
CERN

ATLAS and CMS Experimental beam pipes upgrade

Main LS2 activities with some LS3 considerations

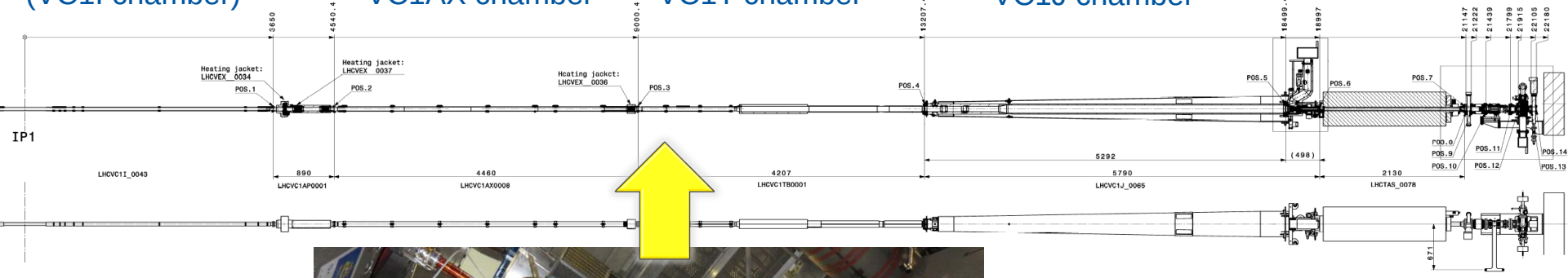
G. Bregliozzi & J. Sestak on behalf of TE-VSC

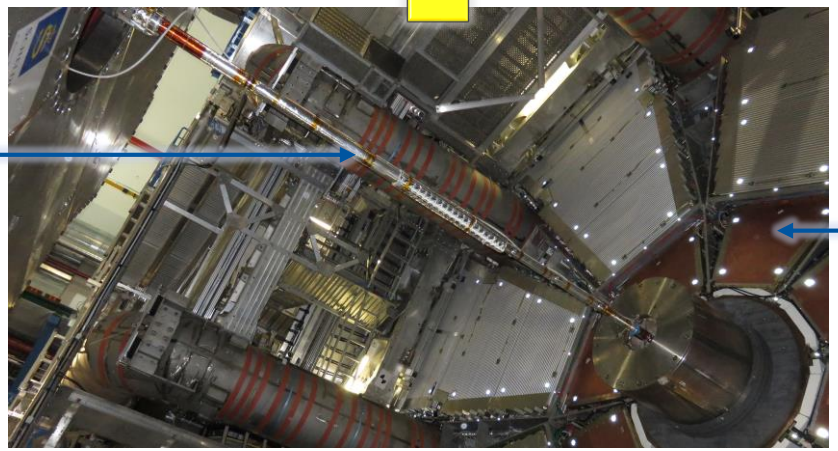
ATLAS Beam vacuum actions during LS2

- Dismount IP1.X layout in order to allow extraction/installation of a new small wheel.

VC1AP chamber

(VC1I chamber) VC1AX chamber VC1T chamber VC1J chamber



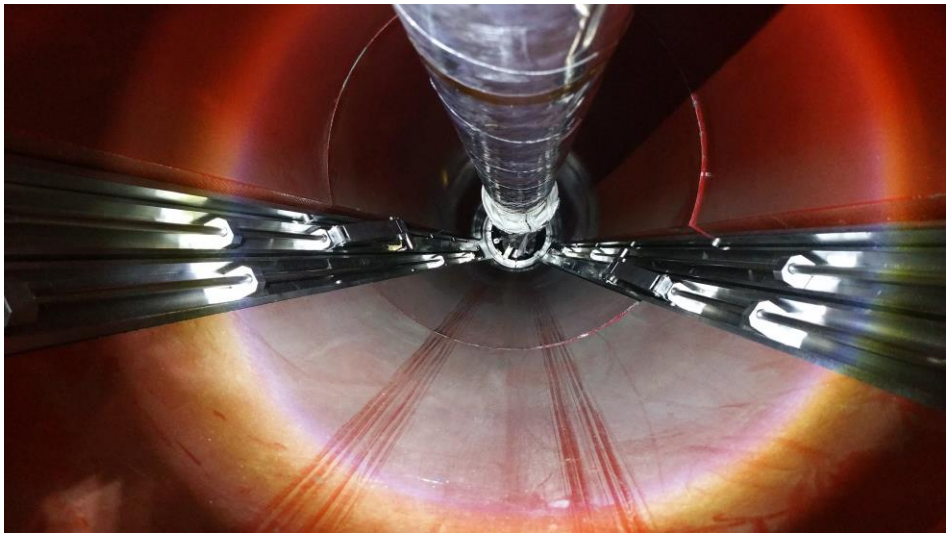


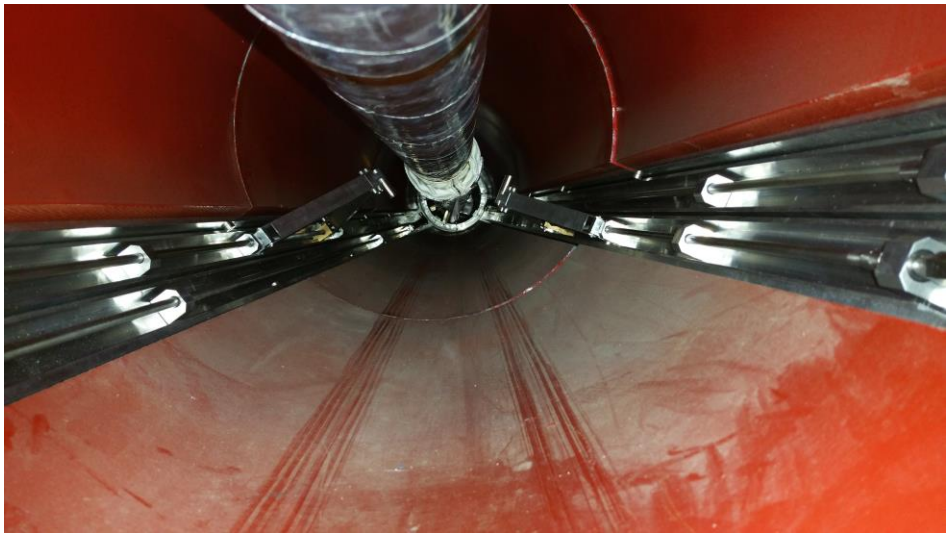
VC1T chamber

Small wheel
(position ECT – out)

ATLAS Beam vacuum actions during LS2

- Possible room for improvements of the remote VT support system - TBD.

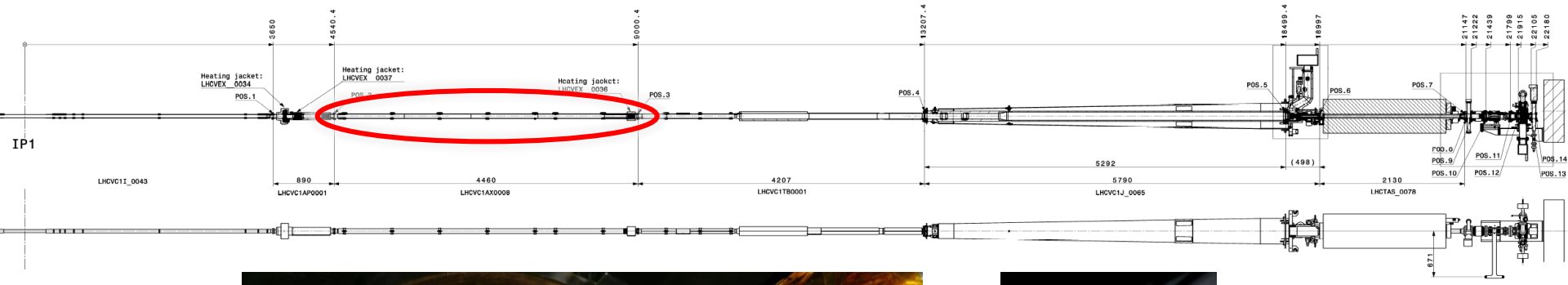


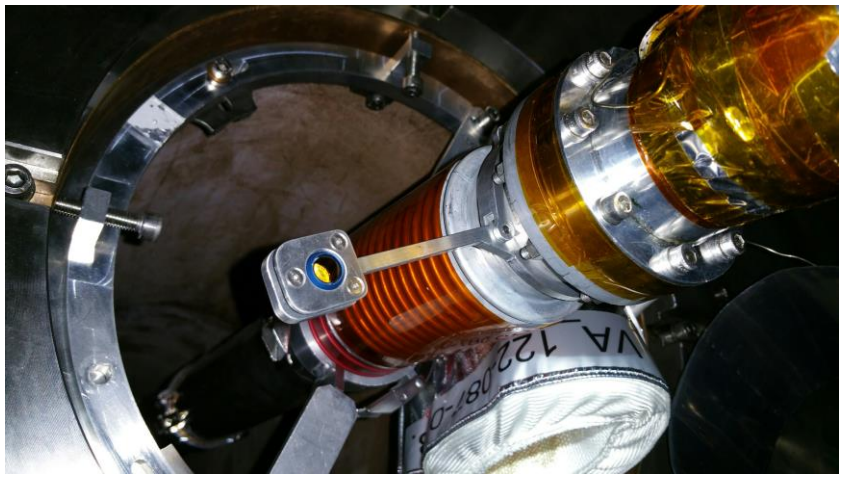


- No “safe” end stop system at the moment.
- Upper support not used – can be dismounted.

