

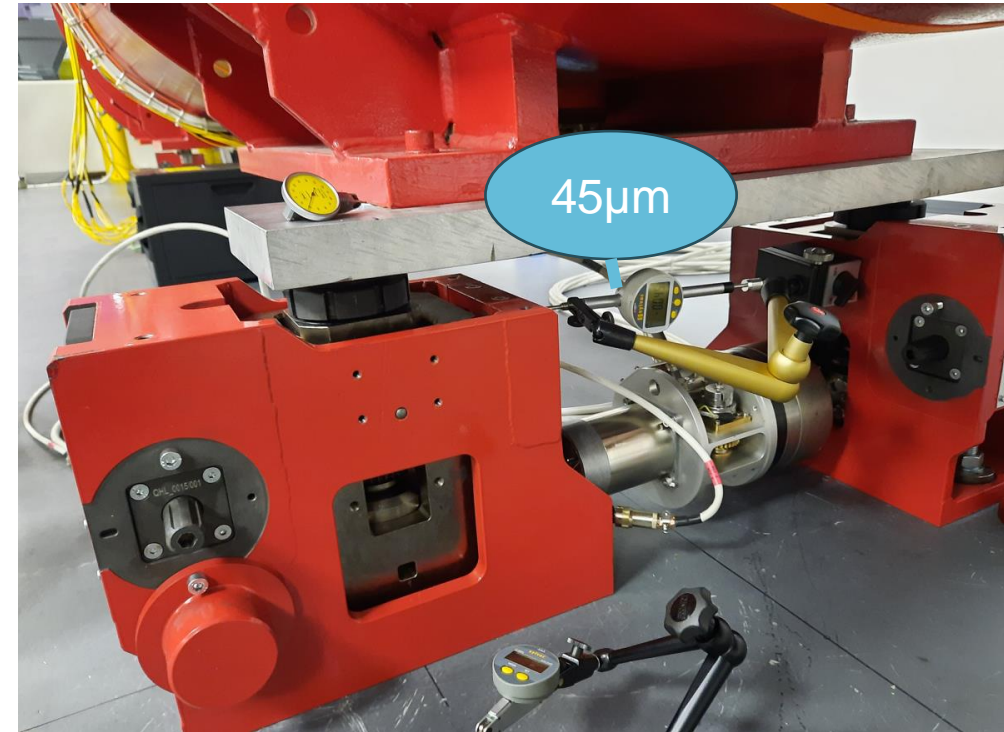


## **Status of SCT and software development**

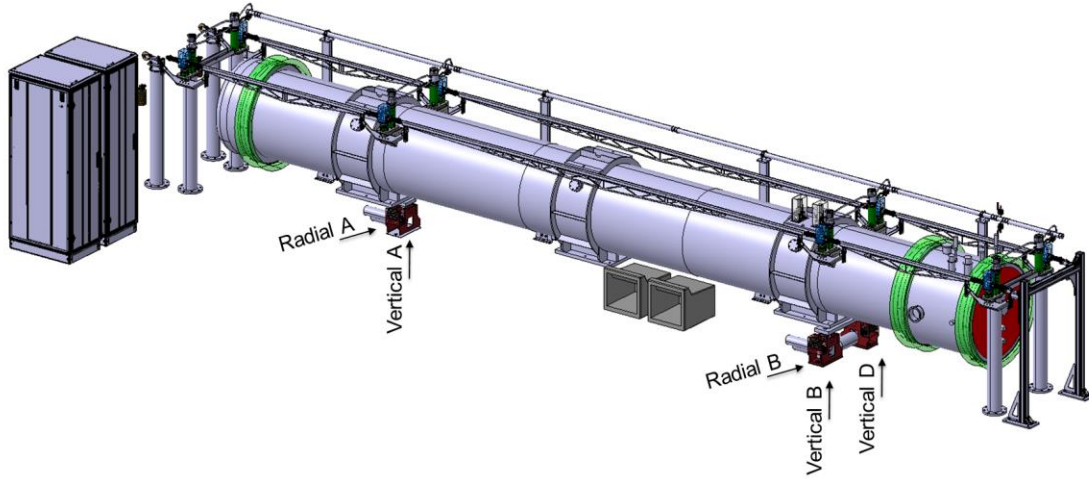
- M. Noir, M. Sosin, V. Rude, B. Schofield
- 2024.06.18

# SCT & Tests status

- The SCT motion tests have been performed :
  - Vertical motion resolution is conform to the specification
  - Radial motion:
    - For the single jack configuration, the global backlash is low
    - For the double jack configuration, system response is Not-OK:
      - Important deformation between the 2 jacks frame observed
      - First action will be to add the epoxy stabilisation glue below the fixation point and to repeat tests – waiting for results.
- Discussion with MRO to be organized to confirm specification on resolver reading
- Motorized adapters tests @22.5 T – hardened screws + electronics availability



