1. INTRODUCTION

At about GMT 2021-07-21, 201/14:50, Russian cosmonaut Oleg Artemyev and European astronaut Samantha Cristoforetti began a spacewalk that would last just over 7 hours. This was the 251st spacewalk for assembly, maintenance, and upgrades of the International Space Station (ISS) & the sixth one outside of the ISS this year. Among other tasks, they continued outfitting a European robotic arm and deployed 10 nanosatellites for radio technology experiments. The extravehicular activity (EVA) concluded with ingress by the two crew members at about GMT 21:55.

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. Crew sleep periods are evident as dark, blue vertical bands, which mark broadband quieting (toward blue on color scale) below 6 Hz. This plot also shows increased structural vibration excitation contained between about GMT 14:50 and 21:55 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.

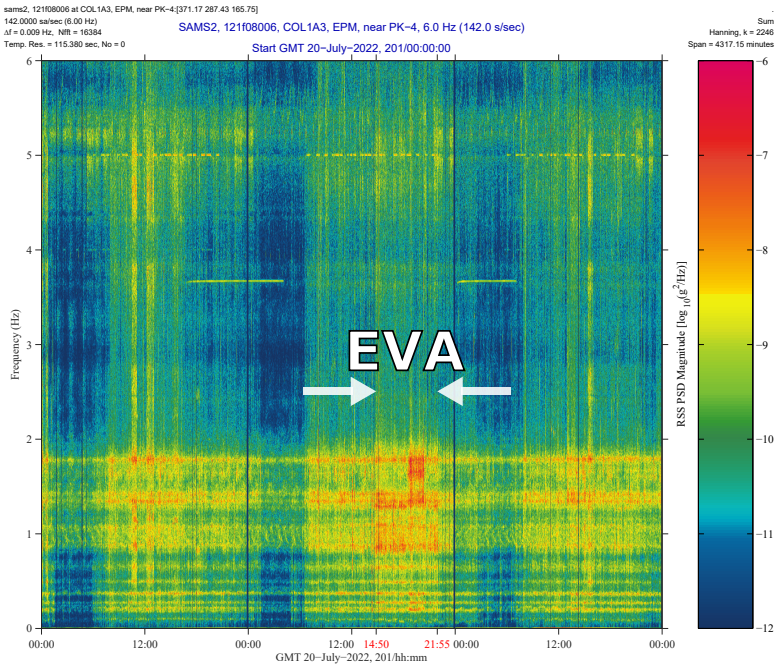

Fig. 1: Spectrogram for 3 Days Centered at EVA on GMT 2022-07-21.

3. QUANTIFY

In order to quantify the impact of this EVA, we know to focus our attention below 2 Hz because this is the portion of the acceleration spectrum where the crew-induced forces were most evident. We use 60-second interval root-mean-square (RMS) values for 5 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 as that of Figure 1. 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 4 sensors' plots of RMS acceleration values versus time shown starting with Figure 3 on page 2, the part of the traces in the pink-shaded time span show the EVA. All sensor's interval RMS plots were put on the same vertical scale for comparison and the COL1A3-located sensor's X-axis dictated the vertical scale. The information in Table 1 on page 5 shows the impact for 5 SAMS sensor heads distributed throughout the ISS.