ATLAS Beam vacuum actions during LS2

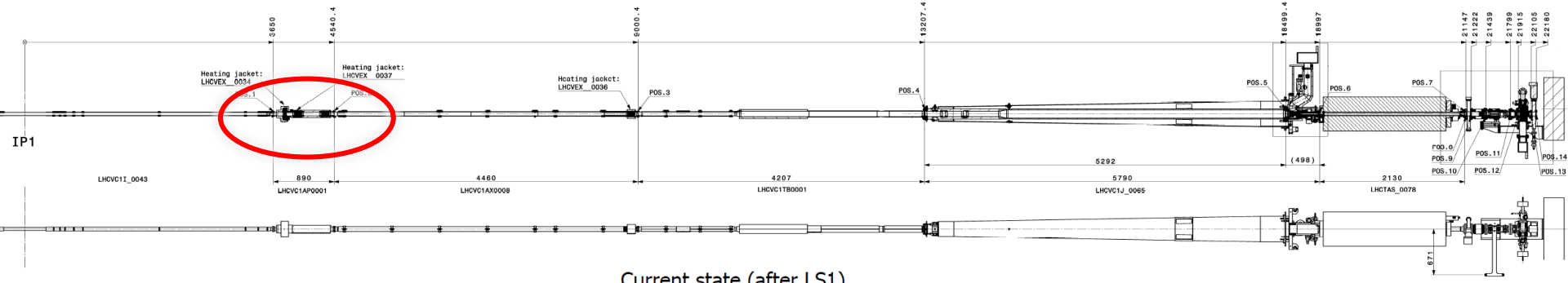
- Reinstallation of the IP1.X layout + replacement of VC1AX-C (bellow issue)



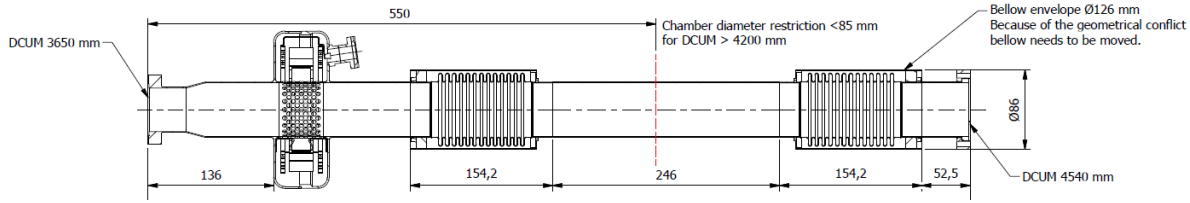


ATLAS Beam vacuum actions during LS2

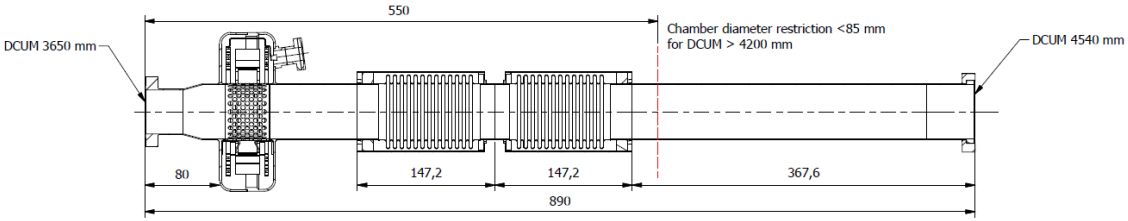
- Installation of a new VC1AP chambers (compatible with LS3 Pixel detector).



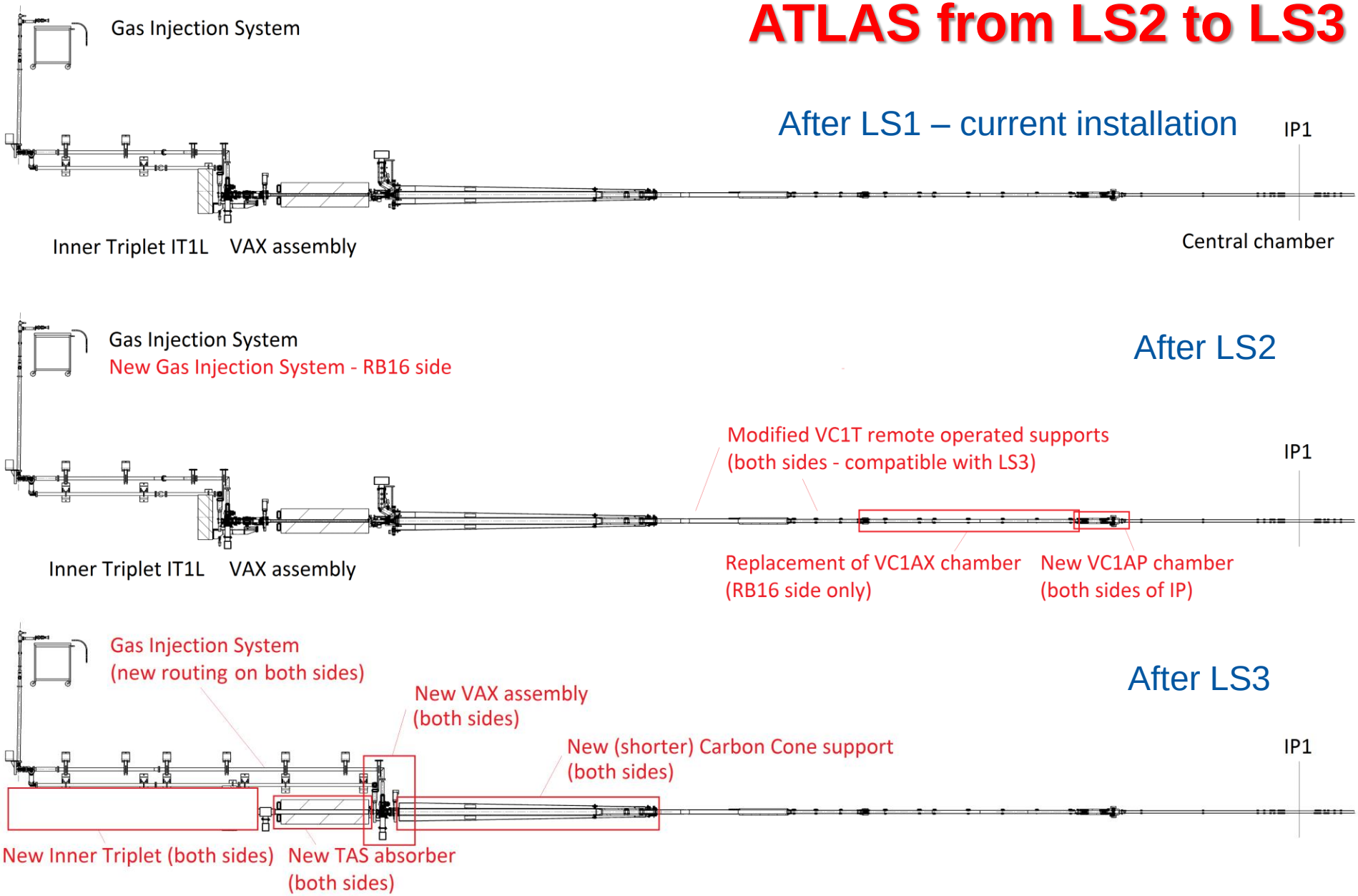
Current state (after LS1)



LS2 design proposal



ATLAS from LS2 to LS3

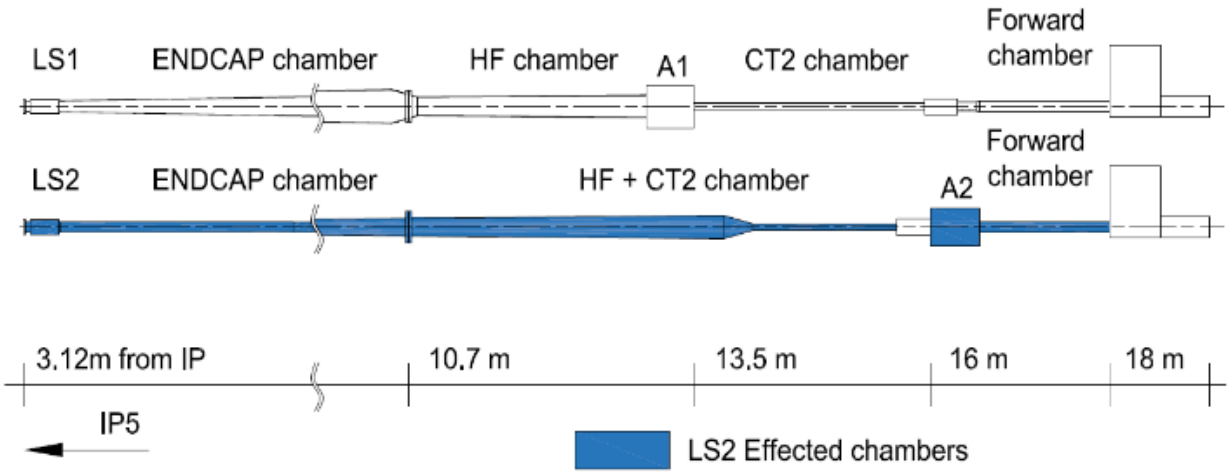


CMS LS2 Activities

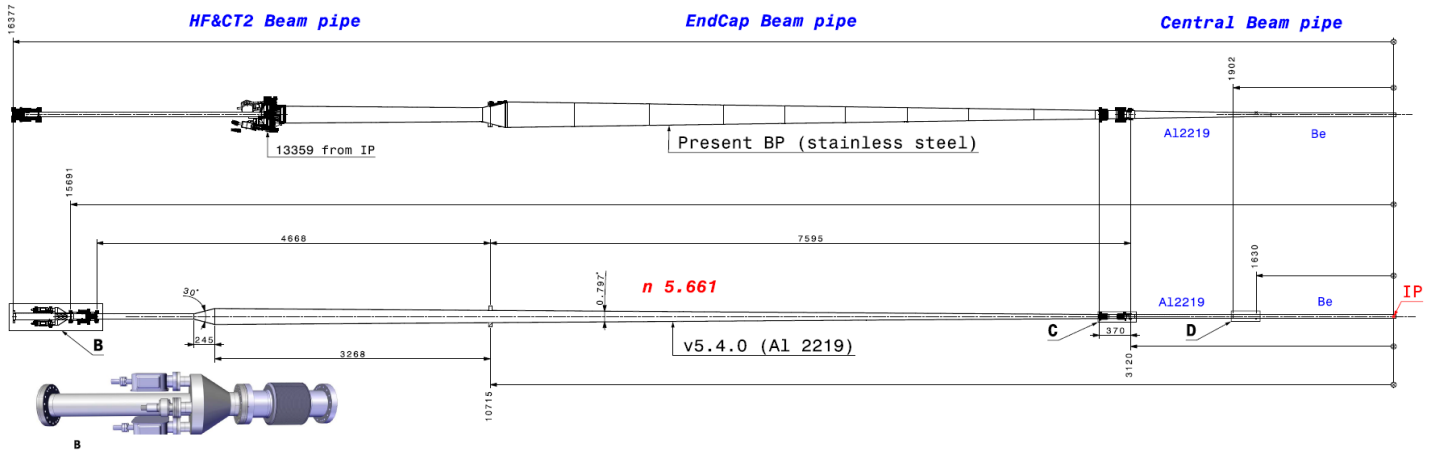
During LS2 the CMS will undergo major upgrade of IP5.X experimental beam vacuum sector.

