EIC Project Overview

Jim Yeck, EIC Project Director

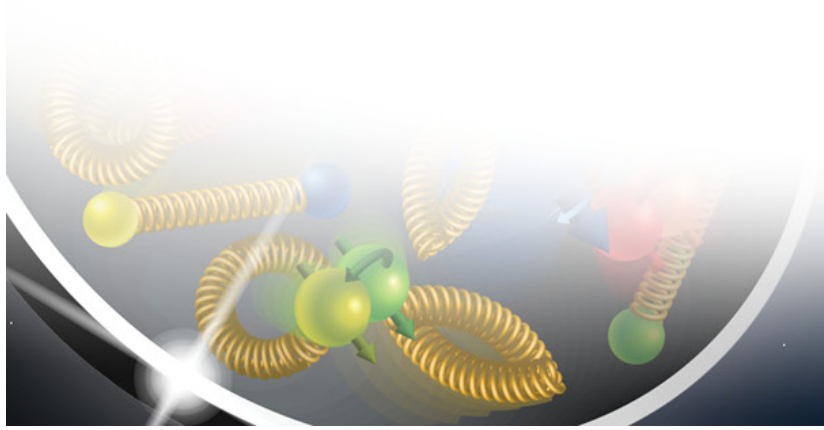
July 15, 2020

Electron-Ion Collider

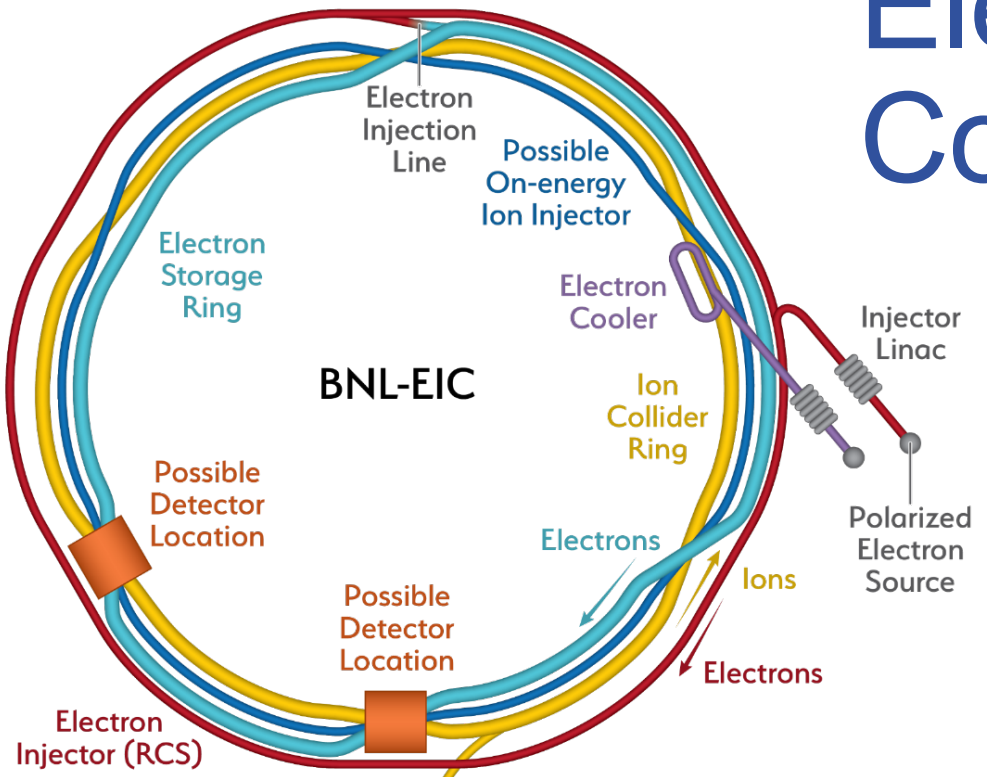
BROOKHAVEN NATIONAL LABORATORY
Jefferson Lab
U.S. DEPARTMENT OF ENERGY | Office of Science

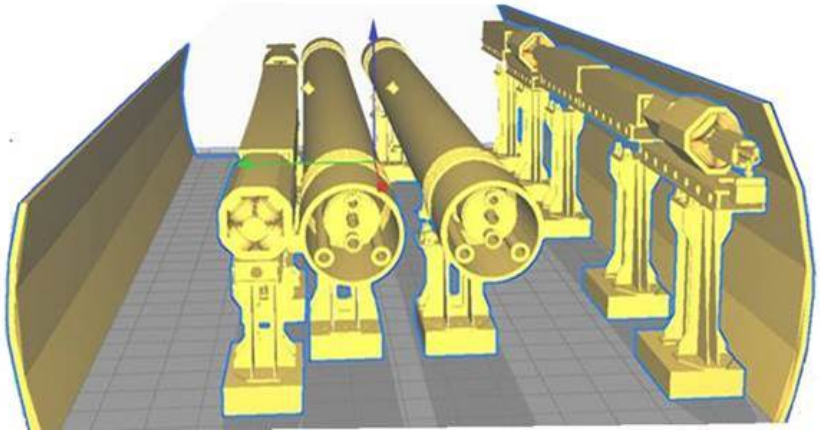
EIC Design Satisfies NSAC and NAS Requirements

