



Update on MQXF

Paolo Ferracin
on behalf of the MQXF collaboration

WP3 Meeting
05 Decemeber 2017
CERN

Acknowledgments

- CERN

- A. Ballarino, H. Bajas, M. Bajko, B. Bordini, J.C. Perez, S. Izquierdo Bermudez, J. Ferradas Troitino, P. Fessia, C. Fichera, L. Fiscarelli, L. Fleiter, P. Grosclaude, M. Guinchard, P. Hagen, O. Housiaux, F. Lackner, P. Moyret, H. Prin, E. Rochepault, S. Sequeira Tavares, E. Todesco, G. Vallone

- BNL

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- FNAL

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- H. Felice

- LASA

- V. Marinozzi, M. Sorbi

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- T. Salmi



Outline

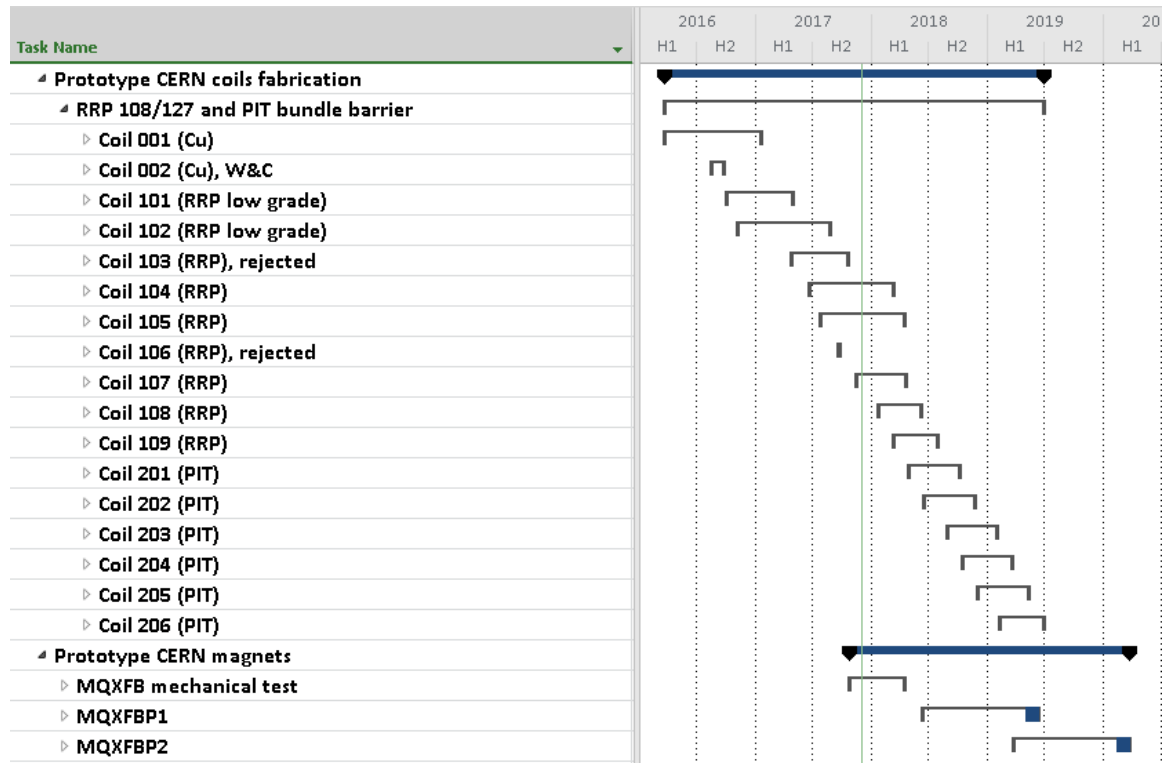
- Status of procurement of components
 - What and how much, when, where (storage)
- Status and plans for short models
 - Coil fabrication and tests
- Status and plans for prototype
 - Coil fabrication and tests
- AUP plans for the next 2 years

Outline

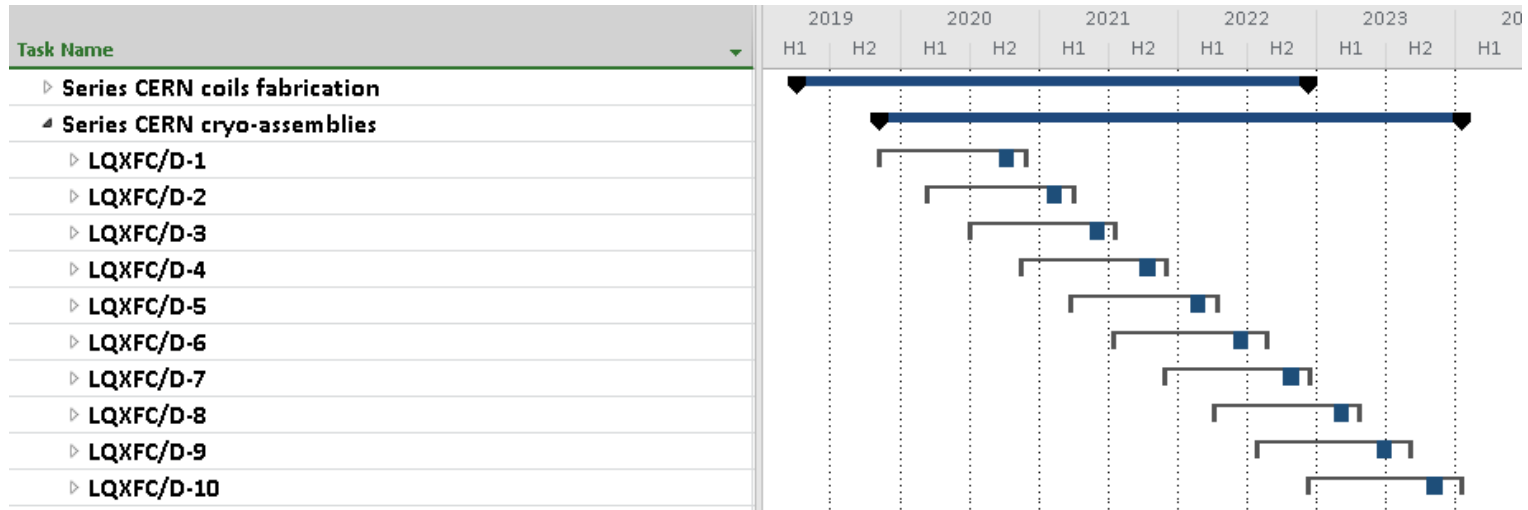
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Some milestones (prototypes)

- **MQXFBP1**
 - Assembly: 06/18
 - Test: 05/19
- **MQXFBP2**
 - Assembly: 04/19
 - Test: 02/20



Some milestones (series)



- First **series coil**
 - Fabrication begins in 04/19
- First **series magnet**
 - Assembly begins in 11/19

Procurement coil components

Coil parts	MQXFBP1	MQXFBP2	Series	Comments
Cable insulation	On going	Order placed	Order placed	
End-parts (spacers, end-shoe)	Delivered	Delivered	All by 08/18	
Poles and end-shoe extensions	Delivered	Delivered	All by 08/18	
Coating for end-parts	Delivered	Order to be placed	Order to be placed	Company qualified found
Wedge	Delivered	Delivered	All by 08/18	
Traces	Delivered	Order to be placed	Order to be placed	IT completed
Mid-plane shim	Delivered	Delivered	All by 12/17	

- First **MQXFBP1 coil (103)**
 - Fabrication started in 05/17
- First **MQXFBP2 coil (201)**
 - Fabrication begins in 05/18
- First **series coil**
 - Fabrication begins in 04/19

Procurement magnet components

- MQXFBP1: Assembly in 06/18;
- MQXFBP2: Assembly in 04/19
- First series magnet: assembly begins in 11/19

Magnet support structure	MQXFBP1	MQXFBP2	Series	Comments
Nitronic material (no armco)	Delivered	Delivered	Delivered	
Thick ARMCO	Delivered	Delivered	All by 04/18	
Aluminum material	Delivered	Delivered	Starting in 03/18	
Aluminum shell	Delivered	Order by 02/18	Starting in 01/19	MQXFBP2 order after mech test
Thick yoke	Delivered	Order by 02/18	Starting in 04/19	MQXFBP2 order after mech test
Thick pad	Delivered	Order by 02/18	Starting in 04/19	MQXFBP2 order after mech test
Collars	Delivered	Order by 02/18	Starting in 04/19	MQXFBP2 order after mech test
Master	Delivered	Order by 02/18	Starting in 01/19	MQXFBP2 order after mech test
End-plate	Delivered	Order by 02/18	Starting in 01/19	MQXFBP2 order after mech test
Thin yoke	Delivered	Order by 02/18	MS to be (re)done	MQXFBP2 order after mech test
Thin pad	Delivered	Order by 02/18	MS to be (re)done	MQXFBP2 order after mech test
Keys	Delivered	Delivered	Delivered	
Bushings	Delivered	Delivered	All by 02/18	
Tie-rods	Delivered	Delivered	Delivered	
Rods	All by 01/18	All by 01/18	All by 01/18	
Pushers SS	All by 01/18	All by 01/18	All by 01/18	
Pushers G11	Delivered	Delivered	Delivered	
Bullets	All by 01/18	All by 01/18	All by 01/18	
Welding blocks	All by 01/18	All by 01/18	All by 01/18	
Backing strip	Delivered	All by 04/18	All by 04/18	
Pole key	Delivered	Delivered	All by 02/18	
Bladders	All by 01/18	Not ordered	Not ordered	

Procurement cold mass components

- MQXFBP1 cold mass: Assembly in 10/18
- MQXFBP2 cold mass: Assembly in 07/19
- First series cold mass: Assembly in 03/20

Cold mass	MQXFBP1	MQXFBP2	Series	Comments
Stainless steel shells material	Delivered	Delivered	IT done, order soon	
Stainless steel shells fabrication	Starting in 04/18	Starting in 04/18	MS to be started in 12/18	
End covers	Not ordered	Not ordered	Not ordered	Design in progress
Heat exchanger tubes	All by 03/18	All by 03/18	Not ordered	

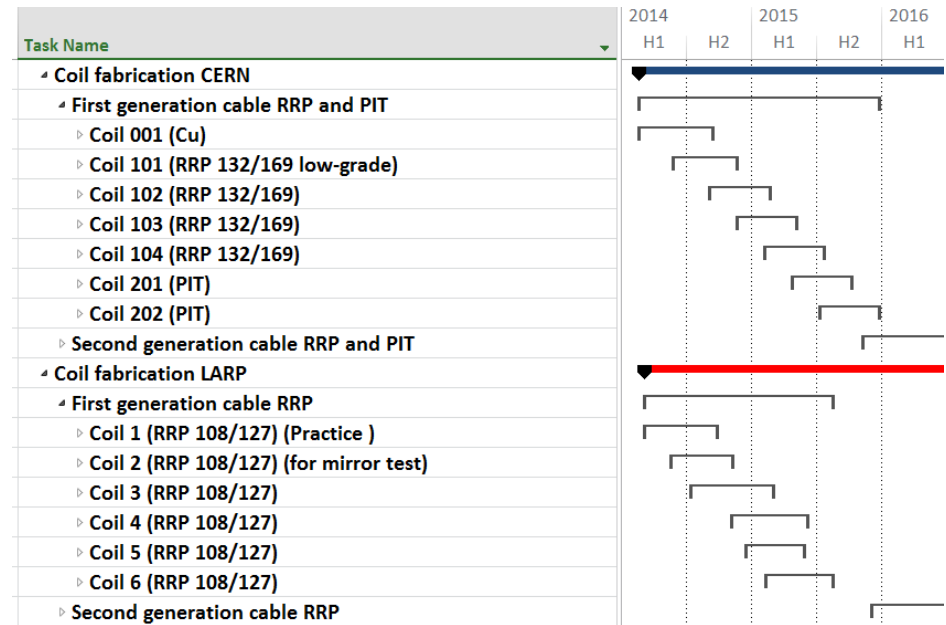
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Short model program

