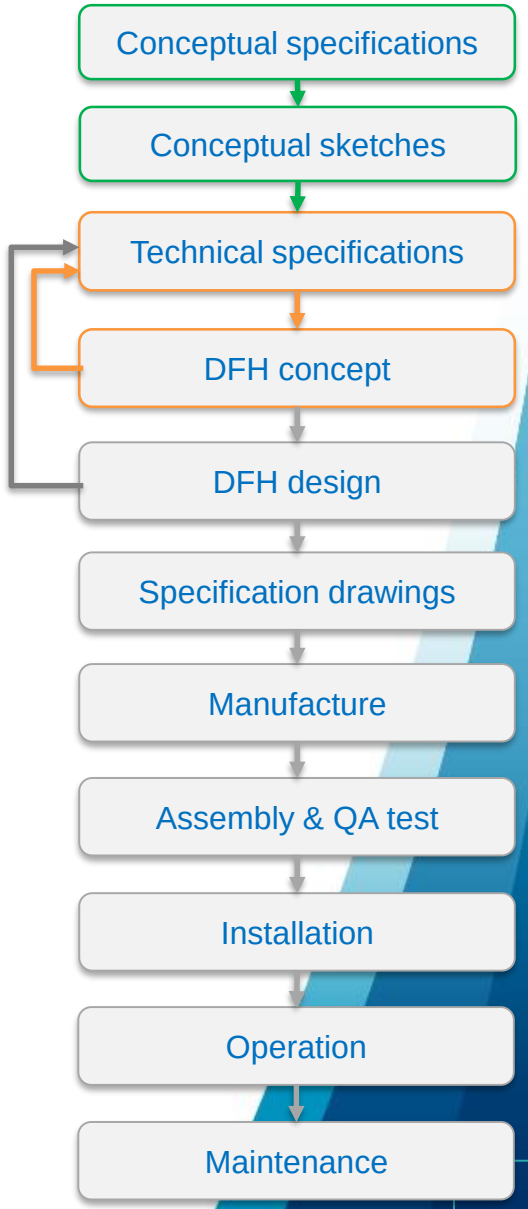
DFHX-Key basic concepts

- 1 unit Vs 2 units
- Concept overview & pending inputs
- DFHx installation problematics



