Design of Distribution Feedbox at LHC P7

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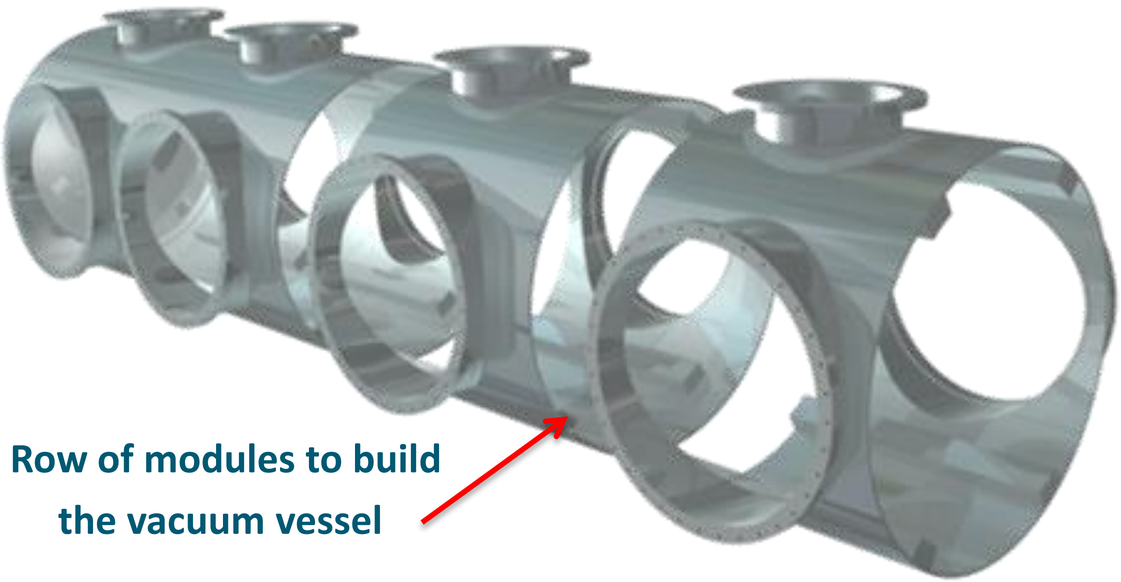
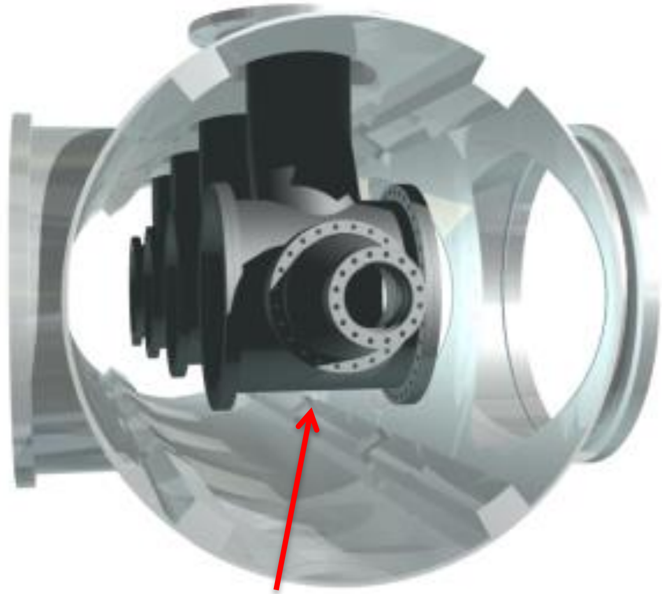


Row of modules to build the vacuum vessel



Helium vessels suspended from top or supported from the base

Advantages

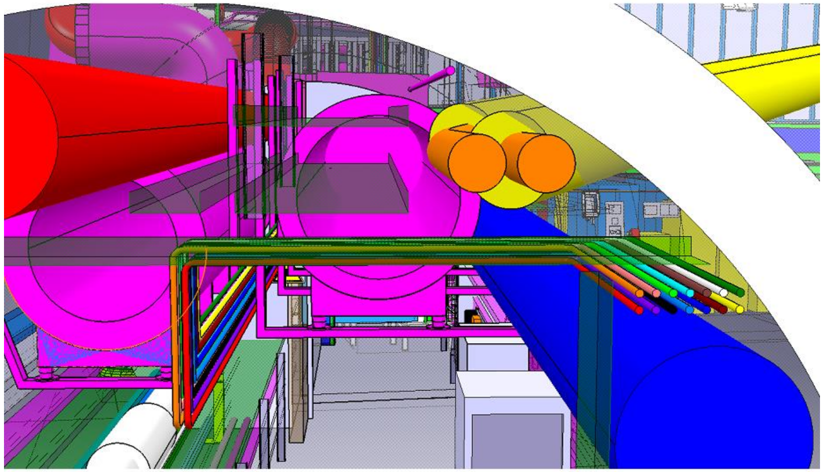
- Cylindrical structure can tolerate a thinner wall section.
- Round flanges and windows panels easy to machine.
- Only three bores and potentially six weld operations to construct each module.

