



# Readiness of test bench for D2 prototype

A Vande Craen on behalf of the test team



WP3 meeting – Towards D2 prototype test – 16/02/2022

# Test configuration

Connection to LHC test benches using flexible hoses, no major modification of the CFB needed

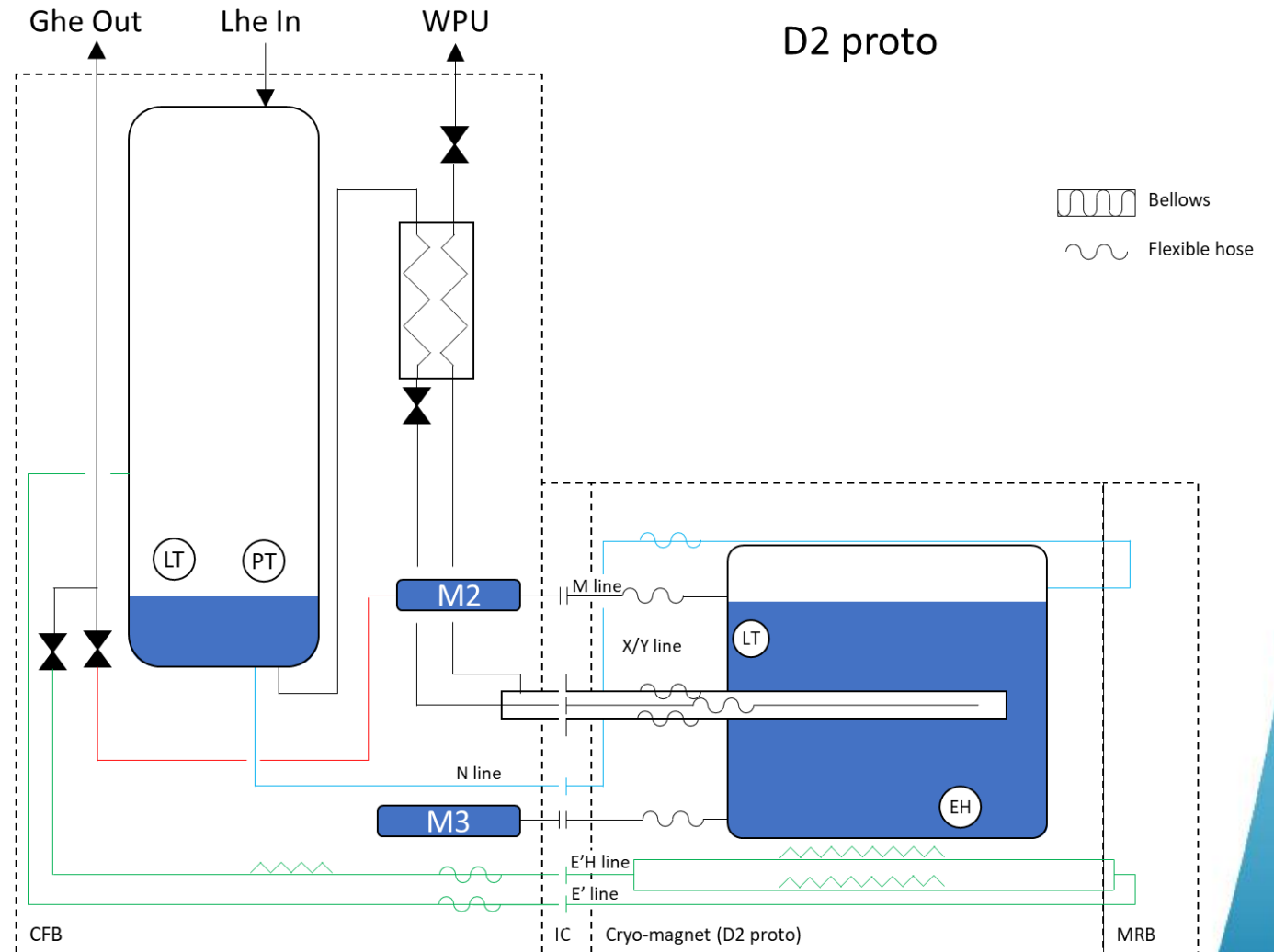
Cryogenic configuration similar to MQXFP