Coil fabrication

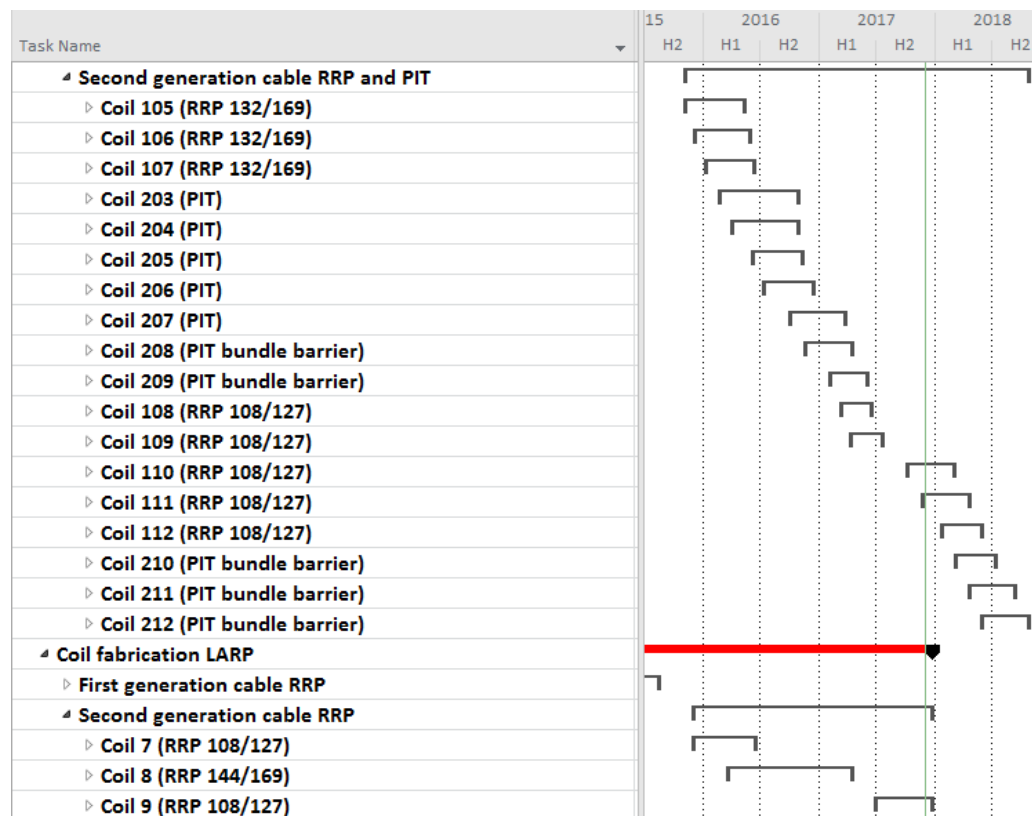
- 1st generation coils: **13**
 - CERN: **7**
 - 1 Cu and 1 low-grade
 - 3 RRP 132/169 and 2 PIT
 - LARP: **6**
 - All RRP 108/127
- Available for test: **8**
- **1** tested in MQXFSM1
 - Coil 2
- **4** tested in MQXFS1
 - 103,104,3,5
- **4** not tested (MQXFS2)
 - 102 (splice issue)
 - 201- 202 (low J_c and RRR)
 - Coil 6



Short model program

Coil fabrication

- 2st generation coils: **21** planned
 - CERN: **18**
 - RRP: 3 (132/169) and 5 (108/127)
 - PIT: 5 (no barrier) and 5 (barrier)
 - LARP: **3**
 - RRP 1 (144/169) and 2 (108/127)
- **5** to be tested in MQXFS3
 - 105,106,107,7 (8)
- **5** to be tested in MQXFS5
 - 203,204,205,206 (207)
- **5** to be tested in MQXFS4
 - 108,109,110,111 (112)
- **5** to be tested in MQXFS6
 - 208,209,210,211 (212)
- **1** to be tested in MQXFS1e
 - 9



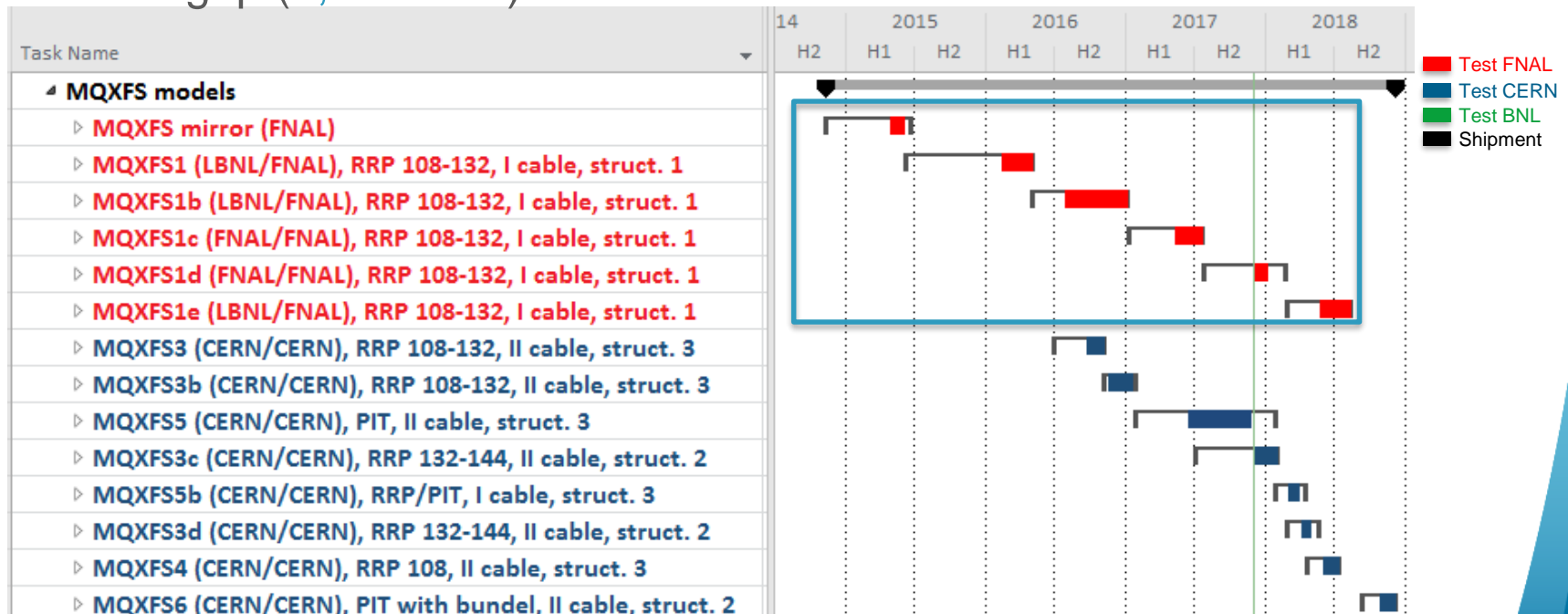
Short model program

Coil fabrication

- Summary
 - **27** coils fabricated from early 2014
 - **19** by CERN
 - **8** by LARP
 - **7** coils to be fabricated by mid 2018
 - **6** by CERN
 - **1** by LARP
 - Total: **34** coils
- Spare or not tested (without major NC)
 - 2nd generation: 207, 107, 212
 - 1st generation: 6

Short model program Magnets

- MQXFS mirror
- MQXFS1
 - RRP coils, first generation cable (a)
 - azimuthal and axial increase (b and c)
 - Stainless steel shell (d, in 01/18) and coil with smaller wedge gap (e, in 05/18)



Short model program

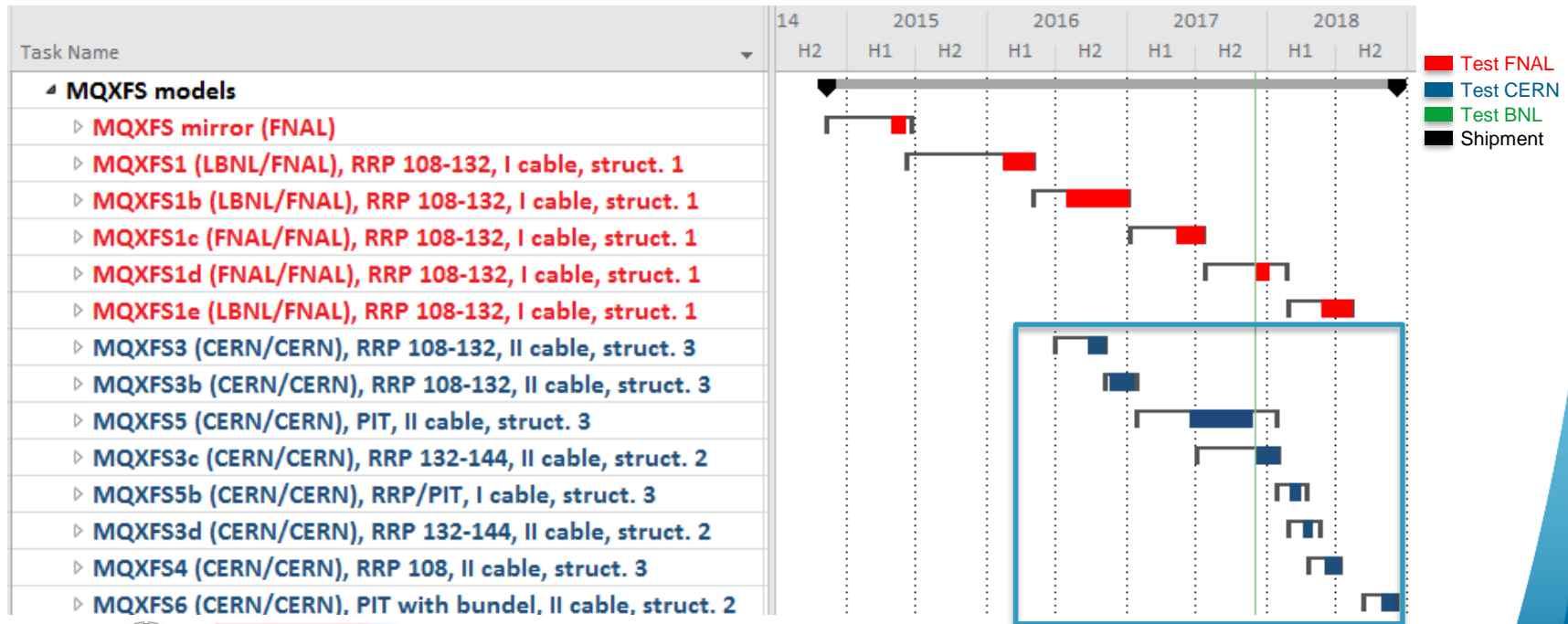
Magnets

- **MQXFS3**

- RRP coils, second generation cable (a)
 - Axial increase (b), change of coil with azimuthal increase (c, *in progress*), stainless steel shell + beam screen (d, *in 04/18*)

