Brookhaven National Laboratory

Jefferson Lab

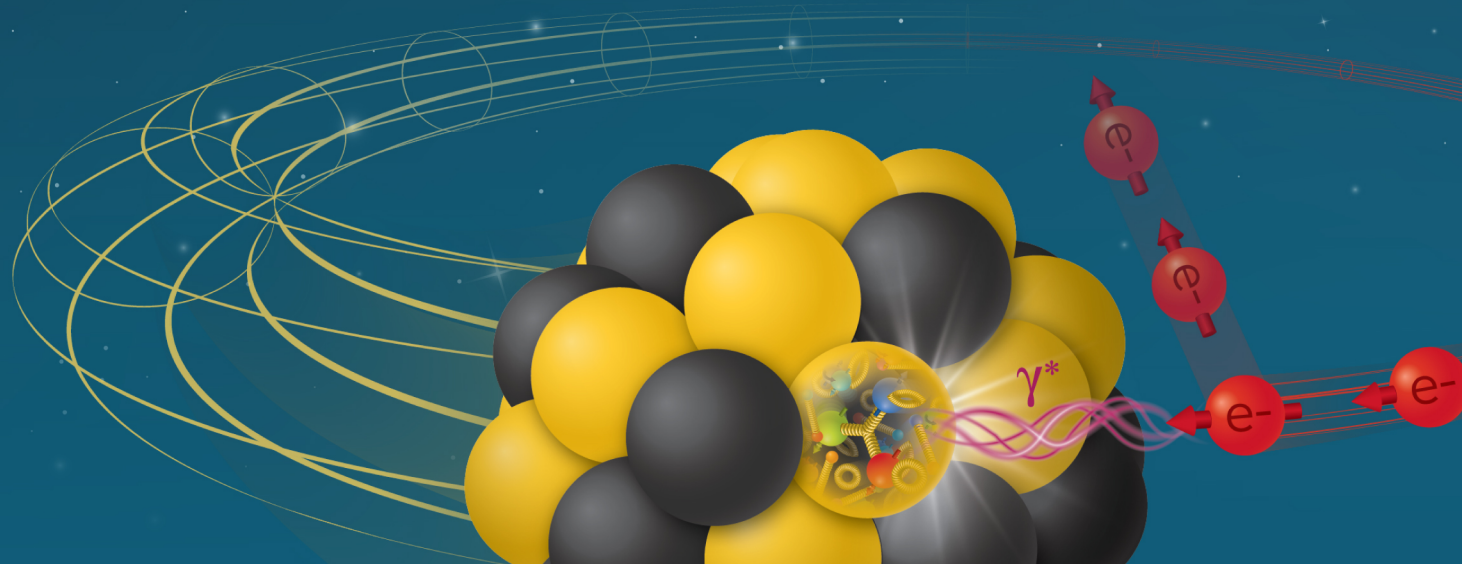
U.S. DEPARTMENT OF ENERGY

Far-forward/far-backward review summary

Yulia Furletova

Feb. 12, 2024

Electron-Ion Collider

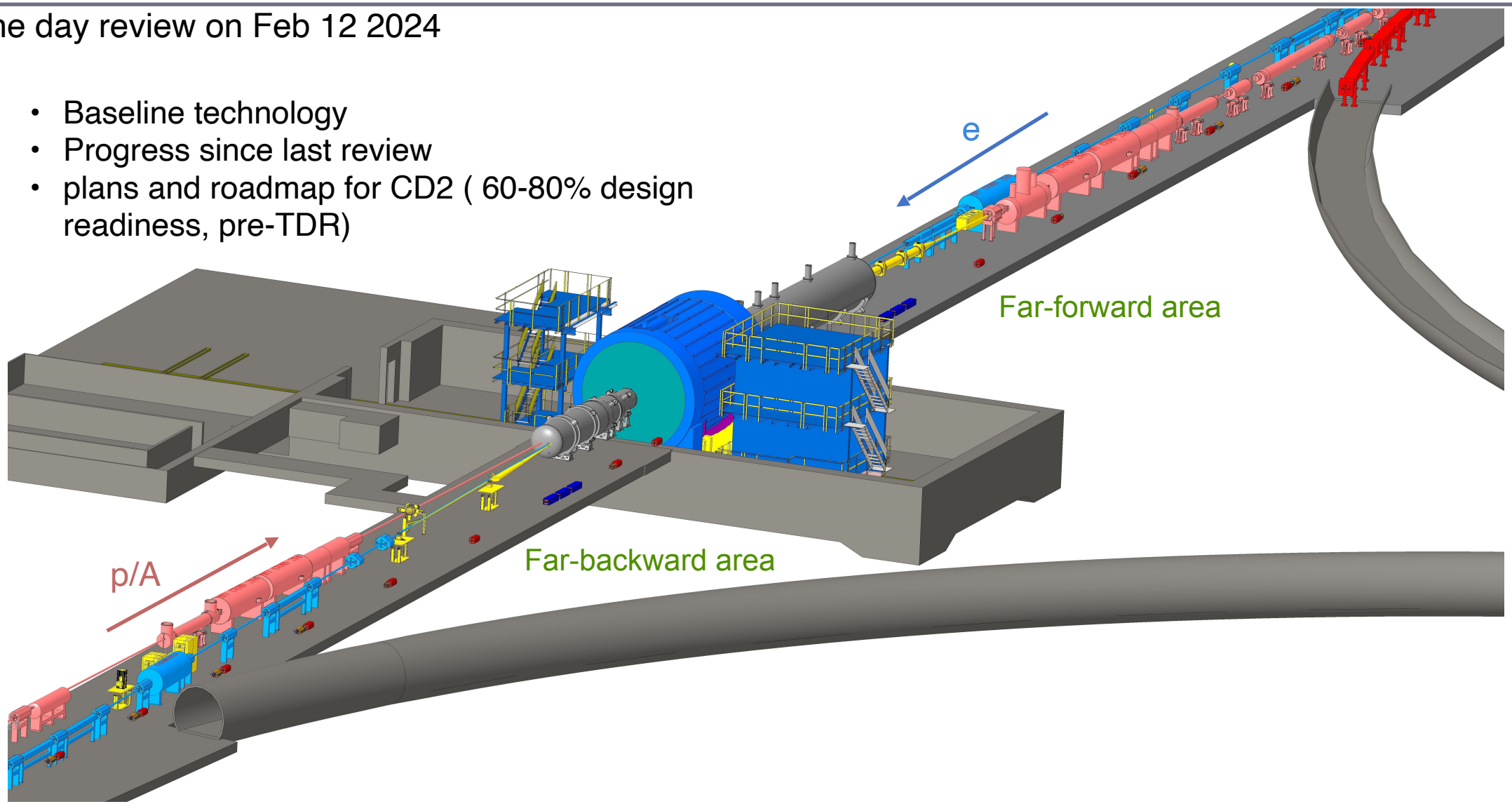


FF/FB review

https://indico.bnl.gov/event/21709/

One day review on Feb 12 2024

- Baseline technology
- Progress since last review
- plans and roadmap for CD2 (60-80% design readiness, pre-TDR)



Charge Questions to be Addressed

1. Are the technical performance requirements appropriately defined and complete for this stage of the project?
2. Are the plans for achieving detector performance and construction sufficiently developed and documented for the present phase of the project?
3. Are the current designs and plans for detectors and electronics readout likely to achieve the performance requirements with a low risk of cost increases, schedule delays, and technical problems?
4. Are the fabrication and assembly plans for the various detector systems appropriately developed for the present phase of the project?
5. Are the plans for detector integration in the interaction region appropriately developed for the present phase of the project?
6. Have ES&H and QA considerations been adequately incorporated into the designs at their present stage?