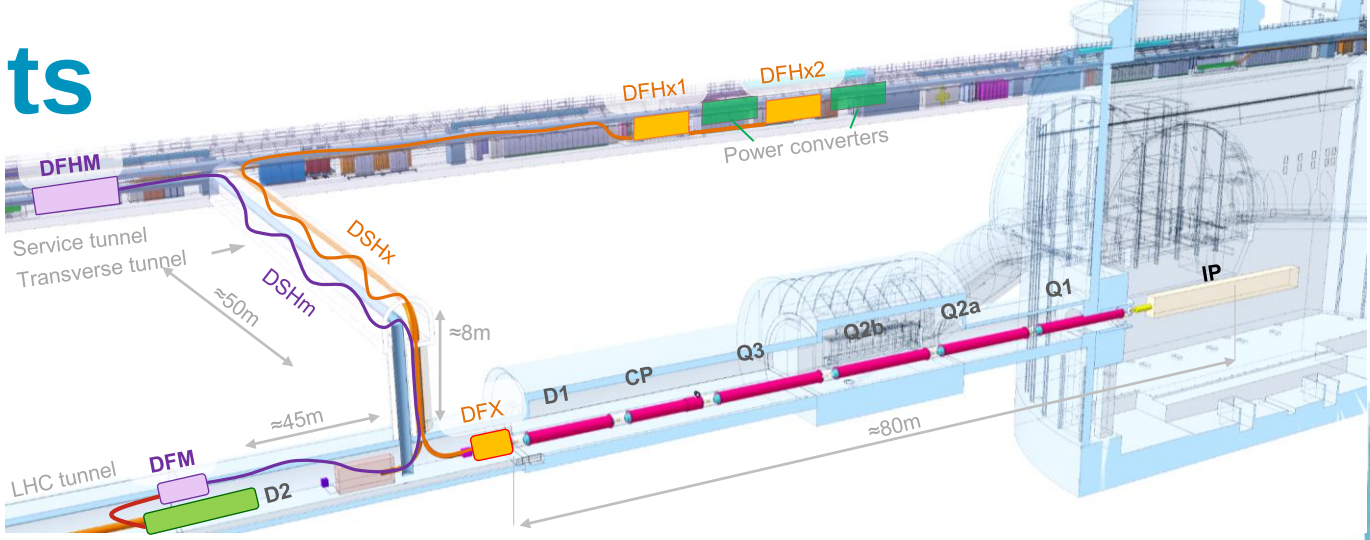
DFHx: 1 unit Vs 2 units

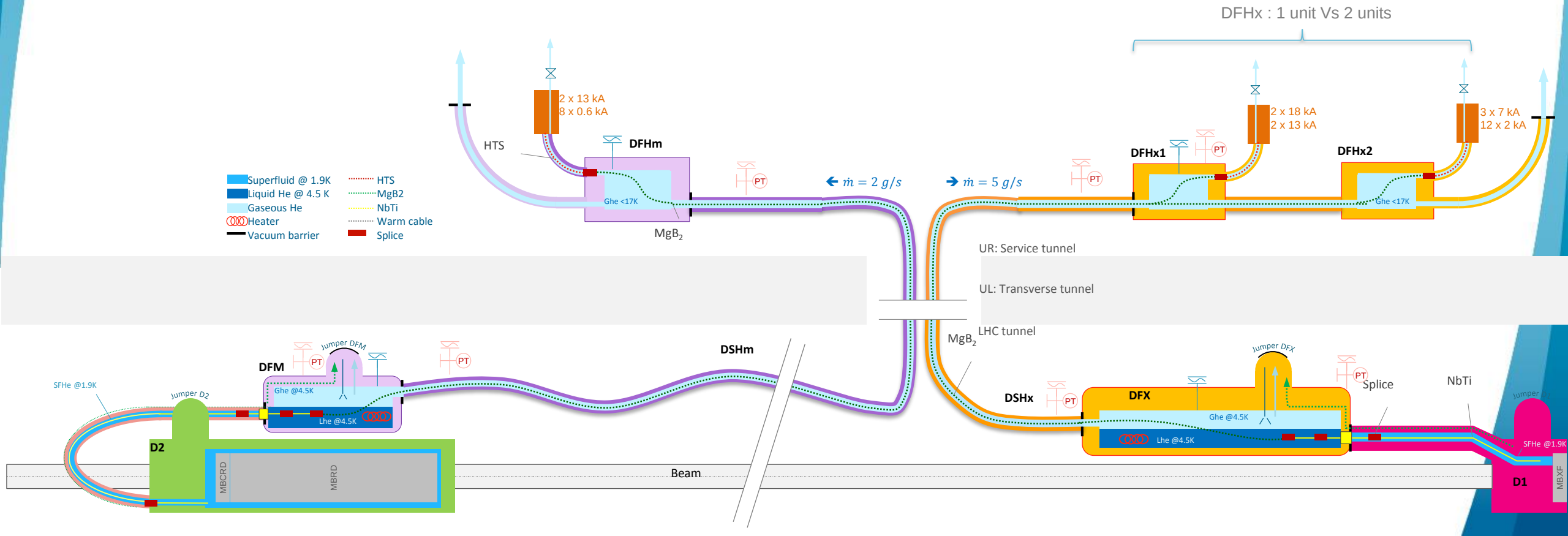
Each IP1 and IP5 sides equipped with 2 cold powering chains of cryostats

- Triplet insertion : DFHx – SC Link (DSH) – DFX
- Matching sections : DFHm – SC Link - DFM

DFX/DFM basic functions:

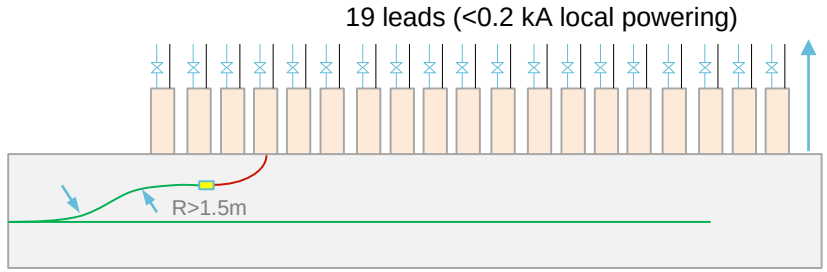
- Electrical interface between SC Link and superconducting magnets
- Supply cryogenics to the SCLink

