EIC Project Overview

Jim Yeck, EIC Project Director

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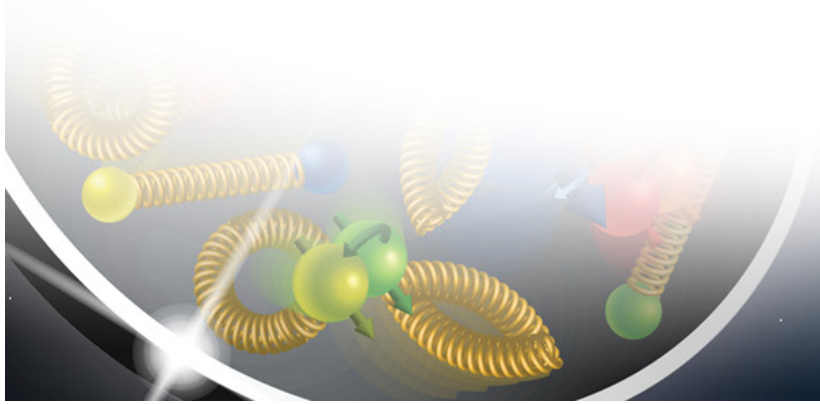
Electron-Ion Collider

BROOKHAVEN NATIONAL LABORATORY
Jefferson Lab
U.S. DEPARTMENT OF ENERGY | Office of Science

Outline

- Introduction
- BNL-JLAB EIC Partnership
- EIC Project Scope
- Organization and Management Approach
- Machine and Experimental Program Plans
- Preliminary Project Execution Scenario
- Plan to DOE CD-1, CD-2, CD-3
- Conclusions



