PD – APA Consortia Interface
Initial Meeting Summary

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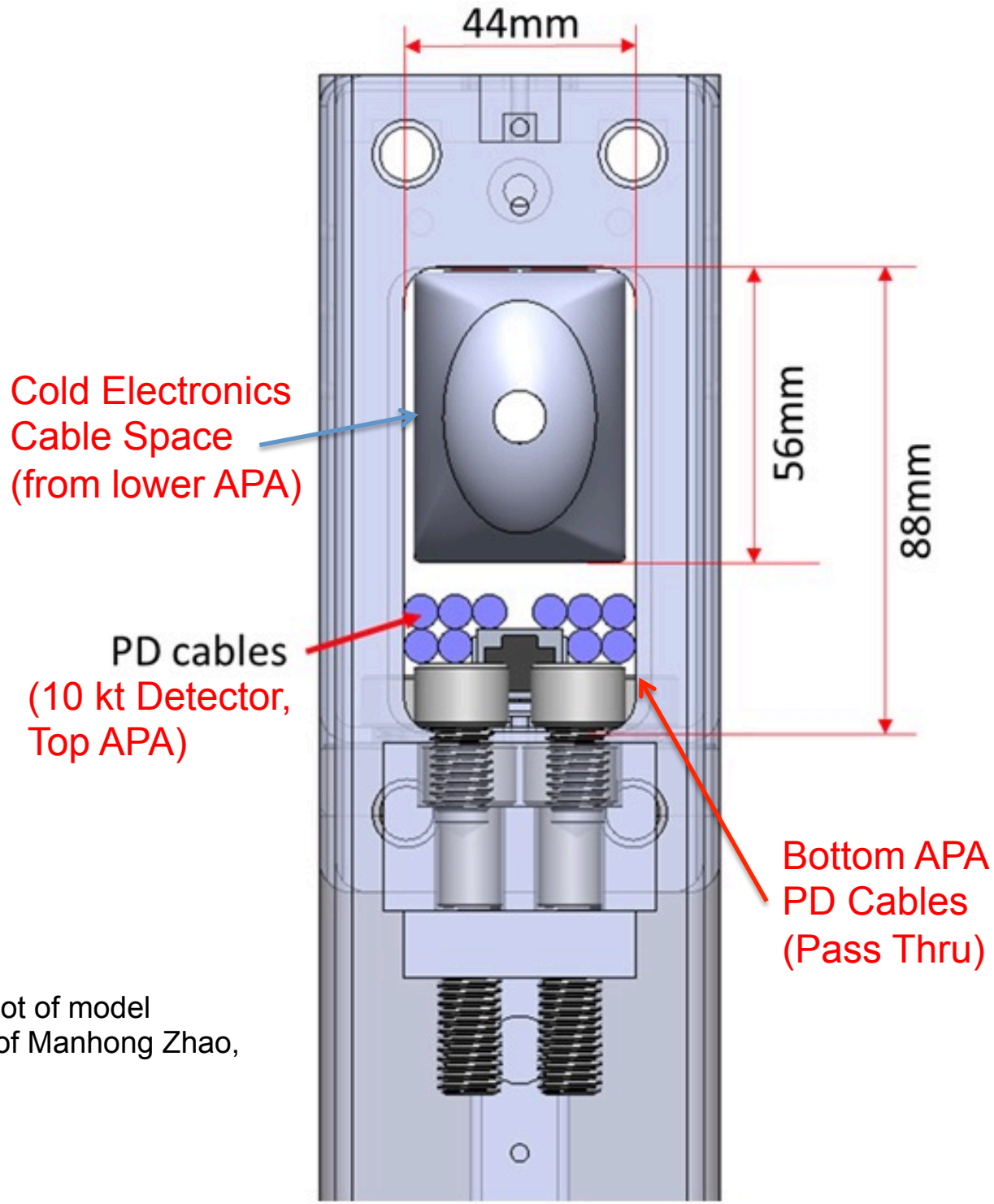
Summary:

- Ettore, Flavio and I were invited to attend the APA consortium meeting Monday Nov. 27 to begin discussing the APA/PD interface.
- I made a presentation (available at https://indico.fnal.gov/event/15816/) regarding PD design and interfacing with the APA (including cabling interface)
- I also made some initial requests to the APA group regarding larger and/or more PD slots in the APA frame.
- Flavio made a presentation regarding the light collector working group's thoughts concerning passive light collectors and veto detectors using the external LAr volume (presentation to follow)
- Our presentations were well received, and it was agreed we would continue to work together
- Clearly we need to develop a contact between the PD integration working group and their opposite number.

Cable Exit from APA

- The most constricted point of the cable routing is through the top APA top box beam
- Half of the cables from the bottom APA cold electronics, as well as all the PD cables (from that side of the APA, ½ total cable count), need to pass through this space
- 10 kt cable count and size, as well as the connector selection, are not ready at this time.
- We will attempt to keep the cable space required the same as in this model.



