Photon Detector System Installation Plans

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LBNF/DUNE-US Directors Review

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Outline

- Installation task responsibility
- Rail/Cable Installation
- Module Installation
- Labor Summary
- QC testing/data maintenance
- Schedule
- Summary

PD installation task responsibility (i)

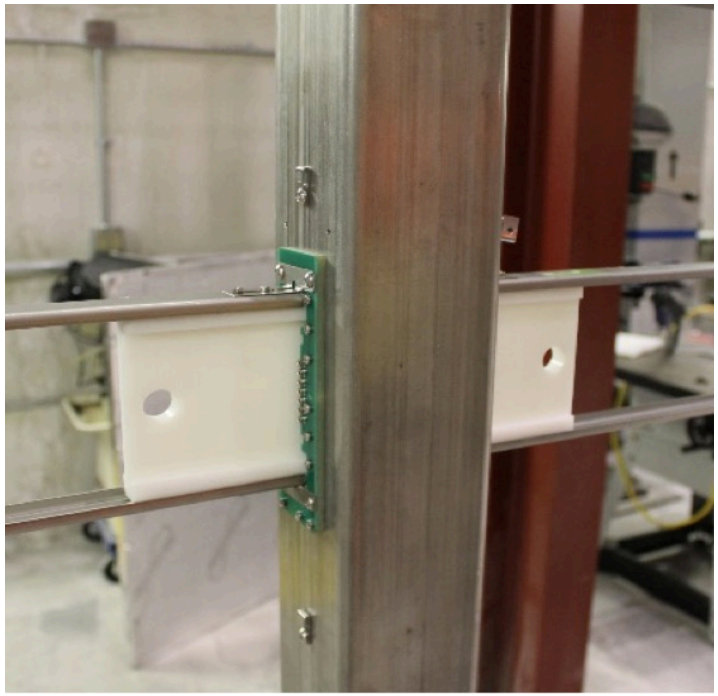
- PD consortium personnel
  - Module Installation
  - DAPHNE installation & checkout
  - Monitoring system LED driver installation & checkout
  - Power supply
  - Warm fiber/signal connections
  - Monitoring of cold box checkout
  - Supervision of other PD related tasks
  - Bi-weekly dark operation in cryostat
  - Supervision of all PD-related installation tasks

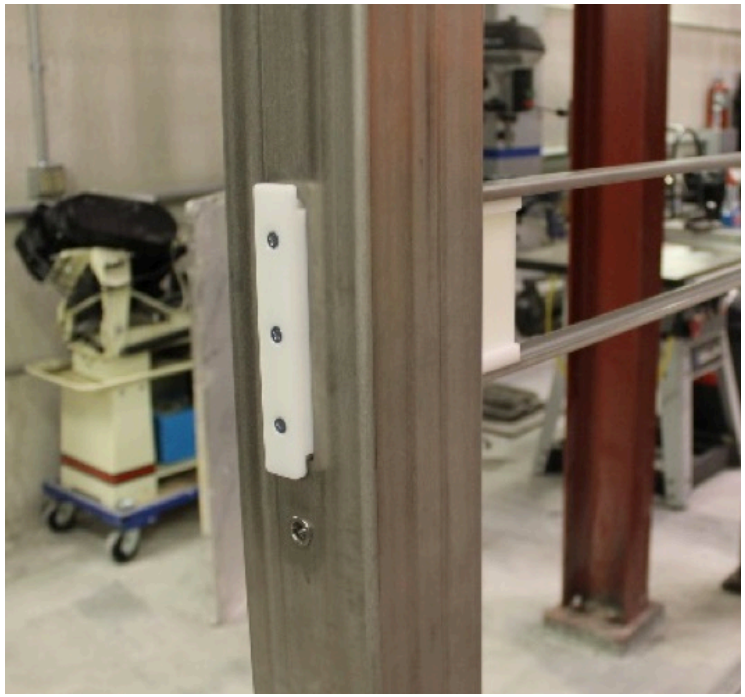
- APA consortium personnel
  - Installation of rails/cables into APAs (with PD supervision)
  - Joining of upper/lower APA PD readout cables

