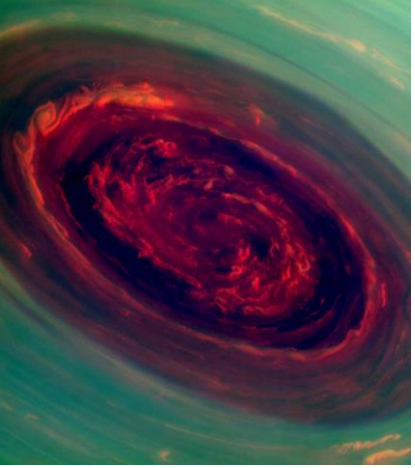

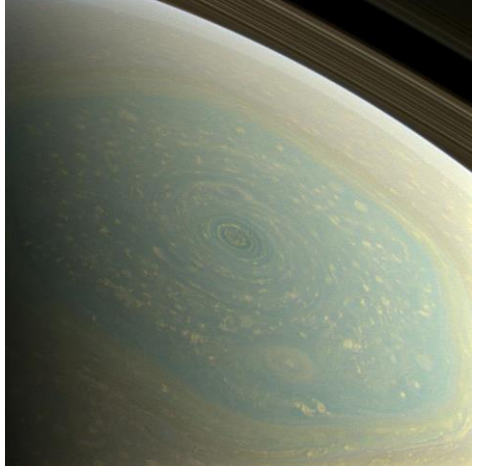
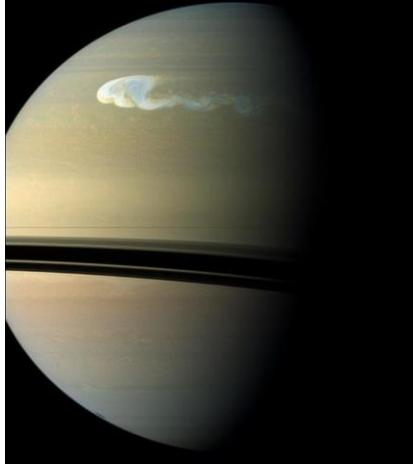

Science Planning & Sequence Team
CASSINI

SATURN TARGET WORKING TEAM

Rev 150 Segment Legacy Package

Segment Boundary: July 9, 2011 – July 13, 2011
2011-190T10:54:00 – 2011-194T10:39:00 (SCET)

Integration Began 10/11/2010
Segment Delivered to S69 Sequence 01/10/2011
Lead Integrator was Nimisha Mittal

Legacy Package Assembled by Shawn Boll

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

Segment Overview and Final Products

Segment Summary

- This was a four day long periapse (4.04 Rs) segment during the first equatorial phase (EQ-1) of the Solstice Mission.

- Phase angles increased as the spacecraft approached the planet, with high phase crescent views presented at periapse. Outbound, the phase angles dropped quickly and by the time the segment ended much of the visible planet was in sunlight. At this point in the mission, ring shadows were present in the southern hemisphere forming a relatively tight band.

- Inbound Saturn science included VIMS equatorial mapping, while a CDA PIE (Pre-Integrated Event) observation explored the ring shadow crossing.

- At periapse, VIMS conducted more equatorial mapping and also observed a pair of stellar occultations (one of which was a PIE).

- Outbound Saturn science included a CIRS compositional sit and stare observation and a VIMS north hemisphere movie.

- Solar boresight viewing issues would have been a concern, but were mitigated by the placement of the CDA PIE.

- Reaction-wheel friendly secondaries were chosen for waypoints. These were compatible with the science pointing largely because of the equatorial orbit.

