



Follow-up of the TAXS integration

8th HL-LHC TCC

02 June 2016

F Sanchez Galan on behalf of WP8

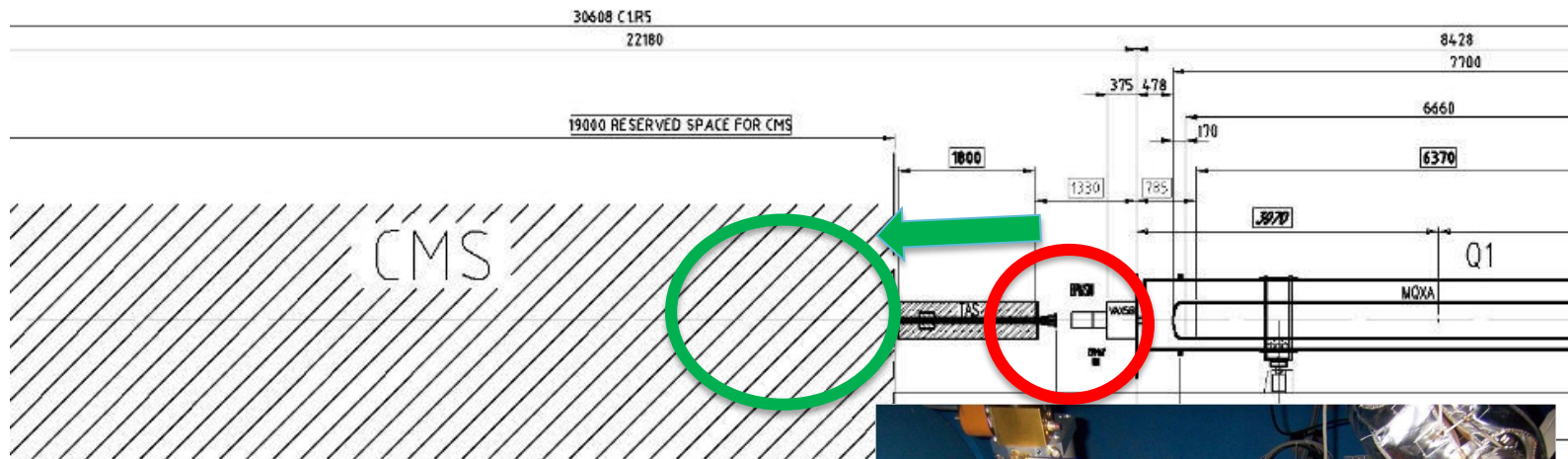
Special thanks to C. Adorisio, J. Albertone, I. Bergstrom, C. Boccard, D. Brethoux, I. Efthymiopoulos, S. Evrard, P. Fessia, A. Gaddi, L. Krzempek, M Lazzaroni, D. Mergelkuhl, J. Perez Espinos, M. Raymond, H. Vincke

Outline

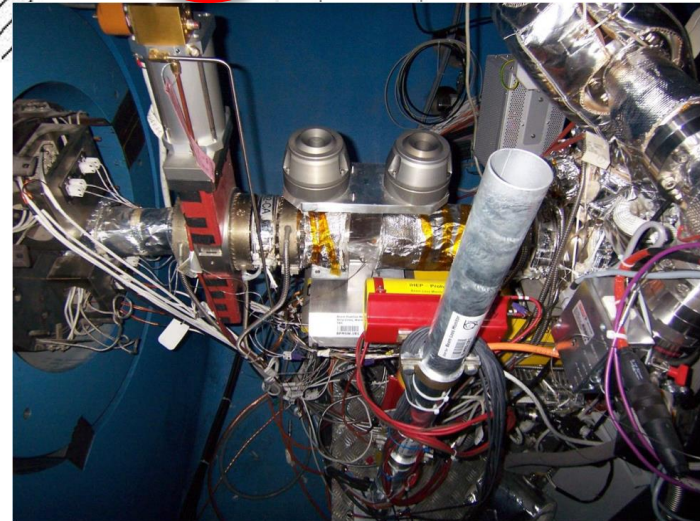
- Recall on space constraints
- Current lay-out, (BPM, beam pipe supports, shielding modifications)
- Services integration
- RP studies
- TAXS Survey and alignment

Recall on available space constraints [LHC]

- Q1-TAS: 1.3 m. Equipment installed: warm BPM, 2 vacuum valves, bellows, bake-out equipment, He tightness dome, Z-stops.



Very tight environment & difficult access. Interventions need to be improved (ALARA). Static.



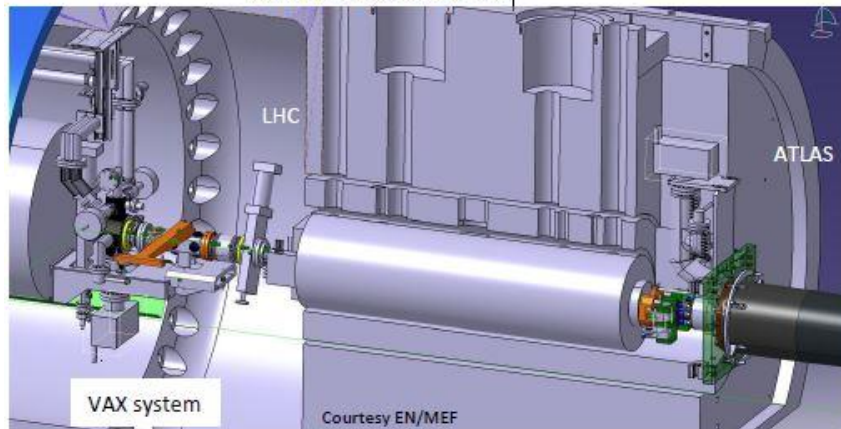
ATLAS Forward shielding



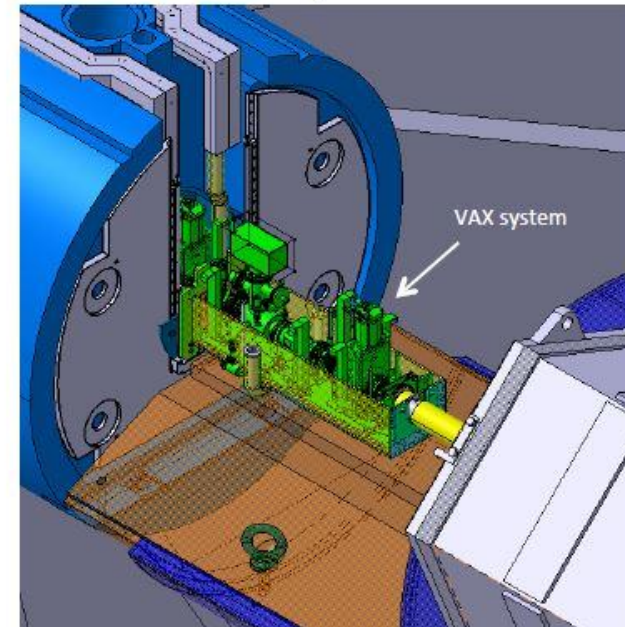


VAX displacement to experiment side

Current situation



Proposal



Main reason of the request

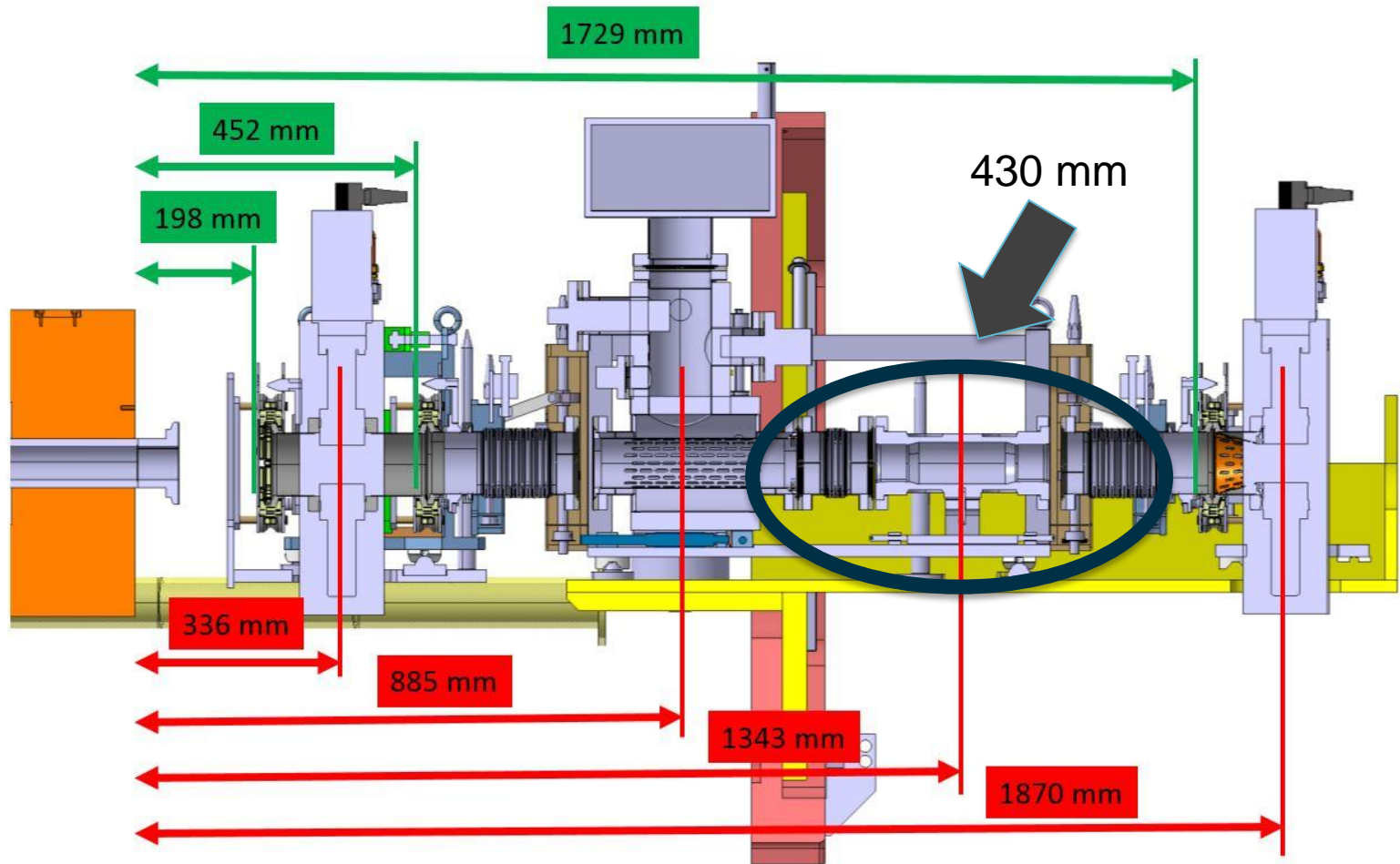
“Reduce and improve interventions in view of LS3.
Q1-TAS is a difficult access area, space is very limited
and subject to high radiation doses (ALARA)”

It has to be noticed that dose rate is about 3 times higher on ATLAS side than HL-LHC side
but access is easier and remote actions are possible

Studied have been started on March 2015, it is very challenging as there are many
conflicts with ATLAS

Courtesy M. Raymond

VAX Relocation (CMS)

