Report from the October 26 Tracking WG meeting

Back-up Plan development for the ePIC Tracker

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Inputs from recent review(s), Project, SP office, DSCs, Tracking WG.

Context

The ePIC-SVT is closely coupled with the ALICE-ITS3 development,

This development is proceeding well, but the sensor is not currently in hand; there are uncertainties/risks,

Back-up possibilities identified in the very early days are not (longer) actual; the DAC, for example, agreed in its review report last year that *“We note also that the ITS2 appears to be no longer being a fallback solution [for the SVT as a whole] since the development effort is commensurate with that of ITS3.”*

Revisited also in conjunction with the CERN-EIC / ALICE-ePIC meeting earlier this Spring (backup slide),

Most recently, the Director’s Review Committee has brought this up in preparation for the CD-3A review on Long-Lead Procurement this upcoming November.

That is, we need to address this topic now.

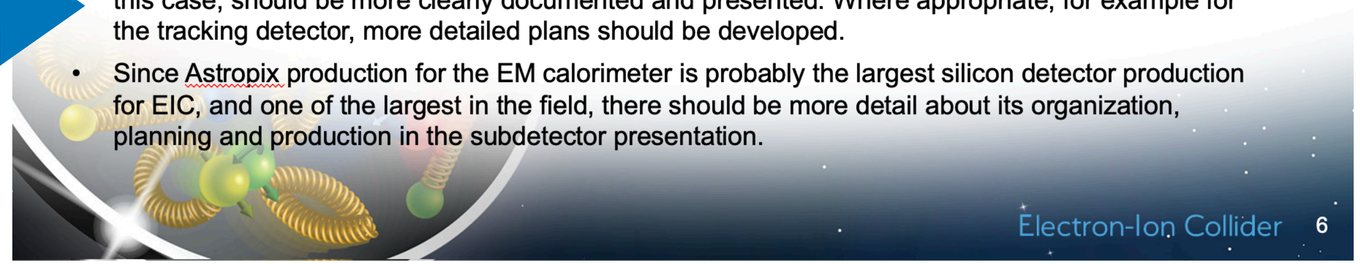
Context

From the slides by Rolf and Elke in the October 20 general meeting (c.f. https://indico.bnl.gov/event/20857/):

CD-3A Director's Review – SC-3 Detector System

Comments:

- The detector group has made impressive progress since CD-1. A rather mature project management, for this stage, exists. International detector collaboration ePIC has been established and the project and the collaboration has good coordination.
- The detector integration both within the detector and also with the accelerator is, as usual, a challenge. At this stage of the project, the detector team is addressing these issues in impressive detail.
- Appropriateness of proposed CD-3A LLP items is central to these reviews. While we got the information from separate talks and questions, a sufficiently detailed summary of these items should be up front in the plenary presentation.
- Presenting a summary of policies regarding ESH and Q for detectors (particularly for outside vendors, universities, and foreign entities) upfront in the plenary session would alleviate concerns from reviewers in a timely manner.
- There are several possible in-kind contributions that could significantly, and positively impact the project, if successful. One is the NSF proposal which, if approved, will cover the costs of the backwards EM calorimeter including the PbWO4 purchase. There is also a possibility of in-kind contribution for the detector solenoid.
- Upfront discussion of risks of R&D not coming to a favorable conclusion, and mitigation plans in this case, should be more clearly documented and presented. Where appropriate, for example for the tracking detector, more detailed plans should be developed.
- Since Astropix production for the EM calorimeter is probably the largest silicon detector production for EIC, and one of the largest in the field, there should be more detail about its organization, planning and production in the subdetector presentation.



Apologies to those of you for whom this is repetitive.

