

EIC Project Overview

Jim Yeck, Project Director
Community Advisory Council

September 10, 2020

Electron-Ion Collider

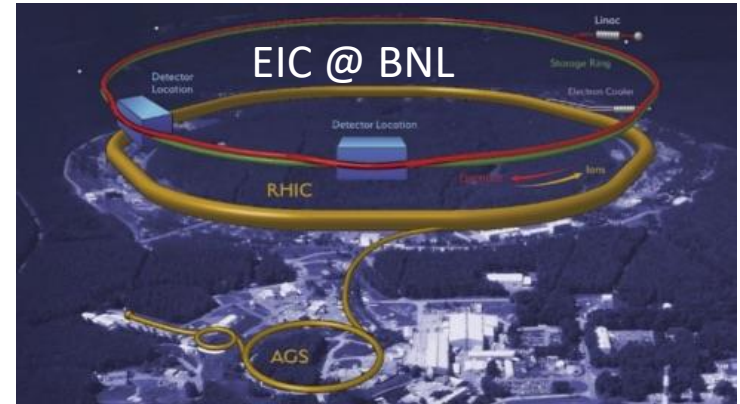
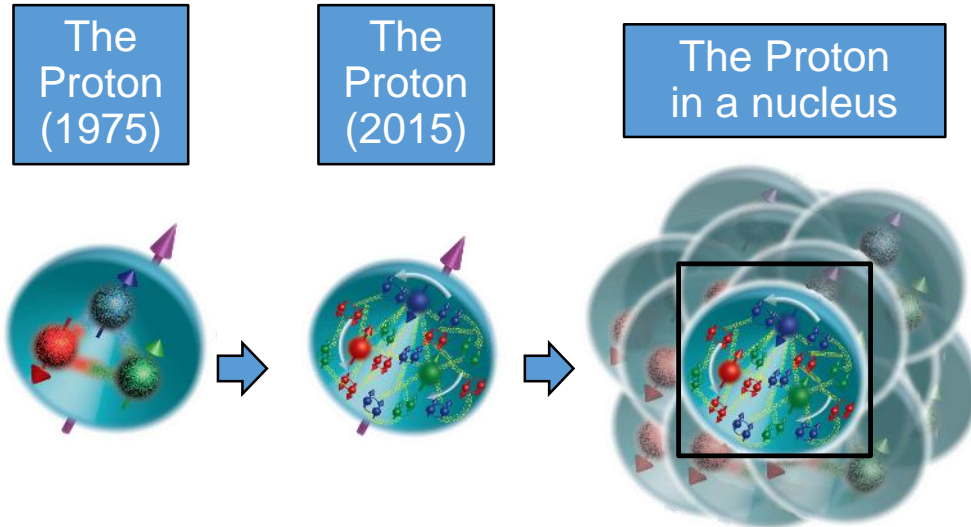


My Background

Research Infrastructure Project/Location	Purpose	Cost CD-3 ~yr	Primary Funding/Owner	Role & Responsibility
Electron-Ion Collider at BNL	Nuclear Physics Cosmology & Astrophysics	~\$1.6-2.6B	DOE	BNL - Director
CMB-S4		~600M	DOE and NSF	Interim Director
European Spallation Source (ESS) Lund Sweden and Copenhagen Denmark	Neutron Source w/ Diverse Users	~\$2.5B 2014	European States	ESS ERIC – Director General & CEO
Deep Underground Science and Engineering Lab (DUSEL) – Lead, SD	Physics, Biology, and Engineering	\$750M 2010	NSF + Private	U of California Assoc. Project Director
National Synchrotron Light Source II at BNL	Photon Source w/ Diverse Users	\$900M 2008	DOE + NIH...	BNL - Deputy Project Director
IceCube Neutrino Observatory at South Pole	Particle Astrophysics	\$300M 2005	NSF + Intl.	U of Wisconsin - Project Director
US Large Hadron Collider (USLHC) In-kind delivered to CERN	High Energy Physics Collider	\$530M 1998	DOE & NSF	DOE/NSF Project Director
Relativistic Heavy Ion Collider (RHIC) at Brookhaven Lab (BNL)	Nuclear Physics Collider	\$600M 1991	DOE + NSF + Intl.	DOE Project Manager

EIC Science

Science: The EIC will, for the first time, provide a complete view of the nucleus:



The EIC will revolutionize our understanding of the inner workings of the nucleus by providing us with detailed knowledge of the internal structure of the proton and more complex atomic nuclei that is comparable to our knowledge of the electronic structure of atoms.