Agenda and Review Panel

Review Panel:

- Eugene Chudakov - JLab
- Wolfram Zeuner – CERN
- Gerrit van Nieuwenhuizen – BNL
- Fulvia Pilat – ORNL

Click here for Zoom Link (Open Session)

Time	Topic	Speaker
08:00 am – 08:30 am	Executive Session	Closed Session
08:30 am – 09:00 am	Far-forward/Far-backward Overview and Requirements	Yulia Furletova (JLab)
09:00 am – 09:20 am	3D layout of IR	Bijan Bhandari (BNL)
09:20 am – 09:40 am	Summary of Backgrounds	Elke Aschenauer (BNL)
09:40 am – 10:10 am	Roman Pots and Off-Momentum Detectors	Alex Jentsch (BNL)
10:10 am – 10:30 am	Break	
10:30 am – 11:00 am	B0 Detectors	Zvi Citron (Ben-Gurion University, Isreal)
11:00 am – 11:30 am	Zero-Degree Calorimeter	Michael Murray (Univ of Kansas)
11:30 am – 11:50 am	Luminosity Detector Pair spectrometer	Nick Zachariou (York, UK)
11:50 am – 12:10 pm	Luminosity Detector: Direct Photon Calorimeter	Krzysztof Piotrzkowski (AGH, Poland)
12:10 pm – 12:30 pm	Break	
12:30 pm –1:00 pm	Low Q2 detector	Ken Livingston (Glasgow, UK)
1:00 pm – 1:25 pm	Engineering Design and Mechanical Support Structures	Jonathan Smith (JLab)
1:25 pm – 1:45 pm	DAQ and Synchronization	David Abbott (JLab)
1:45 pm – 2:00 pm	Further Questions	All
2:00 pm – 3:30 pm	Executive Session	Closed Session
3:30 pm – 4:00 pm	Closeout	

Charge Questions to be Addressed

1. Are the technical performance requirements appropriately defined and complete for this stage of the project? YES, for most components.
2. Are the plans for achieving detector performance and construction sufficiently developed and documented for the present phase of the project? YES for performance, not yet for construction
3. Are the current designs and plans for detectors and electronics readout likely to achieve the performance requirements with a low risk of cost increases, schedule delays, and technical problems? YES for performance, for risks we need to see the risk matrix
4. Are the fabrication and assembly plans for the various detector systems appropriately developed for the present phase of the project? NO, neither fabrication nor assembly plans were presented
5. Are the plans for detector integration in the interaction region appropriately developed for the present phase of the project? YES, for this part of the project, but plans will have to be developed promptly when the IR accelerator design is finalized
6. Have ES&H and QA considerations been adequately incorporated into the designs at their present stage? YES, but plans will need to be refined as the design is finalized

Closeout slides: Introduction

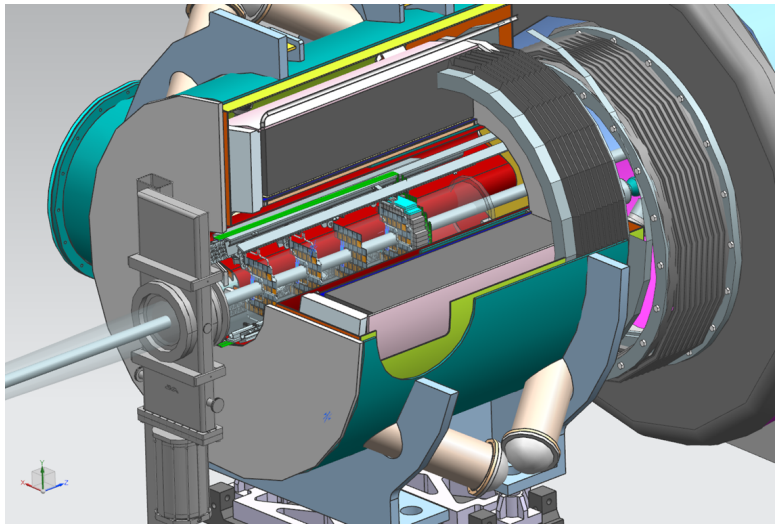
- Thanks for the detailed and **well-prepared presentations**, and for the frank and open discussions
- The Committee is impressed with the **high quality of physics simulations** in general and in particular with the **high quality of background analysis**
- We recognize the **complexity** of the task and the challenge in designing and finalizing multiple systems **while the accelerator design is not completed**
- We appreciate that the team recognizes and leverages **synergies** among different systems within ePIC
- A **very good team is in place**, and we will comment on that later
- We were excited to see the **extent and good quality of CAD modeling** beyond the institution borders that is being used on the project

Response to Charge Questions

1. Are the technical performance requirements appropriately defined and complete for this stage of the project? YES, for most components.