Context

From the slides by Rolf and Elke in the October 20 general meeting (c.f. https://indico.bnl.gov/event/20857/):

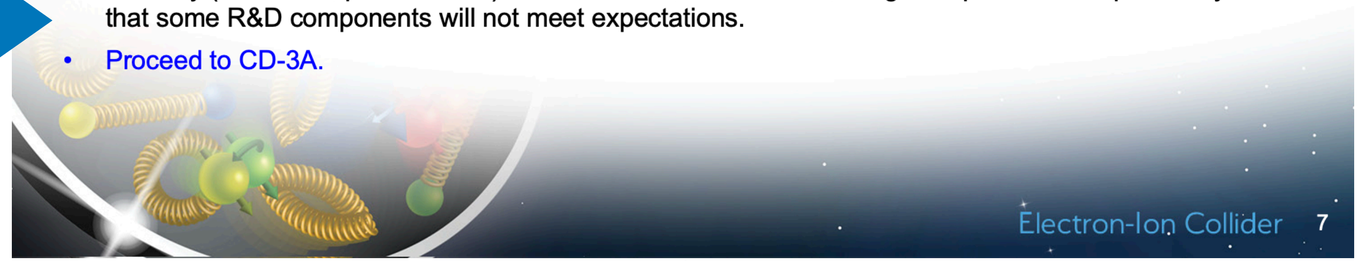
CD-3A Director's Review – SC-3 Detector System

Comments - continued:

- An overarching concern is the oversight of production yield and the distribution of key parameters for certain components over a large-scale production. These factors will need to be adequately accounted for in the project planning and management before CD-2.
- Based on the presentations made during this review, it remains unclear whether the process of selecting components and transitioning from the research and development phase to production includes the validation of a substantial system prototype for all components. Full chain tests for subdetectors should encompass all final components, enabling an assessment of whether these components meet the requirements not only in isolation but also in terms of their integration and overall system performance.
- The magnet LLP is ready to go forward. After CD-3A approval, before the solicitation, the recommendations of the Solenoid Magnet Final Design Review should be implemented.
- The LLP items for the detectors are ready to go forward. Presentation can be improved as described elsewhere in these comments.

Recommendations:

- Quantify (time, cost, performance) and document, before CD-2, mitigation plans for the possibility that some R&D components will not meet expectations.
- Proceed to CD-3A.



Context

From the slides by Rolf and Elke in the October 20 general meeting (c.f. https://indico.bnl.gov/event/20857/):

CD-3A Director's Review – SC-3 Detector System

We do need to urgently follow up on the following comment

> "Upfront discussion of risks of R&D not coming to a favorable conclusion, and mitigation plans in this case, should be more clearly documented and presented. Where appropriate, for example for the tracking detector, more detailed plans should be developed."

for the CD-3A review in November

→ We started discussion with ePIC tracking WG conveners & tracking DSCs

→ Remember that this is ONLY a mitigation plan (a what-if scenario)

→ There is NO change to the current baseline layout of the tracker

Further Timeline:

Thursday 26th Tracking WG meeting first discussion of a possible backup solution and timeline to possible branching points.

Monday 30th Discussion in TIC meeting

Follow up meetings as needed

This is not a new topic – remember the summary of the CERN visit in April 2023 by ePIC leadership, Si tracking proponents, and project leadership