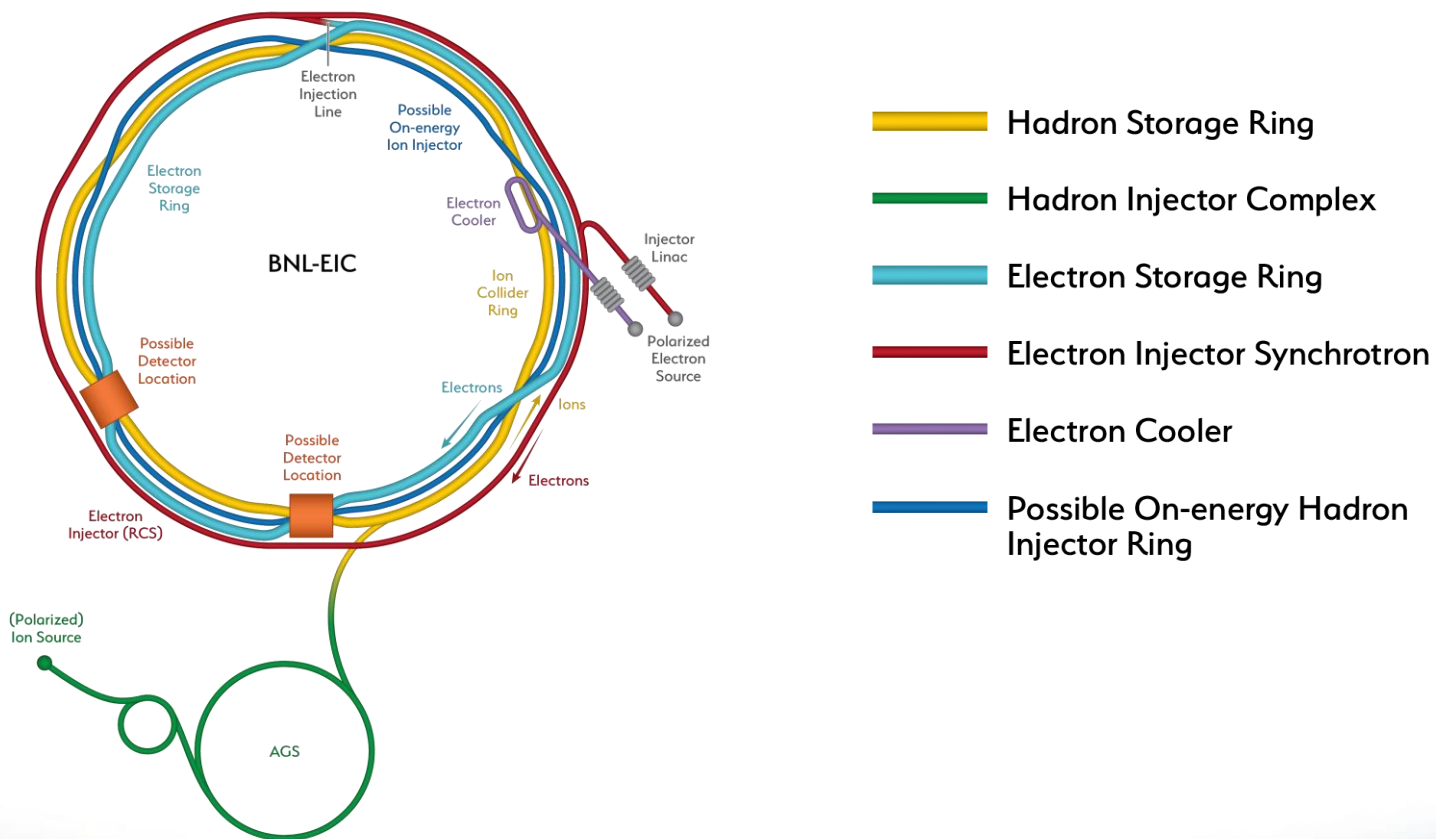
The EIC will be a discovery machine, providing answers to long-elusive mysteries of matter related to our understanding the origin of mass, structure, and binding of atomic nuclei that make up the entire visible universe.

The EIC project will work closely with domestic and international partners to deliver the EIC construction project and then begin EIC operations.

