

1. INTRODUCTION

On GMT 2026-09-25, at 268/15:43, the International Space Station (ISS) began an 18-minute reboost using the Cygnus NG-24 (Cygnus XL) vehicle. The as-flown timeline identifies a reboost Time of Ignition (TIG) of GMT 268/15:43:00 and a duration of 18 minutes. NASA subsequently reported that the burn raised the station's orbit by 1.5 miles at apogee and 0.8 miles at perigee, leaving the ISS in a 265.5 by 256.8 mile orbit. NASA stated that the reboost established phasing for the SpaceX Crew-13 mission.¹

The Cygnus docking location and thrust geometry required the ISS to first maneuver to the so-called “-ZVV” reboost attitude before firing the vehicle's gimbaled delta-velocity engine. In this attitude, the Cygnus thrust direction is arranged so that the resulting ISS acceleration is aligned with the orbital-velocity direction required for reboost. As in the previous, GMT 2026-08-27 NG-24 reboost, this geometry gives rise in Space Acceleration Measurement System (SAMS) data to a highly directional acceleration step in the negative Z-axis direction of the Space Station Analysis (SSA) body-fixed coordinate system.

The as-flown timeline shows the maneuver to the Cygnus reboost attitude beginning at GMT 268/14:25:01 and reaching the -ZVV configuration at about 14:45. Attitude-control handover from the US Segment to the Russian Segment (RS) occurred at 15:00, followed by a reboost quaternion update at 15:05. After the 15:43–16:01 reboost, control was handed from RS back to USTO at 16:18, immediately followed by the maneuver back toward nominal Torque Equilibrium Attitude (TEA), reaching the target attitude at about 16:45. The timeline then shows transition to US momentum management at 16:55.

2. QUALIFY

The as-flown timeline brackets the reboost with attitude maneuvers and an interval of Russian Segment attitude control. These surrounding operations are important context because maneuver and attitude-control thruster activity tend to excite low-frequency structural modes of ISS appendages and modules for substantially longer than the reboost firing itself.

Figure 2 provides the broader time-frequency context from the SAMS sensor 121f02 at its Columbus module's starboard endcone location. The spectrogram spans approximately 12:00–20:00 GMT and 0–6 Hz. It shows the maneuver

¹NASA, “NASA, Northrop Grumman Complete Cygnus XL Space Station Reboost,” 2026-09-25: nasa.gov/blogs/spacestation.

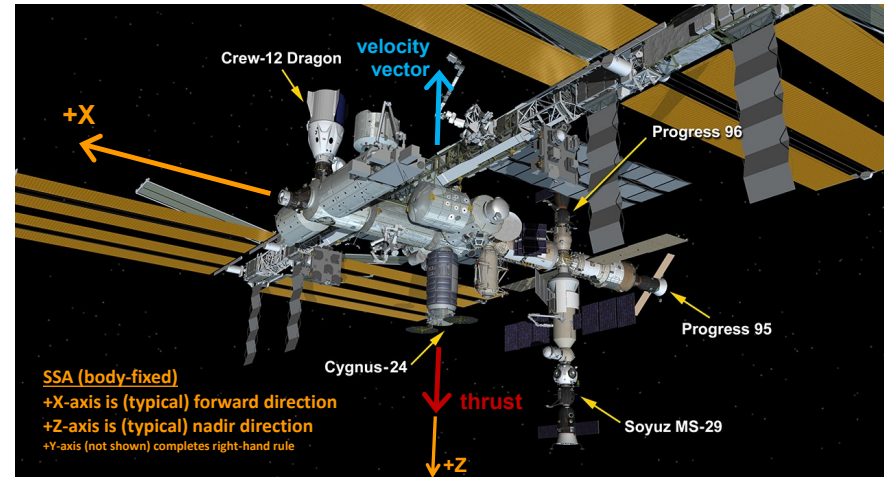


Fig. 1: Cygnus NG-24 location & thrust/velocity vectors during reboost.

to reboost attitude before the burn, sustained low-frequency activity during the annotated reboost interval, and the later maneuver back to nominal attitude as distinct features in the same continuous record. In particular, the reboost interval is accompanied by a broad increase in low-frequency spectral power, superimposed on persistent ISS structural bands. This makes the spectrogram useful for qualifying the event in context and for distinguishing the burn from the surrounding attitude maneuvers and other vehicle activity. A pattern we would typically expect.