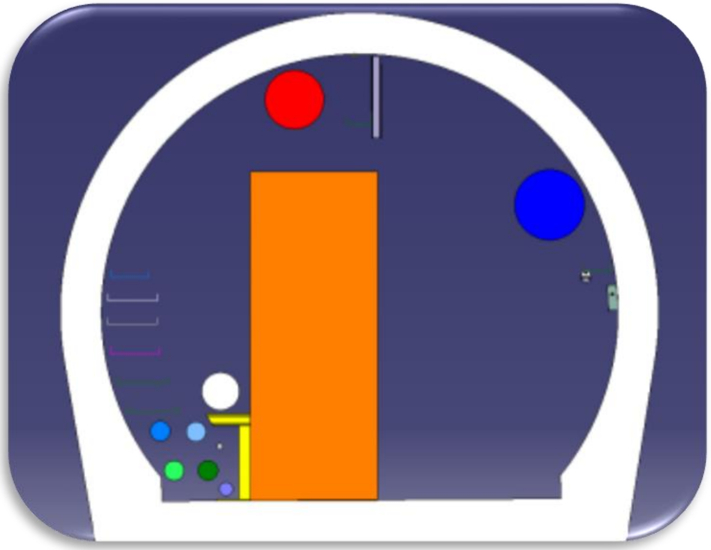
DFB cryostat design at LHC P7 – Concept 1

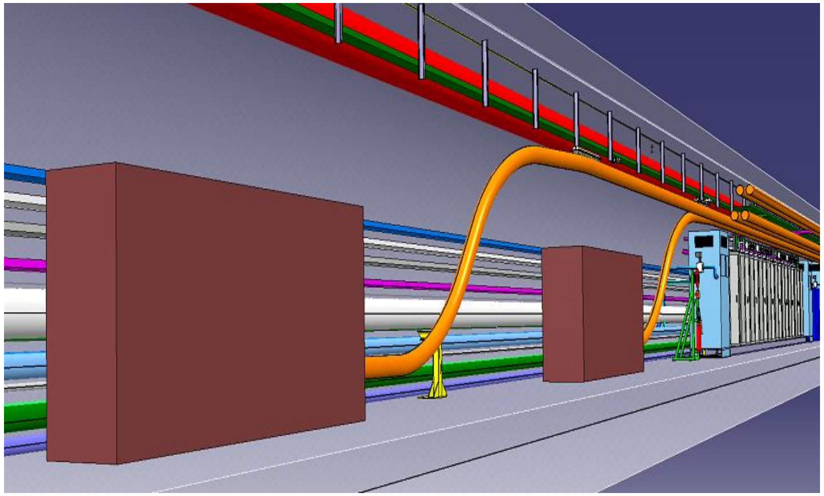
Assembly

- Thermal shield inserted (in sections).
- Helium vessel inserted and lifted + supported.
- Bellows used to connect to next helium vessel.
- Insert the cable.
- Insertion of the current leads with HTS link from top.
- Make HTS link-to-cable connection through side windows.

DFB cryostat design at LHC P7 – Tunnel constraints





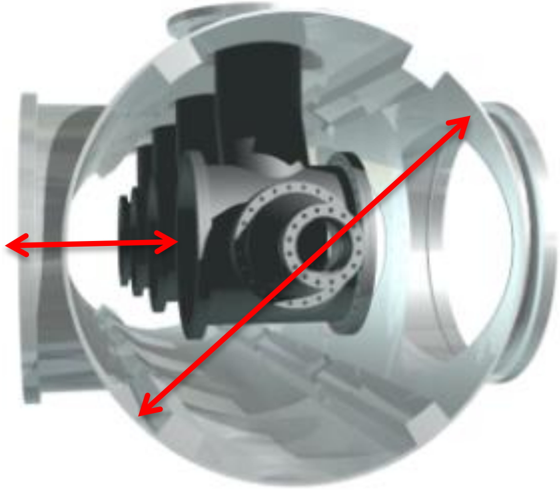


DFB working envelope likely to be

0.6 m wide x 1.6 m tall x 2.5 m long

Access available from one side

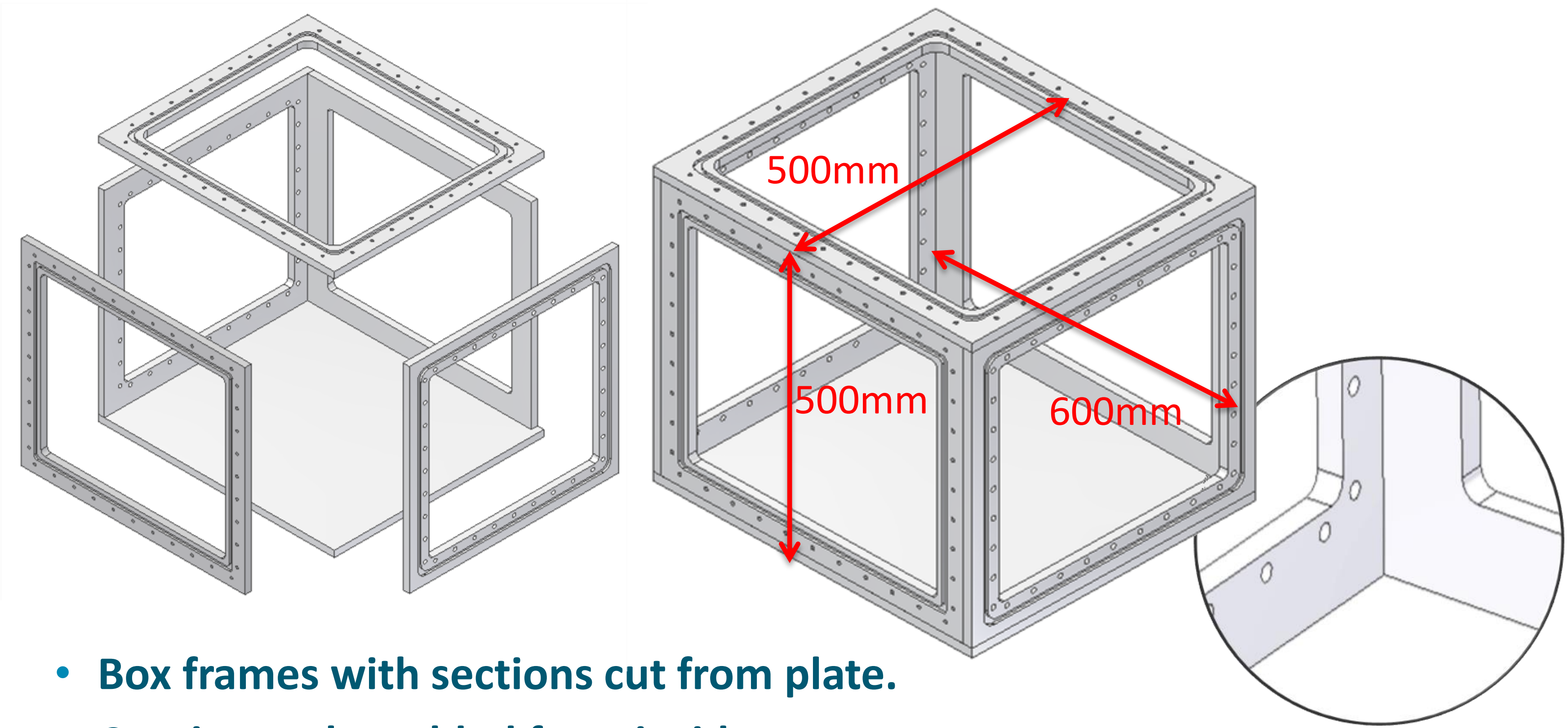
DFB cryostat design at LHC P7 – Evaluation of concept 1