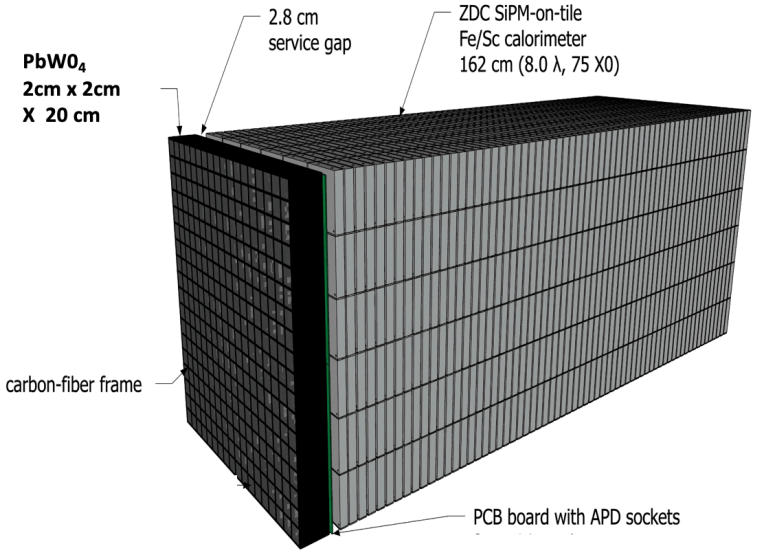
- The requirements are generally well done and credible for all systems
- Concerning the hadron calorimeter good decisions have been taken. **The decision on the crystal type should be taken as soon as possible** as it affects the readout.
- The DAQ is very challenging in general

B0



For EMCAL:
PbWO4 vs LYSO

ZDC



Response to Charge Questions

2. Are the plans for achieving detector performance and construction sufficiently developed and documented for the present phase of the project? YES for plans, but not yet for construction

The plans for achieving detector performance are appropriately developed **but the construction plan are not sufficiently developed.**

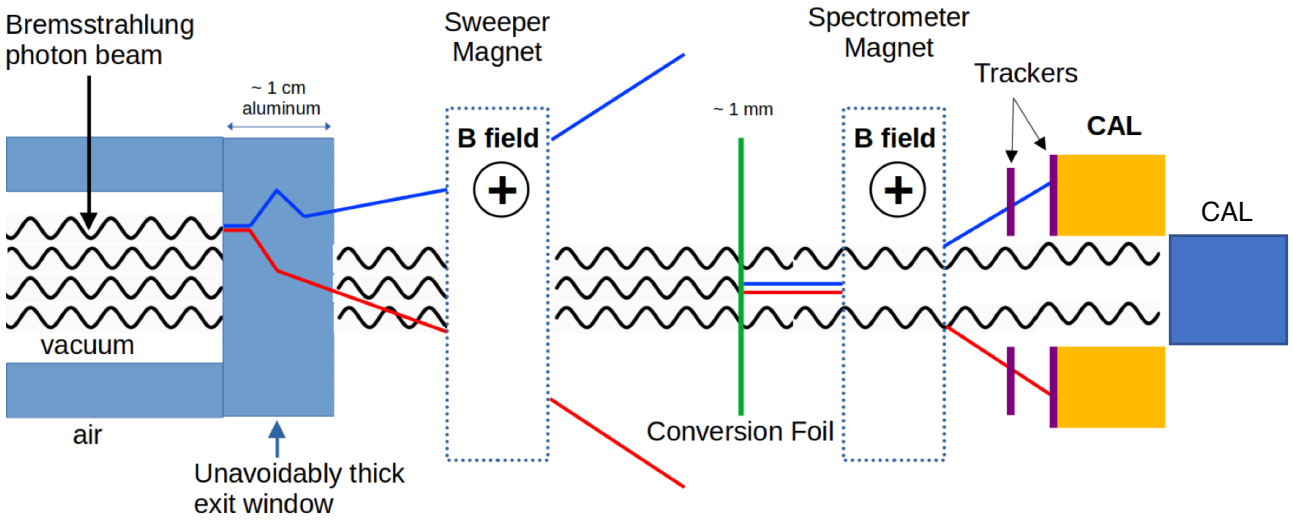
More elaboration and explanation on **how to achieve 1% luminosity** precision with the calorimeter is needed

