Detector movement system and experimental area layout for a Linear Collider (16 February 2011)

Long Term Floor Movement Measurements in LHC Experiments

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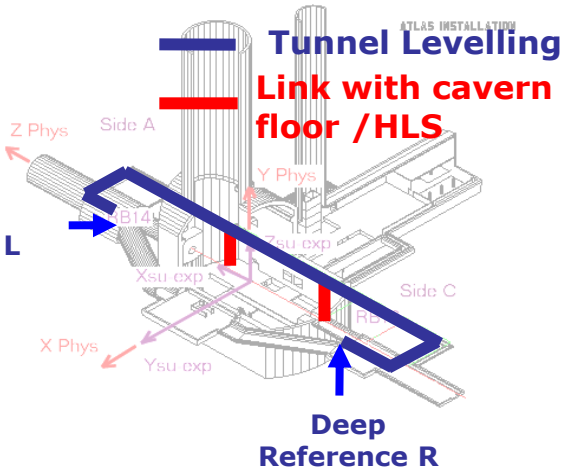
Expected Cavern Movements

- No predictions known by SU for the ALICE, LHCb and CMS caverns
- For LHC civil engineering predicted that some cavern movements could be expected during/after construction.
- Predictions for ATLAS Cavern (EMDS: ATC-T-ER-0004):
  - Up to 2 mm settlement after floor concreting
  - Up to 5.5 mm settlement predicted after ATLAS in place (during first 6 months)
  - In the order of 1 mm uplift per year thereafter

ATLAS – stability points



A17-14 (Floor)

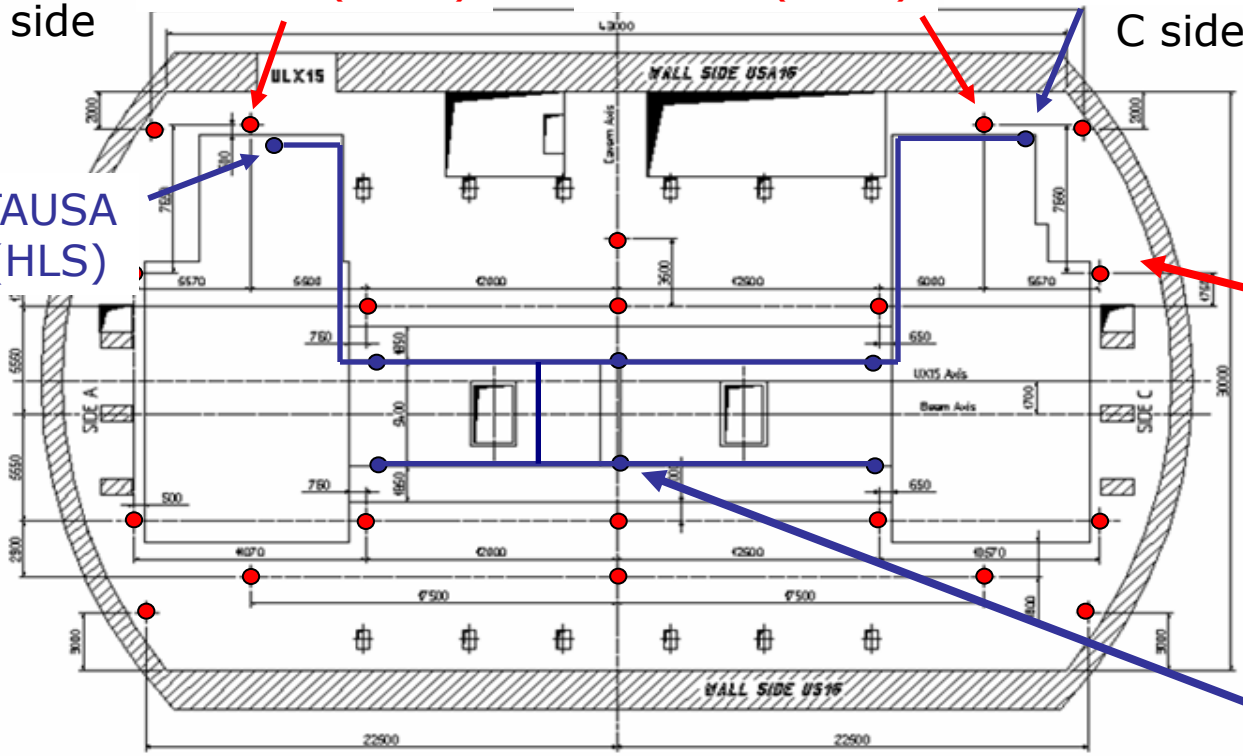
C17-14 (Floor)

TCUSA (HLS)

A side

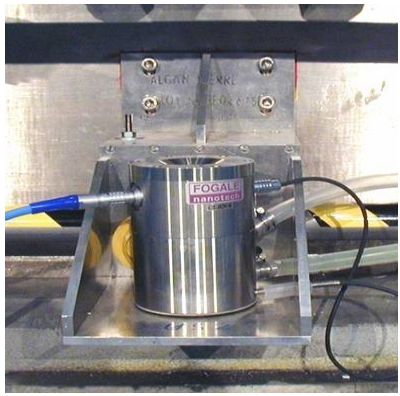
C side

TAUSA (HLS)

