

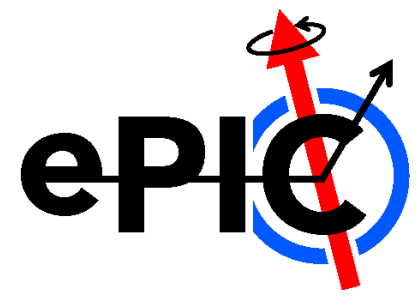
ePIC Collaboration Technical Coordinator Report

Silvia Dalla Torre



Electron-Ion Collider (EIC) Resource Review Board (RRB) Meeting
6th EIC RRB meeting, BNL, November 4th – 5th, 2025

OUTLOOK



- The organizational model of the ePIC detector, a reminder
- Supporting the detector optimization
- Intense ePIC detector activity towards engineering the subsystems
- The ePIC detector in the preTDR
- Resources generated by the Collaboration engagement
- Summarizing

The Dual Nature of the ePIC Detector

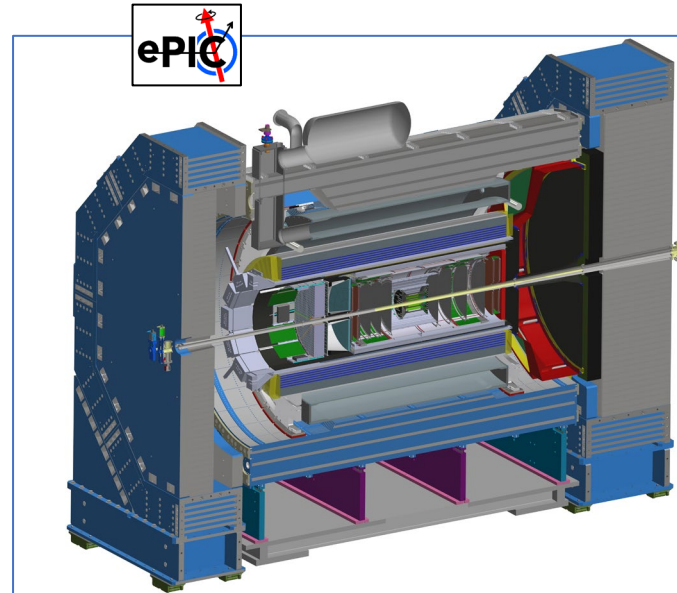
ePIC is the Project Detector

Project mission for the ePIC detector

- ensure that all aspects related to the EIC project realization and completion are satisfied

Project support to the ePIC detector

- Administrative structure
- Engineer team
- Financial support
 - Past : mainly via R&D program
 - Present: mainly via PED (Project Engineering & Design)
 - After CD3: construction



ePIC is the detector to which the ePIC Collaboration is dedicated

Collaboration mission for the ePIC detector

- optimize the physics reach of the detector
- manage the international Collaboration

Collaboration support to the ePIC detector

- Scientific workforce
 - For hardware, software and dedicated physics studies
- Financial support
 - Staff members from Academic Institutions and International Institutions
 - Past and present: international cofinancing R&D, engineering studies
 - International in-kind contributions to constructions

Beyond these specificities, **Project and Collaboration are synergistically cooperating** across the two missions towards the common goal:
a detector matching the overall EIC physics scope.

The Dual Nature of the ePIC Detector

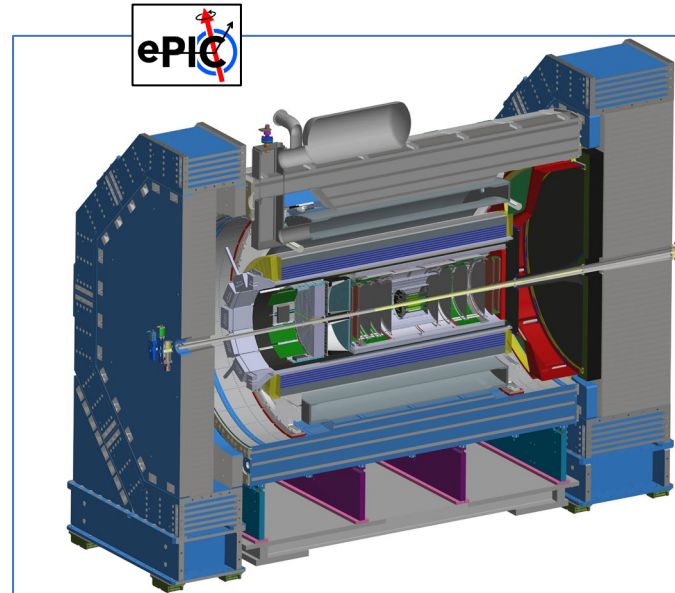
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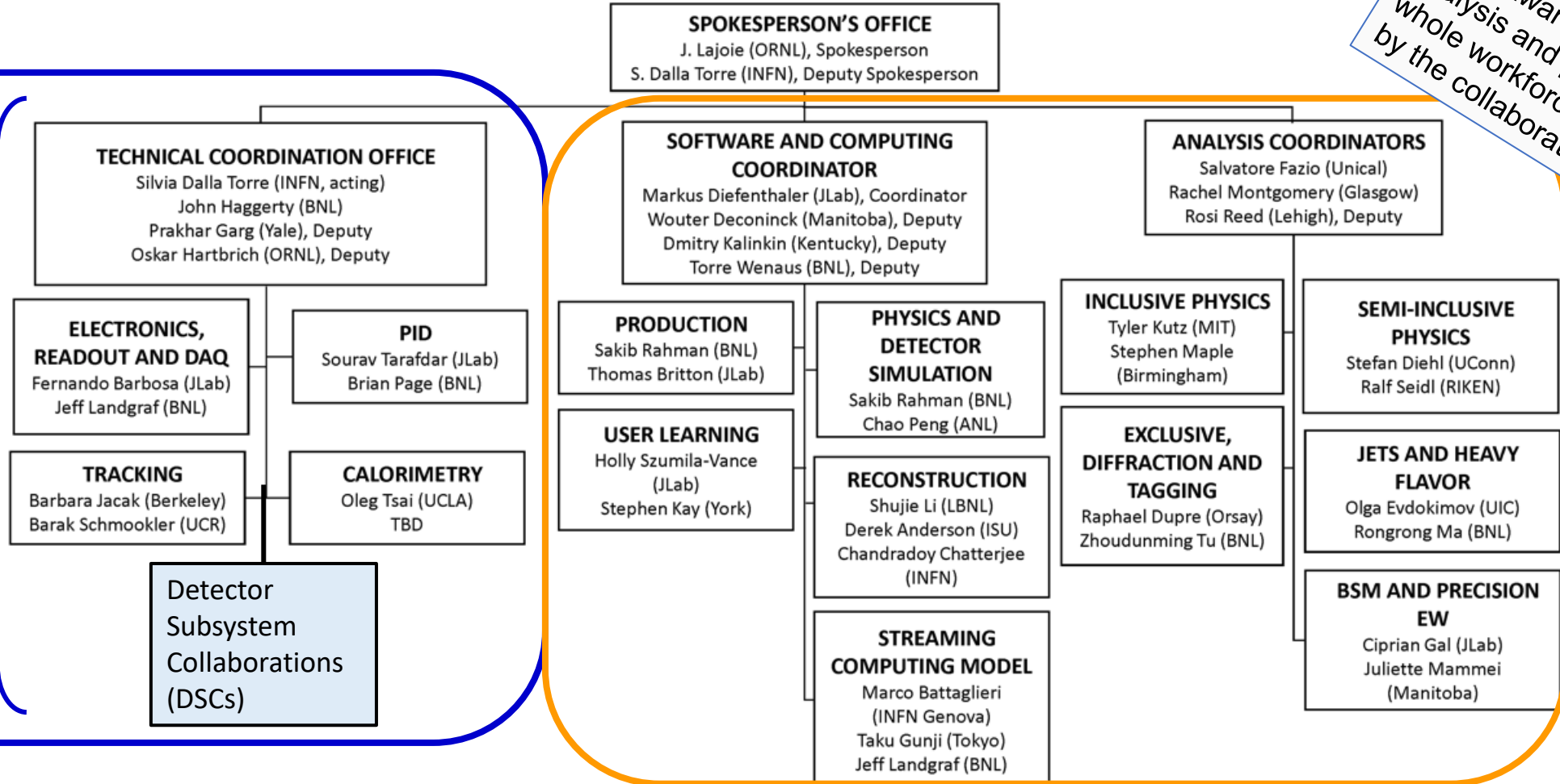
Focus of this report

