ESAC Review February 2013
CEA Saclay

Fresca2 Dipole Structure Assembly

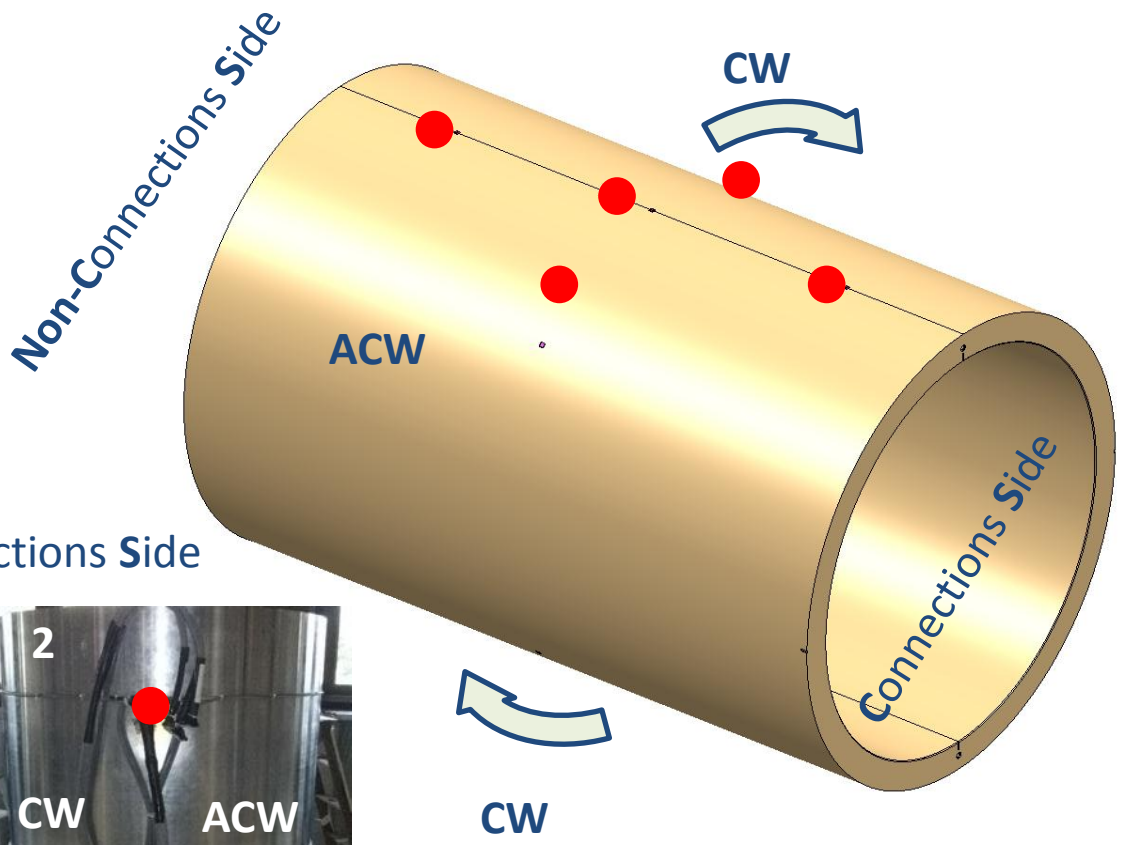
J.C Perez
on behalf of Fresca2 collaboration team

Outline

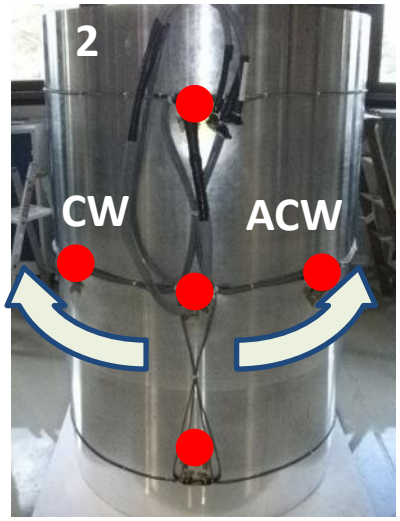
- Mechanical structure validation using Al dummy coils
- Preparation for LN_2 tests
- Next steps
- Conclusion