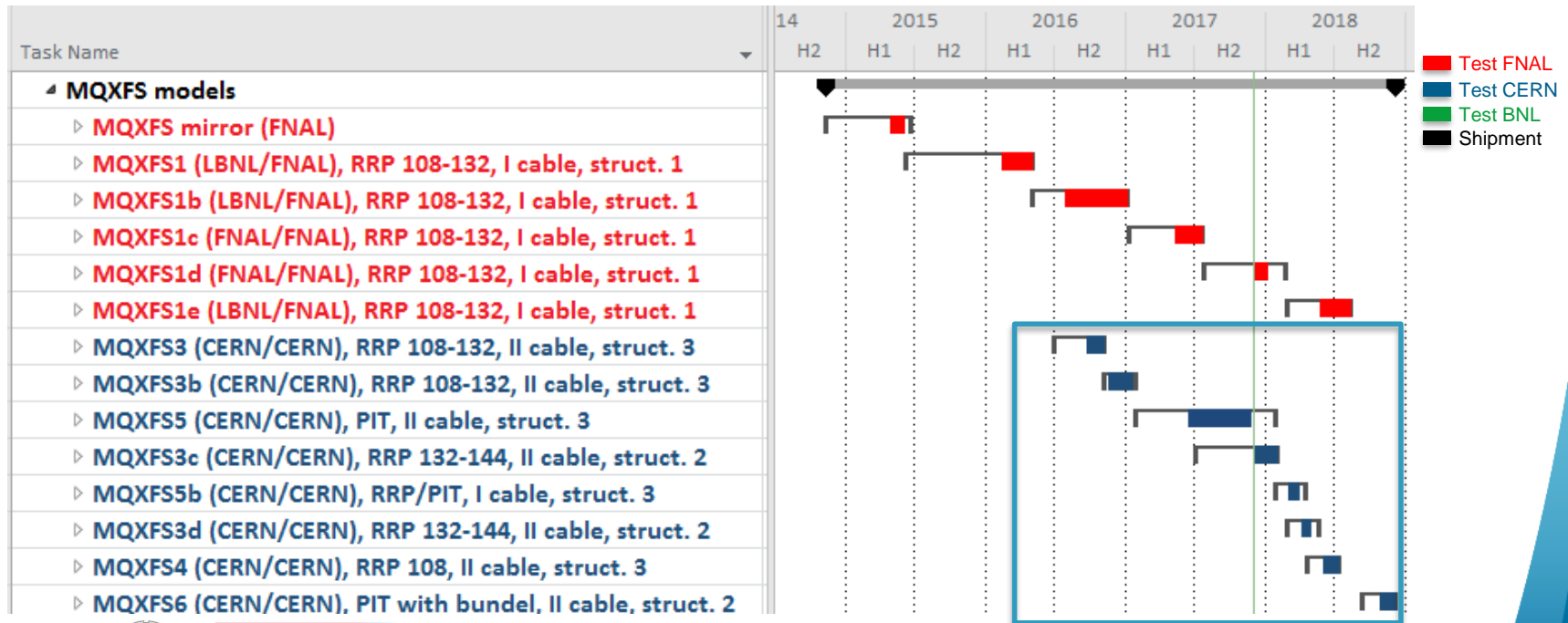
- **MQXFS5 (PIT)**

- RRP coils, second generation cable (a)
 - Replace 1 coil with coil 207: no inner layer quench heaters (b, *in 03/18*)



Short model program Magnets

- **MQXFS4**
 - RRP (final) coils, second generation cable (*a, in 06/18*)
- **MQXFS6 (PIT)**
 - PIT (with bundle) coils, second generation cable (*a, in 11/18*)
- Test to be added: 2000 powering cycles



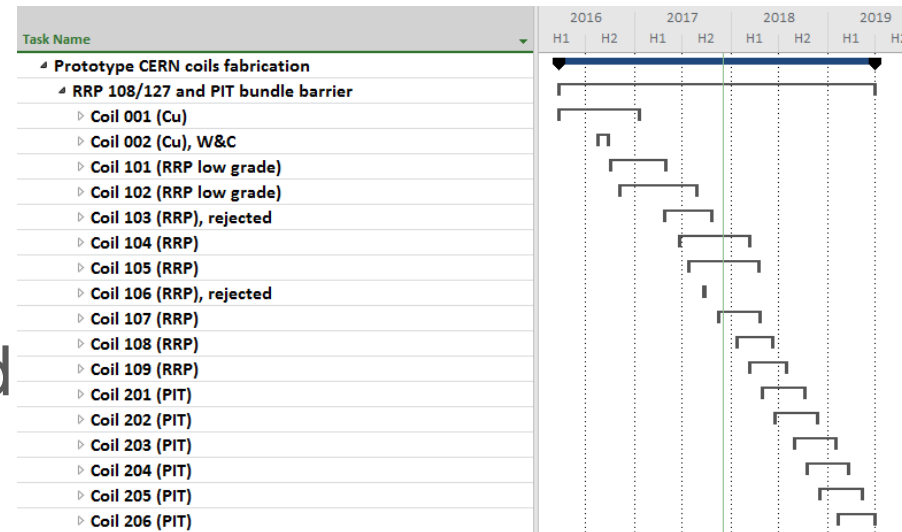
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CERN prototype program

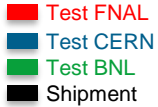
Coil fabrication

- 1 coil with Cu cable and 2 with low grade Nb₃Sn completed
- 1st and 4th prototype coils (103 and 106) rejected for major NC
- New 1st and 2nd prototype coils (104 and 105) wound and ready for reaction
- The 3rd (107) wound
- The 4th (108) to be wound in 01/18
- In total, 5 RRP and 6 PIT coils to be produced

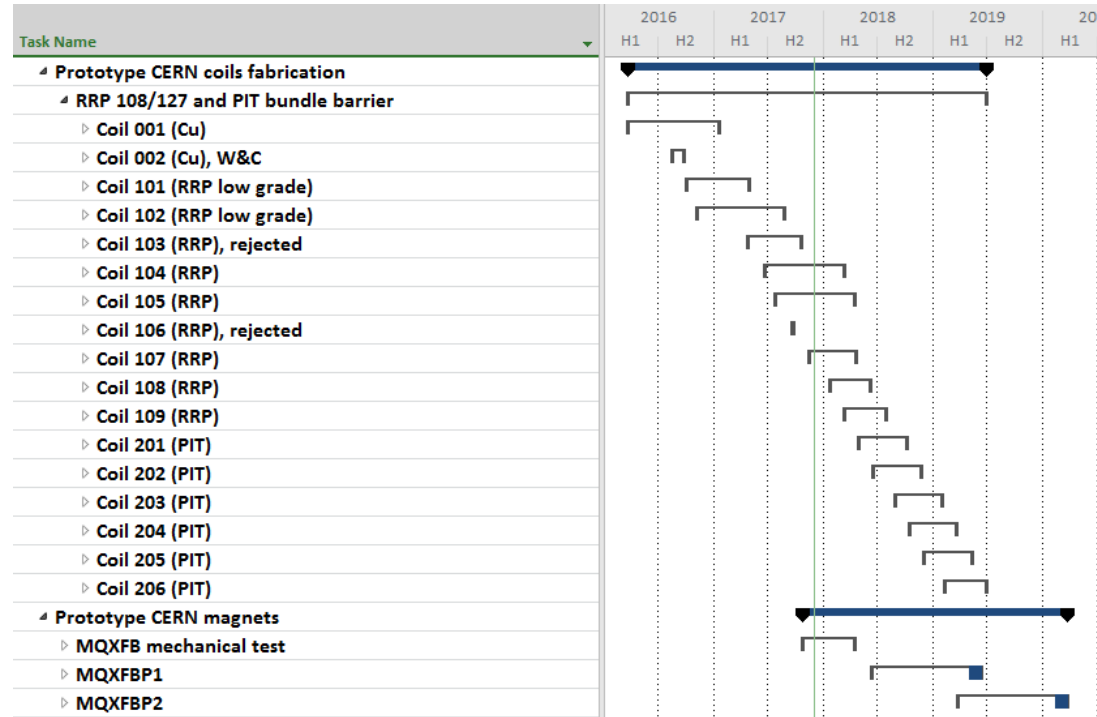


CERN prototype program

Prototype plans

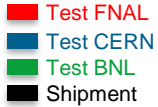


- Assembly structure started
- 4 practice coils available
 - 001,101,102,103
- MQXFB mech. test
 - Goal: full loading
- MQXFBP1
 - Test in May 2019
- MQXFBP2
 - Test in Feb. 2020

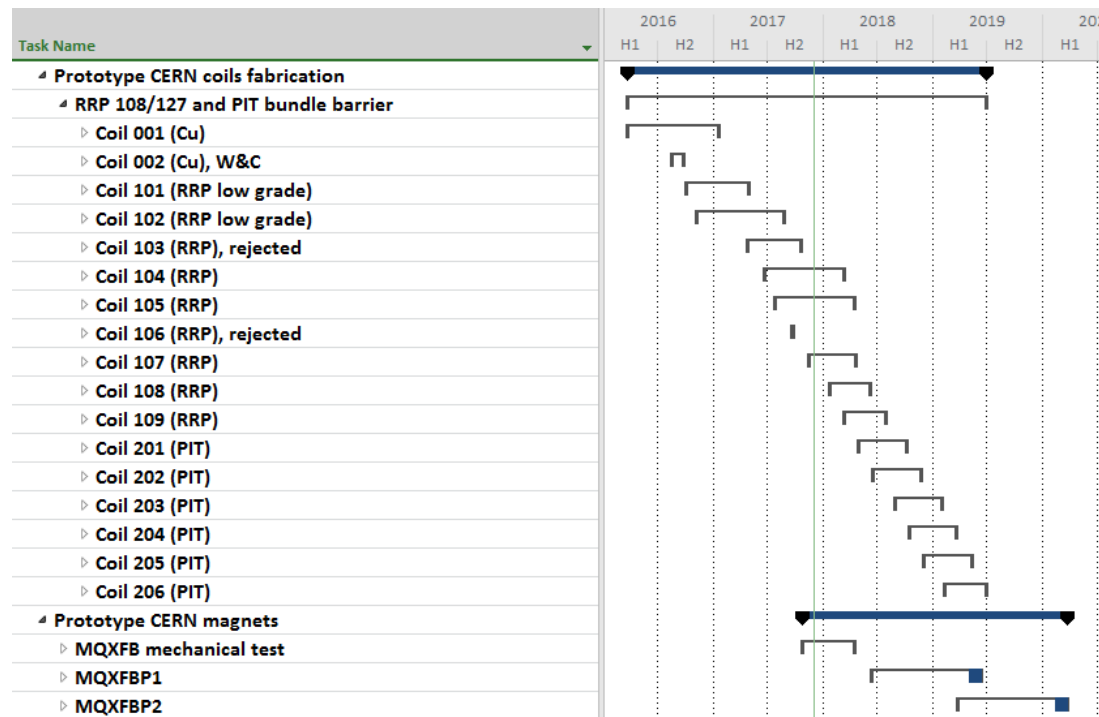


CERN prototype program

Prototype plans



- To be discussed
 - Test of MQXFBP1b with beam screen?
 - Test of full cold mass with corrector?



