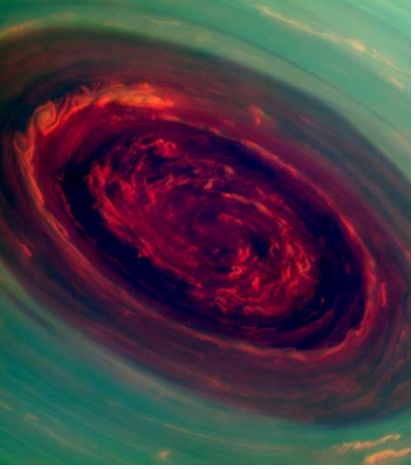
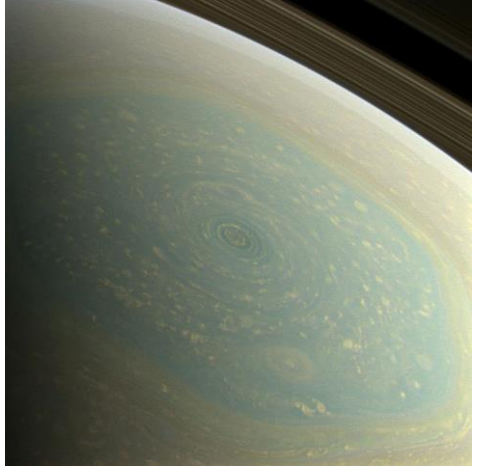
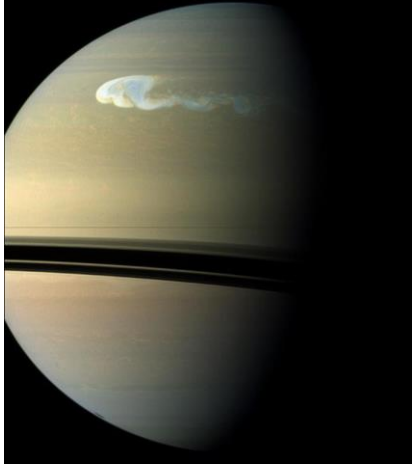


Science Planning & Sequence Team
CASSINI

# SATURN TARGET WORKING TEAM

**Rev 203 Segment Legacy Package**

**Segment Boundary: April 8, 2014 – April 11, 2014**
**2014-098T23:15:00 – 2014-101T13:00:00 (SCET)**

**Integration Began 7/19/2013**
**Segment Delivered to S83 Sequence 09/18/2013**
**Lead Integrator was Shawn Brooks**

**Legacy Package Assembled by Keven Uchida**

# Table of Contents

# Segment Overview and Final Products

# Segment Summary

- This was a very short ~2.5 day long periapse segment in the first inclined phase (IN-1) of the Solstice Mission. The view during this period as exclusively of Saturn's Southern hemisphere. Phase angles ranged between ~65-163 degrees.
- There was one high priority pre-scheduled science observation (PIE) in this segment. UVIS took the lead, studying Saturn's aurora, in concert with the other ORS instruments (riding along) and some particle and fields instruments as well.
- VIMS and UVIS performed mapping observations, and VIMS a stellar calibration.
- A special activity to note – ISS, in coordination with the rest of the ORS instruments, took advantage of the rare opportunity to image Uranus as it skirted Saturn's F-ring from Cassini's perspective.
- With the upgrade of a 34-m station to a 70-m station, there were no data volume issues of note. In fact, this segment was able to absorb 353 Mb of carryover from the previous TOST T100 segment.
- There were no ORS boresight constraints/issues in this segment.

