1. INTRODUCTION

The Expedition 61 crew members Andrew Morgan of NASA and Luca Parmitano of the European Space Agency (ESA) concluded their spacewalk at about GMT 2020-01-25/18:20. During the 6 hour, 16 minute spacewalk, the two astronauts successfully completed leak checks for the cooling system on the Alpha Magnetic Spectrometer (AMS) and opened a valve to begin pressurizing the system. The astronauts also completed an additional task to remove degraded lens filters on two high-definition video cameras. The EVA hatch timeline of Figure 1 indicates EVA activity from GMT 12:05 to 18:15.

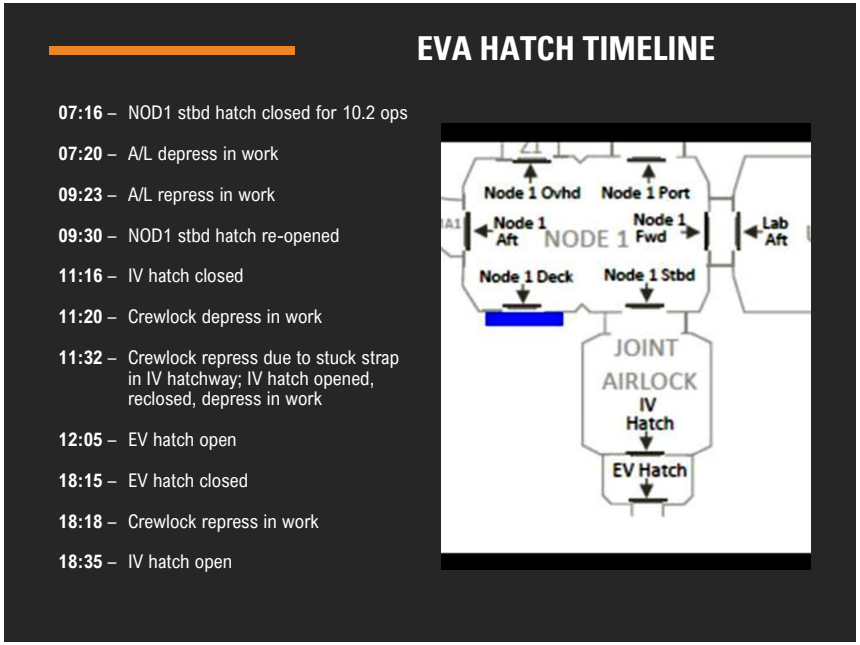

Fig. 1: EVA Hatch Timeline for Node 1 and Airlock (A/L).

2. QUALIFY

The information shown in Figure 2 was calculated from the Space Acceleration Measurement System (SAMS) sensor 121f03 measurements made in the US Laboratory module. This plot shows increased structural vibration excitation between about 12:00 and 18:20 (see magenta "EVA" annotation). The structural excitation is contained mainly below 2 Hz. We also see broadband excitation (vertical yellow/red streaks) below about 5 Hz throughout the activity. Broadband excitation can be thought of as "banging" from a pristine microgravity environmental monitoring perspective. Without direct traceability, we attribute most of the broadband and structural increases to the crew translating and working along the exterior of the station. The increased structural vibrations are evident as more noticeable horizontal streaks (structural/spectral peaks) that change from quieter (green/yellow) to more energetic (orange/red) in the spectrogram plot sporadically during this EVA activity over about 6 hours.

