UNIVERSITY OF LIVERPOOL

Engineering Design

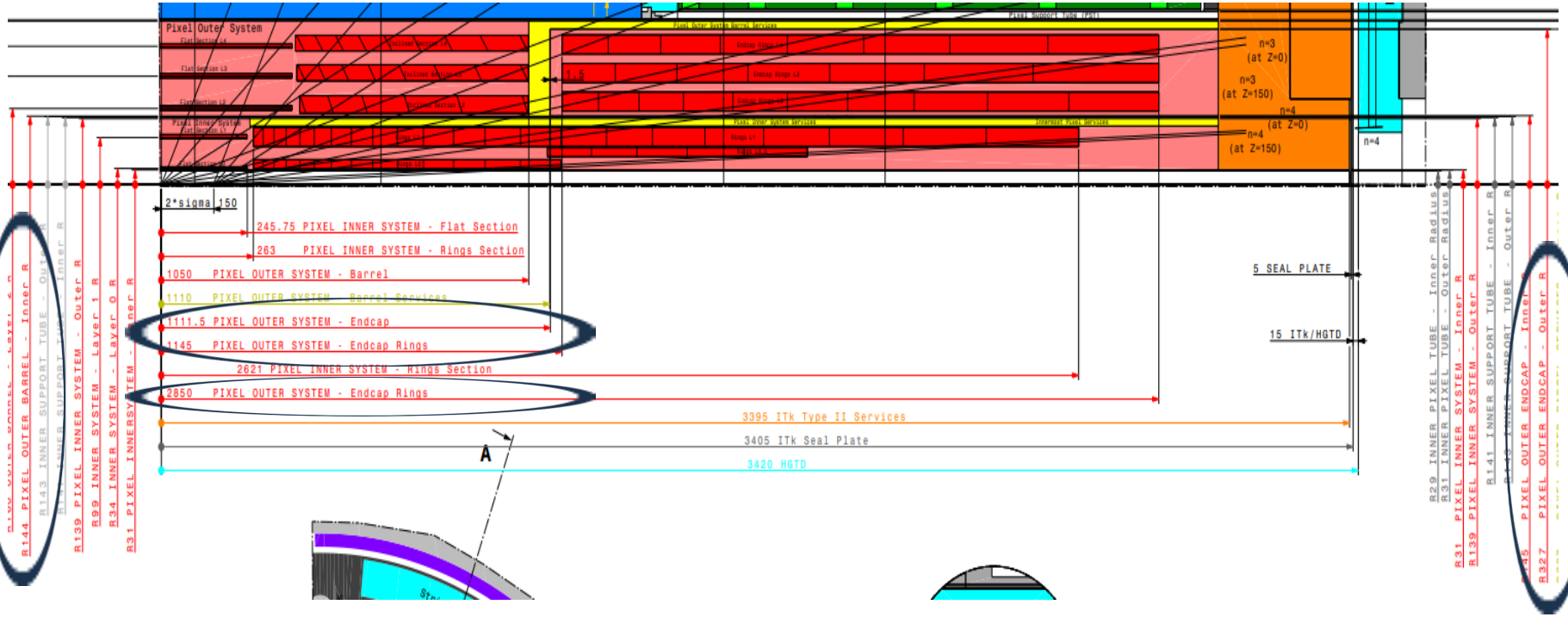
3D CAD Model

John Carroll

10th December 2024

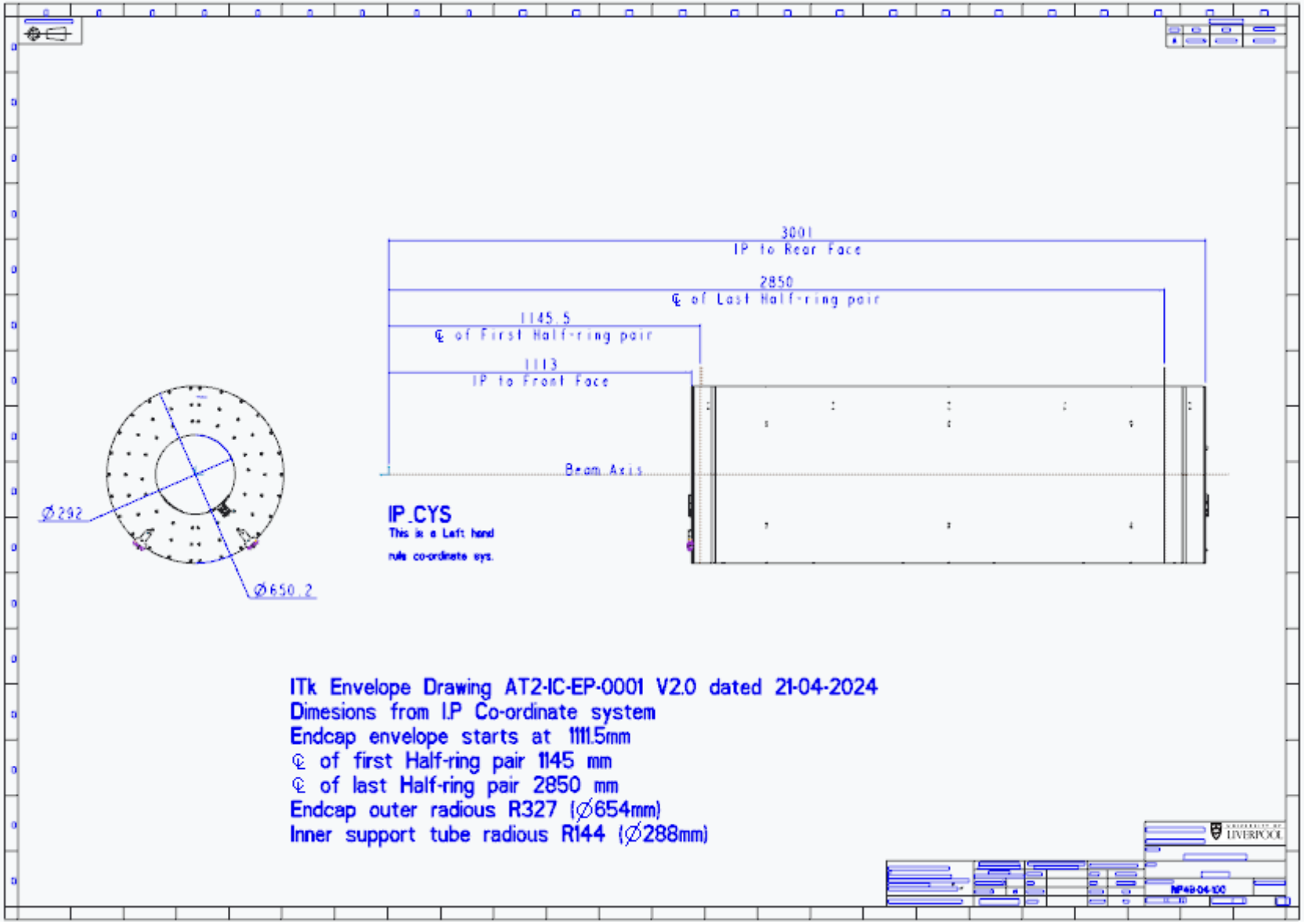
UNIVERSITY OF LIVERPOOL

Endcap Envelope



Detail from ITk Envelope Drawing
AT2-IC-EP-0001 V2.1 dated 7-05-2024

Endcap Envelope

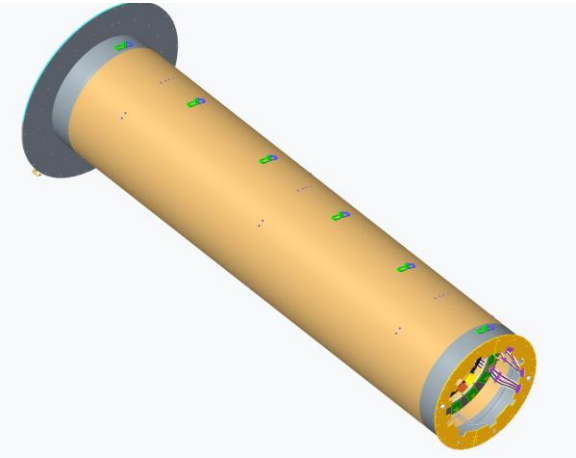


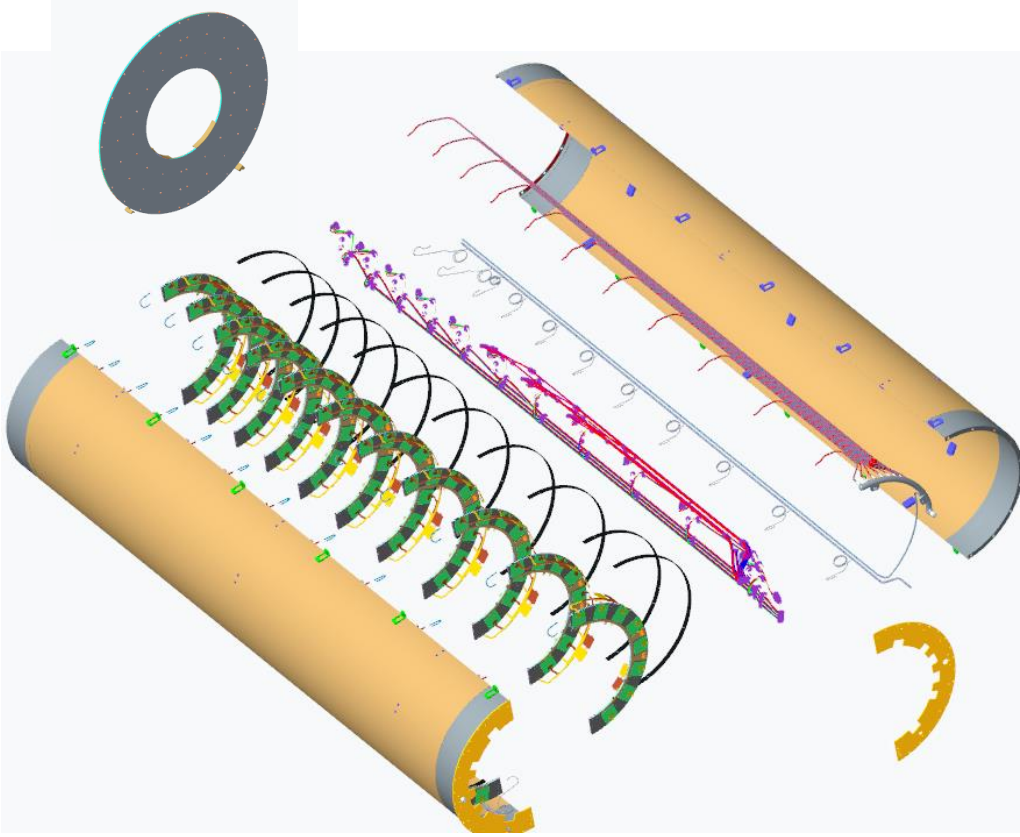
ITk Envelope Drawing AT2-IC-EP-0001 V2.0 dated 21-04-2024