Problems and challenges

- Ideal diameter of vacuum vessel = 0.9m too large.
- Round shape of vacuum vessel made access into the helium vessel too far.
- Gantry maybe required to support current lead during installation.
- Double height required to fit tube over the current lead to close the vacuum.

DFB cryostat design at LHC P7 – Concept 2 " Modular Cryobox"

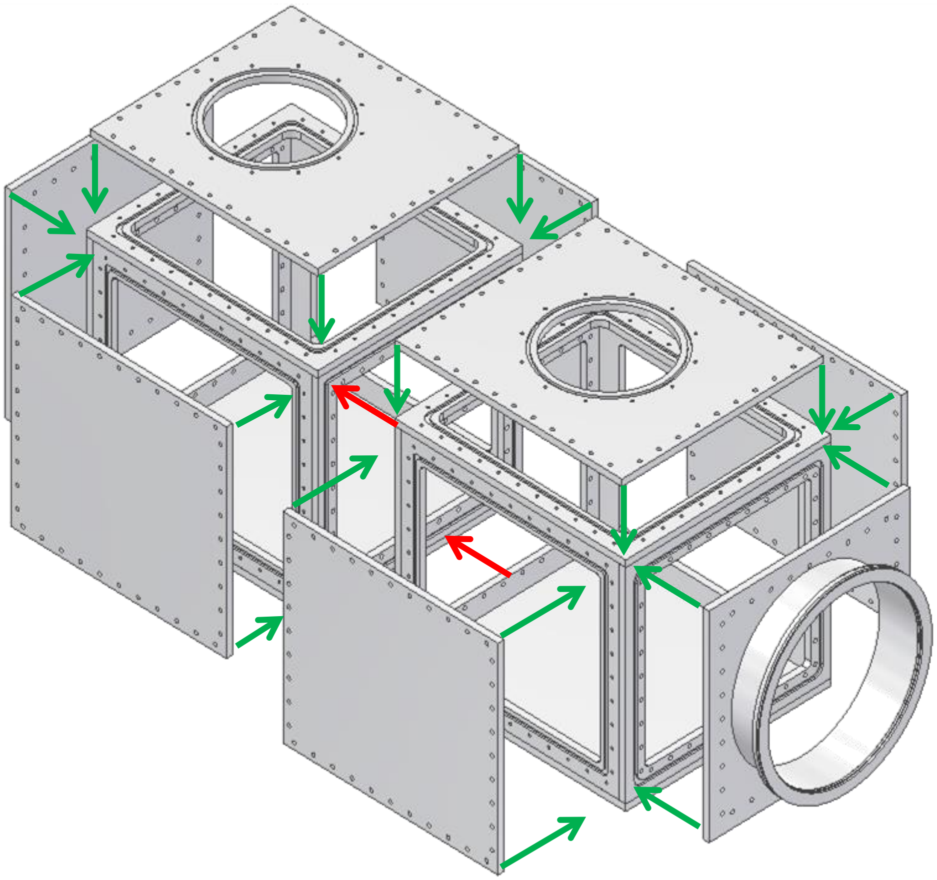


- **Box frames with sections cut from plate.**
- **Continuously welded from inside.**
- **CNC machined to tolerance after welding and to insert o-ring grooves and bolt hole features.**
- **Improved access to inner space.**
- **Within the 0.6m width requirement.**

