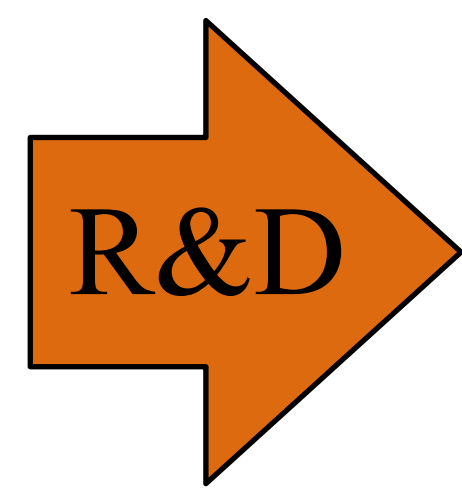
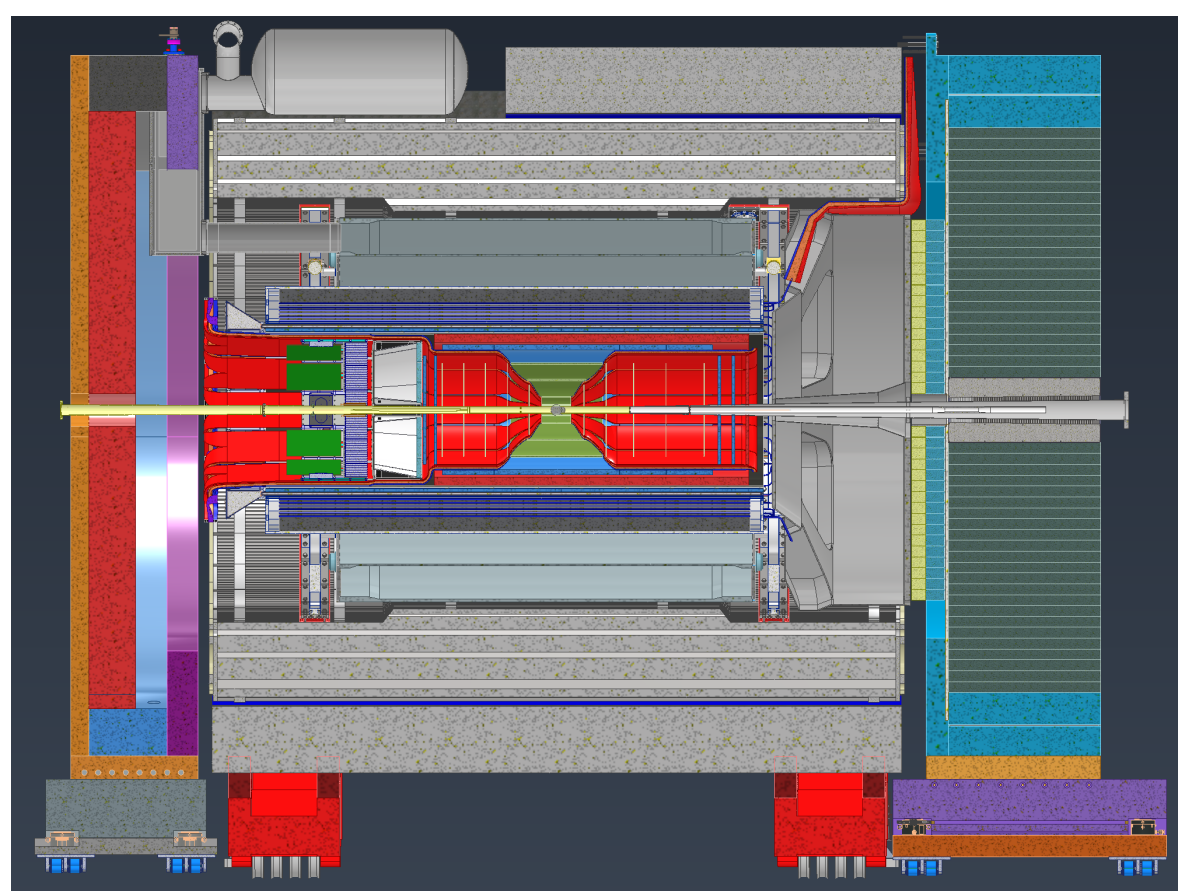
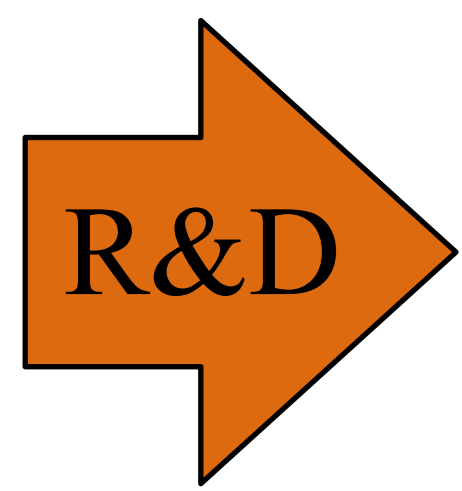
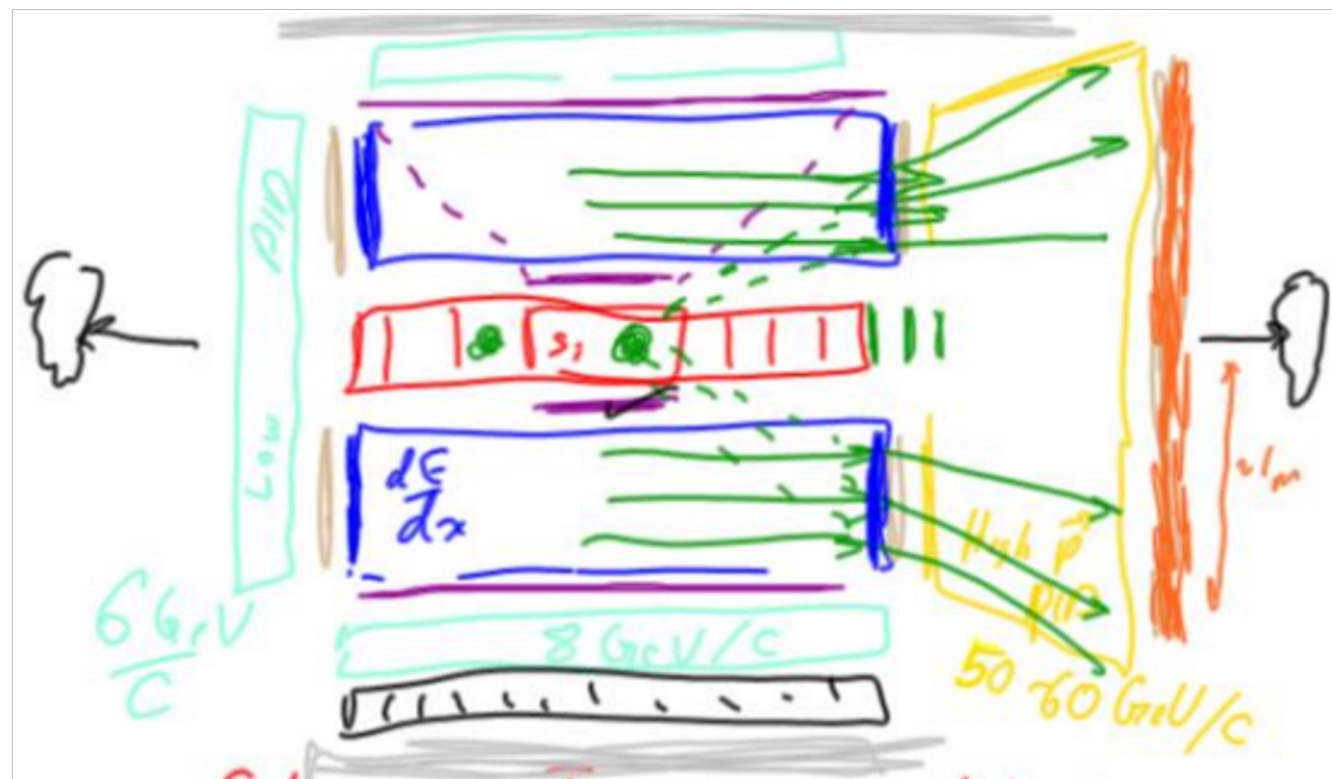


