TC-office Report

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ePIC General Meeting, March 8, 2024

OVERVIEW

- **TIC meetings**
  - **Report from recent TIC meetings**
- **Medium term goals**
- **ePIC TDR effort**
- **Highlights from Feb. 22 PM Report**

TIC meetings

March 2024

- 25 Mar ePIC/EIC Detector R&D day
- 18 Mar TIC meeting - planning for TDR effort (calorimetry, second pass); ZDC simulation studies, update
- 11 Mar TIC meeting - detector integration, an update; layout of the subsystem informatrion in the TDR
- 04 Mar TIC meeting - planning for TDR effort (PID, far detectors); LFHCAL absorbers

Coming meetings

February 2024

- 26 Feb TIC meeting - Tracking update
- 19 Feb TIC meeting - planning for TDR effort (tracking, calorimetry, el/r-o/DAQ); report from the far detector review
- 12 Feb TIC meeting - meeting cancelled (overlap with Far Detector review)
- 05 Feb TIC meeting - Cooling

please, note that the current exercise about "planning for the TDR effort" is distributed in two meetings (2/19, 3/4), with second pass (when needed) on 3/18

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Meetings devoted to other TIC mission items:

- Support the collection of **technical information**
- Help in **planning ancillary activities**
- **Recommend technological choices** for the ePIC detector design
- **Facilitate exchange of information** about detector aspects

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…
The purpose is of course to touch base and discuss the current R&D progress and outlook to FY25.
…

Thomas Ullrich's e-mail, Feb. 16

ePIC / EIC Project Detector R&D Day

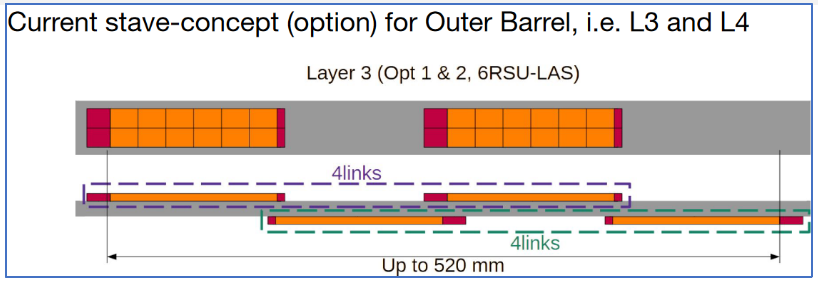
Monday 25 Mar 2024, 09:00 → 16:00 US/Eastern

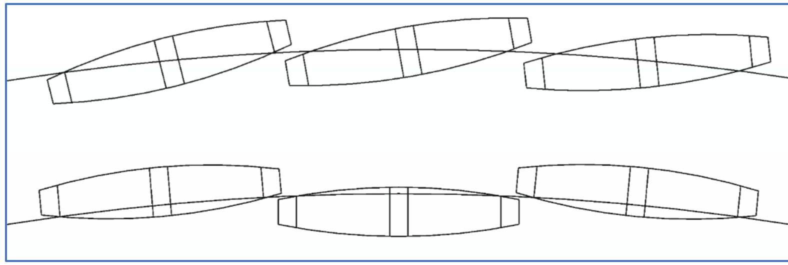
Description Zoom Link

Progress Reports

- 09:00 → 09:15 **Welcome & Introduction**
  Speaker: Thomas Ullrich (BNL)
- 09:15 → 09:45 **eRD112 (ToF/AC-LGAD)**
- 09:45 → 10:15 **eRD102 (dRICH)**
- 10:15 → 10:45 **eRD103 (hpDIRC)**
- 10:45 → 11:05 **Coffee Break**
- 11:05 → 11:35 **eRD108 (MPGDs)**
- 11:35 → 12:05 **eRD109 (ASICs/FEEs)**
- 12:05 → 13:05 **eRD104, eRD111, eRD113 (SVT)**
- 13:05 → 13:35 **Lunch Break**
- 13:35 → 14:05 **eRD110 (Photosensors)**
- 14:05 → 14:35 **eRD106 (Fwd EMCal)**
- 14:35 → 15:05 **eRD107 (Fwd HCal)**
- 15:05 → 15:35 **eRD115 (Barrel EMCal)**

