

Meeting focus: Report from Feedthrough (FT) status from the special Technical Board meeting and Oct. 3rd Cryostat team meeting. Discussion of updated arguments for Laser System.

Indico link: <https://indico.fnal.gov/event/15235/>

Attendees: Sowjanya, Kendall, Josh Klein, Jim Stewart, Juergen, Bo Yu, Chuck Lane, Glenn Horton-Smith, Jack Fowler, Luke Corwin, and possibly others.

DUNE Physics Week Announcement:

DUNE Physics week which is planned for November 14 to 17 is announced with a reminder to register for the meeting. A list of tasks is being prepared for the Physics week and the calibration task force members are requested to join the effort and contribute discussion topics or studies of interest.

<https://indico.fnal.gov/event/15181/>

Talk 1: Report from Special Technical Board Meeting on FT penetrations (Sowjanya Gollapinni)

There are currently 16 FTs in the current design for instrumentation/calibration. The proposal, assuming all needs from both calibration/instrumentation side and that most systems require dedicated ports, from the Task Force (TF) requested for about 3 to 4 times more ports. The Technical Board (TB) and the cryostat team further discussed this and suggested to explore the possibility of using Detector Support Structure (DSS) ports, cryogenic ports and TPC signal cable ports. There are a large number of these ports that are spread around the detector. The TB and the Cryostat team came back with a counter proposal of increasing the 16 ports to 18 (option A) or 20 (option B) such that these can serve as multi-purpose ports serving radioactive source, cameras and the laser system. We are currently iterating on this counter proposal. The counter proposal could also mean that there could be a priority for a given system in timeline. For Thermometers and Purity Monitors, we need to explore further on what is the safest way to mount them (e.g. cable tray, using bolts at the top and bottom edges of the cryostat etc.) so they are not hanging in the detector from a flange but rather held firmly by support structures at the top and bottom of the cryostat.

Comments during the talk:

- If the camera can see the laser, then can get around positional uncertainty. Mirror could be deflected, which could be hard. Not impossible though. (Josh)
- How often laser deployed in uB? Regularly? (Juergen)
 - During shutdowns, beam down time, dedicated laser runs during commissioning period. We had issues with some of the commissioning laser runs, we also collected runs for different E fields. (Sowjanya)
- Some discussion on implications for radioactive source locations being closer to APAs (Jim, Josh, Sowjanya, Juergen,...)
 - Nice to have larger lever arms for electron lifetime. To disentangle warping and response of gamma, would like to be near a cathode plane. Decided from simulations halfway through drift, in case electronics noise is too high, or HV achieved is not what you hoped. (Juergen)
- How far can laser sit away from APA and still be okay? (Sowjanya)
 - Current port is 40cm away, laser designed for SBND is insulating, so, in theory it is not a problem. Further in toward cathode, the more field distortions this opening would produce. Better to be near APA. In terms of rotation, if you have laser head near APA, not physically possible to shine light on photon detectors (PDs), shielded. Otherwise you hit the PDs. Right at the APA side, only need to rotate 90 degrees at the corners. If further in, to cover behind, have to rotate more. Middle is 360 degrees, not sure if technical problems. (Bo)
 - Would you want to fireback to APA? (Jim)
 - Sure, would have to be physically moved. Rotational capability depends on where they are. From TPC stand point, progressively worse distortions into cathode. If you are penetrating the field cage for Laser, need to have a preferred location. Right now, profiles are supports