Dimesions from I.P Co-ordinate system
Endcap envelope starts at 1111.5mm
℄ of first Half-ring pair 1145 mm
℄ of last Half-ring pair 2850 mm
Endcap outer radious R327 (Ø654mm)
Inner support tube radious R144 (Ø288mm)

Layer 2 Assembly

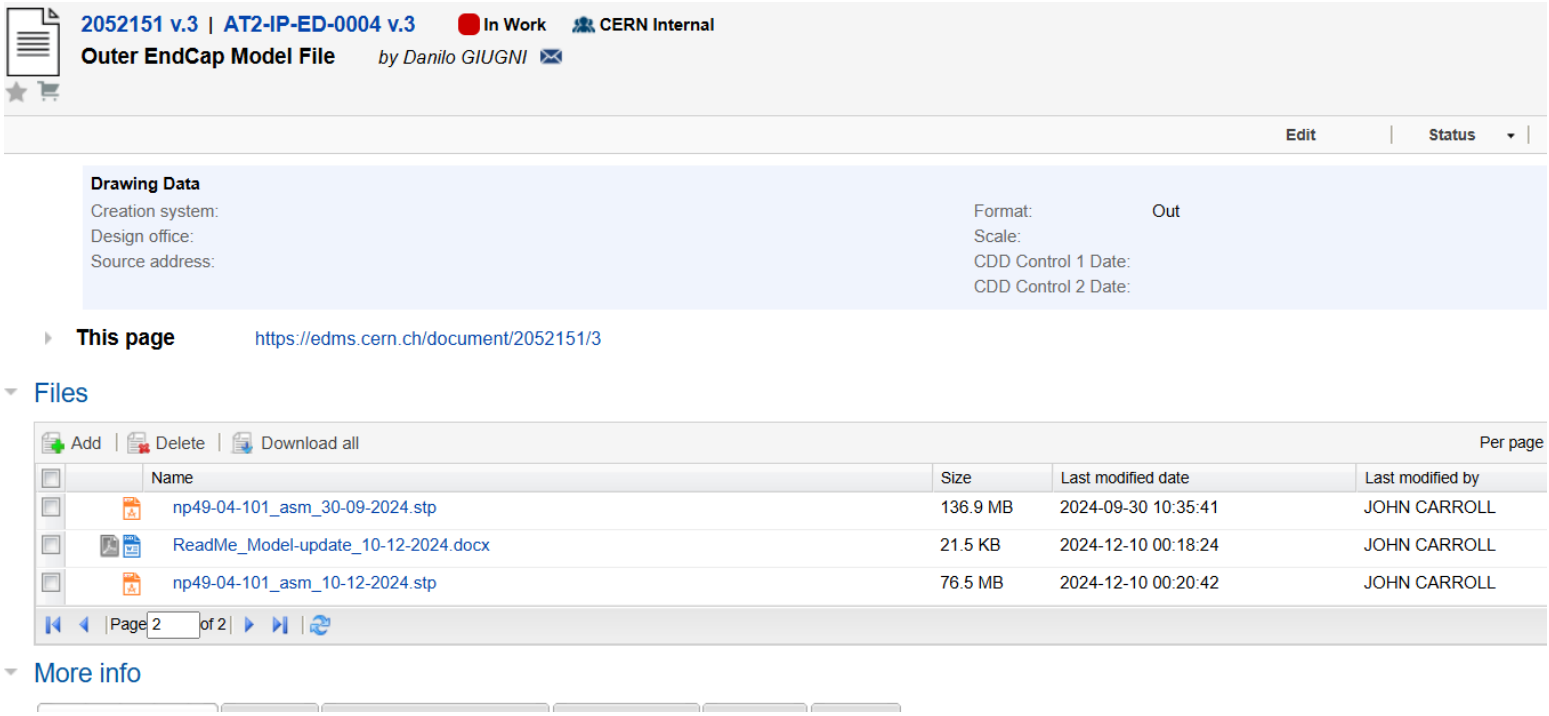
Layer 2 & Front Support
Sub-assemblies:-

Layer 2 Left Hand	NP49-04-184
Layer 2 Right Hand	NP49-04-187
Front Support	NP49-04-26





