TFPX Disk Mechanics and Services: Designs

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Outline

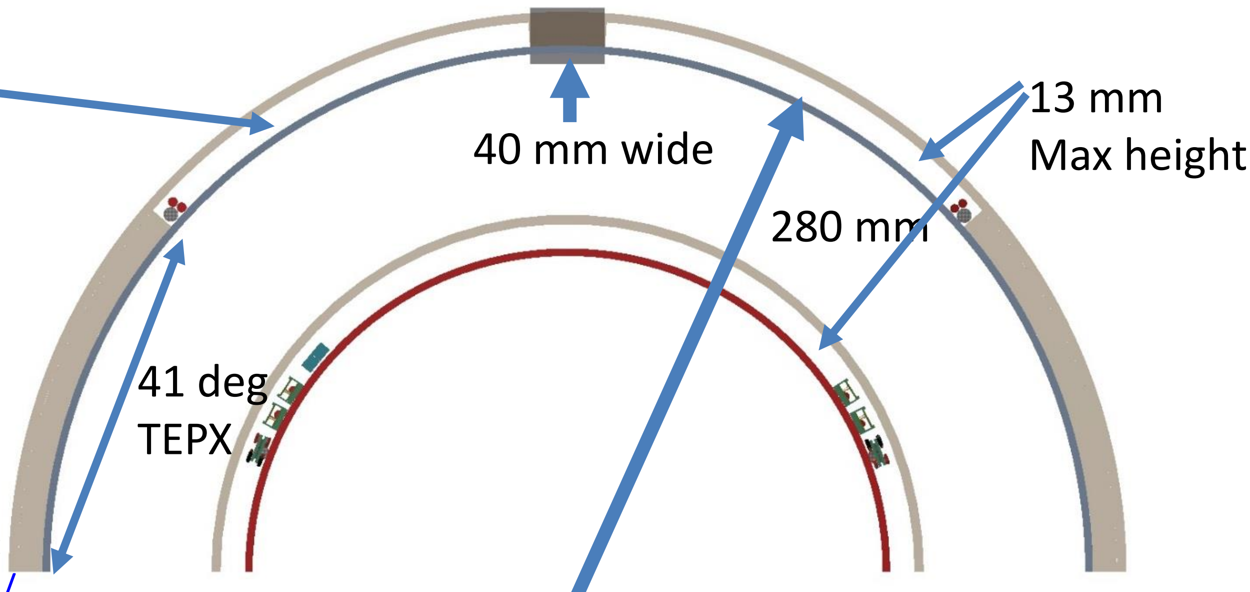
- Cartridge design
- Service cylinder
- Other mechanics related issues
- Concluding remarks

CARTRIDGE ASSEMBLY

TFPX and TBPX available cross section area

	Value	Units
Radius of service cylinder in TEPX region	280.00	mm
Maximum usable height on service cylinder	13.00	mm
Height reserved for cover and cable management	1.00	mm
Angle occupied by each of two TEPX reserved areas on 180 degree cylinder	41.00	degrees
Width of slot in service cylinder	40.00	mm
Approximate angle equivalent of slot	8.20	degrees
Available area over 180 degrees (sum of 2 large openings)	**5378.99**	mm-sq
Area of each opening	2689.50	mm-sq

Cross sectional area limiting factor at larger OD of service cylinder. White area within 13mm boundaries is available space for both TFPX and TBPX

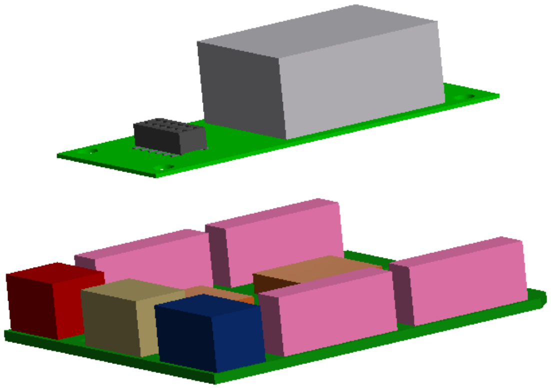


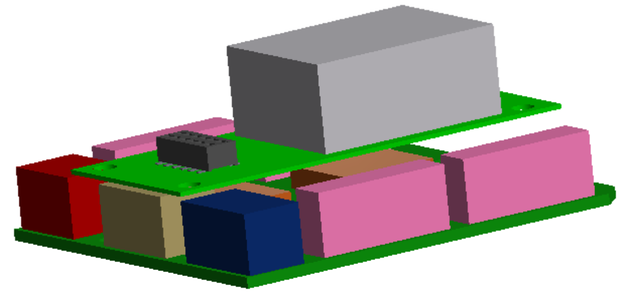
This slide copied from Yadira's slides: https://indico.cern.ch/event/701333/

Port Card Assembly

2^{nd} Stage DC-DC Converter

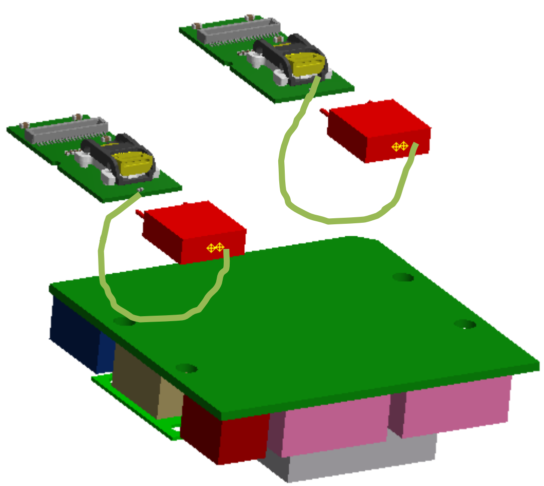
Design of DC-DC still ongoing. Shown is first design

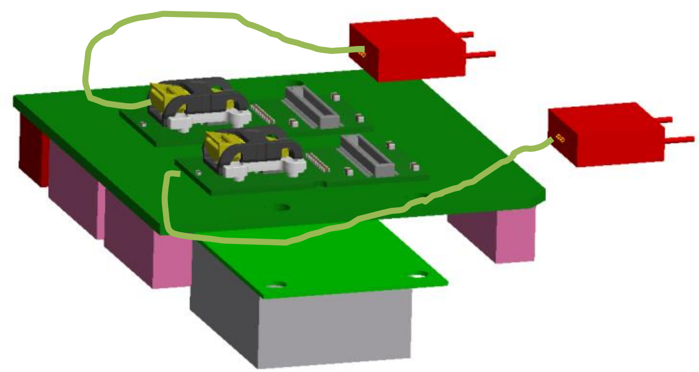




Versalinks

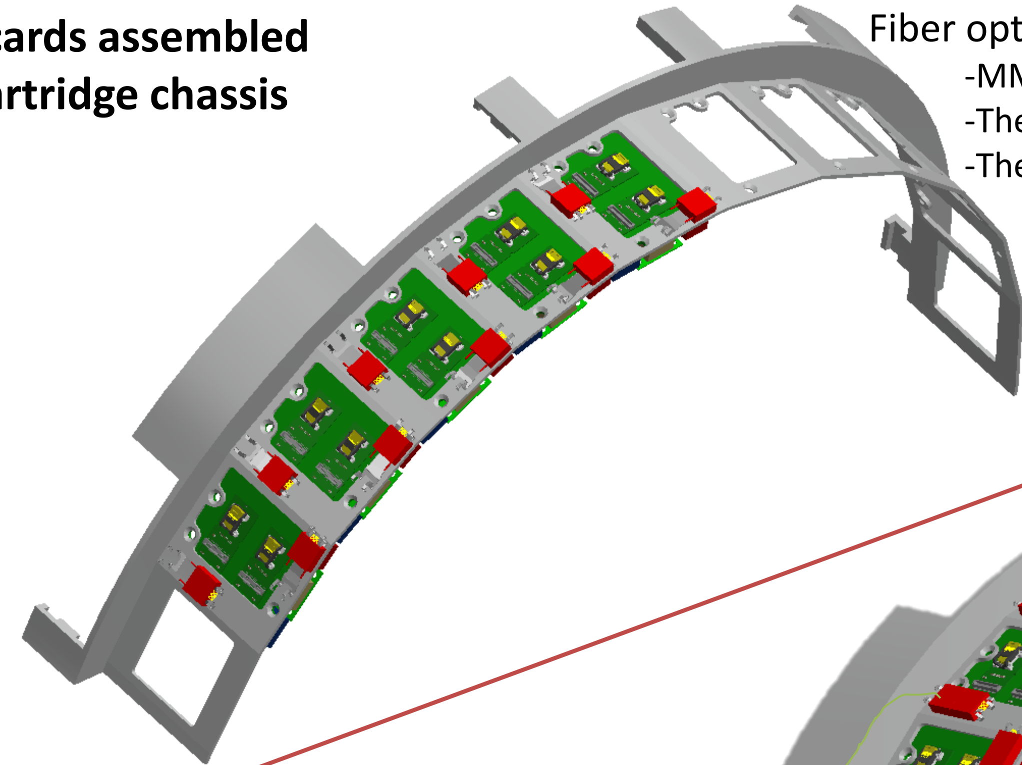
Each versalink has 2 pigtails each with 2 fiber optic cables into MT permanent connectors





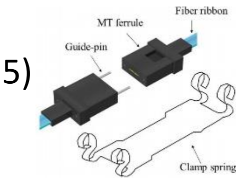
Fiber optic connectors

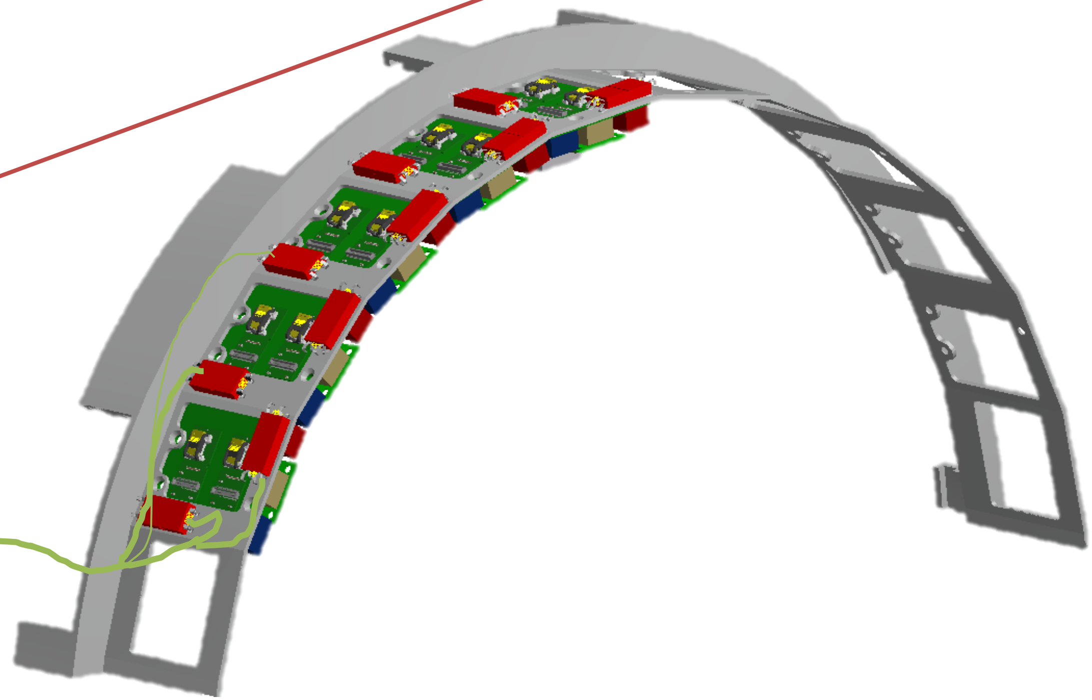
Port cards assembled to cartridge chassis



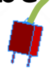
Fiber optic connector parts from US Conec, Ltd.