# Status and Challenges of Future R&D on PID Detection



Thomas Ullrich  
ePIC CM Meeting/PID Session  
January 24, 2025

# From Concept to Reality - Generic R&D for EIC

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- **Generic R&D Program 2011-2021**

- ▶ Operated by BNL and supported through funds by the DOE Office of NP
- ▶ Program explicitly open to international participation
- ▶ Collaboration between Universities and National Laboratories
- ▶ Typical 10-11 projects supported per FY
- ▶ Budget \$1M - \$1.5M/year
- ▶ Consortia for Calorimetry, Tracking, PID
- ▶ FY21: 281 participants from 75 institutions (37 non-US)
- ▶ Many of the subsystems in EPIC were developed and matured in this program and EPIC detector working group/consortia member were part of the program
- ▶ [https://wiki.bnl.gov/conferences/index.php/EIC\\_R%25D](https://wiki.bnl.gov/conferences/index.php/EIC_R%25D)



# Generic R&D Projects 2014-2021

| Project | Topic   |
|---------|---|
| eRD1    | EIC Calorimeter Development   |
| eRD2    | A Compact Magnetic Field Cloaking Device  |
| eRD3    | Design and assembly of fast and lightweight forward tracking prototype systems                              |
| eRD6    | Tracking and PID detector R&D towards an EIC detector   |
| eRD10   | (Sub) 10 Picosecond Timing Detectors at the EIC   |
| eRD11   | RICH detector for the EIC's forward region particle identification - Simulations                            |
| eRD12   | Polarimeter, Luminosity Monitor and Low Q2-Tagger for Electron Beam   |
| eRD14   | An integrated program for particle identification (PID)   |
| eRD15   | R&D for a Compton Electron Detector   |
| eRD16   | Forward/Backward Tracking at EIC using MAPS Detectors   |
| eRD17   | BeAGLE: A Tool to Refine Detector Requirements for eA Collisions in the Nuclear Shadowing/Saturation Regime |

|       |  |
|-------|--|
| eRD18 | Precision Central Silicon Tracking & Vertexing   |
| eRD19 | Detailed Simulations of Machine Background Sources and the Impact to Detector Operations |
| eRD20 | Developing Simulation and Analysis Tools for the EIC                                     |
| eRD21 | EIC Background Studies and the Impact on the IR and Detector design                      |
| eRD22 | GEM based Transition Radiation Tracker R&D   |
| eRD23 | Streaming Readout for EIC Detectors  |
| eRD24 | Silicon Detectors with high Position and Timing Resolution as Roman Pots at EIC          |
| eRD25 | Si-Tracking  |
| eRD26 | Pulsed Laser System for Compton Polarimetry  |
| eRD27 | High Resolution ZDC  |
| eRD28 | Superconducting Nanowire Detectors   |
| eRD29 | Precision Timing Silicon Detectors for combined PID and Tracking System                  |

