1. INTRODUCTION

The Space-X Dragon cargo (SpX-25) vehicle docked to the International Space Station (ISS) on GMT 2022-07-16. Particular interest here is the vibratory impact registered by five Space Acceleration Measurement System (SAMS) sensor heads distributed throughout the space station, including in all 3 of the main labs.

The image in Figure 1 shows the forward-pointing port location on Node 2 where the Dragon was docked on GMT 2022-07-16. Intuition suggests that with the center-of-mass somewhere in the US Lab, we would see an initial negative X-axis acceleration impulse. SAMS plots shown and discussed below will bear this out.

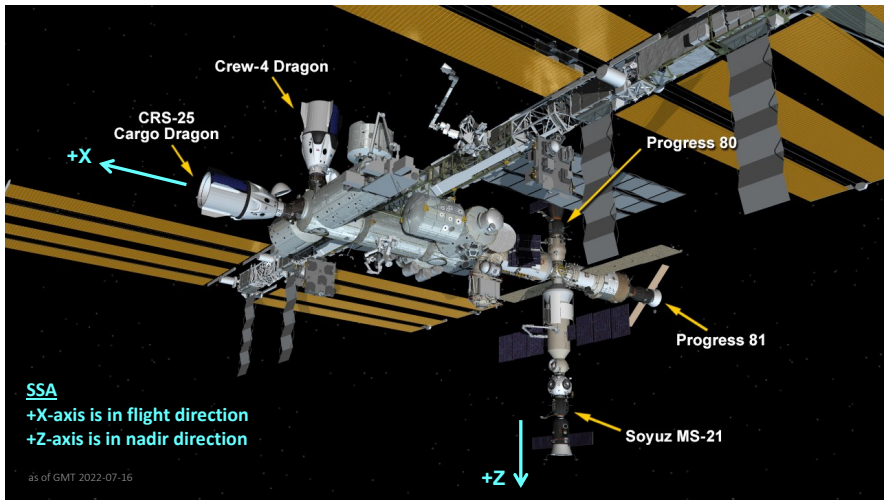

Fig. 1: Dragon SpX-25's Docking Location at Node 2's Forward Port.

2. QUALIFY

The vibratory acceleration spectral information shown in Figure 2 on page 2 was computed from 6-hours of 200 Hz measurements by SAMS sensor head 121f05 in the Japanese lab (JEM). This plot only crudely shows SAMS timing, yet shows close agreement with the as-flown timeline accounting that the docking event occurred at GMT 15:20. This spectrogram helps to qualify some observations for the docking event: (1) the impulsive "bang" at the time of impact as indicated at the time of the down arrow, and (2) the structural response "ringout" that persists for about 45s as will be better shown in a later plot.

The spectrogram in Figure 3 on page 3 shows a zoomed version of the previous spectrogram plot – zoomed in time to a 5-minute span, and zoomed in frequency to below 1.6 Hz. With the zoom-in, we better see that structural ringout after the docking impulse that occurs mostly on the X-axis at about 0.2 Hz or so.

As shown elsewhere, it is good to keep in mind that such docking disturbances become most clear with 6 Hz low-pass filtering of SAMS data; otherwise, we would have a difficult time discerning this disturbance in time domain data when considering as-measured data up to 200 Hz because it would be swamped by other, higher-frequency, higher-magnitude disturbances. Typically, such disturbances are localized, but we will see in the next section from looking at 5 SAMS sensor heads distributed throughout the space station, that the impact from a Dragon docking is truly a global event.

3. QUANTIFY

The per-axis acceleration vs. time plot shown in Figure 4 on page 4 was computed from measurements by SAMS sensor head 121f05 in the JEM at rack location JPM1F1. This plot gives better timing than the earlier spectrogram and we now see the first, negative X-axis impulse occurs at just after GMT 15:21:30 with a peak-to-peak magnitude of about 1 mg. This same vibration signal is repeated at the other 4 SAMS sensor head locations as follows:

1) Figure 5, page 5: SAMS 121f02 in the COL at rack location COL1A1
2) Figure 6, page 6: SAMS 121f08 in the COL at rack location COL1A3
3) Figure 7, page 7: SAMS 121f03 in the LAB at rack location LAB1O1
4) Figure 8, page 8: SAMS 121f04 in the LAB at rack location LAB1P2

4. CONCLUSION

For this Dragon cargo SpX-25 vehicle docking on GMT 2022-07-16, we saw for each of 5 SAMS sensor heads mounted at various locations throughout the ISS, the nearly identical vibratory disturbance signal. Focused on the X-axis, we saw an initial negative-going impulse with a peak-to-peak magnitude of about 1 mg and with structural ringout of nearly a minute on that axis.