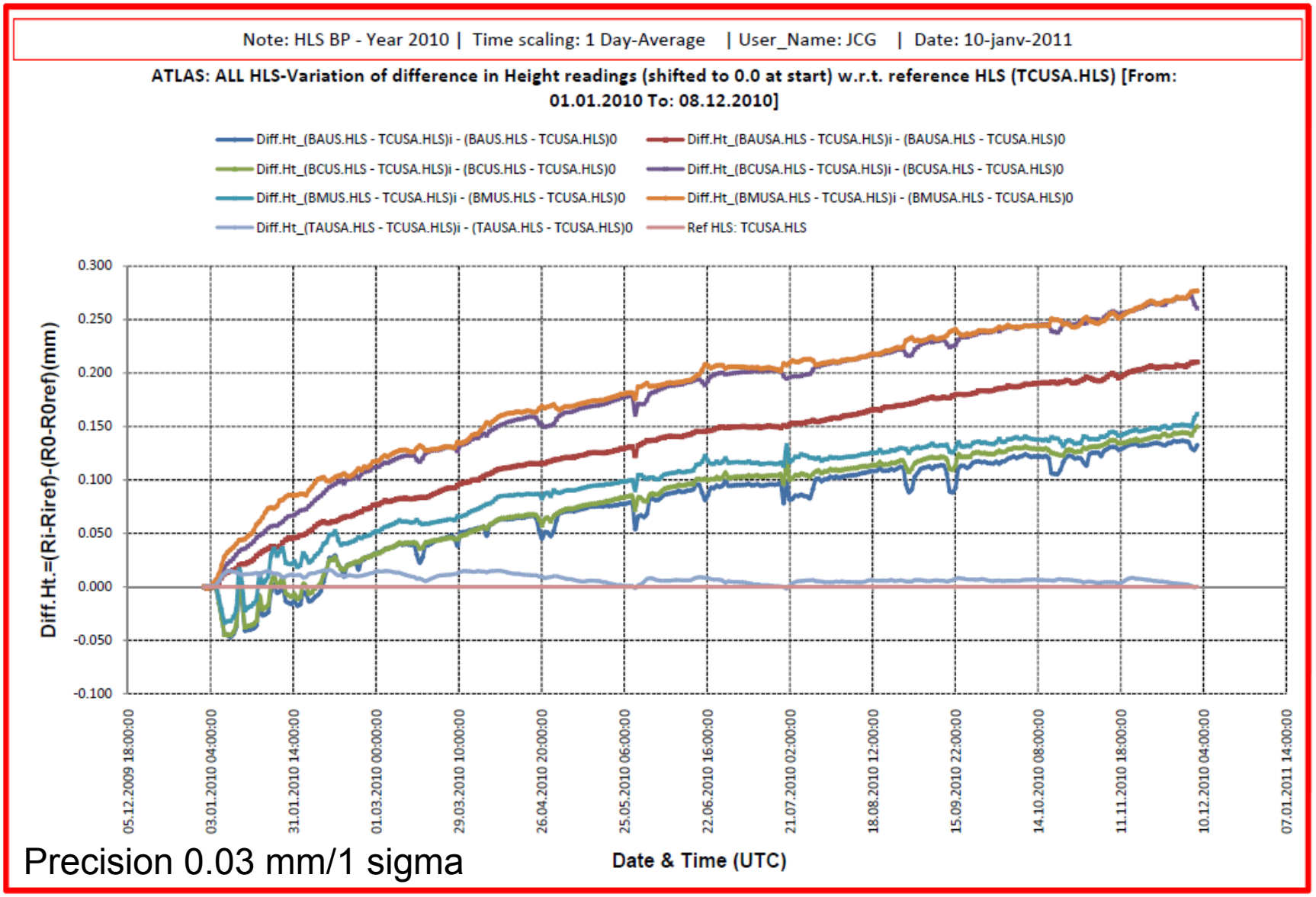


20 Points on the Floor

8 Points on the Bedplate HLS

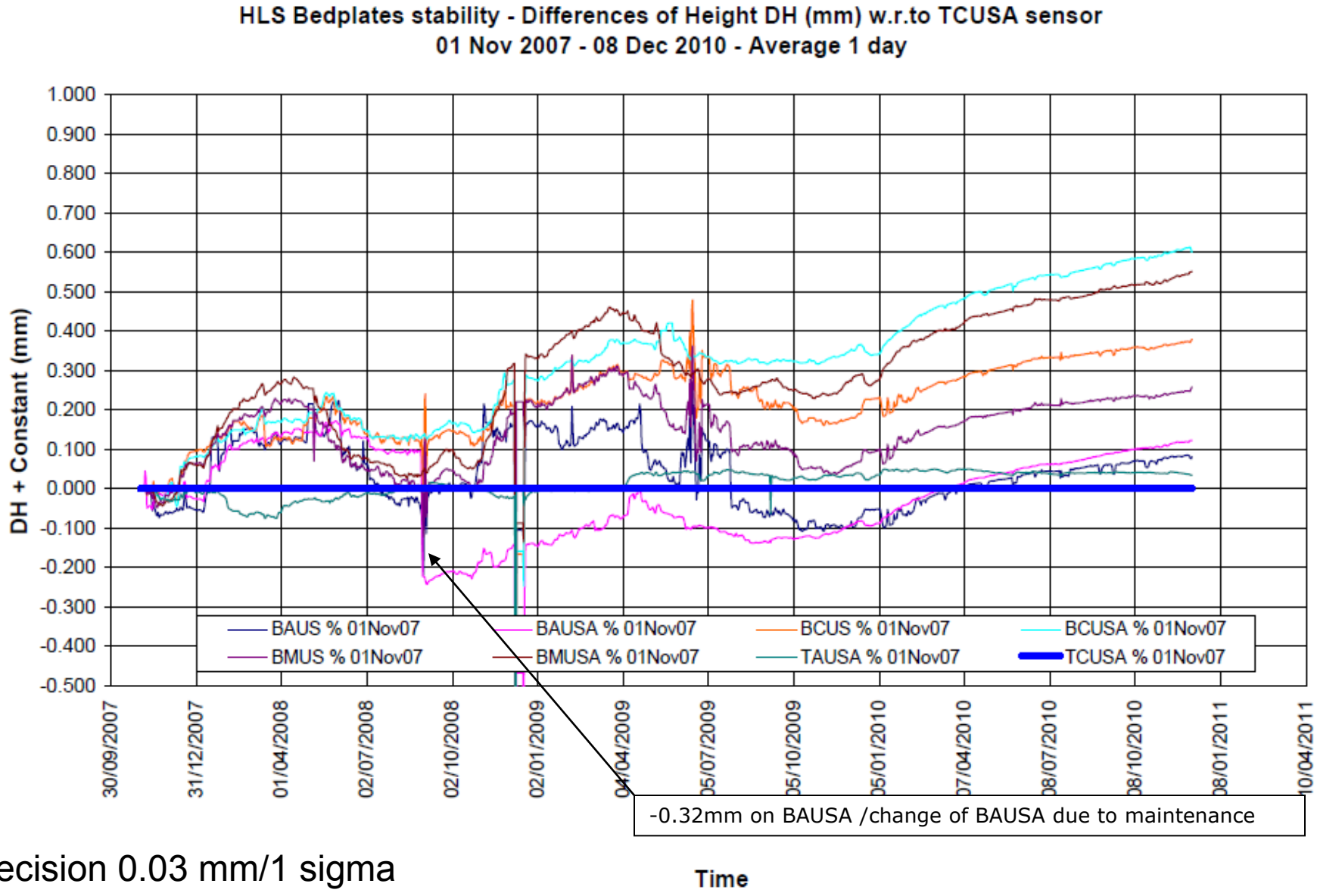


Movements seen by Bedplate HLS in 2010



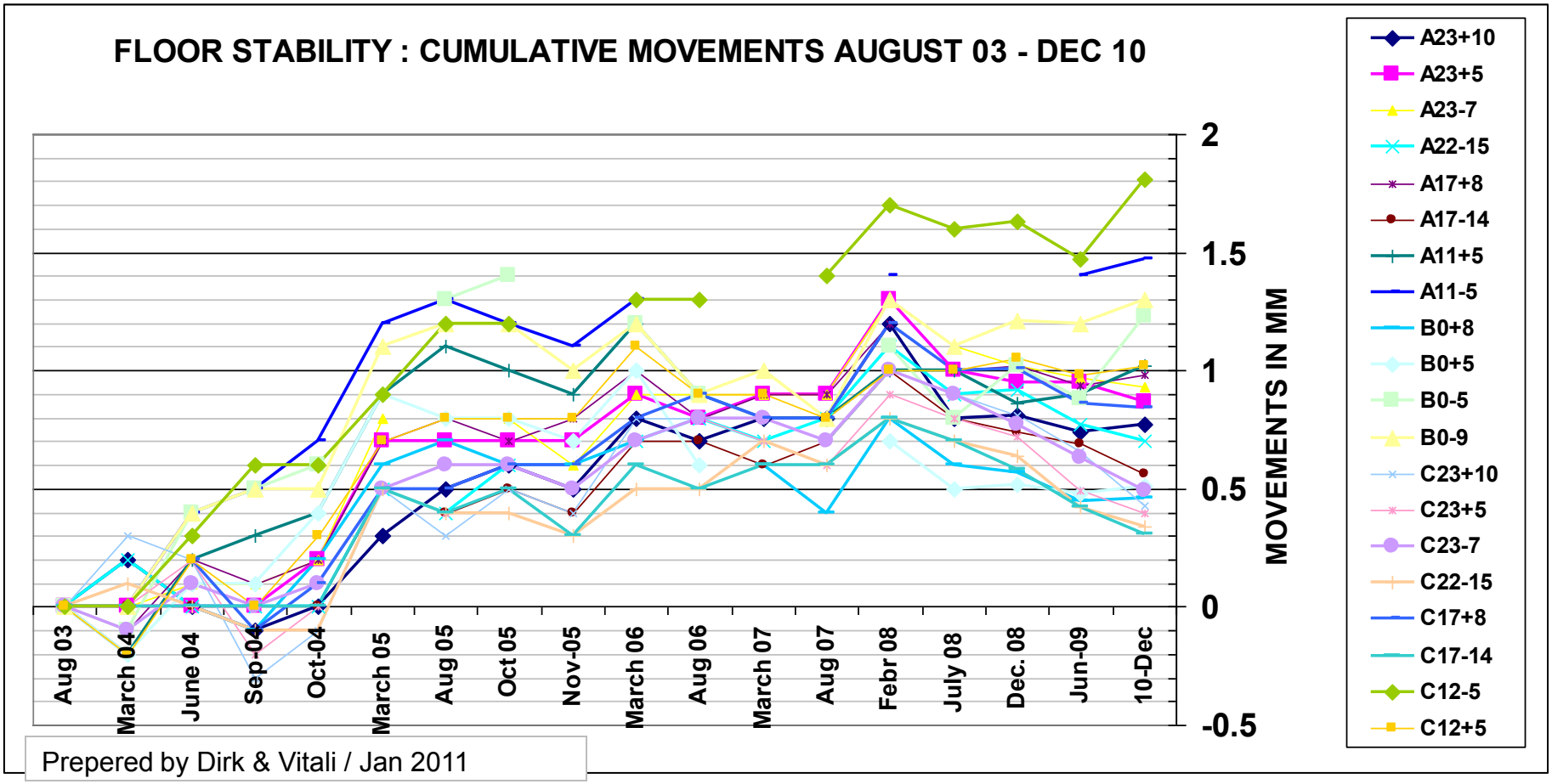
Precision 0.03 mm/1 sigma

Result of ATLAS bedplate HLS



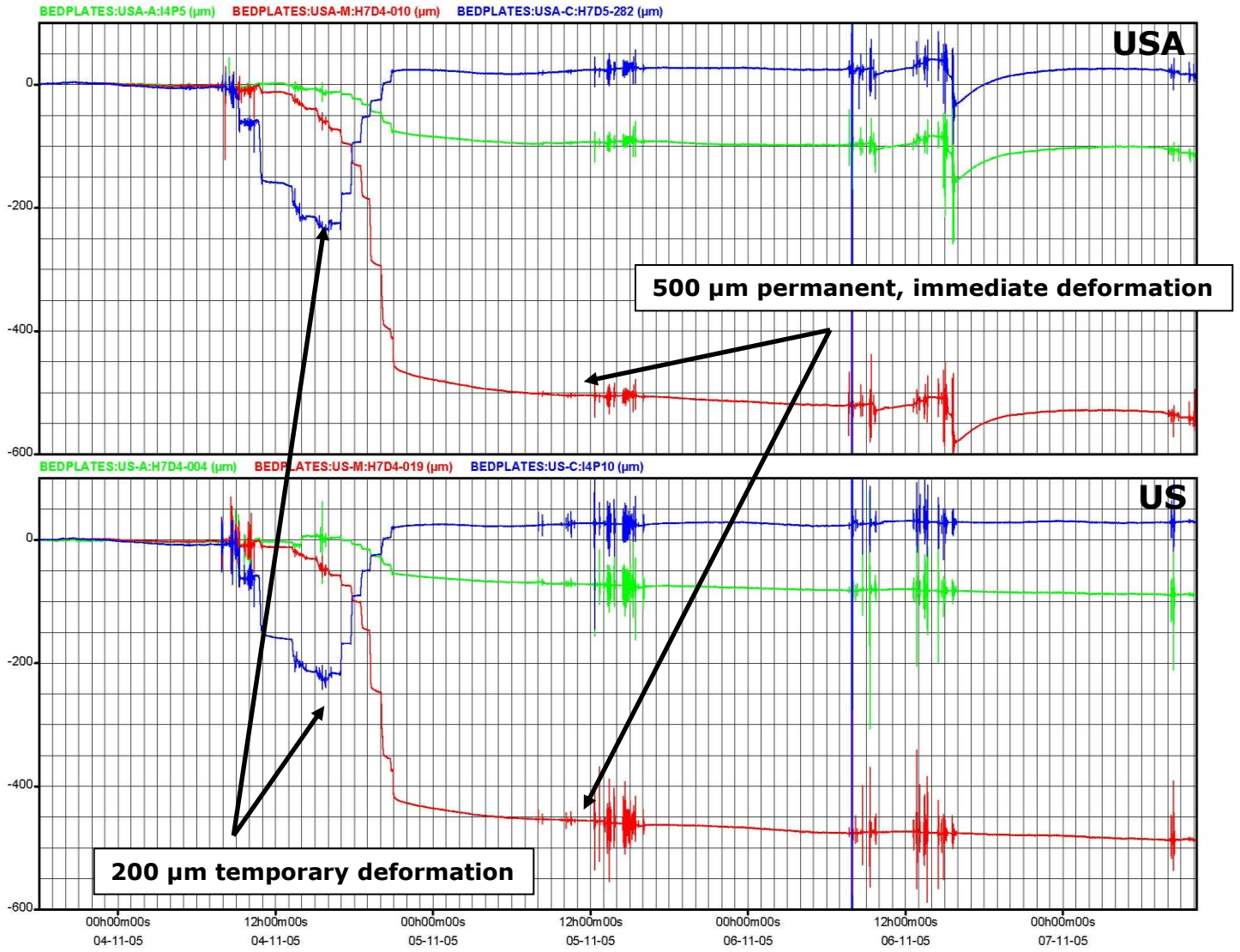
Precision 0.03 mm/1 sigma

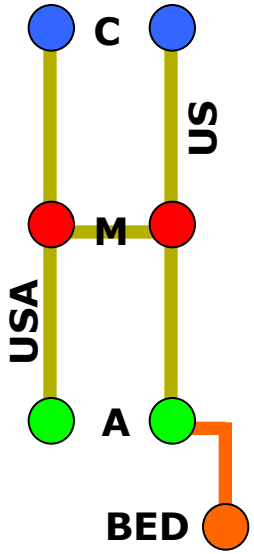
ATLAS Floor Stability Aug 03 – Dec 10



- Reference are deep references in LHC tunnel close to IP1