Screen shot of model
Courtesy of Manhong Zhao, BNL

10 kt PD Design Status

- Baseline PD technology decision to be taken before TDR
  - Alternates may still be in play at that time

- Decision made on the basis of comparative measurements (protoDUNE and dedicated tests) and Monte Carlo simulations

- Besides choosing the most performing device, there are important reasons to increase as much as possible the efficiency and uniformity of the light detection system:
  - ✓ ***Meet the requirements for the detection of low energy events*** *(supernova neutrinos and proton decay) → hard to achieve with the actual number of penetrations even if many unknown are still present (QE of the devices poorly known – measurement are in progress, MC simulation not detailed enough – great effort put in place by SP PD Consortium in this field)*
  - ✓ ***Improve the energy resolution of the detector***
  - ✓ ***3D localization of the events with light***
  - ✓ ***Particle discrimination***

PD System Requests to Improve Performance

- The current (protoDUNE) design foresees the installation of 10 modules (bars) per APA through a slot 19.2mm X 108mm.
- We need to explore the possibility of increasing light collection by:
  - ***increasing the dimensions of the slots***
    - ***Increasing the slot width from 19.2 to 21 or 22mm would greatly improve the ease of PD installation and connector fixation strength***
    - ***Increasing the slot length (from 108 to 150mm? 175mm?) directly increases the light collection at the lowest cost per photon!***
  - ***Increasing the number of the slots***
    - ***Increases light collection for any collector technology selected***
- ***Any increase in coverage translates directly in an increase of efficiency!***
- In our Consortium meetings we are discussing implementing ***an active veto using the LAr which lies outside the TPC***. This would be very beneficial for the proton decay searches, for example.
  - It would imply ***increasing the number of slots for the external APAs*** and ***mounting a diaphragm*** – before wiring the APA – **which separates the internal and external volumes**
- We also want to explore the possibility of installing ***reflecting foils coated with wavelength shifter on the CPA*** →Passively **increases the light collection efficiency** – Significantly improves the **uniformity of light collection** allowing for ***calorimetric measurements with light*** → ***Easy rejection of low energy background*** (*^{39}A, alpha particles, low energy gammas*)

APA Group Comments

- Much of the feedback from the APA group came from Alberto Marchionni
- He was in principle sympathetic to the idea of more detection area for the PDs, and agreed we need to work together to determine our
- His initial thoughts were that larger slots might be easier than more slots, but that all options required engineering verification before he could comment seriously.
- Flavio's presentation was very well received, and we all agreed it was important to continue to develop these ideas
- It was agreed that we should work together in the consortia integration form required by project management between the APA and PD consortia. Twords that end we must develop a contact between the PD integration working group and their opposite number.

Consortia Interface Document Sample

DUNE Interface Document: DAQ/CE

Definition: This document describes the interface between the DUNE single phase far detector DAQ and Cold Electronics. This document describes the necessary interfaces for both DAQ and CE to complete the design, fabrication and installation of their subsystems. This document describes the elements of the scope of each subsystem at the interface between them.

Hardware: The hardware interface between DAQ and CE has two components. The first is the cable for data transfer between the WIB and the first DAQ card. The cable and its two connectors are the responsibility of the DAQ. The second is the cables for timing, trigger and control signals. This cable and its connectors is the responsibility of xxx. Related interface documents describe the interface between the CE and LBNF, DAQ and LBNF, DAQ and Photon and both DAQ and CE with Technical Coordination. The cryostat penetrations including through-pipes, flanges, warm interface crates and feedthroughs and associated power and cooling are described in the LBNF/CE interface document. The rack, computers, space in the CUC and associated power and cooling are described in the LBNF/DAQ interface document. Any cables associated with photon system data or communications are described in the DAQ/Photon interface document. Any cable trays or conduits to hold the DAQ/CE cables are described in the LBNF/Technical Coordination interface documents and currently assumed to belong to Technical Coordination

Software: The software interface between DAQ and CE includes the driver and receiver software for the data transfer and for the communications. This interface is defined in the following way…

Signals: The format of the data and data packets is… the format of the timing and trigger signals is… the format of the slow communications link is…
L0: physical signals (optical/electrical)
L1: data encoding and transmission control
L2: packet protocol (if any)
L3: physics data format

Integration: Various integration facilities are likely to be employed, including vertical slice tests stands, cold electronics test stands, DAQ test stands and system integration/assembly sites. The DAQ consortia will provide DAQ software for… The CE consortia will provide CE emulators and CE hardware for DAQ test stands. Responsibility for installation of DAQ/CE cables in these test stands is assigned to yyy…

Installation: Responsibility for installation of DAQ/CE cables is assigned to xxx.

Commissioning: DAQ and CE will provide staffing for commissioning APAs in the cryostat in the following manner…