1. INTRODUCTION

The Russian Progress MS-12 (73P, No.442) cargo ship launched on time at GMT 212/12:10:46.153 with separation from the launch vehicle at 12:19:36.253. Ascent was nominal and all appendages were deployed. On Orbit 1, the reference attitude was built, the Kurs-NA system was tested with nominal results, and rendezvous maneuver DV1 was performed nominally. The automated rendezvous began at 13:15:04. On Orbit 2, the docking probe was extended nominally, and MCC-M performed a checkout of the Progress TORU system with nominal results. Docking capture to the DC1 nadir port occurred at GMT 212/15:29:17, and Progress hooks were closed at approximately 15:34:12. This was the third such two-orbit rendezvous to the International Space Station(ISS). The image in Figure 1 shows a rendering with the location of the Progress 73P after docking took place.
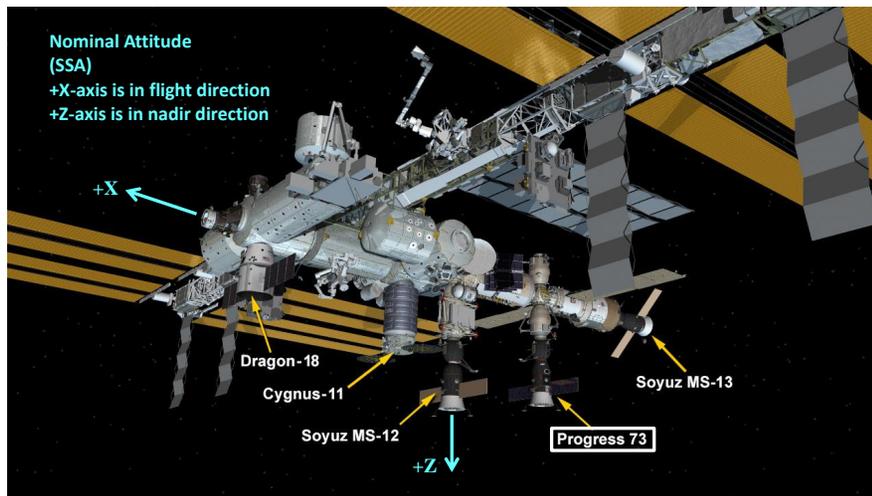

Fig. 1: Progress 73P's location after docking.

2. QUALIFY

The spectral information shown in Figure 2 was computed from SAMS sensor 121f08 measurements made in the Columbus module. This plot annotates some of the activities surrounding and including the docking event as timelined here (note:

the first time hack comes from the as-flown timeline, which appears to be off – the SAMS plot suggests handover was likely at about 13:29 instead of 10:13:00):

1) **GMT 10:13:00** - Handover from US to RS for attitude control.
2) **GMT 15:35:13** - Free drift for docking.
3) **GMT 15:35:18** - Docking.
4) **GMT 15:56:00** - Maneuver to post docking LVLH TEA.
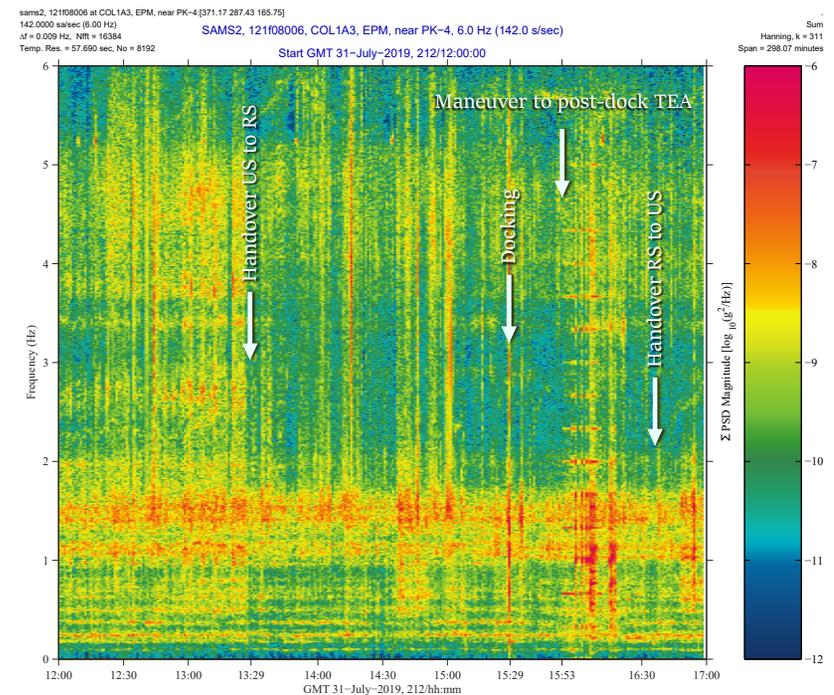5) **GMT 16:32:00** - Handover RS to US for attitude control.

