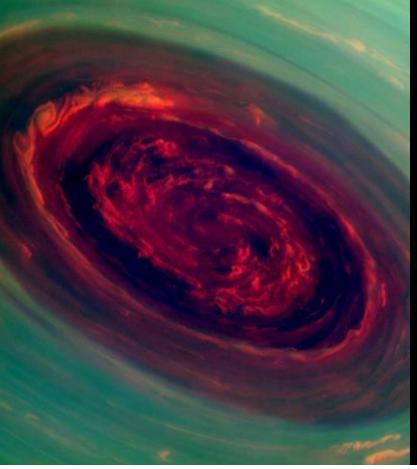

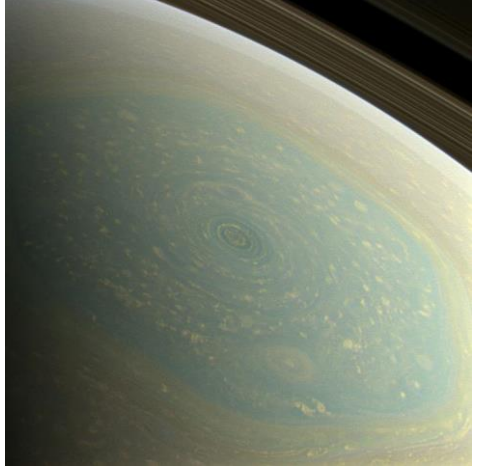
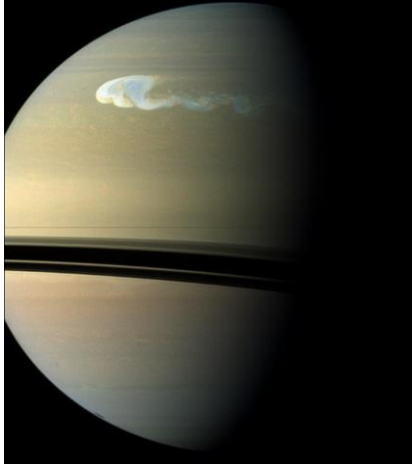

Science Planning & Sequence Team
CASSINI

SATURN TARGET WORKING TEAM

Rev 235 Segment Legacy Package

Segment Boundary: May 4, 2016 – May 5, 2016
124T19:29:00 – 126T19:14:00 (SCET)

Integration Began 06/08/2015
Segment Delivered to S94 Sequence 10/28/2015
Lead Integrator was Keven Uchida

Legacy Package Assembled by Keven Uchida

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

Segment Overview and Final Products

Segment Summary

- Saturn 235 was a two day long periapse segment (R = 13.81 to 8.24 R_S). The S/C was in an inclined orbit. The segment covered a wide range of Saturn phase angles. The view began at Saturn's equator, but was then of southern latitudes for much of the remainder of the segment.
- VIMS focused on hemisphere maps, UVIS on auroral observations.
- The Sun approached to within 13.75 degrees of Saturn center at 126T08:04, so while portions of Saturn were still observable, ORS had to exercise some care to avoid the Sun.
- DOY 125 downlink designated as OTM backup.

