Summary of B2GM & Satellite Meetings

Satellite Meetings:
Saturday, Oct. 17: VXD Mechanics
https://kds.kek.jp/indico/event/19932/
Sunday, Oct. 18: BEAST Mini Workshop
https://kds.kek.jp/indico/event/19922/

B2GM:
Monday, Oct. 19 – Friday, Oct. 23
https://kds.kek.jp/indico/event/19519/timetable/#all.detailed

BPAC:
Saturday, Oct. 24 – Monday, Oct. 26
https://kds.kek.jp/indico/event/19537/timetable/#all.detailed

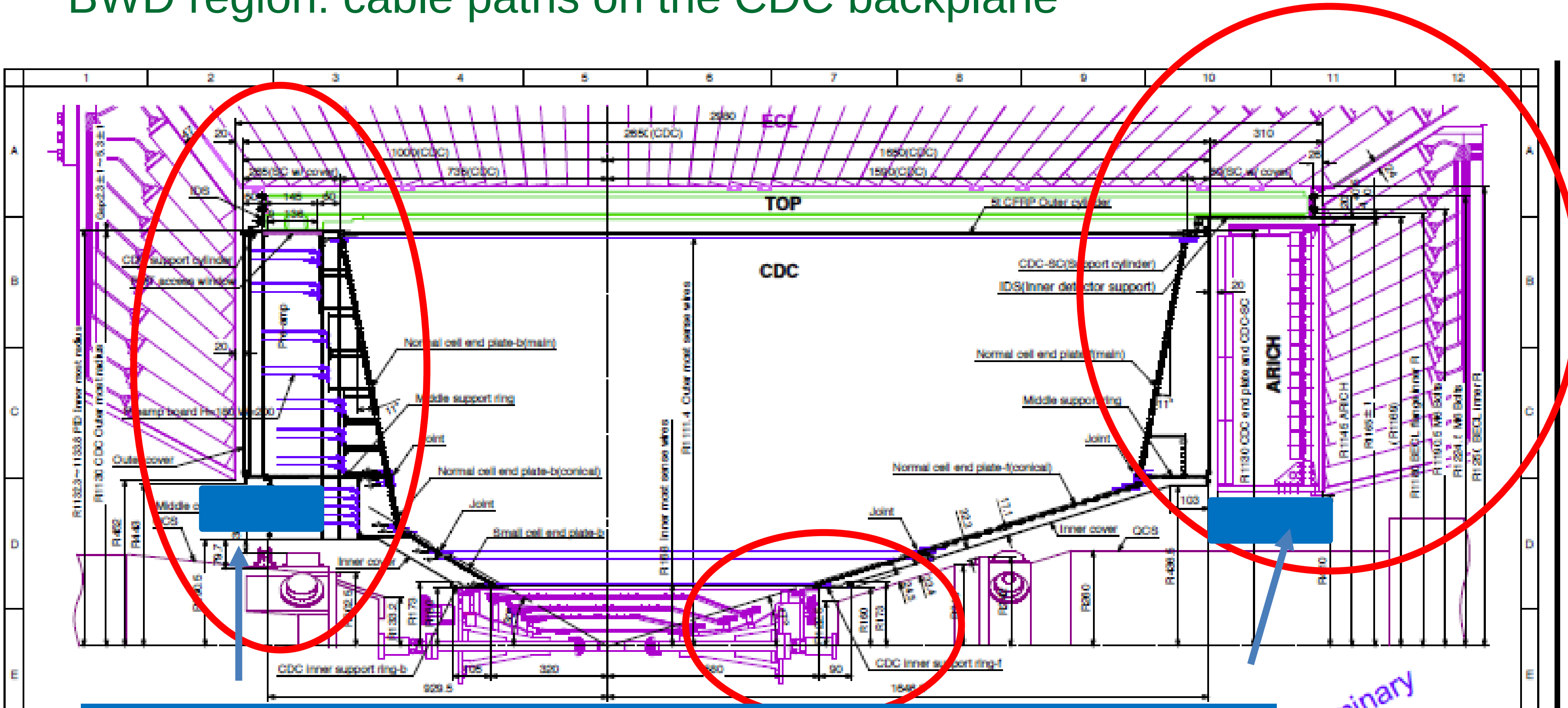
VXD Services

Tscharlie Ackermann (MPI Munich)
Markus Friedl (HEPHY Vienna)

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

Cable & Pipe Count

Services for VXD and Beampipe

14.10.2015 compiled by C. Kiesling / T. Ackermann

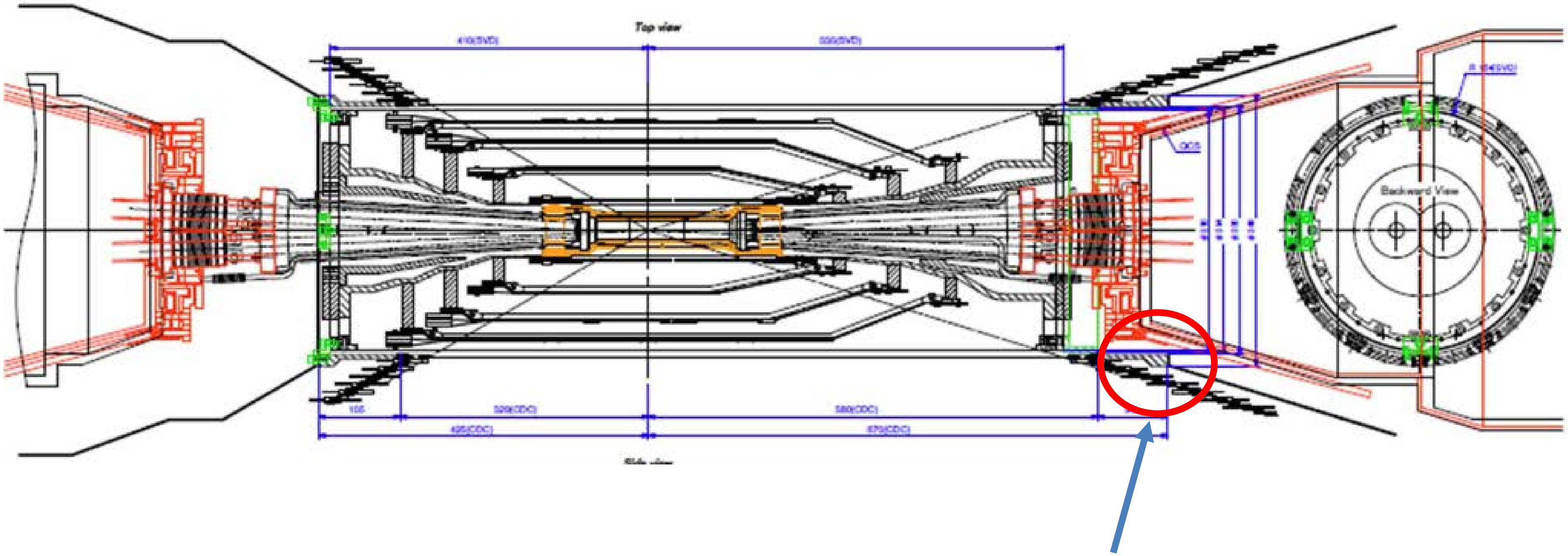
VXD up to Dock boxes

	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	CO_2 pipe (in)	ss (with insulation)	ø 2.6	6	2
3.4	End rings	CO_2 pipe (out)	ss (with insulation)	ø 4.0	6	2
3.5	Dry N_2 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

Service Space in FWD Region



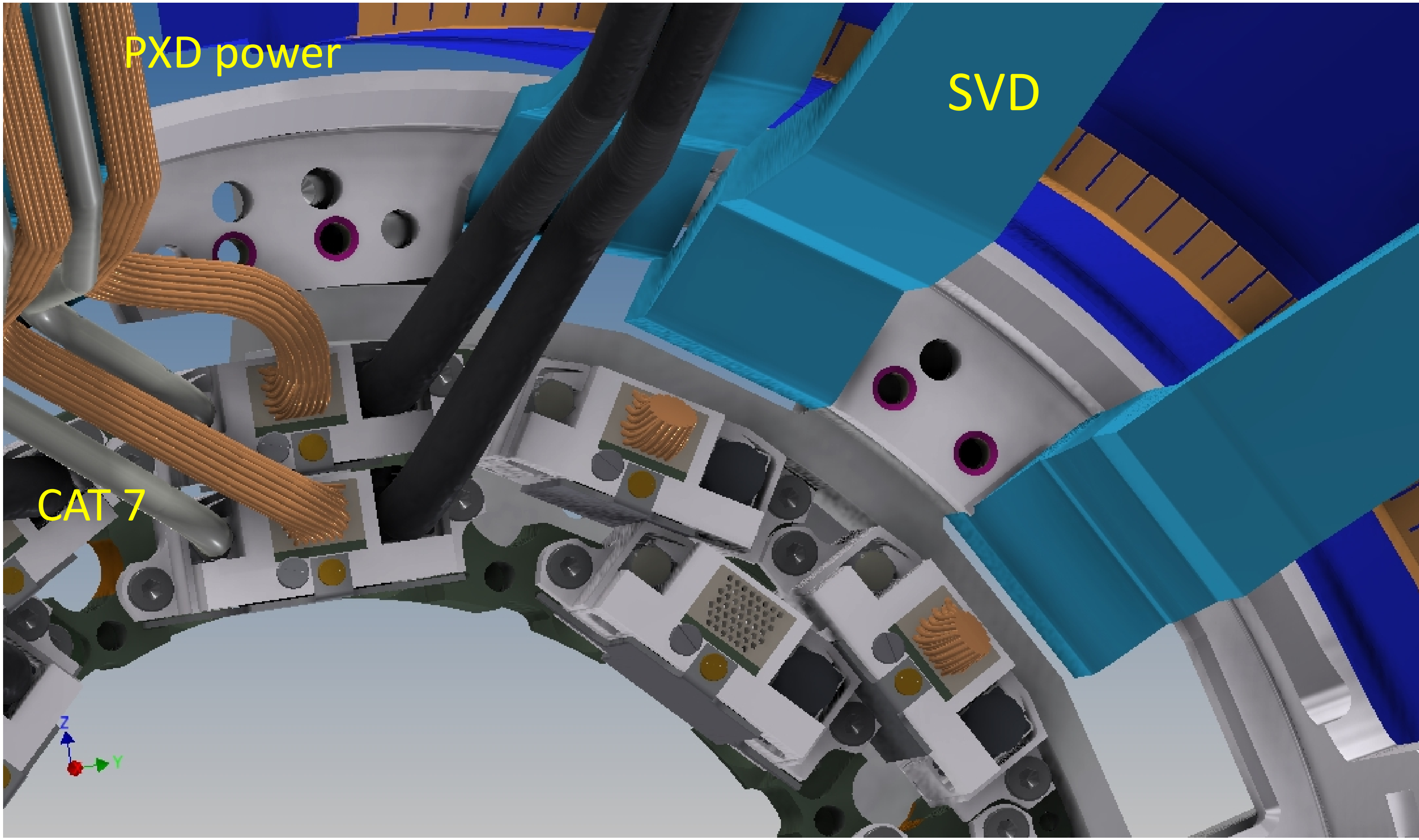
Extremely narrow gap in the FWD regions between inner CDC wall and QCS: only 24 mm clearance.

