

STEREO MOC Status Report
Time Period: 2018:001 - 2018:007

STEREO Ahead (STA) Status:

1. The following Ground System anomalies/events occurred during this reporting period:

- On day 003, during the DSS-14 support, the uplink was delayed 9 minutes due to a transmitter issue. The transmitter was recalibrated and the uplink was established at 1954z. This anomaly resulted in the loss of 9 minutes of commanding and two-way tracking data and 4196 frames of real-time and SSR data. See DR# G118783 for more information.
- On day 004, during the DSS-55 support, turbo decoder lock was lost intermittently between 1353z and 1411z. This anomaly resulted in the loss of 11 frames of SSR data.
- On day 005, during the DSS-34 support, turbo decoder lock was lost briefly at 0734z and 0845z. This anomaly resulted in the loss of 4 frames of SSR data.
- On day 005, during the DSS-63 support, telemetry lock was lost intermittently between 1744z and 1808z due to heavy rain at the Madrid complex. This anomaly resulted in the loss of 41,527 frames of real-time and SSR data. See DR# M110420 for more information.

2. The following spacecraft/instrument events occurred during this week. The Ahead observatory operated nominally during this week.

- The average daily science data return for Ahead was 6.8 Gbits during this week.

STEREO Behind (STB) Status:

1. Detailed status of the recovery activities this week to restore operations is listed below.

- On day 001, during a 4 hour 1 kHz battery recovery support with DSS-14, 306 commands were transmitted for battery state of charge recovery. Due to the duration of the support, only 34 of the 36 frequency segments were commanded.
 - On day 002, during a 4 hour 1 kHz carrier recovery support with DSS-63, 440 commands were sent for transmitter carrier recovery. No carrier was detected by either the DSN station or the radio science receiver team. Due to the duration of the support and the increased commands for each step, only 22 of the 36 frequency segments were commanded. Three commands must be received sequentially to power on the transmitter.
 - On day 005, during a 3 hour 4 kHz battery recovery search pattern support with DSS-63, 320 commands were transmitted during the support. All 7 points on the pattern were covered twice.
 - On day 007 during a 3 hour 4 kHz carrier recovery search pattern support with DSS-14, commanding was interrupted for 14 minutes between 1629z and 1643z due to a configuration issue at the station. See DR# G118795 for more information. This anomaly prevented 20 carrier recovery commands from being transmitted, and resulted in 1 of 7 points on the pattern not being covered twice. Overall, 300 commands were transmitted during the support for carrier recovery. No carrier was detected by either the DSN station or the radio science receiver team. Three commands must be received sequentially to power on the transmitter.
2. The Behind loss of communication anomaly occurred on October 1, 2014 from simultaneous failures of the star tracker and the IMU. Post superior solar conjunction, recovery operations resumed on November 30, 2015. By implementing the NASA Failure Review Board recommendations, the first recovery attempt began with carrier detection by the DSN on August 21st, through September 23, 2016. At a spacecraft range of ~2 AU, the observatory was found to be rotating slowly about its principal axis of inertia for which the uncontrolled attitude allowed some solar array input and continuous uplink and downlink communications on the LGA at emergency data rates. Over the next 22 continuous days, significant obstacles to recovery were overcome with a collaborative effort of the

JHU/APL engineering team, NASA GSFC, DSN, FDF, SSMO scheduling, and Mission Operations teams. This consisted of:

- Reliably commanding a rotating spacecraft with uncontrolled attitude at a distance of 2 AU
- How to power on the spacecraft that was never designed to be off without collapsing the battery voltage
- Acquiring telemetry at 35 bps from a spacecraft that is rotating with an uncontrolled attitude
- Warming a frozen propulsion subsystem with a degraded battery and limited solar array input with an uncontrolled attitude
- Configuring, loading, and verifying EA, C&DH, and G&C parameters and macros with very limited telemetry
- Conducting an autonomous momentum dump in the blind and transitioning to C&DH standby mode and successfully receiving telemetry on the HGA indicating star tracker lock and decreasing system momentum.

However, system momentum level remained above the threshold for re-establishing attitude control with the reaction wheels. Due to the uncontrolled attitude, communication degraded and the last detection of the carrier was on September 23, 2016.

Behind Observatory Status - From the last telemetry received on September 18, 2016 and the telemetry assessment review held on February 24, 2017, main bus voltage is low, 3 out of 11 battery cells are bypassed, attitude remains uncontrolled, rotating about its principal axis of maximum moment of inertia. While likely all ~42 kg of hydrazine remains and is frozen, both pressure transducers are not functioning. EA mode is enabled and autonomy is disabled. The battery charge rate is C/10. RF is configured for the +Z LGA at emergency data rates and the range of the expected best lock frequency (BLF) is known. Necessary macro sequences have been tested to allow the peak power tracker in C&DH standby mode to protect the battery. These macro sequences will be loaded to EEPROM when the communications supports longer commands.

After 2.5 months of daily recovery efforts that began on August 21, 2017, to date the downlink signal has not been detected by the DSN block V receivers or the RSR team. With significant support of the DSN, two different acquisition sequences are being utilized weekly to re-establish communications with STEREO Behind using a 70m track:

1. 4 kHz Sweep - consists of repeatedly sweeping a 4 kHz uplink frequency range for which the BLF was found during the first recovery attempt. Commands are sent to power on the transmitter for 30 minutes. If no carrier signal is detected, the transmitter is powered off and battery recovery commands are sent consisting power off the IEM switched power and PDU 1553 interface bus. This acquisition sequence is used 3 times each week.

2. 4 kHz Sweep with Search Pattern - The DSN created a diamond shaped search pattern with 7 steps of 0.037 deg, dwelling 10 min & 49 sec/step. There are two diamond patterns of 4 steps to cover the area of the estimated ephemeris error. The starting point is offset 0.02 deg for 100% uplink optimization. Repeating each diamond pattern accounts for the 30 minute RTLT. This search pattern acquisition sequence is used twice weekly during 3 hour supports, sending battery recovery commands at each step during the first day and on the second day, sending carrier recovery commands at each step.