• 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



Electron-Ion Collider





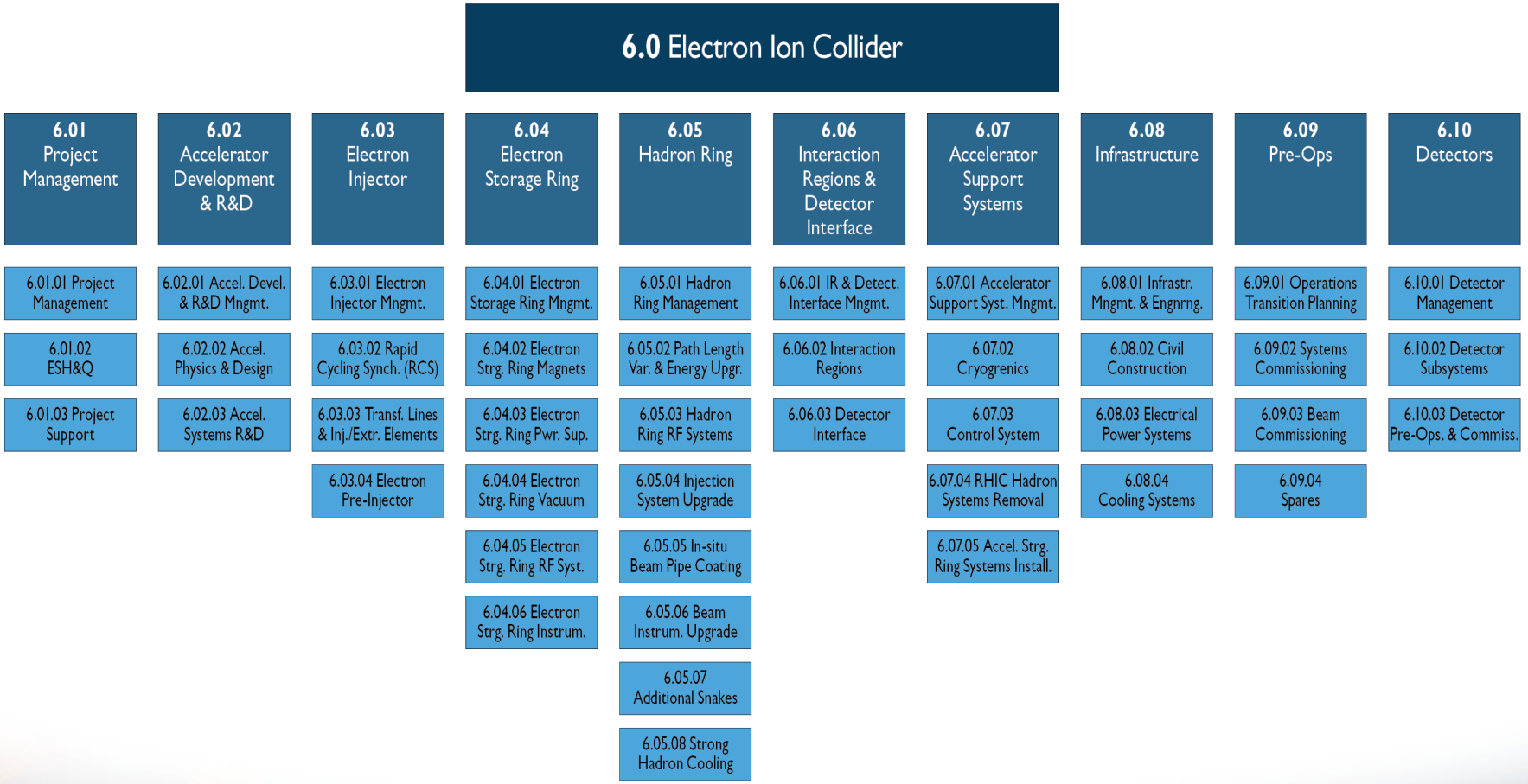
Rapid Cycling Synchrotron (RCS) for electrons and Electron Storage Ring (SR) fit in the existing RHIC tunnel

