1. INTRODUCTION

The first spacewalk of 2022 was performed by cosmonauts Anton Shkaplerov and Pyotr Dubrovon on GMT 2022-01-19 to connect the Prichal Node Module to the International Space Station (ISS). The extravehicular activity (EVA) task list included:

1) relocating the Strela crane over to Nauka so it can be used as a translation path for this spacewalk and the next EVA
2) connecting telemetry and power cables
3) installing handrails
4) relocating television cameras and docking antennas
5) installing docking targets
6) jettisoning unneeded hardware and trash

2. QUALIFY

The information shown in the spectrogram of Figure 1 was calculated from Space Acceleration Measurement System (SAMS) sensor 121f08 measurements made in the Columbus module with data spanning 3 days starting the day before the extravehicular activity (EVA). This plot focuses on the lower-frequency, structural mode and crew activity regime of the vibratory environment, including Urine Processing Assembly (UPA) operations near 3.7 Hz. Crew sleep periods are noted in green text, where we see broadband quieting (toward blue on color scale) below 6 Hz. This plot also shows increased structural vibration excitation contained between about GMT 2022-01-19/12:17 and 19:28 as imparted by the crew working, pushing off, and landing on external structures of the space station. Note the heightened vibrations (red, horizontal streaks) during this EVA period primarily impacting below 2 Hz with distinct, notable excitation below about 0.5 Hz.

3. QUANTIFY

In order to quantify the impact of this EVA, we know to focus our attention below 6 Hz. This is the portion of the acceleration spectrum where the crew-induced forces are uniquely manifest. We use 10-second interval root-mean-square (RMS) values for 6 SAMS sensor heads distributed throughout the ISS to quantify and compare the impact at various sensor locations. For example, Figure 2 shows X-, Y-, and Z-axis interval RMS values (in units of μg) for the same 3-day span

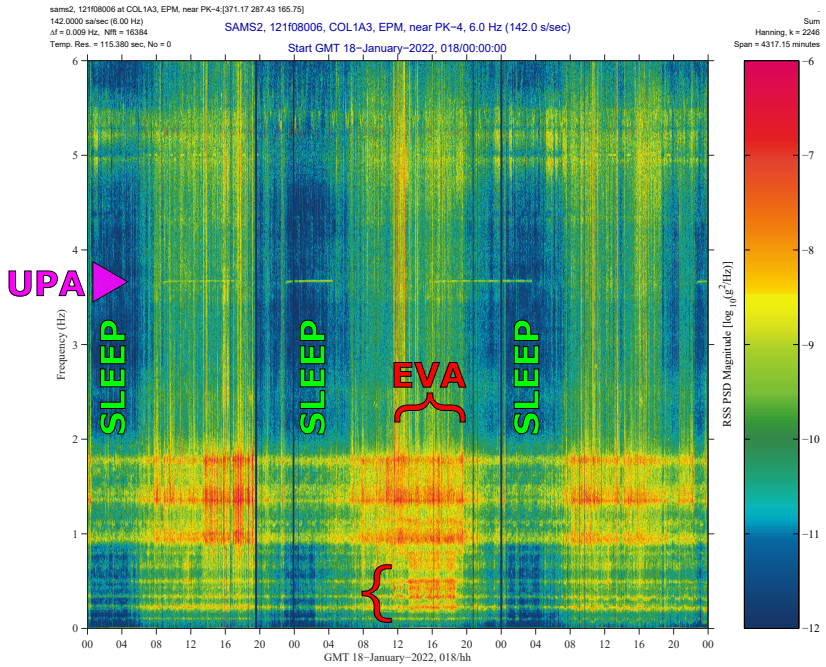

Fig. 1: Spectrogram for 3 Days Centered Near EVA on GMT 2022-01-19.

as that of Figure 1 and using the same sensor measurements. This shows the data for the sensor location most impacted by the EVA, the SAMS sensor mounted on COL1A3 in the Columbus module. For this plot and the other 5 sensors' plots of RMS acceleration values versus time shown starting with Figure 3 on page 2, the part of the traces in green represent crew sleep periods, the traces in red are for the EVA period, and the blue traces are crew wake periods exclusive of the EVA.

4. CONCLUSION

The RMS values for the two SAMS sensors in Columbus show the largest impact due to EVA, particularly on the Z-axis as highlighted in Table 1 on page 5. These show median interval RMS values for those 2 sensors plus 4 other sensors: 3 in the US Laboratory, and 1 in the Japanese Experiment module, Kibo.

