

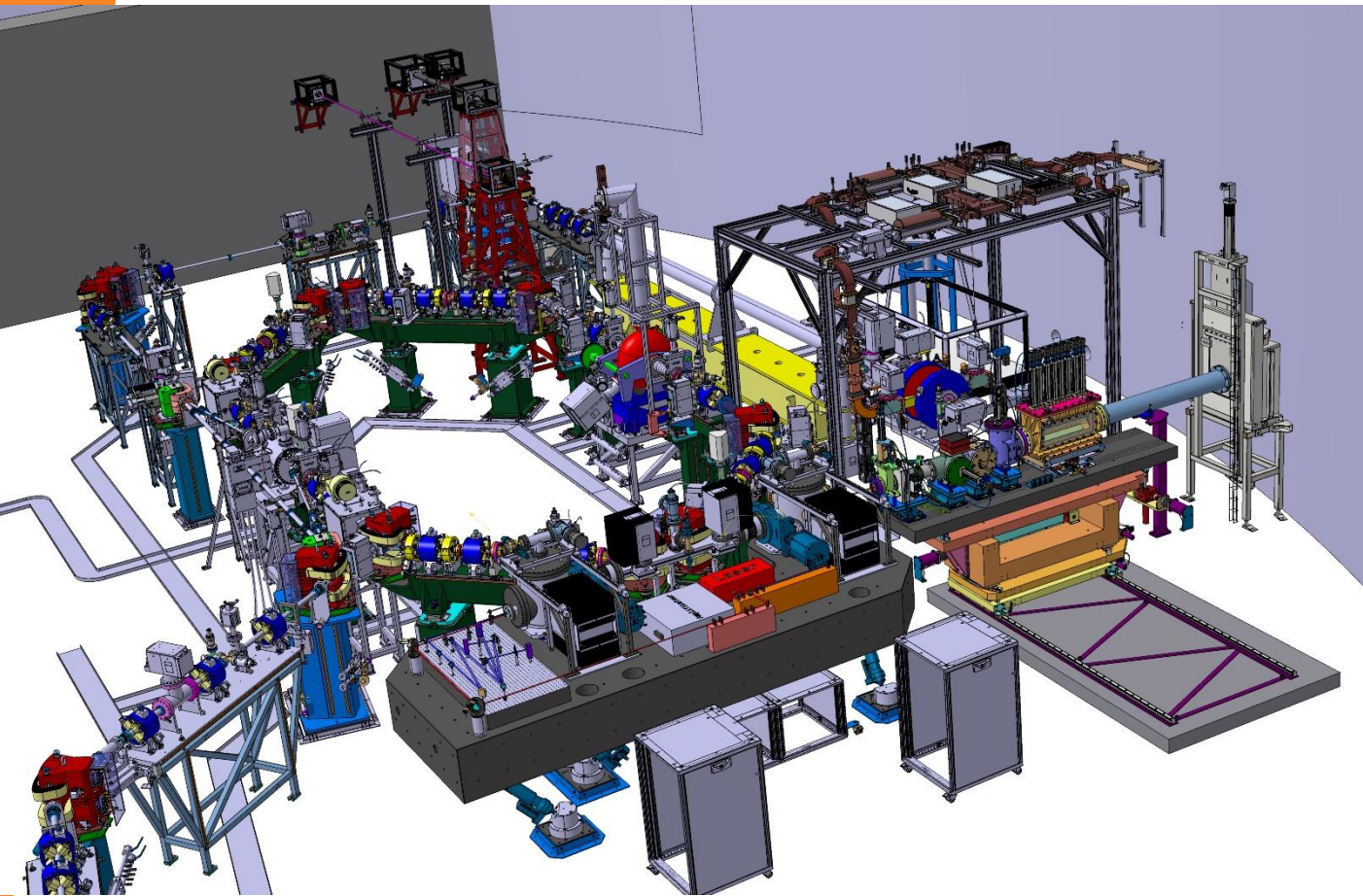
On behalf of :  
Design Office &  
Workshop  
@LAL  
Alignment Group  
@SOLEIL

# Installation planning & Alignment



\*Programme Investissements d'avenir de l'Etat ANR-10-EQPX-51. Financé également par la Région Ile-de-France. Program « Investing in the future » ANR-10-EQOX-51. Work also supported by grants from Région Ile-de-France.





Progress on  
Integration since  
MAC 2017

Alignment Planning  
& Strategy

Integration  
Planning -> 12/2018  
and more



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# Progress since Last MAC

▶ LINAC, Transfer & Extraction Line

All frames installed with QUAD and Sextupoles (missing Dipoles following a tumble of one dipole)

BPMS & Cabling

Scraper

Beam Dump x2

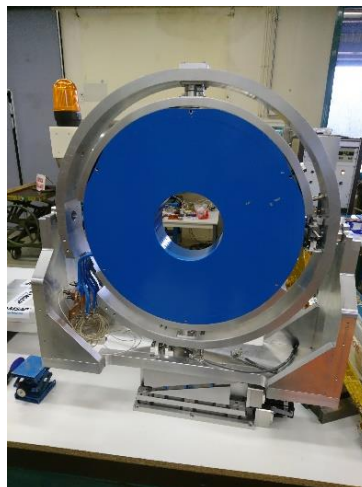
Accelerating LIL section

!! MAC2017 =>

Studies on Solenoid rotation & Translation

Studies on new RF Gun support

New localization of Ground Plate for RF GUN



# Progress since Last MAC

Studies on Solenoid rotation & Translation => cradle that supports 2 gimbal rings based on 4 flex pivot bearing (2 by rotation Axis, LAL Design)