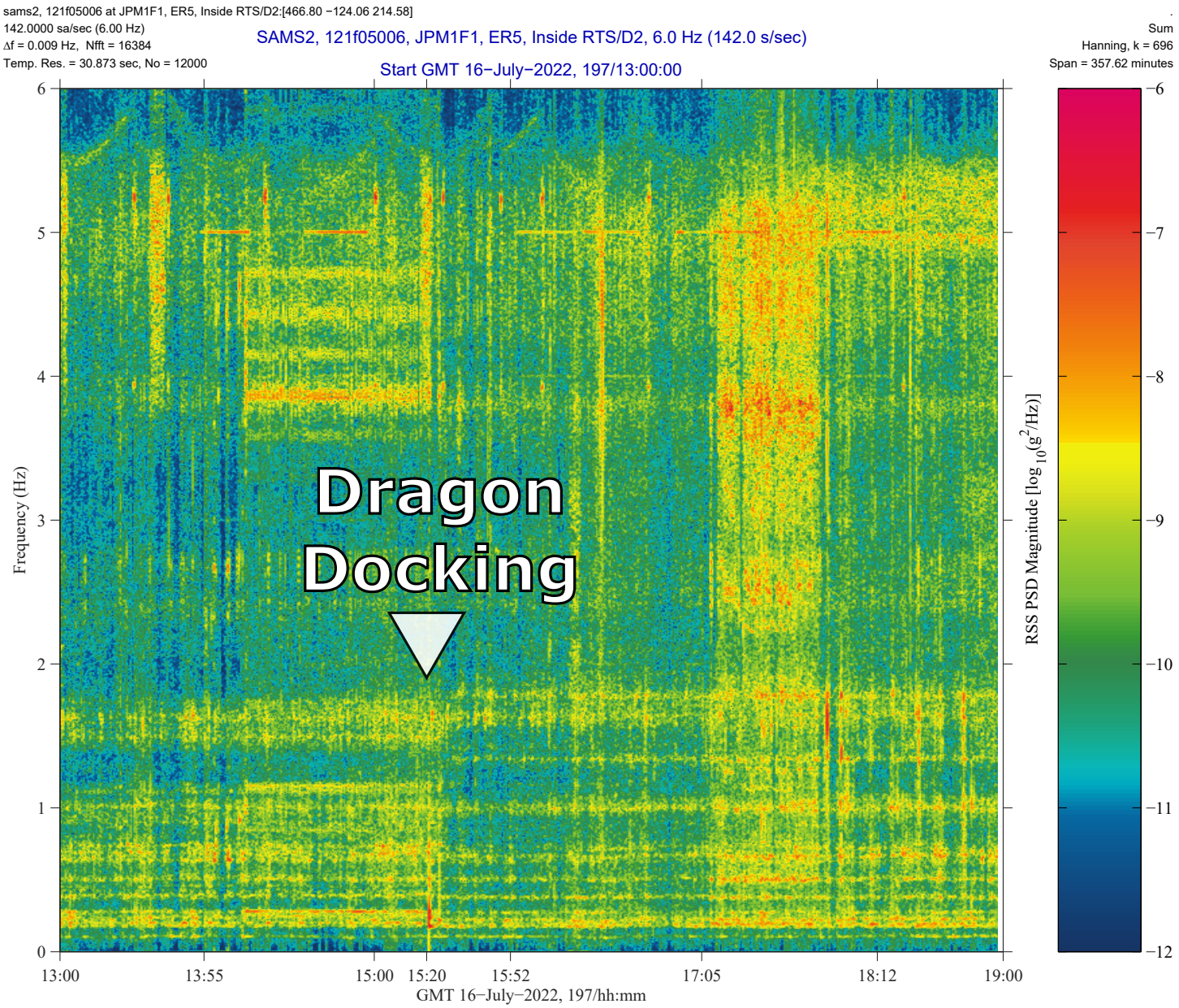

Fig. 2: 6-Hour Spectrogram (below 200 Hz) of Dragon SpX-25 Docking Event on GMT 2022-07-16.