Two existing detector halls available for interaction regions and detectors

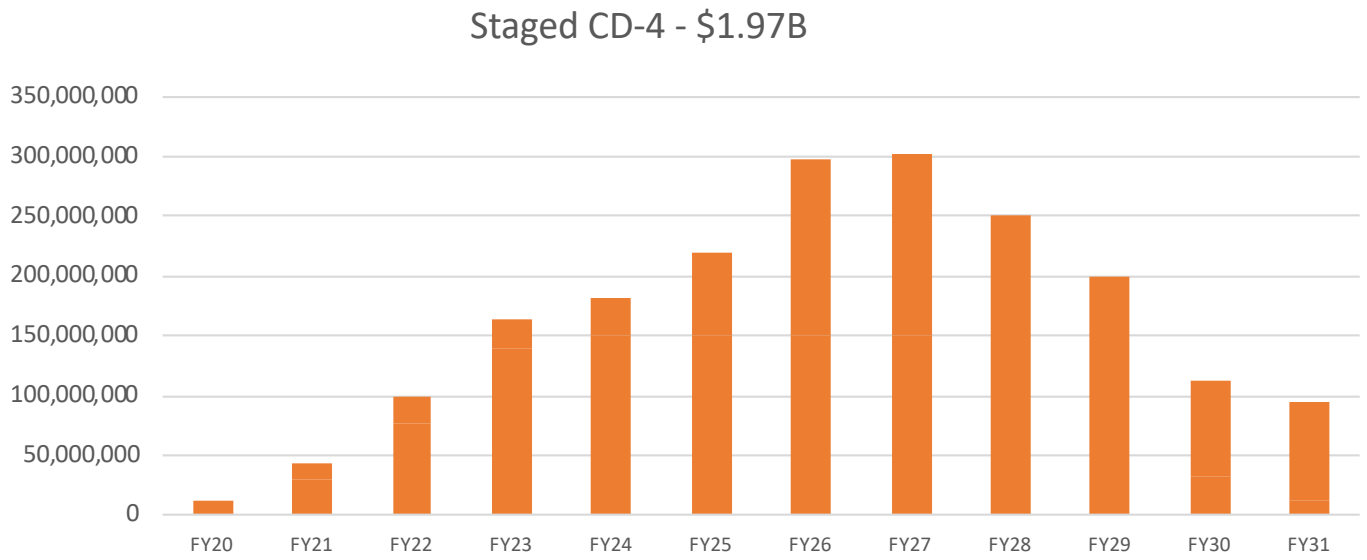
Electron-Ion Collider Project

- 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 years
- Cost
  - CD-0 approved with a range of $1.6B-$2.6B