Final Sequenced SPASS

Request	Riders	Start (SCET)	Start (Epoch)	Duration	End (SCET)	Primary	Secondary	Comments
Sequence S69, length = 66 days		2011-184T11:10:00		065T13:38:00	2011-250T00:48:00			
SATURN_150 Segment		2011-190T10:54:00		003T23:45:00	2011-194T10:39:00			
SP_150EA_WAYPTTURN190_PRIME		2011-190T10:54:00		000T00:40:00	2011-190T11:34:00	ISS_NAC to Saturn	NEG_Z to 37.3/87.3	
NEW WAYPOINT		**2011-190T11:34:00**		**000T12:35:00**	**2011-191T00:09:00**	**ISS_NAC to Saturn**	**NEG_Z to 37.3/87.3**	
VIMS_150SA_EQUATMAP001_PRIME	C	2011-190T11:34:00		000T11:55:00	2011-190T23:29:00	ISS_NAC to Saturn	NEG_Z to 37.3/87.3	
SP_150EA_DLTURN191_PRIME	R	2011-190T23:29:00		000T00:40:00	2011-191T00:09:00	XBAND to Earth	NEG_X to NEP	
NEW WAYPOINT		**2011-191T00:09:00**		**000T10:53:00**	**2011-191T11:02:00**	**XBAND to Earth**	**NEG_X to NEP**	
ENGR_150SC_KPTYBIAS191_PRIME	R	2011-191T00:09:00		000T01:30:00	2011-191T01:39:00	NEG_Z to DELTA_H	NEG_X to Sun	
SP_150EA_C34BWGNON191_PRIME	C, R	2011-191T01:39:00		000T09:00:00	2011-191T10:39:00	XBAND to Earth	Rolling/SRU	NEG_X to NEP or NSP, CAPS
SP_150EA_WAYPTTURN191_PRIME		2011-191T10:39:00		000T00:23:00	2011-191T11:02:00	XBAND to Earth (0.0,-80.0,30.0 deg. offset)	NEG_X to NSP	
NEW WAYPOINT		**2011-191T11:02:00**		**000T03:56:00**	**2011-191T14:58:00**	**XBAND to Earth (0.0,-80.0,30.0 deg. offset)**	**NEG_X to NSP**	
CDA_150OT_RINGSHAD001_PIE	M	2011-191T11:02:00		000T03:18:00	2011-191T14:20:00	XBAND to Earth (0.0,-80.0,30.0 deg. offset)	NEG_X to NSP	
SP_150EA_WAYPTTURN391_PRIME		2011-191T14:20:00		000T00:38:00	2011-191T14:58:00	ISS_NAC to Saturn	NEG_X to 37.3/87.3	
NEW WAYPOINT		**2011-191T14:58:00**		**000T09:11:00**	**2011-192T00:09:00**	**ISS_NAC to Saturn**	**NEG_X to 37.3/87.3**	
VIMS_150SA_EQUATMAP002_PRIME	C	2011-191T14:58:00		000T01:58:00	2011-191T16:56:00	ISS_NAC to Saturn	NEG_X to 37.3/87.3	
Periapse R = 4.039 Rs, lat ...		2011-191T15:59:41		000T00:00:01	2011-191T15:59:42			
VIMS_150SA_ALPORIOCC001_PIE	C	2011-191T16:56:00		000T02:12:00	2011-191T19:08:00	CIRS_FPB to 88.793/7.407 (0.011,-7.998,0.0 deg. offset)	PIC	Collaborative Rider(s): CIRS
VIMS_150SA_ALPCMIOCC001_PRIME	C	2011-191T19:08:00		000T02:10:00	2011-191T21:18:00	CIRS_FPB to 114.825/5.225	PIC	Collaborative Rider(s): CIRS
VIMS_150SA_EQUATMAP003_PRIME	C	2011-191T21:18:00		000T02:11:00	2011-191T23:29:00	ISS_NAC to Saturn	NEG_X to 37.3/87.3	
SP_150EA_DLTURN192_PRIME		2011-191T23:29:00		000T00:23:00	2011-191T23:52:00	XBAND to Earth (0.0,0.0,-15.0 deg. offset)	POS_X to NEP	part 1 of 2
SP_150EA_DLTURN492_PRIME		2011-191T23:52:00		000T00:17:00	2011-192T00:09:00	XBAND to Earth	POS_X to NEP	part 2 of 2
NEW WAYPOINT		**2011-192T00:09:00**		**000T11:10:00**	**2011-192T11:19:00**	**XBAND to Earth**	**POS_X to NEP**	
SP_150EA_YBIAS192_PRIME		2011-192T00:09:00		000T01:30:00	2011-192T01:39:00	XBAND to Earth	POS_X to NEP	
SP_150EA_C70METNON192_PRIME	C, E, R	2011-192T01:39:00		000T09:00:00	2011-192T10:39:00	XBAND to Earth	POS_X to NEP	POS_X to NEP or NSP, CAPS
SP_150EA_WAYPTTURN192_PRIME		2011-192T10:39:00		000T00:30:00	2011-192T11:09:00	ISS_NAC to Saturn (0.0,0.0,-50.0 deg. offset)	NEG_X to 37.3/87.3	part 1 of 2
SP_150EA_WAYPTTURN492_PRIME		2011-192T11:09:00		000T00:10:00	2011-192T11:19:00	ISS_NAC to Saturn	NEG_X to 37.3/87.3	part 2 of 2
NEW WAYPOINT		**2011-192T11:19:00**		**001T12:50:00**	**2011-194T00:09:00**	**ISS_NAC to Saturn**	**NEG_X to 37.3/87.3**	
ISS_150TI_M60R2CLD192_PRIME	C, V	2011-192T11:19:00	E150_M60R2CLD192+000T00:00:00	000T01:30:00	2011-192T12:49:00	ISS_NAC to Titan (0.0,-97.0,0.0 deg. offset)	NEG_X to 37.3/87.3	
CIRS_150SA_COMPSIT002_PRIME	V	2011-192T12:49:00		000T11:40:00	2011-193T00:29:00	CIRS_FP1 to Saturn (0.0,10.0,0.0 deg. offset)	POS_Z to 37.3/87.3	There will be a 3x3 mosaic of ISS WAC frames at beginning, middle, and end of the COMPSIT.
VIMS_150SA_NHEMMOVIE001_PRIME	I	2011-193T00:29:00		000T23:00:00	2011-193T23:29:00	ISS_NAC to Saturn	NEG_X to 37.3/87.3	
SP_150EA_DLTURN193_PRIME		2011-193T23:29:00		000T00:40:00	2011-194T00:09:00	XBAND to Earth	NEG_X to NEP	
NEW WAYPOINT		**2011-194T00:09:00**		**000T11:11:00**	**2011-194T11:20:00**	**XBAND to Earth**	**NEG_X to NEP**	
ENGR_150SC_KPTYBIAS194_PRIME		2011-194T00:09:00		000T01:30:00	2011-194T01:39:00	POS_Z to DELTA_H	NEG_X to Sun	
SP_150EA_C70METNON194_PRIME	C	2011-194T01:39:00		000T09:00:00	2011-194T10:39:00	XBAND to Earth	Rolling	NEG_X to NEP