- -MM Elite MT ferrule (17184)
- -The individual guide pins (16735)
- -The spring clamp (10405)

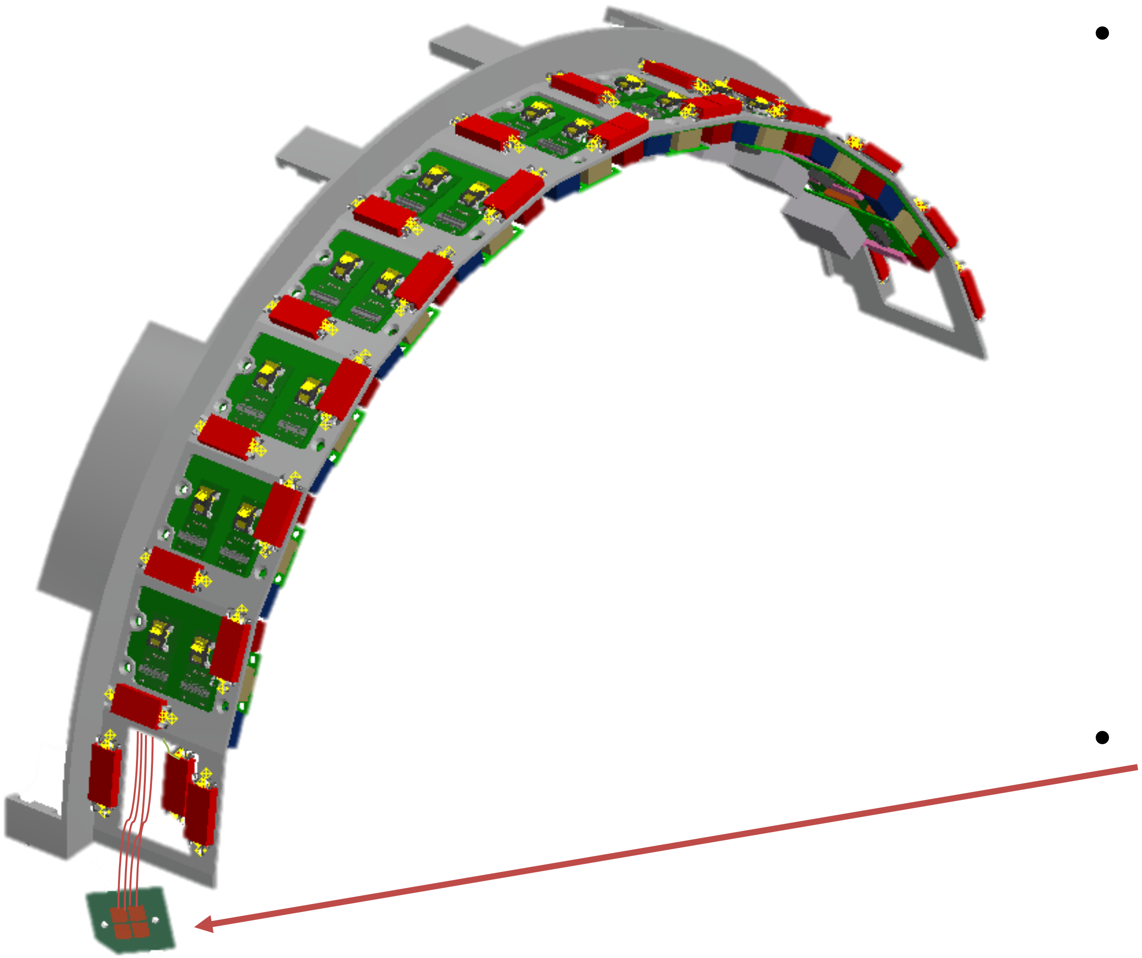




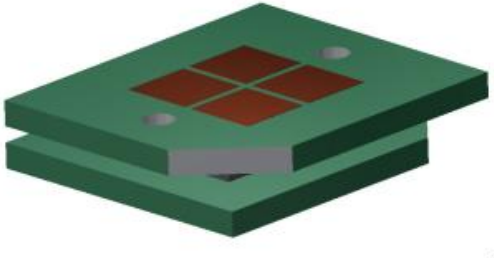
24 wire fiber optic fan out going out to PP0

24 fiber wires

same connector to PP0

Port card power

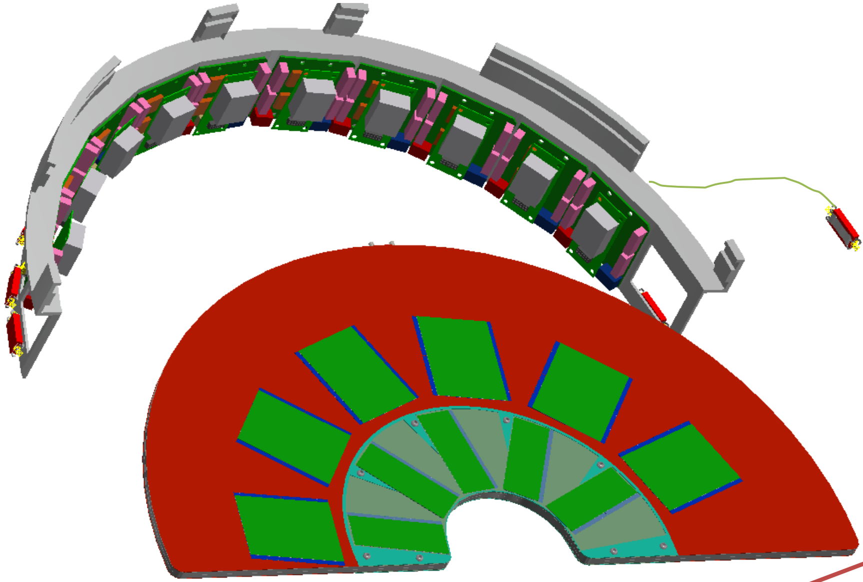


- As [Charlie mentioned yesterday](), the power to all port cards for an even and odd dee for a cartridge is provided by a single 100 pin interposer sandwich



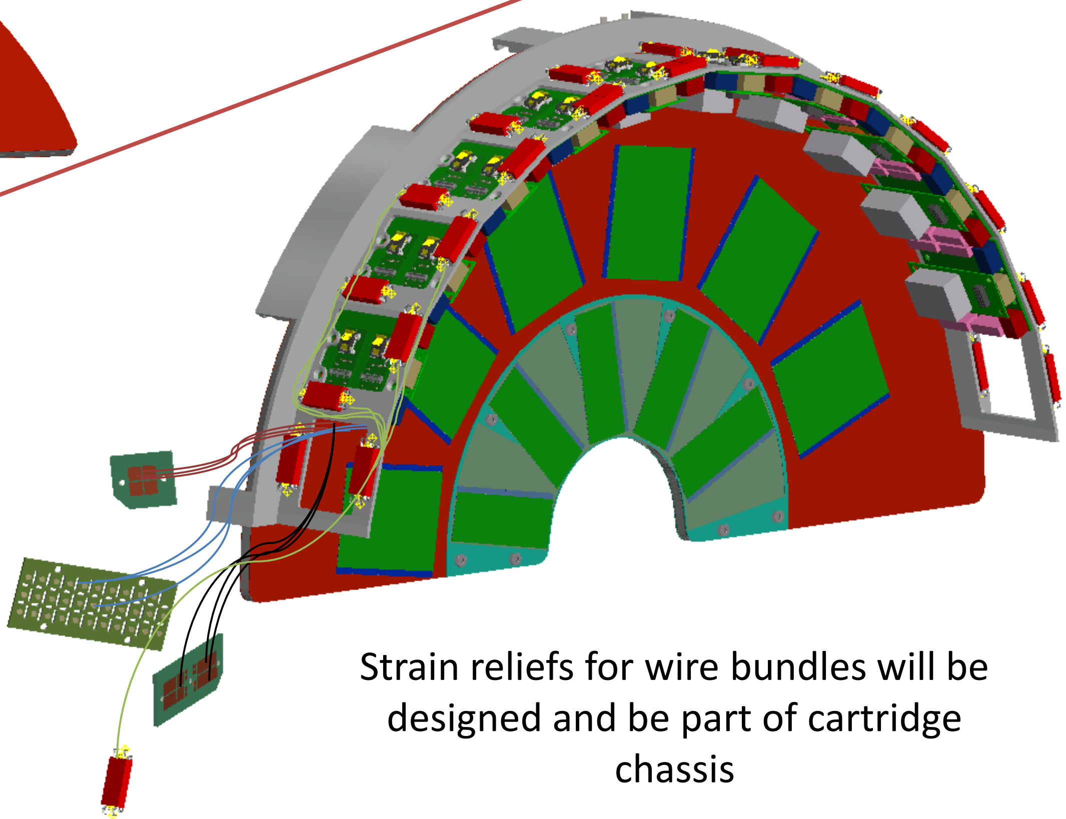
- The female pigtail shown connects to all port cards in this cartridge and exits out to service cylinder to make the mating connection

Dees on cartridge



Dees are slid into slots in cartridge and screwed in place from top into square nuts on dee sandwich