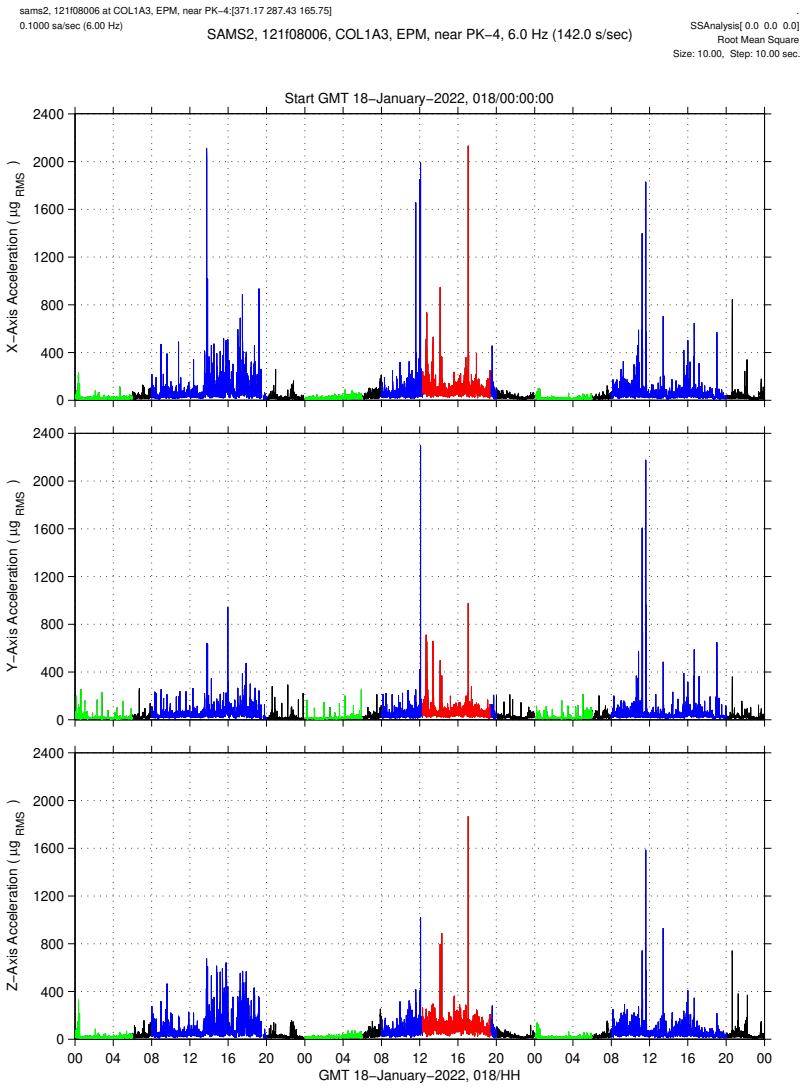

Fig. 2: 10-sec interval average for SAMS 121f08 sensor in COL.