Gap 1

Gap 2

Gap 3

Gap 4

Final Sequenced SMT and Data Volume

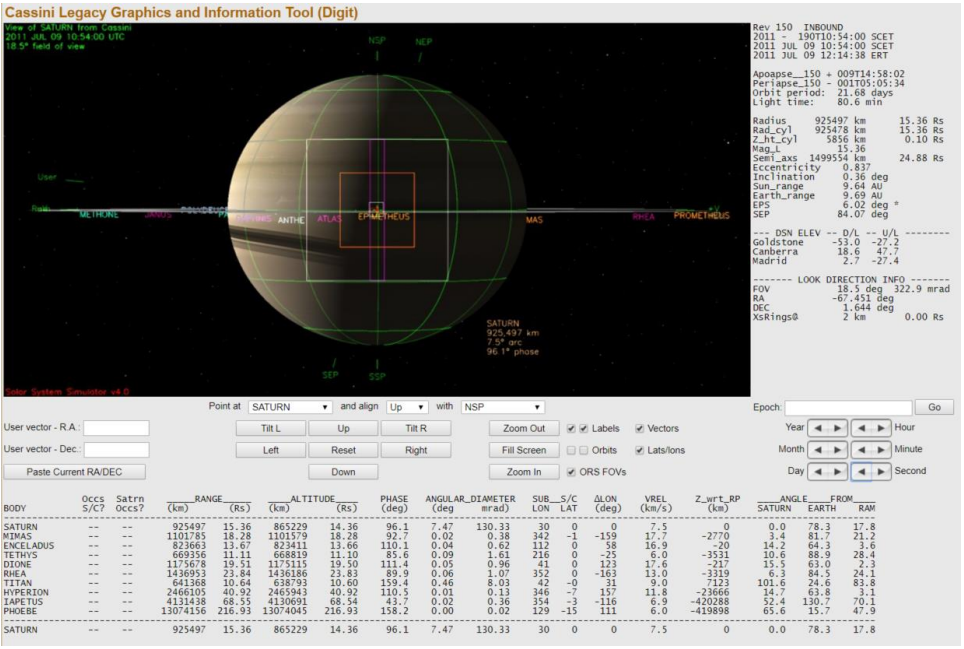
DATA VOLUME SUMMARY --- TRANSFER FRAME OVERHEAD INCLUDED (80 BITS PER 8800-BIT FRAME)

