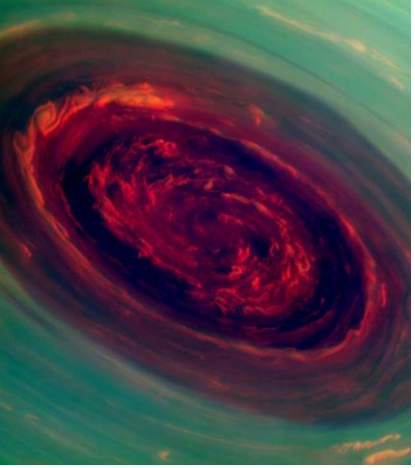
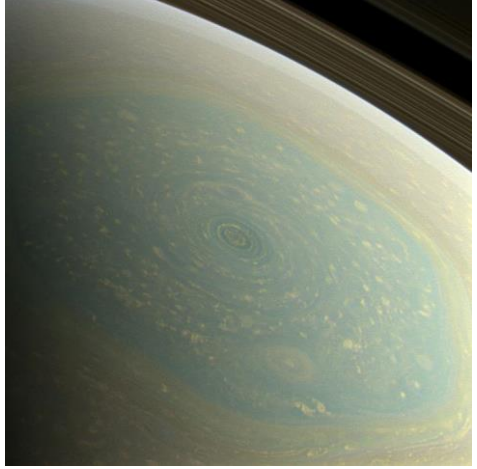
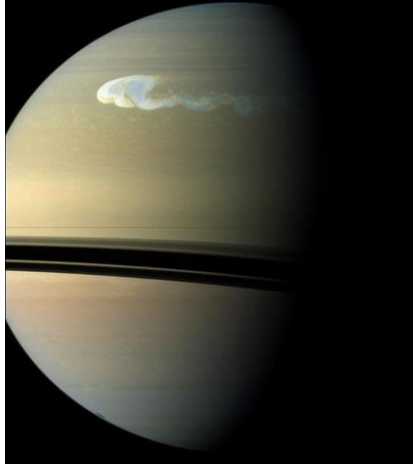


Science Planning & Sequence Team
CASSINI

# SATURN TARGET WORKING TEAM

**Rev 271 Segment Legacy Package**

**Segment Boundary: April 25, 2017– April 29, 2017**
**2017-115T13:12:00 – 2017-119T20:35:00 (SCET)**

**Integration Began 07/11/2016**
**Segment Delivered to S99 Sequence 10/26/2016**
**Lead Integrator was Martin Brennan**

**Legacy Package Assembled by Martin Brennan**

# Table of Contents





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

# Segment Overview and Final Products

# Segment Summary



- Saturn 271 was the first periapse segment of the Proximal Orbits with a periapse of 1.047 $R_S$ , starting ~1 day before perikrone and ending ~3 days after.

- The high inclination Proximal Orbit segment began on the night side, approaching the N. Pole, then passed through perikrone on the day side, where the POST (Proximal periapse pre-integration) science was planned from N. Pole to S. Pole, including an ISS WAC continuous swath ”noodle” observation and CIRS and VIMS observations at the poles

- This low altitude Saturn segment provided extremely high resolution observations not possible to date.

- An HGA to RAM turn was performed during ring-plane crossing in order to protect the spacecraft from potential particle impacts in this never-before-flown region between the planet and the rings (inner D-ring)

- The POST science warranted a large Dual Playback: 1388Mb from integration

- Following periapse, ORS solar viewing constraints impacted science placement and CMT constraint management was required during the occulted period.

- The periapse observation period was extremely contentious for data volume, with more than 3388Mb of oversubscribed data in pre-integration (reduced to 2032Mb at Integration kickoff). Multiple rounds of data cuts were required to remedy these data issues.

- The pre-integration placement of the ISS Enceladus Plume activity did not allow time for a waypoint turn, therefore the prior downlink attitude was used as the waypoint for this observation period.

- 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. Relaxed RBOT constraints simplified the wheel bias solution, but a few changes to the initial pointing designs were requested by AACS.

# Final Sequenced SPASS (1 of 2)



Rev 271 Jumpstart

| Request | Riders | Start (SCET) | St | Duration | End | Primary | Secondary | Comments |
|---|---|---|---|---|---|---|---|---|
| Sequence 599, length = 41 days | | 2017-104T14:55:00 | | 040T18:02:00 | 2017-145T08:57:00 | | | |
| SATURN_271 Segment | | 2017-115T13:12:00 | | 004T07:23:00 | 2017-119T20:35:00 | | | |
| SP_271SA_WAYPTTURN115_PRIME | | 2017-115T13:12:00 | | 000T00:40:00 | 2017-115T13:52:00 | ISS_NAC to Saturn | POS_Z to NSP | |
| NEW WAYPOINT | | 2017-115T13:52:00 | | 001T07:28:00 | 2017-116T21:20:00 | ISS_NAC to Saturn | POS_Z to NSP | |
| VIMS_271SA_NHEMMAP001_PRIME | C,I,U | 2017-115T13:52:00 | | 000T01:00:00 | 2017-115T14:52:00 | ISS_NAC to Saturn | POS_Z to NSP | |
| UVIS_271SA_AURSLEW001_PRIME | V | 2017-115T14:52:00 | | 000T06:38:00 | 2017-115T21:30:00 | VIMS_IR to Saturn | POS_Z to NSP | Collaborative Rider(s): V/VIMS |
| VIMS_271SA_NHEMMAP002_PRIME | C,I,U | 2017-115T21:30:00 | | 000T01:00:00 | 2017-115T22:30:00 | ISS_NAC to Saturn | POS_Z to NSP | |
| VIMS_271SA_NPOLMOV001_PIE | C,I,U | 2017-115T22:30:00 | | 000T08:00:00 | 2017-116T06:30:00 | ISS_NAC to Saturn_North_Pole | POS_Z to NSP | |
| Begin Dual Playback Science... | | 2017-116T06:30:00 | | 000T00:00:01 | 2017-116T06:30:01 | | | |
| Begin Custom | | 2017-116T06:30:00 | | 000T00:00:01 | 2017-116T06:30:01 | ISS_NAC to Saturn | POS_Z to NSP | |
| ISS_271SA_HIRESWACS001_PIE | C,M,V | 2017-116T06:30:00 | | 000T02:20:00 | 2017-116T08:50:00 | ISS_NAC to Saturn | POS_X to NEP | Collaborative Rider(s): CIRS.<br>Pick up at ISS_NAC to Saturn, POS_Z to NSP;<br>Hand off at NEG_Z to Dust_RAM, POS_Y to Sun.<br>No Preference to Secondary pointing |
| SP_271DR_RAMAVOID116_PRIME | I,M,V | 2017-116T08:50:00 | | 000T00:20:00 | 2017-116T09:10:00 | NEG_Z to Dust_RAM | POS_Y to Sun | Collaborative Rider(s): ISS.<br>Pick up at NEG_Z to Dust_RAM, POS_Y to Sun;<br>Hand off at NEG_Z to Dust_RAM, POS_Y to Sun. |
| Dust Hazard HGA-to-Dust-Ra... | | 2017-116T08:57:16 | | 000T00:06:06 | 2017-116T09:03:22 | NEG_Z to Dust_RAM | | |
| Periapse RP = 1.047 Rs, lat ... | | 2017-116T09:03:34 | | 000T00:00:01 | 2017-116T09:03:35 | | | |
| ISS_271SA_HIRESWACS002_PIE | C,M,V | 2017-116T09:10:00 | | 000T01:54:00 | 2017-116T11:04:00 | CIRS_FPB to Saturn (-0.225,15.002,1.088 deg. offset) | NEG_X to NSP | Pick up at NEG_Z to Dust_RAM, POS_Y to Sun;<br>Hand off at CIRS_FPB to 47.677/32.739 (0.0,15.0,0.0 deg. offset),<br>NEG_X to NSP. |
| CIRS_271SA_REGMAP001_PIE | | 2017-116T11:04:00 | | 000T03:26:00 | 2017-116T14:30:00 | CIRS_FPB to Saturn | NEG_Z to NSP | Pick up at CIRS_FPB to 47.677/32.739 (0.0,15.0,0.0 deg. offset),<br>NEG_X to NSP;<br>Hand off at ISS_NAC to Saturn (10.0,0.0,0.0 deg. offset), NEG_Z to NSP. |
| End Dual Playback Science ... | | 2017-116T14:30:00 | | 000T00:00:01 | 2017-116T14:30:01 | | | |
| VIMS_271RI_HIPHASE001_PIE | C,I,U | 2017-116T14:30:00 | | 000T06:45:00 | 2017-116T21:15:00 | VIMS_IR to Rings | NEG_X to NSP | Pick up at ISS_NAC to Saturn (10.0,0.0,0.0 deg. offset), NEG_Z to NSP; |
| SP_271SA_WAYPTTURN116_PRIME | | 2017-116T21:15:00 | | 000T00:05:00 | 2017-116T21:20:00 | ISS_NAC to Saturn (-15.0,0.0,0.0 deg. offset) | NEG_X to NSP | Pick up at ISS_NAC to Saturn (-15.0,0.0,0.0 deg. offset), NEG_X to NSP; |
| NEW WAYPOINT | | 2017-116T21:20:00 | | 000T07:50:00 | 2017-117T05:10:00 | ISS_NAC to Saturn (-15.0,0.0,0.0 deg. | NEG_X to NSP | |
| End Custom | | 2017-116T21:20:00 | | 000T00:00:01 | 2017-116T21:20:01 | ISS_NAC to Saturn (-15.0,0.0,0.0 deg. | NEG_X to NSP | |
| VIMS_271RI_SOLAROCC001_PRIME | U | 2017-116T21:20:00 | | 000T01:40:00 | 2017-116T23:00:00 | UVIS_SOL_OFF to Sun | NEG_X to 302.7/61.915 | Collaborative Rider(s): UVIS |
| UVIS_271SA_AURNSTARE001_PRIME | C,I,V | 2017-116T23:00:00 | | 000T02:39:00 | 2017-117T01:39:00 | UVIS_FUV to Saturn | NEG_X to NSP | Collaborative Rider(s): V/IMS. S. Pole NEG_Y to Sun = 12 deg. at |
| VIMS_271SA_ALPORIOCC001_PIE | C | 2017-117T01:39:00 | | 000T01:10:00 | 2017-117T02:49:00 | VIMS_IR to 88.793/7.407 | NEG_X to NSP | |
| UVIS_271SA_AURSLEW002_PRIME | C | 2017-117T02:49:00 | | 000T01:58:00 | 2017-117T04:47:00 | UVIS_FUV to Saturn | NEG_X to NSP | |
| SP_271EA_DLTURN117_PRIME | | 2017-117T04:47:00 | | 000T00:23:00 | 2017-117T05:10:00 | XBAND to Earth | NEG_X to NSP | |
| NEW WAYPOINT | | 2017-117T05:10:00 | | 001T16:05:00 | 2017-118T21:15:00 | XBAND to Earth | NEG_X to NSP | |
| ENGR_271SC_RWABIAS517_AACS | | 2017-117T05:10:00 | | 000T00:21:32 | 2017-117T05:31:32 | XBAND to Earth | NEG_X to NSP | |
| SP_271EA_G70METNON117_PRIME | C | 2017-117T05:42:00 | | 000T06:30:00 | 2017-117T12:12:00 | XBAND to Earth | Rolling/Bias | SRU. Request waiver of weekly maintenance to ensure the dual playback of mission critical ENGR data. |
| Pointer Reset in preparatio... | | 2017-117T12:12:00 | | 000T00:00:01 | 2017-117T12:12:01 | | | |

