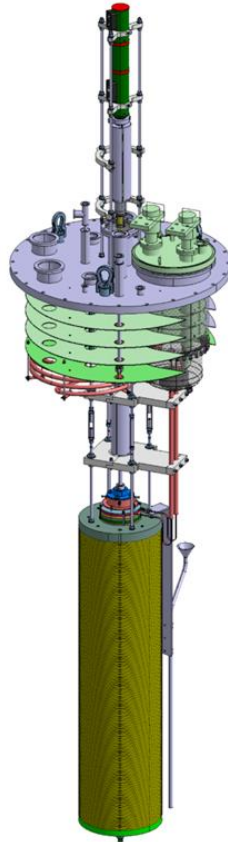


# MQYYM magnetic measurements TECHNICAL REVIEW

**Damien Simon for the MQYYM team**

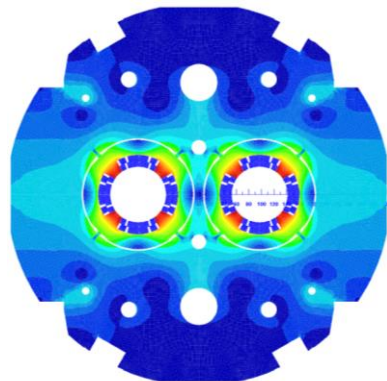
**CEA:** H. Felice, D. Simon, J.M. Gheller, D. Bouziat, A. Madur, M. Segreti, J.M. Rifflet, S. Somsom, R. Machado-Correia

**CERN:** L. Fiscarelli, O. Dunkel, A Foussat, J.C. Perez, E. Todesco, P. Viret

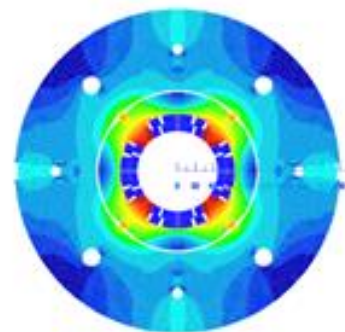


## The MQYY project:

- Collaboration CERN-CEA for the HL-LHC
- Design of the MQYY a double aperture  $\cos(2\theta)$  Nb-Ti matching section magnet
- Fabrication and test of the MQYYM single aperture magnet short model of the MQYY magnet
- Fabrication of the MQYYM coils at CEA
- Assembly and warm magnetic measurements at CERN: **CEA team supported by CERN team**
- Cold magnetic measurements at CEA: **CEA team (with hopefully some CERN support...)**

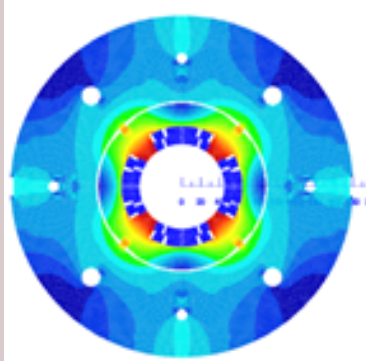


The MQYY



The MQYYM

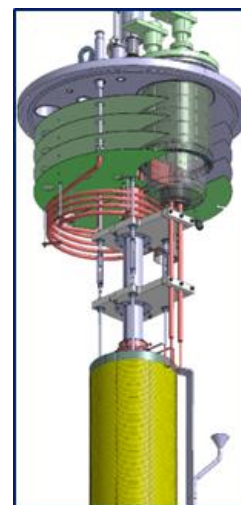
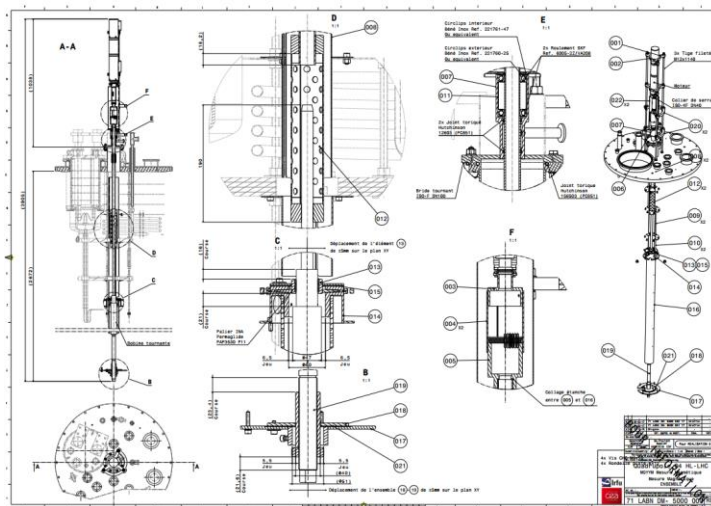
## THE MQYYM QUADRUPOLE

Aperture	90 mm	
Nominal gradient	120 T/m	
Nominal Current	4590 A	
110% Nominal Current	5049 A	
Short Sample Current	5997 A	
Harmonics	$B_{3,6,10} < 1$ unit $B_{14} < 1,5$ units	
Reference radius	$R_{ref} = 30$ mm	
Margin on the loadline	23,4 %	
MQYYM coil physical length	$L = 1350$ mm	
MQYYM magnetic length	$L = 1204$ mm at 1,9 K	

**Main goal of the review:** To validate the design before the call for tenders

How to get there?

1. Presentation of the CEA adaptation design for the magnetic measurements
2. Discussion on the CEA test facilities (Acquisition system, software and hardware of the test facility)
3. Discussion on the CERN equipment necessary for the measurements
4. Preliminary schedule of the tests preparation magnetic tests



09h00-11h30: Presentation of the magnetic measurements system at cold for the MQYYM tests and review of the drawings

11h30-12h00: Discussion on warm magnetic measurement

12h00-13h30: Lunch break

13h30-13h45: Visit of the CEA winding facility and presentation of the MQYYM Coil 0