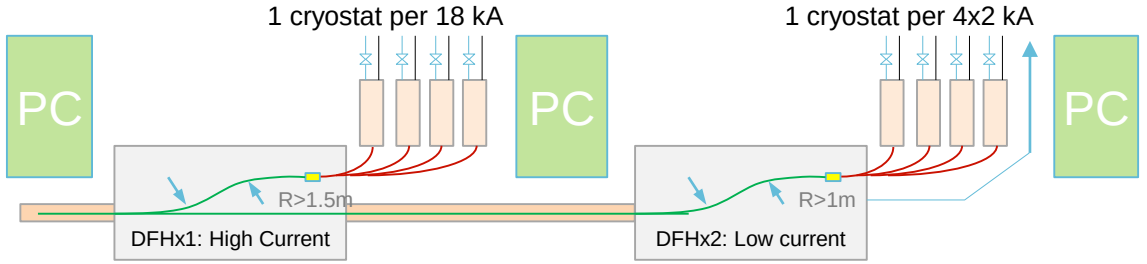




DFHx: 1 Unit Vs 2 Units

- Specifications:
  - Proximity Current leads / Power supply
  - MgB2 cable minimum bending radius : up to 1.25m
  - Current leads and HTS assembled and tested on surface
- Advantages & Drawbacks at DFHx level