TIC, report from recent meetings - 2/26 – TRACKING UPDATE



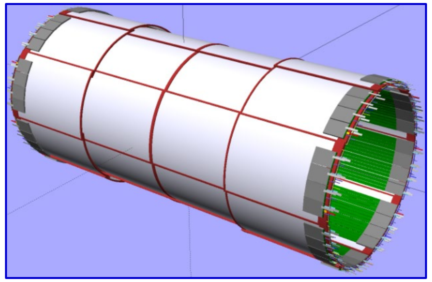


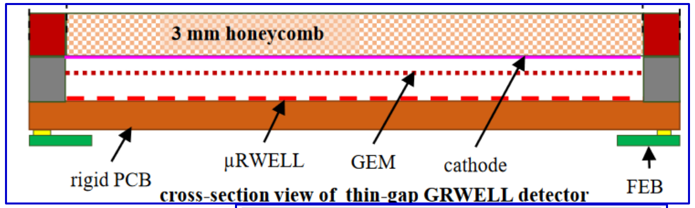
SVT update

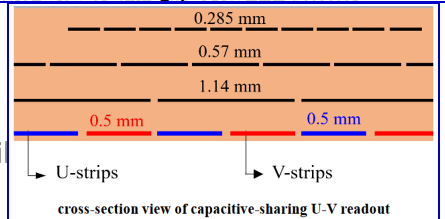
- Progress of the agreement document (CERN=EIC) for ITS3
  - presently, 2 ePIC colleagues are working at CERN within the ALICE ITS3 team
- The differences between MOSAIC (ITS3 for ALICE) and EIC-LAS (ITS3 for ePIC) illustrated
  - in EIC-LAS part of the control functions are implemented in an ancillary chip (time and cost advantages)
- The current model for the implementation of the staves (external barrel layers) and the disks (end-caps) illustrated

MPGD update

- The <u>cylindrical MM</u> will be formed by 4 single-layer detector units with 2-D read-out, each about 50 cm long and with two different radii for integration.
  - 2-D readout tests planned at CERN in 2024
- μR-WELL for the outer tracker, 12 chambers with 34 cm × 170 cm and UV r-o
  - The technological choices are:
    - thin gap ionization / drift volume
    - 1 mm ionization gap (GEM to cathode) & 2 mm induction gap (GEM to μRWELL)
    - 3-layer capacitive-sharing U-V strip readout
- μR-WELL for the endcap disks, traditional architecture, formed by 2 or 4 chambers each
- MPGD integration aspects largely progressed thanks to the workshop at BNL on 02/20/2024
- MPGD simulation also progressing







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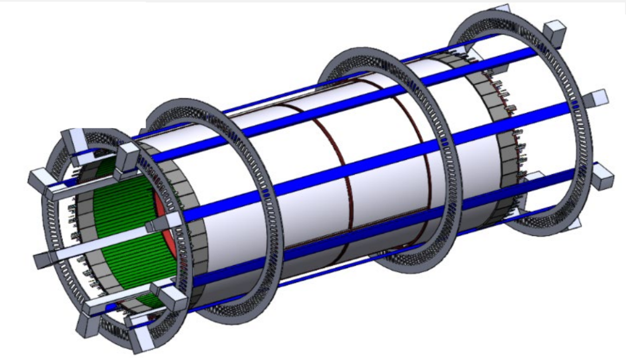


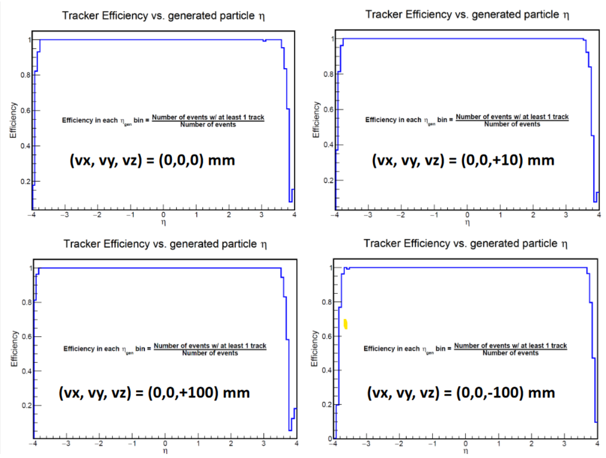
Central Detector integration

- The overall support system for inner detectors including all barrel trackers, apart the one external to DIRC, and the ToF barrel layer is under study. The study includes the mounting strategy.

