MQXFB 8.1m horizontal test cryostat
Progress report

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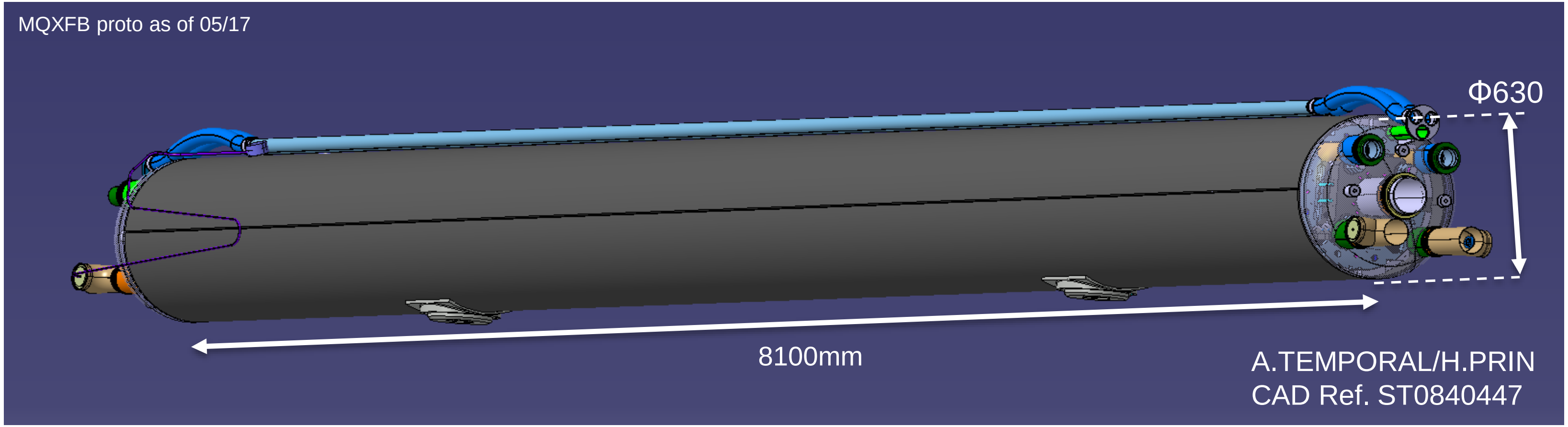
07/03/2018

Context and scope

The first MQXFB 8.1m magnet (no correctors) will be ready to be tested in Feb 2019.

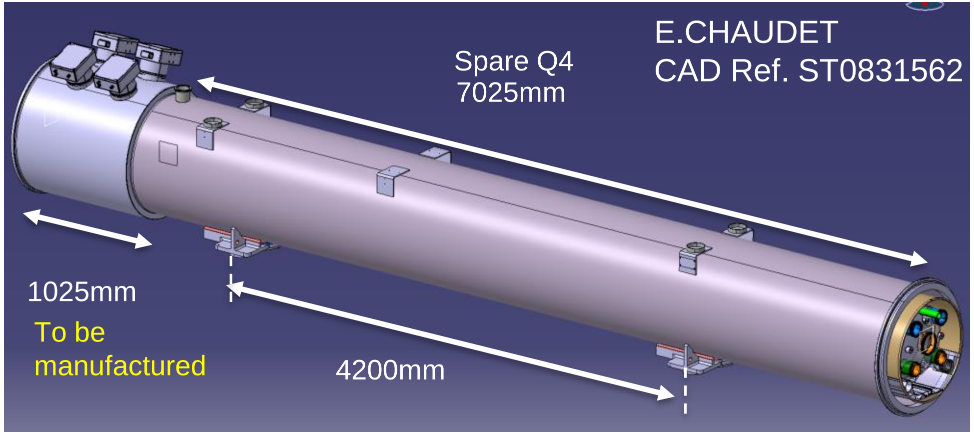
The final triplet cryostat (and cryostating bench) will not be ready before the summer 2019 and are made to house a 10m cold mass (with corrector).