EIC Project Scope



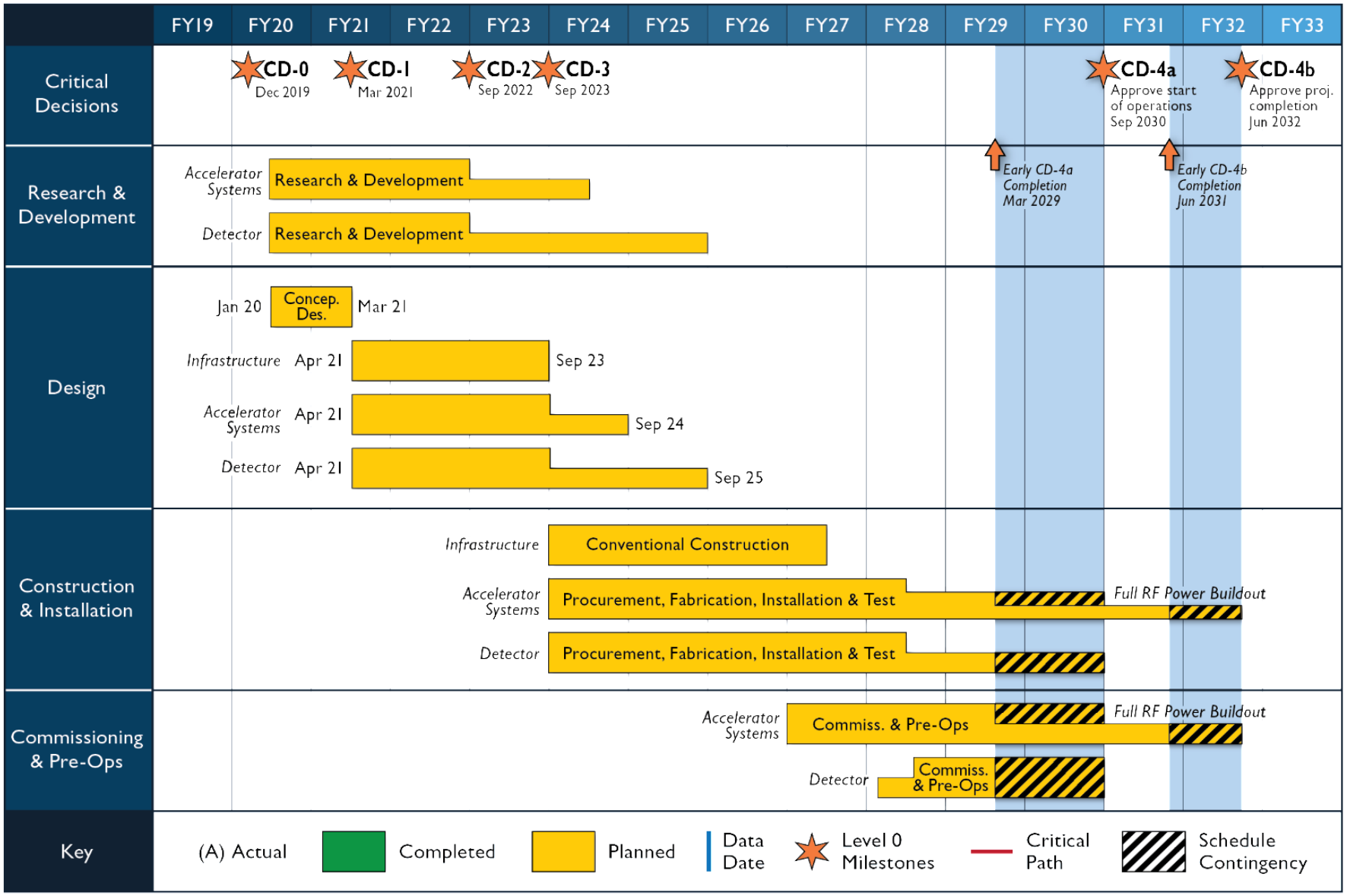
Reference Funding Profile



- CD-1: March 2021
- CD-2: September 2022
- CD-3: September 2023
- CD-4a: September 2030
- CD-4b: June 2032

- Staged Luminosity
  - Operations Start CD-4a
  - Full RF Power Installed by CD-4b
- $100M from New York State toward infrastructure

Reference Schedule



EIC Organization

- 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 participates in the EMT as an ex-officio member providing an additional connection to the User community.

BNL Visit to TJNAF – Feb 28, 2020

ELECTRON ION COLLIDER PROJECT

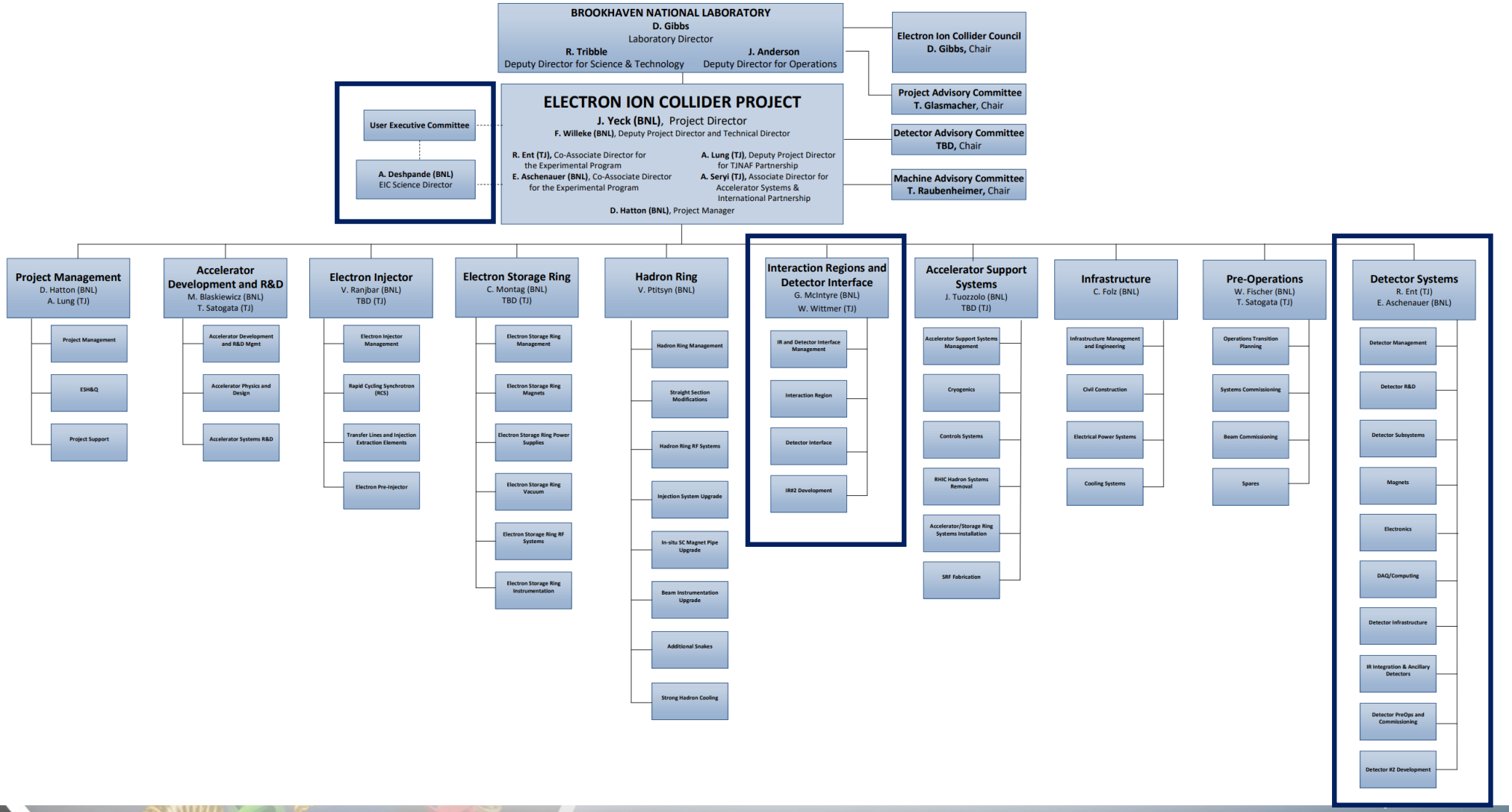
J. Yeck (BNL), Project Director
F. Willeke (BNL), Deputy Project Director and Technical Director

