Solar Orbiter In-situ Working Group meeting

ESAC-16/01/2024

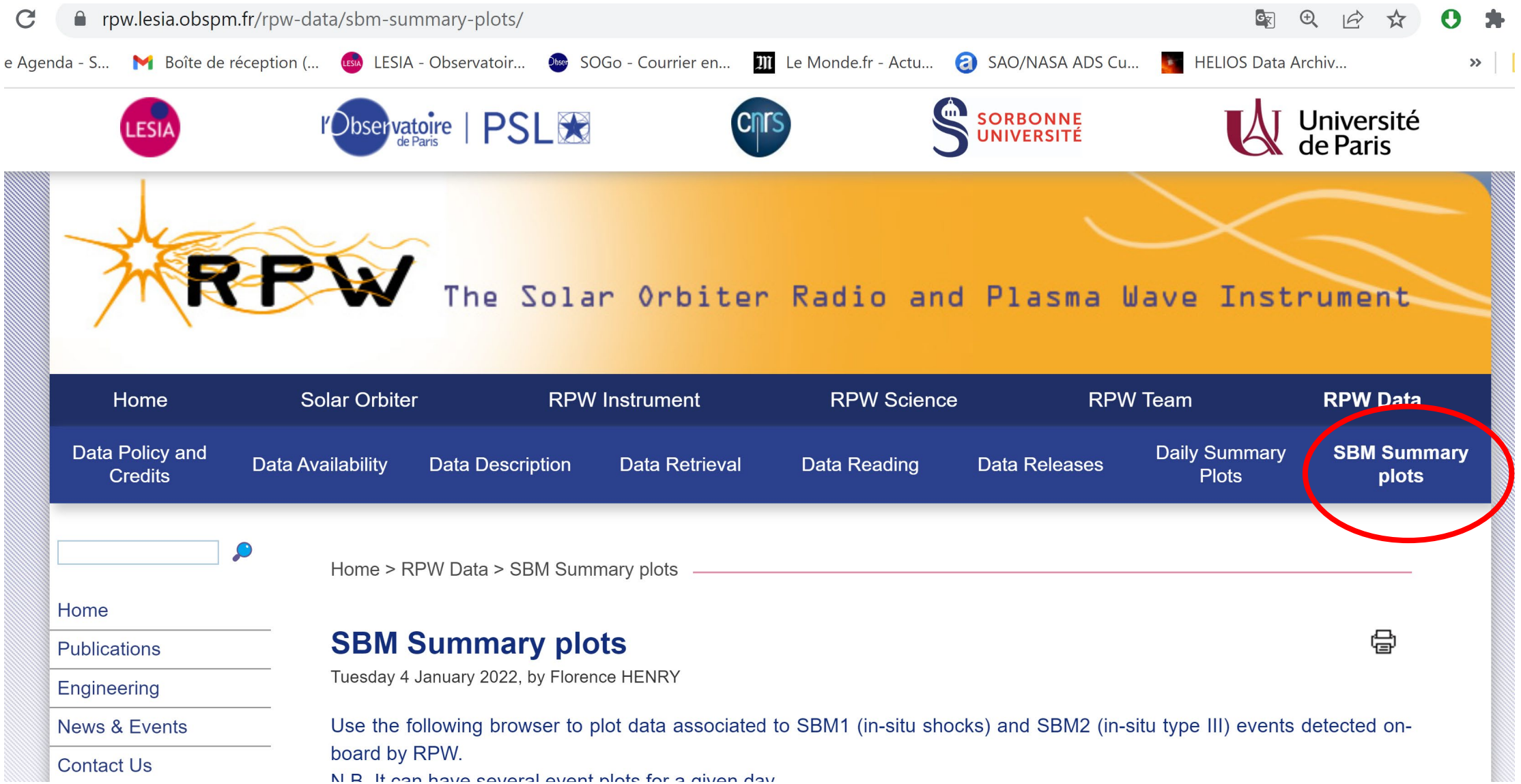
RPW Status

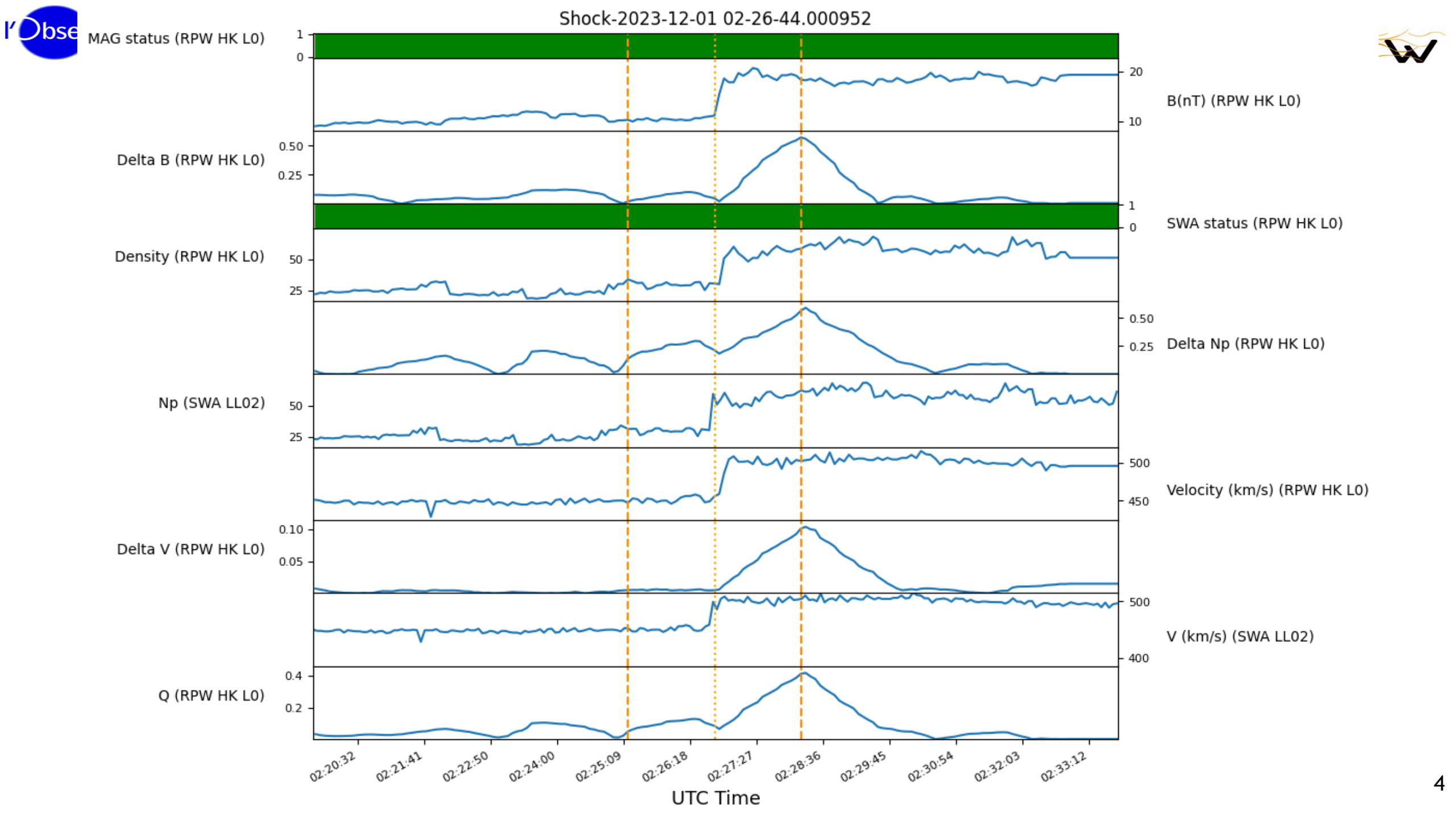
Laboratoire d'Études Spatiales et d'Instrumentation en Astrophysique

