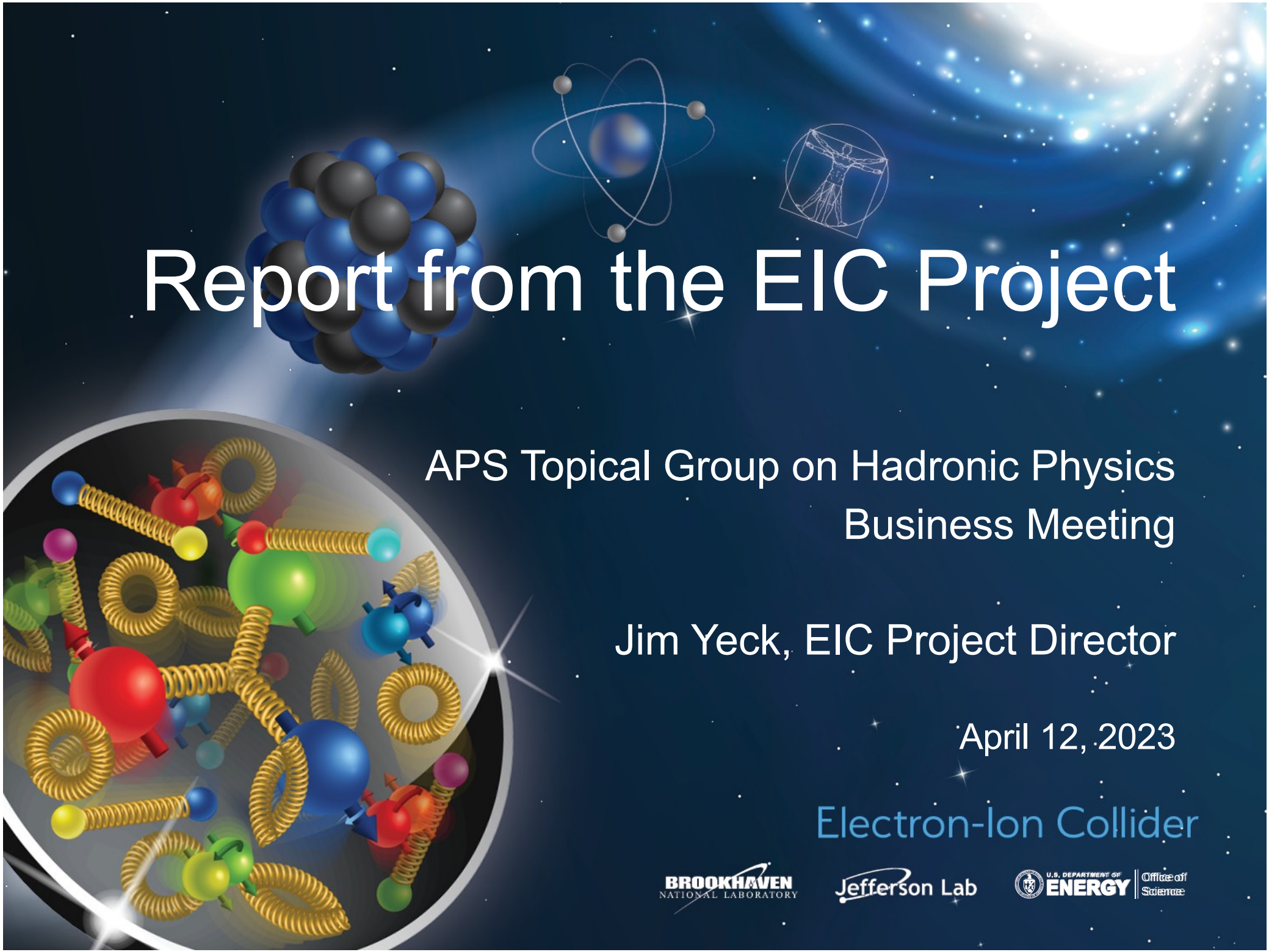
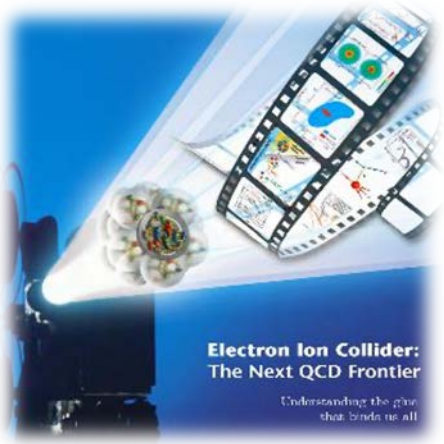

Report from the EIC Project
APS Topical Group on Hadronic Physics
Business Meeting
Jim Yeck, EIC Project Director
April 12, 2023
Electron-Ion Collider
BROOKHAVEN
NATIONAL LABORATORY
Jefferson Lab
U.S. DEPARTMENT OF
ENERGY
Office of
Science

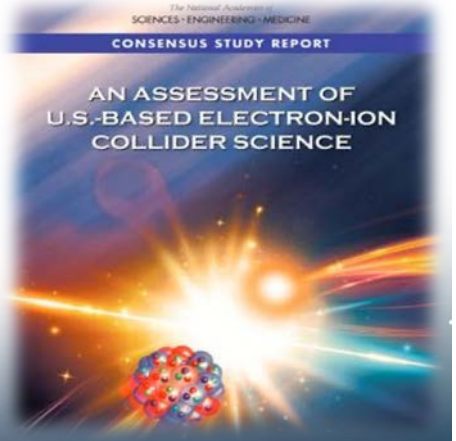
EIC Requirements

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} = 20 – 140 GeV
- Large Ion Species Range: protons – Uranium
- Large Detector Acceptance and Good Background Conditions
- Accommodate a Second Interaction Region (IR)



Conceptual design scope and expected performance meets or exceed NSAC Long Range Plan (2015) and the EIC White Paper requirements endorsed by NAS (2018).



