



# Status and plans of MQXFB magnet

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on behalf of the MQXF collaboration

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CERN

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# Outline

- Coil fabrication status
- First magnet assembly with practise coils
- Towards the assembly of the first prototype
- Further plan and schedule

# Production outlook MQXFB prototypes

1 Mechanical test assembly in 2018 (Low grade, NC and copper coils)

1 Prototype assembly in end of 2018 (RRP conductor)

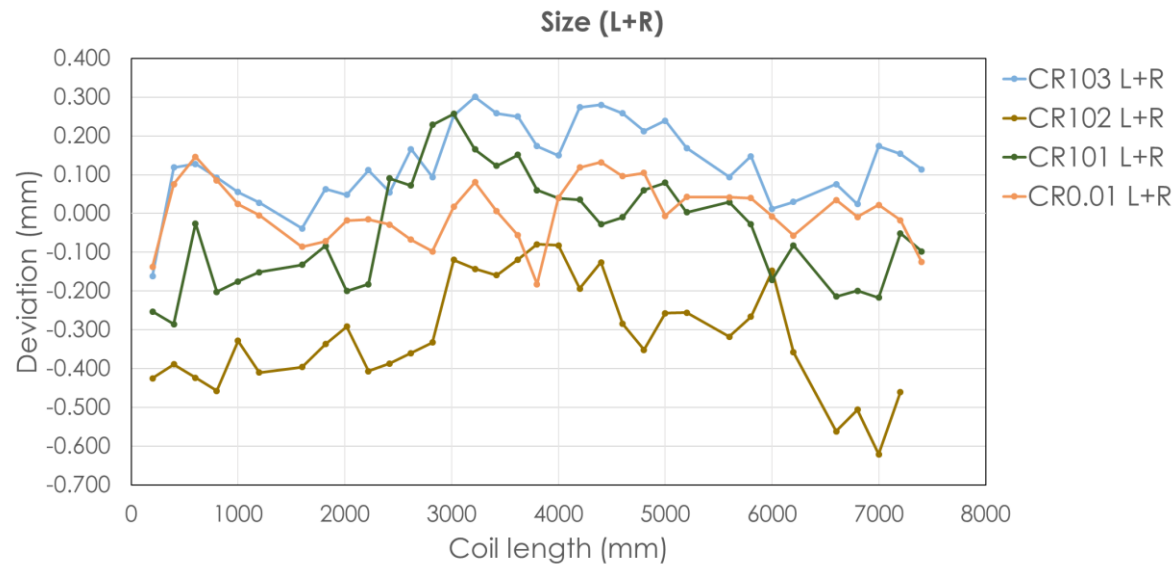
Commissioning and optimization of assembly tooling

## *Availability of impregnated coils*

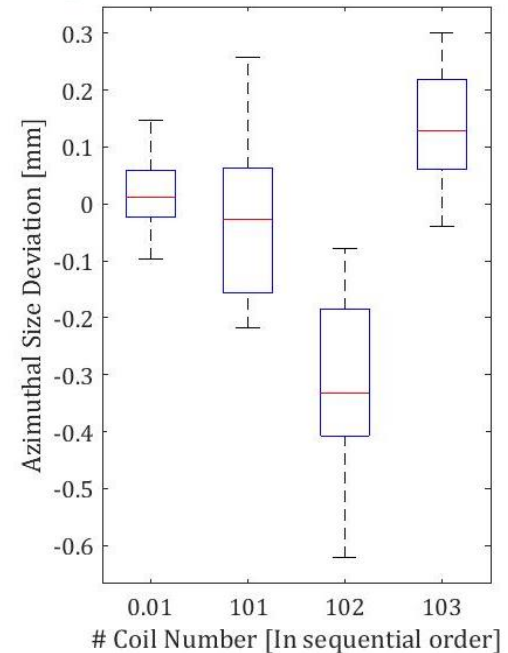
	Coil ID	Finished	Use	Comment
2016	001	Impregnated	1 <sup>st</sup> test assembly	Cu conductor
2017	101	Impregnated	1 <sup>st</sup> test assembly	Low grade RRP conductor
	102	Impregnated	1 <sup>st</sup> test assembly	Low grade RRP conductor
	103	<i>Impregnated but NC</i>	<i>1<sup>st</sup> test assembly</i>	<i>RRP (NC after RHT)</i>
	104	Impregnated	1 <sup>st</sup> Prototype	RRP
	105	Impregnated	1 <sup>st</sup> Prototype	RRP
2018	106	<i>Rejected NC</i>		<i>RRP (NC during winding)</i>
	107	Impregnated	1 <sup>st</sup> Prototype	RRP
	108	Impregnated	1 <sup>st</sup> Prototype	RRP
	109	Impregnated	Spare	RRP
	201	<i>RHT (Oct. 31<sup>st</sup>)</i>	<i>Spare</i>	<i>PIT (NC during winding)</i>
	202	Winding OL	2 <sup>nd</sup> Prototype	PIT
	203	-	2 <sup>nd</sup> Prototype	PIT – Aim for RHT before end 2018

# MQXFBP1 assembled with 4 “practice” coils

- Practice coils
  - Metrological inspection based on FARO measurement
  - Larger spread in coil geometry