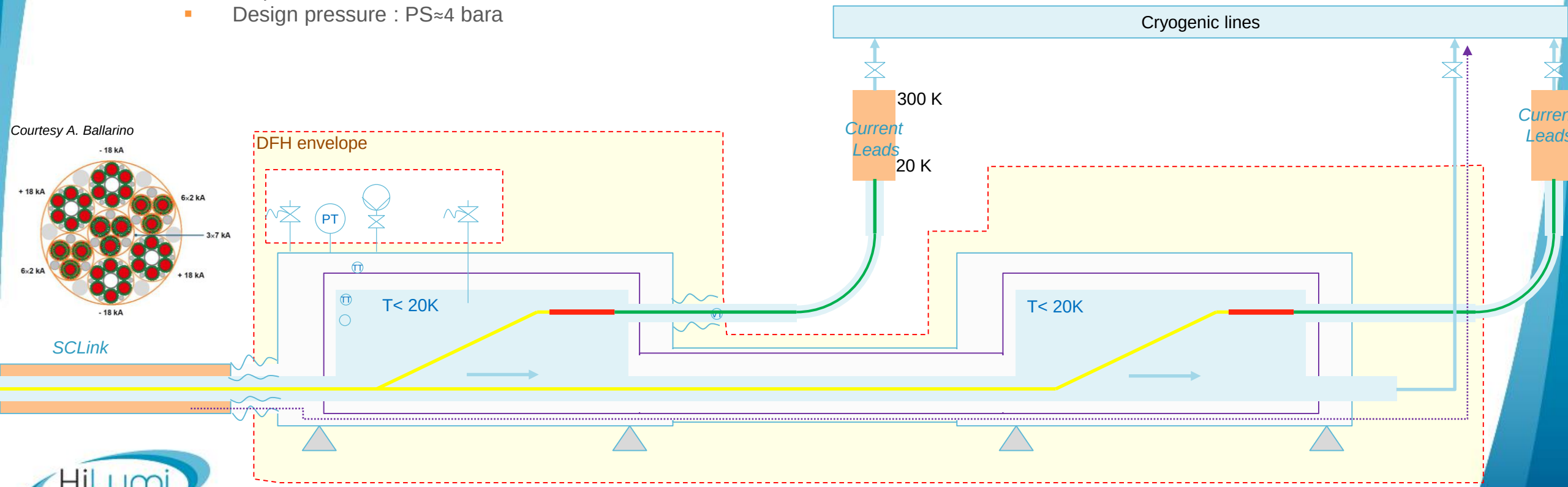




	DFH : 1 unit	DFH : 2 units
Integration UR (for information) - *Disconnector box – Current leads* - *18kA power supply requirements* - *Volume tunnel* - *Position interfaces (cryo/vacuum)*	- Distance mini CL-DB up to 8m - Proximity PC-18kA leads > 4m - Very long DFHx (routing MgB2 R=1.5m) e - 1 packed zone (hydraulic + instru acquisition)	- Distance CL-CDB < 1m - 18 kA current leads – Power supply < 1m - Smaller boxes but 2 + interlink and spread over longer length - 2 uncongested zones (hydraulic + instru acquisition)
DFH design - *General dimensions* - *Access to MgB2-HTS splices*	- Routing 19 leads MgB2 radially ➔ long + wide - Side access from flange	- Split into 2 boxes ➔ spread radial opening of cable to 1.5m Rmin - Allow sleeve sliding system ➔ 360 deg access to splices

➔ DFHx sketch concept

- DFH objectives :
  - Connect the 19 electrical leads from the SCLink side to the current leads interfaces
  - Monitor the electrical connection performance
  - Ensure the cooling of electrical connections and cables
- Overview of the DFH:
  - 19 leads from 2 kA to 18 kA in a flow of gaseous helium below 20K.
  - T operation = 5 to 20 K
  - Design pressure : PS≈4 bara



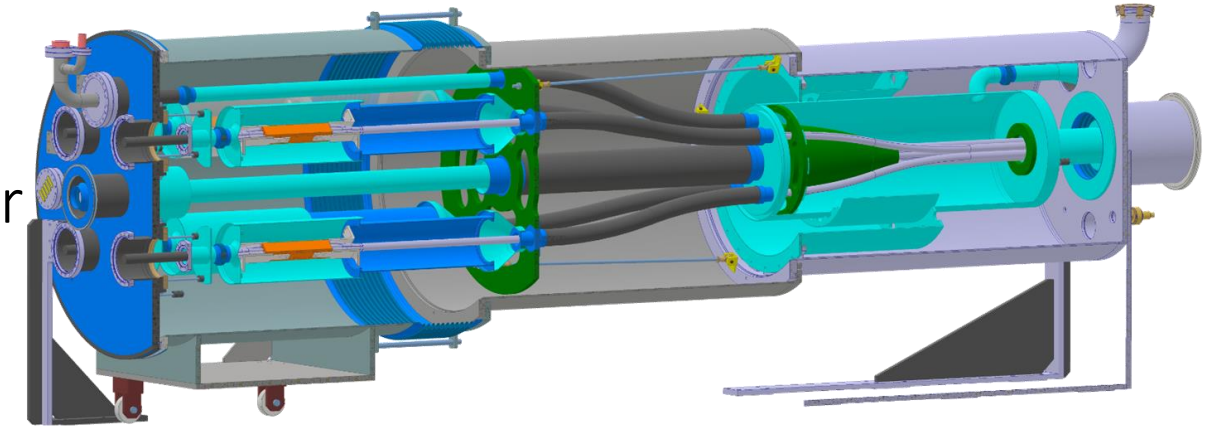
Layout of DFH electrical boxes

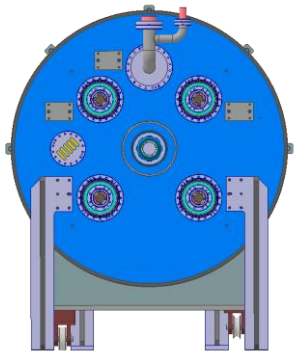
Overview DFHx life sequence and illustrative design