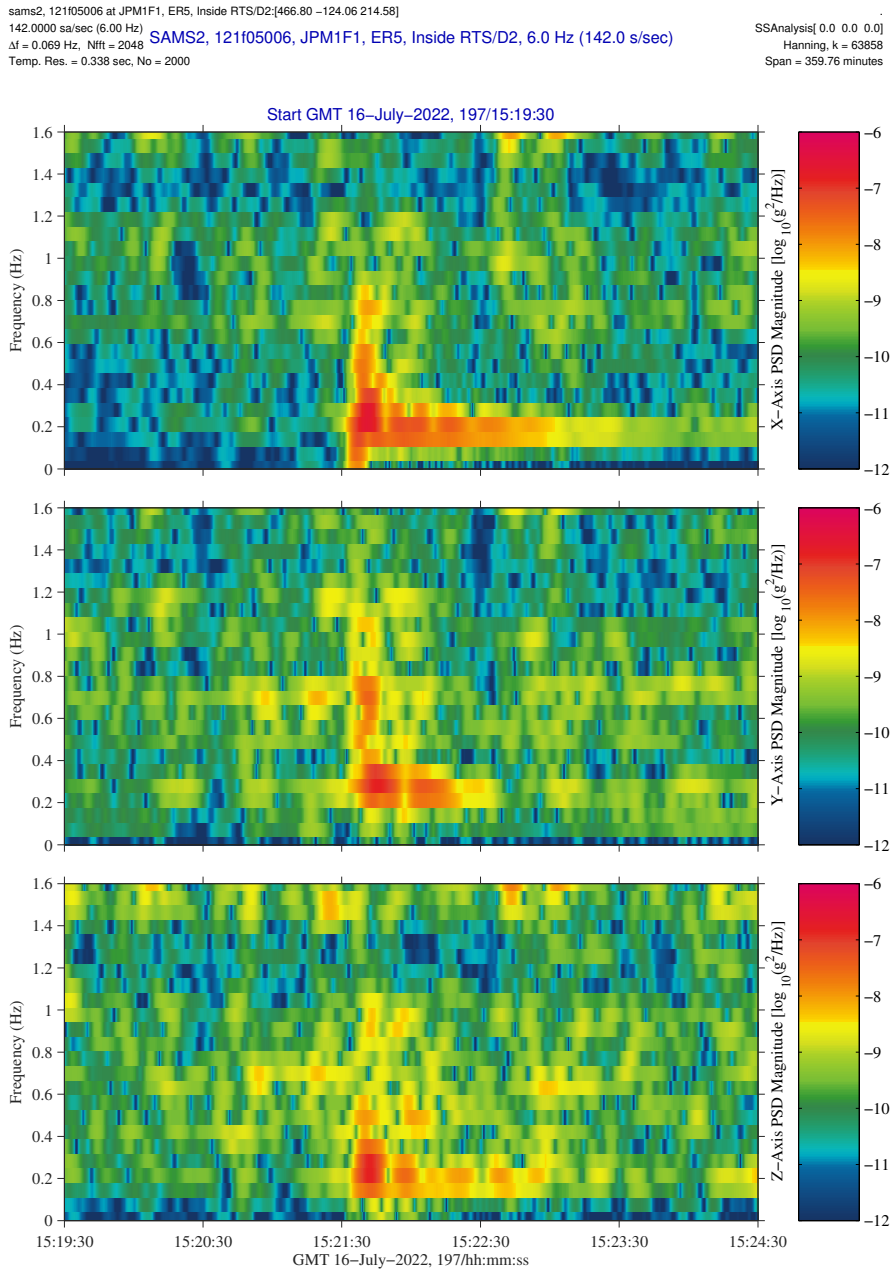

Fig. 3: Per-Axis, 5-Min. Zoom-In Spectrogram (below 1.6 Hz) of Dragon SpX-25 Docking Event on GMT 2022-07-16.

