pfRICH: Vessel Work Fall 2024

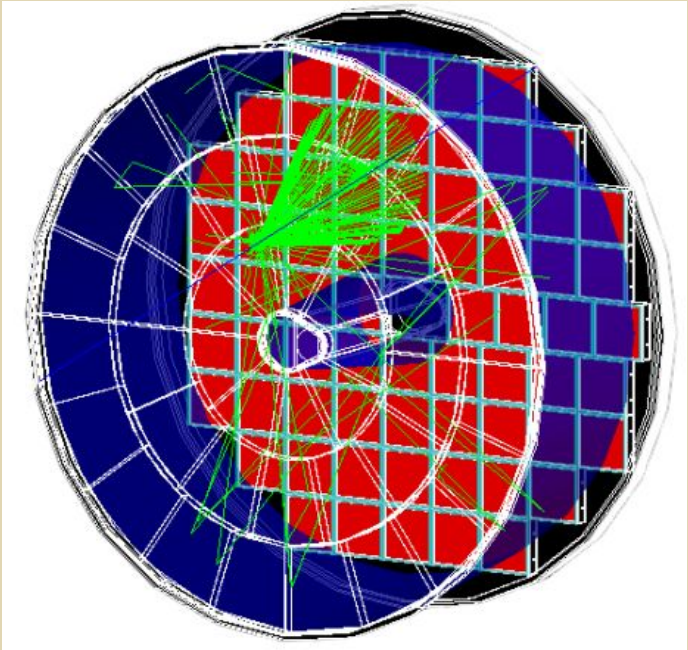
Charles Joseph Naïm, Emmett L. Gebb, Julian Driebeek, Saanvi Madishetty

Overview of pfRICH

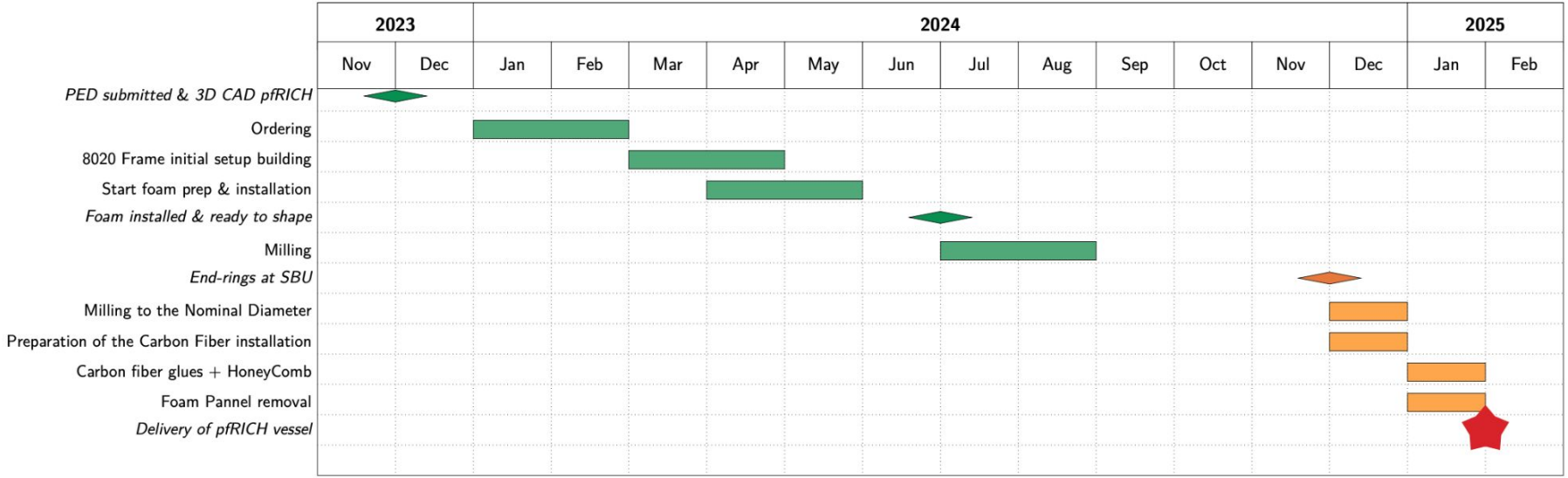
The ePIC detector at Electron-Ion Collider (BNL) includes a proximity-focusing Ring Imaging Cherenkov (pfRICH) detector to detect Cherenkov radiation induced by the passage of charged particles from the final state electron-proton and electron-nucleus collisions.

