



# **Cold Powering System for Hi-Luminosity**

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**CERN, Geneva**

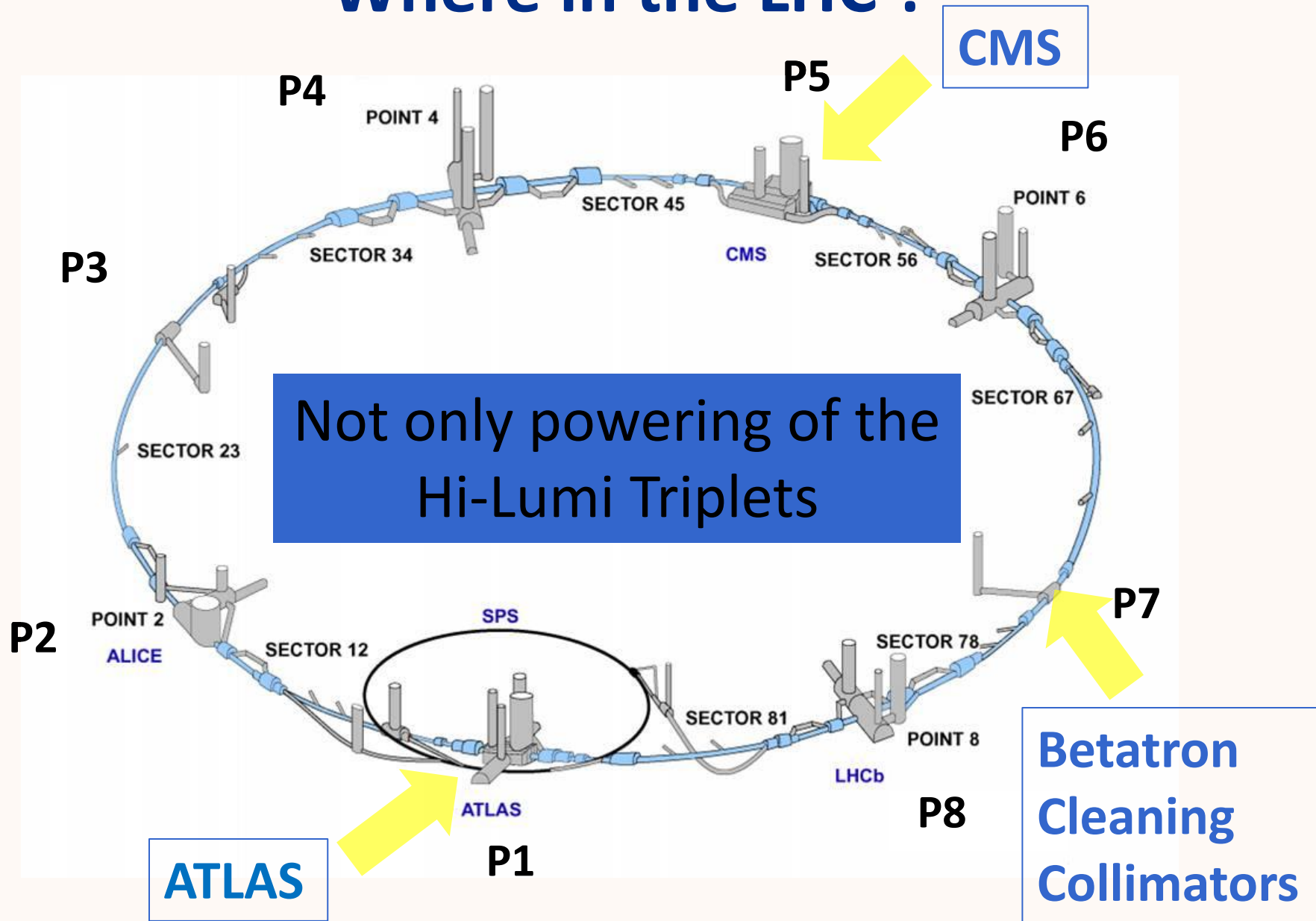
**Technical Meeting on Vacuum for HL-LHC**

**5<sup>th</sup> March 2014**

# Outline

- **System overview**
  - Where in LHC and Why
- **Status of development**
- **Project timeline**
  - Milestones and integration in the LHC machine
- **Conclusions**

