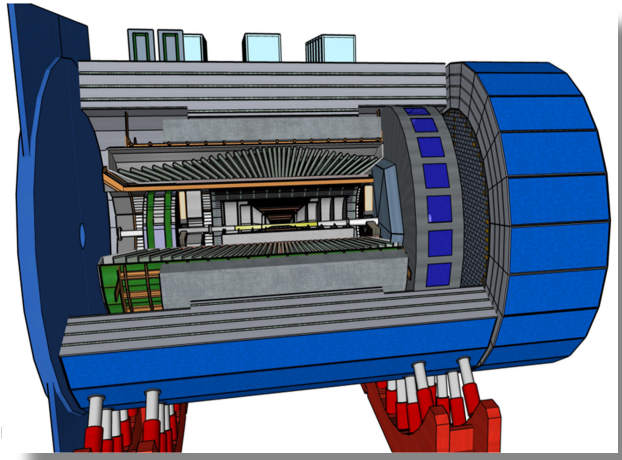
News from the electron-Proton/Ion Collider (ePIC) experiment at IP6 at EIC

Bernd Surrow

TEMPLE UNIVERSITY

On behalf of the ePIC Steering Group (SG)

Silvia Dalla Torre, Or Hen, Tanja Horn, John Lajoie, and Bernd Surrow

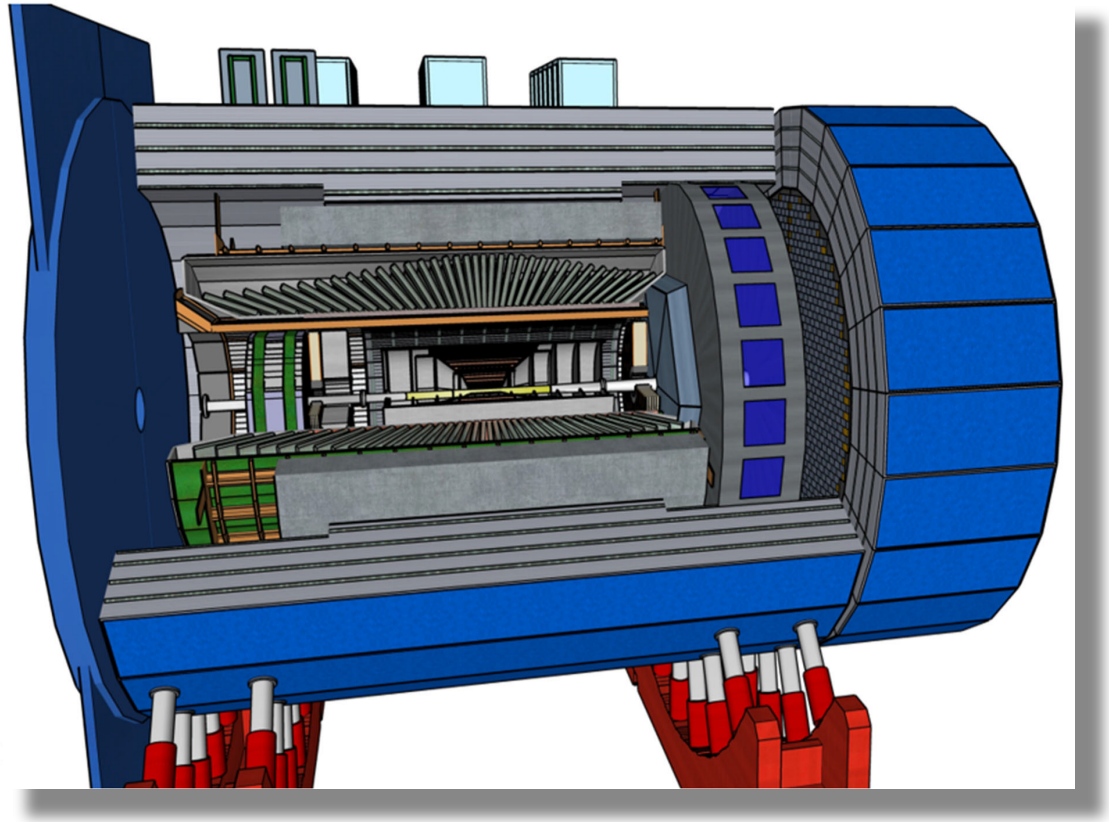


U.S. DEPARTMENT OF ENERGY | Office of Science

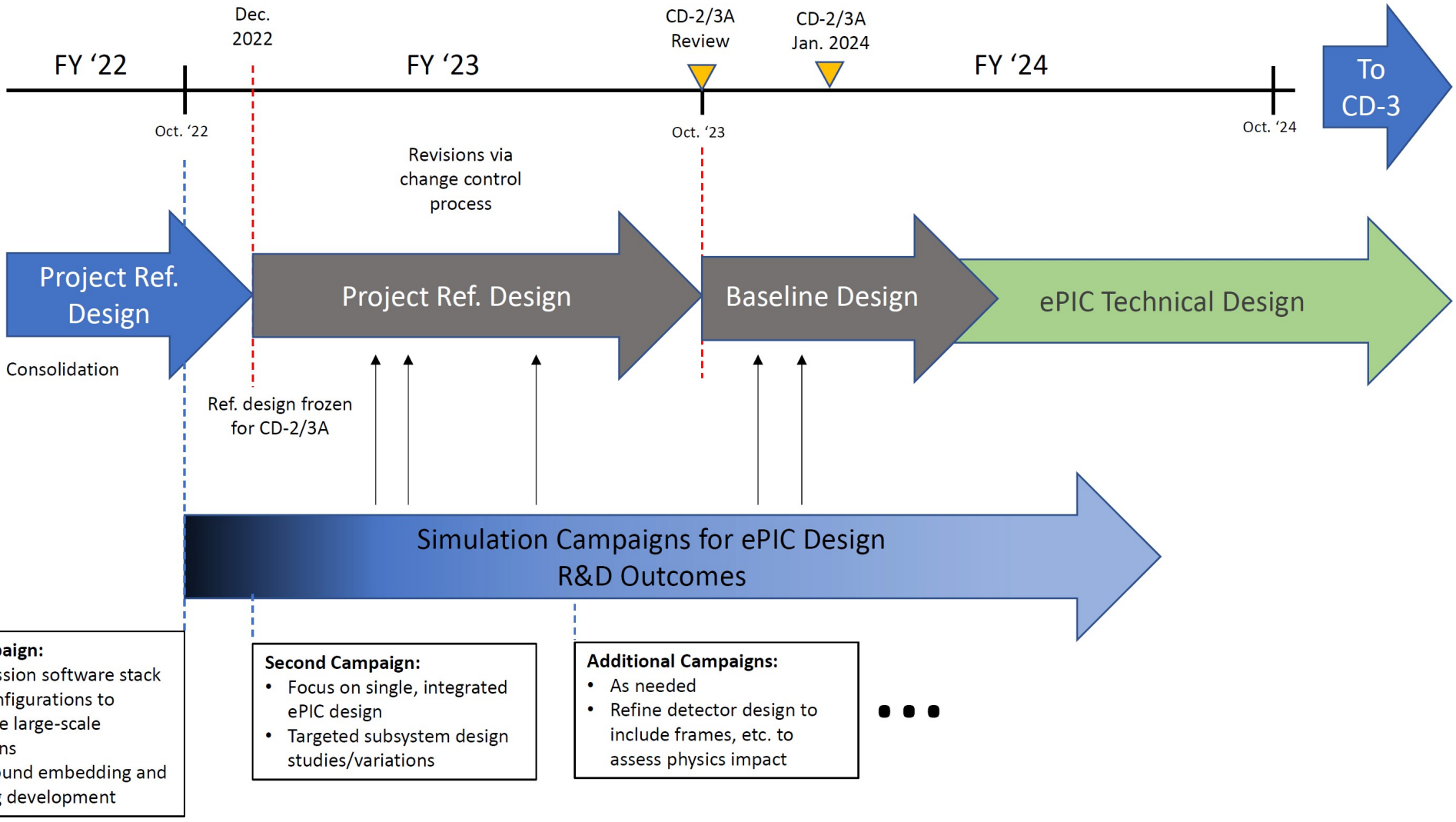
DOE NP contract: DE-SC0013405

Outline

- Overview of Timescale / Review Process
- ePIC experiment
  - Current detector design highlights
  - Collaboration formation
- Community Long-range planning processes
- Summary



Overview of Timescale / Review Process

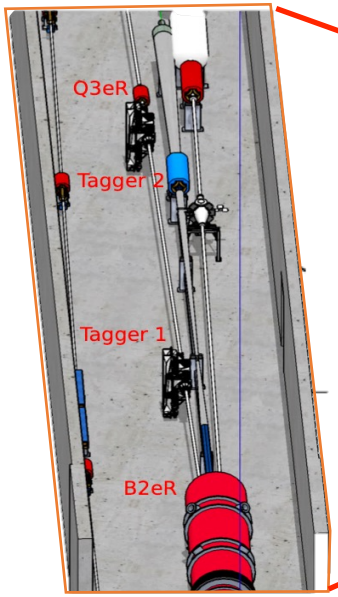


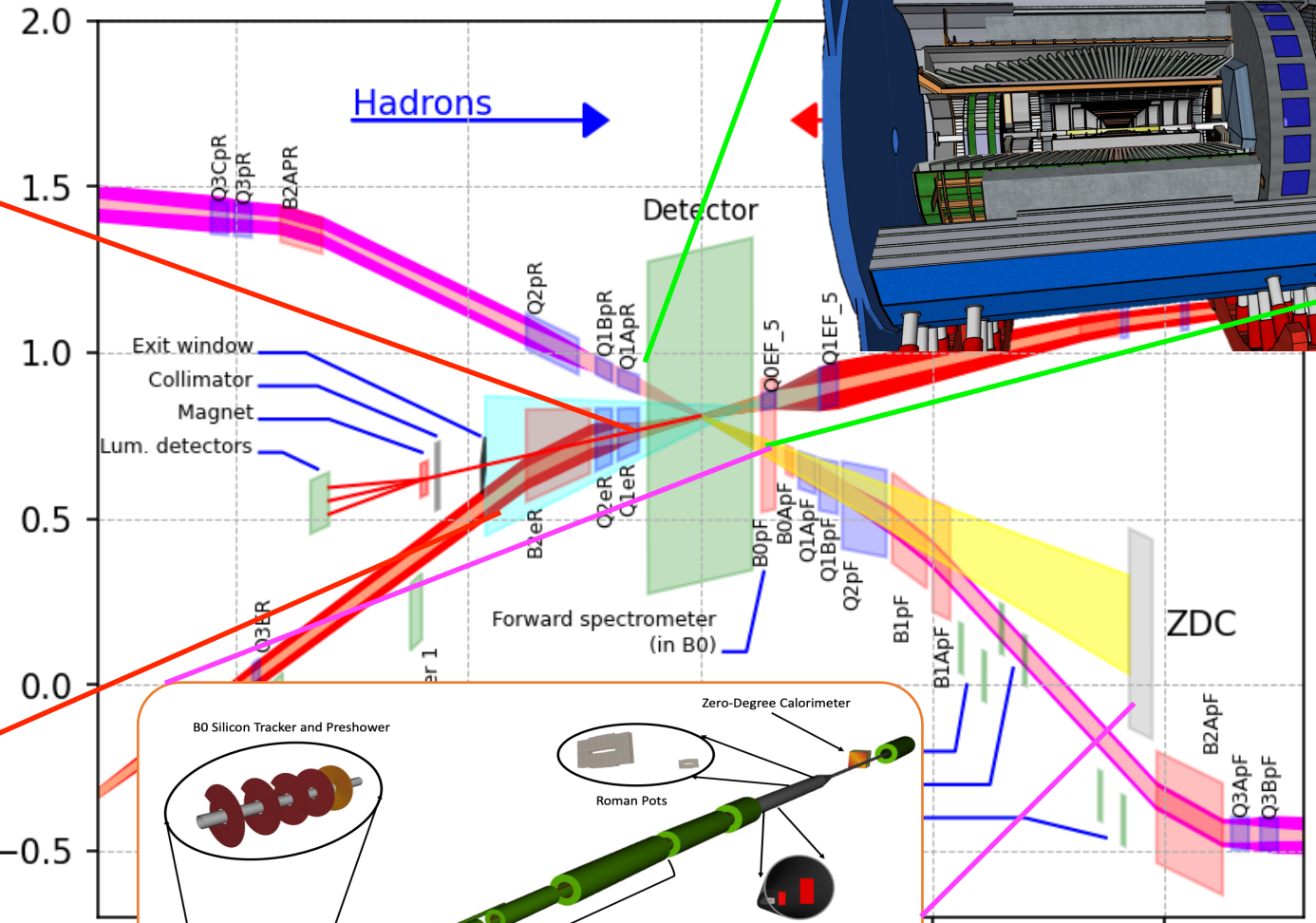
Overview of Timescale / Review Process

- Detector-1 reference design based on YR work for CDR development and CD-1 by EIC project
  - Update after the DPAP process and integrated into the project cost book and basis for EIC Project status review.
- ePIC reference design must be frozen by EIC project in preparation of CD-2/3A, and explicitly for the Office of Project Assessment Review of the EIC in January 2023.
  - Reference design is based on the best understanding at the present time.
  - Work can continue with a ~60% design completion by CD-2/3A toward a baselined detector.
- eRPIC detector optimization will continue and is not expected to be completed by the end of 2022!
  - ePIC design optimization will continue through a series of simulation campaigns.
- ePIC reference design can be updated through the project change control process:
  - Changes must be justified based on performance, cost, and risk!
  - Changes should be the exception, not the rule!
  - Example: Change from SiPM readout to LAPPD readout!
- Goal: Unified ePIC Technical Design towards CD-3!

