Brookhaven National Laboratory

Jefferson Lab

U.S. DEPARTMENT OF ENERGY

pfRICH

Triple I Engineering Meeting Update

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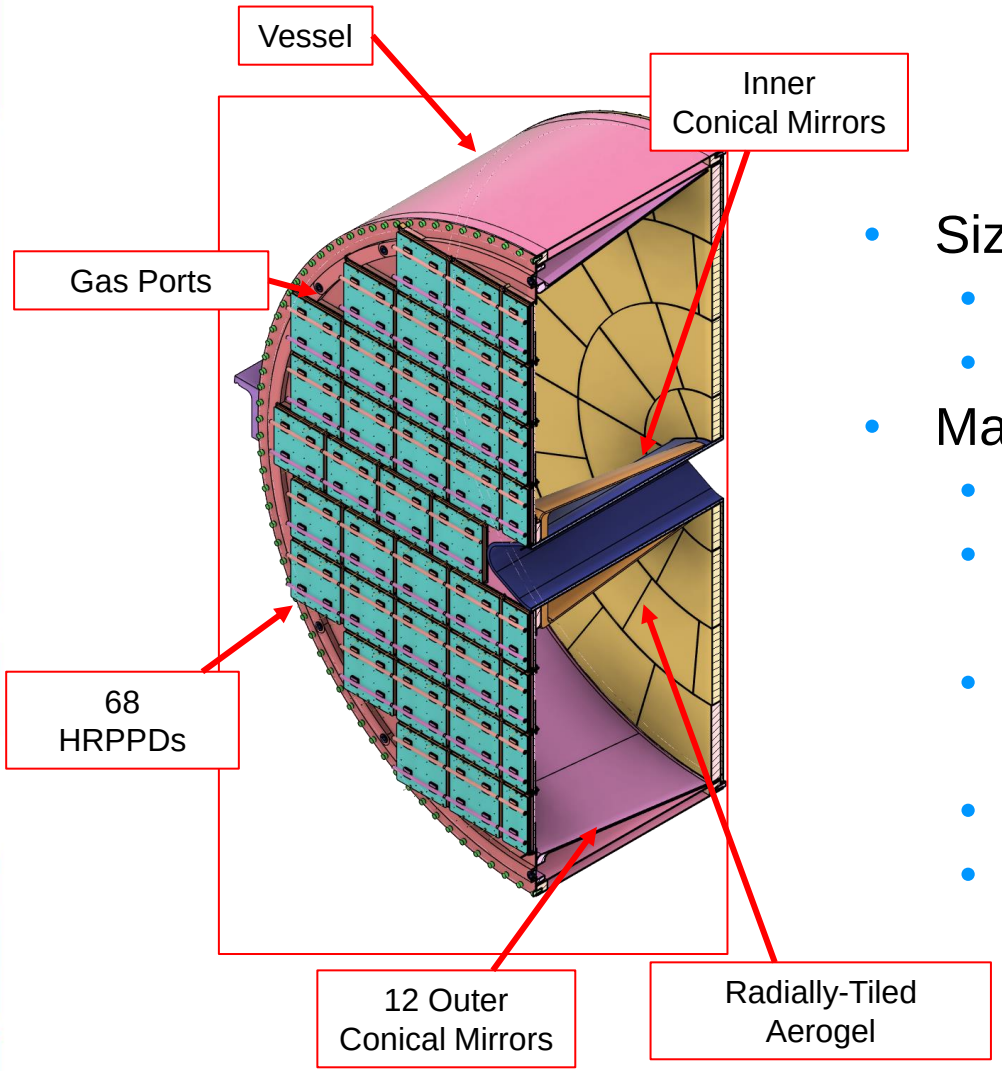
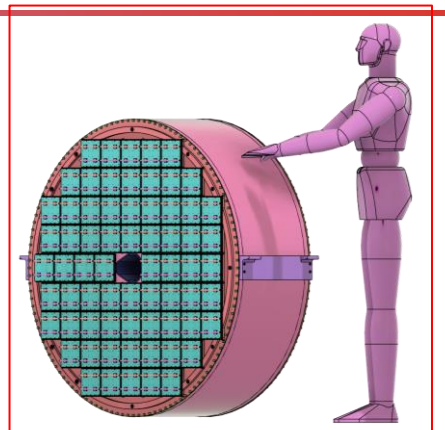
Electron-Ion Collider