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 Management Approach

- BNL/TJNAF Partnership
  - BNL and TJNAF worked together to clarify mandates and membership for the advisory committees (project, machine, and detector)
    - Detector Advisory Committee Meeting – October 2020
    - Conceptual Design Review - November 2020
  - EIC Council established (BNL and TJNAF Directors) with a charter based on experience from recent projects including the LCLS-II and Exascale projects
- Stakeholder Engagement
  - Prospects for significant international and domestic partners are being considered in planning the project for both the accelerator and experimental program
  - Promoting a culture of interdisciplinary and multi-institutional collaboration
  - Bi-lateral meetings with potential partners, including international institutions, underway to discuss opportunities in the accelerator and experimental areas
- DOE/BNL/TJNAF interests in advancing the EIC are aligned and facilitated by weekly project meetings organized by DOE ONP

EIC Project Org Chart - DRAFT



EIC Project Structure

Current concept for experiments, to be discussed

Level 1 (L1) – Executive Management Team – EIC Project

Level 2 (L2) – Major system owners of WBS scope elements, typically $100M+

Level 3 (L3) – Major subsystems

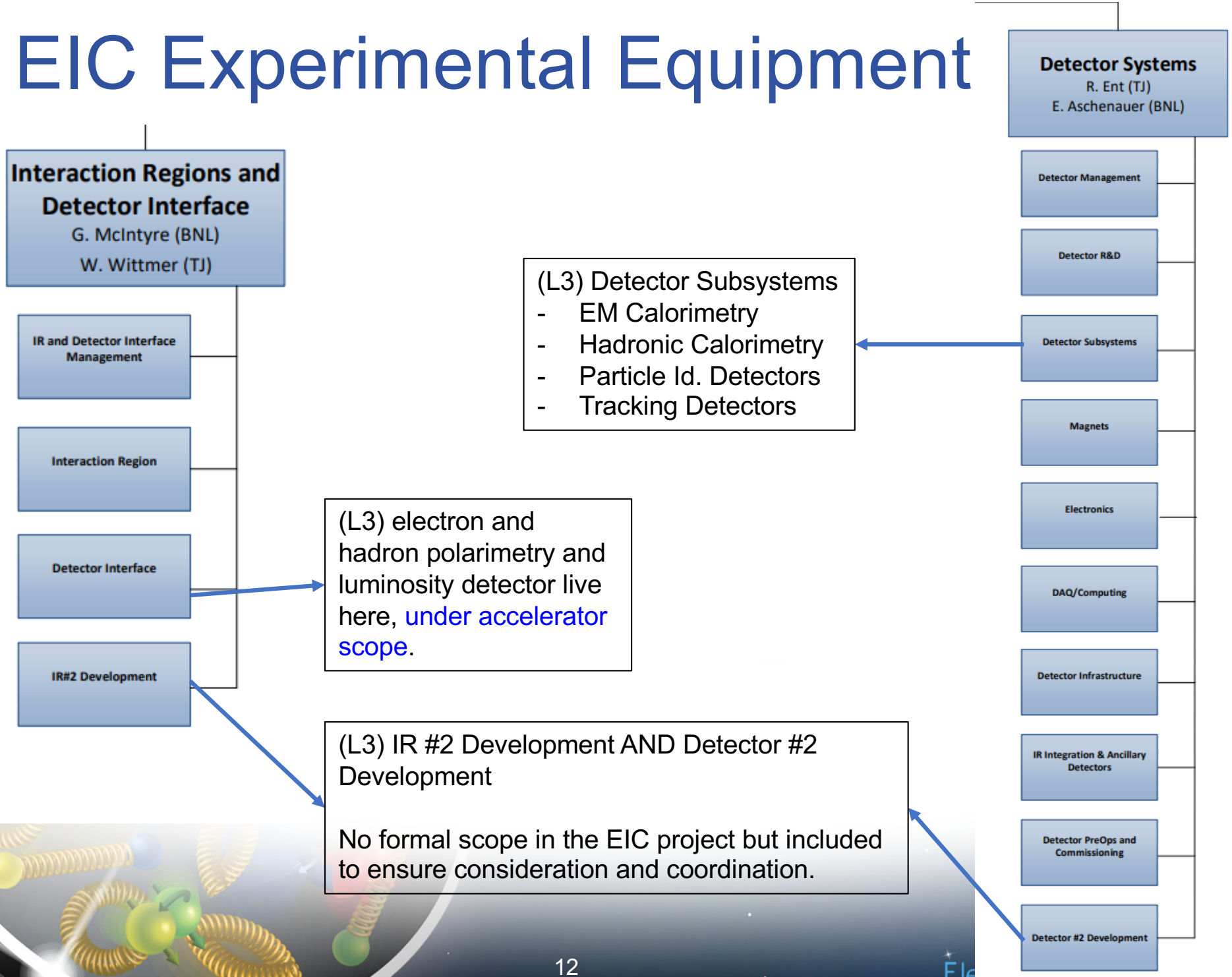
Level 4 (L4) – Complete subsystems/detectors