Dees assembled on cartridge chassis



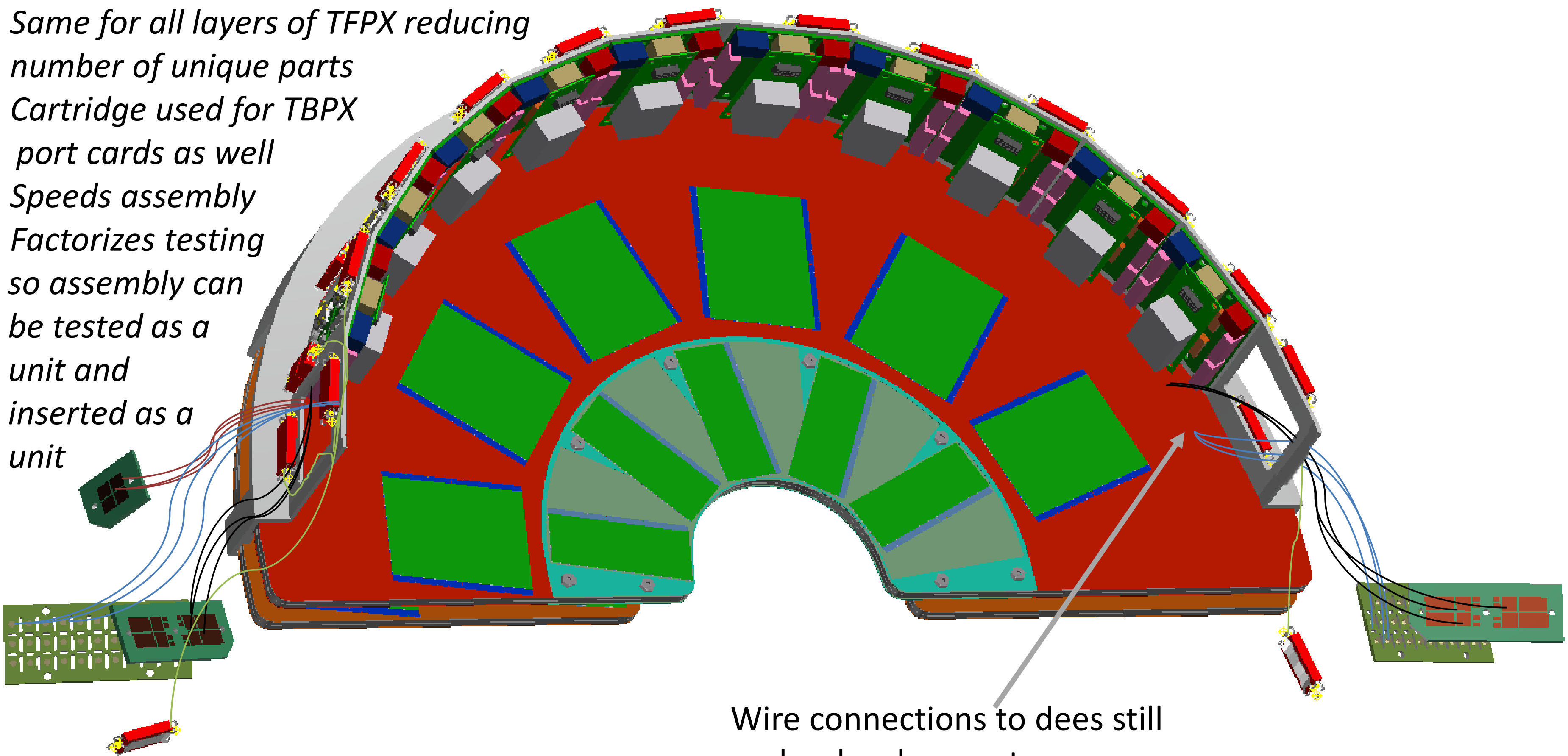
Female PCB's for high voltage, serial power, temperature are wired

Strain reliefs for wire bundles will be designed and be part of cartridge chassis

Assembled cartridge

Modular design

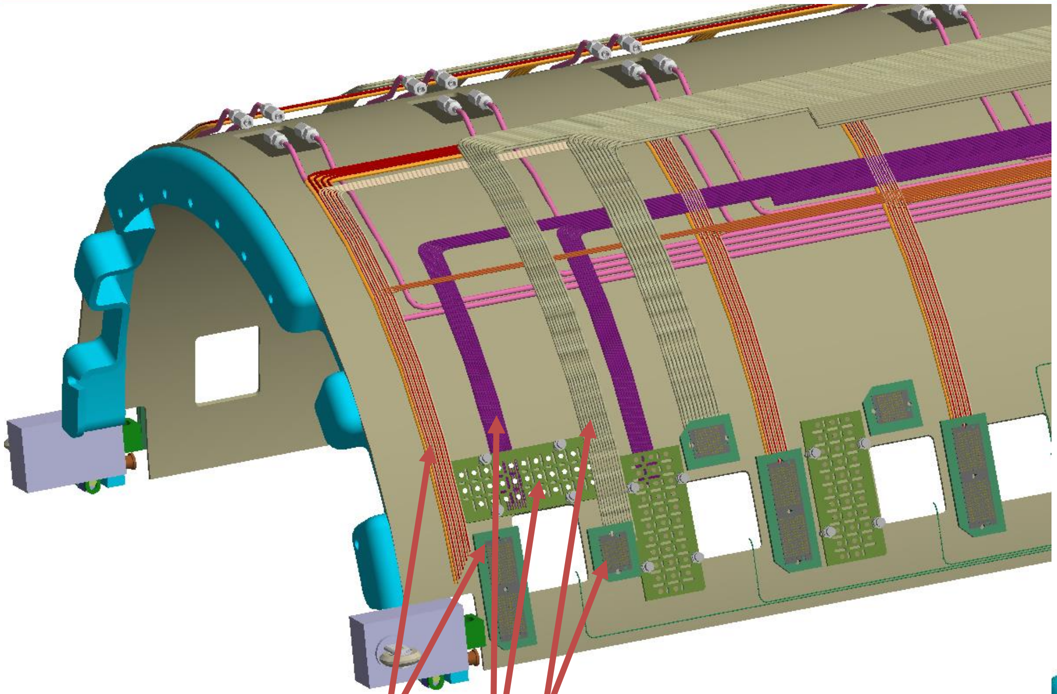
- *Same for all layers of TFPX reducing number of unique parts*
- *Cartridge used for TBPX port cards as well*
- *Speeds assembly*
- *Factorizes testing so assembly can be tested as a unit and inserted as a unit*



Wire connections to dees still under development

Each pigtail bundle exits to either side of the service cylinder to attach to its male counterparts

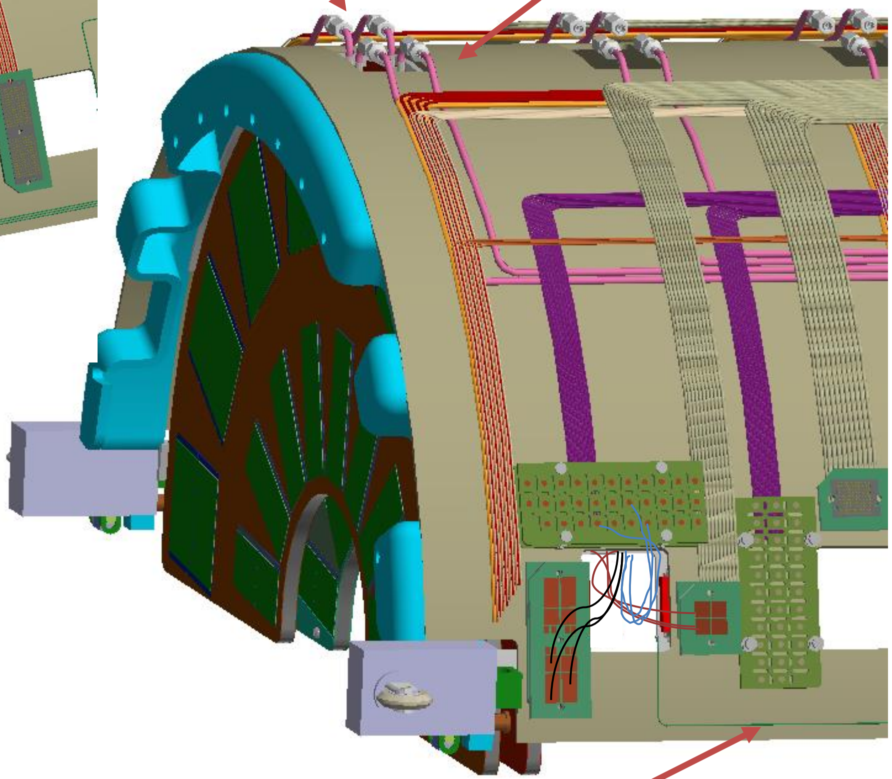
Attaching cartridge to service cylinder



Permanent wires end to male PCB boards attached to service cylinder

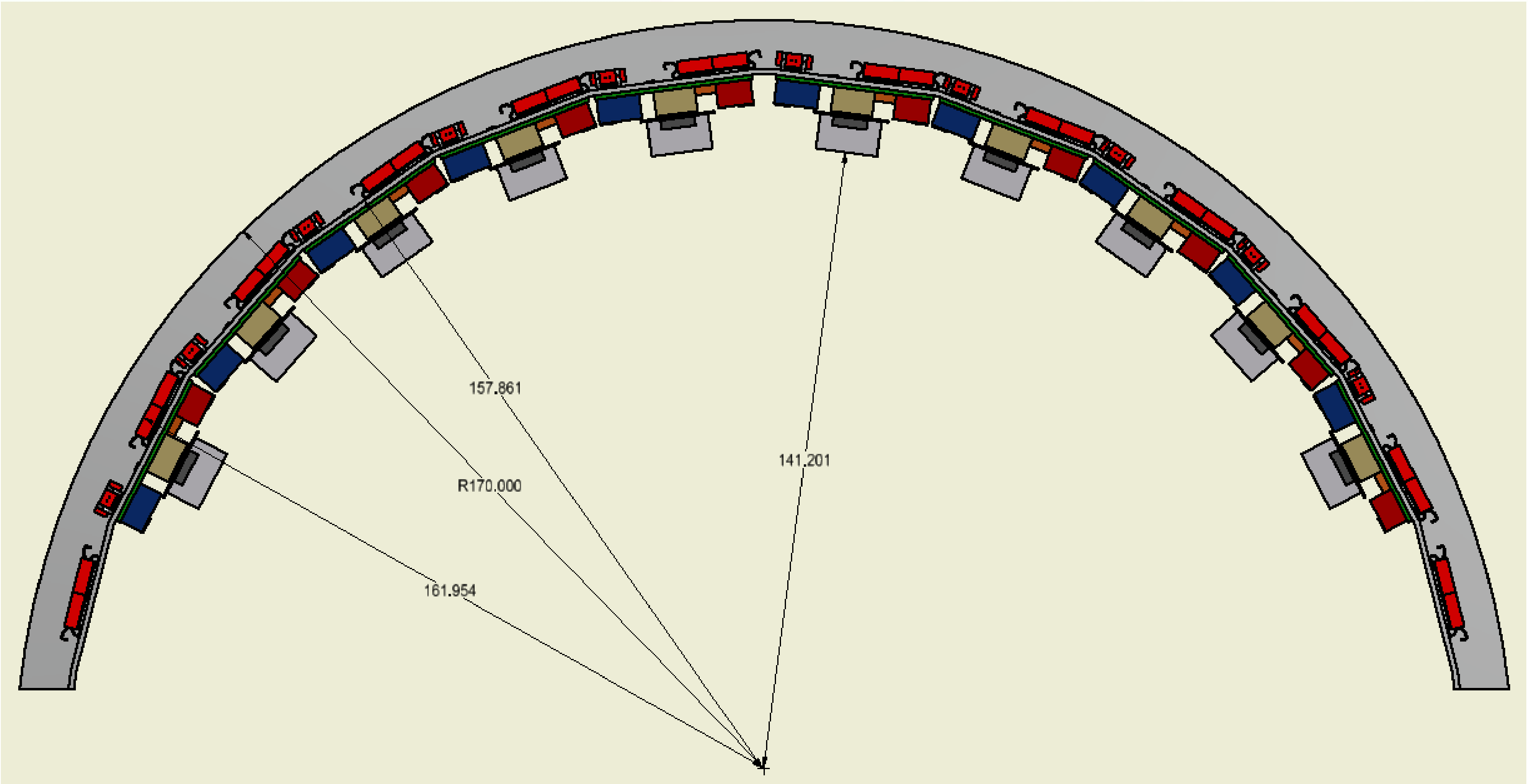
Dee female fitting for cooling tubes connected to male fittings permanent on service cylinder

