CLIC alignment studies

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on behalf of the CLIC pre-alignment team

OUTLINE

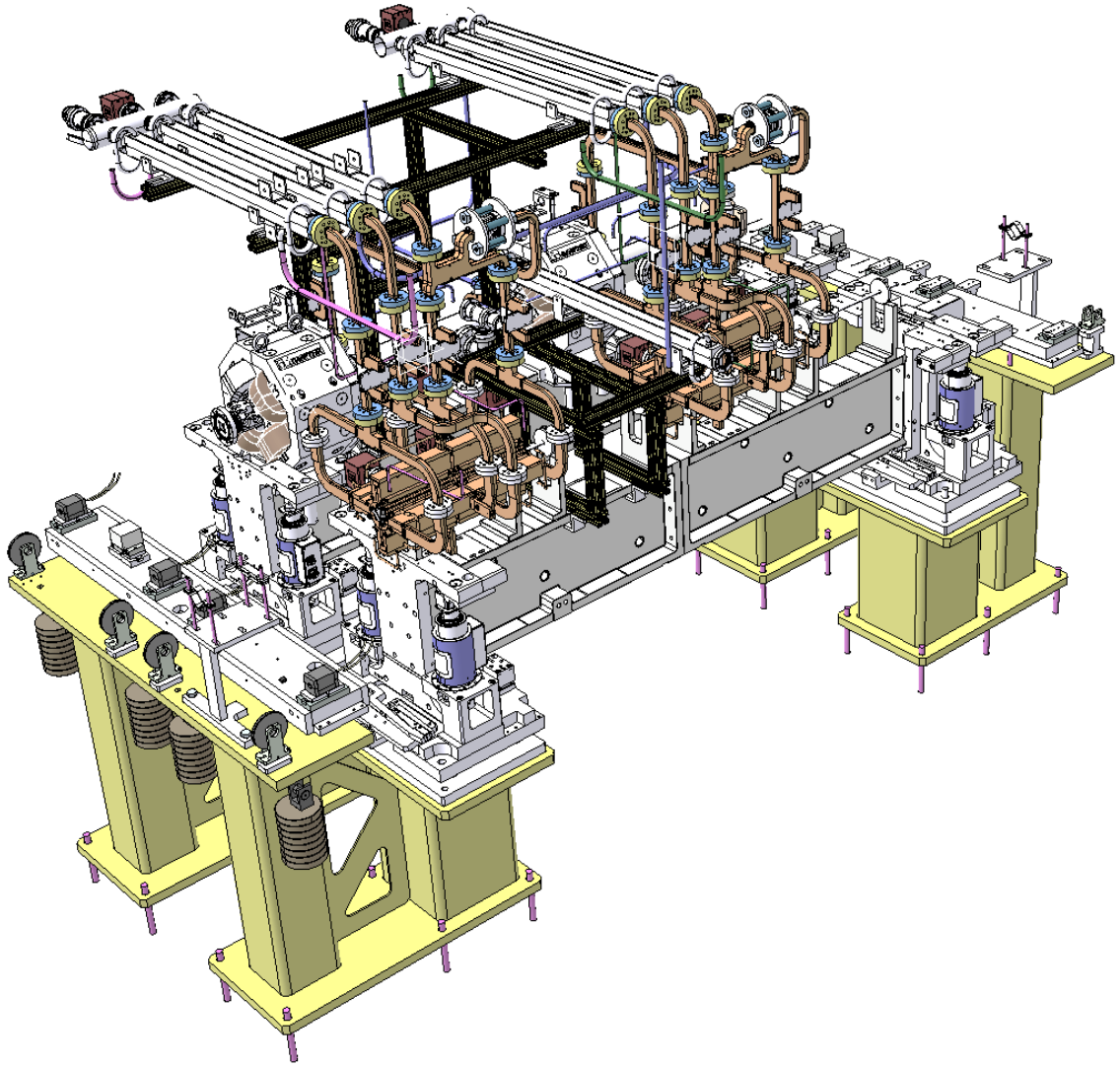
- ✓ CLEX
  - Alignment of the components
  - Impact of beam on sensors readings
  - Long term stability of the supports (girders, DB quad)
- ✓ LAB:
  - New sensors support
  - Universal fiducial support
  - New configuration of sensors

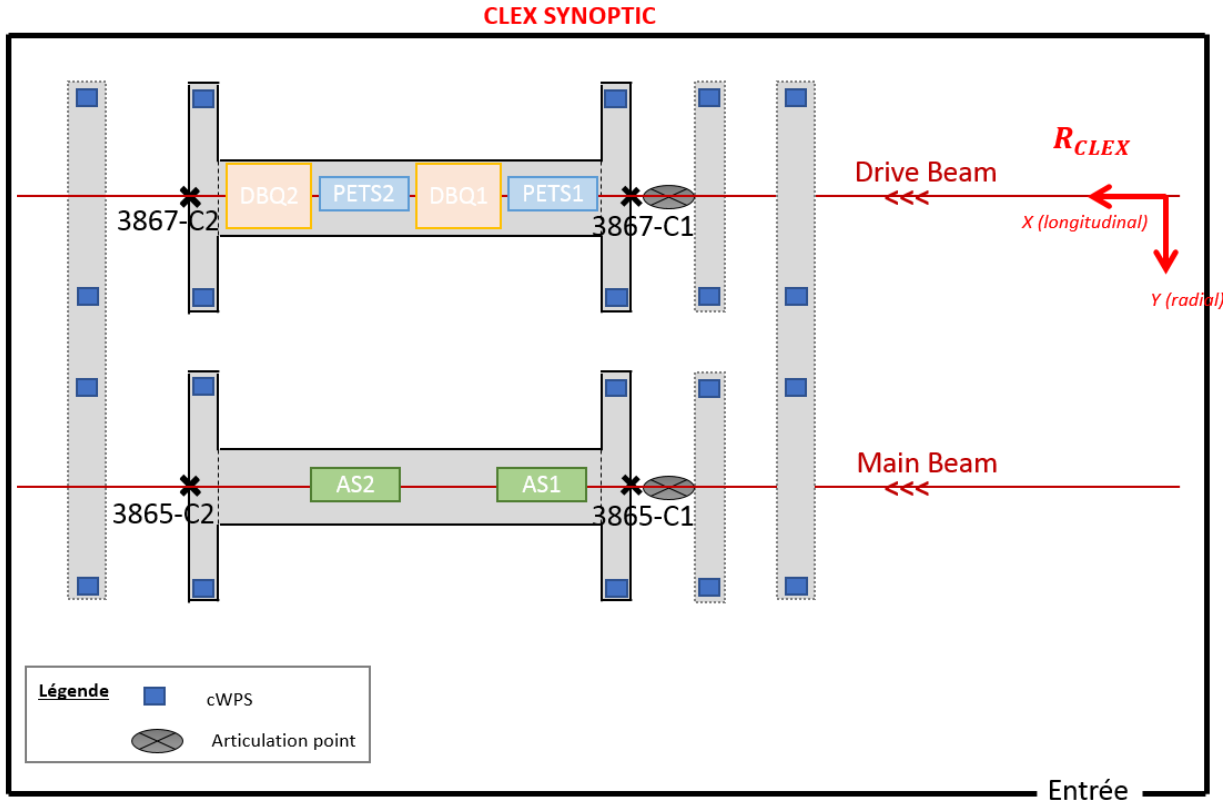
CLIC Project Meeting
09/06/2015

CTC-002 Survey and Alignment

WP: CTC-002	Purpose/Objectives/Goals	Deliverables	Schedule
Task 1: development of sensors and actuators	Development of calibration benches Validation through inter-comparisons Qualification in accelerator environment, development of low cost versions, preparation of industrialization	Low cost precise and accurate sensors (WPS, inclinometers,…) Low cost linear actuators and cam movers	2011-2016
Task 2: tunnel metrology	Development of laser based alternatives Consolidation of stretched wire solution Validation through inter-comparisons	Simulations + experimental validation of laser based and stretched wire solutions.	2011-2016
Task 3: active pre-alignment of TBA modules	Validation on two beam modules in lab and CLEX Adaptation to new designs and new configurations Increasing performance of fiducialisation techniques & strategies	Mock-ups with associated technical reports on experimental tests	2011-2016
Task 4:active pre-alignment & monitoring in MDI	Development & qualification of solutions for: the determination of the position of QD0 w.r.t the 500m last meters, the relative monitoring of QD0 through the detectors, the re-adjustment within 6 DOF	Mock-ups with associated technical reports on experimental tests	2011-2016
Lead collaborator(s): CERN (Helene Mainaud-Durand et al.)- NIKHEF			