# Final Sequenced SPASS



Gap 1

Gap 2

Gap 3

| Request | Riders | Start (SCET) | Start (Epoch) | Duration | End (SCET) | Primary | Secondary | Comments |
|---|---|---|---|---|---|---|---|---|
| SATURN_203 Segment | | 2014-098T23:15:00 | | 002T13:45:00 | 2014-101T13:00:00 | | | |
| SP_203SA_WAYPTTURN098_PRIME | | 2014-098T23:15:00 | | 000T00:40:00 | 2014-098T23:55:00 | ISS_NAC to Saturn | NEG_X to NSP | |
| **NEW WAYPOINT** | | **2014-098T23:55:00** | | **001T02:35:00** | **2014-100T02:30:00** | **ISS_NAC to Saturn** | **NEG_X to NSP** | |
| VIMS_203SA_SPOLMAP001_PRIME | C, U | 2014-098T23:55:00 | | 000T08:39:00 | 2014-099T08:34:00 | ISS_NAC to Saturn | NEG_X to NSP | |
| UVIS_203SA_AURSLEW001_PIE | C, V | 2014-099T08:34:00 | | 000T09:06:00 | 2014-099T17:40:00 | UVIS_FUV to Saturn | NEG_X to NSP | |
| Periapse R = 12.373 Rs, lat... | | 2014-099T16:06:03 | | 000T00:00:01 | 2014-099T16:06:04 | | | |
| VIMS_203SA_SAURSTARE001_PRIME | C, I, U | 2014-099T17:40:00 | | 000T08:10:00 | 2014-100T01:50:00 | ISS_NAC to Saturn | NEG_X to NSP | |
| SP_203EA_DLTURN100_PRIME | | 2014-100T01:50:00 | | 000T00:40:00 | 2014-100T02:30:00 | XBAND to Earth | POS_X to 318.5/5.7 | |
| **NEW WAYPOINT** | | **2014-100T02:30:00** | | **000T11:10:00** | **2014-100T13:40:00** | **XBAND to Earth** | **POS_X to 318.5/5.7** | |
| ENGR_203SC_KPTYBIAS100_PRIME | | 2014-100T02:30:00 | | 000T01:30:00 | 2014-100T04:00:00 | POS_Z to DELTA_H (0.0,0.0,59.002 deg. offset) | NEG_X to Sun | |
| SP_203EA_G70METNON100_PRIME | C | 2014-100T04:10:00 | | 000T08:50:00 | 2014-100T13:00:00 | XBAND to Earth | Rolling | CAPS. NEG_X to NEP or NSP. Delayed roll by one hour to avoid SRU violations. |
| SP_203SA_WAYPTTURN100_PRIME | | 2014-100T13:00:00 | | 000T00:40:00 | 2014-100T13:40:00 | ISS_NAC to 22.923/8.237 | NEG_X to NSP | |
| **NEW WAYPOINT** | | **2014-100T13:40:00** | | **000T14:20:00** | **2014-101T04:00:00** | **ISS_NAC to 22.923/8.237** | **NEG_X to NSP** | |
| CIRS_203SA_FIRMAP001_PRIME | U, V | 2014-100T13:40:00 | | 000T11:10:00 | 2014-101T00:50:00 | CIRS_FP1 to Saturn | NEG_X to NSP | waypoint is RA/Dec of Uranus for following ISS observation |
| ISS_203SA_MUTUALEVE001_PRIME | C, U, V | 2014-101T00:50:00 | | 000T01:30:00 | 2014-101T02:20:00 | ISS_NAC to 22.923/8.237 | NEG_X to NSP | Collaborative Rider(s): CIRS, UVIS |
| VIMS_203ST_STARCAL001_PRIME | | 2014-101T02:20:00 | | 000T01:05:00 | 2014-101T03:25:00 | VIMS_IR to 34.836/-2.978 | NEG_X to NSP | |
| SP_203EA_DLTURN101_PRIME | | 2014-101T03:25:00 | | 000T00:35:00 | 2014-101T04:00:00 | XBAND to Earth | POS_X to 321.1/-4.0 | |
| **NEW WAYPOINT** | | **2014-101T04:00:00** | | **001T11:15:00** | **2014-102T15:15:00** | **XBAND to Earth** | **POS_X to 321.1/-4.0** | |
| SP_203EA_G70UNQOTP101_PRIME | C, E, N | 2014-101T04:00:00 | | 000T09:00:00 | 2014-101T13:00:00 | XBAND to Earth | 4_Hr_Rolling | secondary POS_X to 321.1/-4.0 (from D. Mitchell) |

