DEEP UNDERGROUND NEUTRINO EXPERIMENT

CALCI CI-WG
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towards the may workshop

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The may workshop

- The CALCI workshop will be held at CERN on May 7-8, and probably 9th (Saturday)
- This is crucial for the future of all our systems
- We not only needed to motivate them but also to demonstrate that they are feasible, cost effective and don’t introduce any risks.

The charge

- Provided by Eric few days ago, it will be circulated. Some portions extracted:

Proposed Cryogenic Instrumentation Systems:

1. Temperature Sensors
    a. Within the TPC volume (attached directly to the APAs)
    b. Outside of the TPC volume
    c. Static temperature monitors
    d. Dynamic temperature monitors
2. Purity Monitors
    a. Inline monitors for cryogenic system
    b. Monitors sitting inside of cryostat (short and long options)
3. Level Meters
4. Cameras
    a. Warm (in ullage)
    b. Cold (in liquid)
5. Pressure Sensors
6. Gas Analyzers

Review Committee Charge – Part I: The review committees are asked to look at each of the proposed systems and evaluate the following:

- Does the system have a well-justified role in safeguarding the far detectors and facilitating their operation, and if so, what is the minimum amount of system scope needed to carry out this role? (Cryogenic Instrumentation only)

- Does the system have a well-justified role in facilitating the analysis of far detector data, and if so, what is the minimum amount of system scope required to fulfill this role?

- Have all technical issues related to the feasibility of the system (including those raised in the previous workshops) been resolved?

- Are there any risks to overall detector performance associated with the implementation of the system, and if so, is there a plan in place for mitigating these risks?

- Is there a credible plan in place for demonstrating system performance in ProtoDUNE-II?

- Does the functionality of the system justify its overall cost?

Note that the workshop is not intended to serve as a design review for the systems under discussion. As stated above, the review committees should attempt to assess the technical viability of each proposed system but not worry directly about more detailed technical questions such as how cryostat penetrations will be allocated among the different systems. The intention is to first define the overall required scope for calibration and cryogenic instrumentation systems and then work to figure out how to best globally integrate them. If the committees believe that certain calibration and cryogenics instrumentation systems are likely to have interference issues with other existing detector systems, these concerns would be appropriately be addressed as part of their evaluation of potential risks to overall detector performance.

Review Committee Charge – Part II: Based on their evaluations of the individual systems, the review committees are asked to classify each of the proposed systems in terms of the following categorizations:

1. Essential – Experiment should not be run without this system in place.

2. Highly-desirable – Strong justification for including this system but not viewed as absolutely necessary.

3. Advantageous – Good arguments exist for why this system might be useful but not fully justified in terms of its contribution to overall detector performance.

4. Debatable – System could potentially be useful but not fully supportable based on current arguments.

General comments

- Although the workshop charge is focused mostly on the scope of each of the systems and is not a design review, we think it is crucial:
  - To define the baseline for each of the systems
  - To solve all interfaces with other consortia
  - To identify and reserve cryostat ports
  - To have a well defined cable routing
  - To have a well defined installation plan
  - To provide 3D models as advanced as possible

CFD simulations

- Those are essential to connect purity and temperature measurements, and to understand the overall situation in the cryostat
- Although APA temperature sensors make extrapolations easier, those are still needed to understand the purity and the drift velocity in the active volume
- SDSU will start a new round of simulations. Priority is to better understand the temperature maps in ProtoDUNE-SP

Purity monitors

- We will need to answer (during march I would say) the following questions:
  - **Number of arrays: 1 or 2**
  - **Cryostat ports. This is essential !!! We should agree on that with TC**
  - **Anchoring points: hung from the flange or attached to cryostat corners**
  - **Fibre (and cable) routing inside cryostat**
  - **Space needed on top of the cryostat**
  - **Cable routing to racks**
- Les urgent but needed for the review
  - Number of PrMs per array: baseline is 3
  - Length of PrMs. Justification based on physics arguments