Cold mass turned by 180 on bench

- No impact on cryogenic operation
- Impact on cryostat configuration

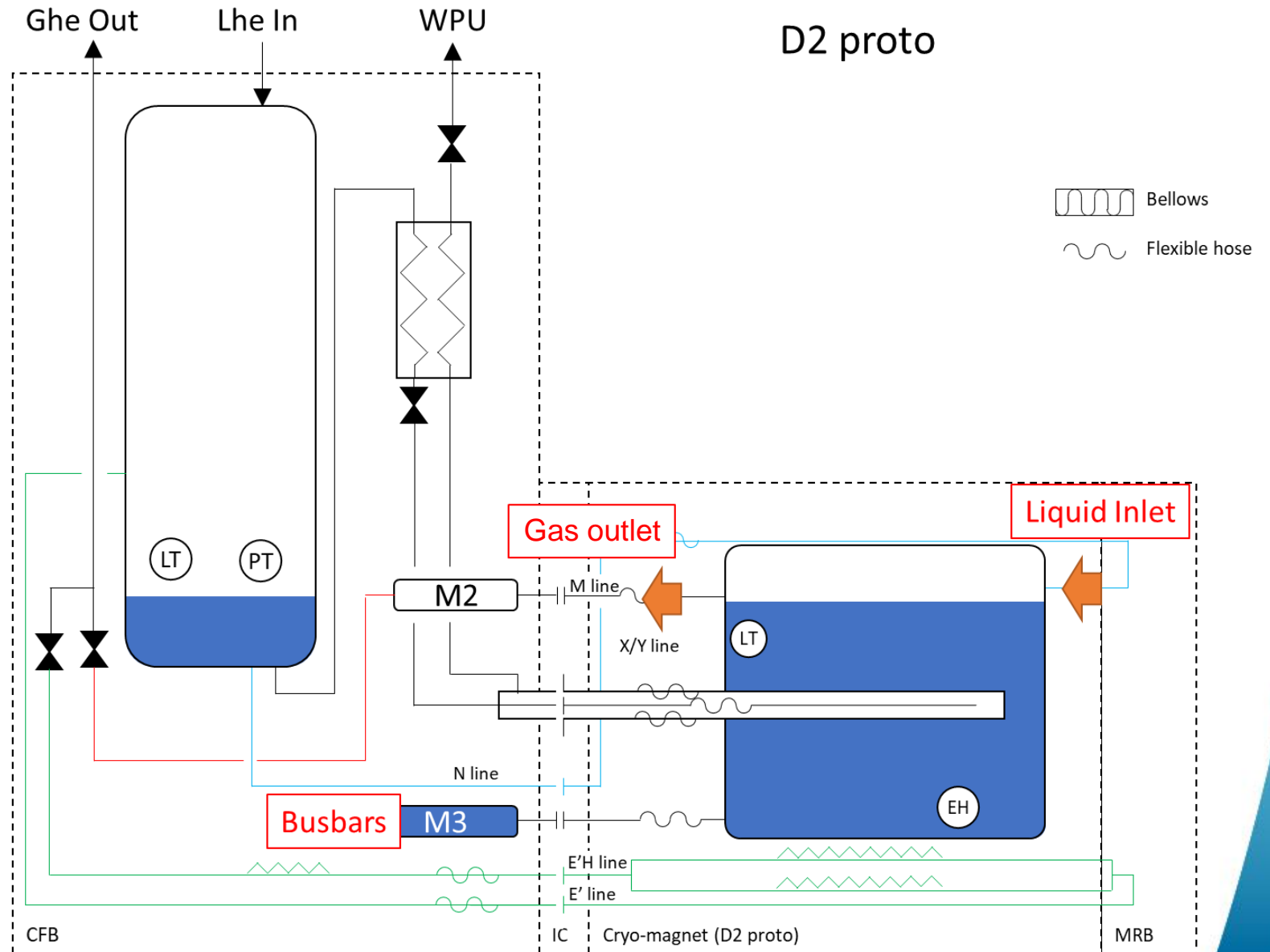
Use of LHC cryogenic configuration

- N line = helium liquid inlet
- M2 line = helium gas return
- X/Y line = heat exchanger



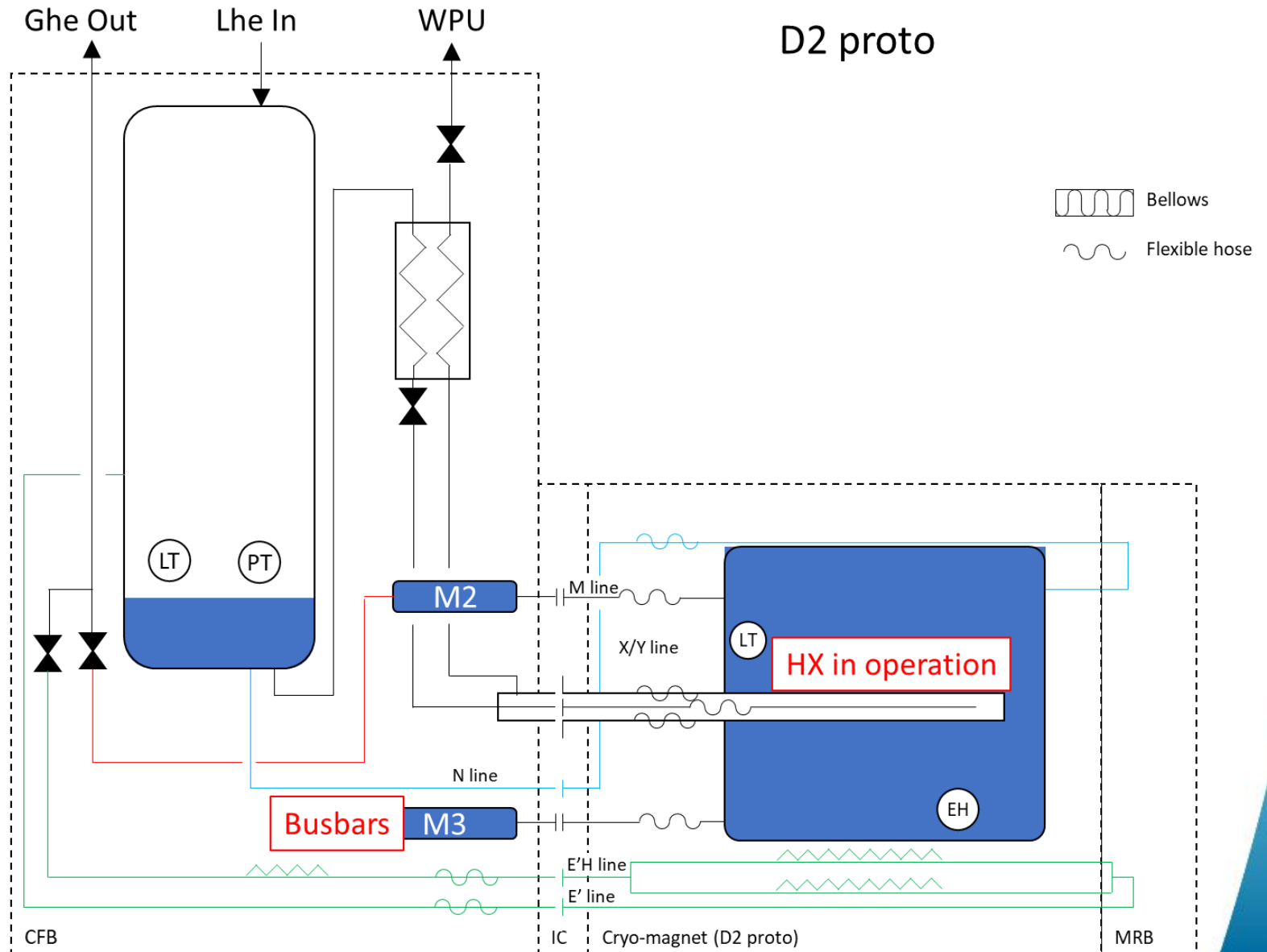
# 4.5 K operation

- Level controlled above coil level
- Separation dipole busbars in liquid helium
- Corrector's busbars in gaseous helium

