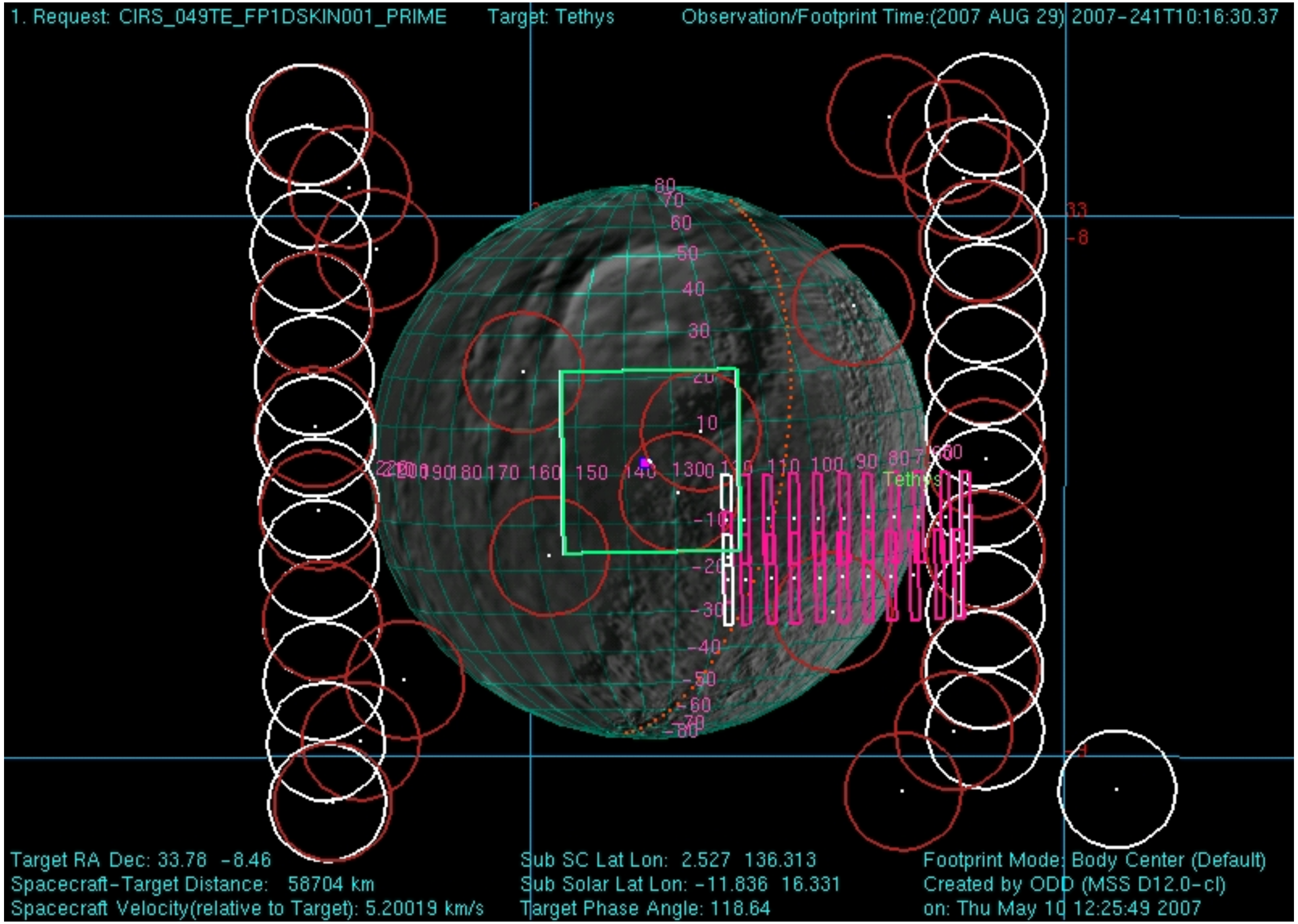
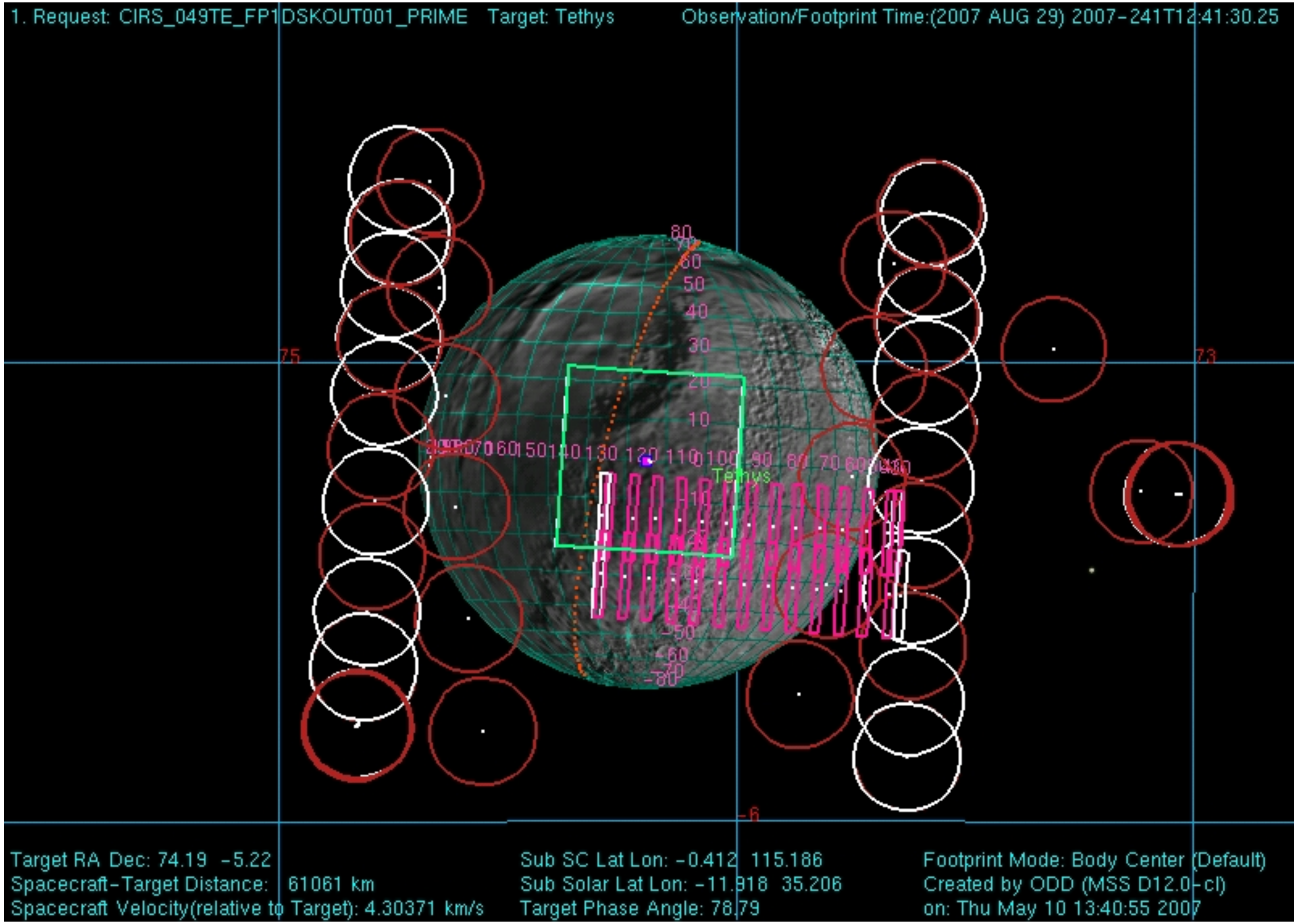
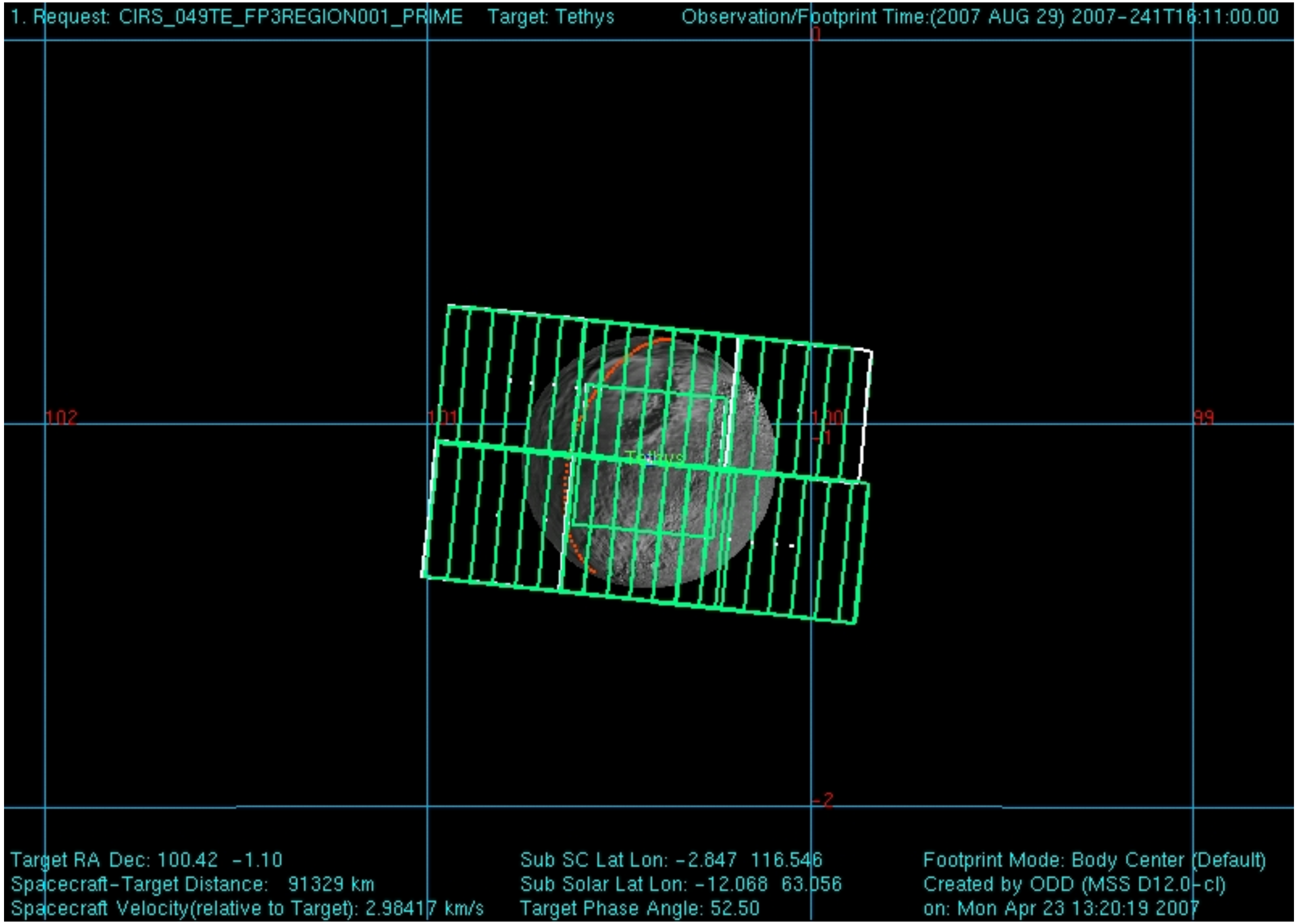
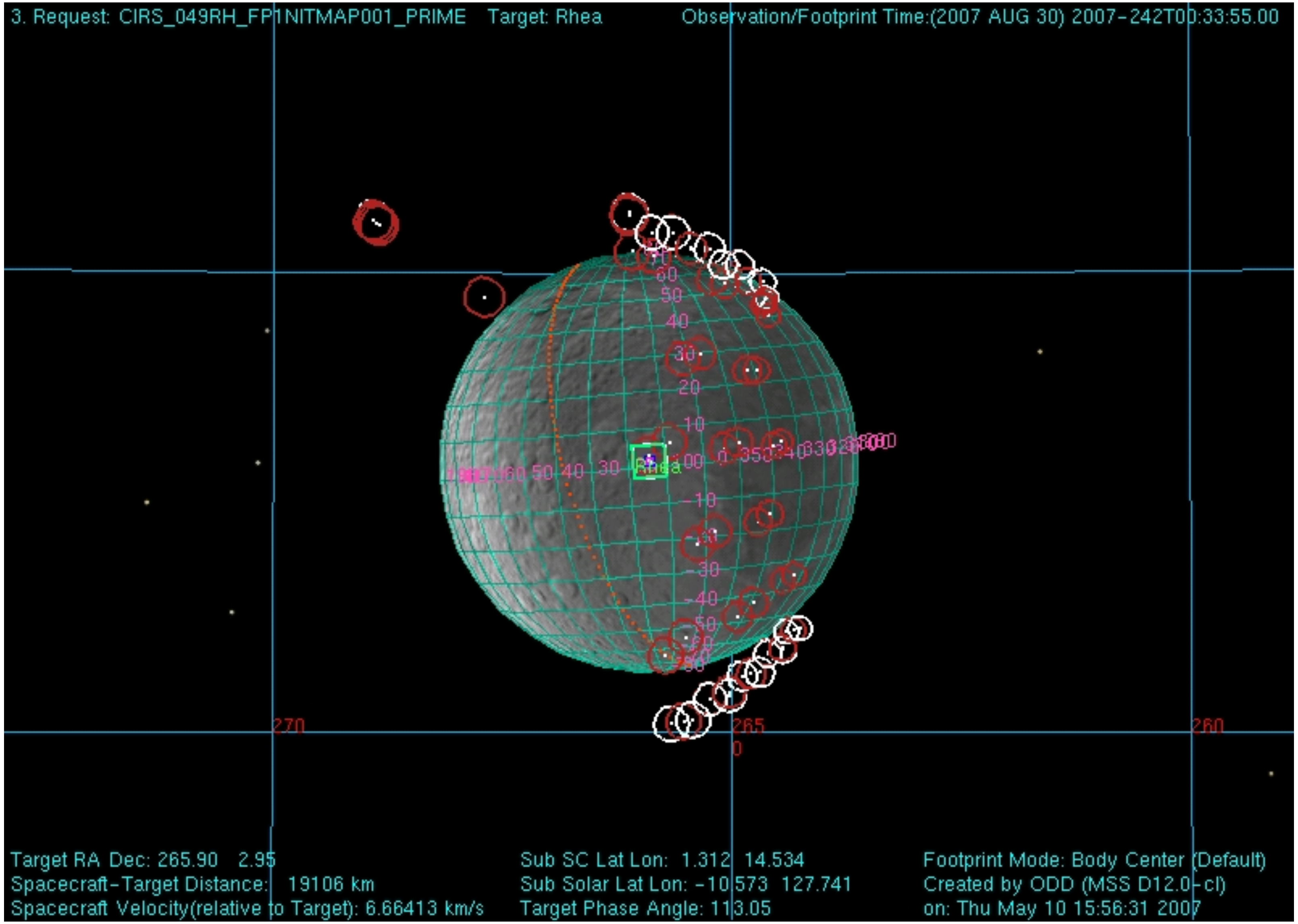
S33: Rhea and Iapetus

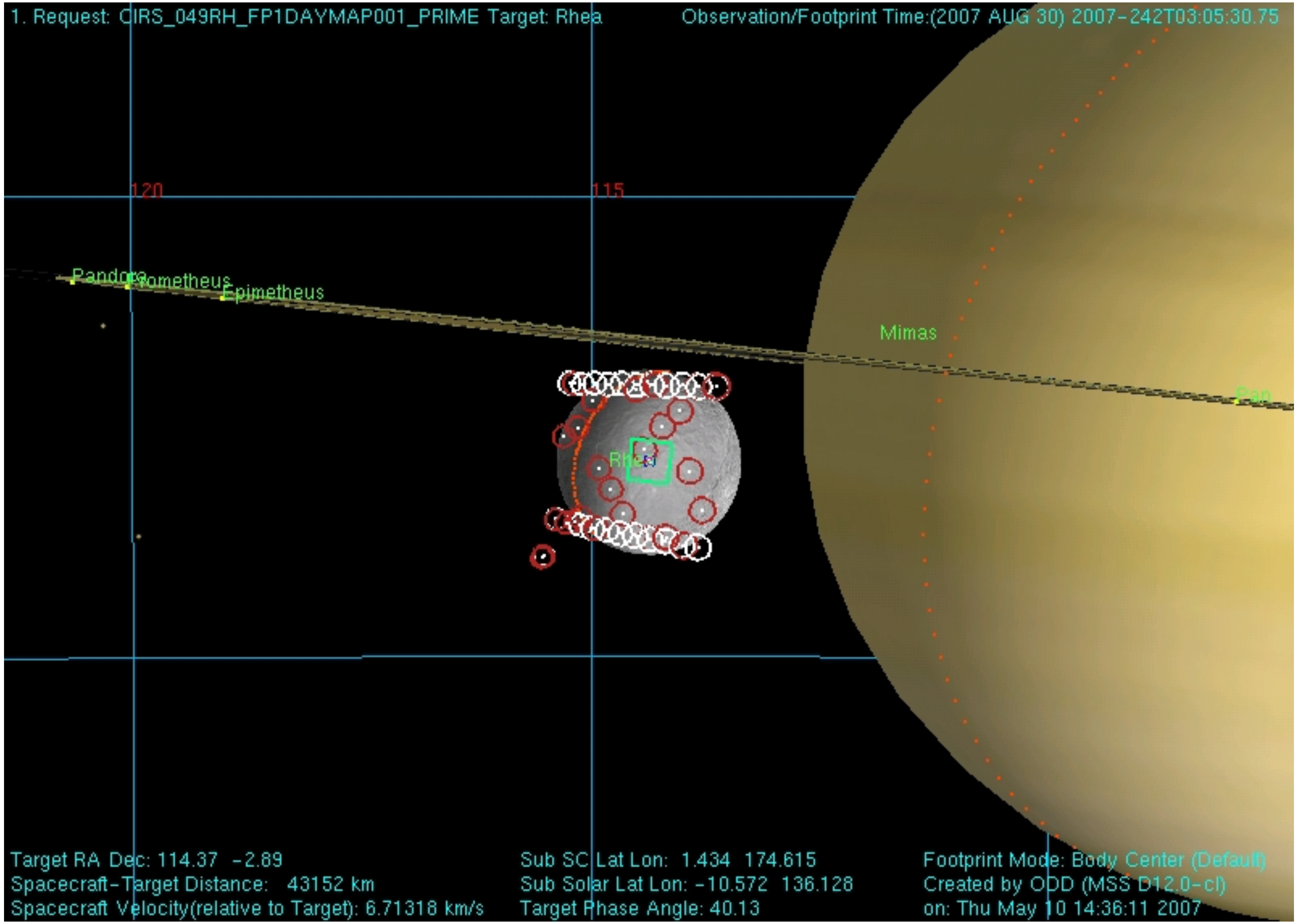
Key Tethys and Rhea mosaic designs and Iapetus preview