STEP Files



At present we have put STEP files in the ap242 format on the CERN EDMS site.
The latest version of the assembly for Layer 2 plus the Front Support is here (np49-04-101_asm_10-12-2024.stp)

https://edms.cern.ch/ui/#!master/navigator/document?P:1494949617:101481126:subDocs

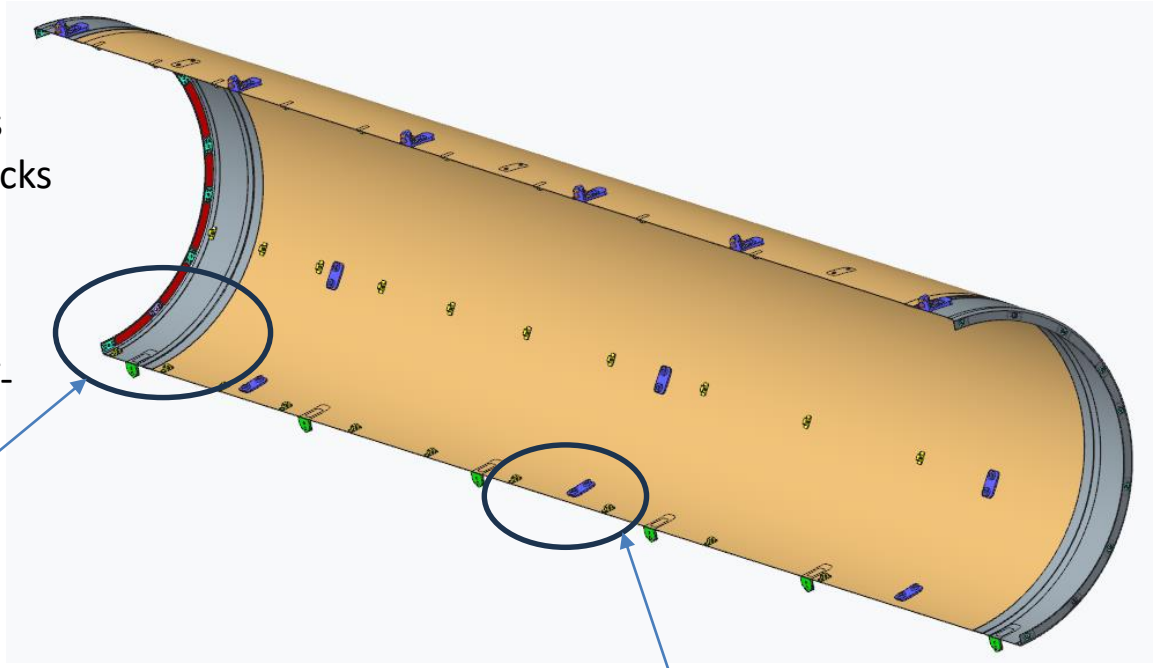
Layer 2 Cylinder

Updates:

1) New design of Cylinder Support blocks
2) New design of Cylinder End Flange blocks

To be Resolved:

1) Addition of ground pads to structure
2) Possible change to the foot of the Half-ring mounts



New design of Cylinder end flange blocks

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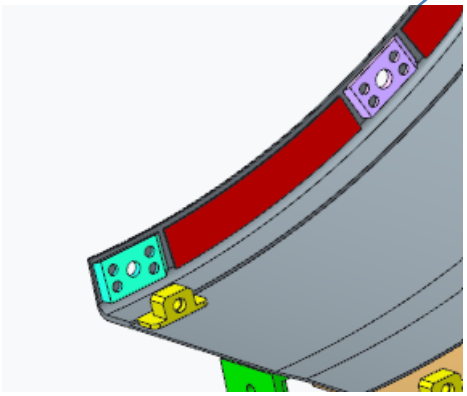
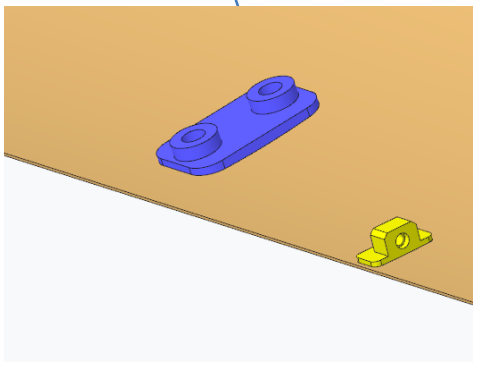


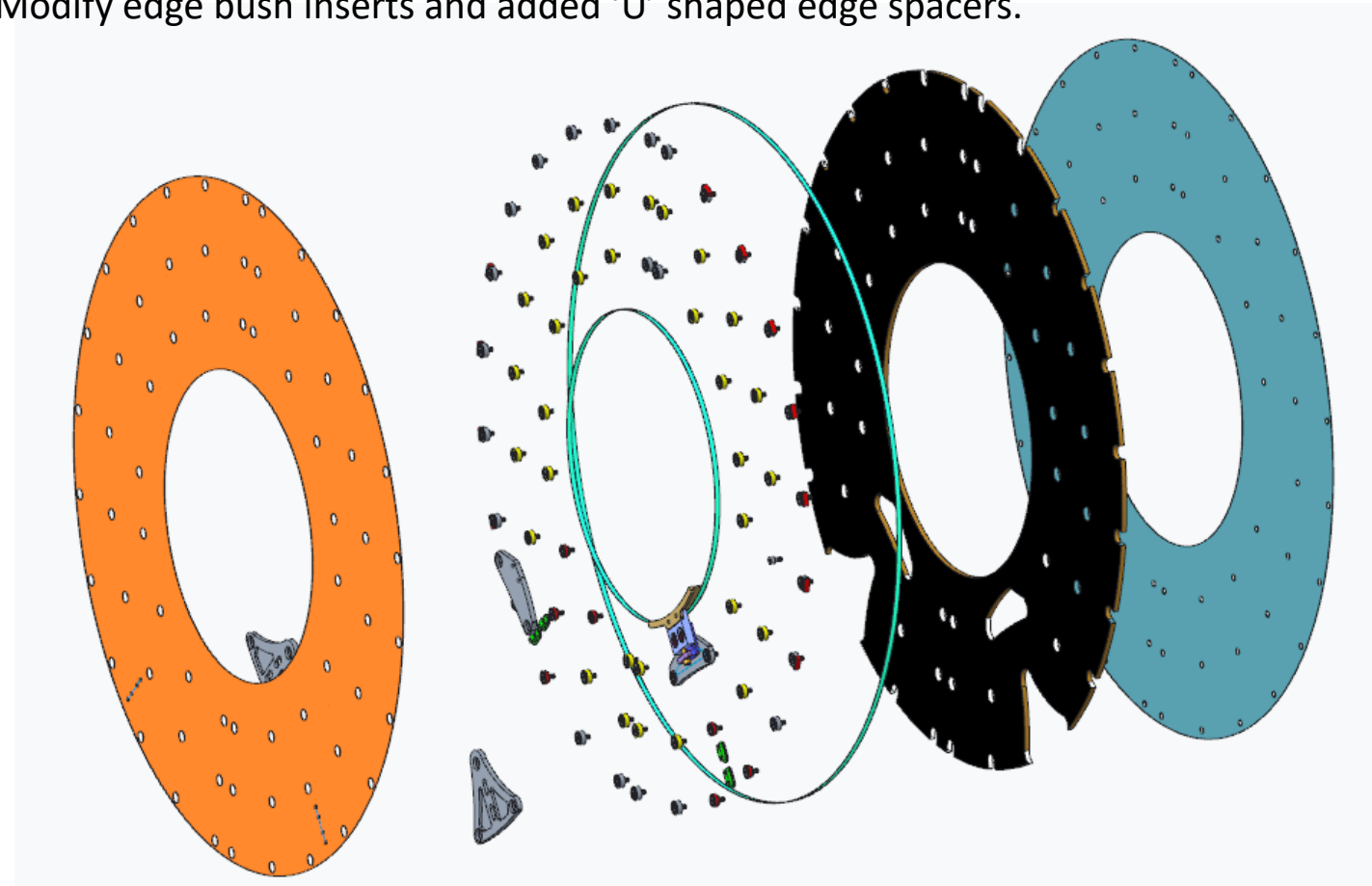
Reposition cylinder support blocks away from the split line and rationalise block design.