			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_150EA_C34BWGNON191_PRIME	191 01:39	191 10:39	74	1336	62	1473	3322	1849	0	432	53	1958	709	-1250	0	0%	1249
SP_150EA_C70METNON192_PRIME	192 01:39	192 10:39	1249	1702	63	3015	3322	307	0	345	53	3413	3224	-189	148	1%	188
SP_150EA_C70METNON194_PRIME	194 01:39	194 10:39	188	2738	165	3091	3322	231	0	219	53	3363	3257	-106	148	1%	106

DATA VOLUME REPORT --- TRANSFER FRAME OVERHEAD NOT INCLUDED

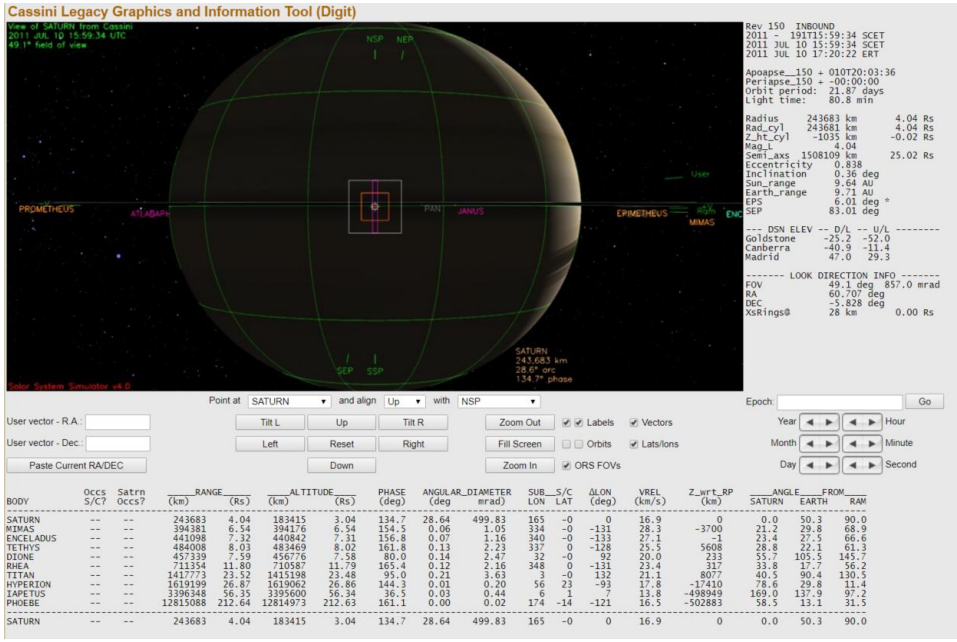
Event	Start doy hh:mm	End doy hh:mm	CAPS (Mb)	CDA (Mb)	CIRS (Mb)	INMS (Mb)	ISS (Mb)	MAG (Mb)	MIMI (Mb)	RADAR (Mb)	RPWS (Mb)	UVIS (Mb)	VIMS (Mb)	PROBE (Mb)	ENGR (Mb)	TOTAL (Mb)
OBSERVATION_NOR	190 10:54	191 01:39	53.1	174.4	171.6	5.3	240.0	26.2	45.1	0.0	58.4	0.0	550.0	0.0	61.6	1385.8
SP_150EA_C34BWGNON191_PRIME	191 01:39	191 10:39	32.4	135.8	86.4	3.2	0.0	16.0	27.5	0.0	121.5	4.9	0.0	0.0	0.0	427.8
DAILY TOTAL SCIENCE	190 10:54	191 10:39	85.5	310.2	258.0	8.6	240.0	42.2	72.7	0.0	179.9	4.9	550.0	0.0	61.6	
OBSERVATION_NOR	191 10:39	192 01:39	54.0	226.4	122.6	15.5	83.0	52.0	45.9	0.0	697.1	0.0	390.0	0.0	62.7	1749.2
SP_150EA_C70METNON192_PRIME	192 01:39	192 10:39	32.4	135.8	86.4	3.2	0.0	16.0	27.5	0.0	35.6	4.9	0.0	0.0	0.0	342.0
DAILY TOTAL SCIENCE	191 10:39	192 10:39	86.4	362.2	209.0	18.7	83.0	68.0	73.4	0.0	732.8	4.9	390.0	0.0	62.7	
OBSERVATION_NOR	192 10:39	194 01:39	140.4	163.4	189.6	14.0	151.5	69.4	119.3	0.0	133.2	42.3	1690.0	0.0	163.0	2876.0
SP_150EA_C70METNON194_PRIME	194 01:39	194 10:39	32.4	17.0	86.4	3.2	0.0	16.0	27.5	0.0	29.2	4.9	0.0	0.0	0.0	216.7
DAILY TOTAL SCIENCE	192 10:39	194 10:39	172.8	180.3	276.0	17.3	151.5	85.4	146.9	0.0	162.3	47.2	1690.0	0.0	163.0	

