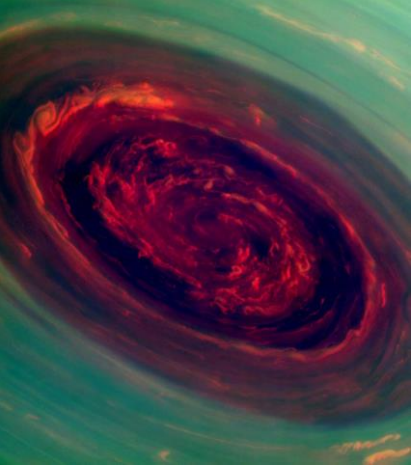
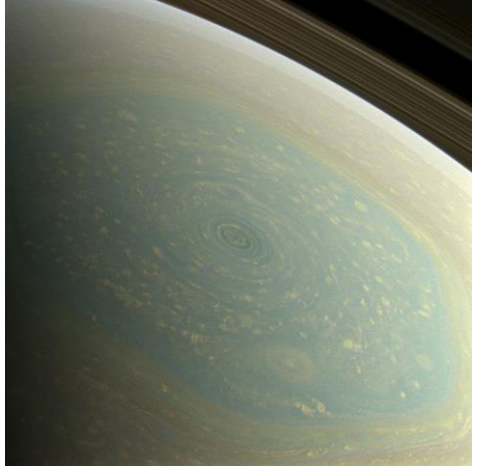
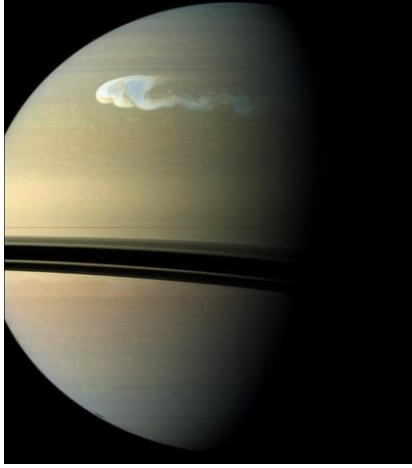


Science Planning & Sequence Team
CASSINI

SATURN TARGET WORKING TEAM

Rev 46 Segment Legacy Package

Segment Boundary: June 9, 2007 – June 11, 2007
2007-160T03:10:00 – 2007-162T03:10:00 (SCET)

Integration Began 04/21/2003
Segment Delivered to S30 Sequence 05/19/2003
Lead Integrator was Shawn Boll

Legacy Package Assembled by Shawn Boll

Table of Contents

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

Segment Overview and Final Products

Segment Summary

- This was a short 2 day segment in an inclined orbit during the Prime Mission. The views of Saturn were of the northern hemisphere as the spacecraft was inbound to periapse. Periapse was not covered by this segment.
- Saturn science included VIMS-led ORS global mapping and ISS lightning searches with the WAC.
- Out-of-discipline activities included ISS images of minor icy satellites for orbit determination, optical navigation images, and a magnetometer calibration roll.
- One waypoint was sufficient for this short segment.

