Detector Advisory Committee Report:

Report on the DAC to the EIC Resources Review Board

- Overview of DAC
- Report on 2023 Activities

Edward Kinney, DAC Chair

Detector Advisory Committee (DAC)

- Formed in Fall 2020 to advise Laboratory and Project Management on issues related to the EIC detector design, EIC Users Group activities and associated R&D efforts

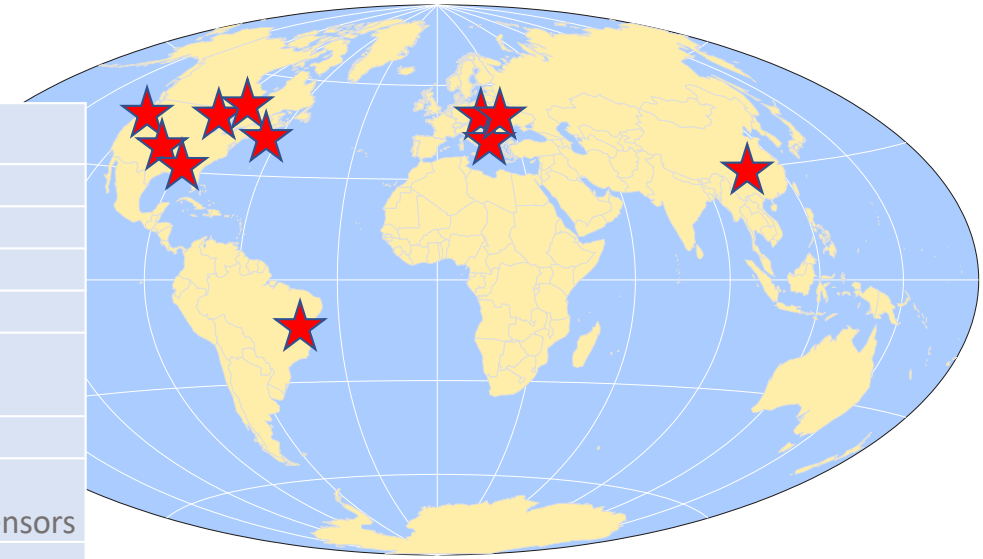
- Composed of 12 members, bringing technical expertise on Calorimetry, Tracking, Particle Identification, Readout Electronics, Data Acquisition, Detector Infrastructure, and EIC science.

- Meets once or twice a year to review project progress and evaluate R&D proposals and reports.

- After first two years, 1/3 of original members have rotated off and were replaced. In the future, we will continue with staggered 3 year terms.

2023 DAC Members

Detector Advisory Committee 2023		
Name	**Institition**	**Expertise**
Edward Kinney	Boulder CO	EIC Science, general
Ken Wyllie	CERN	ASICs/electronics
Petra Merkel	FNAL	R&D, Integration
Antonis Papanestis	Rutherford Appleton Laboratory	Particle Identification
Peter Krizan	U Ljubljana	Particle Identification
Ana Amelia Machado	University of Campinas, Brazil	Particle Identification, Sensors
Heidi Schellman	Oregon State	Computing
Brigitte Vachon	McGill	Electronics
Stefano Miscetti	INFN Frascati	Calorimetry
Etiennette Auffray	CERN	Calorimetry
Andrew White	U. Texas Arlington	Tracking
Chi Yang	SDU China	Tracking



1/3 of DAC members to rotate off this spring.

Past Meetings/Tasks of DAC

- September 28-29, 2020. Bring the DAC up to speed and prepare them for upcoming charges, e.g., related to input on assessment of the call for Expressions of Interest (EoI).
- December 18, 2020. Update DAC on the EIC Project and Yellow Report status, the EoI assessment, international engagement, and planning for call for detector proposals.
- March 24-26, 2021. Transition from the generic EIC detector R&D to the Project detector R&D.
- December 2021 – January 2022. Evaluation of detector technologies, cost and schedule as input to the Detector Proposal Advisory Panel.
- October 19-21, 2022. Review the ongoing project detector R&D. Advise for the FY23 detector R&D.