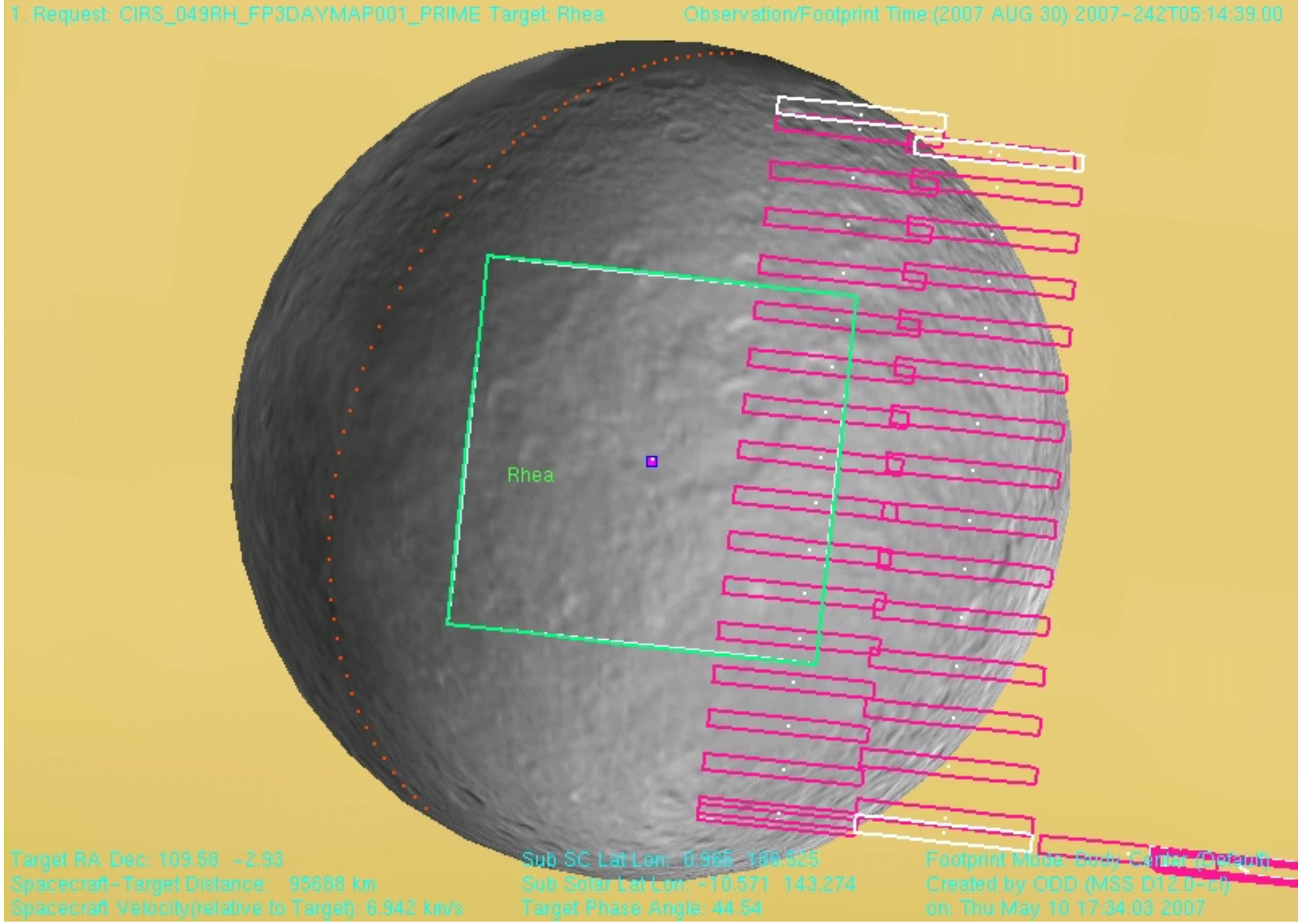

1. Request: CIRS_049TE_FP1DSKIN001_PRIME
Target: Tethys
Observation/Footprint Time:(2007 AUG 29) 2007-241T10:16:30.37
Tethys
Target RA Dec: 33.78 -8.46
Spacecraft-Target Distance: 58704 km
Spacecraft Velocity(relative to Target): 5.20019 km/s
Sub SC Lat Lon: 2.527 136.313
Sub Solar Lat Lon: -11.836 16.331
Target Phase Angle: 118.64
Footprint Mode: Body Center (Default)
Created by ODD (MSS D12.0-cl)
on: Thu May 10 12:25:49 2007

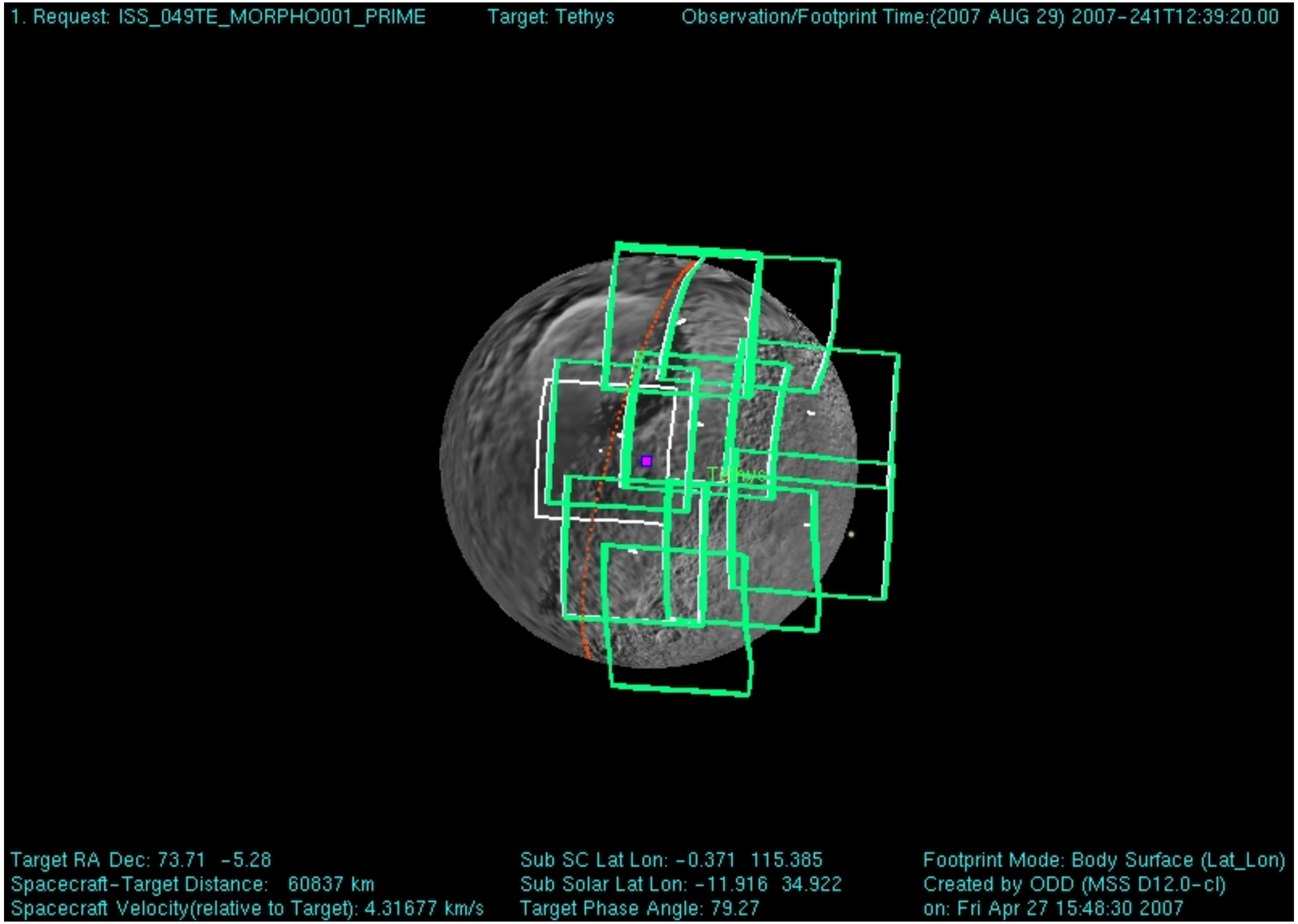

1. Request: CIRS_049TE_FP1DSKOUT001_PRIME Target: Tethys
Observation/Footprint Time:(2007 AUG 29) 2007-241T12:41:30.25
Tethys
Target RA Dec: 74.19 -5.22
Spacecraft-Target Distance: 61061 km
Spacecraft Velocity(relative to Target): 4.30371 km/s
Sub SC Lat Lon: -0.412 115.186
Sub Solar Lat Lon: -11.918 35.206
Target Phase Angle: 78.79
Footprint Mode: Body Center (Default)
Created by ODD (MSS D12.0-cl)
on: Thu May 10 13:40:55 2007

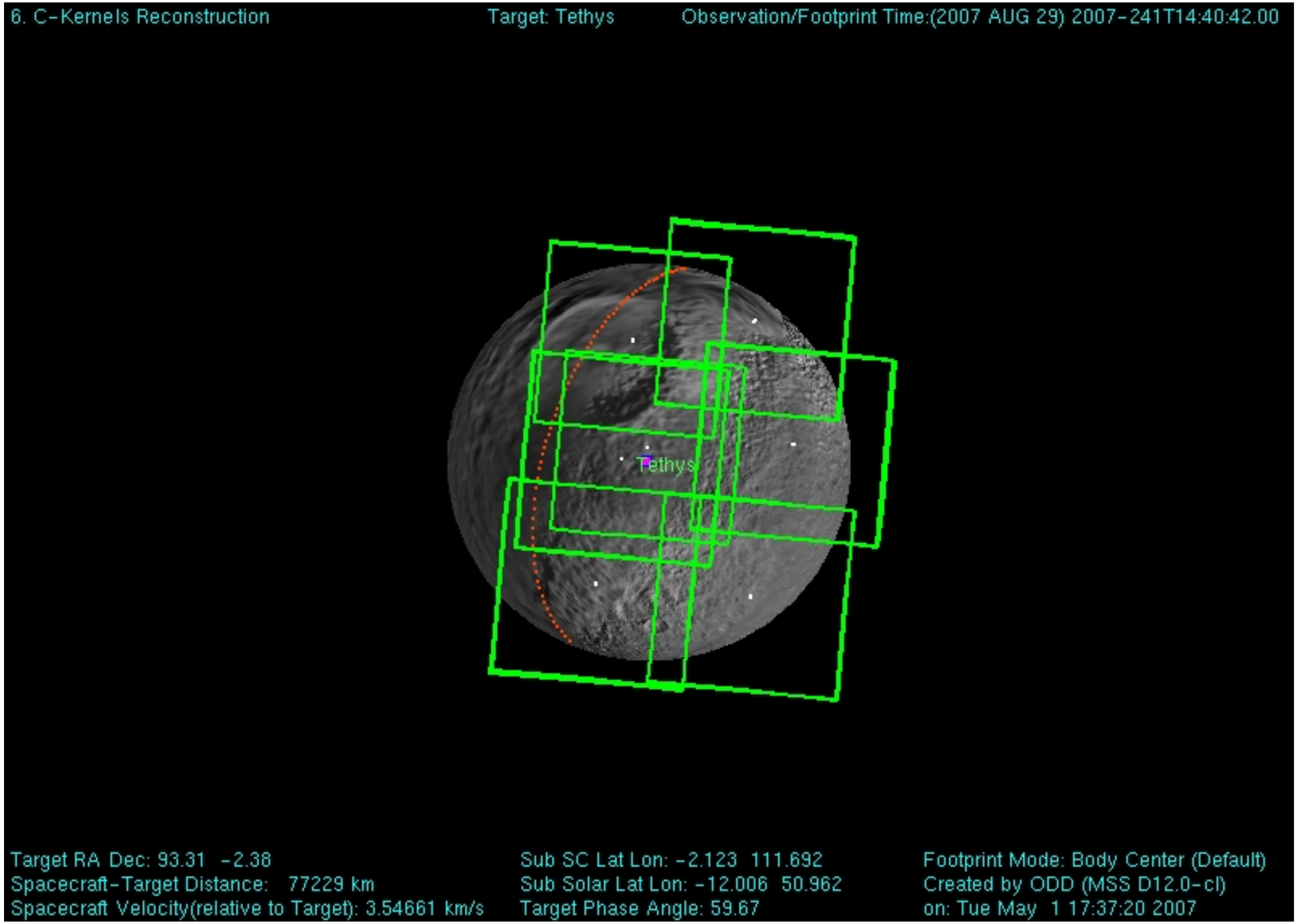

1. Request: CIRS_049TE_FP3REGION001_PRIME
Target: Tethys
Observation/Footprint Time:(2007 AUG 29) 2007-241T16:11:00.00
0
102
101
100
99
-1
-2
Tethys
Target RA Dec: 100.42 -1.10
Spacecraft-Target Distance: 91329 km
Spacecraft Velocity(relative to Target): 2.98417 km/s
Sub SC Lat Lon: -2.847 116.546
Sub Solar Lat Lon: -12.068 63.056
Target Phase Angle: 52.50
Footprint Mode: Body Center (Default)
Created by ODD (MSS D12.0-cl)
on: Mon Apr 23 13:20:19 2007


3. Request: CIRS_049RH_FP1NITMAP001_PRIME Target: Rhea
Observation/Footprint Time:(2007 AUG 30) 2007-242T00:33:55.00
Rhea
270
265
260
Target RA Dec: 265.90 2.95
Spacecraft-Target Distance: 19106 km
Spacecraft Velocity(relative to Target): 6.66413 km/s
Sub SC Lat Lon: 1.312 14.534
Sub Solar Lat Lon: -10.573 127.741
Target Phase Angle: 113.05
Footprint Mode: Body Center (Default)
Created by ODD (MSS D12.0-cl)
on: Thu May 10 15:56:31 2007

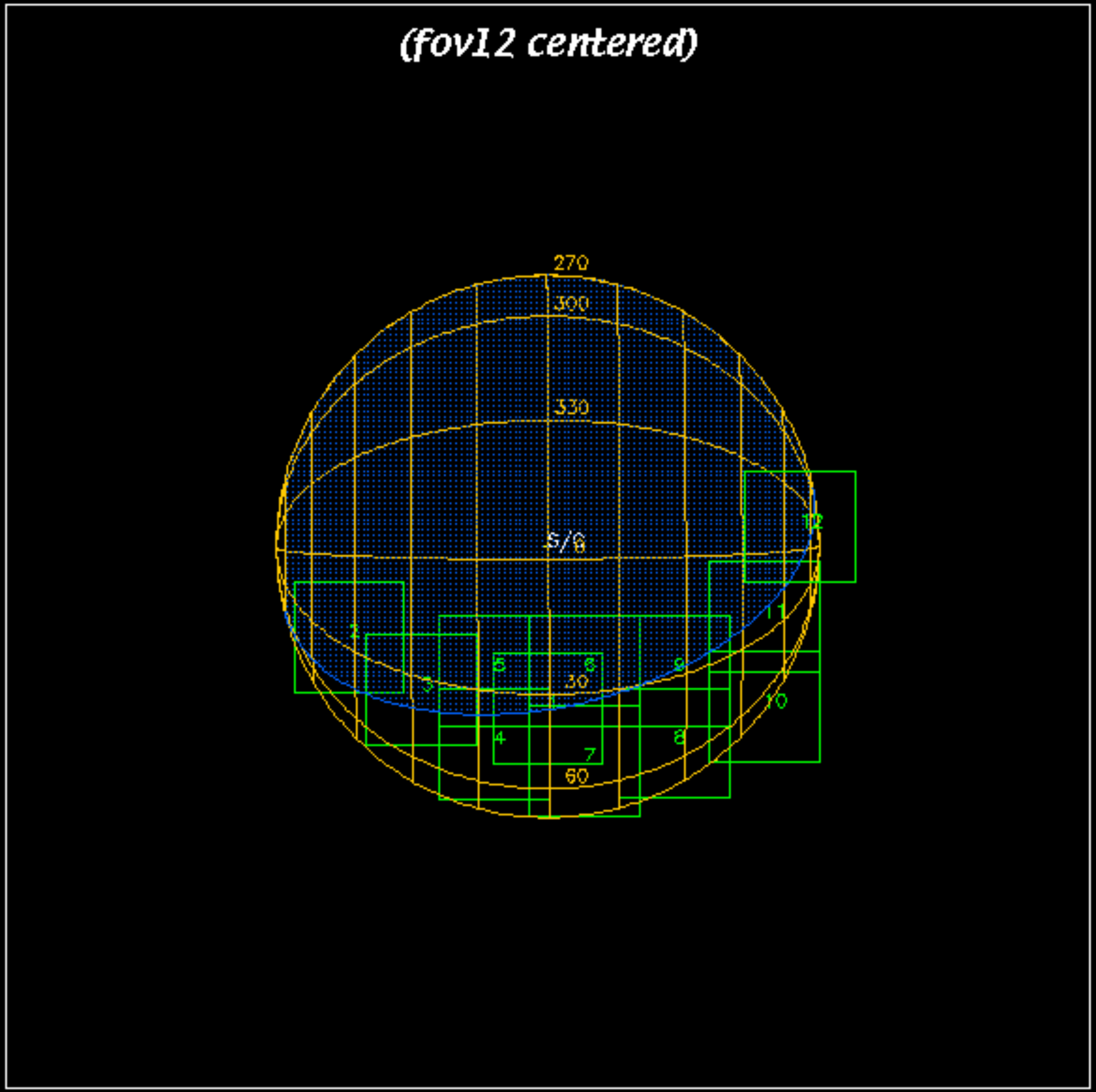

1. Request: CIRS_049RH_FP1DAYMAP001_PRIME Target: Rhea
Observation/Footprint Time:(2007 AUG 30) 2007-242T03:05:30.75
120
115
Pandora
Prometheus
Epimetheus
Mimas
Pan
Rhea
Target RA Dec: 114.37 -2.89
Spacecraft-Target Distance: 43152 km
Spacecraft Velocity(relative to Target): 6.71318 km/s
Sub SC Lat Lon: 1.434 174.615
Sub Solar Lat Lon: -10.572 136.128
Target Phase Angle: 40.13
Footprint Mode: Body Center (Default)
Created by ODD (MSS D12.0-cl)
on: Thu May 10 14:36:11 2007