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

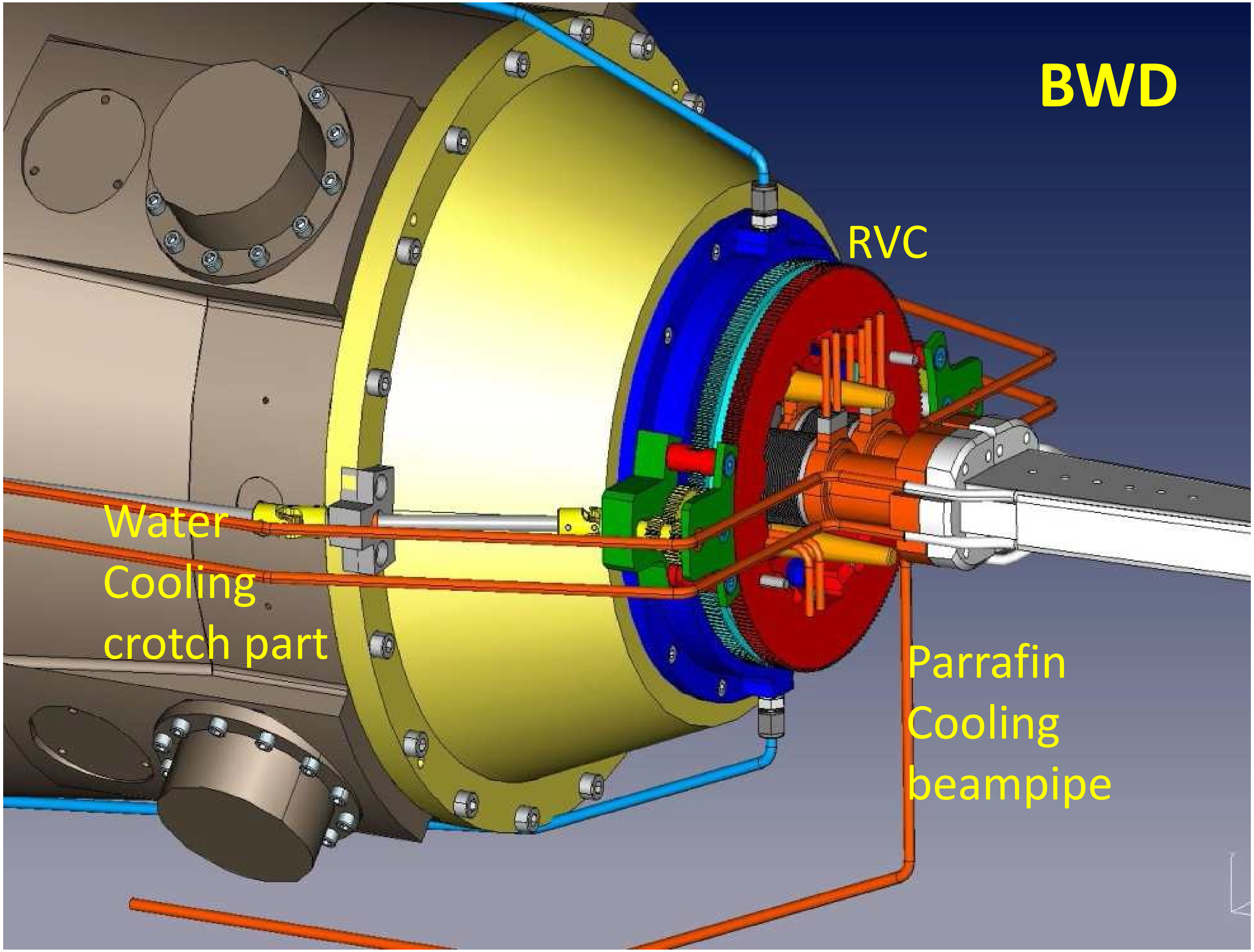
Crowded Region at VXD End Flange

PXD ctrl

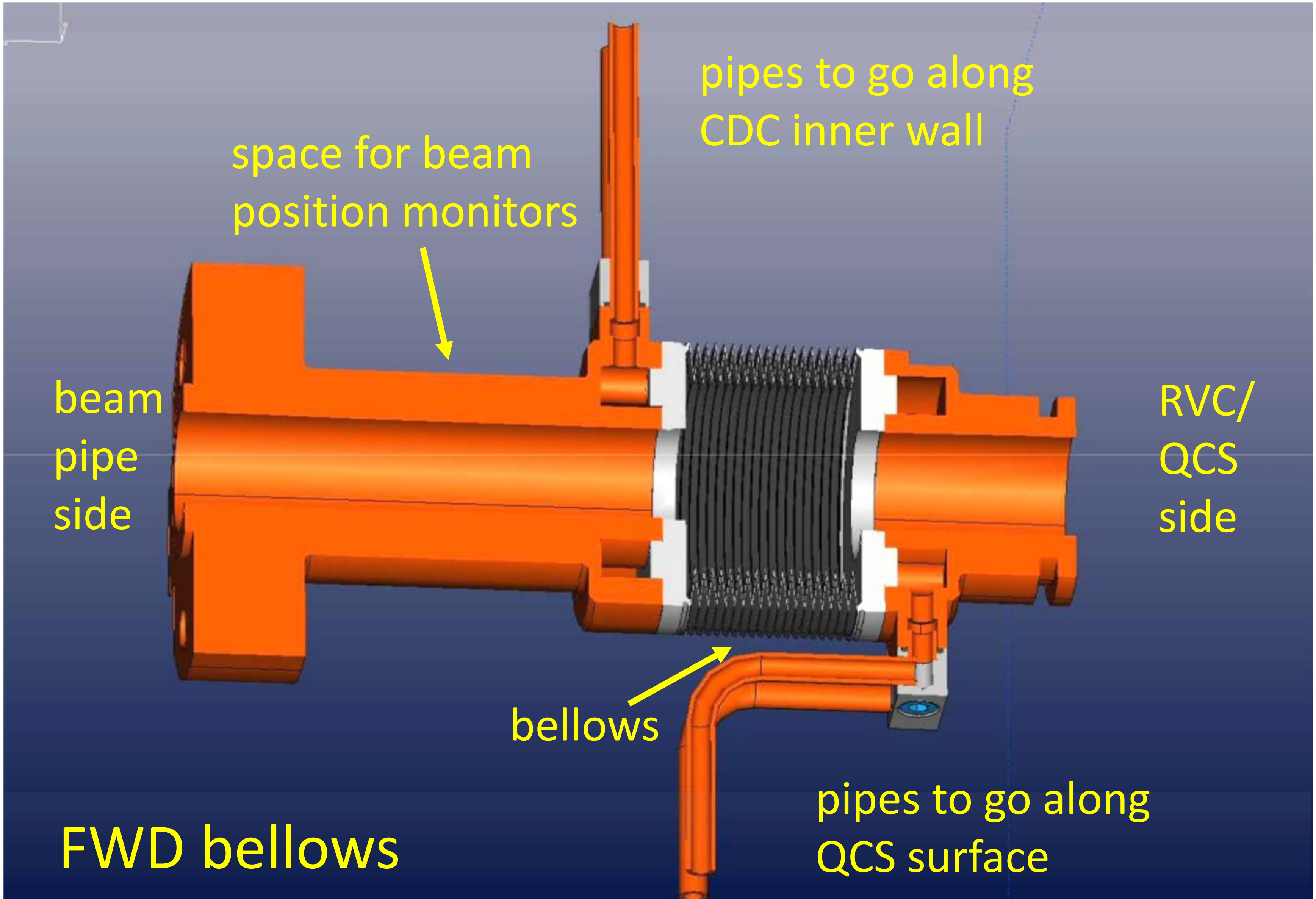
PXD data



Cooling for Machine Elements



Water Cooling for Bellow Flanges



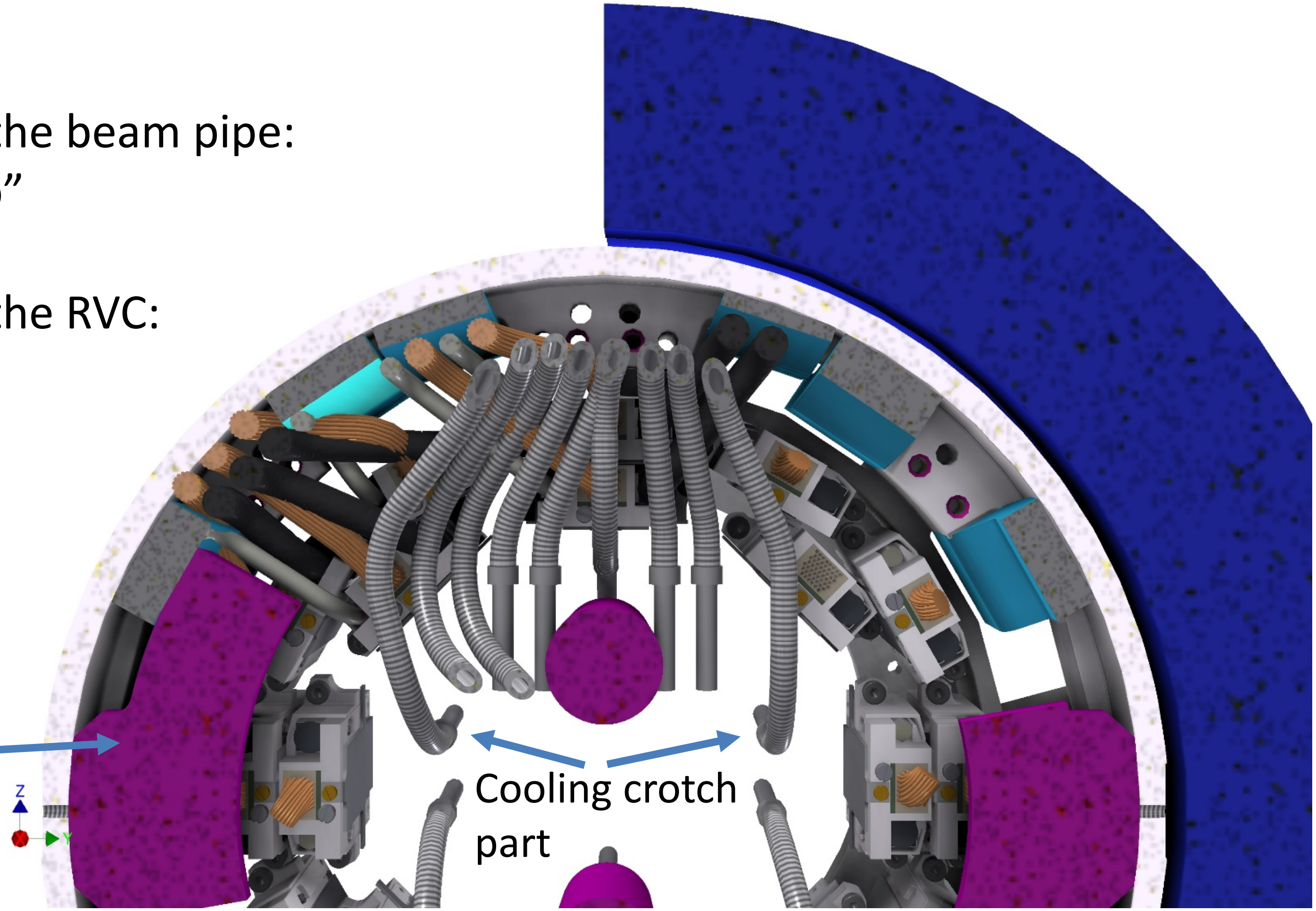
FWD: Possible Solution

Principle of the Solution: ALL cooling pipes of the bellow flanges must go to the inner CDC cone, also those of the flange connected to the RVC

Bellow flange at the beam pipe:
All 4 pipes go “up”

