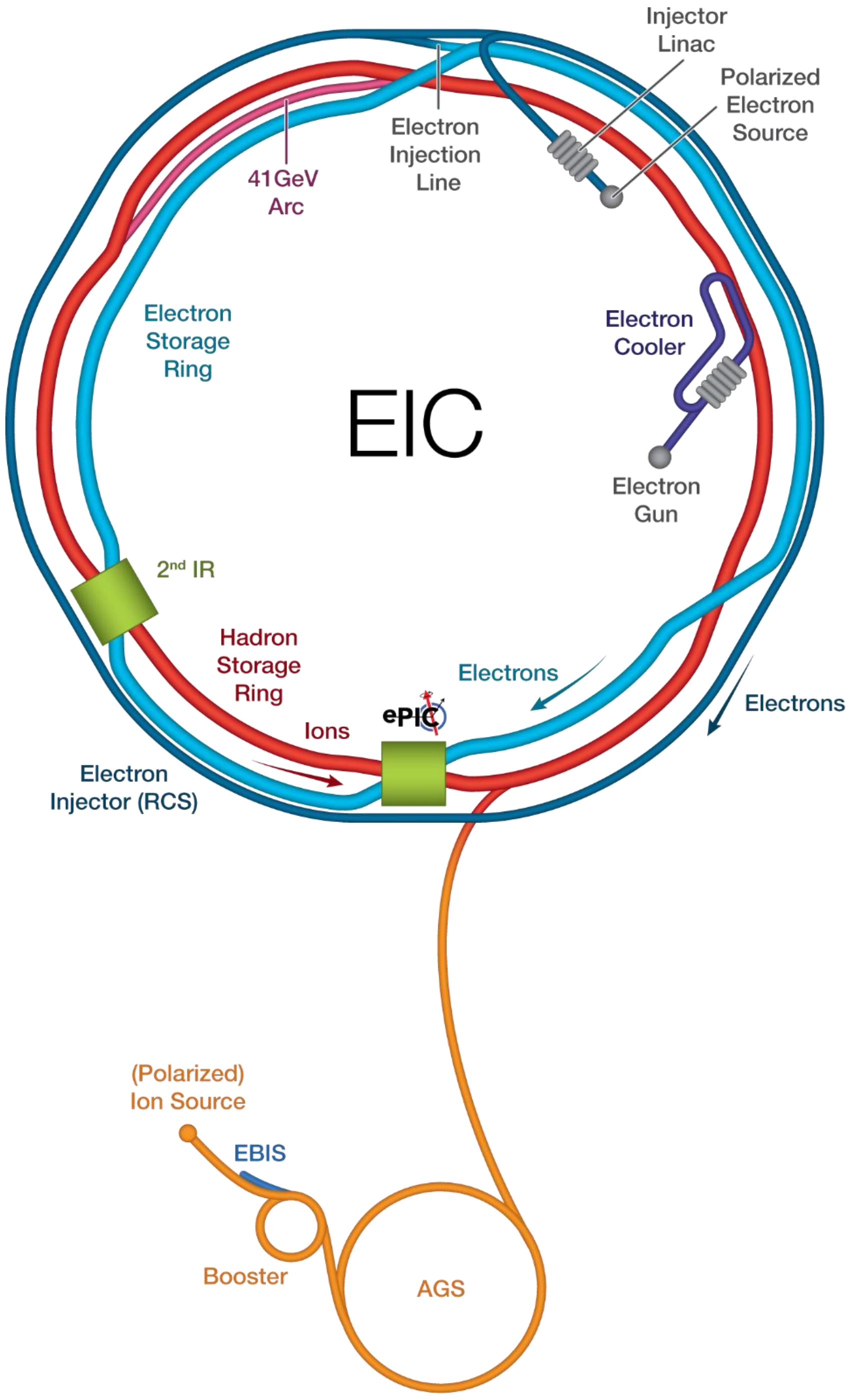


The EIC project and the ePIC detector

Carlos Muñoz Camacho

IJCLab

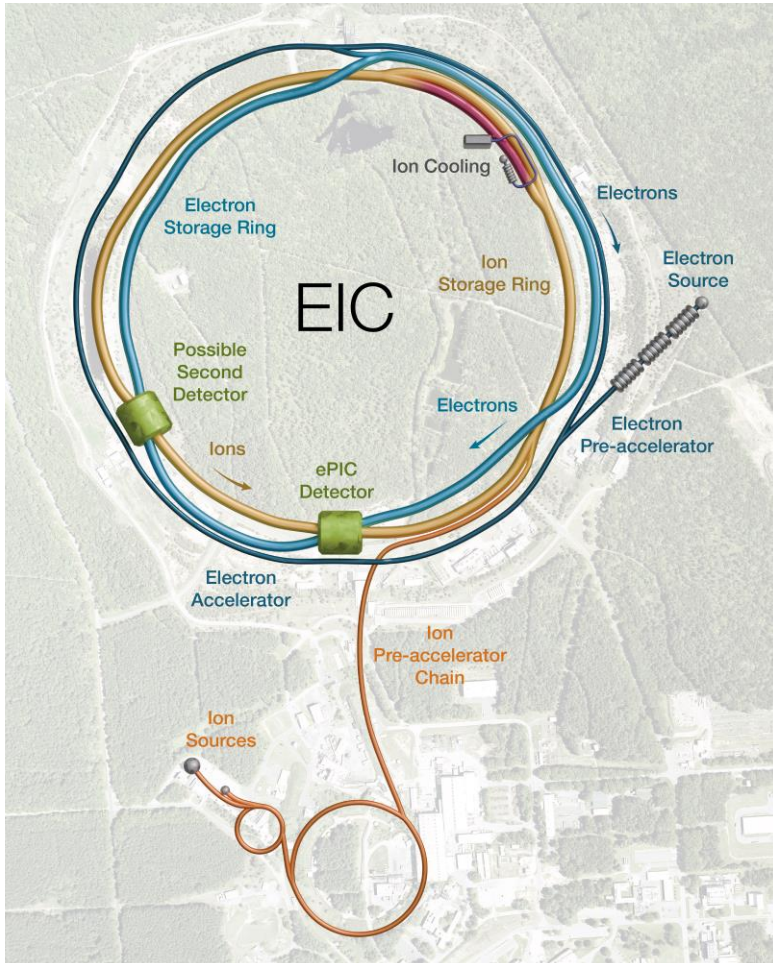
Conseil Scientifique IN2P3

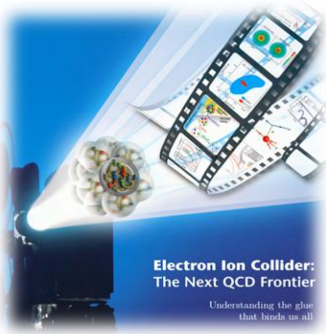
21 octobre, 2024

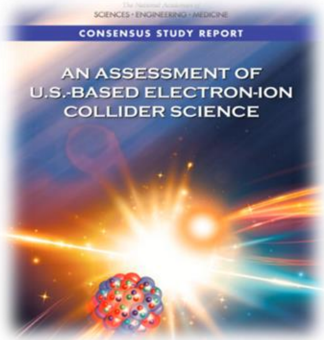
Outline

- The Electron-Ion Collider (EIC) facility
- The ePIC Collaboration and the EIC project detector (ePIC)
- EIC project and schedule
- IN2P3 physics and detector interests
- National perspective and summary

The EIC facility







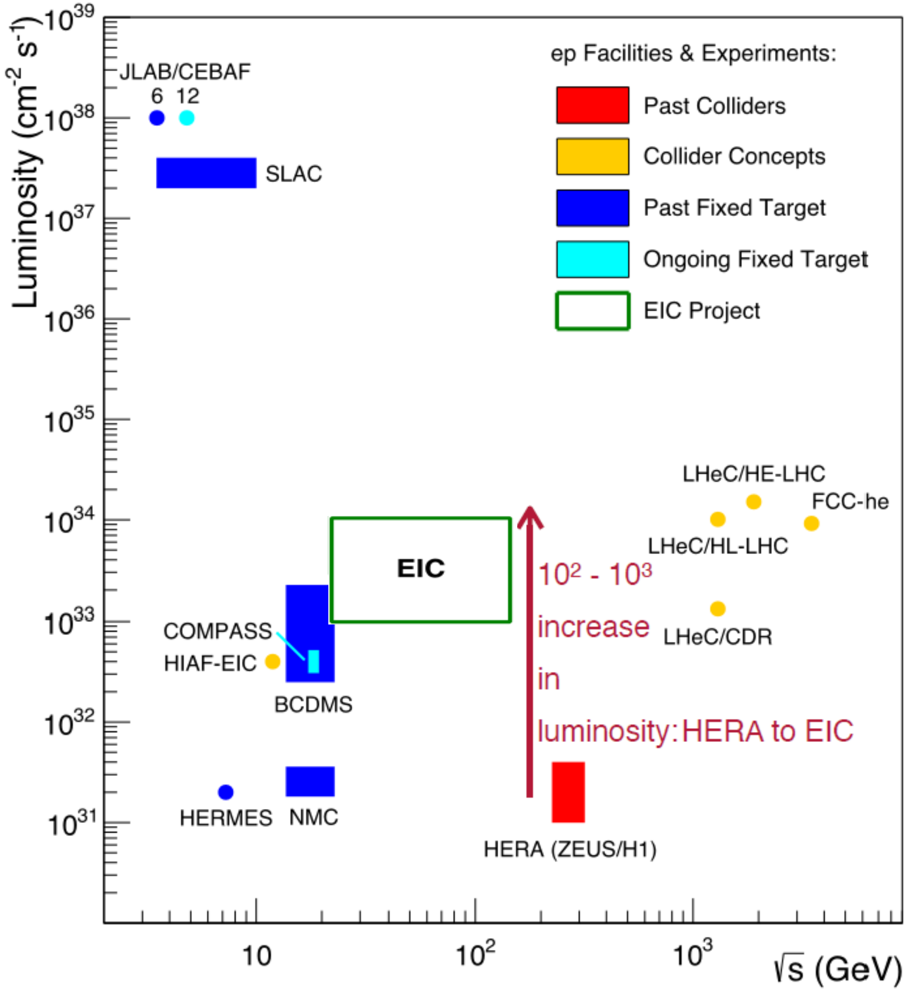
Project Design Goals

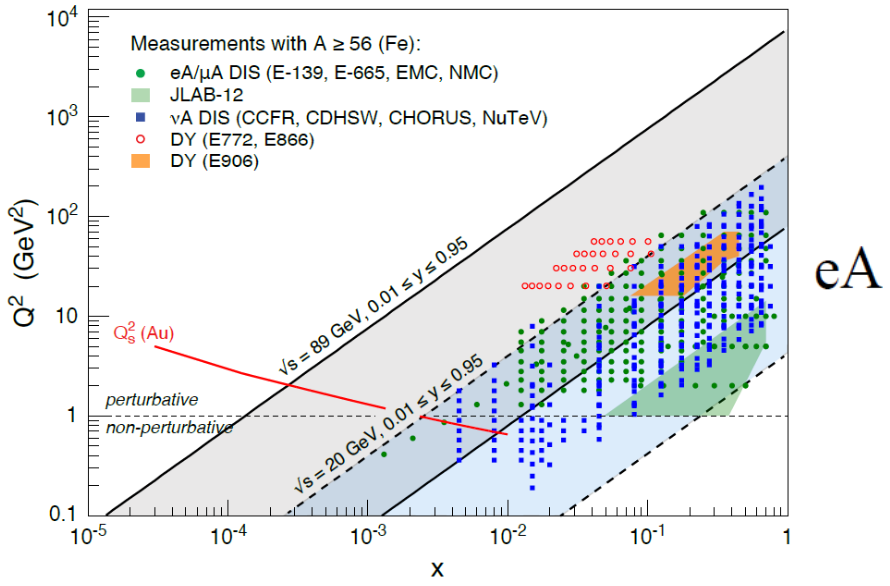
- High Luminosity: L= 10^{33} – 10^{34}cm^{-2}sec^{-1}, 10 – 100 fb^{-1}/year
- Highly Polarized Beams: 70%
- Large Center of Mass Energy Range: E_{cm} = 29 – 140 GeV
- Large Ion Species Range: protons – Uranium
- Large Detector Acceptance and Good Background Conditions
- Accommodate a Second Interaction Region (IR)