13h45-15h00: Visit of the test facility

15h00-16h00: Planning and conclusion

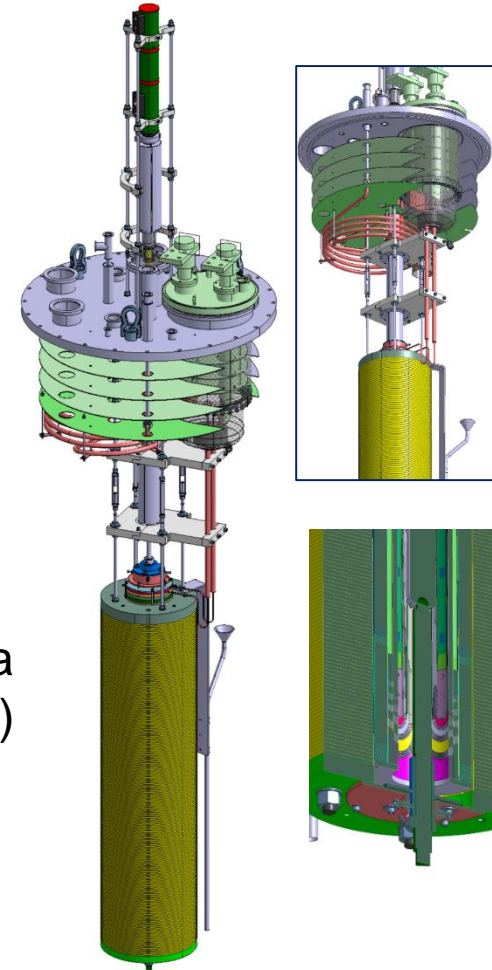


### ***Test of MQYYM in the vertical cryostat at Saclay:***

- 8m cryostat equipped with a 3 m long « sock » (tank)
- Saturated LHe bath at 1,9 K 23 mbar
  - **Main difference with the CERN system**
  - **Importance to seal the system for test at CEA**
- Adaptation of an existing top plate
- Parts manufactured and received in Saclay in May

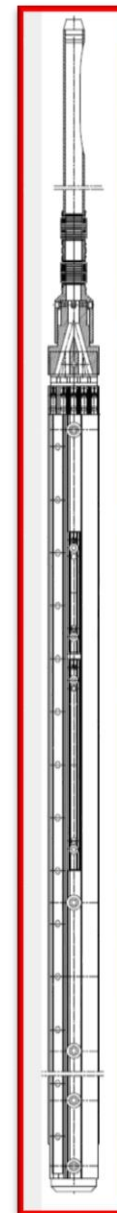
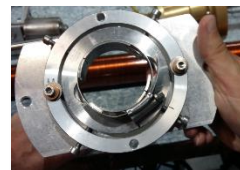
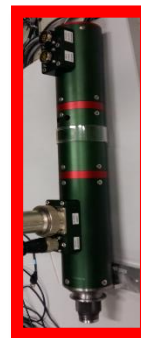
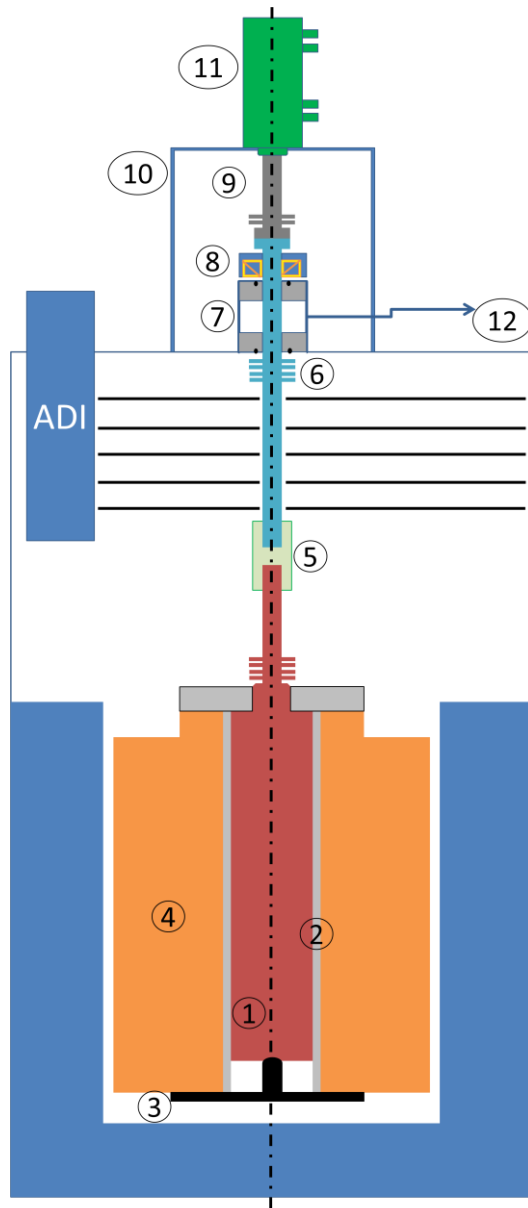
### ***MQYYM Magnetic measurements***

- Cold system identified (Probe LHCMMWEC0209 with a diameter of 47 mm and an effective length of 1180 mm)
- Adaptation of the CERN magnetic system done
- Order has to be placed soon