The spectrogram is intentionally used here as a qualification view rather than as the primary source for the rigid-body acceleration magnitude. Its approximately 90-second temporal resolution emphasizes the evolving vibratory environment and structural response, whereas the 5-second interval-average products we show later isolate the quasi-steady acceleration step much more cleanly. For this event, the strongest quantitative qualification therefore comes from consensus among seven spatially distributed SAMS sensor heads. Each 5-second interval-average plot will show the same sustained negative Z-axis step beginning essentially at the scheduled TIG and lasting approximately 18 minutes. The detected step boundaries differ by only seconds among the sensors (17:59–18:01 measured duration), which is expected from the interval-averaging and change-detection processing we use on

these independent measurement data sets. The X - and Y -axis channels do not show a comparable sustained rigid-body step.

When independent sensors in multiple ISS modules show the same onset, duration, dominant axis, and termination, the response is consistent with whole-vehicle rigid-body acceleration rather than a local vibration source. That is the expected physical result: the reboost accelerates the complete ISS vehicle. The seven plots therefore provide both the qualitative identification and the quantitative basis for estimating the reboost acceleration and integrated velocity change, the telltale ΔV metric.

Reboost Identification and Quantification Logic

planned attitude/thrust geometry $\rightarrow$ expected dominant axis $\rightarrow$ station-wide SAMS consensus $\rightarrow$ separate rigid-body reboost from local vibration $\rightarrow$ quantify acceleration and ΔV

3. QUANTIFY

Analysis of seven distributed SAMS sensor heads shows the expected negative Z -axis step beginning at about the scheduled reboost TIG. Figures 3 through 9 use 5-second interval averages stepped every 1 second. This processing mostly suppresses the superimposed vibratory environment and exposes the nearly constant rigid-body acceleration associated with the reboost. The plotted SAMS axes are inverted to account for the intrinsic polarity convention of these acceleration transducers.

Across all seven sensors, the mean Z -axis step ranges only from -0.0985 to -0.0994 mg, while the measured duration ranges from 17m 59s to 18m 1s. Integrating each measured mean acceleration over its measured duration gives signed Z -direction velocity changes from approximately -1.043 to -1.054 m/s. Expressed as reboost magnitude, the seven-sensor mean is approximately 1.046 m/s, or about 1.05 m/s. The spread among all seven estimates is only about 0.011 m/s, demonstrating very strong station-wide agreement across independent SAMS sensor heads.

NASA's September 25 reporting suggested these values for actual rigid-body ΔV : (predicted) 1.04 m/s and (actual) 1.09 m/s. SAMS typically matches closely with reported actual value for this metric, but here most closely matches the predicted value. The independent NASA result—an 18-minute burn (that raised apogee by 1.5 miles and perigee by 0.8 miles)—is fully consistent with the duration and successful reboost identified in the SAMS data.

A compact quantification of the reboost is given in Table 1. Signed ΔV_z is retained in the table to preserve the measured SSA-axis direction; positive values quoted in the narrative refer to reboost magnitude.

Table 1. SAMS measurements of the Cygnus NG-24 reboost.

Sensor	Mean Z (mg)	Duration	ΔV_z (m/s)	Location
121f02	-0.0986	00:18:00	-1.045	COL Endcone
121f03	-0.0986	00:17:59	-1.044	LAB1O1 (ER2)
121f05	-0.0987	00:18:00	-1.046	JPM1F1 (ER5)
121f08	-0.0985	00:18:00	-1.044	COL1A3 (EPM)
es18	-0.0990	00:17:59	-1.048	LAB1P2 (ER7)
es19	-0.0994	00:18:01	-1.054	JPM1F6 (ER4)
es20	-0.0985	00:17:59	-1.043	LAB1S2 (MSG)

Comparison with the 2026-08-27 NG-24 Reboost

The September 25 event produced essentially the same rigid-body acceleration level as the August 27 NG-24 reboost (about 0.10 mg in the negative SSA Z direction), but the burn was shorter: 18m versus the previous reboost's 20m 43s duration. Consequently, the SAMS-derived reboost magnitude was correspondingly smaller, about 1.05 m/s herein versus about 1.21 m/s on August 27. This is naturally expected behavior when nearly the same acceleration is applied for a shorter interval.