Front Support

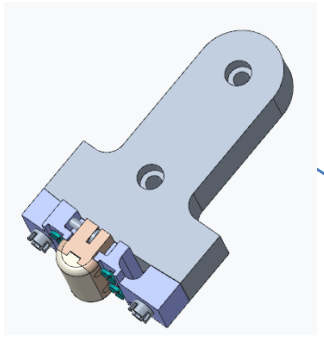
Updates:

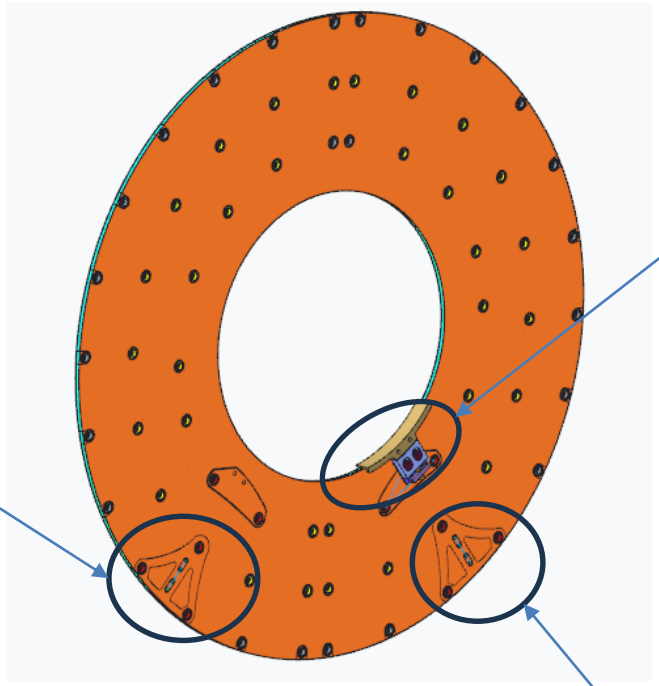
1) Prototype layup of disk
2) New design Saddle and Slider insert mounts.
3) Modify edge bush inserts and added ‘U’ shaped edge spacers.

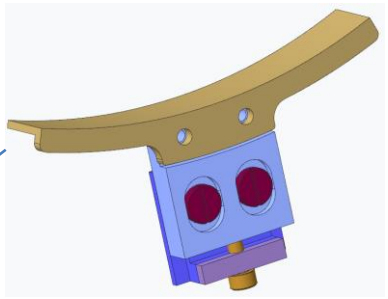


Front Support

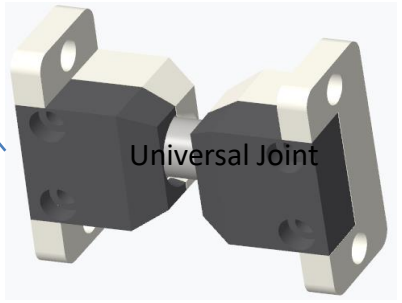
Sliders







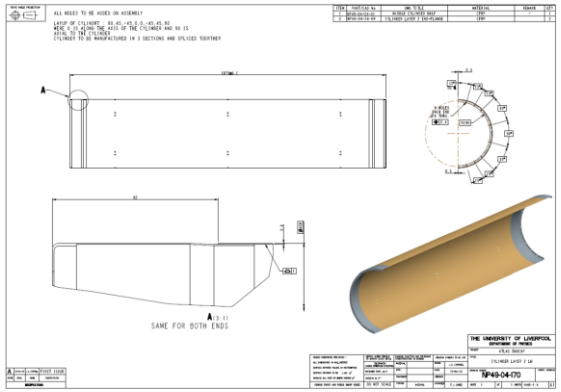
Inner Support Tube Saddle

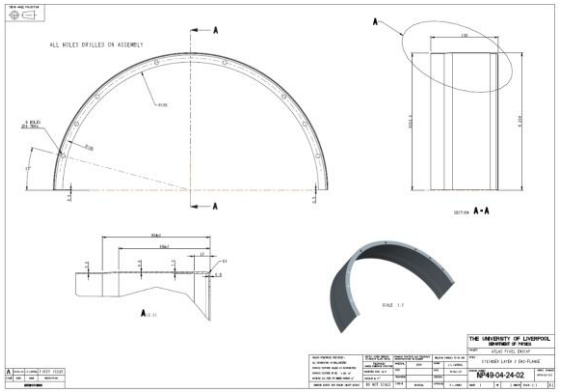


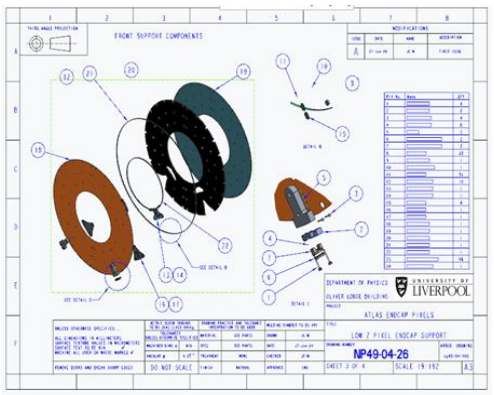
To be Resolved:

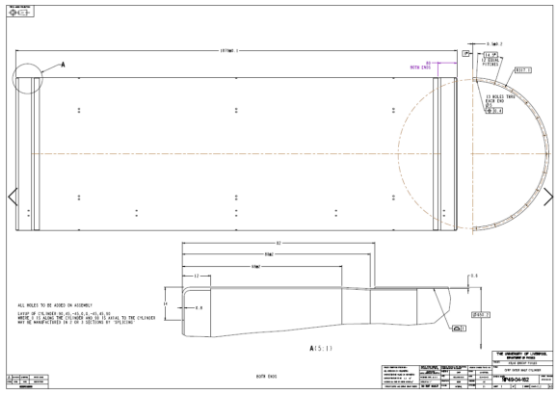
1) Review of integration tooling load points.
2) Final design Inner Support Tube Saddle.
3) Review existing Slider design
4) Addition of ground pads to structure
5) What's happening with Fred's Universal joint?