Technical Bodies within the ePIC Collaboration

ePIC executive structure

For software, computing, analysis and physics the whole workforce is provided by the collaboration

Members of
Technical and Integration Council (TIC),
meeting weekly

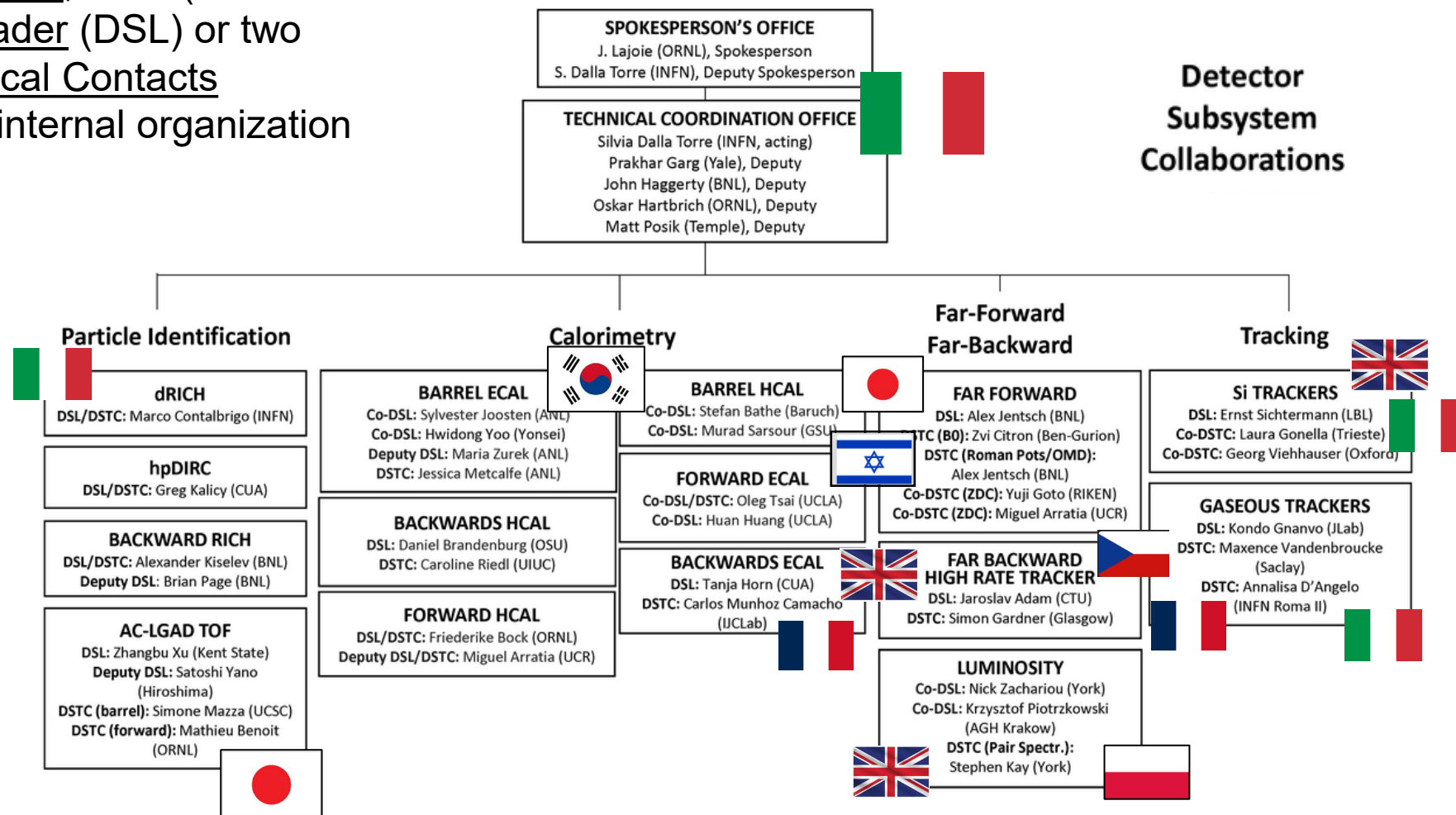


The ePIC organization model for the detector

Detector Subsystem Collaboration, DSC (15 DSCs, in total) guided by a Leader (DSL) or two co-Leaders assisted by Technical Contacts (DSTC) and with autonomous internal organization

Overall Detector Consistency

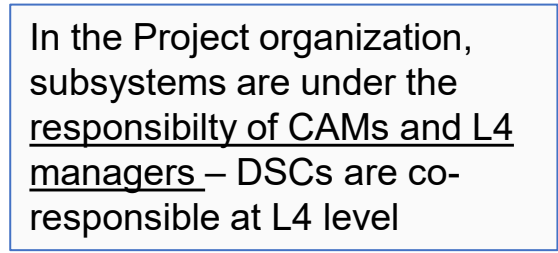
- is ensured by
- ePIC Technical Coordination
 - Role of DSLs/DSTCs in the Project



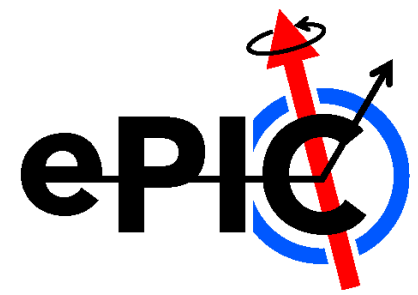
ePIC Collaboration

SON'S OFFICE
, Spokesperson
Deputy Spokesperson

Detector



OUTLOOK



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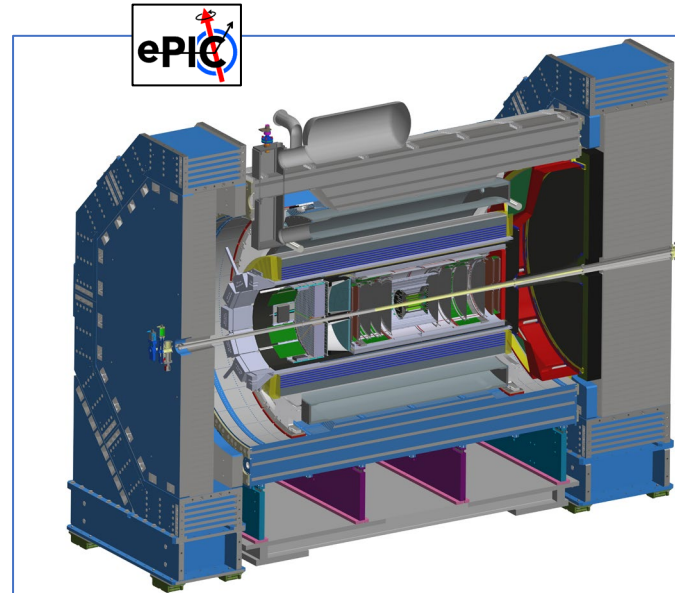
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Focus of this report