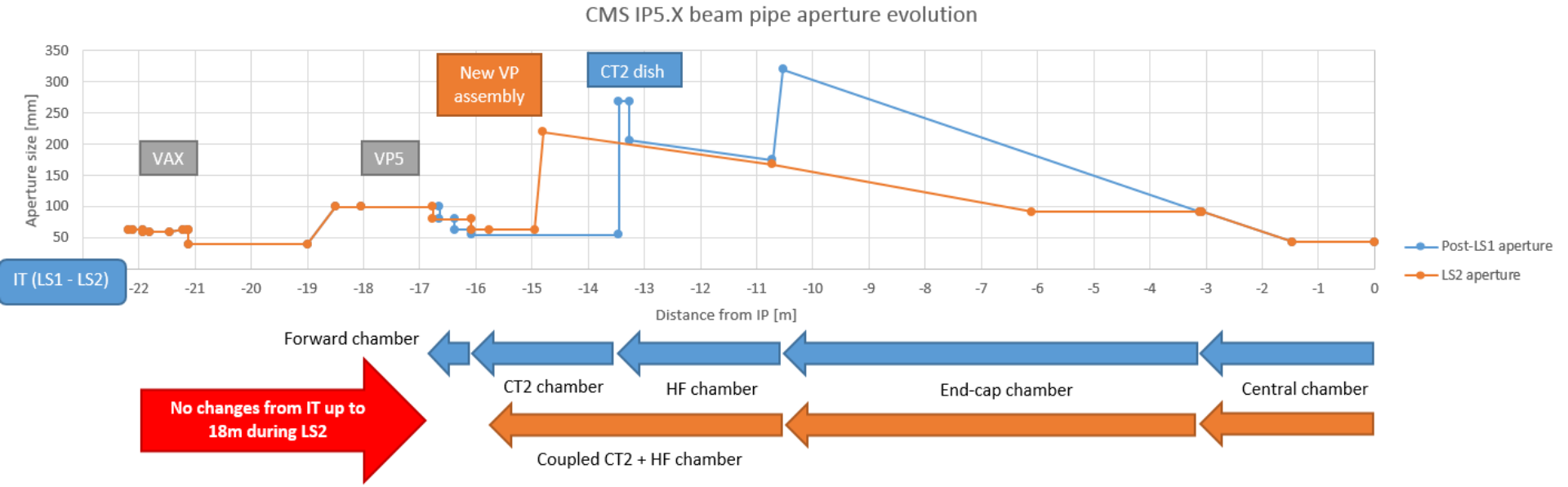
Main motivation:

- Extend calorimetry (reduced η = 4.9 to 5.54).
- Meet ALARA request for light Z chambers.



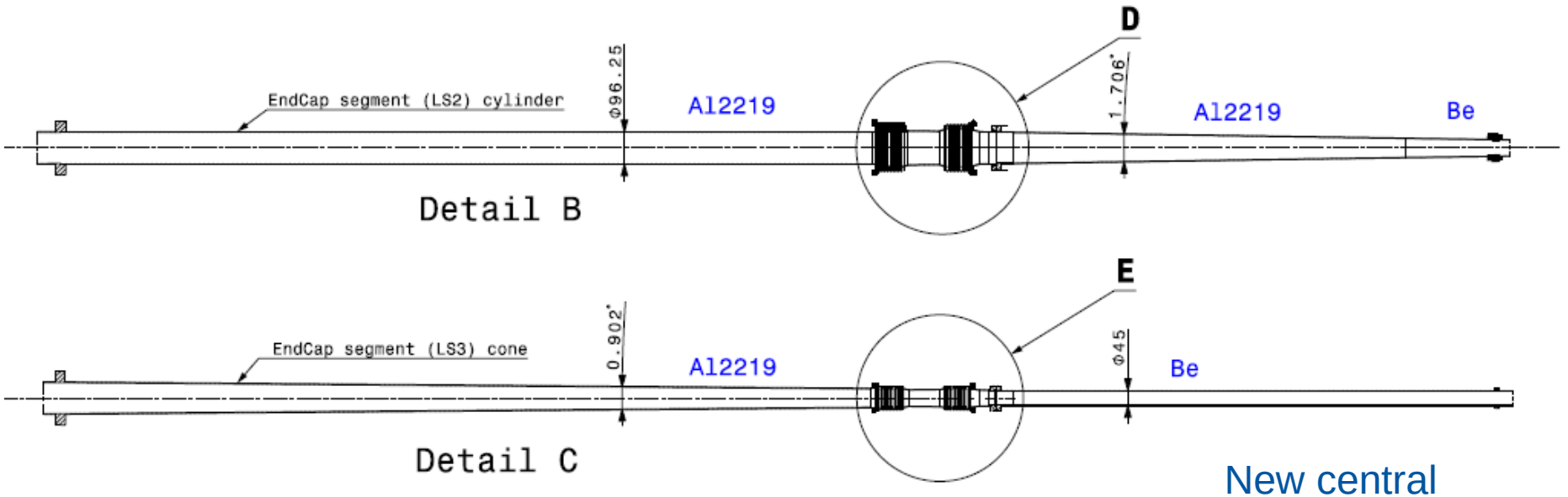
CMS LS2 Proposed design options





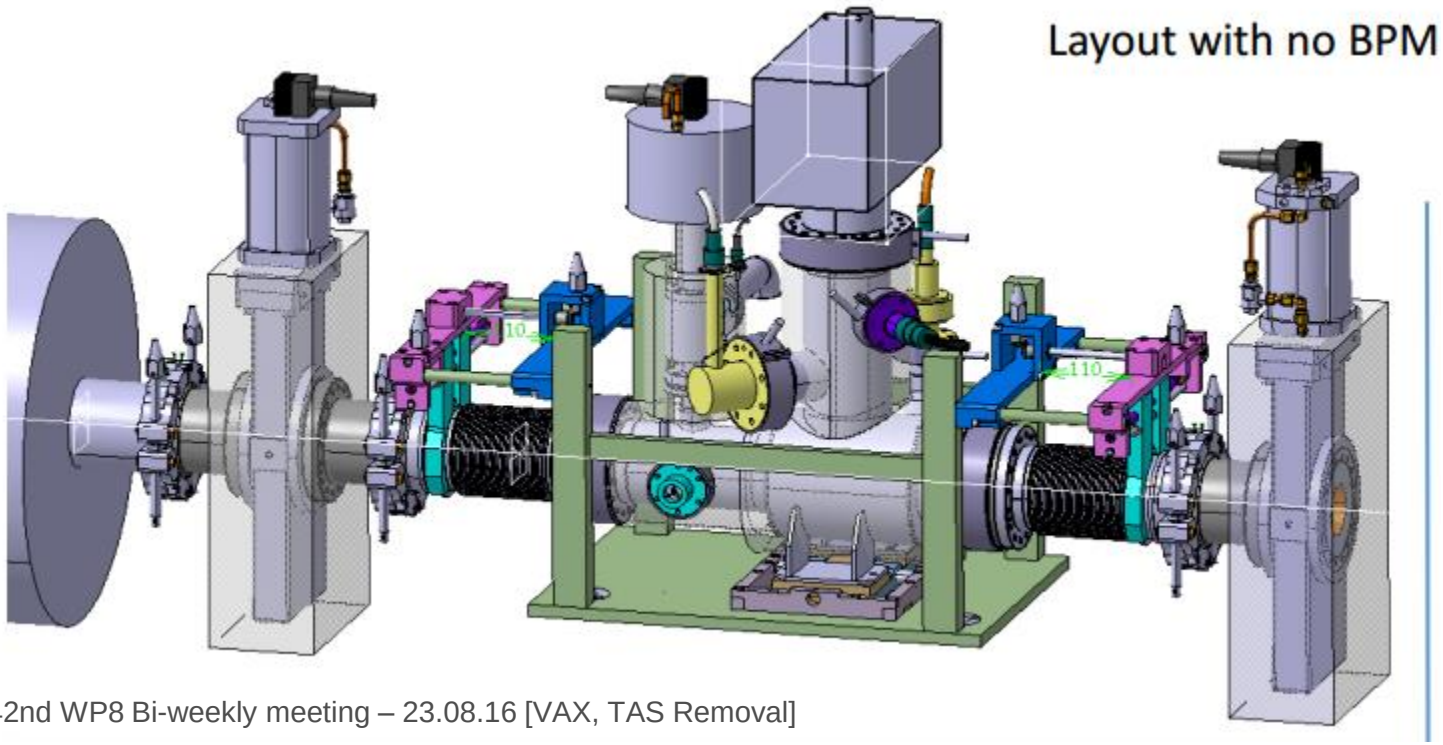
CMS Design constraints in view of LS3

- **Compatibility** of **central beam-pipe** and **VAX relocation** to 18m.