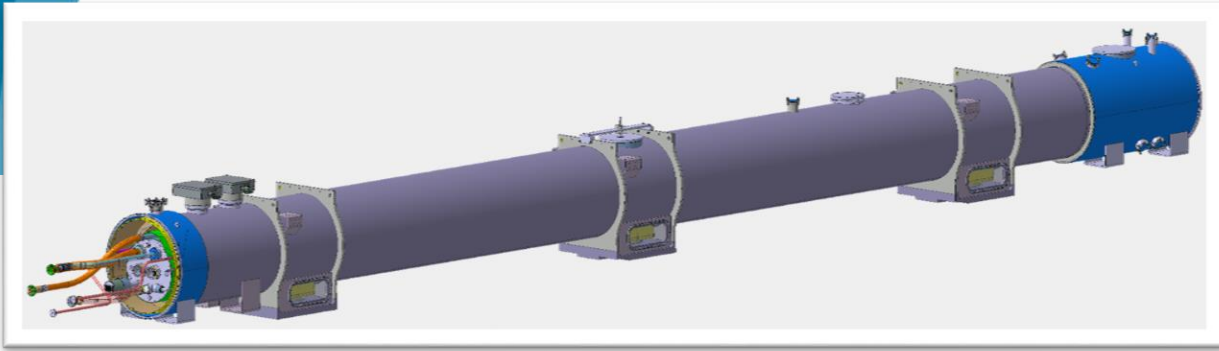


# 1.9 K operation

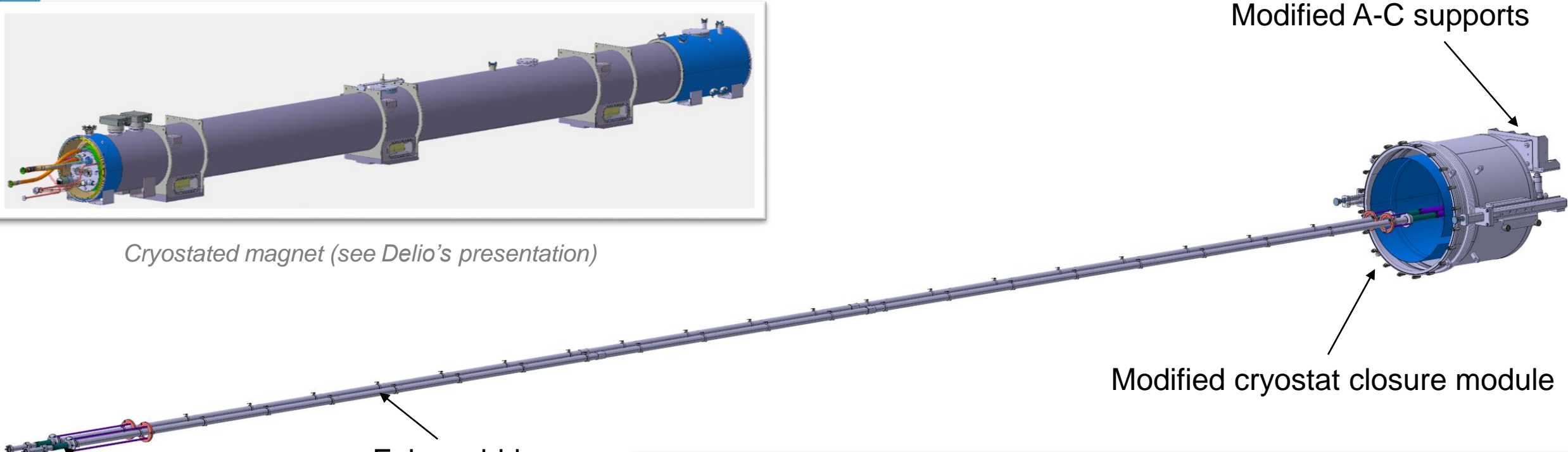
- Heat exchanger in operation
- Subcooled liquid → cold mass filled with liquid
- All busbars in liquid