CERN prototype program



Outline

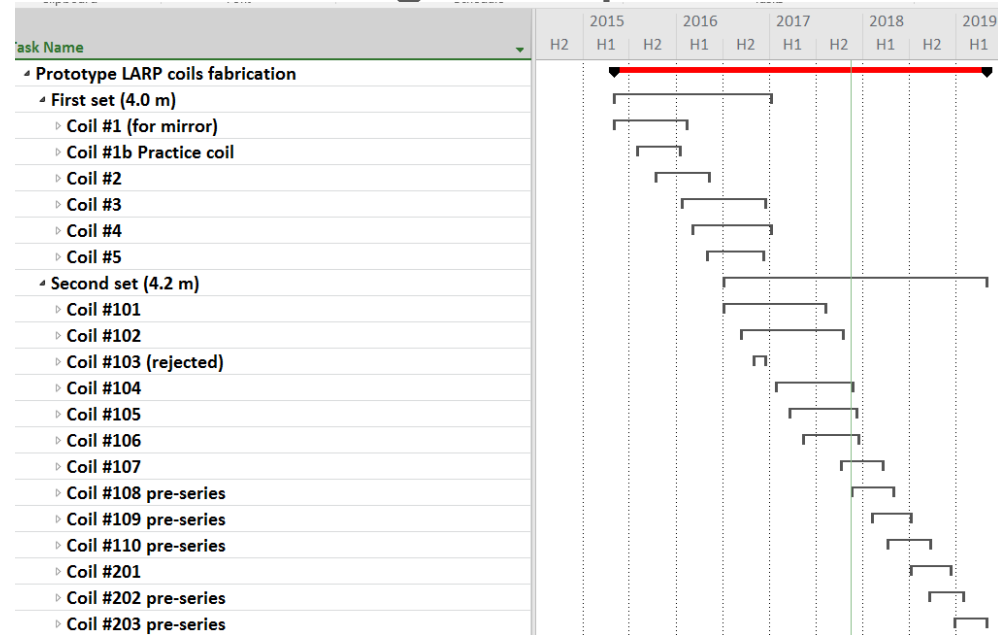
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LARP prototype program

Coil fabrication

- Coils for practice & mirror: **2** coil, 4-m long, completed
 - Coil 01 for mirror (1st generation cable)
 - Coil 01b practice (1st generation cable)
- Coils for MQXFAP1: **4** coils, 4-m long, completed

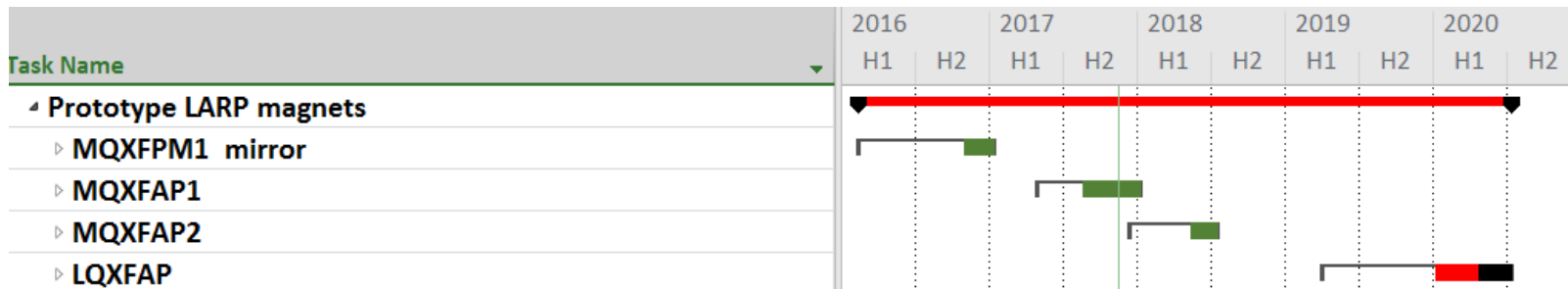
- Coils for MQXFAP2
 - 101 to 106 (FNAL and BNL)
- Coil for MQXFA3
 - From 107 (FNAL) and from 201 (BNL)



LARP prototype program

Prototype plans

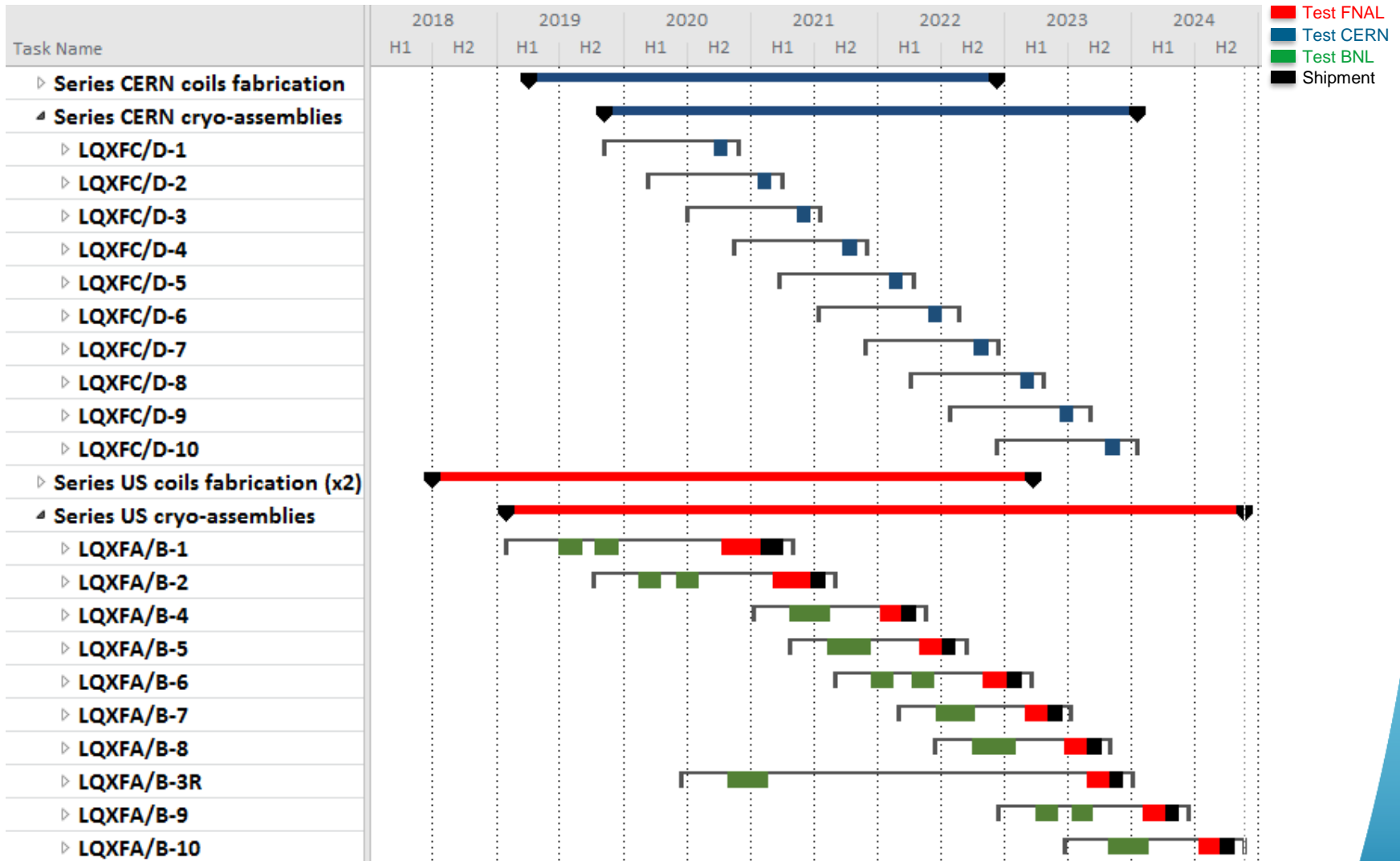
- **MQXFAP1** (4 m long)
 - Test in summer 2017 with coils 02,03,04,05
- **MQXFAP2** (4.2 m long)
 - Test in by mid-2019 with 101,102,104,105 (106)
- **LQXFAP** (prototype cold mass)
 - Test in by early 2020 with MQXFAP1 and MQXFAP2
- **MQXFA3** will be first series magnet



LARP prototype program (MQXFAP1)



Overview of MQXF series



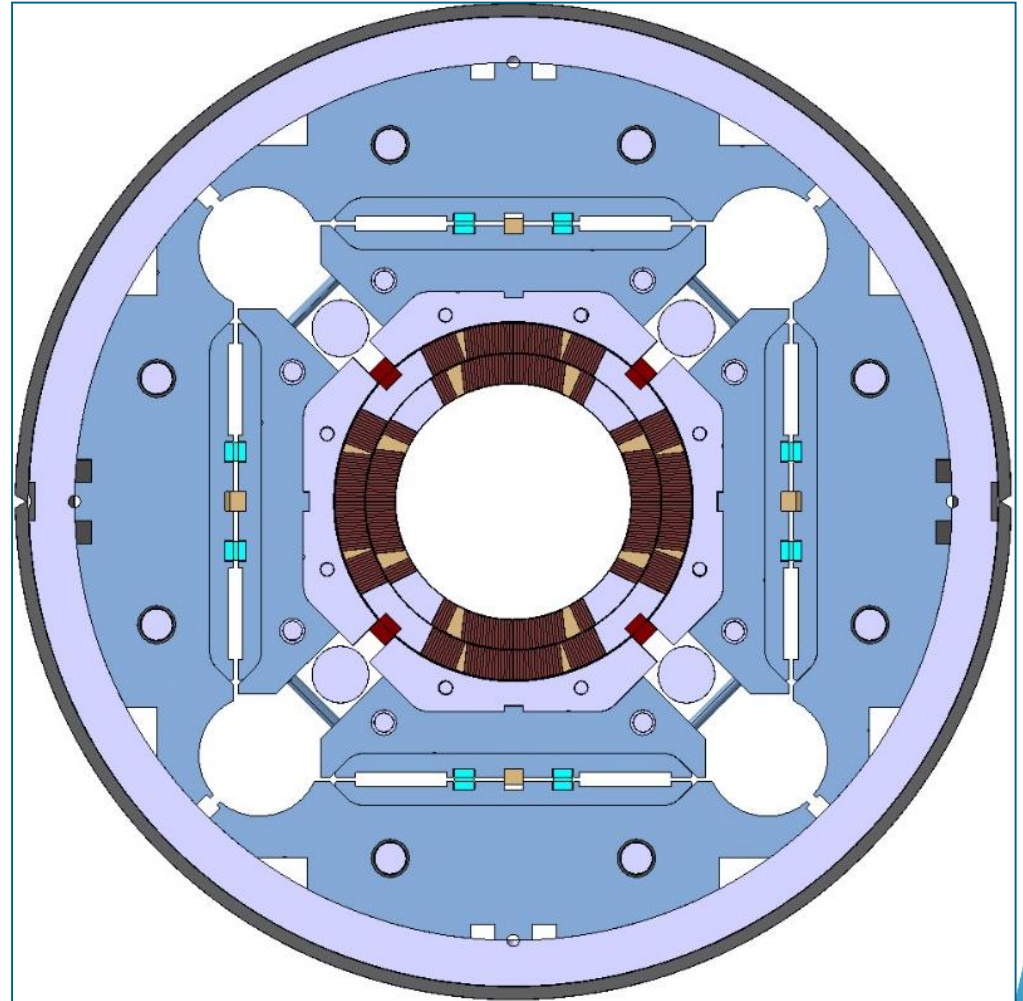
- Test FNAL
- Test CERN
- Test BNL
- Shipment