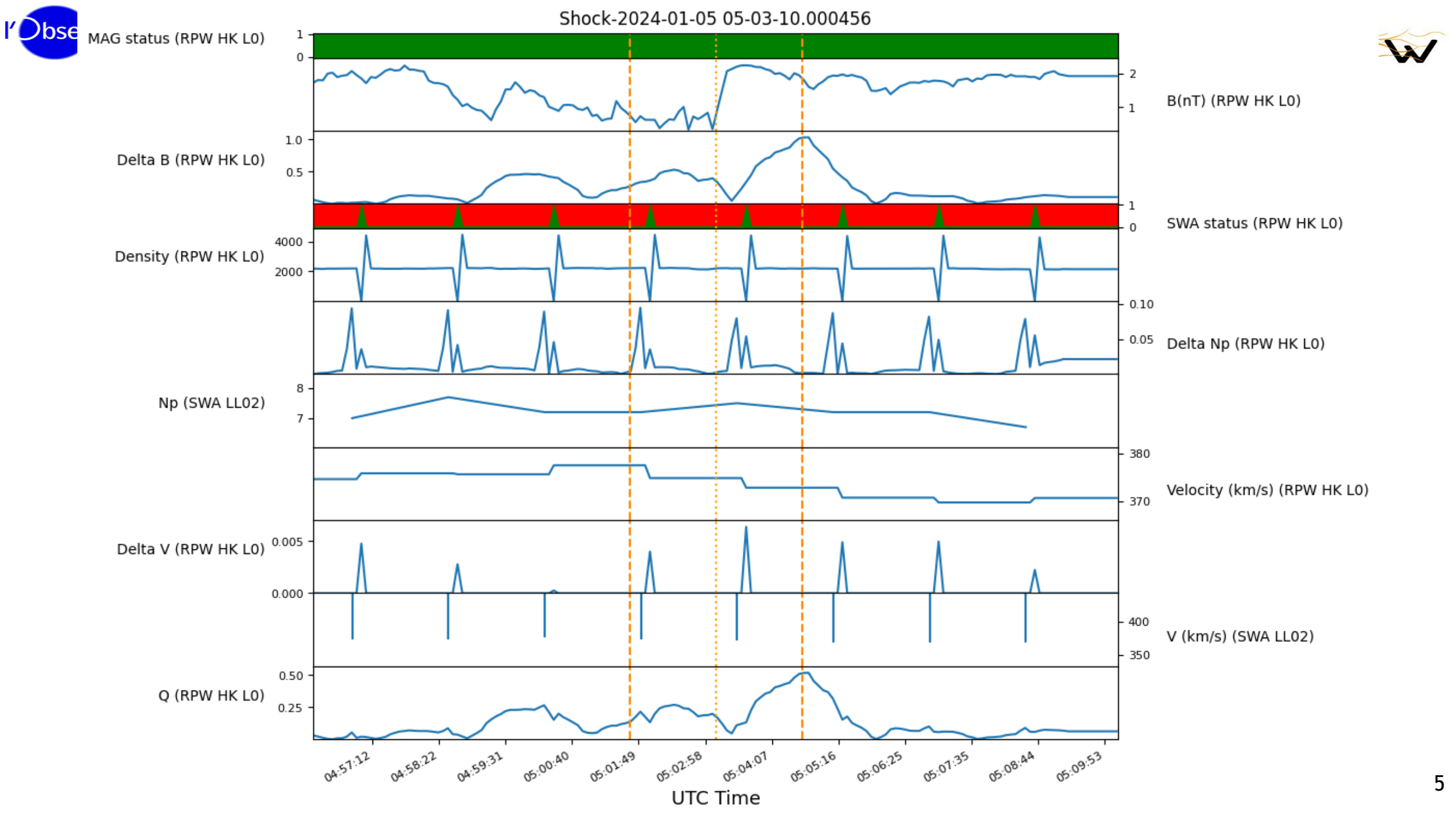
Outline

- RPW shock trigger
- Science data
- ANT3 Anomaly

RPW shock trigger




Shock-2023-12-01 02-26-44.000952
MAG status (RPW HK L0)
B(nT) (RPW HK L0)
Delta B (RPW HK L0)
SWA status (RPW HK L0)
Density (RPW HK L0)
Delta Np (RPW HK L0)
Np (SWA LL02)
Velocity (km/s) (RPW HK L0)
Delta V (RPW HK L0)
V (km/s) (SWA LL02)
Q (RPW HK L0)
02:20:32
02:21:41
02:22:50
02:24:00
02:25:09
02:26:18
02:27:27
02:28:36
02:29:45
02:30:54
02:32:03
02:33:12
UTC Time


Shock-2024-01-05 05-03-10.000456
MAG status (RPW HK L0)
B(nT) (RPW HK L0)
Delta B (RPW HK L0)
SWA status (RPW HK L0)
Density (RPW HK L0)
