Study of
"Proposition baseline for Vacuum equipment layout in the TASX/P1 environment."

- Introduction
- Detailed analysis for ECT movement of 400 mm on Standard Opening
- Conclusions from ATLAS TC

Introduction

A previous analysis of the proposal Vacuum equipment layout in the TASX/P1 environment has shown that many conflicts with ATLAS existing equipment are created by this layout. They can be grouped in 2 clusters:

- ✓ The conflicts in Run configuration, interfering with the cylindrical shielding
- ✓ The conflicts in Standard Opening configuration, interfering with the ECT

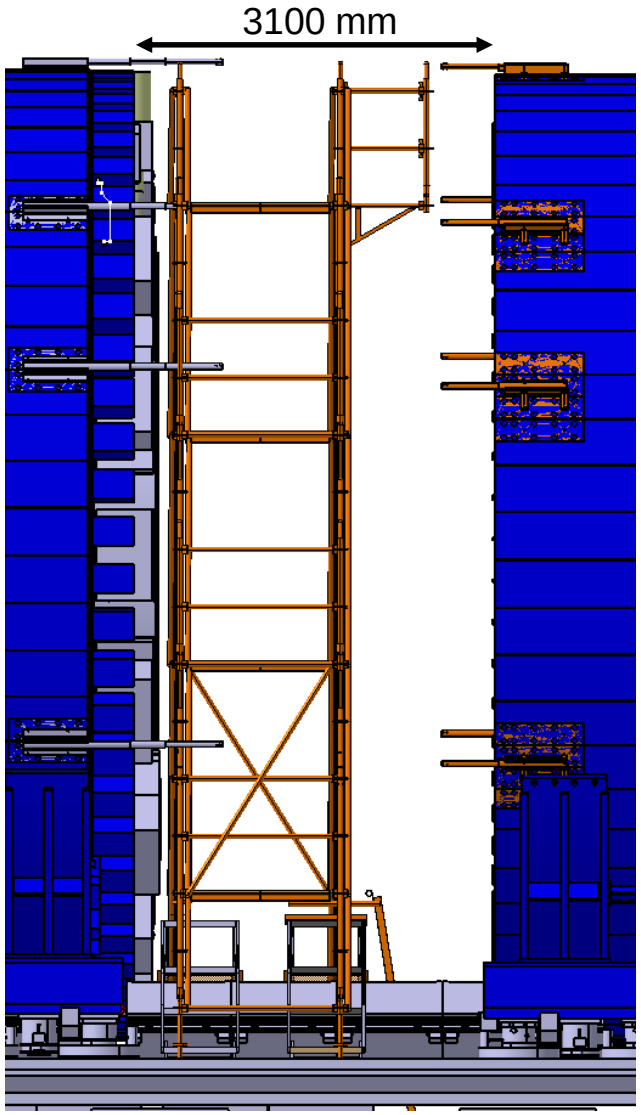
In order to solve the ones of the second groups, HL-LHC WP8 asked ATLAS to check the feasibility of moving ECT by 400 mm toward IP during Standard Opening. It will affect the Standard Opening **after LS3**.
This document summarises the consequences of this change of configuration.
In the present version, it does not include any study about the conflicts with the cylindrical shielding in Run configuration.

Nevertheless, the issue of the conflicts with ECT is far from being the only one !
Other issues are reminded in the conclusion.

Reminder: The Large opening should not be impacted as the vacuum system is supposed to be fully removed. This point is mandatory to get ATLAS in a configuration which is consistent with activities on Long shutdowns.

