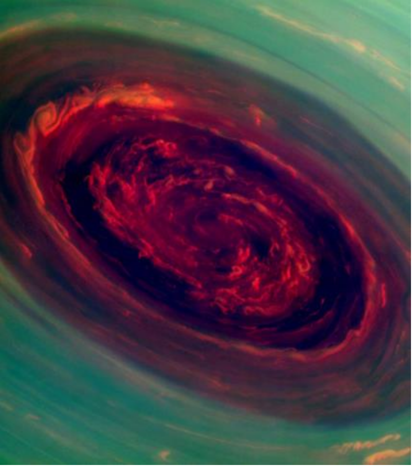
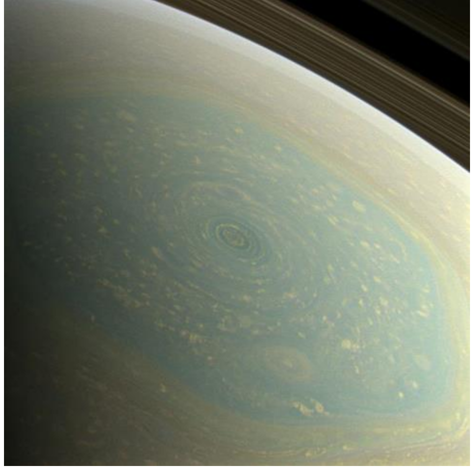
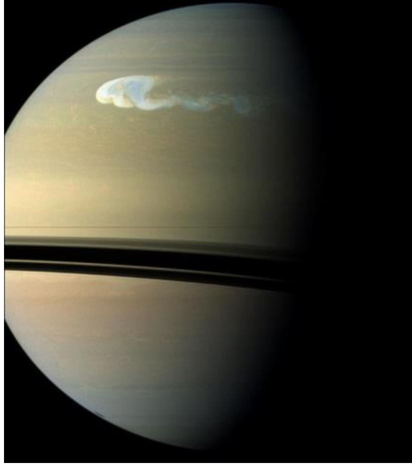
   

Science Planning & Sequence Team CASSINI

# SATURN TARGET WORKING TEAM

**Rev 278_279 Segment Legacy Package**

**Segment Boundary: June 10, 2017 – June 16, 2017**
**2017-161T00:55:00 – 167T12:18:00 (SCET)**

**Integration Began 08/15/2016**
**Segment Delivered to S100 Sequence 12/07/2016**
**Lead Integrator was Keven Uchida**

**Legacy Package Assembled by Keven Uchida**

# Table of Contents



*** N.A. = Slide present but content not available.**

# Segment Overview and Final Products

# Segment Summary



- This was a 6 day long Proximal segment, spanning across both periapse and apoapse.
- This segment began with a “jumpstart” period (see last bullet), containing Radio Science (RSS) gravity and ring occultation measurements/observations (see page 11, “Periapse Quicklooks” and the following “Daily Science Highlights” pages). CDA rides along, performing the first of only two observations of its kind, to measure **small** particles in the main ring.
- Outside of the jumpstart period, the Segment was pre-populated with a high priority (PIE) ISS observation of Enceladus’ Plume (DOY 162).
- The remainder of the segment was integrated with VIMS mapping observations. Three UVIS EUV/FUV activities were placed in this segment. They were coordinated in time/spacing to provide observations over as broad a range of phase angles as possible (between 154 to 139 degrees), and within a short time period, to enhance the science return.
- The Sun passed within 8.1 degrees of Saturn center at 161T23:30 (See page 10; “Solar Geometry – ORS Boresight Concerns”). The only activity impacted by the close approach was the VIMS Southern Hemisphere Map (162T02:38:00 to 162T07:00:00) – mapping had to be directed/limited to Saturn’s southernmost limb, opposite the Sun, in order to avoid violating the ORS-boresight to Sun minimum angle flight rule.
- As noted earlier, this segment contained a “jumpstart” period. Due to the challenging geometry and unique science of this phase of the mission, the timeline for the days around periapse was decided in advance of full segment integration. Detailed pointing analysis, constraint checking, and reaction-wheel bias optimization (RBOT) was performed on the periapse period. No changes were required following this analysis, due to relaxed constraints

# Final Sequenced SPASS (1 of 1)



| | Request | Riders | Start (SCET) | Start (Epoch) | Duration | End | Primary | Secondary | Comments |
|---|---|---|---|---|---|---|---|---|---|
| | Sequence S100, length = 46 ... | | 2017-145T08:57:00 | | 045T16:17:00 | 2017-191T01:14:00 | | | |
| | SATURN_278_279 Segment | | 2017-161T00:55:00 | | 006T11:23:00 | 2017-167T12:18:00 | | | |
| Rev278 Jumpstart | SP_278EA_G34BWGRSS161_PRIME | C, M, R | 2017-161T03:00:00 | | 000T08:00:00 | 2017-161T11:00:00 | XBAND to Earth | POS_X to 299.7/63.6 | Collaborative Rider(s): CDA |
| Rev278 Jumpstart | SP_278EA_C70METRSS161_PRIME | M, R | 2017-161T11:00:00 | | 000T01:01:00 | 2017-161T12:01:00 | XBAND to Earth | POS_X to 299.7/63.6 | Collaborative Rider(s): CDA |
| Rev278 Jumpstart | RSS_278RI_PERIOCC001_PRIME | M, R | 2017-161T12:01:00 | | 000T02:07:00 | 2017-161T14:08:00 | XBAND to Earth | POS_X to 299.7/63.6 | Collaborative Rider(s): CDA |
| Rev278 Jumpstart | Periapse R = 1.055 Rs, lat ... | | 2017-161T12:53:15 | | 000T00:00:01 | 2017-161T12:53:16 | | | |
| Rev278 Jumpstart | SP_278EA_C70METRSS461_PRIME | C, M, R | 2017-161T14:08:00 | | 000T02:24:00 | 2017-161T16:32:00 | XBAND to Earth | POS_X to 299.7/63.6 | Collaborative Rider(s): CDA |
| Rev278 Jumpstart | RSS_278RI_CRDOCC001_PRIME | M, R | 2017-161T16:32:00 | | 000T10:06:00 | 2017-162T02:38:00 | XBAND to Earth | POS_X to 299.7/63.6 | Collaborative Rider(s): CDA |
| Rev278 Jumpstart | VIMS_278SA_SHEMMAP001_PRIME | C, U | 2017-162T02:38:00 | | 000T04:22:00 | 2017-162T07:00:00 | ISS_NAC to Saturn_South_Pole | NEG_Z to NSP | |
| | ENGR_278SC_SSACHK162_AACS | | 2017-162T07:45:00 | | 000T00:45:00 | 2017-162T08:30:00 | XBAND to Earth | NEG_Y to NSP | |
| | SP_278EA_C70METNON462_PRIME | C | 2017-162T08:30:00 | | 000T09:00:00 | 2017-162T17:30:00 | XBAND to Earth | Rolling | |
| | SP_278SA_WAYPTTURN162_PRIME | | 2017-162T17:30:00 | | 000T00:40:00 | 2017-162T18:10:00 | ISS_NAC to Saturn | NEG_X to NSP | |
| | NEW WAYPOINT | | 2017-162T18:10:00 | | 001T12:35:00 | 2017-164T06:45:00 | ISS_NAC to Saturn | NEG_X to NSP | |
| Gap 1a | VIMS_278SA_SHEMMAP002_PRIME | | 2017-162T18:10:00 | | 000T04:20:00 | 2017-162T22:30:00 | ISS_NAC to Saturn | NEG_X to NSP | |
| | ISS_278EN_PLUME001_PIE | C, U, V | 2017-162T22:30:00 | | 000T12:40:00 | 2017-163T11:10:00 | ISS_NAC to Enceladus | NEG_X to NSP | SOST PIE |
| Gap 1b | VIMS_278SA_GLOBMAP001_PRIME | | 2017-163T11:10:00 | | 000T03:00:00 | 2017-163T14:10:00 | ISS_NAC to Saturn | NEG_X to NSP | |
| Gap 1b | UVIS_278SA_EUVFUV001_PRIME | C, I | 2017-163T14:10:00 | | 000T15:55:00 | 2017-164T06:05:00 | UVIS_FUV to Saturn | NEG_X to Sun | |
| | SP_278EA_DLTURN164_PRIME | | 2017-164T06:05:00 | | 000T00:40:00 | 2017-164T06:45:00 | XBAND to Earth | NEG_X to NEP | |
| | NEW WAYPOINT | | 2017-164T06:45:00 | | 000T11:10:00 | 2017-164T17:55:00 | XBAND to Earth | NEG_X to NEP | |
| | SP_278EA_YGAP164_PRIME | | 2017-164T06:45:00 | | 000T01:30:00 | 2017-164T08:15:00 | XBAND to Earth | NEG_X to NEP | |
| | SP_278EA_C70METNON164_PRIME | C | 2017-164T08:15:00 | | 000T09:00:00 | 2017-164T17:15:00 | XBAND to Earth | Rolling | |
| | SP_278SA_WAYPTTURN164_PRIME | | 2017-164T17:15:00 | | 000T00:40:00 | 2017-164T17:55:00 | ISS_NAC to Saturn | NEG_X to Sun | |
| | NEW WAYPOINT | | 2017-164T17:55:00 | | 000T07:05:00 | 2017-165T01:00:00 | ISS_NAC to Saturn | NEG_X to Sun | |
| Gap 2 | UVIS_278SA_EUVFUV002_PRIME | C, I, V | 2017-164T17:55:00 | | 000T06:25:00 | 2017-165T00:20:00 | UVIS_FUV to Saturn | NEG_X to Sun | |
| | Apoapse Per = 6.5 d, inc =... | | 2017-164T18:24:23 | | 000T00:00:01 | 2017-164T18:24:24 | | | |
| | SP_279EA_DLTURN165_PRIME | | 2017-165T00:20:00 | | 000T00:40:00 | 2017-165T01:00:00 | XBAND to Earth | NEG_X to NEP | |
| | NEW WAYPOINT | | 2017-165T01:00:00 | | 000T10:25:00 | 2017-165T11:25:00 | XBAND to Earth | NEG_X to NEP | |
| | SP_279EA_YGAP165_PRIME | | 2017-165T01:00:00 | | 000T01:30:00 | 2017-165T02:30:00 | XBAND to Earth | NEG_X to NEP | |
| | SP_279EA_G34BWGNON165_PRIME | C | 2017-165T02:30:00 | | 000T08:15:00 | 2017-165T10:45:00 | XBAND to Earth | Rolling | |
| | SP_279SA_WAYPTTURN165_PRIME | | 2017-165T10:45:00 | | 000T00:40:00 | 2017-165T11:25:00 | ISS_NAC to Saturn | NEG_X to Sun | |
| | NEW WAYPOINT | | 2017-165T11:25:00 | | 000T19:25:00 | 2017-166T06:50:00 | ISS_NAC to Saturn | NEG_X to Sun | |
| Gap 3 | UVIS_279SA_EUVFUV001_PRIME | C, I, V | 2017-165T11:25:00 | | 000T18:45:00 | 2017-166T06:10:00 | UVIS_FUV to Saturn | NEG_X to Sun | |
| | SP_279EA_DLTURN166_PRIME | | 2017-166T06:10:00 | | 000T00:40:00 | 2017-166T06:50:00 | XBAND to Earth (0.0,0.0,-9.5 deg. offset) | NEG_Y to Saturn | |
| | NEW WAYPOINT | | 2017-166T06:50:00 | | 000T11:10:00 | 2017-166T18:00:00 | XBAND to Earth (0.0,0.0,-9.5 deg. offset) | NEG_Y to Saturn | |
| | SP_279EA_YGAP166_PRIME | | 2017-166T06:50:00 | | 000T01:30:00 | 2017-166T08:20:00 | XBAND to Earth (0.0,0.0,-9.5 deg. offset) | NEG_Y to Saturn | |
| | SP_279EA_C34BWGNON166_PRIME | C, E | 2017-166T08:20:00 | | 000T09:00:00 | 2017-166T17:20:00 | XBAND to Earth (0.0,0.0,-9.5 deg. offset) | NEG_Y to Saturn | MIMI. NEG_Y to SA (0,0,-9.5). |
| | SP_279SA_WAYPTTURN166_PRIME | | 2017-166T17:20:00 | | 000T00:40:00 | 2017-166T18:00:00 | ISS_NAC to Saturn | NEG_X to NSP | |
| | NEW WAYPOINT | | 2017-166T18:00:00 | | 000T06:45:00 | 2017-167T00:45:00 | ISS_NAC to Saturn | NEG_X to NSP | |
| Gap 4 | VIMS_279SA_NHEMMAP001_PRIME | C | 2017-166T18:00:00 | | 000T04:35:00 | 2017-166T22:35:00 | ISS_NAC to Saturn | NEG_X to NSP | |
| Gap 4 | ISS_279TI_M150R3HZ166_PRIME | C, V | 2017-166T22:35:00 | | 000T01:30:00 | 2017-167T00:05:00 | ISS_NAC to Titan | NEG_X to NSP | |
| | SP_279EA_DLTURN167_PRIME | | 2017-167T00:05:00 | | 000T00:40:00 | 2017-167T00:45:00 | XBAND to Earth | NEG_Y to 22.34/-50.0 | |
| | NEW WAYPOINT | | 2017-167T00:45:00 | | 001T04:45:00 | 2017-168T05:30:00 | XBAND to Earth | NEG_Y to 22.34/-50.0 | |
| | SP_279EA_YGAP167_PRIME | | 2017-167T00:45:00 | | 000T01:30:00 | 2017-167T02:15:00 | XBAND to Earth | NEG_Y to 22.34/-50.0 | |
| | SP_279EA_G34B26NON167_PRIME | C | 2017-167T02:15:00 | | 000T04:20:00 | 2017-167T06:35:00 | XBAND to Earth | Rolling | Match following MAPS_279 custom period pickup attitude |
| | SP_279EA_C70METNON167_PRIME | C, E | 2017-167T06:35:00 | | 000T05:25:00 | 2017-167T12:00:00 | XBAND to Earth | 5_Hr_Rolling | Match following MAPS_279 custom period pickup attitude |