Final Sequenced SPASS

Request	Riders	Start (SCET)	Start (Epoch)	Duration	End (SCET)	Primary	Secondary	Comments
Sequence S030, length = 37 ...		2007-124T22:00:00	E044_SEQUENCE_030+000T00:00:00	037T05:10:00	2007-162T03:10:00			
SATURN rev 46 Segment		2007-160T03:10:00		002T00:00:00	2007-162T03:10:00			
SP_046SA_WAYPTTURN160_PRIME	M	2007-160T03:10:00		000T00:30:00	2007-160T03:40:00	ISS_NAC to Saturn	NEG_X to Sun	
NEW WAYPOINT		**2007-160T03:40:00**		**001T23:30:00**	**2007-162T03:10:00**	**ISS_NAC to Saturn**	**NEG_X to Sun**	
ISS_046OT_SATELLORB016_PRIME	M	2007-160T03:40:00		000T00:30:00	2007-160T04:10:00	ISS_NAC to Rocks	NEG_X to Sun	
VIMS_046SA_GLOMAP001_PRIME	I, M	2007-160T04:10:00		000T11:00:00	2007-160T15:10:00	ISS_NAC to Saturn	NEG_X to Sun	
ISS_046OT_SATELLORB017_PRIME	M	2007-160T15:10:00		000T00:30:00	2007-160T15:40:00	ISS_NAC to Rocks	NEG_X to Sun	
NAV_046SK_OPNAV601_PRIME	M	2007-160T15:40:00		000T01:29:00	2007-160T17:09:00	ISS_NAC to Satellites	NEG_X to Sun	Starts at waypoint, ends at Earth point
NAV_046EA_DLTURN601_PRIME	M	2007-160T17:09:00		000T00:01:00	2007-160T17:10:00	XBAND to Earth	NEG_X to 72.0/-48.0	
SP_046EA_G70METSEQ160_PRIME	C, M	2007-160T17:10:00		000T09:00:00	2007-161T02:10:00	XBAND to Earth	5_Hr_Rolling	
SP_046SA_WAYPTTURN161_PRIME	M	2007-161T02:10:00		000T00:30:00	2007-161T02:40:00	ISS_NAC to Saturn	NEG_X to Sun	
ISS_046SA_WALGTNG11001_PRIME	C, M, U, V	2007-161T02:40:00		000T10:45:00	2007-161T13:25:00	ISS_NAC to Saturn	NEG_X to Sun	
MAG_046SU_CALROLL001_PRIME	M	2007-161T13:25:00		000T04:15:00	2007-161T17:40:00	NEG_X to Sun (0.0,0.0,-30.0 deg. offset)	Rolling	
SP_046SA_DLTURN161_PRIME	M	2007-161T17:40:00		000T00:30:00	2007-161T18:10:00	XBAND to Earth	POS_X to 72.0/-48.0	
SP_046EA_G70METOTP161_PRIME	C, M, N	2007-161T18:10:00		000T09:00:00	2007-162T03:10:00	XBAND to Earth	POS_X to 72.0/-48.0	

Final Sequenced SMT and Data Volume

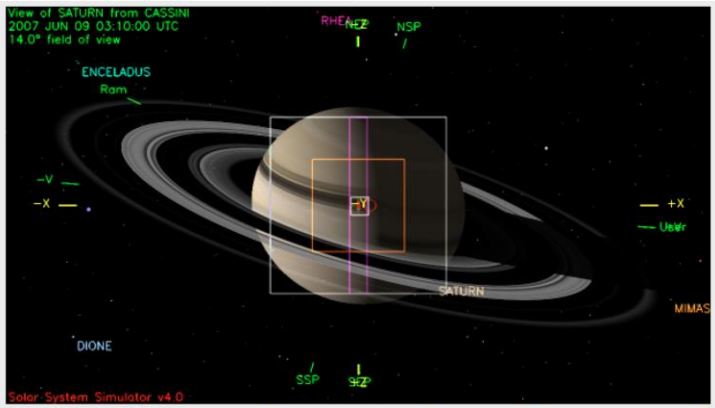
DATA VOLUME SUMMARY --- TRANSFER FRAME OVERHEAD INCLUDED (80 BITS PER 8800-BIT FRAME)

			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_046EA_G70METSEQ160_PRIME	160 17:10	161 02:10	0	2506	59	2565	3511	946	27	1001	53	3635	3732	97	1423	20%	0
SP_046EA_G70METOTP161_PRIME	161 18:10	162 03:10	0	1554	55	1608	3511	1903	0	234	53	1895	3220	1324	1325	41%	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	160 03:10	160 17:10	381.6	14.2	0.0	35.5	254.9	99.6	76.3	0.0	1221.3	0.0	400.0	0.0	11.4	2494.8
OBSERVATION_OPN	160 03:10	160 17:10	0.0	0.0	0.0	0.0	26.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26.1
SP_046EA_G70METSEQ160_PRIME	160 17:10	161 02:10	246.6	9.1	86.4	26.0	0.0	64.0	38.9	0.0	521.2	0.0	0.0	0.0	0.0	992.2
DAILY TOTAL SCIENCE	160 03:10	161 02:10	628.2	23.3	86.4	61.5	254.9	163.6	115.2	0.0	1742.6	0.0	400.0	0.0		
OBSERVATION_NOR	161 02:10	161 18:10	57.6	17.2	77.4	2.9	789.6	111.3	69.1	0.0	75.5	38.9	300.0	0.0	0.0	1539.5
SP_046EA_G70METOTP161_PRIME	161 18:10	162 03:10	32.4	10.7	86.4	1.6	0.0	19.4	38.9	0.0	42.4	0.0	0.0	0.0	0.0	231.9
DAILY TOTAL SCIENCE	161 02:10	162 03:10	90.0	27.9	163.8	4.5	789.6	130.8	108.0	0.0	117.9	38.9	300.0	0.0		