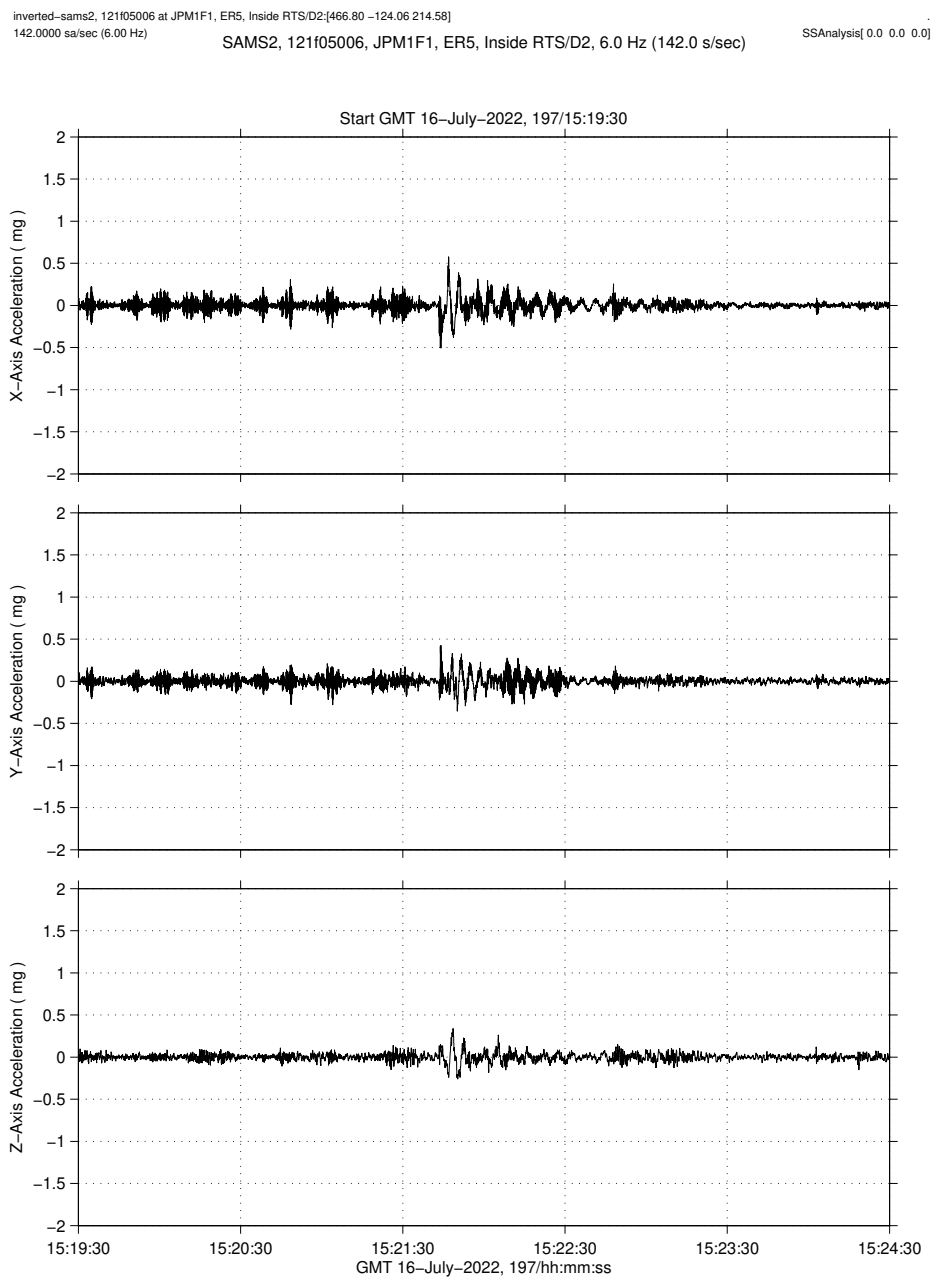

Fig. 4: SAMS 121f05 (JEM) Accel. vs. Time, Dragon SpX-25 Docking Event on GMT 2022-07-16.