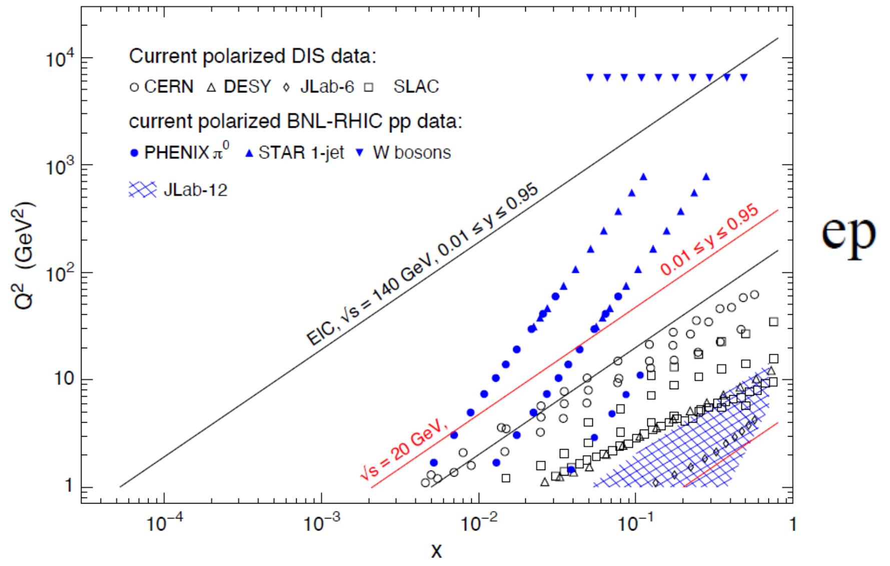
p/A beam → ← e beam

p: 41 GeV, 100 to 275 GeV | **e: 5 GeV to 18 GeV**

Luminosity and kinematic coverage





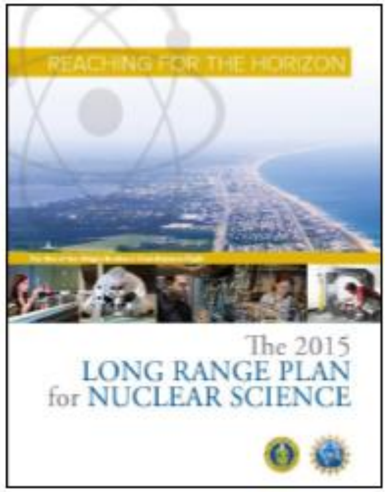


EIC development: some critical steps

- INT workshop series (2010) and white paper (2012, updated in 2014 for LRP)

- 2015: US Long-range plan (LRP)

<u>*Recommendation 3:*</u> construct a high-luminosity polarized electron-ion collider (EIC) as the **highest priority for new construction** following the completion of FRIB

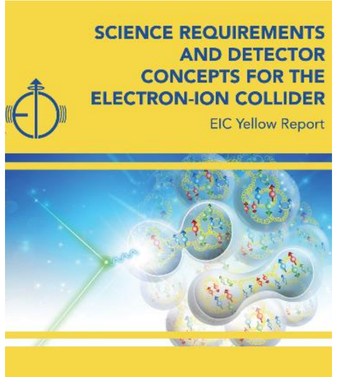


- 2018: Review of the EIC science case by the National Academy of Sciences

  "The committee finds that the science that can be addressed by an EIC is **compelling, fundamental and timely**."

- 2020: DoE announcement of CD-0 ("mission need") and site selection (Brookhaven National Lab)

- 2020: Yellow report initiative



Goal: advance the state and detail of the documented physics studies (White Paper, INT program proceedings) and detector concepts in preparation for the realization of the EIC.

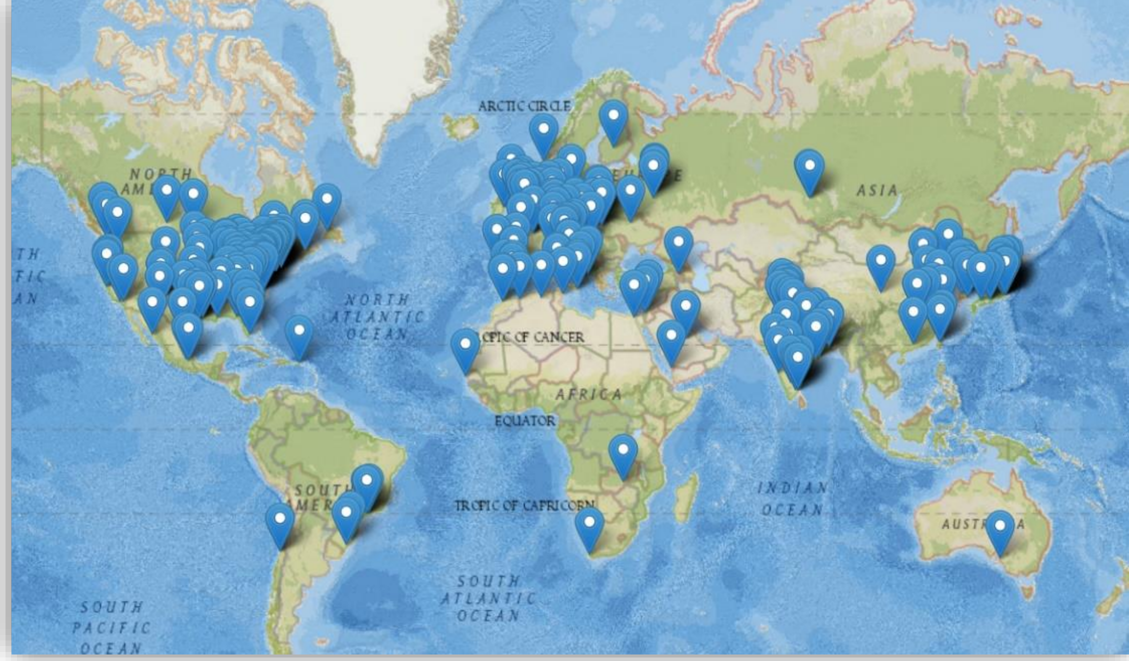
Strong involvement of the French community (both theorists and experimentalists)

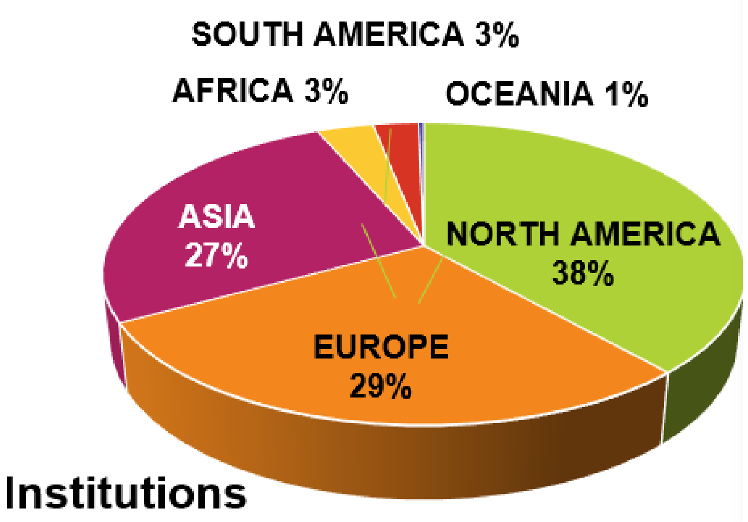
2103.05419 (3/2021), Nucl. Phys. A 1026 (2022) 122447

The EIC Users Group

Formed in 2016, currently:

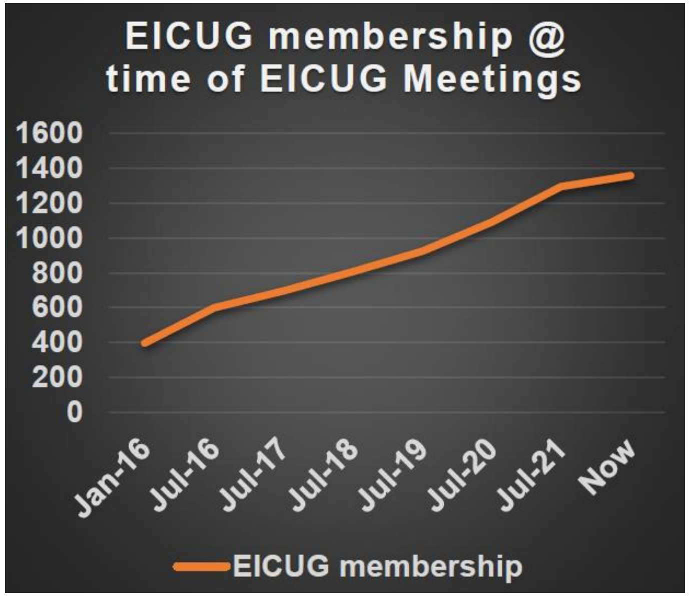
- 1546 members – and growing
- 40 countries,
- 298 institutions





Annual EICUG meeting:

- 2016 UC Berkeley, CA
- 2016 Argonne, IL
- 2017 Trieste, Italy
- 2018 CUA, Washington, DC
- 2019 Paris, France
- 2020 Miami, FL
- 2021 VUU, VA & UCR, CA
- 2022 Stony Brook U, NY
- 2023 Warsaw, Poland
- 2024 Lehigh U, PA



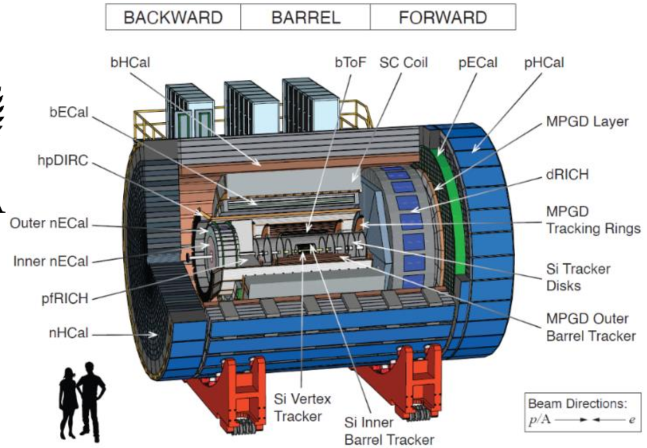
International participation growing

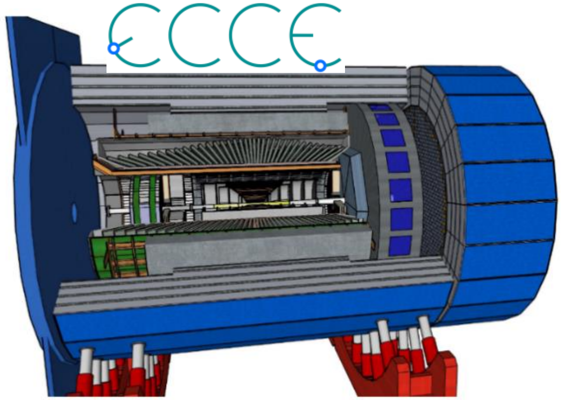
Recent activity (2021-2022)

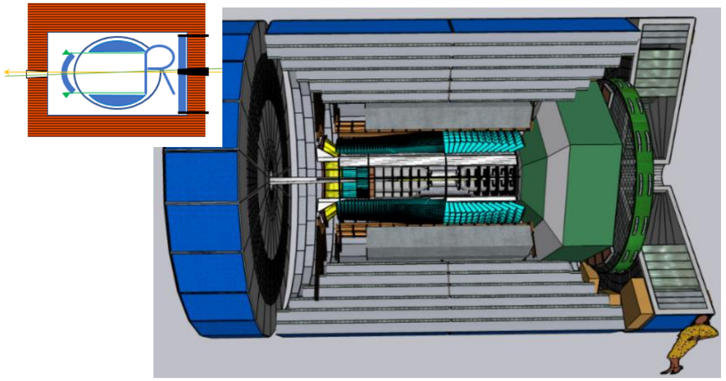
- EIC Conceptual Design Report (CDR)
- Call for detector proposals (2021)

Three proposals submitted:

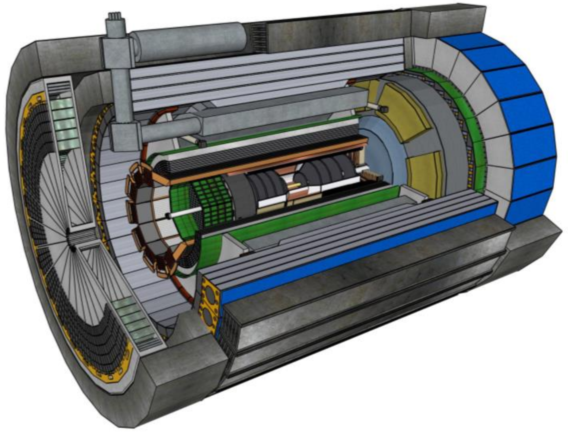
ATHENA







- ➢ ePIC Collaboration formed in 2022
- ➢ Community merged (primarily from ATHENA and ECCE)
- ➢ Detector concept based in ECCE with additions/replacements from ATHENA



- ➢ 2023: **NSAC Long-range plan**
  Recommendation 3:
  expeditious completion of the EIC
- ➢ 2024: **NuPECC Long-range plan**
  EIC/ePIC recommended in 'Infrastructures' and 'Hadron Physics' chapters

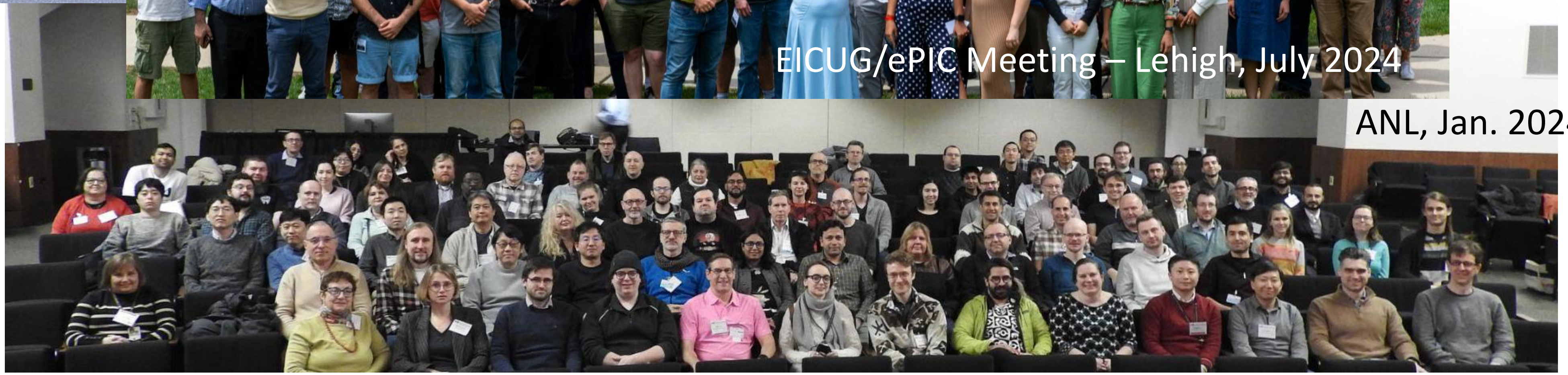
The ePIC Collaboration

Warsaw, July 2023

JLab, Jan. 2023

EICUG/ePIC Meeting – Lehigh, July 2024

ANL, Jan. 2024



- More than 850 collaborators
- 177 Institutions
- 26 Countries

The EIC project detector: ePIC

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

PID:
- Backward pfRICH
- Barrel hpDIRC
- Forward dRICH
- Barrel & Forward TOF (AC-LGAD)

Calorimetry:
- Backward HCal (Steel+scint)
- $PbWO_4$ EMCal in backward direction
- Sampling & Imaging Barrel EMCal
- Outer HCal (sPHENIX re-use)
- Finely segmented EMCal +HCal in forward direction

hadronic calorimeters

Solenoidal Magnet

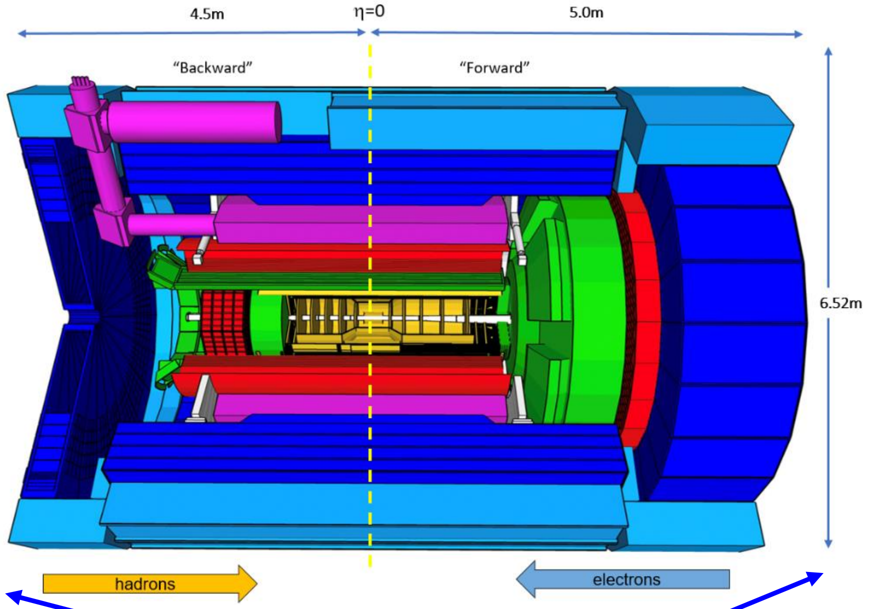
e/m calorimeters

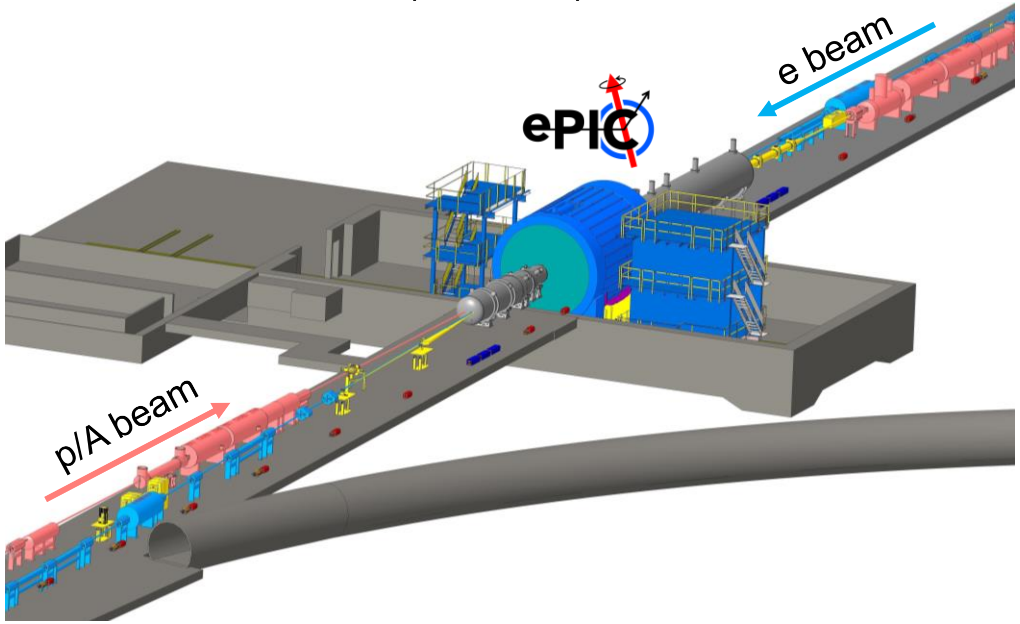
ToF, DIRC, RICH detectors

MPG trackers

MAPS tracker

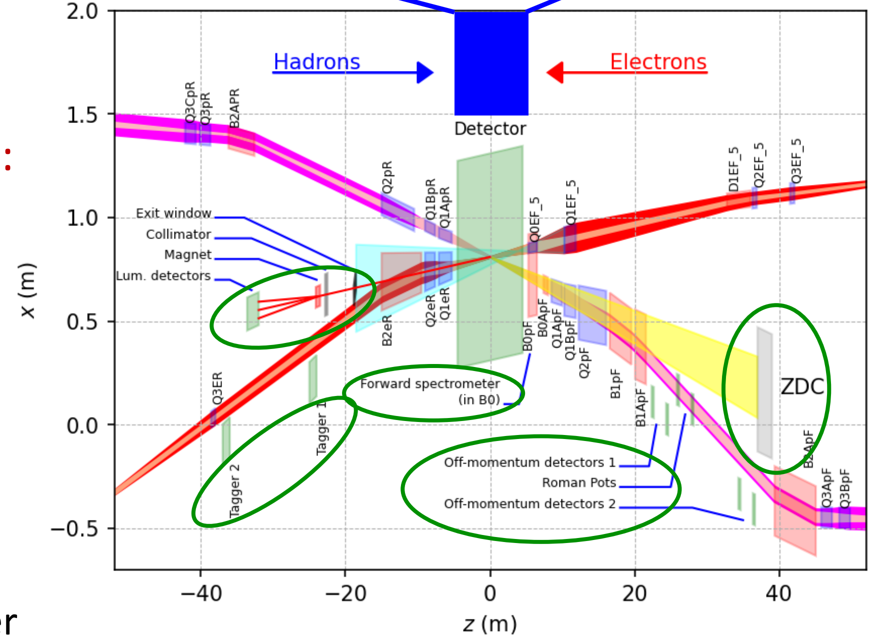
25 subdetectors incl. polarimeters





Far-Backward Detectors:
- Luminosity monitor.
- Low-Q^2 Tagger

Far-Forward Detectors:
- B0 Tracking and Photon Detection
- Roman Pots and Off-Momentum Detectors.
- Zero-Degree Calorimeter



ePIC ASICs

Goal: minimize number of ASICs & exploit commonalities among the different detectors

- EICROC by OMEGA is the only ASIC considered for pixelated AC-LGADs detectors in ePIC
- HGCROC3/CALOROC by OMEGA is the only ASIC considered for SiPM calorimeters in ePIC
- There currently 8 calorimeters in ePIC planning/considering to use CALOROC for their readout
- There are currently 4 pixelated AC-LGAD detectors + 1 HRPPD (pfRICH) are planning to use EICROC for their readout