# Final Sequenced SMT and Data Volume (1 of 2)

DATA VOLUME SUMMARY --- TRANSFER FRAME OVERHEAD INCLUDED (80 BITS PER 8800-BIT FRAME)

| | | | OBSERVATION_PERIOD | | | | | | | DOWNLINK_PASS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | P4 | | | | | | P5 | RECORDED | | PLAYBACK | | | | | |
| DOWNLINK PASS NAME | Start doy hh:mm | End doy hh:mm | START (Mb) | SCI (Mb) | HK+E (Mb) | TOTAL (Mb) | CPACTY (Mb) | MRGN (Mb) | OPNAV (Mb) | SCI (Mb) | ENGR (Mb) | TOTAL (Mb) | CPACTY (Mb) | MARGN (Mb) | NET_MARGN (Mb) | NET_MARGN (%) | CAROVR (Mb) |
| SP_278EA_G34BWGRSS161_PRIME | 161 03:00 | 161 11:00 | 1372 | 0 | 0 | 1372 | 3322 | 1951 | 0 | 705 | 47 | 2124 | 577 | -1547 | 142 | 1% | 1547 |
| SP_278EA_C70METRSS161_PRIME | 161 11:00 | 161 12:01 | 1547 | 0 | 0 | 1547 | 3322 | 1776 | 0 | 231 | 6 | 1783 | 439 | -1345 | 142 | 1% | 1345 |
| SP_278EA_C70METRSS461_PRIME | 161 14:08 | 161 16:32 | 1345 | 548 | 9 | 1901 | 3322 | 1421 | 0 | 290 | 14 | 2206 | 1016 | -1190 | 142 | 1% | 1189 |
| SP_278EA_C70METNON462_PRIME | 162 08:30 | 162 17:30 | 1189 | 1604 | 67 | 2861 | 3322 | 461 | 0 | 786 | 53 | 3700 | 3834 | 134 | 142 | 1% | 0 |
| SP_278EA_C70METNON164_PRIME | 164 08:15 | 164 17:15 | 0 | 3151 | 164 | 3315 | 3322 | 7 | 0 | 199 | 53 | 3567 | 3882 | 314 | 795 | 5% | 0 |
| SP_279EA_G34BWGNON165_PRIME | 165 02:30 | 165 10:45 | 0 | 526 | 39 | 565 | 3322 | 2757 | 0 | 182 | 49 | 796 | 584 | -212 | 480 | 4% | 212 |
| SP_279EA_C34BWGNON166_PRIME | 166 08:20 | 166 17:20 | 212 | 1392 | 91 | 1695 | 3322 | 1627 | 0 | 199 | 53 | 1947 | 918 | -1030 | 480 | 4% | 1030 |
| SP_279EA_G34B26NON167_PRIME | 167 02:15 | 167 06:35 | 1030 | 636 | 38 | 1703 | 3322 | 1619 | 0 | 248 | 26 | 1977 | 352 | -1625 | 480 | 4% | 1625 |
| SP_279EA_C70METNON167_PRIME | 167 06:35 | 167 12:00 | 1625 | 0 | 0 | 1625 | 3322 | 1697 | 0 | 310 | 32 | 1966 | 2122 | 155 | 480 | 4% | 0 |

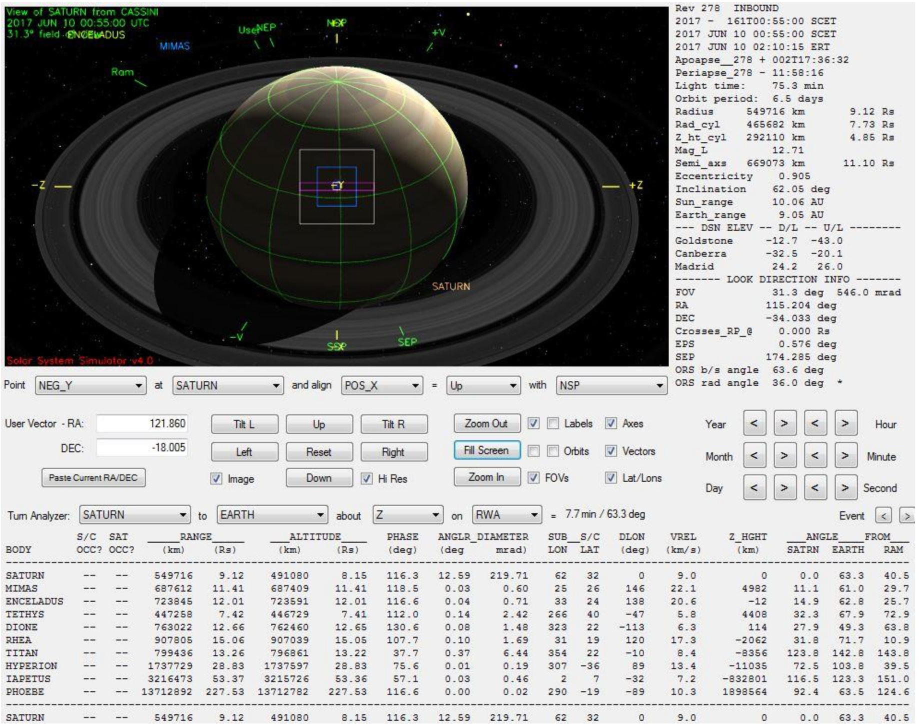
# Final Sequenced SMT and Data Volume (2 of 2)