# Final Sequenced SPASS (2 of 2)



Gap 1

Gap 2

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| SP_271EA_C70METNON117_PRIME | C | 2017-117T12:12:00 | 000T05:33:00 | 2017-117T17:45:00 | XBAND to Earth | Rolling/SRU | |
| ISS_271EN_PLUME001_PIE | C,U,V | 2017-117T17:45:00 | 000T12:31:00 | 2017-118T06:16:00 | ISS_NAC to Enceladus | NEG_X to NSP | SOST PIE |
| VIMS_271SA_GLOBMAP001_PRIME | C | 2017-118T06:16:00 | 000T03:49:00 | 2017-118T10:05:00 | ISS_NAC to Saturn | NEG_X to NSP | |
| SP_271EA_YGAP118_PRIME | | 2017-118T10:05:00 | 000T01:30:00 | 2017-118T11:35:00 | XBAND to Earth | NEG_X to NSP | |
| SP_271EA_C34BWGNON118_PRIME | C | 2017-118T11:35:00 | 000T09:00:00 | 2017-118T20:35:00 | XBAND to Earth | Rolling | |
| SP_271SA_WAYPTTURN118_PRIME | | 2017-118T20:35:00 | 000T00:40:00 | 2017-118T21:15:00 | ISS_NAC to Saturn | POS_Z to NSP | |
| NEW WAYPOINT | | 2017-118T21:15:00 | 000T12:50:00 | 2017-119T10:05:00 | ISS_NAC to Saturn | POS_Z to NSP | |
| CIRS_271SA_COMPSIT001_PRIME | U,V | 2017-118T21:15:00 | 000T10:40:00 | 2017-119T07:55:00 | CIRS_FP1 to Saturn | POS_Z to NSP | |
| ISS_271SA_LIMBINT001_PRIME | U,V | 2017-119T07:55:00 | 000T01:30:00 | 2017-119T09:25:00 | ISS_NAC to Saturn | POS_Z to NSP | |
| SP_271EA_DLTURN119_PRIME | | 2017-119T09:25:00 | 000T00:40:00 | 2017-119T10:05:00 | XBAND to Earth | NEG_X to NSP | |
| NEW WAYPOINT | | 2017-119T10:05:00 | 000T22:37:00 | 2017-120T08:42:00 | XBAND to Earth | NEG_X to NSP | |
| SP_271EA_YGAP119_PRIME | | 2017-119T10:05:00 | 000T01:30:00 | 2017-119T11:35:00 | XBAND to Earth | NEG_X to NSP | |
| SP_271EA_C70METNON119_PRIME | C | 2017-119T11:35:00 | 000T09:00:00 | 2017-119T20:35:00 | XBAND to Earth | Rolling | |
| Apoapse Per= 6.4d, Inc=... | | 2017-119T14:22:49 | 000T00:00:01 | 2017-119T14:22:50 | | | |

# Final Sequenced SMT and Data Volume



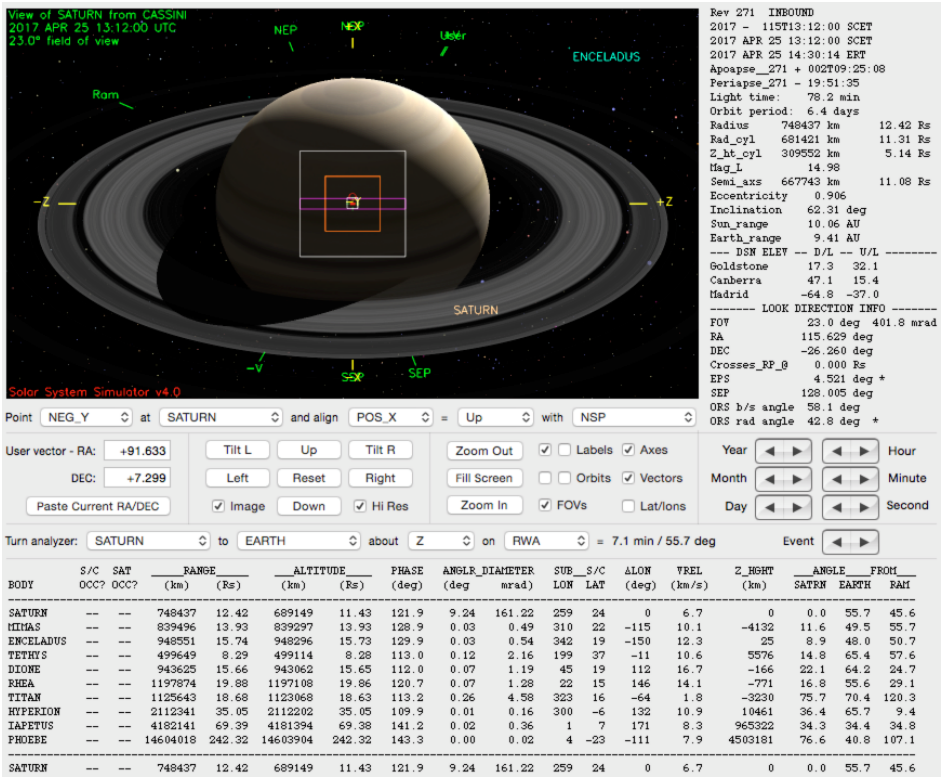
DATA VOLUME SUMMARY --- TRANSFER FRAME OVERHEAD INCLUDED (80 BITS PER 8800-BIT FRAME)

| | | | 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) | (%) | CAROVR (Mb) |
| SP_271EA_G70METNON117_PRIME | 117 05:42 | 117 12:12 | 0 | 3131 | 171 | 3302 | 3322 | 20 | 0 | 365 | 38 | 3705 | 2259 | -1446 | 715 | 4% | 1446 |
| SP_271EA_C70METNON117_PRIME | 117 12:12 | 117 17:45 | 1446 | 0 | 0 | 1446 | 3322 | 1876 | 0 | 1069 | 33 | 2548 | 2380 | -168 | 715 | 4% | 168 |
| SP_271EA_C34BWGNON118_PRIME | 118 11:35 | 118 20:35 | 168 | 2140 | 75 | 2383 | 3322 | 939 | 0 | 199 | 53 | 2636 | 859 | -1777 | 715 | 4% | 1776 |
| SP_271EA_C70METNON119_PRIME | 119 11:35 | 119 20:35 | 1776 | 767 | 63 | 2607 | 3322 | 715 | 0 | 199 | 53 | 2860 | 3834 | 974 | 1087 | 6% | 0 |

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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| OBSERVATION_NOR | 115 13:12 | 117 05:42 | 0.0 | 117.1 | 211.7 | 24.6 | 1088.8 | 124.9 | 153.4 | 0.0 | 537.8 | 166.7 | 677.0 | 0.0 | 169.3 | 3271.4 |
| SP_271EA_G70METNON117_PRIME | 117 05:42 | 117 12:12 | 0.0 | 12.3 | 56.7 | 2.3 | 0.0 | 11.6 | 19.9 | 0.0 | 255.4 | 3.6 | 0.0 | 0.0 | 0.0 | 361.7 |
| SP_271EA_C70METNON117_PRIME | 117 12:12 | 117 17:45 | 0.0 | 10.5 | 16.2 | 2.0 | 0.0 | 9.9 | 17.0 | 0.0 | 57.9 | 3.0 | 0.0 | 0.0 | 943.0 | 1059.5 |
| DAILY TOTAL SCIENCE | 115 13:12 | 117 17:45 | 0.0 | 139.8 | 284.6 | 29.0 | 1088.8 | 146.4 | 190.3 | 0.0 | 851.1 | 173.4 | 677.0 | 0.0 | 1112.2 | |
| OBSERVATION_NOR | 117 17:45 | 118 11:35 | 0.0 | 33.6 | 202.7 | 6.4 | 1200.0 | 31.7 | 54.6 | 0.0 | 84.1 | 187.3 | 320.0 | 0.0 | 74.5 | 2195.0 |
| SP_271EA_C34BWGNON118_PRIME | 118 11:35 | 118 20:35 | 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 | 117 17:45 | 118 20:35 | 0.0 | 50.6 | 289.1 | 9.7 | 1200.0 | 47.7 | 82.1 | 0.0 | 126.5 | 192.3 | 320.0 | 0.0 | 74.5 | |
| OBSERVATION_NOR | 118 20:35 | 119 11:35 | 0.0 | 28.3 | 76.8 | 5.4 | 100.0 | 26.7 | 45.9 | 0.0 | 70.7 | 56.6 | 350.0 | 0.0 | 62.7 | 823.1 |
| SP_271EA_C70METNON119_PRIME | 119 11:35 | 119 20:35 | 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 | 118 20:35 | 119 20:35 | 0.0 | 45.3 | 163.2 | 8.6 | 100.0 | 42.7 | 73.4 | 0.0 | 113.2 | 61.5 | 350.0 | 0.0 | 62.7 | |

# Segment Geometry




```
Rev 271  INBOUND
2017 -  115T13:12:00 SCET
2017 APR 25 13:12:00 SCET
2017 APR 25 14:30:14 ERT
Apoapse__271 + 002T09:25:08
Periapse_271 - 19:51:35
Light time:    78.2 min
Orbit period:  6.4 days
Radius      748437 km      12.42 Rs
Rad_cyl     681421 km      11.31 Rs
Z_ht_cyl    309552 km       5.14 Rs
Mag_L          14.98
Semi_axs    667743 km      11.08 Rs
Eccentricity    0.906
Inclination    62.31 deg
Sun_range      10.06 AU
Earth_range     9.41 AU
--- DSN ELEV -- D/L -- U/L ---------
Goldstone      17.3   32.1
Canberra       47.1   15.4
Madrid        -64.8  -37.0
------- LOOK DIRECTION INFO -------
FOV            23.0 deg  401.8 mrad
RA            115.629 deg
DEC           -26.260 deg
Crosses_RP_0    0.000 Rs
EPS             4.521 deg *
SEP           128.005 deg
ORS b/s angle  58.1 deg
ORS rad angle  42.8 deg  *
```