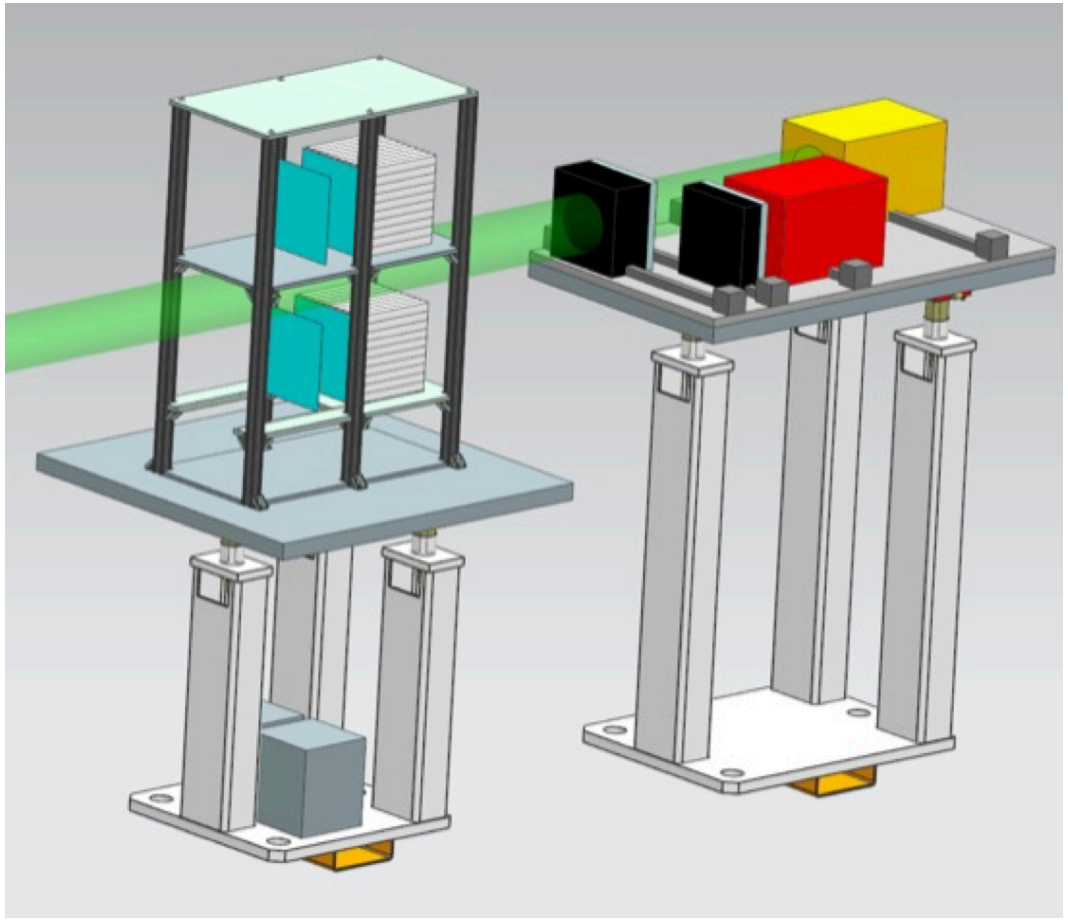
The justification for requirements of the **direct photon calorimeter at high luminosity** is not convincing

The **insertion mechanism of the tracker into the B0** appear extremely challenging and need major development work

Luminosity system

- ✓ To measure integrated luminosity with precision δL/L< 1%
- ✓ Done using two complementary measurements: Pair-spectrometer and Direct-Photon Calorimeter.



