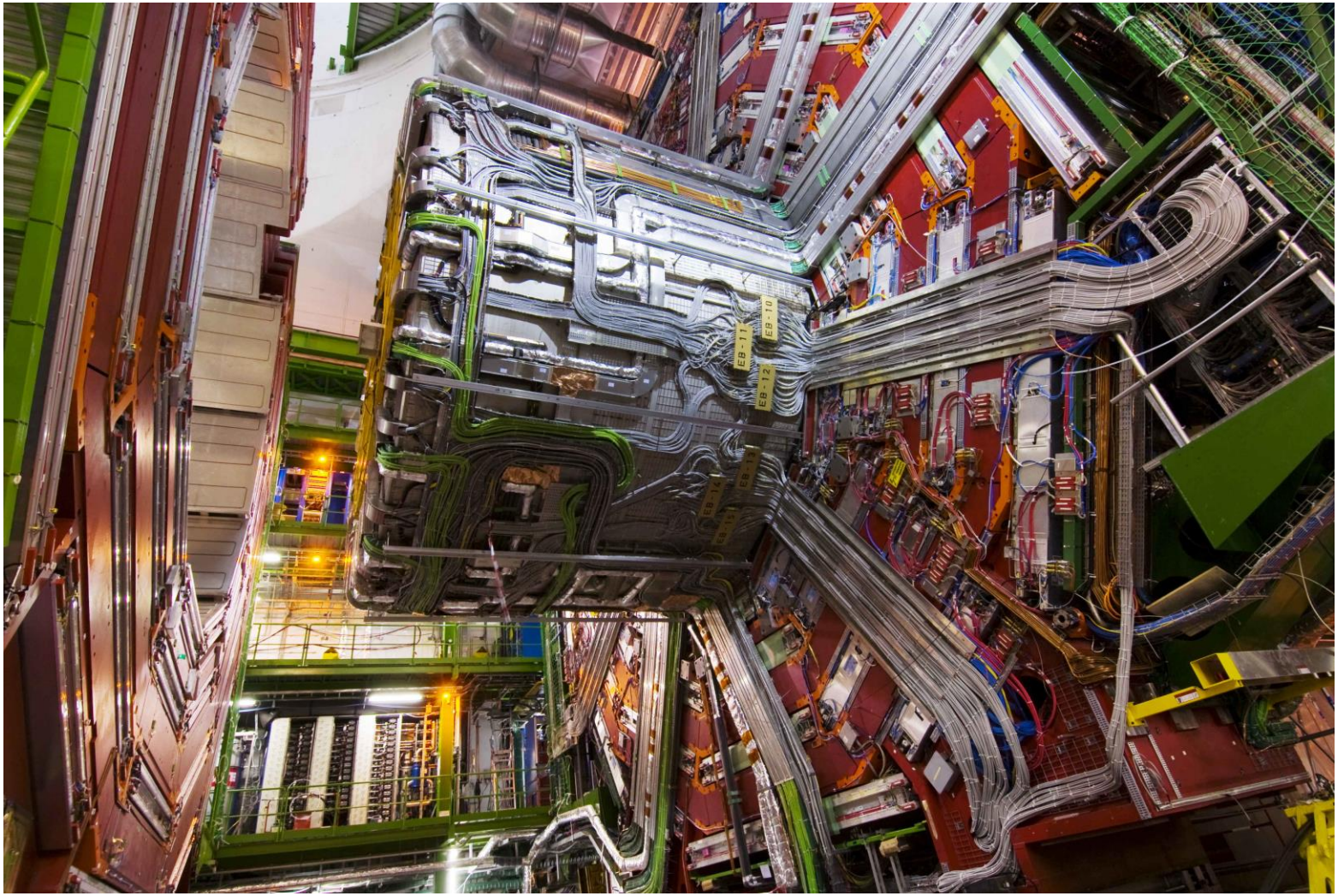
Phase 2 Pixel

- Where do we stand with our present understanding of the services for the Inner Tracker ?
- Some other consideration on beam and alignment to be kept in mind

Obviously nothing is final, all just at the conceptual level, mainly to try to understand if it all fits

Phase 2 Pixel: YB0

- YB0 will be stripped naked of services on the inside and outside of the solenoid



Phase 2 Pixel: YB0

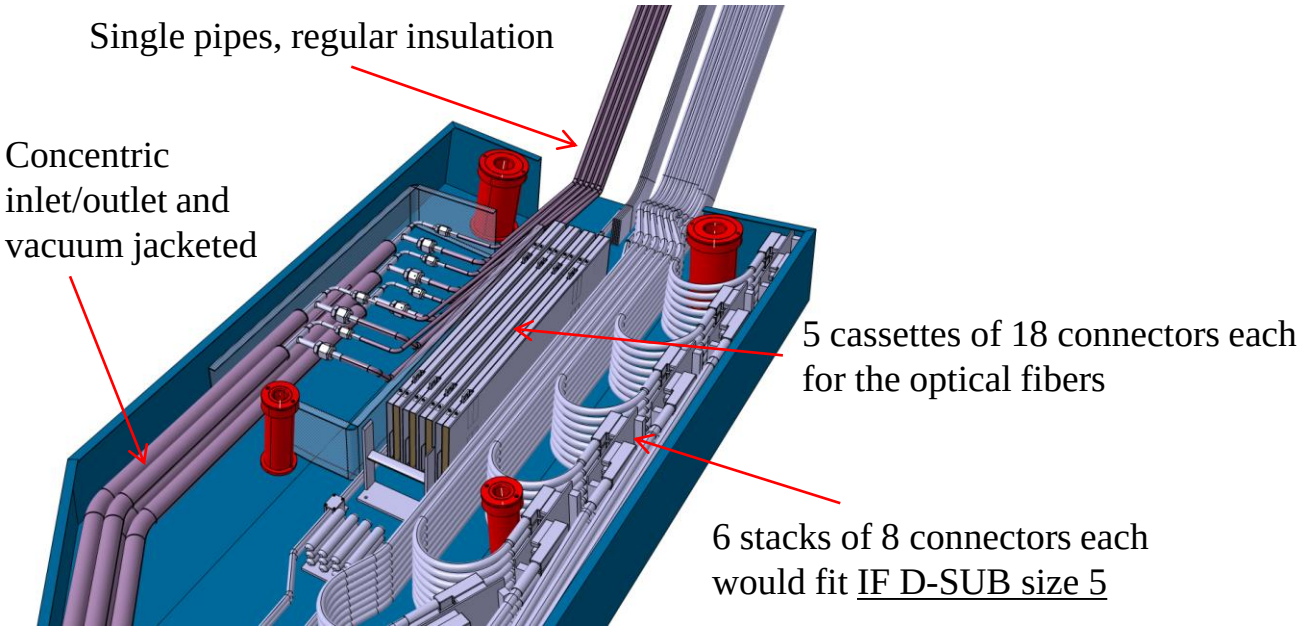
- Services on the inside will be very similar to what we have today, but not quite (wider PP1, toller EB/HB channels)

Phase 2 Pixel: YB0

- Need to evaluate the cross-section available for getting out of YB0

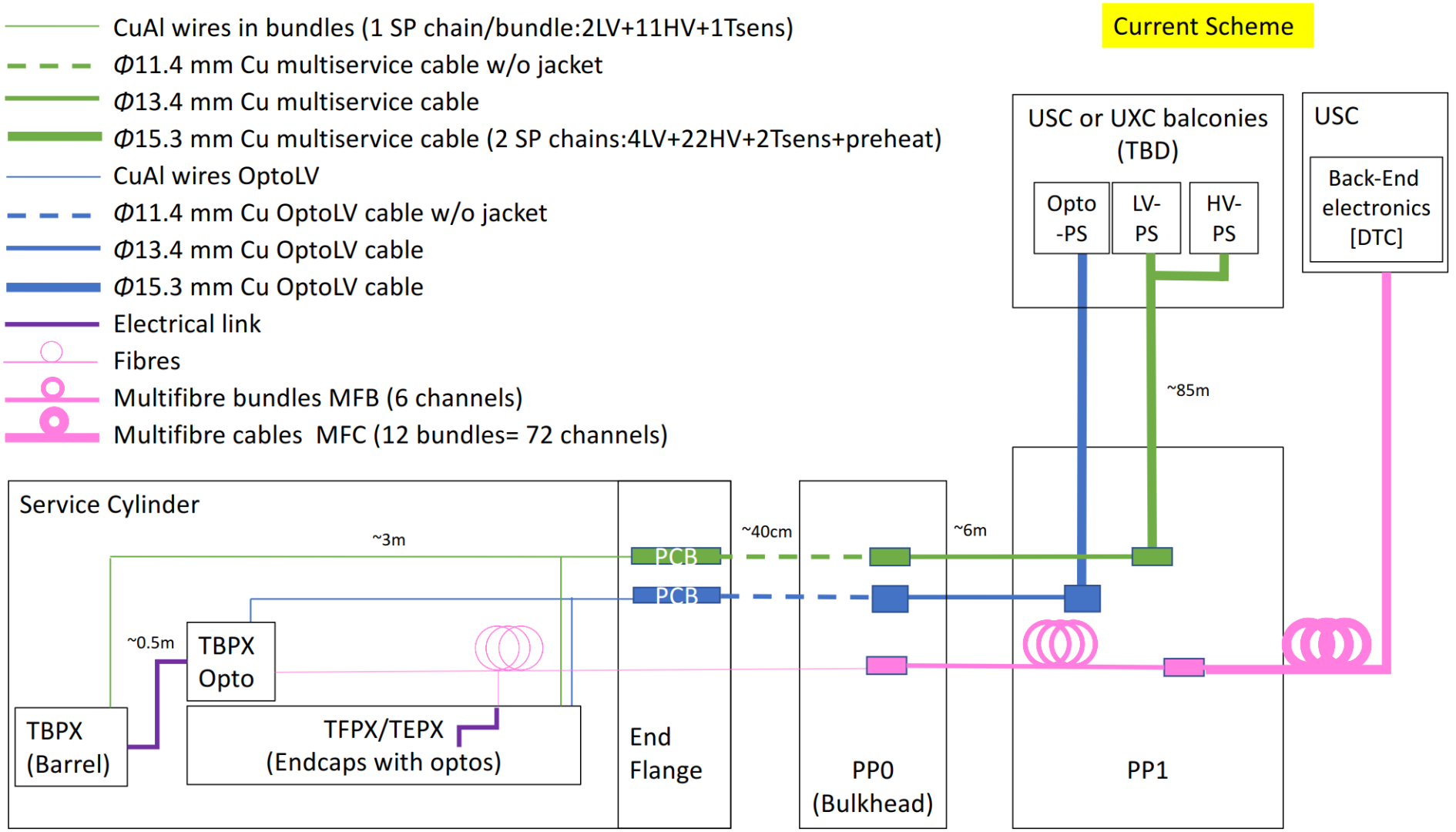
Phase 2 Pixel: PP1 (Same for IT and OT)

- Same general concept as for the present Tracker/Pixel
- 16 full PP1 per end
- Each PP1 is divided into 3 parts:
  - A: either 48 cables or 6 cooling connections
  - B: up to 18X5 = 90 (24X) MFB (going to 15 Trunk Opt. Cables)
  - C: either 48 cables or 6 cooling connections
- 4 full PP1 dedicated to IT on the horizontal plane (i.e. +2, +9, +11, +18)



