Status and proposal for layout and integration around TAS

Outline

- Update on the TAXS & VAX aperture
- Open issues in Q1-TAXS layout

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INPUT FROM P. FESSIA & MEETINGS WITHIN WP8
…AND JOINT SESSIONS WITH WP2, WP3, WP9,WP10, WP12, WP13, WP15

Motivation (REMINDER)

- Access in the **TAXS-Q1 region** needs to be optimised during HL-LHC operation, given the expected radiation levels
  - Presently in the ~1.3m of space there are several equipment installed: warm BPM, 2 vacuum valves, bellows, bake-out equipment

- The presently installed warm BPM is not optimal in terms of operation
  - non-optimal location in collision mode due to beam overlap
  - difficulties in alignment, not fixed reference wrt Q1
  - weak point in the design in case of vacuum leak

TAS-Q1 Layout baseline for HL-LHC operation

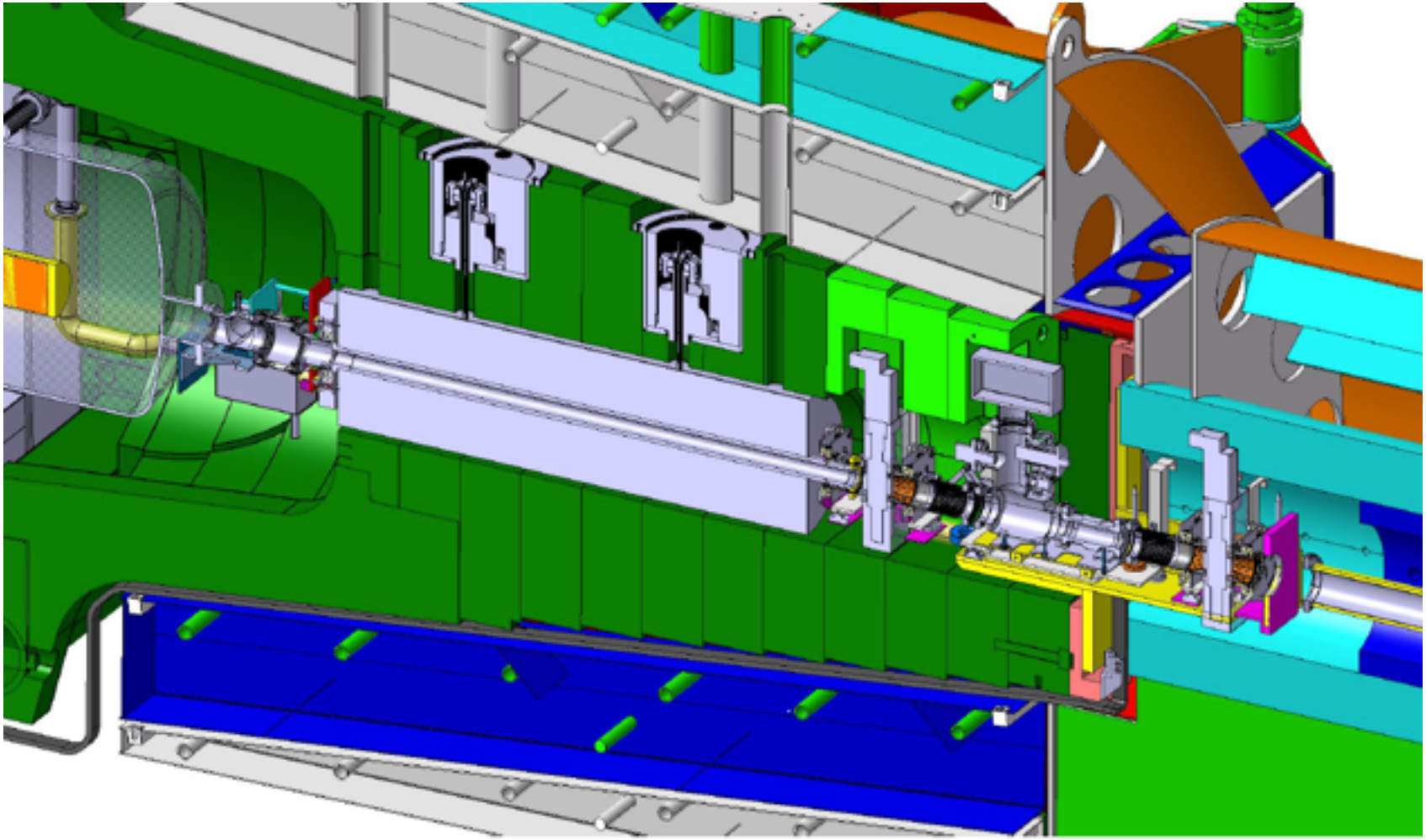
- **A. Maintain the same location of Q1 (L*=23m) and include the Q1-BPM into the cryostat**
  - Allows for fixed mechanical connection between the BPM and the magnet cold mass therefore improved alignment and position monitoring during operations
  - Mitigates the risk of vacuum leak from the warm BPM of today

