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Summary of discussion

Alignment strategy for VAC components in the HL-LHC LSS

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1 Zone of interest

The study that will be carried out is for the HL-LHC project. The zone of interest where secondary beam line components such as collimators, beam instrumentations and equipment from VAC have to be aligned is situated on both sides of point 1 and point 5 between TAXN and D2 – approximately 9 m – and between D2 and Q4 – approximately 40 m. In case the proposals are fundamental to improve the alignment process of the components a modification of the zones in point 2 and point 8 can be investigated as well. At the moment, the project studies the case in LSS 5R.

2 Alignment requirements

From the calculations presented by VB, an alignment budget of ±2 mm is available for the survey activities on the VAC components. The alignment strategy of an accelerator is always based on the task to provide a smooth line. As the main components in a HL-LHC LSS will be equipped with motors, a remote repositioning is possible – in theory – at any moment. Secondary components, e.g. the vacuum components will not be realigned after each remote operation of the main components. They have to be checked and realigned at the Year End Technical Stops (YETS) or if a threshold of the alignment of the main components has been reached during operation.

2.1 Alignment concept

The modifications discussed are based on the current alignment concept based on laser tracker measurements.

2.2 Breakdown alignment budget

Table 1: alignment budget

Description	mm
Free station in local network (including accuracy of survey targets)	0.2
Fiducialization of VAC equipment (shape determination of components)	0.5
Positioning of the support (plug & play interface)	0.2

The breakdown of the alignment budget sums up to 0.9 mm which is approximately 50% of the total budget of 2 mm.

2.3 ALARA optimization

The supports have to be equipped with permanent targets to minimize the time for the operator to be close to this zone that is affected by significant radiation dose levels. The alignment of the interfaces needs at least three targets. For redundancy reasons and reliability of the measurement configuration more targets than the minimum will be requested. For the first integration approach, targets can be specified with a diameter of 1.5 inch as these targets have successfully been tested by SU-MTI to up to 10 MGy.

3 Interfaces

The interfaces hosting the vacuum equipment have to operate vertical charges of 20 kg to 60 kg. All other forces applied by the vacuum in longitudinal or position have not been discussed.

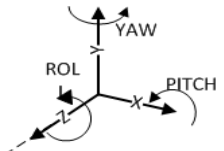
The alignment of the components will be done indirectly by:

- Fiducializing the VAC components at the surface after manufacturing
- Measurement and alignment of the VAC components supports in the tunnel
- Using a “plug and play” type interface to allow exchanging the components without realignment of the supporting platform.

3.1 Displacement requirements

The interface plates have to be able to be displaced in

- radial position (dx),
- vertical position (dy) and
- two rotations (yaw, pitch).



A displacement along the beam axis (dz) is not required; the roll is blocked by the bellow connection. Such a platform has been developed by SU-MTI for the Drive Beam Quad support of CLIC. The system has been presented and mechanical drawings provided to study integration.

3.2 Plug and Play interface

Isostatic interfaces allowing micrometric repositioning of components are currently used SU-MTI for the positioning of the sensors.

All adjustment screws have to face towards the corridor (inside LHC) to ease the adjustment of the platform. To optimize the ALARA concept of the alignment, possible solutions can be:

- extension rods used to stay away to a maximum from the irradiated components or
- a portable motorized box for a “local remote alignment”

4 VAC constraints

The VAC equipment will be permanently equipped with bake-out jackets. Bake-out will take place on site and rise up to 250°C.