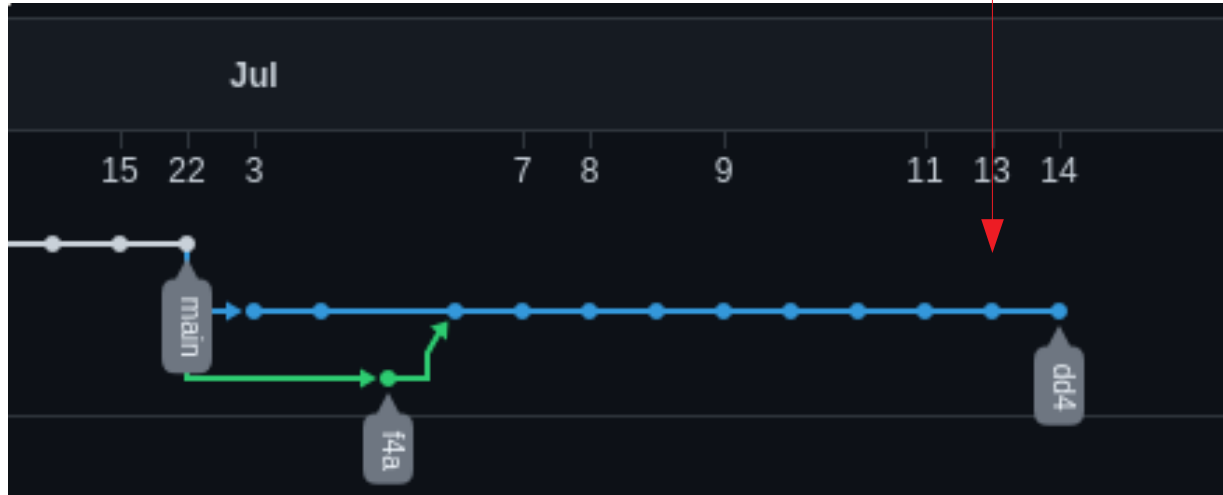


Software Status

minor fix in optics
class

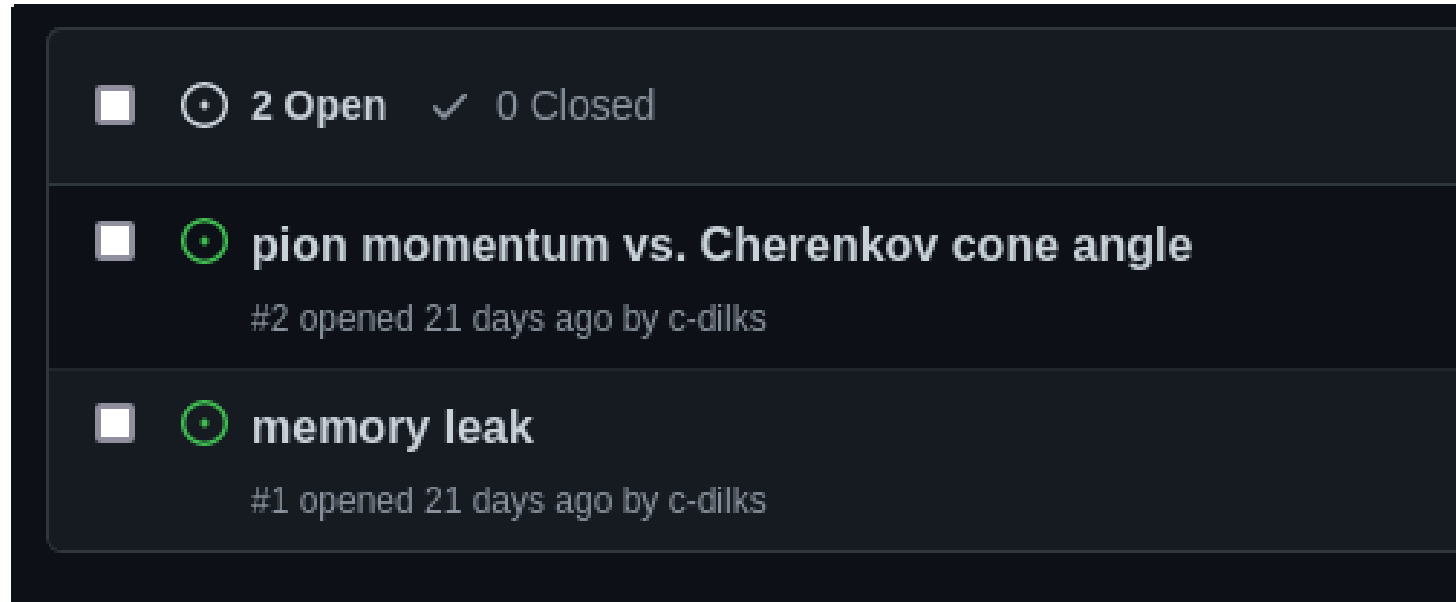


fix in wrapper scripts
for more recent
version of singularity

- dd4 branch fully contained in `dd4` subdirectory
- only contains scripts to support dd4hep port development
- dd4hep code is a part of the athena repository (see documentation in dd4/)
- plan to merge dd4 → main, and move f4a head to this point
- development of ports should still continue on separate dd4 and f4a branches
- should we add contributors?

Software Status

Open issues



A screenshot of a GitHub issues page with a dark theme. At the top, there is a summary bar showing a square icon, a circle with a plus sign, '2 Open', a checkmark, and '0 Closed'. Below this are two issue cards. The first card has a square icon, a green circle with a plus sign, the title 'pion momentum vs. Cherenkov cone angle', and the text '#2 opened 21 days ago by c-dilks'. The second card has a square icon, a green circle with a plus sign, the title 'memory leak', and the text '#1 opened 21 days ago by c-dilks'.

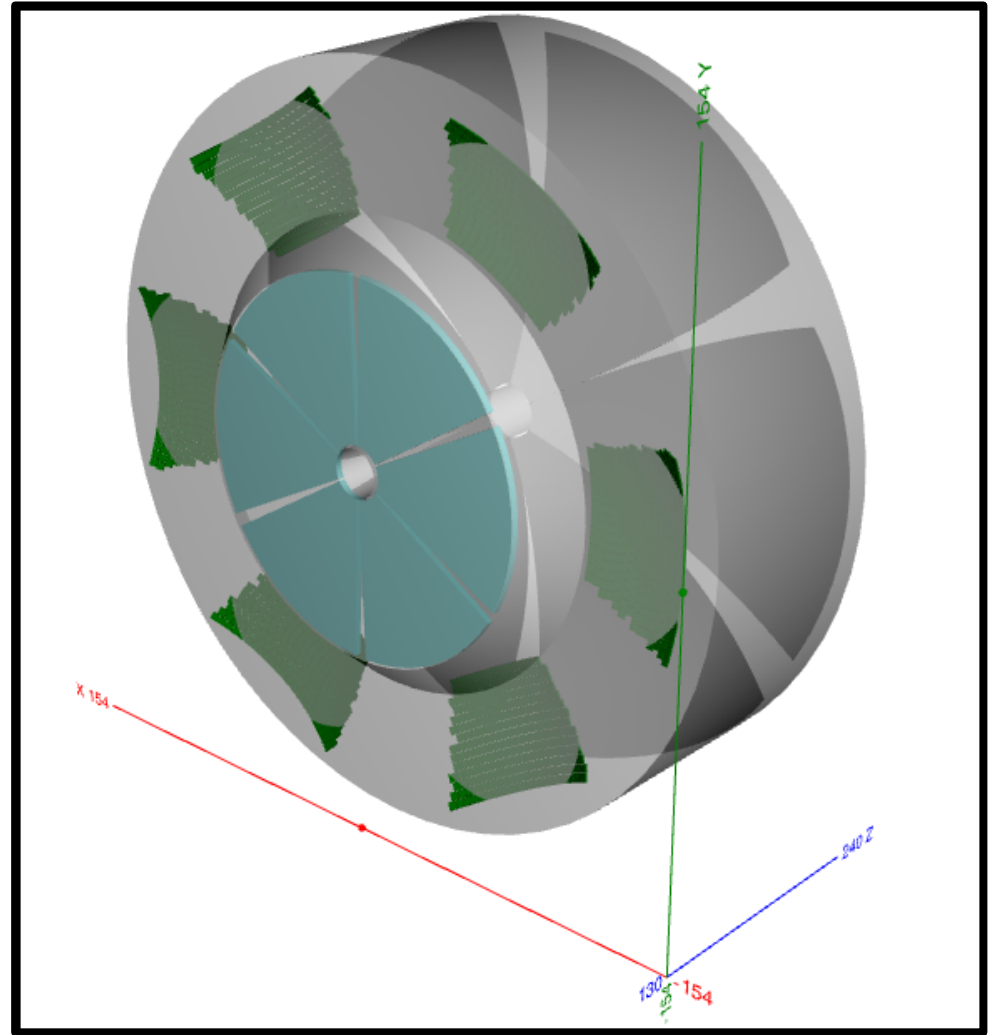
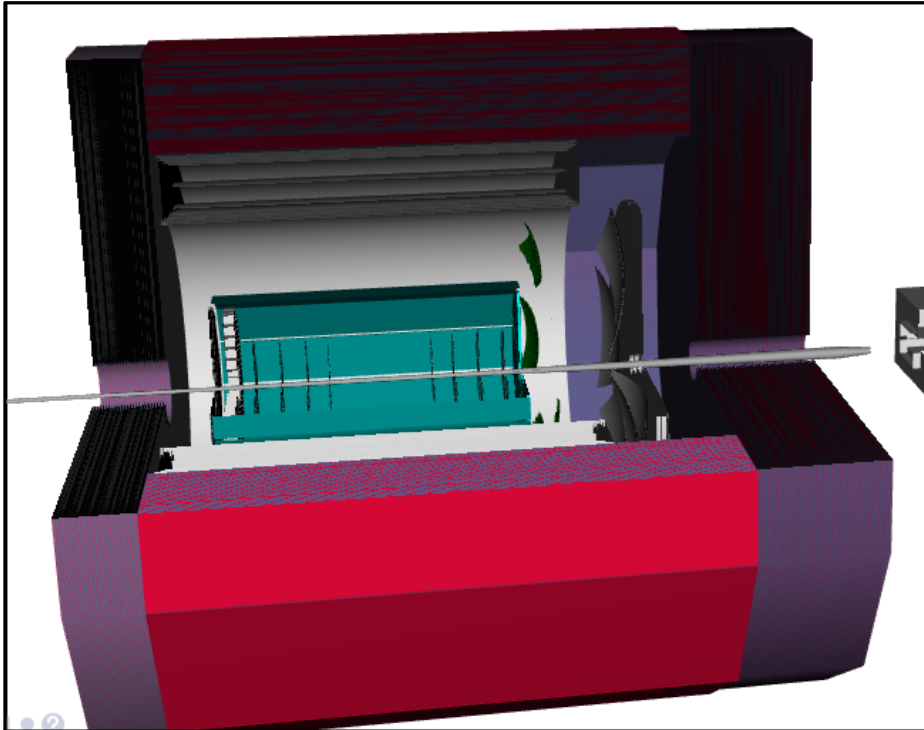
■ ⊕ 2 Open ✓ 0 Closed