Final Sequenced SPASS

Gap 1

Gap 2

Request	Riders	Start (SCET)	Start (Epoch)	Duration	End	Primary	Secondary	Comments
SATURN_235 Segment		2016-124T19:29:00		001T23:45:00	2016-126T19:14:00			
SP_235SA_WAYPTTURN124_PRIME		2016-124T19:29:00		000T00:40:00	2016-124T20:09:00	ISS_NAC to Saturn	NEG_X to NSP	
NEW WAYPOINT		2016-124T20:09:00		000T14:20:00	2016-125T10:29:00	ISS_NAC to Saturn	NEG_X to NSP	
VIMS_235SA_NHEMMAP001_PRIME	C, I	2016-124T20:09:00		000T02:40:00	2016-124T22:49:00	ISS_NAC to Saturn	NEG_X to NSP	Collaborative Rider(s): ISS
VIMS_235SA_SHEMMAP001_PRIME	C, I, M	2016-124T22:49:00		000T11:00:00	2016-125T09:49:00	ISS_NAC to Saturn	NEG_X to NSP	Collaborative Rider(s): ISS
SP_235EA_DLTURN125_PRIME		2016-125T09:49:00		000T00:40:00	2016-125T10:29:00	XBAND to Earth	NEG_X to 356.0/-29.0	
NEW WAYPOINT		2016-125T10:29:00		000T09:40:00	2016-125T20:09:00	XBAND to Earth	NEG_X to 356.0/-29.0	
SP_235EA_C34BWGOTB125_PRIME	C, E, N	2016-125T10:29:00		000T09:00:00	2016-125T19:29:00	XBAND to Earth	4_Hr_Rolling	CAPS.same secondary as OTP pass.OTB.SRU.
Periapse R = 8.330 Rs, lat ...		2016-125T16:34:07		000T00:00:01	2016-125T16:34:08			
SP_235SA_WAYPTTURN126_PRIME		2016-125T19:29:00		000T00:40:00	2016-125T20:09:00	ISS_NAC to Saturn (0.0,0.0,5.0 deg. offset)	NEG_X to NSP	
NEW WAYPOINT		2016-125T20:09:00		000T12:35:00	2016-126T08:44:00	ISS_NAC to Saturn (0.0,0.0,5.0 deg. offset)	NEG_X to NSP	
VIMS_235SA_SPOLEMAP001_PRIME		2016-125T20:09:00		000T01:00:00	2016-125T21:09:00	ISS_NAC to Saturn	NEG_X to NSP	
UVIS_235SA_AURSTARE001_PRIME	C, I, V	2016-125T21:09:00		000T05:00:00	2016-126T02:09:00	UVIS_FUV to Saturn	NEG_X to NSP	Collaborative Rider(s): VIMS
ISS_235SA_LIMBINT001_PRIME	C, U, V	2016-126T02:09:00		000T02:00:00	2016-126T04:09:00	ISS_NAC to Saturn	NEG_X to NSP	
UVIS_235SA_AURSTARE002_PRIME	C, I, V	2016-126T04:09:00		000T03:55:00	2016-126T08:04:00	UVIS_FUV to Saturn	NEG_X to NSP	Collaborative Rider(s): VIMS
SP_235EA_DLTURN126_PRIME		2016-126T08:04:00		000T00:07:00	2016-126T08:11:00	ISS_NAC to Saturn (0.0,0.0,20.0 deg. offset)	NEG_X to NSP	
SP_235EA_DLTURN426_PRIME		2016-126T08:11:00		000T00:33:00	2016-126T08:44:00	XBAND to Earth	NEG_X to NSP	
NEW WAYPOINT		2016-126T08:44:00		000T11:10:00	2016-126T19:54:00	XBAND to Earth	NEG_X to NSP	
SP_235EA_YGAP126_PRIME		2016-126T08:44:00		000T01:30:00	2016-126T10:14:00	XBAND to Earth	NEG_X to NSP	
SP_235EA_C34HEFNON126_PRIME	C, R	2016-126T12:44:00		000T02:50:00	2016-126T15:34:00	XBAND to Earth	Rolling	CAPS.NEG_X to 40.6/83.5 (NSP) or NEP.
SP_235EA_C70METNON126_PRIME	C, R	2016-126T15:34:00		000T03:40:00	2016-126T19:14:00	XBAND to Earth	Rolling	CAPS.NEG_X to 40.6/83.5 (NSP) or NEP.