# Where in the LHC ?

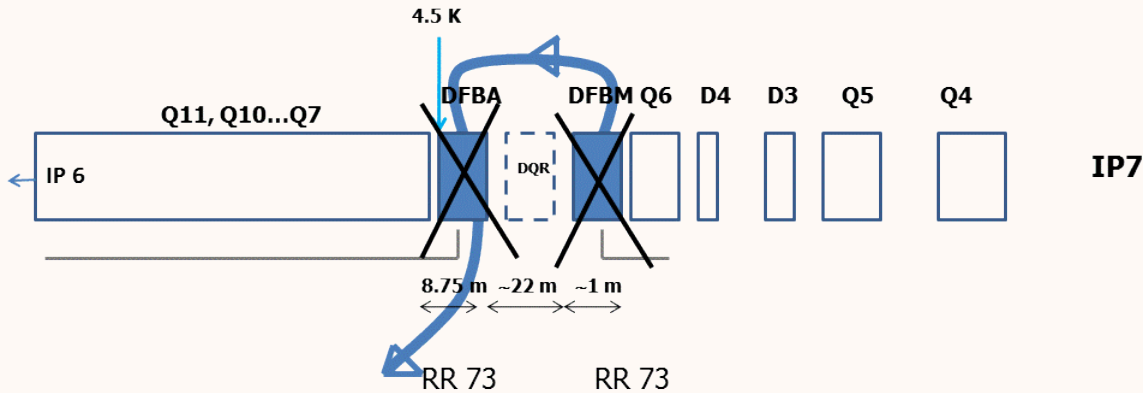


# Distribution Feedboxes removed from LHC Tunnel



# Interventions at P7, P1 and P5

**P7:** Removal of DFBA (2) and DFBM (2)



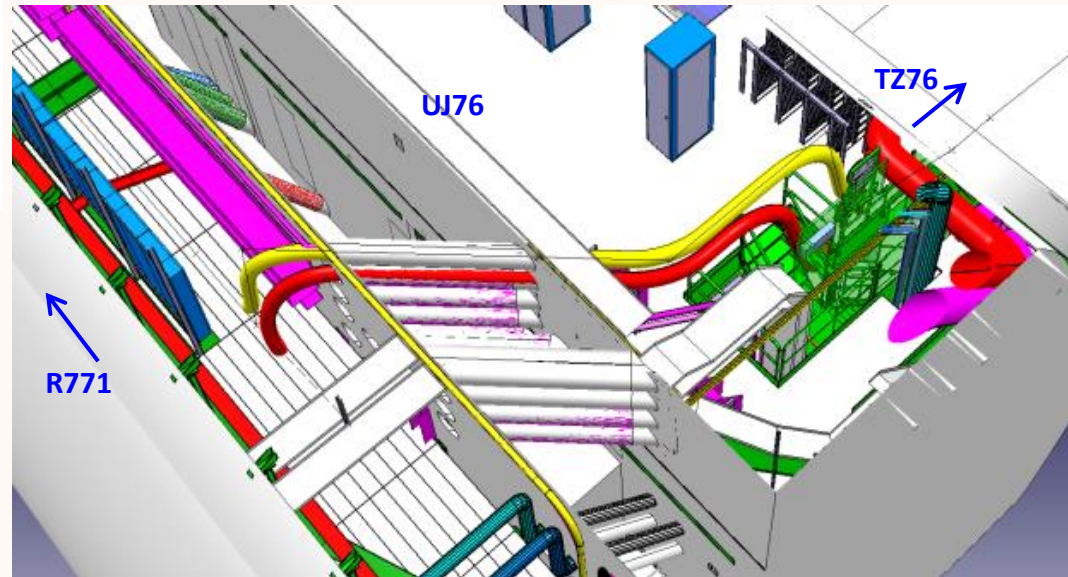
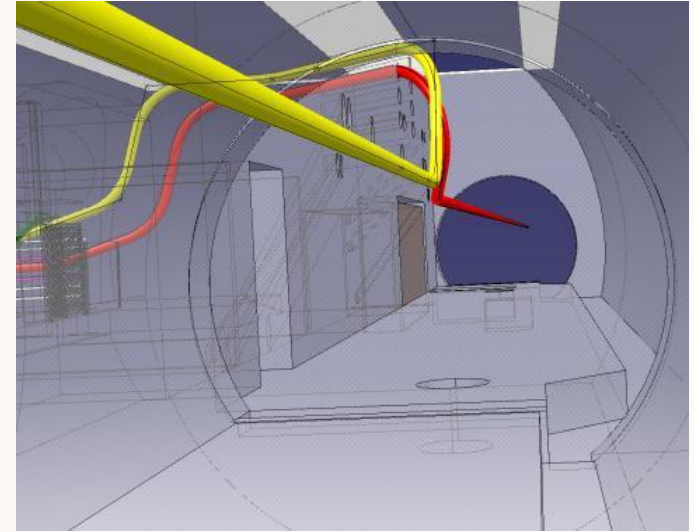
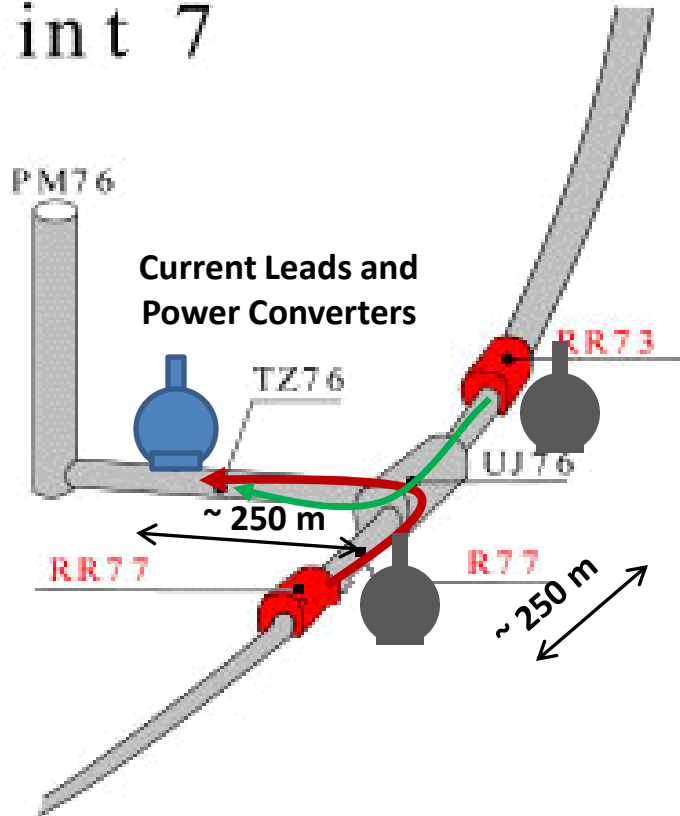
**P1 and P5:** removal of DF BX (2 per point)