Phase 2 Pixel: Cables

Provided by: Stella Orfanelli



Phase 2 Pixel: Services at Bulk-Head (+Z-end)

PP1+9 A	Transfer loops	Cables
TBPX	0	6
TFPX	0	16
TEPX1	0	7
TEPX2	0	7
LpGBT		6
Total	**0**	**42**

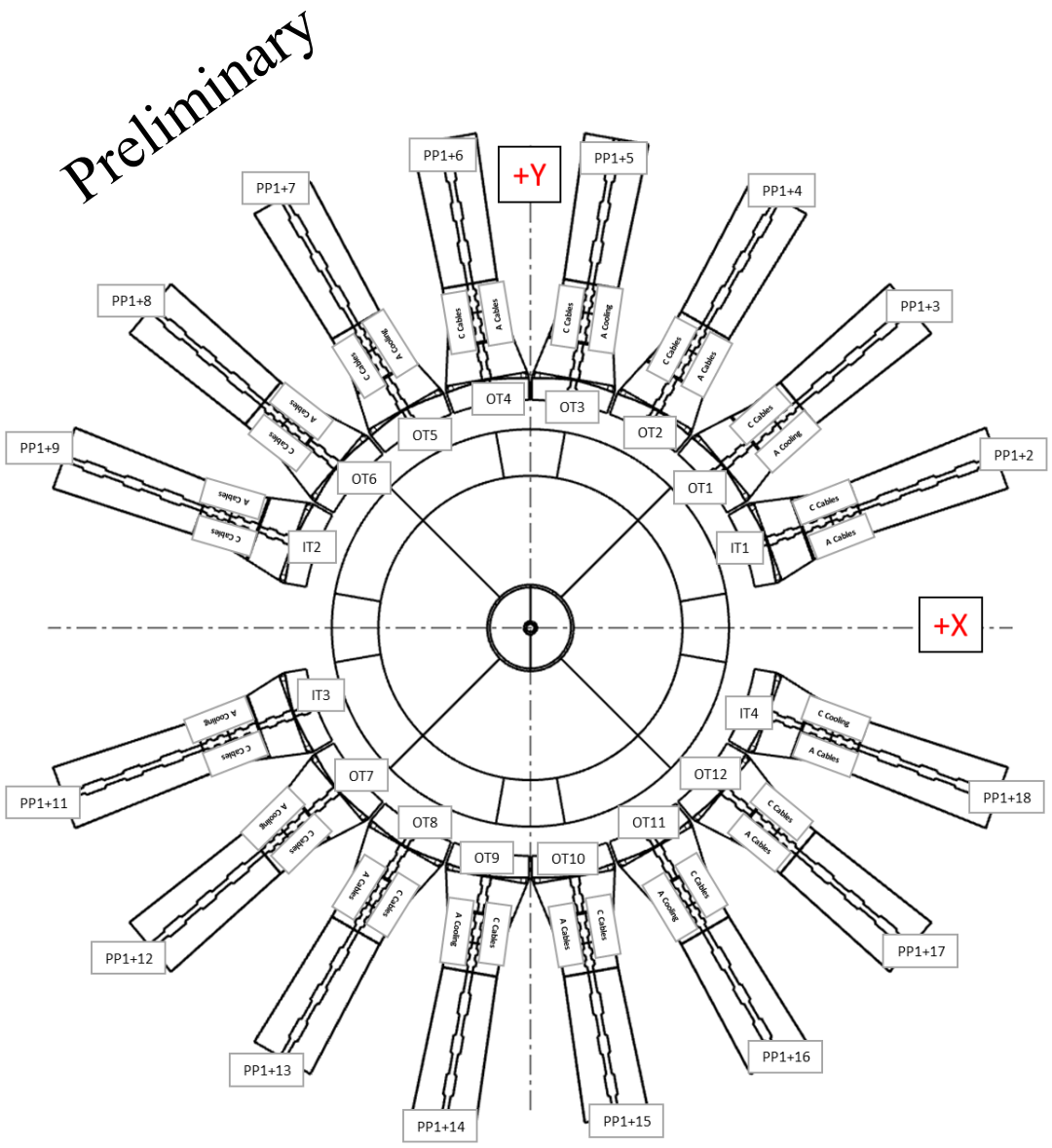
PP1+9 B	MFB
TBPX	4
TFPX	7
TEPX1	3
TEPX2	3
Total	**17**

PP1+9 C	Transfer loops	Cables
TBPX	1	0
TFPX	1	0
TEPX1	1	0
TEPX2	0	0
LpGBT		0
Total	**3**	**0**

PP1+11 A	Transfer loops	Cables
TBPX	1	0
TFPX	1	0
TEPX1	0	0
TEPX2	1	0
LpGBT		0
Total	**3**	**0**

PP1+11 B	MFB
TBPX	4
TFPX	7
TEPX1	3
TEPX2	3
Total	**17**

PP1+11 C	Transfer loops	Cables
TBPX	0	6
TFPX	0	16
TEPX1	0	7
TEPX2	0	7
LpGBT		6
Total	**0**	**42**



PP1+2 C	Transfer loops	Cables
TBPX	0	6
TFPX	0	16
TEPX1	0	7
TEPX2	0	7
LpGBT		6
Total	**0**	**42**

PP1+2 B	MFB
TBPX	4
TFPX	7
TEPX1	3
TEPX2	3
Total	**17**

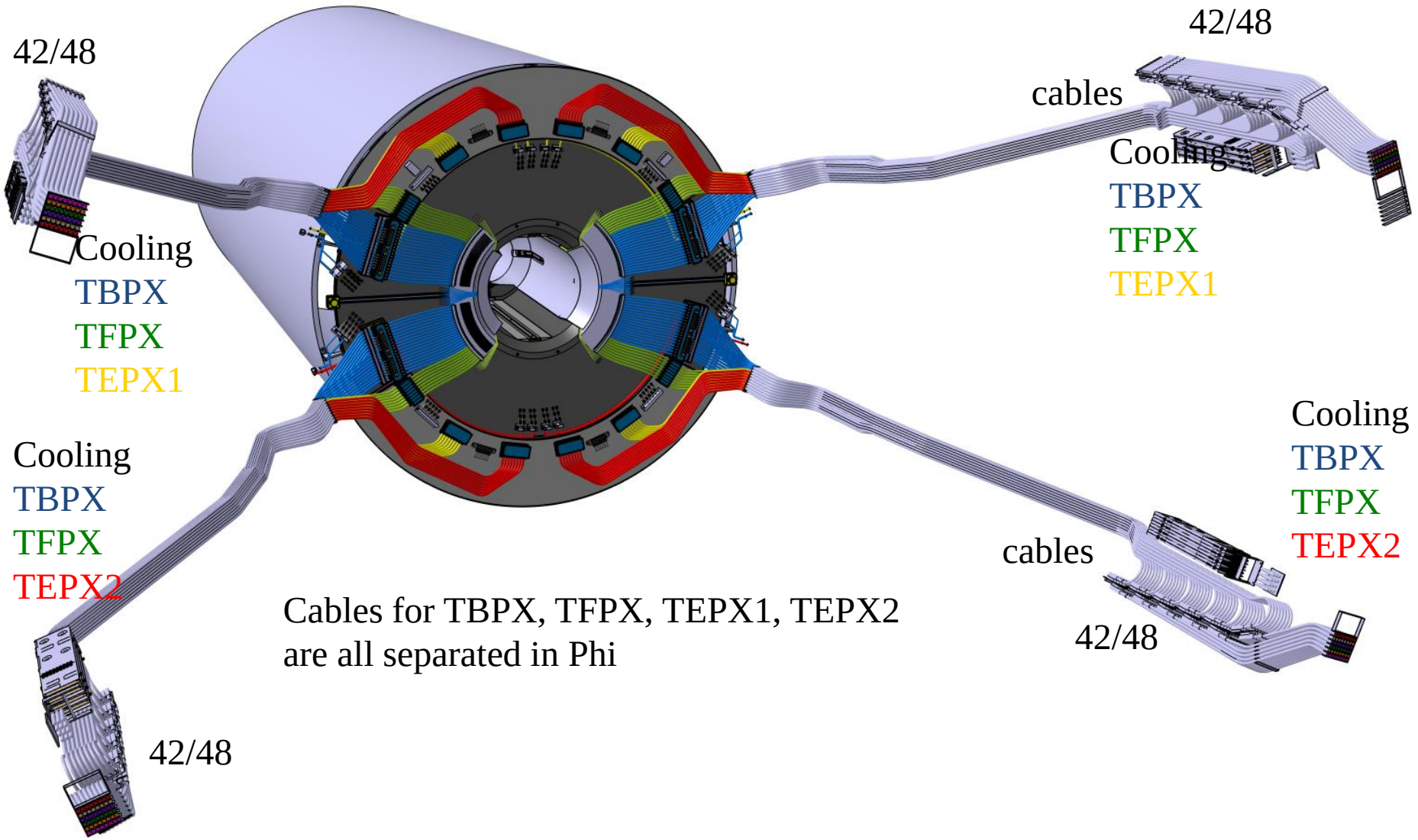
PP1+2 A	Transfer loops	Cables
TBPX	1	0
TFPX	1	0
TEPX1	1	0
TEPX2	0	0
LpGBT		0
Total	**3**	**0**

PP1+18 C	Transfer loops	Cables
TBPX	1	0
TFPX	1	0
TEPX1	0	0
TEPX2	1	0
LpGBT		0
Total	**3**	**0**

PP1+18 B	MFB
TBPX	4
TFPX	7
TEPX1	3
TEPX2	3
Total	**17**

PP1+18 A	Transfer loops	Cables
TBPX	0	6
TFPX	0	16
TEPX1	0	7
TEPX2	0	7
LpGBT		6
Total	**0**	**42**