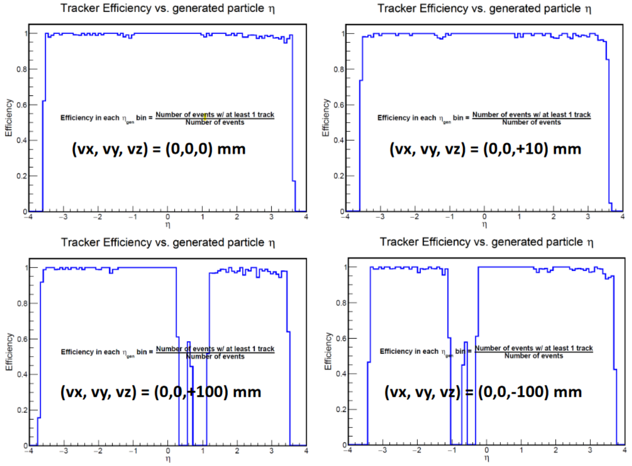
Tracking update

- truth-seeded tracking
  - single-particle tracking looks reasonable for particles generated both on and away from the z axis.
  - Studies of primary vertex finding and fitting performance is ongoing.

- real-seeded tracking
  - single-particle tracking looks reasonable for |z| < 10mm, as well as for generation points up to 1 mm in the transverse plane, while for z values near the edge of the beam spot, inefficiency is present.
  - ongoing effort to implement the ACTS ambiguity solver into EICRecon
  - ongoing effort is for to understanding the effect of the initial error matrix on the input parameters that result from the seed



truth-seeded tracking efficiency

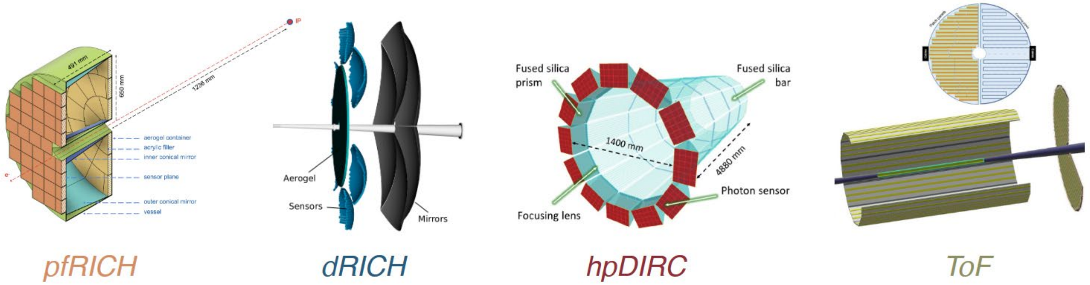


real-seeded tracking efficiency

TIC, report from recent meetings – 3/4 – TRD effort planning

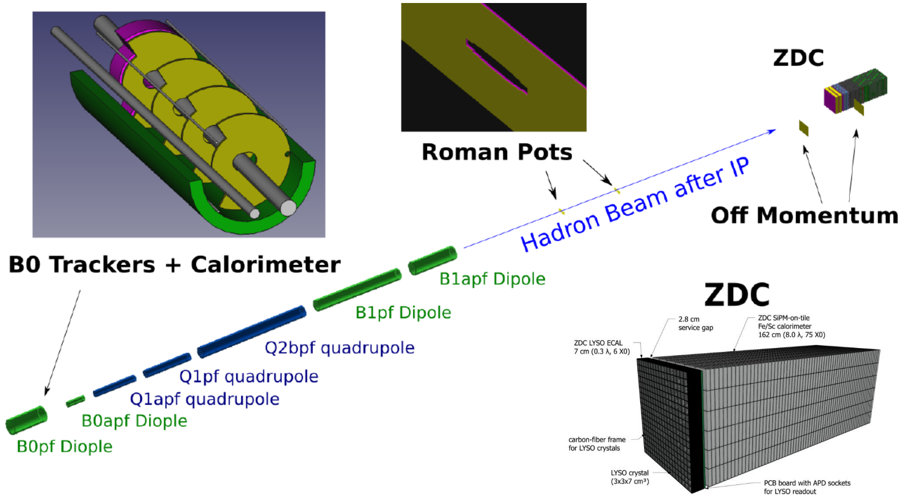
PID

- 4 PID DSCs: pfRICH, HPDIRC, dRICH and ToF by AC-LGADs
- 2024 Timelines clearly spelled out
- main support requested by the different DSCs
  - pfRICH: laboratory and project support for integration and services
  - dRICH: project help for mechanics, safety and infrastrcture, interaction tagger, component QA in USA, further workforce for reconstruction and global PID;
  - hpDIRC: recuperation of BaBar bars, FEE studies, integration of software in EICRecon;
  - ToF: global support and cooling, design of the read-out chain, simulations
- Open question: how to include physical background in simulations when standalone?