DATA VOLUME REPORT --- TRANSFER FRAME OVERHEAD NOT INCLUDED

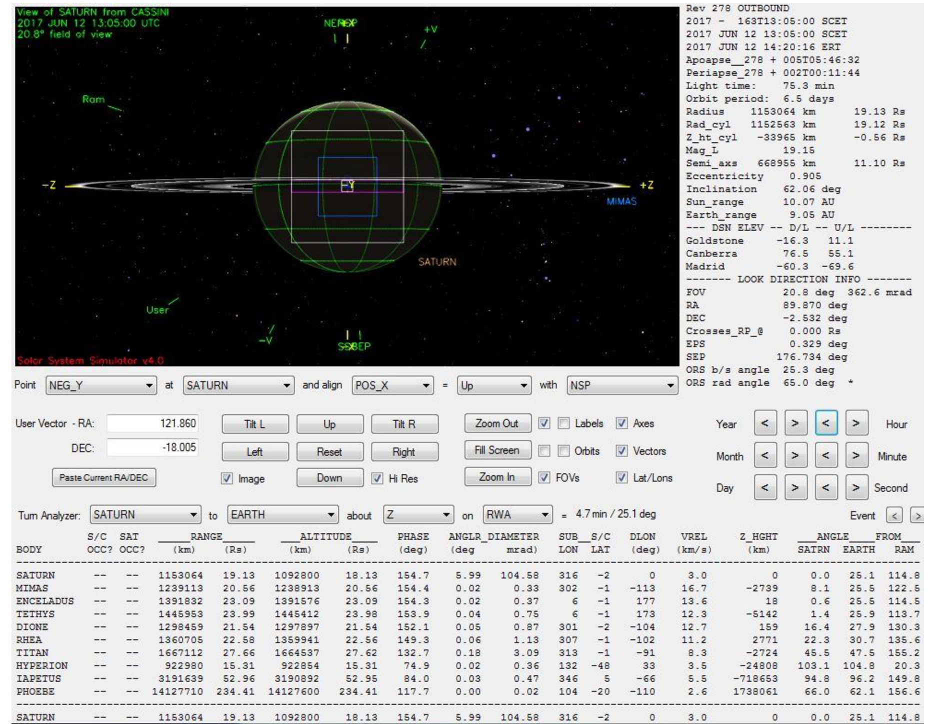
Saturn_278_279

| Event | Start doy hh:mm | End doy hh:mm | CAPS (Mb) | CDA (Mb) | CIRS (Mb) | INMS (Mb) | ISS (Mb) | MAG (Mb) | MIMI (Mb) | RADAR (Mb) | RPWS (Mb) | UVIS (Mb) | VIMS (Mb) | PROBE (Mb) | ENGR (Mb) | TOTAL (Mb) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| OBSERVATION_NOR | 159 06:46 | 160 16:05 | 0.0 | 62.8 | 378.7 | 13.7 | 1100.0 | 59.3 | 101.9 | 0.0 | 391.7 | 1.4 | 119.0 | 0.0 | 139.2 | 2367.8 |
| SP_278EA_C70METNON160_PRIME | 160 16:05 | 160 19:30 | 0.0 | 6.4 | 36.9 | 1.4 | 0.0 | 6.1 | 10.5 | 0.0 | 126.7 | 1.9 | 0.0 | 0.0 | 0.0 | 189.8 |
| SP_278EA_M34BWGRSS160_PRIME | 160 19:30 | 161 03:00 | 0.0 | 18.1 | 11.7 | 3.0 | 0.0 | 13.3 | 23.1 | 0.0 | 353.1 | 4.1 | 0.0 | 0.0 | 0.0 | 426.4 |
| SP_278EA_G34BWGRSS161_PRIME | 161 03:00 | 161 11:00 | 0.0 | 30.2 | 10.8 | 2.9 | 0.0 | 31.1 | 34.6 | 0.0 | 584.7 | 4.4 | 0.0 | 0.0 | 0.0 | 698.6 |
| SP_278EA_C70METRSS161_PRIME | 161 11:00 | 161 12:01 | 0.0 | 12.5 | 0.0 | 1.1 | 0.0 | 7.2 | 4.7 | 0.0 | 202.6 | 0.6 | 0.0 | 0.0 | 0.0 | 228.7 |
| DAILY TOTAL SCIENCE | 159 06:46 | 161 12:01 | 0.0 | 130.1 | 438.1 | 22.0 | 1100.0 | 117.0 | 174.7 | 0.0 | 1658.7 | 12.4 | 119.0 | 0.0 | 139.2 | |
| OBSERVATION_NOR | 161 12:01 | 161 14:08 | 0.0 | 31.9 | 0.0 | 10.2 | 0.0 | 15.1 | 13.2 | 0.0 | 472.4 | 0.0 | 0.0 | 0.0 | 8.8 | 551.6 |
| SP_278EA_C70METRSS461_PRIME | 161 14:08 | 161 16:32 | 0.0 | 12.3 | 15.1 | 0.9 | 0.0 | 17.1 | 10.4 | 0.0 | 230.7 | 1.3 | 0.0 | 0.0 | 0.0 | 287.7 |
| DAILY TOTAL SCIENCE | 161 12:01 | 161 16:32 | 0.0 | 44.2 | 15.1 | 11.0 | 0.0 | 32.1 | 23.6 | 0.0 | 703.2 | 1.3 | 0.0 | 0.0 | 8.8 | |
| OBSERVATION_NOR | 161 16:32 | 162 08:30 | 0.0 | 45.9 | 62.9 | 5.7 | 0.0 | 35.3 | 56.9 | 0.0 | 1166.9 | 15.8 | 200.0 | 0.0 | 66.7 | 1656.2 |
| SP_278EA_C70METNON462_PRIME | 162 08:30 | 162 17:30 | 0.0 | 17.0 | 86.4 | 3.2 | 0.0 | 16.0 | 27.5 | 0.0 | 623.5 | 4.9 | 0.0 | 0.0 | 0.0 | 778.7 |
| DAILY TOTAL SCIENCE | 161 16:32 | 162 17:30 | 0.0 | 62.9 | 149.3 | 9.0 | 0.0 | 51.3 | 84.4 | 0.0 | 1790.4 | 20.8 | 200.0 | 0.0 | 66.7 | |
| OBSERVATION_NOR | 162 17:30 | 164 08:15 | 0.0 | 73.1 | 411.6 | 14.0 | 1250.0 | 68.9 | 118.6 | 0.0 | 182.7 | 483.4 | 520.0 | 0.0 | 162.0 | 3284.2 |
| SP_278EA_C70METNON164_PRIME | 164 08:15 | 164 17:15 | 0.0 | 17.0 | 86.4 | 3.2 | 0.0 | 16.0 | 27.5 | 0.0 | 42.4 | 4.9 | 0.0 | 0.0 | 0.0 | 197.5 |
| DAILY TOTAL SCIENCE | 162 17:30 | 164 17:15 | 0.0 | 90.1 | 498.0 | 17.2 | 1250.0 | 84.9 | 146.1 | 0.0 | 225.2 | 488.3 | 520.0 | 0.0 | 162.0 | |
| OBSERVATION_NOR | 164 17:15 | 165 02:30 | 0.0 | 17.4 | 46.2 | 3.3 | 50.0 | 16.5 | 28.3 | 0.0 | 43.6 | 116.2 | 200.0 | 0.0 | 38.7 | 560.2 |
| SP_279EA_G34BWGNON165_PRIME | 165 02:30 | 165 10:45 | 0.0 | 15.6 | 78.3 | 3.0 | 0.0 | 14.7 | 25.2 | 0.0 | 38.9 | 4.5 | 0.0 | 0.0 | 0.0 | 180.2 |
| DAILY TOTAL SCIENCE | 164 17:15 | 165 10:45 | 0.0 | 33.0 | 124.5 | 6.3 | 50.0 | 31.1 | 53.6 | 0.0 | 82.5 | 120.8 | 200.0 | 0.0 | 38.7 | |
| OBSERVATION_NOR | 165 10:45 | 166 08:20 | 0.0 | 40.7 | 135.0 | 7.8 | 50.0 | 38.4 | 66.0 | 0.0 | 101.8 | 339.7 | 600.0 | 0.0 | 90.2 | 1469.6 |
| SP_279EA_C34BWGNON166_PRIME | 166 08:20 | 166 17:20 | 0.0 | 17.0 | 86.4 | 3.2 | 0.0 | 16.0 | 27.5 | 0.0 | 42.4 | 4.9 | 0.0 | 0.0 | 0.0 | 197.5 |
| DAILY TOTAL SCIENCE | 165 10:45 | 166 17:20 | 0.0 | 57.7 | 221.4 | 11.0 | 50.0 | 54.4 | 93.6 | 0.0 | 144.2 | 344.6 | 600.0 | 0.0 | 90.2 | |
| OBSERVATION_NOR | 166 17:20 | 167 02:15 | 0.0 | 16.8 | 54.6 | 3.2 | 38.5 | 15.9 | 27.3 | 0.0 | 269.8 | 0.0 | 204.0 | 0.0 | 37.3 | 667.4 |
| SP_279EA_G34B26NON167_PRIME | 167 02:15 | 167 06:35 | 0.0 | 8.2 | 36.0 | 1.6 | 0.0 | 7.7 | 13.3 | 0.0 | 176.3 | 2.4 | 0.0 | 0.0 | 0.0 | 245.4 |
| SP_279EA_C70METNON167_PRIME | 167 06:35 | 167 12:00 | 0.0 | 10.2 | 45.0 | 2.0 | 0.0 | 9.6 | 16.6 | 0.0 | 220.4 | 3.0 | 0.0 | 0.0 | 0.0 | 306.7 |
| DAILY TOTAL SCIENCE | 166 17:20 | 167 12:00 | 0.0 | 35.2 | 135.6 | 6.7 | 38.5 | 33.2 | 57.1 | 0.0 | 666.5 | 5.4 | 204.0 | 0.0 | 37.3 | |

## Segment START: 2017-161T00:55



## Segment MIDDLE: 2017-163T13:00:00

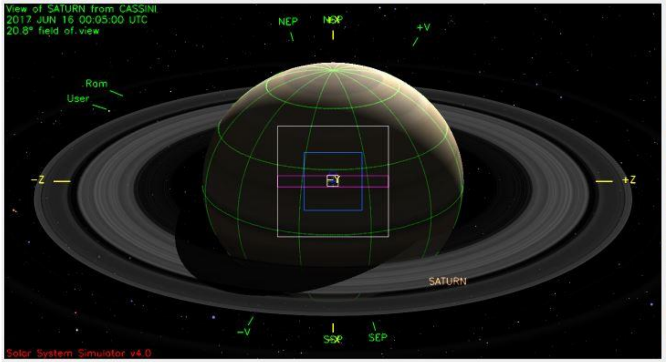


| | Saturn Range | Phase Angle | Sub-S/C Lat. |
|---|---|---|---|
| Segment Start | 9.12 | 161.3 | +32 |
| Periapse | 1.06 | 31.5 | –4 |
| Apoapse | 21.16 | 146.5 | +6 |
| Segment End | 13.76 | 127.7 | +23 |

*Continued on next page*

# Segment Geometry (2 of 2)

## Segment END: 2017-167T00:05:00




```
Rev 279  INBOUND
2017 -  167T00:05:00 SCET
2017 JUN 16 00:05:00 SCET
2017 JUN 16 01:20:14 ERT
Apoapse__279 + 002T05:40:35
Periapse_279 - 23:50:47
Light time:     75.2 min
Orbit period:   6.5 days
Radius      829563 km       13.76 Rs
Rad_cyl     765360 km       12.70 Rs
Z_ht_cyl    319998 km        5.31 Rs
Mag_L           16.17
Semi_axs    668910 km       11.10 Rs
Eccentricity     0.905
Inclination     62.09 deg
Sun_range       10.06 AU
Earth_range      9.05 AU
--- DSN ELEV -- D/L -- U/L --------
Goldstone      -17.5  -48.0
Canberra       -31.8  -16.6
Madrid          25.8   24.5
------- LOOK DIRECTION INFO -------
FOV             20.8 deg  362.6 mrad
RA             106.136 deg
DEC            -25.501 deg
Crosses_RP_@     0.000 Rs
EPS              0.151 deg
SEP            178.502 deg
ORS b/s angle  52.3 deg
ORS rad angle  42.0 deg  *
```

Point NEG_Y at SATURN and align POS_X = Up with NSP

User Vector - RA: 121.860 | Tilt L | Up | Tilt R | Zoom Out | Labels | Axes | Year < > < > Hour

DEC: -18.005 | Left | Reset | Right | Fill Screen | Orbits | Vectors | Month < > < > Minute