BNL-TJNAF Partnership

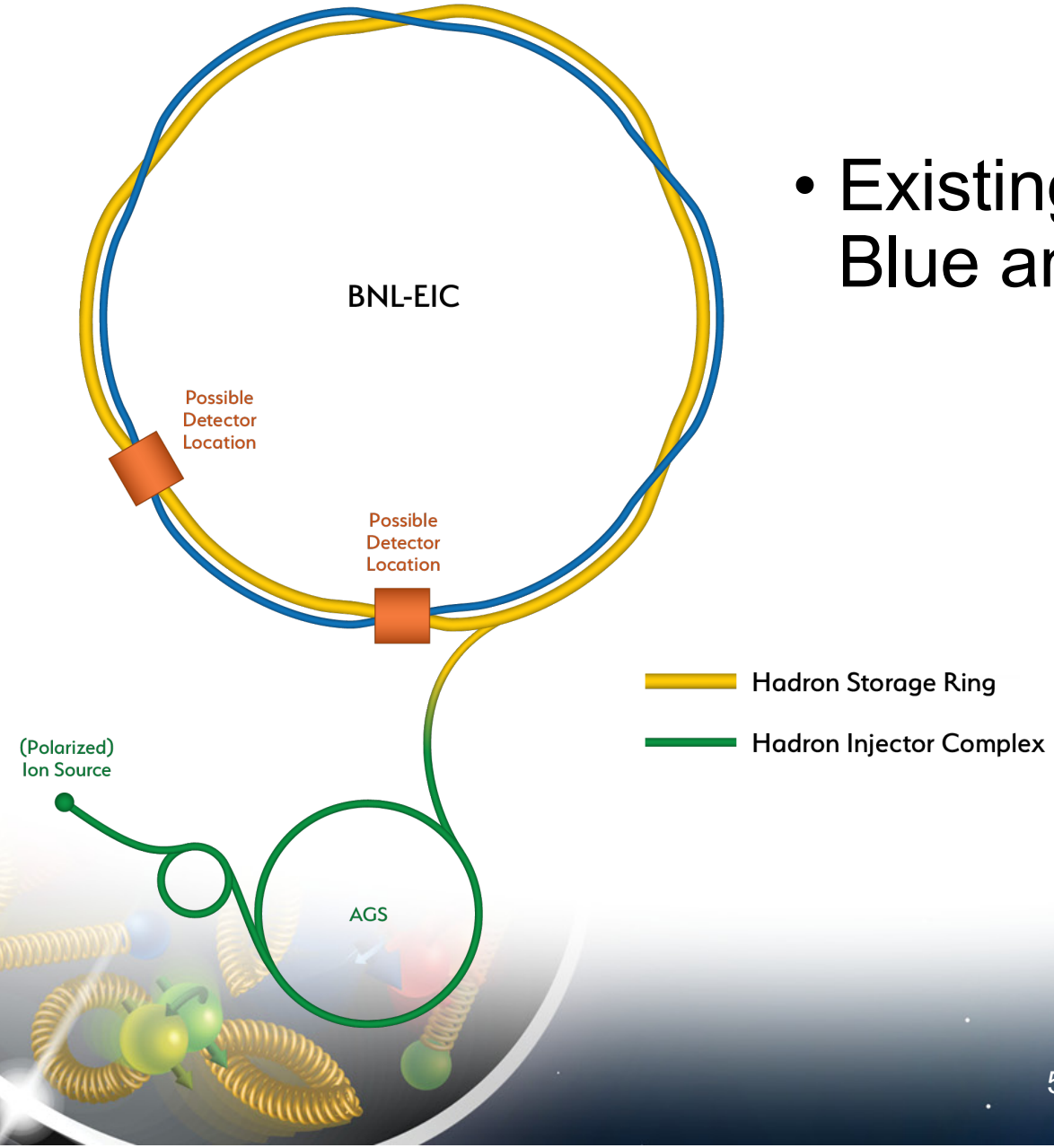
TJNAF Visit to BNL – Feb 10, 2020

BNL Visit to TJNAF – Feb 28, 2020

BNL and TJNAF Discussions

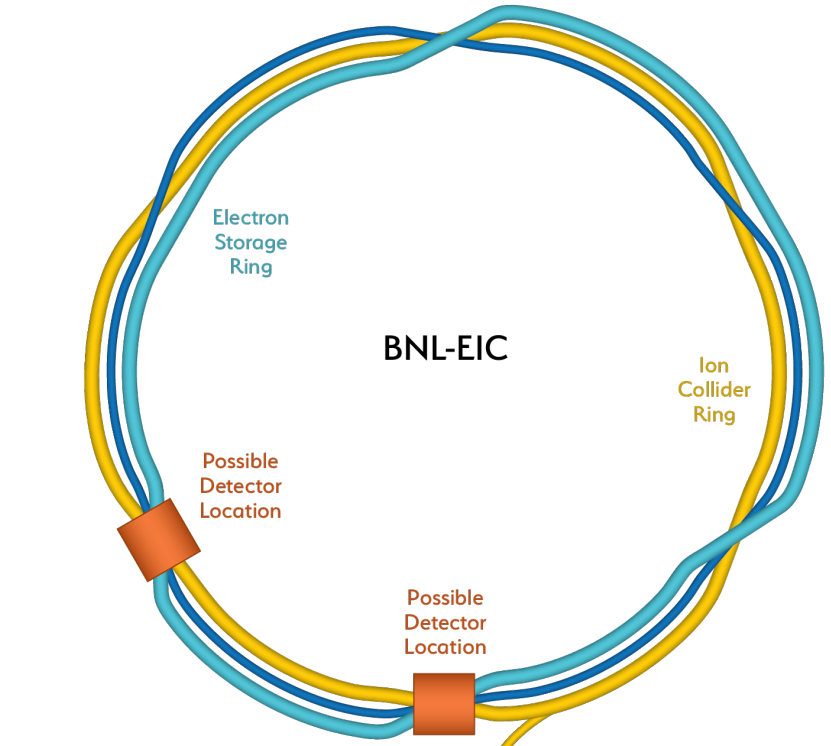
- BNL is ultimately accountable for successful project delivery
- BNL and JLAB have deep and long-standing intellectual interest in the EIC scientific program and have a joint commitment to the scientific goals of the EIC
- BNL and JLAB are committed to the successful development and execution of the Electron Ion Collider (EIC) Project
- BNL and JLAB are also committed to defining roles and responsibilities that utilize the significant capabilities of both laboratories and their user communities
- BNL and JLAB agree to develop and execute a plan for integrating specific scientific, engineering and management capabilities of JLAB into the BNL team charged with the development and management of the design and construction of the EIC facility. In addition, the parties agree to jointly build and nurture the scientific user community and collaborations required to execute a comprehensive EIC research program
- BNL and JLAB are pursing a “Partnering Agreement” and an “Operating Agreement” to capture this mutual understanding

How RHIC is transformed into an EIC

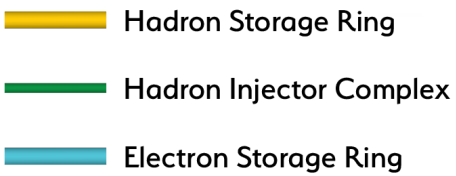


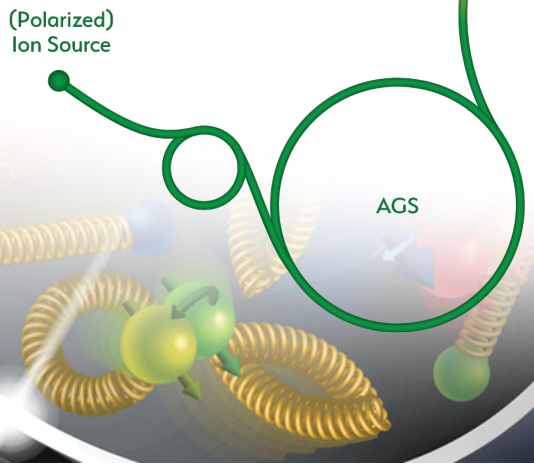
- Existing RHIC with Blue and Yellow ring