Delta Np (RPW HK L0)
Np (SWA LL02)
Velocity (km/s) (RPW HK L0)
Delta V (RPW HK L0)
V (km/s) (SWA LL02)
Q (RPW HK L0)
04:57:12
04:58:22
04:59:31
05:00:40
05:01:49
05:02:58
05:04:07
05:05:16
05:06:25
05:07:35
05:08:44
05:09:53
UTC Time

Further actions for the shock triggerring

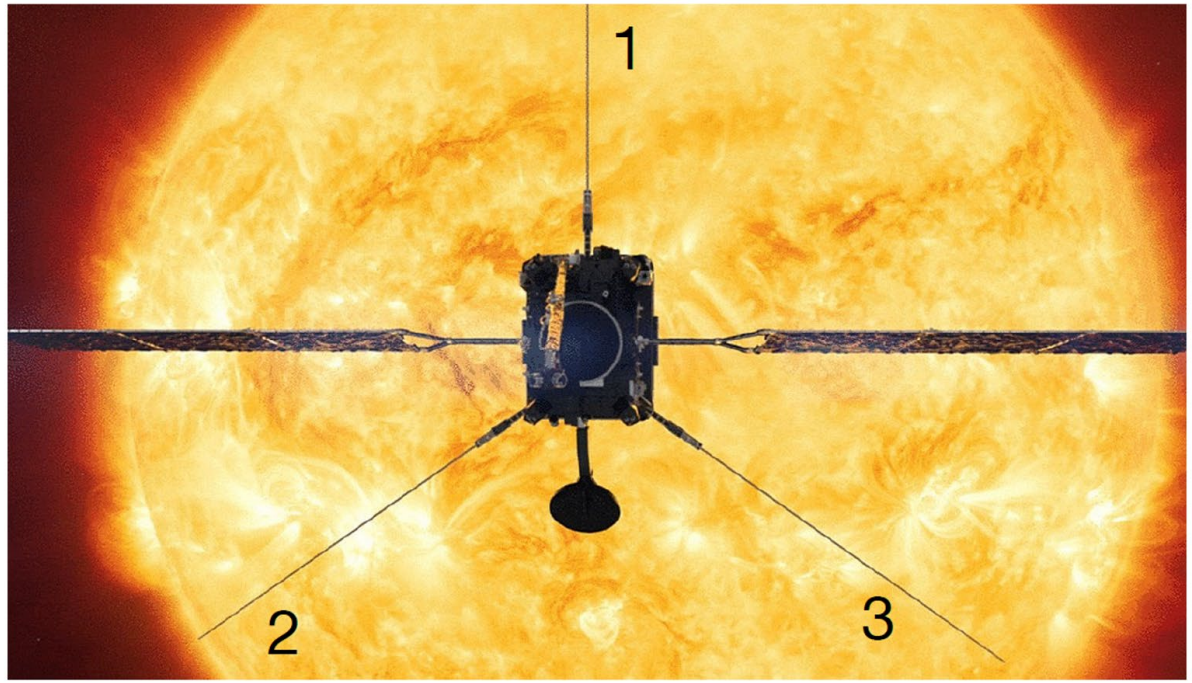
- D. Bérard is on leave
- The RPW team will still investigate on the triggering (comparison with the shock list from Andrew Dimmock).
- However my feeling is that we are globally satisfied with the current situation
  - ➢ For RPW we should be able to use the selective downlink
  - ➢ For SWA : RPW is not triggerring too much now.

