How to technically tackle the required changes and achieve the proposed performance?

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HL-LHC TCC, 29/06/2017

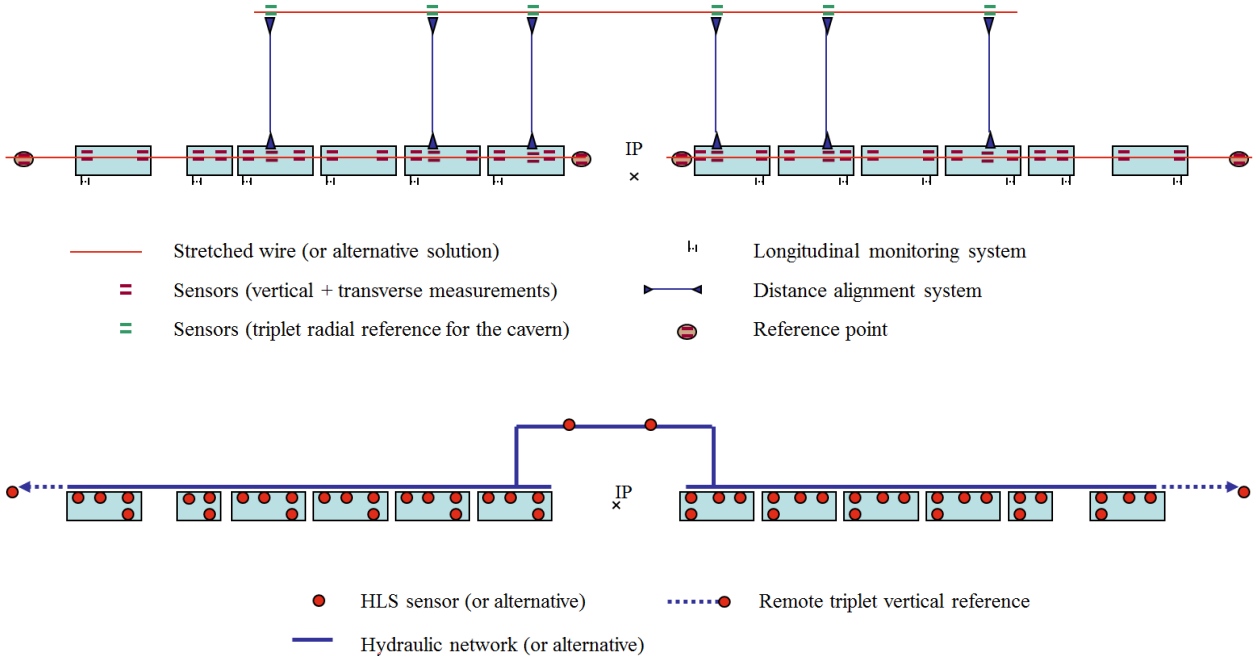
Outline

- Reminder: baseline for the main components
- Solutions to determine the position of components
- Solutions to re-adjust the position of components
- Summary of the solutions

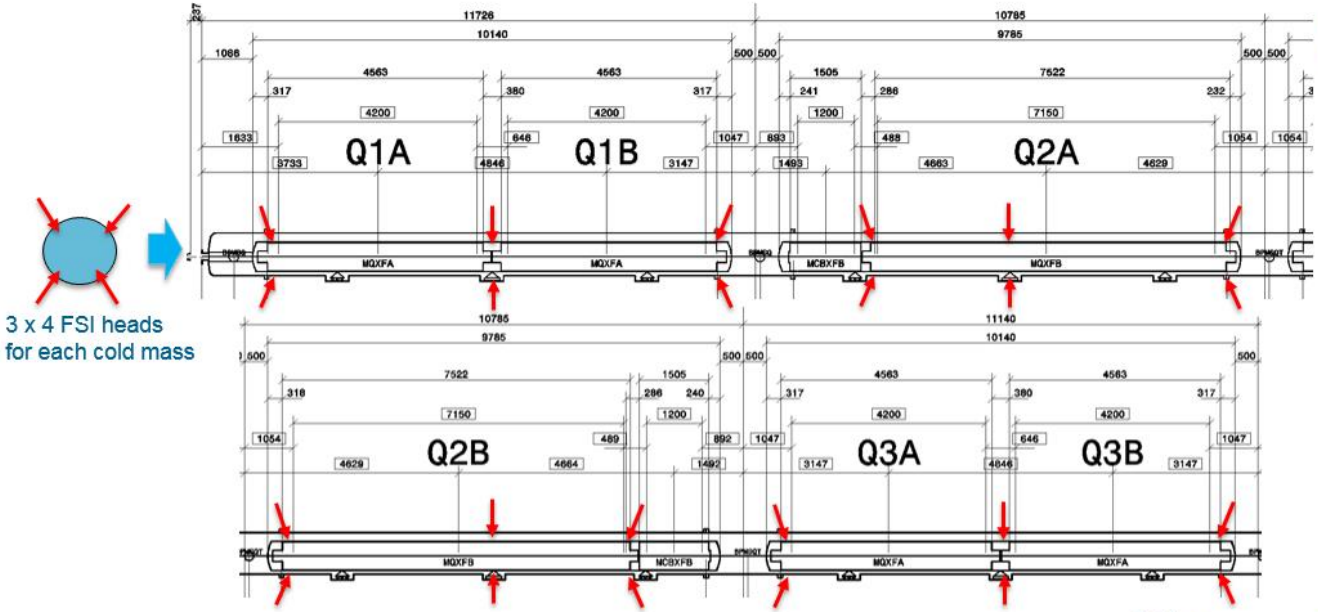
Baseline: alignment of the main components