Segment Geometry




```
Rev 046  INBOUND
2007 -  160T03:10:00 SCET
2007 JUN 09 03:10:00 SCET
2007 JUN 09 04:30:11 ERT
Apoapse__046 + 005T01:53:29
Periapse_046 - 002T21:35:04
Light time:    80.2 min
Orbit period:  16.0 days
Radius      1609457 km      26.71 Rs
Rad_cyl     1559773 km      25.88 Rs
Z_ht_cyl     396814 km       6.58 Rs
Mag_L          28.43
Semi_axs    1222445 km      20.28 Rs
Eccentricity    0.864
Inclination    18.38 deg
Sun_range       9.21 AU
Earth_range     9.64 AU
--- DSN ELEV -- D/L -- U/L --------
Goldstone      29.6   60.7
Canberra       31.6    6.6
Madrid        -33.6  -21.0
------- LOOK DIRECTION INFO -------
FOV            14.0 deg  244.5 mrad
RA           -135.950 deg
DEC            -7.823 deg
Crosses_RP_@    0.000 Rs
EPS             5.598 deg *
SEP            62.293 deg
ORS b/s angle 101.9 deg
ORS rad angle 168.1 deg
```

Point NEG_Y at SATURN and align NEG_X = Left with SUN

User vector - RA: +62.168 | Tilt L | Up | Tilt R | Zoom Out | Labels | Axes | Year | Hour

DEC +11.204 | Left | Reset | Right | Fill Screen | Orbits | Vectors | Month | Minute

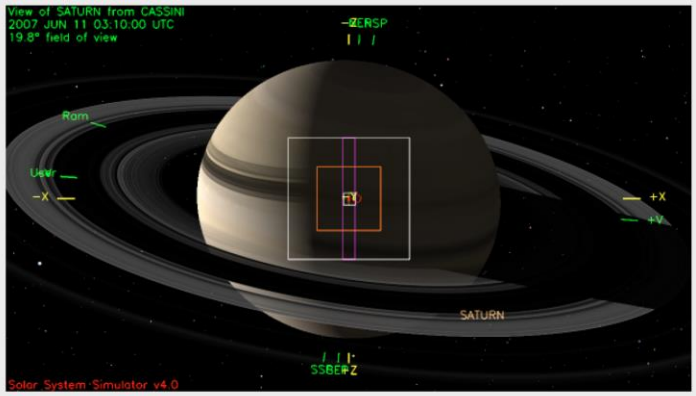
Paste Current RA/DEC | Image | Down | Hi Res | Zoom In | FOVs | Lat/lons | Day | Secon