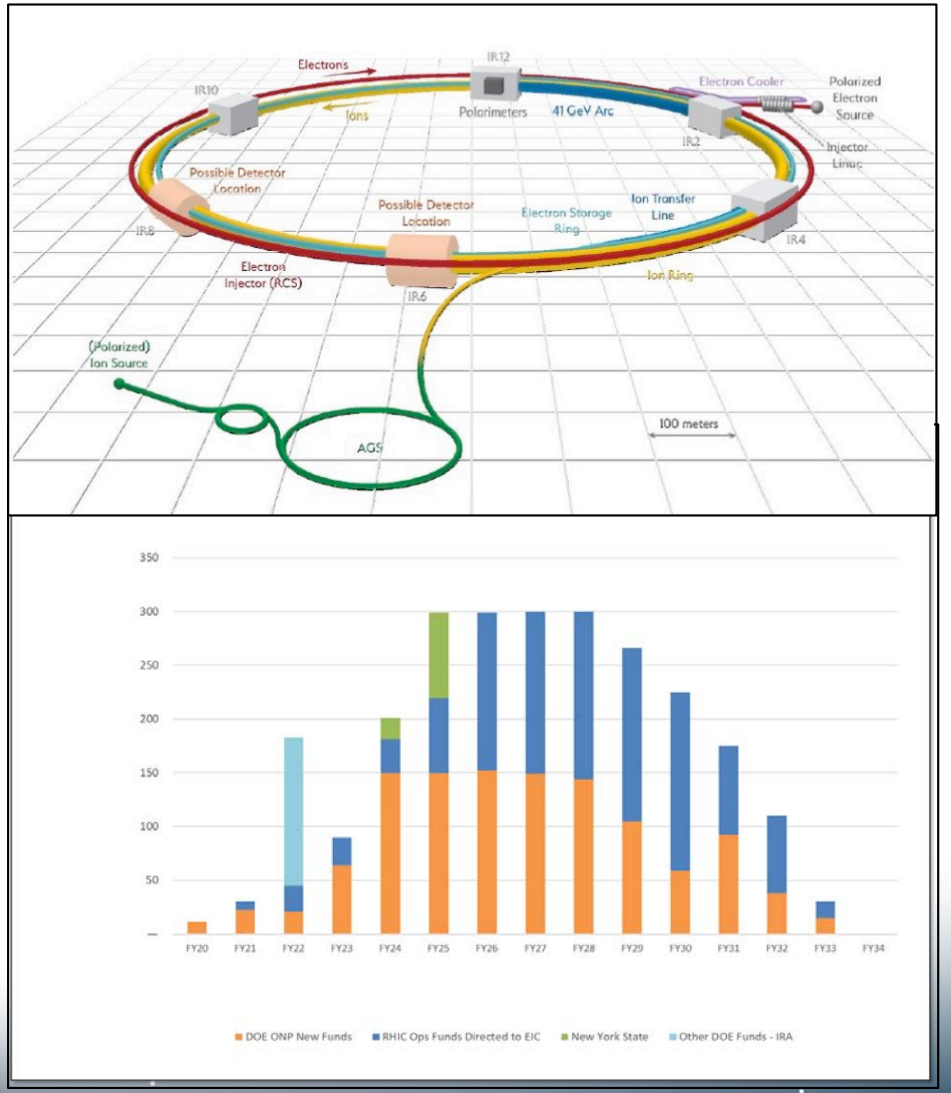
NSAC Long Range Plan (2023) expected to endorse EIC.

Electron-Ion Collider

Summary

- Partnership among Brookhaven Lab, Jefferson Lab, and DOE with support from New York State
- Milestones
  - CD-1, Preliminary Baseline June 2021(A)
  - CD-3A, Long Lead Procurement Jan 2024
  - CD-2/3, Baseline/Const. Start April 2025
  - CD-4a, Initial Operations April 2032
  - CD-4, Construction Complete April 2034
- Schedule and Budget
  - Cost Range at CD-1 = $1.7–2.8B, plus $100M from NYS and $150M In-kind
  - Pursuing technically driven schedule and budget profile (most cost effective)
  - DOE FY23 Enacted: $70 M; IRA: $138 M
    DOE FY24 President's Request: $97.85 M
- EIC will be the only particle collider operating in the U.S.
- Strong national and international interest
  - Over 1360 future users from 267 institutions in 36 countries planning experiments
  - International EIC Advisory Board and Resource Review Board

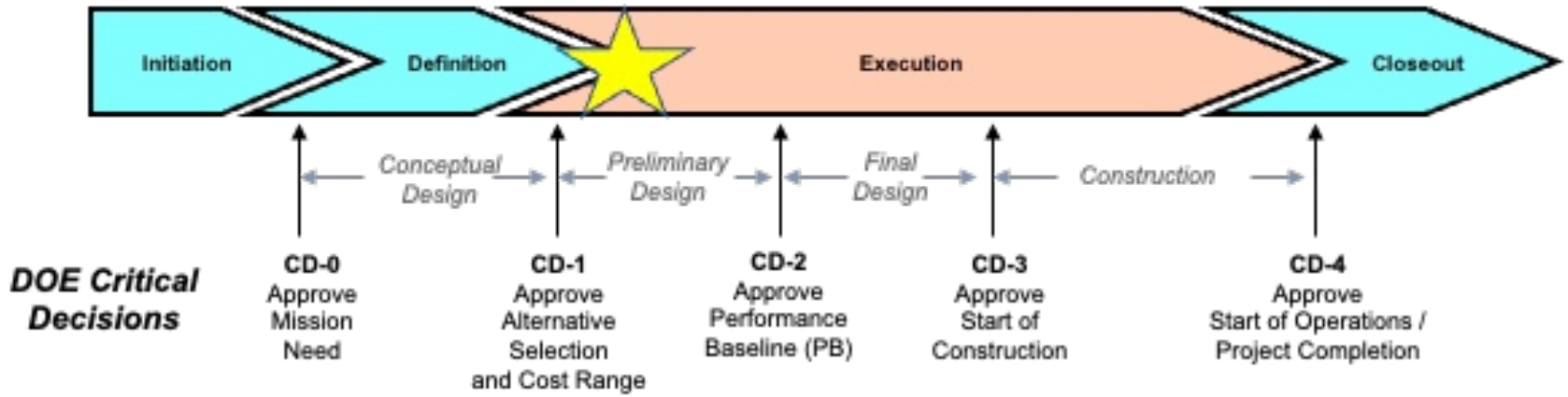
Double Ring Design Based on RHIC Facilities



