

Calibration Task Force Minutes, August 7, 2018

Attendees: Sowjanya G., Kendall M., Tom J., Juergen R., Ritchie D., Viktor P., Hannah R., Chuck L., James Haiston, Jingbo W., and Maggie H.

Indico Page: <https://indico.fnal.gov/event/17931/>

Talk 1: Report from LBNC Meeting (verbal): Kendall reported.

KM: Productive discussion with LBNC, clarified timeline for deployment of sources and individual sources motivation and criticality. LBNC appreciated, after more time to reflect, the IDR and contents— thank you to all who contributed.

They amended after discussion with us, their requests to us, which was quite helpful. Offered a chance to talk before the TDR, please let us know if there is a good reason for that.

SG: Agreed. LBNC's approach this time was more like "help us help you" which was indeed very useful. A lot of questions/discussion on DAQ. But, since we were well prepared, they were satisfied with our answers. In terms of what to do next, for the TDR, they want us to show a baseline demonstration (impact of calibrations on physics) that external and existing systems can calibrate the detector. If not fully to whatever extent possible.

Talk 2: Alignment and Connection to Physics: Tom Junk presented.

SG: p19/20. During discussion earlier, we talked about the crumple mode mainly along the horizontal direction in z, but, vertically also we have two APAs, so, how misaligned vertically?

TJ: Yes, "vertical crumple mode". The two vertical APAs are held by brackets.

TJ: Talking to Alberto, it seems like there are a lot of meetings about that joint. Thread lower APA to upper APA. Brackets bolt together. This makes me nervous. if there's any angular distortion, doesn't take much. Gigantic lever arms, then the bottom will be displaced.

SG: How far in do the brackets go?

TJ: may have to ask the APA people... Lever arm looks small for p17. Don't want too rigid, and want to build in flexibility.

Feature reminded of yesterday by Alberto, support system, holds 3 APAs, not a hanging rod for all. Batches of 3. Gap which widens between groups of 3 APAs and can get bigger during cooling, say about 2cm order. But, we can use cosmics for this.

TJ: (p19) In protoDUNE, have more handles than DUNE, more horizontal cosmics. Red line on p19 is a total guess for excursion (1 cm front to back). ICARUS had 2 cm distortion

Do not trust angles on long distances (space charge) with millions of cosmics, could measure angles well. These may be constrained in protoDUNE with work. Constraints will be strong. But amount of data is large. Not sure what to do for FD. May need to get some practice. Analysis needed to that, is PhD level. Trying to get people started.

TJ: In Eric's Requirements spreadsheet presented to LBNC, he got field uniformity, but maybe need to include planarity?

SG: The list shown is not a complete list. Some things shown are cherry picked as most important items that connect to physics since the set of requirements need to be kept finite. Consortia are maintaining a detailed set of requirements. So, we need to communicate to APA about the planarity requirement.

TJ: They do have a wire displacement in and out of the plane, driven by transparency, and confined to the plane.

KM: OK, can use this for studies, and see?

TJ: number out of a hat, may trash our muon momentum measurement.

1cm off could make our high energy muons will look like low energy— need to study.

KM: We will need to iterate

TJ: Detector support is also different from APA?

SG: DSS is under Technical Coordination, so we need to connect with them.

JR: Claim maybe a little less— TCO area? ProtoDUNE may not be a good test— only the one full height APA on the TCO beam rail. (but joined and slid in... over 60 m)

TJ: and also worried about thermal distortions— bend when cooled

JR: Vic Guarino said under control, shrinks 10cm?

SG: the way APAs are held, large gaps with every 3 APAs. If the gap is larger, possible electrons on the neighboring wire? in z direction.

TJ: I am mainly talking about rotations and the impact is on drift time. Z is of course super important. Some electrons can get lost in the gaps or get collected on other wires. If charge lands on induction, concerned because wires wrap there. Field is not nominal where the wires wrap. Could imagine some electrons lost on insulators or drift toward wrong wire. We can measure the horizontal gaps well, but, in 35-ton, we couldn't measure the charge loss. In ProtoDUNE, we need to do more studies. In 35-ton we had electron deflectors, but we never used it. Useful to use this in ProtoDUNE. This is separate work in itself.

KM: Field lines when crooked, would like to clarify.

TJ: Usually in x direction, where distorted, electrons dodge around, and a little extra distance, adds to time. Position distortions are smaller, can try time first. Can measure position distortion well, but time due to angle may be harder to measure.

At CPA, localized to where it is, field looks uniform far away. Tracks out there are not affected by CPA or APA distortion. But drifting electrons feel APA not CPA. APA crooked affects all tracks, because of drift direction. CPA are only if the distortion E field affects tracks closest to it.