1. Request: CIRS_049RH_FP3DAYMAP001_PRIME Target: Rhea
Observation/Footprint Time:(2007 AUG 30) 2007-242T05:14:39.00
Rhea
Target RA Dec: 109.58 -2.93
Spacecraft-Target Distance: 95688 km
Spacecraft Velocity(relative to Target): 6.942 km/s
Sub Solar Lat Lon: -10.571 143.274
Target Phase Angle: 44.54
Created by ODD (MSS D12.0-cl)
on: Thu May 10 17:34:03 2007

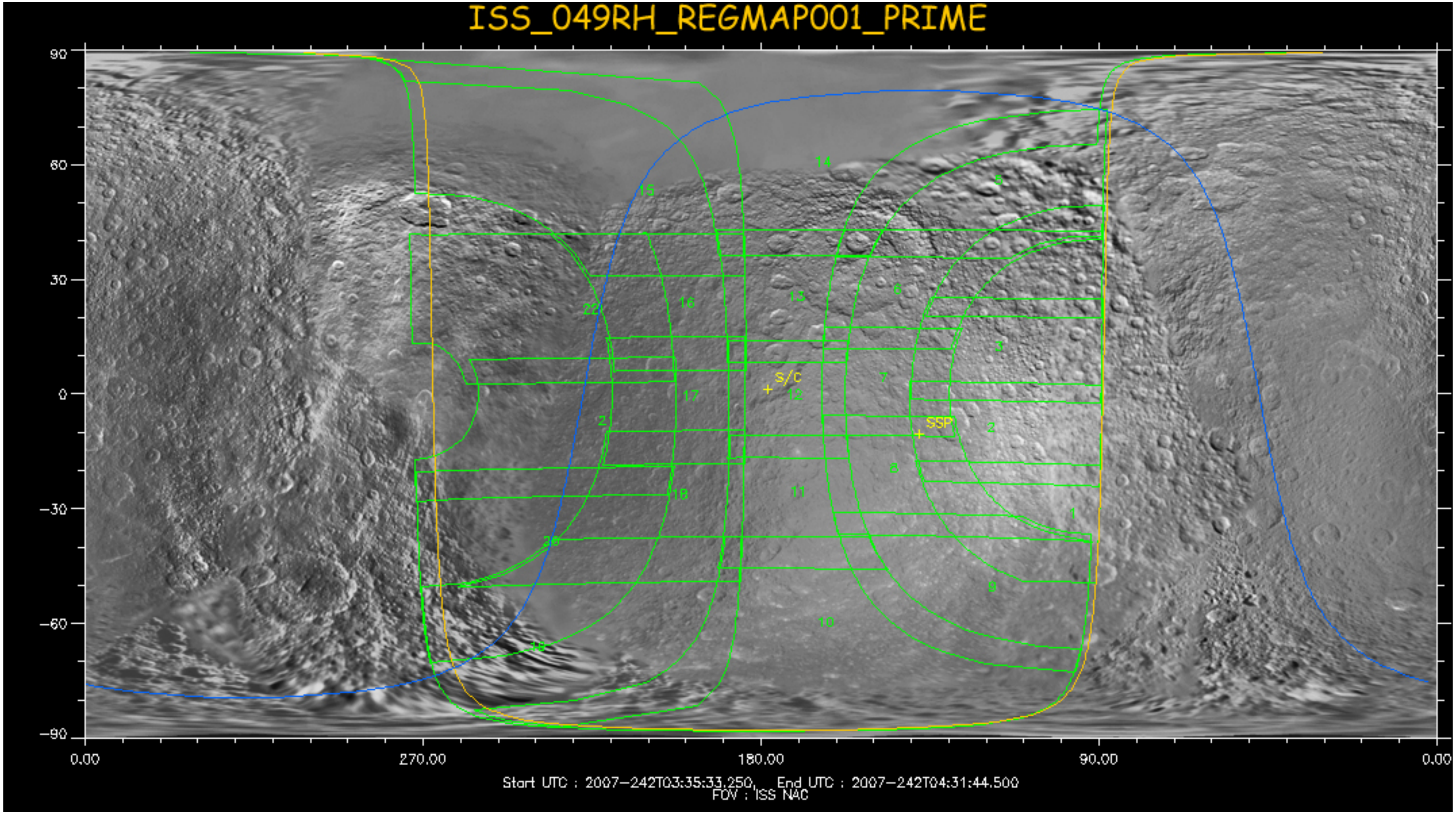

1. Request: ISS_049TE_MORPHO001_PRIME
Target: Tethys
Observation/Footprint Time:(2007 AUG 29) 2007-241T12:39:20.00
Tethys
Target RA Dec: 73.71 -5.28
Spacecraft-Target Distance: 60837 km
Spacecraft Velocity(relative to Target): 4.31677 km/s
Sub SC Lat Lon: -0.371 115.385
Sub Solar Lat Lon: -11.916 34.922
Target Phase Angle: 79.27
Footprint Mode: Body Surface (Lat_Lon)
Created by ODD (MSS D12.0-cl)
on: Fri Apr 27 15:48:30 2007

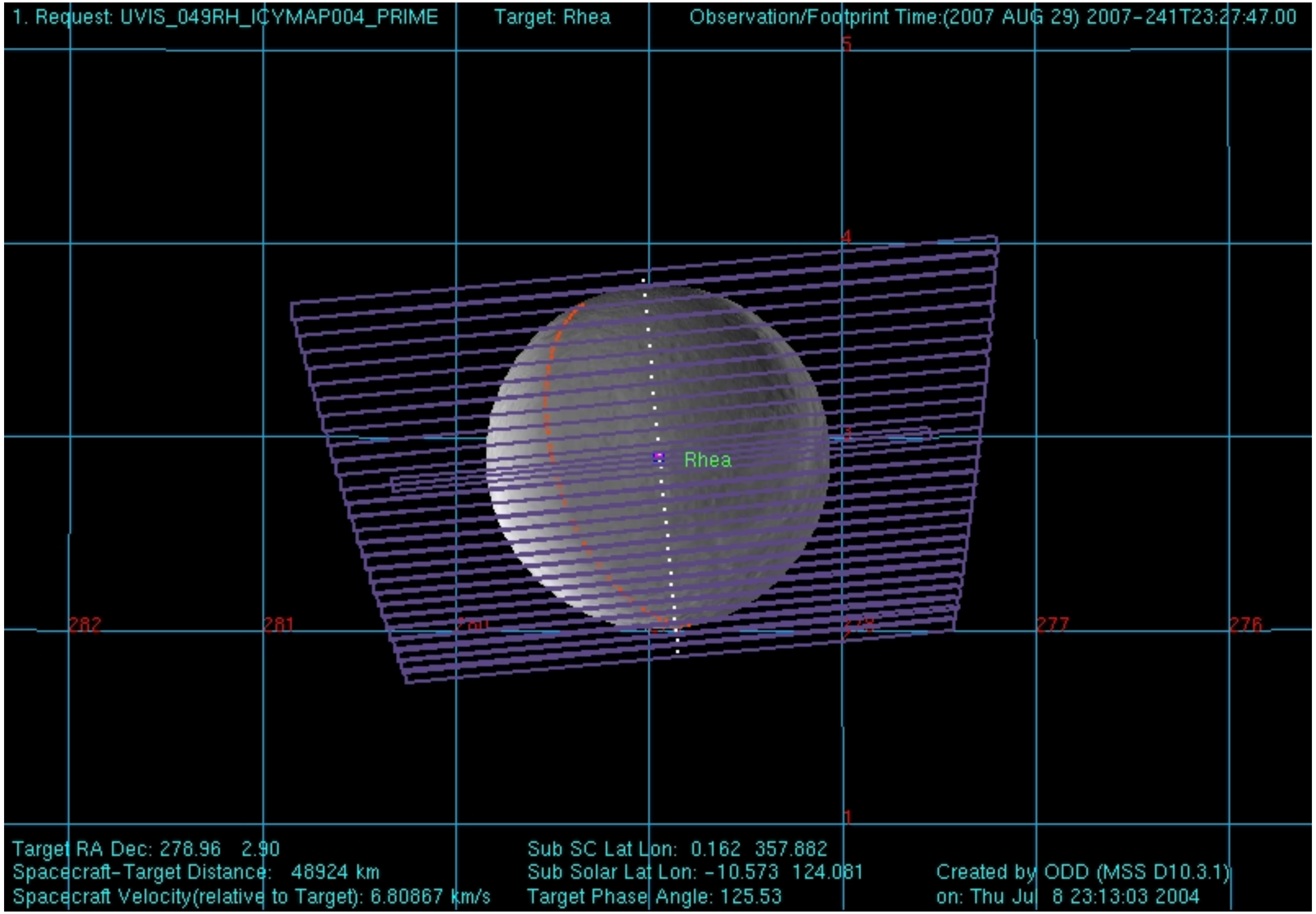

6. C-Kernels Reconstruction
Target: Tethys
Observation/Footprint Time:(2007 AUG 29) 2007-241T14:40:42.00
Tethys
Target RA Dec: 93.31 -2.38
Spacecraft-Target Distance: 77229 km
Spacecraft Velocity(relative to Target): 3.54661 km/s
Sub SC Lat Lon: -2.123 111.692
Sub Solar Lat Lon: -12.006 50.962
Target Phase Angle: 59.67
Footprint Mode: Body Center (Default)
Created by ODD (MSS D12.0-cl)
on: Tue May 1 17:37:20 2007

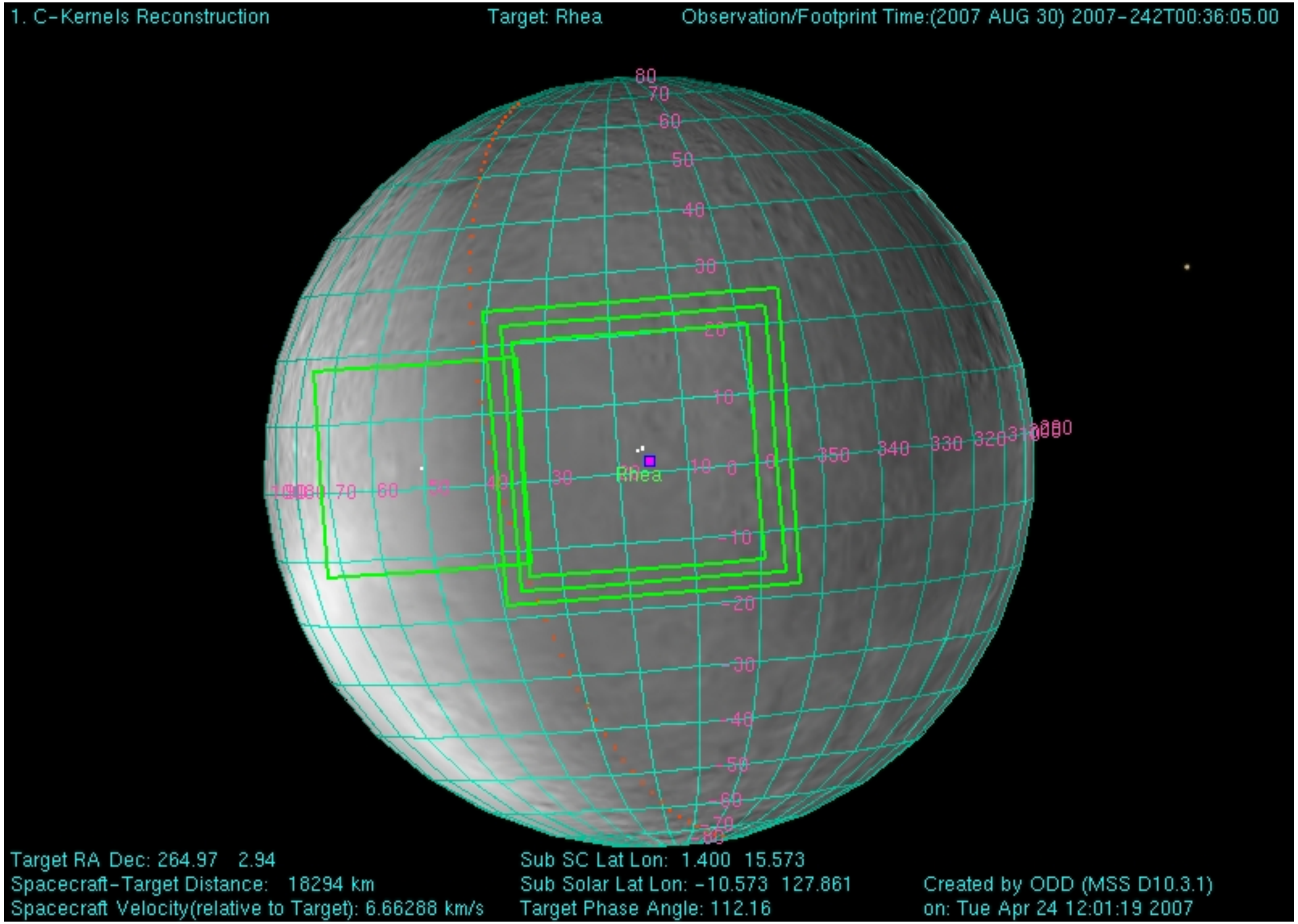
ISS_049RH_CRESCENT001



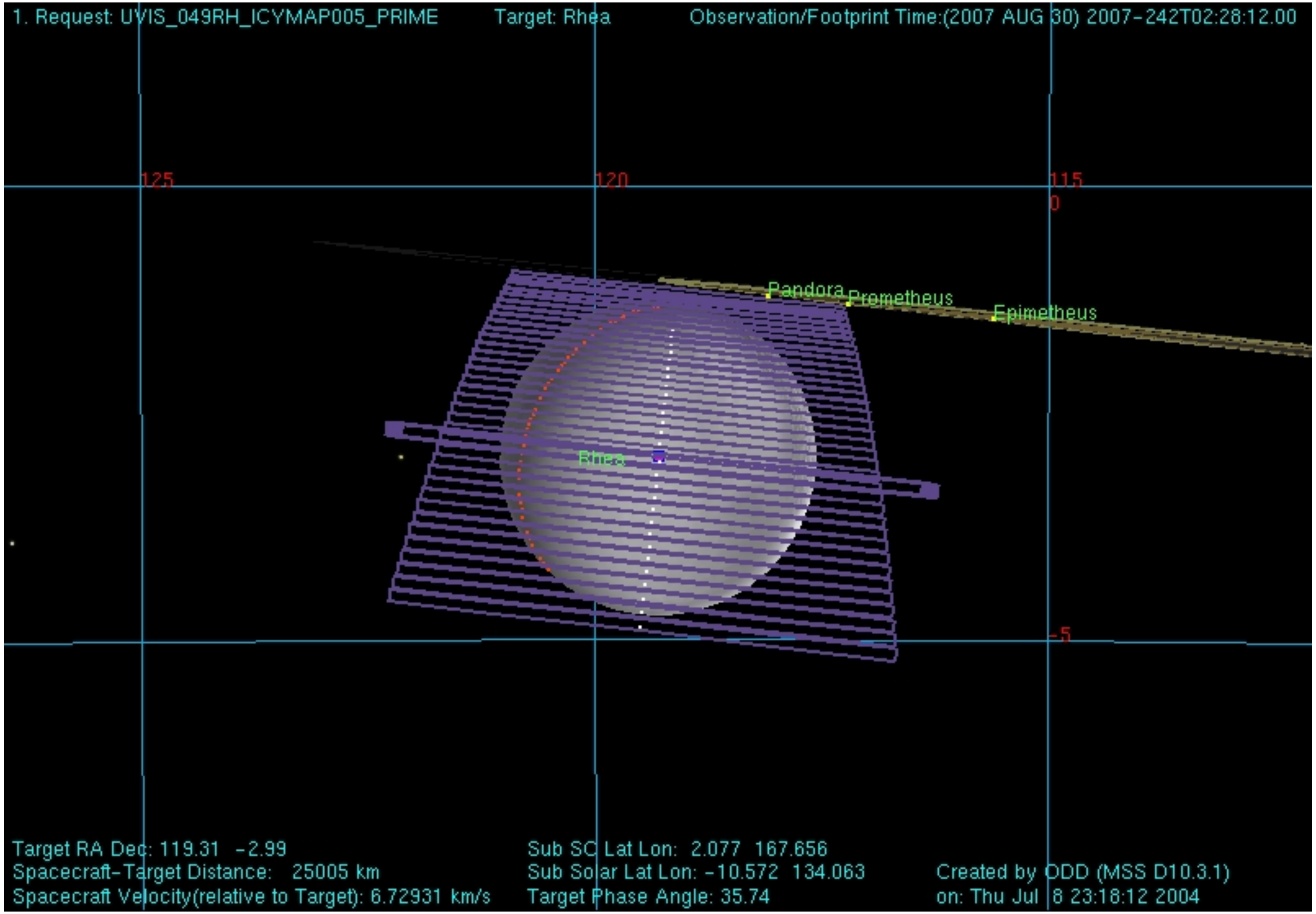
Start UTC : 2007-241T22:43:25.370, End UTC : 2007-241T23:23:10.620
FOV : ISS NAC


