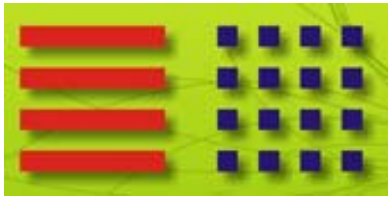


P(V)XD Mechanics

Overview:

- Completed PXD mechanics projects

Open Issues:

- Preparation for module glueing
- Concept of PXD Assembly
- VXD Installation
- VXD Services, cable cage
- Dock rings
- Beam Position Monitors

Summary

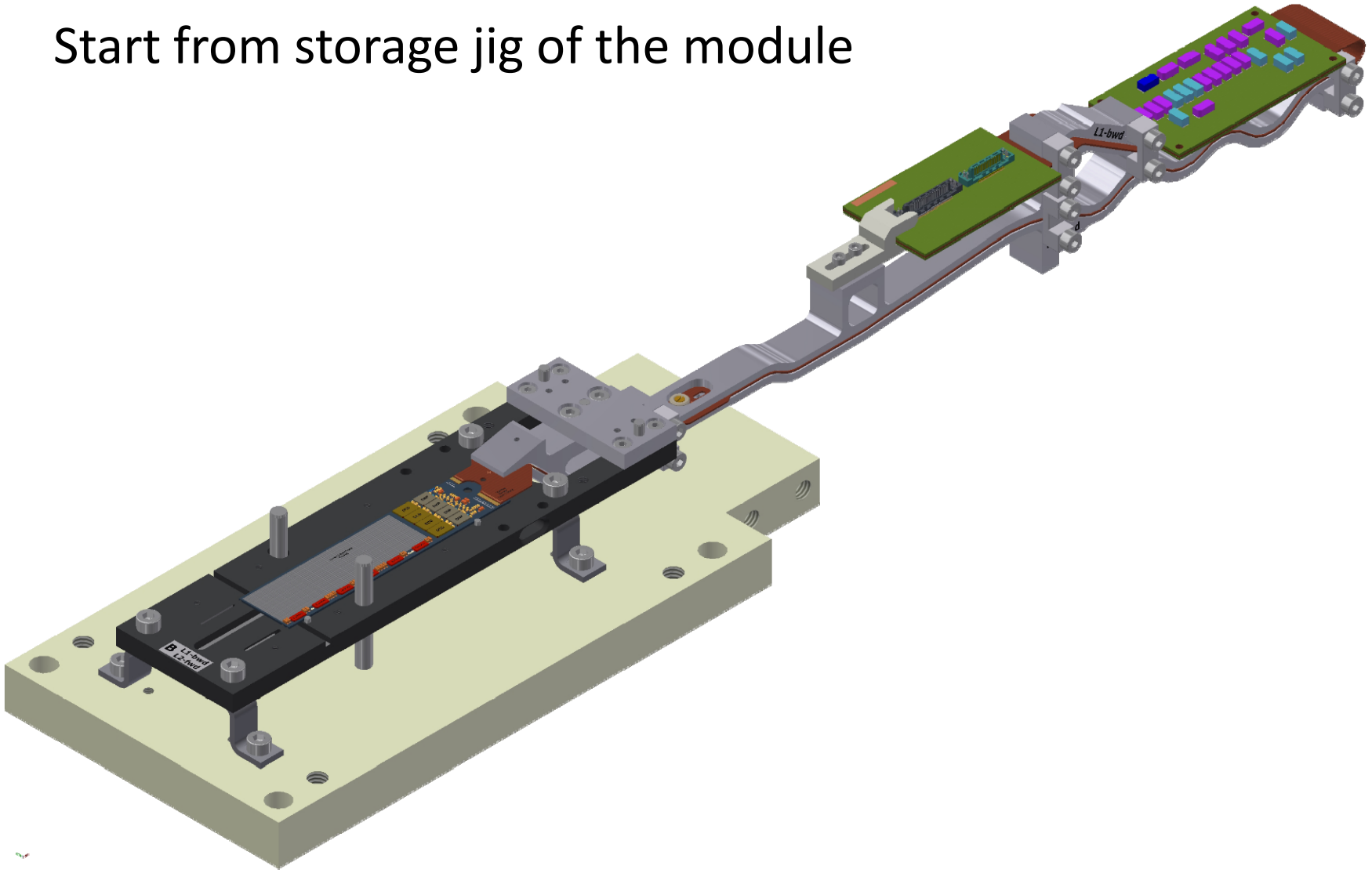
PXD: Mechanics Status (I)

Overview:

- ✓ Mechanical Support of PXD Ladders on SCB done, design frozen
- ✓ Tooling for sensor handling during module production done up to and including Kapton attachment
- ✓ Tooling for electrical tests of finished modules (including water cooling) done
- ▪ Tooling for gluing to modules to a ladder: designs and fabrication drawings done, going into the workshop next week
- ▪ Tooling for electrical tests of ladder designed, fabrication drawings in process, going into the MPI workshop end of January.
- ▪ Decision during this meeting: the four modules for the DESY test will not be glued together, mechanical support by SCB screw and Kapton sufficient

Steps in the Gluing Procedure

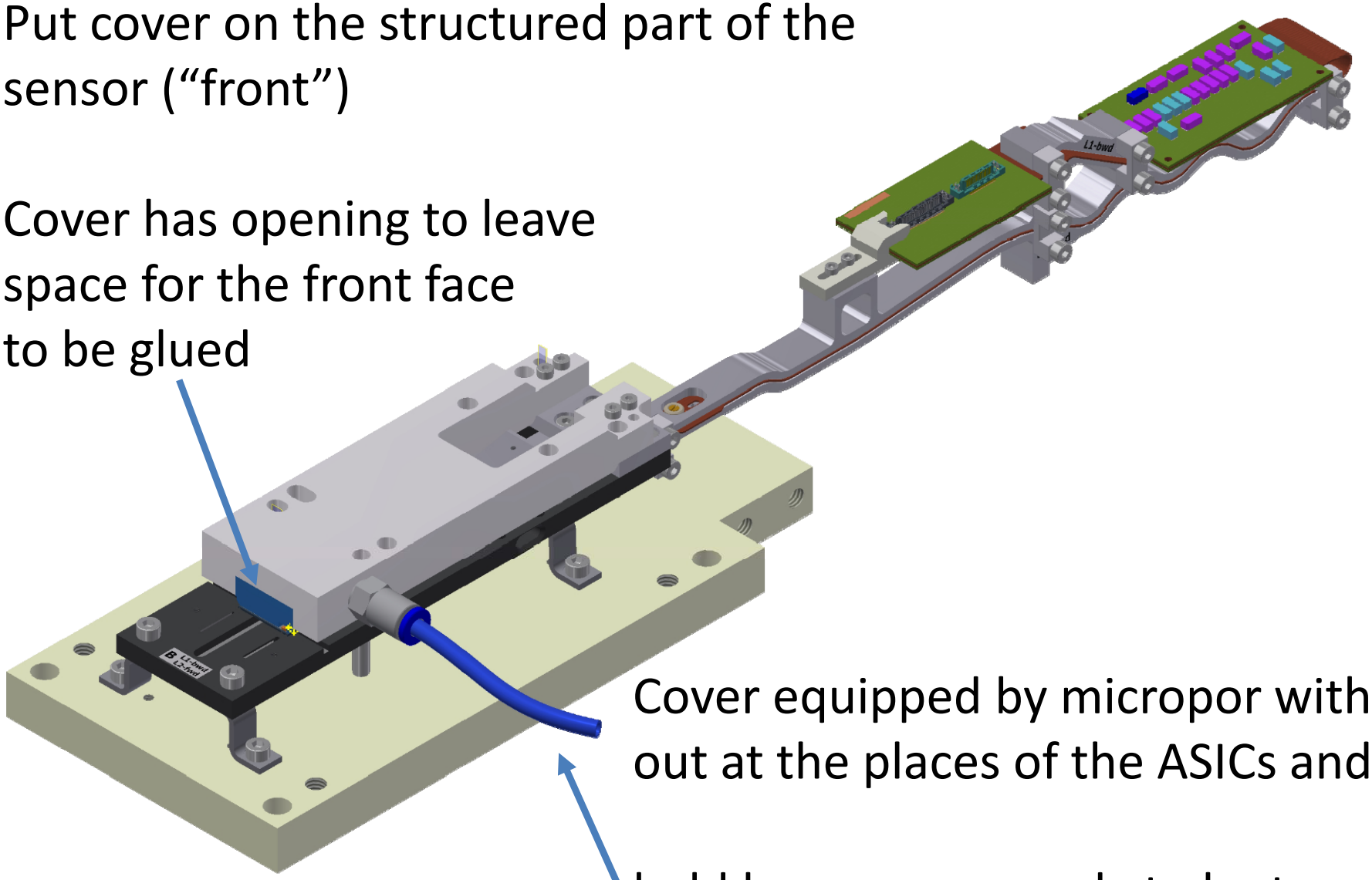
Start from storage jig of the module



Steps in the Gluing Procedure

Put cover on the structured part of the sensor (“front”)

Cover has opening to leave space for the front face to be glued

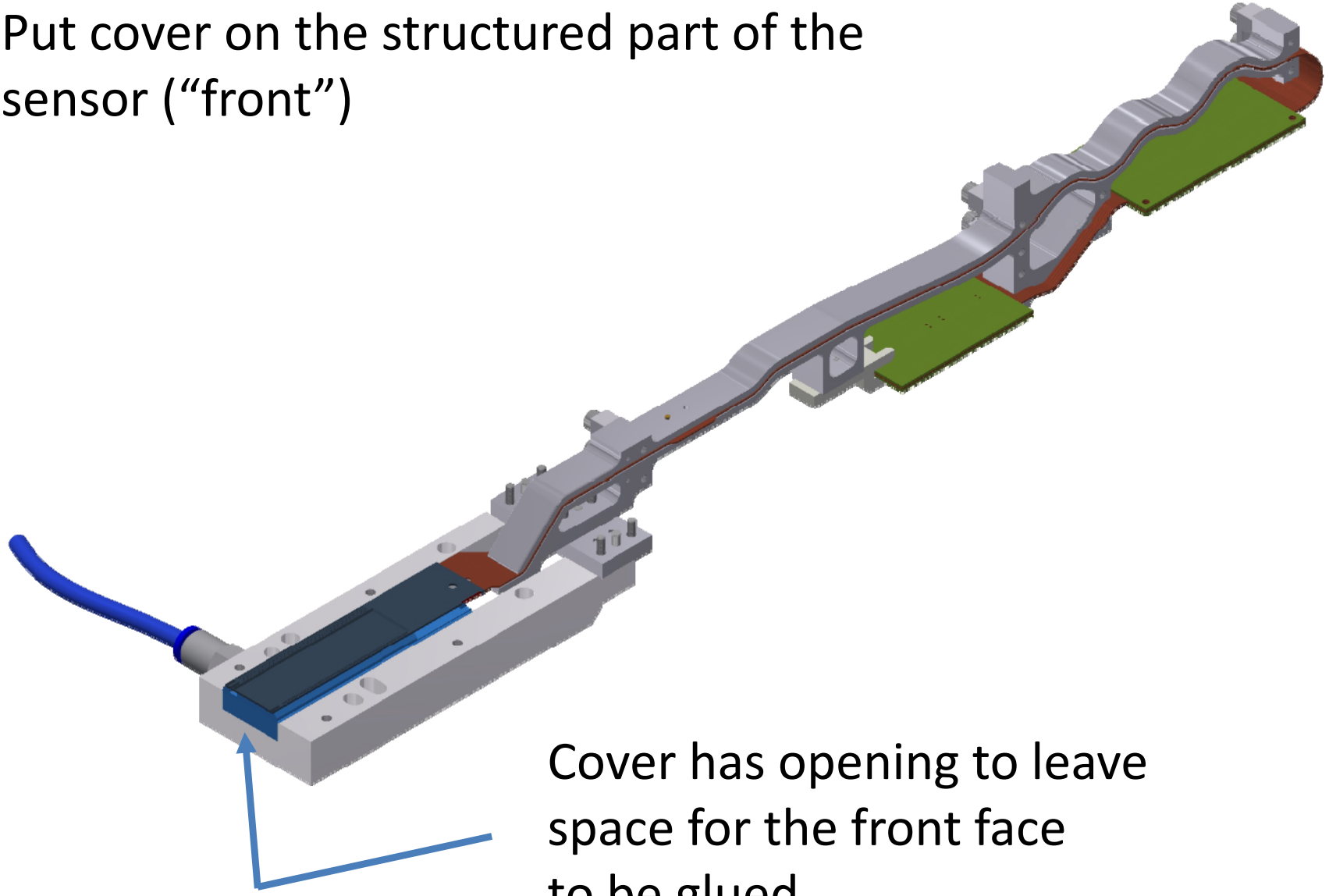


Cover equipped by micropor with cut-out at the places of the ASICs and SMDs

held by vacuum, ready to be turned in its back

Steps in the Gluing Procedure

Put cover on the structured part of the sensor (“front”)