Appendix



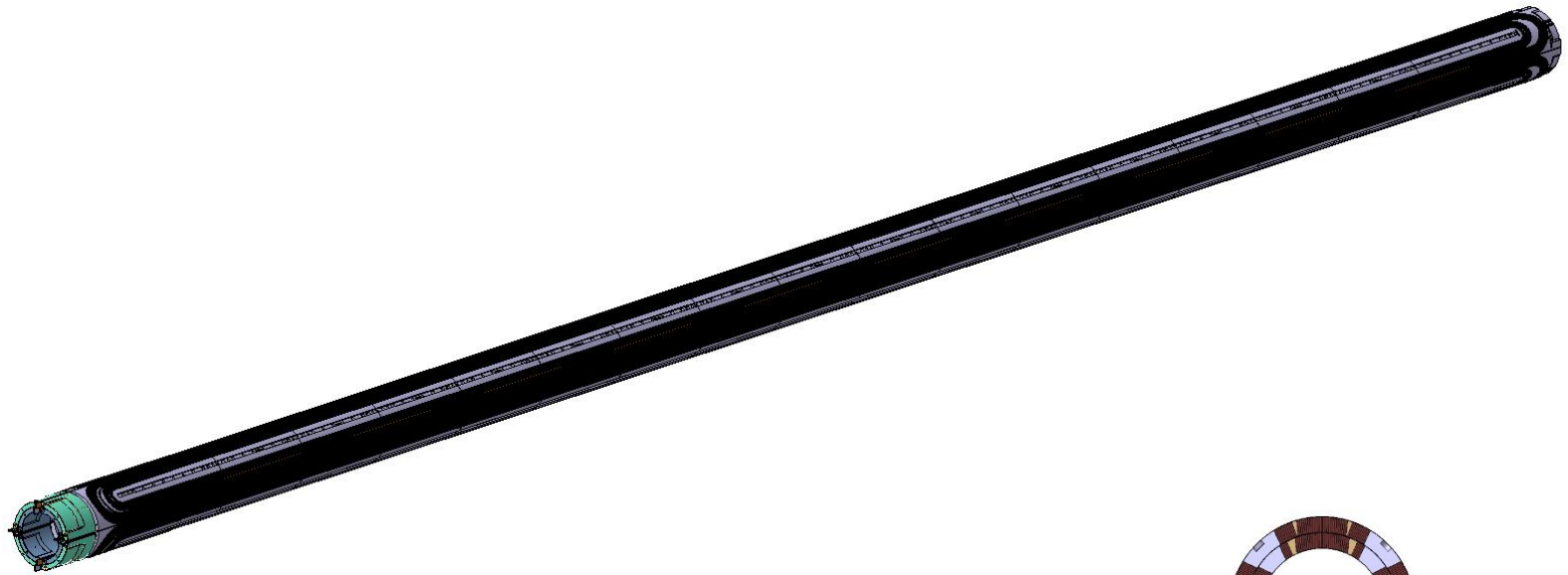
Overview of MQXF design

- OD: 630 m
- Stainless steel shell
 - 8 mm for LHe containment
- Aluminum shell
 - 29 mm thick
- Iron yoke
 - Gaps open
 - 4-fold symmetry
- Iron master plates
 - Bladder and keys
- Iron pad
- SS axial rods
- Aluminum collars
- G10 pole key
- Ti alloy poles



Magnet design MQXFB

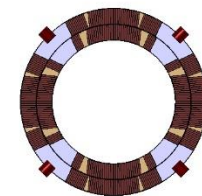
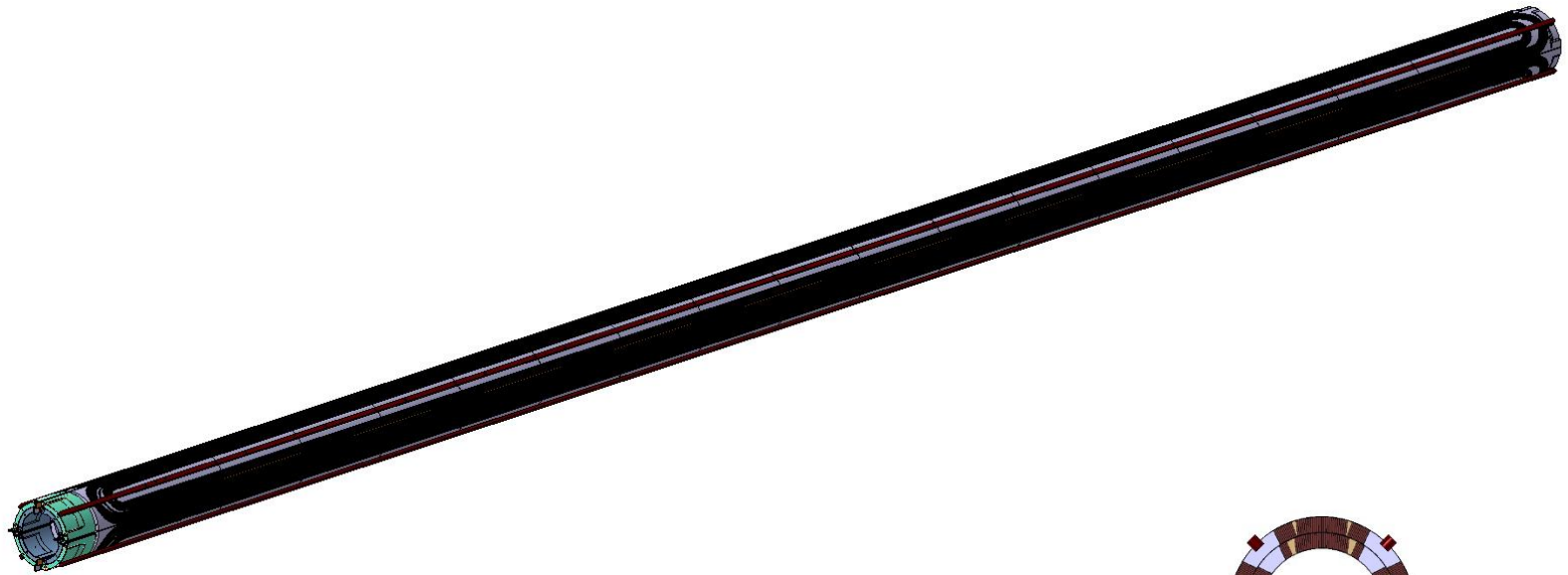
See J. C. Perez



- Superconducting coil

Magnet design MQXFB

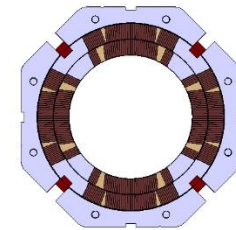
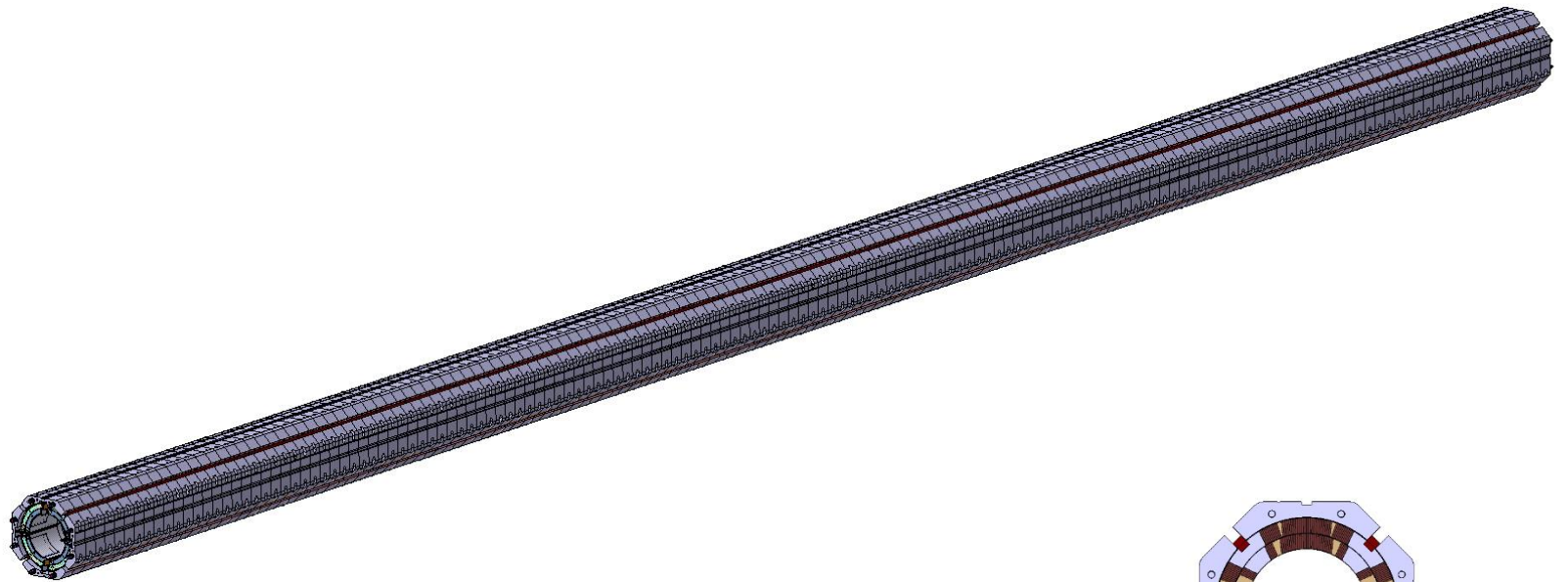
See J. C. Perez



- Pole key for alignment

Magnet design MQXFB

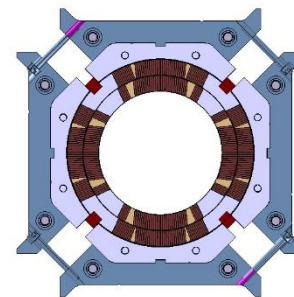
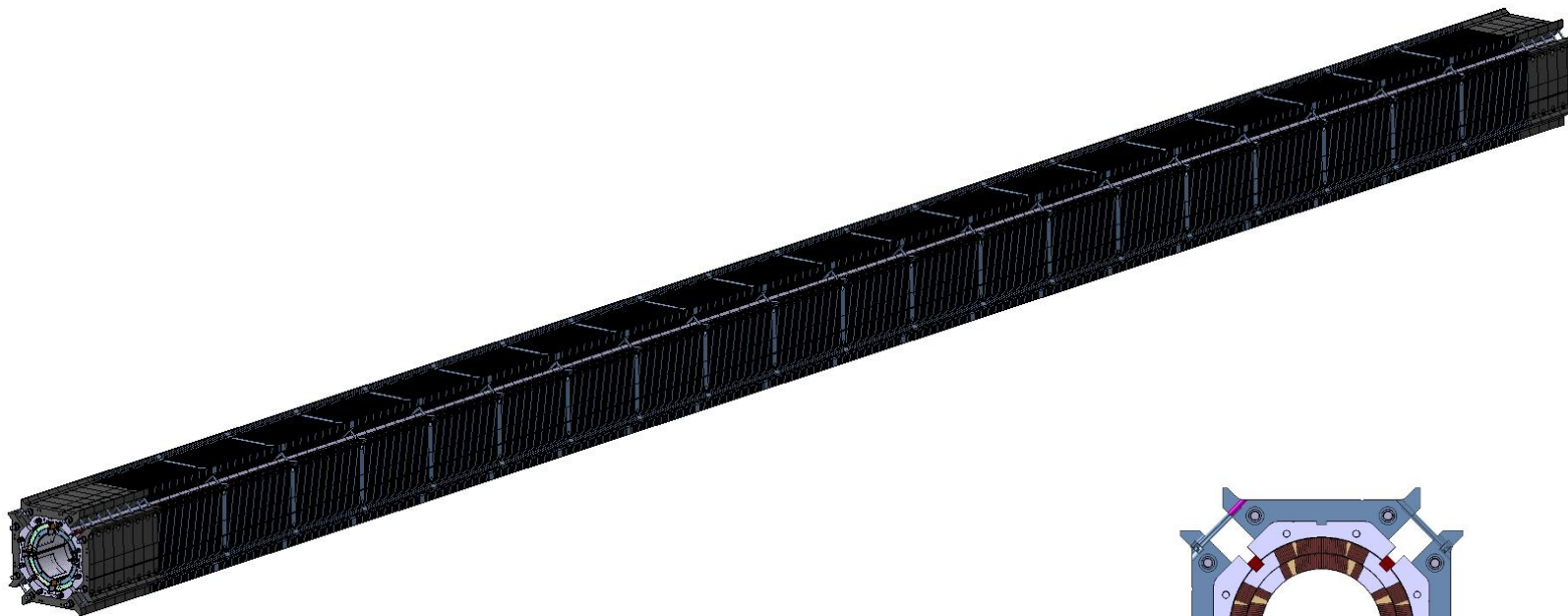
See J. C. Perez