Particles emit radiation when their speed surpasses that of light in a medium. In this case, with an aerogel medium, we have primarily Hadrons whose mass will denote a different emission angle of Cherenkov photons. This pfRICH's Cherenkov radiation will primarily be in the UV range, and with the readout, our goal of reconstructing the emission angle can be executed to distinguish the meson flavors.

The team and I have been tasked with creating the insulating shell for this pfRICH detector over Fall 2023-Spring 2025.



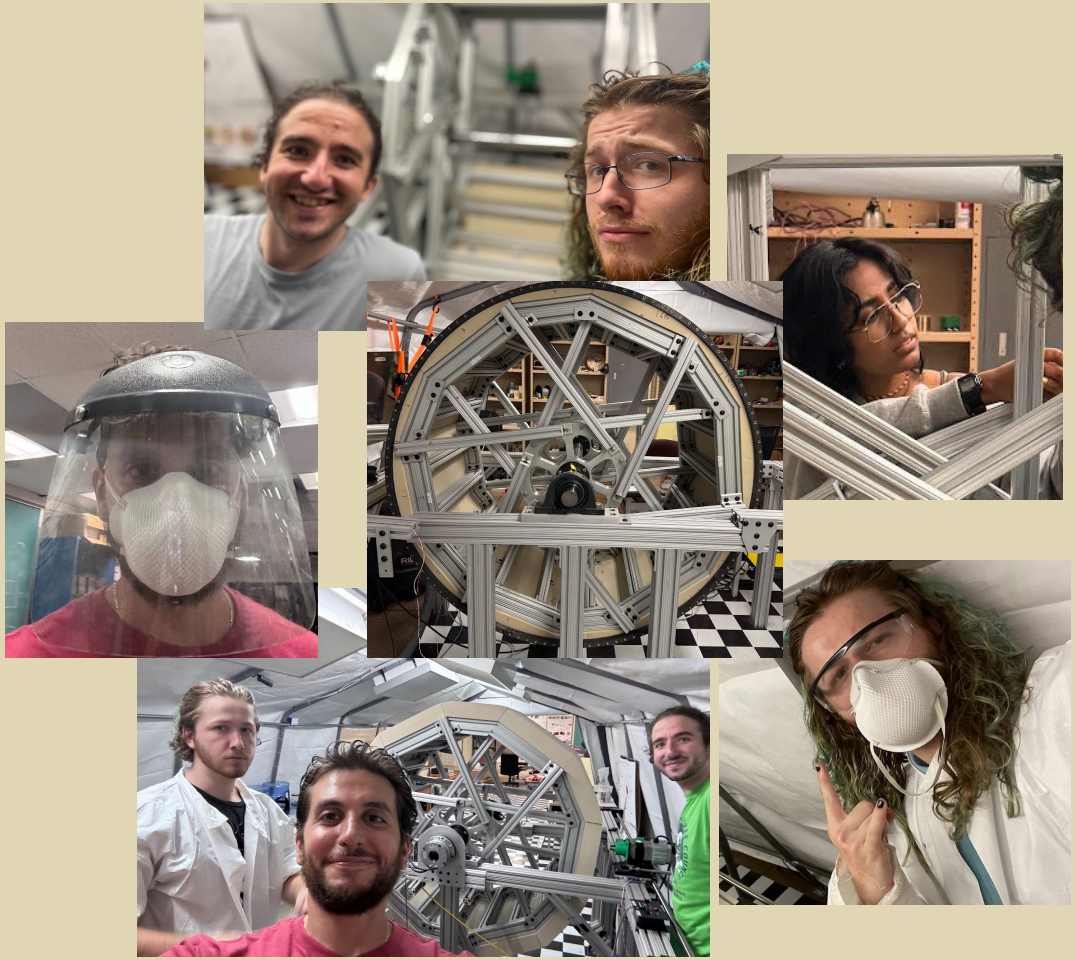
Overview of pfRICH: One-Year Project



Fall 2024 Goal : Minimizing Milling Uncertainty

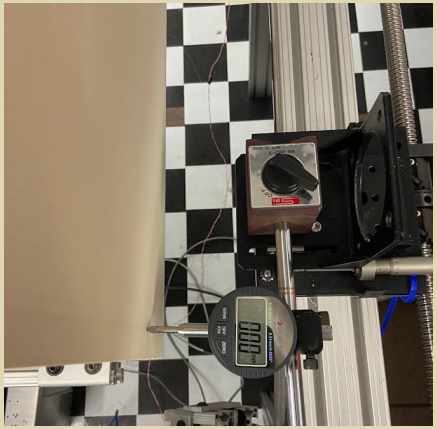
While Perdue Labs work on constructing new End-Rings for the pfRICH Vessel, we focused on ensuring that our foam-board vessel can be milled down 0.5 mm of uncertainty.