PD installation task responsibility (ii)

- JT-HV consortium tasks
  - Mounting of diffusers to CPAs underground
  - Routing fibers to top of CPAs during installation
- TPC consortium personnel
  - Connection of PD cables in cold box test
  - Connection of cables in cryostat to from APA to flange
- I&I support personnel
  - Monitoring system fiber routing on DSS
  - Monitoring system fiber junction during CPA installation
  - Support for cryostat signal cabling connections
  - Communication fiber routing
  - Power supply cable routing

Rail/Cable Installation



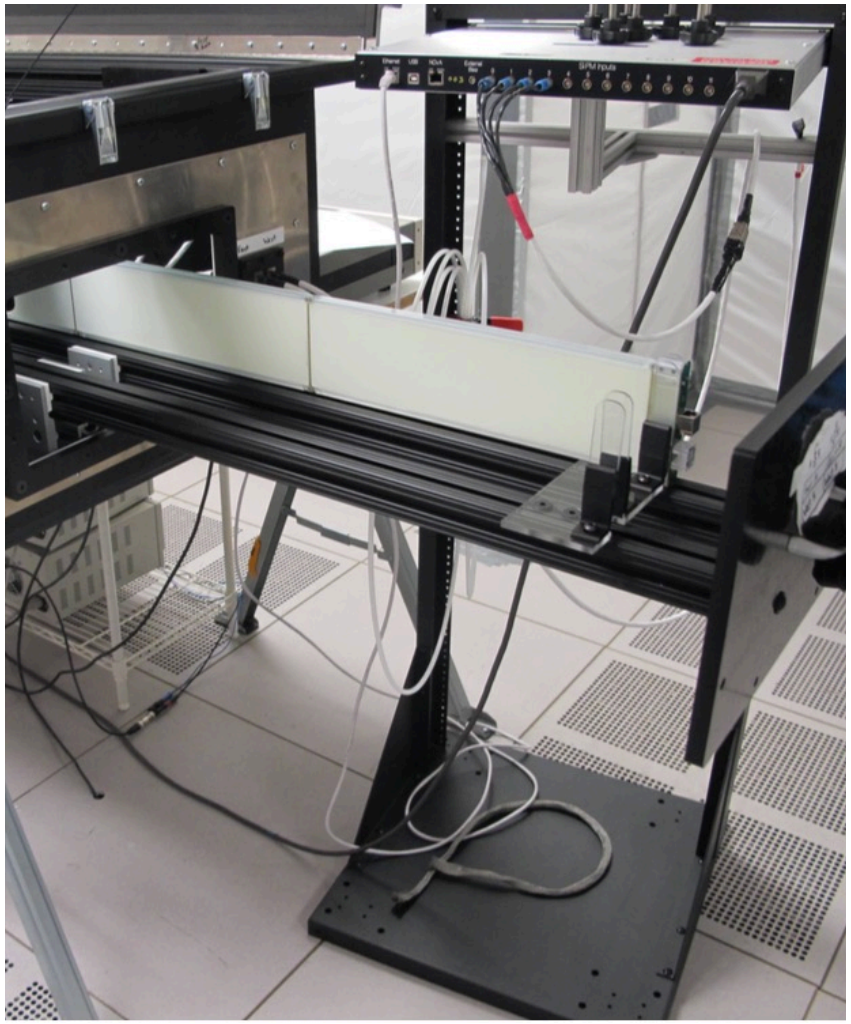


Rail Alignment fixturing prototypes

- Rails and internal cables will be installed during the APA frame assembly prior to wire wrapping.
- Performed by APA personnel
- Procedures generated by and progress monitored by PD personnel

Module Installation (i)

- Pre-installation inspection of modules includes:
  - Visual inspection of module, including critical dimension check and photography
  - LED scanner check-out (as in ProtoDUNE 1)



PD module scanner used in ProtoDUNE 1.
Will increase capacity to 5 modules at a time.

