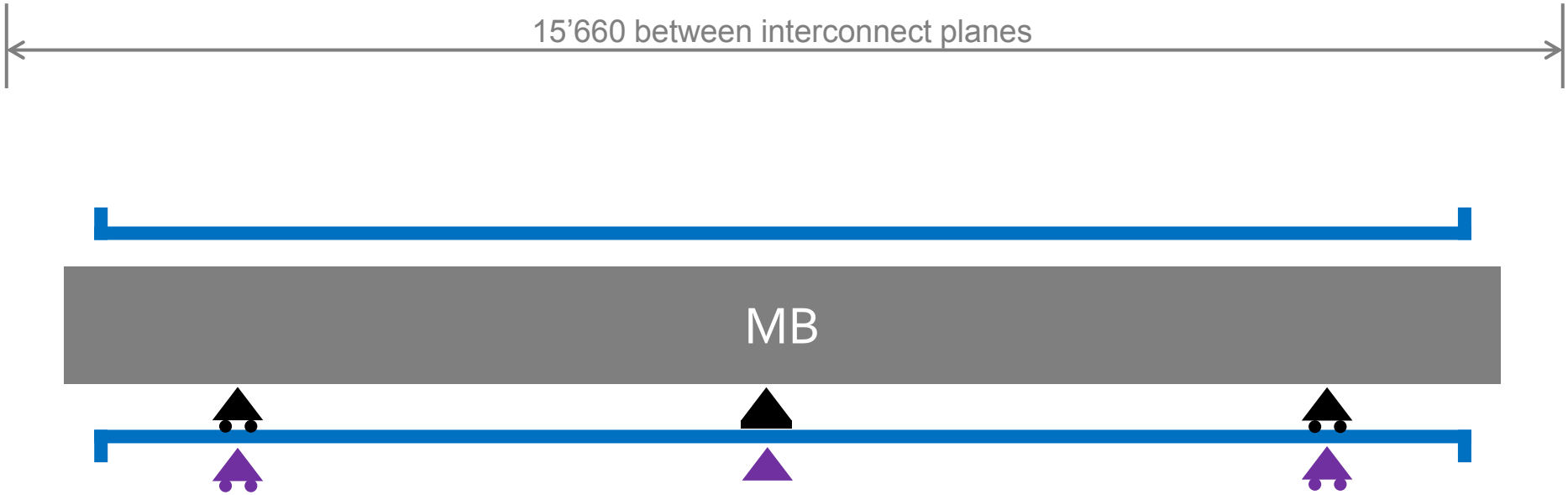
11 T Cryo-assembly for DS Collimator

Integration and vacuum interfaces

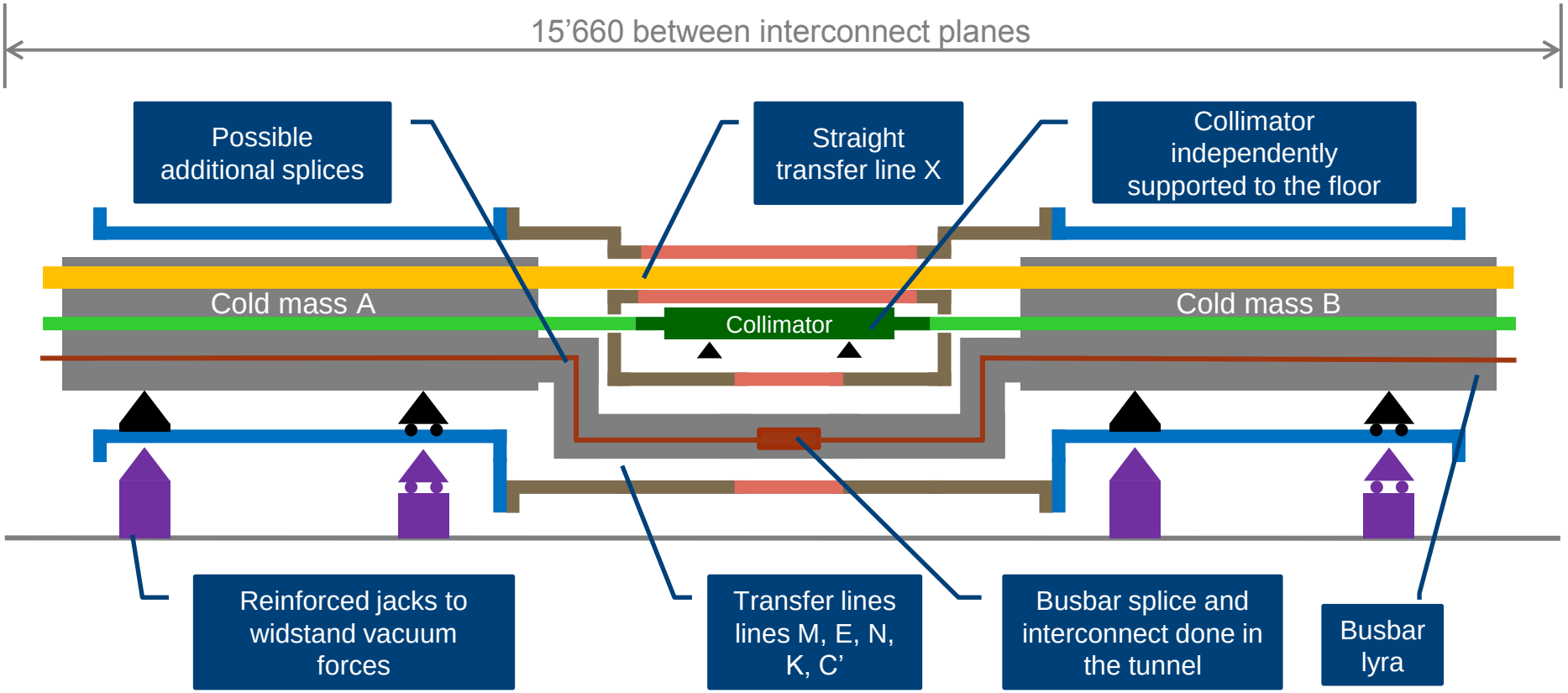
Technical Meeting on Vacuum for HL-LHC, 5.3.2014, Delio.Ramos@cern.ch

Cryostat and collimator integration concept



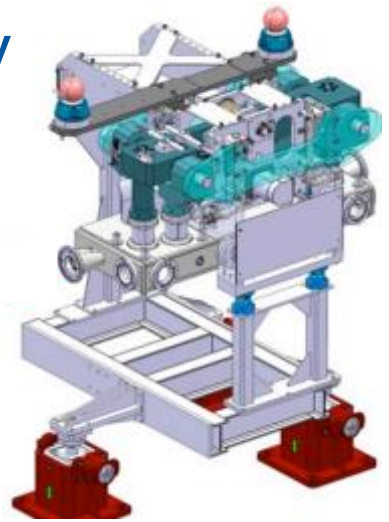
- Replace one LHC dipole with two 11 T magnets plus one collimator