Final Sequenced SMT and Data Volume

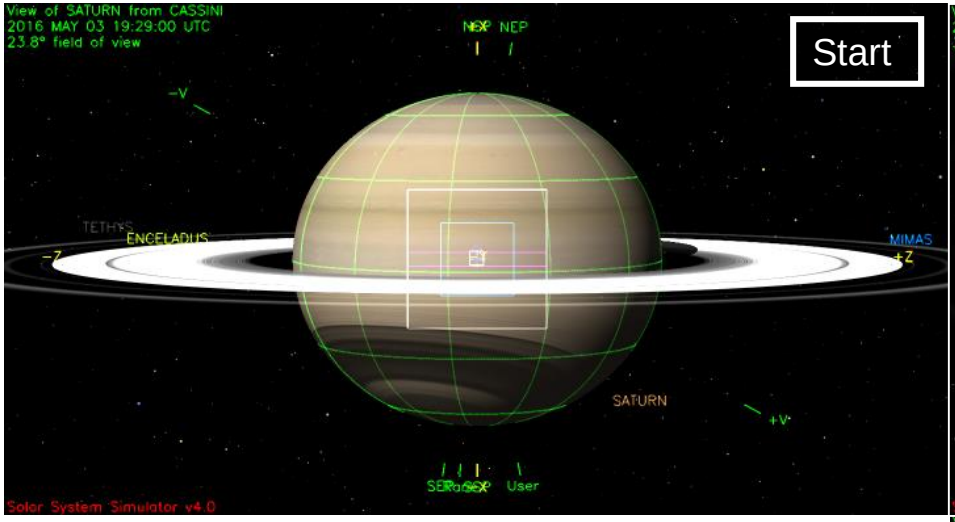
DATA VOLUME SUMMARY --- TRANSFER FRAME OVERHEAD INCLUDED (80 BITS PER 8800-BIT FRAME)

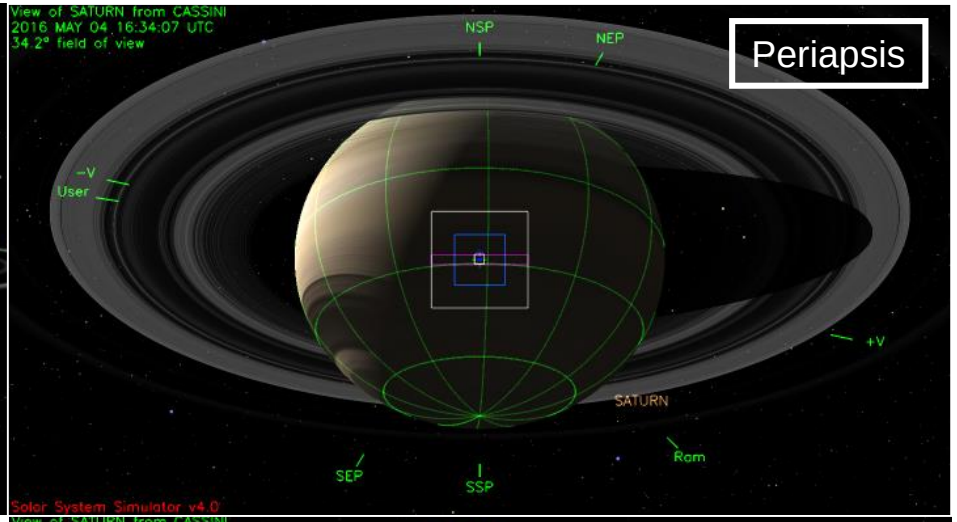
			OBSERVATION_PERIOD							DOWNLINK_PASS						
			P4					P5	RECORDED		PLAYBACK					
DOWNLINK PASS NAME	Start doy hh:mm	End doy hh:mm	START (Mb)	SCI (Mb)	HK+E (Mb)	TOTAL (Mb)	CPACTY (Mb)	MRGN (Mb)	OPNAV (Mb)	SCI (Mb)	ENGR (Mb)	TOTAL (Mb)	CPACTY (Mb)	MARGN (Mb)	NET_MARGN (Mb)	CAROVR (%)	CAROVR (Mb)
SP_235EA_C34BWGOTB125_PRIME	125 10:29	125 19:29	0	1889	63	1953	3322	1369	0	199	53	2205	905	-1301	-277	-2%	1300
SP_235EA_C34HEFNON126_PRIME	126 12:44	126 15:34	1300	1044	73	2417	3322	905	0	66	17	2500	288	-2213	-277	-2%	2212
SP_235EA_C70METNON126_PRIME	126 15:34	126 19:14	2212	0	0	2212	3322	1110	0	86	22	2319	1524	-796	-277	-2%	795