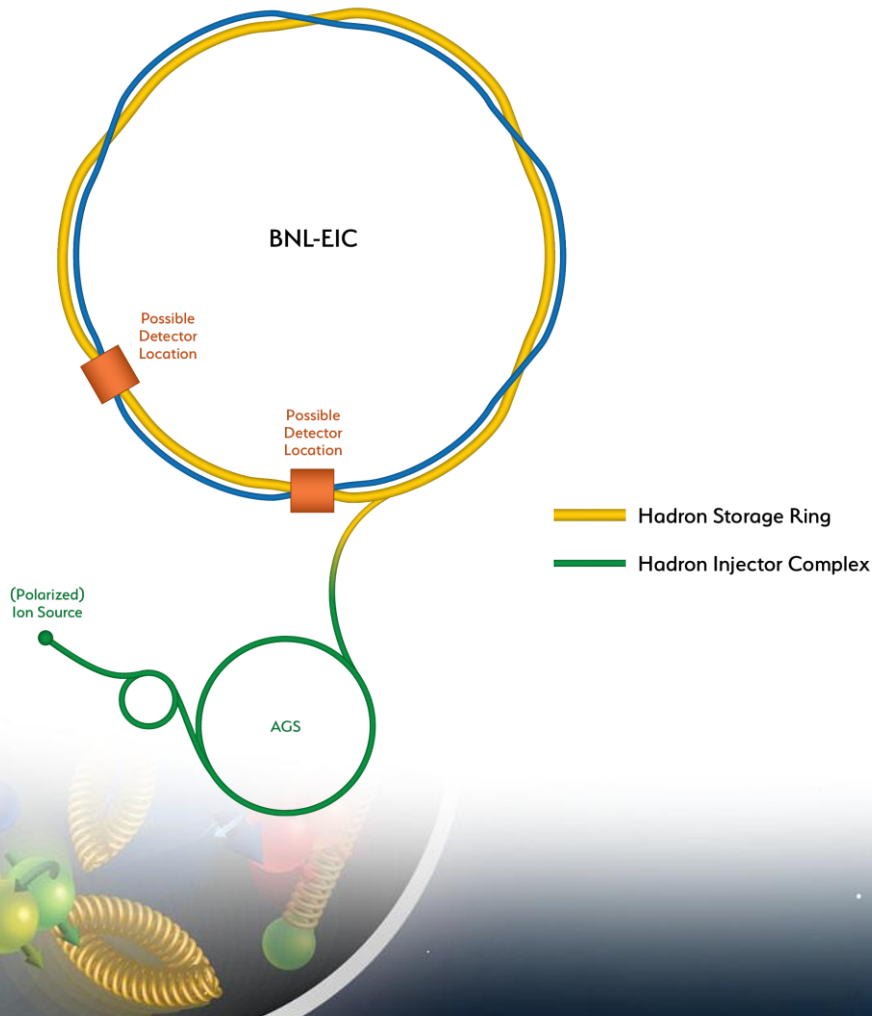
EIC Recent History

Event	Date
DOE Mission Need Statement Approved	January 22, 2019
Independent Cost Review	July 2019
DOE Independent Electron Ion Collider Site Assessment	October 8-9, 2019
CD-0 Approved	December 19, 2019
DOE Site Selection Announced	January 9, 2020
FY2020 Budget Includes EIC TEC and OPC Funding	1st Quarter FY2020
BNL TJNAF Partnership Agreement Approved	May 2020
<i>DOE OPA CD-1 Review</i>	<i>January 26-28, 2021</i>
<i>DOE Critical Decision -1, Preliminary Baseline Approved</i>	<i>2nd Quarter of FY2021</i>

Electron-Ion Collider Concept

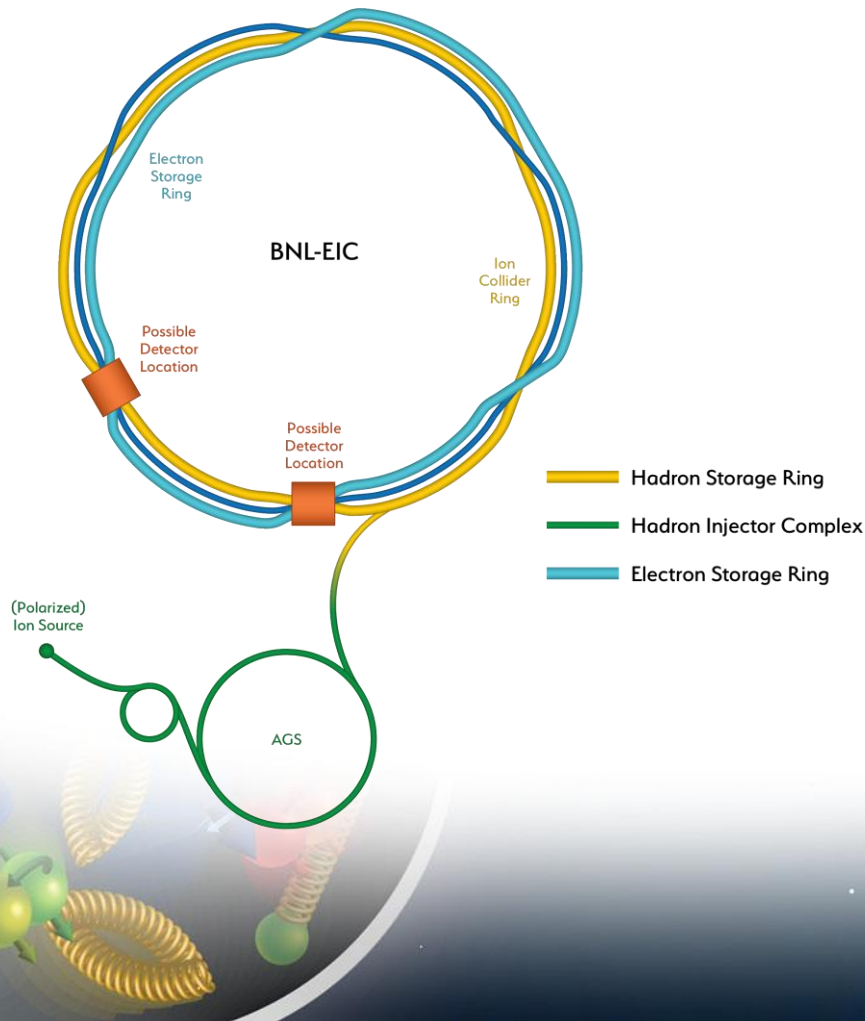


How the Relativistic Heavy Ion Collider (RHIC) is transformed into an Electron-Ion Collider



