

Status of the Electron-Ion Collider

Abhay Deshpande
Brookhaven National Laboratory & Stony Brook University

QCD at LHC 2026, Oxford University
October 2, 2026

Overview

- Background: RHIC to the Electron Ion Collider (EIC)
- EIC Science, the ePIC detector and synergies with LHC & beyond
- EIC accelerator features and relevance to future accelerators
- EIC realization plan, early science and timelines
- Take away messages

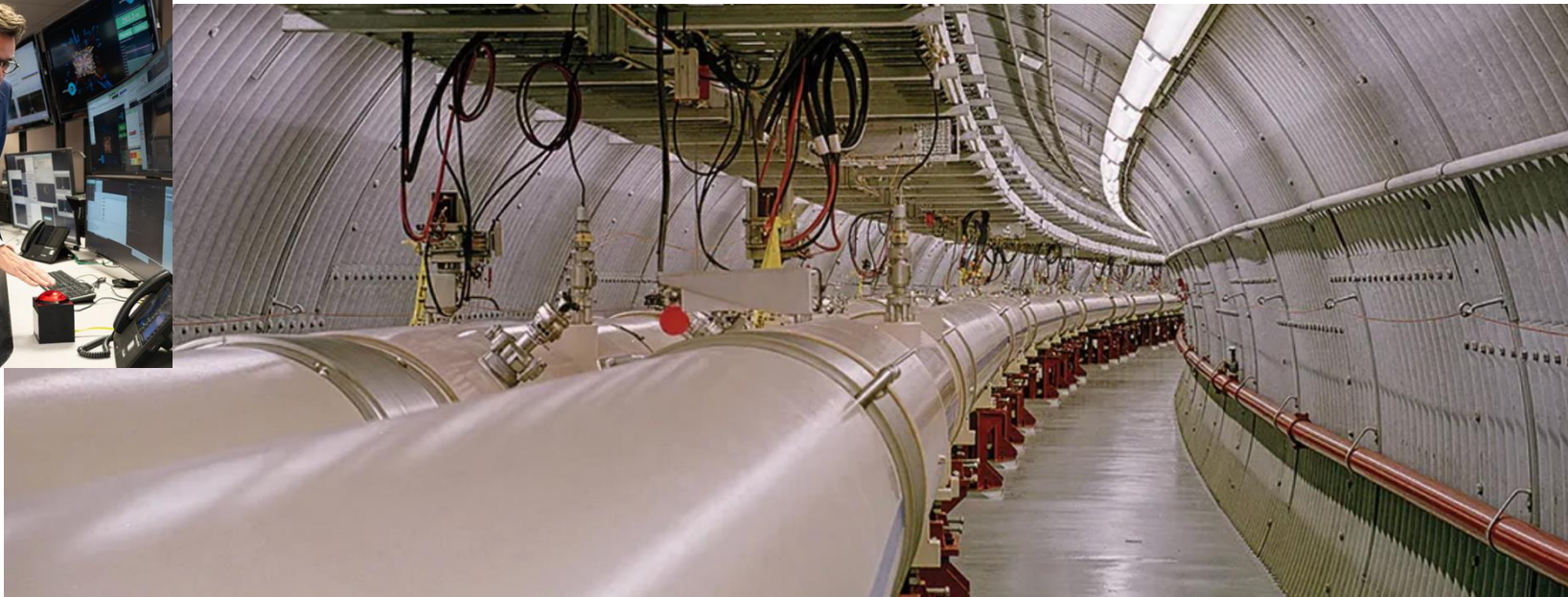
February 6, 2026

EIC CD3 B
approval
announced

Feb 3, 2026:
Last weekly RHIC
planning meeting
started in 2000



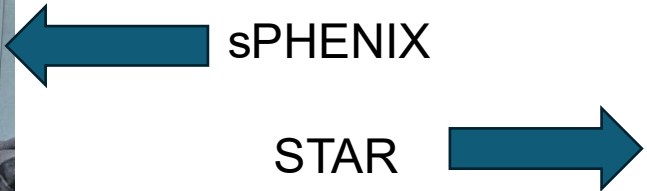
The button that
shut RHIC down



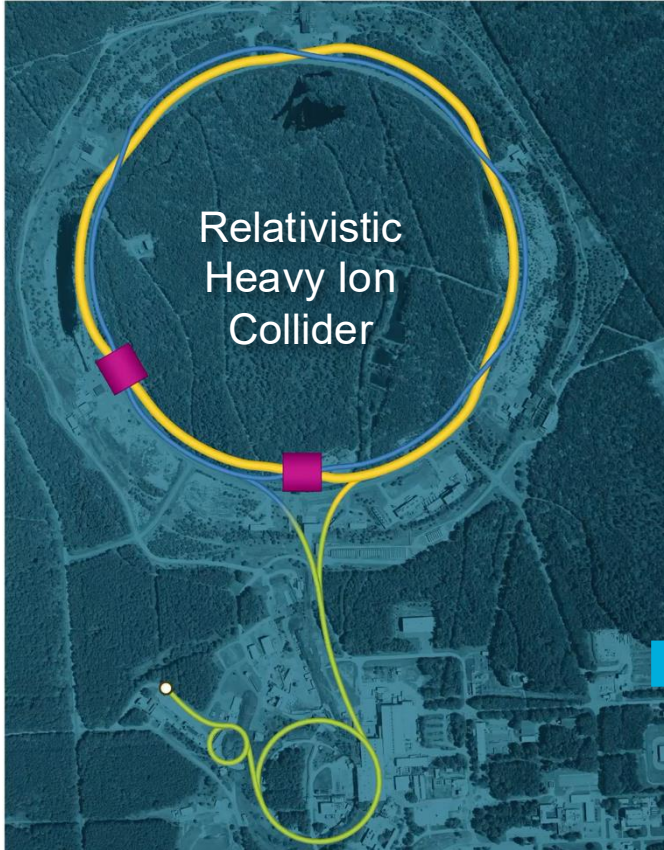
PHYSICS

The only U.S. particle collider shuts down – so a new one may rise

The Relativistic Heavy Ion Collider stops work after more than 25 years of
mind-bending discoveries
By Emily Conover



A New Era of Discovery: From RHIC to the Electron-Ion Collider (EIC)



Building on the ~\$2 billion+ investment in RHIC:

- Re-use existing tunnel
- Minimal modification to ion beam complex (yellow)
- New electron beam facility

Partnership between U.S. Department of Energy, Brookhaven Lab, Thomas Jefferson National Accelerator Facility, New York State, and collaborators around the world.

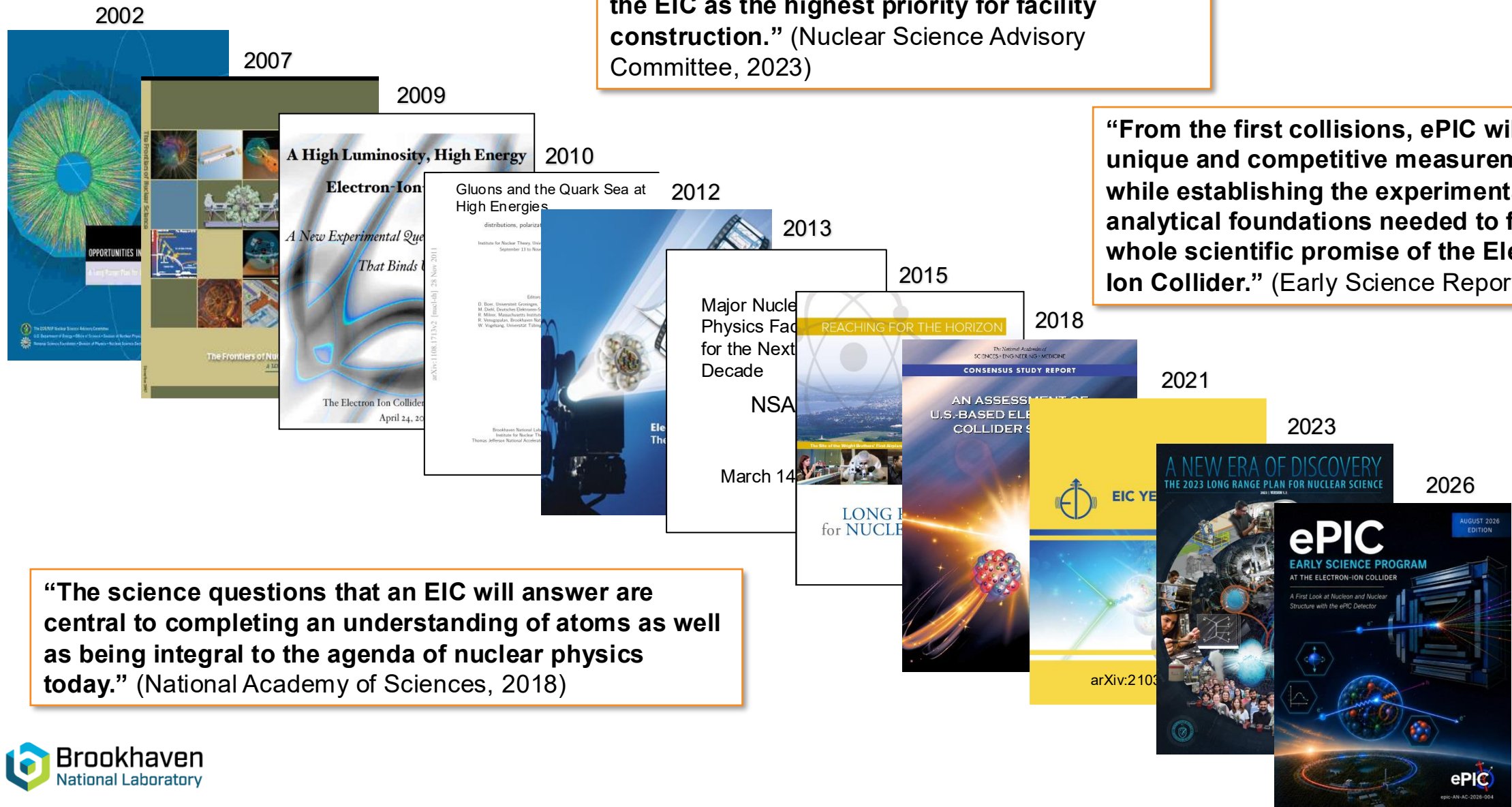


EIC Scientific Case Built Over Decades

“We recommend the expeditious completion of the EIC as the highest priority for facility construction.” (Nuclear Science Advisory Committee, 2023)

“From the first collisions, ePIC will deliver unique and competitive measurements while establishing the experimental and analytical foundations needed to fulfill the whole scientific promise of the Electron-Ion Collider.” (Early Science Report, 2026)

“The science questions that an EIC will answer are central to completing an understanding of atoms as well as being integral to the agenda of nuclear physics today.” (National Academy of Sciences, 2018)



EIC Science Pillars



How do quarks, gluons, and orbital angular momentum contribute to proton spin?

