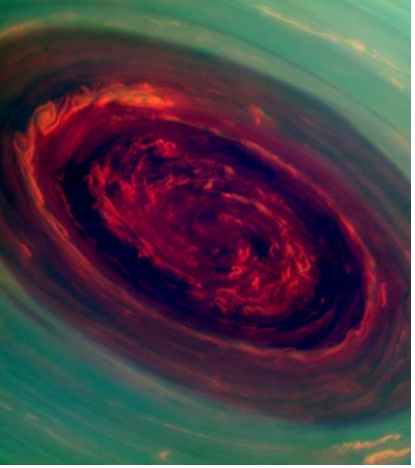
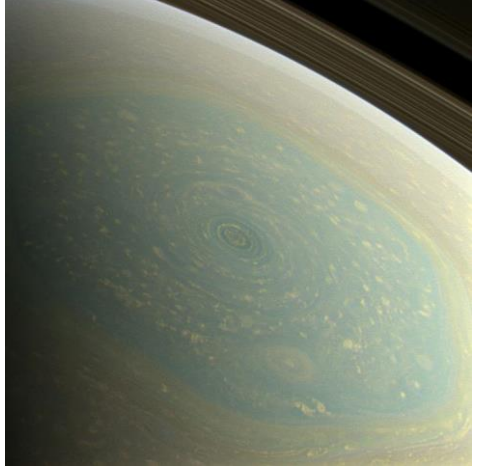
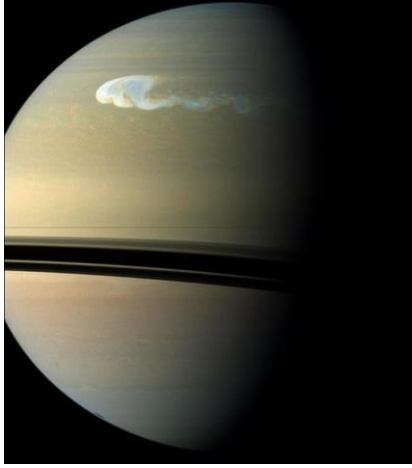


Science Planning & Sequence Team
CASSINI

SATURN TARGET WORKING TEAM

Rev 11b "Outbound" Segment Legacy Package

Segment Boundary: July 15, 2005 – July 18, 2005
2005-196T16:00 – 2005-199T00:00 (SCET)

Integration Began 10/08/2001
Segment Delivered to S12 Sequence 03/01/2002
Lead Integrator was Scott Edgington

Legacy Package Assembled by Kyle Cloutier

Table of Contents

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

Segment Overview and Final Products

Segment Summary

- Rev 11b was an outbound segment (Peri+0T17:45) in the Prime Mission during a slightly inclined orbit.
- This segment was dominated by ISS WAC Saturn Photopolarimetry mosaics (120 Phase). Other Saturn focused science in this segment included a VIMS Saturn Lightning observation and Methane Fluorescence observation, and UVIS EUV/FUV scans.
- Noteworthy out-of-discipline activities included ISS “mutual event” observations of the transit of Pandora across Atlas and the transit of Enceladus across Prometheus.
- An OpNav observation took place on DOY 198.
- This segment comprised only a single observation period and waypoint.