4. CONCLUSION

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

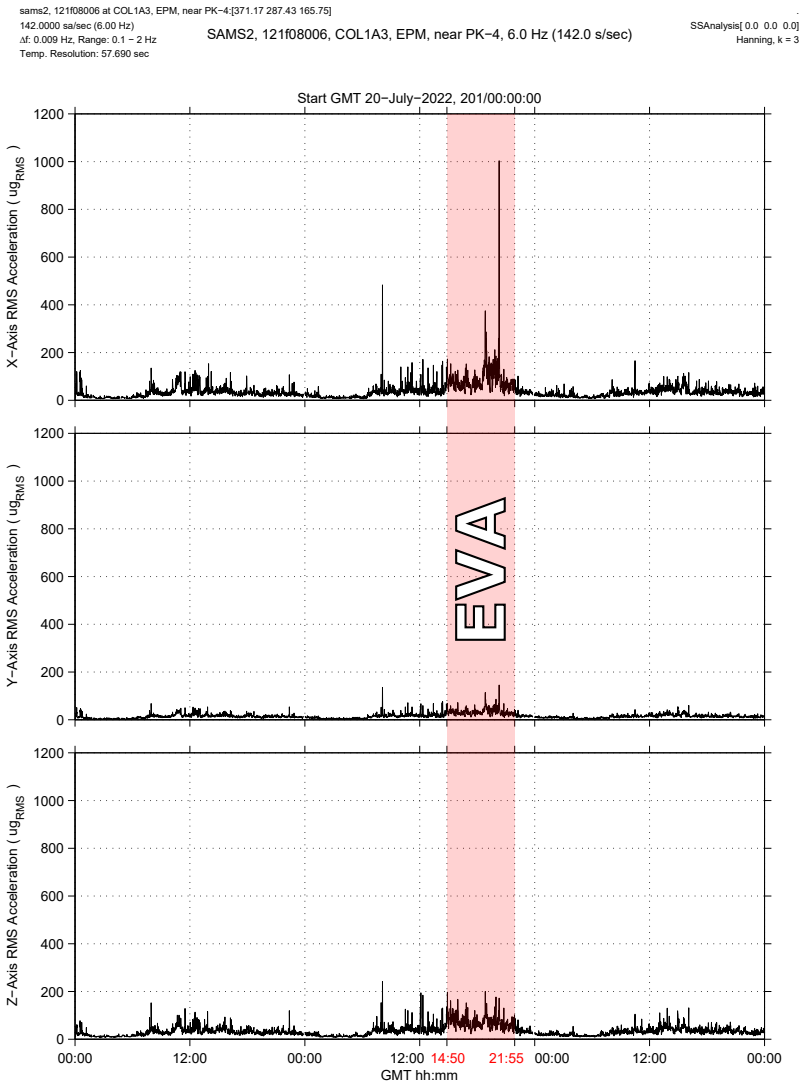

Fig. 2: RMS Below 2 Hz for SAMS 121f08 sensor in COL.