# Cryo-magnet test configuration



*Cryostated magnet (see Delio's presentation)*



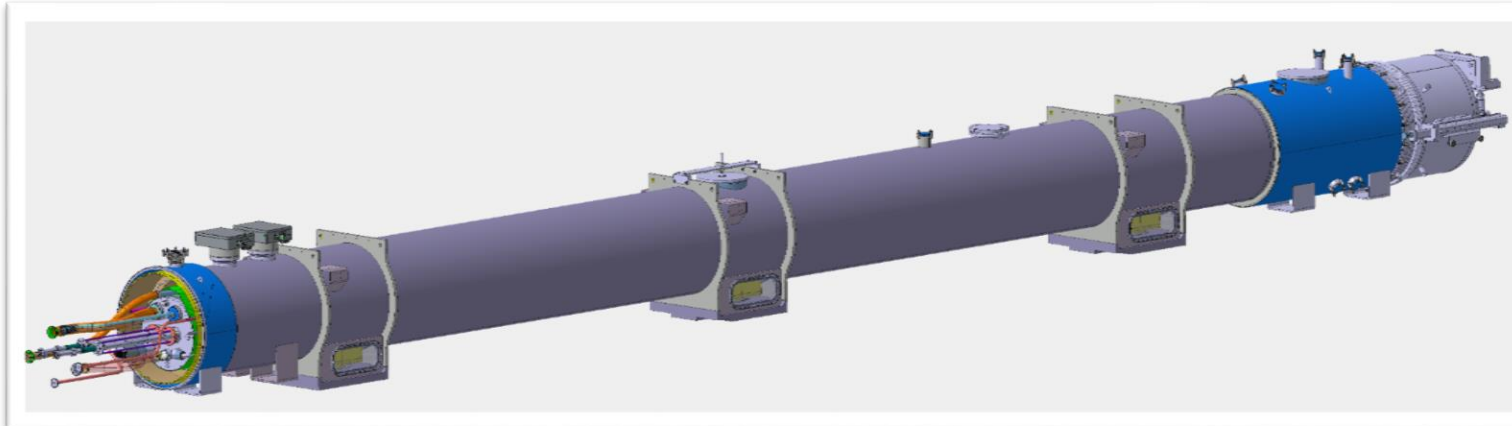
Modified A-C supports

Modified cryostat closure module

Fake cold-bore

LHC dipole anti-cryostat

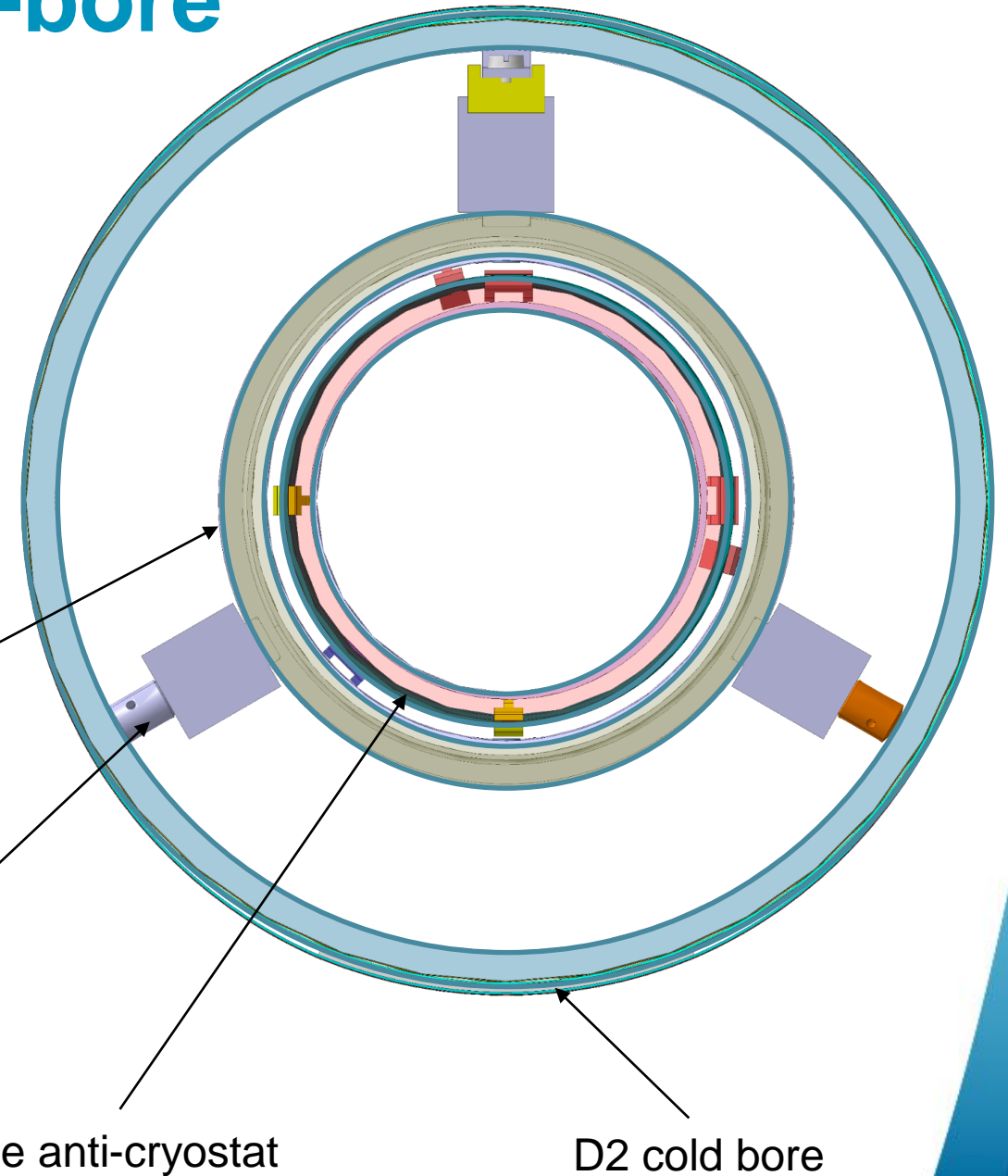
200 mm LHC anti-cryostat extension



*Test configuration*

# Fake cold-bore

- LHC dipole anti-cryostat : made for  $\varnothing$  50 mm cold bore
- D2 cold bore :  $\varnothing$ 94 mm
- Use of a “fake LHC cold-bore”(inner  $\varnothing$  50mm) centred into D2 cold bore using specific support