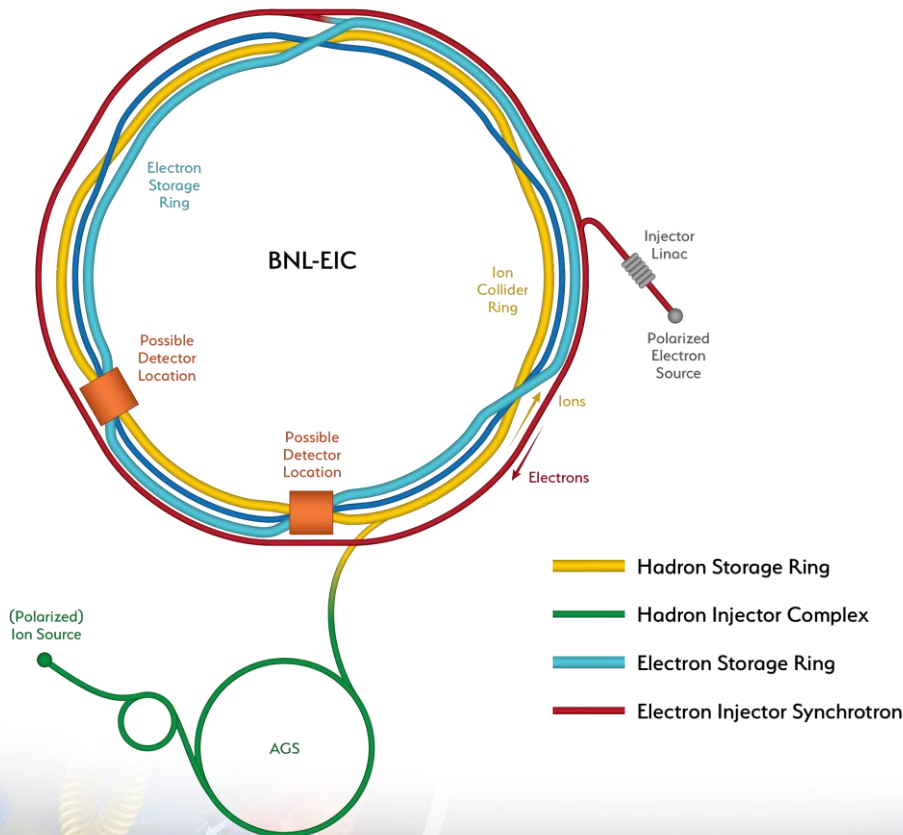
- Existing RHIC accelerator complex with blue and yellow hadron storage rings

How the Relativistic Heavy Ion Collider (RHIC) is transformed into an Electron-Ion Collider



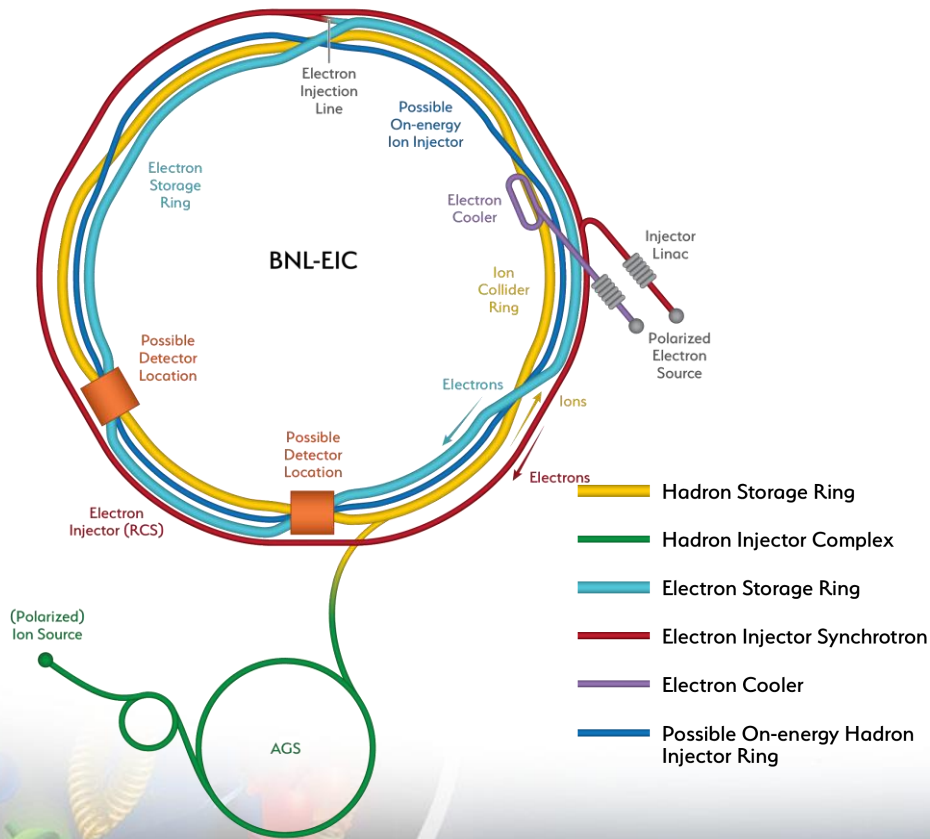
- Add electron storage ring

How the Relativistic Heavy Ion Collider (RHIC) is transformed into an Electron-Ion Collider