Final Sequenced SPASS

Request	Riders	Start (SCET)	Start (Epoch)	Duration	End	Primary	Secondary	Comments
SATURN rev 11 Segment		2005-196T23:30:00		001T23:50:00	2005-198T23:20:00			
SP_011SA_WAYPTTURN696_PRIME		2005-196T23:30:00		000T00:30:00	2005-197T00:00:00	ISS_NAC to Saturn	NEG_X to Sun	
NEW WAYPOINT		**2005-197T00:00:00**		**002T00:30:00**	**2005-199T00:30:00**	**ISS_NAC to Saturn**	**NEG_X to Sun**	
VIMS_011SA_LIGHTNING001_PRIME		2005-197T00:00:00		000T11:40:00	2005-197T11:40:00	ISS_NAC to Saturn	POS_Z to NSP	
ISS_011SA_1X2WPH120001_PRIME	V	2005-197T12:15:00		000T00:50:00	2005-197T13:05:00	ISS_NAC to Saturn	NEG_X to Sun	
ISS_011SA_1X2WPH120002_PRIME	V	2005-197T13:15:00		000T00:50:00	2005-197T14:05:00	ISS_NAC to Saturn	NEG_X to Sun	
ISS_011SA_1X2WPH120003_PRIME	V	2005-197T14:15:00		000T00:50:00	2005-197T15:05:00	ISS_NAC to Saturn	NEG_X to Sun	
ISS_011SA_1X2WPH120004_PRIME	V	2005-197T15:15:00		000T00:50:00	2005-197T16:05:00	ISS_NAC to Saturn	NEG_X to Sun	
ISS_011SA_1X2WPH120005_PRIME	V	2005-197T16:15:00		000T00:50:00	2005-197T17:05:00	ISS_NAC to Saturn	NEG_X to Sun	
ISS_011SA_1X2WPH120006_PRIME	V	2005-197T17:15:00		000T00:50:00	2005-197T18:05:00	ISS_NAC to Saturn	NEG_X to Sun	
ISS_011PA_MUTUALEVE001_PRIME		2005-197T20:00:00		000T00:35:00	2005-197T20:35:00	ISS_NAC to Pandora	NEG_X to Sun	ISS Boresight to Pandora control of secondary axis not
ISS_011EN_MUTUALEVE001_PRIME		2005-197T20:35:00		000T00:40:00	2005-197T21:15:00	ISS_NAC to Enceladus	NEG_X to Sun	ISS Boresight to Enceladus control of secondary axis not
UVIS_011SA_EUVFUV002_PRIME	C, V	2005-197T21:15:00		000T05:15:00	2005-198T02:30:00	UVIS_FUV to Saturn	POS_X to NSP	
VIMS_011SA_CH4FLUOR001_PRIME		2005-198T02:30:00		000T11:00:00	2005-198T13:30:00	ISS_NAC to Saturn	POS_Z to NSP	
NAV_011SK_OPNAV981_PRIME		2005-198T13:30:00		000T00:49:00	2005-198T14:19:00	ISS_NAC to Satellites	NEG_X to Sun	Starts at waypoint, ends at Earth
NAV_011EA_DLTURN981_PRIME		2005-198T14:19:00		000T00:01:00	2005-198T14:20:00	XBAND to Earth	NEG_X to Sun	
SP_011EA_G70METNON198_PRIME	C, R	2005-198T14:20:00		000T09:00:00	2005-198T23:20:00	XBAND to Earth	Rolling/SRU	

Final Sequenced SMT and Data Volume

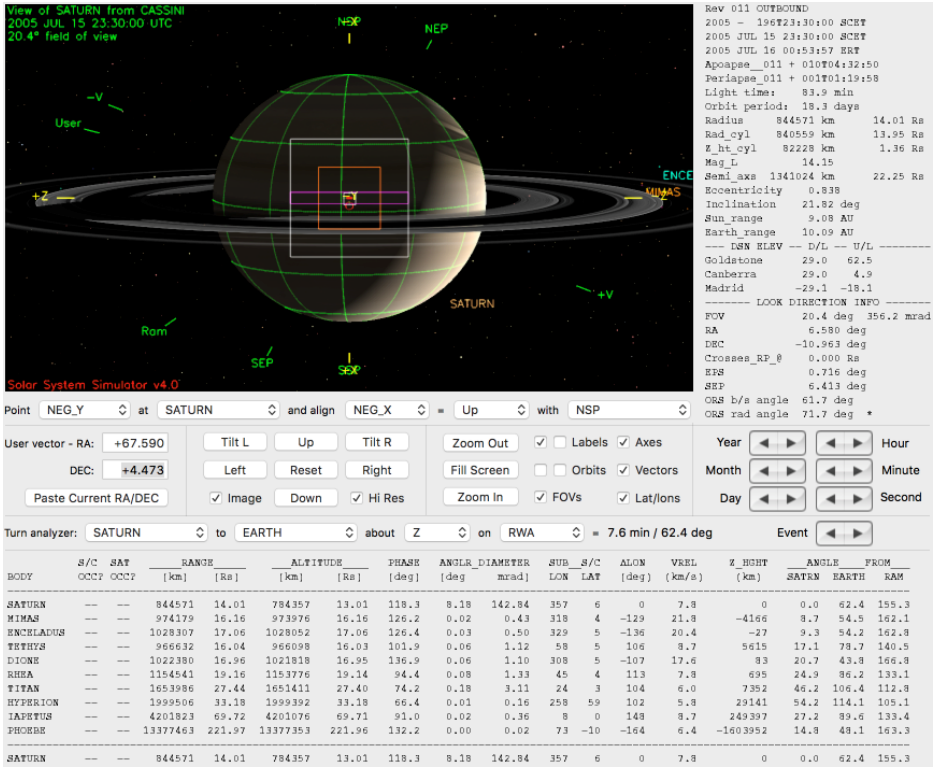
DATA VOLUME SUMMARY --- TRANSFER FRAME OVERHEAD INCLUDED (80 BITS PER 8800-BIT FRAME)

