Minutes, Calibration Task Force Meeting, September 11, 2018:

Attendees: Kendall, Sowjanya, Steve K., Mike M., Tom J., Vitaly K., Jose M., Juergen R., Josh K., Jason H., Jingbo W., Hannah R., Clara C., Wenqiang Gu, P. James Norris, Ed Tatar, Jim Stewart and possibly others.

Indico Page: https://indico.fnal.gov/event/17564/

News from Sowjanya/Kendall:
TJ: Will DAQ measure efficiency, for online, or semi-online?
JK: Clearly need data sets to determine that efficiency
TJ: I see, so special run, to check the trigger behavior?
JK: for the beam events, not sure… CRT using rock muons? Something? but really care about the edges more than that.
SG: There was a meeting between various consortia and (offline) software and computing group. The scope of software and computing was discussed and was made clear that it will be largely offline. Most groups will need online support and an online coordinator role is being formed.

KM: Call back of concerns.
JR: Also in process of electron neutrino beam data, if the noise is large, if we have a bias in the energy reconstruction of little pulses, how does it affect the beam physics. But the most obvious is what was said, trigger efficiency. Don't know the signal, and that's the best way to conclusively study trigger efficiency.
CL: Huge scientific risk if efficiency is not what you have. Likely there is not a second chance for supernovae so we better make sure we have the efficiency to detect them.
JK: Technical comment. Two components— detect individual interactions, and detect a burst. Drives on individual interactions, depends on that threshold. That's not easy to do. If we see 9 MeV— how many do we see? is it the right number? How many did we miss? A lot of the efficiency in the real detector— some of what Juergen mentioned, wires dead, or have noise. Wil be complex. Plan is to deploy the source and also look at low energy radioactivity otherwise. Don't have many handles. Trigger efficiency for beam events, we don't have a source for this. I am worried about this.

EMT Concerns:
KM: There was a comment about whether we need EMT for timing as we get it from the beam window?
JK: Yes, but EMT allows you to test how good your timing is. To give an example, 1% of the time, we think the beam comes 3 milliseconds later. How would you know? But, what is more useful is the Position and direction. Money plot in the paper somewhere: here are tracks where they went, and here is where they were.

MM: In the TDR, since there will be many intrinsic sources along with external systems, where do you plan to hold this discussion and bring it together? More specifically, where would the other calibration sources be mentioned?
KM: (showed the table in IDR) we presented how the various calibration sources will come together in the form of a table. Let us know if you have additional comments on the format presented.
SG: We have to somehow span the physics and technical volumes for calibration. Assuming there will a section on calibration in the physics TDR, we will show strategy, and then will also connect to detector volume as appropriate. For example, the calibration of channels will sit in the CE consortium and that piece will be covered there. Similarly, for the external systems, the relevant requirements, calibration aspects will be described in the detector volumes. The physics TDR portion should include higher level calibration aspects such as impact on LBL and other physics, systematics etc. Agreed that it is not easy to bring it all together.
MM: Calibration has the hardest set of tasks ahead of them. Physics is still setting specifications. And also, for energy scale uncertainty budget, also need to talk to people in different hardware consortium. How well calibrate the gain of a given channel?
SG: Once the EB lands on the recommendations we know what hardware we are putting in and we can then focus on how best to bring it all together.

Report from Josh on Data Selection workshop at Penn:
JK: Big thing is heard from Juergen on Radioactive sources. Coincidence in source tag itself, and TPC or PDS triggering. Solves a lot.
JK: heard a little about electronics calibrations, sounds OK for trigger, but remains to be seen how we drive what part of the DAQ is responsible.
JK: Laser didn't discuss— we know we can window the data— Problem is that we will be triggering ourselves.
KM: I'm worried about PDS— is it efficient enough for us to use photons for triggering radioactive sources?
JK: Yes, worried too. This is option 2. Not confident, need demonstration from e.g. ProtoDUNE. But, the TPC, we have something better, by definition, can use that to trigger on LE, that's how we do the SN trigger.
JR: Yes, and show the photodetection system is better if we can use it. At the last collaboration meeting, PDS has been pursuing methods to improve the efficiency.
SG: Is this quantified?

MM: Changing topic, ruled out radioactive injection sources?
JK: it's 100% external hardware. Doesn't change cryostat design, or the DAQ.
KM: We need to add it to development plan, but no studies planned given other priorities.
JR: Depends on the half-life x circulation time. Need to understand protoDUNE validation of the model. Plate out on lead, would make signals?
MM: Do we have a study showing that?
JR: Have that in radiological modelling, since 2015
JK: In conversation with Tom, 214 BiPo seems like a great possibility to measure position resolution.

Jingbo Wang – Neutron Generator Update:
JW: Almost a hole in cryostat Everything which is not metal is needed to be removed.
SG: Hole in insulation— not a port per-say.
JW: Stainless steel membrane and fire protection wood but not open to air.
TJ: What about steel wool? Insulator?
JW: yes, can put metal.