CLEX → Configuration of sensors & components

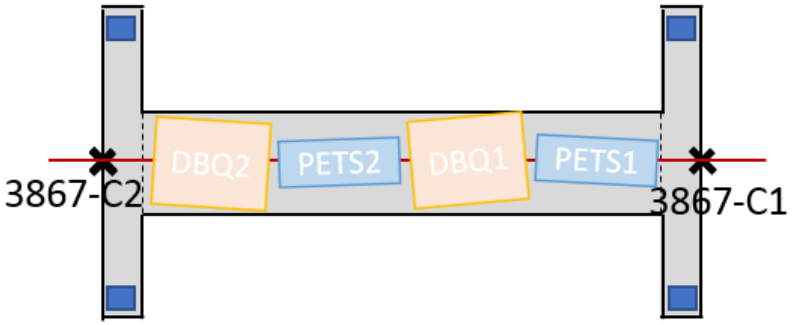




CLEX → Alignment of the DB side components

Drive Beam		Radial (mm)	Vertical (mm)
Girder 3867	Enter (3867-C1)	**0.000**	**0.000**
	Exit (3867-C2)	**0.000**	**0.000**
PETS1	Enter	0.065 *[+/- 0.100]*	0.037 *[+/- 0.100]*
	Exit	-0.027 *[+/- 0.100]*	0.015 *[+/- 0.100]*
DBQ1	Enter	-0.009 *[+/- 0.020]*	-0.004 *[+/- 0.020]*
	Exit	-0.002 *[+/- 0.020]*	0.019 *[+/- 0.020]*
PETS2	Enter	0.028 *[+/- 0.100]*	0.078 *[+/- 0.100]*
	Exit	-0.051 *[+/- 0.100]*	0.058 *[+/- 0.100]*
DBQ2	Enter	0.008 *[+/- 0.020]*	0.011 *[+/- 0.020]*
	Exit	-0.003 *[+/- 0.020]*	-0.014 *[+/- 0.020]*

CLEX Alignment (Drive Beam) : 2 Mars 2015

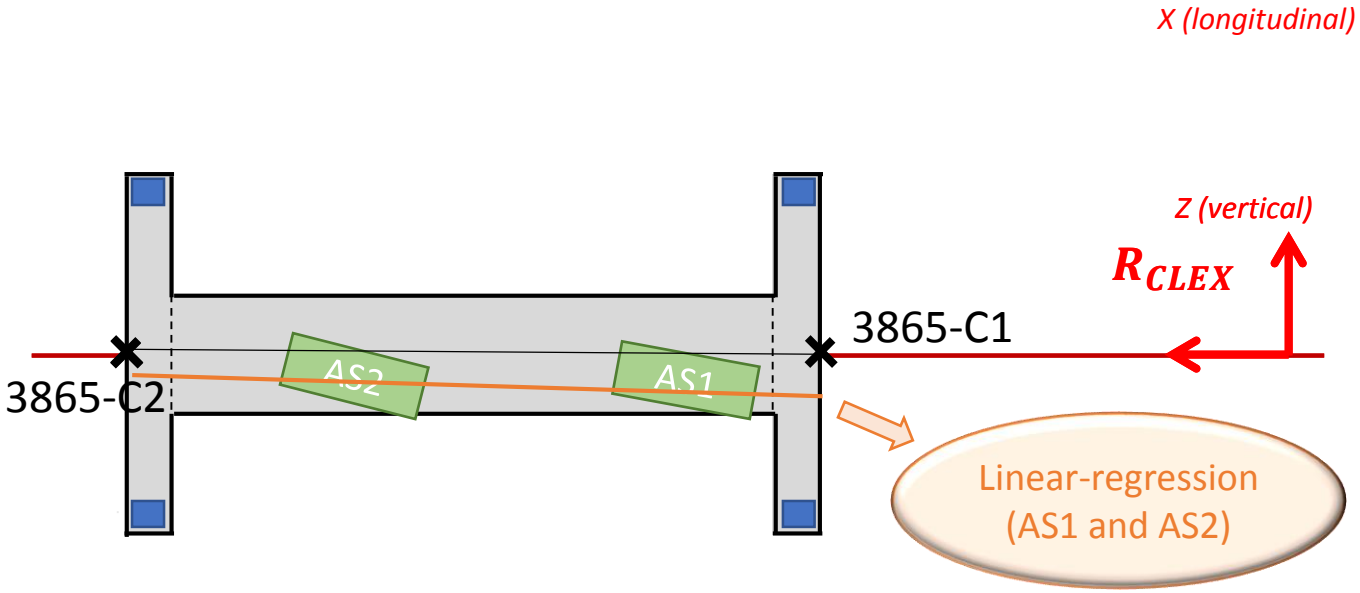


CLEX → Alignment of the MB side components

Main Beam		Radial (mm)	Vertical (mm)	
Girder 3865	Enter (3865-C1)	**0.000** *(+750)*	**0.000**	
	Exit (3865-C2)	**0.000** *(+750)*	**0.000**	
AS1	Enter	-0.051 *[+/- 0.017]*	-0.059 *[+/- 0.017]*	✗
	Exit	-0.161 *[+/- 0.017]*	-0.016 *[+/- 0.017]*	✗
AS2	Enter	-0.068 *[+/- 0.017]*	-0.085 *[+/- 0.017]*	✗
	Exit	-0.139 *[+/- 0.017]*	-0.103 *[+/- 0.017]*	✗