Level 5 (L5) – Complete ingredients of subsystems/detectors

Collaboration(s) take lead roles at Level 3 and below.

Definitions, used later: CAM = Cost Account Manager, AoA = Analysis of Alternatives, NEPA = National Environmental Policy Act, OPA = DOE Office of Project Assessment

EIC Experimental Equipment



Detector 1, Detector 2

(L2) Detectors
Rolf Ent
Elke Aschenauer

(L3) Detector Management
CAM: BNL & TJ

(L3) Detector R&D
CAM: BNL & TJ

Possible Detector 2 – Separate project

Detector 1

Detector Subsystems
(L3) EM Calorimetry – CAM: BNL
(L3) Hadronic Calorimetry – CAM: BNL
(L3) Particle Id. Detectors – CAM: TJ
(L3) Tracking Detectors – CAM: TJ

(L3) Magnet
CAM: TJ

(L3) Electronics
CAM: TJ

(L3) DAQ/Computing
CAM: BNL & TJ

(L3) Detector Infrastructure
CAM: BNL

(L3) IR Integration + anc. detectors
CAM: TJ

(L3) Detector Pre-Ops
CAM: BNL

(L3) Detector 2 Development
Elke Aschenauer
Rolf Ent

Detector 2 Management

Detector Subsystems
- EM Calorimetry
- Hadronic Calorimetry
- Particle Id. Detectors
- Tracking Detectors

