HFM

High Field Magnets

Update on Common Coil activities at CIEMAT

J. García-Matos, C. Martins, F. Toral, CIEMAT
J. C. Pérez, CERN

Table of contents

Prototype magnet laboratory commissioning (I)

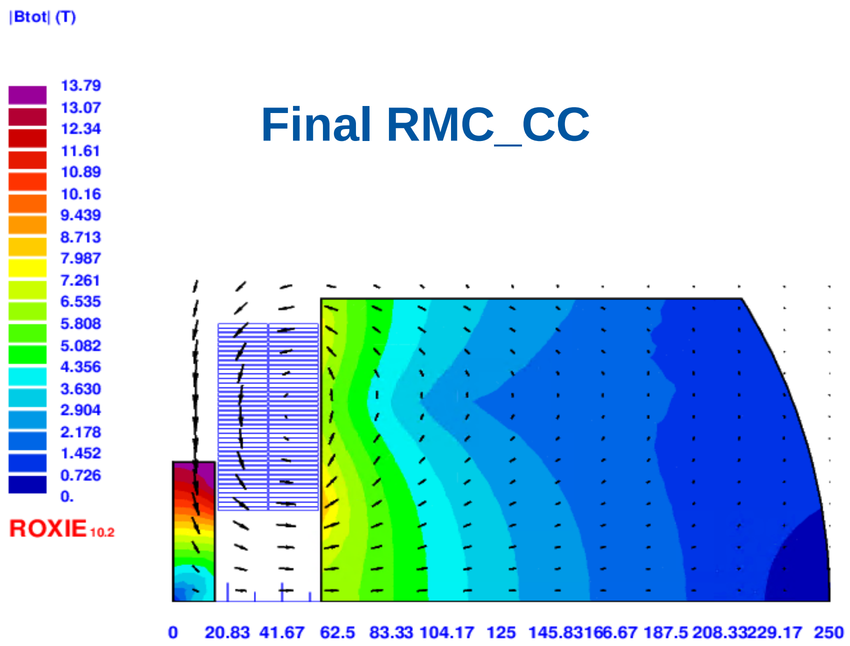
- Some problems with the building: air conditioning, roof leaks, space for winding machine.
- Procurement of small equipment in good progress.
- Call for tenders for reaction furnace and collaring press is ongoing.
- Production of coils for HL-LHC correctors is resumed in-house: important dedication of resources for two years.

Prototype magnet laboratory commissioning (II)

Table of contents

ISAAC magnetic design to provide 14T

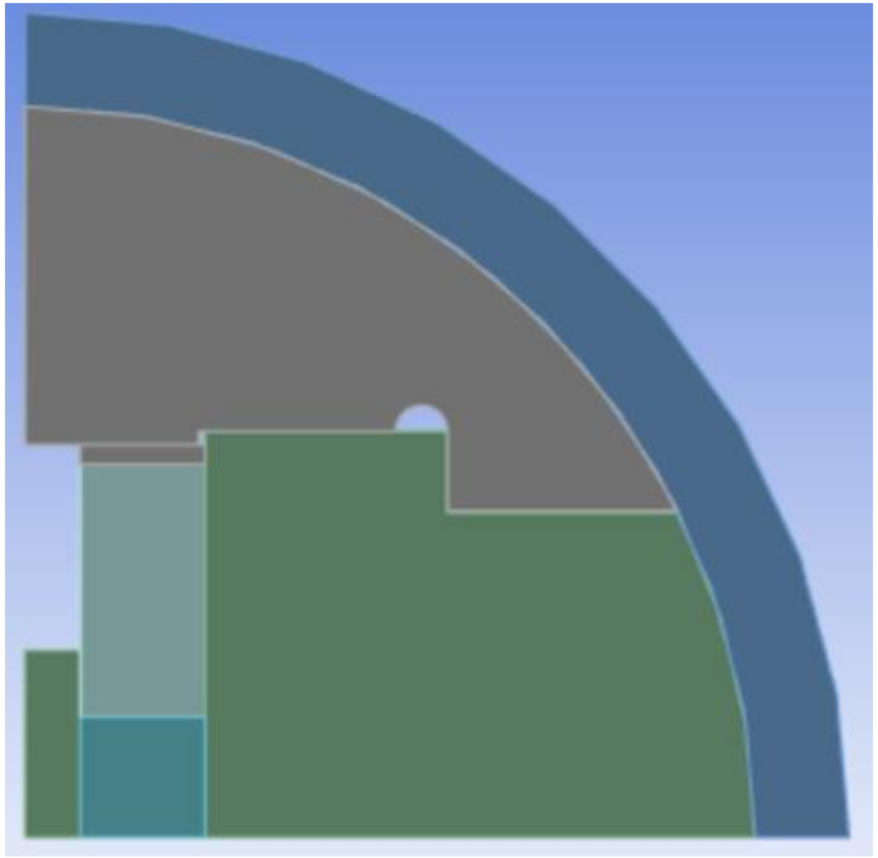
- **ISAAC**: Investigating Superconducting Assembly to Address Common coil mechanics
- Aperture decreased from 50 to **34 mm**
- Yoke very close to the coil (only 1.2 mm distance)
- Intra-beam distance tuned to decrease *a2*
- Middle yoke has a strong influence despite its assembly could be not straightforward
- **Protection** is possible using a dump resistor according to first simulations: R_{dump} = 45 mΩ yields a hotspot temperature of 286K and 900V voltage (adiabatic simulation)