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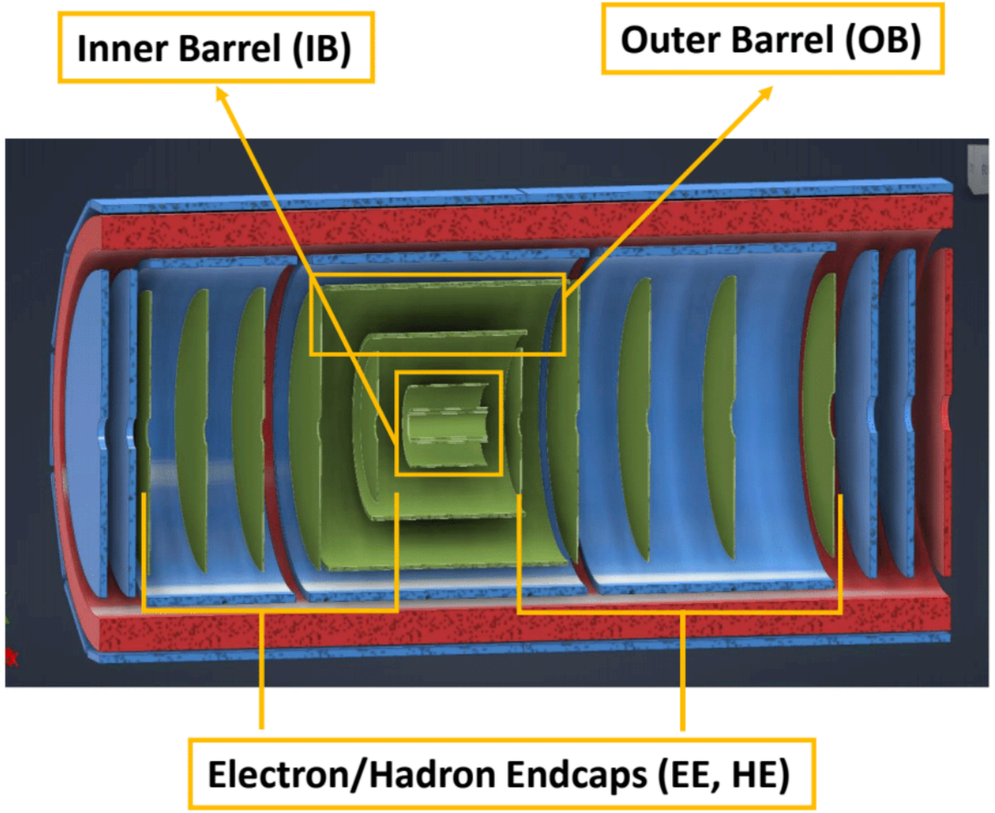
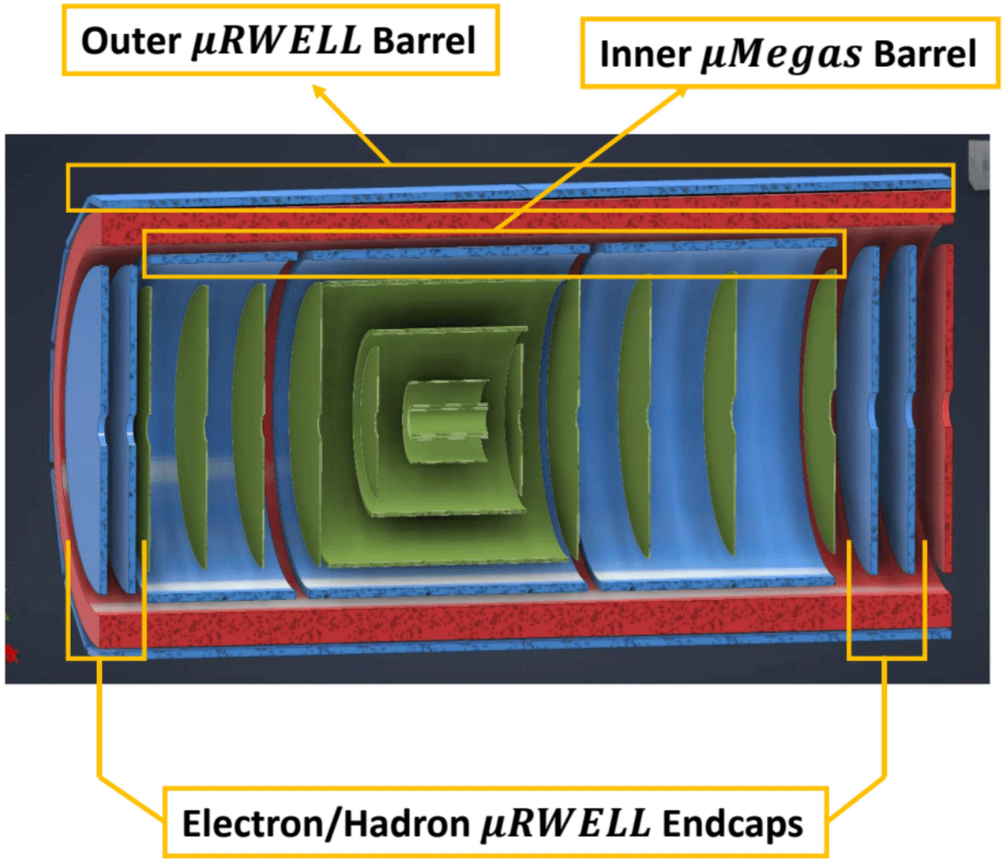
ePIC Tracker

