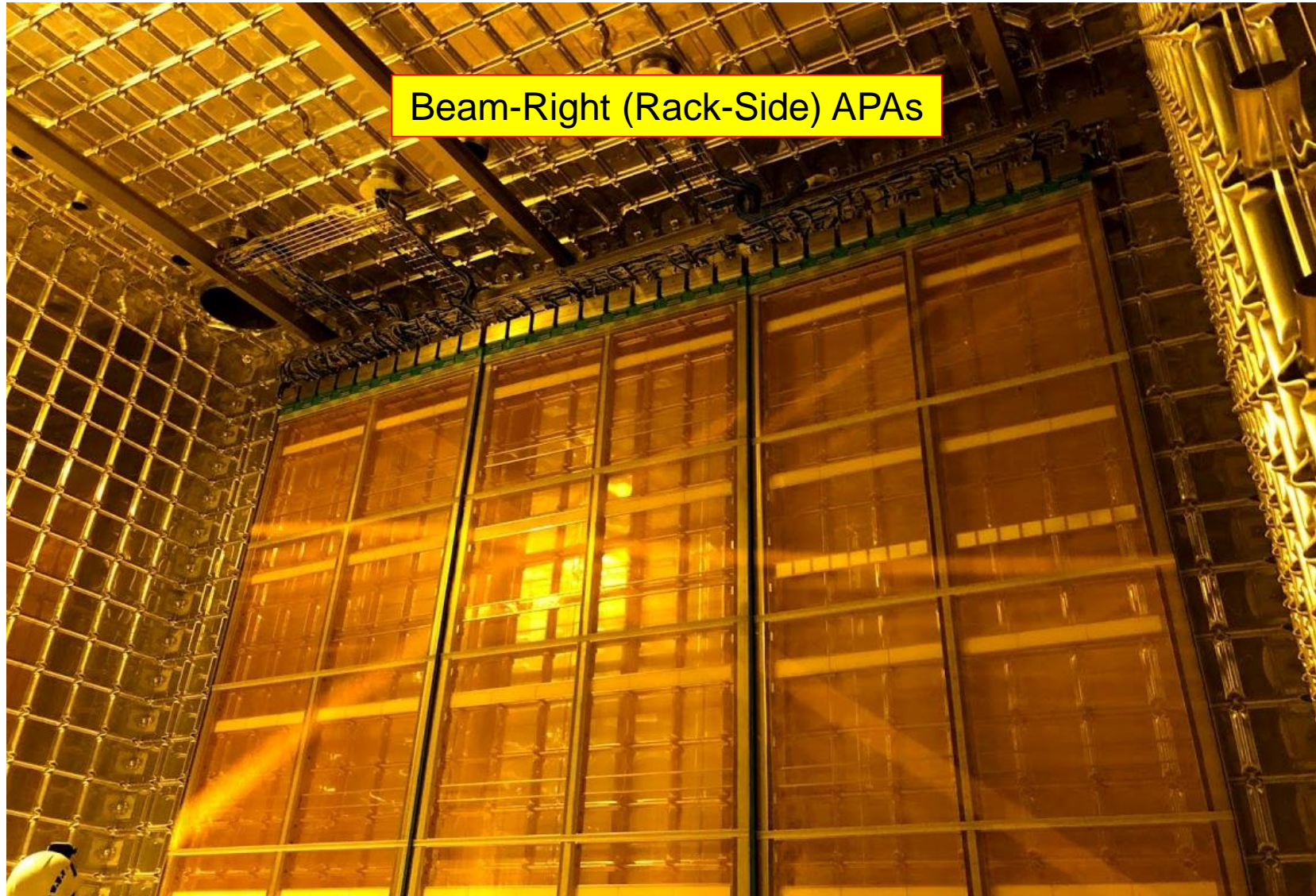
Dip-Coated Light Guides

Double-Shift Light Guides

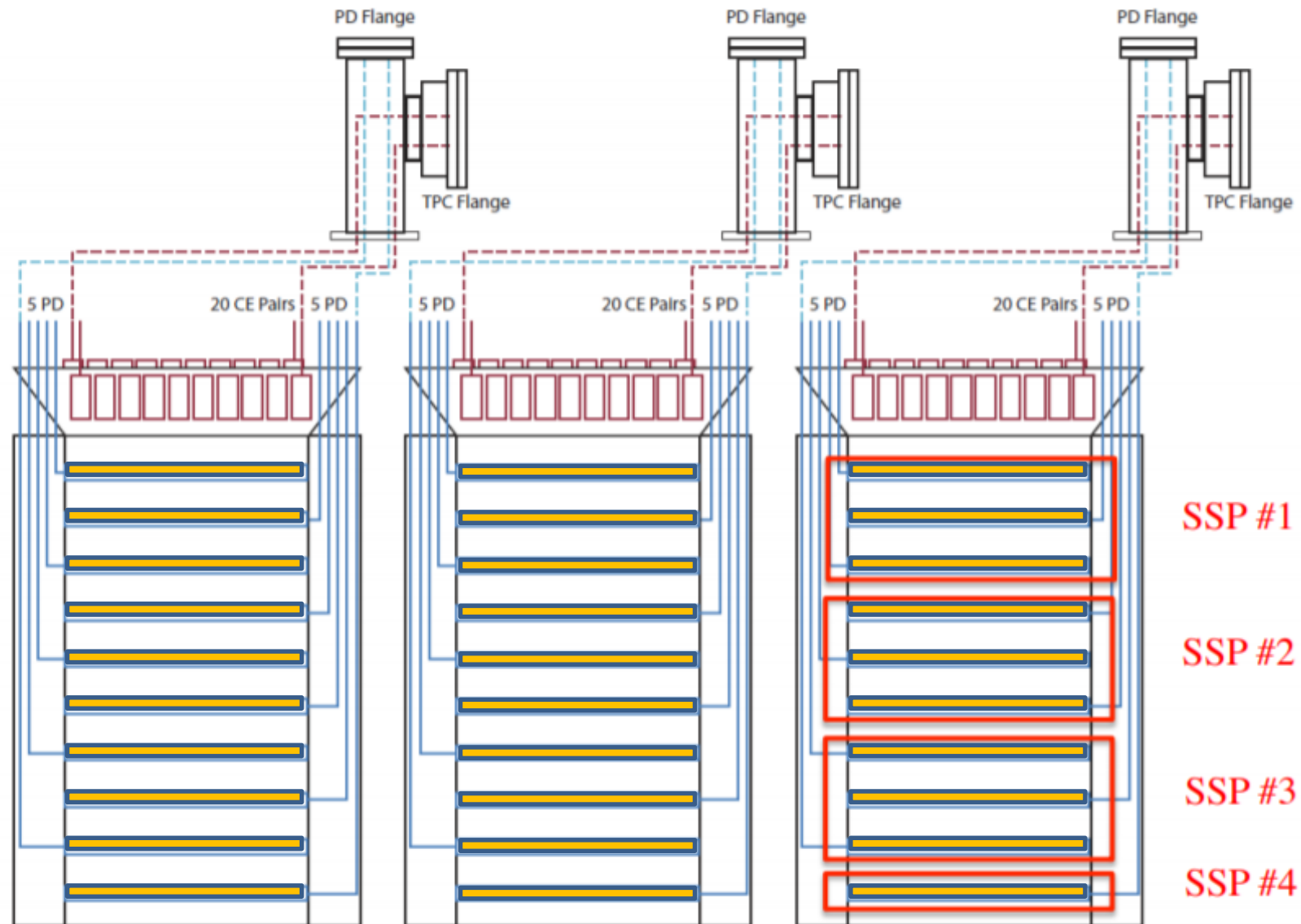
ARAPUCA (Light Trap)