Design ID	Block	Final RMC_CC	CC	CC*	Units
Aperture	74	34	74	74	mm
Intra-beam dist.	-	150	152	252	mm
I_nom	14486	19083	21353	20460	A
Yoke outer radius	246	250	246	246	mm
B	14	14	11.3	11.96	T
Peak field	16.16	14.8	14.27	14.51	T
Peak Field/B	1.154	1.0571	1.263	1.213	-
Load	99.99	99.99	100.2	100.36	%
Stored energy	1752	1038	1701	1733	kJ/m
Static Self Induct.	16.7	5.7	7.46	8.28	mH/m
L*I	242	109	159	169	HA/m
Stray field (20 mm)	1.188	0.44	0.65	1.56	T
Sum Fx Q1	5.1	6.636	5.79	6.53	MN/m
Sum Fy Q1	-4.3	0.474	3.02	0.73	MN/m

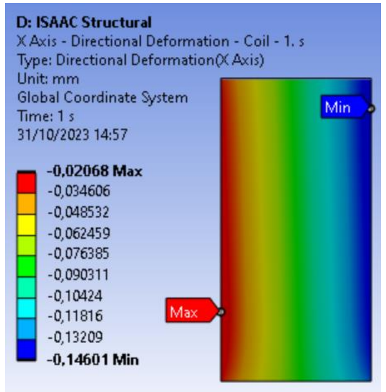
ISAAC mechanical design: stiff support structure

- Let's explore the use of yoke as **support structure**
- Upper part is made in **stainless steel**: it may help to contain the large Lorentz horizontal force
- **Aluminium shell** also contributes to hold the forces
- The coil would lose **contact** with this part during cooling down: it could move horizontally without friction
- Assembly with **bladder and keys** is not modeled yet
- Slight **preload** just to keep contact between parts

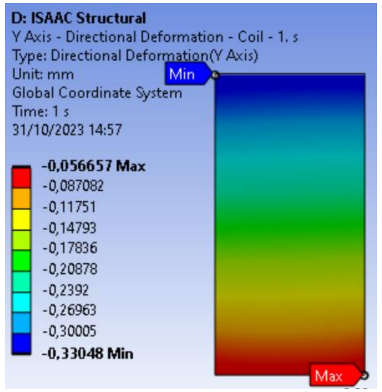


Mechanical design: coil displacement

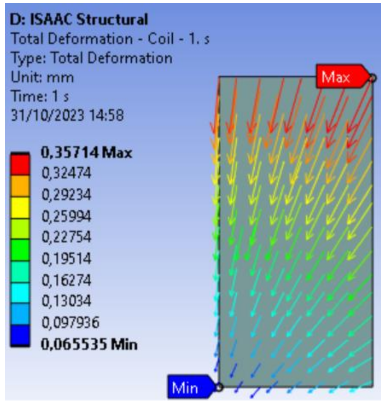
- Horizontal coil displacement below **0.5 mm**