Far Forward

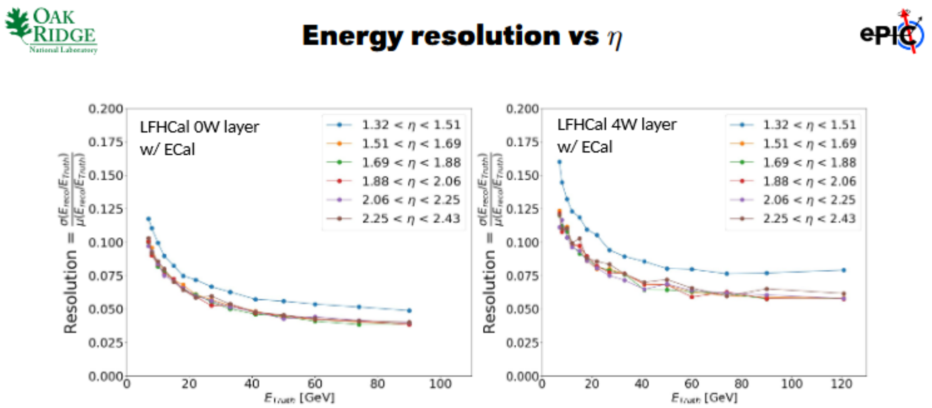
- planning presented for RPs, OMDs, B0 and ZDC
- Further studies ZDC ECal response will be presented on 3/18
- main support requested:
  - for RPs and OMDs: engineering support needed (cooling, support/insertion system);
  - for B0: engineering support needed (cooling, installation concept)

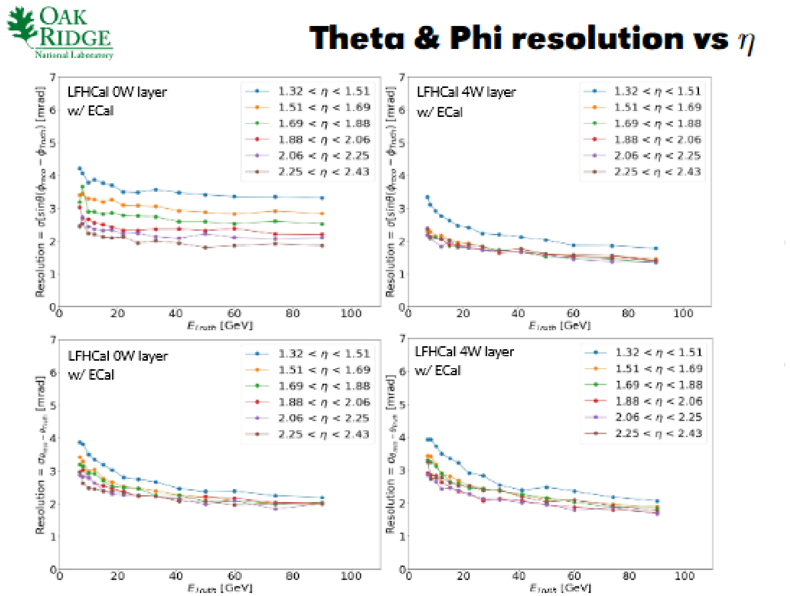


TIC, report from recent meetings – 3/4 – FLHCAL absorber

- proposal of modifying the absorber of the LFHCAL **replacing the tungsten layers with ion layers**
- performance comparison (single particle simulation)
    - ***no relevant differences in energy, space and angle resolution***
- **Easier construction and reduced cost**
- **Complementary information** (from Valerio Calvelli via Elke):
    - "I've made the first simulation with 1020 [selected steel alloy], and results are even better than before! Before we had Fz = -32.2 kN, now we have Fz = -7.6 kN. Impact on the fringe field is just +0.2 G on B5300."