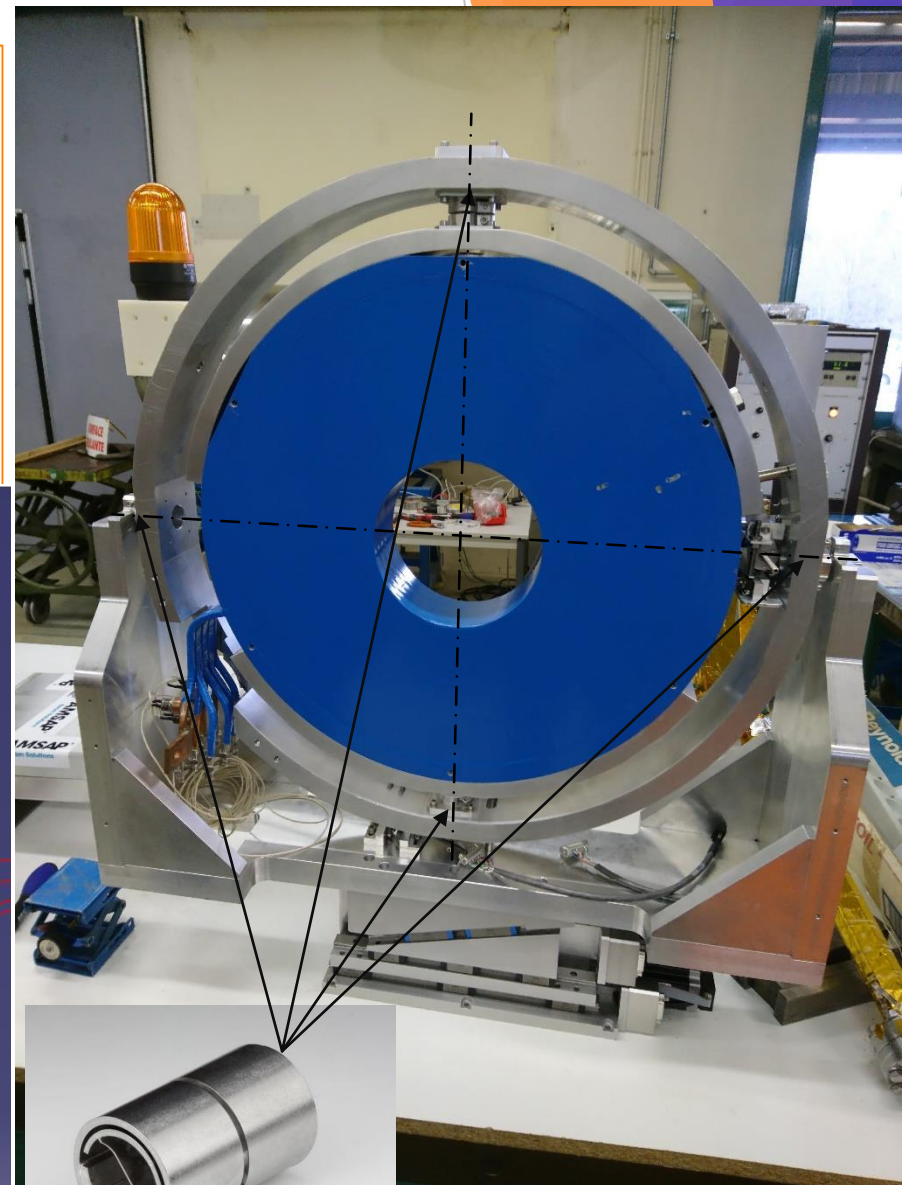
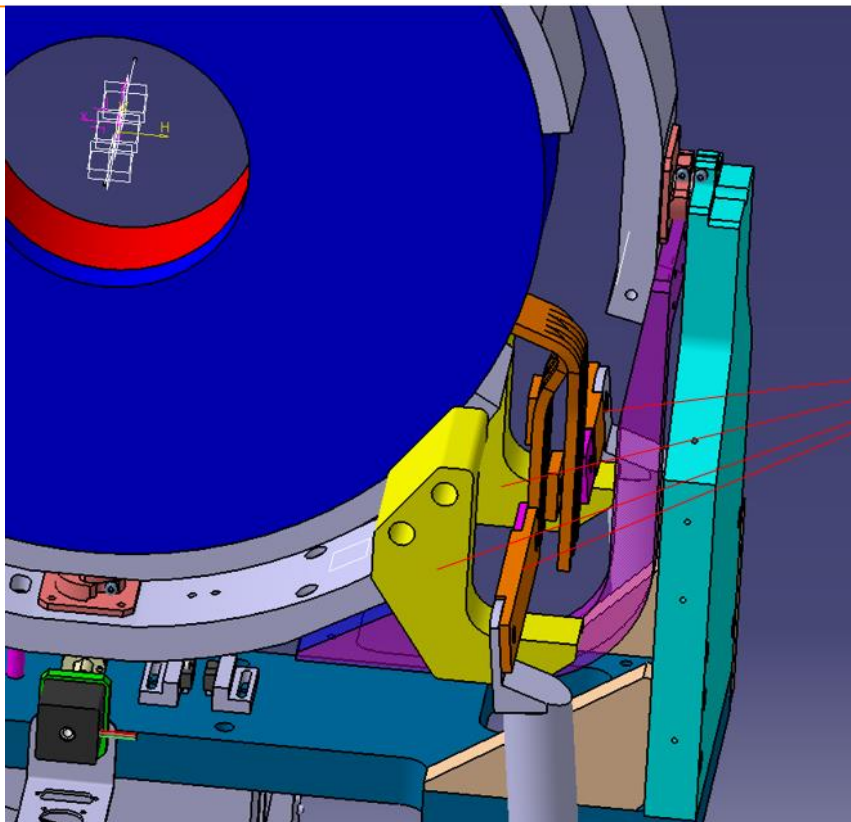
X Y translations max de  $\pm 10\text{mm}$  precision of 10 microns (AXMO Design)

Rotations : travel max  $\pm 1$  degree (17.5 mrad) precision better than 0.046 degrees (0.8 mrad)

Very special Thanks to

Bruno BORGIO => CDD until 12/17

Didier Auguste & Olivier Vitez (with CC team)