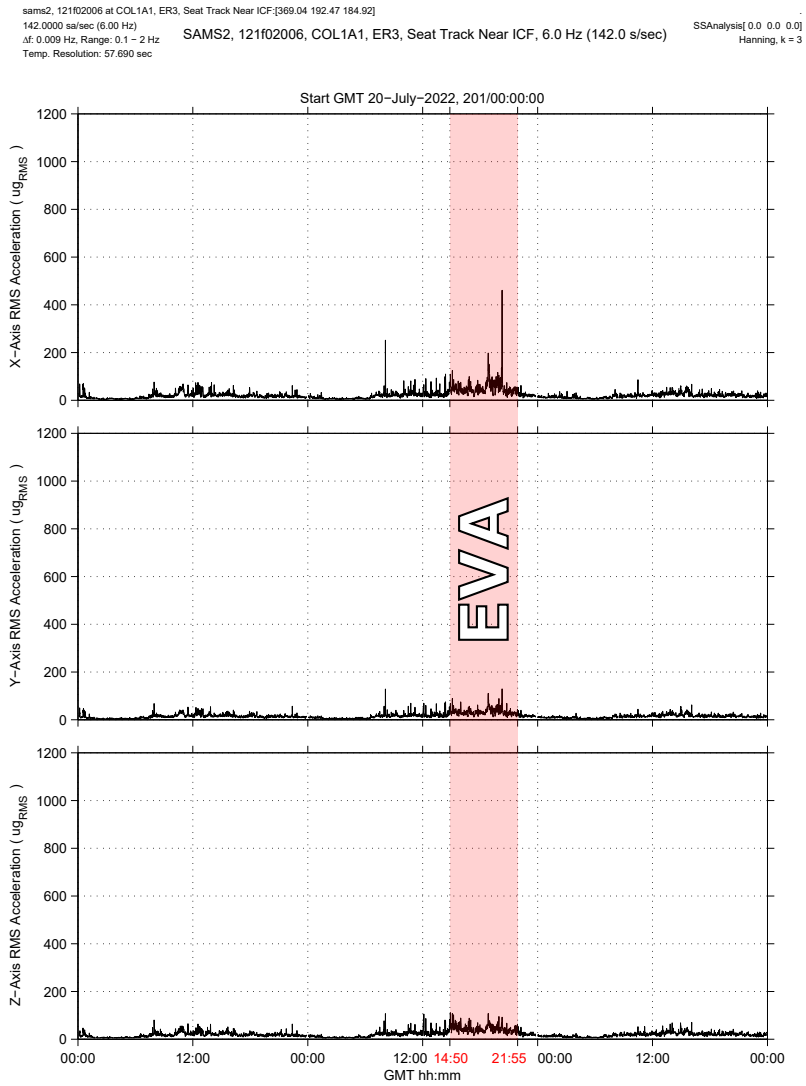

Fig. 3: RMS Below 2 Hz for SAMS 121f02 sensor in COL.

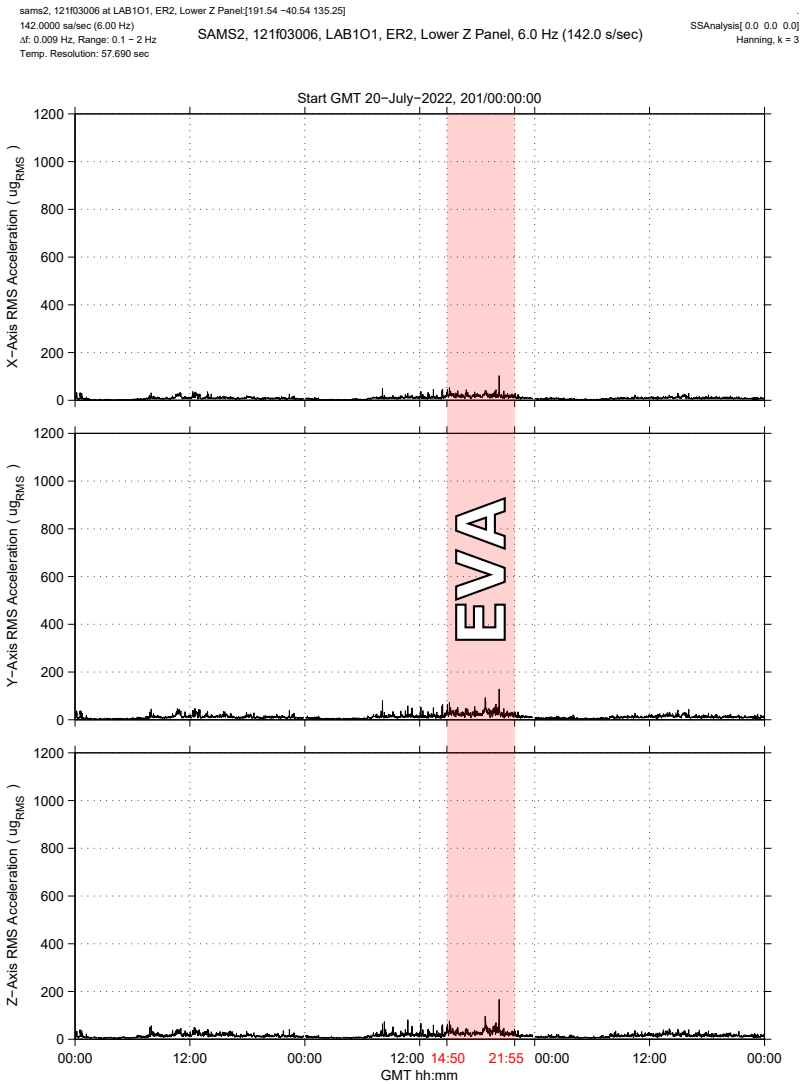

Fig. 4: RMS Below 2 Hz for SAMS 121f03 sensor in LAB.

