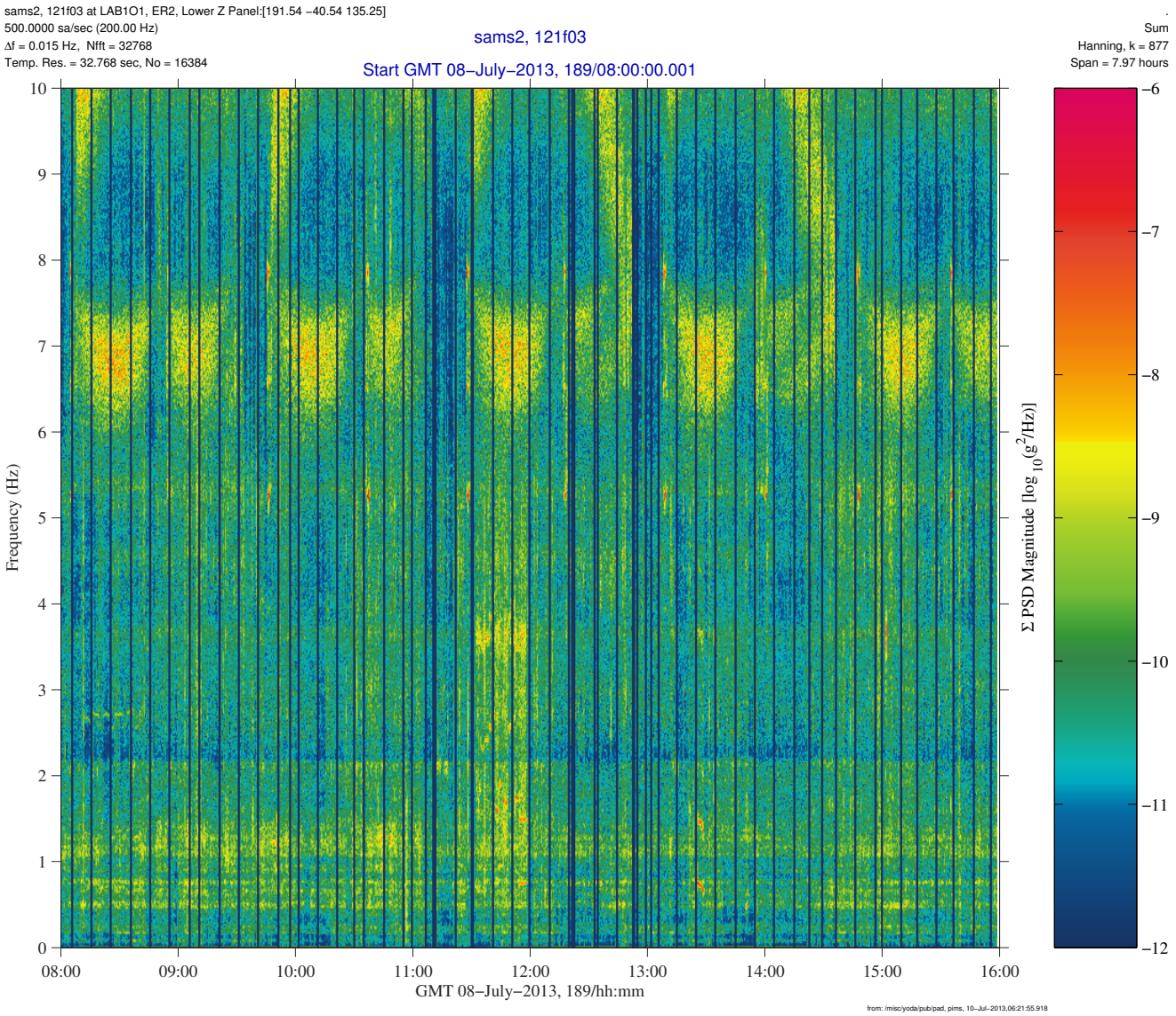
Ku-Band Antenna Controller Swap Qualify



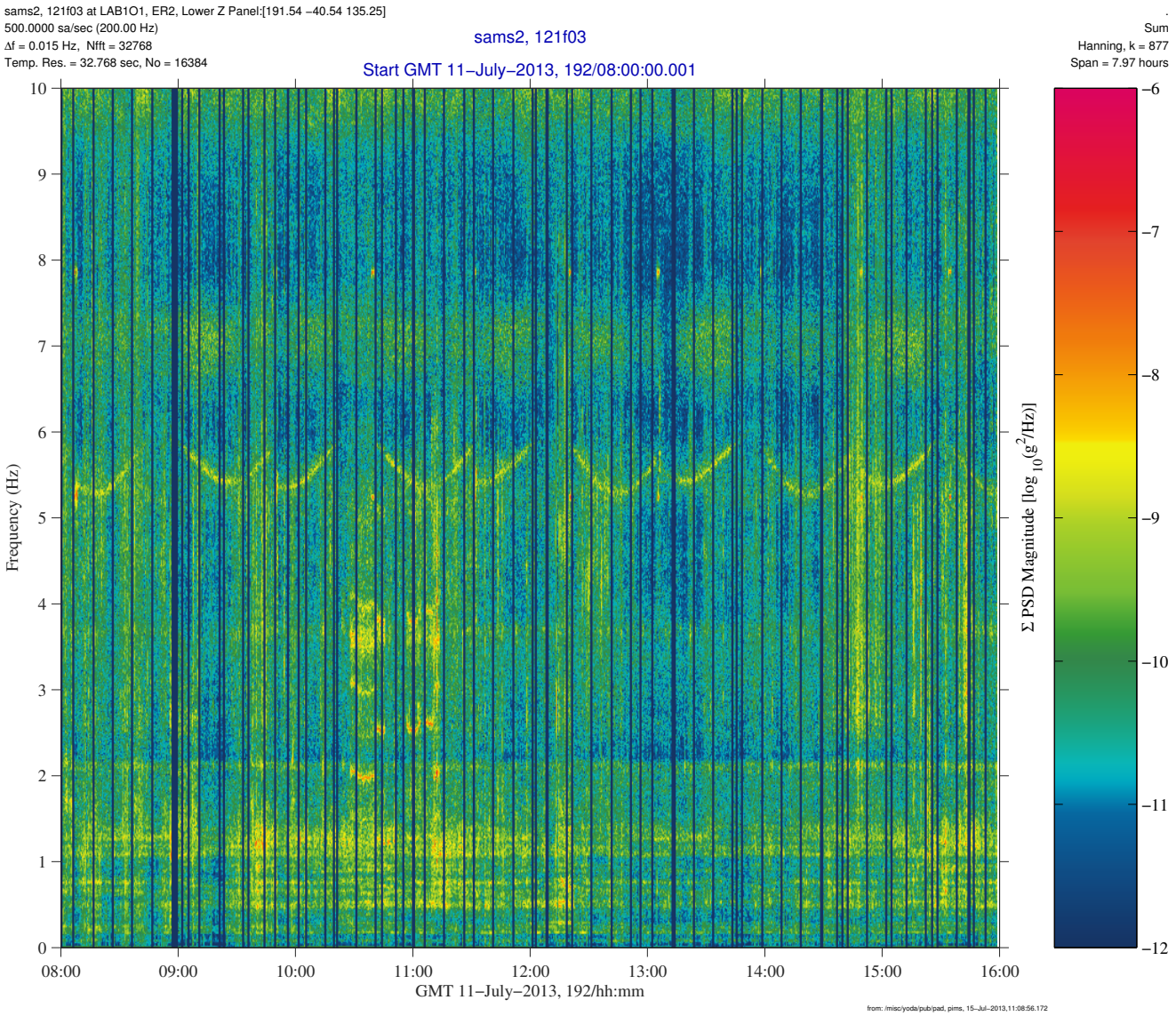
Description	
Sensor	121f03 500 sa/sec (200 Hz)
Location	LAB1O1, ER2, Lower Z Panel
Plot Type	Spectrogram (Σ); f < 10 Hz

Notes:

- Analysis to support the Neutron star Interior Composition ExploreR (NICER) Mission revealed a notable upward trend in vibrations below 10 Hz. This portion of the ISS acceleration spectrum is the domain of vibrations from vehicle structural modes along with the Ku-band antenna.
- The spectrogram here shows an 8-hour span **BEFORE** the swap of a failed Ku-band antenna controller.
- The yellowish horizontal streaks concentrated below about 2 Hz are vehicle structural modes.
- The broader band disturbance seen near 7 Hz is attributable to motion of the Ku-band antenna. This antenna must move to track communications satellites.