Cryostat and collimator integration concept

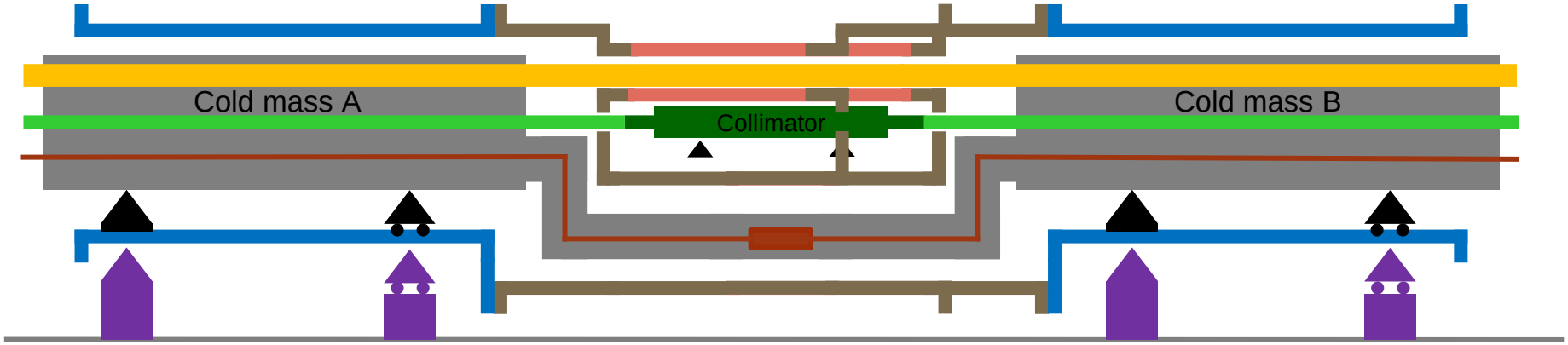


Main features

- Two indenpendently assembled, transported and installed cryo assemblies
  - Expansion joints on transfer lines for alignment flexibility and thermal contraction
  - Interfaces to adjacent magnets remain standard
  - Splice and piping interconnect in the tunnel, prior to collimator installation
- Rom temperature collimator independently supported to the floor
  - Mechanical decoupling of collimator from cryostats
  - Sectorised vacuum baked system
  - One collimator design fits beam 1 and beam 2
  - Profits from existing TCLD design