ePIC Collaboration effort for detector optimization

Decision flow

1. Baseline Modifications for detector optimization initially **elaborated within DSCs**
 - Based on *simulation* and *technical studies*
2. Presented and discussed at **Technical and Integration Council (TIC) meetings** (iterating when improved proposal maturity may be beneficial) → **TIC RECOMMENDATION**
3. **Different paths** according to the modification entity:

- ***Modest modifications:***

- Spokesperson Office approval, in consultation with the Project Management

- ***Substantial modifications:***

- Spokesperson Office submits to Collaboration Council for decision
- SP-office requests to Project management to start a **Change Control Process**

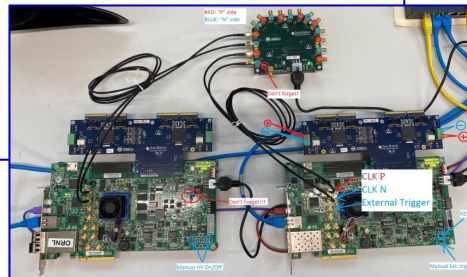
ePIC Collaboration effort for detector optimization

Baseline Modifications, recent and present cases:

CALOROC layout

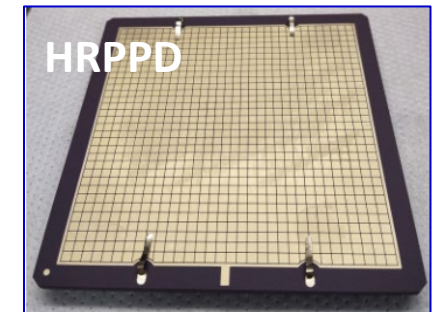
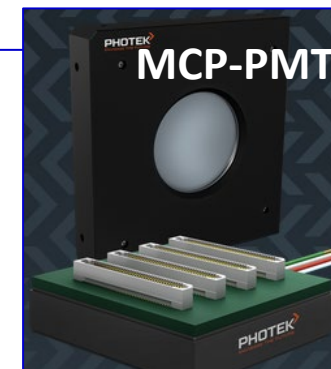
- CALOROC: the FEE ASIC for ePIC Calorimetry
- 36 ch.s instead of 72 ch.s
- Examined:
 - Technical merits;
 - Flexibility in PCB layout; Compatibility with the different Calorimeters;
 - Costs (not significant difference);
 - Risks

→ **TIC RECOMMENDATION : less dense version (36 ch.s) (Sept. 29th, 2025)**



Photosensors for hpDIRC

- Baseline: Photek MCP-PMT
- Alternative: HRPPD by INCOM, used in the pfRICH
- Being considered:
 - hpDIR performance
 - Costs
 - Production timelines
- **Process started on October 20th, on going**



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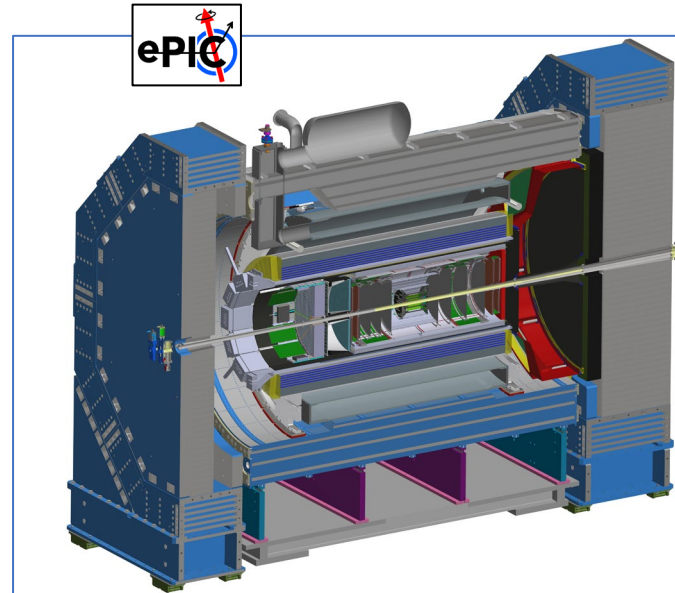
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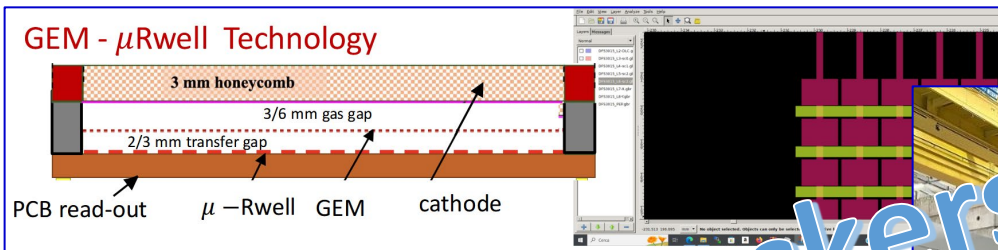
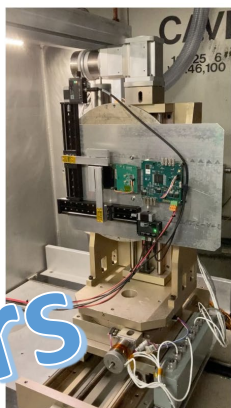
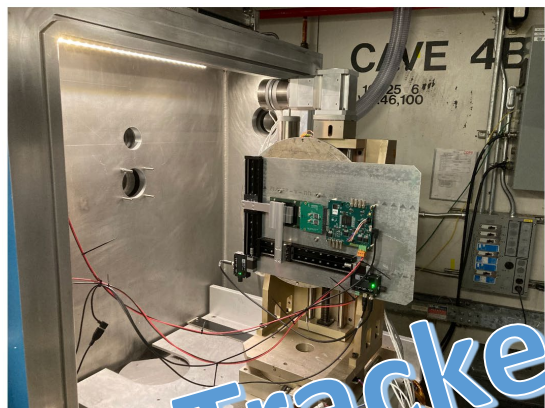
In the following slides images from
Beam Tests, Irradiation Campaigns and
Lab Studies providing a sample of the
recent ePIC subsystem activity

Focus of this report

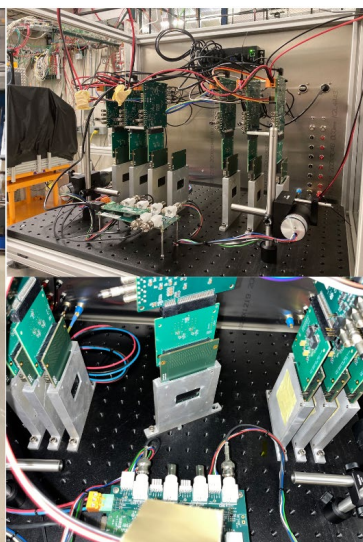
TestBeams and Lab Studies for TRACKING Subsystems