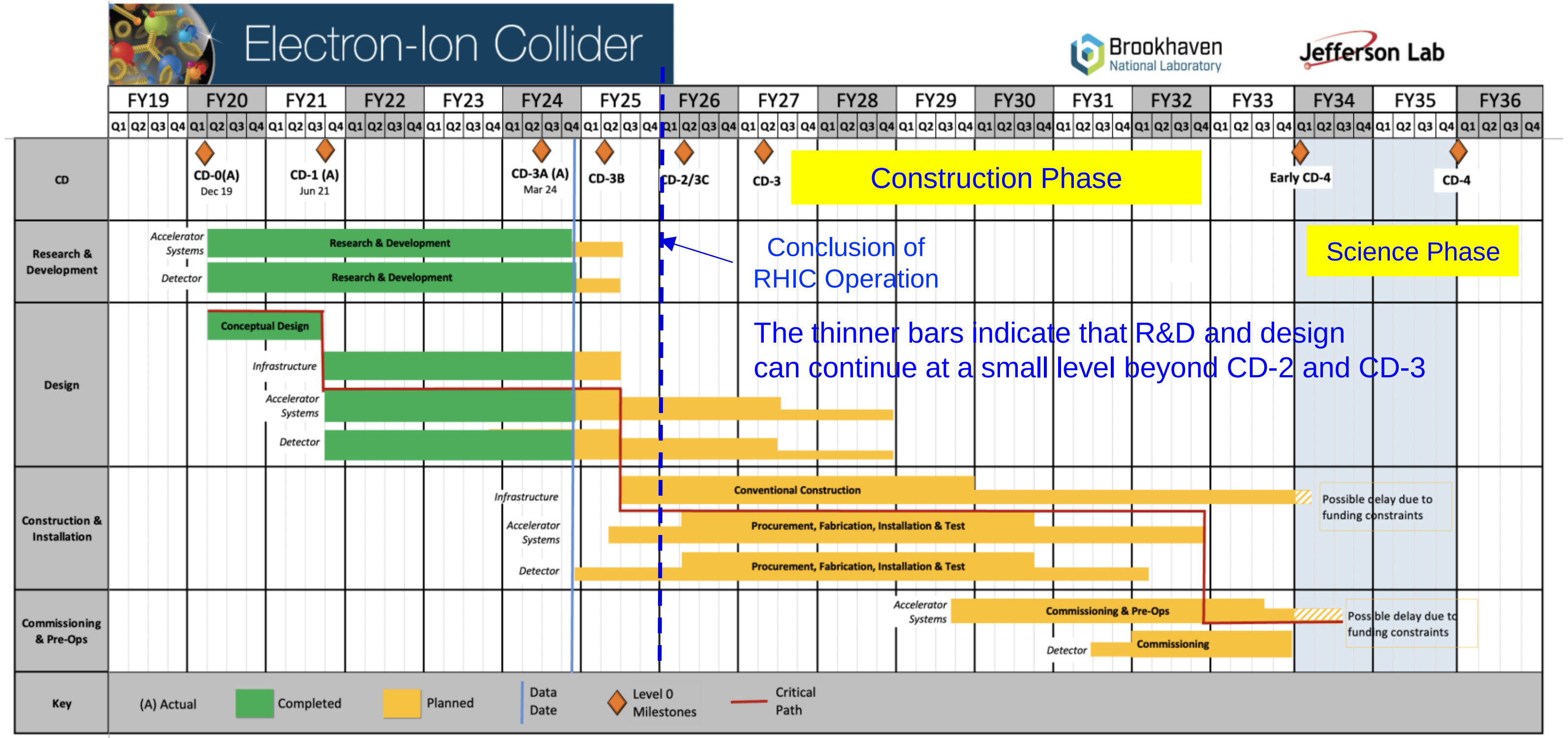
Detector Group	Channels			
	MAPS	AC/DC-LGAD	SiPM/PMT	MPGD
Tracking	32 B			100k
Calorimeters	50M		67k	
Far Forward	300M	2.3M	500	
Far Backward		1.8M	700	
PID		3M-50M	600k	
TOTAL	32 B	7.1M-54M	670k	100k
ASIC	ITS-3	EICROC FCFD HPsOC ASROC FAST	Discrete/COTS HGCROC3 ALCOR-EIC	SALSA

EIC schedule

CD-3A:
Approve start of long-lead procurements
CD-3A items passed final design review
All interfaces related to them are frozen
Authorization received March 28, 2024.

CD-2:
Approve prelim. design for all subdetectors
Design Maturity: >60%
Need “pre-”TDR (or draft TDR)
Baseline project in scope, cost, schedule

CD-3:
Approve final design for all subdetectors
Design Maturity: ~90%
Need full TDR



As presented by the EIC project on Oct 9, 2024

EIC project timeline

- **Dec 2021 (CD-1):** Start of detector design (through CD-3)
- Dec 2025: R&D completed (expected CD-2)
- 2027: Start of construction (expected CD-3),
- 2034: Start of early physics program (expected CD-4A)
- 2036: Project completion (expected CD4) and start of operations

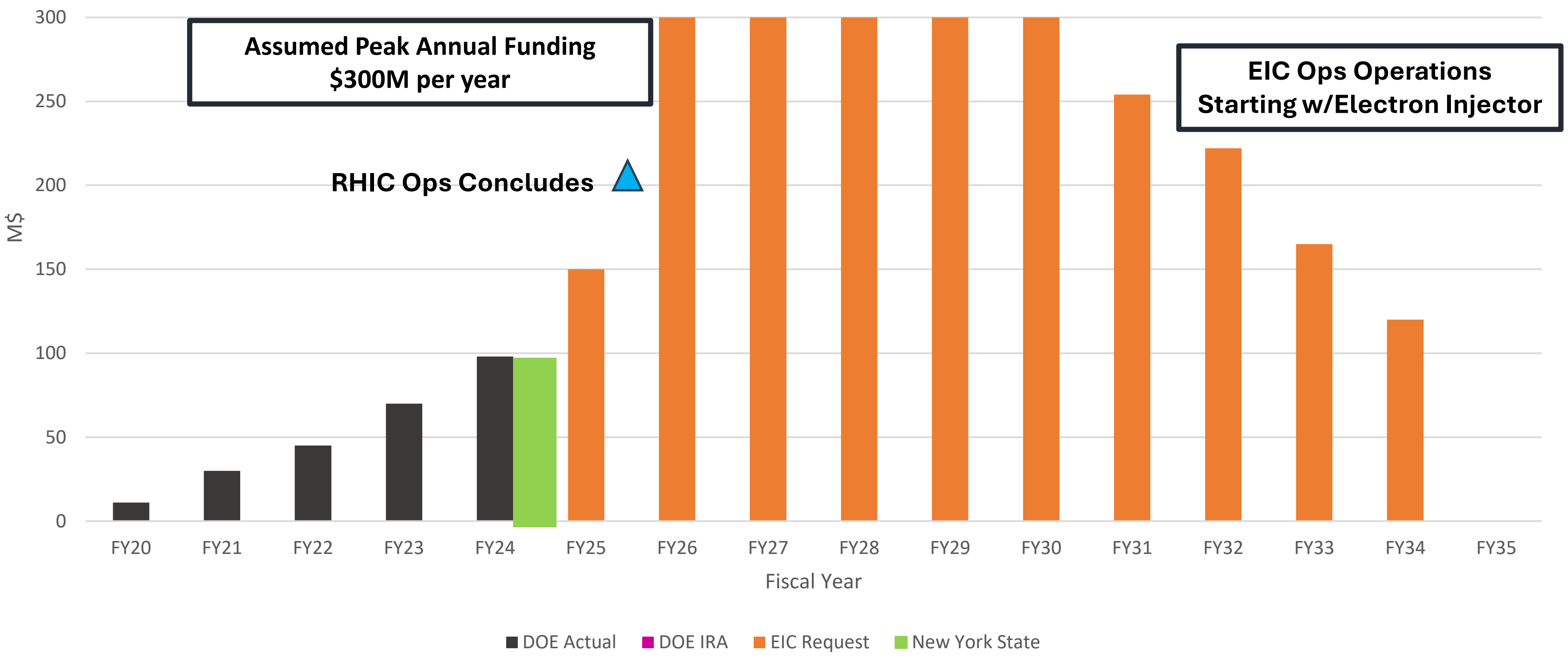
Updated EIC Critical Decision Plan

CD-0/Site Selection	December 2019 ✓
CD-1	June 2021 ✓
CD-3A	March 2024 ✓
CD-3B Review	**January 7-9 2025**
CD-2/3C Review	End of 2025?
CD-3 Review	End of 2026?
early CD-4	December 2034?
CD-4	December 2036?

EIC project cost: budget profile & in-kind contribution

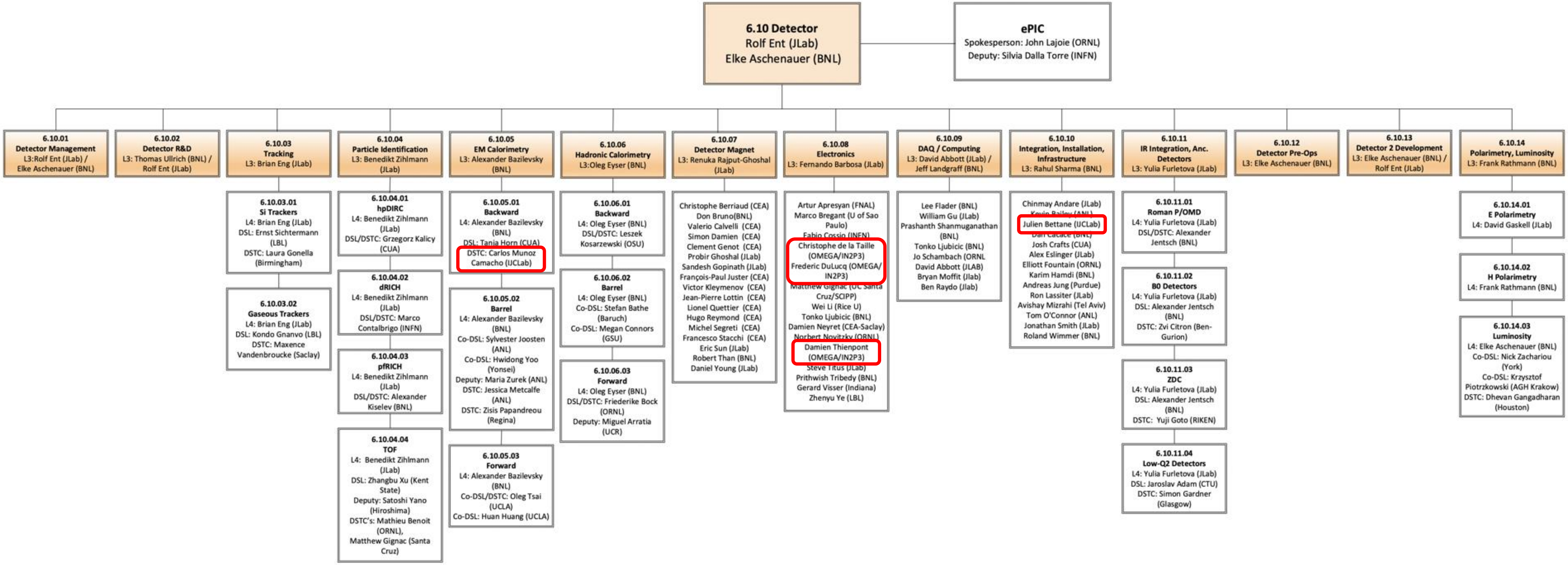
Total cost: $2.8B

- EIC detector: $300M ($200M DoE; $100M in-kind)
- EIC accelerator: $1.3B ($1.25B DoE; $50M in-kind)
- Other: management ($200M), infrastructure ($250M), pre-ops ($50M), contingency…



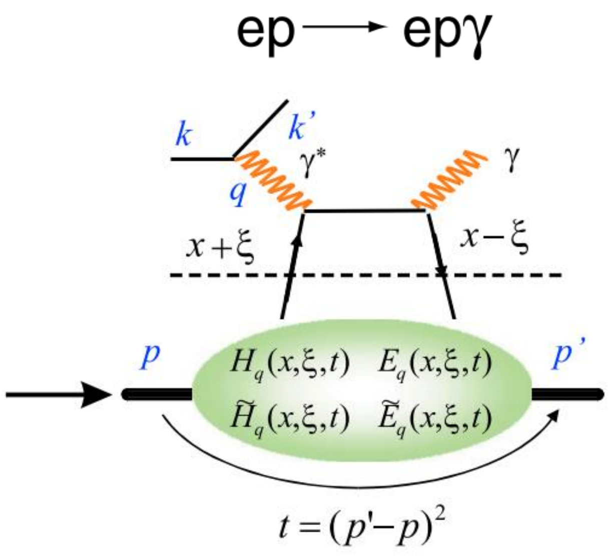
EIC Detector Work Organization

Integration of ePIC Collaboration in EIC Project WBS:



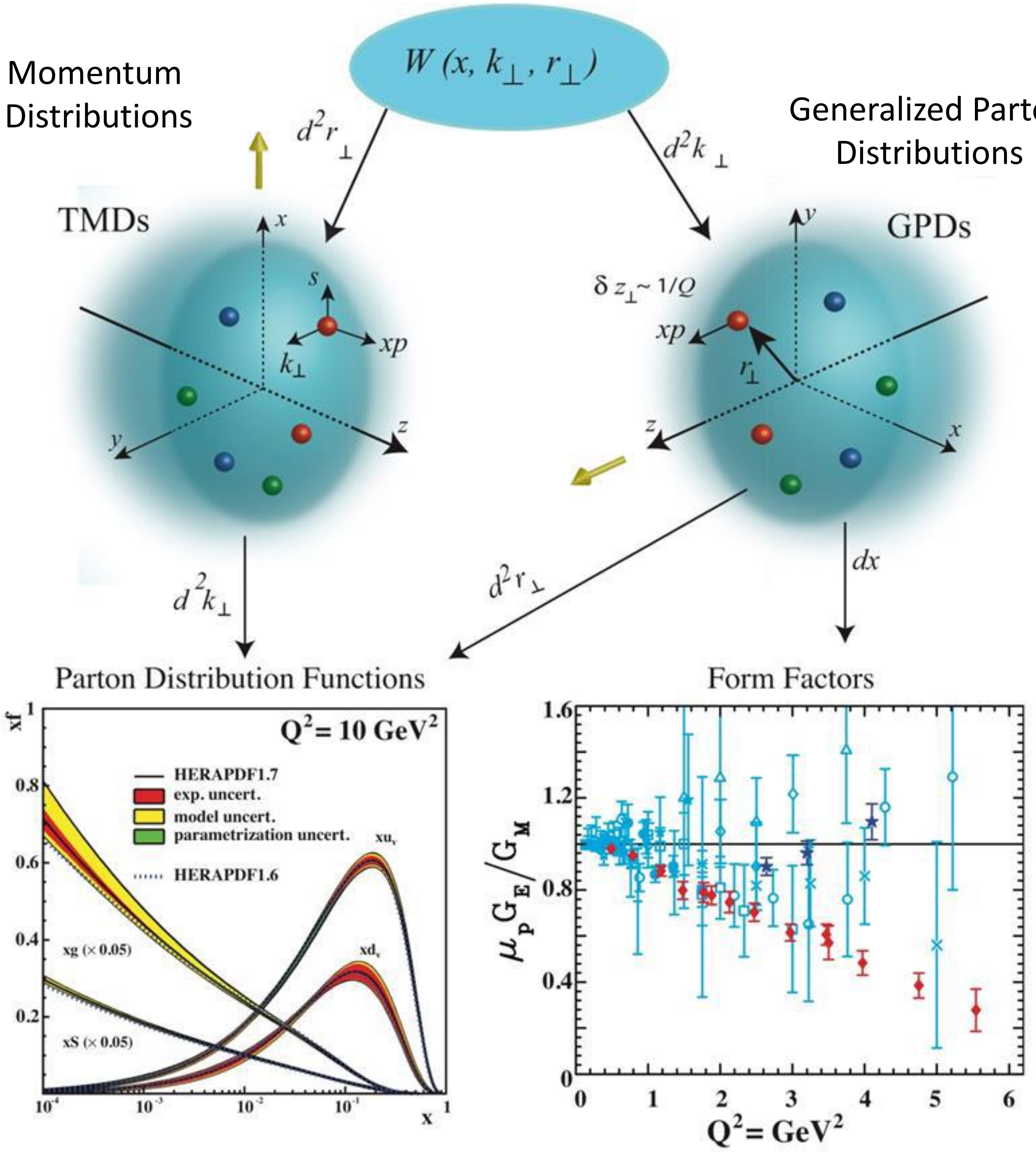
Physics interests of IN2P3 groups: 3D imaging

3D imaging of the nucleon and nuclei
through Generalized Parton Distributions (GPDs)



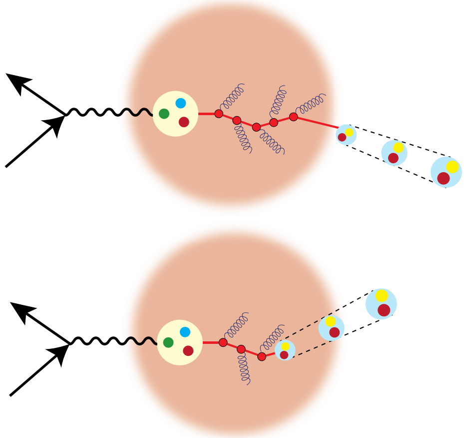
Experimentally accessible with exclusive reactions:

- Deeply Virtual Compton Scattering (DVCS)
- Deeply Virtual Meson Production (DVMP)



Physics interests : hadronization, saturation

Unprecedented ν, the virtual photon energy range @ EIC : *precision & control*



$$\nu = \frac{Q^2}{2mx}$$

Control of n by selecting kinematics;

Also under control the nuclear size.

Colored quark emerges as color neutral hadron

What is the impact of colored media on confinement?

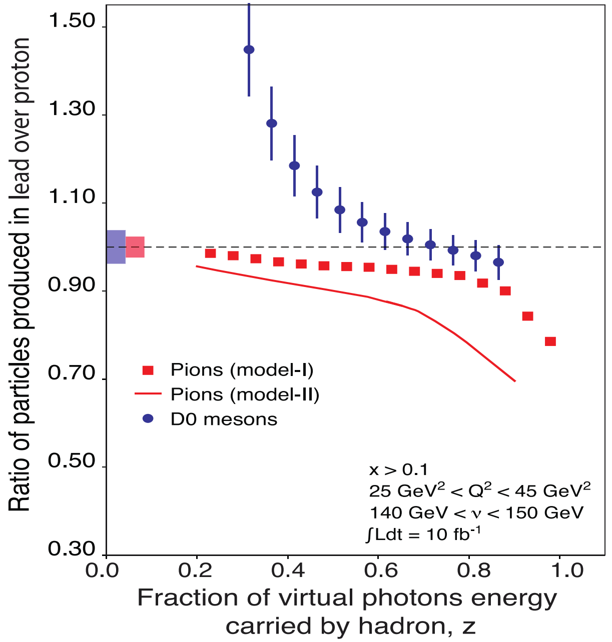
DIS at collider energies enables control of parton/event kinematics

Energy loss by light vs. heavy quarks:

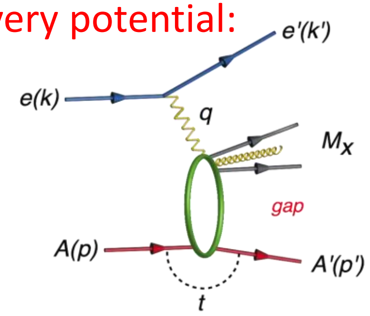
Identify light vs. charm hadrons in e-A:

Understand energy loss of light vs. heavy quarks in cold nuclear matter.

Provides insight into energy loss in the Quark-Gluon Plasma

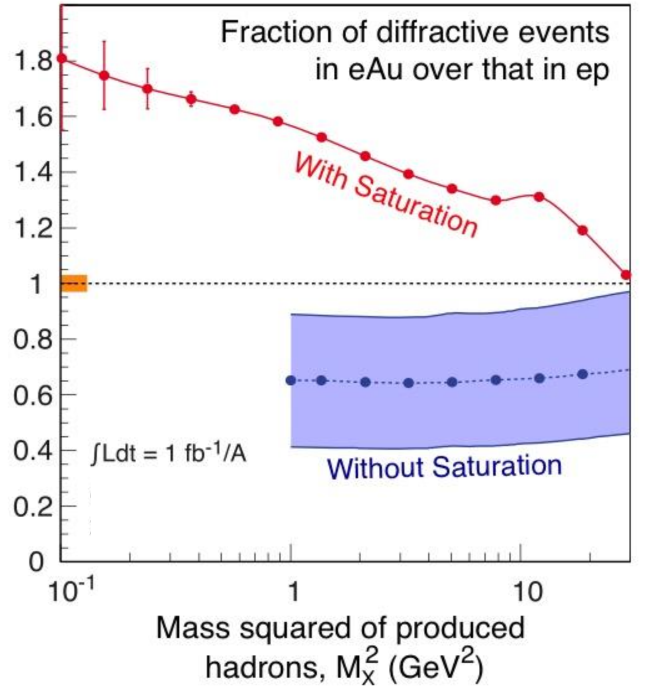


Diffraction cross-sections have strong discovery potential:

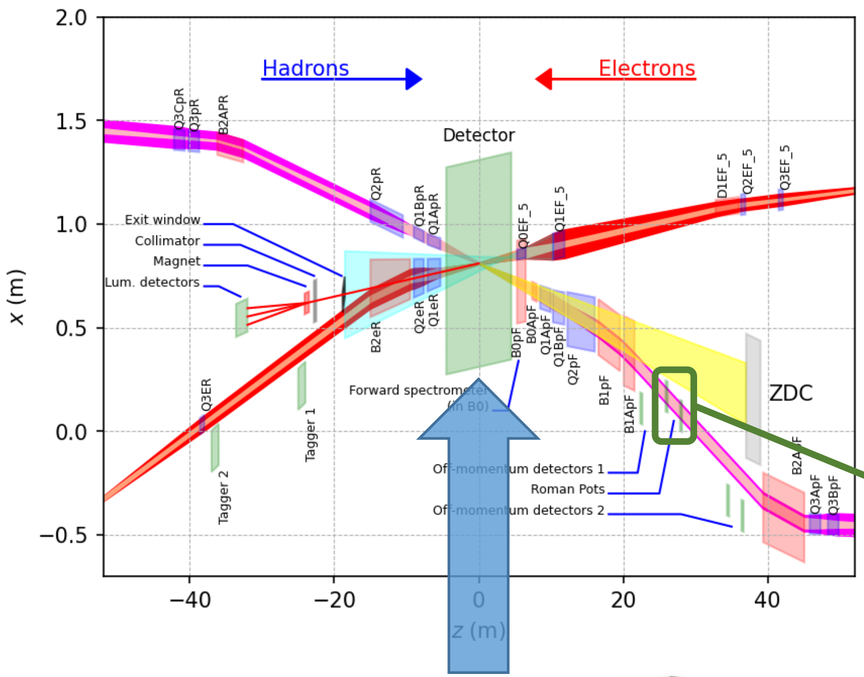


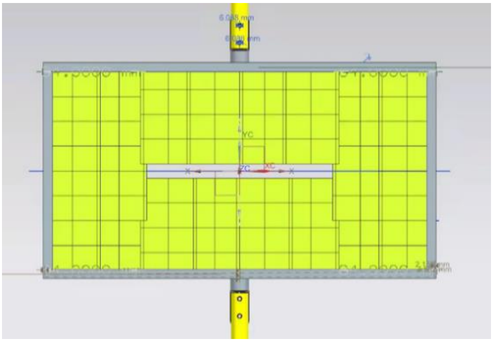
High sensitivity to gluon density in linear regime: $\sigma \sim [g(x,Q^2)]^2$