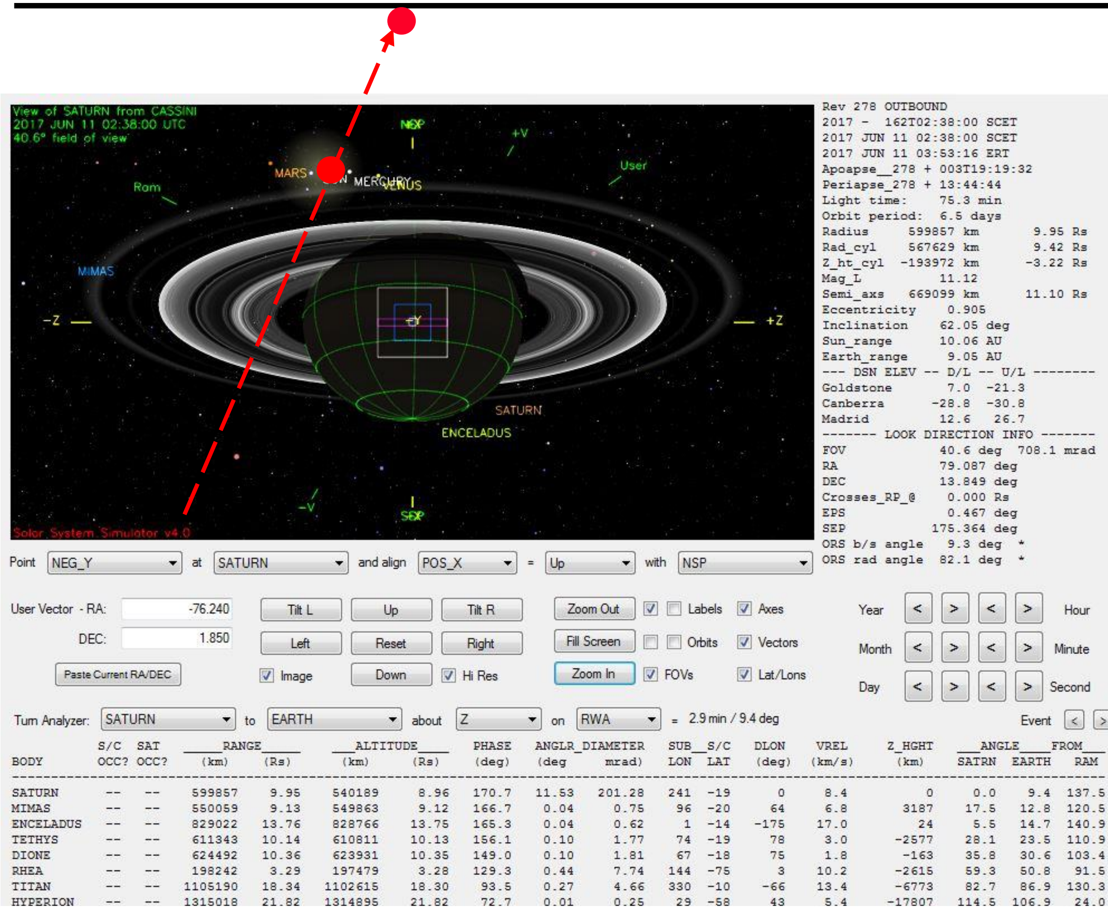
Paste Current RA/DEC | Image | Down | Hi Res | Zoom In | FOVs | Lat/Lons | Day < > < > Second

Turn Analyzer: SATURN to EARTH about Z on RWA = 6.8 min / 52.2 deg | Event < >

| BODY | S/C OCC? | SAT OCC? | RANGE (km) | RANGE (Rs) | ALTITUDE (km) | ALTITUDE (Rs) | PHASE (deg) | ANGLR_DIAMETER (deg | ANGLR_DIAMETER mrad) | SUB_S/C LON | SUB_S/C LAT | DLON (deg) | VREL (km/s) | Z_HGHT (km) | ANGLE FROM SATRN | ANGLE FROM EARTH | ANGLE FROM RAM |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SATURN | -- | -- | 829563 | 13.76 | 770146 | 12.78 | 127.7 | 8.33 | 145.43 | 226 | 23 | 0 | 5.9 | 0 | 0.0 | 52.2 | 48.0 |
| MIMAS | -- | -- | 672239 | 11.15 | 672037 | 11.15 | 120.4 | 0.04 | 0.62 | 156 | 30 | 16 | 15.9 | -2974 | 7.5 | 59.4 | 46.7 |
| ENCELADUS | -- | -- | 618073 | 10.26 | 617819 | 10.25 | 119.4 | 0.05 | 0.83 | 181 | 31 | 3 | 13.0 | -13 | 8.6 | 60.5 | 50.8 |
| TETHYS | -- | -- | 973390 | 16.15 | 972856 | 16.14 | 134.0 | 0.06 | 1.11 | 310 | 19 | -112 | 7.4 | -665 | 16.5 | 45.8 | 62.5 |
| DIONE | -- | -- | 1185299 | 19.67 | 1184736 | 19.66 | 133.6 | 0.05 | 0.95 | 4 | 16 | 175 | 13.1 | -60 | 7.2 | 46.3 | 44.1 |
| RHEA | -- | -- | 401989 | 6.67 | 401225 | 6.66 | 99.7 | 0.22 | 3.82 | 193 | 53 | -3 | 8.9 | -1330 | 30.9 | 80.1 | 67.8 |
| TITAN | -- | -- | 1979320 | 32.84 | 1976745 | 32.80 | 144.0 | 0.15 | 2.60 | 346 | 9 | -157 | 7.3 | 7692 | 19.0 | 35.8 | 57.9 |
| HYPERION | -- | -- | 809111 | 13.43 | 808981 | 13.42 | 24.5 | 0.02 | 0.41 | 270 | -6 | -5 | 6.0 | -26550 | 131.1 | 155.4 | 138.6 |
| IAPETUS | -- | -- | 3334432 | 55.33 | 3333685 | 55.31 | 91.1 | 0.03 | 0.45 | 354 | 9 | -68 | 2.8 | -512836 | 92.3 | 88.7 | 140.0 |
| PHOEBE | -- | -- | 13676186 | 226.92 | 13676077 | 226.92 | 114.0 | 0.00 | 0.02 | 90 | -18 | -94 | 7.3 | 1514711 | 85.3 | 65.5 | 126.1 |
| SATURN | -- | -- | 829563 | 13.76 | 770146 | 12.78 | 127.7 | 8.33 | 145.43 | 226 | 23 | 0 | 5.9 | 0 | 0.0 | 52.2 | 48.0 |

# Solar Geometry – ORS Boresight Concerns






- Pointing to NEG_Y to Saturn (center) would lead to a CMT violation (ORS boresight to Sun < 12 deg) between ~2017-161T19:37 and ~2011-162T06:50.
- Minimum Saturn-center to Sun angle is ~8.1° at 2017-161T23:30.

- At start of VIMS SHEMMAP (162T02:38) Sun is 9.3 deg from Saturn center, 15.5 degrees from lower-right limb.
- At end of VIMS SHEMMAP (162T07:00) Sun is 12.1 deg from Saturn center, 16.5 from southern limb
- CIRS operational FR waiver
(12 deg < ORS-B/S to Sun < 15 deg)
will likely be needed for SHEMAP.

161T19:37 | 162T06:50 | 162T11:39

| -Y to Saturn Center < 12 | -Y to Saturn Center < 15 |
|---|---|

161T16:32 | 162T02:38 | 162T07:00 | 162T18:10

| **RSS CRDOCC** | **VIMs SHEMMAP** | **SP (DL and turns to/from)** | **GAP 1** |
|---|---|---|---|
| | **LR Southern Limb OK** | | **All Saturn Disk OK** |

# Periapse Quicklooks

## Rev 278_279

- SP_278EA_M34BWGRSS161_PRIME
- SP_278EA_G34BWGRSS161_PRIME
- SP_278EA_C70METRSS161_PRIME
- RSS_278RI_PERIOCC001_PRIME
- Periapse R = 1.055 Rs, lat ...
- SP_278EA_C70METRSS461_PRIME
- RSS_278RI_CRDOCC001_PRIME
- VIMS_278SA_SHEMMAP001_PRIME

The Saturn 278_279 segment started ~12 hr before periapsis, with the fourth of six RSS/GRAV Occultation experiments to be performed during the proximal orbits. These observations provided the best opportunity to measure Saturn's gravity as the spacecraft plunged into the deepest recesses of the planet's gravity field. It details deviations of gravity from spherical symmetry, which reveals the *depth* of the strong winds seen at the surface and how density varies with depth. Cassini also feels the gravitational pull from the rings (the B-ring in particular), allowing the ring mass (and implied age) to be determined very accurately.

As periapsis approached, RSS performed the fourth of its near-periapse occultation measurements, observing the rings from a distance < ~1 Rs, starting almost immediately after the S/C crosses the ring plane (PERIOCC001, CRDOCC001). High resolution measurements were obtained. The large opening angle of the rings allowed for maximum possible penetration of the radio signals of optically thick features of the B Ring and its 4 regions of distinct morphology, where most of the ring mass resides.

CDA rode with RSS, performing the first of only two observations where CDA concentrates on SMALL (main ring) particle detection. The small particle detection mode was unique for characterizing the degree of the pollution and age of the rings.

Following the RSS Grav/OCC observations, VIMS obtained one of the highest resolution southern hemisphere maps (SHEMMAP001) obtained during the mission (pixels spanning just over 300 km). VIMS is looking for changes in winds, cloud structures, and perhaps changes in phosphine content as the rate of upwelling changes with season due principally to potential changes in upper atmosphere temperature.

**10 Jun 2017 (DOY 161)**

The Saturn 278_279 segment started a very busy science day, kicking off the **fourth** of the RSS/GRAV Occultation experiments during Cassini proximal orbits. These observations provide the best opportunity to measure Saturn's gravity field by tracking very precisely the orbit of Cassini relative to the Earth, as the spacecraft plunges at about 30 km/s into the deepest recesses of the planet's gravity field, just skimming the atmosphere. Deviations of gravity from spherical symmetry were sought, which reveal the *depth* of the strong winds seen at the surface, and how density varies with depth. Cassini must, however, be very close to Saturn to feel the acceleration caused by the weakest of these gravity perturbations, and this is why the final orbits were so valuable and unique to our understanding of the interior of Saturn - the orbital geometry and the proximity to the planet will allow Cassini to measure surface gravity accelerations as small as 10 million times less than that on Earth. Additionally, while passing close to the planet, Cassini feels the gravitational pull from the rings (the B-ring in particular), and thereby allows the mass to be determined very accurately. The ring mass in turn, gives an indication of the age of the ring system.

Also, at the start of the segment (outside of periapsis) MAG continued its magnetospheric survey measurements in conjunction with the other MAPS instruments: RPWS conducted its auroral campaign to observe the auroral magnetosphere (e.g. the acceleration region) and SKR source regions. INMS examined atmospheric and ionospheric thermal structure. CDA performed regular dust surveys.

Throughout the Proximal orbits, in particular during periapses passes, MAG collected unique measurements which lead to a better understanding of the departure from axisymmetry for the planetary magnetic field, the resolution of the planetary rotation period, the depth to dynamo region, the size of the central core, and the strength of field inside the planet (energy budget). In addition, measurements of field aligned currents lead to a better understanding of auroral processes (in conjunction with other instruments). Each and every periapsis pass provided MAG observations of Saturn's internal magnetic field over a unique orbit track in latitude and longitude space.