Testbeam at BASE (Berkley), May 2024

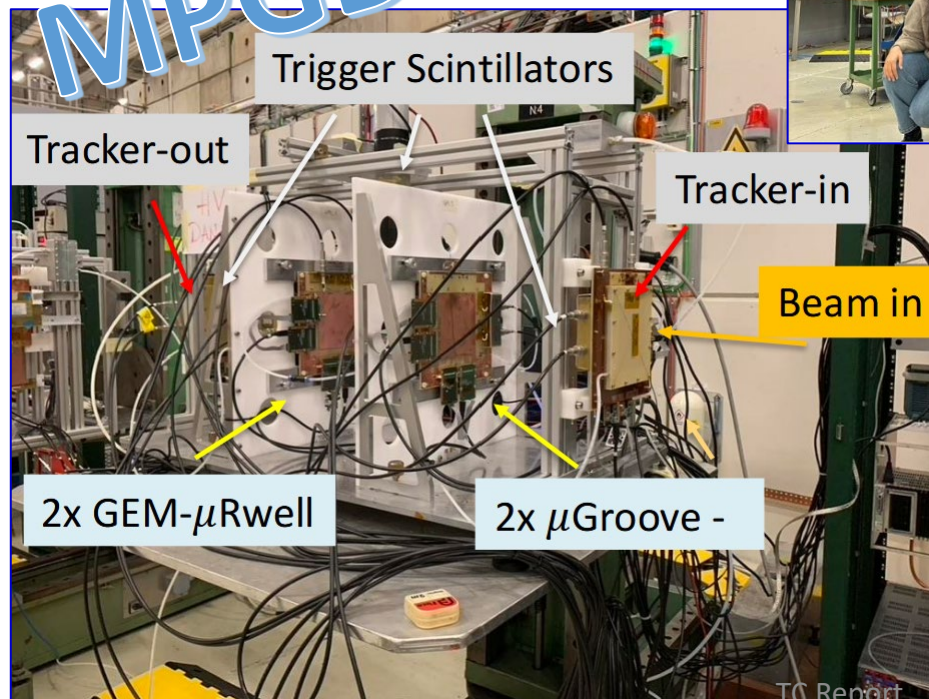
November 11 – 28 Test beam @ PS-T10 - CERN



Si Trackers



MPGD Trackers



Further effort
in November
2025

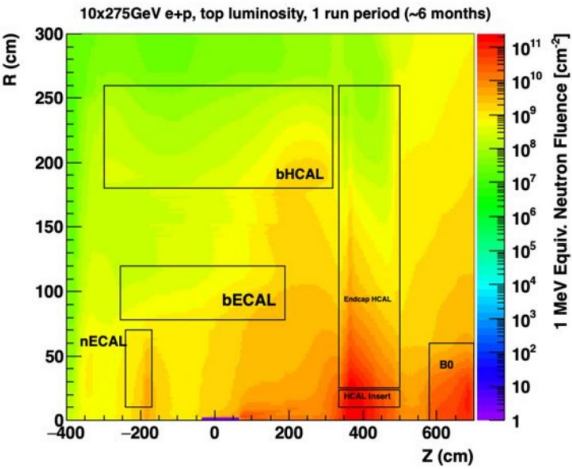
SENSORS for ePIC CALORIMETRY

SiPM sensors for **all** Calorimeters

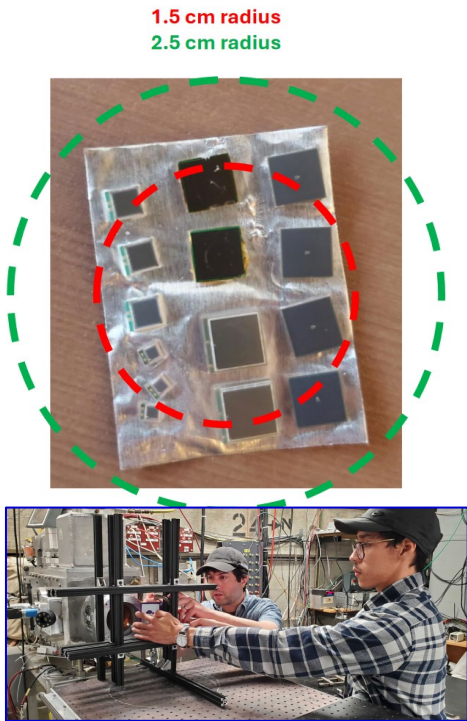
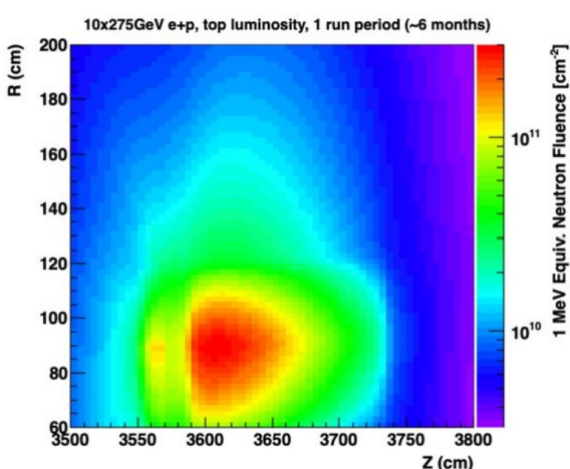
→ Irradiation campaigns for all SiPMs type foreseen in ePIC Colorimetry

Rad Dose

Central detector



Far detectors



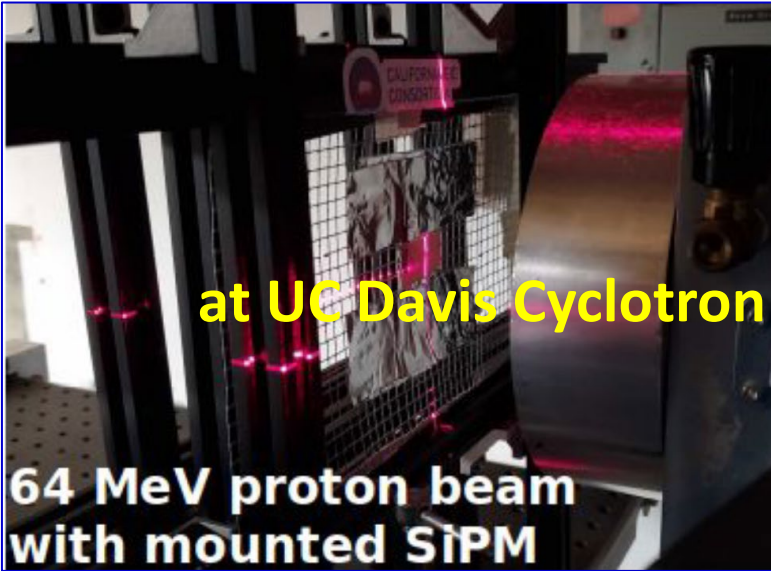
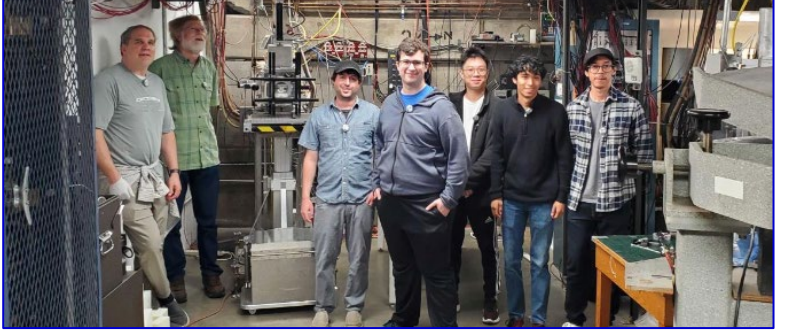
arXiv > physics > arXiv:2503.14622

