

The vessel at Stony Brook

pfRICH project

C-J. Naim

on behalf of the Stony Brook team

Center for Frontiers in Nuclear Science

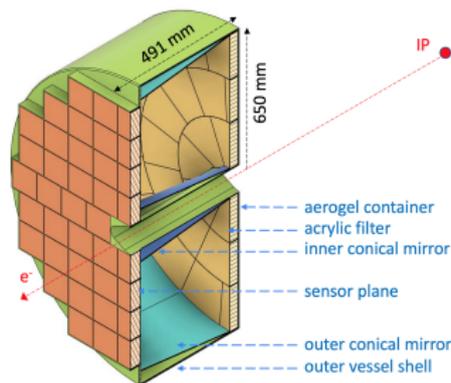
pfRICH group meeting

January 23, 2024



Introduction

- ▶ **Key feature:** Cylindrical vessel outer shell.



- ▶ Engineering aspects need attention for DOE reviews in 2024-2025.
- ▶ Outer shell construction **crucial for light and gas-tight enclosure.**

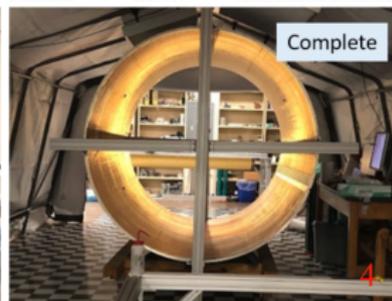
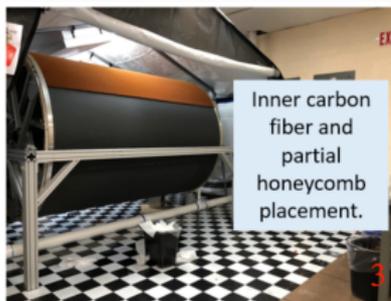
Vessel dimensions: measurements

- ▶ **Shape:** 1/2" thick cylinder (12.7 mm)
- ▶ **Outer Diameter:** 1300 mm
- ▶ **Length:** 491 mm
- ▶ **Precision:** < 1 mm radius and length
- ▶ **Technology:** Carbon-fiber composite material with nomex honeycomb core.



Vessel materials

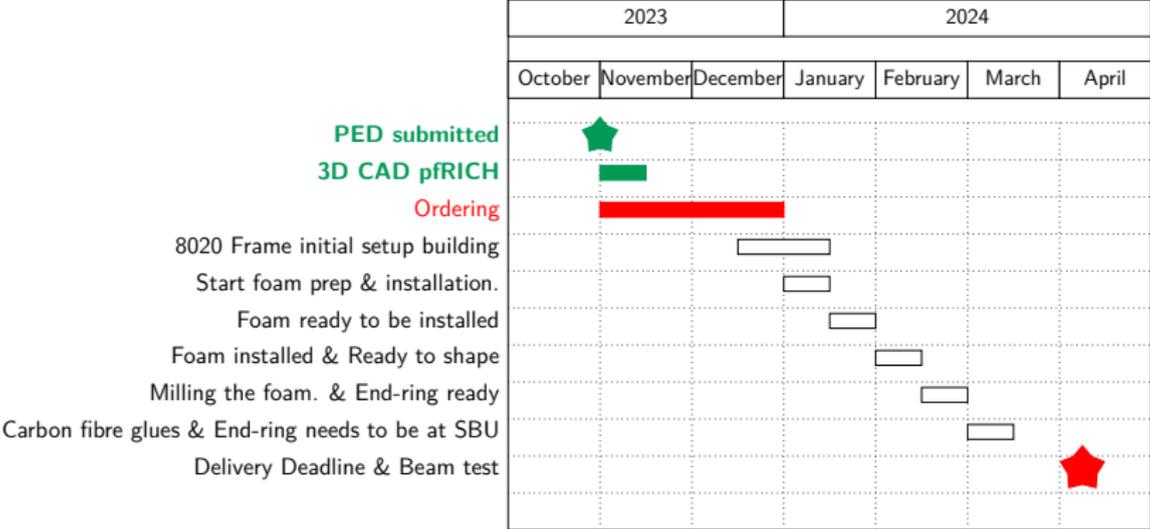
- ▶ Outer shell designed with carbon fiber honeycomb sandwich technique.
- ▶ Mimics the successful sPHENIX TPC construction method.
- ▶ Construction steps identical to sPHENIX TPC outer field cage.



Building the Cylindrical Honeycomb Shell

- **Start:**
 - ▶ Craft a **dodecahedron** base from machinable foam.
 - ▶ Ensure the foam is of **appropriate size**.
- **Precision Shaving:**
 - ▶ Utilize computer-controlled machinery for **exact radius**.
 - ▶ Guarantee **uniformity and precision**.
- **Carbon Fiber Application:**
 - ▶ Apply fine **carbon fiber** selectively incorporating a **honeycomb structure**.
 - ▶ Add **structural rigidity** while maintaining a **lightweight** design.
- **Final Assembly:**
 - ▶ Ensure proper bonding and curing for **carbon fiber** and **honeycomb layers**.
 - ▶ Inspect for **imperfections** or areas requiring **reinforcement**.

