

*Slides from our last meeting*

## CD-3A:

Approve start of long-lead procurements  
 CD-3A items passed final design review  
 All interfaces related to them are frozen  
 Waiting for ESAAB meeting for authorization

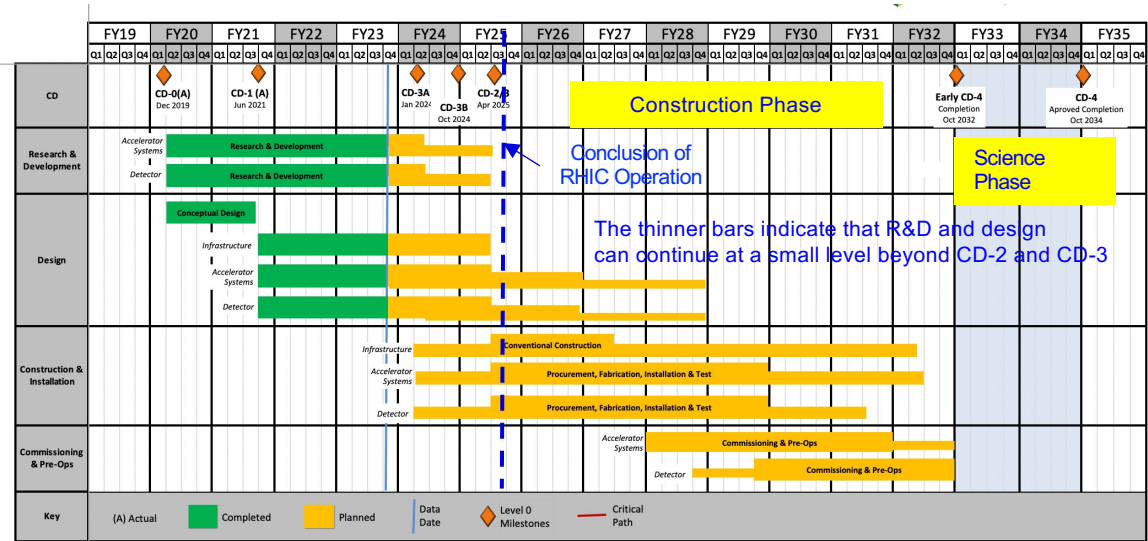
## CD-2:

Approve prelim. design for all subdetectors  
 Design Maturity: >60%  
 Need “pre-”TDR (or draft TDR)  
 Baseline project in scope, cost, schedule

## CD-3:

Approve final design for all subdetectors  
 Design Maturity: ~90%  
 Need full TDR

EIC Critical Decision Plan	
CD-0/Site Selection	December 2019 ✓
CD-1	June 2021 ✓
CD-3A	January 2024
CD-3B	October 2024
CD-2/3	April 2025
early CD-4	October 2032
CD-4	October 2034

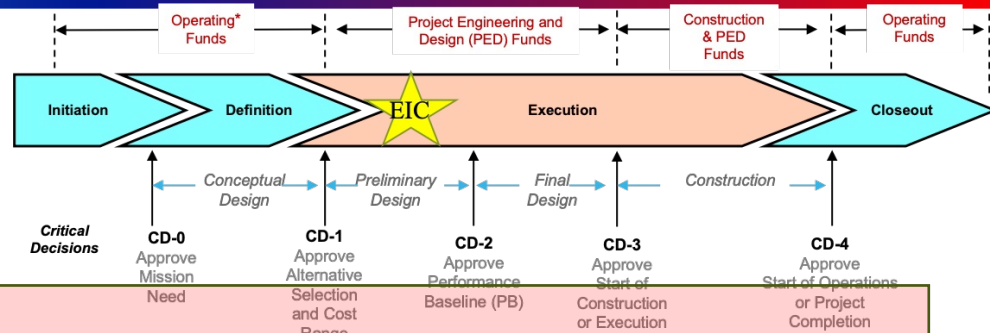


Speculation based on EIC accelerator project status, on still uncertain FY24 and FY25 budget scenarios, and projected RHIC FY24 run:

- CD-3B Approval Dec. 2024
- RHIC operations conclude at end of FY25, in September 2025
- CD-2/3 Approval Dec. 2025, Possibility of CD-3C as needed.