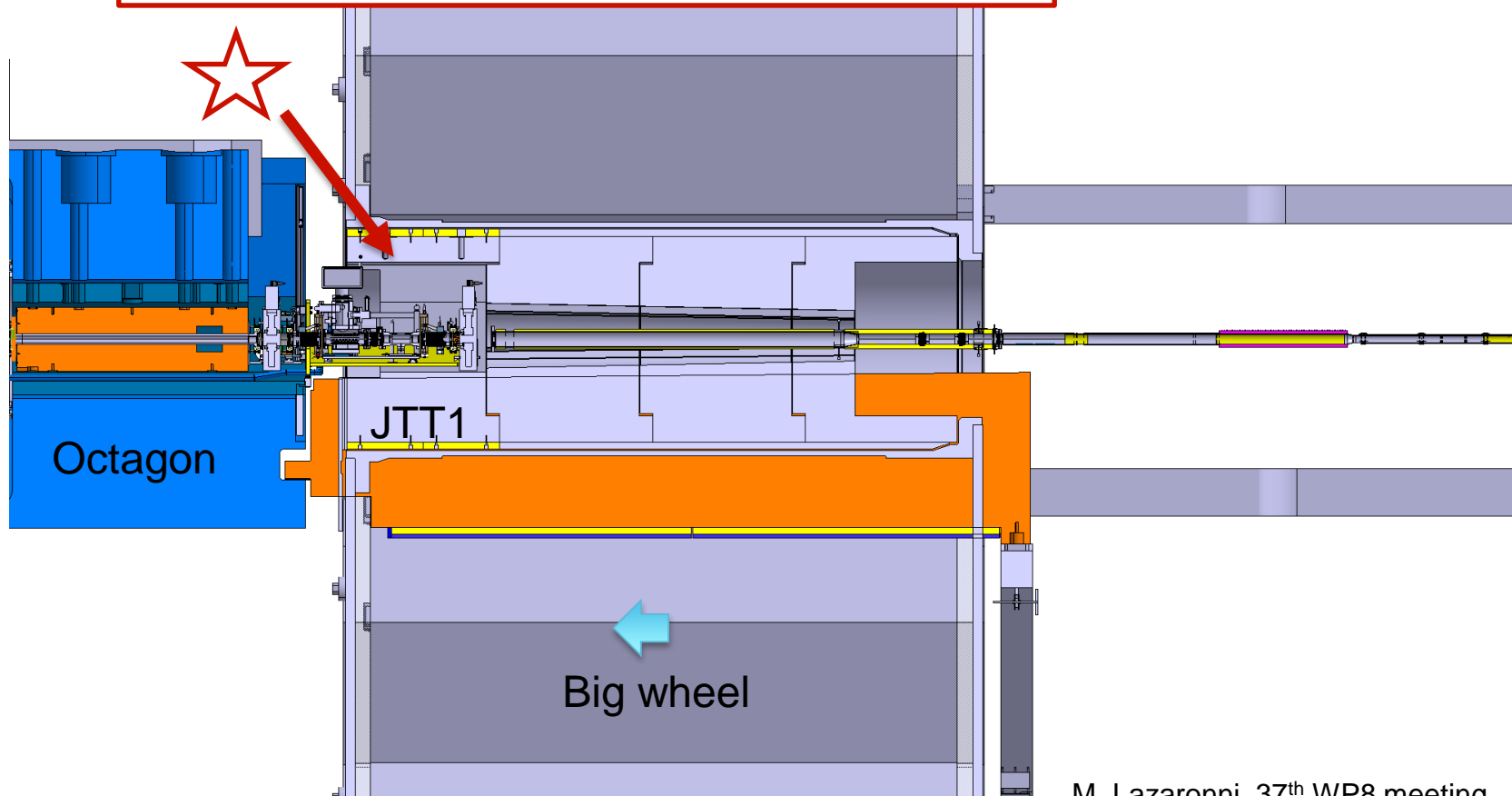


25/04/2016

Damien BRETHOUX EN-EA-EC

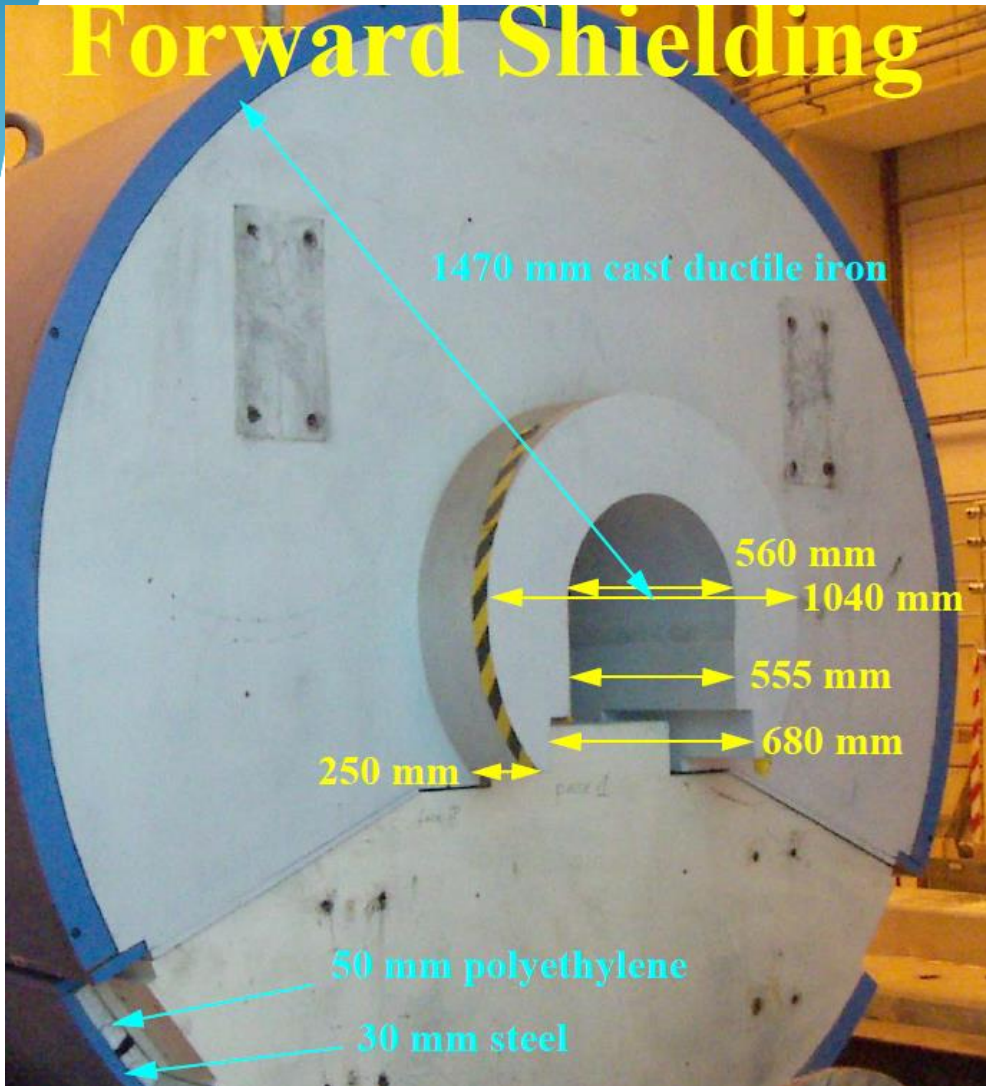
During Shutdown period: Toroid moved toward the octagon

To avoid clash with new HL vacuum configuration, the JTT 1 has to be modified.

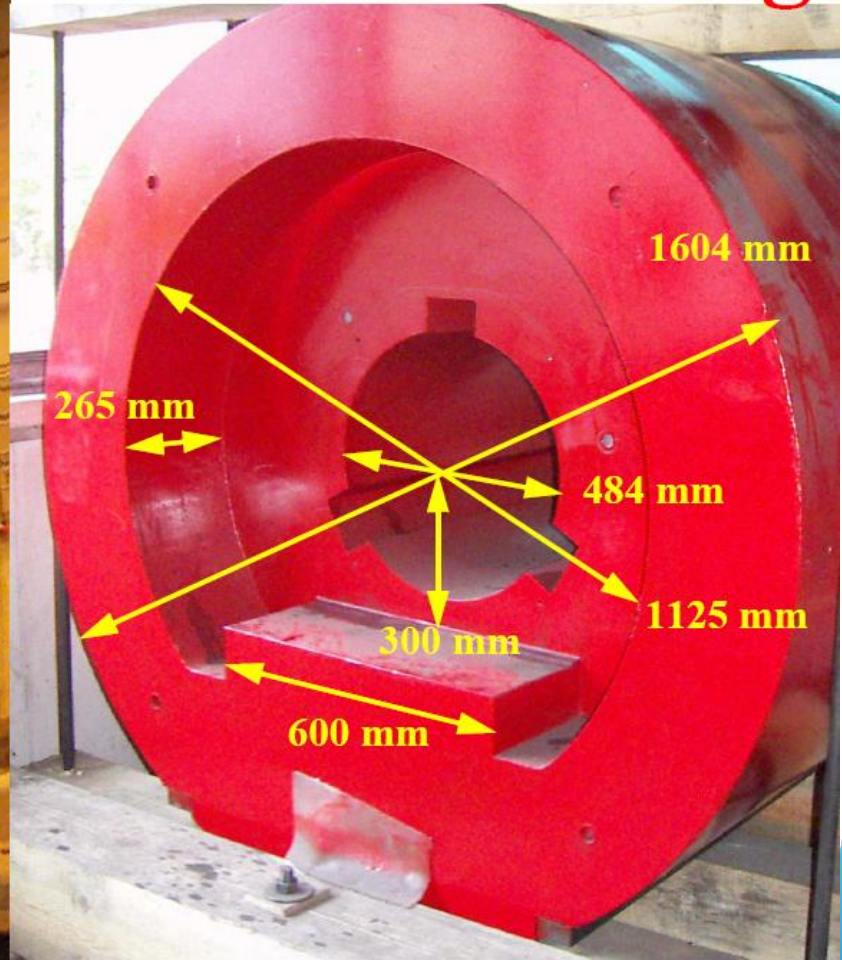


M. Lazaronni, 37th WP8 meeting

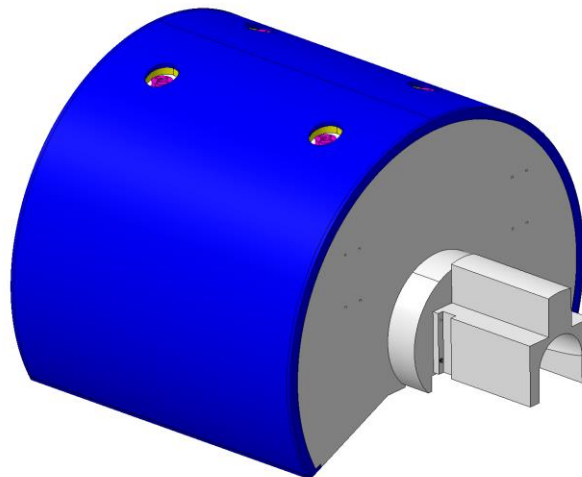
Forward Shielding



Toroid shielding

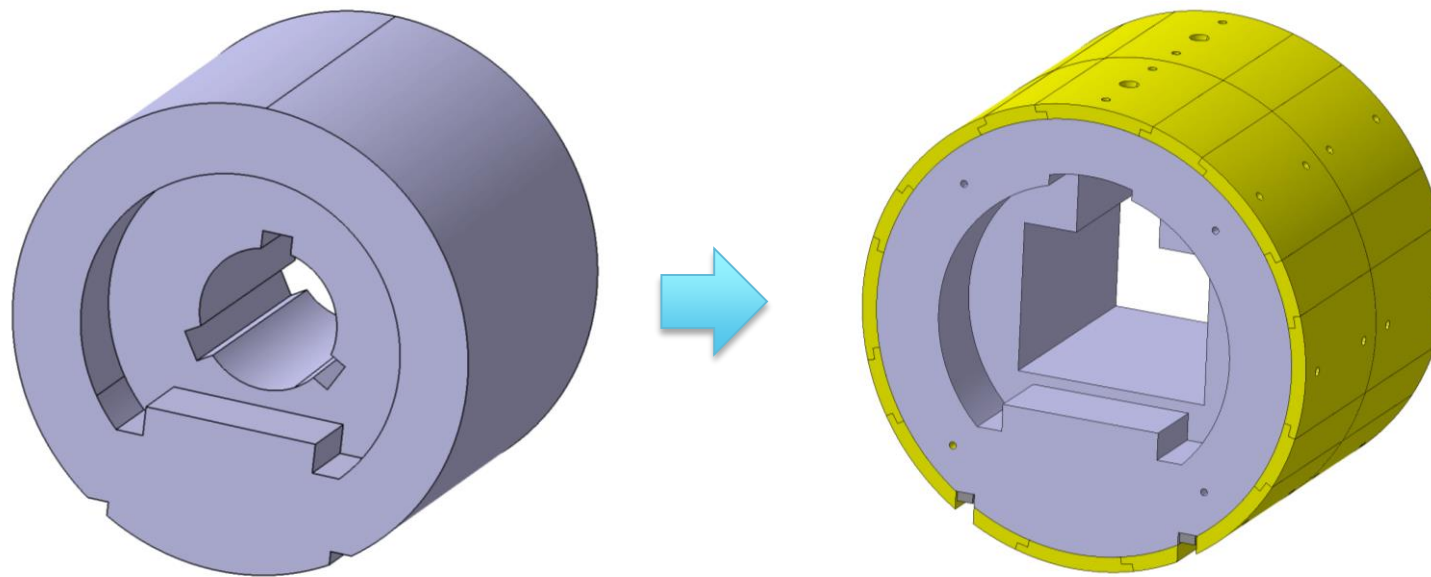


Shielding's modifications on JTT1&JFC2



M. Lazaroni

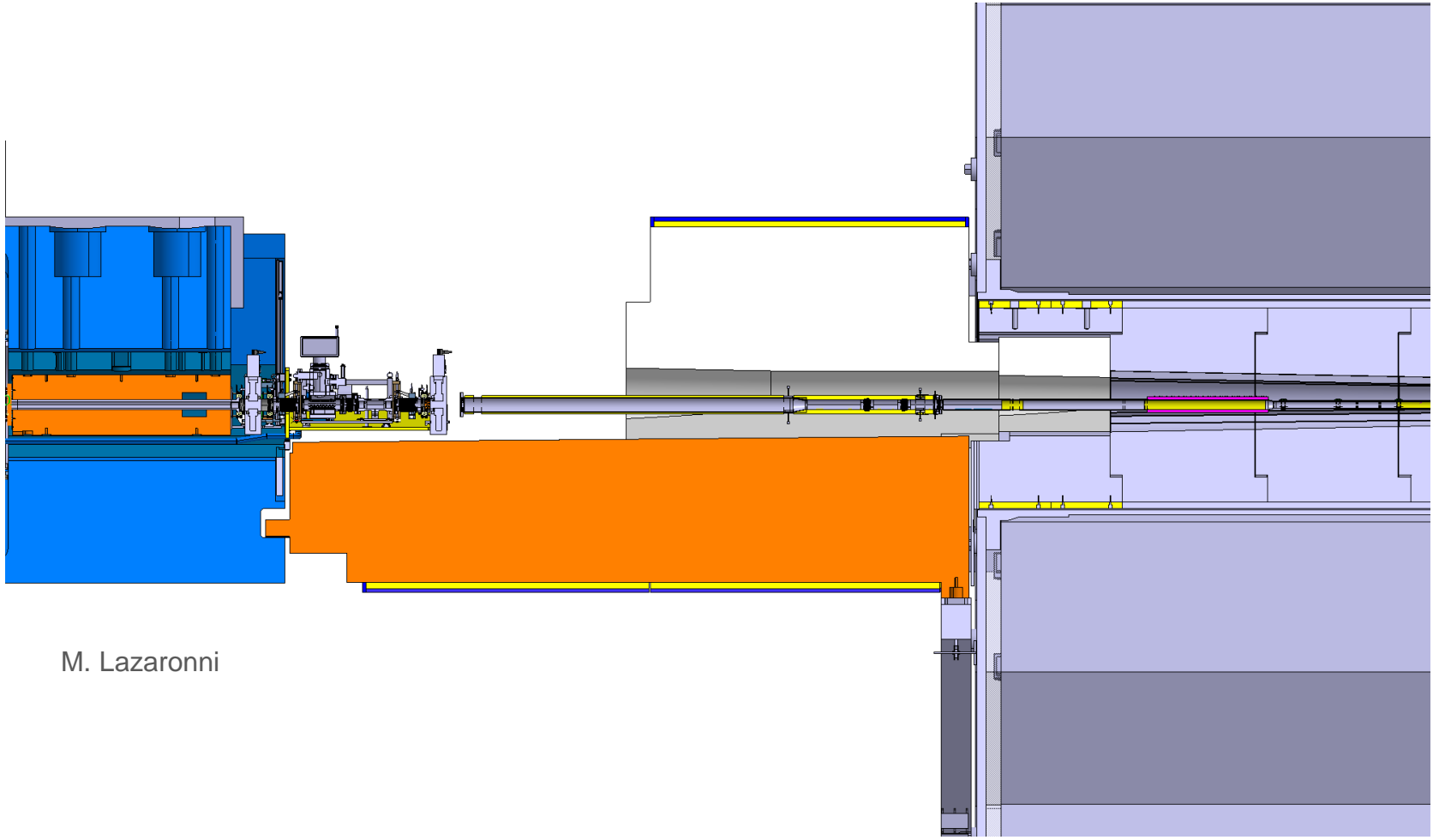
Add a shielding extension JFC2 (1.2 t)