- Solution for the main components from Q1 to Q5 (Q1, Q2a, Q2b, Q3, CP, D1, TANX, D2, Q4, Q5, crabs): *alignment piloted from CCC*
  - Alignment systems to determine the position according to 6 DOF (combination of WPS + HLS sensors)
  - Adjustment systems (motorized jacks) to perform remote alignment (5 DOF).

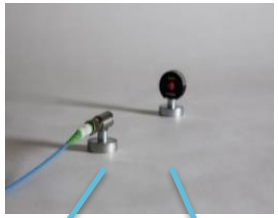
Baseline: alignment of the main components

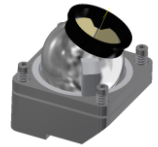


Baseline: internal monitoring inside the IT



IR5 right example:
LHCLSXH_0010

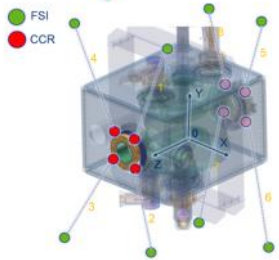




Collimator feedthrough

Corner Cube Reflector

48 FSI heads per triplet needed



(Mateusz Sosin)

Required changes

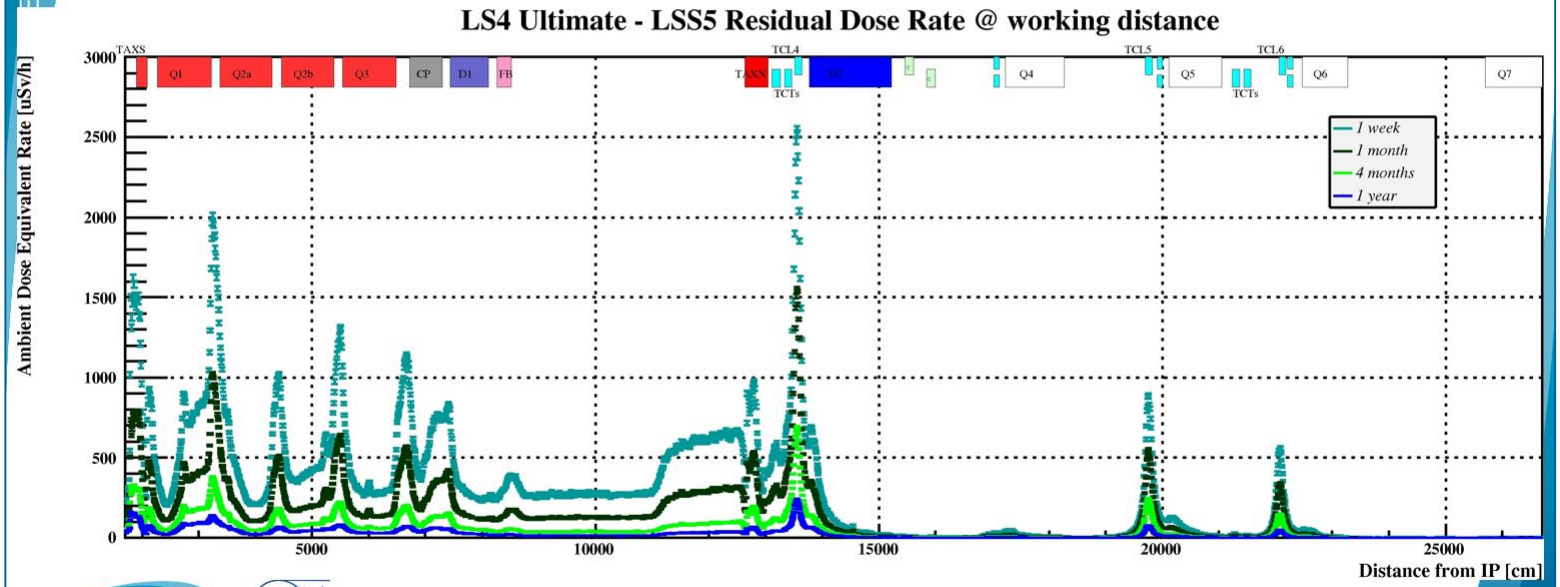
Summary of the addition to the HL baseline leading to change of scope and therefore cost increase