**Baseline for Hi-Lumi Triplets**

**P1 and P5:** removal of DFBA (2 per point) and DFBL (2 per point)

# LHC P7

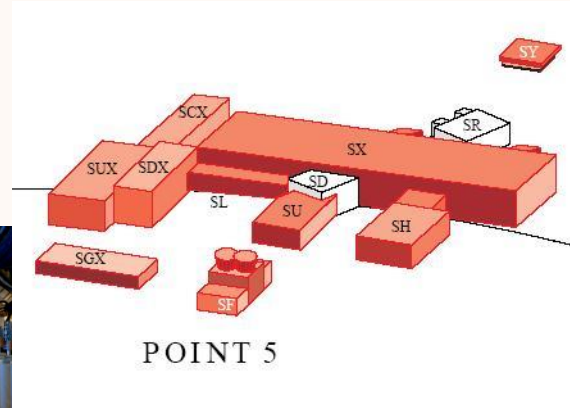
## Point 7



LHC P7: Cleaning Insertions

Underground Installation

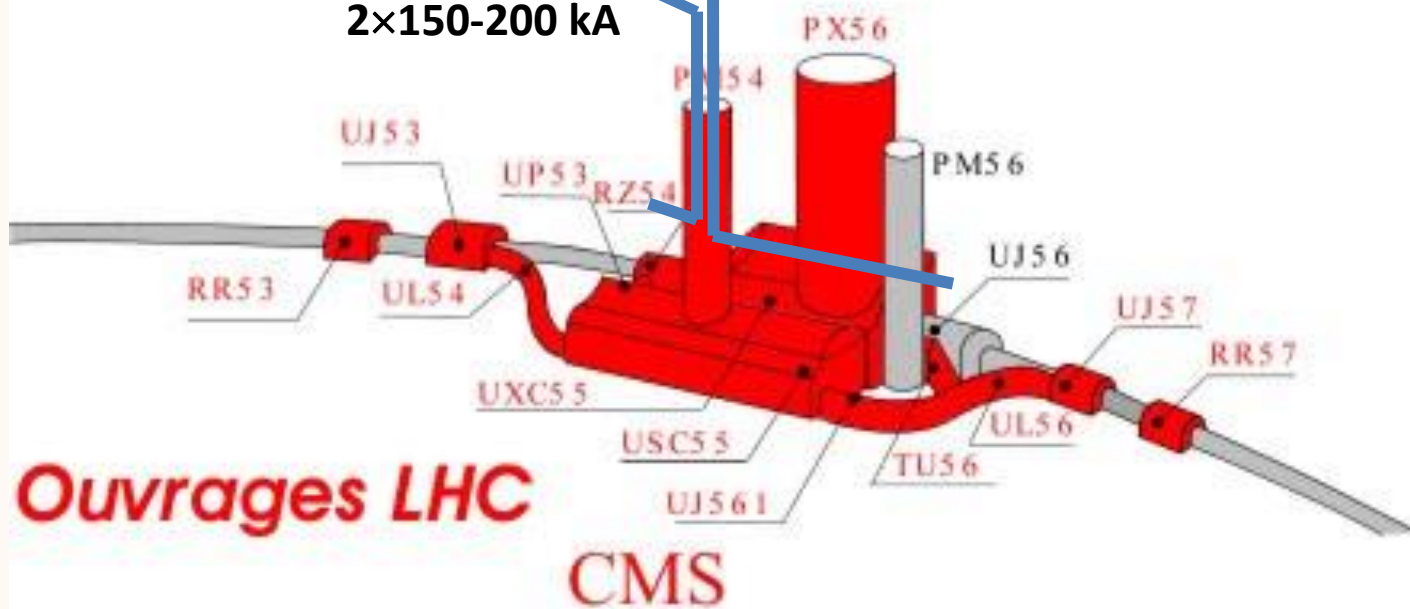
# Superconducting Link at LHC P5



POINT 5

Point 5

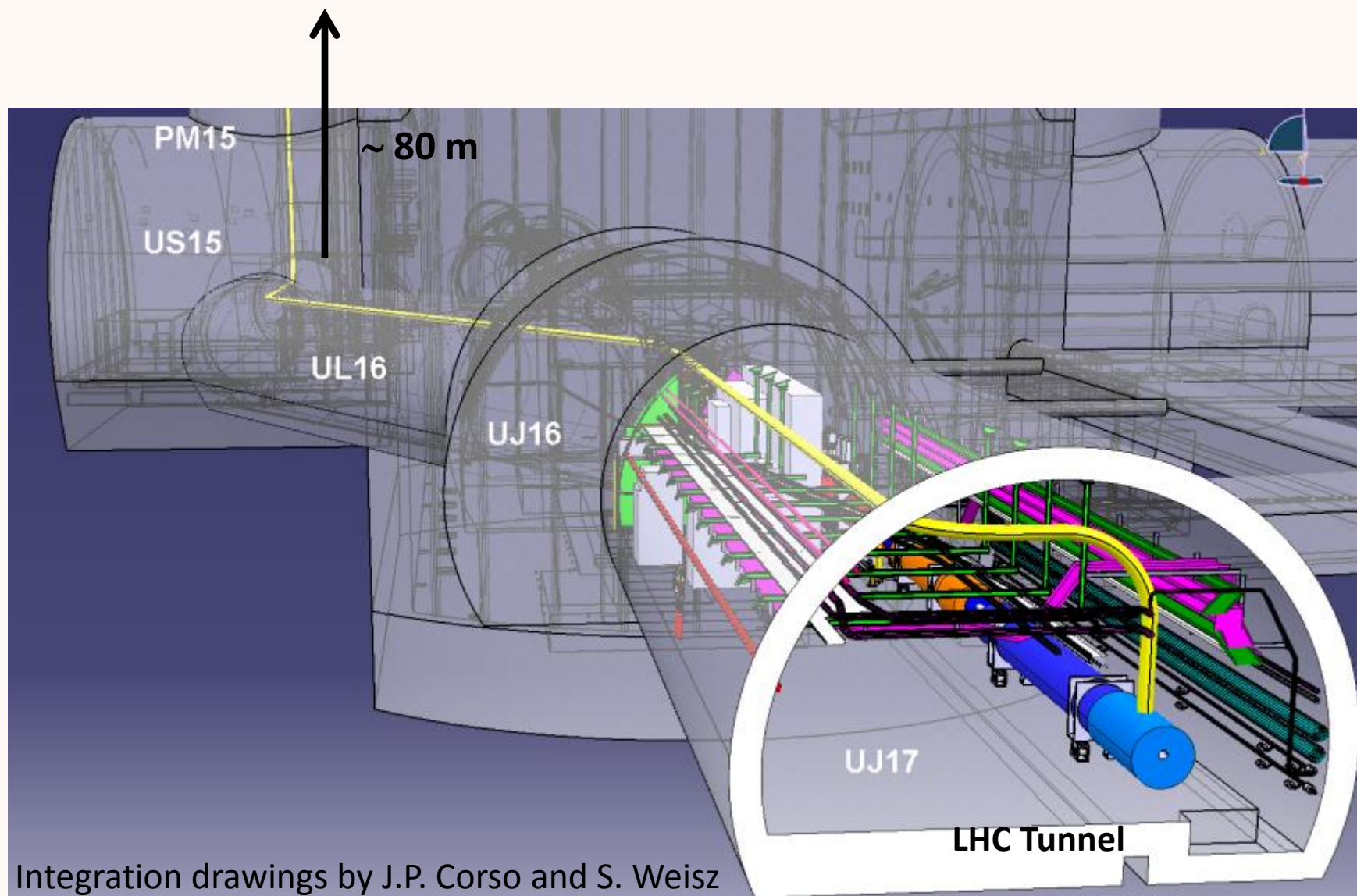
2×150-200 kA



Ouvrages LHC

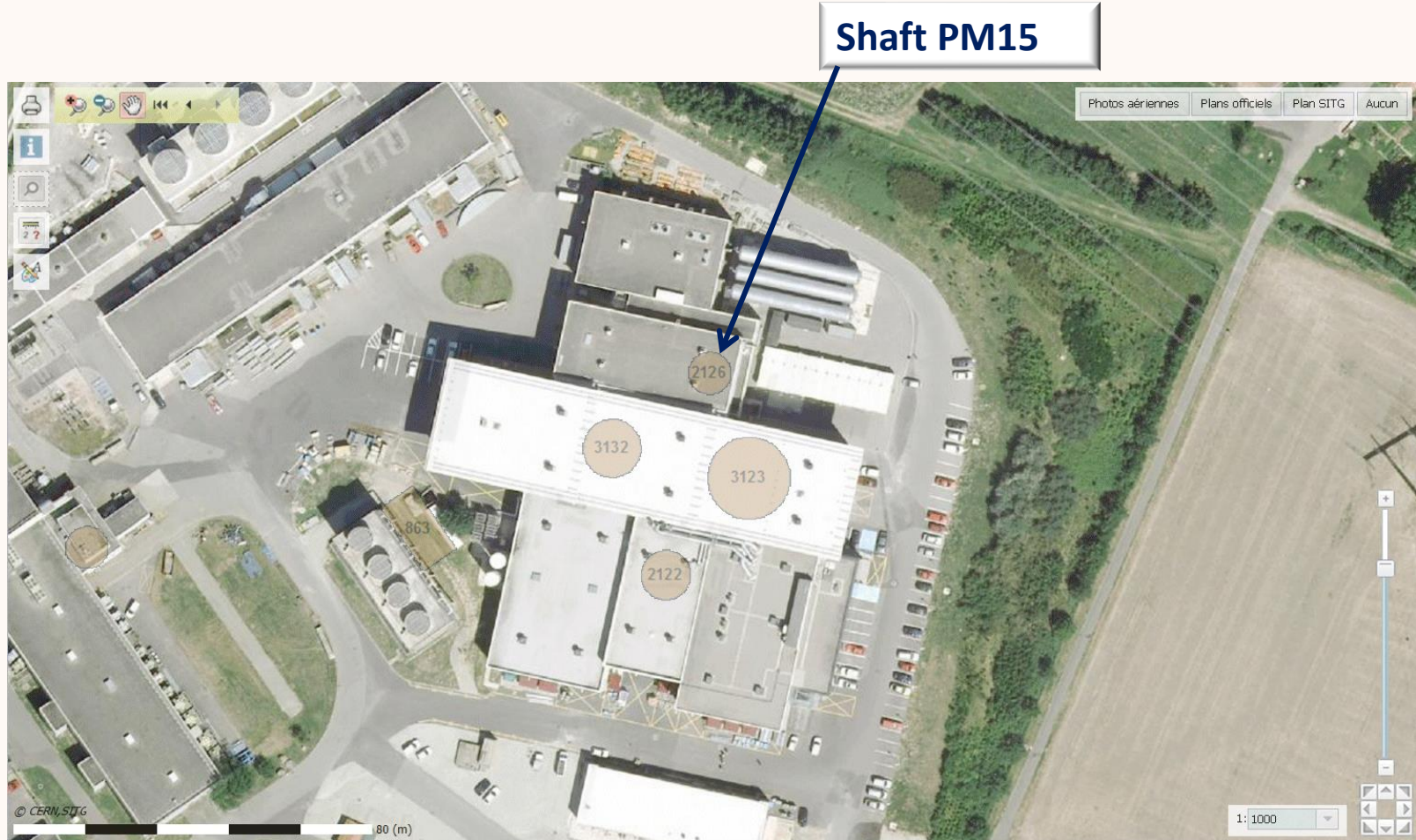
CMS

# Superconducting Link at LHC P1





# LHC P1: Surface Buildings



Integration drawings by J.P. Corso and S. Weisz

# Superconducting Links Characteristics (1/2)

## LHC P7

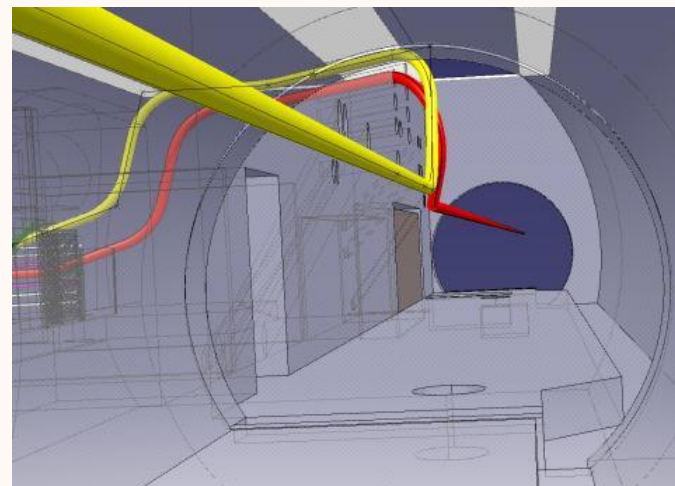
2 Links, Each ~ 500 m long

50 Cables per link rated at 600 A

$$|I_{\text{tot}}| = 30 \text{ kA}$$