Regime:	Vibratory
Category:	Vehicle
Source:	Ku Antenna Controller

Ku-Band Antenna Controller Swap
Qualify (continued)



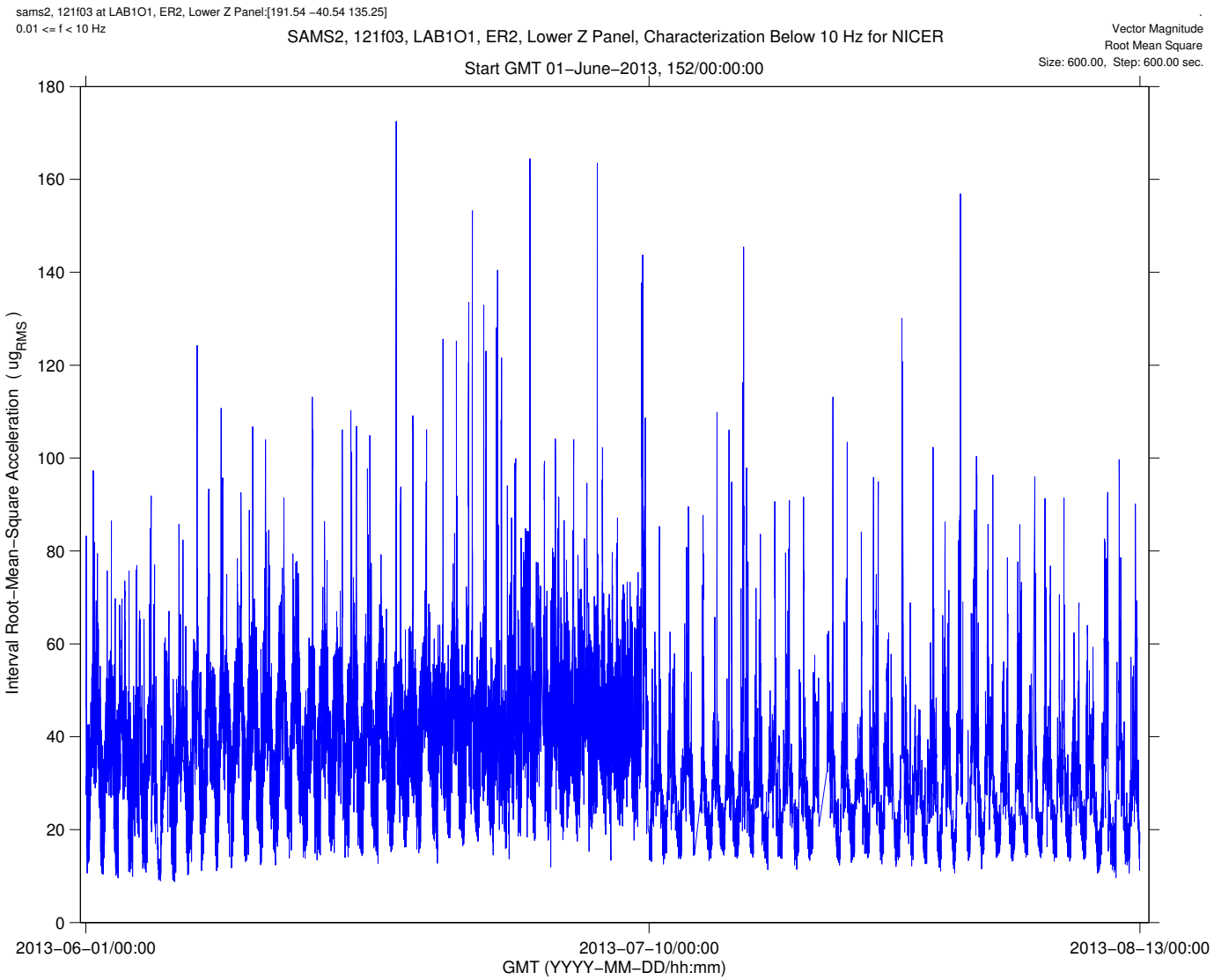
Description	
Sensor	121f03 500 sa/sec (200 Hz)
Location	LAB1O1, ER2, Lower Z Panel
Plot Type	Spectrogram (Σ); f < 10 Hz

Notes:

- This spectrogram shows an 8-hour span **AFTER** the swap of the failed Ku-band antenna controller.
- The yellowish horizontal streaks concentrated below about 2 Hz are vehicle structural modes.
- The narrowband disturbance seen to arc between 5 Hz and 6 Hz is attributable to motion of the Ku-band antenna, but now with a distinctly different spectral signature and with less vibratory disturbance as subsequent pages show below.

