

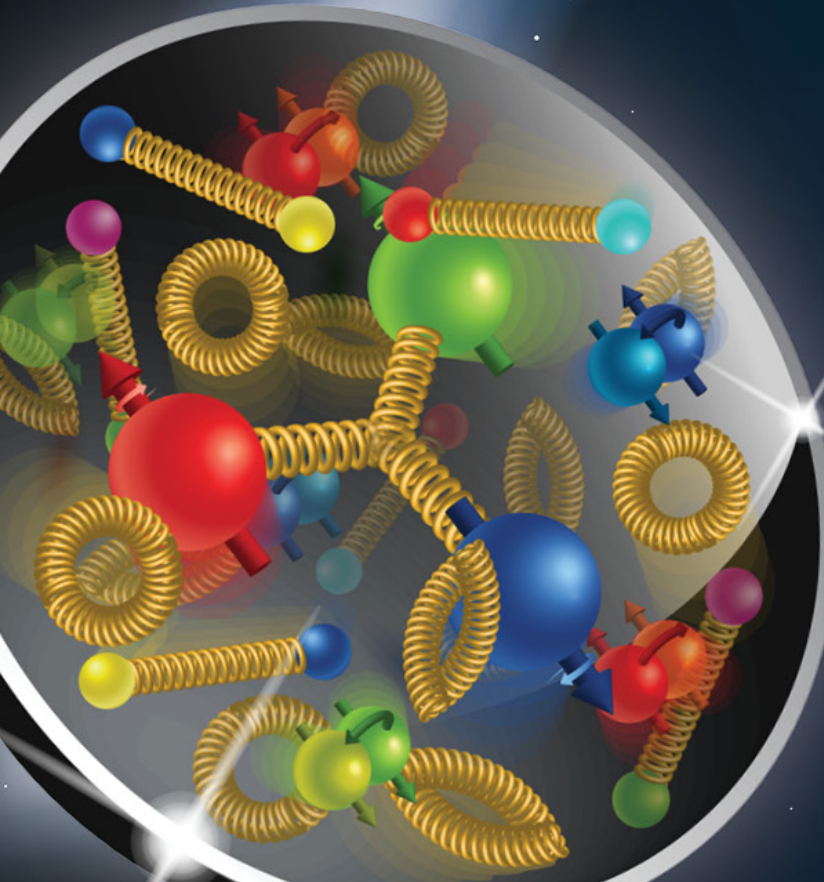
Electron-Ion Collider Project Status

Jim Yeck, EIC Project Director

4th Yellow Report Workshop at LBL

November 19, 2020

Electron-Ion Collider



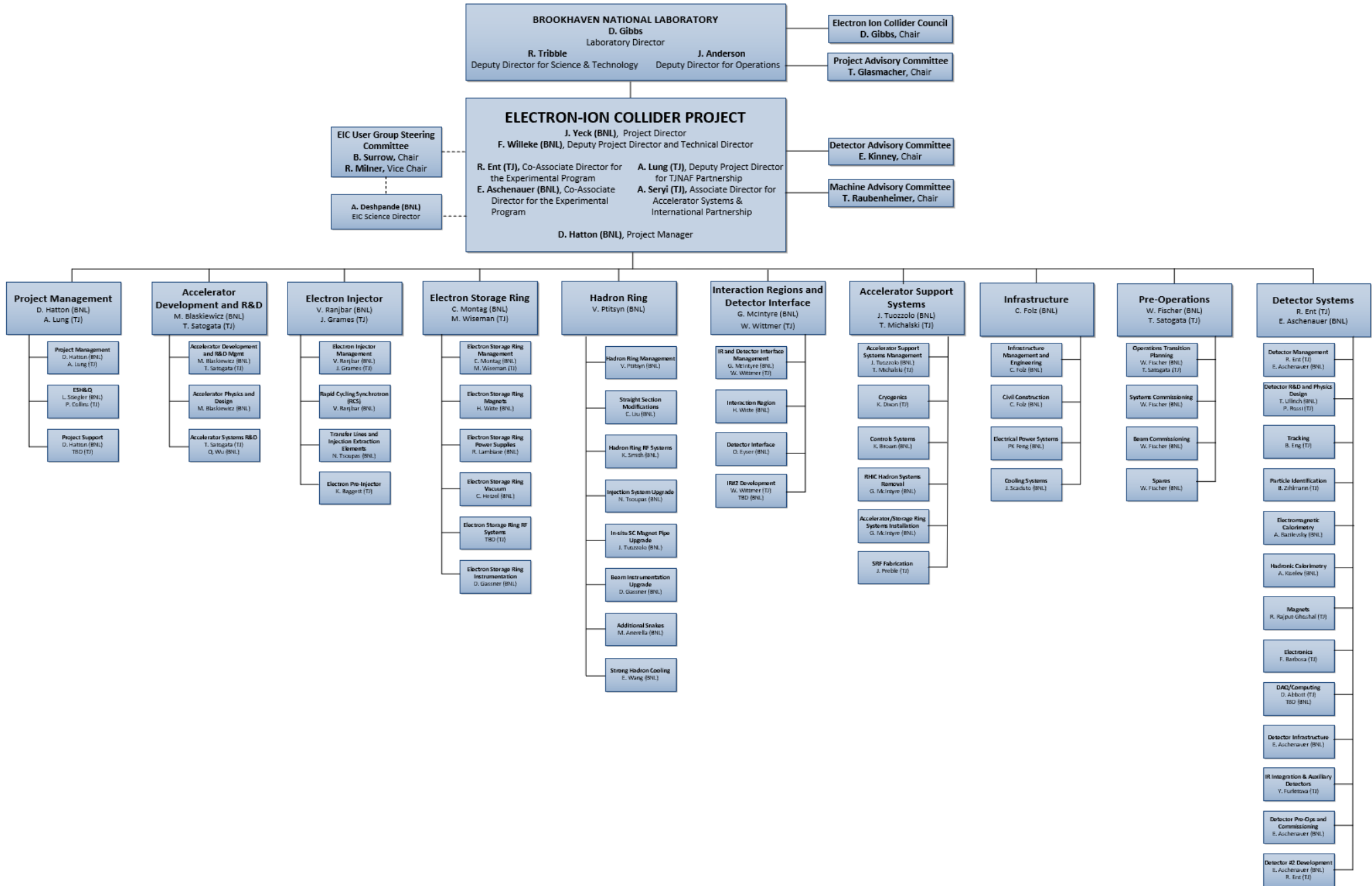
EIC Recent History

Event		Date
Mission Need Statement Approved	2019	January 22, 2019
Independent Cost Review		July 2019
DOE Electron Ion Collider Site Assessment		October 2019
CD-0 Approved	2020	December 19, 2019
DOE Site Selection Announced		January 9, 2020
BNL TJNAF Partnership Agreement Approved		May 7, 2020
EIC Conceptual Design Review		November 16-18, 2020
<i>DOE OPA CD-1 Review</i>	2021	<i>January 26-28, 2021</i>
<i>CD-1 Approval Target Date</i>		<i>March/April 2021</i>

