Brookhaven National Laboratory

Jefferson Lab

U.S. DEPARTMENT OF ENERGY

pfRICH

Triple I Engineering Meeting Update

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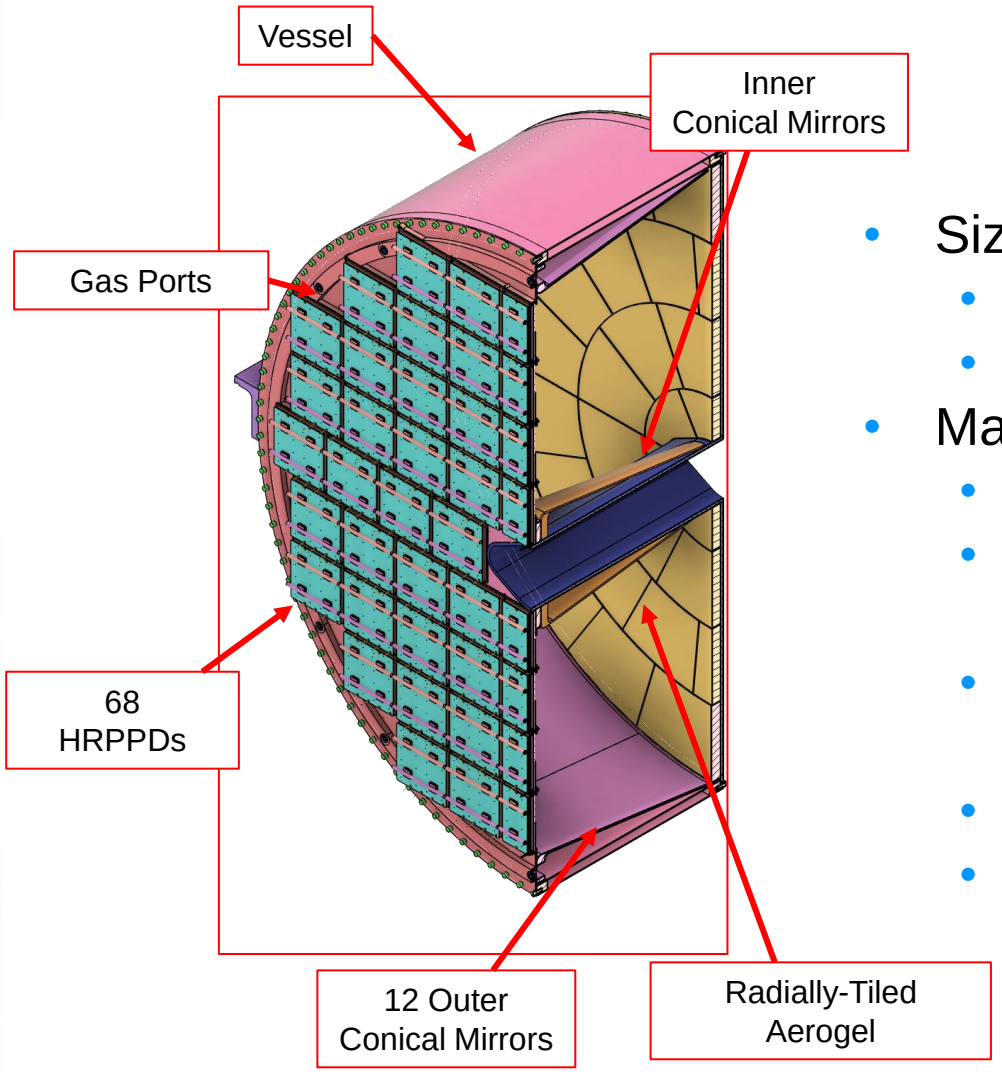
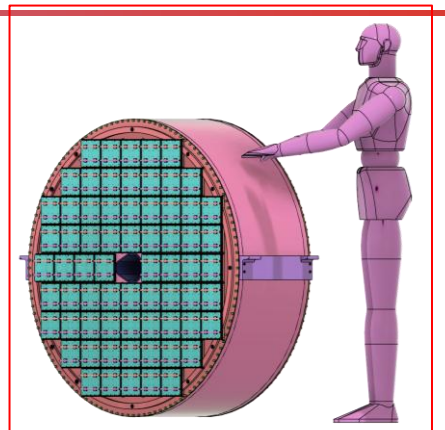
Electron-Ion Collider

