VAX system with implications on ATLAS and CMS vacuum systems

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7th HL-LHC Collaboration Meeting, Madrid, 13-16th November 2017

https://indico.cern.ch/event/647714/timetable/#20171113.detailed

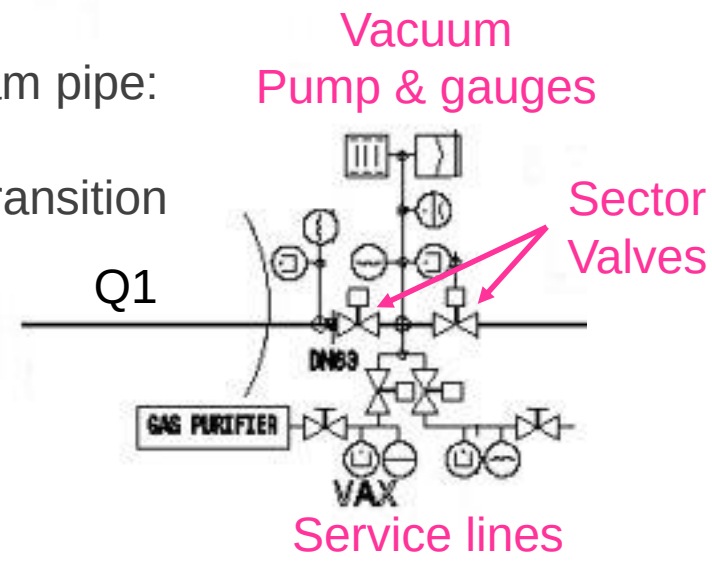
OUTLINE

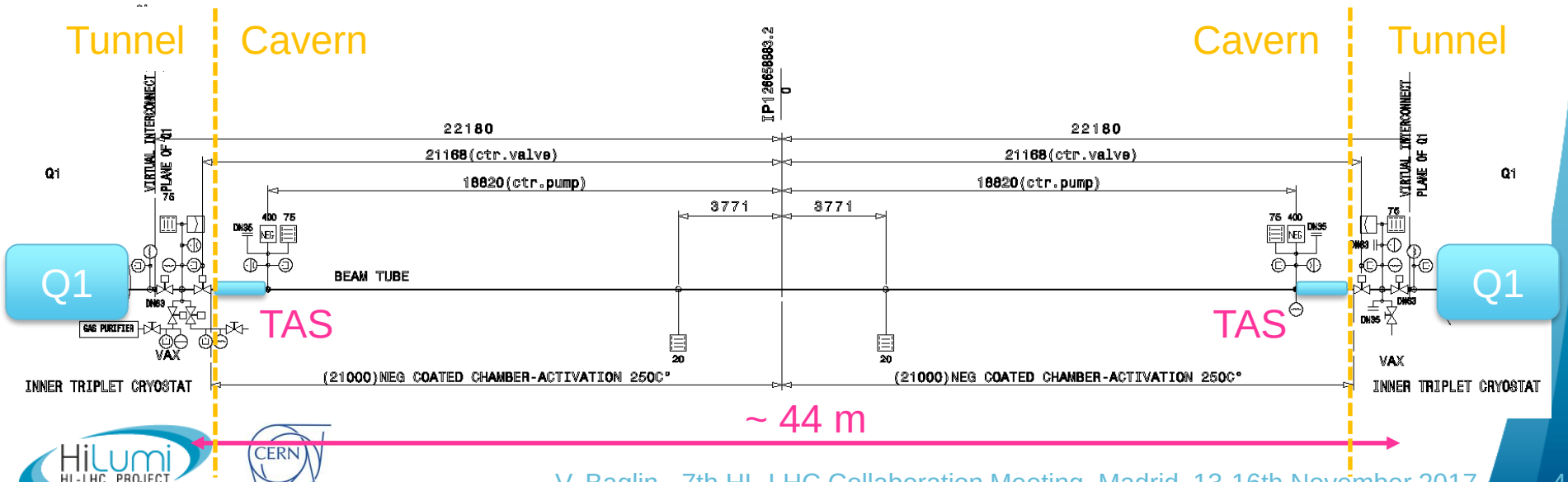
1. Introduction
2. HL-LHC VAX
3. Implication on experimental vacuum system
4. Summary

1. Introduction

LHC vacuum instrumentation in experimental areas: VAX area

- Interface between Q1-TAS and experimental beam pipe:
  - ~ 44 m long vacuum sector
  - 2x2 sector valves located at Q1 cold warm transition
  - Vacuum gauges and ion pumps
  - Pumping and Ne venting lines





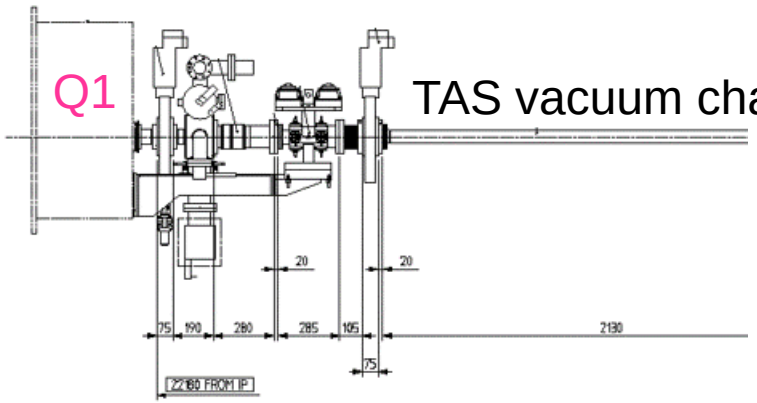
LHC VAX area: integration

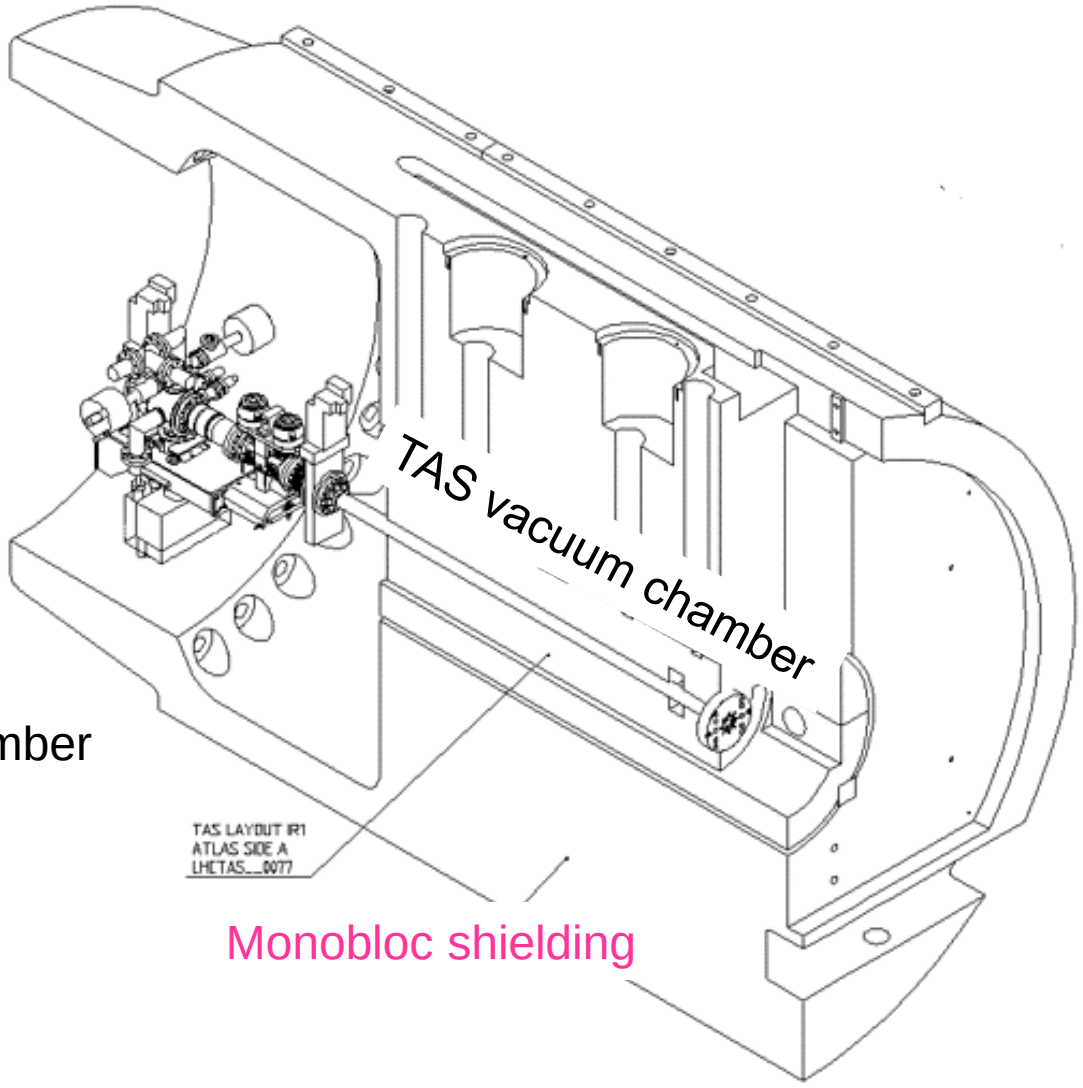
- Very tight integration between Q1 and experiment's shielding:

- Dead-end access!
- High radiation level!

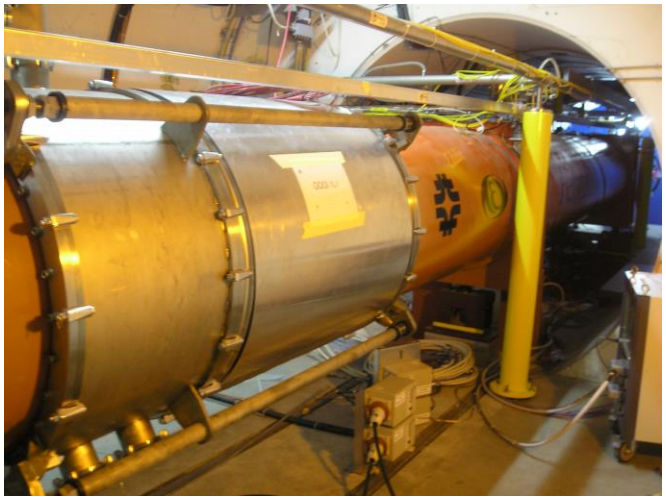
➔ Issue with maintenance/repair

The VAX area needs to be redesigned for HL-LHC era

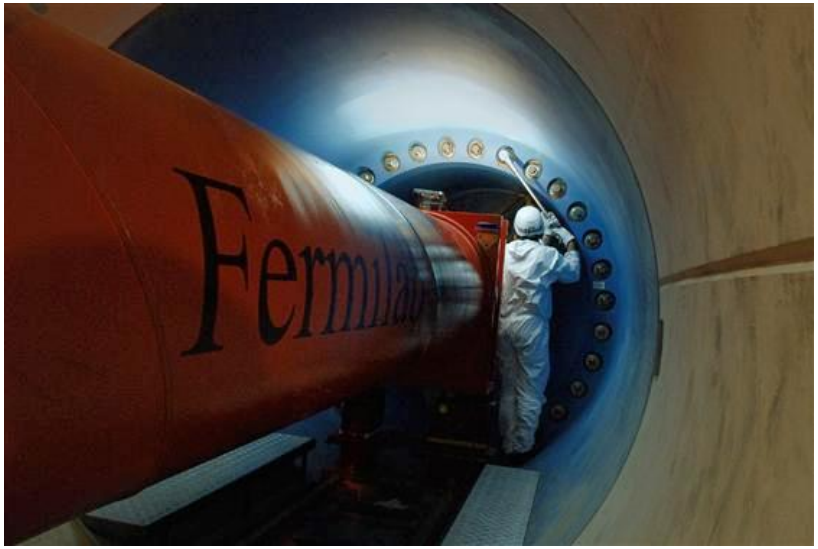




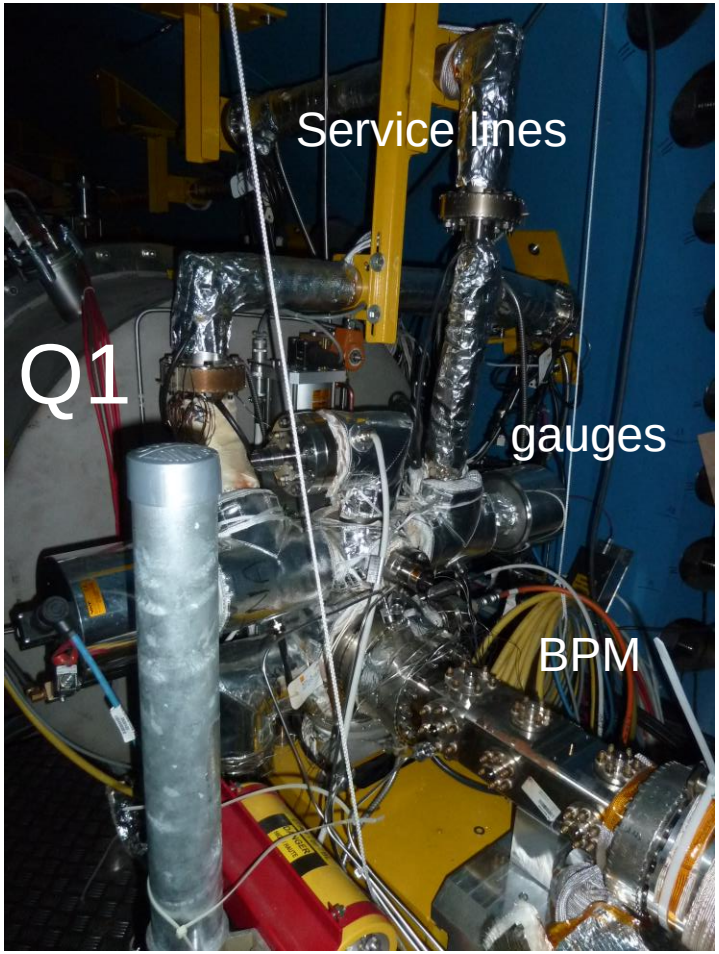
ATLAS VAX area till LS3



Entry towards Q1



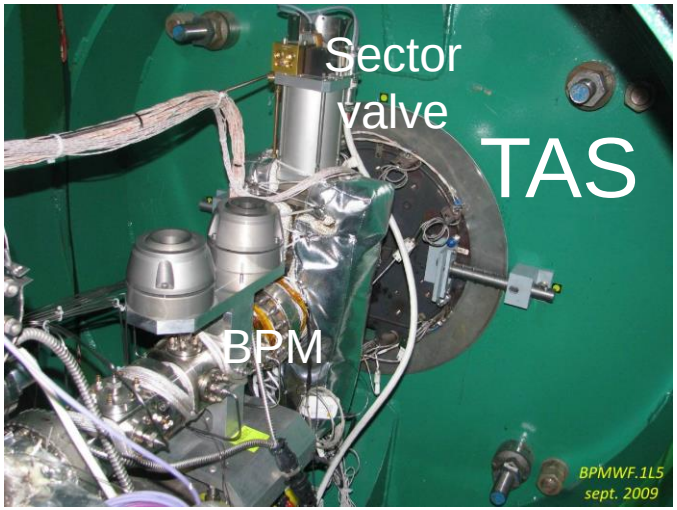
Access to Q1 extremity into the shielding



VAX area

CMS VAX area till LS3

Entry towards Q1



2. HL-LHC VAX

Concept of new VAX area

- The new VAX integration was presented at 6th HL-LHC Collaboration Meeting by F. Sanchez Galan, WP8L:
  - Relocation of the VAX area in the cavern to minimise personnel intervention in the Q1-TAS/TAXS area
  - Integration of BPM in Q1
  - Remote de-installation/installation of vacuum instruments while keeping LHC instrumentation scheme (for TAXS-Experiment side)