Silicon Vertex Tracker



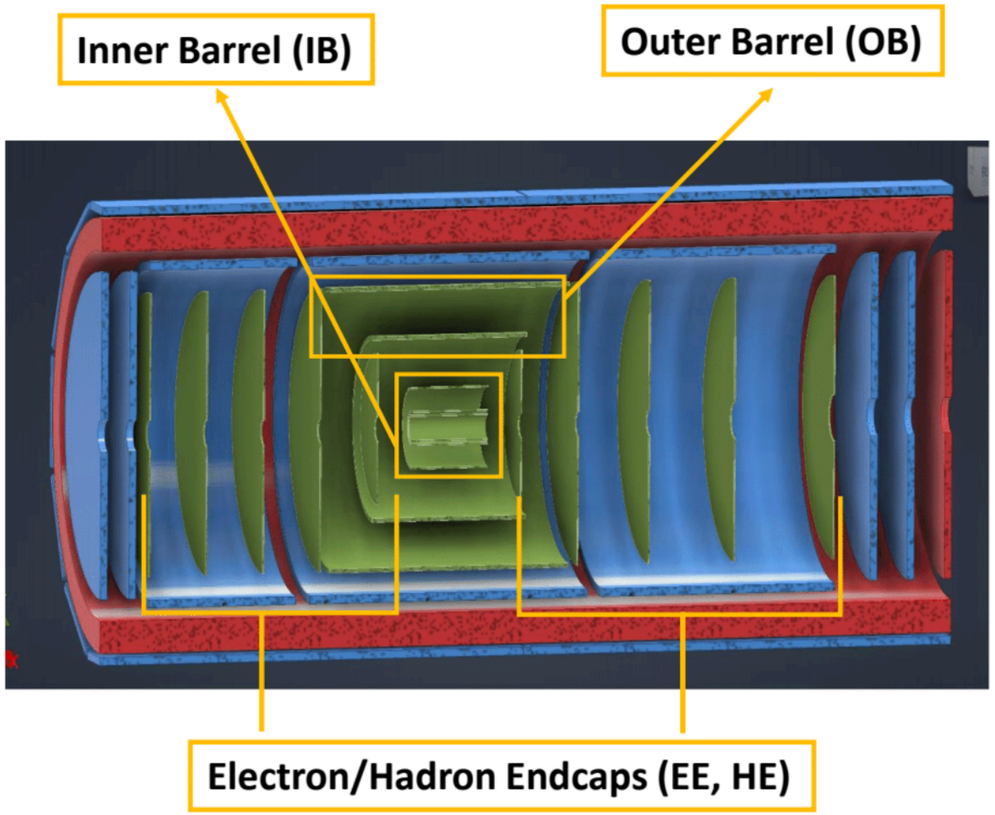
Outer MPGD Tracker



Indeed, the AC-LGAD ToF — shown above in red — contributes to tracking as well; factored out in what follows.

