VAX region, status of proposed changes

F Sanchez Galan & S. Evrard on behalf of HL-LHC WP8

Contents

- Motivation for VAX relocation
- Upgraded VAX system
- Impact on experiments
- Conclusions

TAS to TAXS @ P1 & P5

- To increase the aperture for the beam, **TAS will be replaced for TAXS (ID34 to 60mm)**.
- Functionality, position and design principles will be kept, adapting to the **increased deposited energy and radiation levels.**
- **TAXS Region needs to** be compatible with HL operation, following the **ALARA** principle.

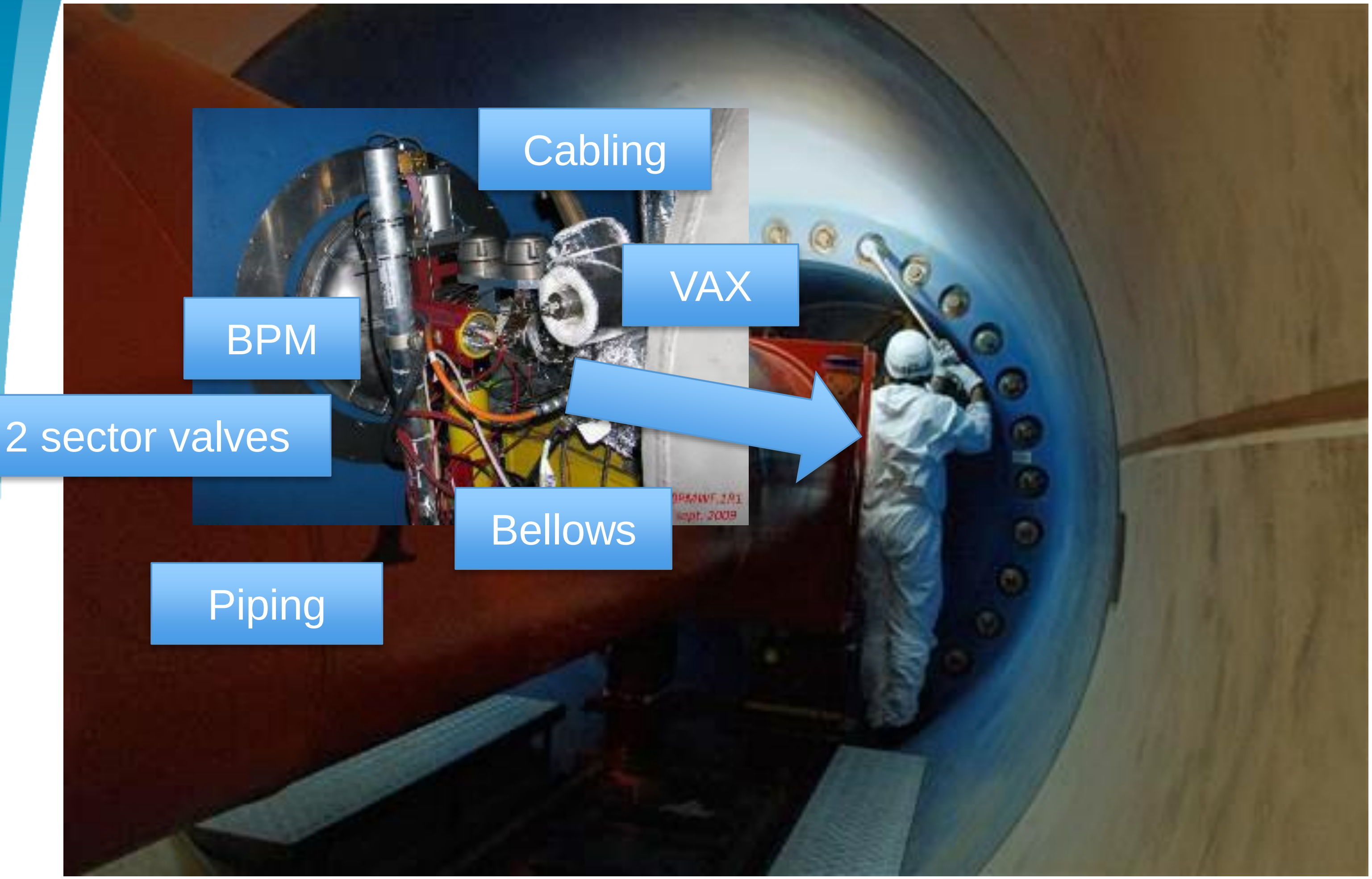
Motivation for VAX Relocation @ P1 & P5

- VAX equipment is situated at the most difficult access region in LHC.
- **Radiation levels and proximity to equipment make routine operations difficult and costly in terms of radiation dose**
- Allocated space can not be modified.

Access Q1 to TAS region (ATLAS)

C.BAULT le 25/09/2003

Access Q1 to TAS region (ATLAS)

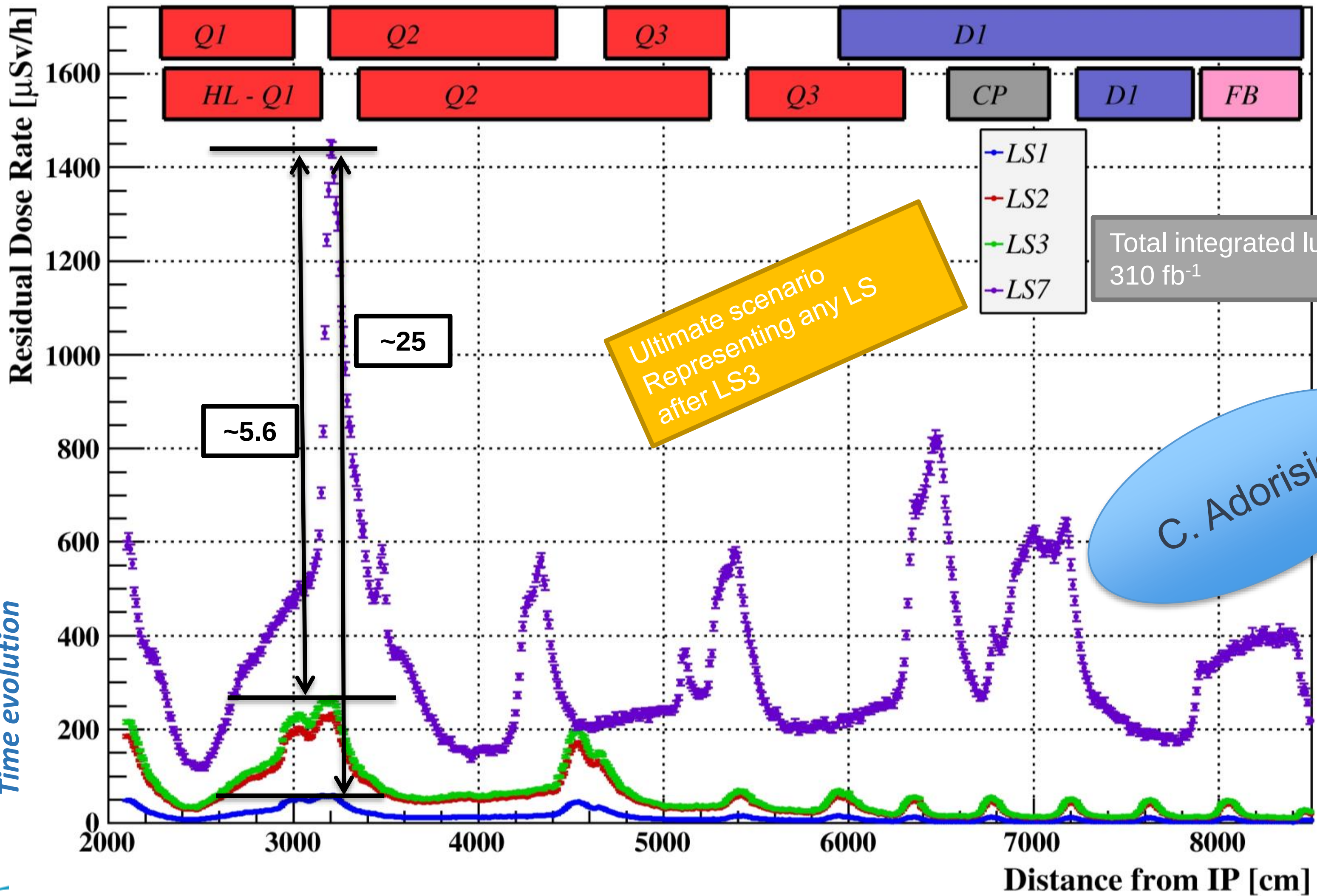


Overview of Radiation (EDMS 1434476)

