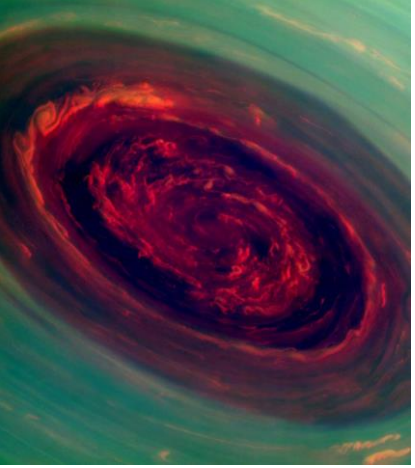
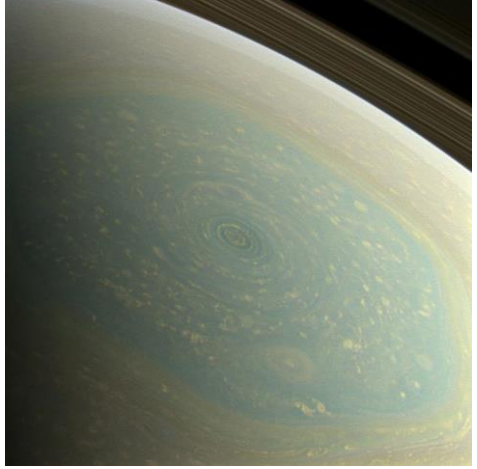
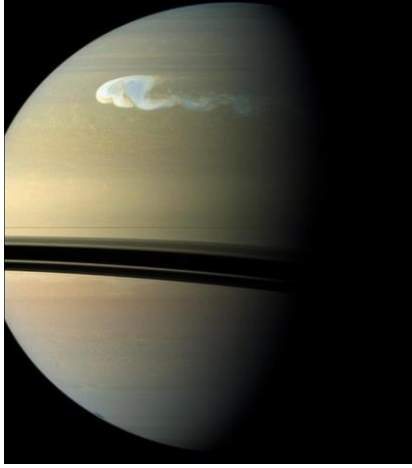


Science Planning & Sequence Team
CASSINI

SATURN TARGET WORKING TEAM

Rev 191 Segment Legacy Package

Segment Boundary: June 3, 2013 – June 7, 2013
2013-154T14:45:00 – 2013-158T00:45:00 (SCET)

Integration Began 07/16/2012
Segment Delivered to S78 Sequence 10/03/2012
Lead Integrator was Nimisha Mittal

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 3.5 day long segment, beginning two days outbound from periapse in the first inclined phase (IN-1) of the Solstice Mission.
- The segment began with nearly fully-lit views of Saturn's north hemisphere. Ring plane crossing came about a day in and then the views were of the southern hemisphere with mid-phase angles and ring shadows stretched across.
- Saturn science included CIRS and VIMS north hemisphere regional mapping, ISS feature tracks, VIMS southern hemisphere mapping, and CIMS composition measurements.
- There were no out-of-disciple science observations or PIEs (Pre-Integrated Events).
- This segment continued on into the following sequence as Rev 191_192, split by the sequence boundary.