DAC Activities in 2023

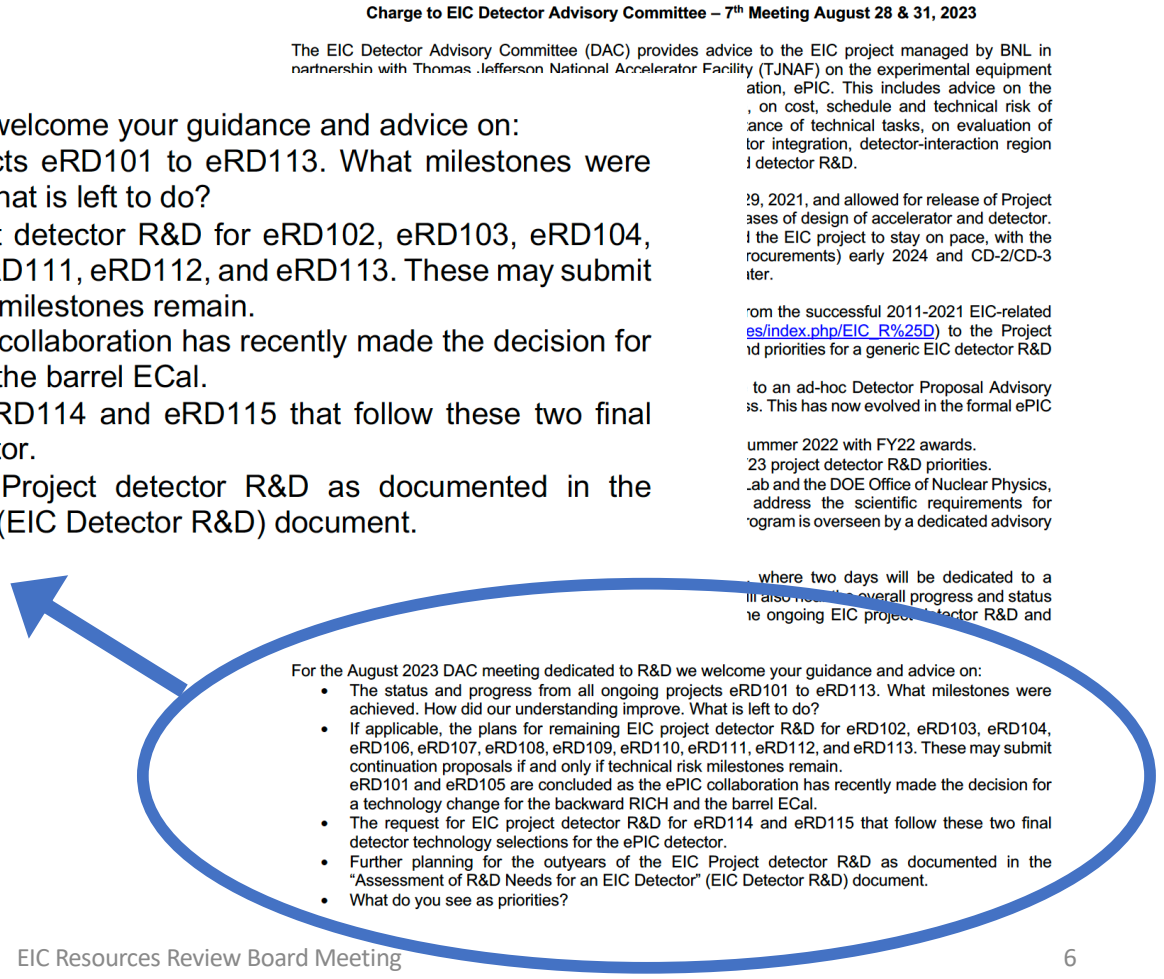
- August 28,31: Review the ongoing project detector R&D. Advise for the FY24 detector R&D.

- August 29-30: Comprehensive Review of EPIC Detector in preparation for upcoming DOE CD-3a and future CD-2 reviews

DAC Charge for Project R&D Review

For the August 2023 DAC meeting dedicated to R&D we welcome your guidance and advice on:

- The status and progress from all ongoing projects eRD101 to eRD113. What milestones were achieved. How did our understanding improve. What is left to do?
- If applicable, the plans for remaining EIC project detector R&D for eRD102, eRD103, eRD104, eRD106, eRD107, eRD108, eRD109, eRD110, eRD111, eRD112, and eRD113. These may submit continuation proposals if and only if technical risk milestones remain.
  eRD101 and eRD105 are concluded as the ePIC collaboration has recently made the decision for a technology change for the backward RICH and the barrel ECal.
- The request for EIC project detector R&D for eRD114 and eRD115 that follow these two final detector technology selections for the ePIC detector.
- Further planning for the outyears of the EIC Project detector R&D as documented in the "Assessment of R&D Needs for an EIC Detector" (EIC Detector R&D) document.
- What do you see as priorities?