ePIC Tracker

Silicon Vertex Tracker

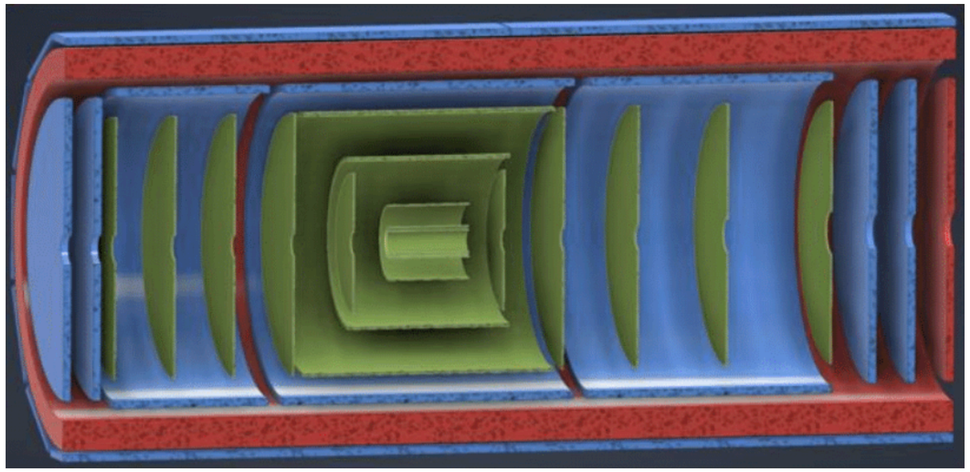


SVT Inner Barrel is based on ITS3 sensors,

Outer Barrel and Endocarps are based on EIC-LAS, which is “forked off” from the ITS3 sensor.

ePIC Tracker

Starting points for the discussion within the October 26 Tracking WG meeting:



There is no change to the current baseline configuration of the ePIC Tracker,

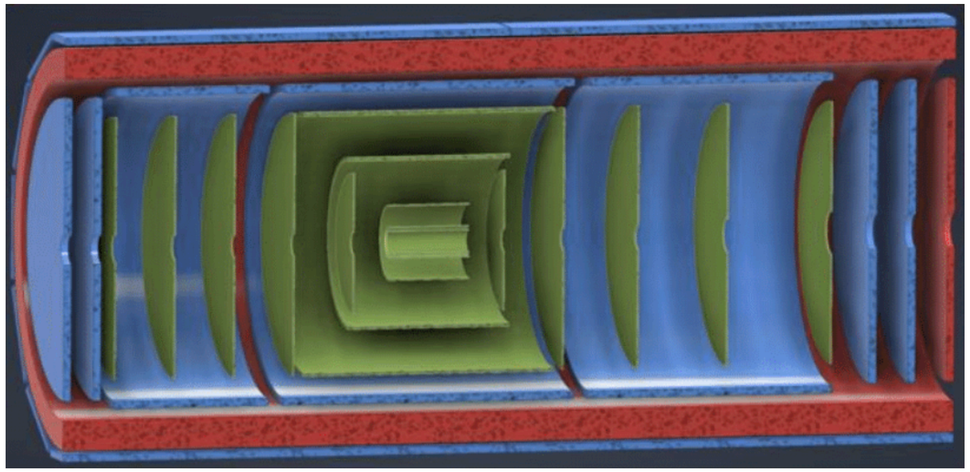
It is only about a mitigation plan (what-if scenarios),

Assumptions for discussion:

- Keep the path to the current baseline configuration open in *all* scenarios,
  - Limit resources spent on any alternatives — no new R&D, (nearly) no redesign,
  - Respect the current subsystem and service envelopes — ensure a pragmatic upgrade path to baseline,
  - Accept initial degraded tracking resolutions if a “what-if” scenario is realized — transition to baseline ASAP,

ePIC Tracker

Starting points for the discussion within the October 26 Tracking WG meeting:



There is no change to the current baseline configuration of the ePIC Tracker,

It is only about a mitigation plan (what-if scenarios),

Assumptions for discussion — consider two branch points:

- ITS3 technology works with a timeline compatible with the EIC project timelines, but the EIC-LAS (“fork”) incurs delays that make its timeline incompatible with the EIC project timelines,
- ITS3 technology works but delays are incurred that make its timeline in ePIC incompatible with the EIC project timelines.