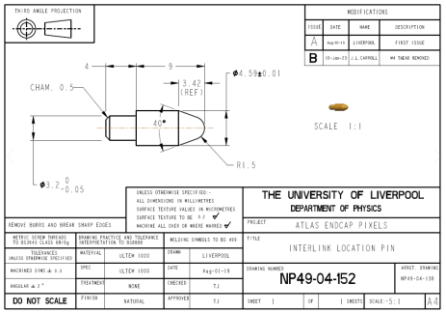
Front Support & Cylinder Drawings

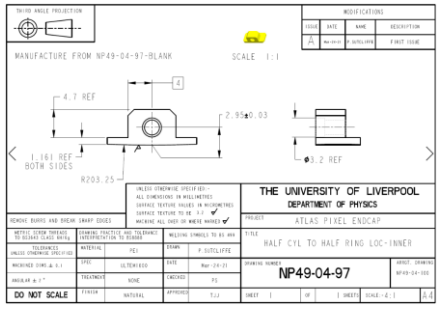


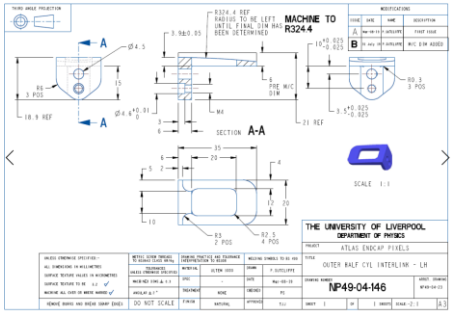


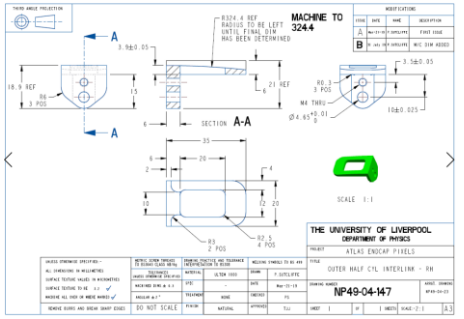






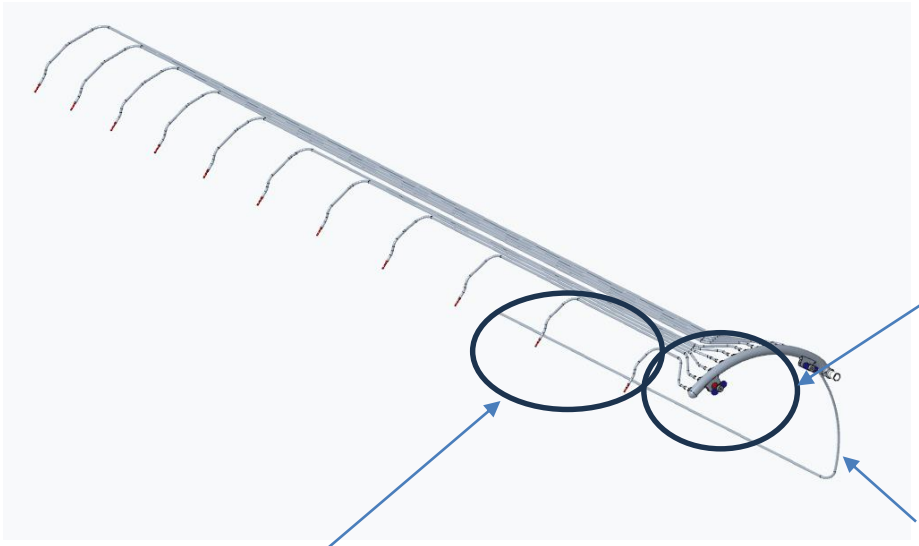


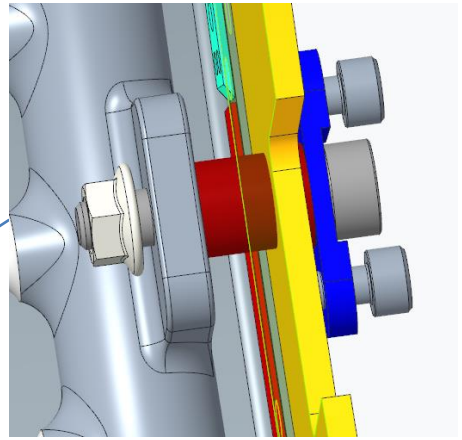




We have initial assembly and part drawings for Layer 2 and the Front Support. Tolerances and assembly procedures still to be documented.

Exhaust Cooling Runs Layer 2

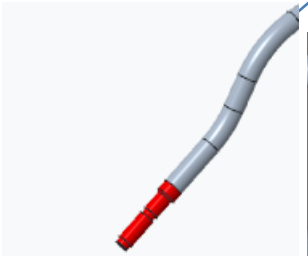




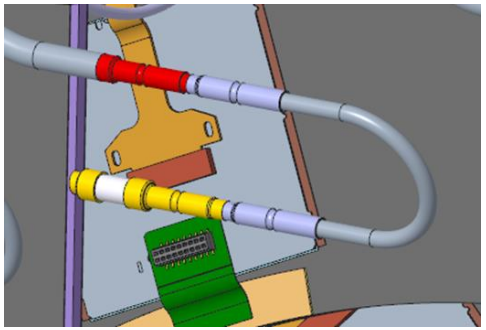
2

Manifold mount

Bypass



Exhaust fitting



Exhaust ‘U’ tube assembly

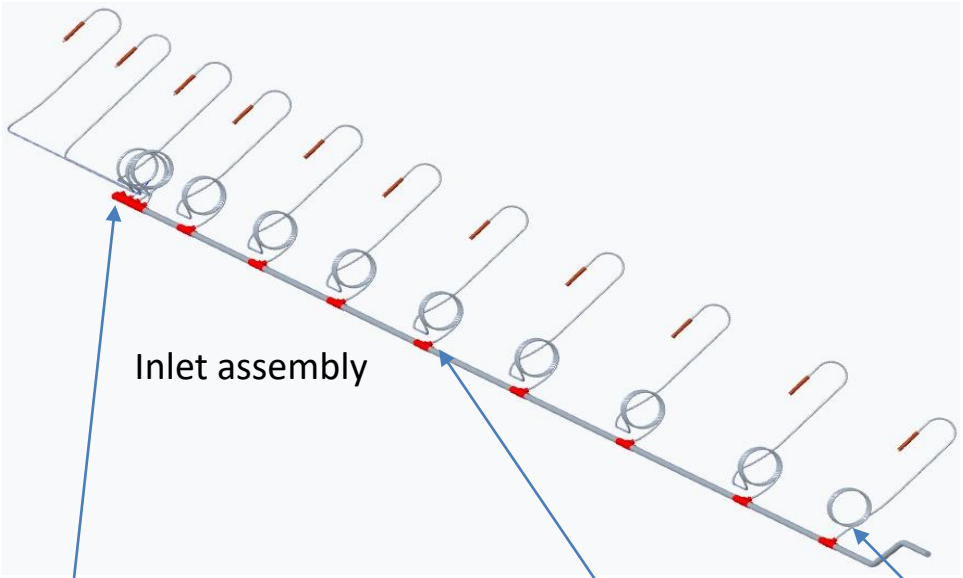
Updates:

1. Final design of the Manifolds, Exhaust runs, ‘U’ pipe assembly and fittings for Layer 2 left and right.
2. Latest Bypass pipe 1
3. Proposed Manifold mount/clamp.