Charge to EIC Detector Advisory Committee – 7th Meeting August 28 & 31, 2023

The EIC Detector Advisory Committee (DAC) provides advice to the EIC project managed by BNL in partnership with Thomas Jefferson National Accelerator Facility (TJNAF) on the experimental equipment ation, ePIC. This includes advice on the , on cost, schedule and technical risk of ance of technical tasks, on evaluation of tor integration, detector-interaction region detector R&D.

9, 2021, and allowed for release of Project ases of design of accelerator and detector. the EIC project to stay on pace, with the rocurements) early 2024 and CD-2/CD-3 ter.

om the successful 2011-2021 EIC-related es/index.php/EIC_R%25D) to the Project d priorities for a generic EIC detector R&D

to an ad-hoc Detector Proposal Advisory s. This has now evolved in the formal ePIC

ummer 2022 with FY22 awards.
23 project detector R&D priorities.
ab and the DOE Office of Nuclear Physics, address the scientific requirements for ogram is overseen by a dedicated advisory

where two days will be dedicated to a overall progress and status ongoing EIC proje tector R&D and

For the August 2023 DAC meeting dedicated to R&D we welcome your guidance and advice on:

- The status and progress from all ongoing projects eRD101 to eRD113. What milestones were achieved. How did our understanding improve. What is left to do?
- If applicable, the plans for remaining EIC project detector R&D for eRD102, eRD103, eRD104, eRD106, eRD107, eRD108, eRD109, eRD110, eRD111, eRD112, and eRD113. These may submit continuation proposals if and only if technical risk milestones remain.
  eRD101 and eRD105 are concluded as the ePIC collaboration has recently made the decision for a technology change for the backward RICH and the barrel ECal.
- The request for EIC project detector R&D for eRD114 and eRD115 that follow these two final detector technology selections for the ePIC detector.
- Further planning for the outyears of the EIC Project detector R&D as documented in the "Assessment of R&D Needs for an EIC Detector" (EIC Detector R&D) document.
- What do you see as priorities?

Agenda: Project R&D Review

EIC Project R&D - DAC Meeting (Aug 2023) - Aug 28, 2023 - Aug 31, 2023
Daily Program: Monday, August 28, 2023

Contribution: eRD104/eRD111/eRD113: Si Tracker/MAPS/Serv. Reduction
Time and Place: (Aug 28, 2023 - Aug 28, 2023)
Presenter: : Ernst Sichtermann

Contribution: eRD108: MPGDs
Time and Place: (Aug 28, 2023 - Aug 28, 2023)
Presenters: : Francesco Bossu; Matt Posik

Contribution: Break
Time and Place: (Aug 28, 2023 - Aug 28, 2023)

Contribution: eRD105: SciGlass
Time and Place: (Aug 28, 2023 - Aug 28, 2023)
Presenter: : Joshua Crafts

Contribution: eRD106: Fwd EMCAL
Time and Place: (Aug 28, 2023 - Aug 28, 2023)
Presenter: : oleg tsai

Contribution: eRD107: Fwd HCAL
Time and Place: (Aug 28, 2023 - Aug 28, 2023)
Presenter: : Friederike Bock

Contribution: eRD115: Imaging Cal
Time and Place: (Aug 28, 2023 - Aug 28, 2023)
Presenter: : Maria Zurek

Contribution: Break
Time and Place: (Aug 28, 2023 - Aug 28, 2023)

Contribution: eRD112: AC-LGAD
Time and Place: (Aug 28, 2023 - Aug 28, 2023)
Presenter: : Zhenyu Ye

Contribution: DAC Meeting/Discussion
Time and Place: (Aug 28, 2023 - Aug 28, 2023)

EIC Project R&D - DAC Meeting (Aug 2023) - Aug 28, 2023 - Aug 31, 2023
Daily Program: Thursday, August 31, 2023

Contribution: eRD101: mRICH
Time and Place: (Aug 31, 2023 - Aug 31, 2023)
Presenter: : Murad Sarsour

Contribution: eRD102: dRICH
Time and Place: (Aug 31, 2023 - Aug 31, 2023)
Presenter: : Marco Contalbrigo

Contribution: eRD103: hpDIRC
Time and Place: (Aug 31, 2023 - Aug 31, 2023)
Presenter: : Grzegorz Kalicy

Contribution: Break
Time and Place: (Aug 31, 2023 - Aug 31, 2023)

