LMBHA001 cold mass

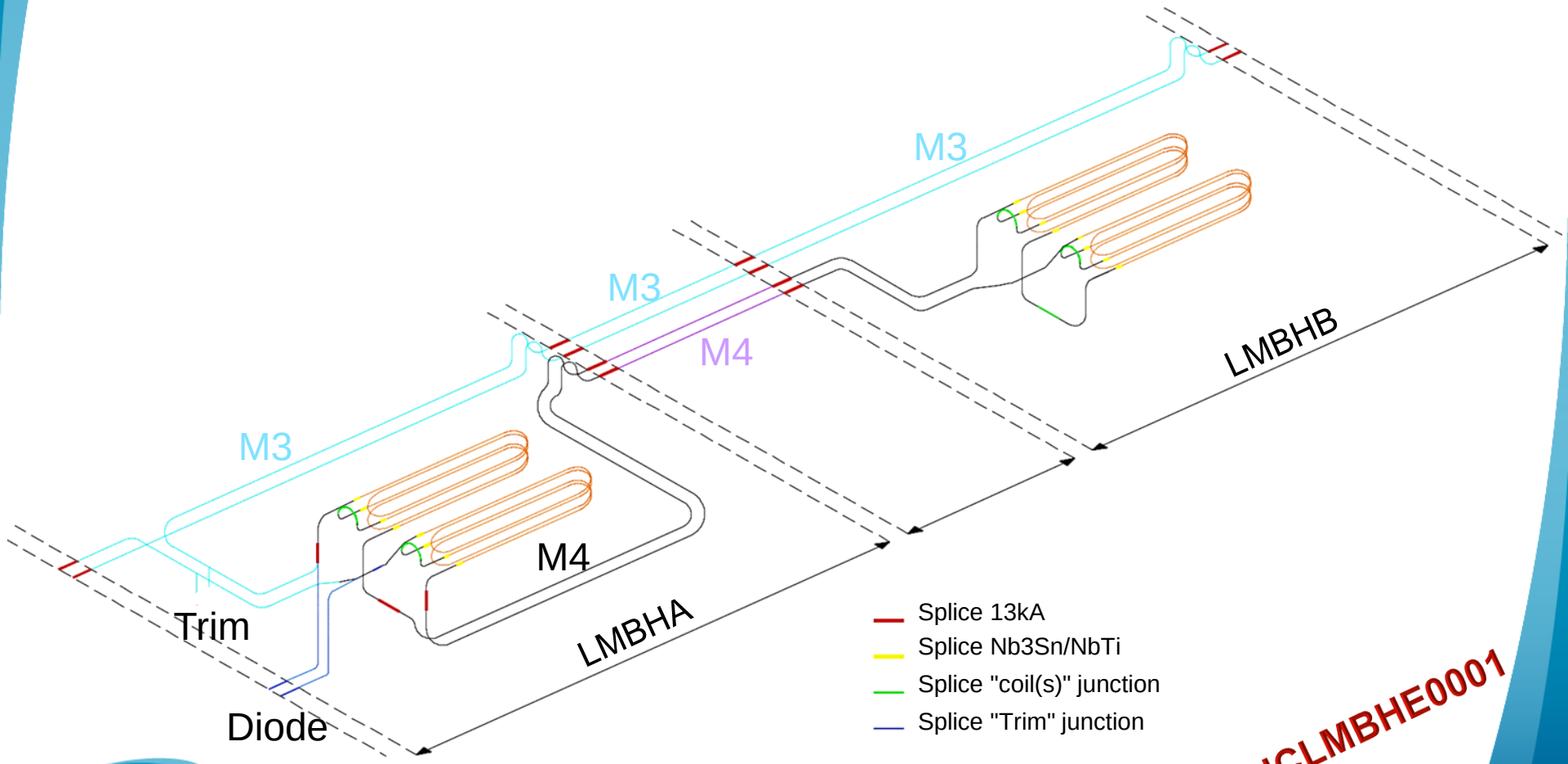
H. Prin

With contribution from R. Principe for the busbars
O. Housiaux for the differences in the assemblies
T. Bampton for assembly details

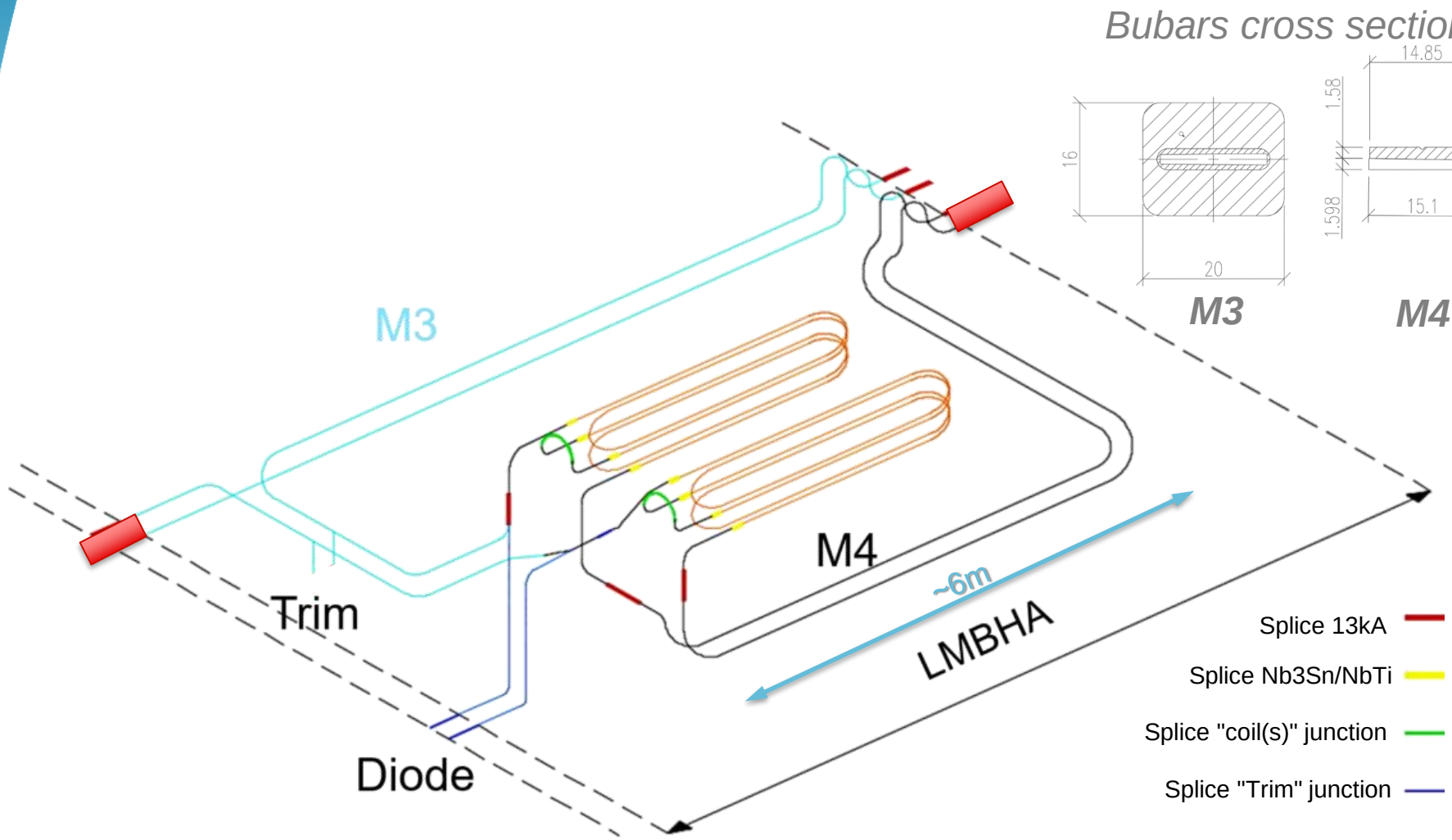
Outline

- Cold mass electrical circuit
- Busbar motion?
- Current loops?
- Differences between S#1, S#2 and S#3?