- Two ECR are under production for implementation of the solutions from LS2 (2019-2020):
  - Shielding modifications in ATLAS (JFC2, JTT-1) and CMS (FIN)

EDMS NO.	REV.	VALIDITY
1817102	0.1	DRAFT

REFERENCE : NOT REQUIRED

HL – LHC Engineering Change Request
MODIFICATIONS IN ATLAS SHIELDING STRUCTURES DURING LS2

ECR DESCRIPTION

WP Originator	WP8 and PBS # when possible	***Process***	Engineering
Equipment	As per drawing	***Baseline affected***	Scope, Schedule
Drawing	ATLJT___0056, LHCVC1__0001, ATLJF___0006	***Date of Issue***	2017-11-03
Document	-	***CI responsible***	F. Sanchez Galan
WPs Affected		***Reference Document***	TDR Version 0.1

EDMS NO.	REV.	VALIDITY
1866583	0.1	DRAFT

REFERENCE : NOT REQUIRED

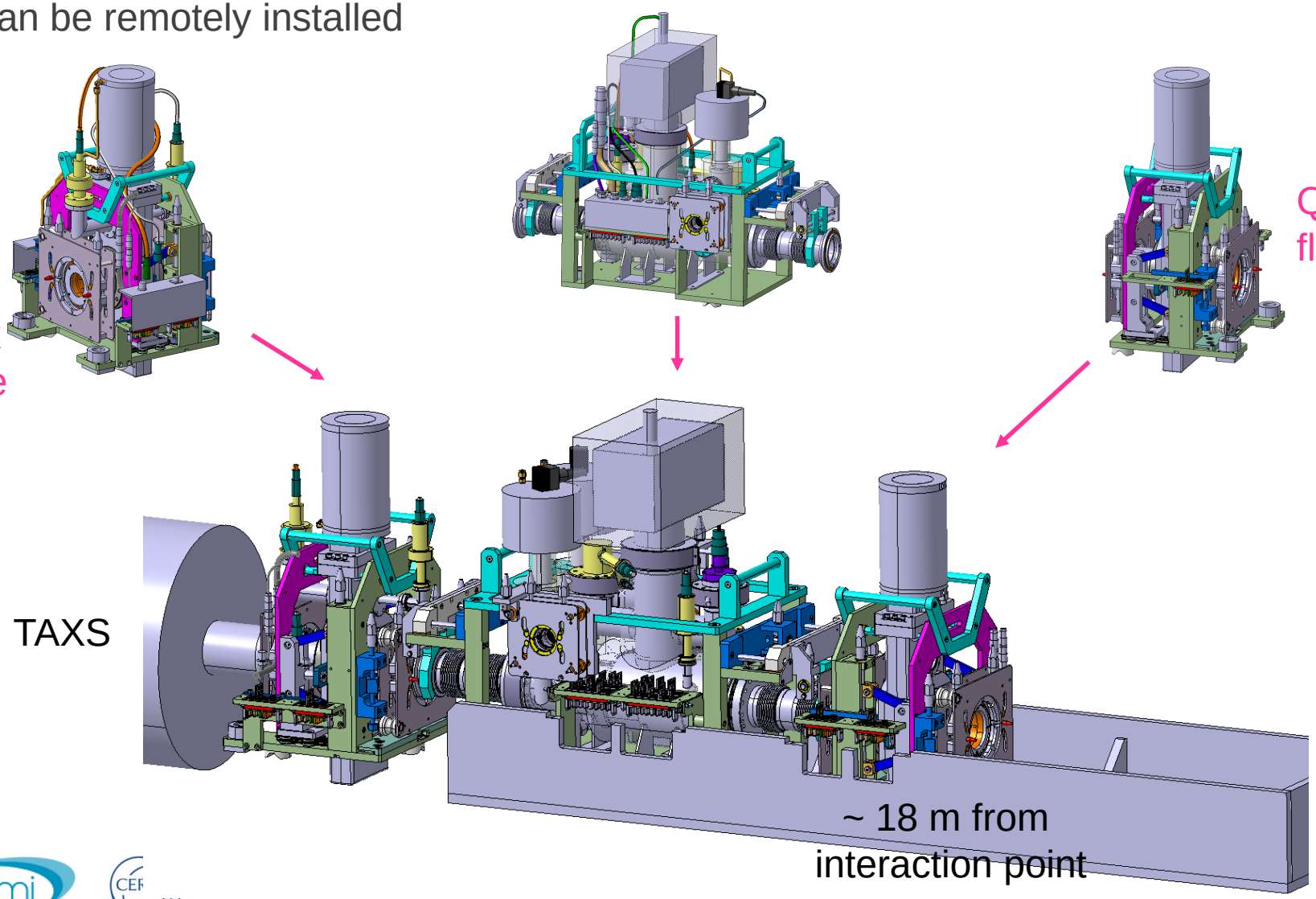
HL – LHC Engineering Change Request
MODIFICATIONS IN CMS BEAM PIPE SUPPORT ON FIN DURING LS2

ECR DESCRIPTION

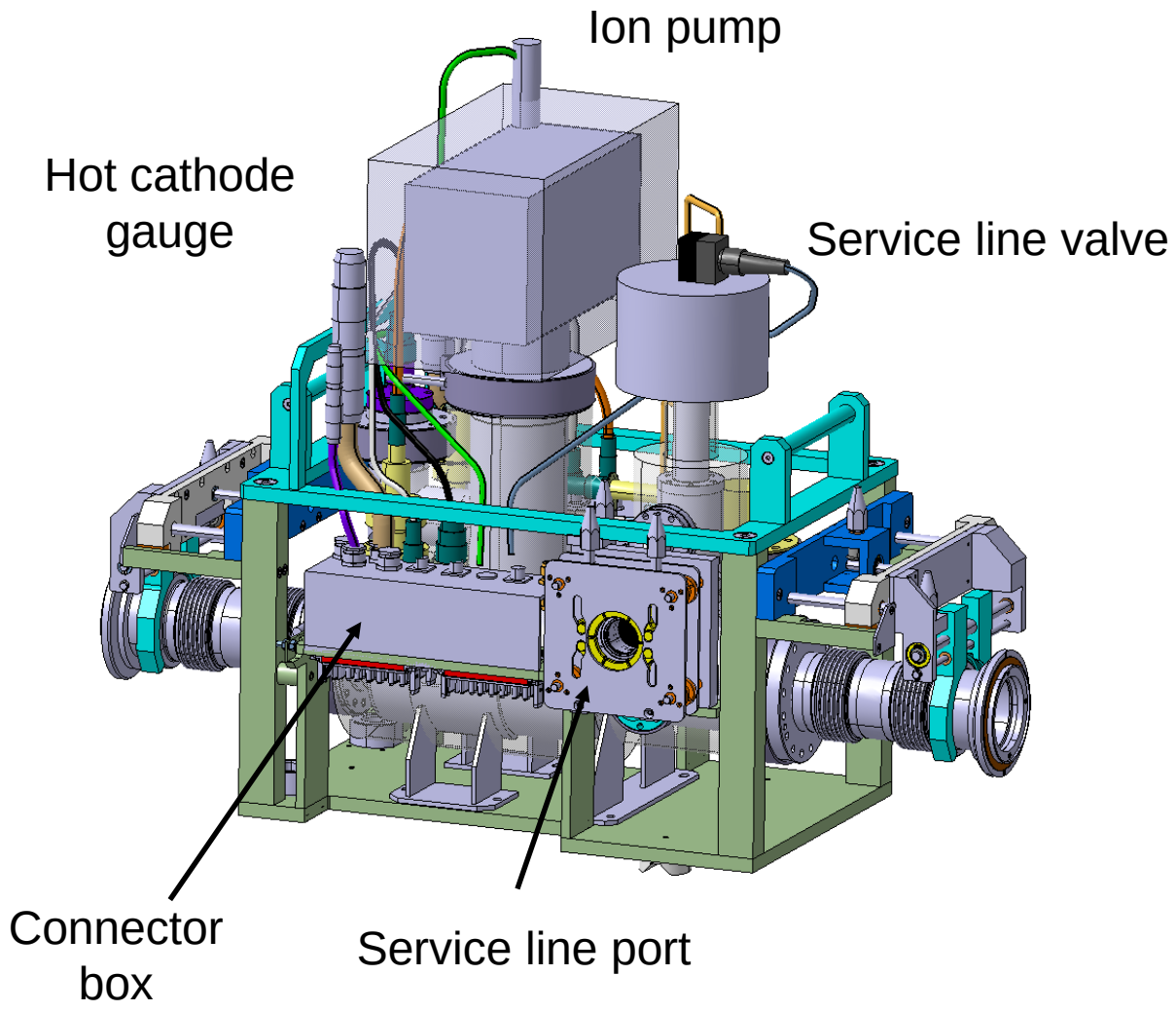
WP Originator	WP8 and PBS # when possible	***Process***	Engineering
Equipment	LHCVH5	***Baseline affected***	Scope, Schedule
Drawing	LHCVH5__0020	***Date of Issue***	2017-11-02
Document	-	***CI responsible***	F. Sanchez Galan
WPs Affected	WP12	***Reference Document***	TDR Version 0.1

