ePIC Collaboration
Technical Coordinator Report

Silvia Dalla Torre

INFN TRIESTE

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

OUTLOOK

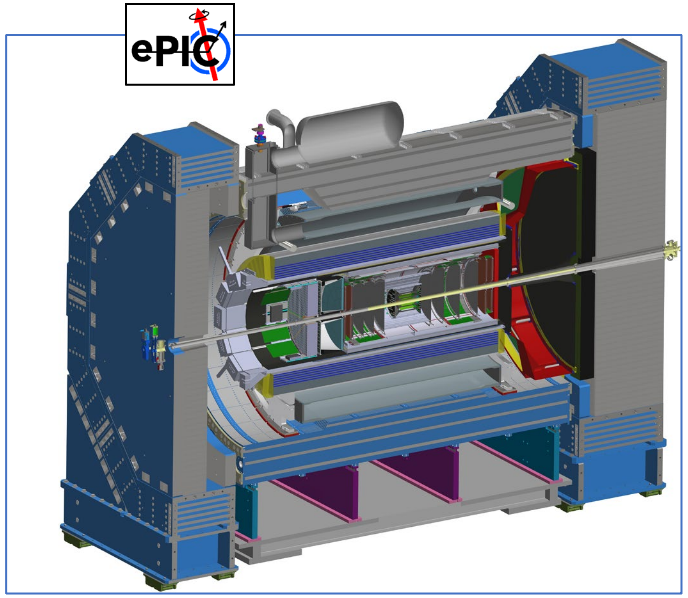
- The organizational model of the ePIC detector, a reminder
- Supporting the detector optimization
- Intense ePIC detector activity towards engineering the subsystems
- The ePIC detector in the preTDR
- Resources generated by the Collaboration engagement
- Summarizing

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.

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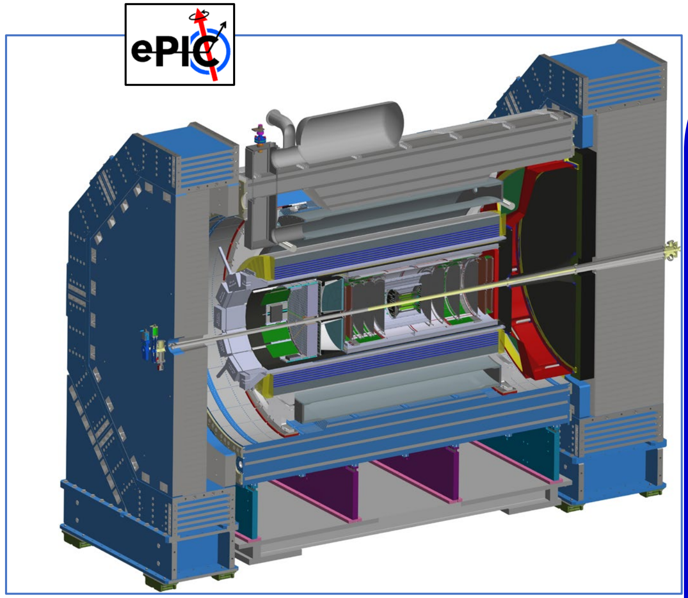

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Focus of this report

Technical Bodies within the ePIC Collaboration

ePIC executive structure

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

SPOKESPERSON'S OFFICE
J. Lajoie (ORNL), Spokesperson
S. Dalla Torre (INFN), Deputy Spokesperson

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

TECHNICAL COORDINATION OFFICE
Silvia Dalla Torre (INFN, acting)
John Haggerty (BNL)
Prakhar Garg (Yale), Deputy
Oskar Hartbrich (ORNL), Deputy

ELECTRONICS, READOUT AND DAQ
Fernando Barbosa (JLab)
Jeff Landgraf (BNL)

PID
Sourav Tarafdar (JLab)
Brian Page (BNL)

TRACKING
Barbara Jacak (Berkeley)
Barak Schmookler (UCR)

CALORIMETRY
Oleg Tsai (UCLA)
TBD

Detector Subsystem Collaborations (DSCs)

SOFTWARE AND COMPUTING COORDINATOR
Markus Diefenthaler (JLab), Coordinator
Wouter Deconinck (Manitoba), Deputy
Dmitry Kalinkin (Kentucky), Deputy
Torre Wenaus (BNL), Deputy

PRODUCTION
Sakib Rahman (BNL)
Thomas Britton (JLab)

USER LEARNING
Holly Szumila-Vance (JLab)
Stephen Kay (York)

PHYSICS AND DETECTOR SIMULATION
Sakib Rahman (BNL)
Chao Peng (ANL)

RECONSTRUCTION
Shujie Li (LBNL)
Derek Anderson (ISU)
Chandradoy Chatterjee (INFN)

STREAMING COMPUTING MODEL
Marco Battaglieri (INFN Genova)
Taku Gunji (Tokyo)
Jeff Landgraf (BNL)

ANALYSIS COORDINATORS
Salvatore Fazio (Unical)
Rachel Montgomery (Glasgow)
Rosi Reed (Lehigh), Deputy

INCLUSIVE PHYSICS
Tyler Kutz (MIT)
Stephen Maple (Birmingham)

EXCLUSIVE, DIFFRACTION AND TAGGING
Raphael Dupre (Orsay)
Zhoudunming Tu (BNL)

SEMI-INCLUSIVE PHYSICS
Stefan Diehl (UConn)
Ralf Seidl (RIKEN)

