1. INTRODUCTION

A daily summary at this link stated that "Expedite the Processing of Experiments to Space Station (EXPRESS) Rack 4 (ER4) International Subrack Interface Standard (ISIS) Drawer Check: Following an Iceberg-1 noise reported by the crew in early July, the issue was determined to be caused by a loose ISIS drawer lid in the location just below the Iceberg-1 unit. The crew attempted multiple troubleshooting steps, but the noise persisted. Ground teams then commanded ER4 to idle mode to reduce the nuisance noise and Iceberg is considered to be performing nominally. Iceberg is a double locker equivalent designed for EXPRESS rack operation and provides additional cold stowage resources aboard the International Space Station (ISS). The units provide an operating range of +4 deg. C to -95 deg. C."

2. QUALIFY

Figure 1 on page 3 is a color spectrogram computed from Space Acceleration Measurement System (SAMS) sensor 121f05 measurements made in ER5 (rack location JPM1F1) of the Japanese Experiment Module (JEM), while ICEBERG-1 is located at nearly the other end of the module in ER4 (rack location JPM1F6). The black upward arrow annotation in the spectrogram figure shows the start of about a 43-minute span beginning at about GMT 16:40:30, which then ended at about GMT 17:31:00 as shown by the black downward arrow in Figure 1. The key features to note are the two narrowband spectral peaks, one at 60 Hz, and another, less distinctive peak at 120 Hz that begin and end at those black arrows. These vibrations will be shown below to correlate precisely with elevated current draw from the ER4 Locker 8 location that powers the ICEBERG-1.

3. QUANTIFY

Figure 2 on page 4 shows the correlation referenced above in the Qualify section. The black trace in this figure shows the root-mean-square acceleration at the SAMS 121f05 location for a narrow band centered on 60 Hz. The distinctive feature here is the step up at GMT 16:48:30. The start of these higher-level 60 Hz vibrations precisely matches the start of elevated current draw (shown as the red trace) for the ICEBERG-1 (ER4 Locker 8) location. Likewise for the step down at GMT 17:31:00. There are some interesting dynamics that start about three-quarters of the way through the plateau in the vibration data that is not further explained by the current draw, however. It is unclear why the sudden additional step up in 60 Hz vibrations at about GMT 17:15:36.

To more fully characterize the impact of these elevated 60 Hz vibrations along with harmonic content at 120 Hz, we plot per-axis renditions of Figure 2 as follows: (1) Figure 3 for RMS near 60 Hz, and (2) Figure 4 for RMS near 120 Hz, both of these plots appear on page 5.

Vibratory Impact of ICEBERG-1's 60 Hz Vibrations

Figure 3 on page 5 shows that with increased current draw, we see signficantly more vibrational energy on the XZ-plane (slightly more on the Z-axis) from ICEBERG-1 indicating that the reciprocating parts of this equipment are constrained to move on this plane. However, the additional, unexplained dynamics that start about three-quarters of the way into the plateau of stronger vibrations appear to align with the YZ-plane and are not so much of an impact on the X-axis. The ICEBERG-1 operations on GMT 2021-07-09 stepped up 60 Hz vibrations in terms of RMS from a baseline of less than 50 μg on the X-axis up to about 250 μg, and from less than 50 μg on the Z-axis up to about 400 μg.

Vibratory Impact of ICEBERG-1's 120 Hz Vibrations

Figure 4 on page 5 shows that with increased current draw, we see only slightly more vibrational energy on all 3 axes from ICEBERG-1. We note too from this plot that while the baseline vibrations at 60 Hz and 120 Hz are on par with each other around 20 to 30 μg at 120 Hz with the exception of the notably noisier Z-axis, with a baseline of around 100 μg.

4. CONCLUSION

SAMS vibratory sensor measurements in the JEM correlate closely in time with elevated current draw from the ICEBERG-1 equipment on GMT 2021-07-09. This equipment's operations resulted in a step up in 60 Hz vibrations mainly on the XZ-plane from a baseline of less than 50 μg to around 400 μg on the Z-axis. There was spectral content too at 120 Hz as a distinctive disturbance, but not much appreciable magnitude at this frequency.