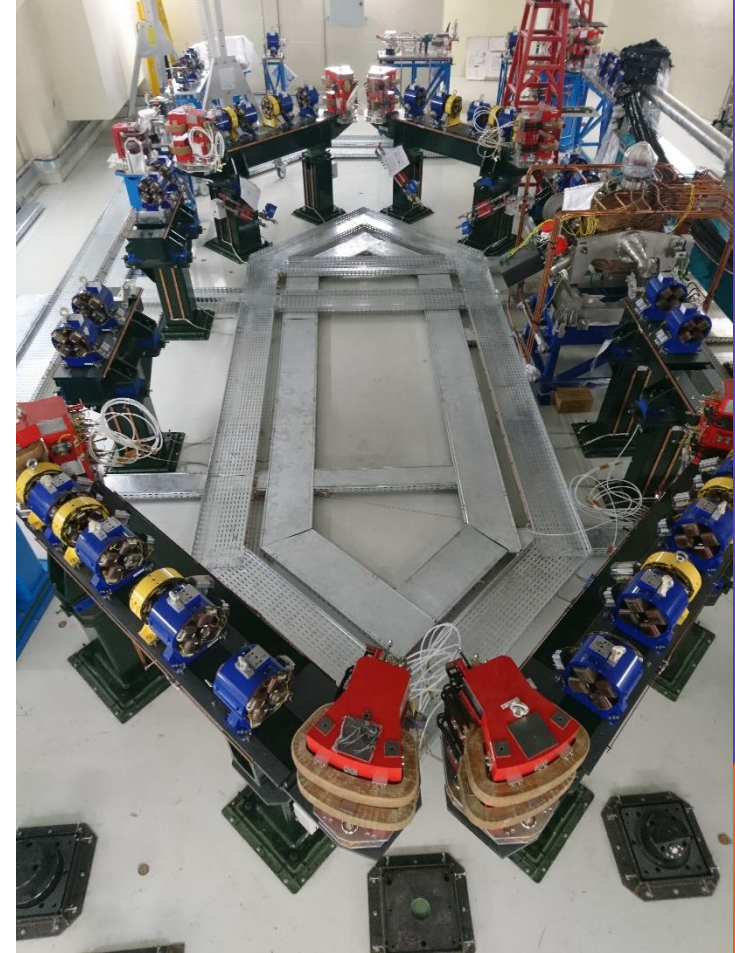




# Progress since Last MAC

## ► RING

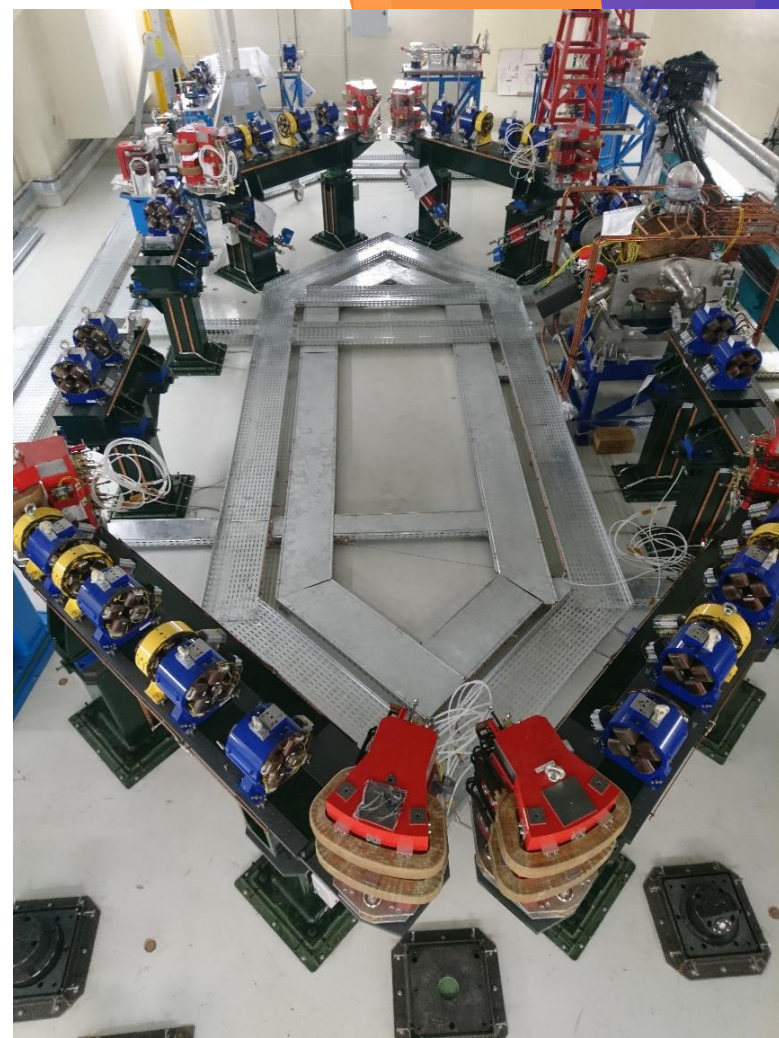
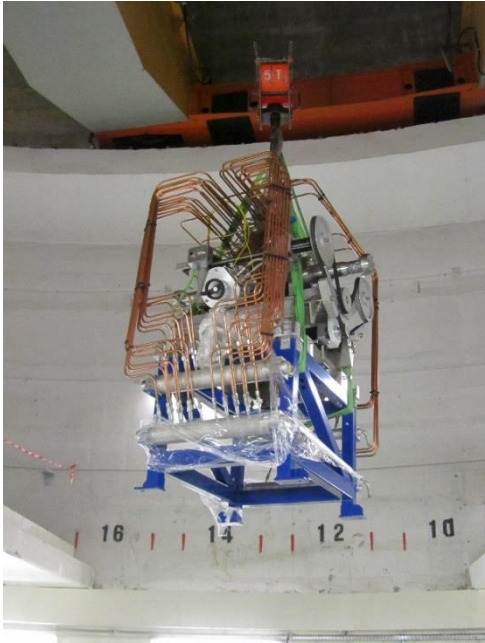
All the Girders including all the magnets  
Cable Trays for all machine cables in the Bunker  
(power, signal ... summer 2017 and more)