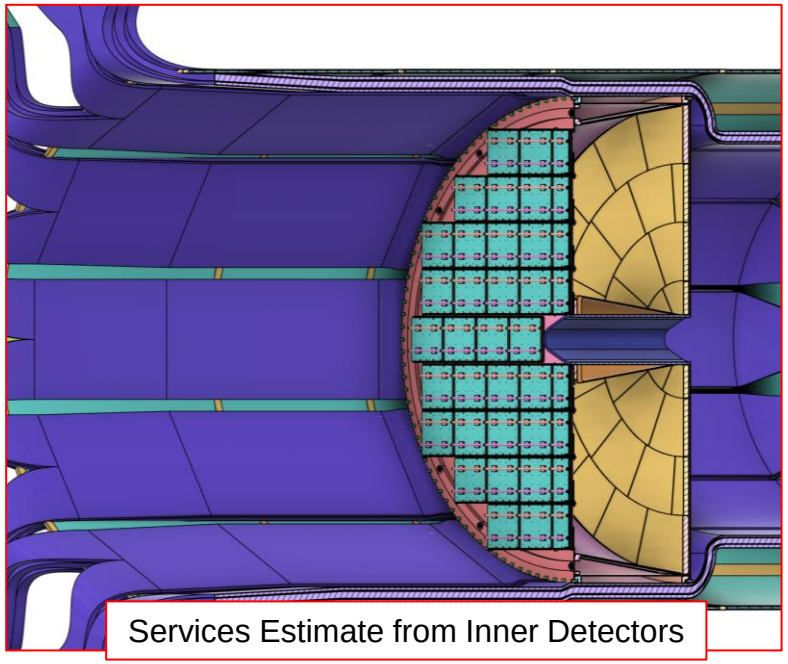
pfRICH: Overview



- 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



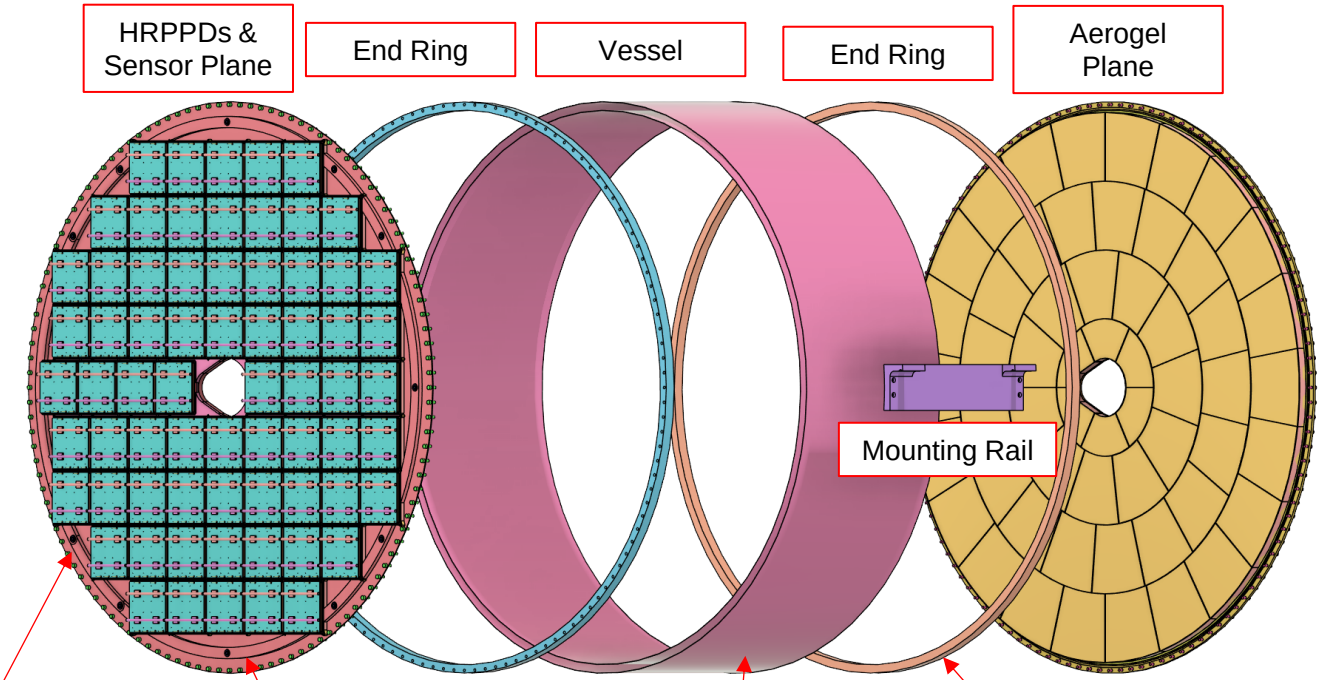
Size and Scale

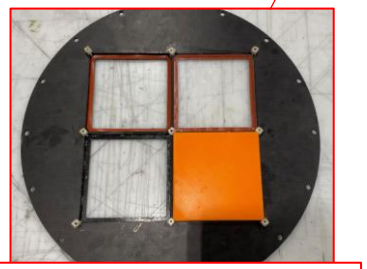


Services Estimate from Inner Detectors

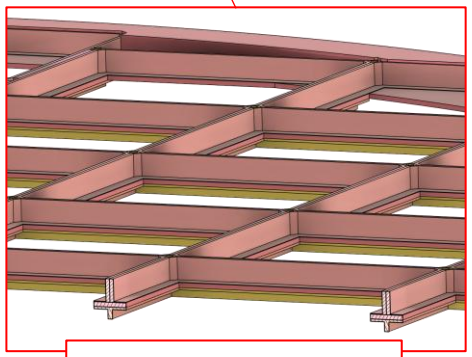