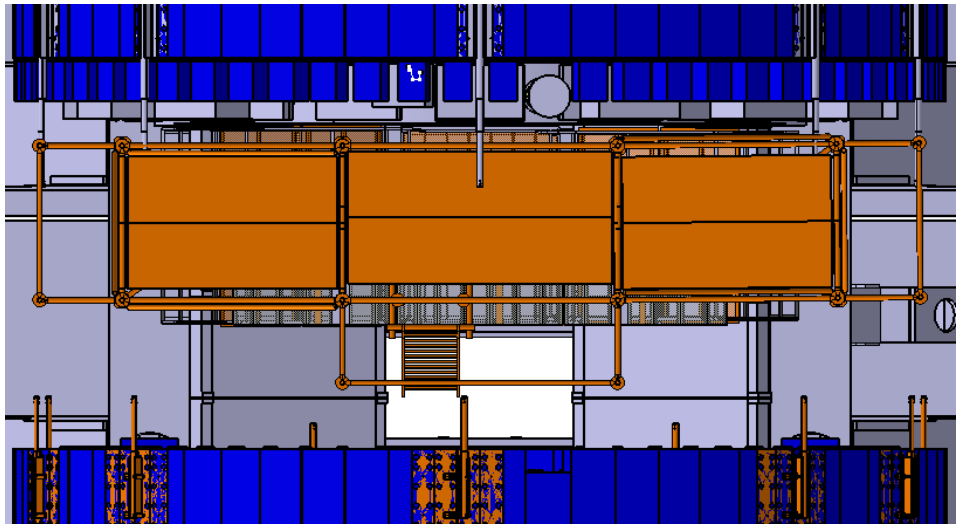
Main requirements for gaps between detectors

During a Standard Opening, 3 gaps are created in between detectors in order to allow access and maintenance.



Inner gap : between Barrel calorimeter and end cap calorimeter

- Nominal distance “Tile to Tile” = 3100 mm
- 3m is the current distance required to extract Tile drawers
- End cap shall be moved enough to make possible the use of the elevator to install the folding bridges and the scaffolding



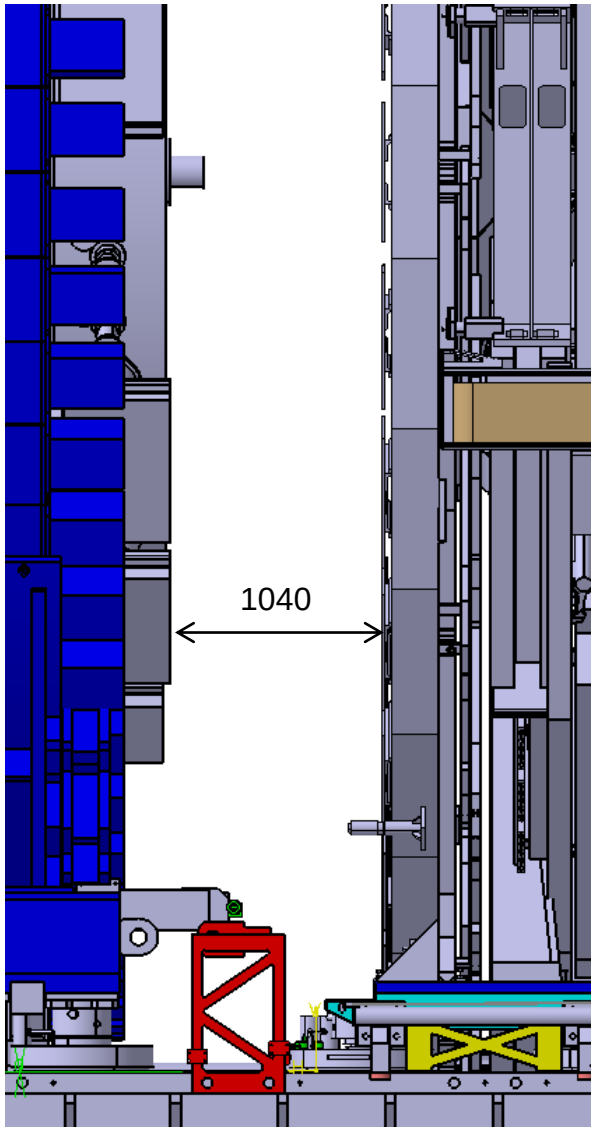
Top view : The full window of sector 13 is useable

Main requirements for gaps between detectors

Intermediate gap : between End cap calorimeter and JD

Nominal (and Minimal) clearance = 1040 mm
→ Scaffolding width = 890 mm
→ ATLAS 0.708º slope : +110 mm
→ Clearance between detector and scaffolding : + 20 mm on each side

The size of this gap is already at the minimal dimension, therefore there is no hope to recover any space from it.