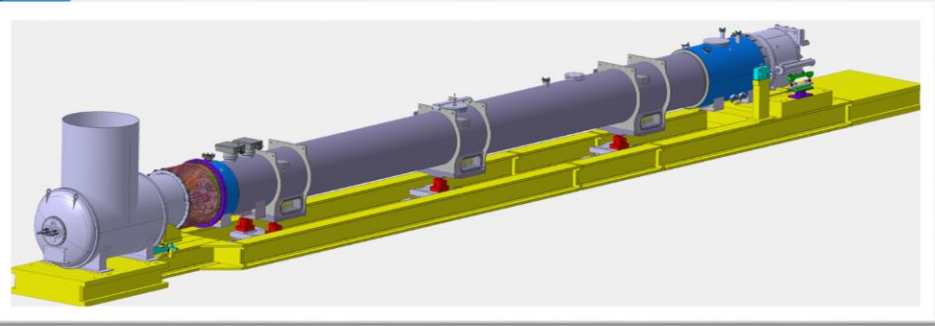
Fake-cold bore

Supports to center fake cold-bore in D2 cold bore  
(evenly distributed over length of D2, spaced of 700 mm)

LHC dipole anti-cryostat

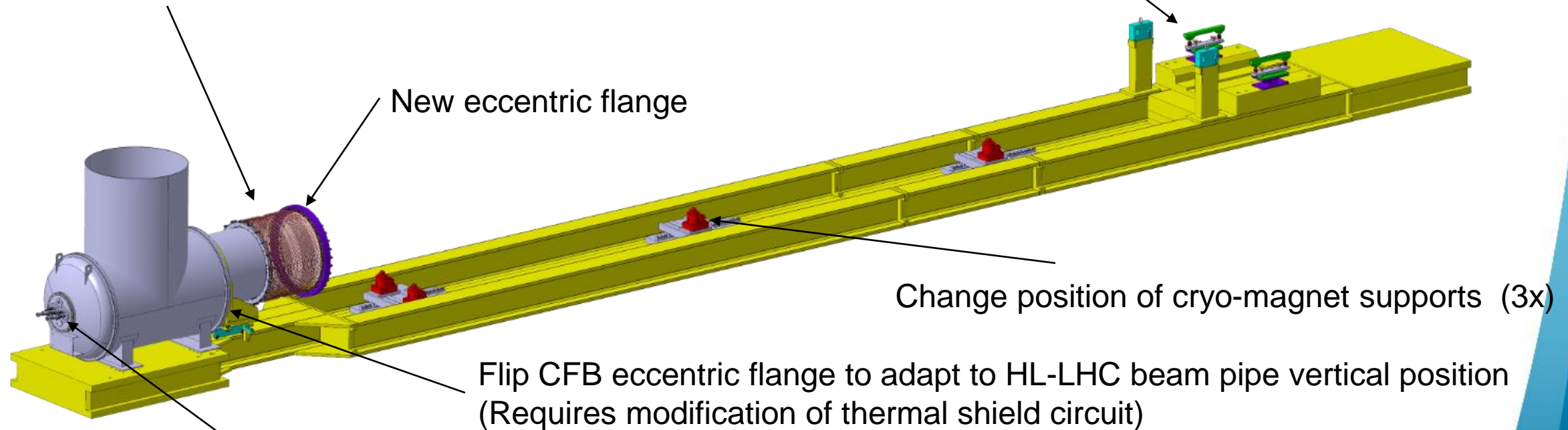
D2 cold bore

# Test bench configuration



Change position of MRB supports

Specific interconnection vacuum vessel and thermal shield



New eccentric flange

Change position of cryo-magnet supports (3x)

Flip CFB eccentric flange to adapt to HL-LHC beam pipe vertical position  
(Requires modification of thermal shield circuit)

Adapt spacing between anti-cryostat to D2 (identical to LHC-D2)

# Component's readiness

Completed BOM available  
Assembly drawings under preparation

- Long lead items: in stock
  - Vacuum vessel extensions and eccentric flange
  - Thermal shield extensions and eccentric
  - Anti-cryostats
  - Fake cold-bores for LHC-D2
- Bench modification completed: ready for test
  - CFB (cryogenic feedbox)
  - MRB (cryostat closure module)
  - Test bench (position of cryostat supports)
- To be fabricated (drawings released)
  - Extensions of support for fake cold bore
  - Anti-cryostat extensions
  - Anti-cryostat supports in MRB