On the basis of the report and the complementary information, **TIC recommends the adoption of the absorber configuration with tungsten replaced by iron.**





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TC-office – ongoing medium-term jobs

2024 test beams

- Information being collected in view of potential synergies

Needs of irradiation studies

- Information being collected to implement synergies (a must for efficiency and cost considerations)

Detector Data BASE

- Analysis of needs and expectation to build-up the model

Detector contribution to PID-LUT

- A fully working example is being built
- PID DSCs running simulations to provide the input to the LUT

IT IS RESPONSIBILITY OF ALL DSCs TO PROMPTLY CONTRIBUTE TO THESE EFFORTS ! Thank you

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ePIC TDR engagement – The context, a quick reminder

- TDR contributions requested from ePIC anticipated by PM at the ePIC meeting in Warsaw (July 2023)

- SP-office elaborated a **proposal for ePIC engagement in the TDR effort**, discussed and enriched with :
  - Coordinators
  - CC management
  - EB

- Proposal **presented to the Collaboration at the general meeting on December 1**, 2023
  - In view of a more ample discussion at the ePIC meering in January 2024

- At the ePIC meeting:
  - **Planning for the ePIC TDR** (in the plenary sessions)
  - Workfest "**Software & Sim TDR Readiness**", then reported in the plenary sessions

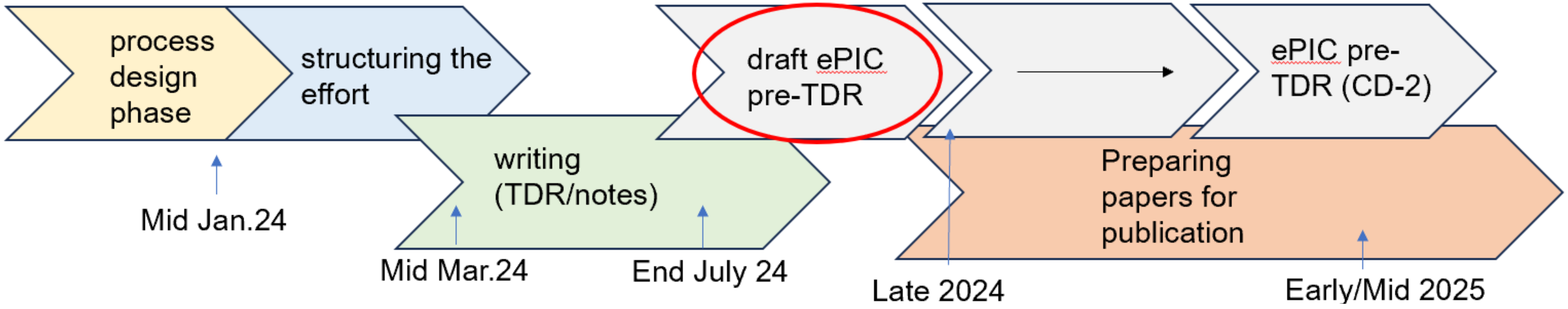
ePIC TDR engagement — The strategy in a nutshel

