

# ePIC pfRICH Laser Monitoring System

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## **pfRICH Detector**

- The pfRICH is the particle-identification detector in the backward region of the ePIC detector at the Electron-Ion Collider.
- It helps with particle identification by using Cherenkov light patterns.

## **Why Do we need a Laser Monitoring system?**

Challenges over time

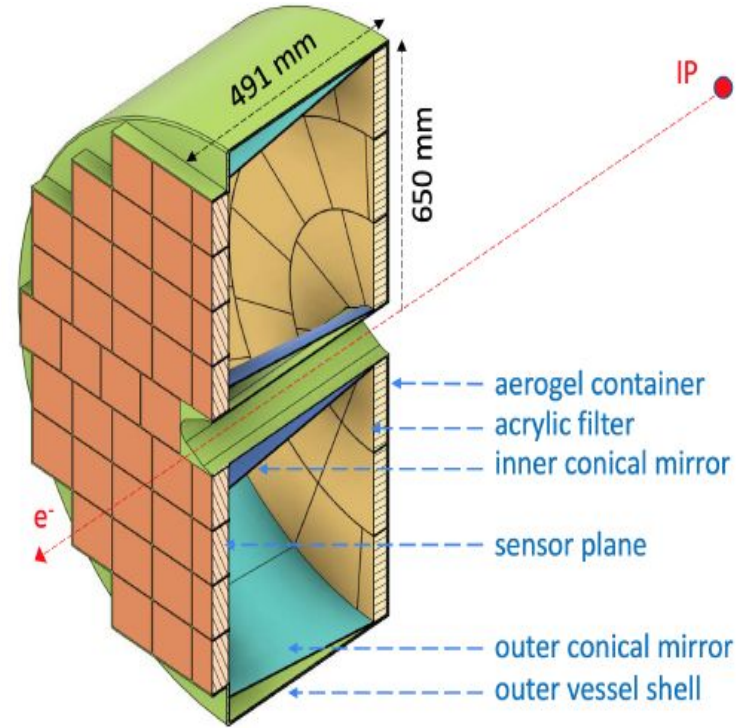
- The Detector instability.
- Complex optical geometry

## **How Laser System helps**

- Ring-imaging capabilities via pulse-height amplitude monitoring over the experiment's lifetime.
- It supports ToF performance with better than 100 ps timing resolution

# pfRICH detector layout

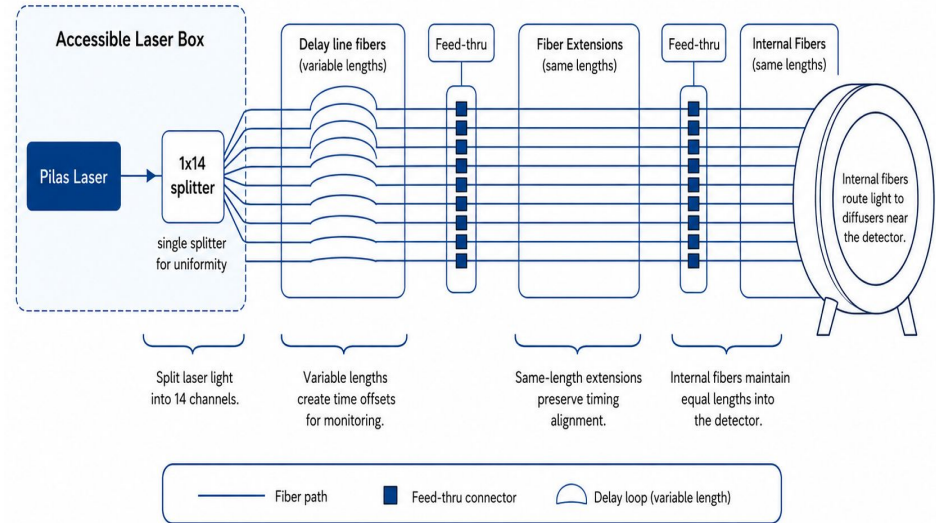
- Aerogel radiator tiles produce Cherenkov photons.
- Inner and outer conical mirrors guide photons toward the sensor plane.
- Complex optical geometry makes stable monitoring essential.



# Laser Monitoring System Layout

- Picosecond laser light is divided by a  $1 \times 14$  fiber splitter.
- Delay fibers and extension fibers route light into the detector volume.
- Internal fibers deliver light to diffusers near the HRPPD plane.
- The diffuser spreads controlled light for timing and photon-coverage monitoring.

## Laser Monitoring System Layout



# TracePro Simulation Setup

- A realistic optical geometry was modeled in TracePro.
- The diffuser/source configuration was adjusted to study photon coverage.
- Different diffuser opening angles were tested:  $41^\circ$ ,  $47^\circ$ , and  $52^\circ$ .

