



# Tracking WG update

F. Bossù, K. Gnanvo, L. Gonella, X. Li

Detector 1 Conveners Meeting

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# Questions from steering committee

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- A summary of the key items/open issues in the consolidation/optimization effort within your WG.
- What are the resources needed to address these issues? In addition to R&D and simulations, please highlight any additional resources that will be required. Are there missing resources or information the SC should be aware of?
- What are the timescale(s) for resolution? What drives the timescale(s)?
- How are the Physics Working Groups integrated into your detector working group efforts?

# Key items/open issues in the consolidation/optimization

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- The kick off meeting identified aspects that need updating related to the **sensor technology**, based on work in eRD108 (gas tech) and EIC SC (Si tech), to the **layout and mechanical design** from eRD108 (gas tech) and eRD104, eRD111 (Si tech), and to accommodate **beam pipe bake-out**.
  - More details in back up slides.
- Starting from the reference design, resolutions, material budget, layers positioning, etc. are being updated to assess impact on performance.
  - See for instance S. Maple at Tracking WG meeting <https://indico.bnl.gov/event/15659/contributions/63563/>
  - And Kondo's report at the GD/I WG meeting <https://indico.bnl.gov/event/16045/contributions/63849/>
  - Further updates and progresses will be reported in the tracking WG meetings.
- Optimisations of detector layers position and number are being explored considering the changes to try and recover performance with realistic technology assumptions and 1.4T B-field.
  - See for instance E. Sichterman at EIC SC general meeting 6 June 2022 <https://indico.bnl.gov/event/16164/contributions/64615/>

# Key items/open issues in the consolidation/optimization

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- In addition, what needs to be folded in in simulations are:
  - More realistic description of (Si + MPGD) services, routing and support structures.
  - Background hits (tracking WG meeting 16 June dedicated to this) to be embedded into physics events.
  - Joint optimization of the gas+Si tracking geometry (detector volume and service parts).
  - Integration between the tracking detector and other subsystem.
- Choice of technology
  - Choice of Silicon technology including backup solutions defined in the EIC SC strategy document, prepared in April 2021, discussed with the project <https://zenodo.org/record/6514350#.YqndfC8w200>
  - Among MPGD technologies,  $\mu$ RWell and MM are the subject of the eRD108 proposal. Decisions will be taken once the requirements are finalized.

# Resources needed

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- R&D
  - Technology R&D is carried out within eRD108 and EIC SC/eRD104/eRD111.
  - Some delays due to continuing resolution but work can now go ahead.
  - Resources for MAPS sensor need to be defined very soon (MAPS sensor not yet in project funded R&D, should change next year) to progress EIC work on sensor with ITS3 (EIC SC discussed this recently with Detector-1 steering committee).
- Simulations
  - Tutorial for newcomers to quickly learn how to use the simulation software.
  - Computing support to maintain the framework and help users to debug their codes.
  - We need backgrounds to be integrated into physics events for simulations → who does this?
- Other
  - More time to get to an advanced conceptual design.
  - A larger B-field.

# Timescale to resolve issues/open points

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- By the July meeting we aim at: An optimised overall layout with final technology choices and updates, accommodating requirements of beam pipe bake out, simulated with single particles, no background.
- We will look at improving in the description of services, routing, supports and include them in simulations by July, if time allows.
- The July tracking and vertex detector layout can then be used in the next simulation campaign to study performance with full events, including background.
  - More studies to be carried out, such as evaluation of the vertex and tracking performance for decay particles such as Lambda and D0.

# Integration with PWG

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- At the moment there isn't a mechanism for integration of PWG into the tracking WG.
  - How are other DWG doing this? Is there a preferred way suggested by the steering committee?
- At a minimum we would need a (updated) list of key tracking requirements such as momentum resolution, vertex and projection spatial resolutions.

# Question from us on first simulation campaign

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- Barbara brought this up at the tracking WG meeting yesterday.
- Our understanding (tracking WG conveners + Sim/SW liaison people) was that this first campaign would be used to help the physics groups to get things going.
- Also, we did not receive any detector working group specific simulation requests and **we are not ready to pass on optimisations at this stage.**
- At the meeting yesterday, some colleagues argued to at least update the material of the Si sagitta layers → we haven't reached an agreement yet on whether to do this or not
  - If we do, it needs to be understood by everyone that **the optimisation of the vertex and tracking detector will be a significant work and this change is far from being all that is needed.**



# Question from us on first simulation campaign

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- However, there was also a comment that this campaign is also the only chance to get performance results by July and that this would be a milestone.
- The DWG are tasked with presenting an advanced layout by the meeting in July, how can we have at the same time also performance plots by the PWG? Any performance plot obtained with this run will not be representative of any advanced layout.
- We would like to obtain a clarification on:
  - The scope of this first simulation campaign.
  - What is required of DWG.
  - Ask the SC and Sim WG to please make sure everyone in the collaboration is on the same page on this (there was a lot of confusion at the tracking WG meeting yesterday).

# Backup

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# Considerations on the Si vertex and tracker

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- Vertex layers
  - The radii need to be adjusted as 5 mm clearance from the beam pipe because of beam pipe backout.
- Tracking layers
  - The material assumed in the ECCE proposal is 0.05% $X/X_0$  per barrel layer. This needs to be updated to 0.55%  $X/X_0$  that is what is suggested by the EIC SC.
  - In addition, check the impact on performance by adjusting the position of the sagitta layers, i.e. move them to smaller radii as in the ATHENA design.
  - Smaller radii & shorter length, allow to use only two sensors along z, services come in from the sides, no services running in active area → less material.
- Disks
  - The last disk on both side in the ECCE design is currently floating and not supported. Service cone needs updating to make the required support connections.
- Hits per track as function of rapidity and  $p_T$ /momentum
  - The average number of hits per track in the electron going direction is 3 hits on average. Needs further verification in simulations.

# Considerations on the MPGD tracker

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- Detectors
  - Redundancy vs number of hits per track.
  - Forward: impact of a MPGD layer beyond the dRICH to be studied. → Clarify this once and for all with PID WG, we will follow up with PID WG.
  - Barrel: Technology selection (MM,  $\mu$ RWELL or both) → Internal discussion within eRD108 and choices presented at Tracking WG meeting.
- Detector thicknesses
  - Redefine the requirements in material thickness for each MPGD layer in the barrel region based on simulation studies and physic needs.
- FEE, concentrators, DC-DC...
  - Reference design: 280k channels.
  - The large number of channels will translate in a large number of FEE cards.
  - Space limitations to be considered.
  - Task to be discussed with DAQ liaison.
- Services
  - Review number of detector modules.
  - Service routing.
- Support structures
  - To be studied.

# Overall considerations

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- Simulations
  - Detector geometry cross-checks and review of material budgets.
  - Background hits (SR and beam-gas) to be included.
  - Track finding algorithm to deal with backgrounds.
- Technology reviews
  - We will start a review of the choice of tracking technologies.
  - Two dedicated meetings for Si & MPGDs, emphasis on technology readiness.
  - Timelines to CD2/3A.
  - Discussion of fallback solutions.
- Requirements inputs from the physics WGs
  - List of key tracking requirements such as momentum resolution, vertex and projection spatial resolutions.
- Coordination with other WGs - Contact liaison are being identified for:
  - DAQ/Electronics/Readout: Kondo (MPGD), Jo (Si)
  - Computing & Software/Simulation Production & QA WG: Matt, Nicholas.
  - PID: Laura (AC-LGAD), more TBC.