Spin is a fundamental property of matter. All elementary particles but Higgs carry spin.

Spin of composite particles such as the proton cannot be explained by a static picture but are caused by the **interplay of properties and interactions of quarks and gluons inside.**

SPIN



Does the mass of visible matter emerge from quark-gluon interactions?

Atom:

Binding/Mass = 0.00000001

Nucleus:

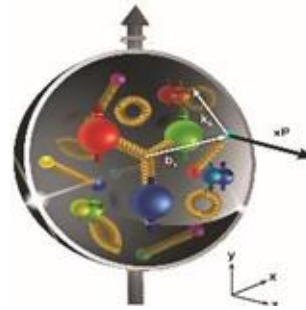
Binding/Mass = 0.01

Proton:

Binding/Mass = 100

The EIC will determine an important term contributing to the **proton mass**, the so-called QCD trace anomaly.

MASS



How are quarks and gluons distributed in space and momentum inside the nucleon & nuclei?

How do the nucleon properties **emerge from them and their interactions?**

How can we understand their **dynamical origin in QCD?**

What is the relation to **Confinement?**

3D-Imaging



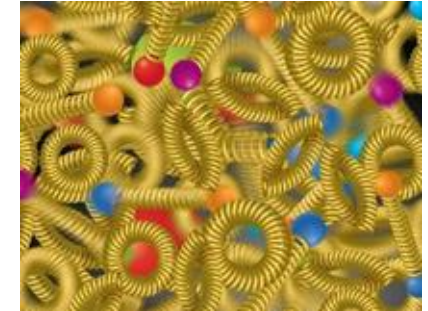
How do the confined hadronic states emerge from quarks and gluons?

Is the structure of a **free and bound** nucleon the same?

How do quarks and gluons **interact with a nuclear medium?**

How do the quark-gluon interactions **create nuclear binding?**

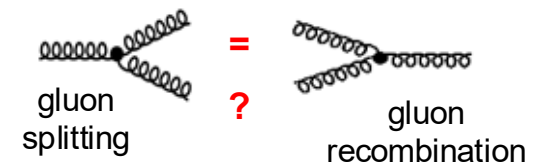
QCD in Nuclei



Does gluon density in nuclei saturate at high energy?

How many gluons can fit in a proton?

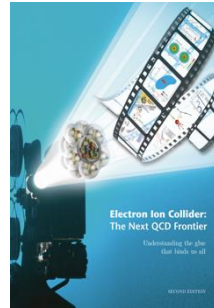
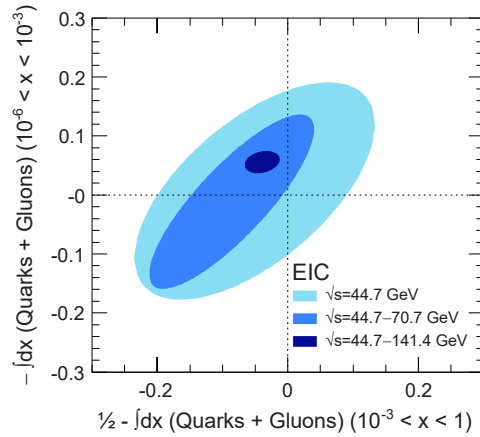
How does a **dense nuclear environment** **affect** the quarks and gluons, their correlations and interactions?



Dense Gluon Systems

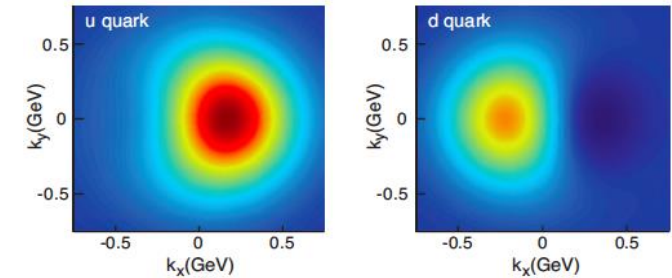
(National Academies of Sciences, Medicine, and Engineering, 2018 Consensus Study Report)

Quark and gluon spin contributions

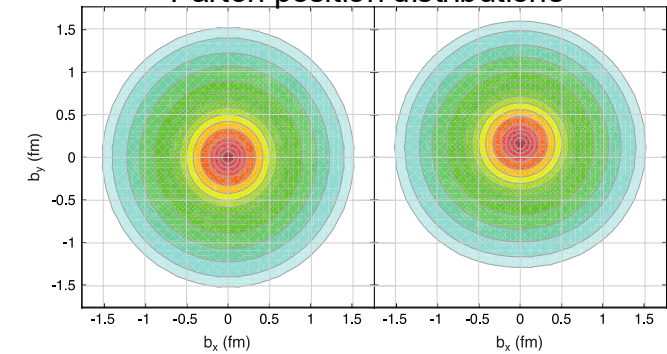


EIC science selected highlights

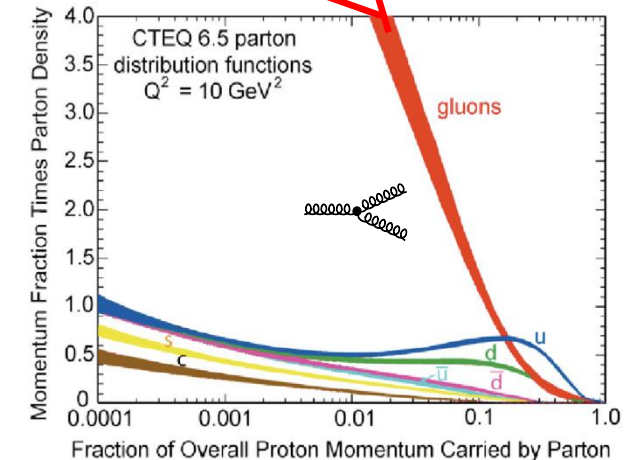
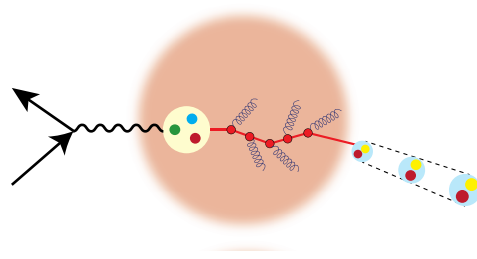
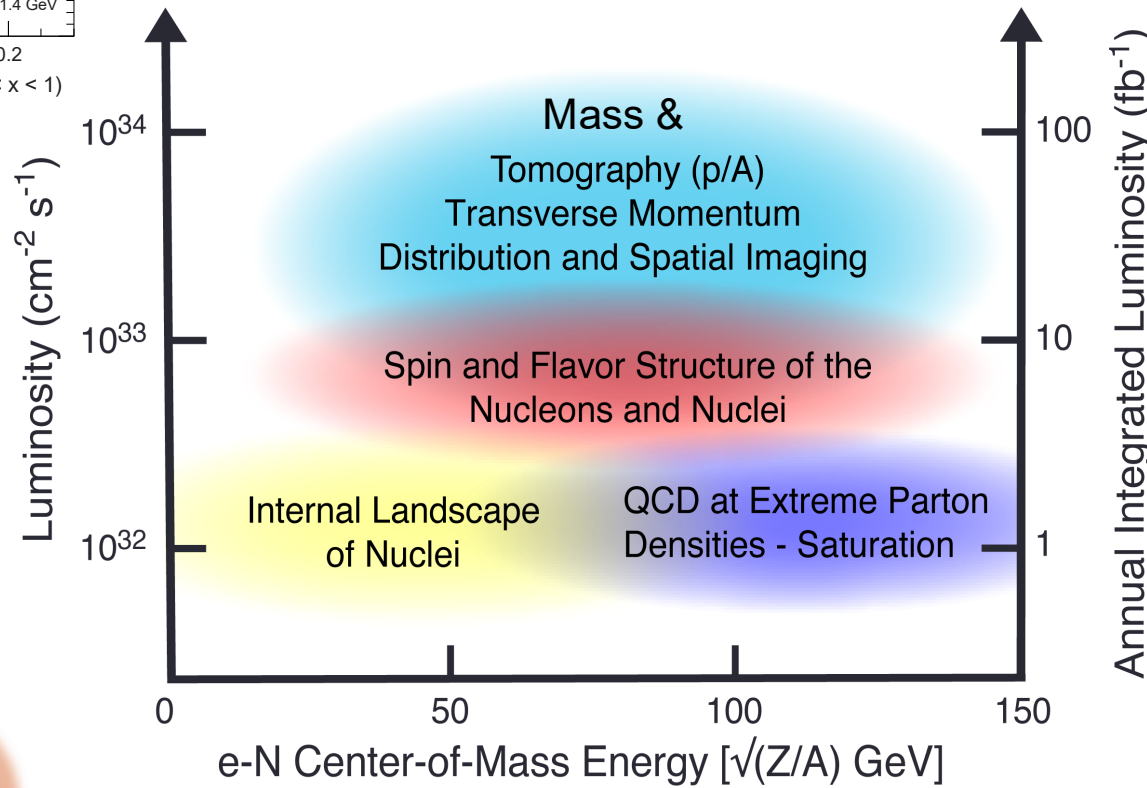
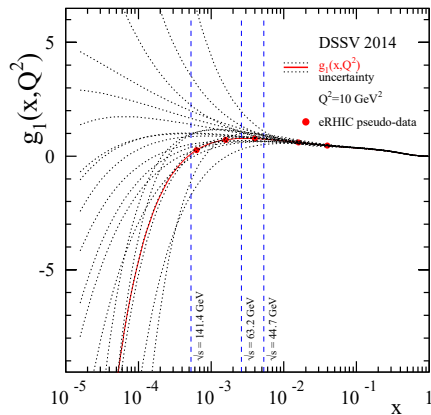
Quark transverse momentum distributions