# SCT & Tests status – motion tests



| 1. Only radial [mm] |                 |                |                  |                  |                   |                    |                    |
|---------------------|-----------------|----------------|------------------|------------------|-------------------|--------------------|--------------------|
| Date                | Timestamp-start | Timestamp-stop | Radial A (Mot 1) | Radial B (Mot 3) | Vertical A(Mot 2) | Vertical B (Mot 4) | Vertical D (Mot 5) |
| 24/05/2024          | 15:18           | 15:19          | 0.2              | 0.2              | 0                 | 0                  | 0                  |
| 24/05/2024          | 15:19           | 15:20          | 0.2              | 0.2              | 0                 | 0                  | 0                  |
| 24/05/2024          | 15:21           | 15:21          | 0.1              | 0.1              | 0                 | 0                  | 0                  |
| 24/05/2024          | 15:22           | 15:22          | 0.1              | 0.1              | 0                 | 0                  | 0                  |
| 24/05/2024          | 15:22           | 15:23          | 0.05             | 0.05             | 0                 | 0                  | 0                  |
| 24/05/2024          | 15:23           | 15:23          | 0.02             | 0.02             | 0                 | 0                  | 0                  |
| 24/05/2024          | 15:24           | 15:25          | -0.2             | -0.2             | 0                 | 0                  | 0                  |
| 24/05/2024          | 15:25           | 15:26          | -0.2             | -0.2             | 0                 | 0                  | 0                  |
| 24/05/2024          | 15:26           | 15:27          | -0.1             | -0.1             | 0                 | 0                  | 0                  |
| 24/05/2024          | 15:27           | 15:28          | -0.1             | -0.1             | 0                 | 0                  | 0                  |
| 24/05/2024          | 15:28           | 15:29          | -0.05            | -0.05            | 0                 | 0                  | 0                  |
| 24/05/2024          | 15:29           | 15:29          | -0.02            | -0.02            | 0                 | 0                  | 0                  |
|                     |                 |                |                  | 0                | 0                 |                    |                    |

| 2. Only vertical (jacks A,B,D synchronicly) |                 |                |                  |                  |                   |                    |                    |
|---|-----------------|----------------|------------------|------------------|-------------------|--------------------|--------------------|
| Date  | Timestamp-start | Timestamp-stop | Radial A (Mot 1) | Radial B (Mot 3) | Vertical A(Mot 2) | Vertical B (Mot 4) | Vertical D (Mot 5) |
| 24/05/2024                                  | 15:31           | 15:32          | 0                | 0                | 0.2               | 0.2                | 0.2                |
| 24/05/2024                                  | 15:32           | 15:33          | 0                | 0                | 0.2               | 0.2                | 0.2                |
| 24/05/2024                                  | 15:34           | 15:35          | 0                | 0                | 0.1               | 0.1                | 0.1                |
| 24/05/2024                                  | 15:35           | 15:35          | 0                | 0                | 0.1               | 0.1                | 0.1                |
| 24/05/2024                                  | 15:36           | 15:36          | 0                | 0                | 0.05              | 0.05               | 0.05               |
| 24/05/2024                                  | 15:37           | 15:37          | 0                | 0                | 0.02              | 0.02               | 0.02               |
| 24/05/2024                                  | 15:37           | 15:38          | 0                | 0                | -0.2              | -0.2               | -0.2               |
| 24/05/2024                                  | 15:38           | 15:39          | 0                | 0                | -0.2              | -0.2               | -0.2               |
| 24/05/2024                                  | 15:39           | 15:40          | 0                | 0                | -0.1              | -0.1               | -0.1               |
| 24/05/2024                                  | 15:40           | 15:41          | 0                | 0                | -0.1              | -0.1               | -0.1               |
| 24/05/2024                                  | 15:41           | 15:42          | 0                | 0                | -0.05             | -0.05              | -0.05              |
| 24/05/2024                                  | 15:42           | 15:43          | 0                | 0                | -0.02             | -0.02              | -0.02              |
|   |                 |                |                  |                  | 0                 | 0                  | 0                  |