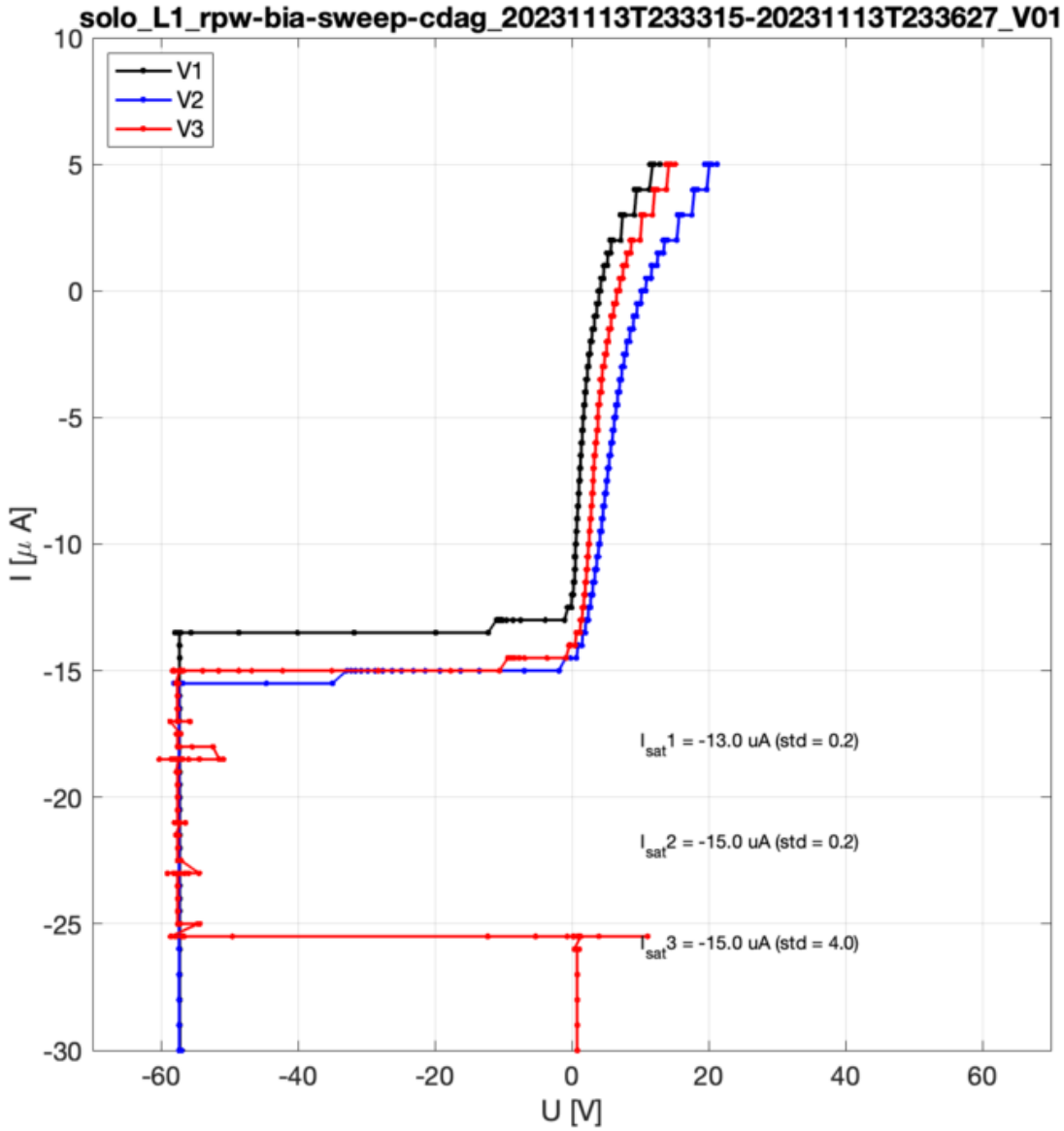
RPW science data

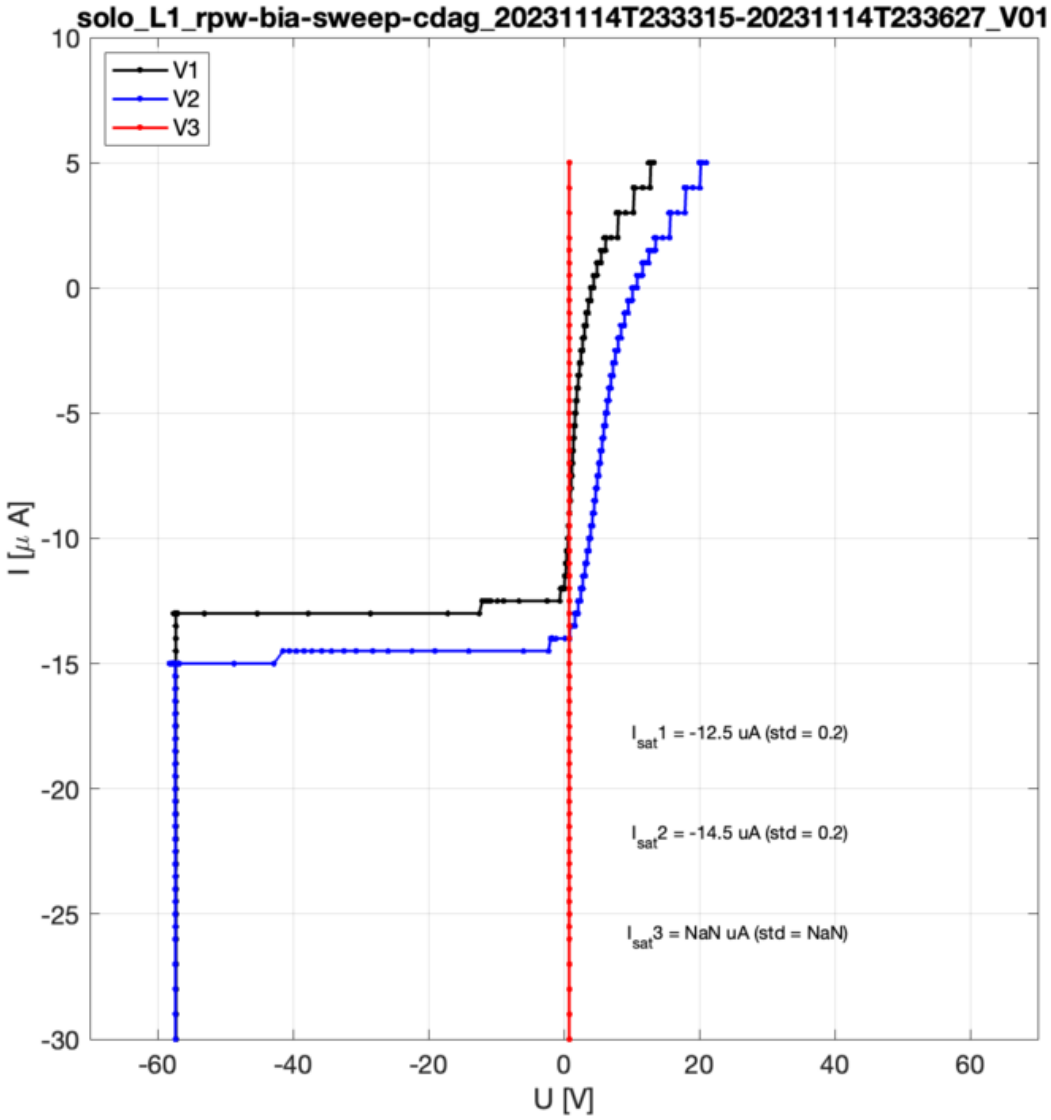
- Last data released Sept. 2023
- L0/L1 delivery in late (Dec 22 / May 22)
- A re-processing of RPW science data (L1/L2/L3) is in preparation
- Main goals are:
  - To be compliant with SolO metadata standard 2.5
  - Perform some updates and fix remaining inconsistencies