- Warm BPM after Q1 and before Q2: connection to the WPS (that is already present in the area) in order to monitor their position. No remote alignment (WP13 and WP 15.4)
- Motorized alignment for the TCL in front of Q4 and Q5 (WP15.4)
- TCTPXH TCTPV and TCLX: need to add remote alignment possibility (WP5 and WP15.4)
- Need to develop approach to trace positon of bellows through life of the machine
- As it will be shown in the next talk ALARA optimisation provide also a strong incentive to make available remote or semi remote alignment

Environmental conditions

Residual Dose Rate Profiles

EDMS. 1770902



Solutions to determine the position of components

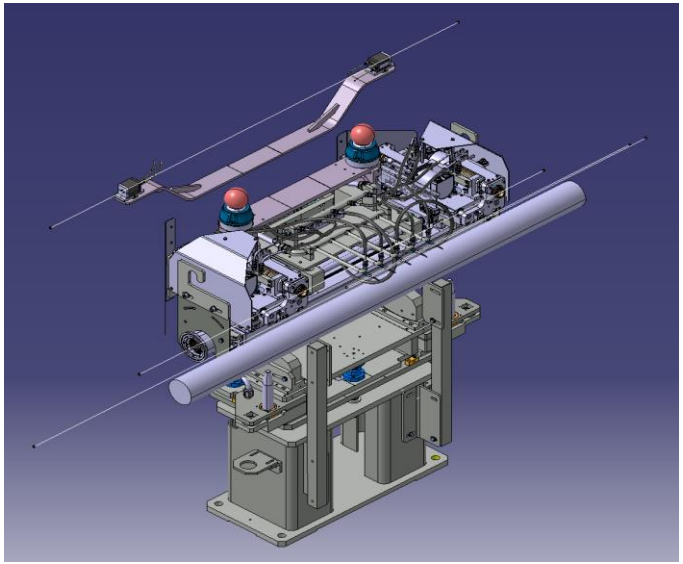
- 2 solutions:
  - Solution 1: using sensors for a **continuous** determination of the position (combination of WPS sensors + rad hard inclinometer)
  - Solution 2: using remote instrumentation for a determination **during TS and YETS** (different options under study); each component equipped with several permanent targets.

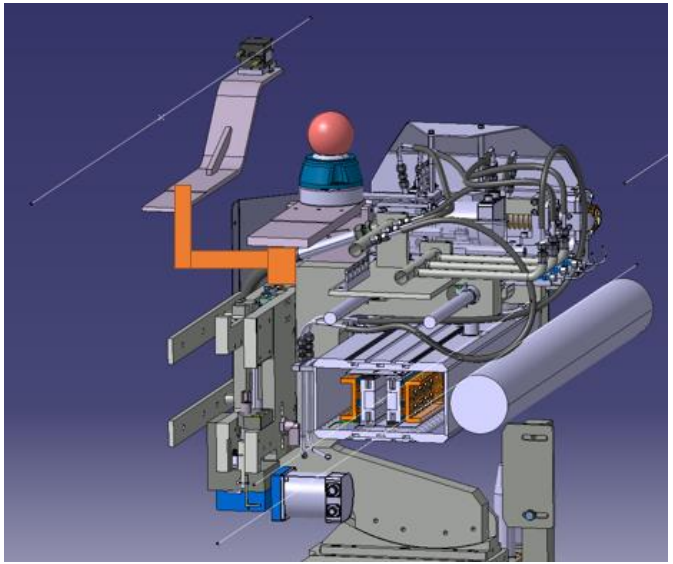
Solutions to determine the position of components