- **B.a Design the new TAS (TAXS) with C-coated vacuum**
  - removes the need for bake-out equipment in the TAS-Q1 region
- **B.b Develop a new quick/remote connection for the TAS-Q1 vacuum**
  - start from the design of the collimators, develop something that can be piloted from a distance

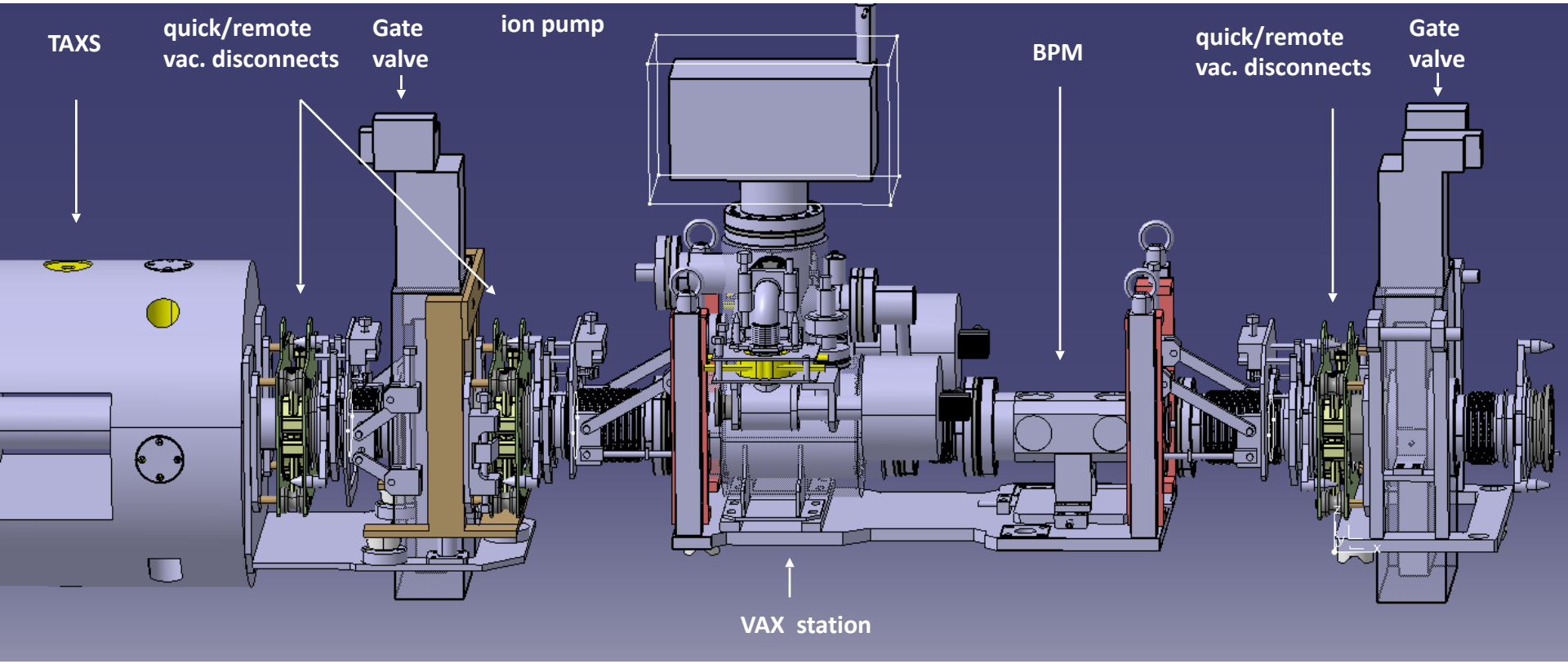
- **C. Displace all vacuum equipment from the TAS-Q1 region to the experimental cavern**
  - Engineer for full **remote operation** to compensate the higher (x3) radiation levels
  - **Modular** design, fast exchange of modules in case of failure
  - Maintain the He isolation of the experimental cavern to LHC tunnel
  - Include a **new warm BPM** that would be located in a good region to allow *optimised beam steering and luminosity optimisation* during operations