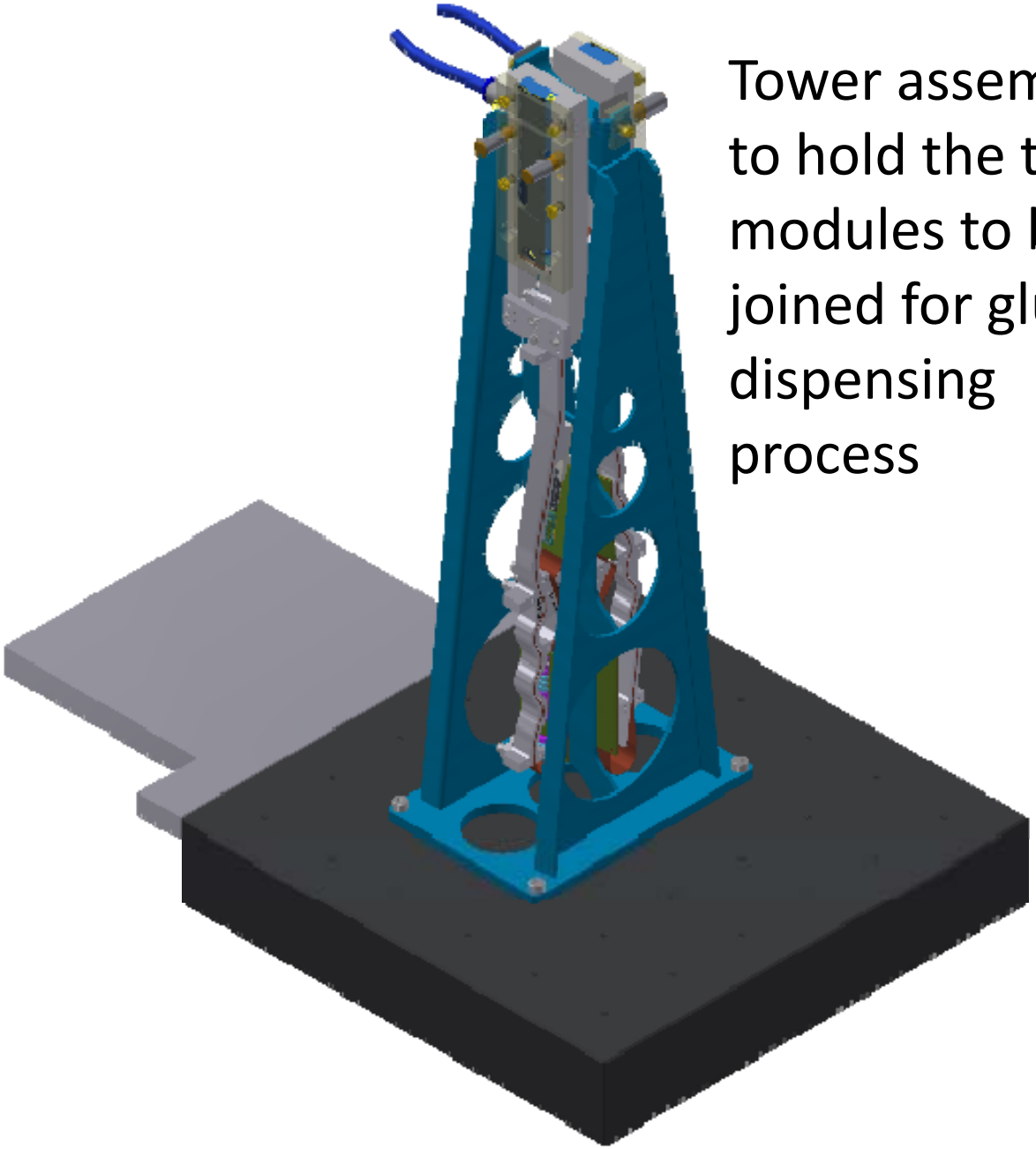


Cover has opening to leave space for the front face to be glued

Steps in the Gluing Procedure

Prgrammable Glue disenser

50µm glue balls

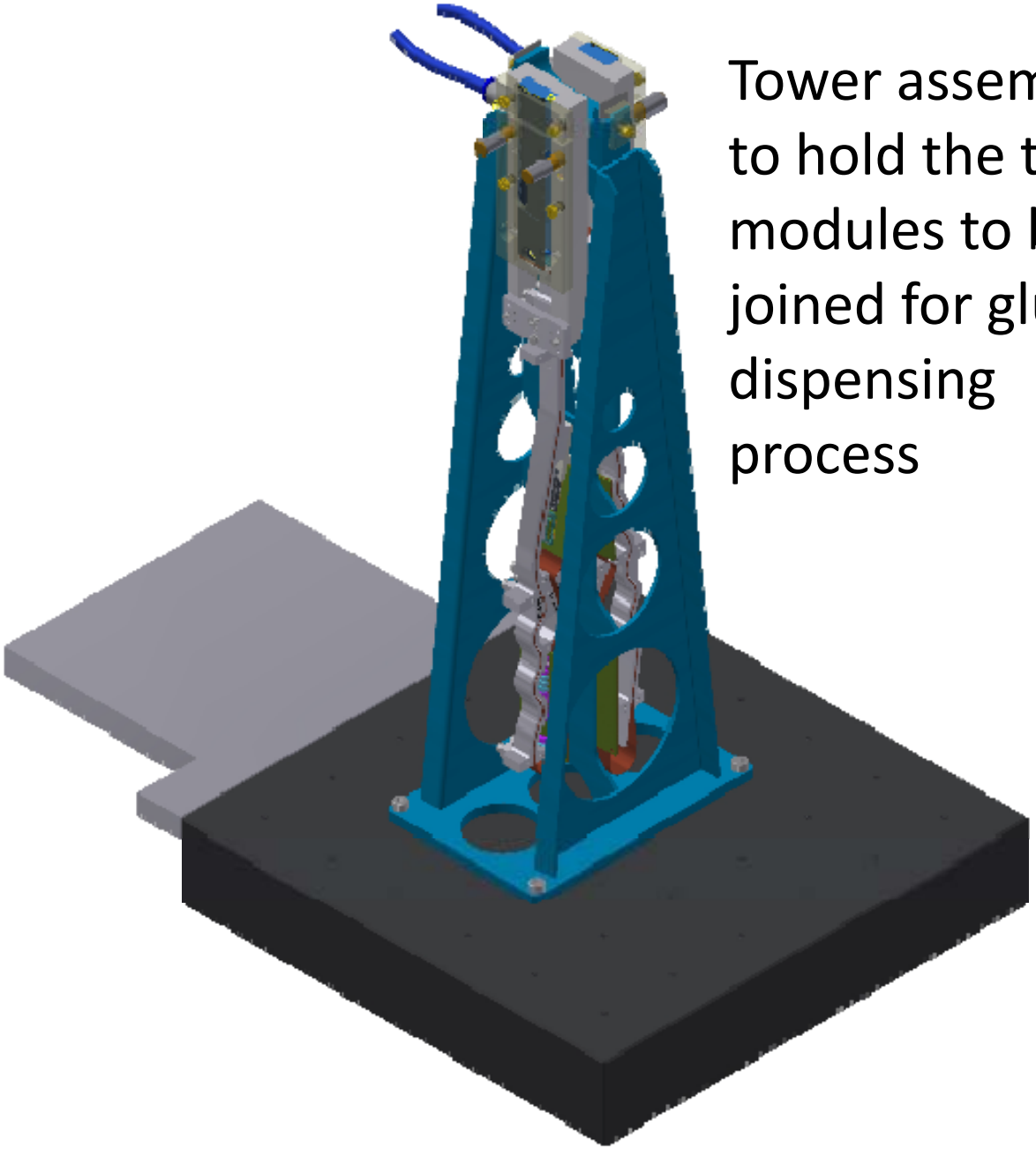


Tower assembly to hold the two modules to be joined for glue dispensing process

Steps in the Gluing Procedure

Programmable glue dispenser

50µm glue balls



Tower assembly to hold the two modules to be joined for glue dispensing process

Steps in the Gluing Procedure

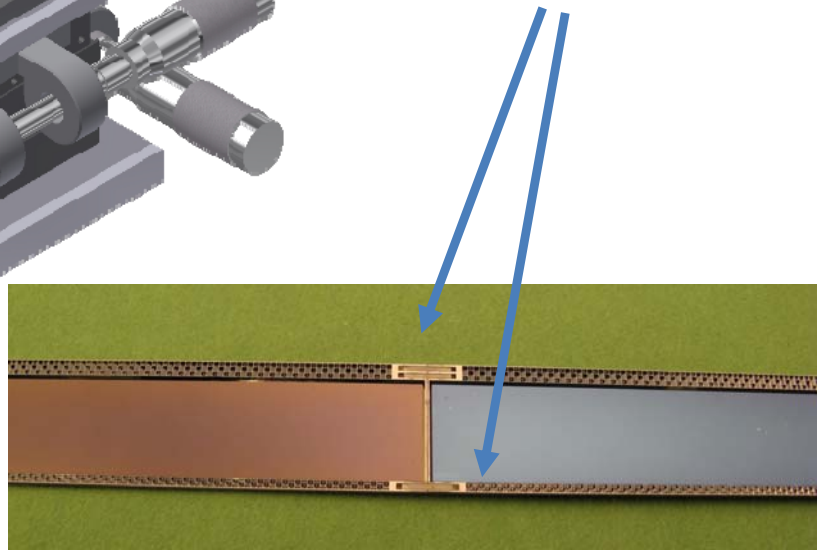
Positioning table: one side (BWD) fixed, other side can be rotated and moved in 3 dimensions,

adjustable under microscope

FWD

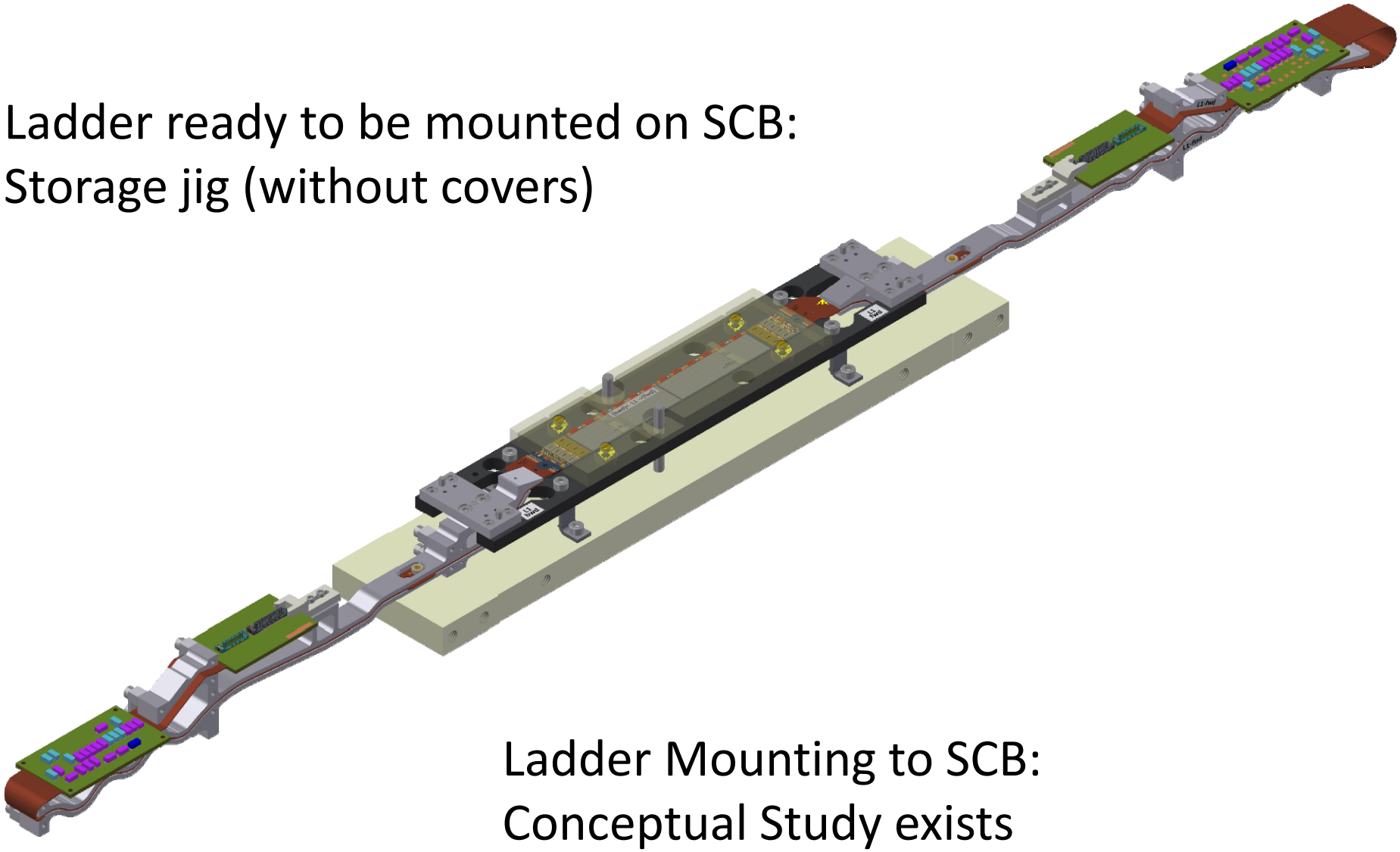
BWD

Ceramic mini rods



PXD: Mechanics Status (II)

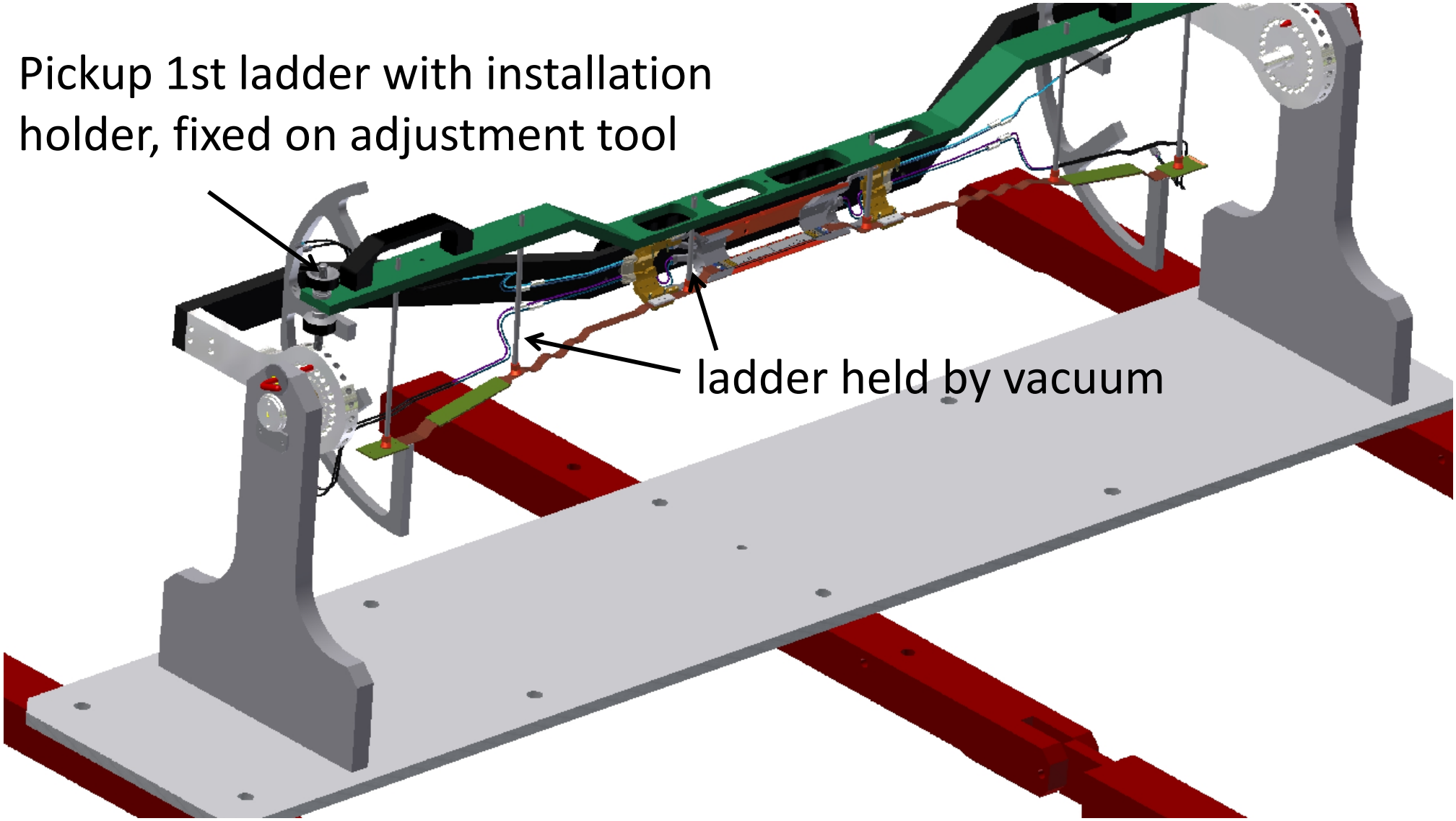
Ladder ready to be mounted on SCB:
Storage jig (without covers)