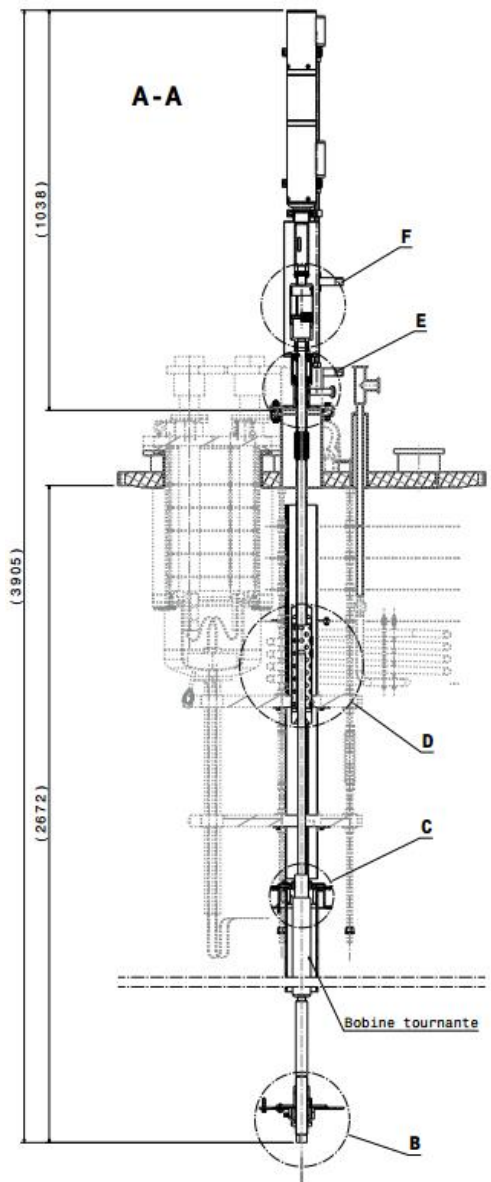
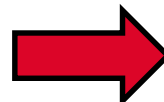
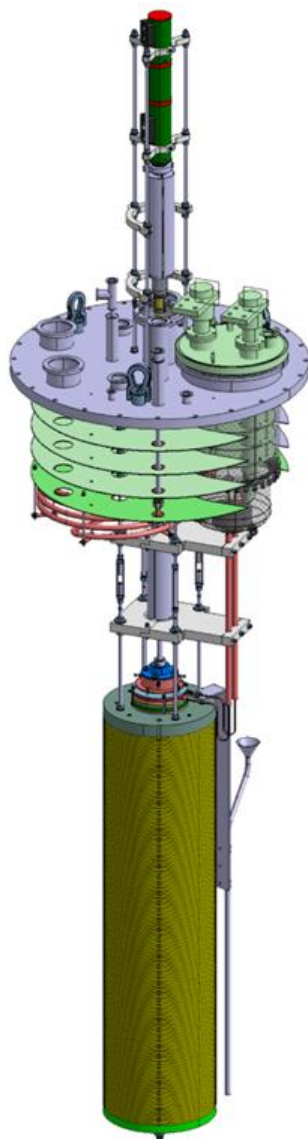
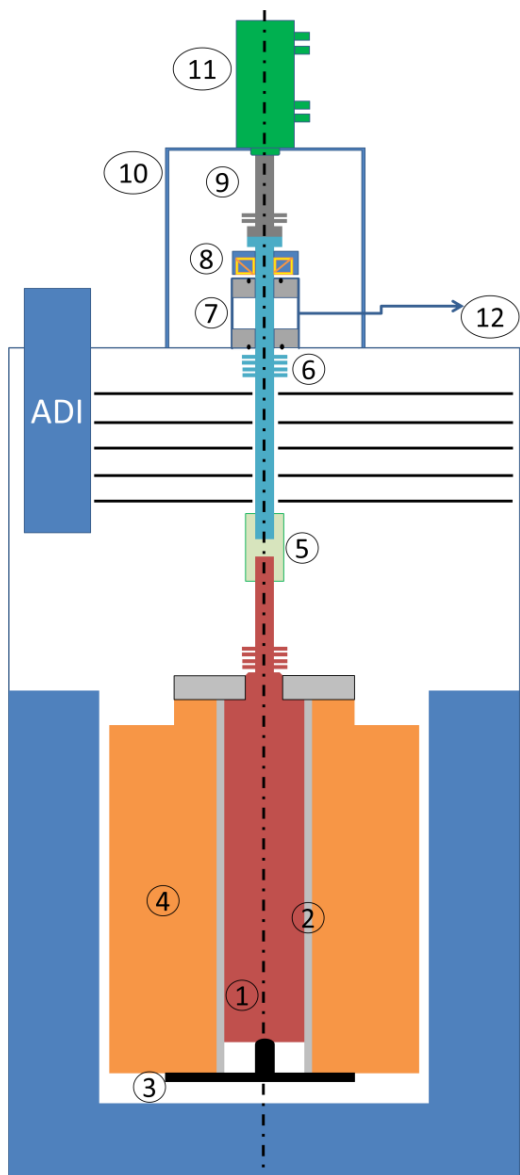


Main adaptation to CERN components to do:

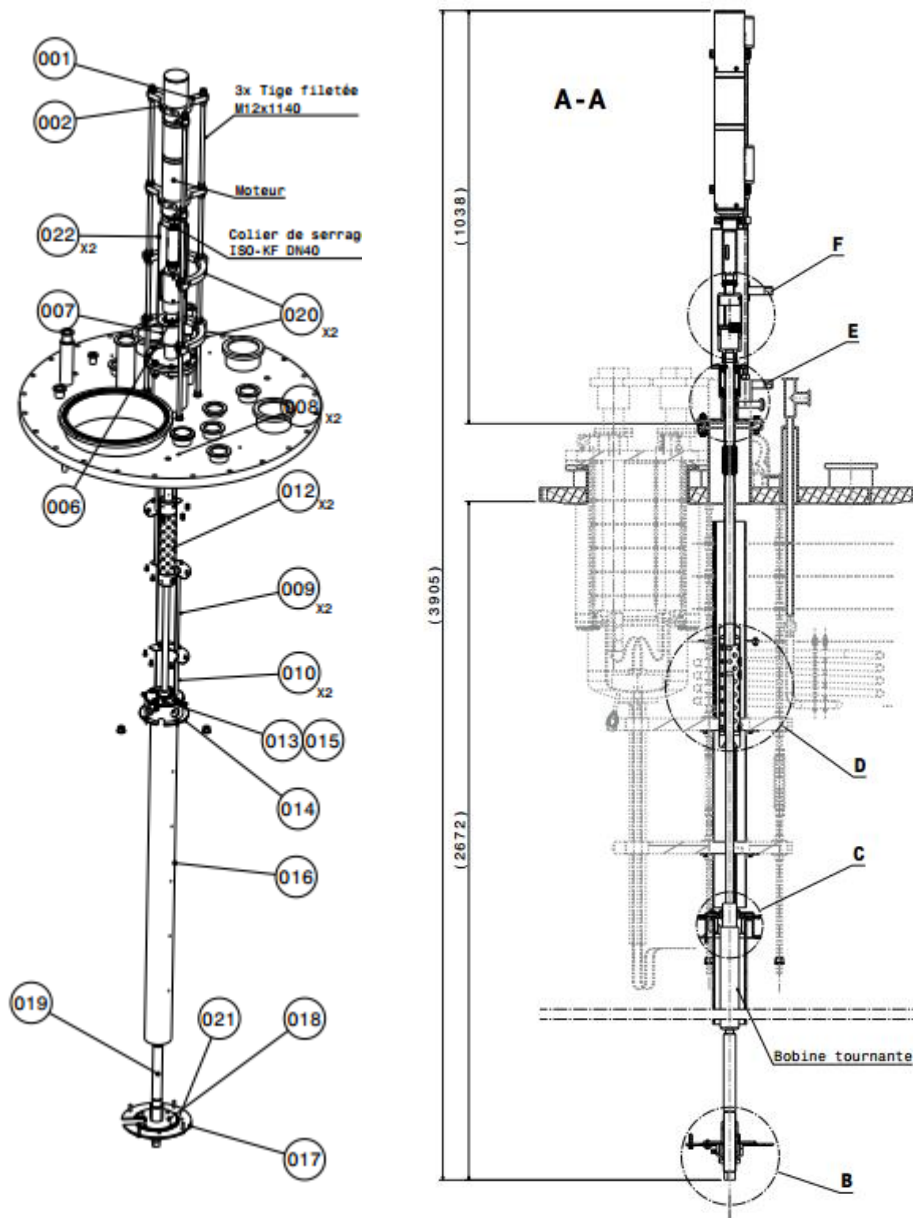
- 1: Rotating Probe (CERN)
- 2: Protection tube (CEA – CERN)
- 3: Pin (CEA)
- 4: MQYYM (CEA)
- 5: Protection for Electrical connection + Drive shaft (CEA)
- 6: Drive shaft (CEA)
- 7: Sealing part (CEA)
- 8: Rolling bearing (CEA)
- 9: Adaptation part (CERN)
- 10: Motor support (CEA)
- 11: Motor (CERN)
- 12: Void pump (CEA)