*Modified MRB*



*Eccentric thermal shield*



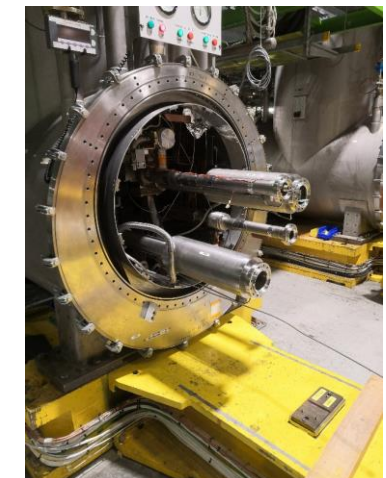
*Eccentric VV flange*



*Bench ready*



*Vacuum vessel extension*



*Modified CFB*



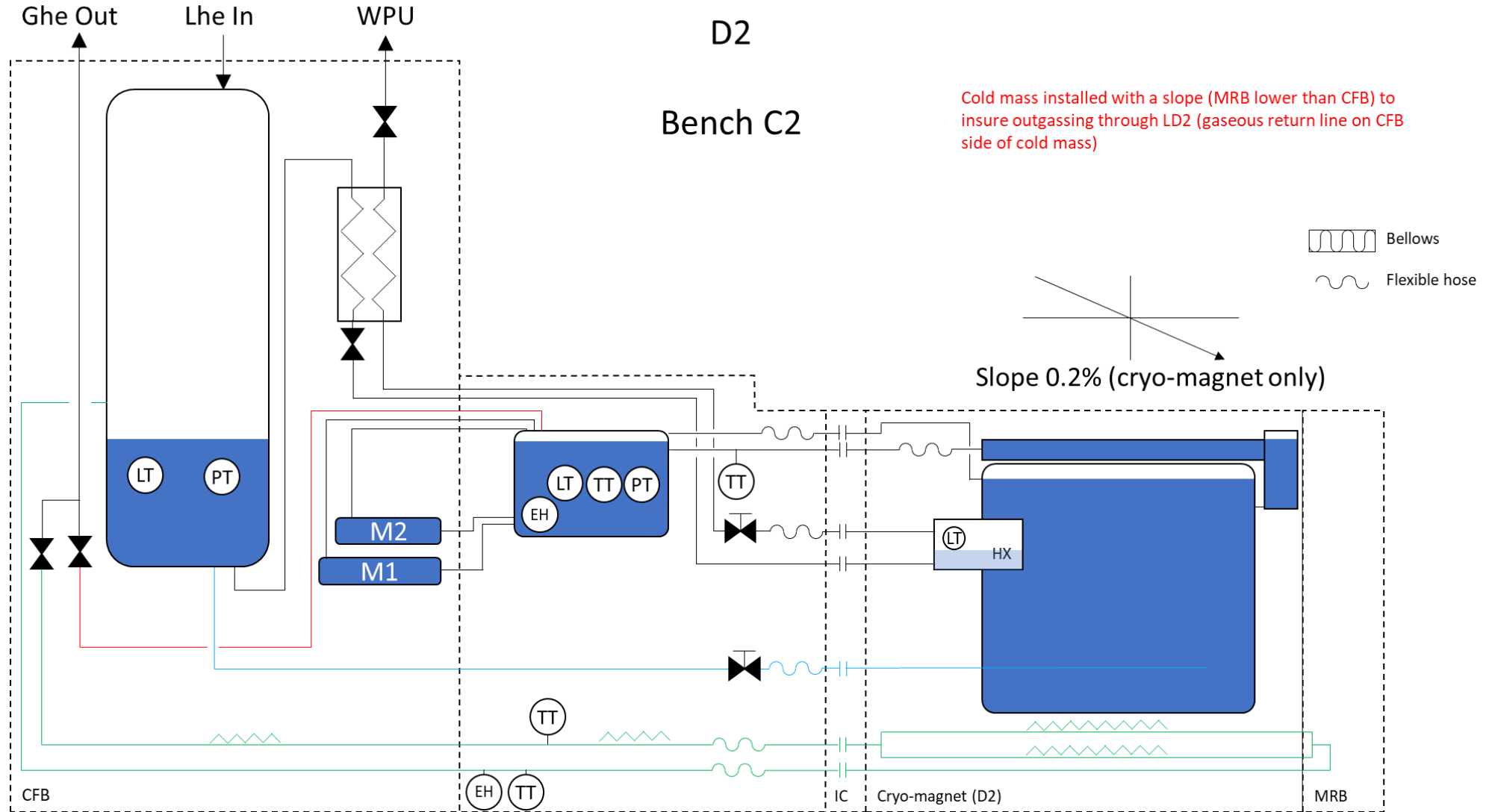
# Planning

- All components for testing magnet will be available for May 2022

	2021				2022					
	9	10	11	12	1	2	3	4	5	6
<b>D2 direct connect (C2)</b>										
Design										
Bench modification										
Manufacturing #1 (VV + TS)										
Manufacturing #2										
A-C and supports assembly										
<b>Magnet testing</b>										