■ ⊕ pion momentum vs. Cherenkov cone angle
#2 opened 21 days ago by c-dilks

■ ⊕ memory leak
#1 opened 21 days ago by c-dilks

Current Geometry Status in dd4hep

- In Gaseous RICH Volume (GRV), it its current placement
- Rescale Fun4all geometry by scale factor 0.668
- Push aerogel forward w.r.t. GRV front by about 2.5 cm
- **Plans:**
 - push more forward and expand radially
 - define a more appropriate volume shape

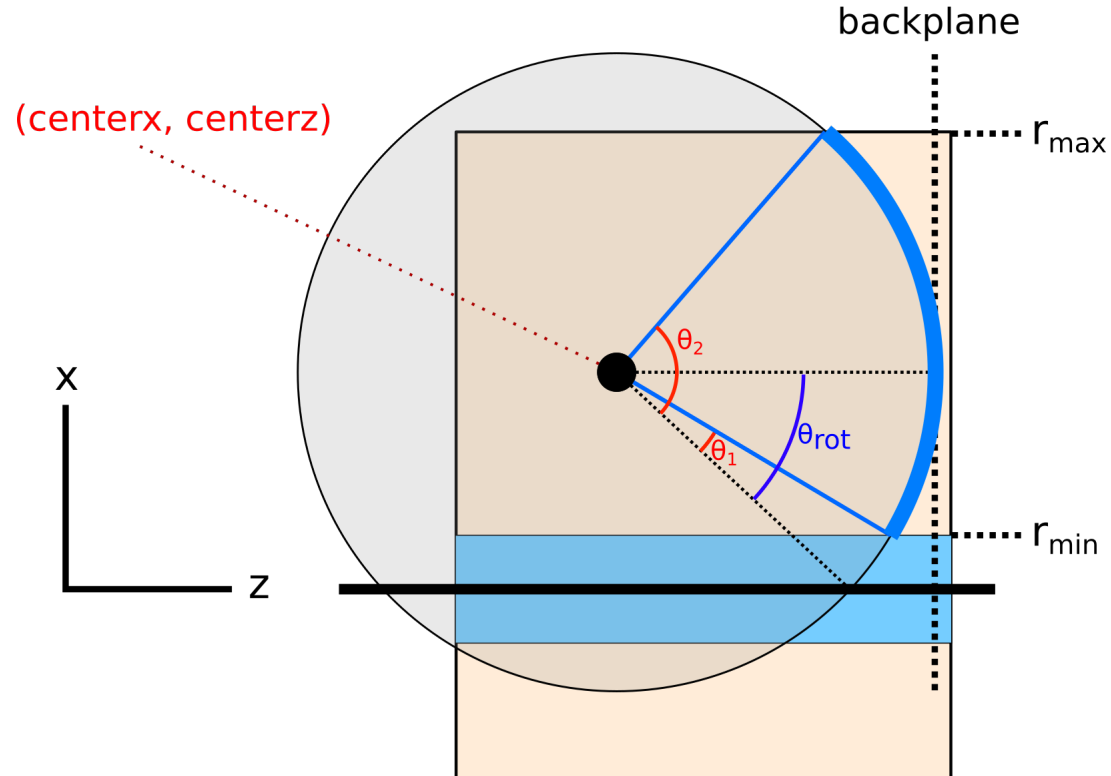


Spherical Mirrors

- Offset sphere to position ($center_x, center_z$), where $center_z$ is defined w.r.t. backplane
- Cut in θ by r_{min} and r_{max}
- Sector cut in ϕ with width ϕ_w

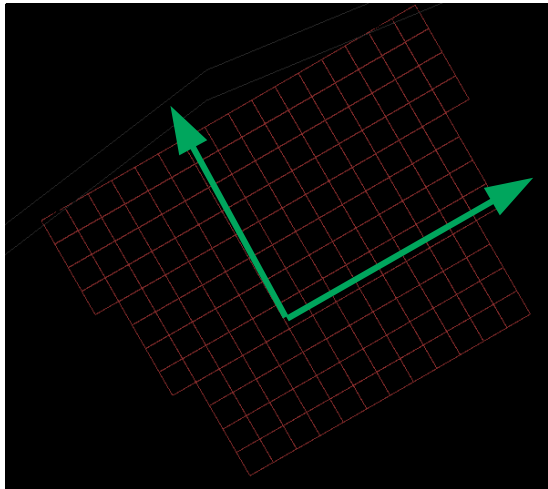
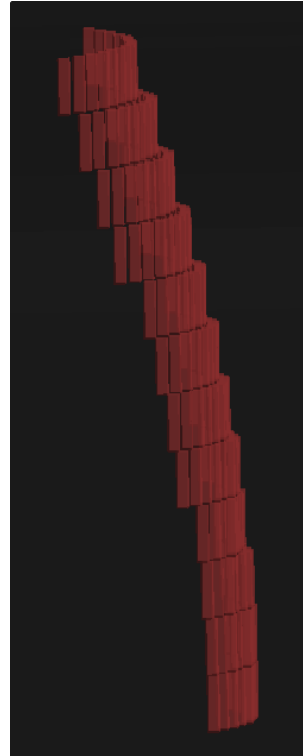
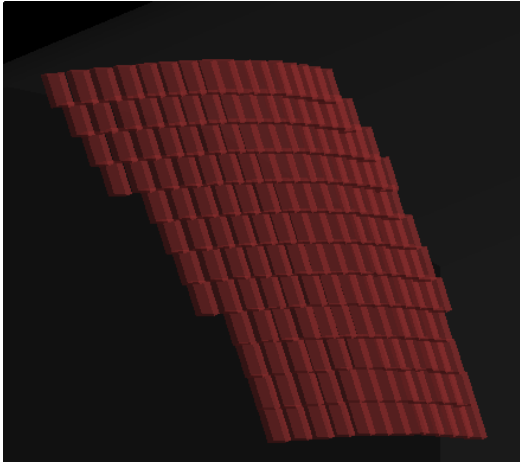
```
<mirror  
  material="PyrexGlass"  
  vis="ci_DRICH_mirror_vis"  
  backplane="ForwardRICH_length-0.5*cm"  
  thickness="0.2*cm"  
  radius="290*DRICH_scale*cm"  
  centerx="145*DRICH_scale*cm"  
  rmin="DRICH_rmin+1*cm"  
  rmax="DRICH_rmax2-1*cm"  
  phiw="56*degree"  
>
```

Spherical Mirror Placement Top View, not to scale

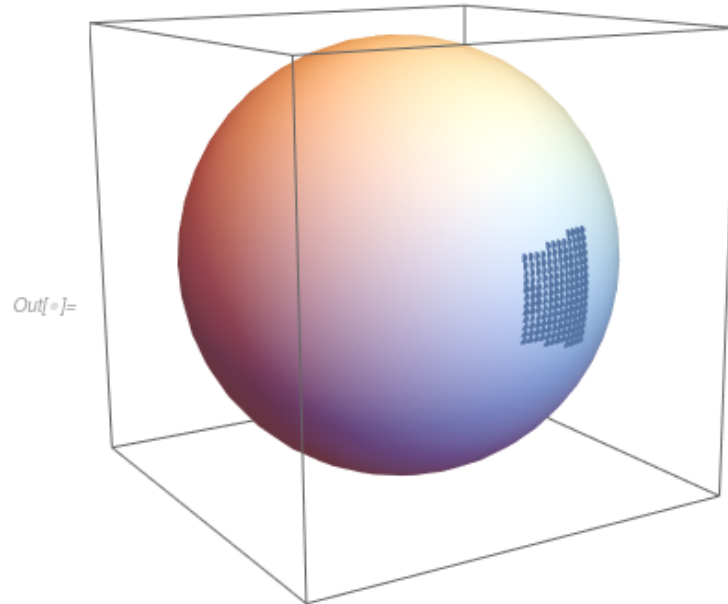


Photosensors in Fun4all

- Placed on a sphere
- Surface normals point toward back plane
- Cartesian placement in orthographic projection

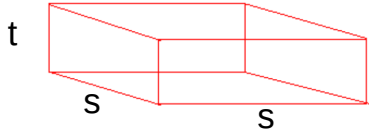


```
(* sphere center and radius (cm), with respect to +x axis sector *)  
sphereCenter = {144.91, 0.00, -197.59};  
sphereRadius = 160.0917;  
Show[  
  Graphics3D[Sphere[sphereCenter, sphereRadius]],  
  ListPointPlot3D[photosensorPoints]  
]
```