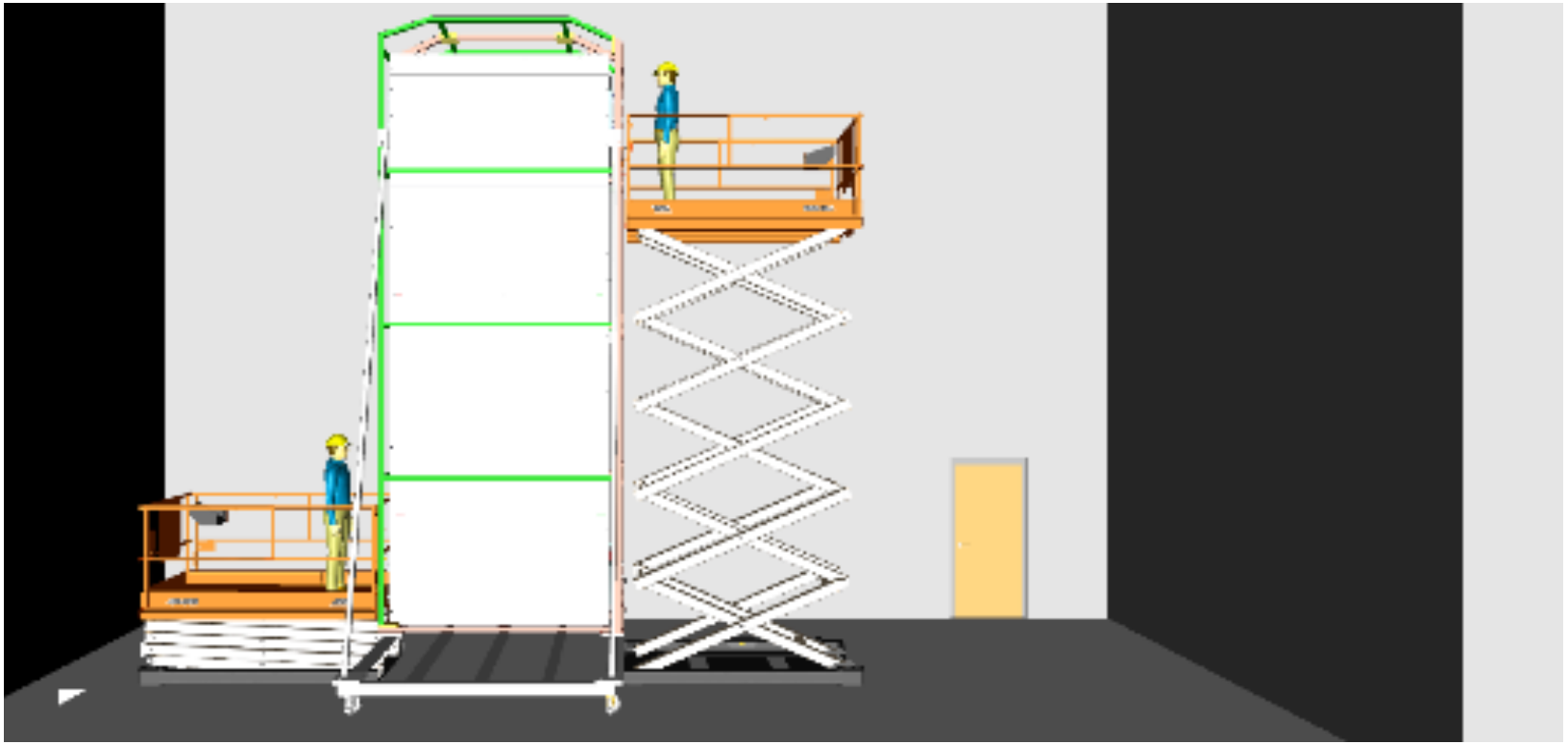
Module Installation (ii)

- Modules are self-fixturing. No external tooling is needed to install them

- One person can safely handle a module (~3kg), however 2 are optimal for installation

Module Installation (iii)

