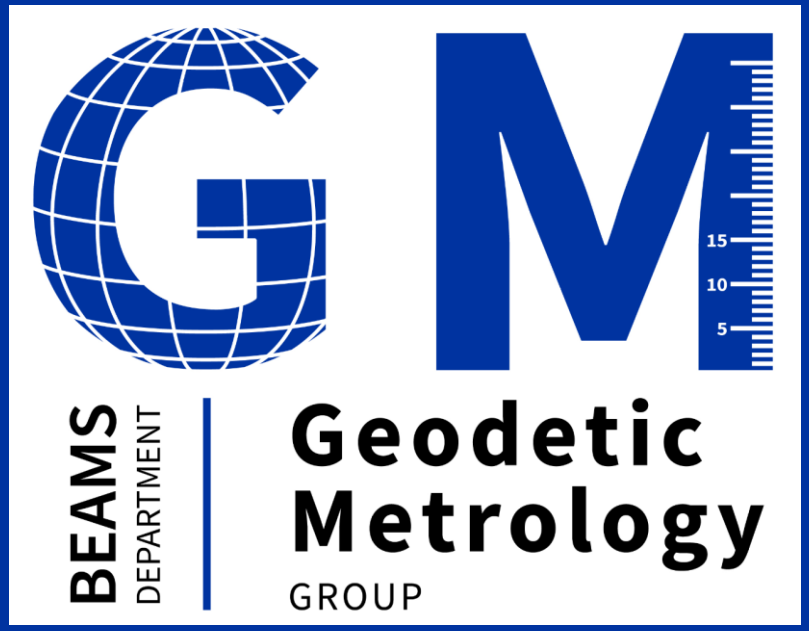


LHC MBX status

Jean-Frederic FUCHS (GM-ASG) - https://indico.cern.ch/event/1160100/

11.05.2021

AGENDA

- **Survey Terminology**
- **LS2 (LSSs / ARCs)**
  - MBX in LSS2 & LSS8
- **YETS_21-22**
  - LSS8 (Q4/Q4)
  - LSS2 (Q4/Q4)
- **Magnets with Banana !**

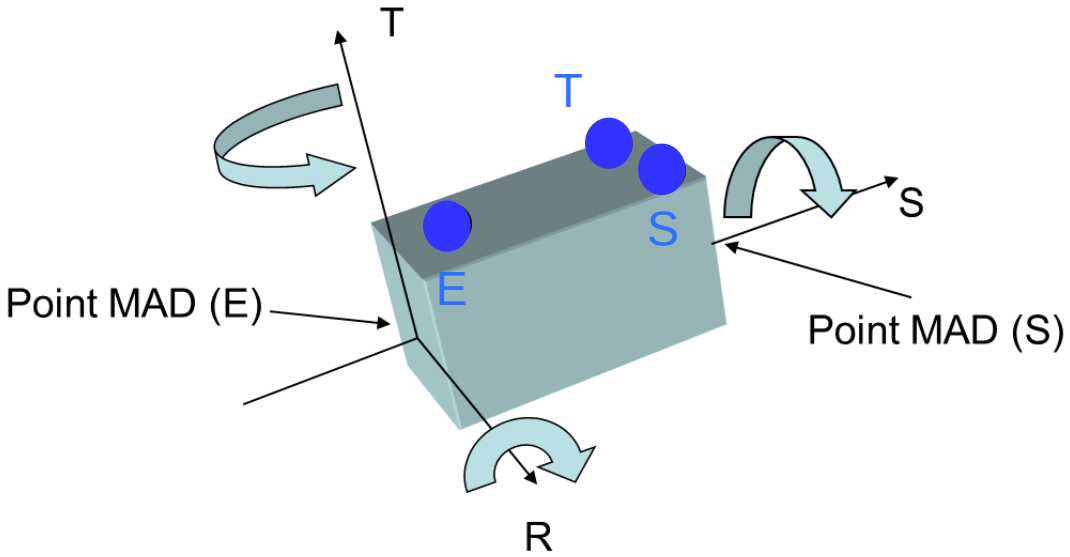
Survey Terminology

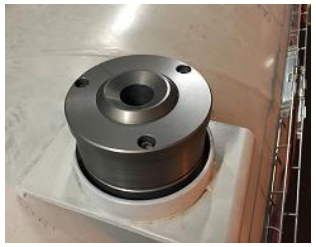
- **Beam points**
- **Sockets**
- **Jacks**

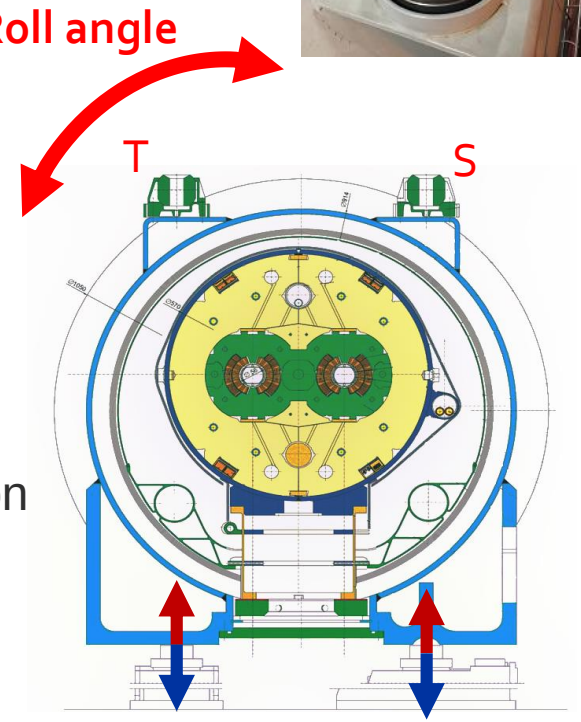
R : Roll angle (transversal inclination)

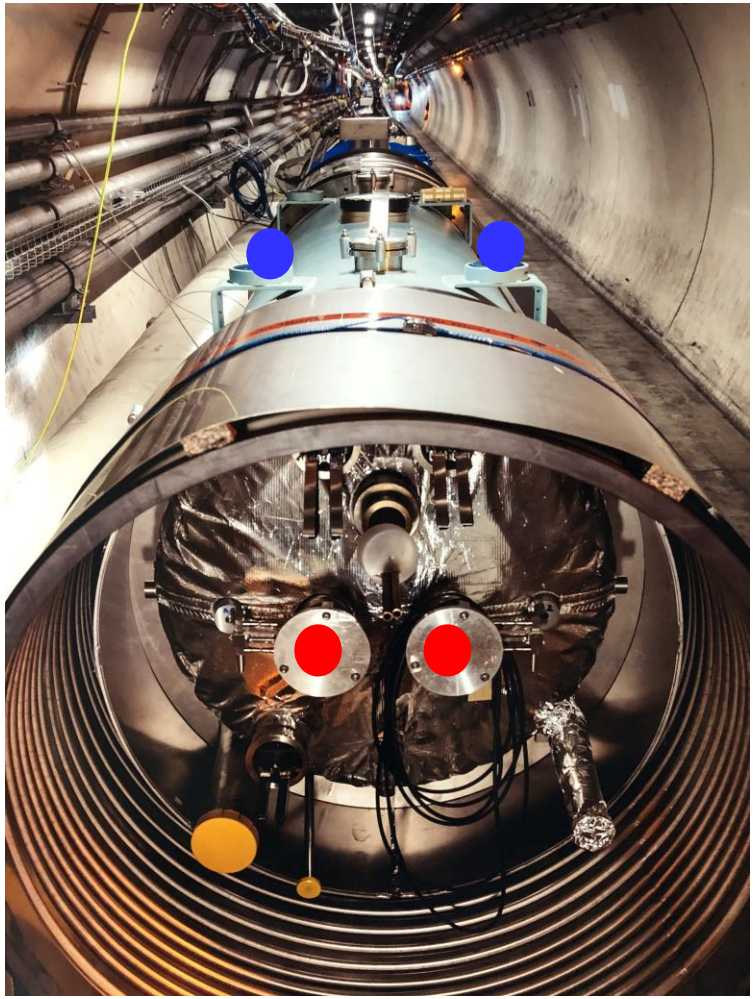
V : Vertical

H : Perpendicular / tranversal to the beam direction



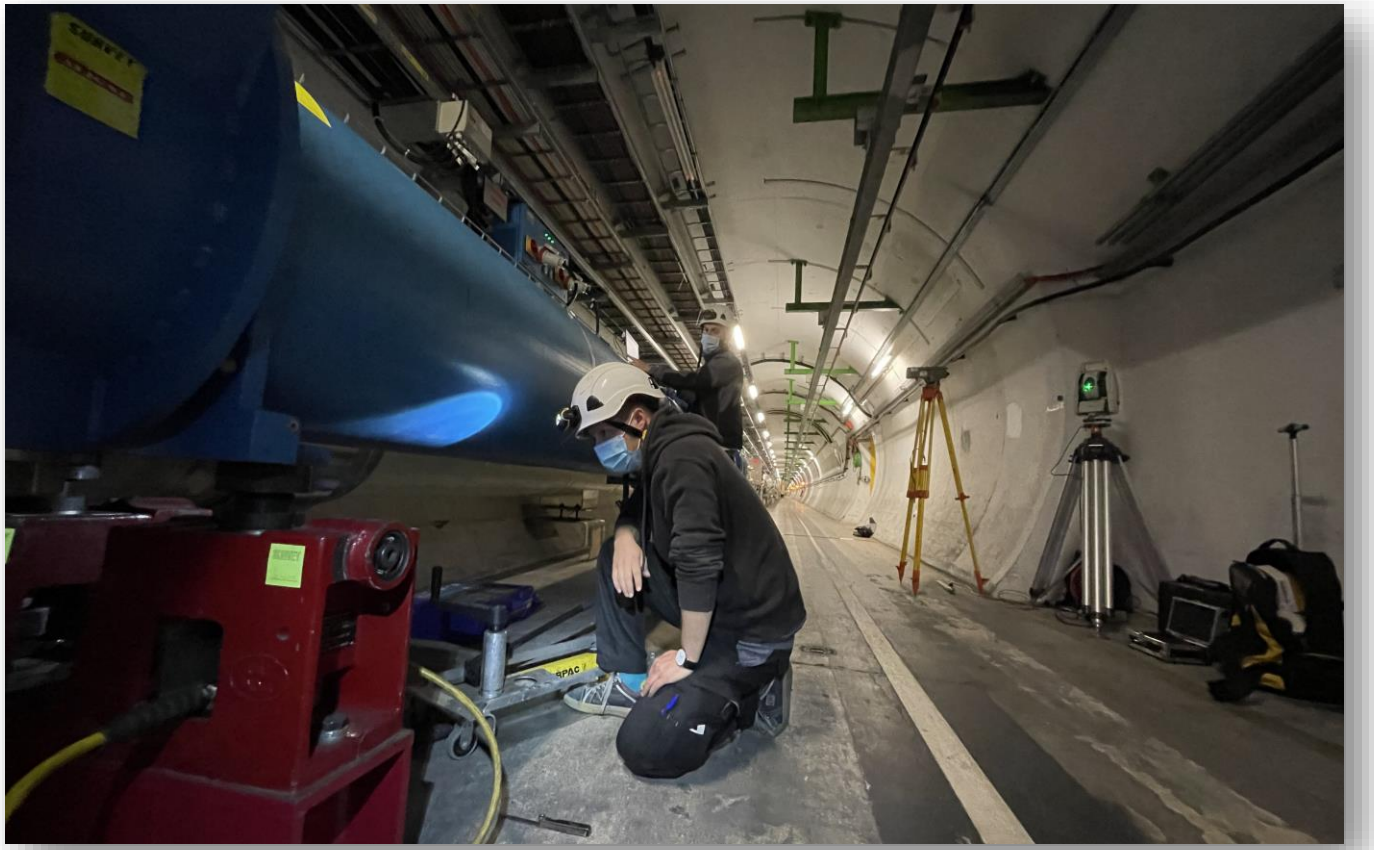






AGENDA

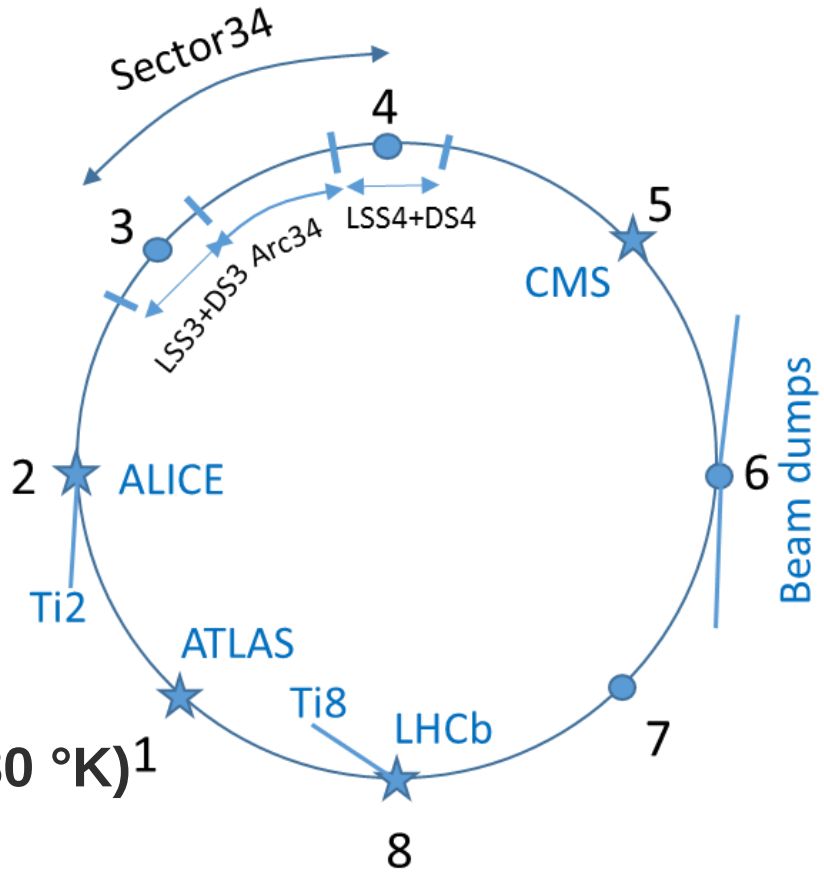
- Survey Terminology
- **LS2 (LSSs / ARCs)**
  - MBX in LSS2 & LSS8
- YETS_21-22
  - LSS8 (Q4/Q4)
  - LSS2 (Q4/Q4)
- Magnets with Banana !