Point NEG_Y at SATURN and align POS_X = Up with NSP

User vector - RA: +91.633 DEC: +7.299 Paste Current RA/DEC

Tilt L Up Tilt R Left Reset Right Image Down Hi Res

Zoom Out Fill Screen Zoom In

Labels Axes Orbits Vectors FOVs Lat/lons

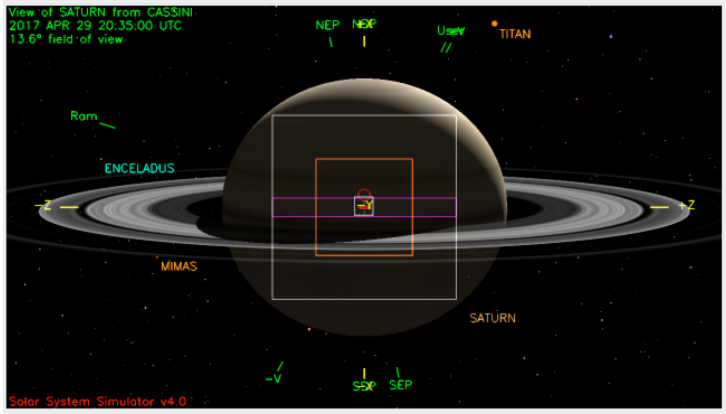
Year Month Day Hour Minute Second

Turn analyzer: SATURN to EARTH about Z on RWA = 7.1 min / 55.7 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 | ALON (deg) | VREL (km/s) | Z_HGHT (km) | ANGLE_FROM SATRN | ANGLE_FROM EARTH | ANGLE_FROM RAM |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SATURN | -- | -- | 748437 | 12.42 | 689149 | 11.43 | 121.9 | 9.24 | 161.22 | 259 | 24 | 0 | 6.7 | 0 | 0.0 | 55.7 | 45.6 |
| MIMAS | -- | -- | 839496 | 13.93 | 839297 | 13.93 | 128.9 | 0.03 | 0.49 | 310 | 22 | -115 | 10.1 | -4132 | 11.6 | 49.5 | 55.7 |
| ENCELADUS | -- | -- | 948551 | 15.74 | 948296 | 15.73 | 129.9 | 0.03 | 0.54 | 342 | 19 | -150 | 12.3 | 25 | 8.9 | 48.0 | 50.7 |
| TETHYS | -- | -- | 499649 | 8.29 | 499114 | 8.28 | 113.0 | 0.12 | 2.16 | 199 | 37 | -11 | 10.6 | 5576 | 14.8 | 65.4 | 57.6 |
| DIONE | -- | -- | 943625 | 15.66 | 943062 | 15.65 | 112.0 | 0.07 | 1.19 | 45 | 19 | 112 | 16.7 | -166 | 22.1 | 64.2 | 24.7 |
| RHEA | -- | -- | 1197874 | 19.88 | 1197108 | 19.86 | 120.7 | 0.07 | 1.28 | 22 | 15 | 146 | 14.1 | -771 | 16.8 | 55.6 | 29.1 |
| TITAN | -- | -- | 1125643 | 18.68 | 1123068 | 18.63 | 113.2 | 0.26 | 4.58 | 323 | 16 | -64 | 1.8 | -3230 | 75.7 | 70.4 | 120.3 |
| HYPERION | -- | -- | 2112341 | 35.05 | 2112202 | 35.05 | 109.9 | 0.01 | 0.16 | 300 | -6 | 132 | 10.9 | 10461 | 36.4 | 65.7 | 9.4 |
| IAPETUS | -- | -- | 4182141 | 69.39 | 4181394 | 69.38 | 141.2 | 0.02 | 0.36 | 1 | 7 | 171 | 8.3 | 965322 | 34.3 | 34.4 | 34.8 |
| PHOEBE | -- | -- | 14604018 | 242.32 | 14603904 | 242.32 | 143.3 | 0.00 | 0.02 | 4 | -23 | -111 | 7.9 | 4503181 | 76.6 | 40.8 | 107.1 |
| SATURN | -- | -- | 748437 | 12.42 | 689149 | 11.43 | 121.9 | 9.24 | 161.22 | 259 | 24 | 0 | 6.7 | 0 | 0.0 | 55.7 | 45.6 |

Seg 271 Start (Left)

Seg 271 End (below)




```
Rev 272  INBOUND
2017 -  119T20:35:00 SCET
2017 APR 29 20:35:00 SCET
2017 APR 29 21:52:48 ERT
Apoapse__272 + 06:12:09
Periapse_272 - 002T23:07:15
Light time:    77.8 min
Orbit period:  6.4 days
Radius     1267344 km      21.03 Rs
Rad_cyl    1258633 km      20.88 Rs
Z_ht_cyl    148334 km       2.46 Rs
Mag_L          21.32
Semi_axs    667766 km      11.08 Rs
Eccentricity    0.906
Inclination    62.33 deg
Sun_range      10.06 AU
Earth_range     9.36 AU
--- DSN ELEV -- D/L -- U/L ---------
Goldstone     -69.4  -39.1
Canberra       30.0   61.4
Madrid        -10.6  -39.8
------- LOOK DIRECTION INFO -------
FOV            13.6 deg  237.6 mrad
RA            102.240 deg
DEC            -9.833 deg
Crosses_RP_0    0.000 Rs
EPS             4.243 deg
SEP           132.340 deg
ORS b/s angle  37.3 deg
ORS rad angle  56.9 deg  *
```

Point NEG_Y at SATURN and align POS_X = Up with NSP

User vector - RA: +91.633 DEC: +7.299 Paste Current RA/DEC

Tilt L Up Tilt R Left Reset Right Image Down Hi Res

Zoom Out Fill Screen Zoom In

Labels Axes Orbits Vectors FOVs Lat/lons

Year Month Day Hour Minute Second

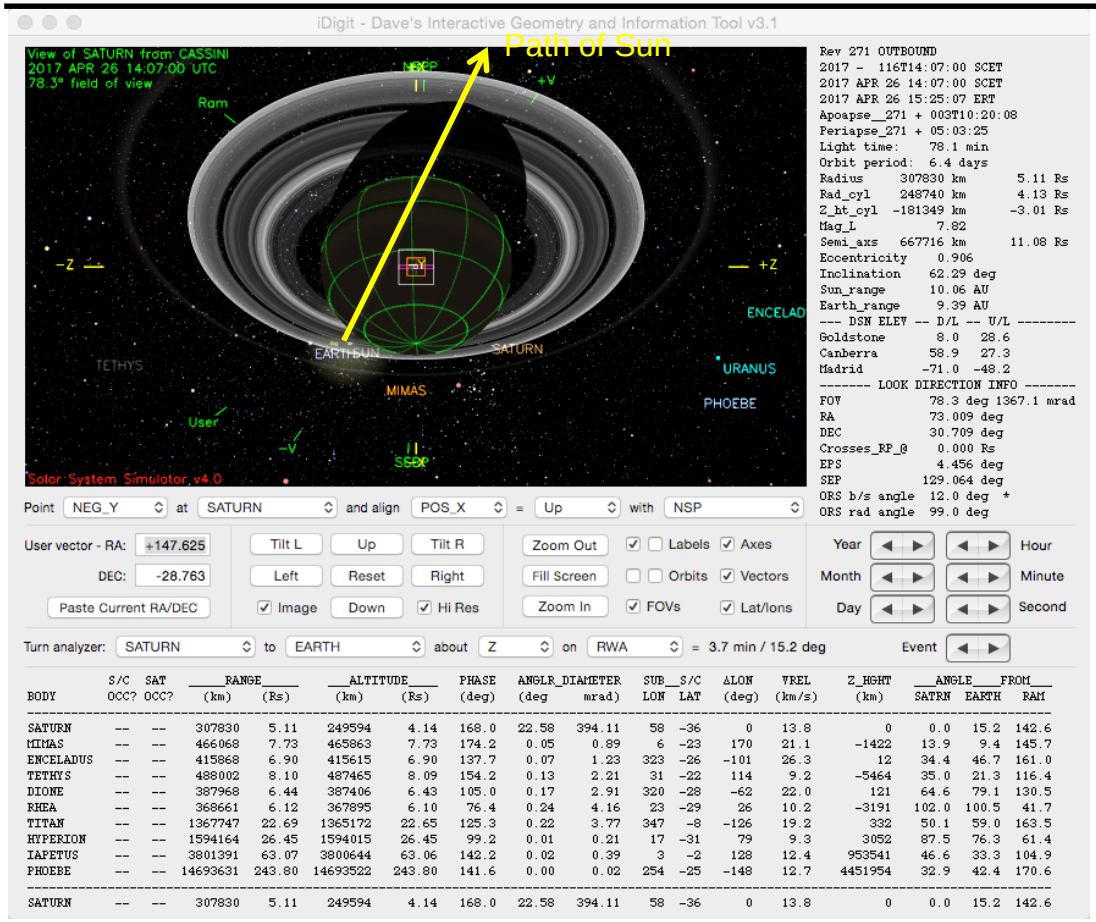
Turn analyzer: SATURN to EARTH about Z on RWA = 5.6 min / 35.2 deg Event