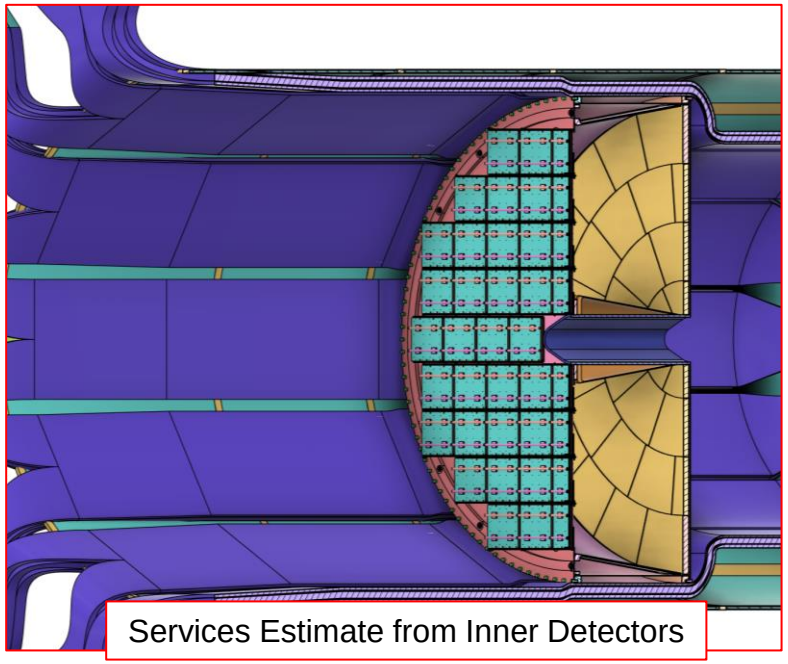
pfRICH: Overview



- Size and scale:
  - Outer Diameter: 130cm
  - Weight: ~200kg
- Major components:
  - Vessel
  - Sensor Plane with 68 HRPPDs
  - Aerogel Plane with radially-tiled aerogel
  - Inner Conical Mirrors
  - Outer Conical Mirrors



