1. INTRODUCTION

The Russian Progress 71P cargo ship (see Figure 1) undocked from the aft end of the International Space Station (ISS), from the Zvezda Service Module, and was instructed to deorbit in a way so as to destruct over the Pacific Ocean. The friction created by high-velocity descent through Earth's atmosphere incinerates the cargo ship and its contents of trash and discarded gear. All burned up over a remote part of the Pacific Ocean. The Progress 71P resupply vehicle ended its mission after being docked to the ISS for 197 days, 13 hours and 12 minutes. Its mission docked to the ISS started on November 18, 2018.

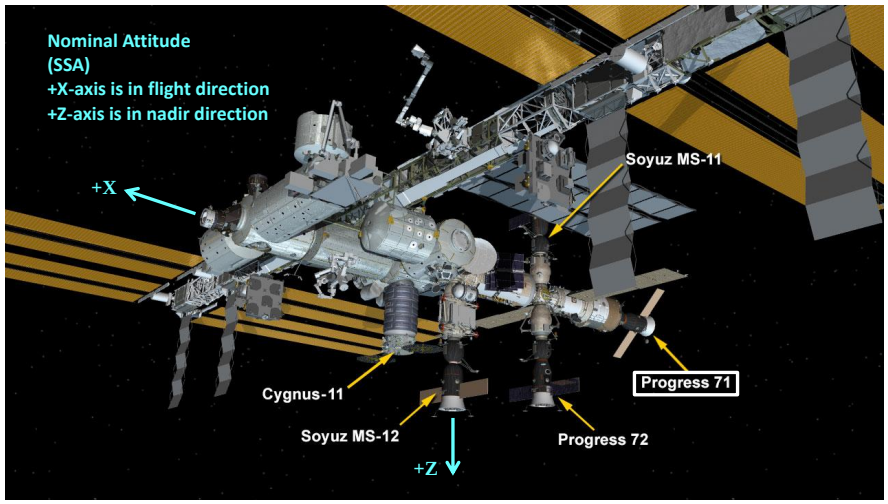

Fig. 1: Progress 71P's location before undocking.

2. QUALIFY

The vibratory acceleration spectral information shown in Figure 2 was computed from SAMS sensor 121f03 measurements made in the US Laboratory (LAB) on the lower Z-panel of EXPRESS Rack 2 (LAB1O1). This plot shows the physical separation event of undocking, but this was not a typical Progress undock scenario insofar as Control Moment Gyroscopes (CMGs) were used to control attitude rather than the typical Russian Segment thrusters.

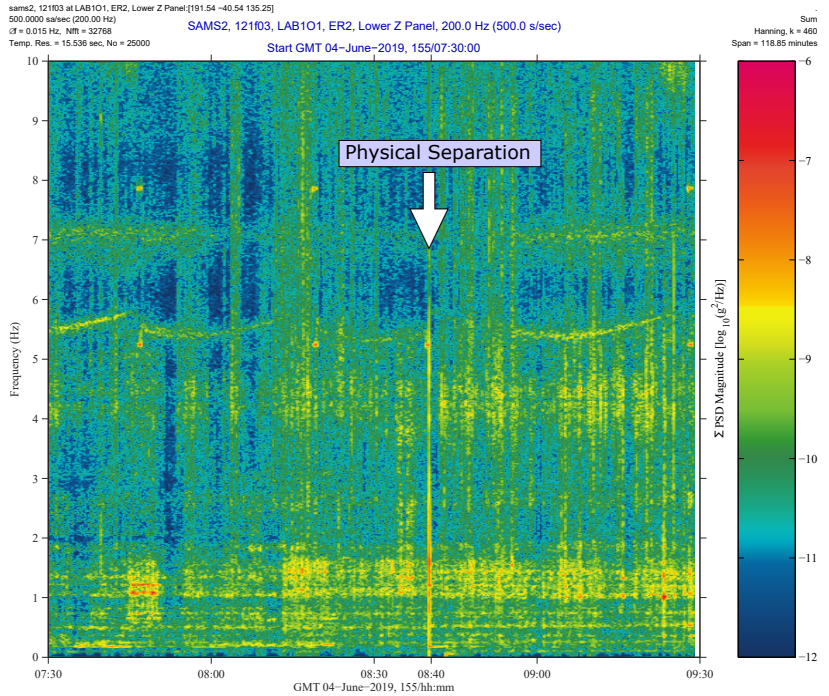

Fig. 2: Spectrogram showing Progress 71P undocking event on GMT 2019-06-04.

Using CMGs for attitude control reduces structural vibration excitation that would otherwise come with Russian Segment thruster control. For an example of Russian attitude control activity associated with an undocking, see this link.