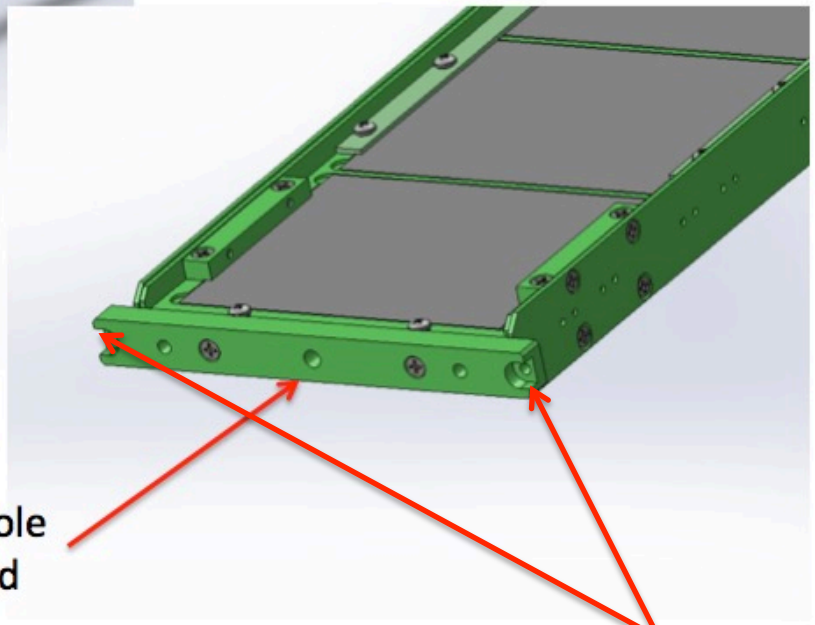
- Module are installed into APA frames before they are removed from the transport frame.
- Two two-person lifts are used to lift installation teams to appropriate height. Modules installed by hand.



Module Installation Tool

Module fixed into APA frame
With two captive screws
(not shown)
Torque wrench will be used

M6 threaded stud



M6 tapped hole
In module end

M4 captive screw here

Post-installation check-out

- Automated module connector test box hooked to cables prior to module installation.
  - Visible during installation from person lift.
  - Visual indicator (green light) indicates successful connection & correct module orientation.
  - Same style of apparatus used during upper-lower APA connection, and during APA installation into cryostat.

Installation labor force

- Two PD shifts per day (10 hours each), 4 days/week
- Each PD installation team consists of:
  - 1 post-doc
  - 1 technician/engineer
  - 2 students
- This labor force will be a combination of US, Latin American and European personnel, with a minimum requirement of 2 post docs, 2 technicians, and 4 students at all times.
  - Expressions of interest from many points
  - We hope to keep at least one additional post-doc and one additional student to assist with electronics installation, supervise other installation steps, participate in bi-weekly TPC slice checkout, and fill in additional hands where necessary.
- A faculty-level responsible person (not necessarily on-site) will provide supervision of installation.
- 1 year duration

QC checks following module installation

- Upper/lower APA connection continuity
- Cold box operation
- Post cryostat installation cable continuity checkout
- Post DAPHNE installation checkout
- Bi-weekly checkout with monitoring system

Bi-Weekly PD operation in darkened cryostat

- A TPC detector slice (6 APAs, two CPA planes) will be installed every two weeks.
- It is planned to darken the cryostat on the weekend shift immediately following the completion of a row to allow an operational test (warm) of the installed PD modules.
- This plan is included in the Installation/PDS interface control document.
- DAPHNE and monitoring system electronics will be installed prior to installation of a TPC slice, to facilitate this test.
- 2 PD personnel will be required for this test beyond the standard 4-day workweek (an additional 10 hour shift is allocated).

Summary

- Advances in module design and cabling have allowed for significant reductions in the required person power for module installation over ProtoDUNE 1
- We understand the steps necessary for installing the PD system and the resources needed
- QC steps during installation are planned and based on ProtoDUNE 1 (with improvements!)
- The TCP dark-cryostat test represents a significant opportunity to address any problems during installation
- Installation plans will advance prior to the FDR.