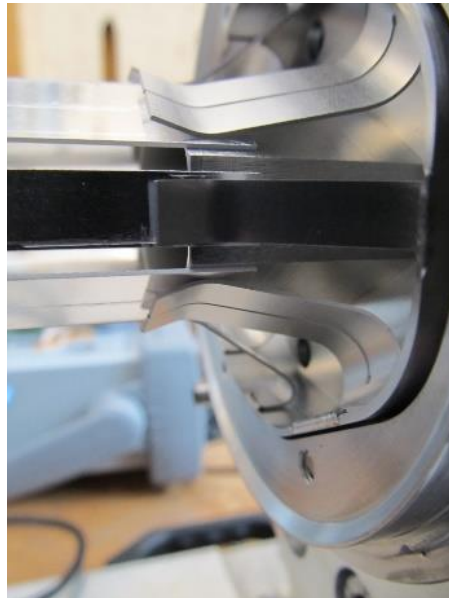


# Progress since Last MAC

## ▶ RING : RF Cavity



- ▶ RING : RF Below 100%
- ▶ FBT : In progress at CECOM (Roma)





# Progress since Last MAC

## ► RING : UHV Chambers

(31/5/2016 to Rial Vacuum in Parma (Italy) 198 628€HT)

Delivery of Phase#1 03/2017 4 Chambers

Problems in machining Chambers with pumping ports and grid \*

Important meeting in 09/2017

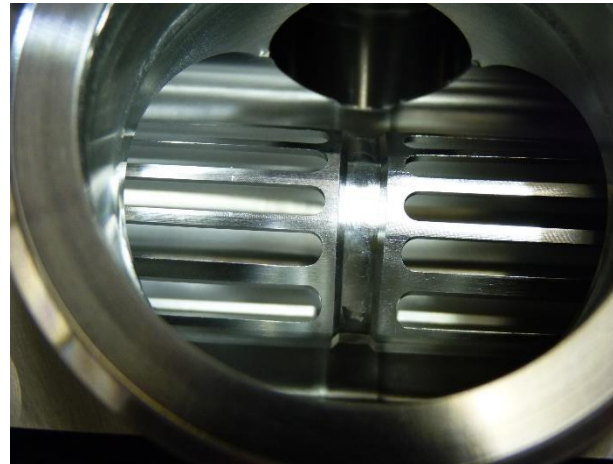
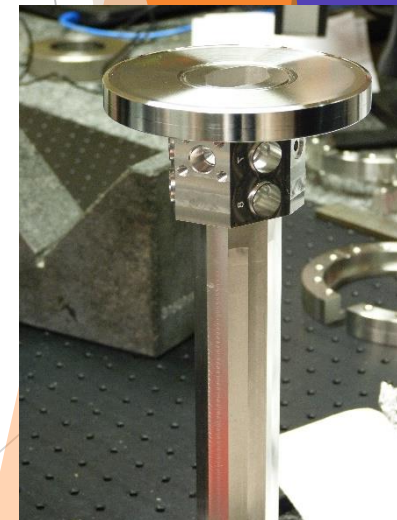
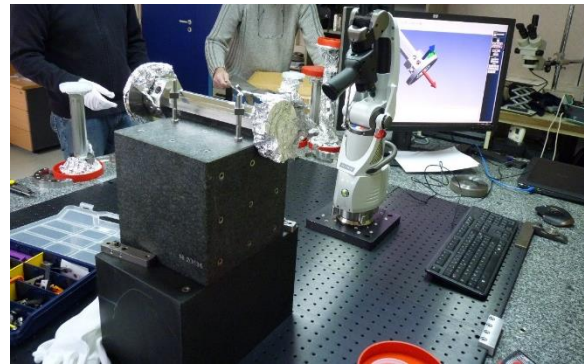
Delay for new conception studies

Final Design for all geometry \* : ~end of 10/2017

Delivery of Batch#1 March 2018 (5 chambers)

Delivery of Batch#2 May 2018 (9 chambers)

Provisional Delivery of Batch#3 July 2018 (4 last chambers) delay to End of October 2018



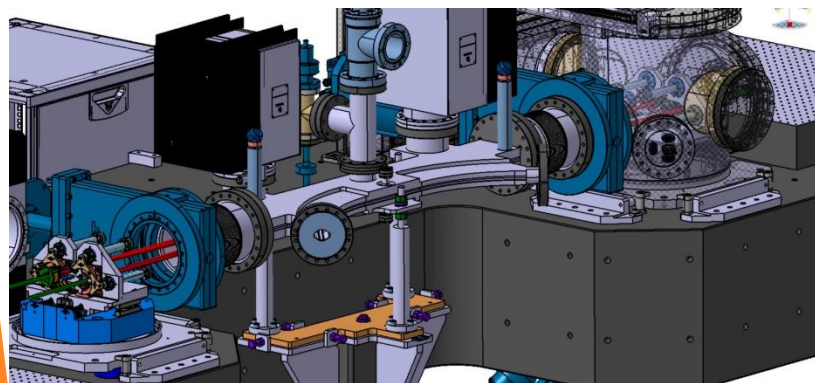
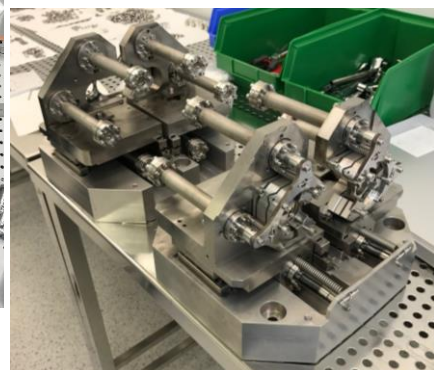
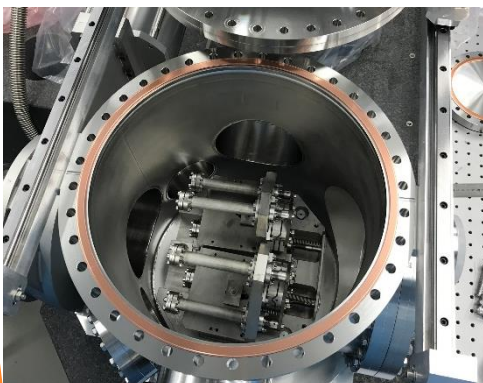
# Progress since Last MAC