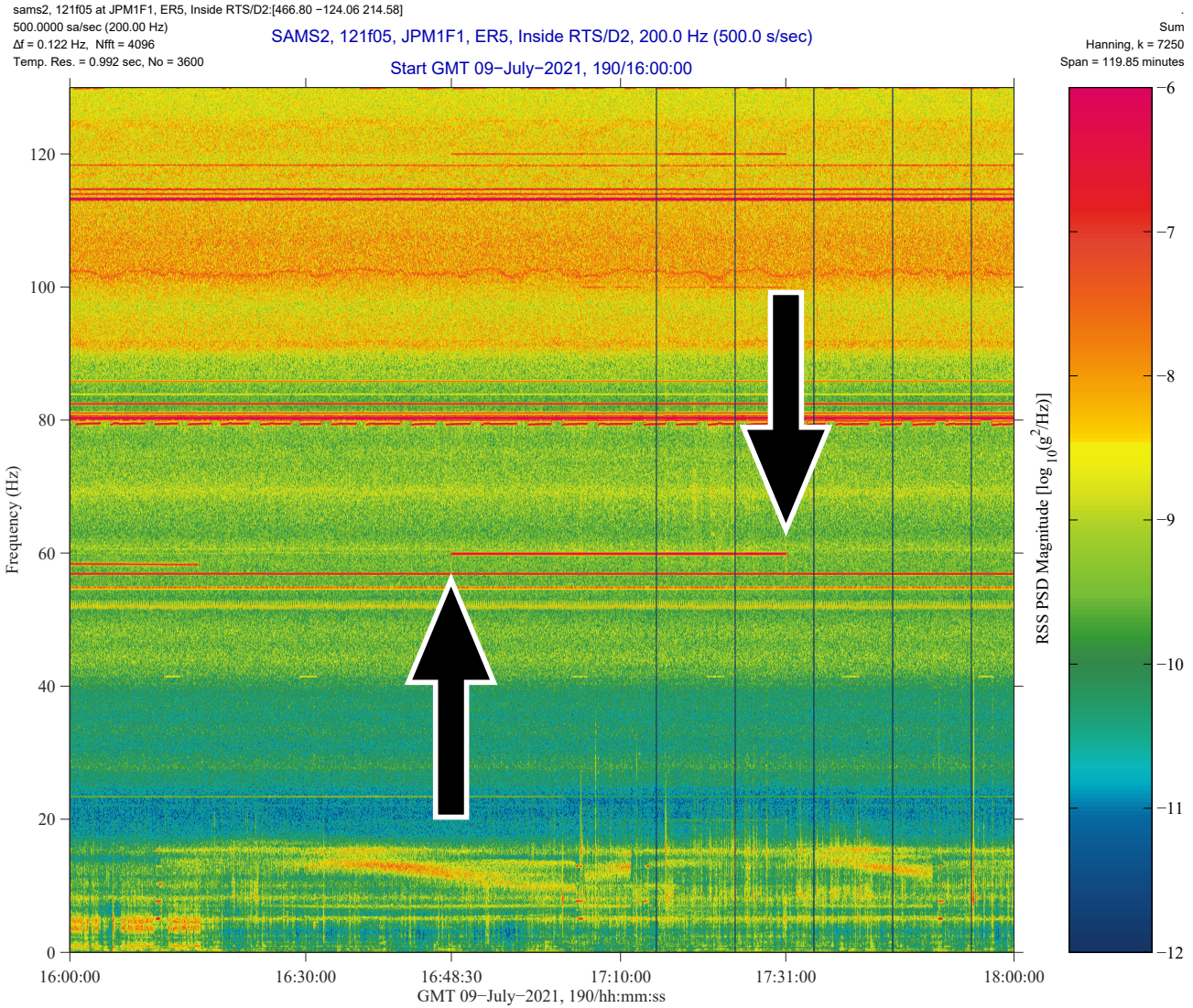

Fig. 1: Spectrogram showing ICEBERG-1 operations on GMT 2021-07-09.