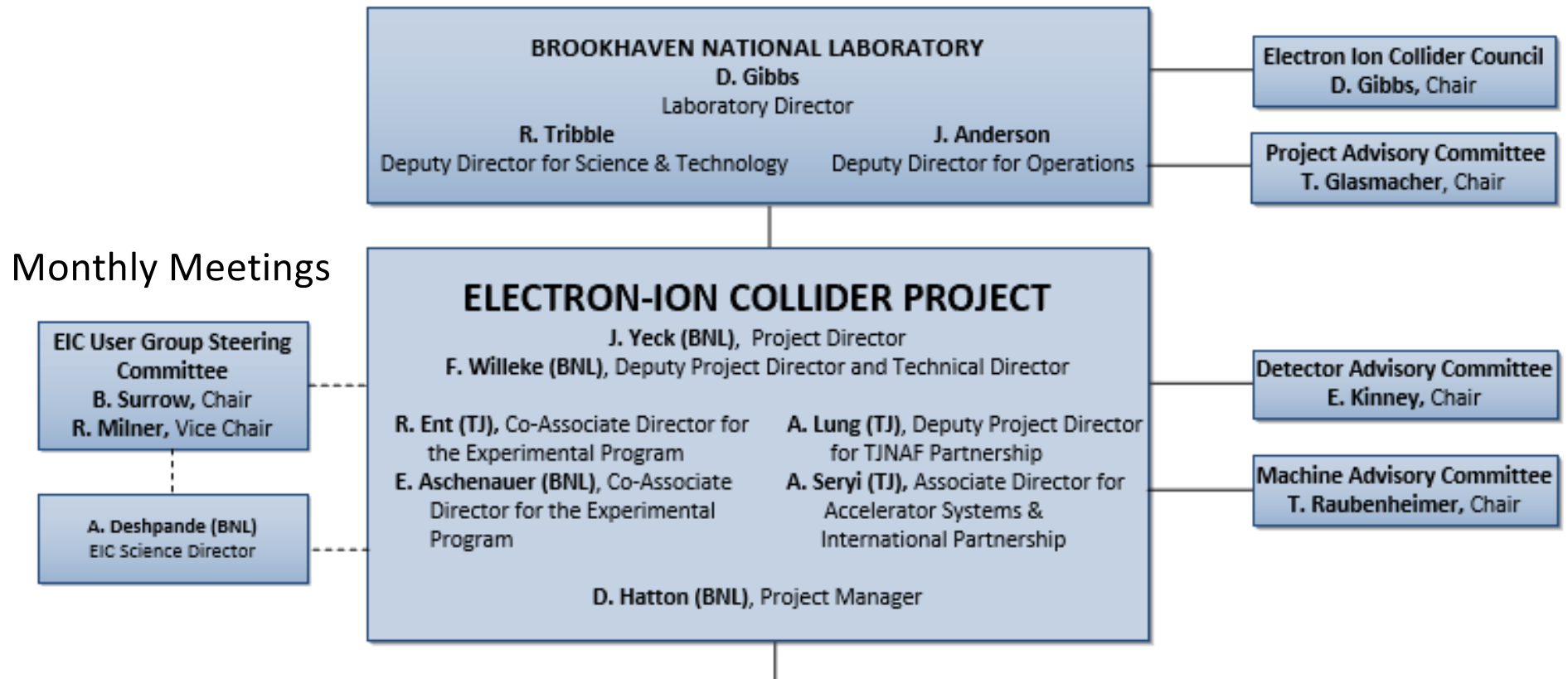
Project Organization

- BNL/TJNAF Partnership
 - BNL and TJNAF partnering agreement signed in May 2020
 - EIC Council, chaired by BNL Director, established in June. TJNAF Director is a founding member. Concept based on recent DOE SC projects including LCLS-II and Exascale. Next meeting on Dec. 1st.
 - Executive Management Team integrates BNL and TJNAF project leadership roles. Weekly and ad hoc meetings.
- BNL and TJNAF worked together to clarify mandates and membership for the standing advisory committees
 - Machine Advisory Committee: 1st Meeting August 26, 2020
 - Project Advisory Committee: 1st Meeting August 27, 2020
 - Detector Advisory Committee: 1st Meeting September 28-29, 2020

EIC Project Organization



Project Leadership, Committees, and Users



EIC Partnership Plans

- Actively promoting a culture of interdisciplinary and multi-institutional collaboration for both the accelerator and experimental program
- International and domestic partners are being pursued and bi-lateral meetings with potential partners are well underway to discuss opportunities in the accelerator and experimental areas
- Accelerator Partnership Activities
 - Workshop October 7-9 Hosted by Cockcroft Institute, UK – *Promoting Collaboration on the Electron-Ion Collider*
 - In-kind contributions to the accelerator design and hardware are being pursued
- Detector Partnership Activities
 - Expressions of Interest (EOI) for potential cooperation on EIC experimental equipment submitted following a call in May: <https://www.bnl.gov/eic/EOI.php>
 - Call for proposals for detector(s) planned for March 2021
- DOE Office of Nuclear Physics organizes regular meetings with international funding agencies. The next meeting will be in February 2021.