U.S. AIR FORCE
To Reality

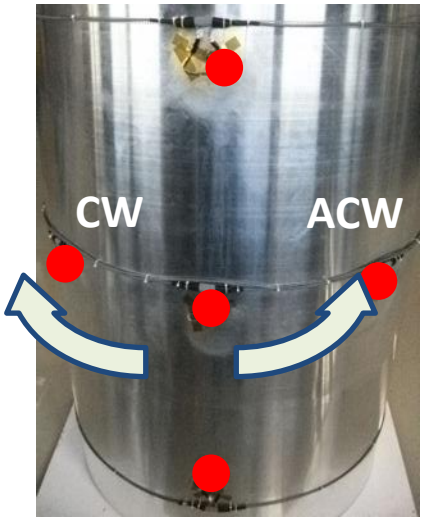
Shell Instrumentation



Connections Side



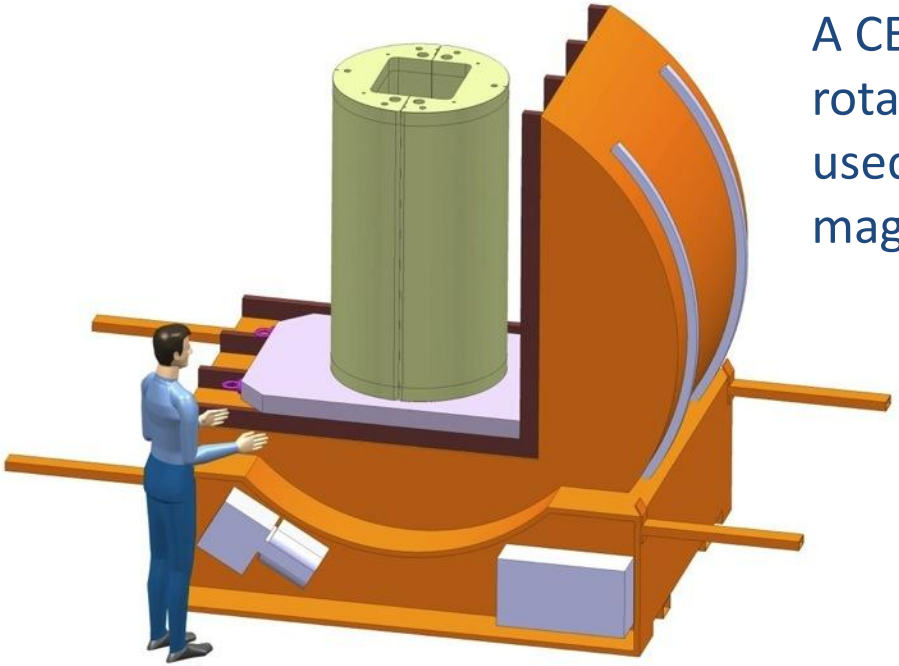
Connections Side



Non-Connections Side

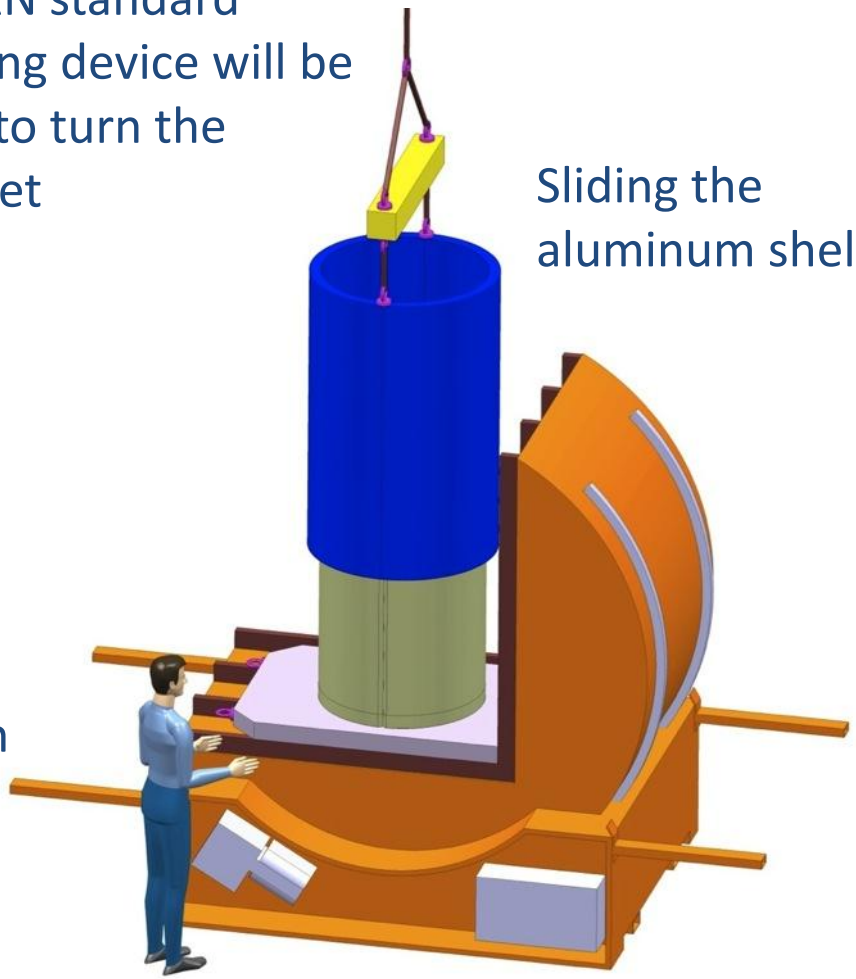
The aluminum shell has been instrumented with 10 measuring stations (see detailed presentation of J.E. Muñoz Garcia & Paolo Ferracin)

Shell and Yoke assembly (1/2)



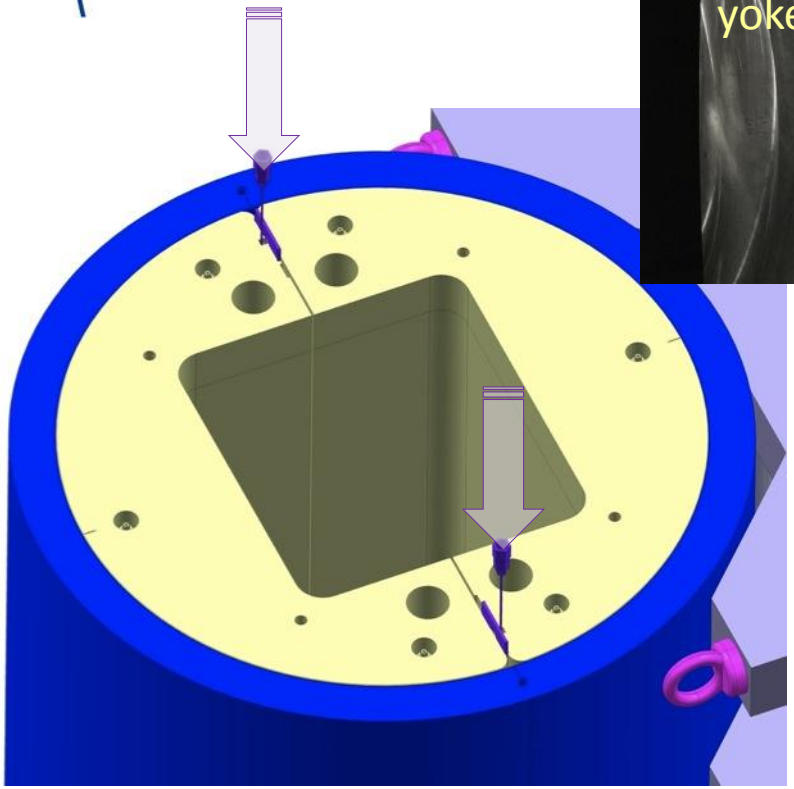
A CERN standard rotating device will be used to turn the magnet