Turn analyzer: SATURN to EARTH about Z on RWA = 10.1 min / 96.3 deg Even

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	--	--	1609457	26.71	1549534	25.71	78.1	4.29	74.91	184	14	0	4.0	0	0.0	96.3	39.5
MIMAS	--	--	1604268	26.62	1604071	26.62	71.9	0.01	0.26	272	16	-85	11.2	1691	6.5	102.5	45.9
ENCELADUS	--	--	1762232	29.24	1761978	29.24	83.7	0.02	0.29	50	13	128	16.6	-7	6.3	90.8	33.3
TETHYS	--	--	1686861	27.99	1686329	27.98	68.5	0.04	0.64	291	13	-100	8.8	-5218	9.9	105.9	49.3
DIONE	--	--	1264633	20.98	1264070	20.97	83.8	0.05	0.89	159	18	16	9.7	-55	6.2	90.6	35.7
RHEA	--	--	2121242	35.20	2120475	35.18	78.9	0.04	0.72	8	11	173	11.4	-400	3.9	95.5	37.3
TITAN	--	--	2763660	45.86	2761085	45.81	85.5	0.11	1.86	13	8	158	9.1	-5700	11.0	89.0	29.6
HYPERION	--	--	2429706	40.32	2429582	40.31	109.3	0.01	0.13	293	-40	108	9.3	-25163	33.1	65.3	7.1
IAPETUS	--	--	4261984	70.72	4261236	70.70	130.5	0.02	0.35	28	3	103	7.2	-939327	52.6	43.9	20.0
PHOEBE	--	--	12619791	209.39	12619681	209.39	79.0	0.00	0.02	123	25	180	3.2	-3529709	3.9	94.9	40.0
SATURN	--	--	1609457	26.71	1549534	25.71	78.1	4.29	74.91	184	14	0	4.0	0	0.0	96.3	39.5

Seg Start (Left)

Seg End (below)




```
Rev 046  INBOUND
2007 -  162T03:10:00 SCET
2007 JUN 11 03:10:00 SCET
2007 JUN 11 04:30:27 ERT
Apoapse__046 + 007T01:53:29
Periapse_046 - 21:35:04
Light time:    80.4 min
Orbit period:  16.0 days
Radius      780373 km      12.95 Rs
Rad_cyl     742858 km      12.33 Rs
Z_ht_cyl    239051 km       3.97 Rs
Mag_L          14.29
Semi_axs    1222491 km      20.28 Rs
Eccentricity    0.864
Inclination    18.38 deg
Sun_range       9.22 AU
Earth_range     9.67 AU
--- DSN ELEV -- D/L -- U/L --------
Goldstone      28.0   59.5
Canberra       32.5    7.9
Madrid        -33.7  -22.0
------- LOOK DIRECTION INFO -------
FOV            19.8 deg  345.8 mrad
RA           -111.083 deg
DEC            -12.171 deg
Crosses_RP_@    0.000 Rs
EPS             5.507 deg *
SEP            60.578 deg
ORS b/s angle  77.2 deg
ORS rad angle 167.2 deg
```

Point NEG_Y at SATURN and align NEG_X = Left with SUN

User vector - RA: +62.168 | Tilt L | Up | Tilt R | Zoom Out | Labels | Axes | Year | Hour

DEC +11.204 | Left | Reset | Right | Fill Screen | Orbits | Vectors | Month | Minute

Paste Current RA/DEC | Image | Down | Hi Res | Zoom In | FOVs | Lat/lons | Day | Secon

Turn analyzer: SATURN to EARTH about Z on RWA = 8.3 min / 71.7 deg Even

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	--	--	780373	12.95	720642	11.96	102.8	8.86	154.61	340	18	0	8.1	0	0.0	71.7	20.9
MIMAS	--	--	842668	13.98	842470	13.98	90.6	0.03	0.49	296	17	-105	11.0	4616	12.2	83.9	32.9
ENCELADUS	--	--	564931	9.37	564677	9.37	99.2	0.05	0.91	201	25	-11	9.2	2	8.6	75.2	27.3
TETHYS	--	--	862535	14.31	862002	14.30	83.1	0.07	1.25	298	16	-96	7.5	-4092	19.9	91.4	40.7
DIONE	--	--	1081649	17.95	1081086	17.94	115.2	0.06	1.04	28	13	138	17.9	99	14.2	59.5	7.5
RHEA	--	--	524961	8.71	524199	8.70	143.5	0.17	2.92	99	27	39	12.3	-770	42.2	31.0	25.5
TITAN	--	--	1835350	30.45	1832775	30.41	126.5	0.16	2.81	16	8	138	13.7	-7785	27.4	48.4	7.8
HYPERION	--	--	1760096	29.20	1759946	29.20	157.1	0.01	0.19	42	-3	98	13.0	-18453	56.4	18.5	35.6
IAPETUS	--	--	3977086	65.99	3976339	65.98	151.4	0.02	0.38	16	1	119	11.4	-905955	48.6	23.2	28.7
PHOEBE	--	--	11750591	194.97	11750478	194.97	78.9	0.00	0.02	186	25	-153	7.9	-3418097	24.1	95.1	45.0
SATURN	--	--	780373	12.95	720642	11.96	102.8	8.86	154.61	340	18	0	8.1	0	0.0	71.7	20.9