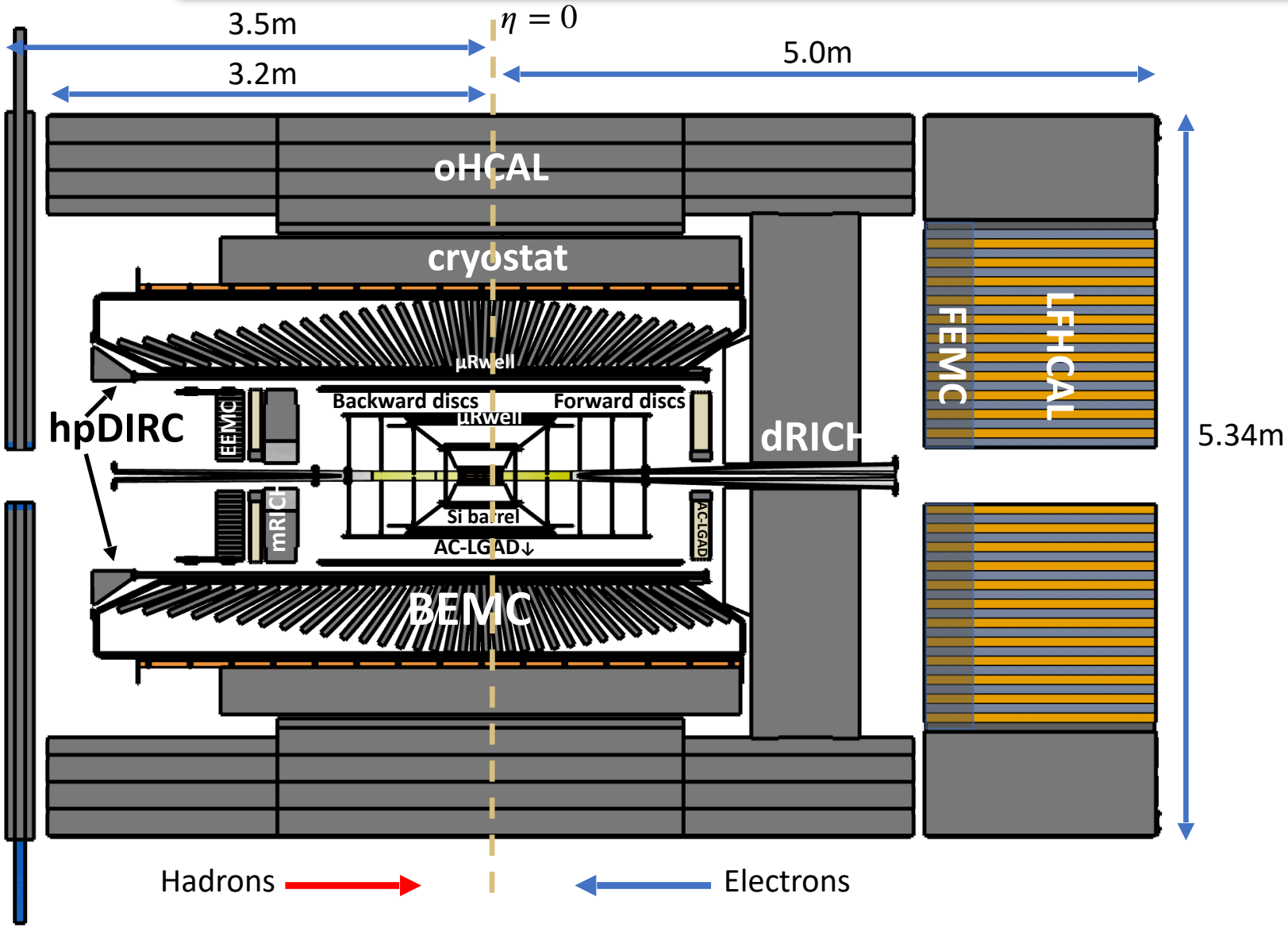
ePIC experiment: Current detector design

- Global ePIC design overview

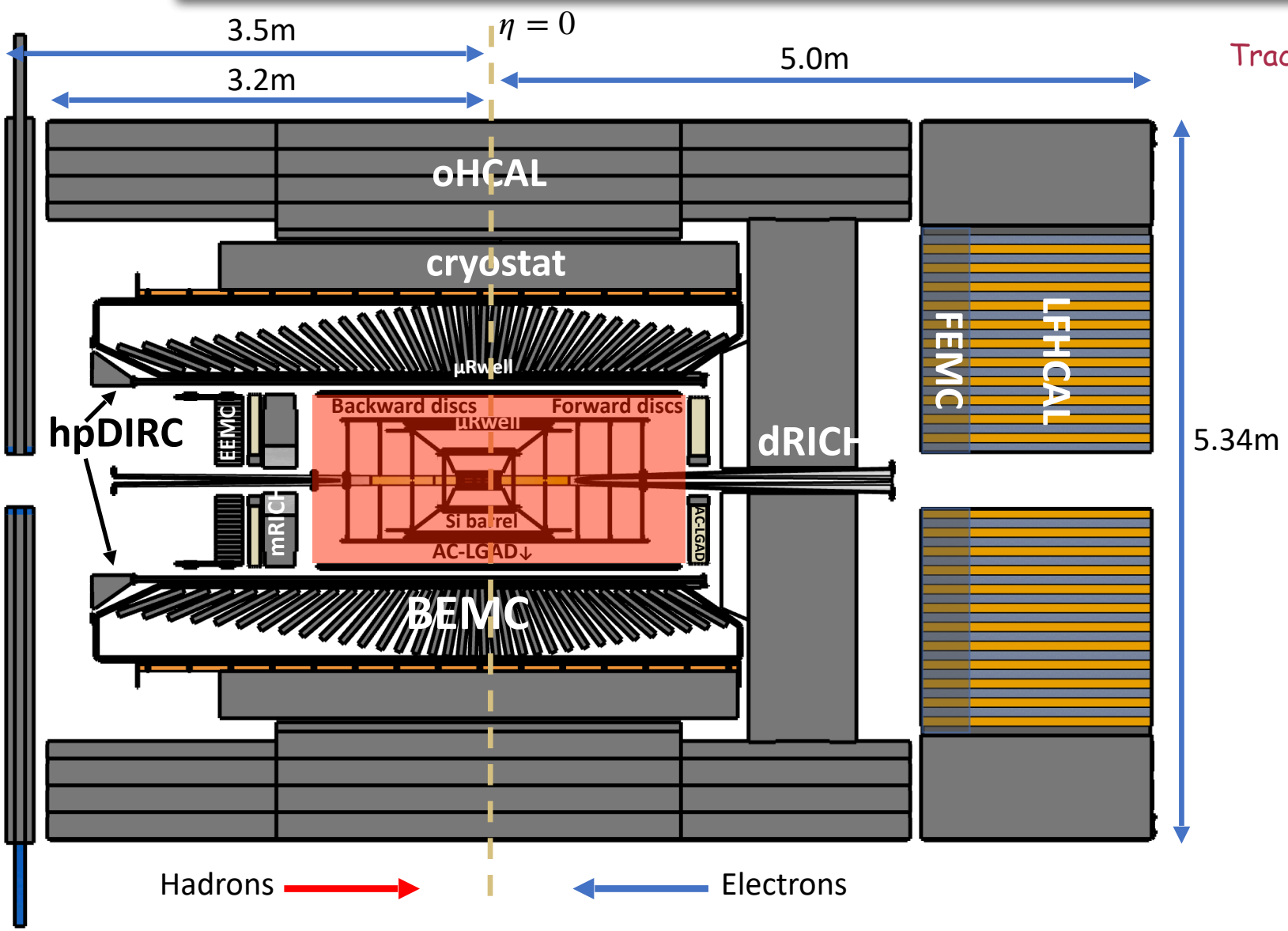




ePIC experiment: Current detector design



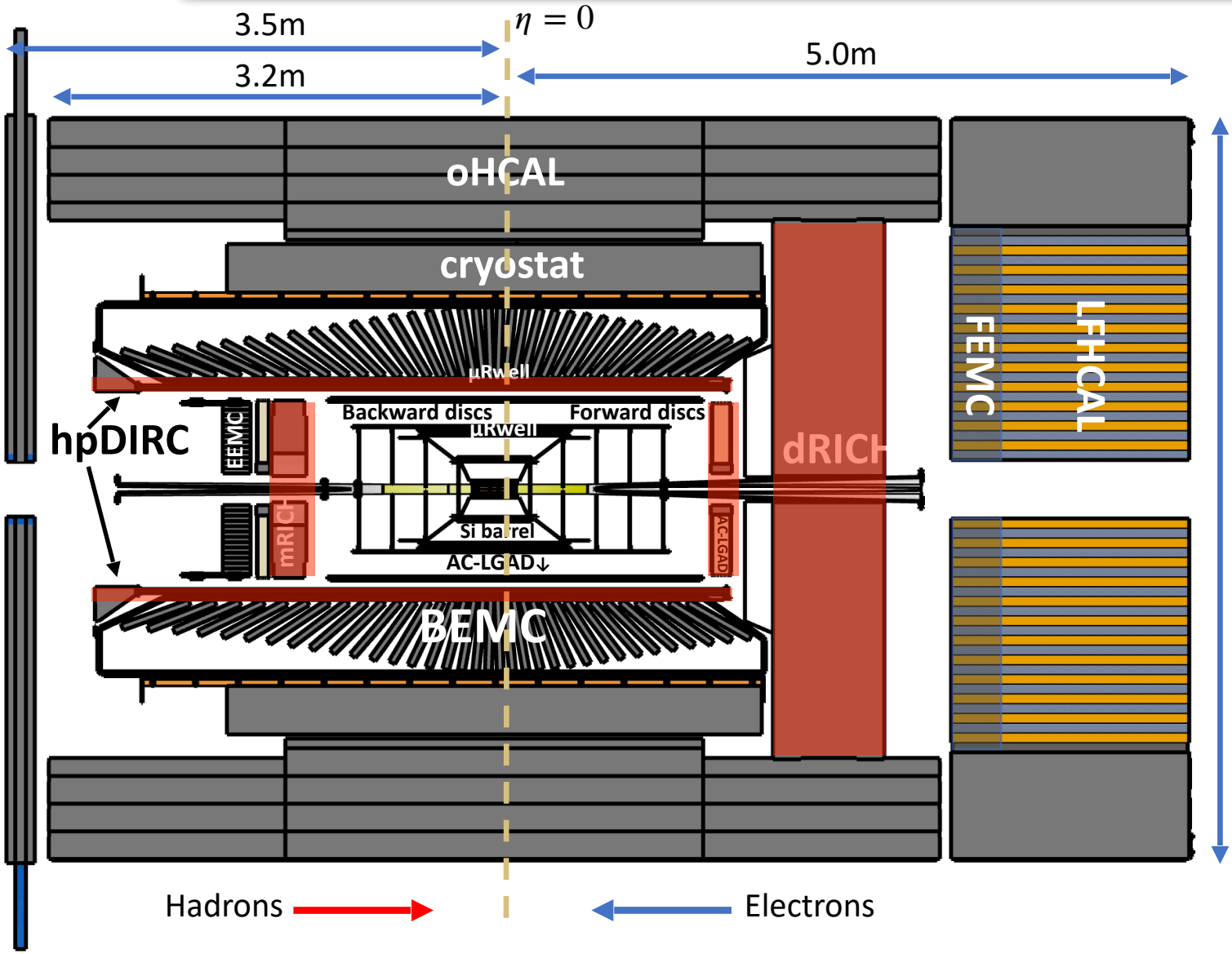
ePIC experiment: Current detector design