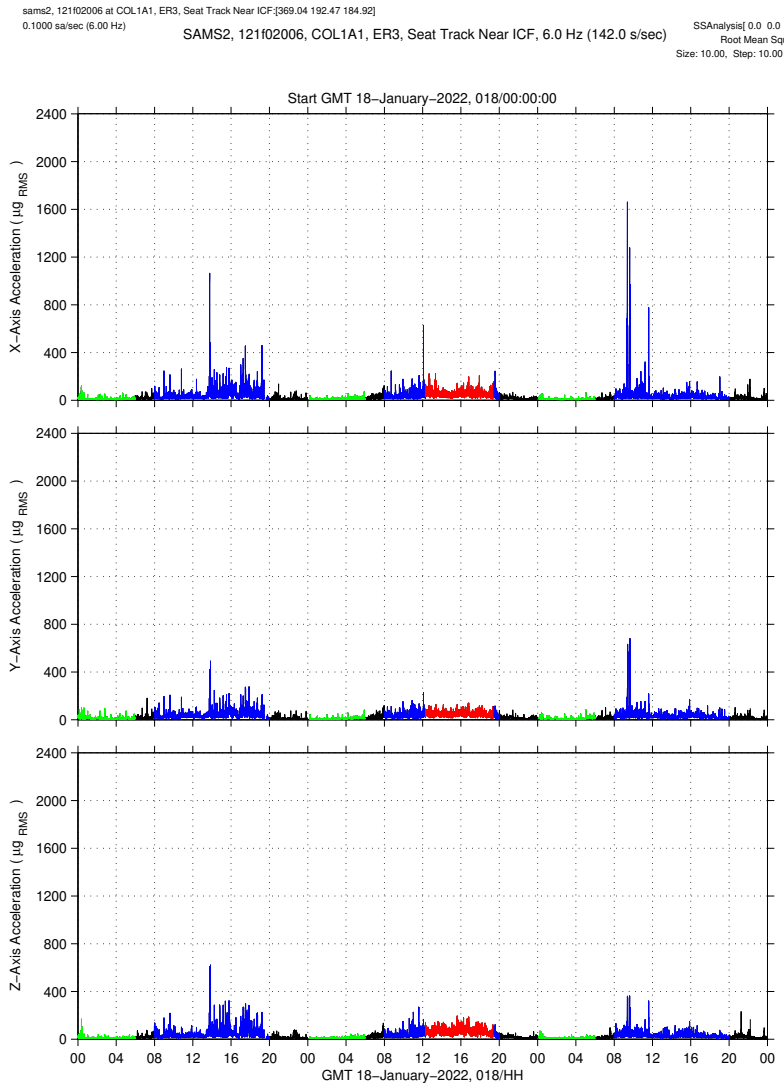

Fig. 3: 10-sec interval average for SAMS 121f02 sensor in COL.

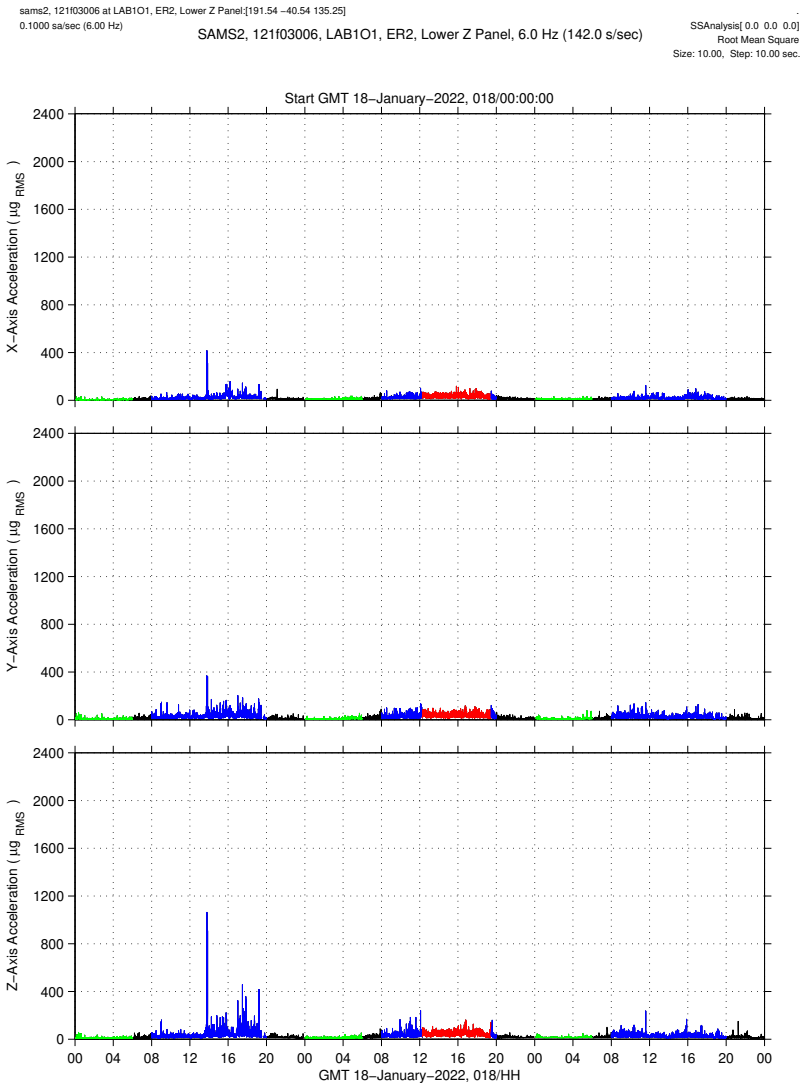

Fig. 4: 10-sec interval average for SAMS 121f03 sensor in the LAB.