RPWS observed neutral molecules in the inner magnetosphere and then, at ring plane crossing (161T12:35), measured/determined the equatorial dust flux and scale height as a function of radial distance and obtains high resolution of plasma waves at the magnetic equator

*(Continued on Next Page)*

**10 Jun 2017 (DOY 161) (*CONTINUED*)**

As periapse approached, RSS performed the fourth of eight near-peripase occultation measurements, observing the rings from a distance < ~1 RS, starting almost immediately after the S/C crosses the ring plane, obtaining high resolution measurements. Also unique about this campaign is that the rings were close to their maximum opening angle (B~26-27° ) as seen from the Earth, possible only close to the 2017 epoch of the Proximal orbits. The large B-angle allowed maximum possible penetration of the radio signals of optically thick features of the B Ring and its 4 regions of distinct morphology, where most of the ring mass resides. The same is true for regions of optical depth enhancements within the many density and bending waves known to populate the A Ring and some in the B Ring, allowing reliable profiling not only of wave frequencies but also of wave amplitudes, crucial for characterization of wave damping and hence ring viscosity, as well as standard inference of rings surface mass density, particularly of the massive B-Ring. The deep penetration was also crucial for reliable profiling of confined and optically thick ringlets across the ring system, in particular the plateau regions of the C Ring where puzzling behavior had been reported. Radio occultations enjoy the advantage of three coherent observation frequencies allowing not only profiling of ring structure but also constraining the structures' physical properties (e.g., particle size).

PERIAPSE at 161T12:53:15 (R = 1.055 Rs)

Throughout the periapse RSS GRAV/OCC (also INMS/MAG) led experiments, CDA rode along to investigate three different classes of particles: **small** debris particles of the main ring system (<50nm), **big** particles close to the ring plane (>50nm), and **small** particles in the Enceladus **L-Shell** region at high latitudes. Each Rev concentrated on one particular type of particle. Saturn_278_279 was the first of only two Revs where CDA concentrated on SMALL (main ring) particle detection. The small particle detection mode was unique and related to determine the age of Saturn's ring. The main ring is bombarded by interplanetary meteoroids and smaller ejecta particles are released which reflect the composition of the ring particles. The very tiny grains have a high charge-to-mass ratio and couple to the strong magnetic field. These particles can leave the ring plane and can be found at higher latitudes. How icy are the ejecta particles? The interplanetary particles bring silicates, organics and metals into the icy ring material. The degree of contamination is therefore related to the age of Saturn's ring. CDA focused on the measurement of the composition of the small debris particles, characterizing the degree of the pollution and age of the rings.

# Daily Science Highlights (3 of 4)

**11 Jun 17 (DOY162)** ***(CONTINUED)***

Following the RSS Grav/OCC observations, at the start of DOY 262, VIMS performed southern hemisphere mapping (SHEMMAP001), with CIRS and UVIS riding along. Probing the clouds and gaseous content of the atmosphere above approximately the 3-bar level via Saturn's 5-um thermal radiation emitted from depth (~ 10 bar), VIMS was looking for changes in winds, cloud structures, and perhaps changes in phosphine content as the rate of upwelling changes with season due principally to potential changes in the upper atmosphere temperature. This observation was of particular interest because the southern region was largely in the middle of the long deep winter. This provided among the highest spatial resolution maps of the south polar region obtained during the mission, with pixels spanning just over 300 km.

The Southern Hemisphere map was immediately followed by an 8h30 downlink to Canberra, and then a second Southern Hemisphere map (SHEMMAP002), of nearly equal duration as the first, to complete the observation of South Hemisphere cloud motions (winds)..

The day ended with ISS capturing an Enceladus Plume PIE observation as part of the plume monitoring campaign (CIRS, UVIS, and VIMS rode along). At a distance of about 0.8-1.35 million km from Enceladus, this 12.5 hr observation allowed brightness variations of the entire plume to be observed on short timescales, which is excellent for testing theories of the plume production. This observation covered a region of mean anomaly in which the plume had been unexpectedly bright in the two previous ISS observations. This new data, along with what was expected in Revs 271 and 286, aid in understanding whether or not this feature is persistent. Due to the exceptional length of this particular PIE, it also covered the region of mean anomaly where normal brightening occurs. More data covering this region helps characterize these variations, leading to a better understanding of long term plume behavior.

**12 Jun 2017 (DOY 163)**

Following the long Plume PIE, VIMS retook the lead with a 3 hour long VIMS Global map (GLOBMAP001). The science was the same as for the other VIMS maps (Southern and Northern), but, from its sub-S/C latitude of -2 degrees, the goal in this case was to cover both hemispheres of Saturn in one go, including parts of the equatorial region missed in previous observations.

About half-way though DOY 163, UVIS began a 3-day long campaign of EUV/FUV observations. If not the last EUV/FUV observation of this mission, it was the last coordinated set to provide observations both over as wide a range of phase angles as possible (between 154 to 139 degrees), and within a short time period, to enhance the science return. The EUV/FUV acquired spectral-image scans of some hydrocarbons such as acetylene and methane in the high atmosphere, as well as signatures of haze and cloud particles.

***CONTINUED***

By observing at a variety of phase angles in separate observations we built up phase angle coverage and that tells us about the angular distribution of particle scattering which is governed by particle size and shape. These observations also imaged auroral emissions and airglow in the high atmosphere, higher than what CIRS senses.

**12 Jun 2017 (DOY 164)**
This entire day/observing-period was filled by the second of the three UVIS EUV/FUV observations.

**14 Jun 2017 (DOY 165)**
This entire day/observing-period was filled by the final of the three UVIS EUV/FUV observations.

**15 Jun 15 2017 (DOY 166)**
Following downlink, DOY 166 science began with a VIMS Northern Hemisphere Map (NHEMMAP001), with CIRS rider. It complimented southern hemisphere mapping, by covering northern hemisphere only features – the remnants of the Great Storm of 2010-2011, and logging seasonal effects on the north polar vortex and the hexagon feature that encircles the vortex. As well, overall, the long-term repeated north polar views obtained by VIMS throughout the ~5 months of the Grand Finale promised measurements of average polar-vortex and hexagon winds at depth near 2 bar with unprecedented precision and a unique record of cloud/wind evolution on approximately monthly scales.

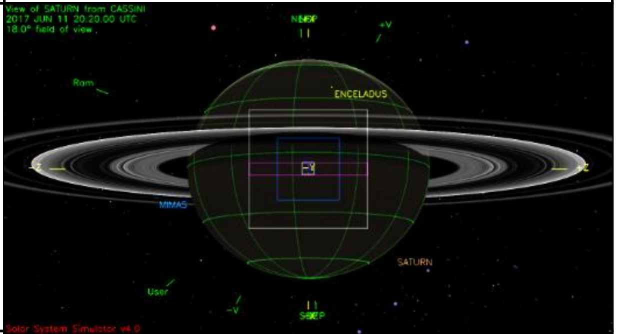
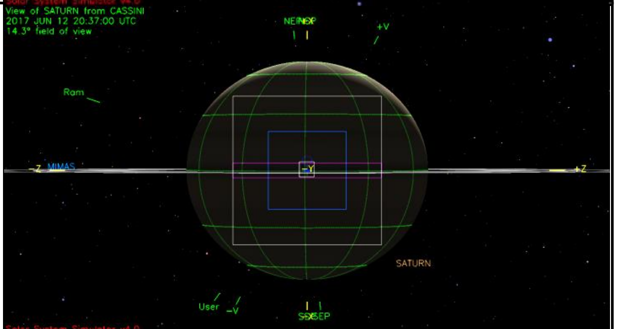
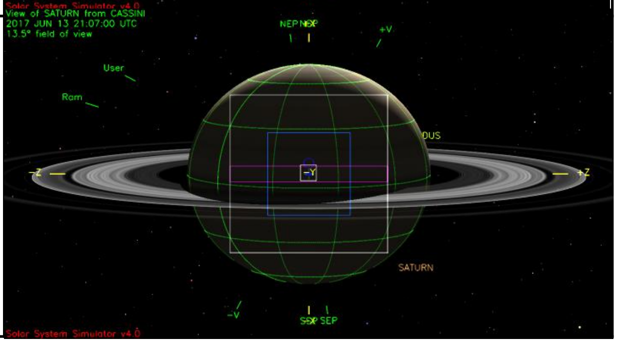
ISS ended the science in this segment with a Titan Cloud Monitoring observation (CIRS and VIMS riders), part of its continuing campaign.

**15 Jun 15 2017 (DOY 167)**
On DOY 167 we downlinked on a split Goldstone/Canberra pass to empty the SSR.

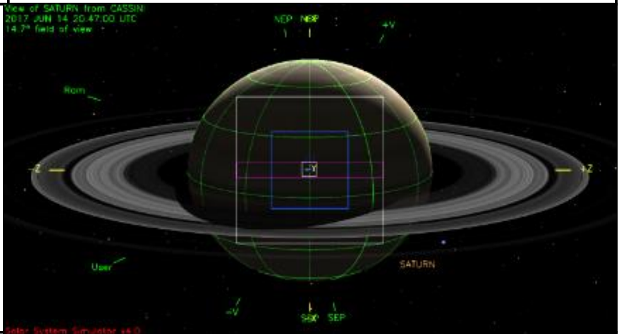
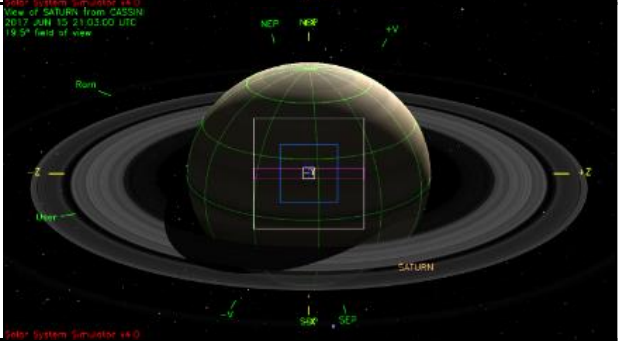
# Segment Integration Planning

# Timeline Gaps and Suggested Observations (1/2)



| Gap | Start | End | Duration | Phase angle (range) | Rs range | Sub-S/C Lat. | Snapshot (mid-gap) |
|---|---|---|---|---|---|---|---|
| 1a | 2017-162T18:10:00<br><br>*Suggested Activities:*<br>*VIMS Southern Hemisphere Mosaic Map* | 2017-162T22:30:00 | 000T04:20:00<br><br>*04h20m* | 161.7 to 159.8 | 15.3 to 16.4 | –8 to –7 |  |
| 1b | 2017-163T11:10:00<br><br>*Suggested Activities:*<br>*VIMS Global Mosaic Map*<br>*UVIS EUV/FUV* | 2017-164T06:05:00 | 000T18:55:00<br><br>*03h00m*<br>*15h55m* | 155.3 to 149.8 | 18.9 to 20.8 | –2 to +3 |  |
| 2 | 2017-164T17:55:00<br><br>*Suggested Activities:*<br>*UVIS EUV/FUV* | 2017-165T00:20:00 | 000T06:25:00<br><br>*06h25m* | 146.7 to 145.0 | 21.2 to 21.1 | +6 to +7 |  |

