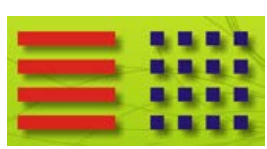




# VXD Services & Space Issues



# Issues of Limited Space



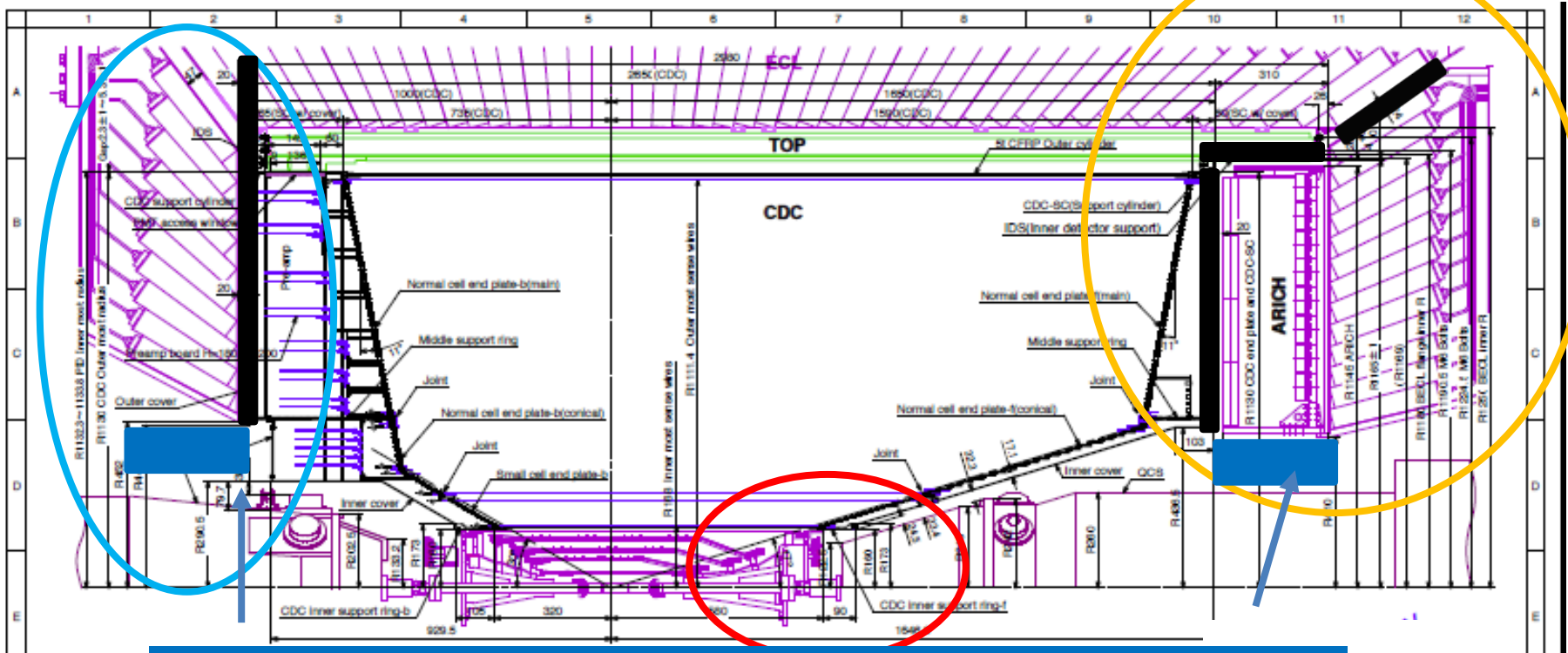
Four critical areas:

**BWD area:** many cables, but space seems sufficient

**FWD area and chicane:** Very tight, especially around the ARICH region

**FWD VXD endflange region:** major difficulties, very careful planning necessary

**CDC endwalls:** many cables/pipes to route, very little space (22 mm)



**General rule: all services must have a connection at the docks**



# VXD Cable & Pipe Count



## Services for VXD and Beampipe

compiled by C. Kiesling / T. Ackermann

VXD up to Dock boxes

	Component	Name	Material / shape	Diameter (mm)	# (BWD)	# (FWD)
<b>1</b>	<b>Beampipe</b>					
1.1	Be part	paraffine cooling lines	stainless steel, round	∅ 6.0	1	1
1.2	croched part	water cooling	stainless steel, round	∅ 6.0	4	4
1.3	croched part	BPMonitors	coax	∅ 3.2	8	8
1.4	Bellows	water cooling	stainless steel, round	∅ 6.0	8	8
1.5	2 PT 100	temp sensor (4-wire)	coax	∅ 0.8	8	8
1.6	4 Radiation monit.	diamonds	lemo coax	∅ 1.7	8	8
1.7	leak search pipes			3.0	2	2
	total				39	39
<b>2</b>	<b>PXD</b>					
2.1	20 Half ladder	Power cables	multiwire + cover	∅ 9.6	20	20
2.21	20 Half ladder	Signal cables	multiwire + cover	∅ 9.4	20	20
2.22	20 Half ladder	CAT 7	multiwire + cover	∅ 5.9	20	20
2.31	3 FOS (position)	fiber optic cable	cladded fibre, round	∅ 1.0	4	4
2.32	4 FOS (environm.)	fiber optic cable	cladded fibre, round	1.0	8	0
2.41	1 Cooling Block	CO2 pipe (in)	ss (with insulation)	∅ 2.6	2	2
2.42	1 Cooling Block	CO2 pipe (out)	ss (with insulation)	∅ 4.0	2	2
2.5	1 Cooling Block	N2 cooling pipes	ss (with insulation)	∅ 2.8	4	4
2.7	1 suction pipe		ss (with insulation)	∅ 6.5	1	1
	total				81	73



# VXD Cable & Pipe Count



3	<b>SVD</b>					
3.1	ladders	signal/power cables	ribbon	32.0 x 1.0	222	122
3.2	6 Radiation monit.	diamonds	lemo coax	∅ 1.7	12	12
3.3	End rings	CO2 pipe (in)	ss (with insulation)	∅ 2.6	6	2
3.4	End rings	CO2 pipe (out)	ss (with insulation)	∅ 4.0	6	2
3.5	Dry N2 in	cold dry vol.	ss (with insulation)	∅ 2.8	0	4
3.6	1 Suction pipe	suction pipe (on end flange)	ss (with insulation)	∅ 6.5	1	1
3.7	64 NTCs	temperature	twisted pair (ribon)	32.0 x 1.0	4	2
3.8	FOS	temp.		1.0	38	0
3.9	4 FOS	distance PXD / SVD		1.0	4	4
	total				293	149

4	<b>VXD</b>					
4.1	Common Ground bus		Cu (with insulation)	20.0 x 2.0 (?)	1	0
4.2	SVD Ground bus to docks		Cu (with insulation)	∅ 2.1	5	3
4.3	FOS	temp. (outer cover)		1.0	6	0
4.4	sniffing pipe	hum. meas. warm dry vol.	ss (with insulation)	6.0	1	1
5.1	2 pressure lines	RVC (on CDC wall)		∅ 6.0	2	2
	total				15	6

**Total on CDC inner wall**

**428**

**267**

5	<b>RVC</b>					
5.2	operation handle			8.0	2	2
5.3	EDI hooks			4.0	0	2

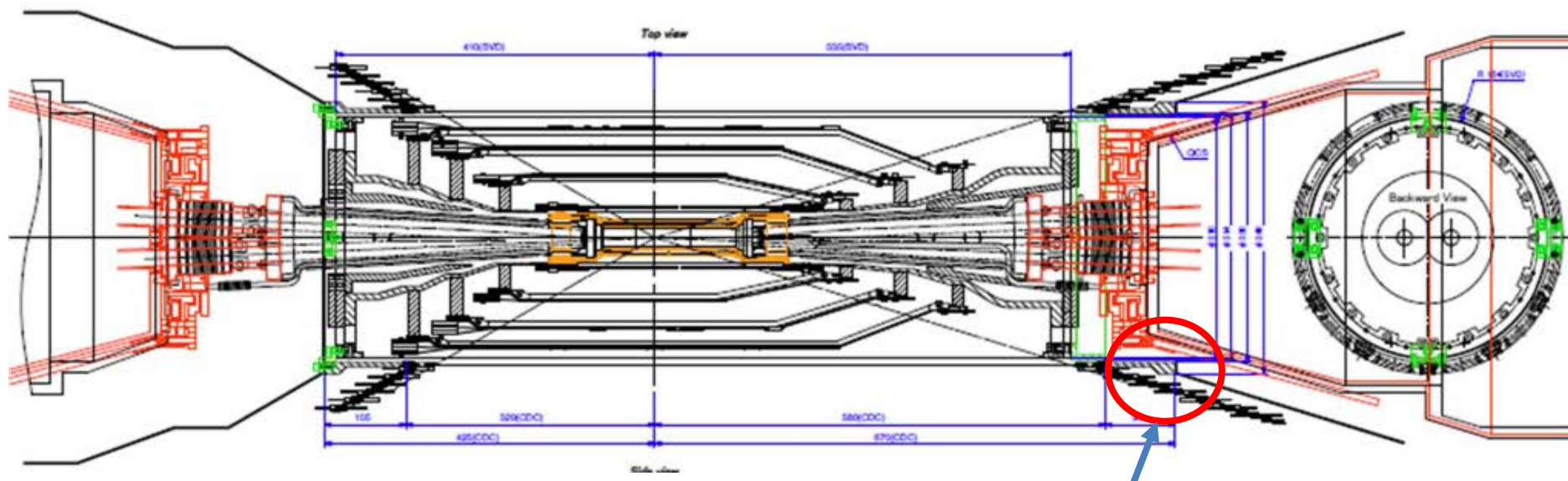
5.5	endoscope channel			10.0	2	2
-----	-------------------	--	--	------	---	---



	total				4	6
--	-------	--	--	--	---	---



# Service Space around the VXD End Flange



Extremely narrow gap in the FWD regions between inner CDC wall and QCS: only 24 mm clearance -> need a special “patch panel cable cage”

For Phase 3: 270+ cables and pipes on each side AND conserve the “7 mm” rule further out in the gap between cables and QCS outer envelope

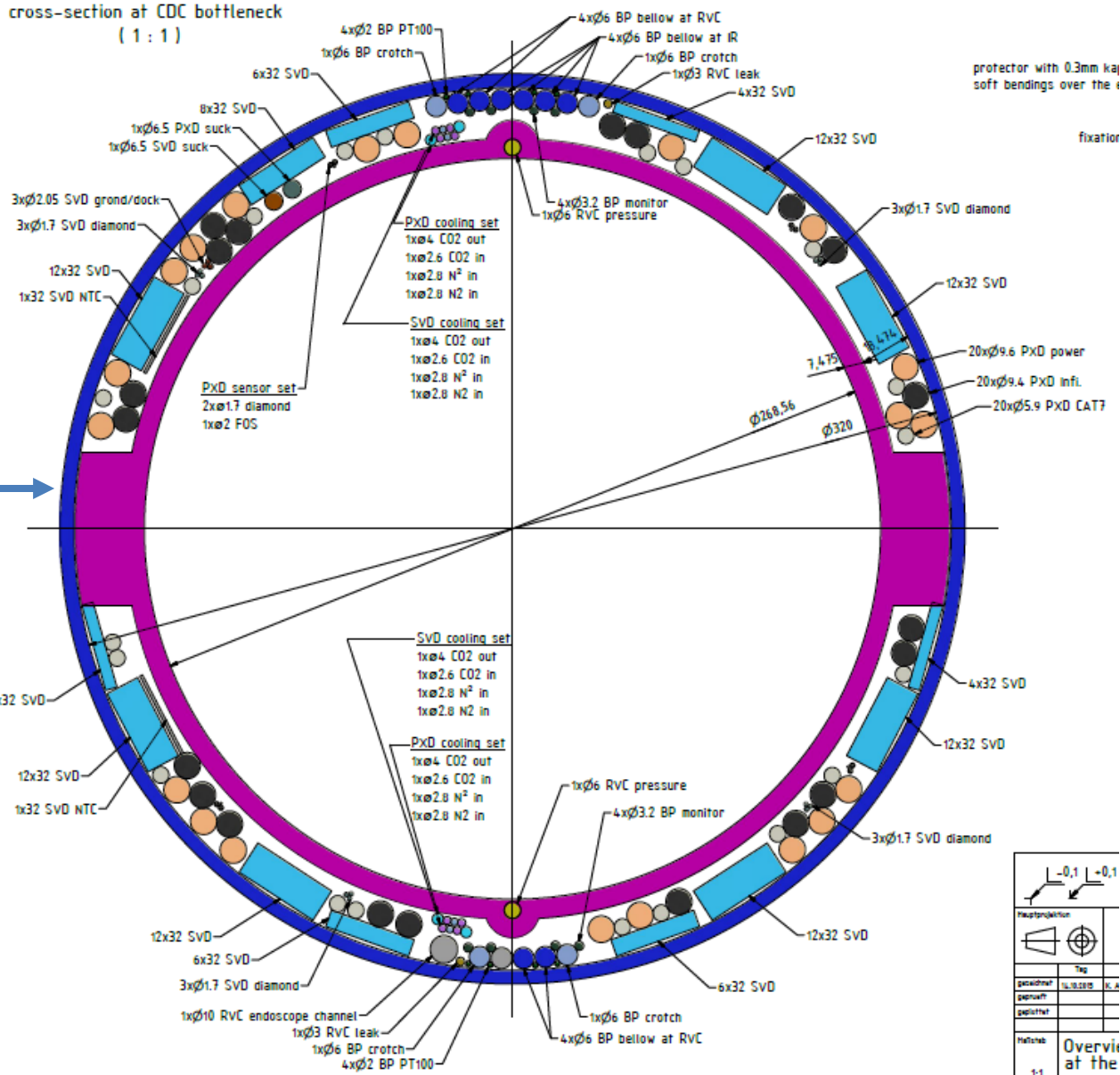
Phase 2 is much easier (much less cables), but good exercise for cables fixtures also needed for Phase 3