TDR Strategy and Publications

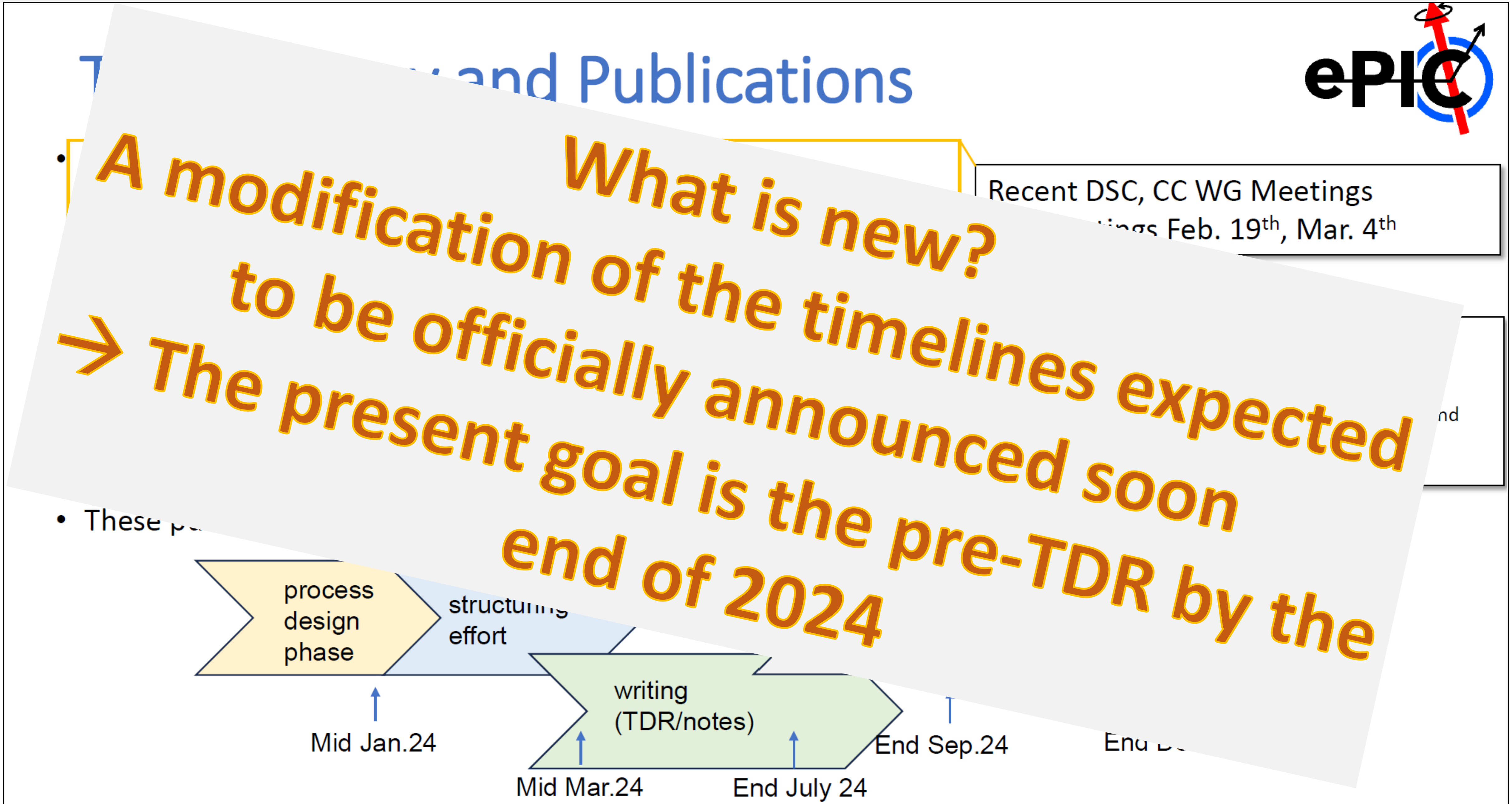
- In 2024 the ePIC collaboration will produce:
  - The ePIC contributions to the EIC TDR
    - The EIC TDR is the top priority
      - Chapters on *Physics Goals and Requirements* and *Experimental Systems*
      - Not just the document, but the simulations and detector R&D that form the basis
      - Requires close cooperation between the collaboration and the project!
- An ePIC Detector Design paper:
    - Derived and expanded from the *Experimental Systems* TDR chapter
- An ePIC Physics Performance paper:
    - Derived and expanded from the *Physics Goals and Requirements* TDR chapter
- Both to be published in a scientific journal (such as NIMA, JINST, or PRC)
- These publications will serve as a focus in developing the ePIC Membership and Publication policies.

Focused activity in the TIC:
Report by Silvia to follow

AC Report in last General Meeting:
https://indico.bnl.gov/event/21562/



ePIC TDR engagement — The strategy in a nutshel



What is new?

A modification of the timelines expected to be officially announced soon

→ The present goal is the pre-TDR by the end of 2024

ePIC TDR engagement — More about the preparatory work

TIC actions

- **Planning the detector TDR effort (dedicated meetings on 2/16 and 3/1)**
  - **2/16**
    - **Tracking**
    - **Calorimetry**
    - **Electronics/R-O/DAQ**
  - **3/1**
    - **PID**
    - **Far Detectors**

- *Major planning goal:*
  - *Share information about the DSC activity during 2024*
  - *Timelines of the activity so that the progress can be followed*
  - *Underline shortages so that needed help can be solicitated*

- **TIC will follow the activity progress in further meetings, as needed**

ePIC TDR engagement — More about the preparatory work

Editorial aspects:

- **Douglas Higinbotham** has accepted to be the **technical coordinator for the draft TDR**
  - **Thank you, Doug!**
- The frame Doug has prepared for us is consistent with the parallel frame ongoing for the project and accelerator by Todd Satogata
- A flavor of what is provided

Style guide

Structure of chapter 2 and chapter 8
Where ePIC will contribute (next slides)