LS2 : LSSs & Arcs

LSS2 and LSS8 have been smoothed at warm

- **LSS2** : MBX.4L2 & MBX.4R2 (D1)
- **LSS8** : MBX.4L8 & MBX.4R82 (D1)

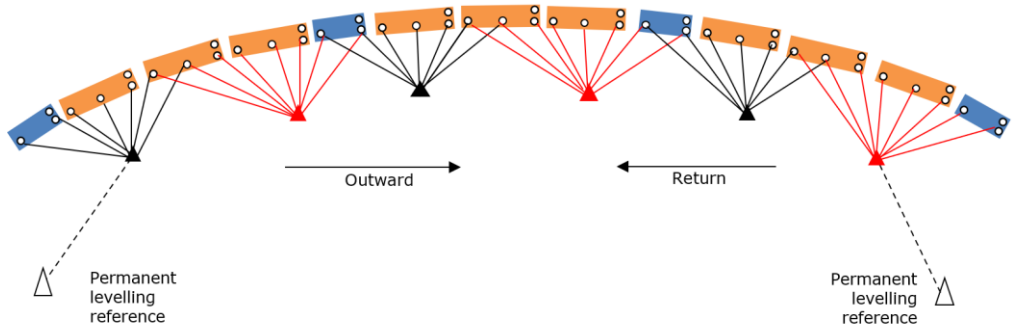


S12 & S23 and S78 & S81 have been smoothed at cold (< 80 °K)

- S12 : LSS1 + Arc12 + LSS2 (MBX.4L2)
- S23 : LSS2 (MBX.4R2) + Arc23 + LSS3

- S78 : LSS7 + Arc78 + LSS8 (MBX.4L8)
- S81 : LSS8 (MBX.4R8) + Arc81 + LSS1

LS2 : LSSs & Arcs



Vertical Measurement done in LSS / Arcs

- **V :** Vertical
- **Measurement** by direct levelling from GITL to GITL (vertical survey reference) ~ 3.5 km

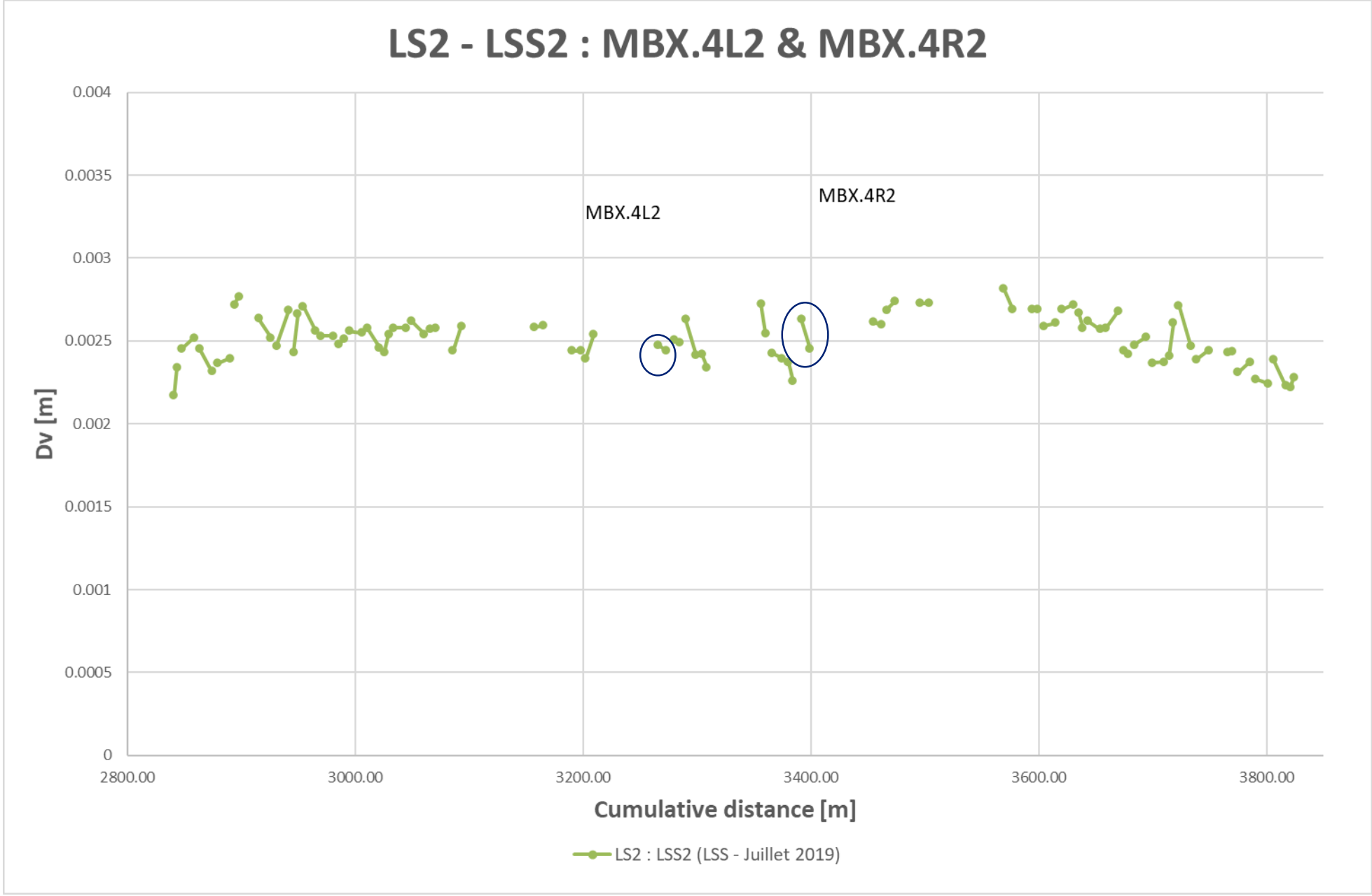
Next slides ….

- Vertical offsets w.r.t. theoretical value
- Sockets

LS2

LSS2 <u>at warm</u>

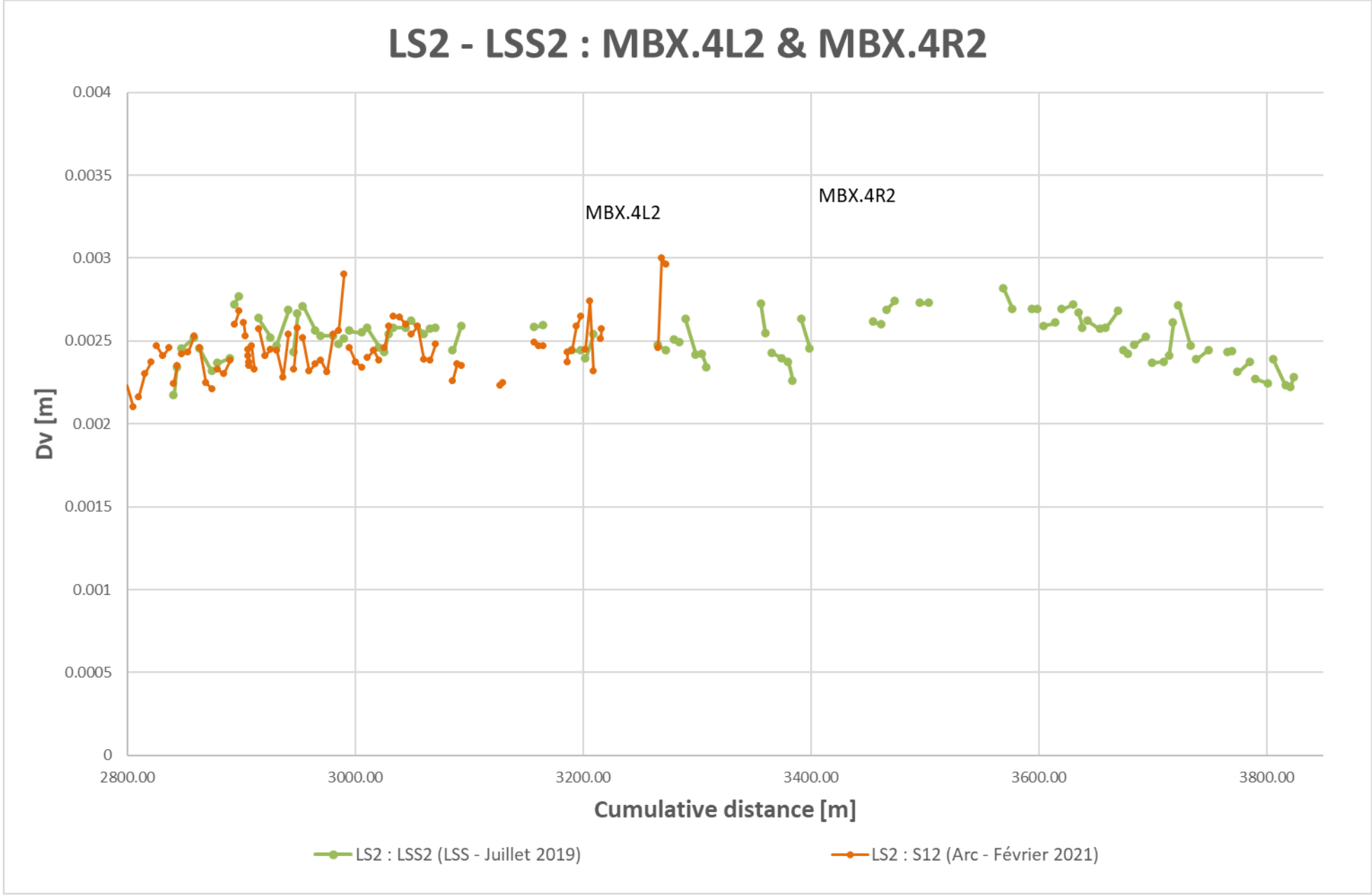
- July 2019



LS2

S12 <u>at cold</u>

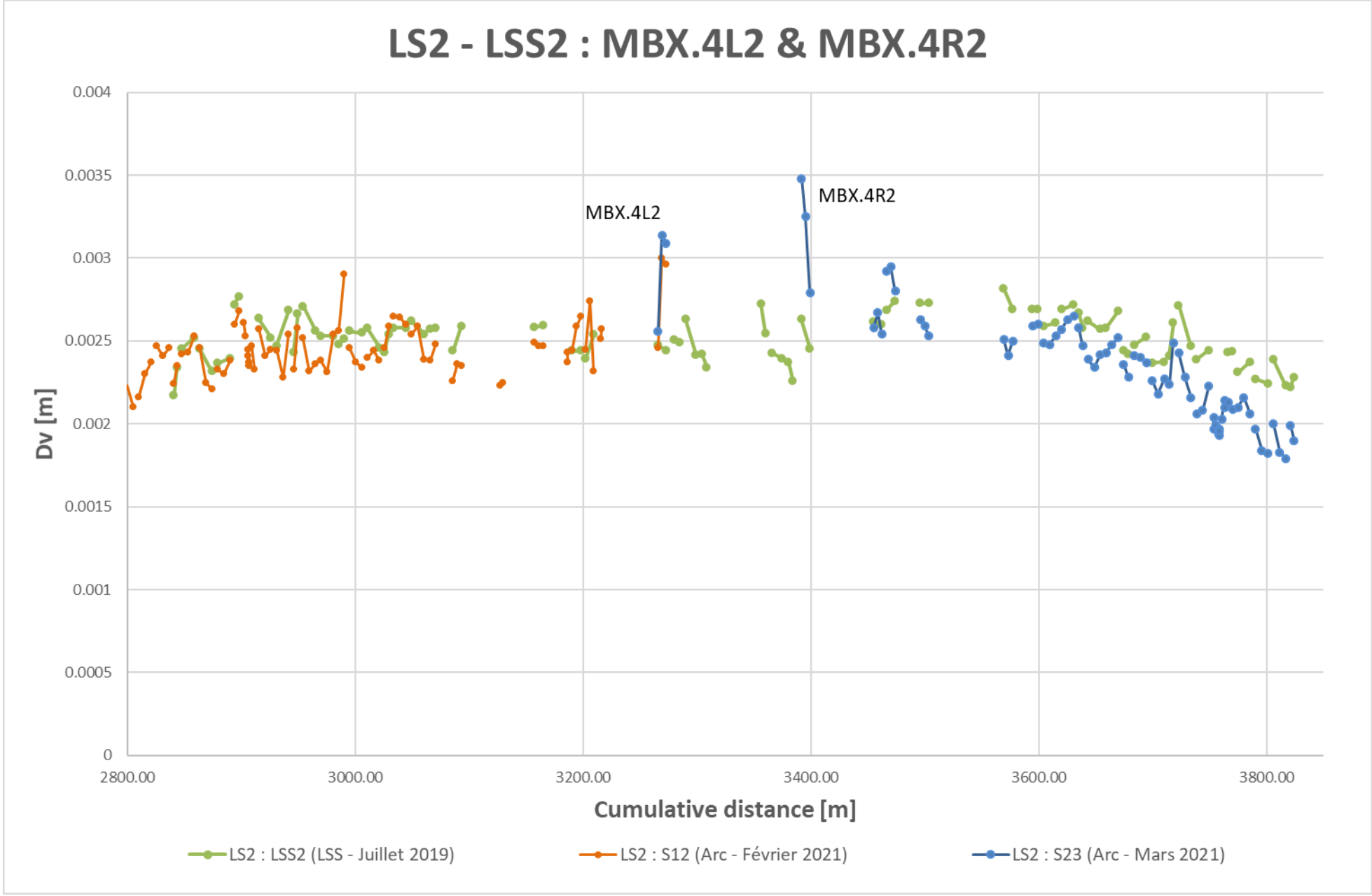
- February 2021
- GITL (4L2)