Progress vs. Cygnus Reboost Note

A Russian Progress cargo vehicle docked at the aft end of the ISS has its reboost thrusters oriented favorably for reboost and therefore does not require the same pre- and post-reboost attitude maneuvers associated with the Cygnus docking geometry. For Cygnus NG-24, the as-flown timeline explicitly shows the maneuver to -ZVV before the reboost and the maneuver back toward TEA afterward; those additional operations help explain the surrounding vibratory and structural activity.

4. CONCLUSION

Seven distributed SAMS sensor heads measured a remarkably consistent rigid-body signature during the GMT 2026-09-25 Cygnus NG-24 reboost: a negative Z-axis acceleration step of approximately 0.1 mg lasting just about 18 minutes. Integrating the measured step yields a SAMS-derived reboost magnitude of approximately 1.05 m/s, with individual sensor estimates tightly spanning 1.043–1.054 m/s.

The measured duration agrees with NASA's reported 18-minute burn. NASA reported that the maneuver raised ISS apogee by 1.5 miles and perigee by 0.8 miles and established the orbital phasing needed for Crew-13. Agreement in onset, duration, dominant axis, and integrated-velocity-change across all seven SAMS locations demonstrates that the signature was observed station-wide and supports expected identification of the event as the intended whole-vehicle rigid-body acceleration. SAMS nearly matching the predicted ΔV_z value versus the actual ΔV_z makes this analyst question the reported actual value or whether ISS orientation distributed some of the step to the Y-axis perhaps?