| 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 | ALON (deg) | VREL (km/s) | Z_HGHT (km) | ANGLE_FROM SATRN | ANGLE_FROM EARTH | ANGLE_FROM RAM |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SATURN | -- | -- | 1267344 | 21.03 | 1207154 | 20.03 | 142.7 | 5.45 | 95.15 | 162 | 7 | 0 | 1.7 | 0 | 0.0 | 35.2 | 84.5 |
| MIMAS | -- | -- | 1099410 | 18.24 | 1099206 | 18.24 | 140.0 | 0.02 | 0.38 | 150 | 8 | 24 | 13.8 | 1841 | 4.1 | 37.6 | 81.0 |
| ENCELADUS | -- | -- | 1473028 | 24.44 | 1472772 | 24.44 | 141.0 | 0.02 | 0.35 | 32 | 6 | 147 | 13.7 | 6 | 5.1 | 36.3 | 79.4 |
| TETHYS | -- | -- | 1451584 | 24.09 | 1451049 | 24.08 | 146.6 | 0.04 | 0.74 | 314 | 6 | -124 | 11.4 | -669 | 9.7 | 32.4 | 93.5 |
| DIONE | -- | -- | 1418764 | 23.54 | 1418203 | 23.53 | 147.2 | 0.05 | 0.79 | 301 | 6 | -106 | 9.8 | 149 | 14.8 | 32.5 | 98.5 |
| RHEA | -- | -- | 1746522 | 28.98 | 1745756 | 28.97 | 139.9 | 0.05 | 0.88 | 23 | 5 | 151 | 9.6 | 151 | 8.5 | 37.1 | 76.0 |
| TITAN | -- | -- | 2494741 | 41.39 | 2492166 | 41.35 | 146.9 | 0.12 | 2.06 | 352 | 3 | -175 | 6.4 | 8574 | 4.3 | 31.1 | 85.8 |
| HYPERION | -- | -- | 1512590 | 25.10 | 1512455 | 25.10 | 87.4 | 0.01 | 0.22 | 236 | -29 | 61 | 5.0 | -19291 | 72.0 | 88.3 | 25.0 |
| IAPETUS | -- | -- | 4602627 | 76.37 | 4601880 | 76.36 | 132.0 | 0.02 | 0.32 | 10 | 6 | 140 | 4.6 | 876377 | 33.8 | 43.7 | 51.2 |
| PHOEBE | -- | -- | 14999189 | 248.87 | 14999078 | 248.87 | 142.5 | 0.00 | 0.02 | 58 | -22 | -120 | 2.7 | 4287723 | 59.4 | 41.3 | 126.9 |
| SATURN | -- | -- | 1267344 | 21.03 | 1207154 | 20.03 | 142.7 | 5.45 | 95.15 | 162 | 7 | 0 | 1.7 | 0 | 0.0 | 35.2 | 84.5 |

| | Saturn Range | Phase Angle | Sub-S/C Lat. |
|---|---|---|---|
| Segment Start | 12.42 | 121.9 | 24 |
| Periapse | 1.05 | 36.0 | -5 |
| Apoapse | 21.12 | 144.3 | 5 |
| Segment End | 21.03 | 142.7 | 7 |

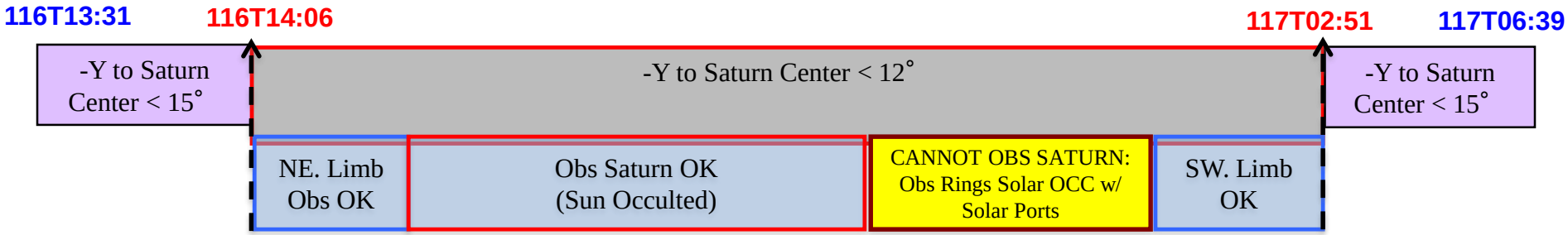
# Solar Geometry – ORS Boresight Concerns






| BODY | S/C OCC? | SAT OCC? | RANGE (km) | RANGE (Rs) | ALTITUDE (km) | ALTITUDE (Rs) | PHASE (deg) | ANGLR_DIAMETER (deg | mrad) | SUB_S/C LON | SUB_S/C LAT | ALON (deg) | VREL (km/s) | Z_HGHT (km) | ANGLE FROM SATRN | ANGLE FROM EARTH | ANGLE FROM RAM |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SATURN | -- | -- | 307830 | 5.11 | 249594 | 4.14 | 168.0 | 22.58 | 394.11 | 58 | -36 | 0 | 13.8 | 0 | 0.0 | 15.2 | 142.6 |
| MIMAS | -- | -- | 466068 | 7.73 | 465863 | 7.73 | 174.2 | 0.05 | 0.89 | 6 | -23 | 170 | 21.1 | -1422 | 13.9 | 9.4 | 145.7 |
| ENCELADUS | -- | -- | 415868 | 6.90 | 415615 | 6.90 | 137.7 | 0.07 | 1.23 | 323 | -26 | -101 | 26.3 | 12 | 34.4 | 46.7 | 161.0 |
| TETHYS | -- | -- | 488002 | 8.10 | 487465 | 8.09 | 154.2 | 0.13 | 2.21 | 31 | -22 | 114 | 9.2 | -5464 | 35.0 | 21.3 | 116.4 |
| DIONE | -- | -- | 387968 | 6.44 | 387406 | 6.43 | 105.0 | 0.17 | 2.91 | 320 | -28 | -62 | 22.0 | 121 | 64.6 | 79.1 | 130.5 |
| RHEA | -- | -- | 368661 | 6.12 | 367895 | 6.10 | 76.4 | 0.24 | 4.16 | 23 | -29 | 26 | 10.2 | -3191 | 102.0 | 100.5 | 41.7 |
| TITAN | -- | -- | 1367747 | 22.69 | 1365172 | 22.65 | 125.3 | 0.22 | 3.77 | 347 | -8 | -126 | 19.2 | 332 | 50.1 | 59.0 | 163.5 |
| HYPERION | -- | -- | 1594164 | 26.45 | 1594015 | 26.45 | 99.2 | 0.01 | 0.21 | 17 | -31 | 79 | 9.3 | 3052 | 87.5 | 76.3 | 61.4 |
| IAPETUS | -- | -- | 3801391 | 63.07 | 3800644 | 63.06 | 142.2 | 0.02 | 0.39 | 3 | -2 | 128 | 12.4 | 953541 | 46.6 | 33.3 | 104.9 |
| PHOEBE | -- | -- | 14693631 | 243.80 | 14693522 | 243.80 | 141.6 | 0.00 | 0.02 | 254 | -25 | -148 | 12.7 | 4451954 | 32.9 | 42.4 | 170.6 |
| SATURN | -- | -- | 307830 | 5.11 | 249594 | 4.14 | 168.0 | 22.58 | 394.11 | 58 | -36 | 0 | 13.8 | 0 | 0.0 | 15.2 | 142.6 |

- Pointing to NEG_Y to Saturn (center) would lead to a CMT (<12˚ ) violation between **2017-116T14:06:53** and **2017-117T02:50:55.**
- Minimum NEG_Y to Saturn to Sun angle is ~1.25˚ at ~**2017-116T17:57:30.**
- Between **116T14:06 – 14:33** observing the North-Eastern Limb brings one out of the 12˚ cone, but possibly not the 15˚ cone. ***A waiver MAY be required.***
- Between **116T14:32:48 – 21:13:33** Sun is behind Saturn, CMT management allows NEG_Y to Saturn & Rings for observations. ***A waiver WILL be required.***
- **Cannot observe Saturn from 116T21:13:33 – ~21:55:00**, therefore observe Ring Solar Occultation with VIMS & UVIS Solar Ports (**116T21:20:00 – 23:00:00**).
- Between **~116T21:55:00 – 02:50:55** observing the South-Western Limb brings one out of the 12˚ cone, but not the 15˚ cone. ***A waiver WILL be required.***



# Periapse Quicklooks

Rev 271

| |
|---|
| VIMS_271SA_NHEMMAP001_PRIME |
| UVIS_271SA_AURSLEW001_PRIME |
| VIMS_271SA_NHEMMAP002_PRIME |
| VIMS_271SA_NPOLMOV001_PIE |
| Begin Custom |
| Begin Dual Playback Science |
| ISS_271SA_HIRESWACS001_PIE |
| SP_271DR_RAMAVOID116_PRIME |
| Dust Hazard (HGA-to-Dust-Ra... |
| Periapse R = 1.047 Rs, lat ... |
| ISS_271SA_HIRESWACS002_PIE |
| CIRS_271SA_REGMAP001_PIE |
| End Dual Playback Science |
| VIMS_271RI_HIPHASE001_PIE |
| SP_271SA_WAYPTTURN116_PRIME |
| NEW WAYPOINT |
| End Custom |
| VIMS_271RI_SOLAROCC001_PRIME |
| UVIS_271SA_AURNSTARE001_PRIME |
| VIMS_271SA_ALPORIOCC001_PIE |
| UVIS_271SA_AURSLEW002_PRIME |

- VIMS NHEMMAP001 performed mosaics of the northern Saturnian hemisphere for an hour.
- UVIS AURSLEW was a collaborative activity staring at the northern aurora (3hr) for VIMS, then repeated slews of the lit northern polar aurora (3hr) for UVIS science.
- VIMS NHEMMAP002 made mosaics for another hour, obtaining the opposite hemisphere.
- VIMS NPOLMOV PIE captured a high resolution movie of the north polar region including Saturn's North Polar Hexagon for nearly a full rotation of Saturn.
- The ISS HIRESWACS PIE began with a collaborative CIRS mosaics of the North Pole region, then ISS captured high resolution WAC images of the upper atmosphere as its field of view skimmed across the North Pole to equator (Begin Dual playback Sci.).
- SP RAMAVOID diverted Cassini to a safe attitude during the RPX, using its HGA as a shield against any ring particles. ISS rider continued its hi-res WAC across the equator, capturing the best resolution images yet, looking for small convective clouds.
- ISS HIRESWACS PIE continued hi-res WAC towards South Pole region.
- CIRS REGMAP PIE hi-res regional South Pole mapping (End Dual Playback Sci.).
- VIMS HIPHASE captured Saturn’s outer faint E-ring down to the D-ring at extremely high solar phase angles which highlight the micron-sized dust particles.
- VIMS SOLAROCC and UVIS used their solar ports to observe a solar ring occultation (A - G rings), studying size and distributions of the smallest ring particles.
- UVIS AURNSTARE and VIMS stared at Saturn’s unlit South Polar Auroral Zone.
- VIMS ALPORIOCC PIE stellar occultation of Saturn’s upper atmosphere attempted to peer deeper than the usual limit of ~5mbar.
- UVIS AURSLEW observed Saturn’s South Polar Auroral Zone with repeated slews

# Daily Science Highlights (1/4)

**25 Apr 2017 (DOY 115):** The Saturn 271 was the first Proximal Orbit segment with the closest Periapse above Saturn's cloud tops to date, as well as an important first time ring plane crossing inside the D-ring. The Segment began as Cassini approached periapse, less than a day away, with VIMS mapping the northern Saturnian hemisphere (NHEMMAP001) with the mosaic centered at 35 deg N Latitude – i.e., covering the remnant region of the Great Storm of 2010-2011 - at a distance of about 12 Saturn radii (CIRS, ISS, and UVIS ride along). UVIS followed this with a collaborative VIMS observation, first staring at the northern aurora (AURSLEW) for 3hr supporting VIMS auroral imaging, then repeated slews across the illuminated northern polar aurora for 3hr of UVIS auroral imaging. Then VIMS (and riders) repeated its northern hemisphere mapping with another mosaic (NHEMMAP002).