Tracking

PID

Calorimetry

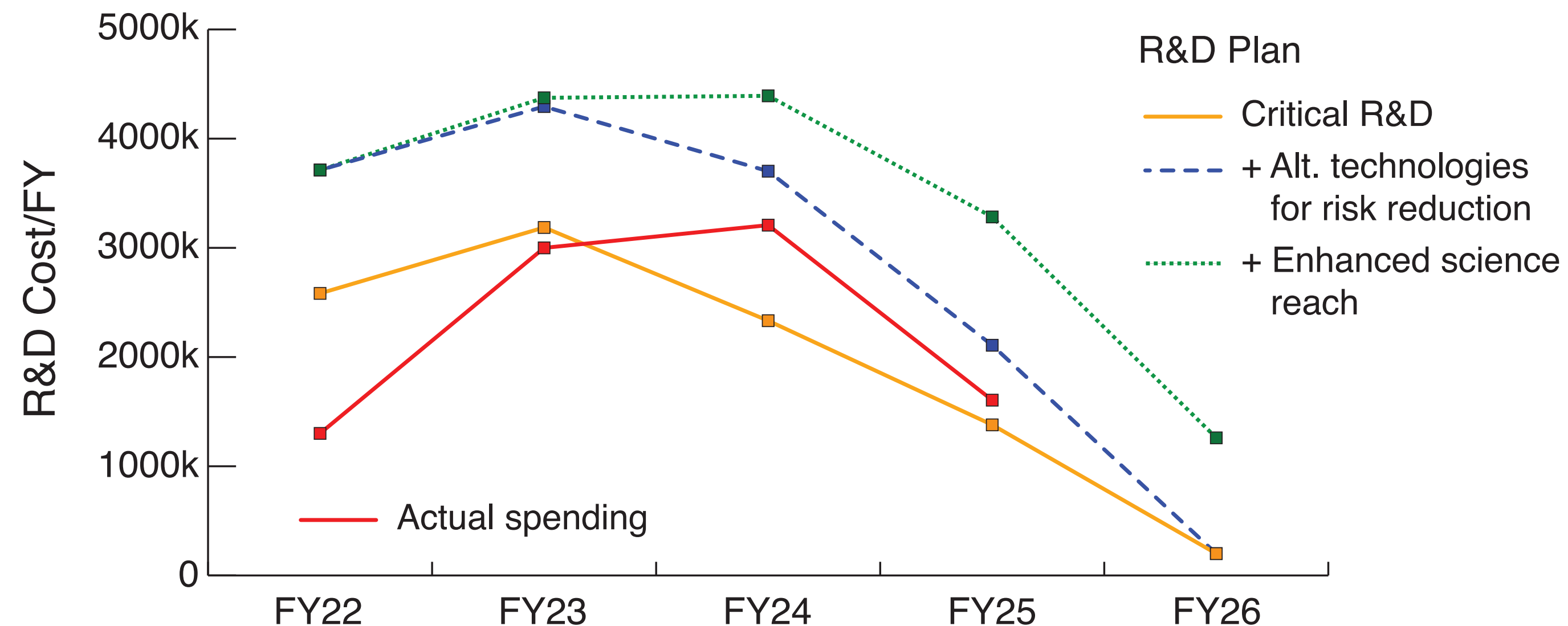
Software/Simulations

Other

# Finalizing & Reducing Risk - Project R&D

## ● Project R&D

- ▶ Aims at achieving the maturity required to carry out final design and construction
- ▶ Support only systems that are baseline in EPIC
- ▶ Supports universities, national labs, US and non-US
- ▶ No funding after CD-2
  - except sensors (MOSAIX/EIC-LAS, AC-LGAD) and ASICs
- ▶ [https://wiki.bnl.gov/conferences/index.php?title=General\\_Info](https://wiki.bnl.gov/conferences/index.php?title=General_Info)



} Hope that generic covers that part

# Project R&D Projects 2022+

| Project | Topic                     |
|---------|---------------------------|
| eRD101  | mRICH                     |
| eRD102  | dRICH                     |
| eRD103  | hpDIRC                    |
| eRD104  | Service reduction         |
| eRD105  | SciGlass                  |
| eRD106  | Forward EMCAL             |
| eRD107  | Forward HCAL              |
| eRD108  | Cylindrical & Planar MPGD |
| eRD109  | ASICs/Electronics         |
| eRD110  | Photosensors              |
| eRD111  | Si-Tracker (no sensors)   |
| eRD112  | ToF with AC-LGAD          |
| eRD113  | ITS3/EIC MAPS development |
| eRD114  | pfRICH                    |
| eRD115  | Imaging Calorimeter       |

Tracking

PID

Calorimetry

Sensors

Electronics

Note: support mix of actual R&D funding and PED

# New Round of Generic R&D

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- **Generic R&D (2022-2024)**

- ▶ After lots of efforts: Generic program reconstituted starting 2022
- ▶ funded by DOE, coordinated by JLab
- ▶ Mission: *This program will support advanced R&D on innovative, cost-effective detector concepts which reduce risk and that either the one detector in the project scope or a second detector could incorporate. (The term "generic" conveys this duality.) The EIC User Group-authored Yellow Report includes requirements for both detectors.*
- ▶ total of 30 proposals received on July 25, 2022
- ▶ total of 20 proposals received on July 15, 2023
- ▶ [https://www.jlab.org/research/eic\\_rd\\_prgm](https://www.jlab.org/research/eic_rd_prgm)
- ▶ **Terminated 2024 by DOE**



# New Round of Generic R&D

- **Generic R&D (2022)**

- ▶ After lots of effort
- ▶ funded by DOE
- ▶ Mission: *This program is to develop an effective detector in the term "generic"*
- ▶ *Report includes*
- ▶ total of 30 proposals
- ▶ total of 20 proposals
- ▶ <https://www.jlab.org>
- ▶ **Terminated 2022**

## GENERIC EIC-RELATED DETECTOR R&D PROGRAM

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### News:

Dear Members of the EIC Community,

The Department of Energy and Jefferson Lab have determined there are insufficient funds available this year to support an FY24 call for proposals for the EIC-related generic detector R&D program. This break in the program is deeply regretted. Although funding is year by year and there are no guarantees about the future, the FY25 budget request includes funding for this program.