- Solution 1: WPS sensors + inclinometer
  - Step 1: Integration feasibility. Possibility to integrate a rigid long term support between the component and the wire.
  - Step 2: estimation of additional costs and budget approval
  - Step 3: detailed design and integration

Solutions to determine the position of components

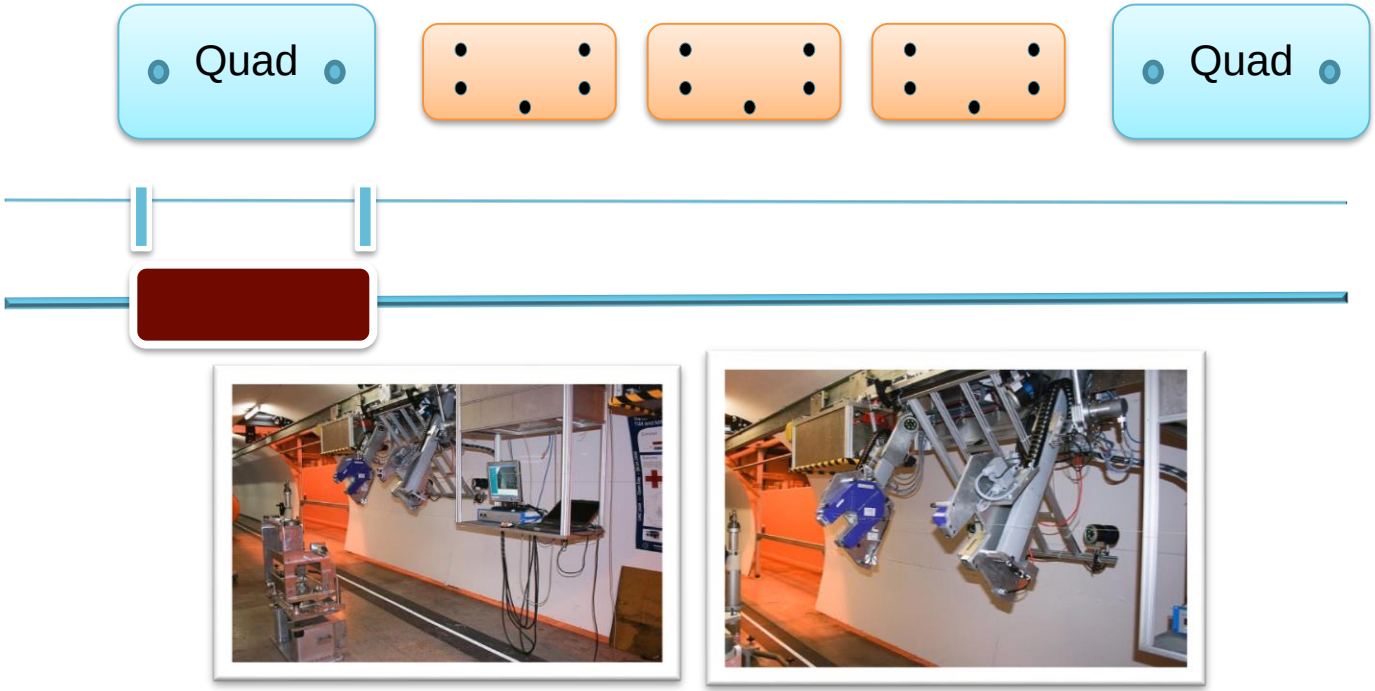
- Solution 1: WPS sensors + inclinometer
  - Example of the collimators

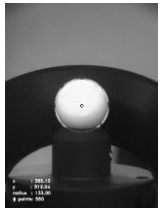


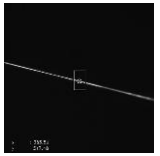


Solutions to determine the position of components

- Solution 2: remote determination
  - Measurement train to be upgraded with new instrumentation







Solutions for adjustment

- Design of a standardized support (same configuration of adjustments for all the components, all adjustment knobs on the transport side)
- 2 possibilities of motorization:
  - With a permanent motorization (**adjustment** possible **during operation**)
  - With plug-in motors (**adjustment** possible only **during YETS**)