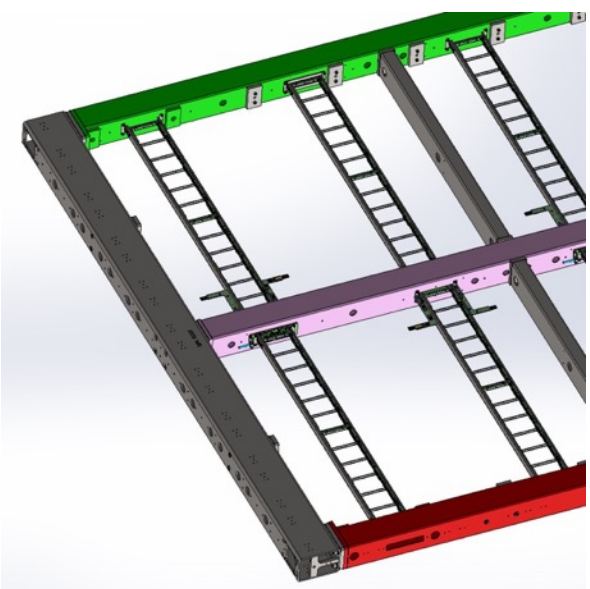
3D models for everything

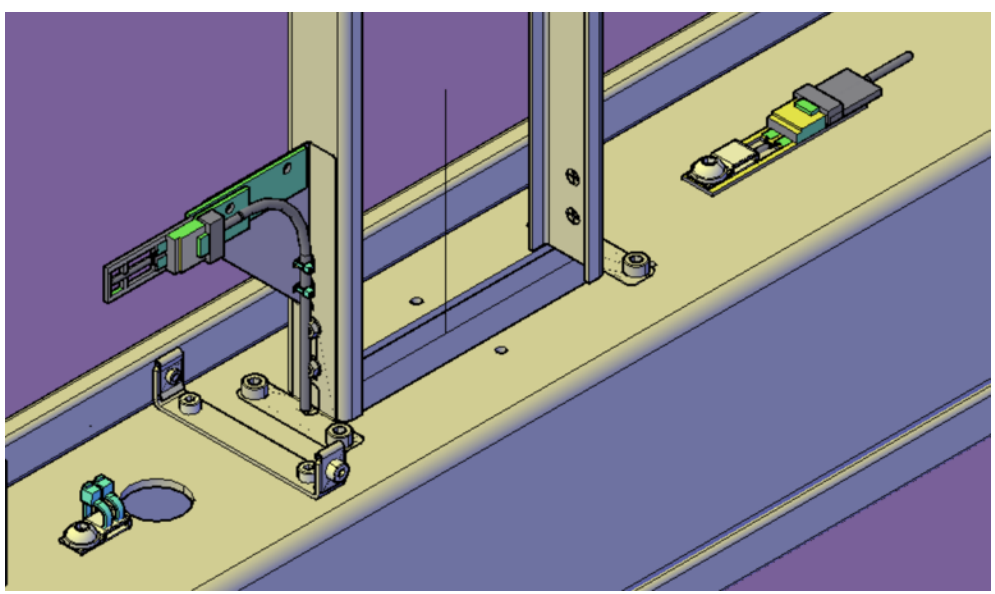
Inline purity monitors

- We know very little about this. A presentation with details should be made as soon as possible (next meeting ?)

Temperature sensors on APAs

- There will be four sensors per APA. Almost converged with Dave and Dan on sensor mounting mechanism and cable routing
- Urgent action items
  - Cable routing outside cryostat, from PD flange to racks
  - Converge on sensor map: # frame sensors and # LAr sensors, randomization, bookkeeping, etc