- Time between measurements varies from 3 to 18 month
- Precision for single epoch 0.2 mm/1 sigma; 0.3 mm between 2 epochs
- Distance between lateral walls -15 mm/8 years

HLS – EBB INSTALLATION





Conclusion ATLAS floor/bedplate stability

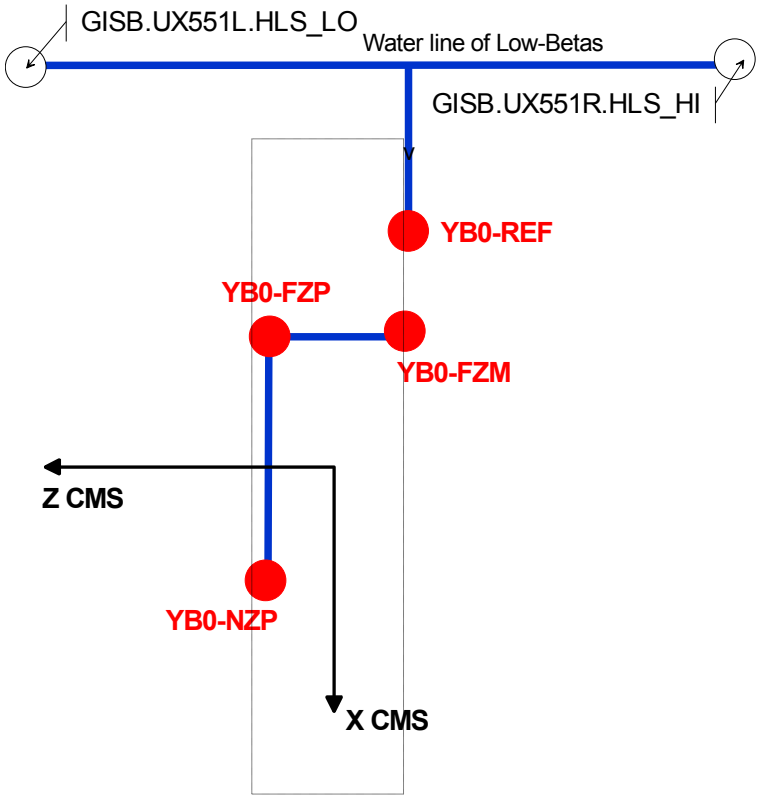
- Floor stability (optical levelling):
  - Measurements linked to the Deep Reference Points
  - 18 epochs March 03 – December 10 (from delivery of new UX15 cavern)
  - movement up to 1.8 mm in ~7.5 years (not linear)