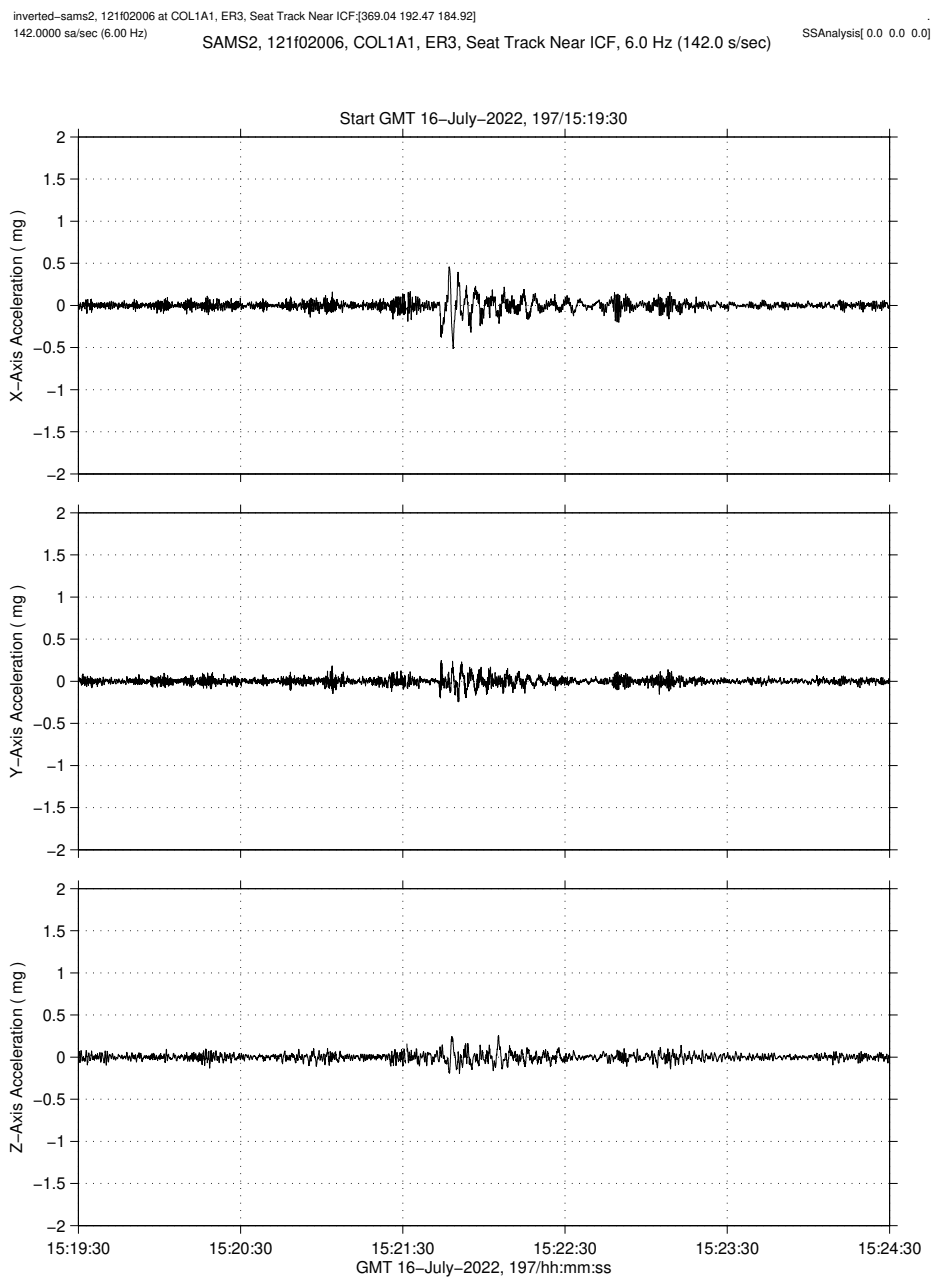

Fig. 5: SAMS 121f02 (COL) Accel. vs. Time, Dragon SpX-25 Docking Event on GMT 2022-07-16.