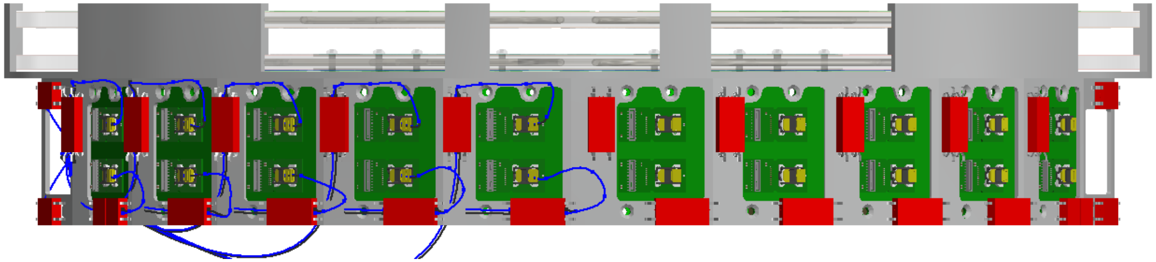
Space available IF cooling needed for port cards



24 wire fiber optic bundle to PP0

Cartridge to be optimized





SERVICE CYLINDER

¼ IT wiring/plumbing estimates

IT Services Placeholder Values
ITServices_v1.4

New wire diameters

	dia. from IT services V1.4 (mm)	New diameter of cable (mm)	count TBPX –Long only	count TFPX	Comments
8 amp SP conductors	2.2	1.53	28 (0L1,0L2,12L3, 16L4)	64 (2 in per dee, 2 out per dee)	
4 amp SP conductors	1.7	1.10	20 (6L1,14L2,0L3,0L4)	64 (2 in per dee, 2 out per dee)	
HV conductors	1.1	0.56	240 (30L1, 70L2, 60L3, 80L4)	432 (22 ODD, 32 Even)	
HV return conductors	1.1	0.56	24 (3L1,7L2,6L3,8L4)	64 (4/dee)	
Temperature conductors	0.5	0.5	48 (6L1, 14L2, 12L3,16L4)	128 (8 wires/dee)	2 wire type rtds (24 AWG solid core wire kapton). Need to add RTDs and wires to measure on service cylinder
LpGBT power conductors	? (1.524)	1.10	86 (2 wires/port card)	160 (2 wires/port card)	Sized assuming similar resistance loss as 4 am SP conductors
Fiber optic cables	?	0.5 (guess)	9 (3L1,3L2,1L3, 2L4)	16 (1/dee)	Assuming fiber bundle with 12 connections
Port Cards			43 (15L1,14L2,6L3, 8L4)	80 (5/dee)	
Cooling tubes	2.2		20 (loops 1L1, 2L2,3L3, 4L4)	32 (2/dee)	

Need to understand number of port cards and Elink connectors for TBPX to finalize number of port cards needed for TBPX

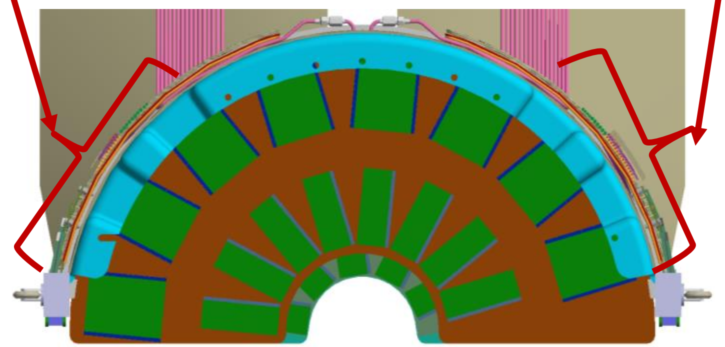
Charlie Strohman (https://indico.cern.ch/event/709400/)

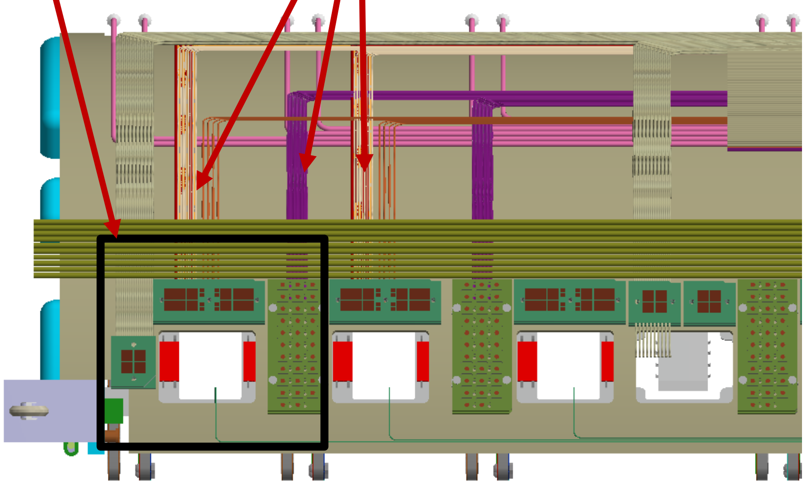
TFPX connector break down

- Connectors placed on the service cylinder for TFPX are mirrored so that odd and even dee side of service cylinder is similar (no port card interposer on odd dee side)
- For TFPX each connector is near the port card assembly exit on the service cylinder
- Wires for male connectors attached to service cylinder are flushed and permanent to service cylinder. TBPX services are placed on top of TFPX permanent services