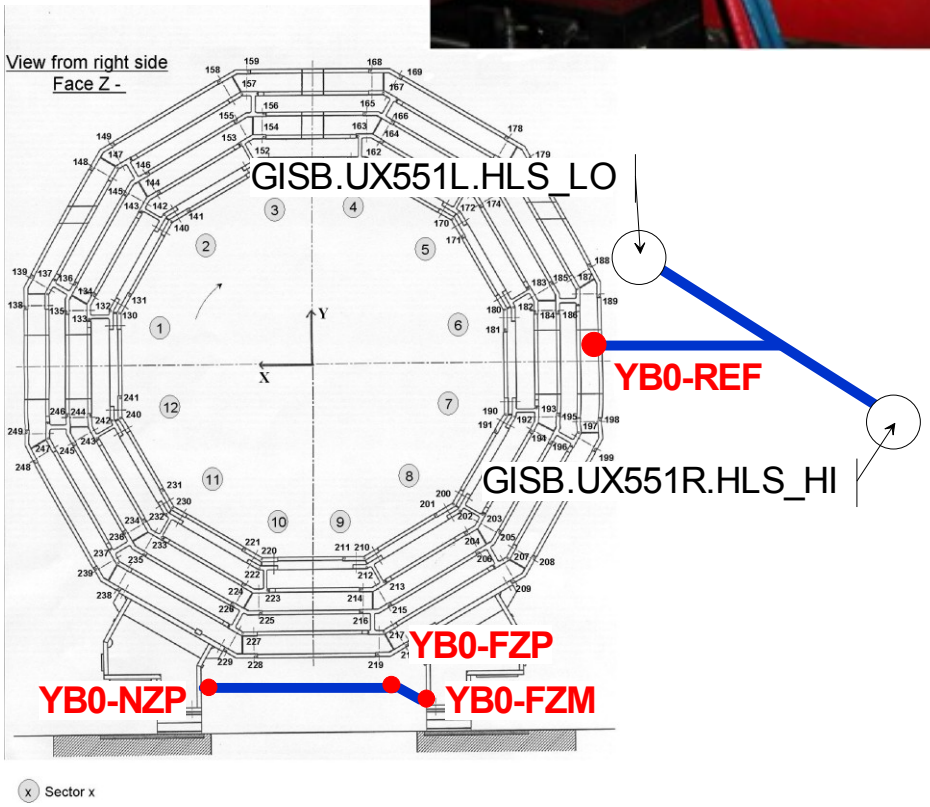
- Bedplates (HLS system):
  - Stable short term – (20 microns / 1 month) – Constant temperature in 2010
  - Long term movements ~0.6 mm / 3 year => 200 micron/year
  - System in very good running from Sept 2009 (last modif)
  - The system is measuring continuously and is controlled periodically (filling/purging tests)
  - Access ATLAS OP see EXT/HLS_Survey
    https://atlasop.cern.ch/atlas-point1/dcs/status_pages.html