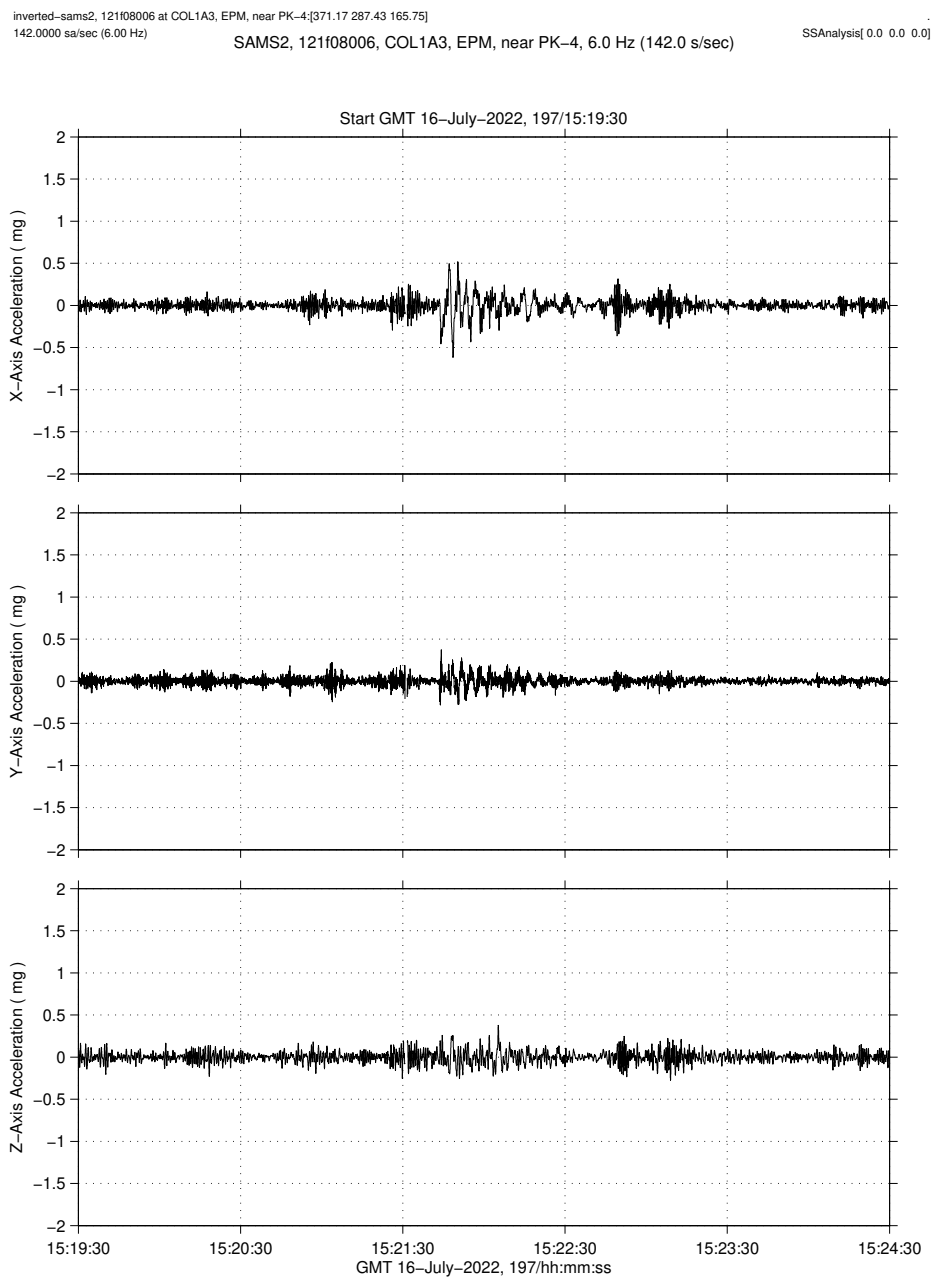

Fig. 6: SAMS 121f08 (COL) Accel. vs. Time, Dragon SpX-25 Docking Event on GMT 2022-07-16.