# Final Sequenced SMT and Data Volume



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

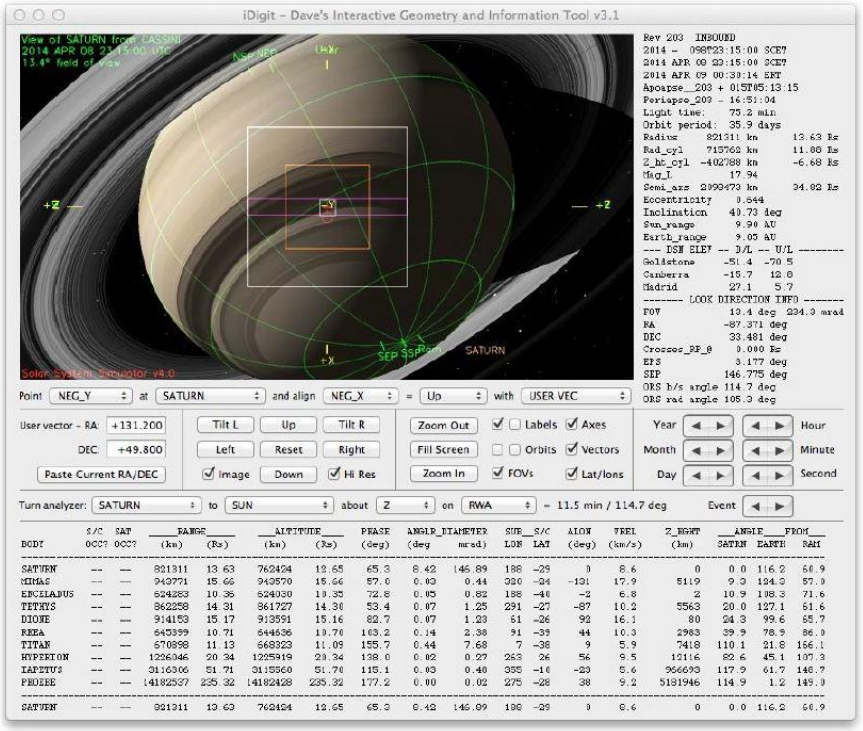
| | | | OBSERVATION_PERIOD | | | | | | | DOWNLINK_PASS | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | P4 | | | | | | P5 | RECORDED | | PLAYBACK | | | | |
| DOWNLINK PASS NAME | Start doy hh:mm | End doy hh:mm | START (Mb) | SCI (Mb) | HK+E (Mb) | TOTAL (Mb) | CPACTY (Mb) | MRGN (Mb) | OPNAV (Mb) | SCI (Mb) | ENGR (Mb) | TOTAL (Mb) | CPACTY (Mb) | MARGN (Mb) | NET_MARGN (%) | CAROVR (Mb) |
| SP_203EA_G70METNON100_PRIME | 100 04:10 | 100 13:00 | 338 | 2212 | 122 | 2672 | 3322 | 651 | 0 | 370 | 52 | 3094 | 3282 | 188 | 783 | 5% | 0 |
| SP_203EA_G70UNQOTP101_PRIME | 101 04:00 | 101 13:00 | 0 | 1522 | 63 | 1585 | 3322 | 1737 | 0 | 498 | 53 | 2137 | 2573 | 436 | 595 | 4% | 0 |