Contribution: eRD110: Photosensors/HRPPD
Time and Place: (Aug 31, 2023 - Aug 31, 2023)
Presenters: : Alexander Kiselev; Pietro Antonioli

Contribution: eRD114: pfRICH
Time and Place: (Aug 31, 2023 - Aug 31, 2023)
Presenter: : Alexander Kiselev

Contribution: Break
Time and Place: (Aug 31, 2023 - Aug 31, 2023)

Contribution: eRD109: ASICs/Electronic
Time and Place: (Aug 31, 2023 - Aug 31, 2023)
Presenter: : Fernando Barbosa

Contribution: DAC Meeting/Discussion
Time and Place: (Aug 31, 2023 - Aug 31, 2023)

Contribution: Close-Out
Time and Place: (Aug 31, 2023 - Aug 31, 2023)

Highlights from Project R&D Review - 1

- Overall, projects made good progress, some groups delayed by test beam shutdown during FNAL safety review.
- Two new efforts related to technology changes by EPIC: Proximity Focusing RICH and Imaging Barrel EM Calorimeter, also some changes to Forward Hadron Calorimeter design; these have a very short time to complete their studies.
- Silicon tracker projects now better integrated with ALICE ITS3 R&D effort, reduction of services using serial power under study to understand feasibility, sensor development continues. Recommend that this group advance as quickly as possible to finalize the collaboration agreement with ALICE and integrate designers in the team at CERN.

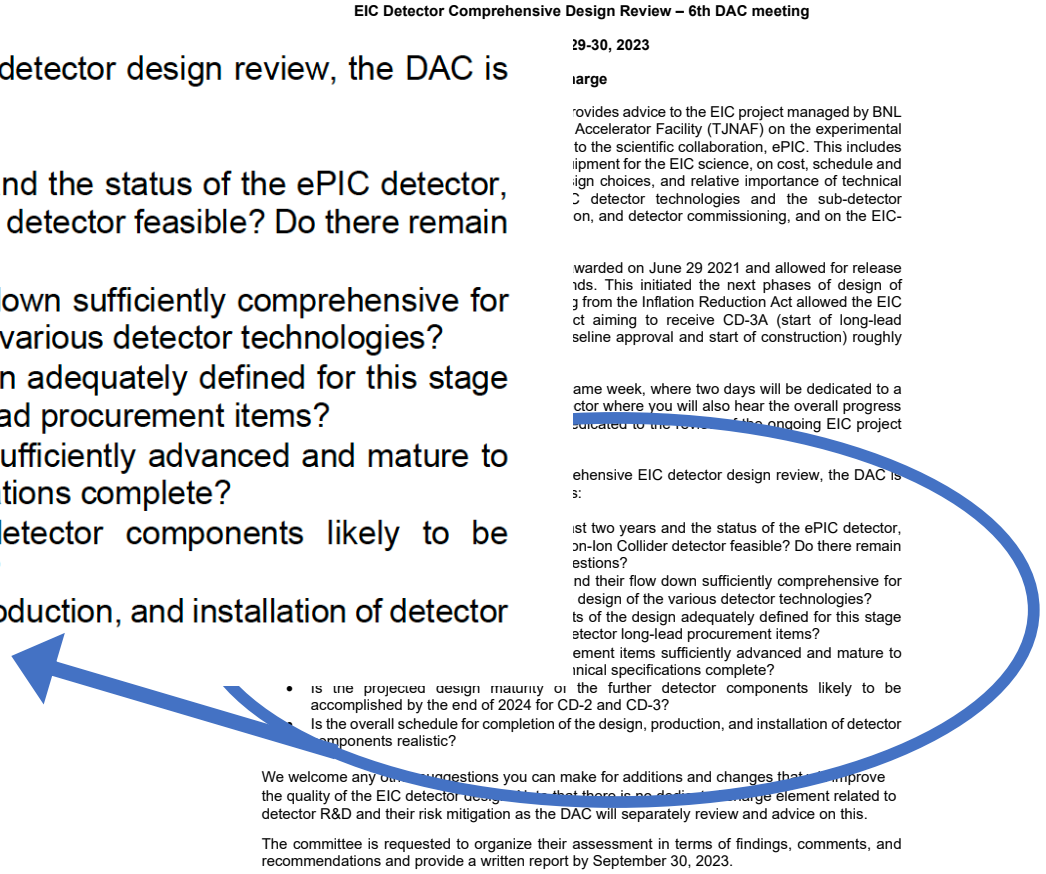
Highlights from Project R&D Review - 2

- Barrel and end-cap micro pattern gas detectors still need significant effort to establish a final design.
- ASIC development ongoing and likely to extend past CD-2, advise push all detector groups to use planned readout electronics at the earliest possible stage.
- Wide use of SiPM requires specification very soon for CD-3a. In some systems (e.g., Dual Radiator RICH), significant infrastructure required for cooling and heating (annealing) services.
- Foundry and supply chain issues remain significant issues.
- Encourage groups to maintain expertise and manpower as they transition to the final detector design, assembly, installation and commissioning.