How RHIC is transformed into an EIC



- Add electron storage ring





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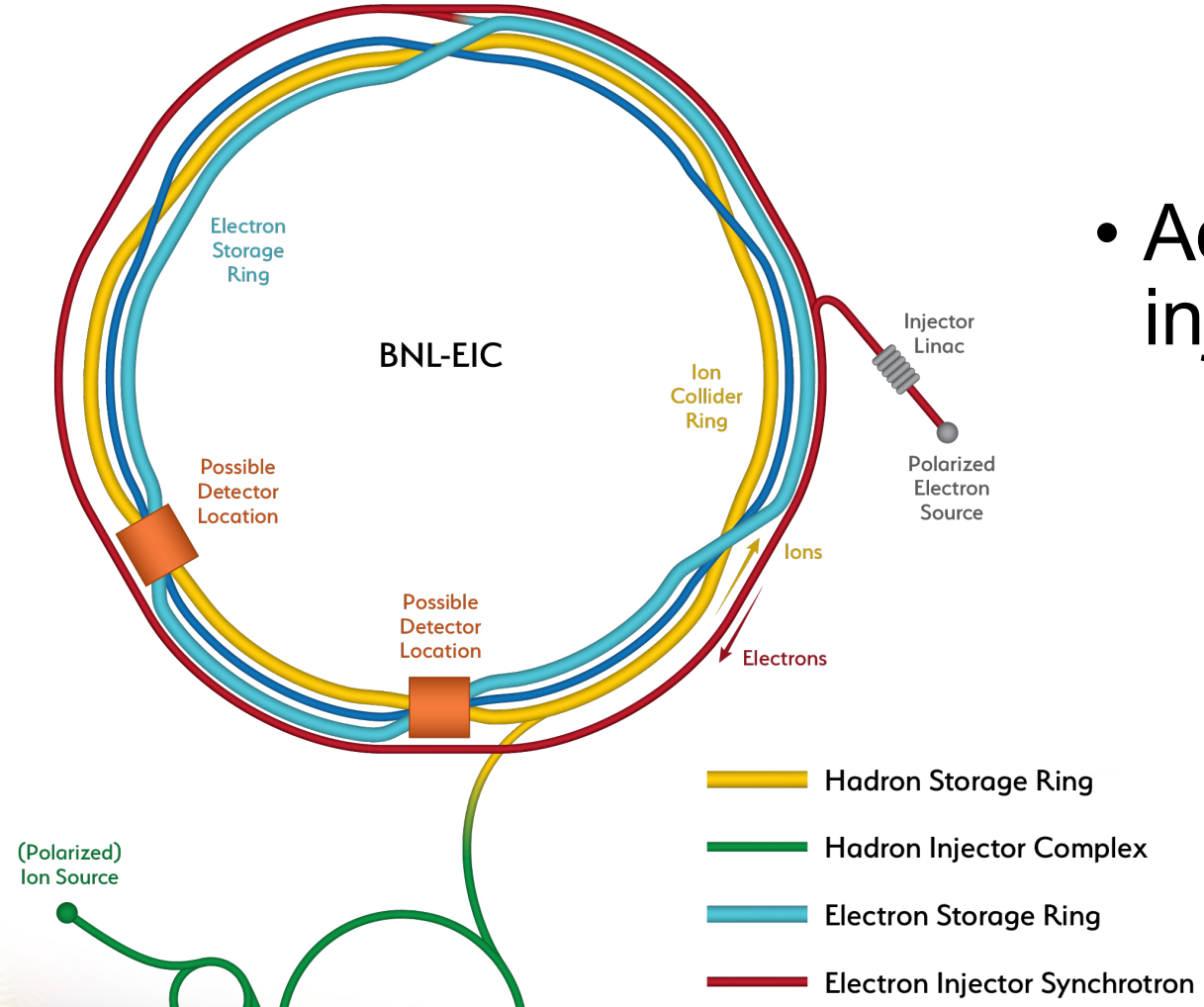
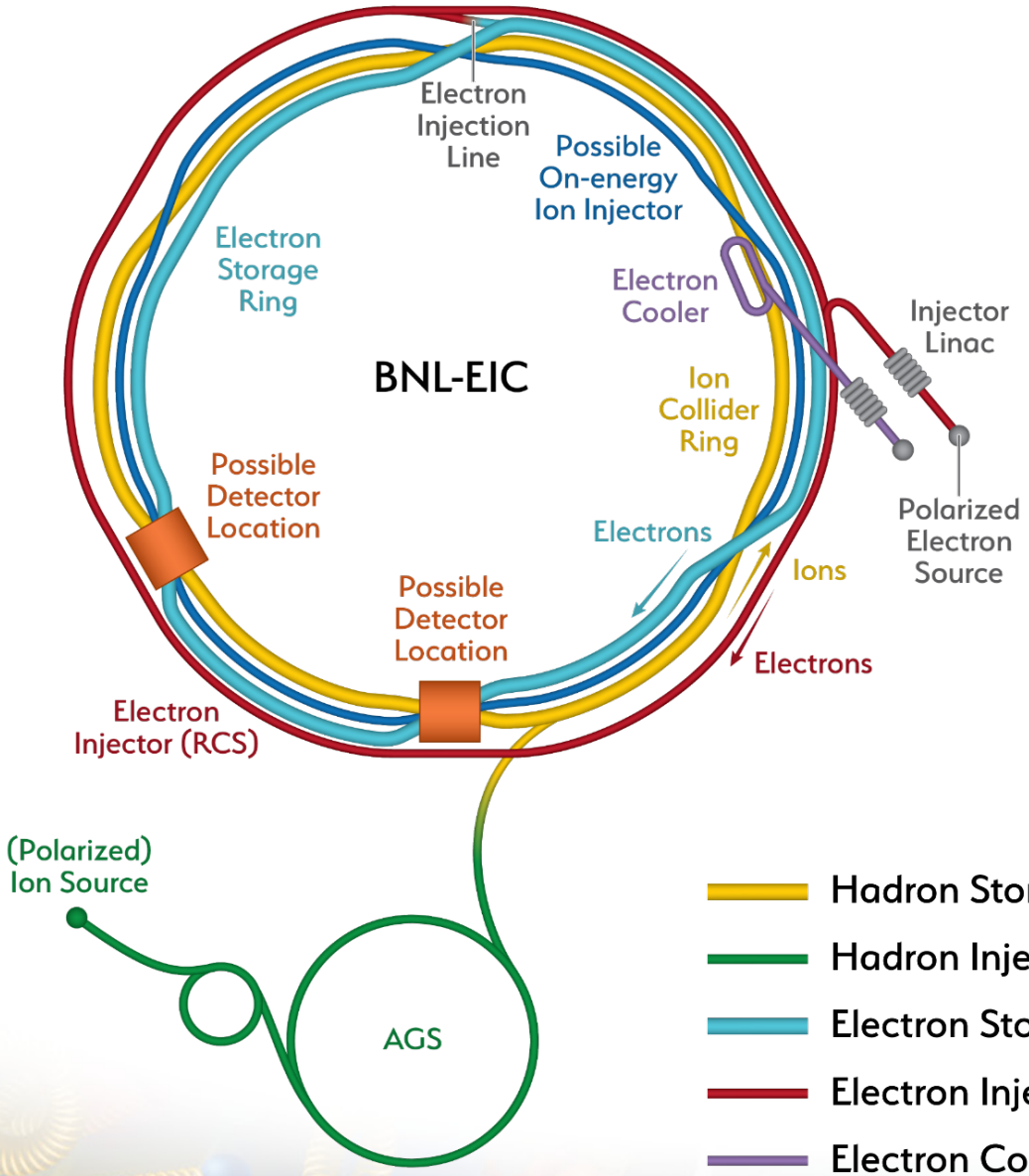