ISS_049RH_REGMAP001_PRIME
90
60
30
0
-30
-60
-90
0.00
270.00
180.00
90.00
0.00
S/C
SSP
Start UTC : 2007-242T03:35:33.250, End UTC : 2007-242T04:31:44.500
FOV : ISS NAC


1. Request: UVIS_049RH_ICYMAP004_PRIME
Target: Rhea
Observation/Footprint Time:(2007 AUG 29) 2007-241T23:27:47.00
Rhea
282
281
277
276
Target RA Dec: 278.96 2.90
Spacecraft-Target Distance: 48924 km
Spacecraft Velocity(relative to Target): 6.80867 km/s
Sub SC Lat Lon: 0.162 357.882
Sub Solar Lat Lon: -10.573 124.081
Target Phase Angle: 125.53
Created by ODD (MSS D10.3.1)
on: Thu Jul 8 23:13:03 2004



1. C-Kernels Reconstruction
Target: Rhea
Observation/Footprint Time:(2007 AUG 30) 2007-242T00:36:05.00
Rhea
Target RA Dec: 264.97 2.94
Spacecraft-Target Distance: 18294 km
Spacecraft Velocity(relative to Target): 6.66288 km/s
Sub SC Lat Lon: 1.400 15.573
Sub Solar Lat Lon: -10.573 127.861
Target Phase Angle: 112.16
Created by ODD (MSS D10.3.1)
on: Tue Apr 24 12:01:19 2007


1. Request: UVIS_049RH_ICYMAP005_PRIME
Target: Rhea
Observation/Footprint Time:(2007 AUG 30) 2007-242T02:28:12.00
125
120
115
0
-5
Pandora
Prometheus
Epimetheus
Rhea
Target RA Dec: 119.31 -2.99
Spacecraft-Target Distance: 25005 km
Spacecraft Velocity(relative to Target): 6.72931 km/s
Sub SC Lat Lon: 2.077 167.656
Sub Solar Lat Lon: -10.572 134.063
Target Phase Angle: 35.74
Created by ODD (MSS D10.3.1)
on: Thu Jul 8 23:18:12 2004

The Rev 049 Iapetus flyby: Scientific goals

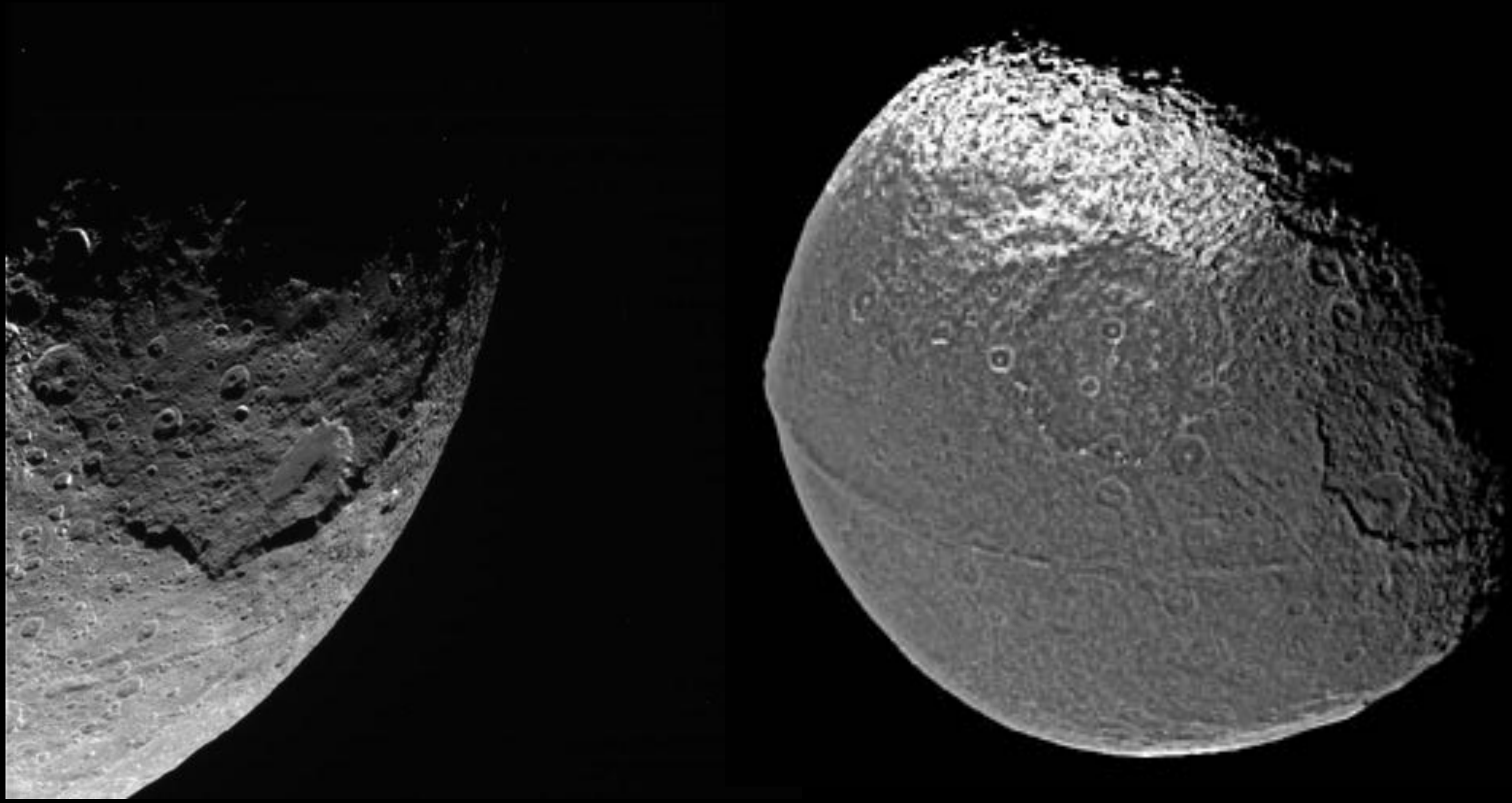
B. Buratti, A. Hendrix, R. Lopes

SOST Preview

August 24, 2007

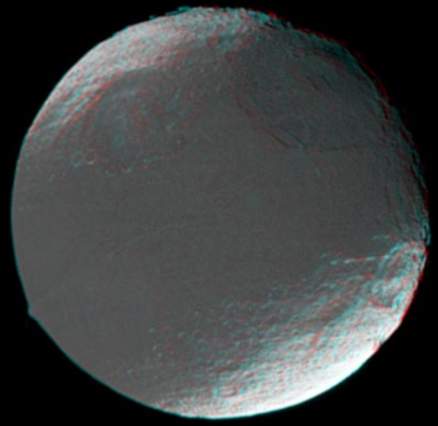
Tilmann Denk graphics

Main results so far



- Deposit seems to be exogenic, but altered by thermal processes
- “Belly band” around equator
- Lack of fresh craters on dark side implies deposition may be ongoing
- Shape consistent with 17 hour rotation; early heating with short-lived radionuclides
- Organics, including PAHs, identified
- CO_2 identified

Main questions



- Does the “belly band” go all around the satellite? Are the “mountains” seen by Voyager part of the belly band?
- How deep is the dark material? Is it fresh? Is the deposition ongoing?
- What is the identity, distribution, and nature of the complex organics?
- What do the dark deposits in the bright material look like?
- What is the morphology of the bright-dark boundary up close?
- What does the relatively bright trailing hemisphere look like up close? Will we discover previously-unseen dark regions within the bright terrain?
- What are the relative ages of the two main terrains? Are there textural differences?

UVIS Science at Iapetus

C. J. Hansen, A. Hendrix

24 August 2007

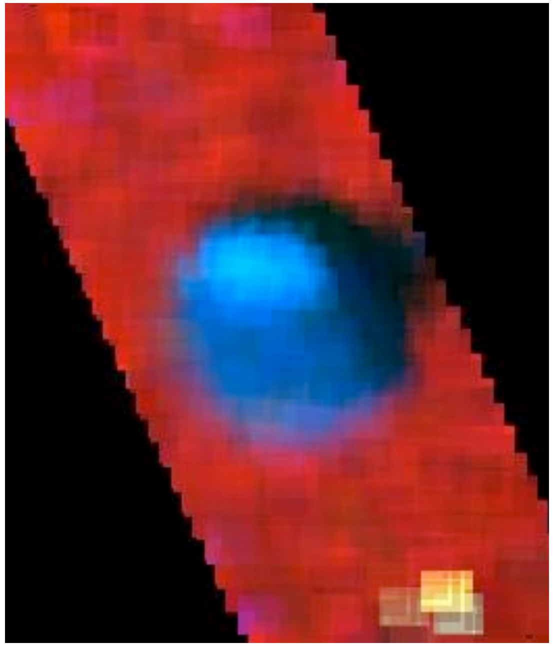
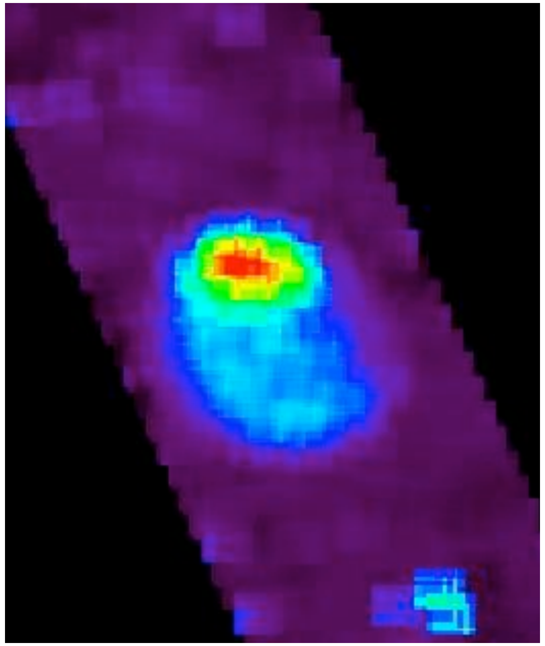
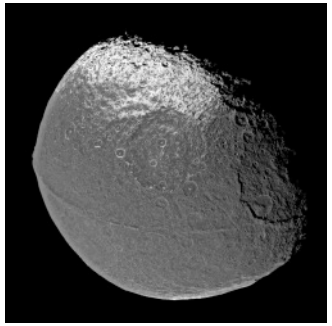
Iapetus Science Questions

- The dramatic albedo difference between the dark and bright sides of Iapetus has been attributed to endogenic or exogenic processes – but which is it? Is Iapetus sweeping up dark material coming from Phoebe or Hyperion?
- How similar is the composition of the dark side of Iapetus to Phoebe? To Hyperion?
- What is the distribution of water on Iapetus' surface? How do the dark and bright sides of Iapetus compare?
- Does Iapetus have a tenuous atmosphere?

What do we know now, from the Rev 00C flyby? What do we expect to learn?

The results we are showing today are from A. R. Hendrix and C. J. Hansen, "The Albedo Dichotomy of Iapetus measured at UV Wavelengths", accepted in Icarus (2007)

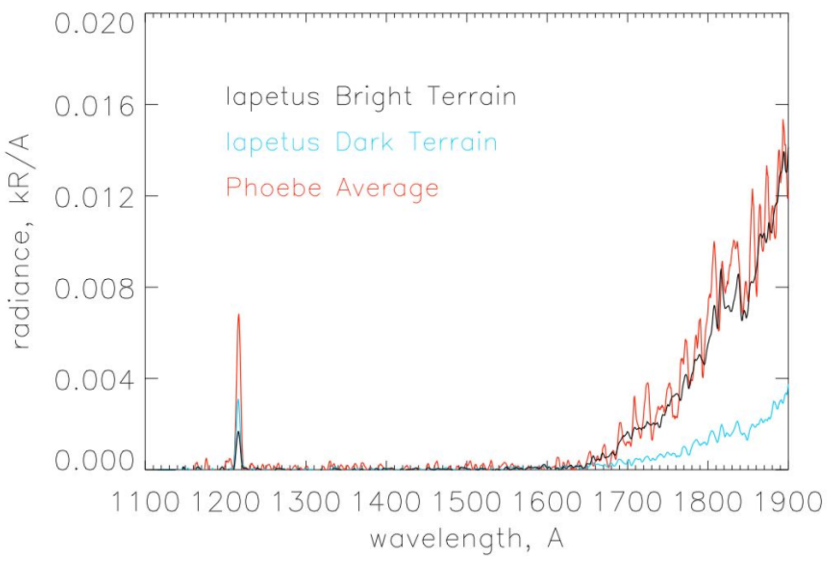
UVIS Views of Iapetus on the Rev 00C Flyby

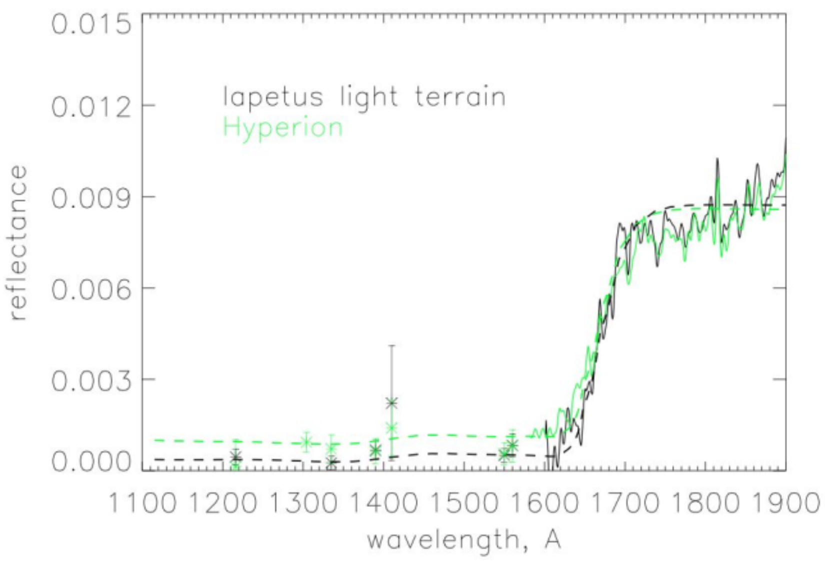




Flyby was primarily on Iapetus' dark side but bright polar region was also imaged

Surface Composition and Volatile Migration

- Is material from Phoebe or Hyperion coating the dark side of Iapetus?
- How similar is the composition of the dark side of Iapetus to Phoebe? To Hyperion?

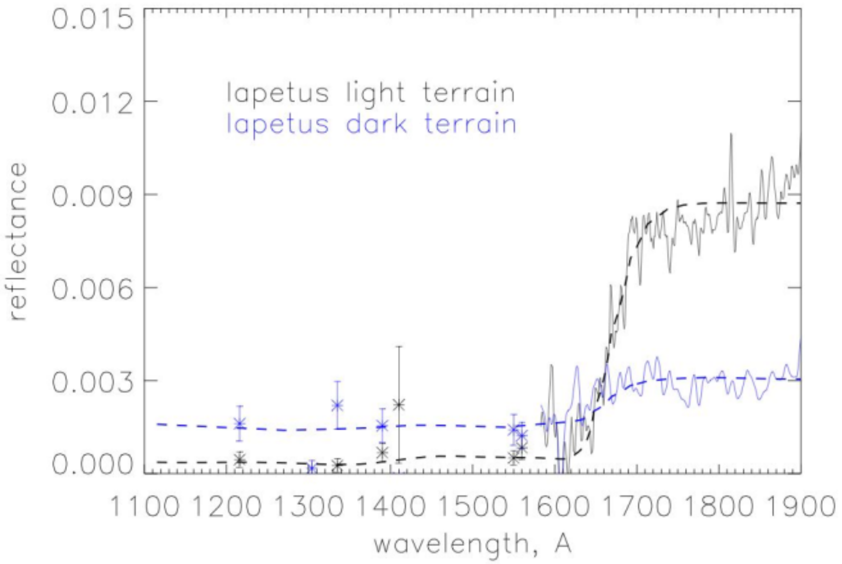




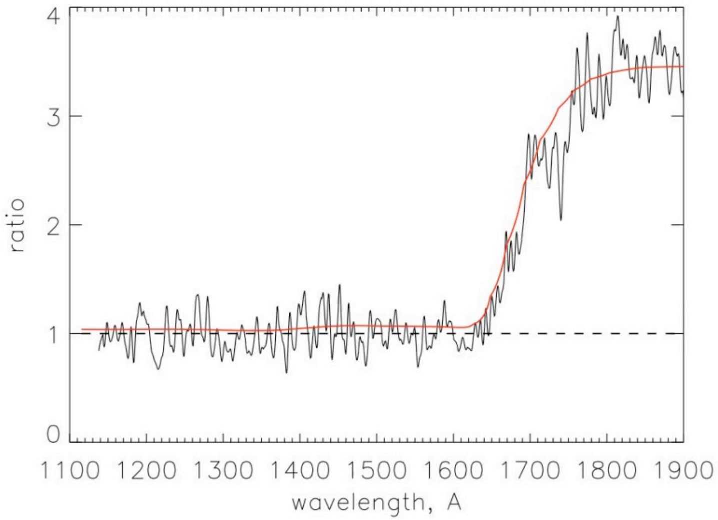
The dark side of Iapetus doesn’t look like Phoebe or Hyperion.