Proposals from FY22 and FY23, as well as their funding status, can be found at [https://www.jlab.org/research/eic\\_rd\\_prgm/receivedproposals](https://www.jlab.org/research/eic_rd_prgm/receivedproposals).

sincerely,

Dave Mack (Chair)

2022

*...vative, cost-  
er the one  
corporate. (The  
authored Yellow*

# Generic R&D Program II - Funded Projects (28)

|  |  |
|--|--|
| CSGlass for hadron calorimetry at the EIC  | Scintillator Fiber Trackers for the ZDC and off-momentum detector  |
| A proposal for MPGD-based transition radiation detector/tracker  | A Fast Timing MAPS Detector for the EIC  |
| Continued Development and Evaluation of a Low-Power High-Density High Timing Precision Readout ASIC for AC-LGADs (HPSoC)                   | Towards a Few-Degree Calorimeter: bridging the Q gap to support the quest for gluon saturation   |
| A new radiation tolerant low power Phase-Locked Loop IP block in a 65 nm technology for precision clocking in the EIC frontend electronics | Pressurized RICH   |
| Refined Methods for Transfer Matrix Reconstruction Using Beamline Silicon Detectors for Exclusive Processes at the EIC                     | Development of High Precision and Eco-friendly MRPC TOF Detector for EIC   |
| Development of a Novel Readout Concept for an EIC DIRC   | Generic glass scintillators for EIC Calorimeters (ScintCalEIC) R&D   |
| Tracking and PID with a GridPIX Detector   | Feasibility of Organic Glass Scintillators for EIC ZDC   |
| Particle identification and tracking in real time using Machine Learning on FPGA   | Slim Edge for LGADs  |
| Superconducting Nanowire Detectors for the EIC   | Photonics-Based Readout and Power Delivery by Light for Large-Area Monolithic Active Pixel Sensors   |
| EIC KLM R&D Proposal   | Z-Tagging Mini DIRC  |
| Development of Thin Gap MPGDs for EIC Trackers   | Design, Fabrication and testing of a multi-channel System on a chip for Low-Power High-Density High Timing Precision Readout ASIC for AC-LGADs (HPSoCv3) |
| Simplified LGAD structure with fine pixelation   | Performance of GridPIX Detector in Magnetic Field with low mass and high efficiency CO2 cooling  |
| Imaging Calorimetry for the Electron-Ion Collider  | Development of Double-sided Thin-Gap GEM- $\mu$ RWELL for Tracking at the EIC  |
| Silicon Tracking and Vertexing Consortium, Section 1: Embedded Monolithic Active Pixel Sensor R&D  |  |
| Silicon Tracking and Vertexing Consortium, Section 2: Aluminum Flexible Circuit Manufacturing Capability                                   |  |