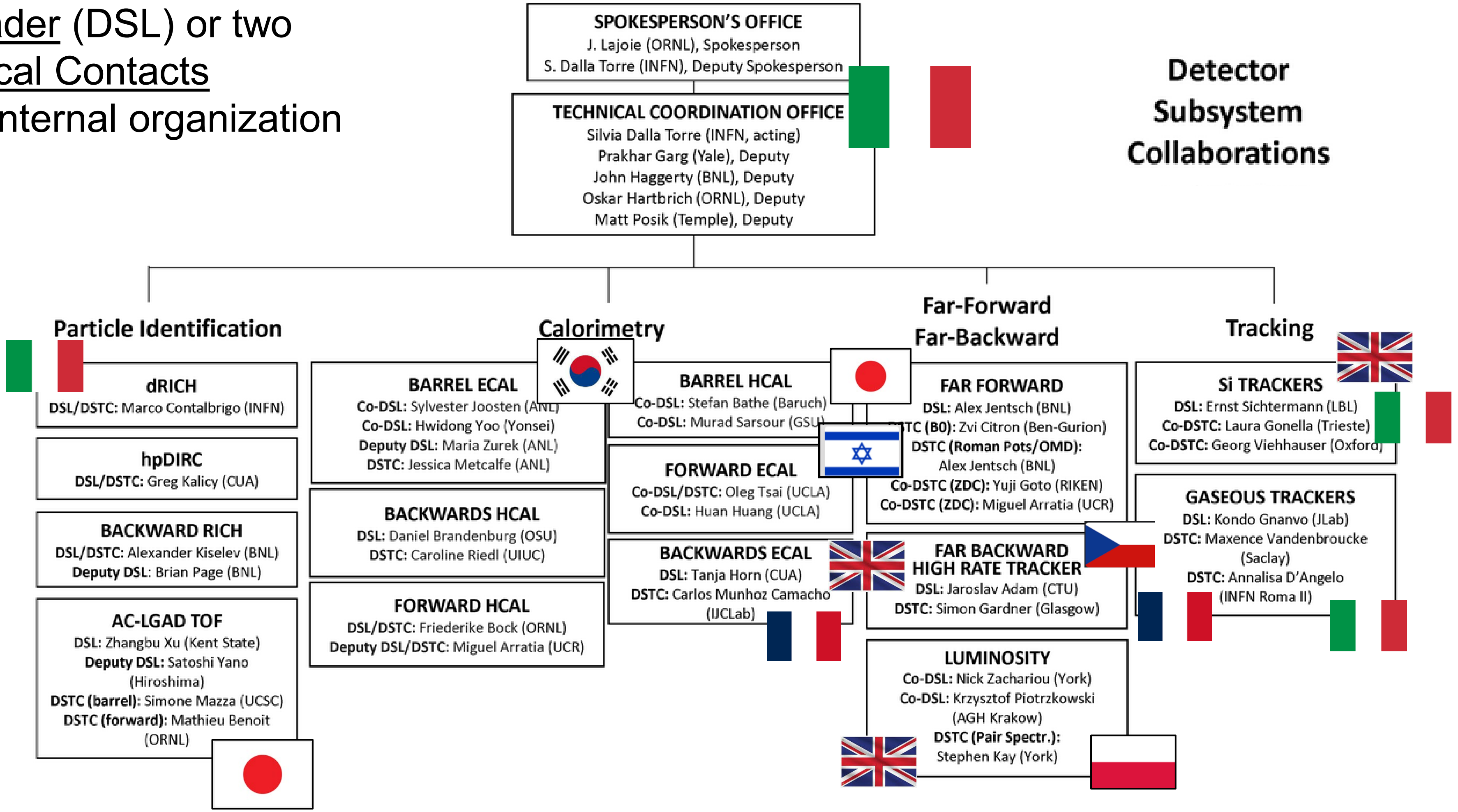
JETS AND HEAVY FLAVOR
Olga Evdokimov (UIC)
Rongrong Ma (BNL)

BSM AND PRECISION EW
Ciprian Gal (JLab)
Juliette Mammei (Manitoba)

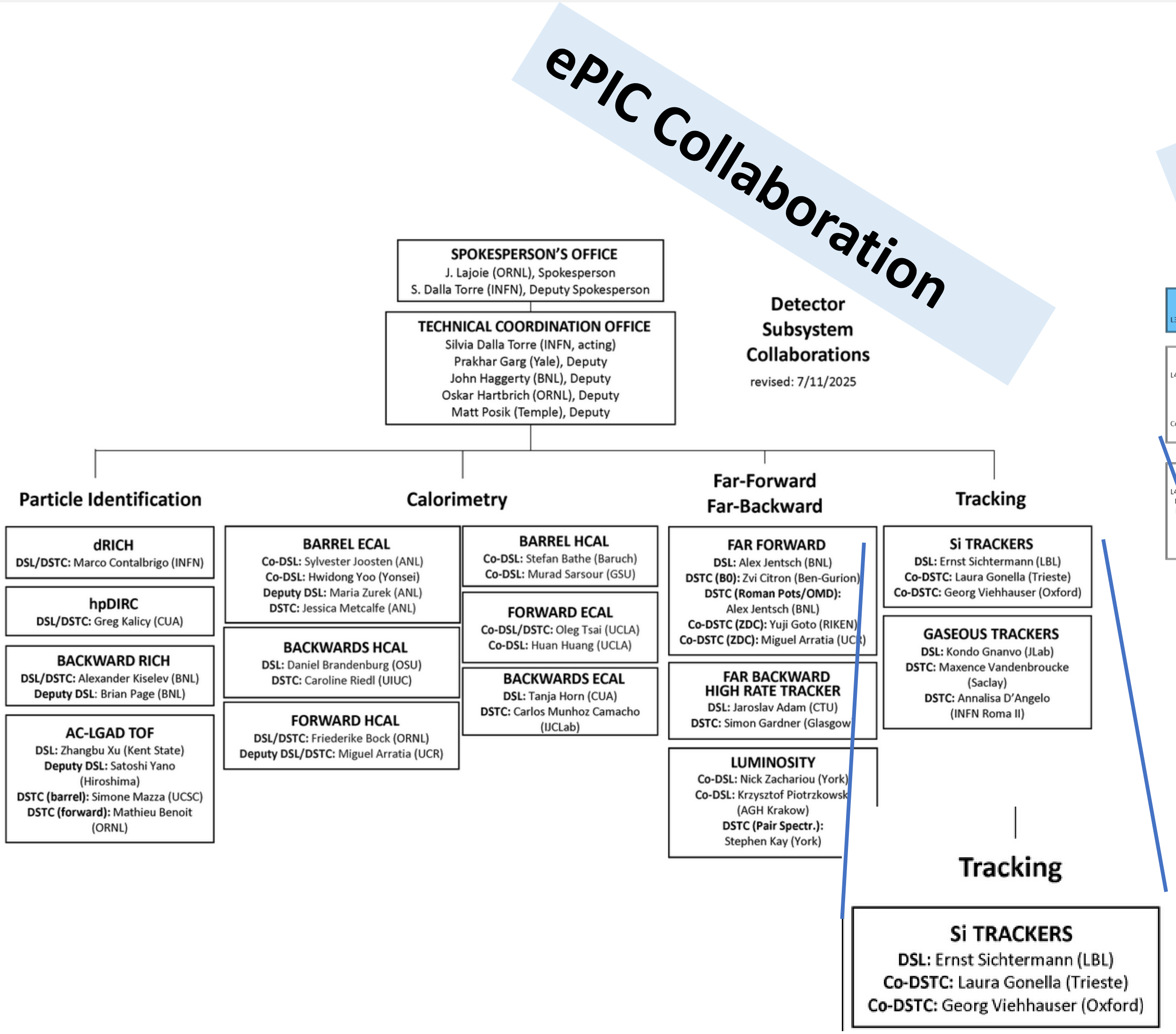
The ePIC organization model for the detector