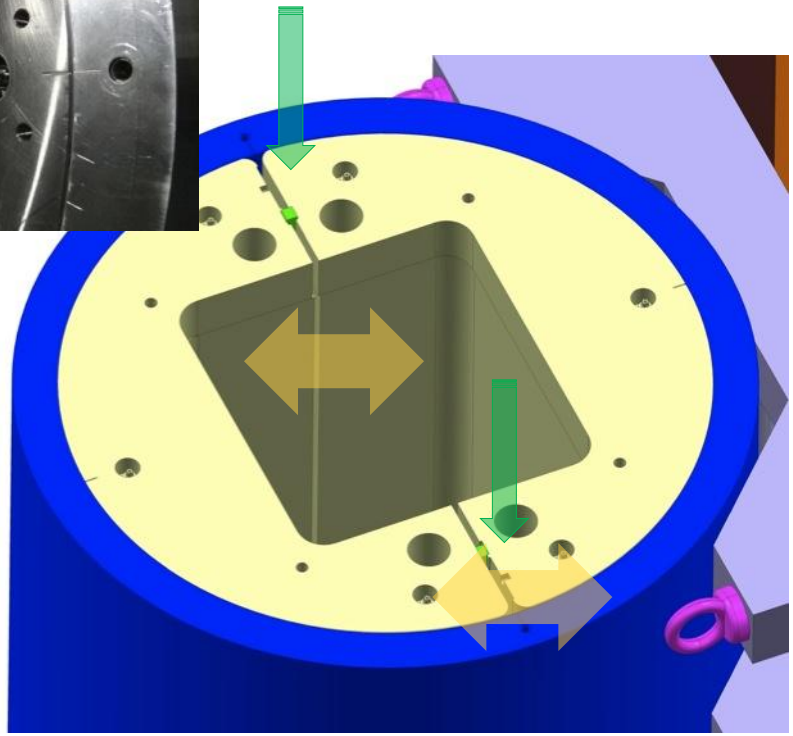
Sliding the aluminum shell



The 2 half yokes will be aligned with no gap in between

Shell and Yoke assembly (2/2)





Two bladders will be used to push the ½ yokes towards the shell inner radius to allow gap keys insertion

The yoke keys will be inserted in between the ½ yokes

Presented in December 2011

Real shell and yoke assembly (1/3)






Juan Carlos Perez TE-MSC

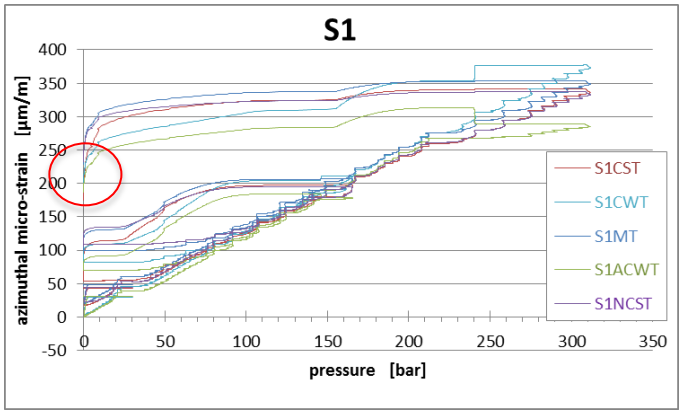
Real shell and yoke assembly (2/3)

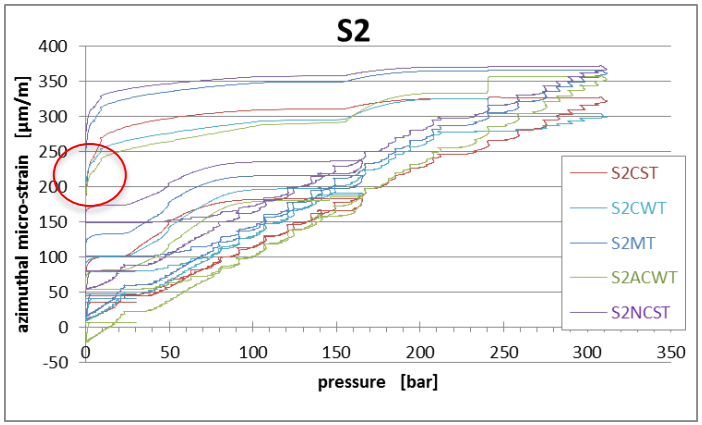
Assembly completed

Juan Carlos Perez TE-MSC

Real shell and yoke assembly (3/3)

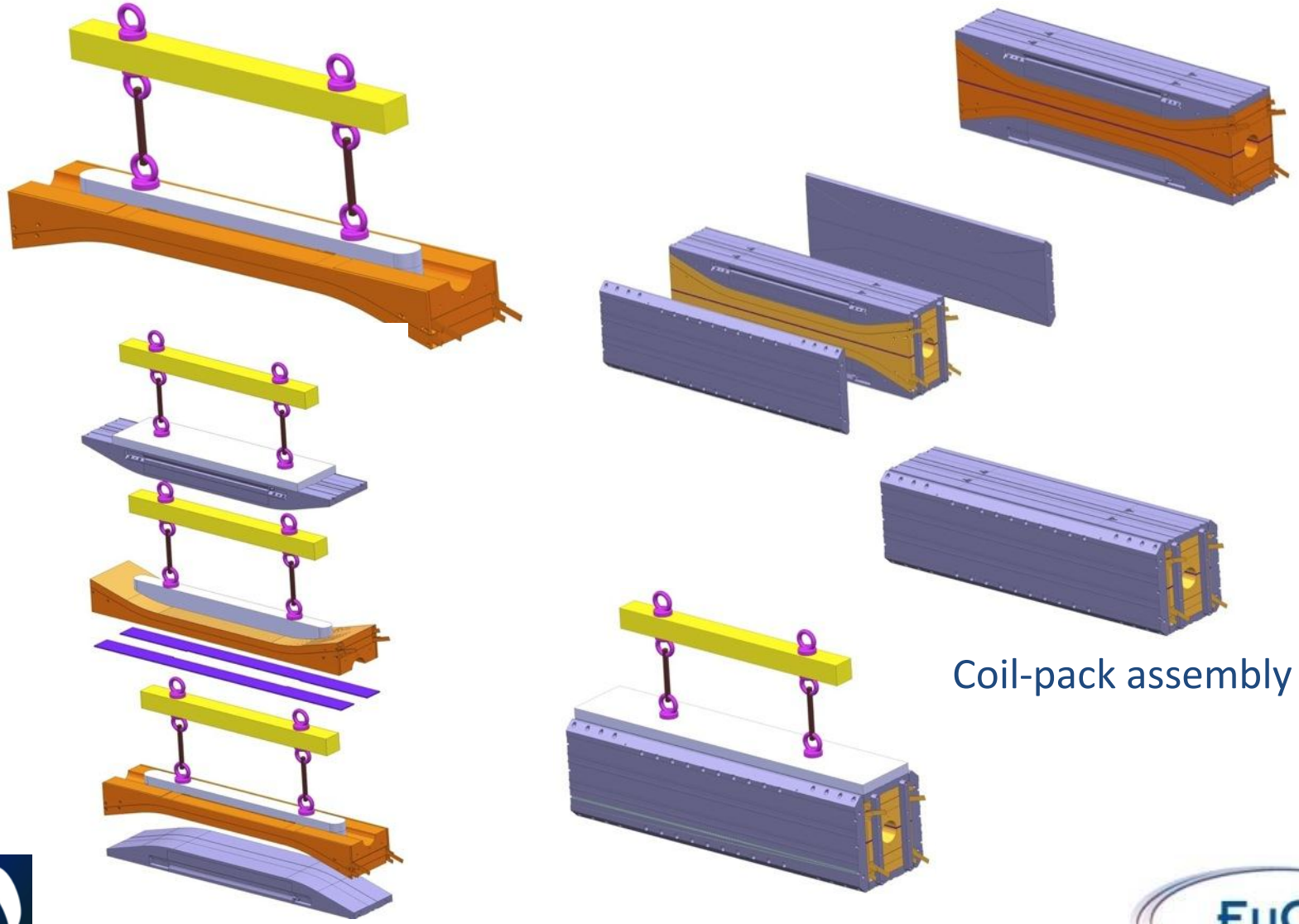
- We had as target to reach **200 micro-strain** in the shell
- By pumping the bladders up-to 300 bars we manage to insert 7.4 mm shims