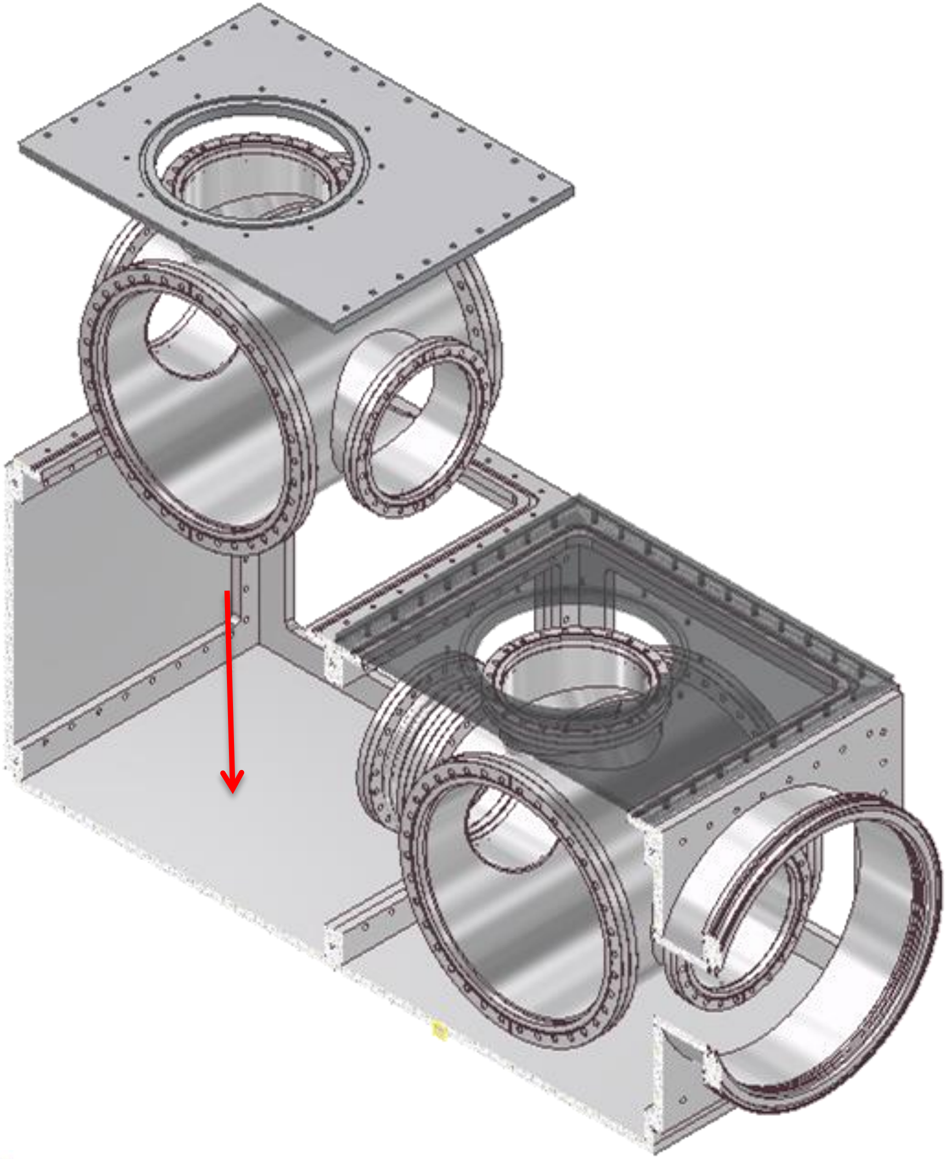
DFB cryostat design at LHC P7 – Concept 2 " Modular Cryobox"

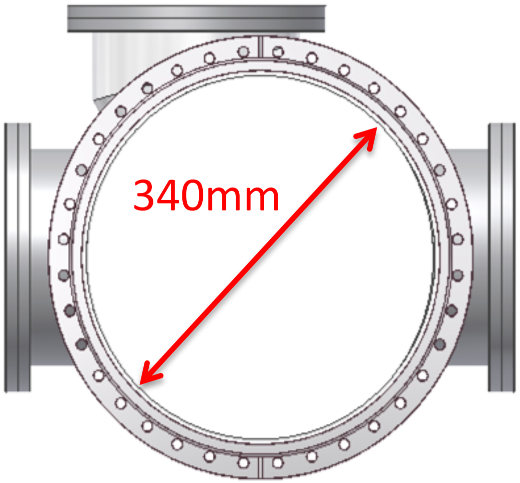
Vacuum vessel design

- Could be made from stainless steel 316L or aluminium 5083-O/6061-T6.
- Must check vessel can withstand a positive pressure of at least 2 bar.
- Panelled doors most at risk!
- Consider 20 mm thick plate.
- Yield strength of St. St = 255 MPa
- Yield strength of Alu = 145 MPa
- σmax = 55 MPa
- ymax = 155 micron if St. St.
- ymax = 450 microns if Alu



DFB cryostat design at LHC P7 – Concept 2 " Modular Cryobox"