Dramatic changes in cross-sections with onset of non-linear strong color fields

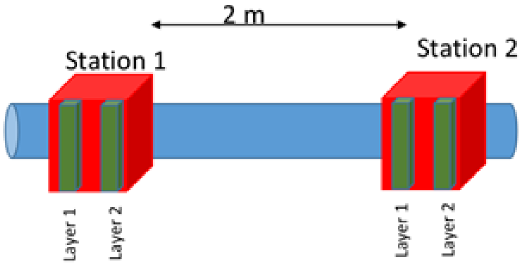


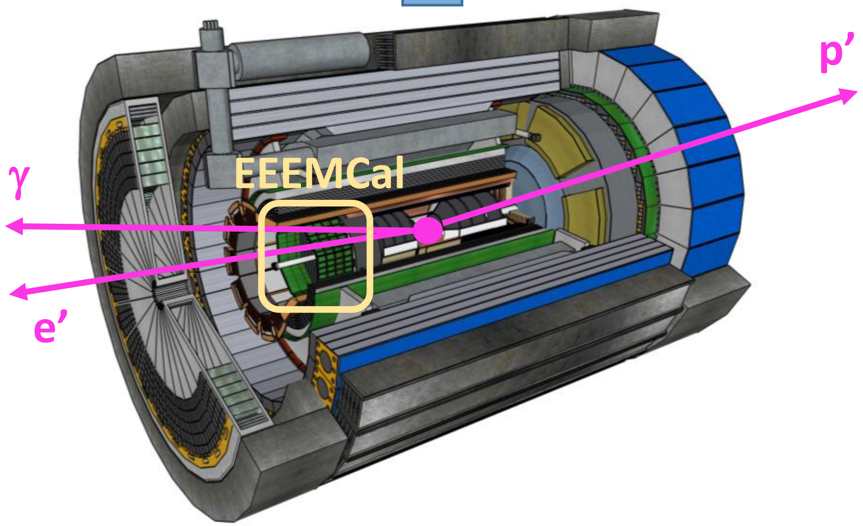
Detector interests of IN2P3 groups





Roman Pots



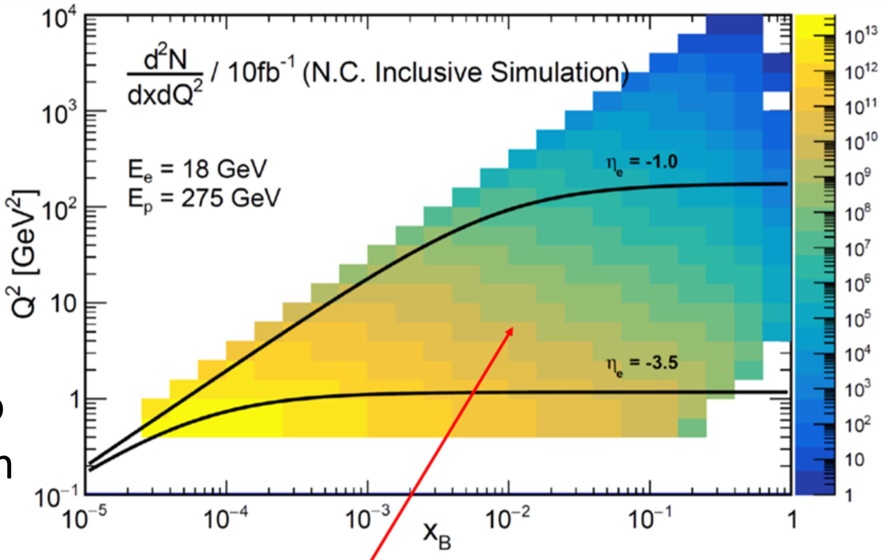


EEMCal:
- PWO crystals
- SiPM readout

Roman Pots:
- AC-LGAD sensors
- Readout ASIC under development

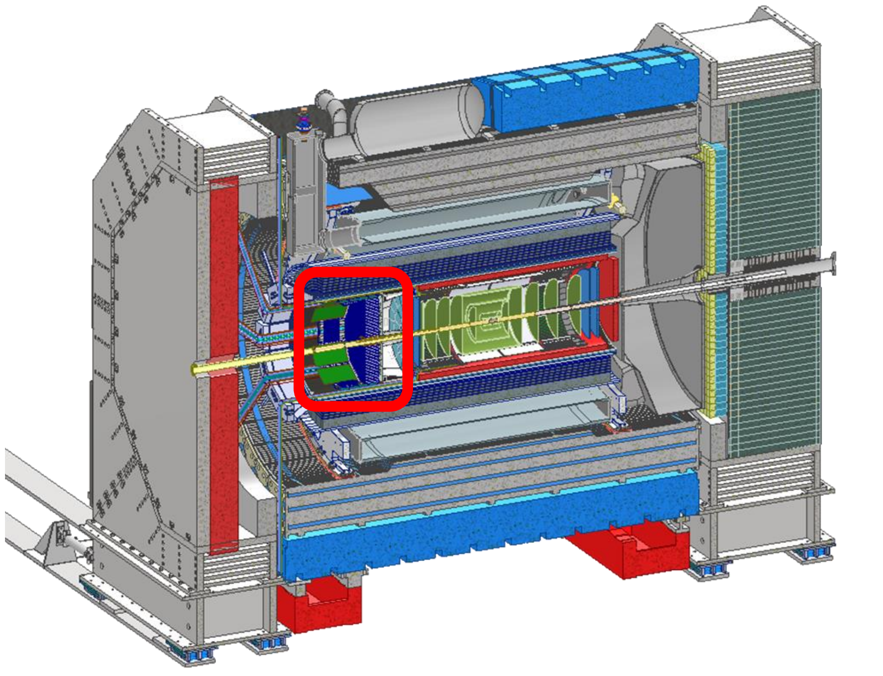
Electron-going endcap ECAL

Electromagnetic (EM) calorimetry is key to any EIC detector concept



Region of physics enabled by the EEEMCal

- Almost every channel needs to measured the scattered electron
- EM e-endcap calorimeter :
$-3.5 < \eta < -1$



International consortium of 14 institutions:

IJCLab Irène Joliot-Curie, Massachusetts Institute of Technology, The Catholic University of America, Abilene Christian University, Florida International University, University of Kentucky, William & Mary, Lehigh University, Laboratoire Leprince-Ringuet, Charles University, James Madison University, A. Alikhanyan National Laboratory, Omega Microelectronics

High resolution in the forward region (endcap) can only be achieved with homogeneous materials, such as crystals and glass

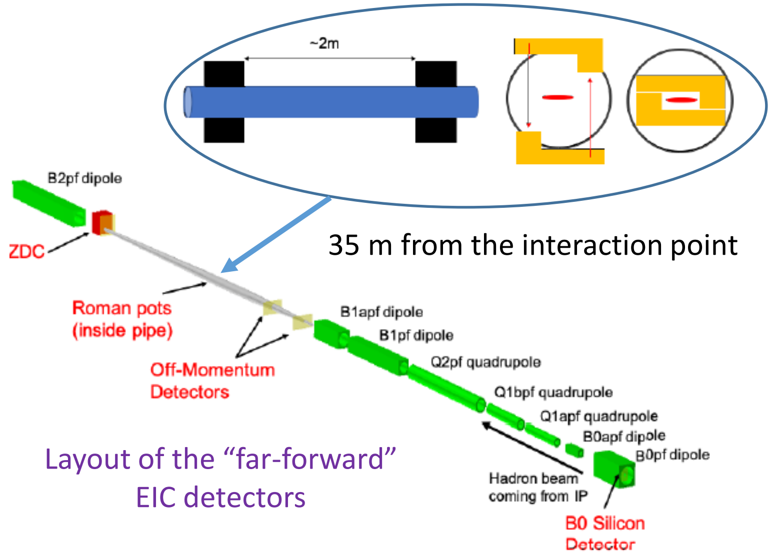
R&D in 2015 with funds from the generic R&D program by the US DoE:

- Building on previous experience with EM calorimeters (JLab Hall A PbF_2, JLab Hall-B PWO IC, JLab Hall-B HPS PWO, PANDA PWO…)
- In synergy with ongoing IJCLab projects for JLab (NPS lead tungsten calorimeter)

EIC Roman Pots

- Key detector for exclusive reactions and diffractive processes
- DVCS protons will mostly be detected by the Roman Pots
- Detector requirements:
  - Good timing (~30 ps) to reduce momentum smearing due to crabbing
  - Good position (0.5×0.5 mm^2) resolution for a p_T resolution <10 MeV/c
  - Be positioned as close as possible to the beam ("edgeless" detectors)

Sketch of the present concept



Layout of the "far-forward" EIC detectors

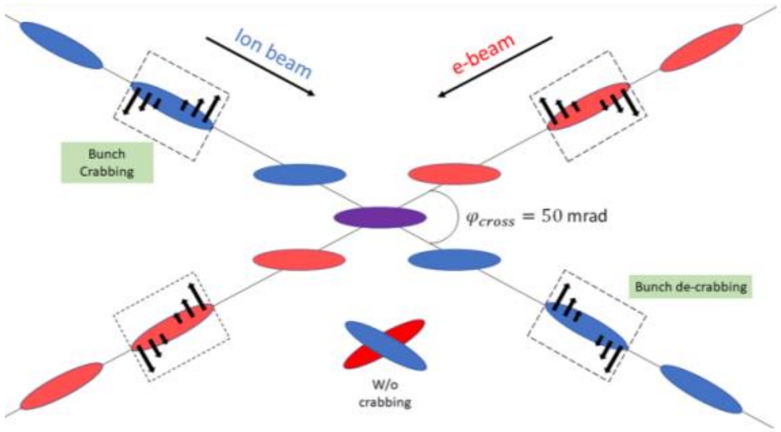
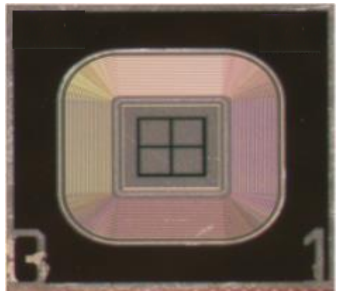
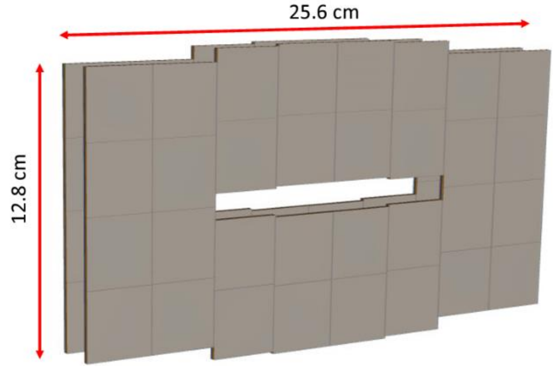


Illustration of crab crossing at EIC



Proposed detector technology:

AC-coupled Low Gain Avalanche Diodes (LGADs)



EIC Roman Pots: organizational chart

Roman Pots
D. Marchand (RS) + O. Brand-Foissac (RT)

WP1 – EICROC Micro-electronics
C. De La Taille

- Front-End
  - C. De La Taille
  - A. Verplancke
- Low power ADC
  - A. Verplancke
- TDC
  - F. Bouyjou
  - E. Delagnes
- Overall Design & Documentation
  - C. De La Taille
  - F. Dulucq
  - N. Seguin-Moreau
  - L. Serin
- PCB
  - P. Dinaucourt
  - J. Favre
- Firmware
  - B.-Y. Ky
- Data acquisition
  - F. Dulucq

WP2 – EICROC Characterization
D. Marchand

- ASIC Functionnal Response
  - O. Brand-Foissac
  - F. Bouyjou
  - S. Conforti
  - D. Marchand
  - N. Seguin-Moreau
  - L. Serin
  - A. Sharma (Post-Doc)
  - A. Verplancke
- ASIC + AC-LGAD Functionnal Response
  - O. Brand-Foissac
  - S. Conforti
  - D. Marchand
  - N. Seguin-Moreau
  - L. Serin
  - A. Sharma (Post-Doc)
  - A. Verplancke
- Source Beta IR Laser Test beam
  - O. Brand-Foissac
  - S. Conforti
  - D. Marchand
  - C. Munoz Camacho
  - L. Serin
  - A. Sharma (Post-Doc)
  - A-S. Torrento
  - A. Verplancke
- Dissemination
  - All people involved in WP1 & WP3

WP3 – Roman Pots Mechanics
R. Dupré / C. Le Galliard

- Cooling design: heat flow simulation
  - C. Le Galliard
  - R. Dupré
- Mechanics design
  - C. Le Galliard
- Prototyping
  - C. Le Galliard
  - Mechanics workshop
- Beam tests
  - C. Le Galliard
  - Instrumentation support
  - Data acquisition support
  - R. Dupré
  - D. Marchand
- Detector simulation
  - R. Dupré
  - A. Sharma (Post-Doc)
- Data analysis
  - R. Dupré
  - A. Sharma (Post-Doc)
- Dissemination
  - All people involved in WP3

WP4 – Management
R.S + R.T. (IJCLab)

- Project follow-up
- Reporting / Proposals
- Recruitements
- Periodic meetings
- Project documentation: ATRIUM (C. Le Gallaird) https://atrium.in2p3.fr/6928d9e1-303b-430f-aeb0-1d75aa60970d
- Dissemination

EIC Roman Pots: human resources

Chercheurs IN2P3 impliqué.e.s (IJCLab)

Nom des personnes	Statut	WP	2024	2025	2026	2027	2028	Total (FTE)
IJCLab			**172%**	**220%**	**220%**	**220%**	**173%**	**10,05**
Dominique Marchand	CR	WP2 & WP4	75%	75%	75%	75%	75%	
Carlos Munoz-Camacho	DR	WP2	10%	10%	10%	10%	10%	
Raphaël Dupré	CR	WP3	20%	20%	20%	20%	20%	
Laurent Serin	DR	WP1 & WP2	20%	15%	15%	15%	15%	
Arzoo Sharma	Post-Doc (P2I)	WP2	47%	53%	–	–	–	
Post-Doctorant.e	Post-Doc (ANR)	WP2	–	47%	100%	100%	53%	
TOTAL (FTE)			**1,72**	**2,20**	**2,20**	**2,20**	**1,73**	**10,05**
+ ? Doctorant.e	*ED PHENIICS*	*WP2*	*–*	*25%*	*100%*	*100%*	*75%*	*3,00*