Main requirements for gaps between detectors

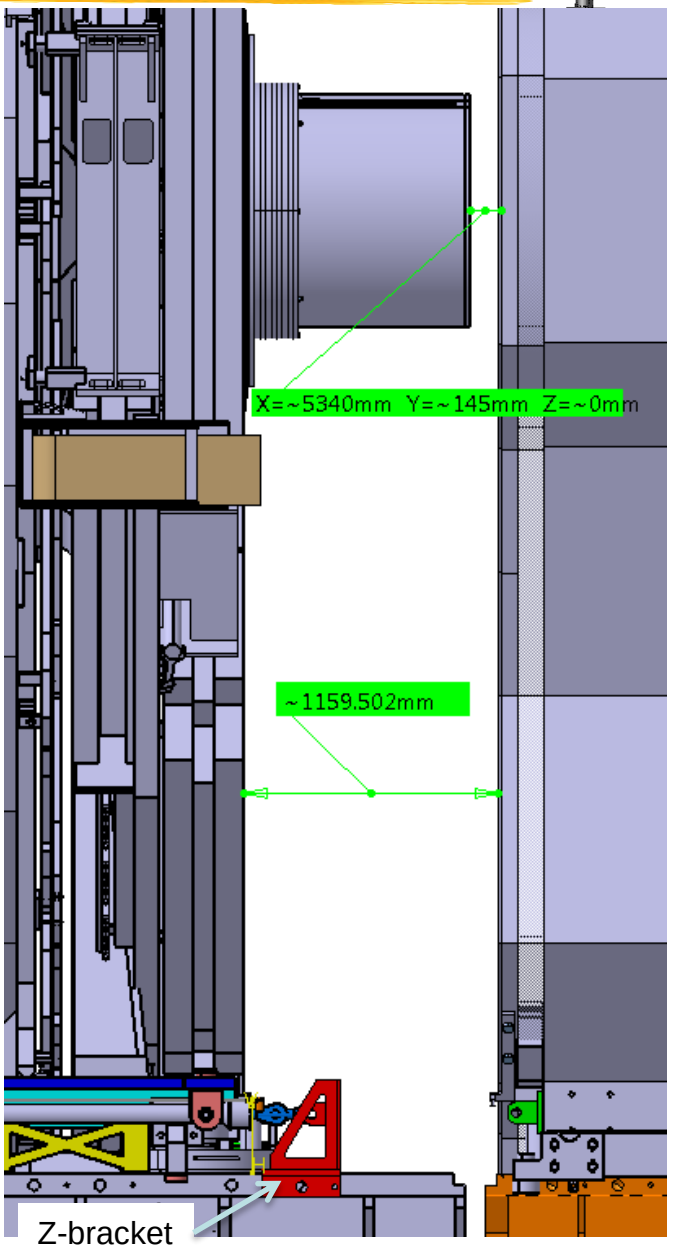
Outer gap : between Small Wheel and ECT

1- Nominal clearance is 1160 mm
Minimal clearance = 1040 mm

- Scaffolding width = 890 mm
- ATLAS 0.708º slope : +110 mm
- Clearance between detector and scaffolding : + 20 mm on each side

2- The gap 145 mm between ECT and JD centre tube is used to support the beam pipe during the shutdown.
Minimizing the gap from 1160 mm to 1040 mm makes the gap equal to 25 mm → a new support must be designed in agreement with TE/VSC (not critical)

3- It must be possible to connect the Z-bracket to the rail so that movement is feasible.