	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_011EA_G70METNON198_PRIME	198 14:20	198 23:20	0	2870	132	3002	3460	457	9	194	53	3259	3364	106	213	2%	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	196 23:30	198 14:20	97.9	45.6	37.8	7.0	658.3	45.4	125.8	0.0	151.0	95.1	1580.0	0.0	0.0	2843.9
OBSERVATION_OPN	196 23:30	198 14:20	0.0	0.0	0.0	0.0	8.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.7
SP_011EA_G70METNON198_PRIME	198 14:20	198 23:20	22.7	4.9	86.4	1.6	0.0	10.5	29.2	0.0	35.0	2.5	0.0	0.0	0.0	192.7
DAILY TOTAL SCIENCE	196 23:30	198 23:20	120.5	50.5	124.2	8.6	658.3	56.0	155.0	0.0	186.0	97.6	1580.0	0.0		

Segment Geometry



Rev 011 OUTBOUND
2005 - 196T23:30:00 SCET
2005 JUL 15 23:30:00 SCET
2005 JUL 16 00:53:57 ERT
Apoapse__011 + 010T04:32:50
Periapse_011 + 001T01:19:58
Light time: 83.9 min
Orbit period: 18.3 days

Radius	844571 km	14.01 Rs
Rad_cyl	840559 km	13.95 Rs
Z_ht_cyl	82228 km	1.36 Rs
Mag_L	14.15	
Semi_axs	1341024 km	22.25 Rs
Eccentricity	0.838	
Inclination	21.82 deg	
Sun_range	9.08 AU	
Earth_range	10.09 AU	

--- DSN ELEV -- D/L -- U/L --------

Goldstone	29.0	62.5
Canberra	29.0	4.9
Madrid	-29.1	-18.1

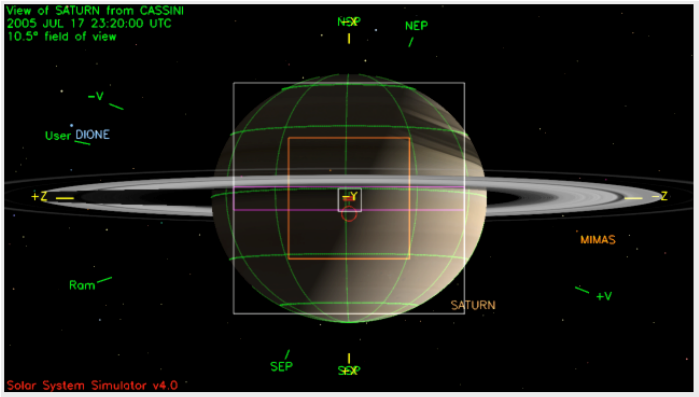
------- LOOK DIRECTION INFO --------

FOV	20.4 deg	356.2 mrad
RA	6.580 deg	
DEC	-10.963 deg	
Crosses_RP_@	0.000 Rs	
EPS	0.716 deg	
SEP	6.413 deg	
ORS b/s angle	61.7 deg	
ORS rad angle	71.7 deg	*