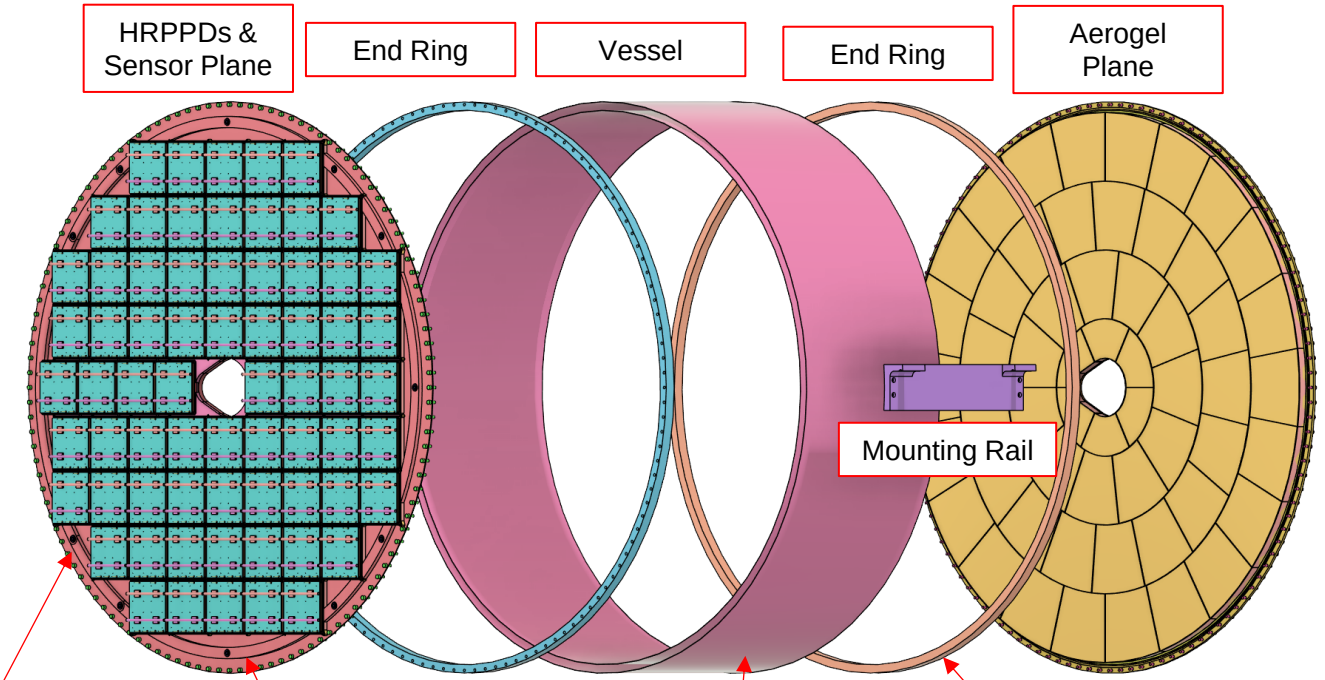
Size and Scale

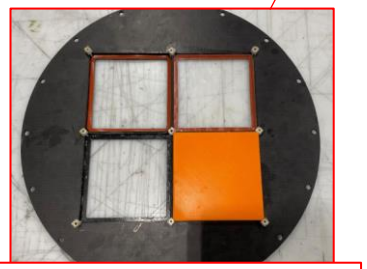


Services Estimate from Inner Detectors

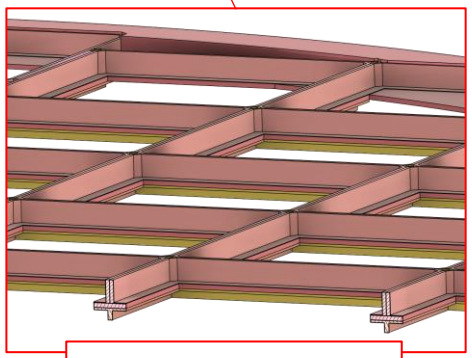
pfRICH: Components (External)

- Prototyping has been ongoing for the various components to verify manufacturing techniques and validate the design
- Stony Brook University (SBU) and Purdue University have been working to create a full-scale prototype (and small-scale test prototypes)
- One of the design changes that came from this prototyping was the layering of the sensor plane (shown in the C-S view)





Prototyping the Sensor Plane (Purdue)