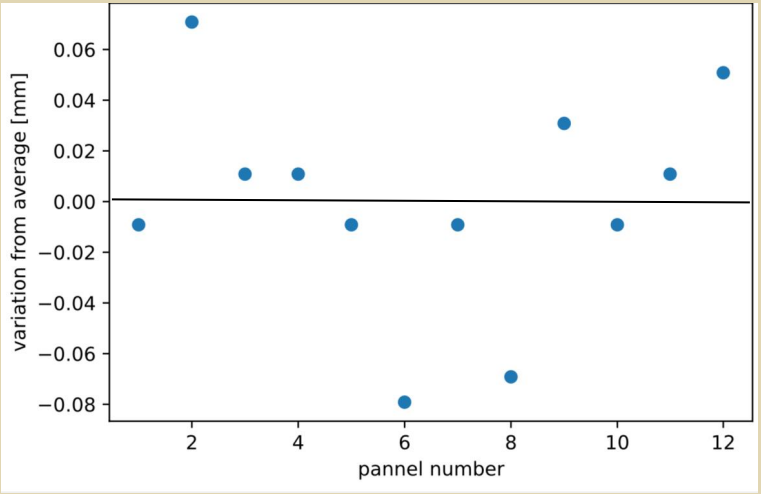
First we worked together to adjust the apparatus to within a small visual uncertainty by using a large caliper at each pillow block.



Minimizing Milling Uncertainty

Then we attached a electronic-caliper to our length-wise stage(this stage usually holds up the cutter). While the end of the e-caliper is pressed up against the body we took measurements for each foam-panel. The results indicated that we needed to adjust the vessel slightly and re-measure. **After adjusting we got an average change of about 0.1 mm with a range of 0.14 mm.**

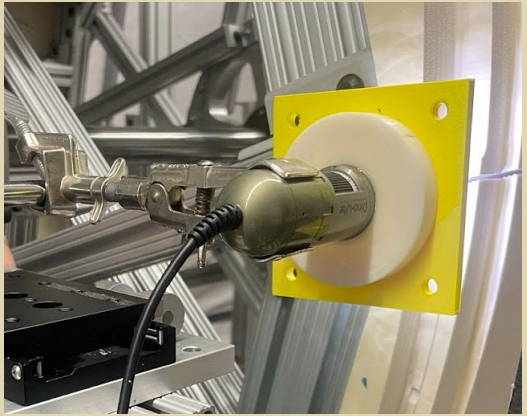


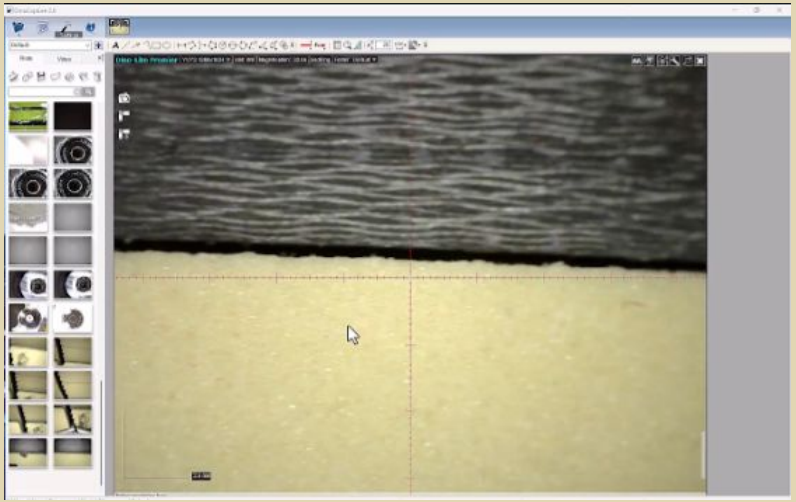


Minimizing Milling Uncertainty

A portion at the end of the vessel was milled down to the target inner radius. We used the same methods as previous to ensure we milled well.