- Aluminium collar
 - No coil pre-load

Magnet design MQXFB

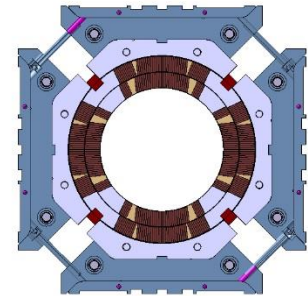
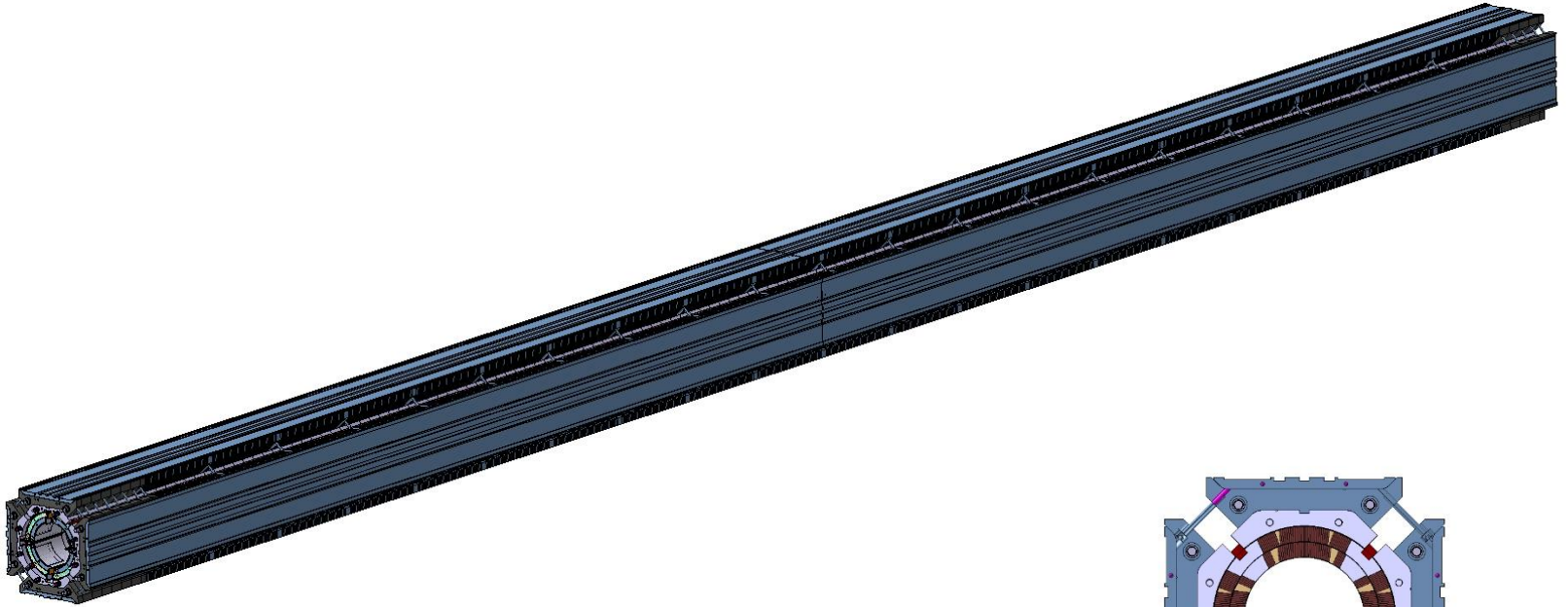
See J. C. Perez



- Bolted iron pad
- No coil pre-load

Magnet design MQXFB

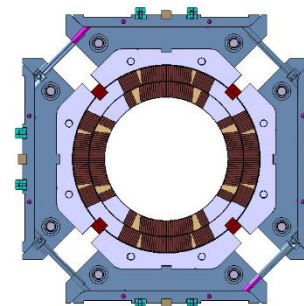
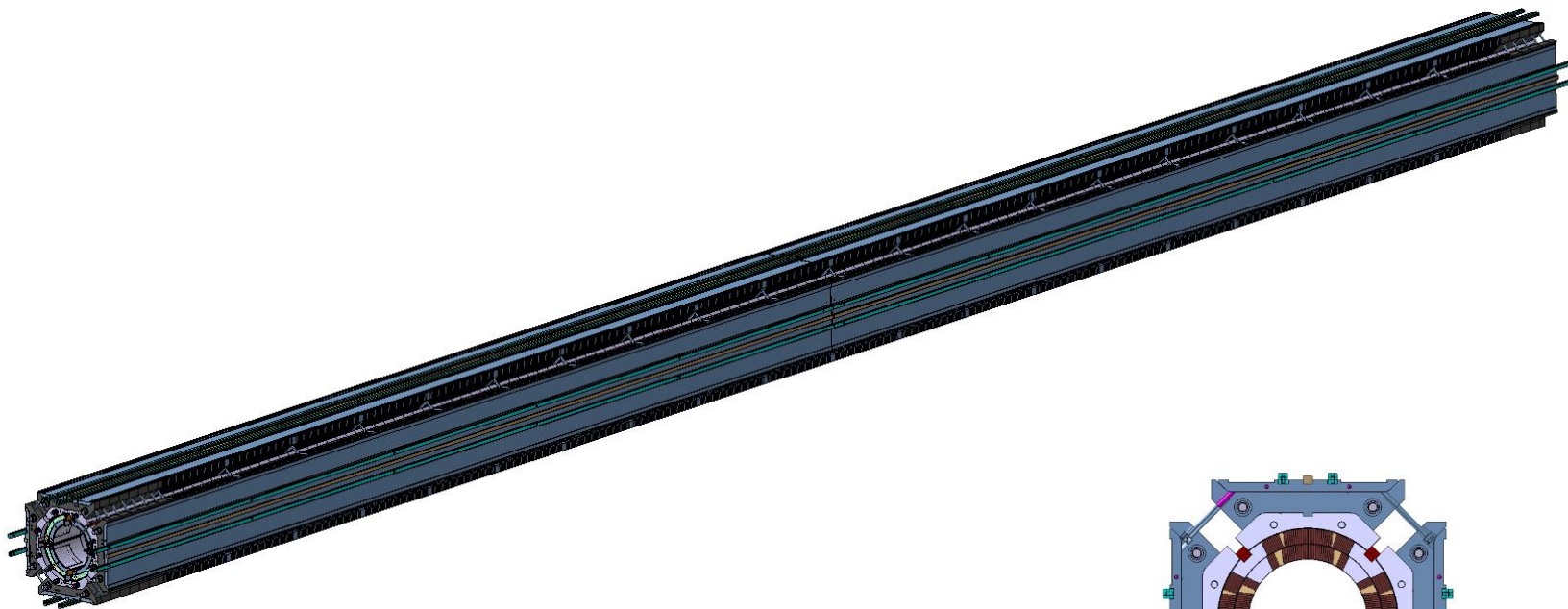
See J. C. Perez



- **Iron master**
 - Half-length plates for bladders and keys

Magnet design MQXFB

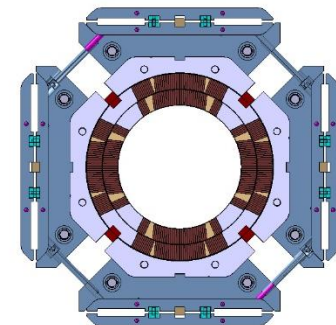
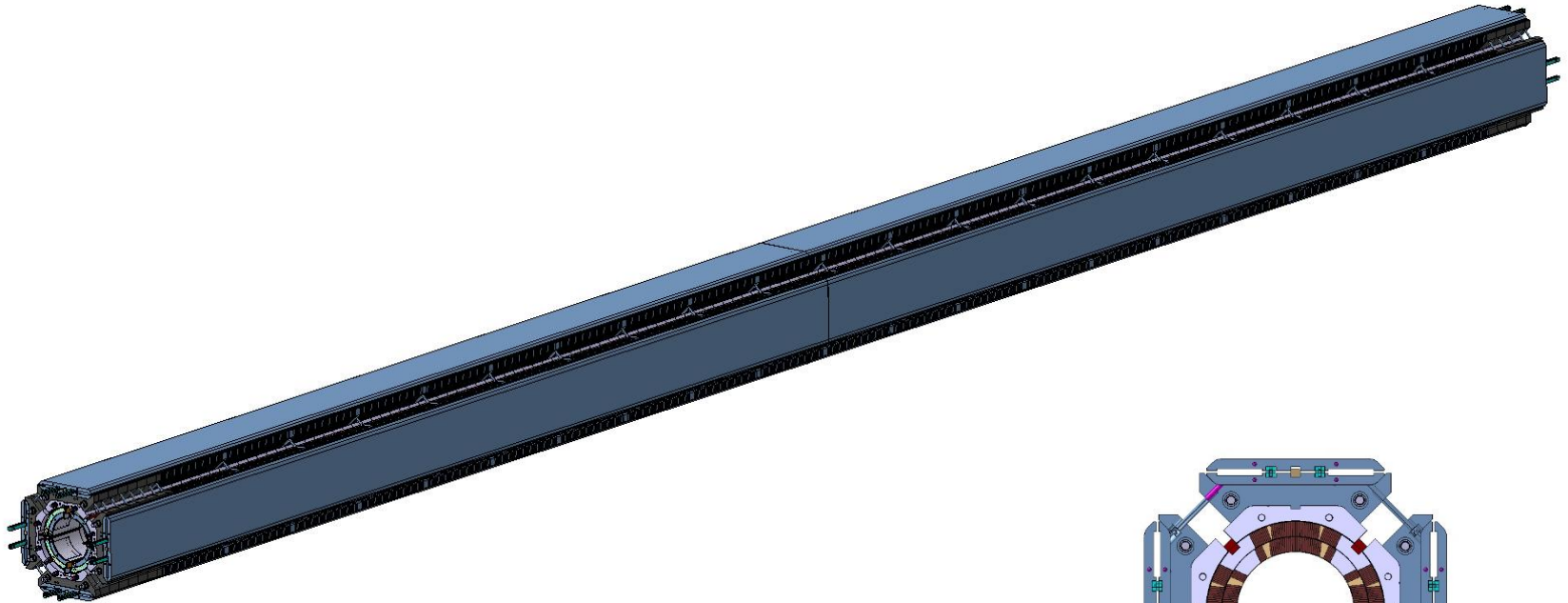
See J. C. Perez