- by two I-beams. If you cut them, then more engineering is needed. (Bo)
- Do all the ports on the TPC in both FT design options (e.g. the FTs near the outer APAs that are circled in pink) close to APAs at 40 cm away? (Sowjanya)
 - Yes, I think that is true (Jack)
- If ports are preferred to be near APA to accommodate laser, then from the source point of view, we will have non-uniform drift coverage for ports outside the Field Cage (FC) and ports on the TPC. (Juergen)
 - If we move the ports outside the FC also close to APAs for consistency, is it still okay for HV monitoring of the HV FTs since we will be away from them closer to APAs? (Sowjanya)
 - For cameras, realized lost most of our camera port requests. If we can develop a periscope, then locations are fine. (Bo)
 - But, we are so close to APAs either way which is not desirable for radioactive sources (Juergen)
- Can you buy a cheap camera, and just leave it?
 - For our purpose looking for sparks. It's energetic enough. It's dark in there. Damage or deformation, many LEDs on the cryostat, perhaps. interlocked with PDs. (Bo)
- How often radioactive sources need to be fired? Once you put the laser head in, is it easy to remove it and put back in? (Sowjanya)
 - Physics signal, when you collect gammas, response of the detector, before and after the dataset need to be analyze. Usually, multiple times across the point of the year. Up to weekly is foreseeable (Juergen)
 - The ones on top of the TPC may not be usable after Laser takes over them, but you still have the 8 ports that are behind the FC (Jim)
 - True. But, that means they get the Y/X resolution but no resolution in Z (Sowjanya)
- For cameras, when will they be mainly deployed? Commissioning or beyond commissioning? (Jim, Sowjanya)
 - Mostly during commissioning (Bo)
- People unhappy with long stick on the D grade monitor. Spooler to do temperature measurements. One can go back with pros and cons against that? Do we need a dedicated port for purity monitor? Have to make it removable? Possibly not, mount it in the detector then you just have cables to route. (Jim)
 - For purity monitors, cable tray is OK. But field is high at the field cage FT locations according to simulations from Bo, so hence would like to move them further out from the FC. May be hard to re-use for dynamic T-gradient. Static ones along the side of the cryostat, bolts can use at the top and bottom to hold them. (Sowjanya)
 - If you don't move the ports outside the FC further away from the FC, there may be an argument for 1 additional port in on either side of the cryostat.
- After my talk, we can discuss this further once we have heard about plans for Laser (Kendall)

Talk 2: Updated arguments for the laser system (Kendall Mahn)

Updated arguments for Laser are presented in terms of identifying scenarios where 1. Laser is superior to ultimate cosmics, and 2. Laser and Cosmics give comparable measurements along with what studies we need to do to bolster the claims, for the TDR, or sooner where possible. Some of the areas identified where Laser is superior to ultimate cosmics are stability of position dependent field effects, global (multiple-APA) alignment, Motion of support structure. Discussion on which one of these require crossing tracks from Laser. Some of the areas where cosmics and Laser are comparable are APA local alignment, cathode and APA flatness, and electronics testing. Along with this motivations for Laser from the HV side are also discussed for e.g. field cage resistor failure. Interdependencies for Laser system are also discussed. The final part of the talk focused on discussing the Laser FT options.

Comments during the talk:

- We have to be careful with space charge. There could be field distortions where space charge is hiding. I remember from GERDA experiment they had space charge from something else (Josh)
 - Ar42 (Juergen)
 - Yes, that is it (Josh)
- Igor has calculated impact of field on energy scale. 10% of field results in 1.5% bias in energy scale. (Josh)
- If we know the arrival times of cosmics, one can use cosmics to understand the APA twists. (Bo)
 - But how well can you do this with cosmics? Since it depends on other things such as drift velocity (Josh)
- Some technical considerations for Laser and mirrors: do not work well with larger angles, steer beam, 180 deg and grazing incidence. one can deploy two mirrors and can only go 90 deg with each one and get full coverage (Bo)
- Some comments implied that we should explore the Photo-calibration laser system.
- Do we know from MicroBooNE, how well the E-field can be measured? (Juergen)
 - No we don't have an official number yet (Sowjanya)
- It would also be good to understand from MicroBooNE for example, what is the reproducibility of angles and positions with mechanics? If we shoot longer, can we achieve the same performance? (Juergen)
 - Agreed. This would be good to know, or one can look at CDR/TDR to get what was assumed in the design.

The TF conveners will follow up with specific questions to understand if the FT counter proposal from the Cryostat team is good for physics among various other considerations. Two specific questions to follow up on: location of the FTs along the drift direction (closer to APAs okay? Middle of the drift desirable? If so, why?) and how to distribute the ports on the TPC?

Talk 3: Radioactive source update (Juergen Reichenbacher)

Deferred to next week – sorry Juergen.