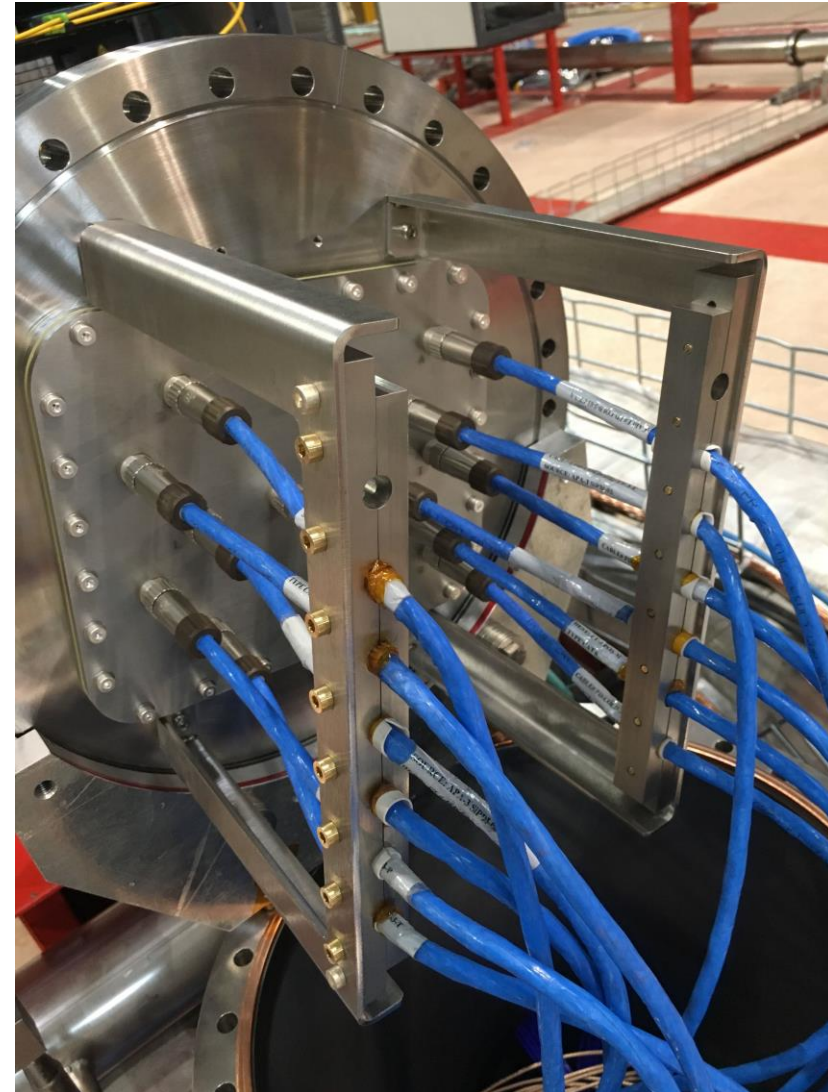
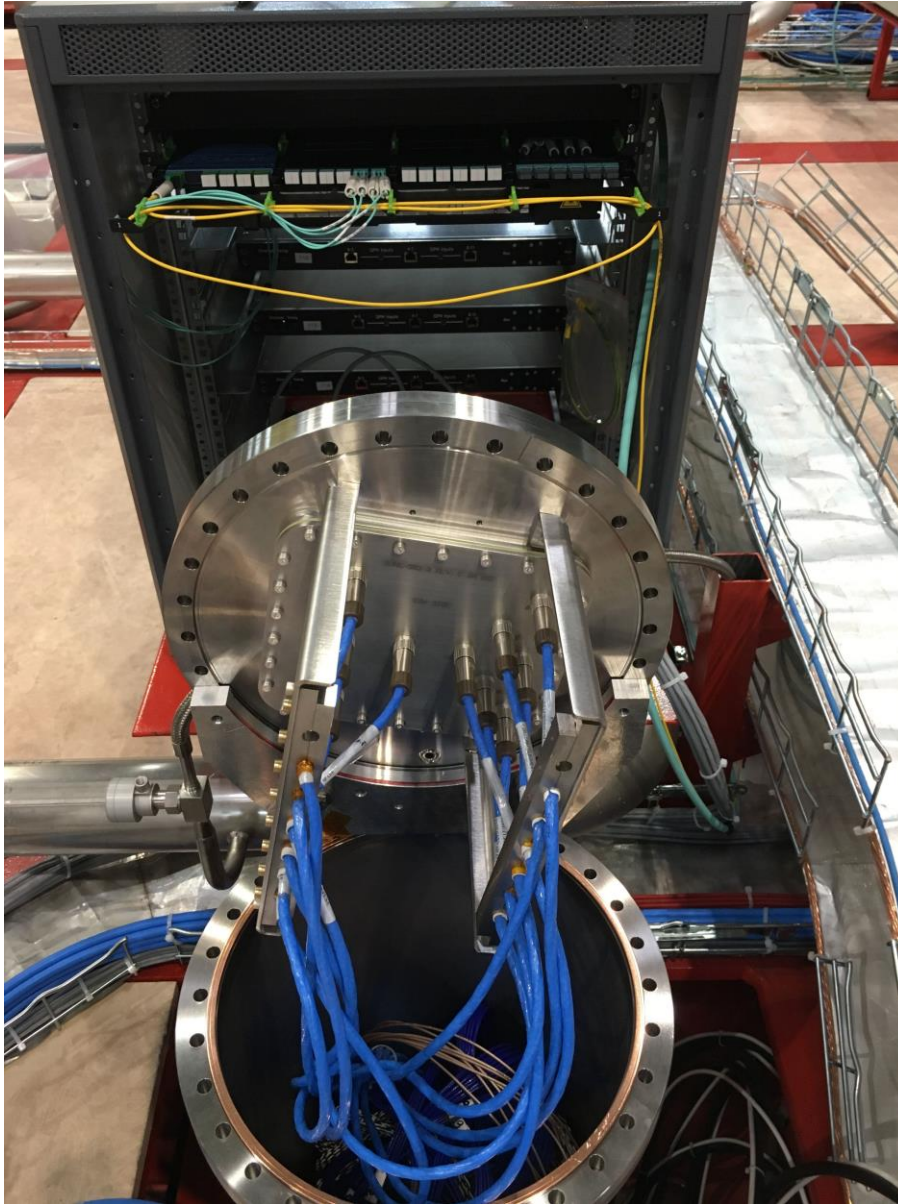
Photon Detector Module Layout