DATA VOLUME REPORT --- TRANSFER FRAME OVERHEAD NOT INCLUDED

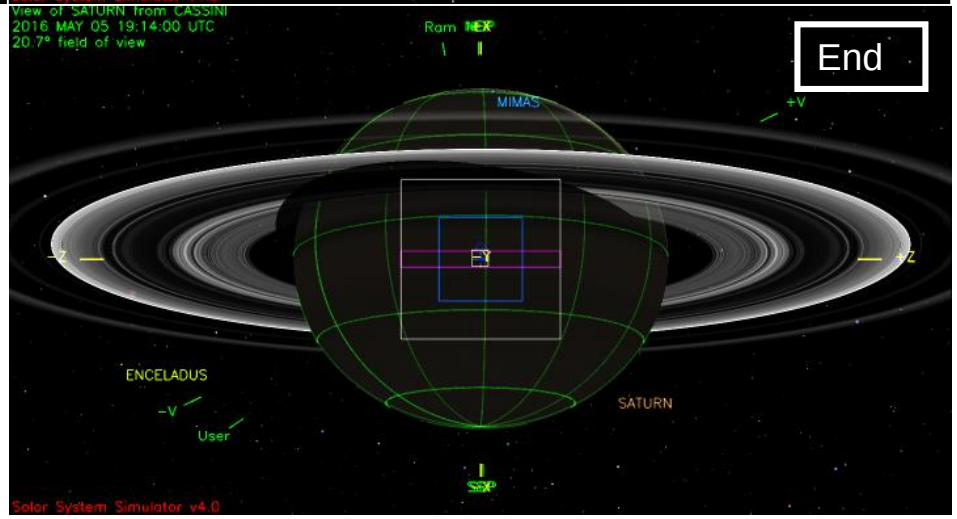
Event	Start doy hh:mm	End doy hh:mm	CAPS (Mb)	CDA (Mb)	CIRS (Mb)	INMS (Mb)	ISS (Mb)	MAG (Mb)	MIMI (Mb)	RADAR (Mb)	RPWS (Mb)	UVIS (Mb)	VIMS (Mb)	PROBE (Mb)	ENGR (Mb)	TOTAL (Mb)
OBSERVATION_NOR	124 19:29	125 10:29	0.0	100.9	98.4	5.4	299.6	26.7	45.9	0.0	610.2	0.0	685.0	0.0	62.7	1934.8
SP_235EA_C34BWGOTB125_PRIME	125 10:29	125 19:29	0.0	17.0	86.4	3.2	0.0	16.0	27.5	0.0	42.1	4.9	0.0	0.0	0.0	197.2
DAILY TOTAL SCIENCE	124 19:29	125 19:29	0.0	117.9	184.8	8.6	299.6	42.7	73.4	0.0	652.3	4.9	685.0	0.0	62.7	
OBSERVATION_NOR	125 19:29	126 12:44	0.0	32.5	94.8	16.3	289.5	30.7	52.8	0.0	80.7	197.3	240.0	0.0	72.1	1106.7
SP_235EA_C34HEFNON126_PRIME	126 12:44	126 15:34	0.0	5.3	30.6	1.0	0.0	5.0	8.7	0.0	13.3	1.6	0.0	0.0	0.0	65.5
SP_235EA_C70METNON126_PRIME	126 15:34	126 19:14	0.0	6.9	39.6	1.3	0.0	6.5	11.2	0.0	17.2	2.0	0.0	0.0	0.0	84.8
DAILY TOTAL SCIENCE	125 19:29	126 19:14	0.0	44.8	165.0	18.6	289.5	42.2	72.7	0.0	111.1	200.9	240.0	0.0	72.1	