Personnes impliquées (chercheurs & ITs) d'autres organismes

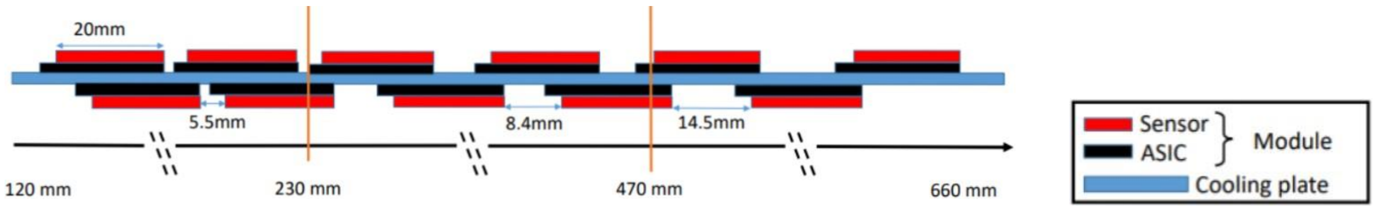
Nom des personnes	Statut	WP	2024	2025	2026	2027	2028	Total (FTE)
CEA/Irfu/DEDIP			**19%**	**19%**	**19%**	**19%**	**14%**	**0,90**
Florent Bouyjou	IR	WP1	15%	15%	15%	15%	10%	
Eric Delagnes	IR	WP1	4%	4%	4%	4%	4%	
BNL			**60%**	**60%**	**60%**	**60%**	**60%**	**3,00**
Alessandro Tricoli	Chercheur	WP1 & WP2	20%	20%	20%	20%	20%	
Gabriele Giacomini	Chercheur	WP1 & WP2	20%	20%	20%	20%	20%	
Alex Jentsch	Chercheur	WP1 & WP2 & WP3	20%	20%	20%	20%	20%	
TOTAL (FTE)			**0,79**	**0,79**	**0,79**	**0,79**	**0,74**	**3,90**

IT IN2P3 impliqué.e.s

Nom des personnes	Statut	WP	2024	2025	2026	2027	2028	Total (FTE)
IJCLab			**104%**	**168%**	**168%**	**208%**	**183%**	**8,31**
Olivier Brand-Foissac (RT)	IR	WP2 & WP4	25%	25%	25%	25%	–	
Beng-Yun Ky (dév. Firmware/software FPGA)	IR	WP1	10%	10%	5%	–	–	
Expert.e développement Firmware/software (FPGA)	IE ou IR	WP1	–	–	5%	50%	50%	
Jérémy Favre	TCN	WP1	8%	8%	8%	8%	8%	
Ana-Sofia Torrento	IR	WP2	25%	30%	30%	30%	30%	
Christine Le Galliard	IR	WP3	20%	40%	40%	40%	40%	
Mécanique (impression 3D)		WP2 & WP3	–	10%	10%	10%	10%	
Mécanique (usinage)		WP2 & WP3	–	10%	10%	10%	10%	
Expertise vide [méca. Roman Pots]		WP3	–	10%	10%	10%	10%	
Instrumentation (tests faisceau)		WP2 & WP3	8%	10%	10%	10%	10%	
Support acquisition données (tests faisceau, interfaces)		WP2 & WP3	8%	15%	15%	15%	15%	
OMEGA			**202%**	**202%**	**202%**	**202%**	**202%**	**10,10**
Christophe de la Taille	IR	WP1	25%	25%	25%	25%	25%	
Nathalie Seguin-Moreau	IR	WP1 & WP2	20%	20%	20%	20%	20%	
Adrien Verplancke	IR	WP1 & WP2	75%	75%	75%	75%	75%	
Selma Conforti	IR	WP1 & WP2	50%	50%	50%	50%	50%	
Frédéric Dulucq	IR	WP1	15%	15%	15%	15%	15%	
Pierrick Dinaucourt	AI	WP1	17%	17%	17%	17%	17%	
Full Digital on Top Designer (RTL, UVM)	IR	WP1	–	–	25%	75%	15%	
TOTAL (FTE)			**6,12**	**7,40**	**7,65**	**8,95**	**7,85**	**18,41**

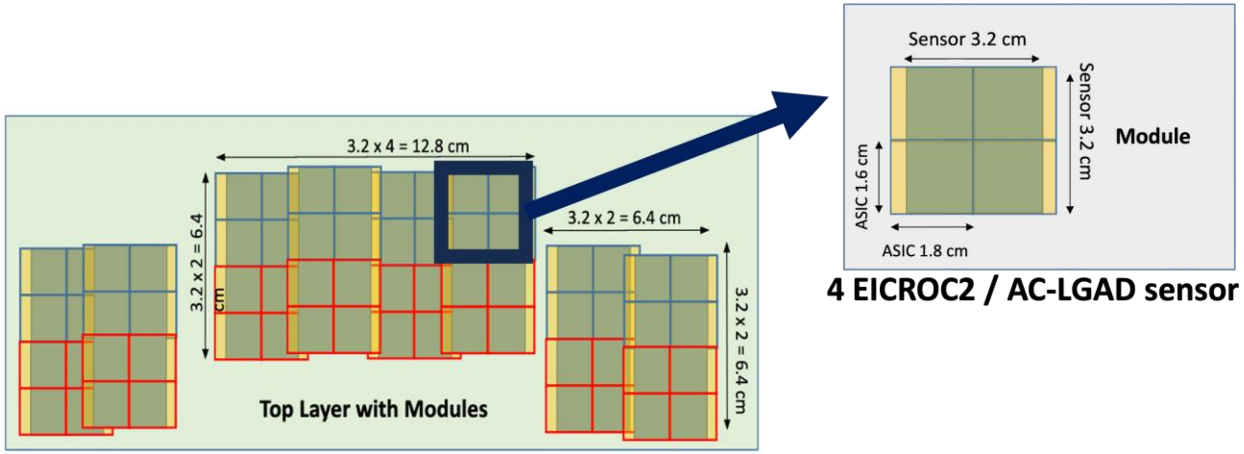
Roman Pots: mechanical contribution

- Cooling system:



Cooling concept for ATLAS-HGTD (LGAD+ALTIROC)

- Module arrangement in Roman Pots station planes:



Preliminary design:

- 4 ASICs per sensor
- 128 ASICs per layer (top & bottom)
- 2 layers per station (512 ASICs)
- 2 stations of RP: 1024 ASICs

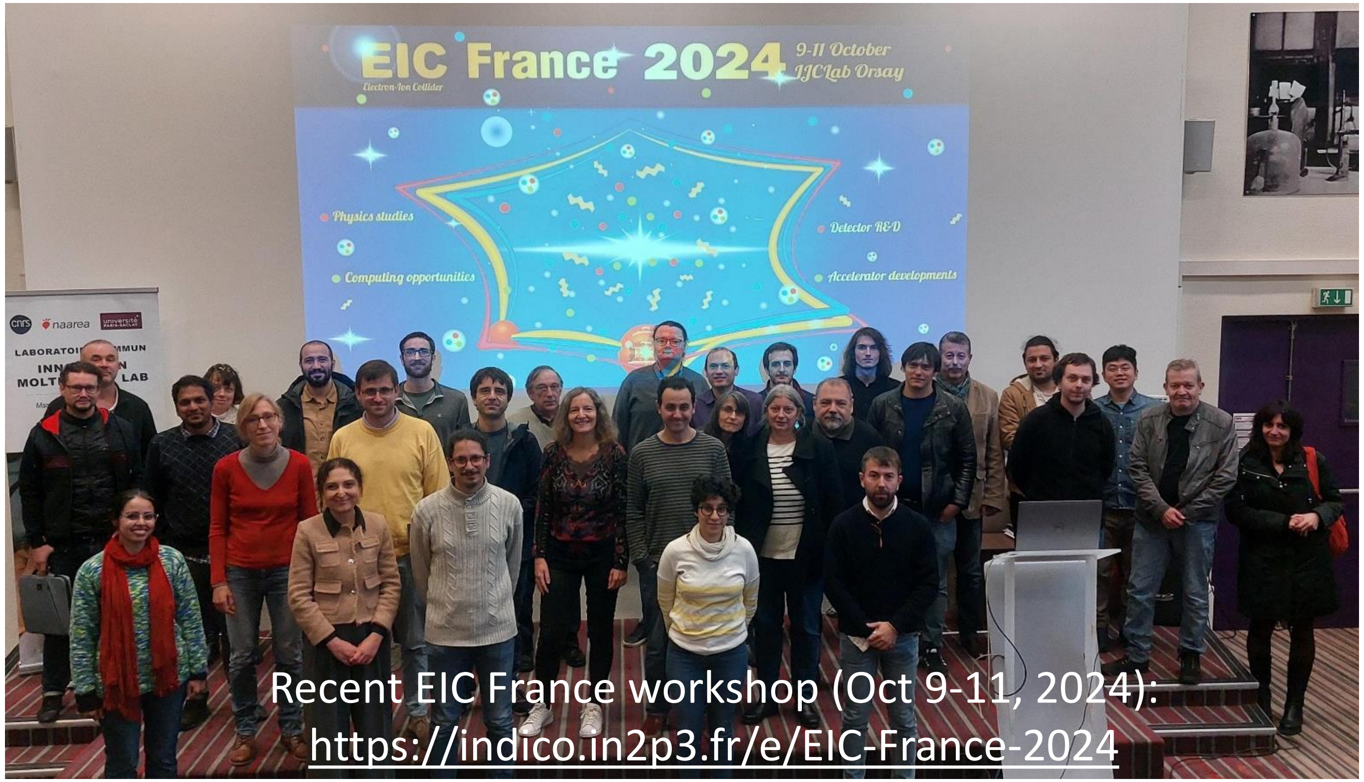
ASIC size	ASIC Pixel pitch	# Ch. per ASIC	# ASICs per module	Sensor area	# Mod. per layer	Total # ASICs	Total # Ch.	Total Si Area
1.6x1.8 cm^2	500 μm	32x32	4	3.2x3.2 cm^2	32	512	524,288	1,311 cm^2

National perspective

- Strong experimental interest from IJCLab, LLR and IRFU/CEA
- Large theory interest from many groups: IN2P3+INP (CNRS) & IPhT (CEA)
- Featured in several funded projects: STRONG 2020 (EU), Gluodynamics (P2IO)
- Discussed within the ‘Exercise de prospective nationale’ (GT03)
  - EIC contribution submitted:
    - 26 permanent staff

      (9 theory, 13 experiment, 4 IT & Accelerator)
    - 8 different labs (3 theory, 5 experiment)
  - EIC appears among the recommendations

    of the report



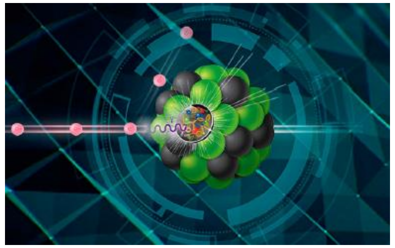
Recent EIC France workshop (Oct 9-11, 2024):
https://indico.in2p3.fr/e/EIC-France-2024

Strong synergy with theory activity in France

- Our physics interests have a large overlap with theory activities at France (IN2P3, INP, CEA)
- Field of GPDs has had strong contributions by French theorists from the start
- Theory interests include:
  - Saturation physics
  - GPDs (through DVCS, DVMP and other processes)
  - TMDs (gluon TMDs in particular)
  - Nuclear PDFs
  - Quarkonia

Summary

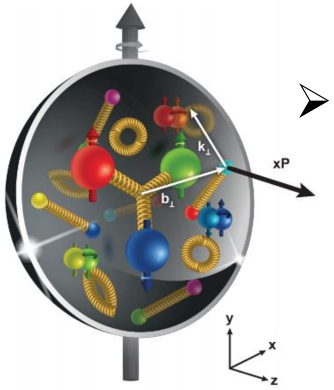
➢ The EIC facility will address fundamental questions on the structure and dynamics of nucleons and nuclei in terms of quarks and gluons, using precision measurements including:



- Parton distributions in nuclei/QCD at extreme parton densities – saturation
- Spin and flavor structure of the nucleon and nuclei
- Tomography (p/A) Transverse Momentum Distributions and Spatial Imaging

➢ We propose to continue and significantly increase our involvement and detector contributions towards the realization of ePIC:

- Mechanical design and front-end electronics for the backward EM
- Readout electronics and mechanical integration for the Roman Pots



➢ ASIC developments for these detectors will benefit many other subsystems in ePIC and will increase our visibility and contribution to the overall detector.

Back-up

Avis des CS précédents (1/2)

➢ Conseil scientifique IPNO, July 2017

- Le CS félicite le groupe de s'impliquer dès maintenant dans une activité à long terme sur EIC, projet de machine au niveau mondial pour la physique hadronique.
- Le groupe de l'IPNO a tous les atouts pour jouer un rôle leader en France.