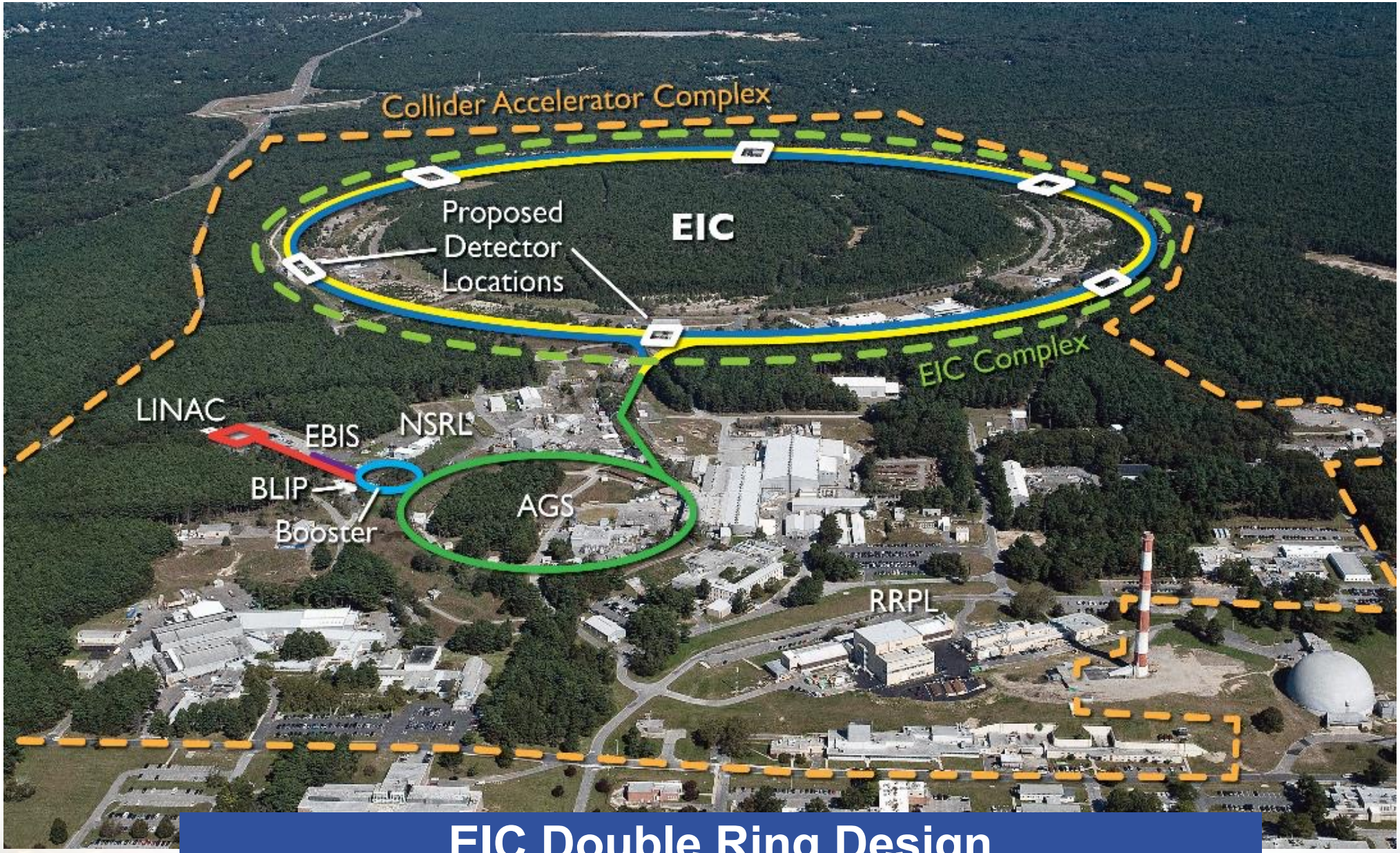
BNL/TJNAF Special Partnership

- BNL/JLab partnership established in early 2020
- Integrated project management and scope
- Serving together as hosts for the EIC experimental program

DOE Project Plan



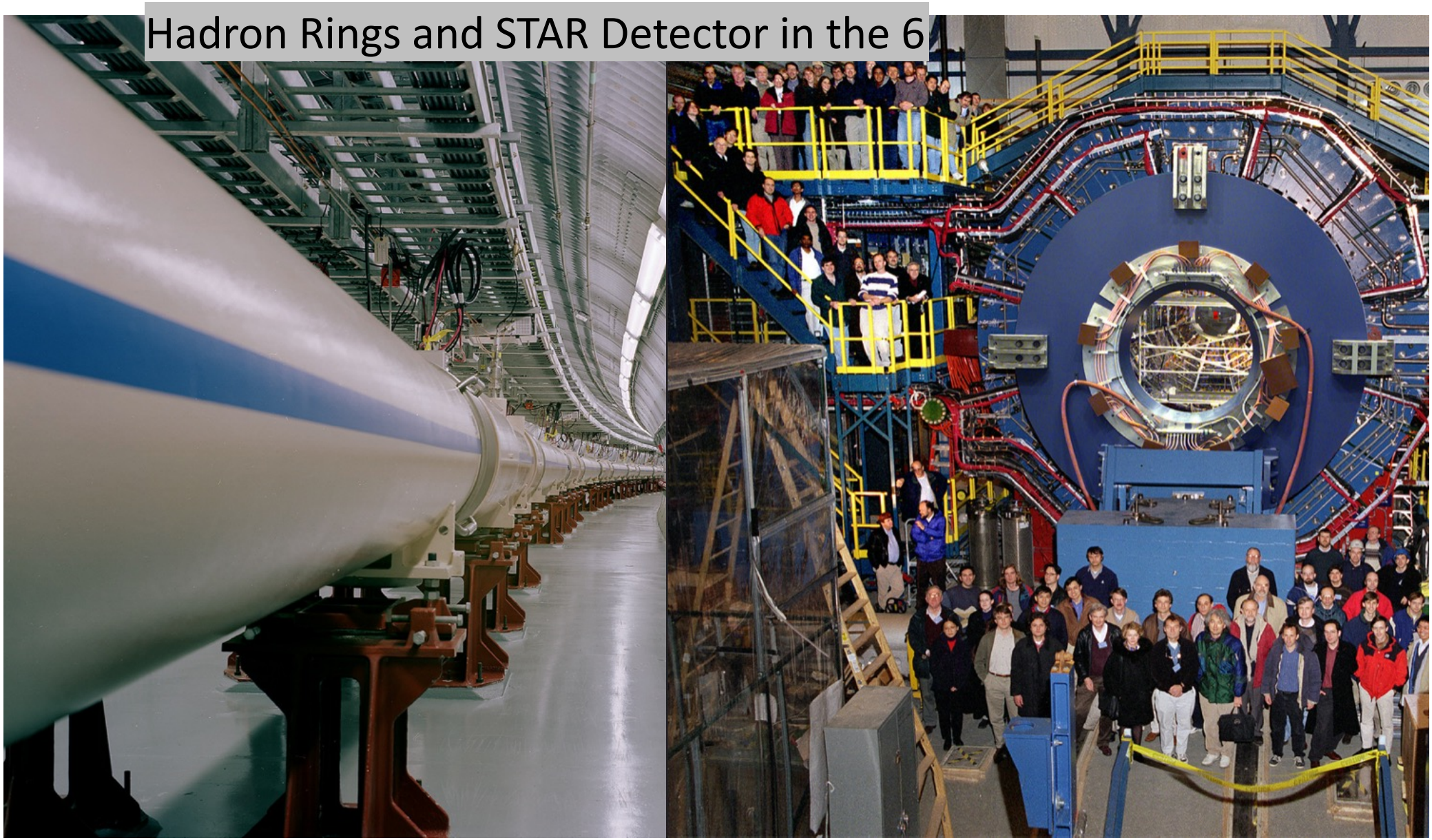
Milestone/Event	Date
CD-0, Mission Need Approved	December 2019
DOE Site Selection Announced	January 2020
BNL - TJNAF Partnership Agreement Established	May 2020
CD-1, Alternative Selection and Cost Range Approved	June 2021
CD-3A, Long Lead Procurement Approval	**January 2024**
CD-2/3, Performance Baseline/Construction Start Approval	**April 2025**
Planned Date for RHIC Shut Down	**June 2025**



