CASSINI SOST SEGMENT

Rev 224 (E21) Handoff Package

Segment Boundary 2015-301T00:30:00 – 2015-303T06:45:00

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Science Highlights

Notes & Liens

Science Highlights

DOY 301:

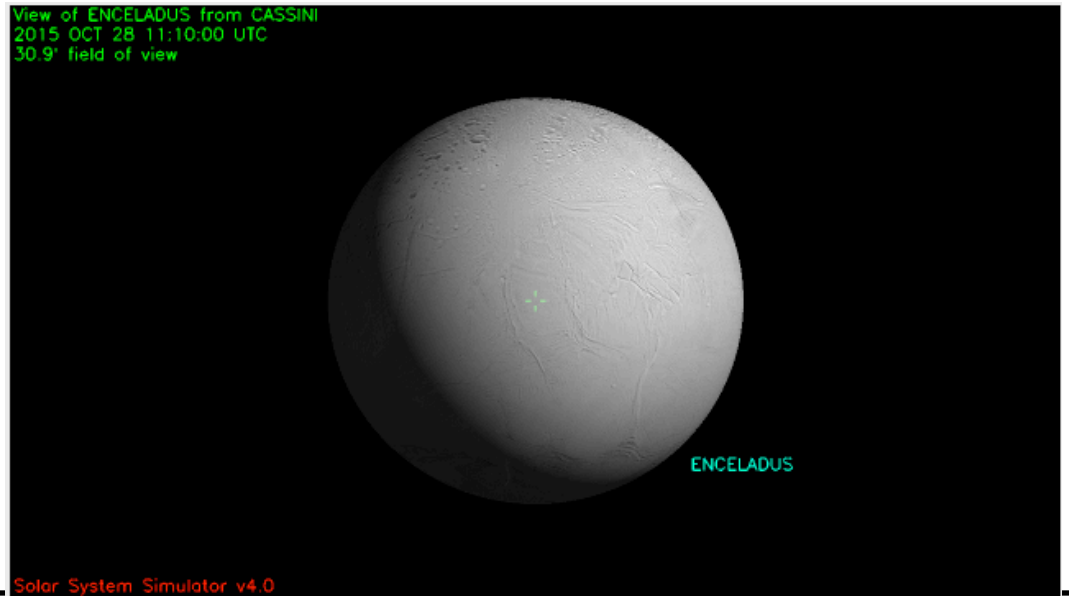
- We start with the first of two observations of irregular satellite Bestla, which is part of a campaign to determine the sidereal rotation period, pole-axis orientation, and shape of this approx. 7-kilometers sized satellite. The observations will provide data of different hemispheres of Bestla and will cover ~85% of its rotational lightcurve. Bestla's phase angle will be 61° (request Bestla 'A') and 70° ('B'), and its brightness is expected to be ~14.2 mag which is relatively bright for an irregular-moon observed by Cassini. The range to the spacecraft is 7.9 ('A') and 7.3 million kilometers ('B'). This is fairly close for an outer moon, but Bestla is still too small to be spatially resolved by the Cassini NAC instrument. These SOST observations are among the last opportunities for Cassini to observe Bestla because range and phase angle will increase again, and no later than end-of-November 2015 Bestla will vanish for Cassini forever.

- We then go to the first of two CDA prime observations. During this lowest-ever (~50km) plume crossing, CDA is performing in-situ measurements of plume composition, number densities, and size distribution of freshly ejected ice particles. As these measurements are known to change with altitude, we will get unprecedented insight in how the icy plume works deep inside. The low altitude will also allow us to get the 'best ever' information on the plume structure by distinguishing different sources contributing to the plume. The second CDA prime observation is after Enceladus closest approach.

Science Highlights

DOY 301 (cont)