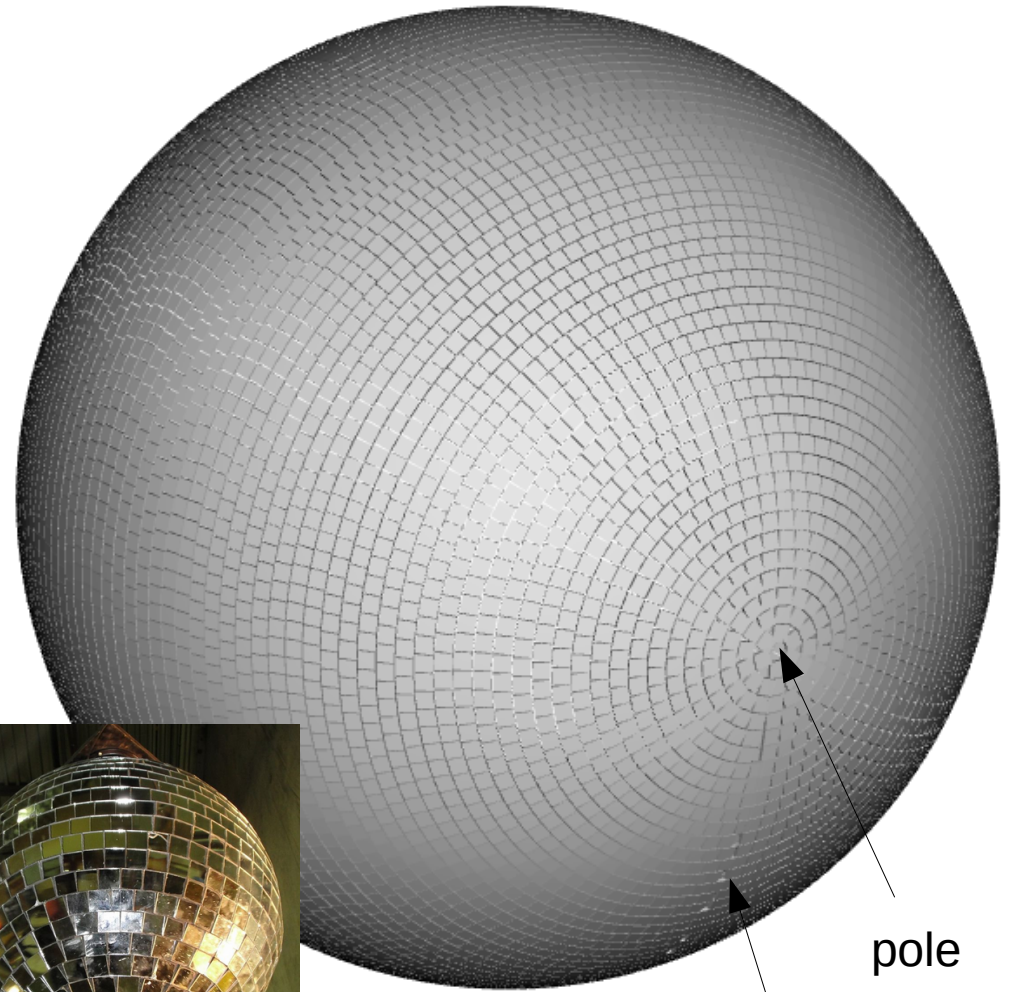
Spherical Tiling

Sensor
Geometry:



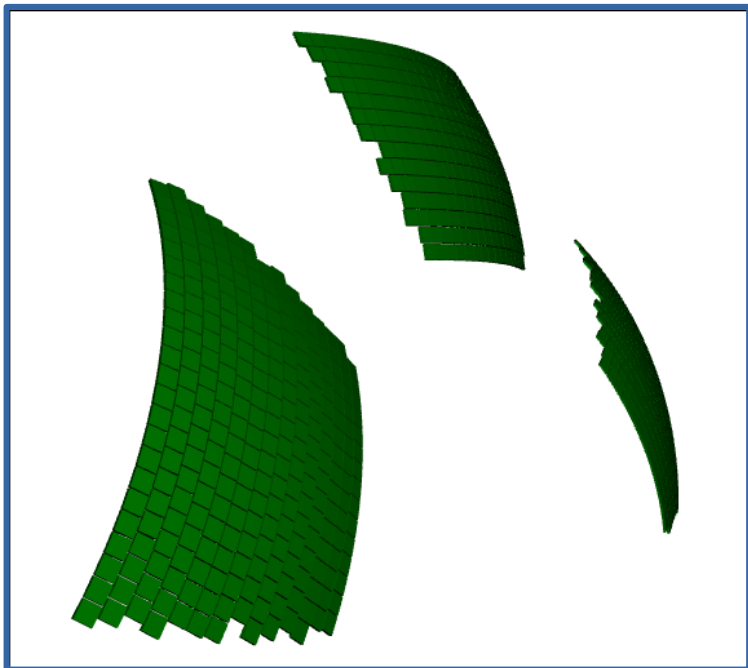
+ gap

- There is no known solution to equally distributing points on a sphere
- Divide θ span $[0, \pi]$ into N_θ latitudes, from one pole to the other (non-integer \rightarrow poles/seams):
 - $N_\theta = \pi r / (s + \text{gap})$ $r =$ sphere radius
- For each latitude, divide ϕ span $[-\pi, +\pi]$ into $N_\phi(\theta)$ longitudes
 - $N_\phi(\theta) = 2 \pi r \sin(\theta) / (s + \text{gap})$
- This fits as many sensors as possible in each latitude, and fits as many latitudes as possible on the sphere
- Patches near the equator are somewhat uniform; must avoid poles, and the “seam” at $\pm\pi$

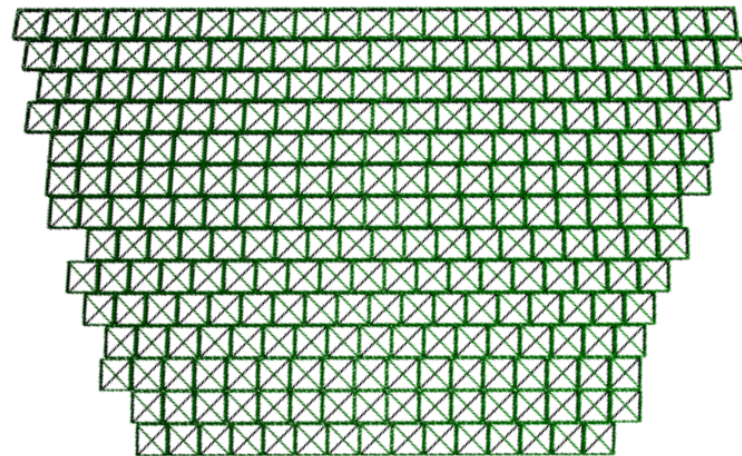


seam
pole

Photosensors in DD4hep



- Sensor surface normals are along sphere radii
- Can use Cartesian coordinates in orthographic projection for sensor ID purposes, but placement is somewhat uneven
- Room for improvement, especially with patch cuts



orthographic projection

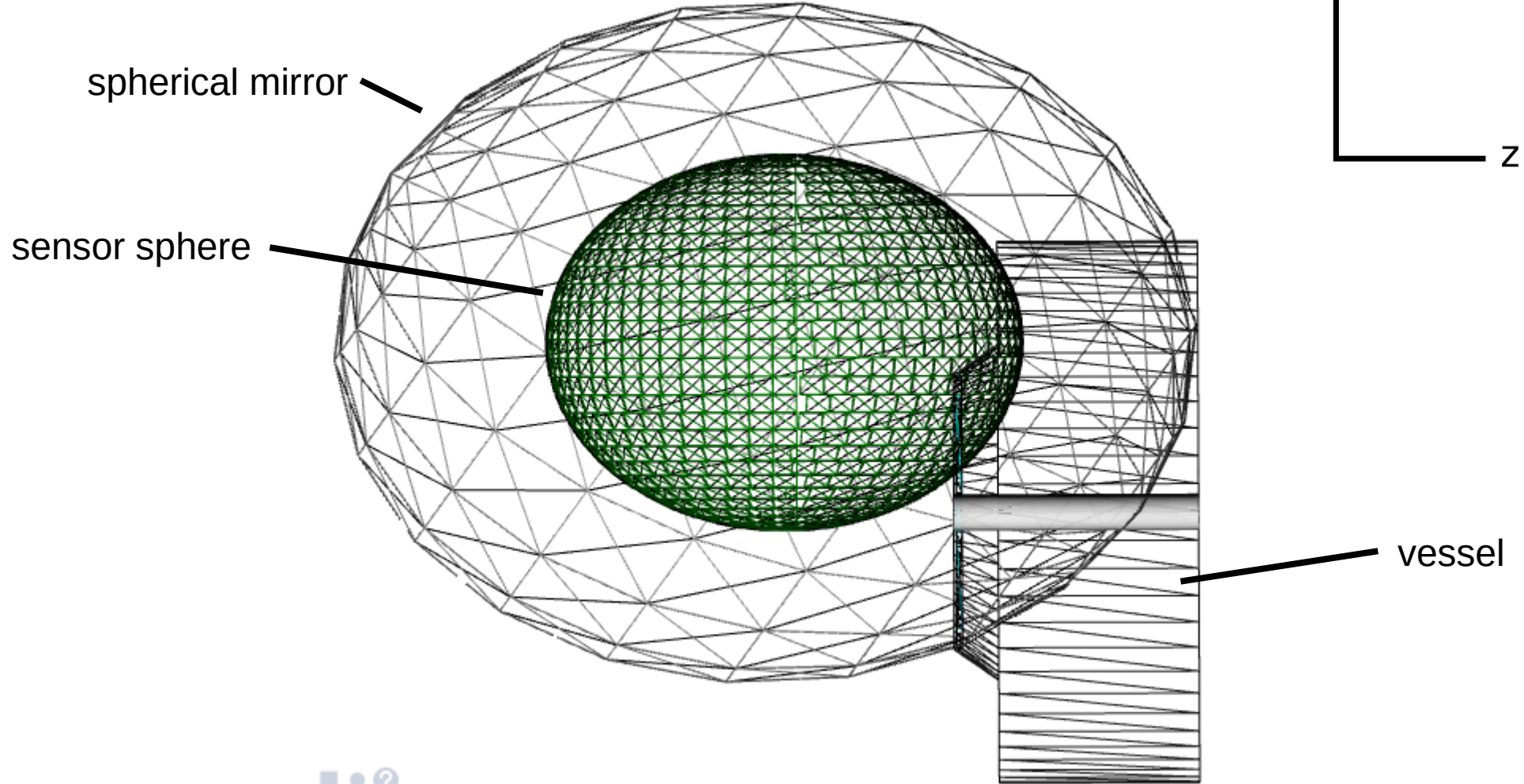
Construction parameters:

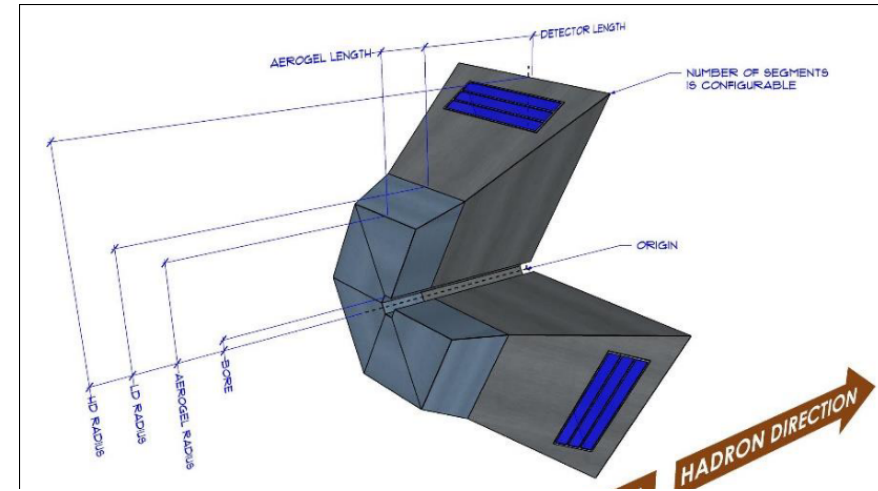
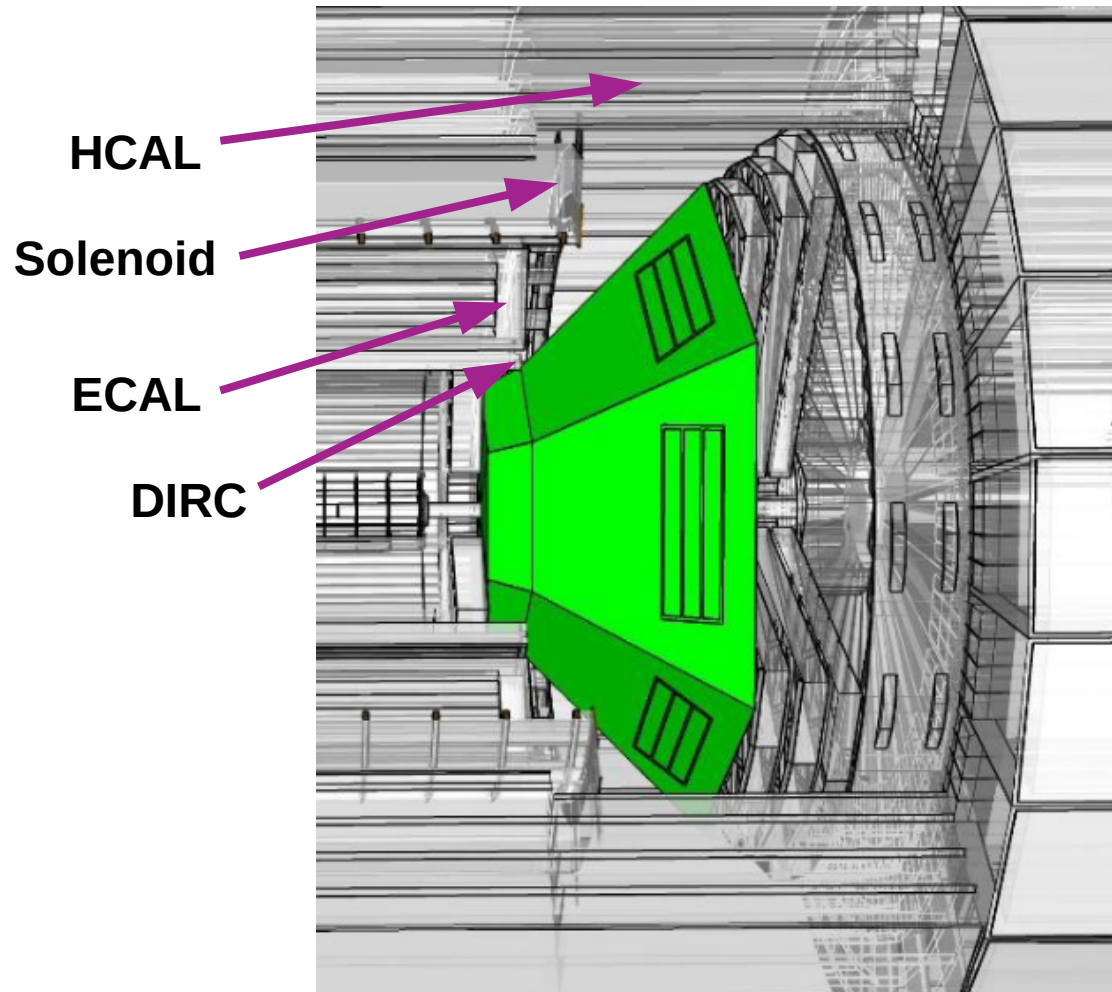
```
<sphere
  radius="159.76*DRICH_scale*cm"
  centerx="144.91*DRICH_scale*cm"
  centery="0*DRICH_scale*cm"
  centerz="-197.25*DRICH_scale*cm + ... "
/>
```

```
<sphericalpatch
  thetamin="-10*degree"
  thetamax="45*degree"
  widthfactor="5"
  taper="56*degree"
/>
```

Sphere Placement

for sector centered at +x

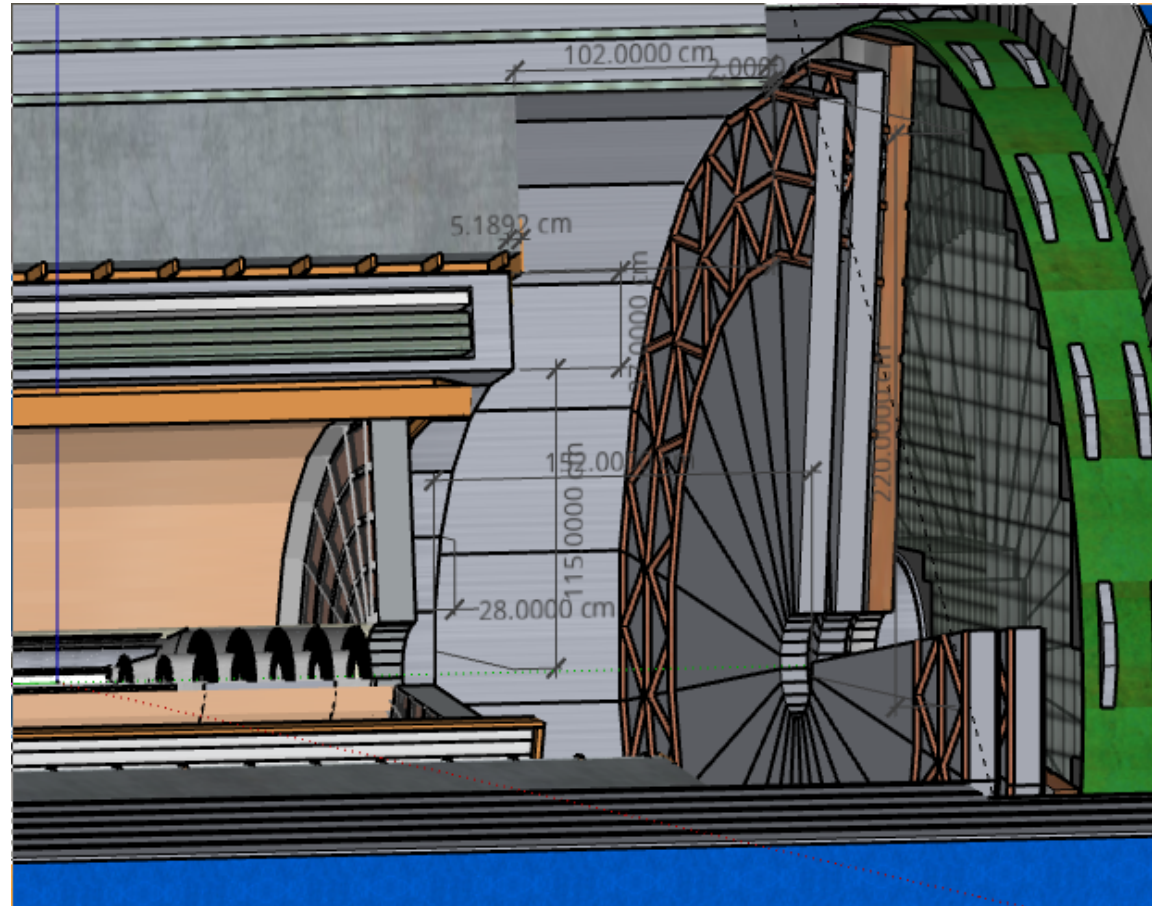
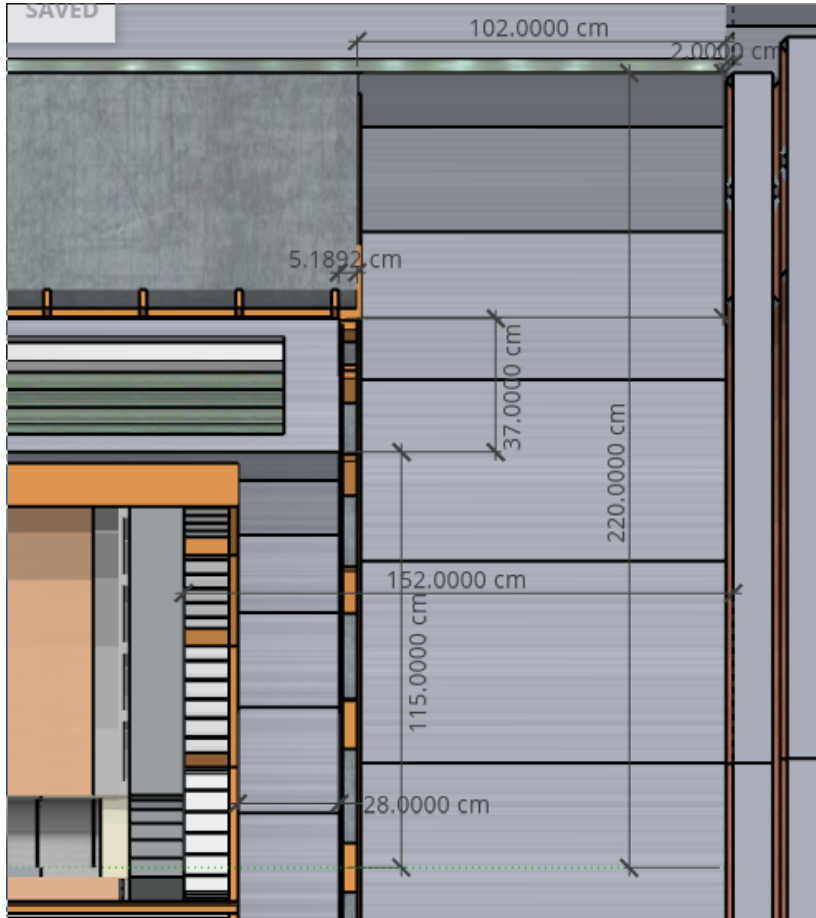