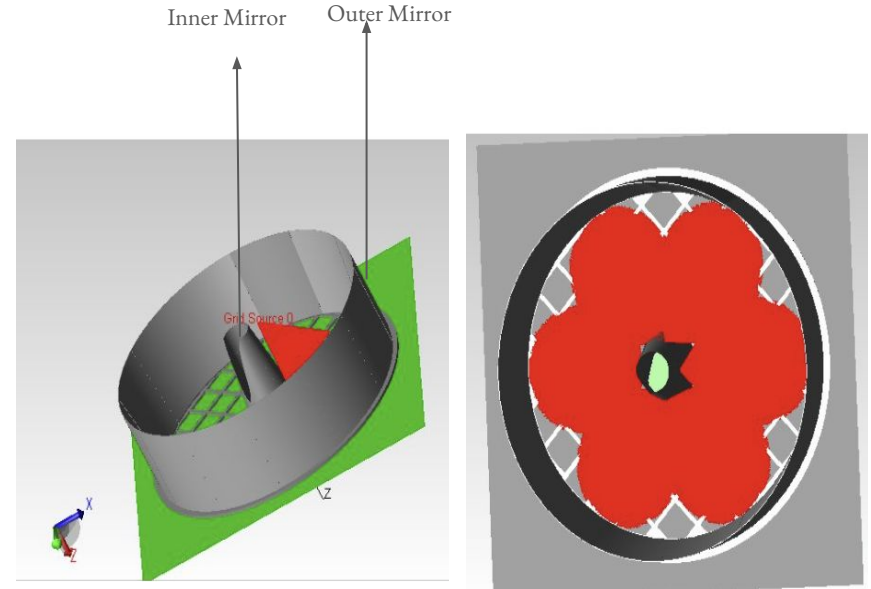
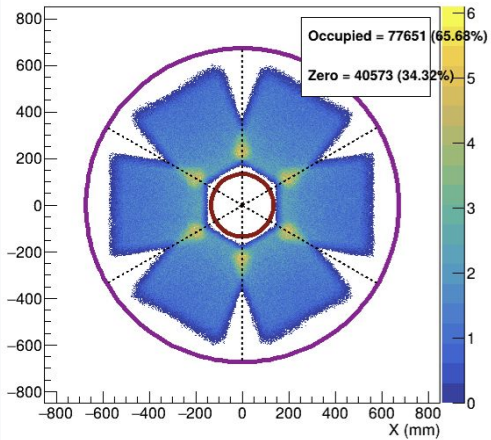


Fig: TracePro optical geometry model

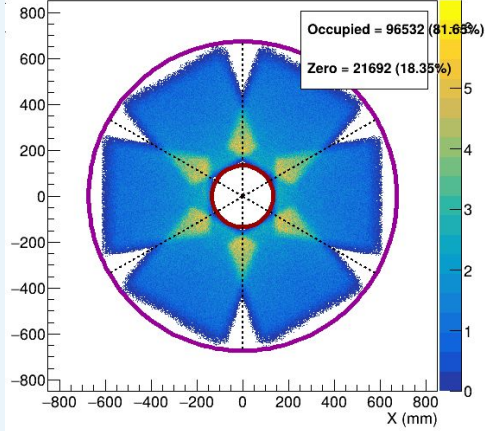
# Simulation Results & Final Selection



**41° Diffuser**

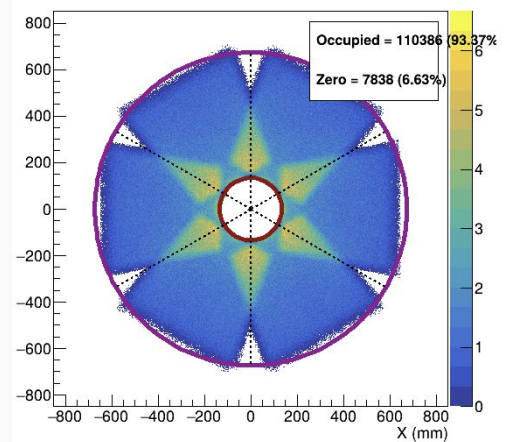
- Narrow light spread
- Lower coverage: **65.68%**

**OPTIMAL**



**47° Diffuser**

- **Balanced performance**
- Coverage: **81.22%**
- *Selected final configuration*



**52° Diffuser**

- Highest coverage: **93.37%**
- Production constraints make this less practical

# Future Work

- Finalize the mechanical integration of the laser monitoring system.
- Fabricate the selected  $47^\circ$  custom diffuser configuration.
- Validate the system experimentally at Brookhaven National Laboratory.