Ladder Mounting to SCB:
Conceptual Study exists

Assembly of PXD Half Shells

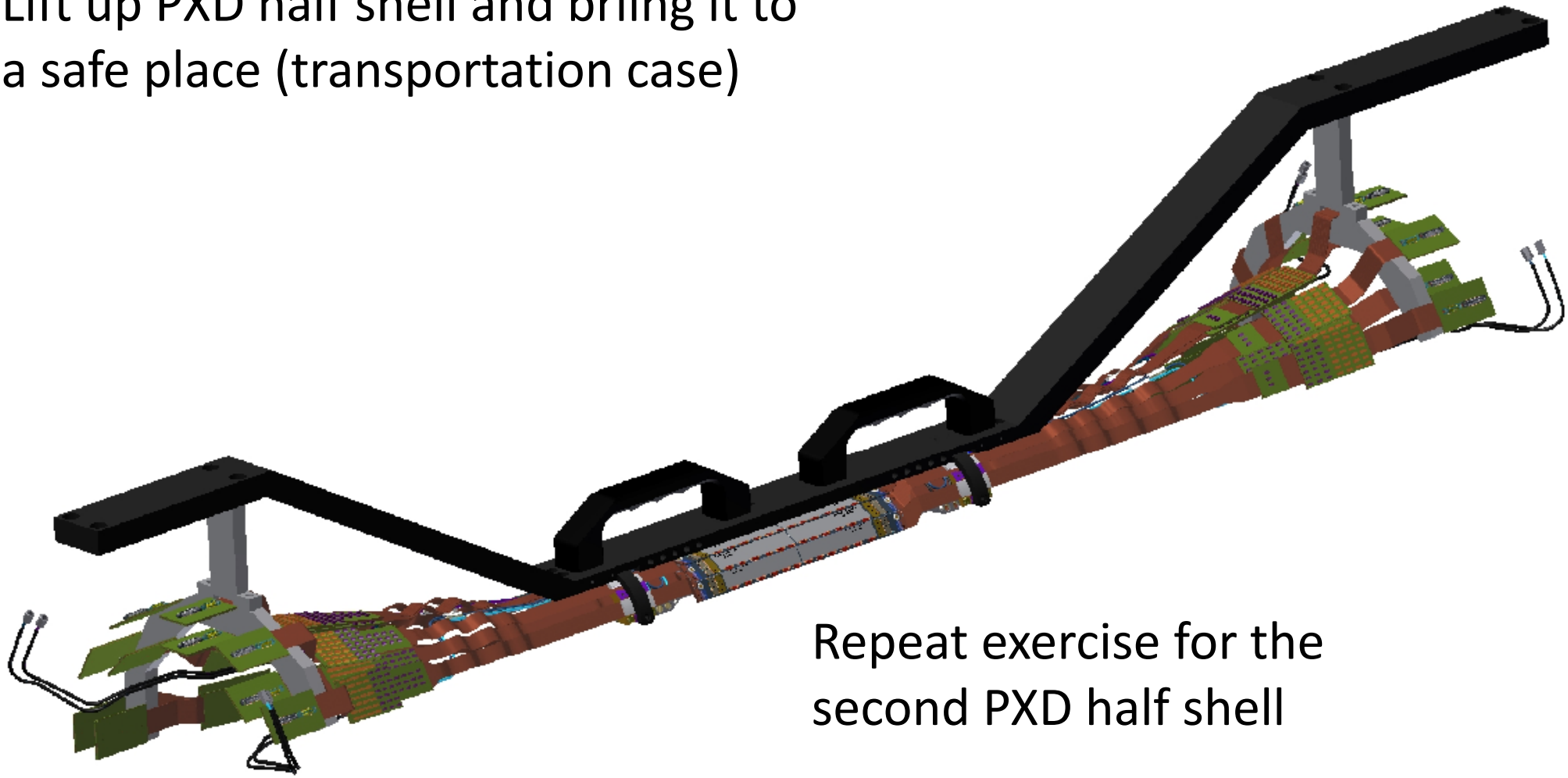
Pickup 1st ladder with installation holder, fixed on adjustment tool



Principle: ladder is supported at any time (no operator needed)

Assembly of PXD Half Shells

Lift up PXD half shell and briing it to a safe place (transportation case)



Repeat exercise for the second PXD half shell

PXD Arrival Checks

PXD will be assembled and tested in Munich
Here are the steps to be executed for the acceptance

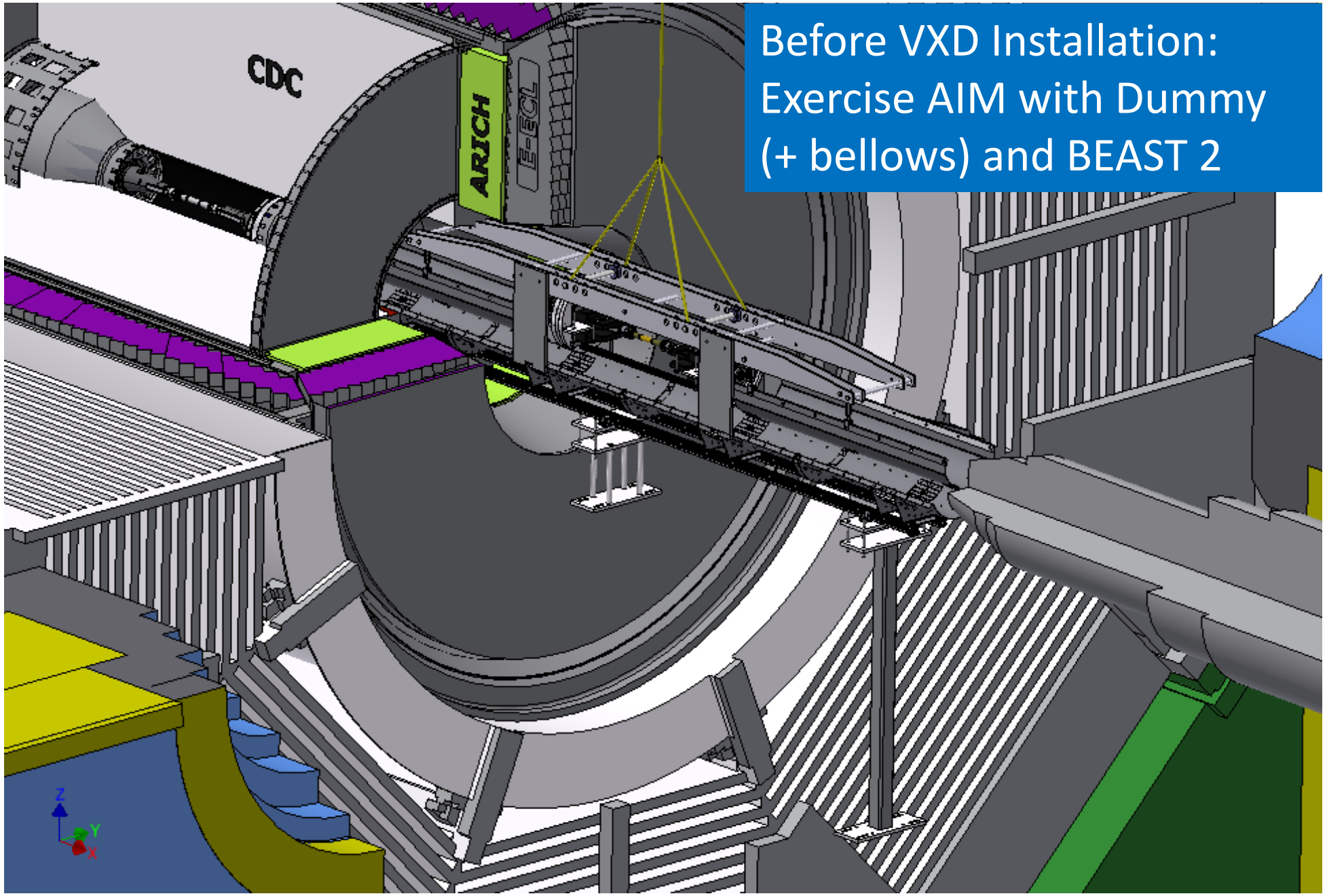
(MARCO CO2 cooling system available in B1)

Upon arrival of PXD in B1 (two small cases, carry-on luggage):

1. Check transport case for damages (optical inspection)
2. Analyze acceleration sensor data (stored on devices)
3. Unpack PXD halves, inspect visually for damages
4. Check tightening torque on all screws
5. Check geometrical positions of mounting holes on SCBs with dummy beampipe (tooling already prepared at MPI)
6. Check collision-free assembly of sensors on SCBs after lowering half-shell on dummy beampipe (tooling being prepared)
7. Electrical tests on individual sensors (FWD / BWD separately)
   For this: connect patch panels one by one, disconnect afterwards

In BACKUP: Detailed action list of VXD assembly and commissioning: 42 more steps

„AIM“ = Alternative Installation Method



VXD Installation: Cabling and Piping

After pushing VXD by hand into the CDC:

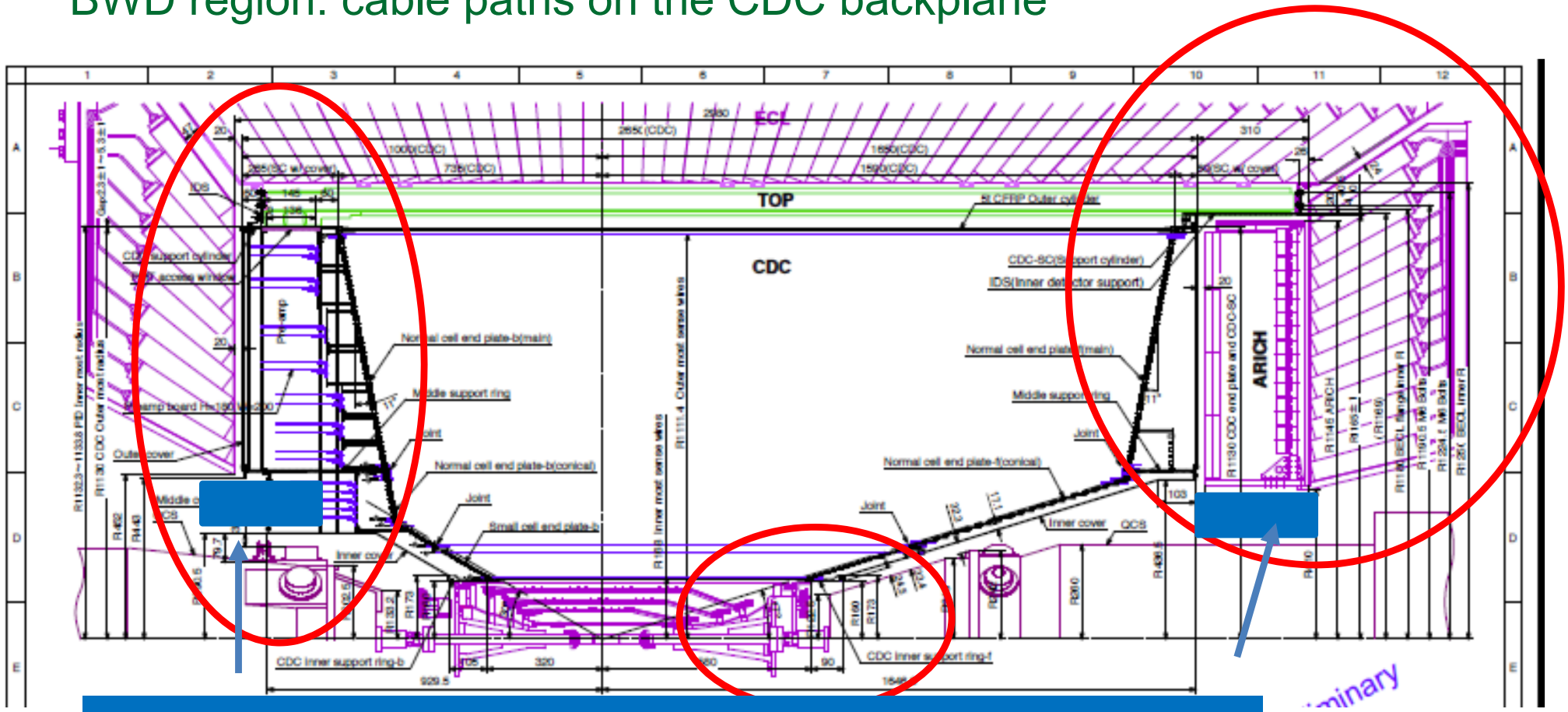
1. Fix BWD installation ring to CDC end plate
2. Install CDC cable cage and secure all cables/pipes along the CDC inner cone on the FWD side
3. Connect all pipes and cables to the prepared connections at the dock boxes
4. Pressure test of the cooling pipes
5. Electrical test of the VXD
6. Install the bellows
7. Connect cooling pipes to bellows
8. Move in QCS
9. Close the RVC