# Timeline Gaps and Suggested Observations (2/2)

| Gap | Start | End | Duration | Phase angle (range) | Rs range | Sub-S/C Lat. | Snapshot (mid-gap) |
|---|---|---|---|---|---|---|---|
| 3 | 2017-165T11:25:00<br><br>*Suggested Activities:*<br>*UVIS EUV/FUV* | 2017-166T06:10:00 | 000T18:45:00<br><br>*18h45m* | 142.0 to 136.1 | 20.5 to 18.1 | +10 to +15 |  |
| 4 | 2017-166T18:00:00<br><br>*Suggested Activities:*<br>*VIMS Northern Hemisphere Mosaic Map*<br>*Titan Meterological Campaign* | 2017-167T00:05:00 | 000T06:05:00<br><br>*04h35m*<br>*01h30m* | 131.1 to 127.7 | 15.5 – 13.8 | +20 to +23 |  |

# Initial SMT and Data Volume (1/3)

## Beginning of Integration:

DATA VOLUME SUMMARY --- TRANSFER FRAME OVERHEAD INCLUDED (80 BITS PER 8800-BIT FRAME)

| | | | OBSERVATION_PERIOD | | | | | | | DOWNLINK_PASS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | P4 | | | | | | P5 | RECORDED | | PLAYBACK | | | | | |
| DOWNLINK PASS NAME | Start doy hh:mm | End doy hh:mm | START (Mb) | SCI (Mb) | HK+E (Mb) | TOTAL (Mb) | CPACTY (Mb) | MRGN (Mb) | OPNAV (Mb) | SCI (Mb) | ENGR (Mb) | TOTAL (Mb) | CPACTY (Mb) | MARGN (Mb) | NET_MARGN (Mb) | NET_MARGN (%) | CAROVR (Mb) |
| SP_278EA_M34BWGRSS161_PRIME | 161 00:55 | 161 03:00 | 0 | 0 | 0 | 0 | 3322 | 3322 | 0 | 0 | 12 | 12 | 120 | 107 | 1768 | 17% | 0 |
| SP_278EA_G34BWGRSS161_PRIME | 161 03:00 | 161 11:00 | 0 | 0 | 0 | 0 | 3322 | 3322 | 0 | 441 | 47 | 488 | 575 | 86 | 1661 | 13% | 0 |
| SP_278EA_C34BWGRSS161_PRIME | 161 11:00 | 161 12:01 | 0 | 0 | 0 | 0 | 3322 | 3322 | 0 | 224 | 6 | 230 | 98 | -133 | 1574 | 12% | 133 |
| SP_278EA_C34BWGRSS162_PRIME | 161 14:08 | 161 16:32 | 133 | 508 | 9 | 649 | 3322 | 2673 | 0 | 212 | 14 | 875 | 239 | -637 | 1574 | 13% | 636 |
| SP_278EA_C70METNON162_PRIME | 162 08:30 | 162 17:30 | 636 | 1044 | 67 | 1748 | 3322 | 1574 | 0 | 505 | 53 | 2306 | 3834 | 1527 | 2451 | 20% | 0 |
| SP_278EA_C70METNON164_PRIME | 164 08:15 | 164 17:15 | 0 | 2236 | 164 | 2399 | 3322 | 923 | 0 | 135 | 53 | 2588 | 3882 | 1294 | 3915 | 46% | 0 |
| SP_279EA_G34BWGNON165_PRIME | 165 02:30 | 165 10:45 | 0 | 107 | 39 | 146 | 3322 | 3176 | 0 | 179 | 49 | 373 | 584 | 210 | 2621 | 57% | 0 |
| SP_279EA_C34BWGNON166_PRIME | 166 08:20 | 166 17:20 | 0 | 249 | 91 | 340 | 3322 | 2982 | 0 | 196 | 53 | 590 | 918 | 328 | 2410 | 60% | 0 |
| SP_279EA_G70METNON167_PRIME | 167 02:15 | 167 10:45 | 0 | 333 | 38 | 370 | 3322 | 2952 | 0 | 493 | 50 | 914 | 2919 | 2005 | 2082 | 68% | 0 |
| SP_279EA_C34BWGNON167_PRIME | 167 10:45 | 167 12:18 | 0 | 0 | 0 | 0 | 3322 | 3322 | 0 | 75 | 9 | 84 | 161 | 76 | 76 | 48% | 0 |

1 = Jumpstart Period

# Initial SMT and Data Volume (2/3)

## Beginning of Integration:

Team Report

DATA VOLUME REPORT --- TRANSFER FRAME OVERHEAD NOT INCLUDED

| Event | Start doy hh:mm | End doy hh:mm | CAPS (Mb) | CDA (Mb) | CIRS (Mb) | INMS (Mb) | ISS (Mb) | MAG (Mb) | MIMI (Mb) | RADAR (Mb) | RPWS (Mb) | UVIS (Mb) | VIMS (Mb) | PROBE (Mb) | ENGR (Mb) | TOTAL (Mb) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SP_278EA_M34BWGRSS161_PRIME | 161 00:55 | 161 03:00 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| SP_278EA_G34BWGRSS161_PRIME | 161 03:00 | 161 11:00 | 0.0 | 30.2 | 10.8 | 0.0 | 0.0 | 31.1 | 34.6 | 0.0 | 325.4 | 4.4 | 0.0 | 0.0 | 0.0 | 436.5 |
| SP_278EA_C34BWGRSS161_PRIME | 161 11:00 | 161 12:01 | 0.0 | 12.5 | 0.0 | 0.0 | 0.0 | 7.2 | 4.7 | 0.0 | 197.2 | 0.6 | 0.0 | 0.0 | 0.0 | 222.2 |
| OBSERVATION_NOR | 161 12:01 | 161 14:08 | 0.0 | 31.9 | 10.8 | 0.0 | 0.0 | 15.1 | 13.2 | 0.0 | 432.0 | 0.0 | 0.0 | 0.0 | 8.8 | 511.8 |
| SP_278EA_C34BWGRSS162_PRIME | 161 14:08 | 161 16:32 | 0.0 | 12.3 | 4.3 | 0.0 | 0.0 | 17.1 | 10.4 | 0.0 | 164.9 | 1.3 | 0.0 | 0.0 | 0.0 | 210.2 |
| DAILY TOTAL SCIENCE | 161 12:01 | 161 16:32 | 0.0 | 86.9 | 25.9 | 0.0 | 0.0 | 70.5 | 62.8 | 0.0 | 1119.5 | 6.3 | 0.0 | 0.0 | 8.8 | |
| OBSERVATION_NOR | 161 16:32 | 162 08:30 | 0.0 | 45.9 | 31.4 | 0.0 | 0.0 | 35.3 | 56.9 | 0.0 | 649.5 | 15.8 | 200.0 | 0.0 | 66.7 | 1101.7 |
| SP_278EA_C70METNON162_PRIME | 162 08:30 | 162 17:30 | 0.0 | 17.0 | 86.4 | 0.0 | 0.0 | 16.0 | 27.5 | 0.0 | 348.1 | 4.9 | 0.0 | 0.0 | 0.0 | 500.0 |
| DAILY TOTAL SCIENCE | 161 16:32 | 162 17:30 | 0.0 | 62.9 | 117.8 | 0.0 | 0.0 | 51.3 | 84.4 | 0.0 | 997.7 | 20.8 | 200.0 | 0.0 | 66.7 | |
| OBSERVATION_NOR | 162 17:30 | 164 08:15 | 0.0 | 73.1 | 233.7 | 0.0 | 1200.0 | 68.9 | 118.6 | 0.0 | 182.7 | 198.2 | 140.0 | 0.0 | 162.0 | 2377.2 |
| SP_278EA_C70METNON164_PRIME | 164 08:15 | 164 17:15 | 0.0 | 17.0 | 29.7 | 0.0 | 0.0 | 16.0 | 27.5 | 0.0 | 42.4 | 1.5 | 0.0 | 0.0 | 0.0 | 134.2 |
| DAILY TOTAL SCIENCE | 162 17:30 | 164 17:15 | 0.0 | 90.1 | 263.4 | 0.0 | 1200.0 | 84.9 | 146.1 | 0.0 | 225.2 | 199.7 | 140.0 | 0.0 | 162.0 | |
| OBSERVATION_NOR | 164 17:15 | 165 02:30 | 0.0 | 17.4 | 0.0 | 0.0 | 0.0 | 16.5 | 28.3 | 0.0 | 43.6 | 0.0 | 0.0 | 0.0 | 38.7 | 144.5 |
| SP_279EA_G34BWGNON165_PRIME | 165 02:30 | 165 10:45 | 0.0 | 15.6 | 78.3 | 0.0 | 0.0 | 14.7 | 25.2 | 0.0 | 38.9 | 4.5 | 0.0 | 0.0 | 0.0 | 177.2 |
| DAILY TOTAL SCIENCE | 164 17:15 | 165 10:45 | 0.0 | 33.0 | 78.3 | 0.0 | 0.0 | 31.1 | 53.6 | 0.0 | 82.5 | 4.5 | 0.0 | 0.0 | 38.7 | |
| OBSERVATION_NOR | 165 10:45 | 166 08:20 | 0.0 | 40.7 | 0.0 | 0.0 | 0.0 | 38.4 | 66.0 | 0.0 | 101.8 | 0.0 | 0.0 | 0.0 | 90.2 | 337.1 |
| SP_279EA_C34BWGNON166_PRIME | 166 08:20 | 166 17:20 | 0.0 | 17.0 | 86.4 | 0.0 | 0.0 | 16.0 | 27.5 | 0.0 | 42.4 | 4.9 | 0.0 | 0.0 | 0.0 | 194.3 |
| DAILY TOTAL SCIENCE | 165 10:45 | 166 17:20 | 0.0 | 57.7 | 86.4 | 0.0 | 0.0 | 54.4 | 93.6 | 0.0 | 144.2 | 4.9 | 0.0 | 0.0 | 90.2 | |
| OBSERVATION_NOR | 166 17:20 | 167 02:15 | 0.0 | 16.8 | 0.0 | 0.0 | 0.0 | 15.9 | 27.3 | 0.0 | 269.8 | 0.0 | 0.0 | 0.0 | 37.3 | 367.1 |
| SP_279EA_G70METNON167_PRIME | 167 02:15 | 167 10:45 | 0.0 | 16.0 | 81.0 | 0.0 | 0.0 | 15.1 | 26.0 | 0.0 | 345.8 | 4.7 | 0.0 | 0.0 | 0.0 | 488.6 |
| SP_279EA_C34BWGNON167_PRIME | 167 10:45 | 167 12:18 | 0.0 | 2.9 | 0.0 | 0.0 | 0.0 | 2.8 | 4.7 | 0.0 | 63.1 | 0.9 | 0.0 | 0.0 | 0.0 | 74.3 |
| DAILY TOTAL SCIENCE | 166 17:20 | 167 12:18 | 0.0 | 35.8 | 81.0 | 0.0 | 0.0 | 33.7 | 58.0 | 0.0 | 678.7 | 5.5 | 0.0 | 0.0 | 37.3 | |

| | CAPS (Mb) | CDA (Mb) | CIRS (Mb) | INMS (Mb) | ISS (Mb) | MAG (Mb) | MIMI (Mb) | RADAR (Mb) | RPWS (Mb) | UVIS (Mb) | VIMS (Mb) | PROBE (Mb) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TOTAL RECORDED (OPNAV data not included) | 0.0 | 366.3 | 652.9 | 0.0 | 1200.0 | 326.0 | 498.5 | 0.0 | 3247.8 | 241.7 | 340.0 | 0.0 |