Bellow flange at the RVC:
2 pipes go up,
2 go down

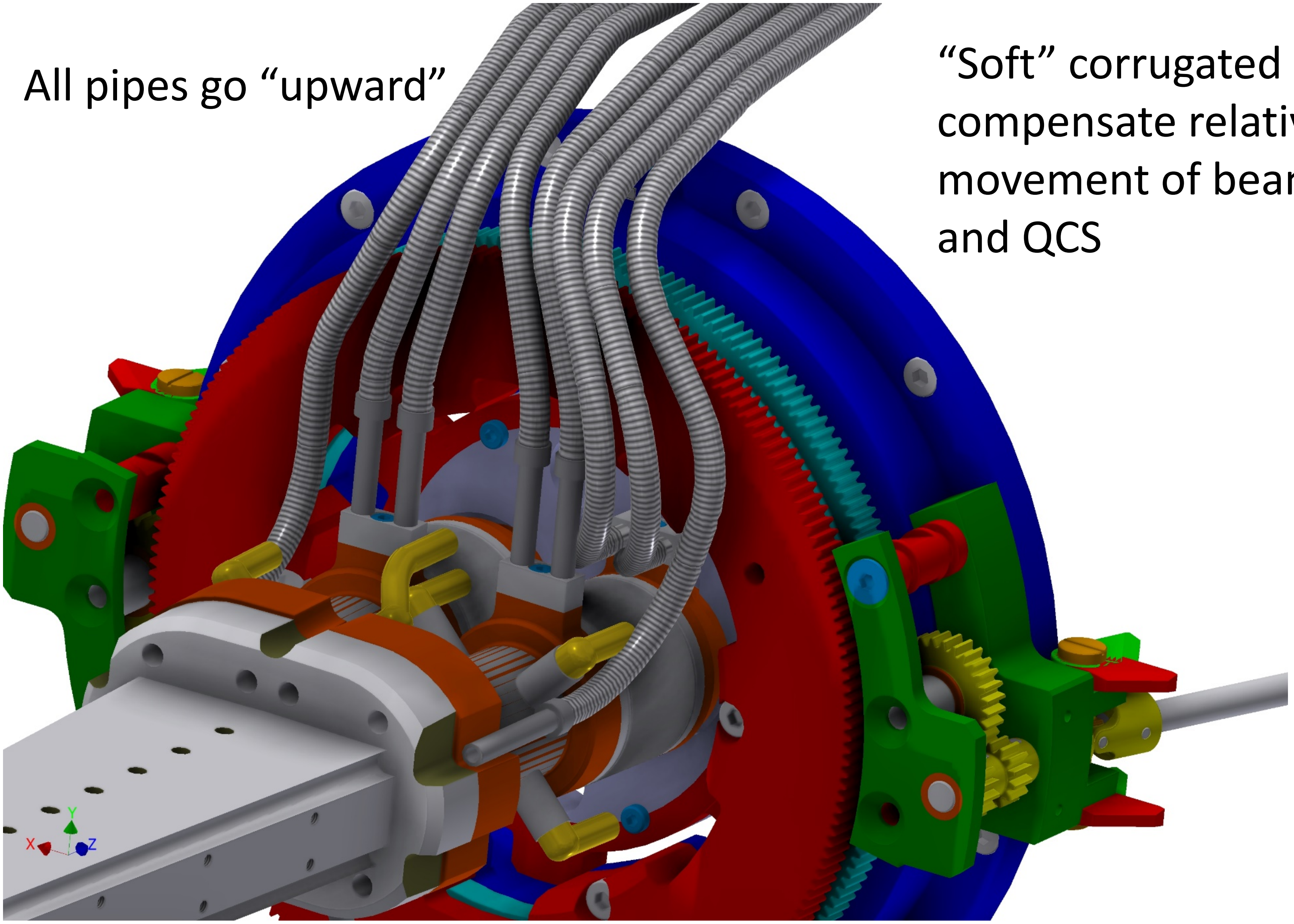
violett:
“forbidden”
space



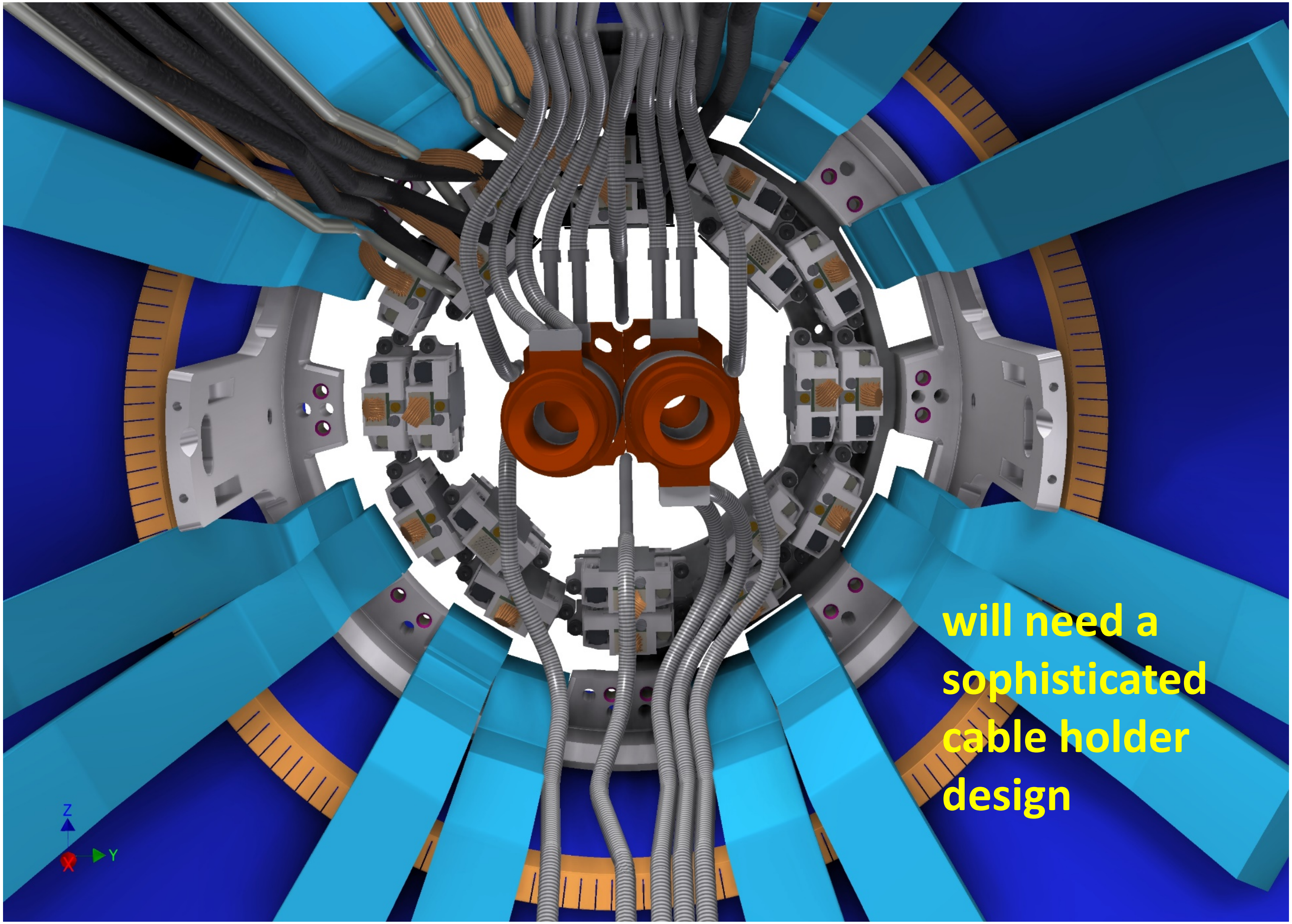
FWD: The Solution

All pipes go “upward”

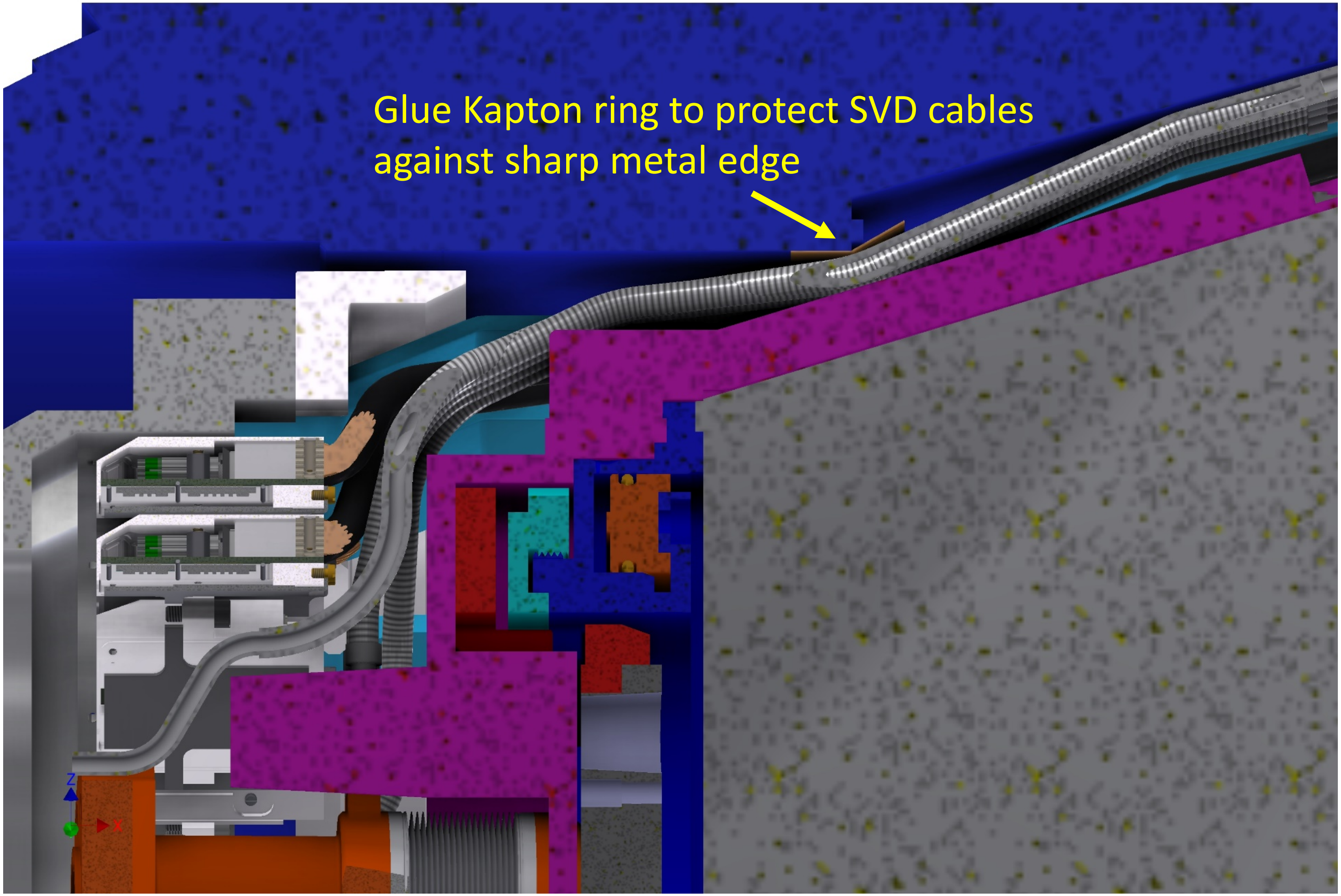
“Soft” corrugated pipes compensate relative movement of beampipe and QCS