LS2

S23 <u>at cold</u>

- March 2021
- GITL (4L2)



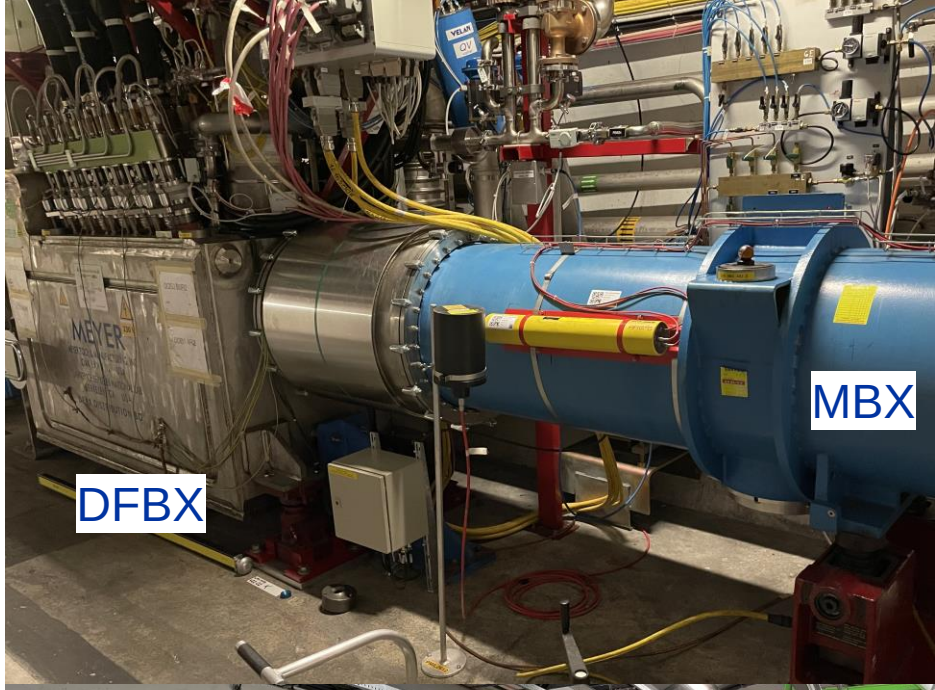
LS2 – LSS2

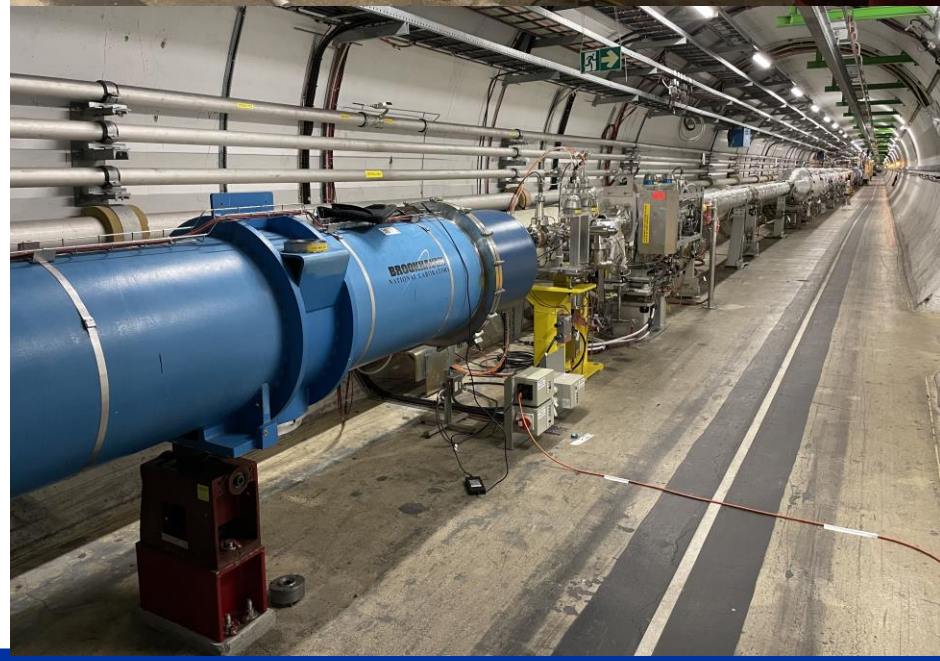
MBX.4L2

- Measured 1 time at warm and 2 times at cold :
  - ENTREE : no displacement
  - SORTIE (= DFBX side) : vertical displacement to the top : ~ 0.5 mm

MBX.4R2

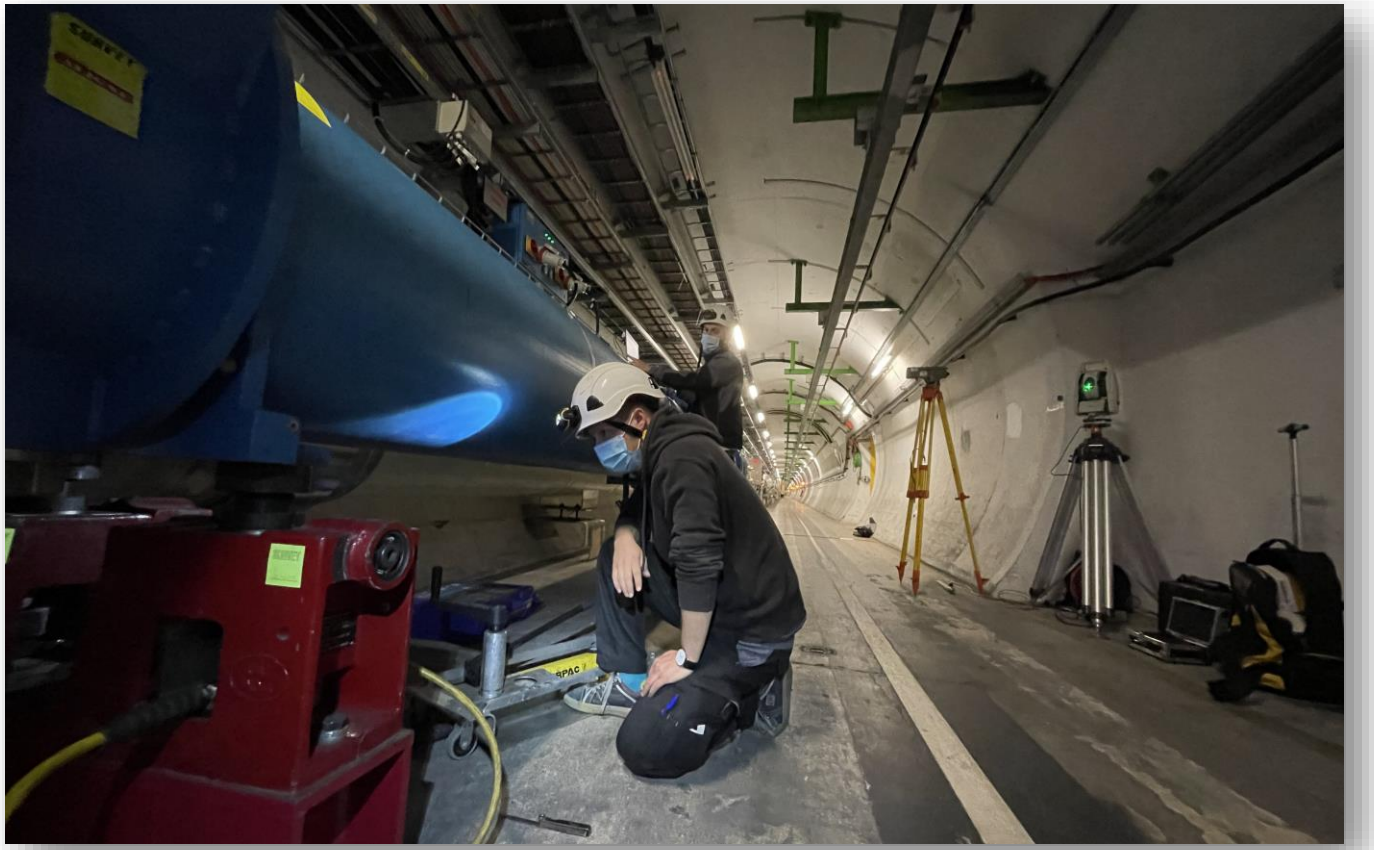
- Measured 1 time at warm and 1 time at cold :
  - ENTREE : vertical displacement to the top : ~ 0.2 mm
  - SORTIE (= DFBX side) : vertical displacement to the top : ~ 0.8 mm





AGENDA

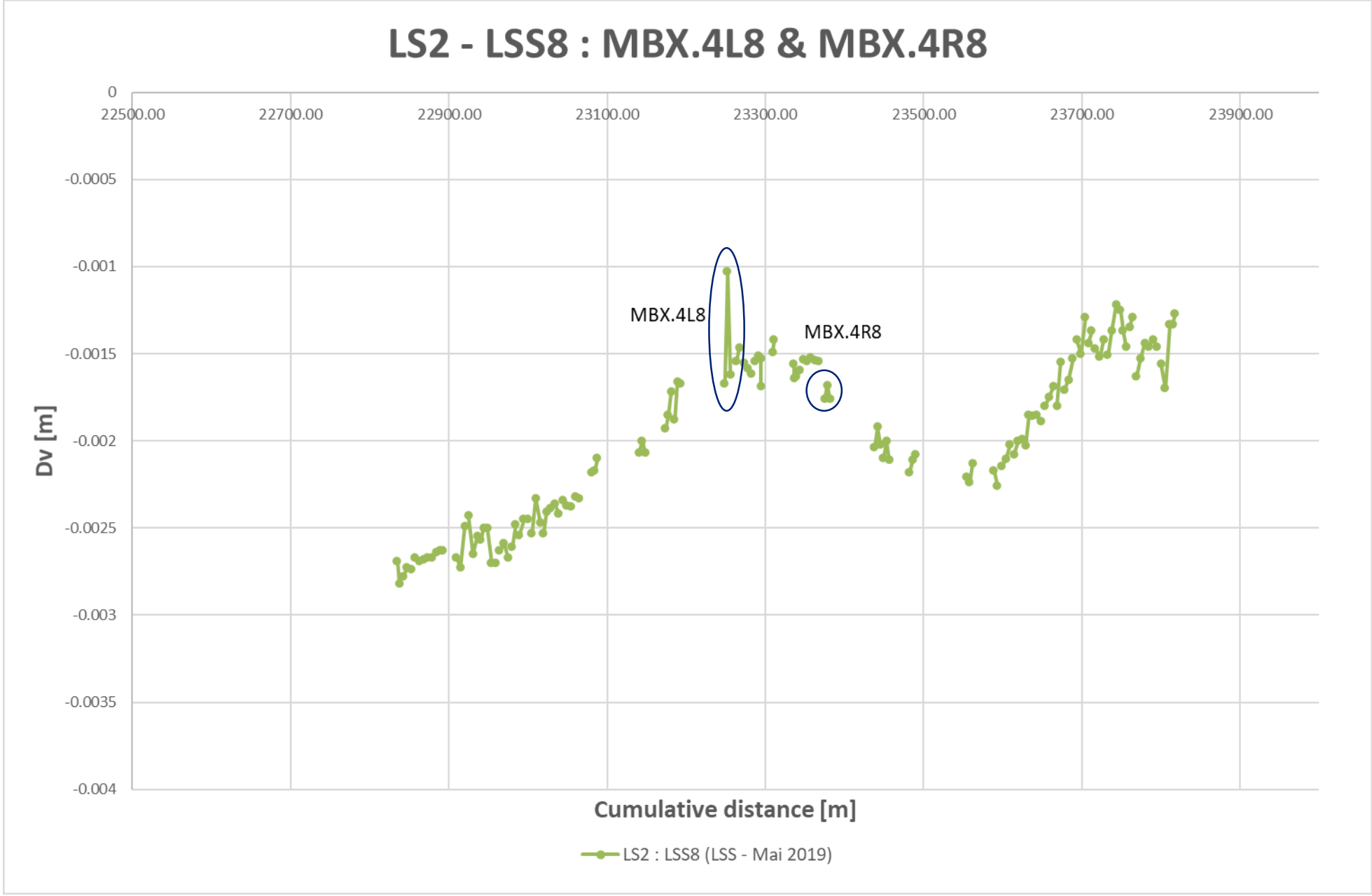
- Survey Terminology
- **LS2 (LSSs / ARCs)**
  - MBX in LSS2 & LSS8
- YETS_21-22
  - LSS8 (Q4/Q4)
  - LSS2 (Q4/Q4)
- Magnets with Banana !