1 month cooling time, dose rates at contact of the cryostat

Ambient Dose Equivalent Rates

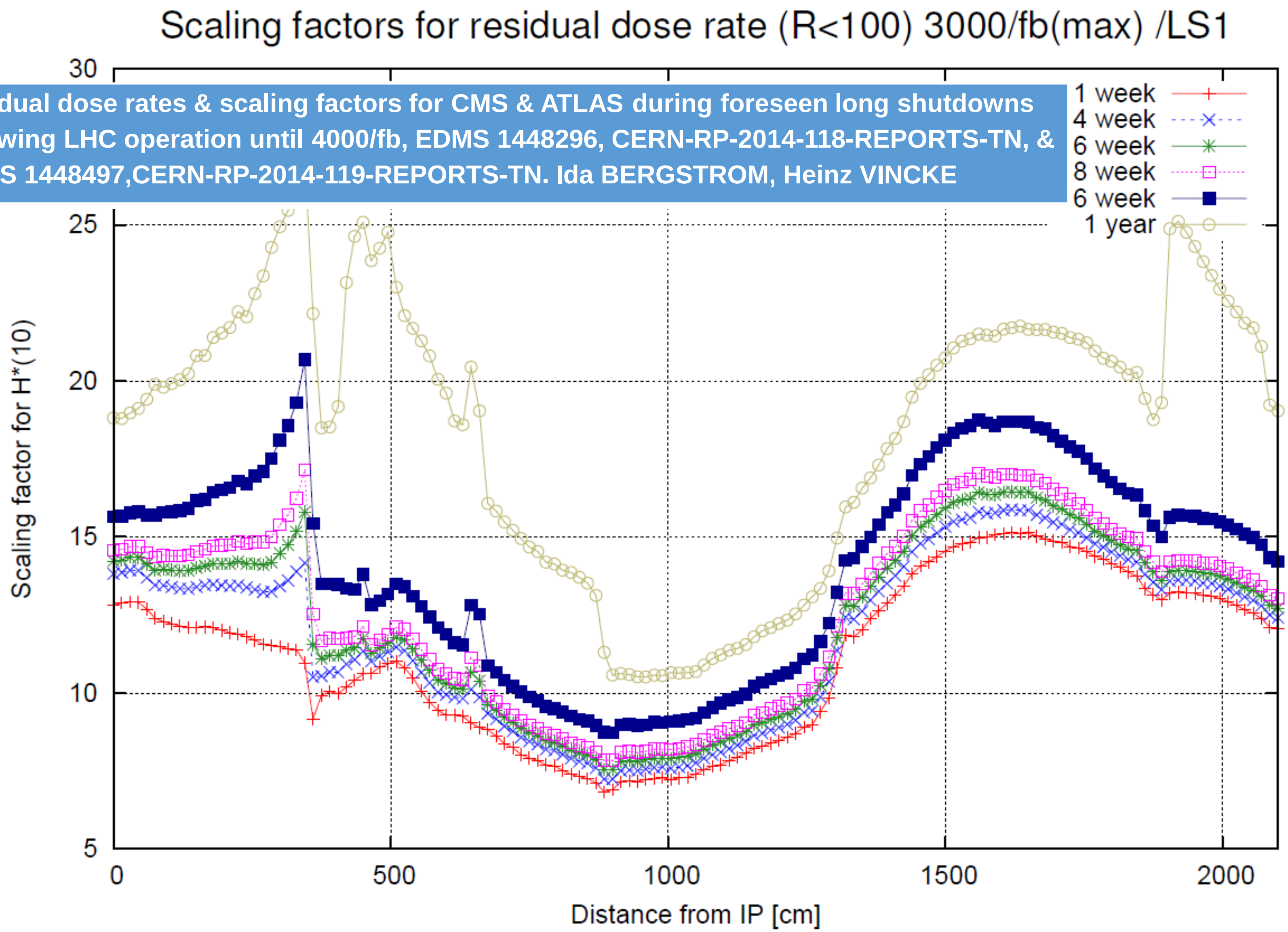
Time evolution



Total integrated luminosity 310 fb^{-1}

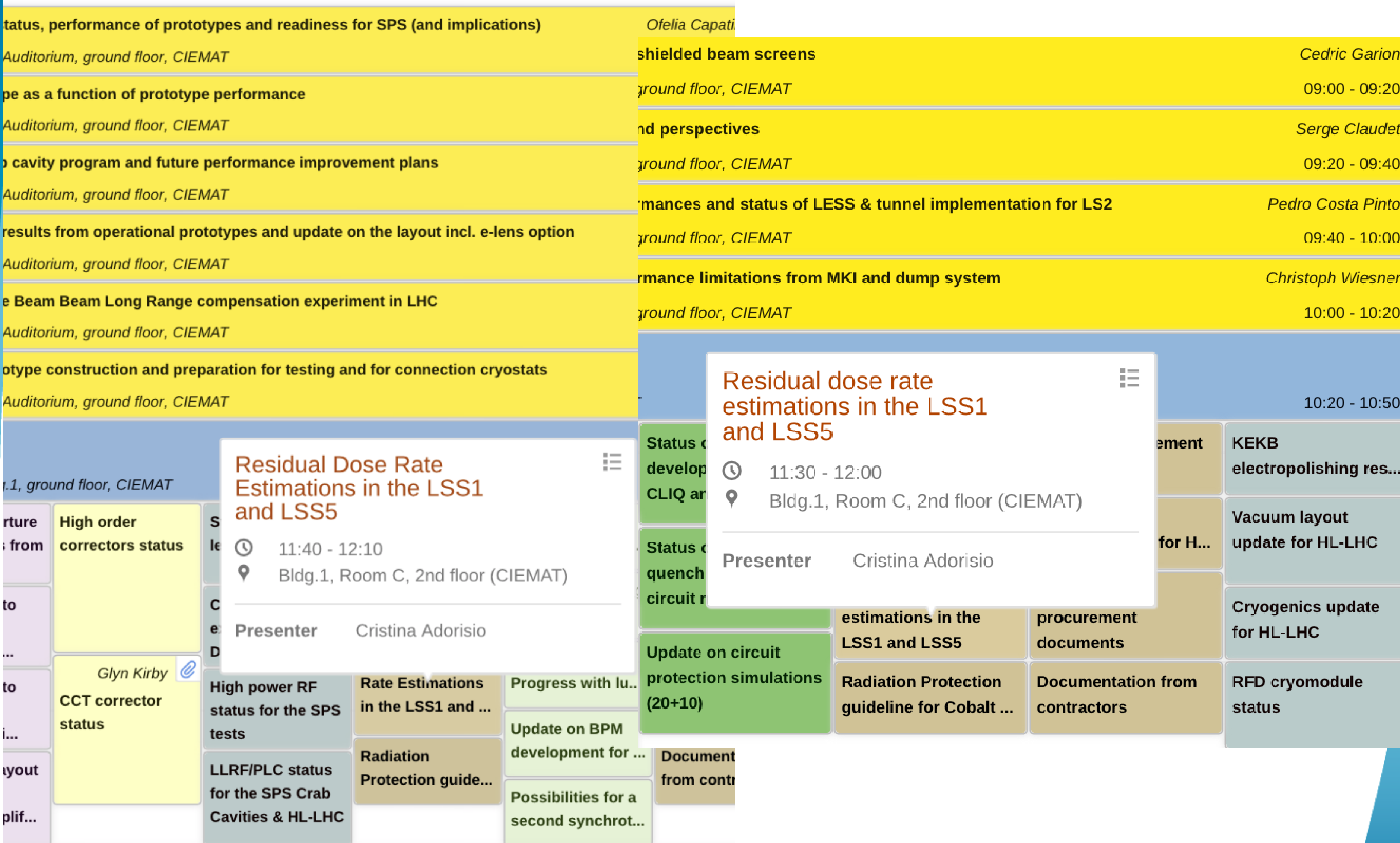
C. Adorisio

Radiation in experiments



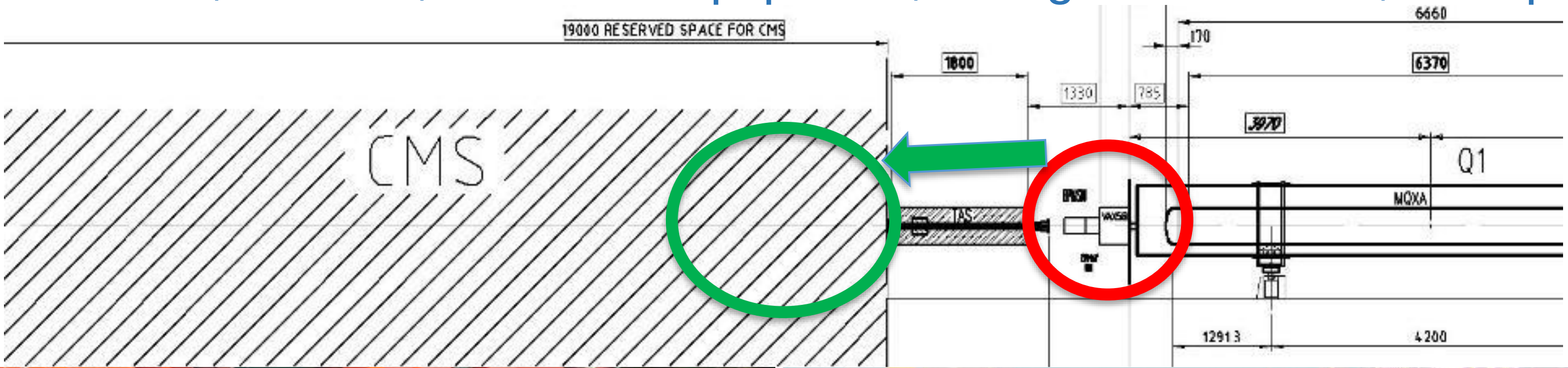
Residual dose rates & scaling factors for CMS & ATLAS during foreseen long shutdowns following LHC operation until 4000/fb, EDMS 1448296, CERN-RP-2014-118-REPORTS-TN, & EDMS 1448497,CERN-RP-2014-119-REPORTS-TN. Ida BERGSTROM, Heinz VINCKE

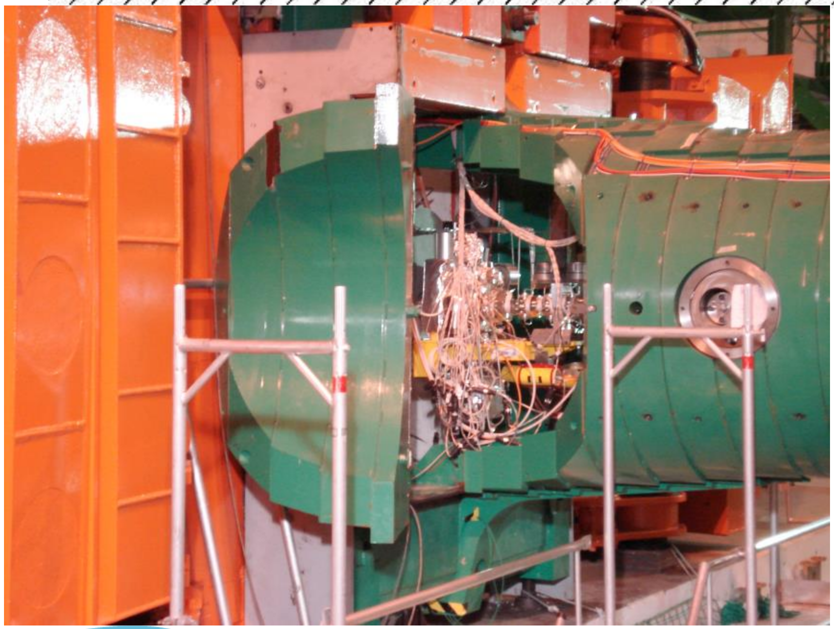
RP related presentations- C. Adorisio [wed, thu]

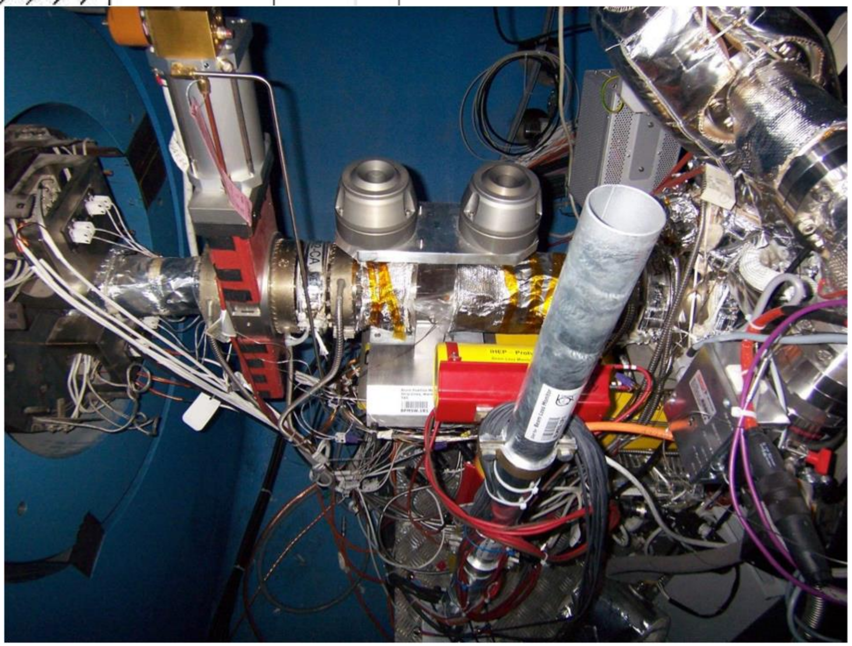


Finding space

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



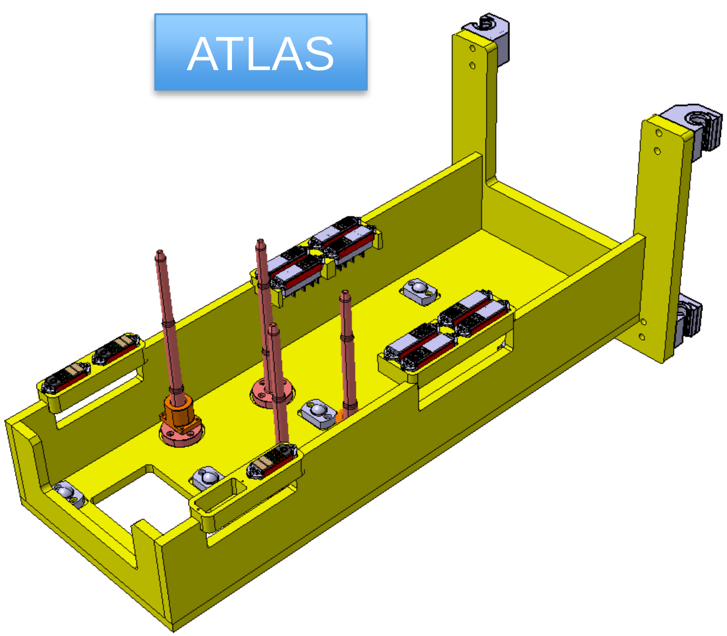


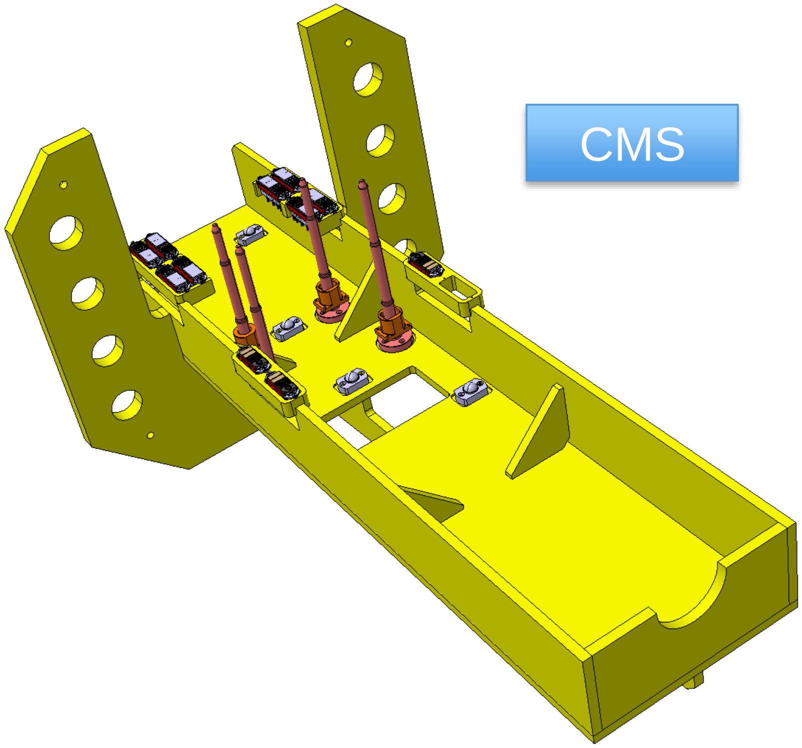


New VAX

Integrate the BPM in Q1 and relocate the VAX equipment from the tunnel to the experiment side in order to improve access & minimize operations.