- +/- 1 mm jacks overall motion (R, V, Yaw, Pitch)
- +/- 0.25 mm jacks overall motion (Roll)
- Total cumulative motion "0" to detect backlash size

| 3. Roll (Vertical jacks B & D opposed) |                 |                |                  |                  |                   |                    |                    |
|--|-----------------|----------------|------------------|------------------|-------------------|--------------------|--------------------|
| Date                                   | Timestamp-start | Timestamp-stop | Radial A (Mot 1) | Radial B (Mot 3) | Vertical A(Mot 2) | Vertical B (Mot 4) | Vertical D (Mot 5) |
| 24/05/2024                             | 15:43           | 15:44          | 0                | 0                | 0                 | 0.1                | -0.1               |
| 24/05/2024                             | 15:44           | 15:45          | 0                | 0                | 0                 | 0.1                | -0.1               |
| 24/05/2024                             | 15:45           | 15:45          | 0                | 0                | 0                 | 0.05               | -0.05              |
| 24/05/2024                             | 15:45           | 15:46          | 0                | 0                | 0                 | 0.05               | -0.05              |
| 24/05/2024                             | 15:47           | 15:47          | 0                | 0                | 0                 | 0.025              | -0.025             |
| 24/05/2024                             | 15:47           | 15:48          | 0                | 0                | 0                 | 0.01               | -0.01              |
| 24/05/2024                             | 15:48           | 15:48          | 0                | 0                | 0                 | -0.1               | 0.1                |
| 24/05/2024                             | 15:49           | 15:49          | 0                | 0                | 0                 | -0.1               | 0.1                |
| 24/05/2024                             | 15:49           | 15:50          | 0                | 0                | 0                 | -0.05              | 0.05               |
| 24/05/2024                             | 15:50           | 15:51          | 0                | 0                | 0                 | -0.05              | 0.05               |
| 24/05/2024                             | 15:51           | 15:51          | 0                | 0                | 0                 | -0.025             | 0.025              |
| 24/05/2024                             | 15:52           | 15:52          | 0                | 0                | 0                 | -0.01              | 0.01               |
|  |                 |                |                  |                  |                   | 0                  | 0                  |

| 4. Yaw (Radial jacks A & B opposed) |                 |                |                  |                  |                   |                    |                    |
|-------------------------------------|-----------------|----------------|------------------|------------------|-------------------|--------------------|--------------------|
| Date                                | Timestamp-start | Timestamp-stop | Radial A (Mot 1) | Radial B (Mot 3) | Vertical A(Mot 2) | Vertical B (Mot 4) | Vertical D (Mot 5) |
| 24/05/2024                          | 15:54           | 15:55          | 0.2              | -0.2             | 0                 | 0                  | 0                  |
| 24/05/2024                          | 15:56           | 15:56          | 0.2              | -0.2             | 0                 | 0                  | 0                  |
| 24/05/2024                          | 15:57           | 15:57          | 0.1              | -0.1             | 0                 | 0                  | 0                  |
| 24/05/2024                          | 15:57           | 15:58          | 0.1              | -0.1             | 0                 | 0                  | 0                  |
| 24/05/2024                          | 15:58           | 15:59          | 0.05             | -0.05            | 0                 | 0                  | 0                  |
| 24/05/2024                          | 15:59           | 15:59          | 0.02             | -0.02            | 0                 | 0                  | 0                  |
| 24/05/2024                          | 16:00           | 16:01          | -0.2             | 0.2              | 0                 | 0                  | 0                  |
| 24/05/2024                          | 16:01           | 16:02          | -0.2             | 0.2              | 0                 | 0                  | 0                  |
| 24/05/2024                          | 16:03           | 16:04          | -0.1             | 0.1              | 0                 | 0                  | 0                  |
| 24/05/2024                          | 16:04           | 16:04          | -0.1             | 0.1              | 0                 | 0                  | 0                  |
| 24/05/2024                          | 16:04           | 16:04          | -0.1             | 0.1              | 0                 | 0                  | 0                  |
| 24/05/2024                          | 16:05           | 16:05          | -0.05            | 0.05             | 0                 | 0                  | 0                  |
| 24/05/2024                          | 16:06           | 16:06          | -0.02            | 0.02             | 0                 | 0                  | 0                  |
|                                     |                 |                |                  | 0                | 0                 |                    |                    |