EIC Double Ring Design
Based on Existing RHIC Facility at BNL
RHIC Operations Concludes in 2025

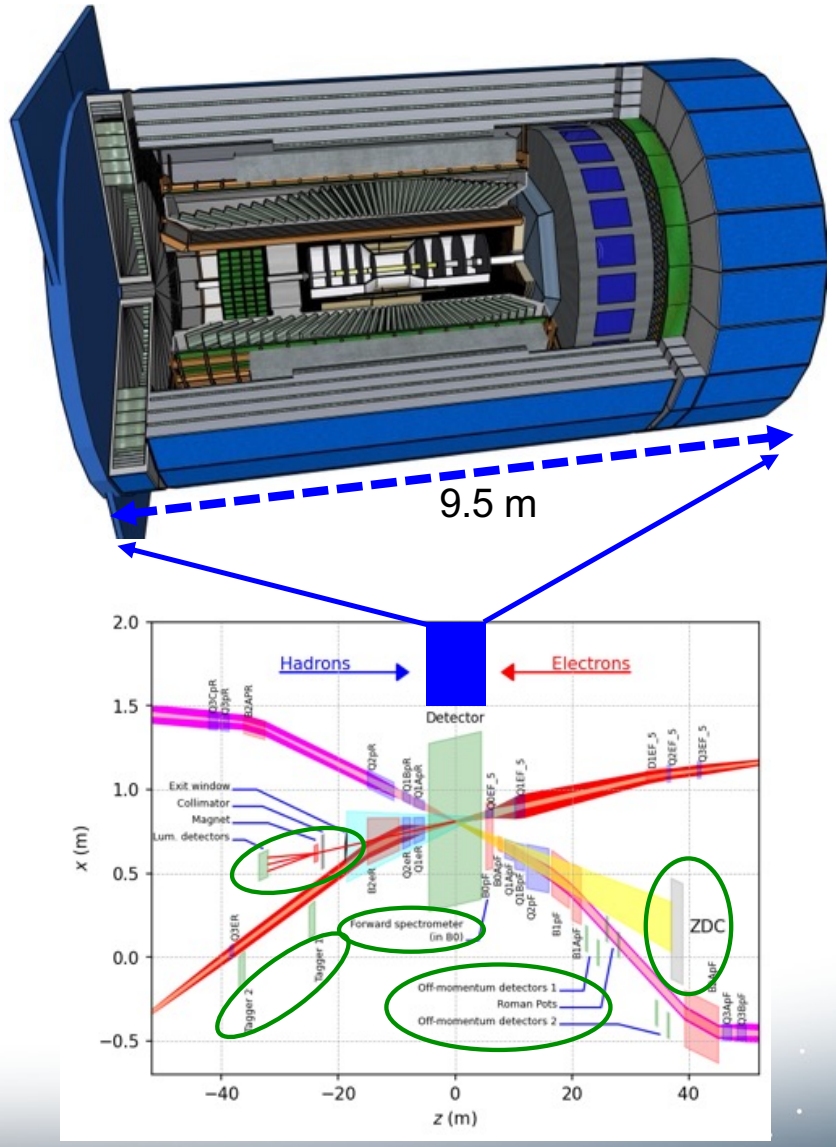
RHIC Infrastructure

Hadron Rings and STAR Detector in the 6

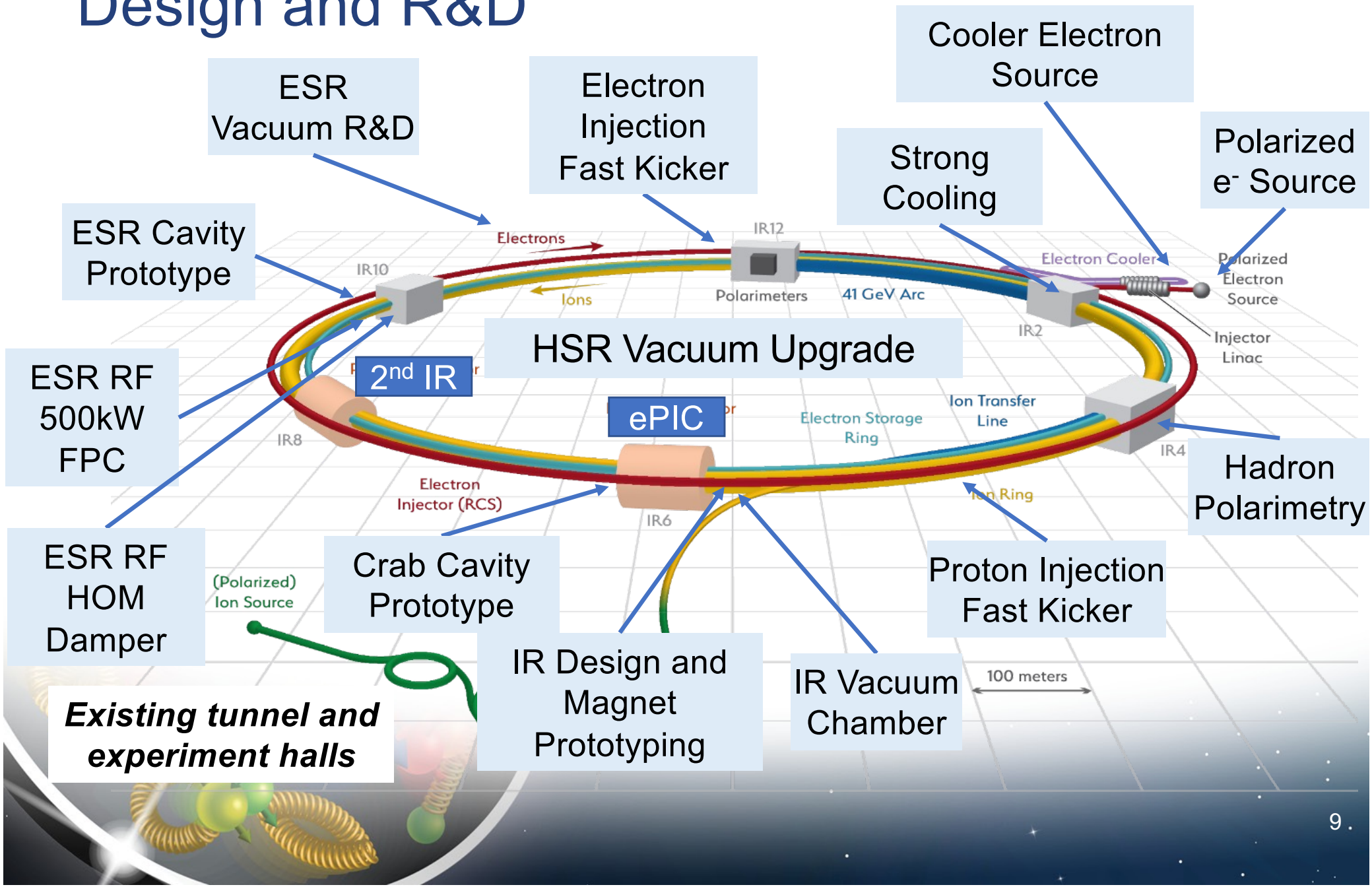


ePIC Detector

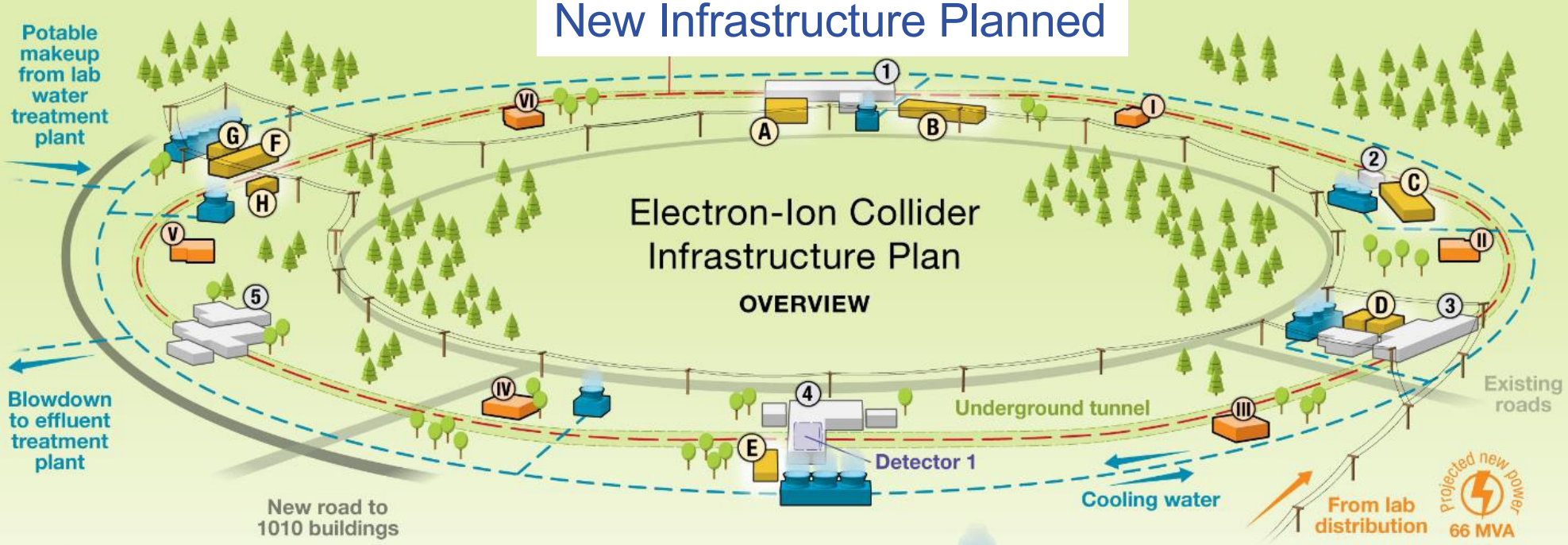
- Asymmetric beam energies
  - → require an asymmetric detector Barrel with electron and hadron endcap → 9.5 m
  - → Tracking, particle identification, EM calorimetry and hadronic calorimetry functionality in all directions
  - → very compact detector **Integration** will be key
- Imaging science program with protons and nuclei
  - → requires specialized detectors integrated in the Interaction Region over 80 m
- Science program required momentum resolution
  - → requires a large bore 2T magnet (1.7 T magnet operation point, stretch goal 2T) that has same geometry as the BaBAR magnet.
- Streaming readout electronics model
  - → highest scientific flexibility



Accelerator Science and Technology - Design and R&D



New Infrastructure Planned



APPROVED NEW BUILDINGS

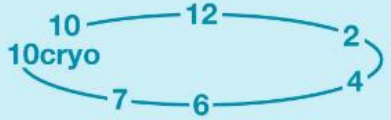
			sq. ft.	MVA
A	1012C	Kicker Power Supply	11,061	1.25
B	1012D	400 MeV Linac	9,812	1.16
C	1002H	Injection Linac	17,948	4.10
D	1004G	Cooling / Kicker	4,421	0.41
E	1006J	Cryo Building	4,738	2.85
F	1010C	RF Power Amplifier	40,844	28.2
G	1010D	DI Pumphouse	5,037	0.99
H	1010E	Cryo Facility	5,325	1.10