- Loading and alignment keys

Magnet design MQXFB

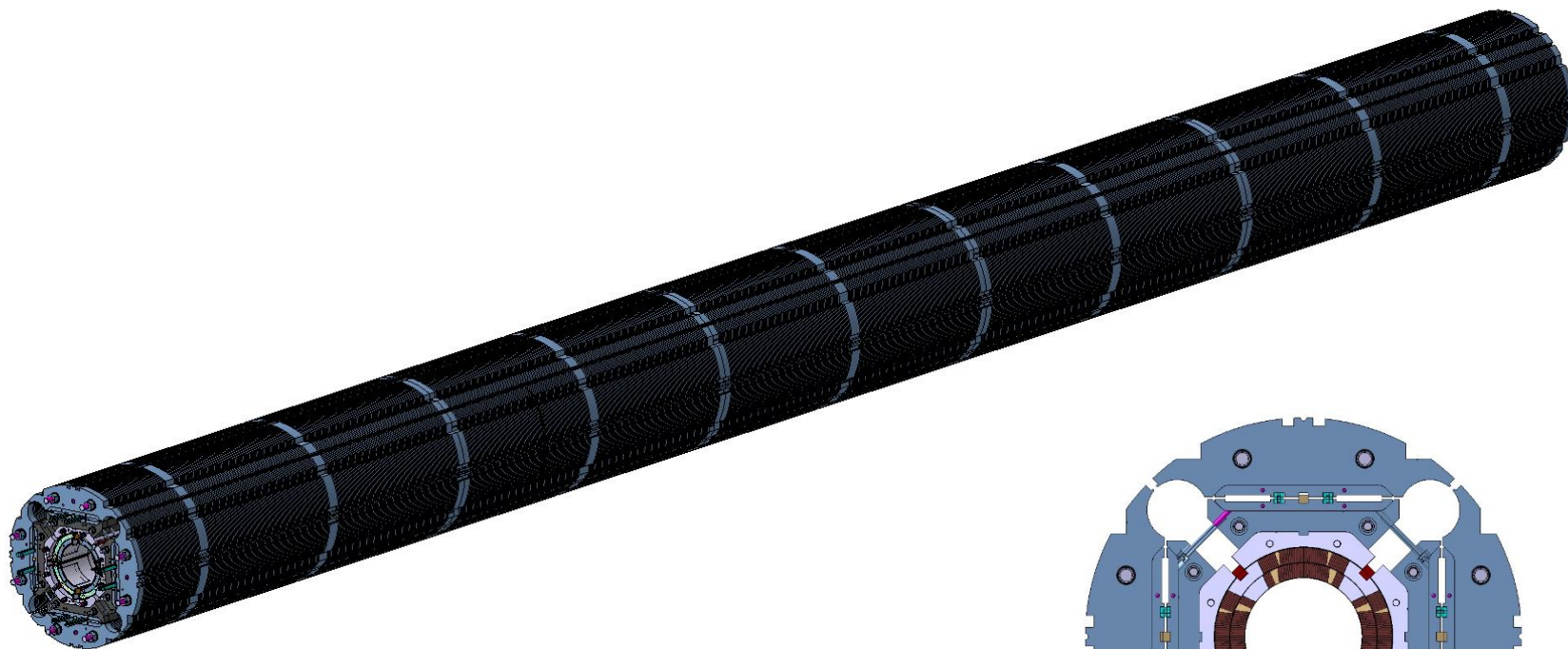
See J. C. Perez



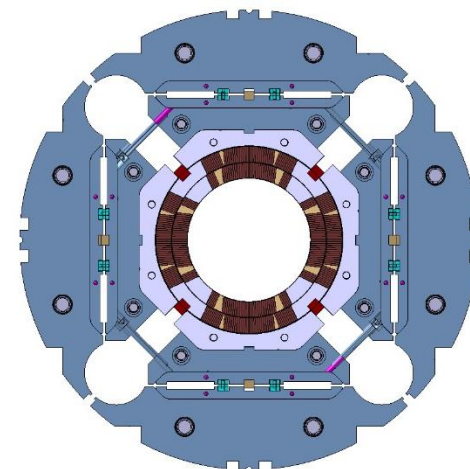
- **Second iron master**
 - Coil-pack sub-assembly

Magnet design MQXFB

See J. C. Perez

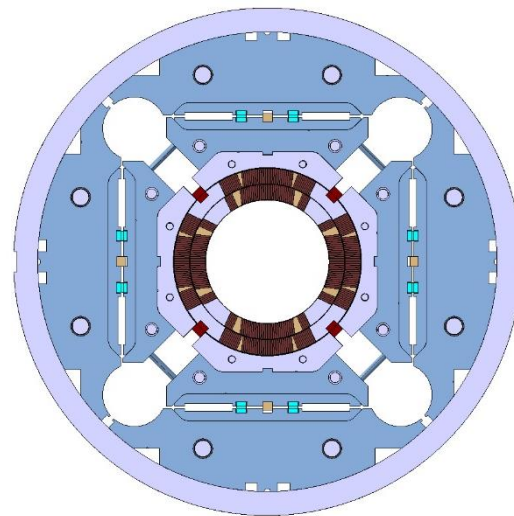
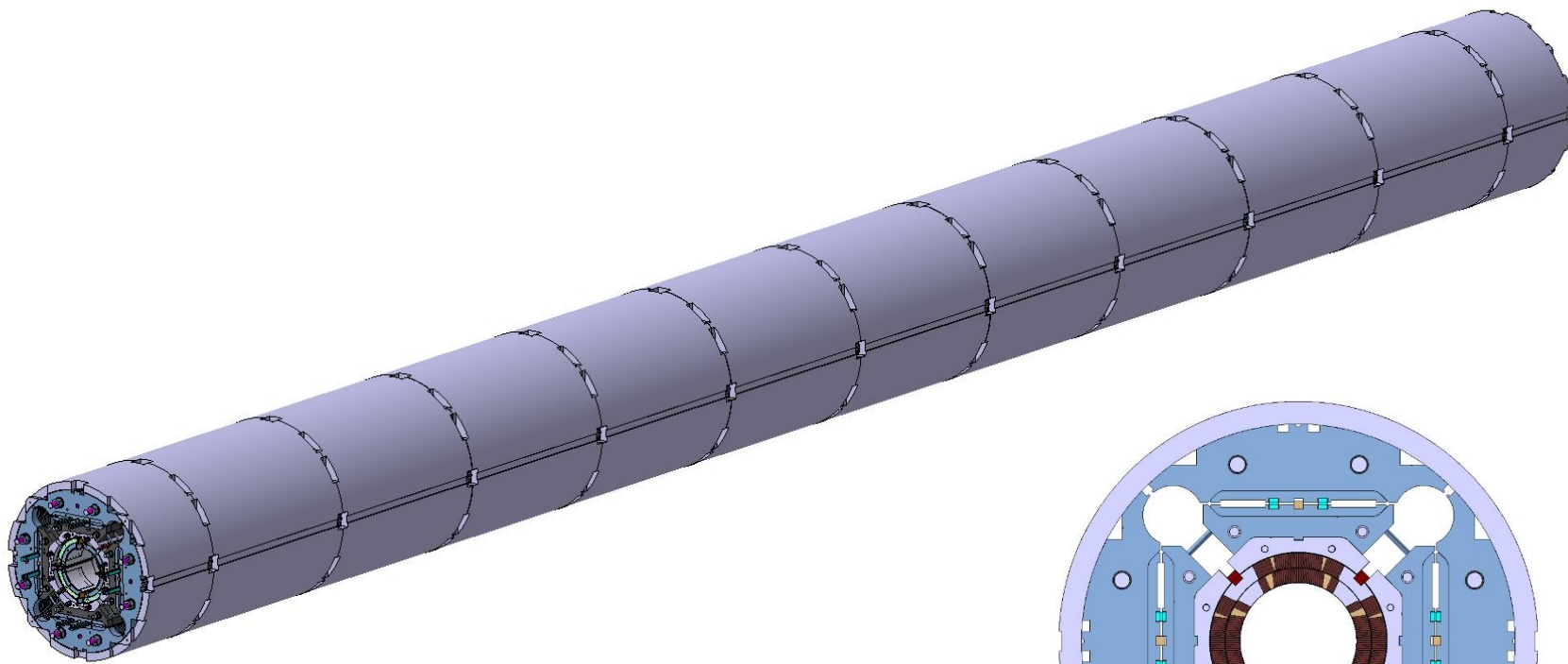


- Iron yoke laminations



Magnet design MQXFB

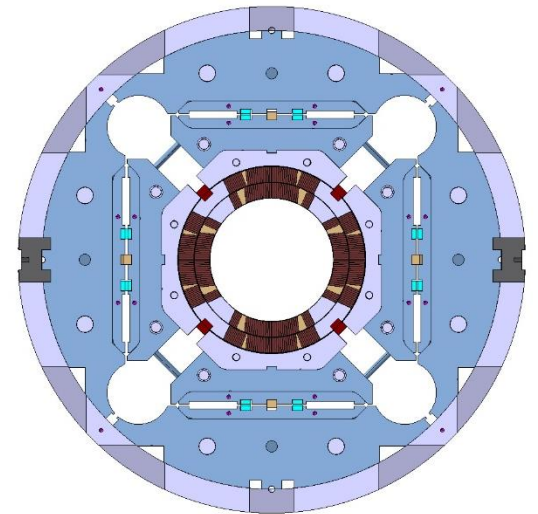
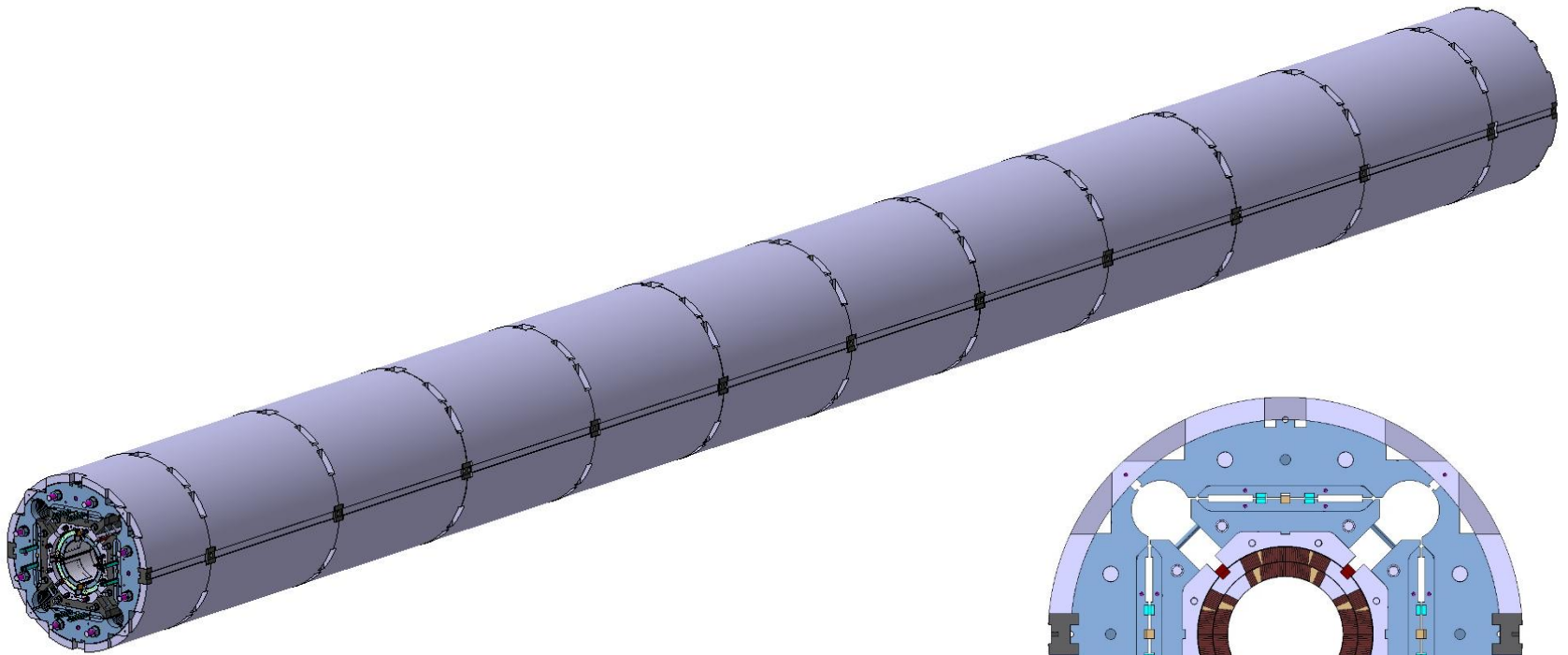
See J. C. Perez



