Adjustment specification

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Outline

- Types of adjustment:
  - Manual/motorized jacks and associated requirements
  - Manual / motorized standardized platform and associated requirements
- Synoptic of adjustment capabilities in IT & MS sections

Scope & hypothesis

- All HL-LHC components, located in the IT or MS area will be supported by an adjustment system, allowing manual (in-situ) or motorized (remote from the CCC) alignment of the components.

- The adjustment system is used at the initial installation and then during the life time of the machine to maximise beam aperture and cover ground motion, jacks installation inaccuracies and components manufacturing non-conformities.

- Hypotheses concerning adjustments in tunnel
    - No adjustments in tunnel during Technical Stops due to radiations of the IT & MS sections
    - Adjustments only if really necessary during YETS.
    - Adjustment of intermediary components during Long Shutdown only
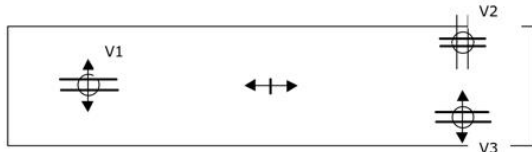
Types of adjustment

- 2 types of adjustment, depending of the size and weight of components:
  - Using standard jacks, for cryostated magnet
  - Using standardized platform (below 1-2 t)
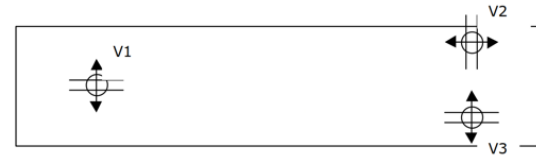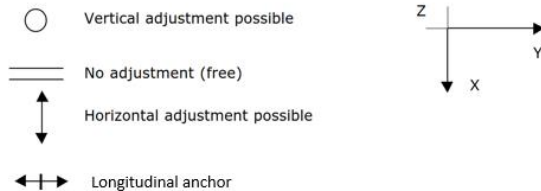- Both can be motorized if needed.
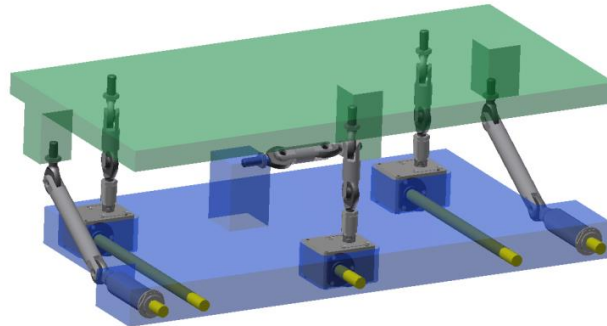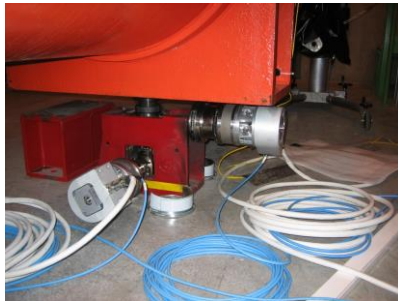
Adjustment using jacks

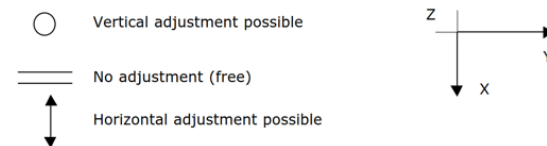- Solution of 3 isostatic jacks chosen by TE-MSC
- Two layouts:

With pressure end effects (Q1, D1)

Requirements

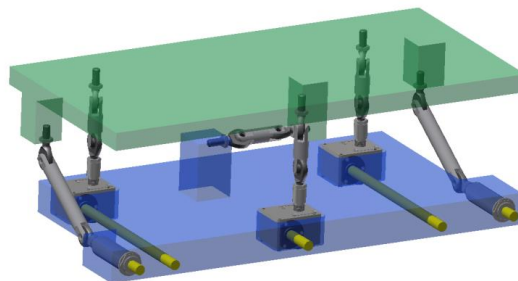| Requirements for jacks	
Longitudinal range:	± 10 mm
Radial range:	± 10 mm
Vertical range:	± 15 mm
Setting resolution:	0.05 mm in transverse direction
Long term stability over 1 year:	< 0.1 mm
Possibility to insert easily and quickly (less than 3 minutes) a motorization to perform remote adjustment on radial and vertical axes.	
Shall provide a high stiffness to the cryostat support, with the first frequencies as high as possible	
Shall provide a high stiffness in transverse directions to allow minimum effective displacements	
To be able to support the loads mentioned in table §3.	
Backlash in radial and vertical < 20 µm over the range	