Parton position distributions



Spin structure function



Many more opportunities at the EIC

Precision QCD Studies with proton & (light & heavy) nuclear targets:

- Heavy quark and quarkonia (c, b quarks) studies with 100-500 times lumi of HERA and with polarization
- Polarized light nuclei (Helium, Beryllium & more) @ the EIC for the very first time in a collider
- Jets – probe of nuclear medium – for the very first time in nuclear DIS in a collider

Physic of jets, multiquark systems, confinement:

- Internal structure of jets in e-p/A collisions, momentum/energy correlators → novel observables with center of mass energy variability and polarized beams
- Entanglement-entropy, connections to fragmentation, hadronization and their relation to confinement
- Quark Exotica: 4,5,6 quark systems: Much interest based on results from Belle-II & LHCb

Highlights of the BSM and Precision EW Studies

Impact of precision SM measurements on search for BSM

- ❖ Precision calculation of α_s : higher order pQCD calculations, twist 3
- ❖ Precision measurements of unpolarized PDFs at high x/Q^2 , impact on LHC-Upgrade results

Precision electroweak and BSM physics: LHC – EIC Synergies –

- SM Effective Field Theory analyses: Connecting precision collider low-energy and electroweak data to probe Beyond Standard Model (BSM) physics.
- Searches for weak mixing angle variations, chiral structure in weak currents, charged lepton flavor violation (CLFV), sterile neutrinos, dark photons, and axion-like particles (ALPs).

Synergies between R&D for FCC/ee and EIC: accelerators & detector

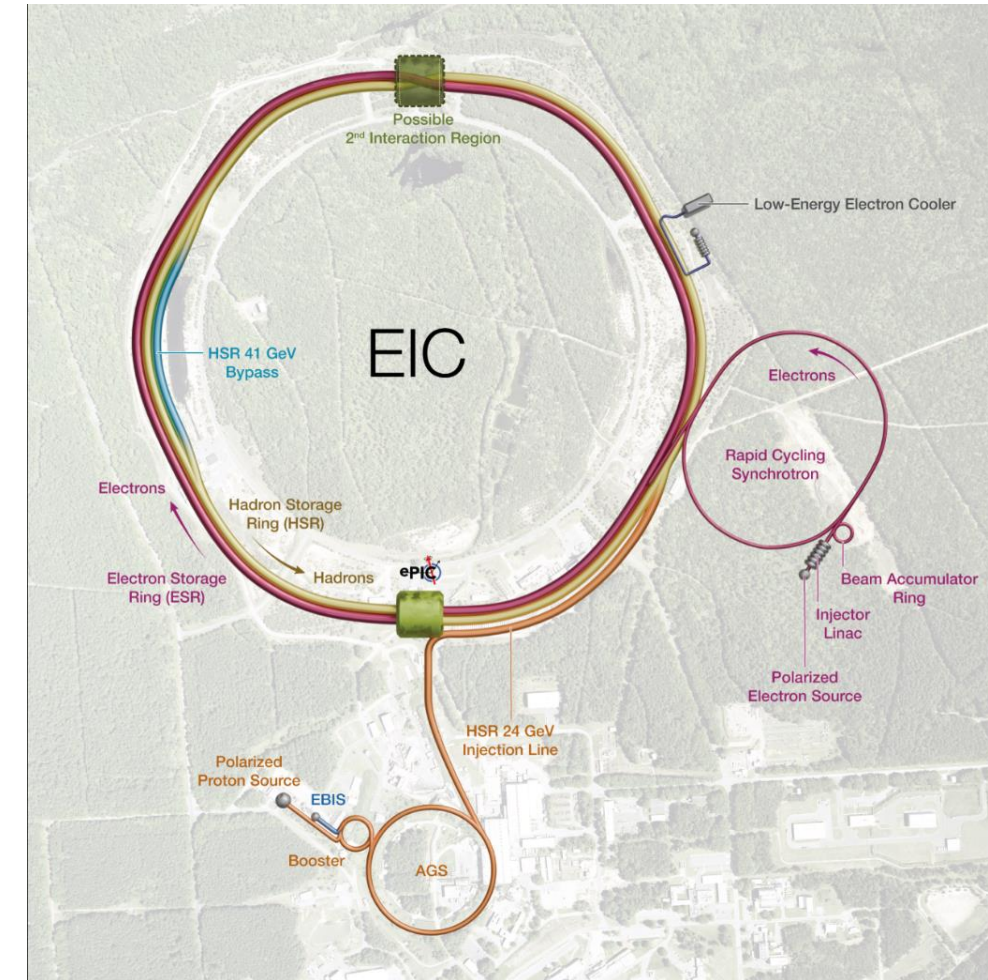
Present EIC Concept (2026)

Ultimate EIC Performance Parameters:

- High Luminosity: $L = 10^{33} - 10^{34} \text{cm}^{-2}\text{sec}^{-1}$
- Highly Polarized Beams: 70% (electrons & light ions)
- Large Center of Mass Energy Range: $E_{\text{cm}} = \sim 28 - 100 (140) \text{ GeV}$
- Large Ion Species Range: protons – Uranium
- Large Detector Forward Acceptance and Low-Background Conditions
- Possibility to Implement a Second Interaction Region (IR)

Accelerator Status at a glance:

- ✓ Polarized light ion/proton source
- ✓ Ion injection and initial acceleration systems – Linac (200 MeV), Booster (1.5 GeV), AGS (25 GeV)
- UPGRADE** Hadron Storage Ring (40, 100-275 GeV) – **HSR**
- NEW** Electron Pre-Injector (750 MeV linac)
- NEW** Beam Accumulation Ring (750 MeV) – **BAR**
- NEW** Electron Rapid Cycling Synchrotron (0.75 GeV – top energy) – **RCS**
- NEW** Electron Storage Ring (5 GeV – 9 GeV, upgrade to 18 GeV) – **ESR**
- NEW** Interaction Region(s) – **IR-6** → 2nd IR-IP-12
- NEW** Low Energy Hadron Cooling System



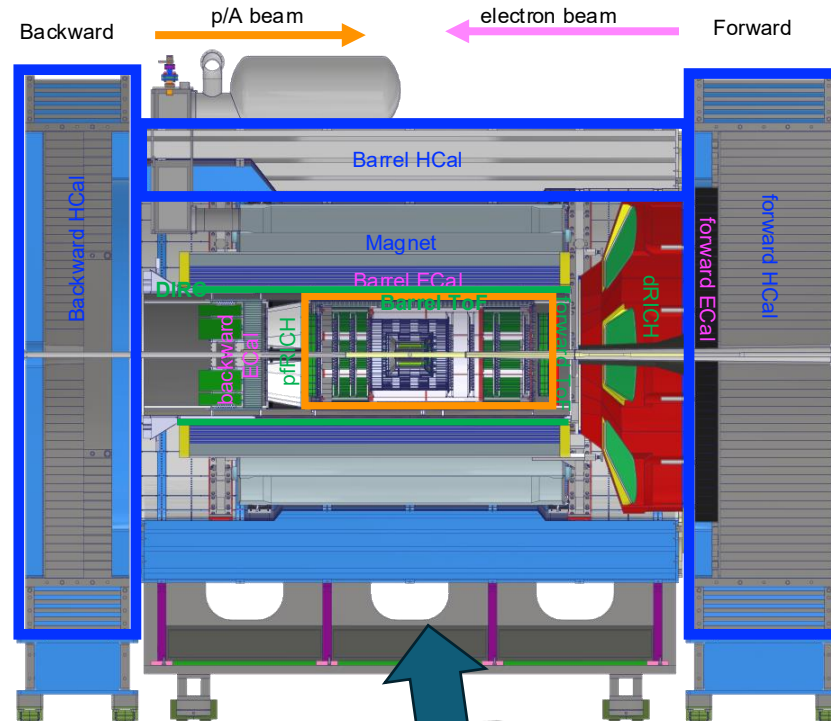
Protons: ~40, 100 – 275 GeV

Electrons: 5 – 9 GeV, upgradable to 18 GeV

EIC Detector -- ePIC

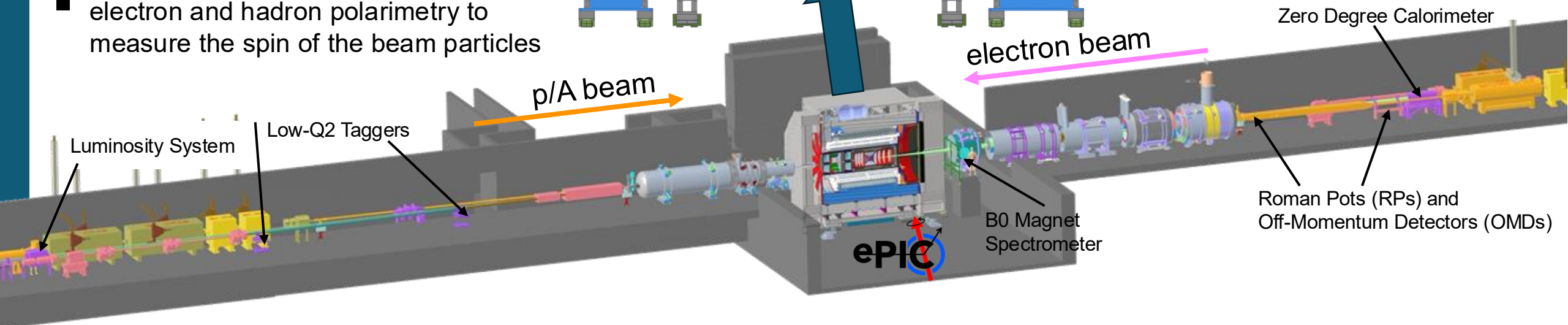
26 subsystems over ± 40 m to measure particle momenta, energy and type