  - Include RPW DOI info
  - Use CDF 3.9 (but with 3.7 features only)
- Should be performed in spring 2024 (TBC)

The bad news

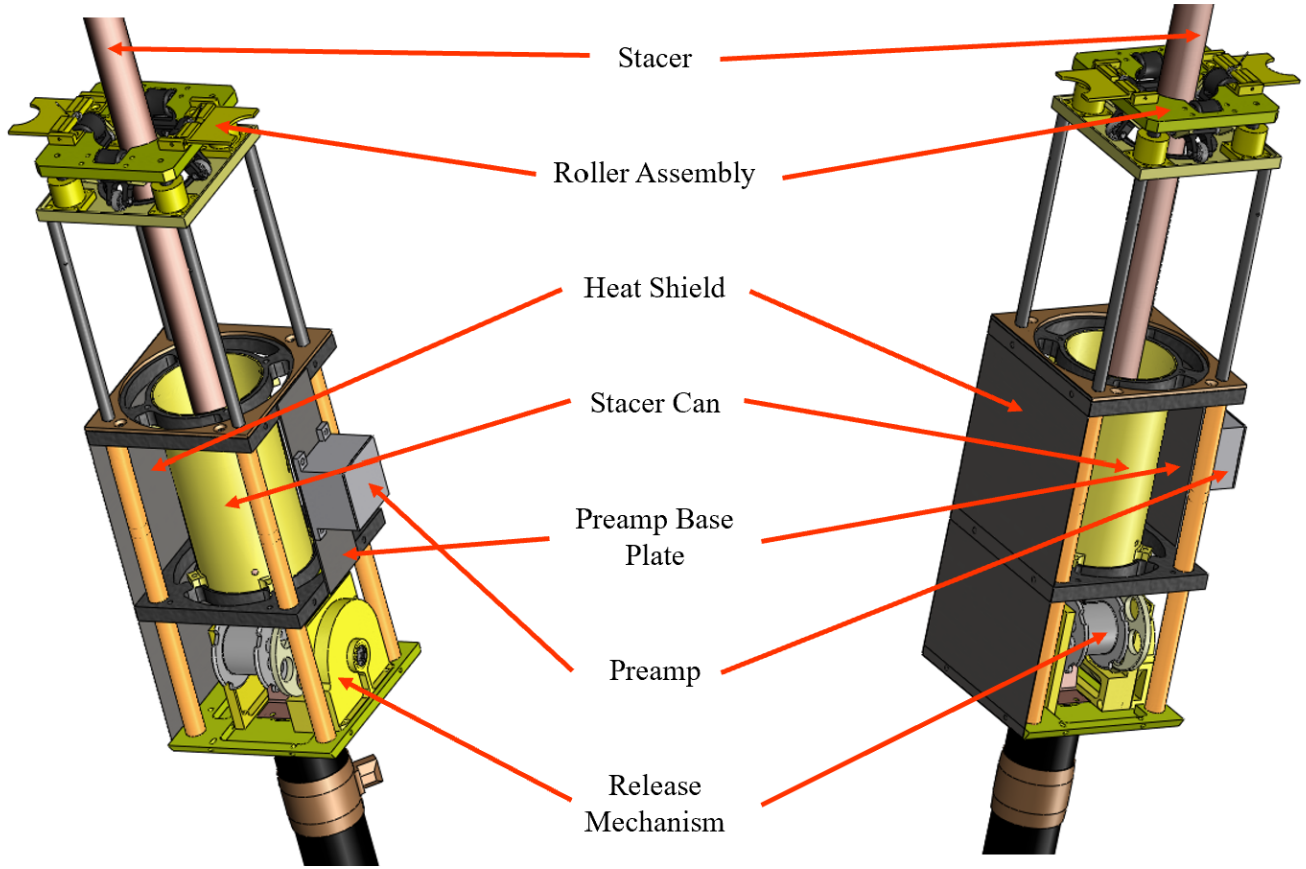
- Antenna 3 is malfunctionning
  - *Internal issue with the pre-amp?*
  - *Mechanical break ?*
  - *Under assessment (review boards will be set)*
  - *There is an impact on the science*