New central beam pipe still under discussion

New VAX System: WP8

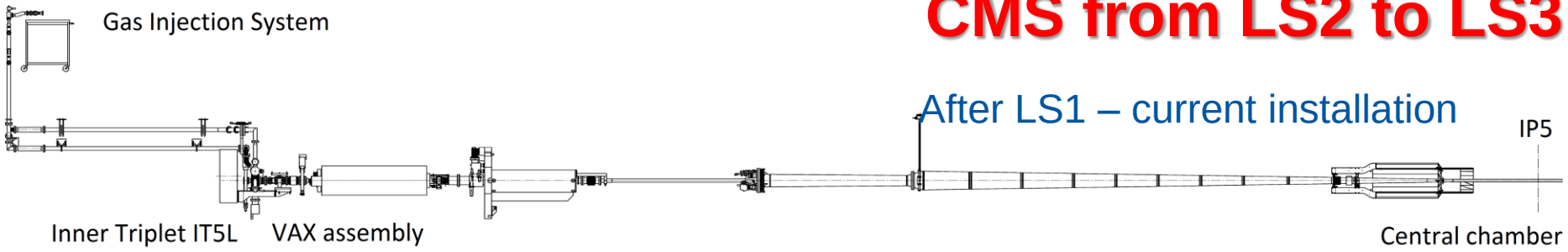


42nd WP8 Bi-weekly meeting – 23.08.16 [VAX, TAS Removal]

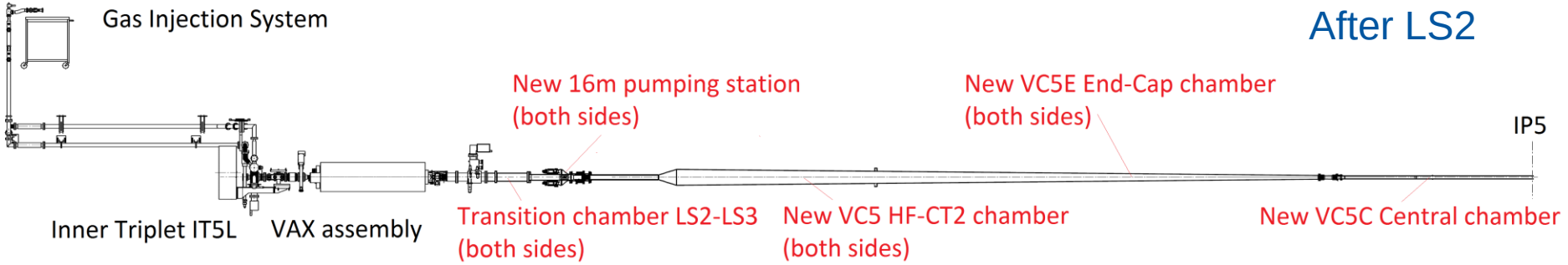
VSC reference for VAX: J.Espinos – L.Krzempek

CMS from LS2 to LS3

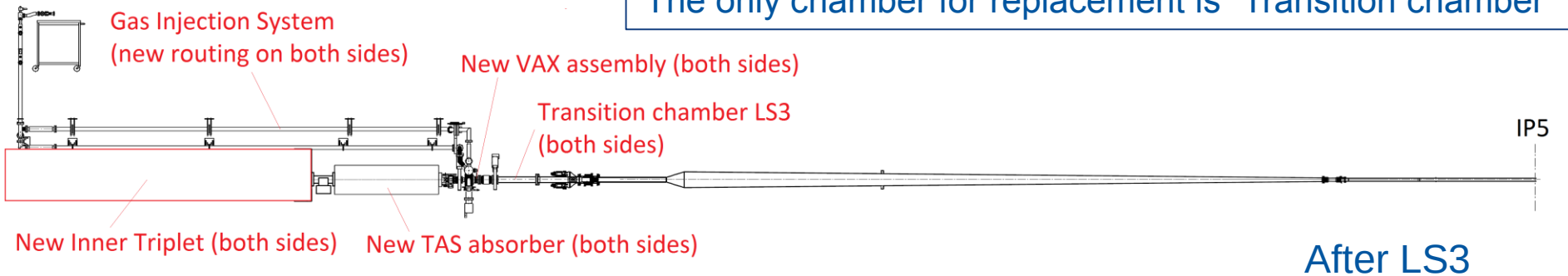
After LS1 – current installation



After LS2



New design of LS2 chambers is compatible with LS3
The only chamber for replacement is “Transition chamber”



After LS3

Summary and outlook

ATLAS

LS2

- Minor layout exchange foreseen during the LS2; upgrade remote supports; correct non conformity

LS3

- New Gas injection system (GIS) is mandatory in RB16 to be conform with LS3 VAX upgrade
- Shorter carbon cone support needed
- Final connection of existing layout to new VAX

CMS

LS2

- Major layout upgrade with possibly new IP beryllium beam pipe
- All new layout upgrade with aluminium beam pipes

LS3

- Layout already fully compatible: need just final connection of existing layout to new VAX

Spare slides
LHCb and ALICE activities

LHCb

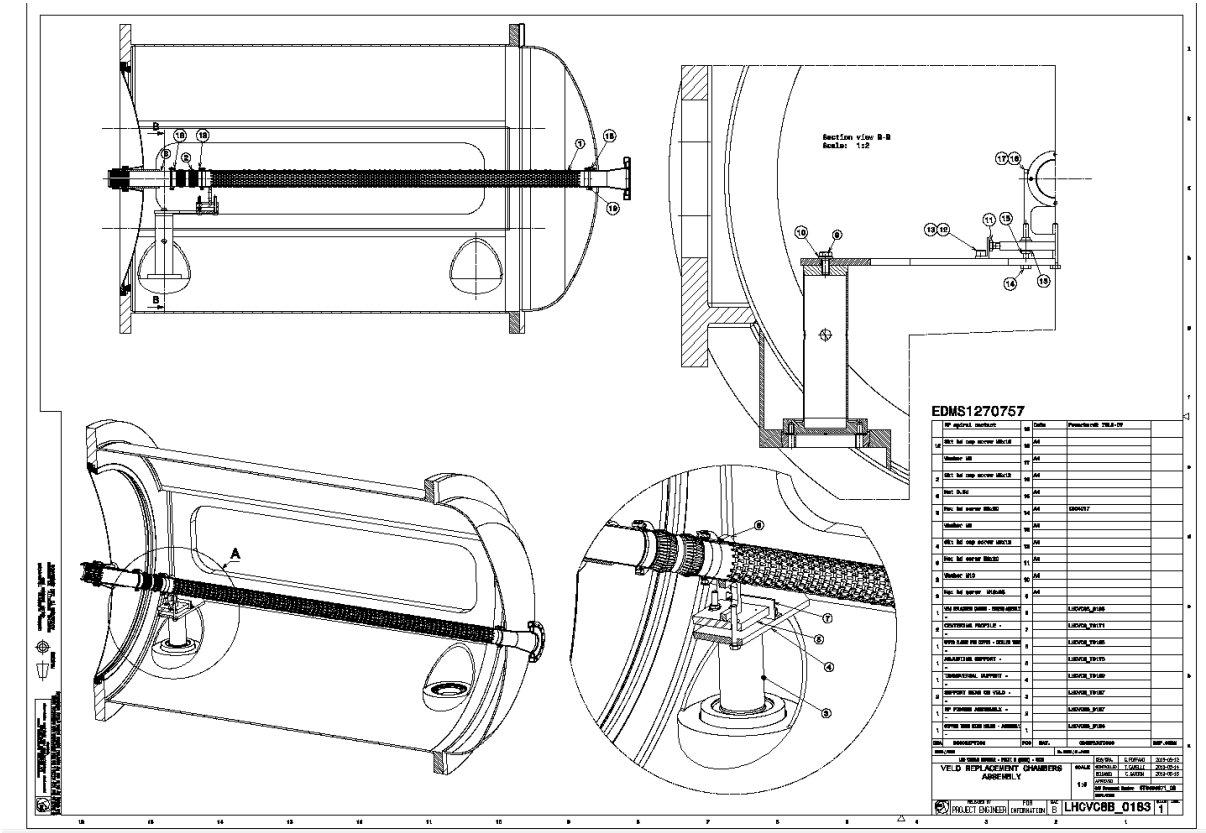
Foreseen activities for LHCb

- **Operational spares and Interventions:**
  - **Aluminium Raw materials**
  - **VELO chamber spare system (Ready for installation in EYETS 2016-2017)**
  - **Replace the upstream copper chamber with aluminium (LS2)**
  - **Integration of calibrated gauges in A1L8.X for VELO/SMOG (EYETS 2016-2017)**
  - **Remote RGA installation and analysis in the VELO system (LS2)**
  - **Remote injection system for VELO/SMOG (YETS 2017-2018 or before)**
  - **Gauge absolute calibration for VELO/SMOG (EYTES 2016-2017)**
  - **Overview of LS2 Activities**
  - **Import all old technical drawings from Euclid to CATIA (Before LS2)**
- **Experimental vacuum system**
  - **Replacement of LHCb VELO RF Boxes (LS2)**
  - **Development of new materials for transparent beam pipes (shared with ALICE, ATLAS and CMS) – (Next 5 years)**
  - **Technical support to LHCb for the feasibility of moving detectors closer to the beam pipe: UNDER DISCUSSION**
- **Remote control and diagnostic**
  - **Integration of VELO vacuum system controls and diagnostics into the LHC vacuum system** (Based on 'Service Agreement on the LHCb VELO Vacuum System' (EDMS 681957))