Actual plug JTT1

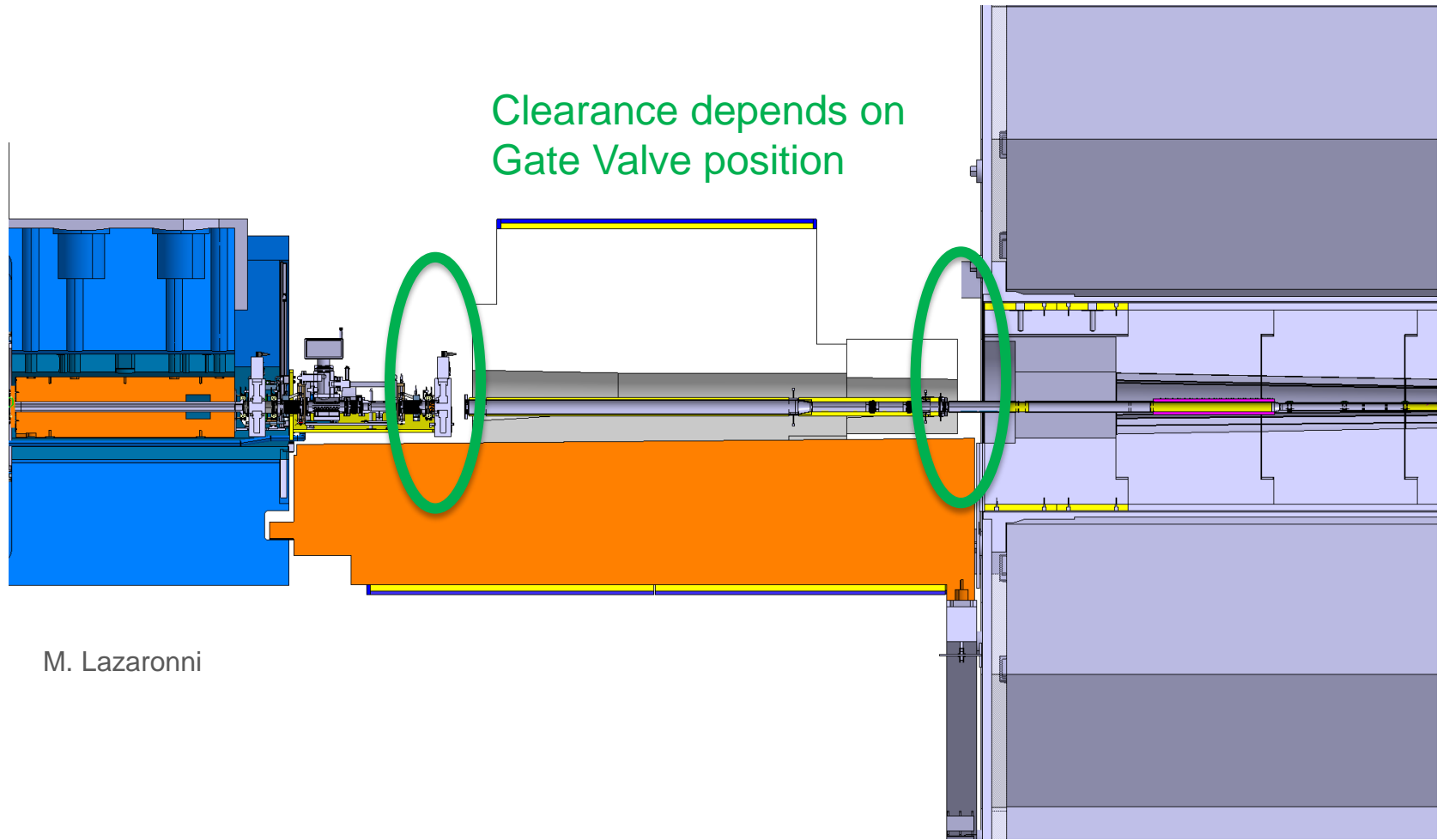
JTT1 modification

JFC 2 removal scenario



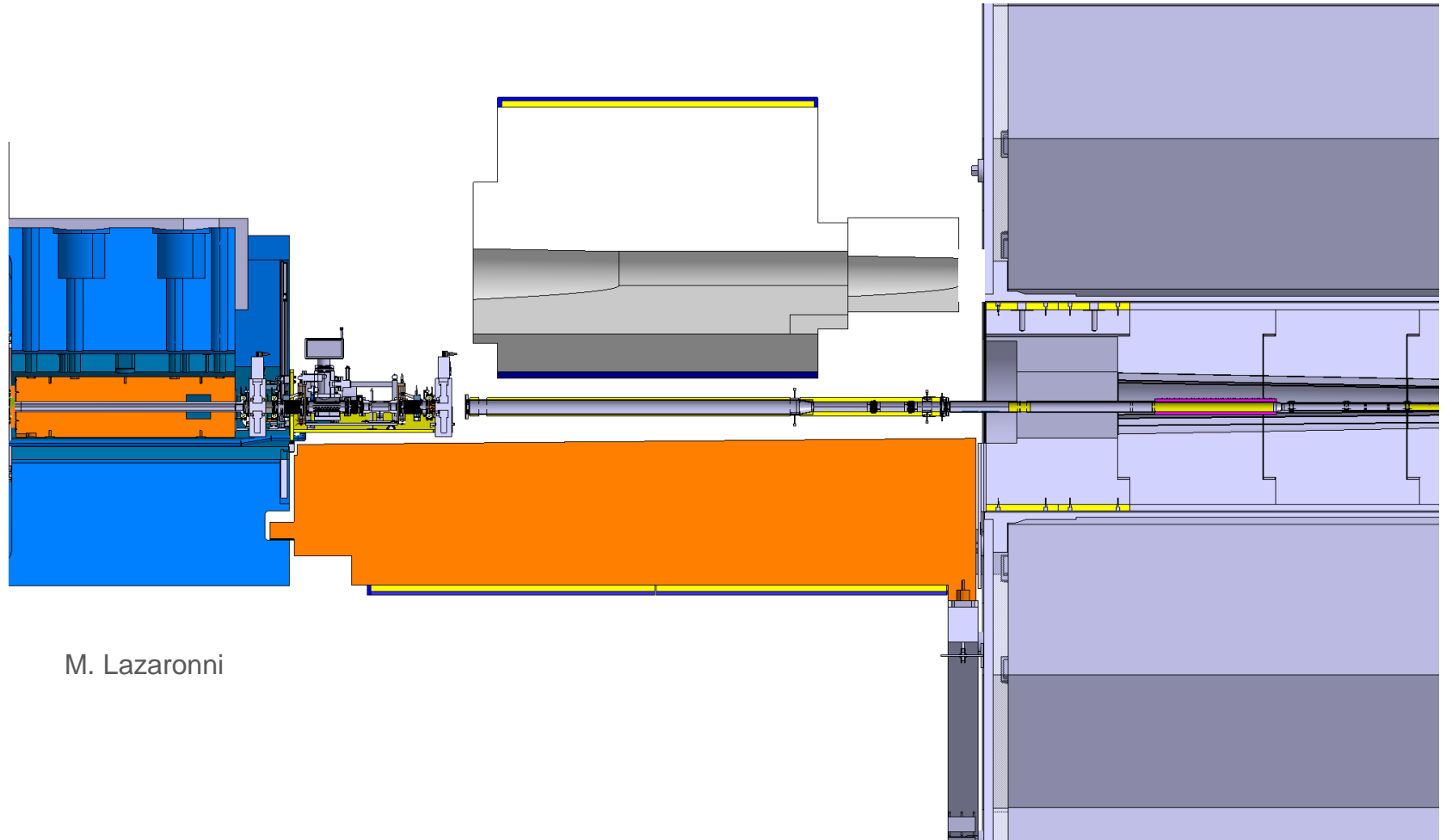
M. Lazaronni

JFC 2 removal scenario : *step 1*



M. Lazaronni

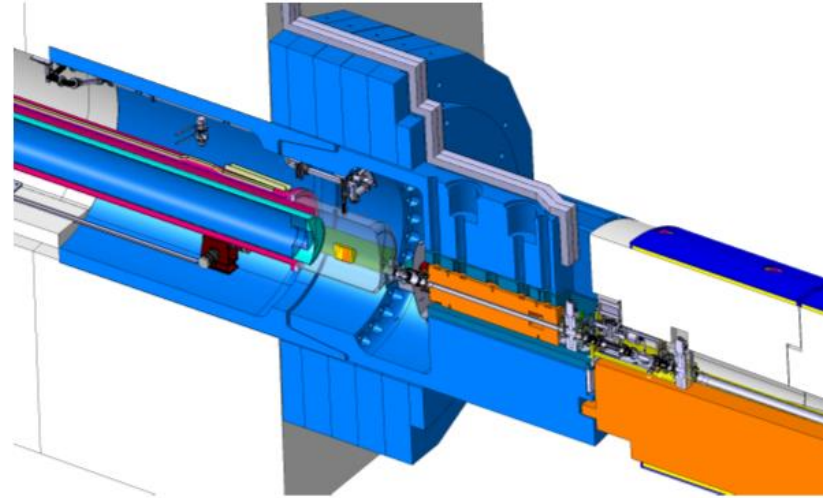
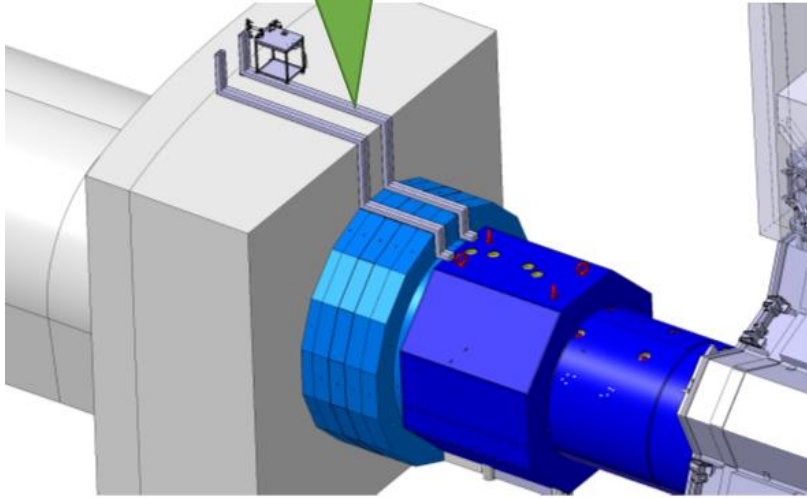
JFC 2 removal scenario : *step 2*