Tracking:

- New 1.7T solenoid
- Si MAPS Tracker
- MPGDs (µRWELL / µMegas)

ePIC experiment: Current detector design



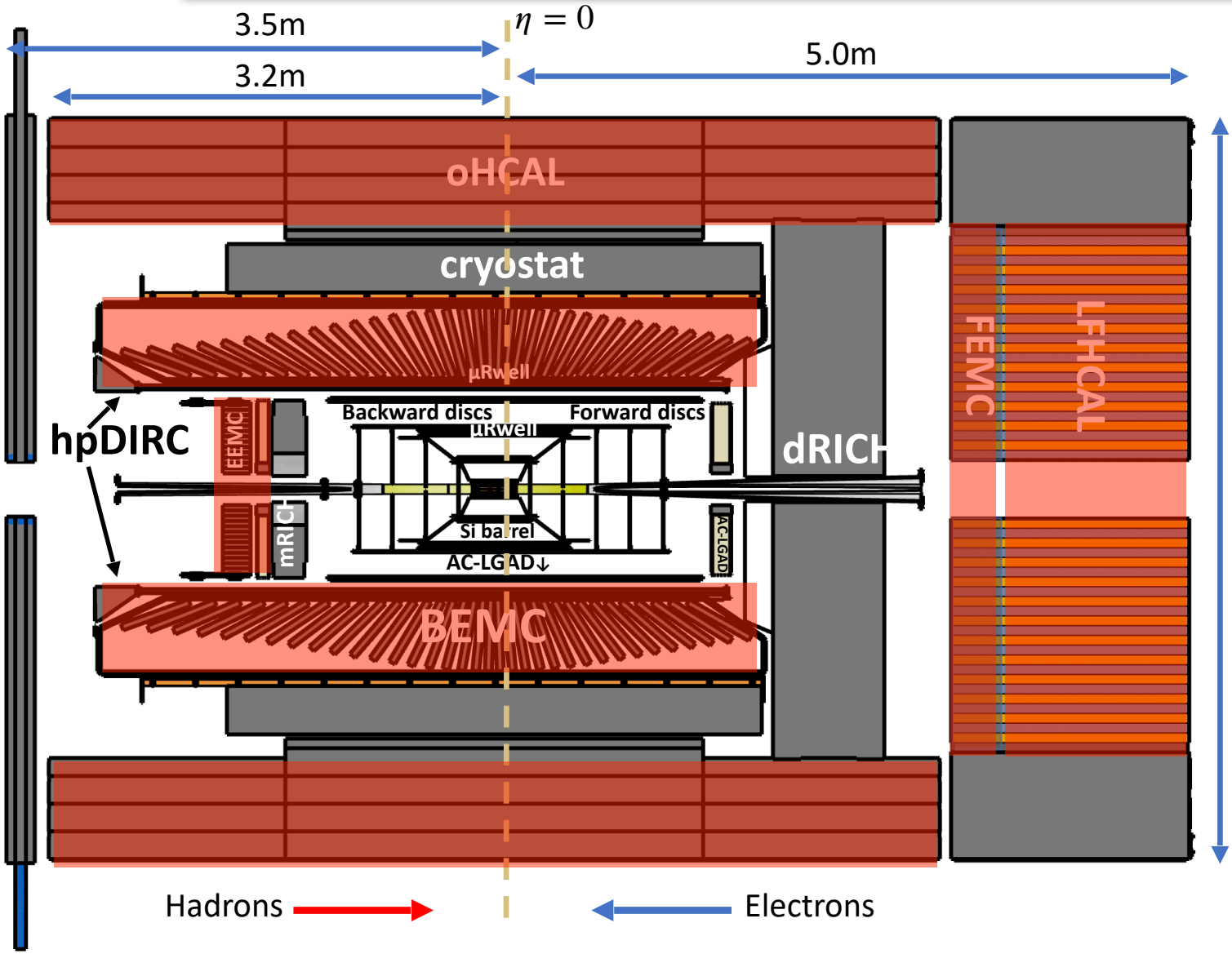
Tracking:

- New 1.7T solenoid
- Si MAPS Tracker
- MPGDs (µRWELL / µMegas)

PID:

- hpDIRC
- mRICH / pfRICH
- dRICH
- AC-LGAD (~30ps TOF)

ePIC experiment: Current detector design



Tracking:

- New 1.7T solenoid
- Si MAPS Tracker
- MPGDs (µRWELL / µMegas)

PID:

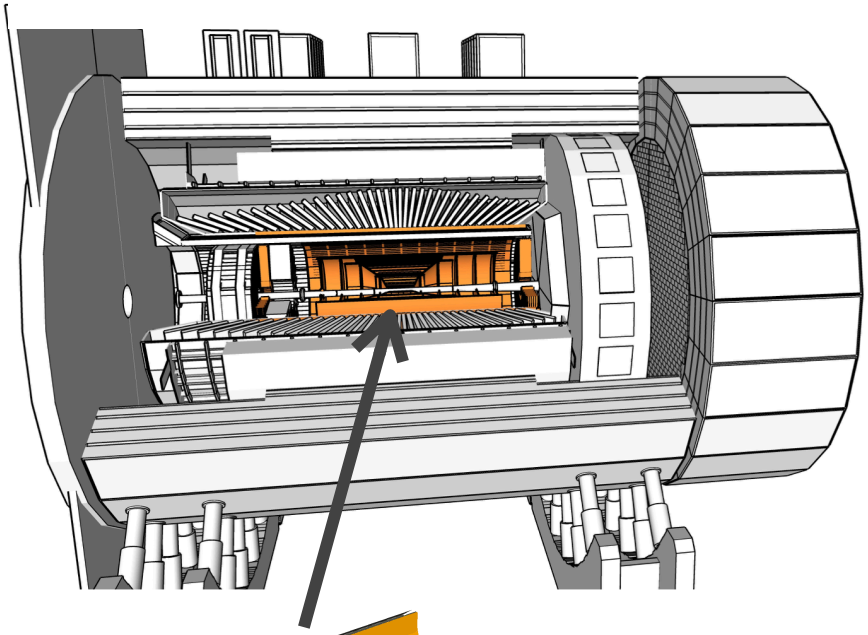
- hpDIRC
- mRICH / pfRICH
- dRICH
- AC-LGAD (~30ps TOF)

Calorimetry:

- SciGlass / Imaging Barrel EMCal
- PbWO4 EMCal in backward direction
- Finely segmented EMCal +HCal in forward direction
- Outer HCal (sPHENIX re-use)

ePIC experiment: Tracking

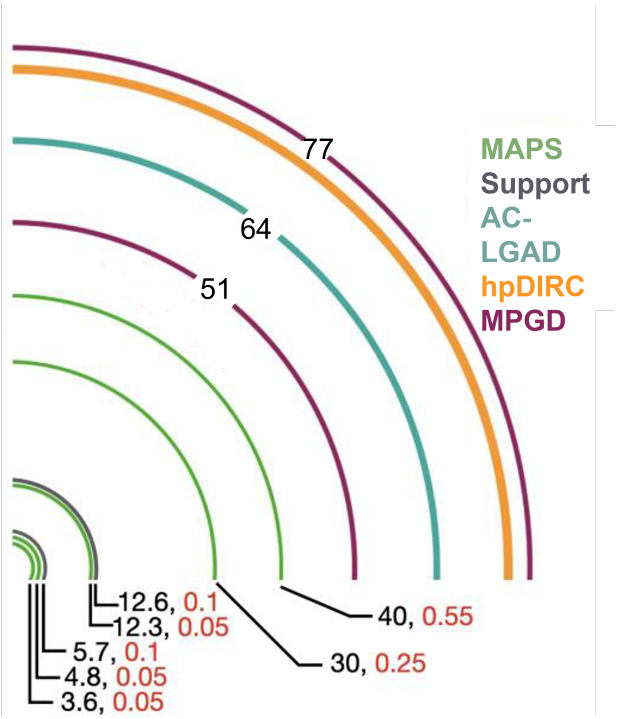
Tracking

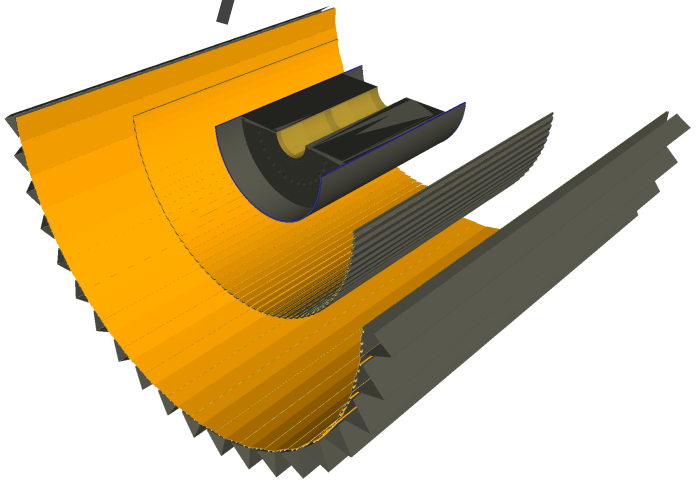


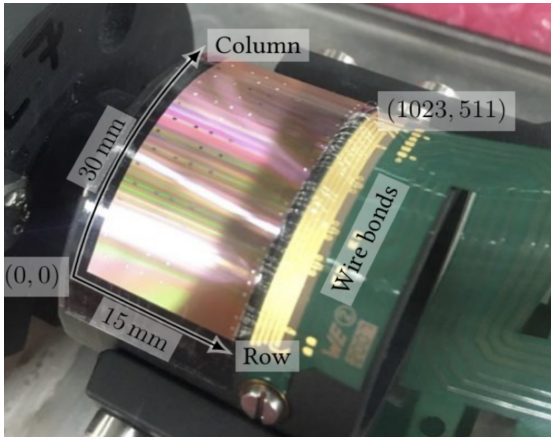
- Si Tracker using ALICE ITS3 65nm MAPS sensors
- Five barrel layers + MPGDs
- Five discs in forward/ backward directions (+MPGD in forward)