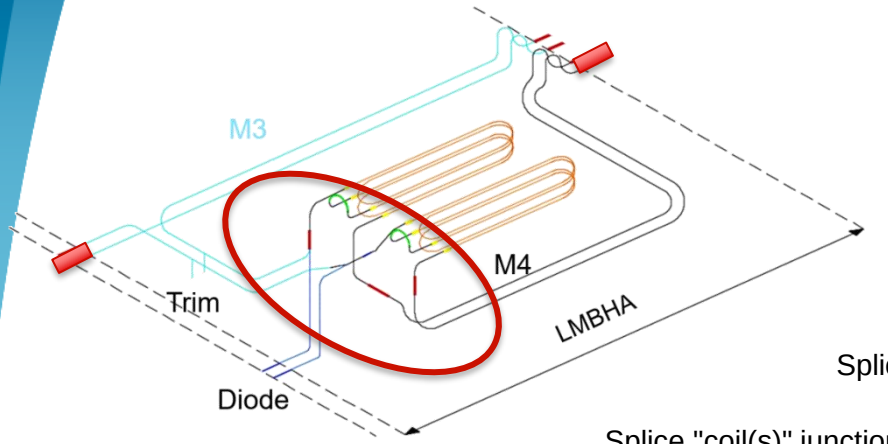
11T Global Circuit

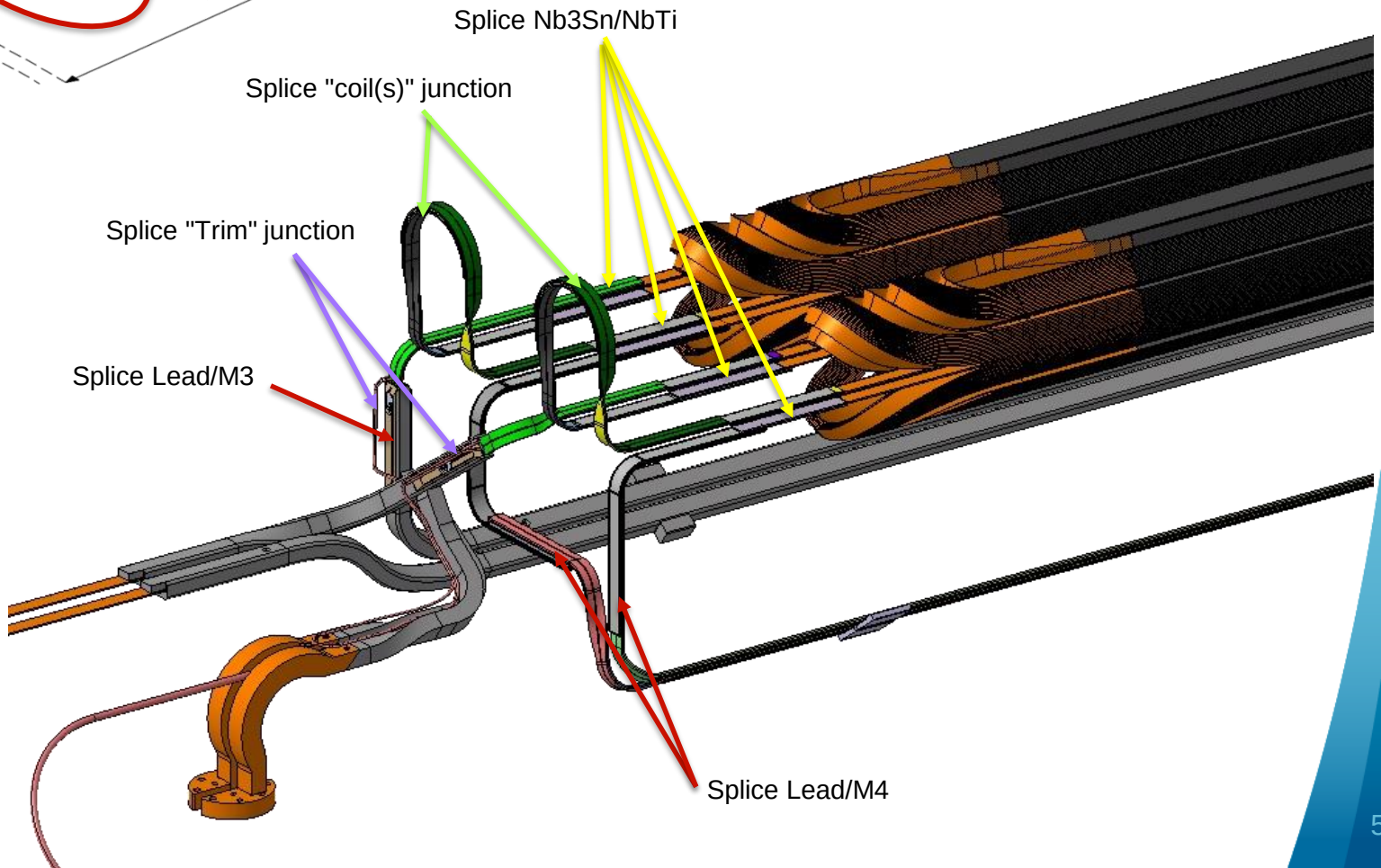


LMBHA Cold Test Circuit

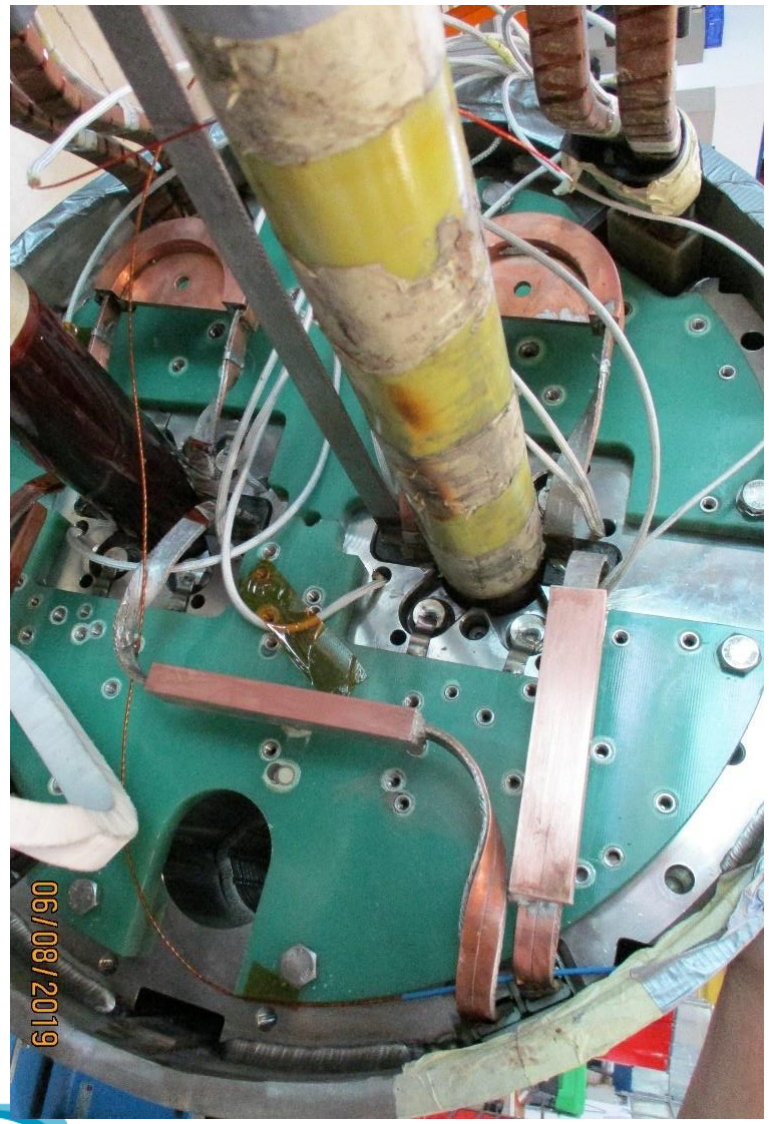


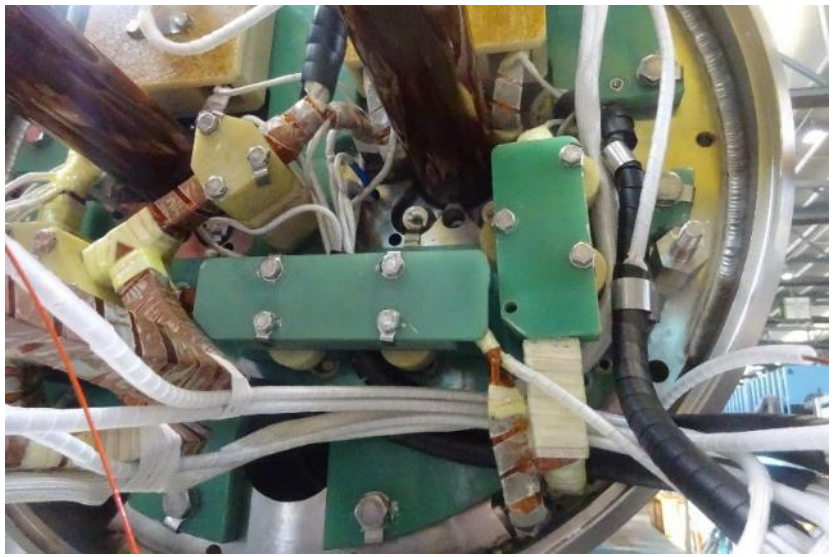
Configuration on the Connection Side





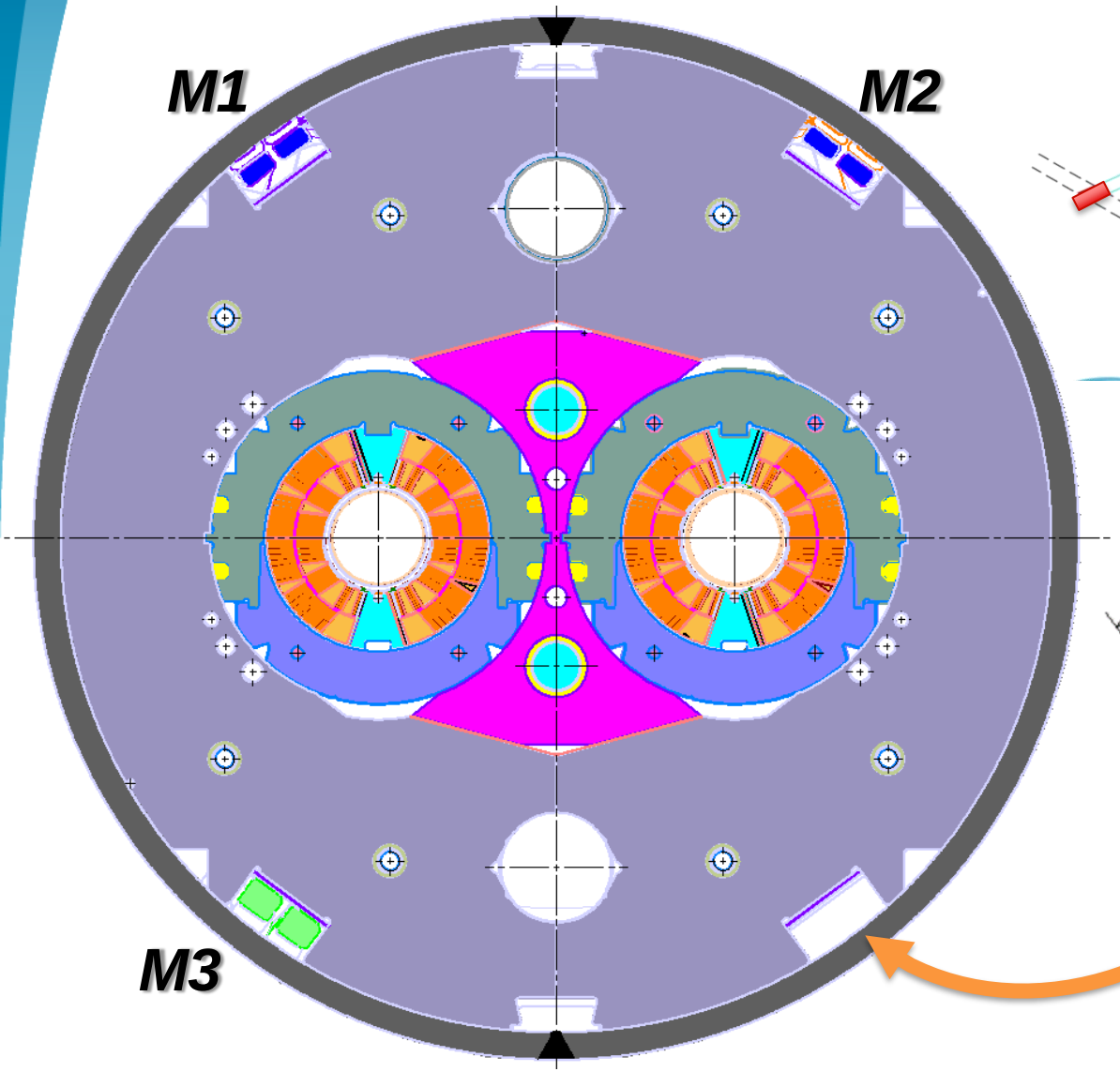
Configuration on the Connection Side Pictures