LS2

LSS8 <u>at warm</u>

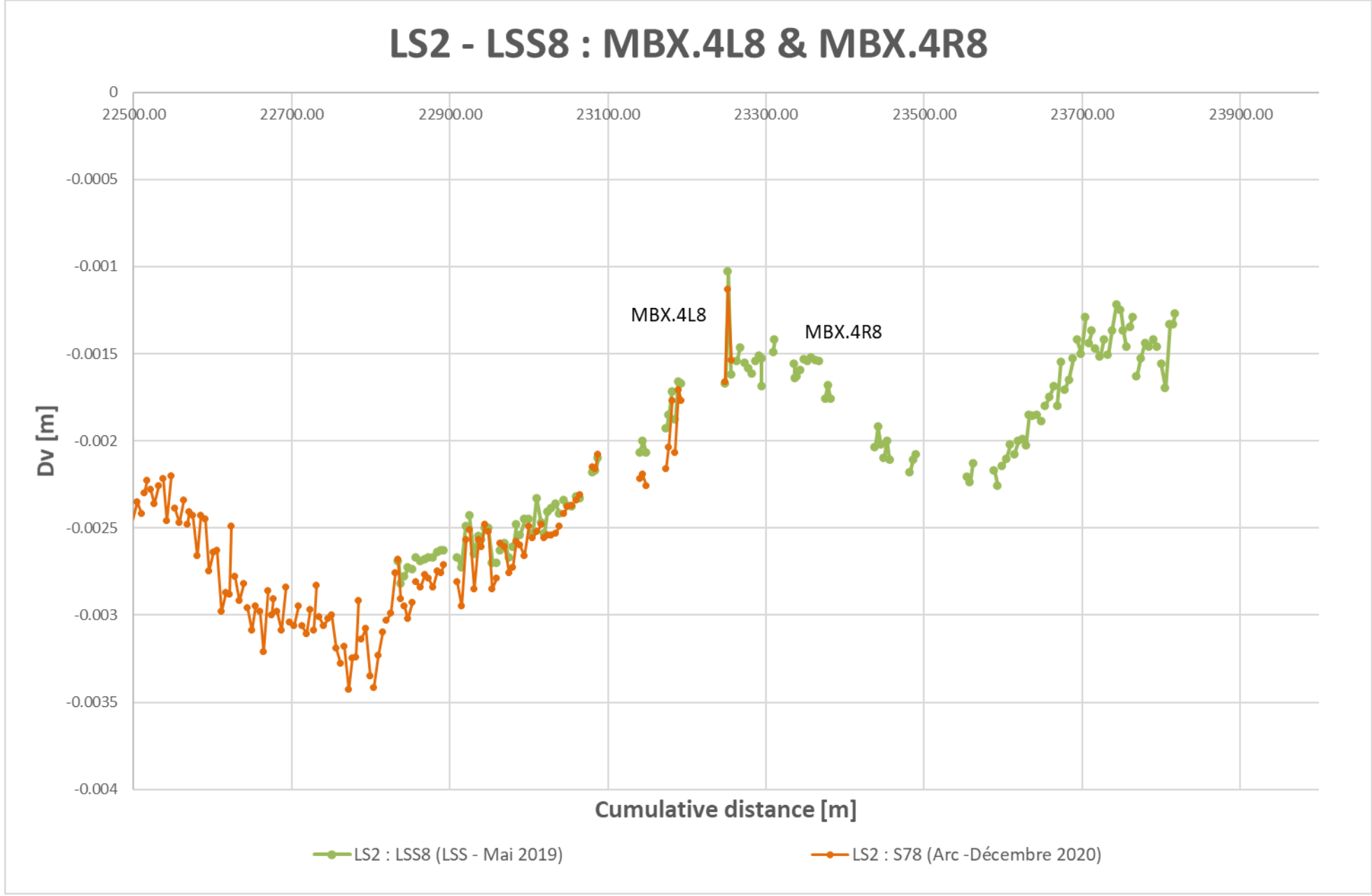
- May 2019



LS2

S78 <u>at cold</u>

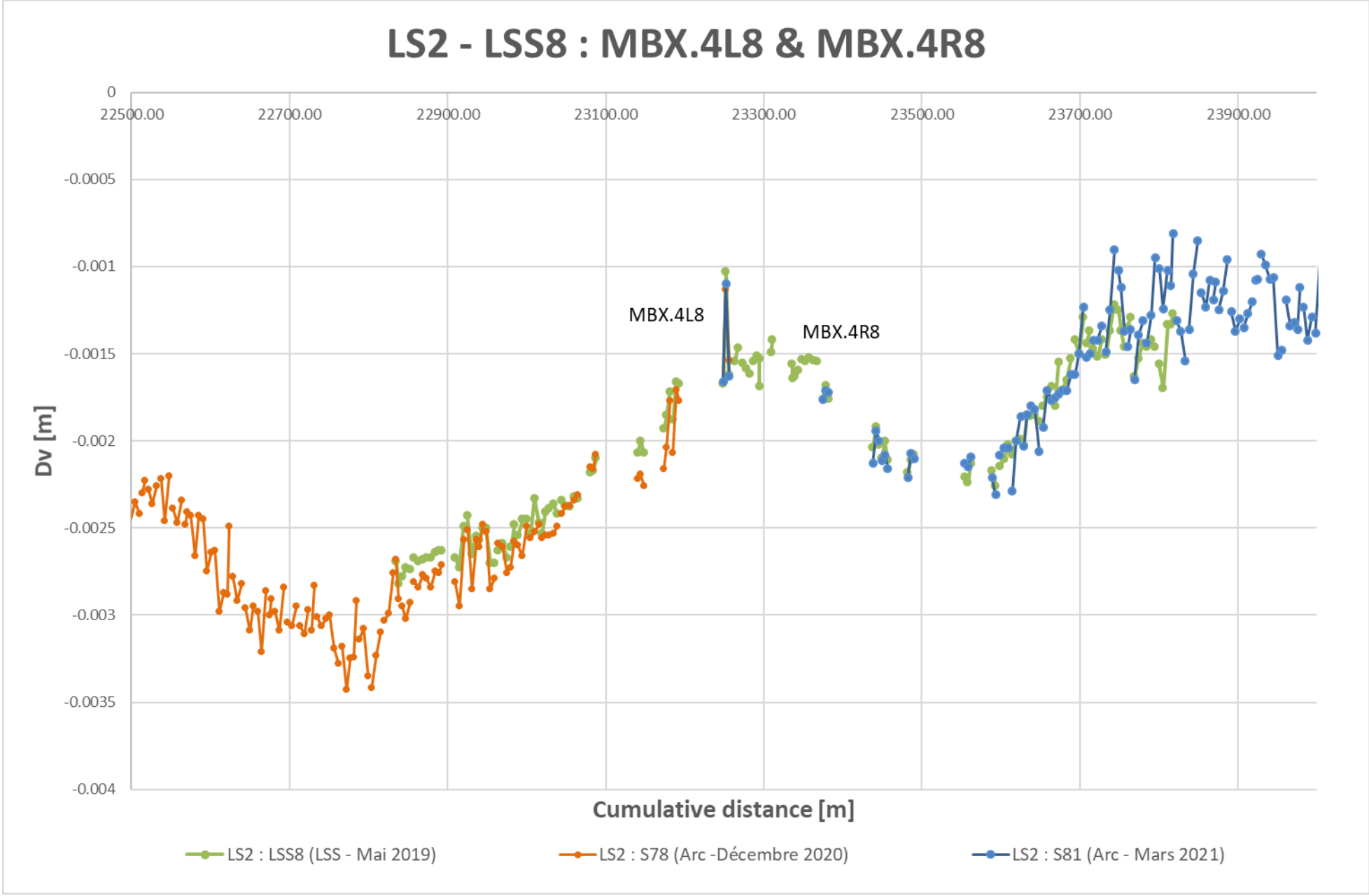
- December 2020
- GITL (1L8)



LS2

S81 <u>at cold</u>

- March 2021
- GITL (1L8)



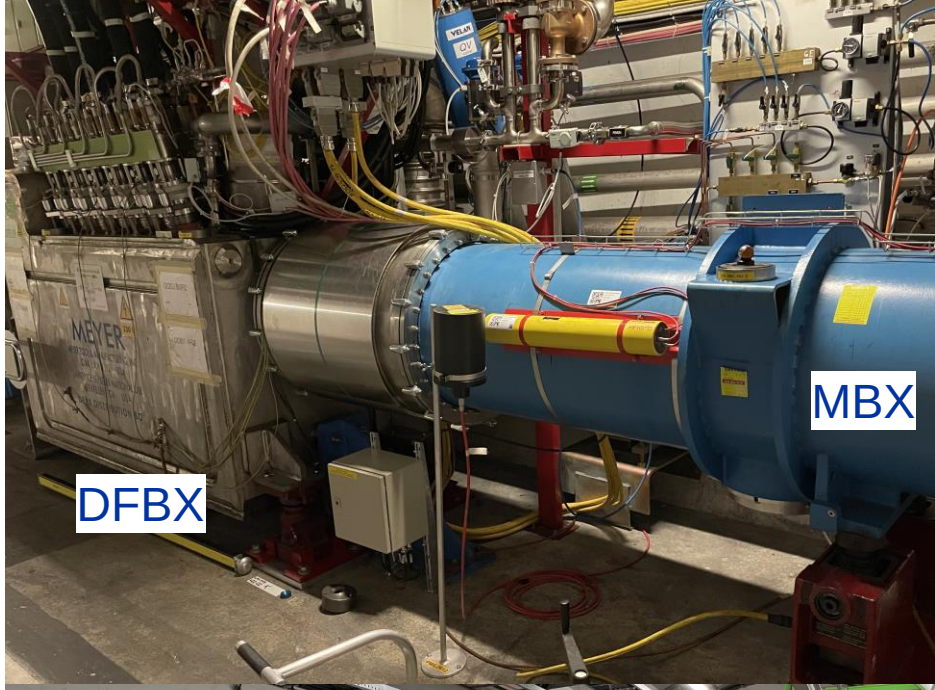
LS2 – LSS8

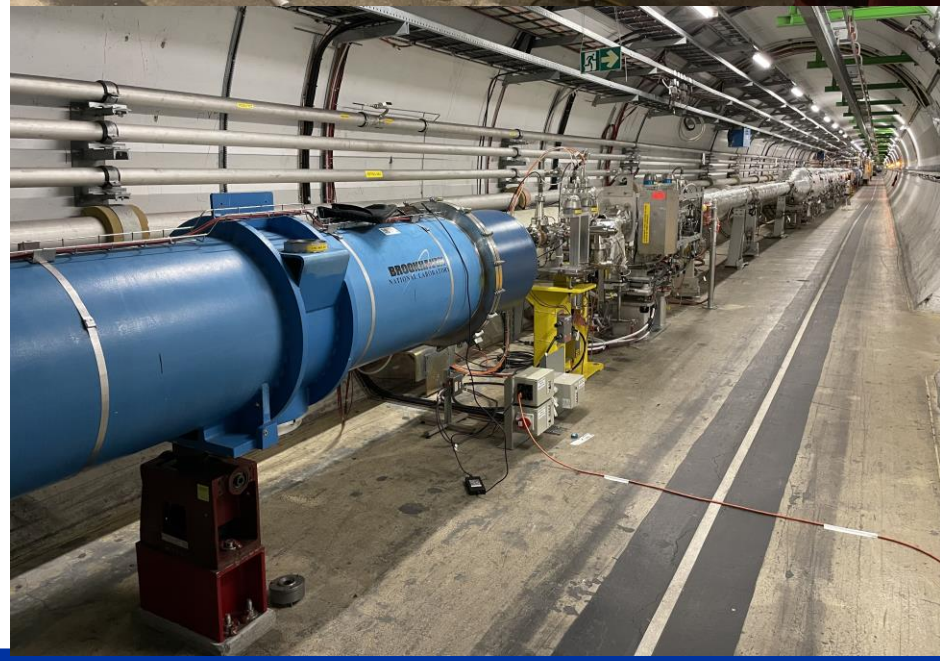
MBX.4L8

- Measured 1 time at warm and 2 times at cold :
  - ENTRÉE & SORTIE : no displacement
  - Banana shapes to the top on the M socket (middle point) :
    - ~ 0.5 mm
    - same situation during LS1

MBX.4R8

- Measured 1 time at warm and 1 time at cold :
  - ENTRÉE & SORTIE : no displacement