3. QUANTIFY

The as-flown timeline for the undocking event indicated physical separation of the ISS and the Progress 71P occurred at GMT 08:40:30. Analysis of Space Acceleration Measurement System (SAMS) data recordings made during the undocking (low-pass filtered at 6 Hz) shows Z-axis ringing that starts just after GMT 08:40:38, see Figure 3 on page 2. The top, X-axis plot in Figure 3 shows a

strong 1.4 Hz response aboard the ISS in the Columbus module when the Progress 71P was undocked. A similar signature shows up in a US LAB SAMS sensor data set seen in Figure 4, except that the ringing does not persist as long at the US LAB location. Signatures for 2 other US LAB sensor locations are on page 3 and on page 4.

4. CONCLUSION

All SAMS sensors registered the Progress 71P undocking to varying degrees. The largest excursion appeared on the X-axis for the SAMS sensor in the MSG, with a brief ringing peak value of just over 3 mg. The longest-lived ringing disturbance was on the X-axis for the SAMS sensor in the Columbus module.

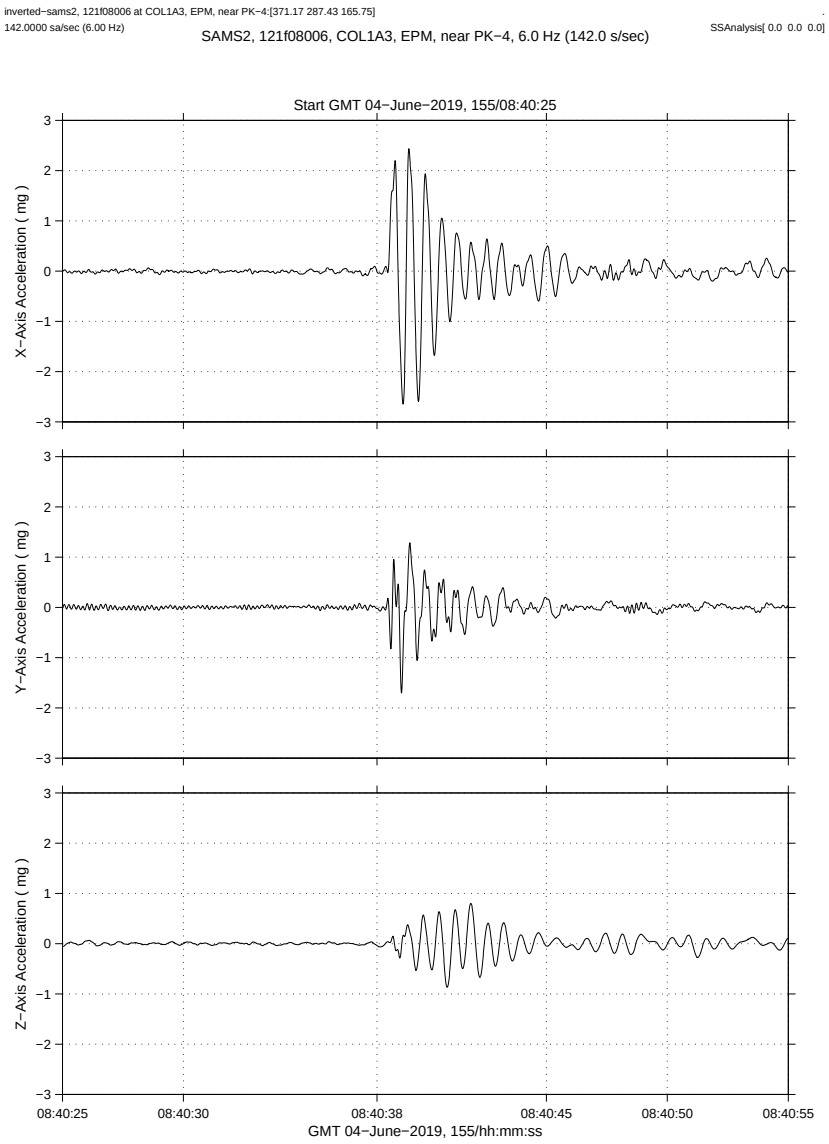

Fig. 3: SAMS 121f08 acceleration data (f < 6 Hz) shows undocking event.