KM: Are the feedthrough insufficient?
JW: Concern is the shielding— may have enough for the source— no shielding around the DD generator. If the insulator is thick enough to shield the neutrons, then the design 3 is the best design.

SG: Ports we have are not insufficient, design 1 is less risky— poke a hole for the insulator, if it fits right in the hole. heat leak is an issue for design 1.

SG: Design 2 is tricky, since sitting in corners, only covering part of the cryostat.
JW: Human access ports are at the corners. If it is possible to open additional hole in design 1, then design 2 doesn't have to be 70 cm.

KM: Uh, what about total weight?
JW: advantage of design 3 is weight.

SG: We can use the I-beams to support it and won't put on the cryostat.
JW: yes, has to be supported.
SG: We need to work with cryostat engineer, understand the practicalities of the designs.

SG: We cannot open a new port. A hole in the insulation, is perhaps workable.
KM: Need to understand the physics tradeoff (if we use manhole) and other logistical concerns we want to address there.

JS: With the manhole— don't have a gate valve with this size. Risk of contaminating the argon. More complicated— we need to figure out that part— need to see if it gets really expensive. Right now, sealed with wire seal. In 25cm, gate valve can buy.

SG: Design 1 more about installation— can you support the weight. The system doesn't stay there forever. Maybe can put back insulation after done?

JS: Do we think insulation is a problem?
JW: Insulation is hydrogen rich, 2.2 MeV gammas. May be OK, need to simulate it.
JS: Problem with 12mm thick steel plate on top? top of the cryostat is covered.
JS: I-Beams are connected to the roof. That's the roof. Also foam insulation has fiberglass— cryostat insulator— foam— but fiberglass reinforced.

SG: Easier if we can avoid touching the cryostat.
JW: If stainless steel layer, may be sufficient blocker for it. Will check it.
SG: Yes, we should first understand if insulation is fine before we make a decision on the three designs. If insulation is okay and we don't have to poke holes then it merely just becomes a installation problem and with I-beams it can be well supported. Simplifies our problem.

James Norris – Preliminary Analysis of ProtoDUNE CFD Simulation
TJ: why are there impurity values greater than 1? (referring to S4)
JR: It is normalized to the average so greater than 1 means impurities are more than average
TJ/MM: Concern about units for mobility cm^2/sec is not correct.
JN: Not sure, will take a look into it.

TJ: He's calculating drift time differences, due to mobility due to temperature?
MM: yes.
TJ: But E field is a bigger effect. (yes)
JK: We don't see to see average temperature variations within this model.

SG: These simulation-based studies are useful to see. There is an effort in protoDUNE to use the instrumentation data to validate the CFD model. But, parameters within the model need to be fine-tuned as we explore agreement with data. I mean we need predictions to compare to data. Is there a plan to join that effort at protoDUNE or work with that group more closely?
PJN: Yes, absolutely. Would like to do a full CFD simulation of protoDUNE.
TJ: David Montanari is an engineer at Fermilab, often at CERN. Send him a note.
SG: Just to clarify, there are two parts to how we do this, right? 1. Erik used simplified protoDUNE model, and you want to make sure you reflect a more realistic model. CFD engineers have put in the various boundary conditions and we need to continue to understand how to tune those for studies with data. 2. One can focus on the cryogenics instrumentation data (e.g. temperature monitors) from protoDUNE, and see what overall variations are, and impact on mobility due to temperature and validate the model.
PJN: Yes. I hope to do my dissertation on that.
SG: Engineers in South Dakota are trying to now work on the boundary conditions and cross check with Erik. Yes, focus on data is appropriate.

TJ: Missing in Erik's model which is steady state solutions. But not turbulence, and plumes. Predict instability.
JK: Is a dynamic model necessary? PhD could address this if it's needed.
CL: Look at Reynolds number should tell you that perhaps?
JK: Depends on driving terms. Spot of insulation which is different.
TJ: Argon is viscous, and a lot of it – it is not small?
JS: If looking at data, look at temp data, and model flows.

JR: Study where in the detector are the "above average" impurities are coming from as it will affect the electron lifetime?
SG: Yes, agreed. That would be very interesting to understand and need to be explored.

TJ: Look at resistance? with the wires on average?
TJ: Also, does Erik's simulations include heating of electronics?

JS: The South Dakota group already looked at this, and made a simplified model. Read the reports from them?
SG: yes, sent those to James already.

Post-LS2 ProtoDUNE Running:
Proposal to CERN, neutrino platform for protoDUNE running after the long shutdown, asked consortium. Calibration wasn't asked, but we prepared anyway. Spokes took the input, and they had a meeting earlier this month with CERN team. We will hear from Spokes on the next steps of this process and we will advise groups on how to proceed.

JR: October 1st deadline? Should we talk about this in CM?
SG: Yes, the exact deadline is not clear. But, there won't be individual proposals, there will be one combined proposal from DUNE to CERN management, led by the Spokes. The deadline is a bit of a worry given that it is already mid-Sept. We will talk to the Spokes and find out.