Black numbers are radii in cm

Red numbers are material in % X0

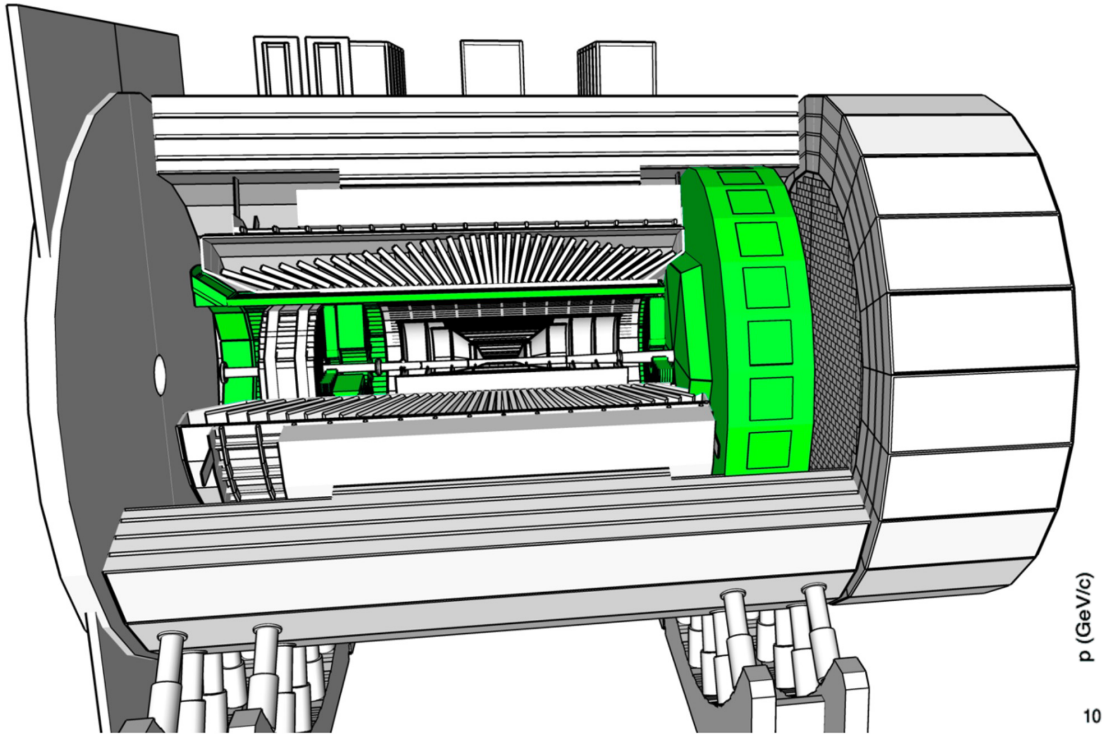




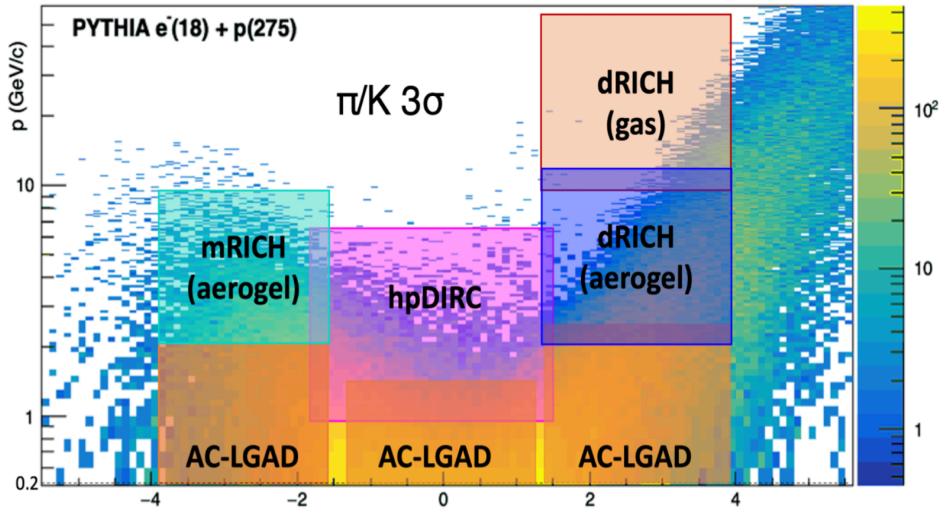


ePIC experiment: Particle ID

- PID

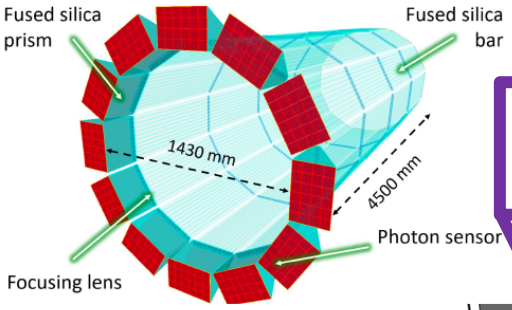


Goal: Complete PID coverage!



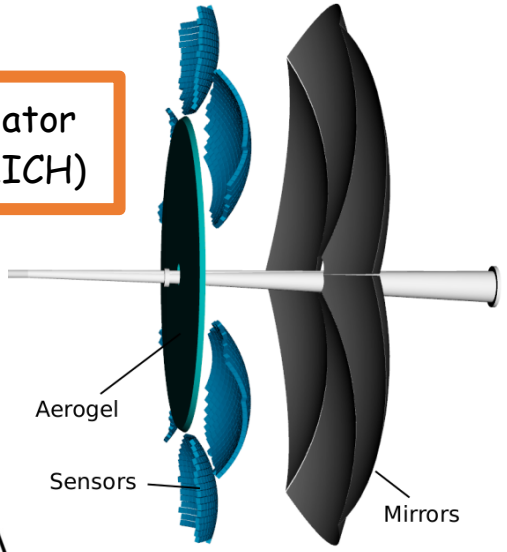
ePIC experiment: Particle ID

- PID

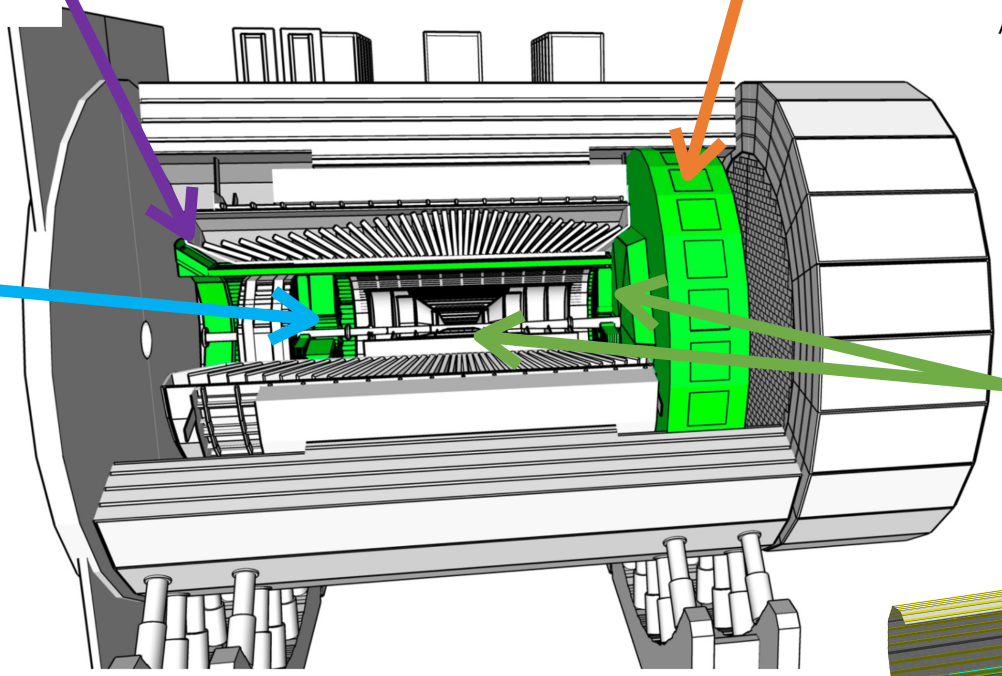


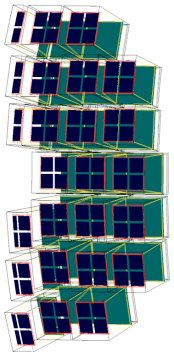
High-Performance DIRC

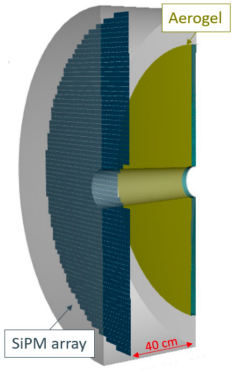
Dual-Radiator RICH (dRICH)



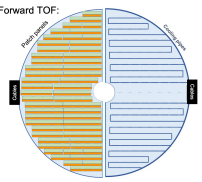
Modular (mRICH) / Proximity Focused (pfRICH)

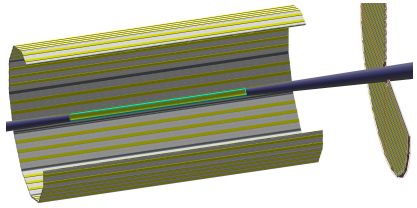






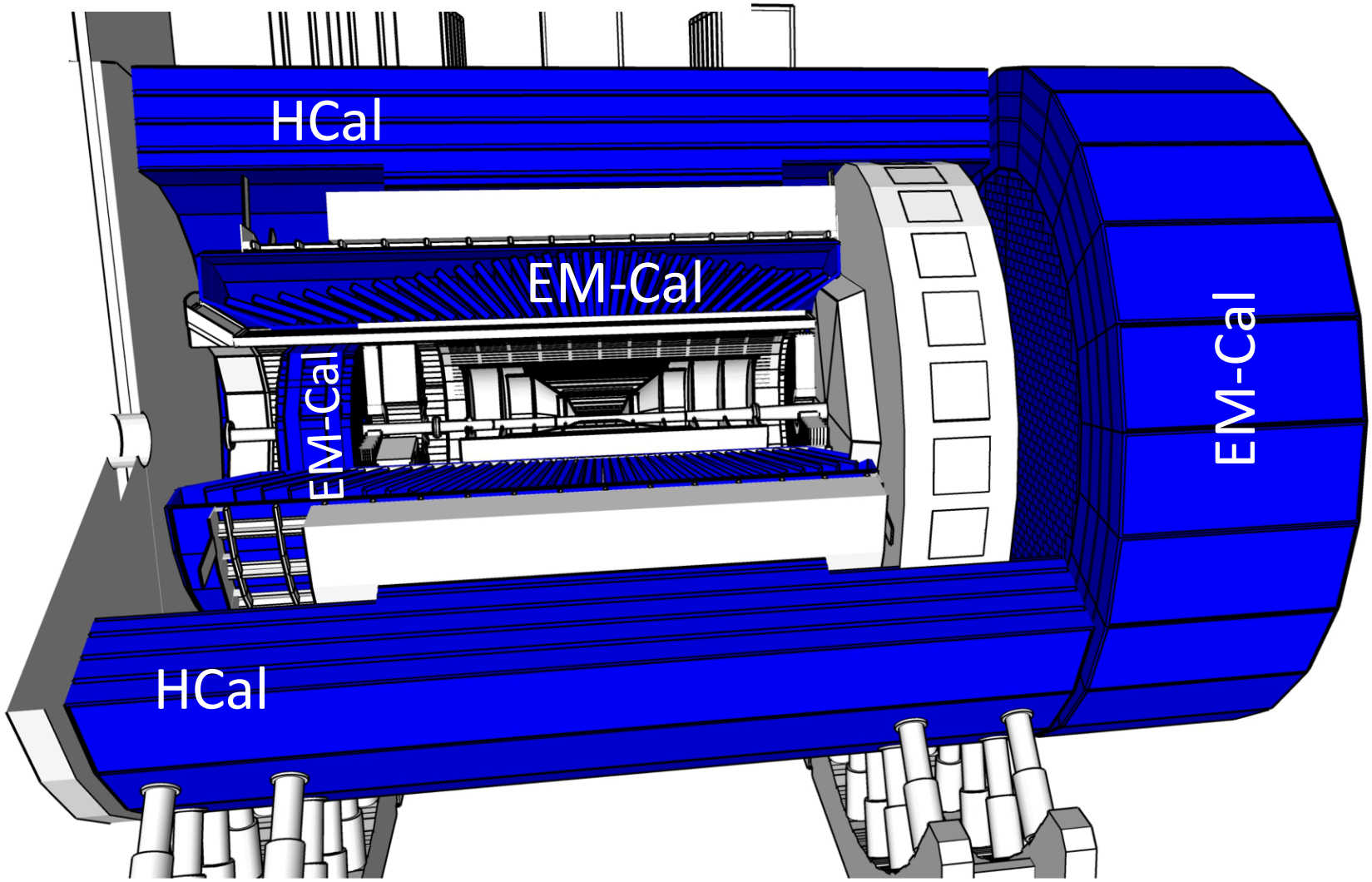
AC-LGAD TOF (~30ps)