Requirements

Requirements for motorized jacks	
All degrees of freedom motorized except the longitudinal translation	
Vertical/Radial displacement range:	± 5 mm *
Vertical/Radial resolution	< 2 μm
Jacks equipped with safety transducers (load sensors) to control radial / vertical reaction forces	
Long term stability over 1 year	< 0.1 mm
Maintenance free over 10 years	
Minimum distance to the control command system	200 m
Motor: radiation hard	> 1 MGy
Control command system located in a non radioactive area.	
Exchange of each motor: duration < 3 minutes	

'*' the range of the motorized displacement will be larger than the established operational window: a remote displacement of all the main components is under study (for a range up to 2.5 mm), and in that case, all the displacements applied on the bellows between adjacent interconnected components would be limited to a fraction of the +/- 2.5 mm. The vertical/radial displacement offset between adjacent components will be limited according to the flexibility of the bellow.

Absolute linear gauges shall be associated with each motor as part of the jack diagnostic system, for safety and maintenance purposes only.

Standardized platform

- For lighter and smaller components
- Keep the same design for all the adjustment supports, with an easy access to the adjustment knobs on the transport side
- All mechanical design proposed by WP15.4, to be integrated by the designer in charge of the equipment support.
- 3 types:
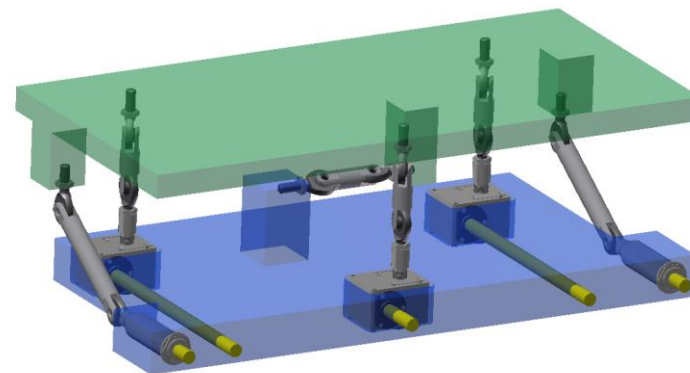 - Manual
  - Plug-in motors
  - Motors

Requirements

Requirements for a standardized platform (manual adjustment)	
Radial range:	± 10 mm
Vertical range:	± 10 mm
Longitudinal adjustment carried out at the initial alignment	
Setting resolution	0.01 mm in transverse direction
Long term stability over 1 year:	< 0.1 mm
Exchange of a motor	< 1 minute
Minimum distance to the control command system	200 m
Motor: radiation hard	>1 MGy

| Requirements for a standardized platform with permanent motors	
Exchange of a motor	< 1 minute
Minimum distance to the control command system	200 m
Motor: radiation hard	>1 MGy

Two sizes of platforms will be proposed and are under definition : small size for compact components (weight < 200 kg), medium size.

Plug-in motors shall be installed and dismounted in less than 1 minute.

Specific cases

- BPM: they will be installed on a manual standardized platform, with the possibility to install a plug-in system. No possibility to perform displacements during TS and YETS.
- Vacuum case under definition
    - Analysis of aperture under way
    - A table with estimated ground motion displacements between LS is under preparation (WP15.4)
- Collimators case:
    - Collimators between TAXN and D2: motorization under study
    - Option 1: motorize the existing adjustment system
    - Option 2: use a standardized platform equipped with permanent motors.

Synoptic of adjustment system
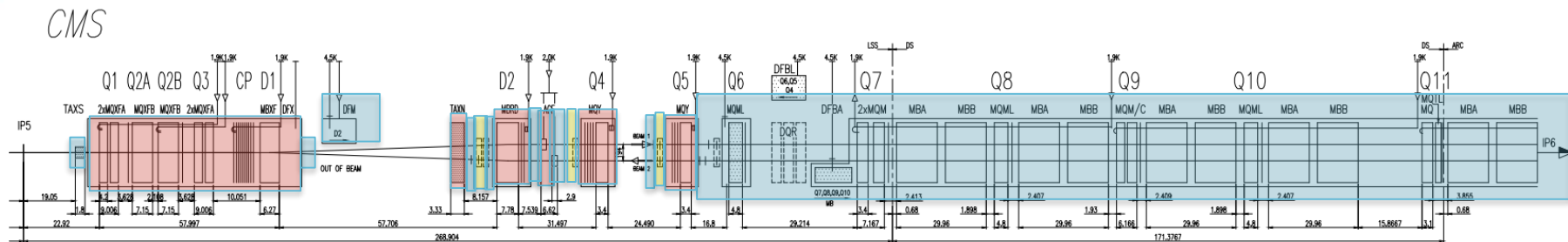
Manual adjustment system: adjustment during LS, in the tunnel