## MQXFB Azimuthal Coil Size



# MQXFBP1 assembled with 4 “practice” coils

- Shell-yoke sub-assembly
  - Completed in early 2018





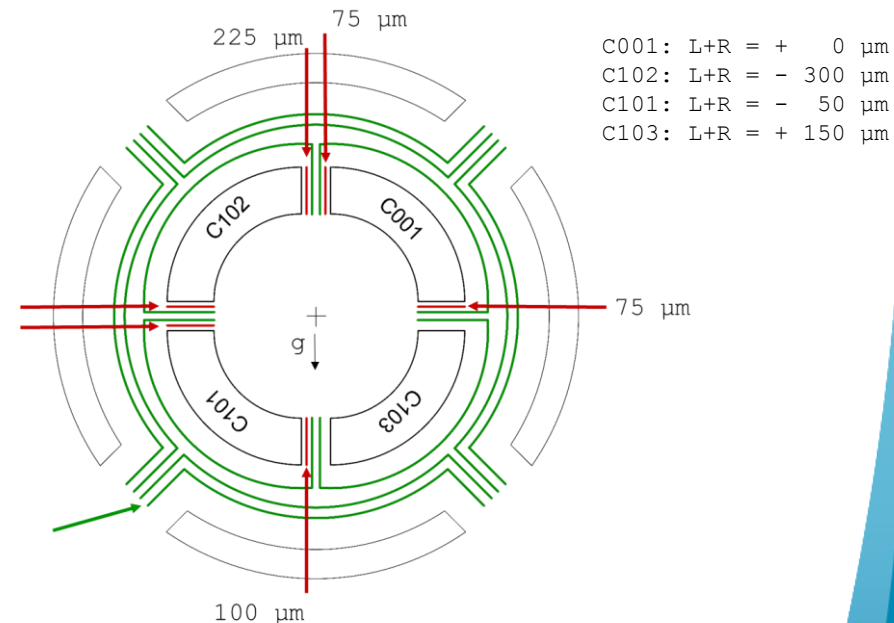
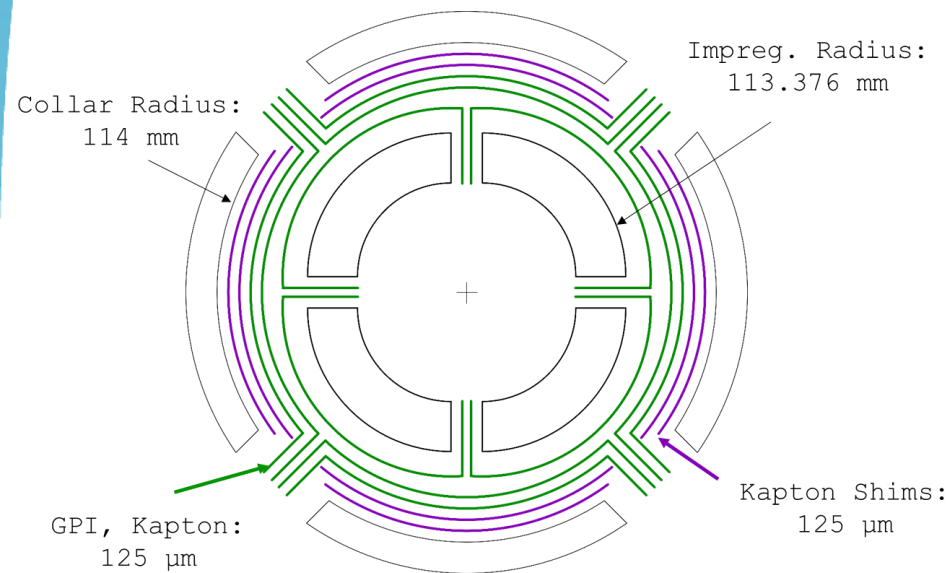
# MQXFBP1 assembled with 4 “practice” coils

- Coil-pack sub-assembly
  - Work carried-out in 03-04 2018



# MQXFBP1 assembled with 4 “practice” coils

- Coil-pack sub-assembly
  - Shimming-plan (nominal vs. “real”)

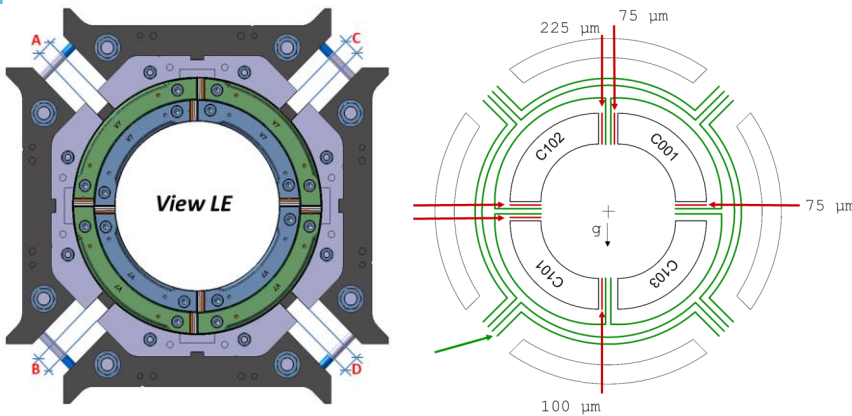


Note: To match the 114 mm collar radius, we removed a 125  $\mu\text{m}$  collar shim.  
Additional shim removed to improve contact.