Segment Geometry

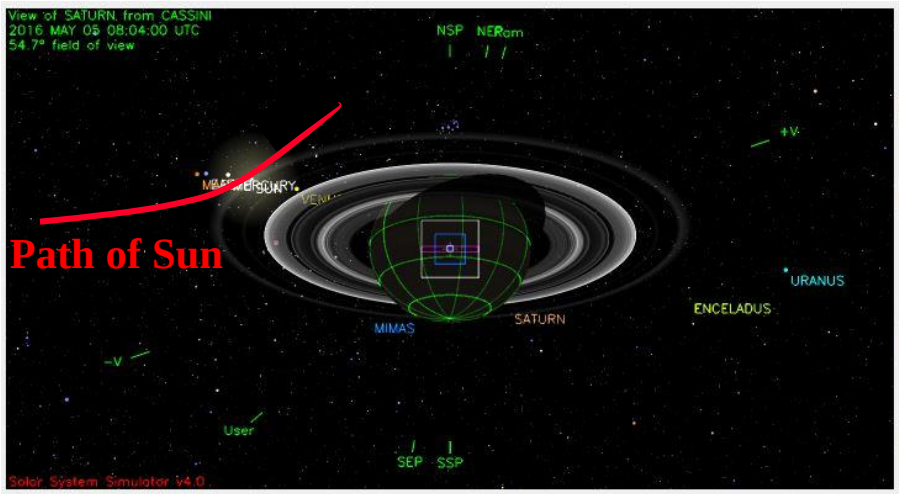




	Saturn Range	Phase Angle	Sub-S/C Lat.
Segment Start	12.21	33.7	4
Periapse	8.34	107.7	-26
Segment End	13.81	163.7	-13



Solar Geometry – ORS Boresight Concerns




```
Rev 235 OUTBOUND
2016 -  126T08:04:00 SCET
2016 MAY 05 08:04:00 SCET
2016 MAY 05 09:20:02 ERT
Apoapse__235 + 016T14:02:51
Periapse_235 + 15:29:52
Light time:    76.0 min
Orbit period:  31.9 days
Radius      644609 km      10.70 Rs
Rad_cyl     596741 km       9.90 Rs
Z_ht_cyl  -243765 km      -4.04 Rs
Mag_L          12.48
Semi_axs  1940185 km      32.19 Rs
Eccentricity    0.741
Inclination    28.81 deg
Sun_range      10.03 AU
Earth_range     9.14 AU
--- DSN ELEV -- D/L -- U/L --------
Goldstone      33.3   19.2
Canberra        3.1  -22.0
Madrid        -24.7    2.6
------- LOOK DIRECTION INFO -------
FOV            54.7 deg  954.6 mrad
RA             57.050 deg
DEC            16.031 deg
Crosses_RP_@    0.000 Rs
EPS             2.873 deg
SEP           150.113 deg
ORS b/s angle  13.8 deg  *
ORS rad angle  85.5 deg  *
```

Point NEG_Y at SATURN and align POS_X = Up with NSP

User Vector - RA: 86.996 DEC: -9.789 Paste Current RA/DEC

Tilt L | Up | Tilt R | Left | Reset | Right | Down

Zoom Out | Fill Screen | Zoom In

Labels | Axes | Orbits | Vectors | FOVs | Lat/Lons | Image | Hi Res

Year | Month | Day | Hour | Minute | Second

Turn Analyzer: SATURN to EARTH about Z on RWA = 3.8 min / 16.6 deg Event

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	DLON (deg)	VREL (km/s)	Z_HGHT (km)	ANGLE FROM SATRN	ANGLE FROM EARTH	ANGLE FROM RAM
SATURN	--	--	644609	10.70	585162	9.71	166.2	10.73	187.26	308	-22	0	9.9	0	0.0	16.6	145.0
MIMAS	--	--	805043	13.36	804838	13.35	168.0	0.03	0.52	19	-18	156	21.7	-1405	7.0	14.2	150.6
ENCELADUS	--	--	780811	12.96	780557	12.95	150.4	0.04	0.66	320	-18	-119	21.7	-0	15.9	32.5	141.1
TETHYS	--	--	389608	6.46	389072	6.46	158.2	0.16	2.77	195	-37	-8	7.2	-3929	16.9	24.1	128.1
DIONE	--	--	368689	6.12	368127	6.11	141.5	0.18	3.06	229	-41	-21	8.7	-107	30.7	40.8	116.7
RHEA	--	--	473088	7.85	472326	7.84	115.7	0.19	3.24	284	-30	-42	11.0	-2189	53.6	66.9	101.7
TITAN	--	--	705797	11.71	703222	11.67	47.9	0.42	7.30	347	-20	-15	7.5	-7001	129.3	132.9	21.2
HYPERION	--	--	1074434	17.83	1074316	17.83	38.4	0.02	0.31	156	-65	-5	6.9	-26785	145.3	141.0	1.3
IAPETUS	--	--	3279727	54.42	3278980	54.41	59.3	0.03	0.46	356	-3	-66	10.8	-942097	107.2	123.5	71.0
PHOEBE	--	--	10436158	173.16	10436046	173.16	18.3	0.00	0.02	46	20	-33	10.9	-5107462	147.9	164.4	46.9
SATURN	--	--	644609	10.70	585162	9.71	166.2	10.73	187.26	308	-22	0	9.9	0	0.0	16.6	145.0