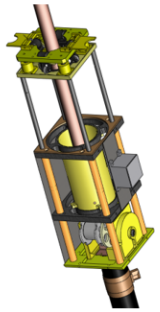



solo_L1_rpw-bia-sweep-cdag_20231113T233315-20231113T233627_V01
V1
V2
V3
I [μ A]
U [V]
I_sat1 = -13.0 uA (std = 0.2)
I_sat2 = -15.0 uA (std = 0.2)
I_sat3 = -15.0 uA (std = 4.0)


solo_L1_rpw-bia-sweep-cdag_20231114T233315-20231114T233627_V01
V1
V2
V3
I [μ A]
U [V]
I_sat1 = -12.5 uA (std = 0.2)
I_sat2 = -14.5 uA (std = 0.2)
I_sat3 = NaN uA (std = NaN)

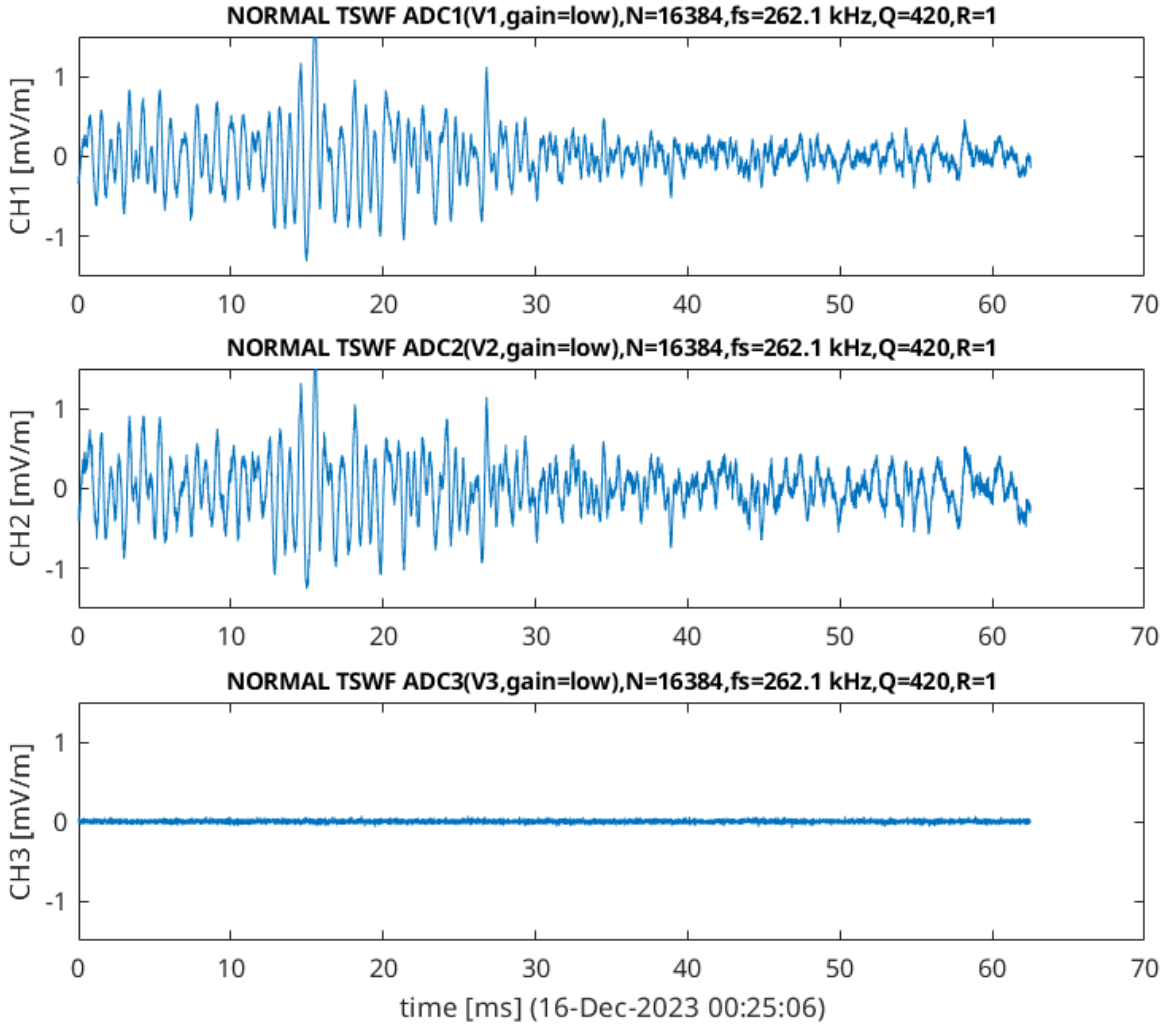
Preamp and Deployment Mechanism





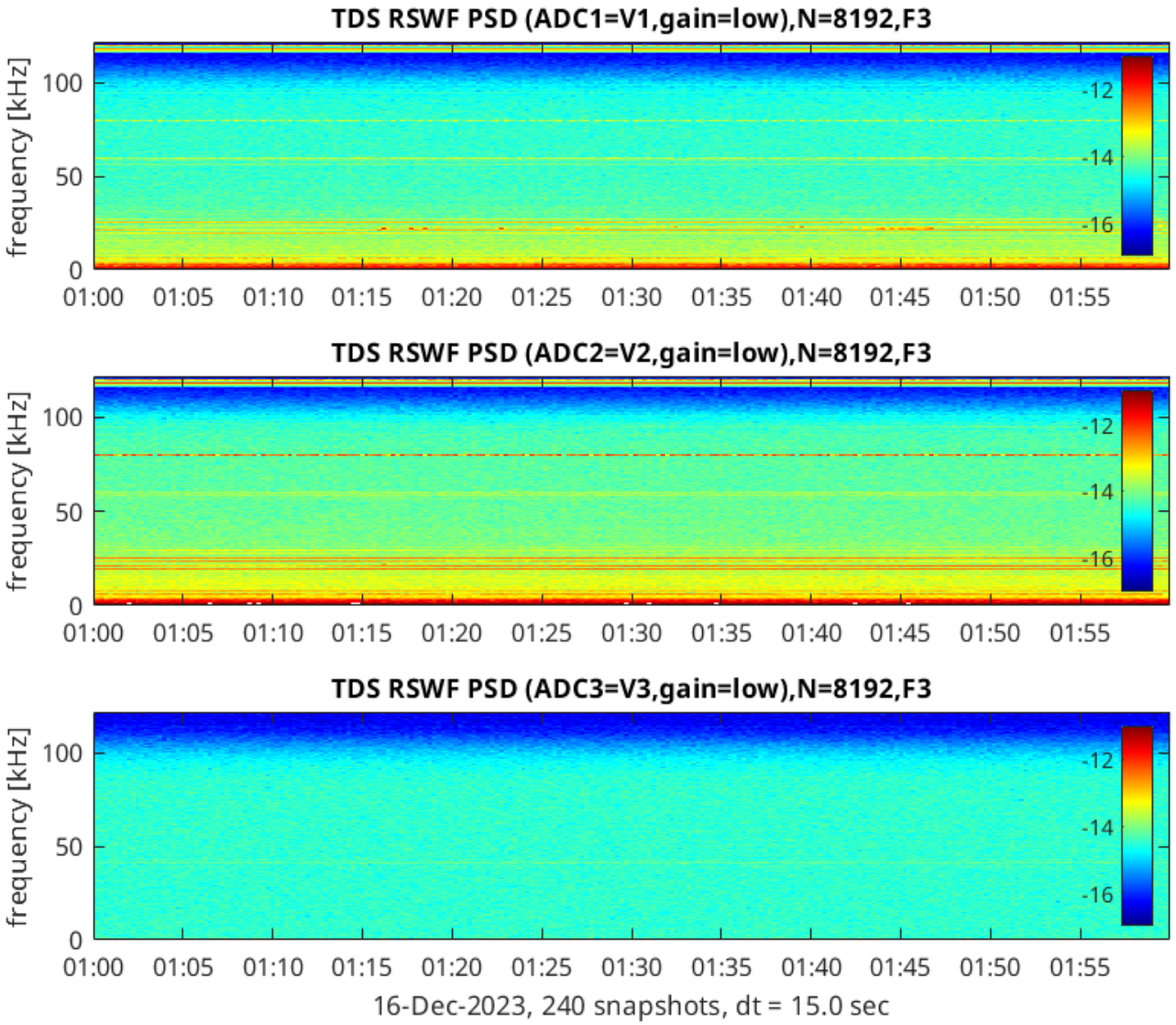
Current SolidWorks Model

TDS data after the anomaly



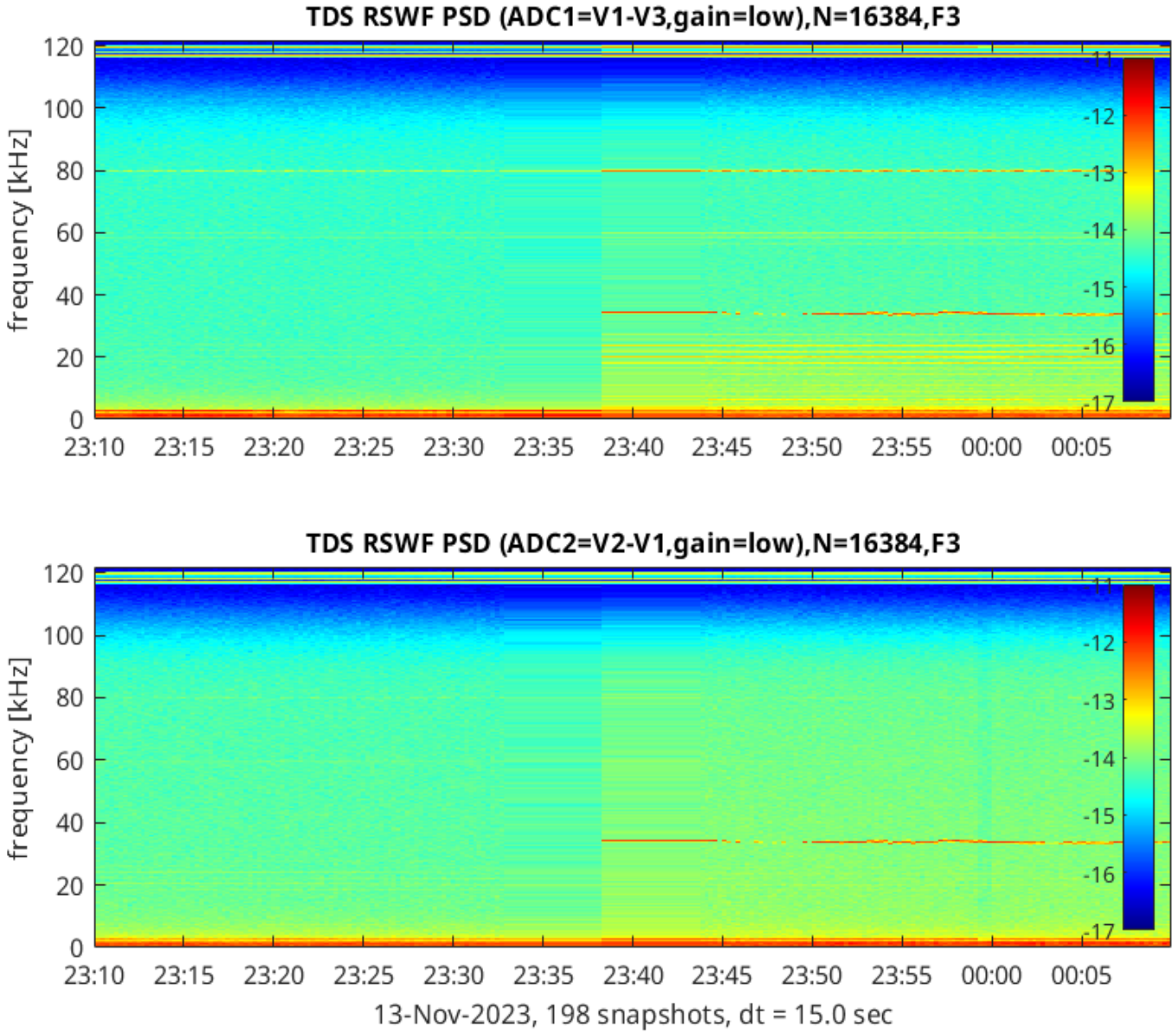
- On December 16, TDS was configured to a monopole mode, where each channel samples a single antenna.
- Clearly, Antenna 3 sees no signal at all
- TDS uses a high frequency preamplifier (different from the one used by the RPW bias), but sharing the same antenna connection “pigtail”

TDS data after the anomaly (spectrum)



- Channel3 only sees (analog) noise, comparable to a situation when the preamplifier would be grounded at its input.
- Even the 120 kHz interference from the PCDU is gone.

TDS data during anomaly on Nov 13



- V3 anomaly occurred on Nov 13, 23:38.
- TDS was in a dipole configuration
- Channel 1 (V1-V3) observes an increase in background interferences due to changing from a dipole to effective monopole