Technical discussion ➔ open to comments, discussions

DFHx1:
Today status
Illustrative concept for discussion

Proposal
In progress
Need inputs



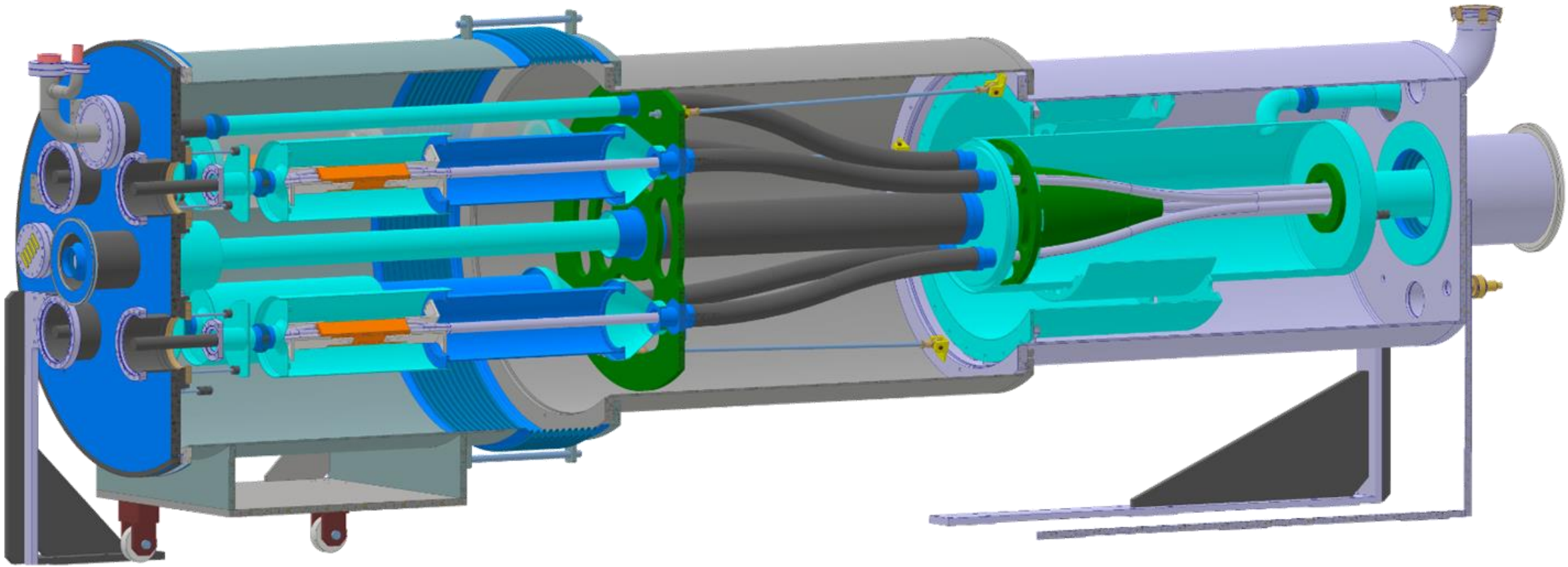


≈ 4 m

≈Ø 1.5m

DN100 relief plate on vacuum volume
Port for pumping interfaces
Helium vessel fixed point
Vacuum vessels config.
Helium vessel <Ø250mm
R=1.5m
Flexible routing MgB2 cables. R=1.5m
Possibility for spare MgB2-HTS splice
Splices with Peek bi-lateral fixation to pipe
Splices individually routed:
Safety relief device covering DFHx + SCLink helium volumes
Mass flow indiv. controlled
PT
MgB2
Current leads flexible
To DFHx2 ➔
Current leads flexible
Bellows He vessels DFHx1-SCLink
Bellows VV vessels DFHx1-SCLink
G10 guiding supports
Sleeve principle for access
CF flanges
Connection to ground to design