DAC Charge for Comprehensive Review

For the 6th DAC meeting that serves as comprehensive EIC detector design review, the DAC is asked to answer the following charge questions:

- Given the detector progress over the last two years and the status of the ePIC detector, are the projected timelines of the Electron-Ion Collider detector feasible? Do there remain significant open detector technology questions?
- Are the requirements for the detector and their flow down sufficiently comprehensive for this stage of the project to complete the design of the various detector technologies?
- Are the interfaces between the elements of the design adequately defined for this stage of the project and to proceed with the detector long-lead procurement items?
- Is the design of these long-lead procurement items sufficiently advanced and mature to start procurement in 2024? Are the technical specifications complete?
- Is the projected design maturity of the further detector components likely to be accomplished by the end of 2024 for CD-2 and CD-3?
- Is the overall schedule for completion of the design, production, and installation of detector components realistic?



EIC Detector Comprehensive Design Review – 6th DAC meeting

29-30, 2023

large

rovides advice to the EIC project managed by BNL Accelerator Facility (TJNAF) on the experimental to the scientific collaboration, ePIC. This includes ipment for the EIC science, on cost, schedule and ign choices, and relative importance of technical C detector technologies and the sub-detector on, and detector commissioning, and on the EIC-

warded on June 29 2021 and allowed for release nds. This initiated the next phases of design of g from the Inflation Reduction Act allowed the EIC ct aiming to receive CD-3A (start of long-lead seline approval and start of construction) roughly

ame week, where two days will be dedicated to a ctor where you will also hear the overall progress dicated to the ... of the ongoing EIC project

ehensive EIC detector design review, the DAC is s:

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- Is the projected design maturity of the further detector components likely to be accomplished by the end of 2024 for CD-2 and CD-3?
- Is the overall schedule for completion of the design, production, and installation of detector components realistic?

We welcome any ... suggestions you can make for additions and changes that ... improve the quality of the EIC detector ... that there is no ... charge element related to detector R&D and their risk mitigation as the DAC will separately review and advice on this.

The committee is requested to organize their assessment in terms of findings, comments, and recommendations and provide a written report by September 30, 2023.

Agenda: Comprehensive Review

Tuesday, August 29, 2023

CLOSED SESSION

ET	WBS	Topic	Presenter	Duration (Min)
9:00-9:30		Executive Session	DAC members	30

PLENARY SESSION

ET	WBS	Topic	Presenter	Duration (Min)
9:30-10:00		Project Overview	Jim Yeck	30
10:00-10:45	6.10.01	Detector Overview and Requirements	Elke Aschenauer/ Rolf Ent	45
10:45-11:00	6.10.01	Requirements and Interfaces Flow	Walt Akers	15
11:00-11:45	6.10.01/6.10.10	CAD status & Infrastructure, Integration and Installation	Roland Wimmer/ Rahul Sharma	45
11:45-12:00	6.10.02	Detector R&D Status and Milestones	Thomas Ullrich	15
12:00-12:30		Vacuum, Backgrounds, Machine-Detector Interface	Elke Aschenauer	30
12:00 – 13:00		*Break*		30
13:00-13:30	6.10.07	Magnet	Renuka Rajput-Ghoshal	30
13:30-14:00	6.10.03	Tracking Detectors	Brian Eng	30
14:00-14:30	6.10.04	Particle Identification Detectors	Benedikt Zihlmann	30
14:30-15:30		Executive Session	DAC members	60
15:30		*Adjourn*		

CLOSED SESSION

ET	WBS	Topic	Presenter	Duration (Min)
14:30-15:30		Executive Session	DAC members	30