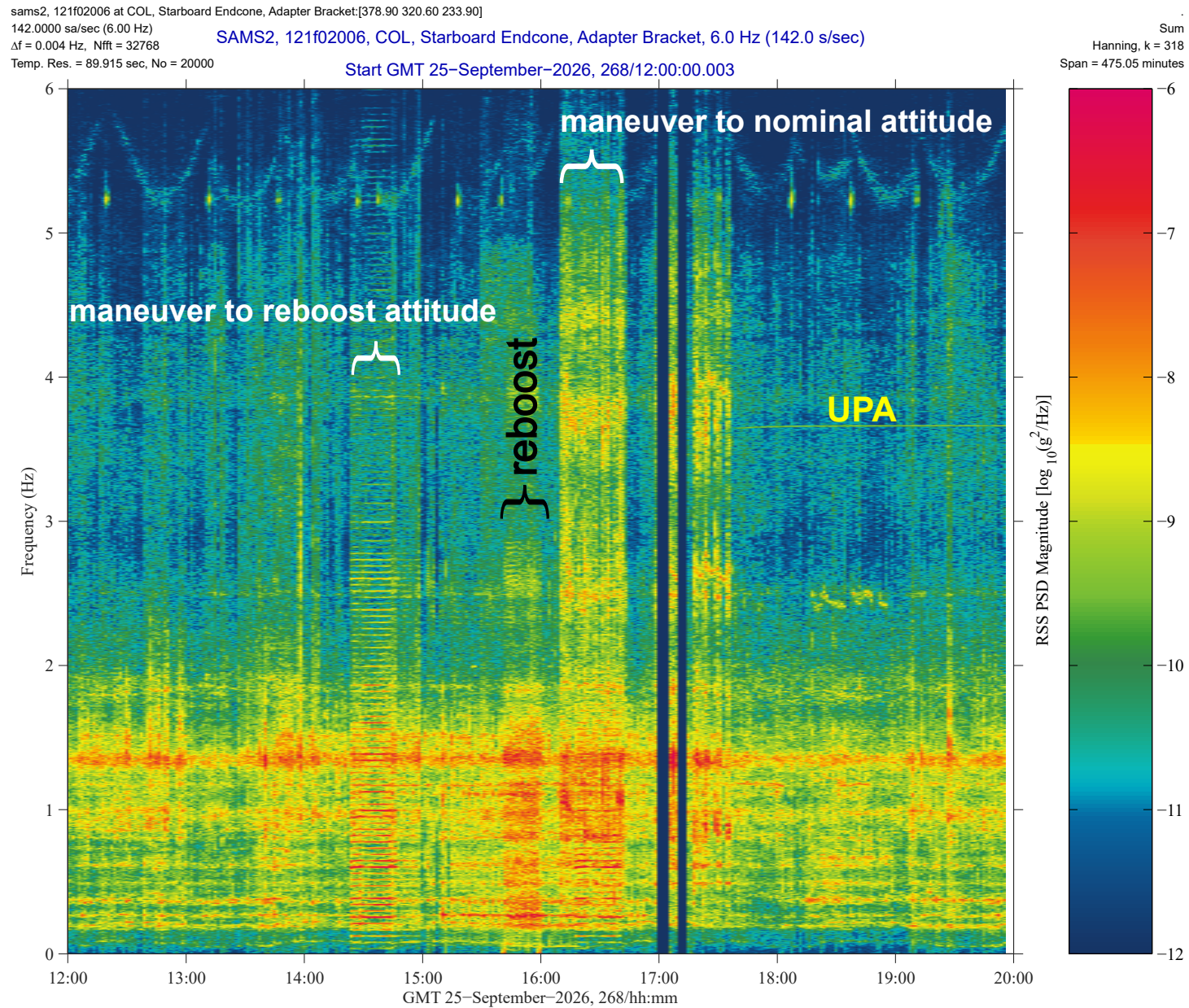


Fig. 2: SAMS 121f02 6 Hz spectrogram at COL Starboard Endcone location shows reboost and surrounding attitude-control activity.

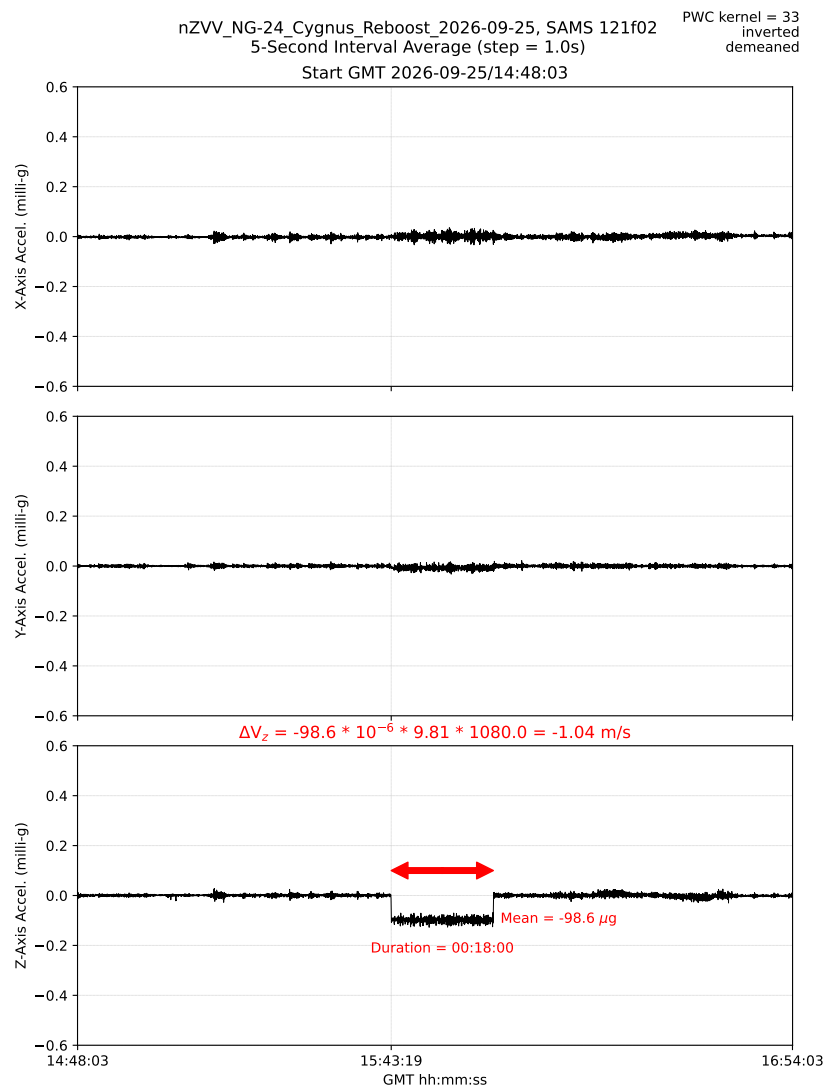


Fig. 3: 5-second interval average for SAMS 121f02 at COL Endcone.