Regime:	Vibratory
Category:	Vehicle
Source:	Ku Antenna Controller

Ku-Band Antenna Controller Swap
Quantify



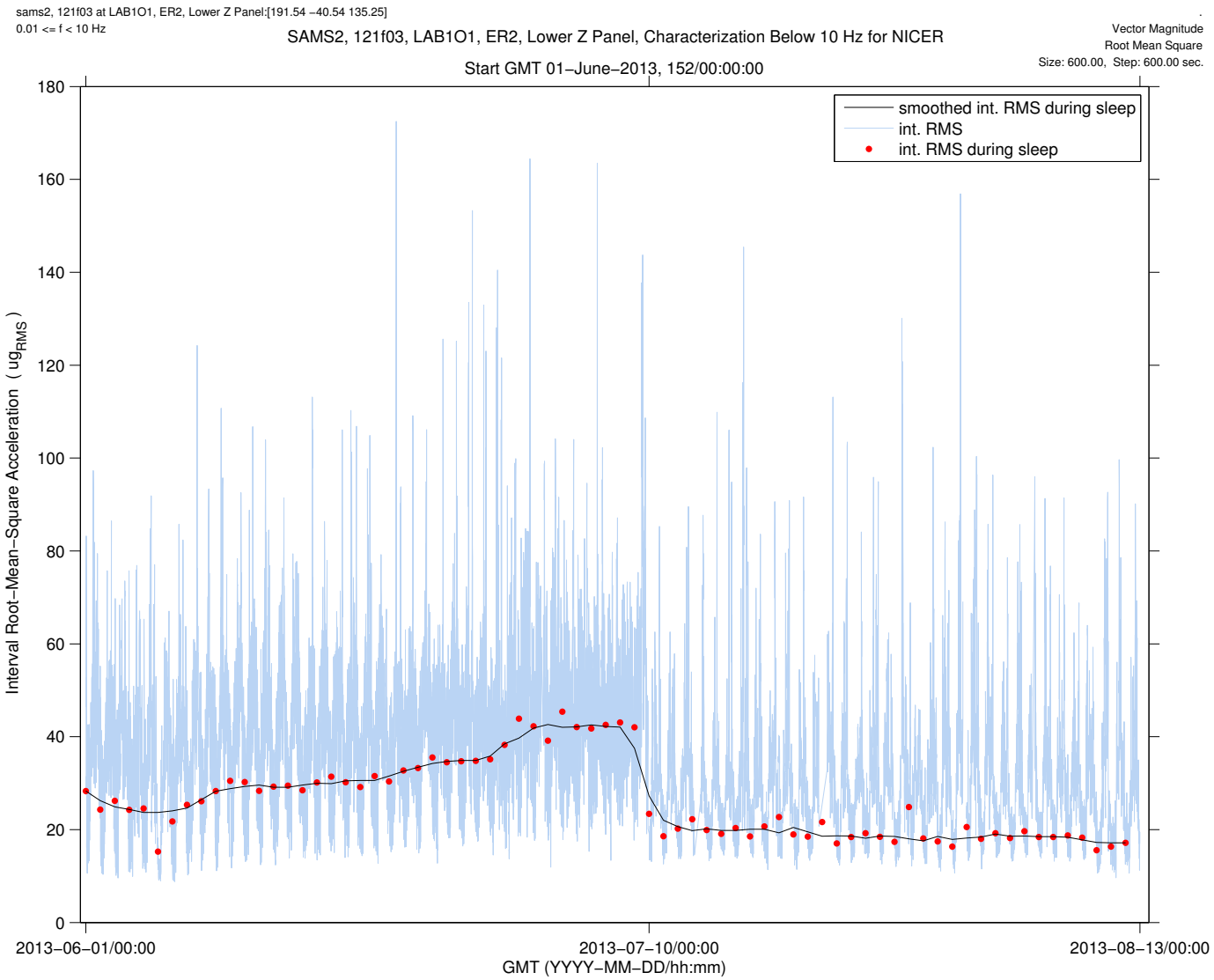
Description	
Sensor	121f03 500 sa/sec (200 Hz)
Location	LAB1O1, ER2, Lower Z Panel
Plot Type	Interval RMS (Σ); f < 10 Hz

Notes:

- The plot here shows ten-minute interval RMS values spanning 72 days starting on GMT 01-June-2013. These results are part of a statistical summary that was produced in support of the NICER Mission.
- The tick along the horizontal time axis at about GMT 10-July-2013/00:00 shows approximately when the upward trend of interval RMS values suddenly ends. This time also approximately coincides with a Ku-band antenna controller swap that occurred late on GMT 09-July-2013.
- The periodic, daily dips downward in RMS value are indicative of structural mode quieting that comes with crew sleep.