Segment Geometry



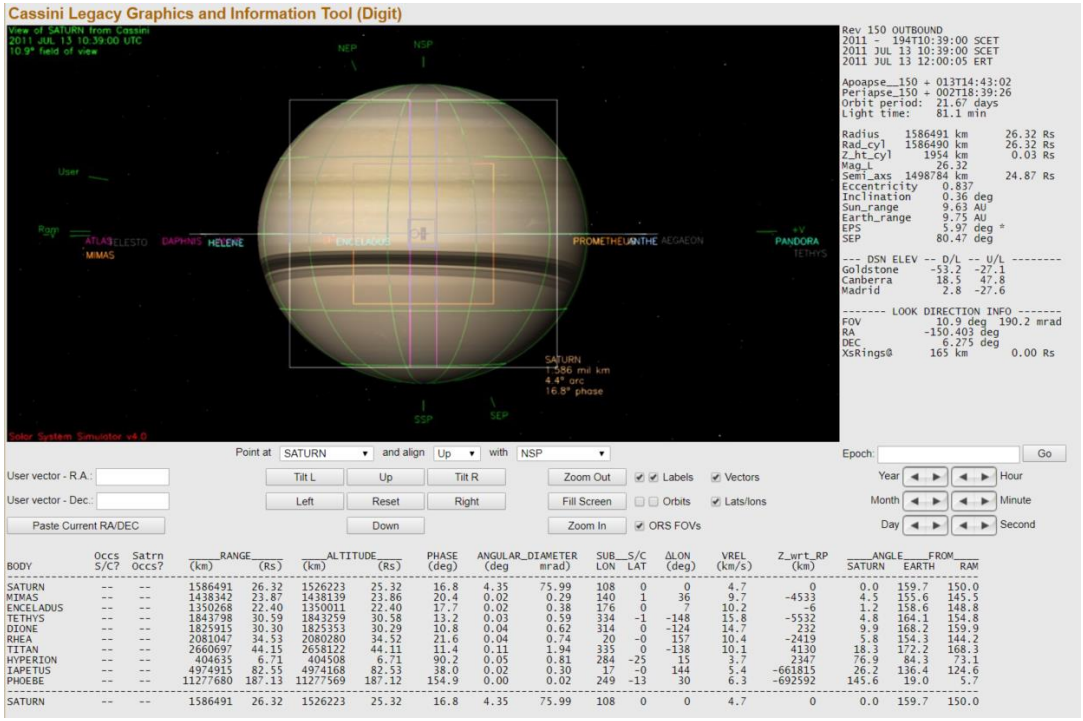
← Seg Start (Left)