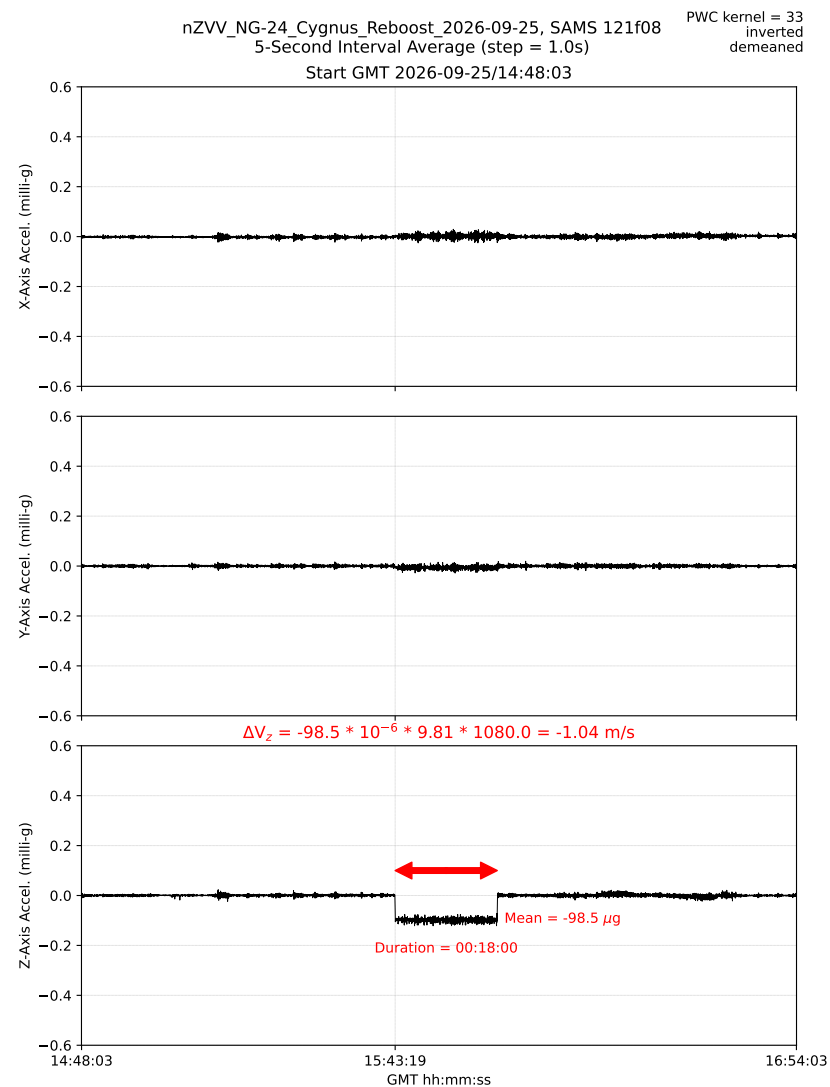


Fig. 4: 5-second interval average for SAMS 121f08 at COL1A3.