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	--	--	844571	14.01	784357	13.01	118.3	8.18	142.84	357	6	0	7.8	0	0.0	62.4	155.3
MIMAS	--	--	974179	16.16	973976	16.16	126.2	0.02	0.43	318	4	-129	21.8	-4166	8.7	54.5	162.1
ENCELADUS	--	--	1028307	17.06	1028052	17.06	126.4	0.03	0.50	329	5	-136	20.4	-27	9.3	54.2	162.8
TETHYS	--	--	966632	16.04	966098	16.03	101.9	0.06	1.12	58	5	106	8.7	5615	17.1	78.7	140.5
DIONE	--	--	1022380	16.96	1021818	16.95	136.9	0.06	1.10	308	5	-107	17.6	83	20.7	43.8	166.8
RHEA	--	--	1154541	19.16	1153776	19.14	94.4	0.08	1.33	45	4	113	7.8	695	24.9	86.2	133.1
TITAN	--	--	1653986	27.44	1651411	27.40	74.2	0.18	3.11	24	3	104	6.0	7352	46.2	106.4	112.8
HYPERION	--	--	1999506	33.18	1999392	33.18	66.4	0.01	0.16	258	59	102	5.8	29141	54.2	114.1	105.1
IAPETUS	--	--	4201823	69.72	4201076	69.71	91.0	0.02	0.36	8	0	148	8.7	249397	27.2	89.6	133.4
PHOEBE	--	--	13377463	221.97	13377353	221.96	132.2	0.00	0.02	73	-10	-164	6.4	-1603952	14.8	48.1	163.3
SATURN	--	--	844571	14.01	784357	13.01	118.3	8.18	142.84	357	6	0	7.8	0	0.0	62.4	155.3

Segment Start: 2005-196T23:30

Segment End: 2005-198T23:20



Rev 011 OUTBOUND
2005 - 198T23:20:00 SCET
2005 JUL 17 23:20:00 SCET
2005 JUL 18 00:43:57 ERT
Apoapse__011 + 012T04:22:50
Periapse_011 + 003T01:09:58
Light time: 84.0 min
Orbit period: 18.3 days

Radius	1650259 km	27.38 Rs
Rad_cyl	1646364 km	27.32 Rs
Z_ht_cyl	-113325 km	-1.88 Rs
Mag_L	27.51	
Semi_axs	1340979 km	22.25 Rs
Eccentricity	0.837	
Inclination	21.82 deg	
Sun_range	9.08 AU	
Earth_range	10.09 AU	

--- DSN ELEV -- D/L -- U/L --------

Goldstone	29.6	63.1
Canberra	28.8	4.3
Madrid	-29.2	-17.7

------- LOOK DIRECTION INFO --------

FOV	10.5 deg	182.5 mrad
RA	31.159 deg	
DEC	-2.438 deg	
Crosses_RP_@	0.000 Rs	
EPS	0.537 deg	
SEP	4.804 deg	
ORS b/s angle	87.4 deg	
ORS rad angle	68.7 deg	*

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	--	--	1650259	27.38	1590018	26.38	92.5	4.19	73.06	149	-4	0	4.2	0	0.0	88.0	141.8
MIMAS	--	--	1806667	29.98	1806463	29.97	95.9	0.01	0.23	330	-5	-145	17.9	-5116	3.5	84.6	144.9
ENCELADUS	--	--	1647201	27.33	1646950	27.33	84.7	0.02	0.31	91	-4	85	9.3	40	8.3	95.7	133.9
TETHYS	--	--	1771992	29.40	1771459	29.39	84.1	0.03	0.61	62	-4	110	9.5	5229	9.0	96.3	133.2
DIONE	--	--	1290113	21.41	1289549	21.40	88.2	0.05	0.87	161	-5	15	7.6	-118	4.4	92.3	138.1
RHEA	--	--	1179029	19.56	1178263	19.55	100.8	0.07	1.30	214	-6	-22	8.7	511	9.7	79.7	151.4
TITAN	--	--	1979171	32.84	1976596	32.80	56.3	0.15	2.60	52	-4	85	2.9	7910	39.0	124.1	104.0
HYPERION	--	--	2497570	41.44	2497440	41.44	55.0	0.01	0.13	30	49	99	3.1	30949	40.5	125.4	102.5
IAPETUS	--	--	5078867	84.27	5078119	84.26	80.7	0.02	0.29	7	-1	163	6.1	394847	11.9	99.6	131.0
PHOEBE	--	--	13771989	228.51	13771877	228.51	130.0	0.00	0.02	128	-10	-139	2.5	-1733962	38.0	50.1	158.8
SATURN	--	--	1650259	27.38	1590018	26.38	92.5	4.19	73.06	149	-4	0	4.2	0	0.0	88.0	141.8