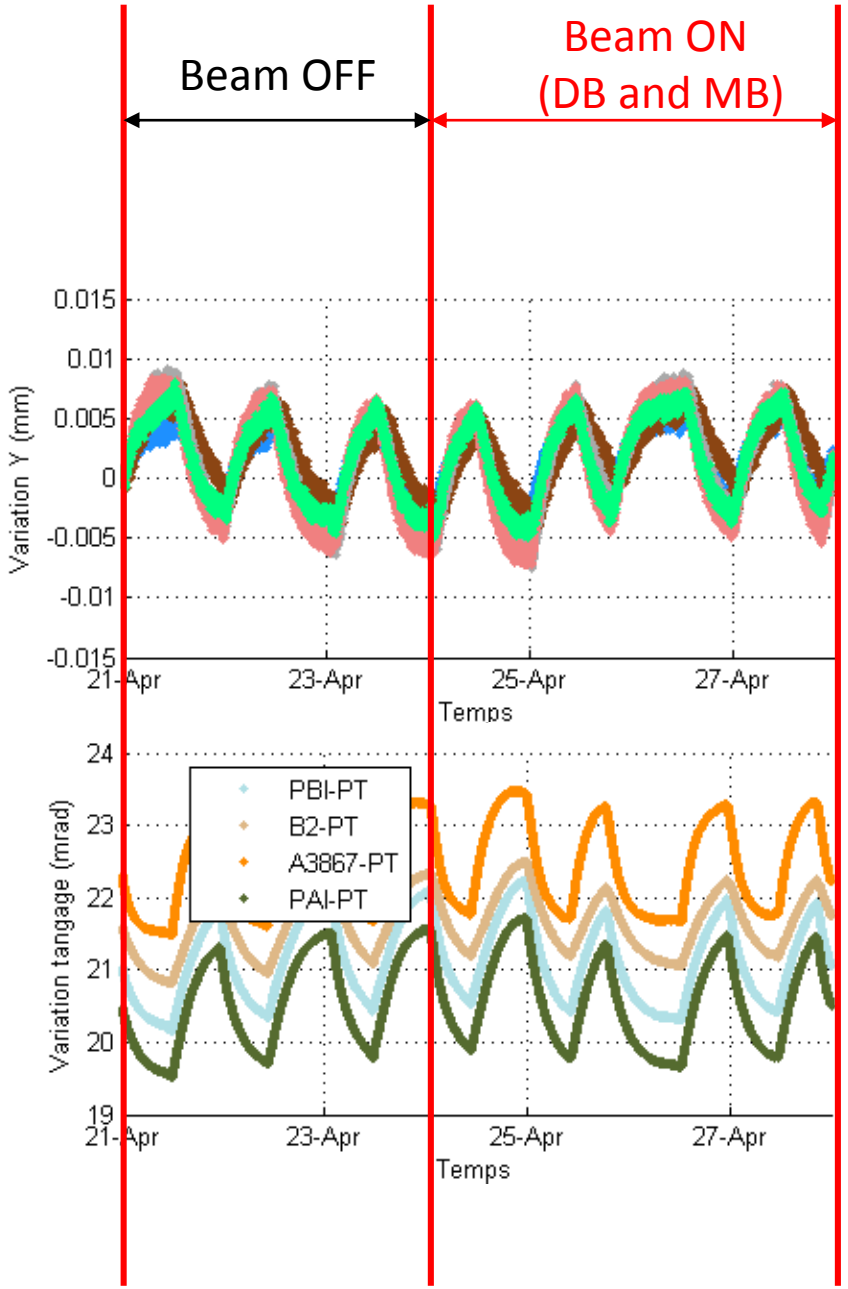
Main Beam		Radial (mm)	Vertical (mm)	
Girder 3865	Enter (3865-C1)	**0.128** *(+750)*	**0.096**	
	Exit (3865-C2)	**0.063** *(+750)*	**0.014**	
AS1	Enter	0.029 *[+/- 0.017]*	-0.024 *[+/- 0.017]*	✗
	Exit	-0.065 *[+/- 0.017]*	0.039 *[+/- 0.017]*	✗
AS2	Enter	0.046 *[+/- 0.017]*	-0.008 *[+/- 0.017]*	✗
	Exit	-0.010 *[+/- 0.017]*	-0.007 *[+/- 0.017]*	✓

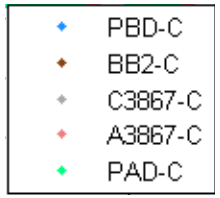
CLEX Alignment (Main Beam) : 2 Mars 2015



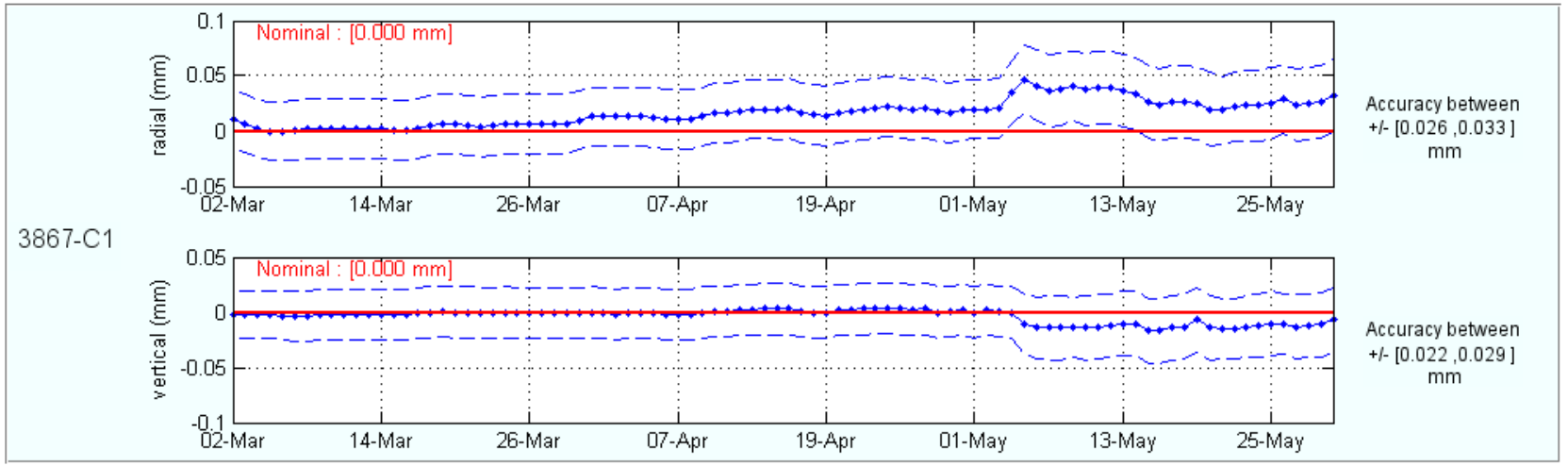
Goal : Positioning the structure along the beam (Best we can !!)

