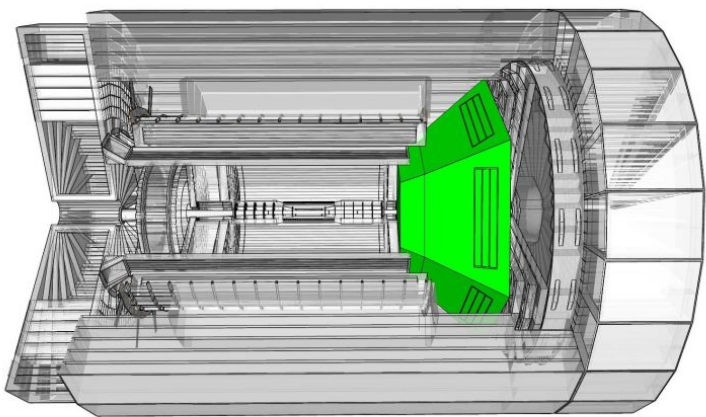


Discussion about forward  
RICH space in ATHENA

# Original dRICH design (JLEIC legacy)

3 Tesla Reference Detector for IP-6

**3** ALTERNATE DIRC: RICH (RING IMAGING CHERENKOV) DETECTOR  
TESLA



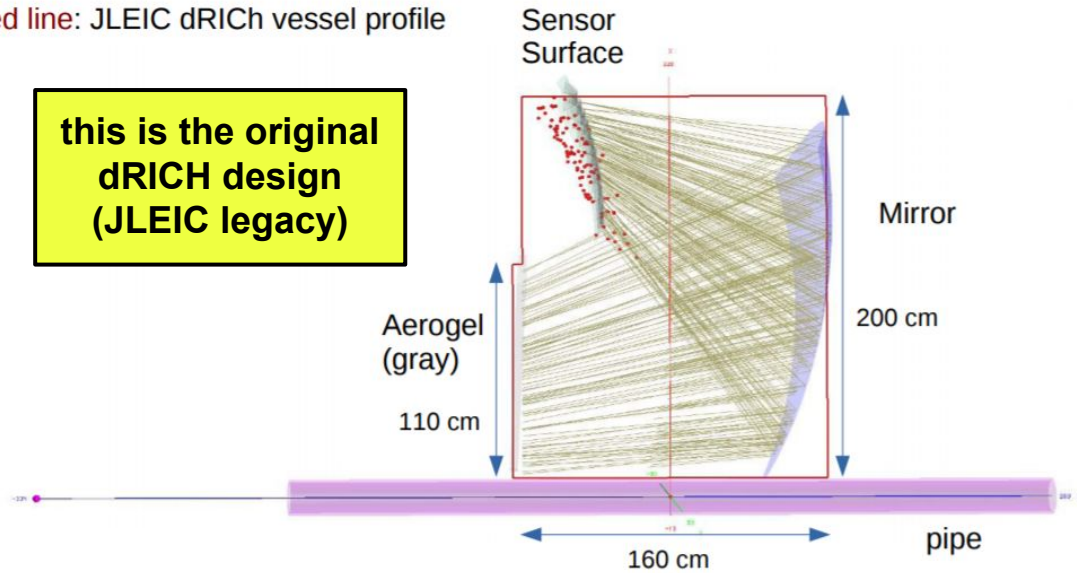
red dots: focal region (approx.)  
yellow lines: photons at gas Cherenkov angles relative to charger particles direction from IP

red line: JLEIC dRICH vessel profile

**this is the original dRICH design (JLEIC legacy)**

**Dimensions/Location**

Overall Length	145 cm
Aerogel Length	35 cm
Aerogel Radius	100 cm
Detector Length	110 cm
Bore	10 cm
HD Radius	220 cm
LD Radius	125 cm
Offset	290 cm in Hadron Direction
Segment Count	6
Total Volume	11.94 m <sup>3</sup>

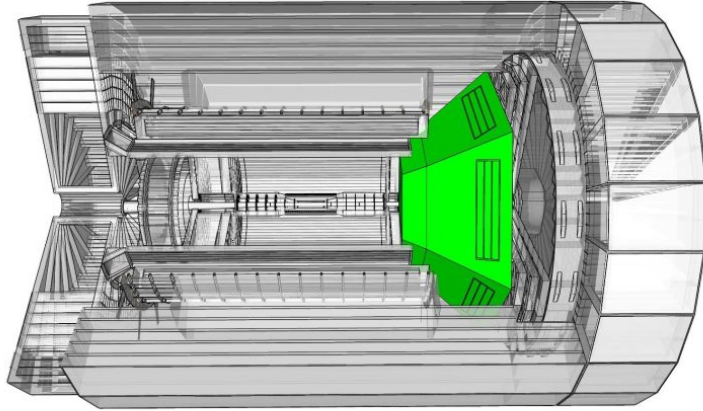


sensor surface ~ matches location of focal plane but it does not fit in the forward RICH envelope that appears in the Detector Menagerie (the alternate version with DIRC readout on the e- side)