Thereafter, we used a gold Dino-Cam to measure the circularity of the vessel. Securing the video camera close to the edge of the vessel we calibrated a x-y plane over the recording image to increments of 2mm. The video recorded as the vessel completed one full rotation. **Through this video we determined that our circularity remained within 0.1 mm from our initial origin point.**

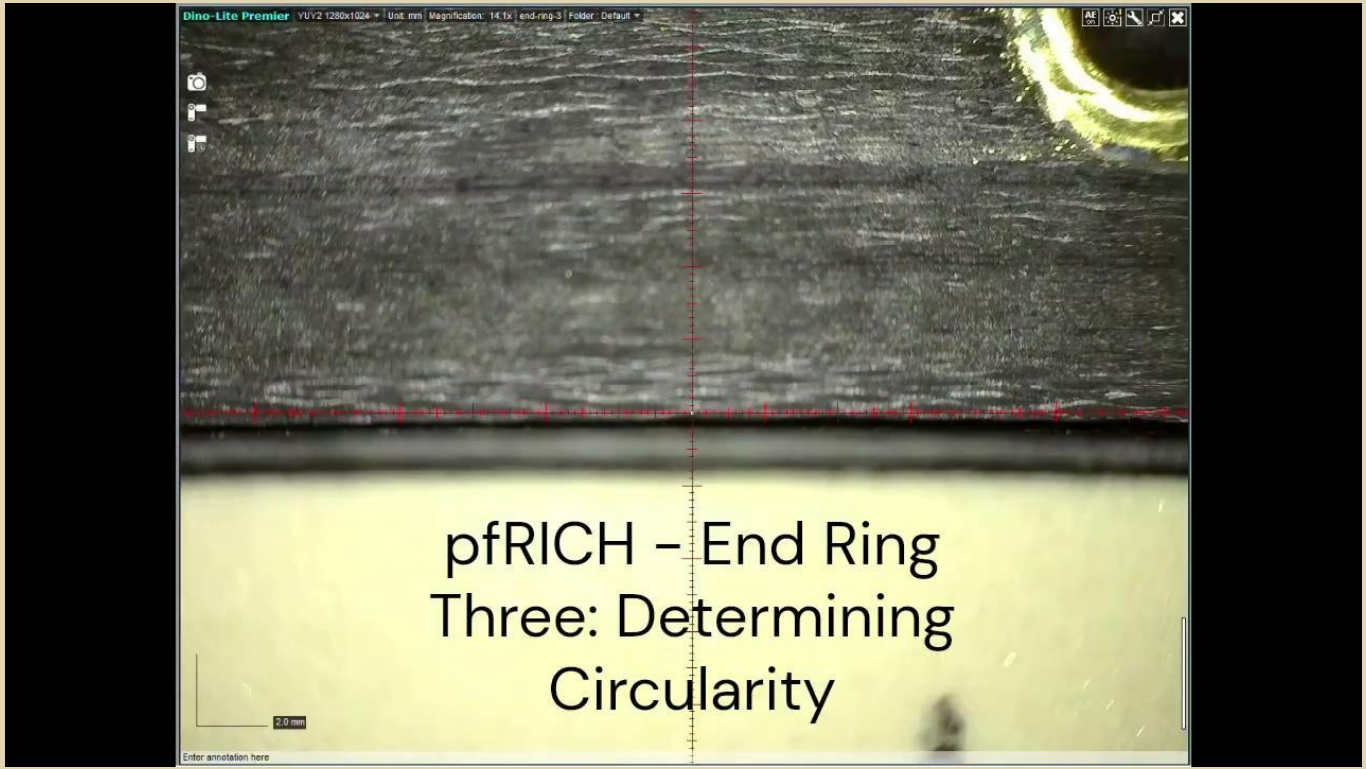




Circularity Video 1

Circularity Video 2

We then measured the circularity of the endrings we have received by securing them onto the target-inner-radius section of the body. To the right is our most recent recording of the new (3rd) end ring.



Summary and Next steps:

Milling Precision

- **Achieved 0.1 mm circularity precision.**
- Mandrel Video

3rd End-Rings

- **Improved geometry**: Uniform and higher quality.
- **Diameter variations**: Up to 1 mm, with ~68% within 0.250 mm.
  - 3rd End-Ring Video
- **Circularity Status**: Acceptable for the 3rd end-ring.
- **Decision pending for the 4th end-ring.**
  - **The first two end-rings have been returned to Purdue University.**