As periapse was just hours away, VIMS captured a high resolution movie of the north polar region (including Saturn's North Polar Hexagon) with multiple 3x3 mosaics for nearly a full rotation of Saturn (NPOLMOV PIE), while CIRS, ISS, and UVIS ride. During this high-priority activity, VIMS took the **sharpest near-infrared movies to date** of the intricate structure and complex movements of features in and around the polar hexagon and the north polar vortex, with altitudes ranging from 7.5 tp 2.2 Saturn radii. **The last two mosaics/frames of the movie were taken with better than 100-km-per-pixel resolution, allowing unprecedented analysis of winds in the near-infrared, while much of the last mosaic is obtained at better than 70 km/pixel resolution, the sharpest near-infrared images yet acquired of the north polar region.**

Throughout this approach period, the MAPS instruments were also continuously collecting unique and valuable data about this new region of the Saturn environment. RPWS was able to observe the inner magnetosphere, followed by the auroral magnetosphere (e.g. the acceleration region) and SKR source regions as Cassini neared periapse over the North pole. **MAG yielded unique observations of Saturn's internal magnetic field throughout this unique orbit track in latitude and longitude space.**

# Daily Science Highlights (2/4)

**26 Apr 2017 (DOY 116):** Just before reaching the first proximal periapse (the closest to Saturn of the Cassini Mission to-date), Cassini passed over Saturn's North Pole at altitudes of 2.2 down to 0.1 Saturn Radii, providing an excellent opportunity for a collaborative CIRS and ISS high resolution observation of the Northern pole region, with VIMS also riding along. This series of ISS and CIRS activities were the highest priority science for this orbit, **warranting a dual playback plan to better guarantee that this high value data was preserved and downlinked.** CIRS first collected high resolution temperature data mosaics **(4X better than previous views) of the upper atmosphere of the North Pole region.** Then ISS captured high resolution WAC images as its field of view traversed across the North Pole towards the equator (HIRESWACS001 PIE) , conducting what is affectionately called "the noodle." While still pointed at the north polar region at the beginning of the traverse, VIMS acquired the highest resolution full-frame images of the planet to date. The main target of the noodle was north equatorial latitudes from about 20 deg North (when the camera reaches around 500m/pix resolution) to about -8 deg South (where Saturn is shadowed by the rings). Such proximity also provided the riding instruments with unprecedented high resolution observations. CIRS obtained 2km resolution, about 20x higher resolution then limb sounding and perhaps 100x higher than previous nadir observations. VIMS obtained about 50x better pixel resolution than the previous best images, but only is able to use a few pixels to obtain a continuous swath.

**As Cassini skimmed over the cloud tops at ~3000 km altitude near the equator, the spacecraft had to divert to a safe attitude for the Ring-plane crossing, using its high gain antenna as a shield against any ring particles (RAMAVOID). During this maneuver, ISS continued its high resolution WAC image "noodle" with the best resolution of about 200 m/pixel (10x better than previous images), looking for small convective clouds and wave features in Saturn's atmosphere, perhaps indicative of deep thunderstorms.**

**Concurrently, the MAPS instruments collected exceptionally valuable science data as well as engineering data to better inform the mission & science planning teams how to protect Cassini during each of the ring-plan crossings.** RPWS determined the equatorial dust flux & scale height as a function of radial distance (down to periapse of 1.05 Saturn radii, equivalent to 2964 km altitude), obtaining high resolution data of plasma waves at the magnetic equator. These measurements help in understanding whether there is a dust population migrating from the rings to the atmosphere.

# Daily Science Highlights (3/4)

**26 Apr 2017 (DOY 116) Continued:** Similarly, as Cassini ascended from the first proximal periapse, the spacecraft passed over Saturn's South Pole spanning altitudes from 0.1 and 1.7 Saturn Radii, providing another excellent opportunity for a collaborative ISS and CIRS high resolution observation of the Southern pole region (HIRESWACS002 PIE), with VIMS riding along. ISS captured high resolution WAC images of the upper atmosphere as its field of view skimmed across the South Pole, outlining the "the noodle," (though in winter darkness, it is hoped that ringshine will allow some valuable cloud imaging)while CIRS also collected high resolution temperature data **(5X better spatial resolution than previous observations).**

Just after periapse and still in close view of Saturn's southern hemisphere, CIRS created a regional map of the south polar region (REGMAP PIE), obtaining temperature data of the southern vortex. This observation occurred at an altitude of 1.7-4.4 Saturn radii, observing between 87S and 90S and **at 2 to 4 times higher resolution than regional maps taken to-date.**

Next VIMS took advantage of this close proximity to perform radial mosaics of Saturn's outer faint rings out to the E-ring as well as the innermost D-ring at extremely solar high phase angles > 165 deg (HIPHASE PIE), which highlighted the micron-sized dust particles within these faint rings. With the disk of Saturn safely blocking (eclipsing) the Sun, the optical remote sensing instruments could observe at these very high phase angles which would otherwise expose Cassini's instrumentation to direct sunlight, damaging them. **What makes this observation even more unique is the close range of 330,000-410,000 km and long observation duration >6 hrs,** which allowed for great spatial resolution for VIMS. This was the only VIMS high phase PIE activity.

As the sun exited from behind Saturn's disk, it was unsafe for typical imaging of Saturn. Thus VIMS and UVIS used their solar ports to collaboratively observe a solar ring occultation (SOLAROCC). As the sun egressed, passing behind the A through G rings of Saturn, the instruments could study the size and spatial distributions of the smallest particles in the rings.

Throughout the ascent from periapse, the MAPS instruments were repeating their science strategy similar to the approach to capture unique and valuable magnetospheric and plasma data close to Saturn, but here over Saturn's South Pole.

# Daily Science Highlights (4/4)

**27 Apr 2017 (DOY 117):** UVIS took the helm with a 2.7 hr auroral observation, staring at Saturn's South Polar Auroral Zone (AURNSTARE), while that region was in darkness. The long dwell times supported the collaborative VIMS imaging, as well as ISS and CIRS ride along observations. Next, VIMS began observing an occultation of Alpha Orionis (better known as Betelgeuse) by Saturn's atmosphere at 76 deg S. Latitude (ALPORIOCC PIE), while others were from 5 – 59 deg S. Latitude. This was the 3rd of 6 Saturn Occultations by Alpha Orionis that VIMS performed in the F/Prox Orbits. It was the brightest star VIMS used during these important occultations, where VIMS (in image mode) followed the star as it is refracted by Saturn's atmosphere during the stellar occultation, thus allowing VIMS to peer deeper than their usual limit of ~5mbar.

Finally, UVIS took the lead again to complete its observation of Saturn's South Polar Auroral Zone (AURSLEW), this time focusing on UVIS imaging as it performed repeated slews, scanning Saturn's South Pole. The Solid State Recorders' unique science data were downlinked during an important 70M split pass. The dual playback was performed on each of the Goldstone and Canberra split passes. With the SSRs nearly emptied, ISS captured an Enceladus Plume PIE observation as part of the plume monitoring campaign (EN_PLUME PIE). At a distance of about 0.75-1.35 million km from Enceladus, this 12.5 hr observation allowed brightness variations of the entire plume to be observed on short timescales, excellent for testing theories of the plume production. This observation covered a region of mean anomaly in which the plume was unexpectedly bright in the two previous ISS observations. This new data, along with what was obtained in Rev 286, helps in understanding this feature and whether or not it is persistent. Due to its exceptional length, it also covered the region of mean anomaly where normal brightening occurs. These data help characterize these variations, as well as promise a better understanding of the long term plume behavior.

**28 Apr 2017 (DOY 118):** VIMS did a couple of global pole to pole Saturn mosaics for almost 4 hours, with CIRS riding along. Next, CIRS led a sit and stare observation studying the composition of the Saturn atmosphere (COMPSIT) for a full Saturn rotation ( about 11 hours).

**29 Apr 2017 (DOY 119):** The last observation of the segment was done by ISS with a bright illuminated limb integration with mid-IR sounding to obtain stratospheric thermal structure (LIMBINT); UVIS and VIMS rode.

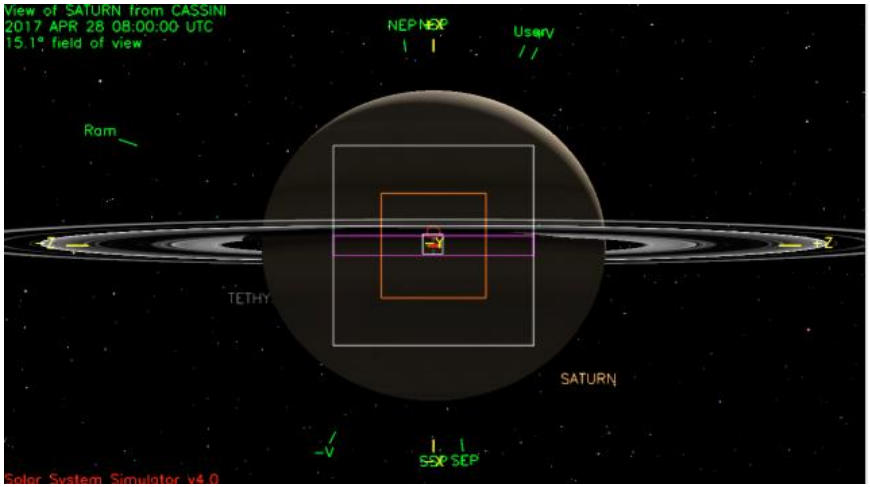
# Segment Integration Planning

# GAP Information (Gaps > 1hr duration)

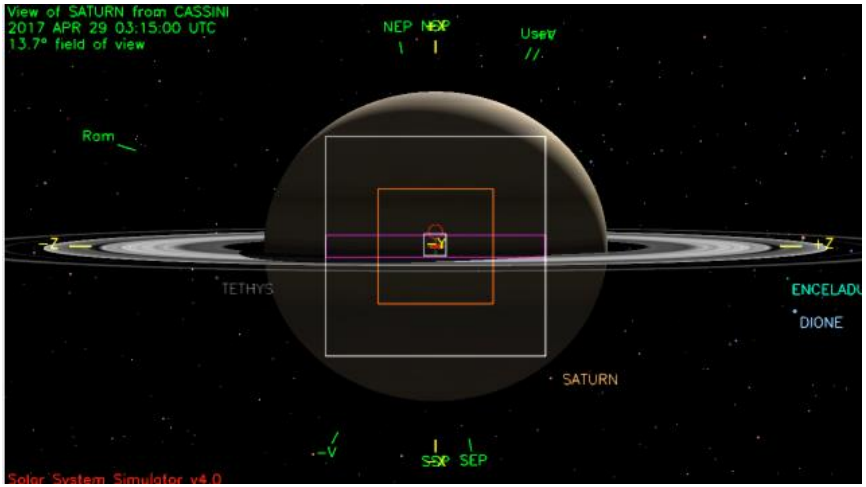


| Gap | Start | End | Duration | Phase angle (range) | Rs range | Sub-S/C Lat. |
|---|---|---|---|---|---|---|
| 1 | 2017-118T06:16:00 | 2017-118T10:05:00 | 000T03:49:00 | 153.8 to 152.5 | 18.67 to 19.24 | -3 to -2 |
| 2 | 2017-118T21:15:00 | 2017-119T09:25:00 | 000T12:10:00 | 149.1 to 145.7 | 20.44 to 21.06 | 1 to 4 |