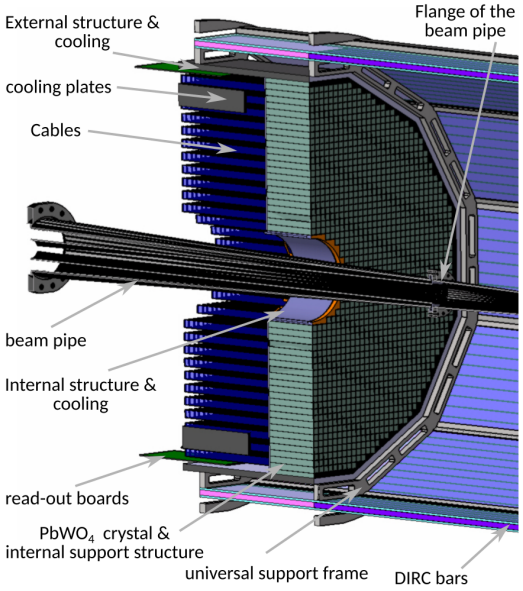
ePIC experiment: Calorimetry

- Calorimetry

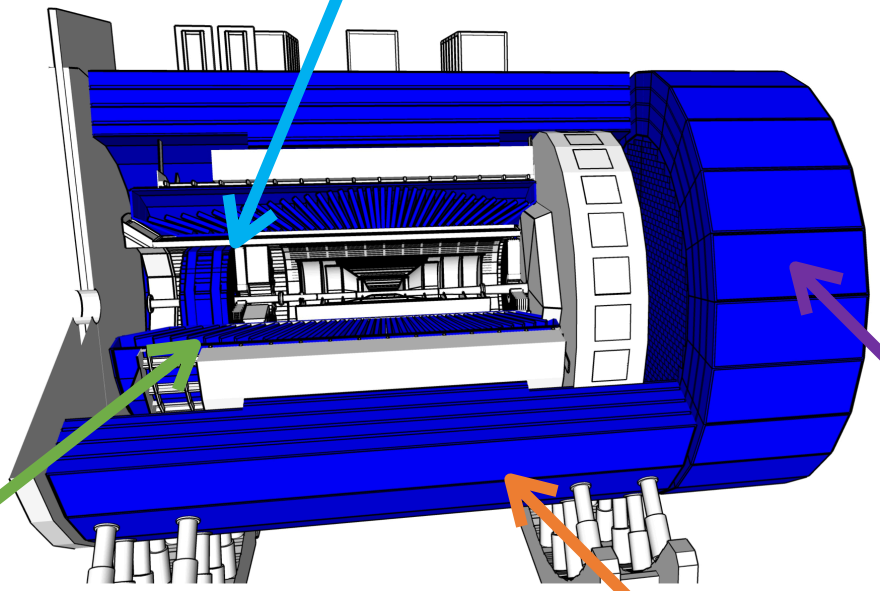


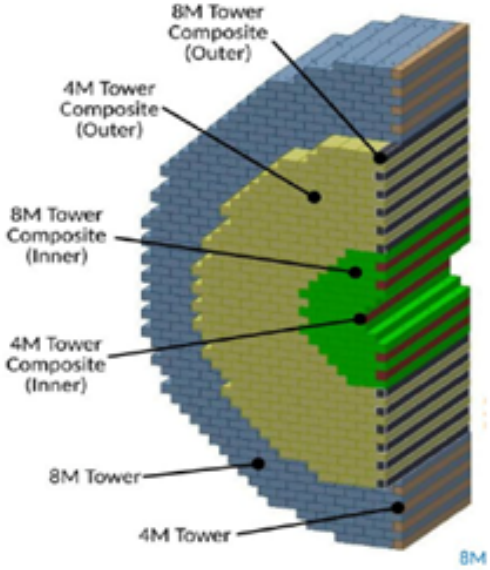
ePIC experiment: Calorimetry

Calorimetry

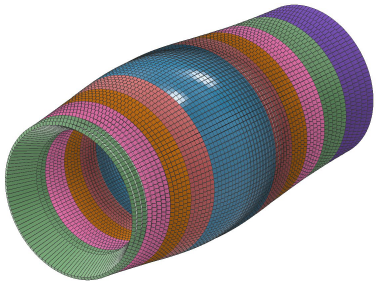


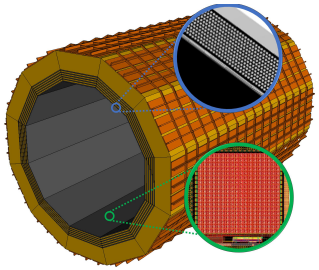
Backwards EMCal PbW04 crystals





BECAL: SciGlass or Imaging Calorimeter



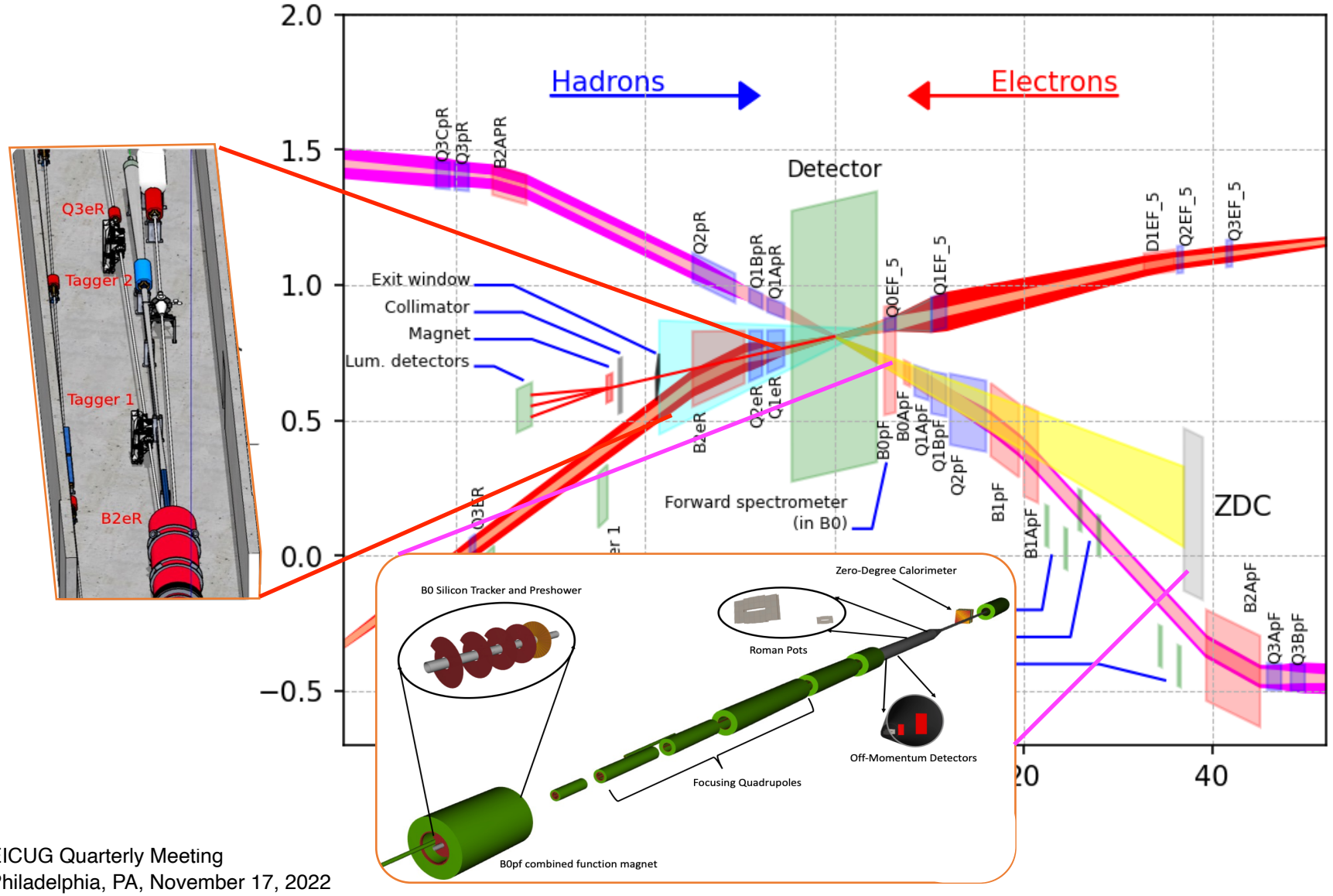


High granularity W/SciFi EMCal Longitudinally separated HCAL with high-η insert

Barrel HCAL (sPHENIX re-use)

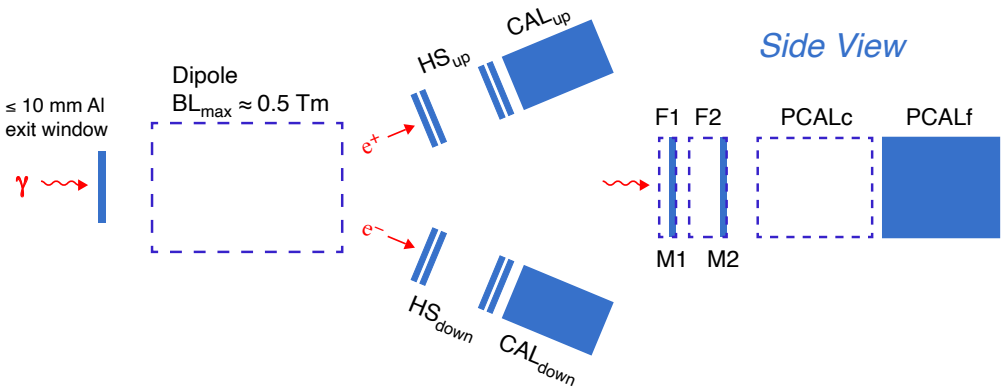
ePIC experiment: Current detector design

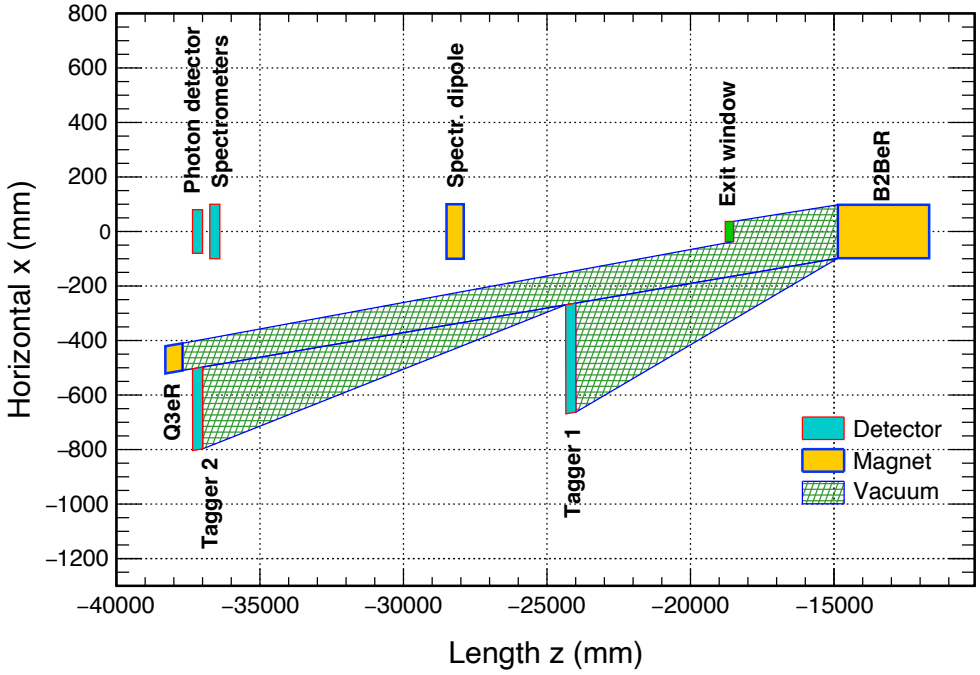
- FarBackward and FarForward Systems



ePIC detector

- FarBackward system



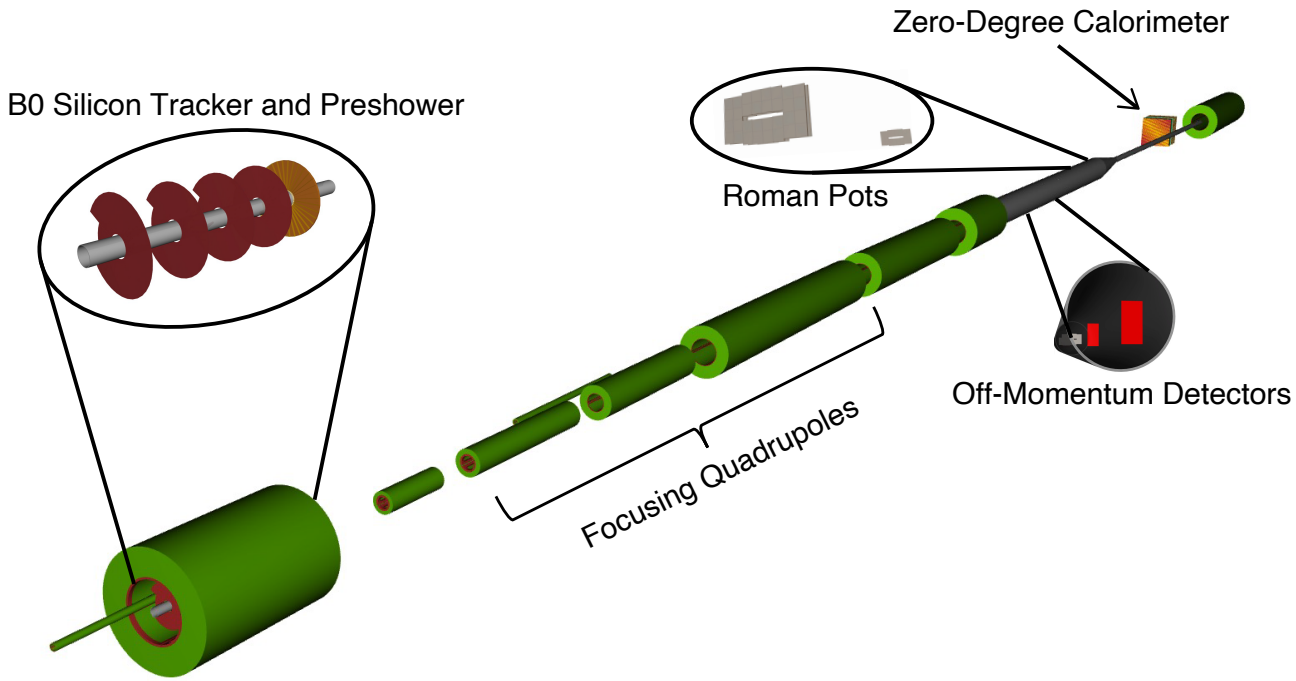


- High precision luminosity measurement at 1% level for absolute luminosity and 0.01% for relative luminosity measurement using several methods based on the Bremsstrahlung process:
  1. Counting photons converted in thin exit window using dipole field and measuring e^+e^- pairs
  2. Energy measurement of unconverted photons
  3. Counting of unconverted photons
2. Two low Q2 taggers