Phoebe and Hyperion spectra are far more similar to the bright side of Iapetus.

Surface Composition and Volatile Migration (cont.)



(a)

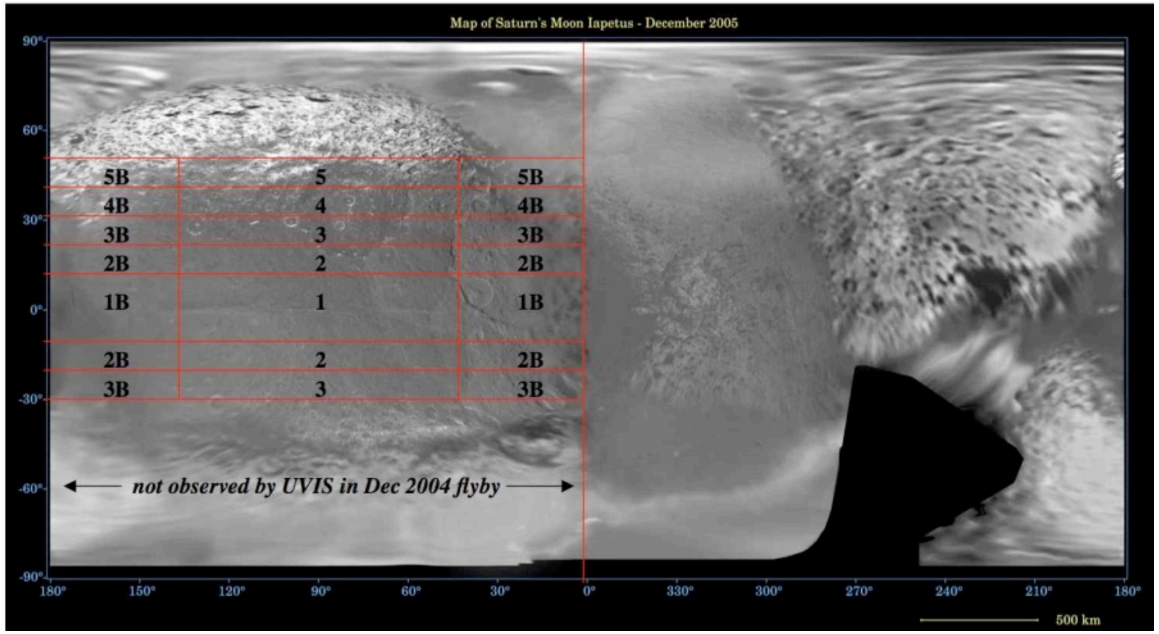


(b)

The big difference between the bright and dark terrains at UV wavelengths is directly attributable to the quantity of water on the surface

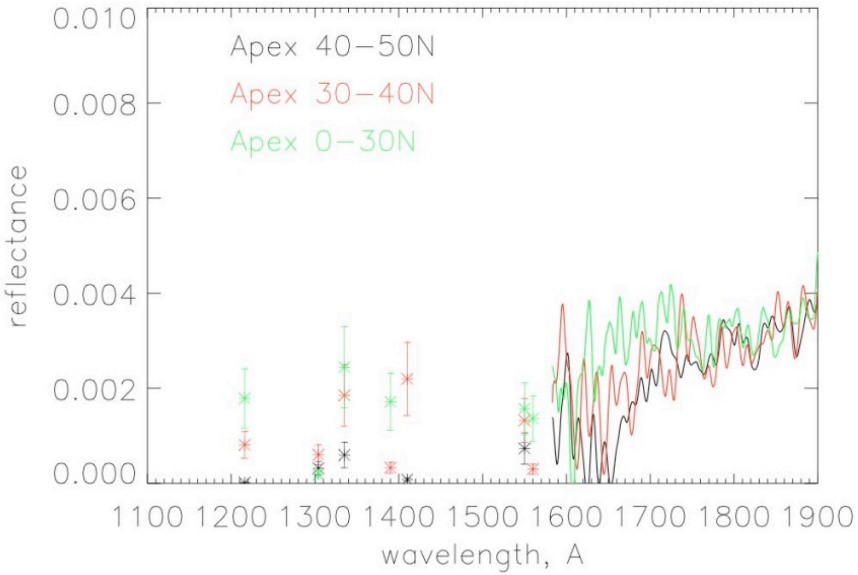
Plot b shows the ratio of the bright to dark terrain, with the spectrum of water over-plotted

Surface Composition and Volatile Migration (cont.)



UVIS data was binned by latitude: 0 - 30 N, 30 - 40 N, and 40 - 50 N

Water is present at even the lowest latitudes, although much reduced in quantity



The bright cold poles will be cold traps for volatiles - the presence of water ice at all implies that the process coating Iapetus’ dark side is ongoing…

Vapor pressure at 110 K = 5.9 x 10^{-14} torr

Vapor pressure at 130 K = 1.8 x 10^{-10} torr

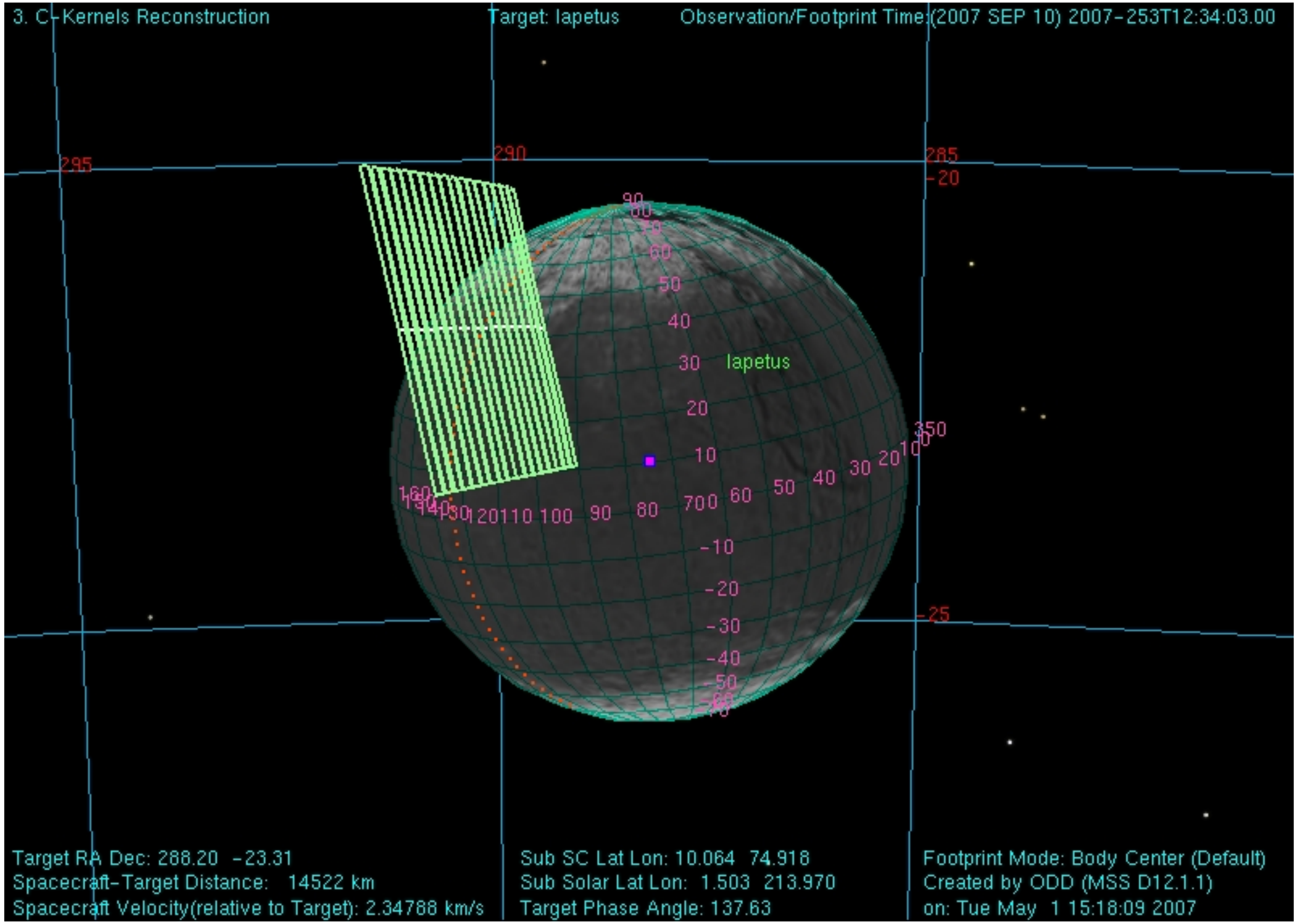
Surface Age and Evolution

General

- The surface albedo of Saturn's icy satellites is affected by radiation darkening and surface chemistry, and thus will vary with the amount of time a surface unit has been exposed to the magnetosphere's radiation and high energy particles. Leading / trailing side asymmetries are expected.
  - Also determined by nature of interactions (e.g. Ganymede's radiation exposure is affected by its own internal magnetic field)
- Surface microstructure will be investigated via the phase function.

Iapetus

- Iapetus, Phoebe and Hyperion all orbit mostly outside Saturn's magnetosphere (except for time in the magnetotail), thus provide the important end cases of primarily exposure to the solar wind
- UVIS uv albedo maps and phase curves will be produced. We will look for uv albedo differences that correlate to geologic ages derived from the imaging data and analyze deviations between our data and crater counts that might suggest more recent modification to the exposed surface skin


3. C-Kernels Reconstruction
Target: Iapetus
Observation/Footprint Time:(2007 SEP 10) 2007-253T12:34:03.00
Iapetus
Target RA Dec: 288.20 -23.31
Spacecraft-Target Distance: 14522 km
Spacecraft Velocity(relative to Target): 2.34788 km/s
Sub SC Lat Lon: 10.064 74.918
Sub Solar Lat Lon: 1.503 213.970
Target Phase Angle: 137.63
Footprint Mode: Body Center (Default)
Created by ODD (MSS D12.1.1)
on: Tue May 1 15:18:09 2007

Tenuous Atmospheres / Exospheres

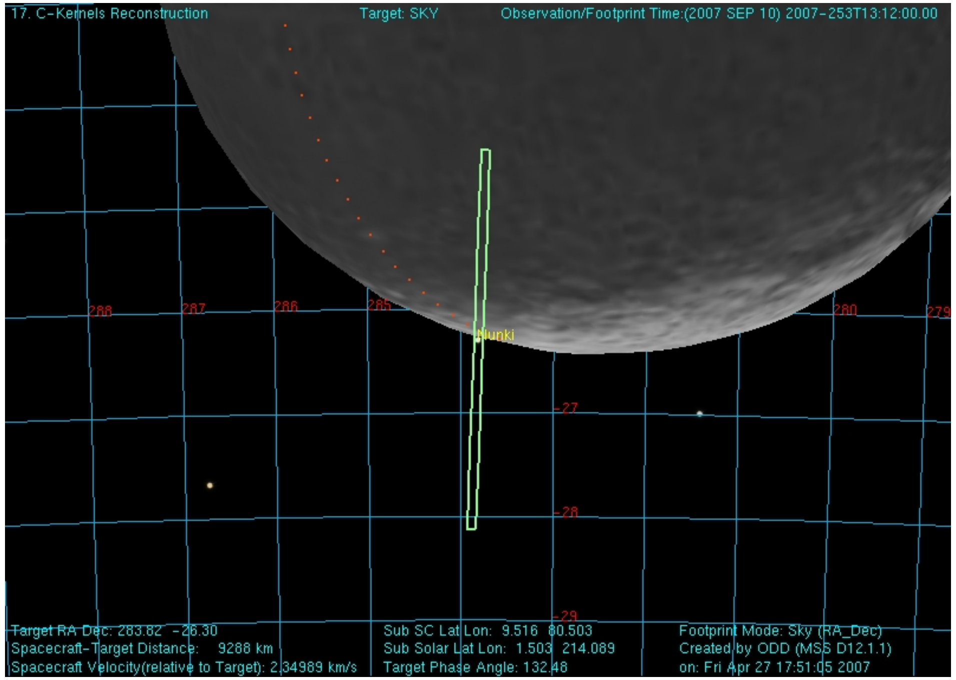
General

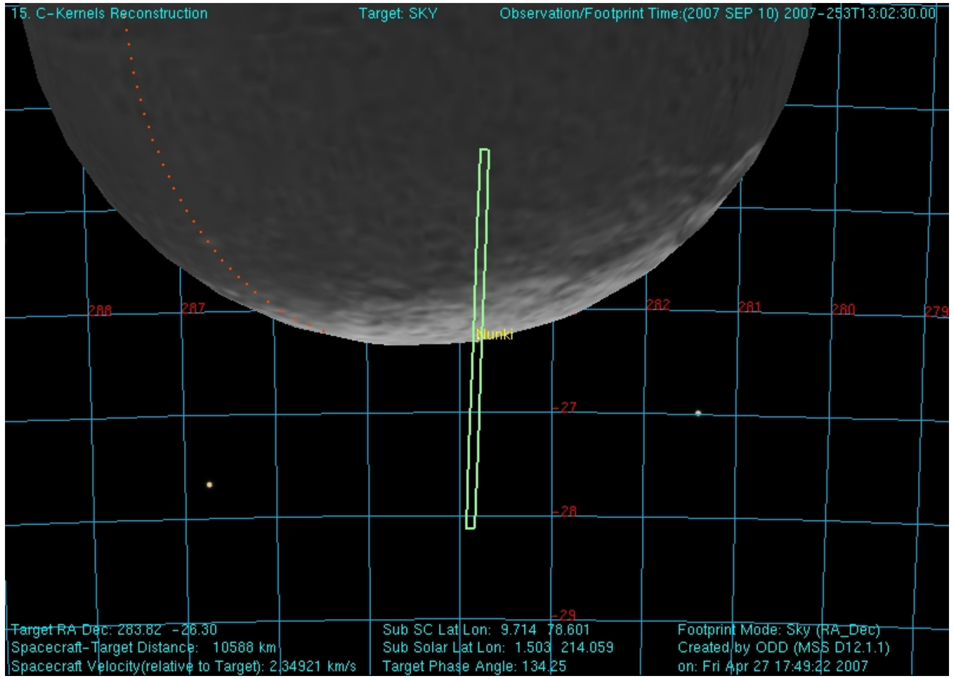
- Molecules are sputtered and sublimated from the surfaces of the icy satellites. By determining the composition of these exospheres we may determine surface composition.
- Gases could be from volatile eruptive activity

Iapetus

- Stellar occultation of sigma Sgr
- UVIS spectra will be examined for emission features such as 130.4 and 135.6 nm (atomic and molecular oxygen), 149.3 nm (atomic nitrogen), etc.

Stellar Occultation of sigma Sgr





Rev. 49 Iapetus: CIRS Preview

John Spencer, John Pearl, Marcia Segura, and the CIRS team

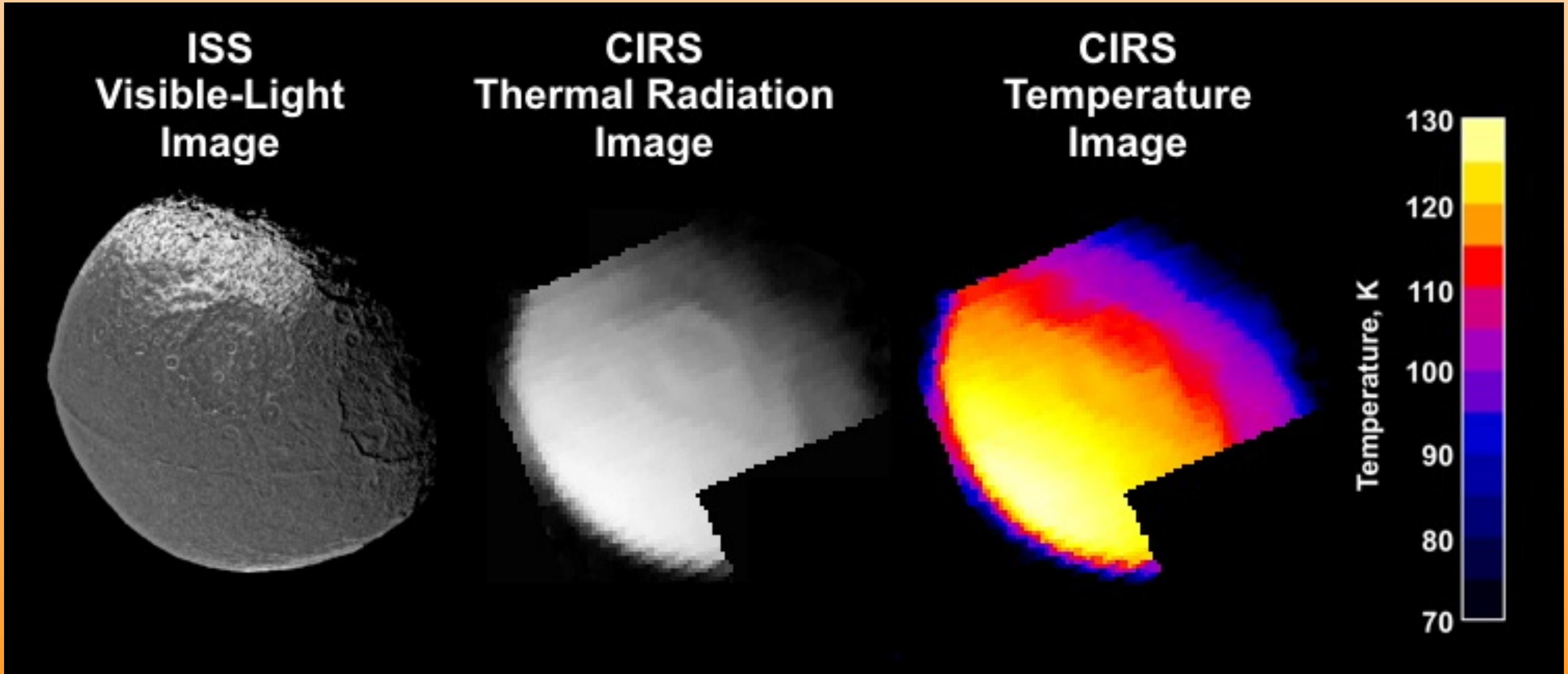
SOST, August 24 2007

Goals

- Daytime and nighttime temperatures of Iapetus to constrain:
  - Thermal inertia
  - Bolometric albedo
  - Volatile stability
  - Etc
- 10 - ~500 μm thermal emission spectra of Iapetus to search for compositionally diagnostic spectral features
- Thermal polarization measurements of Iapetus