Main requirements for gaps between detectors

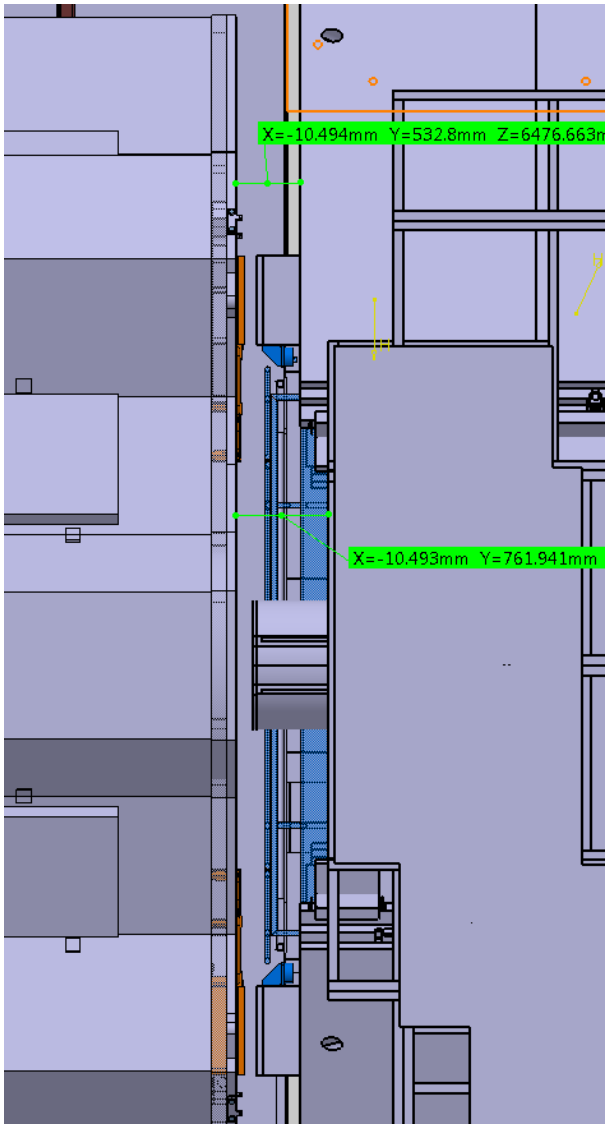
Outer gap : between Small Wheel and ECT (cont'd)

4- Access from the top allows to use the crane to carry material in the gap

- Z-brackets onto the rails (530 mm)
- Small elevator in sector 13 (760 mm)

This gap is also useful for some unforeseen activities like the removal of CSC chambers from SW-A during LS1.

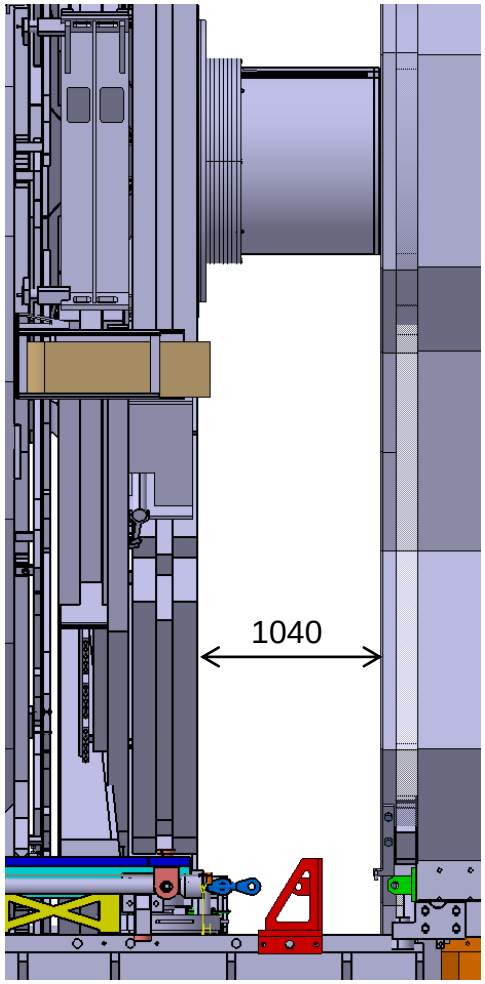
Note : the top ECT platform, as well as the bridge platform at sector 5 are not shown



Top view

ECT moved by 400 mm : which consequences ?