* See detailed presentation of J.E. Muñoz & Paolo Ferracin

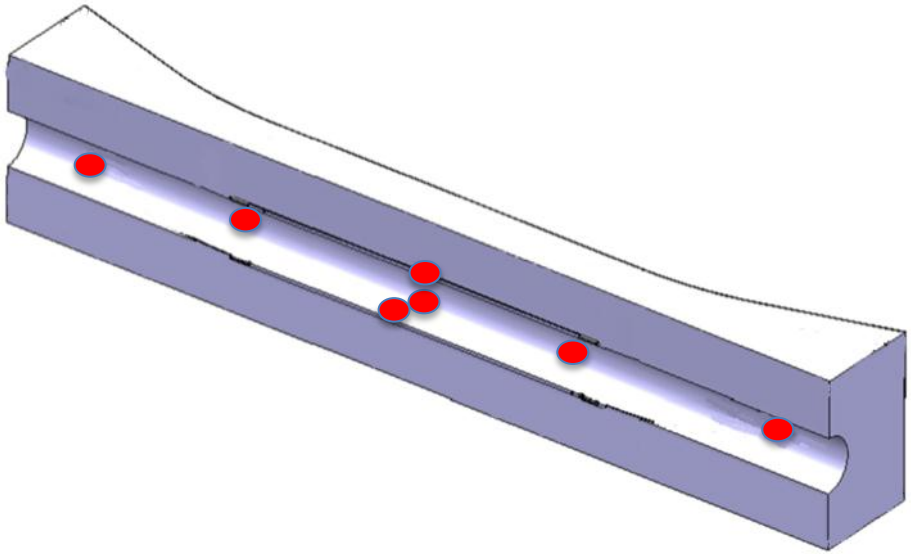
Al dummy coils assembly sequence

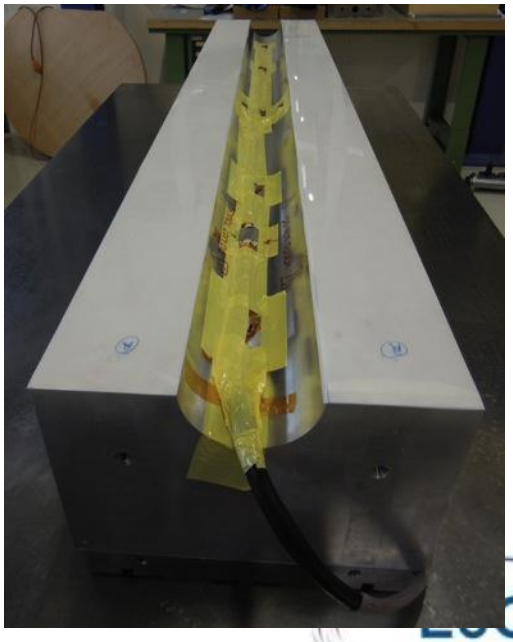


Coil-pack assembly

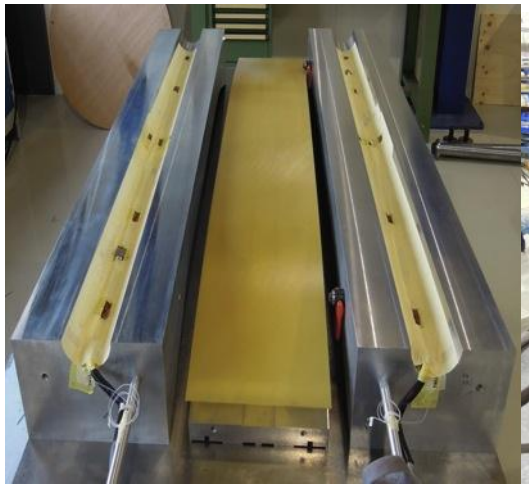
Aluminium dummy coil assembly

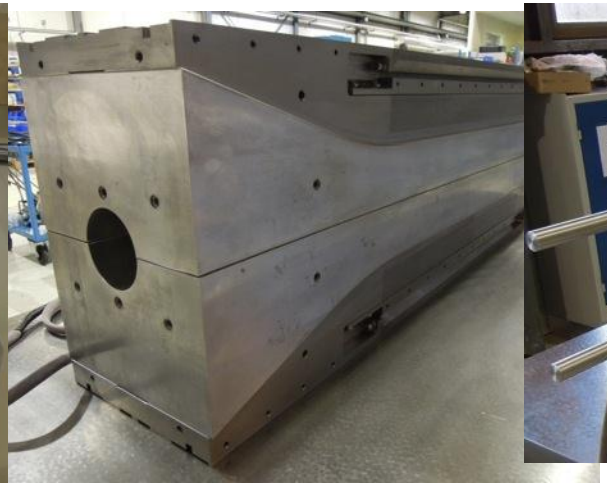
- The first mechanical assembly has been performed using aluminum blocks replacing the real coils
- The aluminum dummy coils have been instrumented with 2*7 strain gauges stations measuring along azimuthal and longitudinal direction
- The contact surface between dummy coil and pads has been checked using pressure sensitive paper