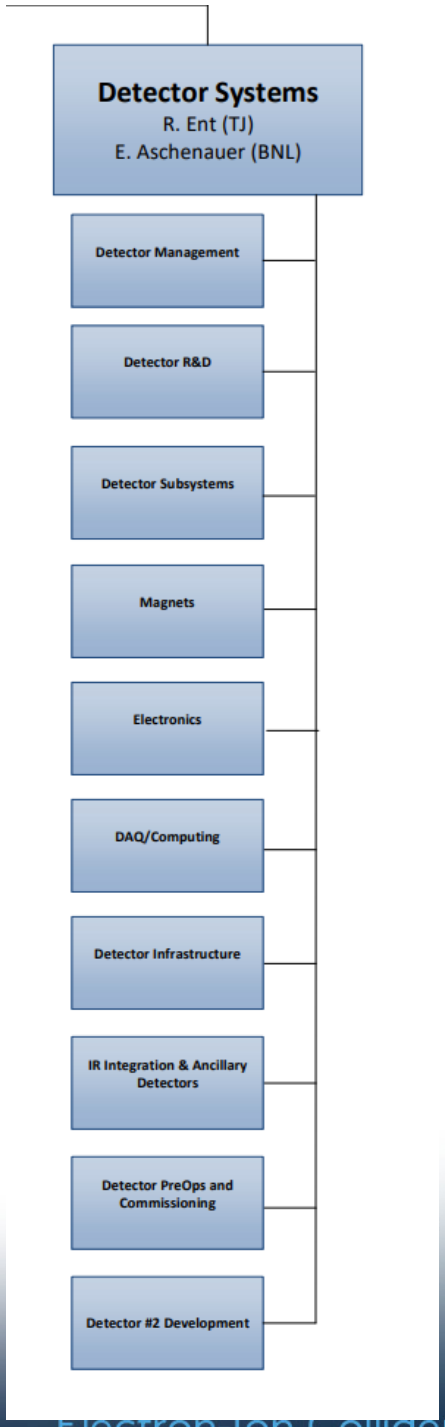
Magnets

Electronics

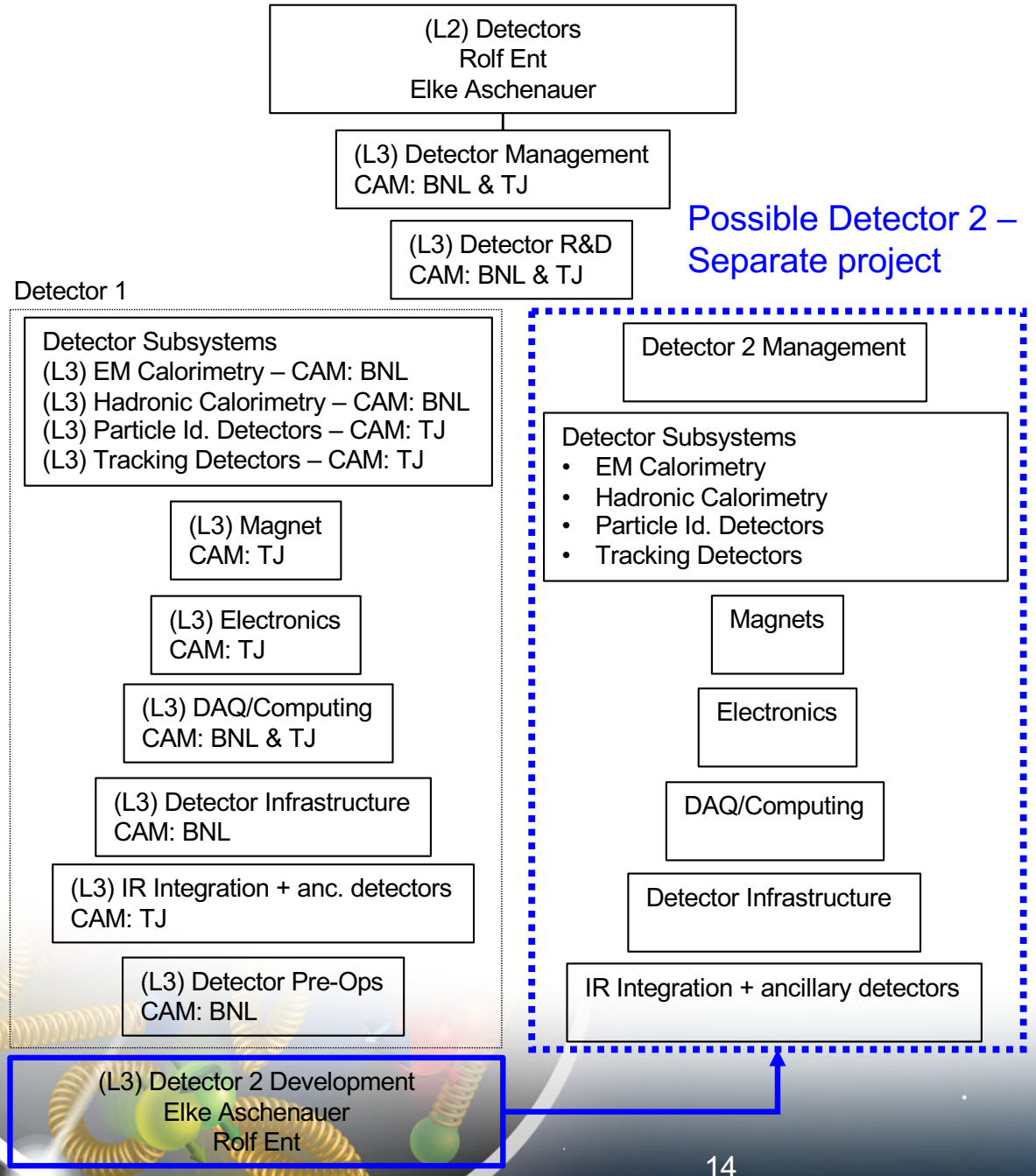
DAQ/Computing

Detector Infrastructure

IR Integration + ancillary detectors



Collaboration View



Present thinking

Detector 1:
Fold in users/collaborators as
- L3/L4 point of contacts?
- L3/L4/L5 owners?
- L4/L5 CAMs?

Example for EM calorimetry:
(L4) Forward EM calorimetry
    (L5) will *e.g.* be readout, blocks/crystals, integration/cooling, etc.
(L4) Central EM calorimetry
(L4) Backward EM calorimetry

Detector 2:
If a standalone project, this would have a separate management and reporting structure with users/collaborators owners and CAMs.