- 2T Solenoid ($\varnothing$ 2.84 m)
- 3 hadronic calorimeters
- 3 electromagnetic calorimeters
- 5 particle Identification detectors
- Various Silicon and Micro-pattern gas tracking detectors
- 7 detectors integrated into the accelerator lattice
- fully streaming readout electronics and DAQ $\rightarrow$ integrating **AI/ML capabilities**
- electron and hadron polarimetry to measure the spin of the beam particles



8 world-first technologies:

4 in Micro-Electronics
4 in detector technologies



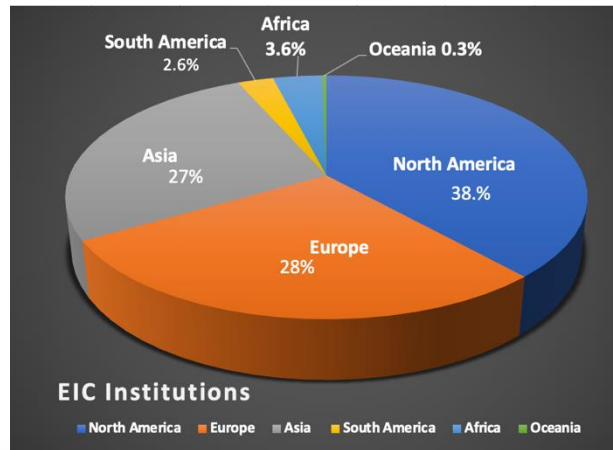
EIC Users & ePIC Detector Community



The EIC Users Group: <https://eicug.org/>

Formed 2016: 400 Users → Now

1563 collaborators, 41 countries, 310 institutions

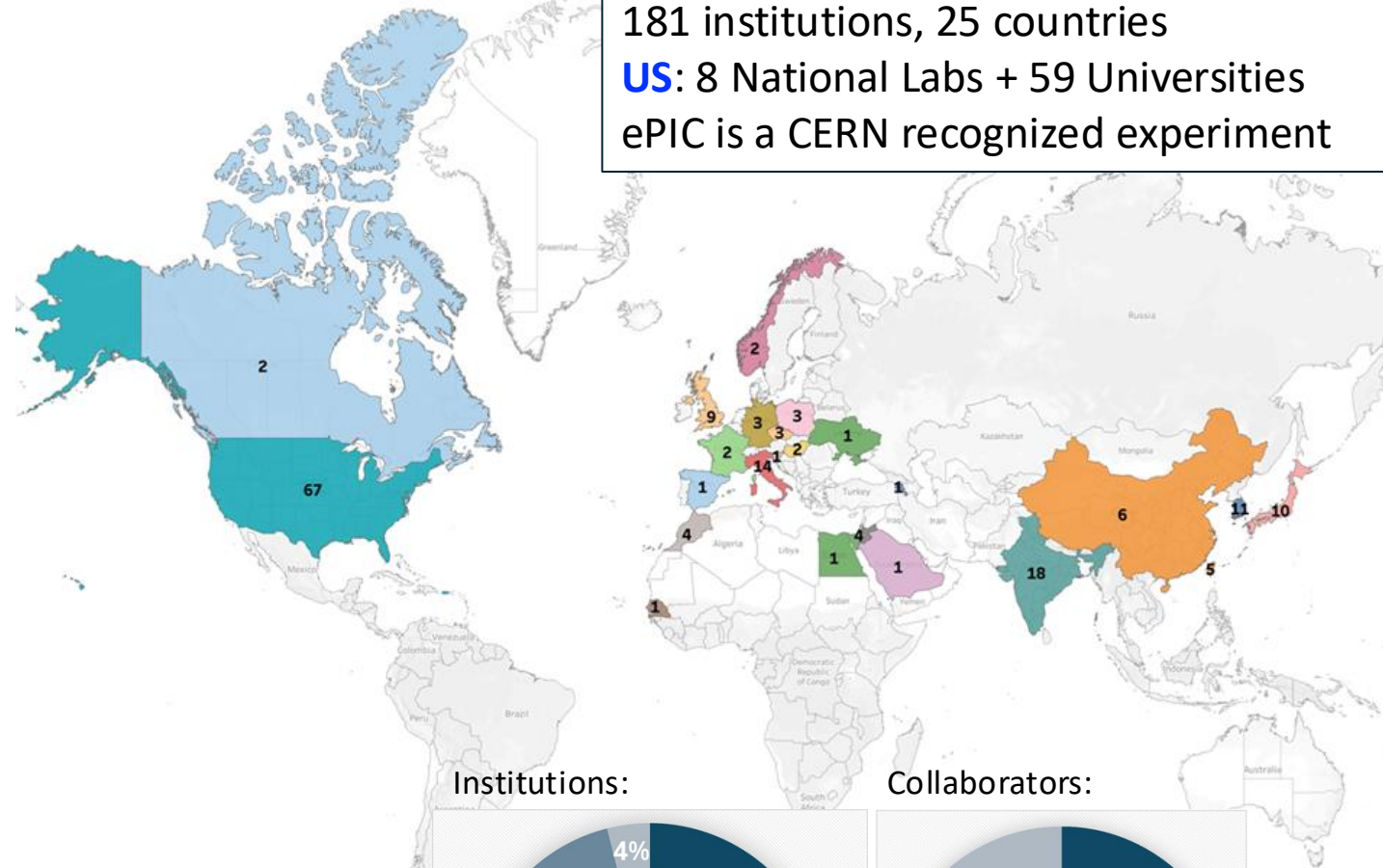


>1100 collaborators

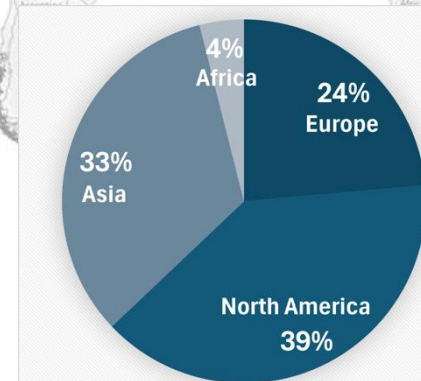
181 institutions, 25 countries

US: 8 National Labs + 59 Universities

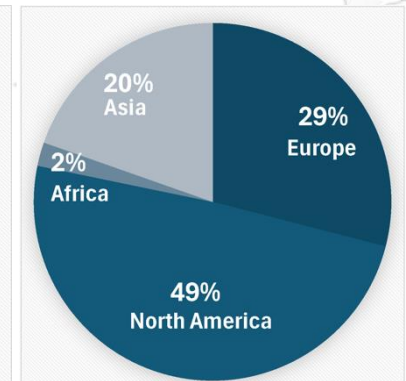
ePIC is a CERN recognized experiment



Institutions:

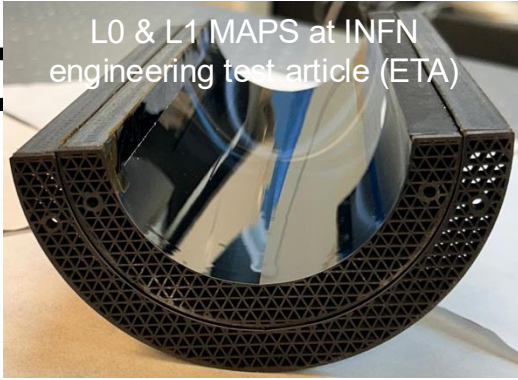


Collaborators:





MicroMega ETAs
(CEA) at CERN
Test Beam Nov 2025



L0 & L1 MAPS at INFN
engineering test article (ETA)



HRPPD
DIRC and pfRICH
Photonsensor at
BNL & JLab



μ RWELL-ECT ETAs (INFN)
at CERN Test Beam 11/25



Team of Japan, Taiwan and Korea at
Jhokai U test beam



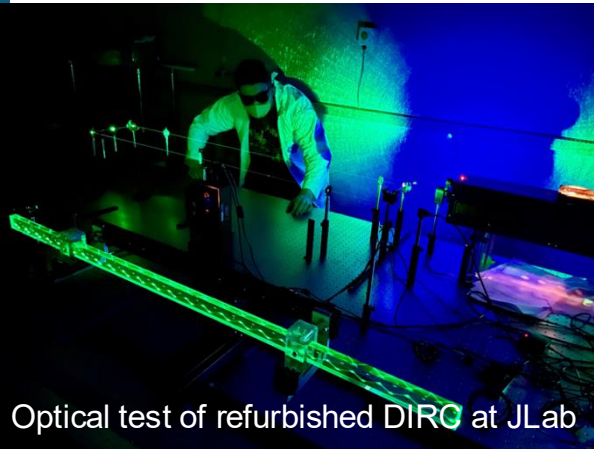
ePIC DAQ Setup at BNL (similar at JLab)



proximity focusing RICH
Carbon fiber vessel at SBU



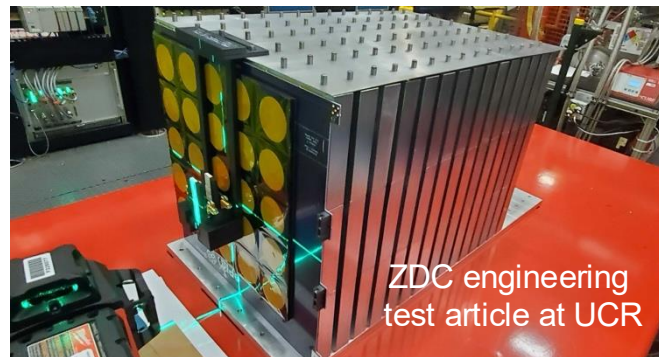
Timepix4
Detectors
Focal Plane Detectors
Spdr4
electrons
Low- Q^2 Tagger ETA
(Glasgow) at test beam