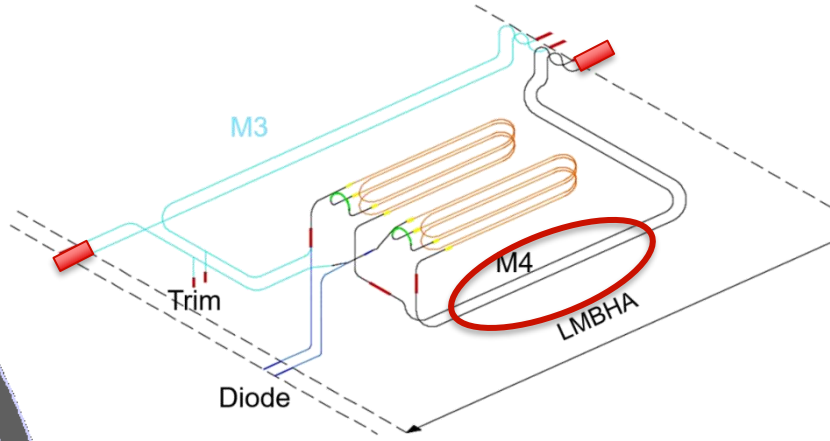


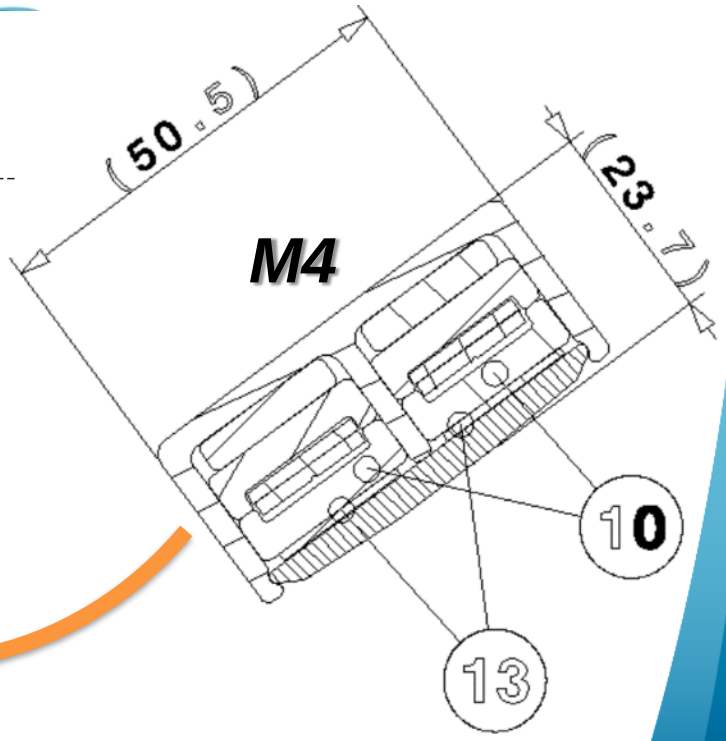


Busbar movement very unlikely

Configuration along the Yoke

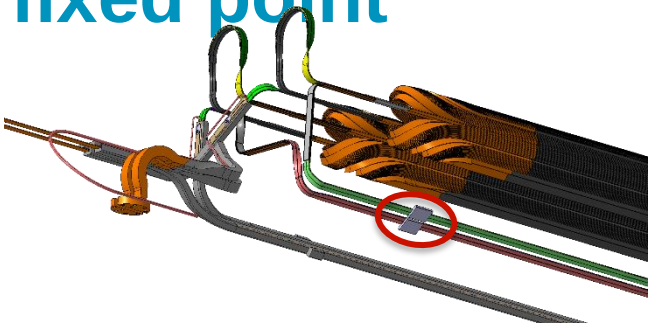


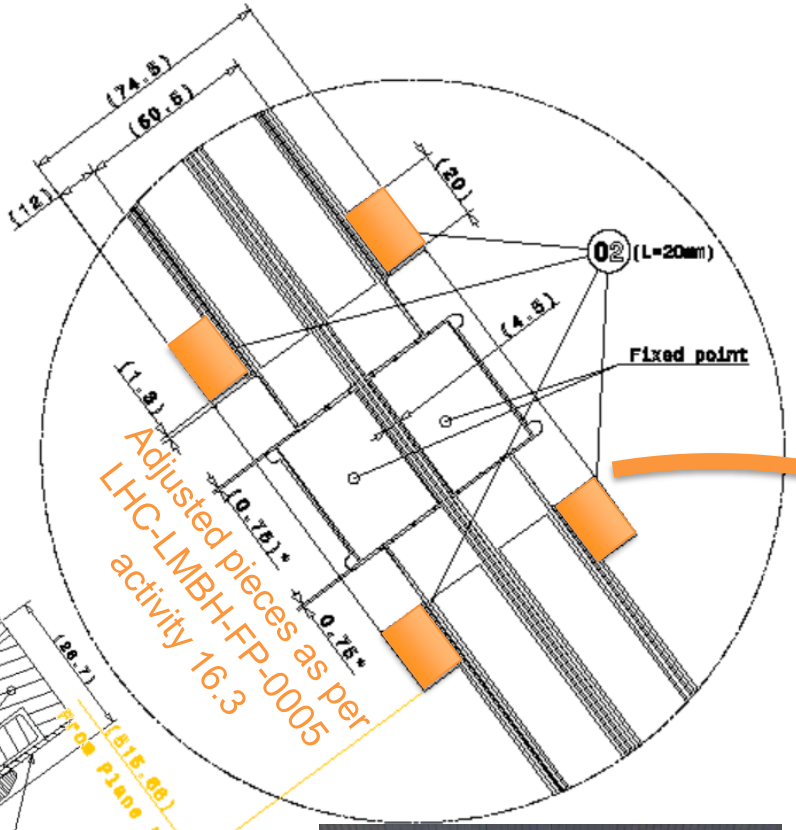


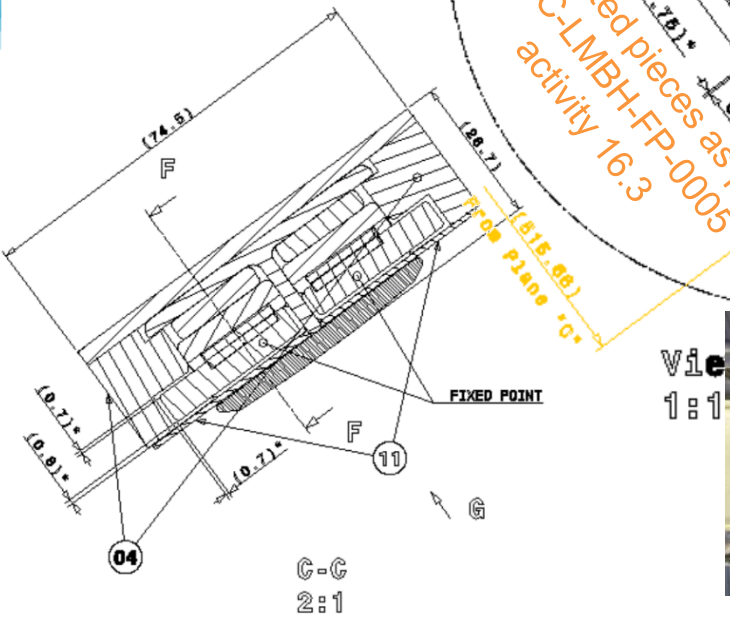


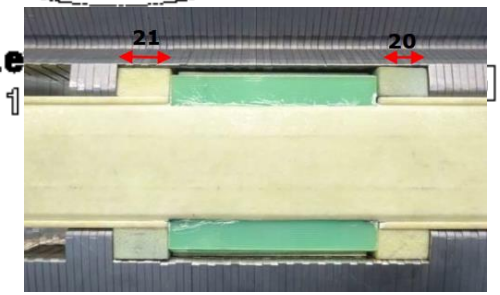
Busbar radial and azimuthal movement impossible