# FWD: Extremely Tight Cable Arrangement



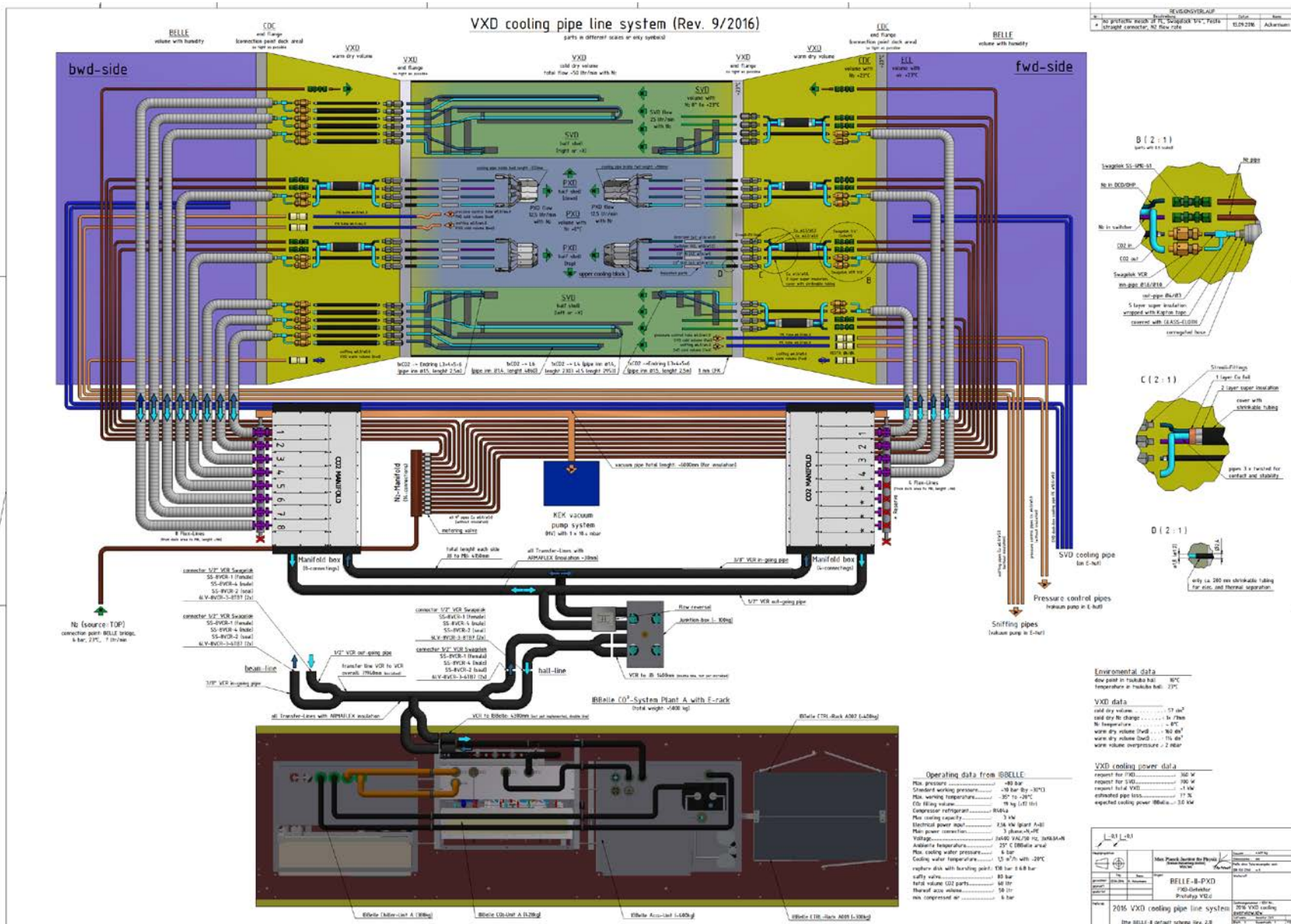
cross-section at CDC bottleneck  
(1 : 1)



violett:  
“forbidden”  
by 7 mm rule



# CO2/N2 Pipe Layout in VXD Area



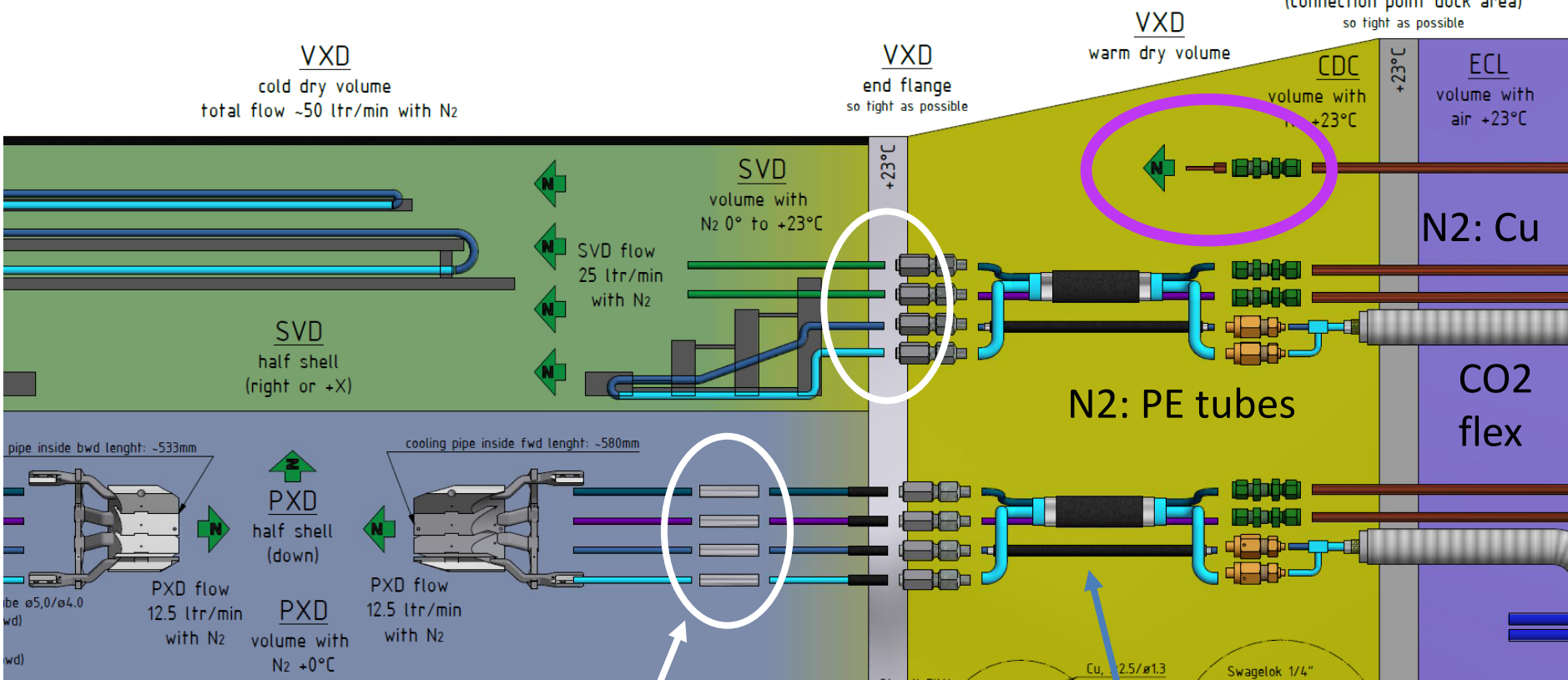


# Cable / Pipe Layout in VXD Area



## D cooling pipe line system (Rev. 9/2016)

parts in different scales or only symbols)



Original isolator position

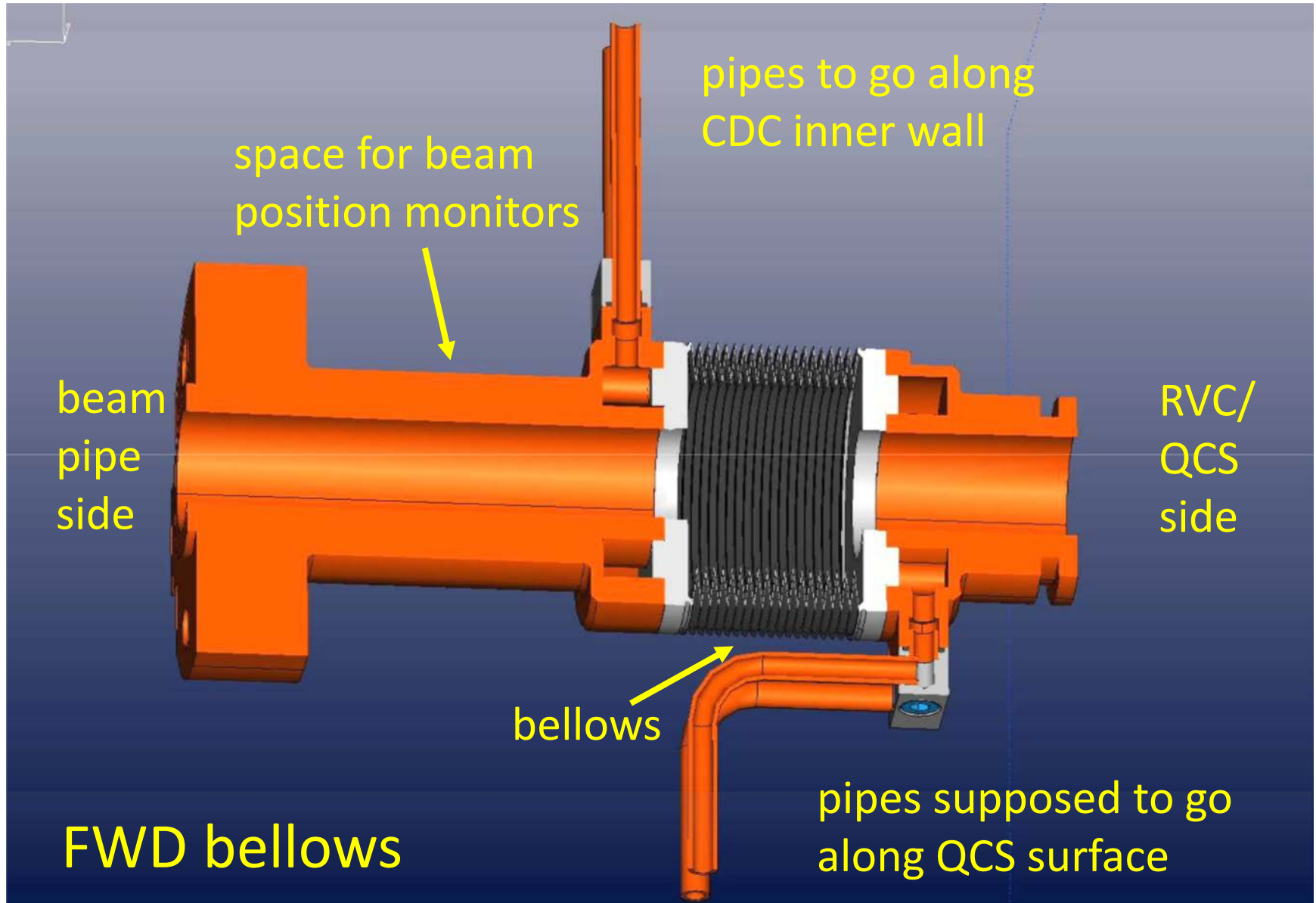
N<sub>2</sub> flow will be ~ 50 l/min in the VXD volume  
2 x 12.5 l/min for PXD, 25 l/min for SVD