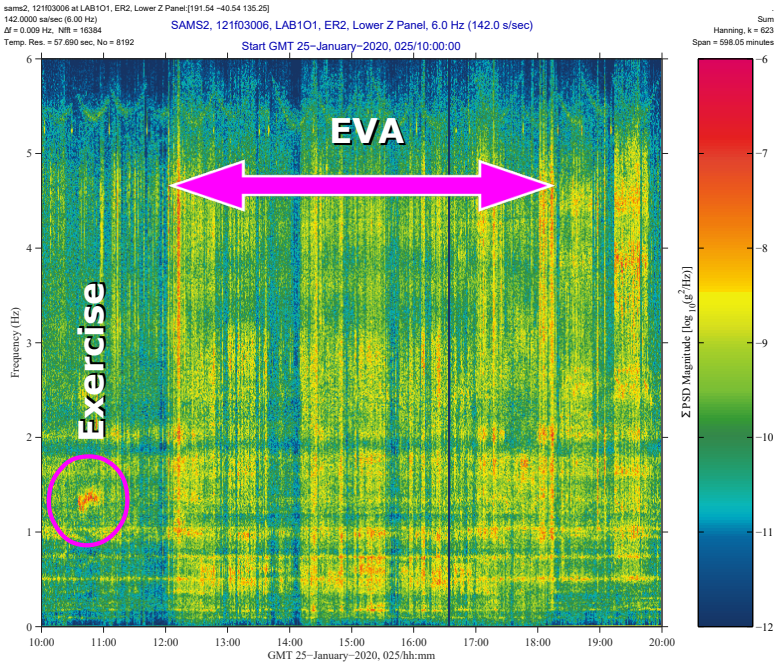

Fig. 2: Spectrogram showing EVA activity on GMT 2020-01-25.

3. QUANTIFY

The EVA hatch timeline of Figure 1 indicates EVA activity from GMT 12:05 to 18:15. Analysis of SAMS data recordings shows that much of that time was quite noisy in terms of root-mean-square (RMS) acceleration below 5 Hz as seen in Figure 3. This is unavoidable in terms of vibratory disturbance since space suit maneuvering is quite taxing and requires crude, gross movement that impinge on external structures and thereby imparts mechanical energy that gets propagated and transmitted along larger structures and components of the space station. The magenta "EVA" annotation and arrows indicate the time frame of this heightened activity whereas the entire plot duration spans one calendar day.

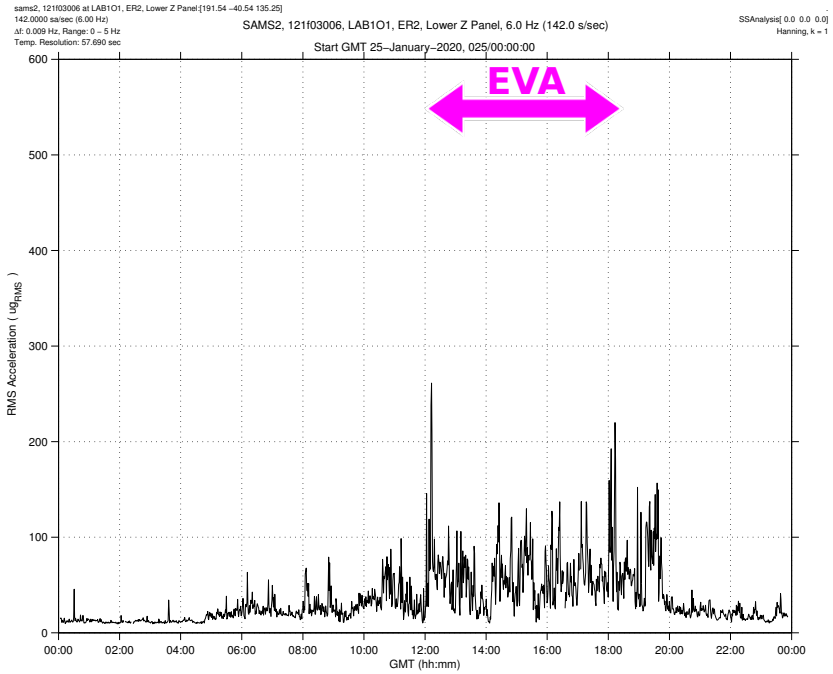

Fig. 3: Interval RMS Below 5 Hz, SAMS Sensor at LAB1O1.

Table 1. **Median RMS** (μg) for EVA & Non-EVA periods for 5 SAMS sensors.

Sensor	Location	During EVA	Non-EVA
121f08	COL1A3 (EPM)	97.5	46.9
121f05	JPM1F1 (ER5)	61.8	29.4
121f02	JPM1A6 (RMS Console)	68.4	35.5
121f03	LAB1O1 (ER2)	53.0	26.3
es20	LAB1O4 (ER6)	54.7	27.6

Four more plots of interval RMS acceleration versus time for SAMS sensors distributed throughout the ISS are shown at the end of this document, starting with Figure 4 on page 3. The interval RMS processing effectively low-pass filtered the data so as to help emphasize the acceleration associated with structural vibrations. The values in Table 1 show RMS during the crew wake period on GMT 2020-01-25. The column labeled **During EVA** shows the median RMS acceleration level for the time frame from GMT 12:00 to 18:00 for each of 5 SAMS sensors. The column labeled **Non-EVA** is the remainder of the waking hours that day. Roughly speaking, this table shows that *during the EVA, the RMS level value was about double what it would be otherwise*.