VELO Chambers Spare chambers

Spare chambers for impedance & pumping reason
Re-use the envelope of the VELO

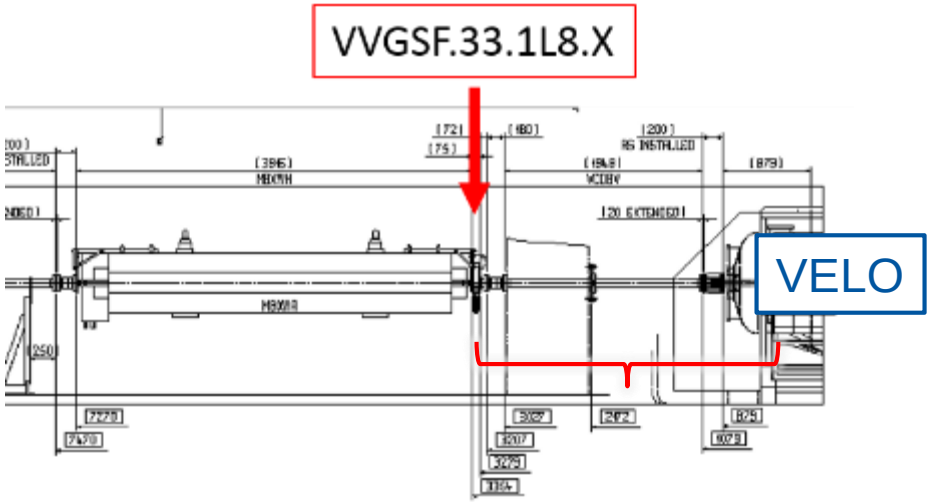
- Replacement chamber manufactured
- Need to be finalized:
  - NEG Coating
  - Special RF Fingers



EYETS 2016-2017

Replace Cu chambers upstream VELO with Aluminium

- Technical drawing done
- Start production 2016
- NEG + vacuum Qualification in 2017

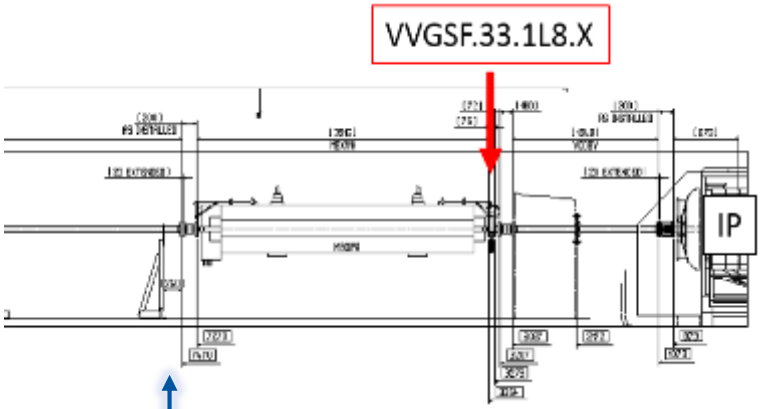


Upstream vacuum chambers of VELO
VCDBV

Foresee LS2

Activities connected with the SMOG system

- Integration of calibrated gauges in A1L8.X (EYETS 2016-2017)
- Remote RGA installation and analysis in the VELO system (LS2)
  - For SMOG injection: Determine cleanliness and detailed % of molecules
- Remote injection system for SMOG/VELO (YETS 2017-2018 or before):
  - Upgrade SMOG system for multiple-gas usage, including safe control interface for operator
- Gauge absolute calibration for SMOG and VELO: Under discussion



Calibrated gauges for SMOG
EYETS 2016-2017

Ideally these could be all activities (Except first) covered by a fellow
50% VSC – 50% LHCb

From 2017 to 2019

Foresee LS2

YETS & LS2 Activities

- YETS & EYETS General Activities:
  - Neon Injection with possible supports of vacuum chambers installation
  - SMOG activities for gas exchanges and RGA analysis: recurrent during each TS
- EYETS 2016-2017:
  - Integration of calibrated gauges in vacuum sector A1L8.X for precise SMOG injection:
    - Layout exchange
    - Fabrication of new modules and cabling for the gauge
    - Mechanical, bake out and final NEG activation
- LS2 Activities:
  - RF Box VELO Exchange main activity:
    - Opening, dismounting, integration, support, mechanical installation, leak detection, bake out installation, NEG activation, etc.
    - RGA integration & calibration
    - Remote injection system for the SMOG

Update of LHCb technical drawing:

- The first layout for these vacuum chambers has been designed during LHC design phase and will soon need a revision to account for modifications required during LS2.

- Updating of vacuum chambers for LHCb to the new practices in use at CERN (new 3D software) and updating them with the modifications already introduced during the past technical stops (i.e. new supports for LHCb vacuum chambers).

Foresee 2017

Replacement of LHCb VELO RF Box

- Provide consultancy in the fields of vacuum physics, bake out and engineering for the upgrade of the VELO box and in particular thin walled corrugated structures.
- Participate in meetings and reviews at CERN or LHCb collaboration institutes as requested by the experiment.
- Perform the etching of final RF boxes.
  - Perform dynamic vacuum simulations and measurements in IP8 as needed.
  - Develop etching method for RF boxes to thin down from a starting thickness of about 400 um to an average of 150 um and with a variation of thickness such that it is contained in a band 120 - 180 um.
  - Perform etching of final RF boxes.
  - Develop setup to perform leak tests of etched RF boxes: perform leak tests of etched RF boxes.
  - Deposit low-SEY coating on RF boxes

Foresee LS2

Technical support to LHCb for the feasibility of moving detector closer to the beam pipe

•Provide LHCb with a technical proposal by October 2012 to allow the TT and IT trackers. The following challenge applies:
- minimize the distance of approach of the detectors to the beam axis
- minimize the amount of material interactions and multiple scattering, which is of increasing importance the smaller the radii from the beam line gets.
One such proposal has been provided by Massimiliano Ferro-Luzzi, shown in Figure 1 below.
•The proposal will then be taken by LHCb and made into a mock-up to test the system. Results of the mock-up are required by end 2012. [MOCK-UP TEST WILL CONCLUDE IN JUNE 2013]

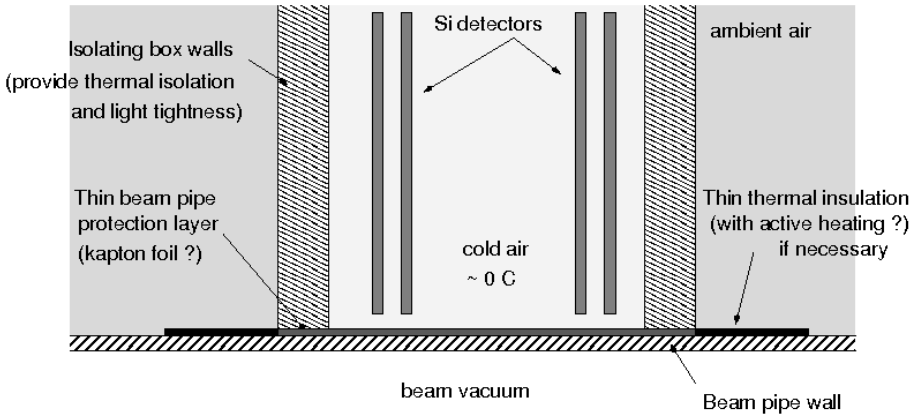


Figure 1: Proposal by M.Ferro-Luzzi

TE-VSC will make available all relevant documents (detailed drawings, installation procedures, as-built and as-installed drawings and configurations).

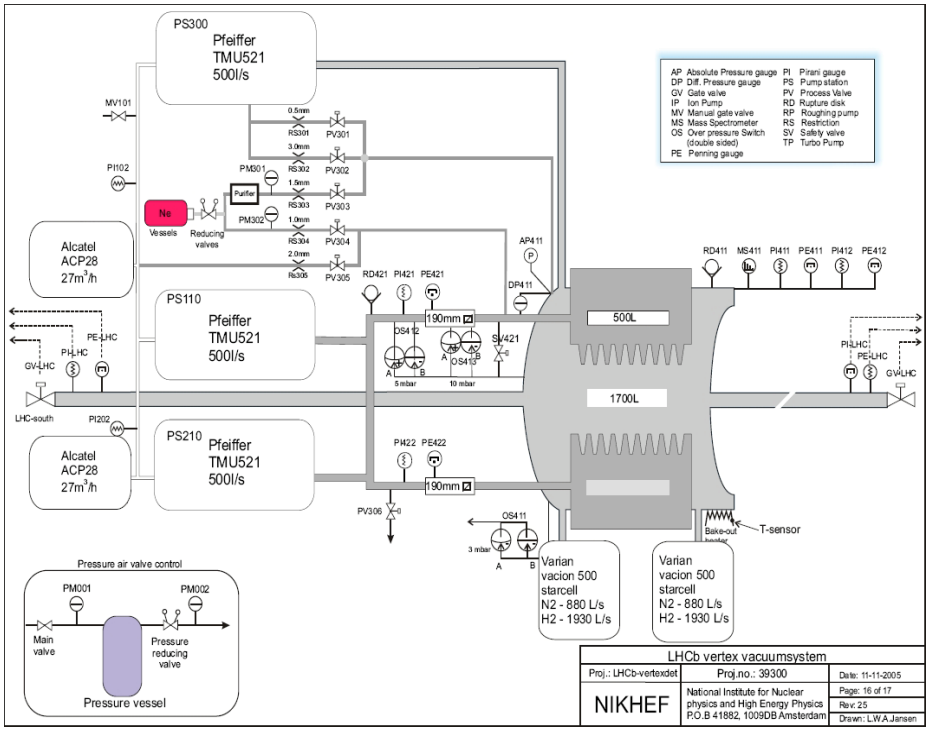
Still under discussion

Development new materials for experiments (shared with ALICE, CMS and ATLAS)

- Glassy carbon:
  - Brazing to metallic interface
  - Thick coating
- Composite chamber + aluminium coating
- Other new materials: We are looking for buying an inductive furnace to do new materials and in particular shape memory alloys.
- Development of next generation components:
  - Al CF flanges & Al body sector valves
  - New joining technics and supplier of beryllium chambers

Until LS2

Integration of VELO vacuum system controls and diagnostics into the LHC vacuum system



Foresee 2017-2018

- Integrating the VELO vacuum system controls and diagnostics into the LHC vacuum system
- Maintaining and operating the complete VELO vacuum system,
- Providing personnel 'on call' and at all times during machine operation for first-line services. In case of a more complex problem a dedicated expert will intervene *at best effort* on the complete VELO vacuum system,
- Keeping up-to-date the documentation of the complete VELO vacuum system,
- Replacing malfunctioning vacuum equipment, with the exception of parts that were fabricated by Nikhef, such as the mechanics, the detector enclosures, the large rectangular bellows, etc.,
- Possible upgrades of the set-up and for the maintenance of the PLC controls (hardware and software).