# Trying to fit it within the envelope (Detector Menagerie)

3 Tesla Reference Detector for IP-6

## 3 ALTERNATE DIRC: RICH (RING IMAGING CHERENKOV) DETECTOR TESLA



### Dimensions/Location

Overall Length	145 cm
Aerogel Length	35 cm
Aerogel Radius	100 cm
Detector Length	110 cm
Bore	10 cm
HD Radius	220 cm
LD Radius	125 cm
Offset	290 cm in Hadron Direction
Segment Count	6
Total Volume	11.94 m <sup>3</sup>

red dots: focal region (approx.)

yellow lines: photons at gas Cherenkov angles relative to charger particles direction from IP (they start after front vessel for coding simplicity)

red line: ATHENA vessel profile

very difficult (impossible?) to adapt the sensor surface to the focal region

**Dynamic RICH**

0 cm

0 cm

0 cm

Aerogel Length  cm

Aerogel Radius  cm

Detector Length  cm

Bore Radius  cm

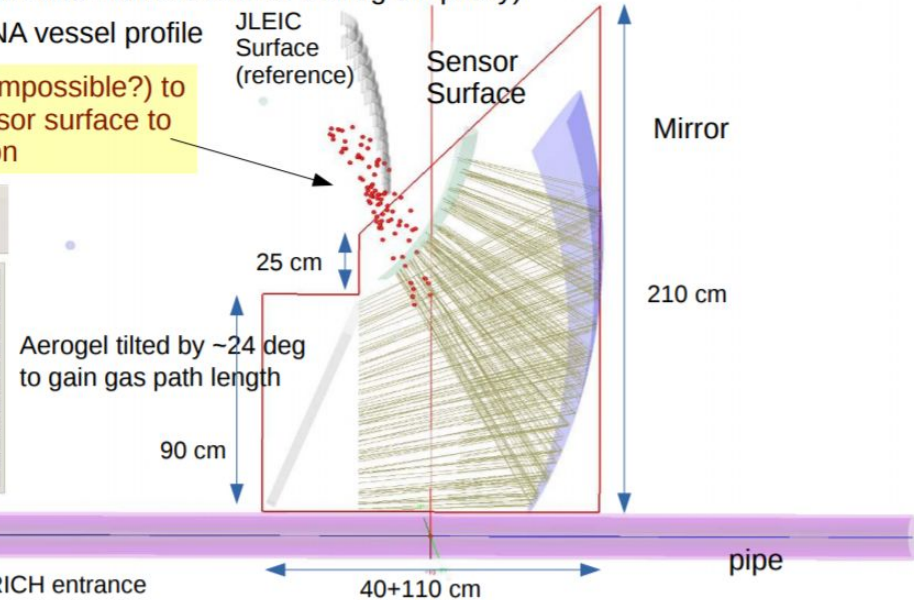
E1 Radius (Corner)  cm

E2 Radius (Corner)  cm

Offset from Center  cm

Segment Count

Volume (Cylindrical)  m<sup>3</sup>

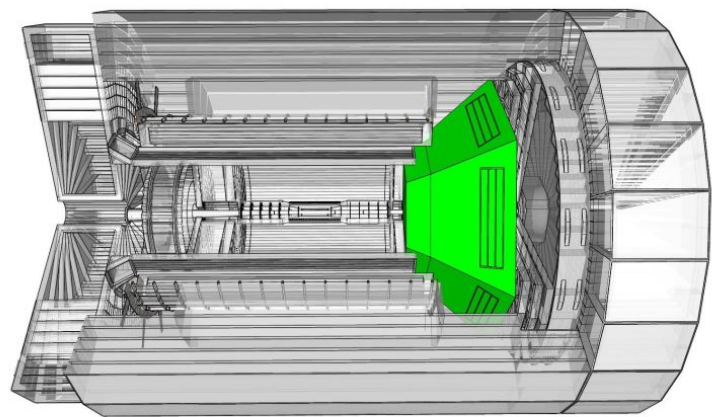


attempts to adapt the dRICH elements (mirror, sensors) within the envelope cannot find enough space to properly locate the sensors on (or near) the focal plane

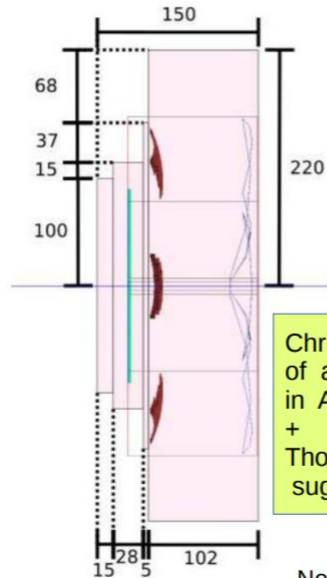
# Other assumptions on the available space