1 = Jumpstart Period

# Initial SMT and Data Volume (3/3)

## Beginning of Integration:

AVERAGE DATA RATE REPORT (calculated over observation periods and downlink passes)

| Event | Start doy hh:mm | End doy hh:mm | CAPS (bps) | CDA (bps) | INMS (bps) | MAG (bps) | MIMI (bps) | RPWS (bps) | UVIS (bps) |
|---|---|---|---|---|---|---|---|---|---|
| SP_278EA_M34BWGRSS161_PRIME | 161 00:55 | 161 03:00 | 0.0 | 1048.0 | 0.0 | 494.0 | 868.9 | 11300.1 | 152.5 |
| SP_278EA_G34BWGRSS161_PRIME | 161 03:00 | 161 11:00 | 0.0 | 1048.0 | 0.0 | 1080.6 | 1200.0 | 11300.1 | 152.5 |
| SP_278EA_C34BWGRSS161_PRIME | 161 11:00 | 161 12:01 | 0.0 | 3418.9 | 0.0 | 1976.0 | 1276.2 | 53879.2 | 152.5 |
| SP_278NA_OBSERV561_NA | 161 12:01 | 161 14:08 | 0.0 | 4192.0 | 0.0 | 1976.0 | 1730.3 | 56693.8 | 0.0 |
| SP_278EA_C34BWGRSS162_PRIME | 161 14:08 | 161 16:32 | 0.0 | 1419.2 | 0.0 | 1976.0 | 1200.0 | 19080.8 | 152.5 |
| SP_278NA_OBSERV161_NA | 161 16:32 | 162 08:30 | 0.0 | 799.1 | 0.0 | 614.7 | 989.3 | 11300.1 | 275.2 |
| SP_278EA_C70METNON162_PRIME | 162 08:30 | 162 17:30 | 0.0 | 524.0 | 0.0 | 494.0 | 850.0 | 10745.1 | 152.5 |
| SP_278NA_OBSERV162_NA | 162 17:30 | 164 08:15 | 0.0 | 524.0 | 0.0 | 494.0 | 850.0 | 1310.0 | 1420.8 |
| SP_278EA_C70METNON164_PRIME | 164 08:15 | 164 17:15 | 0.0 | 524.0 | 0.0 | 494.0 | 850.0 | 1310.0 | 46.6 |
| SP_278NA_OBSERV164_NA | 164 17:15 | 165 02:30 | 0.0 | 523.1 | 0.0 | 494.0 | 850.0 | 1310.0 | 0.0 |
| SP_279EA_G34BWGNON165_PRIME | 165 02:30 | 165 10:45 | 0.0 | 524.0 | 0.0 | 494.0 | 850.0 | 1310.0 | 152.5 |
| SP_279NA_OBSERV165_NA | 165 10:45 | 166 08:20 | 0.0 | 524.0 | 0.0 | 494.0 | 850.0 | 1310.0 | 0.0 |
| SP_279EA_C34BWGNON166_PRIME | 166 08:20 | 166 17:20 | 0.0 | 524.0 | 0.0 | 494.0 | 850.0 | 1310.0 | 152.5 |
| SP_279NA_OBSERV166_NA | 166 17:20 | 167 02:15 | 0.0 | 524.0 | 0.0 | 494.0 | 850.0 | 8405.8 | 0.0 |
| SP_279EA_G70METNON167_PRIME | 167 02:15 | 167 10:45 | 0.0 | 524.0 | 0.0 | 494.0 | 850.0 | 11300.1 | 152.5 |
| SP_279EA_C34BWGNON167_PRIME | 167 10:45 | 167 12:18 | 0.0 | 524.0 | 0.0 | 494.0 | 850.0 | 11300.1 | 152.5 |

1 = Jumpstart Period

# Waypoint Selection

## Good Waypoints

| OBS_NAME | START | END | POS_X_2_NSP | POS_X_2_NEP | NEG_X_2_NSP | NEG_X_2_NEP | POS_Z_2_NSP | POS_Z_2_NEP | NEG_Z_2_NSP | NEG_Z_2_NEP | NEG_X_2_SUN | NEG_Z_2_EARTH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SP_278NA_OBSERV162_NA | 2017-162T18:00:00 | 2017-164T02:30:00 | **BAD** | **BAD** | OK | OK | OK | OK | **BAD** | **BAD** | OK | OK |
| SP_278NA_OBSERV164_NA | 2017-164T11:00:00 | 2017-165T02:30:00 | **BAD** | **BAD** | OK | OK | OK | OK | **BAD** | **BAD** | OK | OK |
| SP_279NA_OBSERV165_NA | 2017-165T10:45:00 | 2017-166T08:20:00 | **BAD** | **BAD** | OK | OK | OK | OK | **BAD** | **BAD** | OK | OK |
| SP_279NA_OBSERV166_NA | 2017-166T17:20:00 | 2017-167T02:15:00 | **BAD** | **BAD** | OK | OK | OK | OK | **BAD** | **BAD** | OK | OK |

## Good Downlink Attitudes

| DOWNLINK | START | END | POS_X_2_NSP | POS_X_2_NEP | NEG_X_2_NSP | NEG_X_2_NEP | POS_Y_2_NSP | POS_Y_2_NEP | NEG_Y_2_NSP | NEG_Y_2_NEP | ROLL_FLAG |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SP_278EA_C70METNON162_PRIME | 2017-162T08:15:00 | 2017-162T18:00:00 | OK | OK | OK | OK | OK | OK | OK | OK | OK |
| SP_278EA_G34BWGNON164_PRIME | 2017-164T02:30:00 | 2017-164T11:00:00 | OK | OK | OK | OK | OK | OK | OK | OK | OK |
| SP_279EA_G34BWGNON165_PRIME | 2017-165T02:30:00 | 2017-165T10:45:00 | OK | OK | OK | OK | OK | OK | OK | OK | OK |
| SP_279EA_C34BWGNON166_PRIME | 2017-166T08:20:00 | 2017-166T17:20:00 | OK | OK | OK | OK | OK | OK | OK | OK | OK |
| SP_279EA_G70METNON167_PRIME | 2017-167T02:15:00 | 2017-167T10:45:00 | OK | OK | **BAD** | **BAD** | OK | OK | OK | OK | 0 |
| SP_279EA_C70METNON167_PRIME | 2017-167T10:45:00 | 2017-167T12:18:00 | OK | OK | **BAD** | **BAD** | OK | OK | OK | OK | 0 |

## RBOT Friendly

| OBSERVATION PERIOD | START | END | POS_X | NEG_X | POS_Z | NEG_Z |
|---|---|---|---|---|---|---|
| SP_278NA_OBSERV162_NA | 2017-162T18:00:00 | 2017-164T02:30:00 | ------ | 178.2/ 32.8 | 178.2/ 32.8 | ------ |
| SP_278NA_OBSERV164_NA | 2017-164T11:00:00 | 2017-165T02:30:00 | ------ | 178.2/ 32.8 | 178.2/ 32.8 | ------ |
| SP_279NA_OBSERV165_NA | 2017-165T10:45:00 | 2017-166T08:20:00 | ------ | 178.2/ 32.8 | 178.2/ 32.8 | ------ |
| SP_279NA_OBSERV166_NA | 2017-166T17:20:00 | 2017-167T02:15:00 | ------ | 178.2/ 32.8 | 178.2/ 32.8 | ------ |

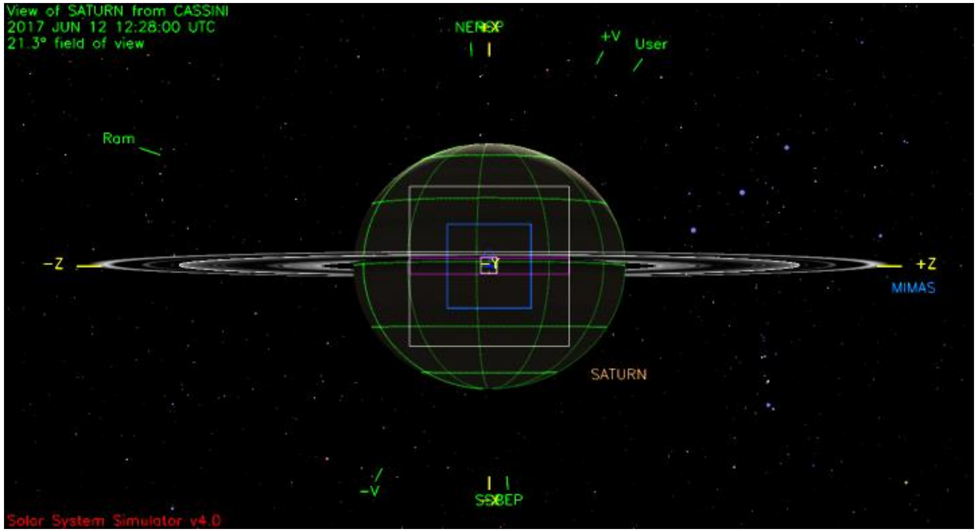
# Waypoints Chosen



Waypoint 1 (2017-161T03:00:00 – 162T18:10:00): XBAND to EARTH, POS_X to 299.7/63.6

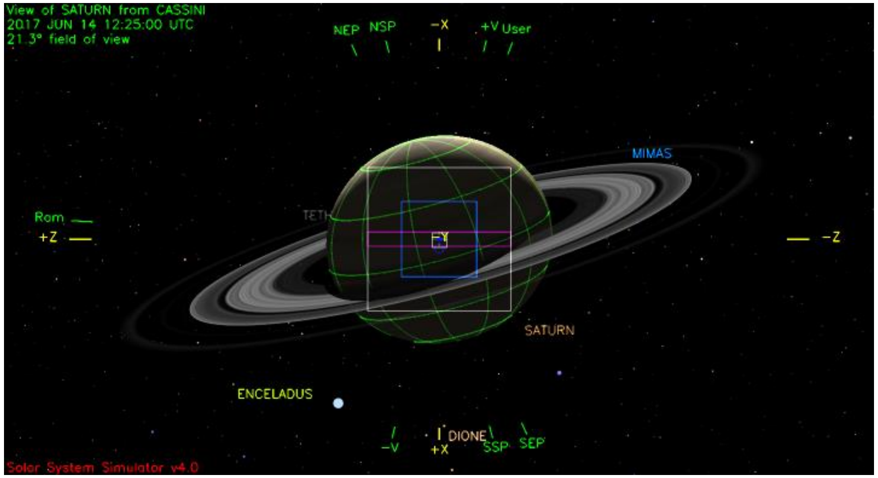
*Not shown here since ORS is not pointed toward Saturn in this period.*
*Waypoint was chosen to maximize CDA science.*