Motorized adjustment system (*baseline*): adjustment during run, from CCC

Motorized adjustment system (*new request*): adjustment during run, from CCC

List of HL-LHC components & associated adjustment system

LIST OF HL-LHC COMPONENTS AND THEIR ADJUSTMENT SYSTEM

Case of IR5 Right considered as example

Component	WP Owner	Adjustment type	Comments	Appr. weight (tonne)
TAXS	WP 8	Manual adjustment	Specific case	
LQXFA (Q1)	WP 3	Motorized jacks		
LQXFC (Q2a)	WP 3	Motorized jacks		
LQXFD (Q2b)	WP 3	Motorized jacks		
LQXFB (Q3)	WP 3	Motorized jacks		
LCXFD (CP)		Motorized jacks		
LBXFD (D1)		Motorized jacks		
DFXJ		Adjustment system under definition		
VA_006		TDC		
BPMSW	WP 13	° Standardized platform with plug-in motors		
DFMJ		Under study		
TAXN	WP 8	Motorized jacks		
TCTPVV		° Option 1 or standardized platform with permanent motors		
TCTPXH		° Option 1 or standardized platform with permanent motors		
TCTPXH		° Option 1 or standardized platform with permanent motors		
TCLX		° Option 1 or standardized platform with permanent motors		

BPMQ		° Standardized platform with plug-in motors		
VA_007		Part of the same platform?		
LBRDD (D2)		Motorized jacks		
VA_007		TBC		
VA_002		TBC		
ACFGA001 (crab 1)		Motorized jacks	Height to be checked	
ACFGA002 (crab 2)		Motorized jacks	Height to be checked	
VA_003		TBC		
APWL		Standardized platform with plug-in motors?		
BPTX				
TCLMB		Standardized platform with permanent motors		
VA_002		TBC		
LQYGD (Q4)		Motorized jacks		
VA_002		TBC		
TCL		° Option 1 or standardized platform with permanent motors		
TCLMB		° Standardized platform with permanent motors		
VA_002		TBC		
LQYHD (Q5)		Motorized jacks		
TCTPV		Current manual adjustment system		
TCTPH		Current manual adjustment system		
VA_003		TBC		
TCL		Current manual adjustment system		
TCLMC		Current manual adjstument system		
VA_002		TBC		
LQNDB (Q6)		Jacks		

° Following approval of ECR #####

Summary

- Functional specification of adjustment systems under preparation

- Some discussions initiated for vacuum components and collimators.

- Detailed analysis of aperture combined with estimated displacements between LS needed.

Thank you very much

TAXN – D2 base line layout

- HL-LHC TCC#29

- 91 mm inner diameter for BPM and vacuum chambers and modules

- DN100 "quick flanges" everywhere except for Y chamber

- VAB with staggered sectors valves (ID100) to provide beam aperture

- New chambers, bellows, RF transitions and VAB to be designed

- 2 beams in one vessel collimators for TCTXH and TCLX (under design by WP5)

- No 5th axis
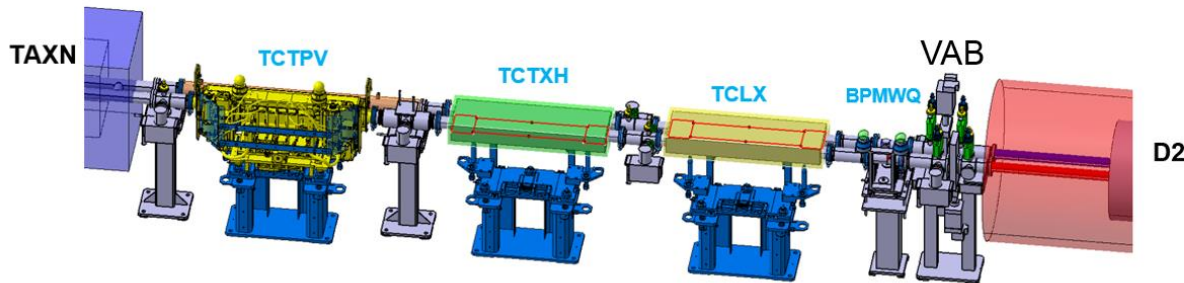
D2-Q4 base line layout

- In coordination with WP2, 4 and 15

- Room temperature sectors (except CC modules): bake-able and NEG coated

- 2 sectorised CC modules: unbaked, operating at cryogenic temperature (2K)

- 3 types of sector valves assemblies (VAB)

- ID 80 mm with DN100 flanges (can be increased to 91 ID if needed)

Cryomodule interconnection
(EDMS 1841111)

Cryomodule1

Cryomodule 2

BPTX

D2

APWL

TCLMB

Q4