Initial Project Timeline: vessel construction at SB



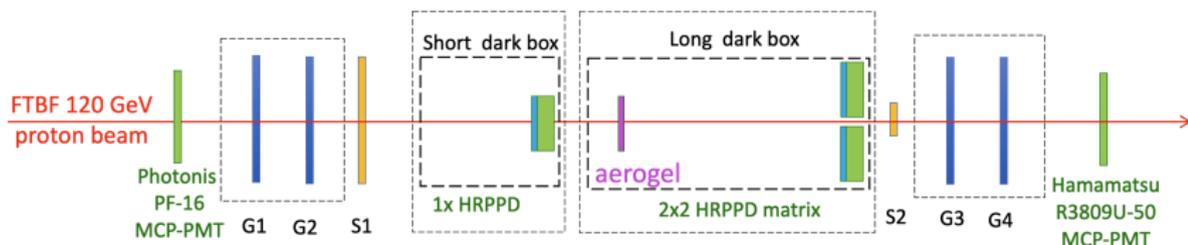
Delays on ordering:

We are behind schedule for the beam test timing.

Beam test and Plan C

... is **completely decoupled** with pFRICH at Stony Brook:

- ▶ Test setup @ Fermilab, FTBF 120 GeV proton beam
- ▶ Components: G1 G2 S1 G3 G4 S2, Hamamatsu R3809U-50 MCP-PMT, 1x HRPPD
- ▶ **Short dark box** with Photonis PF-16 MCP-PMT
- ▶ Aerogel, $\bar{n} \sim 1.040$ with Cherenkov $\theta_c \sim 278$ mrad (15°)



Testing Parameters

- ▶ **Measurement goals:**

- ▶ Ring measurement: ~ 114 mm radius
- ▶ Timing measurement: "photon flash" from proton passing through HRPPD window

- ▶ **Deliverables:**

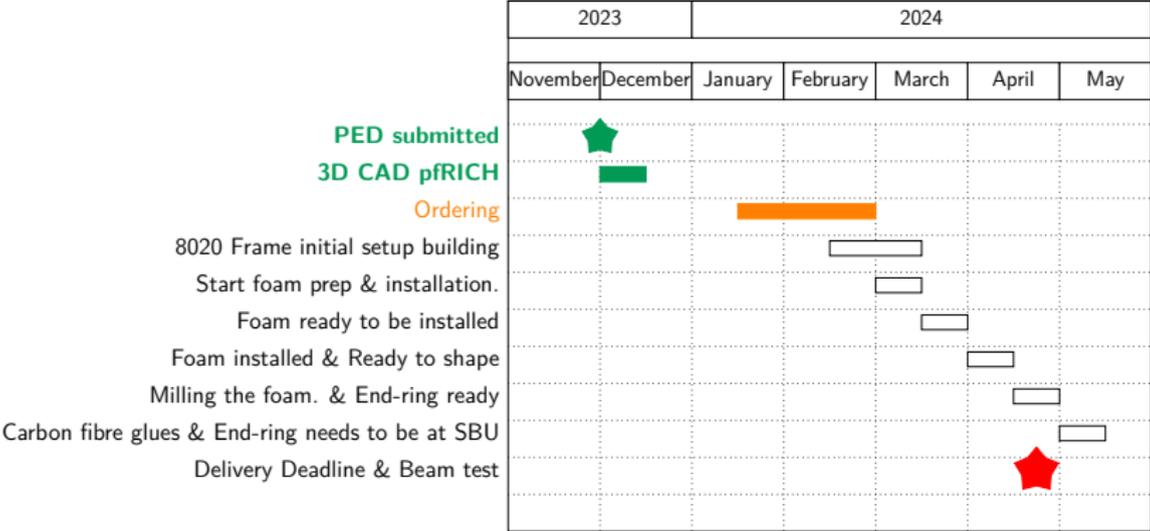
- ▶ Demonstration of \bar{N}_{pe} & θ_c resolution @ 120 GeV, with and without acrylic filter
- ▶ HRPPD performance as t0 reference sensor for ePIC ToF subsystems
- ▶ $\lesssim 50$ ps timing resolution using aerogel Cherenkov photons
- ▶ O(20ps) timing resolution using sapphire window Cherenkov photon flashes

Equipment at BNL

- ▶ Rear side plate with a single HRPPD
- ▶ Front side with short and long dark boxes
- ▶ **Long dark box details:**
 - ▶ Length $> 20''$ (510 mm), square opening 262mm \times 262mm
 - ▶ Accommodates 2x2 matrix of 120mm \times 120mm HRPPDs
 - ▶ Imitates ~ 400 mm long pfRICH expansion volume
- ▶ Design and 3D print a 2x2 HRPPD mounting plate

New Project Timeline: vessel construction at SB

... it is **completely decoupled** with the beam test:



Mission:
Be ready in June.

Conclusion

- ▶ PED (mirror shell) submitted at the end of November: administrative delays in securing funds at SB;
- ▶ Ordering postponed to early March: unable to participate in the beam test;
- ▶ Plan C: **evolving independently of Stony Brook**;
- ▶ Funds arrived at Stony Brook this week;
- ▶ Commencement of orders next week;
- ▶ The entire timeline has been shifted by one month;
- ▶ **Delivery expected in May-June.**