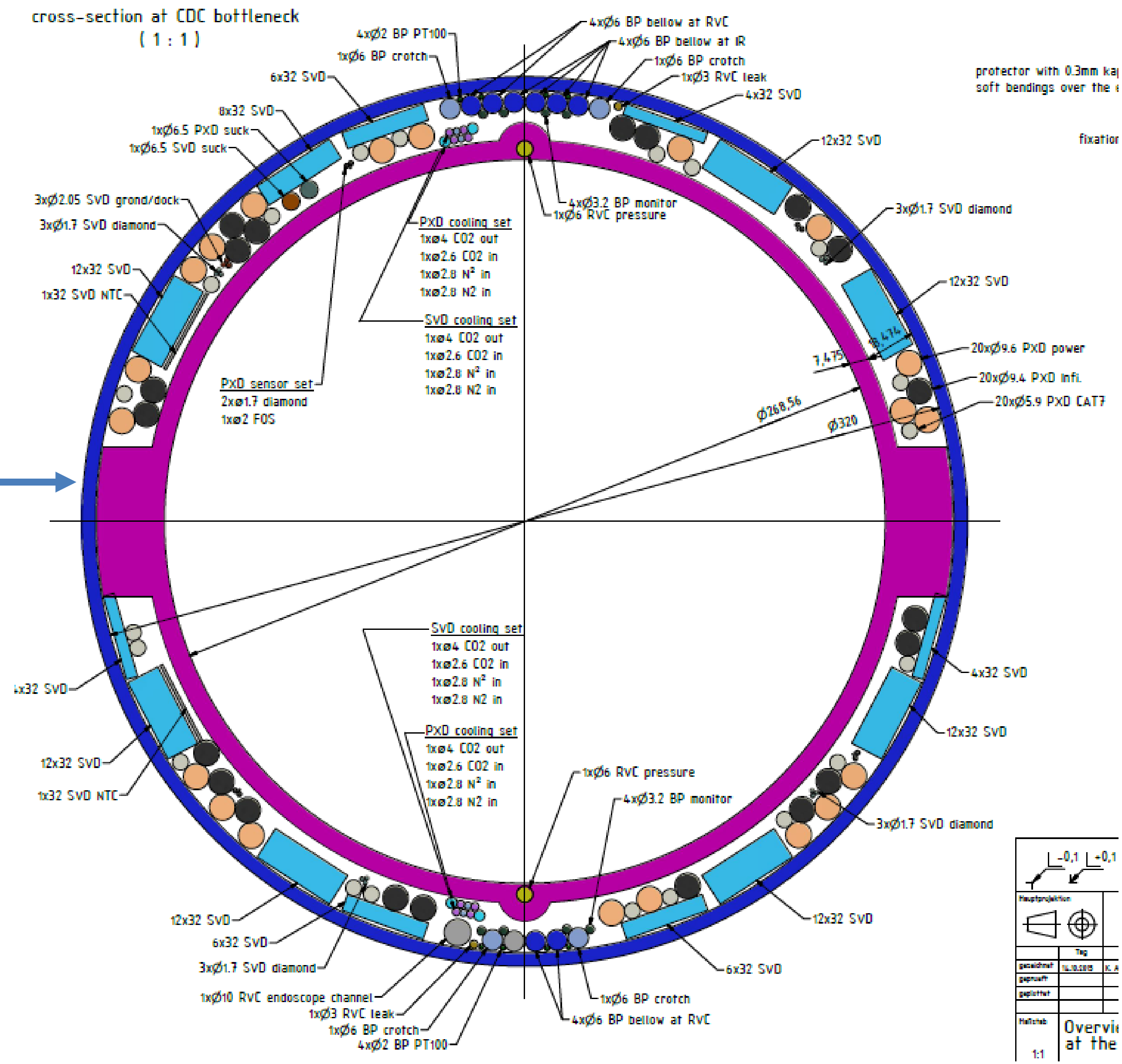
FWD: Extremely Tight Cable Arrangement



FWD: Extremely Tight Cable Arrangement

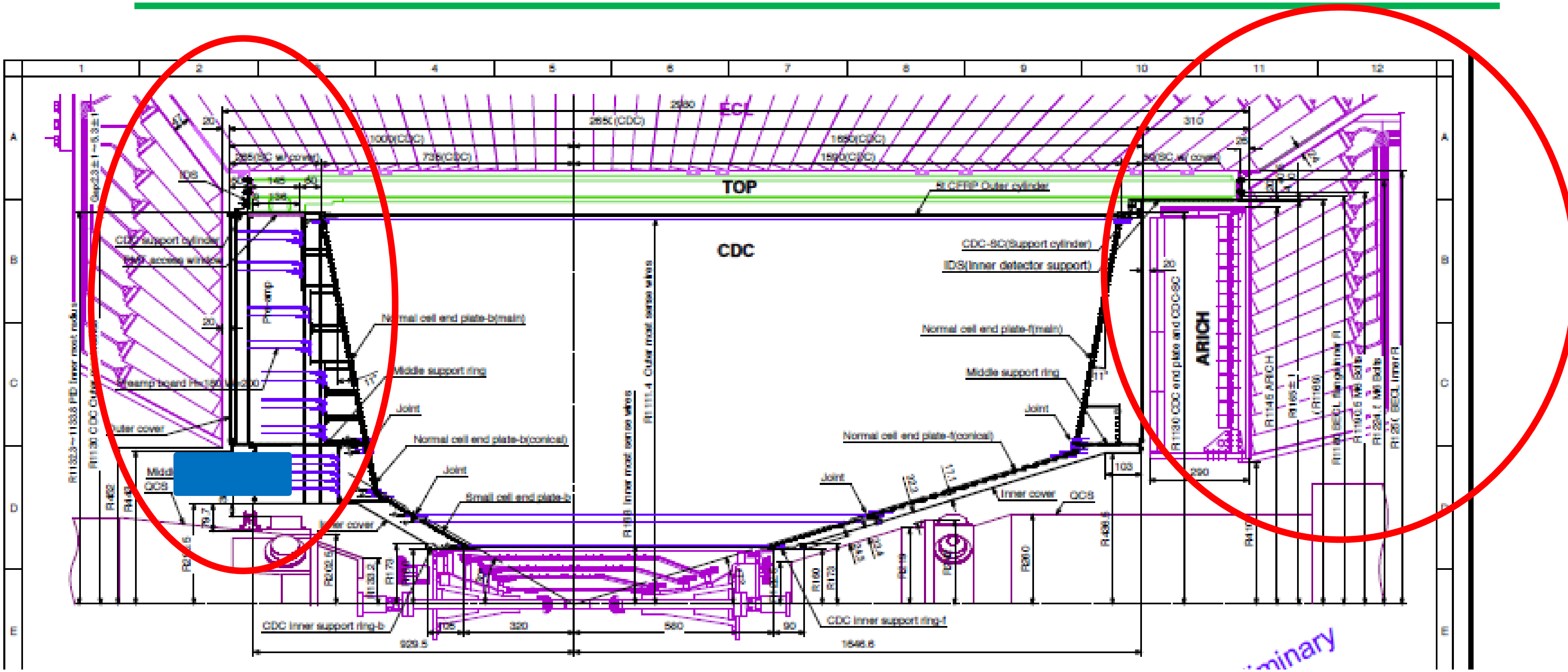


FWD: Extremely Tight Cable Arrangement



violett:
“forbidden”
by 7 mm rule

Going out to the Belle Platform



Problematic: Dock Box area in the BWD region (for SWD)

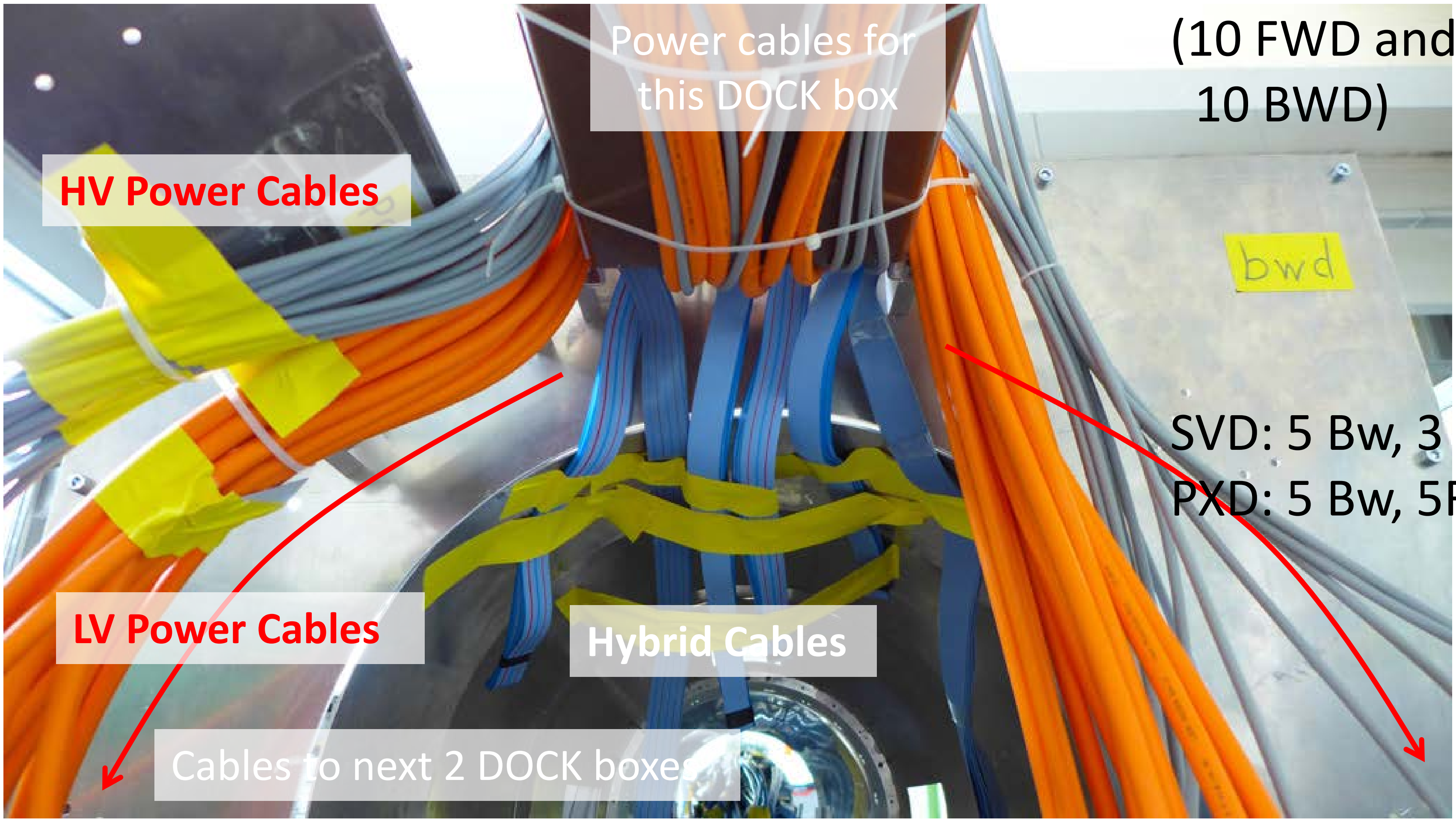
CDC wall in the BWD region

Chicane in FWD

BWD Mockup With SVD Cables

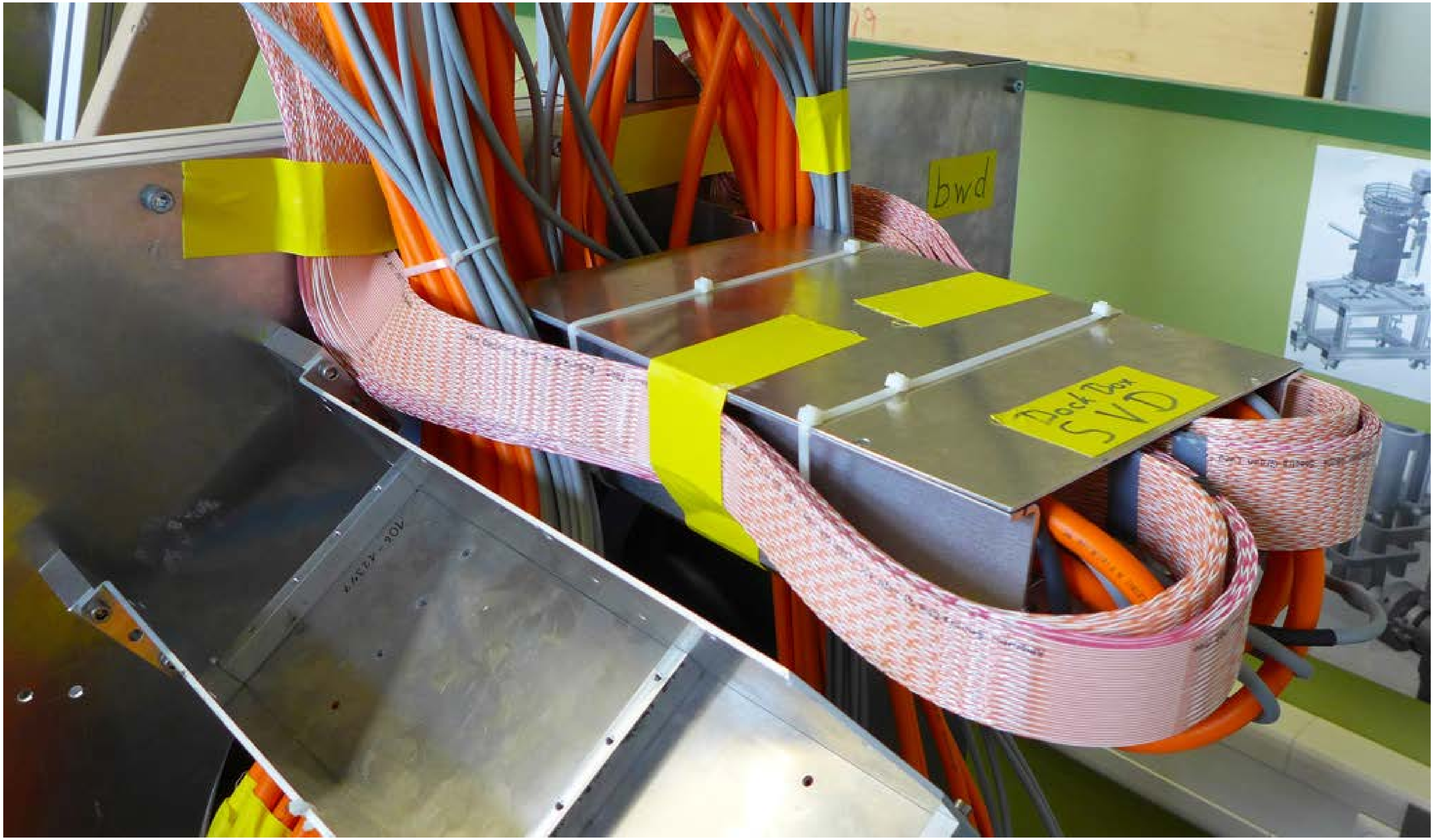
M. Friedl, F. Buchsteiner (Vienna)

Dock Boxes:
(10 FWD and
10 BWD)



SVD: 5 Bw, 3 Fw
PXD: 5 Bw, 5Fw

BWD Mockup With SVD Cables



BWD Mockup With SVD Cables

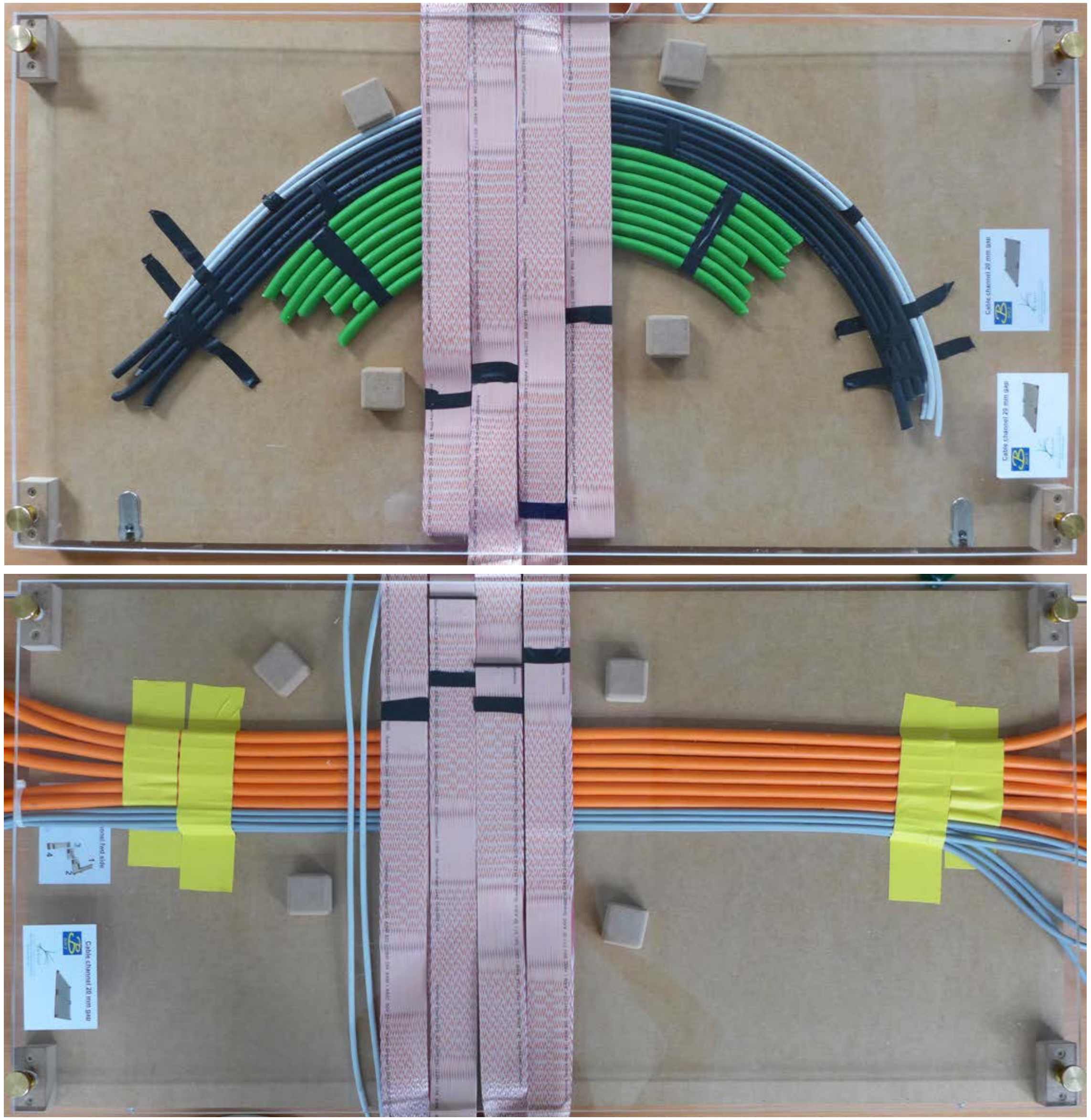
- SVD data cables can easily be folded to follow corners
- Arcs cannot be done (as with round cables), but any kind of angles are possible
- Thicker at bend (two cable layers)