Solutions for adjustment

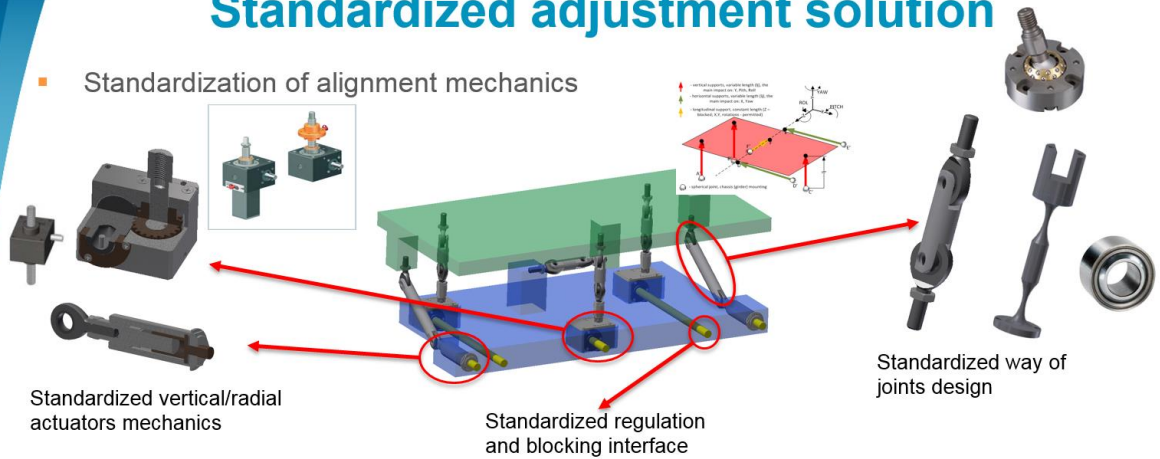
- Standardized support
  - Proposal of standardization of the adjustment platform below the intermediary components to perform 5DOF (no longitudinal adjustment capability)
  - Based on a «Stewart-type» platform developed for the CLIC project, replacing flexural parts by spherical joints.
  - Same configuration of adjustment for all the components, scaled to components' size and customers' needs, compact and efficient.

Standardized adjustment solution

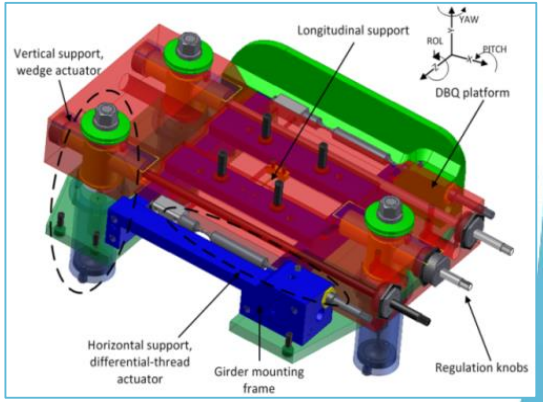
Design by Mateusz Sosin

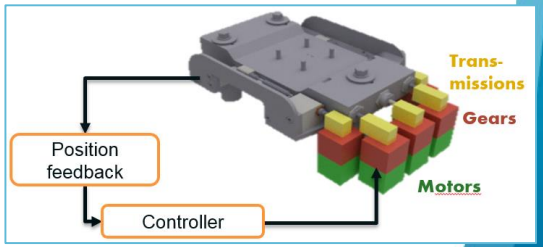
Standardized adjustment solution

- Standardization of alignment mechanics



- Needed discussion with all interested users to recognize all requirements and future parameters:
  - Mechanisms accuracies, resolution, stiffness
  - Platform dimensions limitations, actuators dimensions
  - Maximal loads, external forces, etc.
- Validation of solutions chosen





Demo in video

Summary to achieve the proposed performance

Components	Universal support Plug-in	Universal support with motors	Remote determination during TS	WPS sensors + inclino
Vacuum	X		X	
Cryo			X	
Masks Q4, Q5		X		X
Warm BPM D1, D2	X	(X)		X
Collimators		TBC		X
RF guide	Adjustment by RF team		TBC	

Some cost consideration

- Remote determination of the position per component (2 WPS + 1 inclinometer) = 30 kCHF
- Remote adjustment per component = 40 kCHF
- Discussions to be undertaken with the WP leaders to see if such hardware can be funded from their WP (WP 5, WP 10, WP 13)

Summary

- Technical solutions to achieve the proposed performance:
  - Concerning the determination of the position:
    - For a continuous follow-up: WPS sensors + inclinometer
    - For a control during YETS and LS: measurement train to be upgraded
  - Concerning the adjustment of the components: standardized platform is recommended with
    - Permanent motors for a readjustment during run
    - Plug-in motors for a readjustment during YETS and LS
  - Integration feasibility to be checked.
  - Budget to be discussed with the WP holders.