Configuration along the Yoke
M4 busbars longitudinal fixed point



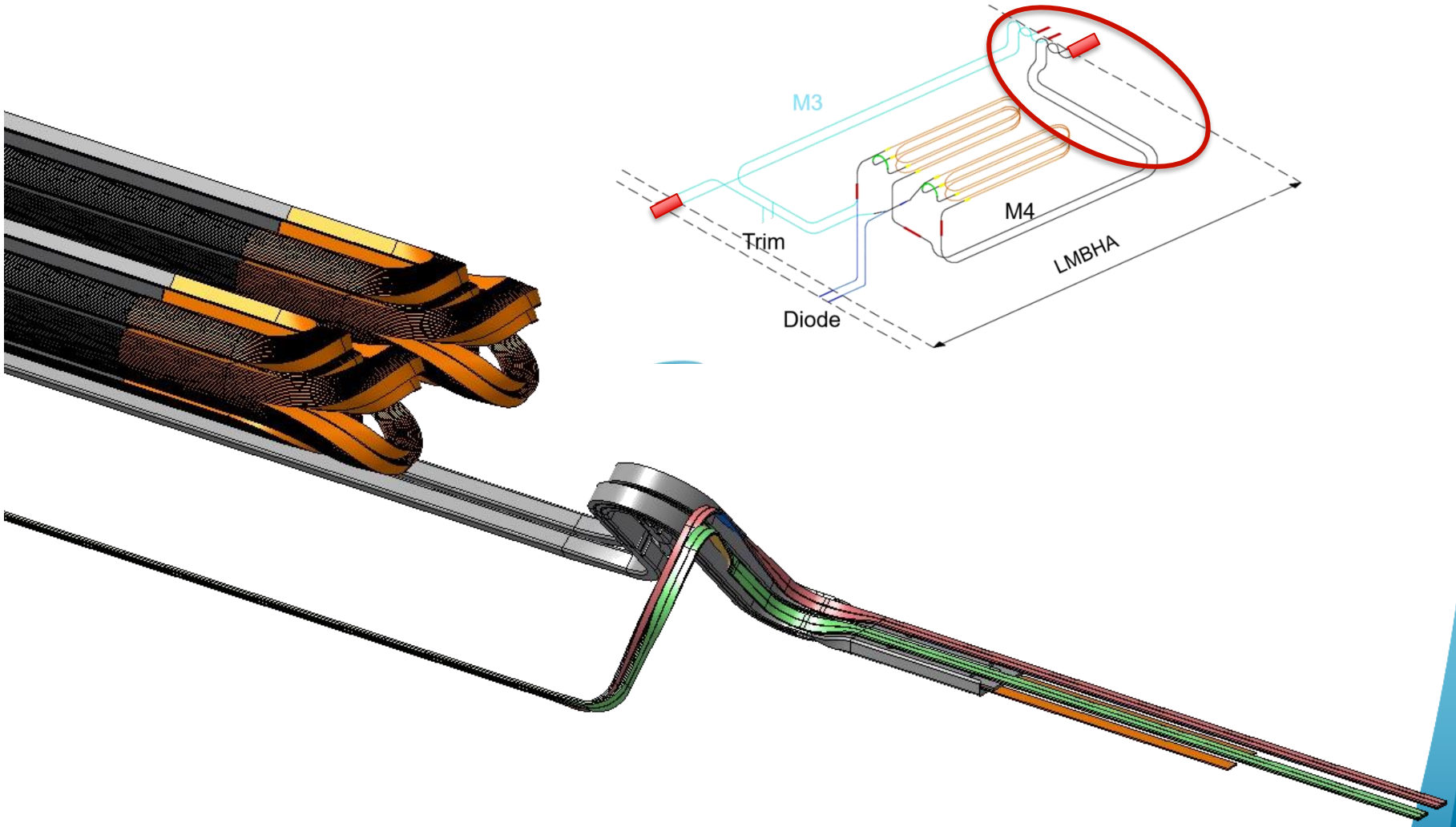




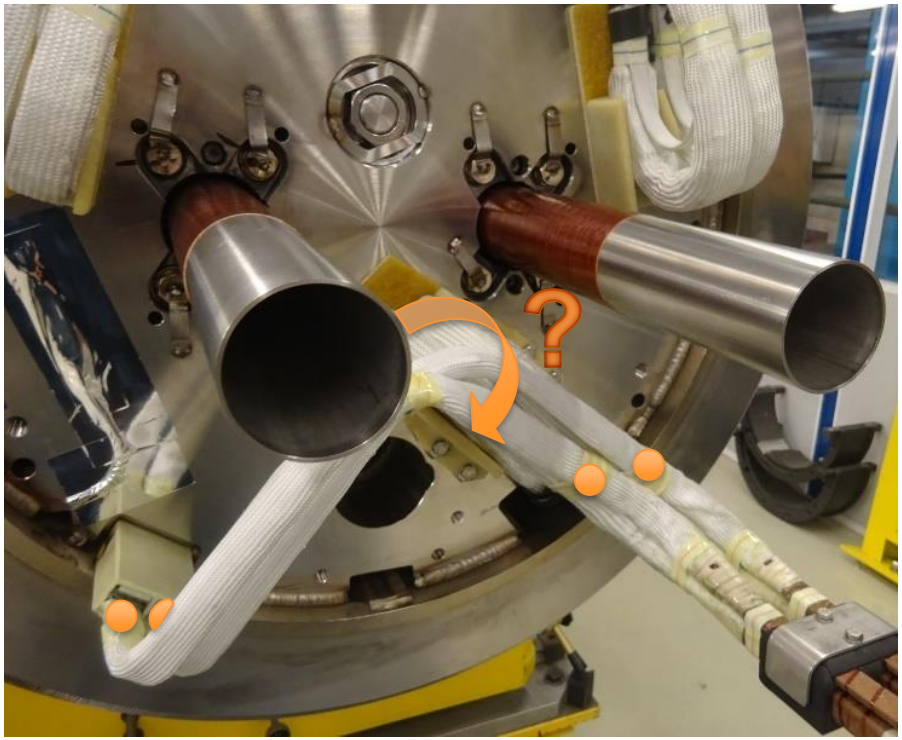


Busbar longitudinal movement impossible

Configuration on the Lyra Side



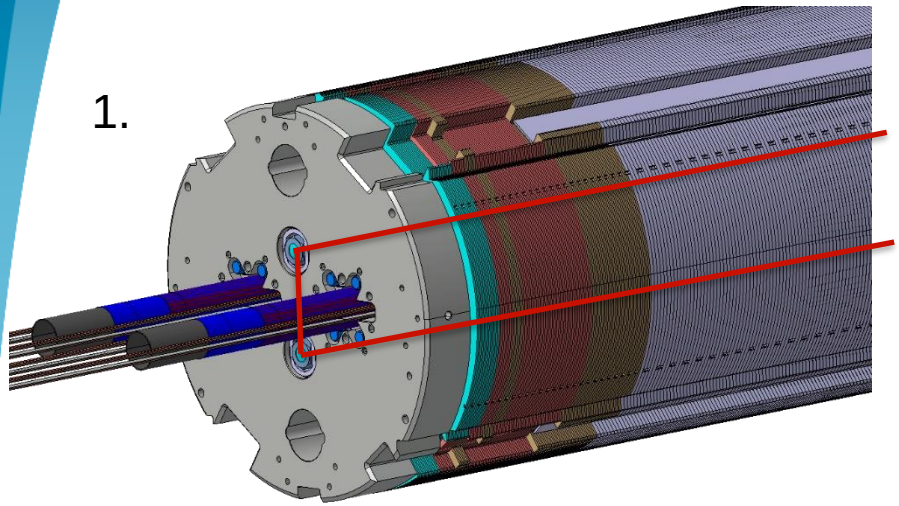
Configuration on the Lyra Side Pictures



Lyre bending movement?

Current loops ? 1/2

1.



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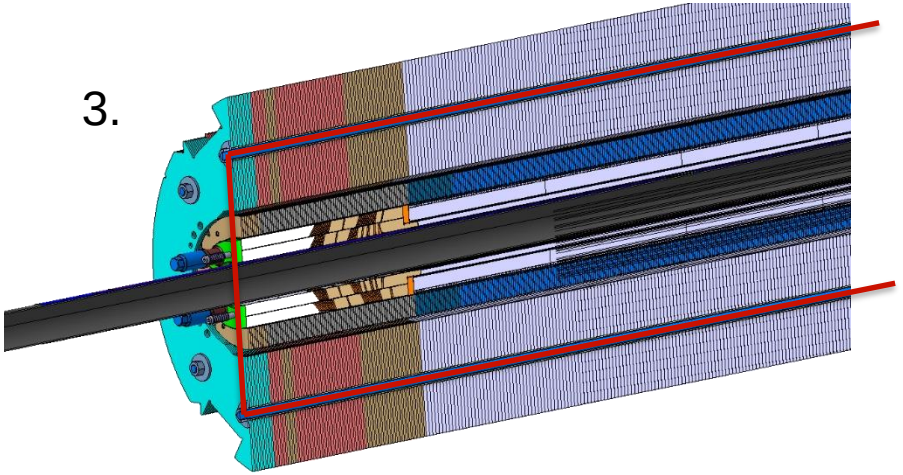

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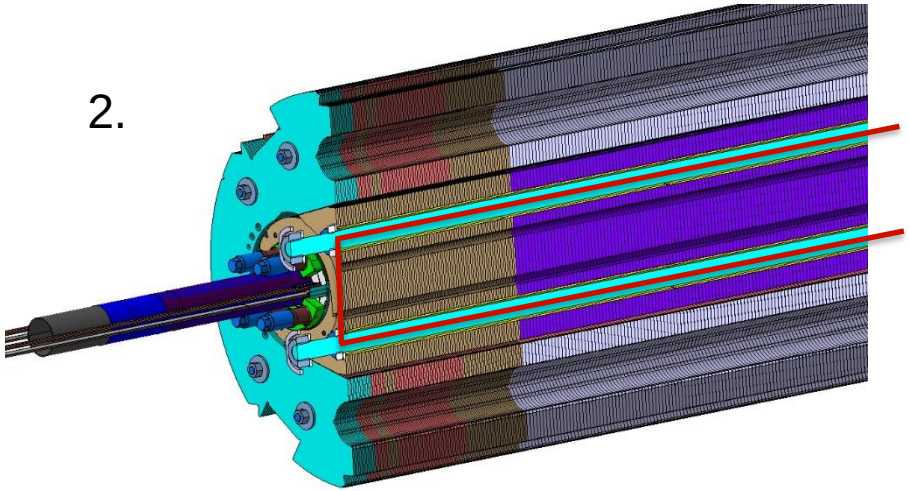