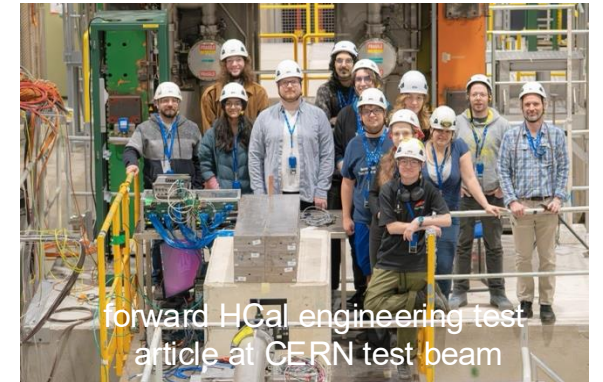
Optical test of refurbished DIRC at JLab



dRICH readout unit
at INFN



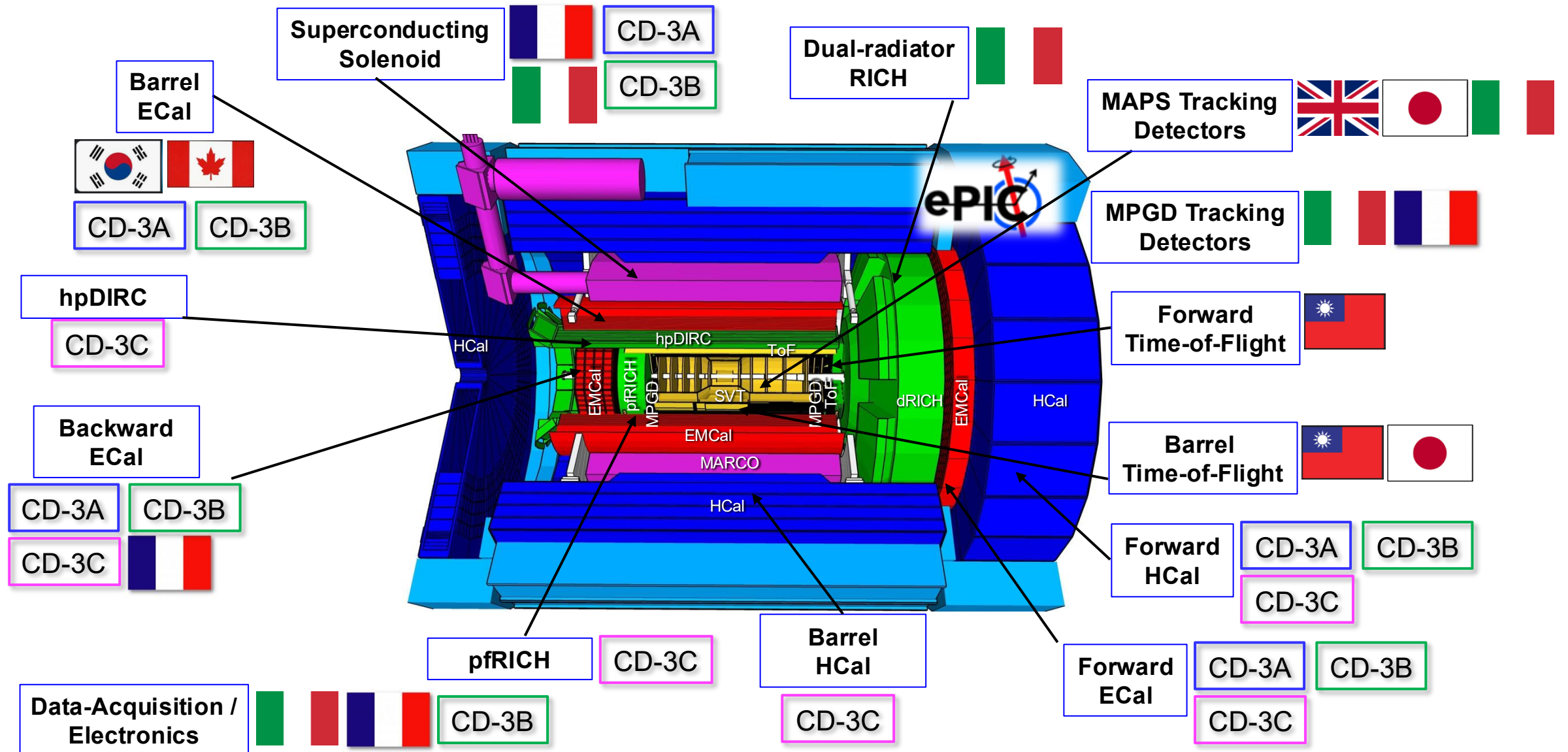
ZDC engineering
test article at UCR



forward HCal engineering test
article at CERN test beam

ePIC- In-Kind contributions & subsystems

In-Kind: \$90M

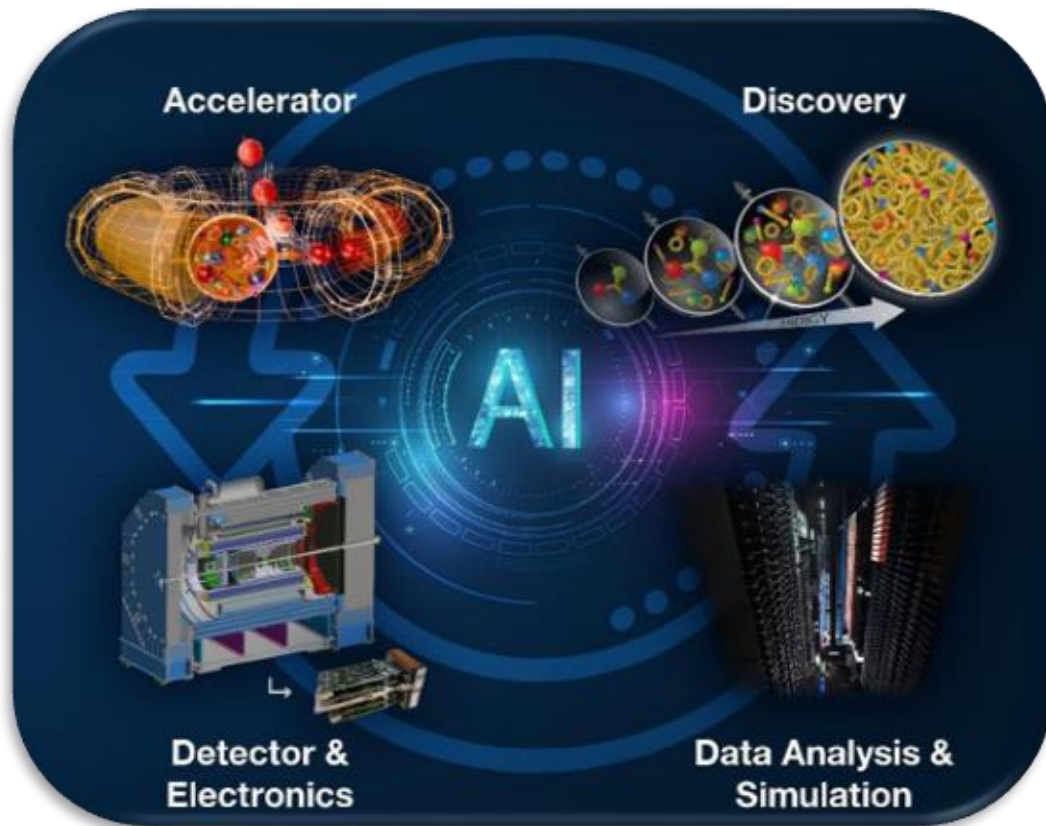


CD3-X = long lead procurements, X= A, B, C,

EIC: First AI-Enabled Collider

Recent successes in Genesis Phase-1's

AI is embedded across the entire discovery pipeline—from accelerator operations and detector systems to simulations and at the end scientific analysis of the (experimental) data and their (theory) interpretation.



AI Across the Lifecycle

- First large-scale facility to leverage AI from the start; R&D and design phases to discovery.

AI for Discovery

- Accelerator, detector, and data analysis will all use — and push the evolution of — advanced AI techniques with potential impacts for other fields and facilities.

AI Foundation

- BNL led “FM4NPP” – foundation model for AI for particle and nuclear physics detectors – being tested & used for RHIC data analyses now & will be extremely useful for the EIC and all future collider and detectors.