Phase 2 Pixel: Services at Bulk-Head



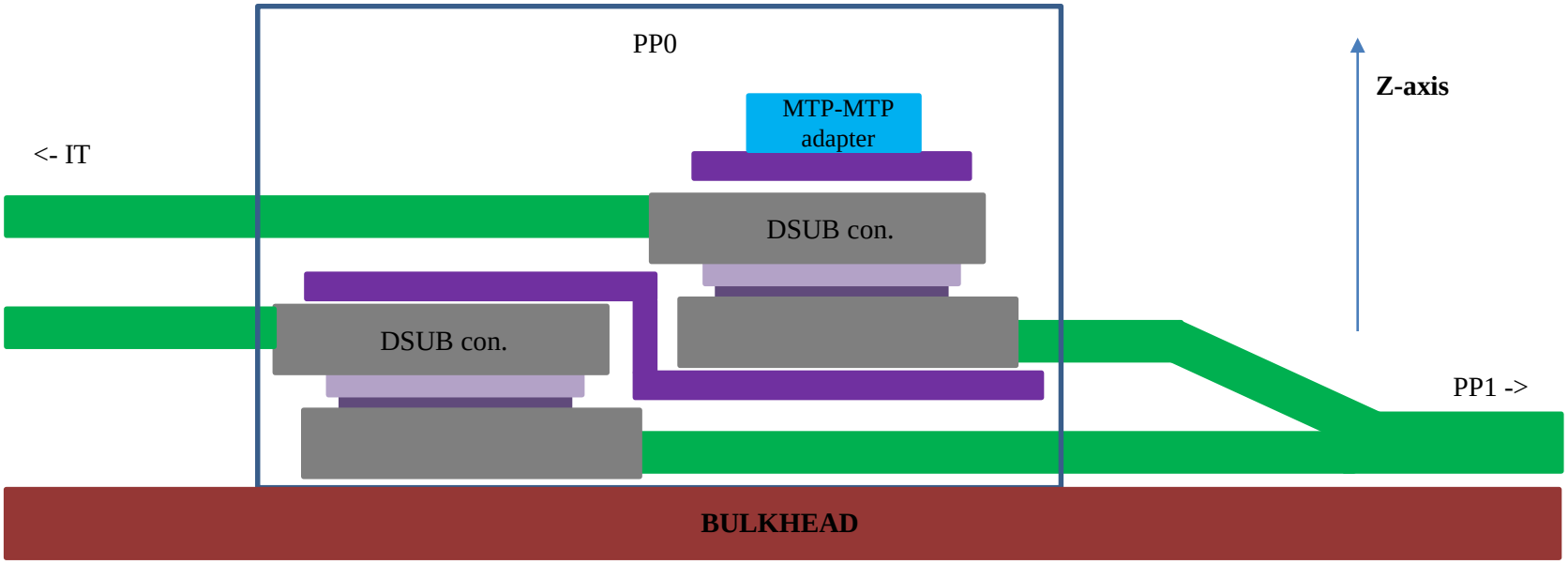
Cables for TBPX, TFPX, TEPX1, TEPX2 are all separated in Phi

Preliminary 3D model (A. Filenius)

Power cable connections in scheme 1

In Scheme 1 the cable coming from the PP1 would be split into two **before** the PP0 connection.

After the split two DSUB –type connectors would be soldered and molded onto the ends, and would be stacked as shown below to ensure minimum height consumption.

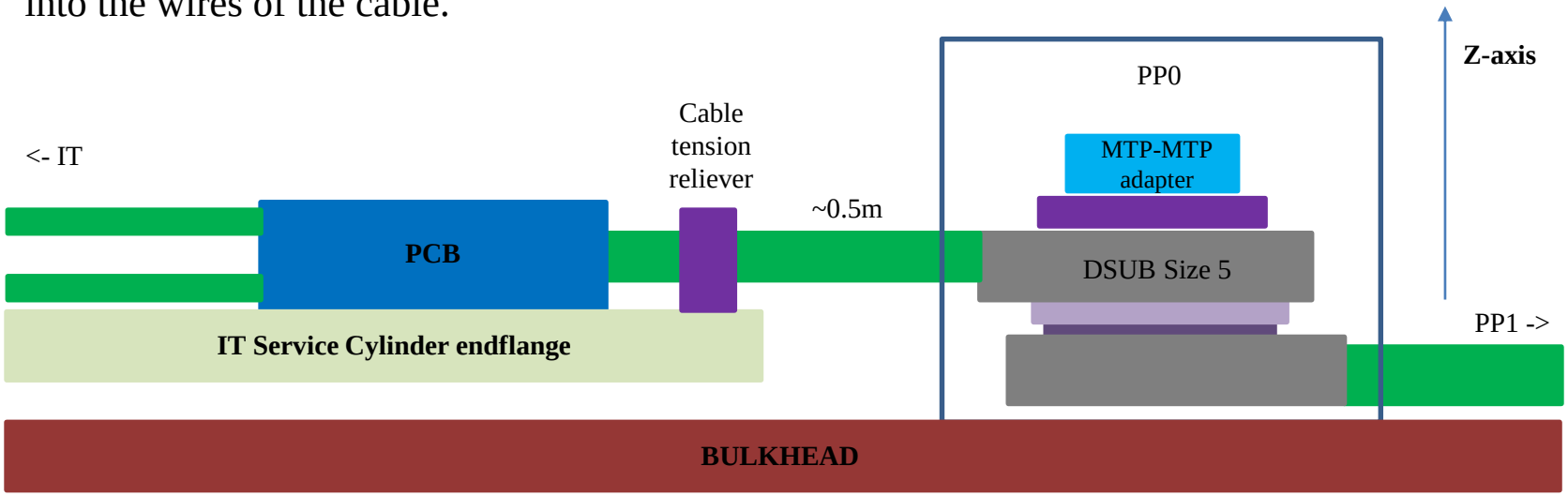


Power cable connections in Scheme 2

In Scheme 2 the cable would be split into two after the PP0 connection, splitting could be done with or without a PCB.

The purpose of the PCB is to provide a sturdy platform to solder onto and to split the cable into two with the possibility to have more desirable wires (diameters) after the PCB.

Without PCB you would simply separate the wires from the cable to their individual bundles. If different wires are desired, PCB could be replaced with simply soldering the desired wires into the wires of the cable.



Phase 2 Pixel: Services at Bulk-Head

Vacuum Jacketed Transfer Line

Outlet Pipe, OD12mm ID10mm

Inlet Pipe, OD8mm ID6mm

Outlet Pipe, OD2.2mm ID2mm

Inlet Pipe, OD2.2mm ID2mm

Outlet manifold

Inlet manifold

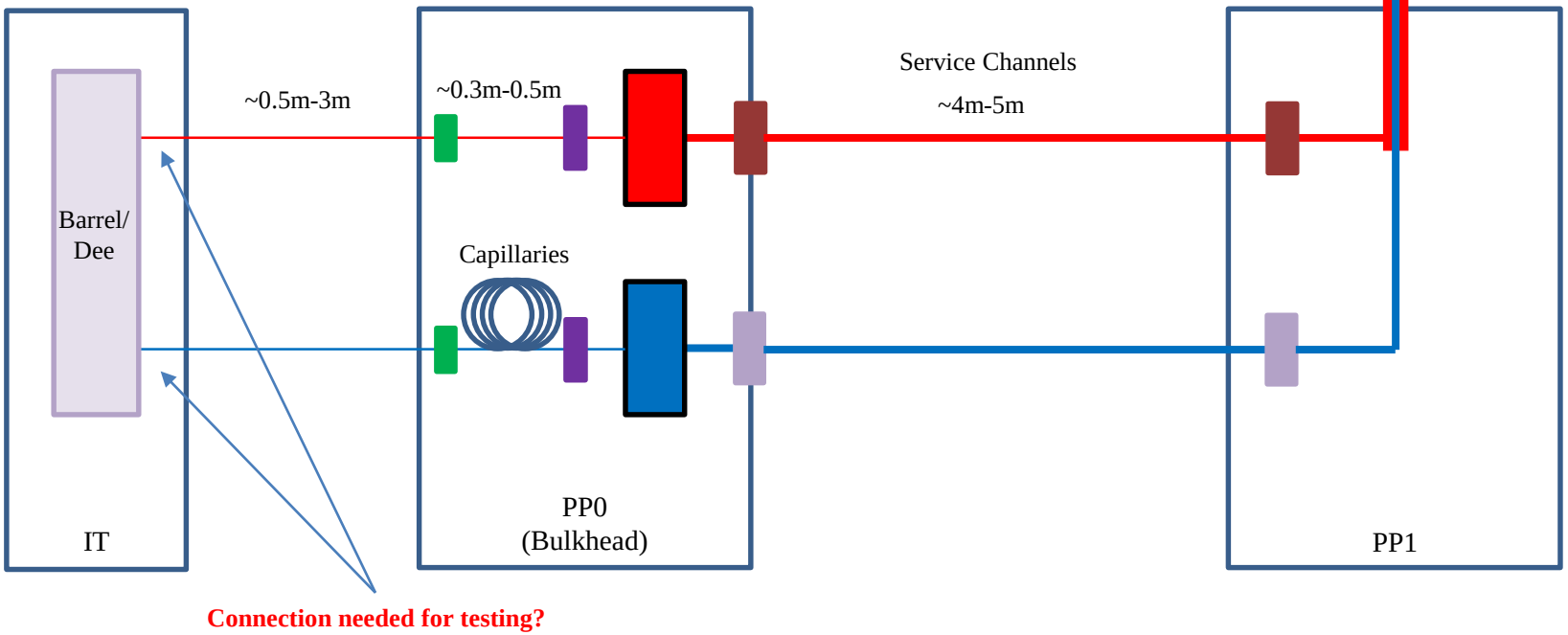
½-inch VCR con.

¼-inch VCR con.

⅛-inch VCR con.

Mini-VCR con.

Pipe dimensions still to be confirmed.