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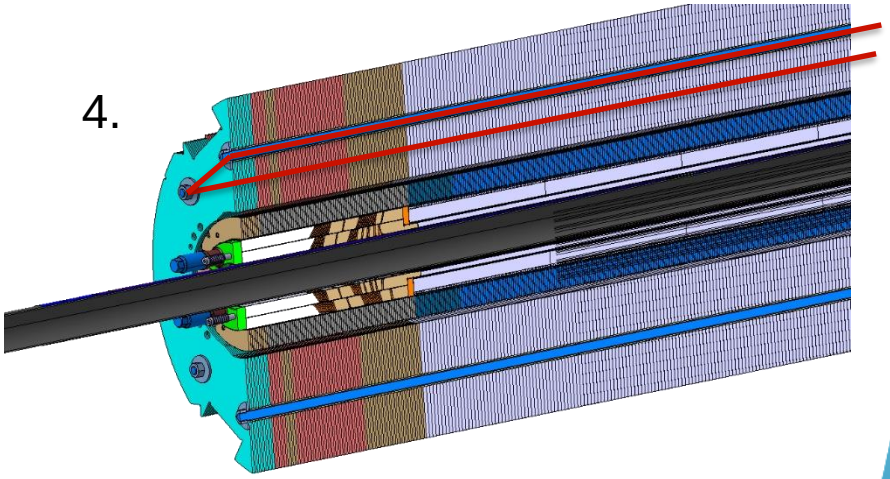
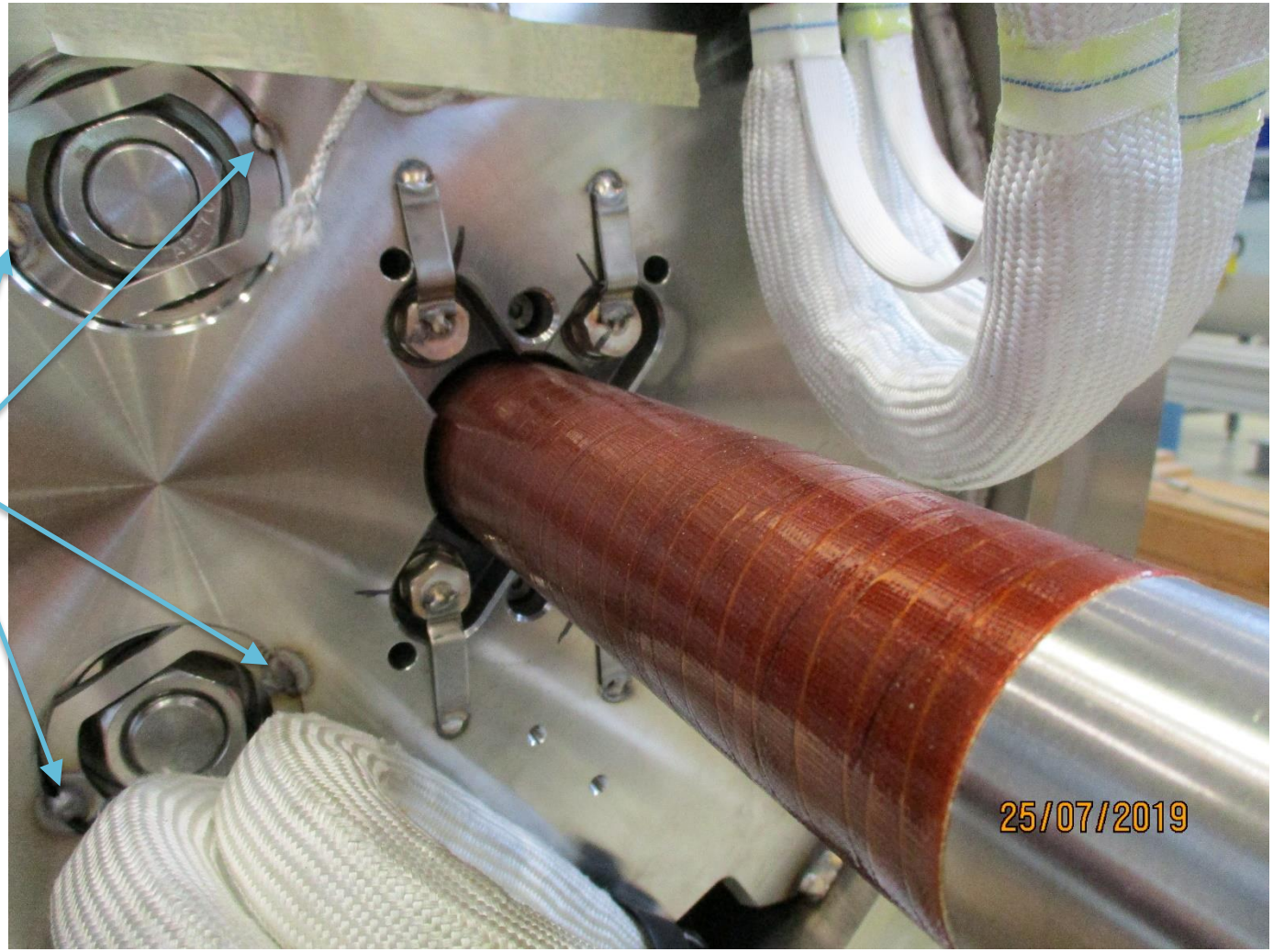
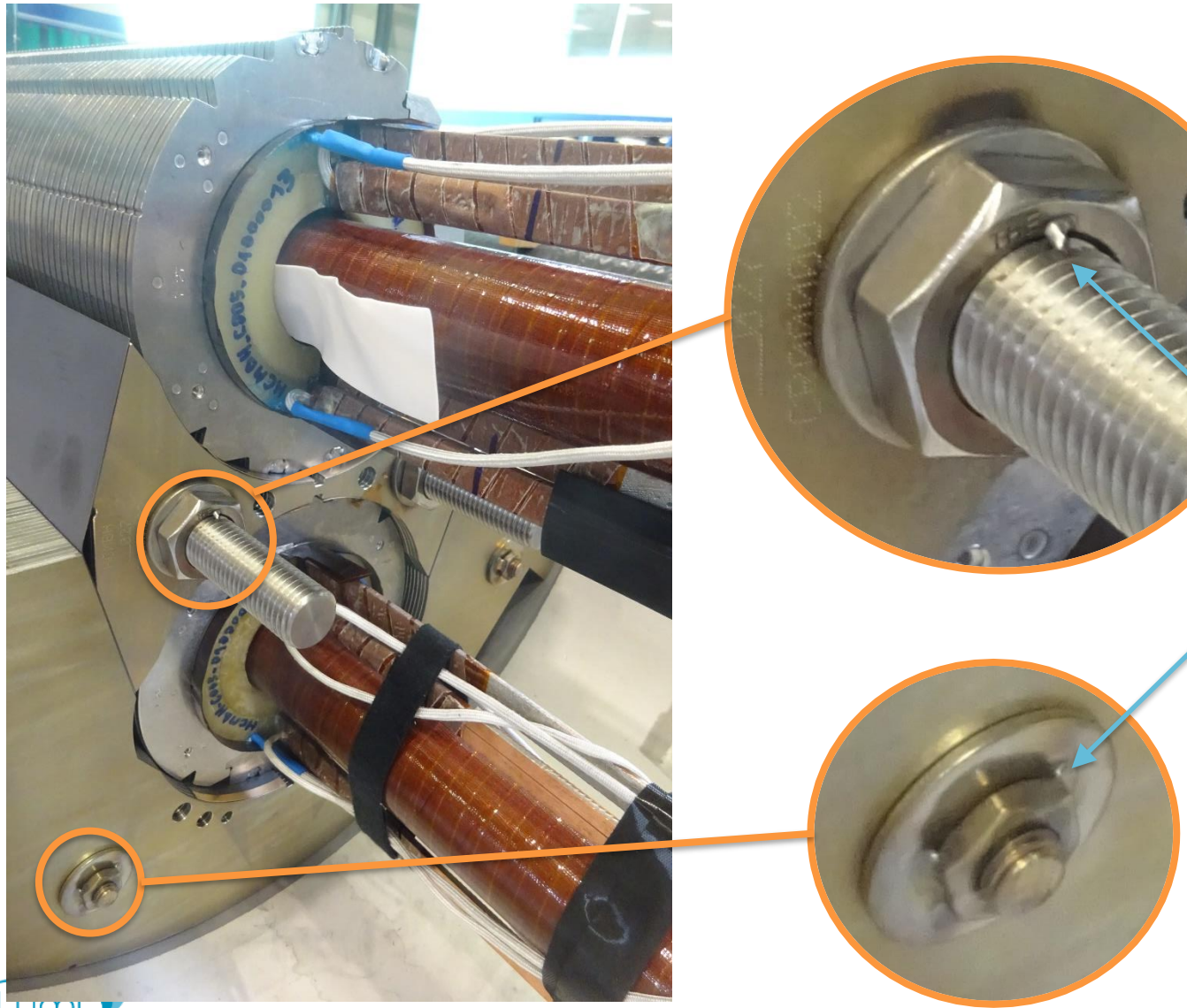


Case 1.

Tack welds



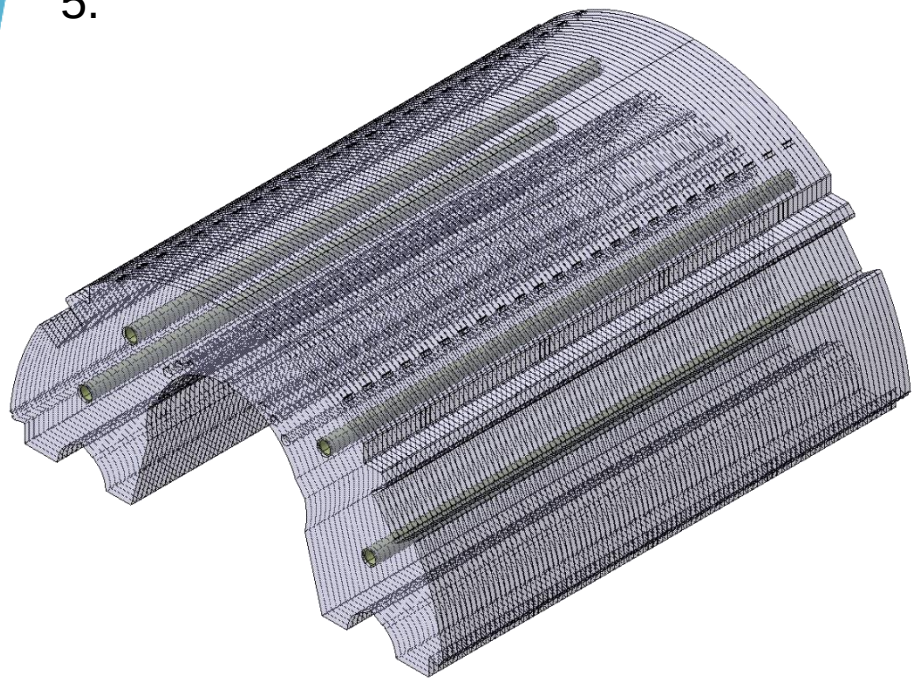
Cases 2, 3, 4



Tack welds

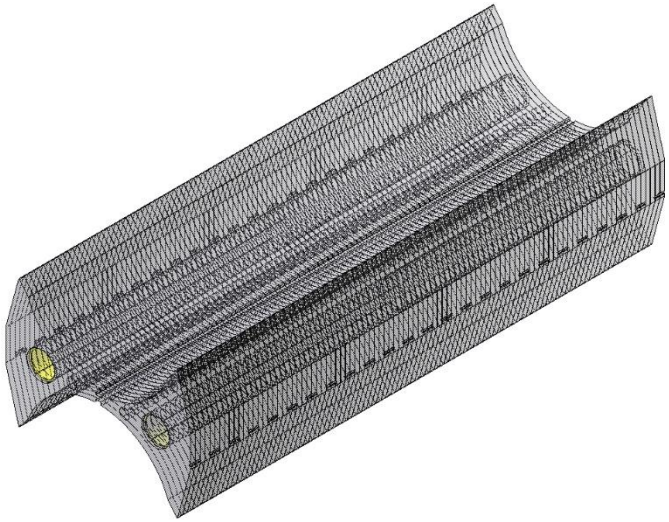
Current loops ? 2/2

5.