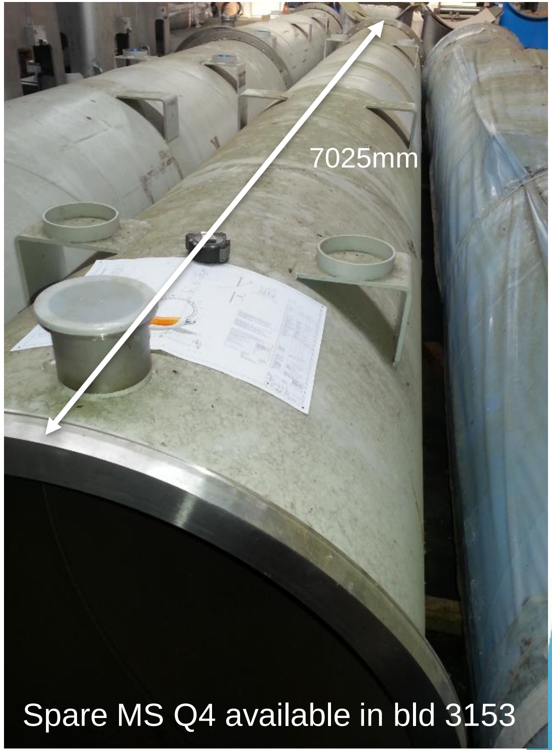
→ This calls for a dedicated test cryostat only for the first MQXFB



In order to provide a suitable cryostat for this activity it was decided to **reuse and adapt a spare LHC MS Q4 cryostat** to fit the dimensions displayed above and provide an exit routing for the instrumentation.