Bedplates and Floor vertical stability detailed Survey reports in:
https://edms.cern.ch/nav/CERN-0000003491/ATF-0000000084
https://edms.cern.ch/nav/CERN-0000003491/ATF-0000000170

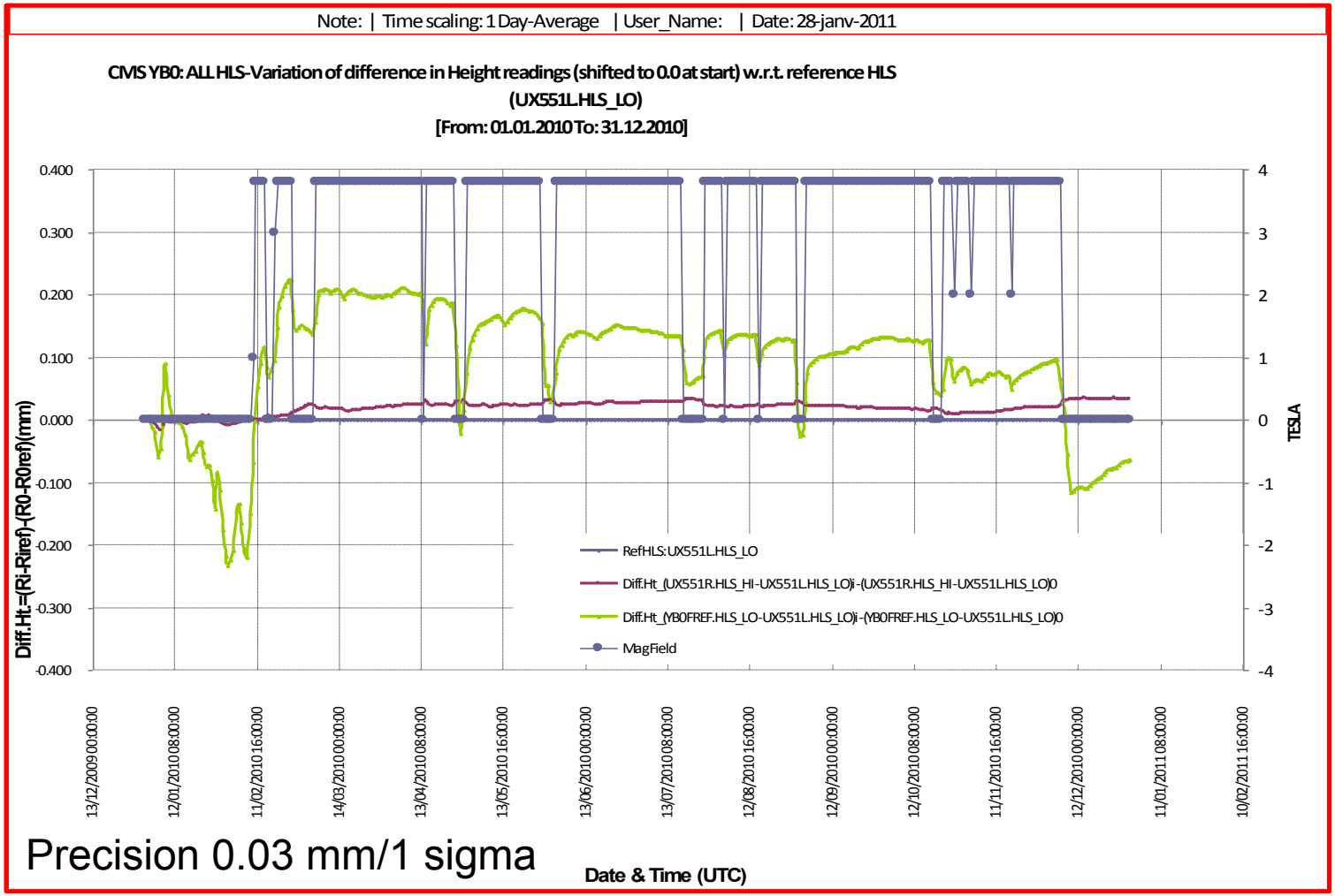
CMS – HLS system layout

- 1x HLS on YB0 at beam level linked to low-beta alignment system
- 3x HLS on YB0 feet as a “bi-directional inclinometer”