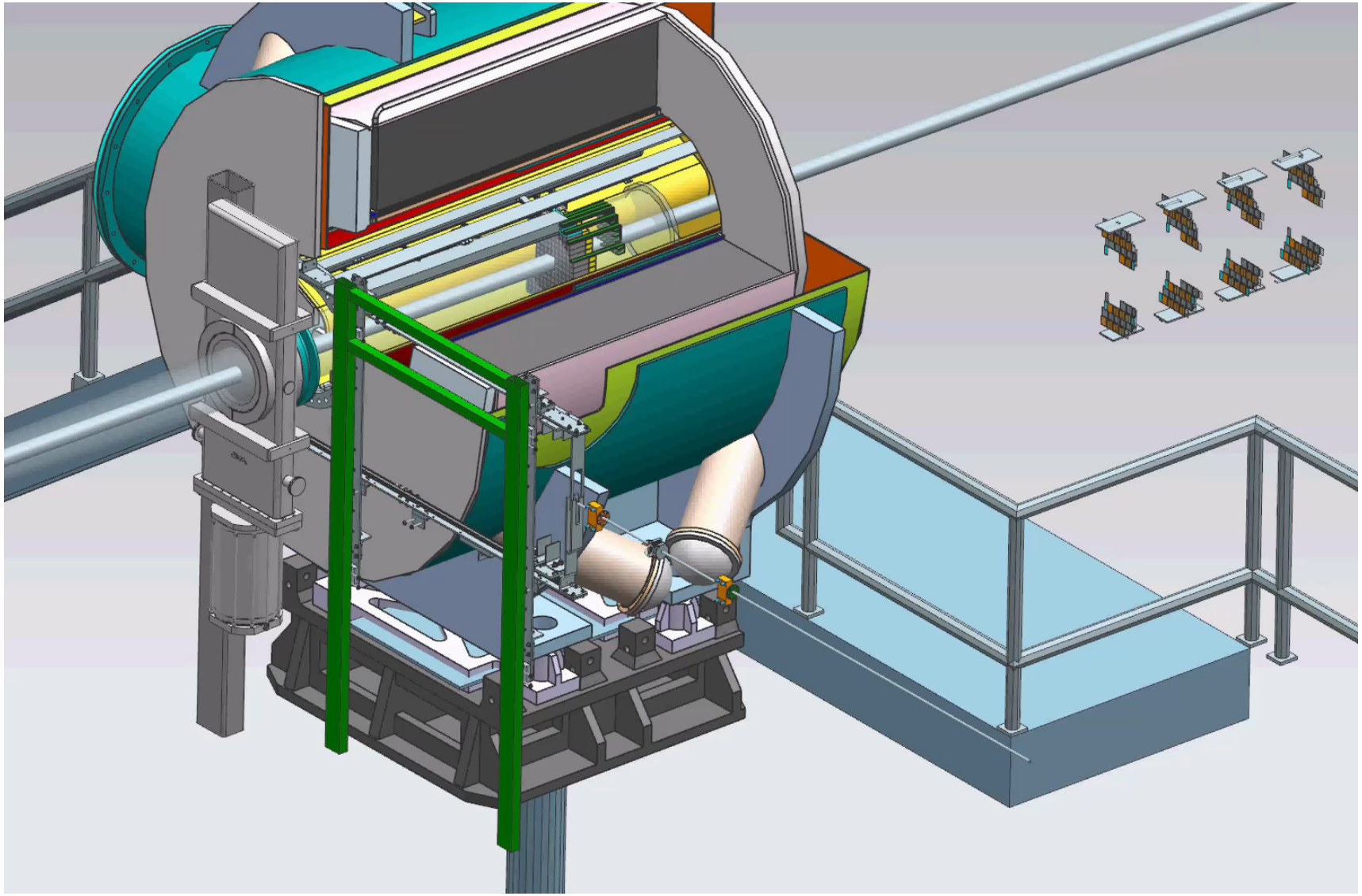


Recommendations

- Develop plans for **insertion** of tracker and calorimeter readout into B0 magnet, including decision whether the device should be **serviceable** as soon as possible but not later than the next review