ALICE

Motivation

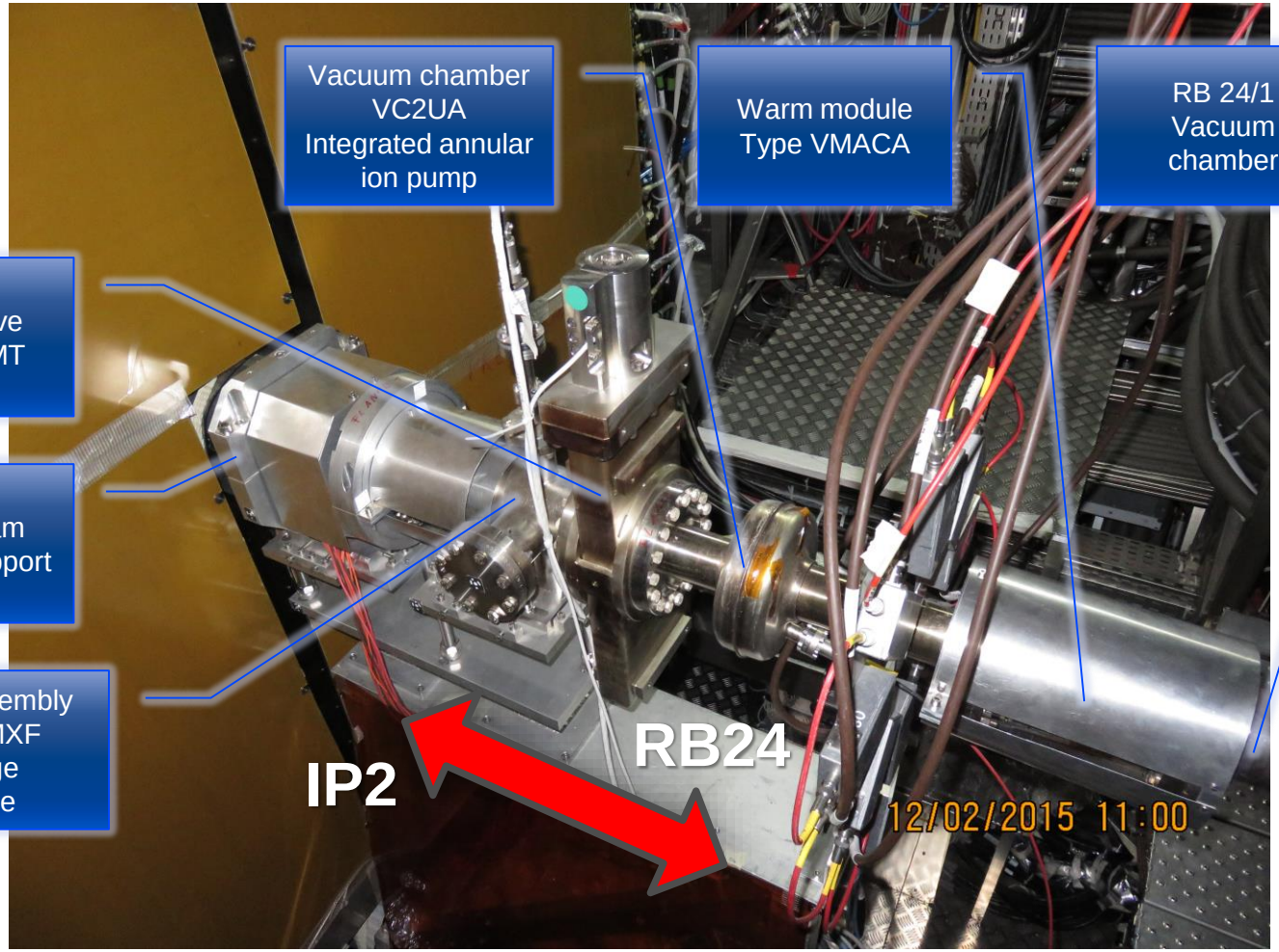
Based on the scope of TE – VSC & ALICE Work Package (EDMS 1065775):

Following presentation shows possible studies of ALICE RB 24 (A – Side) layout for LS2.

Main requirements are:

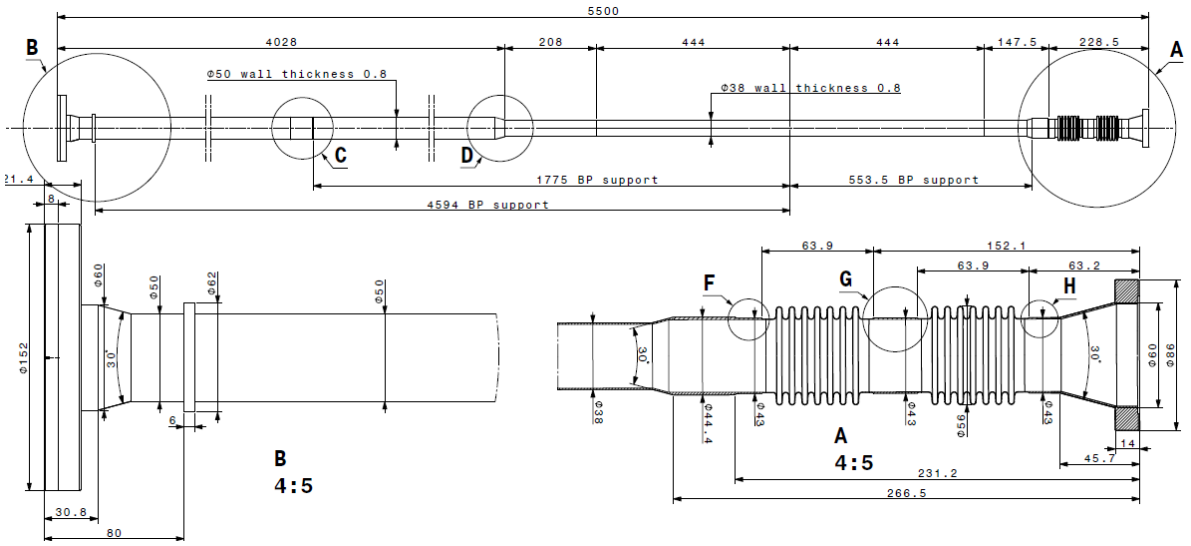
1. Allow to install and operate new **central beryllium beam pipe** (also VC2C).
2. Minimize **background sources** originated by beam vacuum equipment.

Actual installation of RB24

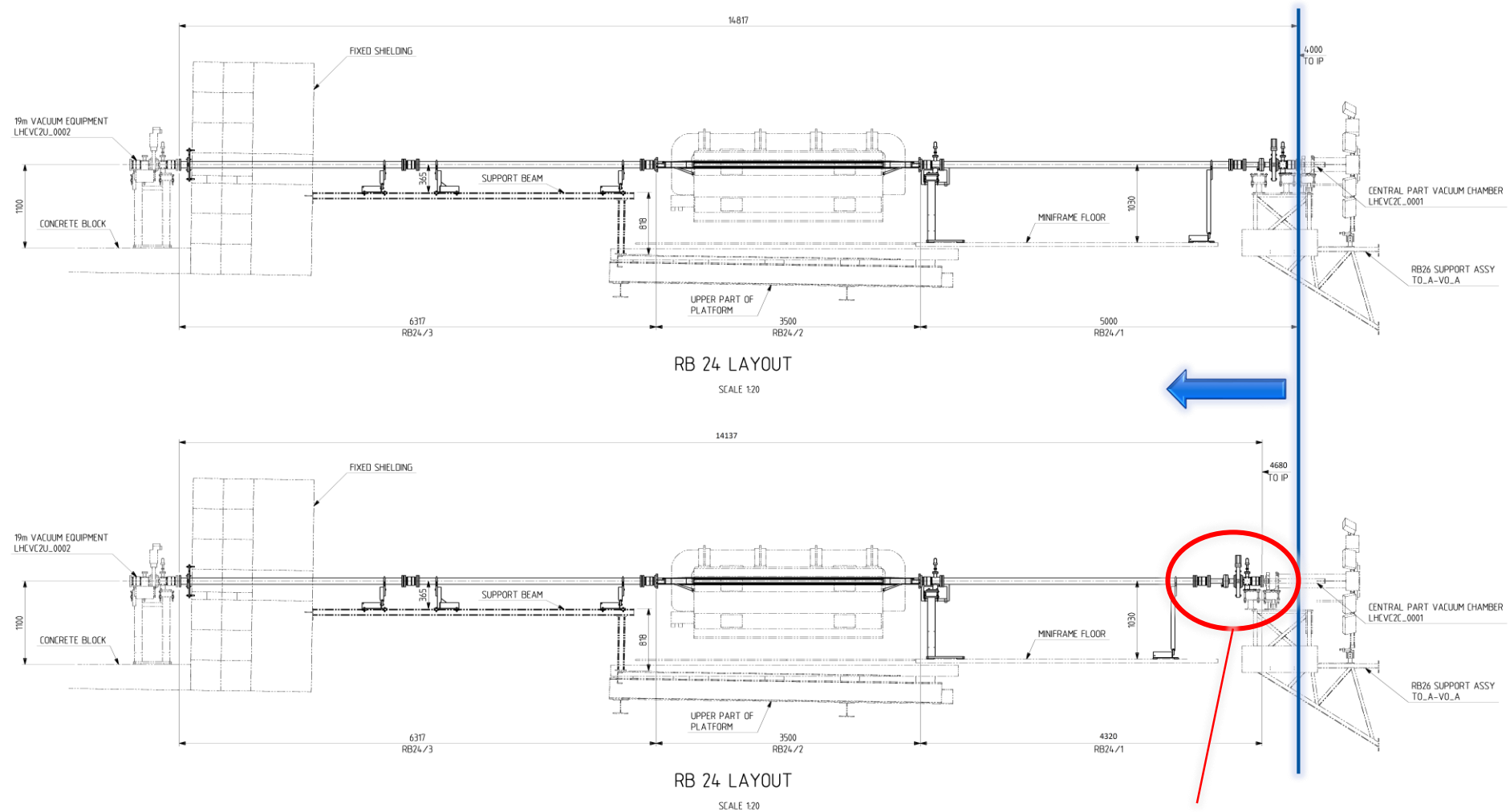


ALICE Central beam pipe for LS2

- Length 5500 mm (actual 4820 mm).
- Interface with RB24 (VAMXF warm module):
  - bimetallic DN 100 CF – F,
  - aperture 58 mm.