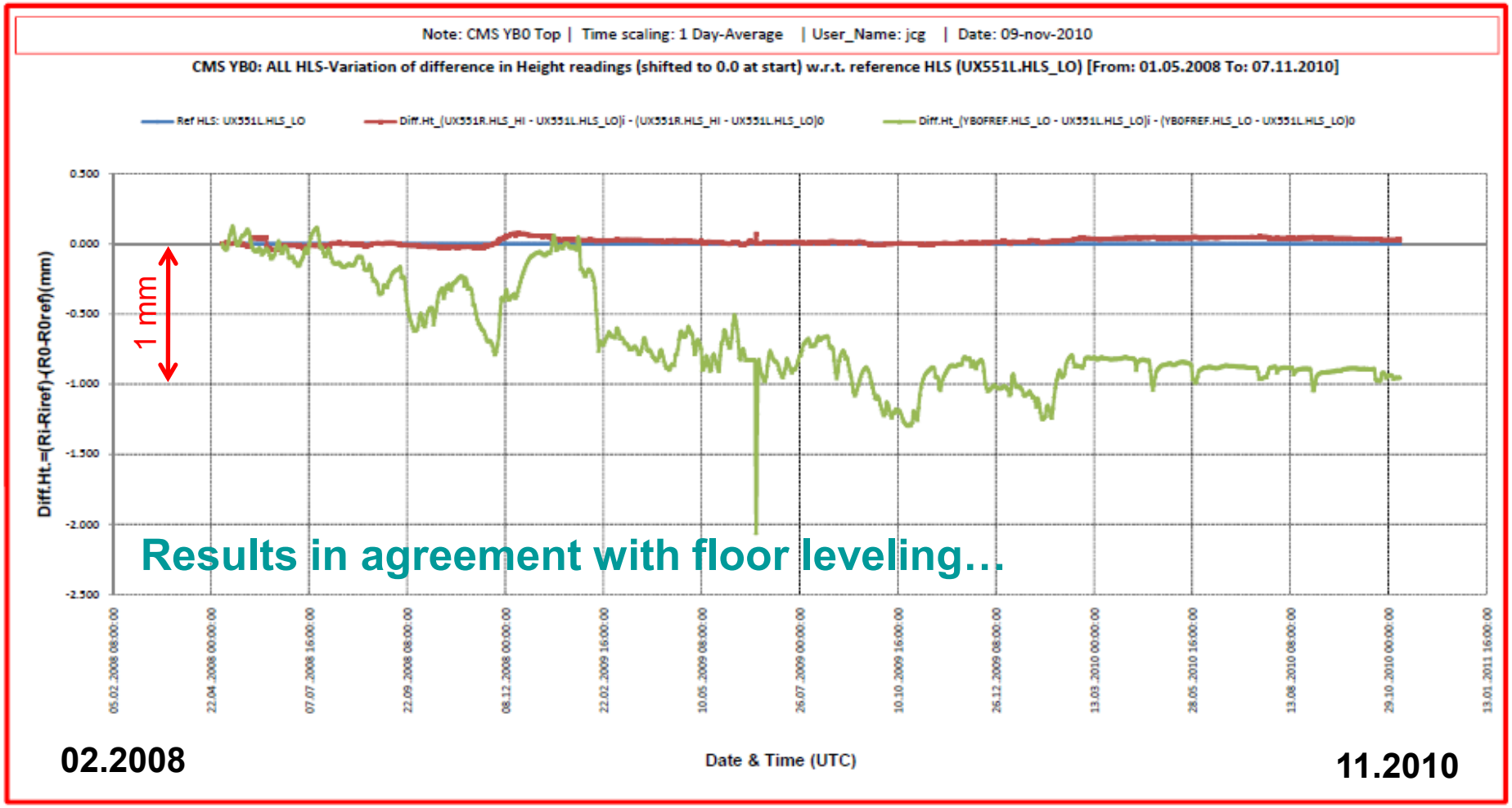
Movements seen by CMS YB0 HLS in 2010



Precision 0.03 mm/1 sigma

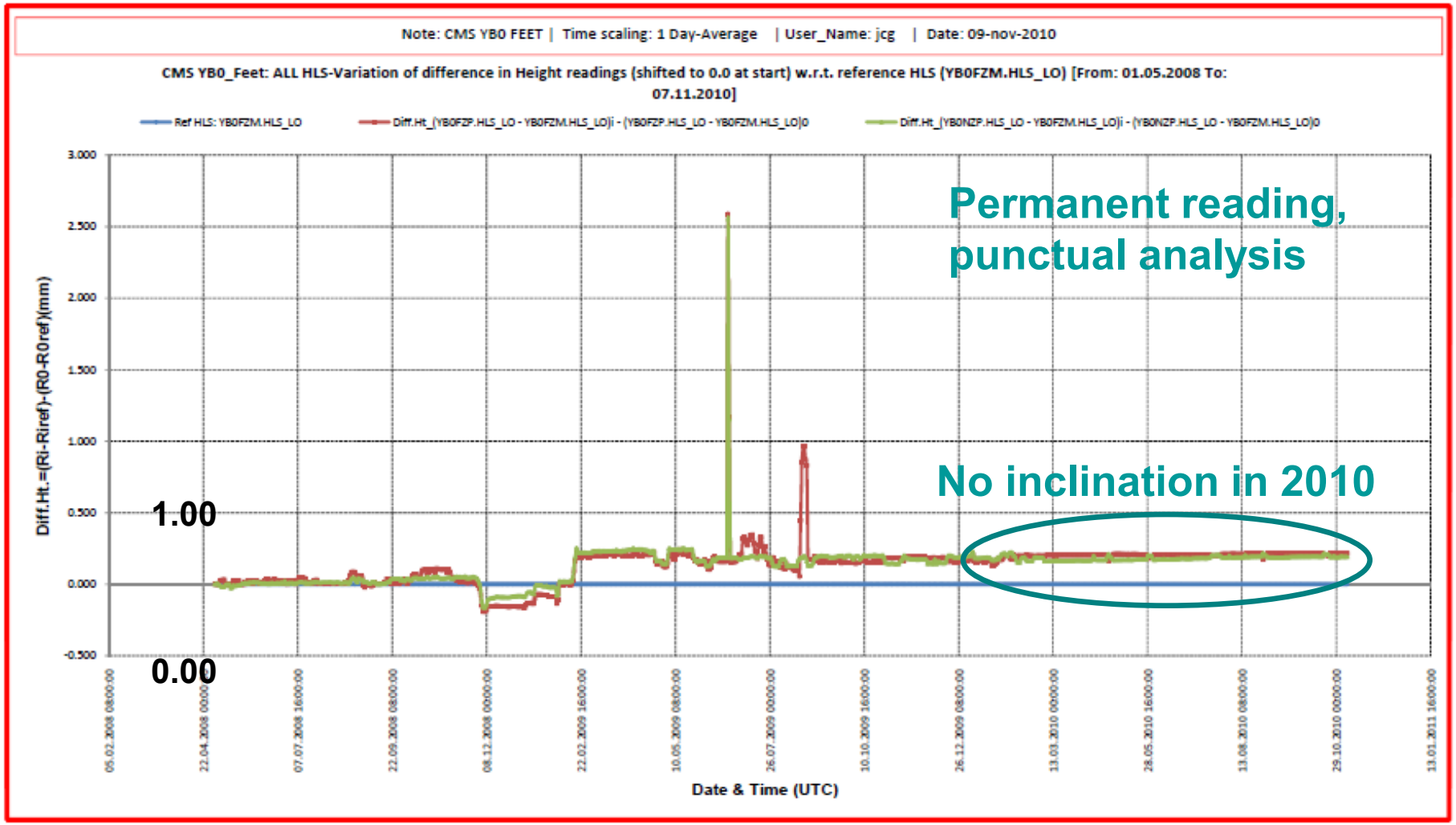
- Correlation to magnetic field visible at beam level
- Sag of ~120 micron/year