Note on SP_235NA_OBSERV125_NA period:

There are Sun to ORS boresight issues near end of period. With NEG_Y to Saturn, the Sun enters within:

- 15 deg of ORS boresight @ 126T07:32:00
- 13.75 deg of ORS boresight by time of last DL turn at 126T08:04

Daily Science Highlights

DOY 124: Saturn 235, a two day long periapsis segment, began on this day with VIMS_235SA_NHEMMAP001. This ~3 hour long VIMS activity consisted of mosaic mapping of Saturn's day lit hemisphere, from the equator to north polar latitudes. After ring plane crossing at 14:22:49, VIMS then performed ~11 hours of mapping from the equator to south polar latitudes (VIMS_235SA_SHEMMAP001) . Both VIMs mapping activities had CIRS and ISS as riders.

DOY 125: Following the hemisphere maps, VIMS concentrated on mapping of Saturn's south polar region (VIMS_235SA_SPOLEMAP001).

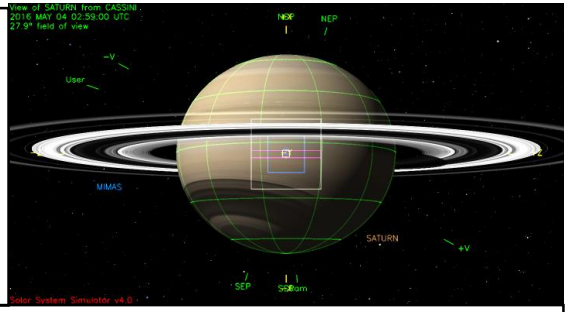
DOY 126: On this day we begn with auroral observations (of the southern auroral zone) led by UVIS (UVIS_235SA_AURSTARE001 and UVIS_235SA_AURSTARE002) – CIRS, ISS and VIMS were riders. Between the two auroral stare activities, ISS spent two hours imaging the thin bright limb of Saturn (ISS_235SA_LIMBINT001), with CIRS, UVIS and VIMS riding along.

Segment Integration Planning

Timeline Gaps and Suggested Observations

Gap 1

Time: 124T20:09:00 - 125T09:49:00
Duration: 13:40:00
Phase Angle: 35.2 – 77.6
Rs Range: 12.0 - 8.9
Sub S/C Lat: +3 to -17

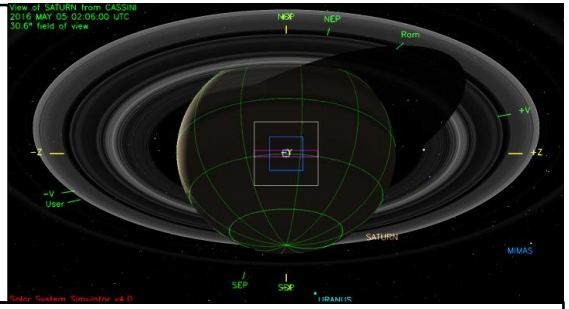


Gap 1: Suggested Observations

- High Res Imaging of N. Equatorial Region (0-15 deg north Lat) Dur: 02h40m
- Note: Ring Plane Crossing @ ~124T22:49:00
- High Res Imaging of S. Equatorial Region (0-15 deg south Lat) Dur: 11h00m