IMPORTANT: in these chapters all section and subsection can be compiled standalone

ePIC TDR engagement — More about the preparatory work

CHAPTER 2

ePIC responsibility

Joint responsibility

Project responsibility

ePIC TDR engagement — More about the preparatory work

CHAPTER 8

ePIC responsibility

Joint responsibility

Project responsibility

TDR – structuring the effort (slides shown at the ePIC meeting in Jan. 2024)

TDR

- **PM Serves as the "managing editors" for the ePIC Contributions to the EIC TDR**

- **TDR Chapter 2**
  - ***Holistic detector performance*** (short form)
    - The TC Office acts as "editor"
    - Organized/supervised by CC WG conveners
  - ***Physics performance and science reach*** (short form)
    - The ACs acting as "editors"
    - The Physics WGs as subgroups for text drafting

- **TDR Chapter 8**
  - ***Detector description and basic performance***
    - Project CAMs/Collab. DSL's acting as "co-editors" for their sections
    - The DSCs provide studies, material, text, etc.
  - ***Software, Analysis and Data Preservation***
    - Project CAMs and SCCs acting as "editors"
    - The electronics/DAQ CC WG and the software WGs

ePIC publications

- **ePIC SP-Office serves as the "managing editors" for the ePIC publications**

- **ePIC Physics Performance Publication:**
  - ***Holistic detector performance*** (extended text)
    - The TC Office acts as "editor"
    - Organized/supervised by CC WG conveners
  - ***Physics performance and science reach*** (extended text)
    - The ACs acting as "editors"
    - The Physics WGs as subgroups for text drafting

- **ePIC Detector Publication**
  - ***Detector description and basic performance***
    - DSL's acting as "editors" for their sections
    - The DSCs provide studies, material, text, etc.
  - ***Software, Analysis and Data Preservation***
    - SCCs acting as "editors"
    - The electronics/DAQ CC WG and the software WGs for text drafting

ePIC TDR engagement — a coming preparatory step

About chapter 8, subsystem texts

- Texts are expected to be **complete and full contained**: the reader can find there everything about a subsystem
- Texts should follow **a common scheme** to facilitate readers
  - When an item is not needed for a given subsystem, it can be skipped
- **The preliminary schematics in this page is shown for information only**
  - It will be **presented and discuss** at the coming TIC meeting on March 11

FOR EACH SUBSYSTEM

- Device **concept and justification** for the technological choice
- **Description**
  - General device description
  - Sensors
  - FEE
  - Other components (f.i.: radiators in calorimetry and in Cherenkov devices, …)
- **Performance** from available input (lab studies, test beam, simulation studies)
- Expected **data rates** from FEE
- **Radiation hardness** of components
- **Services** (cooling, gas system, sensor power supply, FEE power supply, …)
- Subdetector **mechanics and integration**
- **Calibration, alignment and monitoring** strategy and tools
- **Status and remaining design effort**
  - R&D up to here (and missing, if any); E&D status and outlook
  - Other work needed for design completion
  - Status of maturity (with reference to one of the next slides)
- **ES&H and QA** planning
- **Construction planning**
- **Collaborators** (=Institutions) and their role, resources and workforce

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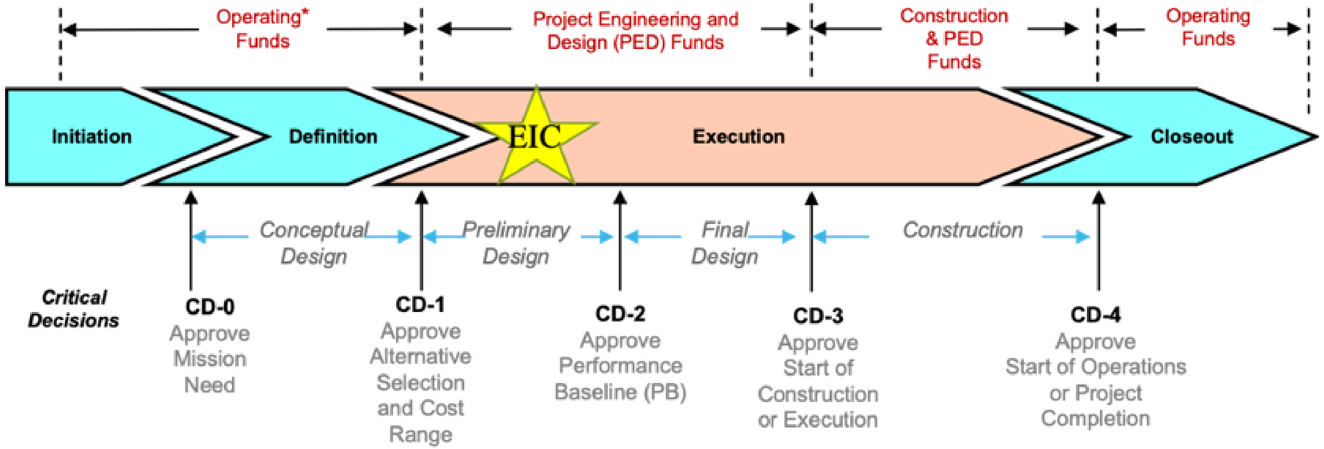
All following slides from PM report on 2/22, where you can find much more of general interest, link: https://indico.bnl.gov/event/21562/contributions/84585/attachments/52856/90409/ePIC_02222024_v1.pptx