- Segmented aluminium shell

Magnet design MQXFB

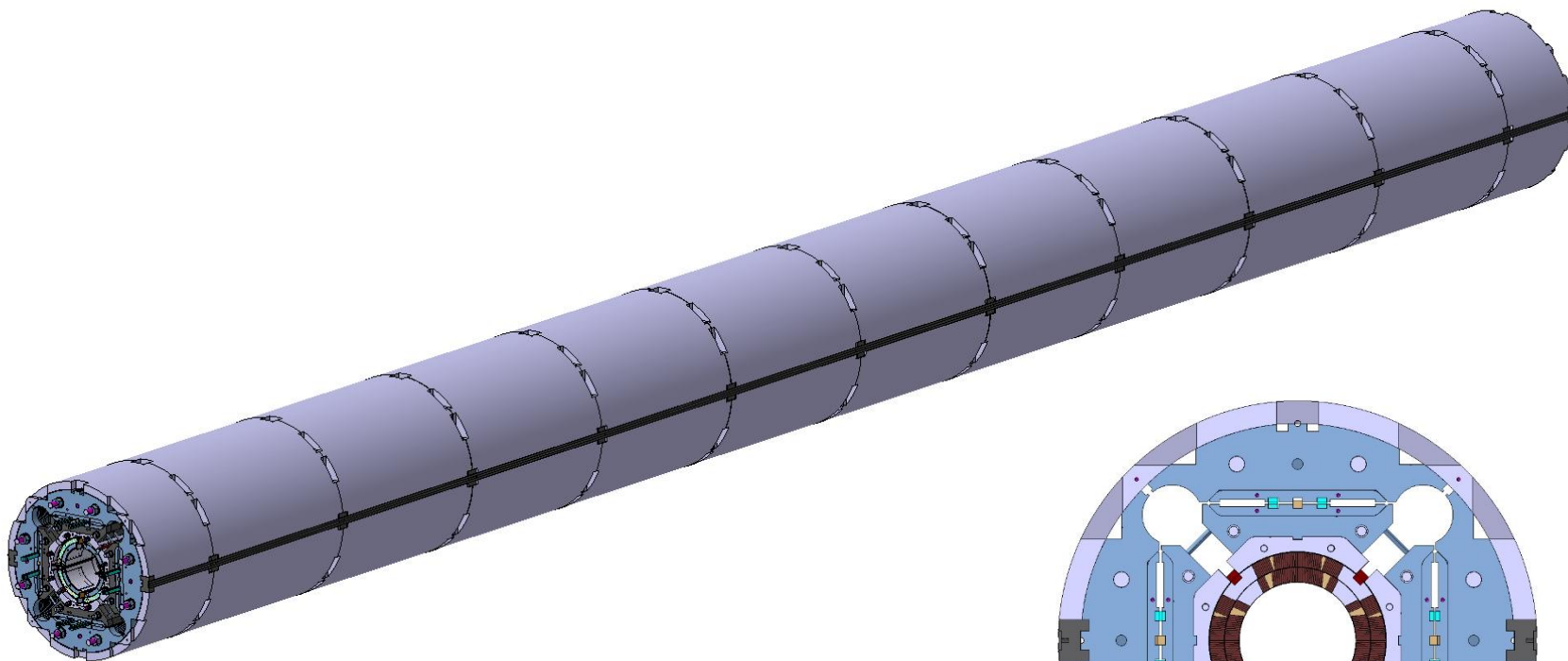
See J. C. Perez



- **Tack-welding blocks**
 - Aligned to the yoke

Magnet design MQXFB

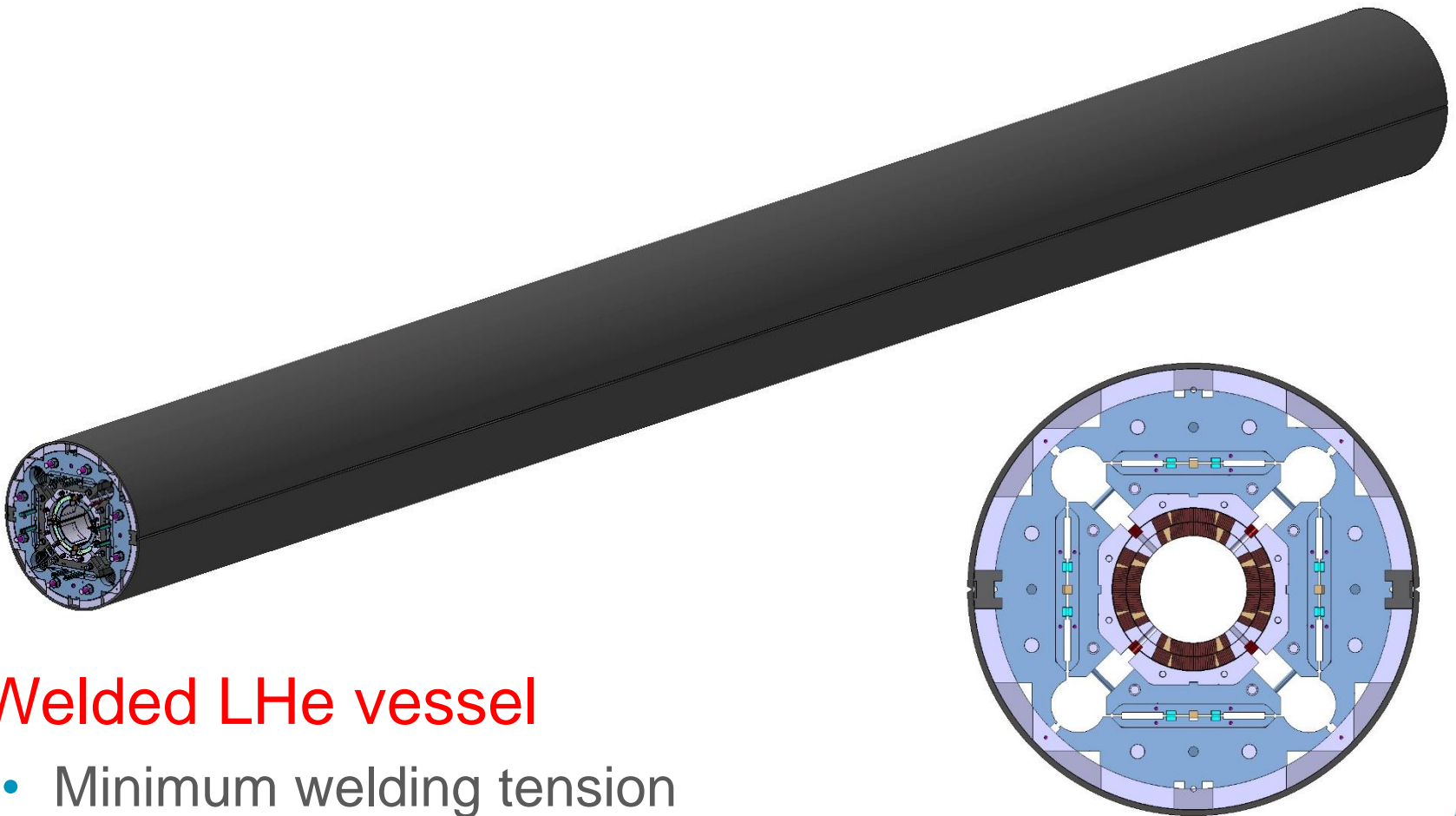
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- **Backing strip**
 - For Lhe vessel welding

Magnet design MQXFB

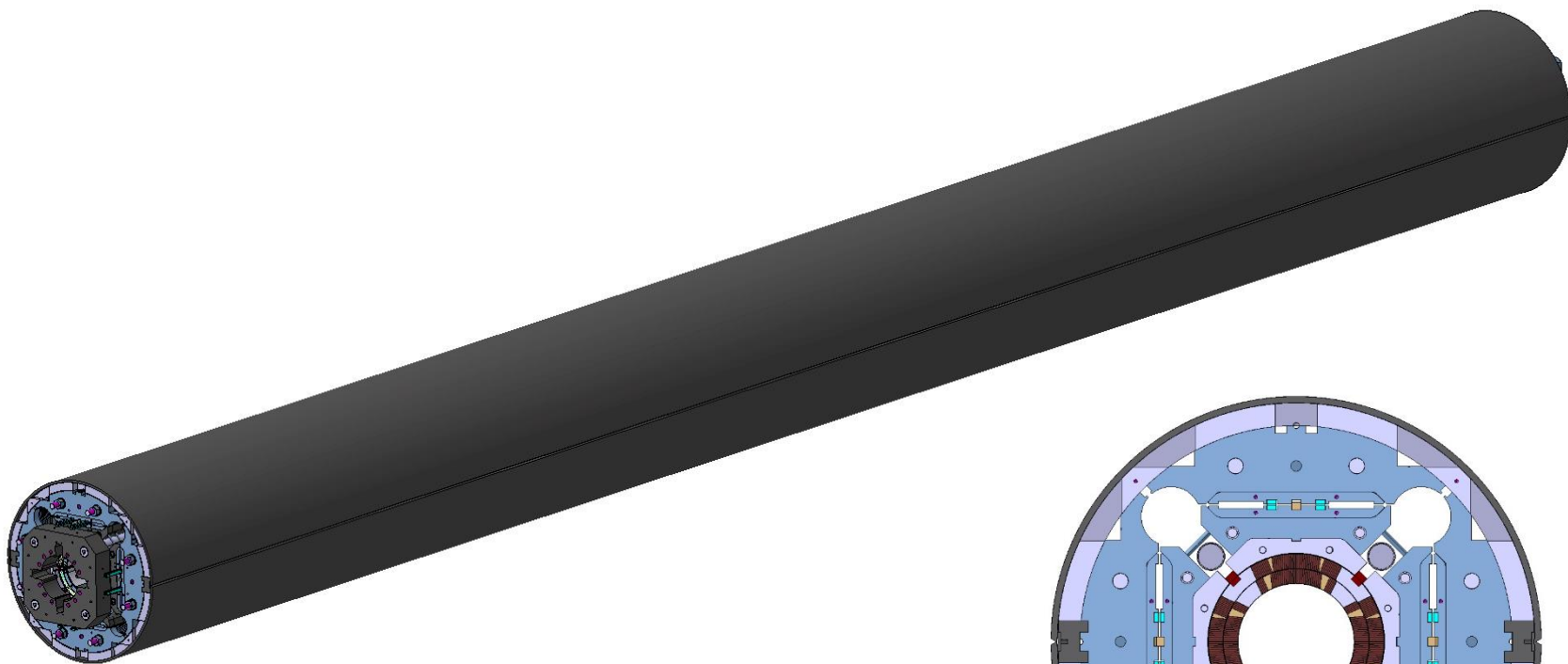
See J. C. Perez



- **Welded LHe vessel**
 - Minimum welding tension

Magnet design MQXFB

See J. C. Perez



- **Axial support system**
 - SS rods and end-plates