Odd dee
TBPX L1 & L3

Even dee
TBPX L2 & L4

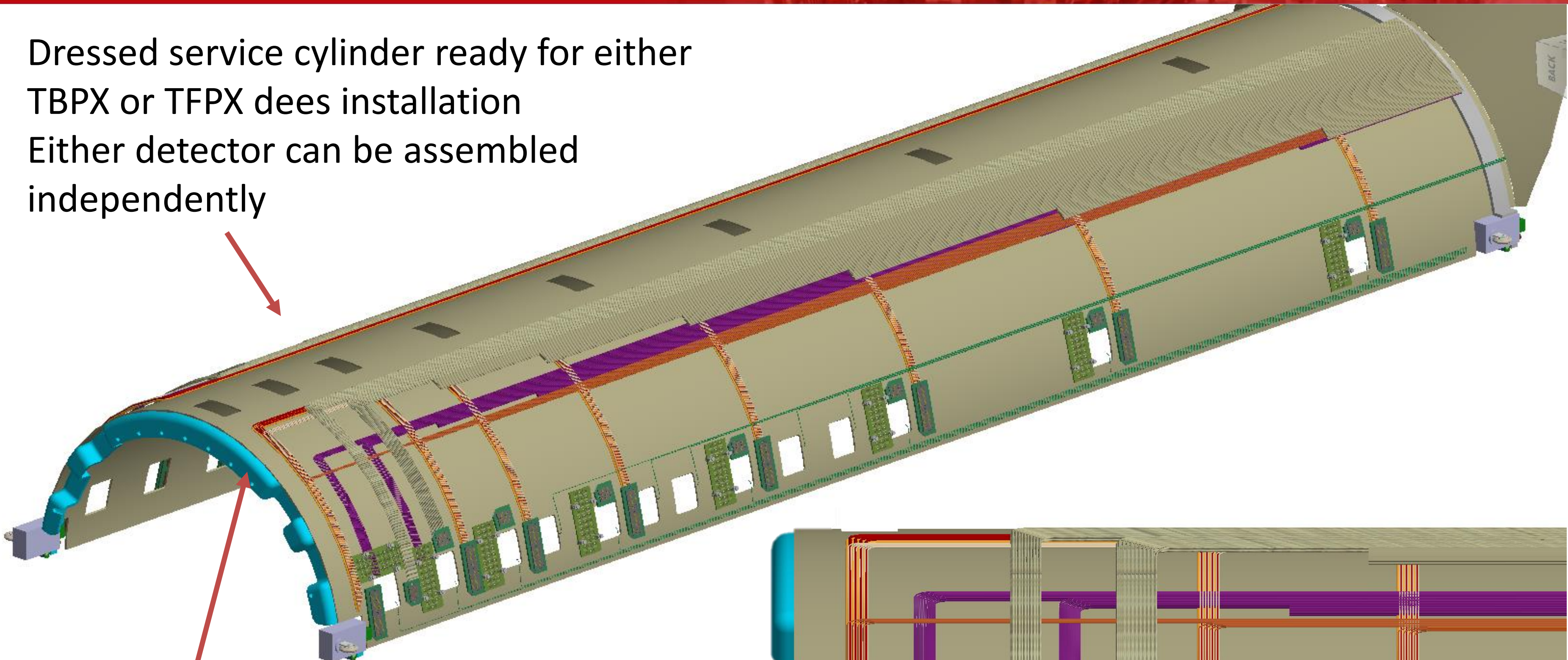




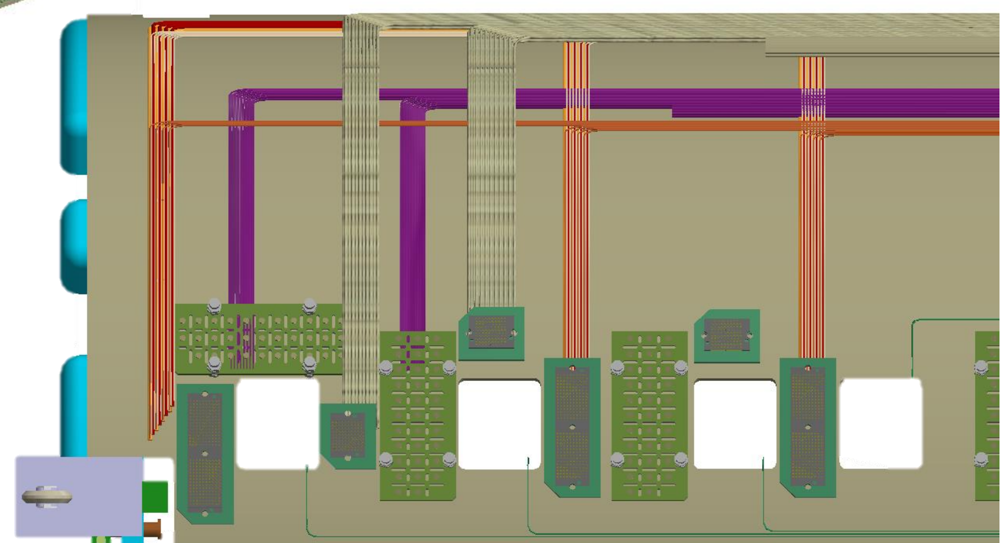
Dee	300 pin interposer	100 pin interposer	HV-in PCB board	Cassette/port card assemblies
Even	8	8	8	8
Odd	8		8	
Total	**16**	**8**	**16**	**8**

TFPX wiring permanent services

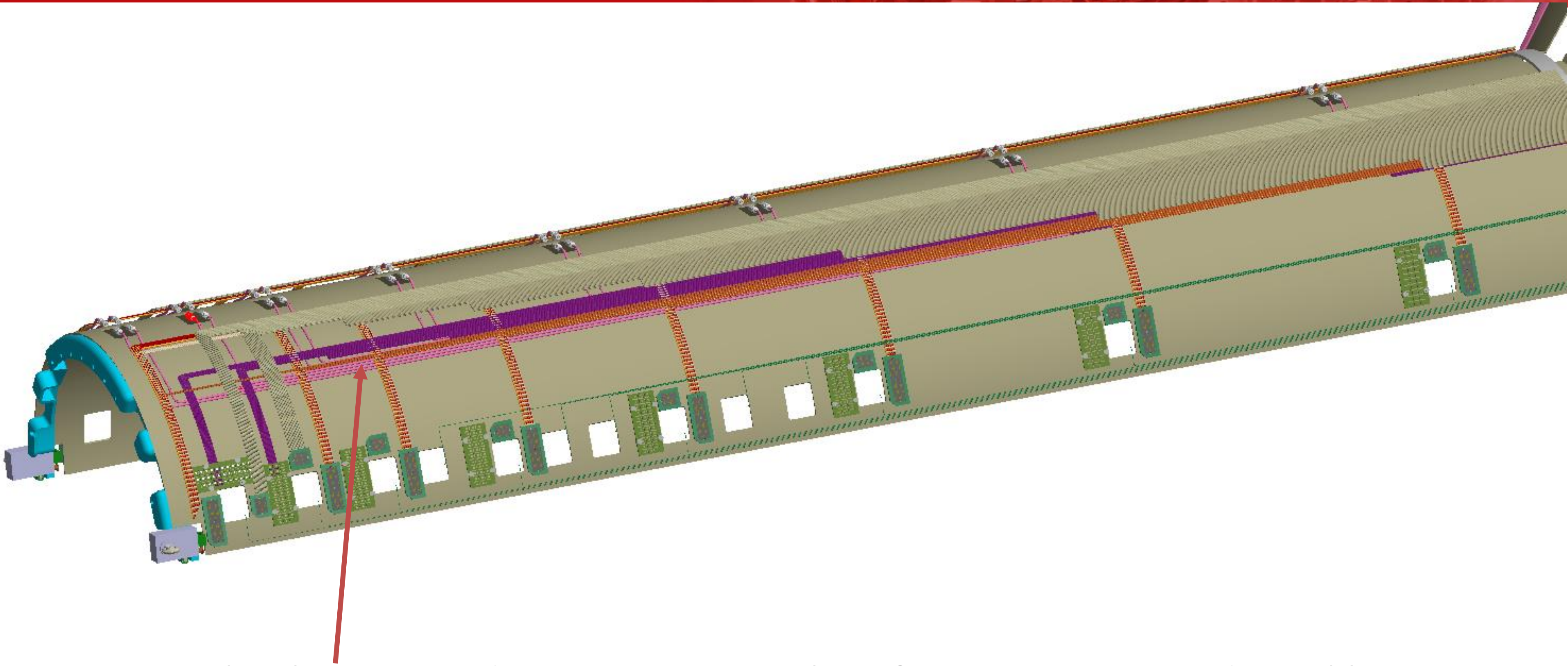
- Dressed service cylinder ready for either TBPX or TFPX dees installation
- Either detector can be assembled independently



- Interface flange holding the cantilevered TBPX detector
- Same mechanism holds the wheels for the service cylinder (wheel mechanism from TBPX phase 1)

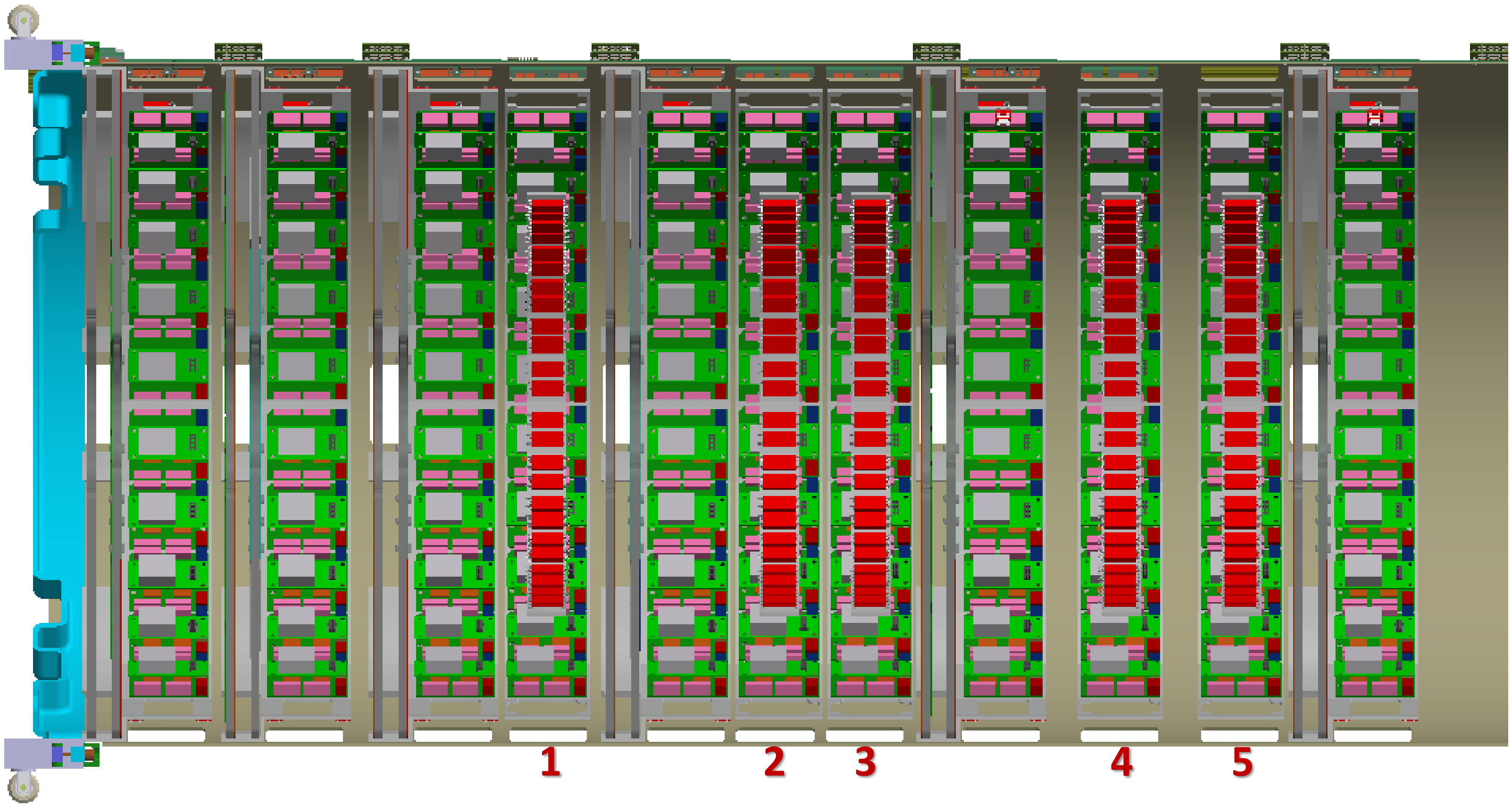


All TFPX services



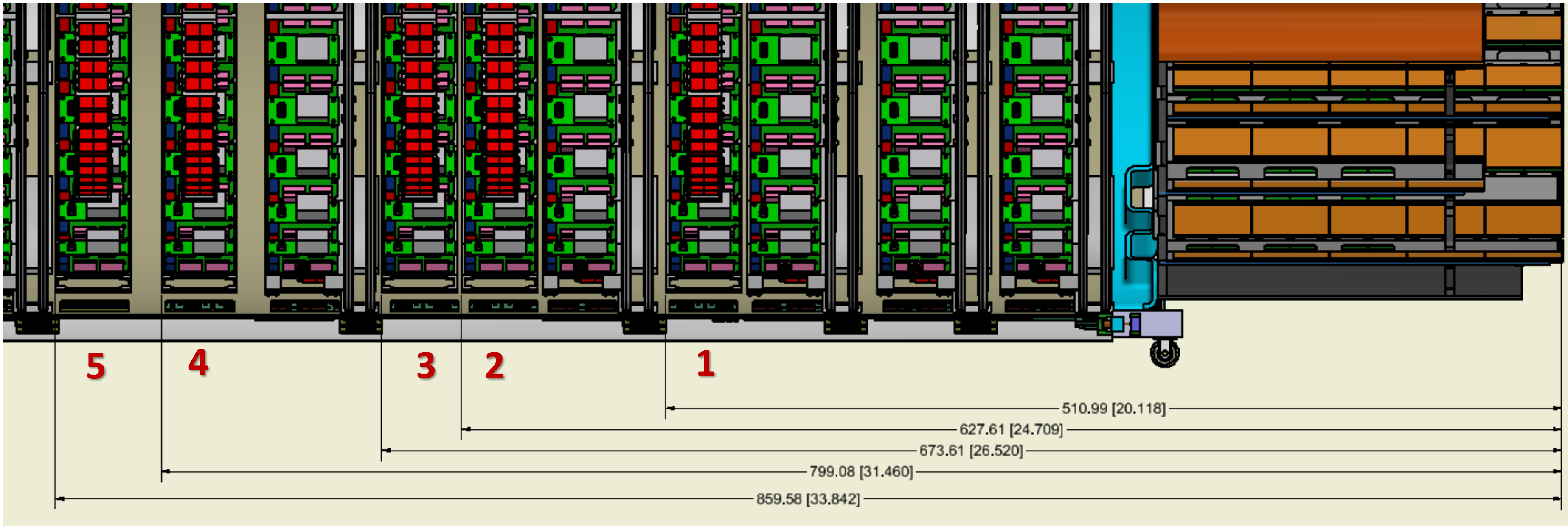
- Cooling lines run under wires to remove heat for services wires and possibly begin the onset of boiling (need to verify total heat load)
- Capillaries could connect to detector dees directly with tube step up happening inside service cylinder (not much coiling at PP0). Need to work on this
- Space available for cooling loops for port cards IF needed