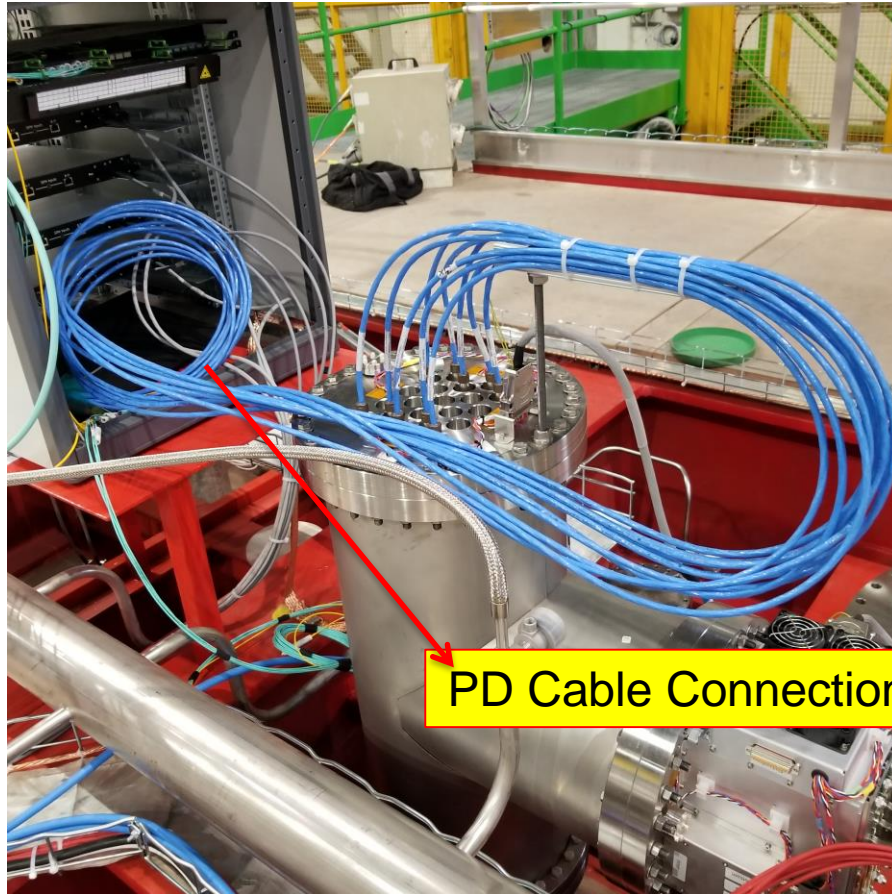
PD Cable Routing



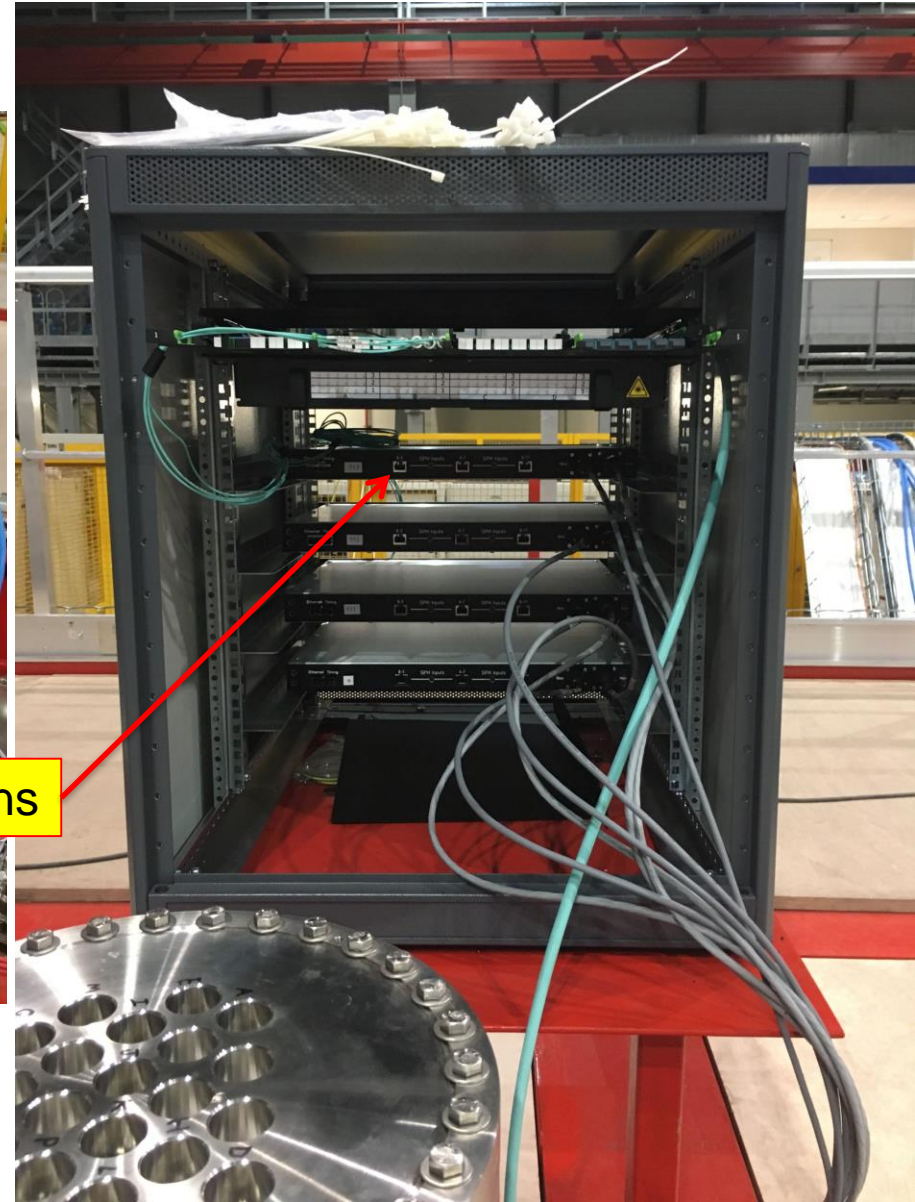
PD Cable Routing



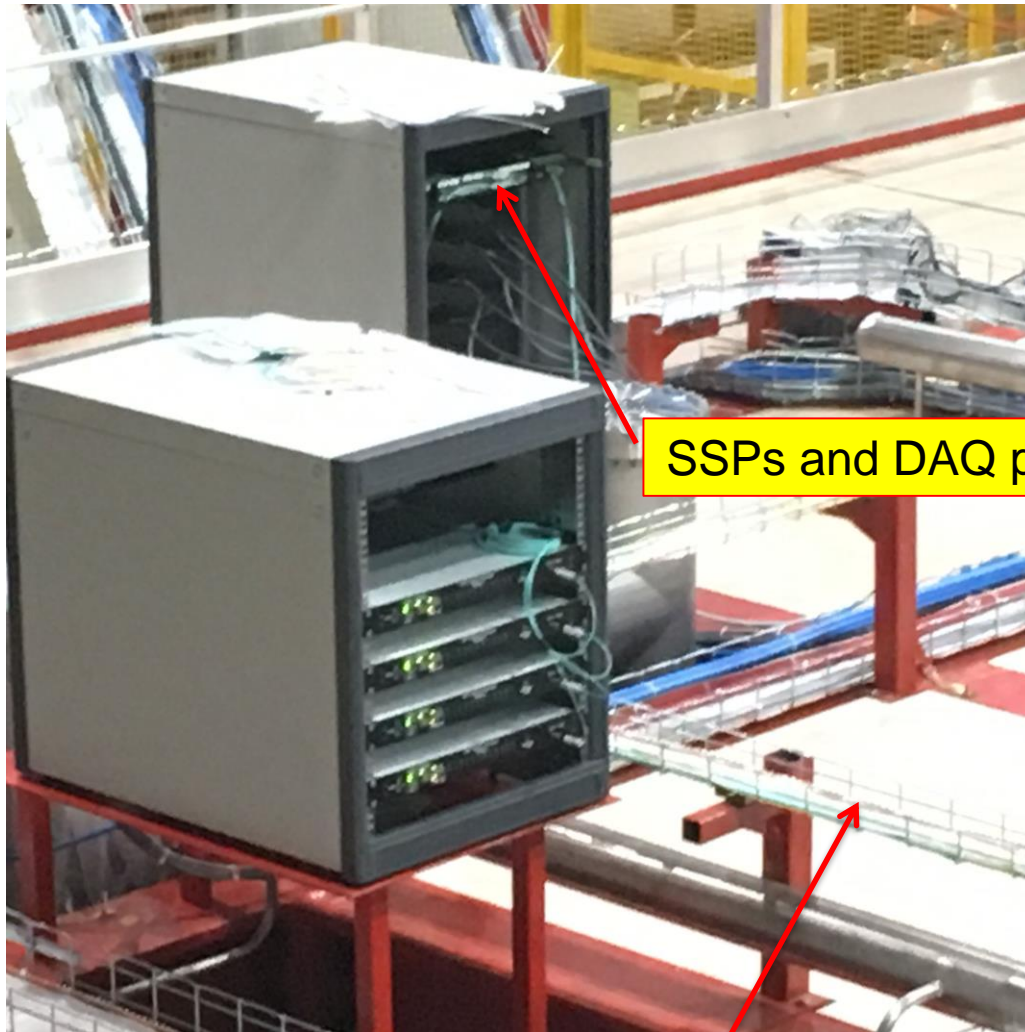
PD Cable Routing



PD Cable Connections

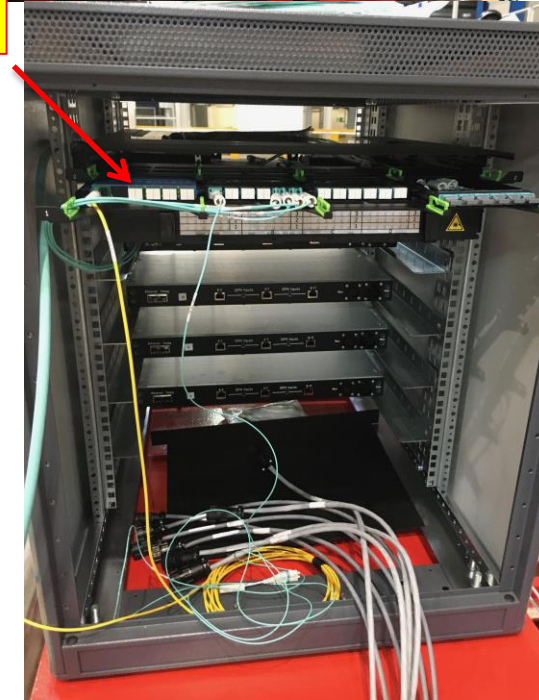


PD Cable Routing



SSPs and DAQ patch panels

Fiber bundles to DAQ



PD Calibration Layout

1. 5 diffusers per drift volume
2. Three are out of commission
 - a. UL-RaS (Beam-Right)
 - b. UR-DaS (Beam-Left)
 - c. Center-DaS (Beam-Left)
3. For more information:
 1. [Click Here](#)