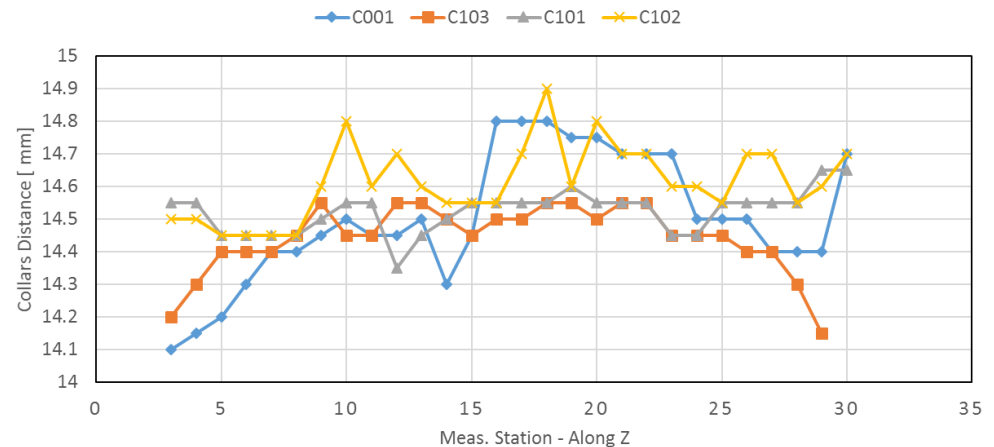


# MQXFBP1 assembled with 4 “practice” coils

- Coil-pack sub-assembly
  - Measurements of pole gaps
    - Pole-key + ground insulation: 14.4 mm
    - Coil pack 2 total gap: 100  $\mu m$ .

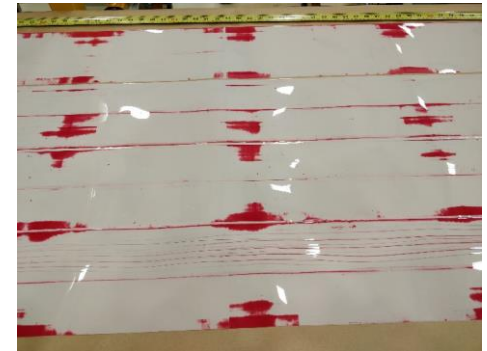
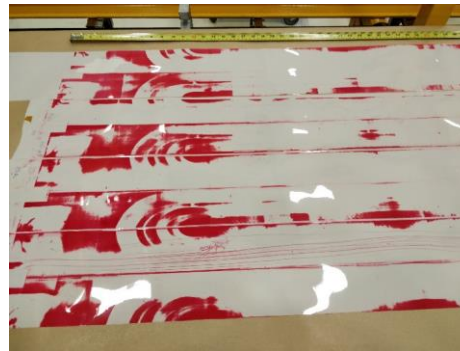
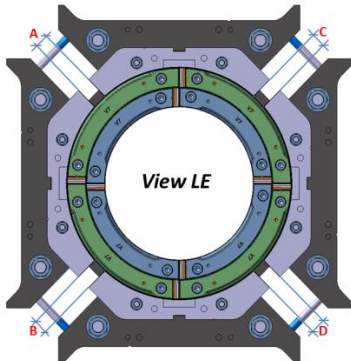


MQXFB - ASSEMBLY TEST - COIL PACK #2



# MQXFBP1 assembled with 4 “practice” coils

- Coil-pack sub-assembly
  - Fuji test in coil pack #1
  - Important: we bolt only the “thick” pads



# MQXFBP1 assembled with 4 “practice” coils

- Insertion of coil-pack sub-assembly in shell-yoke sub-assembly and bladder operation in summer 2018





# MQXFBP1 assembled with 4 “practice” coils

- Strain gauge locations
  - Aluminum shells
    - $\vartheta, z$  in 3 axial location, 4 quadrant  $\rightarrow$  24 gauges

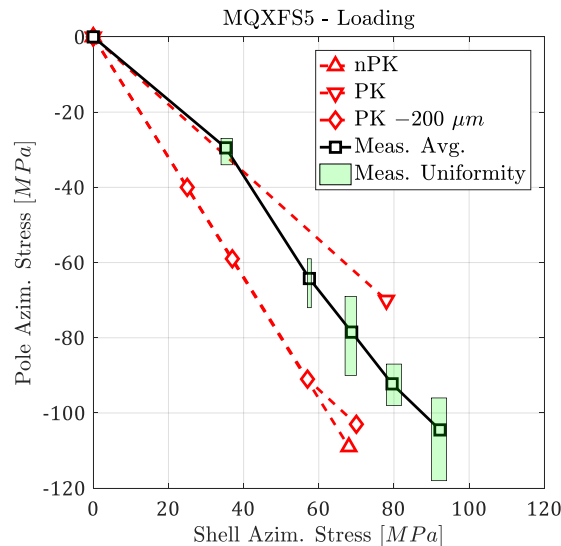
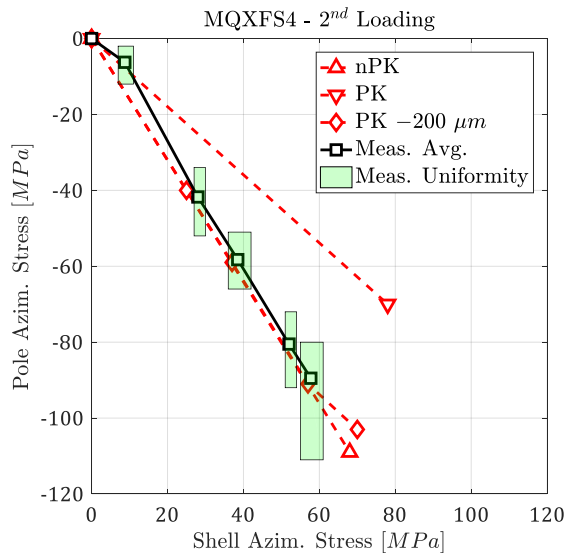


