STEREO MOC Status Report
Time Period: 2015:145 – 2015:151

STEREO Ahead (STA) Status:

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

   - On day 150, the Green Bank Telescope, which has been using the Ahead observatory downlink signal for solar scintillation research, reported receiving a nominal HGA downlink signal post solar conjunction on schedule from the Ahead observatory at 1732z. This occurred after the 22nd HCLT initiated system reset post solar conjunction at a 0.4 degree SPE angle.

2. The following spacecraft/instrument events occurred during this week.

   - The Ahead observatory entered superior solar conjunction at the 2.0 degree SPE angle on day 083, March 24th. It is in its safe mode configuration; rotating slowly at 5 degrees per minute with only the SWAVES instrument on and recording at one packet per minute. The HGA is being held at 8.1 degrees, with respect to the spacecraft-Sun line, to prevent overheating of the HGA feed assembly. The Green Bank Radio Telescope is observing Ahead for solar scintillation research every three days post solar conjunction beginning on day 150, May 30th, at an SPE angle of 0.4 degrees. The next DSN support is on day 180, June 29th, to monitor the exiting of solar conjunction at an SPE angle of 1.6 degrees. Once the uplink communication link is stable at the 2.0 degree SPE angle on July 8th, the observatory will be recovered, instruments will be powered on, and limited science data collection will resume using the 2nd HGA side lobe. Dates for instrument power on and real-time commanding opportunities will be coordinated in June. Once the HGA returns to the main lobe use in mid-November, nominal daily science collection and data return will resume.

STEREO Behind (STB) Status:

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

- On day 124, May 4th, Behind recovery operations resumed as the observatory has cleared solar interference for LGA communications. Based on the Failure Review Board recommendations, the recovery operations consist of recovering the battery state of charge for the first two days. On the third day, the transmitter will be commanded on to receive the carrier. Recovery operations are significantly different than what was conducted in January. This includes a faster frequency segmented acquisition sequence, sweeping a lower frequency range, battery state of charge recovery and powering on the transmitter using only short critical commands. The frequency segmented acquisition sequence is a significant departure for deep space communications which typically require a slow sweep of the entire best lock frequency range. The DSN staff cleverly developed a 10 second automated uplink sweep consisting of 18 one kHz frequency segments followed by repeatedly sending short commands. Note that the use of the JPL radio science receiver capability for the carrier recovery tracks has been delayed until funding negotiations have been completed.

- The Green Bank Radio Telescope and Arecibo Observatory are scheduled to assist periodically in the Behind recovery efforts during the carrier recovery tracks when the MOC will attempt to power on the transmitter.

- On day 145, during the DSS-43 70m support, 225 commands were sent for battery state of charge recovery.

- On day 147, during the DSS-43 70m support, 189 commands were sent for battery state of charge recovery.

- On day 148, during the DSS-14 70m station, 220 commands were sent for powering on the transmitter. Due to the duration of the support and the increased commands for each step, only 11 of the 18 frequency segments were commanded. Three commands must be received sequentially to power on the transmitter. The Green Bank Radio Telescope participated for 3 hours as well as the Arecibo Observatory for 36 minutes. After Green Bank and the DSN reported a possible signal, the JPL radio science receivers were placed on-line as well for the last hour of the support. Subsequent analysis revealed that no downlink signal was detected by any station.

2. Detailed status of the activities that occurred on the Behind loss of communication anomaly, which occurred on day 2014-274, are listed below.

   - The Behind observatory entered superior solar conjunction at the 2.0 degree SPE angle on day 022. Recovery efforts resumed post solar conjunction on day 124, May 4th through day 179, June 28th, as the spacecraft will be clear of solar interference for recovering on the LGA. The Failure Review Board recommendations are being implemented consisting of battery state of charge recovery and powering on the downlink carrier. Due to Behind's orbit going retrograde and re-entering the region of solar interference, recovery operations will be suspended from July through November. The DSN uplink arraying capability will be tested again with the Ahead observatory in October and November, and when it is ready, it will be used to increase the ground transmit power to assist with Behind recovery commanding.

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 day 2014-274, October 1st, 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.

The cause and effect analysis of the loss of communications from the LGAs is continuing. G&C simulations using the biased gyro data flagged good by the IMU are continuing to better understand the potential impact to the observatory state. Recovery from a negative power state is also being investigated. While the recovery and analysis efforts continue on Behind, as the Ahead observatory will enter superior solar conjunction in March, the primary focus of the engineering team is on developing operational configuration changes to add robustness to the G&C rate sensor usage to ensure the Ahead observatory's continued safety.

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.