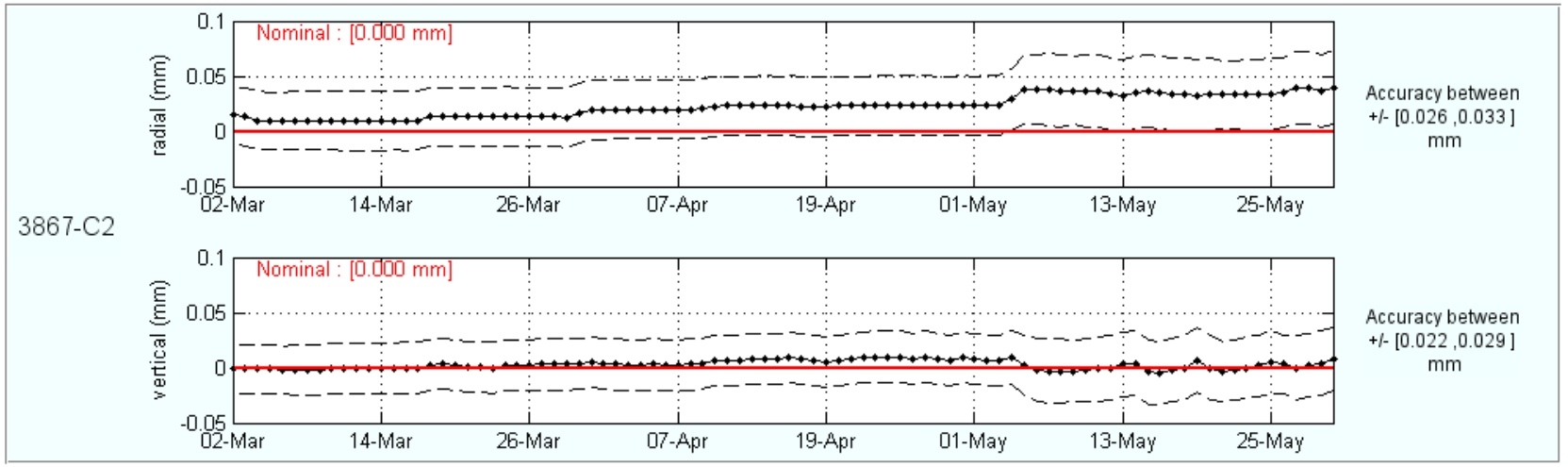
CLEX → Impact of beam

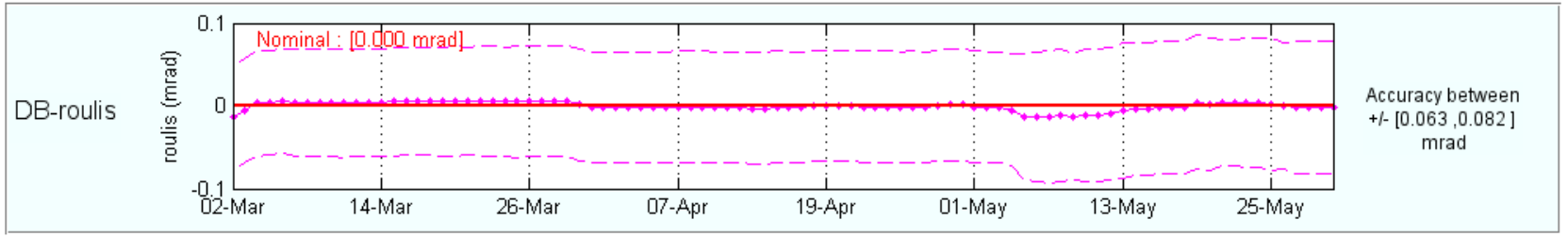


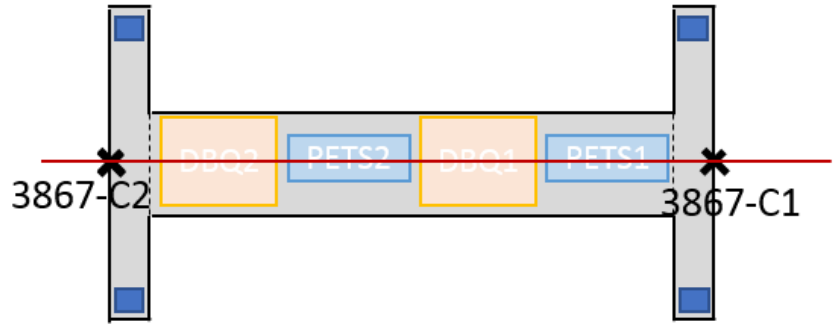


CLEX → Long term stability (DB)

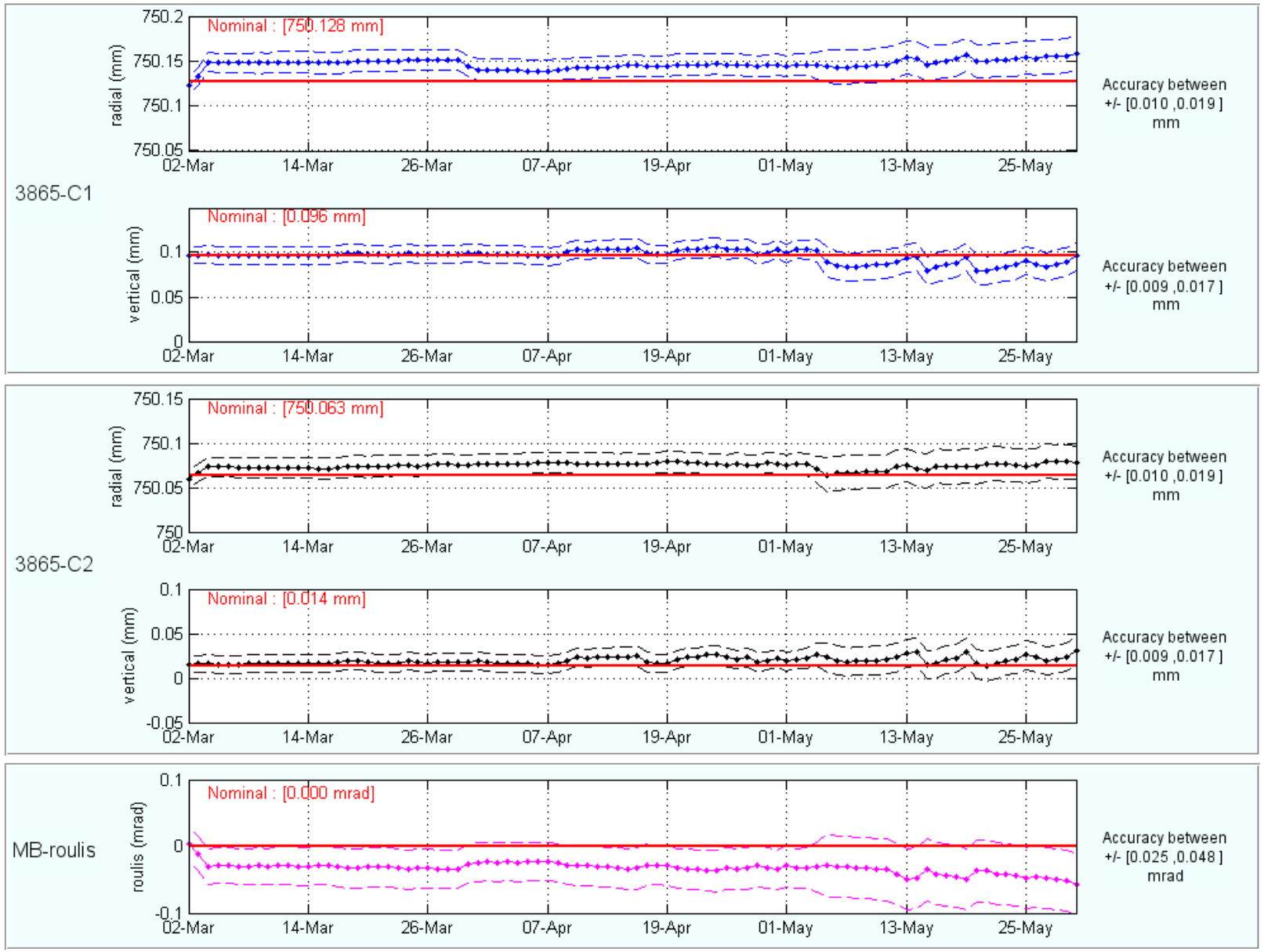


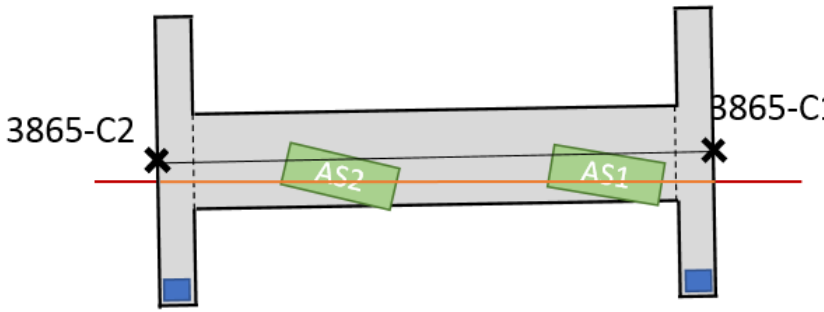




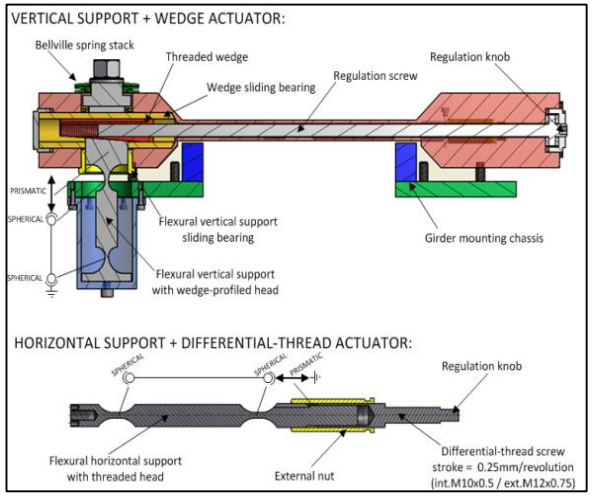


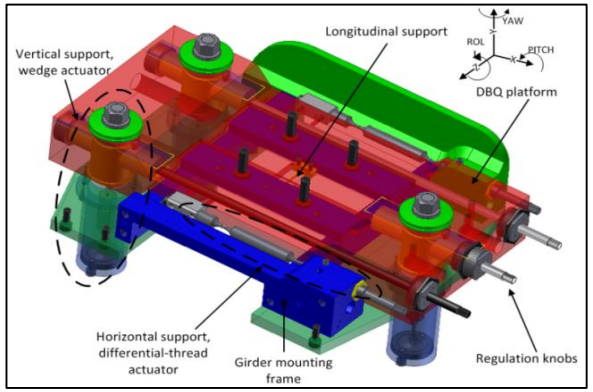
CLEX → Long term stability (MB)