- Add an electron injector complex with Rapid Cycling Synchrotron

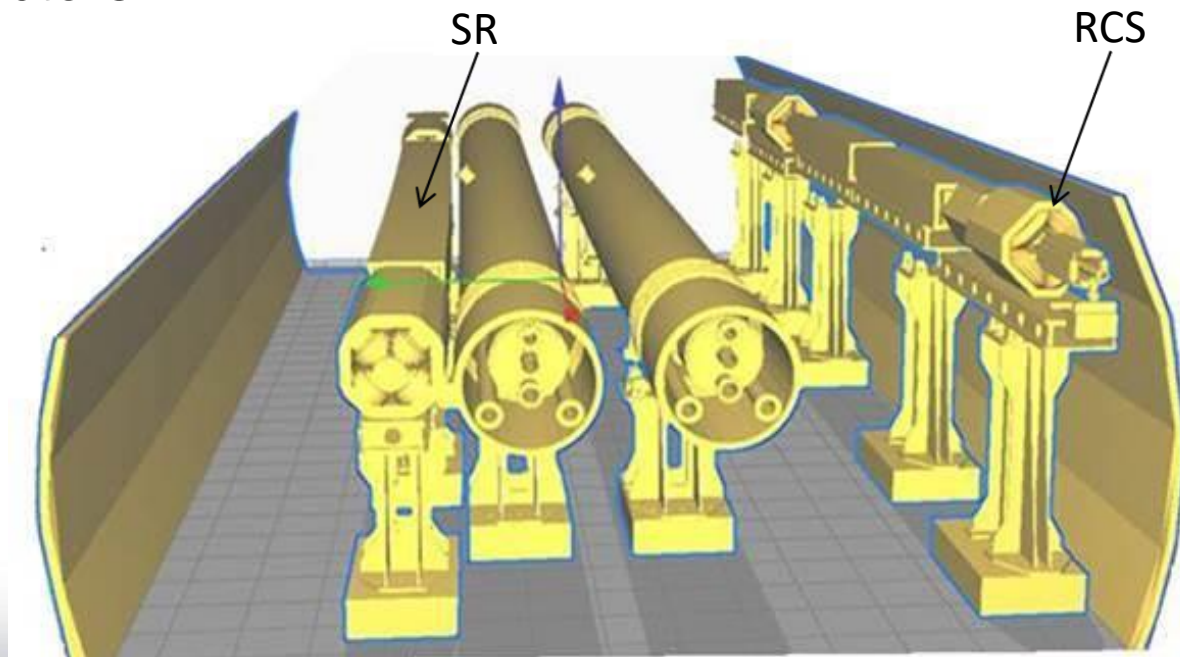
How the Relativistic Heavy Ion Collider (RHIC) is transformed into an Electron-Ion Collider



- Strong hadron cooling completes the facility
- Alternate solution also shown using RHIC blue ring

EIC Machine in the RHIC Tunnel

- Rapid Cycling Synchrotron (RCS) for electrons and Electron Storage Ring (SR) fit into the existing RHIC tunnel
- Two existing detector halls available for interaction regions and detectors



BNL & Jefferson Lab Partnership



Jan 23, 2020 @ JLab

- DOE Office of Nuclear Physics
 - *“An SC Prime Directive: The Project will be carried out as a full intellectual partnership between the BNL and JLAB teams (and other collaborators) with major participation by all”*
- DOE Office of Science
 - *“Look to strengthen smaller/single purpose laboratories to be more multidiscipline”*



Feb 10, 2020 @ BNL



Feb 28, 2020 @ JLab

BNL TJNAF Partnership

- The EIC Project captures project delivery experience from BNL and TJNAF
- BNL-TJNAF Partnering Agreement Approved- May 7, 2020
- EIC Project Executive Management Team (EMT) Established:
Elke Aschenauer, Rolf Ent, Diane Hatton, Allison Lung, Andrei Seryi, Ferdinand Willeke, and Jim Yeck
- Abhay Deshpande, EIC Science Director, participates in the EMT meeting as an ex-officio member providing an additional connection to the User community.