Still to be Resolved:

1. Exhausts runs clamping to Cylinder

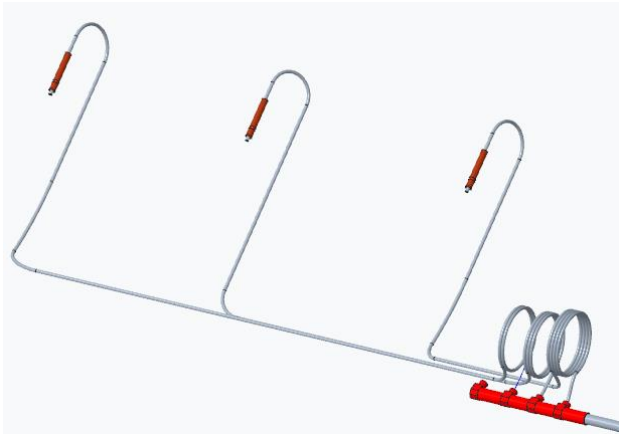
Inlet Cooling Layer 2 Right Hand



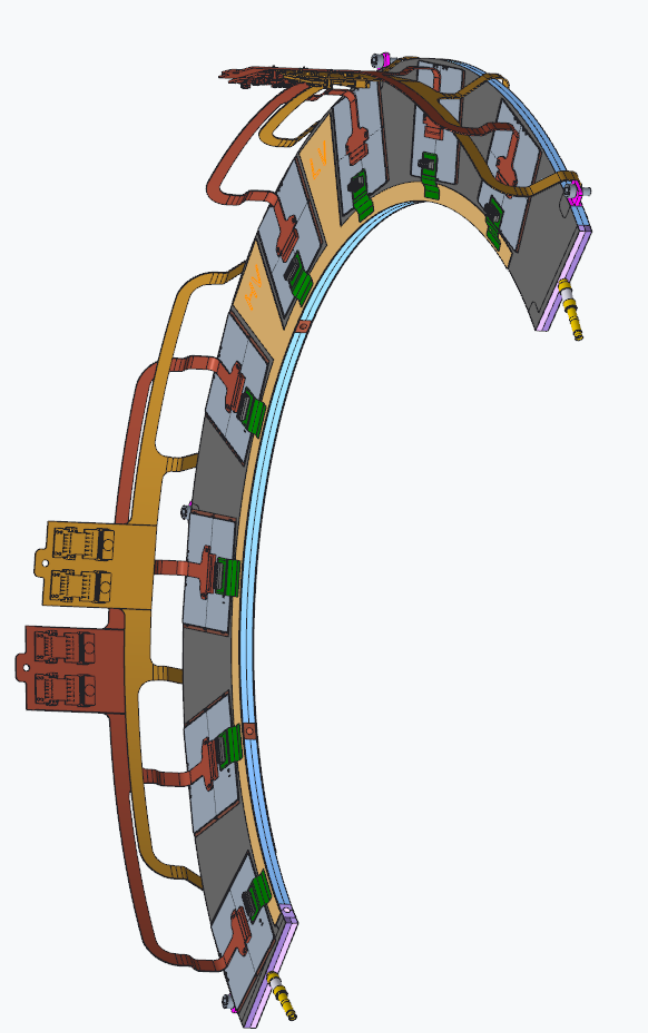
Updates:
New design for Right Hand Inlet line and coils

To be Resolved:

1. Incorporate the inlet assembly into the full cooling tree
2. Review of capillary coil design for manufacture/pressure drop/clamping.
3. Addition of Bypass coil and fittings
4. Cooling run clamping axial and final anchor bracket design and attachment area.
5. Mirrored version for Left Hand side



Half Rings



Half-rings model and drawings have been frozen in the Liverpool archive. Copies of the CAD and associated drawings sent to Alexander Bitadze of Manchester Uni. for review with respect to manufacture. Any changes will be implemented in conjunction with Man.Uni.

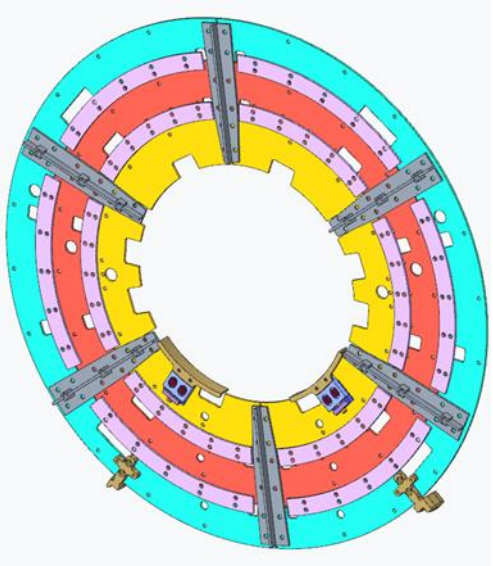
Updates:

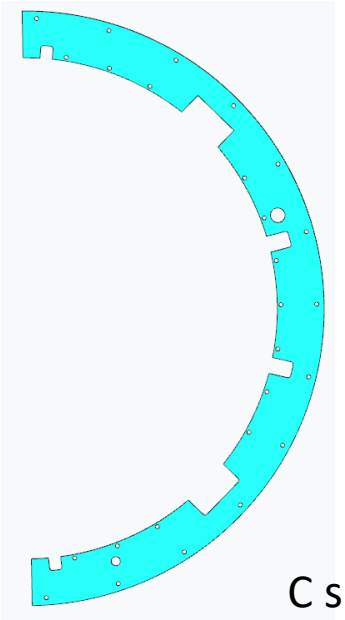
1) Latest version of PP0's flex's now mates with the module connector.
2) Revised Power connectors to tapes

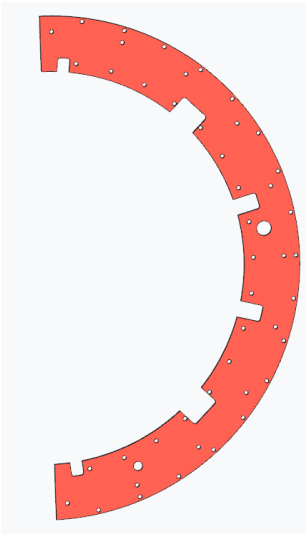
To be Resolved:

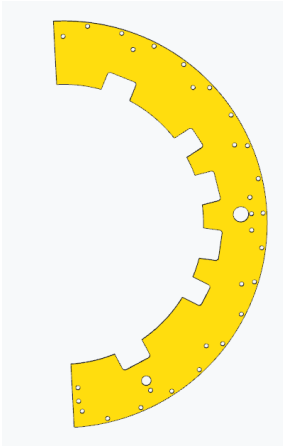
1) Clashes with cooling inlet and outlet 'U' tube assemblies.
2) Service support ring to be detailed.

Rear C Flanges





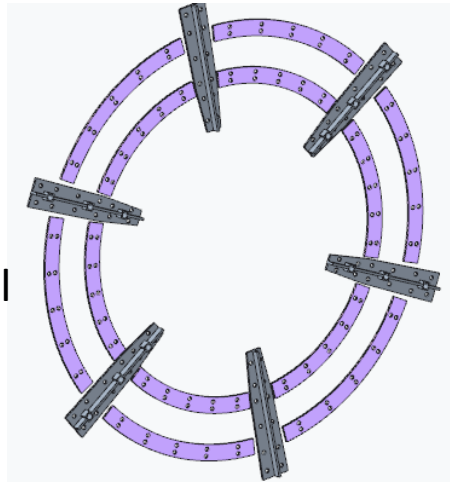




C shaped rear flanges

Still to be Resolved:

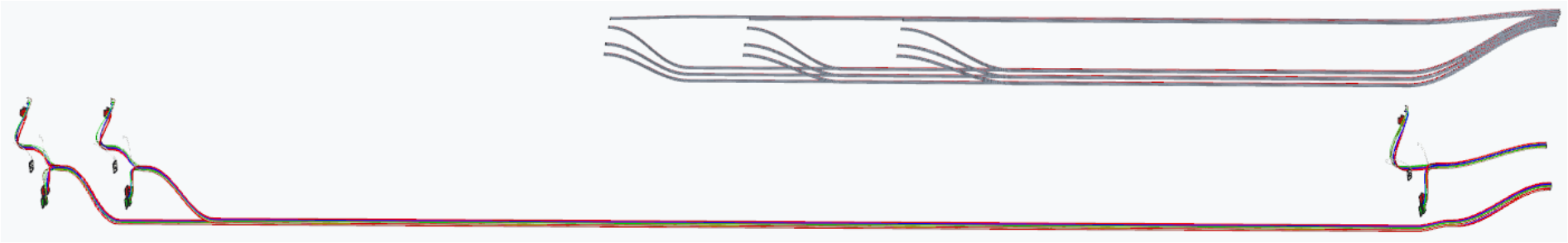
1. Rear interlinks and spokes design.
2. Final size and position for cables slots
3. Cable slot stress relief support structures
4. Final design Inner Support Tube Saddle on layer 2
5. Mounting of Sliders in layer 4
6. Inserts for all fixing points.
7. Addition of ground pads to structure