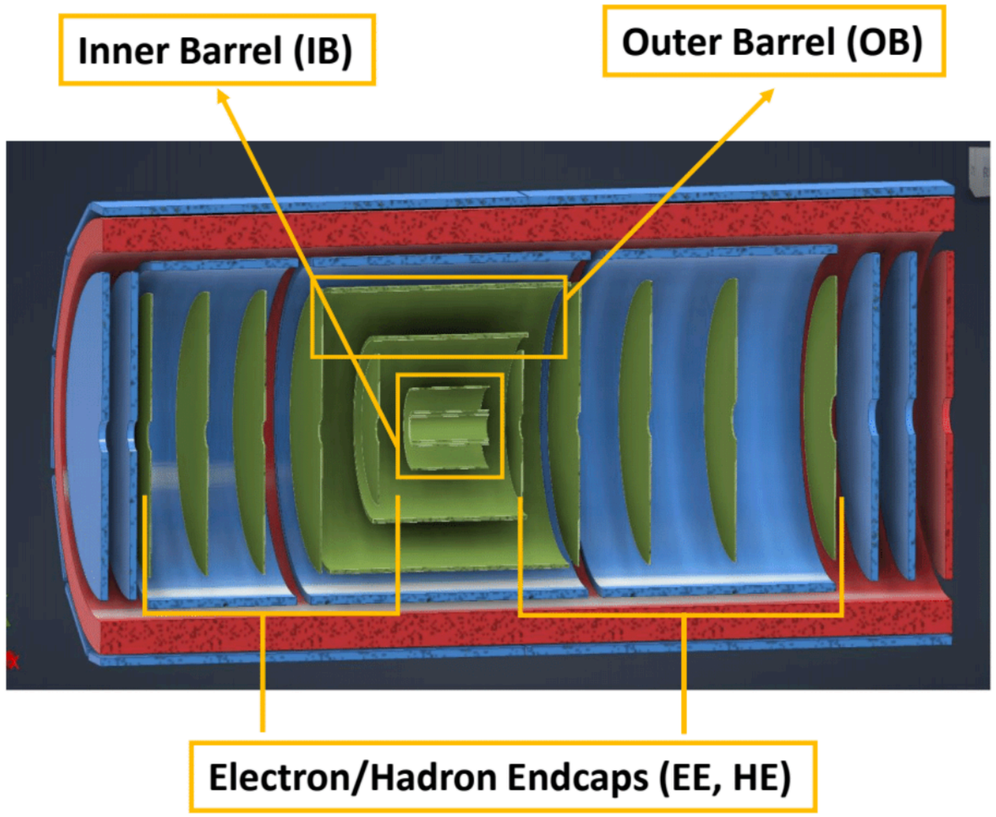
ePIC Tracker

First branch point (“what-if” scenario):

- ITS3 technology works with a timeline compatible with the EIC project timelines, but the EIC-LAS (“fork”) incurs delays that make its timeline incompatible with the EIC project timelines,

Mitigation for discussion:

- The disks in the Electron and Hadron Endcaps are replaced with MPGD disks derived from the disks of the outer MPGD tracker; nominally, this will then result in 7 (near-)identical MPGD disks on each side,
- The two Outer Barrel layers are replaced with MPGD barrel layers derived from the outer MPGD tracker, specifically its innermost (curved, μMegas) layer.