Final Sequenced SPASS

Request	Riders	Start (SCET)	Start (Epoch)	Duration	End (SCET)	Primary	Secondary	Comments
Sequence S78, length = 72 days		2013-085T13:15:00		072T11:30:00	2013-158T00:45:00			
SATURN_191 Segment		2013-154T14:45:00		003T10:00:00	2013-158T00:45:00			
SP_191EA_WAYPTTURN154_PRIME		2013-154T14:45:00		000T00:27:00	2013-154T15:12:00	ISS_NAC to Saturn (0.0,0.0,-2.0 deg. offset)	NEG_X to 150.0/50.0	
SP_191EA_WAYPTTURN454_PRIME		2013-154T15:12:00		000T00:23:00	2013-154T15:35:00	ISS_NAC to Saturn (0.0,0.0,-2.0 deg. offset)	NEG_X to NSP	
NEW WAYPOINT		**2013-154T15:35:00**		**000T12:40:00**	**2013-155T04:15:00**	**ISS_NAC to Saturn (0.0,0.0,-2.0 deg. offset)**	**NEG_X to NSP**	
CIRS_191SA_REGMAP001_PRIME	U, V	2013-154T15:35:00		000T06:00:00	2013-154T21:35:00	CIRS_FPB to Saturn	NEG_X to NSP	slow scans 60N to 90N
VIMS_191SA_NHEMMAP001_PRIME	C, I	2013-154T21:35:00		000T06:00:00	2013-155T03:35:00	ISS_NAC to Saturn	NEG_X to NSP	
SP_191EA_DLTURN155_PRIME		2013-155T03:35:00		000T00:40:00	2013-155T04:15:00	XBAND to Earth	NEG_Y to 294.0/42.0	
NEW WAYPOINT		**2013-155T04:15:00**		**000T11:10:00**	**2013-155T15:25:00**	**XBAND to Earth**	**NEG_Y to 294.0/42.0**	
SP_191EA_YGAP155_PRIME		2013-155T04:15:00		000T01:30:00	2013-155T05:45:00	XBAND to Earth	NEG_Y to 294.0/42.0	
SP_191EA_C34HEFSEQ155_PRIME	C	2013-155T05:45:00		000T09:00:00	2013-155T14:45:00	XBAND to Earth	Rolling	MIMI. NEG_Y to Saturn (0,0,-9.5).
SP_191EA_WAYPTTURN155_PRIME		2013-155T14:45:00		000T00:40:00	2013-155T15:25:00	ISS_NAC to Saturn	NEG_Z to NSP	
NEW WAYPOINT		**2013-155T15:25:00**		**000T10:40:00**	**2013-156T02:05:00**	**ISS_NAC to Saturn**	**NEG_Z to NSP**	
ISS_191SA_FEATRAK001_PRIME	C, V	2013-155T15:25:00		000T10:00:00	2013-156T01:25:00	ISS_NAC to Saturn	NEG_Z to NSP	
SP_191EA_DLTURN156_PRIME		2013-156T01:25:00		000T00:40:00	2013-156T02:05:00	XBAND to Earth	NEG_Y to 294.0/42.0	
NEW WAYPOINT		**2013-156T02:05:00**		**000T04:40:00**	**2013-156T06:45:00**	**XBAND to Earth**	**NEG_Y to 294.0/42.0**	
SP_191EA_G70METNON156_PRIME		2013-156T02:05:00		000T04:00:00	2013-156T06:05:00	XBAND to Earth	Rolling	
SP_191EA_WAYPTTURN156_PRIME		2013-156T06:05:00		000T00:40:00	2013-156T06:45:00	ISS_NAC to Saturn	NEG_Z to NSP	
NEW WAYPOINT		**2013-156T06:45:00**		**001T07:30:00**	**2013-157T14:15:00**	**ISS_NAC to Saturn**	**NEG_Z to NSP**	
VIMS_191SA_SHEMMOV001_PRIME	C	2013-156T06:45:00		000T20:50:00	2013-157T03:35:00	ISS_NAC to Saturn	NEG_Z to NSP	
CIRS_191SA_COMPSIT001_PRIME	U	2013-157T03:35:00		000T10:00:00	2013-157T13:35:00	CIRS_FP1 to Saturn	NEG_Z to NSP	Southern storm alley 40S CML
SP_191EA_DLTURN157_PRIME		2013-157T13:35:00		000T00:40:00	2013-157T14:15:00	XBAND to Earth	NEG_Y to 294.0/42.0	
NEW WAYPOINT		**2013-157T14:15:00**		**000T10:30:00**	**2013-158T00:45:00**	**XBAND to Earth**	**NEG_Y to 294.0/42.0**	
ENGR_191SC_YBIASRTC157_PRIME		2013-157T14:15:00		000T01:30:00	2013-157T15:45:00	POS_Z to DELTA_H	NEG_X to Sun	
SP_191EA_M70METSEQ157_PRIME	C	2013-157T15:45:00		000T09:00:00	2013-158T00:45:00	XBAND to Earth	NEG_Y to 294.0/42.0	MIMI. NEG_Y to Saturn (0,0,-9.5). EOS