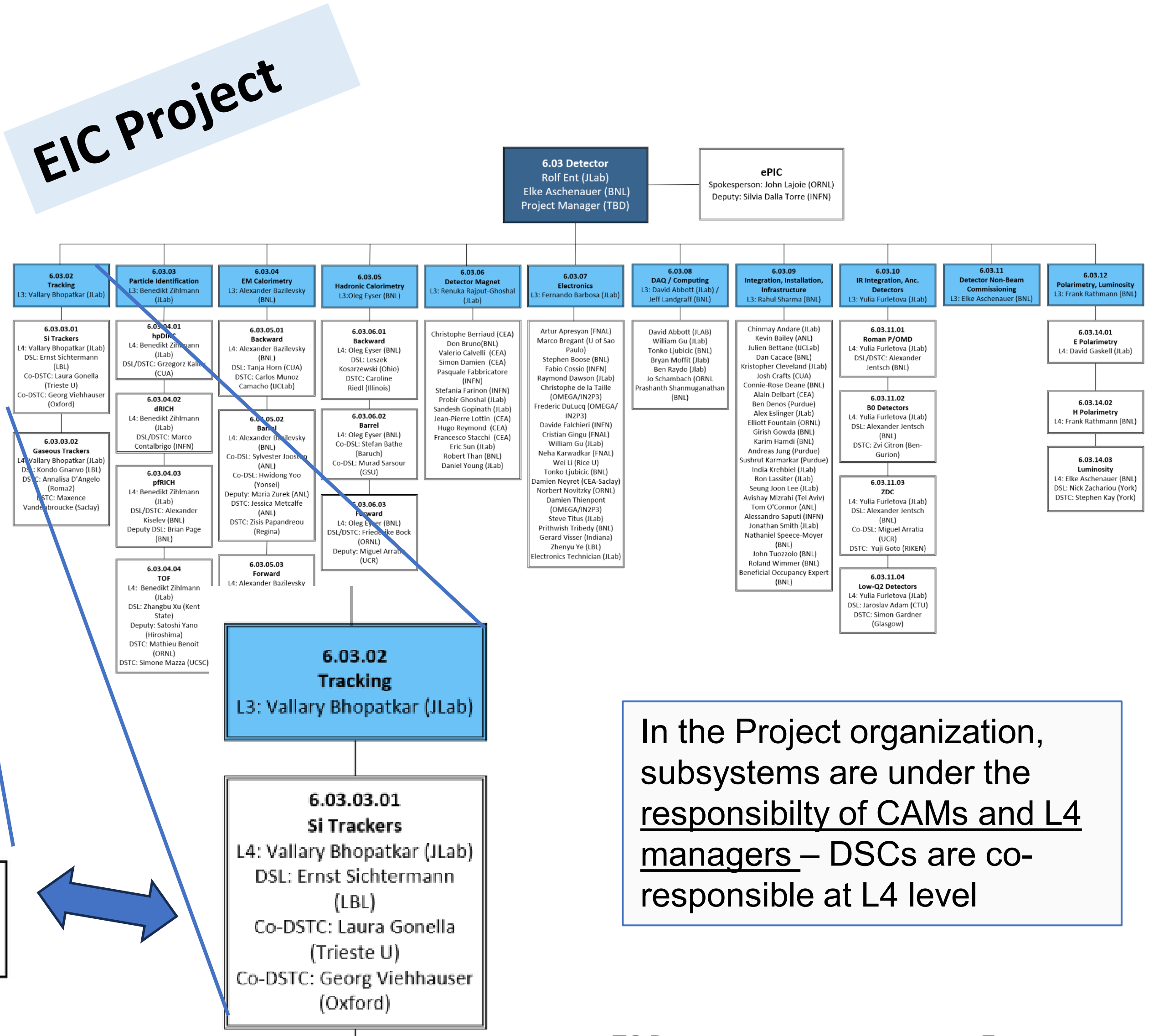
<u>Detector Subsystem Collaboration</u>, DSC (15 DSCs, in total) guided by a <u>Leader</u> (DSL) or two co-Leaders assisted by <u>Technical Contacts</u> (DSTC) and with autonomous internal organization

<u>Overall Detector Consistency</u> is ensured by
- ePIC Technical Coordination
- Role of DSLs/DSTCs in the Project



EIC Project and ePIC Collaboration integrated detector effort





In the Project organization, subsystems are under the <u>responsibilty of CAMs and L4 managers</u> – DSCs are co-responsible at L4 level

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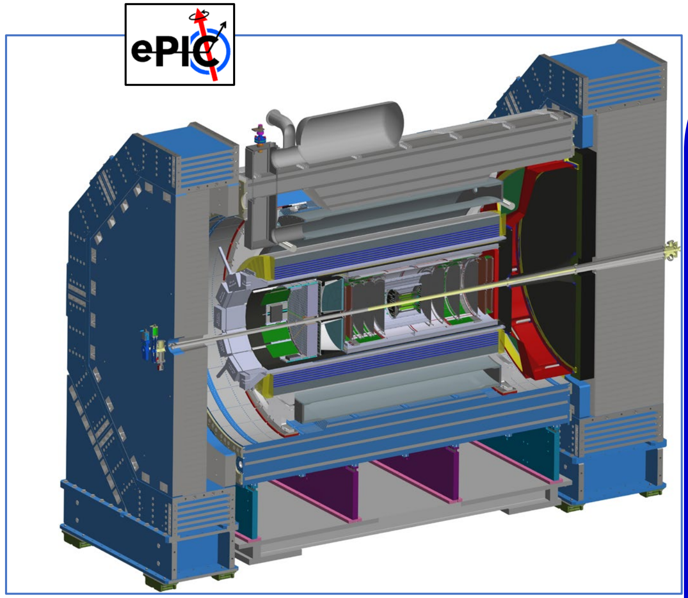

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ePIC Collaboration effort for detector optimization

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**

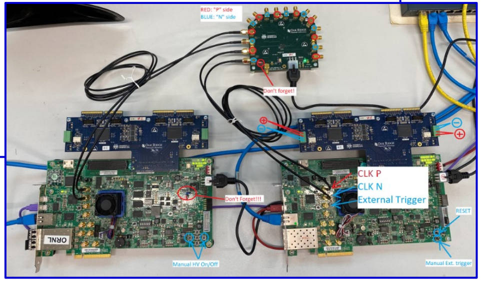
ePIC Collaboration effort for detector optimization

Baseline Modifications, recent and present cases:

CALOROC layout

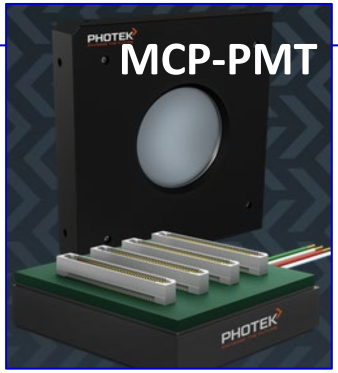
- CALOROC: the FEE ASIC for ePIC Calorimetry
- 36 ch.s instead of 72 ch.s
- Examined:
  - Technical merits;
  - Flexibility in PCB layout; Compatibility with the different Calorimeters;
  - Costs (not significant difference);
  - Risks

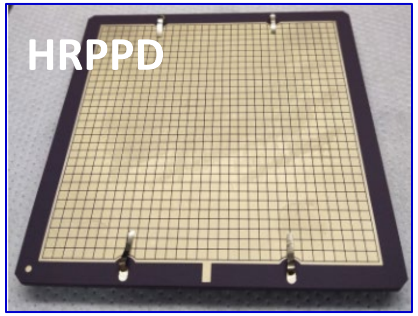
→ **TIC RECOMMENDATION : less dense version (36 ch.s)   (Sept. 29th, 2025)**



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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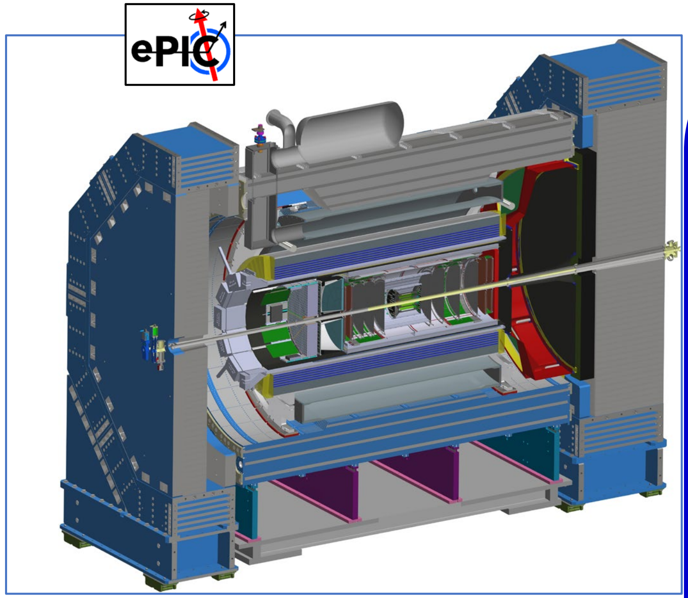