3 Tesla Reference Detector for IP-6

**3** ALTERNATE DIRC: RICH (RING IMAGING CHERENKOV) DETECTOR  
TESLA



available dRICH space,  
Menagerie 3T  
DIRC LD readout

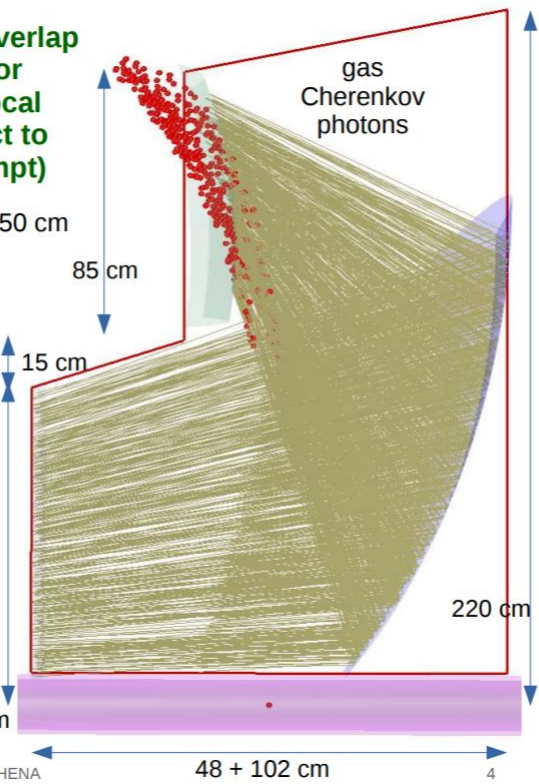


June / 28 / 2021

Much better overlap  
between sensor  
surface and focal  
region (respect to  
previous attempt)

mirror radius = 250 cm

Chris assumption  
of available space  
in ATHENA  
+  
Thom Hemmick  
suggestions