| 5. Pitch (Radial jacks A & B opposed) |                 |                |                  |                  |                   |                    |                    |
|---------------------------------------|-----------------|----------------|------------------|------------------|-------------------|--------------------|--------------------|
| Date                                  | Timestamp-start | Timestamp-stop | Radial A (Mot 1) | Radial B (Mot 3) | Vertical A(Mot 2) | Vertical B (Mot 4) | Vertical D (Mot 5) |
| 24/05/2024                            | 16:07           | 16:08          | 0                | 0                | 0.2               | -0.2               | -0.2               |
| 24/05/2024                            | 16:08           | 16:09          | 0                | 0                | 0.2               | -0.2               | -0.2               |
| 24/05/2024                            | 16:09           | 16:10          | 0                | 0                | 0.1               | -0.1               | -0.1               |
| 24/05/2024                            | 16:10           | 16:11          | 0                | 0                | 0.1               | -0.1               | -0.1               |
| 24/05/2024                            | 16:11           | 16:11          | 0                | 0                | 0.05              | -0.05              | -0.05              |
| 24/05/2024                            | 16:12           | 16:12          | 0                | 0                | 0.02              | -0.02              | -0.02              |
| 24/05/2024                            | 16:13           | 16:13          | 0                | 0                | -0.2              | 0.2                | 0.2                |
| 24/05/2024                            | 16:14           | 16:14          | 0                | 0                | -0.2              | 0.2                | 0.2                |
| 24/05/2024                            | 16:14           | 16:15          | 0                | 0                | -0.1              | 0.1                | 0.1                |
| 24/05/2024                            | 16:16           | 16:16          | 0                | 0                | -0.1              | 0.1                | 0.1                |
| 24/05/2024                            | 16:17           | 16:17          | 0                | 0                | -0.05             | 0.05               | 0.05               |
| 24/05/2024                            | 16:17           | 16:17          | 0                | 0                | -0.02             | 0.02               | 0.02               |
|                                       |                 |                |                  |                  | 0                 | 0                  | 0                  |