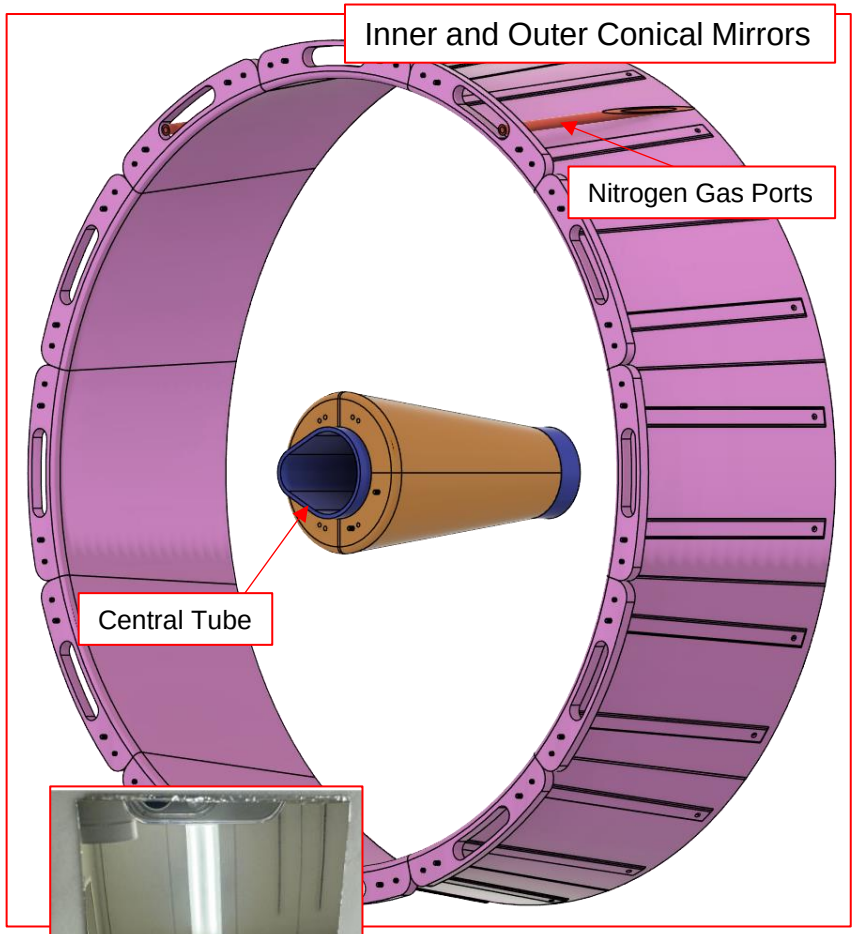
C-S of Sensor Plane

Prototyping the Vessel (SBU)

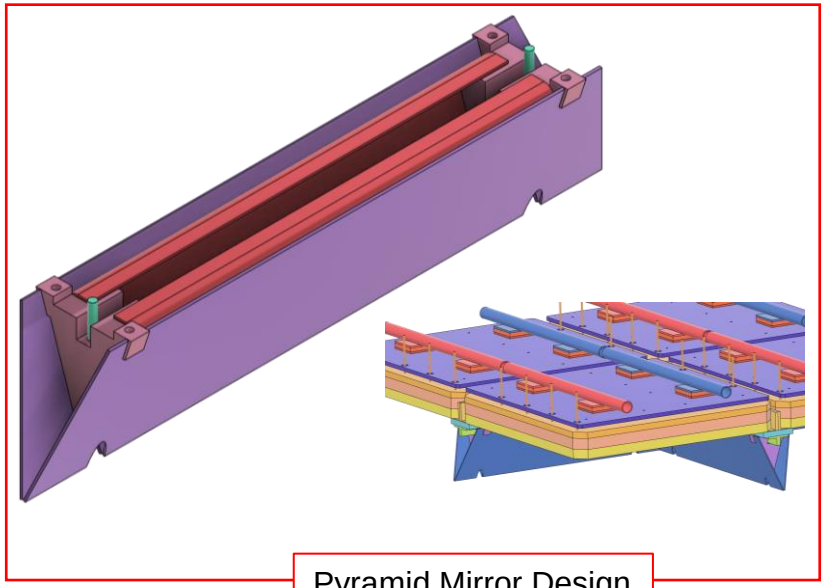
Prototyping the End Rings (Purdue)

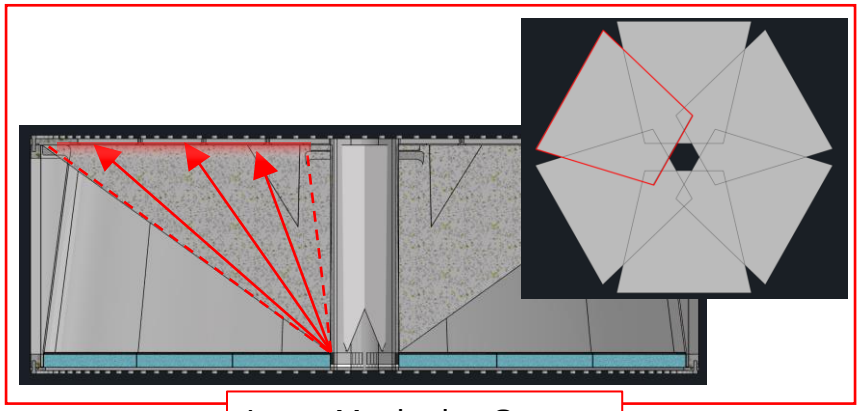
pfRICH: Components (Internal)