X displacement



Y displacement

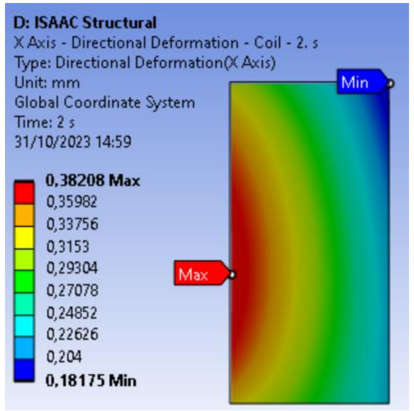


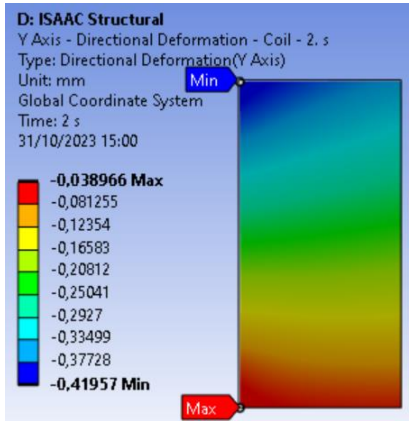
Total displacement

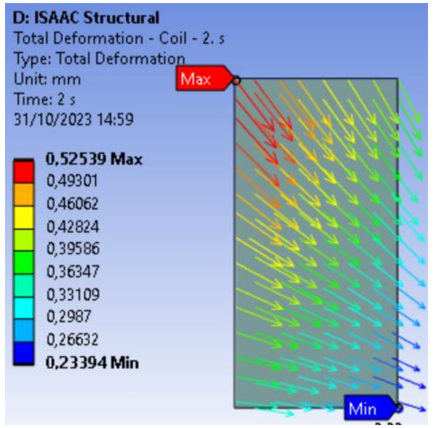
Coil X (Cold)	
Inner	**Outer**
-0,021 mm	-0,146 mm

COOLING

Coil X (EM)	
Inner	**Outer**
0,4054 mm	0,3298 mm





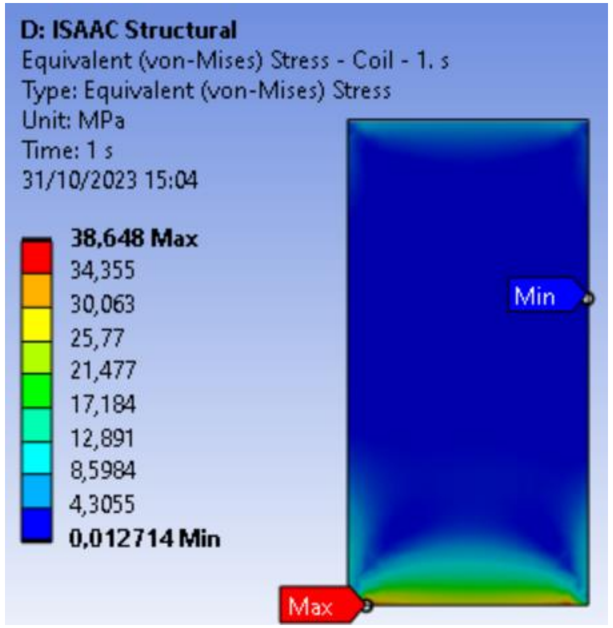


COOLING + EM

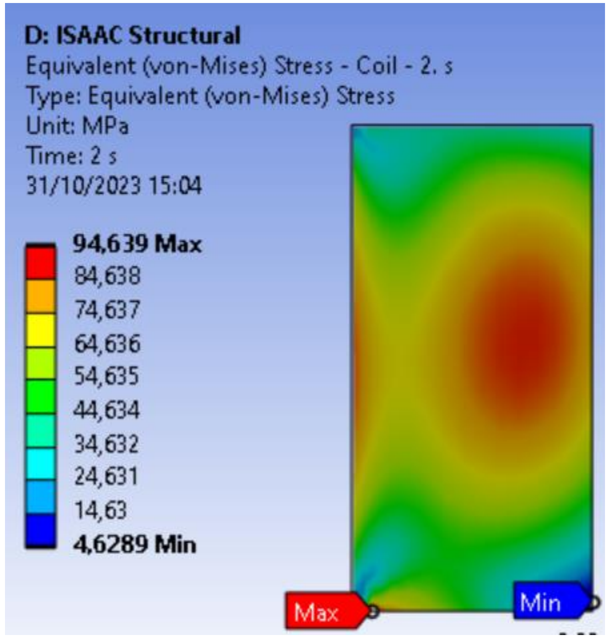
Coil X (Cold+EM)	
Inner	**Outer**
0,3848 mm	0,1838 mm