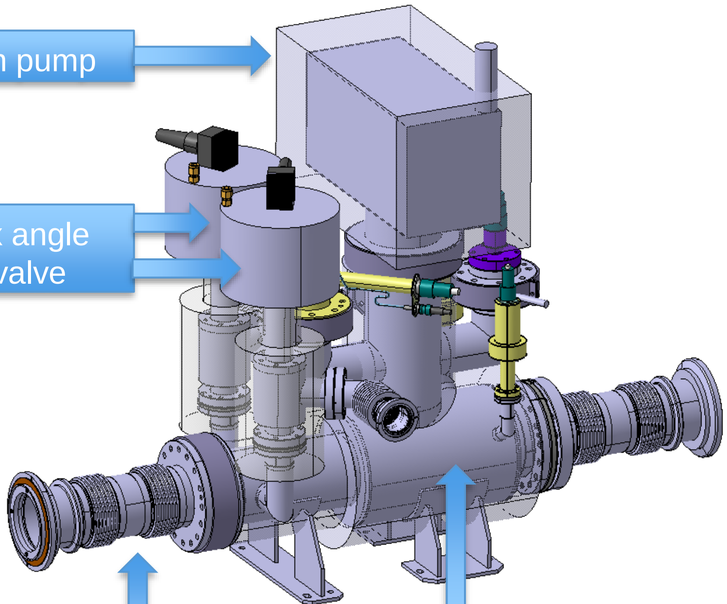
New support structure to host VAX, sector valves and bellows remote handling based on quick connector plugins.

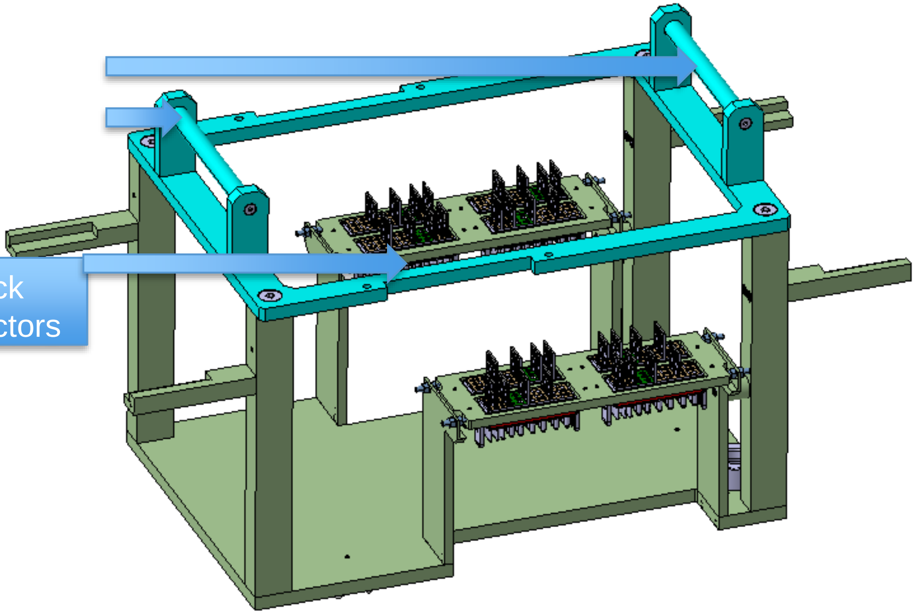


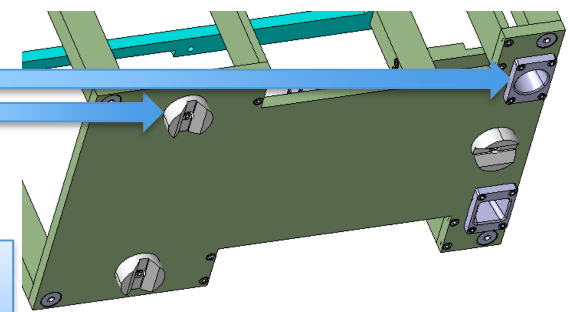


New VAX

Vacuum components inserted and aligned in a self- supported frame structure.