Phase 2 Pixel: Services at Bulk-Head

Manifolding and transfer loops of one IT quarter

	Inlets	Outlets
TEPX1	6	6

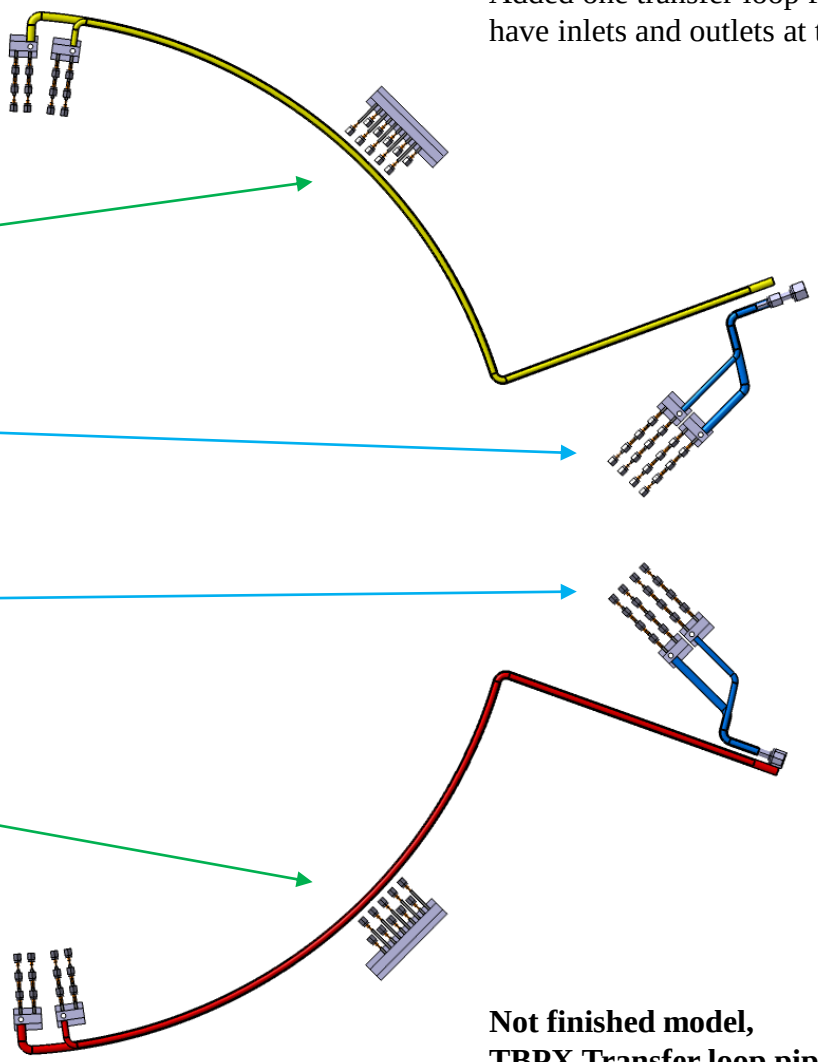
	Inlets	Outlets
TBPX	5	5

	Inlets	Outlets
TFPX	8	8

	Inlets	Outlets
TFPX	8	8

	Inlets	Outlets
TBPX	5	5

	Inlets	Outlets
TEPX2	6	6

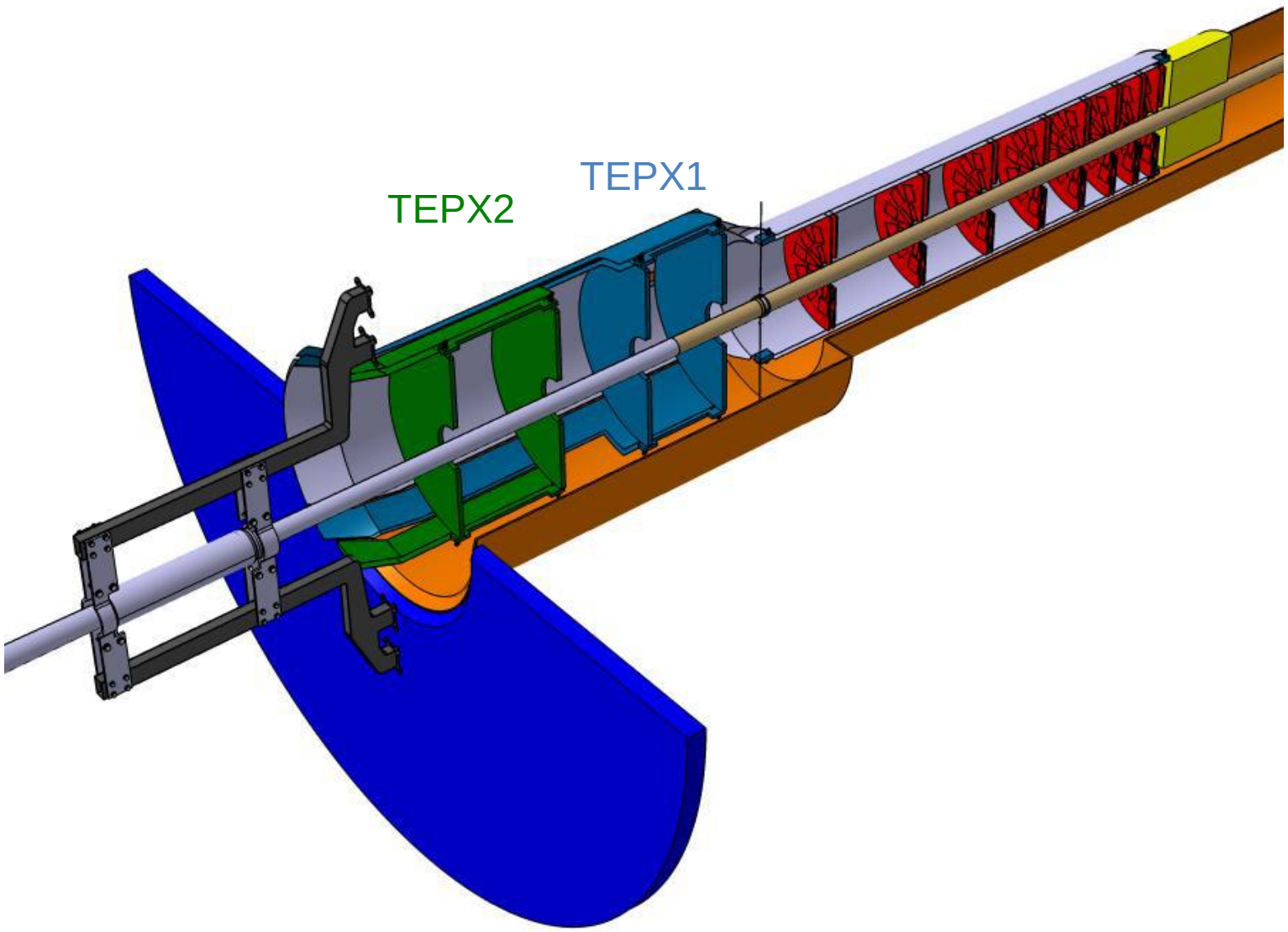


Added one transfer loop for TBPX to be able to have inlets and outlets at top **and** bottom