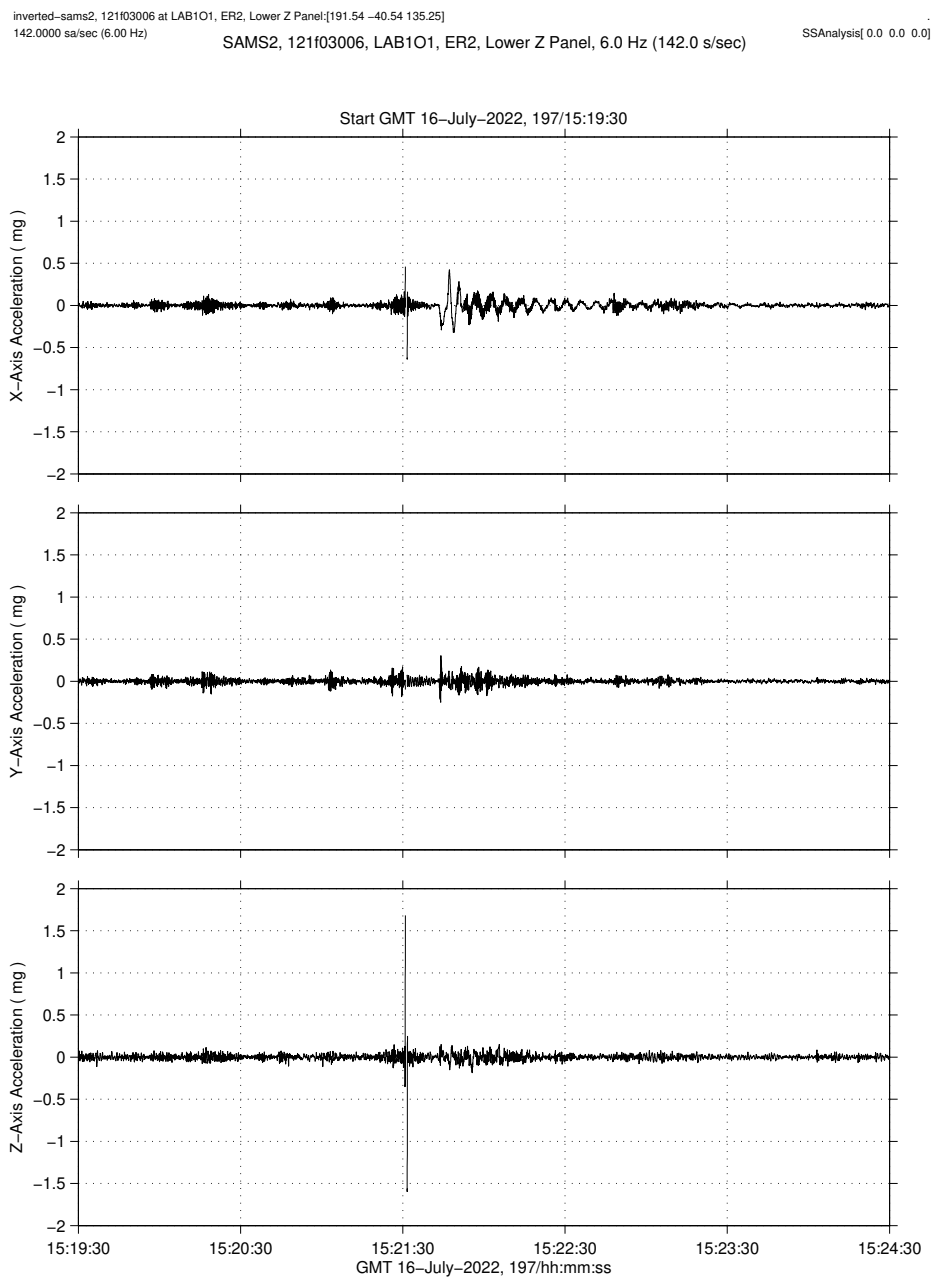

Fig. 7: SAMS 121f03 (LAB) Accel. vs. Time, Dragon SpX-25 Docking Event on GMT 2022-07-16.