Optical Cavity : Mechanical assembly including stepper ISP motors (x12, Oct 2017)

Iso-5 environment

Issues : cabling and Cleanliness in UHV

In progress with Yann, Patrick, Christopher & OC Team  
(See D.Nutarelli Slides)

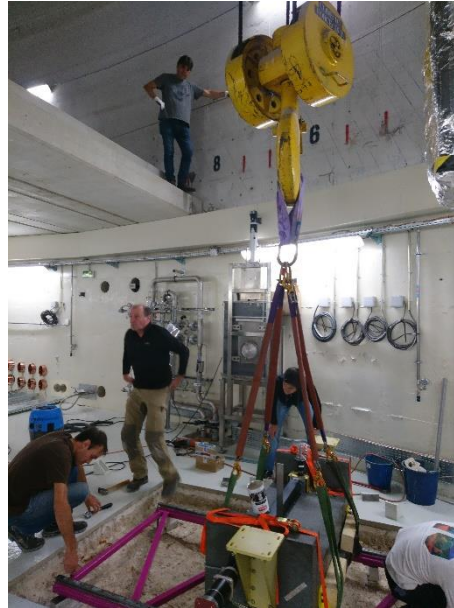
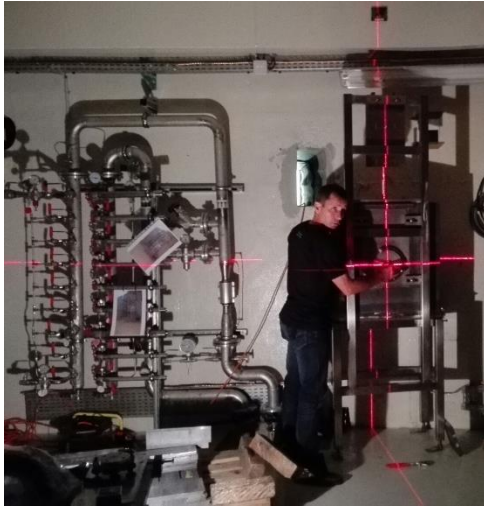


- ▶ IP Chamber : SRV Delivery 01/2018
- Particle Cleaning (chamber, flange)
- Closed & Assembled with vacuum elements
- Leak detection
- RGA +Baking+RGA
- Ready for baking system installation-> 25/6/2018



# Progress since Last MAC

- ▶ Beam Shutter (summer 2017, technical assistance and Alignment)
- ▶ X Line Table 1 : Alignment and sealing (between Oct 2017 and Dec 2017)





# Progress since Last MAC

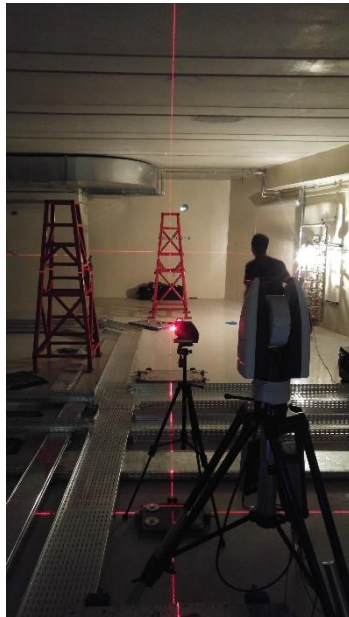


- ▶ Photocathode Laser Transport Line under primary vacuum : installation in progress 90% (Vacuum  $5.10^{-1}$  mbar)

From the Bunker to the Laser Room including 4 Turning Box to be aligned  
Through the penetrations in the walls, ~25m length

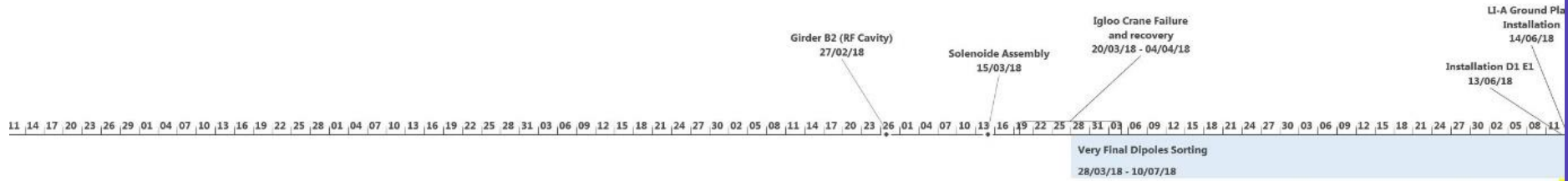
- ▶ CR & SR Diag Lines : installation in progress 90%

From the Bunker to the Laser Room through the bunker penetration to the corridor and to the Laser Room, ~25m length