Cable folding successfully used at STAR-TPC

BWD Mockup With SVD Cables

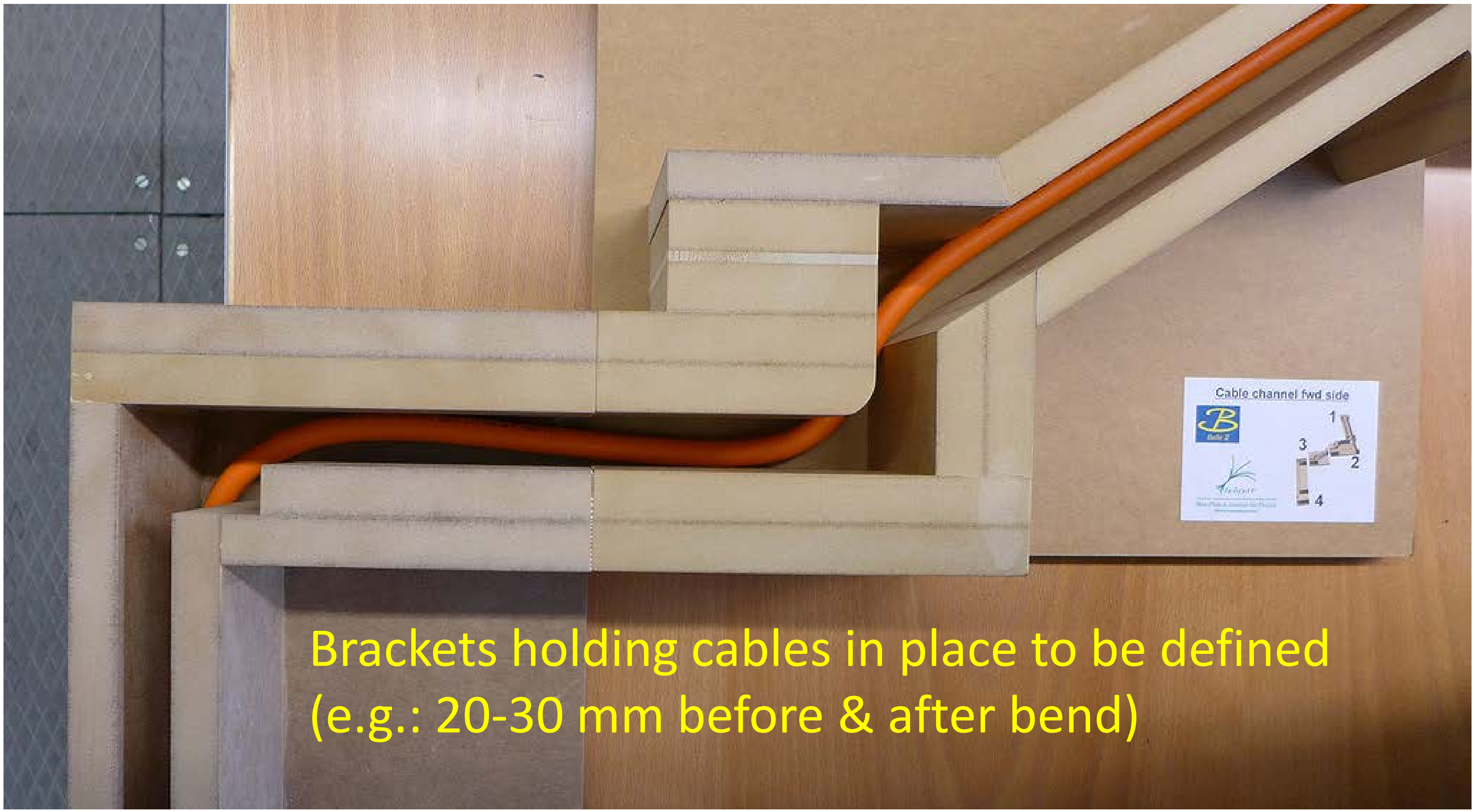
Crossing of PXD and SVD Cables unavoidable on the CDC endwall (BWD)

Mockup shows:
Gap of 20 mm large enough



FWD / BWD Chicane

Chicane gap OK for all cables
Needs to be verified with CO_2 flexlines



Conclusion

Study (Tscharlie Ackermann) shows

- The water cooling pipes of the bellow flange connecting to the RVC so far were guided onto the QCS outer envelope.
- If these pipes lie on the QCS outer envelope, the 7 mm rule cannot be fulfilled

- If the water cooling pipes of bellow flange on the RVC side are guided onto the CDC inner cylinder, together with the other cables/pipes, and when flextubes are used then

- 7 mm rule in FWD area can be fulfilled (agreed with Kanazawa-san)

- FWD cable cage quite complex -> 3D printing, under design

- Cabling at BWD docks for SVD difficult, but doable,
- chicane OK for VXD cables, but CO2 flexlines need to be checked

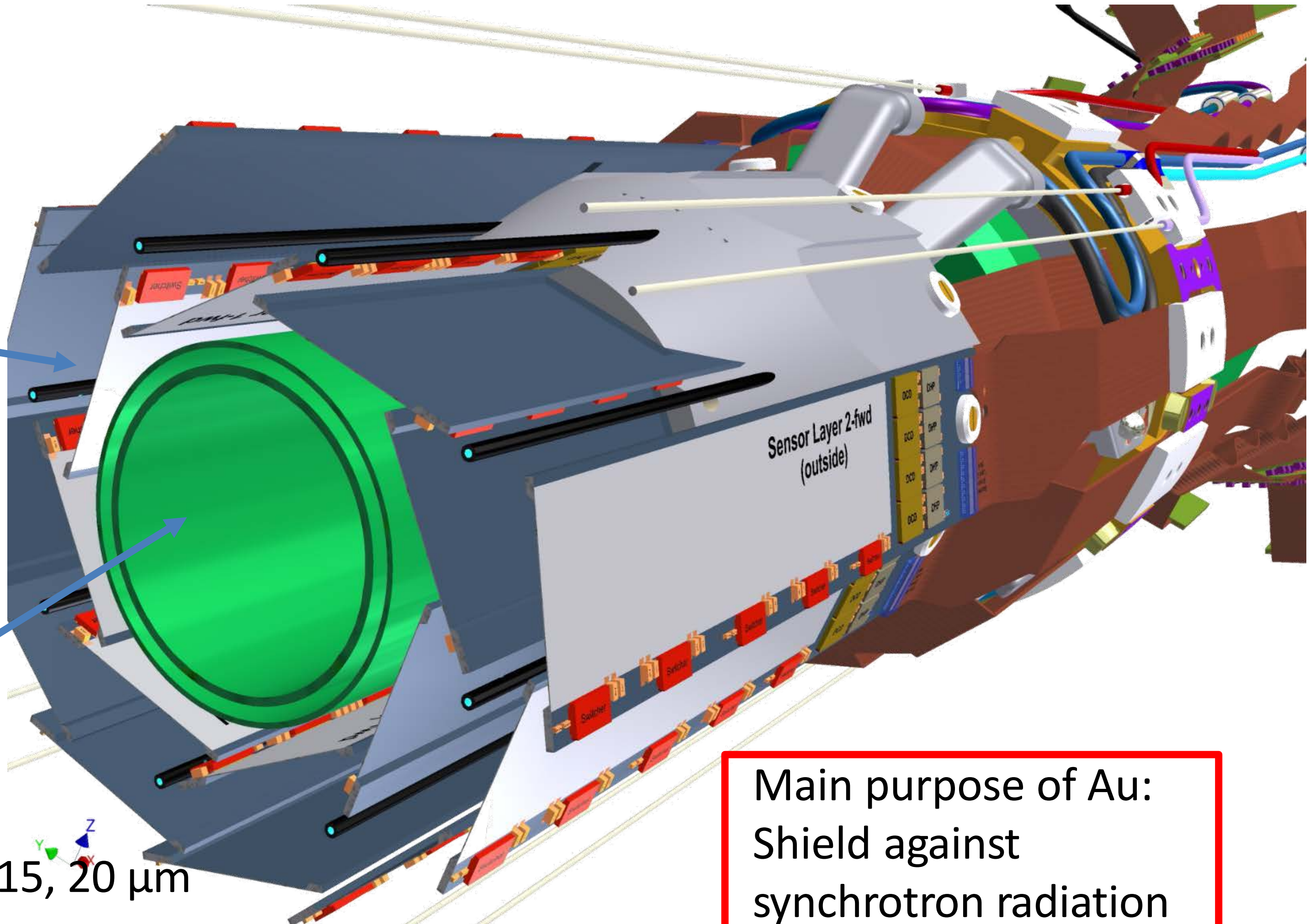
- CDC wall (BWD) gap seems adequate for unavoidable cable crossings

Gold Layer for Phase 3

What should the Gold Layer Thickness be for Phase 3

2 Be layers + paraffine cooling channel in between

0.3% X_0



Inside:
Au coating

Study 6.6, 10, 12.5, 15, 20 µm
(0.3 % X_0 bei 10 µm)

Main purpose of Au:
Shield against synchrotron radiation

Gold Layer for Phase 3

Fernando Abudinen (MPI)

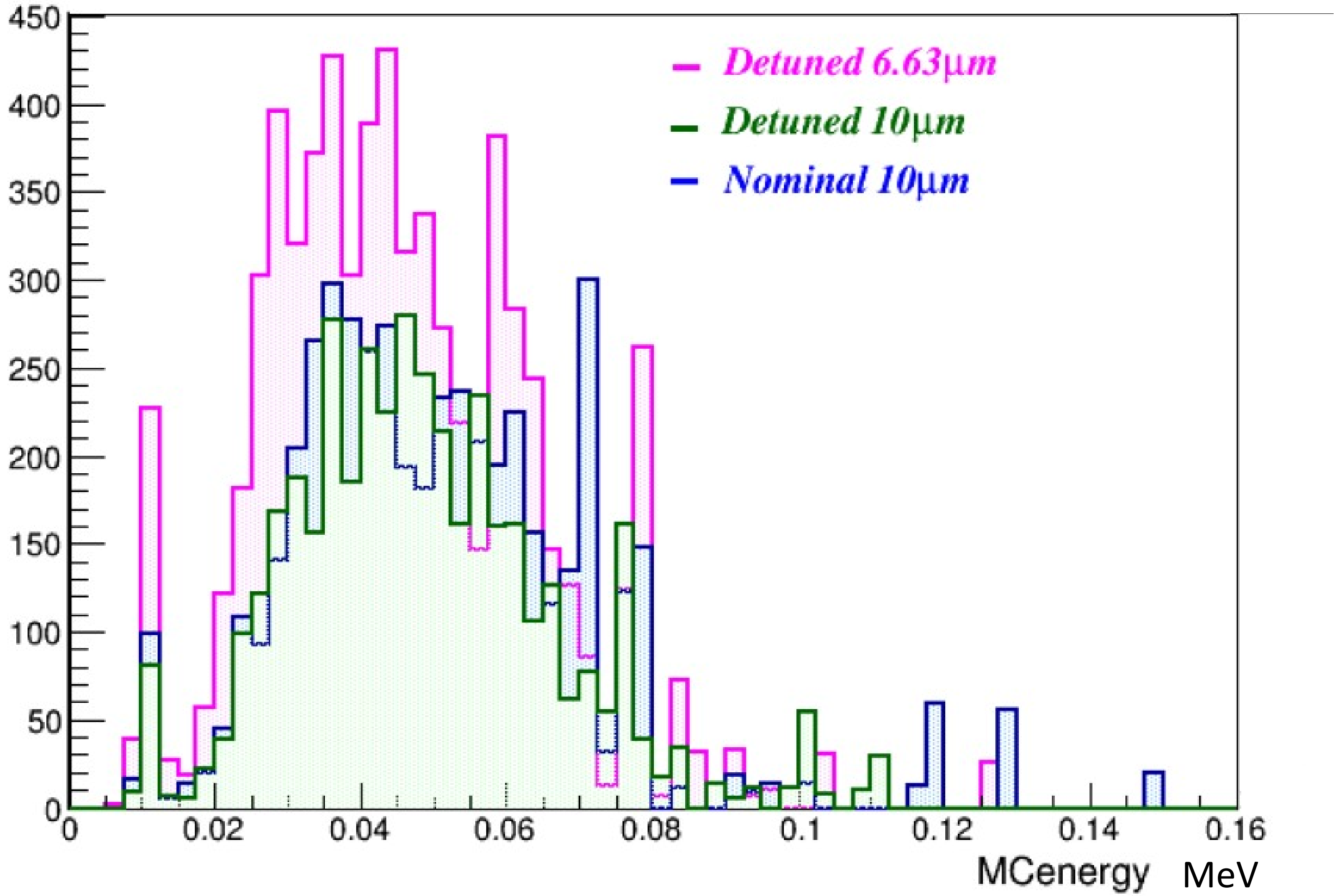
- Full simulation of Belle II VXD + beam pipe