POWER SUPPLY BLDGS.

		sq. ft.	MVA
I	1001A	4,284	1.19
II	1003A	4,284	1.16
III	1005T	6,405	1.73
IV	1007A	9,034	12.6
V	1009A	4,284	1.18
VI	1011A	4,284	1.16

COOLING SYSTEM

	12	2	4	6	7
Heat load (MW)	0.1	10	6	7	1
Flow rate (gal/min)	94	6,612	4,221	4,778	1,028
Blowdown (gal/min)	0.2	18	11	13	3
Makeup (gal/min)	1	88	56	63	14



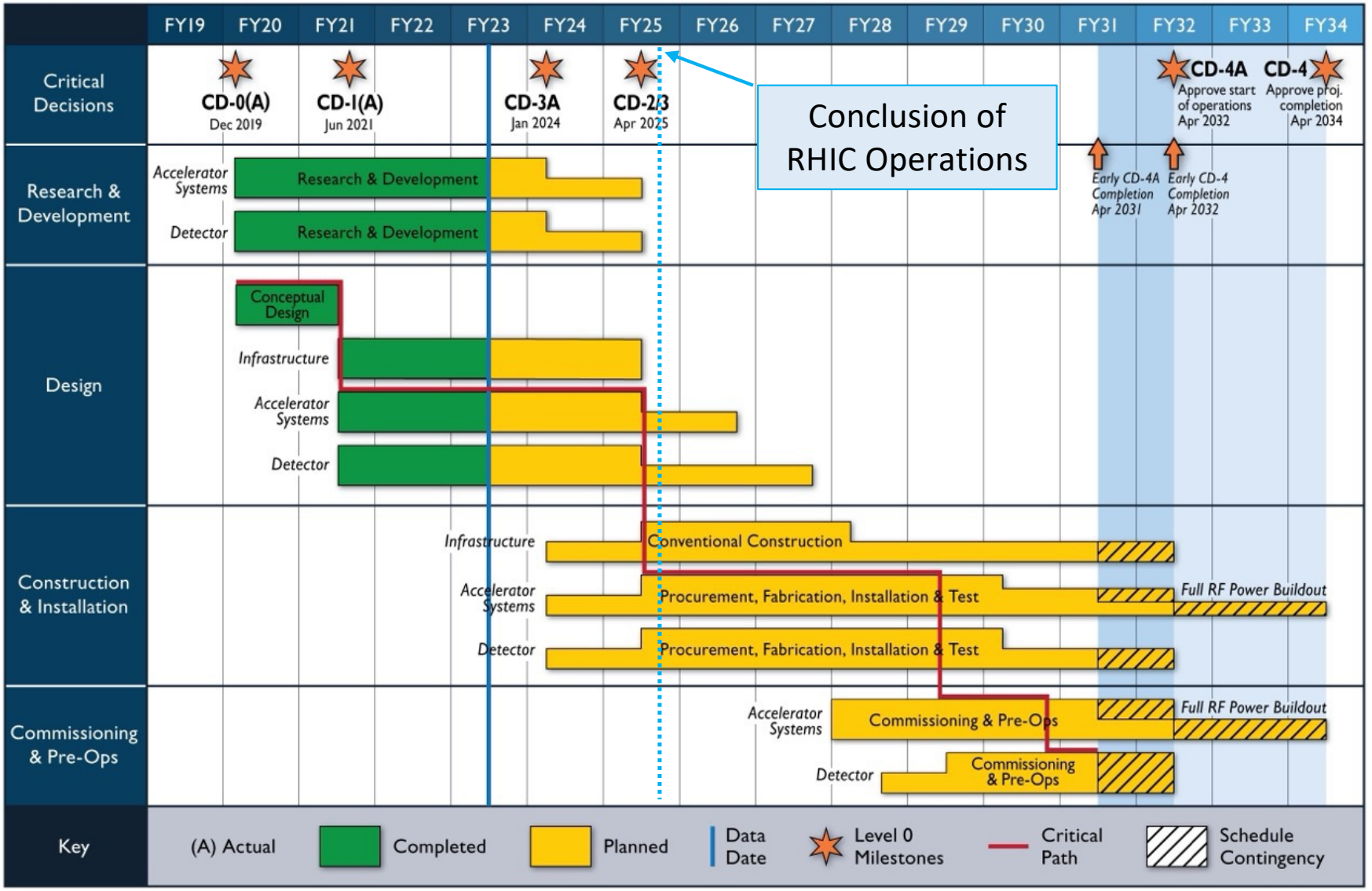
10	10cryo
23	1
15,507	830
41	2
206	11

EXISTING BUILDINGS

1. **1012 & 1012A** Interaction Region & Cryo/Polarimeter Service Building
2. **1002** Interaction Region
3. **1004 & 1004A** RHIC RF Supply Building
4. **1006 Complex** Detector 1 Experimental Hall & Service Buildings
5. **1008 Complex** Detector 2 Experimental Hall & Service Buildings

New York State will provide new EIC support buildings ($100M).

EIC Schedule



Cost Estimate Status (DOE)