- **Internal components consist of:**
  - Conical Mirrors (Inner/Outer)
  - The central support tube
  - “Pyramid” Mirrors
  - Nitrogen gas hardware
  - Laser Monitoring System
- Inner and outer mirrors have been undergoing full scale prototyping
- Pyramid mirror design being considered for an engineering sample to confirm the design



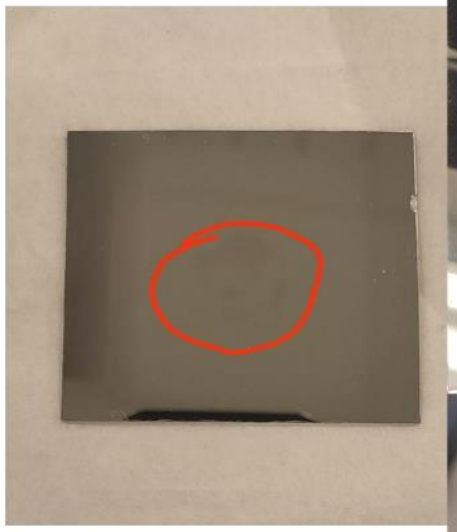

Mirror Coating (SBU/Purdue)

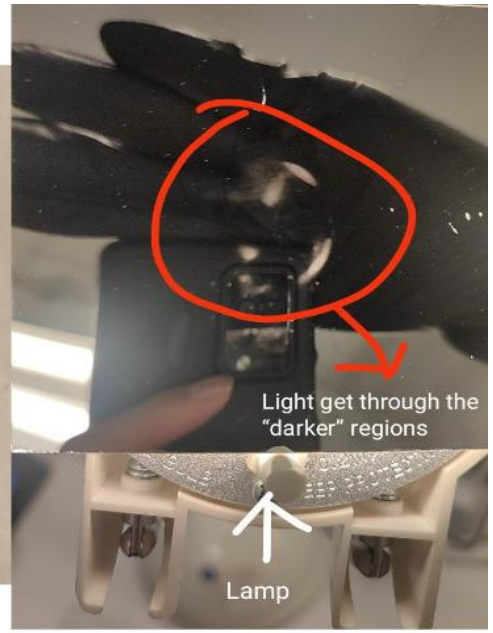

Pyramid Mirror Design

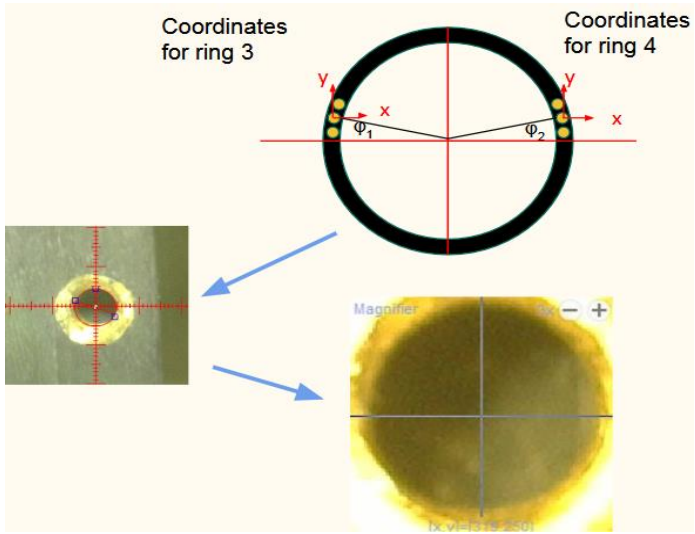

Laser Monitoring System

Status / Updates

- Latest updates:
  - Purdue has been continuing to create the base componentry for the sensor plane plate which consists of three parts: “t-beams,” a ~2mm backing plates, and “sensor frames”. Production is moving forward as planned.
  - SBU has been continuously coating mirrors since the PED started. As we have been moving forward, there have been inconsistencies with the coating reflectivity measurements. We have gone back and looked at all our coating closely and determined there has been an inconsistency problem that we’re working to resolve.
  - SBU vessel construction team did some metrology on the location of the threaded inserts on the end rings to determine how well “clocked” the end rings are on the vessel and how accurate the absolute placement of the inserts is. This information is required to move forward with the machining of the sensor plate at Purdue in mid-July 2025.







Plans Towards PDR

- ~~We need to finalize the vessel construction and work through any remaining issues related to the fabrication.~~
  Done – however, the prototype vessel cannot be used as the final vessel due to an add'l 60mm length in Z
- Prototype the aerogel and pyramid mirror concepts
  - This is awaiting PED funding