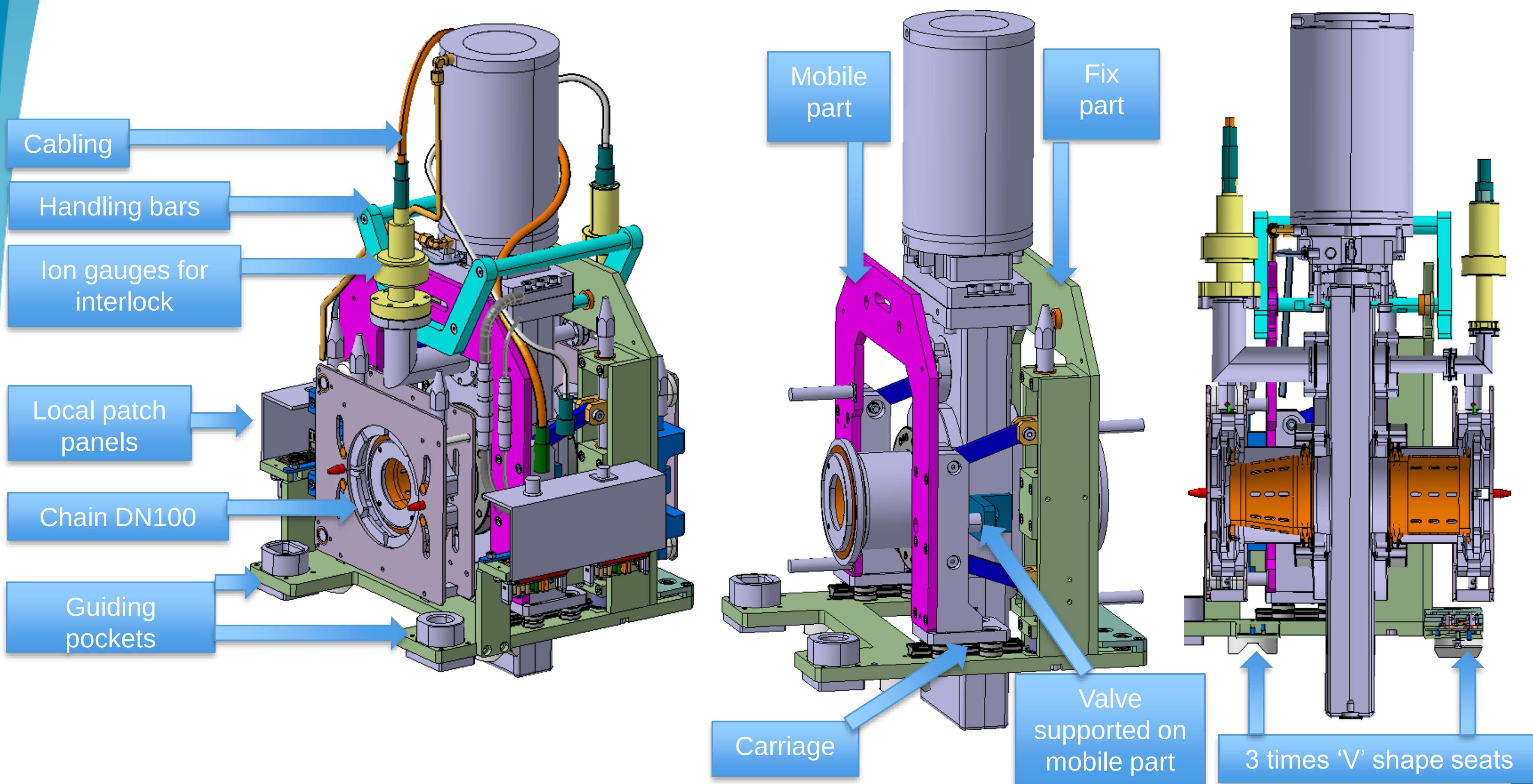




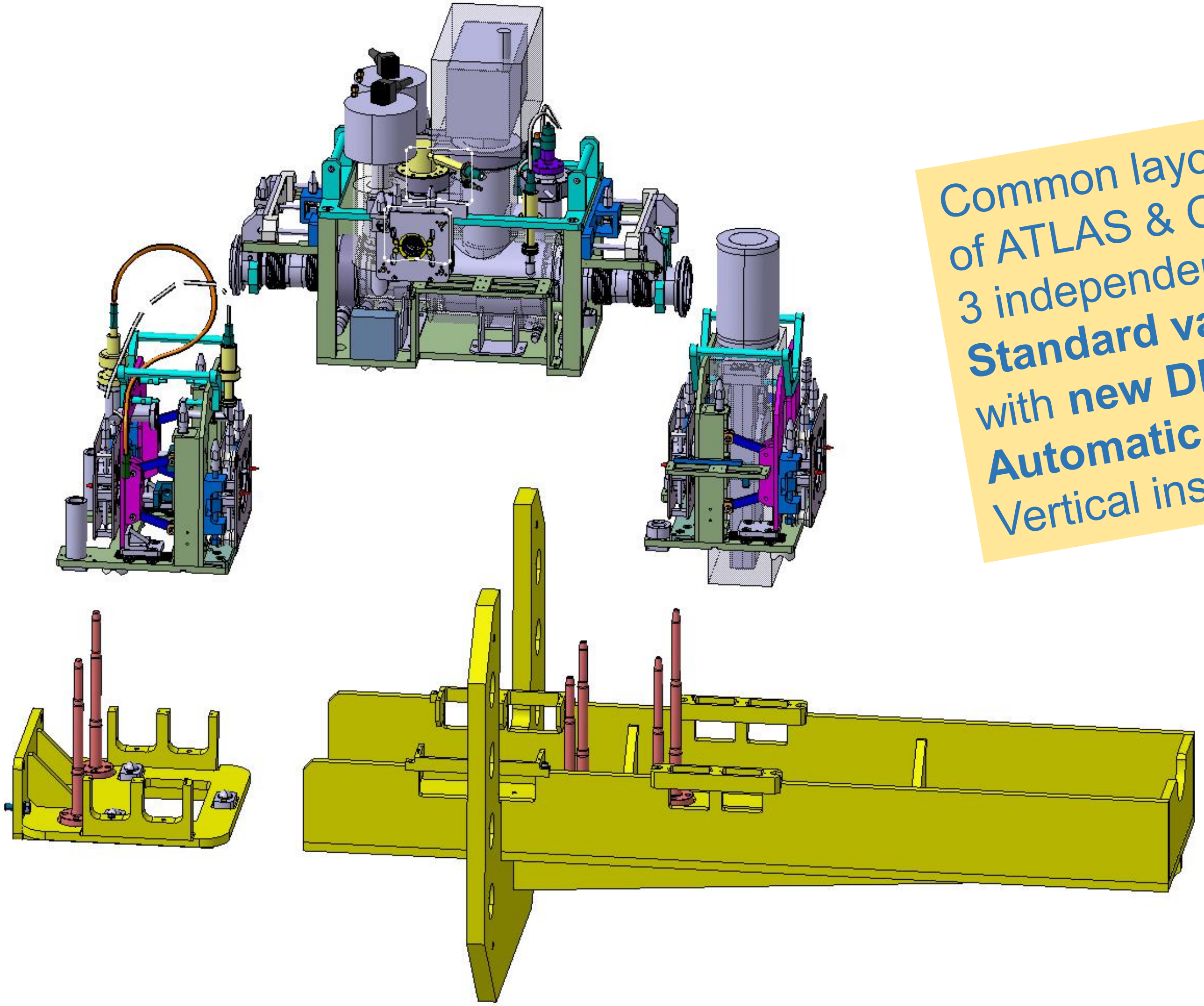


Courtesy of L, Krzkempek, J. Perez Espinos

New VAX. Gate valves



New VAX, principle



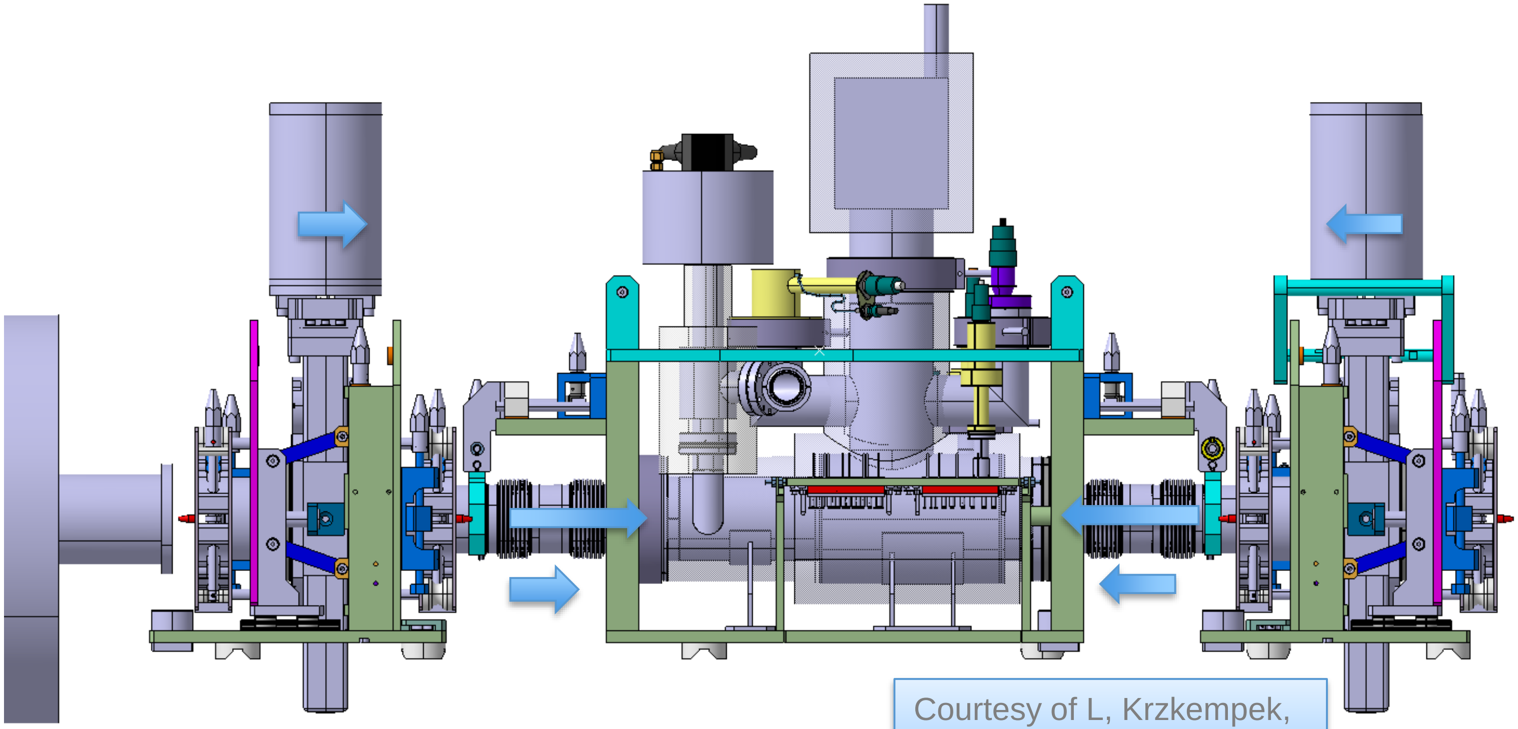
Common layout for both sides of ATLAS & CMS
3 independent frames.
Standard vacuum elements, with **new DN80 gate valve**
Automatic connectors
Vertical installation.

New VAX

Removal of TAS DN63 gate valve

Removal of VAX

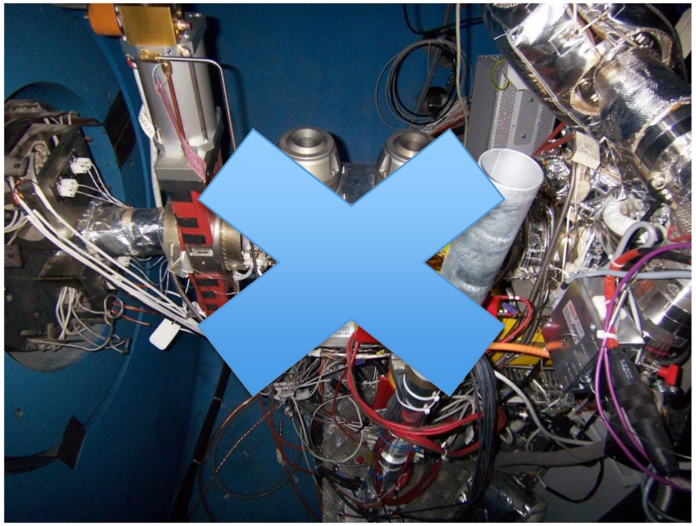
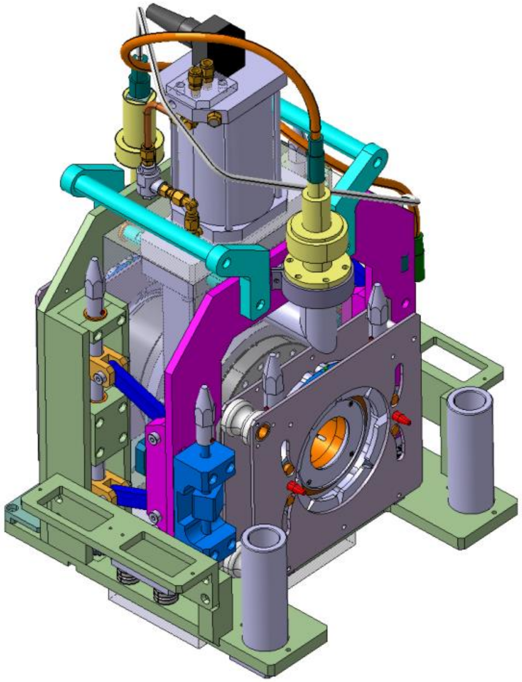
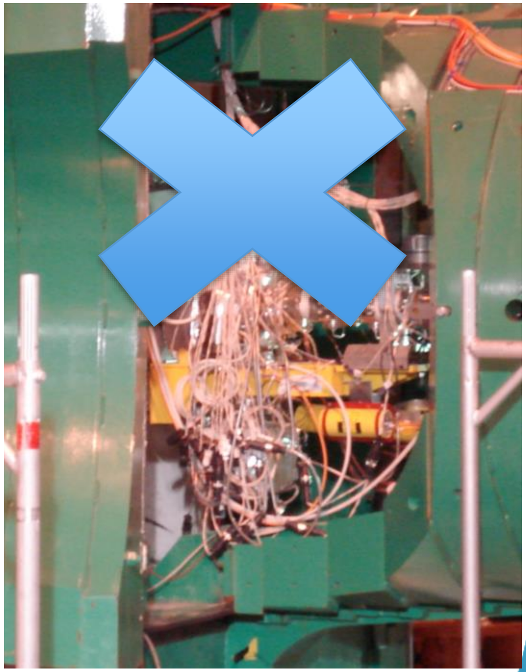
Removal of IP side DN80 gate valve



Courtesy of L, Krzkempek, J. Perez Espinos

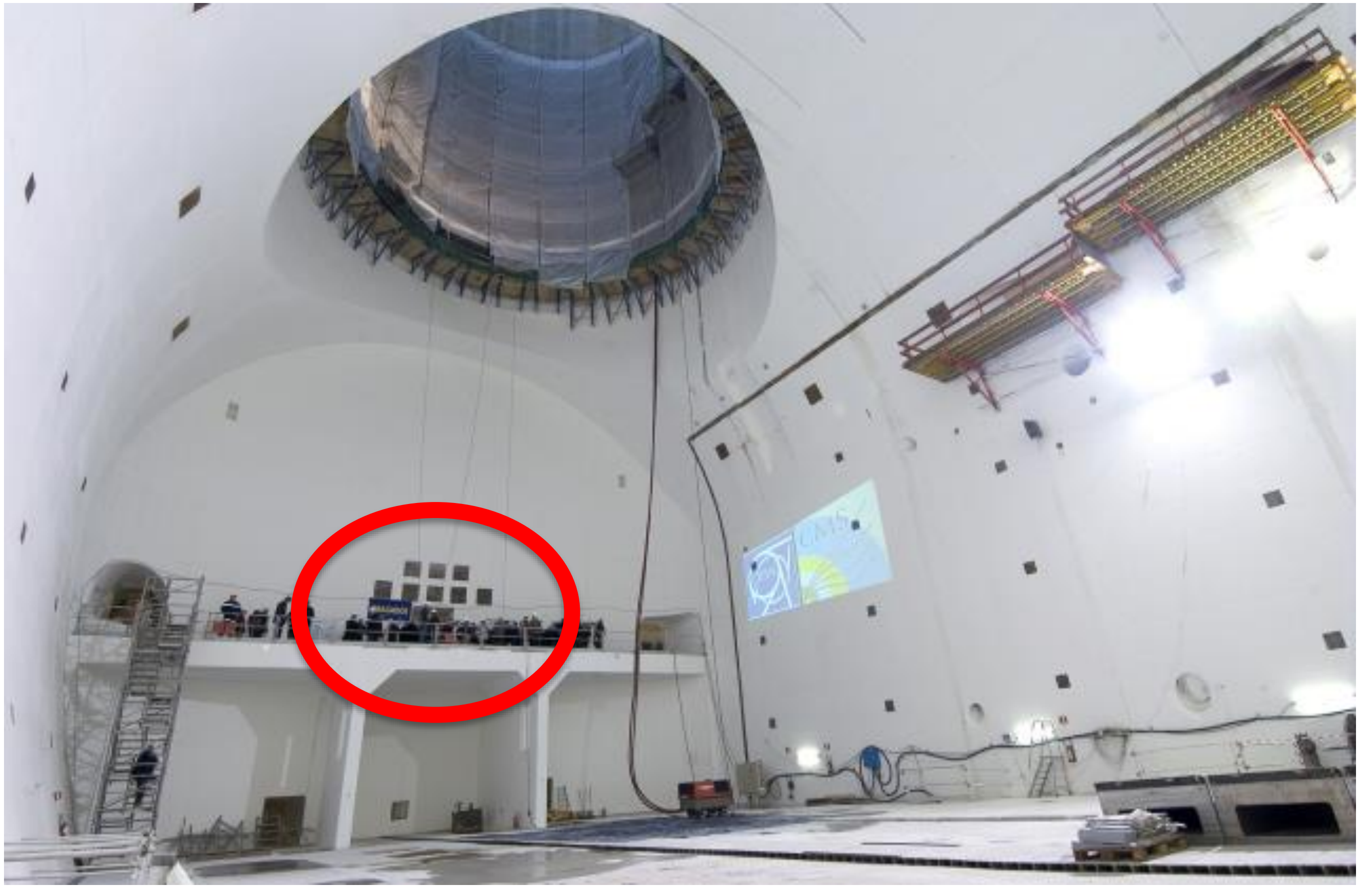
Proposal for cabling (P1 & P5)

- Cabling needs already defined with the collaboration of WP12, TE-VSC, operation.
- Routing discussed/adapted with experiments.
- Quick connectors requirements defined.
- Prototyping ahead.
- https://edms.cern.ch/document/1788841/1