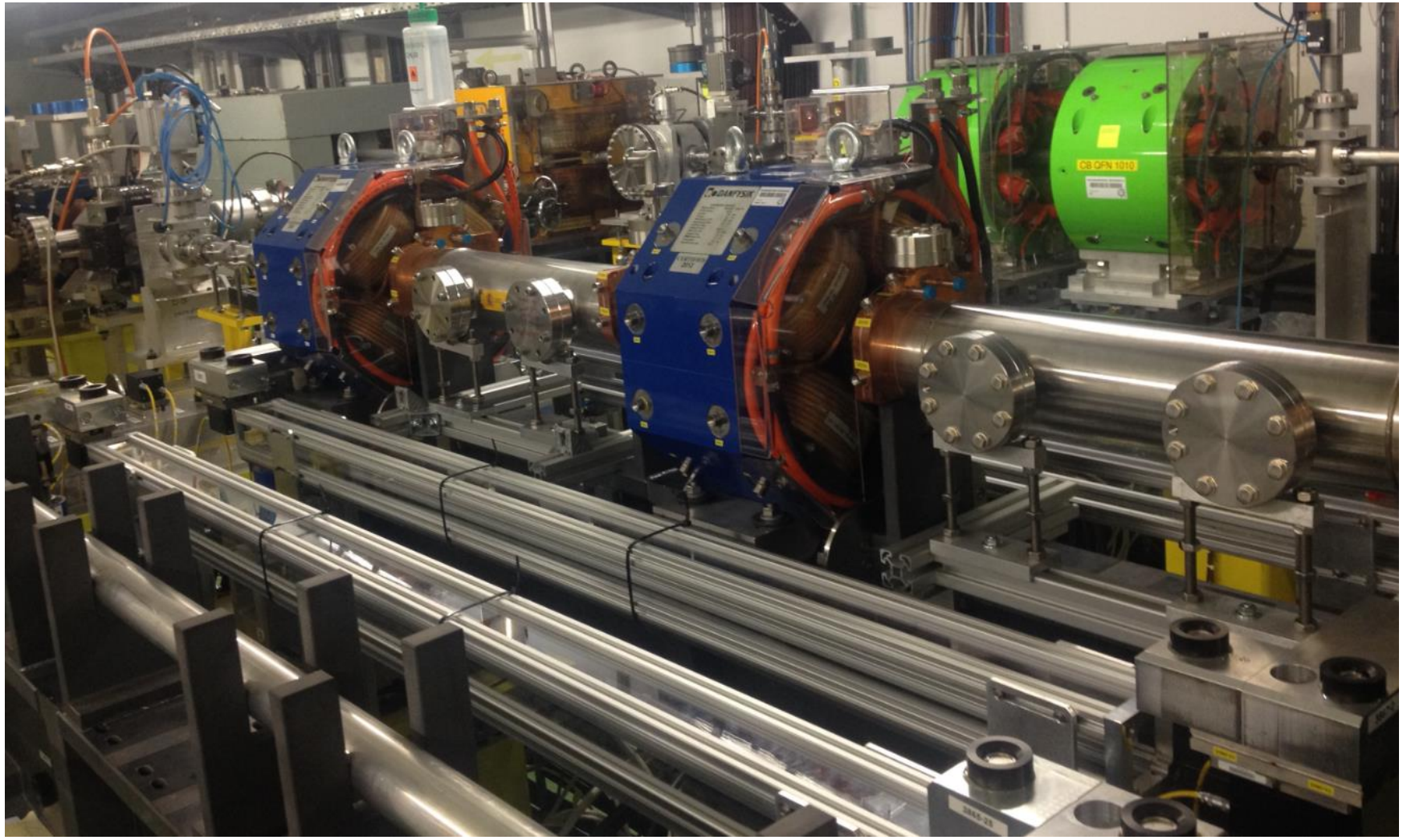
CLEX → Long term stability (DB quad support)



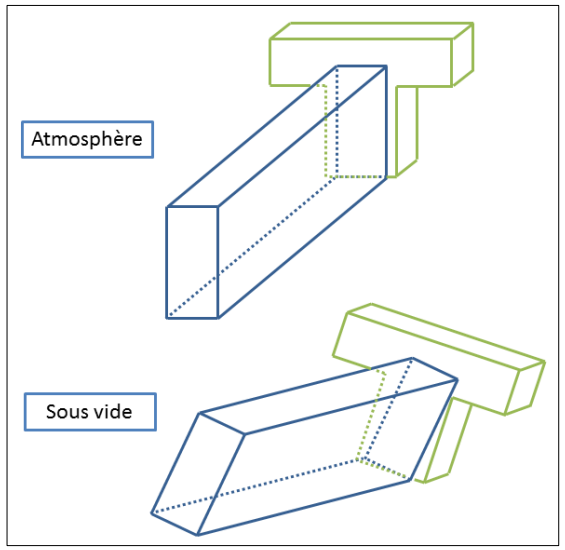


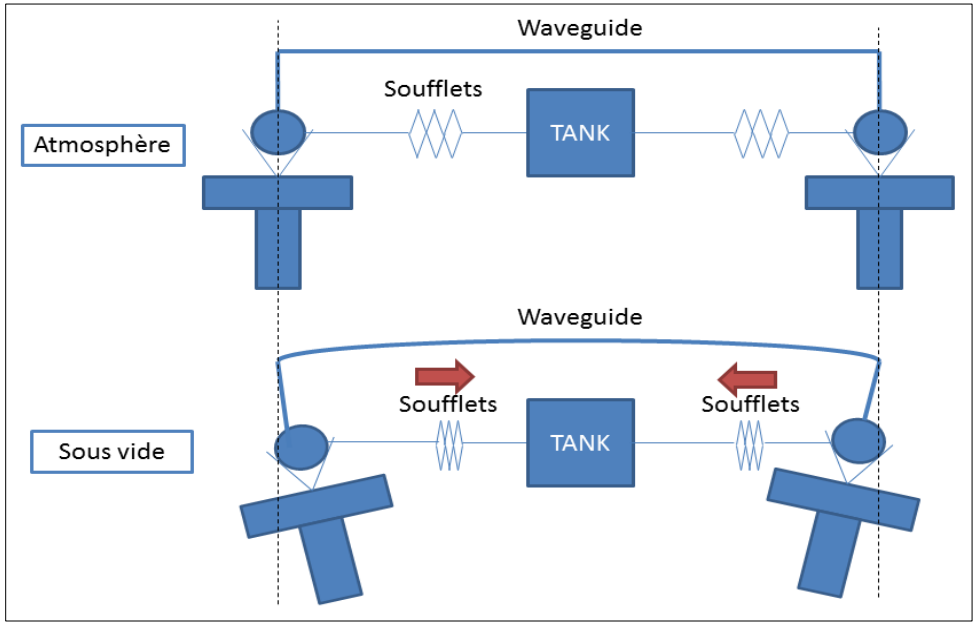
		Radial (µm)	Vertical (µm)
DBQ1	C1	-9	-4
	C2	-3	19
DBQ2	C1	8	11
	C2	-3	-14

Offsets measured after 3 months



LAB → Configuration of sensors & components



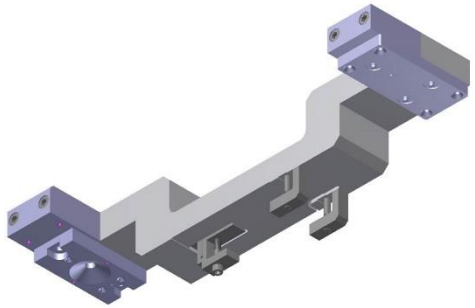


In situ fiducialisation:

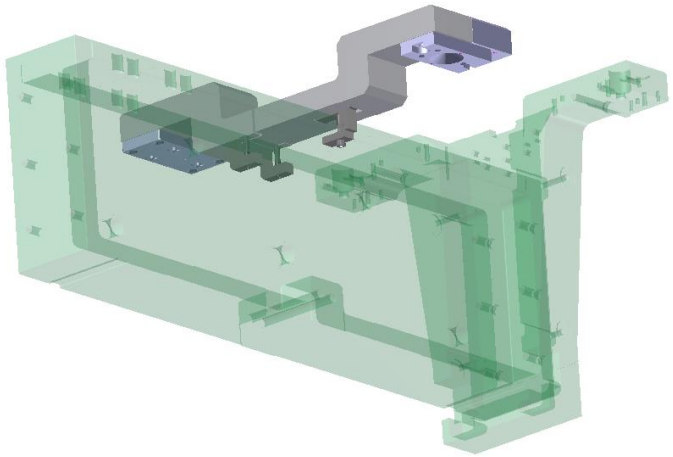
- Alignment sensors are installed on the cradle
- Misalignment between the cradle & the girder

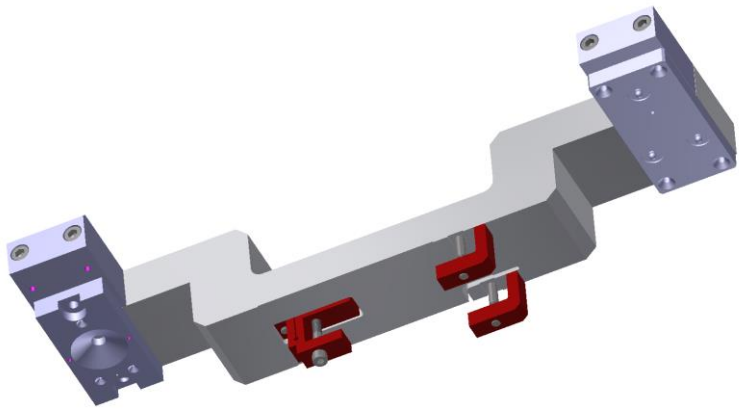
➔ Fiducialisation lost

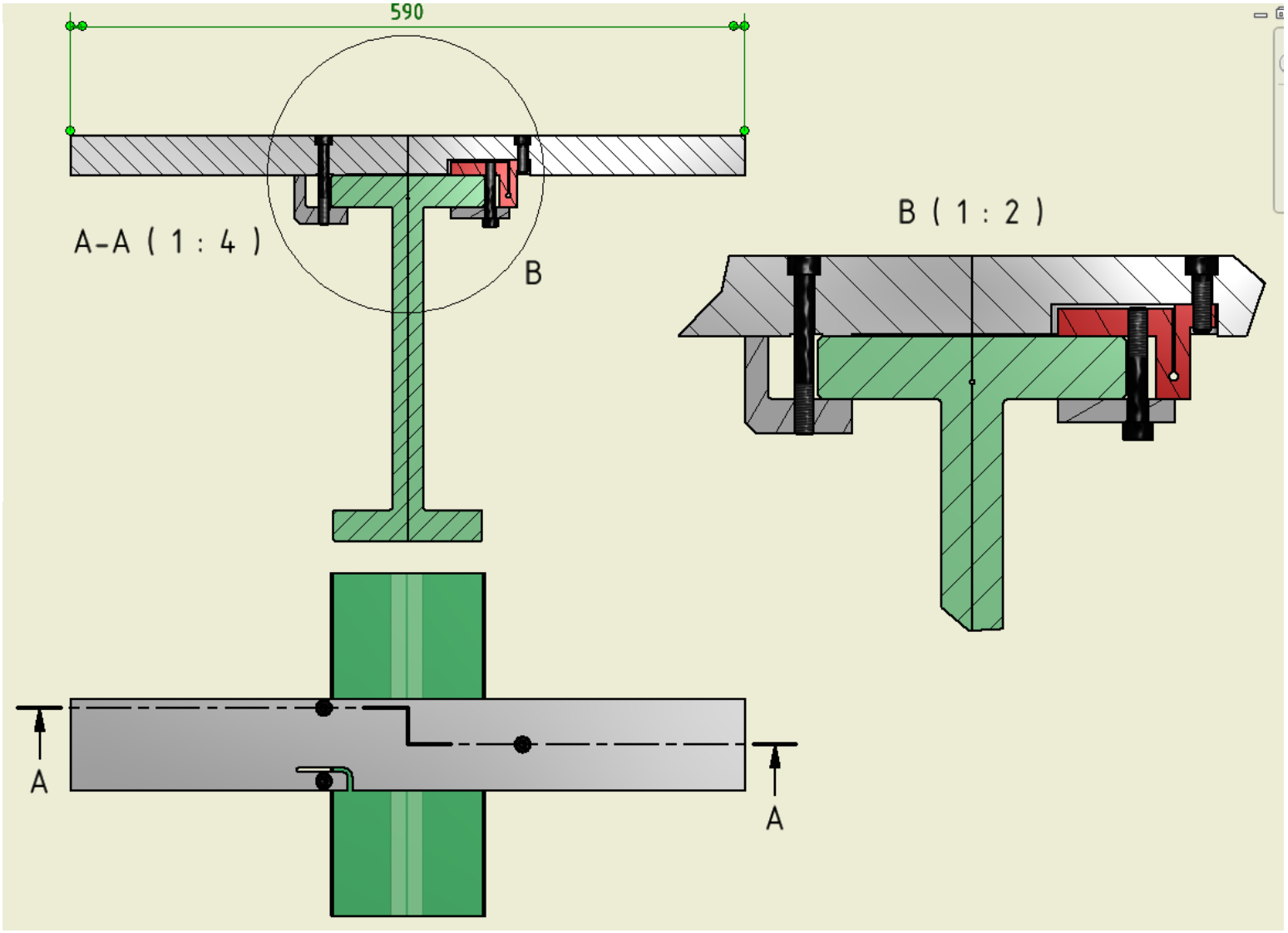
Sensors support on the girder



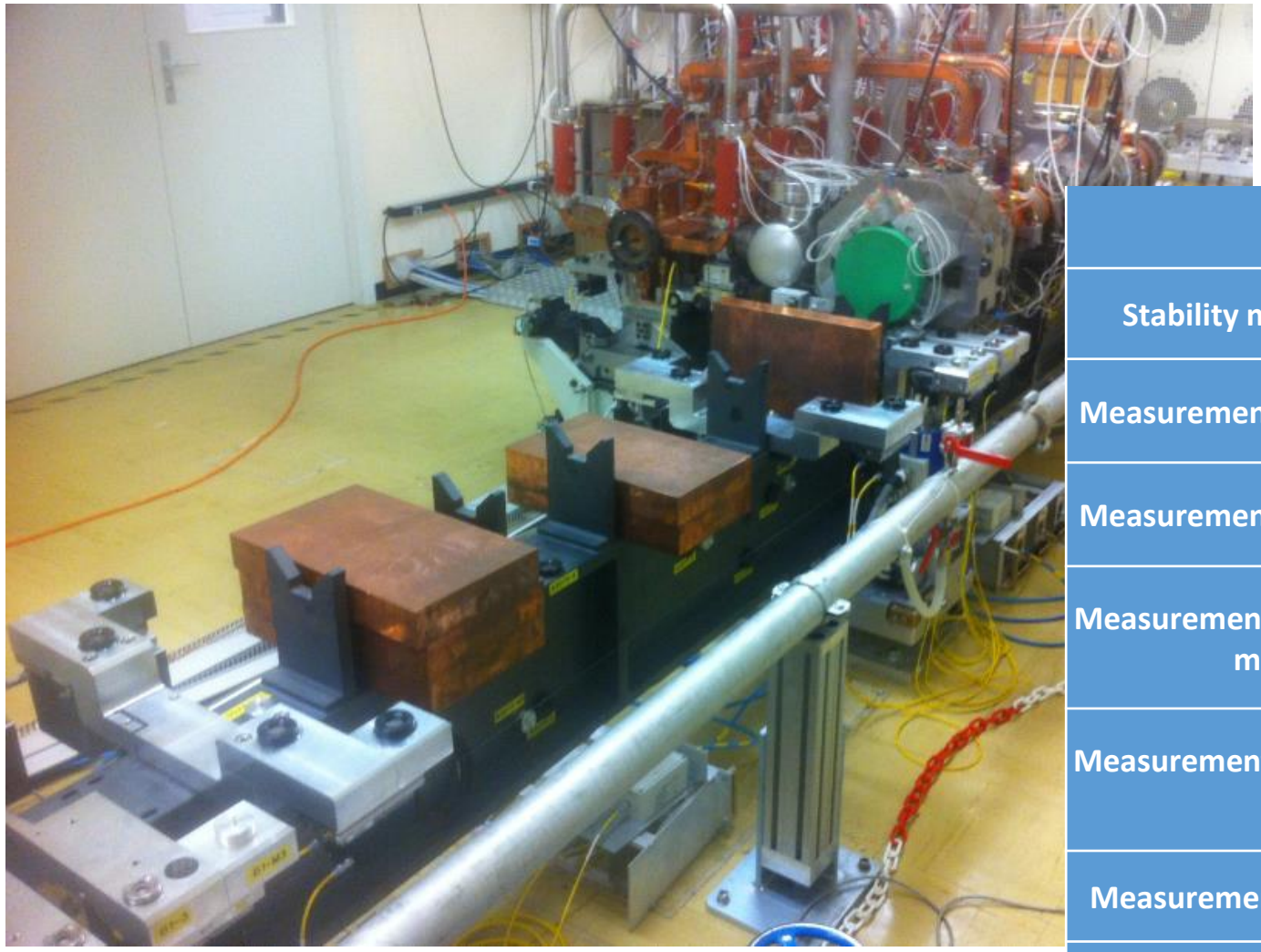
LAB → New sensors support





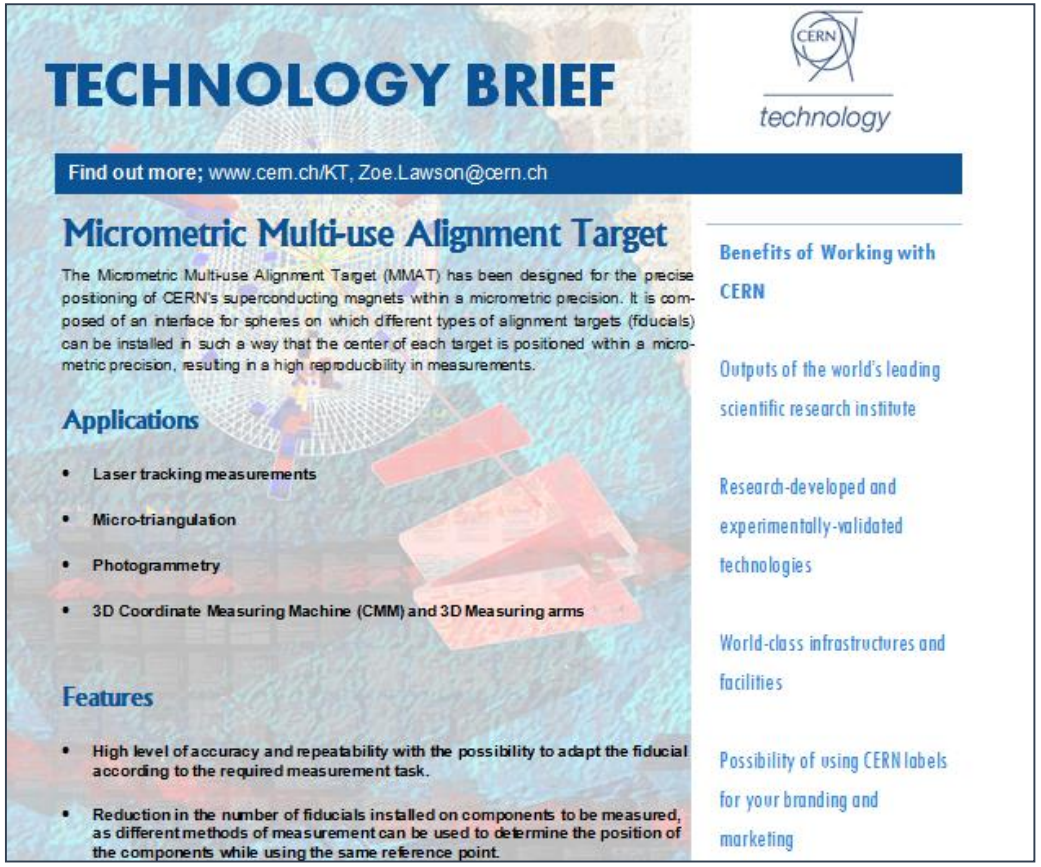


LAB → New sensors support



In µm	Best-fit RMS	Max Girder	Max Support	Max Cradle
Stability measurements 01/06/2015	3	4	9	8
Measurements after warm up 02/06/2015	2	4	8	6
Measurements after warm up 04/06/2015	3	6	12	12
Measurements after 1 displacement of 800 microns 04/06/2015	4	8	8	11
Measurements after several displacements 04/06/2015	3	5	11	23
Measurements after loading 04/06/2014	4	6	11	19
Measurements after warm up + loads 08/06/2015	4	6	13	12

LAB → Universal fiducial



TECHNOLOGY BRIEF

technology

Find out more; www.cern.ch/KT, Zoe.Lawson@cern.ch

Micrometric Multi-use Alignment Target