VXD ready for operation

Critical Space Allocations

Three critical areas for the services:

FWD region: tight space for the 267 cables / pipes for clearance (“7 mm”)
Outer region: chicane through ARICH / ECL
BWD region: cable paths on the CDC backplane

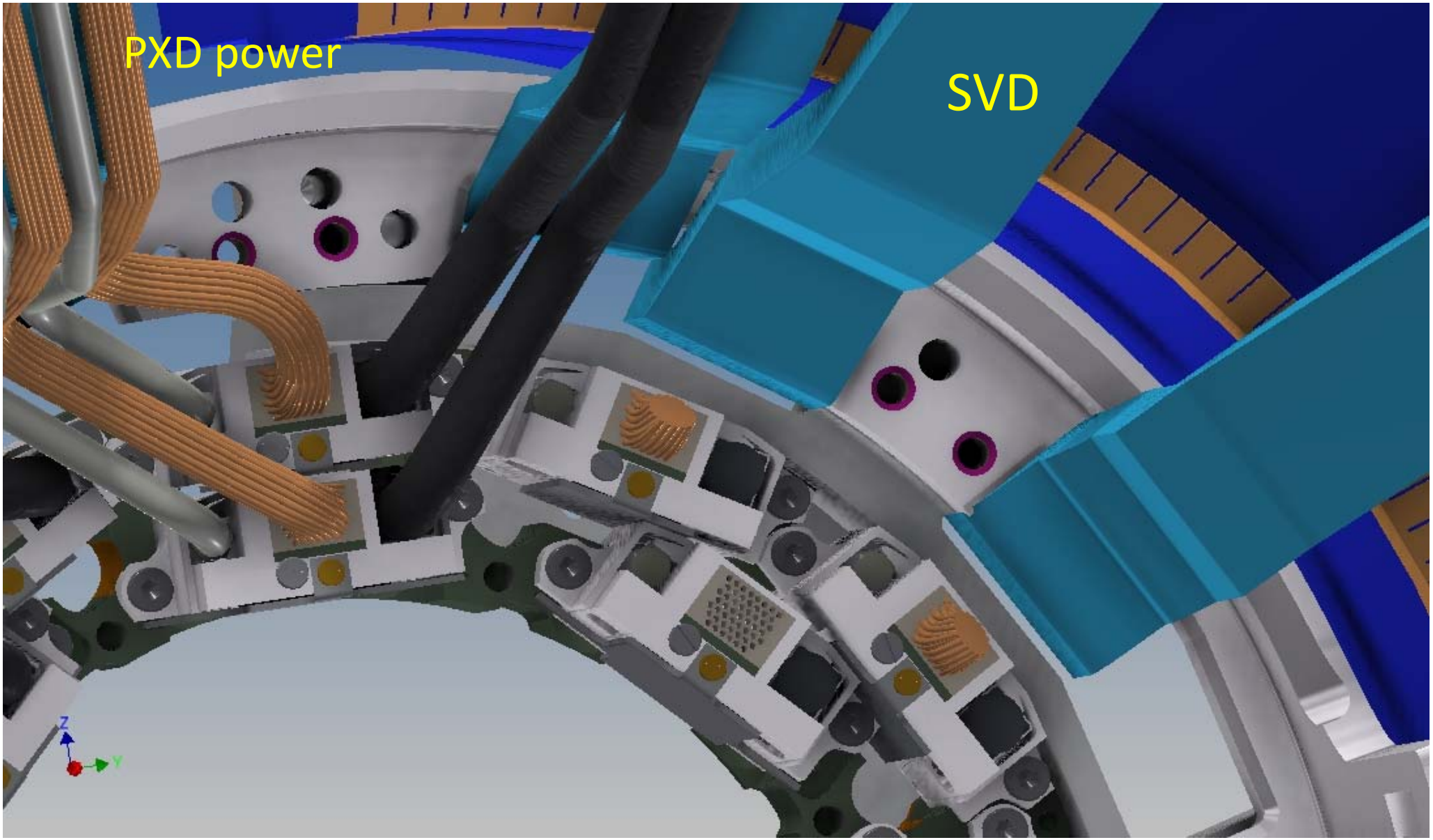


General rule: all services must have a connection at the docks

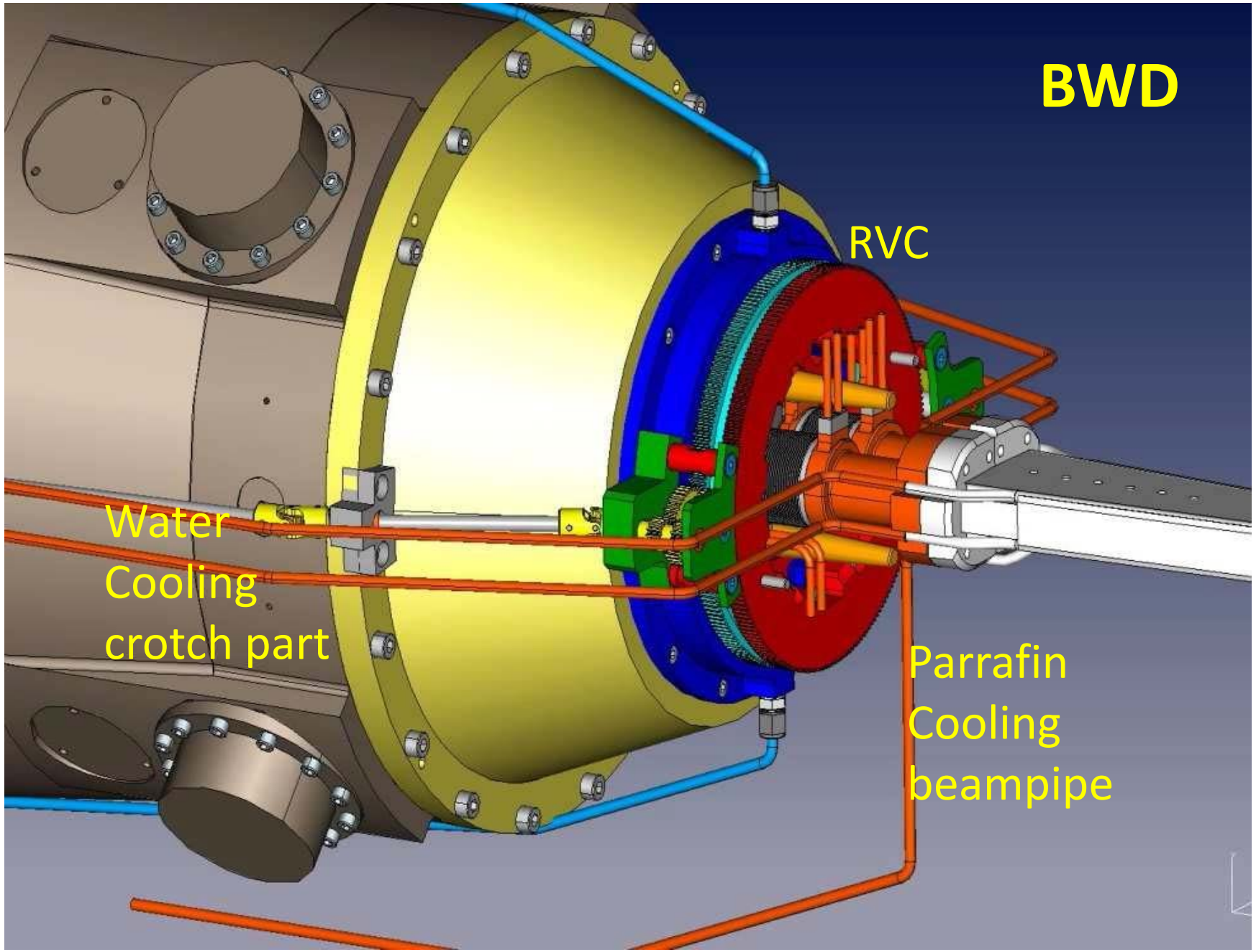
Crowded Region at VXD End Flange

PXD ctrl

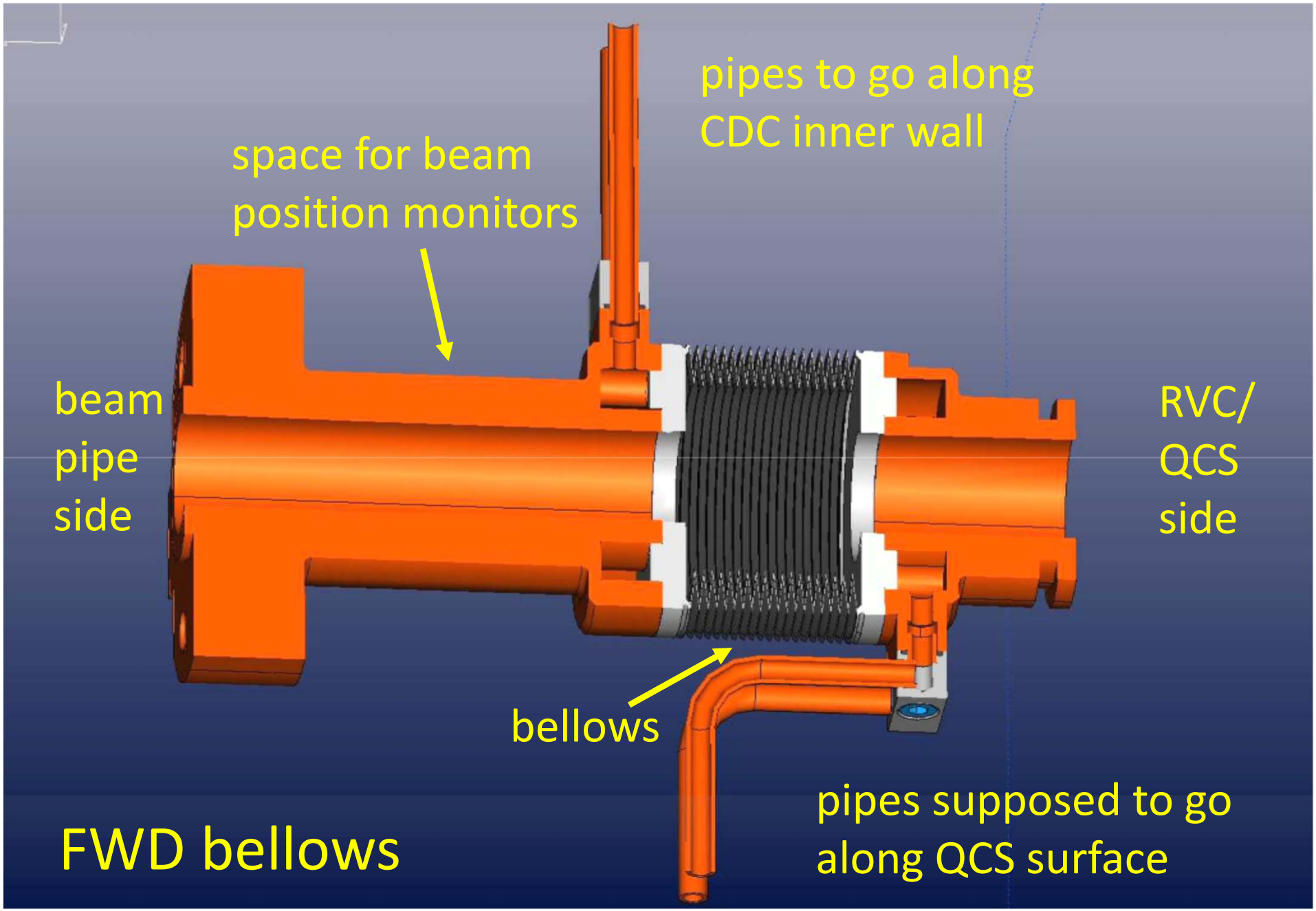
PXD data