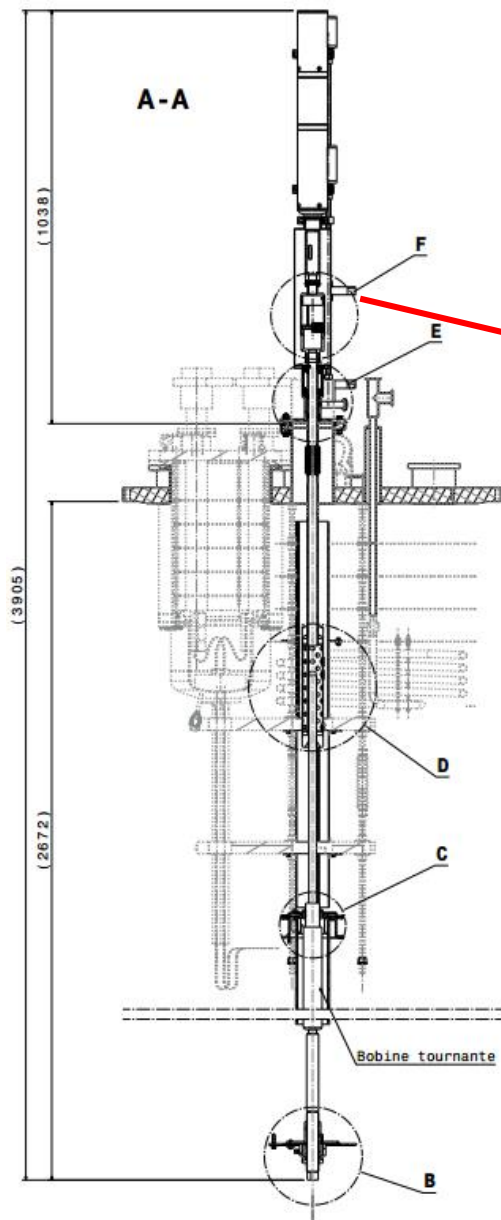
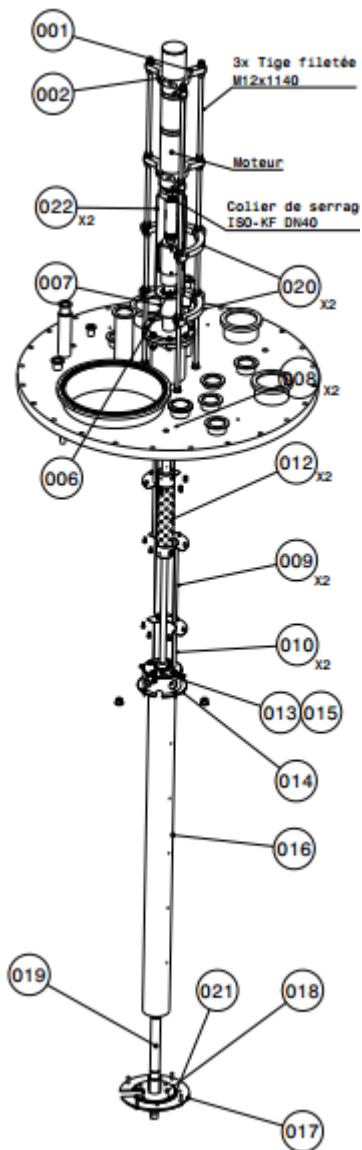
# ADAPTATION DESIGN