Housing the 8.1m long cold mass



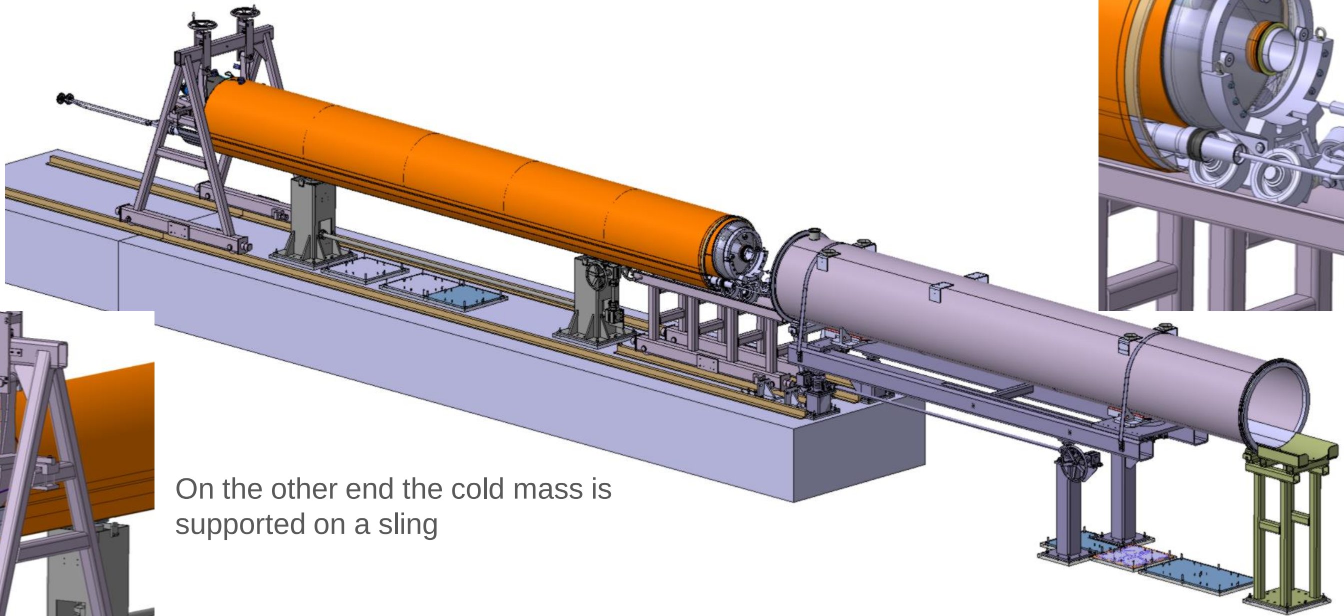


Spare MS Q4 available in bld 3153

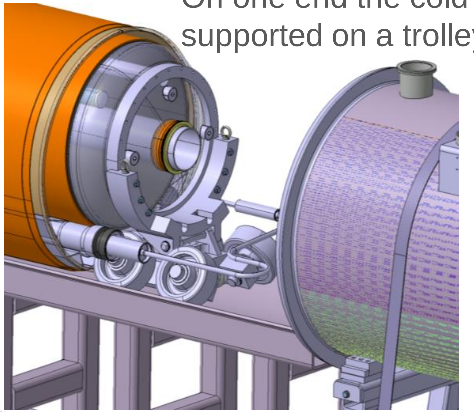
- By manufacturing a dedicated extension, the cold mass will fit in length in a spare Q4 cryostat now available.
  - The cryostat must be reusable as LHC spare after MQXF testing
- The cold foot location is given by the vacuum vessel type – inter foot distance is 4.2m
  - Cold mass sag will be higher than with the final MQXF cryostat (final cryostat will come with 3 feet)
- According to the instrumentation list proposed by MSC/MDT – 4 IFS are overseen

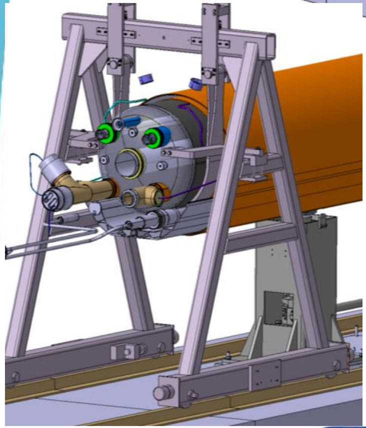
Pulling it altogether

The cold mass will be cryostated using the SSS cryostating bench :



On one end the cold mass is supported on a trolley





On the other end the cold mass is supported on a sling

Dedicated study of the cold mass behavior under cryostating has validated the principle (CM sag of 6.4mm) wrt cold mass integrity

– [EDMS 1830795]

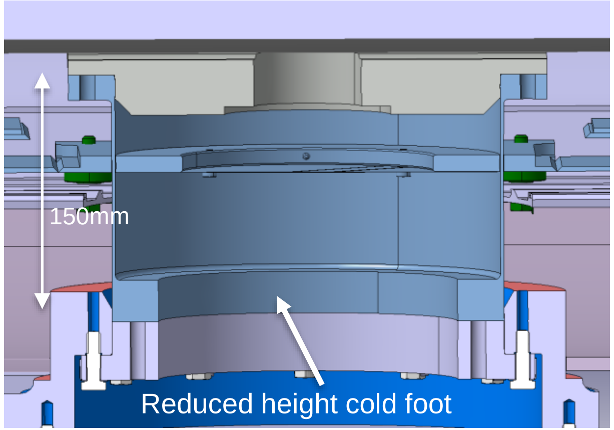
However the vacuum vessel is too thin to roll the cold mass in and needs reinforcement – [EDMS 184878]

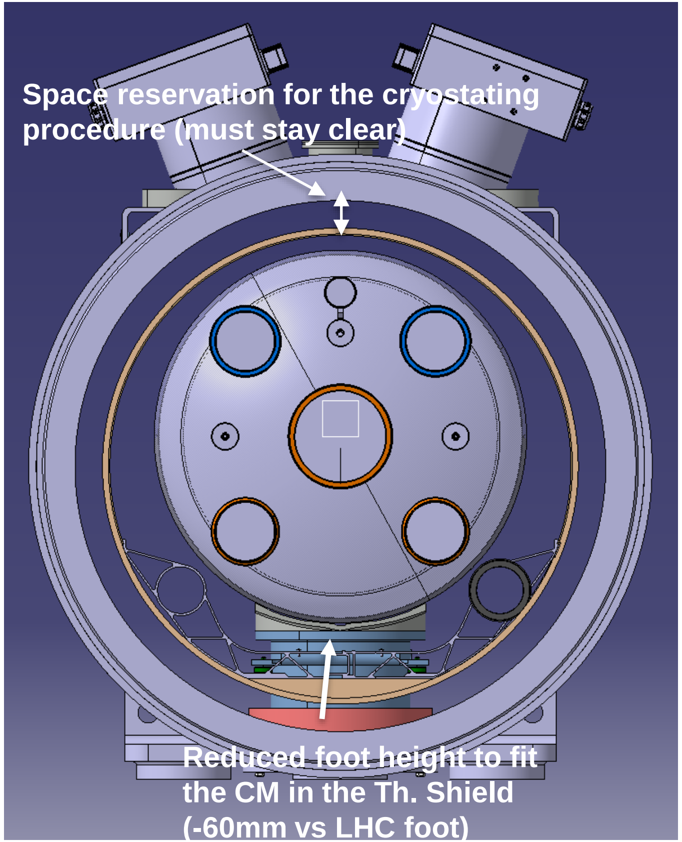
Housing the 8.1m long and 630mm wide cold mass