conic dRICH envelope,
Menagerie 3T, DIRC LD readout

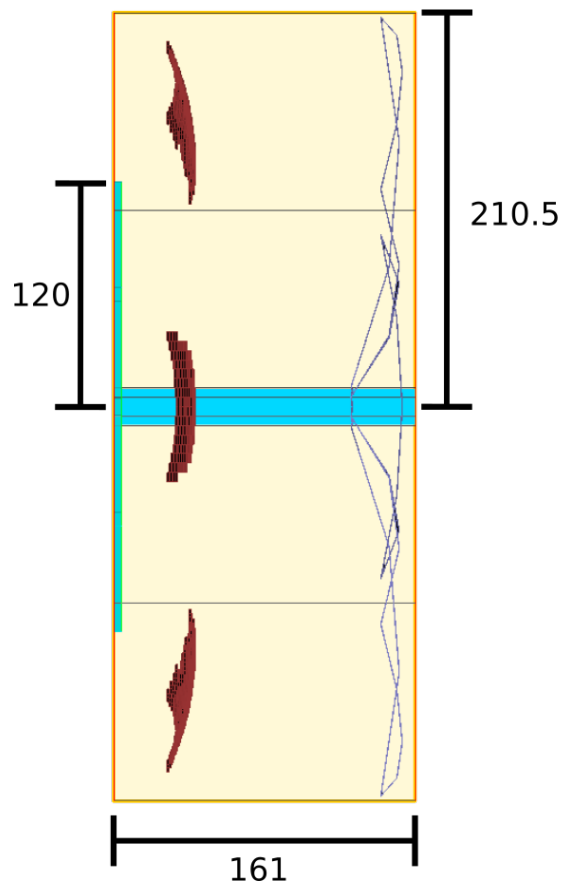
<i>Overall Length</i>	145 cm
<i>Aerogel Length</i>	35 cm
<i>Aerogel Radius</i>	100 cm
<i>Detector Length</i>	110 cm
<i>Bore</i>	10 cm
<i>HD Radius</i>	220 cm
<i>LD Radius</i>	125 cm
<i>Offset</i>	290 cm in Hadron Direction
<i>Segment Count</i>	6
<i>Total Volume</i>	11.94 m ³

dRICH space, Menagerie 3T, DIRC LD readout

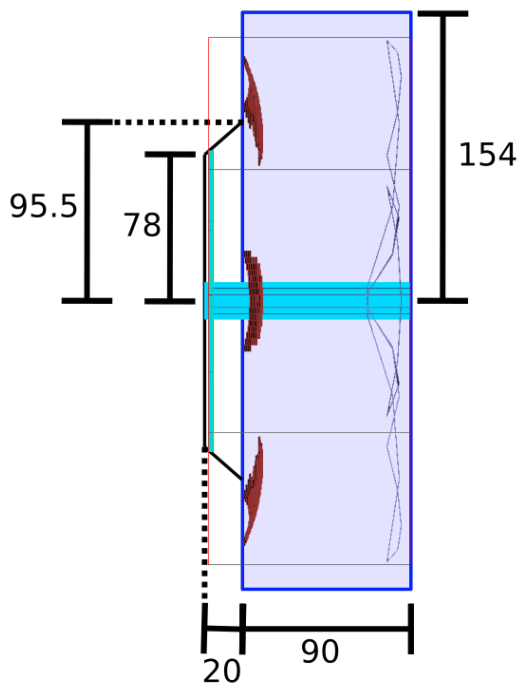


[units=cm]

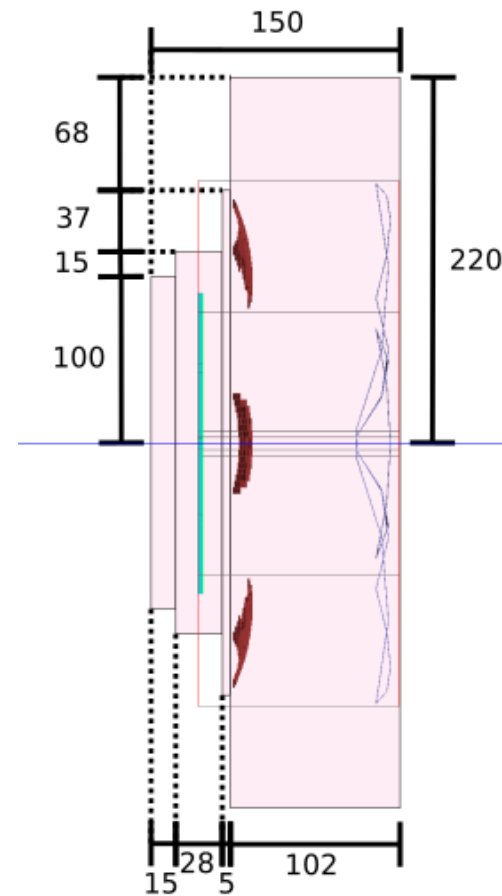
Fun4all



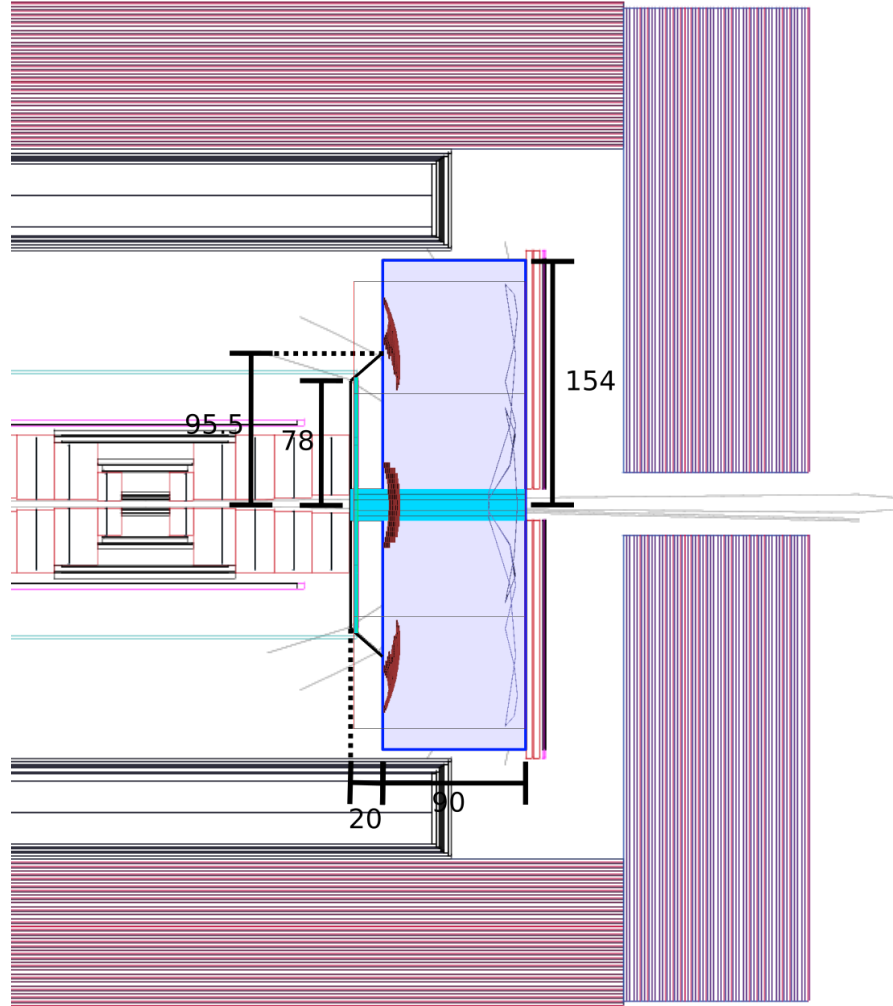
dd4hep Gaseous RICH Envelope



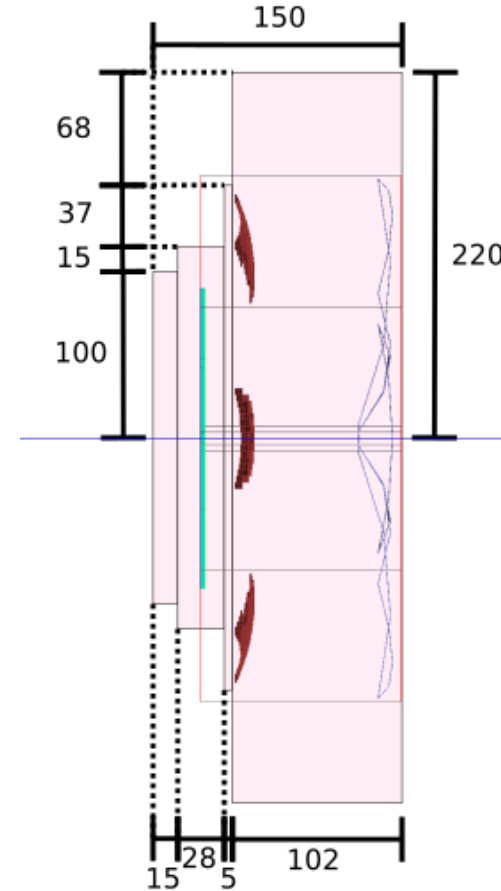
available dRICH space,
Menagerie 3T, DIRC LD readout