↓ Periapse (below)



	Saturn Range	Phase Angle	Sub-S/C Lat.
Segment Start	15.36 Rs	96.1	0
Periapse	4.04 Rs	134.7	0
Segment End	26.23 Rs	16.8	0

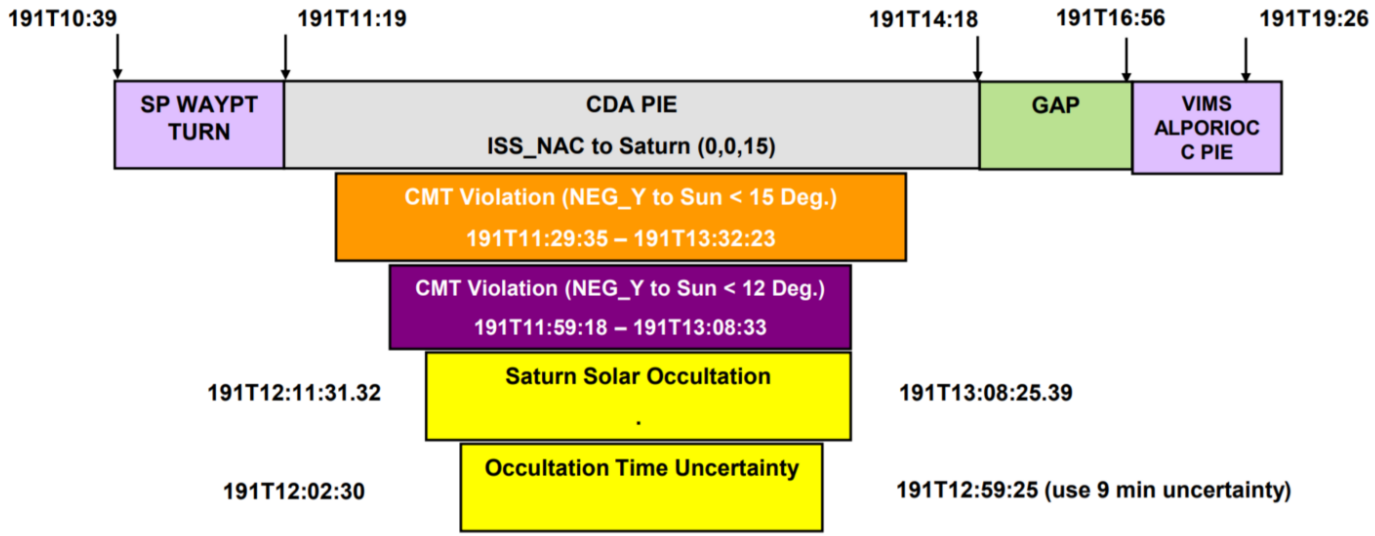
Segment Geometry



Seg End

Solar Geometry – ORS Boresight Concerns

- CMT Management will not be needed for the CDA RINGSHAD001 PIE if they observe with the 15 deg. offset.
- Time of <15 deg and <12 deg violations came from Kevin Grazier's tour atlas files.
- Time of Saturn Occultation is from the tour atlas.
- Timing uncertainty is ± 8.54 minutes as determined using Brad Wallis' "ask_carnac.pro"



Daily Science Highlights

July 9 (DOY 190): VIMS imaged the equatorial region on Saturn in order to complete a census of the sizes and shapes of the plume like features it had spotted previously underneath the unusually thick layer of upper-level hazes in the equatorial region. These features are thought to be sources of these hazes, delivering gases and aerosols from the deep troposphere to the upper atmosphere.