GAP 1

GAP 2

Final Sequenced SMT and Data Volume

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

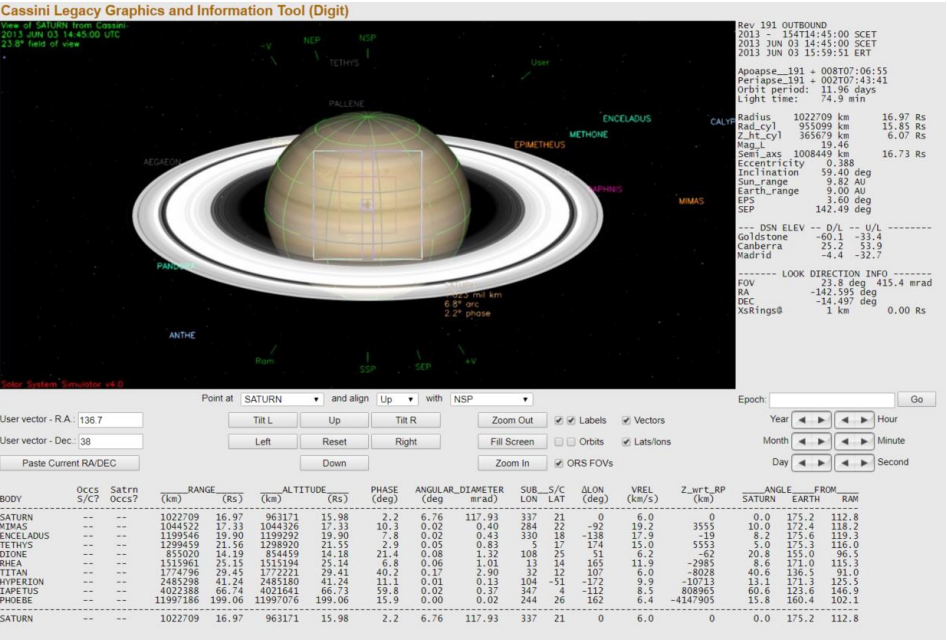
			OBSERVATION_PERIOD							DOWNLINK_PASS							
			P4						P5	RECORDED		PLAYBACK					
DOWNLINK PASS NAME	Start doy hh:mm	End doy hh:mm	START (Mb)	SCI (Mb)	HK+E (Mb)	TOTAL (Mb)	CPACTY (Mb)	MRGN (Mb)	OPNAV (Mb)	SCI (Mb)	ENGR (Mb)	TOTAL (Mb)	CPACTY (Mb)	MARGN (Mb)	NET_MARGN (Mb)	NET_MARGN (%)	CAROVR (Mb)
SP_191EA_C34HEFSEQ155_PRIME	155 07:00	155 14:45	394	1218	69	1680	3322	1642	0	176	46	1902	795	-1107	-212	-3%	1106
SP_191EA_G70METNON156_PRIME	156 02:15	156 06:05	1106	2068	49	3223	3322	99	0	54	23	3300	1645	-1655	-212	-3%	1654
SP_191EA_M70METSEQ157_PRIME	157 15:45	158 00:45	1654	1739	142	3535	3322	-212	0	197	53	3572	3197	-376	0	0%	375

