STEREO MOC Status Report
Time Period: 2016:011 – 2016:017

STEREO Ahead (STA) Status:

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

   - On day 013, MOps was alerted that DSS-14 transmitter had been declared red due with an ETRO of DOY 019-2300z. To allow for repair work on the transmitter, the DSS-14 track was shortened by one hour to duration of 1.3 hours. Two additional supports, on day 017 with DSS-54 and day 018 with DSS-74, ESA New Norcia, were added to preserve daily commanding on Ahead. Thankfully, STEREO has access to the ESA stations. This anomaly resulted in the loss of 1.1 hours of commanding and two-way tracking data. See DR# G116883 for more information.

   - On day 014, during the DSS-55 support, the SSR pointers were repositioned to prevent data loss due to ending the previous DSS-14 support an hour early.

   - On day 014, the 5th uplink array test for STEREO using DSS-24, 25, and 26 was successfully conducted by the DSN. The new configuration consisted of three 34m stations using the 80 kW and two 20 kW transmitters with the HGA main lobe and with the MOC sending no-op commands. An approximate 12 dBm increase in received uplink power, as compared to a single 34m, was demonstrated with all 10 no-op commands being received correctly using the 7.8125 bps uplink rate.

2. The following spacecraft/instrument events occurred during this week. The Ahead observatory operated nominally during this week on the center of the HGA main lobe. The HGA feed assembly was at 117 degrees C and decreasing with the HGA angle at 7.4 degrees and increasing, with respect to the spacecraft-Sun line.

   - On day 014, the Ahead observatory reached perihelion in the orbit.

   - On day 015, the SECCHI SSR science partition (#19) filled and blocked at 2106z for 0.25 hours. This was due to the

shortening of the DSS-14 track on day 013 by one hour to support transmitter repair work.

- The average daily science data return for Ahead was 4.5 Gbits during this week.

STEREO Behind (STB) Status:

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

   - On day 015, MOps was alerted that DSS-26 80 kW transmitter had been declared red with an ETRO of DOY 020-2300z. The 20 kW transmitter was used to send 180 commands for battery state of charge recovery. During the support, the transmitter tripped off-line at 1846z. After recalibrating, the transmitter resumed uplinking at 1849z. This anomaly resulted in the loss of commanding one frequency segment. See DR# G116889 and G116893 for more information.

   - On day 016, during the DSS-26 34m support, using the 20 kW transmitter as the 80 kW transmitter was red, 207 commands were sent for battery state of charge recovery.

   - On day 017, during the DSS-14 70m support, 380 commands were sent for transmitter carrier recovery. The Green Bank Radio Telescope and Allen Telescope Array observed concurrently, however, no downlink signal was detected by them or the DSN. Due to the duration of the support and the increased commands for each step, only 19 of the 36 frequency segments were commanded. Three commands must be received sequentially to power on the transmitter.

2. Detailed status of the recovery activities to restore operations from the Behind loss of communication anomaly, which occurred on October 1, 2014, are listed below. Recovery operations resumed on November 30, 2015.

   - The Behind observatory entered superior solar conjunction at the 2.0 degree SPE angle on January 22, 2015. Recovery efforts resumed post solar conjunction on May 4th through June 27, 2015, as the spacecraft had cleared solar interference for LGA communications. The Failure Review Board recommendations were implemented consisting of

battery state of charge recovery and powering on the downlink carrier. The Green Bank Radio Telescope and the Arecibo Observatory also observed the carrier recovery tracks. To date, no downlink signal has been detected from the Behind observatory since the anomaly occurred. Due to Behind's retrograde motion causing it to re-enter the region of solar interference, recovery operations were suspended from June 28th through November 29, 2015. The Green Bank Radio Telescope and the Allen Telescope Array will also observe the carrier recovery tracks depending on availability. While the Arecibo Observatory is will also assist, the Behind observatory is not in view until April 2016.

- The Failure Review Board's recommended faster frequency segmented acquisition sequence was tested with the Ahead observatory on September 29, 2015. All 18 one kHz frequency steps were tested twice. While stepping down through the 1 kHz segments, on segment #9 going down in frequency, the transponder locked to the BLF and accepted 9 no-op commands as expected. An interesting finding, but not unexpected, was that the transponder continued to follow the moving carrier and accept all commands sent for the remaining 27 segments.

- As commands must be received to recover the Behind observatory, testing of the DSN uplink arraying capability using the Ahead observatory continued on January 14th with the 5th uplink array test successfully conducted for STEREO using DSS-24, 25, and 26. The new configuration consisted of three 34m stations using the 80 kW and two 20 kW transmitters with the HGA main lobe and with the MOC sending no-op commands. An approximate 12 dBm increase in received uplink power, as compared to a single 34m, was demonstrated with all 10 no-op commands being received correctly using the 7.8125 bps uplink rate. This will provide four times the uplink received power as a 70m station. The final test configuration will add the frequency segmented acquisition sequence to the uplink array, scheduled for February 19th. When the uplink array capability is ready, it will be used to increase the spacecraft received signal power to assist with Behind recovery commanding.

- With time the spacecraft range improves RF communications and the ability for other assets to acquire data on Behind. While the STEREO RF link was not designed to be closed

beyond 2 AU, as the Earth range is now decreasing, the LGA uplink margin returns to nominal, 6 dB for the 7.8 bps rate, in March 2016 and the LGA downlink margin returns to nominal, 3 dB for the 12 bps rate, in December 2016.

Significant findings to date:

1. Analysis of the three DSN extracted telemetry frames from the carrier signal just before the planned observatory reset/anomaly occurred on October 1, 2014 showed nominal performance of the spacecraft, i.e., no anomalies, IMU off, and the star tracker providing an attitude solution.

2. Post reset, from the very limited telemetry, three packets, extracted from the carrier signal by the DSN, the X-axis gyro on IMU-A had failed. Unfortunately, this telemetry contained only G&C anomaly data and no spacecraft summary data, i.e., the state of the RF, G&C, fault protection and other subsystems is not known at the time of the anomaly. With a failed IMU and the star tracker being off-line for an undetermined duration, the sun sensors will keep the observatory pointed at the Sun, though the G&C will not have any roll knowledge, and cannot roll the observatory as part of the safing configuration to re-establish communications on the LGAs. From analysis of this telemetry and initial G&C simulations, it is highly suspected that the observatory is rotating about the principal axis of inertia due to an autonomous momentum dump initiated by biased gyro data flagged good by the IMU, but this has not yet been confirmed.

3. At least two anomalies occurred post reset, the star tracker not promoting to AAD mode and the X-axis gyro failure. Unfortunately, due to the number of possible combinations, the STEREO fault protection system is not designed for simultaneous failures.

Once communications are restored and the anomaly resolved, the Behind observatory will be returned to nominal science data collection as soon as it is safely possible.