TBPX port cards



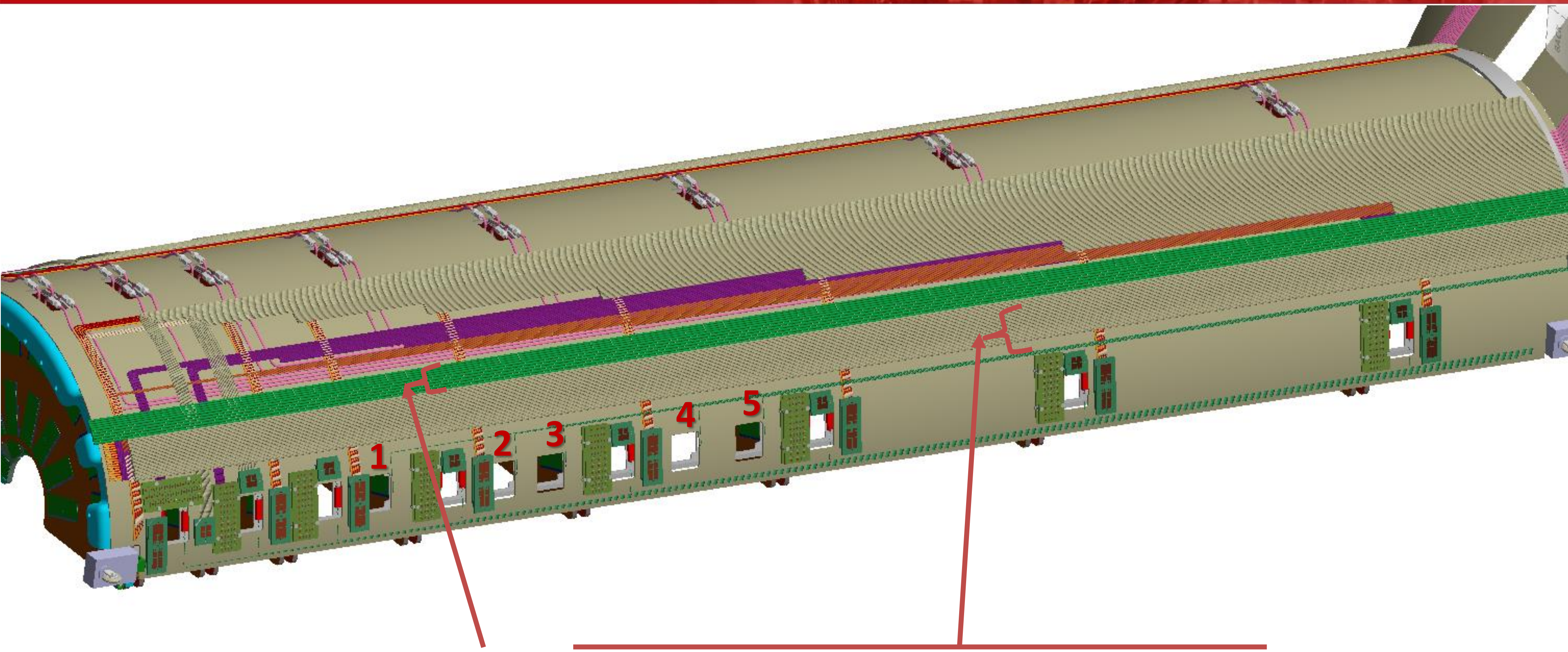
- Due to space constraints and to reduce material near z=0 region TBPX port cards are installed inside TFPX service cylinder
- 50 total port cards in 5 cartridge like assemblies
- Cartridges with layer of red fiber optic cables used only to show TBPX port card cartridges

E-link length for TBPX



- The last port card assembly is successfully placed between layers 3 and 4 of TFPX by moving TFPX layer 3 closer to Z=0 by 15 mm
- New length to last port card assembly is **0.85m** (length of E-Link cable longer due to routing in R; not shown)
- To keep TBPX e-links connections within 1m, routing of cabling will need to be optimized. Otherwise last port card assembly will need to be placed on top of TBPX since there is no space closer

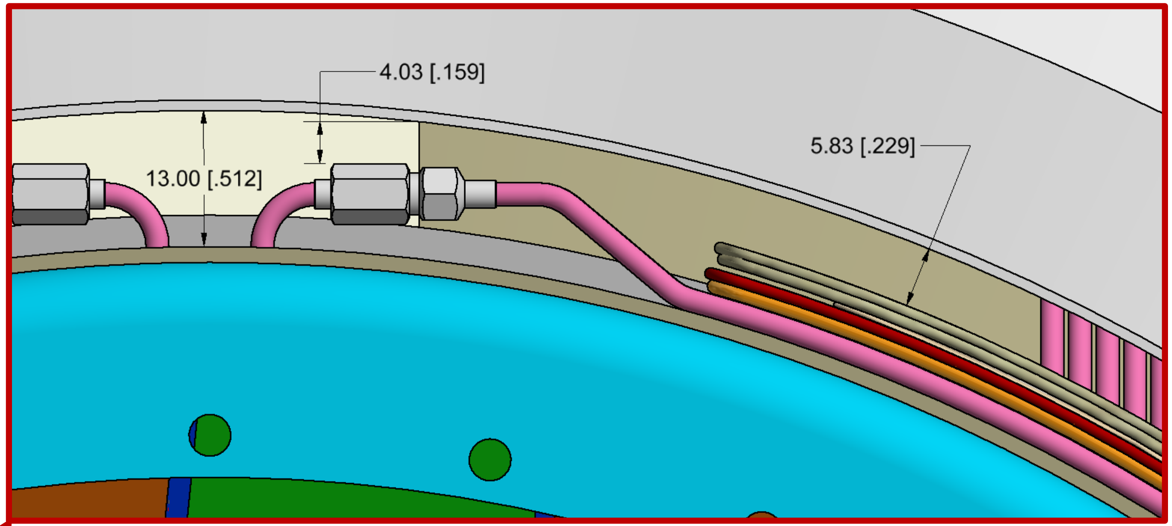
TBPX services

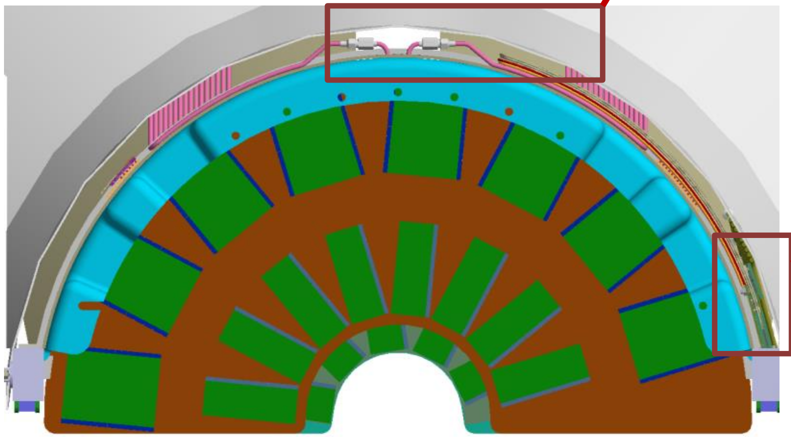


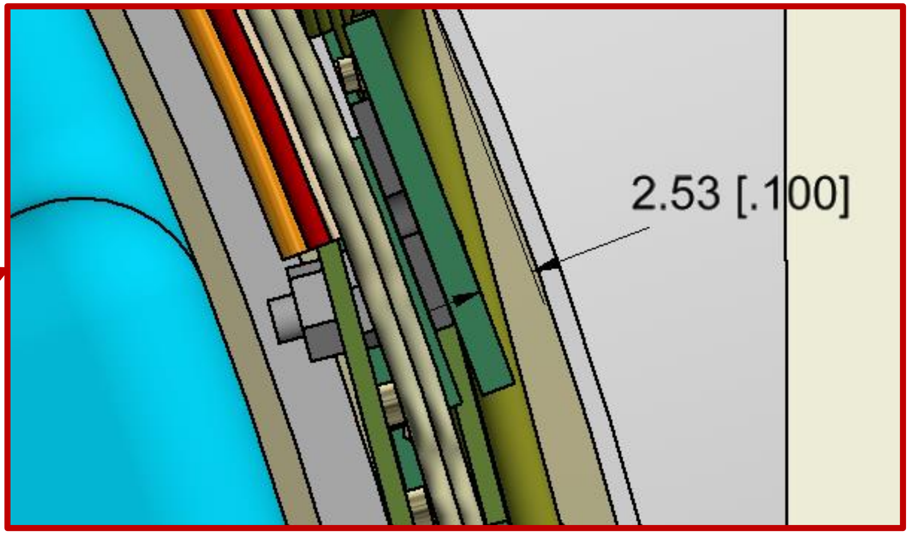
- TBPX cooling lines (green), high voltage, serial power, and temperature run directly to PP0 from the detector (space for intermittent connectors if needed is possible)
- E-links run on top of TBPX wires and into each port card location (1 through 5) possibly using an interposer as interface between TBPX cartridge and service cylinder
- TBPX cartridges can be tested with detector and installed with detector following same testing technique for TFPX