	Saturn Range	Phase Angle	Sub-S/C Lat.
Segment Start	14.01 Rs	118.3 deg	6
Segment End	27.38 Rs	92.5 deg	-4

Solar Geometry – ORS Boresight Concerns

No ORS Boresight Solar Constraints on Science Pointing.

Daily Science Highlights

Science Highlights only for ISS available/documented.

ISS: ISS acquires a series of photometry and polarimetry images of Saturn with the WAC near 120 degrees phase. These are part of a series that cover many phase angles to investigate the nature of the cloud and haze particles. Observations of mutual events achieve careful timings of when one moon eclipses another, allowing very accurate determination of positions.

Other science in this segment includes ISS observations of the transit of Pandora across Atlas and the transit of Enceladus across Prometheus, a VIMS Saturn Lightning observation and Methane Fluorescence observation, and UVIS EUV/FUV scans.

Segment Integration Planning

Timeline Gaps and Suggested Observations

Proposed Strawman:

VIMS Lightning moved 20 hrs later, shortened from 11:00 to 3:00 (may be able to start earlier & add more time, depending on SOST d/l)

CIRS moved 5:45 earlier

VIMS CH4 moved 1:15 later

9-hour d/l assumed (13 hrs. pictured)

Questions

What is real SOST d/l?

CIRS OK w/ move earlier?

What to do with UVIS Dione?

Can OpNav use 198T13:30 to 198T13:55?

Observation	Start Time	Dur	End Time	Data Vol (Mb)
VIMS Lightning	197T01:30	3:00	197T04:30	435
CIRS Far-IR Map	197T04:30	22:00	198T02:30	317
VIMS CH4 Fluoresence	198T02:30	11:00	198T13:30	908
Downlink & CIRS Cal	198T14:20	9:00	198T23:20	87

added →

OpNav Window	198T13:30	0:50	198T14:20

Initial SMT and Data Volume

Beginning of Integration:

Playback	Start doy hh:mm	End doy hh:mm	Volume (Mb)	5% (Mb)	ENG+HK (Mb)	SCIENCE (Mb)	TOTAL (Mb)	MARGIN (Mb)
Gold_99k***	198 14:05	198 23:30	3427	171	212	5506	5717	-2461