pfRICH: Components (External)

- 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)

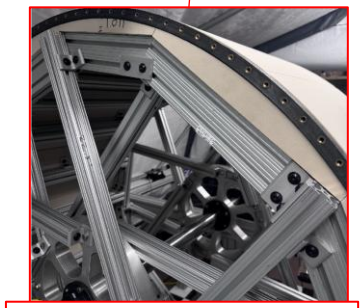




Prototyping the Sensor Plane (Purdue)



C-S of Sensor Plane

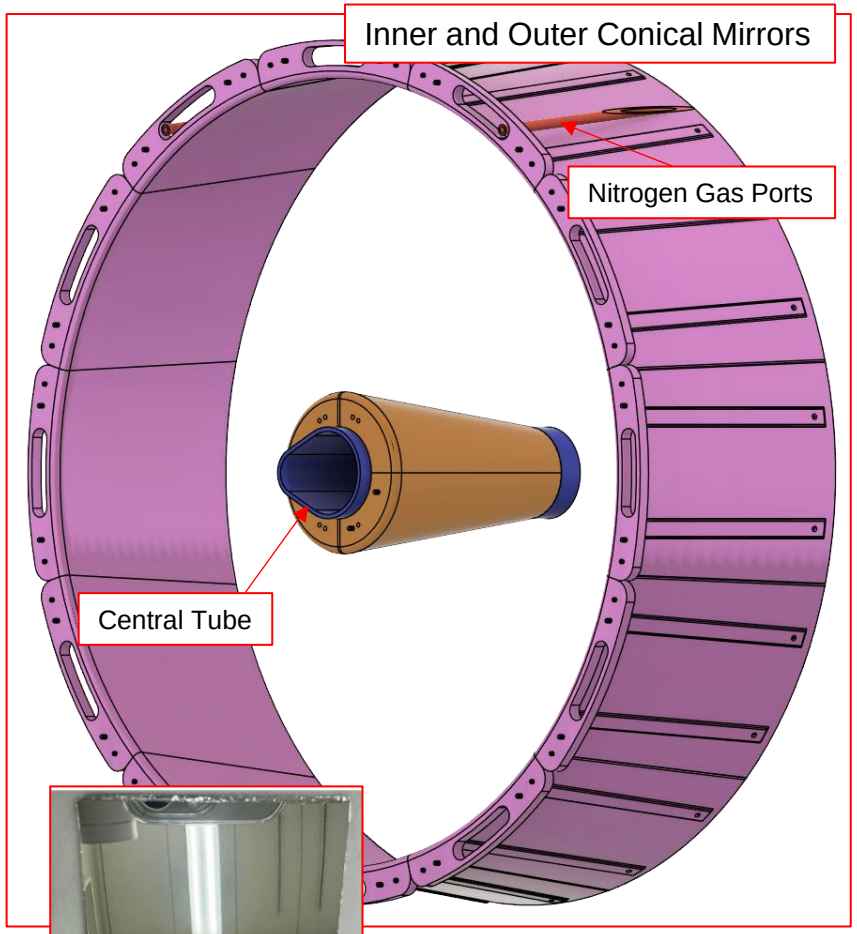


Prototyping the Vessel (SBU)