Integration space constraint changes can be reached: Theoretically

- Models show best case scenario 2.53mm between connectors to upper boundary limit (not optimized)
- Wiring (due to smaller ID changes) and cooling (still under discussion) show space may be enough. Mockups needed to verify

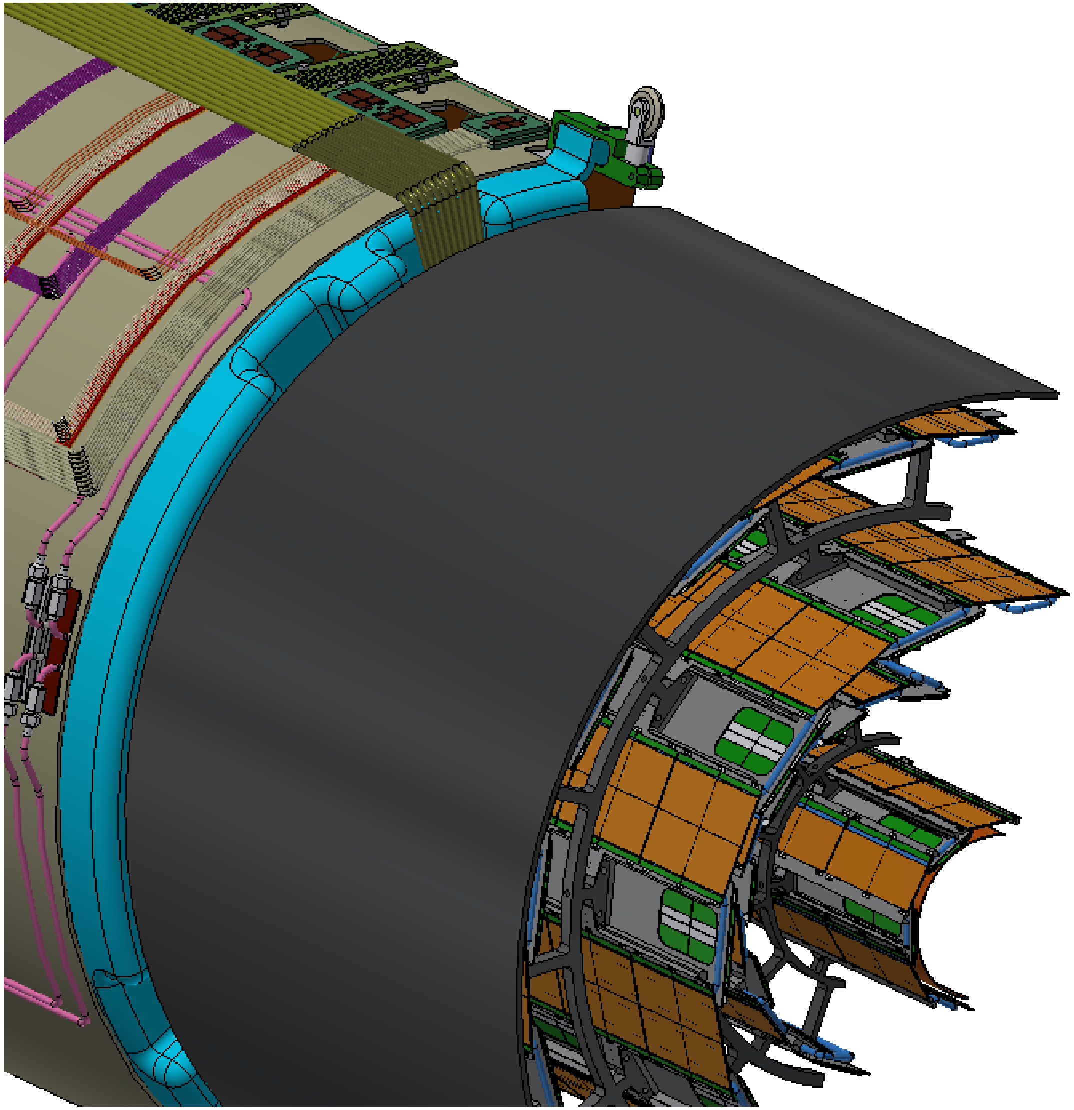






OTHER MECHANICS RELATED ISSUES

TFPX – TBPX Interface Flange

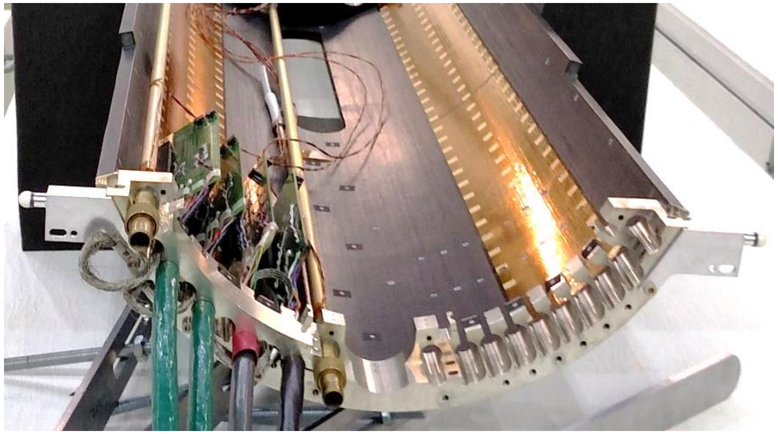


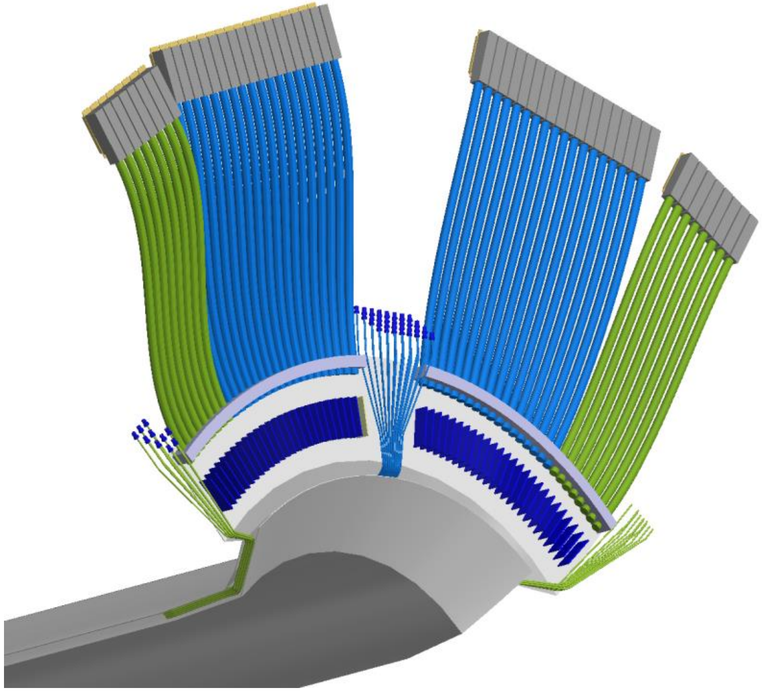
Requirements

- Structurally mount TBPX to TFPX service cylinder
- Structurally support Service Cylinder wheels used for installation and removal
- Kinematically align TBPX to TFPX and CMS
- Allow cooling tubes and TBPX cabling to be installed into TFPX service cylinder
- Strain relief for TBPX tubes and cables

PP0 wiring connections

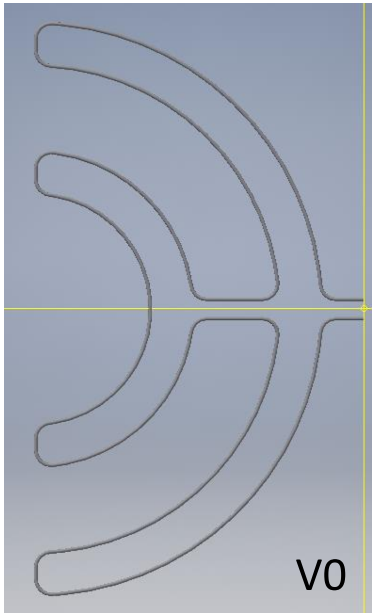
- All wiring from TFPX and TBPX must transition to larger cable bundles at PP0
- Cable bundles larger than height allowance in service cylinder
- Old transition PCB card in a spoke direction used for phase 1 FPIX will not work since this space is not taken by TEPX in phase 2
- Cards will be mounted on a structure part of the service cylinder. Design under development

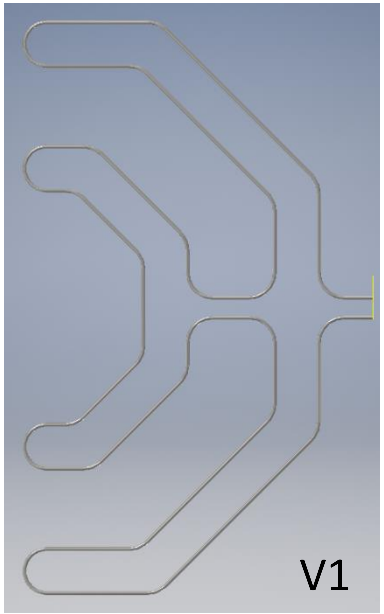


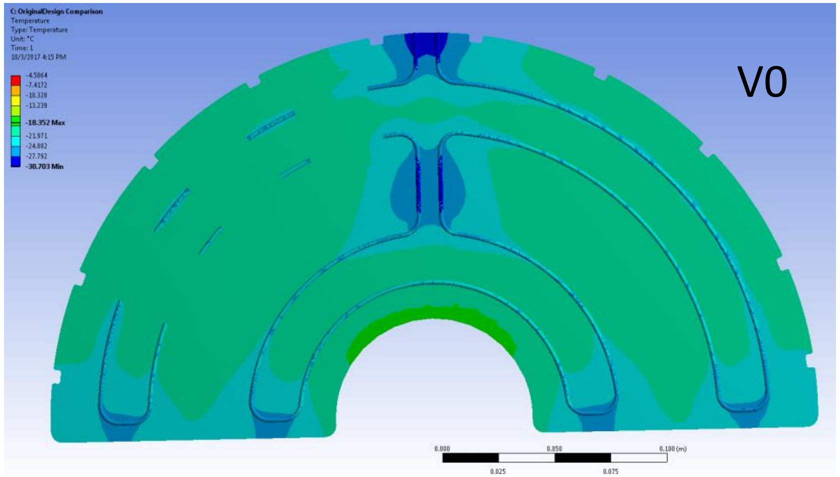


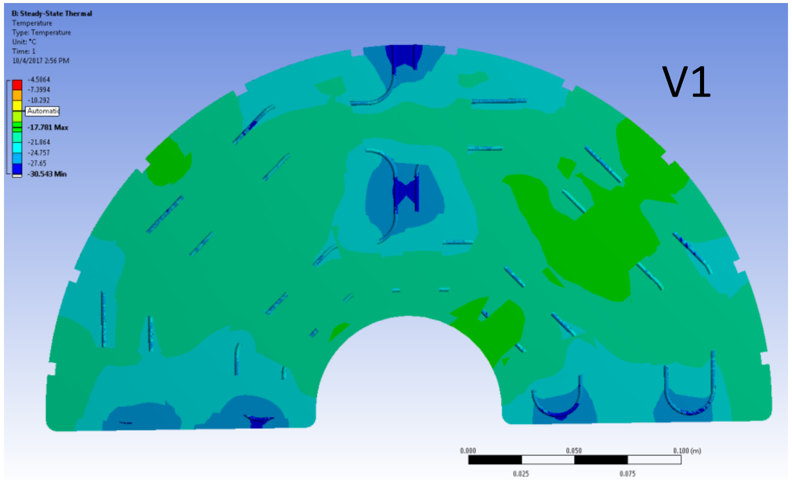
DEE geometry: Cooling tube routing

- To reduce manufacturing time using a jig, cooling tube design changed to have 45, 90, and 180 degree curves only. All at with ½ in (12.7 mm) radius
  - Decrease hand bending and production time (2 days to 1 hour)
  - Better repeatability
  - No significant change in thermal performance seen in ANSYS simulations ~1°C higher for new design (simulation for comparison only, not complete dee simulation)