ePIC detector

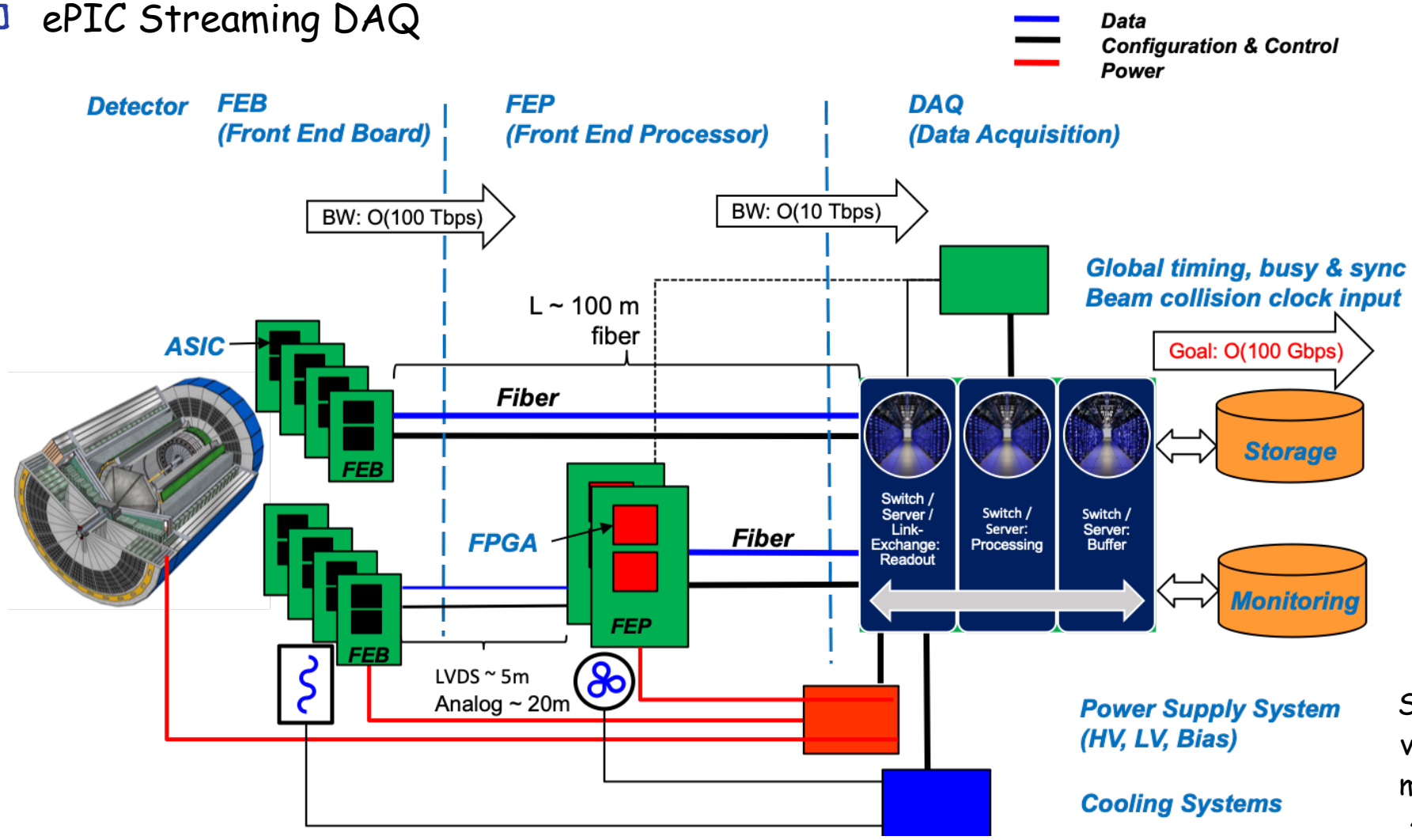
- FarForward system
  - FarForward detector system to measure very forward neutral and charged particle production: 4 detector systems:

Detector	θ accep. [mrad]	Rigidity accep.	Particles	Technology
B0 tracker	5.5–20.0	N/A	Charged particles Tagged photons	MAPS AC-LGAD
Off-Momentum Detector	0.0–5.0	45%–65%	Charged particles	AC-LGAD
Roman Pots	0.0–5.0	60%–95%*	Protons Light nuclei	AC-LGAD
Zero-Degree Calorimeter	0.0–4.0	N/A	Neutrons Photons	W/SciFi (ECal) Pb/Sci (HCal)



ePIC experiment: Streaming Readout

- ePIC Streaming DAQ



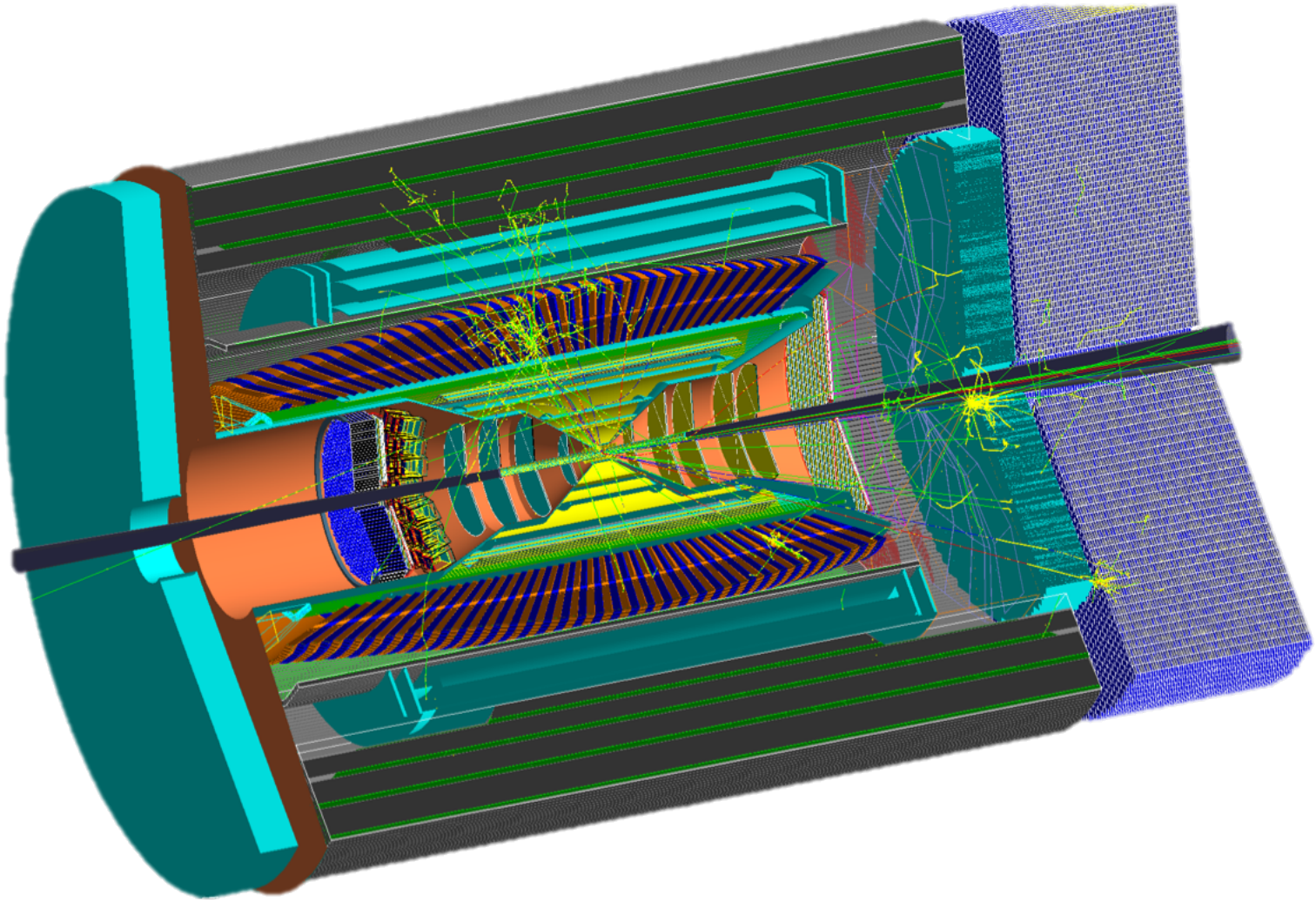
Stored data volumes and manageable, ~O(100Pb) per run

No trigger: Much more flexibility to do physics not planned from the start!

ePIC experiment: FULL GEANT simulation

- Simulations

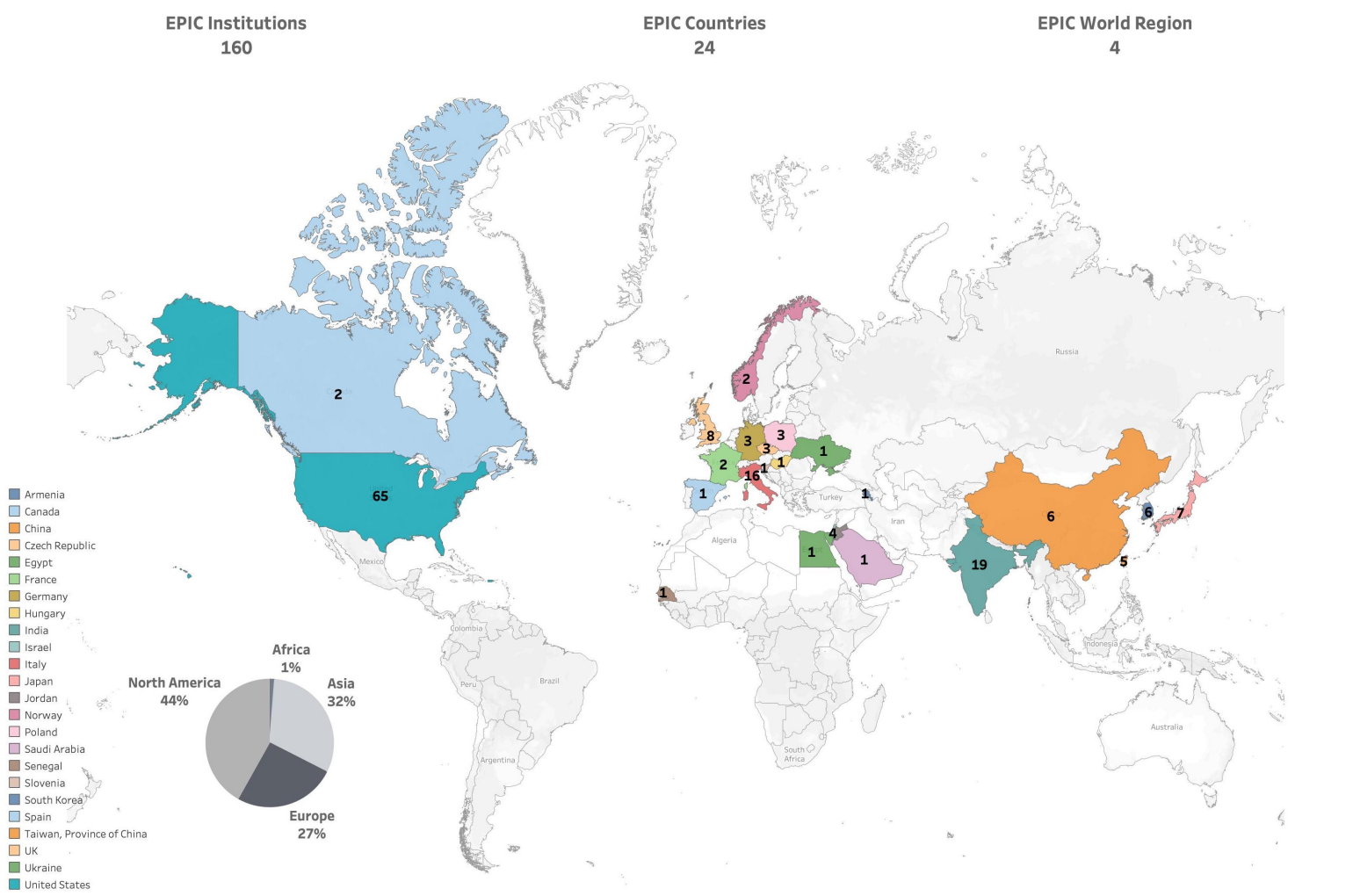
Geant4 Implementation for performance and physics studies