Cooling for Machine Elements



Water Cooling for Bellow Flanges

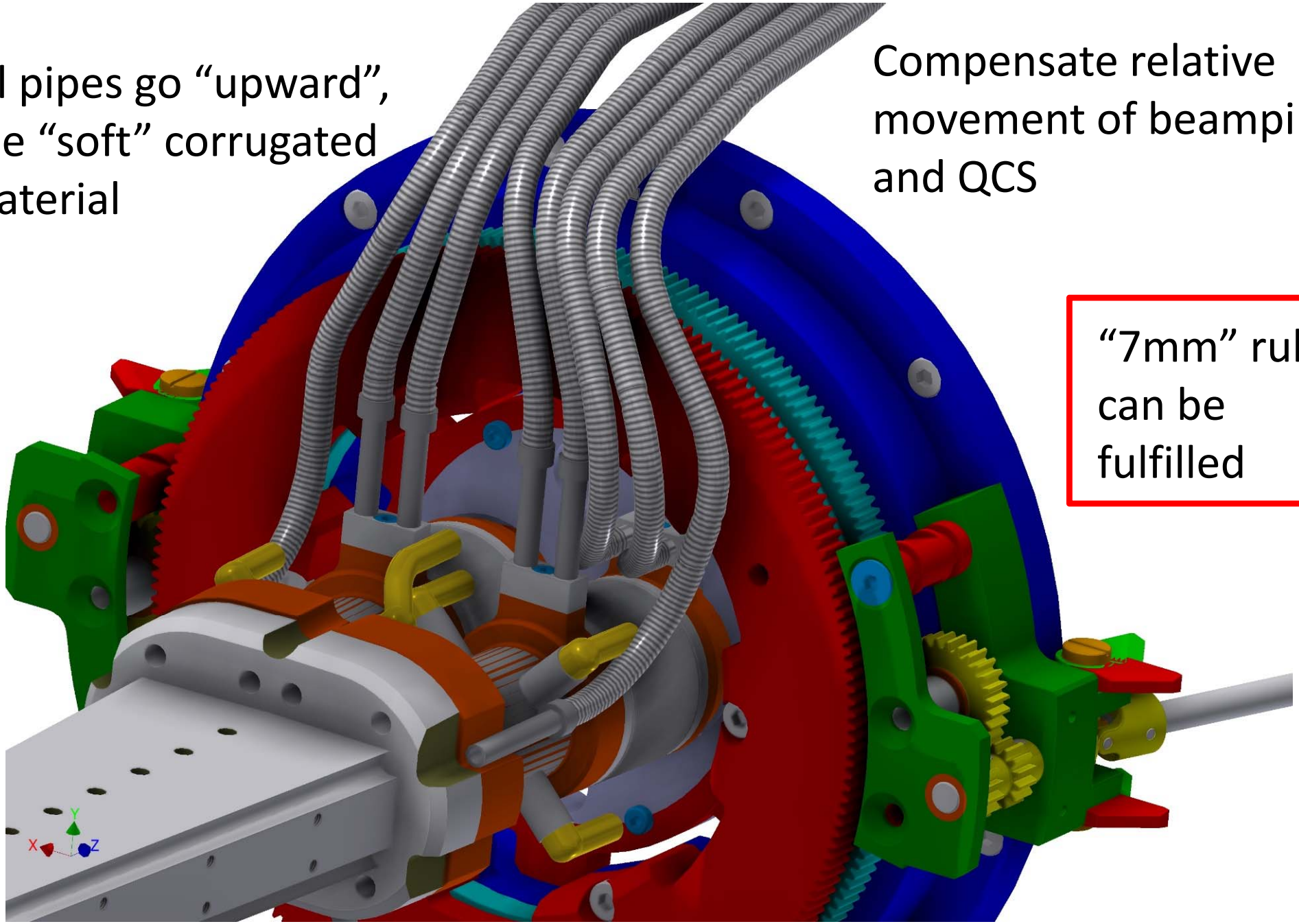


FWD: The Solution

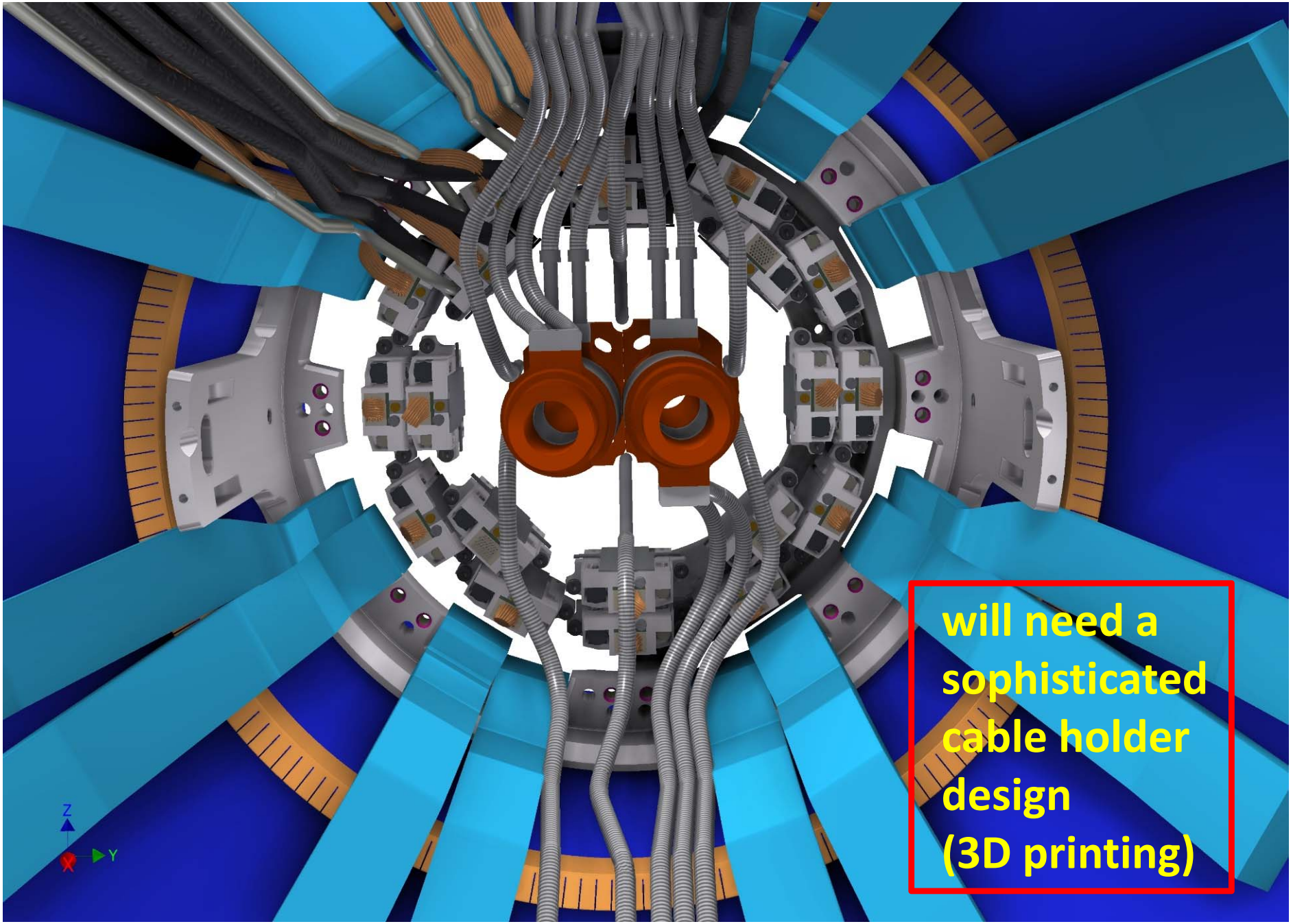
All pipes go “upward”, use “soft” corrugated material

Compensate relative movement of beampipe and QCS

“7mm” rule can be fulfilled



FWD: Extremely Tight Cable Arrangement



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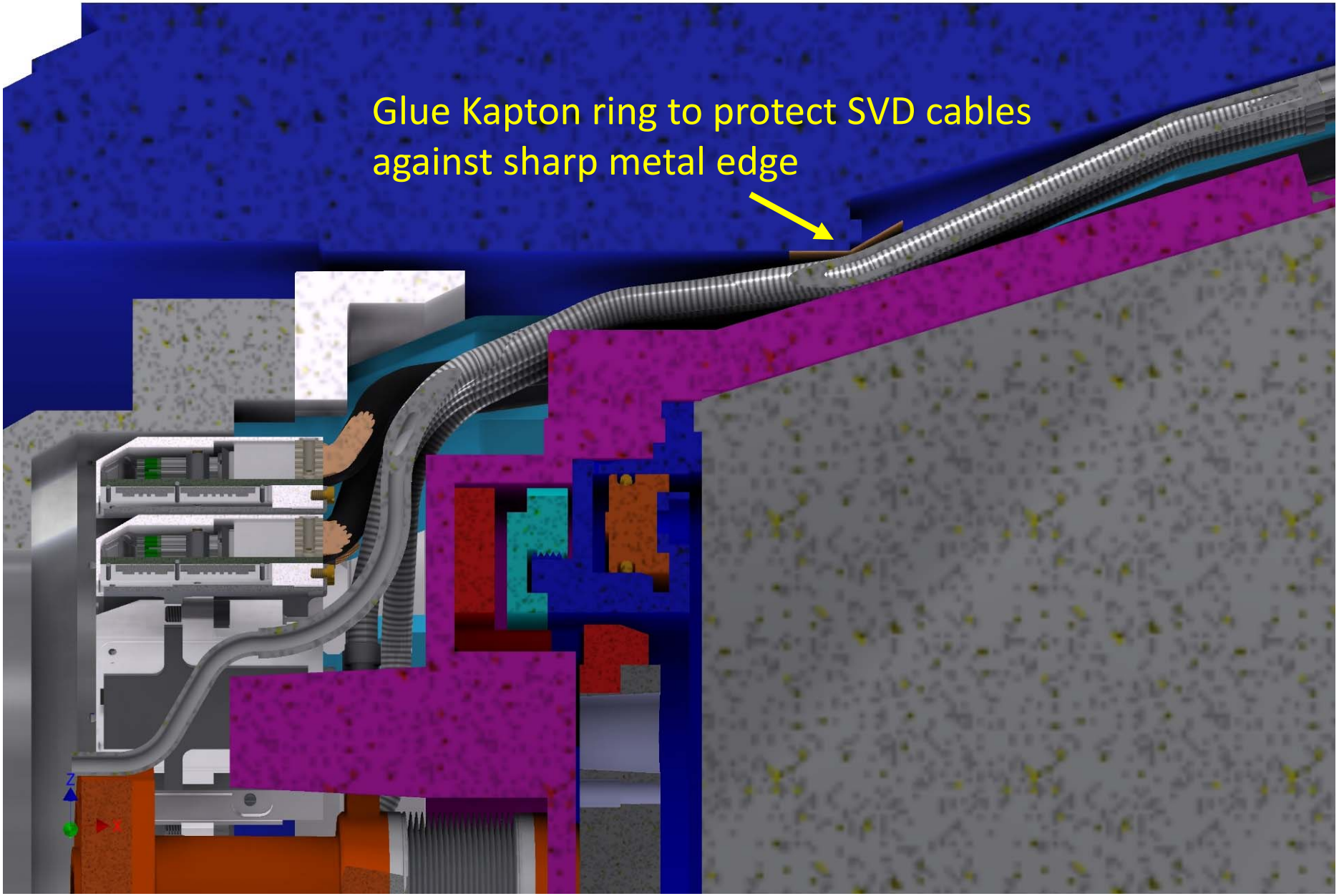
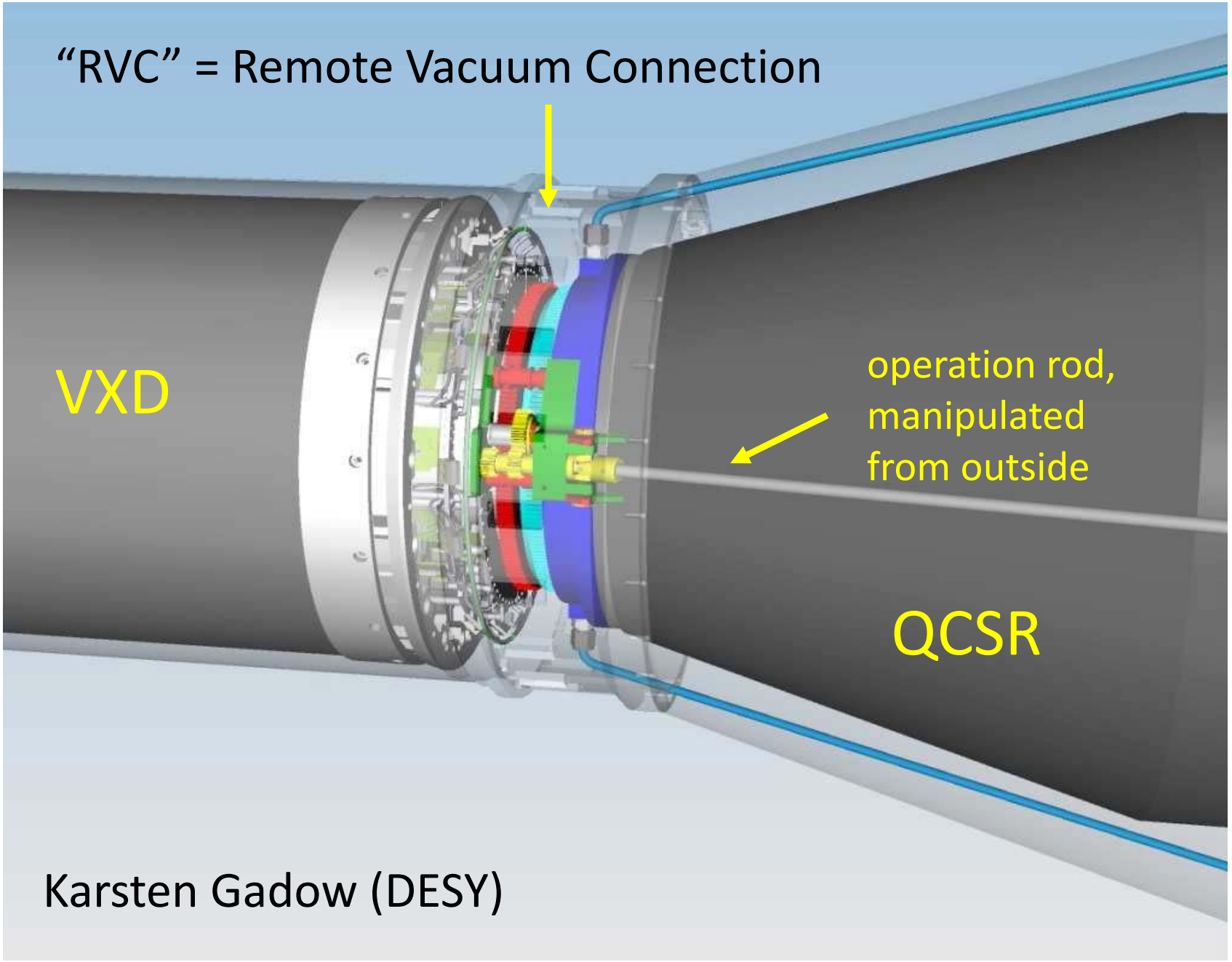
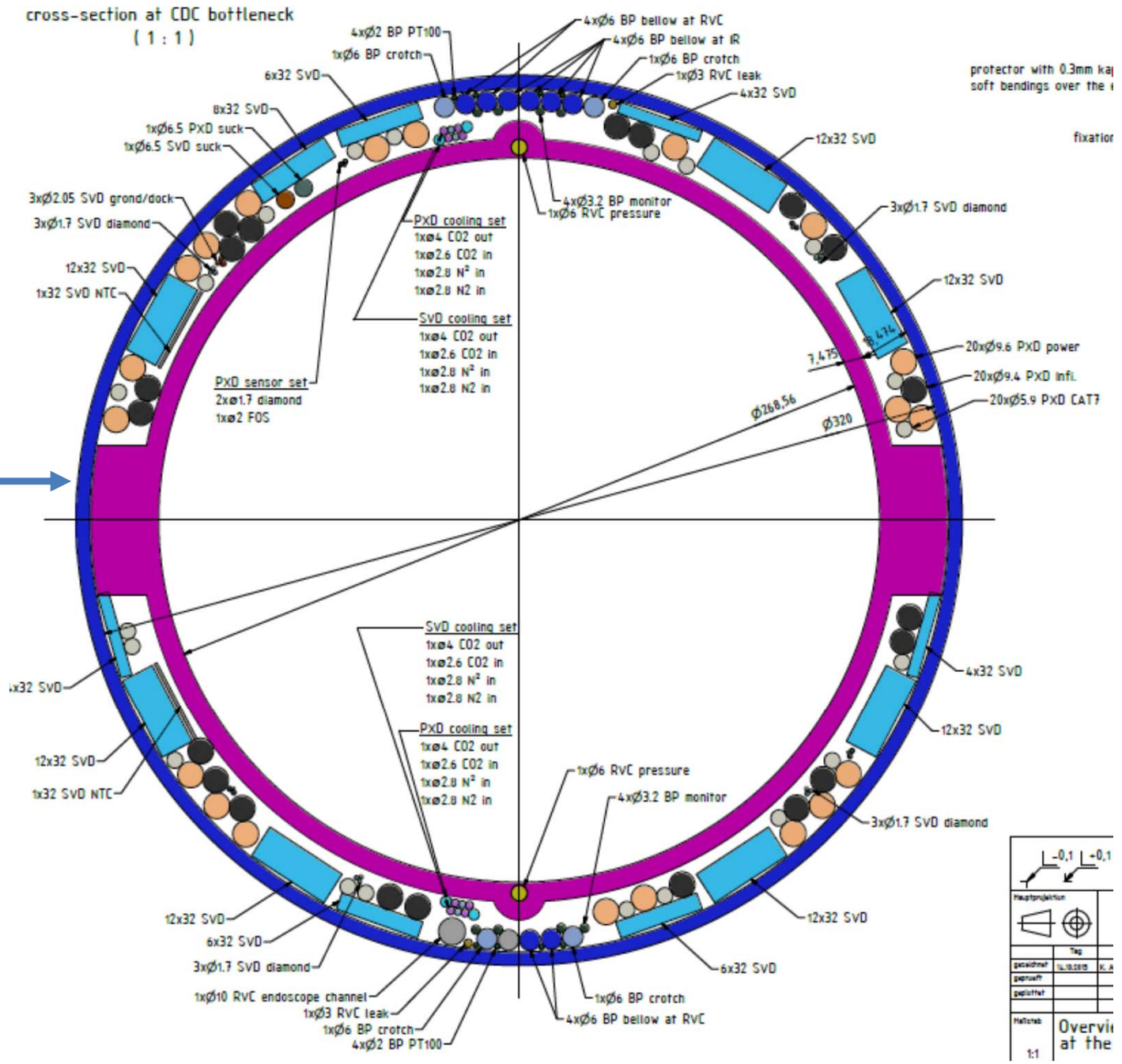