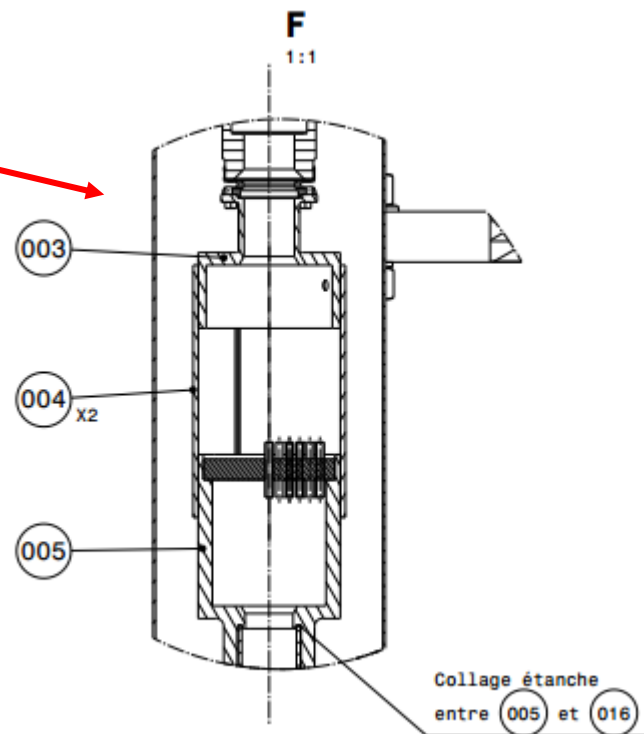


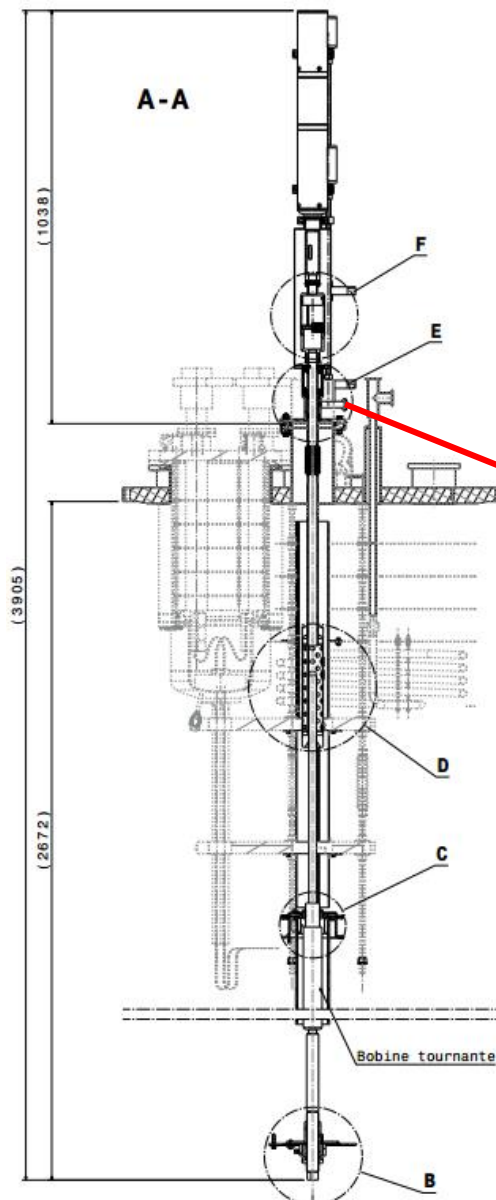
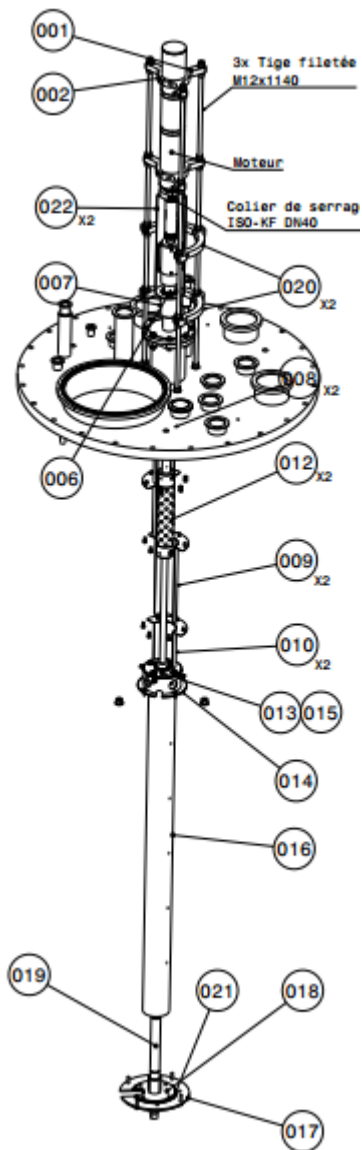


- 21 Parts designed and to be manufactured
- 5 interface area with the MQYYM magnets or the CERN magnetic measurements system (rotating coils, motors)
- Sealing electrical connections of the rotating coil to the motor (F)
- Sealing Part (E)
- Protection for Electrical connection + Drive shaft (D)
- Centering of the probe in the magnet aperture parts (C)
- Maintain of the rotating probe (B)

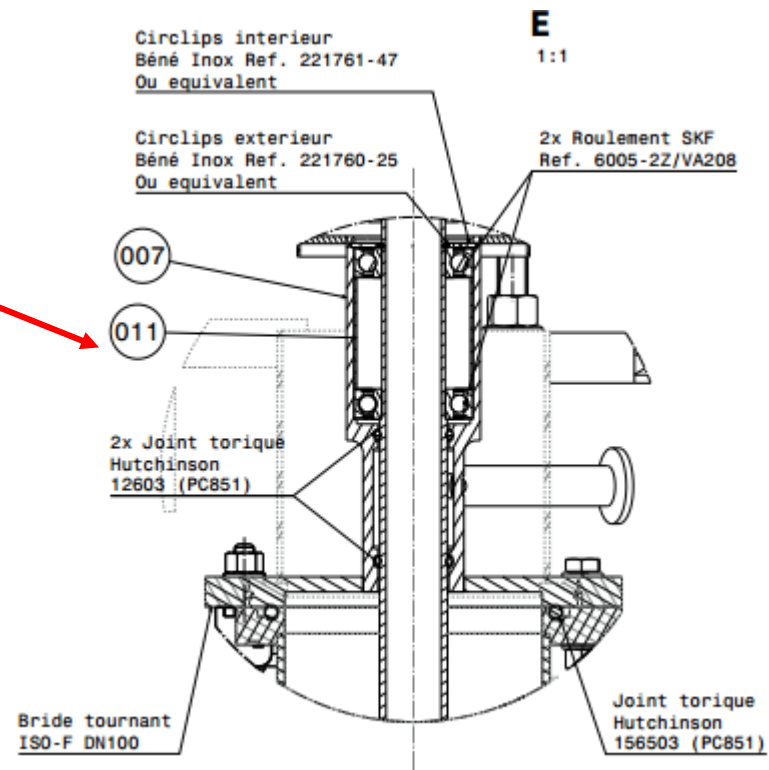


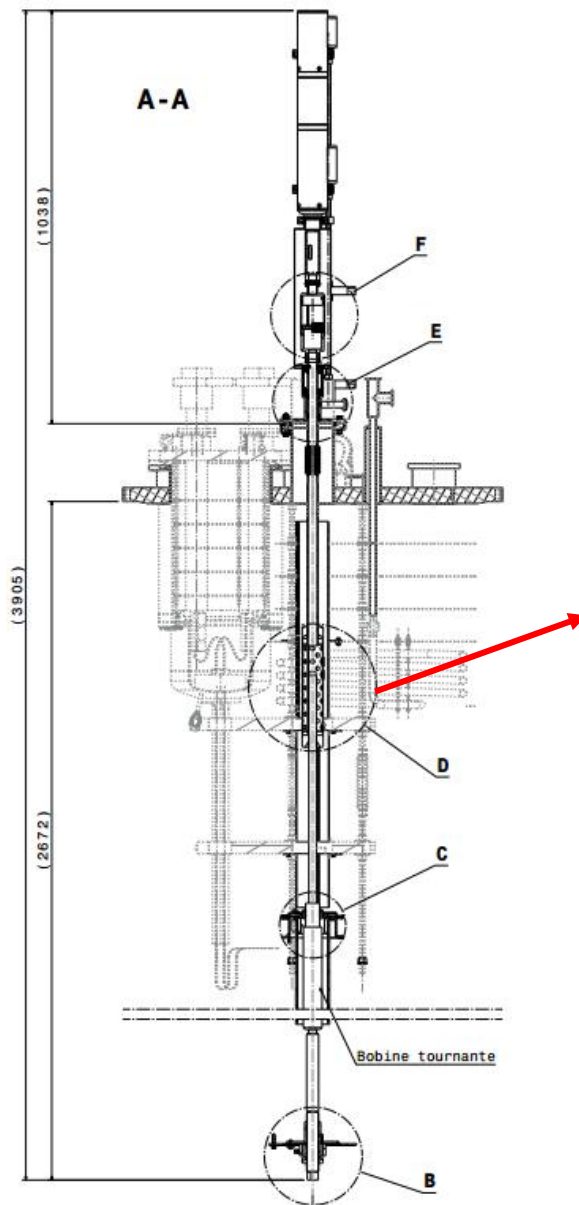
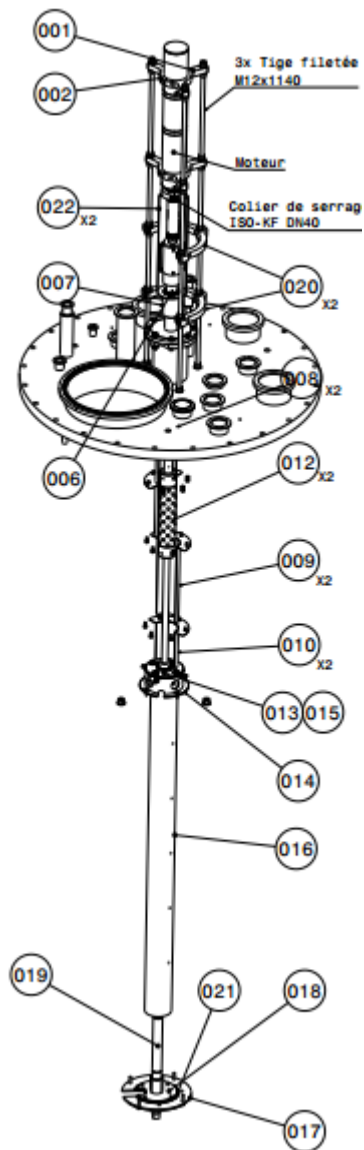
## Sealing electrical connections of the rotating coil to the motor