CO<sub>2</sub> lines in WDV will be in Cu, not in SUS





# Water Cooling for Bellow Flanges



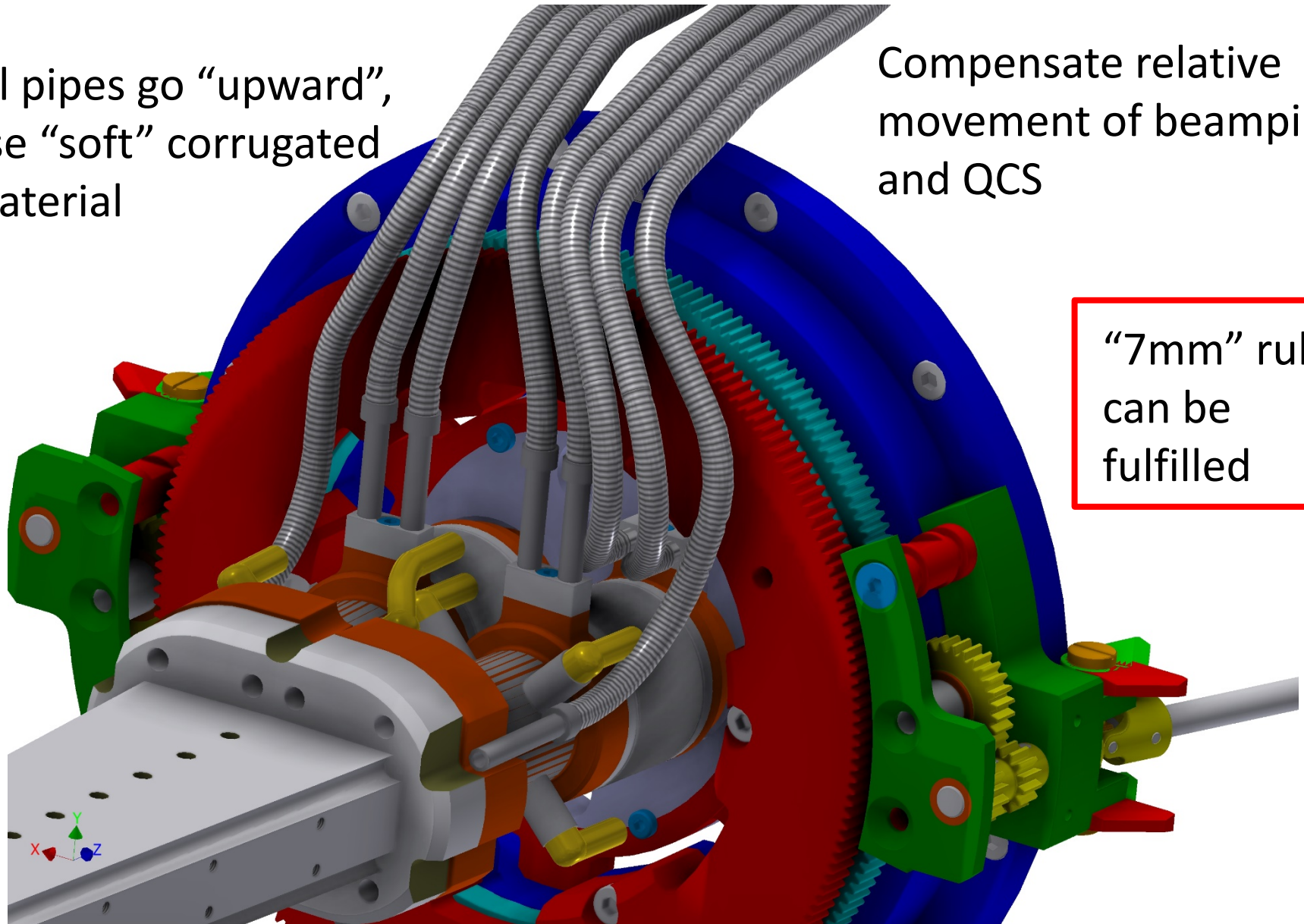


# Beampipe Cooling FWD

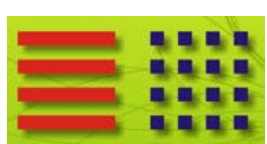


All pipes go “upward”,  
use “soft” corrugated  
material

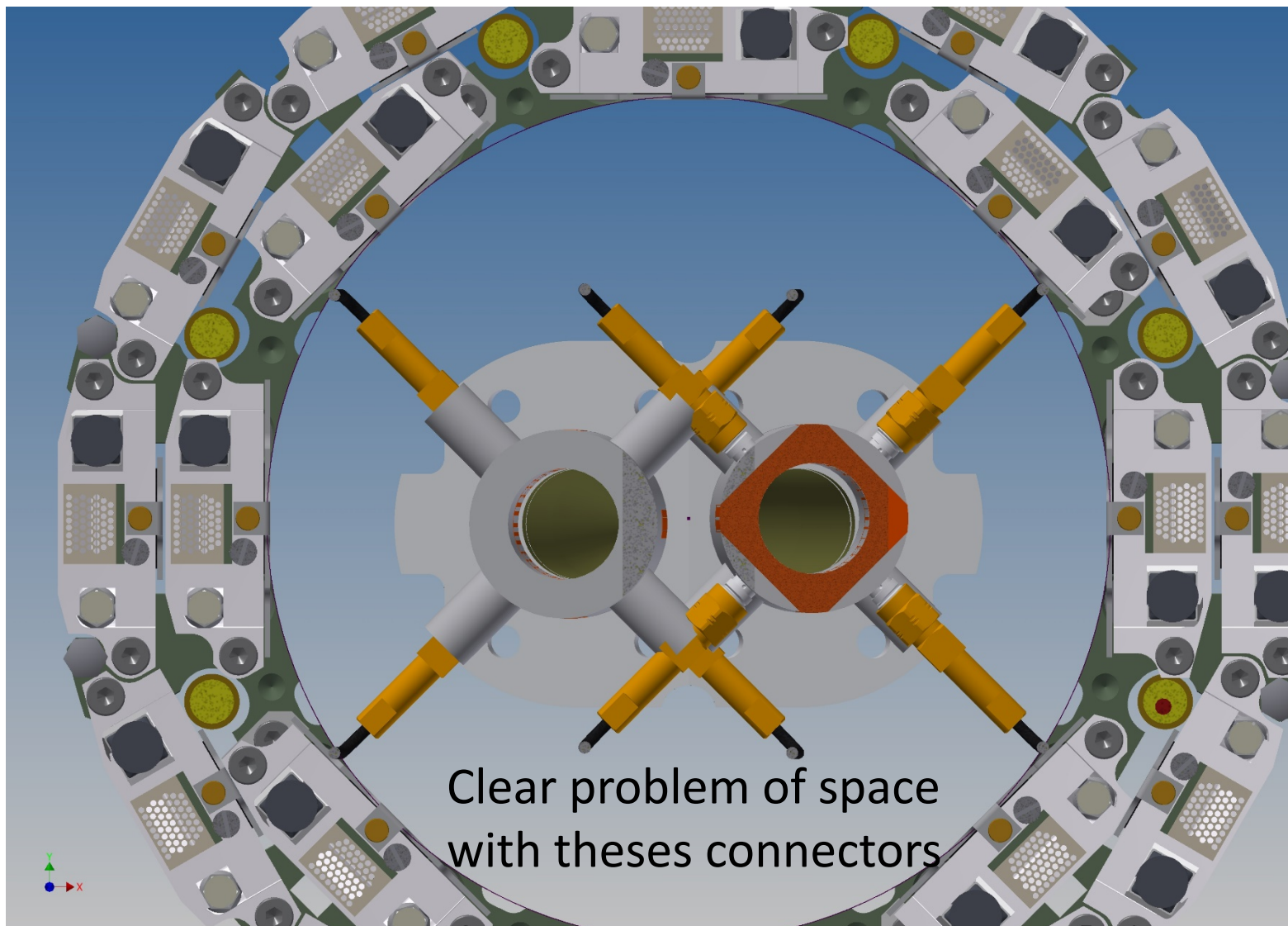
Compensate relative  
movement of beampipe  
and QCS



“7mm” rule  
can be  
fulfilled

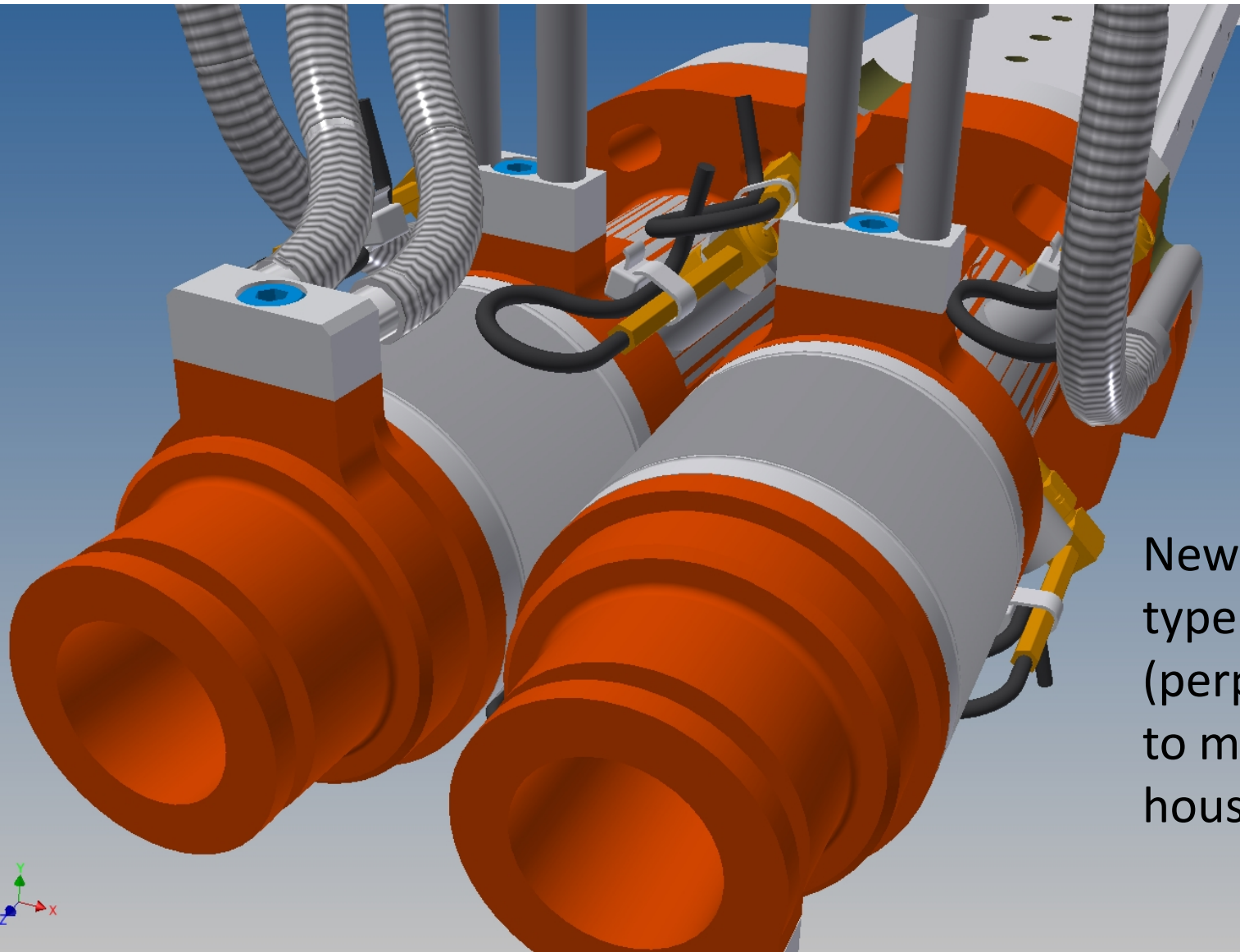


# Beam Position Monitors





# Beam Position Monitors



New connector type chosen (perpendicular to monitor housing)