ePIC detector

World Map - Institutions

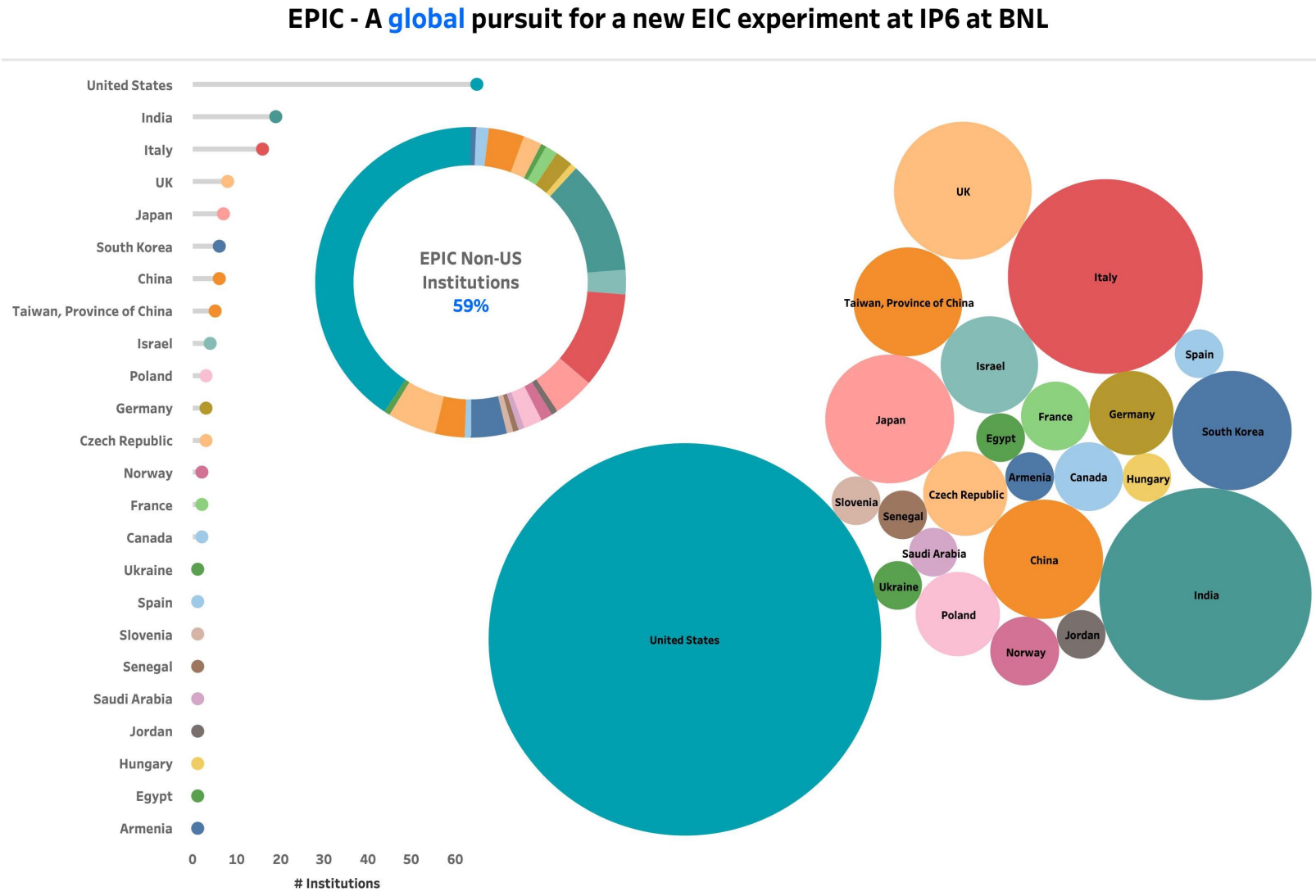
EPIC - A global pursuit for a new EIC experiment at IP6 at BNL



Interactive Tableau link

ePIC detector

- Number of Institutions

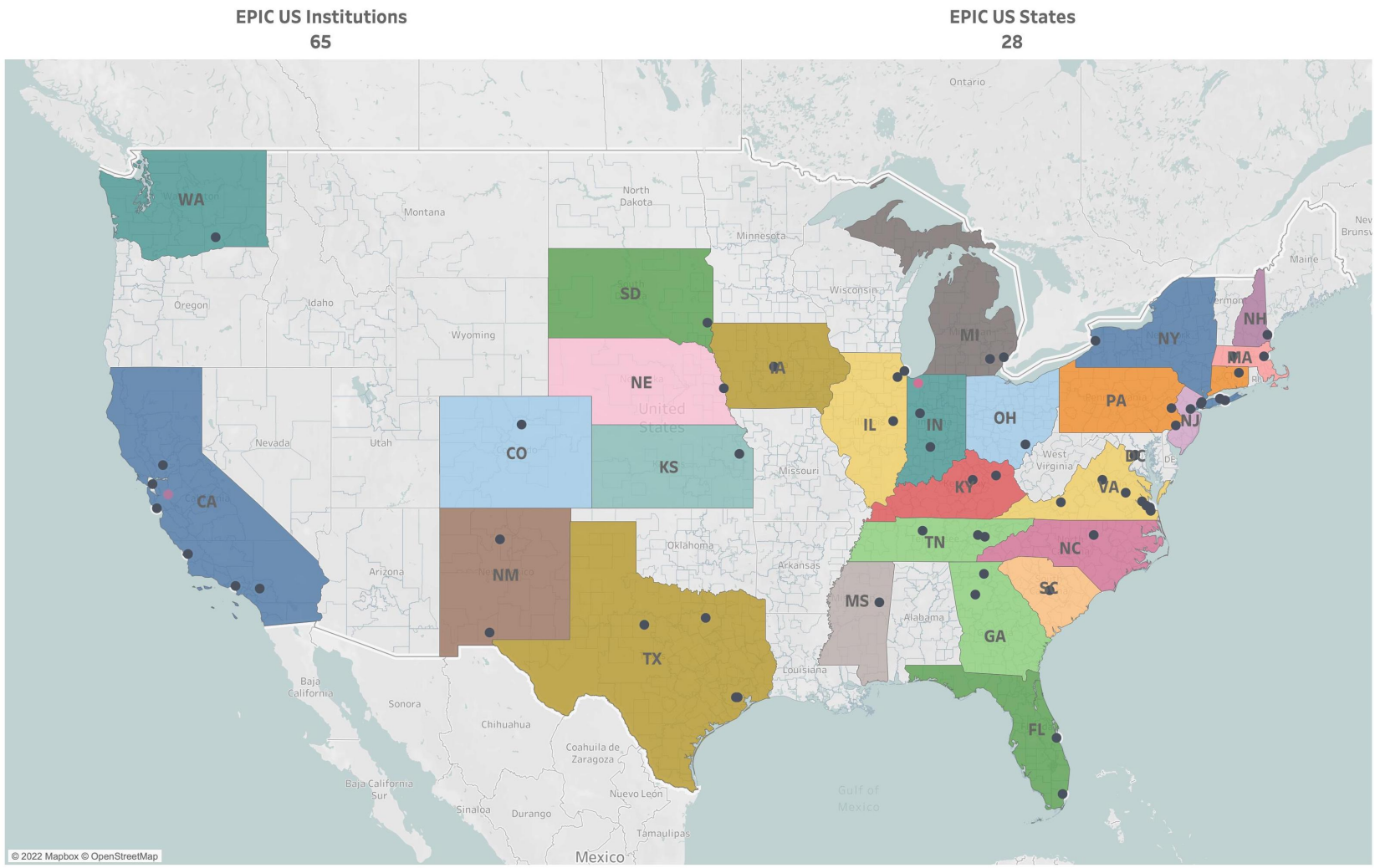


Interactive Tableau link

ePIC detector

- US map - Institutions

EPIC - A global pursuit for a new EIC experiment at IP6 at BNL

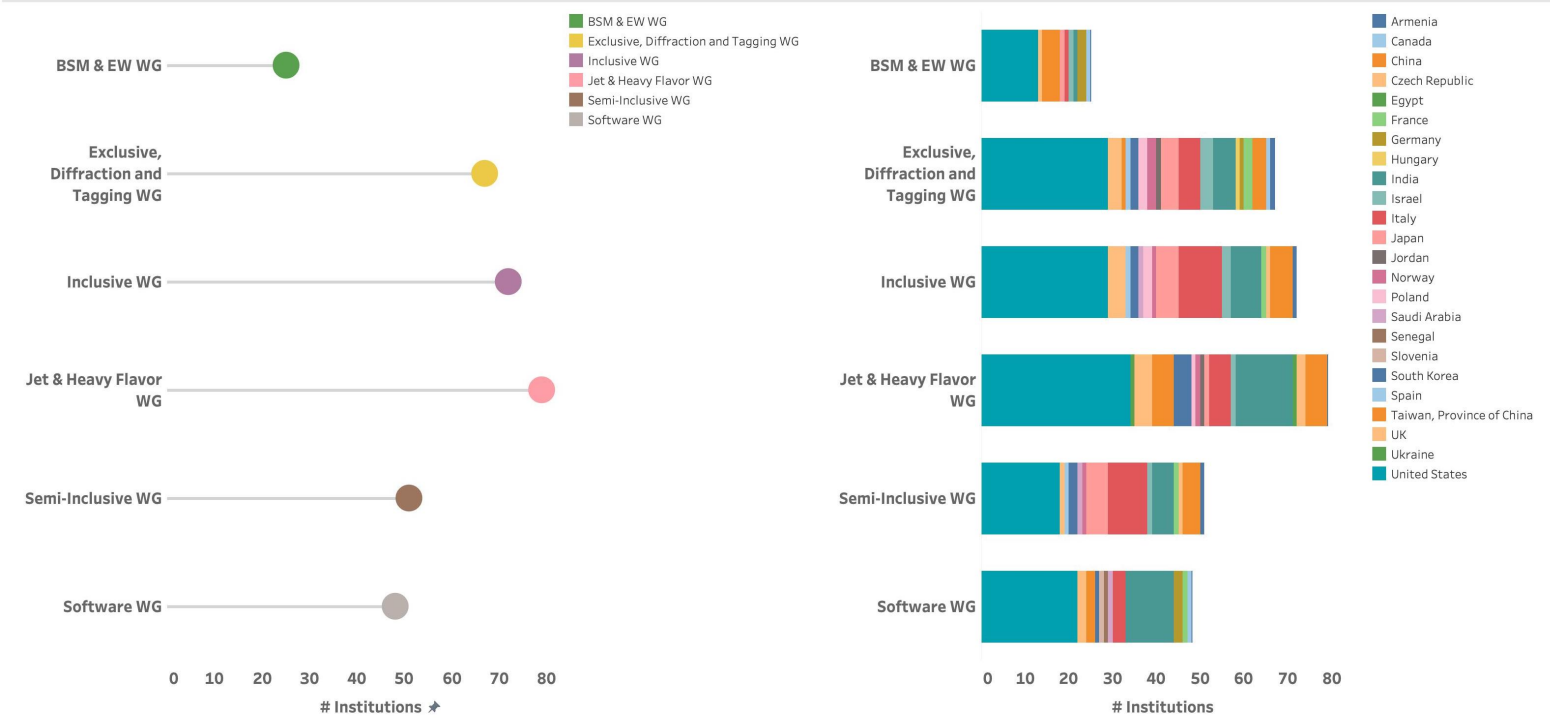


Interactive Tableau link

ePIC detector

Physics Interests - Institutions

EPIC - A global pursuit for a new EIC experiment at IP6 at BNL / Physics Interests



Select category (Detector WG / Country / Institution) from pull-down menu. Institutions fullfilling the chosen category are highlighted in the last column!