The acceleration vector magnitude values shown in Table 2 (in μg) on page 7 show three distinct time frames: (1) the yellow-highlighted columns for a 10-minute window centered on approximate **hatch open** time at about GMT 12:05, (2) the blue-highlighted columns for a 10-minute window centered on approximate **hatch close** time at about GMT 18:15, and (3) the green-highlighted full day values for **full-day** statistical context. As can be seen from this table, hatch close magnitudes in some cases (for some sensors) rival the maximum acceleration magnitudes for the full day, but otherwise are notably smaller.

4. CONCLUSION

The acceleration vector magnitude seen with airlock hatch opening and closing, for the EVA in late January 2020, did not approach or exceed a full-day's maximum value, but did go above the 97.5th percentile across all modules and all SAMS sensors.

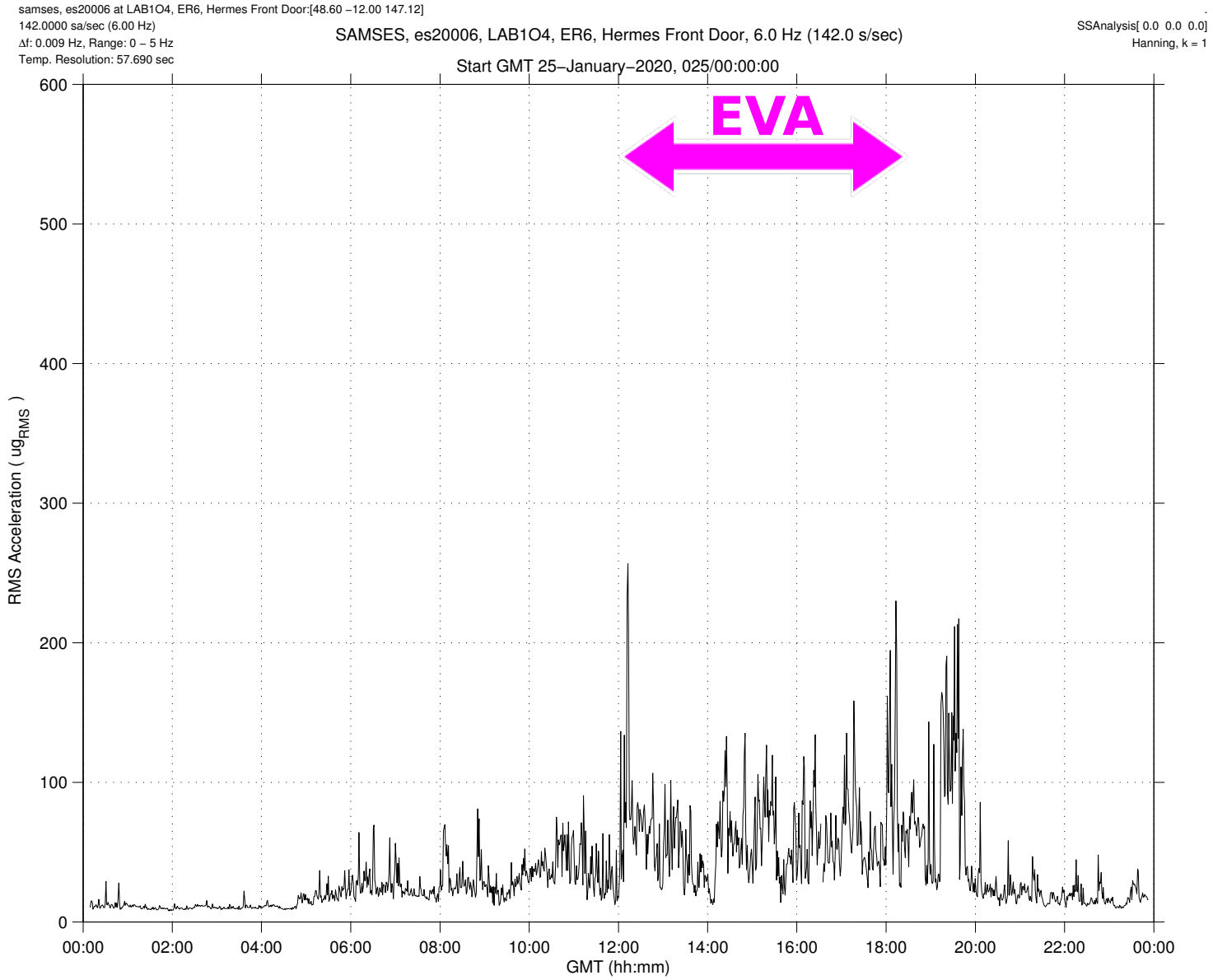

Fig. 4: Interval RMS Below 5 Hz, SAMS Sensor at LAB1O4.