Detector Systems - Other Project Cost (OPC) Activities

Tasks - Joint BNL and JLab efforts, working in sync with YR through the sub-working groups

- Detector
  - Conceptual design of experimental solenoid
  - Engineering concept for the full detector, including integration of detector in current Interaction Region, installation and maintenance.
- Interaction Region
  - Synchrotron and hadronic background simulation, vacuum impact and mitigation, and beam pipe and vacuum pump integration design (IR, ancillary detectors)
- Electronics, Data Acquisition and Computing
  - Evaluation of ASIC, PCB and FPGA needs
  - Resource evaluation of the computing needs for a fully streaming DAQ

Task Owners - Elke Aschenauer (BNL) and Rolf Ent (JLab)

Detector Advisory Committee (DAC)

- DAC Charter, Membership, and White Paper on Detector R&D under discussion with DOE ONP
- International DAC will be assembled with ~12 members and diversity addressed
  - EIC science and general (2)
  - Global integration (1)
  - Detector integration (1)
  - Particle identification (2)
  - Computing (1)
  - Electronics (1)
  - Calorimetry (2)
  - Tracking (2)
- Ex-officio members: Chair and Vice-chair of EICUGM Steering Committee
- Ex-officio members: Chair and Coordinator of Generic EIC Detector R&D program

Timeline to CD-1

EIC Program Steering Group Meeting	May 7, 2020 ✓
Partnership Agreement Signed	May 7, 2020 ✓
Call for EoI for Contributions to Detectors	May 29, 2020 ✓
EIC Director's Council Meeting	June 25, 2020 ✓
Preliminary drafts/full outline of CDR due	June 30, 2020 ✓
Draft CD-1 documents complete	June 30, 2020 ✓
A/E Services Contract awarded	July 3, 2020 ✓
Analysis of Alternatives Team report due	July 15, 2020 ✓
Deadlines for drafts of new CDR material	July 31, 2020
Freeze Design updates for Draft CDR	July 31, 2020
Risk Workshop	Early August, 2020

Timeline to CD-1

Freeze data for DOE Mini Review	August 1, 2020
Independent Review of AoA	Week of August 10, 2020
CD-1 Documents complete	August 15, 2020
AoA Final Report complete	August 25, 2020
Mini MAC (Machine Advisory Com.) Mtg	August 26, 2020
Post Material for DOE Status Review	August 26, 2020
Project Advisory Committee Meeting	August 27, 2020
Draft CDR complete	September 1, 2020
DOE OPA Status Review	September 9-10, 2020
1st Detector Advisory Committee (DAC) Mtg	Early October

Timeline to CD-1

Deadline for Detector EoI	November 1, 2020
Conceptual Design Review	November tbd, 2020
PAC Meeting	November 19, 2020
Post Material for Director's Review	November 23, 2020
NEPA Process Complete	November 30, 2020
CD-1 Director's Review	December 8-10, 2020
Freeze data for DOE CD-1 Review	December 15, 2020
½ Day Briefing with NP and OPA	January 7, 2021
Final CDR Complete	January 12, 2021
Post Material for CD-1 Review	January 12, 2021
DOE CD-1 Review	January 26-28,2021
Evaluate EoI & Draft Call for Detector Proposals	February 2021
Initial Plan for Call for Detectors Proposals	March 2021
Goal for CD-1 Approval	March 31, 2021

Timeline Post CD-1

Start Preliminary Design	April 1, 2021
Focused Technical Reviews	Spring 2021
OPA Status Review	July 2021
OPA Status Review	December 2021
Start using EVMS as practice prior to CD-1	March 2022
CD-2 Director's Review	March 2022
OPA CD-2 Review	June 2022
Goal for CD-2 Approval	September 2022
Goal for CD-3 Approval	July 2023

EIC Challenges

- Affordability – very large project for DOE Office of Nuclear Physics (NP) and Office of Science (SC)
  - Reprioritization of funding to EIC, new funding
  - Critical ramp up of funding in FY2021 needed to maintain timeline for Critical Decisions and efficient project implementation
- COVID-19 Impacts
  - Current EIC work is primarily planning and design work which is carried out remotely
  - There are impacts on efficiency and R&D work, however we remain confident about the path to Critical Decision 1 (CD-1).
  - Indirect impacts will likely to be more significant, including aligning with RHIC operations plans, uncertain fiscal context, design efficiency, R&D efficiency

Conclusion

- Project Delivery Plans Maturing
  - Strong foundation in place: pre-conceptual design, cost and schedule
  - BNL/TJNAF collaboration established and working through details
  - Schedule aligned with reasonable annual funding projections
  - Pursuing broad collaboration around the EIC
  - DOE review and approval process established: CD-1 approval in 2nd Quarter of FY2021
- Experimental Program Planning
  - BNL and TJNAF jointly leading the process for defining detector(s)
  - Community engagement and timeline for the Yellow Book, Call for Expressions of Interest, Call for Proposals, etc. is very important
  - BNL and TJNAF jointly serve as the “host” lab for the international user community - EIC Call for Expressions of Interest (EoI) released: https://www.bnl.gov/eic/EOI.php.
  - Detector(s) plans will align with project CD-4 schedule (operations)