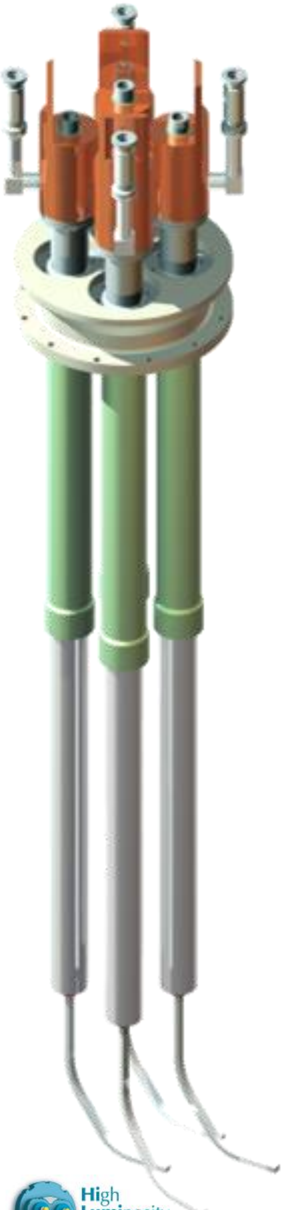




Helium vessel design

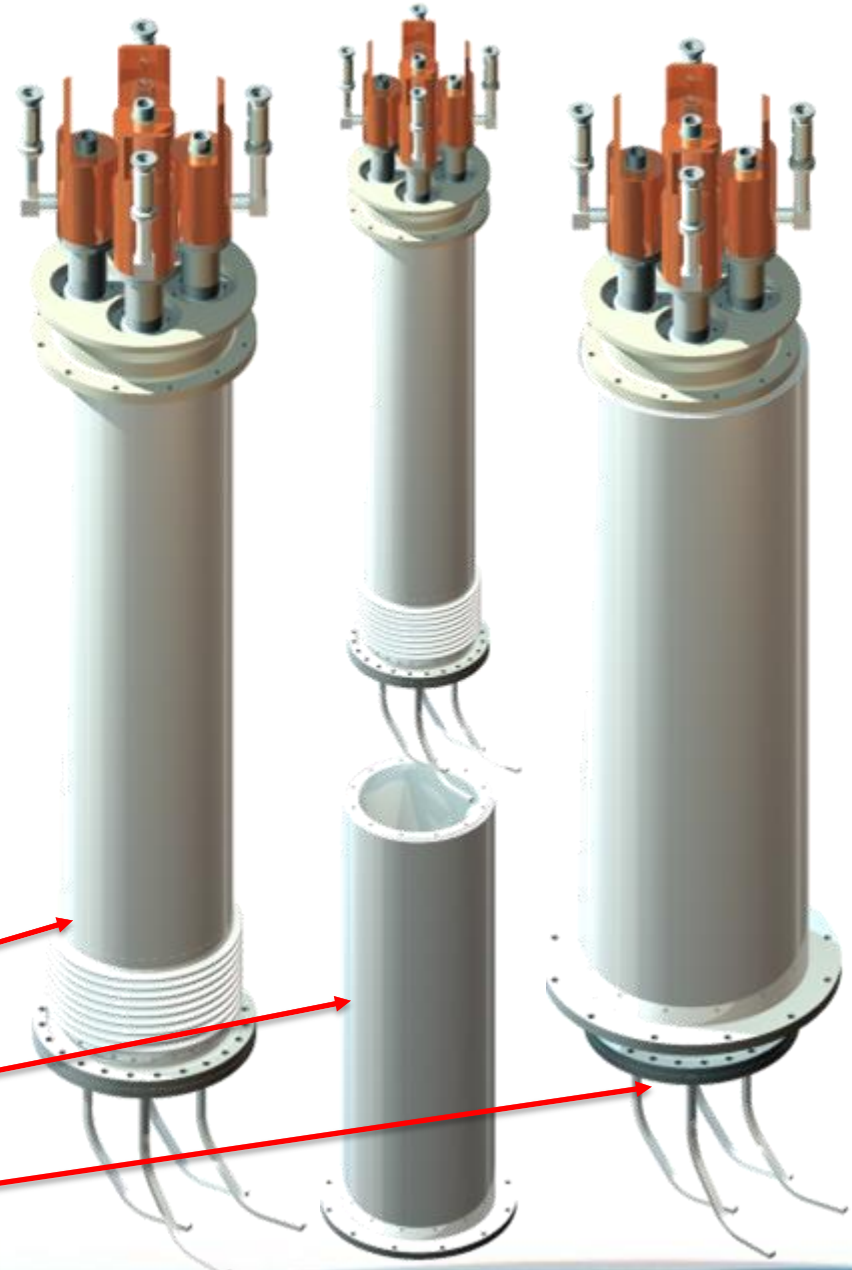
- Made from stainless steel 316.
- Largest front window.
- Offset top flange
- Other windows ~200 mm.
- Radiation shields around the inner modules (not shown)

DFB cryostat design at LHC P7 – 600 A current leads



Current lead sub-assembly

- Gas flow through current lead controlled at exit.
- Tube closing the helium envelope.
- Tube closing the vacuum envelope.
- Current leads can be fully assembled prior to integration.
  reducing the height requirement.