Removal of LHC cryostats from tunnel

Underground installation



## LHC P1 and P5

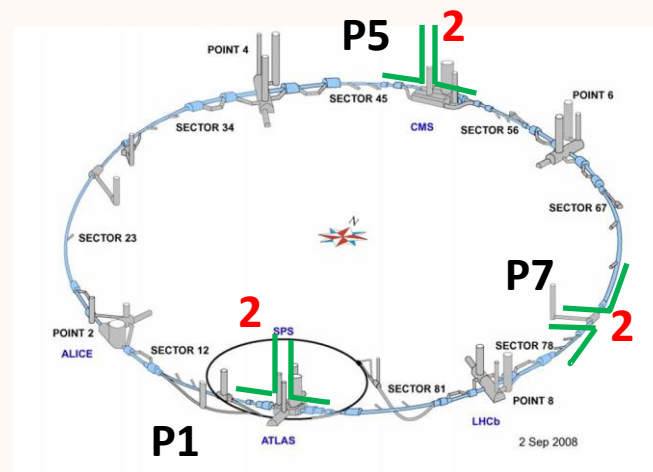
2+2 Links, Each ~ 300 m long

42 Cables per link rated at up to 20 kA

$$|I_{\text{tot}}| = 150 \text{ kA}$$

Upgrade of Hi-Luminosity Triplets

Surface Installation



# Superconducting Links Characteristics (2/2)

## LHC P1 and P5

2+2 Links, Each ~ 300 m long

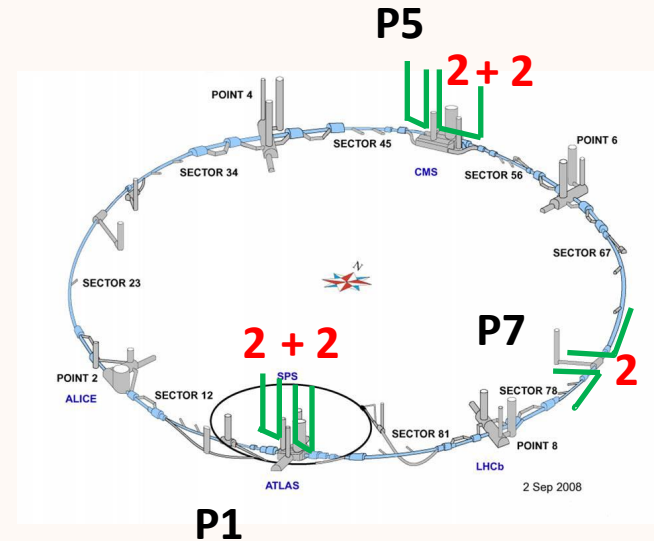
63 Cables per link rated at up to 6 kA

$|I_{tot}| = 200 \text{ kA}$

Removal of LHC cryostats from tunnel

Feeding of Arc and MSs magnets

Surface Installation



**In total:** 10 SC Links

Multi-circuit assemblies

feeding different magnet circuits

Total length of superconductor required > 1000 km (7 tons)