KM: Good, in agreement.

KM: p20. Reference for Thales? We need it.

TJ: Thales may be in indico or old docDB?

KM: OK, if we can correct for it, is the gap a driving issue? Sure, it's a MC correction but maybe reasonably well rooted.

TJ: Agreed. Thales did a study for 5-10 wires in a row. May be more relevant on dead wires, if dead only for readout. That may be common.

If there are gaps between APA, electrons may or may not collect. Slightly wrong place but energy still kept. Not sure, do need to measure it.

TJ: Resolution looks good, compared to range based results, but need to be sure alignment works over long distances.

TJ: p28. At DUNE, 2.5 GeV will stop. Can have a larger range-based vs MCS comparison in DUNE in principle. A very nice project and a paper for a student.

SG: Strongly agree. Indeed.

JR: With MINOS, better resolution with coarser detector. See shadow of sun and moon. IceCube replicated, not much better. ProtoDUNE no confidence because of all the space charge, so we may not achieve this and not a good place to look at.

KM: p29 Any reason to set up a hit shifter in z for gaps?

TJ: Pretty sure can measure well. Can use back of the envelope prior. Question is what fraction of charge lost? Didn't finish that analysis in 35-ton, noise was too much.

Because charge is distorted on the last wire, not as a reliable position vs. ones further away. Cut out the hits right at the edge.

TJ: concern is that gaps are not the same. Average cosmics crosses it, then plenty of data. Each gap separately may need more data. But maybe 6 per day per gap, maybe not so bad.

SG: Need more humans. Will talk to Sim/Reco group about this. There may be overlapping efforts here and we can benefit by collaborating.

TJ: I have pointed Maggie at this hit shifter. Don't know what's in Andrzej's module. If it uses the shift hits, if it does more, then maybe more work. Be able to put into the modes.

TJ: If we do sensitivity with 1 cm, and find it trashes us. What's the take home?

KM: Confirm the tolerances

JR: Vic says +/- 4mm, bow at half height, differences in fluid circulation. Confirm with Vic, requirement on APA, at least as good.

KM: OK, we will talk to him

TJ: If some convection cell?

JR: Guess more transparent? than the CPA?

TJ: Yes

TJ: Distort their fits within LBL for this impact? The question is how much of physics (LBL) depends on muon momentum?

KM: Yes, Liz did a study already on this, how much we can mess with lepton on this. Will check with them and bring back information.

Other Verbal, Round Table Reports:

Radioactive source update:

JR: Refitted for Double Chooz in the far detector. may test at protoDUNE, salvaged, in a box in France! When can do some mechanical deployment tests (esp. 10 kg source). Stage a mock up over a great height. One APA to start with.

For the LBNC and TDR, probably have to use simulation data, for the Radioactive sources, Jason prepared a simulation.

Working on the simulation production for MCC11 production.

Will release a Technical note in 1-2 weeks advance for the DAQ data selection workshop at U. Penn, ideally.

KM: Will you attend the meeting in person?

JR: No, will dial in for DAQ workshop and give my presentation.

External Muon Tagger (EMT) Update:

RD: read the LBNC report from last May, having been looking into the 1% requirements for physics. Been doing studies, to test the constraint.

On the blue flow chart of low level parameters, one thing confused about if electric field calibration is for all 3 unit vectors, or magnitude only? Currently doing for all 4 parameters, in addition to seeing sensitivity to drift velocity. Can get drift velocity to 1% and magnitude to 1%, and one or two of the Cartesian vectors? Direction moving in with cosmic only samples. Rock muon event generators, muons may not be OK with.

KM: next presentation time?

RD: just moved for my new appointment and need to take after orientation, around early Sept? in 2-3 meetings?

Neutron Generator:

JW: Ongoing.

Count number of gammas from two isotopes. Can also do activation test, in the neutron beamline in Berkeley.

need to test the cryostat installation sample. If get a sample to do shielding test, with DD generator. Can do this in DANCE.

JR: Yes, what we want to see, anything with Ar37 and 35.

TJ: Speaking for neutrons, high energy ones, sometimes rarely produced in cosmic ray interactions. Talking to DAQ when cosmic goes through? Josh says, we currently read out the entire module when a cosmic goes through because of neutrons. But we don't know what the cosmic production is for neutrons. May be a fight to understand it?

CL: Business of neutrons and cosmic rays, long standing.

TJ: Higher neutron multiplicity, lower efficiency will be. Detect some of them... in denominator.