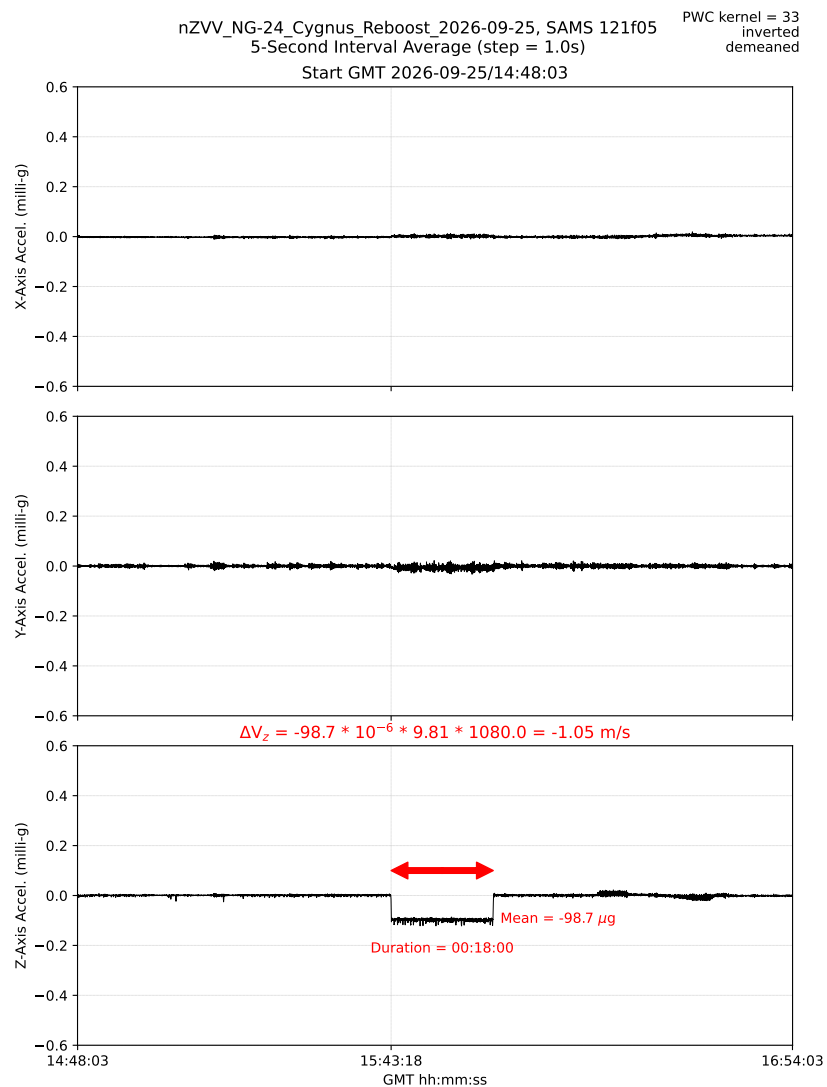


Fig. 5: 5-second interval average for SAMS 121f05 at JPM1F1.

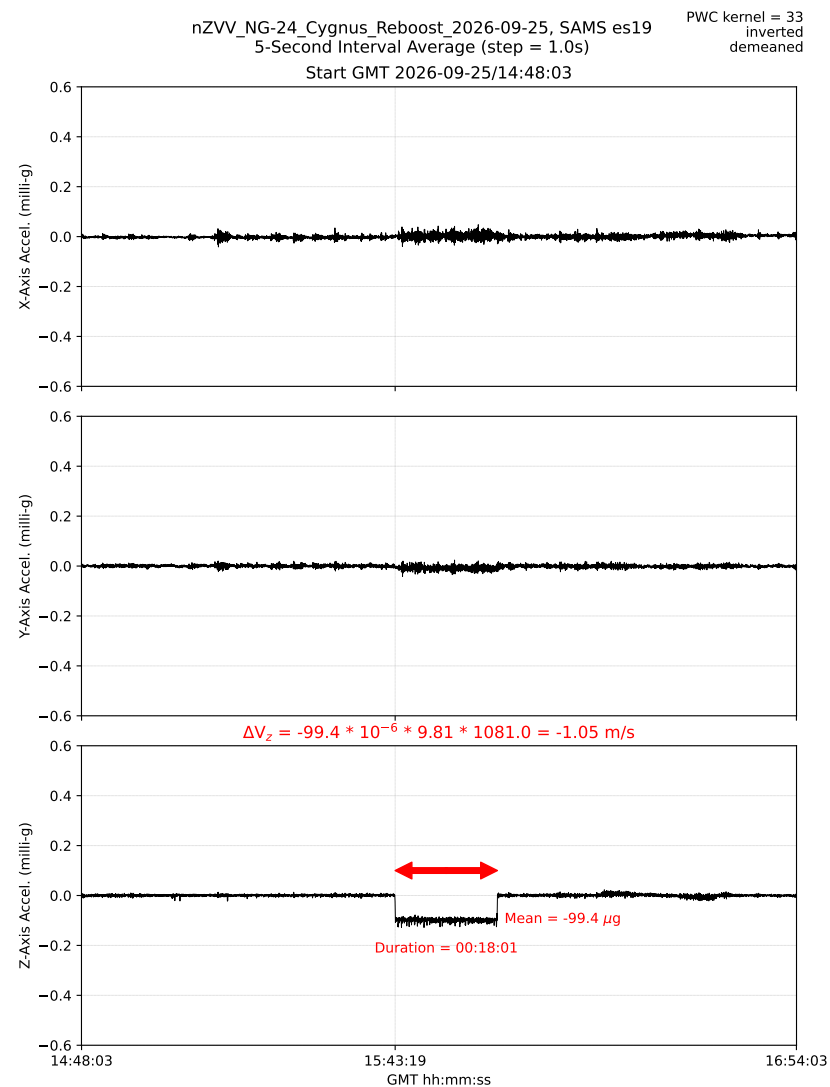


Fig. 6: 5-second interval average for SAMS es19 at JPM1F6.