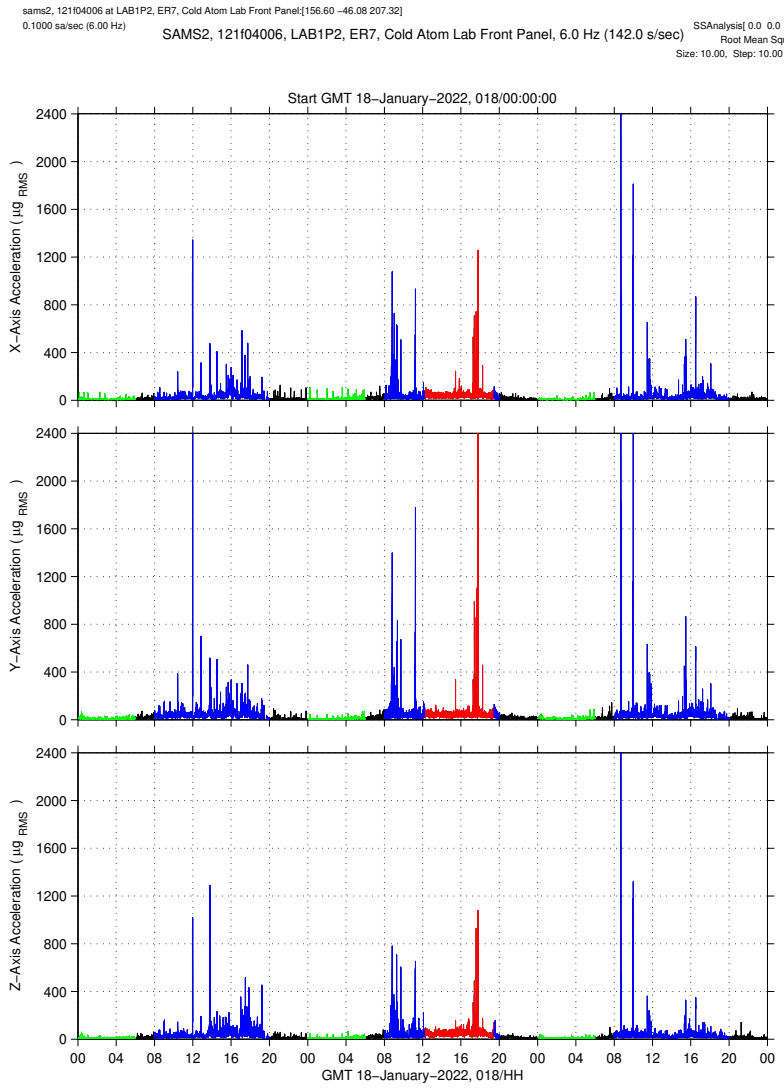

Fig. 5: 10-sec interval average for SAMS 121f04 sensor in the LAB.

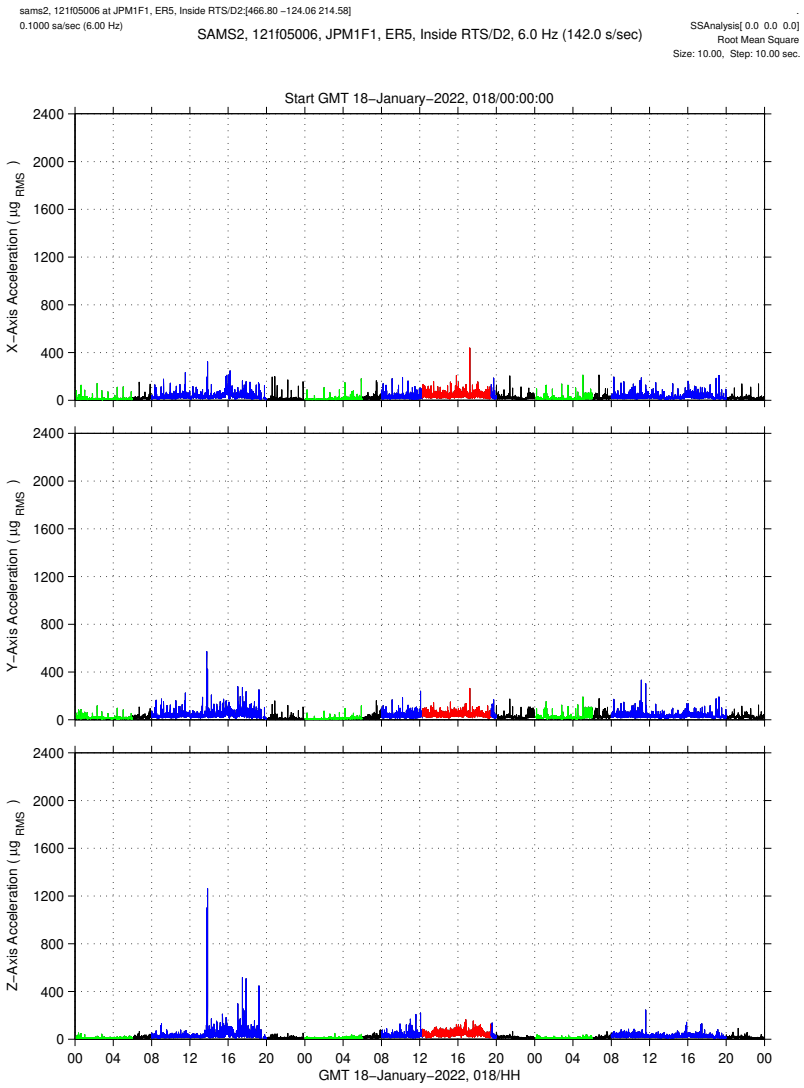

Fig. 6: 10-sec interval average for SAMS 121f05 sensor in the JEM.