Helium envelope

Vacuum envelope

Fixing flange exposed

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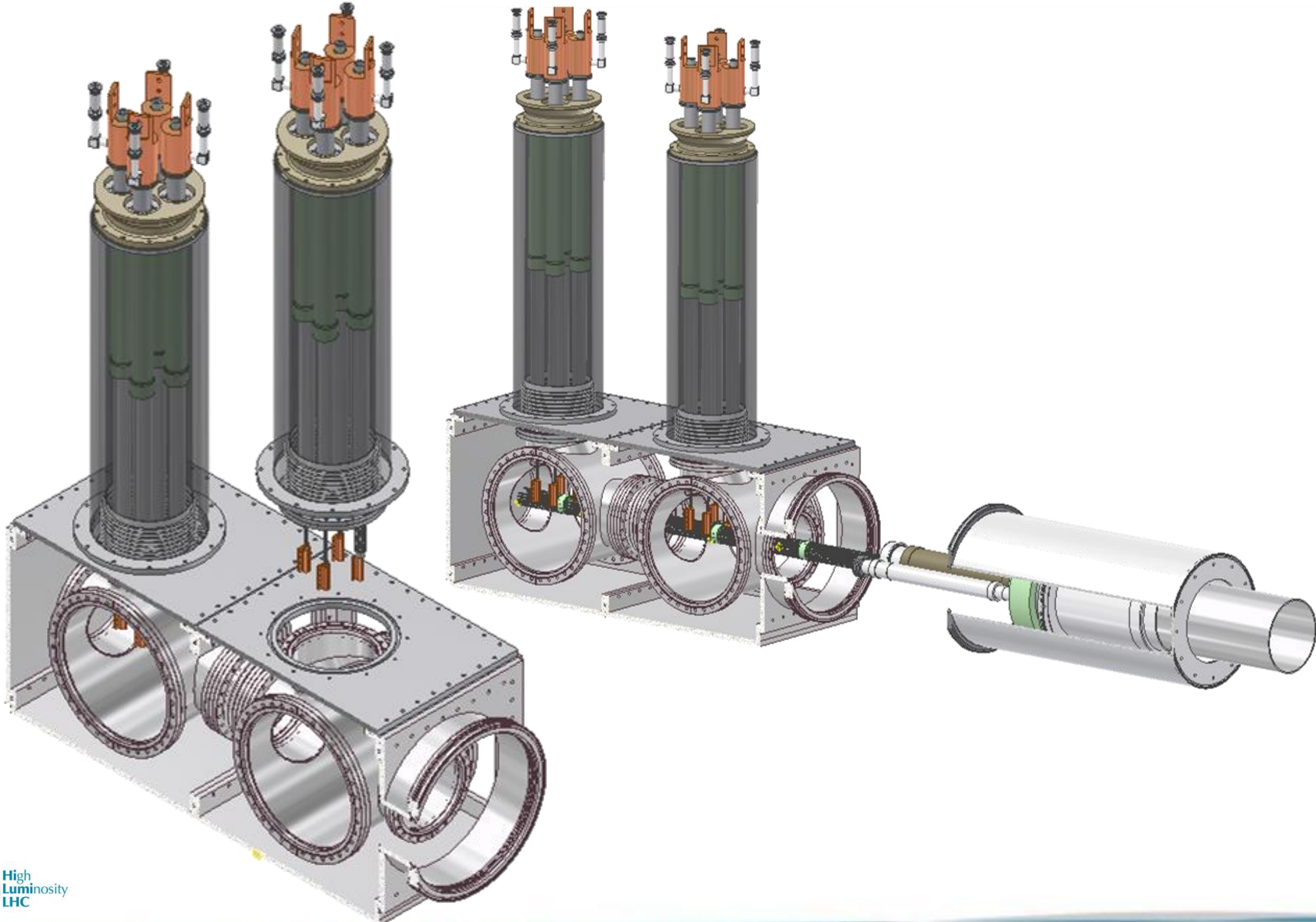

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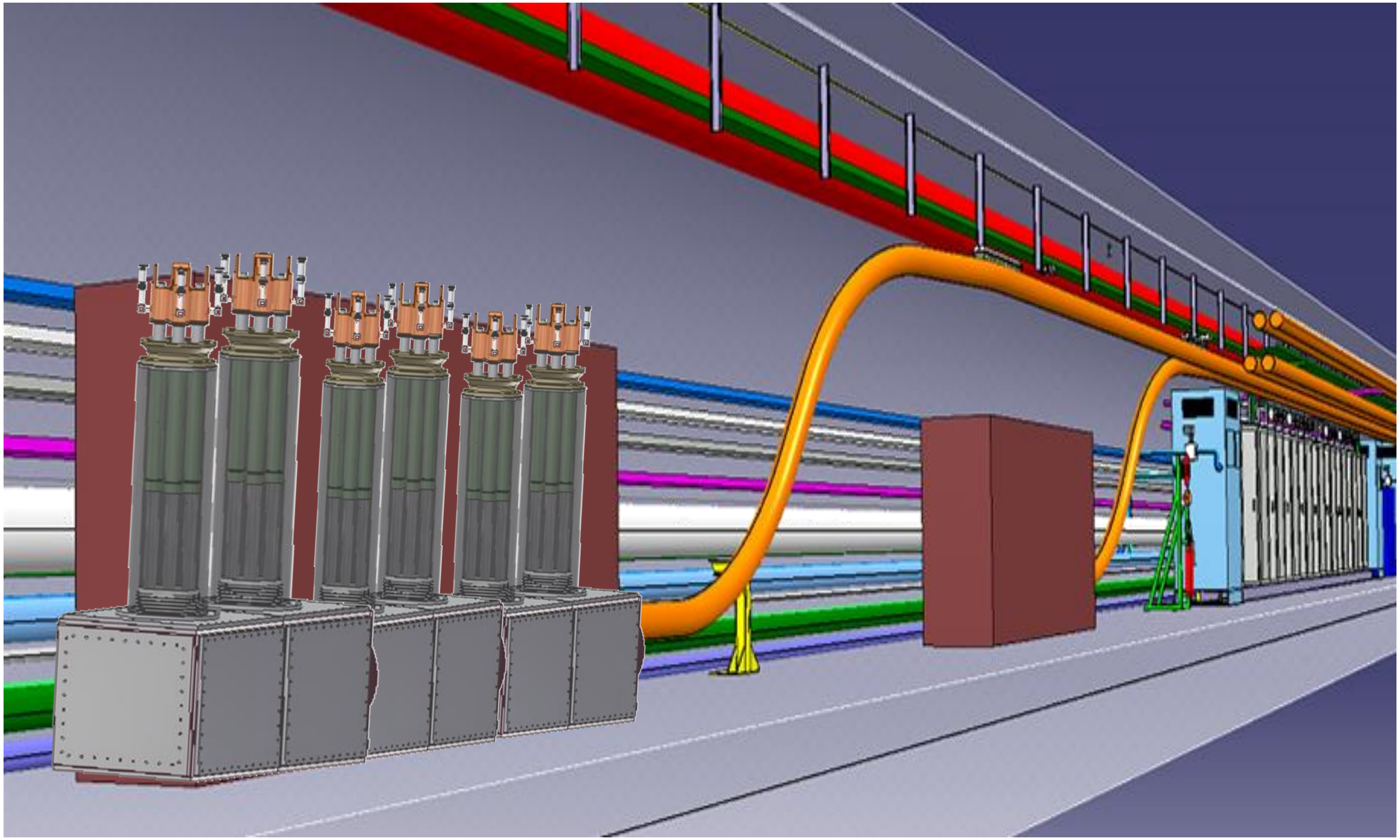
DFB cryostat design at LHC P7 – Concept 2 " Modular Cryobox"