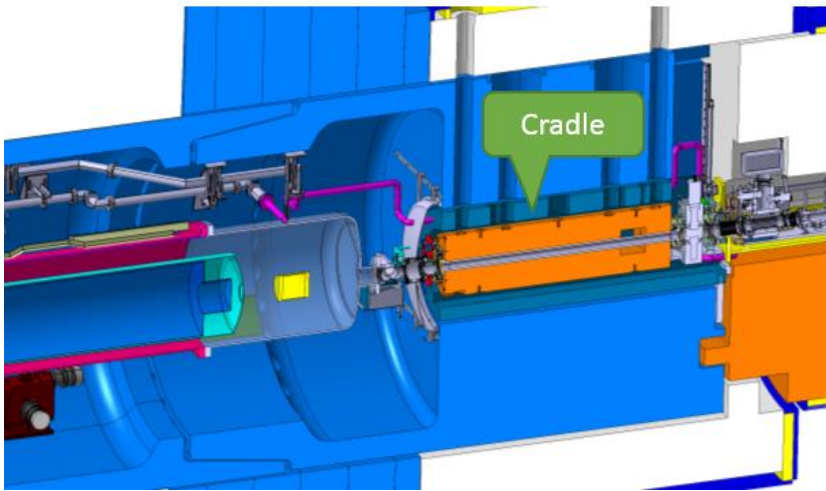
M. Lazaronni

Services routing

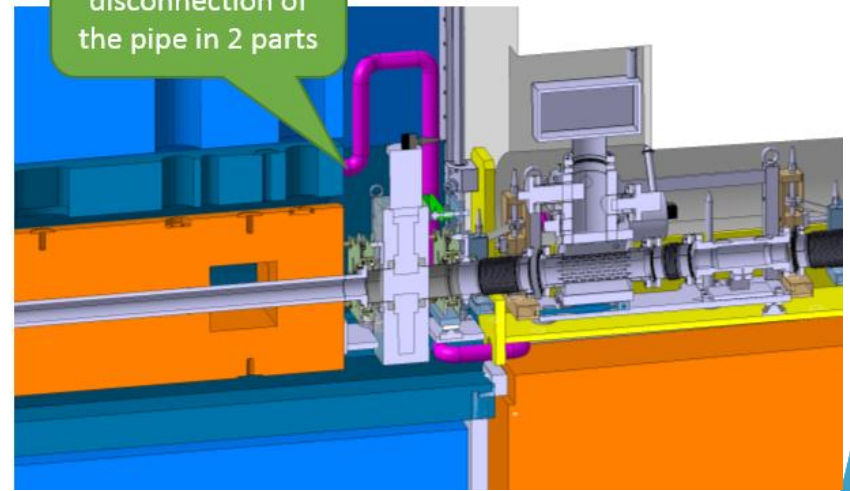
Routing for pipes and cables



Cradle

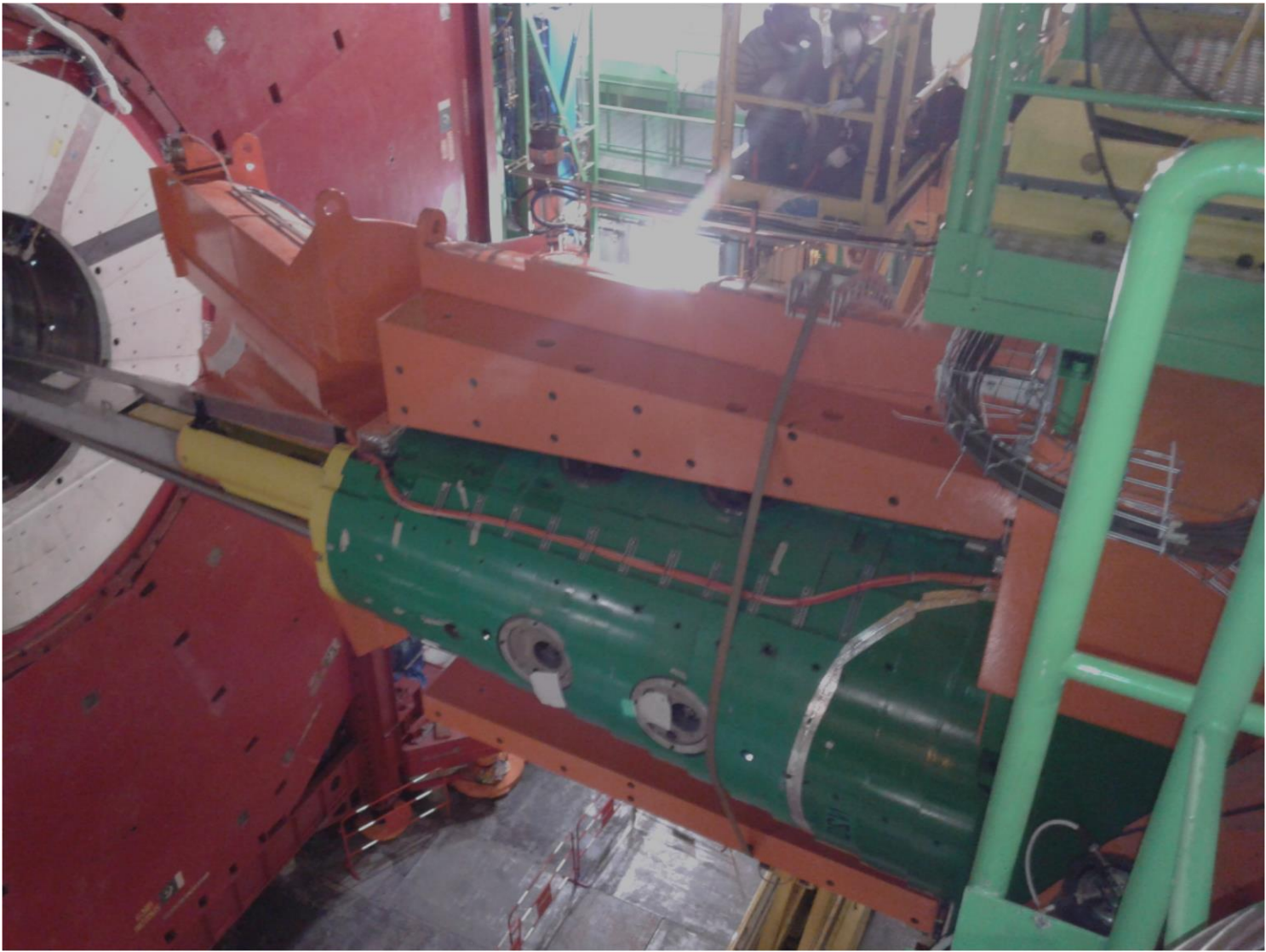


disconnection of the pipe in 2 parts

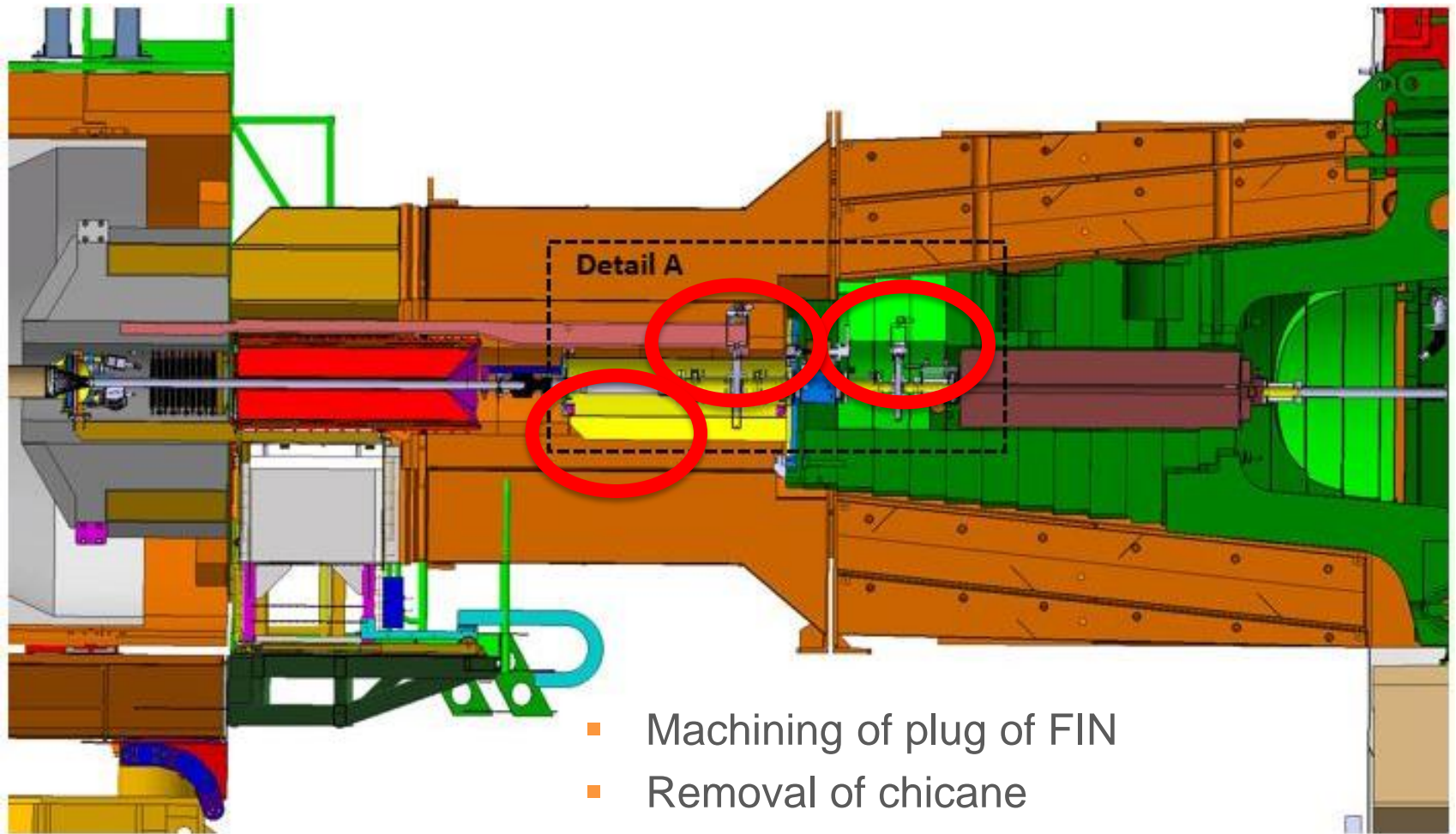


CMS Forward Shielding





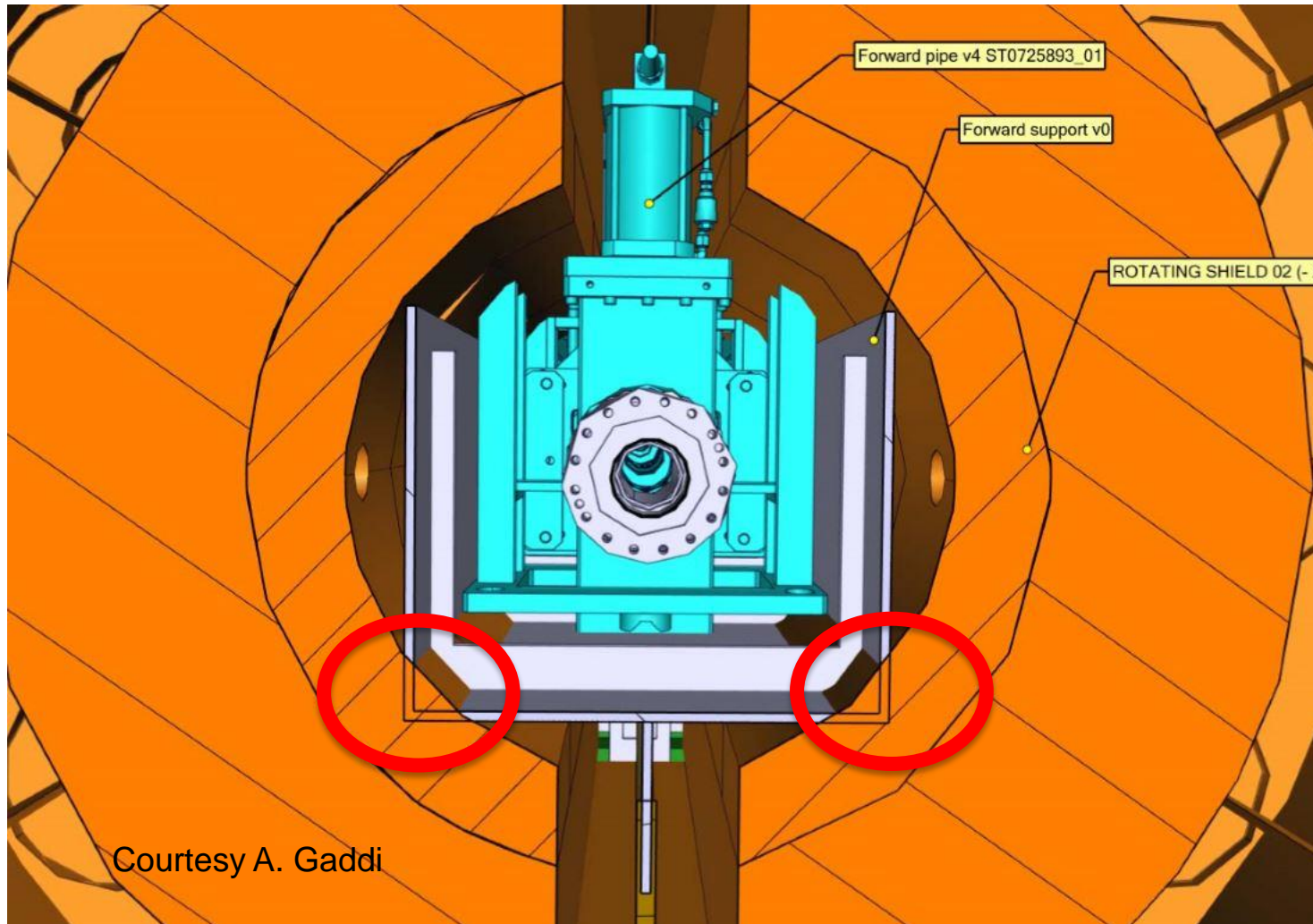
Shielding modifications (1/2)