Movements seen by CMS YB0 HLS 2008-2010



- Precision 0.03mm/1 sigma
- Sag of 1.0 mm in 2.5 years at beam level

Stability HLS: relative monitoring YB0 feet



02.2008

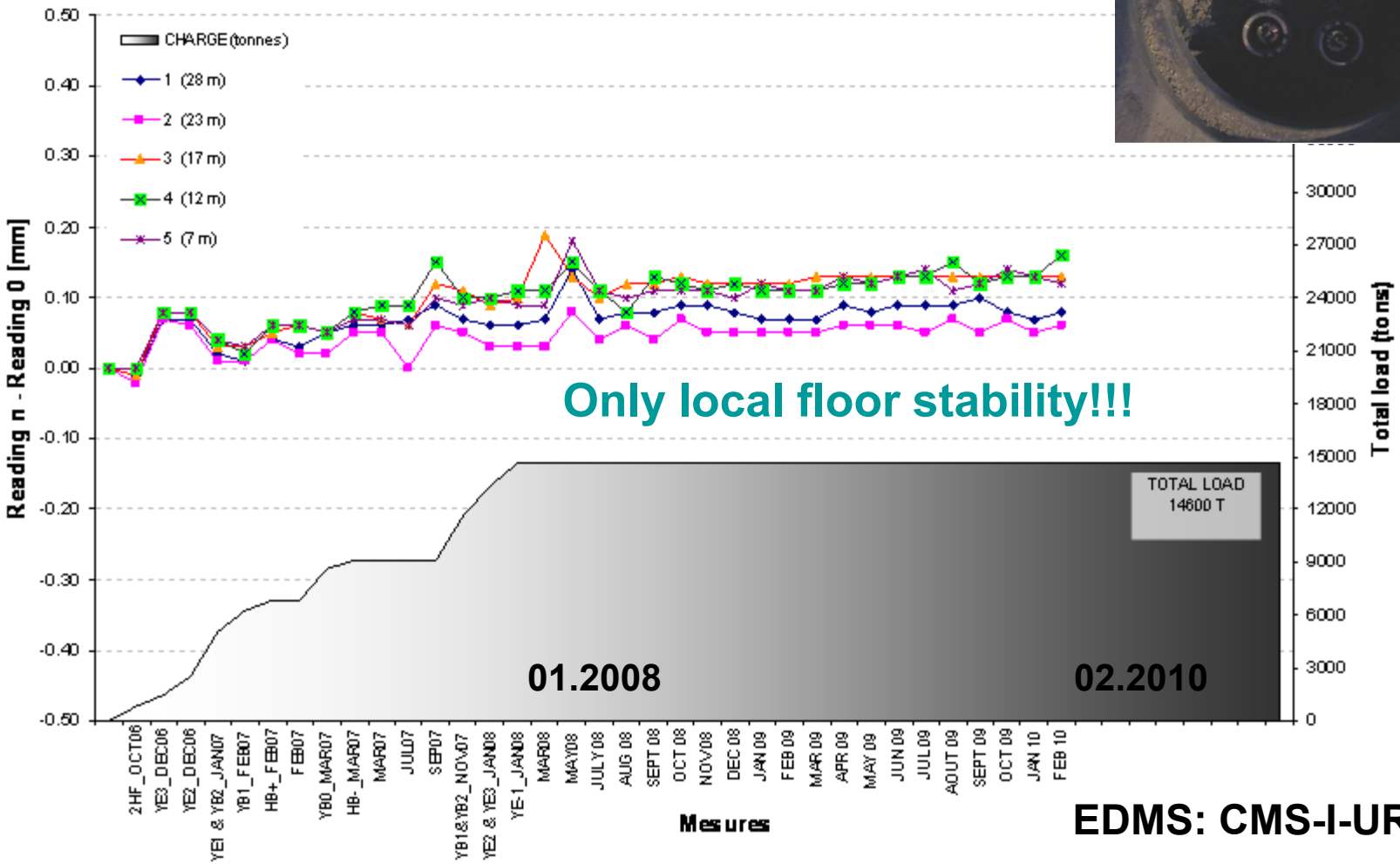
Precision 0.03 mm/1 sigma

11.2010

CMS – floor stability at deep references

ACCURACY OF THE RESULTS : +/- 0.05mm

Difference w.r.t. the first reading done on the 12.09.2006
LAST MEASUREMENT : 5.02.2010