VAX: assembly principle

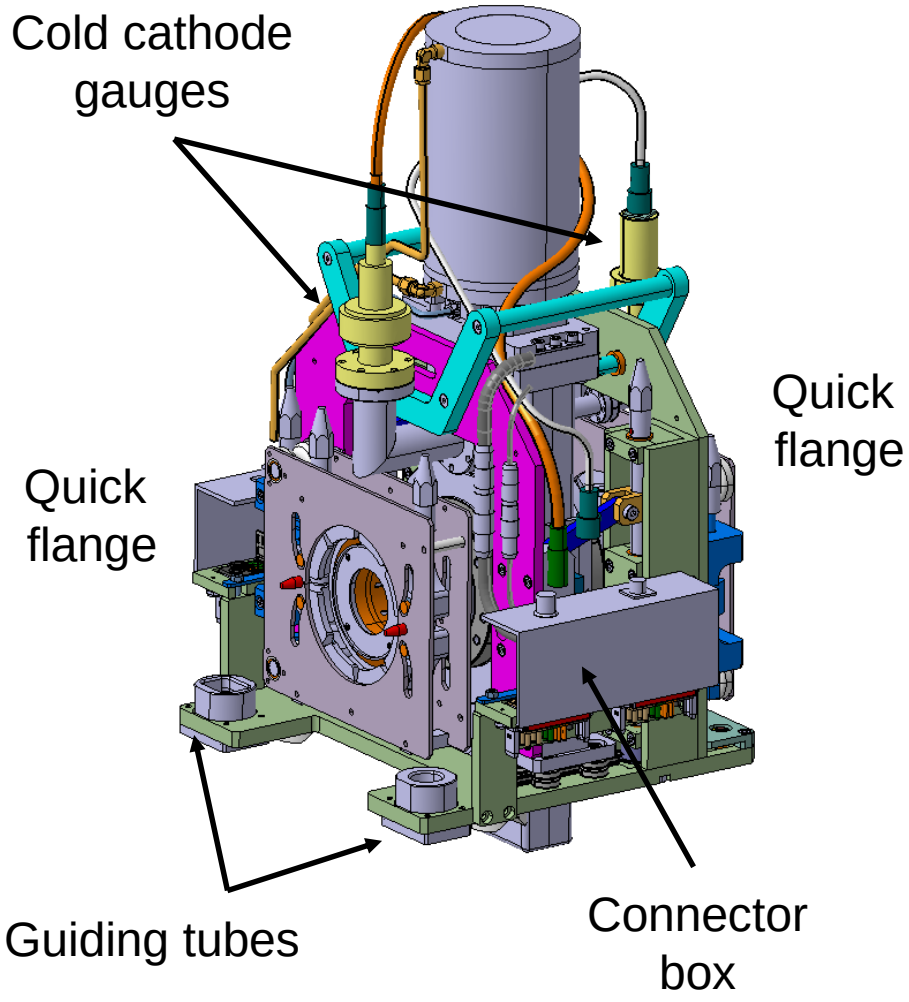
- 3 independent modules: valve#1 + instruments + valve #2
- LHC type “Quick flange” based on LHC collimators design (~ 300 QCF installed)
- Can be remotely installed

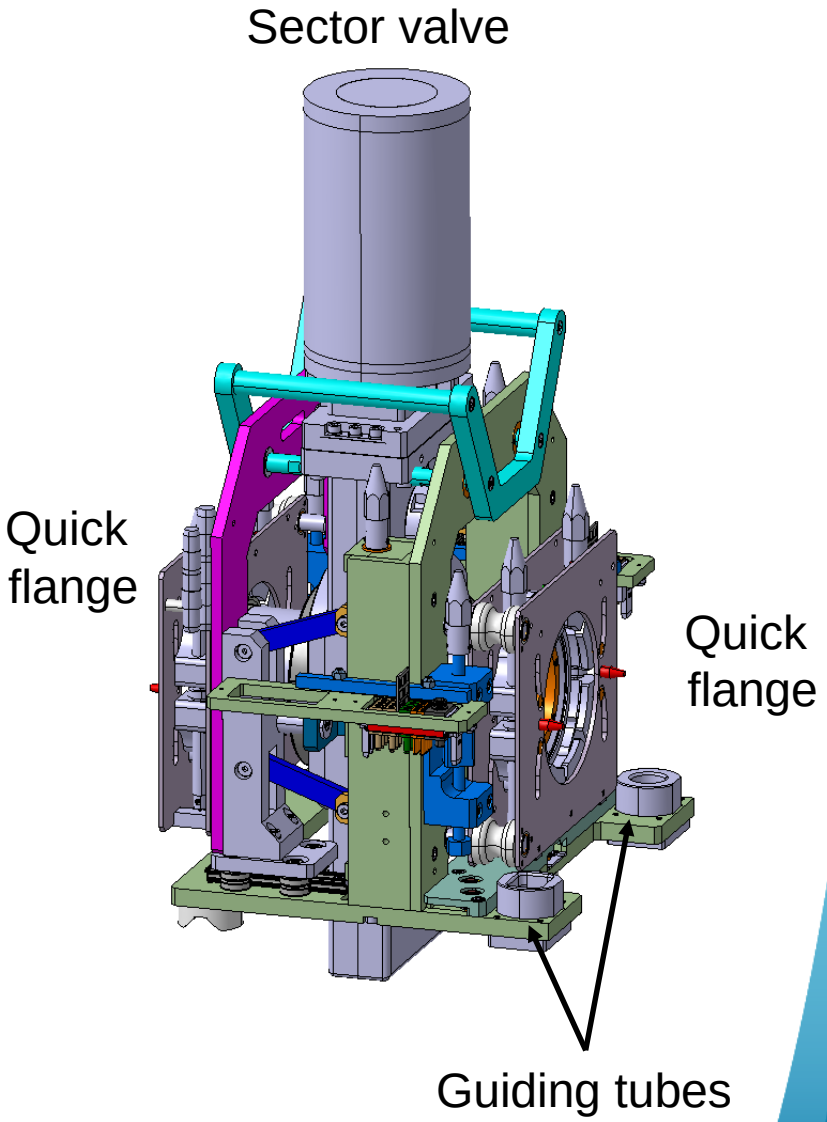


VAX instrumentation



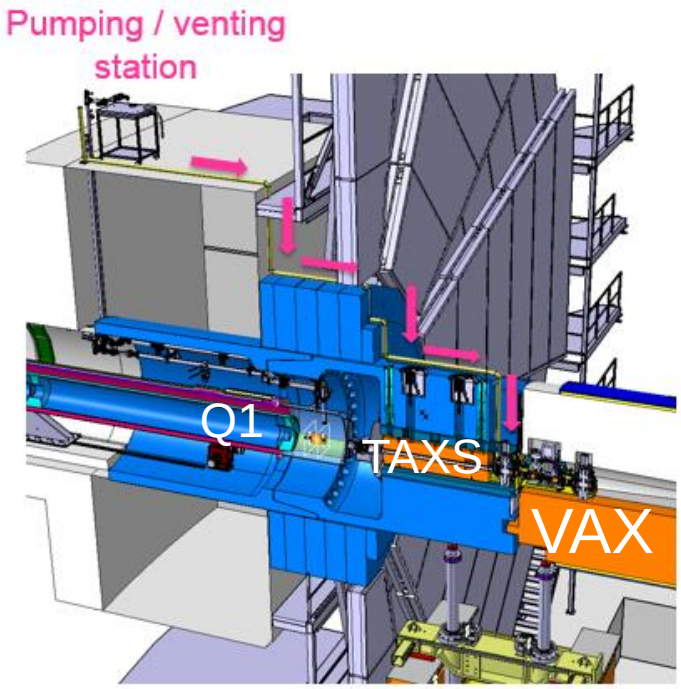
VAX instrumentation (2)