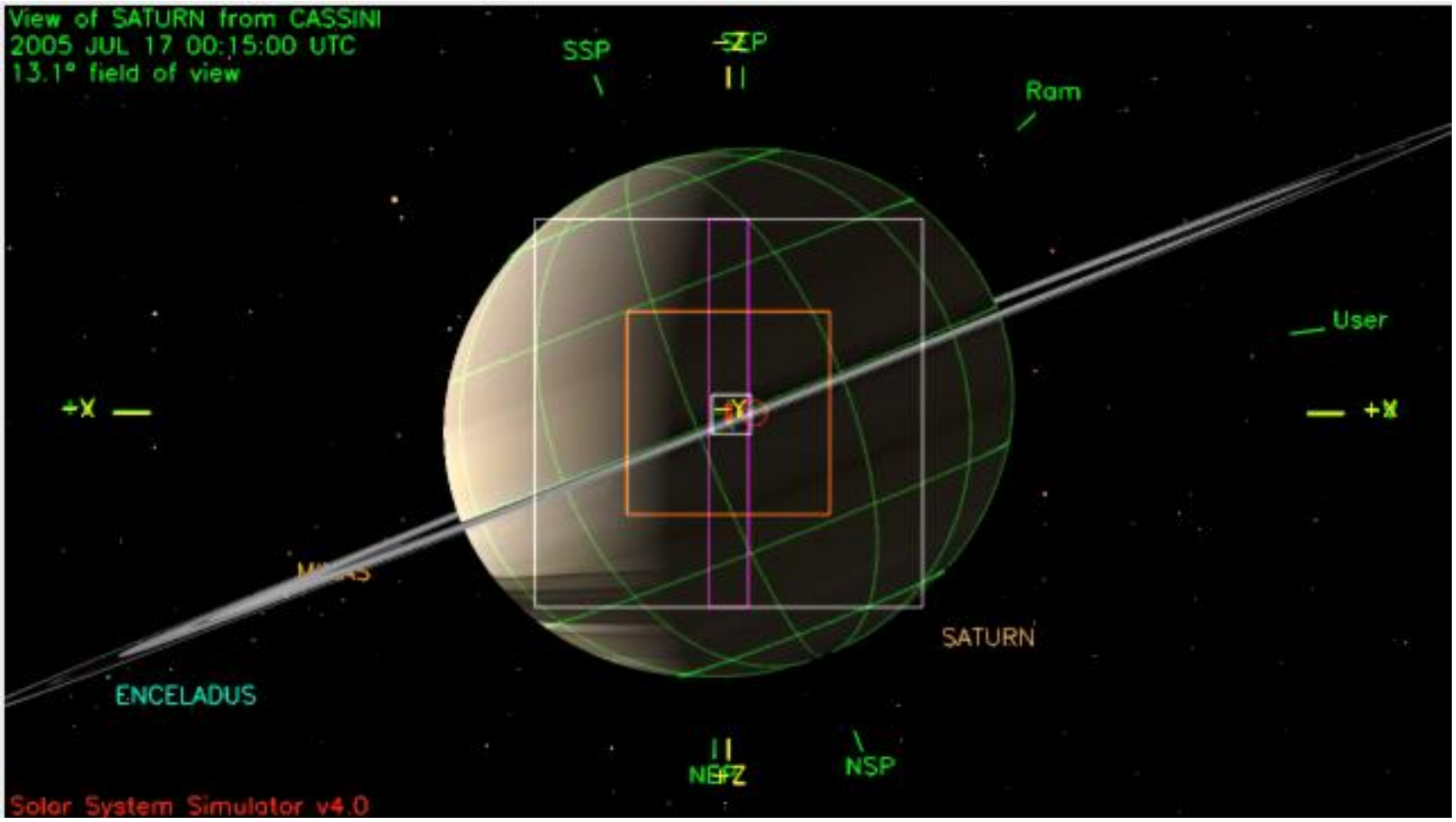
Event	Start doy hh:mm	End doy hh:mm	CAPS (Mb)	CDA (Mb)	CIRS (Mb)	INMS (Mb)	ISS (Mb)	MAG (Mb)	MIMI (Mb)	RADAR (Mb)	RPWS (Mb)	UVIS (Mb)	VIMS (Mb)	ENG (Mb)	SCIENC (Mb)	TOTAL (Mb)
OBSERVATION	196 15:59	198 14:05	165.9	54.0	320.4	8.3	765.6	99.5	149.3	0.0	215.7	135.5	3365.0	119.1	39.2	5437.5
Gold_99k***	198 14:05	198 23:30	33.9	5.1	86.4	1.7	1.8	20.3	30.5	0.0	44.1	2.5	0.0	53.5	0.1	279.9

Waypoint Selection

No Waypoint Selection Info Available.

Waypoints Chosen

Waypoint 1 (2005-197T00:00 – 199T00:30): NAC to Saturn, NEG_X to Sun



Saturn Rev 11 Outbound Open Issues

- **Pointing Issues**
  - OPNAV secondary axis may not be compatible with choice of primary axis.
- **Data Volume Issues**
  - None
- **CIMS Issues**
  - None
- **Power Issues**
  - None
- **Flight Rule/Mission Planning Guideline and Constraint Issues**
  - None
- **Other Issues**
  - None