- ❑ The MQXF bigger diameter calls for the design of dedicated cold foot to limit the total height (limited by cryostating procedure).

A collaboration with EP/DT is being setup to produce new LHC-like cold supports (4mm wall GFRE supports).

→ These will be machined in-house from prepreg glass fibers.





How much will it cost ?

Note: the following values are a rough estimates of the final cost at this stage of the project. These costs will be updated and made available in the cryostat wrap up report.

Design studies – ~70 kCHF - 95% completed:

CAD – 55 kCHF (920h @ 60CHF/h)

Engineering studies – 16 kCHF (~1y@15%FTE@60CHF/h)

Manufacturing – ~55 kCHF - 5% completed :

QQS manufacturing ~10kCHF

Cold support manufacturing ~20 kCHF

Cryostating bench modifications ~5 kCHF

Vacuum vessel reinforcement ~5 kCHF

Bottom tray ~6kCHF

Total cryostat cost – ~120 kCHF

Conclusion

- ✓ Throughout 2017, studies for the adaptation of a spare cryostat have been carried out. → this looks feasible
- ✓ The cost of adapting a spare cryostat for a new cold mass is around 100 kCHF
  → not as cheap and straightforward as it may have seemed.
- ✓ We are ready to carry on with manufacturing – no obvious show stopper to be ready in 02/2019 from where we stand

Thank you

	Material (kCHF)	Plate rolling (hrs)	Machining (hrs)	Man hour (hrs)	Total
Vacuum vessel reinforcement	3.5	24	8	24	4.5 kCHF
Cryostating bench modifications	1	/	40	/	4 kCHF
QQS manufacturing	3	8	40	40	10 kCHF
Cold support manufacturing	2	/	40	240 (3wks, 2FTE)	21 kCHF
Total	9.5	32	128	302	40 kCHF

+ bottom tray machining +5 kCHF
+ MLI supply +5kCHF
+ small parts and unforeseen → +5kCHF = 55 kCHF