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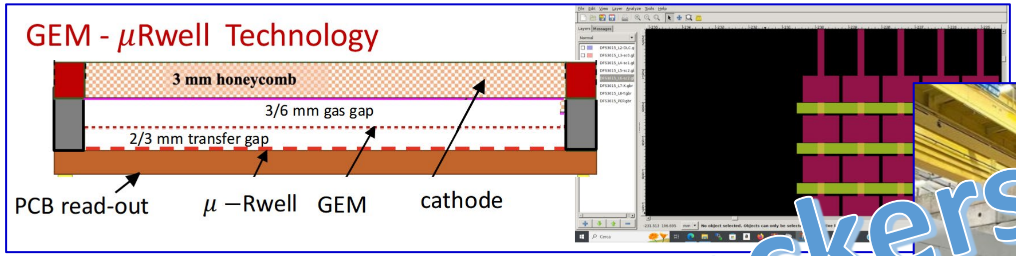
In the following slides images from Beam Tests, Irradiation Campaigns and Lab Studies providing a sample of the recent ePIC subsystem activity

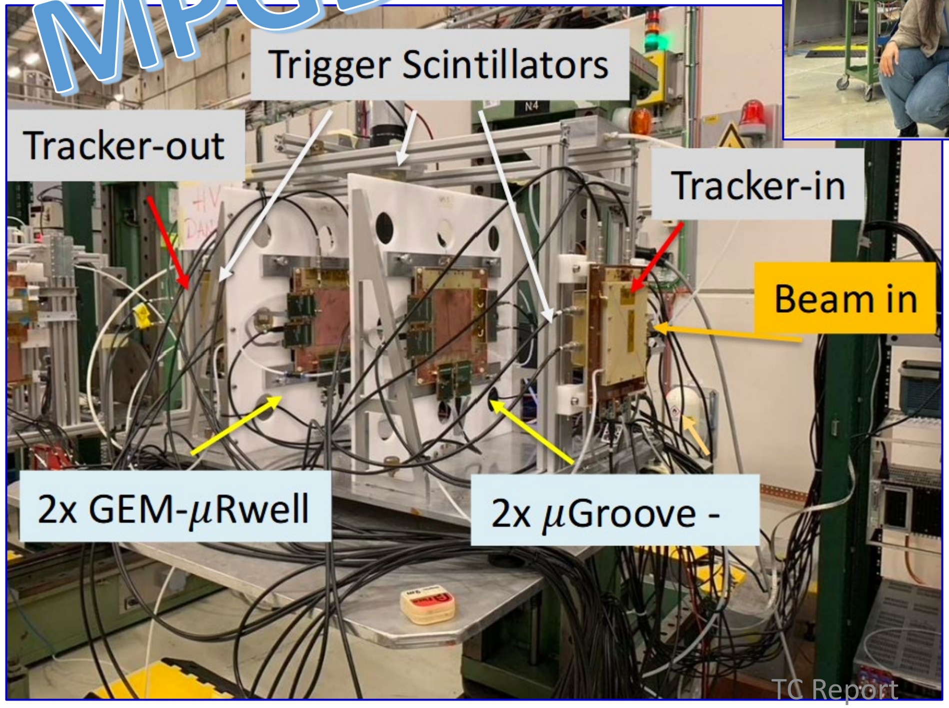
Focus of this report

TestBeams and Lab Studies for TRACKING Subsystems

Testbeam at BASE (Berkley), May 2024

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





Further effort in November 2025

SENSORS for ePIC CALORIMETRY


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

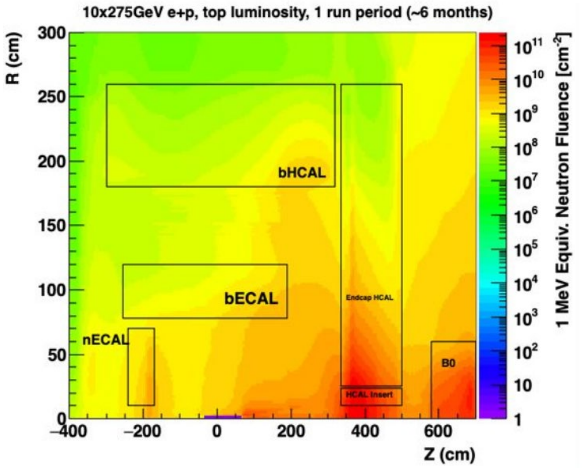
Jiajun Huang, Sean Preins, Ryan Tsiao, Miguel Rodriguez, Barak Schmookler, Miguel Arratia

SiPM sensors for all Calorimeters

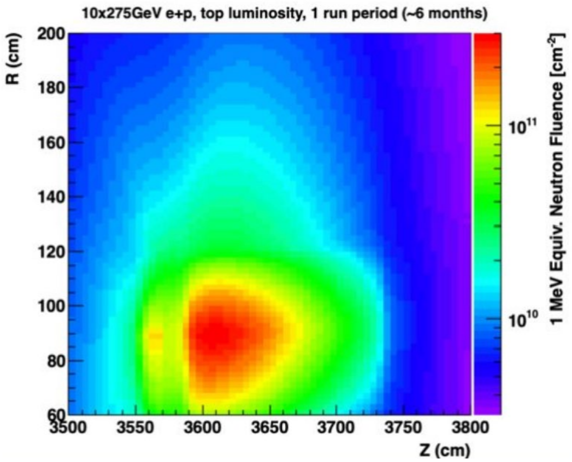
→ Irradiation campaigns for all SiPMs type foreseen in ePIC Colorimetry