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	154 14:45	155 07:00	58.5	30.7	132.3	5.9	189.0	28.9	49.7	0.0	52.6	109.4	550.0	0.0	67.9	1274.9
SP_191EA_C34HEFSEQ155_PRIME	155 07:00	155 14:45	27.9	14.6	62.1	2.8	0.0	13.8	23.7	0.0	25.1	4.3	0.0	0.0	0.0	174.3
DAILY TOTAL SCIENCE	154 14:45	155 14:45	86.4	45.3	194.4	8.6	189.0	42.7	73.4	0.0	77.8	113.6	550.0	0.0	67.9	
OBSERVATION_NOR	155 14:45	156 02:15	41.4	21.7	72.0	4.1	1498.6	20.5	35.2	0.0	37.3	0.0	318.7	0.0	48.1	2097.6
SP_191EA_G70METNON156_PRIME	156 02:15	156 06:05	13.8	7.2	0.0	1.4	0.0	6.8	11.7	0.0	12.4	0.0	0.0	0.0	0.0	53.4
DAILY TOTAL SCIENCE	155 14:45	156 06:05	55.2	28.9	72.0	5.5	1498.6	27.3	46.9	0.0	49.7	0.0	318.7	0.0	48.1	
OBSERVATION_NOR	156 06:05	157 15:45	121.2	63.5	222.0	12.1	0.0	59.9	103.0	0.0	109.1	32.1	1000.0	0.0	140.7	1863.6
SP_191EA_M70METSEQ157_PRIME	157 15:45	158 00:45	32.4	17.0	64.8	3.2	0.0	16.0	27.5	0.0	29.2	4.9	0.0	0.0	0.0	195.1
DAILY TOTAL SCIENCE	156 06:05	158 00:45	153.6	80.5	286.8	15.4	0.0	75.9	130.6	0.0	138.2	37.0	1000.0	0.0	140.7	

* NOTE: Negative SSR (P4) Margins did not result in data loss due to compression/under-utilization.