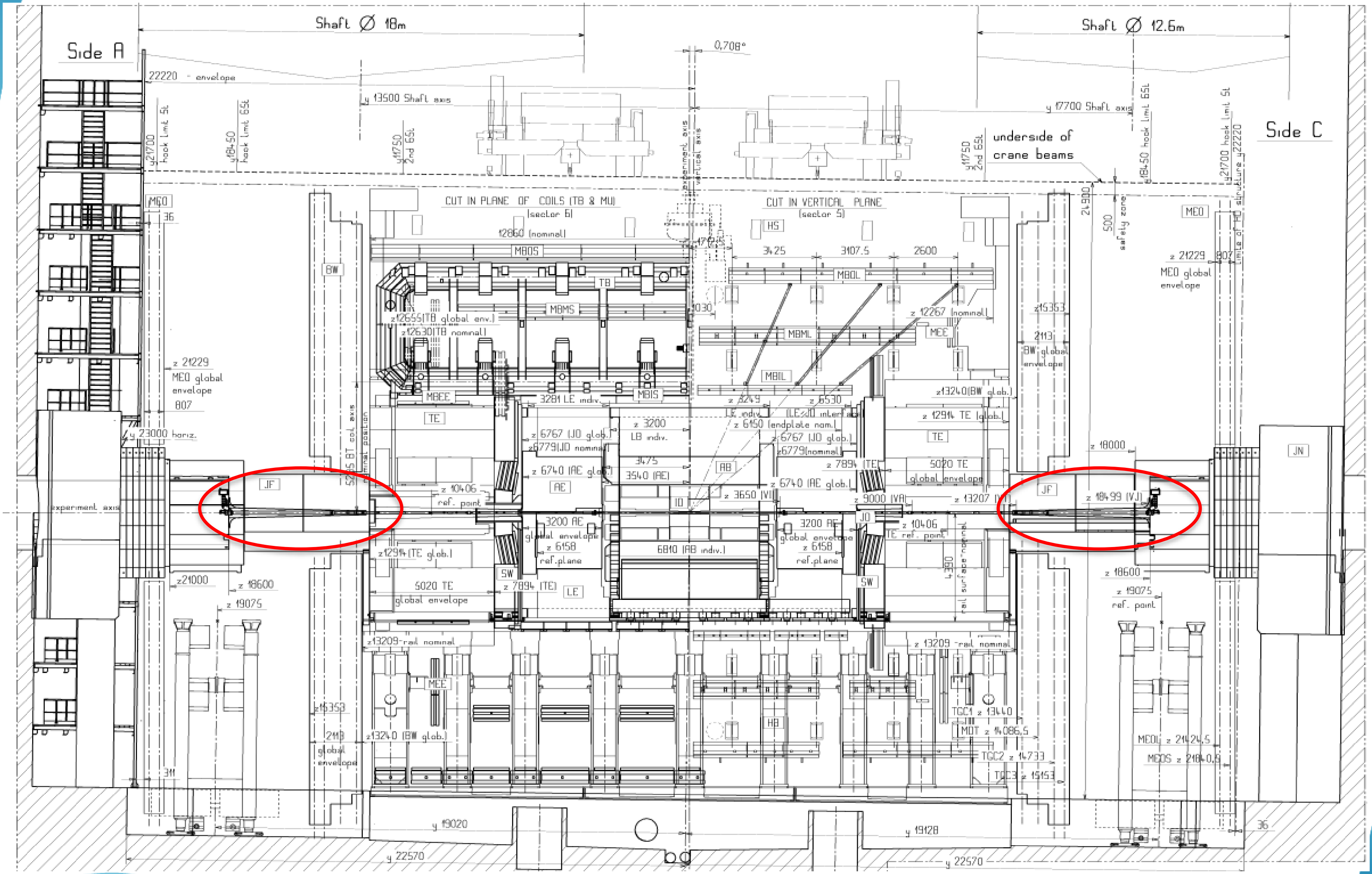




An ideal world

- Available space at the experimental side?



The real world-ATLAS example



Detectors opening

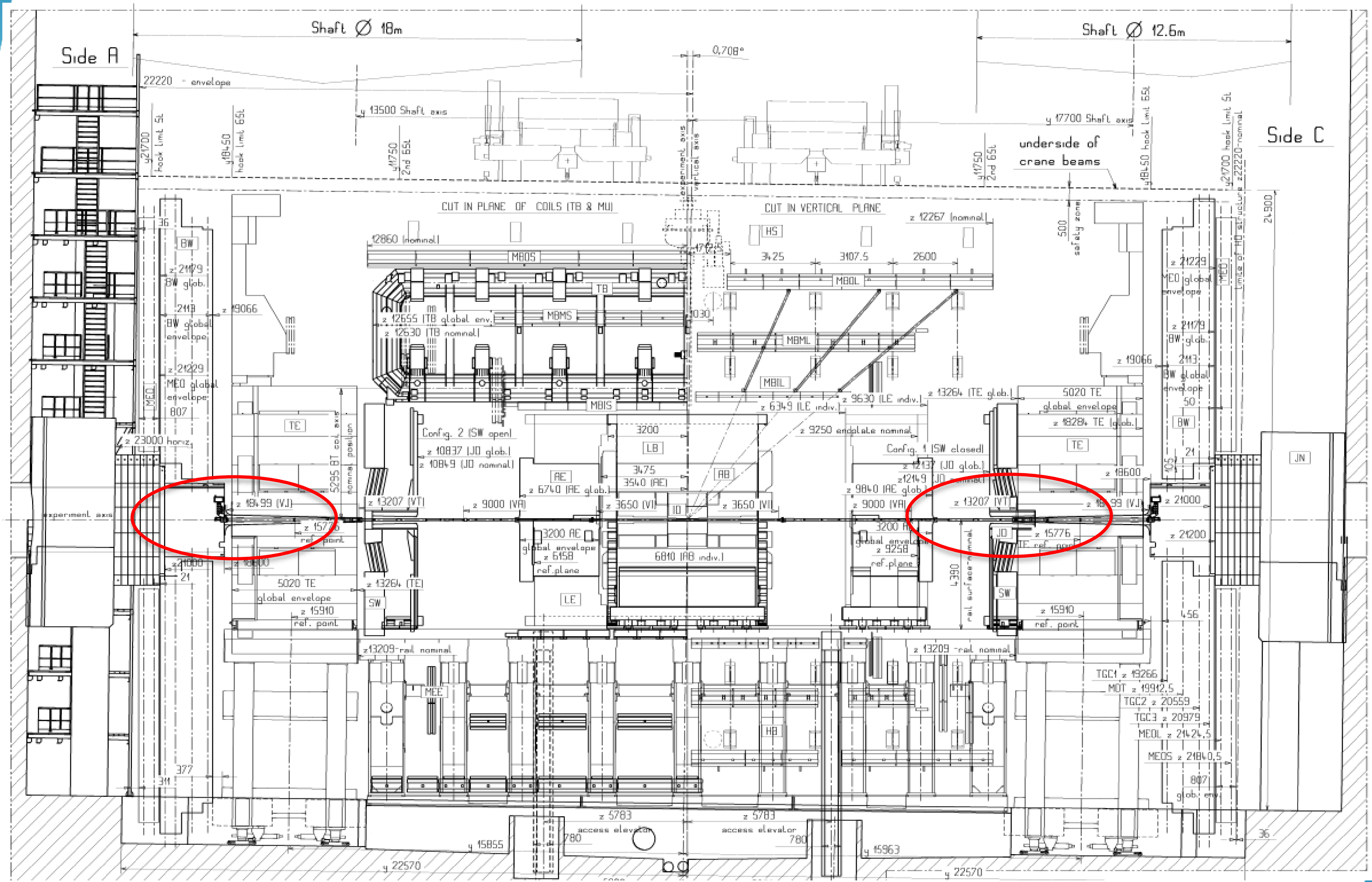
CMS

Standard opening
RS unfolds.
Detector opening: Endcap opens towards blockhouse, around fix nose

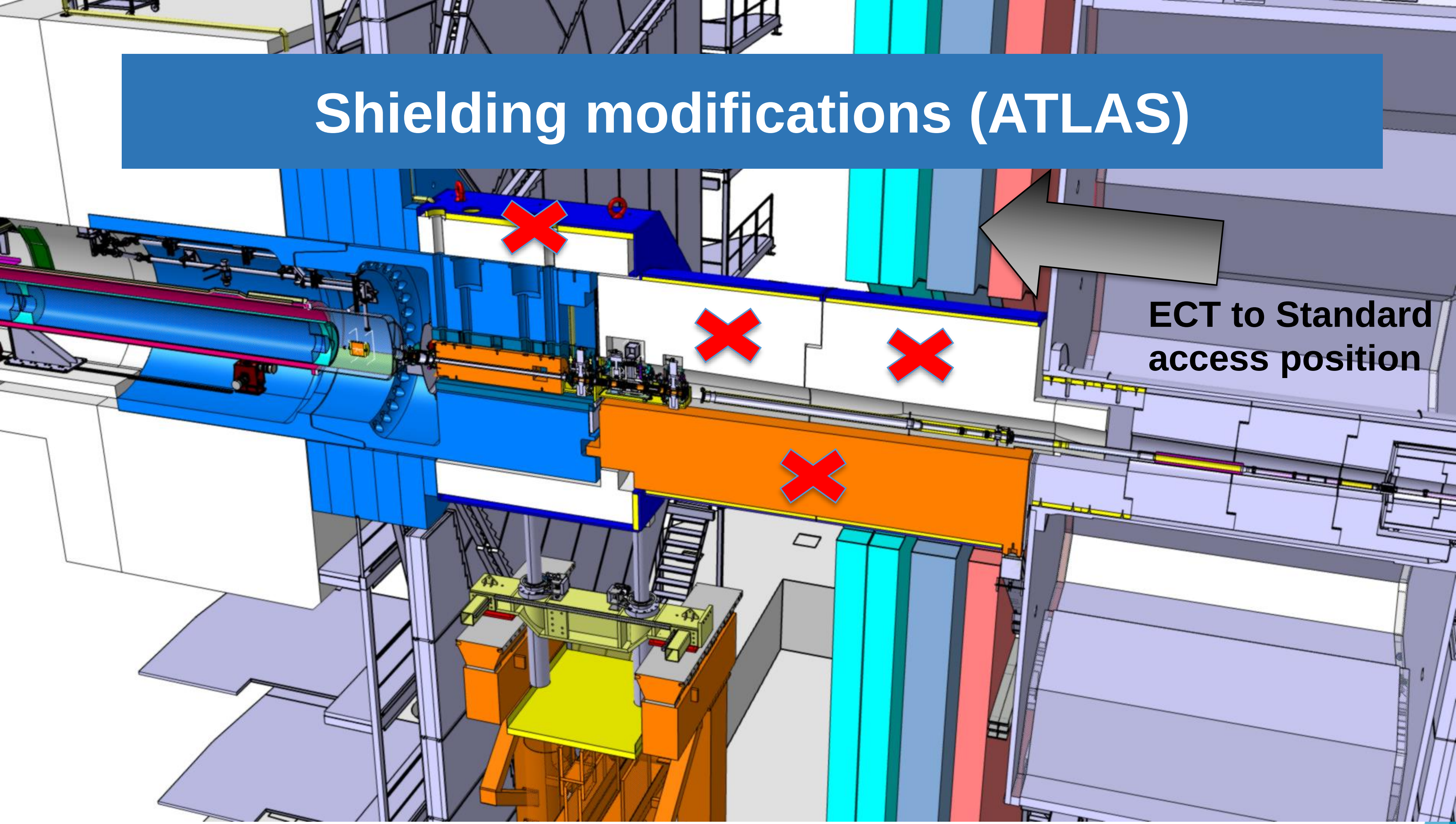
ATLAS

Standard opening
Octogon, JSC2, JSC3, JSC1 removed
ECT opens towards TX1S surrounding the beam pipe
Long shutdown opening
JSC1 and beam pipe are removed
ECT opens towards TX1S and moves laterally.