July 10 (DOY 191): A CDA PIE took measurements to understand the shadow resonances of charged particles , their charging time and how they influence the asymmetry of the E-Ring. VIMS continued its imaging to complete mapping the entire equatorial region of Saturn. Just after periapse, a collaborative VIMS and CIRS PIE observed the atmosphere in stellar occultation mode (as the star Alpha Ori, commonly known as Betelgeuse, was occulted) to gather data to determine the atmospheric H/He ratio. A second collaborative stellar occultation observation, this time of the star Alpha CMI, followed. These VIMS-CIRS occultation observations were repeated in Rev 151 at the same latitude for verification of the measurements.

July 11 (DOY 192): As part of the Titan Meteorological Campaign, ISS observed Titan to look for planet-wide cloud events observed by Earth based telescopes in the past. CIRS then targeted the Saturn limb to measure oxygen compounds (H_20, CO_2) in the stratosphere.

July 12 (DOY 193): VIMS mapped Saturn's northern hemisphere continuously over 20 hours to observe time variability of winds, and to study temporal variations of features comprising the String of Pearls (discrete, semi-regularly-spaced clearings in the clouds), the Saturn Ribbon feature, and the "smoke rings". Observations over two rotations were planned to provide valuable information on the oscillatory nature of the pearls.

Segment Integration Planning

Timeline Gaps and Suggested Observations

Gap	Start	End	Duration	Phase angle (range)	Suggested observations/activities
1	2011-190T11:34:00	2011-191T00:59:00	13:25:00	96.8° -117.5°	11 hrs – VIMS 1.5 hr pre-peri Y-bias
2	2011-191T14:37:00	2011-191T16:56:00	02:19:00	153.1°-121.8°	VIMS
3	2011-191T21:18:00	2011-192T00:59:00	03:41:00	73.6° - 50.9°	1.5 hr post-peri Y-bias
4	2011-192T12:49:00	2011-194T00:59:00	001T12:10:00	20.5° - 14.1°	ISS/VIMS movie

A note about prime observations and gaps in the strawman:
Gap 3 starts at 191T19:08:00 and has a duration of 05:51:00 if VIMS_ALPCMIOCC is not included

Gap 4 starts at 192T11:19:00 and has a duration of 001T13:40:00 if ISS_M60R2CLD is not included

Initial SMT and Data Volume

No Initial SMT Report Available.

Waypoint Selection

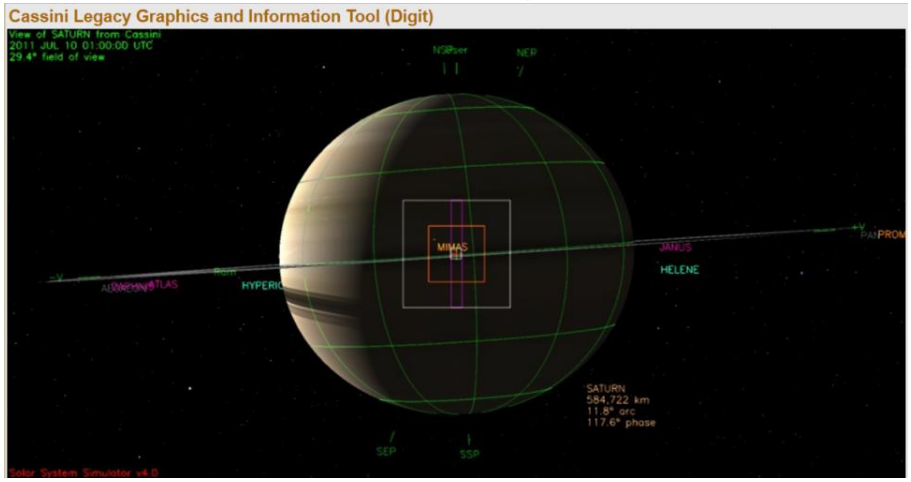
Saturn_150 RBOT friendly waypoints

			Primary	Secondary	
OBSERVATION PERIOD	**START**	**END**		**NEG_X**	**NEG_Z**
SP_150NA_OBSERV190_NA	2011-190T10:54:00	2011-191T01:39:00	Saturn	37.6/ 83.7	37.6/ 83.7
SP_150NA_OBSERV191_NA	2011-191T10:39:00	2011-192T01:39:00	Saturn	------	------
SP_150NA_OBSERV192_NA	2011-192T10:39:00	2011-194T01:39:00	Saturn	37.3/ 83.7	------