## Main observations (1s data):

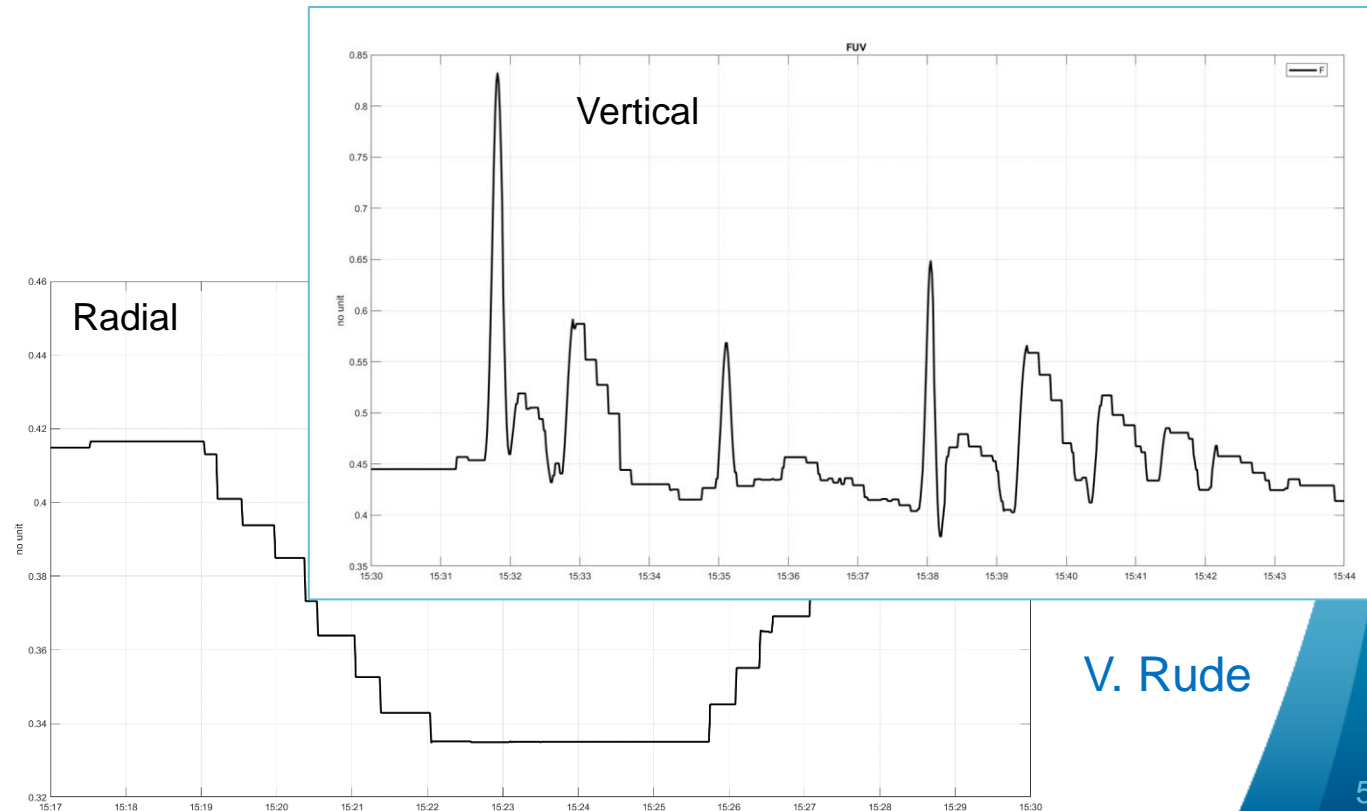
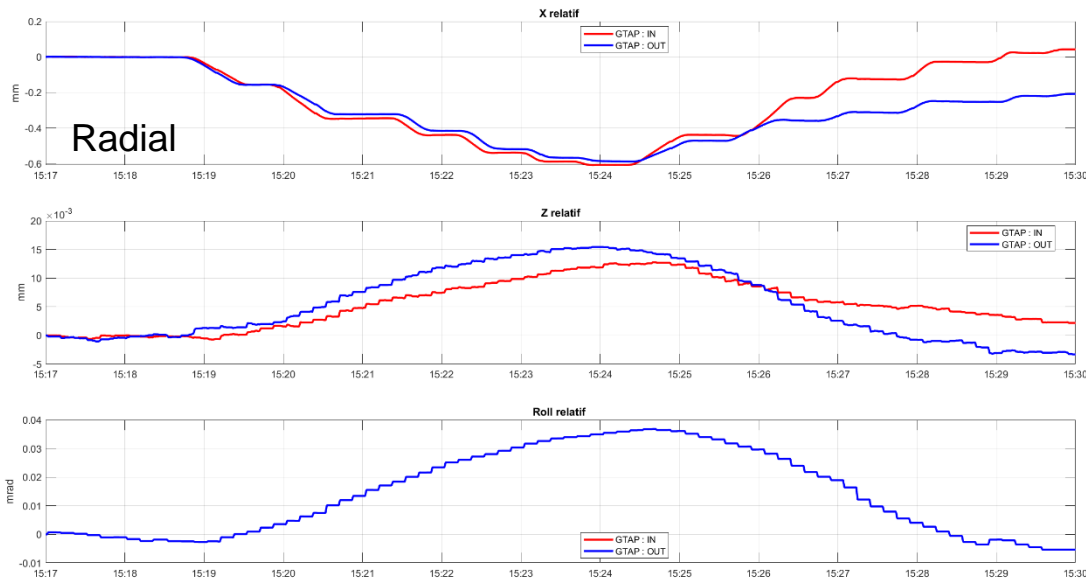
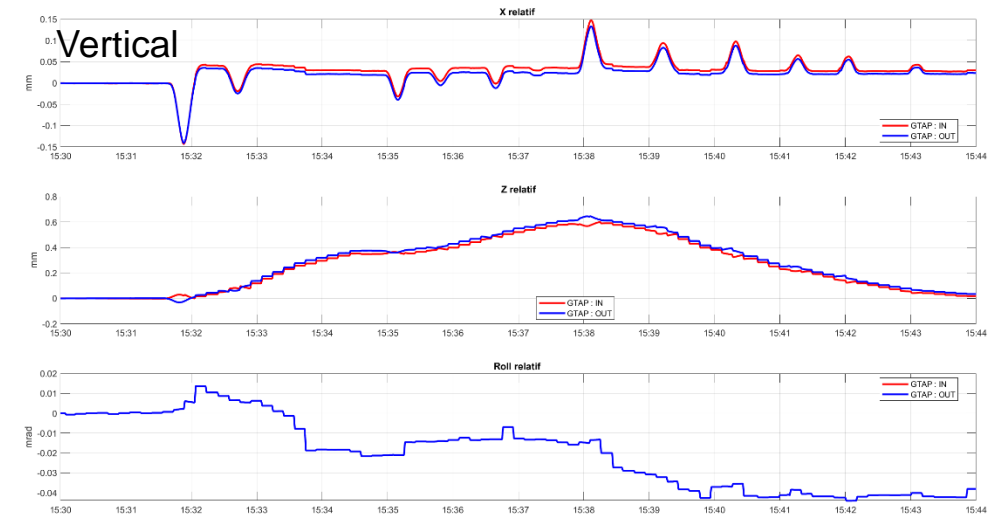
- NXCALS logging ow WPS and HLS sensors shifted by ~2 min. Given to Brad (discrepancy in FECs time settings)
- Coherent motion of WPS vs. HPS measurements. LGC measurements OK (see next slides)
- Wave effects on HLS difficult to compare as still 5s cycle, but “peak” overshoot visible also on WPS, hence not wave nature



# SCT & Tests status

## Motion test:

- Only radial motions: LGC calculation OK (FUV OK < 0.85). Backlash on B-D jacks (OUT) visible X~0.2 mm, Z~5um
- Only vertical motions: LGC calculation OK (FUV OK < 0.45). Small backlash – motion only in vertical