TAS-Q1 Layout baseline for HL-LHC operation

CMS implementation



TAXS-VAX-BPM module for HL-LHC



Status - Apertures

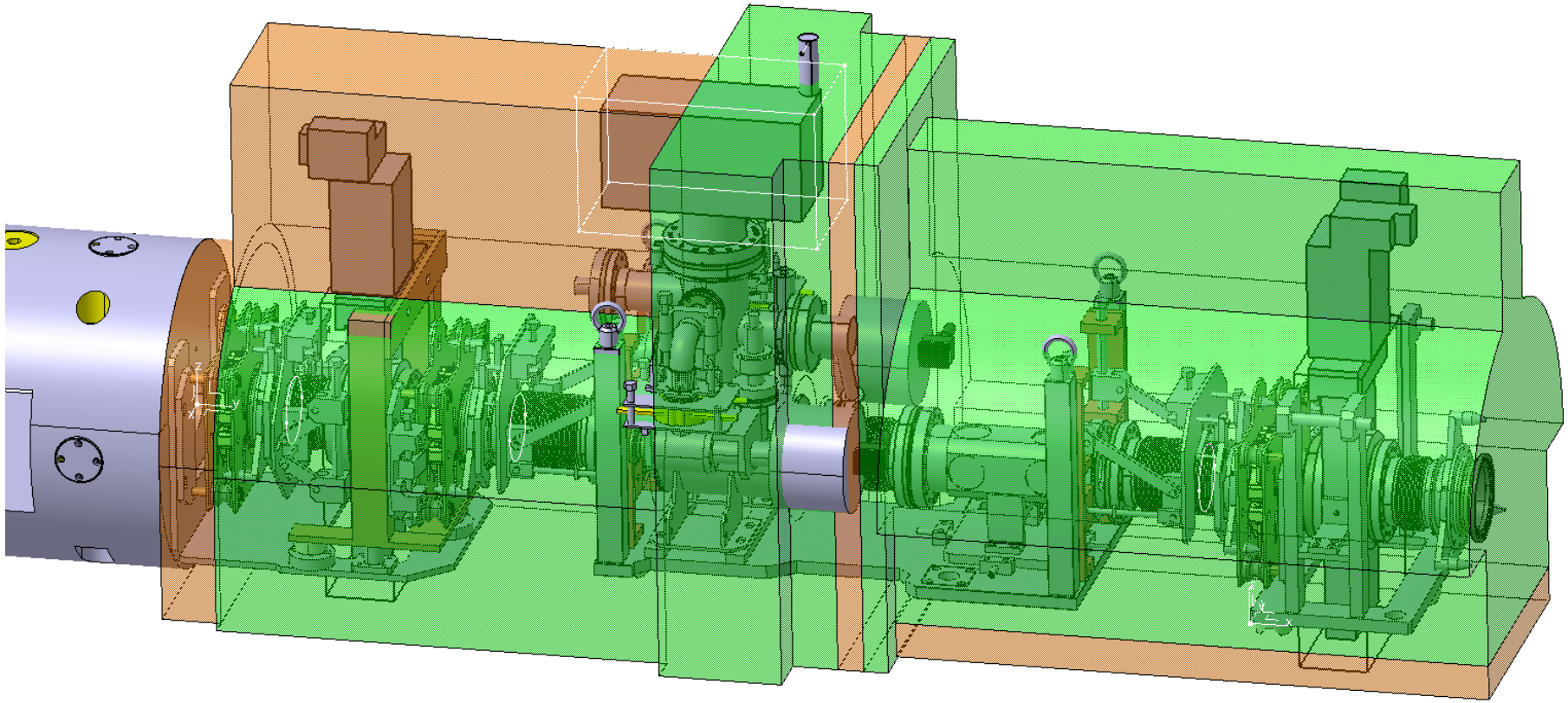
- The proposed layout is almost feasible with the shielding arrangements in both experiments (ATLAS & CMS), **only using DN63 gate valves**
  - This leaves a clearance of only **1.5 mm in radius** between the TAXS with an aperture of **60mm**∅, to ensure that the gate valves remain in the shadow of the TAXS, for less background to experiments, and avoid the direct beam impact on the gate valves

- Is it sufficient ?