- Coils
  - $\vartheta, z$  in 3 axial location, 4 coils  $\rightarrow$  24 gauges

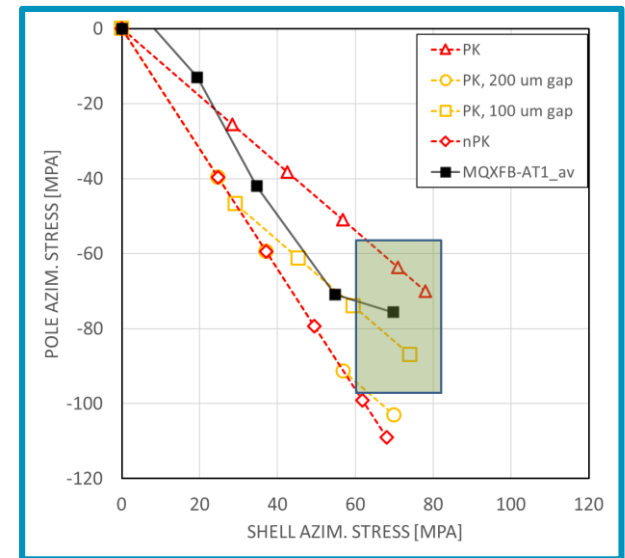
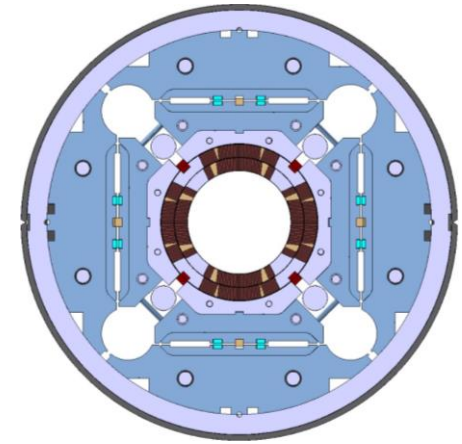


# MQXFBP1 assembled with 4 “practice” coils

- Bladder operation
  - MQXFB with practice coil case
    - In between “pole key” and “no-pole-key” but large spread



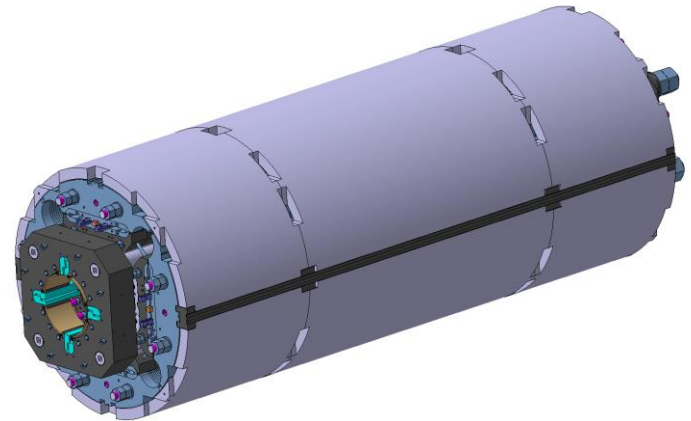
- Pre-load interrupted due to bladder failure





# MQXFBP1 assembled with 4 “practice” coils

- Axial loading
  - Not performed due to
    - Variation in coil length
    - Interference axial loading system with aluminum tube
- Modification/update of the axial system in progress



# MQXFBP1 assembled with 4 “practice” coils

- No show stoppers so far, but some issues to address and modifications to implement
  - Preliminary bladders have led to leakage during loading
  - New bladders fabricated with extruded tube, available for 1<sup>st</sup> prototype assembly
  - New tooling developed to extract bladders
  - Tooling modifications are currently implemented



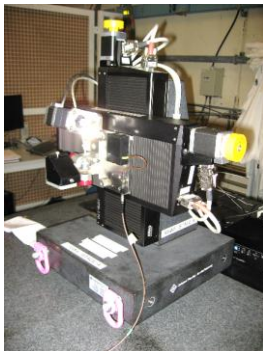
# MQXFBP1 assembled with 4 “practice” coils

- Magnetic measurements at room temperature
- Based on rotating coil scanner



## Single stretched wire

- X-Y tables with 155-mm span
- Fast Digital Integrator
- FFMM software with user-friendly GUI
- DC and AC mode