The Micrometric Multi-use Alignment Target (MMAT) has been designed for the precise positioning of CERN's superconducting magnets within a micrometric precision. It is composed of an interface for spheres on which different types of alignment targets (fiducials) can be installed in such a way that the center of each target is positioned within a micrometric precision, resulting in a high reproducibility in measurements.

Applications

- Laser tracking measurements
- Micro-triangulation
- Photogrammetry
- 3D Coordinate Measuring Machine (CMM) and 3D Measuring arms

Features

- High level of accuracy and repeatability with the possibility to adapt the fiducial according to the required measurement task.
- Reduction in the number of fiducials installed on components to be measured, as different methods of measurement can be used to determine the position of the components while using the same reference point.

Benefits of Working with CERN

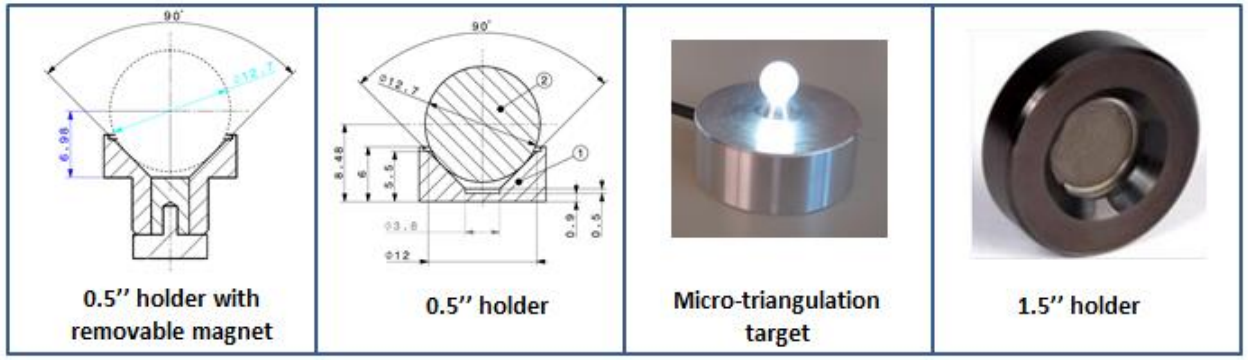
Outputs of the world's leading scientific research institute

Research-developed and experimentally-validated technologies

World-class infrastructures and facilities

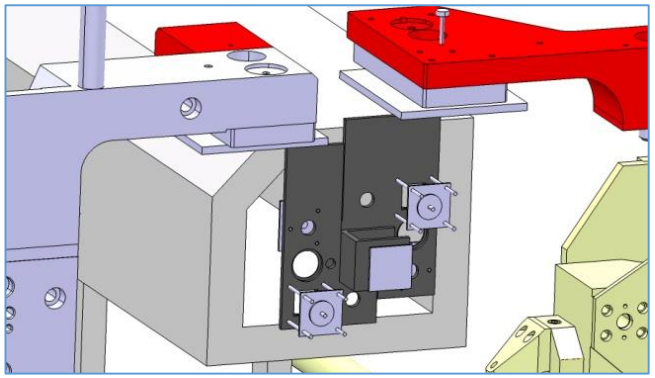
Possibility of using CERN labels for your branding and marketing