Thank you very much

Environmental conditions (88 m/IP, 136 m /IP)

- Ground motion at point 1

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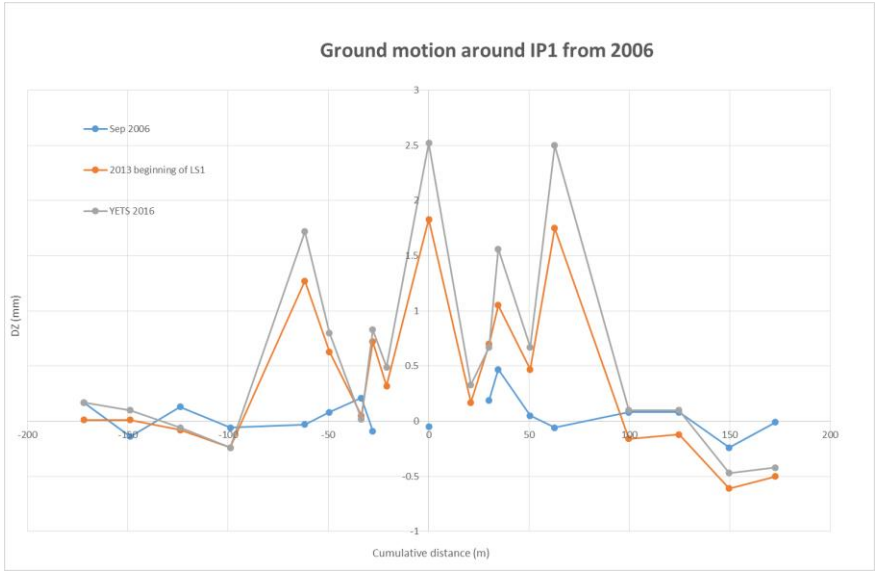

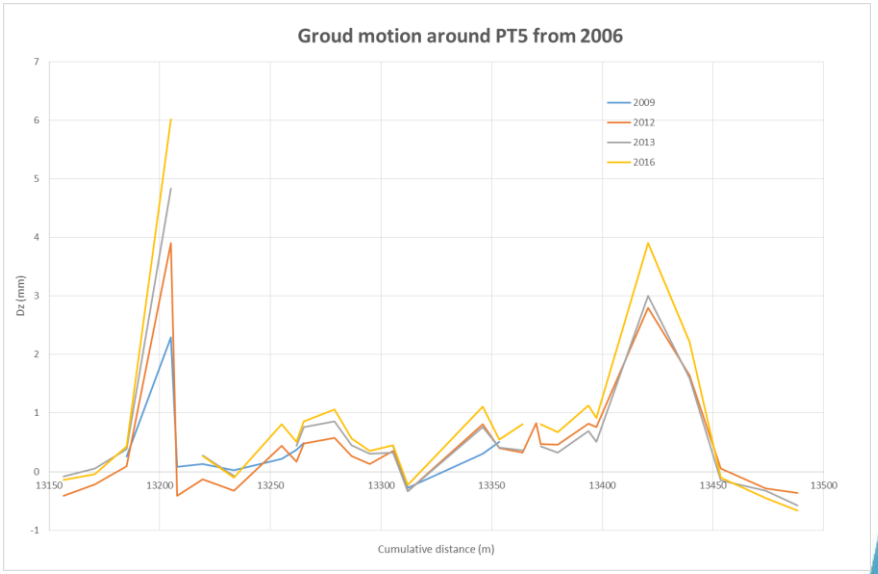

Point 1 (vertical): + 0.25 mm/year

- Near the center of the cavern floor
- Between cavern and tunnel

Stable area after 100 m on each side of IP1

Point 5 (vertical): ground motion observed at the level of the new UJ caverns:

80m-130 m on each side of IP5