400 mm have to be saved, therefore outer and intermediate gaps have been resized at 1040 mm.
Let's see the consequences.

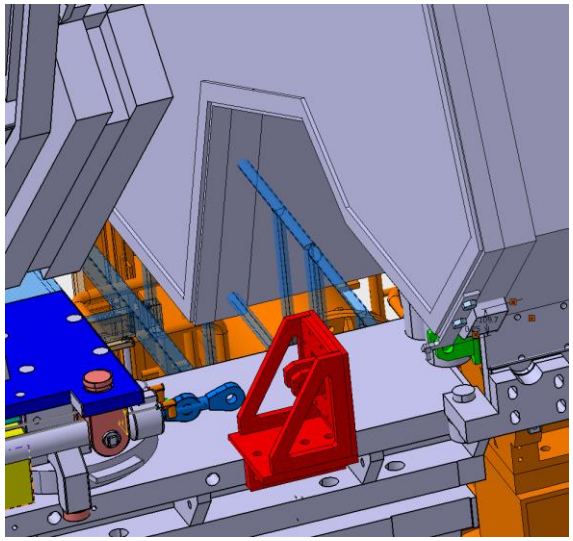


<u>Outer gap</u>

The gap between JD centre tube and ECT is now limited to 25 mm → a new support must be designed in agreement with TE/VSC (not critical)

The connection and use of the Z-bracket is still possible

The handrail has to be modified in sector 13. The access there is more difficult from the trench (it is the current path to bring in scaffolding and other tooling)



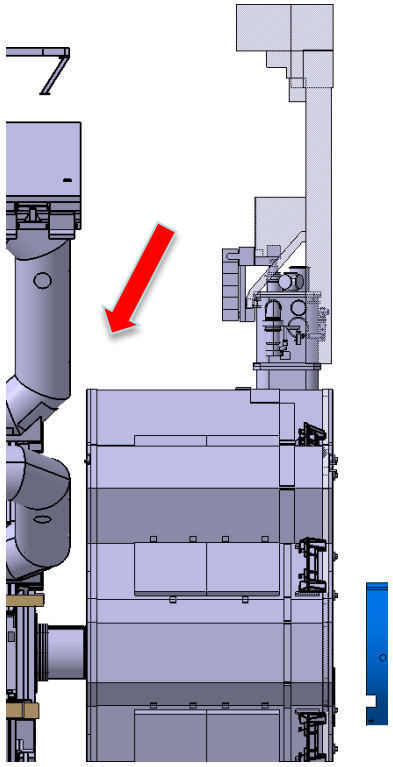
ECT moved by 400 mm : which consequences ?

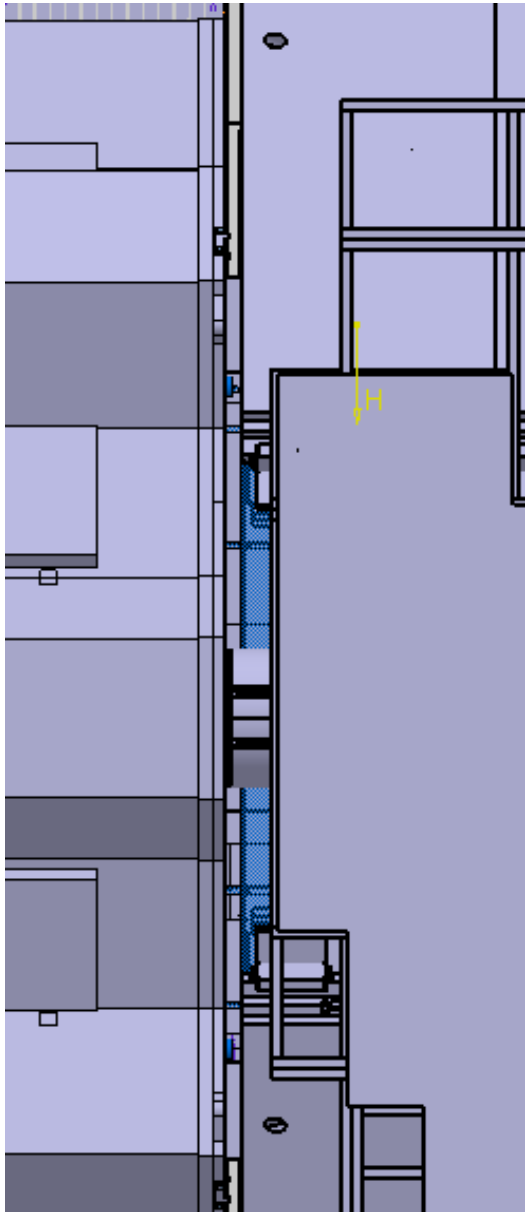
Outer gap (cont'd)