Rad Dose

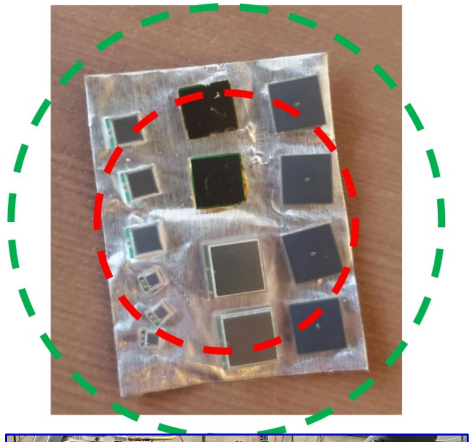
Central detector

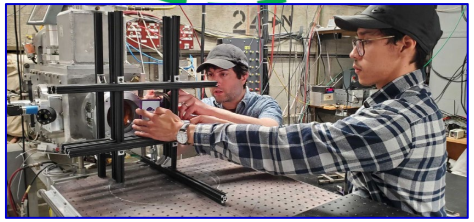


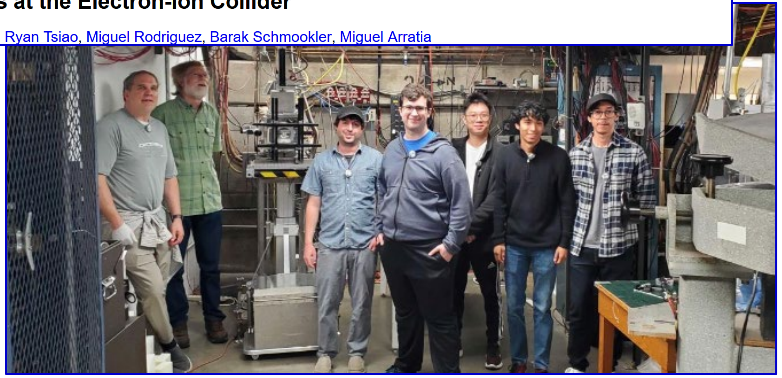
Far detectors

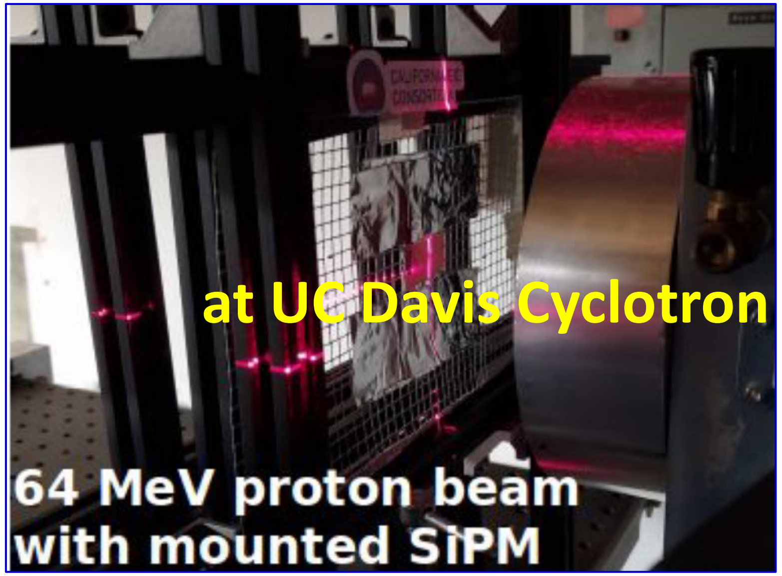


1.5 cm radius
2.5 cm radius









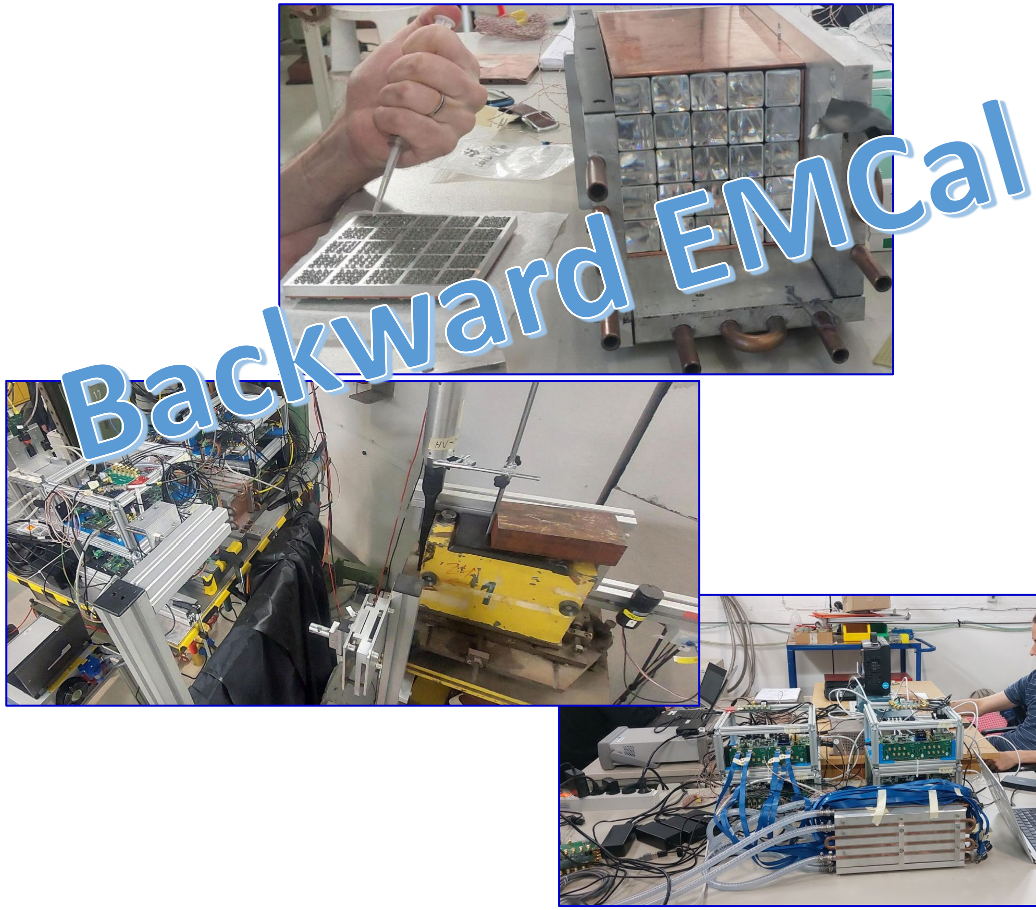
Models of SiPMs	10^8 N_{p^+}	10^9 N_{p^+}	10^{10} N_{p^+}	10^{11} N_{p^+}	10^{12} N_{p^+}	10^{13} N_{p^+}	ePIC Detector Usage
S14160 1315PS	1	3	3	3	3	2	nHCAL, pHCal
S14160 3015PS	1	2	2	3	3	1	nEMCAL , bHCAL, pHCal(Insert), ZDC
S14160 6015PS	1	1	1	2	2	1	nEMCAL, bEMCAL, pEMCAL
S14160 6050HS	2	4	4	4	4	2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