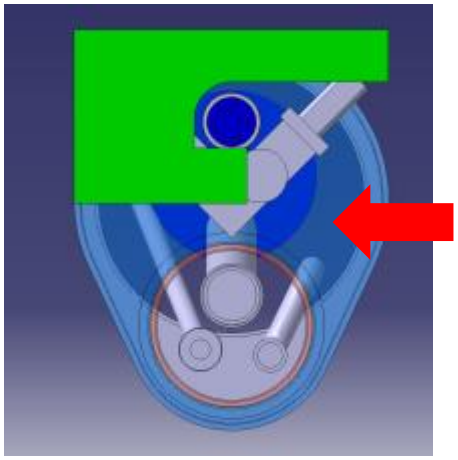


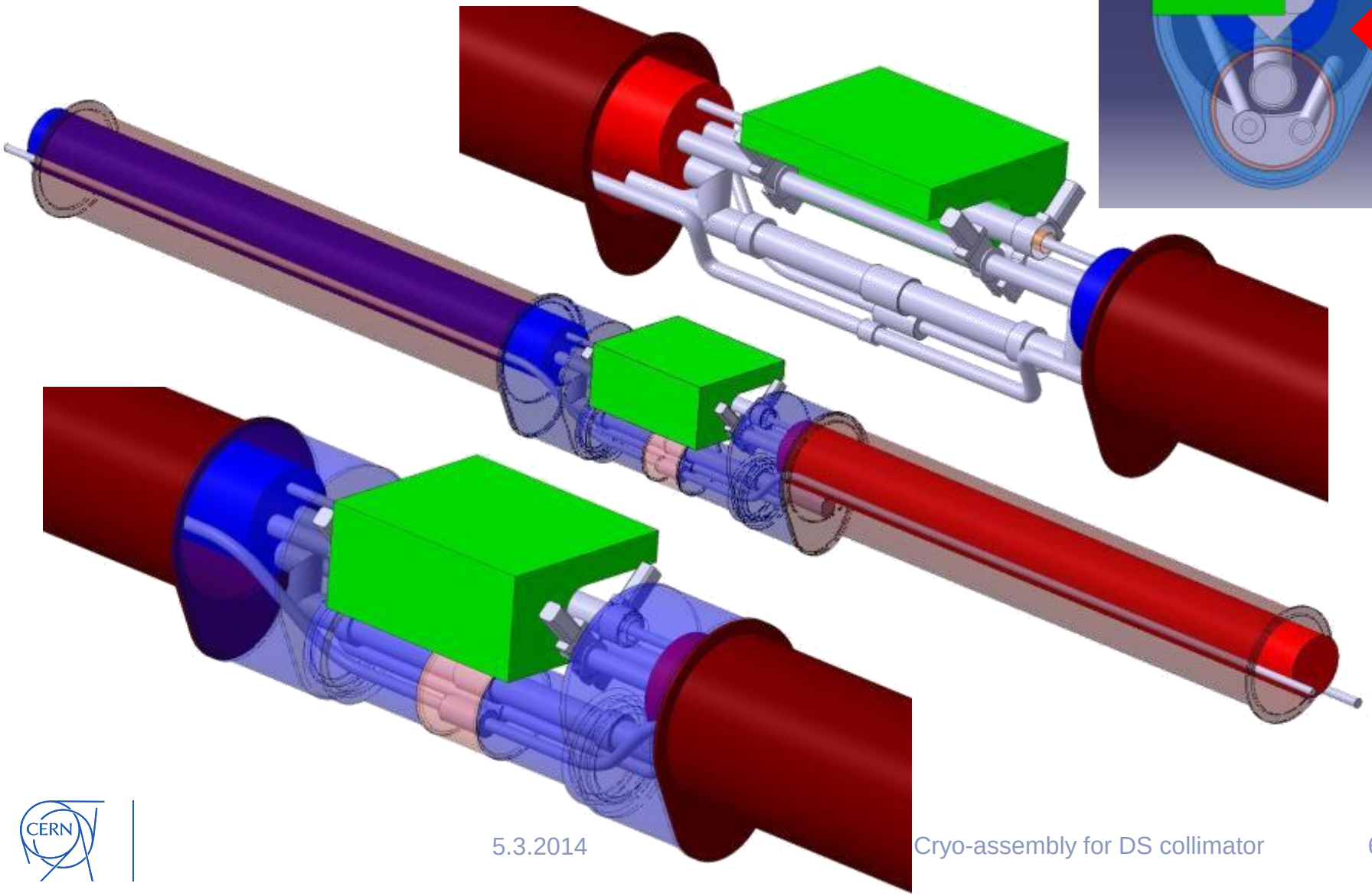
Access for in-situ repair



- Once the collimator removed, the vacuum vessel cover can slide open (welded joints designed for cut and re-welding)
- In-situ access for repair of “fragile” components: Expansion joints, Flexible hoses, Diode (tbc), Instrumentation feedthrough (IFS), Trim current leads (tbc), etc