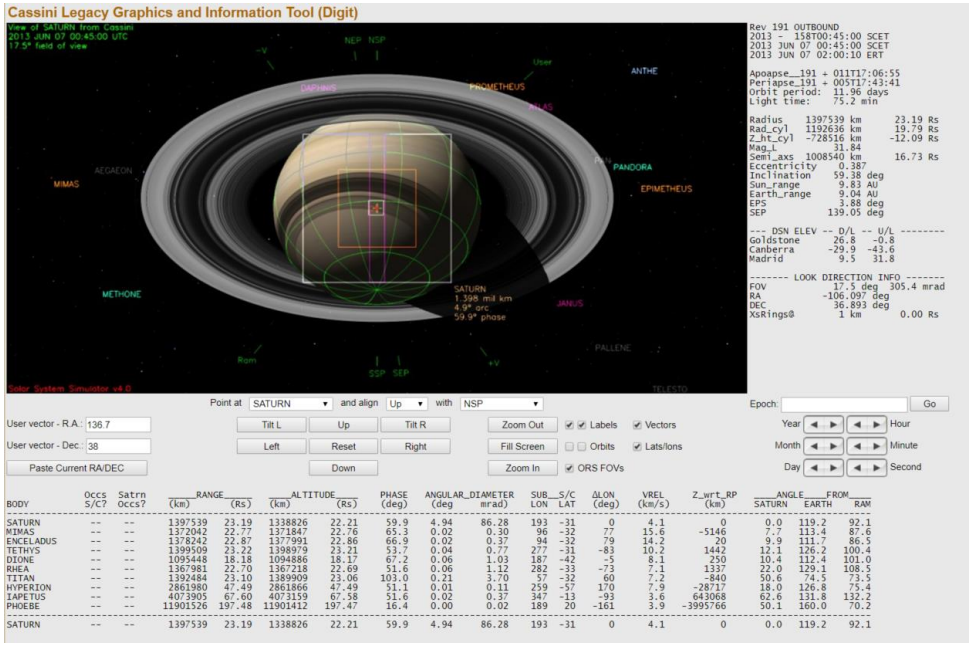
Segment Geometry



BODY	Occs S/C?	Satrn Occs?	RANGE (km)	RANGE (Rs)	ALTITUDE (km)	ALTITUDE (Rs)	PHASE (deg)	ANGULAR_DIAMETER (deg)	ANGULAR_DIAMETER mrad)	SUB_S/C LON	SUB_S/C LAT	ΔLON (deg)	VREL (km/s)	Z_wrt_RP (km)	ANGLE_FROM SATURN	ANGLE_FROM EARTH	ANGLE_FROM RAM
SATURN	--	--	1022709	16.97	963171	15.98	2.2	6.76	117.93	337	21	0	6.0	0	0.0	175.2	112.8
MIMAS	--	--	1044522	17.33	1044326	17.33	10.3	0.02	0.40	284	22	-92	19.2	3555	10.0	172.4	118.2
ENCELADUS	--	--	1199546	19.90	1199292	19.90	7.8	0.02	0.43	330	18	-138	17.9	-19	8.2	175.6	119.3
TETHYS	--	--	1299459	21.56	1298920	21.55	2.9	0.05	0.83	5	17	174	15.0	5553	5.0	175.3	116.0
DIONE	--	--	855020	14.19	854459	14.18	21.4	0.08	1.32	108	25	51	6.2	-62	20.8	155.0	96.5
RHEA	--	--	1515961	25.15	1515194	25.14	6.8	0.06	1.01	13	14	165	11.9	-2985	8.6	171.0	115.3
TITAN	--	--	1774796	29.45	1772221	29.41	40.2	0.17	2.90	32	12	107	6.0	-8028	40.6	136.5	91.0
HYPERION	--	--	2485298	41.24	2485180	41.24	11.1	0.01	0.13	104	-51	-172	9.9	-10713	13.1	171.3	125.5
IAPETUS	--	--	4022388	66.74	4021641	66.73	59.8	0.02	0.37	347	4	-112	8.5	808965	60.6	123.6	146.9
PHOEBE	--	--	11997186	199.06	11997076	199.06	15.9	0.00	0.02	244	26	162	6.4	-4147905	15.8	160.4	102.1
SATURN	--	--	1022709	16.97	963171	15.98	2.2	6.76	117.93	337	21	0	6.0	0	0.0	175.2	112.8

Seg Start (Left)

Seg End (below)



BODY	Occs S/C?	Satrn Occs?	RANGE (km)	RANGE (Rs)	ALTITUDE (km)	ALTITUDE (Rs)	PHASE (deg)	ANGULAR_DIAMETER (deg	ANGULAR_DIAMETER mrad)	SUB_S/C LON	SUB_S/C LAT	ΔLON (deg)	VREL (km/s)	Z_wrt_RP (km)	ANGLE_FROM SATURN	ANGLE_FROM EARTH	ANGLE_FROM RAM
SATURN	--	--	1397539	23.19	1338826	22.21	59.9	4.94	86.28	193	-31	0	4.1	0	0.0	119.2	92.1
MIMAS	--	--	1372042	22.77	1371847	22.76	65.3	0.02	0.30	96	-32	77	15.6	-5146	7.7	113.4	87.6
ENCELADUS	--	--	1378242	22.87	1377991	22.86	66.9	0.02	0.37	94	-32	79	14.2	20	9.9	111.7	86.5
TETHYS	--	--	1399509	23.22	1398979	23.21	53.7	0.04	0.77	277	-31	-83	10.2	1442	12.1	126.2	100.4
DIONE	--	--	1095448	18.18	1094886	18.17	67.2	0.06	1.03	187	-42	-5	8.1	250	10.4	112.4	101.0
RHEA	--	--	1367981	22.70	1367218	22.69	51.6	0.06	1.12	282	-33	-73	7.1	1337	22.0	129.1	108.5
TITAN	--	--	1392484	23.10	1389909	23.06	103.0	0.21	3.70	57	-32	60	7.2	-840	50.6	74.5	73.5
HYPERION	--	--	2861980	47.49	2861866	47.49	51.1	0.01	0.11	259	-57	170	7.9	-28717	18.0	126.8	75.4
IAPETUS	--	--	4073905	67.60	4073159	67.58	51.6	0.02	0.37	347	-13	-93	3.6	643068	62.6	131.8	132.2
PHOEBE	--	--	11901526	197.48	11901412	197.47	16.4	0.00	0.02	189	20	-161	3.9	-3995766	50.1	160.0	70.2
SATURN	--	--	1397539	23.19	1338826	22.21	59.9	4.94	86.28	193	-31	0	4.1	0	0.0	119.2	92.1

	Saturn Range	Phase Angle	Sub-S/C Lat.
Segment Start	16.97 Rs	2.2	21
Segment End	23.19 Rs	59.9	-31

Solar Geometry – ORS Boresight Concerns

No ORS Boresight Solar Constraints on Science Pointing Noted.