Tracking

PID

Calorimetry

Software/AI

ASICs/FEE



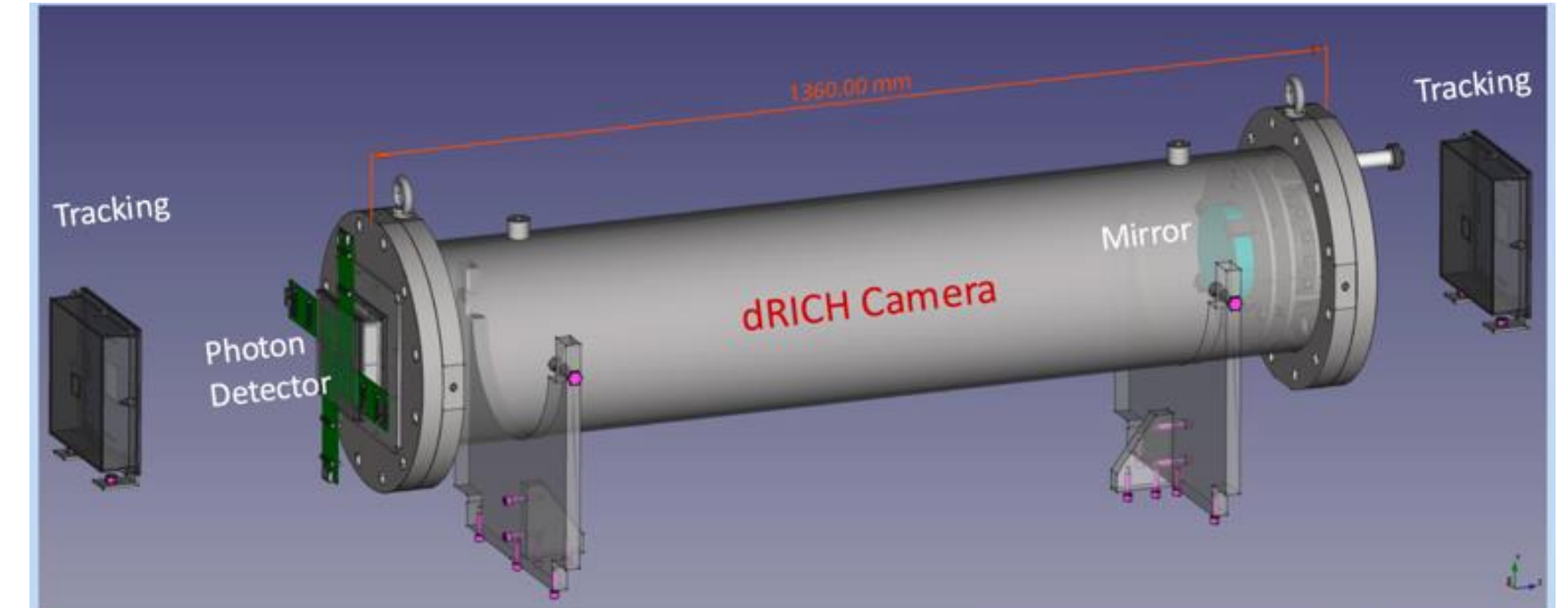
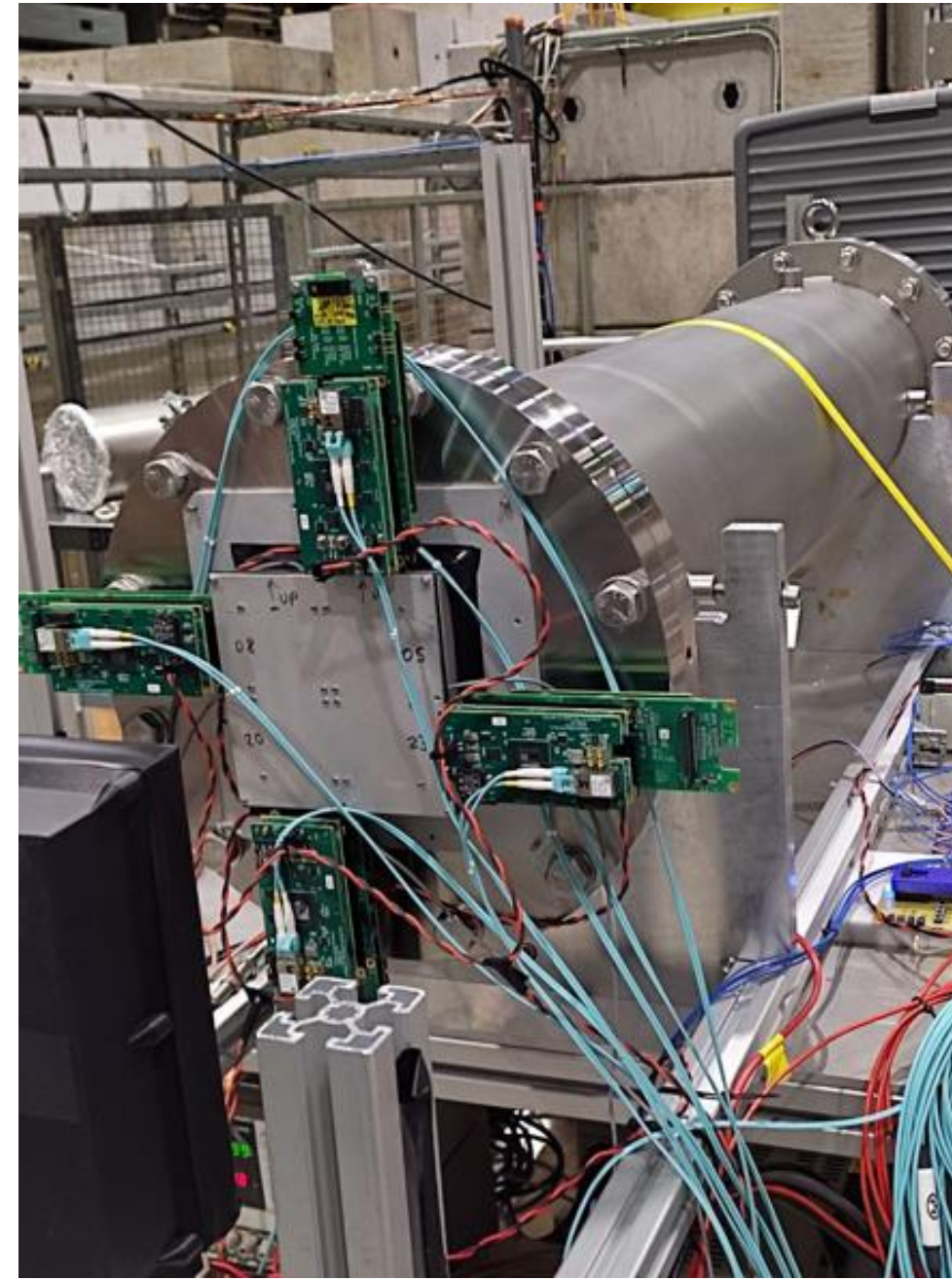
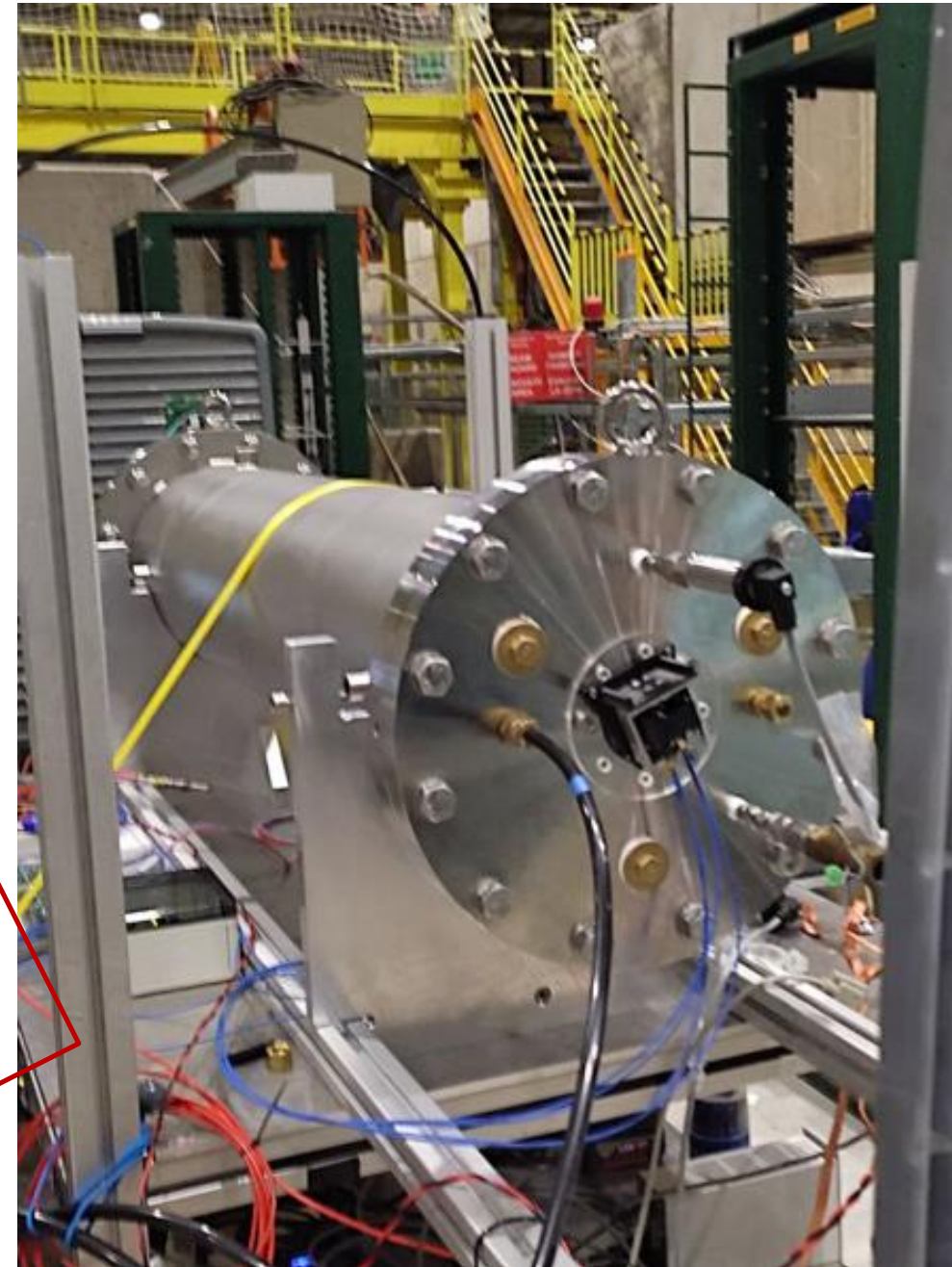
# Generic R&D Example: Pressurized RICH