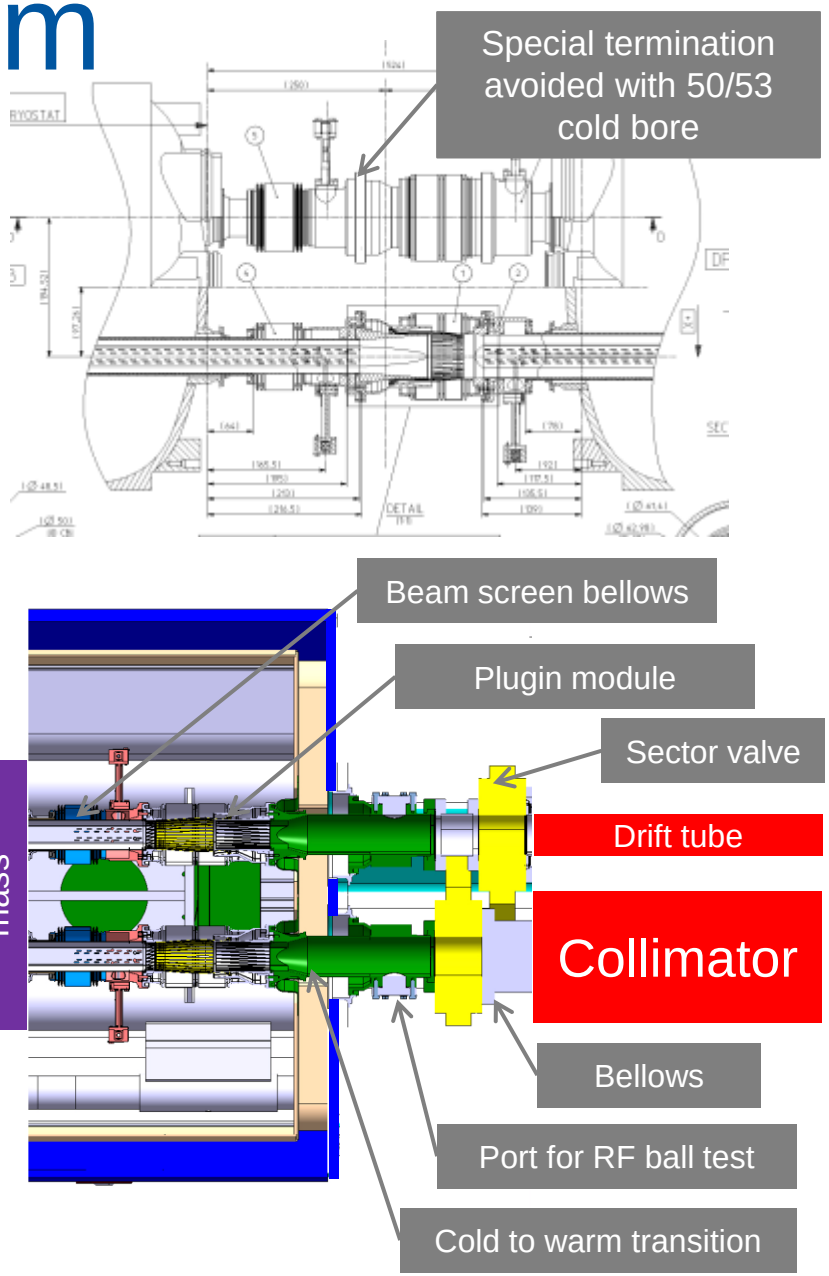
Conceptual 3D integration



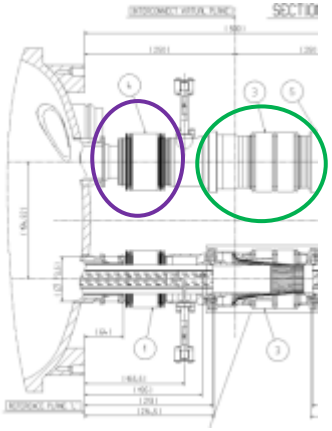


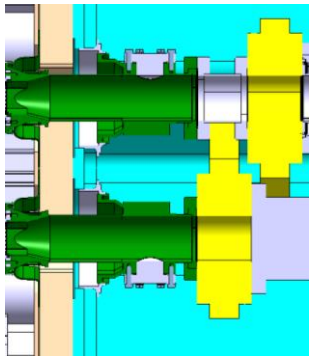
Cold beam vacuum

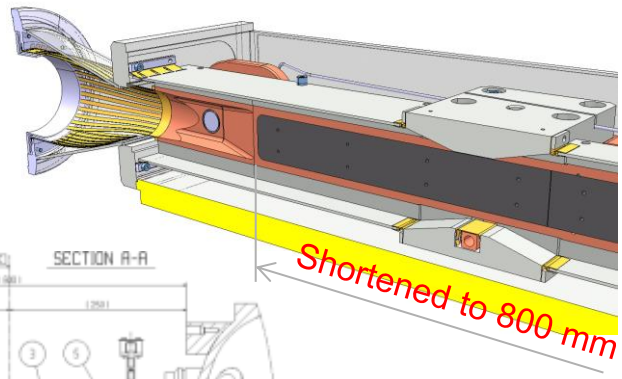
- Standard 50/53 mm cold bore and beam screens
  - Magnet bore 60 mm (MB is 56 mm): annular He volume for improved cooling
  - Aperture to be confirmed by on-going beam dynamics studies
  - No changes to adjacent magnets
- Cold to warm transition
  - Based on Q1 design for minimised length
  - External port for RF-ball test
  - Standard assembly procedure