  Vary Gold layer : 6.6, 10, 12.5, 15, 20 µm

- Studies:

  - Synchrotron photon absorption
  - Vertex resolution
  - Gamma conversion

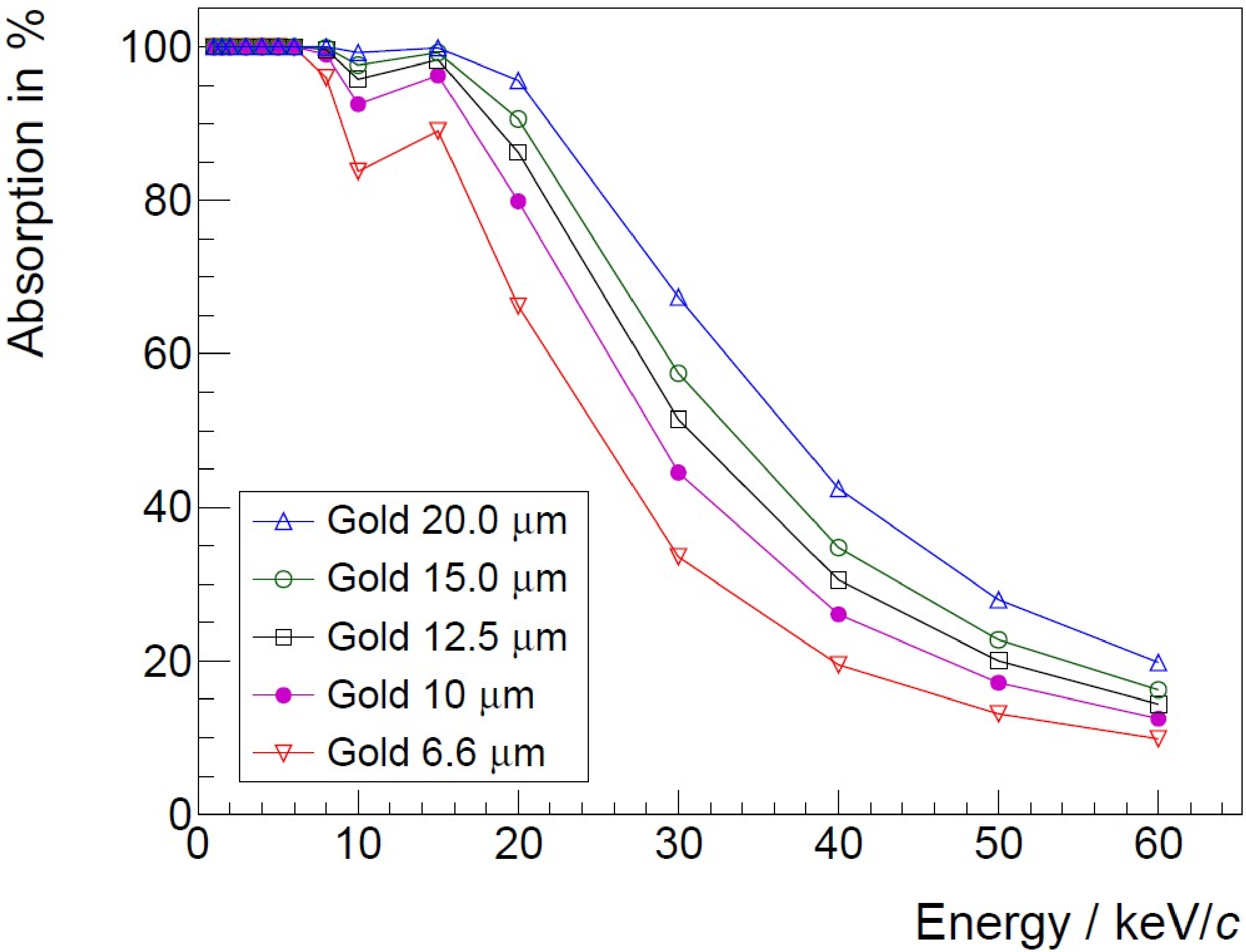
Spectrum of Syn Rad



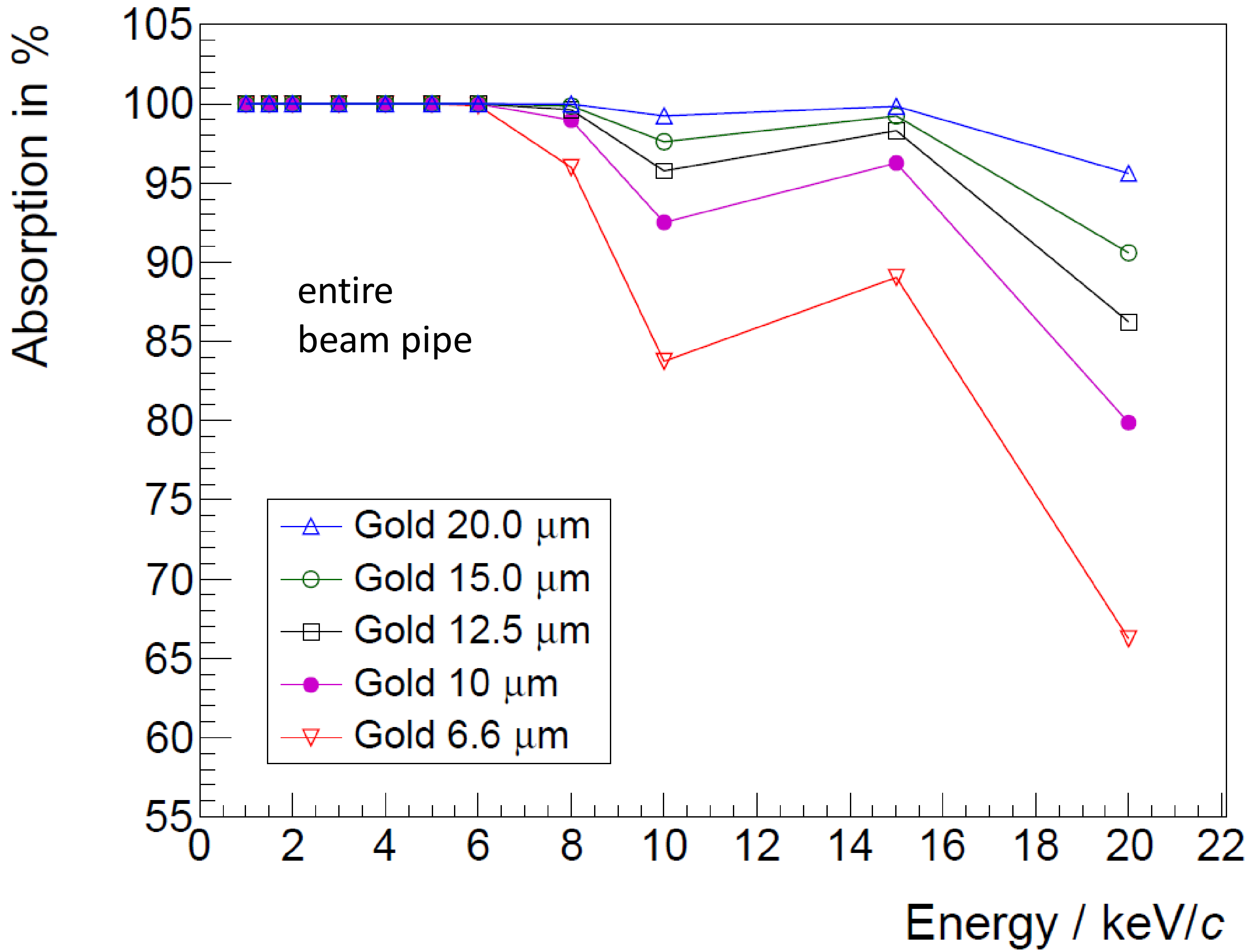
MeV

Yuri Soloviev

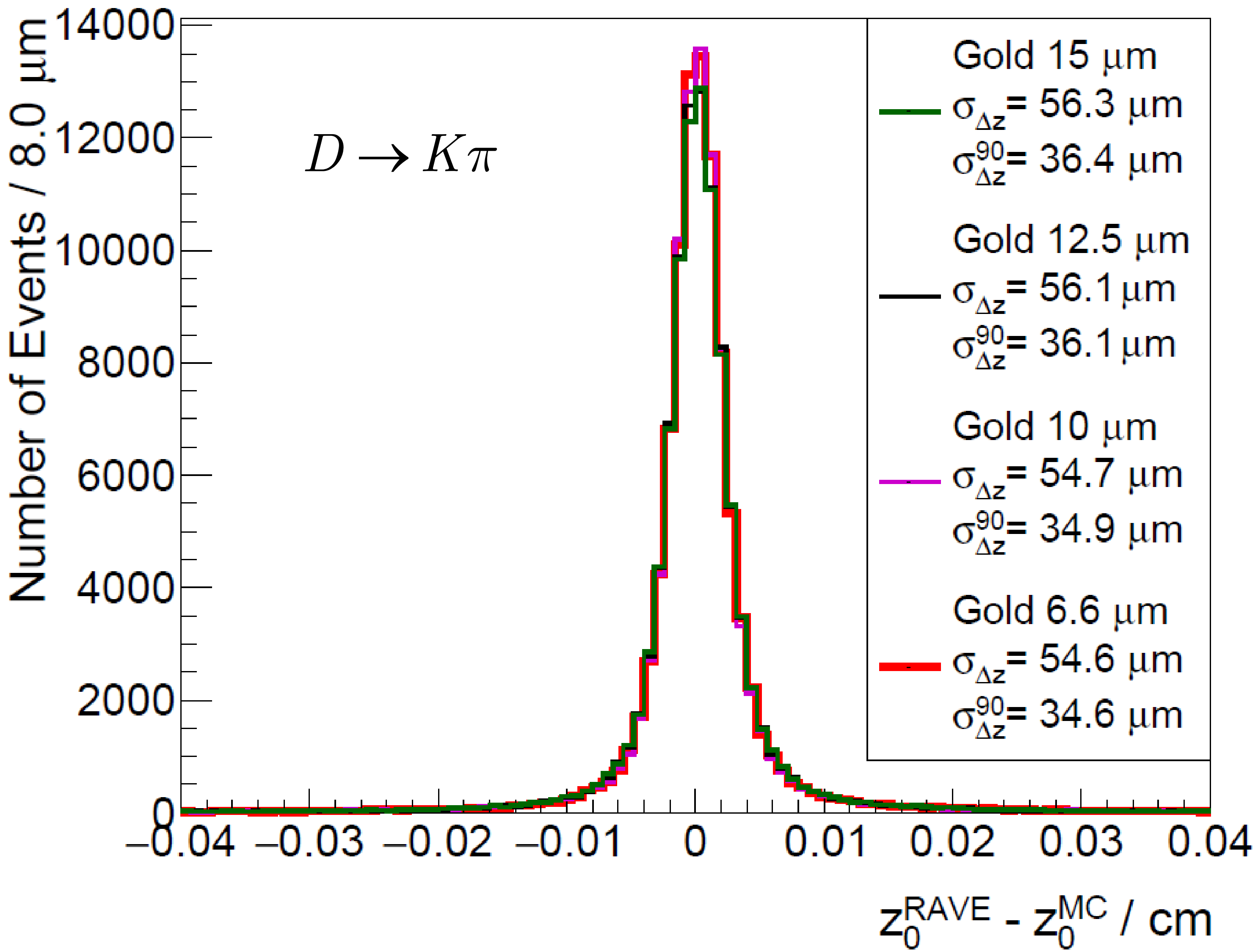
PXD Mission @ Belle II : Minimize Syn Rad