To use the crane to carry material in the gap is not possible anymore

- To carry Z-brackets onto the rails is an issue (90 kg each)
- Small elevator in sector 13 becomes impossible
- Study of ECT anti-seismic brackets has to be re-done, not easy because ECT sticks out of the Truck envelope.
- No crane access to Small Wheel

Note : the top ECT platform, as well as the bridge platform at sector 5 are not shown, but the last one would need to be shortened.



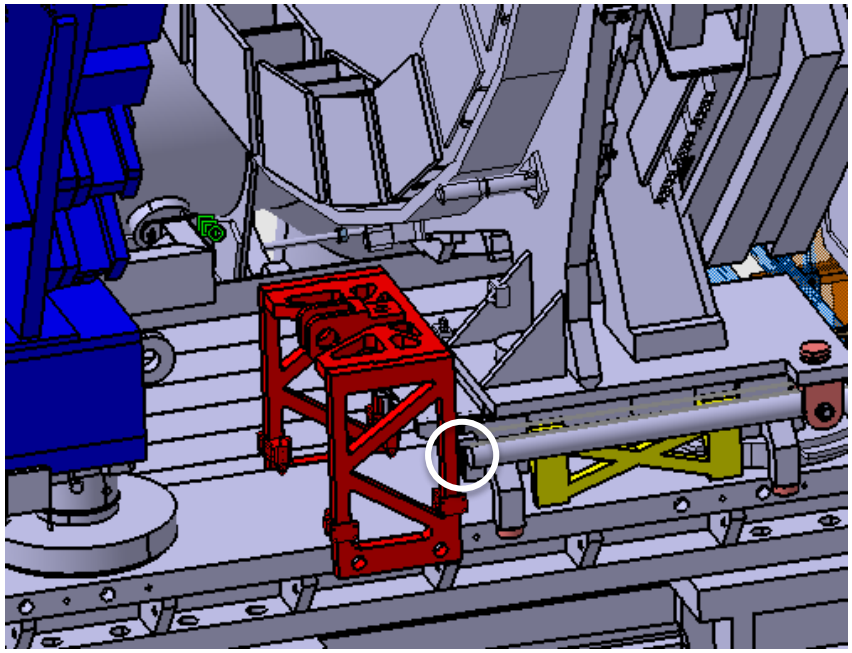


ECT moved by 400 mm : which consequences ?

Intermediate gap : between End cap calorimeter and JD

Nominal (and Minimal) clearance = 1040 mm kept unchanged

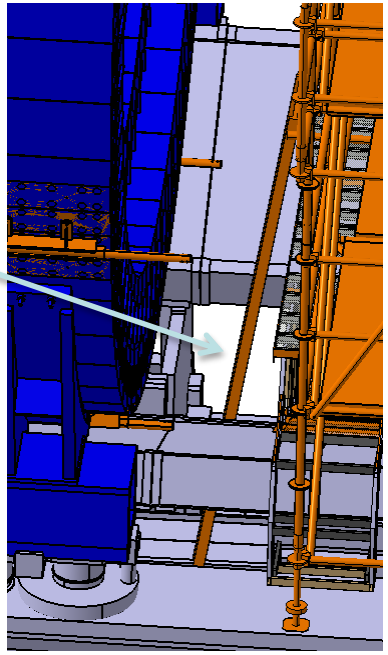
The gap is “just” moved toward IP by 280 mm.
According 3D model there is no additional conflict, however the Z-bracket is very close to be in contact with JD (≈1 cm !)