➢ Conseil scientifique IN2P3, Feb. 2018

- Le groupe de l'IPNO affiche d'ores et déjà son intérêt et participe activement au développement de ce projet. Le conseil note que l'IRFU est aujourd'hui plus clairement engagé dans l'EIC que l'IN2P3.
- Un engagement dans l'un des deux au moins, l'EIC et/ou FAIR, est indispensable à l'avenir de la physique hadronique en France, en complément de ce qui se fera auprès du LHC.

➢ Conseil scientifique IJCLab, Nov. 2020

- A joint PhD thesis (typically, hardware in EIC and data analysis in JLab) is a good idea today.
- The calorimeter project has relatively moderate risk: there is a strong need of a calorimeter in the backward. This will thus ensure a visible contribution of the EIC-IJCLab group in one important sub-detector.
- The Roman pots part is riskier since there is no guarantee that a viable ASIC can be developed for this solution. If it works, it will also be a very visible contribution.

Avis des CS précédents (2/2)

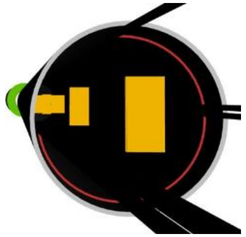
➢ Conseil scientifique IN2P3, Octobre 2022

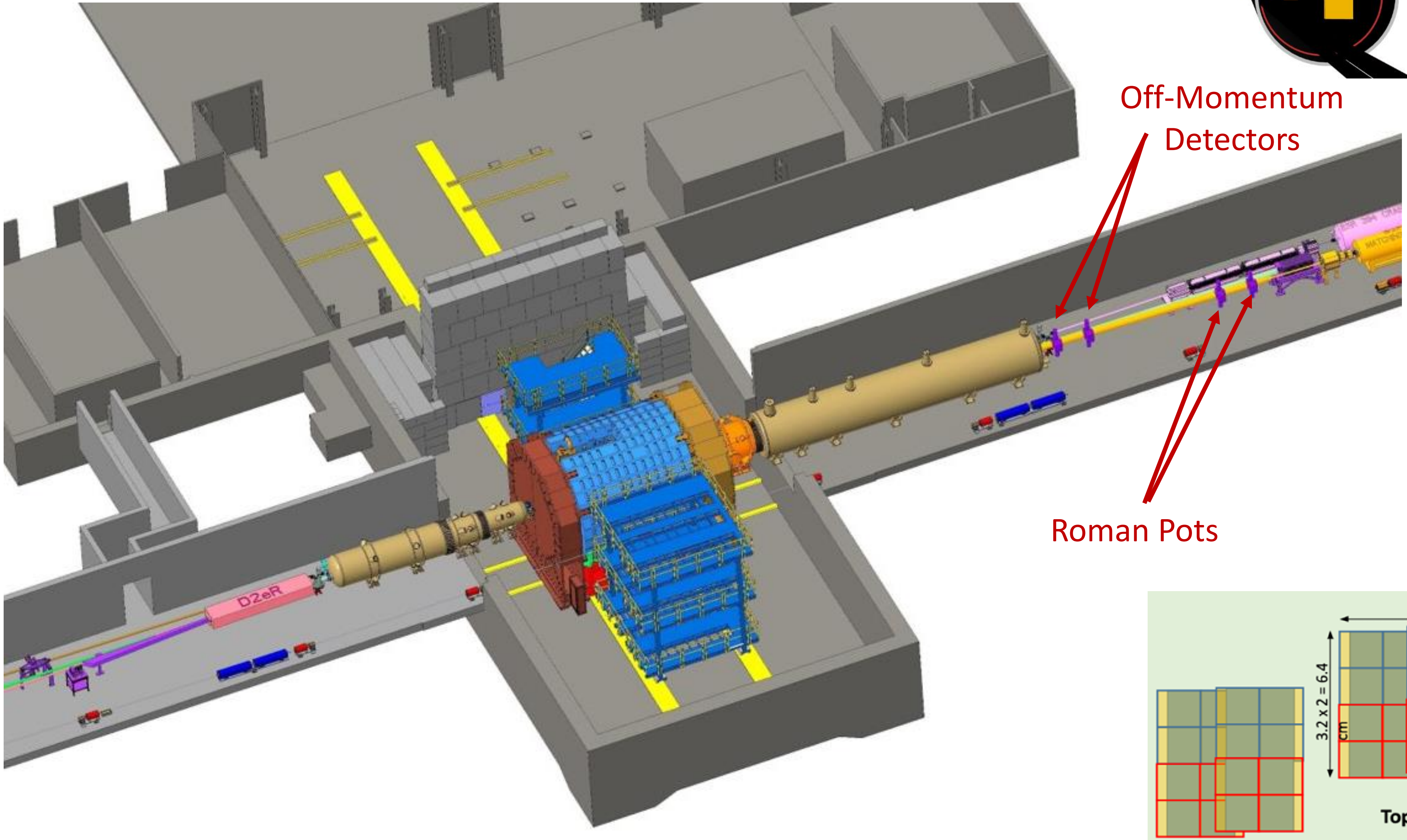
- Il est donc judicieux pour les équipes de l'IJCLab de se positionner maintenant et d'ouvrir les discussions à un plus haut niveau entre l'IN2P3 et la DOE.
- les deux engagements techniques […] ne sont pas en adéquation avec le petit nombre de physiciens permanents de l'institut (2.4 FTE) engagés sur le projet actuellement. […] Il encourage l'équipe concernée à rechercher d'autres partenaires ou à se recentrer sur un nombre plus réduit de contributions.

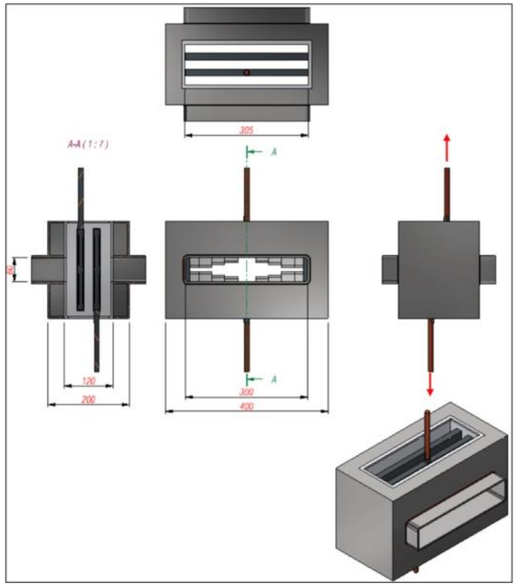
➢ Conseil scientifique LLR, Janvier 2024

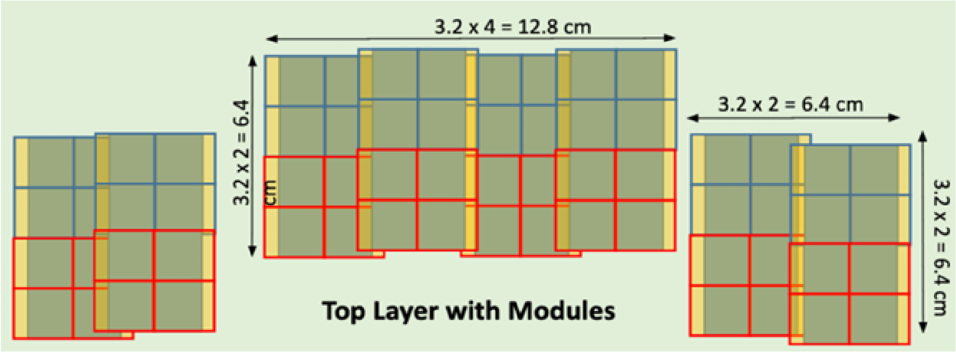
- Le CS souligne en effet la pertinence de la contribution technique proposée, laquelle s'inscrit dans l'expertise historique du laboratoire sur la calorimétrie, renforce les liens avec OMEGA et valorise l'expérience acquise avec CALICE, CMS-HGCAL et HyperKamiokande sur la caractérisation d'ASICs.

Roman Pots mechanical integration









Schedule – what do the CD milestones mean?

- **CD-0 – Approve mission need**: this documents that a scientific goal or a new capability, requiring material investment exists.
- **CD-1 – Approve Alternative Selection and Cost Range**: serves as a determination that the selected alternative and approach is optimized to meet the mission need defined at CD-0. What is perhaps most relevant is that CD-1 allows for release of Project Engineering and Design (PED) funds, which means the next phases of design of accelerator and detector can begin.
- **CD-2 – Approve Performance Baseline**: CD-2 is an approval of the preliminary design of the project and the baseline scope, cost, and schedule. What is most relevant is that CD-2 means there is now a definitive plan that the project will be measured against in cost, schedule and technical performance.
- **CD-3 – Approve Start of Construction**: CD-3 is an approval of the project's final design and authorizes release of funds for construction. What is most relevant is that projects can now proceed with construction related procurements and activities. CD-3 is sometimes split in CD-3A in a tailored approach to approve start construction for long-lead procurements.
- **CD-4 – Approve Start of Operations or Project Completion**: CD-4 provides recognition that the project's objectives have been met. CD-4 is sometimes split in CD-4A that allows, after agreed-upon criteria for technical success have been met, for transition into operations, and CD-4B that provides the formal closeout of the project.

Outlook to CD-2 – Detector In-Kind Contributions (IKC)

- The IKC target for the EIC detector is about 30% of the total scope approx. $100M.
- The INFN/detector iCRADA is the most advanced.
  PPDs preparations are ongoing.
- The preparation of iCRADAs – Second Phase – is starting.

First Phase of Milestones for Detector IKC

Agency	Milestone	Target Date	STATUS:
Italy-INFN	JLab iCRADA (for dRICH, Si/ITS3, GEM-muRwell) drafted*	✓ Apr 2024	Two iterations, complete after final check $ amount
UK	JLab iCRADA (for Si/LAS, Low-Q2, Lumi) drafted**	✓ Apr 2024	Comments? Need to add (minor) fixes as for INFN
UK	BNL iCRADA (for Si/LAS) drafted	Jun 2024	
Italy-INFN	JLab iCRADA (for solenoid) drafted	✓ March 2024	Resume in August, need minor fixes
France-CEA	JLab iCRADA (for solenoid) drafted	✓ March 2024	
France-IN2P3	JLab iCRADA (for EEEmCAL, RPs, ASICs) drafted**	✓ May 2024	Comments?
France-CEA	JLab iCRADA (for MicroMegas, SALSA) drafted	✓ June 2024 → July	Sent in July (week ago)
	PPDs preparation could start at the end of drafting the iCRADA and completed in 2025	Mar 2025 Ready to be signed	Prep work started on PPD with Italy/detector and UK
	CD-2 Director's Review / All ICRADA and PPDs signed	Sep or Oct 2025	
	DOE CD-2 and Status OPA Review	Late 2025	

* *JLab iCRADA draft to start process, Si scope moves to BNL iCRADA*
***JLab iCRADA draft to start process, then may move to BNL iCRADA*

Plan to start **Second Phase** of draft iCRADAs once scope is clear and as aligned with time scales of foreign agencies, e.g., Korea, Canada, Japan, India, Israel…

Request to start on Korea to be aligned with funding proposal process. Plan to also start on Japan.

Electron-Ion Collider
EIC Advisory Board Meeting August 2 2024 13

Status: folding in
- Reuse of components enabled by explicit design (e.g., barrel HCal, cradle, DIRC bars, ….)
- In-kind contributions to PED
- Likely IKC
  - UK detector (UKRI/STFC)
  - Italy/INFN detector
  - Italy/INFN magnet
  - CEA/IN2P3 detector
- Possible IKC
  - Japan detector
  - Korea detector
  - Canada detector
  - Taiwan detector
  - NSF/MSRI

we would surpass this $100M goal.

This is coded in P6 in anticipation of further proposal confirmations and the signed formal agreements.

EIC project cost assumptions (2022)

EEEMCal

Total cost: $9.1M

- $7.1M Materials:
  $5.5M project + $1.6M in-kind
- $2.0M Labor (36249 h):
  $0.3M project + $1.7M in-kind

Roman Pots

Total cost: $0.96M

- $0.30M Materials:
  $0.300M project + $0.002M in-kind
- $0.66M Labor (6500 h):
  $0.59M project + $0.07M in-kind