- Add an electron injector complex

Electron Ion Collider

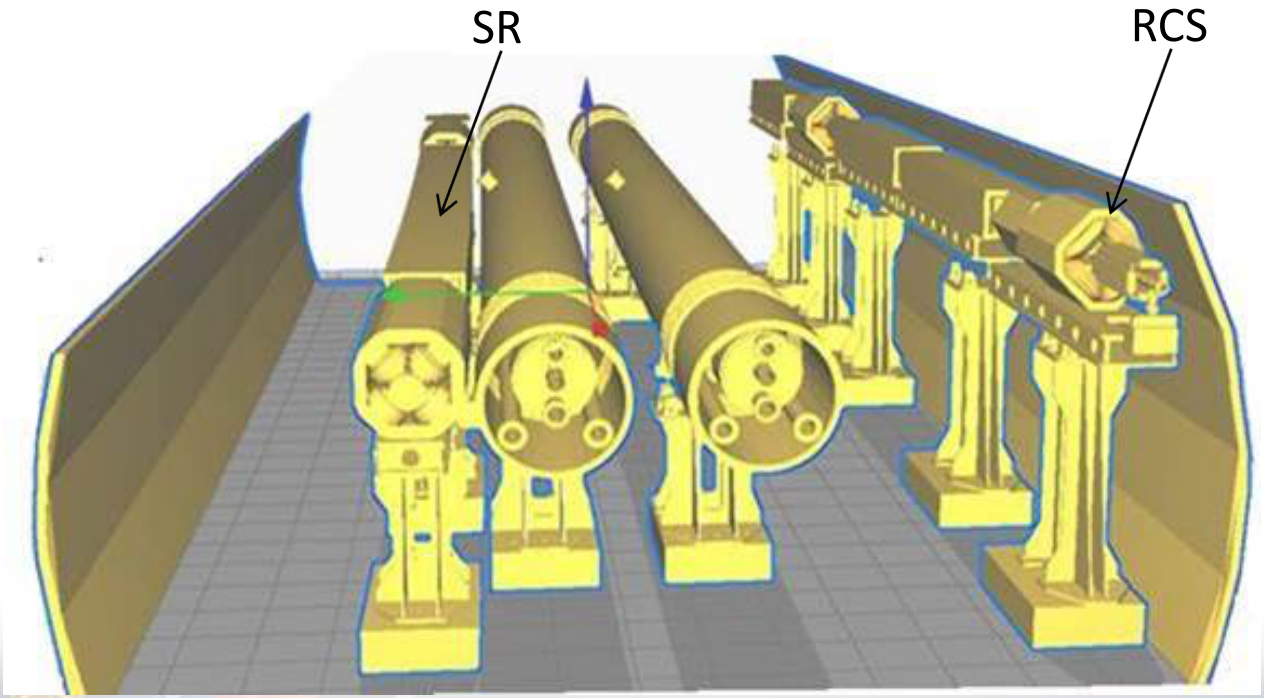


- Hadron Storage Ring
- Hadron Injector Complex
- Electron Storage Ring
- Electron Injector Synchrotron
- Electron Cooler
- Possible On-energy Hadron Injector Ring

EIC Machine in the RHIC Tunnel

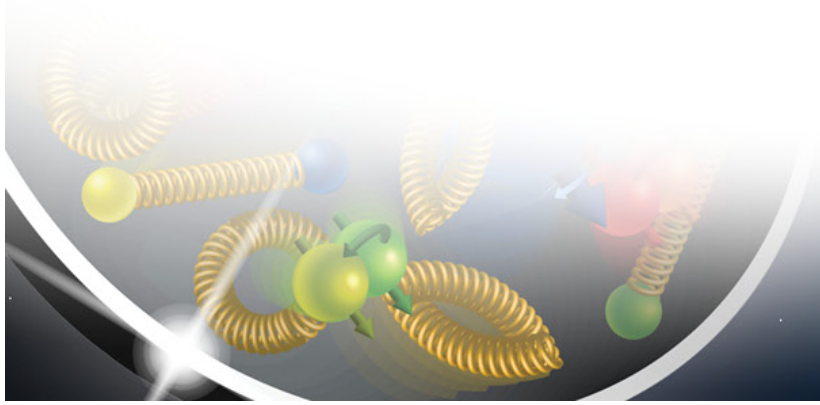
- Rapid Cycling Synchrotron (RCS) for electrons and Electron Storage Ring (SR) fit easily into the existing RHIC tunnel

- Two existing detector halls available for interaction regions and detectors



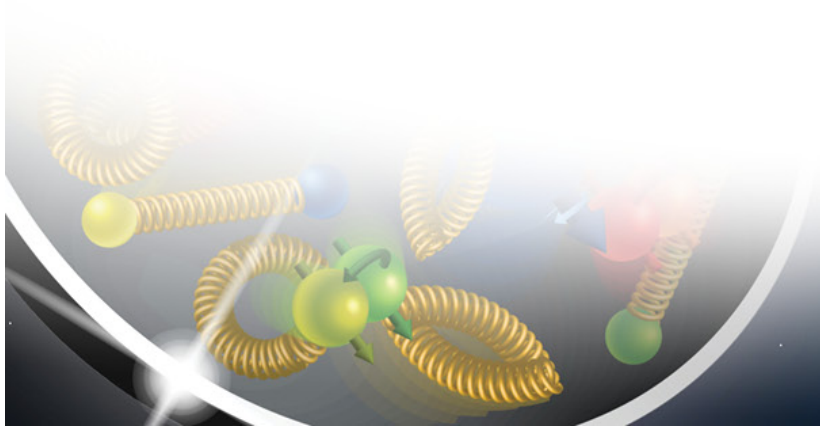
EIC design will meet NSAC and NAS Requirements