Experimental Program Preparation

BNL and TJNAF Jointly Leading Process for Defining Detector(s)

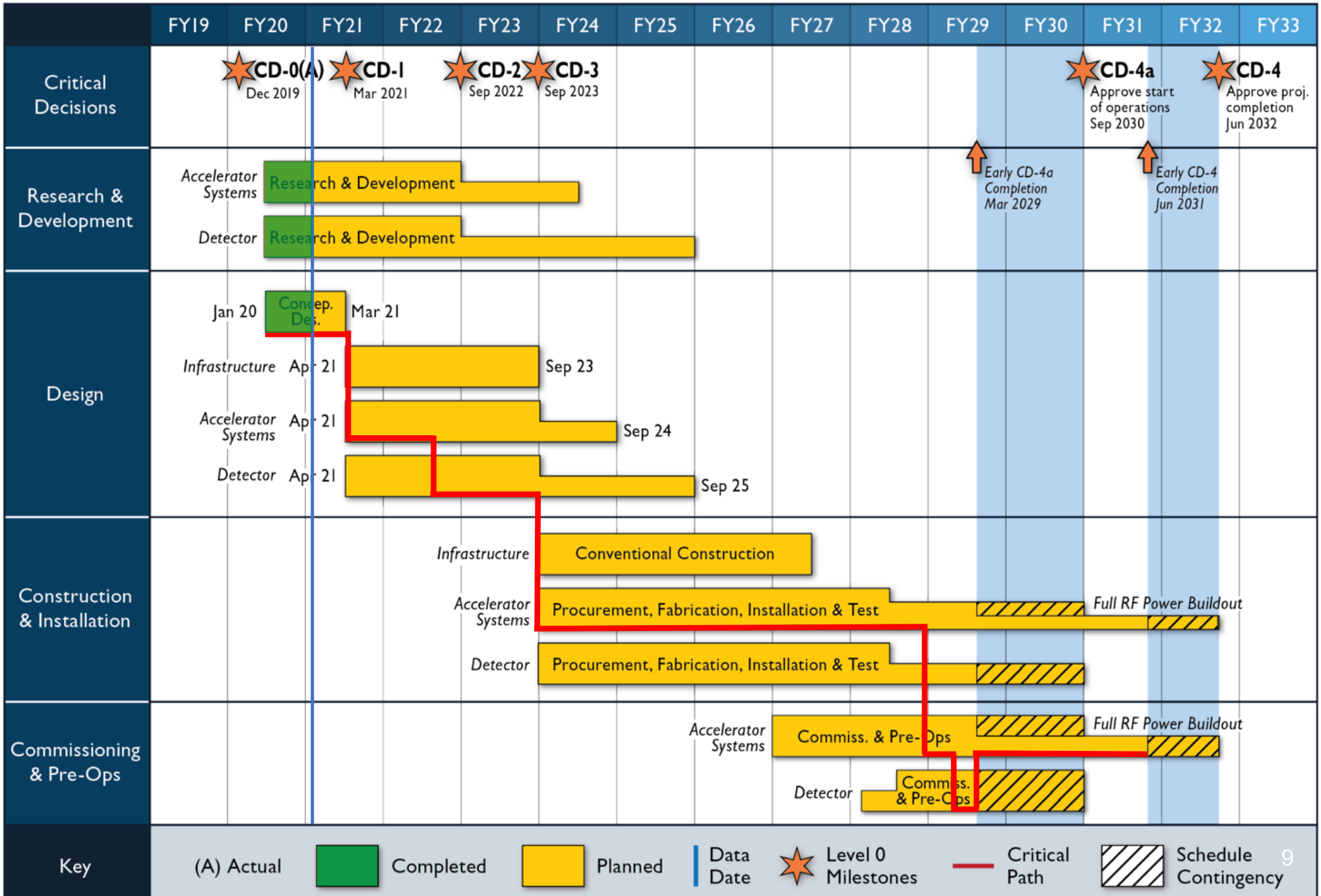
Call for Expressions of Interest (EOI) for “Potential Cooperation on the EIC Experimental Program”	May 2020
EOI responses	November 2020
Assessment of EOI Responses	On-going
BNL/TJNAF to organize a committee to advise on initial EIC experimental program	
Call for Detector Proposals	March 2021
Decision on Detector(s)	December 2021

2nd Detector and IR Planning

EIC will be capable of supporting a science program that includes two detectors/interaction regions