Design Review 2024 Plans – Updates in Blue

- Design Reviews
  - ✓ **PDR2: IR Integration and Auxiliary Detectors – February 12, 2024 – main emphasis on baseline choices and progress**
  - PDR1: Tracking Detectors – **March 20-21, 2024** – main emphasis on baseline tracking layout, if we are on track and plans
  - PDR2: Electronics/DAQ – May 2024? – continuation of PDR1 to ensure we are on track and show progress
  - PDR: Integration, Infrastructure and Installation – Summer/Autumn 2024? – includes detector support structures
  - PDR2: Particle Identification Detectors – Summer 2024?
  - PDR2: Barrel EM Cal – Summer/Fall 2024 – emphasis on mechanical design & AstroPix readiness
  - FDR: Backward & Forward EM Calorimetry, Barrel & Forward HCAL – Fall 2024
  - PDR2: Polarimetry – timescale TBD (but before CD-2)
  - FDR for any potential CD-3B scope: Magnet Power Supply, perhaps VTRx+/lpGBT, perhaps magnet steel – see NOTE
  - FDR Magnet Power Supply – Spring 2024; Magnet Steel perhaps Summer 2024; VTRx+/lpGBT add ½ day to electronics/DAQ PDR2
- Detector R&D Day – **March 25** – check R&D progress and outlook to FY25
- DAC-Meetings 2024 under planning:
  - ~April 2024: Project Status, Baseline Detector, International Engagement, Detector R&D progress (expect 1+ day)
  - ~August 2024: Detector R&D annual review (expect 2 days) – deadline for submission July 1, 2024
- Next ePIC Computing & Software review by host labs – Late Summer 2024?

NOTE: CD-3B for detector will include continuation phases for SiPMs, SciFi, PbWO4, Forward HCAL. Further scope has to be known essentially now and needs FDRs.

Design Maturity



What does 60% design maturity roughly mean:

1) One matured from a conceptual design (CD-1) to a preliminary design (CD-2)
2) There can still be open E&D questions but no showstoppers
3) One needs to have detailed knowledge that one can define the cost and schedule
4) The review committee can judge that one will be able to address those open questions by the projected time of CD-3.

What does 90% design maturity roughly mean:

1) The design matured to final (CD-3), i.e., there are no open E&D questions
2) One can still do design detailing and producing drawings to accompany procurements
3) One can still do design validations as found needed during the vendor construction process; for vendor design-build contracts such as the detector solenoid one can still do design updates as needed.

Detector Cooling Integrated View

- We are ready to go the next step → To further define integration constrains and envelops → we need to refine the following information
  - what is the power, which needs to be cooled → both Sensor and Electronics
  - we need a schematics of the readout chain, so all important items can be integrated in ME model

    Example:

	MAPS Sensor	→ Cable →	VTX+	→ Cable	→ RDO	→ Cable →	……..
Size/Length		30 cm	$5x3x1cm^3$	1.5m	$8x6x1cm^3$	40cm	
Power	2W		0.1W				

  - need to detail Requirements:
    - size of boards and how many sitting in the inner part of the detector
    - Next iteration of cable needs → update services
- information of power and heat distribution will flow into ANSYS simulations

  → input to optimize the cooling for the different subsystems and ePIC globally

Will work with all the DSCs and DAQ WG to find all the info, collect it and integrate it

Detector Gas Handling Systems Integrated View

- Will approach the gas systems the same way as the services and cooling system
  - Will collect requirements and general information on the gas systems
  - Will provide experts to help to design the gas systems, integrate them into BNL, so they fulfill the national lab rules
  - Environmental sustainability will be crucial