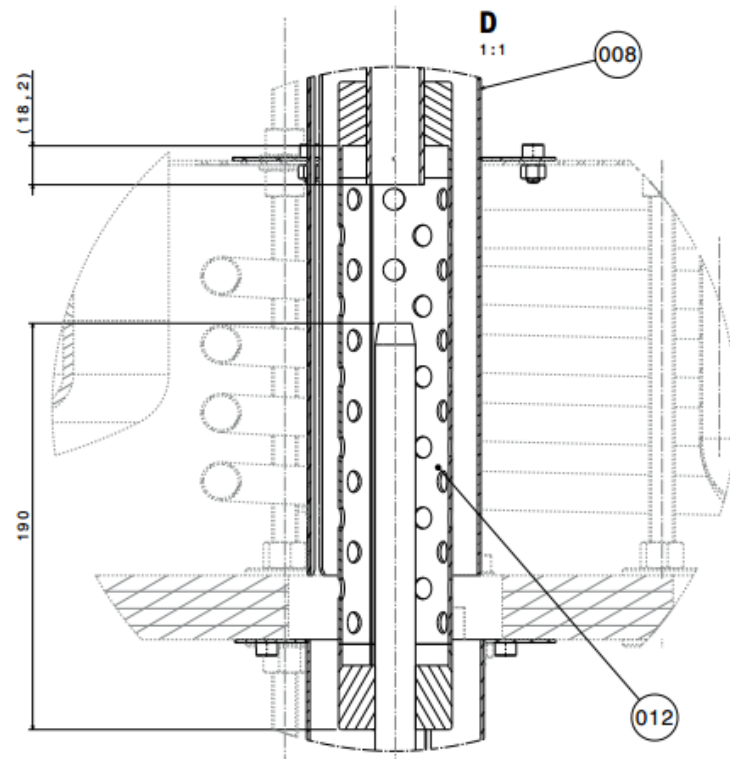


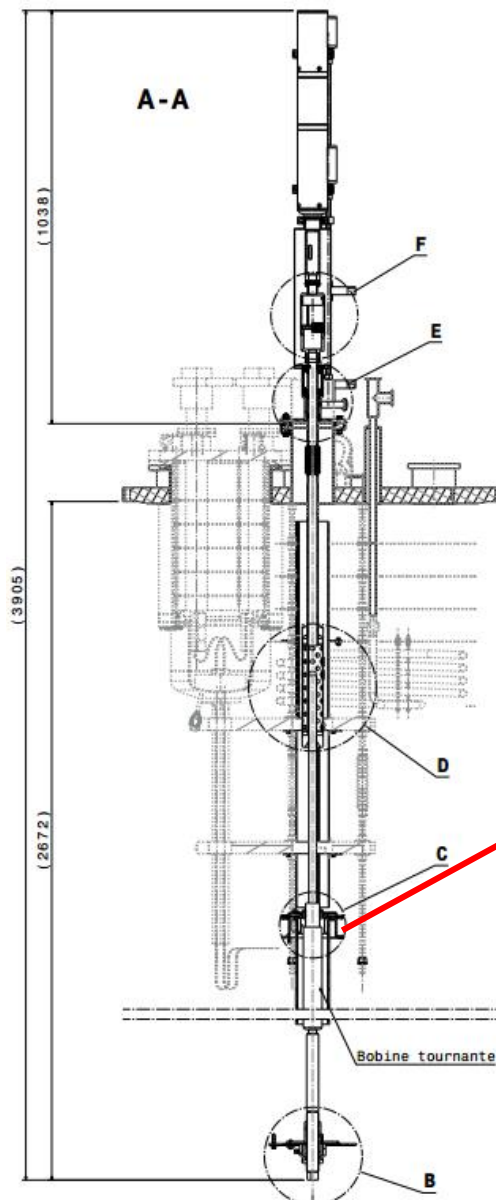
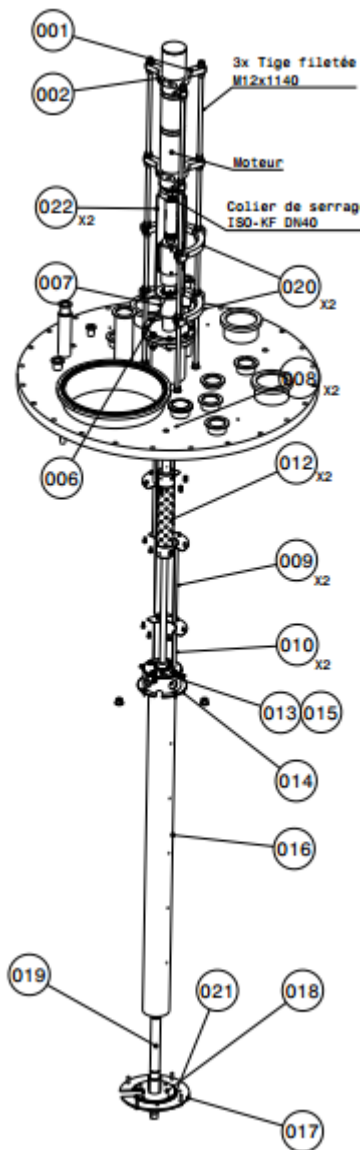
## Sealing Parts