Physics > Instrumentation and Detectors

[Submitted on 18 Mar 2025]

Measurement of SiPM Dark Currents and Annealing Recovery for Fluences Expected in ePIC Calorimeters at the Electron-Ion Collider

Jiajun Huang, Sean Preins, Ryan Tsiao, Miquel Rodriguez, Barak Schmookler, Miquel Arratia



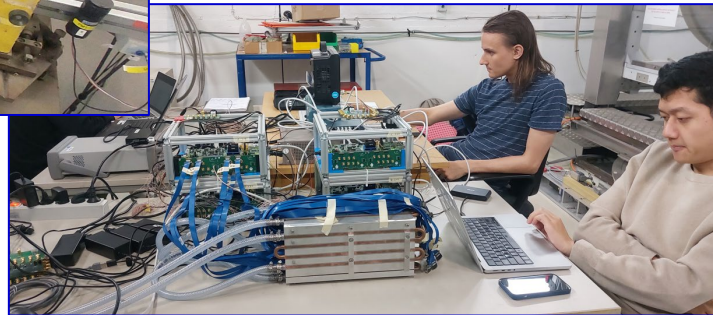
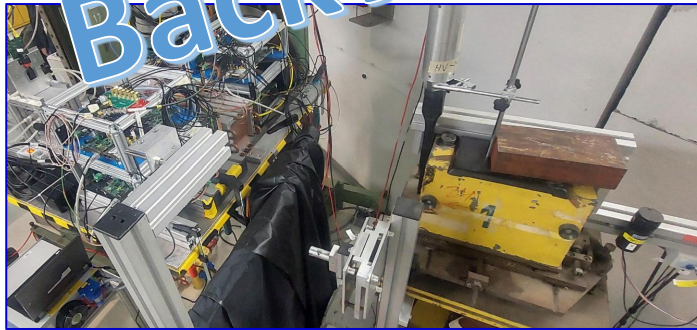
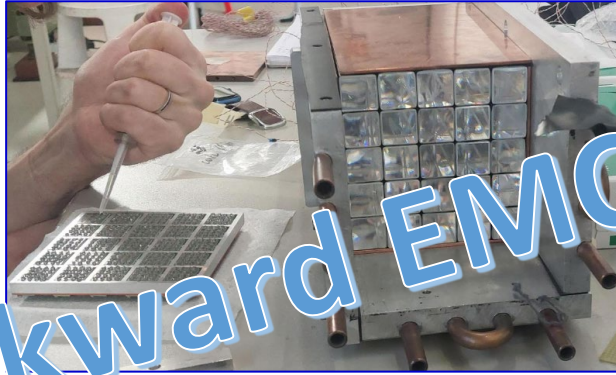
Models of SiPMs	10 ⁸ N _p ⁺	10 ⁹ N _p ⁺	10 ¹⁰ N _p ⁺	10 ¹¹ N _p ⁺	10 ¹² N _p ⁺	10 ¹³ N _p ⁺	ePIC Detector Usage
S14160 1315PS	1	3	3	3	3	2	nHCAL, pHCAL
S14160 3015PS	1	2	2	3	3	1	nEMCAL , bHCAL, pHCAL(Insert), ZDC
S14160 6015PS	1	1	1	2	2	1	nEMCAL, bEMCAL, pEMCAL
S14160 6050HS	2	4	4	4	4	2	bEMCAL , pEMCAL, pHCAL (Insert), ZDC
S13360 6050VE	2	2	2	2	2	0	bEMCAL

TestBeams and Lab Studies for EM Calorimeters

Backward Ecal

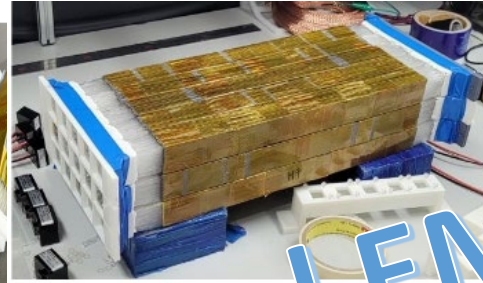
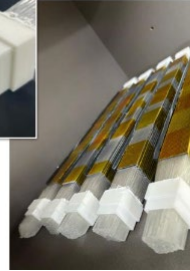
test beams at DESY:

- Feb 17- Mar 2
- Mar 28 – April 7



Barrel ECal

beam test in Aug 2024 at CERN PS T10

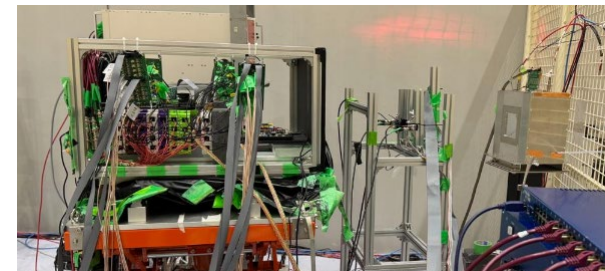


Barrel EMCal



beam test in Mar 2025 at KEK PF-AR

AstroPix data taking between Pb/SciFi layers



TestBeams and Lab Studies for Hadronic Calorimeters

Forward Hcal: INNOVATIVE ORIGINAL DESIGN : "SiPM on tile"

- inspired by CALICE developments adopted by ePIC

Sept/Oct 2024:

First module at test beam

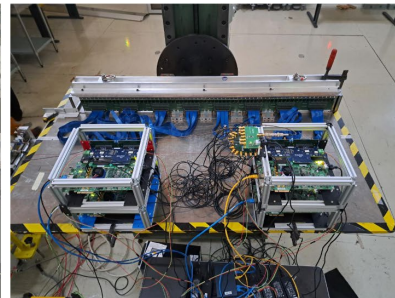
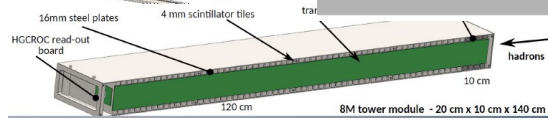
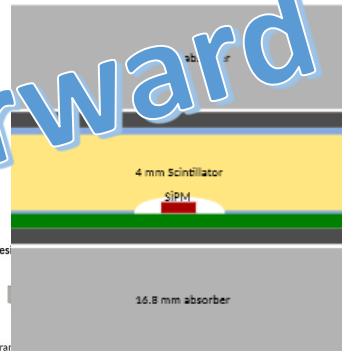
2025:

Test beam in November

2026:

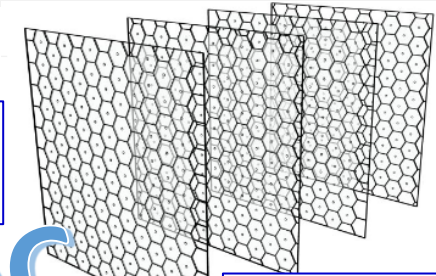
Test beam with an enlarged sample of 8 modules

SiPM on tile

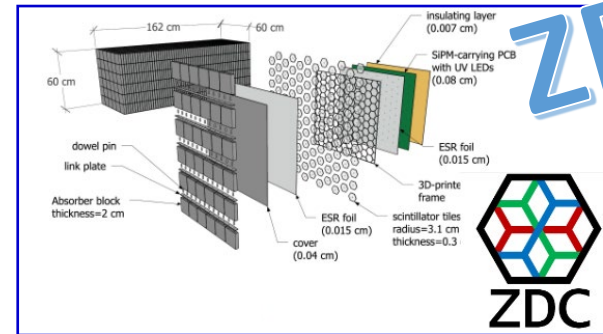


Same technology :

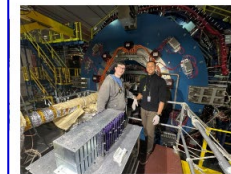
- Zero Degree Calorimeter



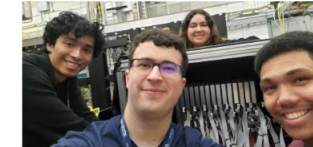
ZDC module tested at STAR in 2024



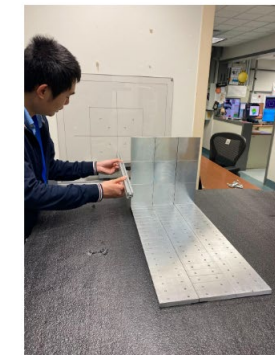
2024-2025



2025



2025



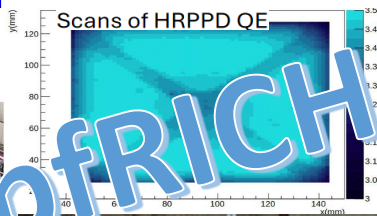
TestBeams and Lab Studies for PID Subsystems

BaBar fused silica bars infrastructure for bar disassembling and testing



BaBar bars disassembling successfully progressing!

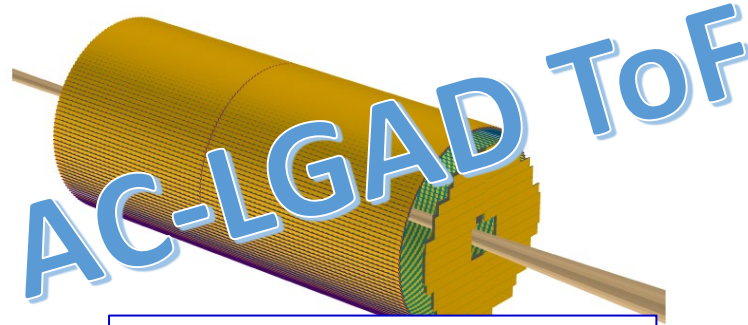
HRPPD characterization



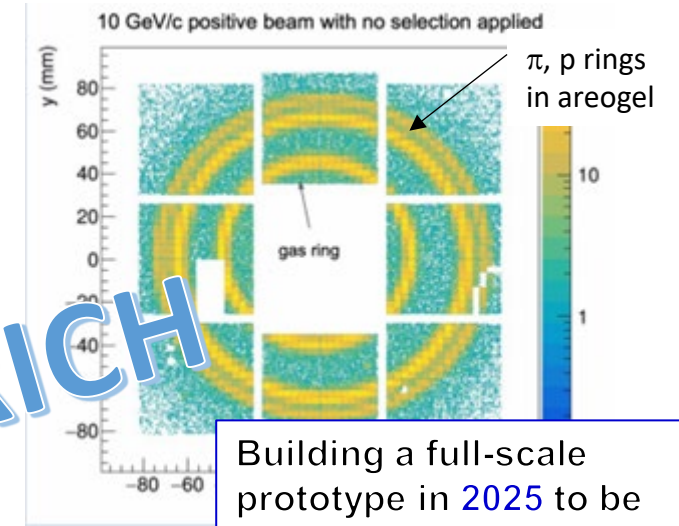
Characterization in magnetic field



ageing studies ongoing in 2025

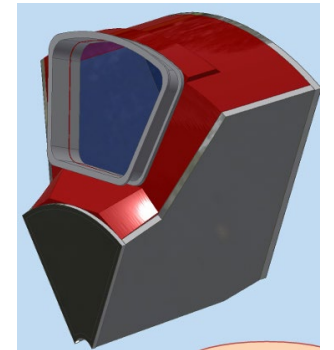
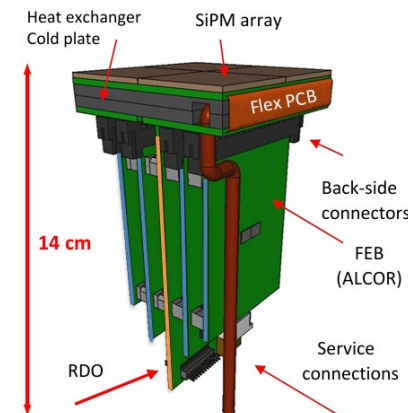


AC-LGAD test beam at Jlab in July-August 2025



Building a full-scale prototype in 2025 to be commissioned in the test beam in November 2025 and validated in test beam in 2026

Engineered photon detector unit already used in 2024 test beam



The ePIC detector, substantial value recognized

EPPSU - Two slides from the plenary talk dedicated to:

“Tools for Discovery – Instrumentation Requirements for Future Projects”

European Strategy
for Particle Physics

PLENARY / DETECTOR TECHNOLOGIES

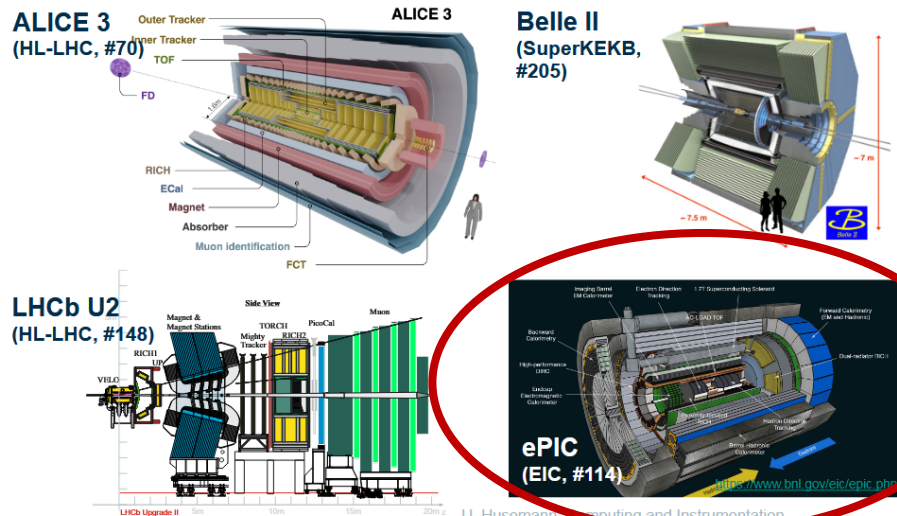
Tools for Discovery
Instrumentation Requirements for Future Projects
Ulrich Husemann (KIT)

23-27 JUNE 2025 Lido di Venezia

A Simplified Timeline

Key Collider Projects

■ Era 1: ALICE 3, LHCb Upgrade II, Belle II, ePIC



A Simplified Timeline

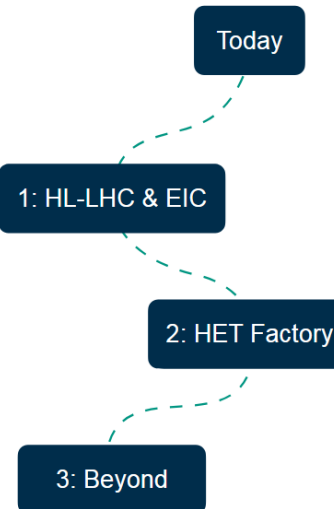
Future Requirements in Today's or Tomorrow's Experiments?