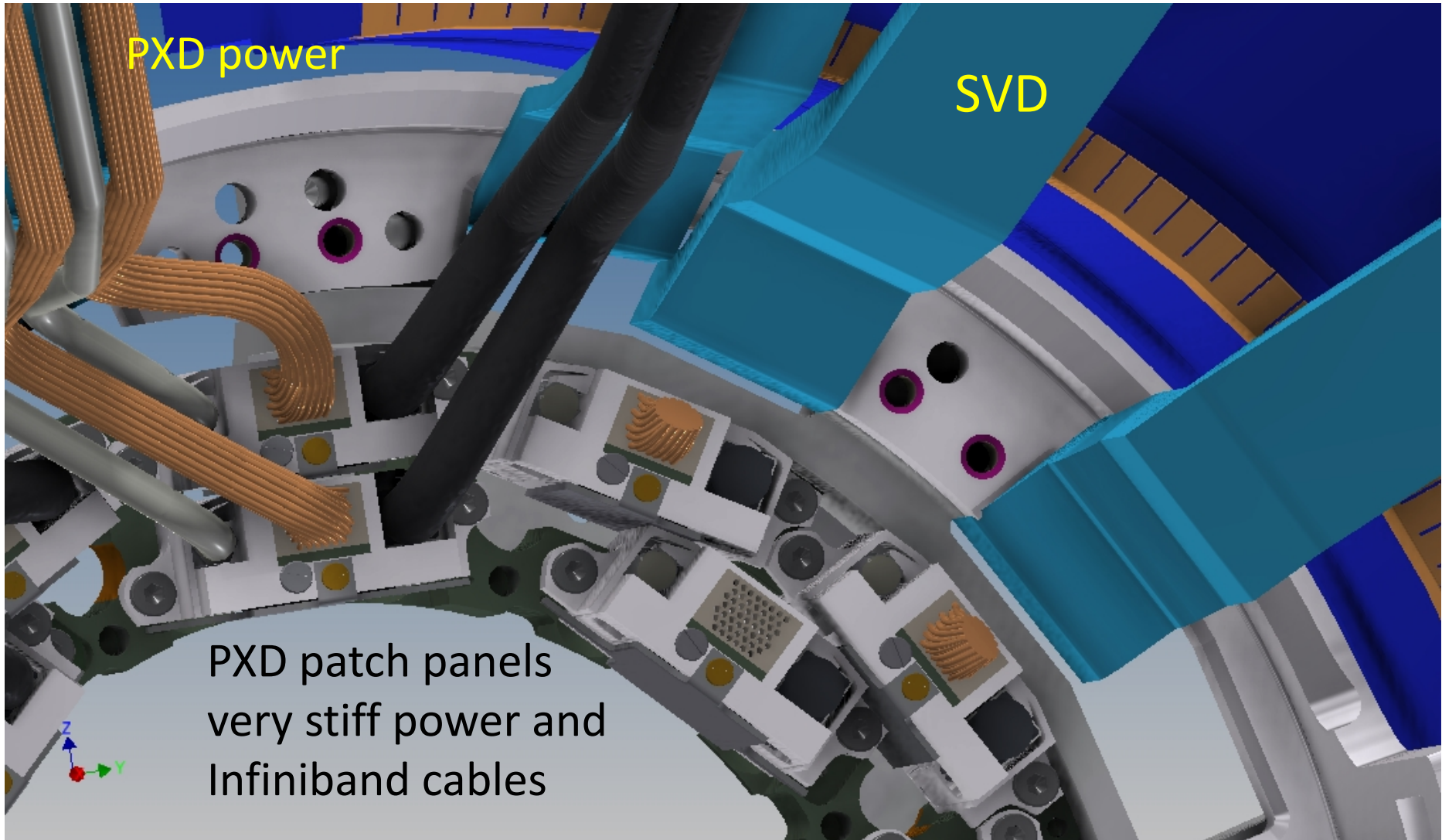


# VXD End Flange Region



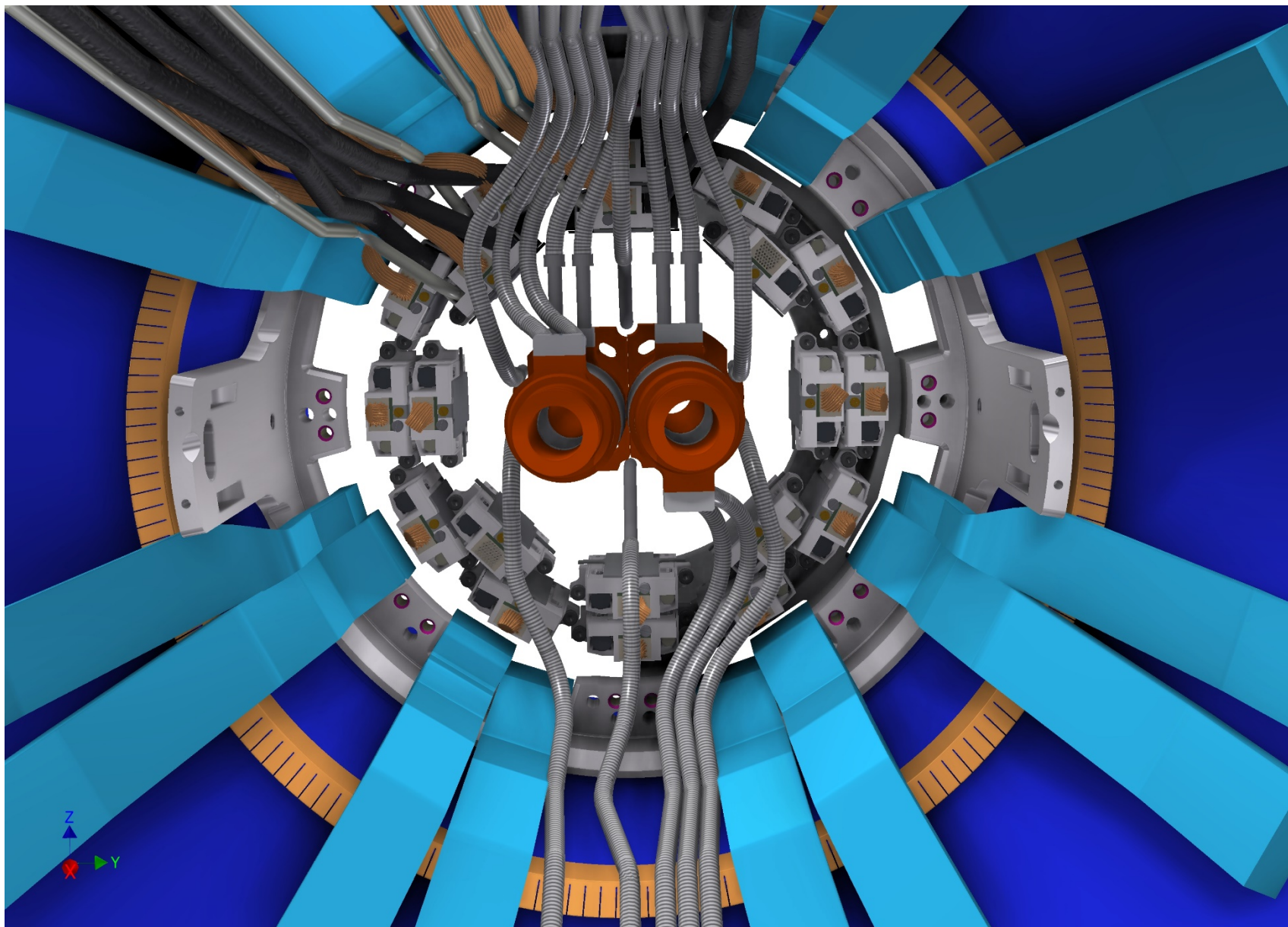
PXD ctrl

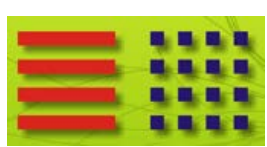
PXD data



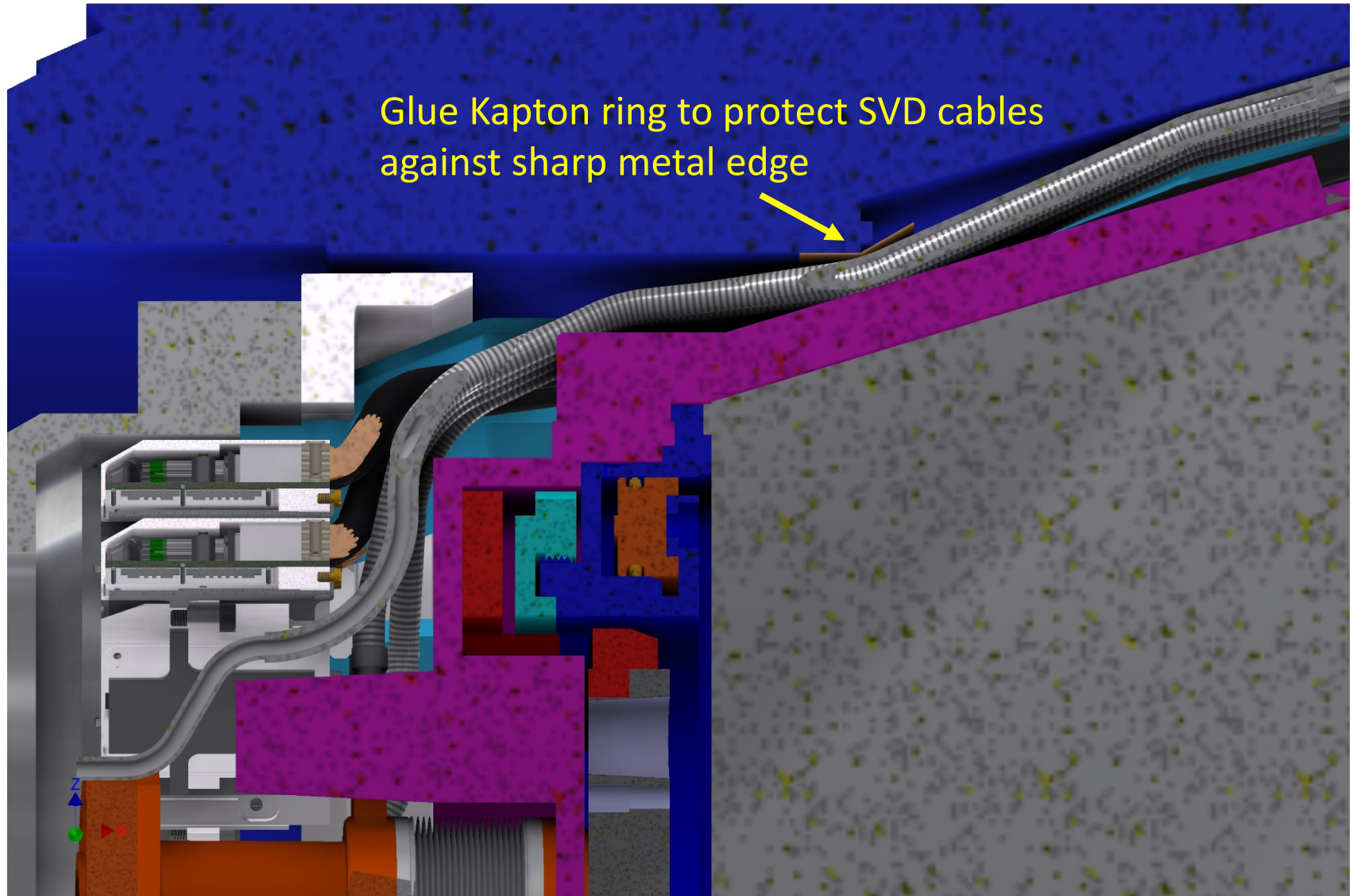


# FWD: Extremely Tight Cable Arrangement



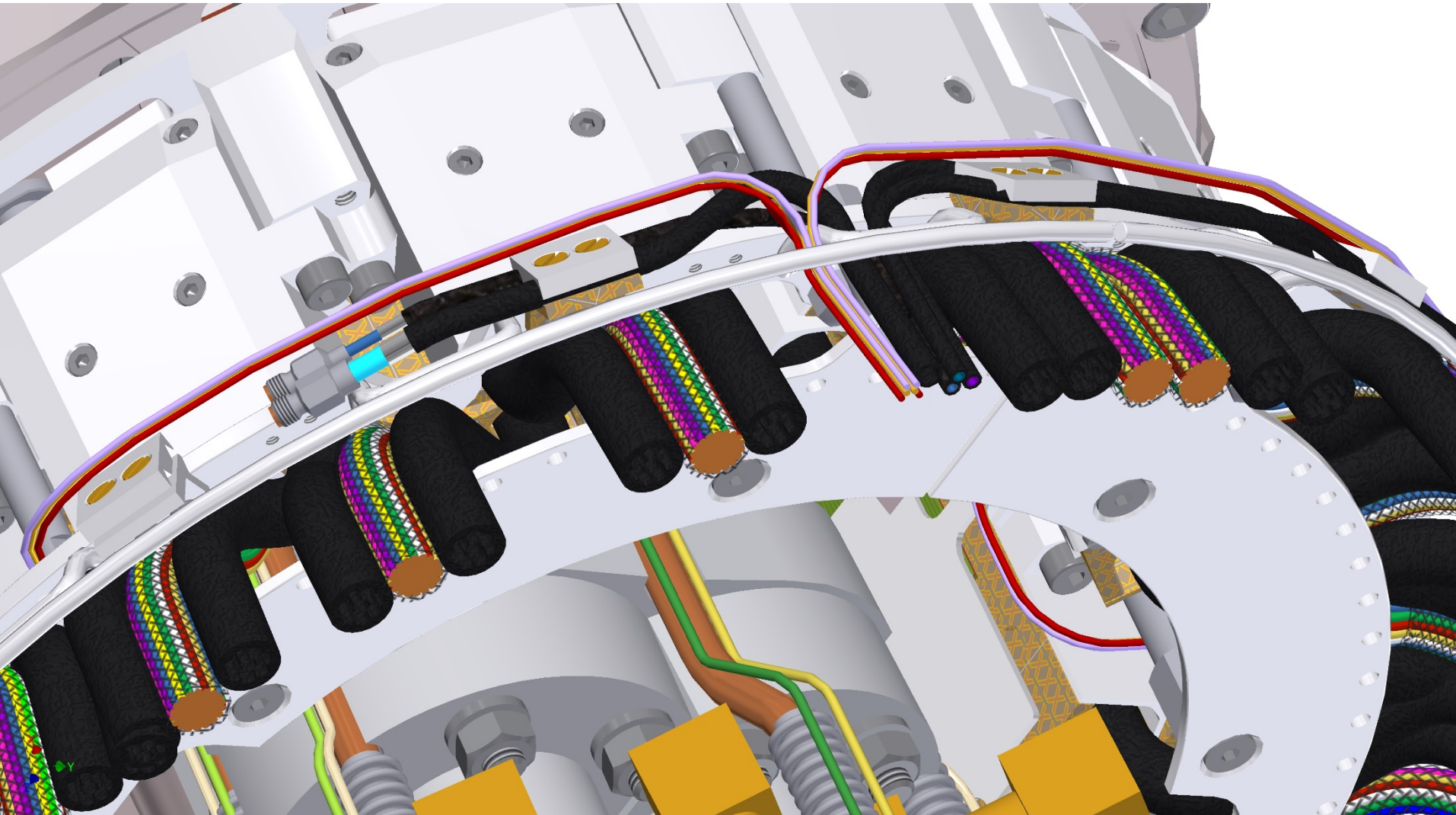


# FWD: Extremely Tight Cable Arrangement



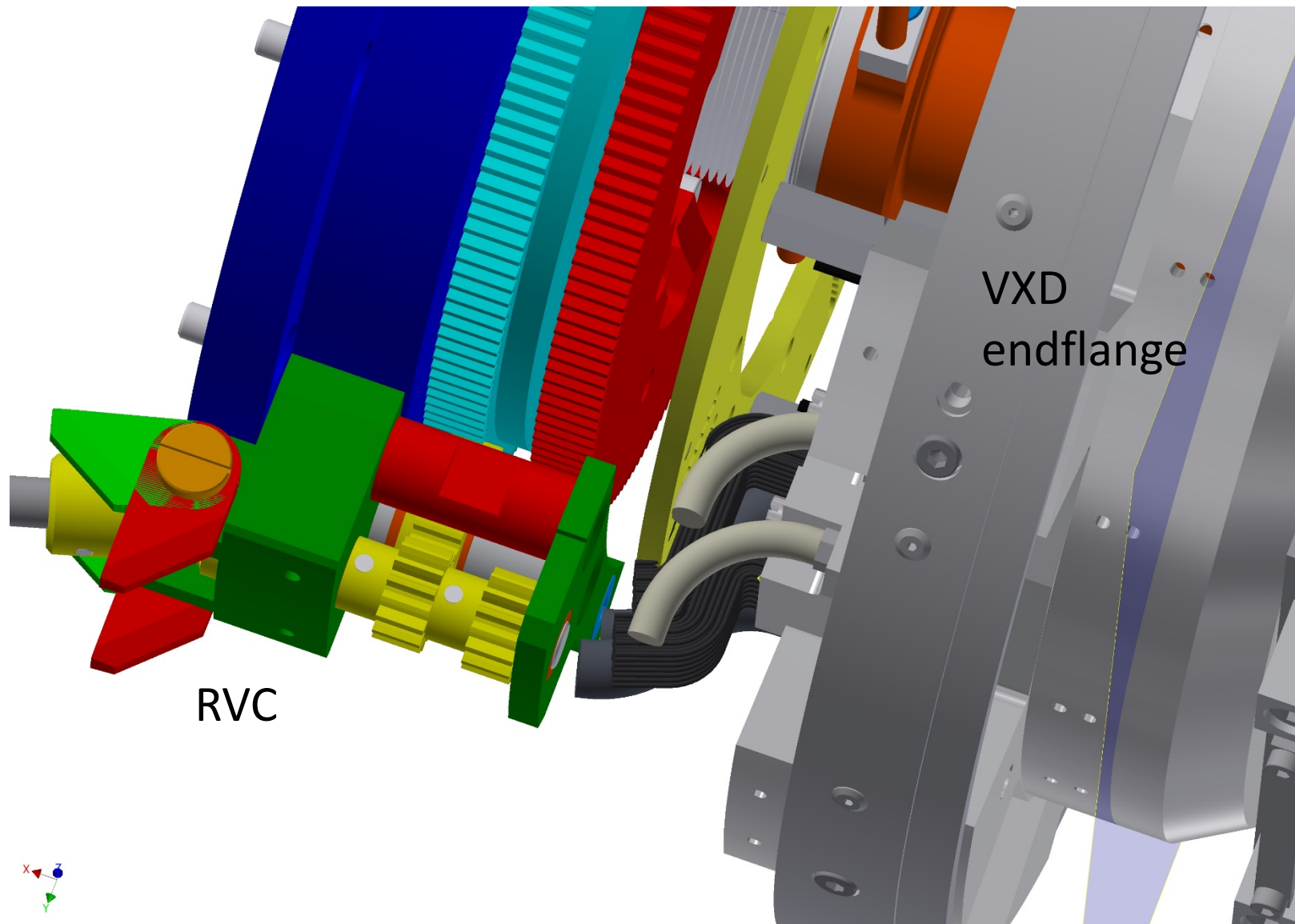
# Patch Panel Cable Cage

No final design, just to demonstrate the principle