EIC Performance Ramp up during early Years

Goal: commission EIC's unique capabilities and provide opportunities for world first science

- longitudinal electron and light ion (proton and He-3) longitudinal and transverse polarization
- electron – ion collisions
- large center-of-mass range → hadron beam with radial shift

Ramp-up of Performance and Science Capability

Year - 1	Year - 2	Year - 3	Year - 4	Year - 5
Electron – Ion collisions 9 GeV electrons on Ion beam with $A/Z \sim \frac{1}{2}$ (Ag, Nb, Cu, Ru)	9 GeV long. polarized electrons on 130 GeV/u Deuterium	9 GeV long. polarized electrons on 130 GeV/u transverse/longitudinal polarized hadrons	9 GeV long. polarized electrons on 110 GeV/u Au / 275 GeV polarized protons	9 GeV long. polarized electrons on 166 GeV/u polarized He-3 beams
New Capability: Commission electron polarization in parallel	New Capability: Commission hadron polarization in parallel	New Capability: Commission running with hadron spin rotators in parallel	New Capability: Commission running hadron beam with radial shift	New Capability: Commission running polarized He-3 beam
Physics: Dense Gluon Systems QCD in Nuclei	Physics: QCD in Nuclei Flavor structure of nucleons and nuclei	Physics: Flavor structure of nucleons and nuclei, Spin	Physics: Dense Gluon Systems QCD in Nuclei	Physics: Spin structure of nucleons
QCD in Nuclei	3D-Imaging	SPIN 3D-Imaging	Dense Gluon Systems	SPIN

Summer shutdowns: install additional equipment to build out EIC capabilities*

* ESR-RF-Cavities, ESR & HSR Crab Cavities, 41 GeV Bypass, Low Energy Cooler
18 GeV capability

Early Running Configurations

9 GeV electron beam (at 10 nC bunch charge) collides with a staged sequence of hadron and ion beams

Stage 1: Commissioning

Unpolarized mid and light-weight ions for technical stability in RHIC → EIC transition

Stage 2: e^- Polarization

Longitudinal electron polarization via spin rotators; far-forward system become operational; transversely polarized hadron beams become available

Stage 3: Hadron Polarization

Hadron spin rotators enable longitudinal proton polarization

Eventually, at the end of the period, polarized ^3He ions will be available

Note: $e + A$ luminosity is per nucleon

Species	Beam energy (GeV)	Integrated luminosity (fb^{-1})	Electron-beam polarization	Hadron-beam polarization
$e + \text{Ag}$	9×115	1.0	NO	N/A
$e + \text{D}$	9×130	1.5	LONG	NO
$e + p$	9×130	1.0	LONG	TRANS and/or LONG
$e + p$	9×275	2.5	LONG	TRANS and/or LONG
$e + \text{Au}$	9×100	1.0	LONG	N/A
$e + ^3\text{He}$	9×166	1.5	LONG	TRANS and/or LONG

Assumptions:

Running 30 weeks/year; 2.5 hour turn around time; 80% facility availability

Other configs technically possible:

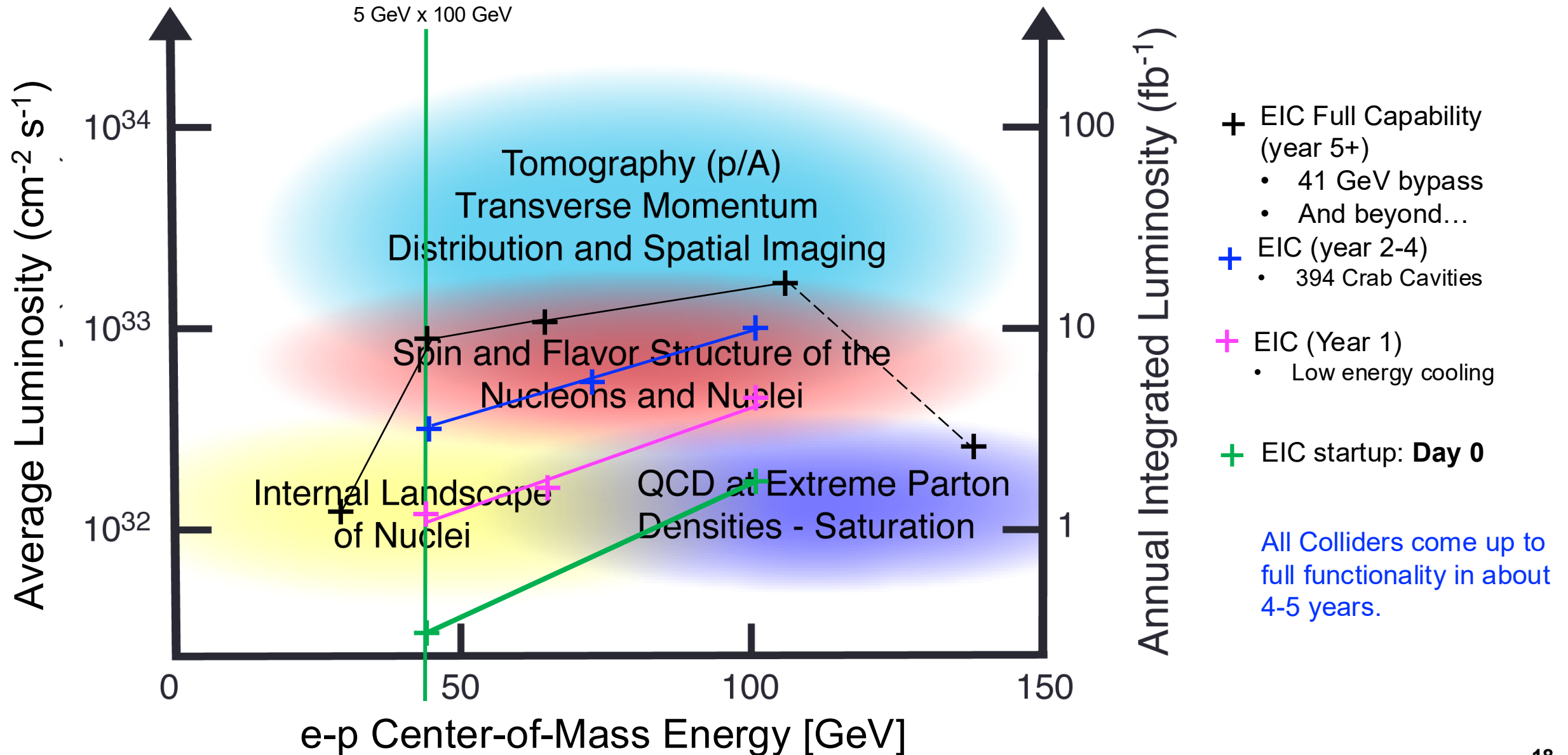
$e + p$ 5 x 100 ($0.5 \text{ fb}^{-1}/\text{yr}$);

$e + \text{Au}$ 5 x 110 ($2 \text{ fb}^{-1}/\text{yr}$);

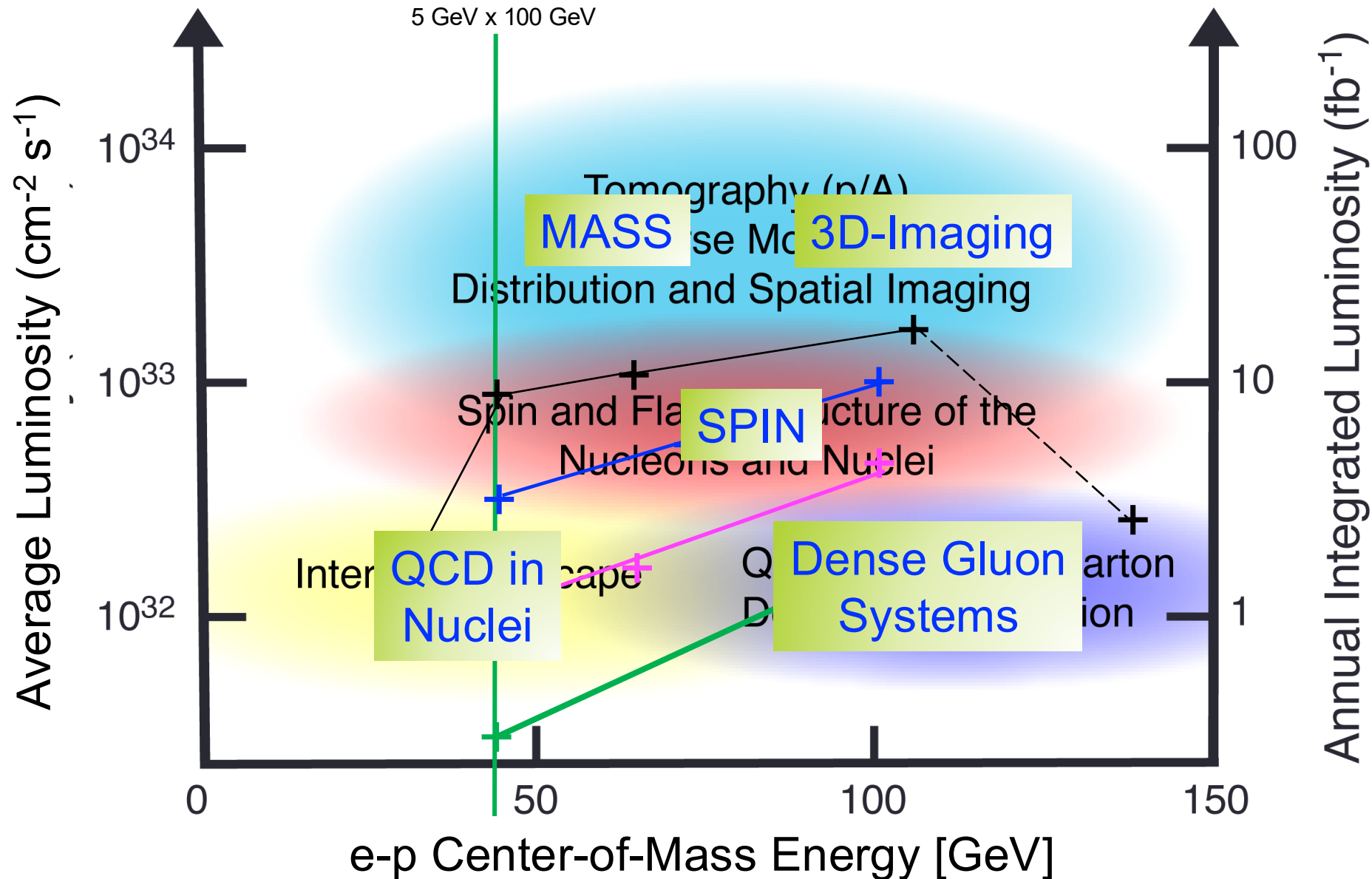
$e + \text{Ag}$ 5 x 110 ($2 \text{ fb}^{-1}/\text{yr}$);

Compare with HERA - delivered 0.5 fb^{-1} to each of H1 and ZEUS in its lifetime!