BNL Visit to TJNAF – Feb 28, 2020

ELECTRON ION COLLIDER PROJECT

J. Yeck (BNL), Project Director

F. Willeke (BNL), Deputy Project Director and Technical Director

R. Ent (TJ), Co-Associate Director for
the Experimental Program

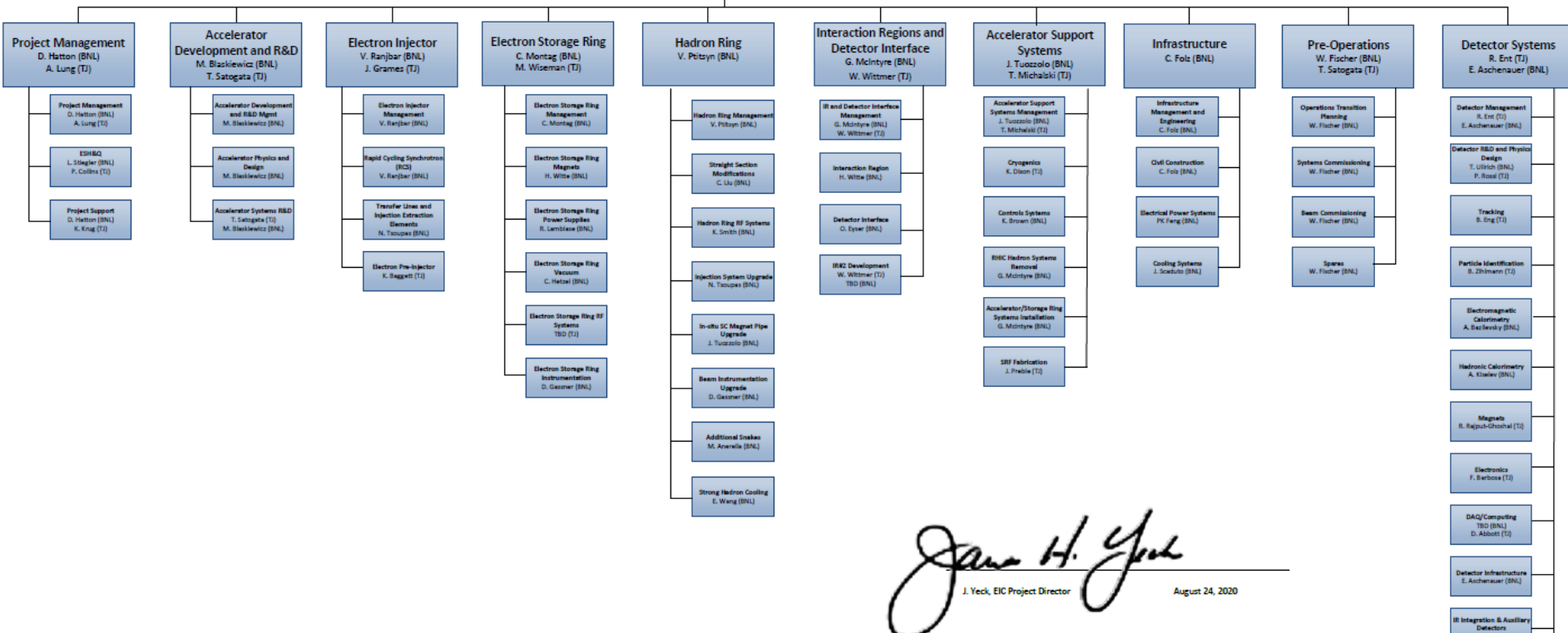
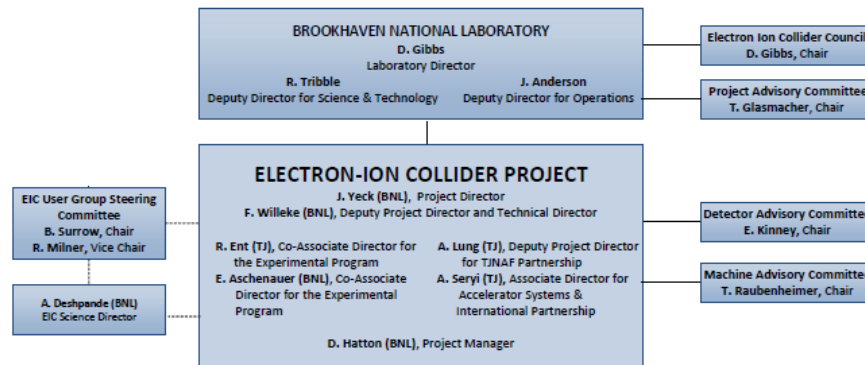
E. Aschenauer (BNL), Co-Associate Director
for the Experimental Program

A. Lung (TJ), Deputy Project Director
for TJNAF Partnership

A. Seryi (TJ), Associate Director for
Accelerator Systems &
International Partnership

D. Hatton (BNL), Project Manager

EIC Project Organization

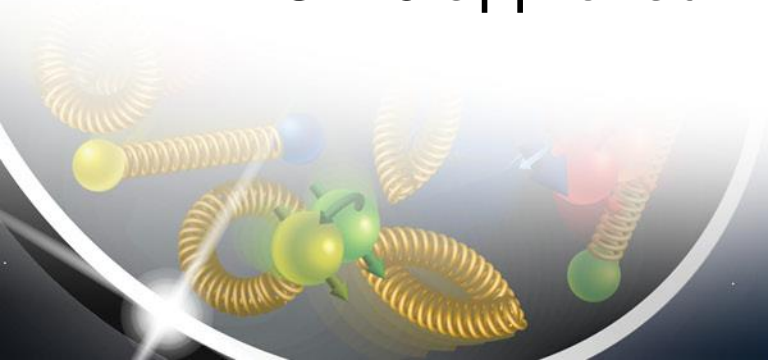


Jana H. Yeck
 J. Yeck, EIC Project Director

August 24, 2020

Electron-Ion Collider Project

- Performance and Scope
 - Full-energy, full-luminosity accelerator (NSAC and NAS recommended)
 - One interaction region with allowance for a second
 - One detector
- Schedule
 - Completion in ~10-15 years
- Cost
 - CD-0 approved with a range of \$1.6B-\$2.6B