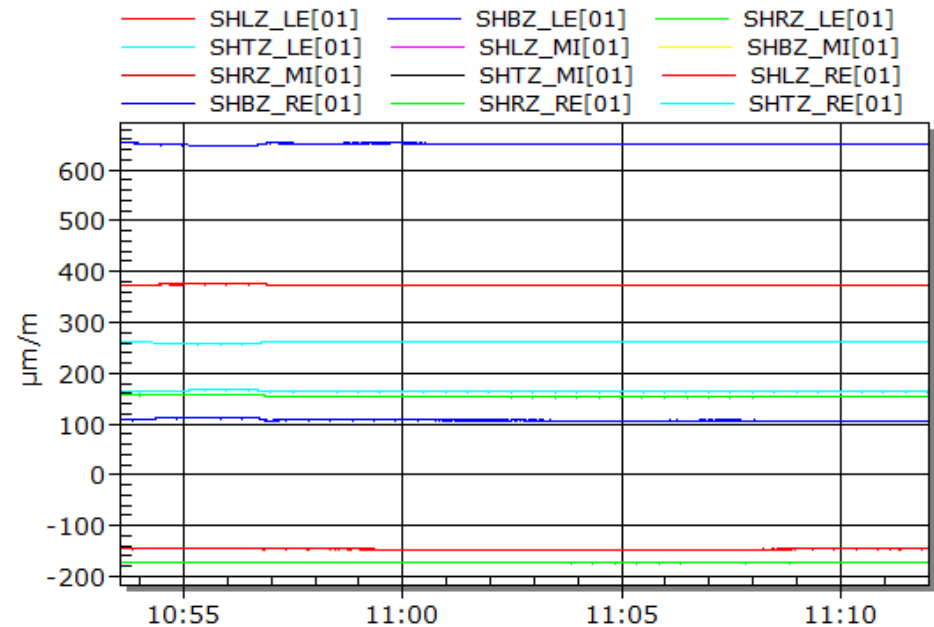


- B2 is 20% smaller than expected
- The magnetic center is displaced toward the quadrant 3 (coil 103 – with major non-conformity !)
- Multipoles show large values with a pattern compatible with an issue in quadrant 3 (coil 103)
- Measurement on test coil pack still very useful exercise to set-up the procedure and measurement routine.



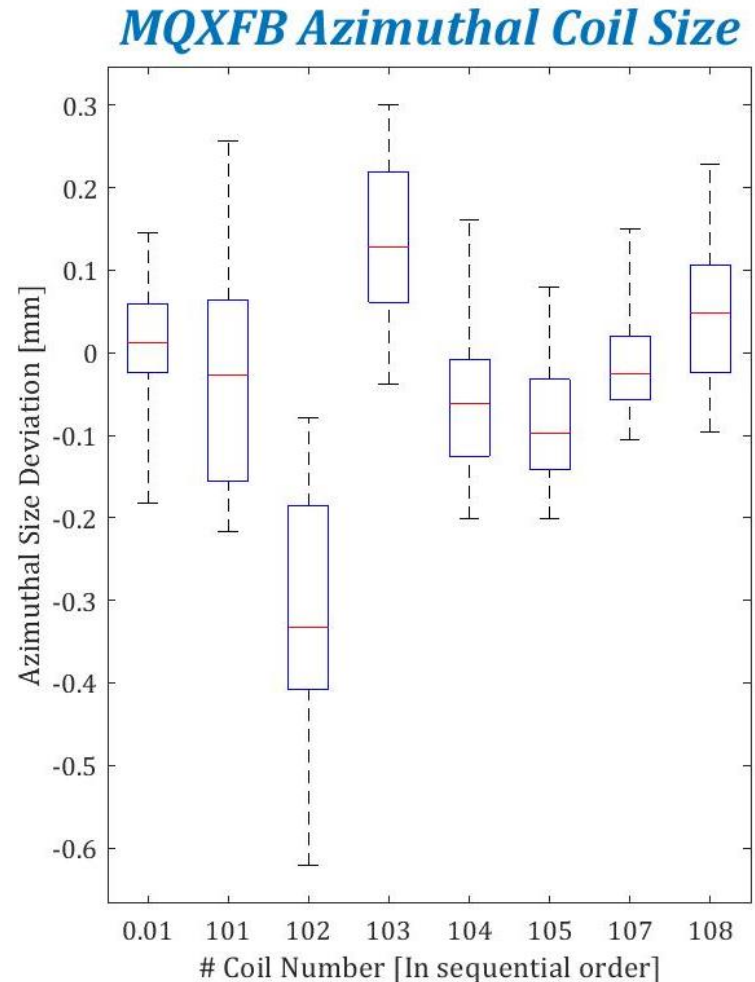
# MQXFBP1 assembled with 4 “practice” coils

- Lifting test based on new lifting girder
- Strain gage reading has shown no impact



# 1<sup>st</sup> Prototype

- Disassembly of magnet and coil-pack (09/2018)
- Assembly of the MQXFBP1 magnet with coils 104, 105, 107, 108, (Spare 109) in 10-12/2018
  - Better results for dimensional measurements in 104,105,107,108
  - Weak insulation coil to pole on coil 104 and 105, but still  $>M\Omega$