B0-installation

Jonathan Smith



Response to Charge Questions

3. Are the **current designs** and plans for detectors and electronics readout **likely to achieve the performance requirements** with a low risk of cost increases, schedule delays, and technical problems? ? YES for performance, for risks we need to see the risk matrix

- The current designs are sound and likely to achieve the stated goals
- We **need more information**, in particular a comprehensive discussion **of risk management** and risk matrix, to answer this question
- We suggest to **provide** an assessment of competence, readiness and resources (**number of FTEs** etc) **for all collaborating groups**
- The Committee **support the hiring of an expert in cooling and temperature stabilization** and encourage the project to pursue this as soon as possible
- We advise to follow up with **an analysis of humidity control** in the tunnel enclosures

Recommendations

- Prepare and present a comprehensive risk analysis for the next FF-FB system review

Response to Charge Questions

4. Are the fabrication and assembly plans for the various detector systems appropriately developed for the present phase of the project? NO

Fabrication and assembly plans were not presented and we look forward to hearing at the next review

Recommendation: present fabrication and assembly plans at the next review

Response to Charge Questions

5. Are the plans for detector integration in the interaction region appropriately developed for the present phase of the project? YES, for this phase of the project, but plans will have to be developed in more details when the IR accelerator design is finalized

- Design and installation of far-forward and far-backward systems are quite challenging
- The Committee commends the systematic approach adopted and the good progress in planning
- We commend in particular the **good work done in developing a 3D CAD model of the FF and FB** regions
- We suggest to add **specific details about site services** and ancillary systems
- **Installation** during construction and **maintenance/repair** of systems during operations will be critical and challenging because of the limited access space
- It could be beneficial **to extend the use of 3D CAD model** to include assessment of space needed **for installation, maintenance and repair,** possibly including realistic dynamic process modeling
- It will be important to create the culture and expectation that **the collaborating institutions** be active not only in delivering systems but **partnering in the installation and commissioning of systems**

Response to Charge Questions

6. Have ES&H and QA considerations been adequately incorporated into the designs at their present stage? YES, but plans will need to be refined as the design is finalized

- The ESH&Q plans will need to evolve and focus as the system designs will progress and finalize
- The next Review could benefit from **an overall presentation focused on ESH** for the FF/FB regions as a complete an integrated system, and that shows as the ESH&Q plans are integrated with the overall ESH&Q project plans.
- The **QA plans** should be developed and **presented system by system,** and once the production plans are better developed

Comments/Recommendations

The ESH&Q plans will need to evolve and focus as the system designs will progress and finalize

The next Review could benefit from an overall presentation focused on ESH&Q for the FF/FB regions as a complete an integrated system, and that shows as the ESH&Q plans are integrated with the overall ESH&Q project plans

Other topics discussed during presentations

- Maintenance sequence , radiation Hot-spot areas, placement near vacuum “stay clear zone”
- In-kind contributions and international agreements
- Background, NEG-coating, beam-pipe “Bake-Out” , thermal neutrons (electronics and readout, in particular SiPMs)
- RPs/OMD: cooling in the vacuum , Dew-point. Production timeline of AC-LGADs and EICROC
- B0: Material budget of B0-tracker, temperature stabilization, alignment procedure/survey, cooling, installation sequence, installation near the vacuum, shielding for the readout , decision making on PbWO4 vs LYSO (when?).
- ZDC: testbeams, cooling, decision making on PbWO4 vs LYSO (when?), rigidity
- Luminosity: spot-size (1mrad cone- need to add to requirements), how to do calibration (with multiple photons) , data-rate , ASICS development and production plan (direct-photon lumi)
- CAD: exchange of information / how stable is floor -> ground-motion / alignment/ humidity and cooling/ space for maintenance/
- DAQ: placement of electronics and FPGA/DAQ components/ shielding for the readout. data-reduction /

Backup