# High-Current Rating, LHC P1 and P5

## Hi-Lumi Triplets

Cu

MgB<sub>2</sub>,  $\Phi = 0.85$  mm

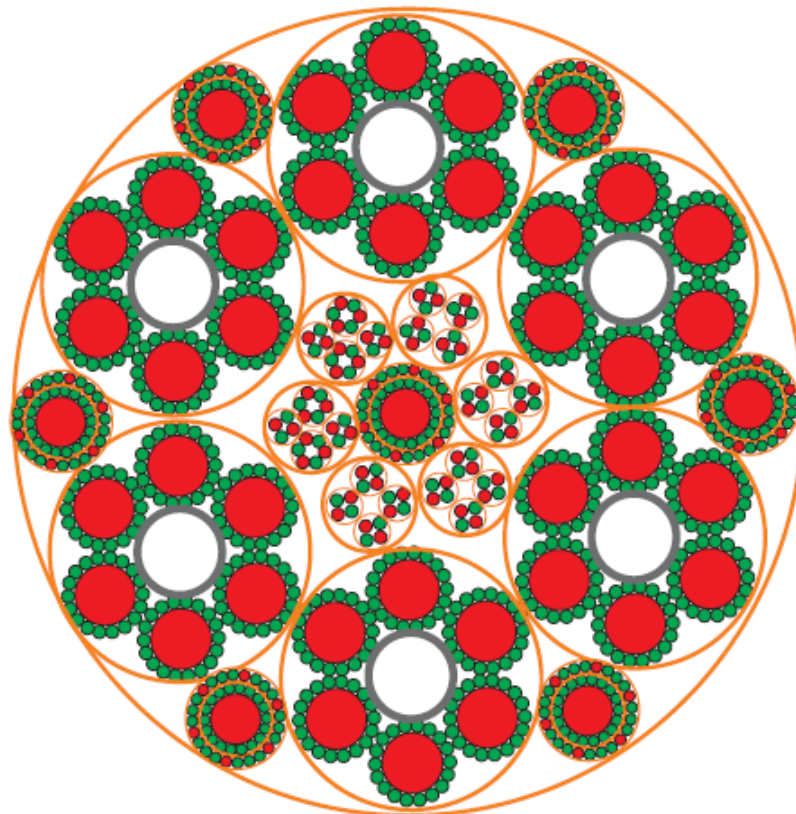
18 MgB<sub>2</sub> wires  
 $\Phi = 6.5$  mm