	Saturn Range	Phase Angle	Sub-S/C Lat.
Segment Start	26.71	78.1	14
Segment End	12.95	102.8	18

Solar Geometry – ORS Boresight Concerns

No ORS Boresight Solar Constraints on Science Pointing.

Daily Science Highlights

In the final days of S30, the Visual and Infrared Mapping Spectrometer (VIMS) and Imaging Science Subsystem (ISS) performed global mapping of Saturn, and all the Optical Remote Sensing (ORS) instrument teams hunted for lightning on Saturn. Additionally, the Magnetometer Subsystem performed the last calibration roll for this sequence.

Segment Integration Planning

Timeline Gaps and Suggested Observations

Rev 46 - TOL

Activity	Start	Duration	Pointing	Notes	TLM
Segment Start/Turn to Waypoint	2007-160T04:00:00	00:30:00			
Waypoint					
ISS Satorb	160T04:30:00	00:30:00			
VIMS Saturn Global Map	160T05:00:00	11:00:00			
OPEN	160T16:00:00	01:40:00			
Turn to Downlink	160T17:40:00	00:30:00	XBAND to Earth;		
Downlink	160T18:10:00	09:00:00		34M Goldstone HEF (Seq. U/L)	
Turn to Waypoint	161T03:10:00	00:30:00			
ISS Saturn WALGTNG	161T03:40:00	07:00:00			
UVIS Saturn EUV/FUV	161T10:40:00	07:00:00			
Turn to Downlink	161T17:40:00	00:30:00	XBAND to Earth;		
Downlink	161T18:10:00	09:00:00		34M Goldstone HEF	

Initial SMT and Data Volume

Beginning of Integration:

DATA VOLUME SUMMARY

	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)	MARGIN (Mb)	MARGIN (%)	OPNAV (Mb)	SCI (Mb)	ENGR (Mb)	TOTAL (Mb)	CPACTY (Mb)	MARGIN (Mb)	MARGIN (%)	CAROVR (Mb)
SP_046EA_G34HEFSEQ160_PRIME	160 18:10	161 03:10	0	1329	51	1380	3464	2084	60%	52	226	53	1711	918	-793	-86%	793
SP_046EA_G34HEFOTP161_PRIME	161 18:10	162 03:10	793	2435	51	3279	3568	290	8%	0	141	53	3472	776	-2696	-347%	2696

DATA VOLUME REPORT

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	160 03:10	160 18:10	142.2	8.1	0.0	4.2	62.8	72.9	82.5	0.0	296.8	0.0	660.0	0.0	0.0	1329.4
OBSERVATION_OPN	160 03:10	160 18:10	0.0	0.0	0.0	0.0	52.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	52.2
SP_046EA_G34HEFSEQ160_PRIME	160 18:10	161 03:10	32.4	4.9	86.4	1.6	0.0	19.4	38.9	0.0	42.4	0.0	0.0	0.0	0.0	226.0
OBSERVATION_NOR	161 03:10	161 18:10	54.0	9.1	100.8	2.7	789.6	32.4	64.8	0.0	70.7	50.7	1260.0	0.0	0.0	2434.9
SP_046EA_G34HEFOTP161_PRIME	161 18:10	162 03:10	32.4	6.5	0.0	1.6	0.0	19.4	38.9	0.0	42.4	0.0	0.0	0.0	0.0	141.3
TOTAL (OPNAV data not included)			261.0	28.5	187.2	10.1	852.4	144.1	225.0	0.0	452.5	50.7	1920.0	0.0	0.0	

Rev 46 Waypoint Options

SAFE WAYPOINTS:

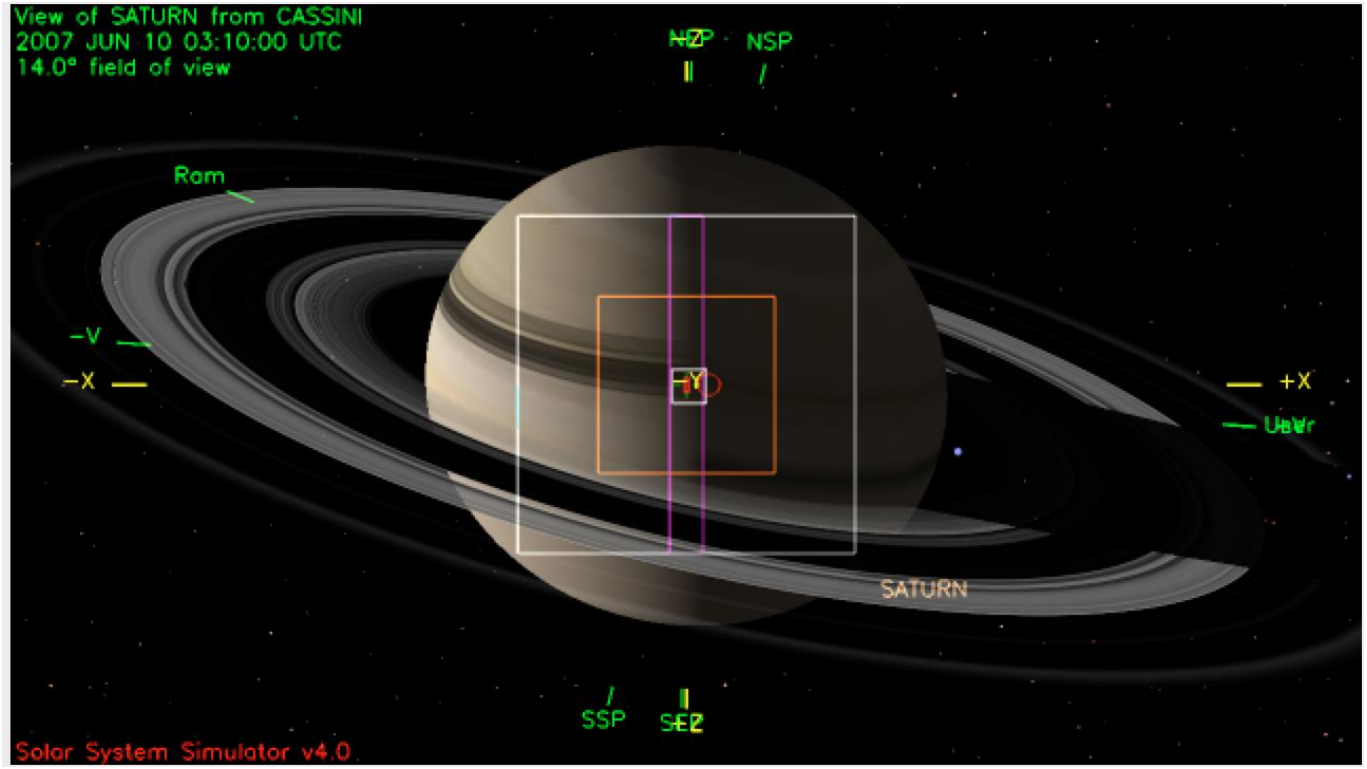
- NAC to Saturn; POS_X to POLE_DIR
- NAC to Saturn; NEG_X to Sun
- NAC to Saturn; NEG_Z to POLE_DIR

UNSAFE WAYPOINTS:

- NAC to Saturn; POS_X to NEP

Waypoints Chosen

Waypoint 1 (Whole Segment): ISS_NAC to Saturn, NEG_X to Sun



Saturn Rev 46 Open Issues

- **Pointing Issues**
  - None
- **Data Volume Issues**
  - None
- **Telemetry Mode Issues**
  - None
- **CIMS Issues**
  - None
- **Power/OPMODE Issues**
  - None
- **Flight Rule/Mission Planning Guideline and Constraint Issues**
  - None
- **Other Issues**
  - The DSN Station request may be 5-10 minutes earlier than necessary.