Current dd4hep configuration
(ECAL and DIRC not visible)



available dRICH space,
Menagerie 3T, DIRC LD readout

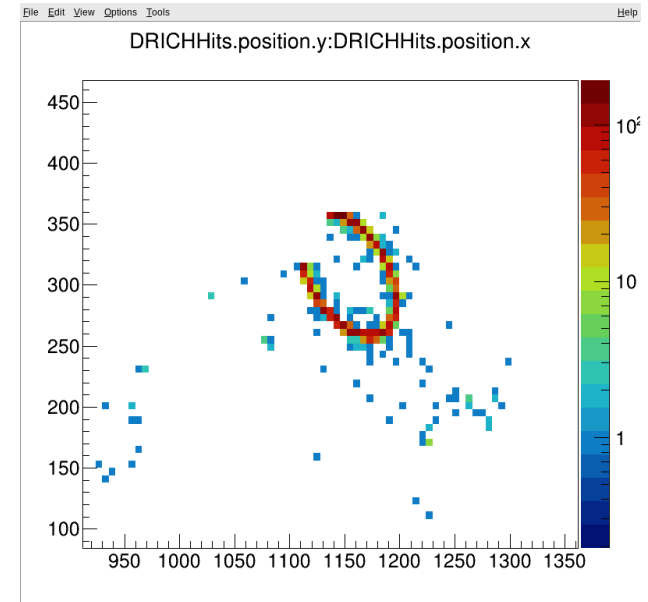


Material Properties

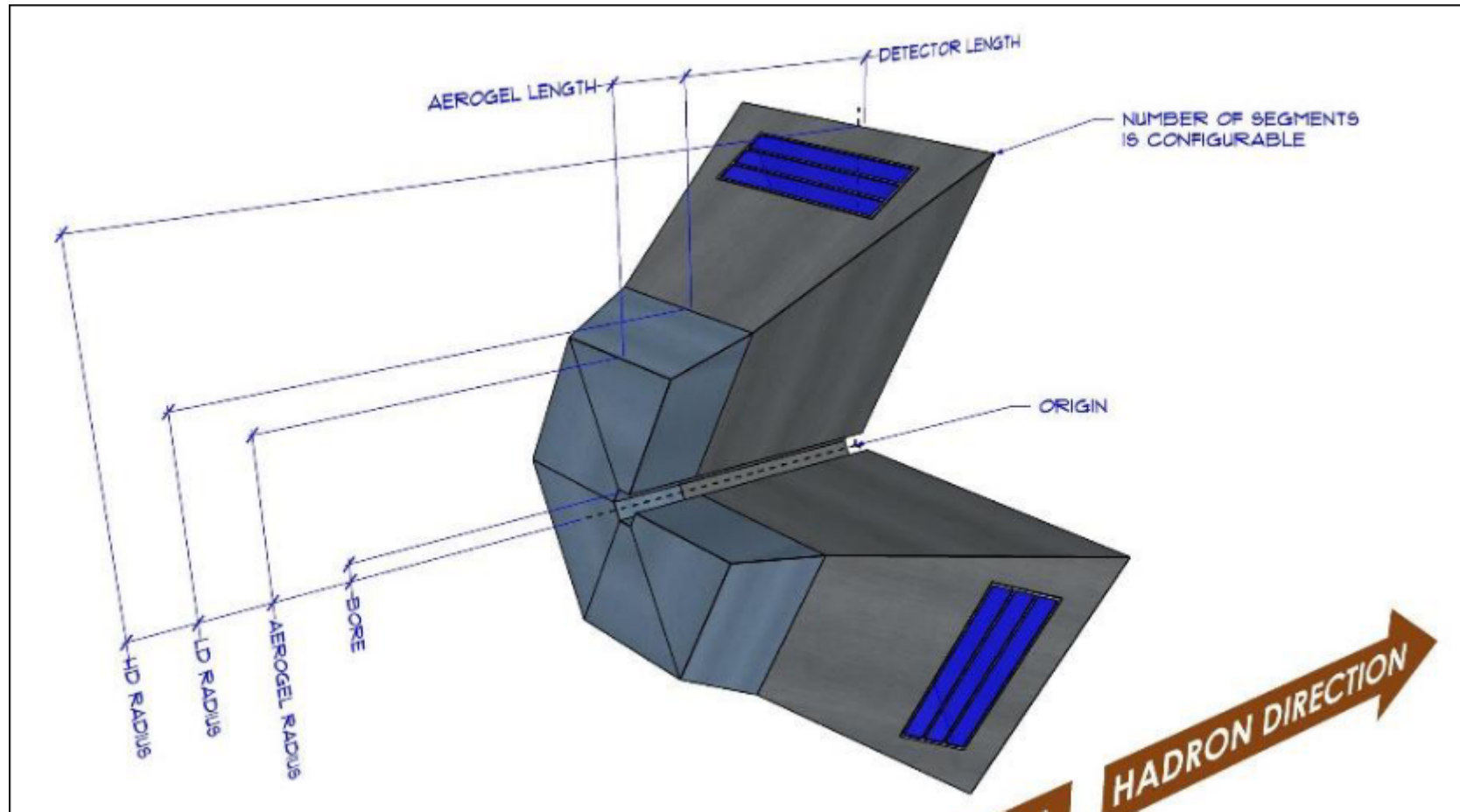
- dumped from `share/source/g4dRICHOptics.hh` → `G4MaterialPropertiesTable::DumpTable()`
- currently stored in `dd4/materialTableDump.txt`
- let's keep `g4dRICHOptics.hh` as the “main” class for maintaining these tables; if we make updates, we can dump the results and copy-paste to `dd4hep`

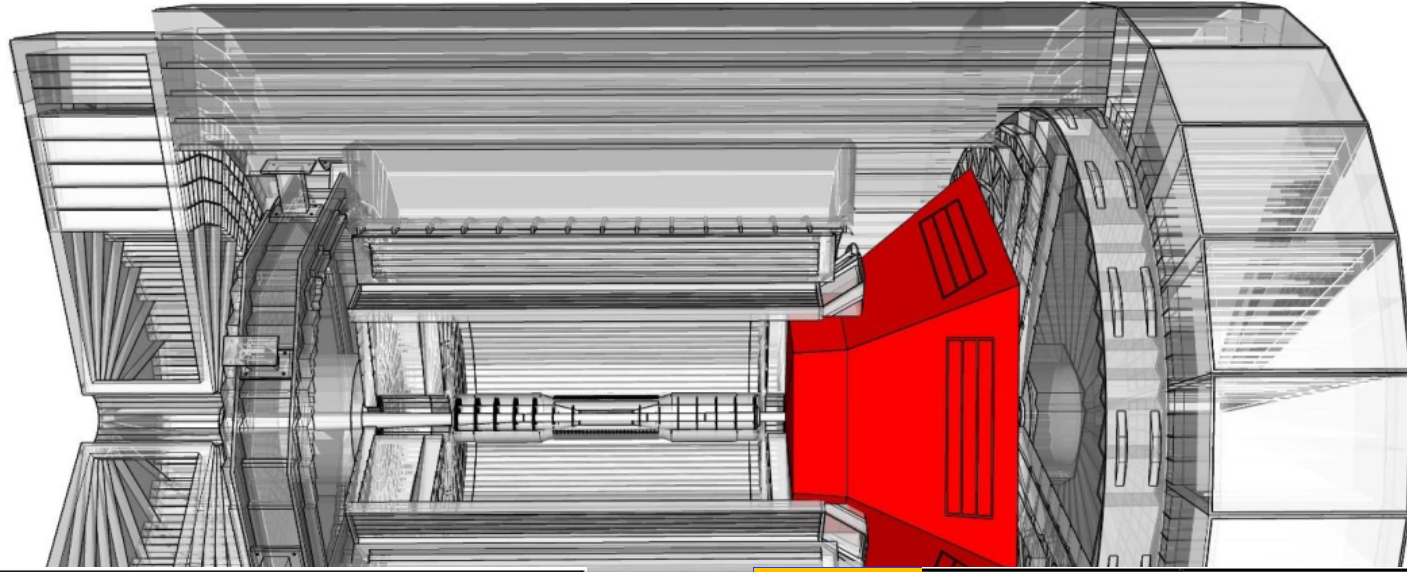
This might be a dRICH ring from `dd4hep`, but much work to do:

- double-check material and surface properties implementation
- event visualization
- too few optical photons?
- no second ring?
- ring does not seem to be in the right position...