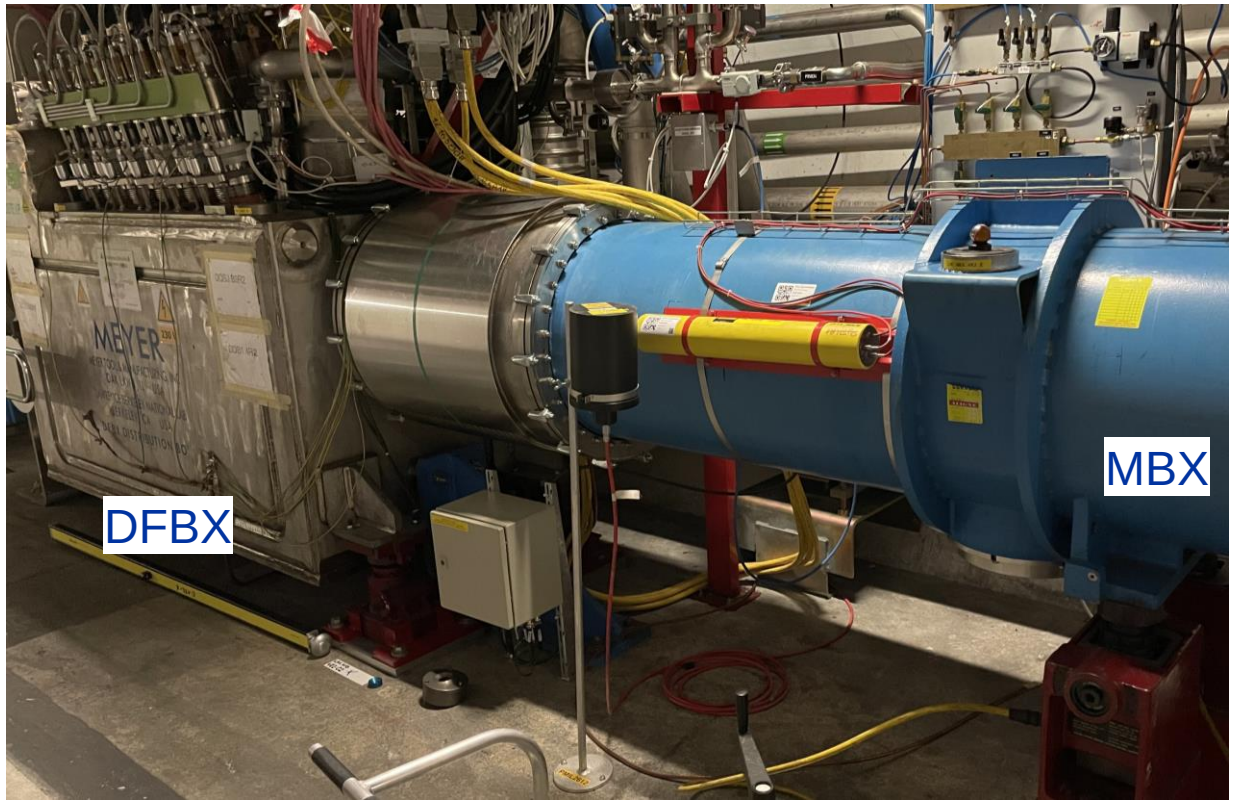




Conguration ….

- **LSS8 : no displacement warm / cold but a banana shape ….**

- **LSS2 : displacements warm /cold …. Why ?**
  - Mechanical configuration ?
  - Installation ? Fixed point ?
  - ….



Discussion with OP about the MBX …..

Discussion in March 2021 with Jorg …..

→ Wait feedback after test Beam

→ Action during YETS_21-22 (?)

Re: LSS2 : mouvements verticaux sur les MBX (chaud / froid)

Jorg Wenninger
À : Jean-Frederic Fuchs
Cc : Michela Pirozzi; Kacper Widuch
Vous avez répondu à ce message le 11/01/2022 10:26.

Bonjour,

Ok, attendons de voir le beam test.

Ciao, Jorg

On 07/09/2021 11:38, Jean-Frederic Fuchs wrote:

Bonjour Jorg,

Au printemps 2021, nous avions évoqué un « mouvement » verticaux en LSS2 sur les D1 entre leur alignement à chaud en juillet 2019 (lissage LSS2) et la remesure lors des secteurs adjacents 12 et 23 début 2021 (à froid) : voir email et graph ci-dessous

Concernant le LSS8

1. Je n'ai pas constaté le même phénomène chaud / froid
2. A noter que le point MBX.4L8.M est ~ 0.5 mm trop haut mais nous n'arrivons pas à le faire descendre (situation identique lors du LS1)

Pour le prochain YETS : la planification d'une nouvelle mesure en LSS2/ LSS8 et d'un éventuel réalignement des D1 est complexe en raison du cryo-lockout à obtenir pour la zone des aimants lowbeta (j'ai besoin d'accéder à cette zone pour avoir des aimants en référence)
Je proposerai de laisser cette activité LSS2/LSS8 au planning « en standby » en attendant ton feedback sur les D1 après le beam pilot.

Quel est ton avis ?

Meilleures salutations,

Jean-Frederic FUCHS

ASG Section Leader – Accelerator Survey & Geodesy
Beam Department – Geodetic Metrology
CERN - European Organization for Nuclear Research
CH-1211 Geneva 23 - Switzerland
Bureau : +41 22 767 6349
Port. : + 41 75 411 97 37 – 16 97 37

De : Jean-Frederic Fuchs
Envoyé : lundi 29 mars 2021 09:14
À : Jorg Wenninger <Jorg.Wenninger@cern.ch>
Objet : RE: LSS2 : mouvements verticaux sur les MBX (chaud / froid)

Bonjour Jorg,

La LSS2 a été alignée à l'été 2019 et les triplets à « chaud » fin aout 2020, un dernier ajustement à froid sera peut-être nécessaire en 2021 (à distance)

Tu peux peut-être m'appeler ce matin, je suis au bureau

Meilleures salutations,

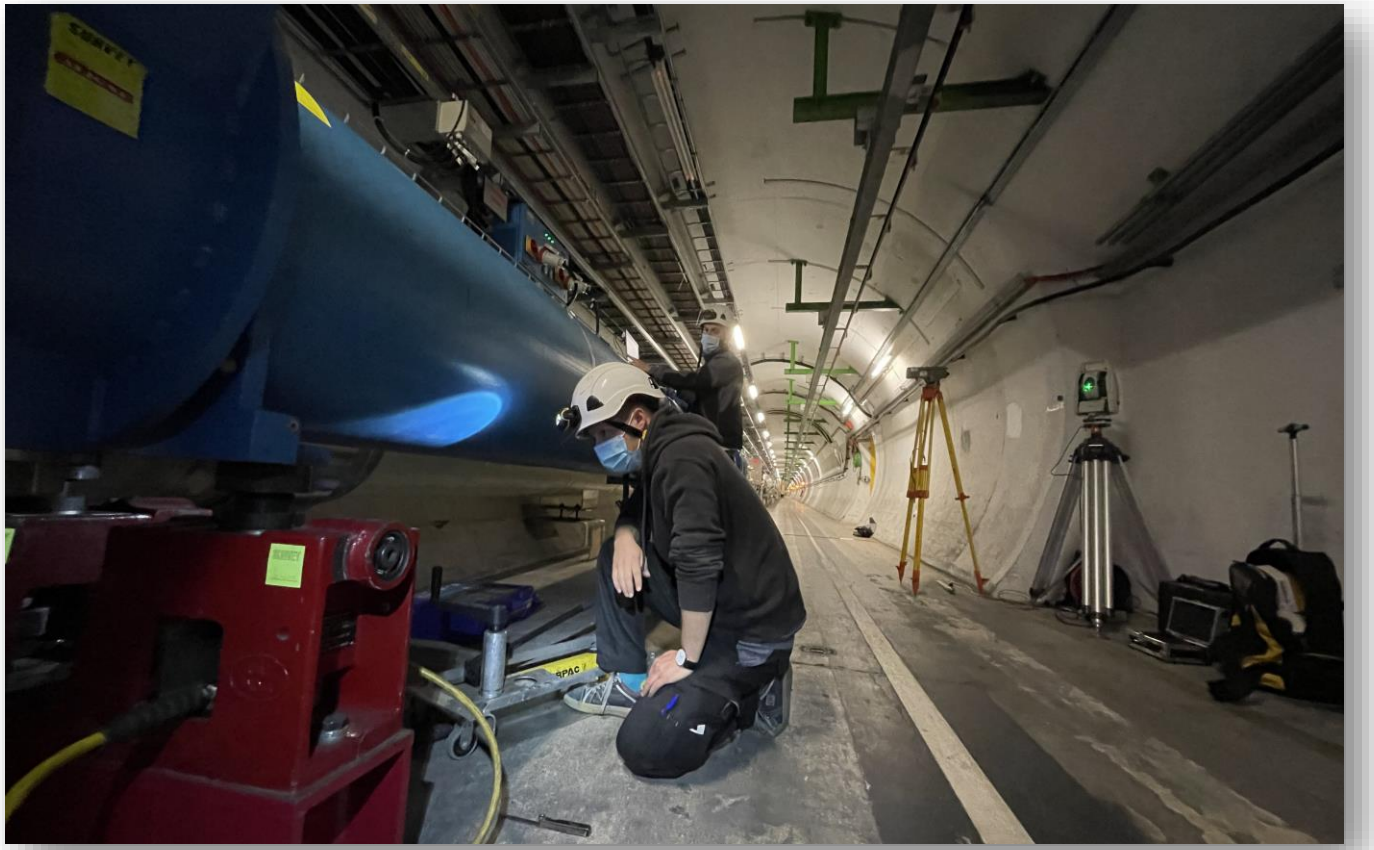
Jean-Frederic FUCHS

ASG Section Leader – Accelerator Survey & Geodesy
Beam Department – Geodetic Metrology
CERN - European Organization for Nuclear Research
CH-1211 Geneva 23 - Switzerland
Bureau : +41 22 767 6349
Port. : + 41 75 411 97 37 – 16 97 37

From: Jorg Wenninger <Jorg.Wenninger@cern.ch>
Sent: Sunday, March 28, 2021 20:44
To: Jean-Frederic Fuchs <jean-frederic.fuchs@cern.ch>
Subject: Re: LSS2 : mouvements verticaux sur les MBX (chaud / froid)

AGENDA

- Survey Terminology
- LS2 (LSSs / ARCs)
  - MBX in LSS2 & LSS8
- **YETS_21-22**
  - LSS8 (Q4/Q4)
  - LSS2 (Q4/Q4)
- Magnets with Banana !



YETS_21-22

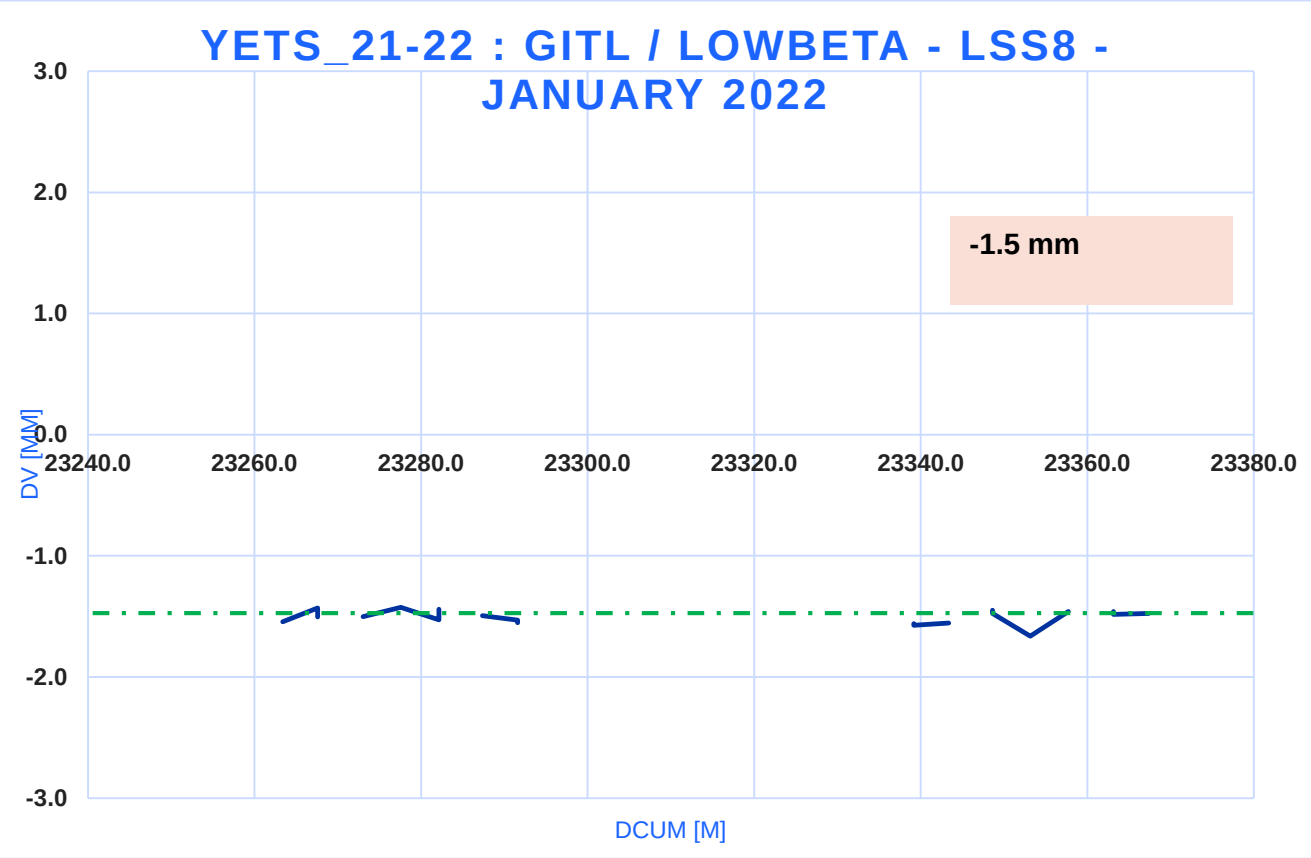
Vertical absolut measurement for the experiment (GITL / Lowbeta)

->> New vertical measurement in LSS2 / LSS8 on a short distance from Q4/Q4

- **GITL** (vertical survey reference)
- **LOWBETA**
- **MBX & Q4**
- **GM sensors on lowbeta**

YETS_21-22 : LSS8

LSS8 : IP & Lowbeta : -1.5 mm



YETS_21-22 : LSS8

LSS8 vertical offsets :

- **MQY.B4L8.E**
  - Vertical displacement done

- **MBX.4R8**
  - Vertical displacement done

RE: [LSS8] Lissage vertical entre Q4 et Q4

Sandrine Le Naour
À Riccardo De Maria; Jean-Frederic Fuchs; Rogelio Tomas Garcia; Jorg Wenninger; Stephane Fartoukh
Cc Helene Mainaud Durand; Kacper Widuch; Yannis Papaphilippou

Vous avez répondu à ce message le 27/01/2022 08:29.