New Year 2005 Flyby: Daytime Temperatures

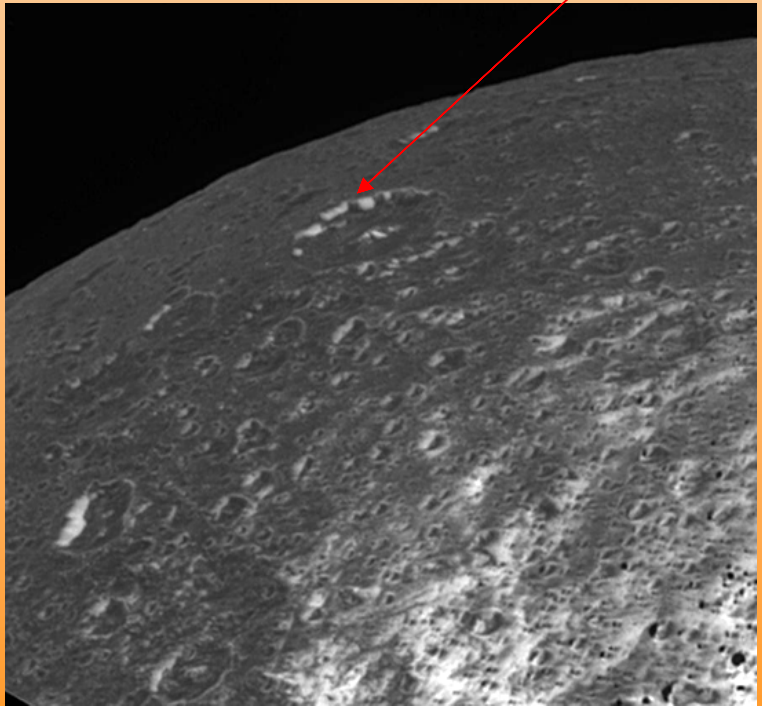
- FP3, best resolution ~35 km
- Temperature variations due to crater topography
- Poor nightside data: too cold for FP3, too distant for FP1



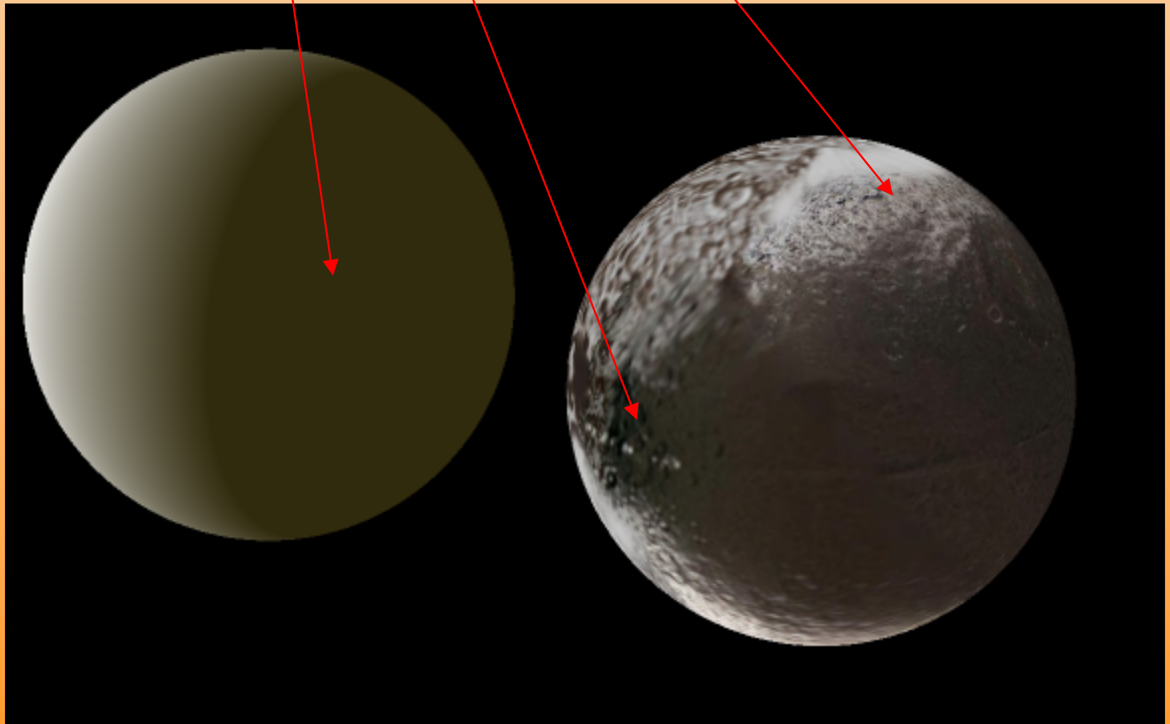
Thermal Contributions to Iapetus' Albedo Dichotomy?

- Simple exogenic models darken the leading hemisphere, but:
  - Iapetus' bright material extends over the poles
  - Dark material extends around the equator
  - Pole-facing slopes are bright

ISS Press Release

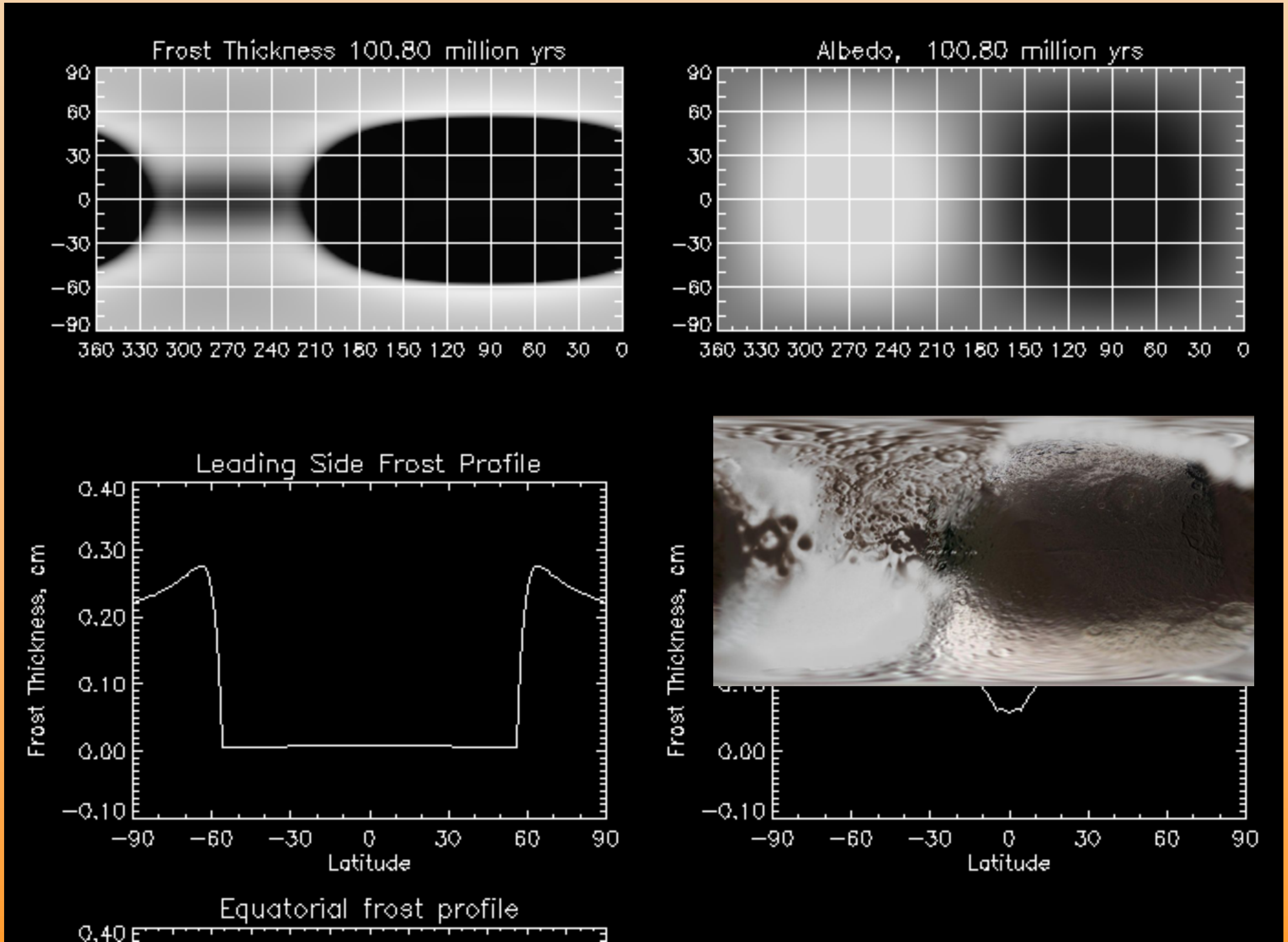


Iapetus map by Steve Albers



Frost Migration Model

- Spencer et al. (2005)
- Can explain shape of leading/trailing frost boundary
- Darking of trailing side depends on bright terrain temperatures



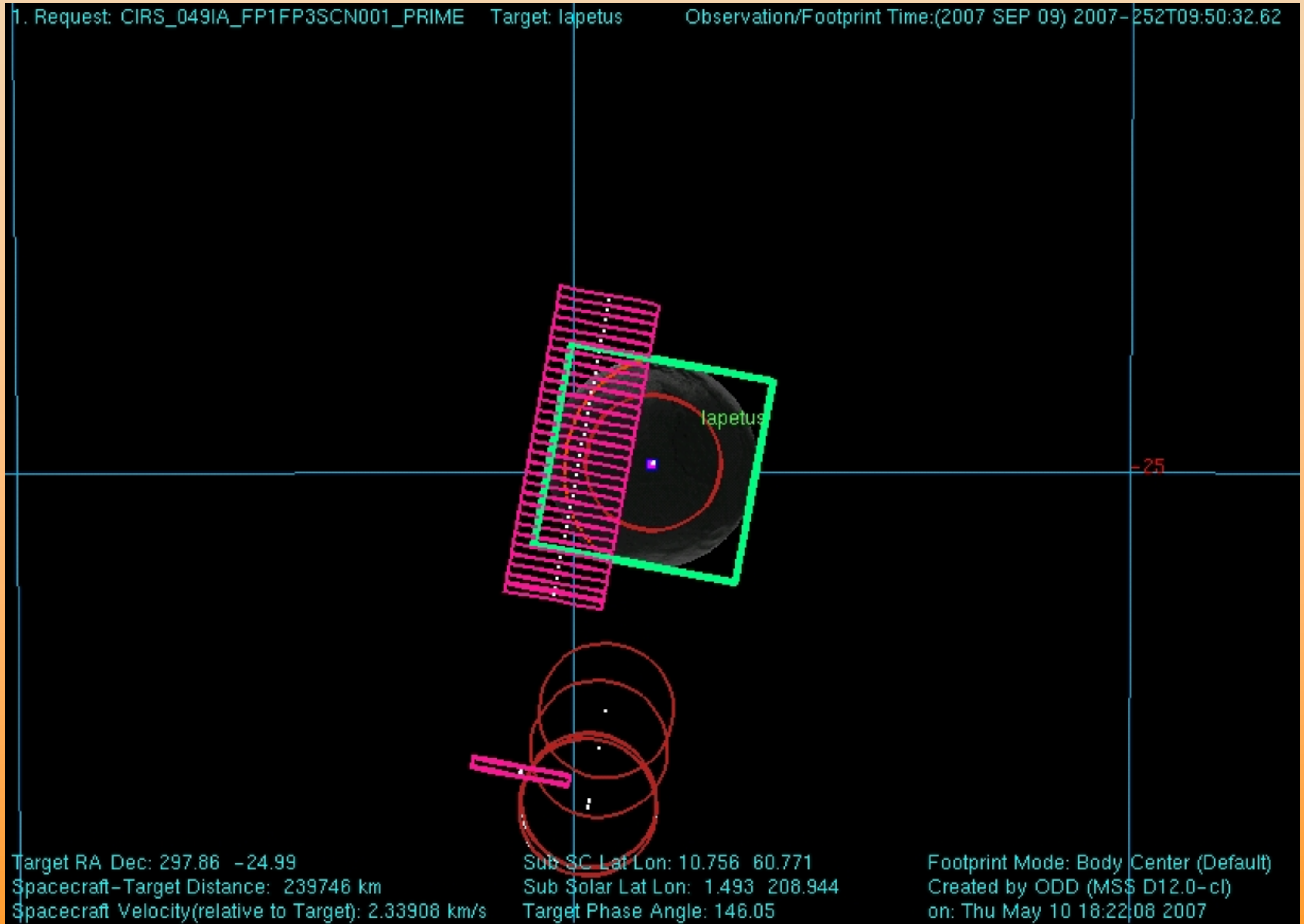
Rev. 49 Timeline

- CIRS prime in pink
- C/A 14:15 UT

CIRS_049IA_FP1FP3SCN001_PRIME	U, V	2007-252T09:50:00		000T02:00:00
ISS_049IA_GLOBMAPG001_PRIME	C, U, V	2007-252T11:50:00		000T00:21:00
SP_049EA_DLTURN252_PRIME		2007-252T12:11:00		000T00:08:00
SP_049EA_DLTURN452_PRIME		2007-252T12:19:00		000T00:26:00
SP_049EA_G70METOTB252_PRIME	N	2007-252T12:45:00		000T08:49:00
SP_049IA_WAYPTTURN452_PRIME	N	2007-252T21:34:00		000T00:04:00
SP_049IA_WAYPTTURN552_PRIME	N, R	2007-252T21:38:00		000T00:27:00
ISS_049IA_LIMBTOPOG001_PRIME	C, R, U, V	2007-252T22:05:00		000T00:20:00
CIRS_049IA_NITPOLRIZ001_PRIME	C, R, U, V	2007-252T22:25:00		000T01:30:00
RADAR_049IA_SCATTRAD004_PRIME		2007-252T23:55:00		000T02:50:00
VIMS_049IA_IAPETUS006_PRIME	C, R, U	2007-253T02:45:00		000T01:35:00
ISS_049IA_SATUSHINE001_PRIME	C, R, U, V	2007-253T04:20:00		000T01:06:00
SP_049EA_DLTURN754_PRIME	C, R	2007-253T05:26:00		000T00:14:00
SP_049EA_DLTURN854_PRIME	C, R	2007-253T05:40:00		000T00:20:00
NEW WAYPOINT		**2007-253T06:00:00**		**000T16:40:00**
SP_049EA_M70METNON253_PRIME	R	2007-253T06:00:00		000T02:44:53
SP_049NA_DEADTIME253_PRIME	**R**	**2007-253T08:45:00**		**000T00:05:00**
Begin Custom		**2007-253T08:50:00**		**000T00:01:00**
CIRS_049IA_FP1NITMAP001_PRIME	I, R, U, V	2007-253T08:50:40	GMB_E049_Iapetus-000T05:25:00	000T02:15:00
RADAR_049IA_SCATTRAD001_PRIME	M	2007-253T11:05:40	GMB_E049_Iapetus-000T03:10:00	000T01:25:00
ISS_049IA_CASSREG001_PRIME	C, M, U	2007-253T12:30:40	GMB_E049_Iapetus-000T01:45:00	000T00:01:00
UVIS_049IA_ICYMAP003_PRIME	C, I, M	2007-253T12:31:40	GMB_E049_Iapetus-000T01:44:00	000T00:24:00
UVIS_049IA_ICYEXO009_PRIME	C, I, M, V	2007-253T12:55:40	GMB_E049_Iapetus-000T01:20:00	000T00:25:00
VIMS_049IA_ORSHIRES001_PRIME	C, I, M, U	2007-253T13:20:40	GMB_E049_Iapetus-000T00:55:00	000T03:55:00
CIRS_049IA_FP1DAYMAP001_PRIME	I, R, U, V	2007-253T17:15:40	GMB_E049_Iapetus+000T03:00:00	000T02:00:00
VIMS_049IA_IAPETUS013_PRIME	C, I, R, U	2007-253T19:15:40	GMB_E049_Iapetus+000T05:00:00	000T00:44:00
End Custom		**2007-253T19:59:40**	**GMB_E049_Iapetus+000T05:44:00**	**000T00:01:00**
SP_049NA_DEADTIME453_PRIME	**R**	**2007-253T20:00:00**		**000T00:05:00**
SP_049EA_C70METUNQ253_PRIME	R	2007-253T20:05:00		000T02:15:00
SP_049IA_WAYPTTURN253_PRIME	C, R	2007-253T22:20:00		000T00:20:00
NEW WAYPOINT		**2007-253T22:40:00**		**001T23:25:00**
ISS_049IA_REGMAPTRL001_PRIME	C, R, U, V	2007-253T22:40:00		000T02:00:00
CIRS_049IA_DAYPOLRIZ001_PRIME	C, R, U	2007-254T00:40:00		000T01:40:00
ISS_049IA_REGCOLTRL001_PRIME	C, R, U, V	2007-254T02:20:00		000T00:40:00
RADAR_049IA_SCATTRAD002_PRIME		2007-254T03:00:00		000T02:10:00
SP_049EA_DLTURN254_PRIME		2007-254T05:10:00		000T00:20:00
SP_049EA_M70METNON255_PRIME	C	2007-254T05:30:00		000T07:50:00
SP_049EA_G70METNON254_PRIME		2007-254T13:20:00		000T07:05:00
SP_049IA_WAYPTTURN254_PRIME		2007-254T20:25:00		000T00:20:00
VIMS_049IA_IAPETUS010_PRIME	I, U	2007-254T20:45:00		000T02:15:00
CIRS_049IA_FP1FP3MAP001_PRIME	R, U	2007-254T23:00:00		000T04:00:00