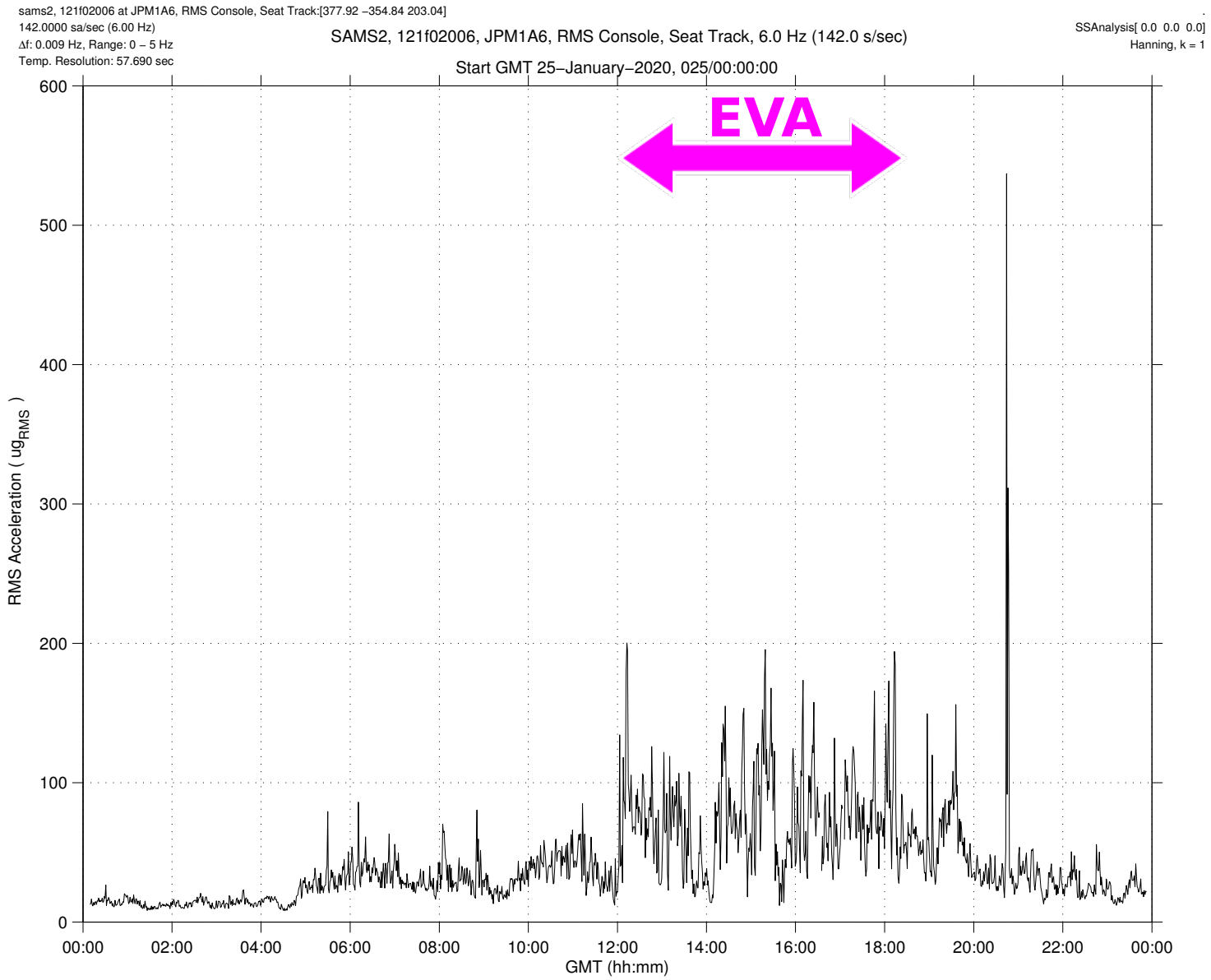

Fig. 5: Interval RMS Below 5 Hz, SAMS Sensor at JPM1A6.