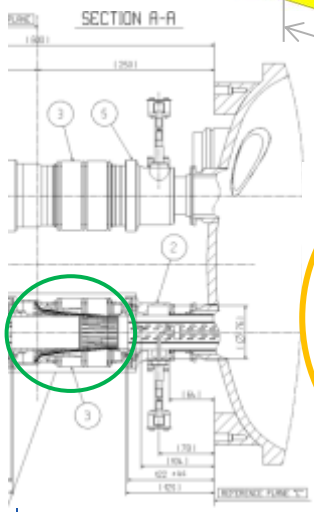


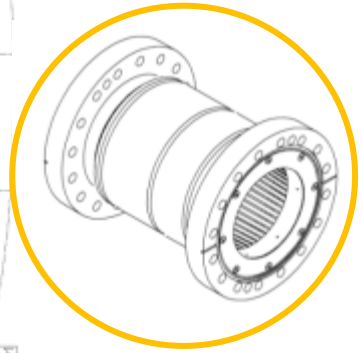
Will it fit in 15660 mm? (Lengths for collimator beam line)











Section	Element	Length standard	Length optimised
Interconnect upstr.	Interconnect	250	250
Interconnect upstr. Total		250	250
Cold mass A	Cold mass A		
Cold mass A	End cover	154	154
Cold mass A	Outer shell extension	56	56
Cold mass A	End plate	75	70
Cold mass A	Coil	5622	5622
Cold mass A	End plate	75	70
Cold mass A	Outer shell extension	56	56
Cold mass A	End cover	154	154
Cold mass A Total		**6192**	**6182**
Cold line A	beam screen termination with nested bellows	213	181
Cold line A	Plug-in module	165	147
Cold line A	Cold warm transition with RF ball insertion port	263.5	263.5
Cold line A Total		**641.5**	**591.5**
Warm line A	Sector valve	75	75
Warm line A	RF-shielded bellows	163	121
Warm line A Total		**238**	**196**
Collimator	RF transition and flange	140	140
Collimator	Jaw tapering and pick-up	100	100
Collimator	Tungsten	1000	800
Collimator	Jaw tapering and pick-up	100	100
Collimator	RF transition and flange	140	140
Collimator Total		**1480**	**1280**
Warm line B	RF-shielded bellows	163	121
Warm line B	Sector valve	75	75
Warm line B Total		**238**	**196**
Cold line B	Cold warm transition with RF ball insertion port	263.5	263.5
Cold line B	Plug-in module	165	147
Cold line B	beam screen termination fixed side	122	122
Cold line B Total		**550.5**	**532.5**
Cold mass B	End cover	154	154
Cold mass B	Outer shell extension	56	56
Cold mass B	End plate	75	70
Cold mass B	Coil	5622	5622
Cold mass B	End plate	75	70
Cold mass B	Outer shell extension	56	56
Cold mass B	End cover	154	154
Cold mass B Total		**6192**	**6182**
Interconnect downstr.	Interconnect	250	250
Interconnect downstr. Total		**250**	**250**
Grand Total		**16032**	**15660**
Dipole length		**15660**	**15660**
Margin		**-372**	**0**