Waypoint 2 (2017-162T18:10:00 – 164T06:45:00): NEG_Y to Saturn, NEG_X to NSP

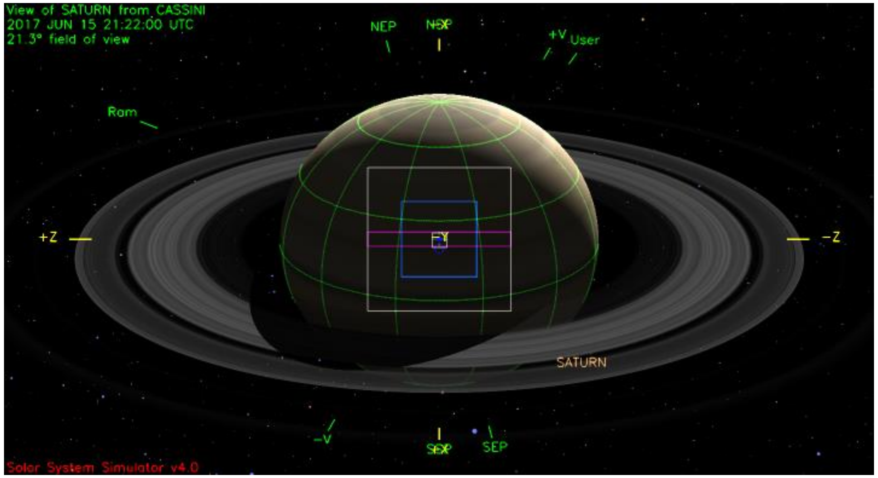


# Waypoints Chosen

Waypoint 3 (2017-164T17:55:00 – 166T06:50:00): NEG_Y to Saturn, NEG_X to Sun




Waypoint 4 (2017-166T18:00:00 – 167T00:45:00): NEG_Y to Saturn, NEG_X to NSP



# Notes (1/4)

- Pointing:
  - Waypoints
    - **No valid waypoint for Periapse observation period at start of segment 2017-161T00:55 --- 162T07:00.** The waypoint attitude is XBAND to Earth / POS_X to 299.7/63.6. The overlying science requests (primarily RSS GRAV/OCC) mostly use this attitude. There are CIRS and VIMS consumable heating for which waivers will be written (see next bullet). This is part of the jumpstart/POST predesign period, which has been verified in PDT.
  - CIRS and VIMS temperature/boresight violations.
    - CIRS consumable FR heating violation (Max heating of $T_{max}$= 85.0 deg, $\Delta T$ =10.4 degrees @ 161T14:12 SCET) during RSS Grav/OCC experiment (SP_278EA_C70METRSS461_PRIME)
      - Consumable FR waiver will be required (SPLAT item)
      - E-mail approval by M. Flasar 11/16.
    - CIRS boresight to sun incursions of < 15 degrees during VIMS_SHEMMAP001_PRIME (approximately between 2017-162T02:58 - 162T06:29), and within16 hr of CIRS science.
      - CIRS Boresight Operational FR waiver needed (SPLAT item)
      - E-mail approval by M. Flasar; Same 11/16 email above.
    - VIMS consumable FR heating violation (Max heating of $T_{max}$ = 67.0 deg, $\Delta T$= 7.3 degrees @ 161T15:20 SCET) during RSS Grav/OCC experiment (SP_278EA_C70METRSS461_PRIME).
      - Consumable FR waiver will be required (SPLAT item)
      - E-mail approval by E. Audi, R. Brown 09/29.
  - Predesigned (in PDT) and merged periapse jumpstart SASFs from 2017-161T12:01 - 162T07:00 (SPLAT item)

| | |
|---|---|
| RSS_278RI_CRDOCC001_PRIME | (POST) |
| RSS_278RI_PERIOCC001_PRIME | (POST) |
| VIMS_284SA_SHEMMAP001_PRIME | (Jumpstart) |

- Data Volume:
  - No issues, No carryover

# Notes (2/4)



- DSN:
  - **Level 3 Station Requests**
    - Level 3 request for DSN stations between 2017-160T19:15 and 2017-161T03:45 ERT (for RSS Proximal GRAV/OCC experiment) .
      DSS-55 (DOY160), DSS-25, DSS-43, DSS-35, DSS-63, DSS-55 (DOY161)
  - Station DSS-55 request for RSS Grav/Occ crosses TOST_278/Saturn_278_279 segment boundaries. The corresponding DL "PRIME" block had to be split into the following two requests to avoid CIMS issues.
    - SP_278EA_M34BWGRSS160_PRIME **in TOST_278 segment** (2017-160T19:30:00 to 161T00:55:00)
    - SP_278EA_M34BWGRSS161_PRIME **in SATURN_278_279 segment** (2017-161T00:55:00 to 161T03:00:00)

    Once in sequence, SIP leads may merge the two PRIME requests if desired.
  - Station Changes/Upgrades
    - SP_278NA_C70METNON164_SP was upgraded from Goldstone 34m (DSS-25) with permission of Dep SIP manger 07/29/16, and moved to Canberra 9with track shift), due to possible extended maintenance conflict with G70.
    - G34/C70 split DSN pass ending sequence (167T02:15) was changed from original G70/C70 (with boundary change) to minimize 70m use and to avoid G70 extended maintenance conflict.
  - Juno Conflicts
    - SP_278NA_C70METNON164: ~50% overlap with preceding Juno request (per RevL only of Juno conflict analysis spreadsheet).
    - SP_279EA_C70METNON167: Conflict with Juno request (per RevL only of Juno conflict analysis spreadsheet) that arose due to move to accommodate G70 maintenance.

*(Continued on Next Page)*

# Notes (3/4)



- DSN (Continued):
  - Dispositions of ap_downlink report check warnings
    - 2017-161T00:45:00 (SP_278EA_DSS84MRSS161_SP) DSS code is inconsistent with complex/antenna
      2017-161T18:35:00 (SP_278EA_DSS74NRSS161_SP) DSS code is inconsistent with complex/antenna
      2017-161T22:15:00 (SP_278EA_DSS84MRSS461_SP) DSS code is inconsistent with complex/antenna
      Ignore all – DSS code 0142 is to be used for ESA stations.
    - 2017-161T00:45:00 (SP_278EA_DSS84MRSS161_SP) has a short precal time for an RSS pass
      2017-161T18:35:00 (SP_278EA_DSS74NRSS161_SP) has a short precal time for an RSS pass
      2017-161T22:15:00 (SP_278EA_DSS84MRSS461_SP) has a short precal time for an RSS pass
      Ignore all – Time of 45m is confirmed the proper pre-cal time for ESA stations
    - 2017-161T00:55:00 (SP_278EA_M34BWGRSS161_PRIME) does not follow an observation period
      Ignore – Per design of RSS Proximal Grav/OCC experiment, the segment starts with a downlink which confuses ap_downlink
    - 2017-161T03:00:00 (SP_278EA_G34BWGRSS161_PRIME) has an unusual DSN lockup time; usual for post-handover passes is 60 sec.
    - 2017-161T11:00:00 (SP_278EA_C70METRSS161_PRIME) has an unusual DSN lockup time; usual for post-handover passes is 60 sec
      Ignore all – Per design/requirement of RSS Proximal Grav/OCC experiment.

# Notes (4/4)



- Resource checker:
  - Dispositions of resource checker items.

    The following two items appear because the Saturn_278_279 segment does not start with a waypoint. The waypoint is defined near the end of the preceding TOST_278 segment. This confuses Resource Checker. Both warnings will disappear once segments are integrated into the sequence.

    - 2017-162T07:00:00 (SP_278EA_YGAP162_PRIME) Turn to downlink does not have the request name DLTURN. Change request name to contain DLTURN.
    - 2017-162T02:38:00 (VIMS_278SA_SHEMMAP001_PRIME) Turn away from downlink does not have the name WAYPTTURN.

- Opmodes:
  - RWA-slow mode RSS3BRWAS is used between 161T10:00:18 and 162T02:38:00.

    *(ISS & VIMS asleep, UVIS No HDAC modulation)*

    - HAND EDITS required (by SIP in PDT sasf and RSS in their deliveries) – all turns in this time-period should use "slow" acceleration rates of (x,y,z) = (0.005, 0.008, 0.012 mrad/$s^2$). (SPLAT item). Applicable requests:

      SP_278EA_C70METRSS161_PRIME, RSS_278RI_PERIOCC001_PRIME

      SP_278EA_C70METRSS461_PRIME, RSS_278RI_CRDOCC001_PRIME

- Hydrazine:
  - N/A

- Special Activities:
  - RSS Gravity / Rings occultation experiment 2017-160T19:25:00 to 2017-162T02:38:00.

    *Note: First 5h30 minutes of range listed above is within the preceding TOST_278 segment. RSS performs warmup and conducts some KA-band data monitoring during this time.*
  - ISS_278EN_PLUME001_PIE (See science highlights)

# Liens (1/1)



**Sequence Liens (should all be SPLAT items):**

- SPLAT100000216: CIRS consumable FR heating violation (Max heating of $T_{max}$= 85.0 deg, $\Delta$T =10.4 degrees @ 161T14:12 SCET) during RSS Grav/OCC experiment. Consumable FR waiver will be required. E-mail approval by M. Flasar 11/16.

- SPLAT100000218: CIRS boresight to sun incursions of < 15 degrees approximately between 2017-162T02:58 - 162T06:29, within 16 hr of CIRS science. CIRS Boresight Operational FR waiver needed. E-mail approval by M. Flasar 11/16.

- SPLAT100000217: VIMS consumable FR heating violation (Max heating of $T_{max}$ = 67.0 deg, $\Delta$T= 7.3 degrees @ 161T15:20 SCET) during RSS Grav/OCC experiment. Consumable FR waiver will be required. E-mail approval by E. Audi, R. Brown 09/29.

- SPLAT100000219: The following activities occur while in the RSS3BRWAS opmode (161T10:00:18 and 162T02:38:00):

  SP_278EA_C70METRSS161_PRIME, RSS_278RI_PERIOCC001_PRIME

  SP_278EA_C70METRSS461_PRIME, RSS_278RI_CRDOCC001_PRIME

  SIP and RSS should us slow accelerations on all turns [Max accel(x,y,z) = (0.005, 0.008, 0.012 mrad/s^2)] contained within.

- SPLAT100000220: The following requests from 2017-161T12:01 --- 162T07:00 in Saturn_278_279 have been pre-designed in PDT during integration.

  RSS_278RI_CRDOCC001_PRIME (POST)
  RSS_278RI_PERIOCC001_PRIME (POST)
  VIMS_284SA_SHEMMAP001_PRIME (Jumpstart)

  teams identified shall deliver these designs as part of the Port 1 delivery. SIP leads to monitor.

- SPLAT100000252: The following requests from 2017-161T12:01 --- 162T07:00 in Saturn_278_279 are **POST** observations, pre-designed in PDT during integration.

  RSS_278RI_CRDOCC001_PRIME (POST)
  RSS_278RI_PERIOCC001_PRIME (POST)

# RBOT Summary



Saturn_278_279 RBOT assessment (By Dave Bates):

No changes to the nominal plan/merge was required to satisfy the RBOT solution.