Scope

6.0 Electron Ion Collider

6.01 Project Management	6.02 Accelerator Development & R&D	6.03 Electron Injector	6.04 Electron Storage Ring	6.05 Hadron Ring	6.06 Interaction Regions & Detector Interface	6.07 Accelerator Support Systems	6.08 Infrastructure	6.09 Pre-Ops	6.10 Detectors	
6.01.01 Project Management	6.02.01 Accel. Devel. & R&D Mngmt.	6.03.01 Electron Injector Mngmt.	6.04.01 Electron Storage Ring Mngmt.	6.05.01 Hadron Ring Management	6.06.01 IR & Detect. Interface Mngmt.	6.07.01 Accelerator Support Syst. Mngmt.	6.08.01 Infrastr. Mngmt. & Engrng.	6.09.01 Operations Transition Planning	6.10.01 Detector Management	6.10.08 Electronics
6.01.02 ESH&Q	6.02.02 Accel. Physics & Design	6.03.02 Rapid Cycling Synch. (RCS)	6.04.02 Electron Strg. Ring Magnets	6.05.02 Path Length Var. & Energy Upgr.	6.06.02 Interaction Regions	6.07.02 Cryogenics	6.08.02 Civil Construction	6.09.02 Systems Commissioning	6.10.02 Detector R&D	6.10.09 DAQ / Computing
6.01.03 Project Support	6.02.03 Accel. Systems R&D	6.03.03 Transf. Lines & Inj./Extr. Elements	6.04.03 Electron Strg. Ring Pwr. Sup.	6.05.03 Hadron Ring RF Systems	6.06.03 Detector Interface	6.07.03 Control System	6.08.03 Electrical Power Systems	6.09.03 Beam Commissioning	6.10.03 Tracking	6.10.10 Detector Infrastructure
		6.03.04 Electron Pre-Injector	6.04.04 Electron Strg. Ring Vacuum	6.05.04 Injection System Upgrade	6.06.04 IR#2 Development	6.07.04 RHIC Hadron Systems Removal	6.08.04 Cooling Systems	6.09.04 Spares	6.10.04 Particle Identification	6.10.11 IR Integration & Ancillary Detectors
			6.04.05 Electron Strg. Ring RF Syst.	6.05.05 In-situ SC Mag. Beam Pipe Upgrade		6.07.05 Accel. Strg. Ring Systems Install.			6.10.05 Electromagn. Calorimetry	6.10.12 Detector Pre-Ops & Commiss.
			6.04.06 Electron Strg. Ring Instrum.	6.05.06 Beam Instrum. Upgrade		6.07.06 SRF Fabrication			6.10.06 Hadronic Calorimetry	6.10.13 Detector #2 Development
				6.05.07 Additional Snakes					6.10.07 Magnets	
				6.05.08 Strong Hadron Cooling						

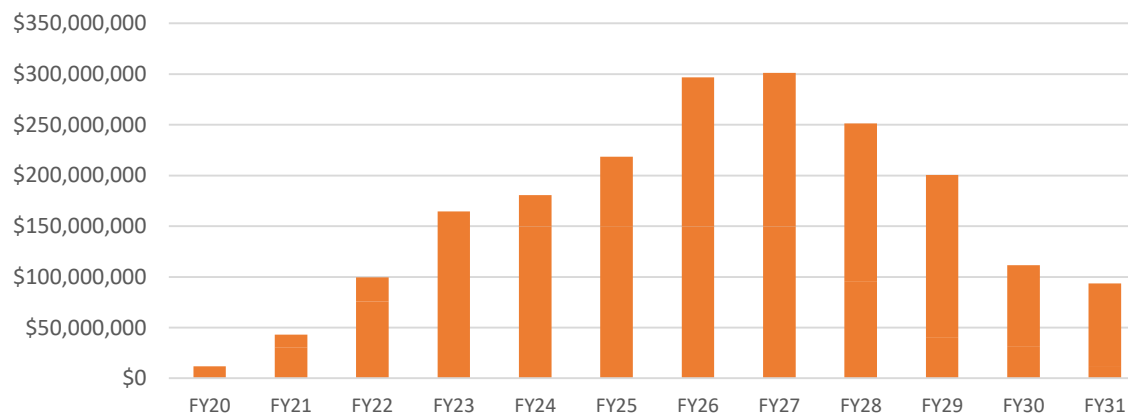
Experimental Program Preparations

- EIC Community's Yellow Report Initiative (Kickoff in December 2019, [site](#))
 - Four workshops planned to advance the state and detail of the documented physics studies and detector concepts in preparation for the realization of the EIC.
- Call for "Potential Cooperation on the EIC Experimental Program" published end of May 2020
 - Includes two questionnaires, FAQ, and input received
 - Expressions of Interest (EOIs) due November 1, 2020
- Following the EOI Response Deadline
 - Status report at 4th Yellow Report meeting in November
 - Responses evaluated and Call for Proposal(s) finalized
 - Assessment by Users Group and Project Management with advice from EIC Detector Advisory Committee (DAC)
 - Call for Detector Proposal(s) in March 2021