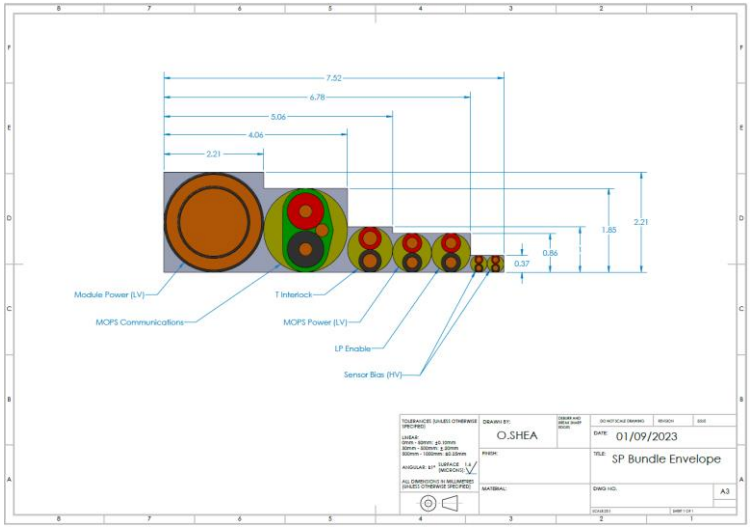
Spokes and Radial links

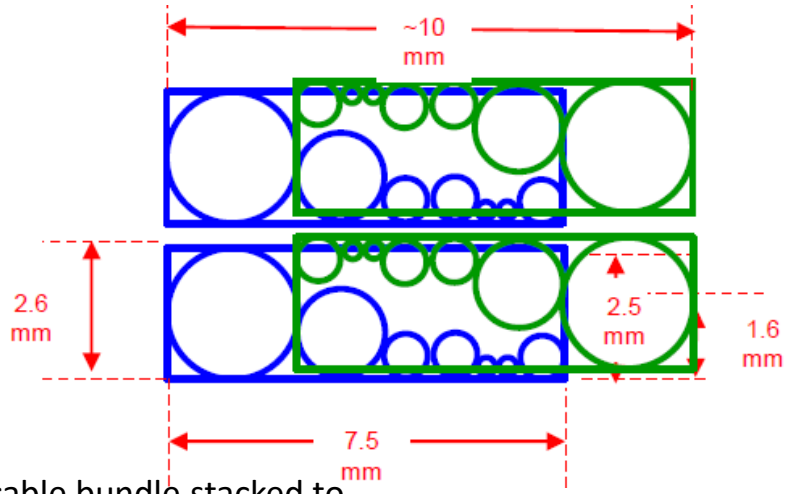
Other Slides

Cable Harness



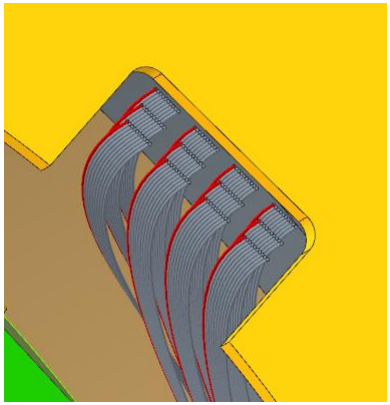
Updated scheme provided by Stephan Eisenhardt and Gabriel
This used a new power cable bundle layout and extends to terminate on the Half-rings.





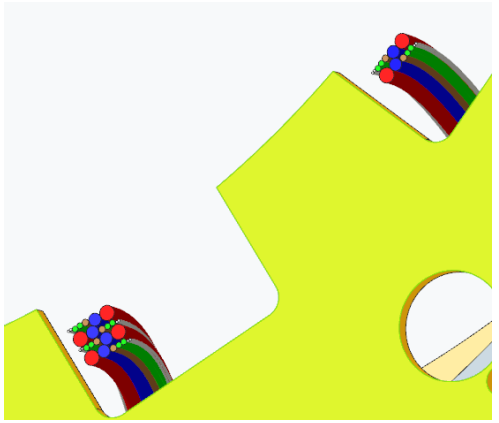
New cable bundle stacked to power back & front of two Half-rings

Cable Harness



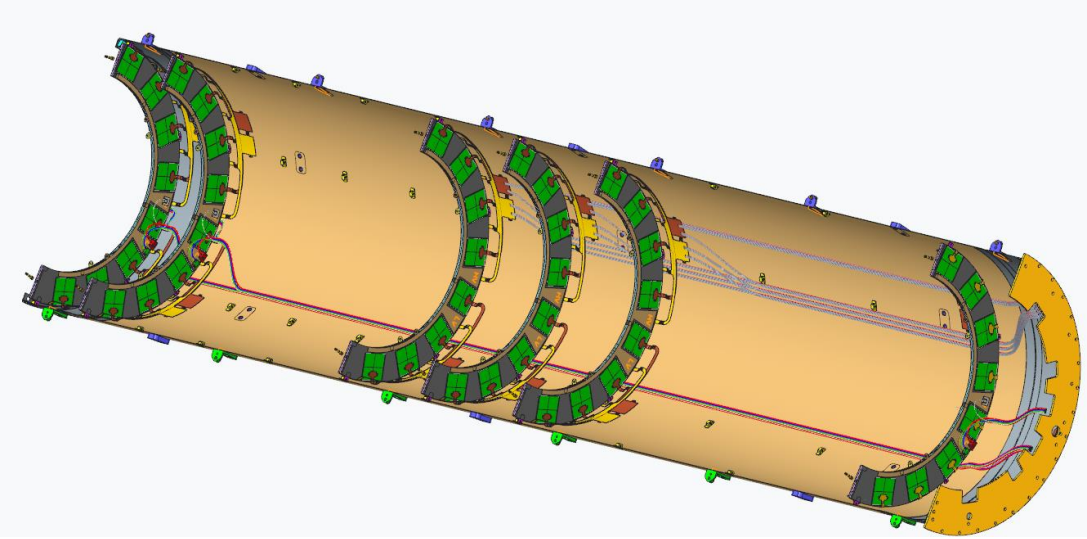
Current state:

1) Cables modelled only on Layer 2 left-hand side
2) Power bundle cable from High Z flange to terminal connectors on Half-rings 1,2 & 11
3) Data cables for Half-rings 6,7, & 8 from High Z flange to current PPO (awaiting end position).