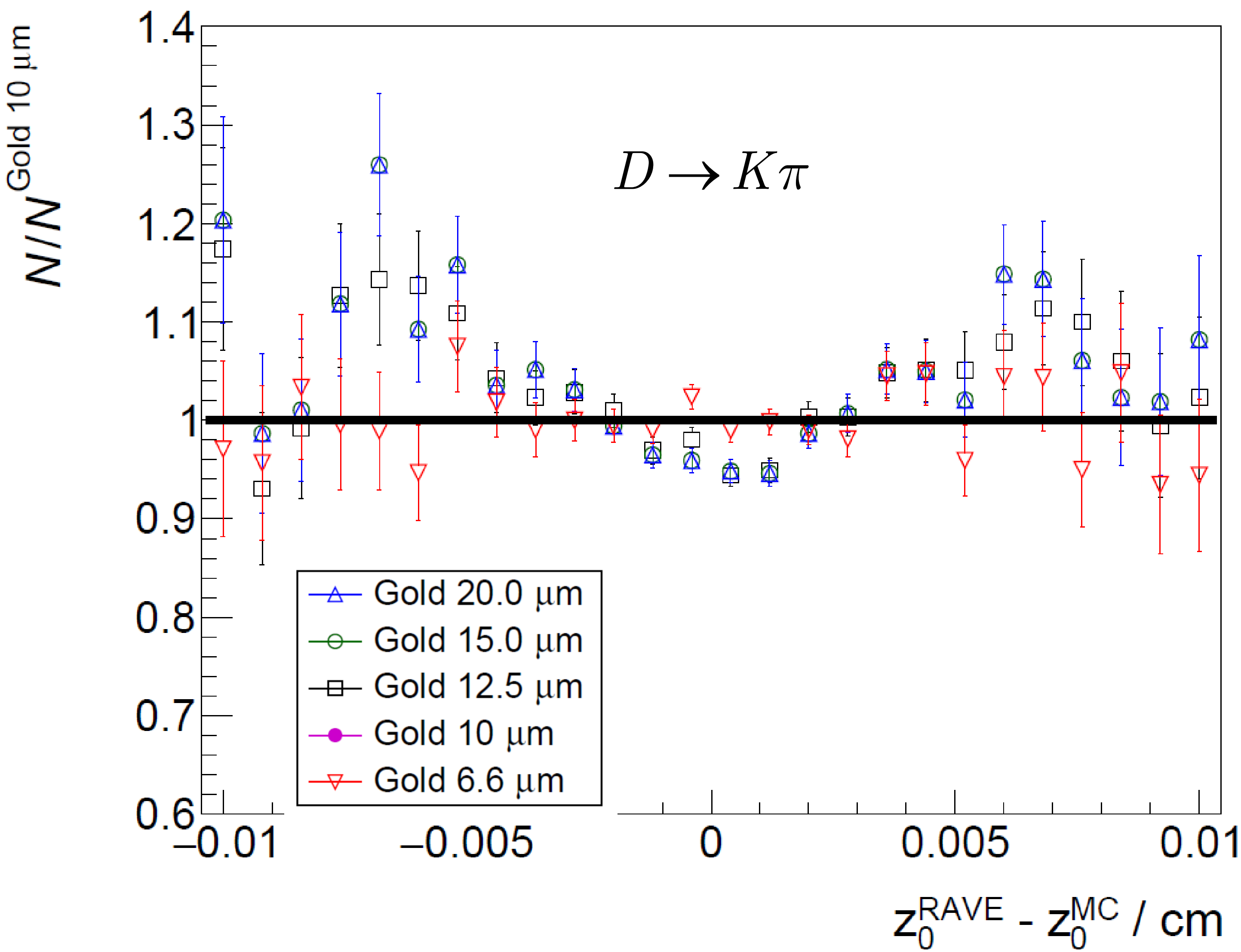
Gold Mission @ Belle II : Minimize Syn Rad for PXD



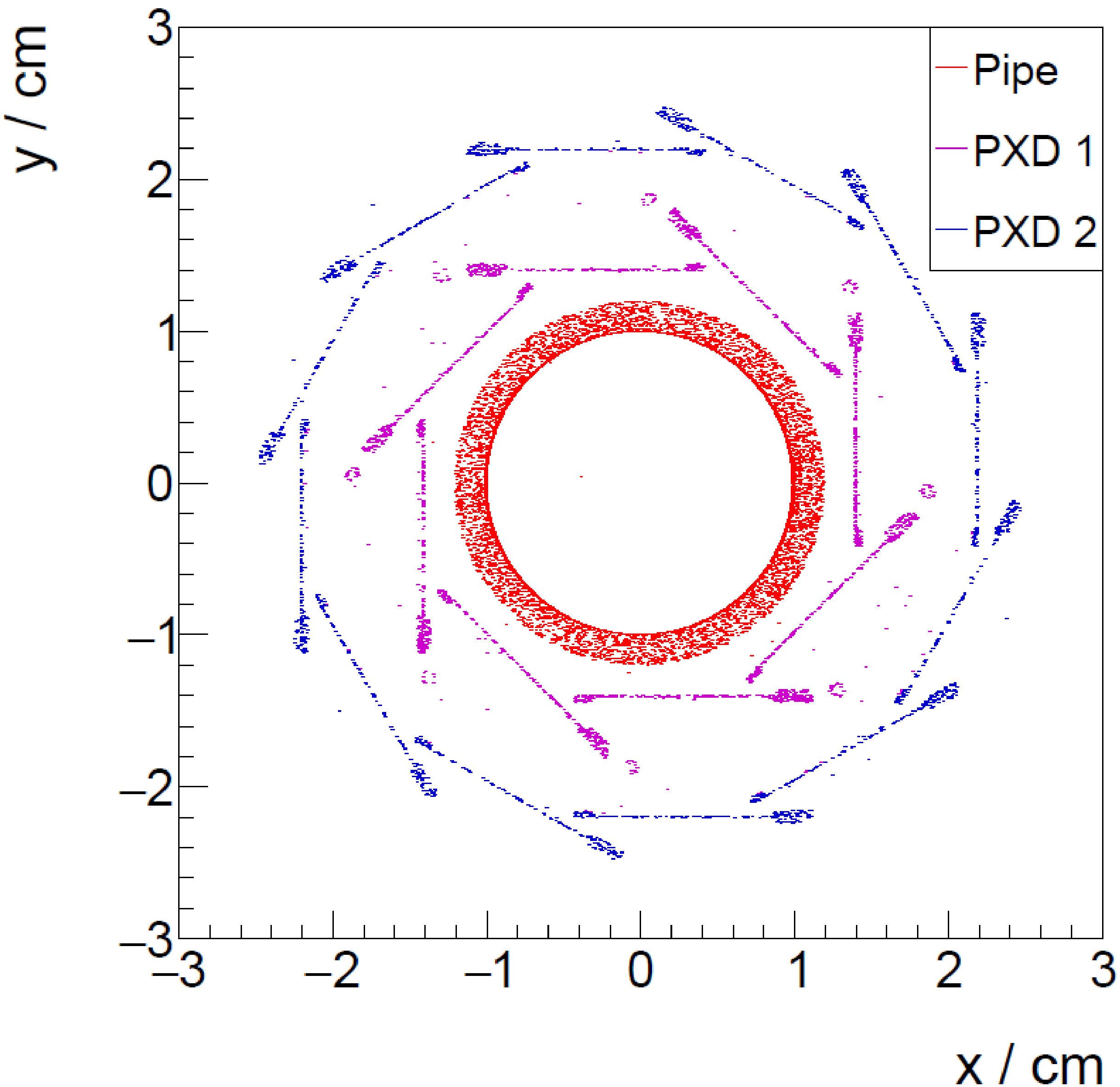
PXD Mission @ Belle II : Precision Vertexing



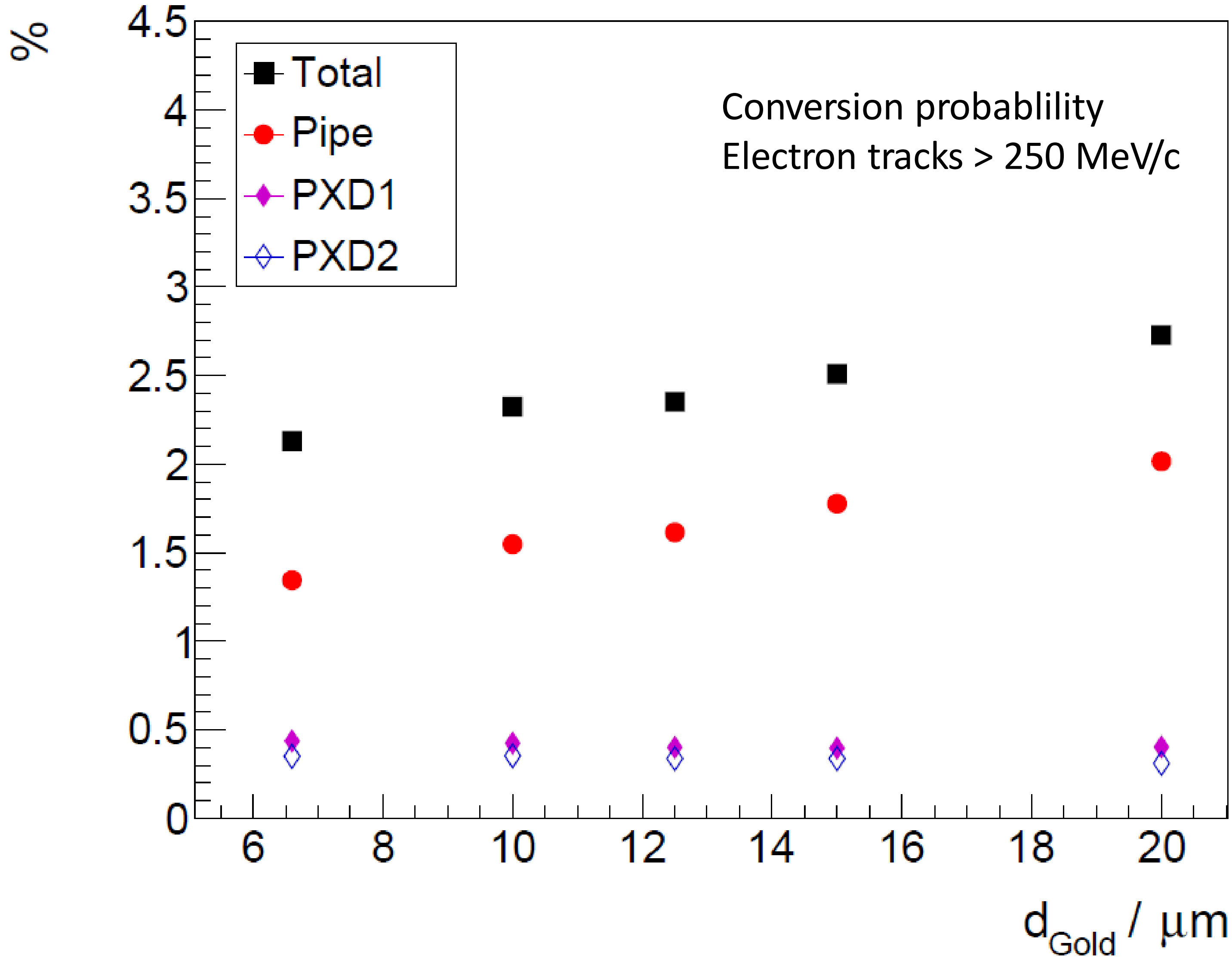
PXD Mission @ Belle II : Precision Vertexing



B Decays with Neutral Particles : „Vertexing“



B Decays with Neutral Particles : „Vertexing“



Conclusion on Gold Layer

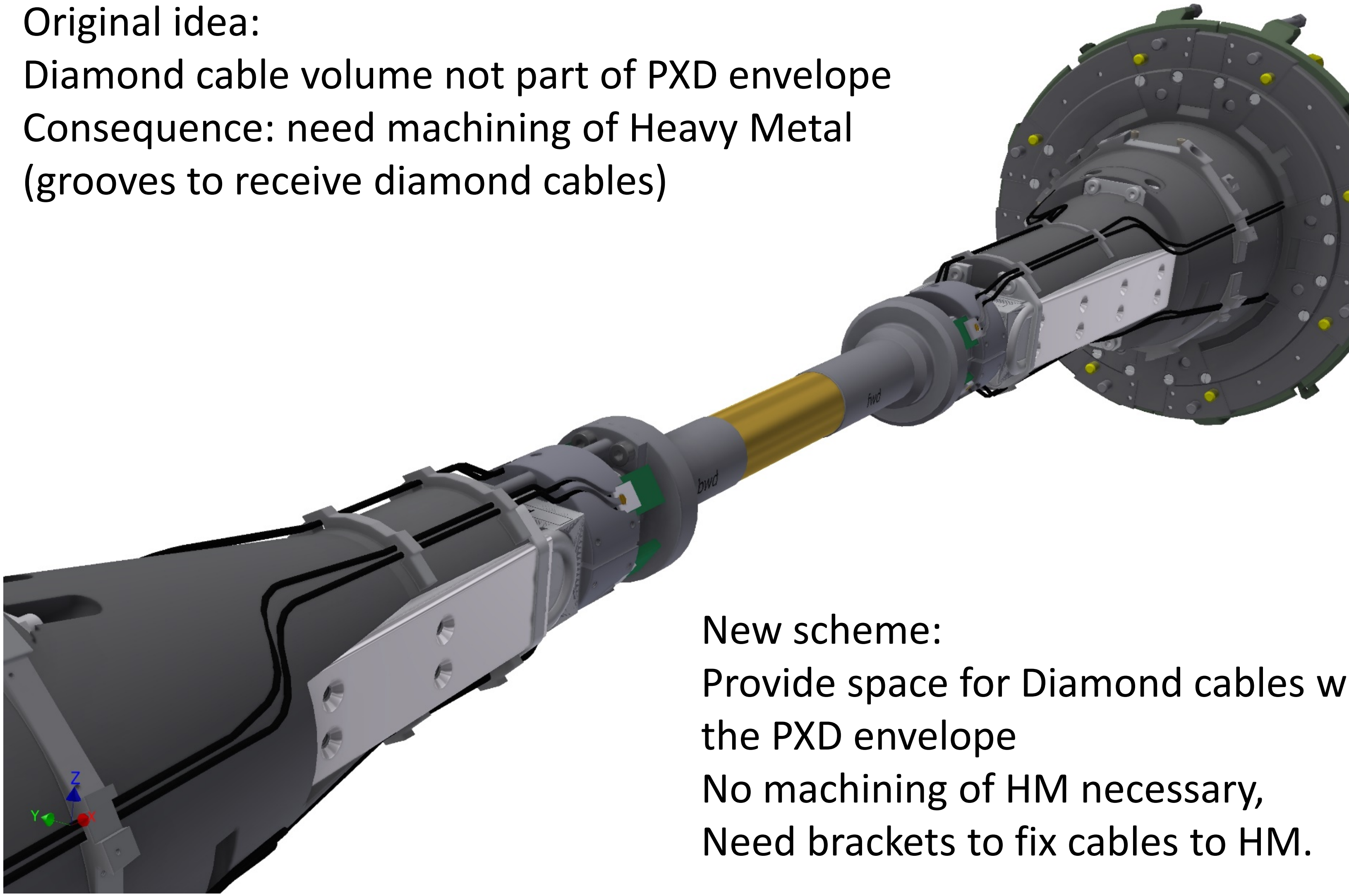
- Preliminary study (Fernando Abudinen, MPI) shows
- Low energy synchrotron rad is effectively absorbed at 10 µm
- Vertex reconstruction is pretty insensitive to small changes in Au layer: 10 µm seems a good compromise
- Photon conversion in beam pipe desirable, but not too much profit for AU < 20µm