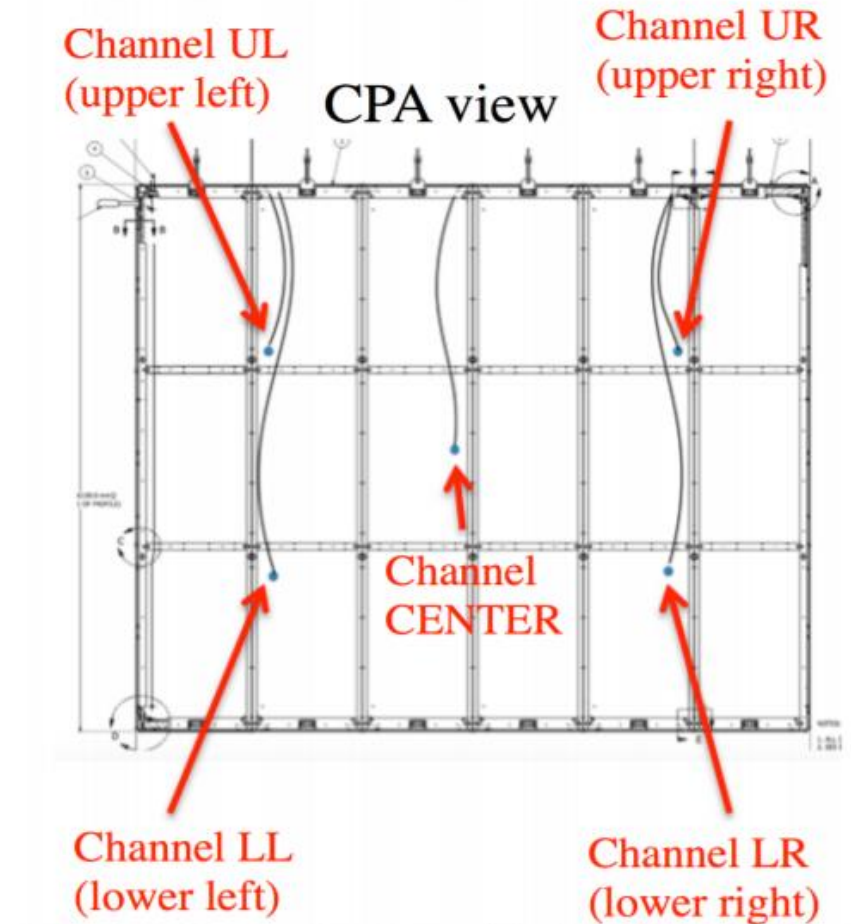


Figure 2: An CPA view from APA, with five light diffuser locations.

Zelimir Djurcic, et al.
[DUNE-doc-#11191-v3](#)

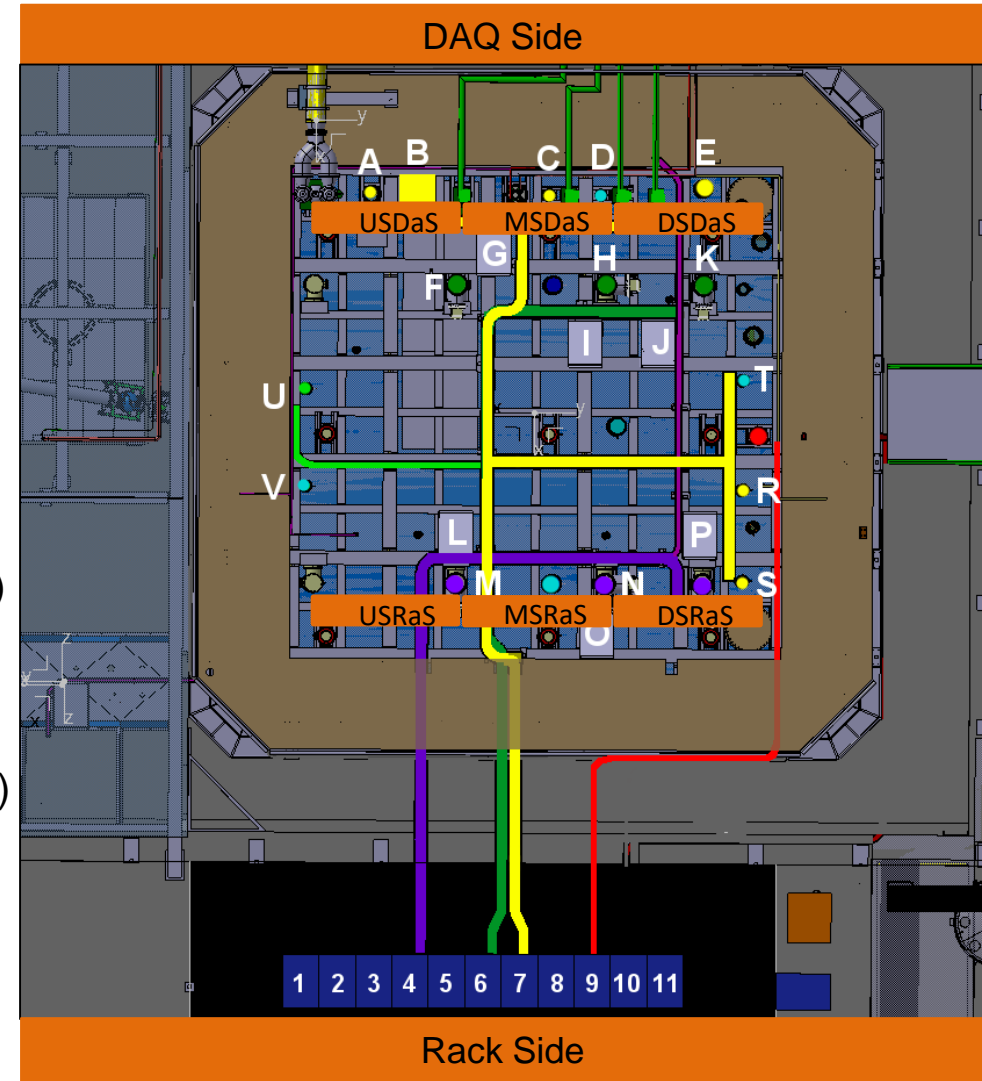
4. PD Channel Mapping

APA Mapping



- Split into two sections:
 - DAQ side*
 - Rack side
- DAQ Acronyms
 - USDaS - Upstream-DAQ Side (APA#5)
 - MSDaS - Midstream-DAQ Side (APA#6)
 - DSDaS - Downstream-DAQ Side (APA#4)