- Services routing needs to be finalized with a focus on installation and entry/exit points and patch panel placement
  - Ongoing conversations regarding design changes for ePIC will affect design decisions here
- Laser Monitoring subsystem needs to be finalized
- Installation support is being co-developed with the GST/PST conversations
  - Awaiting information regarding design decisions related to the GST/PST. Do we have any updates? (pfRICH installed on 2 or 4 rails?)
- Depending on the ASIC configuration:
  - Cooling is still in a "draft" form awaiting final electronics layout for HRPPDs
  - There may be a need to sink the sensors into the expansion volume depending on the electronics layout (concept design already considered)
- We're still considering vessel grounding/shielding to protect sensors from noise and to aid in light-tightening the vessel
- Still an ongoing concern about the beampipe bakeout effects on pfRICH componentry
  - Destructive testing of a small carbon fiber mirror sample has shown that it can withstand significant heat
  - The HRPPD has an indium seal which is only good for ~70C

Services Estimates

- Current estimate for power for the whole detector remains unchanged at less than ~500w
- 68 HRPPD sensors in total:
  - 340 HV Lines (5 HV Lines per HRPPD)
  - 68/136 LV Lines (1 or 2 LV Lines per HRPPD)
  - 340 Fibers (5 total fibers per HRPPD)
  - ~2mm diameter per fiber
- Laser Monitoring System: ~12 fiber lines
- Vessel Gas (N2): 4 lines (2 inlet & 2 outlet)
  - Designed to attach to either ¼” NPT or 3/8” NPT fittings (bulkhead)
- Cooling: Liquid lines 15C, ¼” OD at HRPPD, design still dependent on ASICs

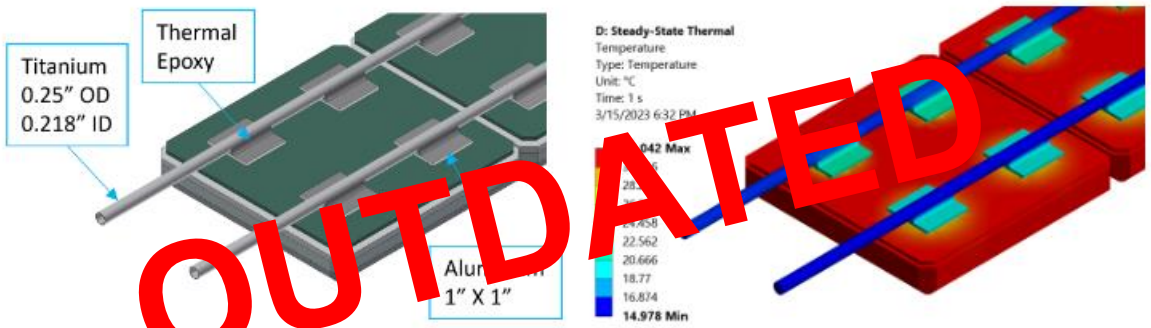


Figure 4.1: (Left) Schematic of the on-detector cooling assembly. (Right) Expected thermal gradiant across various sensor stack components.

Question & Comments