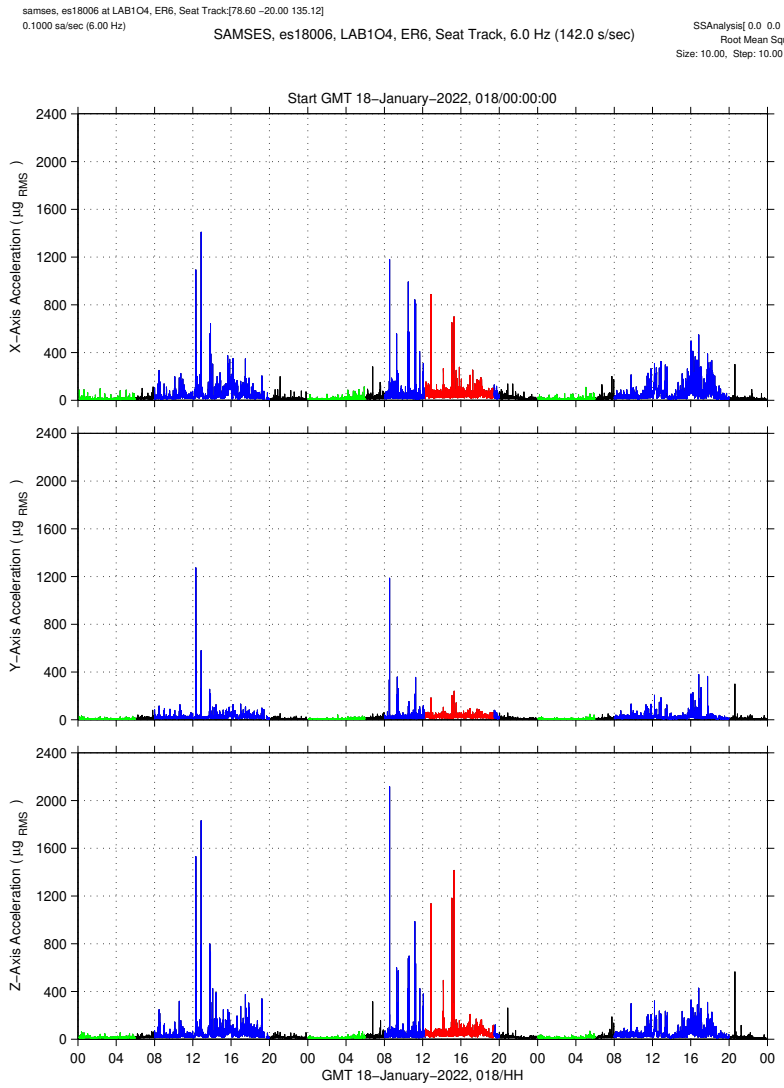

Fig. 7: 10-sec interval average for SAMS es18 sensor in the LAB.

Table 1. RMS Comparison Sleep vs. Wake, Non-EVA Periods vs EVA.

Space Acceleration Measurement System (SAMS) Location			Median Value (micro-g RMS below 6 Hz)								
			SLEEP			WAKE, NON-EVA			WAKE, EVA		
Sensor	Module/Rack	Payload	X	Y	Z	X	Y	Z	X	Y	Z
121f08	COL/EPM	PK-4	13.21	12.16	13.93	46.39	34.94	49.72	73.56	51.09	**93.38**
121f02	COL/ER3		7.94	8.54	8.64	28.14	27.54	29.35	48.15	43.53	61.17
es18	LAB/MSRR	MSL	9.84	6.03	11.89	28.54	17.40	32.07	47.38	27.13	47.81
121f05	JEM/ER5	Plant Habitat	9.55	12.15	8.30	25.43	30.94	24.59	41.39	43.52	44.62
121f03	LAB/ER2	Struc&Mech	9.03	7.19	12.41	17.01	22.46	26.68	32.46	34.76	43.64
121f04	LAB/ER7	Cold Atom Lab	6.93	7.74	7.98	21.25	29.63	26.95	36.69	37.17	43.40