CD-1 Approved Cost Range 1.7-2.8B

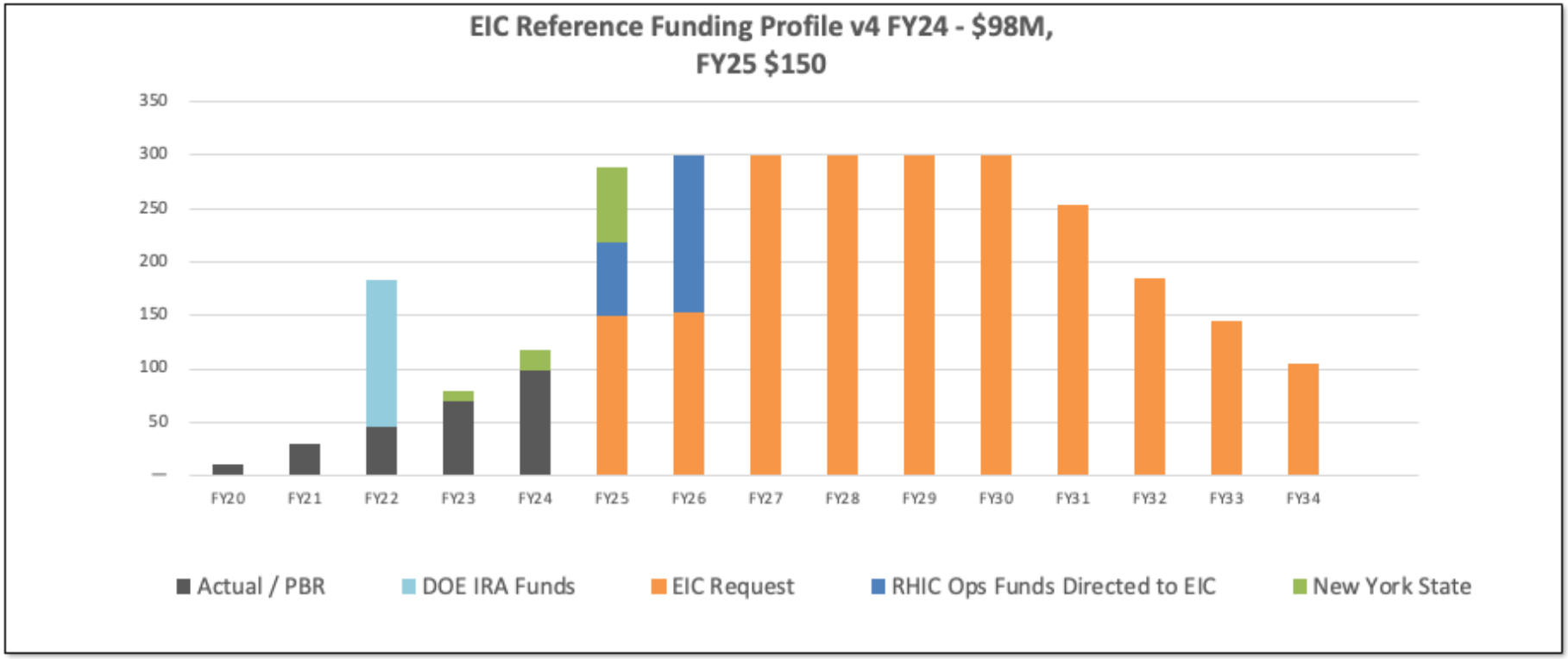
DOE total project cost estimate and overall project schedule provide the basis for the DOE funding profile.

$150M IKC assumptions:
$50M accelerator
$100M detector (1/3)

10% on LOE activities
35% on balance

WBS	DOE+IRA schedule working Jan-2023
6.01 - Project Management	$ 184,214,124
6.02 - Accelerator Dev. & R&D	$ 74,971,335
6.03 - Injector System	$ 187,982,740
6.04 - Electron Storage Ring	$ 180,590,034
6.05 - Hadron Ring	$ 108,733,042
6.06 - Interaction Region & Detector Interface	$ 167,463,407
6.07 - Accelerator Systems Support	$ 218,809,284
6.08 - RF Systems	$ 366,647,360
6.09 - Cryogenics	$ 144,964,733
6.10 - Detector	$ 225,873,364
6.11 - Infrastructure	$ 251,542,932
6.12 - Pre-Operations	$ 51,119,308
P6 Total (incl. escalation & overhead)	**$ 2,162,911,663**
Approved Scope_Cost Changes to be Implemented in P6	$ 82,748,000
Less Excess Escalation for activies beyond CD-4 dates (estimated)	$ (58,003,992)
Less In Kind Contributions balance (not coded in P6)	$ (86,977,421)
Less Actual Costs (AC) thru Nov. 22	$ (69,781,005)
Total work to go	**$ 2,030,897,245**
Contingency	$ 627,598,742
Total w Contingency	**$ 2,658,495,987**
Actual Costs (AC) thru Nov-2022	$ 69,781,005
Estimated Total Project Cost	**$ 2,728,276,992**

Current DOE Funding Plan

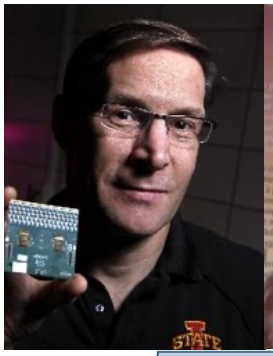


- DOE Inflation Reduction Act funding of $138M allocated in September 2022. Actual FY2023 funding is $70M. DOE request for FY2024 is $98M.
- RHIC shut down planned for June 2025. Significant RHIC Operations funding will be redirected to EIC construction starting in FY2025 and reaching ~$150M/year in FY2026.
- Current funding supports DOE CD-3A, Long Lead Procurement Approval, in January 2024. Long lead procurement items mitigate risks: technical, supply chain, inflation, schedule etc.










BROOKHAVEN NATIONAL LABORATORY
D. Gibbs
Laboratory Director
R. Tribble
Deputy Director for Science & Technology
J. Anderson
Deputy Director for Operations

ELECTRON-ION COLLIDER PROJECT
J. Yeck (BNL), Project Director
F. Willeke (BNL), Deputy Project Director and Technical Director
K. Smith (BNL), Deputy Technical Director

R. Ent (TJ), Co-Associate Director for the Experimental Program
E. Aschenauer (BNL), Co Associate Director for the Experimental Program
A. Lung (TJ), Deputy Project Director for TJNAF Partnership
A. Seryi (TJ), Associate Director for Accelerator Systems & International Partnership
Technical Integration

L. Lari (BNL), Project Manager

A. Deshpande (BNL)
EIC Science Director

M. Chamizo Llatas (BNL)
EIC In-Kind Manager
K. Amm (BNL)
EIC SC Magnet Production Manager

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EIC Resource Review Board
H. Gao, BNL Associate Lab Director for Nuclear & Particle Physics
D. Dean, TJ Deputy Director for Science
TBD Co-Chair, International Funding Agency

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Machine Advisory Committee
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Detector Advisory Committee
E. Kinney, Chair
Infrastructure Construction Advisory Committee
M. Fallier, Chair

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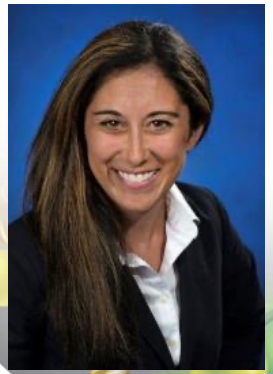
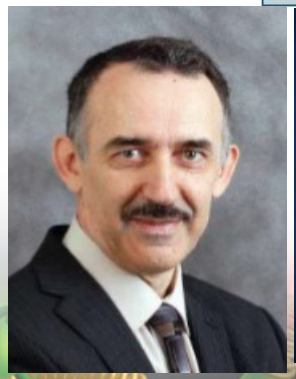
EIC User Group Steering Committee
R. Fatemi, Chair
M. Radici, Co-Chair
ePIC Collaboration
TBD – Spokesperson



EIC Boards and Committees

- DOE, BNL, and JLab envision an EIC facility that is “fully international in character,” [Tim Hallman].
- EIC Advisory Board provides oversight and advice on the construction of the facility, focusing on the accelerator.
- EIC RRB to provide oversight of the experiments, 1st meeting today!
- EIC Project Advisory Committee established in 2020 and provides advice on the successful delivery of the DOE Project (management, scope, schedule, cost, and performance).