backup

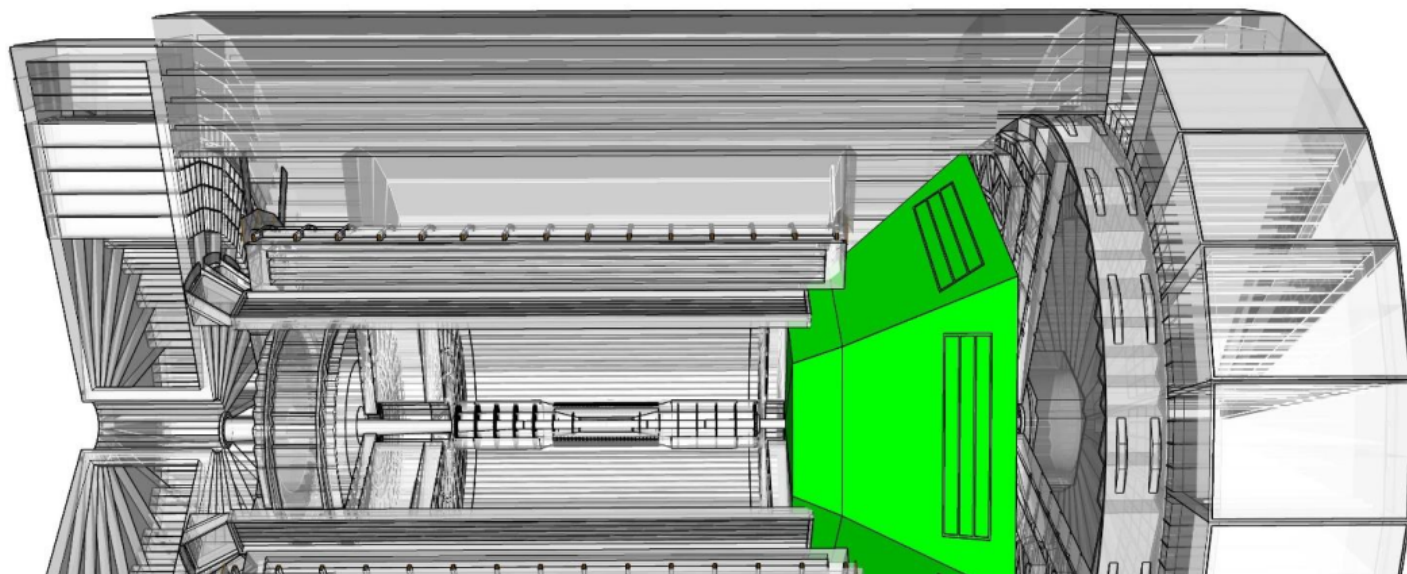




3 TESLA	Overall Length	150 cm
	Aerogel Length	40 cm
	Aerogel Radius	105 cm
	Detector Length	110 cm
	Bore	10 cm
	E1 (Far) Radius	200 cm
	E2 (Near) Radius	110 cm
	Offset	295 cm in Hadron Direction
	Segment Count	6
	Total Volume	9.99 m ³

Figure 15: RICH Detector

1.5 TESLA	Overall Length	80 cm
	Aerogel Length	20 cm
	Aerogel Radius	75 cm
	Detector Length	60 cm
	Bore	10 cm
	HD Radius	160 cm
	LD Radius	85 cm
	Offset	260 cm in Hadron Direction
	Segment Count	6
	Total Volume	3.32 m ³

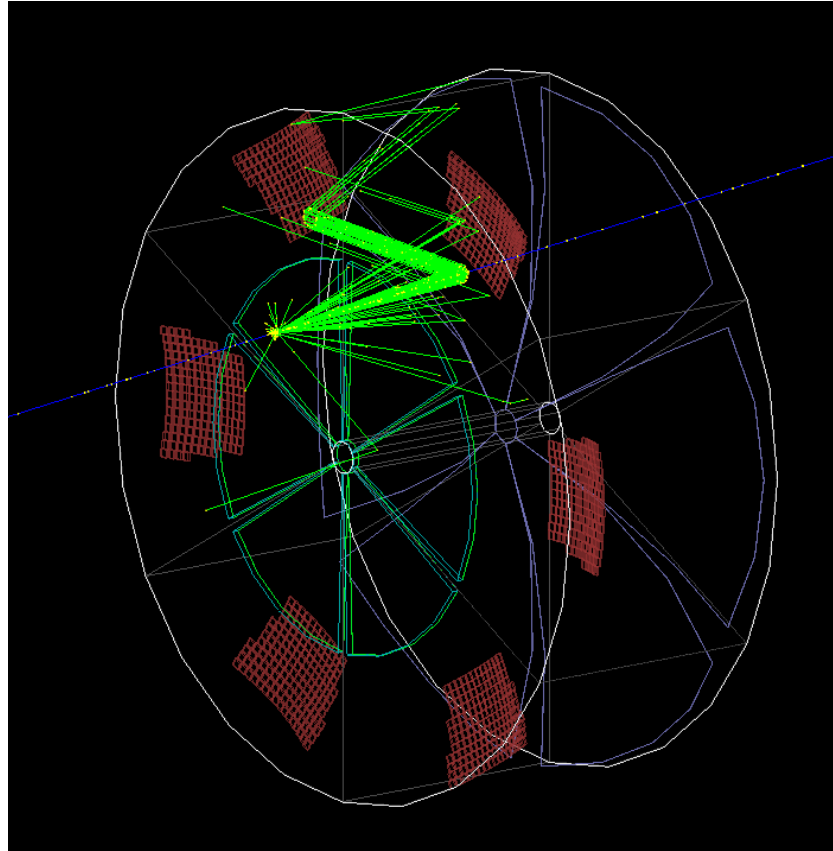


3 TESLA	Overall Length	145 cm
	Aerogel Length	35 cm
	Aerogel Radius	100 cm
	Detector Length	110 cm
	Bore	10 cm
	HD Radius	220 cm
	LD Radius	125 cm
	Offset	290 cm in Hadron Direction
	Segment Count	6
	Total Volume	11.94 m ³

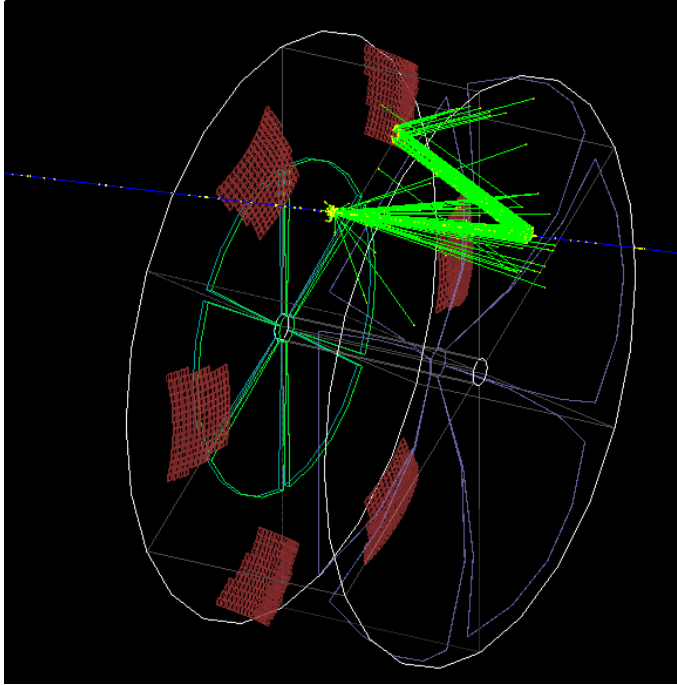
1.5 TESLA	Overall Length	110 cm
	Aerogel Length	20 cm
	Aerogel Radius	60 cm
	Detector Length	90 cm
	Bore	10 cm
	HD Radius	160 cm
	LD Radius	70 cm
	Offset	260 cm in Hadron Direction
	Segment Count	6
	Total Volume	4.20 m ³

Figure 26: RICH Detector

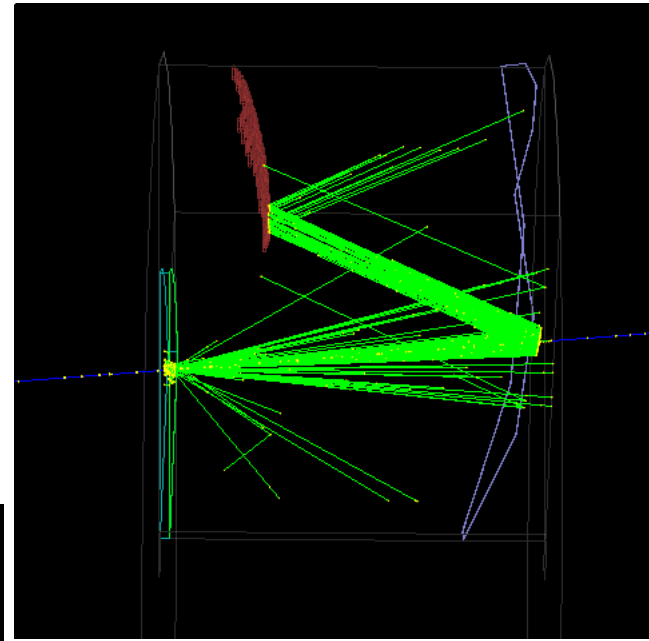
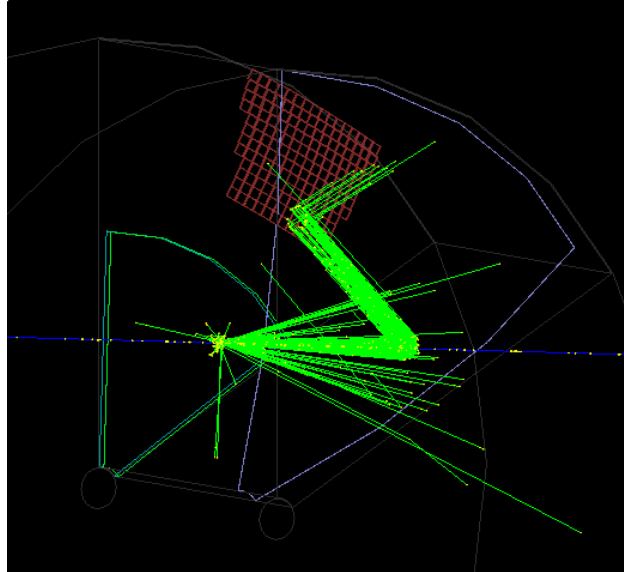
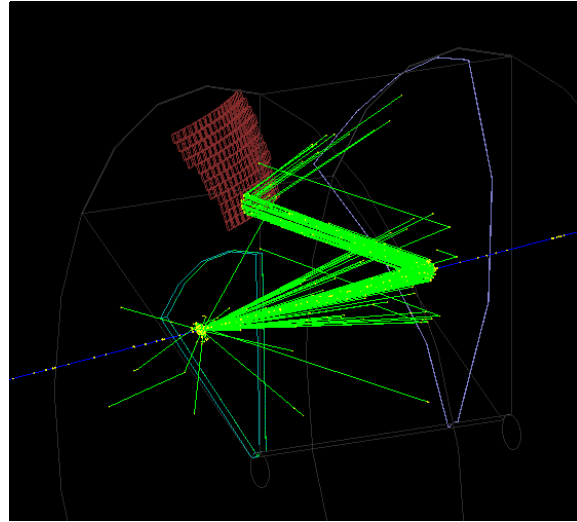
Fun4all Event