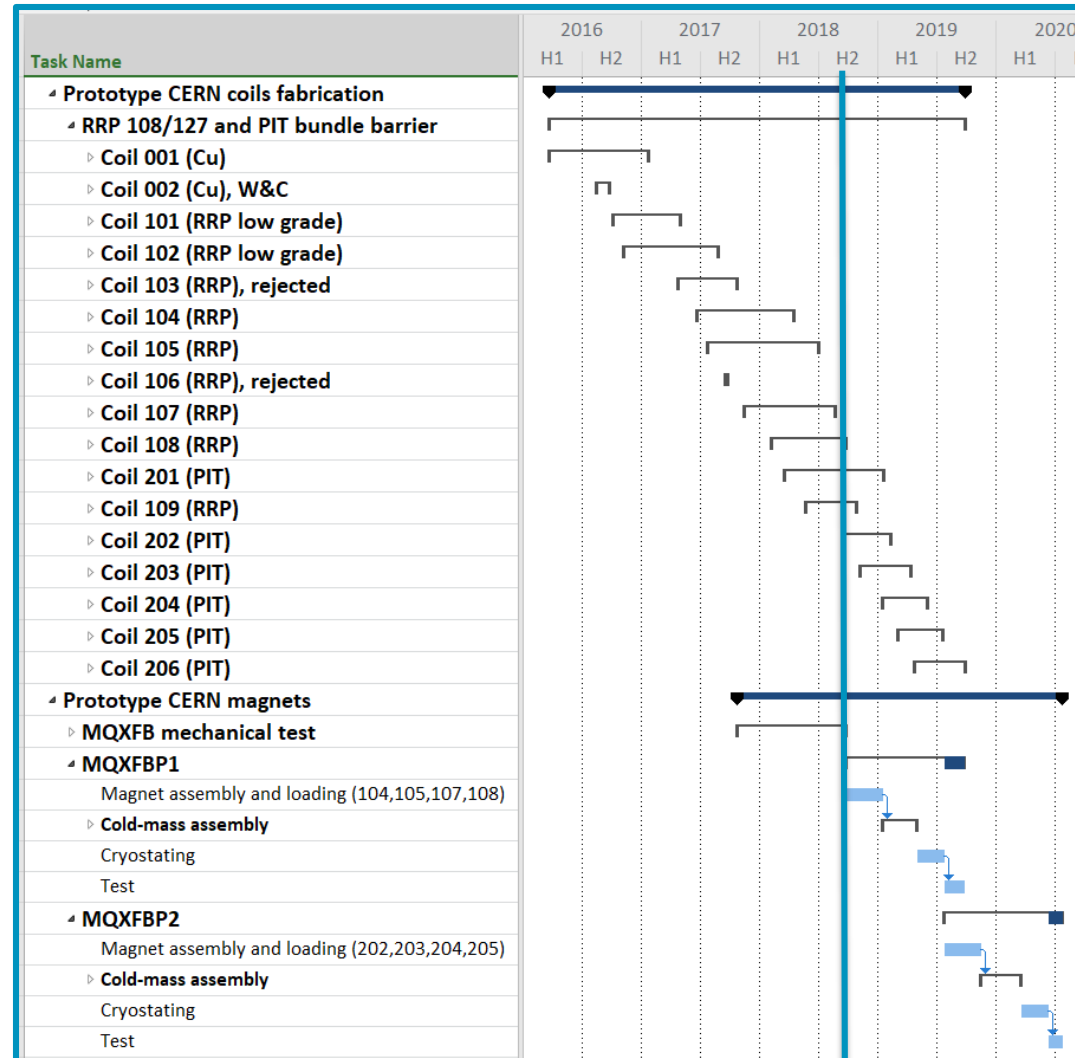




# CERN prototype program

## Coil fabrication

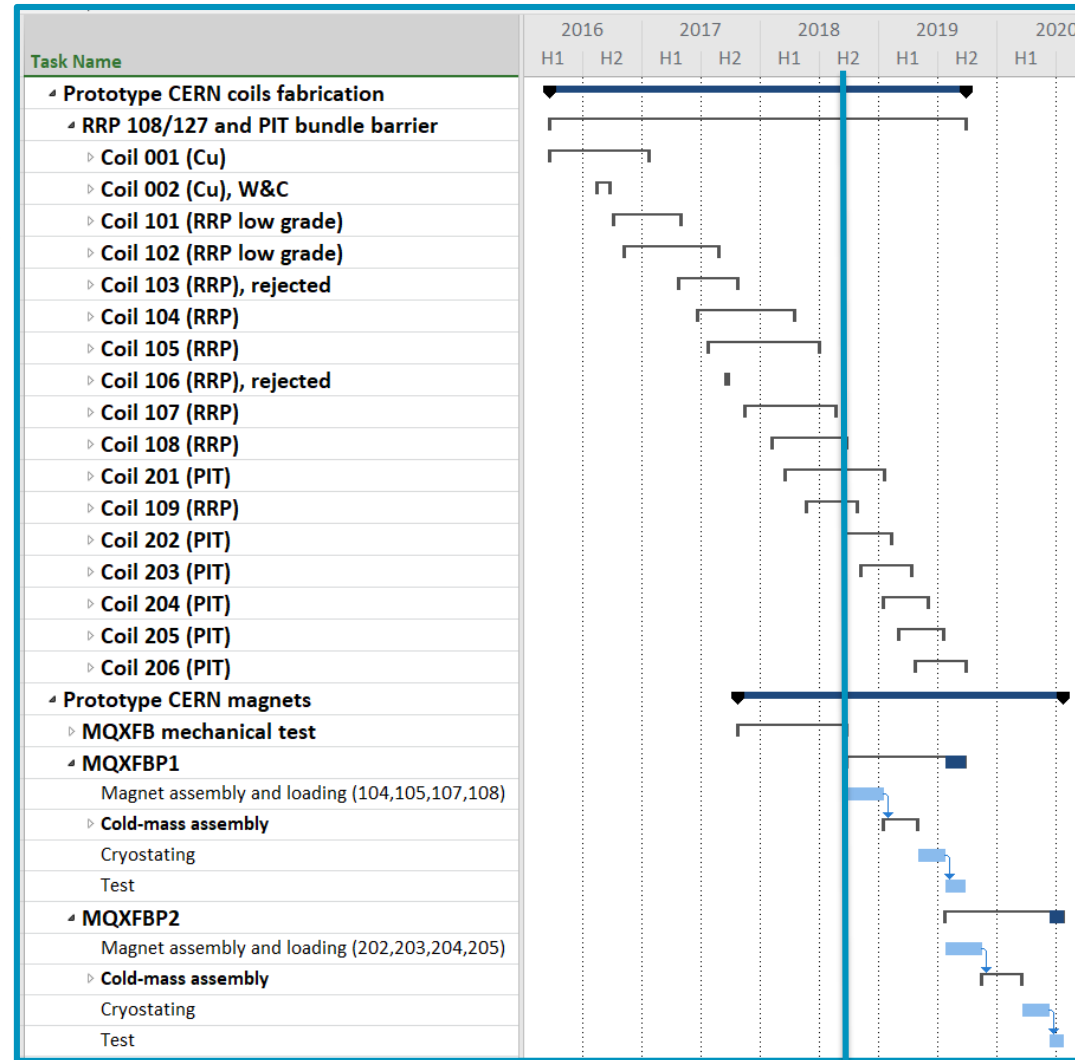
- 1<sup>st</sup> prototype coils
  - Coils (103 and 106) rejected for major NC
  - Coils 104, 105, 107, 108, 109 completed