Opening environment



Shielding modifications (ATLAS)

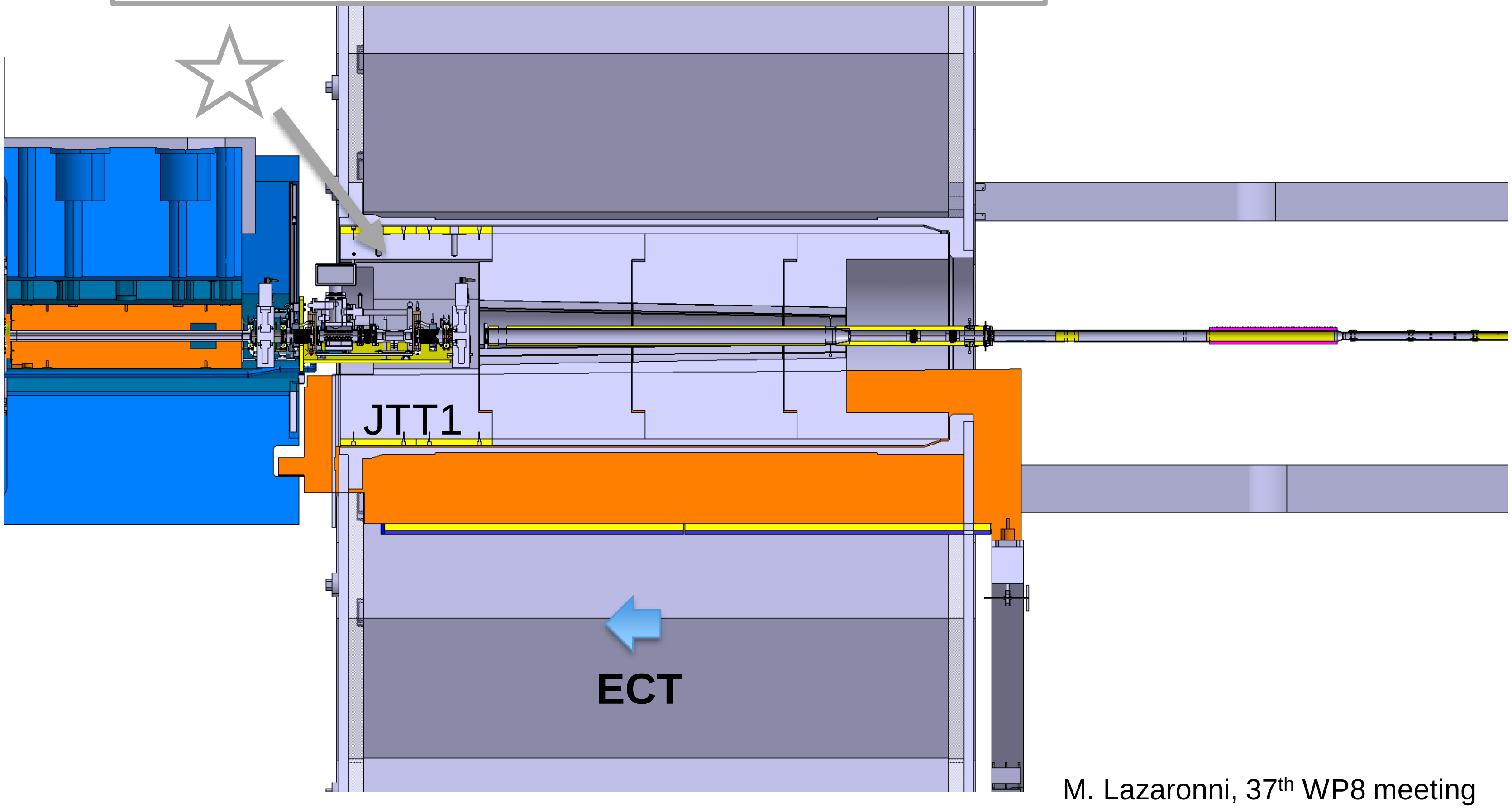


IMPACT on the VT supports

For a standard access configuration. ECT must accommodate VAX in existing JTT plug 1 area.

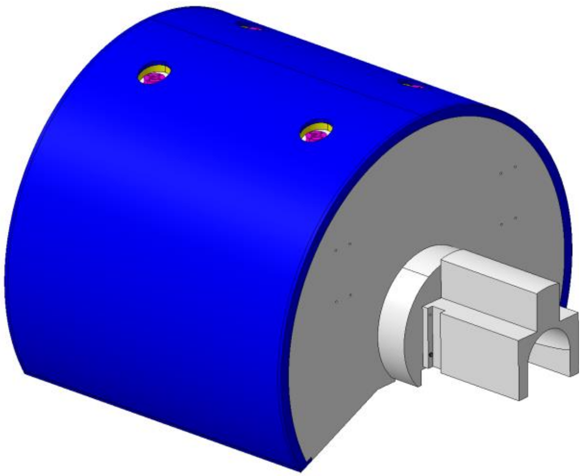
During Shutdown period: Toroid moved towards the TAS

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

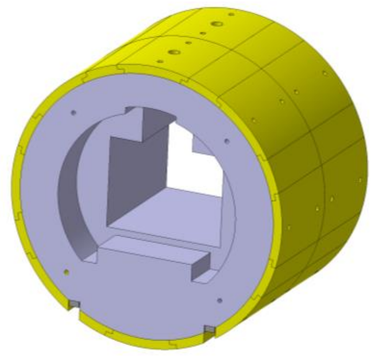


M. Lazaronni, 37th WP8 meeting

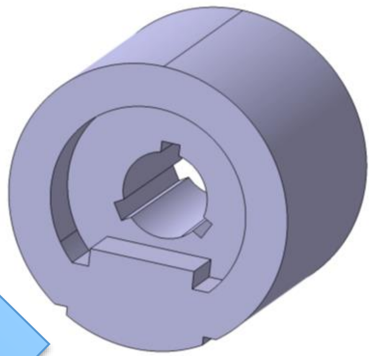
JTT modifications



Shielding extension JFC2 (1.2 t)

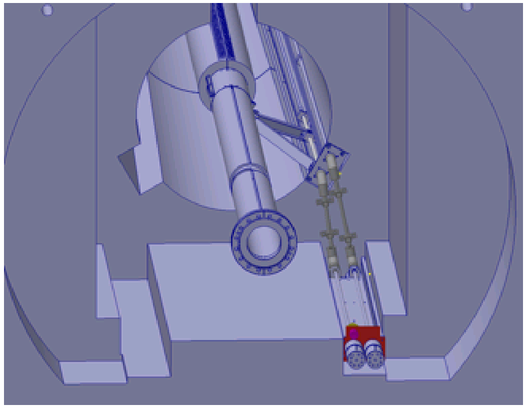


JTT1 modification

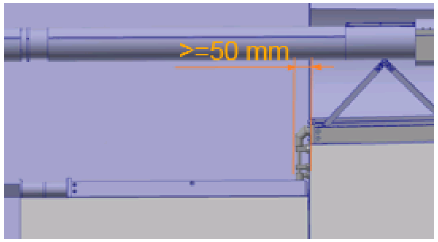


Actual plug JTT1

- Shorter rail system – starts in JTT plug 2



Design and validation of extension mechanism to be performed

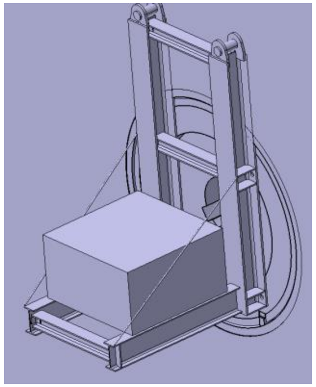
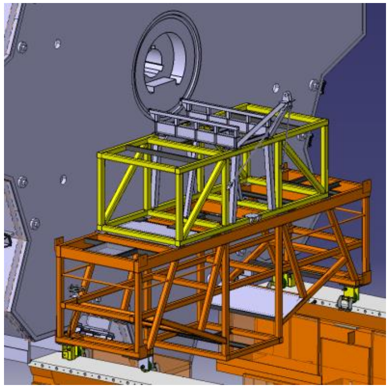
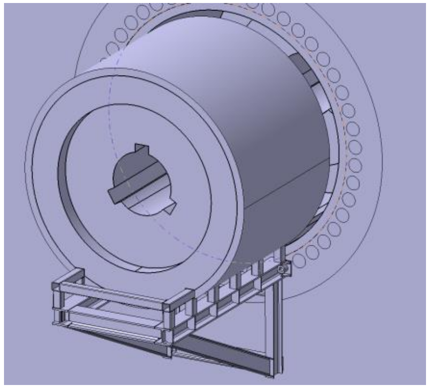


- ➕ No displacement of supporting point
- ➕ Accessibility in plug 1
- ➖ New components to be procured and tested

WP12, J. Sestak

JTT removal & installation Assessment

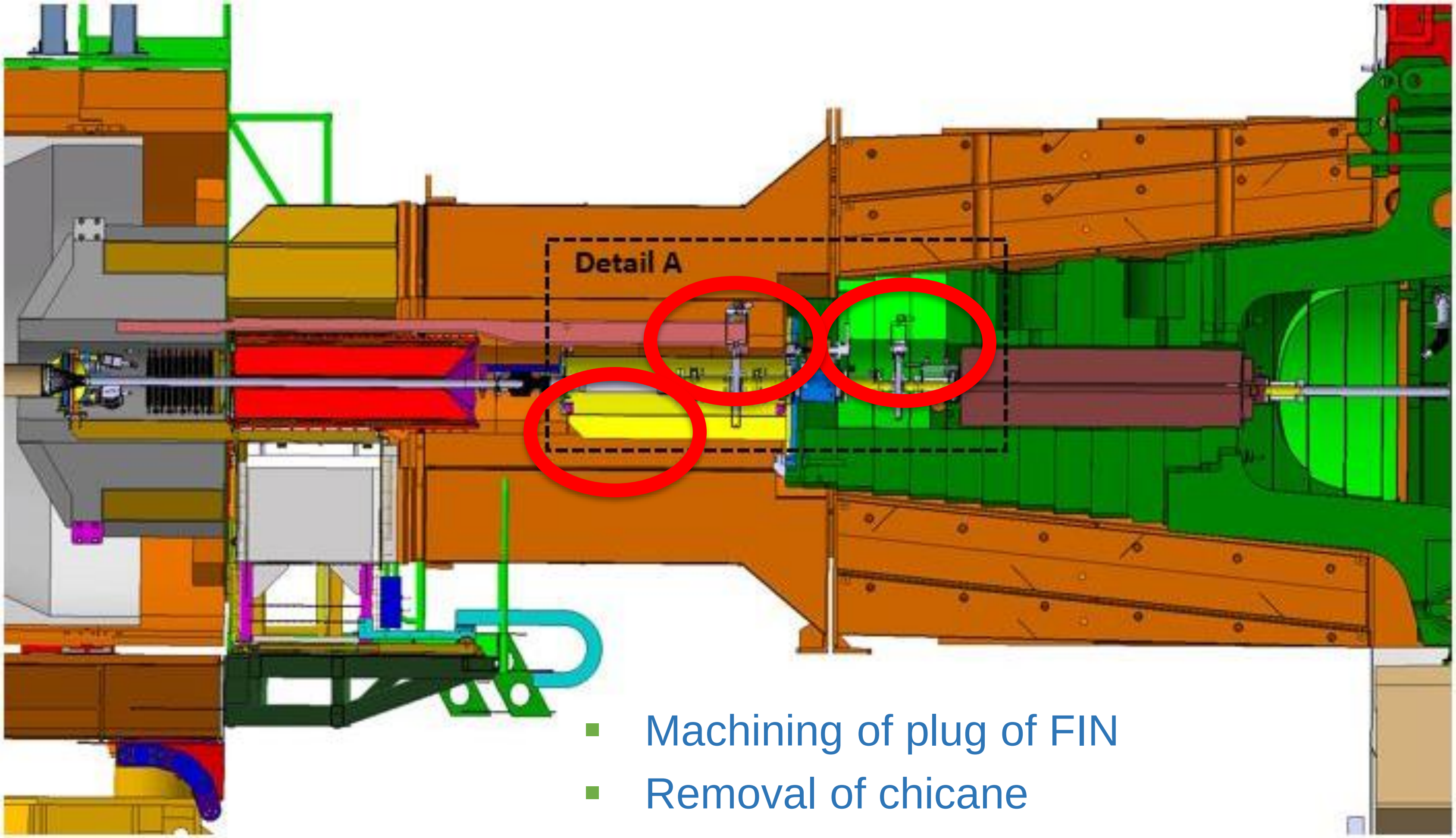
Version 1	Version 2	Version 3	Version 4
Very few extra equipment needed	Difficult to balance the weight	Easy handling	Easy handling
Difficult handling	Requires a complex weight adjustment system	A lot of equipment can be reused	Requires changes to the ECT
Highest risk for the operators	Space in the tube is very limited	Not sure if the mini van is stable enough	Additional load to the ECT end plate

P. Strahle

F Sanchez Galan & S. Evrard on behalf of WP8, 7th HL-LHC Collaboration Meeting, Nov 2017