Gap 2

Time: 125T20:09:00 - 126T08:04:00
Duration: 11:55:00
Phase Angle: 124.2 – 166.2
Rs Range: 8.5 – 10.7
Sub S/C Lat: -29 to -22



Gap 2: Suggested Observations

- CIRS COMPSIT (Gap 2 start to 126T01:09)
- ISS bright limb/crescent imaging (126T01:09 to 126T04:09)
- CIRS COMPSIT (126T04:09 to Gap 2 end)

or

- VIMS south polar region campaign with auroral mapping (at beginning of Gap 2)

Initial 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_235EA_C70METOTB125_PRIME	125 10:29	125 19:29	0	251	63	315	3322	3007	0	112	53	480	3834	3354	5884	77%	0
SP_235EA_C70METNON126_PRIME	126 10:14	126 19:14	0	730	62	793	3322	2530	0	112	53	957	3806	2848	2848	75%	0

No initial data volume issues

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	124 19:29	125 10:29	0.0	100.9	0.0	5.4	0.0	26.7	45.9	0.0	70.2	0.0	0.0	0.0	62.7	311.8
SP_235EA_C70METOTB125_PRIME	125 10:29	125 19:29	0.0	17.0	0.0	3.2	0.0	16.0	27.5	0.0	42.1	4.9	0.0	0.0	0.0	110.8
DAILY TOTAL SCIENCE	124 19:29	125 19:29	0.0	117.9	0.0	8.6	0.0	42.7	73.4	0.0	112.3	4.9	0.0	0.0	62.7	
OBSERVATION_NOR	125 19:29	126 10:14	0.0	27.8	0.0	15.4	0.0	26.2	45.1	0.0	609.0	0.0	0.0	0.0	61.6	785.2
SP_235EA_C70METNON126_PRIME	126 10:14	126 19:14	0.0	17.0	0.0	3.2	0.0	16.0	27.5	0.0	42.1	4.9	0.0	0.0	0.0	110.8
DAILY TOTAL SCIENCE	125 19:29	126 19:14	0.0	44.8	0.0	18.6	0.0	42.2	72.7	0.0	651.1	4.9	0.0	0.0	61.6	

	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)	0.0	162.7	0.0	27.3	0.0	84.9	146.1	0.0	763.5	9.9	0.0	0.0

Waypoint Selection

RBOT - Friendly

OBSERVATION PERIOD	START	END	POS_X	NEG_X	POS_Z	NEG_Z
SP_235NA_OBSERV124_NA	2016-124T19:29:00	2016-125T10:29:00	------	189.4/ 66.9	------	189.4/ 66.9
SP_235NA_OBSERV125_NA	2016-125T19:29:00	2016-126T10:14:00	------	------	------	------

Standard Waypoints

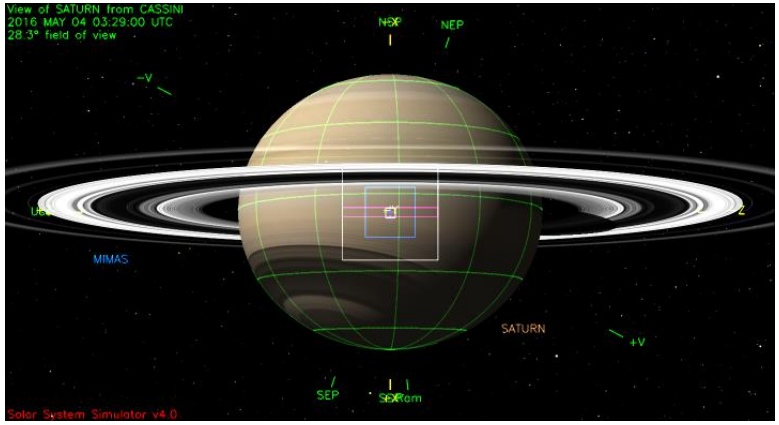
START	END	POS_X_2_NSP	POS_X_2_NEP	NEG_X_2_NSP	NEG_X_2_NEP	POS_Z_2_NSP	POS_Z_2_NEP	NEG_Z_2_NSP	NEG_Z_2_NEP	NEG_X_2_SUN	NEG_Z_2_EARTH
2016-124T19:29:00	2016-125T10:29:00	**BAD**	**BAD**	OK	OK	**BAD**	**BAD**	OK	OK	OK	OK
2016-125T19:29:00	2016-126T10:14:00	**BAD**	**BAD**	**BAD**	**BAD**	**BAD**	**BAD**	**BAD**	**BAD**	**BAD**	**BAD**