DATA VOLUME REPORT --- TRANSFER FRAME OVERHEAD NOT INCLUDED

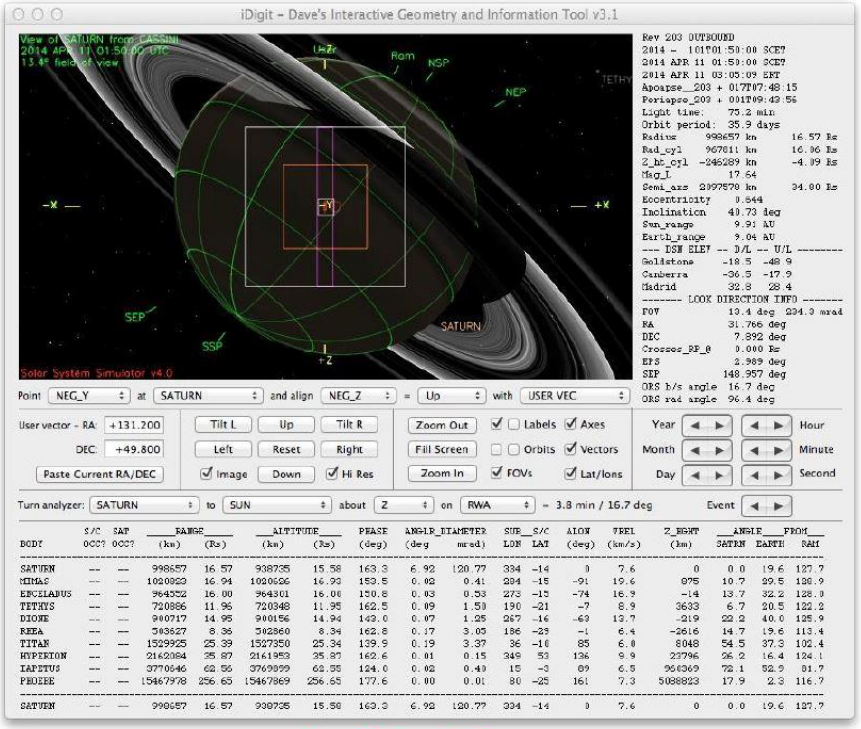
| Event | Start doy hh:mm | End doy hh:mm | CAPS (Mb) | CDA (Mb) | CIRS (Mb) | INMS (Mb) | ISS (Mb) | MAG (Mb) | MIMI (Mb) | RADAR (Mb) | RPWS (Mb) | UVIS (Mb) | VIMS (Mb) | PROBE (Mb) | ENGR (Mb) | TOTAL (Mb) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| OBSERVATION_NOR | 098 23:15 | 100 04:10 | 0.0 | 54.5 | 314.4 | 10.4 | 80.0 | 164.8 | 88.5 | 0.0 | 633.7 | 265.2 | 580.0 | 0.0 | 120.9 | 2312.4 |
| SP_203EA_G70METNON100_PRIME | 100 04:10 | 100 13:00 | 0.0 | 16.7 | 86.4 | 3.2 | 0.0 | 31.4 | 27.0 | 0.0 | 197.2 | 4.8 | 0.0 | 0.0 | 0.0 | 366.7 |
| DAILY TOTAL SCIENCE | 098 23:15 | 100 13:00 | 0.0 | 71.2 | 400.8 | 13.6 | 80.0 | 196.2 | 115.5 | 0.0 | 830.8 | 270.0 | 580.0 | 0.0 | 120.9 | |
| OBSERVATION_NOR | 100 13:00 | 101 04:00 | 0.0 | 28.3 | 182.4 | 5.4 | 60.0 | 52.3 | 45.9 | 0.0 | 396.2 | 207.7 | 530.0 | 0.0 | 62.7 | 1570.9 |
| SP_203EA_G70UNQOTP101_PRIME | 101 04:00 | 101 13:00 | 0.0 | 17.0 | 86.4 | 3.2 | 0.0 | 16.0 | 27.5 | 0.0 | 338.6 | 4.9 | 0.0 | 0.0 | 0.0 | 493.7 |
| DAILY TOTAL SCIENCE | 100 13:00 | 101 13:00 | 0.0 | 45.3 | 268.8 | 8.6 | 60.0 | 68.3 | 73.4 | 0.0 | 734.8 | 212.7 | 530.0 | 0.0 | 62.7 | |

# Segment Geometry






*inbound*




*outbound*

| | Saturn Range | Phase Angle |
|---|---|---|
| Segment Start | 13.6 $R_{Saturn}$ | 65.3° |
| Periapse | 12.4 $R_{Saturn}$ | 103.7° |
| Segment End | 17.9 $R_{Saturn}$ | 163.1° |

# Solar Geometry – ORS Boresight Concerns



**No ORS Boresight Solar Constraints on Science Pointing**

# Daily Science Highlights

**DOY 099 (09 April 2014)**: With the MAPS instruments preparing to study Saturn's inner magnetosphere on approach to periapse, the Saturn_203 segment started off with VIMS taking a mosaic of Saturn's southern hemisphere, from the south pole up to its mid-southern latitudes. Control of the spacecraft was subsequently handed off to UVIS, which then led a high priority, coordinated study of Saturn's aurora in concert with the other ORS instruments, as well as some of Cassini's particles and fields instruments. Several slow slews across Saturn's southern auroral oval were executed. The day's science activities concluded with a VIMS observation of Saturn's southern polar region, staring at latitude 70 degrees South on the planet's night side. Rev 203 periapse occured on this day.