• Center of Mass Energies	20 GeV – 141 GeV
• Maximum Luminosity	10^{34} $cm^{-2}s^{-1}$
• Hadron Beam Polarization	80%
• Electron Beam Polarization	80%
• Ion Species Range	p to Uranium
• Number of interaction regions	up to two



New York State Support

- NYS will support the EIC at BNL with a $100M grant for infrastructure development
- Execution of this scope requires close collaboration between BNL support organizations, the collider accelerator department, and the EIC project
  - New infrastructure
  - Improvement and refurbishment of existing infrastructure
  - Improvement on technical sub-systems



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!**

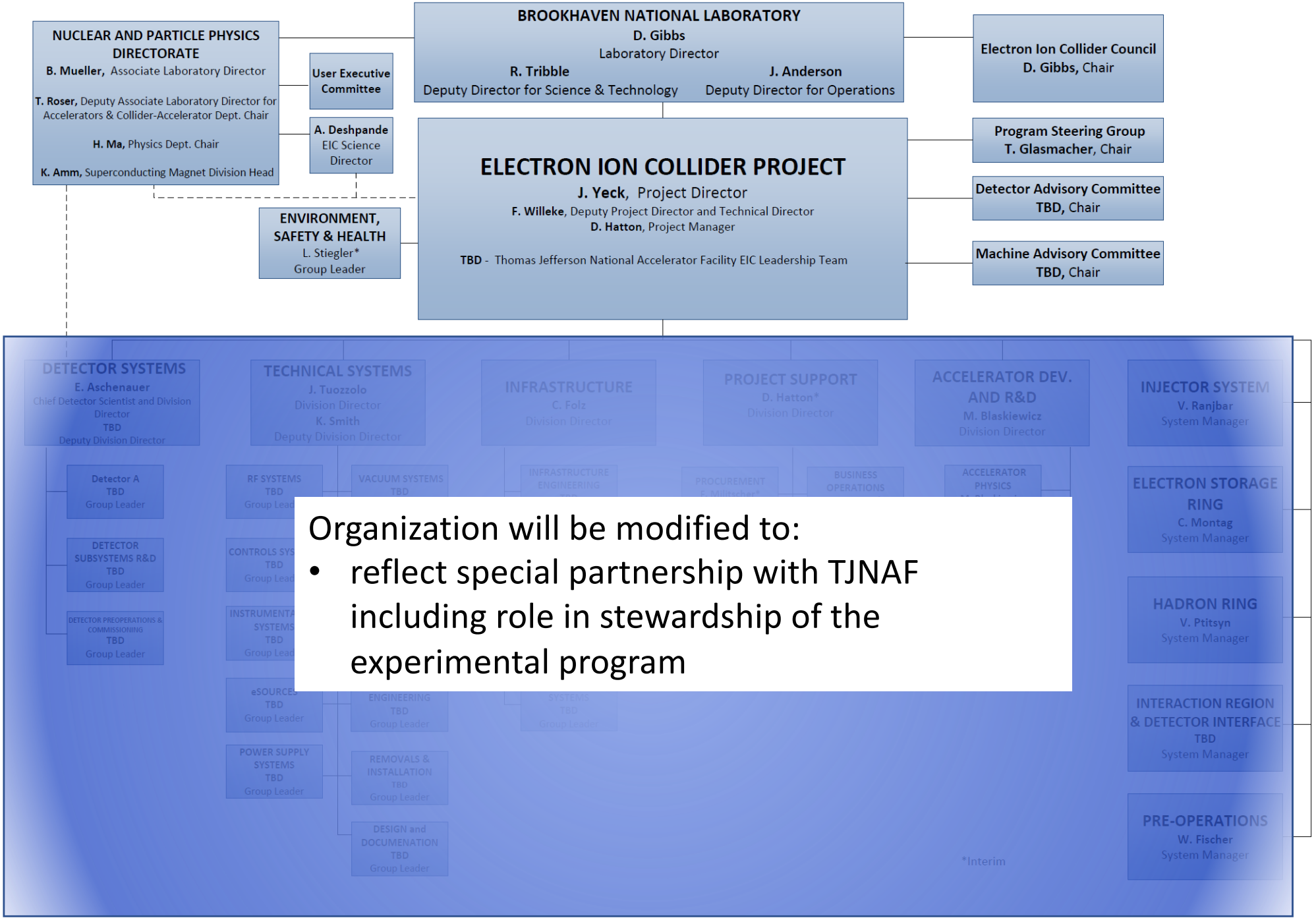
Project leaders who prioritize on schedule performance and exhibit behaviour that is consistent with a "project culture" are likely to be successful!

PLI PROJECT LEADERSHIP INSTITUTE

Organization

- Opportunities for improvement in the EIC management approach
  - Organization structure is being reassessed to benefit from the TJNAF commitment and prospects for international and domestic partners
  - Project accountability requirements to be clarified – DOE, BNL, TJNAF, other partners, the scientific community and all other stakeholders
  - Director's Council will be reevaluated based on project experience from other projects including LCLS-II, Exascale, and other recent large projects, particularly DOE projects
  - Project Leadership Team to be strengthened, roles better understood and defined, advisory committee membership and mandates clarified

BNL Organization Proposed in October 2019



Organization will be modified to:

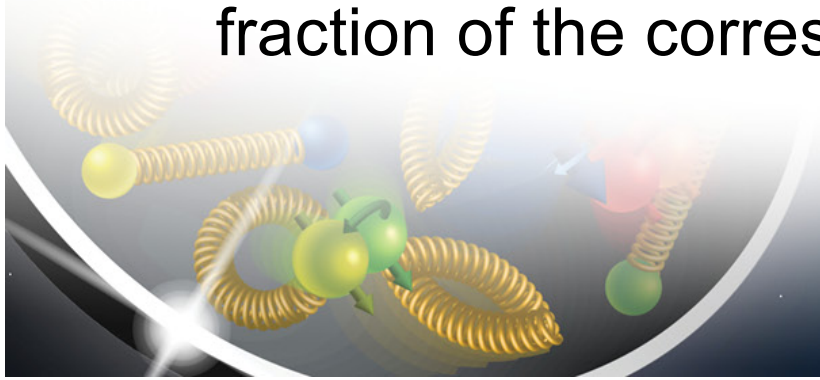
- reflect special partnership with TJNAF including role in stewardship of the experimental program

International Partnership

- General approach and strategy for engaging potential international partners in the EIC
  - Bob Tribble and Bob Mckeown are Points of Contact for international partners
  - Experimental Program
    - Build on historical engagement in RHIC and CEBAF, engage new partners
    - Detector(s) – International collaborations propose detectors that include plans for in-kind contributions and are delivered by project teams
  - Machine – Leveraged off interests in the scientific program and interests in accelerator technologies (XFEL, ESS, PIP-II …)
- Considerations
  - Expectations for the experimental program including scale of international engagement
  - Alignment with DOE Office of Science and international funding agency objectives

Machine Collaboration

- Common design tasks forces formed
- Final discussions and formalization in progress
- Some design and conceptual changes of EIC being discussed
- R&D prototyping efforts expected to start in ~one month
- Design development governed by a controlled design change procedure with a design board
- TJNAF is invited to assume responsibility for a large fraction of the corresponding scope – to be discussed



Experimental Program

- Detector requirements and design are driven by EIC physics program and defined by the community
- EICUG Yellow Report – critical input for detector proposals

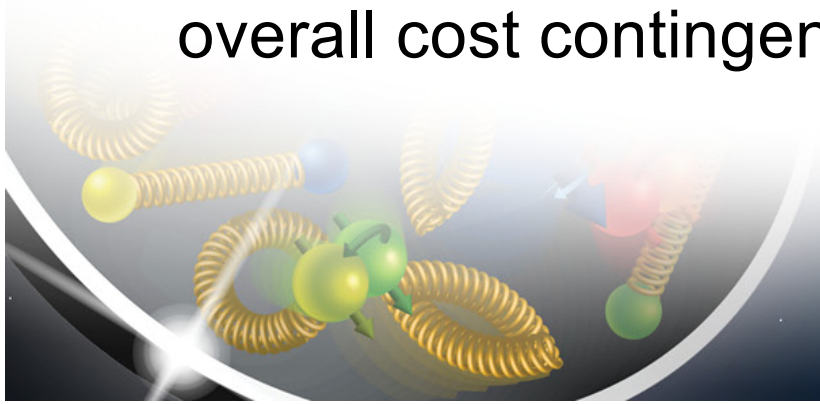
• December 2019	Kick-off meeting at MIT
• March 2020	1st meeting at Temple
• May 2020	2nd meeting at Pavia/Italy
• August 3-7 2020	EIC-UG Meeting at Miami
• September 2020	3rd meeting at CUA
• November 2020	4th meeting at UCB/LBL
• January 2021	completion Yellow Report
• July/August 2021	EICUGM at Warsaw/Poland

Program Development - Rolf Ent will elaborate

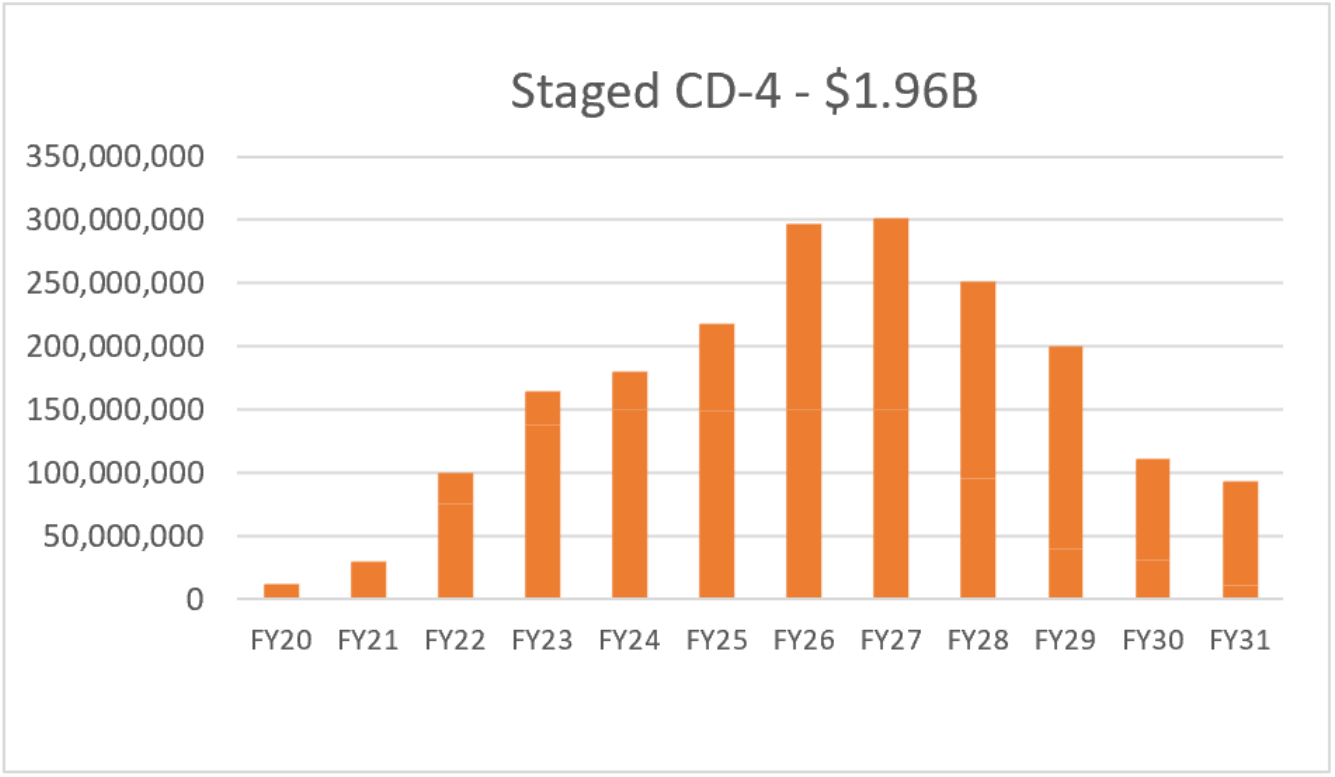
Expressions of Interest (EoI) Timeline Formal Starting Point (critical input, although not binding or required)	
EIC-UG Meeting – Review/Discuss Planned EoI Call	August 3-7, 2020
Call for EoI for contributions to EIC Detectors	August 2020
EoI Submission Deadline	November 2020
EoI Evaluations followed by Call for Detector Proposal(s)	February 2021