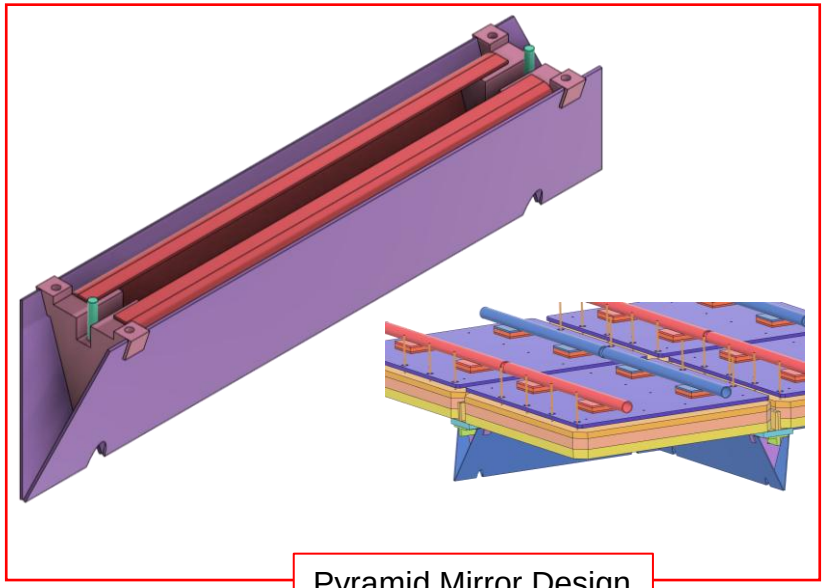
Prototyping the End Rings (Purdue)

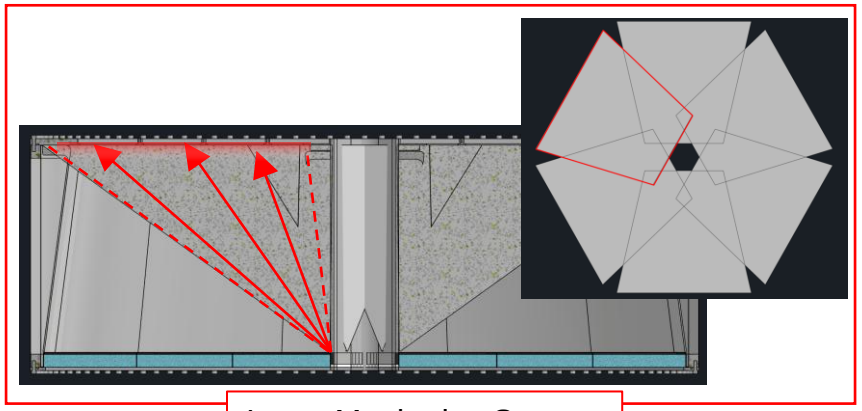
pfRICH: Components (Internal)

- **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



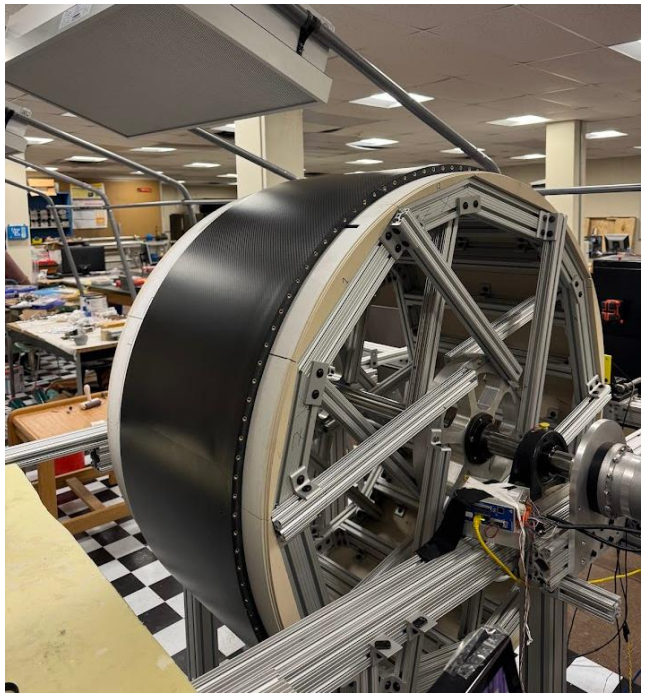

Mirror Coating (SBU/Purdue)