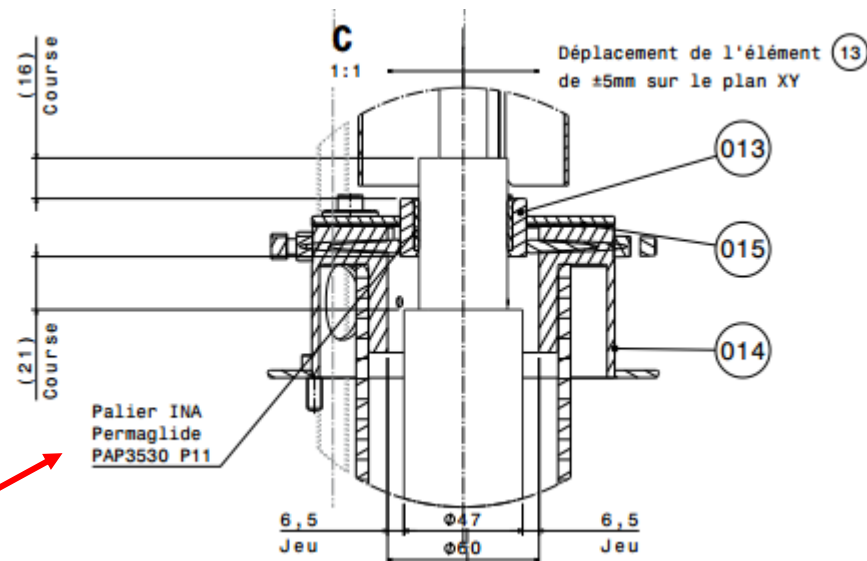


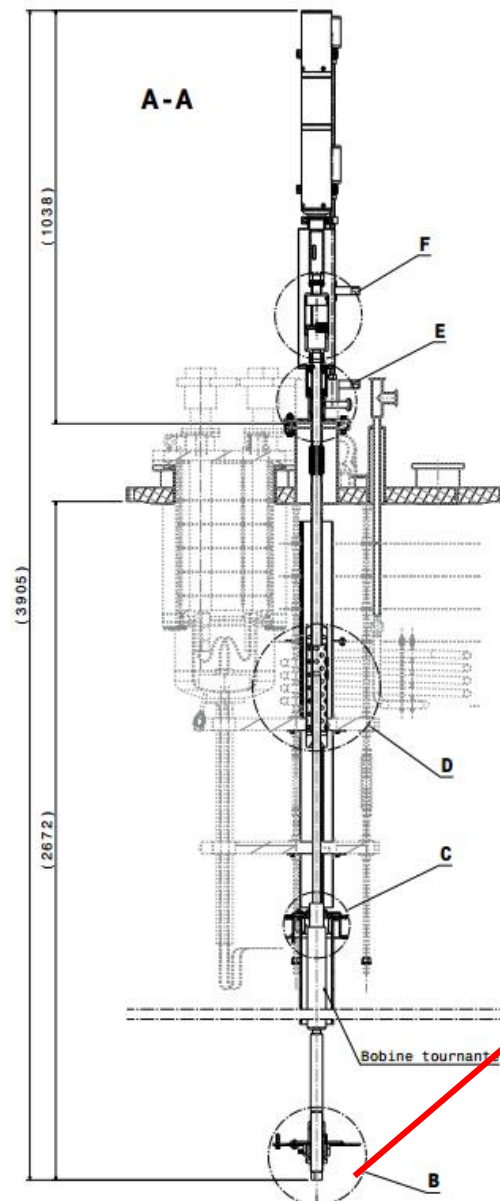
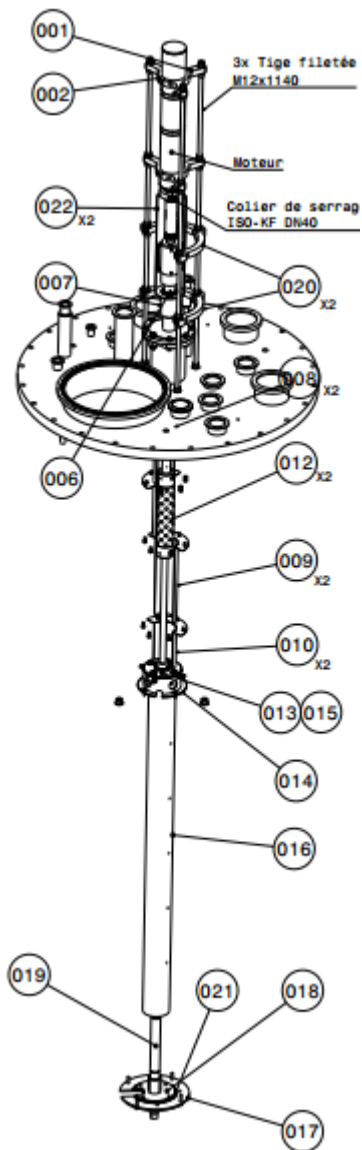
## Protection for Electrical connection + Drive shaft