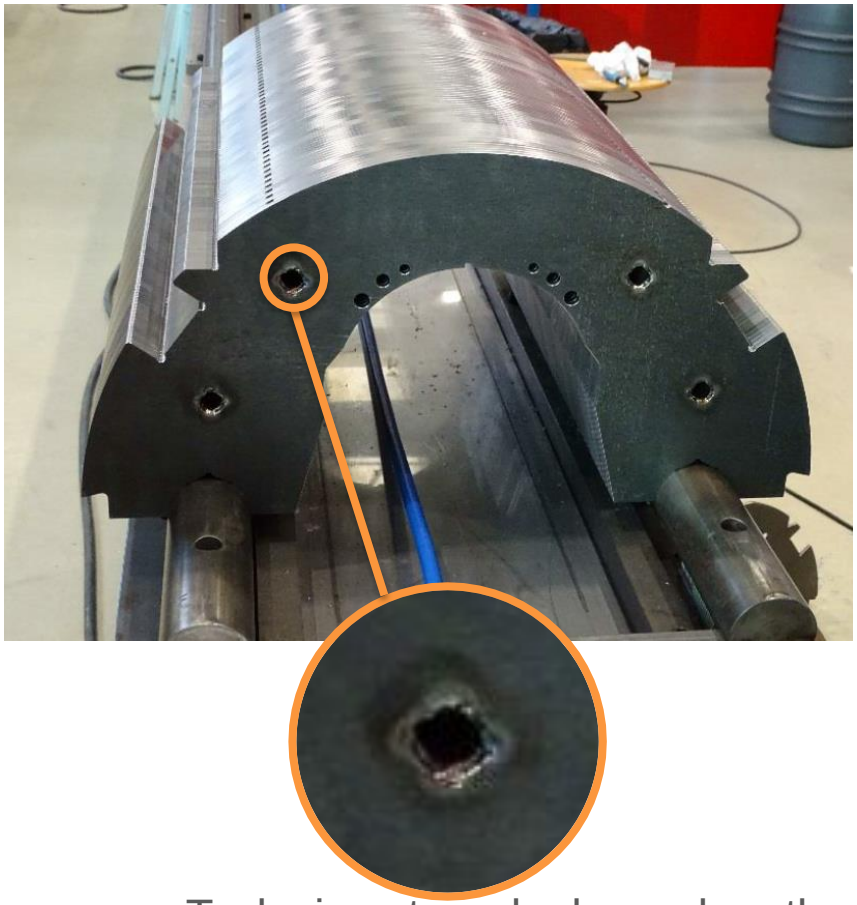
Yoke pack
18 per cold mass
L = 395 or 580mm

6.



Central lamination pack
9 per cold mass
L = 395 or 580mm

Cases 5, 6



Tack size strongly depend on the welder.
316L tubes, material certificate requested
Filler material is not strictly controlled (308L or 309L).
No Welding Procedure Specification defined since the weld is not structural.

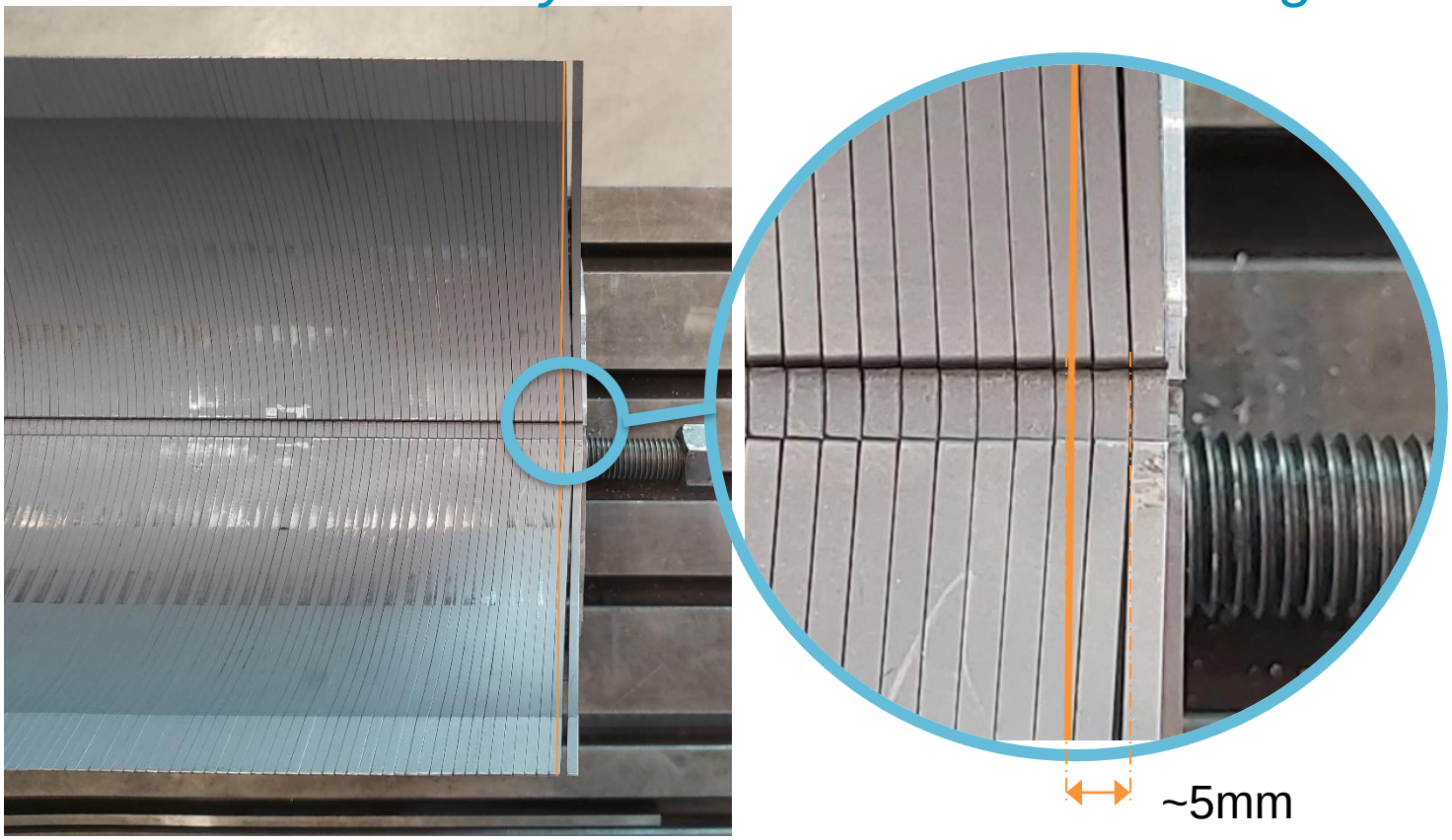
Current loop over the yoke packs cannot be excluded

Differences between S#1, S#2 and S#3 Active Part assembly

	S#1 LMBHB002 MIP : 2165830	*S#2* LMBHA001 MIP : 2173283	*S#3* LMBHA002 MIP : 2217792
LHC-LMBH-FP-0005	V0.4	V0.5	V1
Yokes batch	1st half yoke 3 & 1(SST) 2nd half yoke 4 & 3(SST) Central half 3	1st half yoke 4 & 1(SST) 2nd half yoke 4 & 3(SST) Central half 3	1st half yoke 1 & 1(SST) 2nd half yoke 4 & 3(SST) Central half 1&2, 1&5(SST) (reused from LMBHP001)
Extremity yokes filing factor for central laminations	98%	98%	100%
Shims Coil/yoke length	2mm shorter than yoke	2mm shorter than yoke	4mm shorter than yoke
Bullets molykoting	No	Yes	Yes
Tie rods tack welds	nut/washer + washer yoke	Rod/nut + nut/washer	Rod/nut + nut/washer
Lyre side end plates positioning	Respect to the yoke	Respect to the yoke	Respect to the end plate on the connection side