ALICE Central beam pipe for LS2

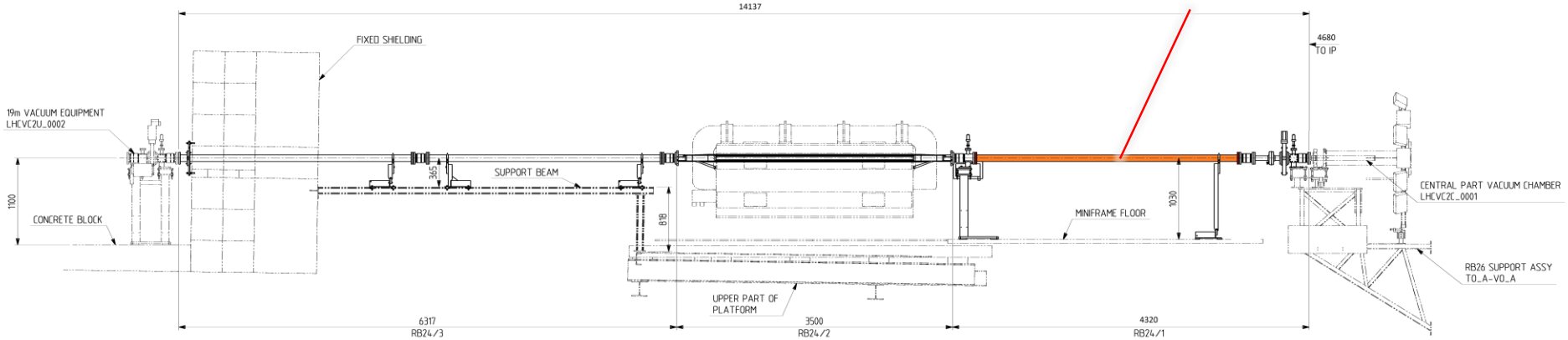


Instrumentation needs to be shifted 680mm

ALICE Central beam pipe for LS2

- Central beam pipe extension can be compensated by shorter RB 24/1 chamber.

Vacuum chamber with reduced length.



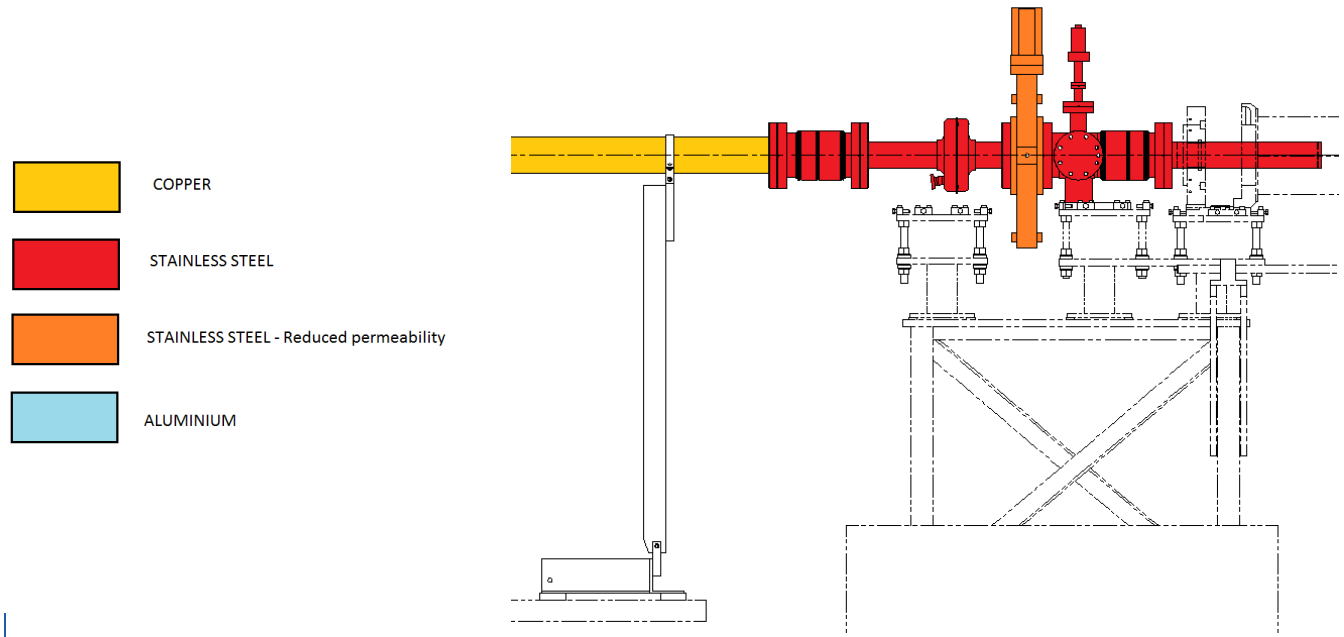
RB 24 LAYOUT

Name	ID [mm]	Length [mm]	Upstream flange	Downstream flange	Material	Coating
RB24/1 - VC2UB (actual)	80	3815	DN 100 CF -F	DN 100 CF -F	Cu OFS	NEG
VCDBF	80	3145	DN 100 CF -F	DN 100 CF -F	Cu OFS	NEG
Compensated length	*670 mm (wanted length difference is 680 mm so the rest would compensate annular ion pump chamber)*					

ALICE Background sources

Presented by Arturo Tauro 28/10/2014.

In **current configuration** the beam vacuum equipment bring significant background for ALICE – TPC approx. 30% and ITS approx. 25%.

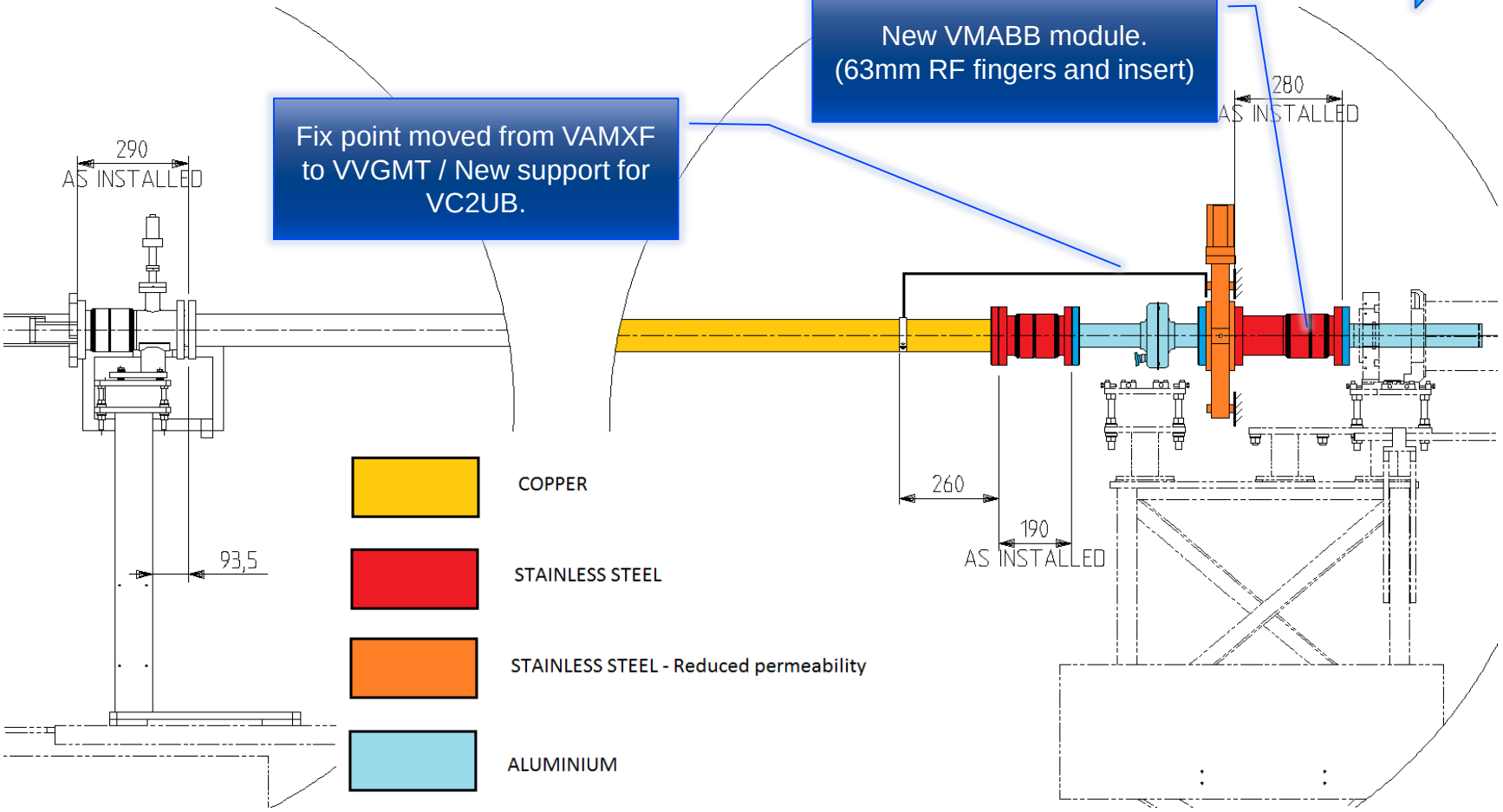


ALICE RB24: Proposed upgrade

Pirani relocated to LHC A1R2 sector valve

New VMABB module. (63mm RF fingers and insert)

Fix point moved from VAMXF to VVGMT / New support for VC2UB.