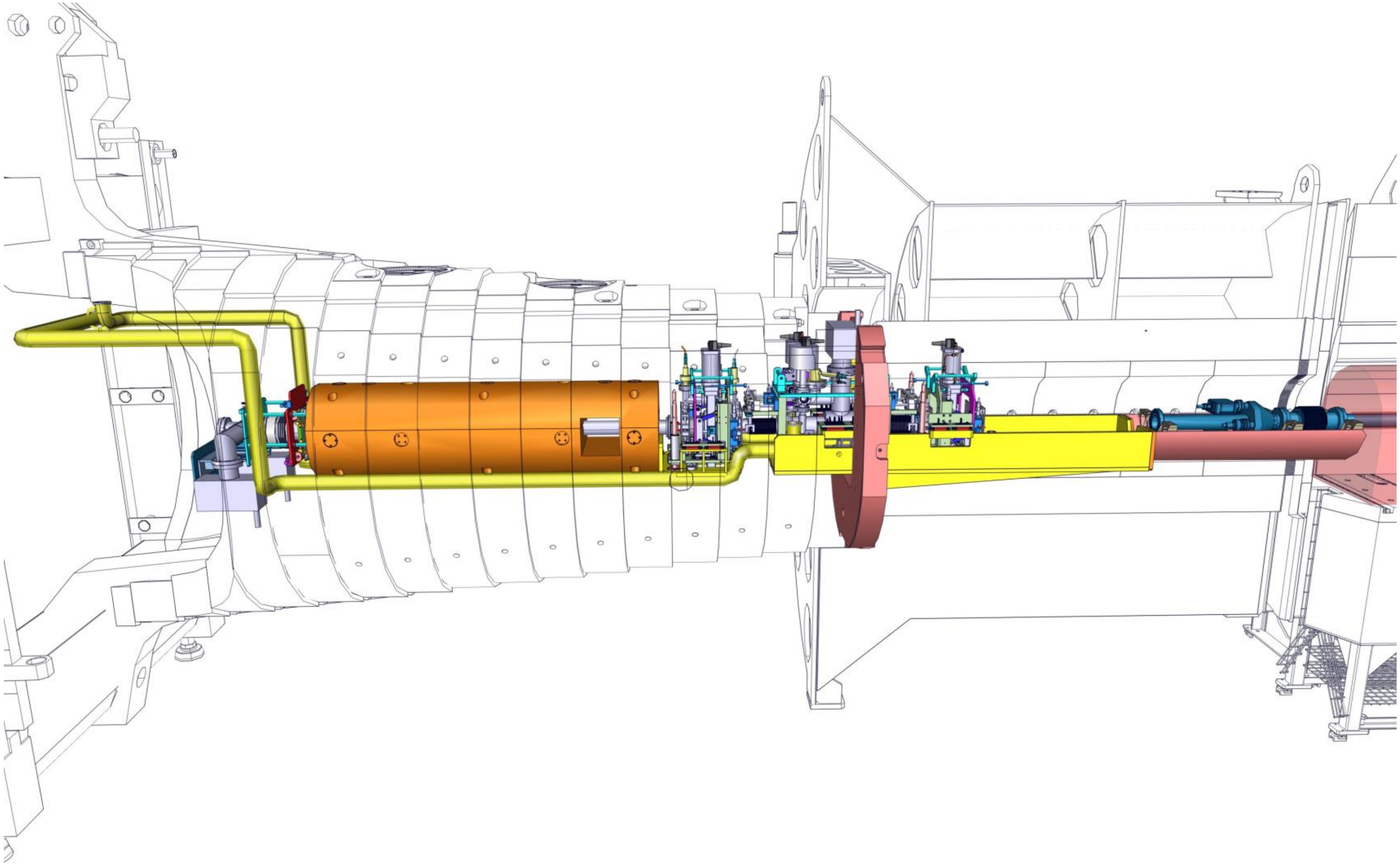
Shielding modifications (CMS)



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

Services routing in CMS



CMS Engineering and Integration Center, March 2017.

Impact on experiments

- Shielding modifications: CMS Minor in terms of weight and lay-out.
- ATLAS: Mobile shieldings: Minor in terms of weight and lay-out. JTT will be removed
- some of them are time consuming will be advanced to LS2.

- Operation: Experiment opening procedures mostly unchanged, but removing VAX equipment needs the experiments closed.

- Radiation: Residual dose assessed, increase in proximity of VAX due to activated materials.

Conclusions

- Relocated VAX is compatible with experiment shielding and opening procedures. Still, a number of minor modifications of shielding structures are required.
- Current design is based on standard solutions. Strong interest in reducing pumps, valves sizes and going to Al materials.
- Shielding performance within the same range. Residual dose rates assessed.
- Operations advanced to LS2 relax LS3 schedule.

Still, TAXS change itself has a non-negligible impact on LS3 planning for experiments.

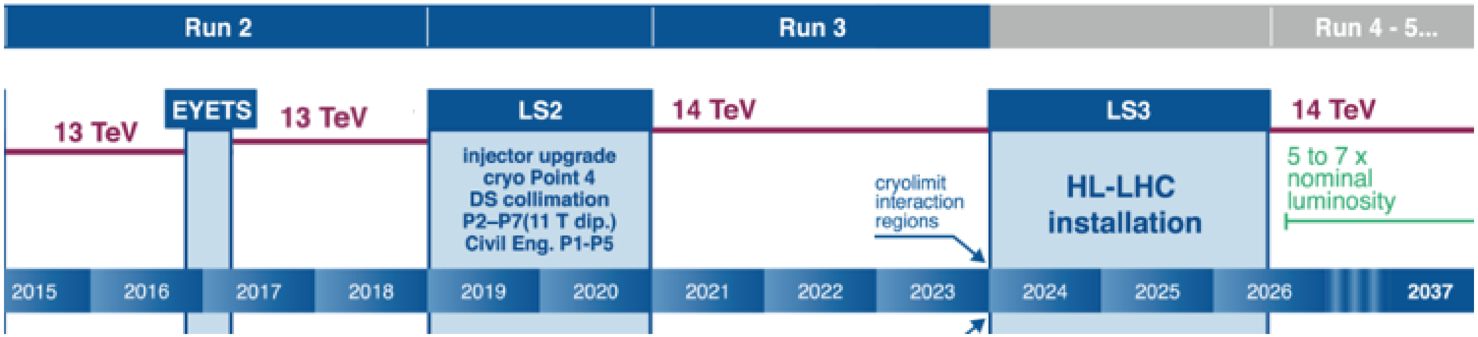
LHC to HL-LHC: TAS-TAN deinstallation & TAXS-TAXN installation
S. Evrard (17:30 Bldg. 1, Room C, 2nd floor)
VAX system with implications on ATLAS and CMS vacuum systems
V. Baglin (17:50, Bldg. 1, Room C, 2nd floor)

Thanks to all members of WP8 & contributors

Special thanks to C. Adorisio, V. Baglin, D. Brethoux, S. Evrard, A. Gaddi, L. Krzempek, M. Lazzaroni, D. Mergelkuhl, G. Pigny, J. Perez Espinos, M. Raymond, J. Sestak, H. Vincke.

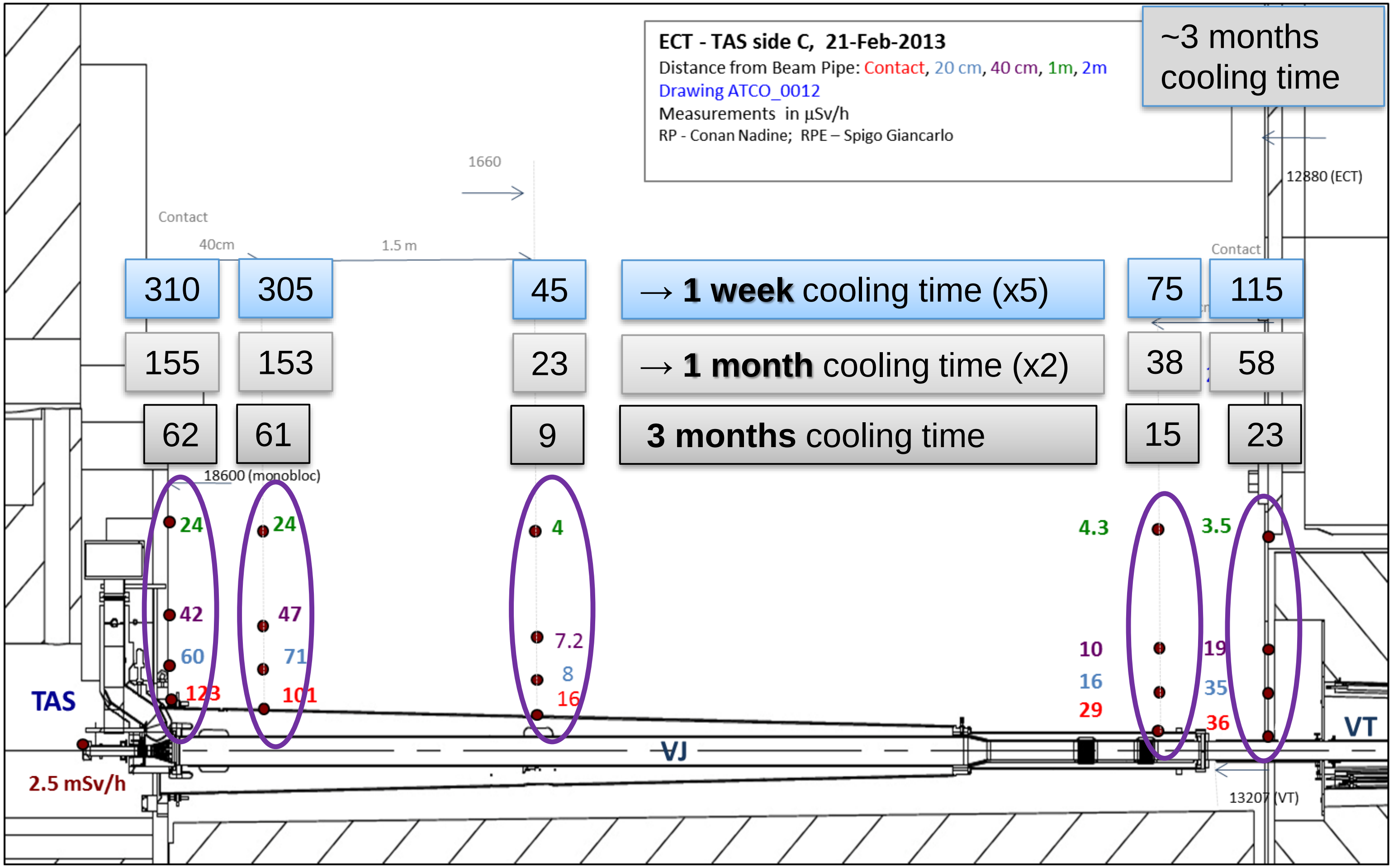
Next steps VAX

- Preparation LS2: Modifications in shieldings, Beam pipe supports
- Continue R&D on key elements (valves, pumps).
- Impedance validation.
- Prototype: Connectors, handling. Detailed definition of alignment capabilities, interventions & recovery scenarios. (ITHACA)
- Removal and installation scenarios LS2 & LS3.