Daily Science Highlights

DOY 154: Saturn_191 kicked off with a CIRS regional map observation, in which CIRS scanned Saturn's north polar region for temperature measurements of the northern vortex. UVIS and VIMS rode along. VIMS then started mosaicking the north pole to map the after-effects of the huge northern storm from 2011, and find out if the String of Pearls has re-emerged. CIRS and ISS also rode along to make thermal measurements and take images in the visible spectrum, since the planet was well lit by the Sun (low phase angles).

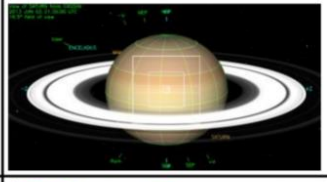
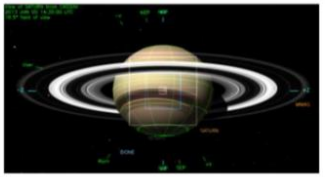
DOY 155: ISS imaged selected Saturn latitudes over a range of emission angles as the planet rotated. CIRS and VIMS also rode along.

DOY 156: VIMS made mosaics of Saturn's southern hemisphere, concentrating on the mid-latitude region known as the 'storm alley' near 35-40^{o} S latitude. Mosaics were made contiguously over two Saturn rotations to measure cloud-tracked winds. CIRS also acquired thermal measurements.

DOY 157: At the conclusion of the VIMS two-rotation mapping**,** CIRS followed with concentrated compositional mapping of the "storm alley" region, to measure trace gases and isotopes. UVIS rode along. This observation concluded the segment.

Segment Integration Planning

Timeline Gaps and Suggested Observations

Gap	Start	End	Duration	Phase angle (range)	Rs range	Sub s/c latitude	Snapshot (mid-gap)
1	2013-154T15:25:00	2013-155T03:35:00	000T12:10:00	1.6° - 11.2°	17.0 - 18.6	20° to 10°	
2	2013-155T15:25:00	2013-157T13:35:00	001T22:10:00	21.4 °- 53.1°	19.9 - 22.9	1° to -26°	

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_191EA_C34HEFSEQ155_PRIME	155 05:45	155 14:45	0	233	63	297	3322	3026	0	232	53	582	919	337	2281	55%	0
SP_191EA_M70METSEQ157_PRIME	157 15:45	158 00:45	0	762	207	969	3322	2353	0	232	53	1254	3197	1943	1943	61%	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	154 14:45	155 05:45	54.0	28.3	0.0	5.4	0.0	26.7	45.9	0.0	70.7	0.0	0.0	0.0	62.7	293.7
SP_191EA_C34HEFSEQ155_PRIME	155 05:45	155 14:45	32.4	17.0	86.4	3.2	0.0	16.0	27.5	0.0	42.4	4.9	0.0	0.0	0.0	229.9
DAILY TOTAL SCIENCE	154 14:45	155 14:45	86.4	45.3	86.4	8.6	0.0	42.7	73.4	0.0	113.2	4.9	0.0	0.0	62.7	
OBSERVATION_NOR	155 14:45	157 15:45	176.4	92.4	0.0	17.6	0.0	87.1	149.9	0.0	231.1	0.0	0.0	0.0	204.8	959.4
SP_191EA_M70METSEQ157_PRIME	157 15:45	158 00:45	32.4	17.0	86.4	3.2	0.0	16.0	27.5	0.0	42.4	4.9	0.0	0.0	0.0	229.9
DAILY TOTAL SCIENCE	155 14:45	158 00:45	208.8	109.4	86.4	20.9	0.0	103.1	177.5	0.0	273.5	4.9	0.0	0.0	204.8	