Bonjour,

Je n'ai pas d'explication precise au sujet des cryostats en banana, mais certains triplets ont des « bretelles » pour rester en contact au sol !

- LHC.MQY.B4L8.E 0.38mm : A aligner ? Je dirai oui à reduire entre 0.2-0.3 mm

- LHC.MBX.4R8.E 0.24mm : A aligner ?
- LHC.MBX.4R8.M 0.25mm : A aligner ?
- LHC.MBX.4R8.S 0.33mm : A aligner ?

J'aurai tendance a dire de le laisser la ou il est, mais si ABP le demande on peut le remonter de 0.25mm

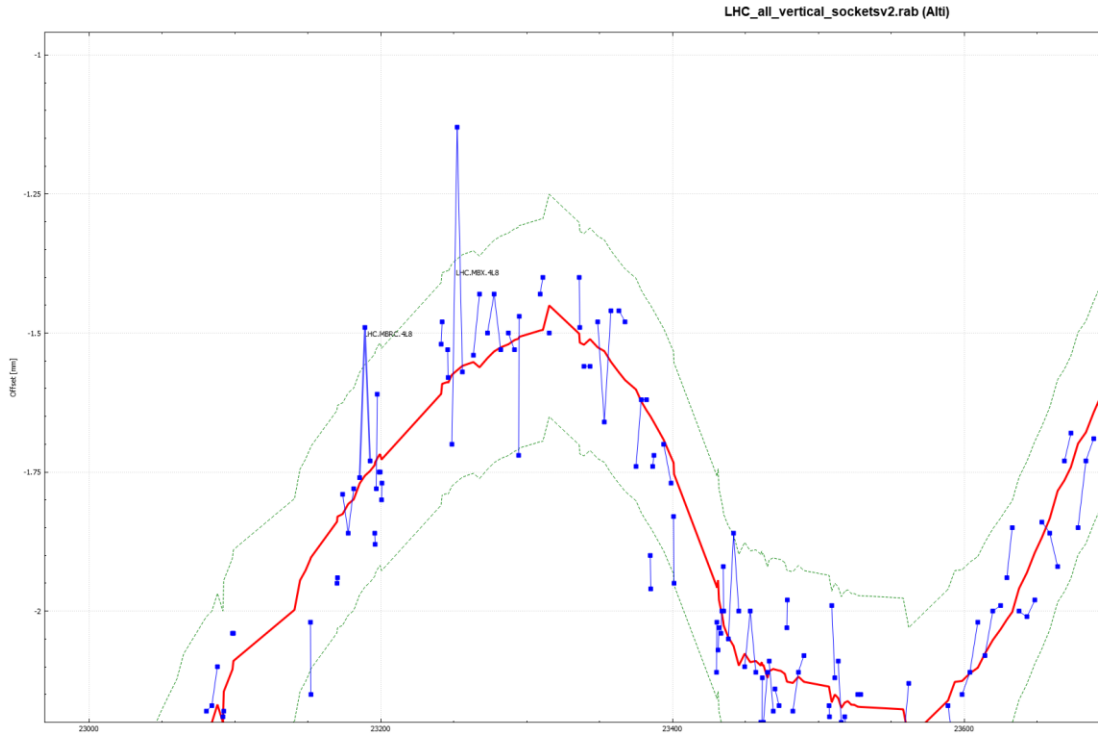
Bonne journée
Sandrine

From: Riccardo De Maria <Riccardo.De.Maria@cern.ch>
Sent: mardi 25 janvier 2022 11:54
To: Jean-Frederic Fuchs <jean-frederic.fuchs@cern.ch>; Rogelio Tomas Garcia <rogelio.tomas@cern.ch>; Jorg Wenninger <Jorg.Wenninger@cern.ch>; Stephane Far
Cc: Helene Mainaud Durand <Helene.Mainaud.Durand@cern.ch>; Kacper Widuch <kacper.widuch@cern.ch>; Yannis Papaphilippou <ioannis.papaphilippou@cern.c
Subject: RE: [LSS8] Lissage vertical entre Q4 et Q4

Bonjour,

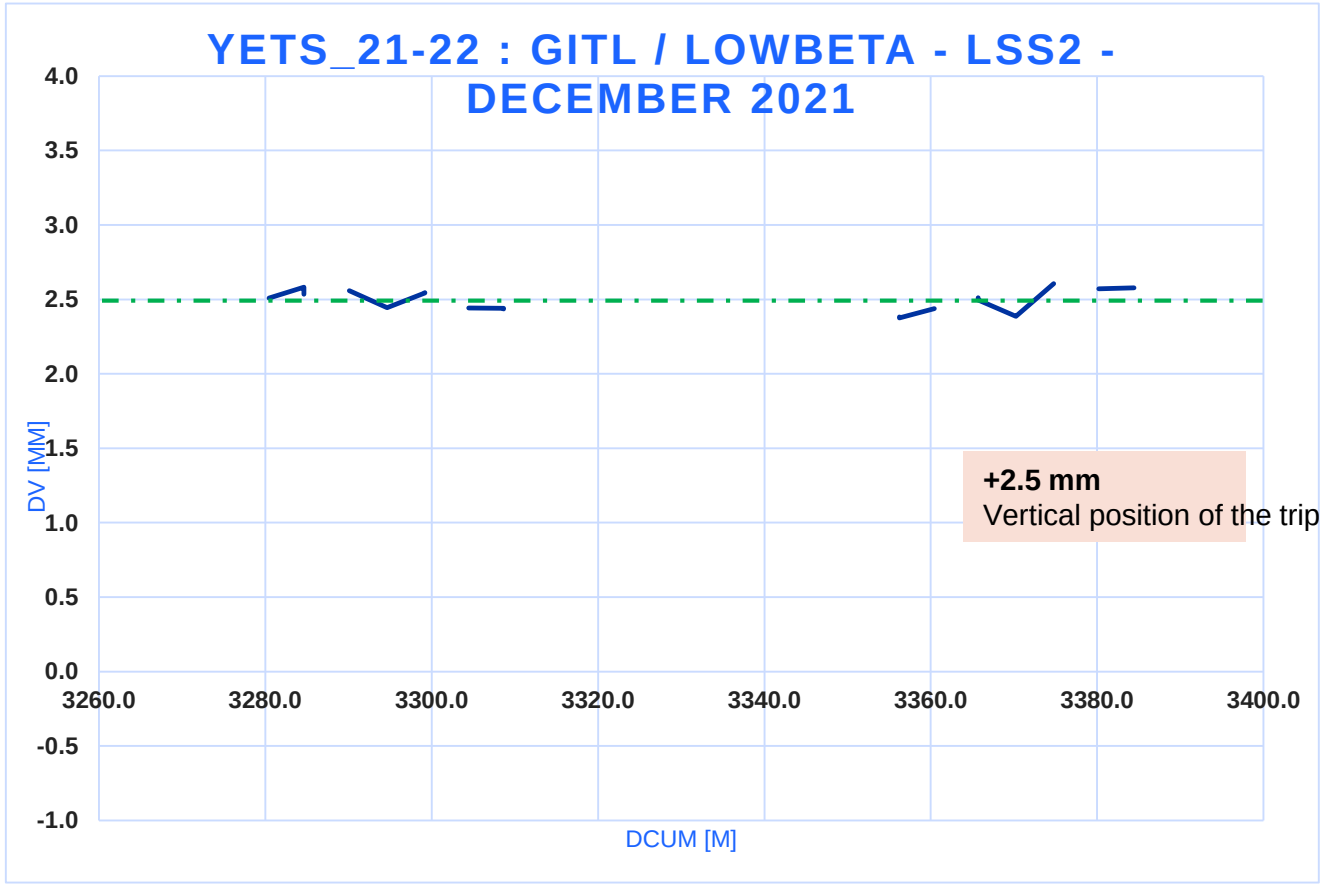
Jean-Frederic, Sandrine, do you have an explanation for the the banana shape? What is pushing the middle of MBX up so strongly to lift the support?

Best,
Riccardo



YETS_21-22 : LSS2

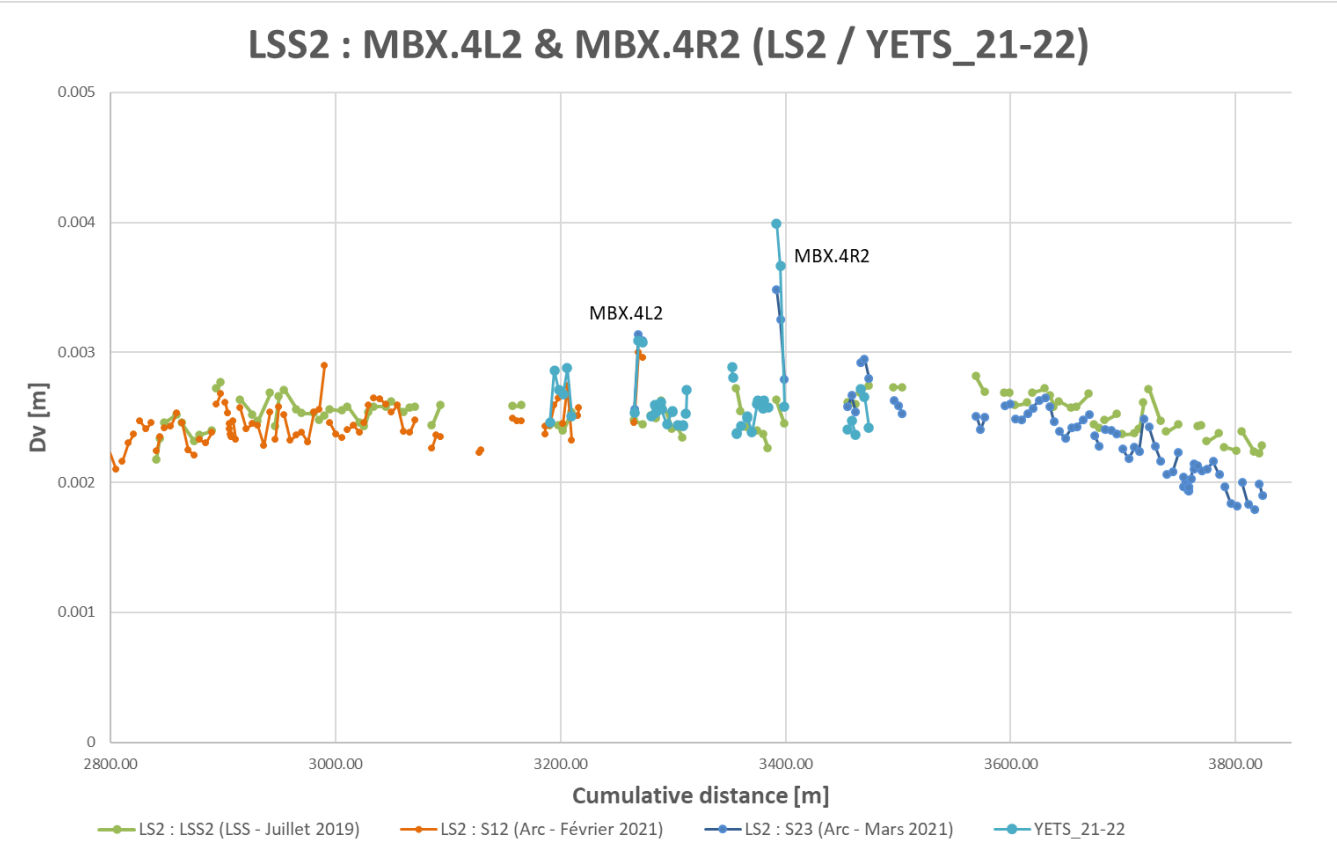
LSS8 : IP & Lowbeta : +2.5 mm



YETS_21-22 : LSS2

LSS2 vertical displacement

- **MBX.4L2**
  - Vertical displacement done
- **MBX.4R2**
  - > 1 mm !