- Increase of the 40 kHz interference observed on both channels, this is common after a BIAS current change.
- A slight increase of background noise on V2-V1 channel observed too. Origin unknown, may or may be related to the anomaly or a bias current change.

Data loss and possible mitigations on TDS

- On TDS we usually run in a dipole config, sampling
  - CH1 = V3-V1
  - CH2 = V1-V2
  - CH3 = V2

This configuration is not suitable anymore, because the V3-V1 dipole is degraded

- Short term configuration (since January 22)
  - A full monopole config CH1 = V1, CH2 = V2, CH3 = V3
- Short term configuration (since January 22)
  - CH1 = V1
  - CH2 = V1-V2
  - CH3 = V2
- After this configuration change, the data degradation on TDS will not be too bad
  - We will still be able to recover two components of E-field
  - Triggering of the automatic detection can be done on the V1-V2 dipole as until now, which provides the cleanest spectrum.
  - Slightly increased noise on the V1 and V2 monopoles, compared to dipole measurements
  - On the other hand, this configuration is (somehow) better for dust detection.

Science impact BIAS

- Spacecraft potential and plasma density are OK – using V1 only.
- 2D DC/LF electric field is no longer measured. L3 E-FILED data product likely to be discontinued.
- One component of DC/LF electric field is available.

Science impact LFR

- Spectral products combining 2D DC/LF electric field components are no longer possible (radial component of the Poynting flux, phase velocity)
- Power spectrum of 1 DC/LF electric field component can still be measured.

Science impact THR

- We have lost the capability of doing full Direction finding analysis – but this was not yet implemented
- We will use mostly the V1-V2

The way forward

- First internal meeting next Friday
- And ARB will be called by ESA. There will also be a review at CNES
- We have requested the ESA project to look at S/C HK data

Preliminary feedback from Chris Watson (10/01)

- I see that the sweep occurred during an offpointing sequence, …. one of the component slews starts at 23:36 so this may align with the failure. … maybe the sequence as a whole may excite some sort of mechanical resonance in the antennas that persists beyond the individual slews(?), and maybe this can give rise to trouble.
- I did not see any evidence of a micrometeorite hit in TM. …and indeed we never saw any attitude signature in TM from the SA discrete events, where we are fairly sure the micrometeorites hits are involved

The good news : we still do science

https://sites.google.com/view/jointrpwfields/