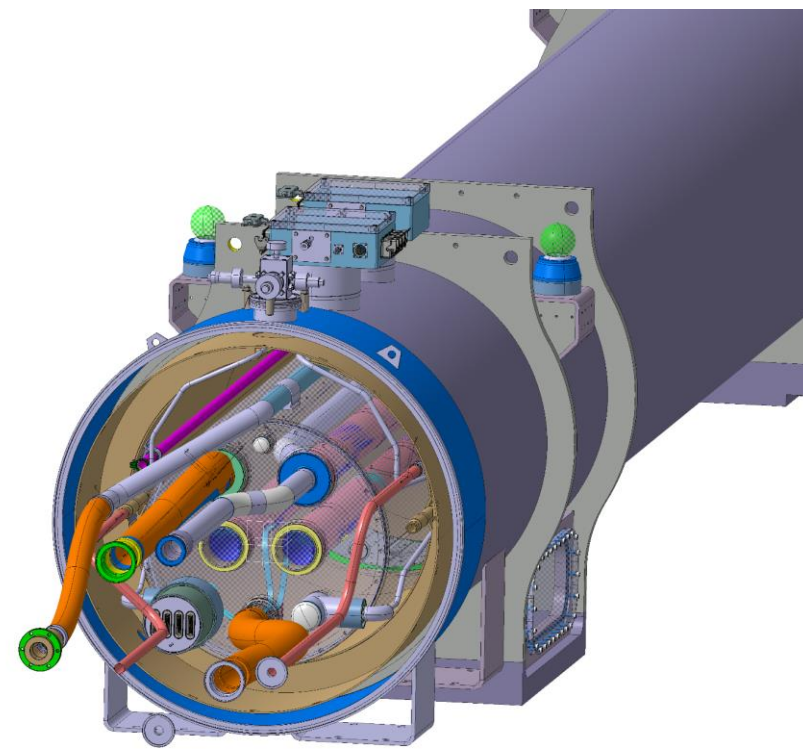
# Spare slides

# PFD of series D2

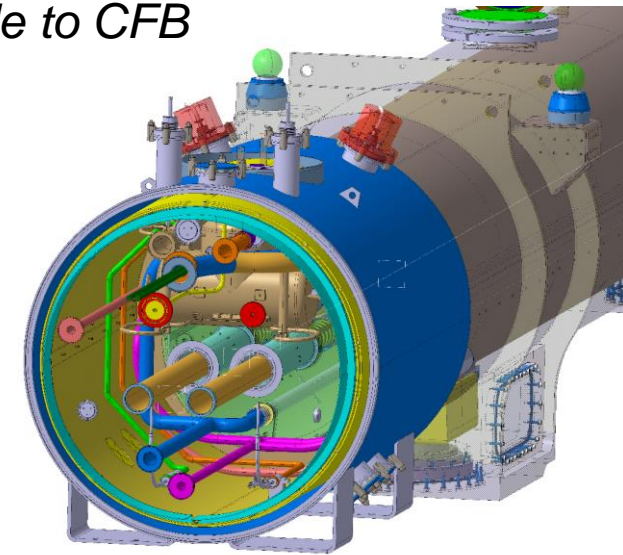


# Cold mass and cryostat

- Modified cold mass
  - Change routing of busbars in cold mass
  - Exchange flat end
  - Modified extremities + flexible hoses/piping
  - Use of bayonet heat exchanger
- Modified cryostat
  - Connect cryostat from IP side (instead of non-IP on shuffling module)
  - Change thermal shield pipes routing
  - Use VSC flange for connection of cold mass mechanical instrumentation



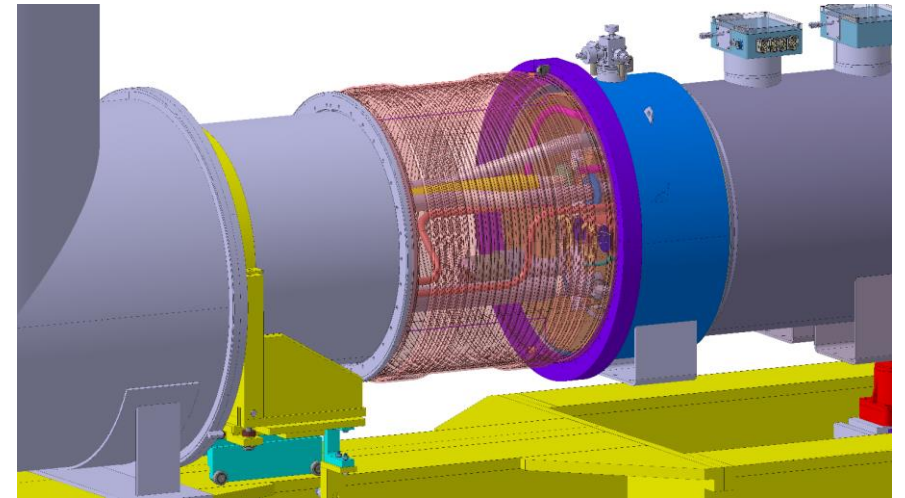
*D2 proto connection side to CFB*



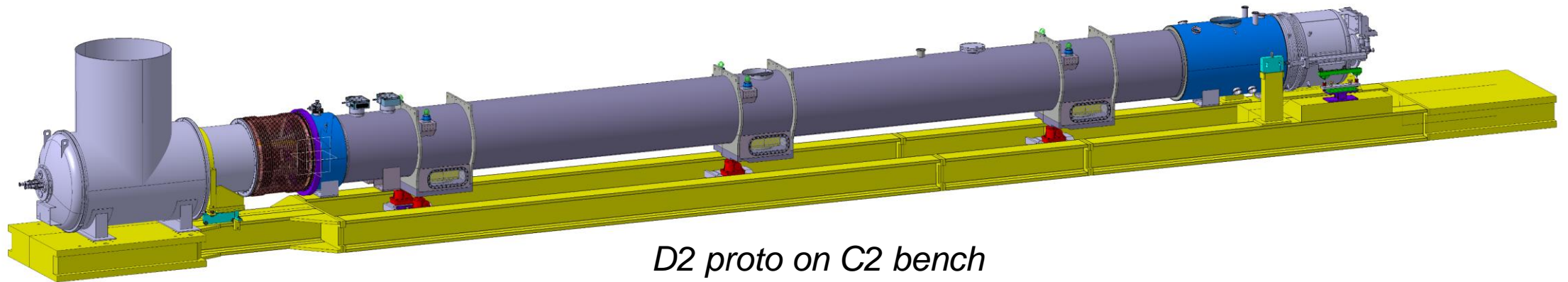
*D2 series*

# Test bench

- Turn the CFB eccentric upside down
  - Modification of the thermal shield
  - Modification of the cooling circuit
  - Already done one A1 bench
- Re-use of Vacuum Vessel extension of LHC undulator (770 mm + short W bellows)
- New components required
  - Eccentric flange for D2
- Study needed for support positioning
  - Eccentric thermal shield



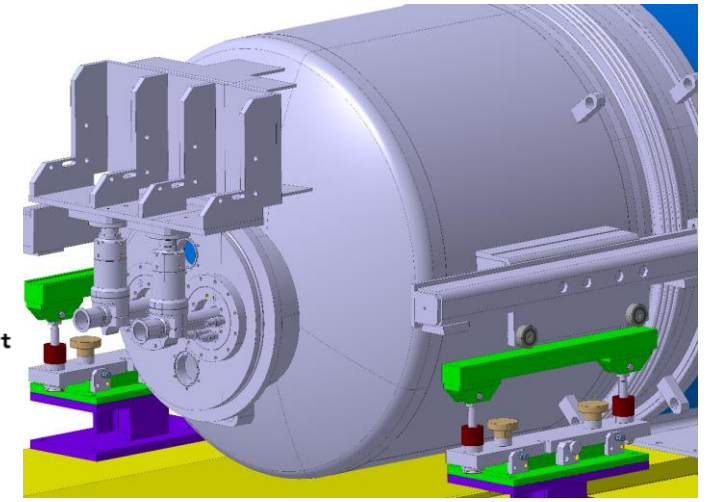
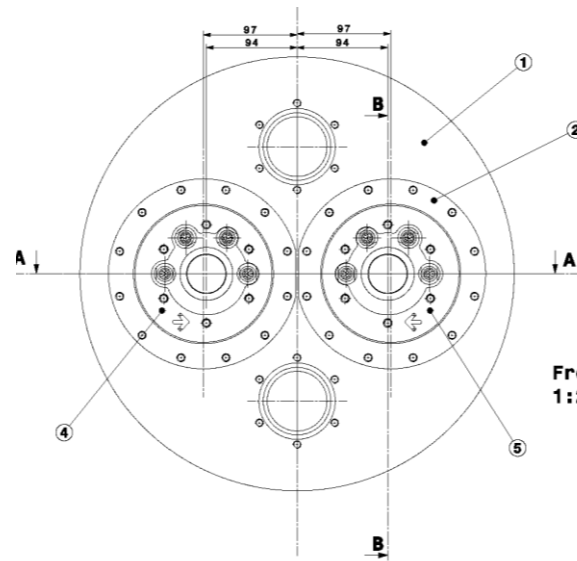
*Interconnection area (extension + eccentric ring)*