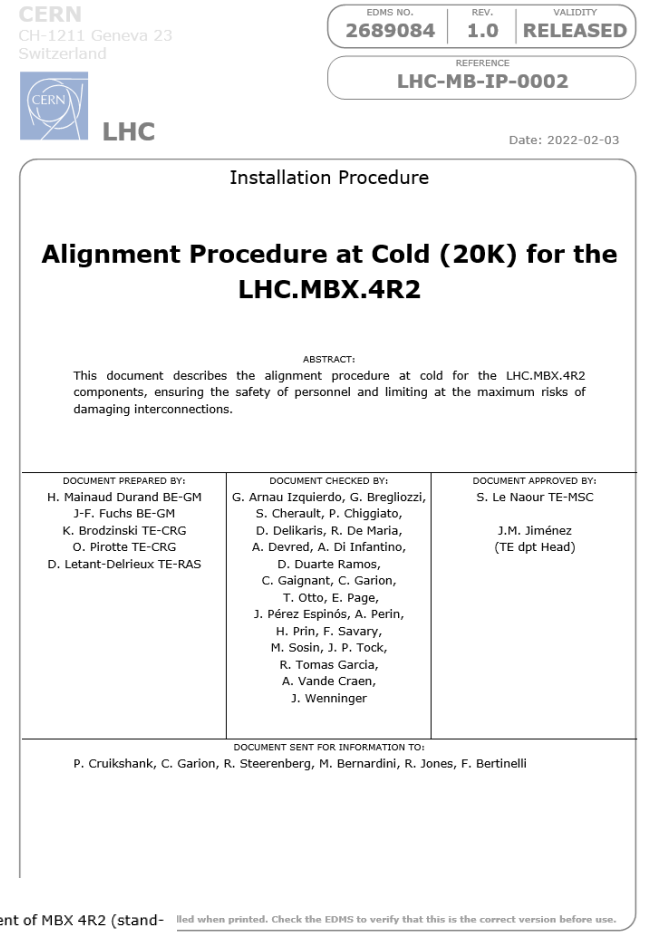


YETS_21-22 : MBX.4R2

Alignment Procedure at Cold (20K) for the LHC.MBX.4R2

- **The successful process of alignment followed for the LEBL.11L4 in February 2021 will be applied for the MBX.4R2, with some simplifications :**

- Risk analysis
- Operators from TE-CRG and TE-VSC followed the pressure and temperatures
- The load applied on jacks has been continuously monitored (hydraulic pumps systems)
- Mechanical and aperture thresholds have been defined
- Step by step vertical process



CERN
CH-1211 Geneva 23
Switzerland

LHC

EDMS NO. 2689084 | REV. 1.0 | VALIDITY RELEASED

REFERENCE LHC-MB-IP-0002

Date: 2022-02-03

Installation Procedure

Alignment Procedure at Cold (20K) for the LHC.MBX.4R2

ABSTRACT:

This document describes the alignment procedure at cold for the LHC.MBX.4R2 components, ensuring the safety of personnel and limiting at the maximum risks of damaging interconnections.

DOCUMENT PREPARED BY:	DOCUMENT CHECKED BY:	DOCUMENT APPROVED BY:
H. Mainaud Durand BE-GM J-F. Fuchs BE-GM K. Brodzinski TE-CRG O. Pirotte TE-CRG D. Letant-Delrieux TE-RAS	G. Arnau Izquierdo, G. Bregliozzi, S. Cherault, P. Chiggiato, D. Delikaris, R. De Maria, A. Devred, A. Di Infantino, D. Duarte Ramos, C. Gaignant, C. Garion, T. Otto, E. Page, J. Pérez Espinós, A. Perin, H. Prin, F. Savary, M. Sosin, J. P. Tock, R. Tomas Garcia, A. Vande Craen, J. Wenninger	S. Le Naour TE-MSC J.M. Jiménez (TE dpt Head)

DOCUMENT SENT FOR INFORMATION TO:

P. Cruikshank, C. Garion, R. Steerenberg, M. Bernardini, R. Jones, F. Bertinelli

2.5.2 CRYO CONDITIONS AND INSULATION VACUUM PRESSURE

The following cryogenic conditions will be provided for the alignment of MBX 4R2 (stand-alone magnet) in s23:

- The magnets within the same vacuum volume (MBX.4R2+IT R2) will be conditioned with gaseous helium and stabilised at temperature about ~ 20 K prior the realignment operation;
- Pressure in the magnets main helium circuit (IT and standalone MBX.4R2) within the same vacuum volume, beam screen and thermal screen circuits will be stabilized at about 1.3 bara +/-100 mbar (all depressurized circuits will be connected to line D of the QRL with active aspiration by main compressor station);
- The beam screen (BS) will be kept floating in temperature with no helium circulation;
- During the intervention, the sector valves of the beam vacuum shall be closed for the entire LSS.

During the intervention, operators from TE-CRG and TE-VSC will follow the pressure and temperatures of specific magnet.

During the whole process of alignment of the magnet, the related insulation vacuum pressure will be monitored and visualized remotely in real time on PVSS. In case of a vacuum degradation, the operating teams will go out the tunnel.

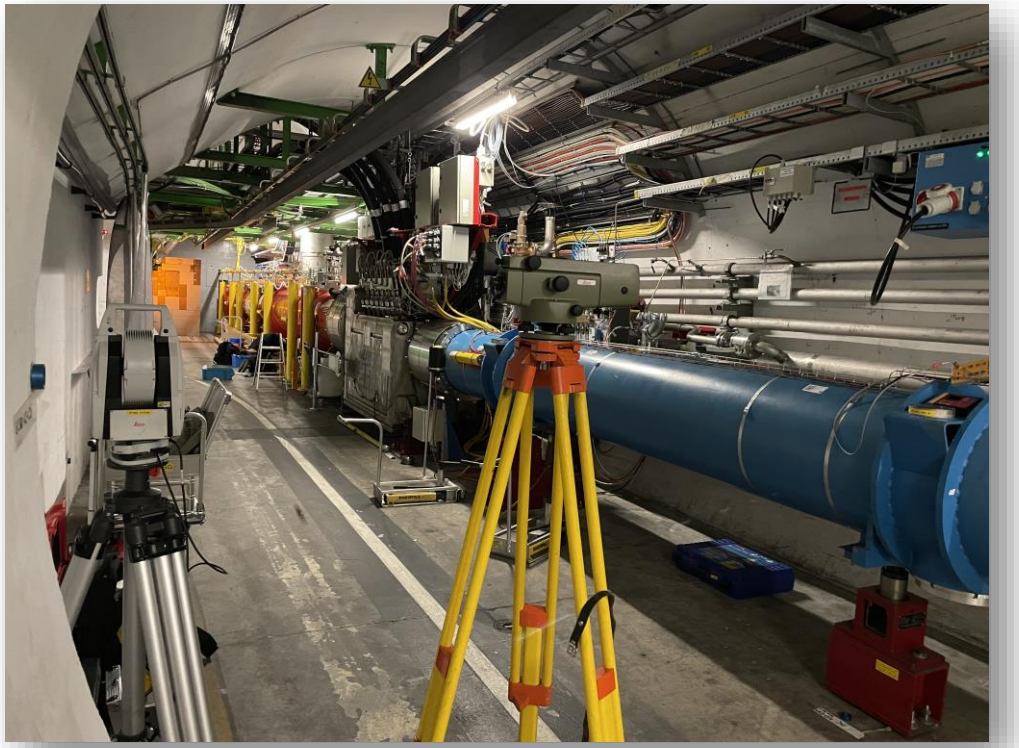
MBX.4R2

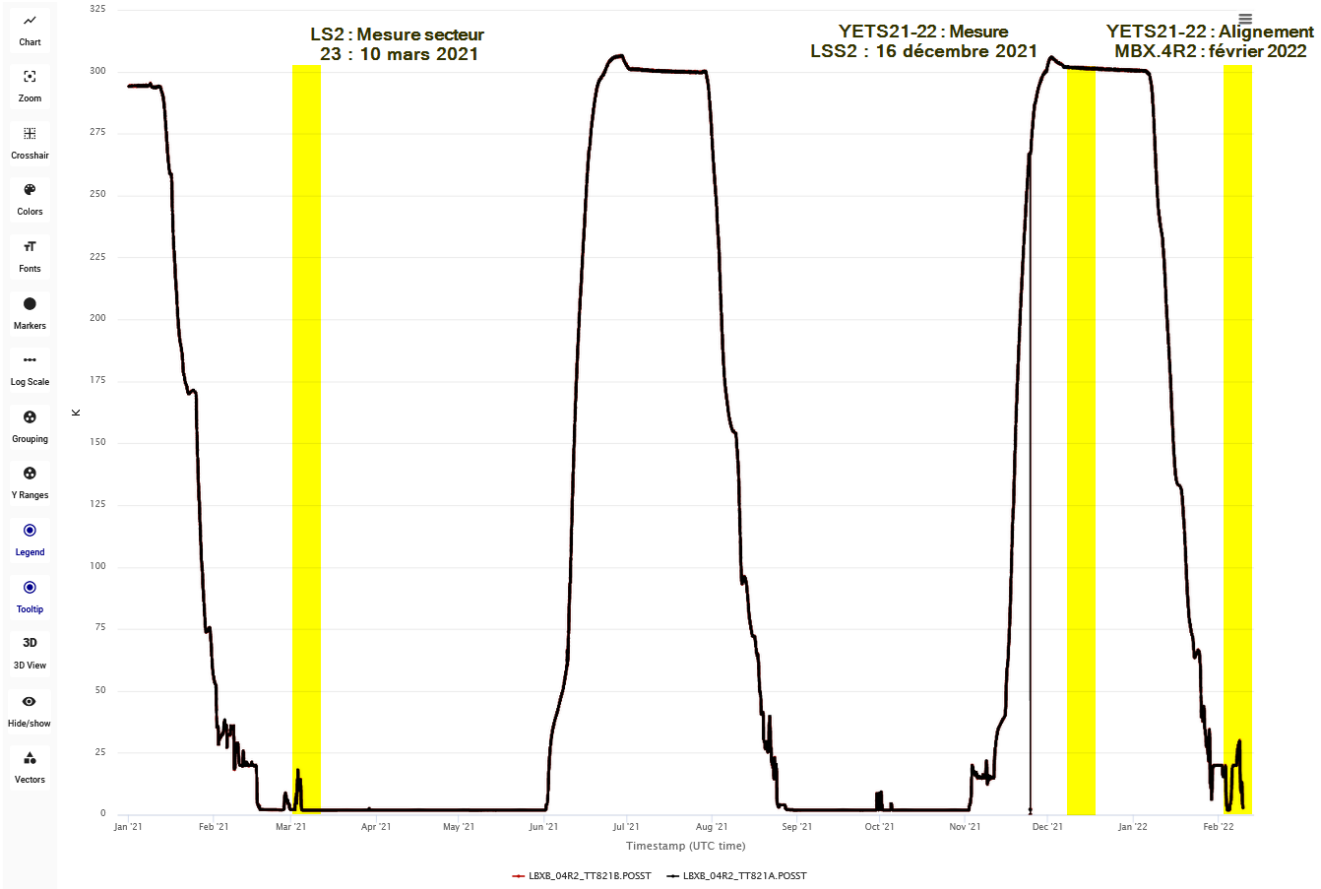
- 3D+1 setup : AT40xx + NA2
- We applied the relative displacements on the 08.02.2022
- New V measurement after alignment
- Data computation (office) : The MBX.4R2 is not at the good absolute position (!)
- New alignment on the 09.02.2022

MBX.4R2

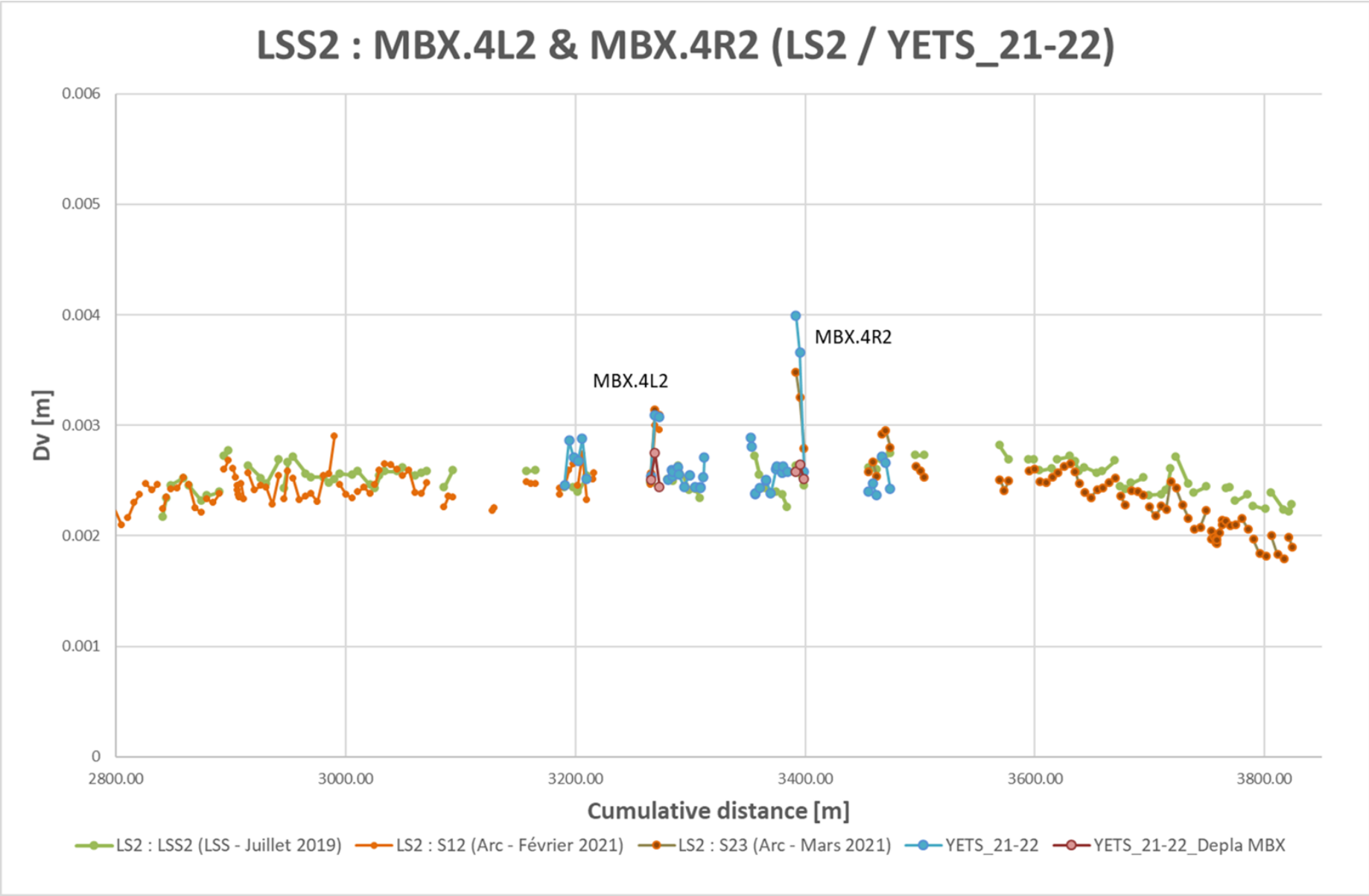
The issue was due to a vertical « displacement » ~ - 0.5 mm between the initial measurement on the 16.12.2021 at warm and the alignment on the 08 & 09 of February 2022 at cold

To be investigate (?)