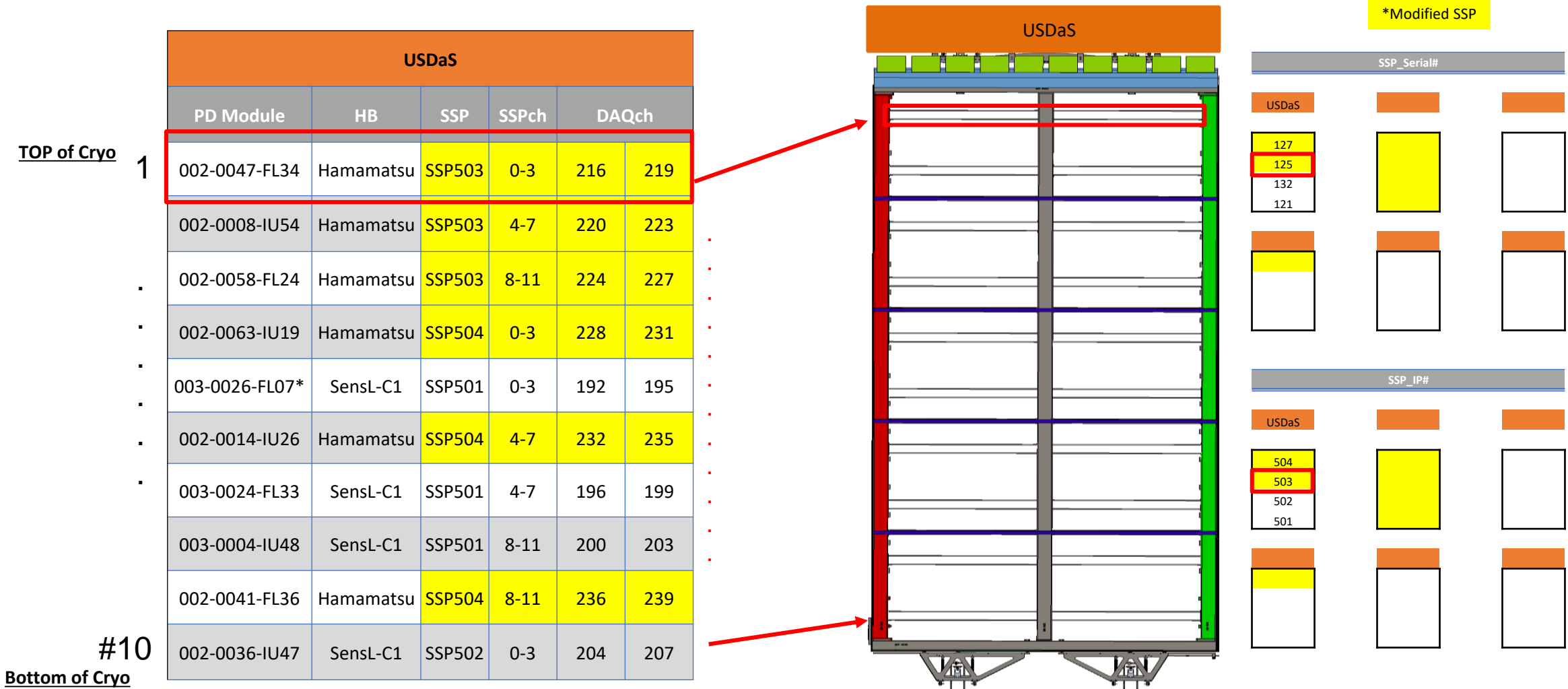
 - USRaS - Upstream-Rack Side (APA#3)
 - MSRaS - Midstream-Rack Side (APA#2)
 - DSRaS - Downstream-Rack Side (APA#1)

*The DAQ is now calling "Jura side" the "DAQ side".



PD Channel Mapping

-  APA- Face A
-  APA- Face B



Entire PD Channel Map



APA- Face A



APA- Face B

= Readout end

USDaS						
PD Module	HB	SSP	SSPch	DAQch	OptDet	
002-0047-FL34	Hamamatsu	SSP503	0-3	216	219	41
002-0008-IU54	Hamamatsu	SSP503	4-7	220	223	43
002-0058-FL24	Hamamatsu	SSP503	8-11	224	227	45
002-0063-IU19	Hamamatsu	SSP504	0-3	228	231	47
003-0026-FL07*	SensL-C1	SSP501	0-3	192	195	49
002-0014-IU26	Hamamatsu	SSP504	4-7	232	235	51
003-0024-FL33	SensL-C1	SSP501	4-7	196	199	53
003-0004-IU48	SensL-C1	SSP501	8-11	200	203	55
002-0041-FL36	Hamamatsu	SSP504	8-11	236	239	57
002-0036-IU47	SensL-C1	SSP502	0-3	204	207	59

MSDaS						
PD Module	HB	SSP	SSPch	DAQch	OptDet	
002-0002-FL22	Hamamatsu	SSP601	0-3	240	243	21
002-0054-IU22	Hamamatsu	SSP601	4-7	244	247	23
002-0059-FL08	Hamamatsu	SSP601	8-11	248	251	25
002-0020-IU09	Hamamatsu	SSP602	0-3	252	255	27
002-0060-FL39	Hamamatsu	SSP602	4-7	256	259	29
ARAPUCA-2	Hamamatsu	SSP603	0-3	264	267	31
		SSP603	4-7	268	271	
		SSP603	8-11	272	275	
002-0055-FL40	Hamamatsu	SSP602	8-11	260	263	33
002-0013-IU01	Hamamatsu	SSP604	0-3	276	279	35
002-0011-FL15	Hamamatsu	SSP604	4-7	280	283	37
002-0031-IU02	Hamamatsu	SSP604	8-11	284	287	39

DSDaS						
PD Module	HB	SSP	SSPch	DAQch	OptDet	
001-0003-FL01	SensL-C1	SSP401	0-3	144	147	1
002-0044-IU50	SensL-C1	SSP401	4-7	148	151	3
002-0039-FL29	SensL-A1	SSP401	8-11	152	155	5
003-0002-IU27	SensL-C1	SSP402	0-3	156	159	7
002-0025-FL25	SensL-C1	SSP402	4-7	160	163	9
003-0011-IU37	SensL-C1	SSP402	8-11	164	167	11
003-0048-FL42	SensL-C1	SSP403	0-3	168	171	13
002-0023-IU53	SensL-C1	SSP403	4-7	172	175	15
002-0038-IU35	SensL-C1	SSP403	8-11	176	179	17
002-0040-FLP06*	SensL-C1	SSP404	0-3	180	183	19

USRaS						
PD Module	HB	SSP	SSPch	DAQch	OptDet	
003-0031-IU20	SensL-A1	SSP301	0-3	96	99	40
002-0055-FL03	SensL-A1	SSP301	4-7	100	103	42
002-0020-IU31	SensL-A1	SSP301	8-11	104	107	44
ARAPUCA-1	Hamamatsu	SSP304	0-3	132	135	46
		SSP304	4-7	136	139	
		SSP304	8-11	140	143	
002-0042-IU52	SensL-A1	SSP302	0-3	108	111	48
002-0056-FL30	SensL-A1	SSP302	4-7	112	115	50
002-0047-IU17	SensL-A1	SSP302	8-11	116	119	52
002-0054-FL38	SensL-A1	SSP303	0-3	120	123	54
001-0039-IU51	SensL-A1	SSP303	4-7	124	127	56
003-0015-FL04	SensL-C1	SSP303	8-11	128	131	58

MSRaS						
PD Module	HB	SSP	SSPch	DAQch	OptDet	
002-0049-IU16	SensL-A1	SSP201	0-3	48	51	20
001-0054-FL18	SensL-A1	SSP201	4-7	52	55	22
002-0035-IU13	SensL-A1	SSP201	8-11	56	59	24
002-0006-FL14	SensL-A1	SSP202	0-3	60	63	26
001-0044-IU18	SensL-A1	SSP202	4-7	64	67	28
002-0012-FL19	SensL-A1	SSP202	8-11	68	71	30
002-0027-IU12	SensL-A1	SSP203	0-3	72	75	32
002-0015-FL21	SensL-A1	SSP203	4-7	76	79	34
001-0052-IU14	SensL-A1	SSP203	8-11	80	83	36
003-0025-FL06	SensL-A1	SSP204	0-3	84	87	38