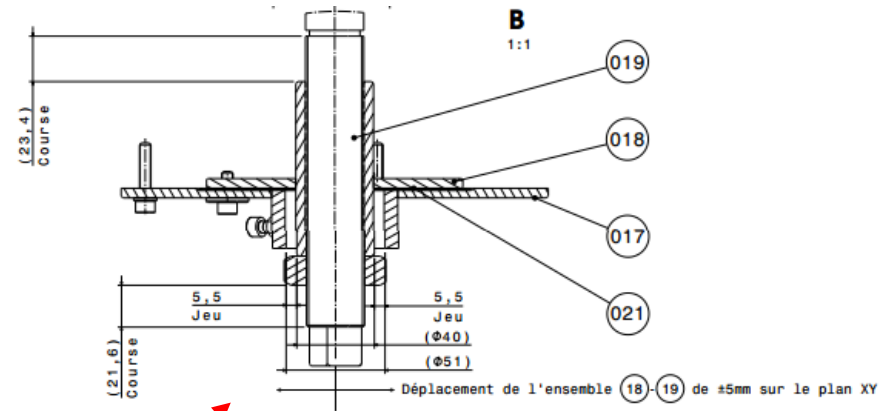


## Centering of the probe in the magnet aperture parts





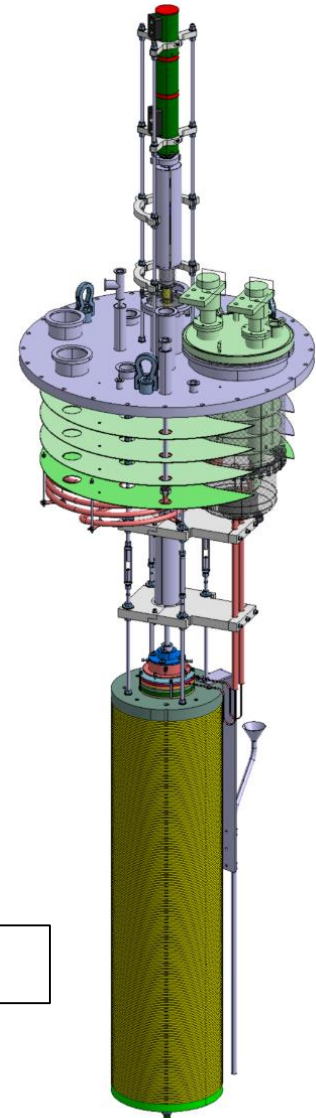
## Maintain of the rotating probe



## Presentation of the 3D CAD model:

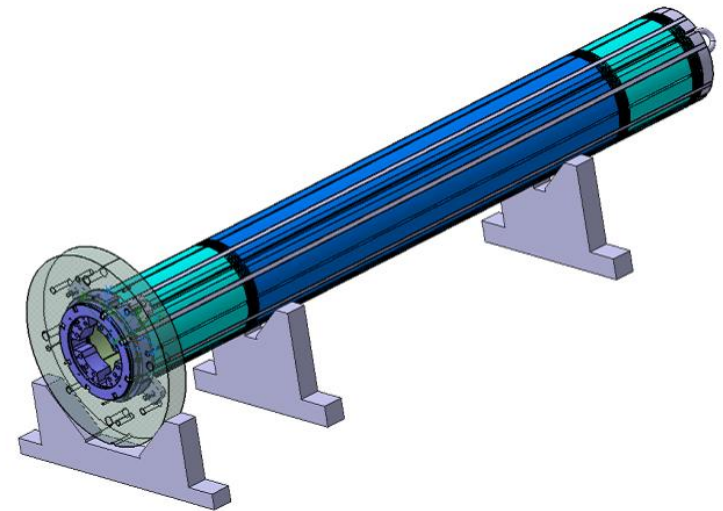
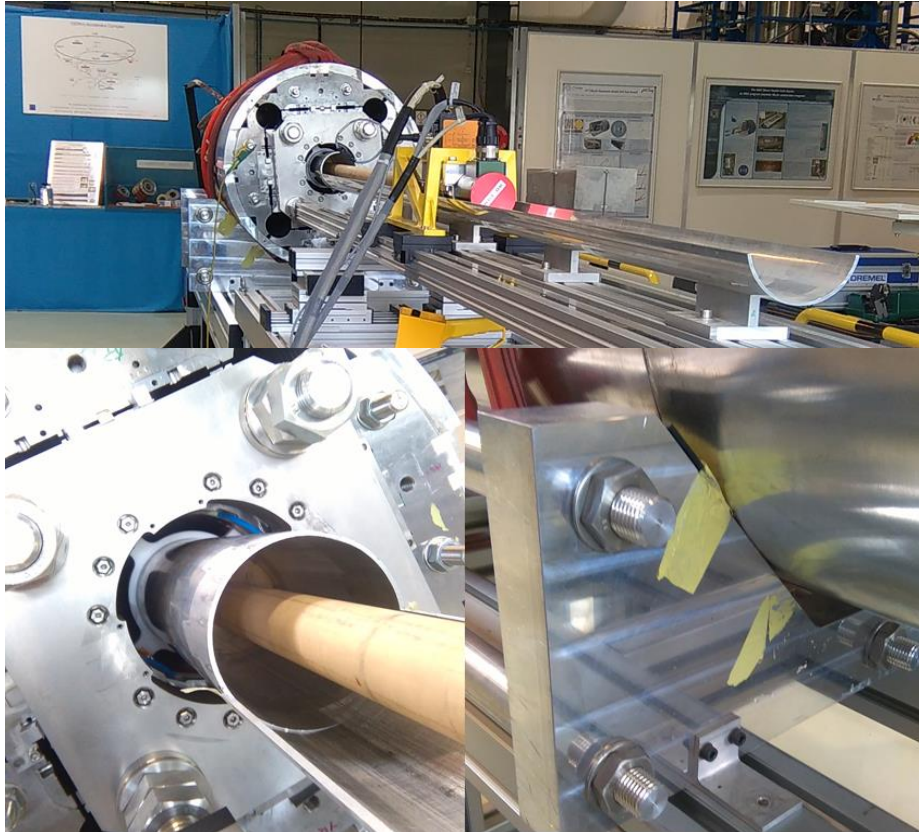
1. Presentation of the components
  - Presentation of the probe centering technics
  - Presentation of the shaft (torsion limitation)
  - Presentation of the sealing parts
  - Presentation of the probe protection
2. Discussion on the connection (acquisition, supra)
3. Discussion on the assembly
4. Discussion on the cryogenics

Jean-Marc GHELLER, Patrick GRAFFIN, Denis BOUZIAT



## Warm magnetic measurement on 927:

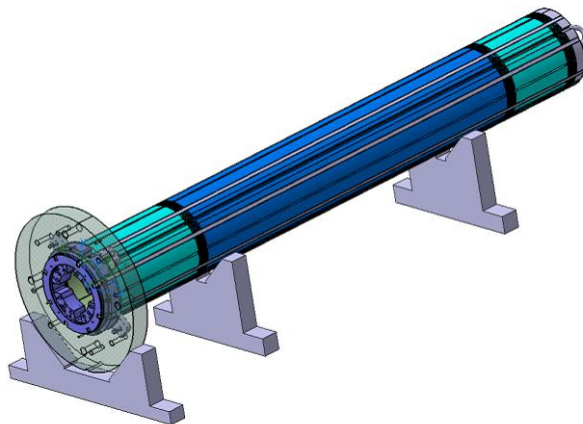
- Assembly of the magnet on 927
- Warm magnetic measurement before and after yoking





## Warm magnetic measurement on 927:

- Assembly of the magnet on 927
- Warm magnetic measurement before and after yoking



	2017						2018				
	July	August	Sept	October	Nov	Dec	Jan	Feb	March	April	May
Fabrication of 4 coils for MQYYM											
All components and tooling at CERN				x							
Collaring* incl mech measurement of the coils + connection box											
Warm magnetic measurements											
Yoking											
Magnet at CEA								x			
Magnetic Measurement Acquisition System at CEA								x			
Cold test preparation											
Cold test and cold magnetic measurements											

\* pending availability of the CERN team. To be discussed with JC Perez and N Bourcey

- Warm magnetic measurements: end of 2017
- Cold magnetic measurements (incl. prep): T1-T2 2018