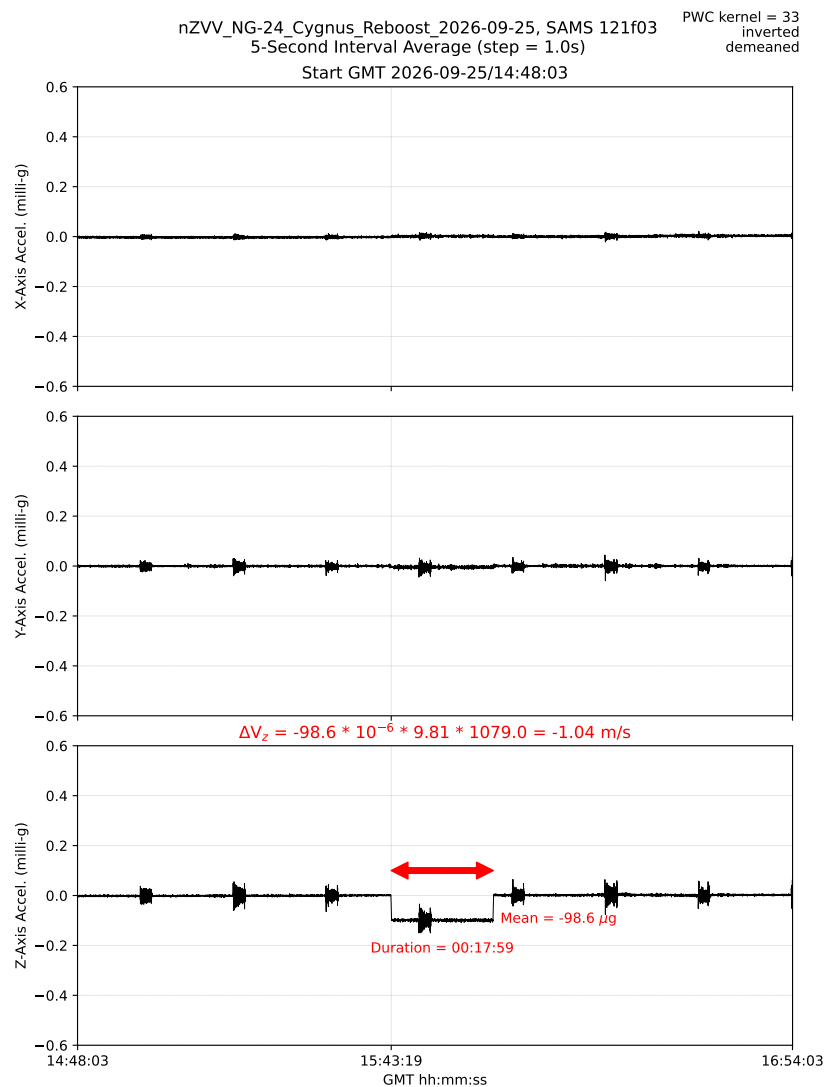


Fig. 7: 5-second interval average for SAMS 121f03 at LAB1O1.