# Patch Panel Cable Cage





# Issues of Limited Space



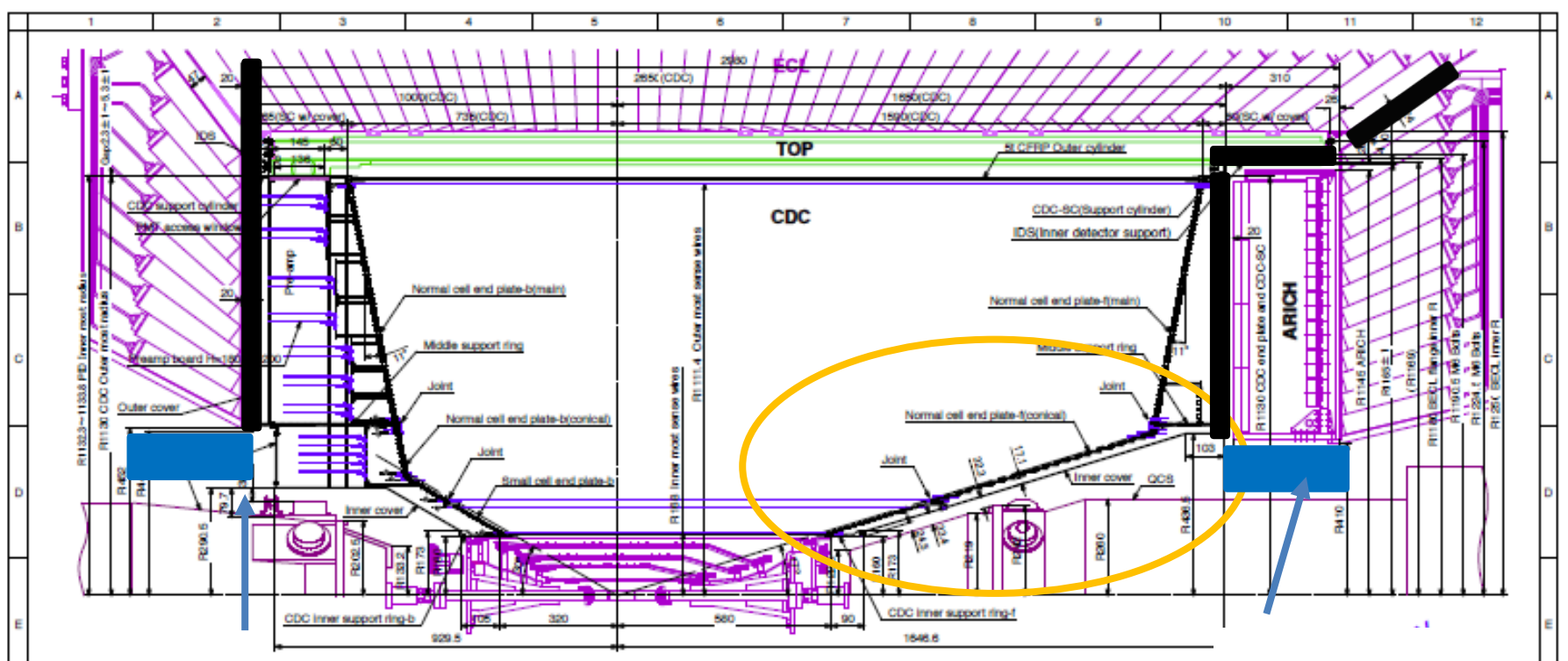
Four critical areas:

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**FWD VXD endflange region:** major difficulties, very careful planning necessary

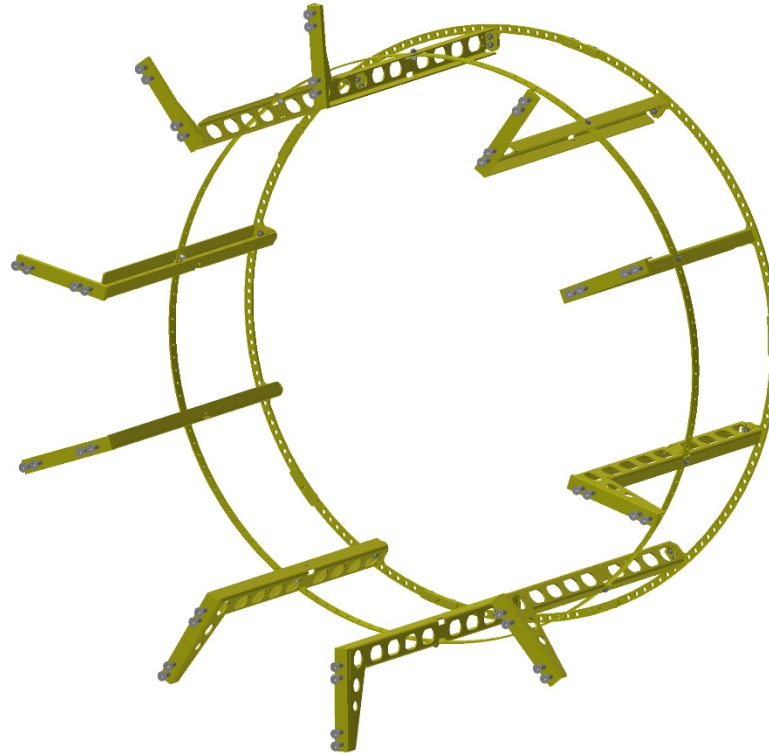
**CDC endwalls:** many cables/pipes to route, very little space (22 mm)



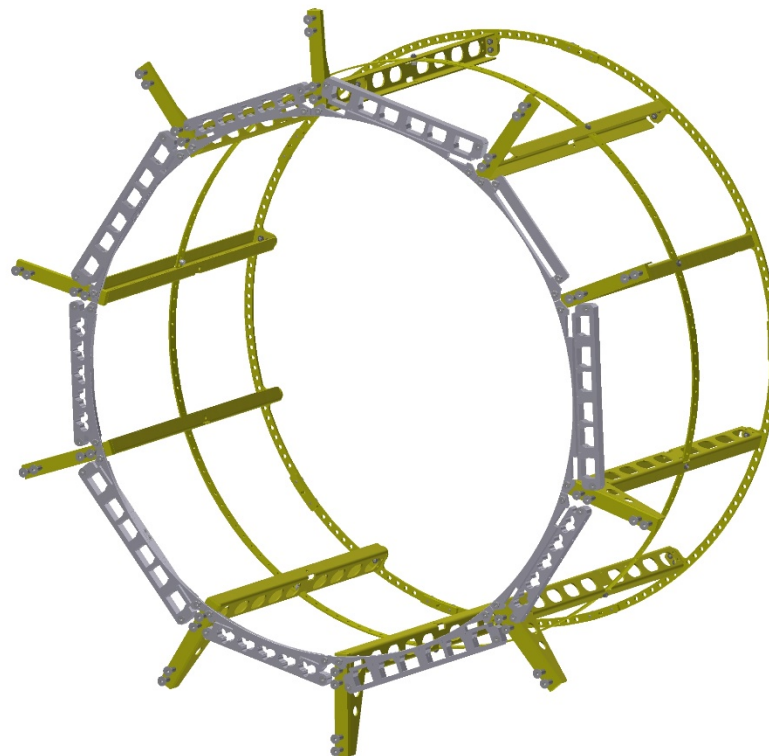
# Mechanical Tools: Cable Routing inside CDC