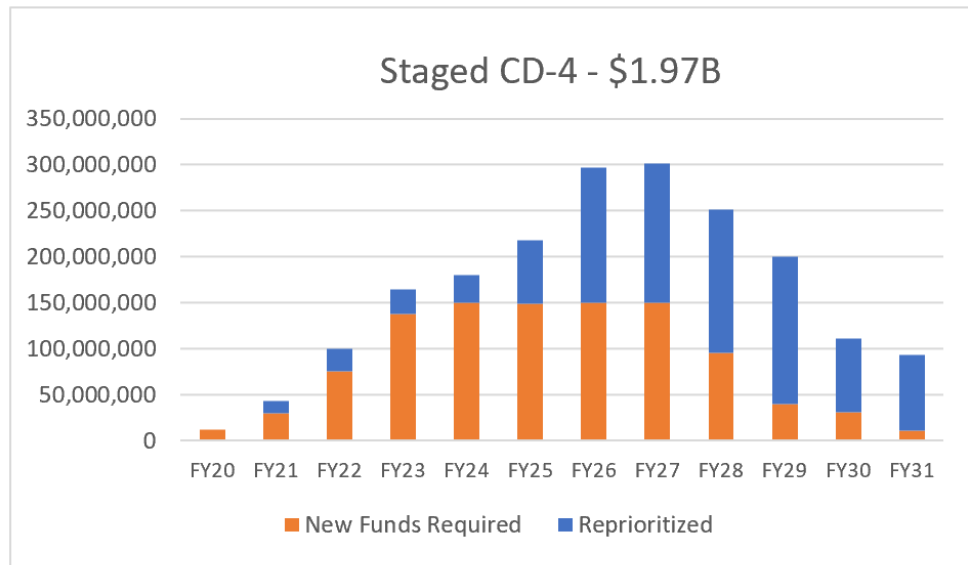
- EIC project planning includes ensuring the viability of a 2nd Interaction Region (IR) and detector
- EIC project budgets support construction of one IR and approximately two-thirds of one detector
- Stakeholders agree that a 2nd IR and detector with a similar timeline as the EIC project detector is desirable, and routes to making this possible will be explored
 - Discussion and dedicated session(s) on the 2nd IR during Yellow Report Workshop meeting this week
 - Series of workshops on 2nd IR to initiate in February 2021

Schedule



Reference Funding Profile

Fiscal Year	FY 20	FY 21	FY 22	FY 23	FY 24	FY 25	FY 26	FY 27	FY 28	FY 29	FY 30	FY 31	Total (\$M)
OPC	\$10	\$18	\$9	\$3									\$40
TEC PED	\$1	\$25	\$91	\$120	\$95	\$30							\$129
TEC Construction				\$41	\$86	\$189	\$294	\$271	\$216	\$172	\$102	\$85	\$1,456
Pre-Ops							\$3	\$30	\$35	\$29	\$10	\$8	\$115
Total Project Cost (\$M)	\$11	\$43	\$100	\$164	\$181	\$219	\$297	\$301	\$251	\$201	\$112	\$93	\$1,973



New Funds Capped at \$150M/year

- FY2021 budget TBD (Continuing Resolution)
- DOE ONP supporting planned use of reprioritized funding to stay on schedule for CD-1
- Funding profile fixed at CD-2 when the project performance baseline is approved

Recent DOE Status Review

OPA review of the EIC project on September 9-11, 2020.

- Assessed progress towards Critical Decision 1 (CD-1)
- 21 external reviewers, plus observers
- 30 recommendations
- Major Conclusions
 - Schedule for CD-1 remains valid and the DOE CD-1 review is schedule for January 26-28, 2020
 - Roles of partners need to be defined for CD-2, Project Performance Baseline

EIC Conceptual Design Review Committee

November 16-18

**Independent Review of the
Electron Ion Collider Conceptual Design at BNL
November 16-18, 2020**

**Sarah Cousineau, ORNL, Co-Chair
Mark Reichanadter, SLAC-retired, Co-Chair**

SC1

Accelerator & RF Systems

John Seeman, SLAC *
Elena Chapochnikova, CERN
Andreas Lehrach, Julich
Sergei Nagaitsev, FNAL
Uli Wienands, ANL