Mechanical design: stress distribution

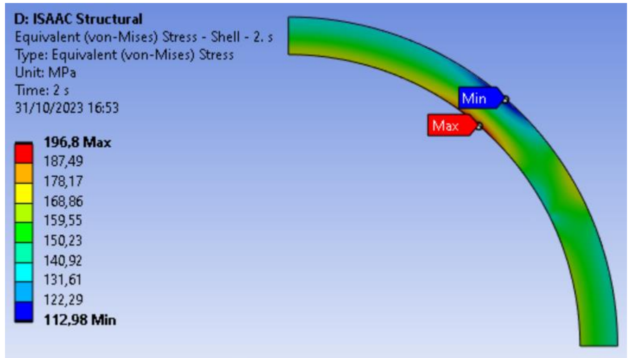
- Coil stress **below 95 MPa**!!
- No significant problems for the structural parts.
- Detailed design is ongoing.

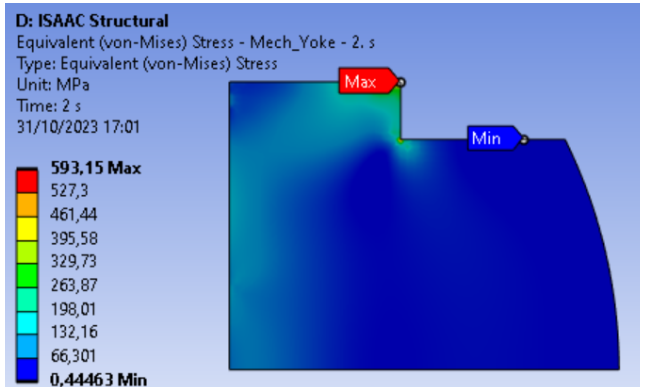


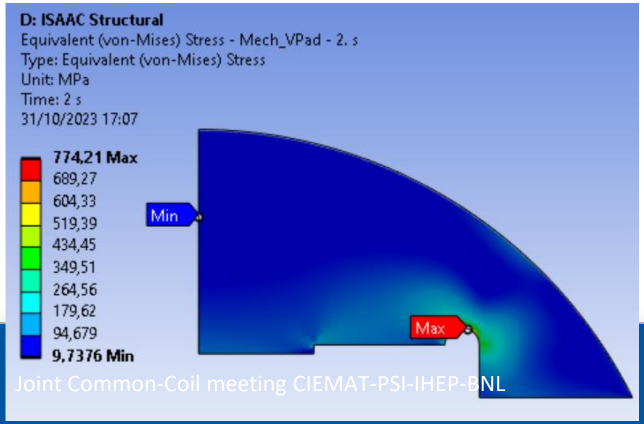
COOLING



COOLING + EM





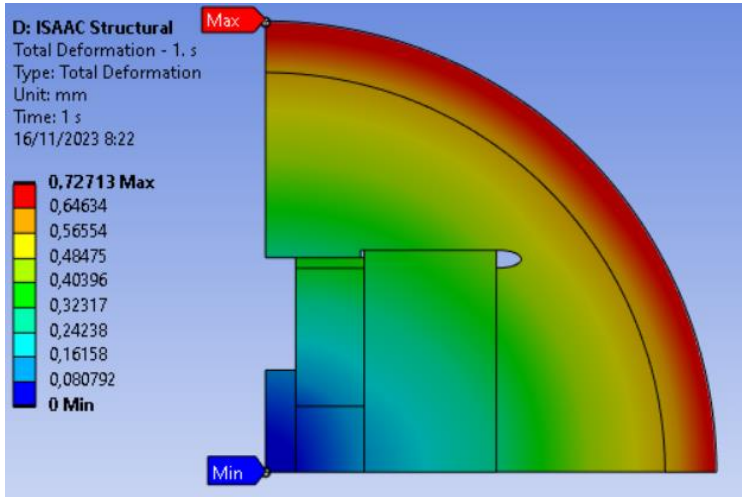


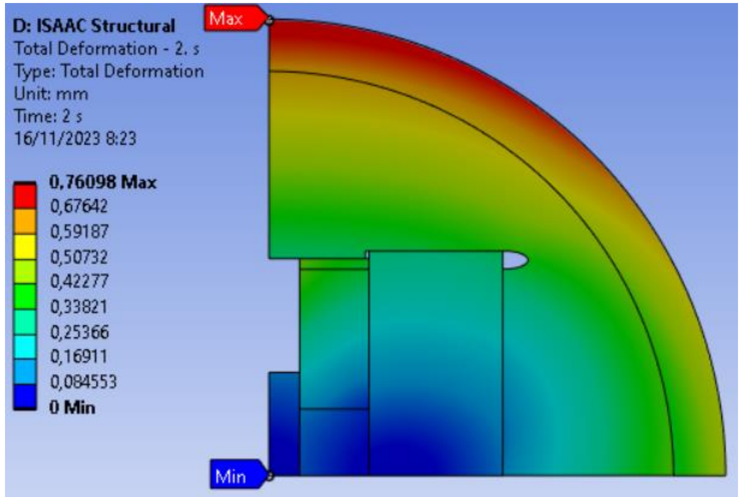
ISAAC mechanical design optimization

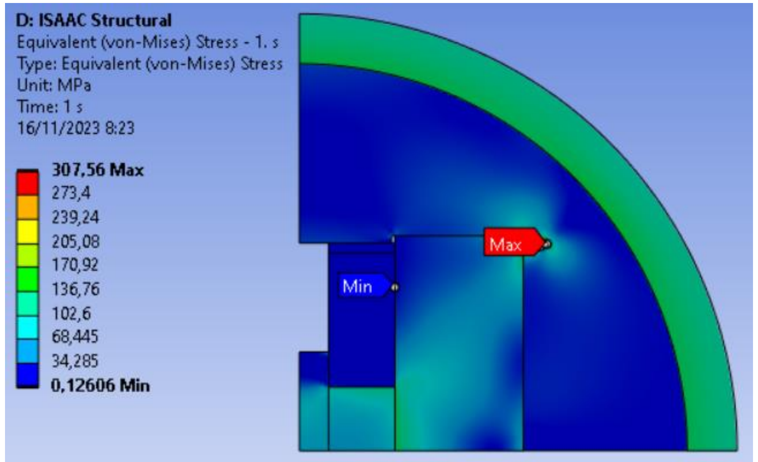
- We are exploring different design options to minimize stresses and coil displacements.
- No final results yet.

COOLING

COOLING + EM