EIC Project Planning Assumptions

- NSAC and NAS performance requirements
- TPC range is $1.6B – $2.6B, established at DOE CD-0
- Reference cost is the BNL estimate prepared for the CD-0 Independent Cost Review (ICR)
- New York State funding of $100M for infrastructure scope
- One interaction region included in the reference costing
- Project completion will be dependent on funding, early 2030's
- Currently assuming one year of schedule float and an overall cost contingency of 35%



Proposed Project Scenario



DOE Critical Decisions

- CD-1: Q2/Q3 FY2021
- CD-2: Q4 FY2022
- CD-3: Q4 FY2023
- CD-4a: Q4 FY2029
- CD-4b: Q4 FY2032

Note: Achieves luminosity goals as soon as technically feasible

Schedule

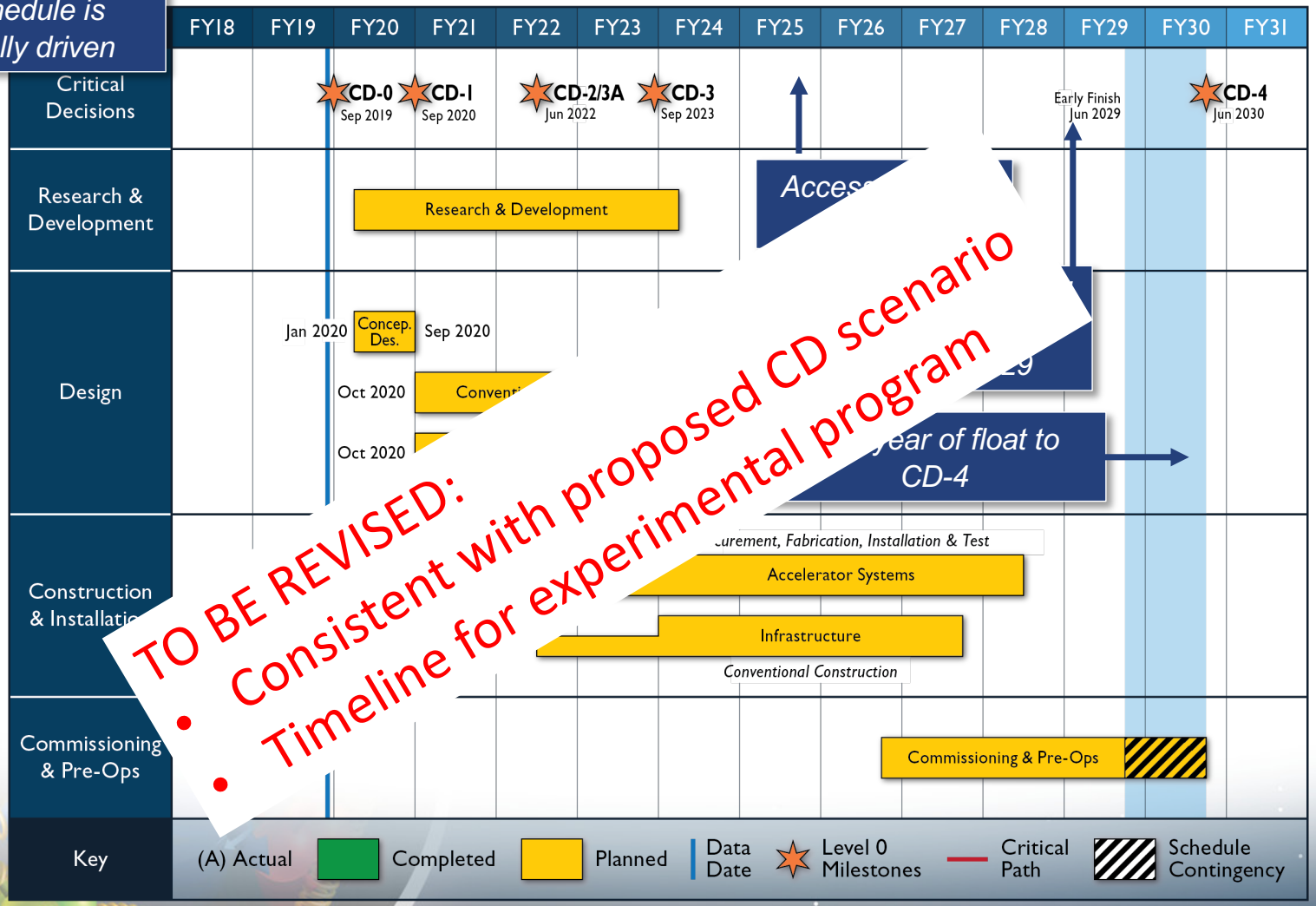
RHIC Beam Energy Scan

Commissioning and operations sPHENIX

Existing obligations taken into account

EIC

EIC schedule is technically driven



TO BE REVISED:

- Consistent with proposed CD scenario
- Timeline for experimental program

Proposed Timeline to CD-1

NEPA Process Start	**January 10, 2020**
Partnership Agreement between TJNAF and BNL Signed	**April 15, 2020**
A/E Services Contract Award	**May 1, 2020**
DRAFT CD-1 Documents Complete	**June 30, 2020**
1st Machine Advisory Committee Meeting	**August 1, 2020**
First DRAFT Conceptual Design Report (CDR) Complete	**August 30, 2020**
CD-1 Documents Complete	**September 1, 2020**
Final DRAFT CDR Complete	**September 30, 2020**
NEPA process Complete	**September 30, 2020**
Conceptual Design Review Convened by BNL/TJNAF	**October 2020**
CD-1 Director's Review	**October 2020**
DOE Independent Project Review (IPR)	**December 2020**
ESAAB Approval of the EIC Critical Decision 1	**Q2 or Q3FY2021**
Start Preliminary Design	**Q3FY202**

CD-1 Requirements

- Acquisition Strategy
- Risk Management Plan
- Conceptual Design
- Preliminary Hazards Analysis Report
- Preliminary Quality Assurance Program
- NEPA Strategy

DECISION / REQUIREMENTS[1] / APPROVAL[2] \ TOTAL PROJECT COST (TPC)		$750M or more
CD-1--APPROVE ALTERNATIVE SELECTION AND COST RANGE		S-4
PRIOR TO CD-1--CONCEPTUAL DESIGN	Approve Acquisition Strategy	Reviewed by SC-28 Approved by SC-1
	Approve Preliminary Project Execution Plan (PEP)	S-4
	Appointment of the Federal Project Director (FPD)	S-4
	Approve Integrated Project Team (IPT)	S-4
	Develop a Risk Management Plan	Project
	Comply with the One-for-One Building Space Replacement	Project
	Complete a Conceptual Design	Project
	Document High Perf. & Sustainable Bldg. & Sustainable Env. Stewardship considerations	Project
	Conduct a Conceptual Design Review	Team external to project
	Complete a Conceptual Design Report	Project
	Prepare a Preliminary Hazard Analysis Report	Site Office or Lab
	Develop and Implement an Integrated Safety Management Plan	Site Office or Lab
	Establish Preliminary Quality Assurance Program (QAP)	Site Office or Lab
	Identify general Safeguards and Security requirements for the recommended alternative	Site Office or Lab
	Complete National Environmental Policy Act (NEPA)Strategy by issuing a determination (i.e., EIS, EA)	Site Office or Lab
	Conduct Preliminary Security Vulnerability Assessment, if necessary	Site Office or Lab
	Conduct Independent Project Review or External Independent Review	ICE or ICR by PM & SC-28
	Update PDS, or other funding documents for MIE and OE projects, and OMB 300s, if applicable.	SC-AD
Nuclear Facility	*Hazard Cat. 1,2,3 Nuclear Facility--Update Safety Design Strategy (SDS)*	*SBAA & FPD, w/ CNS or CDNS concurrence, as appropriate*
Nuclear Facility	*Hazard Category 1, 2, and 3 nuclear facilities, conduct an Independent Project Review (IPR)*	*PSO*
Nuclear Facility	*Hazard Cat. 1,2,3 Nuclear Facility--Prepare a Conceptual Safety Design Report (CSDR)*	*SBAA via the CSVR*
Nuclear Facility	*Hazard Cat. 1,2,3 Nuclear Facility--Prepare Conceptual Safety Validation Report (CSVR)*	*SBAA*
Nuclear Facility	*Hazard Cat. 1,2,3 Nuclear Facility--Initiate a Code of Record*	*Project*
POST CD-1	Submit approved CD or equivalent documents to APM	SC-28
	Allow expenditure of PED, MIE OR OE funds for project design.	Project
	Submit budget request for the remainder of TPC **If CD-2 is approved w/i 2 years of OMB submission**	SC-AD
	Update PARS II with monthly status	Prog. Mgr. & FPD No Earned Value (EV)
	Continue with Monthly or Quarterly Project Reporting/Meeting	SC-AD Invite SC-1 and SC-28
	Develop an Acquisition Plan if applicable	
Nucl	*Hazard Cat. 1,2,3 Nuclear Facility--Develop a Checkout, Testing & Commissioning Plan*	*Project*

Conclusion

- Project Organization
  - Engage partners
  - Clear accountable for project delivery
- Project Delivery Plans
  - Strong basis: pre-conceptual design, cost estimate, schedule
  - Collaboration with TJNAF
  - Aligned with reasonable annual funding projections
  - DOE approval process (Critical Decisions) is important: CD-1 in FY2021
- Experimental Program Scenarios
  - Community engagement essential including role of BNL and TJNAF in the process
  - Timeline for Yellow Book, Call for Expressions of Interest, Call for Proposals, etc.

Summary

- EIC pre-CD0 design efforts support all NSAC and NAS requirements
- Pre-CD0 Development is a good starting point for the Conceptual Design
- EIC exploits existing RHIC accelerator tunnel, service buildings, superconducting accelerator rings, and hadron injector chain incl. polarized particle sources and infrastructure ➔ enables cost effective implementation
- Design of the electron storage ring and its injectors relies on established accelerator technology
- Single design parameters are within values which have been demonstrated at other facilities before, but are novel and unprecedented as a whole

➔ Results in robust, low risk concept, implementable in a straightforward way

… will be quickly commissioned;

means that routine operation & physics data emerge soon after startup

- First pass on EIC organization; is under discussion with potential partners
- Efforts so far include many contributions from collaborators
- Project execution envisioned as a multi laboratory partnership