EIC EOI Site: <https://www.bnl.gov/eic/EOI.php>

Reference Funding Profile

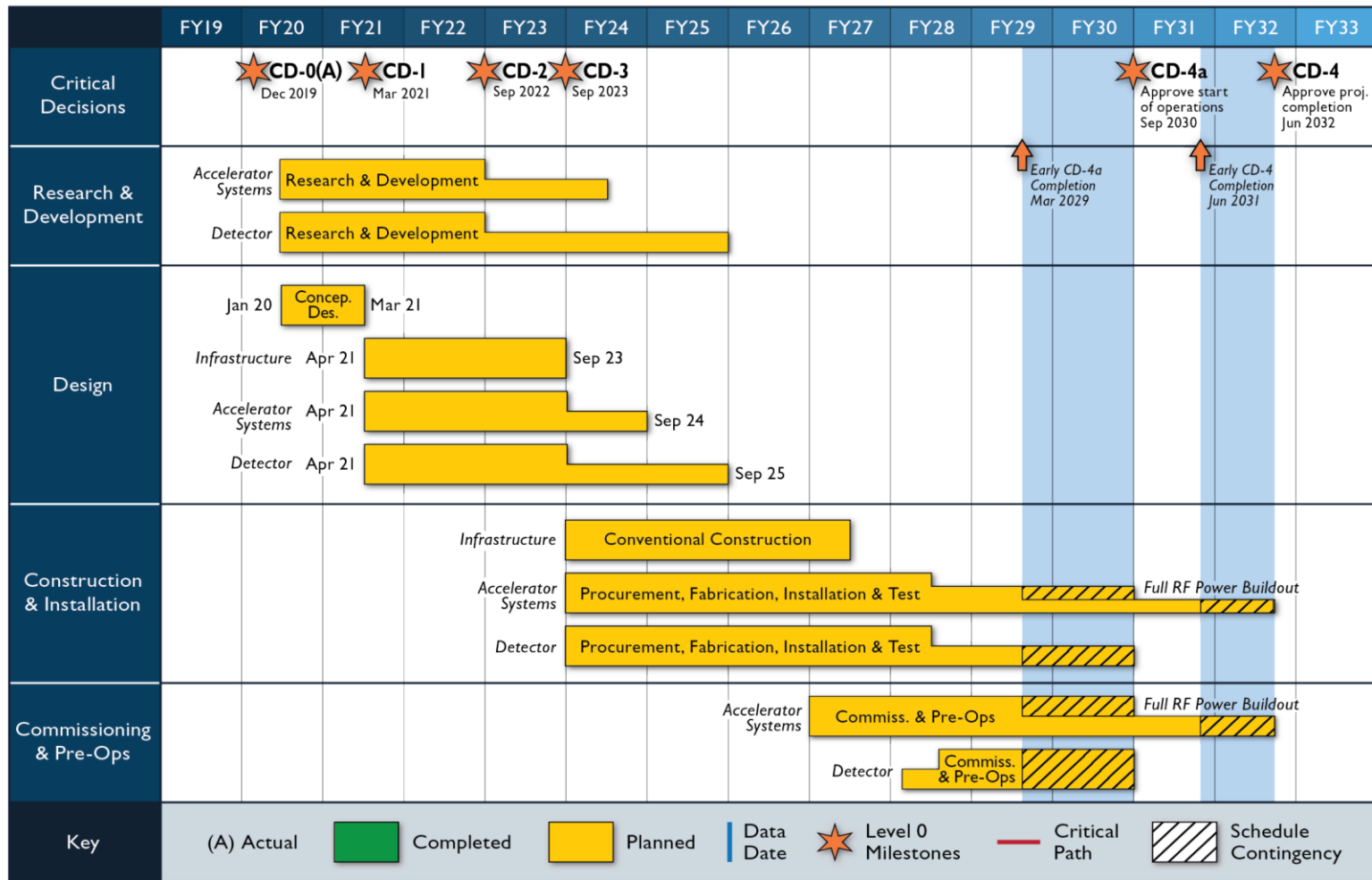
\$1,973M Total Project Cost and Initial Operations in 2030



(US Fiscal Years)

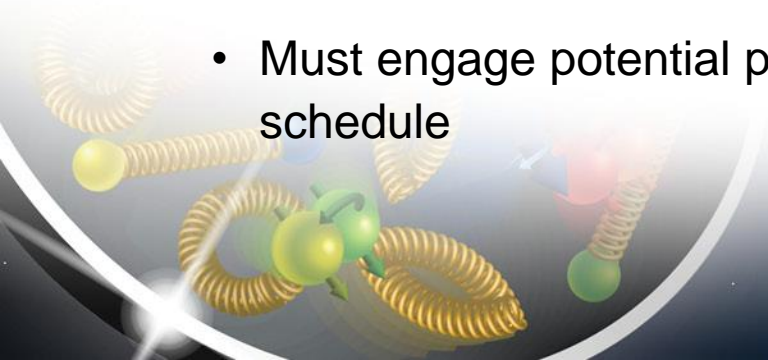
- CD-1: March 2021
- CD-2: September 2022
- CD-3: September 2023
- CD-4a: September 2030
- CD-4: June 2032
- Staged CD-4
 - Operations Start - CD-4a
 - Install full RF Power - CD-4
- \$100M from New York State toward infrastructure

Schedule



EIC Challenges and Opportunities

- **Affordability** – EIC is very large project for DOE Office of Nuclear Physics (NP) and Office of Science (SC)
 - Requires reprioritization of RHIC operations funding to EIC and new funding
 - Significant ramp up of project funding (annual doubling) starting in FY2021 is required to maintain timeline for Critical Decisions
 - Most cost-effective project follows closely to a technically driven schedule
- **Partner Engagement** – **Expectations and Implementation**
 - International and domestic engagement highly desirable and widely expected
 - In-kind contributions to the accelerator and experiment(s) will be pursued
 - Must engage potential partners now given the EIC technically driven schedule



Conclusion

- Project Delivery Plans Maturing
 - Strong foundation in place: pre-conceptual design, cost & schedule
 - BNL/TJNAF collaboration established
 - Cost effective EIC implementation possible with the reprioritization of RHIC funding support
 - Pursuing broad international collaboration around the EIC
 - DOE review and approval process established: CD-1 in Q2 FY2021
- Experimental Program Planning
 - BNL and Jefferson Lab jointly leading the process for defining detector(s) and serve as the “host” lab for the international user community
 - Call for Expressions of Interest: <https://www.bnl.gov/eic/EOI.php>.
 - Community engagement and timeline for the Yellow Book, Call for Expressions of Interest, Call for Proposals, etc. is very important
 - Detector(s) plans will align with project CD-4 schedule (operations)