Note: IP is at 290 cm from  
entrance of the dRICH

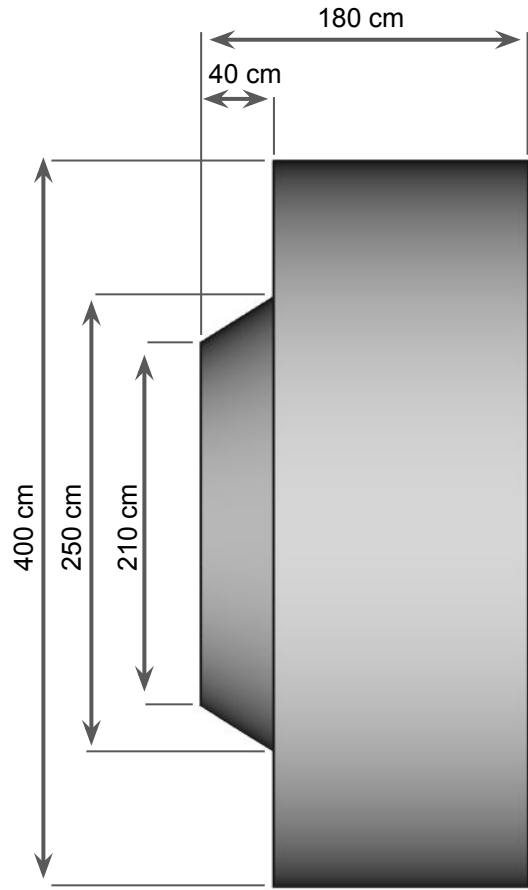
dRICH vs ATHENA

**Dimensions/Location**

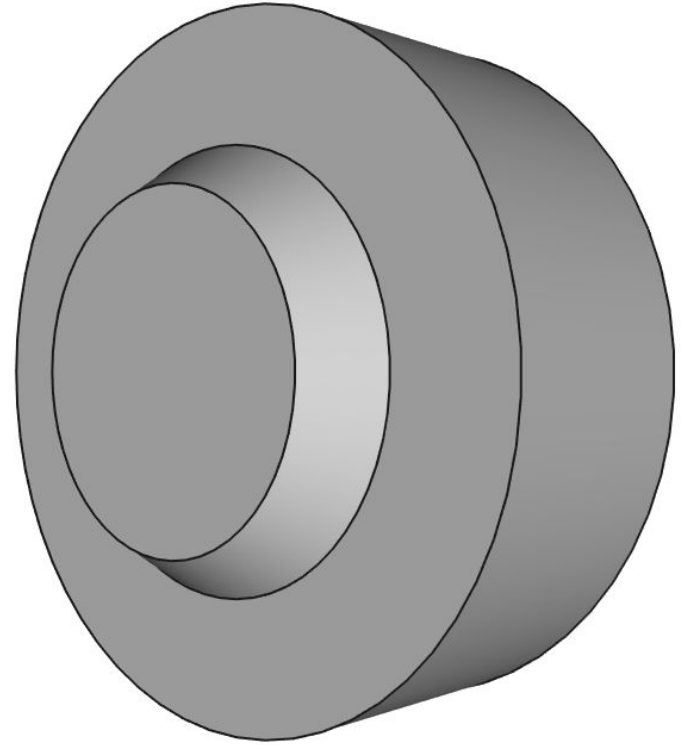
Overall Length	145 cm
Aerogel Length	35 cm
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Detector Length	110 cm
Bore	10 cm
HD Radius	220 cm
LD Radius	125 cm
Offset	290 cm in Hadron Direction
Segment Count	6
Total Volume	11.94 m <sup>3</sup>

a few exercises done by Chris and Evaristo indicate that with more space situation can improve → discuss and better estimate space in ATHENA that can be “given” to dRICH, ask EIC project to validate proposal and update Menagerie



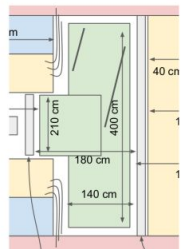


hole for beam  
pipe is missing





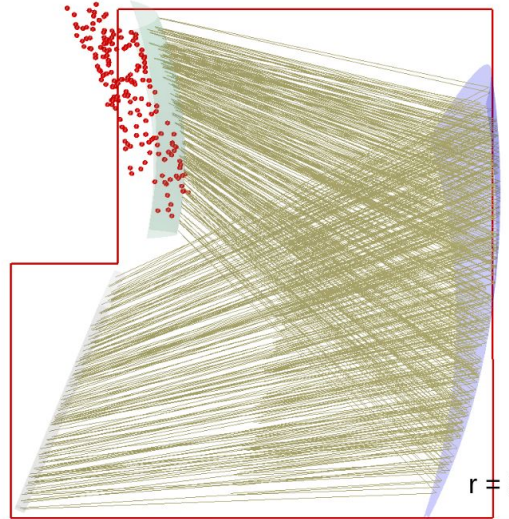
# Preliminary dRICH exercises on the proposed envelope



ATHENA  
Roberto  
constraints

single mirror  
configuration

red points represent the focal region



IP at 200 cm from dRICH entrance

sensor surface ~ matches location of focal plane  
but it does not fit in the forward RICH envelope  
that appears in the Detector Menagerie (the alternate  
version with DIRC readout on the e- side)

There is much more margin of improvement  
(than previous geometry) thanks to the  
transverse available space, in the back vessel.  
Possible directions:

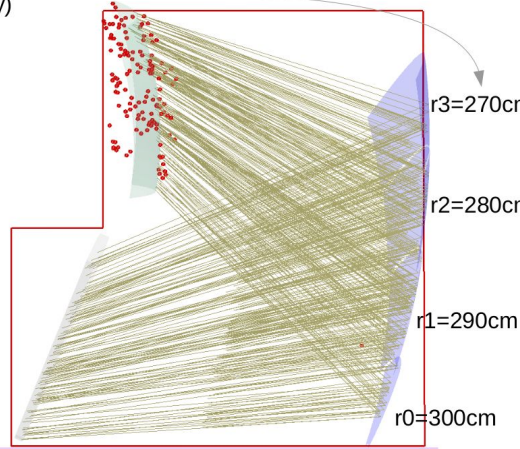
- tune mirror radius, its rotation, the sensor position
- use double reflections scheme with sensor above mirror
- use segmented mirrors with different radii of curvature
- ...

Each mirror segment has a different radius  
and center (accordingly)

the sensor surface can better  
match the focal region  
than in single mirror  
configuration

!!! very preliminary !!!

4 mirror segments



# Summary

- **discuss among ATHENA Detector Integration Committee**
  - space taken by calorimetry and other systems after RICH (i.e. GEM / LGAD)
  - do we have a forward TRD?
    - in the baseline is not there
    - will we have it in any of the upcoming detector configuration?
  - in the tracking presentation it does not see there is GEM layer right before the RICH
    - is it not foreseen?
- **forward proposal to EIC project**
  - cross-check with engineers and adjust around it (if acceptable)
  - especially if enough clearance for cables, pipes, supports, installation, ...
  - obtain validated envelope for the forward RICH, updated Detector Menagerie
- **back to dRICH experts for detector optimisation**
  - tune mirror radius, rotation, sensor location, ...
  - can also explore option with double reflector, segmented mirrors, ...