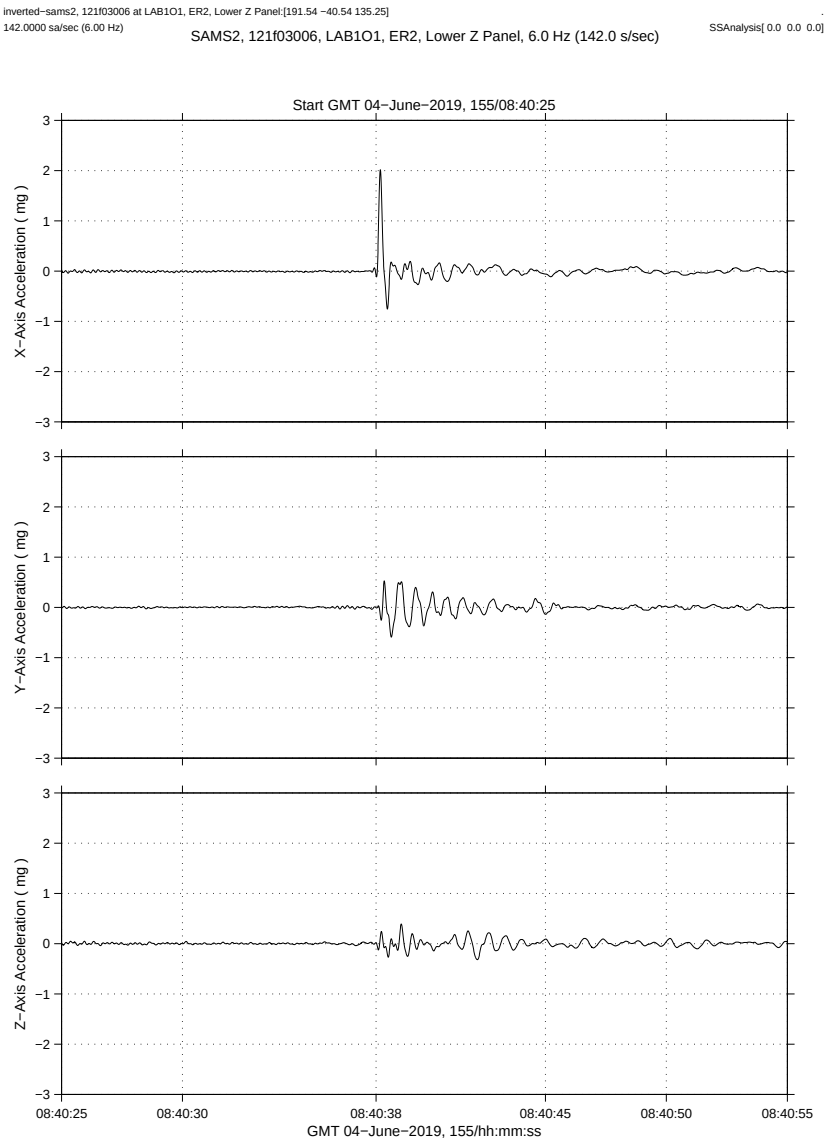

Fig. 4: SAMS 121f03 acceleration data (f < 6 Hz) shows undocking event.