More Pictures

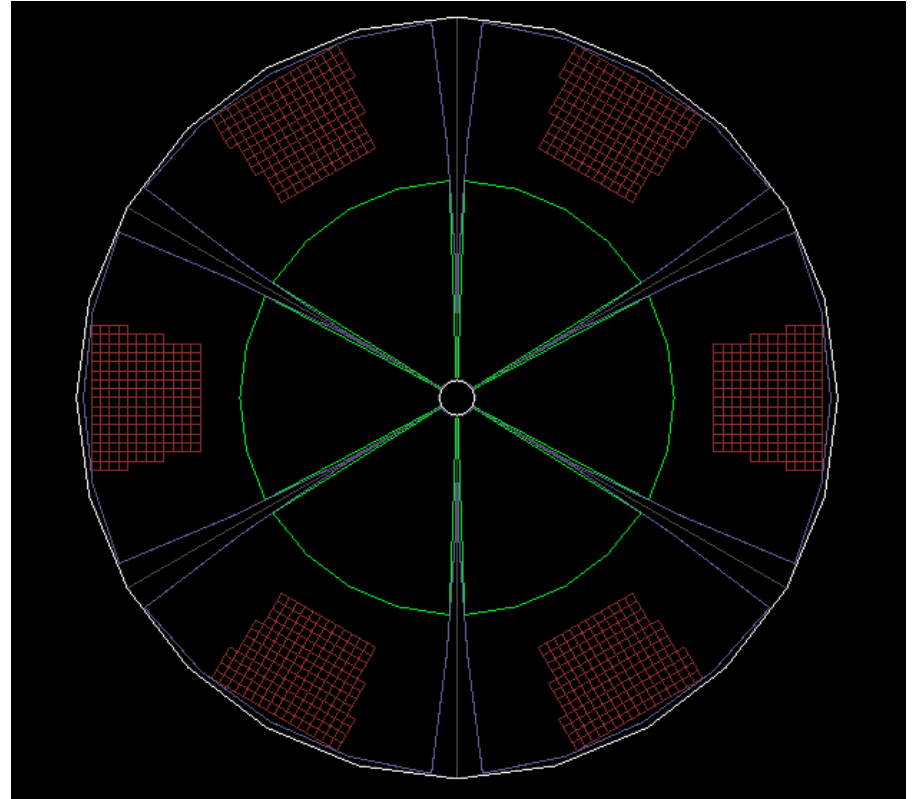
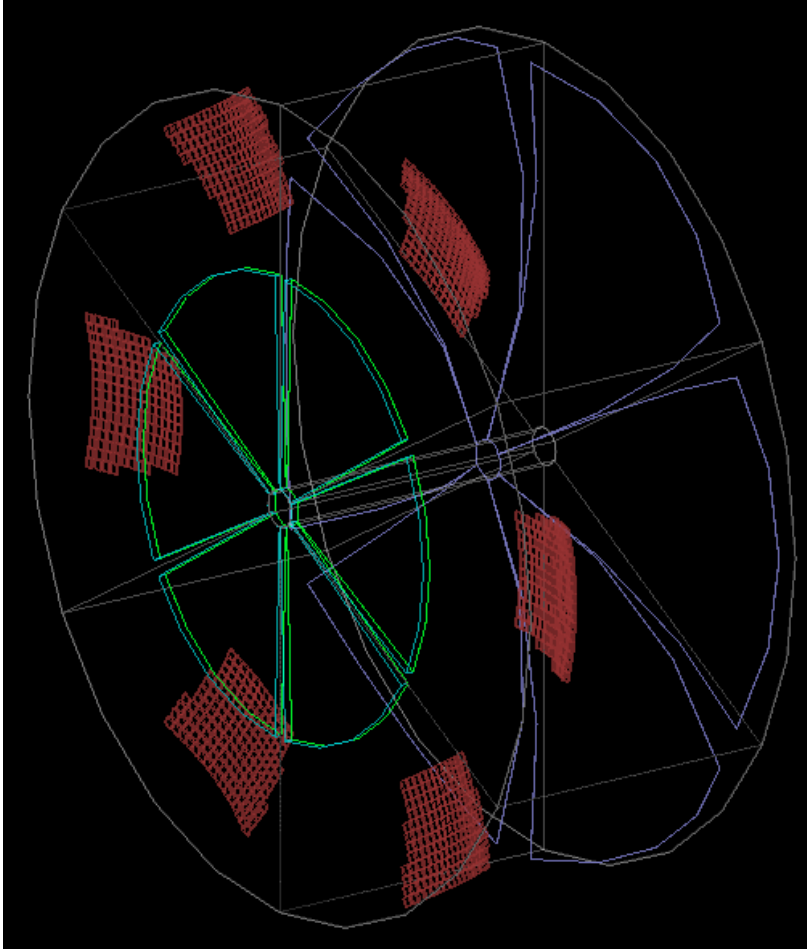


view from behind

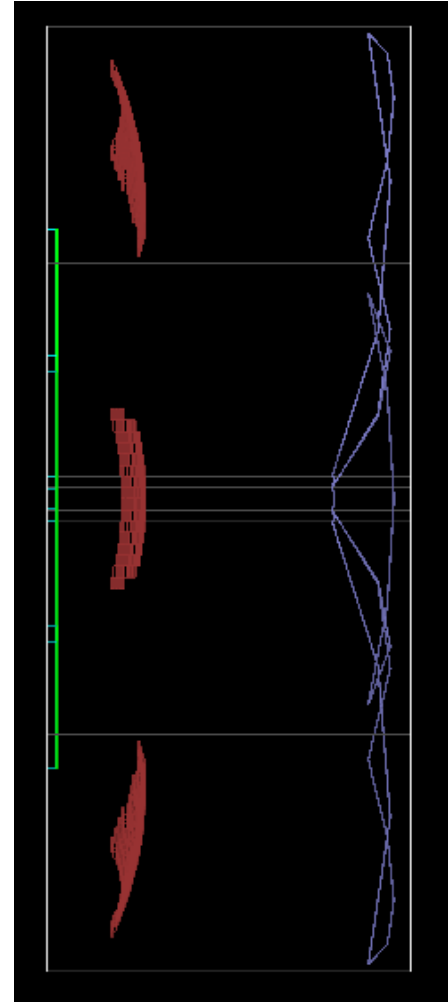
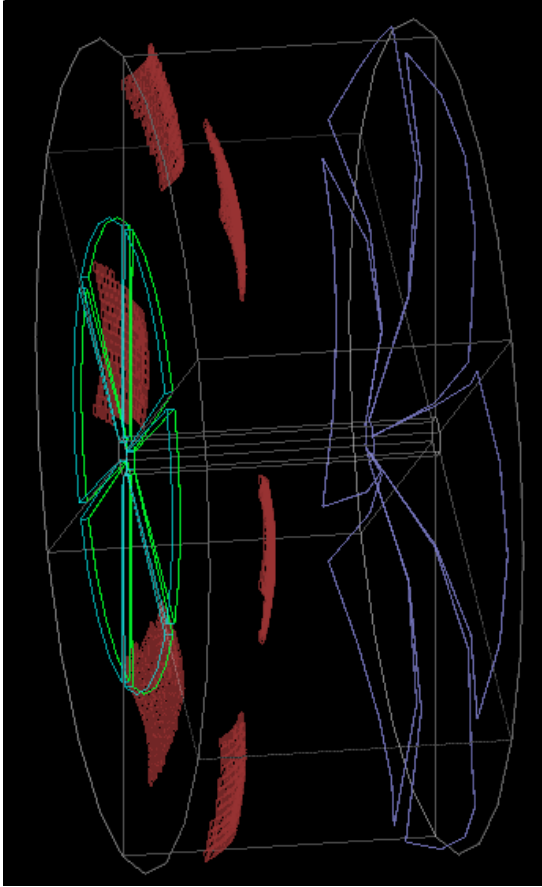


single petal views

Geometry Pictures

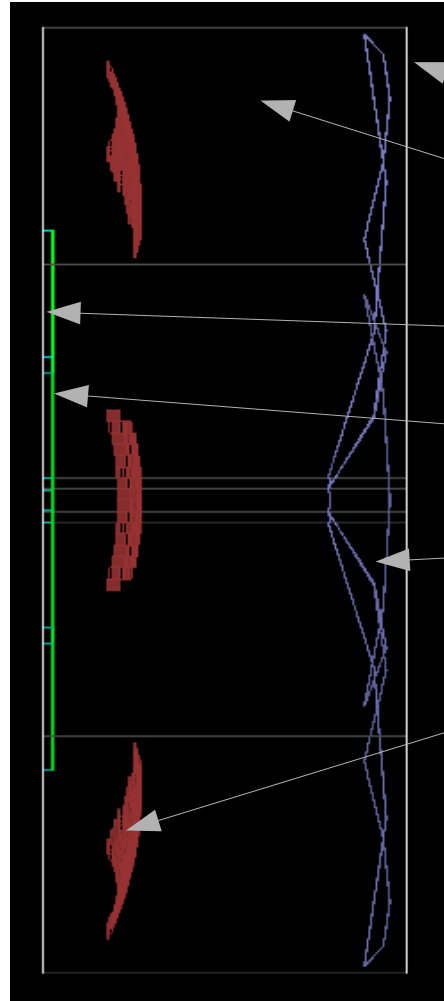


Geometry Pictures



Geometry Notes

Volume Hierarchy



Vessel (white) – Aluminum volume

Petal (grey) [x6] – Gas volume

Aerogel (blue)

Filter (green)

Spherical Mirror (purple)

Photosensors (PSST) (red)