20 kA  
Six cables,  $\Phi = 19.5$  mm

Concentric  $\pm 3$  kA  
Seven cables,  $\Phi = 8.4$  mm

0.4 kA  
Four cables

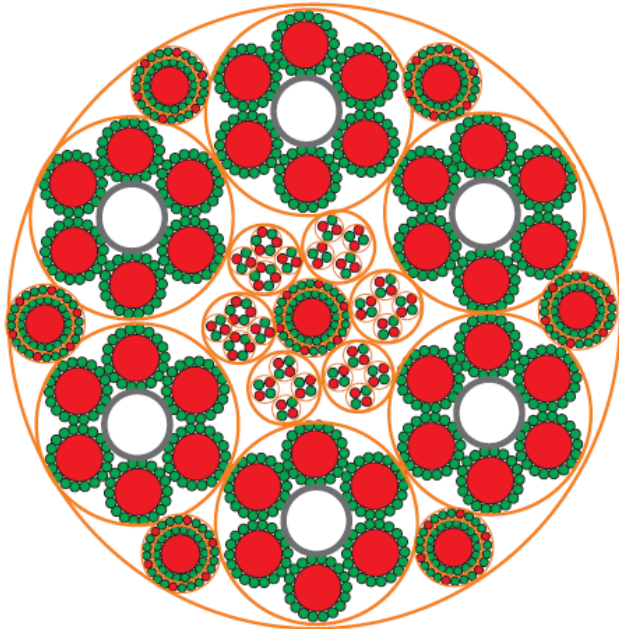
0.12 kA  
Eighteen cables



$\Phi_{\text{ext}} \sim 65$  mm

# Cable for Hi-Luminosity Magnets

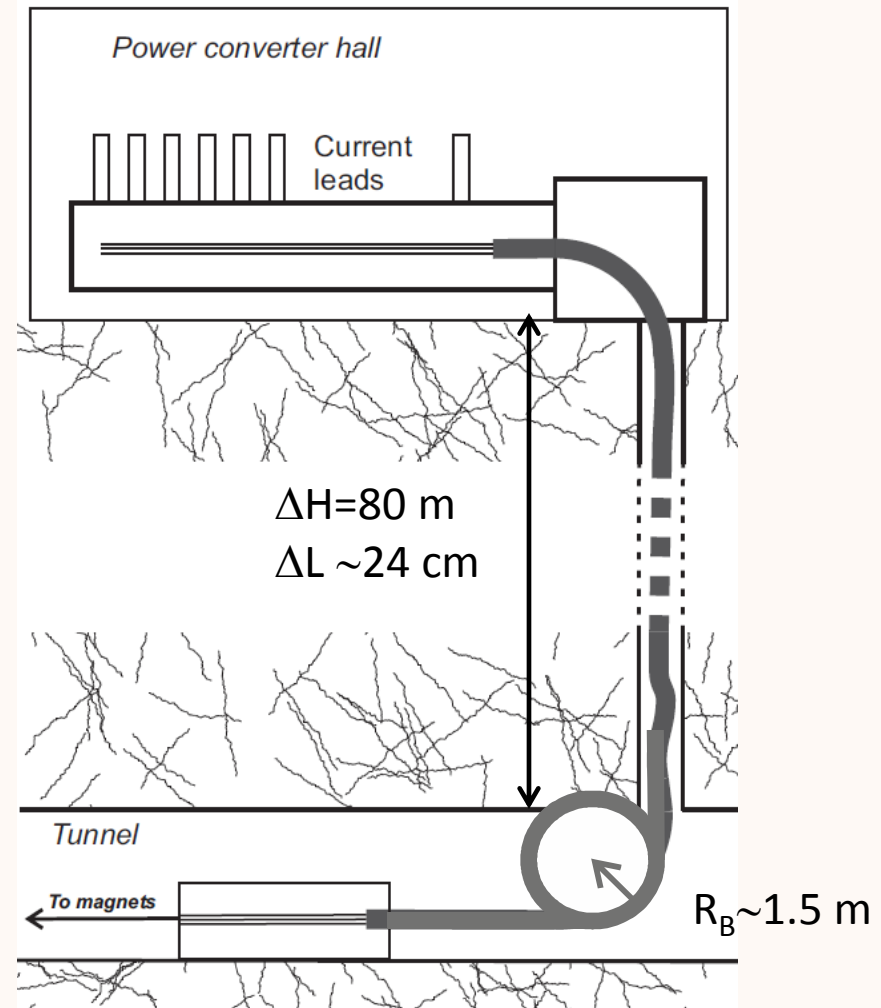
## LHC P1 and P5



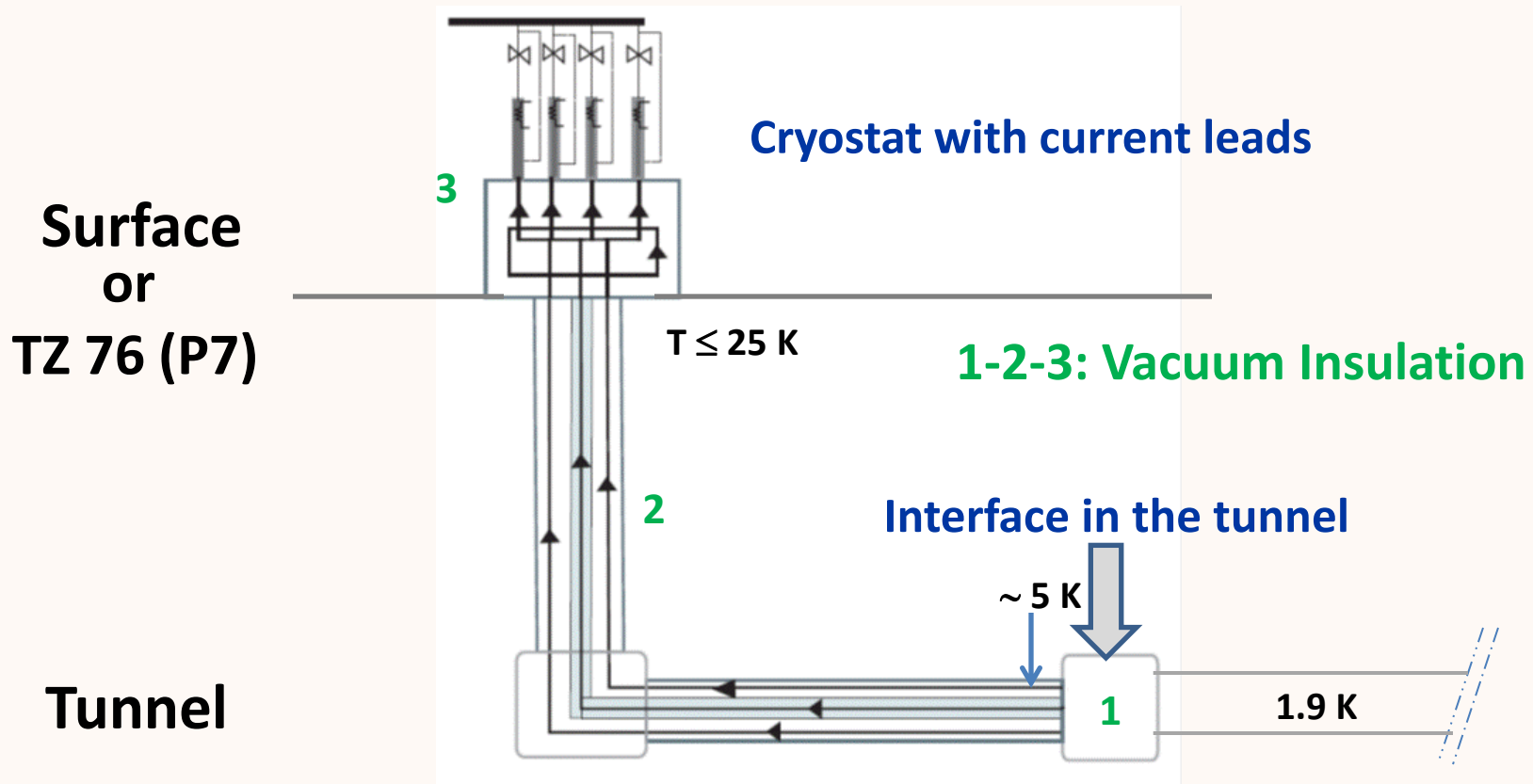
$$|I_{\text{tot}}| = 150 \text{ kA}$$

Mass  $\sim 11 \text{ kg/m}$   
(880 kg for  $\Delta H=80 \text{ m}$ )

Semi-flexible cryostat external diameter = 220 mm



# Superconducting Link Cooling



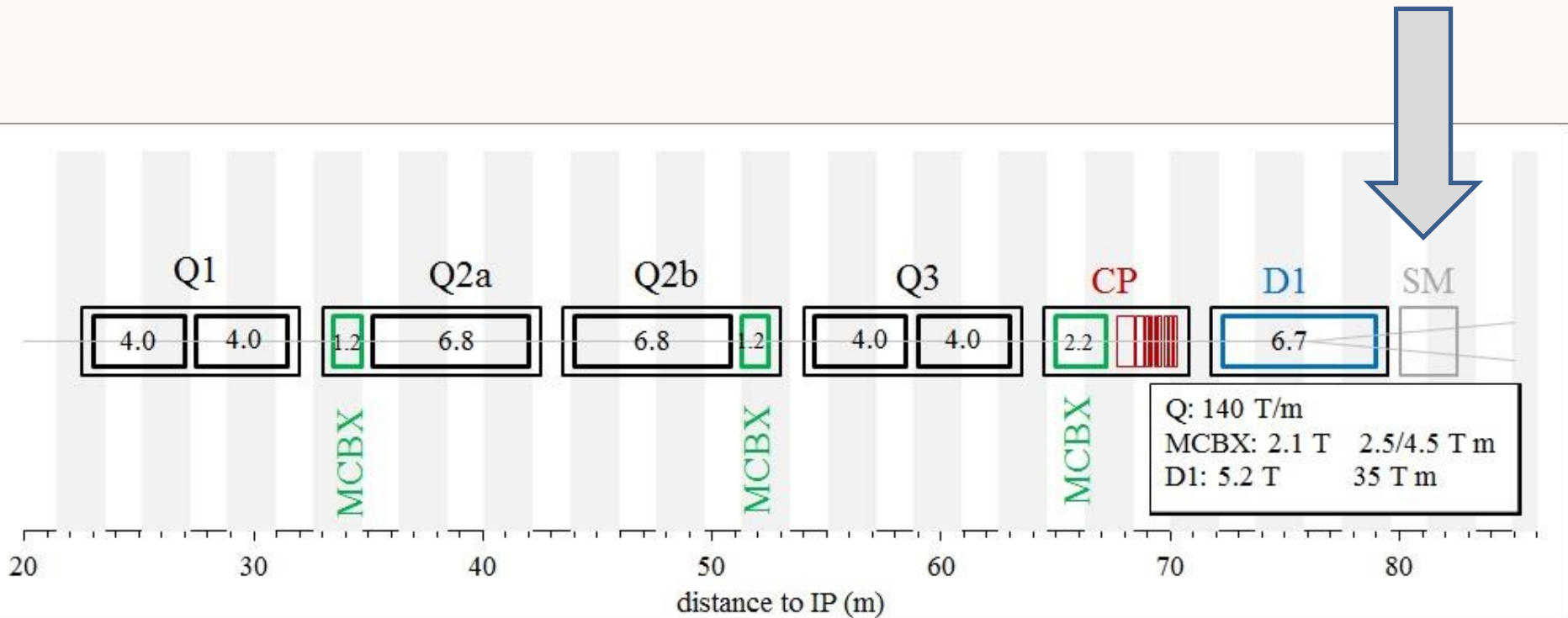
**Maximum operating temperature of the cables = 25 K**