Crucial Component: RVC

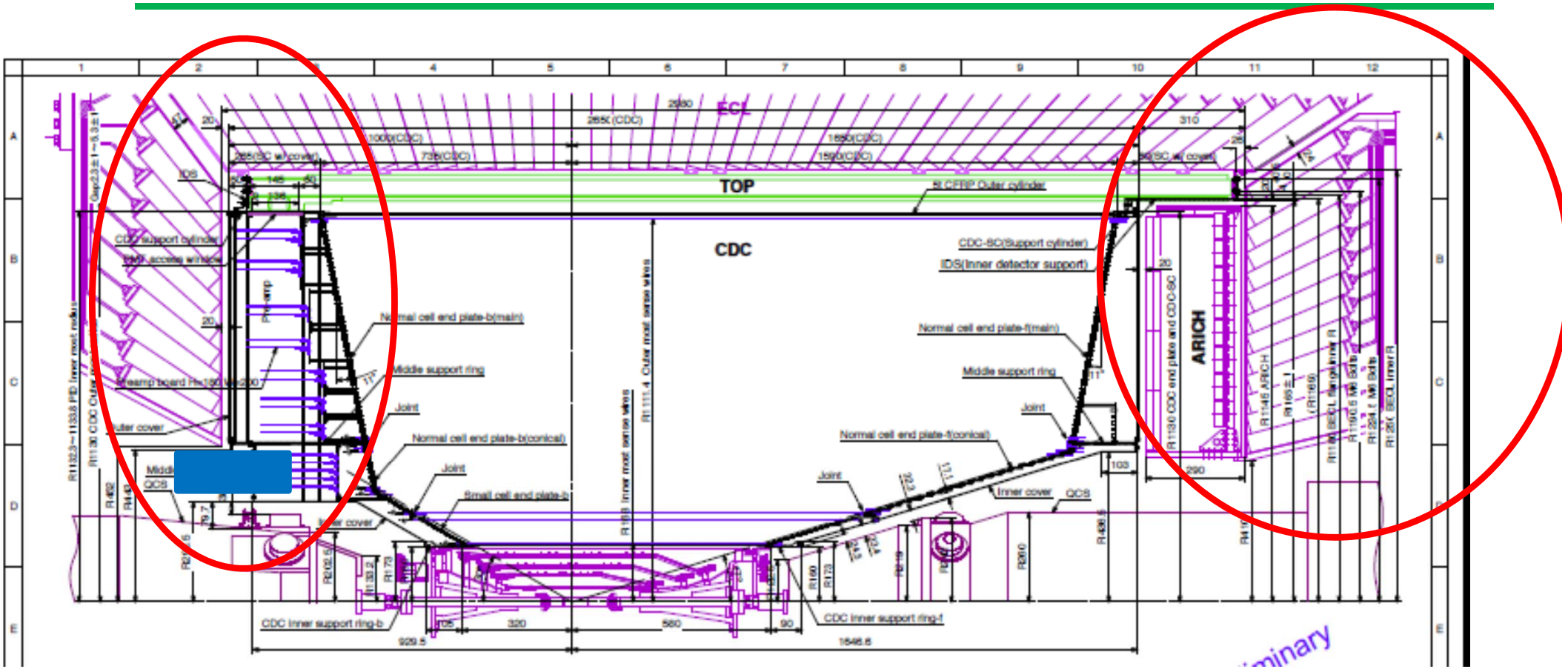


FWD: Extremely Tight Cable Arrangement

violett:
“forbidden”
by 7 mm rule



Going out to the Belle Platform

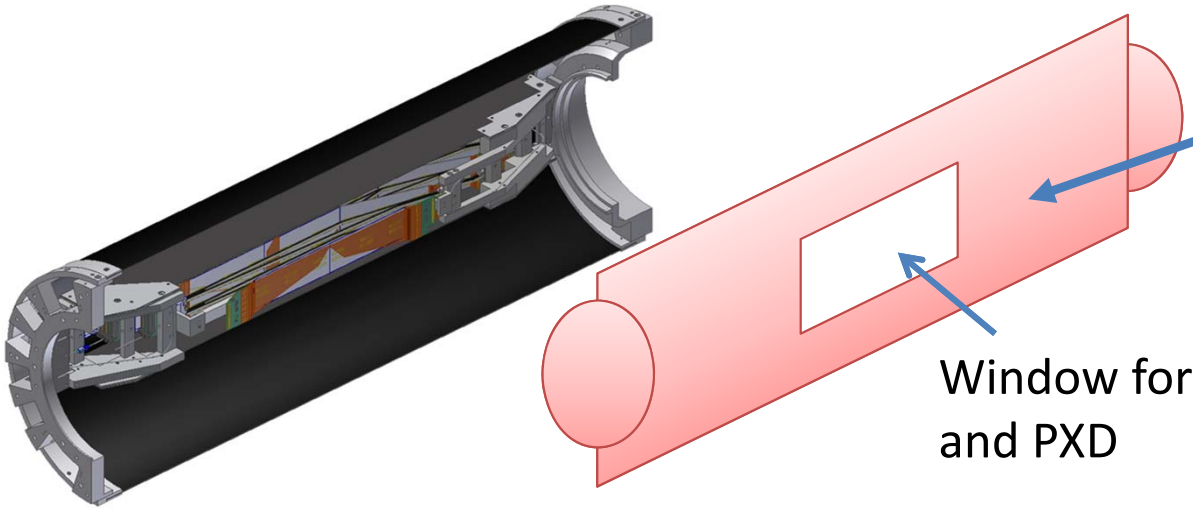


Problematic: Dock Box area in the BWD region (for SWD)
CDC wall in the BWD region
Chicane in FWD

Discuss cable routing again with Adachi-san

DESY Test: VXD Mechanics

Original idea (Katsuro Nakamura in Trieste)



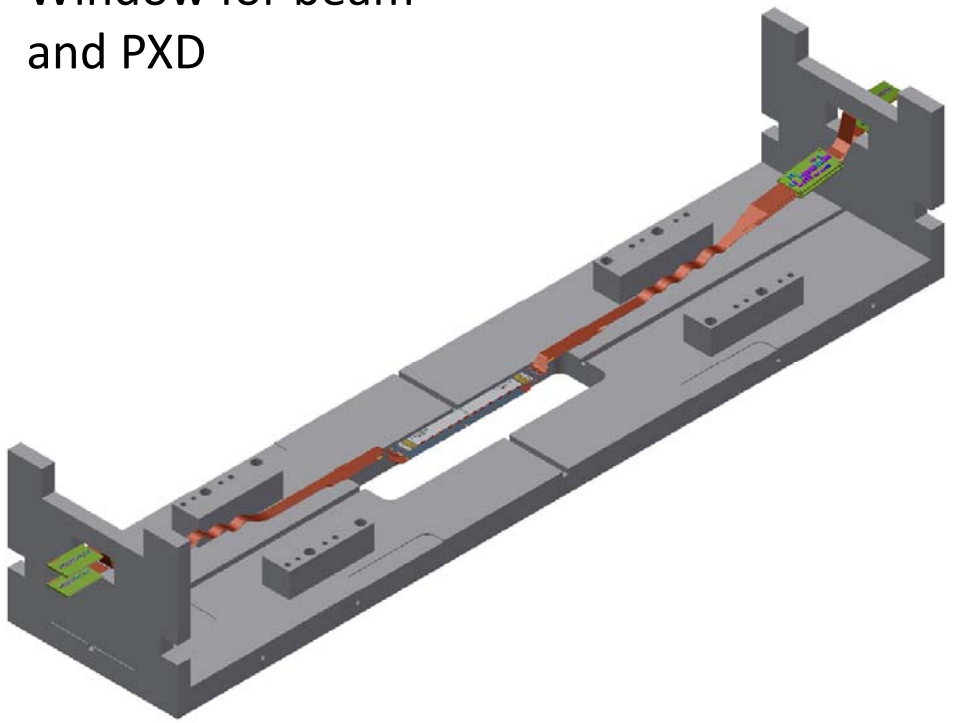
Mount SCB on ground plate

Window for beam
and PXD

New (favored) idea:

make a “box” and provide
fixtures for the SVD cartridge

[Box is closed by cover, cables holes
by EPDM]



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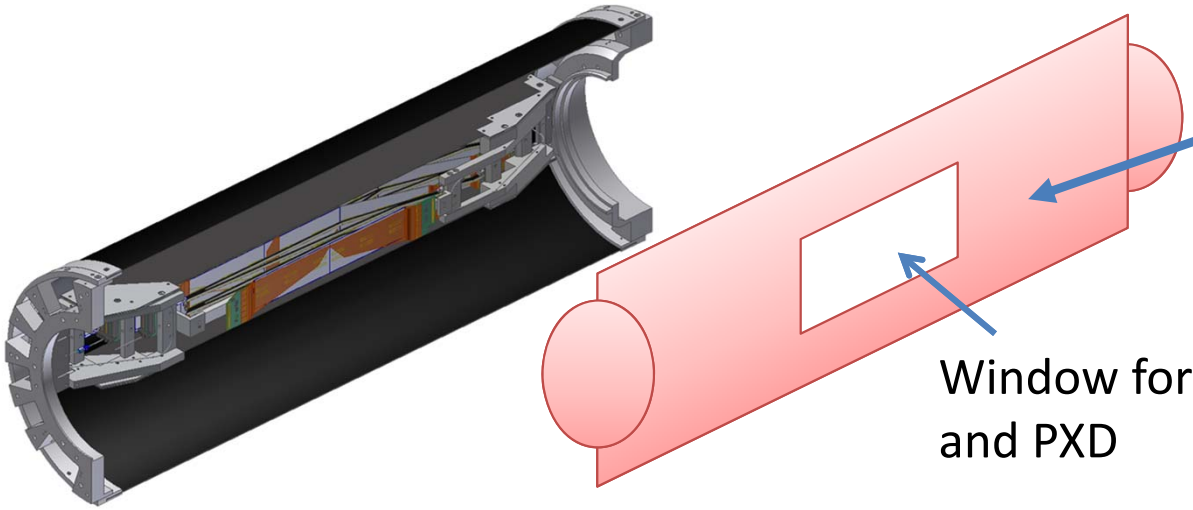