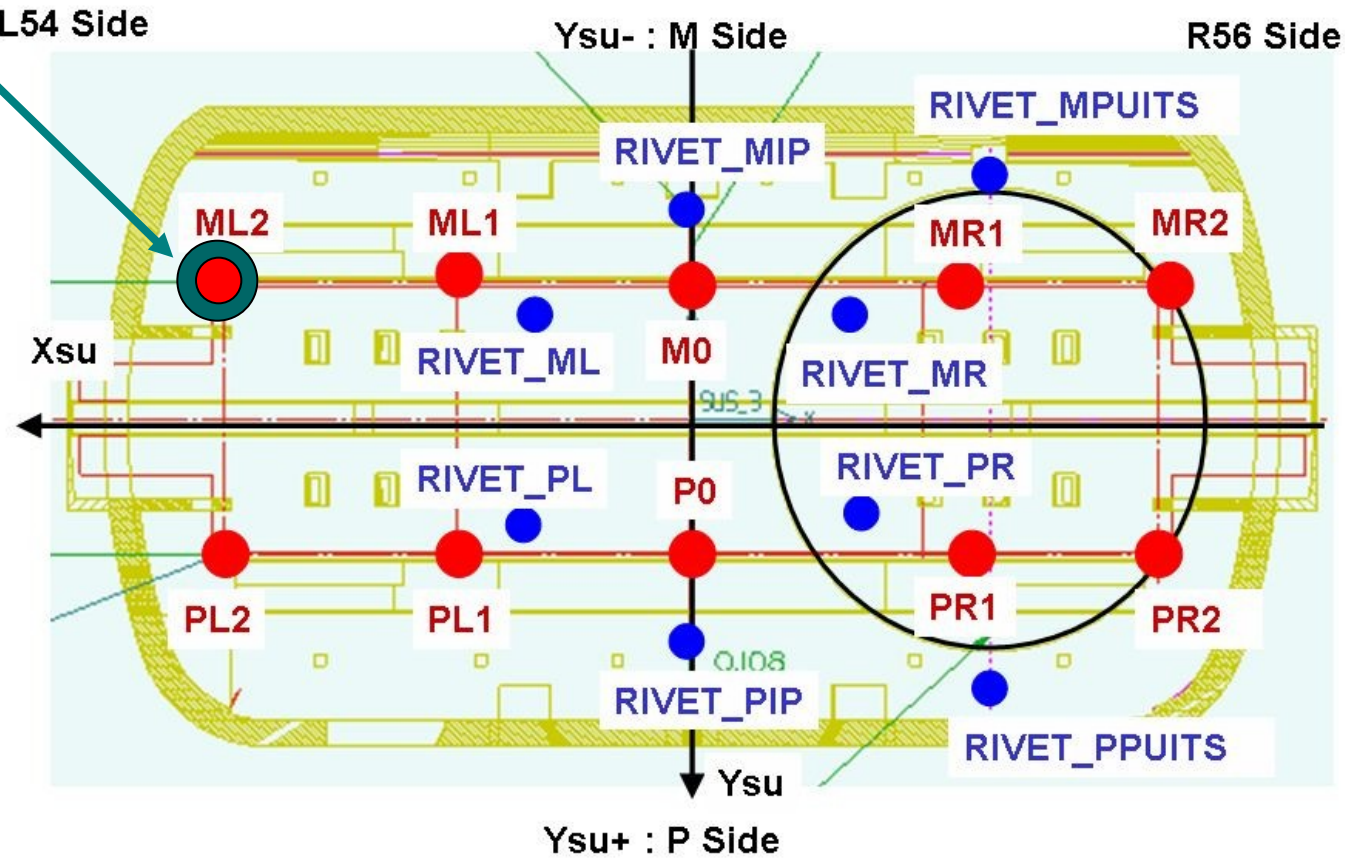


Only local floor stability!!!

EDMS: CMS-I-UR-0207

CMS – floor stability (leveling)

Reference: deep references



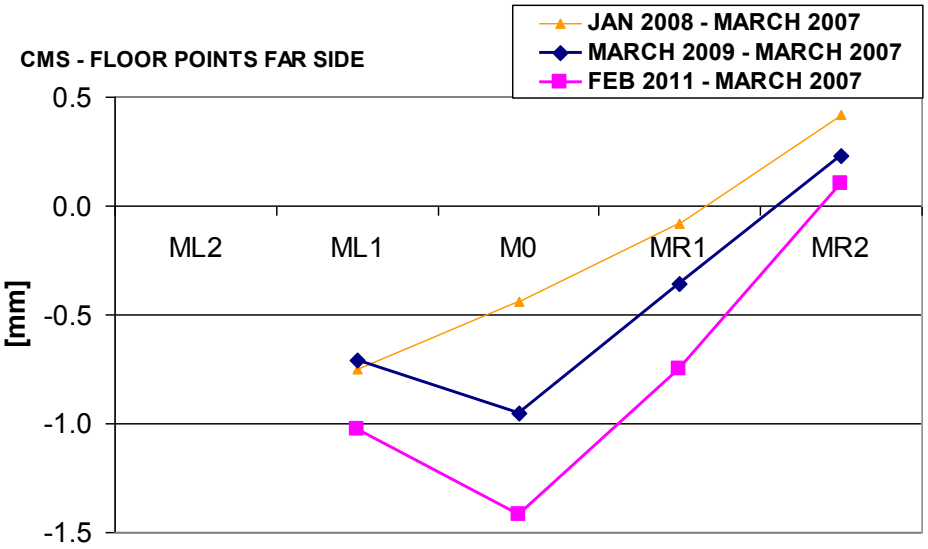
- **Punctual survey campaigns: Mar 2007, Jan 2008, Mar 2009, Feb 2011**

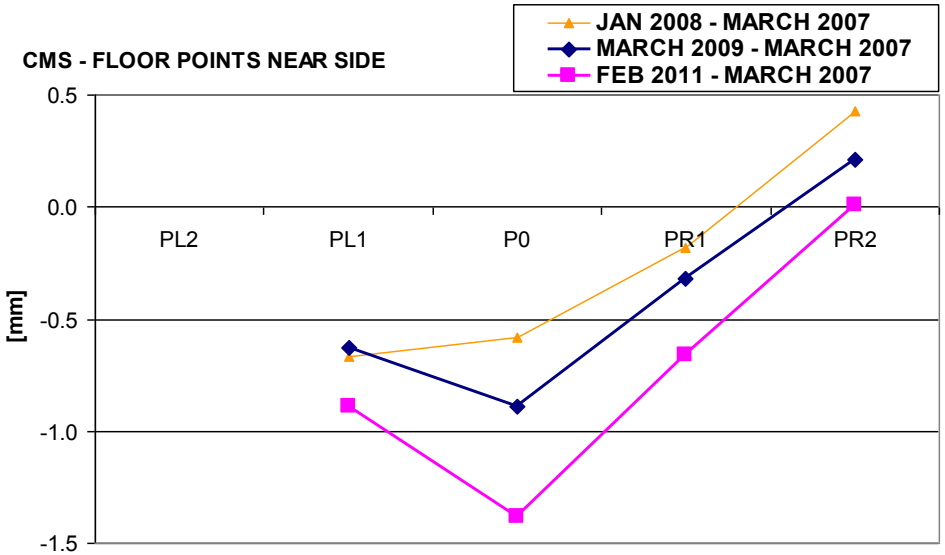
➔ **M0 and P0 moved down by 1.4 mm max.**

CMS – floor stability (results)

Summary of CMS floor stability by optical leveling (Mar 2007 - Feb 2011)			
	JAN 2008 - MARCH 2007	MARCH 2009 - MARCH 2007	FEB 2011 - MARCH 2007
NAME	DZ [mm]	DZ [mm]	DZ [mm]
ML2	---	---	---
ML1	-0.8	-0.7	-1.0
M0	-0.4	-0.9	-1.4
MR1	-0.1	-0.4	-0.8
MR2	0.4	0.2	0.1
PL2	---	---	---
PL1	-0.7	-0.6	-0.9
P0	-0.6	-0.9	-1.4
PR1	-0.2	-0.3	-0.7
PR2	0.4	0.2	0.0

Precision 0.3 mm/1 sigma





Conclusion CMS stability

- Floor stability:
  - Deep references in UX55 stable to "very local" vicinity
  - Measurements linked to the Deep Reference Points in UX55
  - 4 epochs March 07 – February 11
  - movement up to -1.4 mm in ~4 years around YB0
- relative HLS system on YB0 feet:
  - No inclination visible on feet of YB0
  - System in very good running from Apr 2008
  - The system is measuring continuously and is controlled periodically (filling/purging tests)
- HLS system on YB0 beam line level:
  - Long term movements -120 micron/year in 2010 on beam line level
  - Major influence by temperature changes in UX55 (in ~9 m height)
  - Correlation to magnetic field strength (deformation of YB0)
  - The system is measuring continuously and is controlled periodically (filling/purging tests)

Movements seen by CMS YB0 HLS in 2010 and YB0 HLS temperature changes