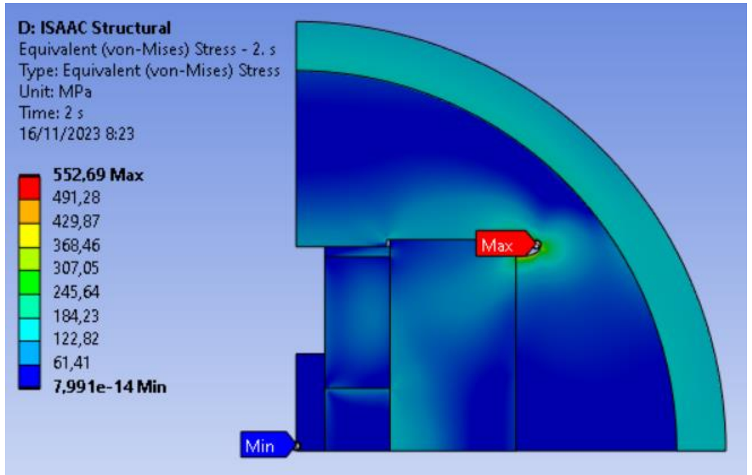


Table of contents

14 T CC demonstrator: magnetic design

- Based on existing strands at CERN.
- Aiming at 14 T at 50 mm aperture, 2 m long.
- First choice is 1.1 mm strand for high field coil and 1 mm strand for low field coil.
- 1.1 mm strand is requested by CEA, PSI and CIEMAT.
- No final design yet.

Conclusions

- Progress on magnet laboratory commissioning, but long way still to finish. Full operation for the end of 2024.
- Detailed mechanical design of ISAAC model magnet is ongoing.
- Magnetic design of 14 T common coil demonstrator is ongoing to define the needs for 1.1 mm strand.