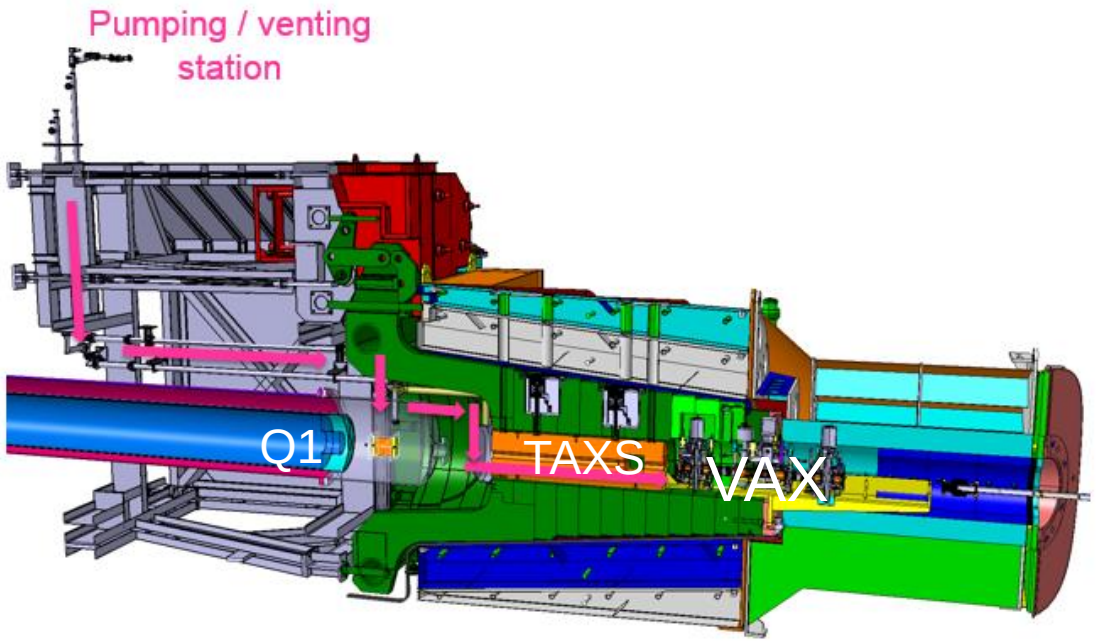


Vacuum service lines routing

- ATLAS: routing outside the shielding and the cavern
- CMS: routing "through" the TAXS shielding and inside the LHC tunnel:
  - extension of present services lines
  - redundancy of CMS service lines