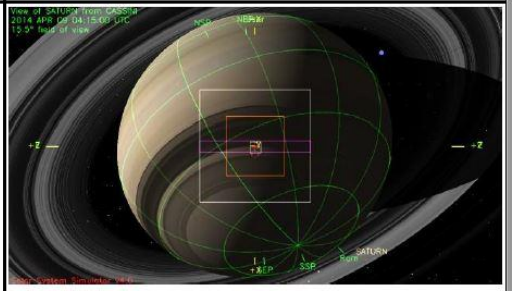
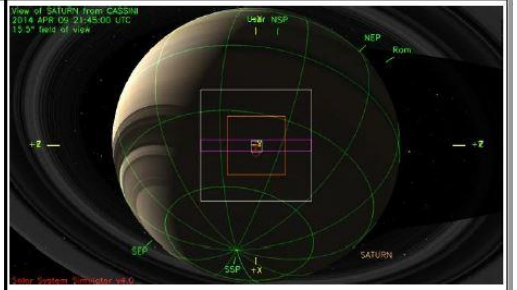
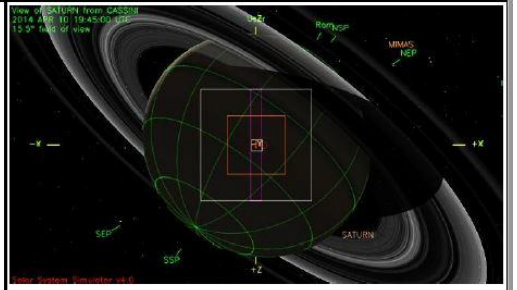
**DOY 100 (10 April 2014)**: The first half of the day was dedicated to downlinking the science obtained on the previous day. Following this, the spacecraft again focused its attention on Saturn, with CIRS mapping out Saturn's southern hemisphere in the mid- to far-infrared.

**DOY 101 (11 April 2014)**: The first science observation of the day was an imaging of the planet Uranus, as it appears to skirt Saturn's F ring from Cassini's perspective. CIRS, ISS, UVIS and VIMS were all utilized to capture the moment. RPWS intensified its data collection in an attempt to study Saturn's magnetotail. The last of the day's science was a stellar calibration for VIMS, which stared at the star *omicron* Ceti. Following this, the spacecraft pointed back towards the Earth to download the last of the data collected during the Saturn_203 segment. This downlink was scheduled to be briefly interrupted in order to execute Orbital Trim Maneuver #377.

# Segment Integration Planning

# Timeline Gaps and Suggested Observations



| Gap | Start | End | Duration | Range ($R_{Saturn}$) | SSC latitude | Snapshot (mid-gap) |
|---|---|---|---|---|---|---|
| 1 | 2014-098T23:55:00 | 099T08:34:00 | 000T08:39:00 | 13.5 – 12.7 | 30° S – 38° S |  |
| | Suggested Observation: VIMS South Polar Map | | | | | |
| 2 | 2014-099T17:40:00 | 100T01:50:00 | 000T08:10:00 | 12.4 – 12.8 | 41° S – 37° S |  |
| | Suggested Observation: VIMS Auroral Stare | | | | | |
| 3 | 2014-100T13:40:00 | 101T01:50:00 | 000T12:10:00 | 14.3 – 16.6 | 26° S – 14° S |  |
| | Suggested Observation: CIRS/VIMS mapping | | | | | |

# 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 (Mb) | (%) | CAROVR (Mb) |
| SP_203EA_G34HEFNON100_PRIME | 100 04:00 | 100 13:00 | 0 | 840 | 121 | 962 | 3322 | 2360 | 0 | 199 | 53 | 1214 | 804 | -410 | 1335 | 38% | 409 |
| SP_203EA_G70METOTP101_PRIME | 101 04:00 | 101 13:00 | 409 | 311 | 63 | 784 | 3322 | 2538 | 0 | 498 | 53 | 1335 | 2670 | 1334 | 1335 | 50% | 0 |

- The DSN strategy reflected above differs from the nominal DSN plan, which has a 70-meter station on DOY 100 and a 34-meter BWG on DOY 101.
- There is 1.33 Gb available for new science requests.