BWD CDC cable cage



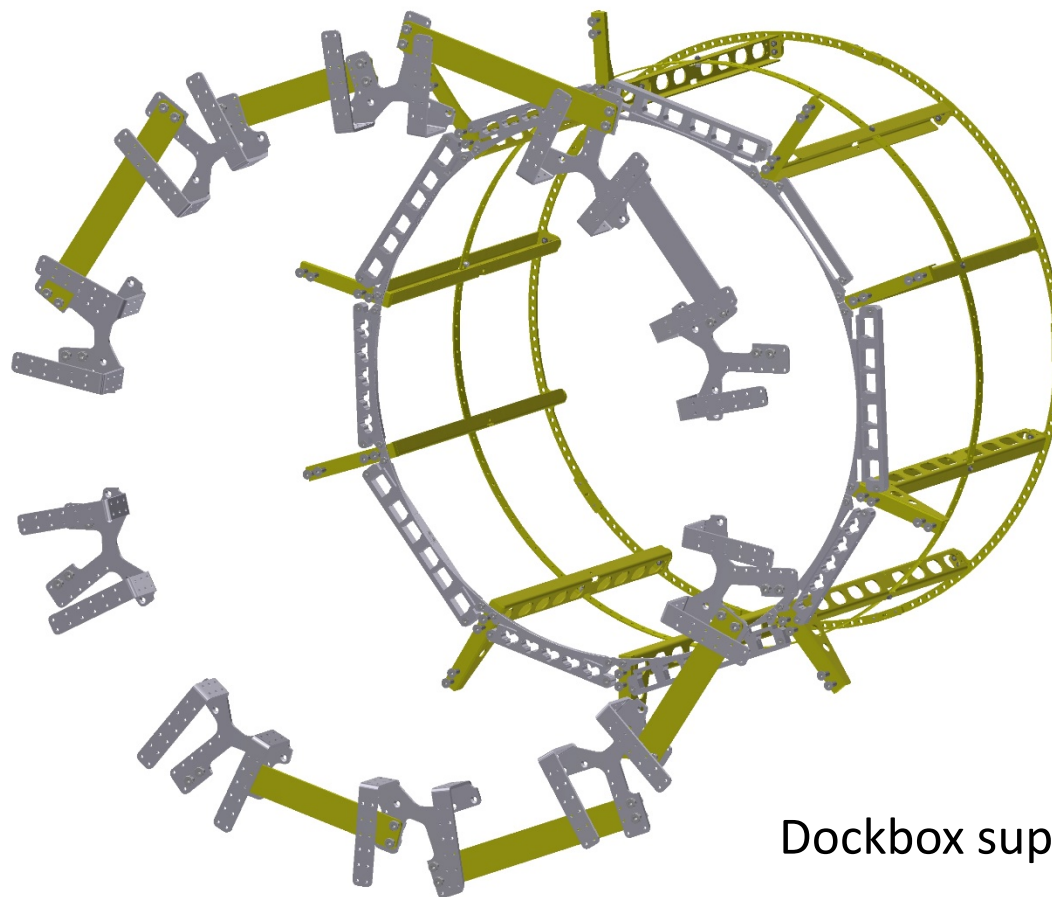
# Mechanical Tools: Cable Routing inside CDC



Cable comb  
(arrange cables on  
perimeter)



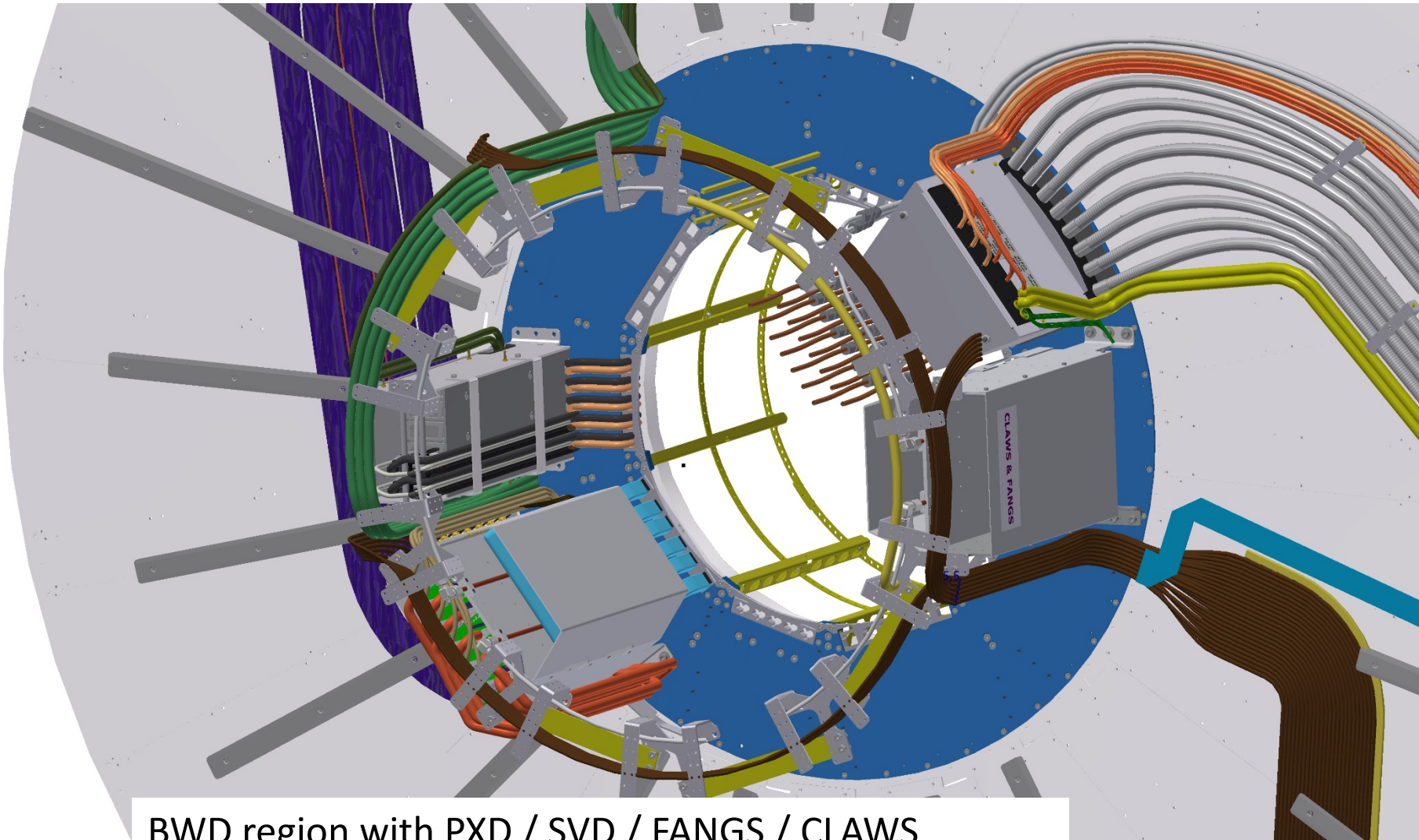
# Mechanical Tools: Cable Routing inside CDC