1 unique support of fiducials for different means of measurements

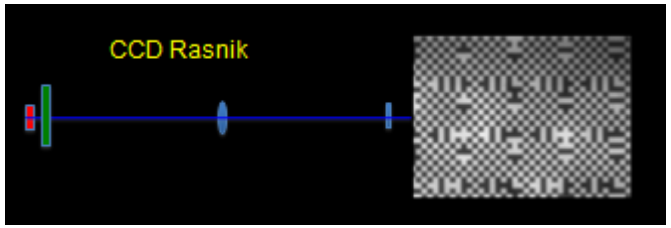


- Identification of potential companies
- Patenting study by a patent attorney

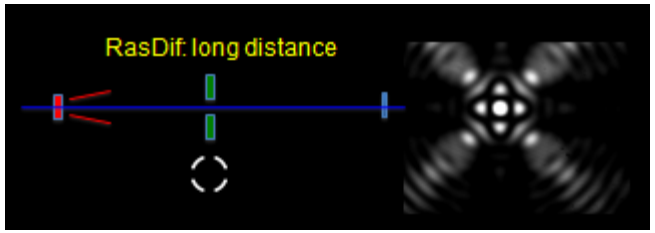
LAB → New configuration of sensors

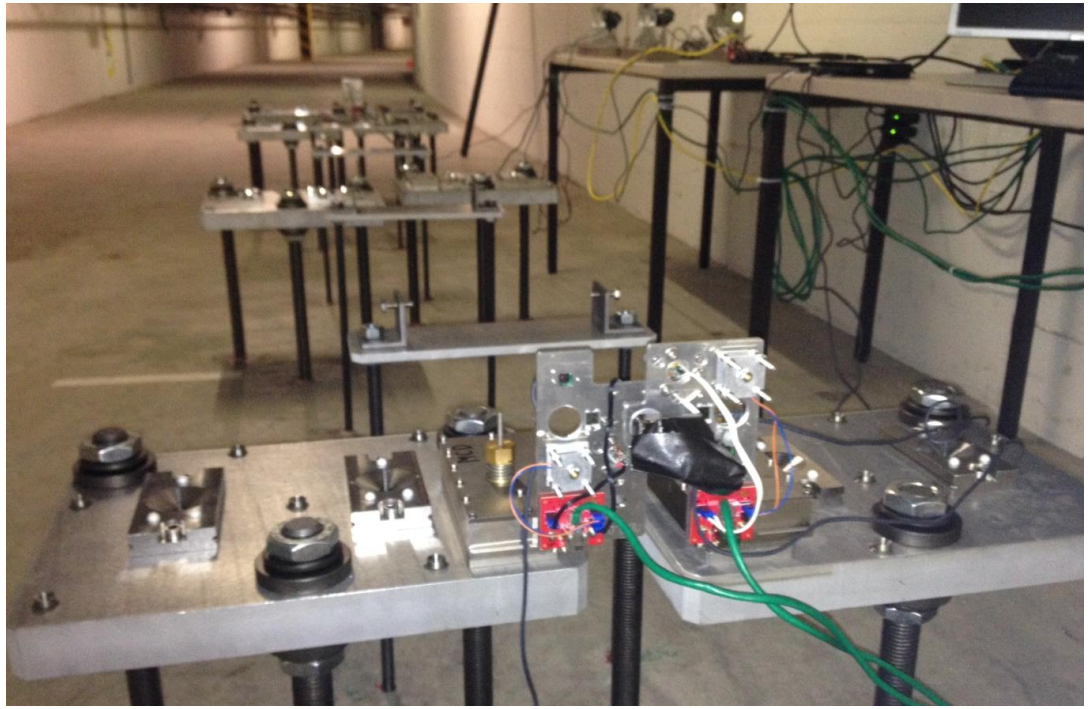


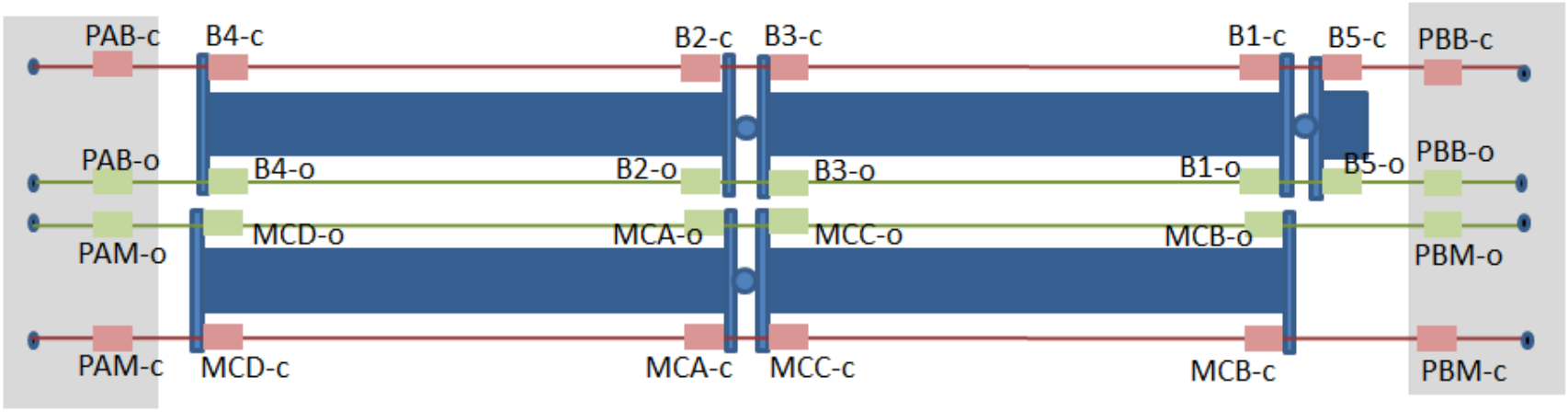
RasNik

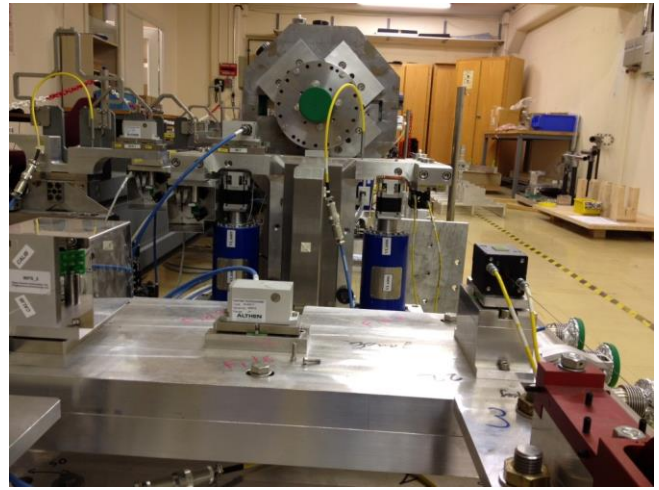


RasDif









Perspectives

- CLEX
  - Implementation & validation of the active pre-alignment algorithm
  - Various studies with beam: WPS sensors readings w.r.t WFM, optimization of the position with beam

- LAB:
  - End of the study: cradle w.r.t. girder
  - Re-installation of oWPS (replacing NIKHEF sensors)
  - Validation & test of motorized DBQ supports
  - Fiducialisation, alignment of the components of type 0 -2

- TT1:
  - Relative comparison between NIKHEF laser based alignment systems and WPS systems

Thank you very much for your attention

Special thanks to:

- Mateusz Sosin
- Vivien Rude
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- Guillaume Stern
- Nikkie Deelen