- Consider :
  - TAXS vacuum ID tolerance : ±0.5mm
  - TAXS - gate-valve relative alignment error : 1.0mm (pessimistic)
  - beam squeezing towards IP : ~1.2-1.4mm/m
- Proposal
  - maintain the TAXS aperture to **60mm diameter net** (i.e. TAXS aperture to 61mm∅)
  - engineer the alignment of the VAX-BPM module wrt the TAXS to ensure they **remain within ±1.0 mm after the closure of the shielding in the experiments** - challenging !!!

Status - Layout

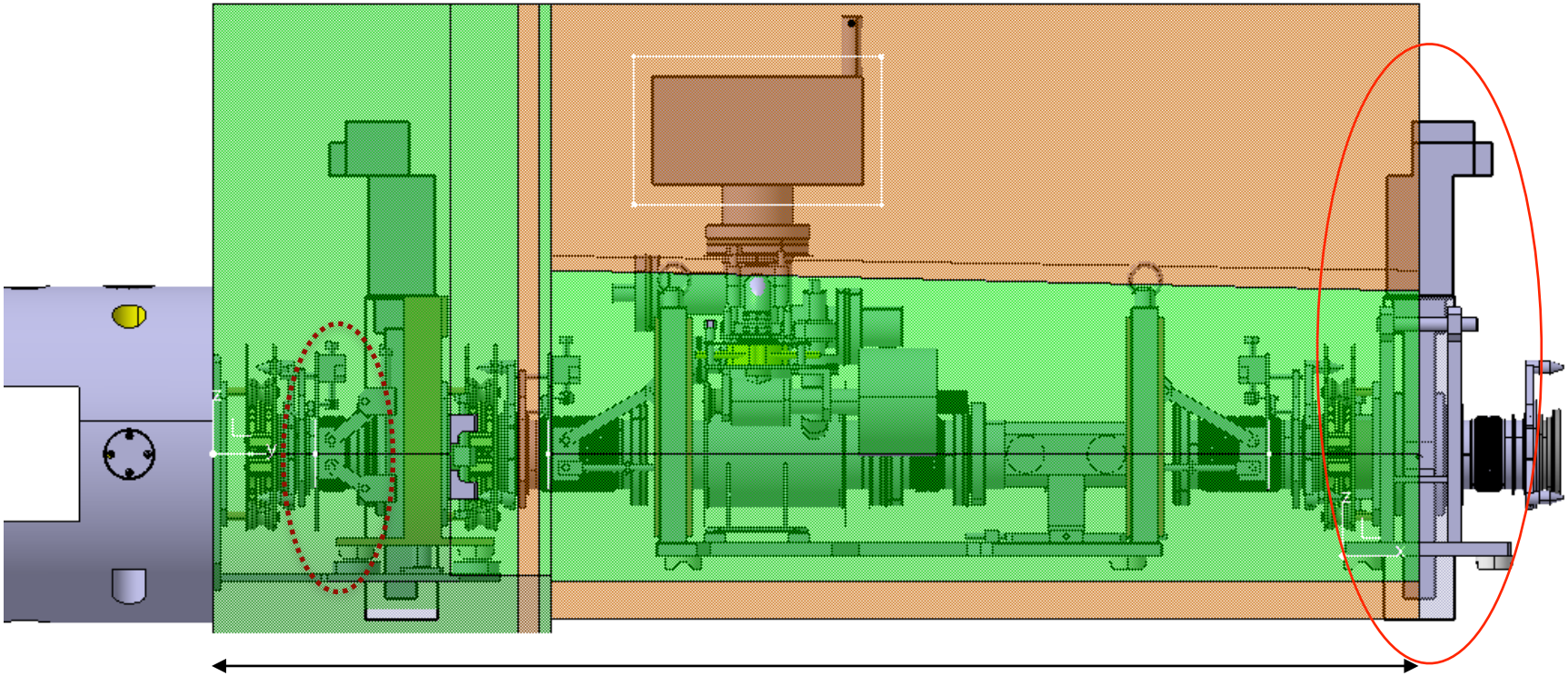
- TAXS-VAX integration with the experiments - **CMS**