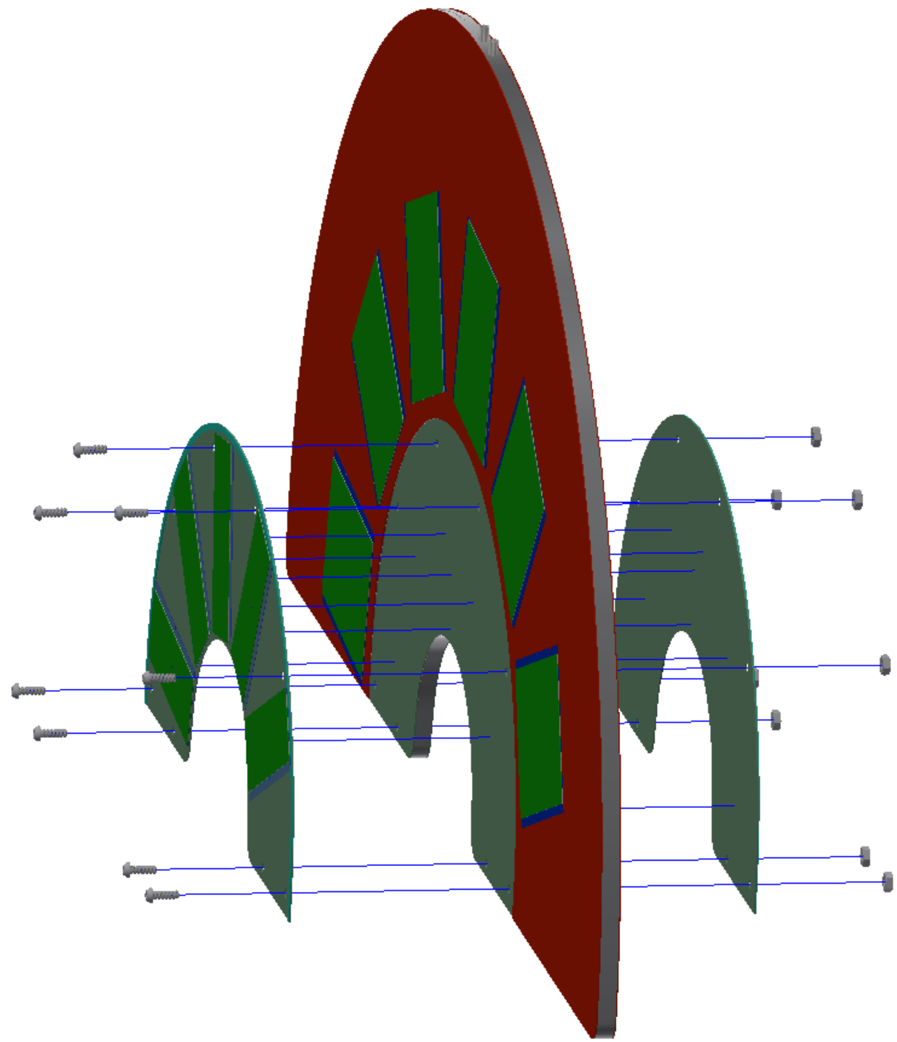






Inner Composite plate removed

- Additional CF piece with modules already glued and wired is used (pre-assembled)
- Tubes, foam, and 2 to 3 layer CF stay in place (layup or machining needs to be explored)
- Easy to remove-fast installation/maintenance
- More mass due to CF additional layer, thermal contact material (under study), nuts and bolts (materials also being studied)
- Thermal interface must be studied
- Mechanically weak, must be optimized to hold the weight and mechanical CF structure on top
- Even with all problem areas, of 7 possible scenarios this was easiest to manufacture and maintain



Concluding remarks

- TBPX services still under development. Figuring out E-link type of connection is key to last interposer design that needs to fit near opening of port cards and total number of port cards for TBPX
- Design of removable inner ring for odd dee is under development
- Testing and simple mockups construction to begin this summer to verify CAD models and test installation procedure

THANK YOU!
QUESTIONS?

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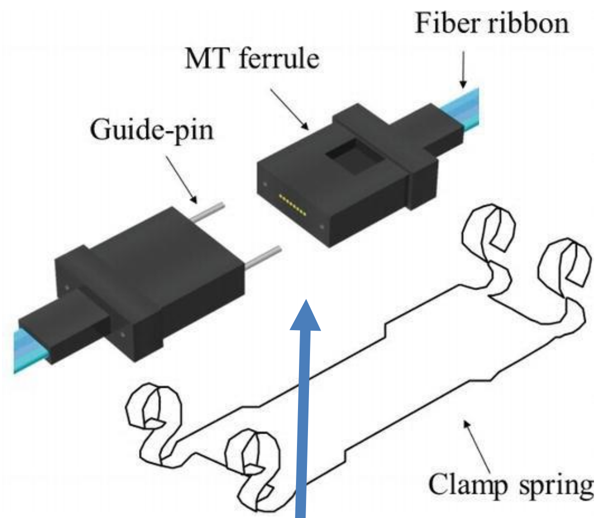
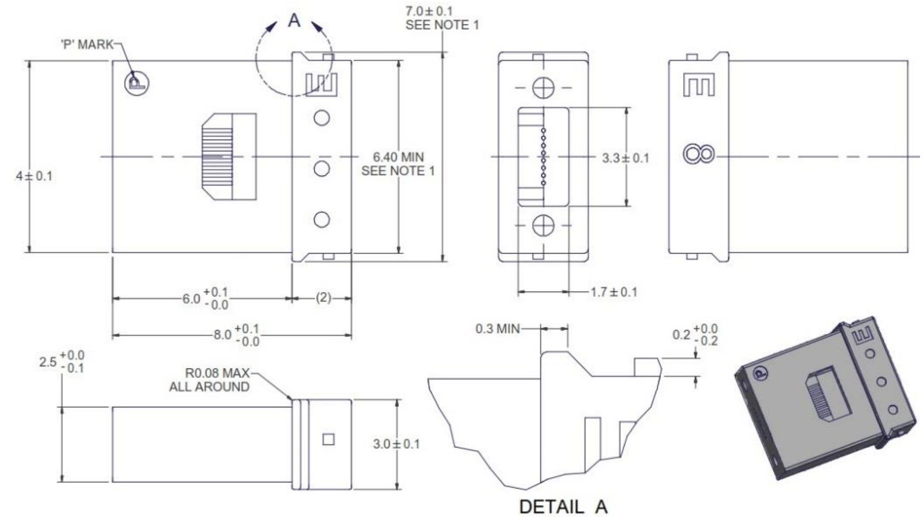
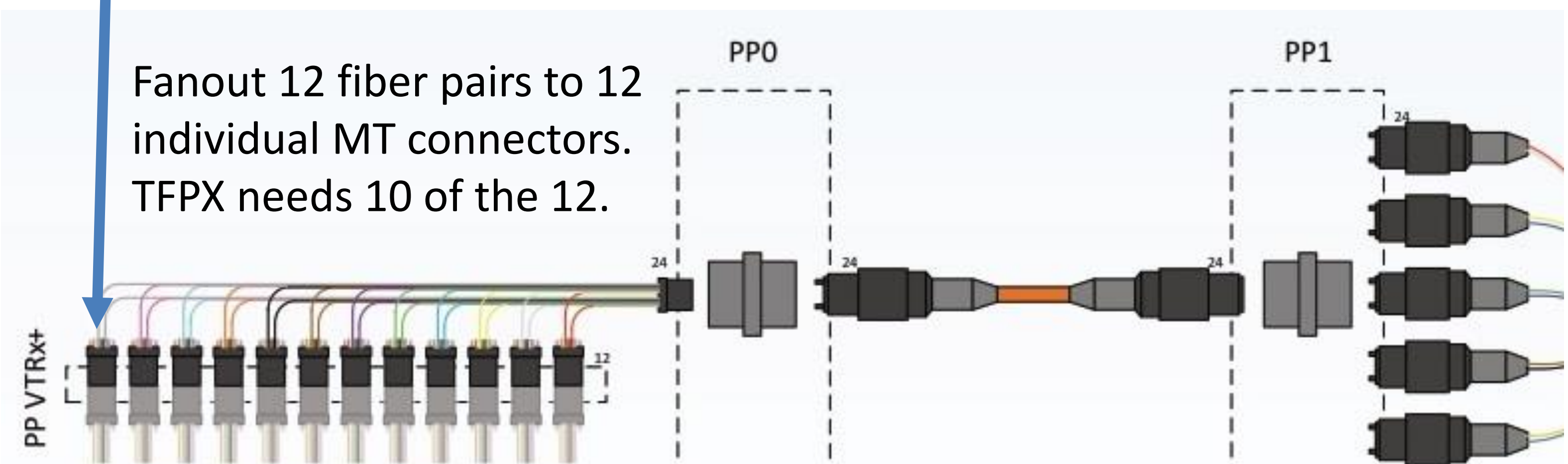
MT-MT Fiber Junction





Fanout 12 fiber pairs to 12 individual MT connectors.
TFPX needs 10 of the 12.



1 coupler per port card
Downlink fiber
Uplink fiber