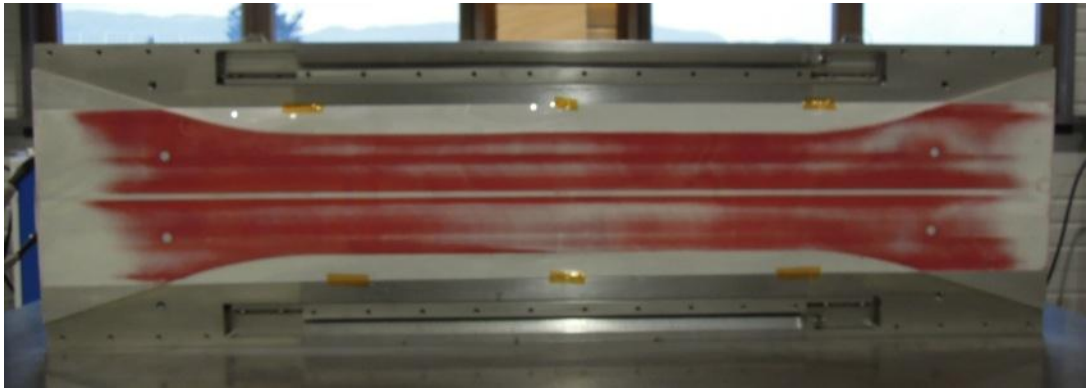


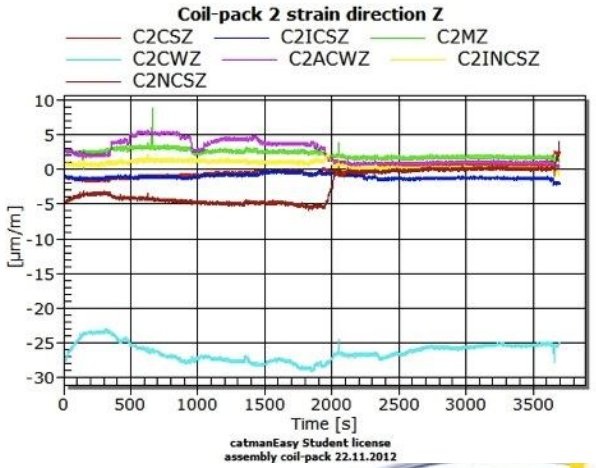


Al Dummy Coils assembly



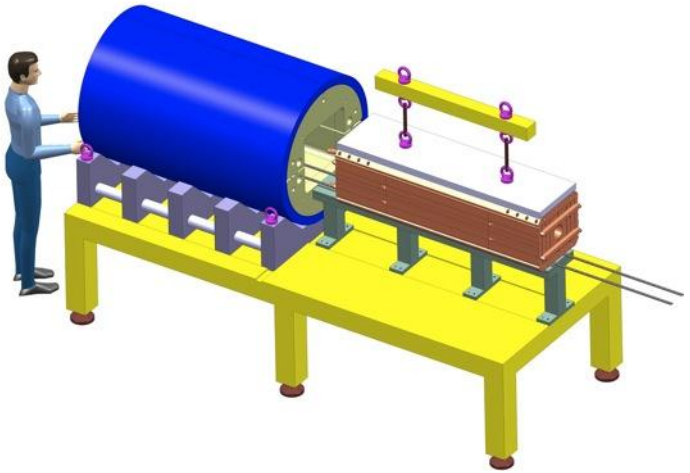




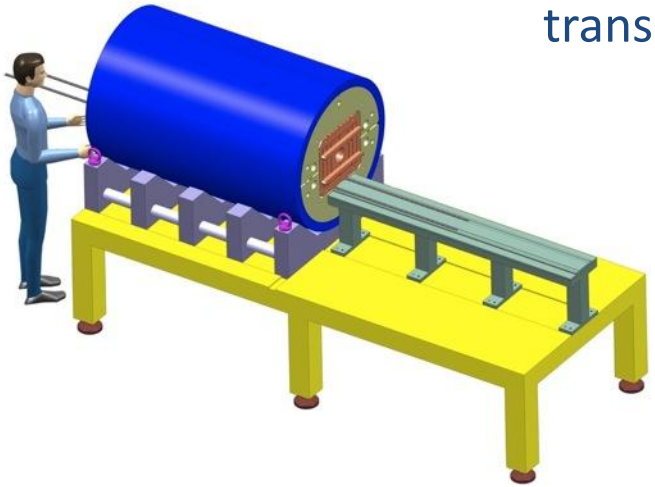


Sliding the coil pack in the structure

The pre-assembled yoke and shell will be rotated to horizontal position



The coil-pack and the magnet body will be transported to the assembly table



The coil-pack will be pushed into the yoke aperture

Real Sliding of coil pack in the structure

The pre-assembled yoke and shell are rotated to horizontal position

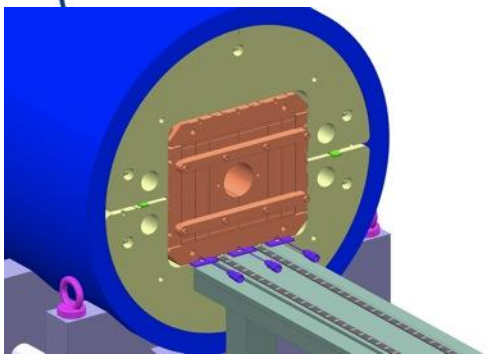
Magnet structure installed on the assembly table