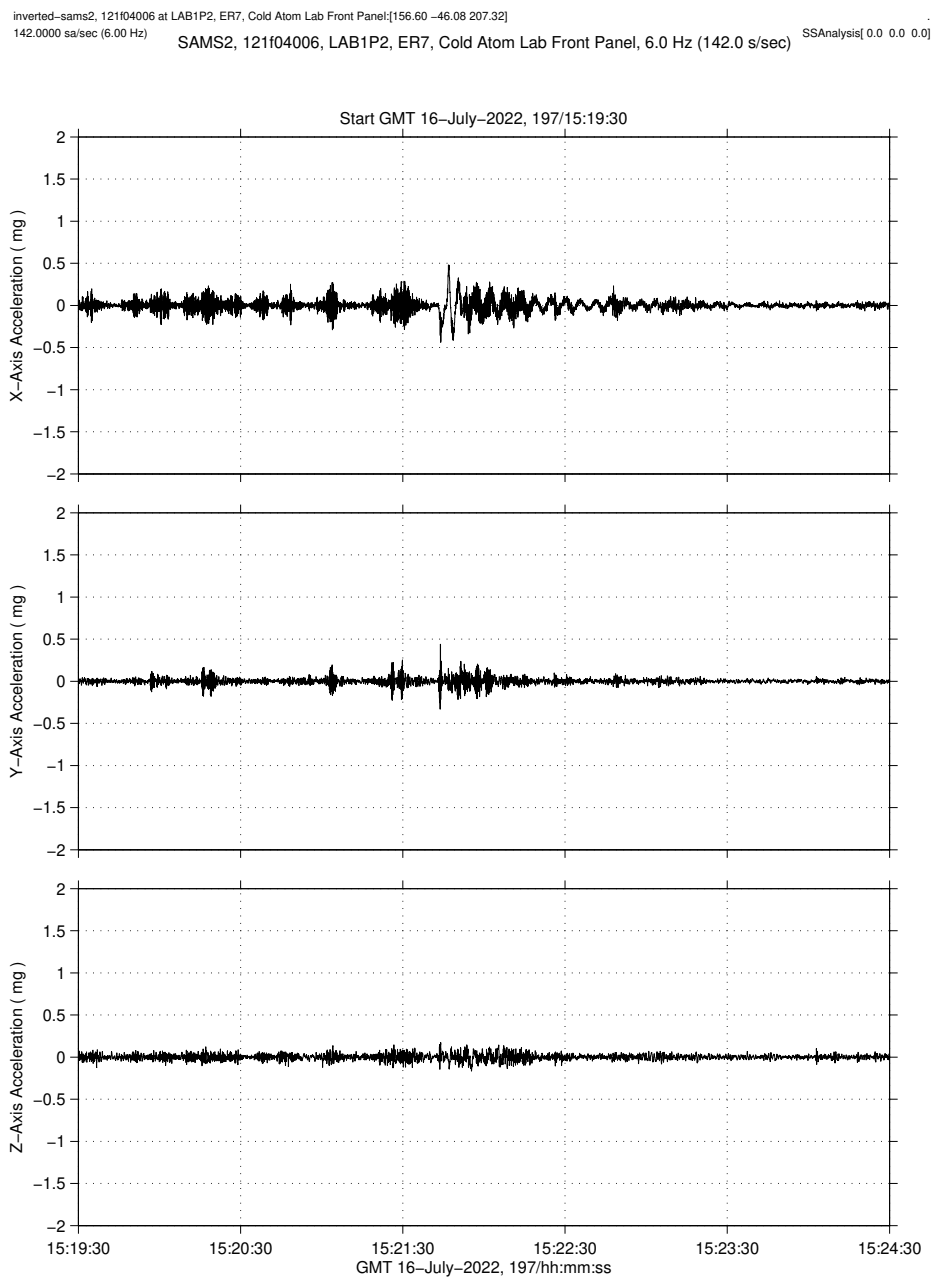

Fig. 8: SAMS 121f04 (LAB) Accel. vs. Time, Dragon SpX-25 Docking Event on GMT 2022-07-16.