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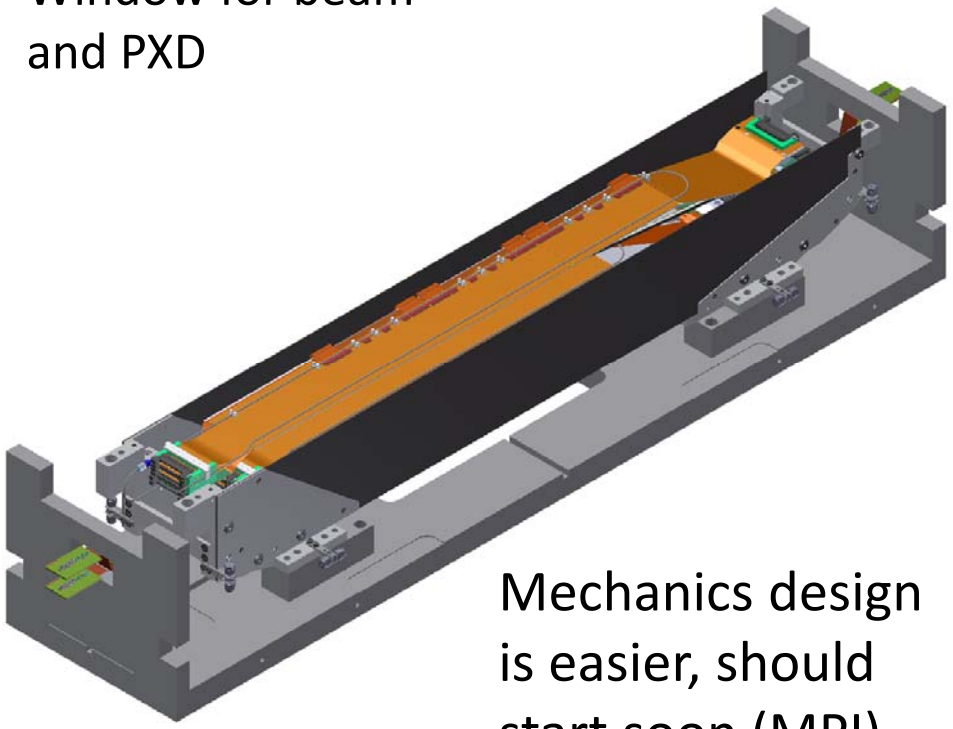
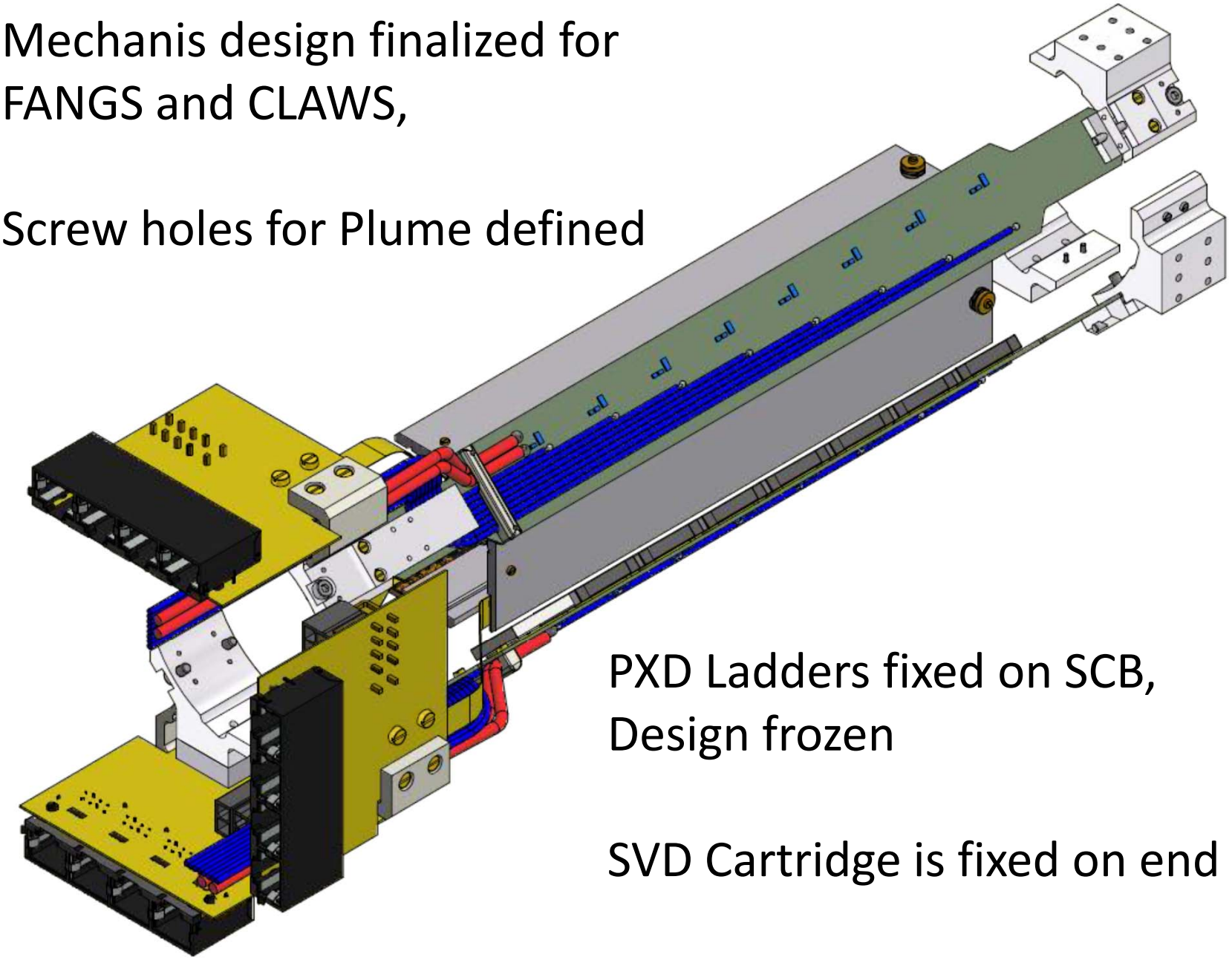


Mechanics design
is easier, should
start soon (MPI)

BEAST 2: VXD Mechanics

Mechanis design finalized for FANGS and CLAWS,

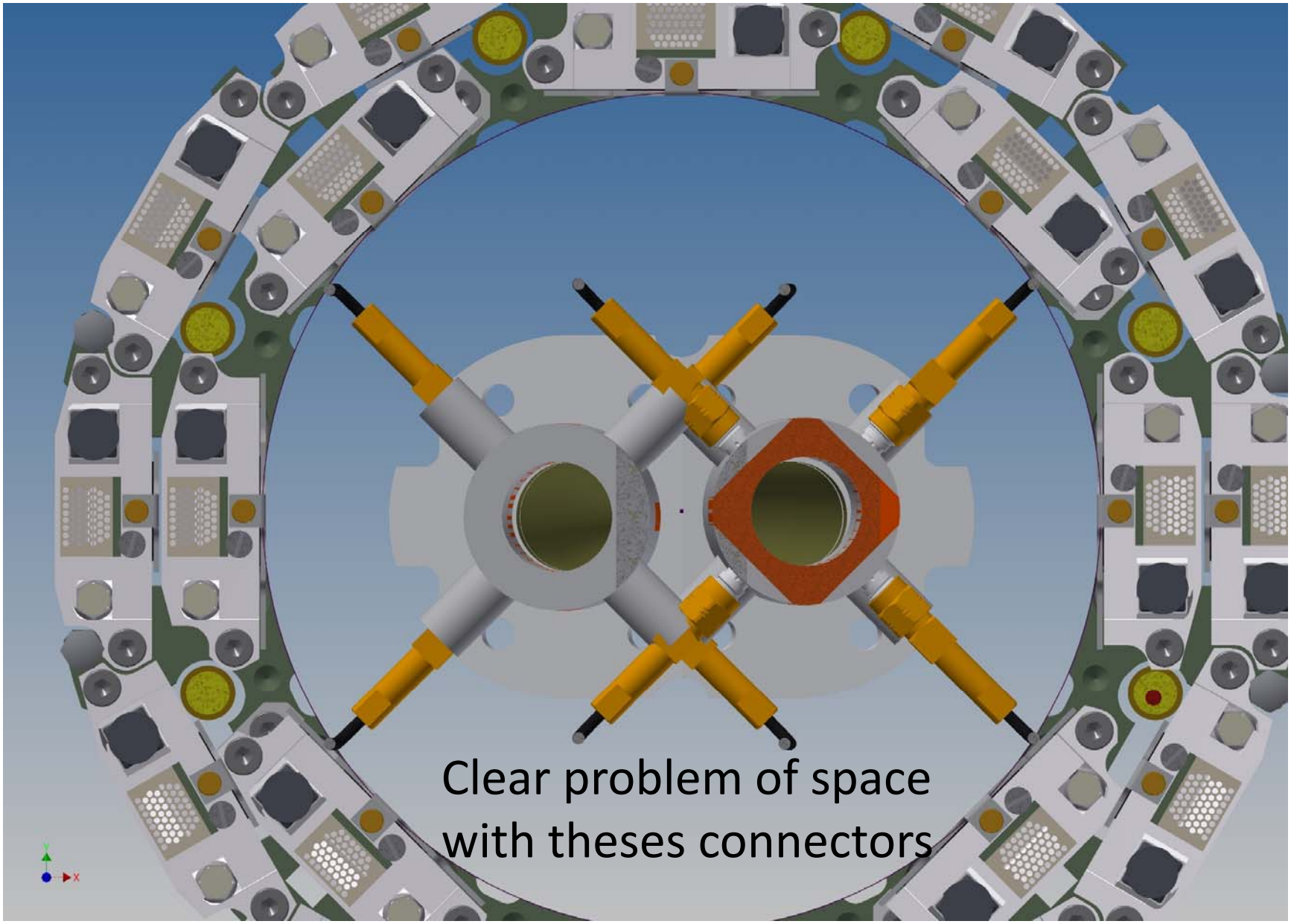
Screw holes for Plume defined



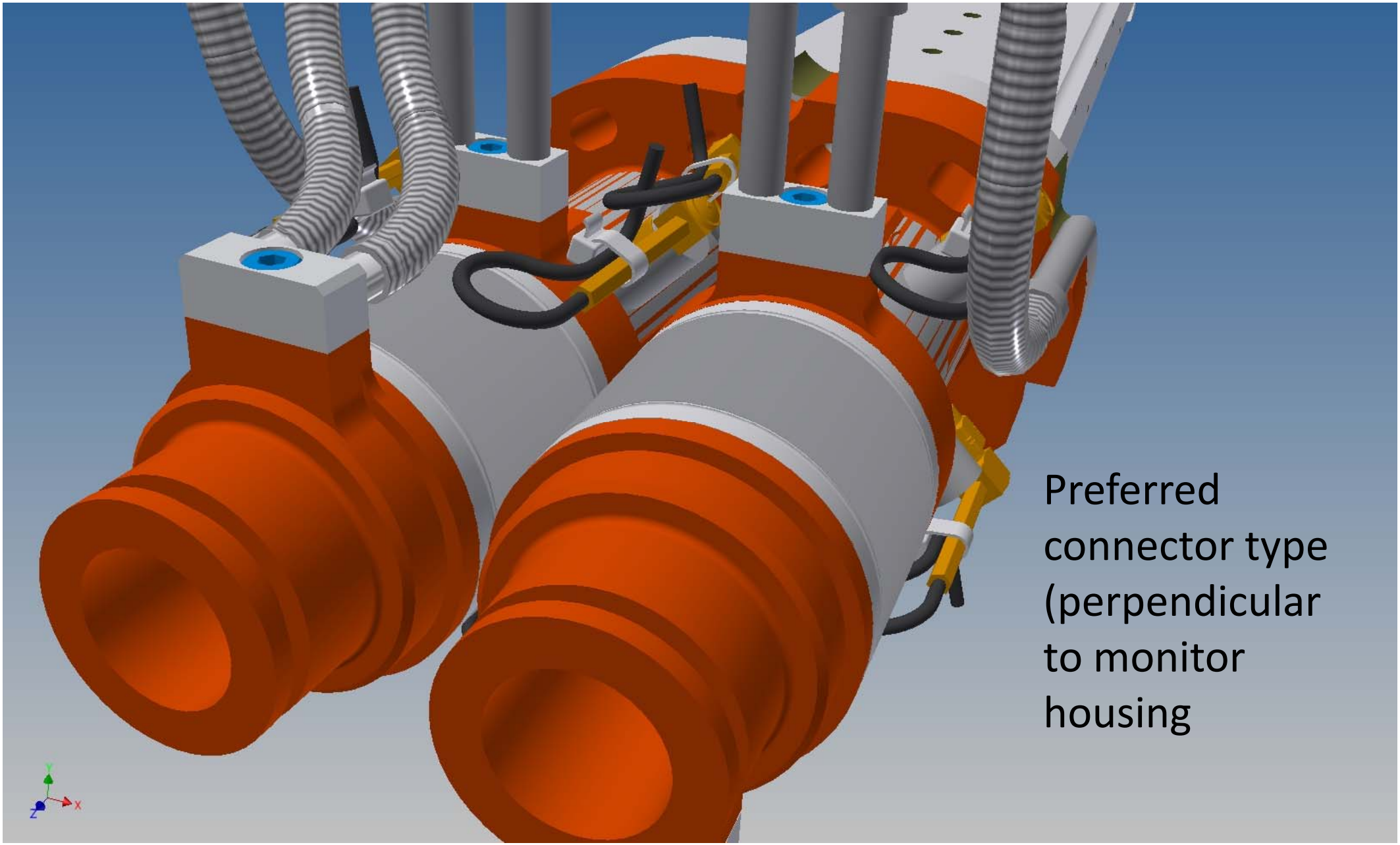
PXD Ladders fixed on SCB, Design frozen

SVD Cartridge is fixed on end flange

Beam Monitors



Beam Monitors



Conclusions

- Very good progress in mechanical design / fabrication of jigs for PXD module production
- Clear concept for last glueing step (modules –> ladders)
- Design of jigs for testing / storage / transport of ladders available
- Conceptual ideas for ladder mounting on SCB
- Detailed list of integration steps for the PXD and SVD
  Installation Mockup very desirable (could use thermal test modules ?)

- Still on the list to tackle
  - Cable cage in the FWD region
  - Dock rings, sandwiching the dock boxes (prevent sagging of dock boxes)
  - Bellows for dummy VXD (AIM and EDI exercises)
  - Connectors for beam position monitors

- Option:
  - Mockup for BEAST 2 detectors : Is it needed ?