Gap 1




Gap 2



# Initial SMT and Data Volume

## 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 (%) | CAROVR (Mb) | |
| SP_271EA_G70METNON117_PRIME | 117 05:42 | 117 13:42 | 0 | 5184 | 171 | 5355 | 3322 | -2032 | 0 | 429 | 47 | 3798 | 2643 | -1155 | 1758 | 19% | 1155 |
| SP_271EA_C70METNON117_PRIME | 117 13:42 | 117 17:45 | 1155 | 0 | 0 | 1155 | 3322 | 2167 | 0 | 176 | 24 | 1354 | 1770 | 415 | 1758 | 27% | 0 |
| SP_271EA_C34BWGNON118_PRIME | 118 11:35 | 118 20:35 | 0 | 1904 | 75 | 1979 | 3322 | 1343 | 0 | 196 | 53 | 2228 | 859 | -1370 | 1716 | 37% | 1369 |
| SP_271EA_C70METNON119_PRIME | 119 11:35 | 119 20:35 | 1369 | 173 | 63 | 1606 | 3322 | 1716 | 0 | 196 | 53 | 1855 | 3834 | 1978 | 1979 | 52% | 0 |

**Science data allocation > SSR Capacity**

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) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| OBSERVATION_NOR | 115 13:12 | 117 05:42 | 0.0 | 117.1 | 346.9 | 0.0 | 1565.0 | 124.9 | 153.4 | 0.0 | 1026.5 | 565.7 | 1237.2 | 0.0 | 169.3 | 5306.1 |
| SP_271EA_G70METNON117_PRIME | 117 05:42 | 117 13:42 | 0.0 | 15.1 | 72.9 | 0.0 | 0.0 | 14.2 | 24.5 | 0.0 | 294.3 | 4.3 | 0.0 | 0.0 | 0.0 | 425.2 |
| SP_271EA_C70METNON117_PRIME | 117 13:42 | 117 17:45 | 0.0 | 7.6 | 0.0 | 0.0 | 0.0 | 7.2 | 12.4 | 0.0 | 19.1 | 2.2 | 0.0 | 0.0 | 125.4 | 173.9 |
| DAILY TOTAL SCIENCE | 115 13:12 | 117 17:45 | 0.0 | 139.8 | 419.8 | 0.0 | 1565.0 | 146.4 | 190.3 | 0.0 | 1339.9 | 572.2 | 1237.2 | 0.0 | 294.7 | |
| OBSERVATION_NOR | 117 17:45 | 118 11:35 | 0.0 | 33.6 | 175.2 | 0.0 | 1200.0 | 31.7 | 54.6 | 0.0 | 84.1 | 187.3 | 120.0 | 0.0 | 74.5 | 1961.1 |
| SP_271EA_C34BWGNON118_PRIME | 118 11:35 | 118 20:35 | 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 | 117 17:45 | 118 20:35 | 0.0 | 50.6 | 261.6 | 0.0 | 1200.0 | 47.7 | 82.1 | 0.0 | 126.5 | 192.3 | 120.0 | 0.0 | 74.5 | |
| OBSERVATION_NOR | 118 20:35 | 119 11:35 | 0.0 | 28.3 | 0.0 | 0.0 | 0.0 | 26.7 | 45.9 | 0.0 | 70.7 | 0.0 | 0.0 | 0.0 | 62.7 | 234.3 |
| SP_271EA_C70METNON119_PRIME | 119 11:35 | 119 20:35 | 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 | 118 20:35 | 119 20:35 | 0.0 | 45.3 | 86.4 | 0.0 | 0.0 | 42.7 | 73.4 | 0.0 | 113.2 | 4.9 | 0.0 | 0.0 | 62.7 | |

# Waypoints

## Standard Waypoints

GAP 1

GAP 2

| 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_271NA_OBSERV115_NA | 2017-115T13:12:00 | 2017-117T05:57:00 | **BAD** | **BAD** | **BAD** | **BAD** | **BAD** | **BAD** | **BAD** | **BAD** | **BAD** | **BAD** |
| SP_271NA_OBSERV117_NA | 2017-117T17:45:00 | 2017-118T11:35:00 | **BAD** | **BAD** | OK | OK | OK | OK | **BAD** | **BAD** | OK | **BAD** |
| SP_271NA_OBSERV118_NA | 2017-118T20:35:00 | 2017-119T11:35:00 | **BAD** | **BAD** | OK | OK | OK | OK | **BAD** | **BAD** | OK | **BAD** |

## RBOT Friendly Waypoints

| | OBSERVATION PERIOD | START | END | POS_X | NEG_X | POS_Z | NEG_Z |
|---|---|---|---|---|---|---|---|
| | SP_271NA_OBSERV115_NA | 2017-115T13:12:00 | 2017-117T05:57:00 | ------ | ------ | ------ | ------ |
| GAP 1: | SP_271NA_OBSERV117_NA | 2017-117T17:45:00 | 2017-118T11:35:00 | 185.8/ 33.1 | 185.8/ 33.1 | 185.8/ 33.1 | ------ |
| GAP 2: | SP_271NA_OBSERV118_NA | 2017-118T20:35:00 | 2017-119T11:35:00 | 185.8/ 33.1 | 185.8/ 33.1 | 185.8/ 33.1 | ------ |

## Good Periapse Waypoints

| OBSERVATION PERIOD | START | END | POS_X | NEG_X | POS_Z | NEG_Z |
|---|---|---|---|---|---|---|
| SP_271NA_OBSERV000_NA | 2017-115T13:12:00 | 2017-116T07:03:34 | 186.8/ 33.1 | 186.8/ 33.1 | 186.8/ 33.1 | ------ |
| SP_271NA_OBSERV000_NA | 2017-115T13:12:00 | 2017-116T06:03:34 | 186.8/ 33.1 | 186.8/ 33.1 | 186.8/ 33.1 | ------ |
| SP_271NA_OBSERV000_NA | 2017-115T13:12:00 | 2017-116T05:03:34 | 186.8/ 33.1 | 186.8/ 33.1 | 186.8/ 33.1 | ------ |
| SP_271NA_OBSERV000_NA | 2017-115T13:12:00 | 2017-116T04:03:34 | 186.8/ 33.1 | 186.8/ 33.1 | 186.8/ 33.1 | ------ |

## Good Downlinks

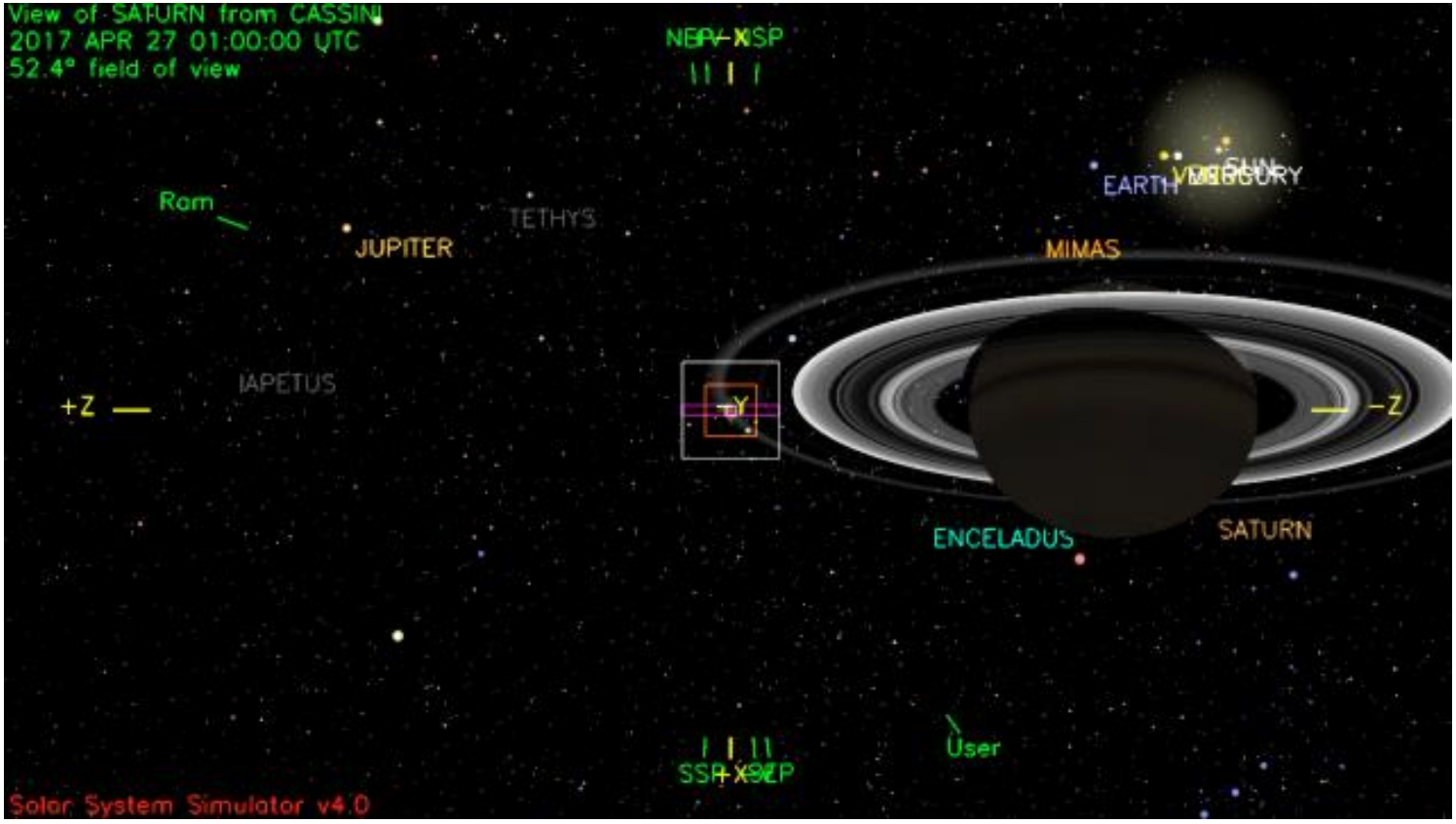
| DOWNLINK | START | END | POS_X_2_NSP | POS_X_2_NEP | NEG_X_2_NSP | NEG_X_2_NEP | POS_Y_2_NSP | POS_Y_2_NEP | NEG_Y_2_NSP | NEG_Y_2_NEP | ROLL_FLAG |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SP_271EA_G70METNON117_PRIME | 2017-117T05:57:00 | 2017-117T13:42:00 | OK | OK | OK | OK | **BAD** | **BAD** | OK | OK | OK |
| SP_271EA_C70METNON117_PRIME | 2017-117T13:42:00 | 2017-117T17:45:00 | OK | OK | OK | OK | **BAD** | **BAD** | OK | OK | OK |
| SP_271EA_C34BWGNON118_PRIME | 2017-118T11:35:00 | 2017-118T20:35:00 | OK | OK | OK | OK | **BAD** | **BAD** | OK | OK | OK |
| SP_271EA_C70METNON119_PRIME | 2017-119T11:35:00 | 2017-119T20:35:00 | OK | OK | OK | OK | **BAD** | **BAD** | OK | OK | OK |