MBX.4R2


LSS2 : MBX.4L2 & MBX.4R2 (LS2 / YETS_21-22)
0.006
0.005
0.004
0.003
0.002
0.001
0
Dv [m]
MBX.4L2
MBX.4R2
2800.00
3000.00
3200.00
3400.00
3600.00
3800.00
Cumulative distance [m]
LS2 : LSS2 (LSS - Juillet 2019)
LS2 : S12 (Arc - Février 2021)
LS2 : S23 (Arc - Mars 2021)
YETS_21-22
YETS_21-22_Depla MBX

MBX.4R2

- As a reminder, on the lowbeta magnets between the warm / cold states we observe :
  - Some vertical movements of the order of a few tenths
  - 2 to 4 mm in length on the lowbeta between the hot and cold states….

<u>Concerning the MBX</u>

- Why MBX in LSS8 are stable” compared to LSS2 ?
- It would be interesting to know if the D1 move in longitudinal direction …. and investigate the reason of the vertical movement.
  - Internal condition of the MBX / DFBX : Temperature / pressure?
  - DFBX constraints ?

AGENDA

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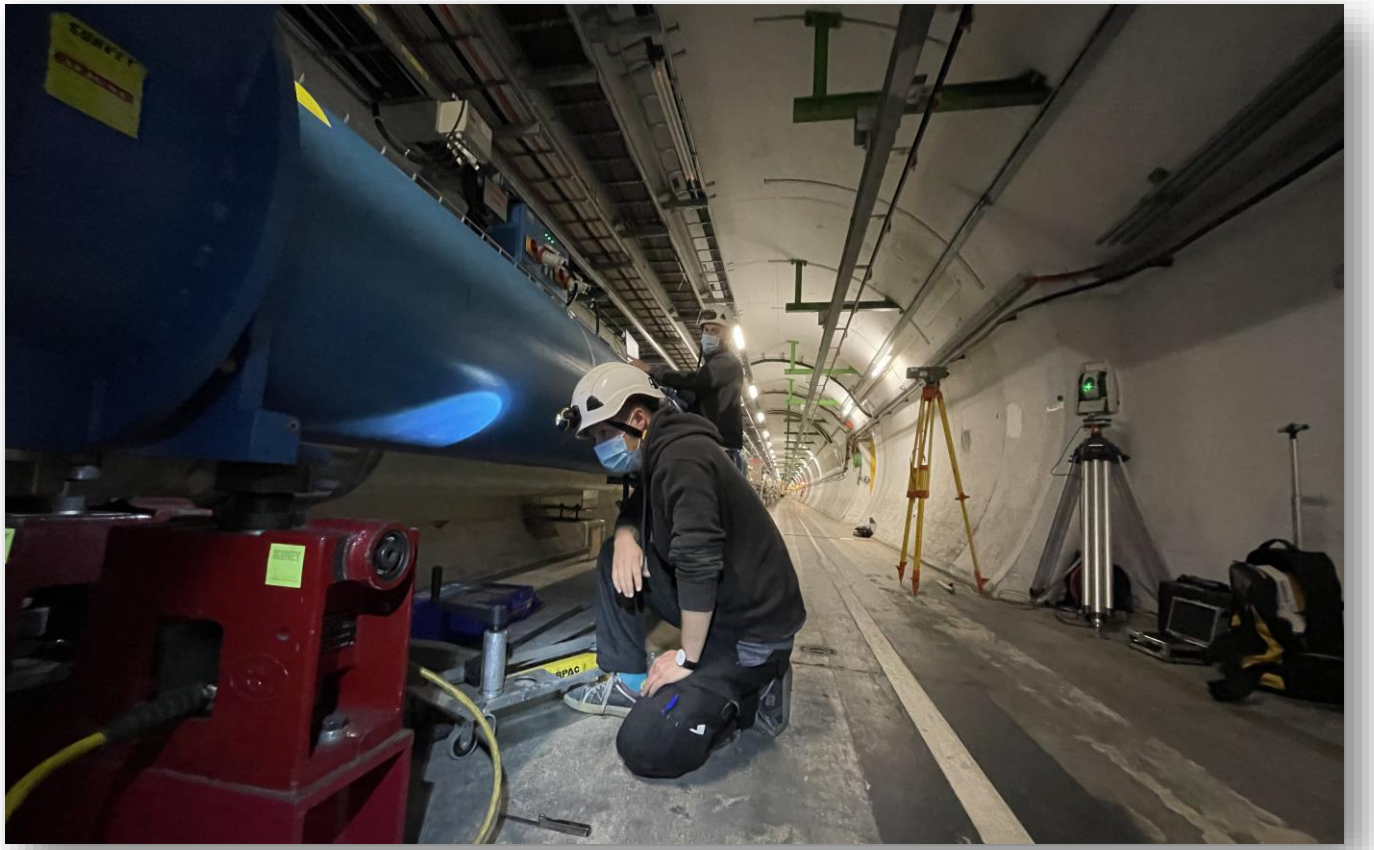
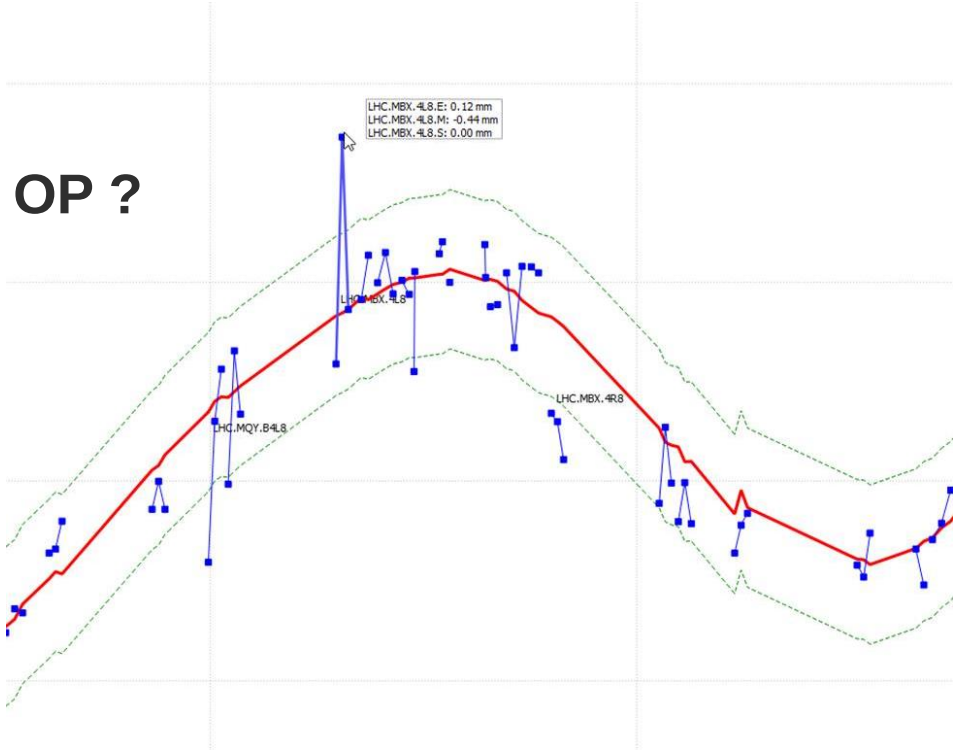
- LS2 (LSSs / ARCs)
  - MBX in LSS2 & LSS8
- YETS_21-22
  - LSS8 (Q4/Q4)
  - LSS2 (Q4/Q4)
- **Magnets with Banana !**



Banana …..

As MBX.4L8 some other magnets have a banana shapes on M socket

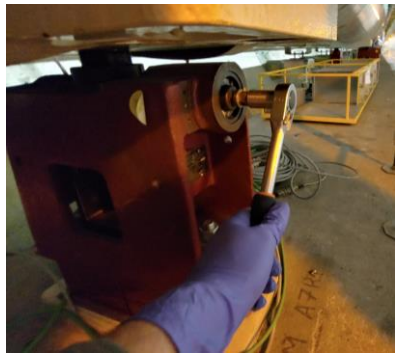
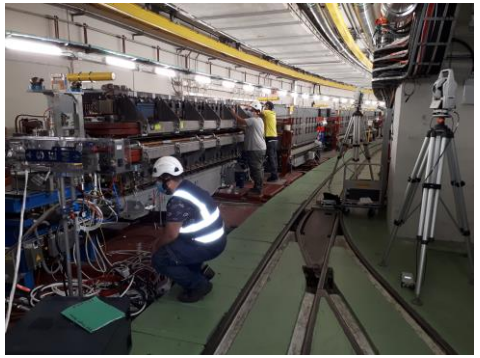
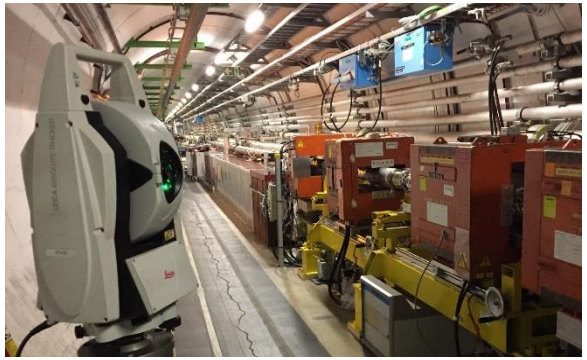
- M socket is measured in vertical direction (only)



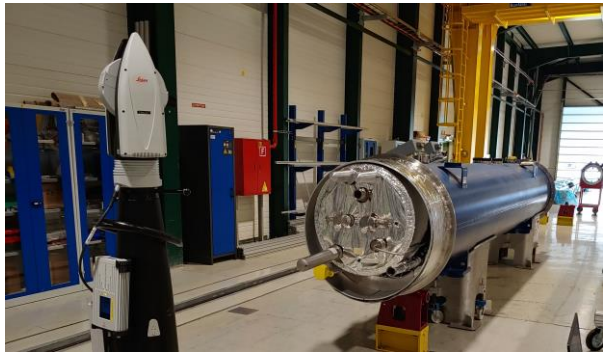
Is it an aperture issue ? What is the feedback from ABP ? OP ?

#M Socket Name	Displacement [mm]
LHC.MQTLH.A6L3.M	-0.21
LHC.MBX.4L2.M	-0.25
LHC.LEBR.11L6.M	-0.25
LHC.MB.B21R6.M	-0.26
LHC.MBRC.4L8.M	-0.27
LHC.LEGR.11R5.M	*-0.29*
LHC.LEIR.11L7.M	*-0.30*
LHC.MQY.B4L2.M	-0.31
LHC.MBRC.4L2.M	-0.32
LHC.MBRC.4L1.M	-0.34
LHC.MBX.4L8.M	-0.44

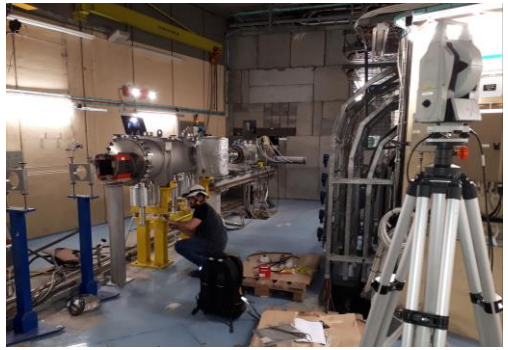
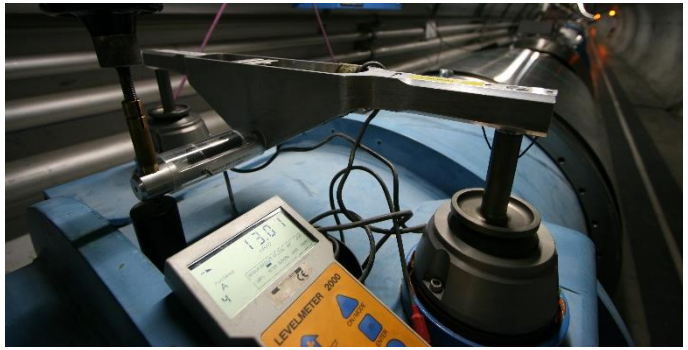
Questions / discussions …..

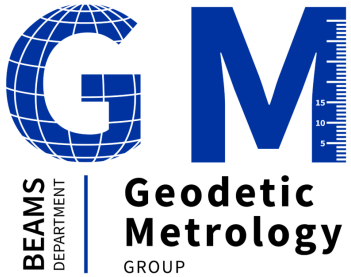










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