- Design Reviews
  - ✓ **PDR2: IR Integration and Auxiliary Detectors – February 12, 2024 – main emphasis on baseline choices and progress**
  - PDR1: Tracking Detectors – **March 20-21, 2024** – main emphasis on baseline tracking layout, if we are on track and plans
  - PDR2: Electronics/DAQ – May 2024? – continuation of PDR1 to ensure we are on track and show progress
  - PDR: Integration, Infrastructure and Installation – Summer/Autumn 2024? – includes detector support structures
  - **PDR2: Particle Identification Detectors – Summer 2024?**
  - PDR2: Barrel EM Cal – Summer/Fall 2024 – emphasis on mechanical design & AstroPix readiness
  - FDR: Backward & Forward EM Calorimetry, Barrel & Forward HCAL – Fall 2024
  - PDR2: Polarimetry – timescale TBD (but before CD-2)
  - FDR for any potential CD-3B scope: Magnet Power Supply, perhaps VTRx+/lpGBT, perhaps magnet steel – see NOTE
  - FDR Magnet Power Supply – Spring 2024; Magnet Steel perhaps Summer 2024; VTRx+/lpGBT add ½ day to electronics/DAQ PDR2
- Detector R&D Day – **March 25** – check R&D progress and outlook to FY25
- DAC-Meetings 2024 under planning:
  - ~April 2024: Project Status, Baseline Detector, International Engagement, Detector R&D progress (expect 1+ day)
  - ~August 2024: Detector R&D annual review (expect 2 days) – deadline for submission July 1, 2024
- Next ePIC Computing & Software review by host labs – Late Summer 2024?

**NOTE: CD-3B for detector will include continuation phases for SiPMs, SciFi, PbWO<sub>4</sub>, Forward HCAL. Further scope has to be known essentially now and needs FDRs.**



What does 60% design maturity roughly mean:

- 1) One matured from a conceptual design (CD-1) to a preliminary design (CD-2)
- 2) There can still be open E&D questions but no showstoppers
- 3) One needs to have detailed knowledge that one can define the cost and schedule
- 4) The review committee can judge that one will be able to address those open questions by the projected time of CD-3.

What does 90% design maturity roughly mean:

- 1) The design matured to final (CD-3), i.e., there are no open E&D questions
- 2) One can still do design detailing and producing drawings to accompany procurements
- 3) One can still do design validations as found needed during the vendor construction process; for vendor design-build contracts such as the detector solenoid one can still do design updates as needed.

# What does this actually mean for us?

- **There is no real urgency with having a pfRICH beam test in Spring 2024 at all**
  - The coming year can be better spent to test the components separately on a bench ...
  - ... and be better prepared for beam tests in 2025+
  
- Reality check, anyway
  - Only two months left between now and May 1<sup>st</sup>, but no Fermilab 2024 schedule is available
  - No HRPPDs performance scans can start at BNL until at least end of March
    - Yet four out of five tiles were produced already, and we will know quite something from JLab tests by then
  - HGCROC3 ASIC backplane production is delayed either
    - Yet V0 iteration FPGA bare boards were shipped from HK yesterday (and a first one will be assembled next week)
  - *The two (HRPPDs & ASICs) will not see each other on a bench at least until beginning of April*
  
- EIC Project can only provide funding for “must have” beam tests
  - Beam test budget needs to be substantially increased (DOE Lab employee salaries!)
    - Hard to justify an “emergency” beam test, given a risk with it being potentially too short (and potentially incon<sup>5</sup>clusive)

# Therefore, plans for 2024 / 2025 and beyond

- 2024: activities towards CD-2 and a pre-TDR
  - Vessel and mirror PEDs, aerogel bench tests, HGCROC3 ASIC backplane construction
  - HRPPD bench tests at JLab/BNL/INFN/UoG/Yale, Argonne B-field campaign, INFN ageing studies, etc
  - All sorts of modeling and geometry optimization for CD-2 purposes
- 2025: activities towards CD-2/3 and a TDR
  - Cosmic ray test stand at BNL (?)
  - Beam test #1 in Spring 2025
    - A “partial chain” test with HGCROC3 analog frontend (a proof of principle run; aerogel / mirrors / HRPPDs)
  - All sorts of remaining modeling and PED work (including services) for CD-3 purposes
- 2026+
  - Beam test #2 (**once EICROC electronics is available**)
    - A full chain test (a final word on pi/K separation, imaging+timing performance at once, etc)

*Slides prepared for a TIC  
meeting on 03/04/2024*

# pfRICH Work Packages

## Engineering design oversight

A. Eslinger (JLab)

## Vessel & mirrors: 3D printing & molding

A. Jung (Purdue)

## Vessel: outer shell

C.-J. Naim (Stony Brook)

## Mirrors: aluminum coating

W. Li (Stony Brook)

## Construction coordination

C.-J. Naim (Stony Brook), Z. Tu (BNL)