**He gas cooling**

**Operation in self-field ( $B < 1 \text{ T}$ )**

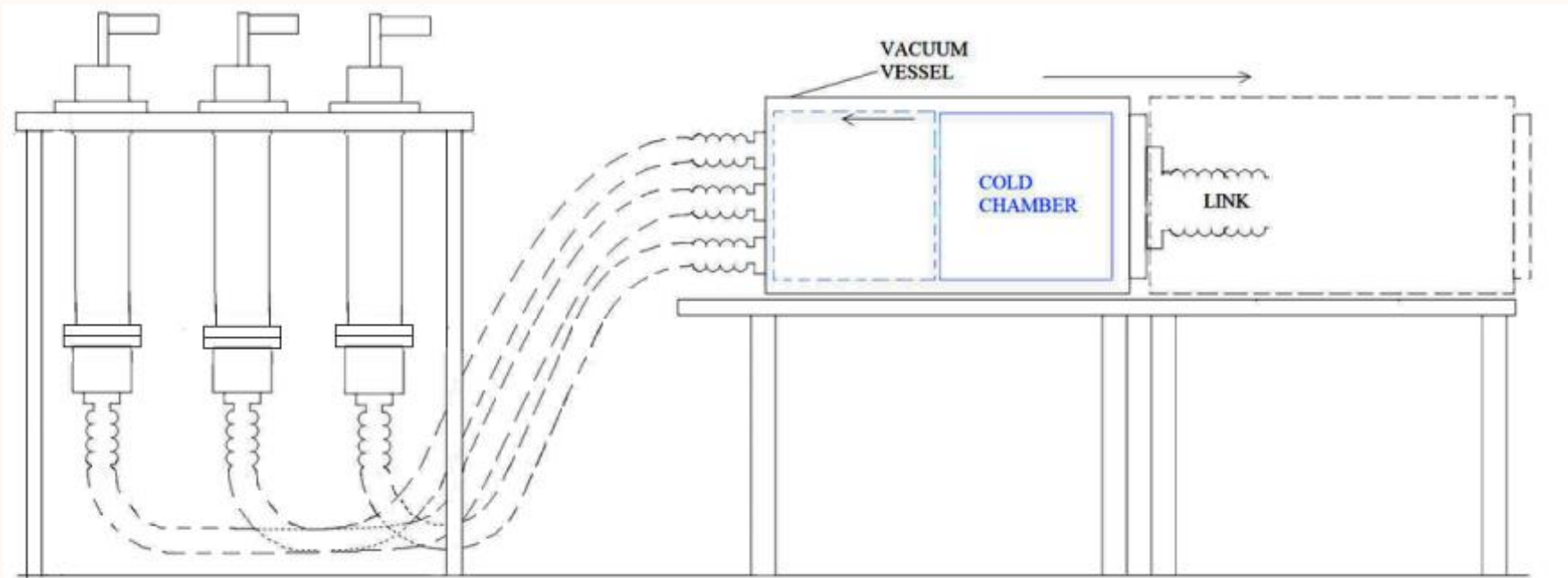
# In the tunnel

Nb-Ti to HTS connections  
Cryogenic supply



E. Todesco

# At the surface or in TZ 76

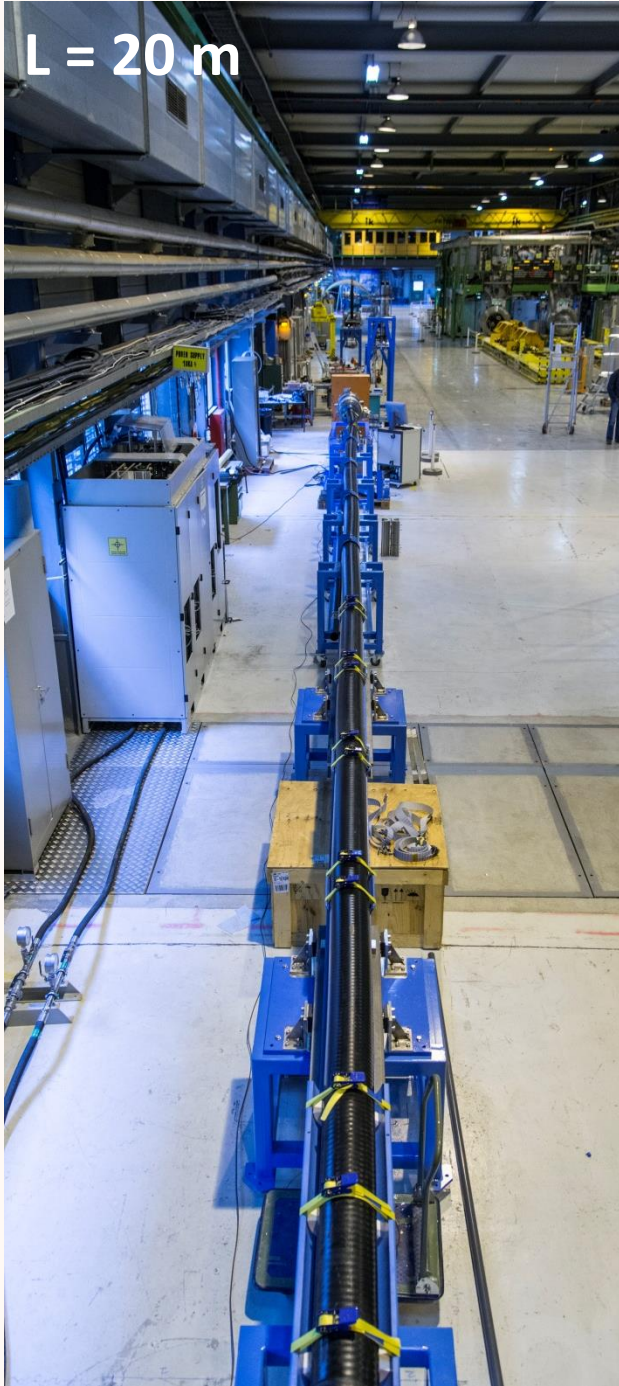


**New concept: no DFB cryostat**

Conceptual design at the University of Southampton, Task 3 of WP 6



$L = 20 \text{ m}$



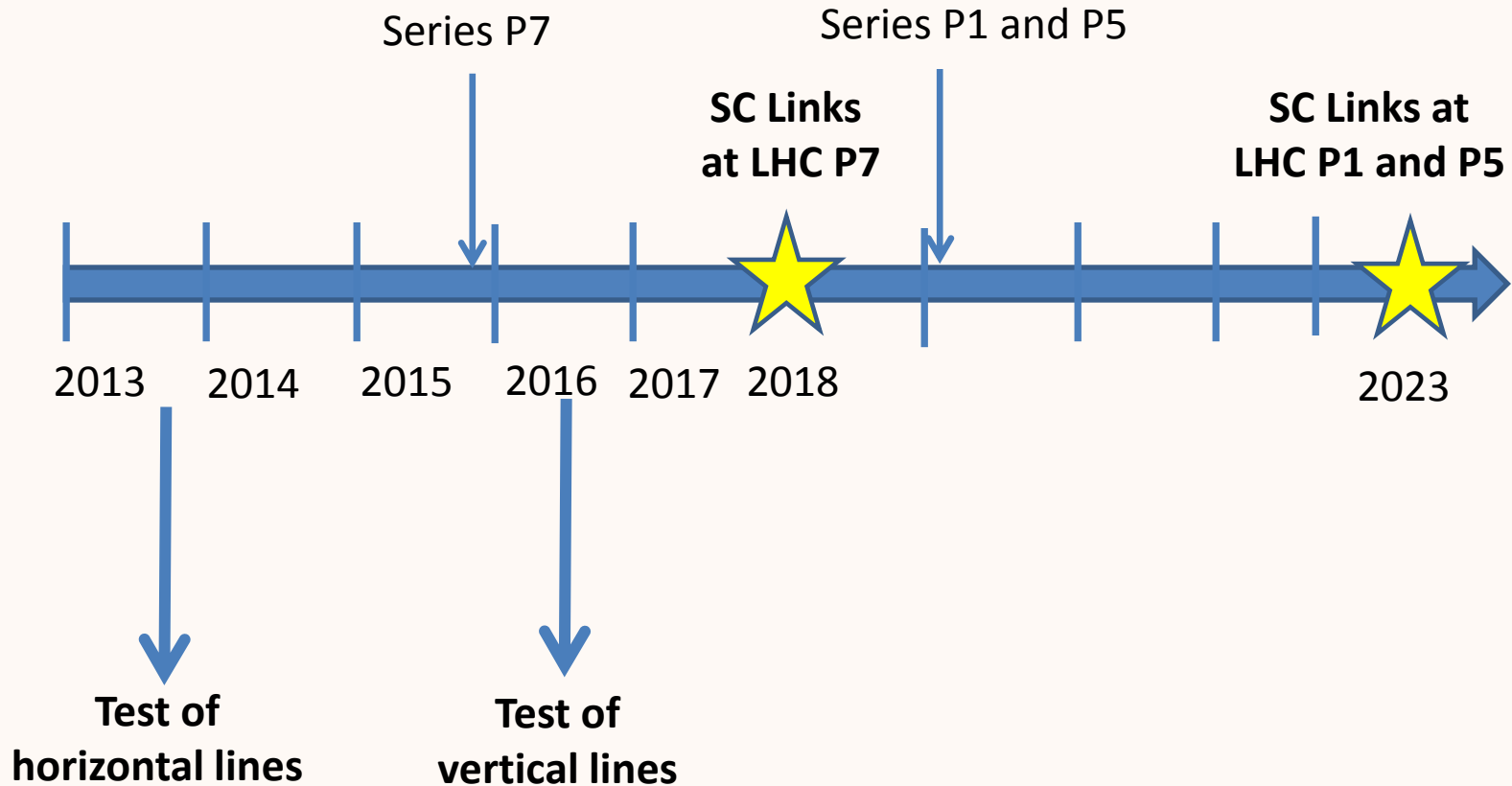