DSRaS						
PD Module	HB	SSP	SSPch	DAQch	OptDet	
403-003-0063-IU28	SensL-A1	SSP101	0-3	0	3	0
403-003-0041-FL9	SensL-A1	SSP101	4-7	4	7	2
403-002-0001-IU15	SensL-A1	SSP101	8-11	8	11	4
403-003-0054-FLP12	SensL-A1	SSP102	0-3	12	15	6
403-001-0006-IU49	SensL-A1	SSP102	4-7	16	19	8
403-003-0064-FLP13	SensL-A1	SSP102	8-11	20	23	10
403-001-0061-IU04	SensL-A1	SSP103	0-3	24	27	12
403-001-0042-FLP4	SensL-A1	SSP103	4-7	28	31	14
403-001-0025-IU21	SensL-A1	SSP103	8-11	32	35	16
403-003-0020-FL5	SensL-A1	SSP104	0-3	36	39	18

*Modified SSP

SSP_Serial#		
USDaS	MSDaS	DSDaS
127	131	120
125	130	119
132	129	118
121	128	117
123	113	109
116	112	108
115	111	107
114	102	106

SSP_IP#		
USRaS	MSRaS	DSRaS
504	604	404
503	603	403
502	602	402
501	601	401
304	204	104
303	203	103
302	202	102
301	201	101



PD Channel Summary

- Module Count
 - (29) Double-Shift Light Guides
 - 4 channels/module
 - (29) Dip-Coated Light Guides
 - 4 channels/module
 - (2) ARAPUCAs
 - 12 channels/module
- Total Channels
 - (256) channels
 - 288 available channels (24 SSPs, 12 chs/SSP)
 - Known dead channels
 - DAQ ch: 49, 51 , 73, 75, 101, 156
 - Known *high trigger rate* channels
 - DAQ ch: 25, 36, 58, 62, 65, 82, 110*,119

*finicky

5. Getting Started with LArSoft

Creating your *dunetpc* LArSoft Environment @FNAL

(Specifically for PDs @ pDUNE)

1. Log in to a dune gpvm
\$ ssh -Y <username>@dunegpvm01.fnal.gov
2. Setup your dune space
'\$ source /cvmfs/dune.opensciencegrid.org/products/dune/setup_dune.sh
3. Make your user space for your LArSoft dist., programs, etc.
\$ mkdir /dune/app/users/<username>/pDUNE_PD_larsoft_env
4. Initial setup of LArSoft from your user space (.../ pDUNE_PD_larsoft_env)
\$ setup root v6_12_06a -q c2:prof
\$ setup dunetpc v07_11_00 -q e17:prof *
\$ setup larsoft v07_11_00 -q e17:prof *
 Check for a newer version via *ups list -aK+ dunetpc* or *ups list -aK+ larsoft*
\$ mrb newDev
\$ source /dune/app/users/<username>/pDUNE_PD_larsoft_env/localProducts_<XXXX>/setup
\$ cd srcs
\$ mrb g dunetpc
\$ cd \$MRB_BUILDDIR
\$ mrbsetenv
\$ mrb i -j4
\$ mrbsetenv
\$ setup sam_web_client

* May be out of date

Creating your *dunetpc* LArSoft Environment @FNAL contin.

(Specifically for PDs @ pDUNE)

5. Next time you log in to dune gpvm, to setup your environment

```
$ source /cvmfs/dune.opensciencegrid.org/products/dune/setup_dune.sh
$ cd /dune/app/users/<username>/pDUNE_PD_larsoft_env
$ source localProducts_XXXX/setup
$ mrbsetenv
$ setup sam_web_client
```

6. Edit SSPRawDecoder module here:

```
/dune/app/users/<username>/
pDUNE_PD_larsoft_env/srcs/dunetpc/dune/Protodune/singlephase/RawDecoding/SSPRawDecoder_module.cc
```

7. Adding a new module

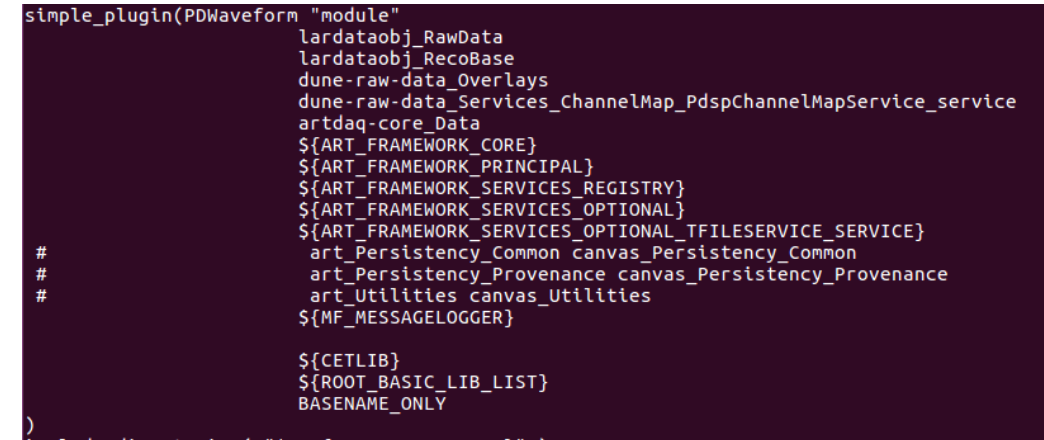
- a. Need to edit Cmakelists.txt and add plugin

8. Rebuilding Environment

```
$ cd $MRB_BUILDDIR
$ mrbsetenv
$ make i -j4
```

9. Check that it worked and is located here:

```
$ cd ${MRB_BUILDDIR}/dunetpc/lib/
> <edited_module>.so
```



```
simple_plugin(PDWaveform "module"
  lardataobj_RawData
  lardataobj_RecoBase
  dune-raw-data_Overlays
  dune-raw-data_Services_ChannelMap_PdspChannelMapService_service
  artdaq-core_Data
  ${ART_FRAMEWORK_CORE}
  ${ART_FRAMEWORK_PRINCIPAL}
  ${ART_FRAMEWORK_SERVICES_REGISTRY}
  ${ART_FRAMEWORK_SERVICES_OPTIONAL}
  ${ART_FRAMEWORK_SERVICES_OPTIONAL_TFILESERVICE_SERVICE}
  #
  # art_Persistency_Common canvas_Persistency_Common
  # art_Persistency_Provenance canvas_Persistency_Provenance
  # art_Uilities canvas_Uilities
  ${MF_MESSAGELOGGER}

  ${CETLIB}
  ${ROOT_BASIC_LIB_LIST}
  BASENAME_ONLY
)
```

Creating your *dunetpc* LArSoft Environment @CERN

(Specifically for PDs @ pDUNE)