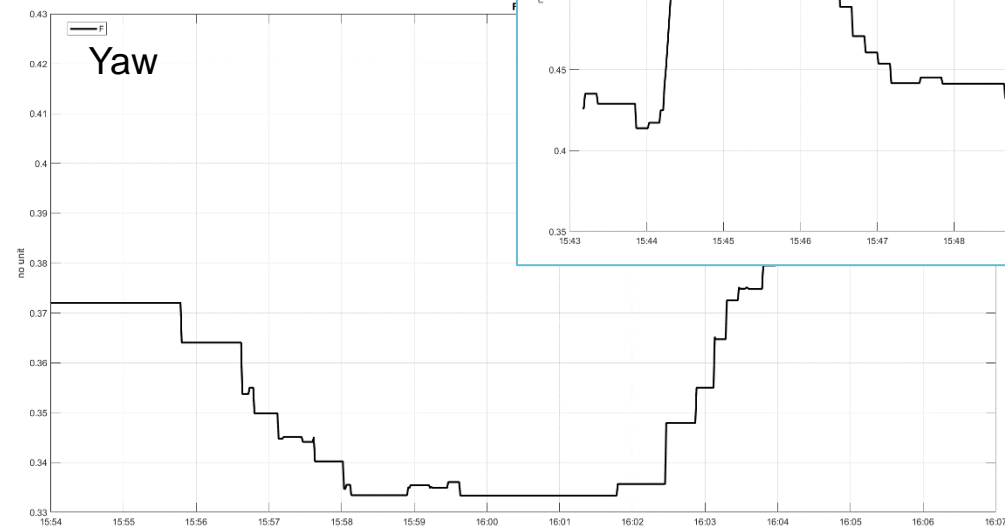
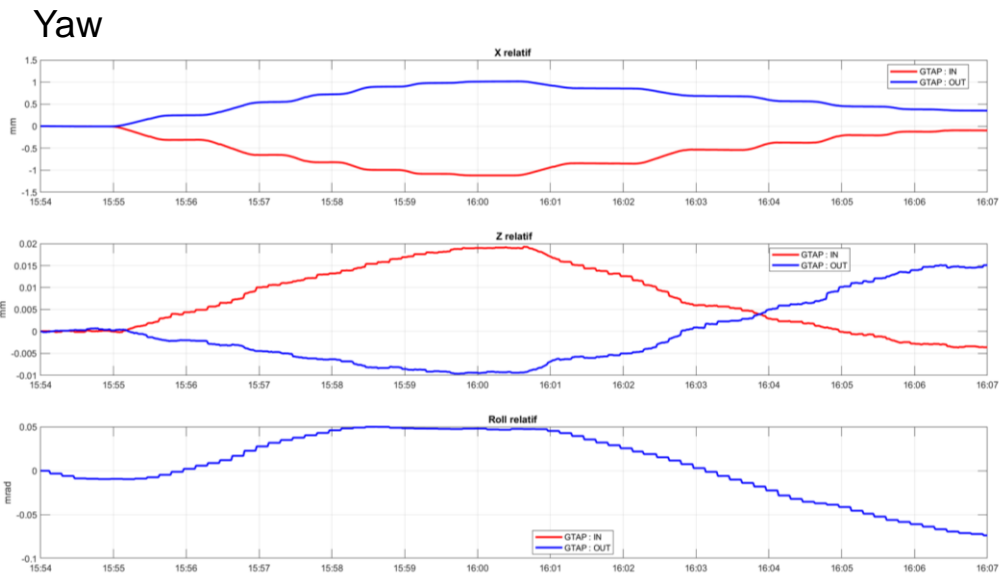
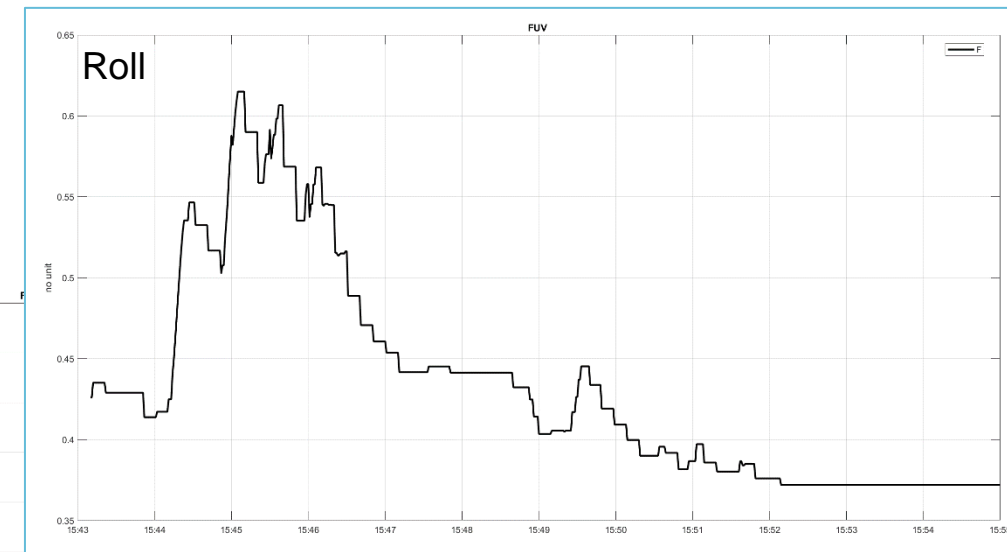
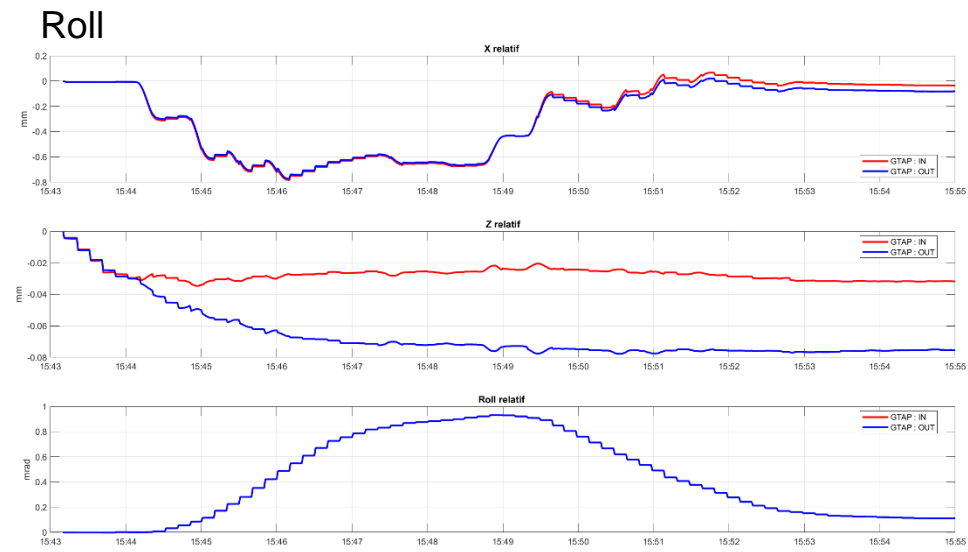