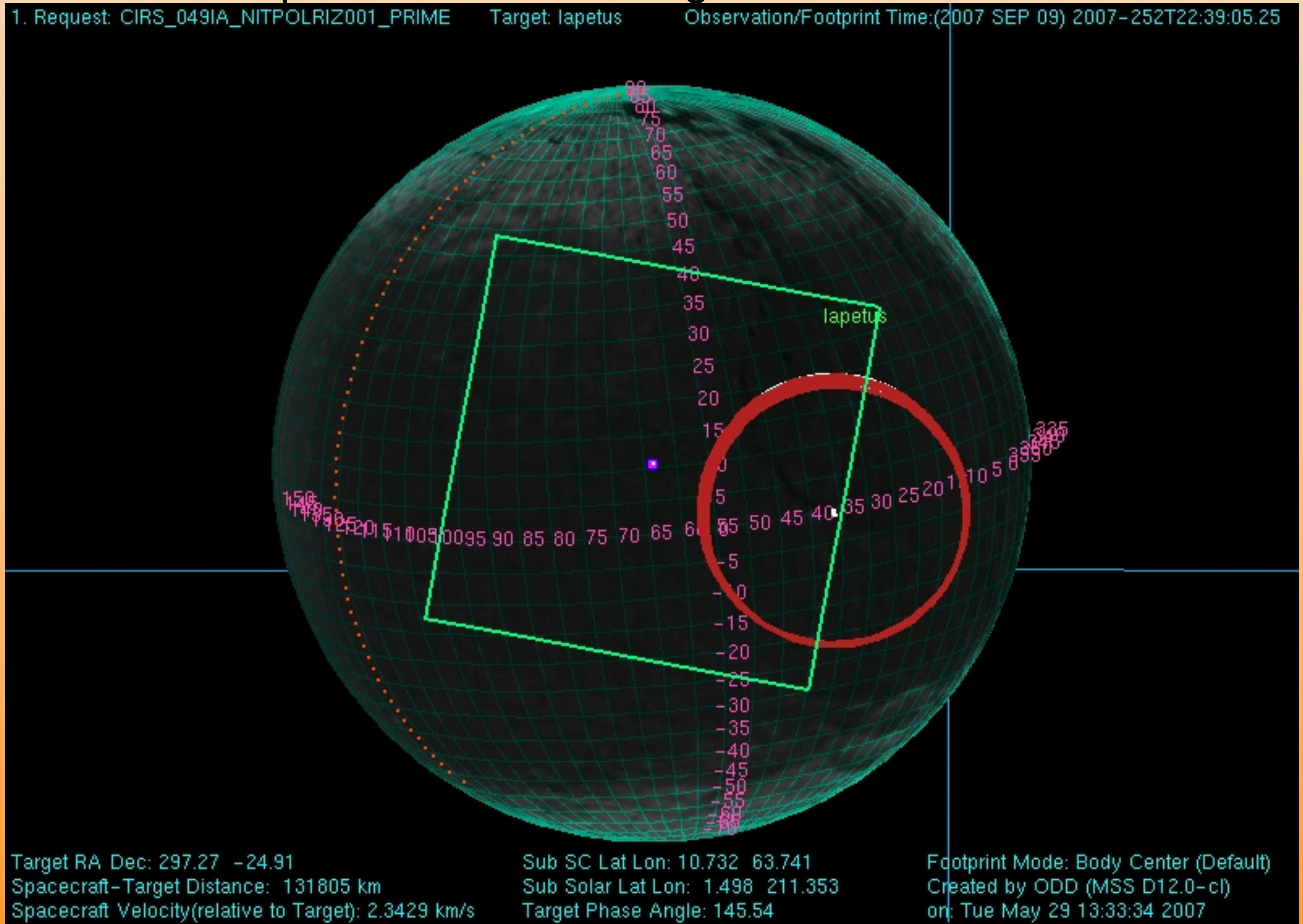
C/A -28 hours

- FP3 scan of lit crescent



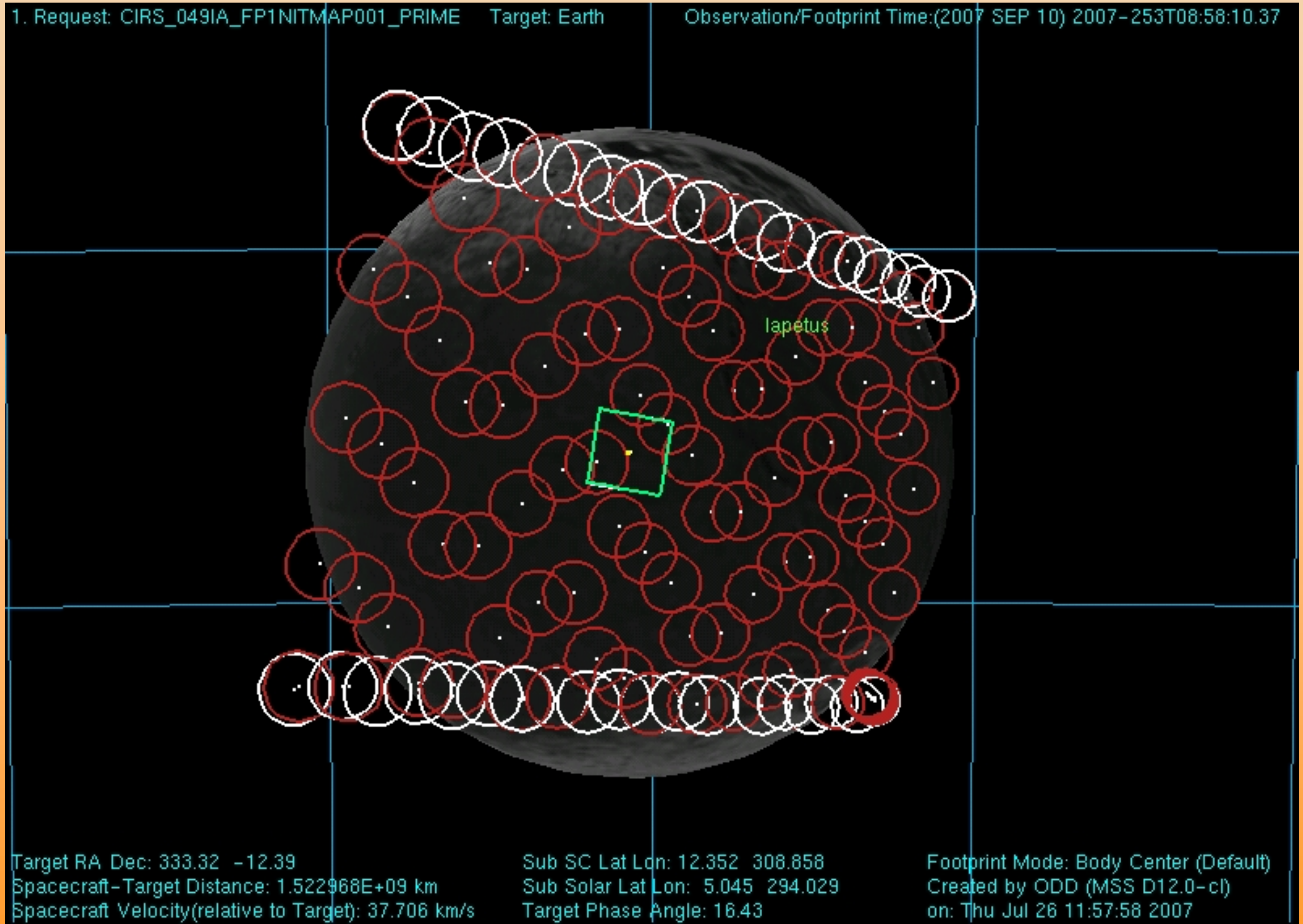
C/A -16 hours

- Polarization measurements of night side thermal emission with FP1
  - Constrains local slopes and surface roughness



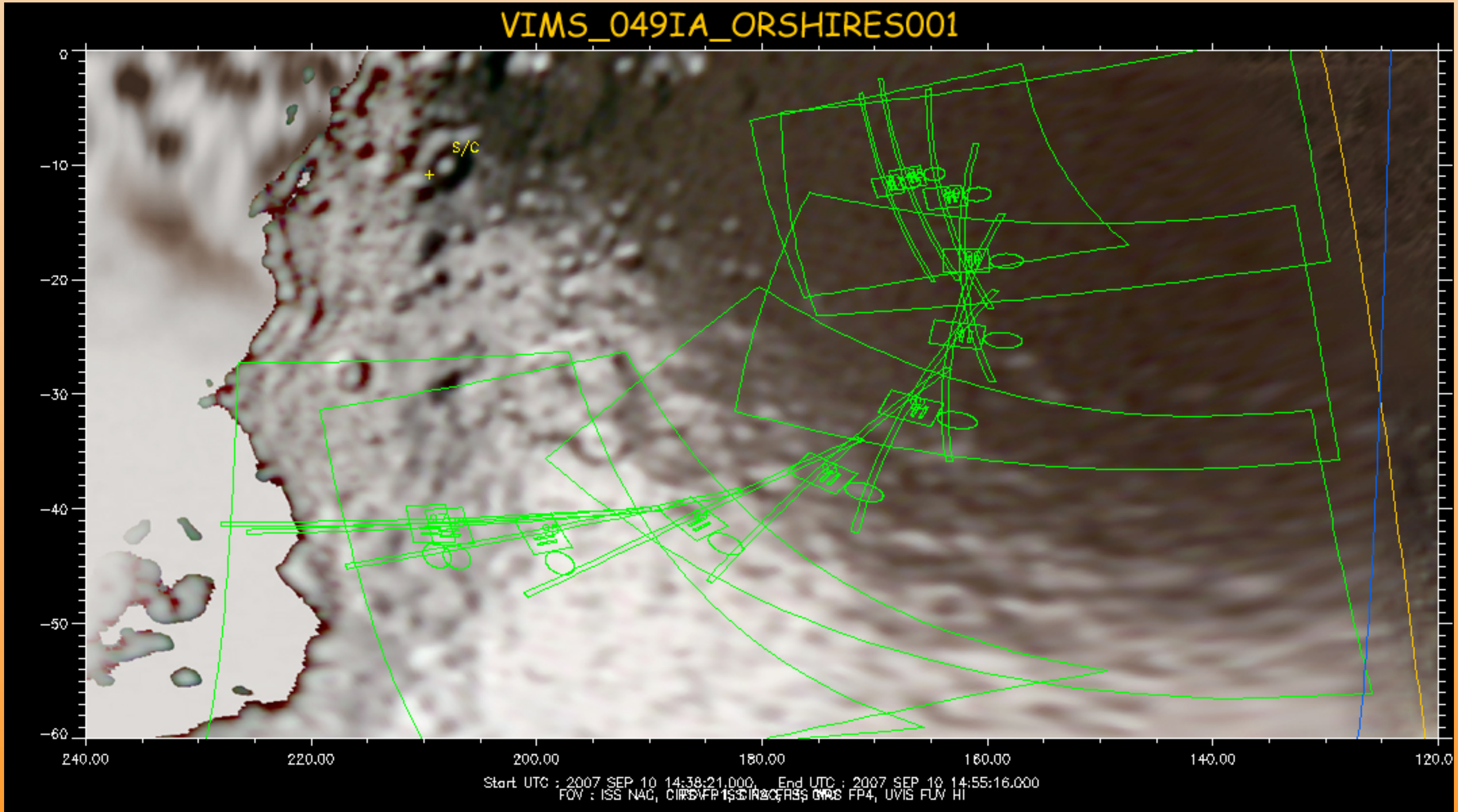
C/A -4.5 hours

- Hi-res nighttime FP1 mosaic, 2 hour duration



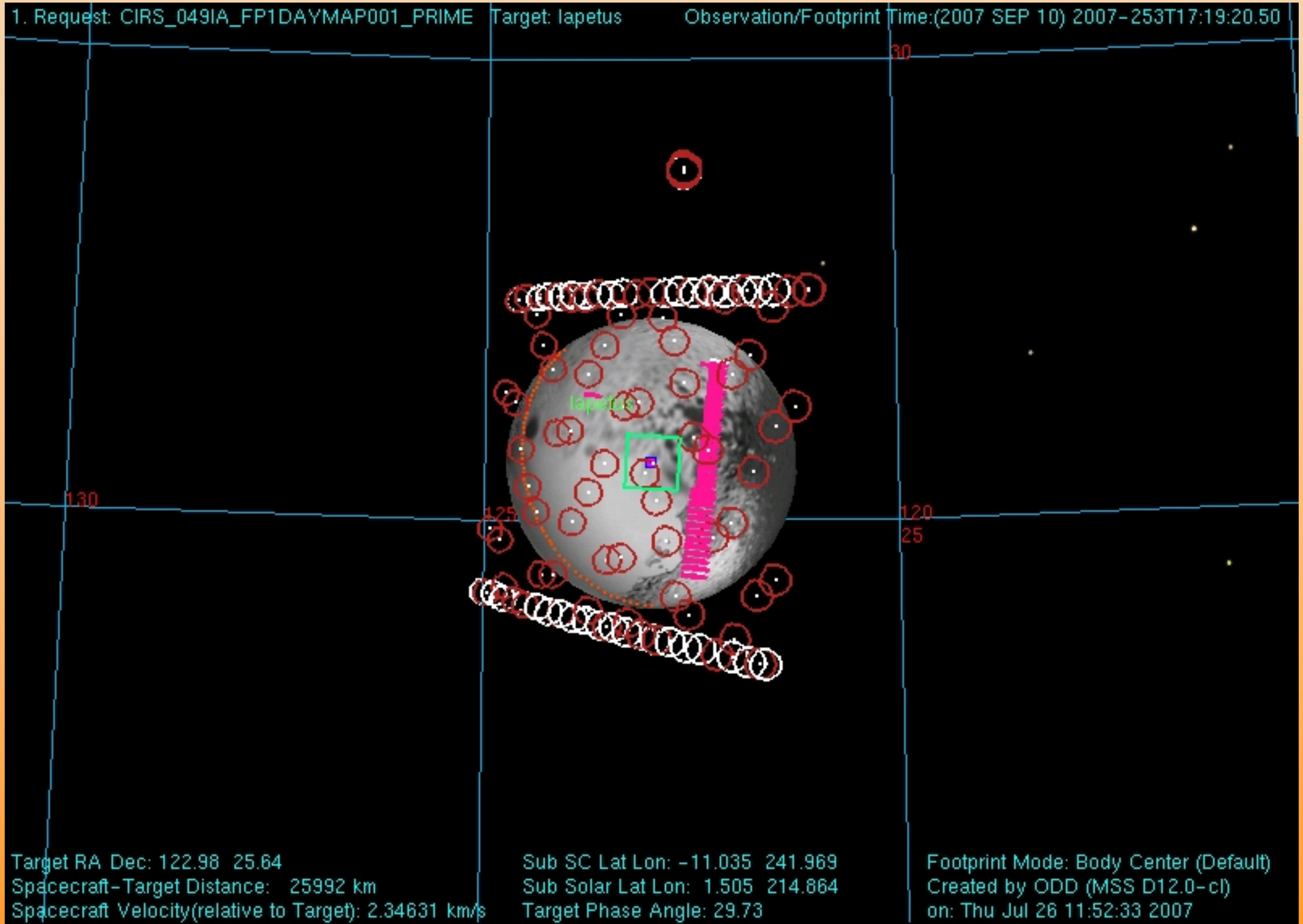
C/A Observations

- VIMS_049IA_ORSHIRES001_PRIME
  - Multiple ORS observations combined in a single sequence
- CIRS observations include 4-minute scans of bright and



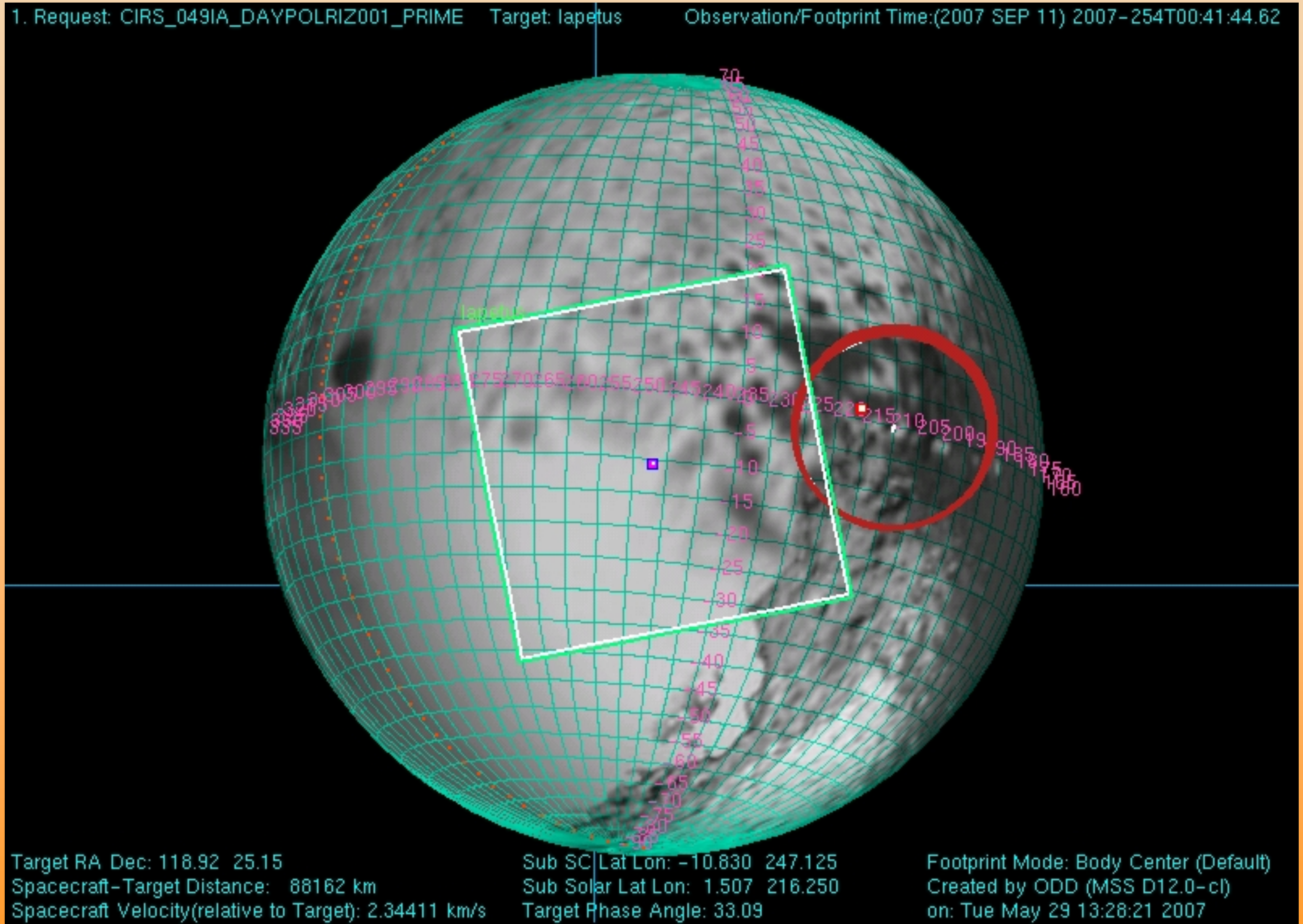
CA + 4 hours

- Daytime global scan with FP1 (2 hours)
  - Regional scan of bright/dark boundary with FP3