# Waypoints Chosen (1/2)



Waypoint 1 (2017-115T13:52:00 – 2017-116T21:20:00): No acceptable valid waypoint, custom period used.

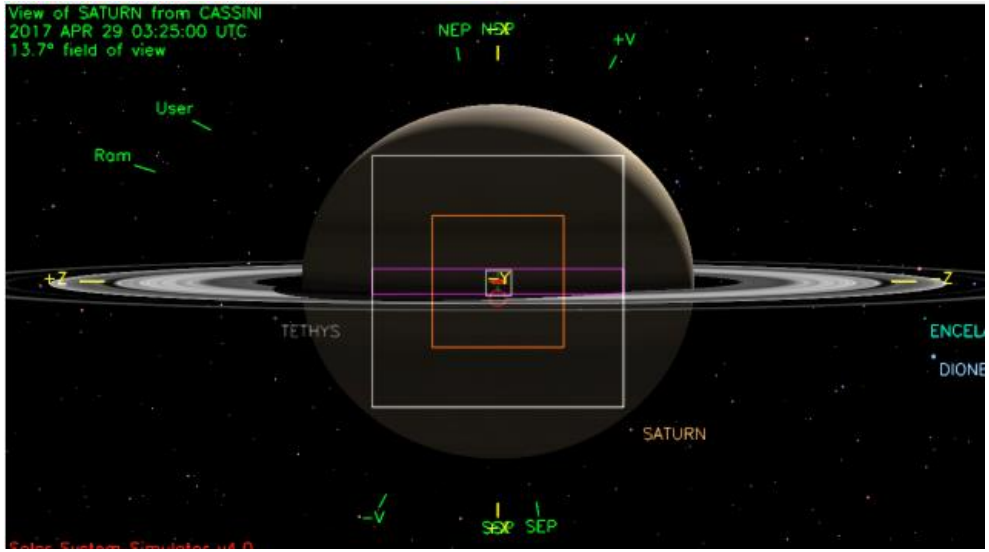
Waypoint 2 (2017-116T21:20:00 – 2017-117T05:10:00): ISS_NAC to Saturn (-15.0,0.0,0.0 deg. offset), NEG_X to NSP



# Waypoints Chosen (2/2)

Waypoint 3 (2017-117T17:45:00 – 2017-118T21:15:00): Downlink attitude (XBAND to Earth, NEG_X to NSP) used without establishing a new waypoint to maximize ISS Enceladus Plume observation time

Waypoint 4 (2017-118T21:15:00 – 2017-119T10:05:00): ISS_NAC to Saturn, POS_Z to NSP



# Notes (1/2)

- Pointing:
  - Waypoints:
    - RBOT friendly waypoints used when compatible with science
    - No Valid Waypoint for Periapse Period (2017-115T13:52 – 116T21:20 SCET, Duration 001T07:28): Use Custom Period
  - Custom Period (2017-116T06:30 – 116T21:20 SCET) – Used to minimize turn times among instruments and avoid Waypoint issues
  - YGAPS & Quiescent Gaps:
    - Earth-pointed Z-bias during G70METNON117: Approval from SCO & NAV per email (Chuck Kirby & Duane Roth 6/29)
    - Earth-pointed 47 minute quiescent gap: 117T05:10 – 05:57
  - Collaborative PRIME/RIDER activities:
    - UVIS_271SA_AURSLEW001_PRIME: Collaborative w/ VIMS
    - ISS_271SA_HIRESWACS001_PIE: Collaborative w/ CIRS
    - SP_271DR_RAMAVOID116_PRIME: Collaborative w/ ISS
    - VIMS_271RI_SOLAROCC001_PRIME: Collaborative w/ UVIS
    - UVIS_271SA_AURNSTARE001_PRIME: Collaborative w/ VIMS
  - CIRS and VIMS temperature/boresite violations:
    - CIRS Max Temp = 81.46K (ΔT = 6.86K) at 116T09:19, >1.6K: 116T08:40 - 15:13, >5K: 116T09:05 - 10:29 (During SP RAMAVOID116)
      - CIRS provided approval via email (Paul Romani 10/26)
      - **Consumable FR Wavier will be required (See SPLAT item)**
    - VIMS Max Temp = 64.16K (ΔT = 5.50K ) at 116T09:23, >1K: 116T08:22 - 117T08:37, >2K: 116T08:44 -117T00:07 (During SP RAMAVOID116)
      - VIMS provided approval via email (Ed Audi 8/18)
      - **Consumable FR waiver will be required (See SPLAT item)**
    - CIRS Boresite to Sun < 15° during DOY 116 – 117 (During CIRS REGMAP, VIMS HIPHASE, UVIS AURNSTARE & AURSLEW002)
      - CIRS Boresite to Sun angle < 12° occur only during Solar Occultation behind Saturn
      - CIRS provided approval via email (Paul Romani 10/26)
      - **Operational FR Wavier will be required (See SPLAT item)**
  - **CMT Management required during the period 2017-116T14:39:47 – 21:06:32 SCET for the following violations (see SPLAT item):**
    - NEG_Y to SUN angle < 12° (Min NEG_Y to Sun angle = 0.323° at 2017-116T16:41:09)
      - CMT Management required during the following activities:
        - VIMS HIPHASE PIE (violation at 116T14:40:40 - 21:06:20)
    - POS_X to SUN angle < 83° (Min POS_X to Sun angle = 81.702° at 2017-116T16:31:10)
      - CMT Management required during the following activities:
        - VIMS HIPHASE PIE (violation at 116T14:52:45 - 16:34:15)
    - Sun occulted behind Saturn between 2017-116T14:32:47 – 21:13:32 (from Tour Atlas)

# Notes (2/2)



- Pointing (continued):
  - **SIP Pre-SPTURN SPASS TXT Hand Edits for SP RAMAVOID116: Delete initial Collaborative Rider information leaving only pick up/hand off info:**
    - **WAS: "Collaborative Rider (s): ISS. Pick up at NEG_Z to Dust_RAM, POS_Y to Sun; Hand off at NEG_Z to Dust_RAM, POS_Y to Sun. …"**
    - **IS: "Pick up at NEG_Z to Dust_RAM, POS_Y to Sun; Hand off at NEG_Z to Dust_RAM, POS_Y to Sun. …"**
  - PDT Violation: ISS HIRESWACS001 & 002 Excessive Turn Rates – OKAY b/c ± 3 hours of periapse
  - Periapse Jumpstart of Merged PDT & AACS analysis for teams early PDT deliveries during 2017-115T13:52 – 117T04:47 (see SPLAT item)
- Data Volume:
  - Dual Playback:
    - Hi-value data (116T06:30:00 – 14:30:00): ISS HIRESWACS001, SP RAMAVOID (RPX), ISS HIRESWACS002, CIRS REGMAP
    - Dual Playback/Hi-value data volume: 1388.27Mb
    - 814Mb of data recorded on SSRB before Hi-value Period begins
    - 633Mb carryover of non Hi-value data after 2nd playback
  - SMT Warnings:
    - SP_271EA_G70METNON117_PRIME Priority List conflicts with selected SSR. (SSRAP4,SSRBP4): OKAY b/c Dual Playback (1st playback)
    - SP_271EA_C70METNON117_PRIME Priority List conflicts with selected SSR. (SSRAP4,SSRBP4): OKAY b/c Dual Playback (2nd playback)
- DSN: No Level 3 requests identified
  - Juno Conflict with G70METNON117 (conflict of ~4hr at BOT): RPX/DPB 1st pass per Juno14day_ConflictAnalysis_RevL_nv.xlsx, (Juno plans likely changed)
  - ap_downlink report check warnings dispositions (except %70M stations, ignore):
    - SP_271EA_G70METNON117_PRIMEhas an unusual priority playback list: OKAY b/c Dual Playback (1st playback)
    - SP_271EA_C70METNON117_PRIME has an unusual priority playback list: OKAY b/c Dual Playback (2nd playback)
  - Difference from original DSN strawman allocation:
    - G70METNON117 Extended BOT by 15 min
    - Moved handover of split pass 1.5 hr earlier between G70METNON117 and C70METNON117
- Resource checker dispositions:
  - G70METNON117: First_Part value of SSRAP4 does not match default… : OKAY b/c Dual Playback
  - C70METNON117: First_Part value of SSRAP4 does not match default… : OKAY b/c Dual Playback
  - DLTURN117: Gap of 32 minutes between DLTURN117 and G70METNON117: OKAY Gap intentional
- Opmodes: No unusual opmodes
- Hydrazine: N/A
- Special Activities:
  - PIES: VIMS_271SA_NPOLMOV001_PIE (2017-115T22:30:00 - 2017-116T06:30:00)
    - ISS_271SA_HIRESWACS001_PIE (2017-116T06:30:00 - 2017-116T08:50:00)
    - ISS_271SA_HIRESWACS002_PIE (2017-116T09:10:00 - 2017-116T11:04:00)
    - CIRS_271SA_REGMAP001_PIE (2017-116T11:04:00 - 2017-116T14:30:00)
    - VIMS_271RI_HIPHASE001_PIE (2017-116T14:30:00 - 2017-116T21:15:00)
    - VIMS_271SA_ALPORIOCC001_PIE (2017-117T01:39:00 - 2017-117T02:49:00)
    - ISS_271EN_PLUME001_PIE (2017-117T17:45:00 - 2017-118T06:16:00)