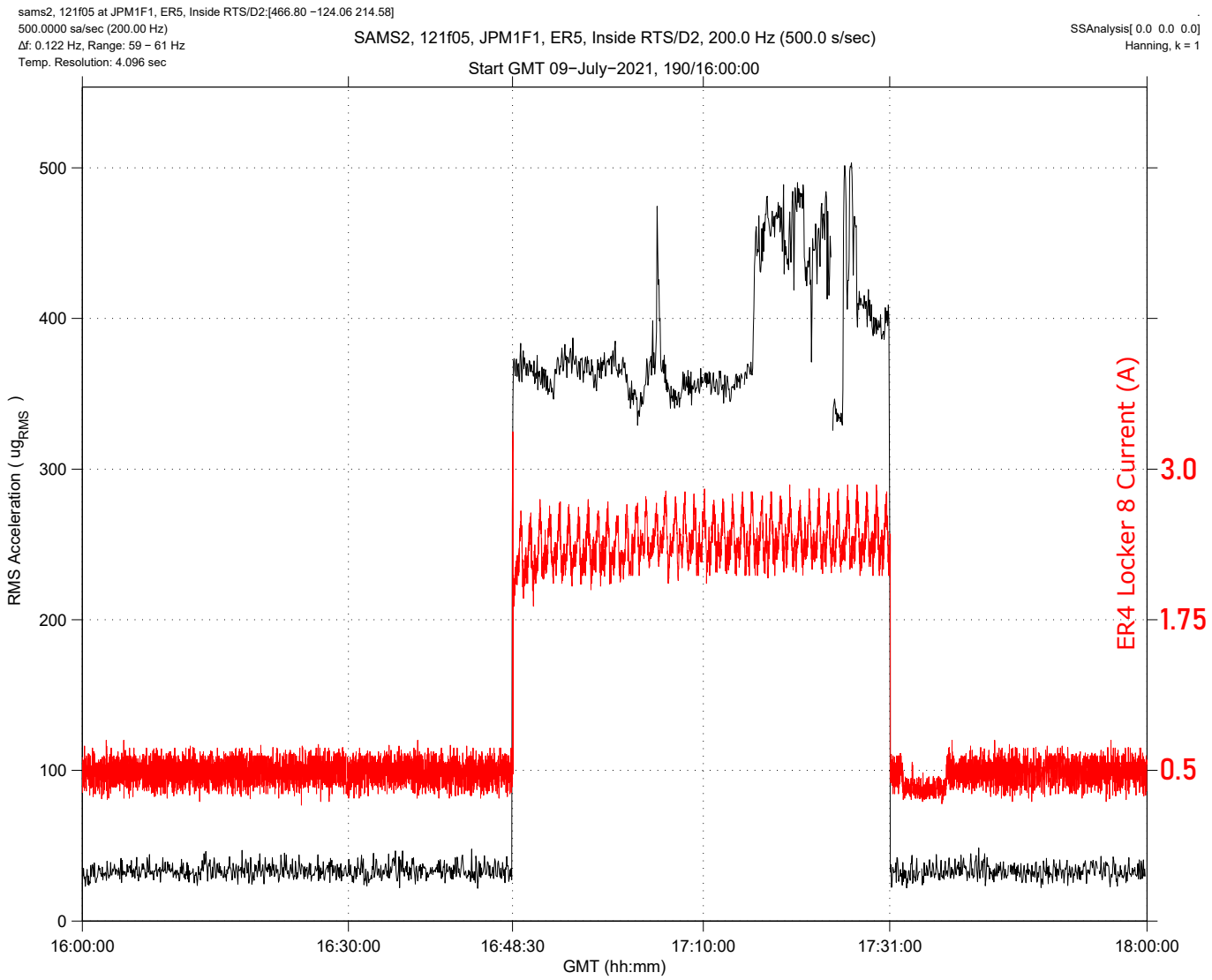

Fig. 2: 60 Hz Interval RMS Accel. & ICEBERG-1 Locker Current Draw on GMT 2021-07-09.