Fig. 2: Spectrogram showing Progress 73P docking events on GMT 2019-07-31.

3. QUANTIFY

The as-flown timeline for the undocking event indicated physical docking of the Progress 73P spacecraft with the ISS occurred at GMT 15:35:18. Analysis of

Space Acceleration Measurement System (SAMS) data recordings made during the docking (low-pass filtered at 6 Hz), however, suggests the actual docking time was between about 15:29 and 15:30, see Figure 3 on page 3.

4. Conclusion

The 2 SAMS sensors used for analysis here both registered the Progress 73P docking, but to differing degrees. The largest excursion appeared on the X-axis for the SAMS sensor (121f08) in the Columbus module, with brief ringing peak-to-peak value of just over 5 mg.

sams2, 121f08006 at COL1A3, EPM, near PK–4:[371.17 287.43 165.75]
142.0000 sa/sec (6.00 Hz)   SAMS2, 121f08006, COL1A3, EPM, near PK–4, 6.0 Hz (142.0 s/sec)   SSAnalysis[0.0 0.0 0.0]
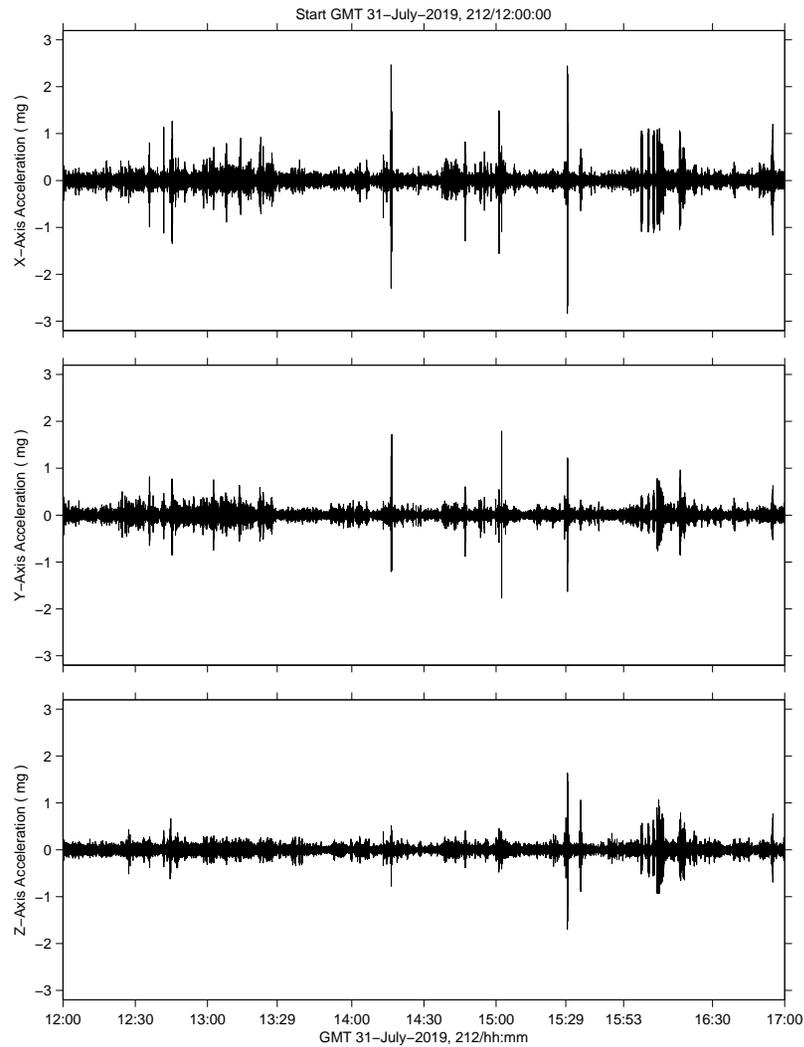
sams2, 121f03006 at LAB1O1, ER2, Lower Z Panel:[191.54 –40.54 135.25]
142.0000 sa/sec (6.00 Hz)   SAMS2, 121f03006, LAB1O1, ER2, Lower Z Panel, 6.0 Hz (142.0 s/sec)   SSAnalysis[0.0 0.0 0.0]
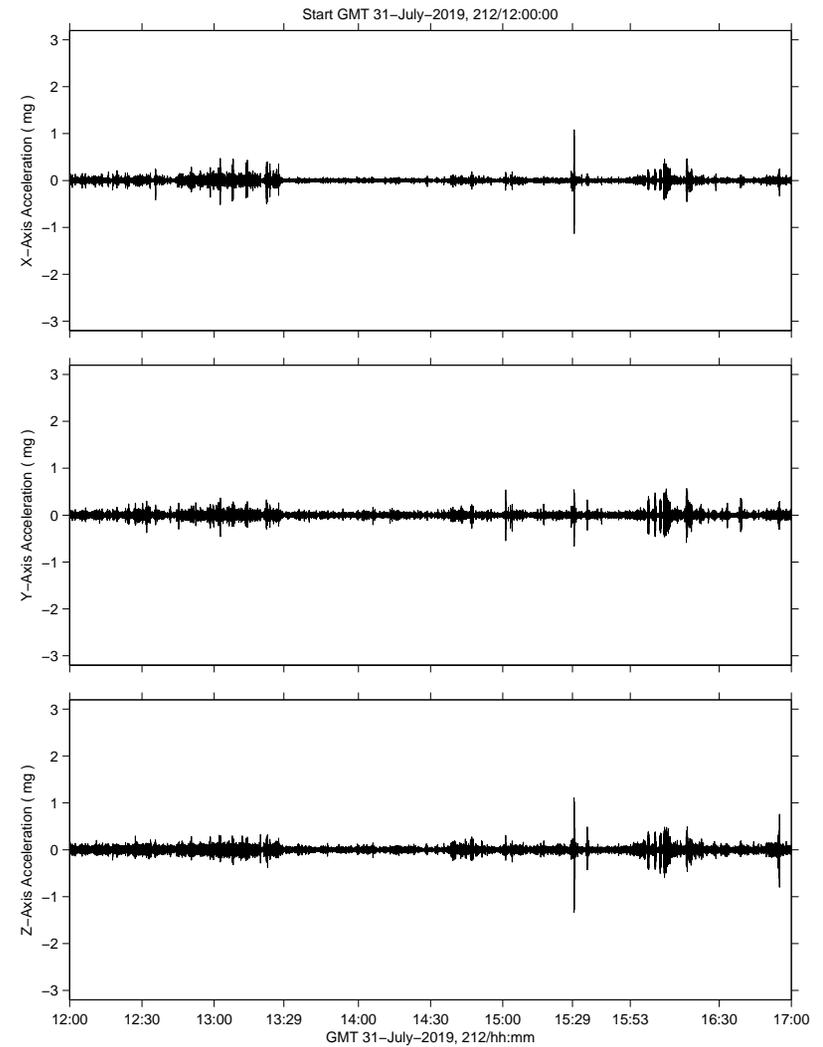

Fig. 3: SAMS COL 121f08 acceleration data (f < 6 Hz) shows docking event.

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