Courtesy A. Gaddi

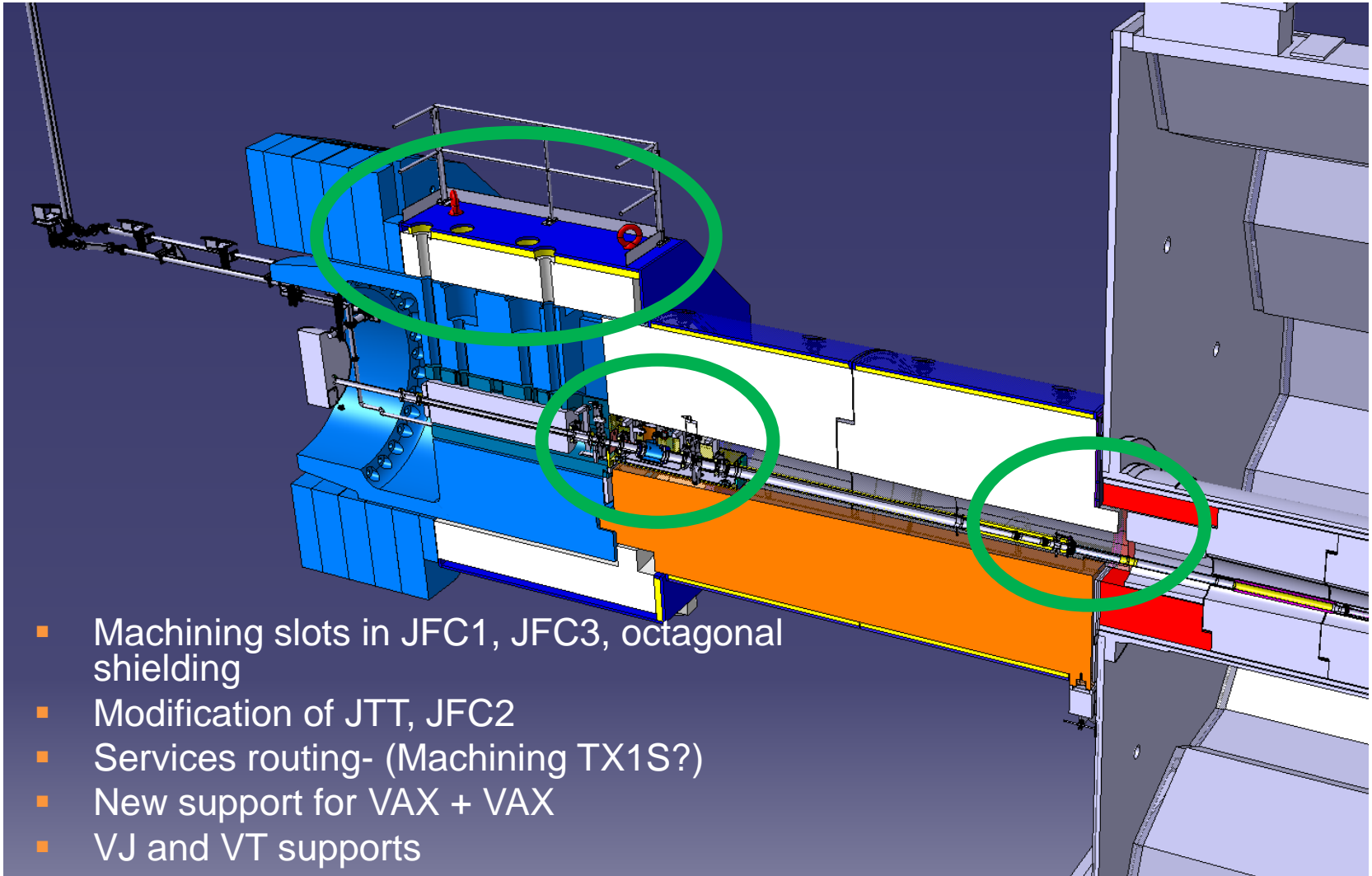
- Machining of plug of FIN
- Removal of chicane
- New support for Vacuum Chamber-Advance installation to LS2 (!)
- Re-routing of services to pumps

Shielding modifications (2/2)



Courtesy A. Gaddi

ATLAS. Modifications in existing shielding structures



Overview of Radiation (EDMS 1434476)

- The residual dose rate increase until LS3 depends on operational scenario, cooling time and material and is about a factor of 4 to 6
- The residual dose rate increase until HL-LHC era depends on operational scenario, cooling time and material and is about a factor of 15 to 30
 - Short cooling times: no differences among the LSs after LS3
 - Longer cooling time: slightly increasing (but not evident along the triplet)
 - HL vs LS3: a factor 4 to 6 higher
 - HL vs LS1: a factor 15 to 30 higher
- HL-LHC Ultimate vs Nominal: a factor 1.2 to 1.5 higher, depending on the cooling time (mainly driven by the instantaneous luminosity)

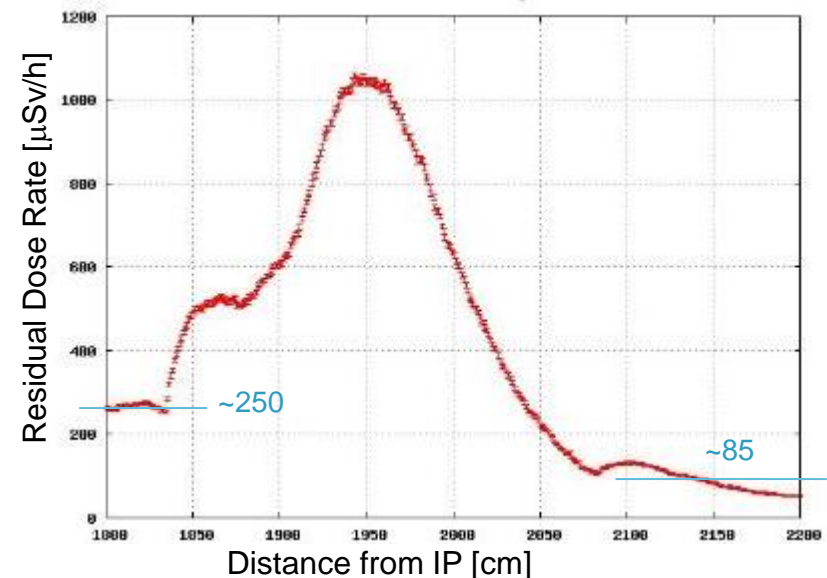
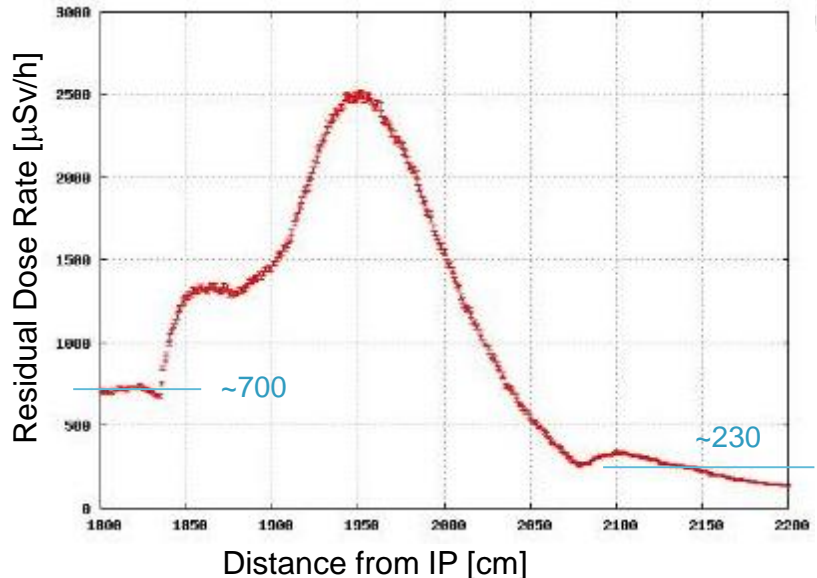
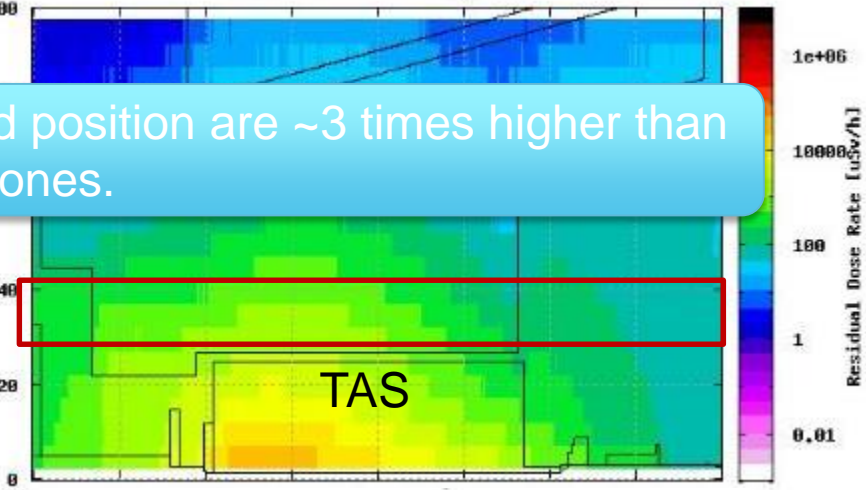
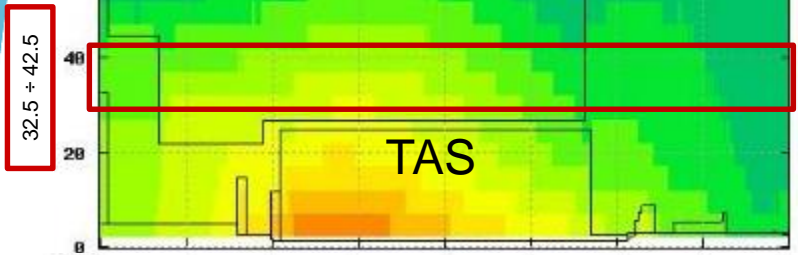


LS3 estimation

LS3 - 1 month cooling time

LS3 - 4 months cooling time

Experiment side dose rates @considered position are ~3 times higher than tunnel side ones.



CMS Scaling factors – maximum

(Based on average res. dose rate $R < 100$ cm)

CMS (Maximum luminosity for HL-LHC)

Maximum ratio of dose rates #/LS1	1 week	4 weeks	6 weeks	8 weeks	16 weeks	1 year
LS2	2.0	2.0	2.1	2.2	2.5	3.4
LS3	3.1	3.2	3.3	3.4	3.8	5.0
LS4 (1281 fb ⁻¹)	17	18	18	19	20	26
3000 fb ⁻¹	17	18	18	19	23	34

For Comparison: ATLAS (Maximum luminosity for HL-LHC)

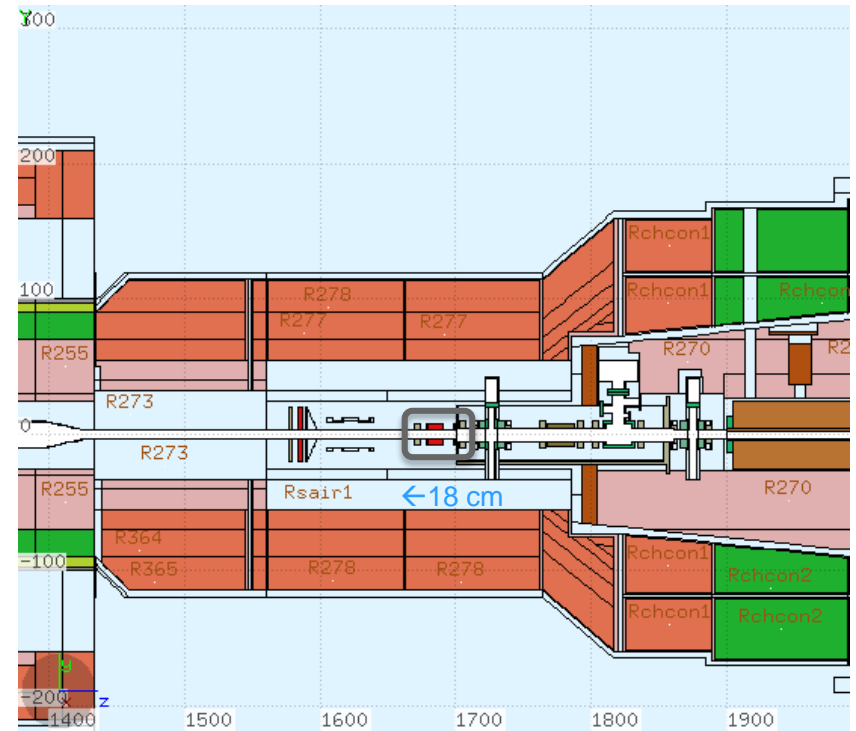
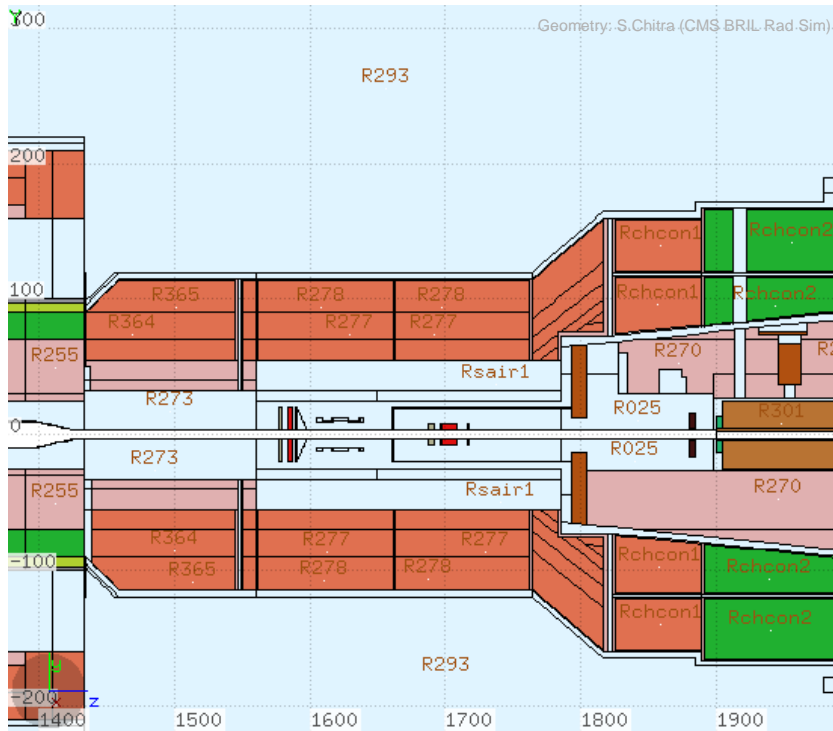
Maximum ratio of dose rates LS#/LS1	1 week	4 weeks	6 weeks	8 weeks	16 weeks	1 year
LS2	1.9	1.9	1.9	2.0	2.3	2.7
LS3	2.9	2.9	3.0	3.1	3.3	4.0
LS4 (1281 fb ⁻¹)	15	16	16	17	18	21
3000 fb ⁻¹	15	16	16	17	21	27