$H \sim 4 \text{ m}$



# Timeline

**Today:**

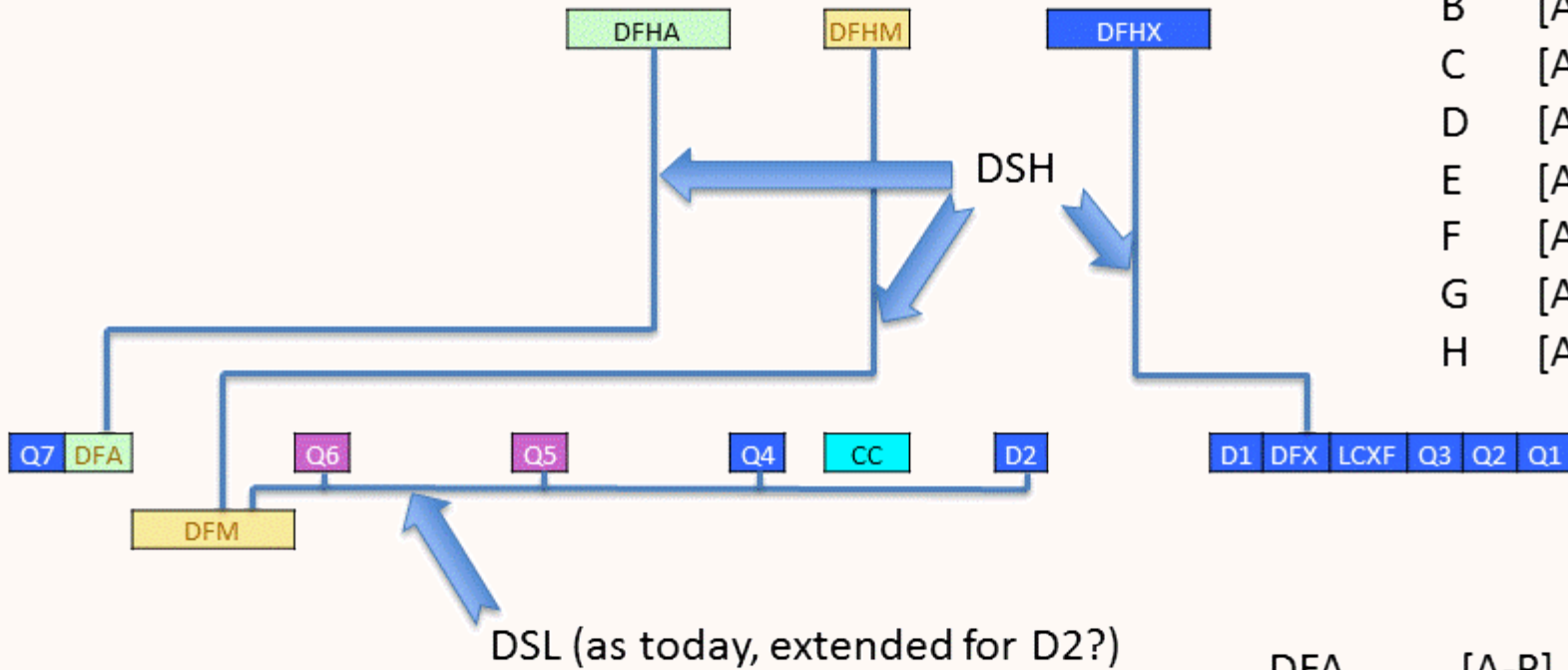
**Development and test of 20 kA @ 24 K MgB<sub>2</sub> SC-Link 20 m long**



# Naming Proposal

DFHA [A-H] (or [A-P]?)  
 DFHM idem  
 DFHX [A-D]

DSH A [A-F]  
 B [A-F]  
 C [A-B]  
 D [A-D]  
 E [A-F]  
 F [A-D]  
 G [A-B]  
 H [A-F]



DFA [A-P]  
 DFM [A-P]  
 DFX [A-H]

*Thanks for your attention*