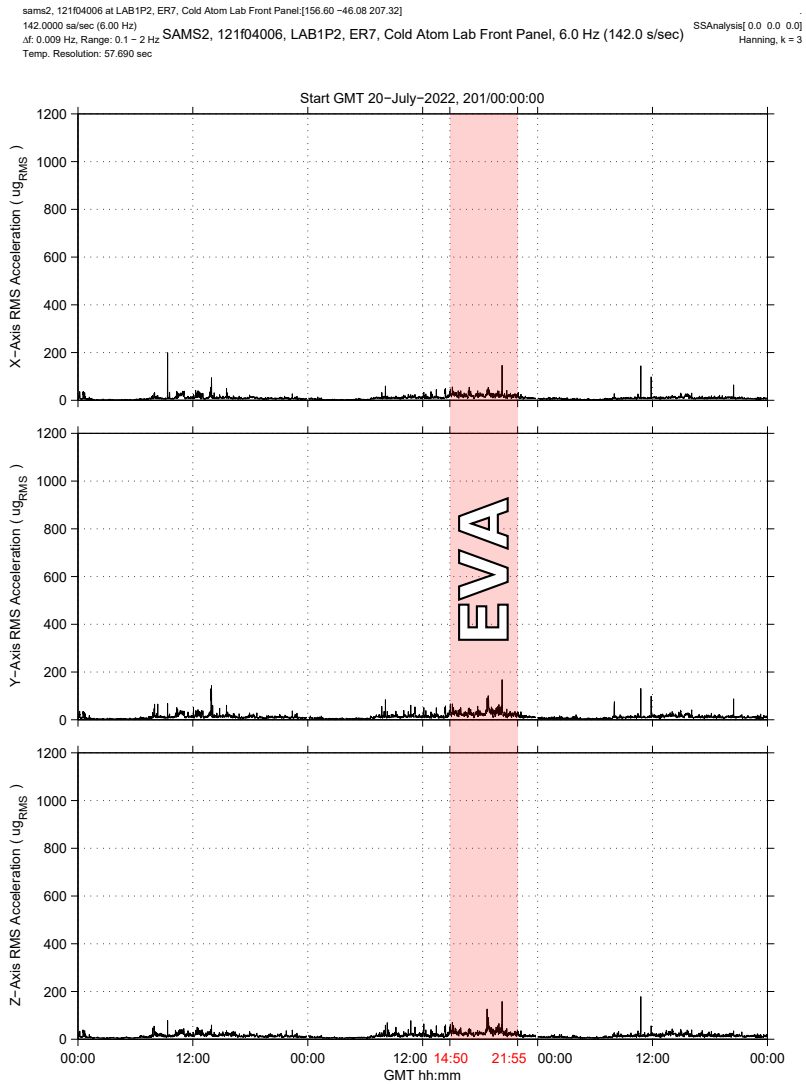

Fig. 5: RMS Below 2 Hz for SAMS 121f04 sensor in LAB.