Regime:	Vibratory
Category:	Vehicle
Source:	Ku Antenna Controller

Ku-Band Antenna Controller Swap
Quantify (continued)



Description	
Sensor	121f03 500 sa/sec (200 Hz)
Location	LAB1O1, ER2, Lower Z Panel
Plot Type	Interval RMS (Σ); f < 10 Hz

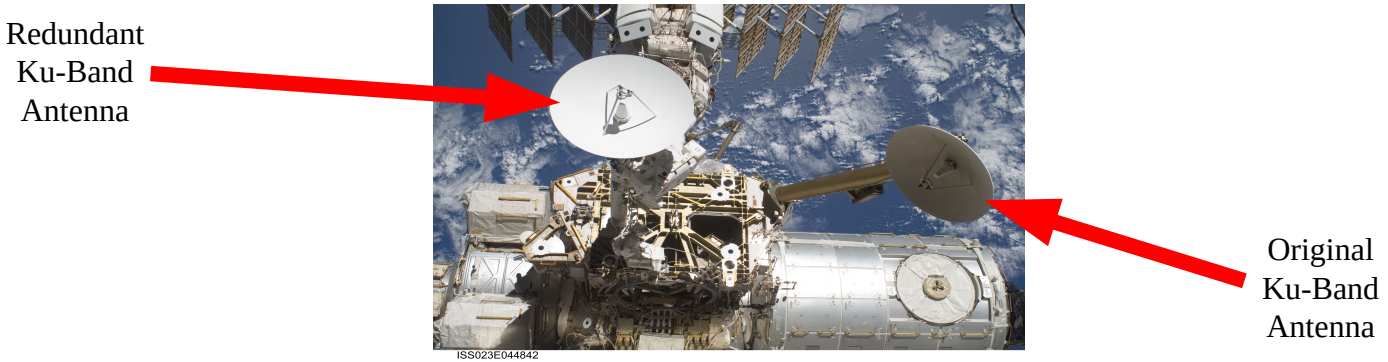
Notes:

- This plot shows the same ten-minute interval RMS quantity plotted versus time as on previous page, however, here it is shown as a light blue trace.
- The legend shows 2 other quantities: (1) red dots at average daily values during crew sleep, and (2) a black solid line for a smoothed rendering of average daily values during sleep.
- Focusing on the smooth black trace, we see more clearly the upward vibrational trend that we attribute to motion of the Ku-band antenna being driven by a degrading Transmitter / Receiver Controller (TRC).
- For the first 40 days of these analysis results, SAMS measurements show well over a 50% increase in RMS leading up to swap from Ku-band Antenna Group 1 to Group 2 by the crew at around GMT 190/23:19. The RMS values go from about 27 ugRMS to 42 ugRMS over those 40 days before settling to about 19 ugRMS after the swap out of failed TRC.

Ku-Band Antenna Controller Swap
Ancillary Information

The image below shows the two Ku-band antenna groups installed on the Z1 truss assembly of the ISS. The space station has redundancy with respect to its Ku-Band Tracking and Data Relay Satellite System communications link. The intent of redundancy was to help minimize the time required (from on the order of weeks down to just hours) to restore the Ku-Band communications link. The redundant components were given the names SGANT-2 and SGTRC-2 to differentiate them from the original Ku-Band string.

To summarize findings based on analysis of acceleration data, the interval RMS value below 10 Hz measured by SAMS in the USL showed a steady upward trend in RMS value from GMT 01-June-2013 through 09-July-2013. A check of the MER console log showed references to Ku-band antenna reset by the Flight Director due to poor signal strength. More information was pursued via email to the JSC Structures and Mechanism (S&M) team along with the PIRATe team. This led to further pursuit with the Command and Telemetry (C&T) team. This thread led to the fact that at around GMT 190/23:19, the crew swapped from Ku-band Antenna Group 1 (old) to Antenna Group 2 (new). It was reported that things were operating nominally until Ku-band did not lock on TDRS. After some troubleshooting, it was realized that there was a Transmitter/Receiver Controller (TRC) failure. It is currently unknown what component failed in TRC, but it is coming down on SpaceX3. The Ku-band Antenna Group 1 was operating from 16-Dec-2012 to 09-July-2013. A noticeable spectral difference is clear in SAMS roadmap spectrograms starting on 16-Dec-2013 at about GMT 20:00 and around the transition from late 09-July-2013 to early 10-July-2013.



Two Ku-Band Antenna Groups on Z1 Truss