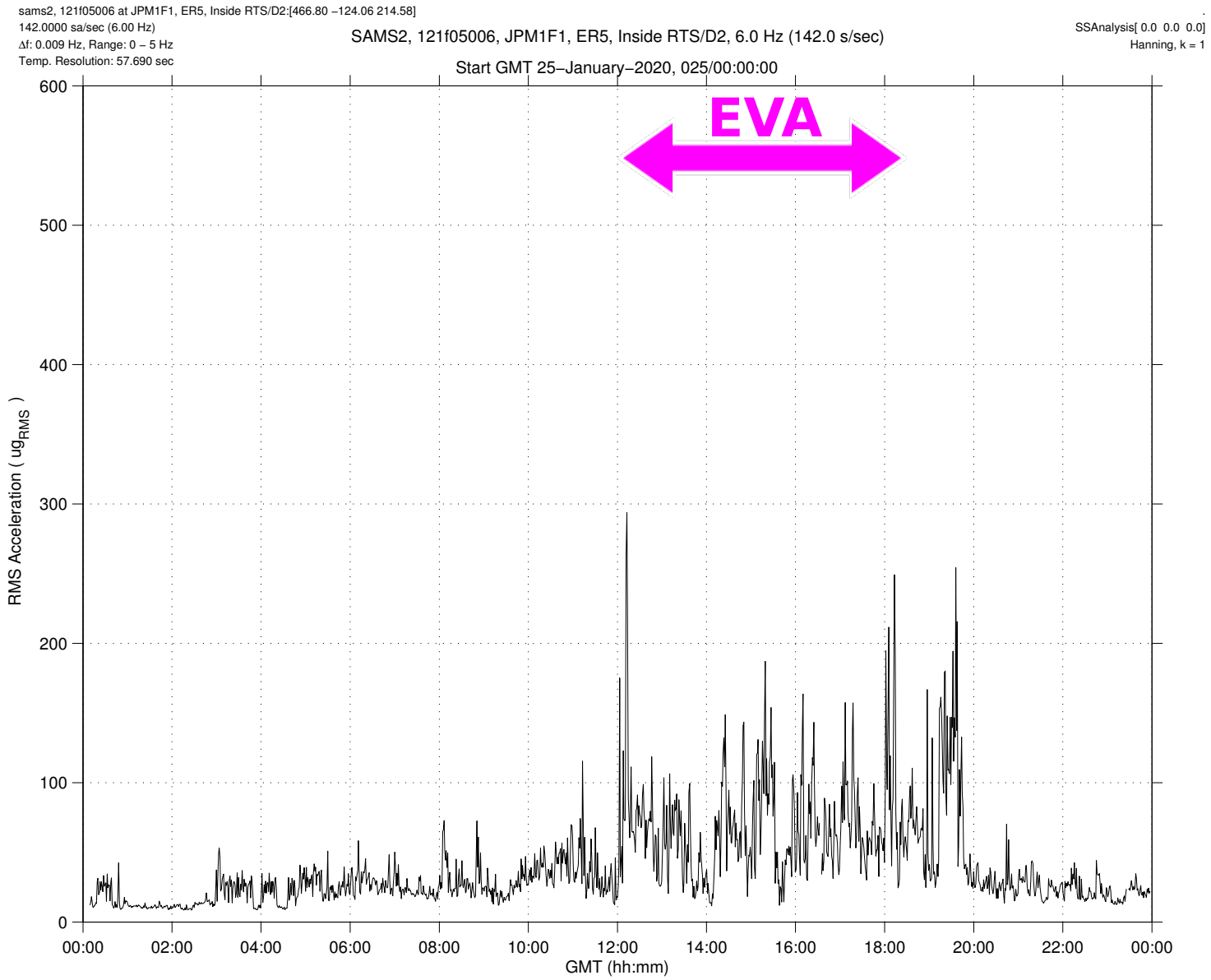

Fig. 6: Interval RMS Below 5 Hz, SAMS Sensor at JPM1F1.