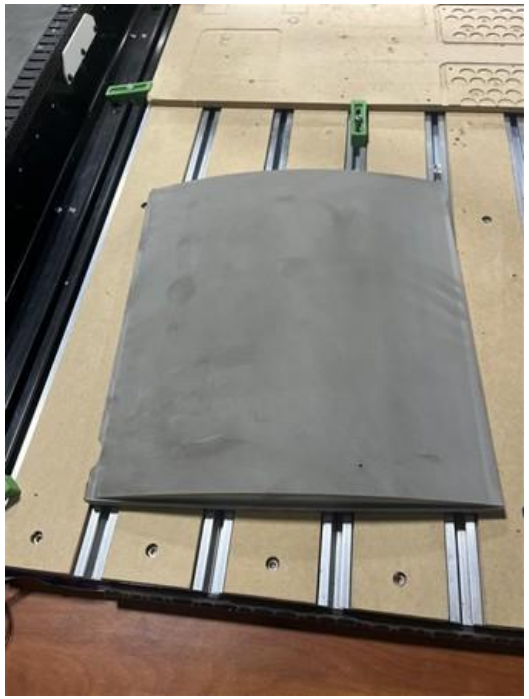

Pyramid Mirror Design


Laser Monitoring System

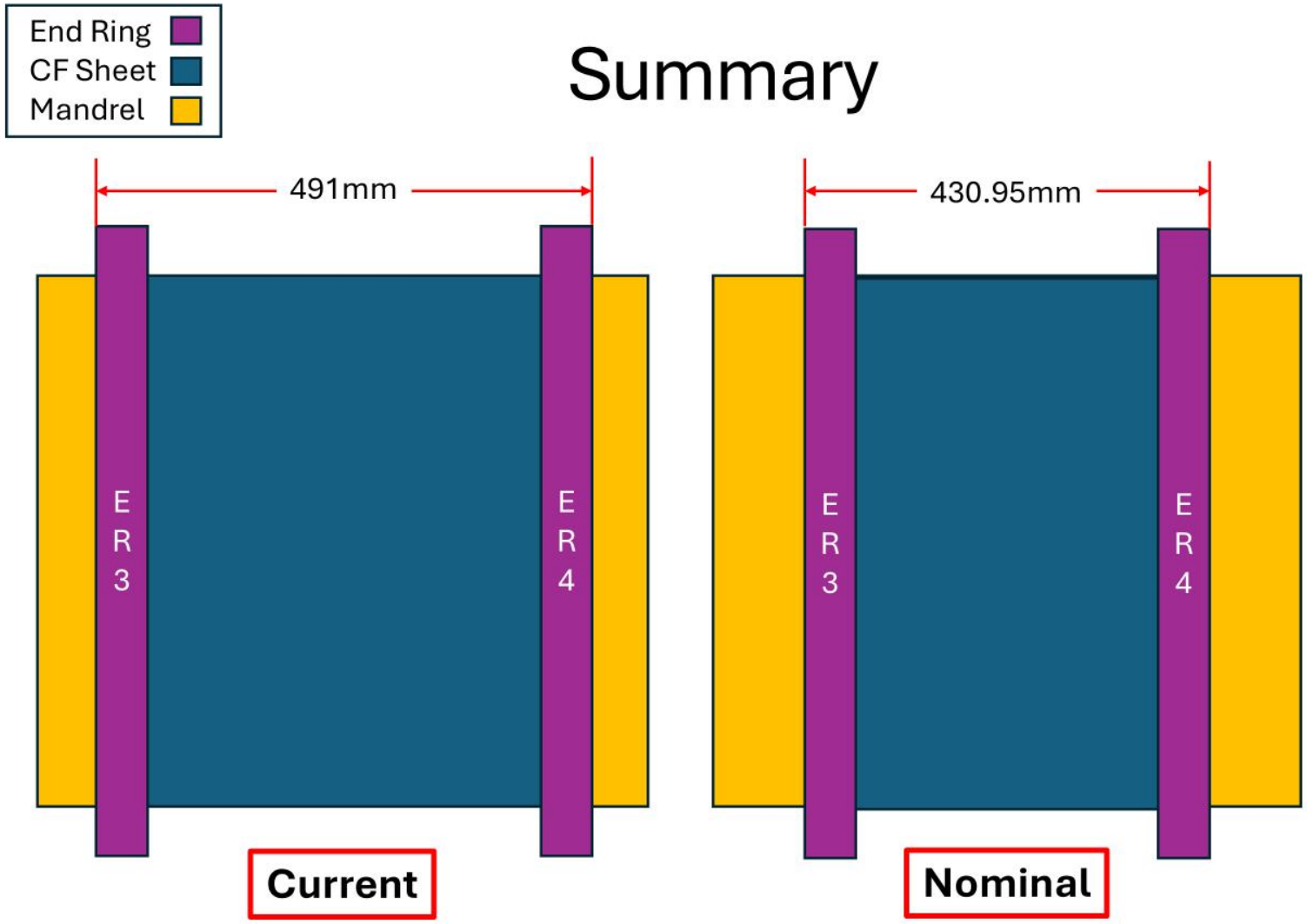
Status / Updates

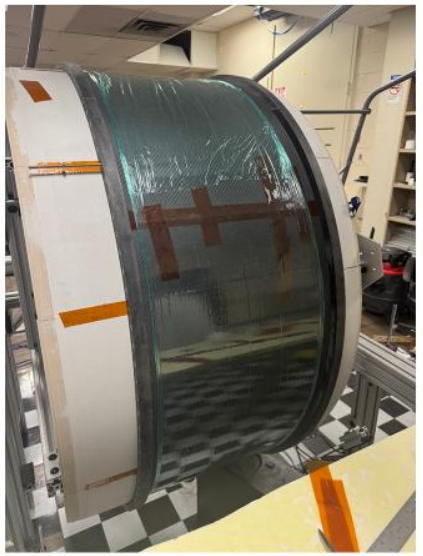
- Latest updates:
  - Prototype vessel has been completed and a report is being compiled to ensure that the final vessel incorporates lessons learned. This marks a major milestone in our full-scale prototype construction
  - Curved mirror forms are being fabricated at Purdue. Once they are complete, they will be sent to SBU to be coated. All mirror coatings so far have been on small flat samples.
  - The sensor plane design is being finalized as we have just finished the sealing test. The design has been modified to change the way we stack up each piece to also accommodate the “pyramid mirror” additions

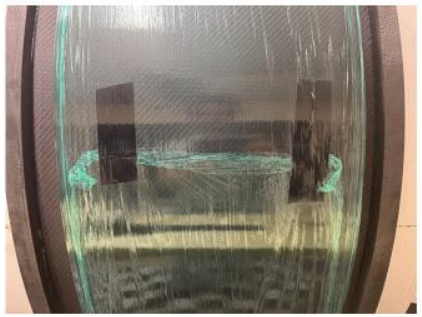


Summary


End Ring
CF Sheet
Mandrel
491mm
ER3
ER4
Current
430.95mm
ER3
ER4
Nominal





Plans Towards PDR

- Finalize the vessel construction and work through any remaining issues related to the fabrication.
  - The vessel cylinder has been completed; however, due to a miscommunication, the vessel was produced 60mm too long
  - Options were discussed regarding how to fix the vessel before continuing production, but the decision was made to leave it as is
  - Consequently, the prototype vessel cannot be used as the final product, as was intended
- Prototype the aerogel and pyramid mirror concepts
  - This is awaiting PED funding from the CAM
- Services routing needs to be finalized with a focus on installation and entry/exit points and patch panel placement
  - In progress
- Laser Monitoring subsystem needs to be finalized
- Installation support is being co-developed with the GST/PST conversations
  - No updates regarding the GST/PST; still operating under the assumption of two rails for the pfRICH at 3 and 9 o'clock
- 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)
- 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