- no major conflicts so far
- For both experiments : a solution for the services (cables, vac gas pipes) is found but need to be finalised

Status - Layout

- TAXS-VAX integration with the experiments - **ATLAS**



- conflict in length
- could be partially reduced if the first gate valve is directly attached to the TAXS
- but we must also consider clearances (mechanical & safety during shielding removal/ installation)

Status - Layout

Open issues

- accommodate the foreseen equipment in the available space - ATLAS
- finalise the design and optimisation of the Q1-TAXS quick connection
- alignment & stability of BPM in the experimental cavern

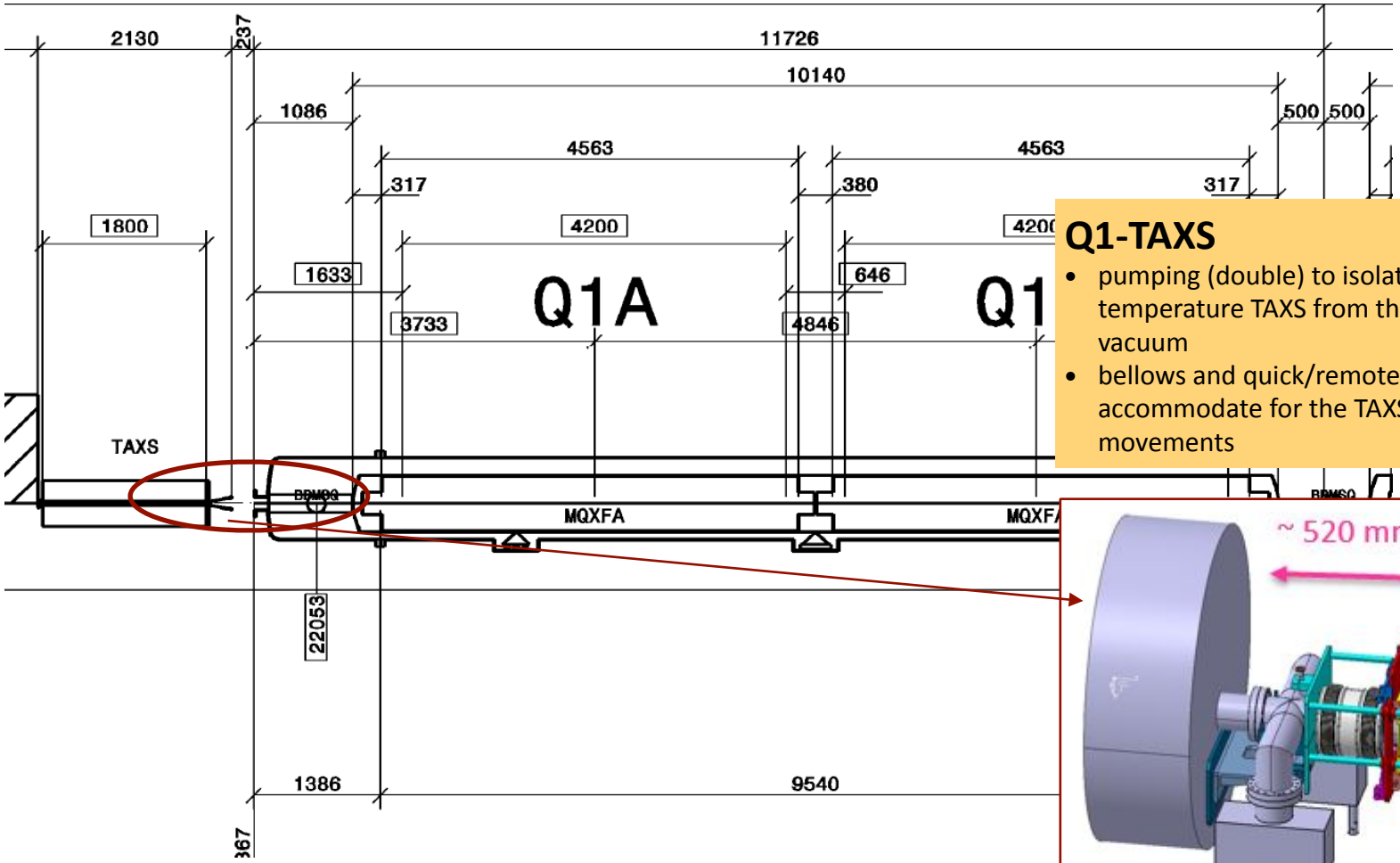
Status - Layout

Action plan:

- **Option A** : remain with the baseline solution, try to reduce the length of the valves-VAX-BPM assembly to fit within the available volume in particular for ATLAS
  - ongoing work within WP8 & WP12 - possible?
  - cons : requires beam-based alignment to be able to use the BPM-exp in operation, BPM-Q2 remains in the blind region

- **Option Ba** : could we eliminate the need of the BPM-exp ?
  - pros : eliminate the weakest element in terms of vacuum leaks - reduce the need for 'hot' exchange of modules, reduce the number of services
  - cons : must place the BPM-Q1 in the good region, (advance wrt present layout by ~200 mm!)
- **Option Bb** : rearrange the LSS layout to maximise the number of BPMs in the good region
  - pros : bring also BPM-Q1 and BPM-Q2 in good region - ideal solution for Luminosity and operations
  - cons : re-design of equipment (inner-triplet magnet, services)

Q1-TAXS layout - baseline



Q1-TAXS

- pumping (double) to isolate the room temperature TAXS from the cold Q1 vacuum
- bellows and quick/remote connect to accommodate for the TAXS movements

HLLHCv1.2 BPM positions

	BPM	BPM [m]	LR [#]	Delta [m]
1	TAXS-Q1	22.053	6	-0.387
2	Q1b-Q2a	33.193	9	-0.467
3	Q2a-Q2b	43.978	12	-0.902
4	Q2b-Q3a	54.763	15	-1.337
5	Q3b-CP	65.903	18	-1.417
6	CP-D1	73.619	20	-1.181
7	D1-TAXN	82.089	22	-0.192

Blind area |Delta|<0.57 m

Negative Delta BPM is in between IP and LR
(570-387)=183
(570-467)=103

If Q1 assembly is moved by ~200-210 mm(183 + ~20mm to consider the thermal contraction) towards the IP, BPM 1 and 2 become effective.

In alternative at the expenses of β* reach and further layout changes:

- Q1 should be moved by 1037 mm towards the arc
- Q2a should be moved by 1472 mm towards the arc
- Q2b should be moved by 1907 mm towards the arc
- Q3a should be moved by 1987 mm towards the arc

Action Plan - Options Ba-Bb

- Several possibilities to investigate

Option	*Info*	*Comment*
1	*Displace BPM-Q1 inside the Q1 cryostat (i.e. displace by -183mm)*	*Need to work the cold-warm transition, maintain the present 520 mm external to Q1*
2	*Displace whole Q1 inside the cryostat, bring BPM-Q1, and BPM-Q2 in good region*	*Challenge to maintain the Q1-TAXS space* *Possible to reduce L* to 23.7m*
3	*Position BPM-Q1 in the warm area but in secondary vacuum*	*Need to ensure the correct alignment with the Q1 cold mass to make it operational and thus eliminate the BPM-exp.* *Failures? need for access in the Q1-TAXS area?*

Action Plan - Options Ba-Bb

- … and with more drastic changes

Option	*Info*	*Comment*
4	*Displace the whole Q1 as option 2 but attach the TAXS to the cryostat of Q1*	*Eliminates the need of the bellows between TAXS-Q1. Eliminates the need for TAXS alignment ⇒ less operations (ALARA), opens route for services Reduce L* , No need for a remote connection between TAXS & Q1* *Major redesign of the Q1 cryostat, supports, alignment, installation and handling operations*
5	*Embed a warm BPM in the TAXS on either side*	*Redesign of the TAXS, much check shielding efficiency, but could be compensated with denser material?* *Need to address the case it fails - fast change?*

Action Plan - Next Steps

- Agreed to study the various options starting with cases 1-2 as the most realistic ones
  - Work of several WP is required to advance with some level of technical details
- Given the workload in all groups, we ask the TC to endorse the strategy and set the proper priority level to these studies in the relevant WPs

- We'll coordinate the efforts in focused meetings within the WPs involved and special sessions in the Friday integration meetings

- We aim for a first evaluation by end of **January'16** (dictated by the CE contract timeline) to define the new baseline
  - Review session to organise including technical drawings at the appropriate level to make sure the solution is fully validated - **no turning point**

Thanks to all colleagues of WP8, WP2, WP3, WP9,WP10, WP12, WP13, WP15

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