- **CMS results consistent with ATLAS**
- The small difference in *maximum scaling factors* are possibly due to bulky material at various points along the beam line (see next slides)

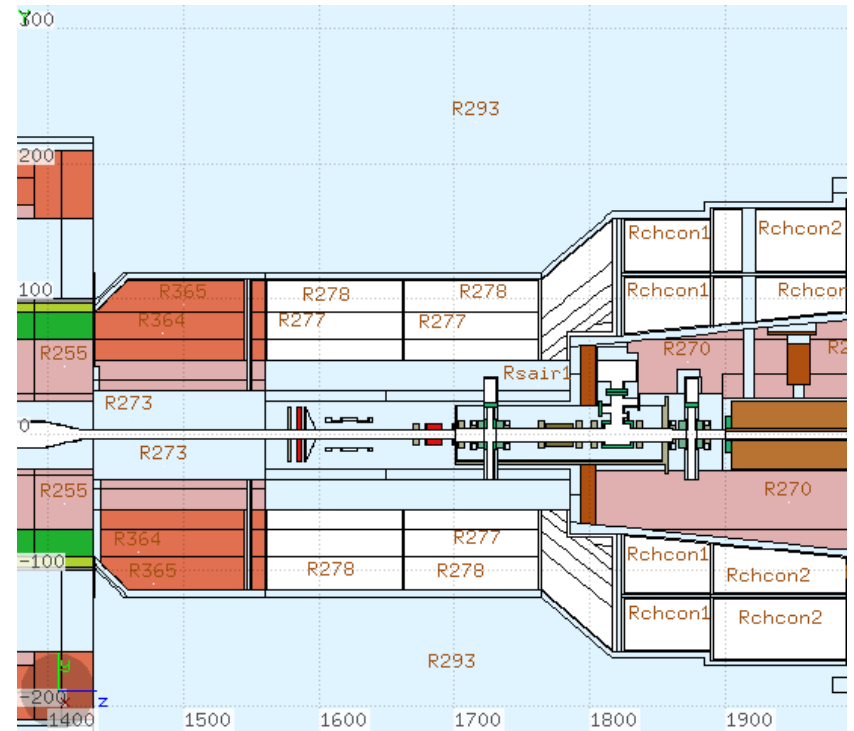
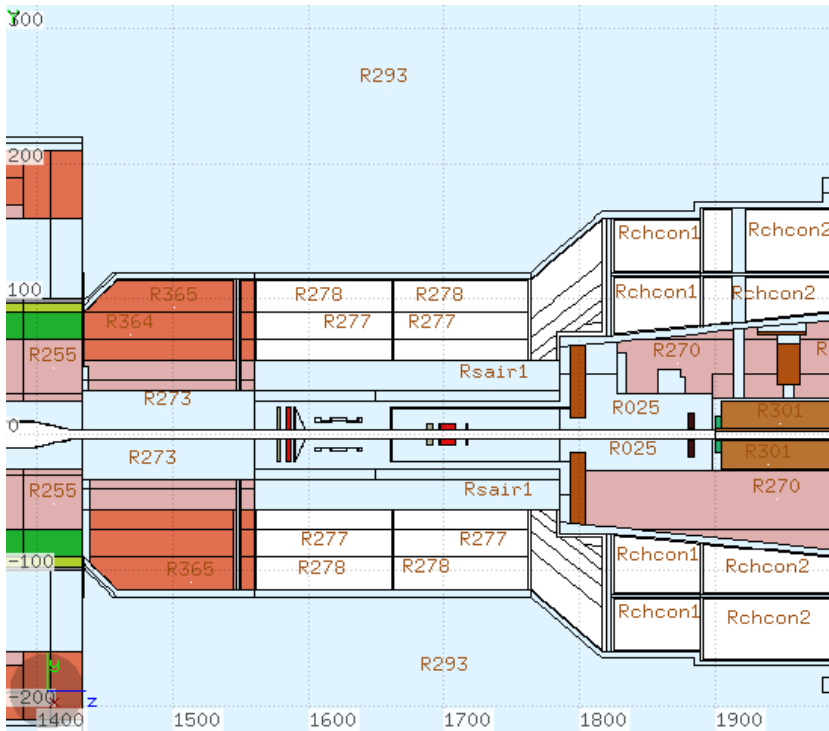
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ECFA Oct 2014
CMS & ATLAS joint talk

VAX installation in CMS



Rotational Shielding (RS) fully open

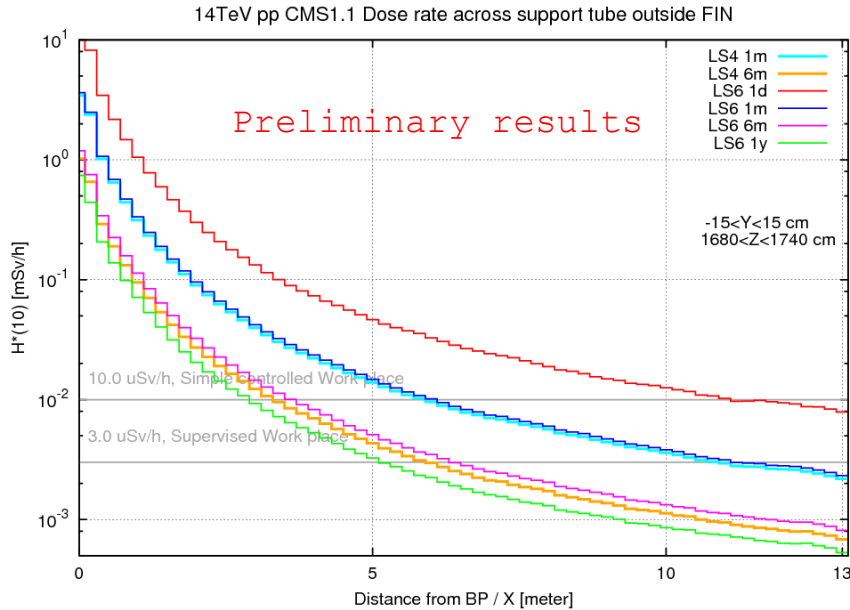


Irradiation assumptions

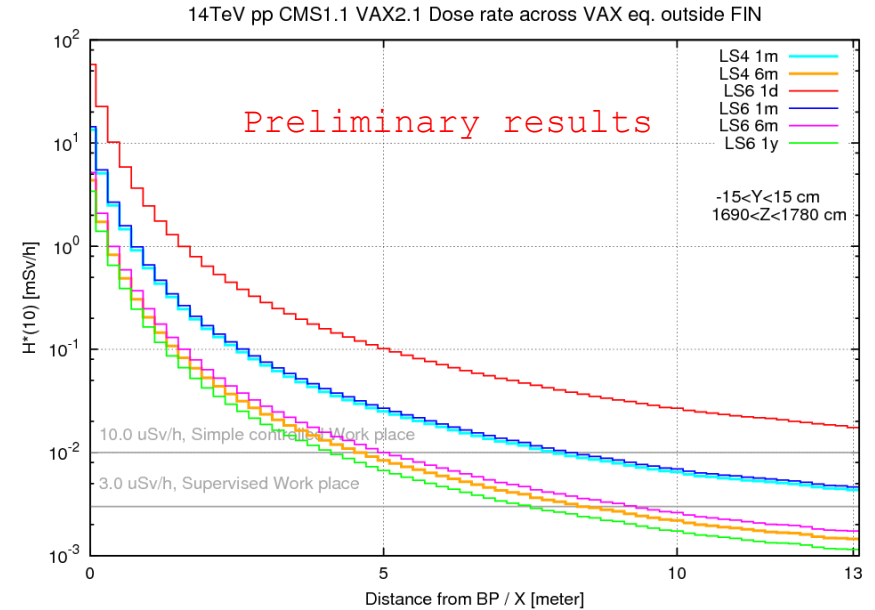
- Integrated lumi: 300/fb per year in HL-LHC
 - 3 years operation, 1 year shutdown
 - Previous contribution (total 320/fb) ignored.
H*(10) in HL- shutdowns increase by factor 5-6 compared to LS3#.
- Peak lumi: $7.5E34 \text{ cm}^{-2}\text{s}^{-1}$ (levelling)
- 7+7 TeV pp-collisions, 75 mb inelastic cross section
- Cooldown: 1 day, 1 month, 6 months, 1 year

(#) see scaling factor in extra slides

H*(10) in mSv/h across beam line [1/2]



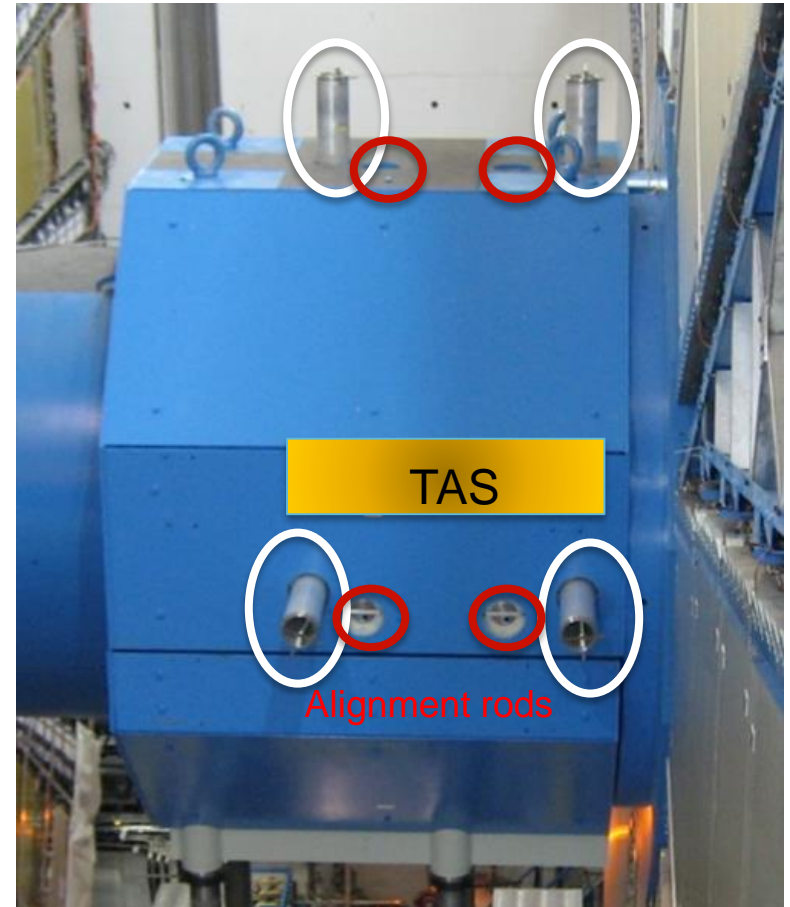
Dose rate in CMS cavern in hottest region with RS open



.... and with VAX installed.