Dockbox support ring

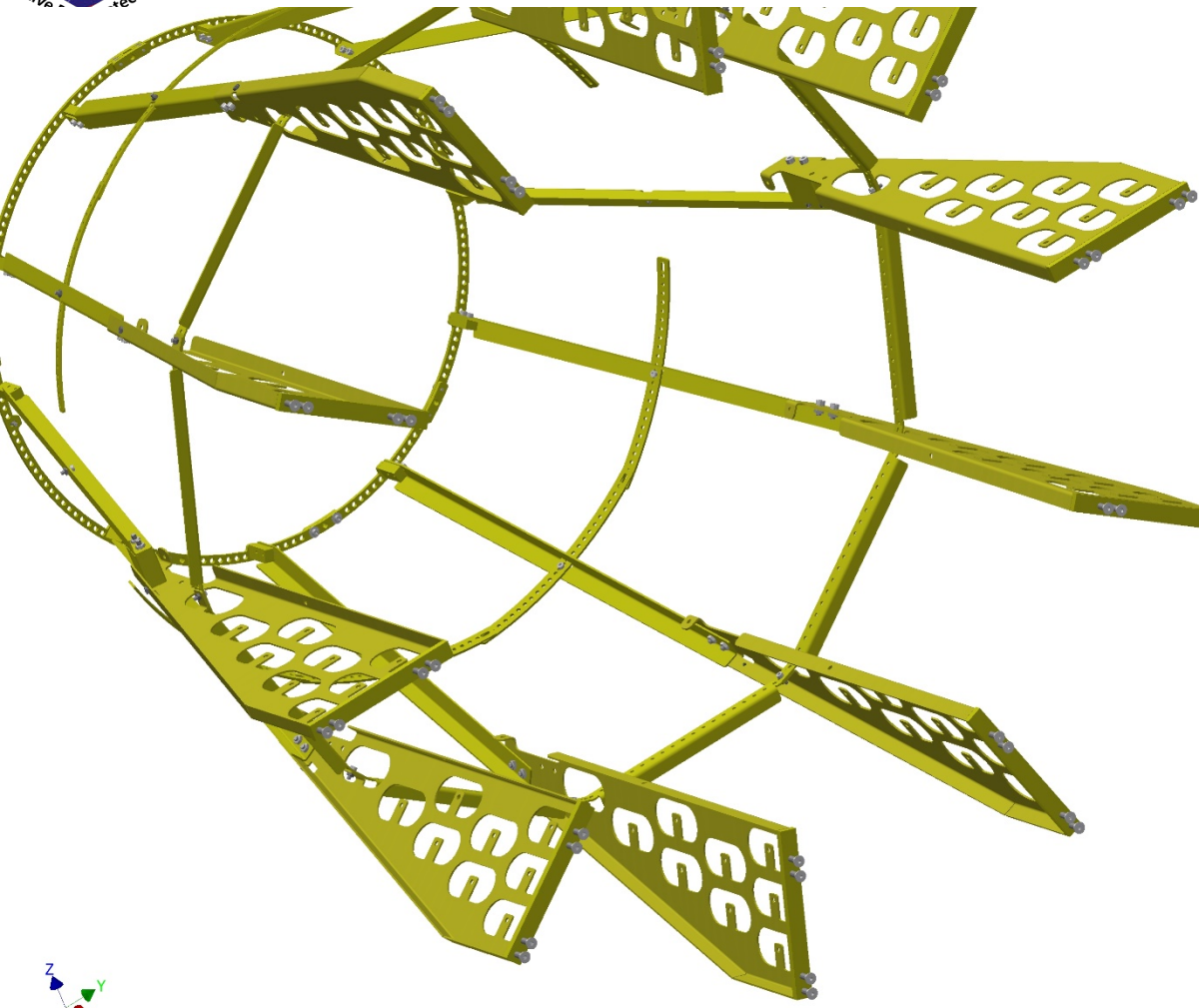


# Mechanical Tools: Cable Routing inside CDC



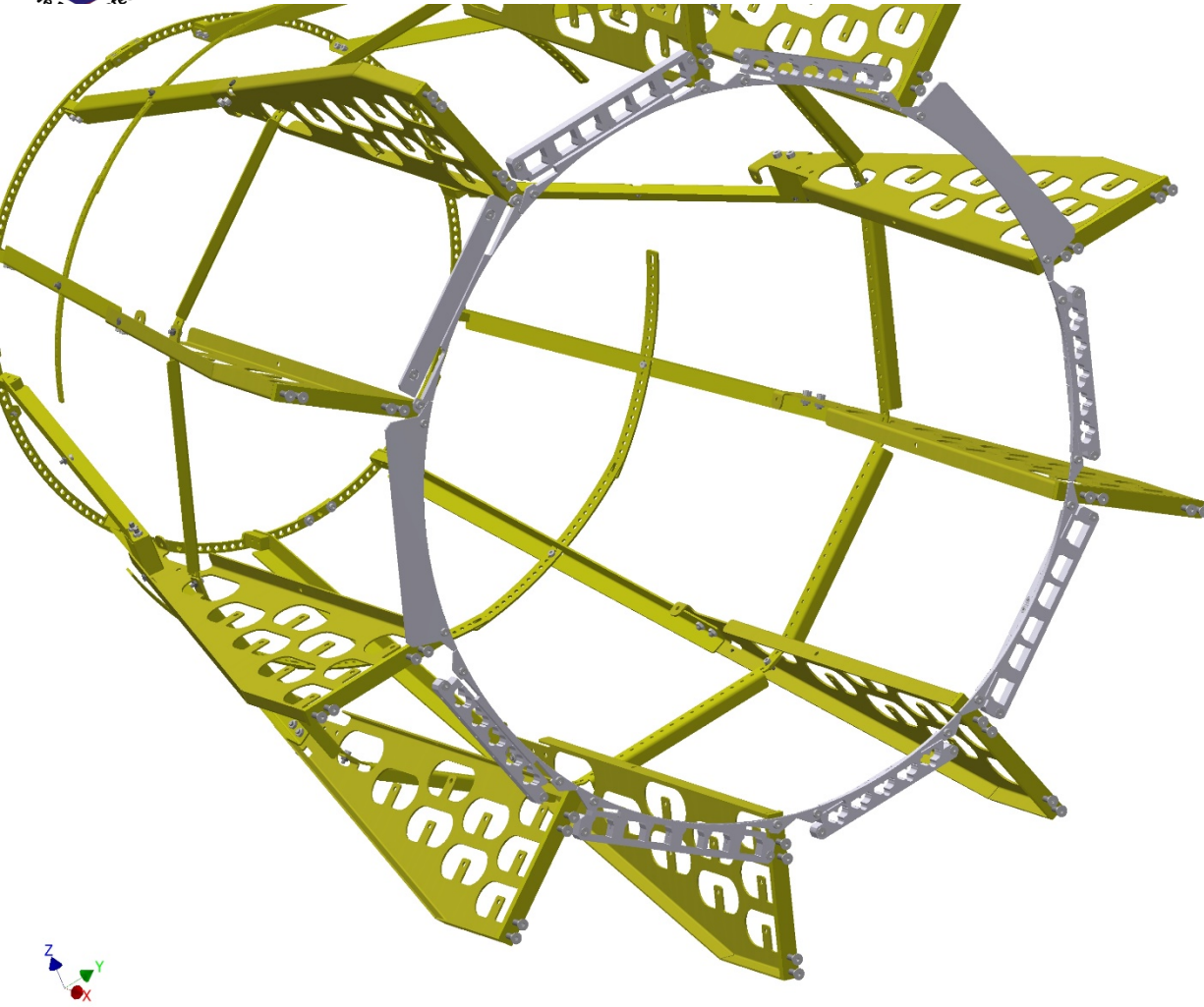
BWD region with PXD / SVD / FANGS / CLAWS  
(TPC / He boxes not shown)

# Mechanical Tools: Cable Routing inside CDC



CDC cable cage FWD region

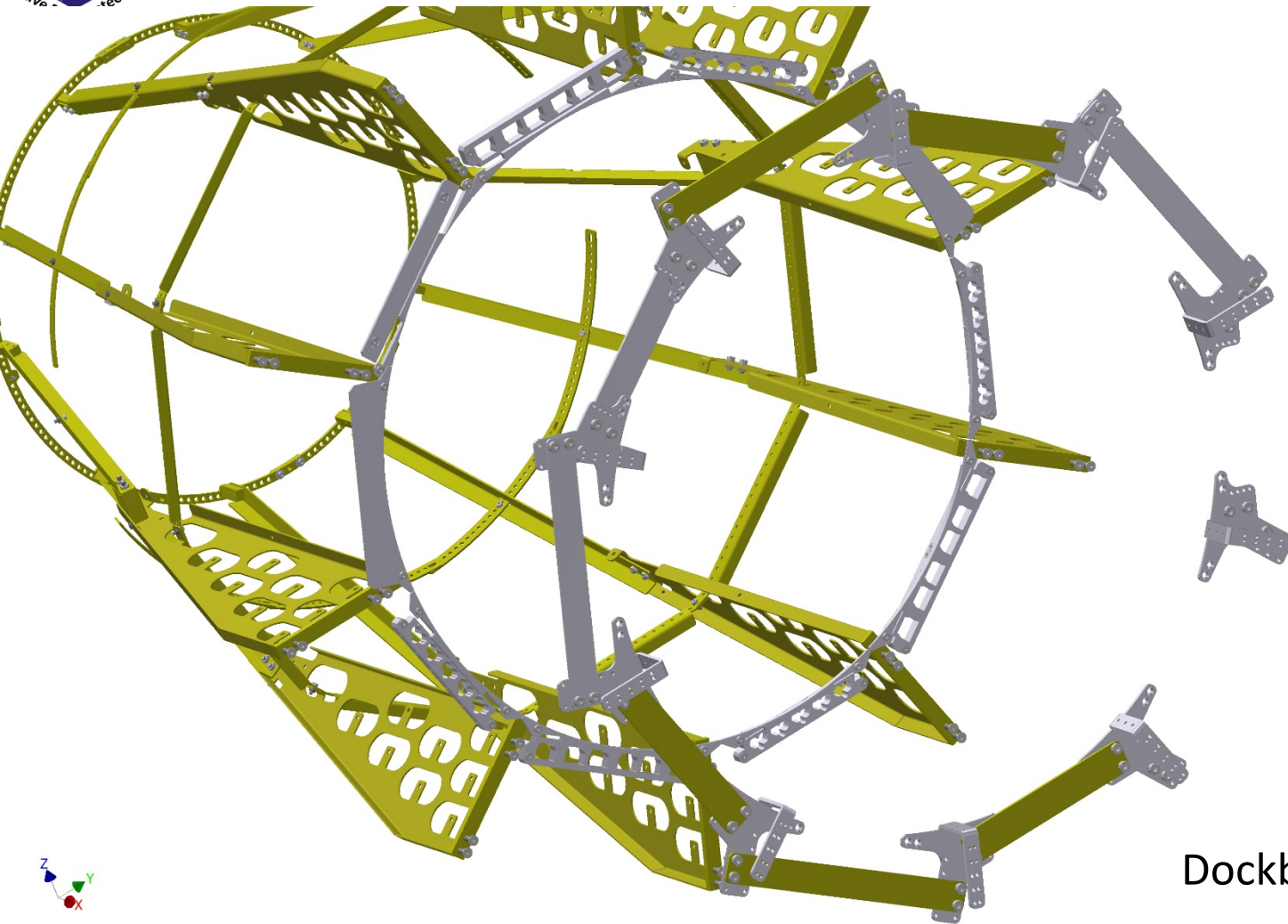
# Mechanical Tools: Cable Routing inside CDC



Cable comb  
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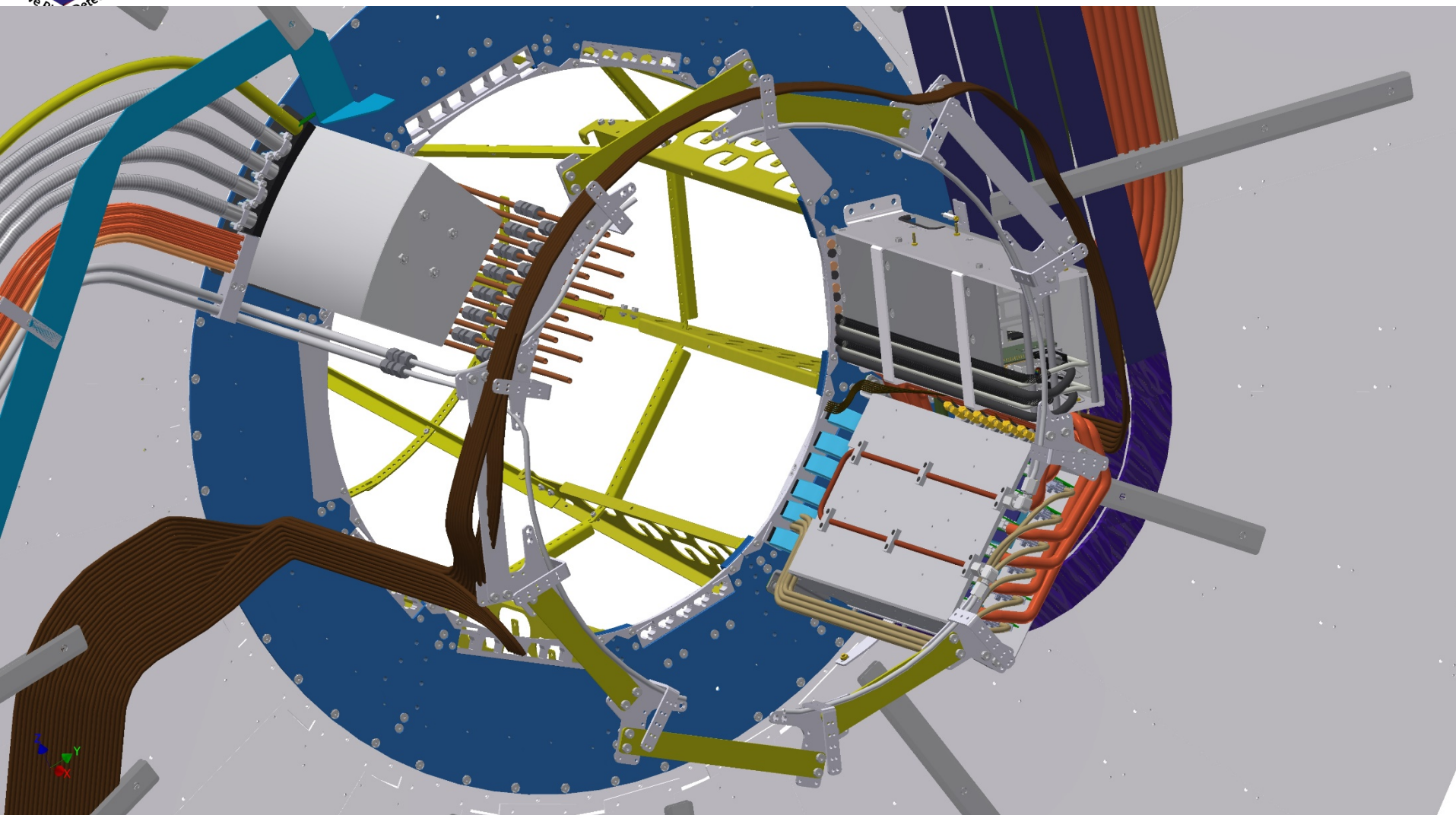


# Mechanical Tools: Cable Routing inside CDC



Dockbox support ring

# Mechanical Tools: Cable Routing inside CDC

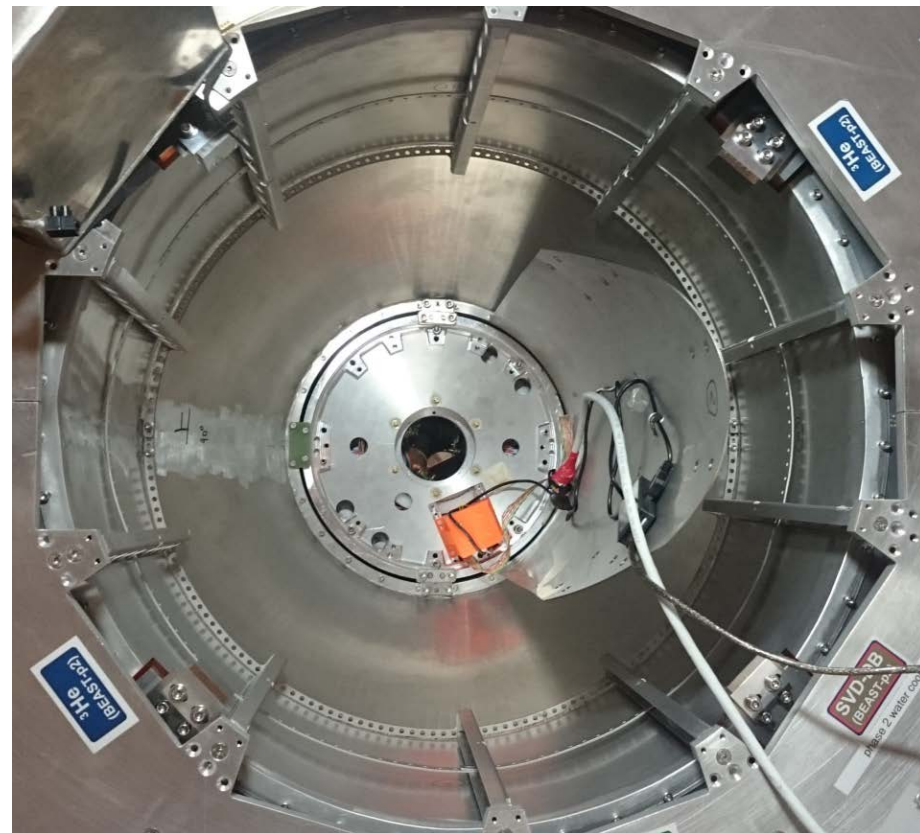


FWD region with PXD / SVD (Plume / TPC / He boxes not shown)