WG / Sub-system: Inclusive WG

Country: All

Institutions: All

Inclusive WG

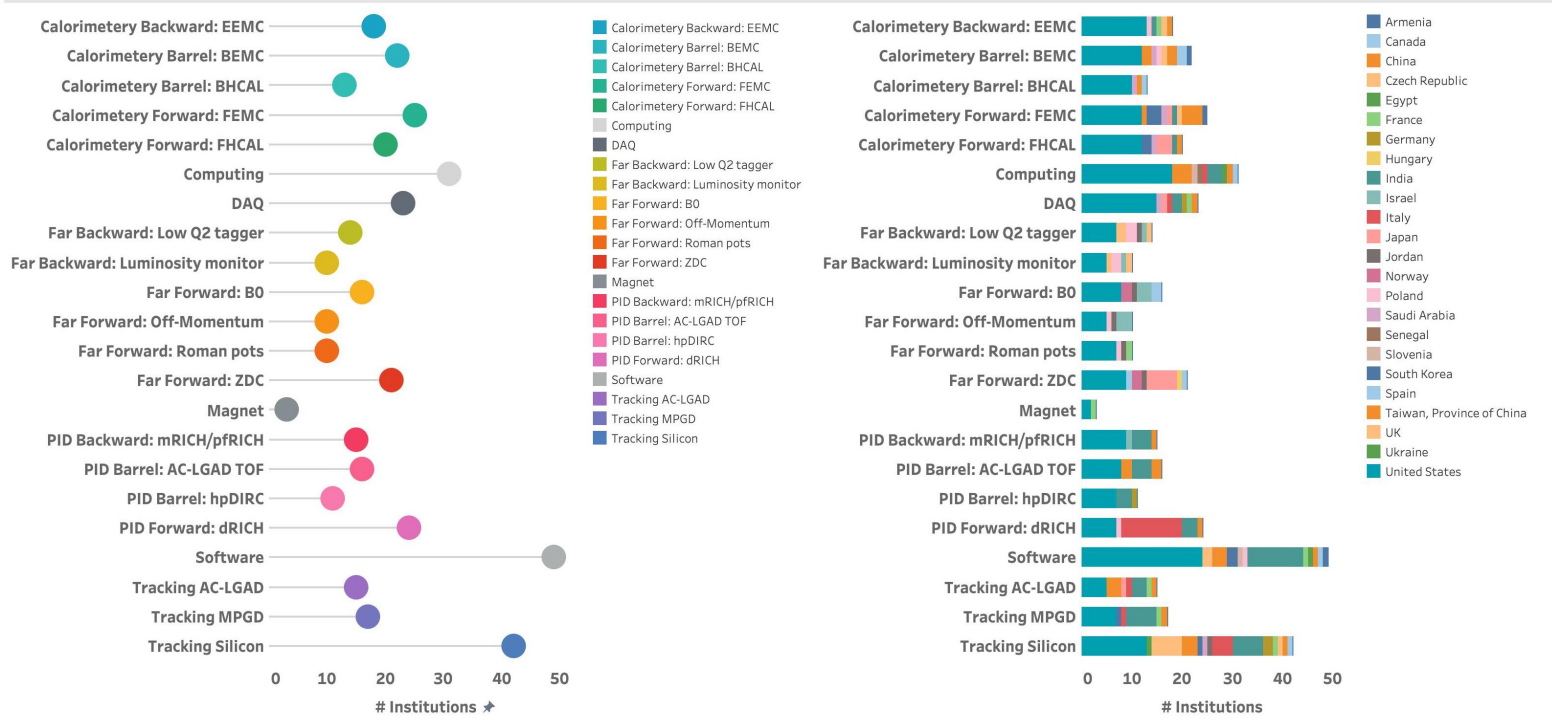
Institutions	City	Country	Contact Name	Email
A. I. Alikhantan National Science Laboratory	Yerevan	Armenia	Mkrtchyan, Hamlet	mkrtchyan@yerphi.am
Abilene Christian University	Abilene	United States	Daugherity, Michael	mike.daugherity@acu.edu
AGH University of Science and Technology	Krakow	Poland	Przybycien, Mariusz	mariusz.przybycien@agh.edu.pl
Aligarh Muslim University	Aligarh	India	Abir, Raktim	raktim.ph@amu.ac.in
Argonne National Laboratory	Lemont	United States	Meziani, Zein-Eddine	zmeziani@anl.gov
Augustana University	Sioux Falls	United States	Grau, Nathan	ngrau@augie.edu
Banaras Hindu University	Ajagara	India	Singh, B. K.	bksingh@bhu.ac.in
Baruch College, City University of New York	New York	United States	Bathe, Stefan	stefan.bathe@baruch.cuny.edu
Ben Gurion University of the Negev	Beer Sheva	Israel	Citron, Zvi	zhcitron@bgu.ac.il
Brookhaven National Laboratory	Upton	United States	Steinberg, Peter	peter.steinberg@bnl.gov

Interactive Tableau link

ePIC detector

Sub-system Interests - Institutions

EPIC - A global pursuit for a new EIC experiment at IP6 at BNL / Sub-System Interests



Select category (Physics WG / Country/Institution) from pull-down menu. Institutions fullfilling the chosen category are highlighted in the last column!

WG / Sub-system: Inclusive WG

Country: All

Institutions: All

Inclusive WG

Institutions	City	Country	Contact Name	Email
A. I. Alikhantan National Science Laboratory	Yerevan	Armenia	Mkrtchyan, Hamlet	mkrtchyan@yerphi.am
Abilene Christian University	Abilene	United States	Daugherity, Michael	mike.daugherity@acu.edu
AGH University of Science and Technology	Krakow	Poland	Przybycien, Mariusz	mariusz.przybycien@agh.edu.pl
Aligarh Muslim University	Aligarh	India	Abir, Raktim	raktim.ph@amu.ac.in
Argonne National Laboratory	Lemont	United States	Meziani, Zein-Eddine	zmeziani@anl.gov
Augustana University	Sioux Falls	United States	Grau, Nathan	ngrau@augie.edu
Banaras Hindu University	Ajagara	India	Singh, B. K.	bksingh@bhu.ac.in
Baruch College, City University of New York	New York	United States	Bathe, Stefan	stefan.bathe@baruch.cuny.edu
Ben Gurion University of the Negev	Beer Sheva	Israel	Citron, Zvi	zhcitron@bgu.ac.il
Brookhaven National Laboratory	Upton	United States	Steinberg, Peter	peter.steinberg@bnl.gov

Interactive Tableau link

ePIC experiment: Collaboration Formation

- Timeline
  - April: Formation of joint working groups and start of technological consolidation process
  - June: Collaboration roster established via institutional survey
  - July:
    - Name selection via members vote,
    - Collaboration council establishment and interim chairs appointment,
    - Collaboration formation meeting @ Stony Brook University (July 26th-28th).
  - August: Formation of charter committee
  - October:
    - 6th: Draft bylaws sent to collaboration,
    - 14th: Collaboration council meeting to discuss draft bylaws,
  - Late October – Early November:
    - Comments and feedback collection of draft bylaws,
    - Final bylaws circulated to collaboration members,
    - Vote and adoption of collaboration bylaws.
  - November/December: Nomination process & Collaboration leadership election as defined by bylaws.

ePIC experiment: Collaboration Formation

Joining Collaboration

ePIC is forming into a full collaboration, with bylaws, etc. A collaboration council (institutional board equivalent) has been formed and governance documents are being drafted.

Once formal bylaws are adopted there will be a formal requirement for approval of new institutions by the collaboration council. Until that time, joining ePIC is simply done by formally expressing interest in being involved in ePIC:

(0) Email the ePIC Steering committee (Silvia Dalla Torre, Or Hen, Tanja Horn, John Lajoie, and Bernd Surrow)

(1) Fill out the institutional survey at:

https://forms.gle/FMMgEcaux9MY9noC8

Don't need to fill all FTE information right now. What is important is the institutional interest and contact details. This will get your institution into the institutional roster, and we will add your contact information so they can get the emails from the current Collaboration Council co-chairs: Vicki Greene and Franck Sabatie.

(2) Fill individual institute members contact information:

https://forms.gle/cdec9ffq6hrDV1ET6

(3) Go to lists.bnl.gov and sign up to eic-projdet-collab-l, and all other relevant working group mailing lists.

You will want to distribute this internally at your institution so other interested people can sign up as well.

Long-Range plan process

- Community Long-range plans

NuPECC LRP2024 Comm

May 30, 2022 to October 30, 2022

Europe/Berlin timezone

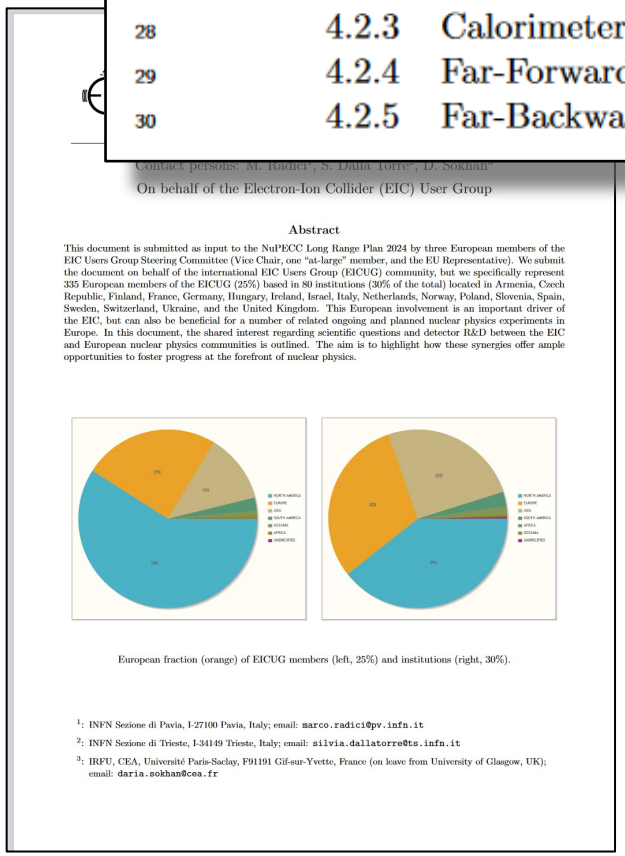
Overview

Call for Abstracts

Registration

Contact

nupecc_lrp2024@ph.tu...



Contact persons: M. Radici[1], S. Dalla Torre[2], D. Sokhan[3]

On behalf of the Electron-Ion Collider (EIC) User Group

Abstract

This document is submitted as input to the NuPECC Long Range Plan 2024 by three European members of the EIC Users Group Steering Committee (Vice Chair, one "at-large" member, and the EU Representative). We submit the document on behalf of the international EIC Users Group (EICUG) community, but we specifically represent 335 European members of the EICUG (25%) based in 80 institutions (30% of the total) located in Armenia, Czech Republic, Finland, France, Germany, Hungary, Ireland, Israel, Italy, Netherlands, Norway, Poland, Slovenia, Spain, Sweden, Switzerland, Ukraine, and the United Kingdom. This European involvement is an important driver of the EIC, but can also be beneficial for a number of related ongoing and planned nuclear physics experiments in Europe. In this document, the shared interest regarding scientific questions and detector R&D between the EIC and European nuclear physics communities is outlined. The aim is to highlight how these synergies offer ample opportunities to foster progress at the forefront of nuclear physics.

European fraction (orange) of EICUG members (left, 25%) and institutions (right, 30%).

[1]: INFN Sezione di Pavia, I-27100 Pavia, Italy; email: marco.radici@pv.infn.it

[2]: INFN Sezione di Trieste, I-34149 Trieste, Italy; email: silvia.dallatorre@ts.infn.it

[3]: IRFU, CEA, Université Paris-Saclay, F91191 Gif-sur-Yvette, France (on leave from University of Glasgow, UK); email: daria.sokhan@cea.fr

1: Francesco Bossu, Laura Gonella, Kondo Gnanvo

2: Xiaochun He, Greg Kalicy, Franck Geurts, Zhenyu Ye

3: Friederike Bock

4: Alex Jentsch, Michael Murray

5: Krzysztof Piotrzkowski, Nick Zachariou

- Closed kickoff meeting Oct. 26 in New Orleans
  - Agencies will talk to committee
  - Presentation about budgets
  - Subcommittees
  - Writing assignments & proposed outline of LRP
  - Agenda and timing of resolution meeting
- Writing underway
- Whitepapers due end of February 2023
- Late spring/summer: 5 - 7 day resolution meeting
  - 1st part will include presentations by people who are n committee
  - 2nd part will be closed and in-person
- Editing LRP document
- October 2023 – draft report ready

NSAC

Summary and Next Steps

- Merging of ATHENA and ECCE proposal efforts forming a new ePIC collaboration!
- Formal adoption of ePIC charter, followed by nomination and election process of ePIC leadership starting shortly thereafter!
- The ePIC detector is maturing into a detailed technical design: EIC detectors are an enormous undertaking that will require participation and expertise from both the RHIC and JLab communities, as well as key international contributions!
- ePIC collaboration meeting at JLab, January 9-11, 2023:

  https://www.jlab.org/conference/EPIC
- A very exciting time is ahead of us to explore the structure and dynamics of matter at a new ep/eA collider facility, following years of preparation!
- Join us!