# Integration Planning - Before MAC2018

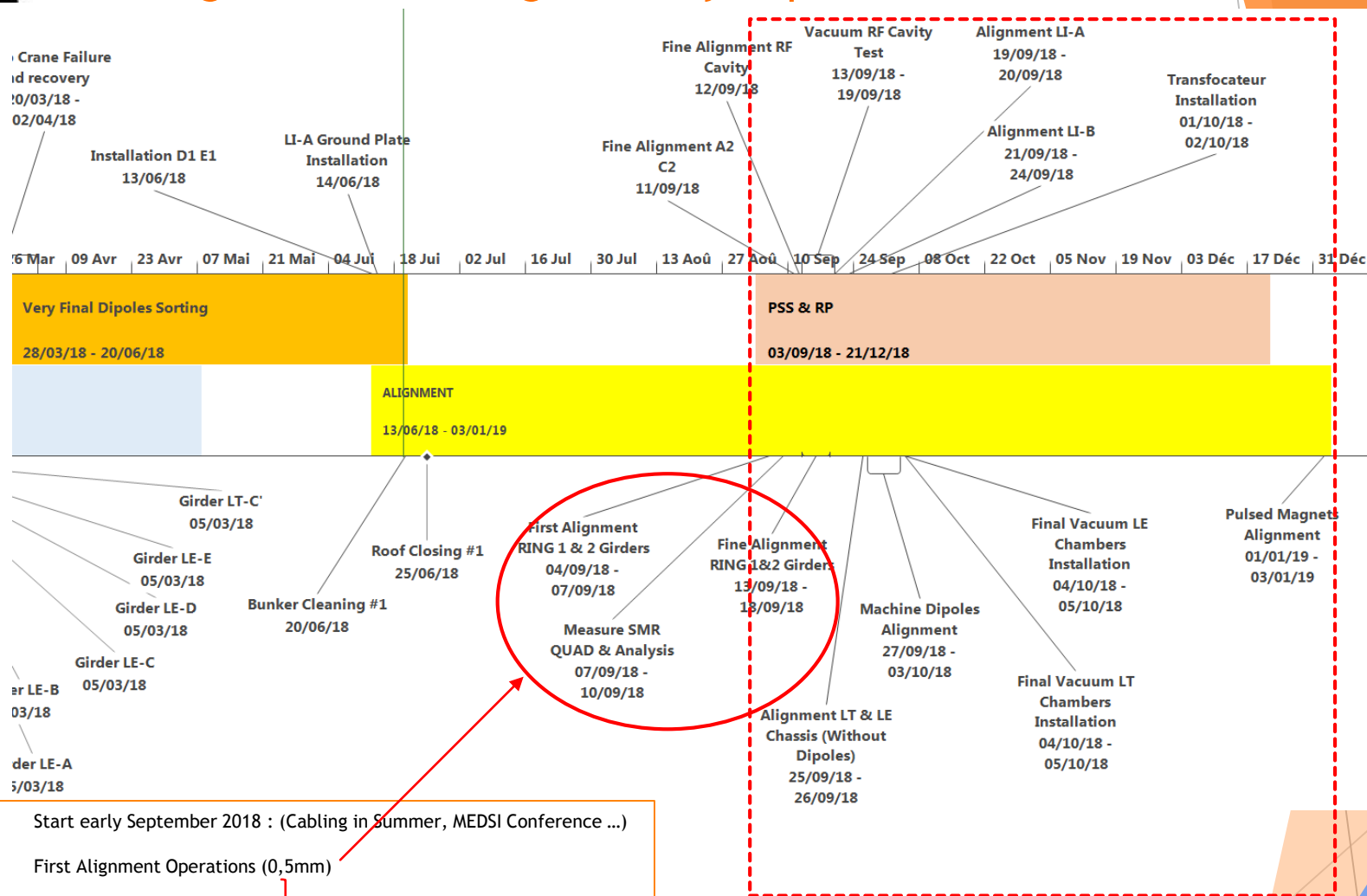


- A1,A2, C1,C2 March 2018
- D2,E2 April 2018
- D1,E1 June 2018

- ▶ All girders installed : RING, LT, LE
- ▶ LT & LE Chambers 75% (In progress ... next weeks)
- ▶ RF Cavity without RF Power cable (Power Supply and test ?)
- ▶ Diagnostics Lines & PhotoCathode Laser Transport Line 80%
- ▶ Missing : Pulsed Magnets, Ring Chambers , LT LE Dipoles



# Alignment Planning -> ~Early Sept and after ...



Co activities on the site between :  
 PSS - RP / cabling / Alignment / End of procurements (Ring Chambers, FBT, Pulsed Magnets, RF Cavity)

- ▶ Start early September 2018 : (Cabling in Summer, MEDSI Conference ...)
- ▶ First Alignment Operations (0,5mm)
- ▶ Fine Alignment A2 C2 } => RF Cavity Vacuum
- ▶ Fine Alignment RF Cavity
- ▶ Alignment of LIL, RF Gun, LT & LE Frame
- ▶ Alignment of machine dipoles
- ▶ Final Alignment better than 0,1mm (Full machine)

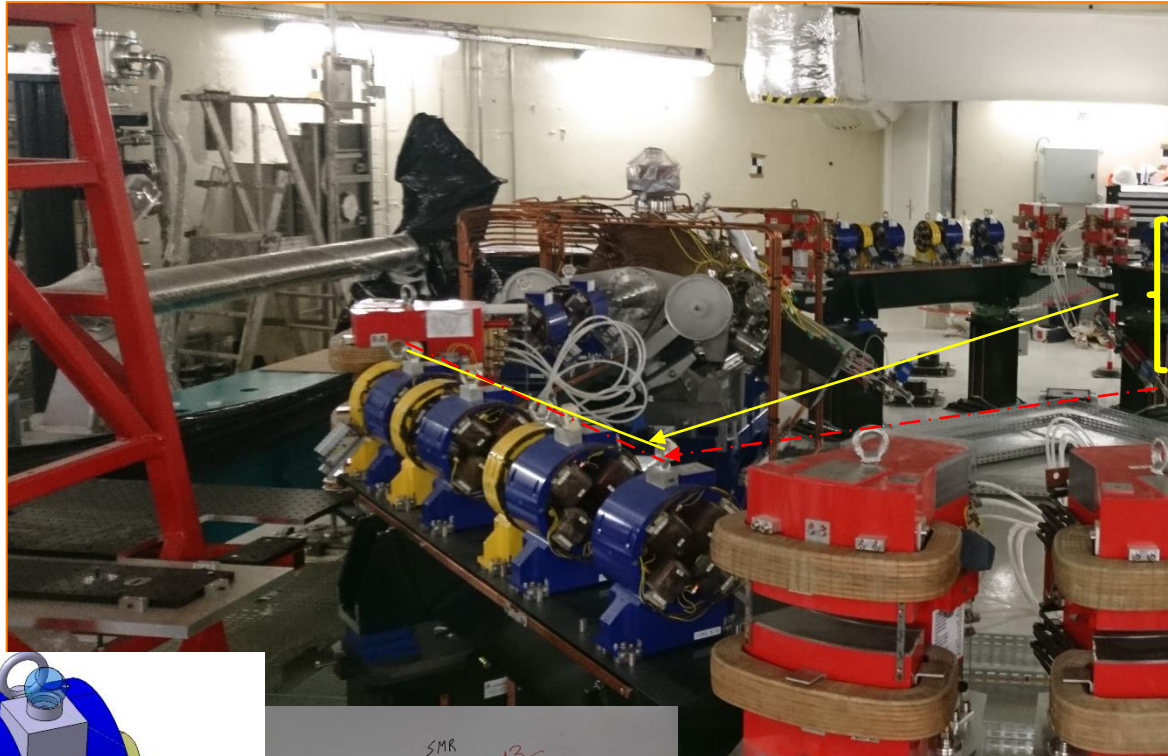




# Alignment Strategy : RING Girders...



- ▶ Ground Plates glued & Aligned in the absolute Coordinate Systems (~10 fiducial points to localize the Tracker better than 50  $\mu\text{m}$ )
- ▶ Girders installed on their supports (Building 208)
- ▶ Magnets positioned after Sorting (Building 208)