Still to be complete:

1) Review current runs
2) Add Power bundles Half-rings 3 to 10
3) Add Data cables Half-rings 1 to 5 and 9 to 10
4) Update Clamping rings design to incorporate the final fixing of the various cables and support the PP0 flex
5) Expand design to Layers 3 & 4 and mirror for right-hand side



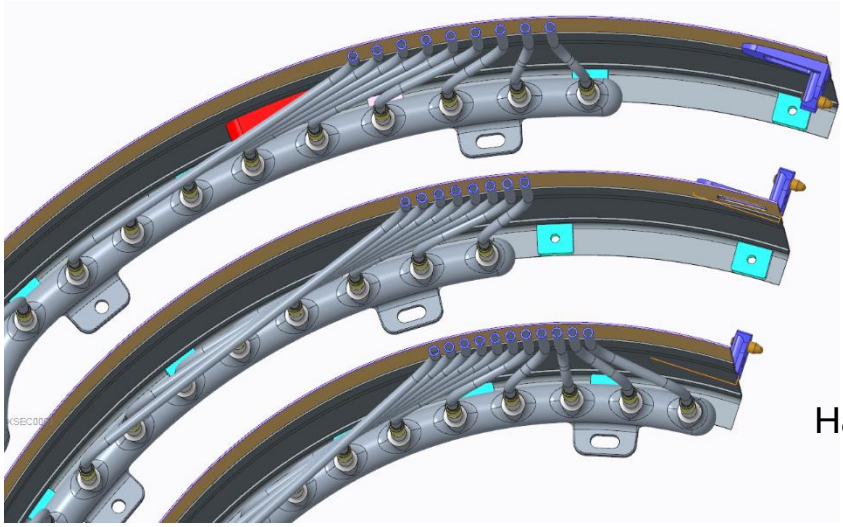
NOMINAL RADIAL GAPS

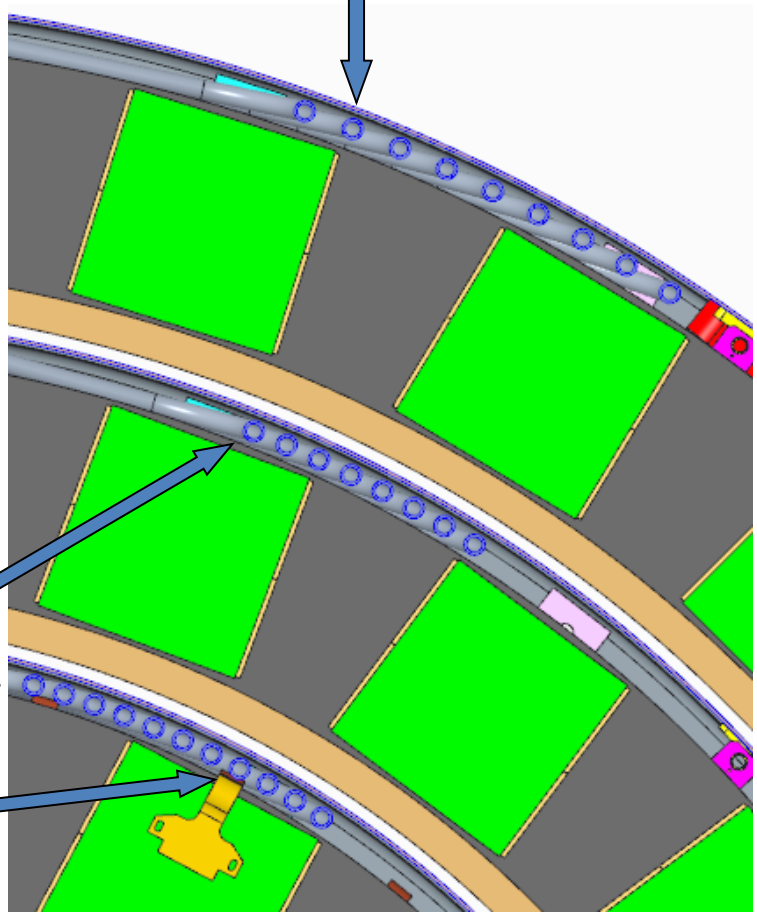
Gaps between Cylinder Shells, Pipes and Half rings (mm)

Layer	Cylinder Shell to Pipe*	Detector Halfring to pipe+
L2	1.4/0.8	0.8
L3	1.45/0.85	1.15
L4	1.5/0.9	2.1

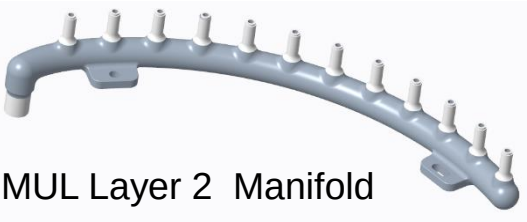
* Cylinder body/Cylinder end

\+ 4 way flat flex sits in this gap (0.5mm)

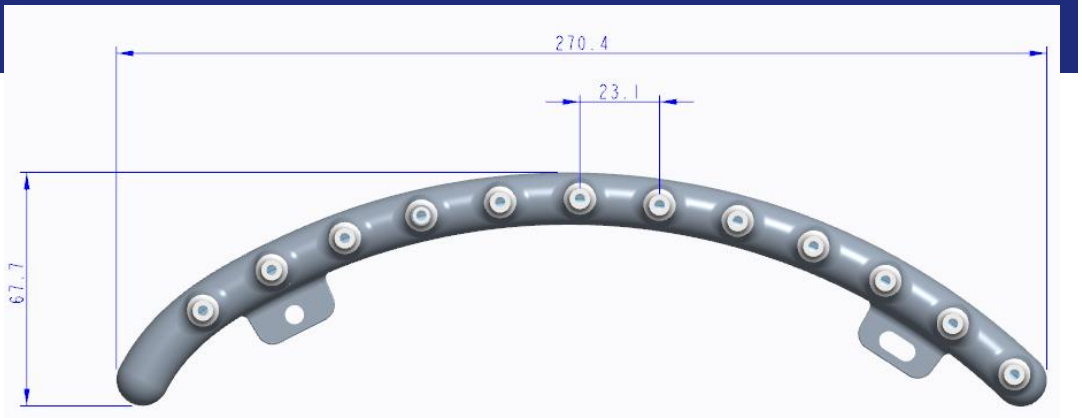


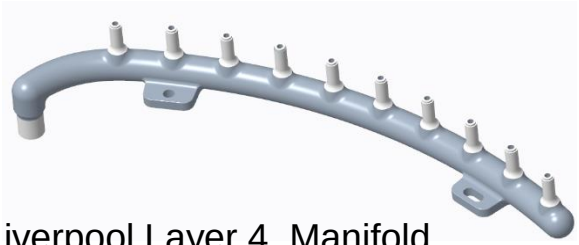


MANIFOLDS

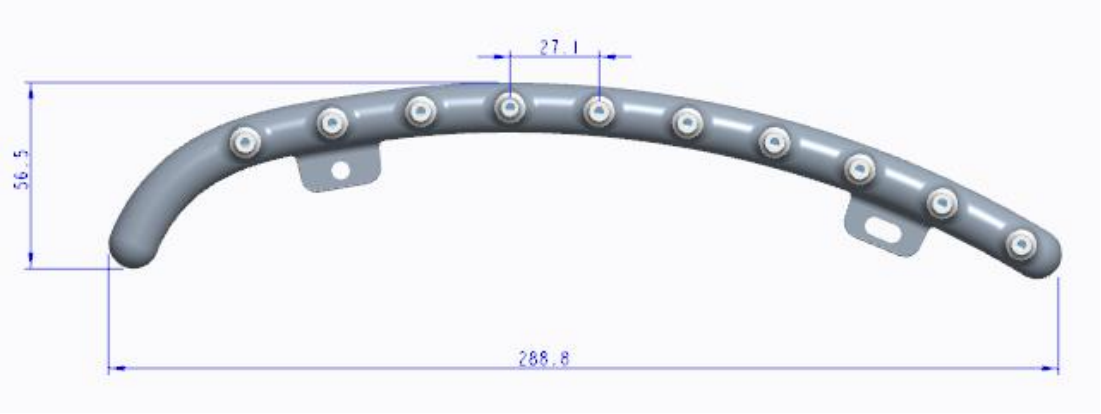


QMUL Layer 2 Manifold





Liverpool Layer 4 Manifold



Note
Layer 3 Manifold is smaller then Fred's layer 2 Manifold

- Design Criteria
- Maximum Pattern size for 3D printing
- Orbital Weld head spacing for ports
- Internal preparation and cleaning