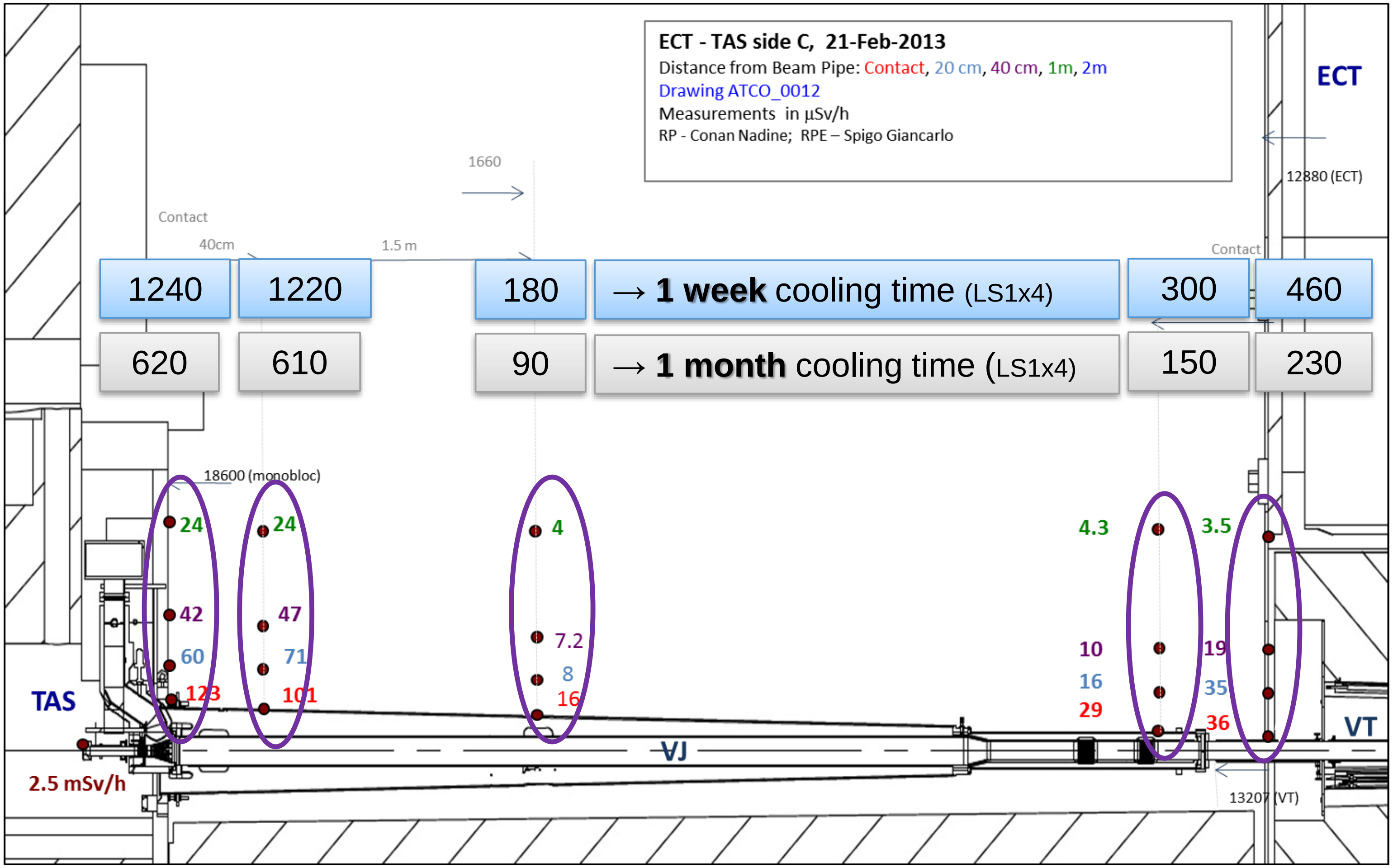


Backup slides

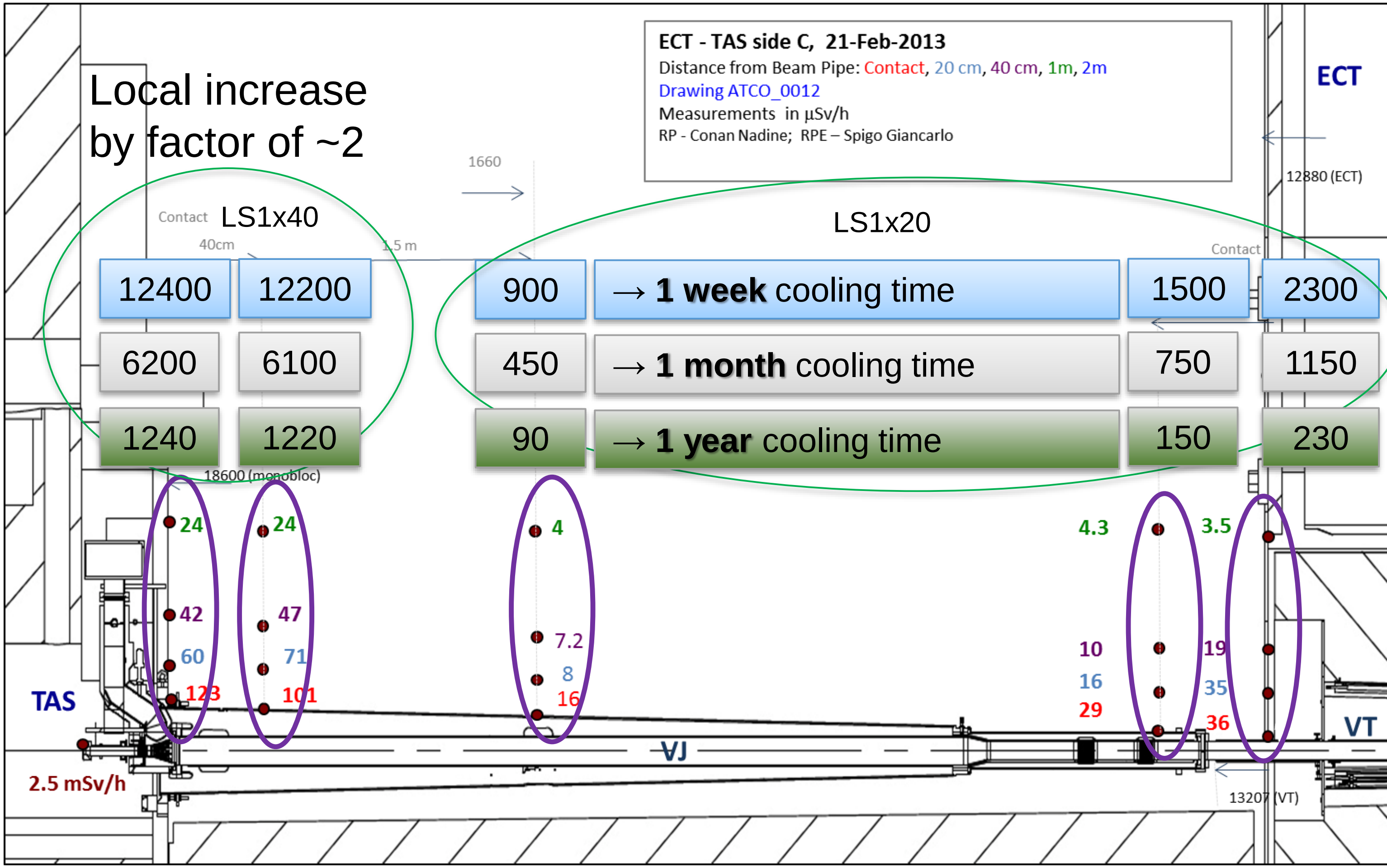
LS1 measurement



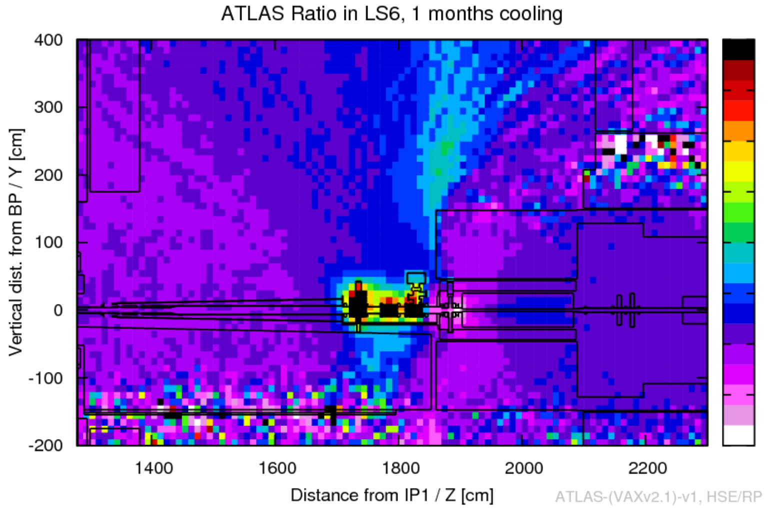
LS1 measurement RESCALED TO LS3

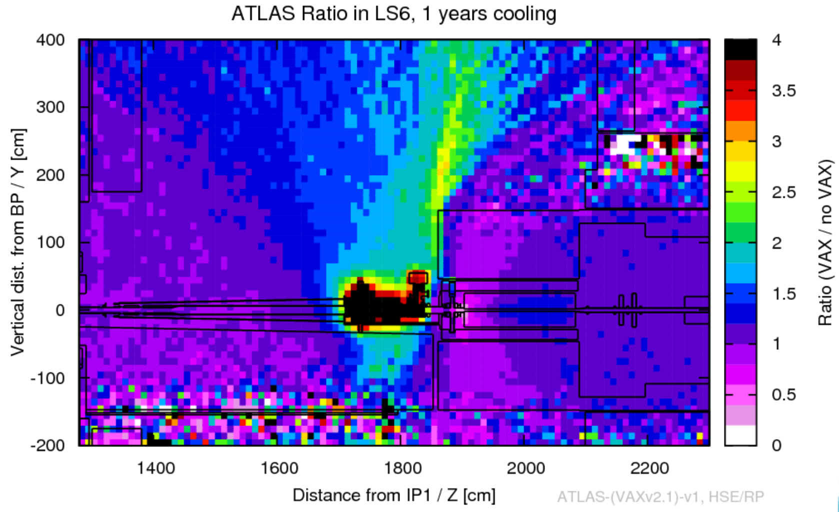


LS1 measurement RESCALED TO $LS_{HL\text{-}LHC}$



Ratio of H*(10) in LS6 (ATLAS)

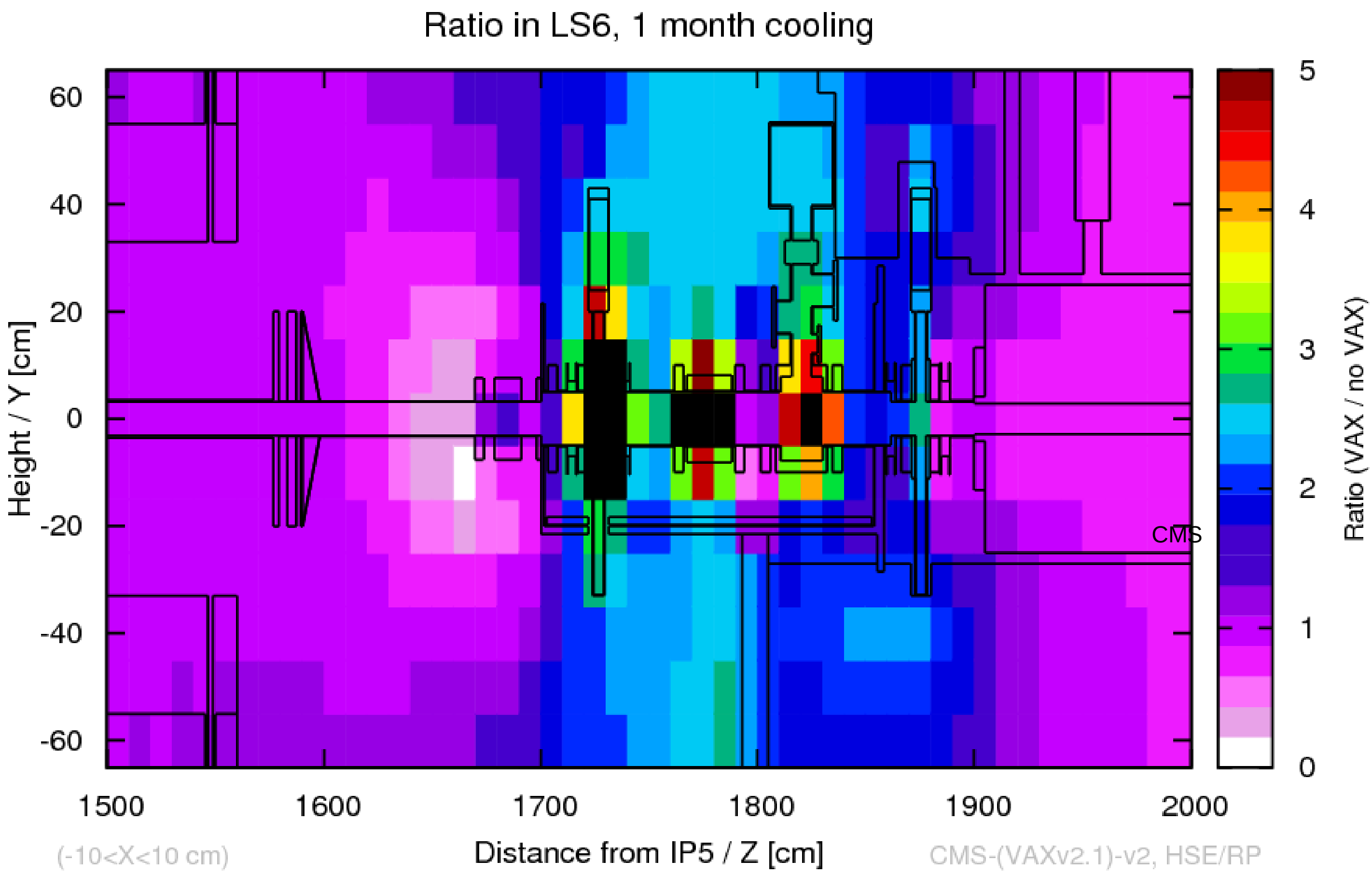




- Increase in dose rate with VAX after 1 months cooling
- Increase in dose rate with VAX after 1 years cooling

Local increase of about a factor of 1.5 – 2
More increase very close to equipment

CMS H*(10) in mSv/h, LS6 1 months cooling



Ida Bergstrom, Heinz Vincke (HSE/RP)