# Mechanical Tools: Cable Routing inside CDC



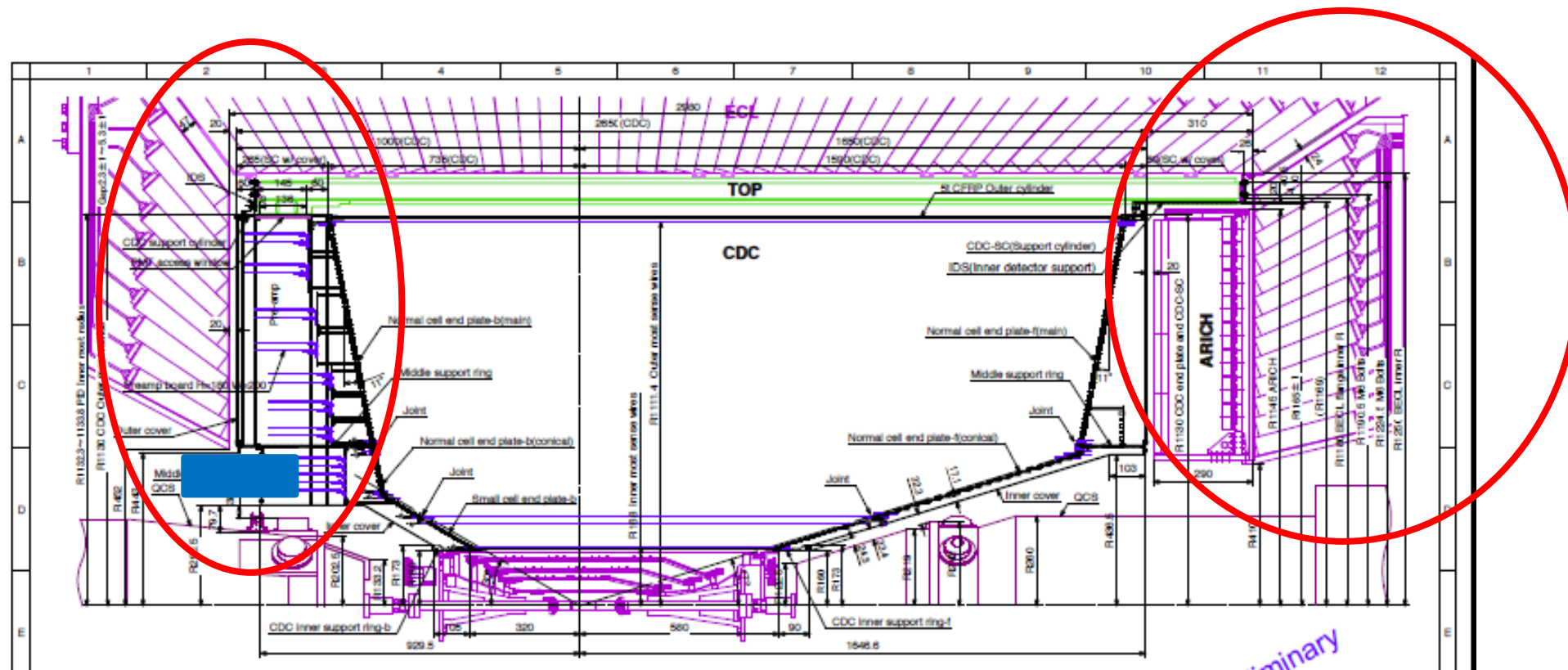
FWD CDC cable cage installed  
(inner spokes removed for  
B-Field Mapper installation)



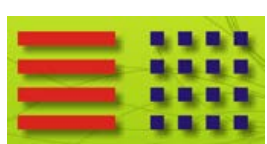
BWD CDC cable cage installed



# Going out to the Belle Platform



Problematic: Dock Box area in the BWD region (for SWD)  
 CDC wall in the BWD region  
 Chicane in FWD



# Cable Routing on CDC BWD Side

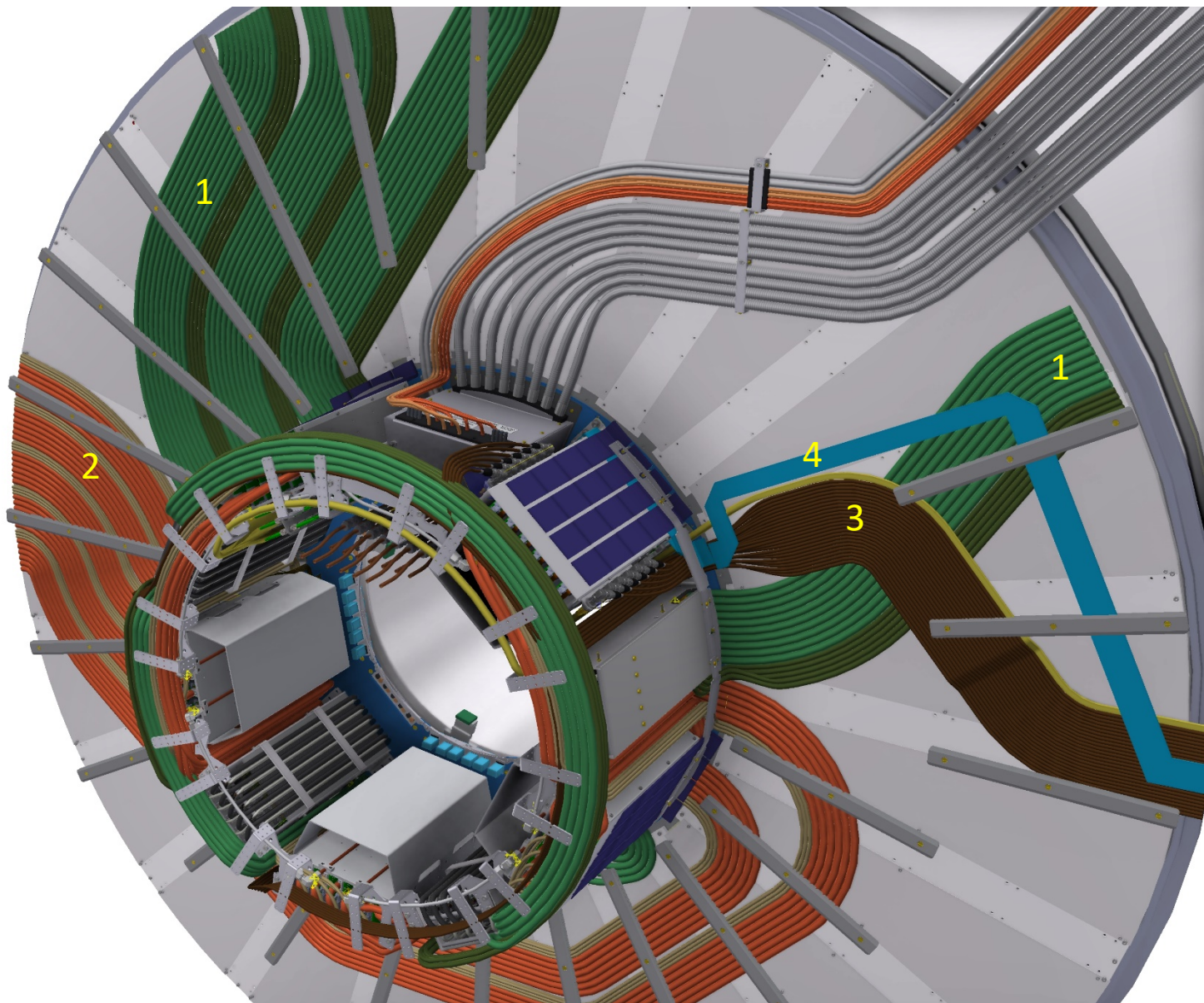


Preview. Phase 3

- 1 : PXD Power
- 2 : SVD LV
- 3 : diamond signals
- 4 : NTC services

Important:

PXD Power and  
SVD LV must be  
guided in  $\phi$  on the  
DBS ring  
(no space for  
crossing on the CDC  
wall )  
(FWD side is easier)





# Cable Routing on CDC BWD Side

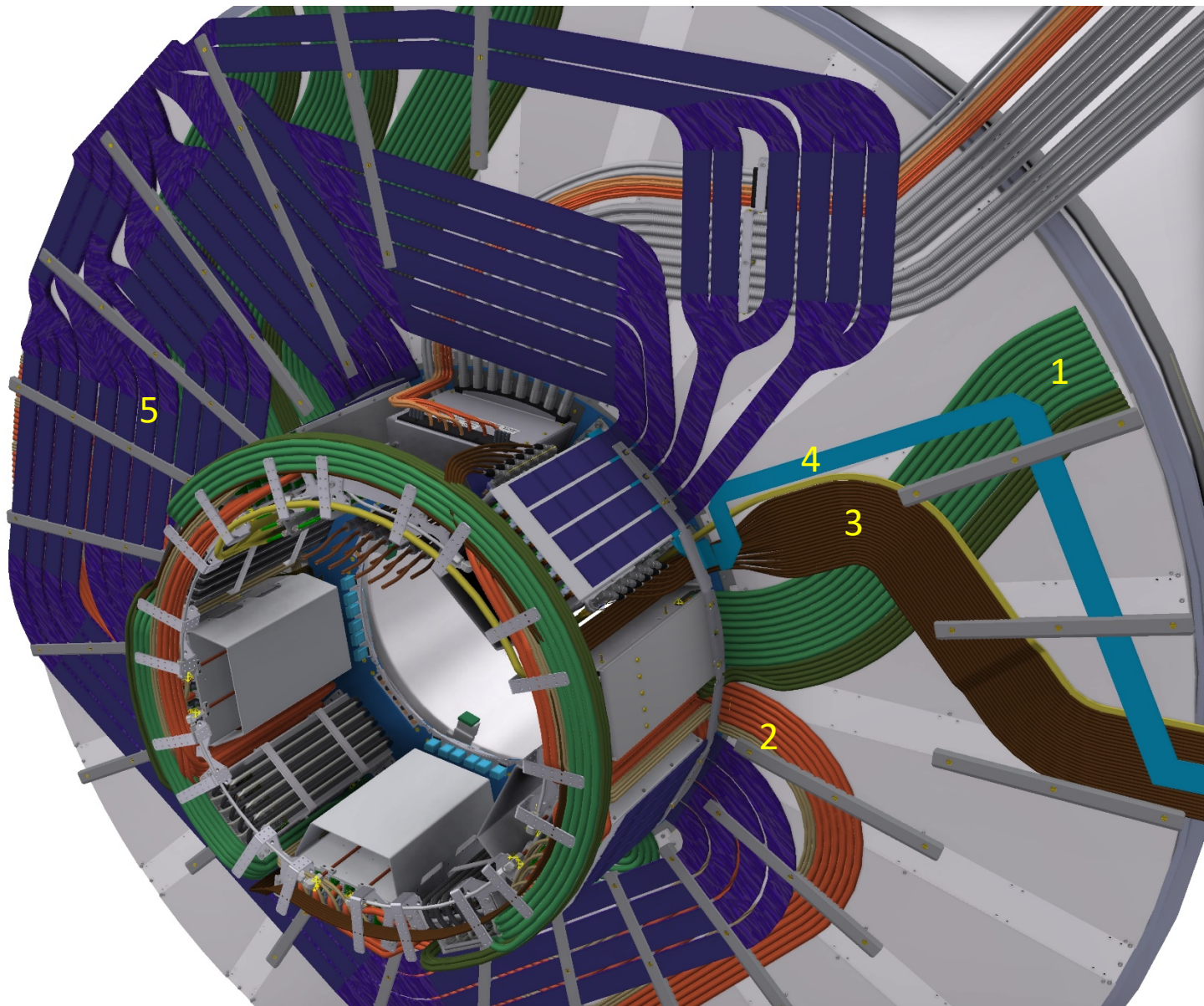


Preview. Phase 3

- 1 : PXD Power
- 2 : SVD LV
- 3 : diamond signals
- 4 : NTC services
- 5 : SVD signal

Important:

PXD Power and  
SVD LV must be  
guided in  $\phi$  on the  
DBS ring  
(no space for  
crossing on the CDC  
wall )  
(FWD side is easier)






# Summary



The VXD has a huge number of service lines (pipes and cables) to install: ~270 in FWD, ~420 in BWD

Service space very limited due to RVC and other Belle detectors (typically 22 mm gap for services available) 

FWD area is particularly difficult: need special “cages” to keep allowed envelope

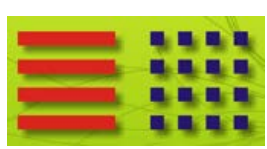
Many cables (and all pipes) are extremely stiff (e.g. power cables for PXD and SVD)

Detailed cable plan worked out on CAD, but needs to be verified by the real detector environment. Phase 2 will be an excellent learning ground



# *Backup*





# VXD Nomenclature