Start	End	Primary	Secondary
2011-191T09:00:00	2011-192T01:39:00	ISS_NAC to Saturn (0.0,0.0,15) offset	Neg X to NSP

Waypoints Chosen

Waypoint 1 (2011-190T11:34:00 – 2011-191T14:58:00): ISS_NAC to Saturn; NEG_Z to 37.3/87.3

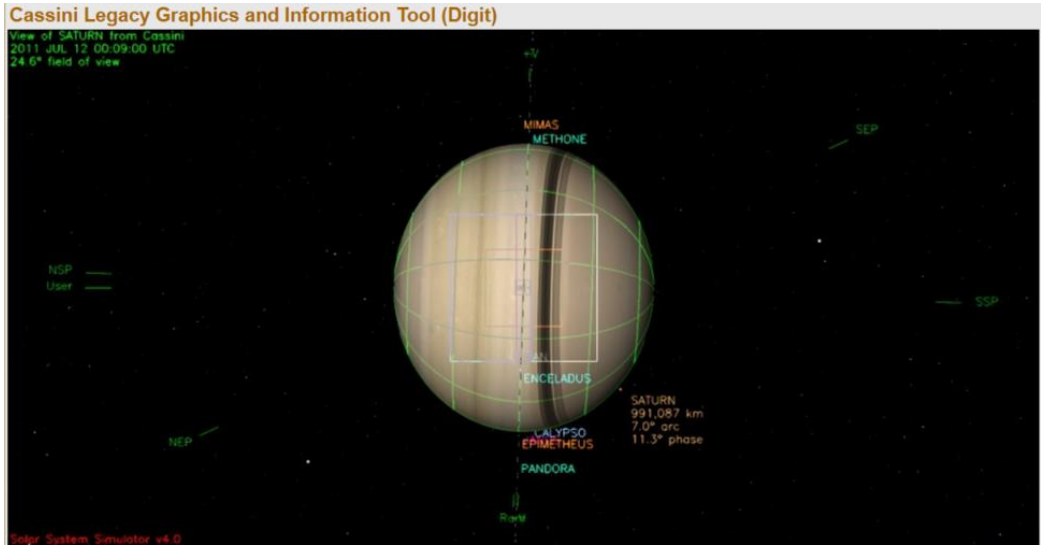


Waypoint 2 (2011-191T14:58:00 – 2011-192T00:09:00):
XBAND to Earth (0.0,-80.0,30.0 deg. offset); NEG_X to NSP

Not Pictured - Earth Pointed w/large offset for CDA and to avoid boresight to sun FR violations.

Waypoints Chosen

Waypoint 3 (2011-192T00:09:00 – 2011-194T00:09:00): ISS_NAC to Saturn; NEG_X to 37.3/87.3



Notes & Liens

- Pointing:
  - Collaborative primes
    - VIMS_150SA_ALPORIOCC001_PIE (with CIRS_150SA_ALPORIOCC001_VIMS)
    - VIMS_150SA_ALPCMIOCC001_PRIME (with CIRS_150SA_ALPCMIOCC001_VIMS)
  - RBOT friendly waypoint secondaries used for all observations except
    - CDA_150OT_RINGSHAD001_PIE which uses the waypoint secondary for the downlink
    - CIRS_150SA_COMPSIT002_PRIME for which the secondary was science driven (CIRS prefers its arrays to be North-South oriented during compsits when it will be targeting Saturn's left limb)
    - VIMS_150SA_ALPORIOCC001_PIE and VIMS_150SA_ALPCMIOCC001_PRIME list PIC for their secondary attitudes.
  - There are no observations > 3 hrs that track a target through >60 degrees

- Data Volume: None
- DSN: None
- Opmodes:
  - The 2 RSS ORTs in segment require the following RSS opmodes
    - RSSPRWAF
    - RSSKRWAP-FULL
    - RSS2RWAP-FULL
- Liens:
  - For concerns about the CIRS Warm Body flight rule violations due to Saturn or the Sun during downlinks, consult the Saturn TWT leads.