STEREO MOC Status Report
Time Period: 2018:008 - 2018:014

STEREO Ahead (STA) Status:

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

   - On day 010, during the DSS-34 support, turbo decoder lock was lost briefly at 0913z. This anomaly resulted in the loss of 2 frames of SSR data.

   - On day 010, during the DSS-15 support, the transmitter tripped off-line at 011-0130z. The transmitter was recalibrated and the uplink was established at 0136z. This anomaly resulted in the loss of 6 minutes of commanding and two-way tracking data and 308 frames of real-time telemetry and SSR data. See DR# G118802 for more information.

   - On day 011, during the DSS-55 support, turbo decoder lock was lost briefly 1300z, 1327z, and 1328z. This anomaly resulted in the loss of 10 frames of real-time telemetry and SSR data.

   - On day 011, during the DSS-63 support, the antenna brakes were set at 1815z due to low film height. The antenna was reset and SSR pointers were repositioned to minimize data loss. This anomaly resulted in the loss of 4 minutes of real-time telemetry, commanding, and tracking data. All SSR data was received. See DR #M110428 for more information.

   - On day 014, during the DSS-63 support, telemetry lock was lost intermittently between 1418z through 1527z due to heavy rain at the Madrid complex. This anomaly resulted in the loss of 49,158 frames of real-time telemetry and SSR data. See DR# M110433 for more information.

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

   - On day 007 fine pointing was lost beginning at 1004z through 008-0724z. These occurrences are associated with transients that occurred as wheel 2 passed through zero. In total, there were 44 occurrences of the Fine Specs Met

flag being zero for 21 hours which is well within the 3-sigma jitter specification. These transients can occur with no gyro operations and are not indicative of any problem with the spacecraft G&C.

- 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 009, during a 3.5 hour 1 kHz battery recovery support with DSS-63, the station stopped tracking due to antenna brakes being set at 1107z. After station personnel cleared the problem at 1235z, the uplink was resumed and 170 commands were transmitted for battery state of charge recovery. Due to the anomaly and duration of the support, only 18 of the 36 frequency segments were commanded. See DR# M110423 for more information.

   - On day 012, 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 014, during a 3 hour 4 kHz battery recovery search pattern support with DSS-14, 320 commands were transmitted during the support. All 7 points on the pattern were covered twice.

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.