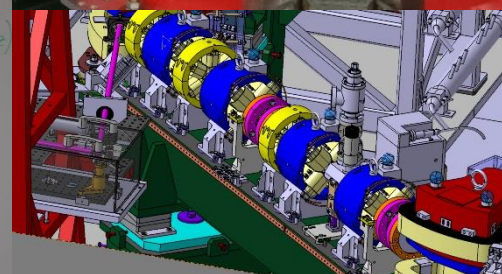
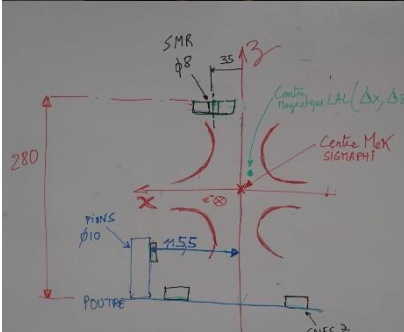
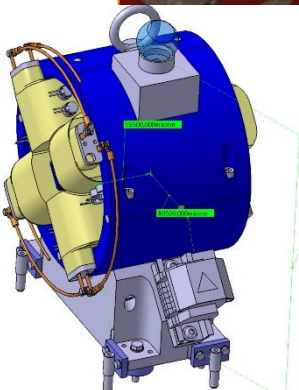


- ▶ Girders to be positioned (Height, Orientation)
- ▶ Measure of the 4 QUAD SMR Position in real life with the AT960 Tracker = > Spatial Analyser (SA)
- ▶ Calculus of the Best Fit Line for this 4 SMR centres
- ▶ Comparison to the theoretical QUAD Line (coming from the 3D model in CATIA)
- ▶ Movement to be done with the whole Girder
- ▶ Finally : bring the measured BFL on the theoretical QUAD Line (Including the Magnetic Offset)

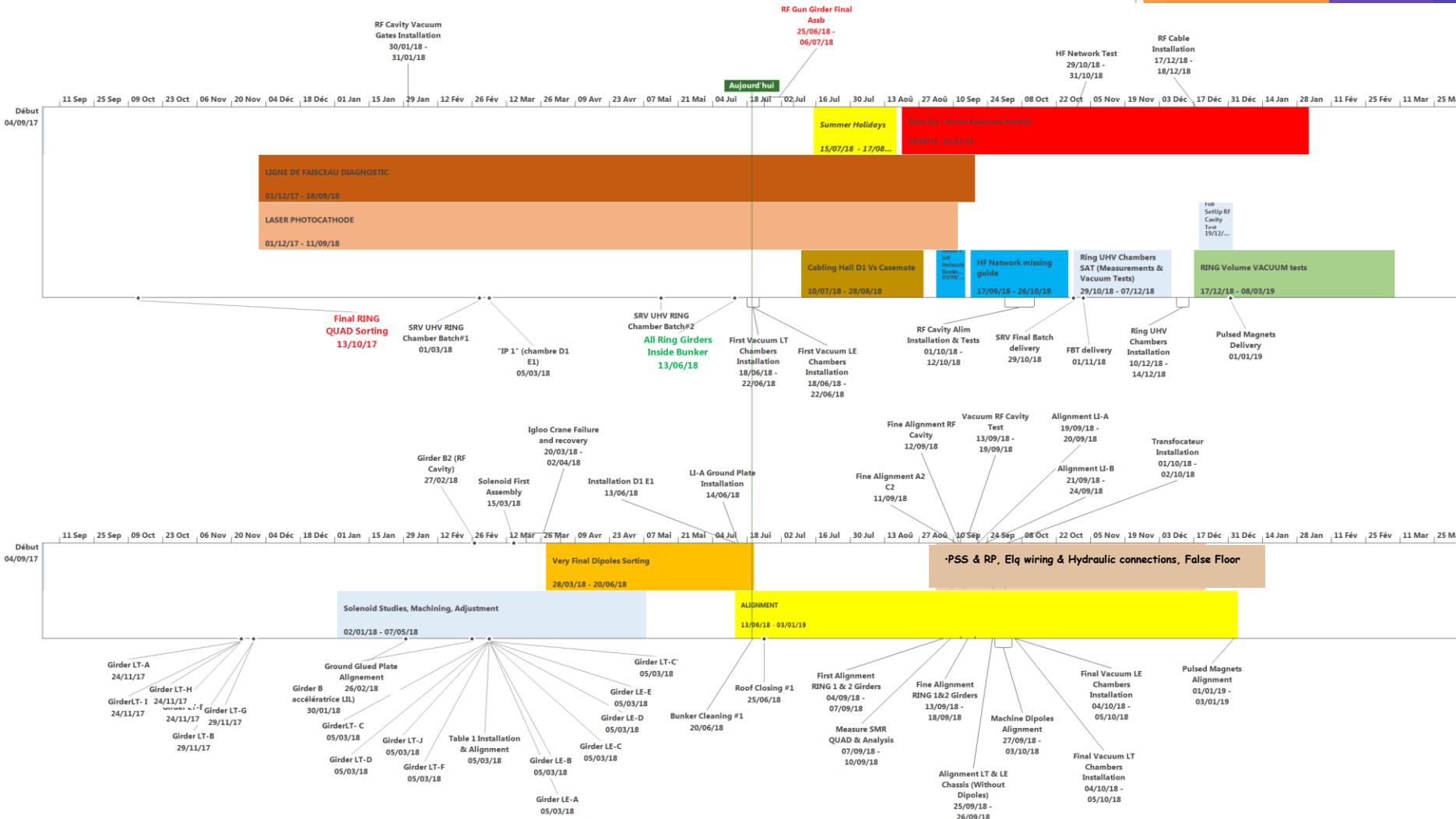
Flatness of 0,03mm on 1,6m to allow fine adjustment between chambers of 50 $\mu\text{m}$  and 100 $\mu\text{m}$  between girders