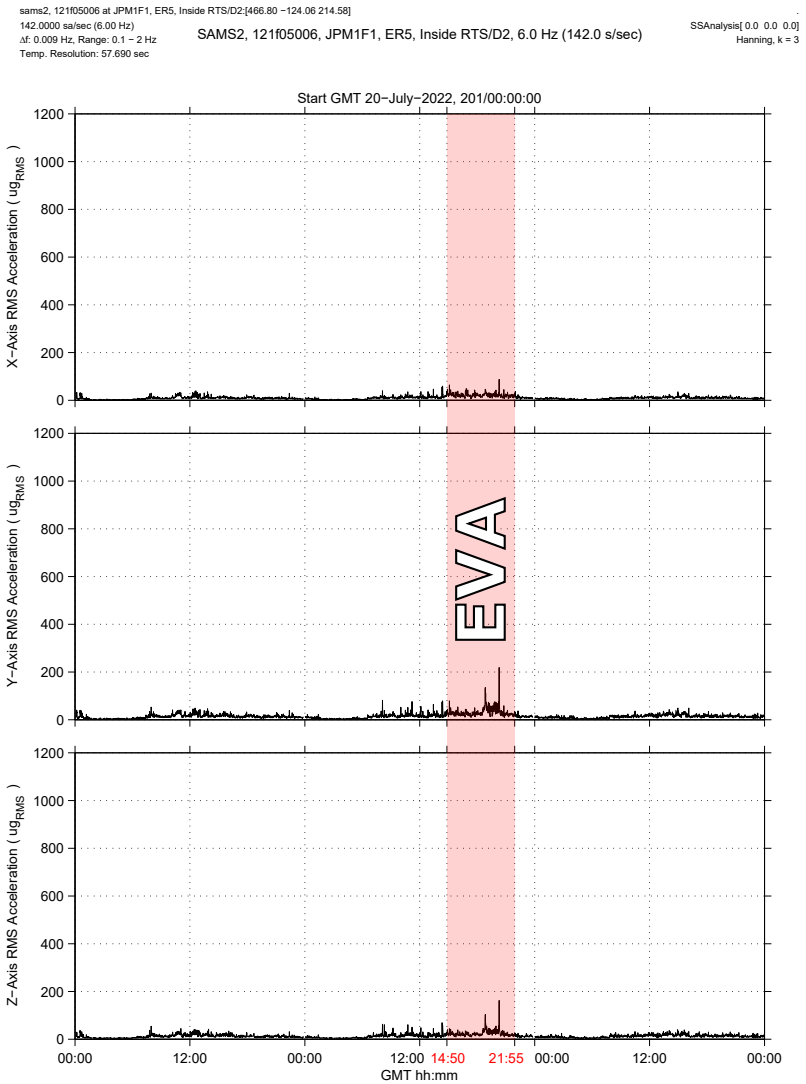

Fig. 6: RMS Below 2 Hz for SAMS 121f05 sensor in JEM.

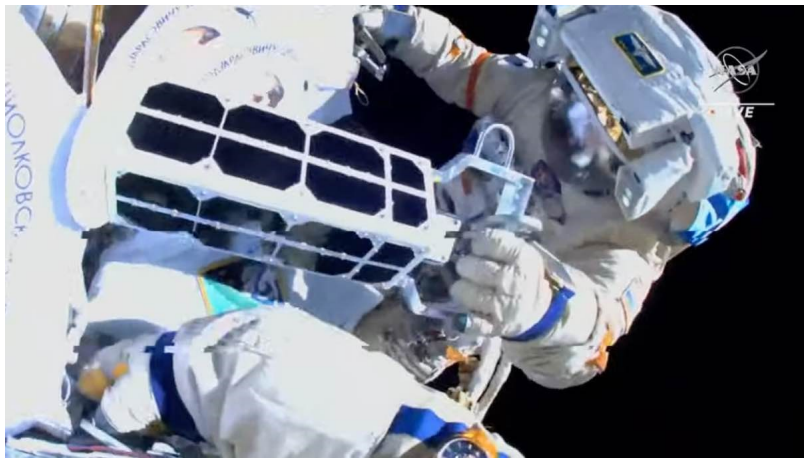

Fig. 7: ESA astronaut Samantha Cristoforetti During the EVA.

Table 1. RMS Comparison Below 2 Hz EVA vs. Non-EVA Periods.

Space Acceleration Measurement System SAMS				Median Value (micro-g RMS below 2 Hz) GMT 14:50-21:55								
				GMT 2022-07-20			GMT 2022-07-21 (EVA)			GMT 2022-07-22		
Sensor	**Location**	**Rack**	**Payload**	**X**	**Y**	**Z**	**X**	**Y**	**Z**	**X**	**Y**	**Z**
121f08	COL1A3	EPM	Near PK-4	29.5	13.6	30.7	**73.2**	**30.1**	**68.5**	34.3	14.9	34.9
121f02	COL1A1	ER3	Near ICF	17.7	13.7	19.0	45.3	30.0	41.1	20.7	15.0	21.2
121f03	LAB1O1	ER2	Lower Z-Panel	8.0	10.4	14.5	18.8	25.1	26.5	9.1	11.3	14.9
121f04	LAB1P2	ER7	Cold Atom Lab	8.2	10.5	13.9	20.4	25.3	25.6	9.4	11.2	14.5
121f05	JPM1F1	ER5	Inside RTS/D2	8.9	13.3	12.1	20.8	26.0	21.9	10.0	14.6	14.1