# CERN prototype program

## Coil fabrication

- 2<sup>nd</sup> prototype coils
  - Coil 201 with major NC, dismissed unless needed for spare
    - RHT (Until Oct. 31<sup>st</sup>)
  - Coil 202 to be Curing of OL on 18<sup>th</sup> of Oct.
    - First coil to correct  $b_6$

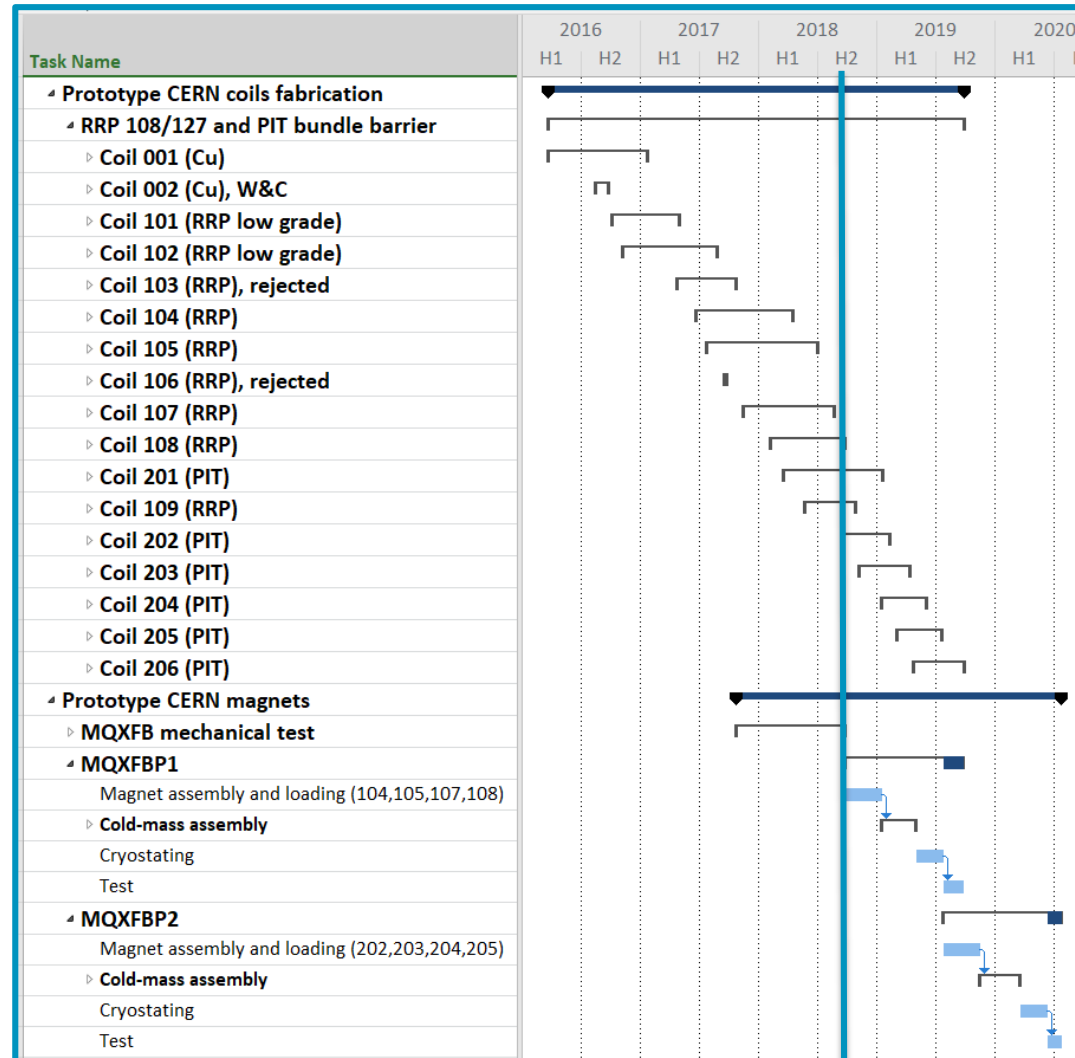


# CERN prototype program

## Magnet fabrication

### • MQXFBP1

- Coil 104, 105, 107, 108 (109 spare)
- Magnet assembly starts in 10/18
- Cold-mass assembly starts in 01/19
- Cryostating starts in 04/19
- Test in 07-08/19