TestBeams and Lab Studies for EM Calorimeters

Backward Ecal

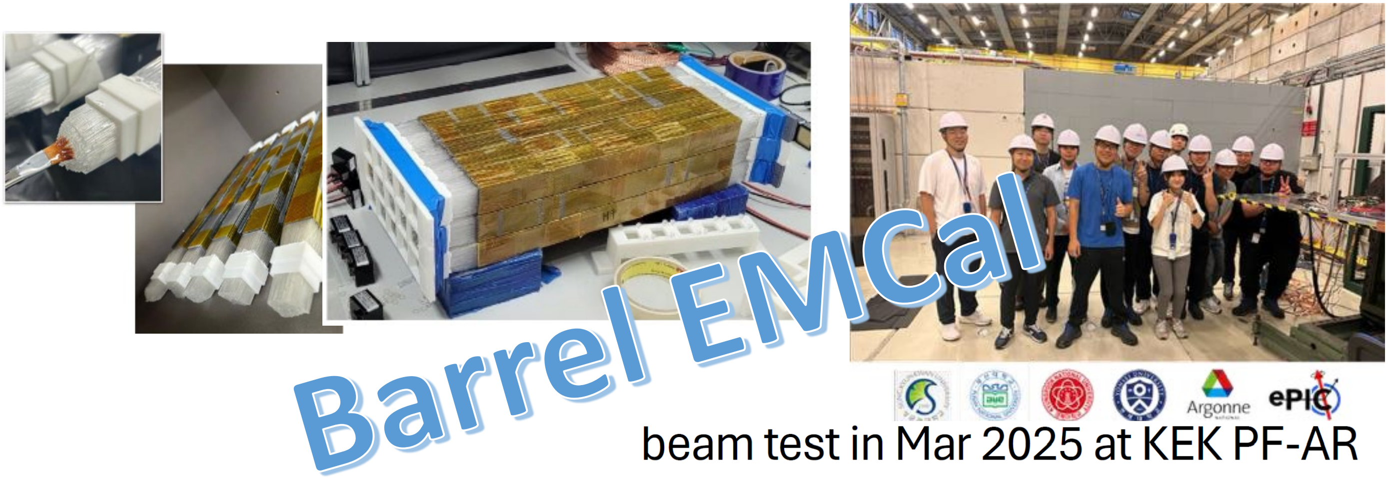
test beams at DESY:

- Feb 17- Mar 2
- Mar 28 – April 7



Barrel ECal

beam test in Aug 2024 at CERN PS T10



beam test in Mar 2025 at KEK PF-AR

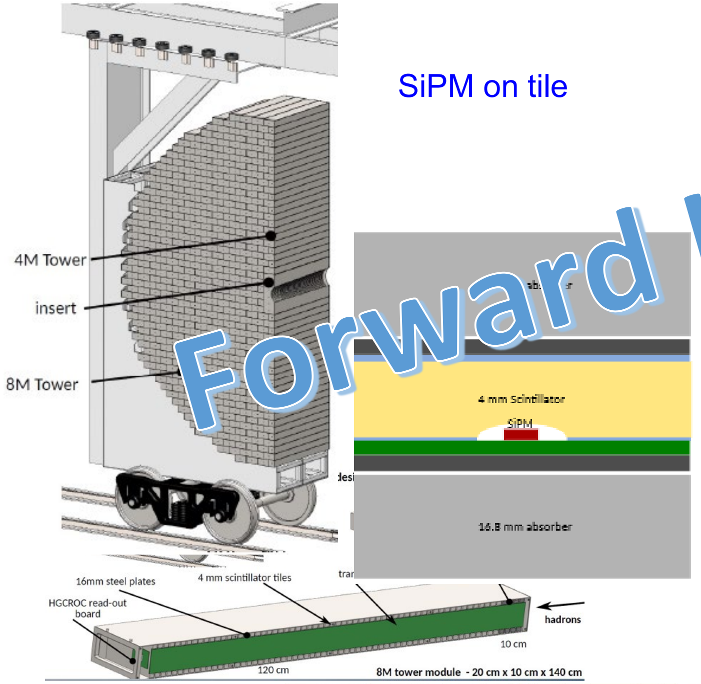
AstroPix data taking between Pb/SciFi layers

TestBeams and Lab Studies for Hadronic Calorimeters

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

- inspired by CALICE developments adopted by ePIC

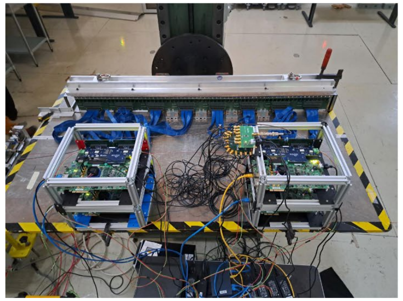
SiPM on tile



Sept/Oct 2024:
First module at test beam

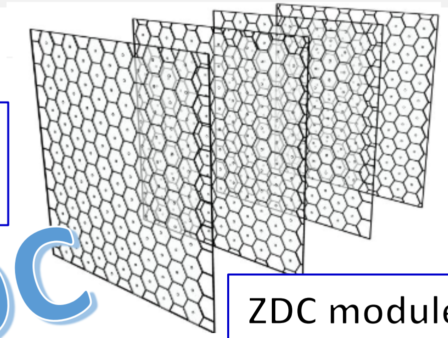
2025:
Test beam in November

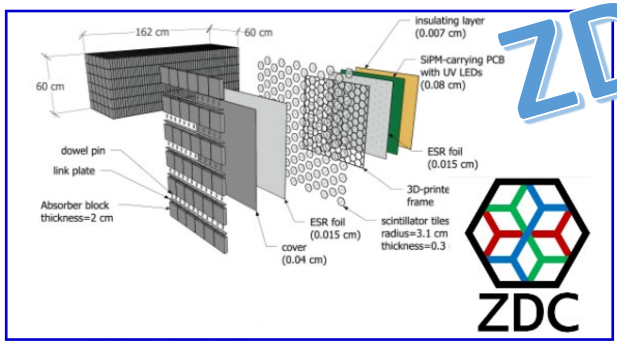
2026:
Test beam with an enlarged sample of 8 modules



Same technology :

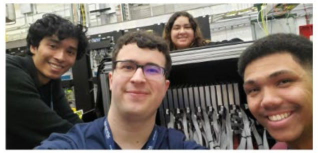
- Zero Degree Calorimeter

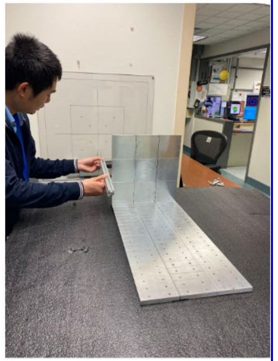




ZDC module tested at STAR in 2024

2024-2025	2025	2025
Brookhaven National Laboratory	Jefferson Lab	Brookhaven National Laboratory, NASA





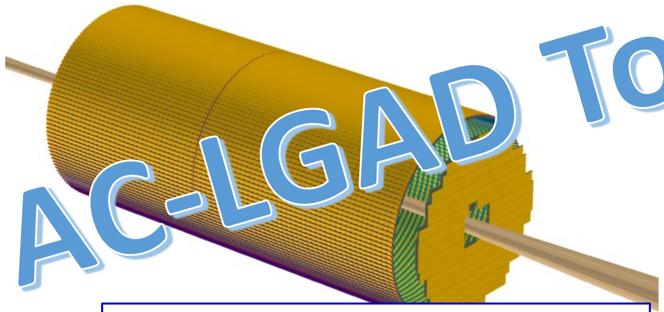
TestBeams and Lab Studies for PID Subsystems

hpDIRC

BaBar fused silica bars infrastructure for bar disassembling and testing

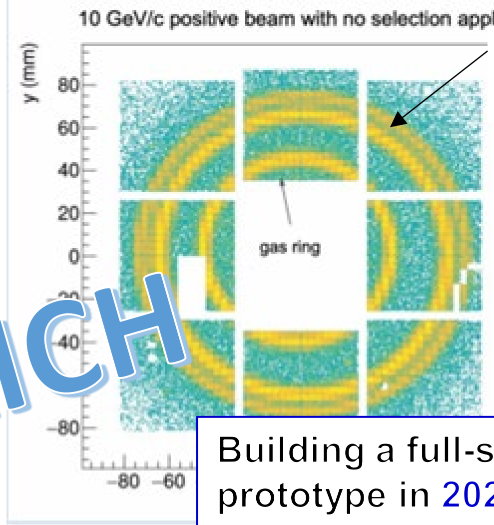
BaBar bars disassembling successfully progressing!