EIC will evolve to full performance in ~5 years



EIC will evolve to full performance in ~5 years



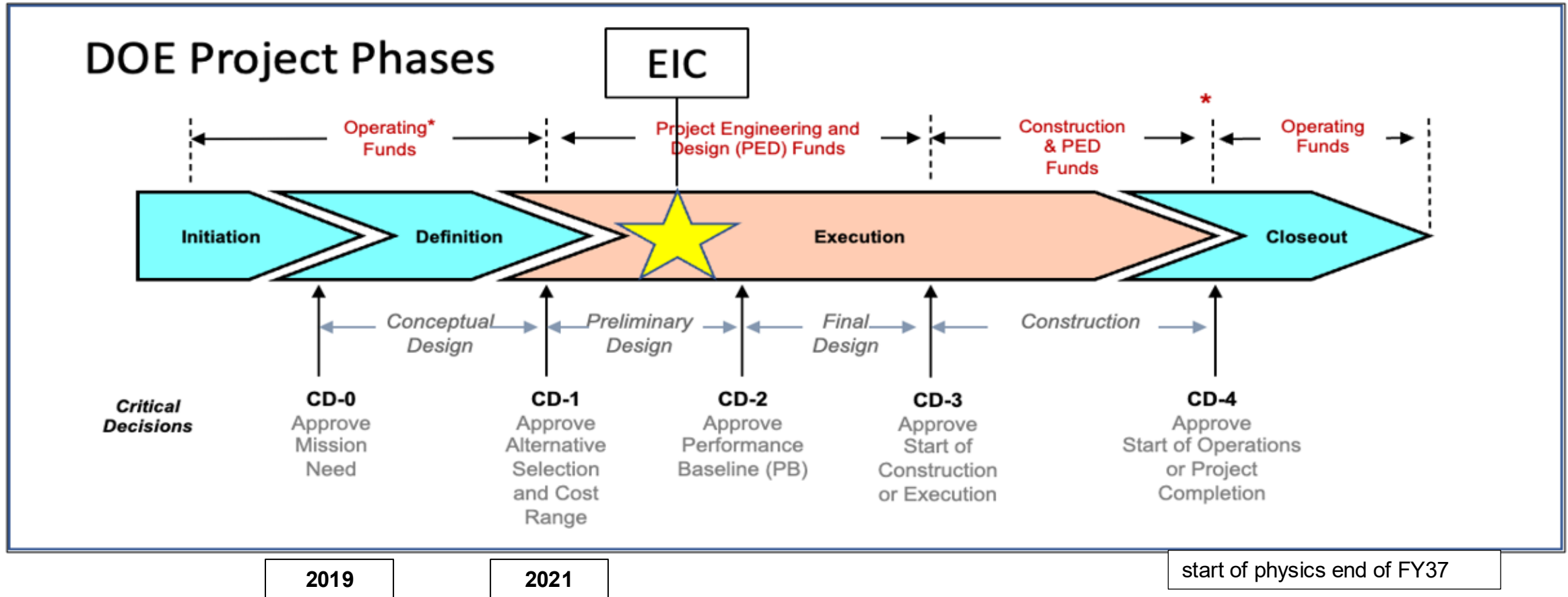
- + EIC Full Capability (year 5+)
 - 41 GeV bypass
 - And beyond...
- + EIC (year 2-4)
 - 394 Crab Cavities
- + EIC (Year 1)
 - Low energy cooling
- + EIC startup: **Day 0**

All Colliders come up to full functionality in about 4-5 years.

Strategic EIC Schedule

DOE Approval		Electron-Ion Collider																Fiscal Year (FY) = Oct 1 - Sep 30																																							
CD-0	2019	FY24				FY25				FY26				FY27				FY28				FY29				FY30				FY31				FY32				FY33				FY34				FY35				FY36				FY37			
CD-1	2021	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4												
CD-3A	2024																																																								
CD-3B	Jan 2026																																																								
CD-3C	Jan 2027																																																								
CD-2/3 (INF-1)	Jan 2027																																																								
Long Lead Procurement		CD-3A 3B 3C 3D																																																							
6.02 Infrastructure		INF-1 INF-2																																																							
Accelerator	6.04 Electron Injector	ACC CD-2/3																																																							
	6.05 Collider																																																								
6.03 Detector		DET CD-2/3 *DET CD-3D																																																							
6.06 Pre-Operations/Ops		Preliminary Internal Baseline CD-4																																																							
* New York State & DOE Funded Infrastructure - Site Clearing and Collider Buildings		Light Color Design Critical Path Dark Color Procurement, Construction, and Installation DOE ESAAB Approvals Planning Milestones																																																							

DOE EIC Critical Decision Milestones & Risks



The EIC Project is divided in subprojects: Accelerator (HSR, ESR, IR, EIN), Detector and Infrastructure Combine CD-2 and CD-3 for the different subprojects from now to FY2029

September 2026 DOE Independent Project Review Outcome

The review supported the next execution decisions and defined the work required to establish a fully executable baseline.

WHAT THE REVIEW CONFIRMED

Significant technical maturation and a stronger project execution approach

Four phased subprojects provide a logical sequence

Strong systems engineering, project controls, and ES&H/QA foundations

NEAR-TERM DECISIONS

Proceed with INF-1 CD-2/3 after final required documents

Proceed with CD-3C Accelerator and Detector long-lead procurements

Resolve New York State grant terms before INF-1 funds are used

SIX-MONTH FOCUS

Preliminary performance baseline with bottom-up contingency by 1 April

Configuration management and complete installation logic by 1 April

Affordability decisions, resource leveling, funding alignment, and portfolio dependencies

The review maintains momentum for the first Infrastructure Subproject - CD2/3 and critical Long-Lead Procurements - CD-3C, while the Project completes the preliminary performance baseline and the affordability work needed to support future decisions.

EIC Project Status & FY27 Priorities

- The EIC project is already underway, with an estimated Total Project Cost of about **\$3.5 billion**, a **CD-3B, Long Lead Procurements**, approved **Jan 2026**, and roughly **~\$500 million** spent so far, another recently **~\$200M** reviewed **positively in September 2026**.
- BNL using a “**portfolio**” strategy for EIC’s Long term success. Key activities planned for FY26–FY27 include:
 - Removal and repurpose RHIC equipment for EIC - ongoing
 - New York State financed EIC buildings and infrastructure – recently reviewed and approved
 - EIC ready for next steps – subprojects moving forward, equipment coming to BNL and being stored for installation

DOE Under Secretary D. Gil –
End of RHIC and Start of EIC



Blue Ring Removal –
April 2026



Ultrasonic Tank –
Clean Room Assembly



Arrival of ANL APS &
MIT Bates Magnets



Key take-aways:

1. EIC is not a “future” project; significant progress towards realization already. ~\$500M already committed out of the \$3.5B, Collaborations formed, DOE and other funding agencies engaged
2. EIC will certainly transform our understanding of QCD
 - Origin of mass and spin of protons, high density gluon fields and **many more**
 - Significant implication for **HEP science**:
 - ✓ Better SM background subtraction in BSM searches → improved precision in α_s and PDFs
 - ✓ Potential: EW and BSM searches via complementary techniques/phase spaces
3. Synergetic development of **detector technologies** (partnerships between NP-HEP community)
 - Next-generation detector technologies, electronics, software, AI, and superconducting systems
4. Potential collaboration **accelerator technologies** of the future
 - Driven by needs at the EIC, with implications far beyond the EIC – beam cooling, polarization/spin manipulation, crab activities...
5. **Workforce development**: Students, postdocs trained at the EIC ↔ future HEP facilities

If you are looking for a place where fundamental science, cutting-edge instrumentation, and future collider physics connect, EIC → an excellent opportunity

The \$3.5B EIC Project delivers first collisions in FY37; luminosity increases over a five-year initial operations and science exploration phase

LINE-ITEM PROJECT SCOPE

\$3.53B Total Project Cost
\$0.50B Actuals to Date
\$0.75B Remaining Contingency
\$2.25B Cost to Go

Key Performance Parameters (KPPs)

- Average Luminosity $2 \times 10^{32} \text{ cm}^{-2} \text{ s}^{-1}$
- Polarized electron and hadron beams 70%
- Ion Species through Uranium
- Unique initial program in gluon, spin, and nuclear structure

First collisions FY37

INITIAL OPERATIONS RAMP

\$274M Total Cost

- Candidate scope for in-kind **contributions**

Performance

- Average Luminosity $3 \times 10^{33} \text{ cm}^{-2} \text{ s}^{-1}$
- Peak luminosity $10^{34} \text{ cm}^{-2} \text{ s}^{-1}$ @ 100 GeV CoM

Scope items provide capability when needed

- SRF \$68M (AIPs)
- SRF Crab cavities \$78M (In-kind from Canada)
- Low-energy cooling \$128M (In-kind interest)

The investments planned for initial operations are not required for first collisions and are sequenced to increase luminosity in step with the needs of accelerator commissioning and the science program.

HERA vs EIC

Parameter	HERA	EIC	Comparison
Electron–proton beam energies	27.5 GeV × 920 GeV	5–18 GeV × 41–275 GeV	EIC Flexible CoM energies
ep luminosity	reference HERA-II $3.6 \times 10^{31} \text{ cm}^{-2} \text{ s}^{-1}$	$10^{33} - 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$	EIC 30–300× the HERA reference luminosity
Polarization	polarized electron; unpolarized proton	~70% electron and proton/light-ion polarization	EIC enables precision spin-dependent DIS
Ion species	only p	protons through heavy ions (up to uranium)	EIC adds systematic nuclear-QCD measurements

EIC initial average luminosity is 5 x HERA and after 5-years is >100 x HERA.