## HRPPD test stand

P. Garg (Yale)

## Aerogel QA station

M. Posik (Temple)

## HRPPD QA station

A. Kiselev (BNL)

## MCP-PMT test stand

R. Montgomery (Glasgow)

## Standalone GEANT software & modeling

A. Kiselev (BNL)

## Software support in ePIC framework

BNL NPPS group, K. Kauder (BNL)

## Physics modeling

B. Page (BNL)

## DAQ software & firmware

... (BNL)

## Gas system

P. Shanmuganathan (BNL)

## HV & LV systems

T. Camarda (BNL)

## Cooling system

D. Cacace (BNL)

## Light monitoring system

F. Barbosa (Jlab)

## Frontend electronics

... (Debrecen)

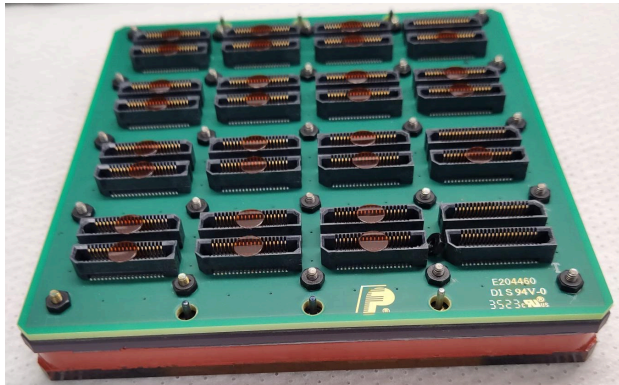
## Mirror QA station

... (BNL)

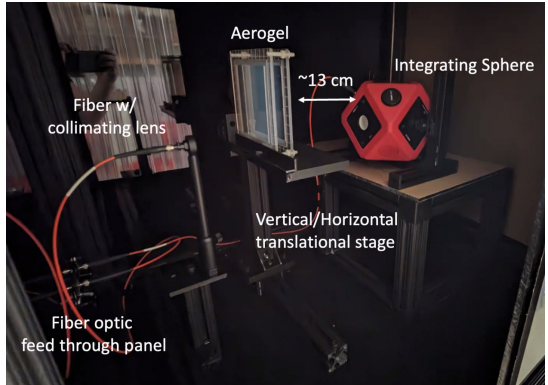
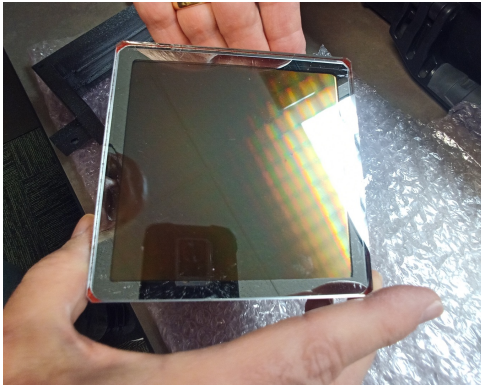


# Lab / test beam / prototyping

	M	A	M	J	J	A	S	O	N	D	Comments
Aerogel characterization @ Temple	x	x	x	x							Transmission, refractive index, other
HRPPD characterization @ BNL		x	x	x	x	x					Surface scans: QE, PDE, gain, timing
HRPPD B-field study @ Argonne					?						eRD110 [defined by HRPPD delivery time]
HRPPD ageing study @ INFN Trieste							?	?			eRD110 [defined by HRPPD delivery time]



EIC HRPPD #1



Aerogel QA stand @ Temple

**NO beam tests for the pre-TDR stage (2024)**

# Lab / test beam / prototyping

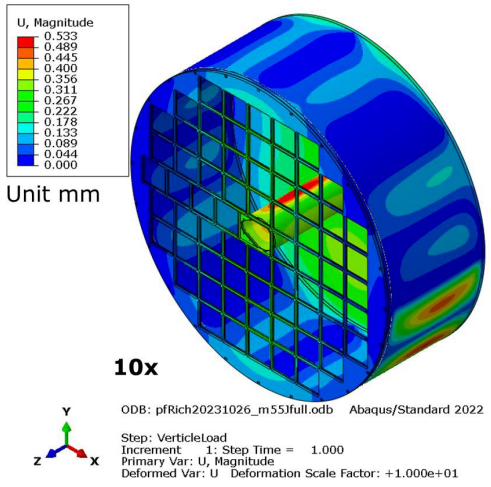
	M	A	M	J	J	A	S	O	N	D	Comments
Other MCP-PMT evaluation @ Glasgow		x	x	x	x	x					eRD110
Mirrors 1 <sup>st</sup> article @ Purdue & Stony Brook	x	x	x	x	x						Funded PED proposals
Vessel 1 <sup>st</sup> article @ Purdue & Stony Brook	x	x	x	x	x						Funded PED proposals
ASIC FE V0 work (I2NP3/Debrecen/BNL/ORNL)	x	x	x	x							A new PED proposal in works