ECT moved by 400 mm : which consequences ?

Inner gap : between Barrel calorimeter and end cap calorimeter

- Distance “Tile to Tile” is reduced to 2820 mm : it makes impossible the drawer extraction in one shot, but current idea of Tile group is to make shorter drawers anyway : to be carefully checked with Tile PL
- There is still no conflict with scaffolding or folding bridges when they are installed
- The access through Sector 13 ladder becomes very narrow (41 cm only !)
- The possibility to use the elevator to install the folding bridges and the scaffolding has to be checked in detail. The aperture goes down from 920 mm to 724 mm. The elevator width is 700 mm, but the 0.708º tilt has to be considered and some clearance for safety as well.
- It may be needed to modify the Liquid Argon purge line to match the new position of the end cap calorimeter (to be checked with cryogenics)



Comment : to move end cap calorimeter further, then built the access and finally move the calorimeter to final position is a doable process. But it would take about 1 more day on each side at opening AND closing.

ECT moved by 400 mm : which consequences ?

- The analysis does not take into account the possible addition of detector related to Large Eta analysis
  - ✓ Segmented timing-preshower in front of EMEC/FCal
  - ✓ Muon spectrometer options (μ tagger ?)

- ATLAS is more and more “dense”, existing clearances and gaps are progressively “fulfilled” (BME, RPC upgrade for phase II, Large Eta, …), we are pushed to reduce detector envelopes. In such a context, the decrease of the gaps between detectors will have many consequences that will make intervention in Toroid Area longer and more tricky. To give numbers is quite difficult but it is a reality for people working underground.

- The analysis does not take into account any additional shielding that may be required in the main gaps after LS3.

- Even if we don’t have data yet, we can anticipate that the dose map will be higher with the additional vacuum components, it will have an impact on activities such as vacuum chamber alignment, shielding handling and Forward detector (LUCID) interventions.

ECT moved by 400 mm : conclusions

1. Loss of capability
   1. No crane access to the Outer gap :
      - ✓ Z-bracket installation ?
      - ✓ No elevator → scaffolding to be built and removed (+20 hours for 4 tech. on YETS)
      - ✓ No crane activity (i.e. Muon chambers)
2. To be checked
   1. Feasibility of folding bridges installation at Inner gap (if not the only solution is to perform an additional movement of each calorimeter)
   2. Distance “Tile to Tile” is reduced to 2820 mm : is it acceptable after LS3 ?
   3. Any conflict after new detector installation (Large Eta) ?
3. Additional difficulties and inconvenience
   1. Transport of material from Trench to Sector 13 (Outer gap)
   2. Personal access to Inner Gap scaffolding reduced to 41 cm wide
   3. Clearance very narrow : difficulty to install the scaffolding and to work in the area
   4. Activation in the forward region will be higher
4. Required modifications to make it possible :
   1. Shortening of bridge platform between ECT and Sector 5
   2. Modification of platform/handrail at Sector 13
   3. Temporary VT support (at ECT end)
   4. ECT seismic brackets
   5. Modification of Liquid Argon purge line

Conclusions

- Reduction of shielding would have strong consequences on background, hence is not acceptable (by the way it has just been increased on LS1…)
  - No machining
  - No slot in any part
  - Simulations can be provided to justify this decision
- On Large Opening (i.e. on every long shut down) the vacuum chambers must be removed up to the JN Monobloc.
- LUCID has to be moved toward IP : even if it is possible, services will cross the area where the valve and ion pump would be installed.
  The same for vacuum chamber services (VT + VJ) : we need to understand how these services will be managed.
- A detailed analysis of the intervention time and procedure is expected to quantify the benefit of moving the vacuum system to ATLAS side and check possible impact of the dose budget (ALARA).
- The 40 cm protrusion of vacuum system toward IP is not acceptable
- JTT replacement could be an option, it is open to discussion