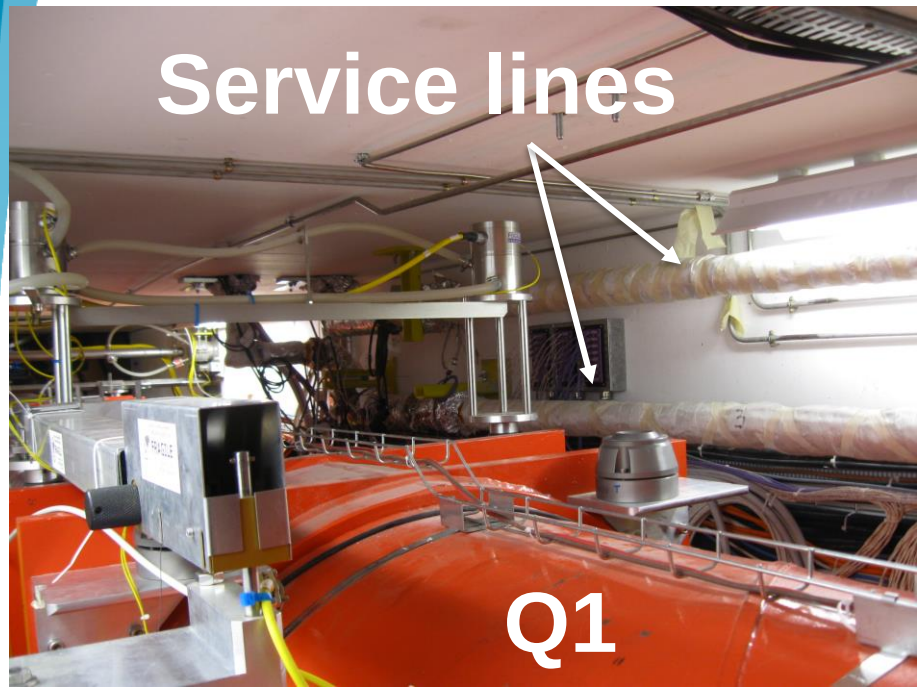


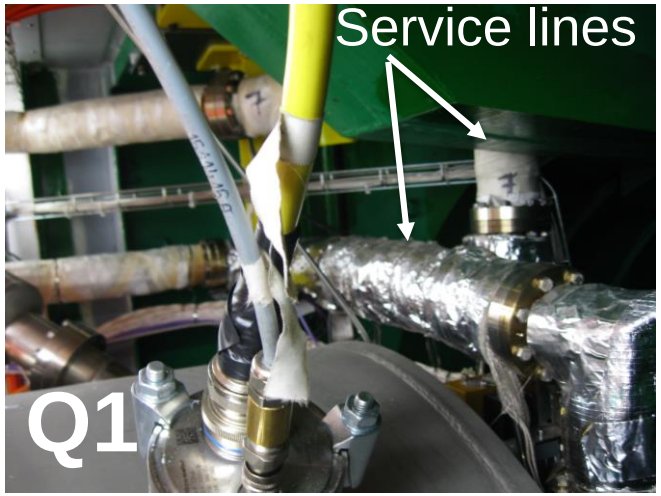
ATLAS

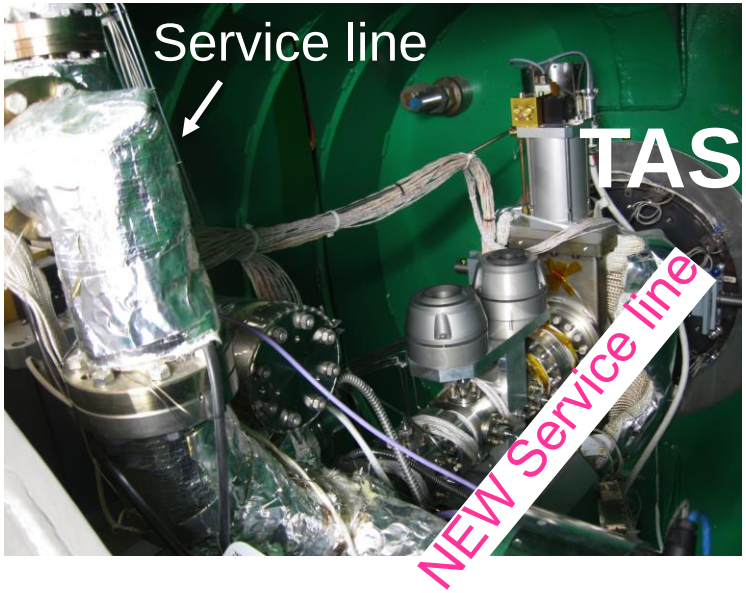


CMS

Example CMS Vacuum service lines routing inside the tunnel

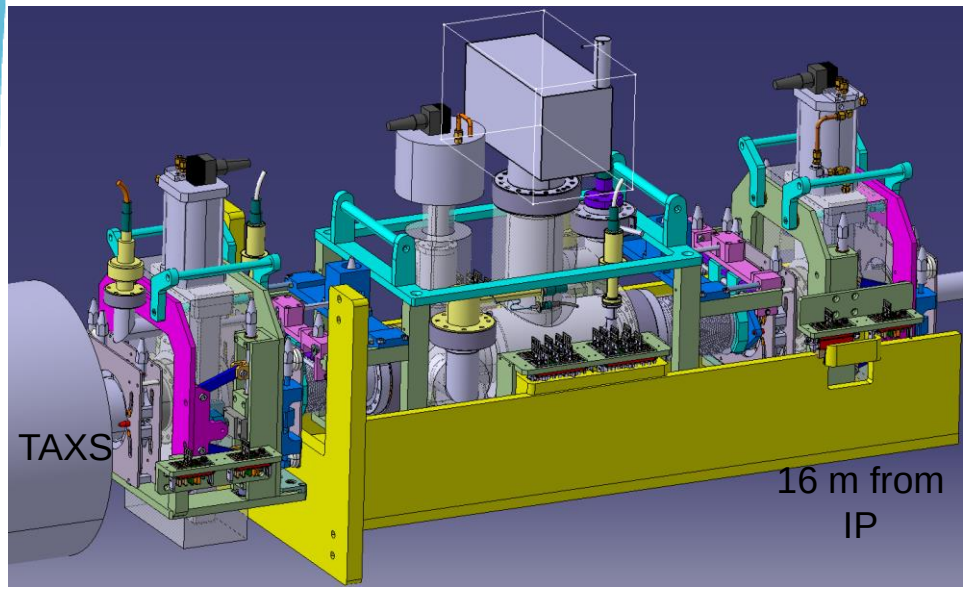




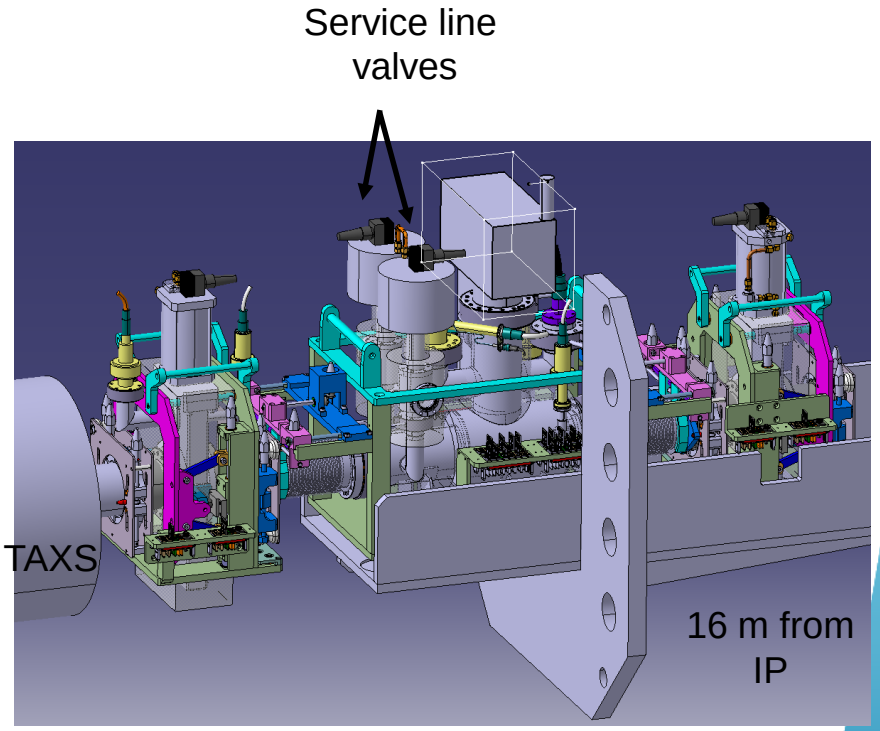


ATLAS & CMS integration

- Integration of the ATLAS and CMS detector particularities for the design of the two solutions
- Coordinated by WP8



ATLAS

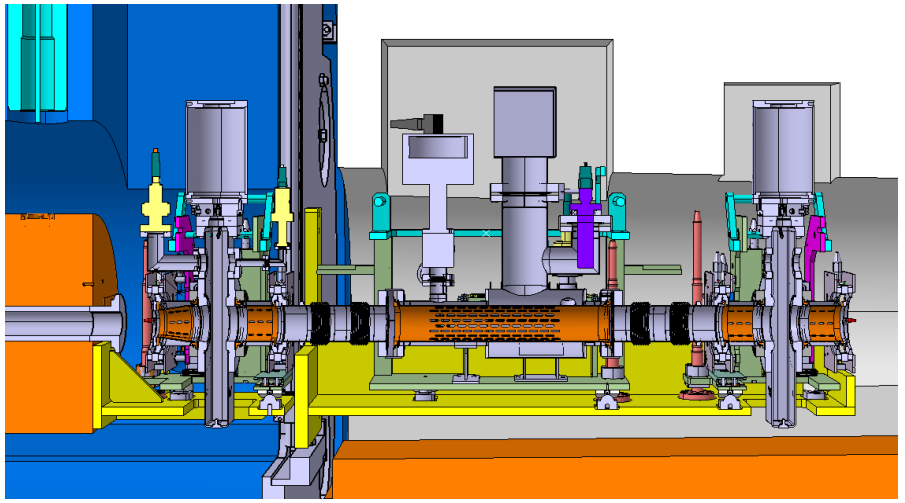


CMS

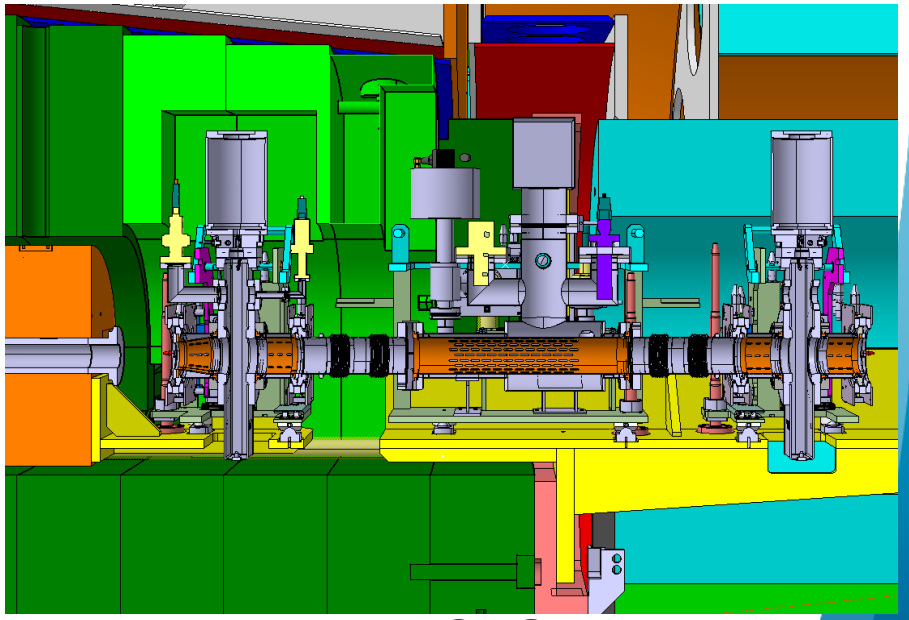
VAX cross section

- Smooth aperture cross section variation along the VAX:
  - ➔Providing some (minor) modification of ATLAS and CMS infrastructures to allow the insertion of a new type of valve !!!
- TAXS ID = 60 mm
- VAX ID = 80 mm thanks to the insertion of new sector valve (still under development) with:
  - 200 deg bakeability
  - increase of radiation hardness (Viton less)
- Less sensitive to mis-alignement
- NEG coated Cu inserts with slots
- If needed, bellows equipped with deformable RF bridges