Goal: Mitigate the risk associated with long-term usage of fluorocarbon greenhouse gases (e.g.  $C_2F_6$  in dRICH)

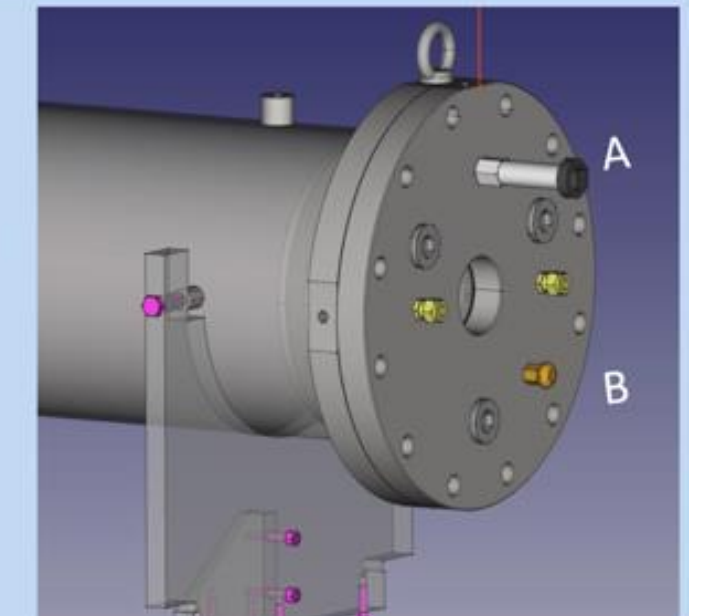
**Task 1:**  
Pressurized chamber  
to adjust the refractive  
index of (inert) gases

Compare performance:

- $C_2F_6$  at 1 bar
- Argon at 3 bar



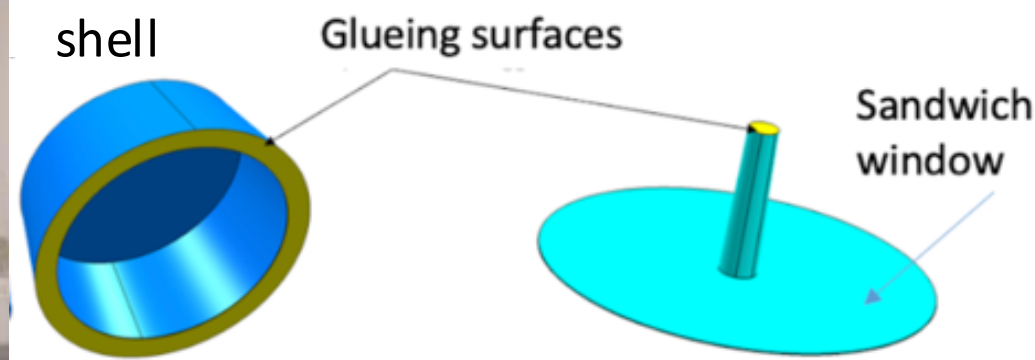
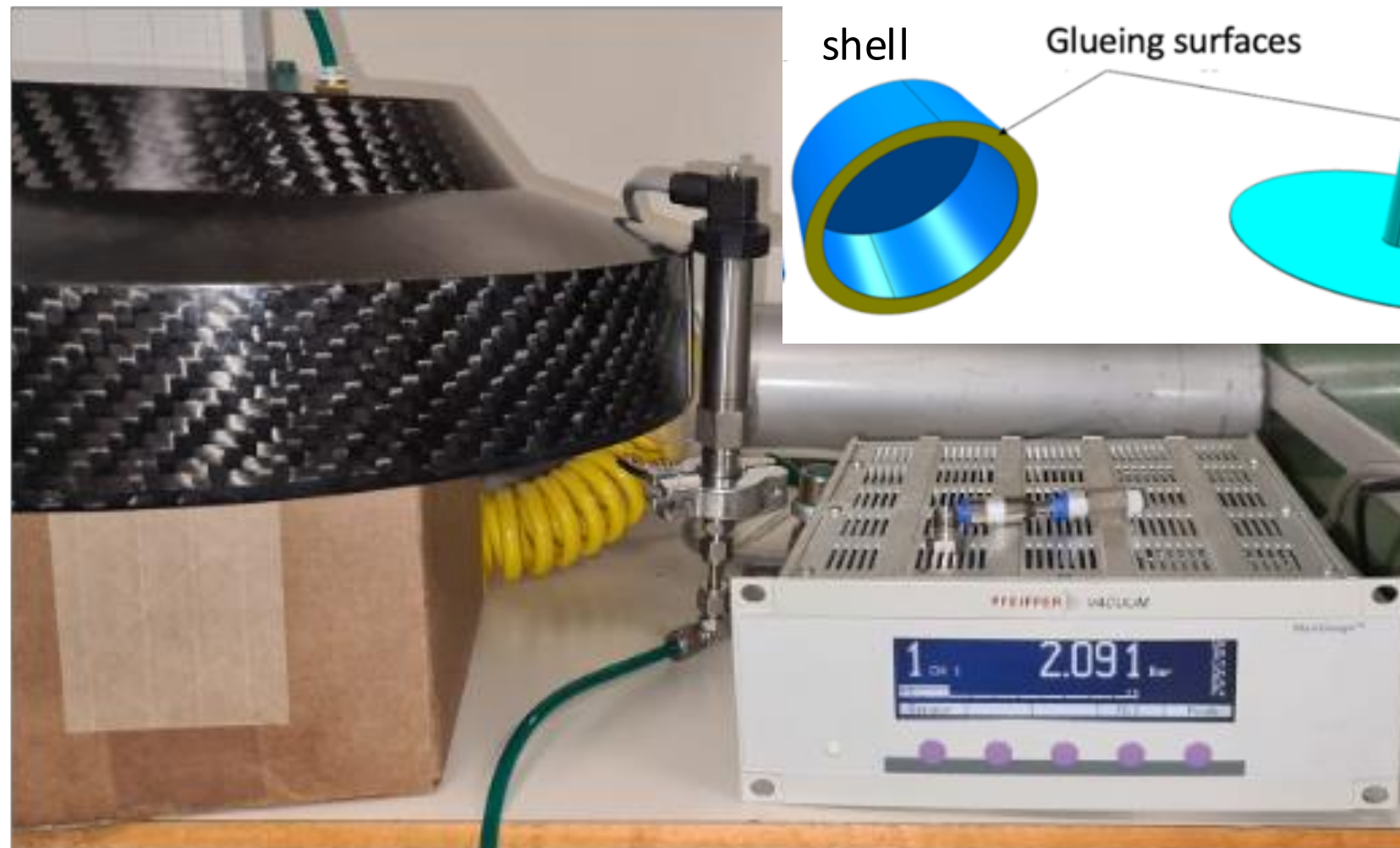
Cat-I Pressure Chamber (71 lt, +2.5 bar)  
for comparing  
-  $C_2F_6$  at atmospheric pressure  
- Ar at 3 bar (absolute)  
A) Probe: Piezo APR\_265\_Pfeiffer  
B) Pressure valve: CERN 40.10.40.250.1