The coil-pack being pushed into the yoke aperture

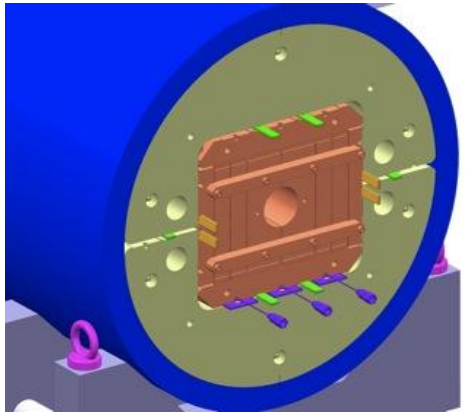
* See video

Juan Carlos Perez TE-MSC

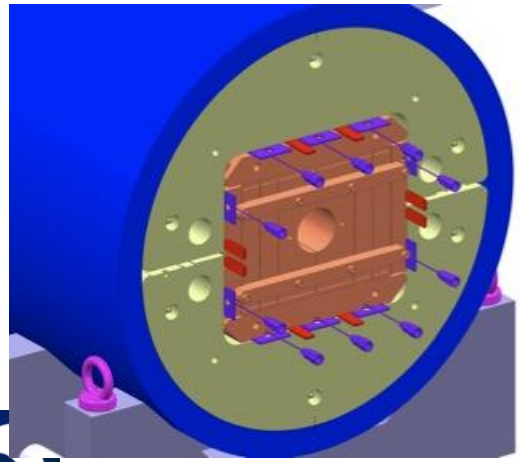
Coil pack Pre-loading



3 vertical bladders will be used to lift the coil pack and remove the rollers



Temporary keys will be inserted to center the coil –pack into the yoke aperture



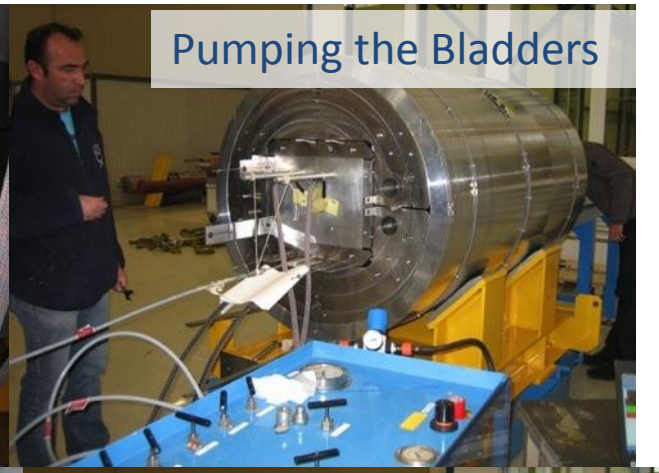
<u>Pumping bladders & insertion of the keys</u>

- The horizontal keys are inserted to obtain a tight assembly of the coil-pack
- The vertical shimming will be gradually increased to reach the pre-defined stress target value on the shell
- Finally the horizontal shimming will be increased

Juan Carlos Perez TE-MSC

Coil pack Pre-loading

Sliding rollers extraction



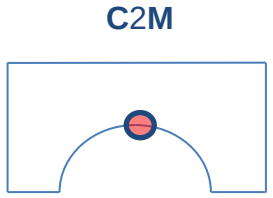
Pumping the Bladders

Running FEM program

Bladder insertion

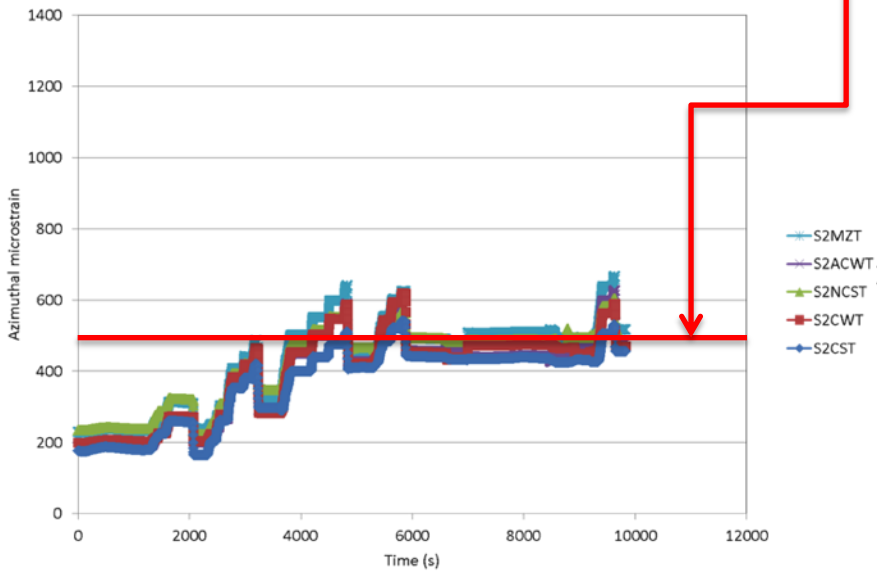
Well done !!

Targets VS. Obtained results

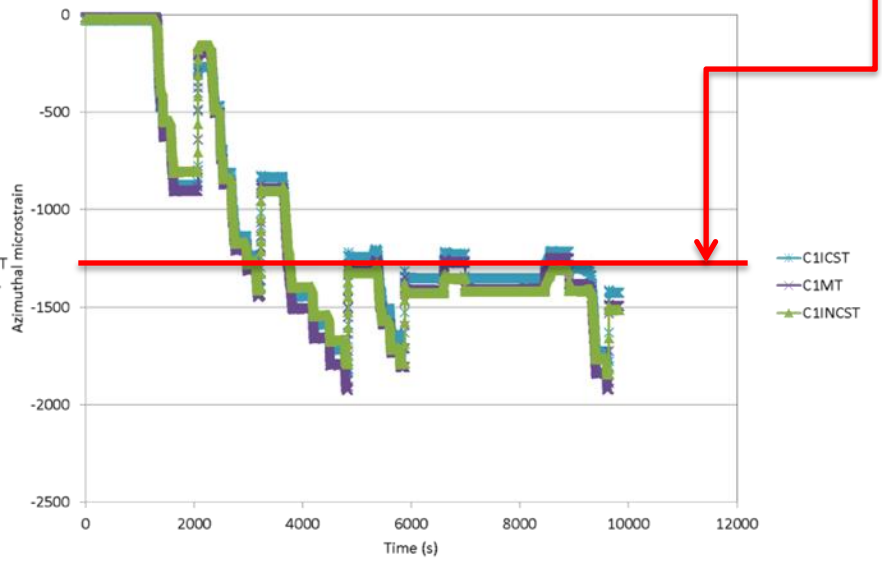


- Shell
  - Azimuthal strain: +500 µstrain
  - Azimuthal stress @ 300K: +35 MPa
  - Azimuthal stress @ 77K: +110 MPa

- Coil
  - Azimuthal strain: -1450 µstrain
  - Azimuthal stress @ 300K: -100 MPa
  - Azimuthal stress @ 77K: -220 MPa