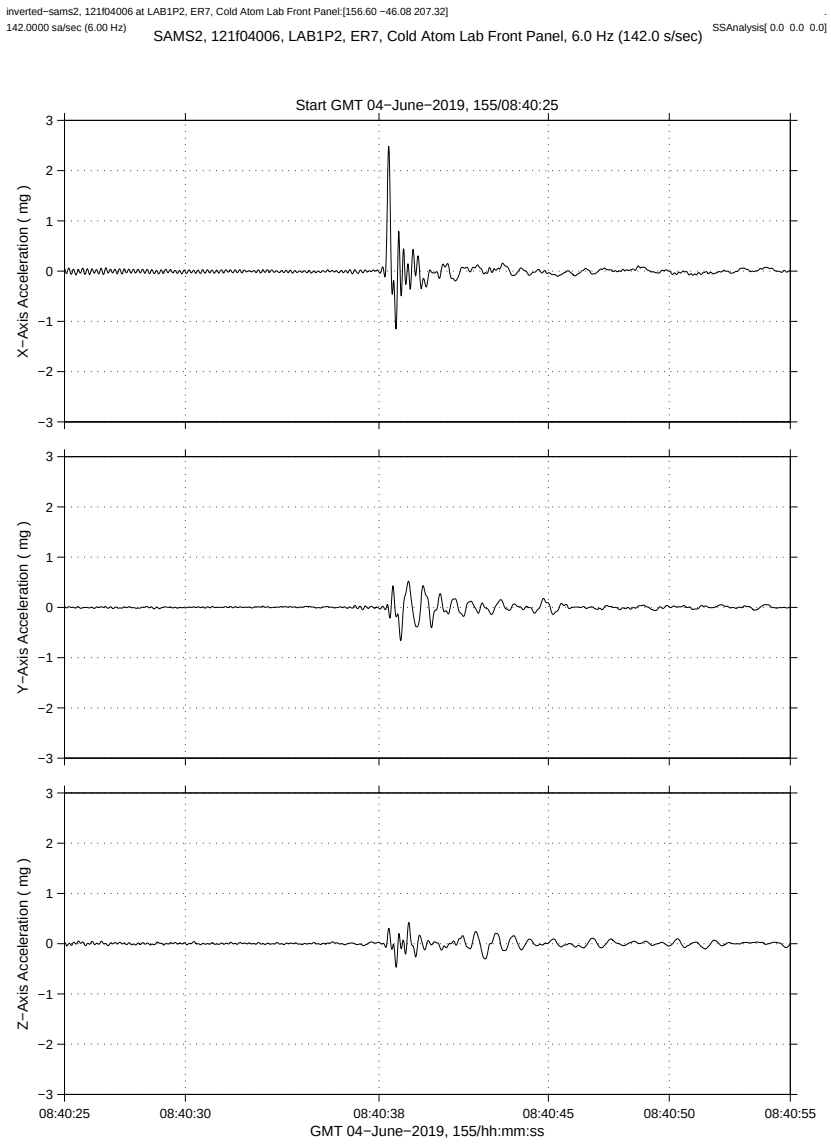

Fig. 5: SAMS 121f04 acceleration data (f < 6 Hz) shows undocking event.

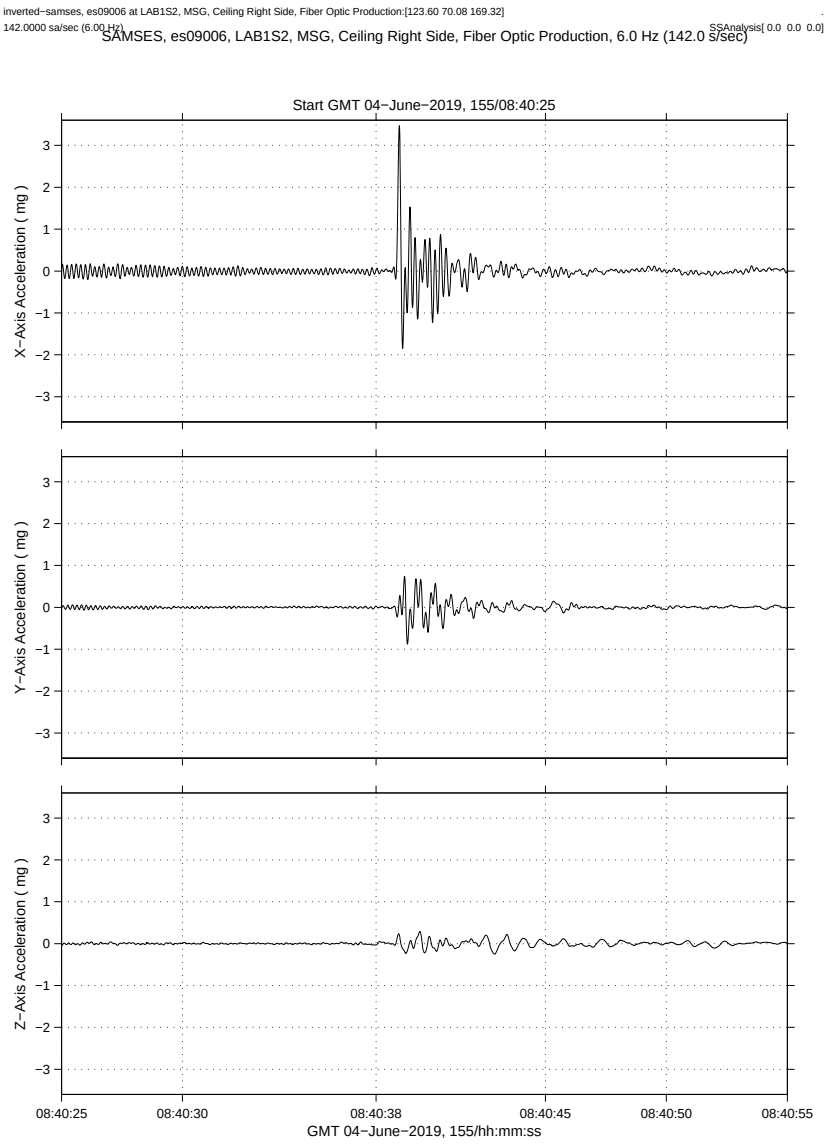

Fig. 6: SAMS es09 acceleration data (f < 6 Hz) shows undocking event.