One ¼	Transfer loops
TBPX	2
TFPX	2
TEPX1	1
TEPX2	1
Total	**6**

Not finished model,
TBPX Transfer loop pipes (green) missing

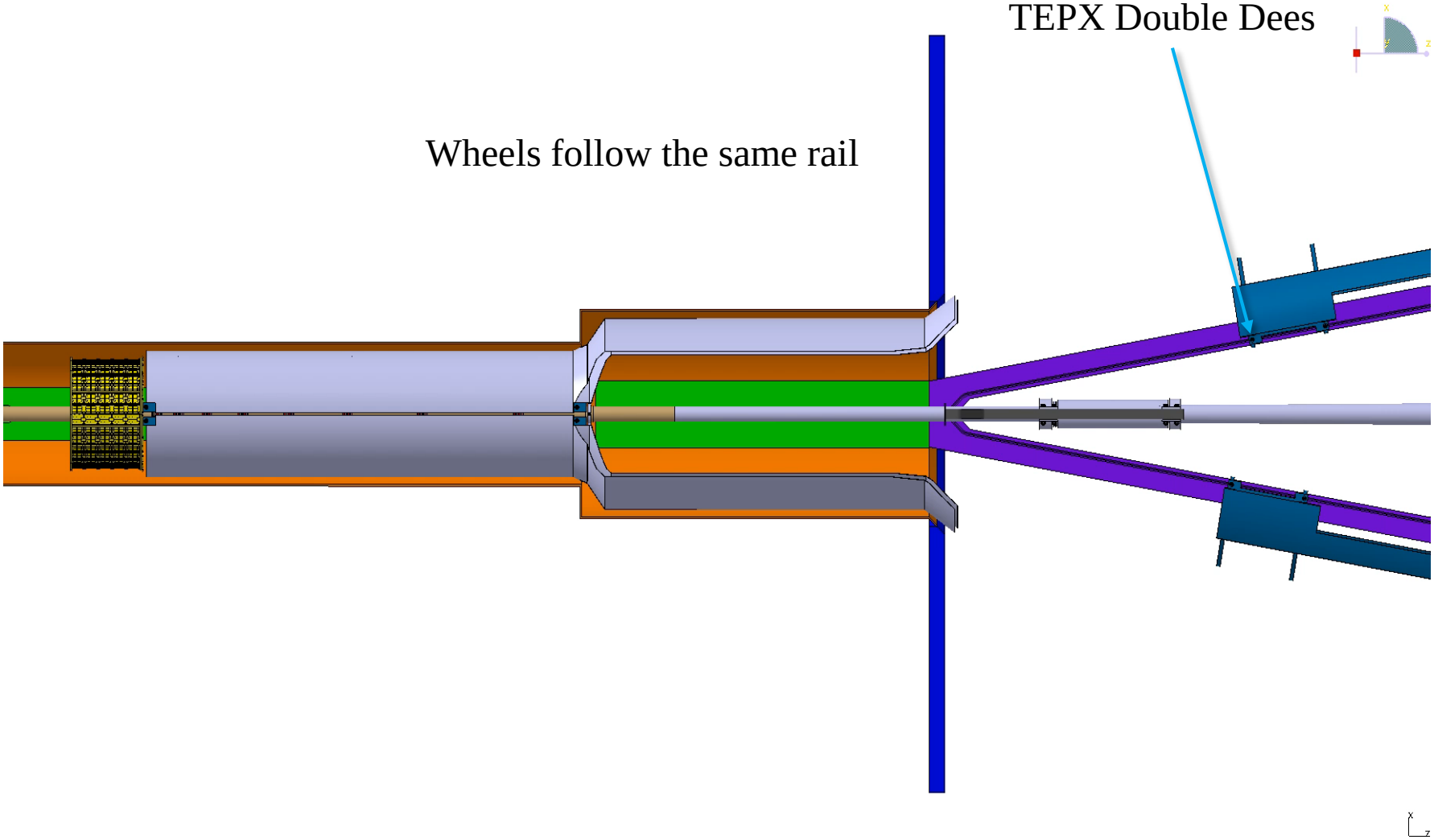
Phase 2 Pixel: Services at Bulk-Head



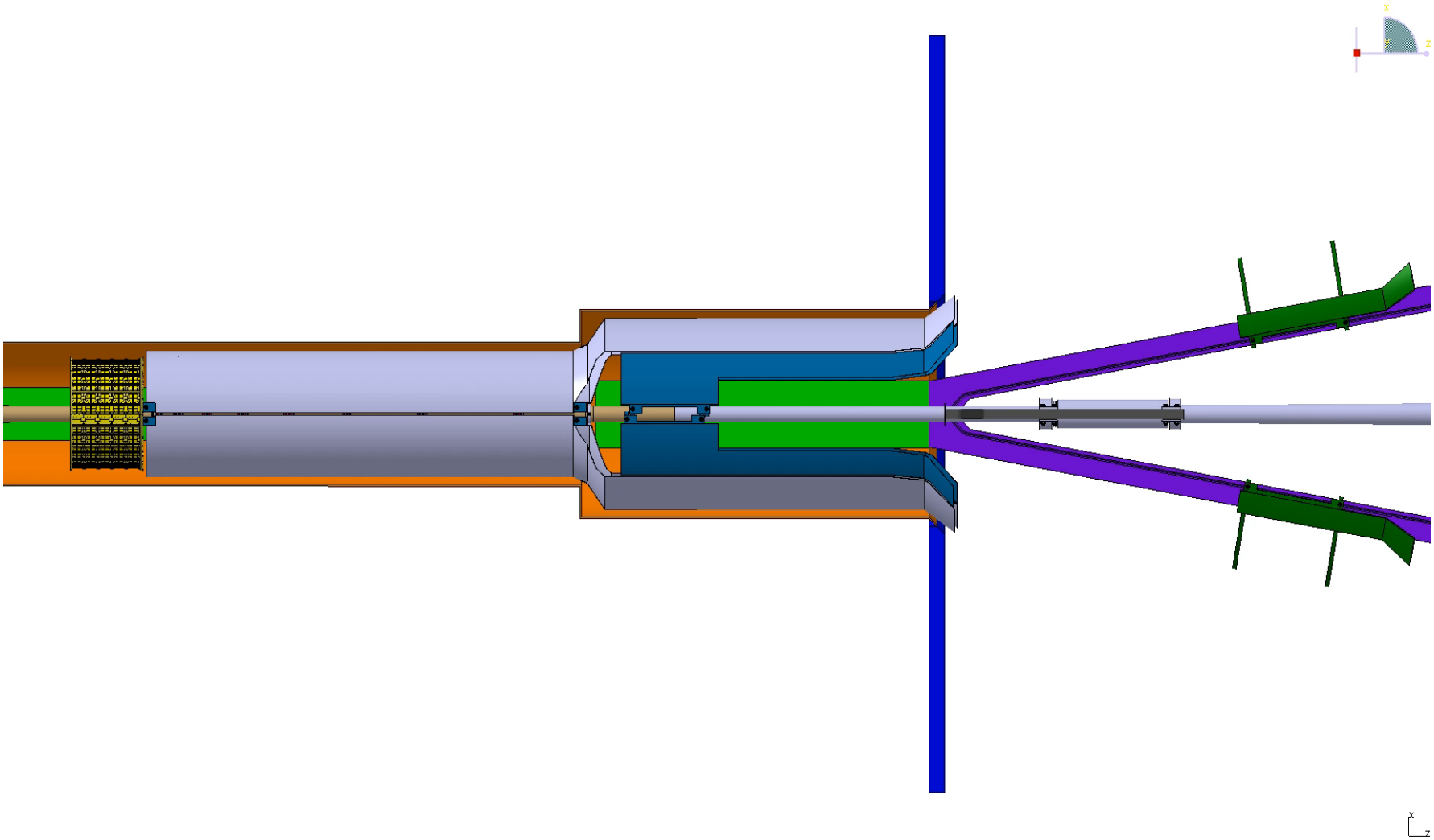
TEPX1 Installation

Wheels positioned at the middle of the TEPX Double Dees

Wheels follow the same rail



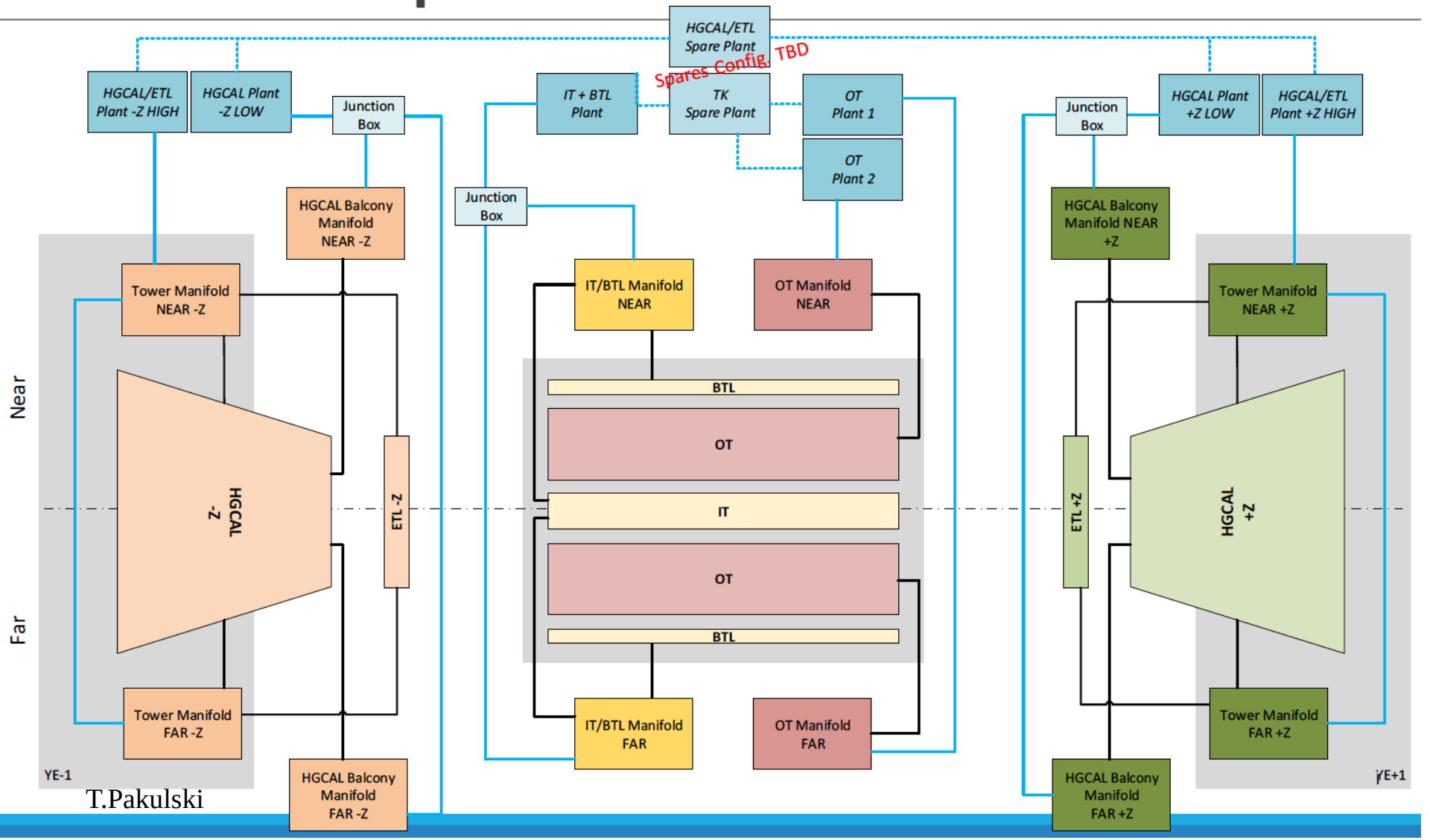
TEPX2 Installation



Phase 2 Pixel: Cooling concept

- Similar to Phase1 Pixel detector
- Cooling plant in USC, manifold distribution in UXC
- Cooling plant vs Detector grouping still not settled
- Cooling plant systems will have automatic back-up plant upon failure of a single plant
- Vacuum jacketed inlet-in-outlet transfer line from Cooling plants to manifolds and from manifolds up to PP1
- Single pipes and regular insulation from PP1 to PP0

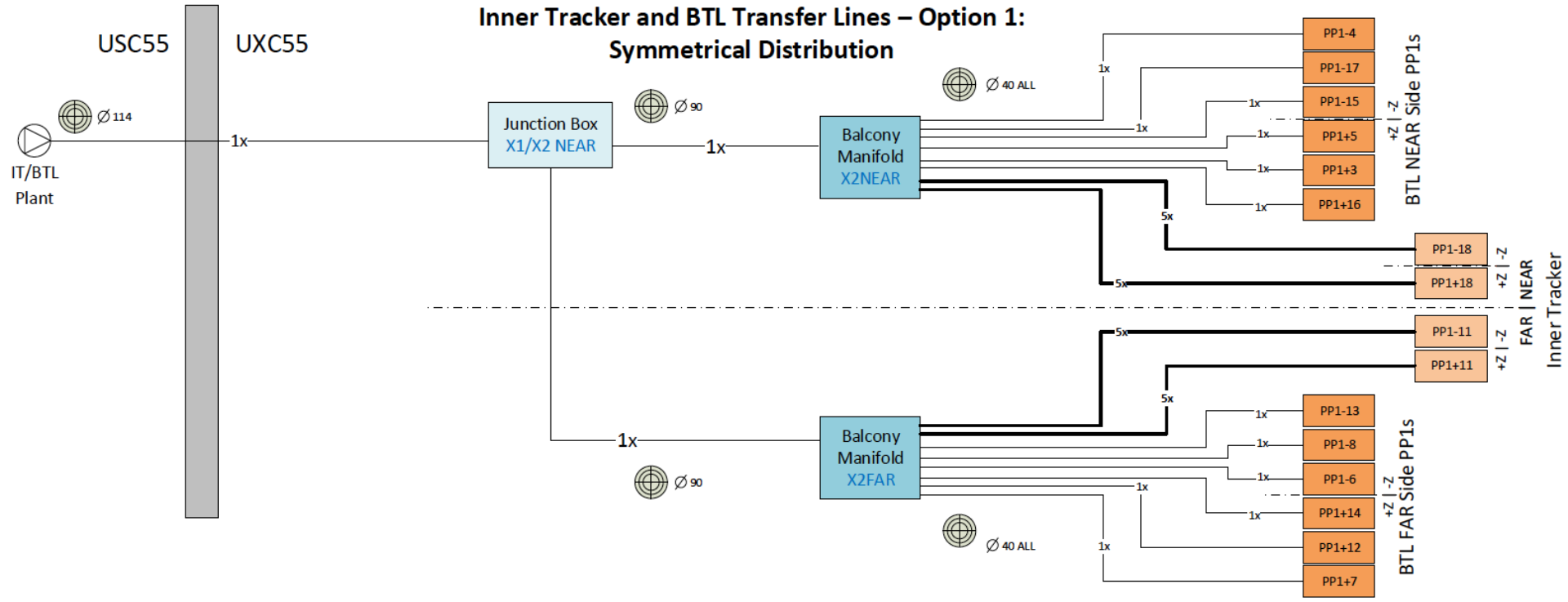
Phase 2 Pixel: Cooling concept



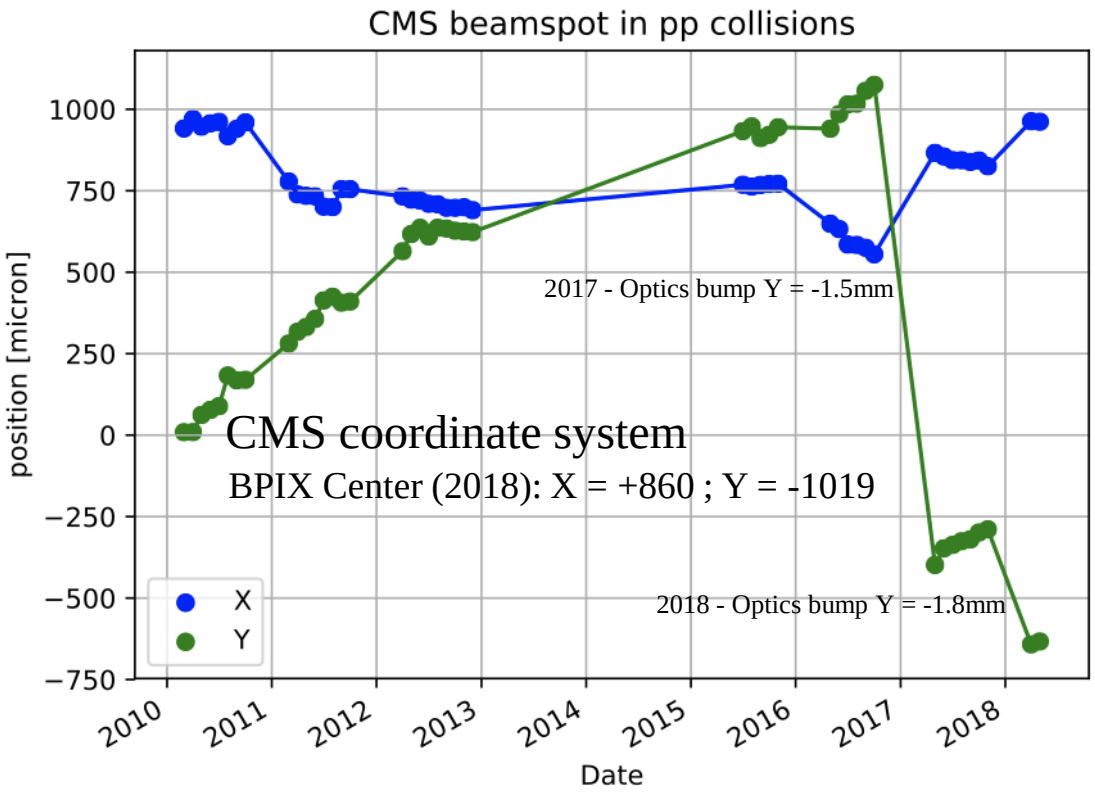
T.Pakulski

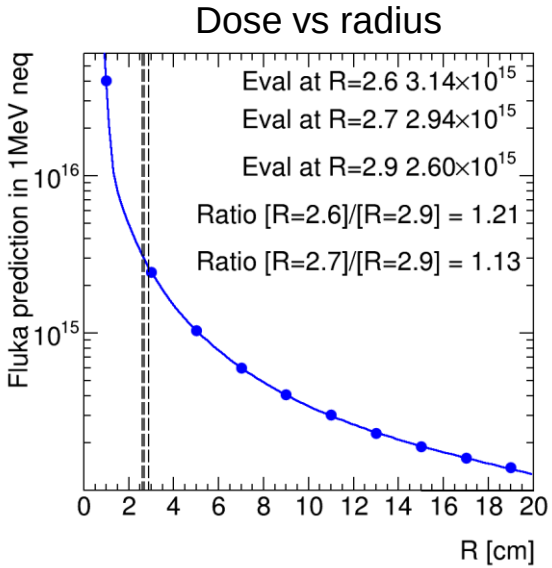
Phase 2 Pixel: Cooling concept

- Working also on the alternative of having the manifolds in X0 in order to minimize the length of the lines to PP1.