Deformable RF bridge with 3 convolutions



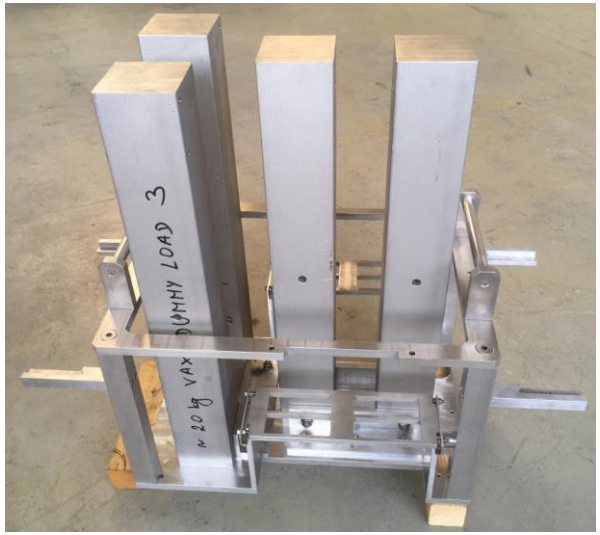
ATLAS

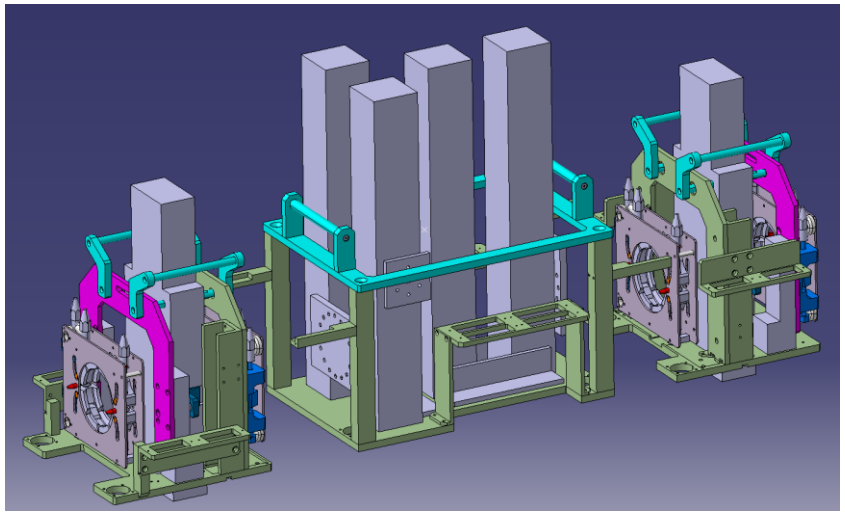


CMS

VAX: prototype

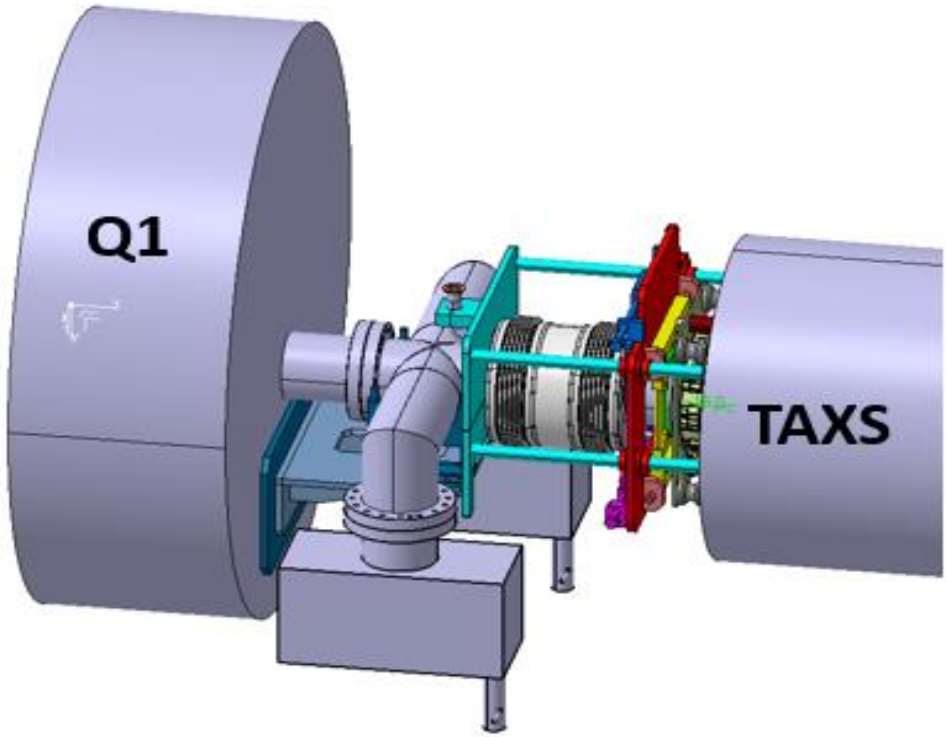
- Objectives, check the behaviour of:
  - remote handling and VAX assembly with dummy loads
  - guiding system
  - Mechanism test
  - Test of connectors
- Underway
- First results foreseen by beginning of next year





What next?

- The connecting vacuum system between Q1 and TAXS needs to be studied

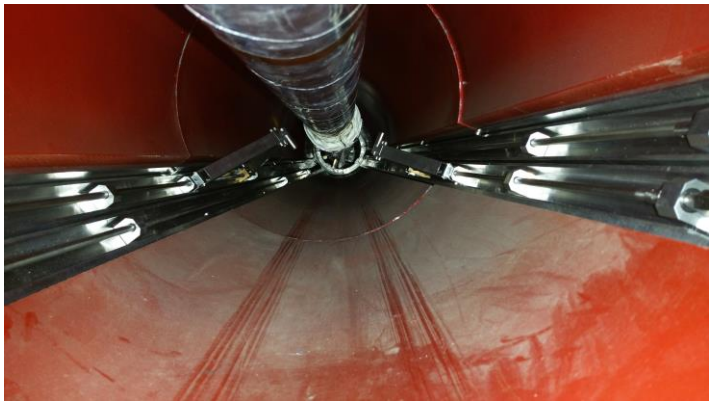


Pumping and bellow to decouple room temperature TAXS from cryogenic temperature triplet

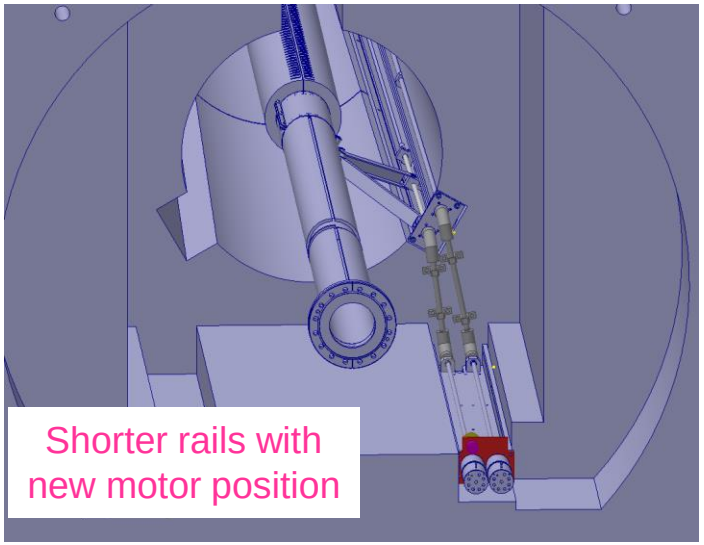
3. Implication on experimental vacuum system