ACTUAL ATLAS TAS ALIGNMENT CONCEPT

- TAS alignment based on bars attached to TAS and traversing the JFC and JFS shielding
- Bars are made of two parts
 - 1st part fix inside TX1STM
 - 2nd part removable in JFS and supports the targets
- 2nd part needs to be (dis-)mounted for opening/closing
- Z-coordinates of 2 top points determine vertical alignment
- X-coordinates of 2 side points determine radial alignment
- Alignment in single configuration possible (experiment closed, shafts open, cherry-picker available)
- Regular manual intervention with constraints on configuration, planning, access, exposure



D. Mergelkuhl EN-ACE-SU
WP8 meeting, 10-05-2016

F. Sanchez Galan, 8th HL-LHC-TCC 02-06-2016

ATLAS TAS survey history

A-side

March 2016	adjust
November 2014	measure
February 2013	measure
March 2012	adjust
February 2011	measure

- Only measurement dates with the possibility (configuration) of adjustment shown.
- Data during installation not shown

Courtesy D. Mergelkuhl: History of ATLAS TAS alignment 2008-2016, available at 35th WP8 bi-weekly meeting <https://indico.cern.ch/event/512614/>

ATLAS TAS survey history

C-side

March 2016	adjust
November 2014	measure
February 2013	measure
March 2012	adjust
February 2011	measure

- Only measurement dates with the possibility (configuration) of adjustment shown.
- Data during installation not shown

Courtesy D. Mergelkuhl: History of ATLAS TAS alignment 2008-2016, available at 35th WP8 bi-weekly meeting <https://indico.cern.ch/event/512614/>

ATLAS TAS survey history

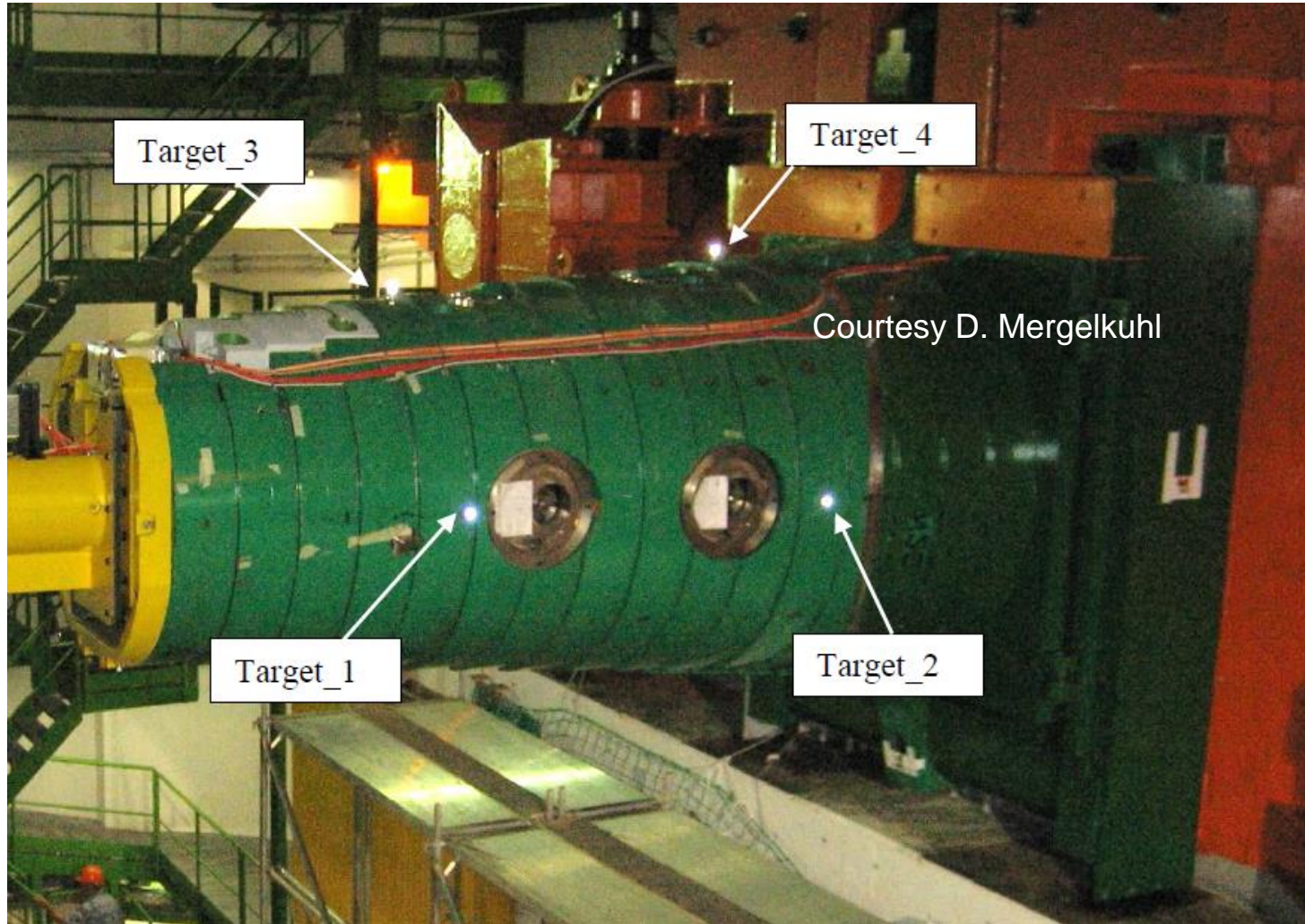
C-side

March 2016	measure
December 2014	adjust
February 2013	measure
March 2012	adjust
28+31 January 2011	adjust

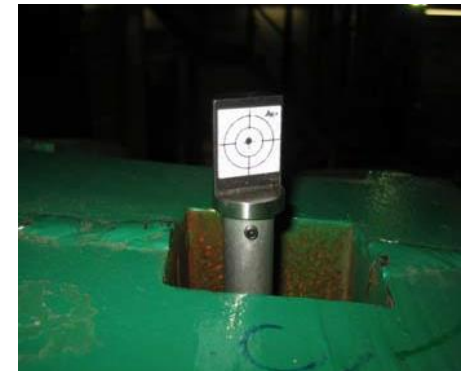
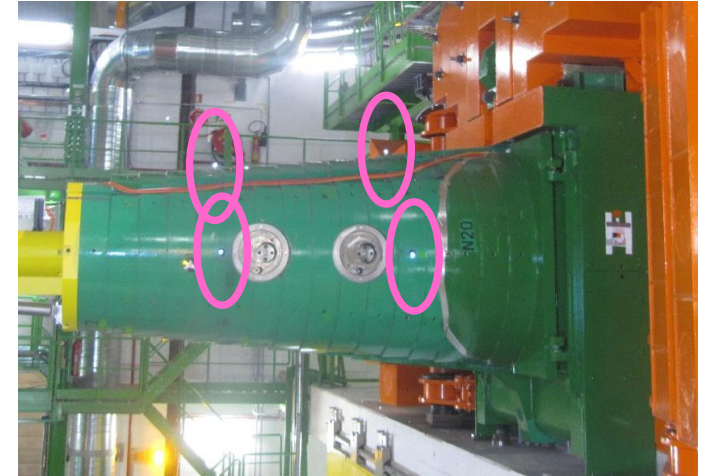
- Only measurement dates with the possibility (configuration) of adjustment shown.
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Courtesy D. Mergelkuhl: History of ATLAS TAS alignment 2008-2016, available at 35th WP8 bi-weekly meeting <https://indico.cern.ch/event/512614/>

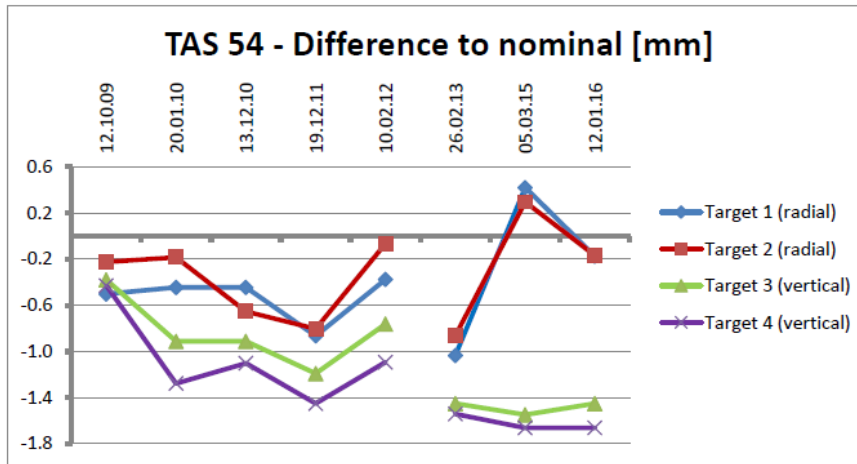
CMS TAS survey targets



- TAS alignment based on bars attached to TAS and traversing the FIN shielding (green)
- Single parts of bars stay permanently
 - 1st fix part inside FIN
 - Retro-targets are mounted as targets
- Rotating shielding needs to be open for measurement
- Z-coordinates of 2 top points determine vertical alignment
- X-coordinates of 2 side points determine radial alignment
- Manual intervention with constraints on configuration, planning, access, exposure



Motorization: CMS TAS survey history



35th WP8 Biweekly meeting
<https://indico.cern.ch/event/512614/>

Figure 6. Coordinate differences to nominal

Courtesy D. Mergelkuhl

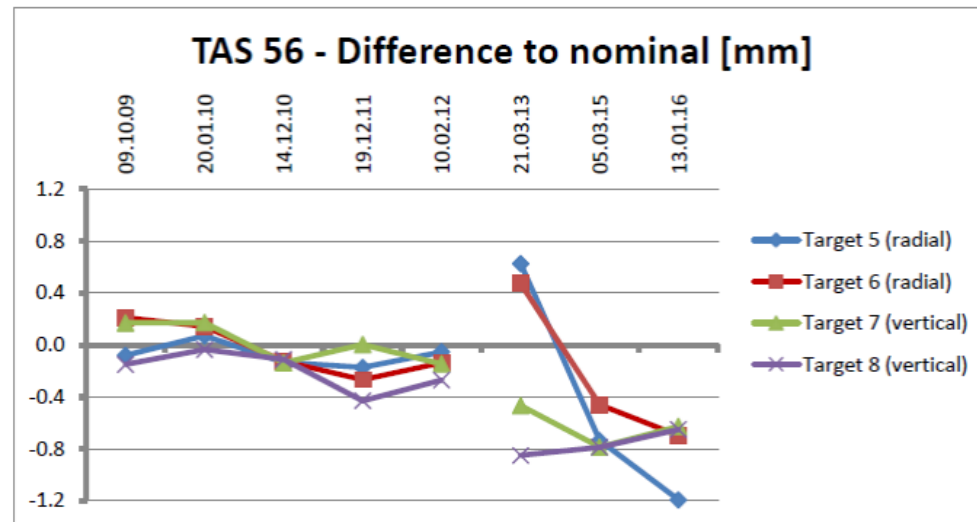
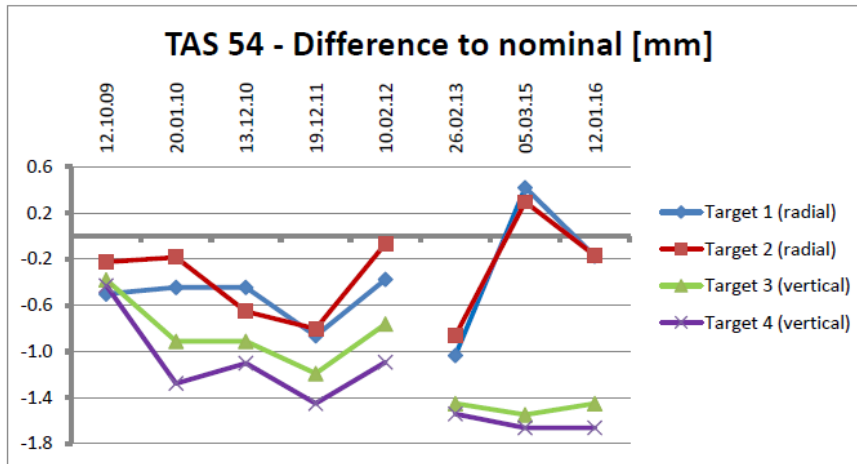


Figure 6. Coordinate differences to nominal

Motorization: CMS TAS survey history



35th WP8 Biweekly meeting
<https://indico.cern.ch/event/512614/>

Figure 6. Coordinate differences to nominal

Courtesy D. Mergelkuhl

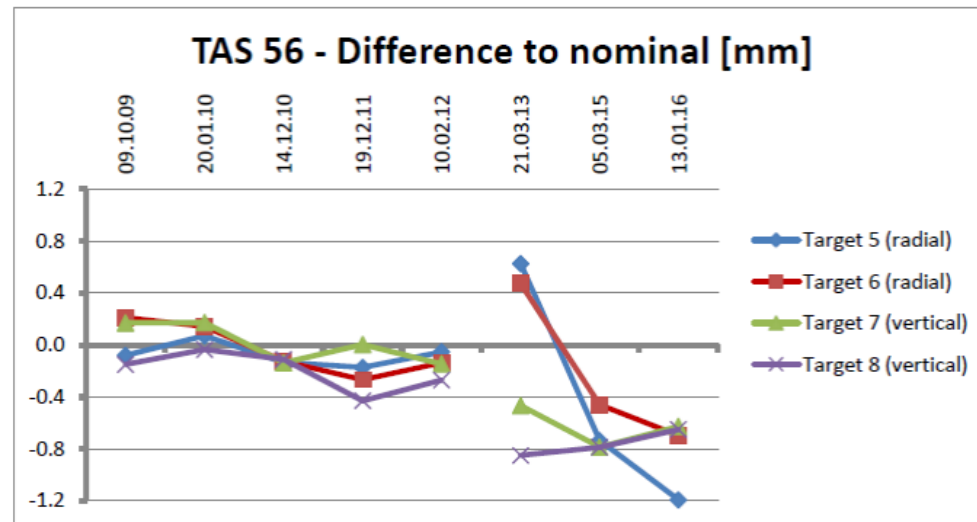


Figure 6. Coordinate differences to nominal

TAXS Alignment strategy

- No alignments done for CMS since 1st Run
- Few alignments for ATLAS, installation of survey targets takes most of the intervention time.
- An electric motor for alignment with such a low level of use... good approach? → ALARA

Following the lessons learned from the actual system the list of propositions is:

Change to single fixed bar (as CMS) or tubes

Change to Laser Tracker

Change to permanent retro reflectors

Major advantages:

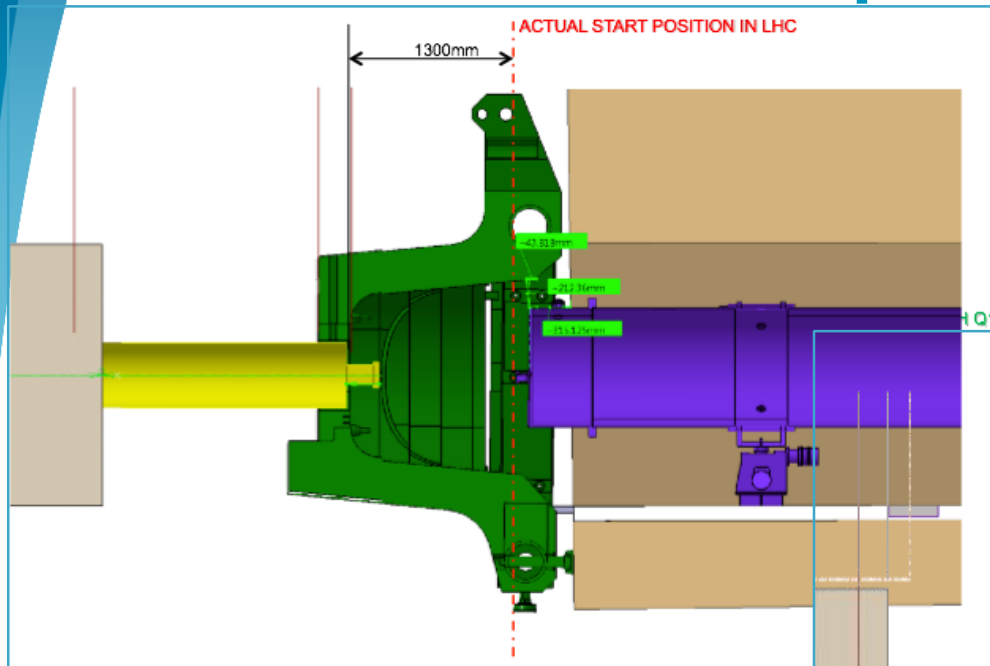
- Less interventions in ATLAS as no mounting/dismounting of bars
- Measurement of 6DOF for TAS
- Controlled measurements
- Shorter interventions
- More precise measurements
- Measurement system exists (AT401) => no development, high reliability
- No active components on TAS or shielding => limited maintenance on TAS

Constraints:

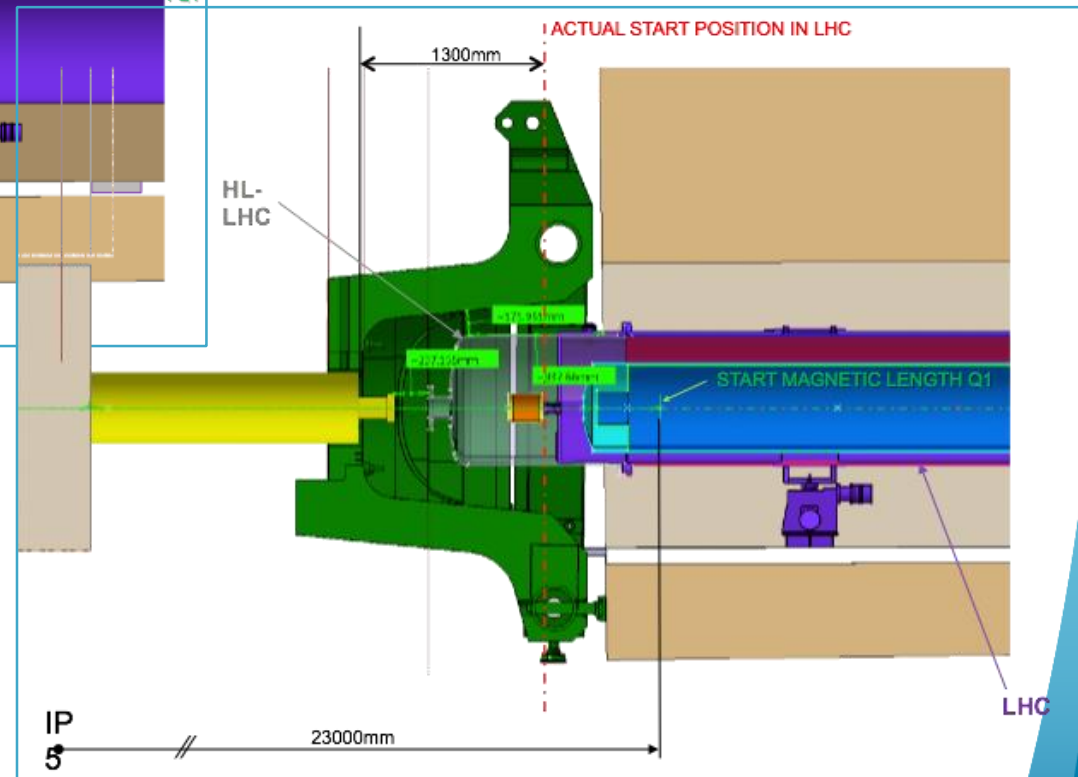
- No real-time monitoring
- No measurement in run configuration! At least top of JFS to be dismantled respectively rotational shielding open
- Cost of prisms as permanent targets
- Modification of plugs (ATLAS)
- New configuration for survey network

D. Mergelkuhl EN-ACE-SU

Recall on available space constraints [HL-LHC]

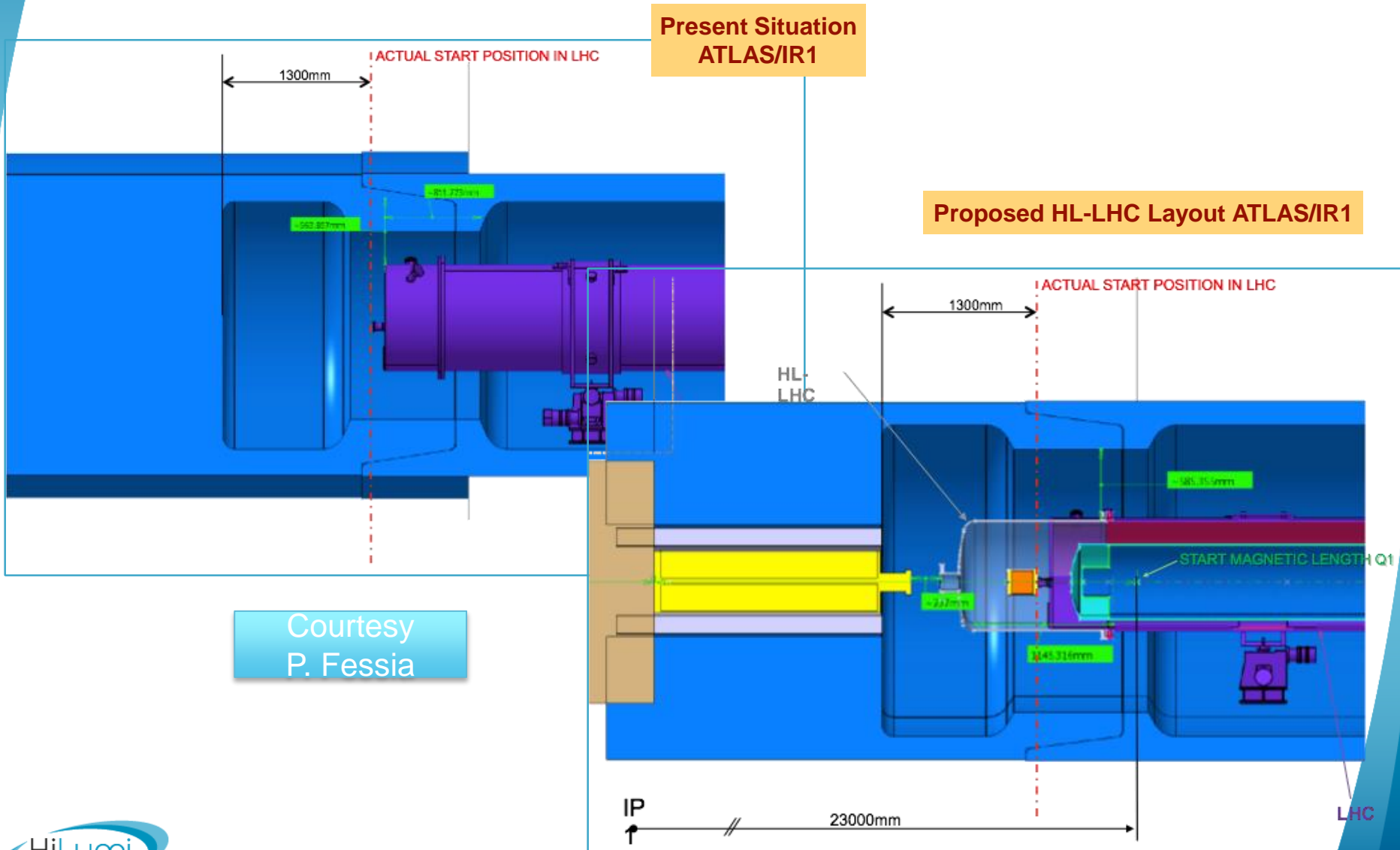


Remote operations need always more space: (Additional bellows & bigger connectors)



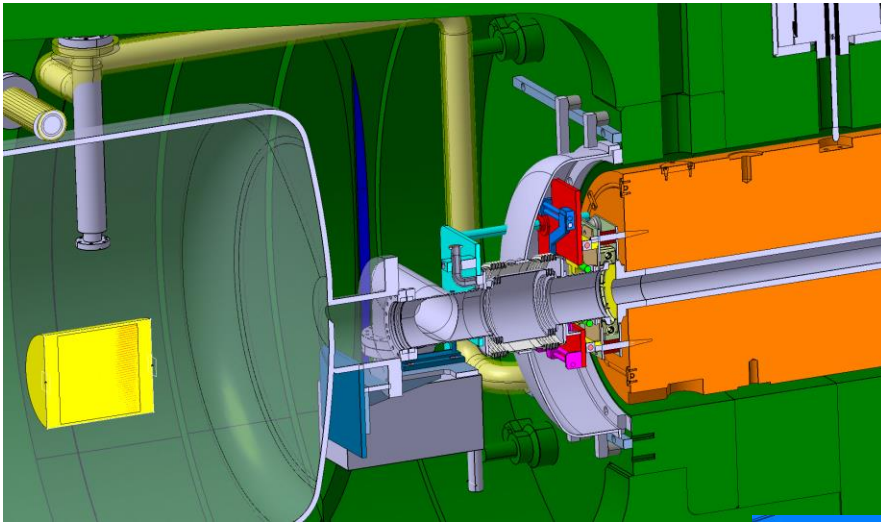
- Q1-TAS: 550 mm
- TAS- Experiments: Available space has to be compatible with Forward shielding structures & dynamic environment. Space is mainly limited transversally in CMS longitudinally in ATLAS.

TAS-Q1 Layout proposal for HL-LHC operation



Courtesy
P. Fessia

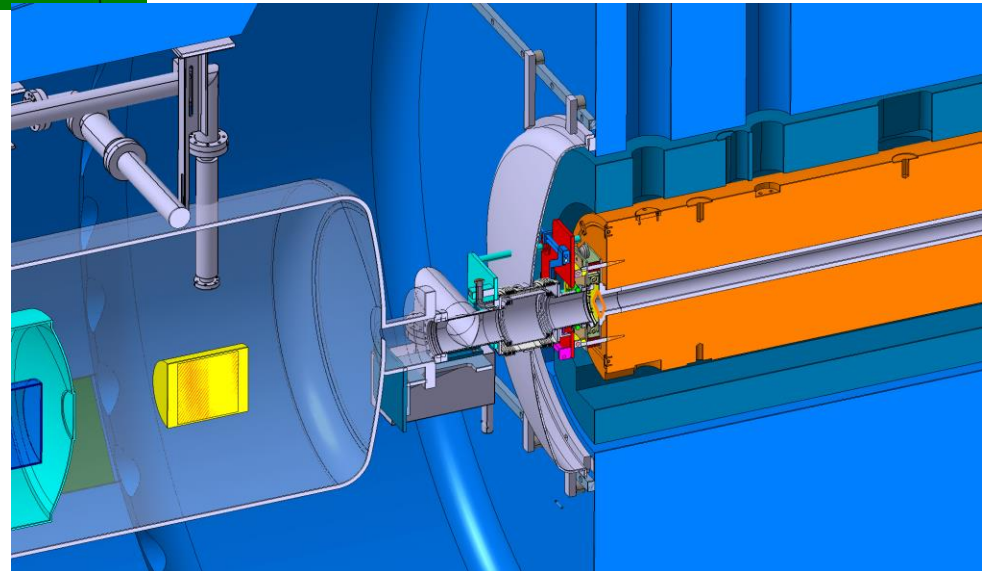
Q1-TAXS



In 550 mm

- He leak protecting dome
- Double pump
- Quick connector

Installation & removal scenarios to be developed



TAXS, next steps

- Services integration: Choice between services routing (ATLAS).
- Survey proposal.
- TAXS remote alignment.
- Quick connections & supports with Beam Pipe
- BPM position- beam pipe supports, shielding modifications.
- Q1-TAXS region



Review meeting(s)

Conclusions

- ❑ Very good collaboration & support from experiments (Thanks!)
- ❑ Shielding modifications could be advanced to LS2, reducing exposure and relaxing LS3 planning. Close contact with beam pipe team.
- ❑ Relocation of vacuum equipment from the tunnel to the experimental area (from 22-21m to 19 to 17m) seems feasible, but has implications on experiments:
 - Modifications in experiment shielding.
 - Modifications in auxiliary systems.
- ❑ BPM decision on hold, outside of Exp. Area relaxes space constraints, reduces interventions and improves alignment. It has a major implication on beam pipe supports, shielding modifications, alignment requirements.
- ❑ Radiation levels 3x on the experiment side, remote operations compulsory for VAX exchange...
- ❑ No alignment done in CMS, few in ATLAS where most of the dose comes from the installation/removal of survey targets. Alignment philosophy to be agreed.
- ❑ Q1-TAS remains one of the most difficult access areas to access in the accelerator. He leak protecting dome, quick connector Q1-TAS and double pump integrated in 550 mm