Recommendation: 10 µm seems a good compromise

- Decision (10µm) was taken in the First Meeting of the Belle II Technical Board

Diamond Cable Arrangement

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



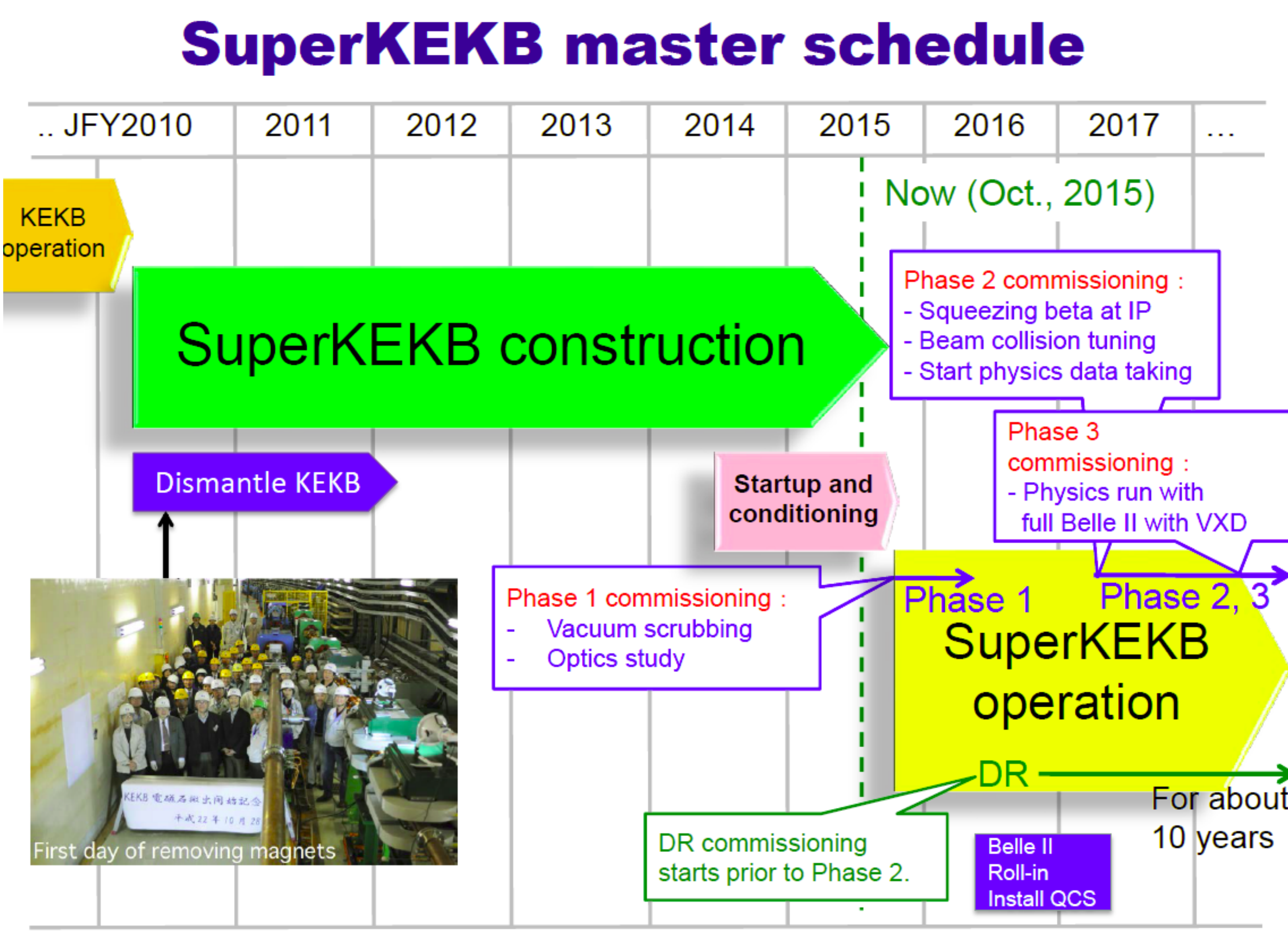
New scheme:
Provide space for Diamond cables within the PXD envelope
No machining of HM necessary,
Need brackets to fix cables to HM.

SuperKEKB status, schedule and commissioning plan for phase 1 and phase 2

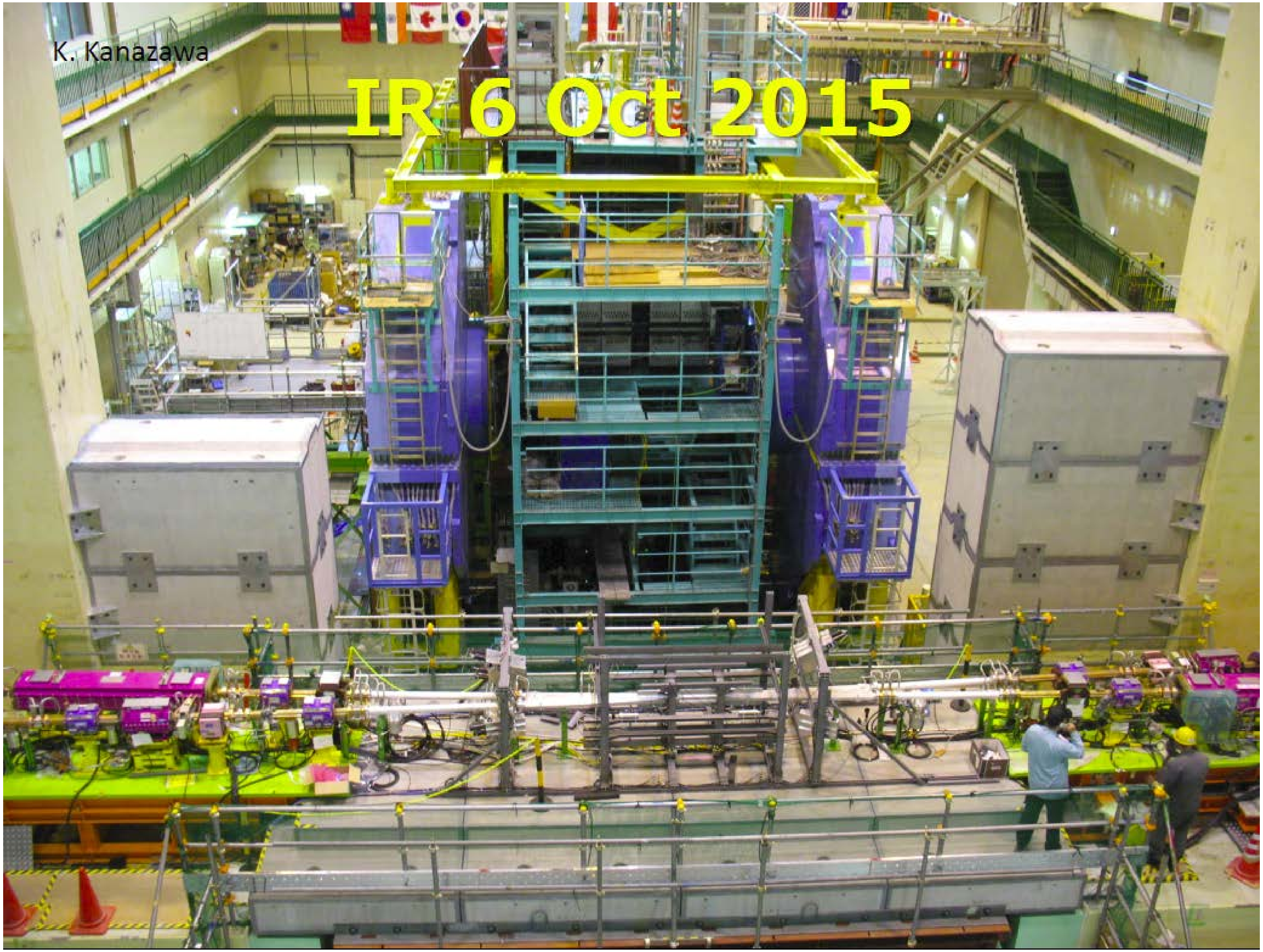
- Y. Funakoshi
- Accelerator Laboratory, KEK

- 2015. 10. 19 @B2GM

B2GM: Machine Status



B2GM: Machine Status



Summary and prospects

- Most of hardware improvements required for phase 1 operation has been completed, as scheduled.
- Some remaining works will be finished before the Phase 1 commissioning.
- In the present plan, Phase 1 commissioning will start from Feb. 1st 2016.

Phase 1 commissioning milestones

- Step 0
  - Beam tuning from Linac to the end of BT (beam transport) line
- Step 1
  - First beam storage (1 ~ 2 days for both rings?)
- Step 2
  - Storage of ~30mA beam (~2 week from the beginning of ring commissioning?)
    - Optics study needs >~30mA.
- Step 3
  - Beam storage of 0.5 ~ 1A (after ~ 3months of beam scrubbing time)

Radiation safety : 50% of design currents（LER:1.8A, HER:1.3A）

What do we have to do in Phase 2?

- Enough machine study toward a high luminosity with Belle II solenoid
  - Squeezing β_y^* (beta functions at IP)
  - Commissioning of tools for the luminosity tuning
- We have to decide to install the vertex detectors
  - Understanding of beam background
  - Establish conditions for stable machine operation
    - Stable physics run on a parallel with the luminosity tuning with a relatively high peak luminosity (> ~1 x 10^{34} $cm^{-2}s^{-1}$)
      - Some data taking for physics experiment

B2GM: Machine Planning, Phase 2

Damping ring Milestones

- ☑ 2012.12 Tunnel construction finished
- ☑ 2013.11 PS Building construction completed
- ☑ 2014.3 Conventional Facility (LCW and the electricity) constructed
- ☑ 2014.5~12 DR Construction phase-1 (Installation of power cables, etc)
- ☐ 2015.5~12 DR Construction phase-2 (Installation of magnets and BPM cables, etc)
- ☐ 2015.12~2016.12 DR Construction phase-3

- Machine studies
  - 4~5 months
- Physics run with a parallel with luminosity tuning
  - 1~2 months

Expected luminosity in the luminosity tuning phase

- There is much uncertainly in the achievable luminosity in Phase 2.
  - The reason why the luminosity prediction is difficult is that we do not have experiences on the extremely low IP beta functions like SuperKEKB (nobody in the world has the experiences).
- Tentative target of the peak luminosity is 1 x 10^{34} $cm^{-2}s^{-1}$.
  - One extreme case is that this luminosity projection is too pesmistic and we can achieve >~5 x 10^{34} $cm^{-2}s^{-1}$.
  - Another extreme is that we cannot accumulate the luminosity almost at all due to some accidents or for some other unexpected reasons (such as too high detector beam background).
- Rough estimation on the accumulated luminosity in Phase 2 is 20 $\pm$ 20 fb^{-1} for 1~2 months.

B2GM: Machine Planning, Phase 2

Important for Phase 2: Final Focus quadrupoles

- The QCSL magnet-cryostat had serious electrical troubles, but now they are being repaired.
  - The delivery of the magnet-cryostat is scheduled to be Nov. 30th 2015.
- Due to the QCSL troubles, the QCSR construction gets behind the schedule.
  - We are considering the measures to start Phase-2 in June 2017.

B2GM: Status of Belle II

Phase 2: Belle II on beam line, before: install ITOP, CDC and ARICH