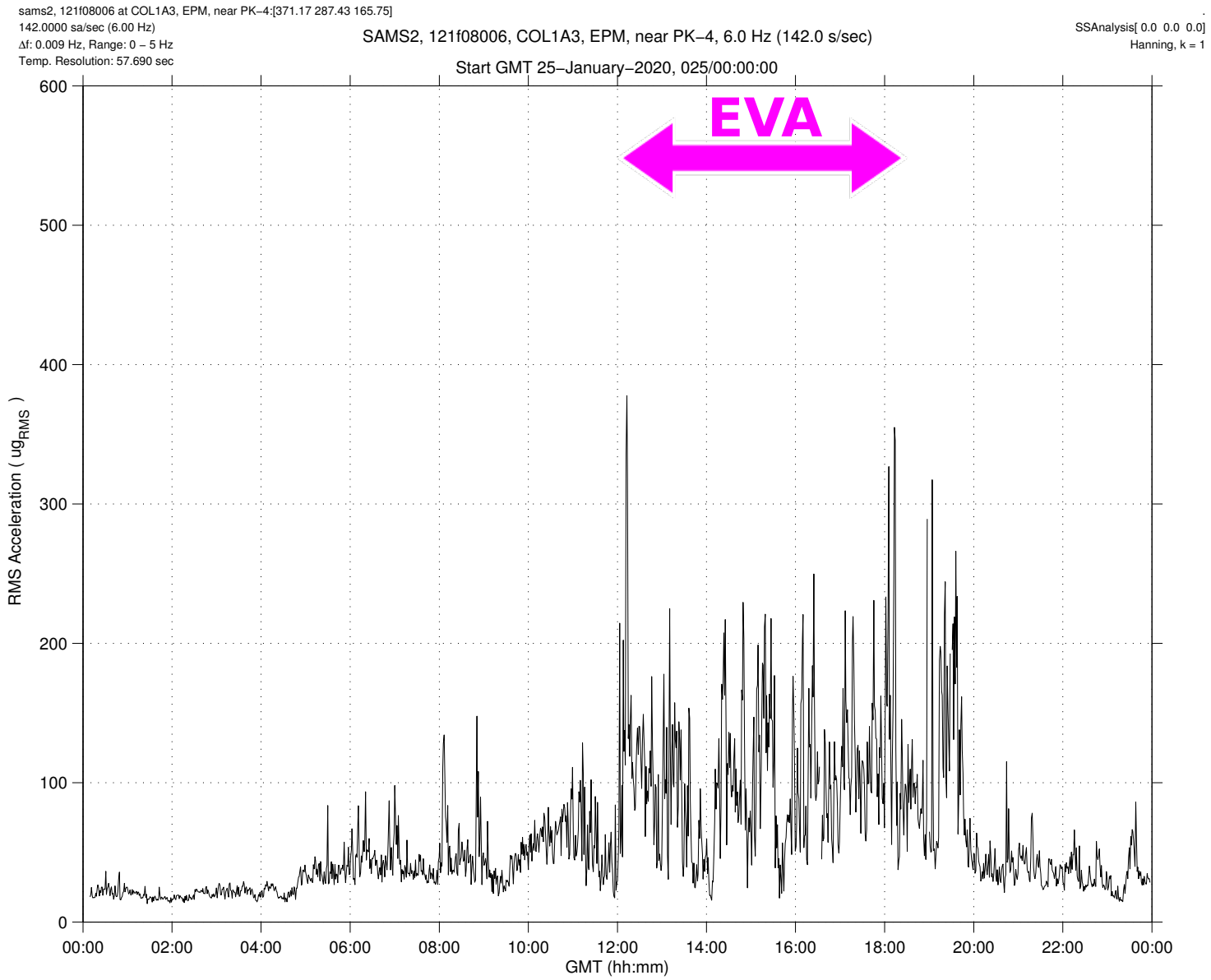

Fig. 7: Interval RMS Below 5 Hz, SAMS Sensor at COL1A3.

SAMS		Acceleration Vector Magnitude (ug)						
6 Hz Filtered		Hatch Open (GMT 12:00-12:10)		Hatch Close (GMT 18:10-18:20)		Full Day 2020-01-25		
Sensor	Module	GMT	Max.	GMT	Max.	Median	97.5th Pct.	Max.
121f08	COL	25-Jan-2020 12:08:27	992.2	25-Jan-2020 18:15:21	1581.7	35.5	208.4	1664.7
121f05	JEM	25-Jan-2020 12:03:59	952.8	25-Jan-2020 18:14:03	1129.9	28.3	160.8	2010.5
121f03	LAB	25-Jan-2020 12:08:27	622.4	25-Jan-2020 18:14:25	957.6	19.1	117.9	1519.3
121f02	JEM	25-Jan-2020 12:08:27	375.9	25-Jan-2020 18:15:21	783.8	26.1	136.7	6055.5
es20	LAB	25-Jan-2020 12:08:43	666.7	25-Jan-2020 18:15:21	940.2	19.9	128.3	2044.6

Table 2. Acceleration Vector Magnitude for Hatch Open/Close.