Estimated potential for optimisation
Important contribution from TE-VSC

Today's main integration topics

Topic	Issue	Status
Sizing of cold beam lines	• Standard 50 mm cold bore tubes and beam screens	Aperture to be confirmed
Powering	• Current baseline: In series with MB magnets • Trim circuit required • Possible 2x 300 A current leads integration	On-going
Magnet protection	• Difficult integration of diode stack in cryo-assembly B	In work, possibly one diode for both 11T magnets
Spools	• One pair can be integrated in cold mass B, downstream end cover • Extra pair would be an issue	To be confirmed
Longitudinal integration	• Re-design vacuum components to optimise length	On-going (TE-VSC)
Electromagnetic interference	• Interference between busbar magnetic field and collimator LVDT's?	New magnetic field tolerant instrumentation, to be confirmed
Over pressure safety devices	• Insulation vacuum: number and placement of DN 200's • Beam vacuum: rupture disks	To be discussed All SSS equipped with rupture disks during LS1 (TE-VSC)
Interfaces	• Prepare and approve interface specification	On-going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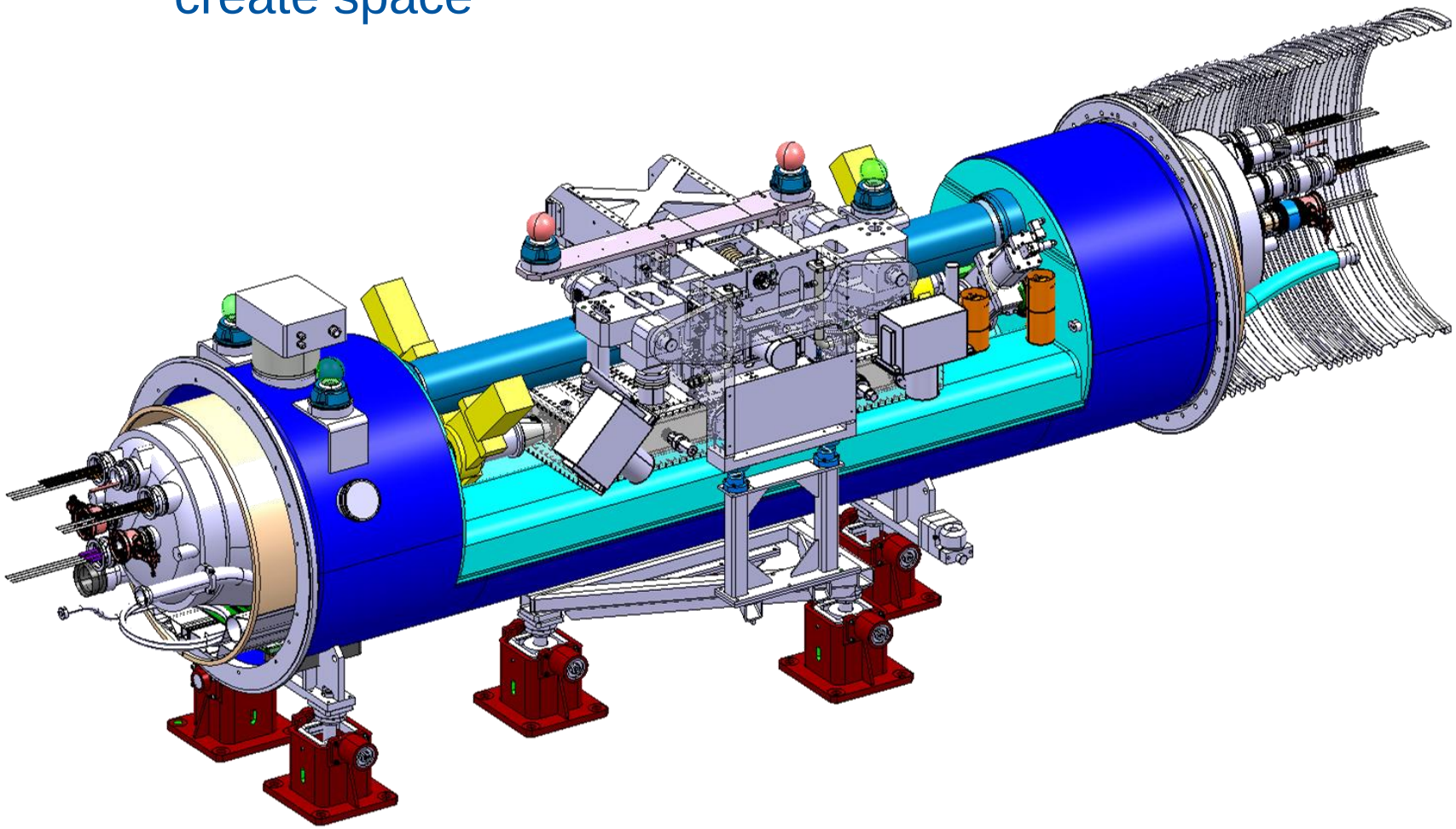
Before the 11 T magnet development: QTC (2010)

- Main drawback: extensive machine layout changes to create space



4.0 m + 0.5 m interc. = **4.5 m** installation length

Could the QTC cryostat concept be “extended”?

- Can only be **finished after cryostating**
- Dealing with **welding distortions** is a major issue
  - **Distortions amplified with length**
  - **Adjustment of cold support posts** is required
  - Complicated assembly procedure