From 98 to 100% filling factor in the extremities

LMBHP001 Hybrid cold mass dismantling

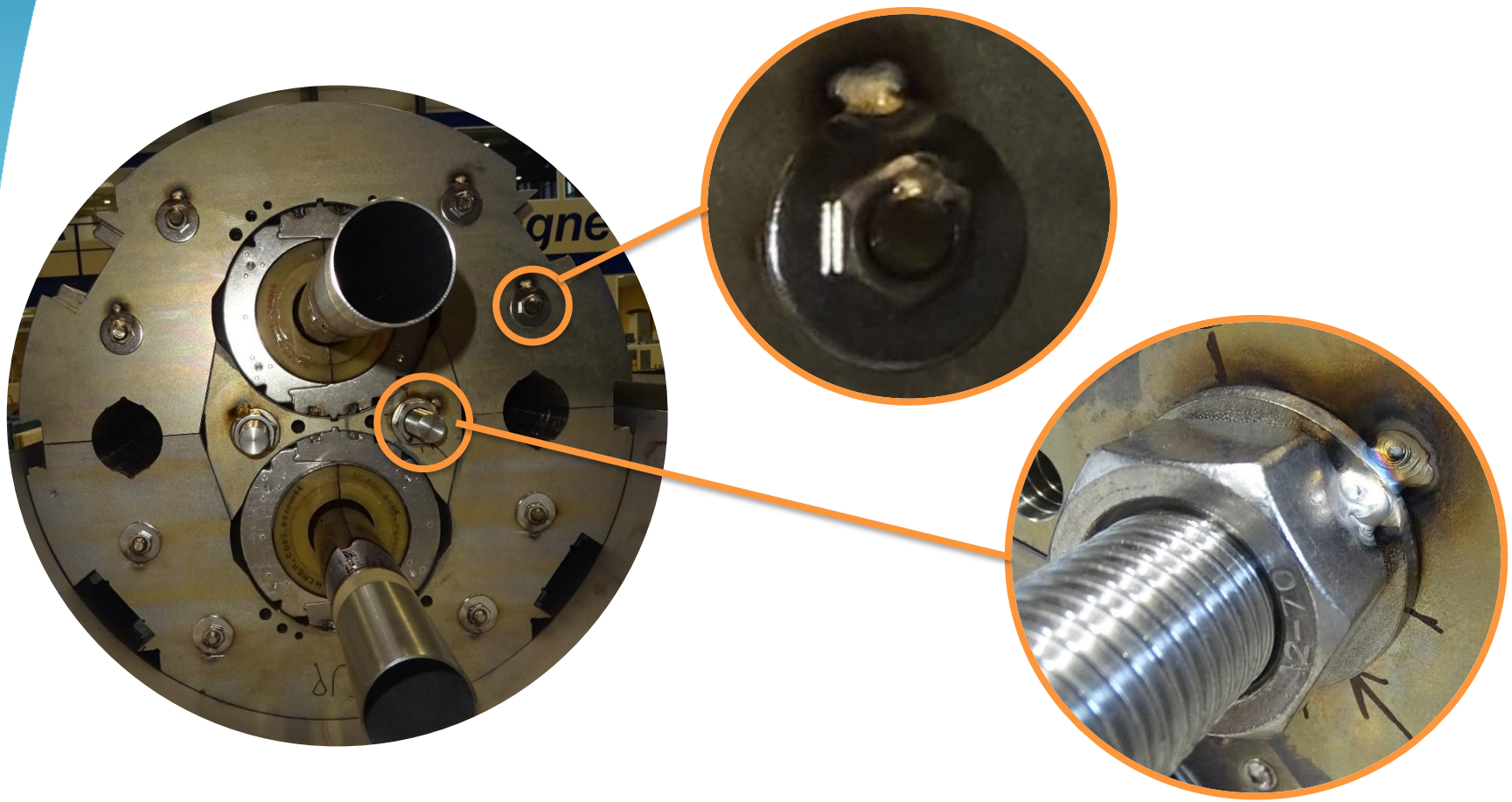


Buckling most probably due to the collared coils length difference in the hybrid. Another explanation could be the differential thermal contraction between collared coil and yoke assemblies during cool down and warm up.

Such a behaviour is not expected in the series cold masses.

⇨ to be checked during the S#3 dismantling even if assembled at 100%.

Tie rods tack welds



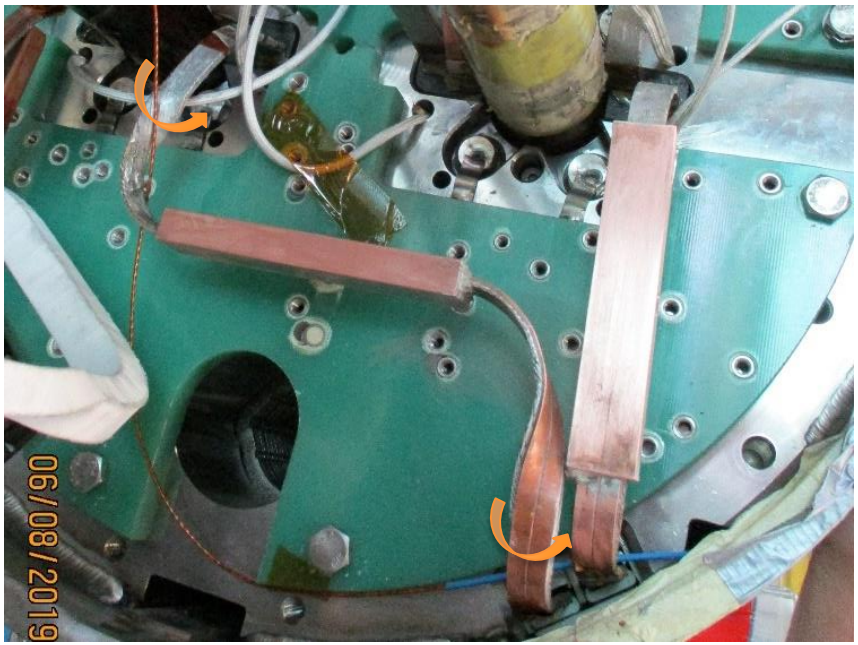
Spot welds to the yokes were abandoned after S#1 LMBHB002 to the magnet end plates assembly. To avoid the nut rotation, these welds are done between the rod threads and the nut.

Differences between S#1, S#2 and S#3 Electrical internal connections and preparation before welding the end covers

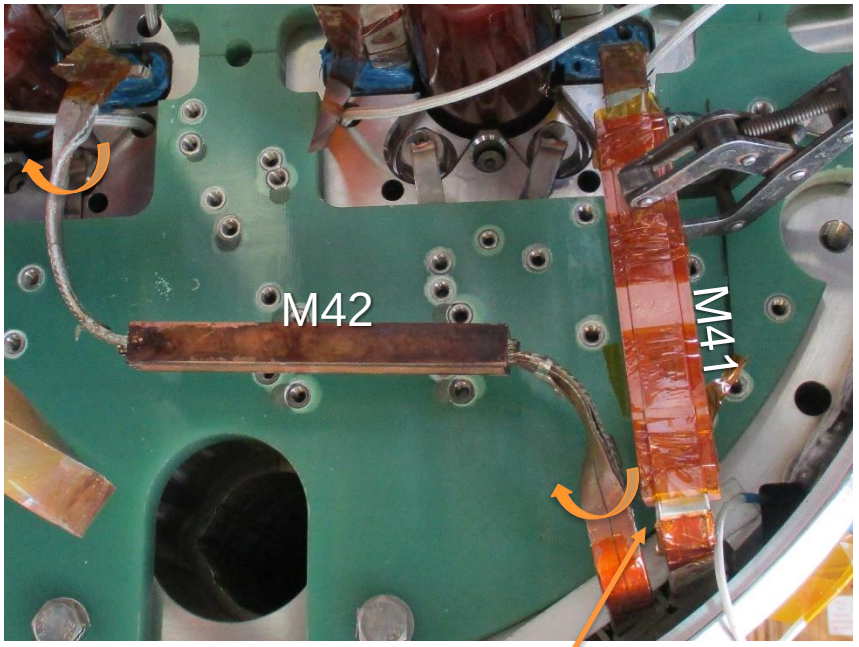
	S#1 LMBHB002 MIP : 2165830	*S#2* LMBHA001 MIP : 2173283	*S#3* LMBHA002 MIP : 2217792
LHC-LMBH-FP-0019 Electrical connections	V0.1	V1.1	V1.2
		Additional controls on the V-Taps	trim leads V-taps fixation and I–Tap fixation reviewed
			M4 prep length reviewed M42 splice orientation
LHC-LMBH-FP-0022 Preparation before welding the end covers	V0.2	V1	V1.1
	Specific procedure for type B	Specific procedure for type A	Endoscopic control between bullets and NB_3Sn V-Taps
			M4 Peek sleeve relieves both sides
			Glass fibber fixation position M3-M4
			M4 control during forming

M42 splice orientation

S#2 LMBHA001



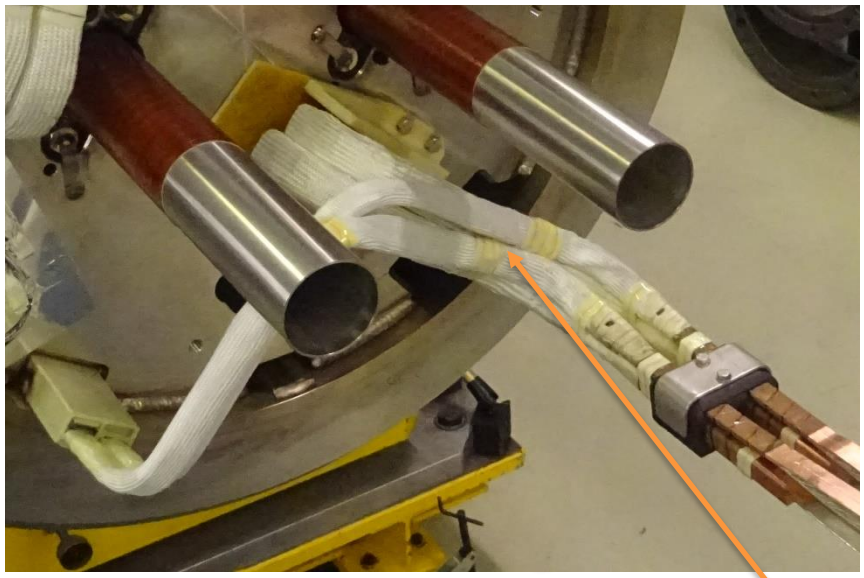
S#3 LMBHA002



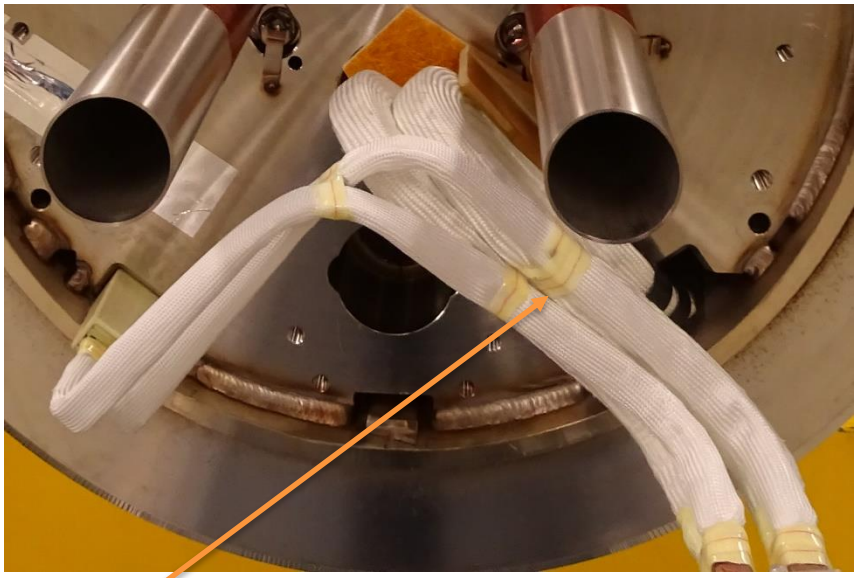
The cable torsion direction is inverted to increase the gap between the two M4 busbars to relocate the so called M42 splice in a better position