Equipment in preparation  
before extensive tests

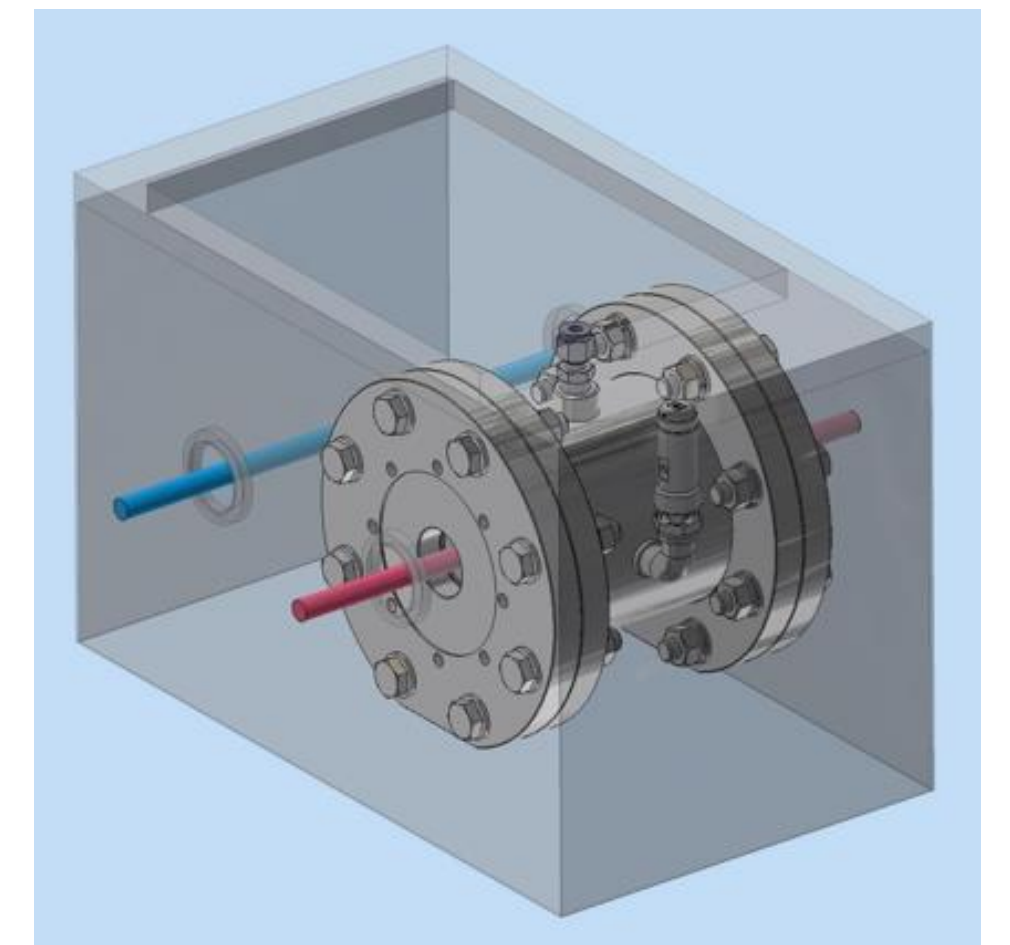
**Task 2:**  
CFRP mockup

Test composite  
materials for  
over-pressure  
(and permeability)



**Task 3:**  
10-bar chamber compatible  
with a spectrophotometer

Test compatibility of aerogel  
with a pressurized atmosphere





# DOE Takes Over

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**From:** 'Shinn, Michelle' via EICUG Steering Committee <eicug-sc@eicug.org>  
**Sent:** Wednesday, October 2, 2024 5:19 PM  
**To:** eicug-sc@eicug.org  
**Subject:** [EXTERNAL] [eicug-sc] FY25 DOE Office of Science Notice of Funding Opportunity now includes EIC-related Generic Detector R&D

The FY 2025 Continuation of Solicitation for the Office of Science Financial Assistance Program Notice of Funding Opportunity (NOFO) (<https://science.osti.gov/grants/FOAs/-/media/grants/pdf/foas/2024/DE-FOA-0003432.pdf>) solicits proposals from eligible applicants for projects aligned with the goals ascribed for the Generic EIC Detector R&D Program described in section 6j. Note that the deadline for submission is **November 15, 2024**.

Regards,  
Michelle Shinn

Michelle Shinn, Ph.D.  
Program Manager for Industrial Concepts  
Office of Nuclear Physics

# Details

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## **FY 2025 Continuation of Solicitation for the Office of Science Financial Assistance Program**

### **Executive Summary**

The Office of Science (SC) of the Department of Energy (DOE) hereby announces its continuing interest in receiving applications for support of work in the following program areas: Advanced Scientific Computing Research, Basic Energy Sciences, Biological and Environmental Research, Fusion Energy Sciences, High Energy Physics, Nuclear Physics, Isotope R&D and Production, and Accelerator R&D and Production. On September 3, 1992, DOE published in the Federal Register the Office of Energy Research Financial Assistance Program (now called the Office of Science Financial Assistance Program), 10 CFR 605, as a Final Rule, which contained a solicitation for this program. Information about submission of applications, eligibility, limitations, evaluation and selection processes and other policies and procedures are specified in 10 CFR 605.

- Not specific to EIC - much will depend on composition of review committee
- Grant based not contract based
- Expected dollar amount of individual awards: \$5,000 to \$5,000,000
- Only for US institutions (non-US can participate but PI needs to be US based)
- Tailored for universities - more complex process for Nat. Labs
- Joint projects among universities complicated for grant (different overheads, need of collaboration among different universities grant offices)
- Deadline was too short for many



# Next Steps

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- Some EIC groups applied but time was too short for many and non-US groups are left out
- EIC can only succeed on the long term if we start to think about upgrades early. This will also keep hardware based groups active and involved.
- Possible Scheme
  - ▶ Formation of consortia (here PID ~ eRD14) that includes universities, labs, and non-US groups
  - ▶ Lead PI - US universities
  - ▶ Potential consortia: RICH based PID, ToF based PID, Photosensors for PID, ...
  - ▶ Start to work on proposal early to also solve legal issues among different groups - now is the time to start forming groups
  - ▶ Include industry, e.g. INCOM