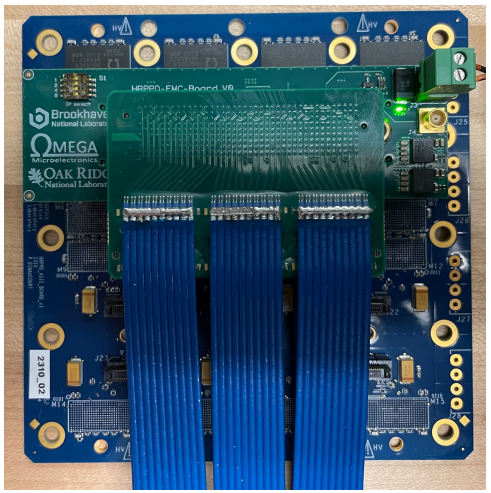
Mandrel assembly



First mirror samples



Vessel FEA work



ASIC backplane

# Reconstruction software & simulations

	M	A	M	J	J	A	S	O	N	D	Comments
Standalone code refinement	x	x	x	.	.	.	.	.	.	.	ML add-on, timing code update, etc
Aerogel / HRPPD / mirror parameterizations			x	x							Once lab test data is available
Geometry porting to dd4hep											Pretty much completed
Optics configuration porting to EICrecon	.	.	?	?	?	.	.	.	.	.	Low priority (not needed for a pre-TDR)
IRT 2.0 interface to EICrecon	.	.	?	?	?	.	.	.	.	.	Low priority (not needed for a pre-TDR)
pfRICH geometry update & Co	x	x	.	.							Minor changes required; B field, etc
LUTs for ePIC simulation campaigns	x	x	x	x	.	.	.	.			Up until a pre-TDR input is frozen
Basic single-track performance confirmation	x	x	x	x	x	.	.	.	.		Follow reconstruction code updates
Background studies			?	?							TBD
Multi-track DIS event performance studies	.	.	.	.	.						Reconstruction code update required
pfRICH PID SIDIS money plots				?	?						Repeat March 2023 studies
Tracking resolution effects		x	x	x						x	

# Engineering design

	M	A	M	J	J	A	S	O	N	D	Comments
Outer vessel shell											Completed
HRPPD (rear) sensor plate		X	X								Assuming PED completion by August 1 <sup>st</sup>
Front vessel plate & aerogel support		X	X	X							--- " --- " --- " --- " --- " --- " --- " --- " --- " ---
Inner (beam pipe) vessel wall			X	X							--- " --- " --- " --- " --- " --- " --- " --- " --- " ---
Mirrors	X	X	X								--- " --- " --- " --- " --- " --- " --- " --- " --- " ---
Installation concept; support structure	.	X	X	.	.	.	.	.	.	.	TBC; an ongoing effort
Gas system	X									X	Preliminary design exists
HV system		X	X	X						X	--- " --- " --- " --- " --- " ---
LV system										X	--- " --- " --- " --- " --- " ---
Cooling system										X	--- " --- " --- " --- " --- " ---
Front end electronics											2024 focus: analog FE evaluation
DAQ interface											Once RDO for EICROC is conceptualized
Slow Control											TBD

**Integration and services work depends on the EIC Project timelines**  
**Continuous support by EIC Project engineers is essential**

*Assembly procedure and  
space required at BNL*

# Questions / suggestions

- Vessel / mirror / *bare sensor plate* / (mounting fixtures) pre-assembly at Stony Brook?
  - Including a final mirror 3D alignment scan (or we do it at BNL later)? Anyway, conical mirrors only?
  - Requires a clean room space at Stony Brook
  - Then a pre-assembled vessel shipped to BNL in a hermetic container
- *Sensor plane population* and final tests in a clean room at BNL in Physics (510D)?
  - Should just reserve one of the existing Class 100 clean rooms on the second floor?
- Aerogel “inner container volume” *pre-assembly* at BNL in 1006?
  - Requires a clean room in 1006 as well? A final pfRICH assembly happens in this same clean room?
- Final assembly in 1006
  - Move pfRICH (all but aerogel) from 510D to 1006 by truck
  - Open the front wall, insert aerogel container (and acrylic filter?), close, and never open again