SC2

Cryogenic Systems

Matt Howell, ORNL *
Amalia Ballarino, CERN
Ting Xu, MSU

SC3

Global Systems and Control Systems

Karen White, ORNL *
Mark Heron, Diamond
Markus Steck, GSI

SC4

Interaction Regions

Frank Zimmermann, CERN*
Katsunobu Oide, CERN
Michael Sullivan, SLAC
Alexander (Sasha) Zlobin, (FNAL)

SC5

ESH & Infrastructure

Greg Herman, PNNL *
Javier Sevilla, SLAC
James Tarpinian, Consultant

SC6

Detectors & Computing

Steve Vigdor, Indiana Univ-Emeritus
Iris Abt, MPI-Munich
Patty McBride, FNAL

LEGEND

SC - Subcommittee
* Chairperson

Count: 23 (excluding observers)

- Closeout presentation on November 23.
- Final report on December 7.

EIC Design Review Charge Questions

The review committee should respond to the following questions:

1. Are the EIC science requirements appropriately defined? Will the overall collider and reference detector conceptual design support the performance goals?
2. Is the conceptual design for the EIC accelerator, infrastructure, and reference detector in an appropriate configuration for starting preliminary engineering design?
 - a. Does the conceptual design provide a sound design basis to support CD-1?
 - b. Is there sufficient breadth and detail in the CDR (including external documentation) to support the development of an estimated project cost and schedule range?
3. Are the technical risks appropriately identified and being addressed?
 - a. Does the conceptual design have mitigation pathways for the possible risks?
 - b. Is the EIC R&D program appropriately focused to investigate these key risk areas and support the conceptual and preliminary design?
 - c. Are there any project assumptions that could represent a risk to meeting the EIC requirements?
4. Based on the EIC conceptual design, are the Preliminary Key Performance Parameters (KPPs) adequate and reasonable?
5. Is ES&H being properly addressed in the conceptual design? How well do the conventional facility requirements accommodate the EIC science requirements? How thoroughly does the conceptual design and supporting documentation delineate project criteria (i.e., statutes, regulations, DOE directives, standards, codes, site, and local requirements) that the project intends to follow?
6. We welcome any other suggestions you can make for additions and changes that will improve the quality of the EIC conceptual design.

CD-1 Director's Review Committee

December 8-10

CD-1 Director's Review of the
Electron-Ion Collider (EIC) Project at BNL
December 8-10, 2020

Rod Gerig, Retired ANL, Co-Chairperson
Natalie Roe, LBL, Co-Chairperson

SC1

Accelerator Systems

* Petra Schutt, GSI
Timur Shaftan, BNL
Thomas Taylor, CERN

Willeke/Seryi - EIC POC

SC2

Global Systems

* Chris Adolphsen, SLAC (RF)
Steve Gourlay, LBL (Magnets)
TBD (Cryogenics)

Tuozzolo/Smith - EIC POC

SC3

Detector Systems

* Maria Chamizo Llatas, BNL
Jim Fast, TJNAF
Jay Marx, Retired Cal Tech (P)

Aschenauer/Ent - EIC POC

SC4

Infrastructure

* Keith Orr, LANL
Rusty Sprouse, TJNAF
Canon Cheung, SLAC

Folz - EIC POC

SC5

Environment, Safety, Health & Quality

* Crystal Schrof, retired ORNL
Jemila Adetunji, FNAL

Stiegler/Porretto - EIC POC

SC6

Cost and Schedule

* Monty Middlebrook, ORNL
Emil Nassar, PPPL
Helen Taaffe, ANL

Lavelle - EIC POC

SC7

Project Management

* Erik Johnson, BNL
Lia Meringa, FNAL (P)
Elmie Peoples Evans, ANL (P)

Yeck/Lung/Hatton - EIC POC

Observers

David Asner, BNL
Joel Dolbeck (TJNAF)
Kathleen Amm (BNL)