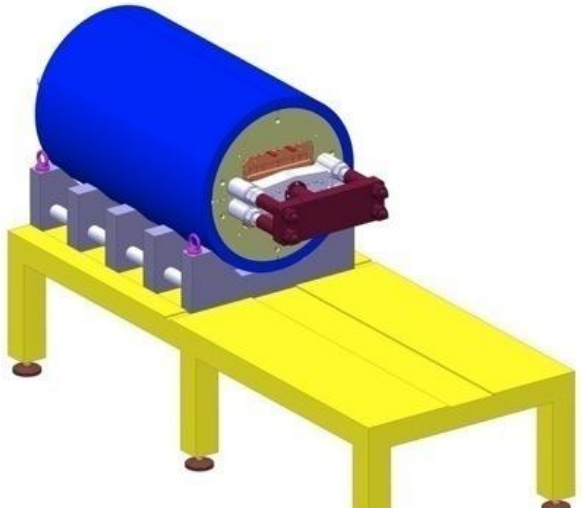
Shell azimuthal strain



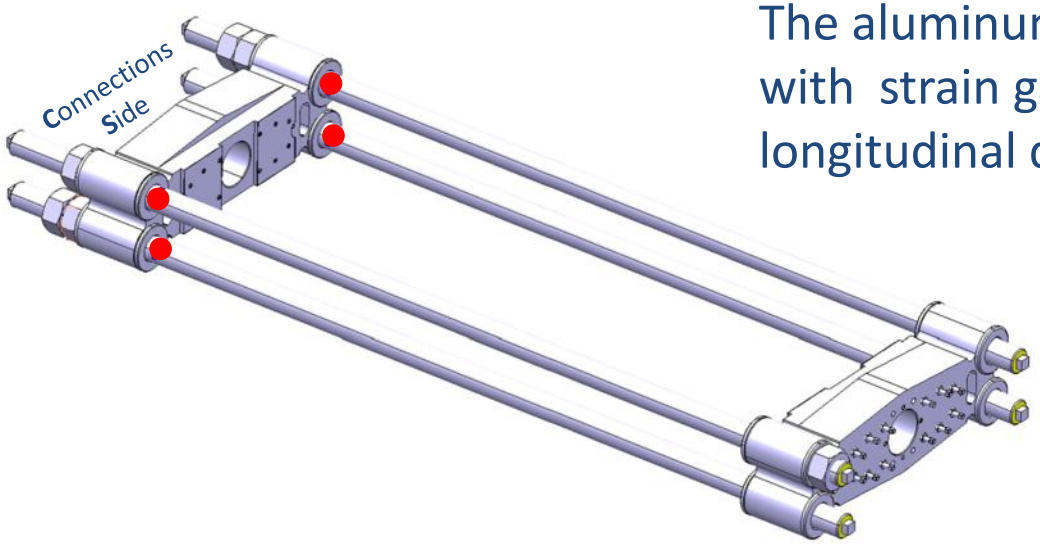
Coil azimuthal strain

* See detailed presentation of Paolo Ferracin & J.E. Muñoz Garcia

Axial compression system



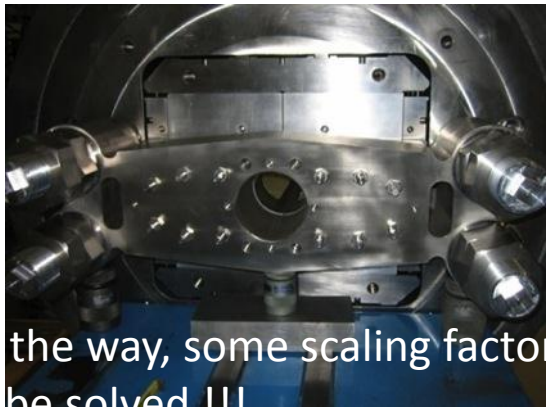
- A 200 t hydraulic cylinder will be used to tension the rods to the targeted stress value at 300 k
- Bladders operation to change coil pre-stress remains possible after assembly of the end plates



The aluminum rods will be instrumented with strain gauges measuring along the longitudinal direction

Presented in December 2011

Axial compression system assembly

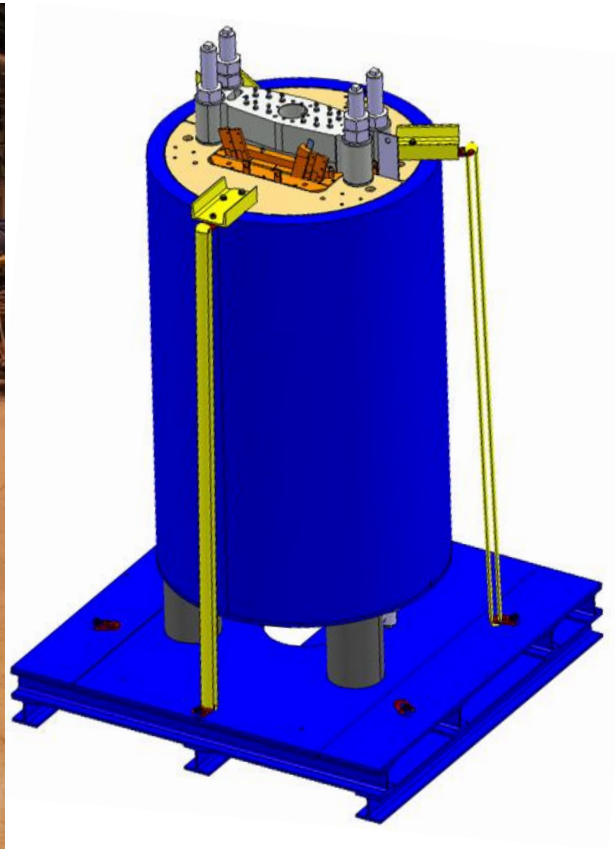



- A force of 500 kN has been applied to the rods using the hydraulic cylinder:
  - Azimuthal target microstrain/stress @ 300K: +710 µstrain/+ 50 MPa
  - Azimuthal target microstrain/stress @ 77K: +1350 µstrain/+ 105 MPa
- The strain in the rods is well balanced within 10 µstrain.
- The end plates compress directly the Al dummy coils.
- The possibility to compress on the yoke at 300 K and transmit the force to the coil during cool-down will be tested on next assembly (See J.E. Muñoz Presentation).