Backup

PXD/VXD Installation Procedure in B1 (II)

PXD assembly on beampipe:

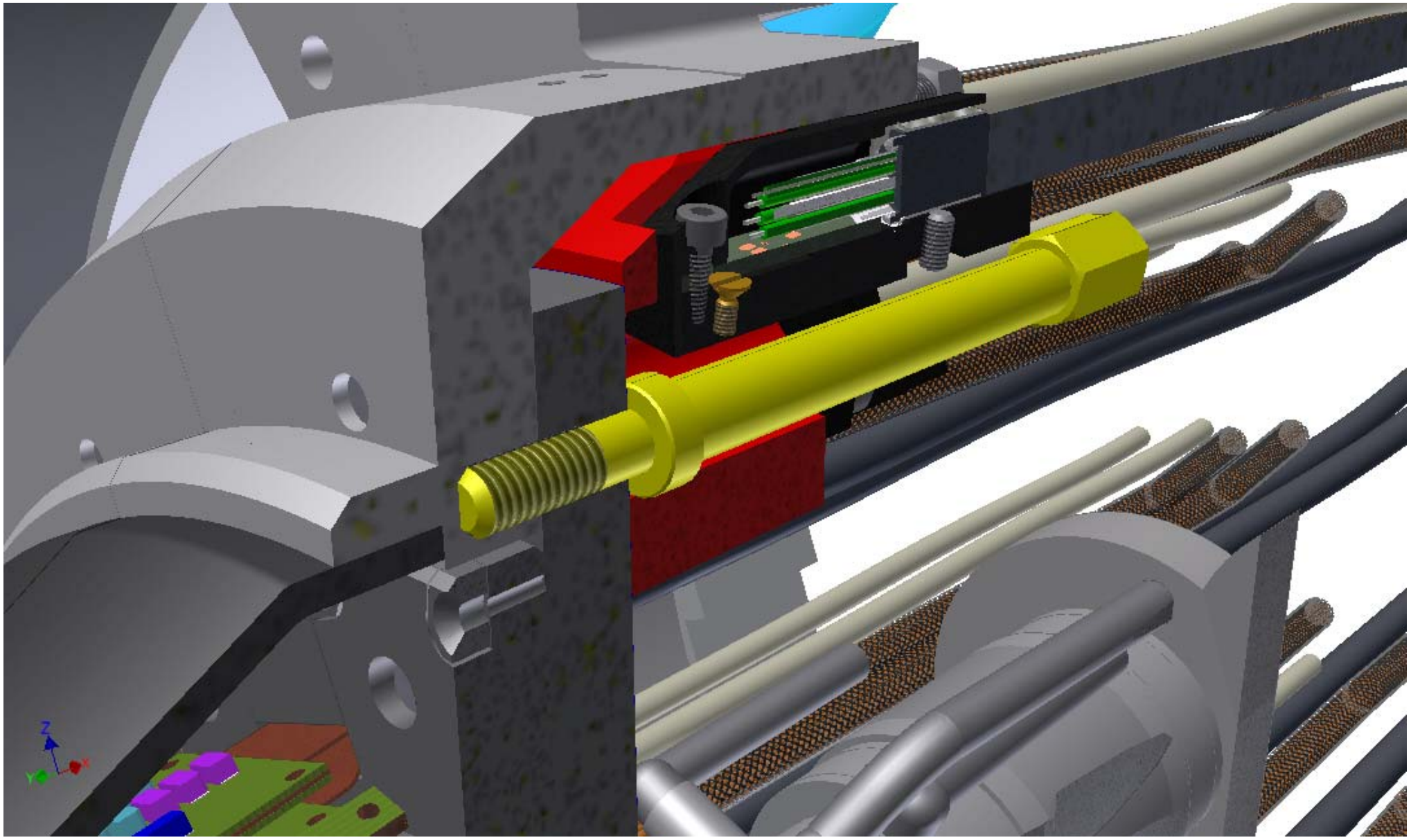
8. Installation of PXD mounting on KEK granite table
   (real beampipe with heavy metal, diamonds and beampipe services is already prepared and aligned on rotational holding structure)
9. Check pins on PXD mount blocks with dummy SCB assembly
10. Grab first PXD half-shell with tool and lower from above, tighten screws on SCBs with nominal torque
11. Arrange Kaptons on the Heavy Metal structure and fit through end flange
12. Turn mounting table by 180°
13. Check pins on PXD mount blocks with dummy SCB assembly
14. Grab second PXD half-shell with tool and lower from above, tighten screws on SCBs with nominal torque
15. Arrange Kaptons on the Heavy Metal structure and fit through end flange.

PXD/VXD Installation Procedure in B1 (III)

PXD (both halves) fixed on beampipe: Cable attachment

16. Attach Patch Panel support on BWD and FWD sides
17. Attach Patch Panels (with cables) on both sides
18. Guide cables radially and keep in position with temporary support
19. Mount cable support on both BWD and FWD sides
20. Bring cable one by one in position and fix them at a distance of about 300 mm from the end flange at their default positions. Cables are now in their default position
21. Final positioning check using precision arm (register positions on data base)
22. Electrical test cable by cable, one module after the other (no CO2 cooling yet)
23. Remove PXD mounting too from KEK granite table

Mechanics: VXD Assembly



PXD/VXD Installation Procedure in B1 (IV)

PXD complete with cables on beampipe: Add SVD

24. Assemble SVD mounting tool on KEK granite table.
25. Bring first SVD half-shell vom the +x side
26. Fix SVD cable on the VXD cable support
27. Bring second SVD half-shell vom the -x side
28. Fix SVD cable on the VXD cable support
29. Mount cover plate of cable support to keep cables away from RVC.
30. Connect CO2 pipes on each side to the CO2 cooling unit
31. Connect all cables to their services with proper cable strain relieves
32. Power CO2 unit
33. Do electrical tests for PXD
34. Do electrical tests for SVD
35. Removal of SVD mounting tool from the KEK granite table.
36. Install comsic ray trigger counter
37. Do cosmic ray test

PXD/VXD Installation Procedure in B1 (V)

VXD after Cosmic Ray Test: Preparations for the transport to Belle

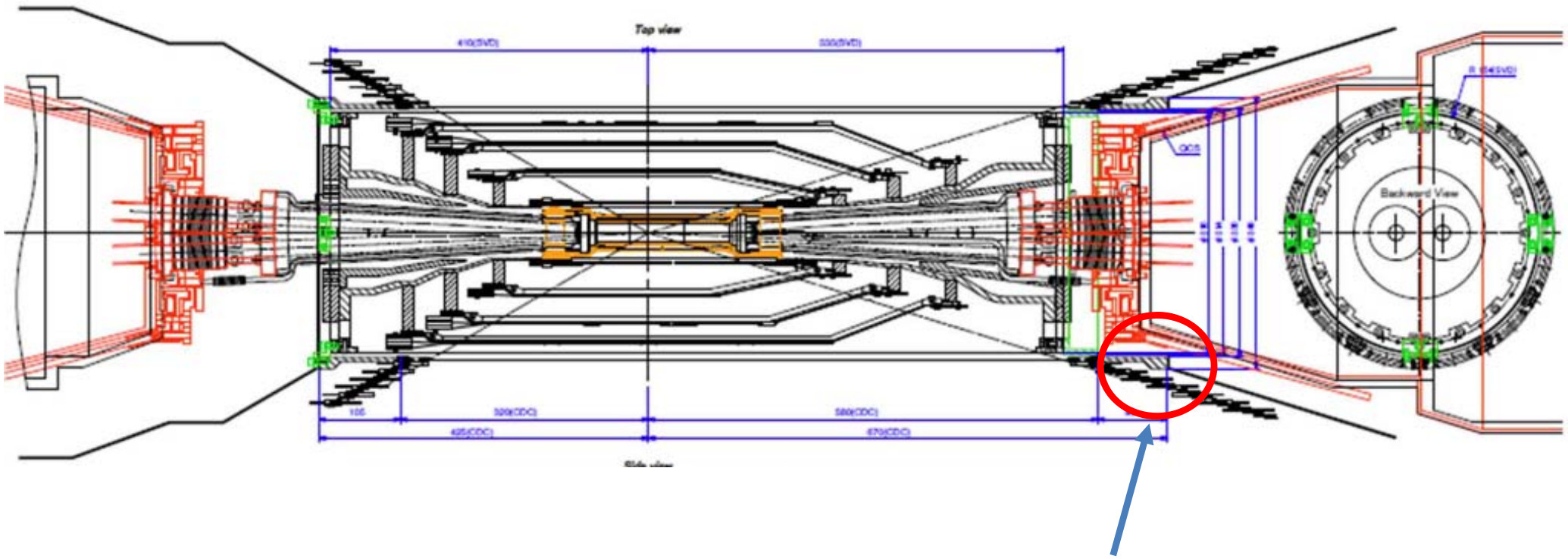
38. Mounting of the first AIM components
39. Support of PXD now switched from support on beampipe to support by the end rings so that a further installation is possible.
40. Mounting of additional AIM components such as cable trays etc.
41. Repositioning of the VXD with cable trays attached from the KEK granite table onto the movable transport cart (using small crane and a steel traverse prepared at MPI)
42. Protective foil cover of entire VXD for transport (protect against dirt and dust on the way down to the beam line
43. Install support on the gallery outside B1 to receive the VXD

PXD/VXD Installation Procedure in B1 (VI)

VXD after Cosmic Ray Test: Preparations for the transport to Belle

44. Move VXD out of B1 and position before the support structure
45. Reposition VXD from the transport cart onto the support structure (using the steel traverse and the small crane).
46. Move the VXD on support structure out and connect the hall crane to the steel traverse
47. Transport the VXD via the hall crane to the beam line
48. Position the VXD onto the mounting tube and the monting tube extensn of AIM (which has been prepared beforehand)
49. Install VXD using the AIM procedure

Service Space in FWD Region



Extremely narrow gap in the FWD regions between inner CDC wall and QCS: only 24 mm clearance.

This must be sufficient for the 267 cables and pipes AND has to conserve the “7 mm” rule: gap between cables and QCS outer envelope

Cable & Pipe Count

Services for VXD and Beampipe

14.10.2015 compiled by C. Kiesling / T. Ackermann

VXD up to Dock boxes

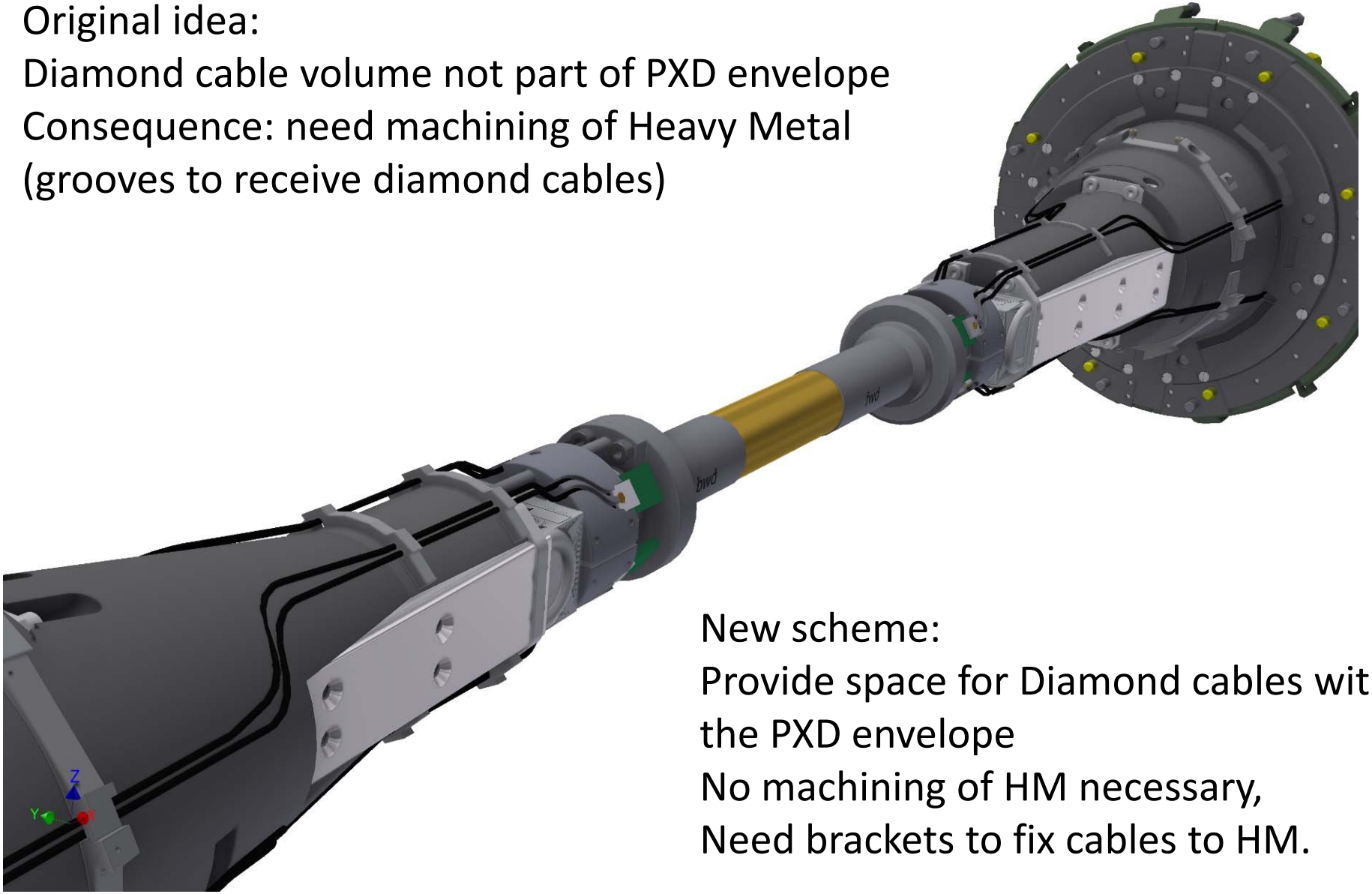
	Component	Name	Material / shape	Diameter (mm)	# (BWD)	# (FWD)
1	**Beampipe**					
1.1	Be part	paraffine cooling lines	stainless steel, round	ø 6.0	1	1
1.2	crotched part	water cooling	stainless steel, round	ø 6.0	4	4
1.3	crotched part	BPMonitors	coax	ø 3.2	8	8
1.4	Bellows	water cooling	stainless steel,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

Cable & Pipe Count

3	**SVD**					
3.1	ladders	signal/power cables	ribbon	32.0 x 1.0	222	122
3.2	6 Radiation monit.	diamonds	lemo coax	ø 1.7	12	12
3.3	End rings	CO2 pipe (in)	ss (with insulation)	ø 2.6	6	2
3.4	End rings	CO2 pipe (out)	ss (with insulation)	ø 4.0	6	2
3.5	Dry N2 in	cold dry vol.	ss (with insulation)	ø 2.8	0	4
3.6	1 Suction pipe	suction pipe (on end flange)	ss (with insulation)	ø 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	**VXD**					
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)	ø 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)		ø 6.0	2	2
	total				15	6
	Total on CDC inner wall				**428**	**267**
5	**RVC**					
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

Diamond Cable Arrangement

Original idea:
Diamond cable volume not part of PXD envelope
Consequence: need machining of Heavy Metal
(grooves to receive diamond cables)



New scheme:
Provide space for Diamond cables within the PXD envelope
No machining of HM necessary,
Need brackets to fix cables to HM.