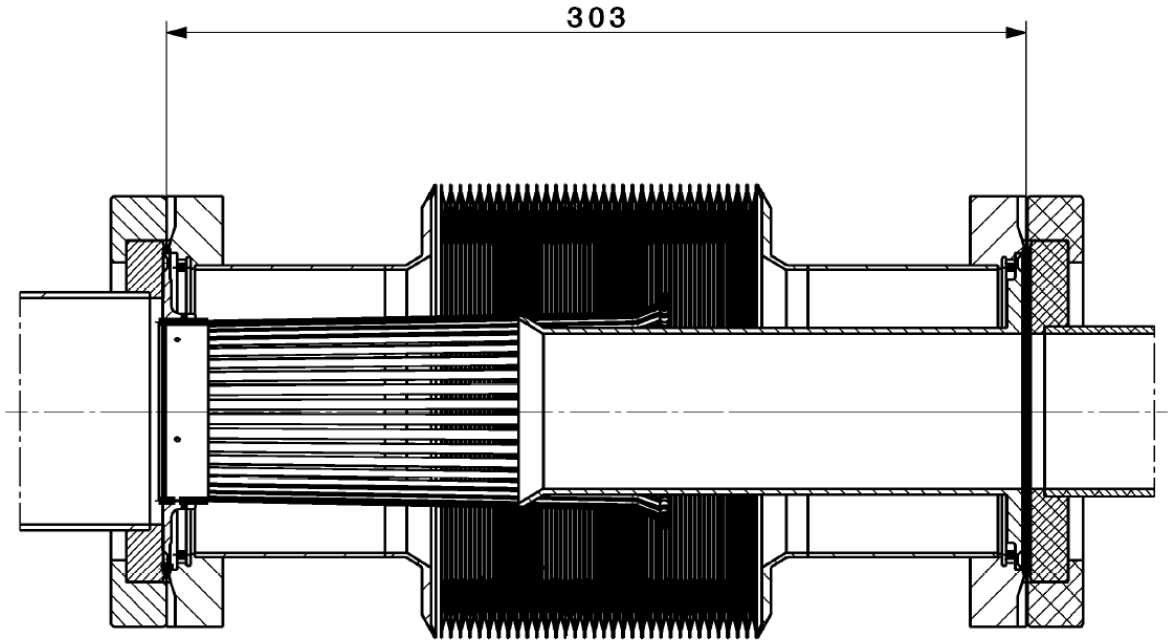
CMS Design constraints

- New chambers will be made from 3D forged aluminum alloy series 2219–T6 (heat treated and artificially aged).
- Aluminum bellows will be produced from alloy 5083.

	Stainless steel 316L	Aluminum 2219
E [GPa]	193	73.1
Re 0.2 [MPa]	290	240
Rm [MPa]	558	365
Coefficient of thermal expansion [µm/m·K]	16.2	23.4

CMS Design constraints

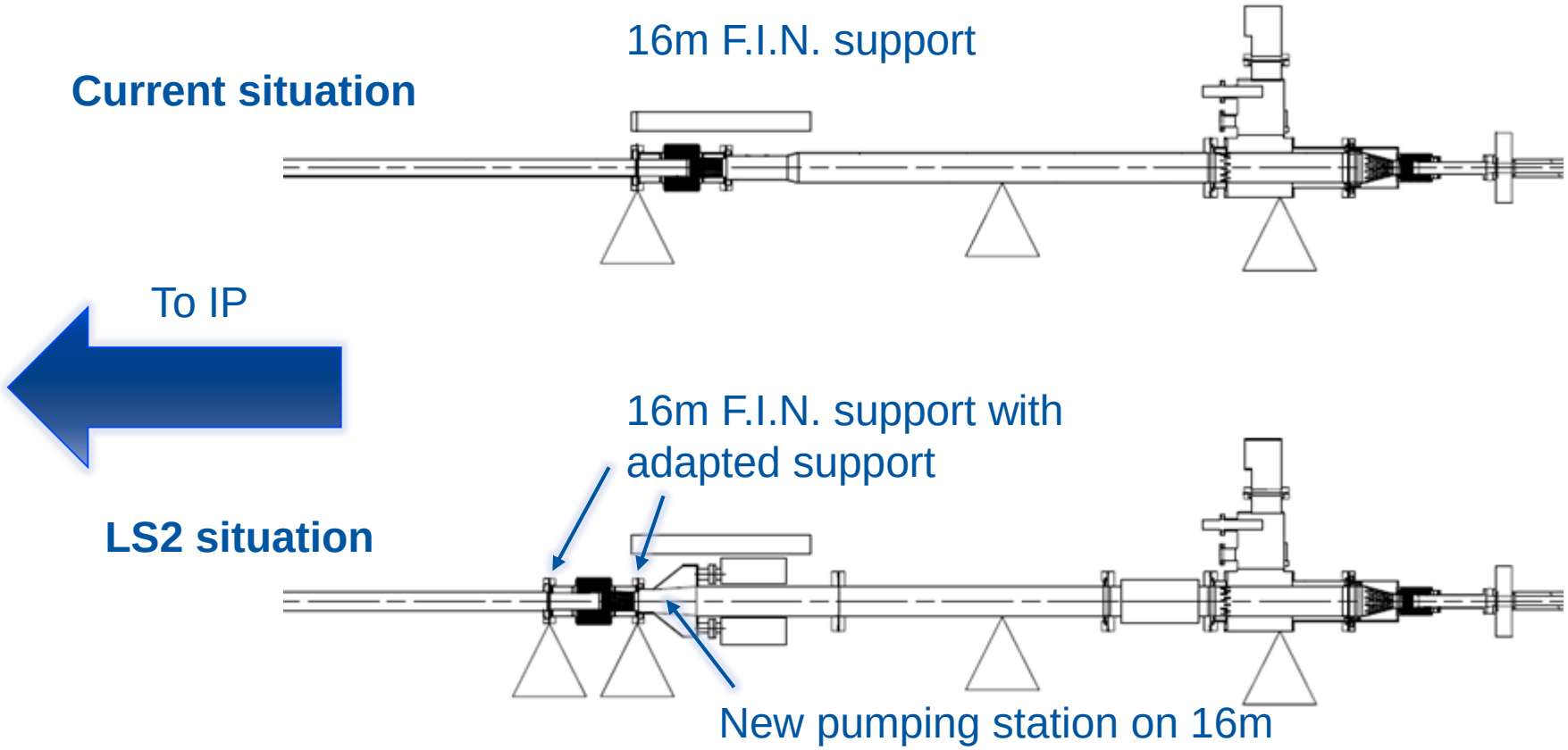
- Beam-pipe supports will remains in the same position.
- Extra thermal expansion needs to be accommodated during the bake-out (200ºC).



Existing module on 16m is capable to accommodate additional expansion (both diaphragm and RF bridge will be in conform position).

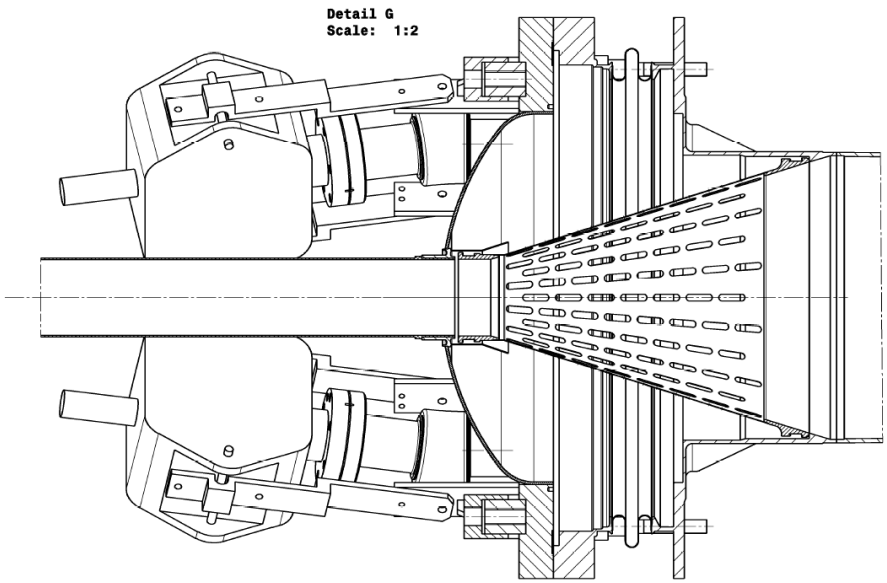
CMS Design constraints

- New installation can reuse existing module.

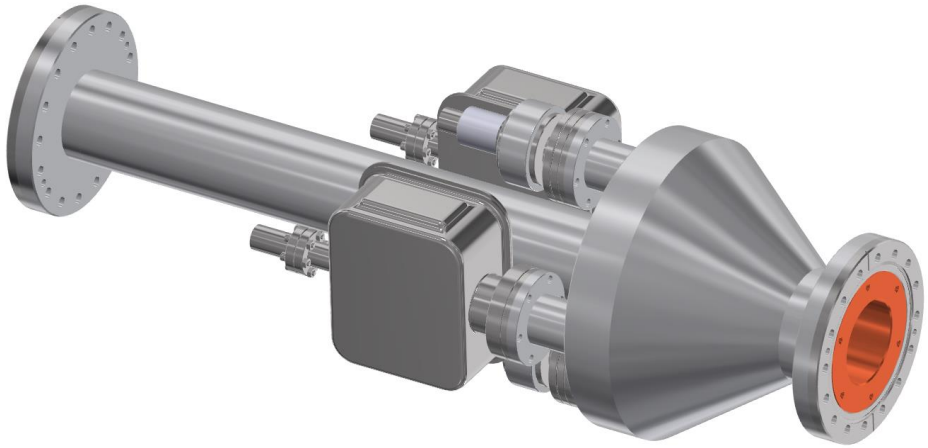


CMS Design constraints

- CT2 dish with 3x VPIXE ion pumps and 2x VGPB penning gauges will be suppressed.
- Alignment of the VC5EC still possible using VBX5A module (previous slide).



New aluminum chamber will accommodate 2x 20l/s ion pumps and 2x VGPB gauge.



Chamber is equipped with fix-point