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EIC Resource Review Board

H. Gao, BNL Associate Lab Director for Nuclear & Particle Physics

D. Dean, TJ Deputy Director for Science

D. Bettoni, International Funding Agency

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EIC User Group Steering Committee

R. Fatemi, Chair

M. Radici, Co-Chair

ePIC Collaboration

John Lajoie, Spokesperson

Silvia Dalla Torre, Deputy Spokesperson

Project Advisory Committee

- EIC Project Advisory Committee (PAC) meets 3-4 times each year
- Meeting Feb 22-23, 2023
- PAC Membership
  - Halina Abramowicz, Tel Aviv University
  - Thomas Glasmacher, MSU/FRIB
  - Barbara Jacak, LBNL
  - Jay Marx, LIGO Director-retired
  - Lia Merminga, FNAL
  - Elmie A. Peoples-Evans, ANL
  - Mark Reichanadter, SLAC

AGENDA

EIC Project Advisory Committee

Host: Jim Yeck

February 22-23, 2022

BNL / ZoomGov Hybrid Meeting

BROOKHAVEN NATIONAL LABORATORY

Wednesday, February 22, 2023

Click here for ZOOM

Time (in ET)	Topic	Facilitator
10:30-12:00	Tours	
12:00-13:00	Lunch Discussion	PAC and members of EMT
13:00-13:10	Welcome	D. Gibbs
13:10-14:00	DOE Review Results and Strategic Objectives: • General Feedback and Recommendations • CD-3a Review in November and CD-2/3 Likely Combined • Challenges • Strong Hadron Cooling	J. Yeck, Discussion Lead F. Willeke, Discussion Lead
14:00-14:45	Preparation for the CD-3a Review	L. Lari, Discussion Lead
14:45-15:15	Preparing EIC as an International Facility: • EIC Advisory Board and EIC Resource Review Board Status and Plans • EIC User Group and BNL Guest and Visitor Support	J. Yeck, Discussion Lead
15:15-15:30	Break	

15:30-16:15	Positioning EIC for Success:
	• Response to Report
	  ○ Organization and IPT
	  ○ Procurement
	  ○ Facilities Support
	  ○ Other
		J. Yeck, Discussion Lead

16:15-16:30	Staff Planning and Hiring Status	BNL and JLAB
16:30-17:00	PAC Discussion with Project Director	
17:00-17:30	PAC Closed Discussion	T. Glasmacher
18:30	Dinner at Chachama Grill	

Thursday, February 23, 2023

Click here for ZOOM

Time (in ET)	Topic	Facilitator
8:30-9:30	Response to Homework	
9:30-11:00	PAC Report Preparation	
11:00	Closeout	
12:00	Lunch	

DOE Reviews

- DOE Annual and Critical Decision Approval Reviews.
- DOE Annual Status Review on Jan 31 – Feb 2, 2023:
  - Numerous comments and 17 recommendations (next slide);
  - Host laboratories and the project support the results;
  - Supported CD-3A, Long Lead Procurement Approval, in January 2024 (feasible due to availability of Inflation Reduction Act (IRA) funding); and,
  - Recommended that CD-3A LLP scope should be inclusive, prioritized, and executed as funding is available.
- CD-2 and CD-3 reviews in 2025 should be combined.

DOE Recommendations

- **Develop a detailed plan to evaluate the risks and benefits associated with the various approaches to strong hadron cooling** in order to prepare a successful baseline design for CD-2; report by October 2023.
- **Prepare scenarios of facility operation start-up in the absence of strong hadron cooling**, identifying a smooth ramp-up path from Day-1 operation to ultimate performance; report by October 2023.
- Develop interface definitions for services for all technical options being considered and present at the next DOE/SC review. **Prioritize completing the associated R&D topics** so that choices can be made as early as possible.
- **Expedite the award of the A/E contract to maintain the current schedule date of June 2023.**
- **Expedite the issuance of the CM/GC Phase I** Request for Proposal and subsequent contract award by no later than March 2024 (award).
- **Re-evaluate the need to include the electrical distribution equipment in the long lead procurement list prior to June 2023.**
- **Prior to CD-3A, determine how to manage the performance baseline** for the CD-3A scope that is currently integrated within the full schedule of activities.
- **Within the next six months, re-evaluate the tailoring strategy** to ensure it serves the best interest of DOE while enabling efficient execution of the project.

EIC Summary

- Project scope and design meet the science requirements.
- Strong DOE support and increasing international engagement.
- DOE Inflation Reduction Act funding ($138M) supports significant Long Lead Procurement (LLP).
- Project Goals in 2023:
  - Fully implement EIC governance bodies, e.g., RRB;
  - Continue to build the project team and clarify role of partners;
  - Grow the ePIC collaboration with RRB support;
  - Prepare LLP items for CD-3A approval in Jan 2024;
  - Develop designs, cost estimates, and schedules for CD-2/3 (Baseline/Construction Start) approval in 2025.

Project Leadership Experience – Ingredients to success

- ✓ **Facility is a priority of the science community!**
- ✓ **Strong funding agency commitments and host role**
- ✓ **Project leaders viewed as enabling success of others**
- ✓ **Establish realistic goals – "Experience over hope"**
- ✓ **Credibility through openness and transparency**
- ✓ **Collective ownership of problems and solutions**
- ✓ **Populate organization with critical experience**
- ✓ **Success requires energy and enthusiasm!**

Project leaders who prioritize on schedule performance and exhibit behaviour that is consistent with a "project culture" are likely to be successful!