LEGEND

SC Subcommittee
* Chairperson
(P) EIC Project Advisory Committee (PAC) Member

CD-1 Director's Review Charge

1. Is the accelerator conceptual design technically sound and likely to meet the following performance expectations identified in the 2015 Long Range Plan?
 - a high degree of beam polarization ($\sim 70\%$) for electrons and light ions
 - availability of ion beams from deuterons to the heaviest stable nuclei
 - variable center of mass energies $\sim 20\text{-}100$ GeV, upgradeable to ~ 140 GeV (e-p)
 - high collision luminosity ($\sim 10^{33\text{-}34}$ $\text{cm}^{-2}\text{s}^{-1}$)
 - possibly more than one interaction region
2. Is the plan for defining the experimental program appropriate? Does the reference detector design meet the scientific requirements (as defined in the Nuclear Science Advisory Committee Long Range Plan - 2015)?
3. Are the envisioned Key Performance Parameters (KPPs) appropriately defined?
4. Is there an R&D plan that adequately supports the design effort and mitigates the technical risks?
5. Are the cost and schedule estimates credible and reasonable for this stage of the project? Do these estimates include an assessment of cost and schedule uncertainty? Is there a project-wide risk analysis?
6. Does the project have a credible plan, as reflected in a Preliminary Project Execution Plan, to manage the EIC project?
7. Is the management team organized and staffed adequately to carry out both the current preliminary design and future execution phases of the project?
8. Are ES&H aspects being properly addressed given the project's current stage of development?
9. Has the project satisfactorily responded to the recommendations from previous reviews?
10. Has the project met the CD-1 prerequisites?
11. Is the project ready for the DOE CD-1 review?
12. Are there any suggestions on how we can improve the presentations or delivery of documentation to help ensure a successful CD-1 review?

Cost and Schedule Status

- Reference cost, schedule, and risk assessment based on CD-0. Very close to a technically driven schedule.
- Reference funding profile used to establish the DOE Critical Decision timeline and TPC point estimate of \$1,973M – Reference Baseline.
- Base costs, cost uncertainty, and schedule estimates, and risk assessment updated in preparation for a CD-1 preliminary baseline.
 - Cost estimate update well underway (~5% increase in base estimate)
 - Scrubbing costs and cost uncertainty estimates and adjusting the schedule to soften the funding profile to align with the reference profile and schedule for Critical Decisions
 - Contingency expected to be ~35% based on update cost uncertainty and risk evaluation.
- CD-1 cost range will be similar to the CD-0 current range.

Preparations for DOE CD-1 Review

Accelerator Collaboration Workshop	October 7-9, 2020
EOIs for Experimental Equipment Due	November 1, 2020
Conceptual Design Review	November 16-18, 2020
Final EICUG Yellow Report Workshop	November 19-21, 2020
NEPA Process Complete	November 30, 2020
PAC (project) & EIC Council Meetings	December 1, 2020
CD-1 Director's Review	December 8-10, 2020
Conceptual Design Report Complete	January 12, 2021
DOE CD-1 Review	January 26-28, 2021

Post CD-1 Timeline

Accelerator Technical Reviews	Spring/Summer 2021
Call for Detector Proposals	March 2021
Start Preliminary Design	April 2021
Detector Proposals	September 2021
Selection of Detector(s)	December 2021
In-kind Deliverables - Agreements	Spring 2022
Start Earned Value Tracking	March 2022
Goal for CD-2 Approval	October 2022
Goal for CD-3 Approval	July 2023

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 ops funding to EIC and new funding
 - Significant ramp up of project funding (annual doubling) starting in FY2021 is required to maintain timeline for DOE Critical Decisions
 - Most cost-effective project follows closely to a technically driven schedule
- **Partner Engagement** – **Expectations and Implementation**
 - In-kind contributions to the accelerator and experiments are being pursued
 - Lessons learned from other projects are being considered, including governance models
 - DOE and the EIC project welcome feedback on plans

Conclusion

- Preparations for CD-1 are progressing according to plans
- We are looking forward to the results of the recent independent design review (technical focus) and the upcoming Director's review (project focus & CD-1 dry run)
- Yellow Report is aligned with the current project plans and will be an important input to the DOE CD-1 review and decision
- CD-2 milestone is in two years, end of 2022, and requires:
 - Project detector selection by end of 2021
 - Also strategy for 2nd IR and detector by end of 2021