Phase 2 Pixel: Beam and alignment





- Beam moved up by ~1.3mm in 8 years
- With beam non centered
  - Increase in radiation damage
  - Unbalanced hit rate

	2010	2012	2015	2017	2018
Distance between beam and BPIX center (mm)	4.5	4.6	2	0.9	0.4

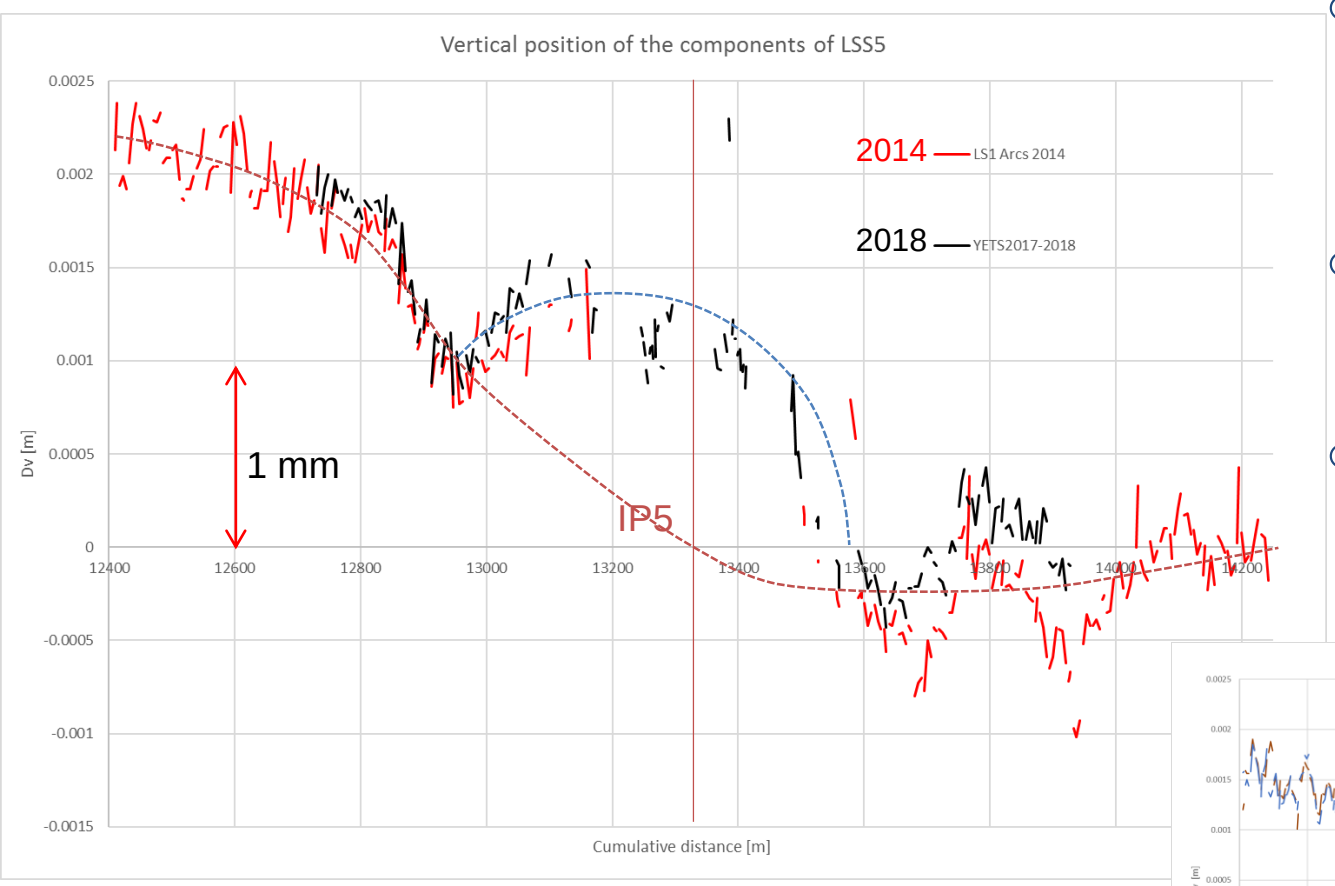
BPIX shimmed up by 3mm

New BPIX shimmed up by 3mm, beam lowered by 1.5mm

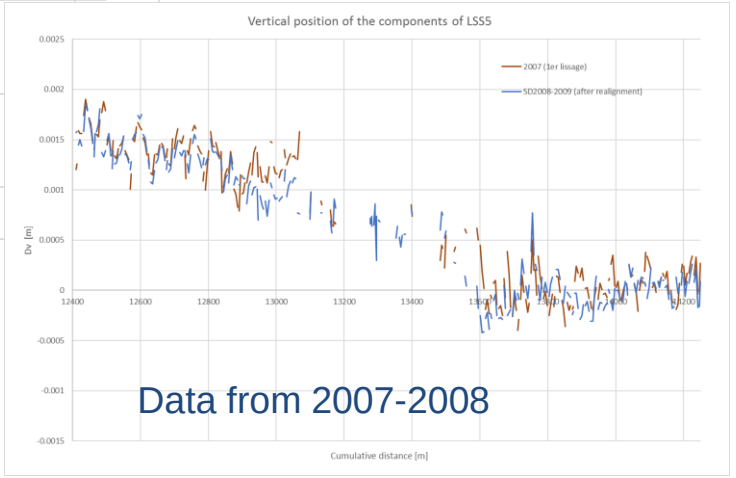
Beam lowered by further 0.3mm

It has been a struggle to keep the beam centered over the years

Phase 2 Pixel: Beam and alignment

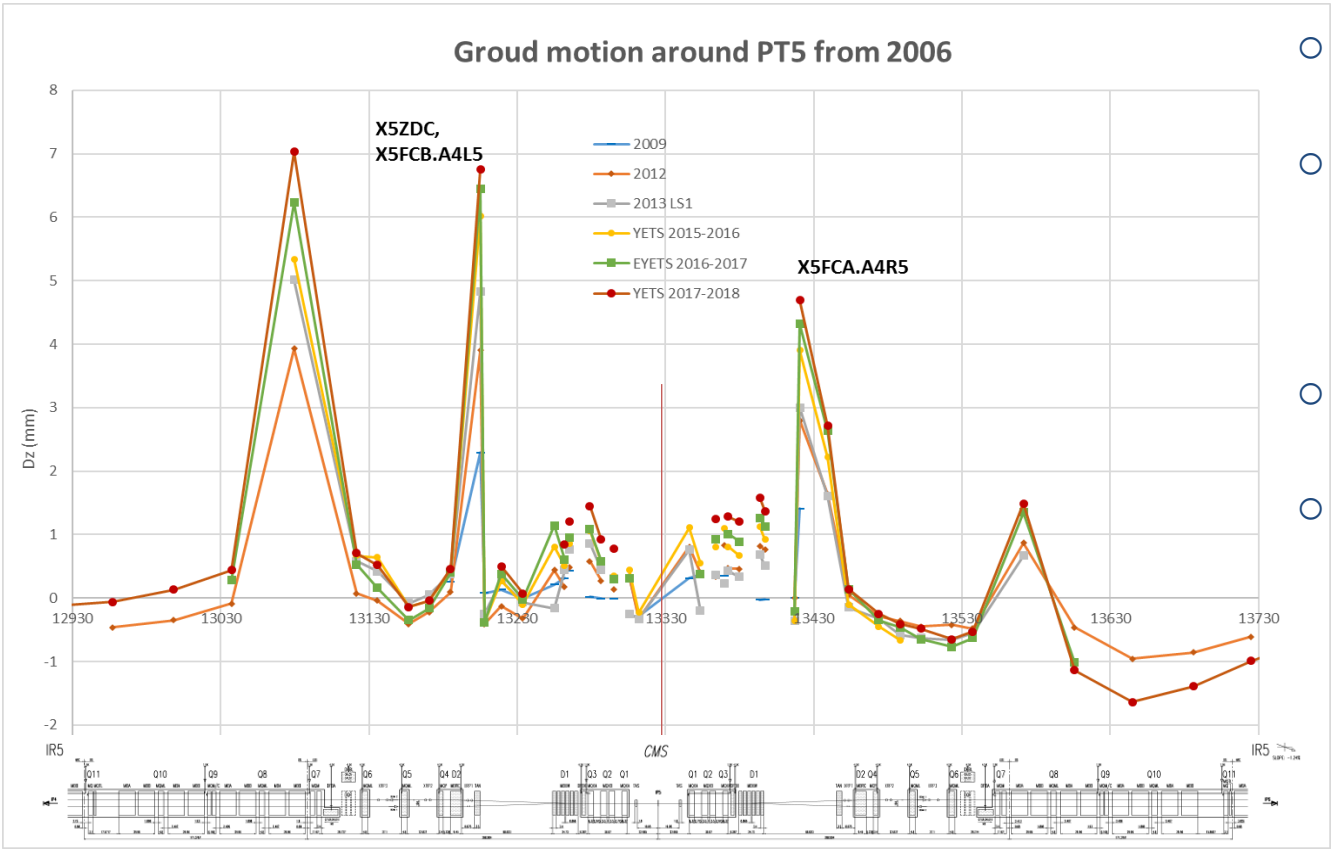


- Magnetic elements around IP5 are surveyed every year
- They are found on the rise every year
- Over the years a clear “bump” developed around IP5