M4 Busbars Lyra

S#2 LMBHA001



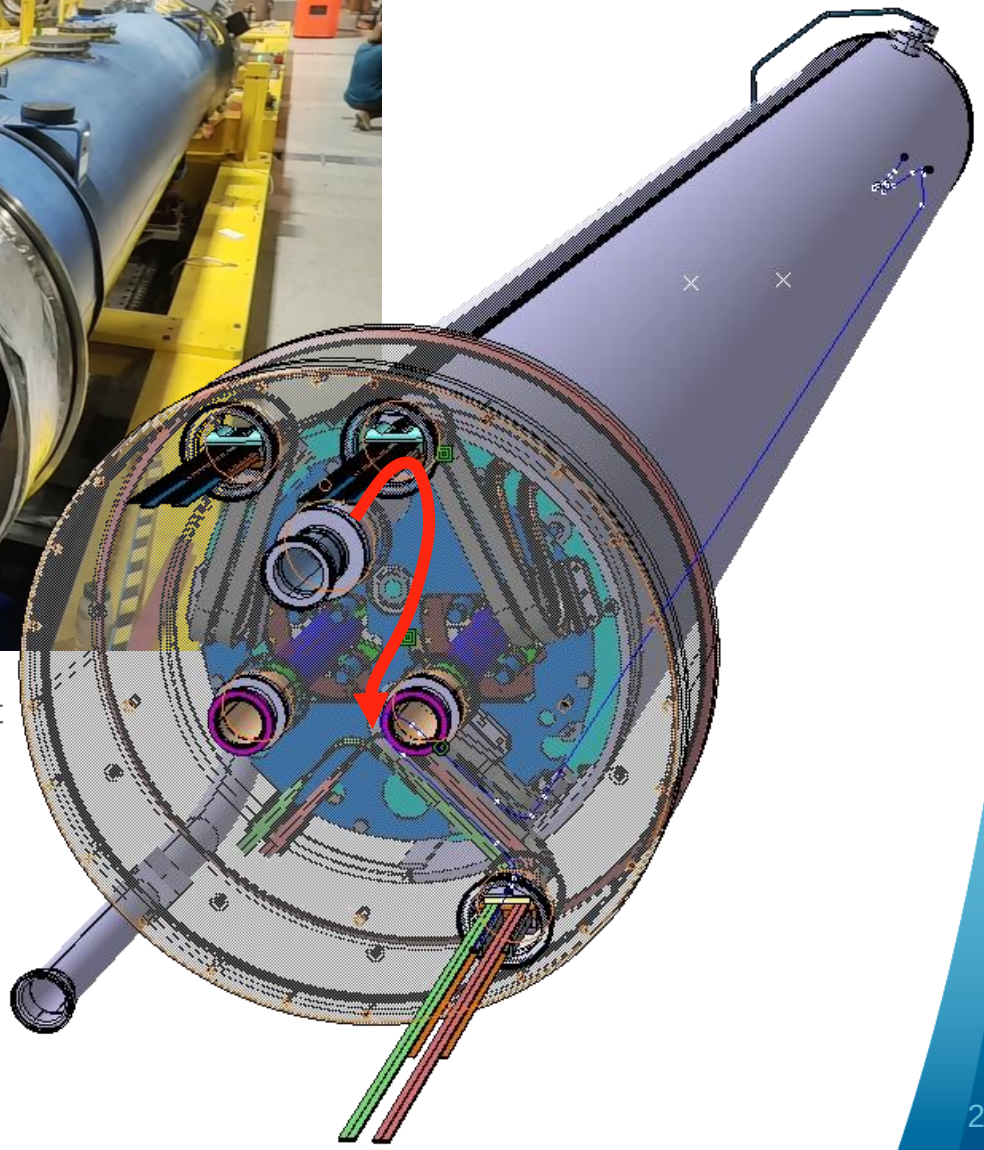
S#3 LMBHA002



M4 fixing rings to M3 busbars have been displaced upper along the path to procure a better fixation.

About doubled bending moment to displace M4 top position compared to M3.

M4 lyra fixing to M3 tentative



M4 fixing to M3 busbars could be envisaged before next cool down within three days:

- opening the junction to the CFB
- Cutting the M1 cap
- Consolidating the fibber glass rings upper
- Electrical test
- M1 cap welding
- CFB junction closing

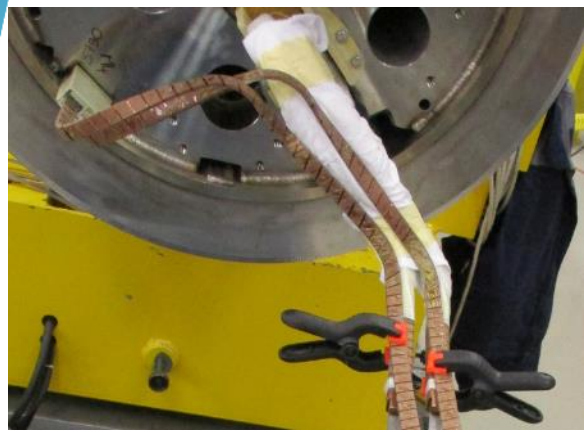
Summary

- **Busbar motion?**
  - ⇨ very unlikely except a possible rotation of the M4 lyra
- **Current loops through tie rods?**
  - ⇨ very tiny tack welds between rods, nuts and washers
  - ⇨ no weld to the yoke nor to the end plates
- **Current loops inside yoke packs?**
  - ⇨ Cannot be excluded over 580mm
- **Differences between S#1, S#2 and S#3?**
  - ⇨ No major difference that could explain the current spikes

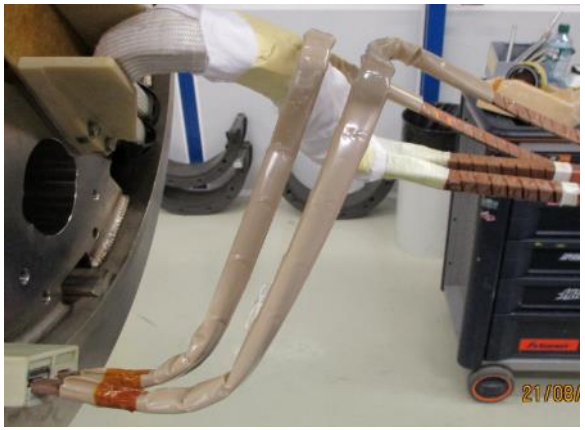
⇨ *If the M4 lyra is a concern it could be fixed within 3 days before the next cool down*

Spare slides

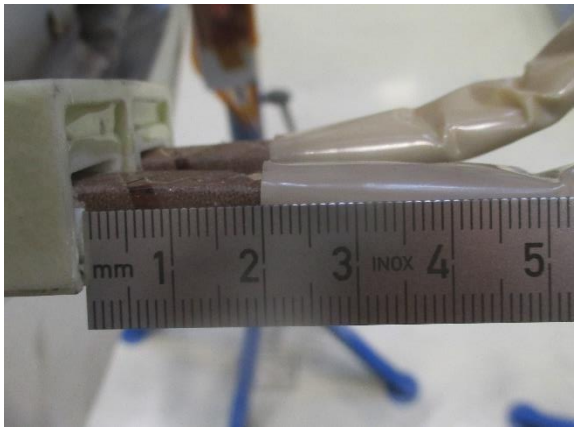
M4 busbars



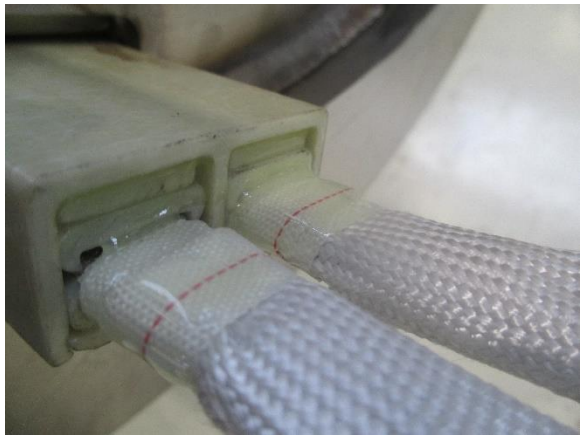
Polyimide and Prepreg insulation wrapping



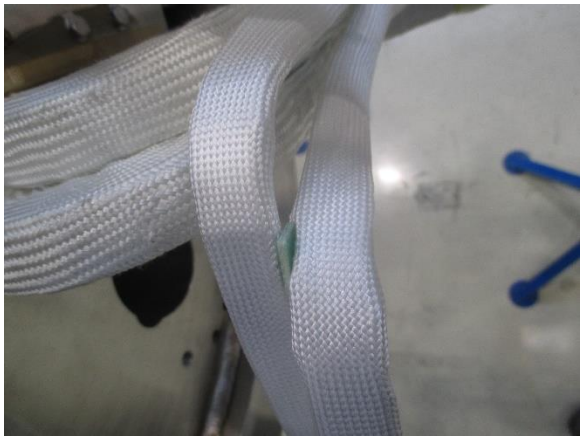
PEEK insulation sleeves



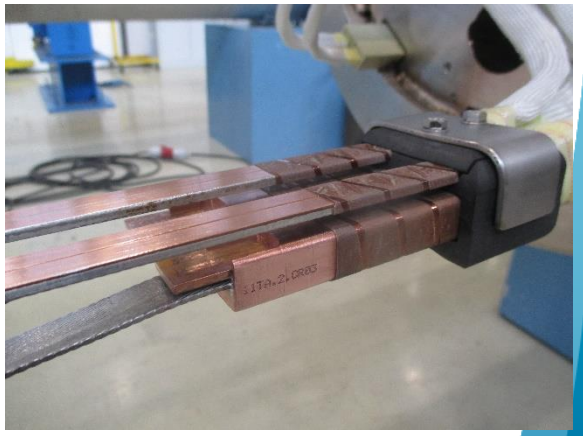
PEEK insulation sleeves distance to gutter



M4 gutter



G11 spacer before glass wrapping



M3/M4 spacer