Wednesday August 30, 2023

PLENARY SESSION

ET	WBS	Topic	Presenter	Duration (Min)
9:00-9:30	6.10.05	Electromagnetic Calorimetry	Alexander Bazilevsky	30
9:30-10:00	6.10.06	Hadronic Calorimetry	Alexander Kiselev	30
10:00-10:30	6.10.11	Interaction Region integration and Ancillary Detectors	Yulia Furletova	30
10:30-11:00	6.10.14	Polarimetry	Oleg Eyser/ Dave Gaskell	30
11:00-11:15		Break		15
11:15-11:45	6.10.08	Electronics	Fernando Barbosa	30
11:45-12:15	6.10.09	DAQ and Scientific Computing	David Abbott/ Jeff Landgraf	30
12:15-12:30	6.10.12	Pre-Ops planning	Elke Aschenauer/ Rolf Ent	15
12:30-13:00		*Break*		30
13:00-15:15		Executive Session		135
15:15-15:45		Closeout		30
15:45		*Adjourn*		

CLOSED SESSION

ET	WBS	Topic	Presenter	Duration (Min)
13:00-15:15		Executive Session	DAC members	135

Summary from Comprehensive Review

- **Charge 1:** Given the detector progress over the last two years and the status of the ePIC detector, are the projected timelines of the Electron-Ion Collider detector feasible? Do there remain significant open detector technology questions?
  - Timelines are aggressive but appear feasible. Magnet and Silicon Vertex Tracker have significant risk. Magnet as it drives detector assembly, and Silicon as it is a large external dependency.
  - All central detector technologies have been chosen and appear appropriate, however, not all are at the same stage of design and some still require R&D.

- **Charge 2:** Are the requirements for the detector and their flow down sufficiently comprehensive for this stage of the project to complete the design of the various detector technologies?
  - Implemented formal system engineering approach seems critical to successful comprehensive integration and understanding of flowdown of detectors.
  - Committee recommended continued study of background effects on detector performance and requirements as well as an overall survey/alignment plan.

- **Charge 3:** Are the interfaces between the elements of the design adequately defined for this stage of the project and to proceed with the detector long-lead procurement items?
  - The identified long-lead items were the superconducting solenoid magnet, a large number of SiPMs for use in the PID/CAL detectors, the $PbWO_4$ crystals for the electron endcap calorimeter, the scintillating fibers for the calorimeters, and the absorber for the forward HCAL/insert.
  - The demonstrated systems engineering approach gave confidence that the interfaces are sufficiently well defined that the long-lead items can be procured with small risk to the project.
- **Charge 4:** Are the requirements for the detector and their flow down sufficiently comprehensive for this stage of the project to complete the design of the various detector technologies?
  - The magnet, HCAL, $PbWO_4$ and scintillating fiber specifications are clear and the design appears quite mature and nearly completed.
  - Some concerns that SiPM background effects needing close attention and more information on Astropix procurement requested.

- **Charge 5:** Is the projected design maturity of the further detector components likely to be accomplished by the end of 2024 for CD-2 and CD-3?
  - Overall maturity of the design and integration is good, but some systems still have R&D cycles to accomplish in roughly a year(!)
  - Silicon Vertex tracker is tied with ALICE ITS3 development, and μRWELL foils are produced only at CERN so R&D/design is less controllable.
  - Overall concern with changing availability of silicon foundries and suppliers.

- **Charge 6:** Is the overall schedule for completion of the design, production, and installation of detector components realistic?
  - The overall schedule is aggressive but achievable as presently estimated.
  - Contingency plans in case of delay of magnet and silicon vertex tracker should be developed.

General Comments and Recommendations from Comprehensive Review

1) Congratulations to all involved in the EIC project on the rapid development of a nearly complete design for the EIC detector. This was extremely impressive to the committee, especially in the organization of the many different project components and tasks. This inspired confidence in the successful completion of this incredibly complex facility.
2) Enormous progress has been made in developing a coherent design for detector to carry out EIC research goals, with minimal open technology choices at present.
3) The committee recommends continued study of the detector readout and DAQ strategy. In particular, significant resources will be necessary to support all aspects of the R&D, production and commissioning, throughout the period between CD2/3 and CD4. The committee applauds the adoption of common solutions, but their development and support must be properly resourced to guarantee the success of this approach.
4) ASIC development has historically been on the critical path in many projects, often due to a lack of personnel resources. We encourage the EIC community to carefully monitor the progress of the various ASIC projects and ensure these are properly resourced.

Summary and Outlook

- The EPIC collaboration, BNL and Jlab project personnel continue to make excellent progress on the design and development of the Electron-Ion Collider.
- DAC plans for next year: Pre-CD 2 review of the ePIC detector and in-kind engagement, and the next phase of Project Detector R&D.
- New DAC members will join in spring 2024.