Transportation frame

Magnet ready to be transported to SM18

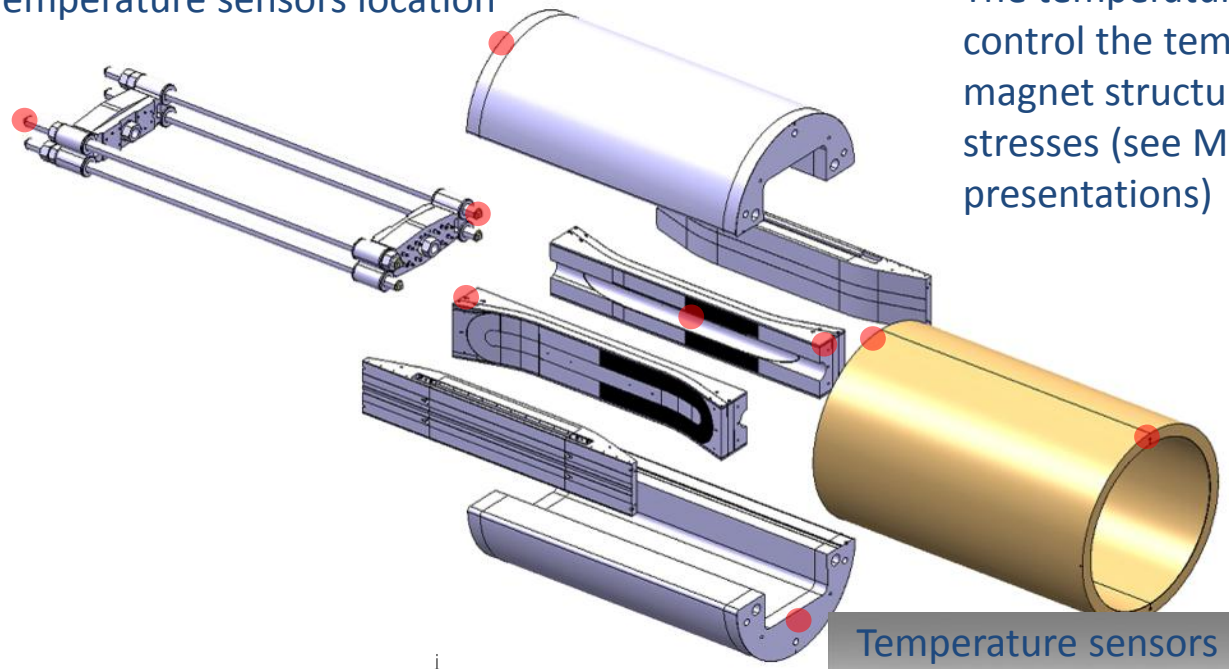
Assembly area in SM18 for LN_2 tests preparation



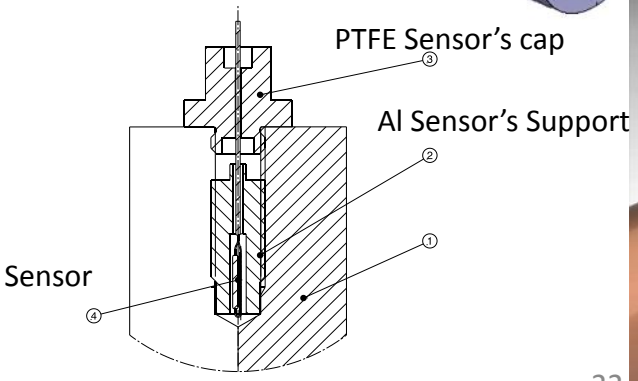
Structure preparation for cold tests: see Marta's presentation

Additional instrumentation for Cool-down control

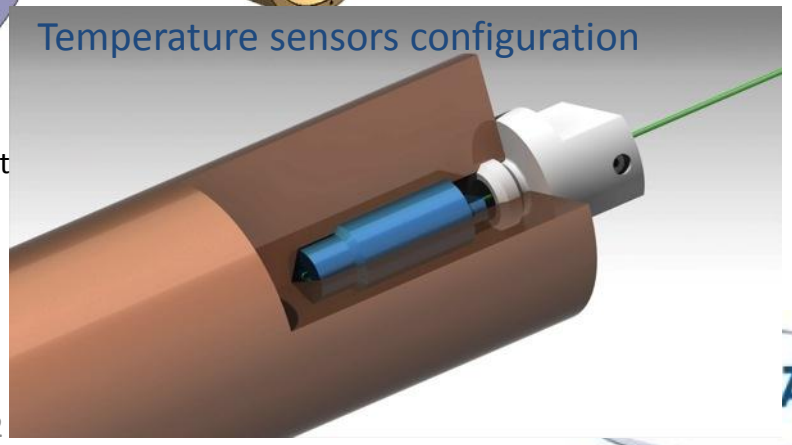
Temperature sensors location



The temperature sensors will be used to control the temperature gradient across the magnet structure to limit thermal induced stresses (see M. Bajko & J.E. Muñoz detailed presentations)



Temperature sensors configuration

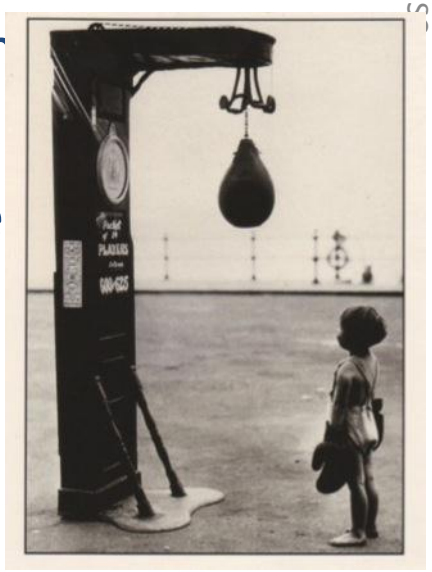


Next steps

- The structure will be rotated to vertical position in SM18
- Temperature sensors will be mounted
- LN_2 transfer line will be inserted in the bore
- The external skin and joints to optimize the cooling time of the structure will be assembled
- The structure will be transported near the cryostat and inserted using a truck crane
- First cool-down to 77 K is expected for mid of April

Conclusions

- All structure components have been delivered to CERN
- Shell, rods and aluminium dummy coil have been instrumented with strain gauges and temperature sensors
- The first mechanical assembly using aluminium dummy coils is completed
- Strain gauges data are being processed
- The cryostat to cool-down using LN_2 has been installed
- Temperature sensors acquisition system, cryoger cryogenic control system will be ready in April
- First cool-down of the structure to 77 K schedule 2013



Still a long way to go but we are getting closer !

Fresca2 Collaboration Team

FRESCA 2

Thanks for your attention

The Lord of High Fie

www.cern.ch