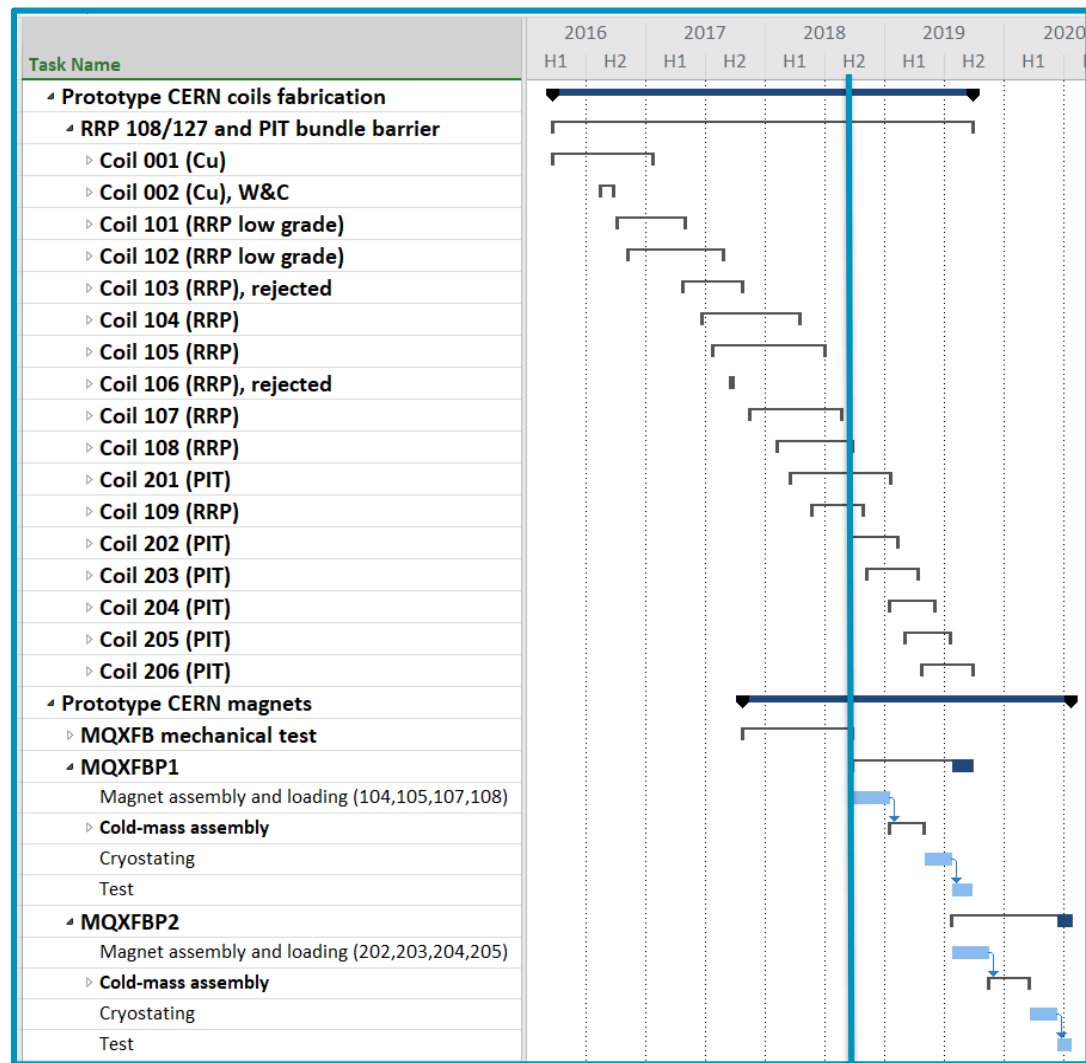


# CERN prototype program

## Magnet fabrication

- **MQXFBP2**

- Coil 202, 203, 204, 205 (206 spare)
- Magnet assembly starts in **08/19**
- Cold-mass assembly starts in **11/19**
- Cryostating starts in **02/20**
- Test in **05-06/20**



# Conclusions

- ❑ Prototype coil fabrication has continued in 2018, five coils made from RRP conductor available for the first prototype magnet assembly. Coil fabrication based on PIT conductor for 2<sup>nd</sup> prototype is currently ongoing.
- ❑ Successful test assembly based on practice coils has been carried out. Conclusive findings regarding tooling optimization and component modification.
- ❑ Test assembly allowed to draft first version of assembly procedure and follow up file by LMF QA.
- ❑ Axial loading has not been carried out due to large spread in coil length.
- ❑ Warm magnetic measurements have shown expected results (mainly due to non conform coil 103).
- ❑ QA procedures and follow up files available up to impregnated coil.
- ❑ Aim to deliver 1<sup>st</sup> prototype magnet for cold mass assembly in end of 2018 and 2<sup>nd</sup> prototype in Nov. 2019.