Neg_X_2_NSP (0,0,5)

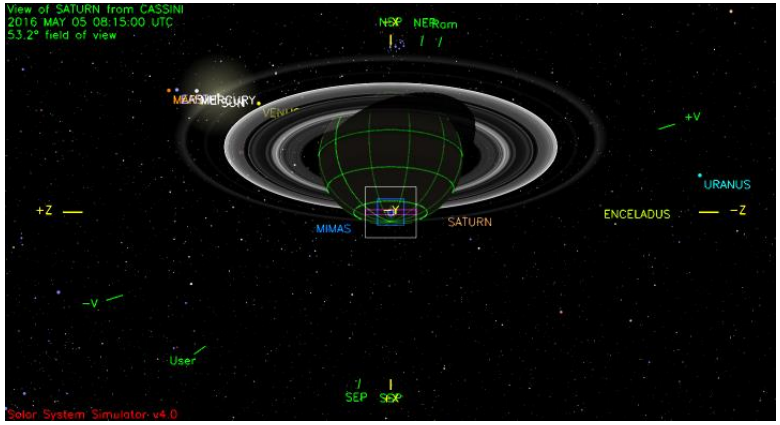
Neg_Z_2_NSP (-5,0,0)

Waypoints Chosen

Waypoint 1 (2016-124T20:09 – 125T10:29): NEG_Y to Saturn, NEG_X to NSP



Waypoint 2 (125T20:09 – 126T08:44): NEG_Y to Saturn (0,0,5), NEG_X to NSP



Notes and Liens (1/2)

- Pointing:
  - All waypoints used are valid.
    - Sun enters within15 deg of Saturn center at 126T07:32:00 near the end of the first observation period (SP_235NA_OBSERV124_NA). Used [ISS_NAC to Saturn (0.0,0.0,5.0 deg. offset), NEG_X to NSP] as a valid waypoint.
  - SP_235EA_DLTURN126_PRIME receives the following PDT FR violation ----- "2016-126T08:04:02.000 Profile_Acceleration_Violation ...". Also at 2016-126T08:05:52.000
    - SIPS must manually reduce/increase the RWA Angular Acceleration Z-Axis Component (in the PDT SASF) from 2.20000072611e-0 to 2.20e-0
  - UVIS_235SA_AURSTARE002_PRIME may require a CIRS operational boresight waiver for last ~1 hr of this activity.

- Data Volume:
  - No SMT warnings

- DSN:
  - No Level 3 requests
  - ap_downlink warning: 70m usage for sequence exceeds project commitment of <= 35%; is at 50% Warning: number of sequence upload passes is 0; should be 5 or more
    - Periapsis segment – One of only two DLs is a 70m. Negotiate in integration.
  - ap_downlink warning: number of sequence upload passes is 0; should be 5 or more
    - This is not an end of sequence segment requiring upload passes.

Notes and Liens(2/2)

- Resource checker:
  - SP_235EA_C34BWGOTB125_PRIME: Manually verify identical inertial pointing, the primary OTM may exist in the previous segment/sequence.
    - We confirm identical inertial pointing with preceding OTP in XD_235 segment (XBAND to Earth / Neg X to 356.0/-29.0)
- Opmodes:
  - No **UNIQUE** opmodes
  - RSS2RWAP-FAST (SCO verified) is used for RSS Operations Readiness Test (ORT) over SP_235EA_C70METNON126 pass.

Sequence Liens (should all be SPLAT items):

- List any Liens to be worked in SIP, ie
  - None