# Waypoint Selection

## RBOT-Friendly

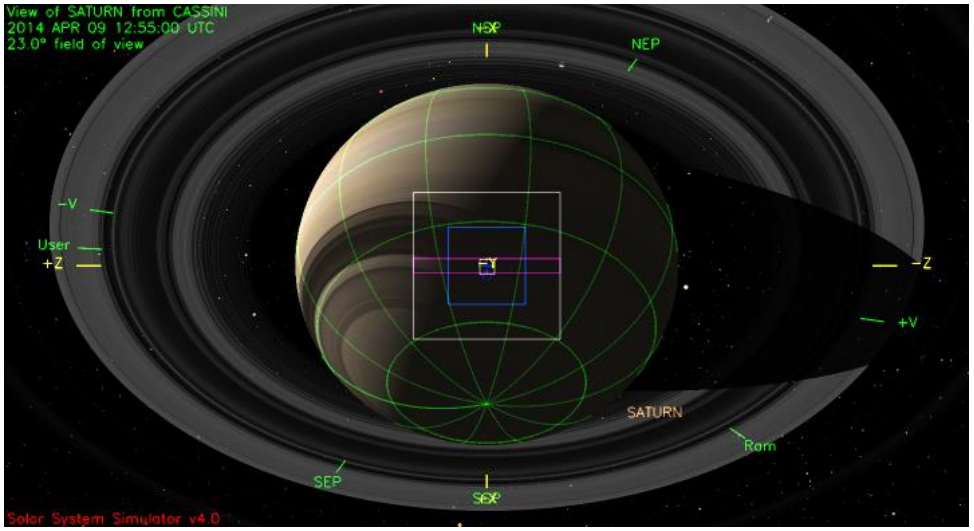
| OBSERVATION PERIOD | START | END | POS_X | NEG_X | POS_Z | NEG_Z |
|---|---|---|---|---|---|---|
| SP_203NA_OBSERV098_NA | 2014-098T23:15:00 | 2014-100T04:00:00 | ------ | 131.2/ 49.8 | ------ | 131.2/ 49.8 |
| SP_203NA_OBSERV100_NA | 2014-100T13:00:00 | 2014-101T04:00:00 | ------ | 131.2/ 49.8 | ------ | 131.2/ 49.8 |

## NSP-oriented

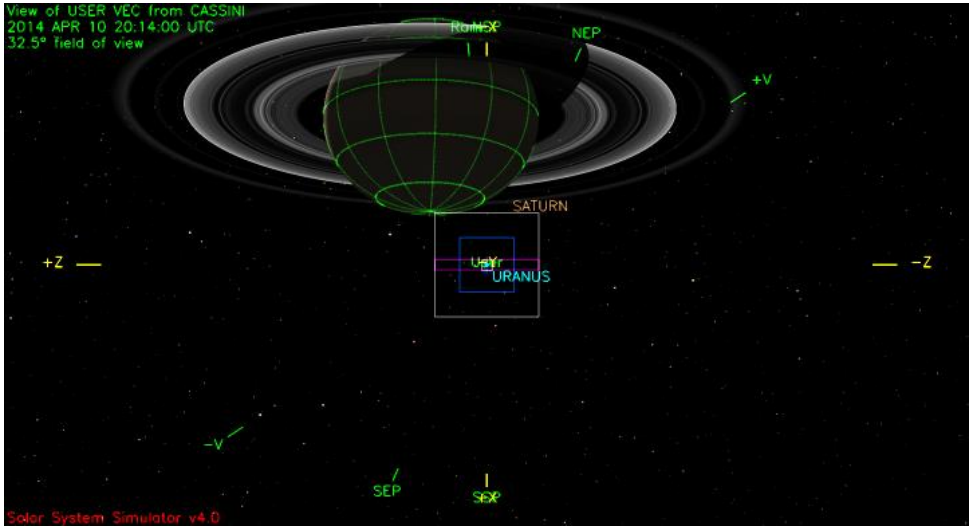
| OBSERVATION PERIOD | START | END | POS_X | NEG_X | POS_Z | NEG_Z |
|---|---|---|---|---|---|---|
| GAP 1 | 2014-098T23:55:00 | 2014-099T08:34:00 | ------ | ✓ | ------ | ✓ |
| GAP 2 | 2014-099T17:40:00 | 2014-100T01:50:00 | ------ | ✓ | ------ | ✓ |
| GAP 3 | 2014-100T13:40:00 | 2014-101T01:50:00 | ------ | ✓ | ------ | ✓ |

# Waypoints Chosen

Waypoint 1 (2014-098T23:55 – 100T02:30:00): NEG_Y to Saturn, NEG_X to NSP




Waypoint 2 (2014-100T13:40 – 101T004:00:00): ISS_NAC to 22.923/8.237, NEG_X to NSP



# Notes

- Pointing:
  - The two observations in this segment utilize a secondary of `NEG_X to NSP` instead of the identified RBOT-friendly secondary. `NEG_X to NSP` was deemed to be sufficiently close to the RBOT secondary and preferable from a science standpoint.
- Data Volume:
  - The Saturn TWT has agreed to accept 353 Mb of data carryover from the preceding TOST segment (T100).
- DSN:
  - none
- Resource checker:
  - none
- Opmodes:
  - none
- Hydrazine:
  - N/A
- Special Activities:
  - The observation ISS_203SA_MUTUALEVE001_PRIME represents an attempt to image the planet Uranus as it fortuitously appears to skirt Saturn's F ring. This observation is collaborative.

# Liens

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

- List any Liens to be worked in SIP:
  - none