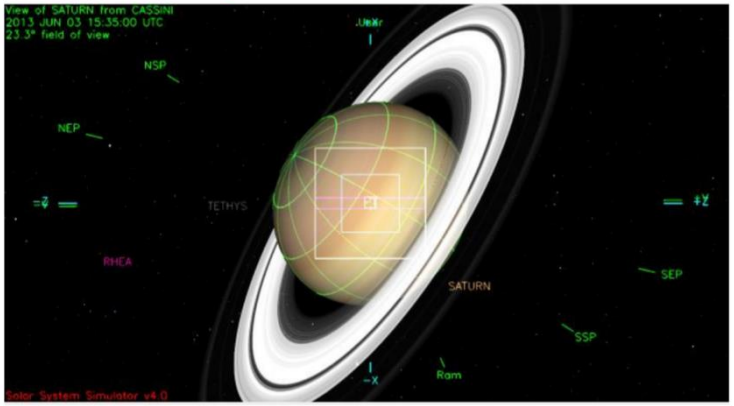
	CAPS (Mb)	CDA (Mb)	CIRS (Mb)	INMS (Mb)	ISS (Mb)	MAG (Mb)	MIMI (Mb)	RADAR (Mb)	RPWS (Mb)	UVIS (Mb)	VIMS (Mb)	PROBE (Mb)
TOTAL RECORDED (OPNAV data not included)	295.2	154.7	172.8	29.5	0.0	145.8	250.9	0.0	386.7	9.9	0.0	0.0

Waypoint Selection (1 of 2)

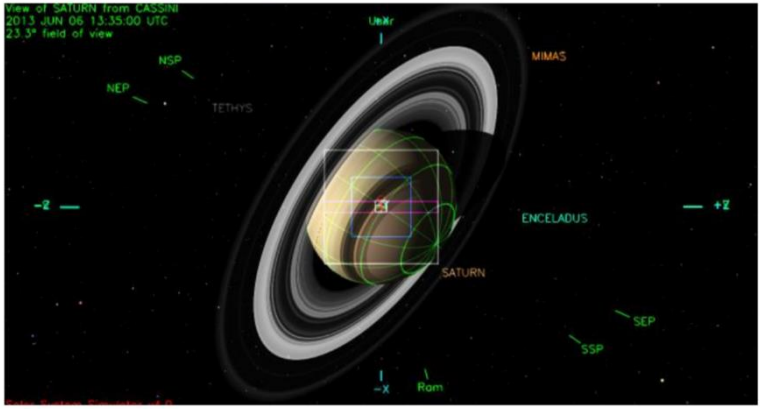
RBOT - Friendly

OBSERVATION PERIOD	START	END	POS_X	NEG_X	POS_Z	NEG_Z
SP_191NA_OBSERV154_NA	2013-154T14:45:00	2013-155T05:45:00	136.5/ 31.5	136.5/ 31.5	------	------
SP_191NA_OBSERV155_NA	2013-155T14:45:00	2013-157T15:45:00	136.5/ 31.5	136.5/ 31.5	------	------

Segment Start



Segment End



Waypoint Selection (2 of 2)

