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Memo

Date: November 21, 2018

To: Ed O'Brien

From: John Haggerty, Glenn Young, Dave Lynn, Dan Cacace, Don Lynch, Jim Mills, Richie Ruggiero, Mickey Chiu

Subject: MVTX Review

An Interim Design Review for the MVTX components to be purchased in the near future on Monday, November 19, 2018 in 2-219. The agenda, charge, and slides are here:

https://indico.bnl.gov/event/5351/

The purpose of the review is to determine whether the state of readiness of the design of the MVTX allows the purchase of components from CERN and other purchase expected in the coming months. Since the purchased components are to be installed in the detector, a key question is to assure sPHENIX management that plans for detector installation are sufficiently advanced to reasonably ascertain that the components fit in the allowed envelope and can be installed into the crowded inner bore of the TPC. Before the purchases are made, a Procurement Readiness Review will be held to check the orders for the components.

This review is needed to satisfy the normal cadence of sPHENIX design and procurement reviews, and to satisfy a recommendation of the PMG:

"Conduct a technical review with subject matter experts for the installation of the MVTX into sPHENIX (conduct before November 14, 2018). The details of the installation need to be understood and agreed upon before issuing the procurement for the power cables."

There were no evident showstoppers in the presentations, and substantial progress was shown from the review in the summer of 2018.

Recommendations

1. The outline of the step-by-step assembly procedure for the MVTX showing installation of the barrel staves, power cables, and signal cables, should be written down and summarized in one or two slides. This does not have to be the final, more comprehensive assembly procedure, but should show the installation of major components and at what point tests are conducted.
2. The cables to the racks probably need to be longer than 8m, and this should be assessed conservatively.
3. A memo approving the halogenated cables should be on file from the fire protection group.
4. A proposal for extending the beam pipe to move the flanges further from the IP should be discussed with CAD and sPHENIX, as well as beginning a discussion of the beam pipe support.

Comments from Mickey Chiu

1. How is the assembly procedure different from the Alice one? The MVTX has two inner patch panels vs just one for Alice, so the assembly has to be different.

2. Related to the above, I didn't see any description of how the assembly will be done, and whether it is even possible. There has been a worry that the cables will interfere with being able to install the staves, and thus you can't assemble the MVTX. It would be good to have a step-by-step (with illustrations at the cartoon level) that show the assembly can be done.

3. Since the assembly is being done at LBNL and the two assembled halves will be shipped to BNL, there should be very reliable connections. Is the Alice spring pin going to be used, and how? Also, was this done with the STAR HFT, ie, did they assemble the HFT at LBNL and ship to BNL from there? What was that experience like? Is there a plan for assembly and possible disassembly in case there are problems with any staves on testing when the MVTX arrives at BNL (before installation).

4. In Walt's talk, the cooling cables (containing the negative pressure cooling water) aren't included in the cross-section on slide 10. Are there any other cables that are needed in there? Is the inert air expected to be just blown down the entire cylinder, or are there air hoses that will be used?

5. The location of where the flanges on the Be-beampipe needs to move has to be specified. C-AD needs this number before they can go out to Brush-Wellman to see if it is feasible and how much it would cost. Related to this, is there a backup plan in case the beam-pipe can't be extended?

Comments from Dan Cacace

I'd just like to preface my comments and questions with the note that all may not be within the scope of the charge.

Walter's Talk:

1. Is the dry air/nitrogen sufficient to dehumidify the MVTX to prevent condensation? What temperature is the cooling fluid at the inlet? What is the heat generated per stave and in total? Is there sufficient thermal insulation between the MVTX in the INTT?
2. Given that each layer's shell covers the exterior access to connections at patch panel 1a, is there enough room on the internal radius to attach, and detach if need be, all connections?
3. Can the service barrel be attached to the MVTX with power cables extended to patch panel 1b?
4. Given that the 5-pound MVTX, the 16-pound service barrel and the unknown but considerable weight of the cables, water cooling lines, air cooling lines, patch panels and other supports will be supported at least 4 feet away, will the cantilevered scheme allow for sufficient clearance with the beam pipe?
5. How are the two halves of the in the MVTX align with one another as well as the beam pipe?
6. If the beam pipe flange is not moved out further in Z, will the MVTX need to remain open and clamshell closed around the beryllium section of the beam pipe? If the beam pipe flange is moved out further in Z, and the MVTX halves clamshell around the beam pipe exterior to the TPC, can the two-millimeter gap between layer 0 and the beam pipe be maintained during installation? How far in Z does the flanges need to be moved for this option?
7. Is the 3D printed plastic rad hard enough? Why not use a machined (milled, water or laser cut) rad hard plastic?
8. Is the 8 m cable length enough to reach the MVTX's rack?

More general questions:

9. Where can the beam pipe be supported from?
10. Where is the MVTX supported from? (Presumably the support ring)

Comments from Dave Lynn

1. I would like to see a drawing making clear how the different layers are supported, and how they (I think) are supported by the outer shell
2. Double check how the voltage standoff from the TPC to the INTT/MVTX is to be handled. A simple dielectric could make things worse.

I think the assembly sequence Mickey requested in his second point will go a long way towards convincing us there are no show stoppers.

Comments from Don Lynch

David, Dan and Mickey have covered almost everything that I have on my notes, except for these few items, some of which overlap others comments. Dan's comment about relevance to the review charge probably applies to my comments as well, but her goes:

1. How will the cable connections be secured in place, (what mechanism secures the connection)?
2. What is the power consumption/heat load per stave? A thermal design/analysis report on all of the relevant cooling and inerting issues would be appropriate.
3. Will there be any shared mechanical support features between the INTT and MVTX.
4. What is the preferred installation sequence for the inner detectors and the beampipe. (Right now the assumption is TPC then beampipe then INTT then MVTX then MBD). Are there other alternative sequences considered and if so what are the tradeoffs?
5. FEA of the VTX cantilevered support is needed and should be supported by a mockup simulation to verify FEA.
6. Will there be any internal supports for the beampipe and if so what are the risks? An analysis of the possibilities, tradeoffs and risks is needed but it is unclear who needs to lead this effort.
7. The negative pressure cooling system location and characteristic tradeoffs need to be analyzed (on carriage in IR, off carriage in IR or outside of IR, cooling system maintenance and reliability, backup system, etc.).

Comments from John Haggerty

Ming's slides:

1. We should formally close the recommendations from the summer 2018 review.
2. The organization chart should be changed to reflect the inclusion of the project into sPHENIX (i.e., Ming is the Level 2 manager).
3. Slide 8 creates some confusion because it doesn't show how the assembly can be done. I suggest a step-by-step recipe that shows the pieces going together.

4. Fully assembled and tested half barrels will be delivered to BNL.

5. We discussed who is designing the installation tooling needed to install the detector at the IP; probably that tooling will be provided by the MVTX group, but we will have to be clear where the dividing line between MVTX and Installation/Integration comes.

Sho's slides:

1. Extended FPC's have been shown to be ok.

Walt's slides:

1. MVTX group should propose the additional length desired between flanges on the beam pipe.

2. MVTX group will have to work with integration group to demonstrate how the load is supported from the inner HCAL ring.

3. Jim Mills suggested that we get a memo that approves the halogenated cable the MVTX proposes to use (there is an email).

4. Radiation damage to the mechanical components, even 3D printed plastic, does not appear to be a problem with the expected doses of tens of krad.

5. The cables from PP-2 to the rack would appear to be more like 10m than 8m.

6. The MVTX pont-of-contact for cabling is Ross Corliss.