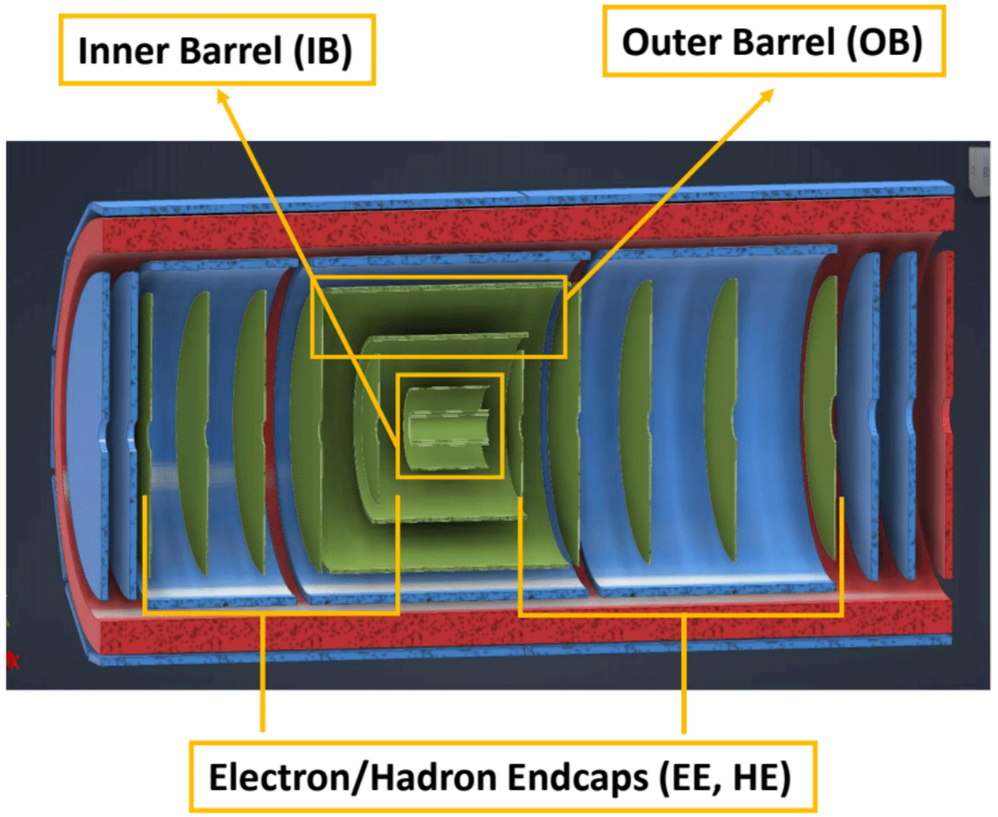
ePIC Tracker

Second branch point (“what-if” scenario):

- ITS3 technology works but delays are incurred that make its timeline in ePIC incompatible with the EIC project timelines,

Mitigation for discussion:

- The Inner Barrel is replaced with two or three layers based on the existing ITS2 sensor, as used in ALICE and sPHENIX without EIC-specific modifications,
- The Outer Barrel and Endcaps are replaced with MPGD barrel and disks as in the first branch point.



TL;DR

The comment from the Director's Review in preparation for the CD-3A review:

"Upfront discussion of risks of R&D not coming to a favorable conclusion, and mitigation plans in this case, should be more clearly documented and presented. Where appropriate, for example for the tracking detector, more detailed plans should be developed."

needs an answer by the CD-3A review scheduled for mid-November. That is, now.

The recommendation from the Director's Review in preparation for the CD-3A review:

"Quantify (time, cost, performance) and document, before CD-2, mitigation plans for the possibility that some R&D components will not meet expectations"

needs an answer in the lead-up to the CD-2 review. The project timeline for CD-2 approval is April 2025.

The two branch points from the previous slides, if triggered, would have significant implications for the realization of the EIC science program. The proposed mitigations should allow to keep the focus on achieving the baseline and ease any required upgrade path towards it.

Summary Points from the Discussion in the Tracking WG

There is consensus on the proposed branch points and mitigations.