AC-LGAD ToF



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

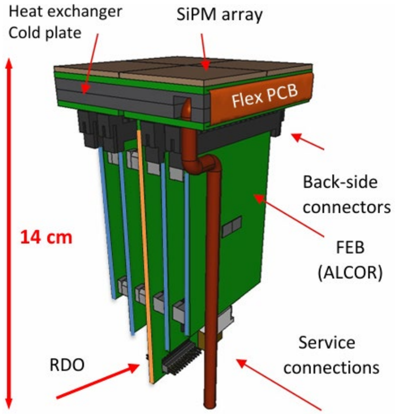
dRICH

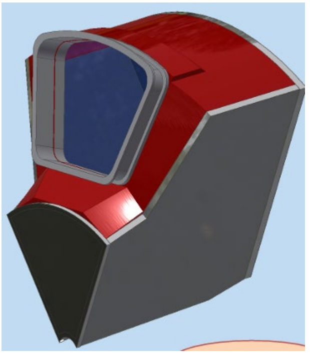


π, p rings in areogel

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

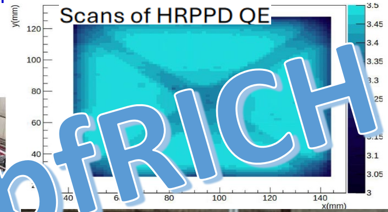
Engineered photon detector unit already used in 2024 test beam

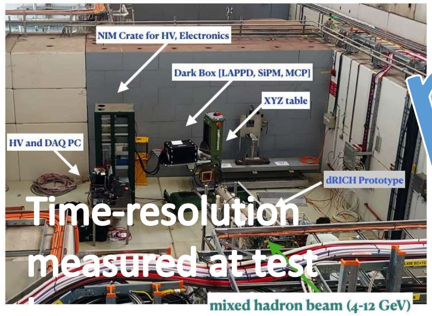




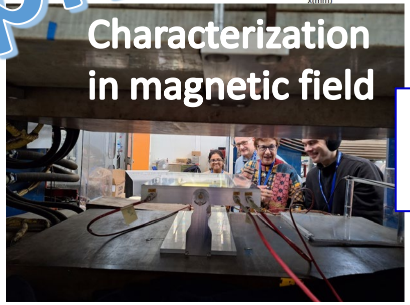
pfRICH sensors

HRPPD characterization





Time-resolution measured at test



Characterization in magnetic field

ageing studies ongoing in 2025

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
KIT

Tools for Discovery
Instrumentation Requirements for Future Projects

Ulrich Husemann (KIT)

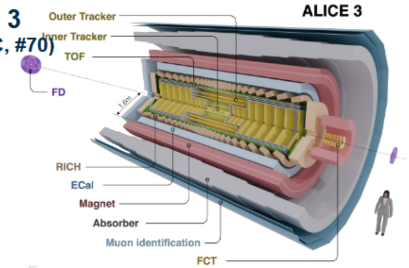
23-27 JUNE 2025 Lido di Venezia

A Simplified Timeline

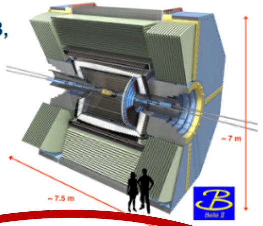
Key Collider Projects

- **Era 1: ALICE 3, LHCb Upgrade II, Belle II, ePIC**

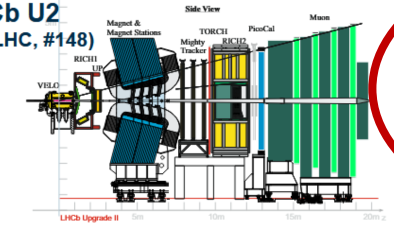
ALICE 3
(HL-LHC, #70)

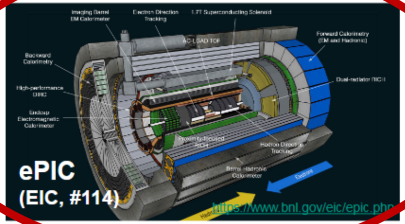


Belle II
(SuperKEKB, #205)



LHCb U2
(HL-LHC, #148)





Today
1: HL-LHC & EIC

7 U. Husemann: Computing and Instrumentation

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**

Today
1: HL-LHC & EIC
2: HET Factory
3: Beyond

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The Detector preTDR is now a standalone document

The ePIC Collaboration has taken responsibility for the Detector preTDR

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

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

The Detector preTDR - presently

400 pages, 360 figures

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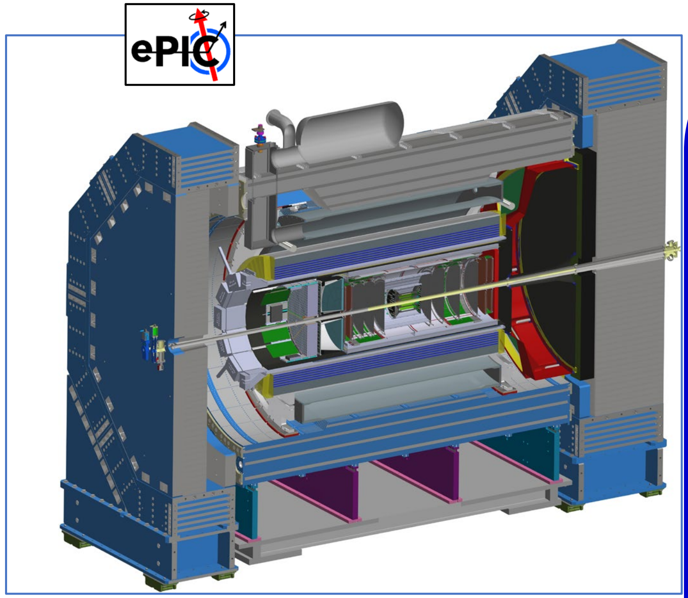
  - Present: mainly via PED (Project Engineering & Design)
  - After CD3: construction



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

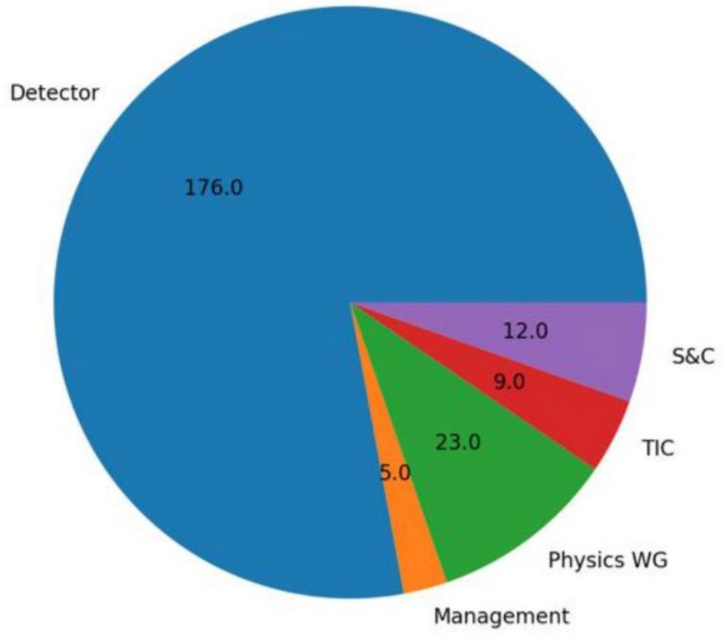
From the survey of the Statements of Service in 2025 (collected at the end of 2024):