# Liens (1/2)

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

- Dual Playback:
  - "During DSN negotiations ensure that SSR-A is emptied before the pointers are reset. This item cannot be closed until the DSN negotiations are complete for both downlink passes, or the dual playback is deleted."
- CMT Management waiver required for the period 2017-116T14:39:47 – 21:06:32 SCET due to the following CMT violations:
  - NEG_Y to Sun < 12° violation during VIMS_271RI_HIPHASE001_PIE at 2017-116T14:40:40 - 21:06:20. Minimum NEG_Y to Sun angle = 0.323° at 2017-116T16:41:09.
  - POS_X to Sun < 83° violation during VIMS_271RI_HIPHASE001_PIE at 2017-116T14:52:45 - 16:34:15. Minimum POS_X to Sun angle = 81.702° at 2017-116T16:31:10
  - Sun occulted behind Saturn between 2017-116T14:32:47 – 21:13:32 (from Tour Atlas)
- CIRS Boresite to Sun < 15° Operational FR waiver required during DOY 116 – 117 (During CIRS REGMAP, VIMS HIPHASE, UVIS AURNSTARE & AURSLEW002)
  - CIRS Boresite to Sun angle < 12° occur only during Solar Occultation behind Saturn
  - Sun occulted behind Saturn between 2017-116T14:32:47 – 21:13:32 (from Tour Atlas)
- CIRS heating violation Consumable FR waiver required during SP_271DR_RAMAVOID116_PRIME
  - CIRS Max Temp = 81.46K (ΔT = 6.86K) at 116T09:19, >1.6K: 116T08:40 - 15:13, >5K: 116T09:05 - 10:29
- VIMS heating violation Consumable FR waiver required during SP_271DR_RAMAVOID116_PRIME
  - VIMS Max Temp = 64.16K (ΔT = 5.50K ) at 116T09:23, >1K: 116T08:22 - 117T08:37, >2K: 116T08:44-117T00:07
- AACS KPT/RBOT Analysis Actions:
  - Tweak the VIMS_271RI_SOLAROCC001_PRIME observation about the "UVIS_SOL_OFF" vector by 13 deg. This can be accomplished by using RA/DEC 302.700/61.915 as the secondary – OK per VIMS, implemented in CIMS (to fix in Port1 SASF)
  - Insert a bias at the downlink attitude before the downlink rolls begin for SP_271EA_G70METNON117_PRIME between 2017-117T05:10 – 05:57
  - Slow the acceleration of the VIMS_271RI_HIPHASE001_PIE turn at 2017-116T21:03:00 – OK per VIMS (to fix in Port1 SASF)

# Liens (2/2)

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

- The following science requests from 2017-115T13:52 to 117T04:47 in Saturn 271 have been designed in PDT during integration. Teams identified shall deliver these designs as part of the Port 1 delivery; SIP Leads to monitor.

  VIMS_271SA_NHEMMAP001_PRIME

  UVIS_271SA_AURSLEW001_PRIME

  VIMS_271SA_NHEMMAP002_PRIME

  VIMS_271SA_NPOLMOV001_PIE

  ISS_271SA_HIRESWACS001_PIE **(POST)**

  SP_271DR_RAMAVOID116_PRIME **(POST)**

  ISS_271SA_HIRESWACS002_PIE **(POST)**

  CIRS_271SA_REGMAP001_PIE

  VIMS_271RI_HIPHASE001_PIE **(RBOT change to be delivered in Port1)**

  VIMS_271RI_SOLAROCC001_PRIME **(RBOT change to be delivered in Port1)**

  UVIS_271SA_AURNSTARE001_PRIME

  VIMS_271SA_ALPORIOCC001_PIE

  UVIS_271SA_AURSLEW002_PRIME

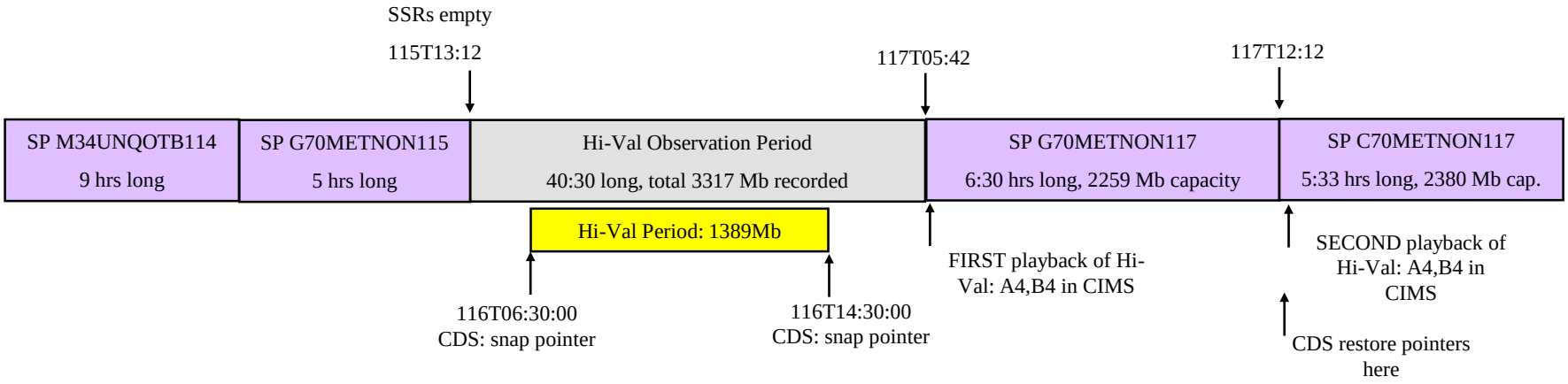
- SIP Leads to check that the POST science requests from 2017-116T06:30 to 116T11:04 in Saturn 271 are the same as what has been approved in integration:
  https://cassini.jpl.nasa.gov/tools/index.php?q=file_exchange/dl/sip_xxm/s99/integration/sasf/Saturn_271_160811.sasf

# Dual Playback: Saturn_271 (CDA/RPWS & ISS/CIRS PIES)



| Saturn271 | BEGHIVAL | ENDHIVAL | P4 Dual Playback Data Volume | SSR empty before hi-val observation period? (if not verify any carryover on A fits with Hi-Val data) | SSR-A empty after first playback ? | PPL set to A4,B4 for first AND second playbacks? | SSRs empty after second playback? (if not does any Hi-Val data carry over?) |
|---|---|---|---|---|---|---|---|
| RPX & ISS/CIRS PIEs | 116T06:30 | 116T14:30 | 1388.266Mb | Yes | Yes | Yes | **No**, but no Hi-Val carryover |

## Playbacks contiguous:

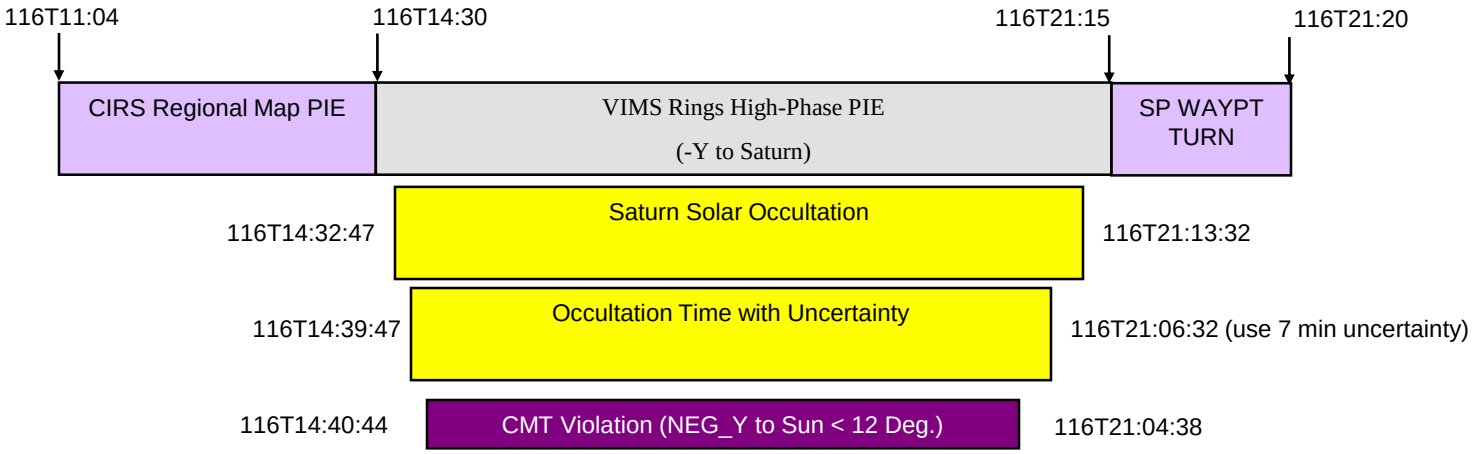



Reminder - ALL instruments' data is played back twice during P4 dual playback periods

# CMT Management: -Y to Sun violation



- -Y to Sun CMT Management and flight rule waivers will be needed for the VIMS Rings High-Phase PIE on DOY 116 during the solar occultation
  - Time of Saturn Solar Occultation is from the tour atlas.
  - Timing uncertainty is ± 1.321 minutes as determined using Brad Wallis' "ask_carnac.pro" with a total of 7 minutes pad recommended



# RBOT Summary

AACS Evaluation of Saturn 271 Jumpstart by David Bates (10/12/16)

- Rev 271 solution simplified by use of relaxed RBOT constraints for proximal orbits
  - Tweak the VIMS 271RI SOLAROCC001 observation about the "UVIS_SOL_OFF" vector by 13 deg. This can be accomplished by using RA/DEC 302.700/61.915 as the secondary – OK per VIMS
  - Insert a bias at the downlink attitude before the downlink rolls begin for G70METNON117 between 2017-117T05:10 – 05:57, no special action needed
  - Slow the acceleration of the VIMS 271RI HIPHASE001 PIE turn at 2017-116T21:03:00 – OK per VIMS