Note: thermal shield not shown

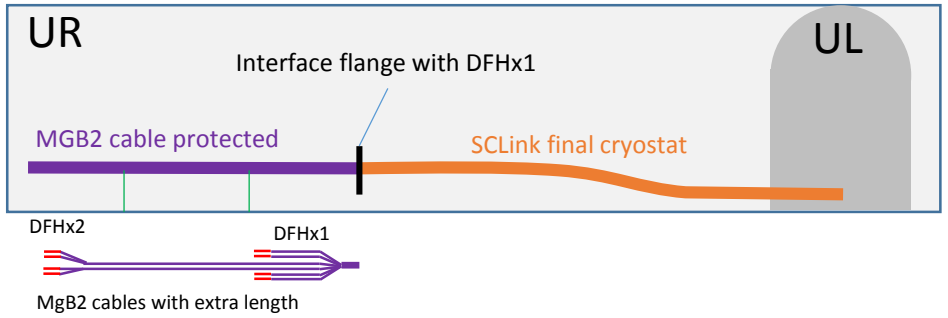


Sequence proposal

Environment : no racks installed

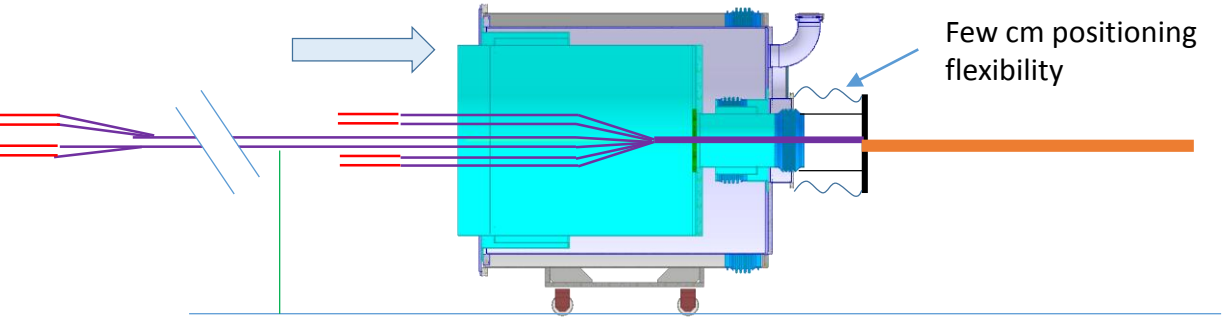
1. SCLink cables ends on supports

SCLink is pre-assembled before all other components. Fixed in position on DFX side. Interface with DFHx1 located within cm. The cable bundle is reduced to minimum diameter for transport purposes.



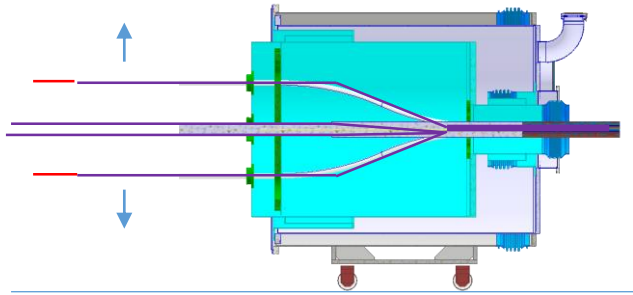
2. Insertion module 1: VV1+HeV1

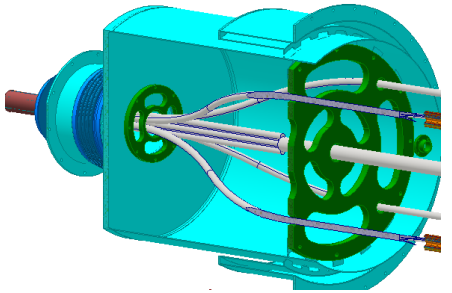
The DFHx1 module is “rolled” around the SCLink cable all the way from DFHx2.



3. Matching lead with Current lead radial positions (opening of cables bundle)

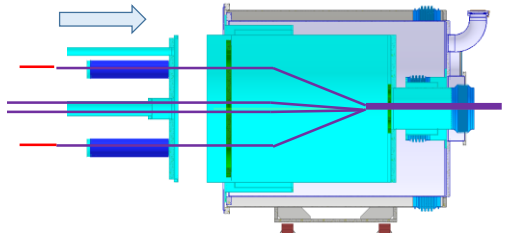
The MgB2 cables are internally routed and fixed in radial position in the DFHx1 to match the current leads interfaces. (+ installation instrumentation)





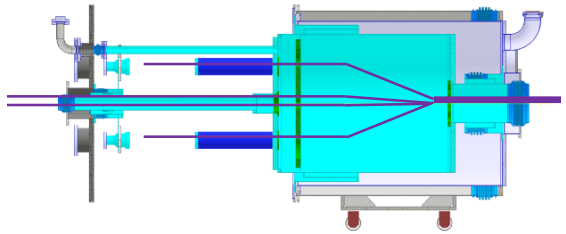
4. Insertion module 2 (sleeves opened)

Once cables are radially positioned, the internal helium vessel is closed with MgB2 extra length going out in individual tubes (to ease access to individual splice, ease welding, perform clean splice, increase & individualise turbulent flow locally at splice level).