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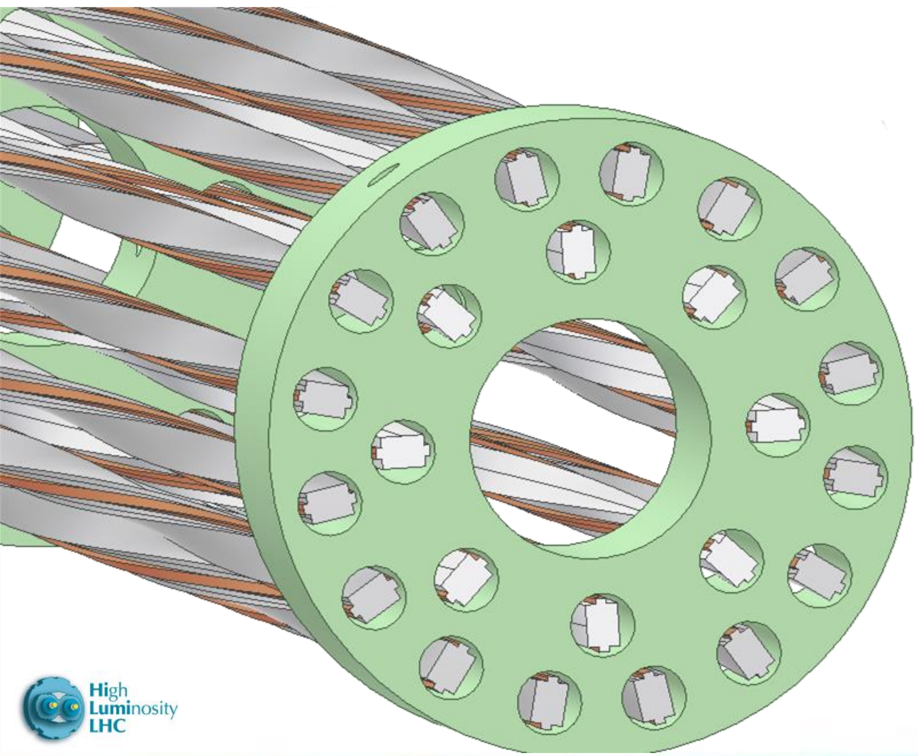
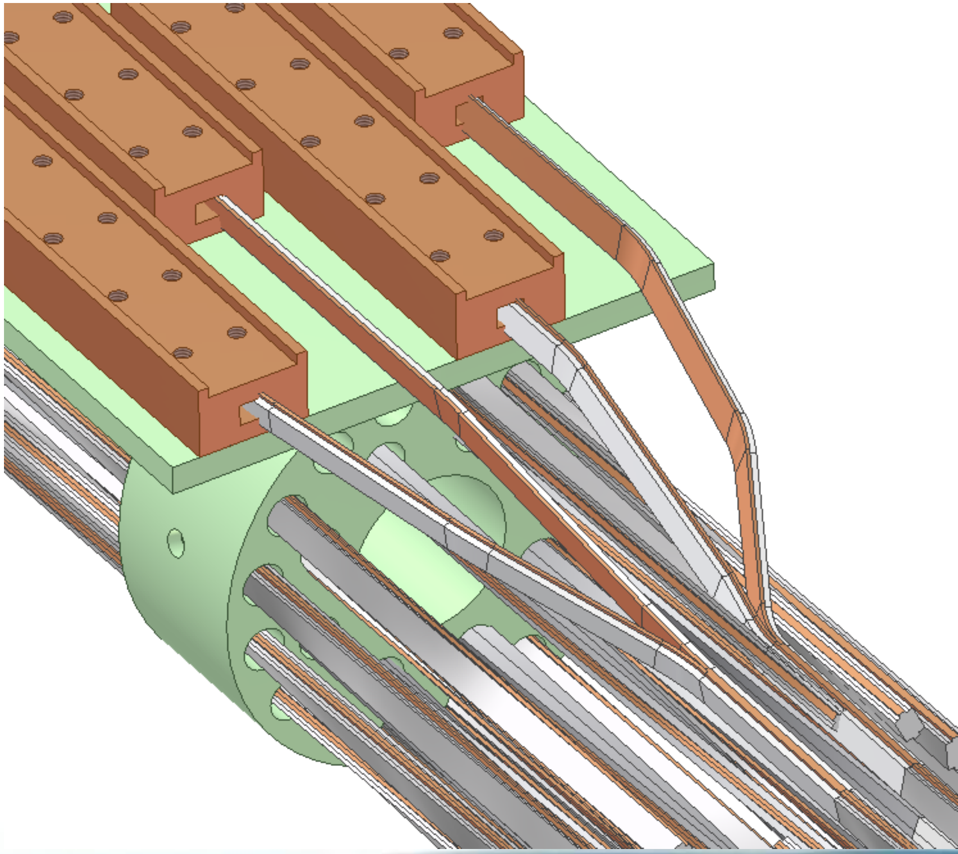
DFB cryostat design at LHC P7 – Splicing the incoming cable