Small-scale experiments:

- **Individual requirements** similar to future flagships (“technology benchmarks”), see e.g. #46, #92, #115
- But: future flagships require **full detector systems** → non-trivial combinations of requirements

Era-1 experiments and upgrades as a showcase:

- ALICE 3 and LHCb Upgrade II at the HL-LHC, **ePIC at the EIC**, Belle II + Upgrade at SuperKEK
- **Similar requirements**: vertexing with low material budget (MAPS), tracking with gaseous/silicon detectors, triggerless high-rate readout, new superconducting solenoids → exploit **synergies**



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The Detector preTDR is now a standalone document

The ePIC Collaboration has taken responsibility for the Detector preTDR

Document layout :

- **Executive Summary**
- **CHAPTER 1 – Introduction**
 - About the EIC project and the accelerator complex (high level approach)
- **CHAPTER 2 – Requirements**
 - Project requirements resulting as an evolution of the YR ones
- **CHAPTER 3 – Experimental Systems**
 - Presenting the detector subsystems matching the requirements (mainly individual performance)
- **CHAPTER 4 – Detector Performance for the EIC physics program**
 - Presenting the holistic detector performance by the performance for key physics measurements
- **CHAPTER 5 – Detector-Accelerator interfaces**
 - Integration into the facility

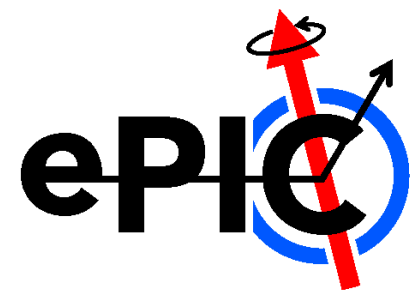
- Advanced progress;
- Polished version by the end of 2025;
- Dedicated Editorial Board established and intensively at work

The Detector preTDR - presently

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400 pages, 360 figures

OUTLOOK



- The organizational model of the ePIC detector, a reminder
- Supporting the detector optimization
- Intense ePIC detector activity towards engineering the subsystems
- The ePIC detector in the preTDR
- Resources generated by the Collaboration engagement
- Summarizing

The Dual Nature of the ePIC Detector

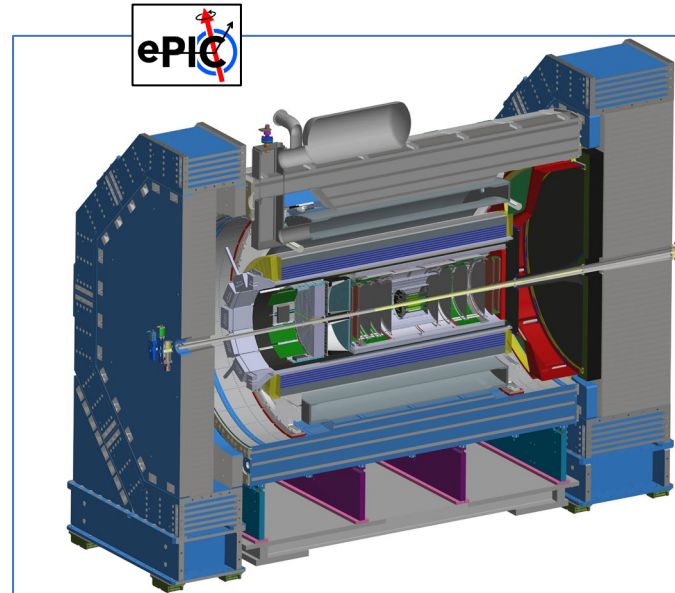
ePIC is the Project Detector

Project mission for the ePIC detector

- ensure that all aspects related to the EIC project realization and completion are satisfied

Project support to the ePIC detector

- Administrative structure
- Engineer team
- Financial support
 - Past : mainly via R&D program
 - Present: mainly via PED (Project Engineering & Design)
 - After CD3: construction



ePIC is the detector to which the ePIC Collaboration is dedicated

Collaboration mission for the ePIC detector

- optimize the physics reach of the detector
- manage the international Collaboration

Collaboration support to the ePIC detector

- Scientific workforce
 - For hardware, software and dedicated physics studies
- Financial support
 - Staff members from Academic Institutions and International Institutions
 - Past and present: international cofinancing R&D, engineering studies
 - International in-kind contributions to constructions

Focus of this report

Collaboration workforce

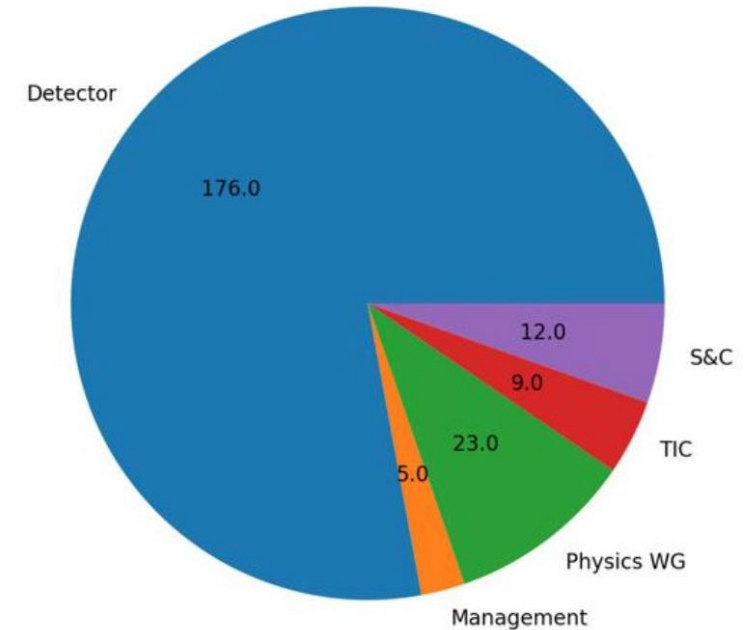
From the survey of the Statements of Service in 2025 (collected at the end of 2024):

199.5 FTE

The 2025 update (October 2025) indicates an effective workforce even larger than foreseen:

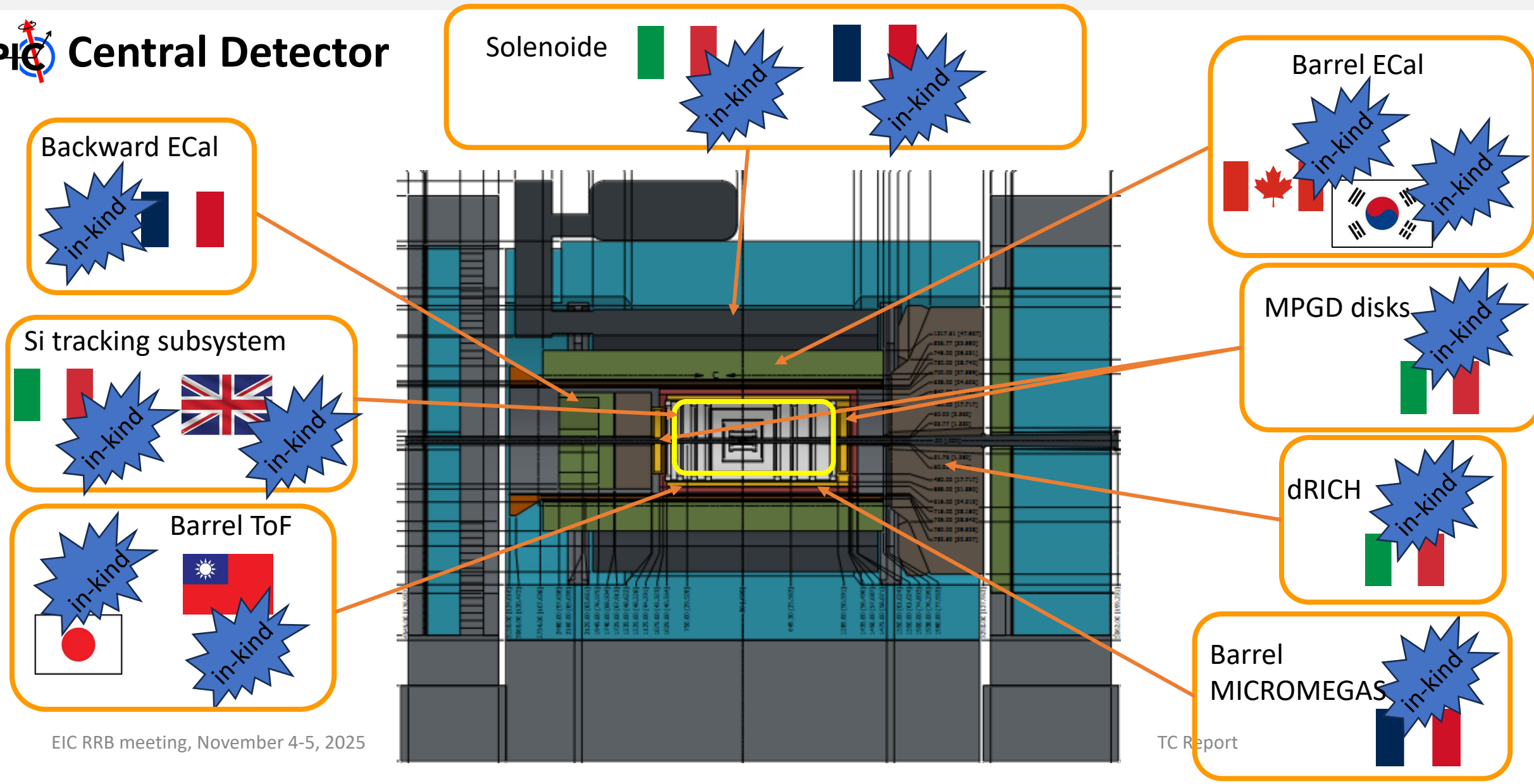
200 FTE → 250 FTE

Survey ongoing for 2026



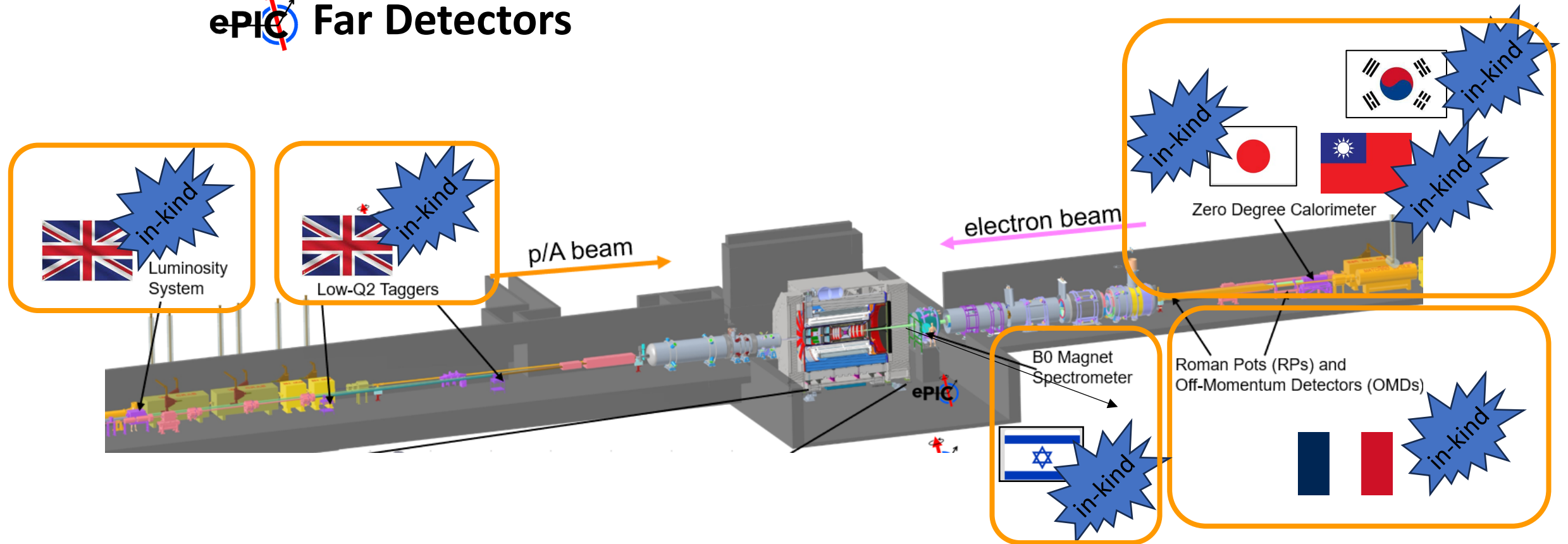
“In-kind” being generated by the Collaboration engagement

ePIC Central Detector



“In-kind” being generated by the Collaboration engagement

ePIC Far Detectors

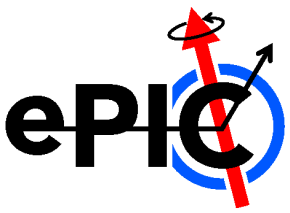


OUTLOOK



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Take-away messages



- The synergistic integration of the **EIC Project** and the **ePIC Collaboration** is established and fully functional to provide a detector covering the **whole EIC Physics Scope**
- The **ePIC Collaboration**
 - Brings in scientific workforce
 - 2025: ~250 FTE committed;
 - Allows for a holistic approach (hardware complemented by simulation and physics studies);
 - Opens the way to in-kind contributions;
 - Is intensively at work for the detector optimization;
 - The present ePIC Detector status, being summarized in the preTDR, is largely due to the Collaboration effort

Thank you