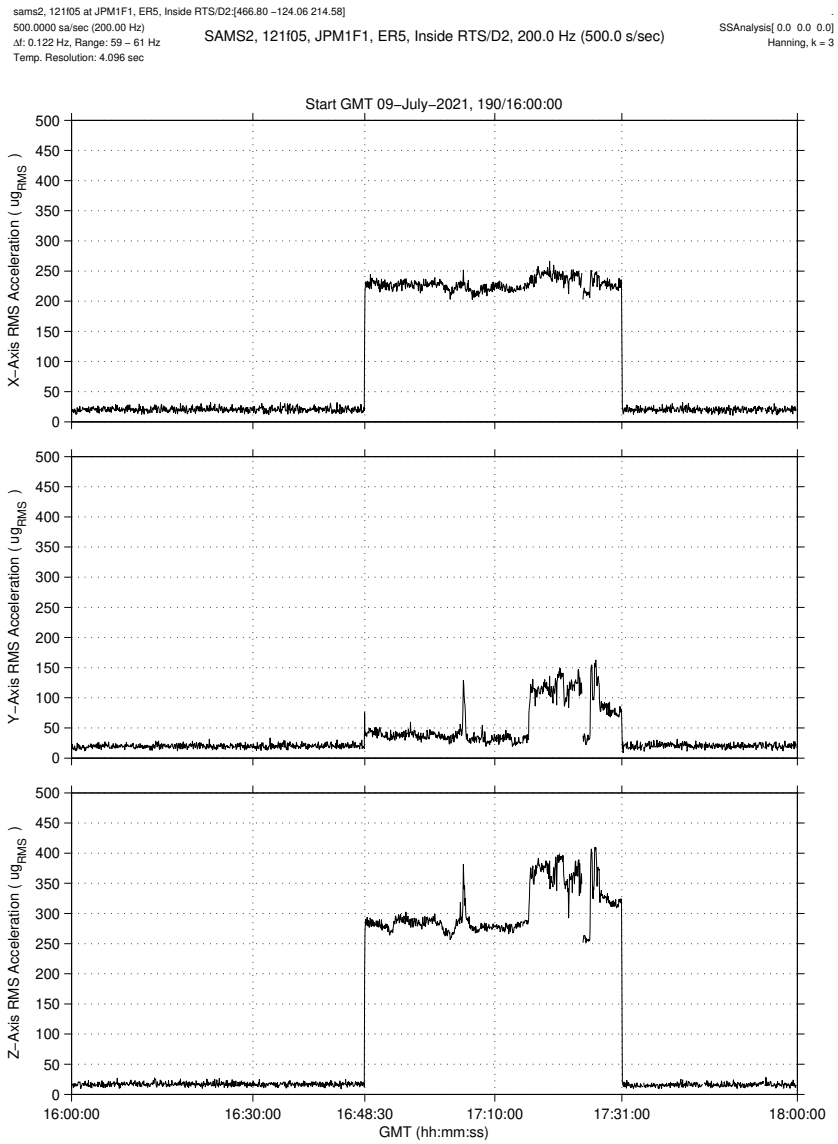

Fig. 3: Per-Axis 60 Hz Interval RMS Accel. at 121f05 (JEM) on GMT 2021-07-09.

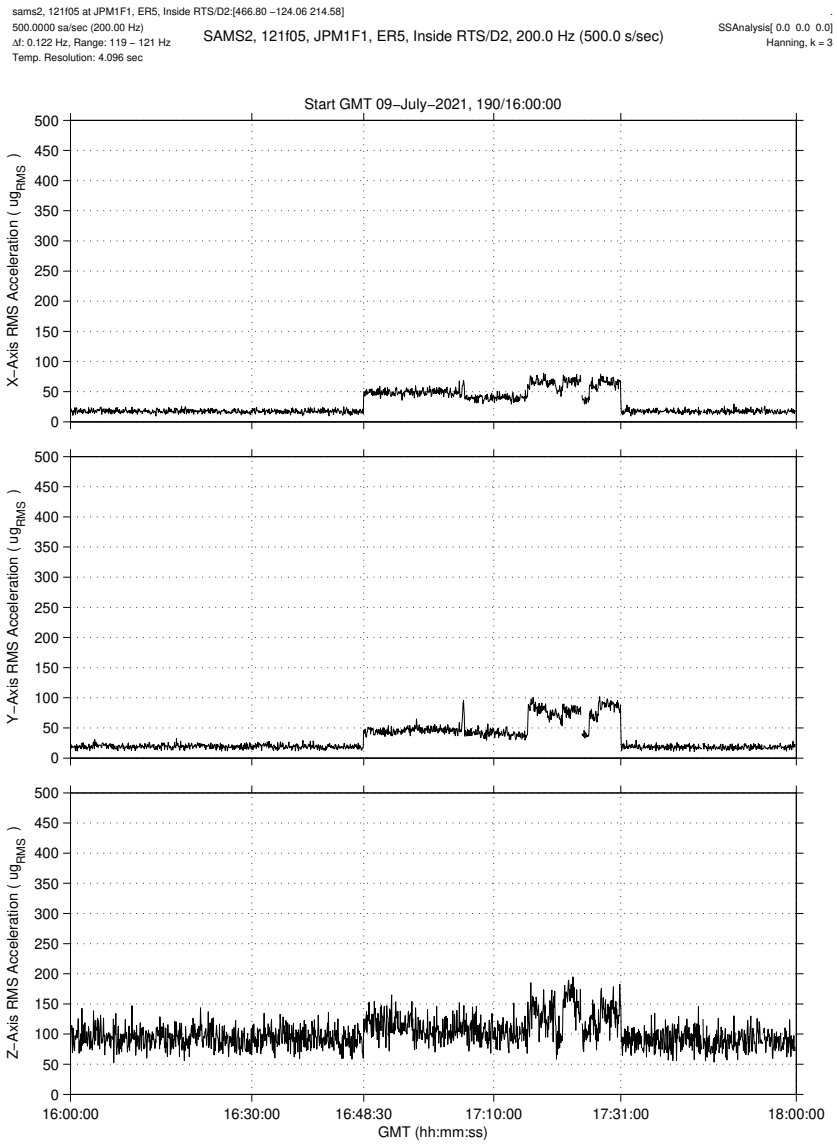

Fig. 4: Per-Axis 120 Hz Interval RMS Accel. at 121f05 (JEM) on GMT 2021-07-09.