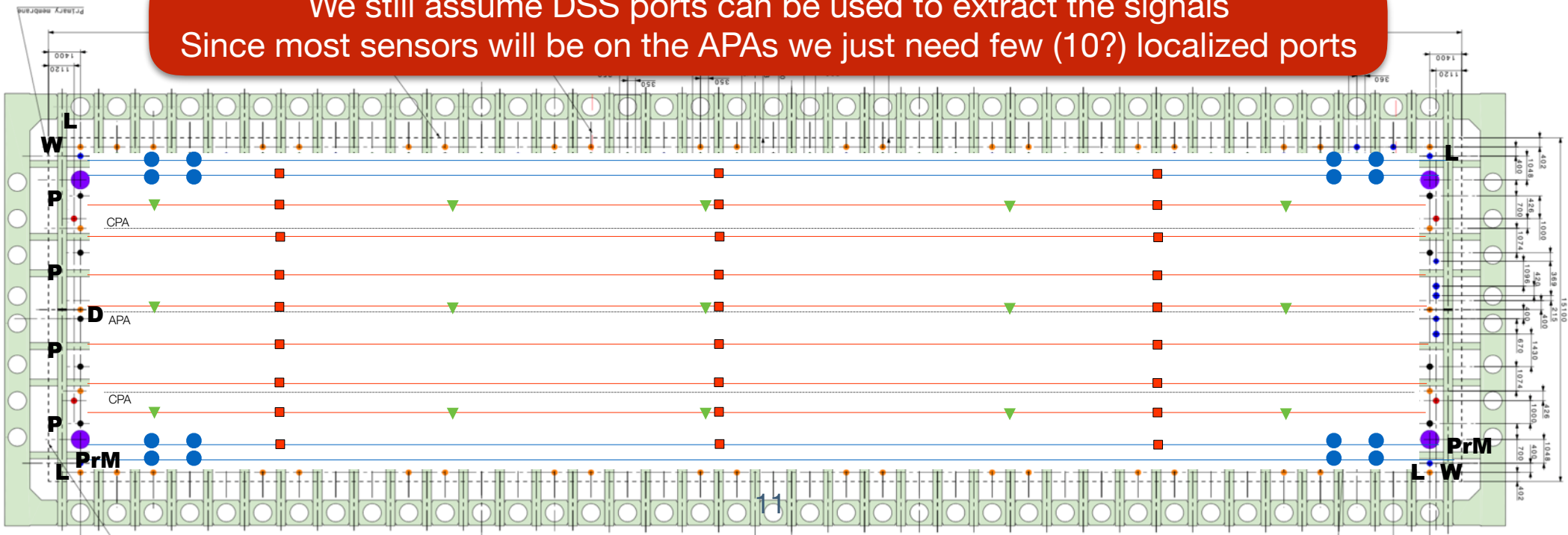


Dave and Dan

Other temperature sensors

- **LAr pumps (P) and inlets (●):** Important input for CFD simulations
- **Top GP sensors (■):** Several transverse arrays of sensors to better know what happens between two APA rows
- **Floor sensors (▼):** Standard sensors epoxied to the floor for detecting the presence of LAr when filling starts
- **Wall sensors (W):** Standard sensors to measure the vertical gradient of the cryostat membrane during cool-down

We still assume DSS ports can be used to extract the signals
Since most sensors will be on the APAs we just need few (10?) localized ports



Action items

- Finalise sensor map. Recent changes (APA sensors, no bottom GPs) prevented us to converge earlier
- **Identify suitable ports (DSS?) for extracting signals and work out the details with the owner of those ports**
- **Anchoring mechanism for all type of sensors, specially for the ones on the GPs.**
- Design mechanism to route cables from the bottom of the cryostat (also for cameras). Two options:
  - **Bring all cables to the four vertical corners**
  - Have a bottom-top cable routing mechanism in the middle of the cryostat (a SS string attached to bolts in top/bottom corners ?)
- Installation plan depends very much on the above.

3D models for everything

Dynamic thermometer

- The current design assumes a static array with ~50 sensors and a movable set of 5 sensors to cross-calibrate the static array.
- We have a dedicated port
- This system is certainly useful, but no matter what we say it is always under debate. The main concern is the moving system
- Action items:
  - Better motivate the system
  - Advance **3D models** to demonstrate that the system is feasible and does not introduce any risk
    - Mainly the inner part with the static array and the moving system
    - But also the outer part (vacuum tightness, space needed, …)

3D models for everything

Cameras

- There will be two types of cameras: cold (inside the liquid) and warm (in the ullage).
- The HV consortium has basically agreed on taking under their scope the cameras looking at HV devices
- Glenn is exploring the option of integrating cameras into the laser periscopes
- But we will need some extra cameras: bottom, APA gaps, etc
- Urgent action items:
  - Finalize camera map and anchoring mechanism
  - Cryostat ports (DSS, HV …)
  - Cable routing inside the cryostat, which could be problematic for cameras at the bottom

3D models for everything

Pressure sensors

- Most likely sensors in two flanges in oposite sides of the cryostat
- We don’t ave dedicated flanges so we would need to use space in already used flanges or have side ports in other ports (DSS)

- Those devices are mandatory, but currently no group is taking care of that. Volunteers welcomed.

Level meters

- Baseline is 4 long (4 m) capacitive level meters in the four cryostat corners, as in ProtoDUNE-DP

- Those devices (or similar) are mandatory, but currently no group is taking care of that. Volunteers welcomed.

3D models for everything

Gas analyzers

- Those are comercial systems but they need to be interfaced to the cryogenics system and a routing panel is needed
- Action items:
  - Is the system descrived in the TDR the current baseline ?
  - Converge on number and type of gas analyzers.
  - Location of the analysers
  - Resolve the interface with the cryogenics system and other consortia (?)
  - (?) 3D models for the routing panel

Next steps

- Please try to address all points mentioned in the talk during the next month
- We will contact individually the responsible of each system to monitor the progress
- We will start posting documents into EDMS