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

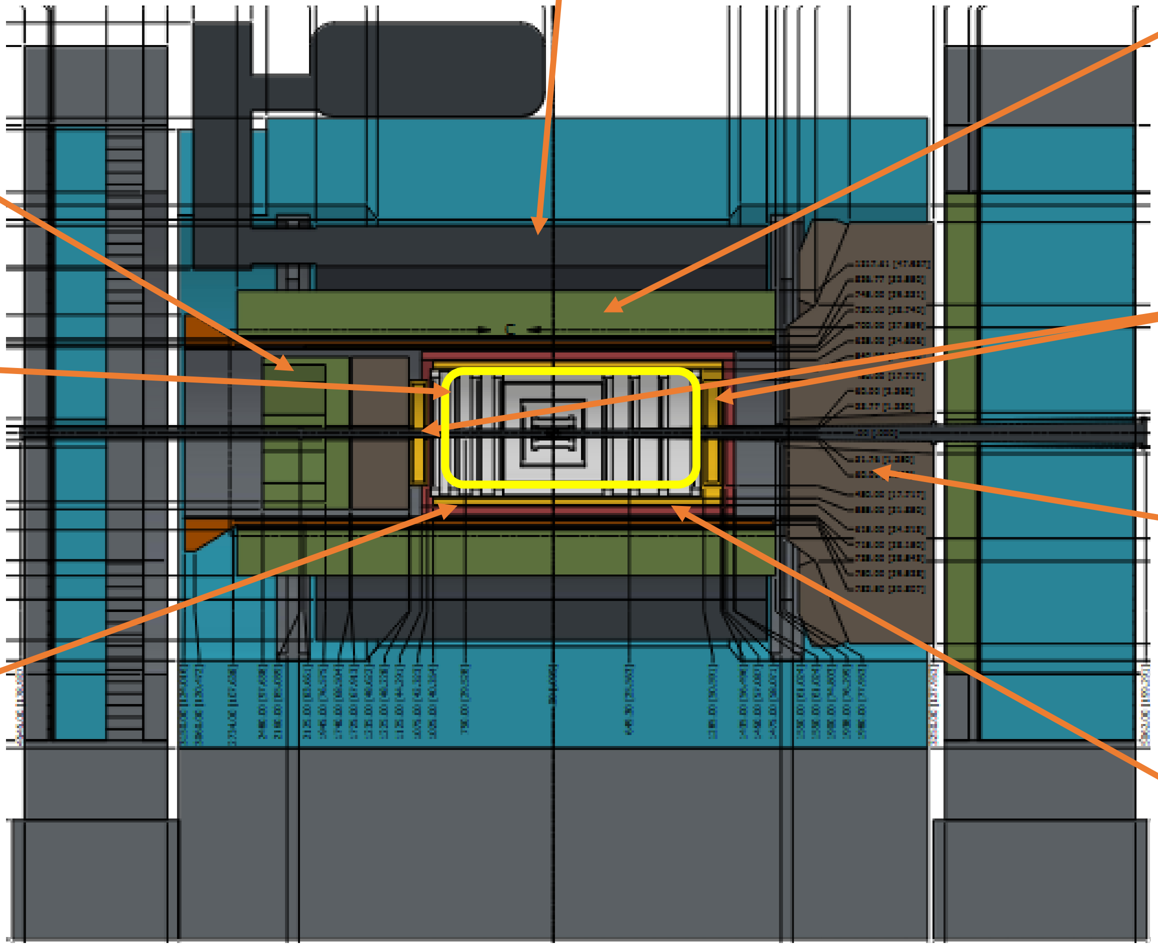
ePIC Central Detector

Solenoide
in-kind
in-kind

Backward ECal
in-kind

Si tracking subsystem
in-kind
in-kind

Barrel ToF
in-kind
in-kind



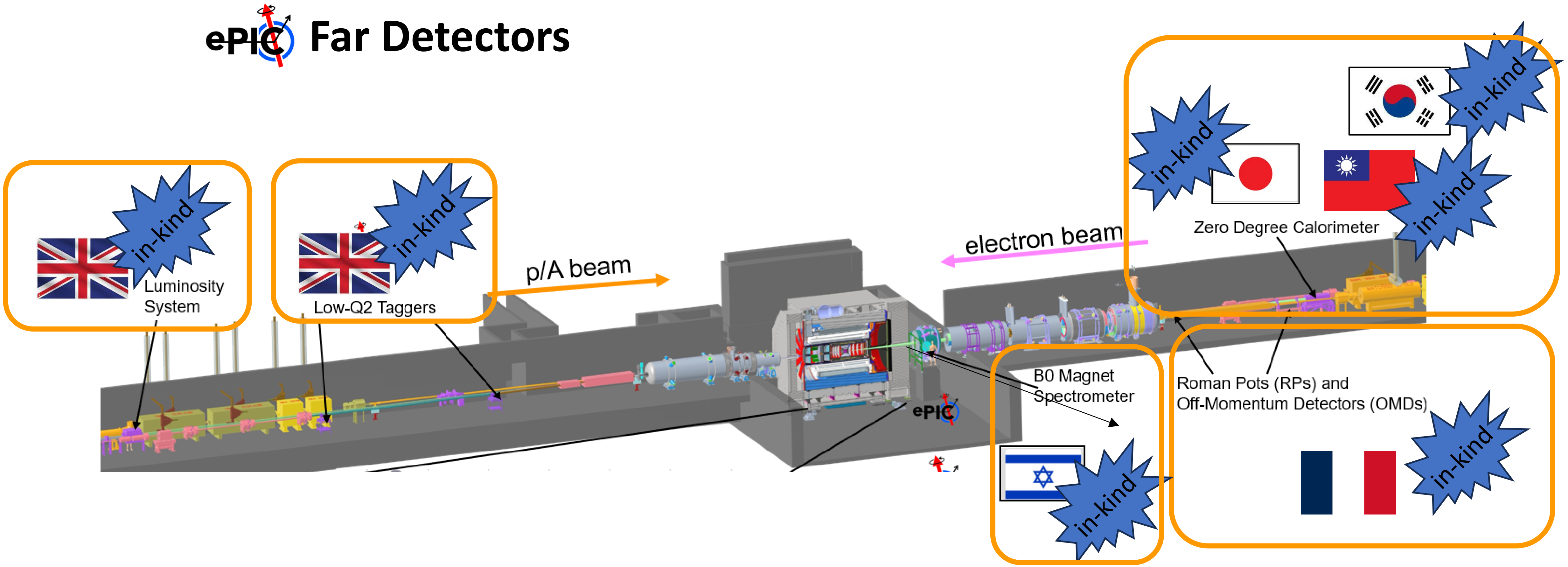
Barrel ECal
in-kind
in-kind

MPGD disks
in-kind

dRICH
in-kind

Barrel MICROMEGAS
in-kind

“In-kind” being generated by the Collaboration engagement



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

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