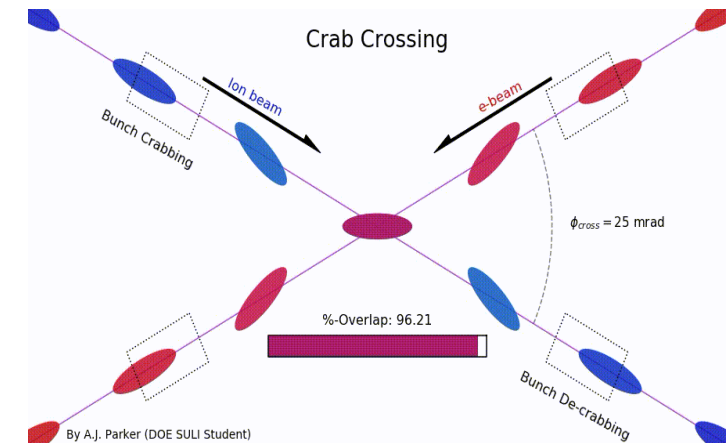
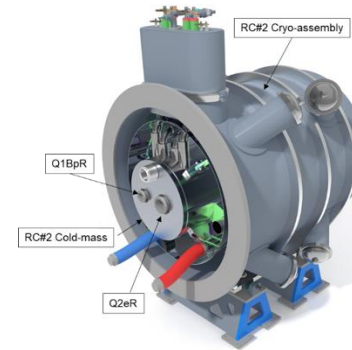
The Path to EIC with Ultimate Performance

To keep cost under control we will build out full the EIC capability (construction and installation) during first 5y of operations → Installation priority during initial operations determined by science

1. Construct/Install 4 additional SRF systems for ESR full bunch current @9GeV
2. Construct/Install Low-Energy Cooler
3. Construct/Install 394 MHz Crab Cavities
→ This supports the mission-need luminosities of $10^{33-34} \text{cm}^{-2}\text{s}^{-1}$
4. Construct/Install 41 GeV Bypass
→ This extends the center-of-mass energy down to 29 GeV
→ mission need: $E_{\text{cm}} = \sim 20 - 100 \text{ GeV}$ (upgradeable to 140 GeV)
6. Upgrade to 18 GeV
→ RCS and the corresponding RCD 2K Construct/Install 2 additional SRF systems in the ESR, 6 additional SRF systems and cryoplant in the RCS, and remaining arc magnet girders
→ This extends the center-of-mass energy up to 140 GeV

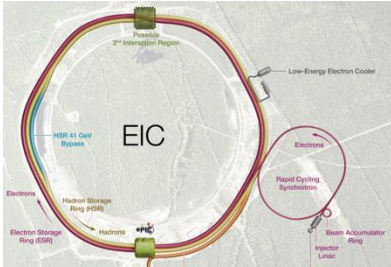
Key EIC Accelerator Technologies Relevant also for Future Colliders

- **Hadron beam cooling**
 - Ribbon-like (flat) hadron beam (11:1 transverse emittance/size ratio)
 - Upgrade path: high-energy hadron cooling at collisions would require a high-current ERL.
- **Spin preservation** from source to collisions (protons and electrons)
- **Large crossing angle** (25 mrad)
 - SRF crab cavities both for electron and hadron beams
- Large-aperture superconducting magnets
- SRF cavities for high-current beams (2.5 A)
- AI/ML embedded: to design, simulations (accelerator twins) optimized operations



Key concepts that achieve a luminosity of $\sim 10^{34} \text{ cm}^{-2}\text{s}^{-1}$ and maintain high polarization over a broad range of Center-of-Mass energies at the EIC → Synergies with future HEP Accelerators

Complementarity for 1st-IR & 2nd-IR

	1 st IR (IP-6)	2 nd IR (IP-12)
Globally:	same accelerator highlights and challenges	
Geometry:	ring inside to outside	ring outside to inside
Crossing Angle:	25 mrad	35 mrad → more difficult to get acceptance at high η
		
	different blind spots	
	different far-forward/backward detector acceptances	
Luminosity:	same luminosity at both IRs Luminosity is shared between both IRs same center-of-mass energy coverage	
IR-Design:	far-forward acceptance $0.2 \text{ GeV} < p_T < 1.3 \text{ GeV}$	2 nd Focus → improved low p_T acceptance $x_L \sim 1 \rightarrow p_T \sim 0$
Detector:	complementarity through different subdetector technologies	

Why a 2nd Detector / IR

Conventional reasons for a 2nd Detector / IR:

- Cross-checks and Discovery Validation
 - Control of Systematic Uncertainties
 - Complementary Technologies, Technology Redundancy and Physics Reach
 - Cross Calibration
- Scientific productivity will be optimized with two complementary detectors. This will ensure the greatest yield of science, guarantee that discoveries can be confirmed and precision results can be cross-checked.

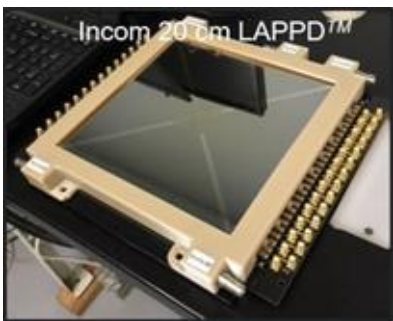
What if we develop a Complementary science case with complementary detector technologies and with complementary scientists. People from HEP - BSM searches, please join and lead the way. A second detector design idea and realization awaits you!

New Physics Opportunities at the EIC – SMEFT, Precision Couplings, and BSM Searches

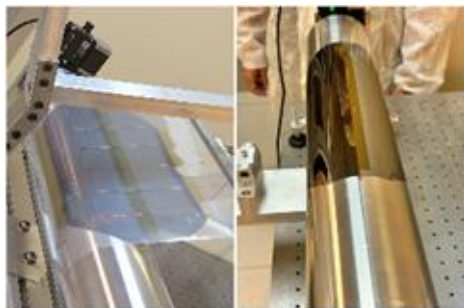
- **SMEFT at the EIC and other discussions:**
 - LHC measurements are largely (SM)-like → new physics to above 1 TeV.
 - SMEFT provides a unifying framework to globally combine top, Higgs, di-boson, EWPO, and flavor data. (S. Dawson)
 - Low-energy measurements (precision Parity-Violating Electron Scattering, PVDIS) at the EIC can help disentangle dimension-6 from dimension-8 operators and break degeneracies missed by high-energy LHC data. (V. Cirigliano, S. Gardner)
- **Precision Couplings:**
 - EIC can approach ~0.1% precision on the weak mixing angle. (Nycz)
 - Light quark electroweak couplings and α_s (the strong force constant) can be improved, improving global SM fits – background subtraction in BSM searches. (T. Kutz, Z. Demiroglu)

Experimental Searches – CLFV, Sterile Neutrinos, Dark Photons & Axion-Like-Particles

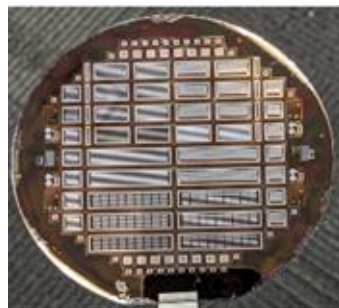
- **Charged Lepton Flavor Violation (CLFV):** (Fuyuto, Nycz, Y. Furlatova)
 - EIC competitive in BSM searches involving third-generation. (e.g., $e+p \rightarrow \tau X$).
 - Preliminary simulations: EIC sensitivity could rival or complement low-energy and LHC bounds
- **Sterile Neutrinos:** (S. U.-Quiroga)
 - Lepton-number-violating (LNV) processes like $e^-p \rightarrow \nu_{jjj}$, targeting sterile neutrinos $m \sim 100$ GeV.
 - Projected EIC exclusions at 95% C.L. can significantly improve for both $e\nu$ and $\mu\nu$ sectors—competitive with other collider and low-energy probes.
- **Dark Photon & Axion-like Particle (ALP) Searches:** (H. Davoudiasl, E. Niel, S. Gardner)
 - EIC enables unique searches in coherent heavy-ion scattering, leveraging large Z^2 enhancements.
 - Projected sensitivity contours competitive with and complementary to Belle II, LHC, and rare decay experiments.
 - Enhanced sensitivity for displaced decays and lepton-flavor-violating ALP final states.



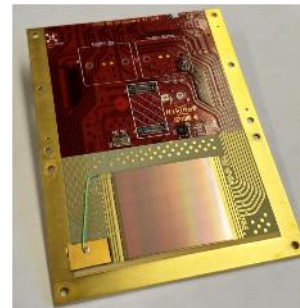
LAPPD



Monolithic Active Pixel Sensor



AC-coupled Low Gain
Avalanche Diodes



Application-Specific
Integrated Circuit

Silicon Detectors: Joint development of **ALICE ITS3 MAPS technology** and the EIC Large Area Sensor (LAS) for next-generation low-mass tracking.

Particle Identification: Shared R&D on AC-LGAD timing detectors, SiPM photon sensors, LAPPDs, GEMs, μ RWELLS, and advanced Cherenkov detectors.

Electronics & ASICs: Collaborative development and future production of streaming-readout ASICs (EICROC, CALOROC, SALSA, ALCOR, FCFD).

Superconducting Magnet: International development of the **MARCO solenoid**, leveraging CERN and European expertise in detector magnet technology.

DAQ, Software & AI: Common streaming-readout architecture, ACTS software, detector simulation, data management, AI/ML for detector optimization, calibration, and analysis.