V. Rude

# SCT & Tests status

## Motion test:

- Roll: LGC calculation OK (FUV OK < 0.65).  
Jacks backlash of ~0.04 mm visible between IN and OUT
- Yaw: LGC calculation OK (FUV OK < 0.43).  
Backlash visible in X~0.5 mm between IN and OUT (?) TBC



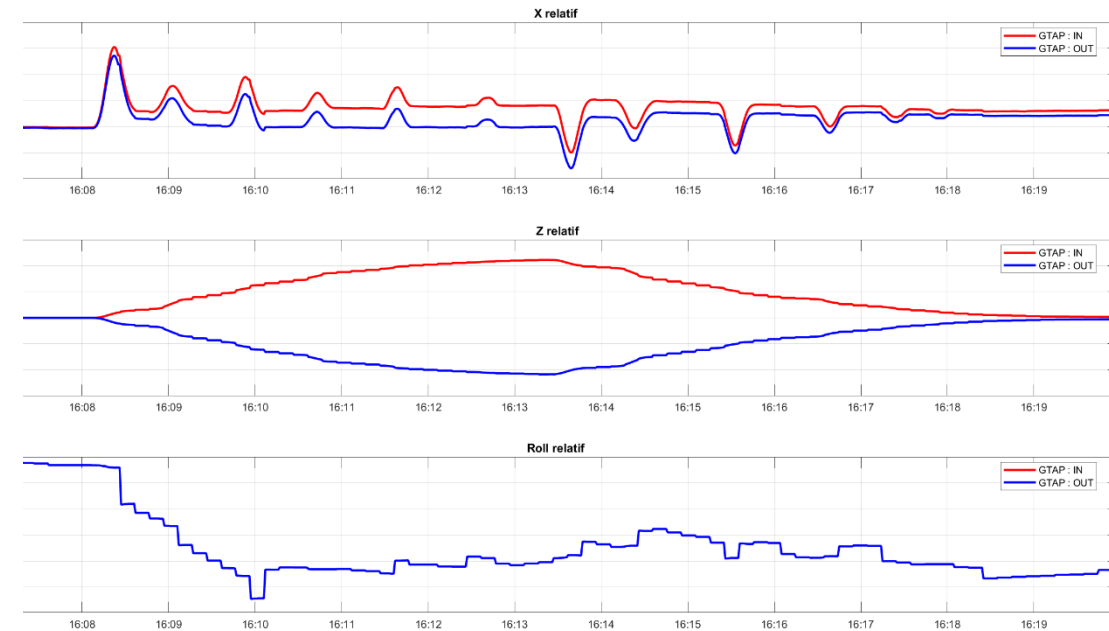
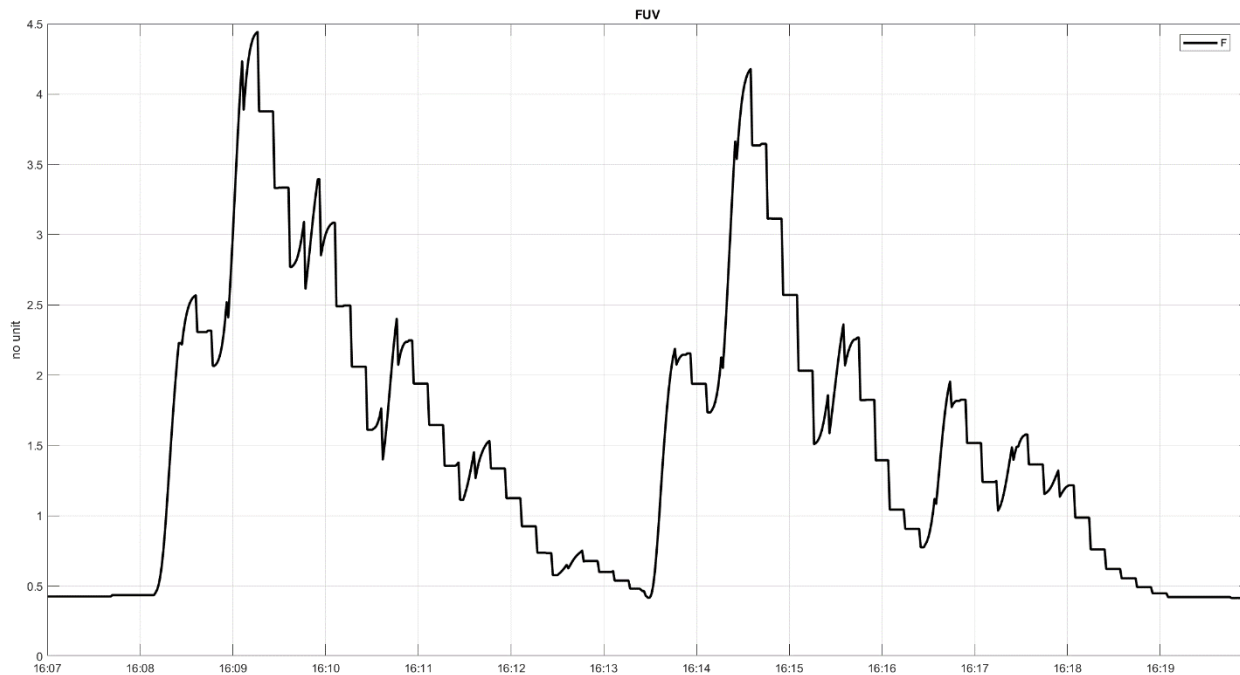
V. Rude



# SCT & Tests status

## Motion test:

- Pitch: LGC calculation OK only on later stage (FUV goes to 4.5 at the initial motion).
- More detailed investigations to be addressed



# Software status

See minutes:

<https://readthedocs.web.cern.ch/display/FRAS/Meetings+and+Minutes>

- FRAS Software specification (EDMS 2776384) – inclinometer update (Motors block discussed, to be added in next step).
- Bellows safety functions specification (EDMS 3065181) – ONGOING.
  - Decision of simplification of final approach after discussions with Borja, Brad ([LINK](#)):
    - Capacitive layer based on LGC (no new sensors needed); FSI – only rotation covered; Resolver – only relative simple calculations
    - Final descriptions of safety functions implementation – ongoing (Vivien, Mateusz). Capacitive – as simplified LGC block
    - Implementation of the safety functions – analysis and initial development ongoing. Borja made updates in risk assessment calculations
    - The LGC capacitive PL prototype to be tested on collimator test stand (as LGC based)
  - DRF deformations – specification draft and request for confirmation of deformation values sent to Delio
  - Discussion with E. Montesinos on FR Guides deformation – possible to reach +/-2.5mm.
- Implementation of CCC (CCR Key) interlock for FRAS (EDMS 3065183) – Most details agreed, ON-HOLD



# Software status

See minutes:

<https://readthedocs.web.cern.ch/display/FRAS/Meetings+and+Minutes>

- **SCT software activities update 17<sup>th</sup> June (Brad):**
  - Required upgrade of SCADA part to new (supported version 3.19) – DONE
  - Miguel and Brad working on finalization of Inclinator classes – beta version should be ready by the end of this week
  - NXCALS some naming still not updated (residuals, inclinometer) – need to finish first the inclinometer class update
  - ‘Bellows objects’ – FESA part done. First tests to be initiated after FRAS Software meeting (end of this week)

**Thank you!**