1. Log in to lxplus

```
$ ssh -Y <username>@lxplus.cern.ch
```

2. Setup your dune space

```
'$ source /cvmfs/dune.opensciencegrid.org/products/dune/setup_dune.sh
```

3. Make your user space for your LArSoft dist., programs, etc.

```
$ mkdir /eos/user/<first letter of username>/<username>/pDUNE_PD_larsoft_env
```

OR

```
$ mkdir /afs/cern.ch/work/<first letter of username>/<username>/private/workspace/pDUNE_PD_larsoft_env
```

(to increase your workspace quota, go here: <https://resources.web.cern.ch/resources/Help/?kbid=067040>)

4. Initial setup of LArSoft from your user space (.../ pDUNE_PD_larsoft_env)

```
$ setup larsoft v07_11_00 -q e17:prof *
```

Check for a newer version via *ups list -aK+ dunetpc* or *ups list -aK+ larsoft*

```
$ mrb newDev
```

```
$ source localProducts_XXXX/setup
```

```
$ cd srcs
```

```
$ mrb g dunetpc
```

```
$ cd $MRB_BUILDDIR
```

```
$ mrbsetenv
```

```
$ mrb i -j4
```

```
$ mrbsetenv
```

* May be out of date

Creating your *dunetpc* LArSoft Environment @CERN contin.

(Specifically for PDs @ pDUNE)

5. Next time you log in to lxplus, to setup your environment

```
$ source /cvmfs/dune.opensciencegrid.org/products/dune/setup_dune.sh
$ cd /eos/user/<first letter of username>/<username>/pDUNE_PD_larsoft_env
$ source /eos/user/<first letter of
username>/<username>/pDUNE_PD_larsoft_env/localProducts_XXXX/setup
$ mrbsetenv
```

6. Edit SSPRawDecoder module here:

```
/eos/user/<first letter of username>/<username>/pDUNE_PD_larsoft_env
/srcs/dunetpc/dune/Protodune/singlephase/RawDecoding/SSPRawDecoder_module.cc
```

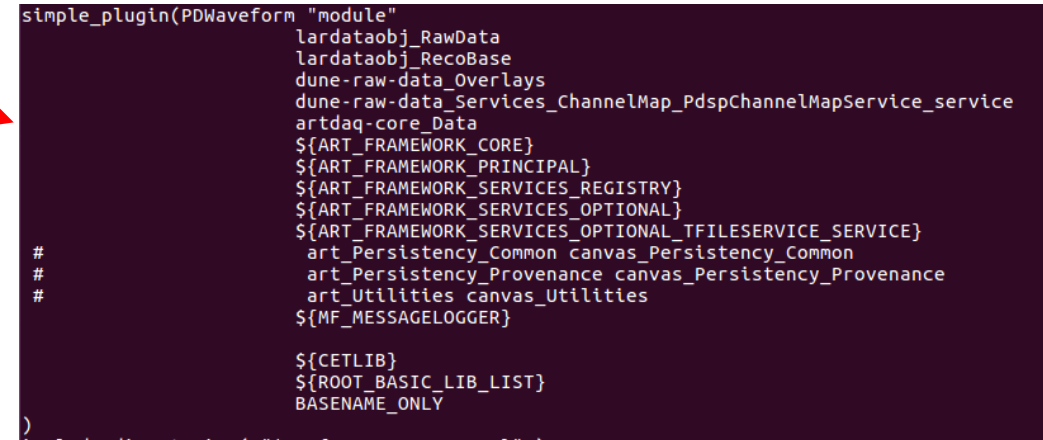
7. Edit Cmakelists.txt with new module

8. Rebuilding Enviroment

```
$ cd $MRB_BUILDDIR
$ mrbsetenv
$ make i -j4
```

9. Check that it worked and is located here:

```
$ cd ${MRB_BUILDDIR}/dunetpc/lib/
> <edited_module>.so
```



```
simple_plugin(PDWaveform "module"
  lardataobj_RawData
  lardataobj_RecoBase
  dune-raw-data_Overlays
  dune-raw-data_Services_ChannelMap_PdspChannelMapService_service
  artdaq-core_Data
  ${ART_FRAMEWORK_CORE}
  ${ART_FRAMEWORK_PRINCIPAL}
  ${ART_FRAMEWORK_SERVICES_REGISTRY}
  ${ART_FRAMEWORK_SERVICES_OPTIONAL}
  ${ART_FRAMEWORK_SERVICES_OPTIONAL_TFILESERVICE_SERVICE}
  art_Persistence_Common canvas_Persistence_Common
  art_Persistence_Provenance canvas_Persistence_Provenance
  art_Uilities canvas_Uilities
  ${MF_MESSAGELOGGER}

  ${CETLIB}
  ${ROOT_BASIC_LIB_LIST}
  BASENAME_ONLY
)
```

Running LArSoft w/ YOUR Environment.

(Specifically for PDs @ pDUNE)

Run module over data

1. Running over ONE data file:

```
$ lar -c RunSSPWaveforms.fcl <raw data file location>
```

Ex: `$ lar -c RunSSPWaveforms.fcl /pnfs/dune/tape_backed/dunepro/protodune/np04/beam/detector/None/raw/08/43/12/85/np04_raw_run005929_0012_dl4.root`

2. Running over multiple data files:

```
$ lar -c RunSSPWaveforms.fcl -S <txt file containing all raw data file locations>
```

Ex: `$ lar -c RunSSPWaveforms.fcl -S Run_5933_file_locs.txt` (where each line of `Run_5933_file_locs.txt` is file location like (a))

3. Can add things like:

- “-n<number of events>”

Ex: `lar -c RunSSPWaveforms.fcl -S Run_5933_file_locs.txt -n3000` (for 3,000 events)

- And many more...(please see a LArSoft expert)

6. Useful Links

1. [How to Take PD Data](#)
2. [DAQ-PD Runs- ProtoDUNE](#)
3. Text files with path to all corresponding raw data files/momentum/run.
 - a. located on a duneqvm here: ``/dune/app/users/cmacias/Public/pDUNE``

You will find a directory per momentum, with n-amount of txt files (one per Run), containing the (Fermilab) “pnfs” path of all raw data root files.
4. [LArSoft UK Workshop](#)
5. [Accessing ProtoDUNE-SP Cold Box Test Data in LArSoft](#)
6. [PD Cable Continuity Checks](#)
7. <https://twiki.cern.ch/twiki/bin/view/CENF/SSPBasicOp>
8. https://twiki.cern.ch/twiki/bin/view/CENF/DUNEProtSPDAQ#Useful_links
9. <https://twiki.cern.ch/twiki/bin/view/CENF/PdspOMOp>.
10. [SSP manual](#)