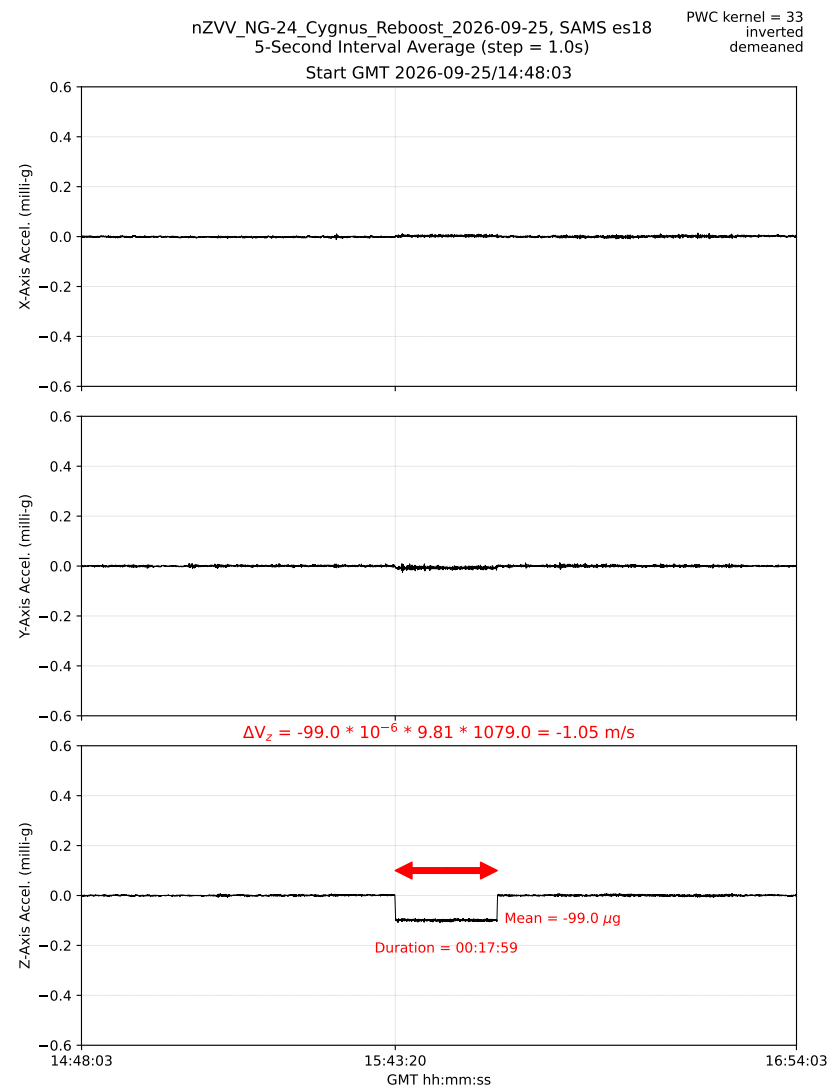


Fig. 8: 5-second interval average for SAMS es18 at LAB1P2.

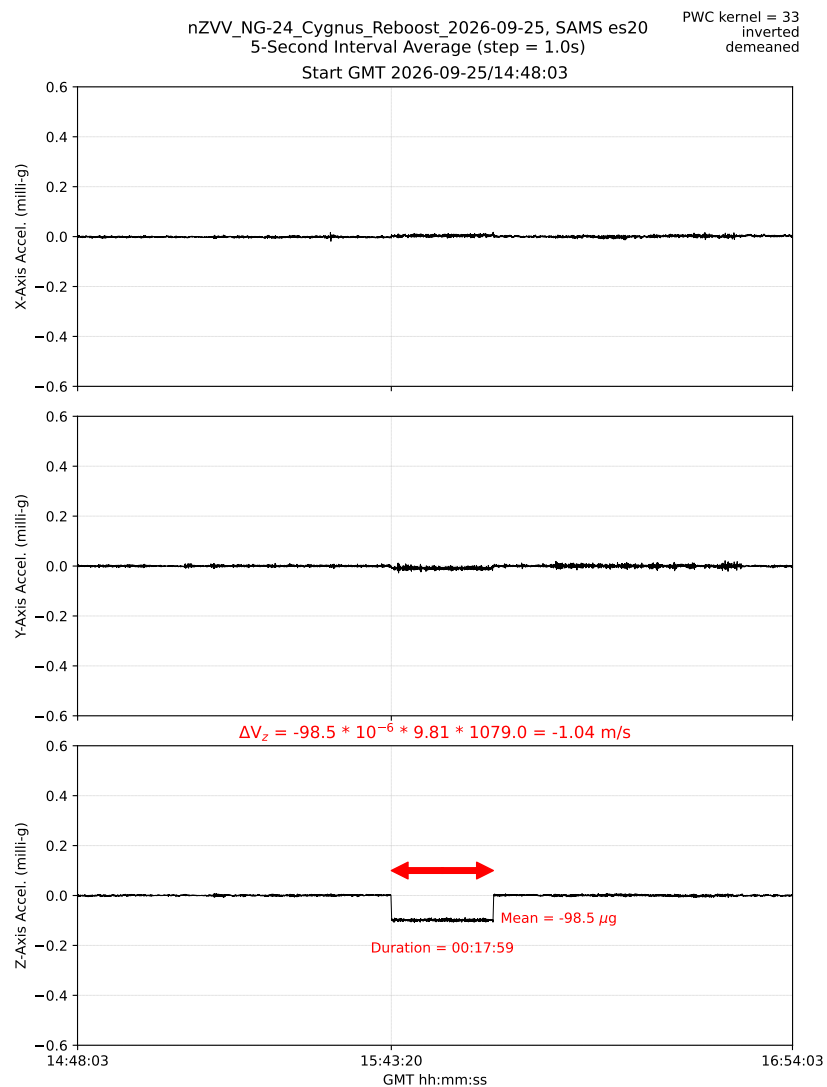


Fig. 9: 5-second interval average for SAMS es20 at LAB1S2.