5. Installation interfaces with current leads

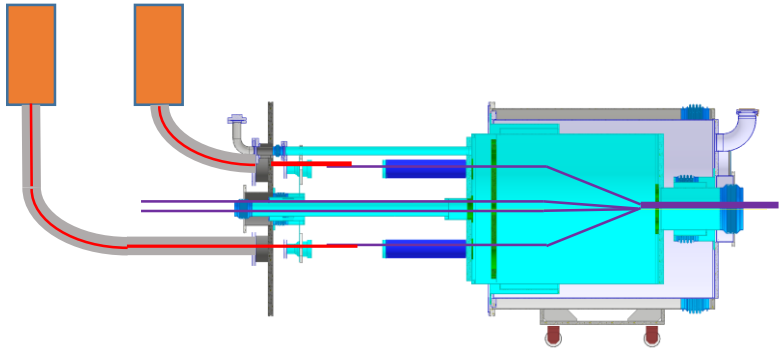
Installation of interface with DFHx2 and interface flange with current leads.



Sequence proposal

6. Assembly current leads

Racks and current leads are installed around the DFHx1. flexible ends of current leads are connected to DFHx1 interface flange.

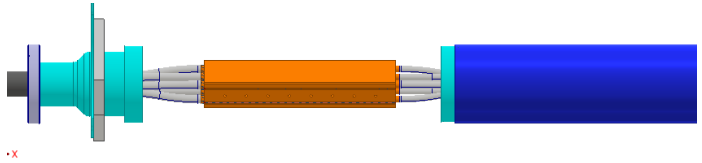


7. Adjust MgB2 leads to length

HTS end lengths of current leads are fixed, in order to face few cm positioning of the SCLink in the tunnel + solder on “fresh unsoldered MgB2 + to optimise the splice performance, it is suggested to cut the extra length of MgB2 at this stage.

8. Splice

Splices are independent (for DFHx1 18kA and 13 kA leads). Other splices can be independently protected when working around. Installation of V-taps

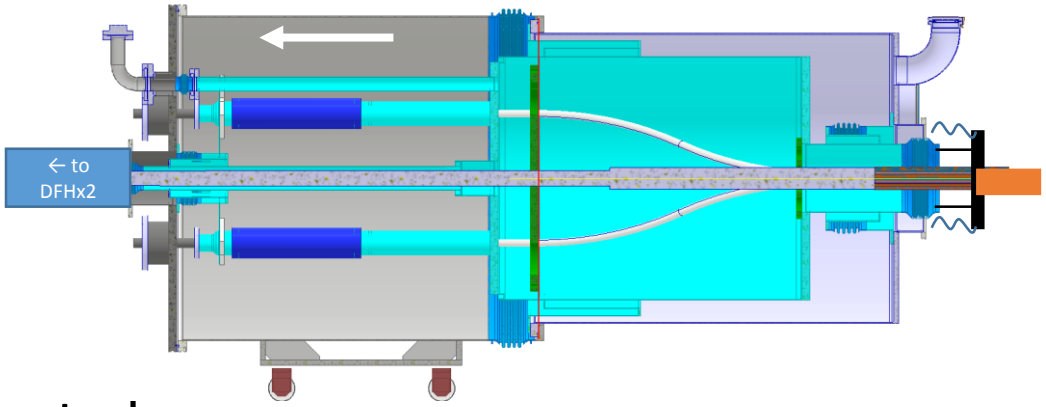


9. Close sleeves

It is suggested to use standard interconnection sleeves with standard tooling for cutting and welding.

10. Close vacuum vessel

The vacuum vessel is a sleeve itself closed with standard elastomer O-rings (LHC type connection).



11. Transient phase

The insulation vacuum is common with current leads and SCLink. Pumps and relief plates are assembled on module1.

During cool down, the internal helium vessel is fixed in the middle, splices are longitudinally fixed relatively to the helium vessels.

Thermal contraction of the cable is covered form the entry in the DFHx1. The helium vessels contractions is covered on SCLink side by bellows, on current leads side by current leads internal bellows.

The geometry allow to individually control each mass flow around splices.