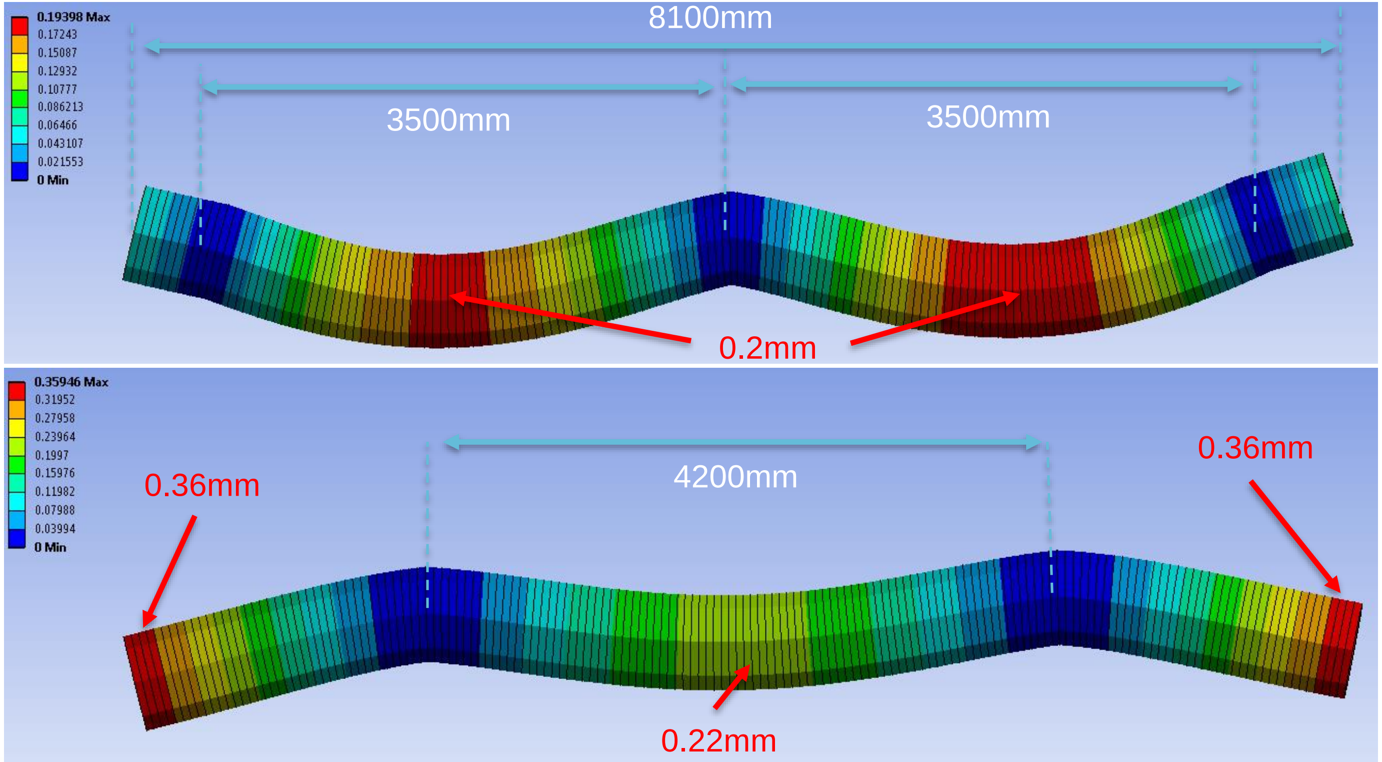
Technical drawings

MQXF Horizontal test cryostat

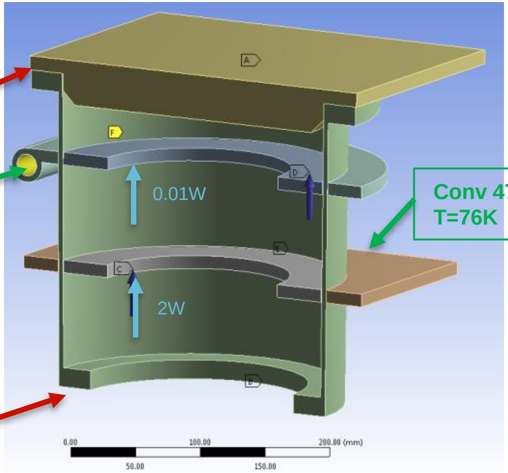
MQXF COLD MASS FOR TEST

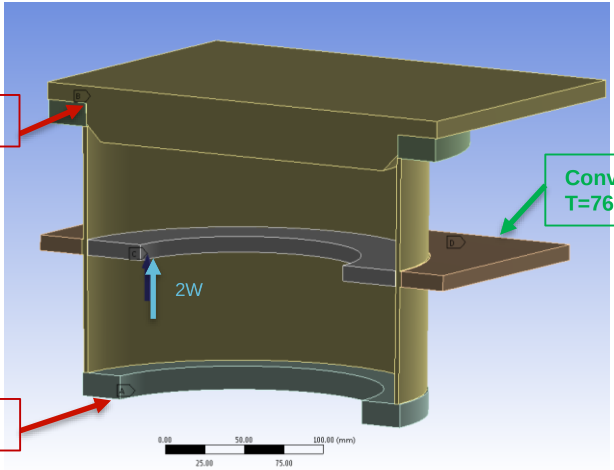
Cold mass sag study wrt. support position

Hypothesis: only the 316L shell is considered for stiffness (R_{ext} =315mm/Rint=307mm).
linear weight retained = 2.3T/m



Design driver 3 – Heat load on the 1.9K cold mass





Material	thickness	Heat flux to E-line (W)	Heat flux to He 5K (W)	Heat flux to cold mass (W)
G10	4	7.7	0.7	0.05
Stainless steel	2	39.4	/	8.5
	3	52.8	/	14.3
Titanium	3	31.6	/	7.3

/!\ Values pertain to a ½ foot (x2 to get power on the cold mass)