Linear adjustment : X,Y,Z =  $\pm 20\text{mm}$   
Rotations : X =  $\pm 3^\circ$  Y =  $\pm 0,38^\circ$  Z =  $\pm 1,9^\circ$

Very fine machining and holes localization to place the magnets ( $\text{Ø}8\text{H}7$  40 $\mu\text{m}$ )



# Integration Planning ->~Until December 2018... after

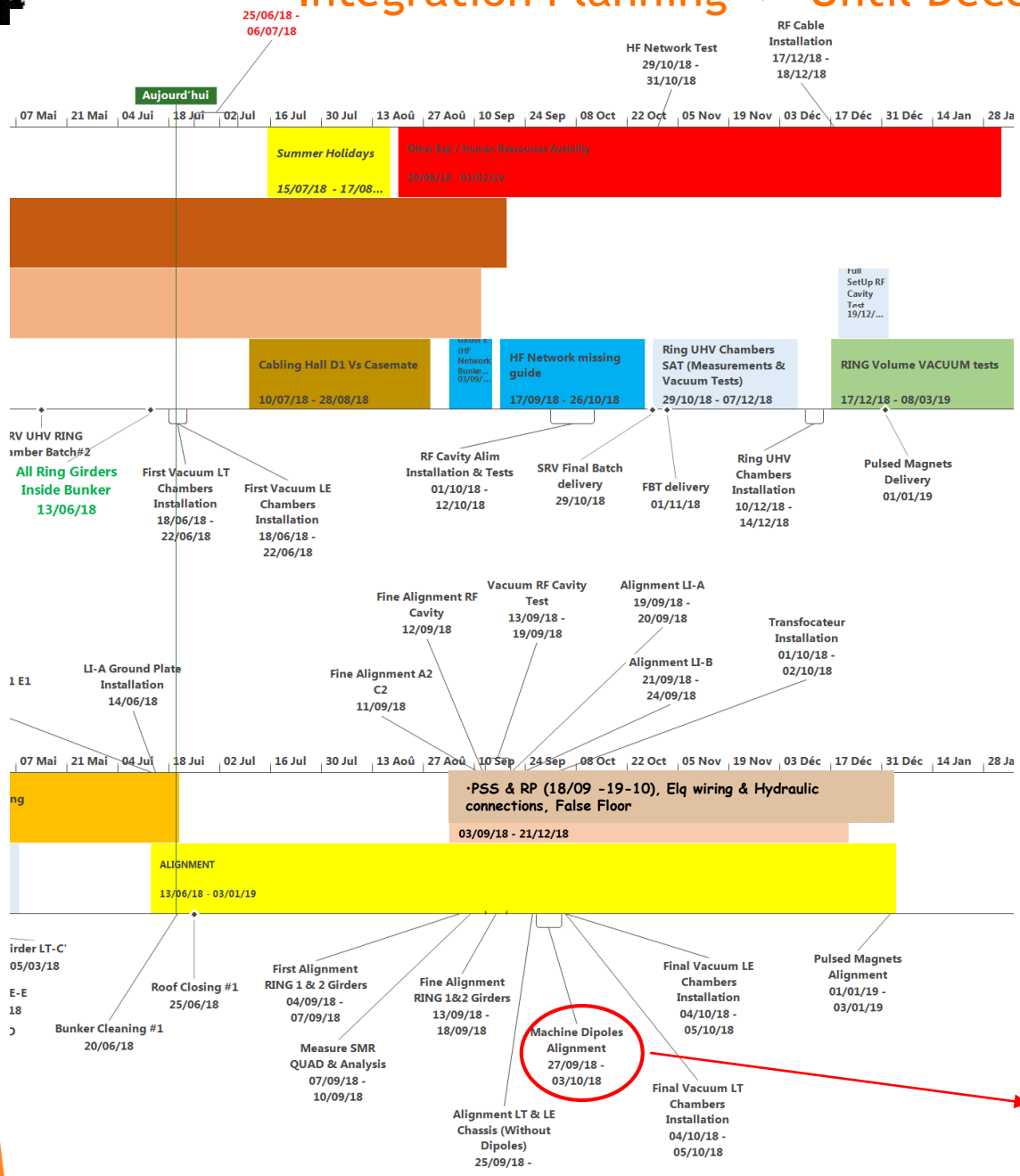


- ▶ Human Resources on ThomX project : Design Studies & Workshop Members => On site installation, Studies, Machining, Measurements & Alignment works, Last Tender's supervision (PM, Ring chambers, FBT)
- ▶ Other Projects : in progress or about to (re)start (?) Xenon @LNGS, ARICH Detector@KEK, QUBIC+LiteBird, ELI-NP@Magurele, LaseriX@LAL, DUNE@Sanford Underground Research Laboratory ... 3 or 4 project/h
- ▶ Very important Tasks TBD : PSS & RP, Electrical wiring & Hydraulic connections, false floor





# Integration Planning -> ~Until December 2018...



- ▶ Background activities : Diag Lines a PhotoCathode Laser BTL
- ▶ RF Gun on site installation
- ▶ HF Network
- ▶ RING Chambers LAL tests (closing the tender)
- ▶ RING Chambers & supports installation
- ▶ RF Cavity Activities : RF Power supply test and Cable installation
- ▶ Pulsed Magnets installation
- ▶ To be done in // with Alignment tasks with the integration Team

Last LT Dipoles installation depending on :

- ▶ The Roof Opening/Closing (no More Space for Gantry Crane)
- ▶ Or better technical solution for Lifting Dipoles ( #FalseFloor)



Thank you for your Attention

Thanks to all the design  
Office, Workshop,  
Logistic Teams