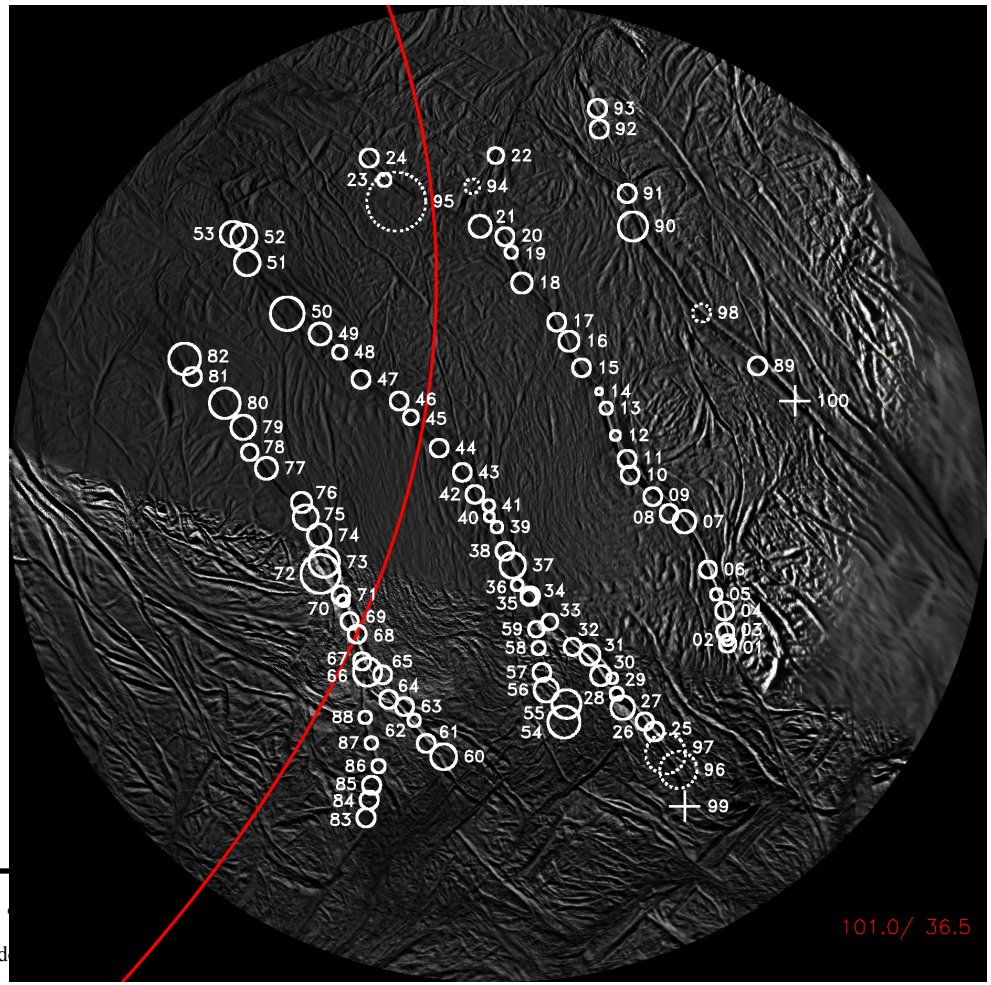
- ISS_224EN_ENCEL001_PRIME begins at 2015-301T11:10:00 and goes until 2015-301T13:30:00. It is a collaborative observation between ORS instruments and MAPS. The ORS instruments will view the trailing hemisphere of Enceladus from above the equator throughout this portion of Cassini's approach as the spacecraft range decreases from 142,504 km to 59,500 km at phase angles between 50 to 42 degrees, respectively. The overall strategy is to alternate between ISS multicolor imaging at NAC UV through IR3 filters, with attendant spectral tiepoints to UVIS and VIMS and scans of Enceladus by CIRS. Enceladus will be smaller than a NAC field of view for the first 1h 37m. Near the end of the request, Enceladus will be large enough in size to be covered by a 2x2 NAC multi-spectral mosaic with footprint dwell times long enough for VIMS to obtain complementary coverage.



Science Highlights

INMS PIE:

- E21 is the final Enceladus observation for INMS and the last chance to resolve some of the open questions from analysis of previous flybys. One of the main objectives is to use INMS' open source neutral beaming mode to constrain estimates of H2. This is an ORS drag observation, with CIRS, VIMS, and UVIS attempting to image Enceladus jet #68. MIMI also rides along.

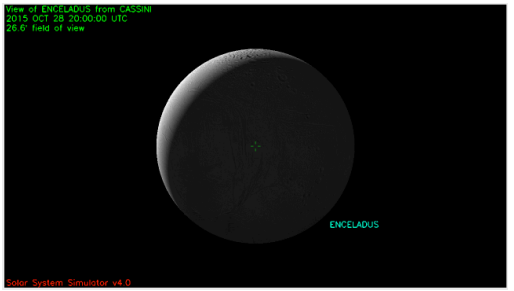


Plot of NEG_Y ground track, crossing jet #68. However, there will be some cross-track errors of up to 6km, per the navigation team. Targeting for this flyby should attempt to minimize those errors.

Science Highlights

DOY 301 (cont)

- ISS_224EN_PLUME001_PIE, ISS_224EN_PLMHPMR001_PRIME: These plume observations are part of our campaign to observe the plume over the full range of mean anomaly. This coverage will help us constrain the models for plume activity, furthering our understanding of Enceladus's interior.



- **DOY 302** contains the second plume observation and the second Bestla observation, described above.

- Also on DOY 302 is a UVIS star-occultation PIE. Occultations by UV-bright stars sense atomic and molecular hydrogen and some light hydrocarbons in Saturn's upper atmosphere. They are especially valuable because they provide detailed vertical profiles of these constituents and temperature in the region of the atmosphere (pressures around 1 nbar) where the heating mechanism is still unexplained, and where much of the conversion of methane to other hydrocarbons occurs. No other instrument senses this region. The near-equatorial samples are also important for mission operations because they give a measure of the density of the atmosphere where the orbiter will sample in the final five orbits. Previous UV occultations in this region showed expansion of the atmosphere until about 2011 and a small amount of shrinkage after that time. If the atmosphere is too dense when the orbiter enters it will tumble. If too rarefied the INMS instrument will not obtain a good in situ measure of the constituents.