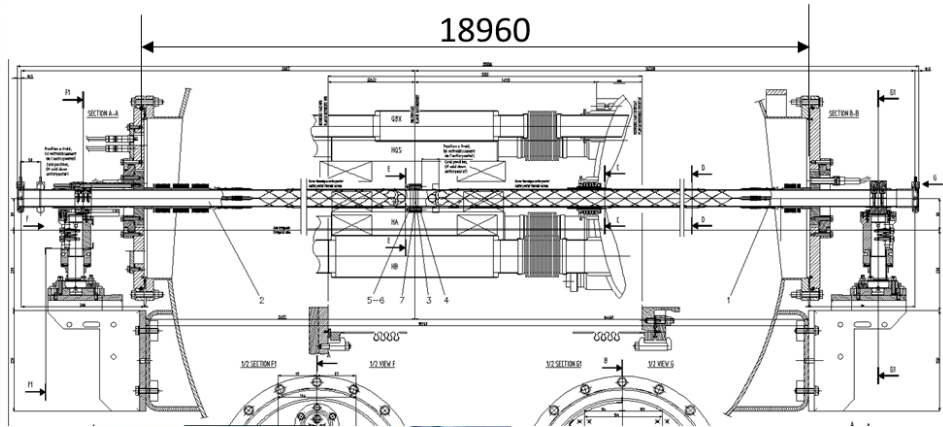
*D2 proto on C2 bench*

# Anti-cryostat

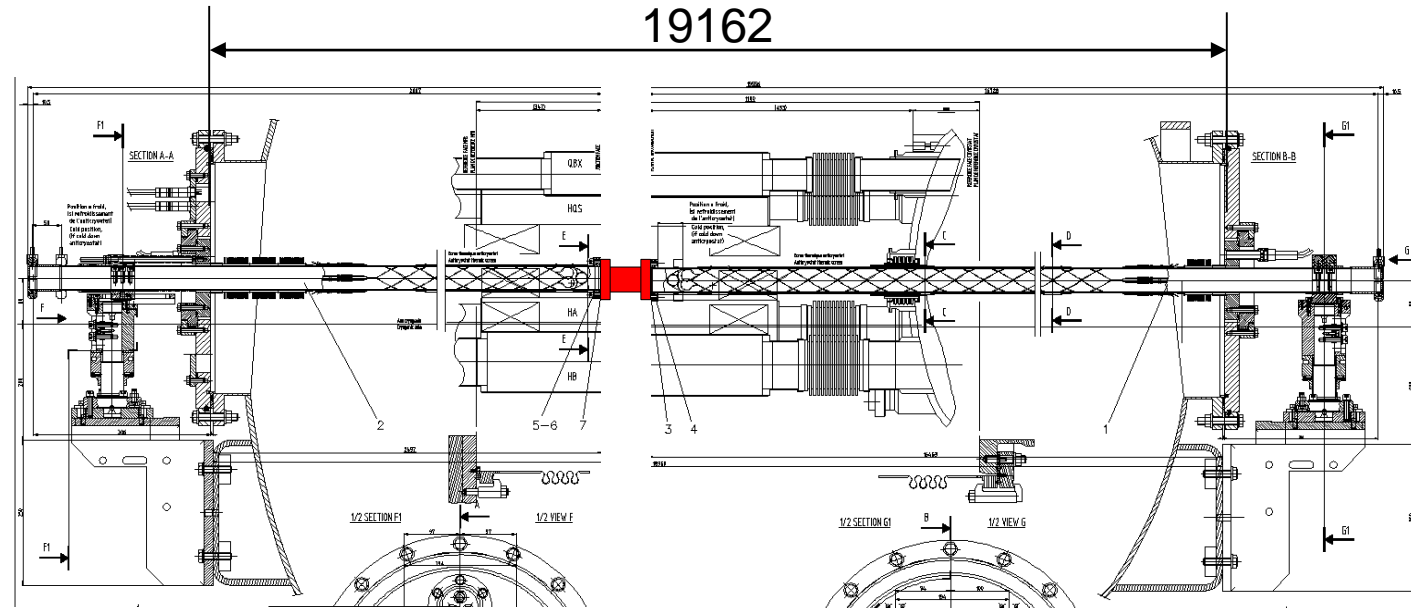
- LHC anti-cryostat
  - ~200 mm too short → Add an A-C extension in interconnection
  - Small diameter → need centering pieces in cold bore
- Different beam line spacing from dipole
  - Re-use eccentric plates for LHC D2 → Correct spacing (188 mm)



*MRB turned upside down + eccentric for 188 mm beam line spacing*



**HiLumi** HL-LHC PROJECT *LHC dipole configuration*



*D2 proto configuration*