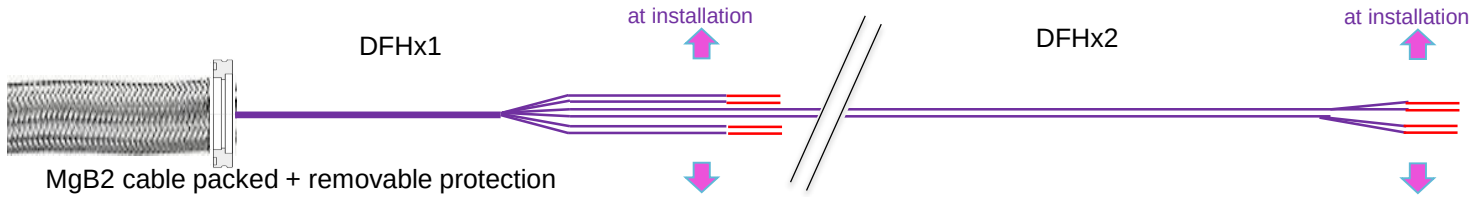
Next meetings

Handling MgB2 cable at installation : 2 proposals

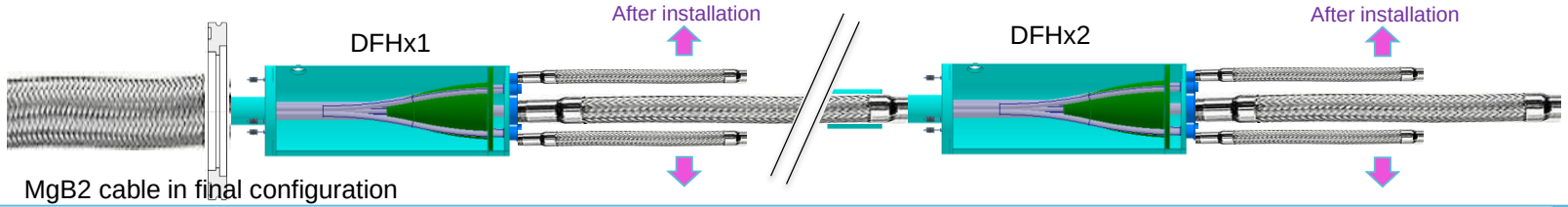
- Assumptions:
  - DFHx=DFHx1 & DFHx2
  - SCLink rolled on a max Ø4mx2.5m turret
  - DFH assembled after SCLink, before CL & PC

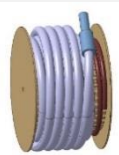
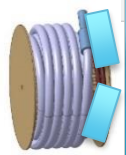
Transport configurations

Option#1: Sclink transported with compact MgB2 cable configuration: opened at installation.



Option#2: Sclink tested and transported with partially pre-routed cables: partially opened at installation.



	Option#1	Option #2
SCLink transport to UR	• SCLink rolled on turret after SM18 test (removable protection) • Simple unrolling from DFX end • Reduced SCLink vacuum jacket flange diameter 	• Difficulties to roll 4m protective boxes (10m apart) on the turret • Feasibility of unrolling the turret to be proven • Bigger SCLink vacuum jacket flange 
Testing phase	• MgB2 cable is packed after testing in SM18 and re-opened in the tunnel	• MgB2 cable is never touched between testing and tunnel installation.
Installation & integration *Protection of MgB2 cable* *Match angularly SCL and HTS leads* *Routing of MgB2 leads* *Vacuum vessel dimensions* *Pressure welding & QA* *Interlink dimensions* *HTS lengths* *Thermal contraction Interlink* *Instrumentation routing*	• MgB2 protection must be removed at some point • Routing within He vessel • Manual forming of MgB2 leads • Minimised to compact diameter of cable bundle • Big PED weld to realise • Minimised to compact cable bundle diameter • Minimised • Not solved yet • Done in the tunnel	• Never touched after testing in SM18 • Need extra length of flexible (1m) ➔ DFH length • Only flexible part • Scaled to He vessel diameter (to slide vessels). Big • No big welds (max DN100) • Inner Ø > then He vessel OD (DN350) • Bigger interlink ➔ HTS + 1m • May use big interlink DN350… TBD • Done at the surface before testing