Notes

- Pointing:
  - Original downlink secondary was CAPS for both passes. The turns to the downlink secondaries from the DLWG spreadsheet had FR violations, so I just used an attitude that worked for both OTP and OTB.
  - List periods with NO VALID WAYPOINT
    - Waypoint –Y to Enceladus, -X to NEP is NOT VALID during Enceladus closest approach due to RWA CMT rate violations. However, we will be at the INMS attitude during this time
  - ORS drags (MAPS prime, secondary chosen for ORS)
    - ORS drag during INMS_224EN_ENCEL21001_PIE. Since E21 is targeted, work with Nav to reduce cross-track errors
    - INMS collaborated with CIRS, ISS, and MIMI for pointing during this PIE
  - RBOT: This segment does not use RBOT secondaries because:
    - None available during first observation period
    - Desire to minimize science turn time during second observation period. Have chosen an inertially fixed waypoint.
  - Describe any deleted/shortened PIEs and justification.
    - Plume PIE shortened because it overlapped the downlink.
    - INMS PIE gave 30 minutes to prior ORS observations.
  - The initial waypoint turn has SRU violations, but the preceding downlink is non-rolling, and it is a short turn, so there should be sufficient time for an SID_Suspend.

Notes

- Data Volume:
  - No issues

- DSN:
  - ap_downlink report check warnings:
    - SP_224EA_C70METOTP301_PRIME has an usual gap time. Disposition: This PRIME only covers the first 3 hours of the track, and the OTM will take place over the second downlink pass.
    - 70m usage for sequence exceeds project commitment. Disposition: work at sequence level
    - Number of seq upload passes is 0; should be 5 or more. Disposition: work at sequence level
  - OTP301 is a split pass. It was originally a 9-hour 70m pass. I kept the 70m time for the first 3 hours for data, then I downlink via a 34m pass. The 34m pass is a full 9 hours for NAV.
  - OTB302 was originally 34m, but I upgraded to 70m for data (justification is that this is a targeted flyby segment)

- Resource checker warnings:
  - SP_224EA_C70METOTP301_PRIME: OTP Downlink Pass Playback gap is not 01:22:00
    - Disposition: The C70 only covers the first three hours. The playback gap is implemented in SP_224_EA_C34BWGOTP301_PRIME
  - SP_224EA_C70METOTP301_PRIME: Downlink containing prime OTM is rolling for more than four hours
    - Disposition: This PRIME is marked as 'Rolling', but since the pass is only 3 hours, the roll will be 2:26, which meets OTM requirements
  - CIRS_224EN_ENCEL21001_INMS: Rider request start/end times are inconsistent with PRIME.
  - ISS_224EN_ENCEL21001_INMS: Rider request start/end times are inconsistent with PRIME.
    - Dispositions: This was done on purpose, both because the rider time of interest is shorter, and for data volume

INMS PIE Details

- E21 is the final Enceladus observation for INMS and the last chance to resolve some of the open questions from analysis of previous flybys. One of our main objectives is to use INMS' open source neutral beaming mode to constrain estimates of H2. INMS' open source, however, has a narrow field of view so we would like to adjust our pointing to -X to Enceladus SC Ram with an offset of (0, 0, 3 deg). Due to the low sun angle, heating accumulates quickly at this attitude and we have shortened our CA observation to only CA-7:00 to CA+10:00. Even after shortening the amount of time with –X to SC_Ram, considerable heating remains, 15K heating for CIRS and 11.6K for VIMS.
- Updated INMS design:
  - CA-1:52:43 (13:30:00) +X to Corotation offset (0, 0, –40 deg), +Z to Saturn North Pole Direction
  - CA-0:41:05 turn to +X to Corotation, -Y to RA/DEC 116.8/41.7 (ORS secondary)
  - CA-0:23:05 turn to –X to Enceladus_SC_Ram offset (0, 0, 3 deg), -Y to 116.8/41.7
  - CA-0:07:00 turn complete
  - CA+0:10:00 turn to +X to Corotation, -Y to 116.8/41.7
  - CA+0:25:00 turn complete
  - CA+2:37:17 (18:00:00) end of observation
- https://cassini.jpl.nasa.gov/tools/index.php?q=file_exchange/dl/data/data/INMS_E224_ENCEL_PIE_2015-02-19.xfr
- https://cassini.jpl.nasa.gov/tools/index.php?q=file_exchange/dl/data/data/INMS_E224_ENCEL_PIE_2015-02-19.sasf
- PDT notes & Waivers:
  - The flyby is very fast relative to Enceladus and the turn to and from Enceladus SC RAM incurs heating, so we request using the faster RWA turn rates for <60 degree turns even though the turns are greater than 60 degrees (FR07D145).
  - There are a number of SRU violations
  - CIRS/VIMS waivers requested for heating

Liens

Sequence Liens (should all be SPLAT items):

- List any Liens to be worked in SIP,
  - INMS will need a waiver from CIRS and VIMS for heating during INMS_224EN_ENCEL21001_PIE, and also a waiver for fast turn rates. This is not currently a SPLAT item