There is agreement that MAPS-based mitigation, if necessary, is primarily in the realm of the SVT-DSC and MPGD-based mitigation, if necessary, is primarily in the realm of the MPGD-DSC. That is, it follows the delineation for the baseline (not that of the geometrical envelopes; this may seem obvious and is now explicit).

The needs for CD-3A ("now") were separated from those in the lead up to CD-2 (CD-2 itself has a target date of April 2025),

Costs estimates of any mitigation now would have large uncertainties and are needed in the lead-up to CD-2,

Likewise, quantified performance estimates from full simulations are needed in the lead-up to CD-2,

Several aspects of the timeline for when the branch points need to be triggered were discussed — among them:

- it is natural to try pushing them out as far as possible (but not any further),
- must be consistent ensure construction completion in 2029 (i.e. for the installation phase at the BNL site; note that this is not a single date),
- Inputs from both the SVT and MPGD DSCs — work together,
- will need revisiting in the lead-up to CD-2, e.g. with ITS3 ER-2 submission actuals (as one example of many dependencies),
- indeed, it gets involved, quickly,
- …

Agreement to prepare a "better" answer — i.e. beyond an enumeration of factors and their timestamps — "now."

Any estimates needed "now" will need to be explicitly preempted with the need for updates in the lead up to CD-2 / the (pre-)TDR.

Backup

Context

From the slides by Rolf and Elke in the October 20 general meeting (c.f. https://indico.bnl.gov/event/20857/):

Summary on ITS-3 ALICE –EIC SiC

Overall a very positive and successful meeting → clear goal to cooperate as much as possible in boundary conditions.

Main lessons learned and next steps

From ePIC general meeting of May 11 (https://indico.bnl.gov/event/19185/)

- ITS3 open to sharing their sensor design with EIC → necessary agreements will need to be put in place in the next month.
- ITS3 development made significant progress → received a lot of critical technical information to guide the next steps in R&D for both sensor and system design/integration of the ePIC SVT
- but there remains still some risk in the ITS development → ALICE team will need to remain focused on their requirements and timeline challenges

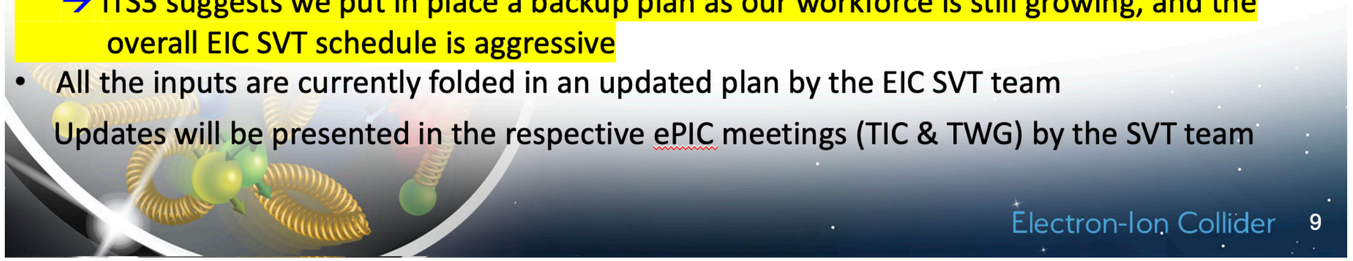
  → ITS3 welcomes/seeks partnership in development with EIC designers contributing to ITS3

  → Received extremely valuable input to overall schedule and workforce needs for EIC SVT

  Example: relation between schedule for ITS3 ER2/ER3 submission and evaluation and the EIC/LAS development schedule → adjust our schedule to give more time for the sensor modifications and the schedule and integrate lessons learnt from ITS3

  → ITS3 suggests we put in place a backup plan as our workforce is still growing, and the overall EIC SVT schedule is aggressive
- All the inputs are currently folded in an updated plan by the EIC SVT team

  Updates will be presented in the respective ePIC meetings (TIC & TWG) by the SVT team



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