Safe secondary attitudes

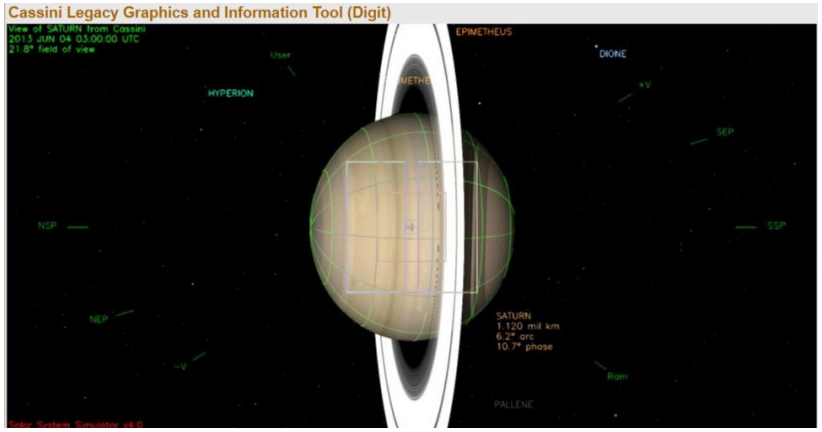
GAP 1	POS_X to NSP	NEG_X to NSP	POS_Z to NSP	NEG_Z to NSP
154T15:25:00				
154T16:25:00				
154T17:25:00				
154T18:25:00				
154T19:25:00				
154T20:25:00				
154T21:25:00				
154T22:25:00				
154T23:25:00				
155T00:25:00				
155T01:25:00				
155T02:25:00				
155T03:25:00				

Legend
Safe
FR violation

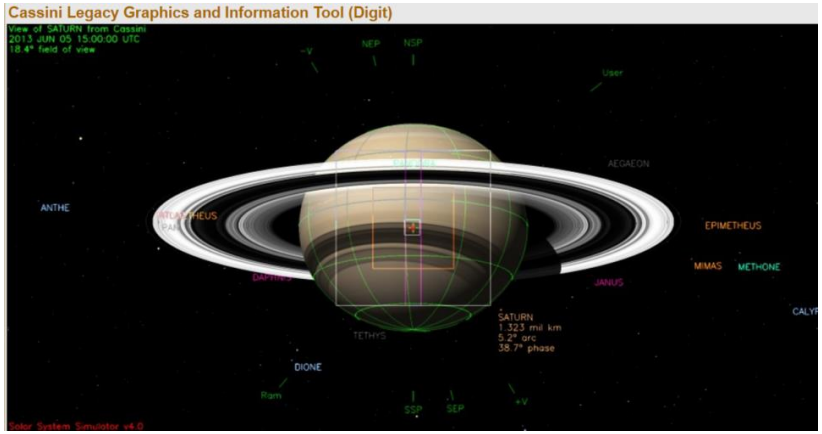
GAP 2	POS_X to NSP	NEG_X to NSP	POS_Z to NSP	NEG_Z to NSP
155T15:25:00				
155T17:25:00				
155T19:25:00				
155T21:25:00				
155T23:25:00				
156T01:25:00				
156T03:25:00				
156T05:25:00				
156T07:25:00				
156T09:25:00				
156T11:25:00				
156T13:25:00				
156T15:25:00				
156T17:25:00				
156T19:25:00				
156T21:25:00				
156T23:25:00				
157T01:25:00				
157T03:25:00				
156705:25:00				
157T07:25:00				
157T09:25:00				
157T11:25:00				
157T13:25:00				

Waypoints Chosen

Waypoint 1 (2013-154T15:35:00 – 2013-155T15:25:00):
ISS_NAC to Saturn (0.0,0.0,-2.0 deg. offset); NEG_X to NSP



Waypoint 2 (2013-155T15:25:00 – 2013-157T14:15:00): ISS_NAC to Saturn; NEG_Z to NSP



Notes & Liens

- Pointing:
  - RBOT friendly secondaries were not used for waypoints in this segment for a couple of reasons:
    - One of the RBOT friendly secondaries provided in the IN-1 RBOT waypoints, NEG_X to 136.5/31.5, was causing CIRS Radiator FR violations. This would have been the preferred secondary for science observations. Instead, secondary attitudes of NEG_X to NSP and NEG_Z to NSP were used, since they were the attitudes preferred by CIRS and VIMS.
- DSN:
  - An additional 4-hour DSN track was added on DOY 156 to accommodate data volume requirements. No Y-bias window was added since the minimum track duration for Y-gap addition should be 4 hours 15 minutes per Y-bias guidelines.