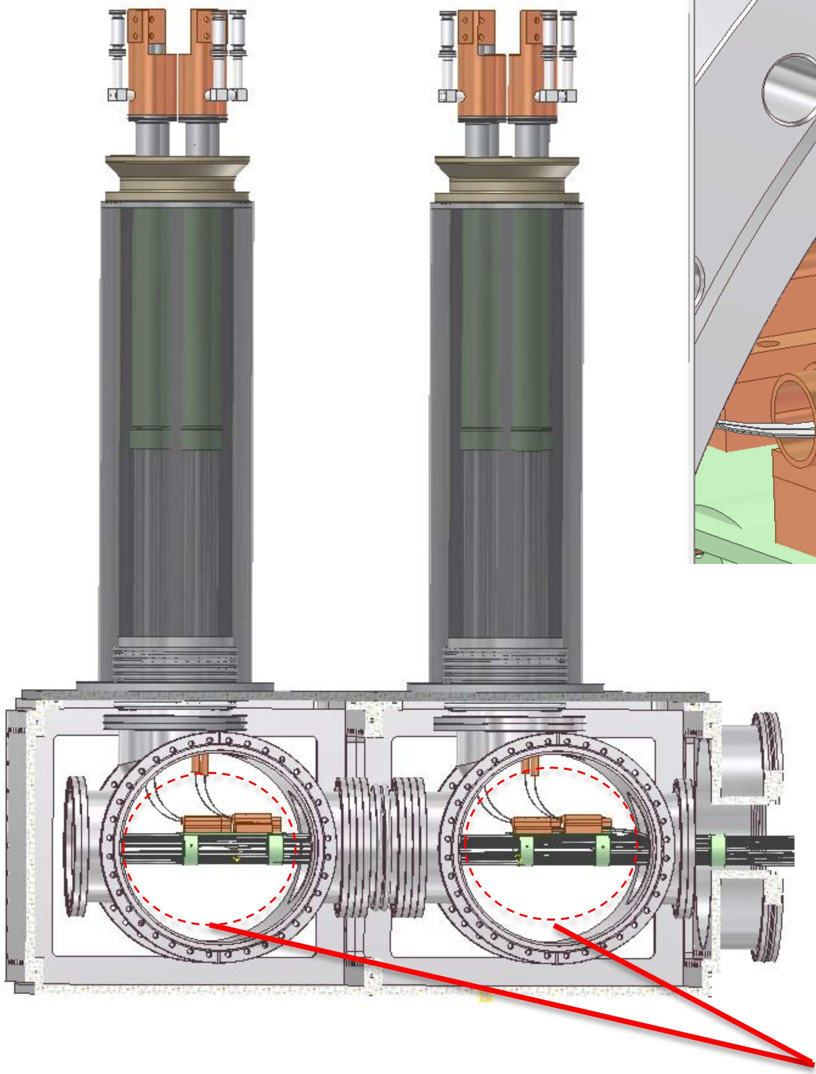
Conceptual ideas for cable splicing

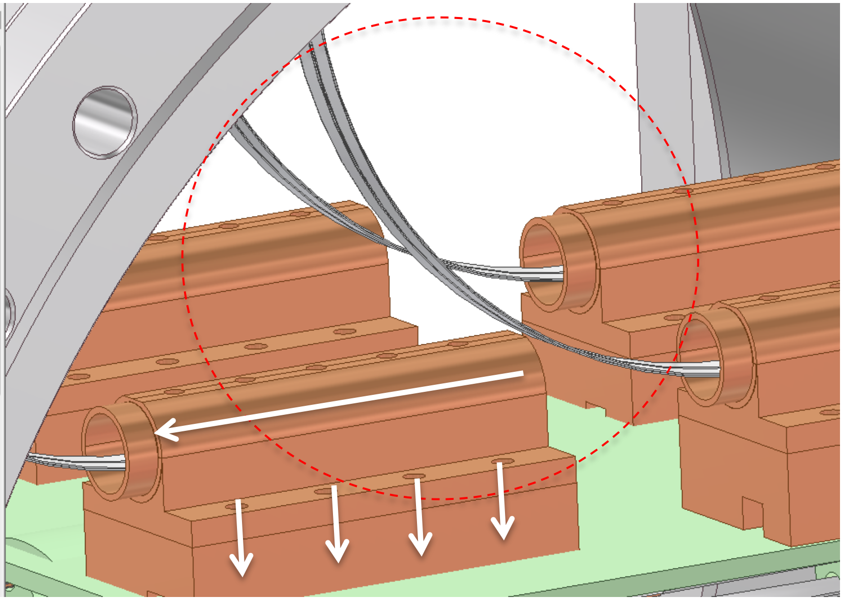
- The architecture of the cable not fully defined.
- Our splicing concept based on a distribution of 24 twisted pairs.
- 2 twisted pairs to be separated and soldered to copper blocks.
- Ideally splicing would be performed before sliding cable into the DFB cryostat.
- Termination to each splice pre-fabricated on cable prior to insertion if possible.





DFB cryostat design at LHC P7 – HTS soldered link to splices





- Flexibility/curvature required in BSSCO links.
- Copper-to-copper joint performed in-situ.
- Promoted gas flow over joint.
- Flexible bellow connected to "copper spout" to carry gas over HTS link.

For a 6 metre length of cable, ~30 mm of contraction in the cable must be accommodated by the flexible HTS link

THANK YOU FOR YOU ATTENTION.