Implication on ATLAS vacuum systems LS2

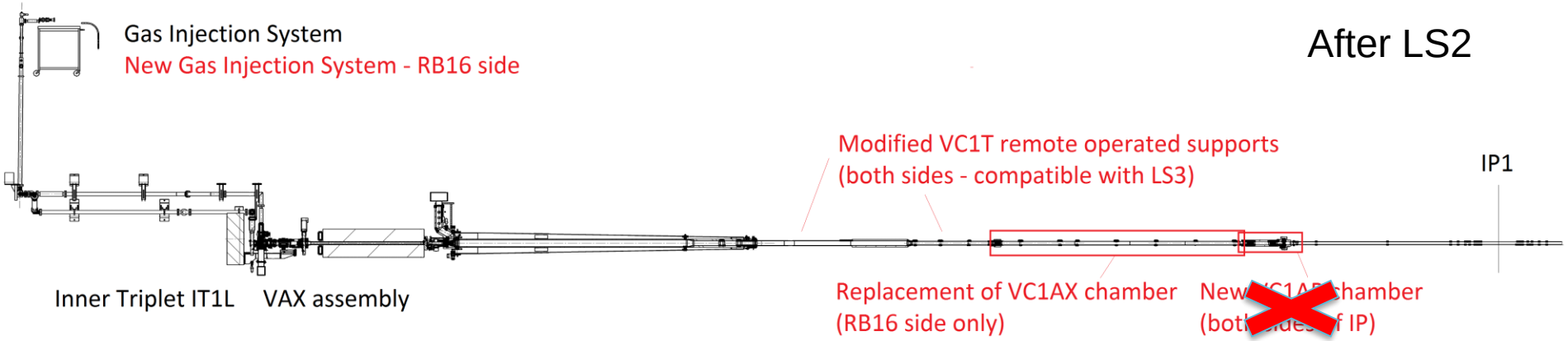
- Annual maintenance of the detector:
  - Modification of JTT & JF shielding with modification of the pantograph supporting system with relocation of the motors



Retracting the VT supports (YETS 2016)

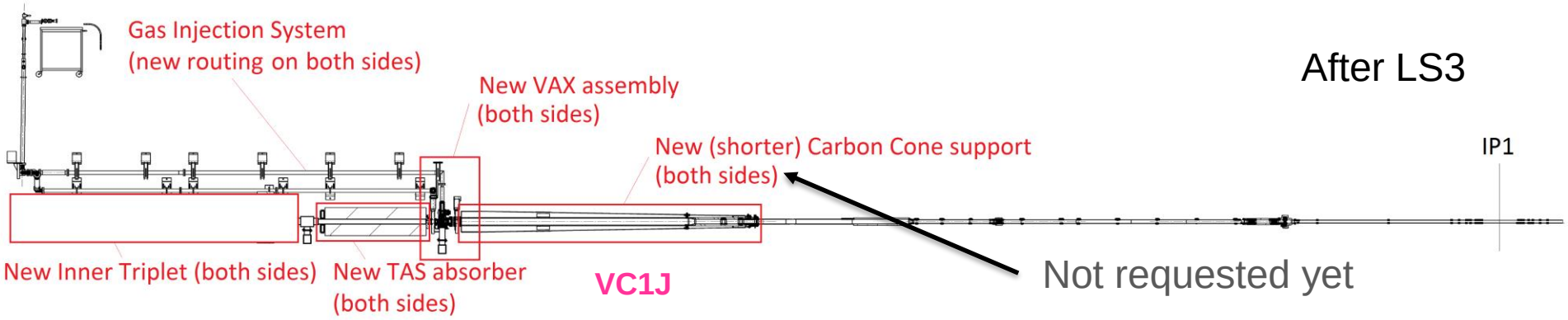


After LS2



Implication on ATLAS vacuum systems LS3

- New VAX and TAXS
- New VC1J chamber and installation of a 2nd Gas Injection System (within LHC scope)
- Fully new GIS / pumping system routing on both sides
- Till LS3, manual intervention to release fixed points and transfer loads during annual maintenance. But, continuous improvement of tooling & procedures since LS1 in order to reduce intervention time.
  - ➔ Reduce radiation to the operator during maintenance
- ATLAS fully remotely aligned minimising the dose to the operator
  - ➔design & integration of a new system to release fixed points and transfer loads

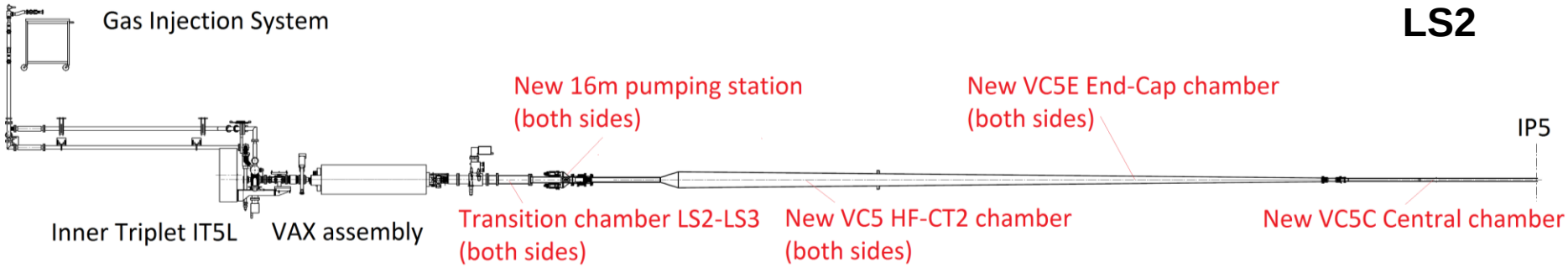


Implication on CMS vacuum systems LS2

- Installation of new Al beam pipes (16 m pumping station, VC5 HF-CT2, VC5E End cap, VC5C central chambers) with permanent bakeout system (except VC5C)

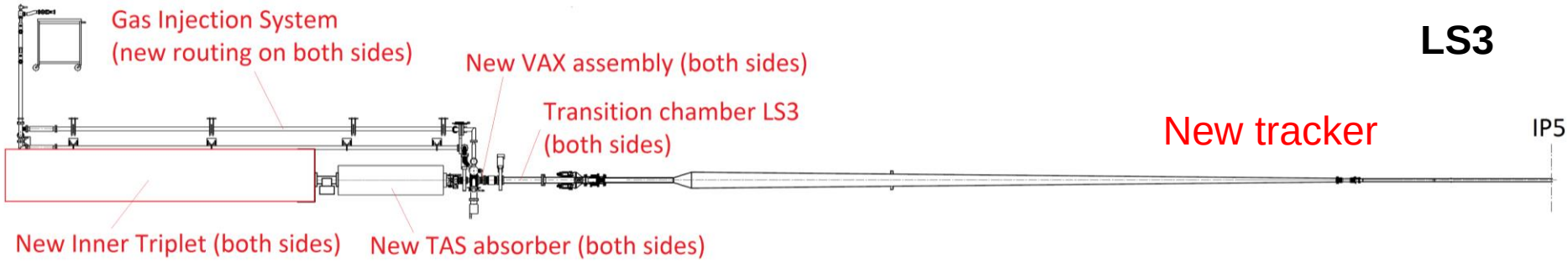
- Modification of the forward chamber supporting system on FIN (Fixed Iron Nose) to prepare VAX installation during LS3

- Specific transition chamber to provide interfaces compatibility for the period LS2-LS3



Implication on CMS vacuum systems LS3

- New VAX and TAXS
- CMS beam pipe already adapted !
  ➔Installation of new shorter transition chamber between new VAX and 16 m pumping station
- New GIS / pumping routing trough TAXS towards VAX on both sides (extending present LHC routing)



4. Summary

Summary

- The LHC vacuum instruments station (VAX) of ATLAS and CMS experiments needs to be relocated for the HL-LHC era.
  - Personnel exposed to less radiation dose
  - Increase of reliability

- The HL-LHC VAX is made of 3 modules:
  - Can be remotely installed/de-installed

- Detailed studies performed under the coordination of WP8:
  - Integration dedicated to ATLAS and CMS specificities
  - Optimised vacuum chamber cross section for aperture & impedance

- The Q1-TAXS are needs to be studied

- Thanks to the approval by ATLAS and CMS of the new VAX system, its installation will start from LS2 with:
  - Modifications of ATLAS and CMS shielding (ECR under preparation)
  - Modifications of ATLAS and CMS beam pipe supporting system (ECR under preparation)

Thank you for your attention

Many thanks to J. Perez Espinos, L. Krzempek and J. Sestak for their significant, valuable and important contributions