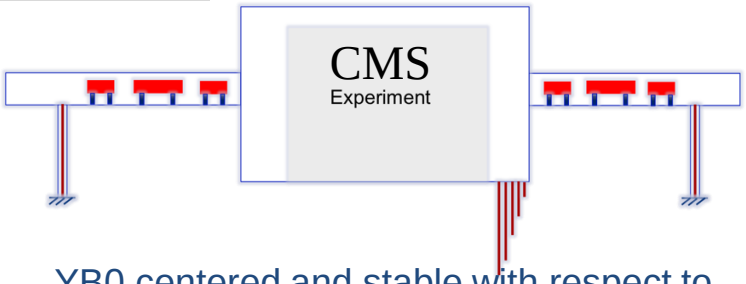
Data from 2007-2008

Phase 2 Pixel: Beam and alignment



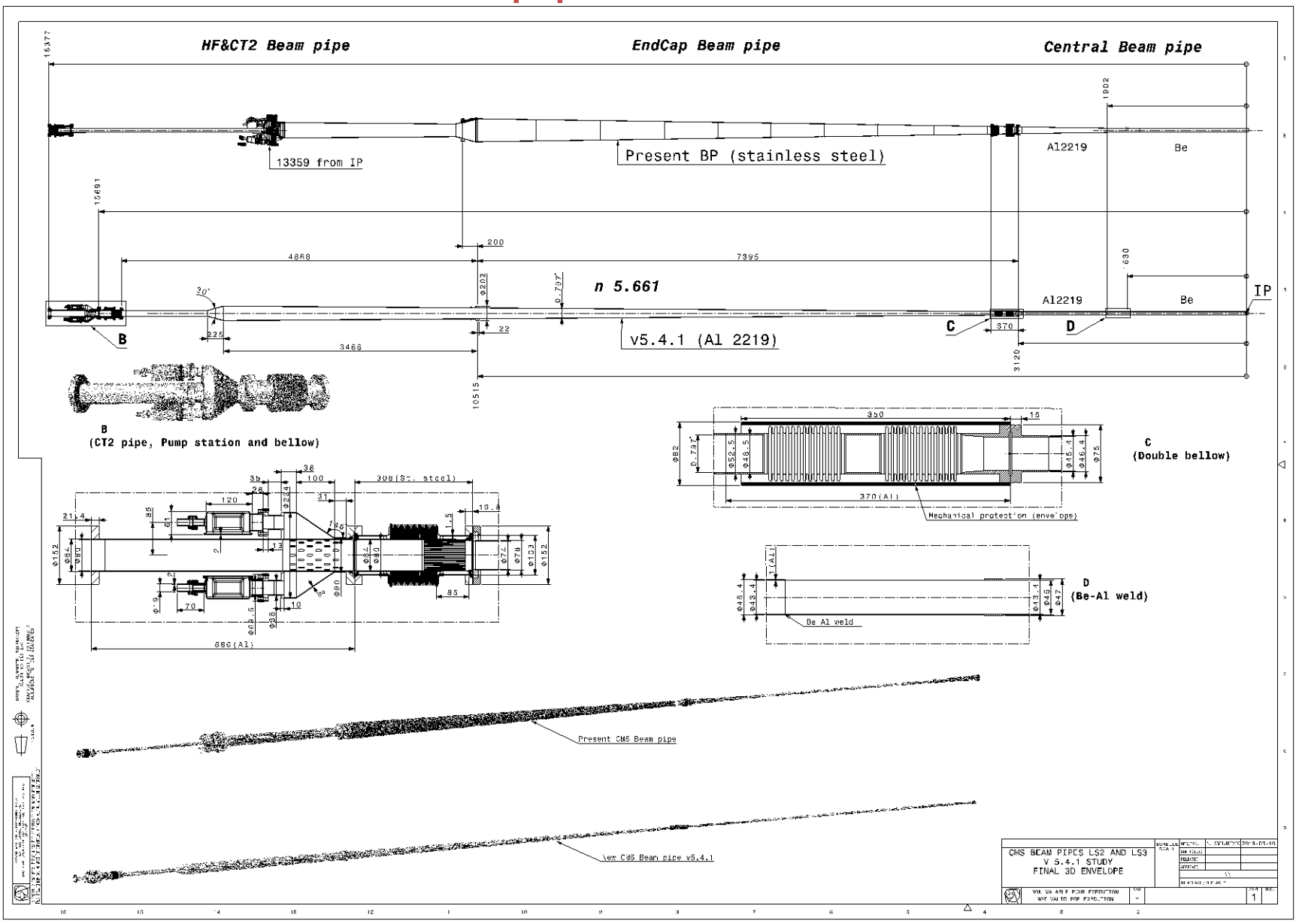
- Ground around IP5 is indeed moving up
- Will realign during LS2 (from LQ10 to RQ10) with the goal of lowering IP5 by 3mm
- Trend will continue into the HL-LHC era
- Motorized adjustment will be introduced with HL-LHC from LQ5 to RQ5, but will it be enough?

- We are considering shimming up YB0 during LS3 (but difficult and risky)
- Change of strategy (w.r.t. 2007) and align the Tracker in order to have the center of the ITST in YB0 centered (or higher) than the nominal beam line.



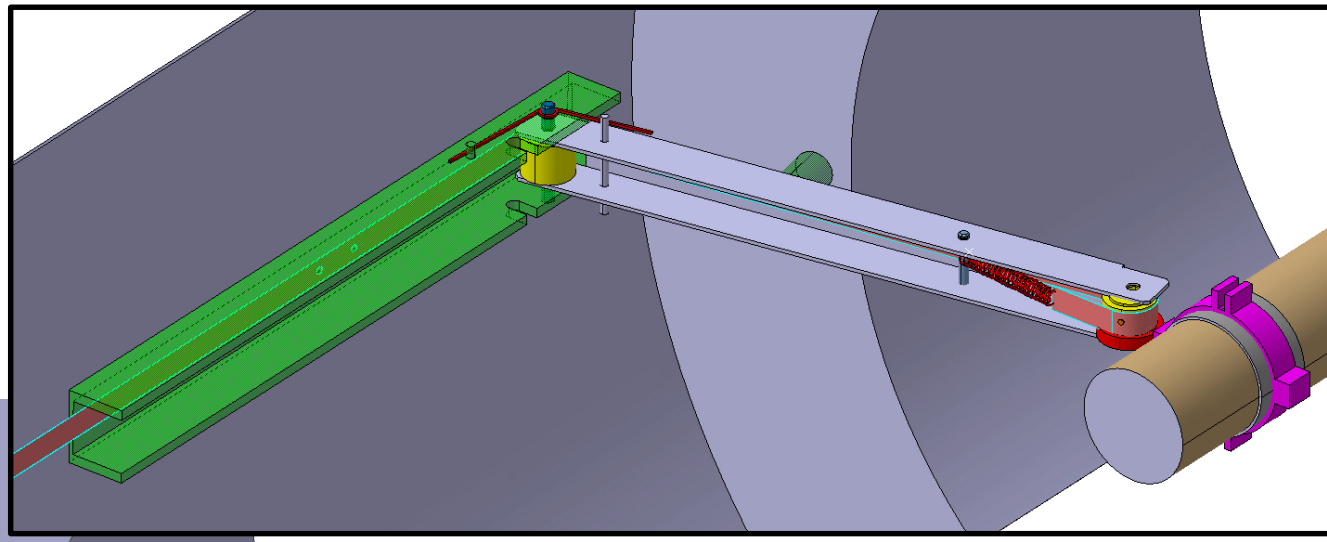
YB0 centered and stable with respect to deep reference probes both in UXC55 and LHC tunnel

Phase 2 Pixel: Beam pipe

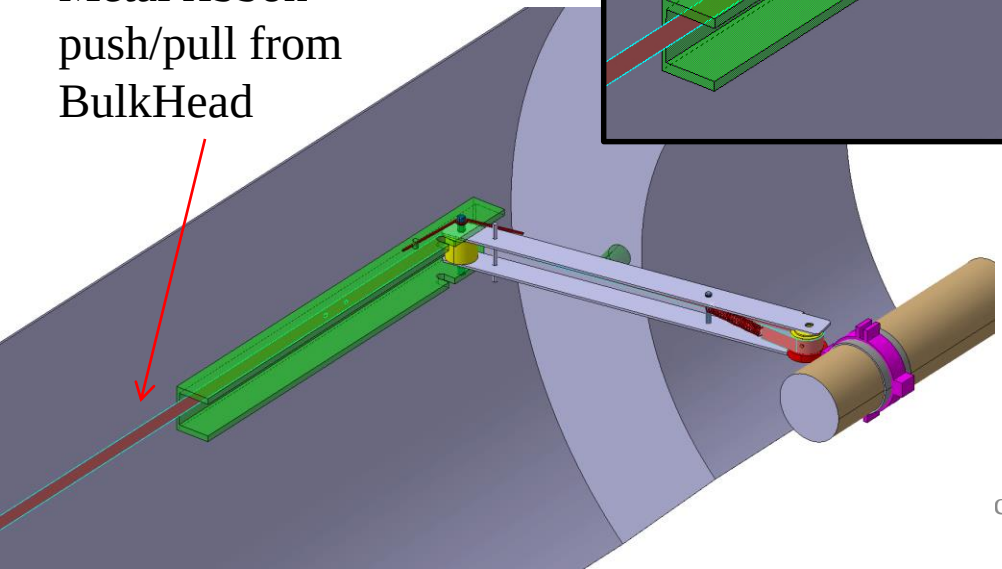


Phase 2 Pixel: Beam pipe/Supports

- New beampipe design is finished and construction should start soon.
- Installation during LS2
- No change in beam pipe supports (1.6m, 3.1m, 3.5m) between LS2 and LS3. We will just add an adapter flange at 3.1m
- Start looking at some ideas for LS3:



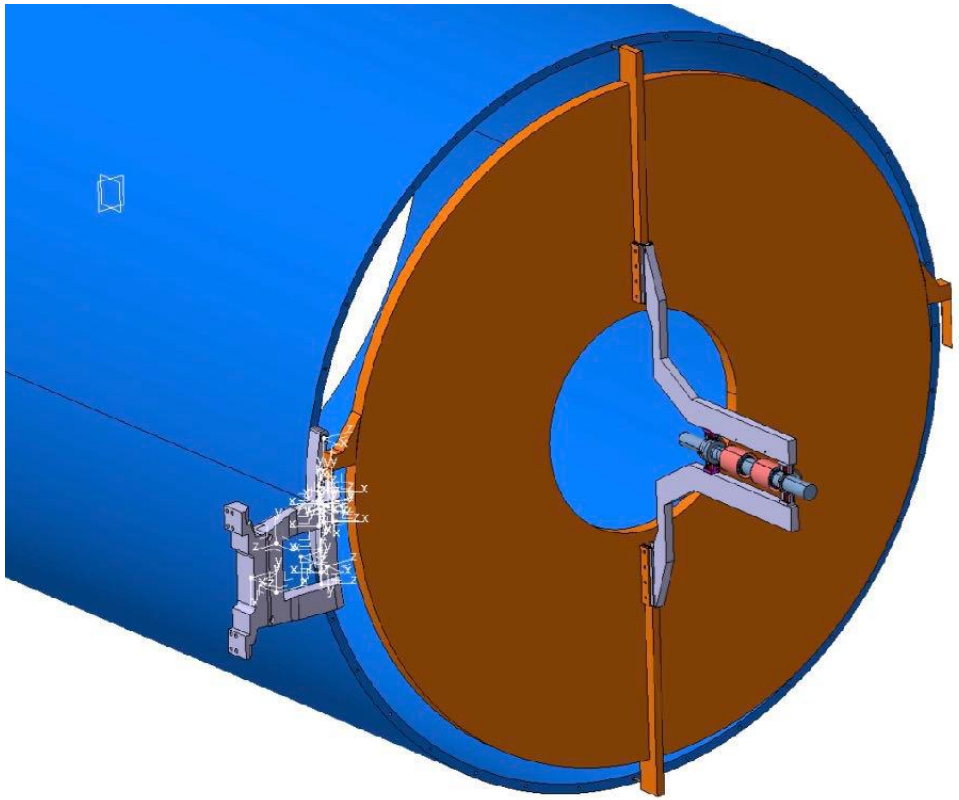
Metal ribbon push/pull from BulkHead

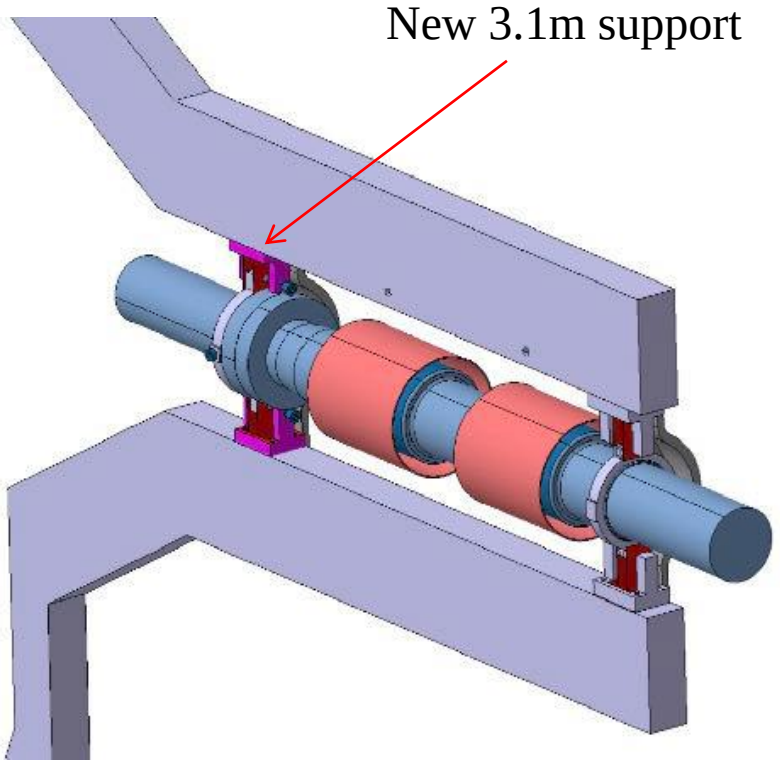


Sketch of the 1.6m support with rigid arm (horizontal support wire no longer possible as detectors extend beyond 1.6m)

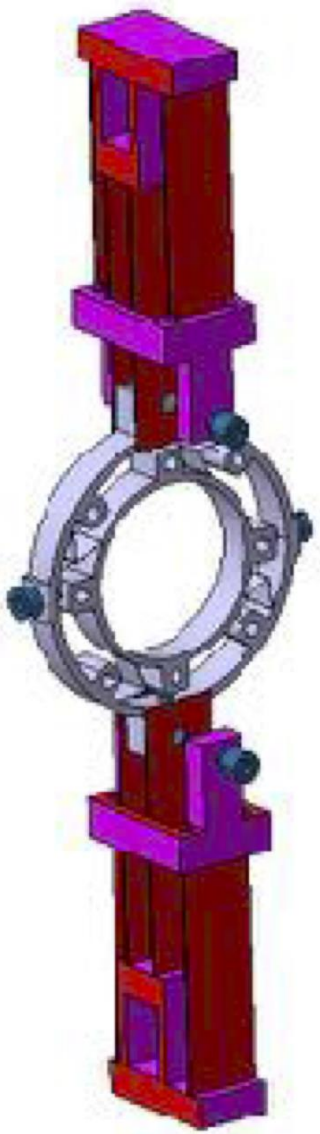
Phase 2 Pixel: Beam pipe/Supports

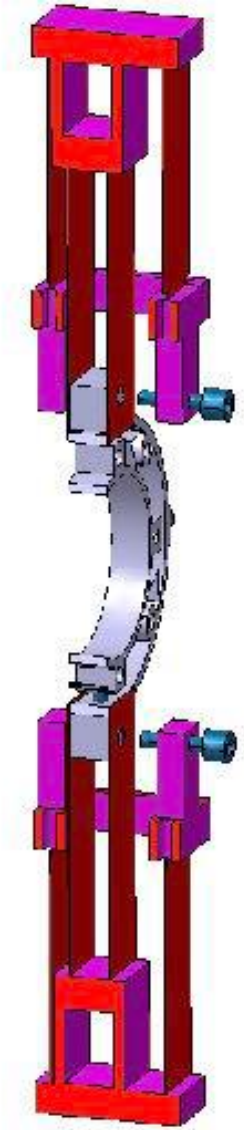
- Fishing rods now supported from Bulk-Head
- New ideas (R.Loos) for supporting the beam pipe at 3.1m
- Goal would be to make it more compact and easy to adjust at 3.1m



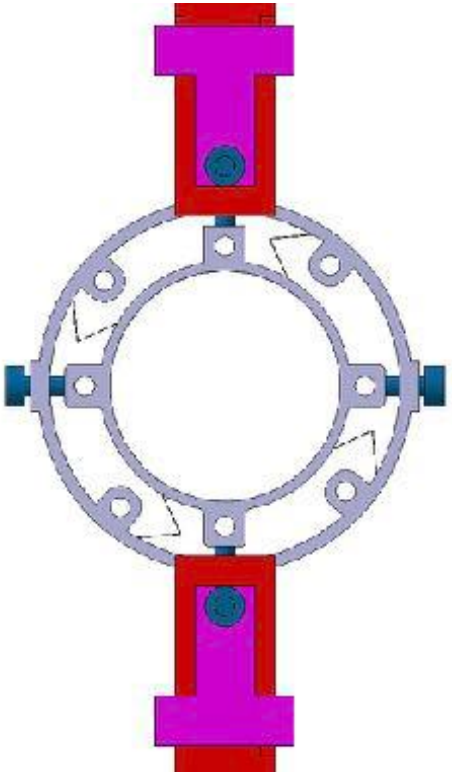


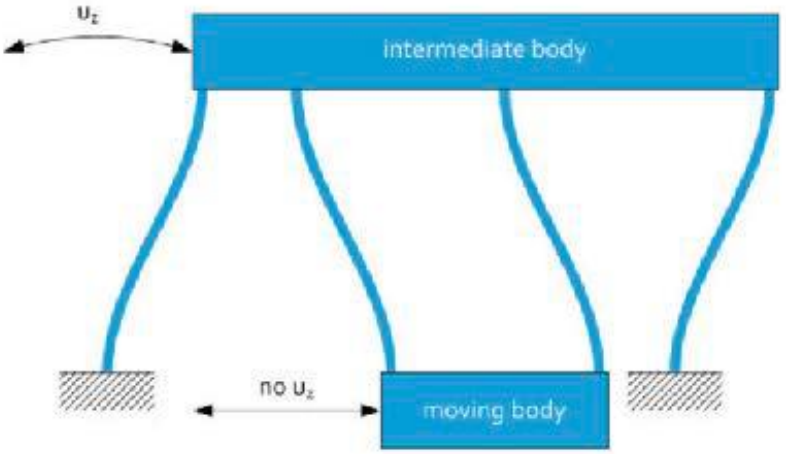
Phase 2 Pixel: Beam pipe/Supports



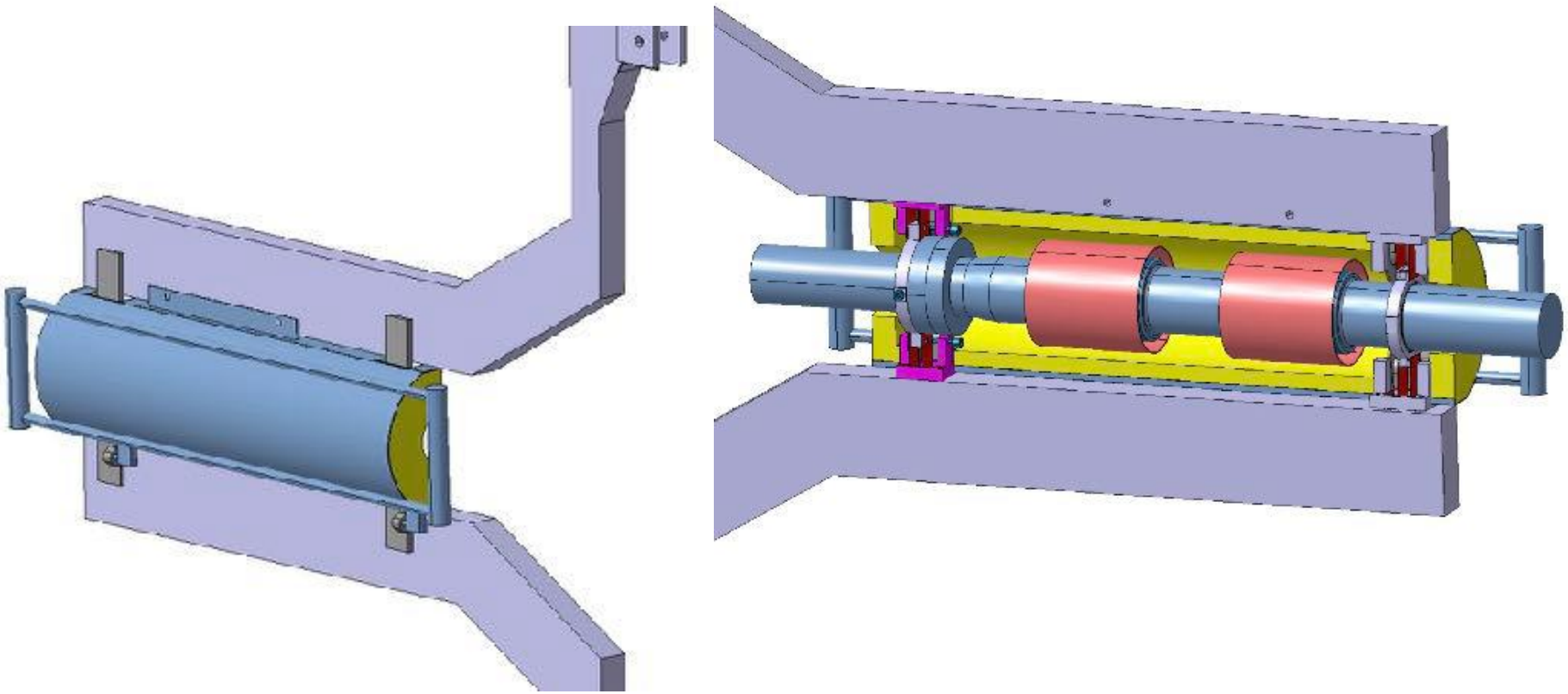


3.1m support
R. Loos





Phase 2 Pixel: Beam pipe/Supports



- We need to consider the presence of an RP shield as the flange (although now in Al) is still the dominating source od radiation near the beam pipe.