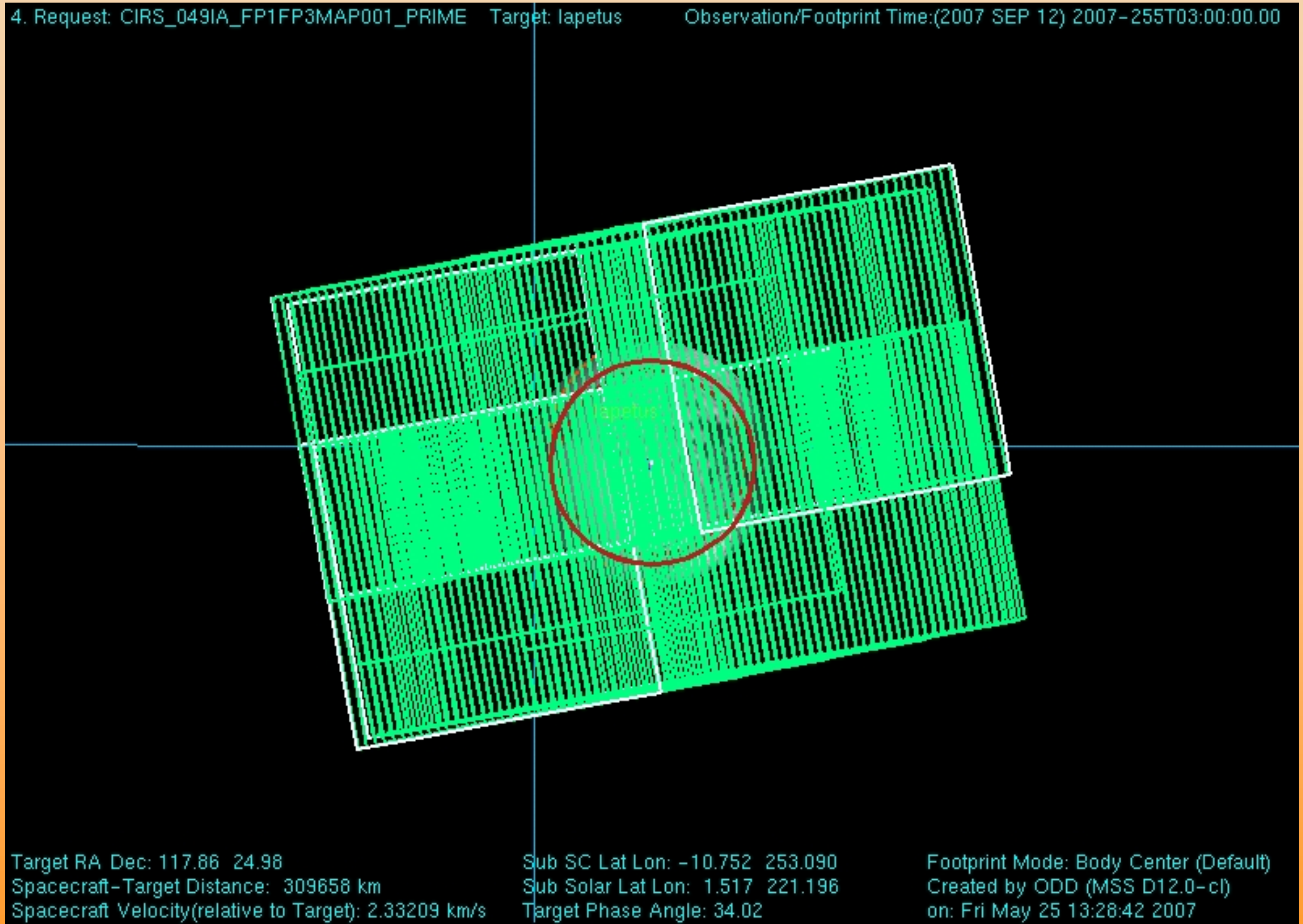
CA + 11 hours

- Daytime polarization measurement with FP1 to complement earlier nighttime measurement



CA + 34 hours

- Global FP3 scan

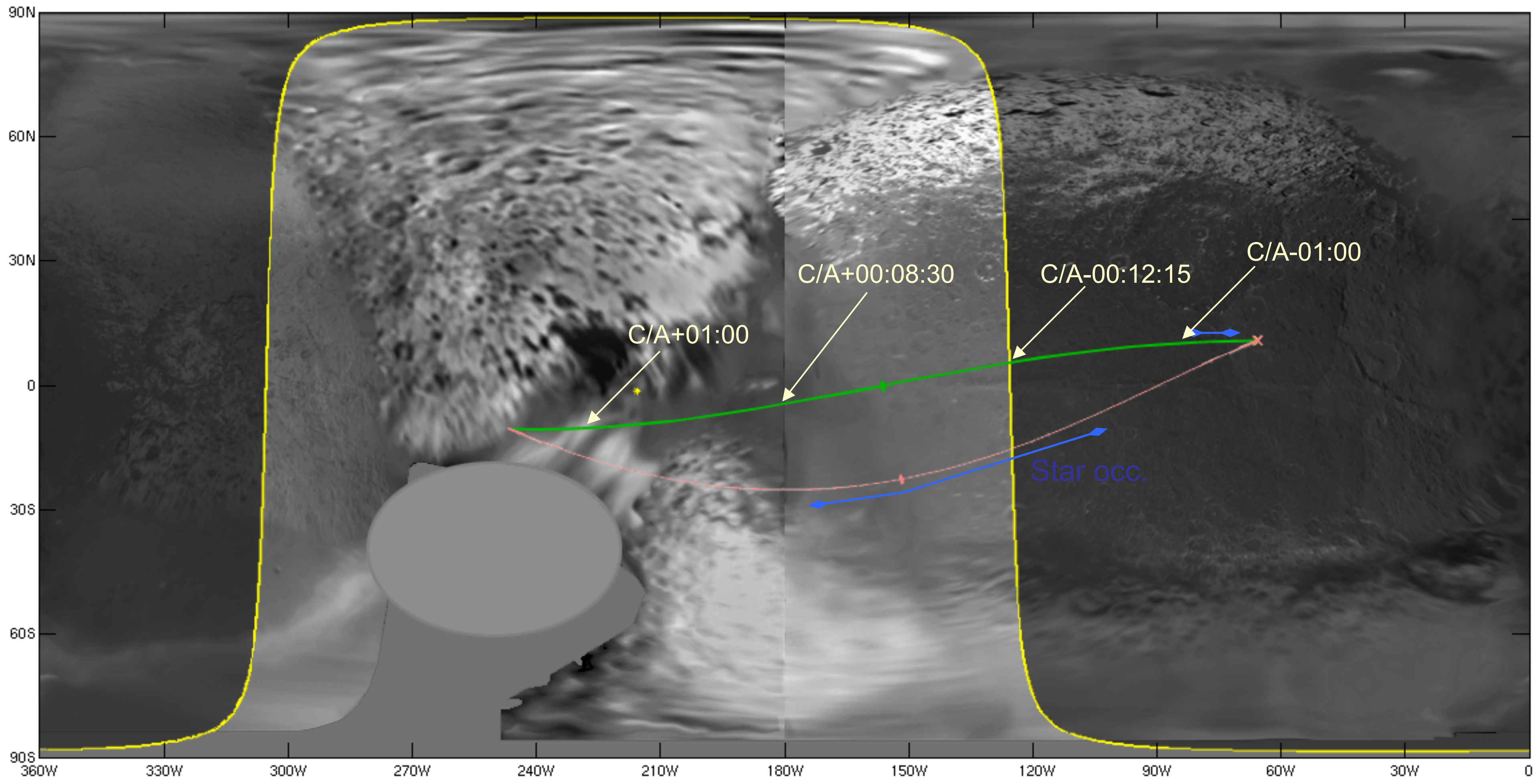


Iapetus Targeted Flyby
September 10, 2007
Imaging Plan

Tilmann Denk, Cassini ISS Team

Flyby preview telecon
Friday 24 Aug 2007 19:00

10 Sep 2007: Iapetus Targeted Flyby

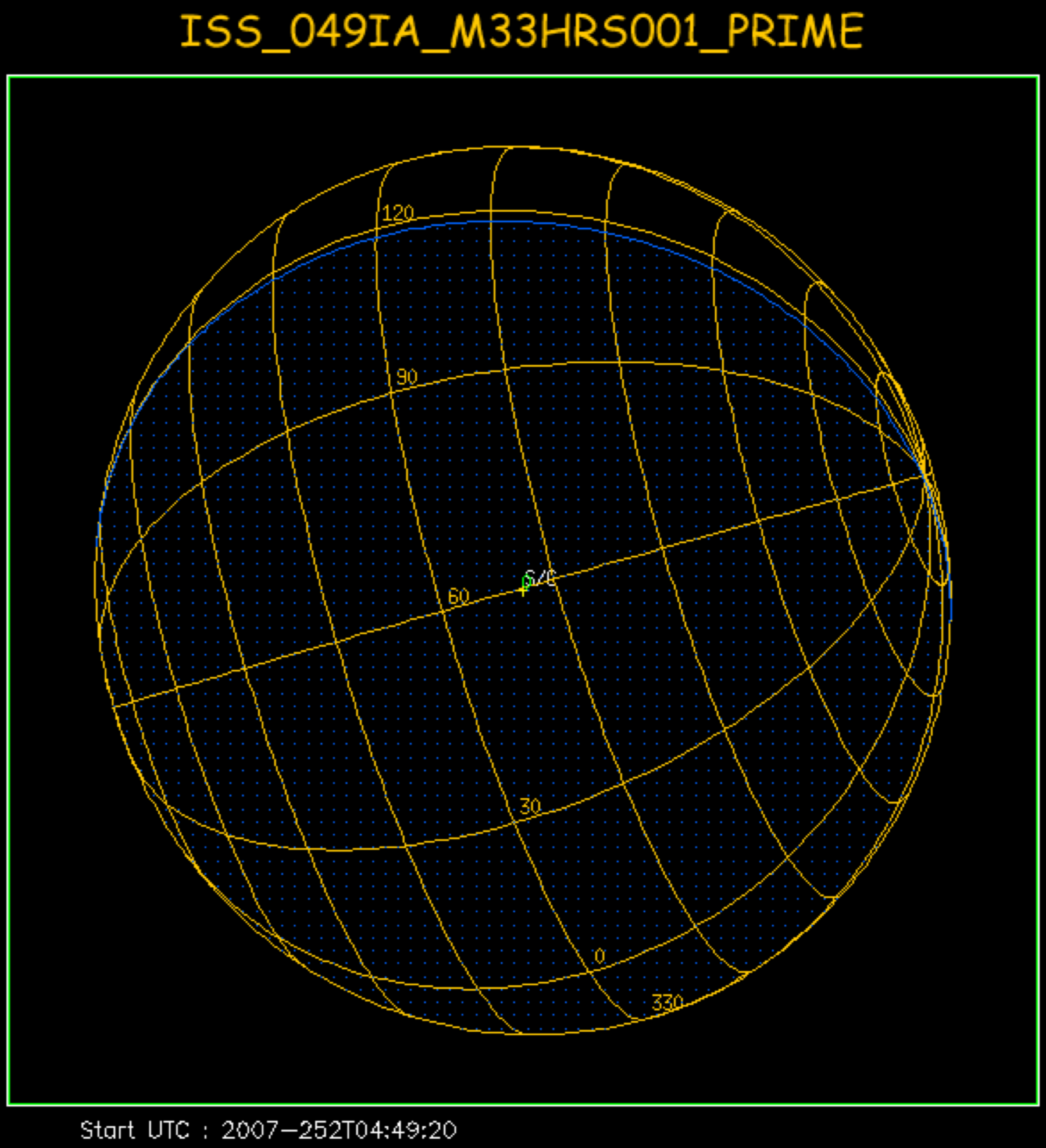


red: old Cassini reference trajectory   green: new ref. traj.   yellow: terminator; +...sub-sol point

10 Sep 2007

Iapetus Targeted Flyby

All ISS footprints in SOST rev 49 Iapetus segment



10 Sep 2007: Iapetus Targeted Flyby

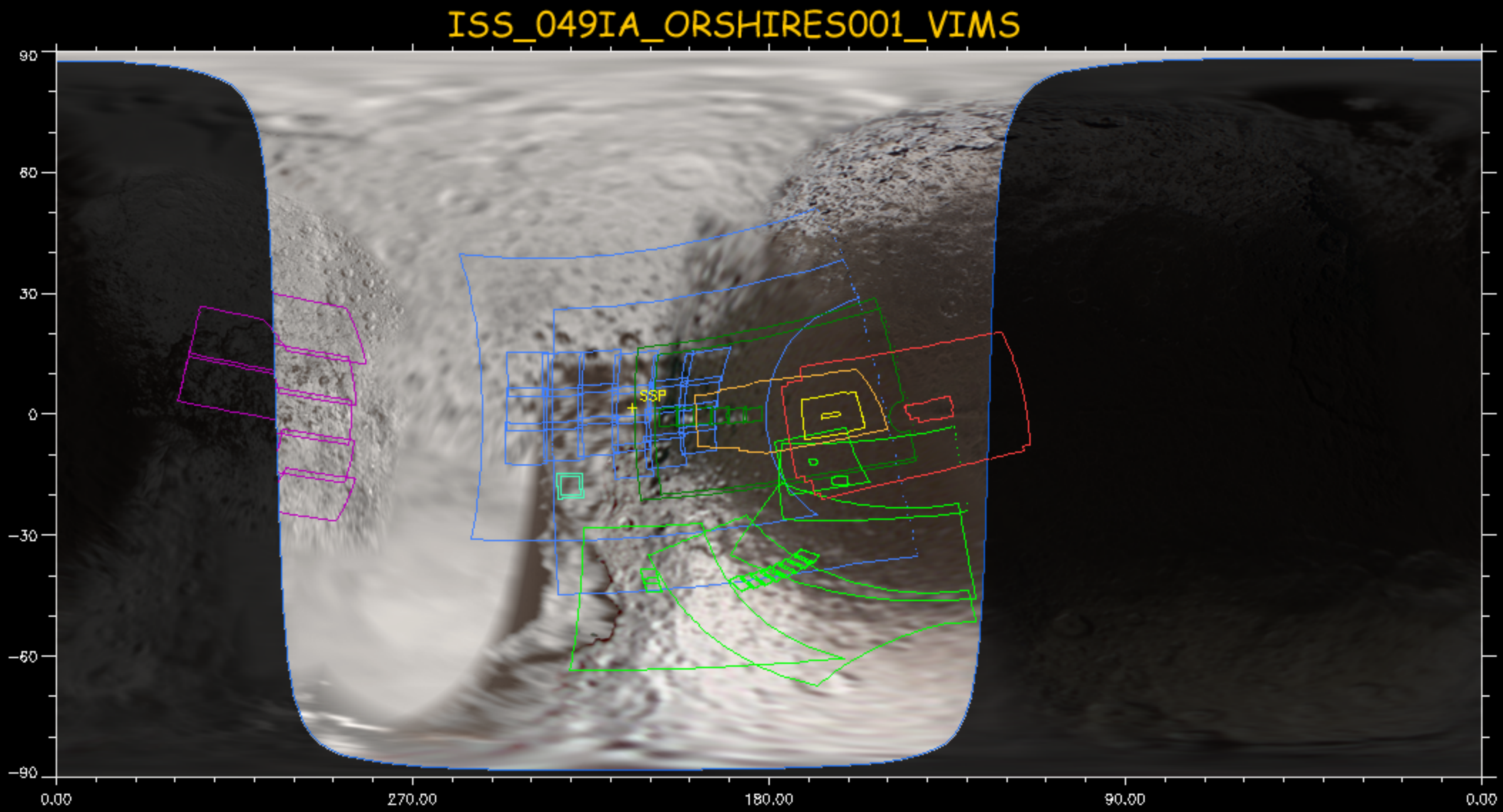
Observation planning ISS: Freie Universität and DLR Berlin

Please, go to:

http://www.geoinf.fu-berlin.de/projekte/cassini/cassini_fu_iapetus_flyby.php

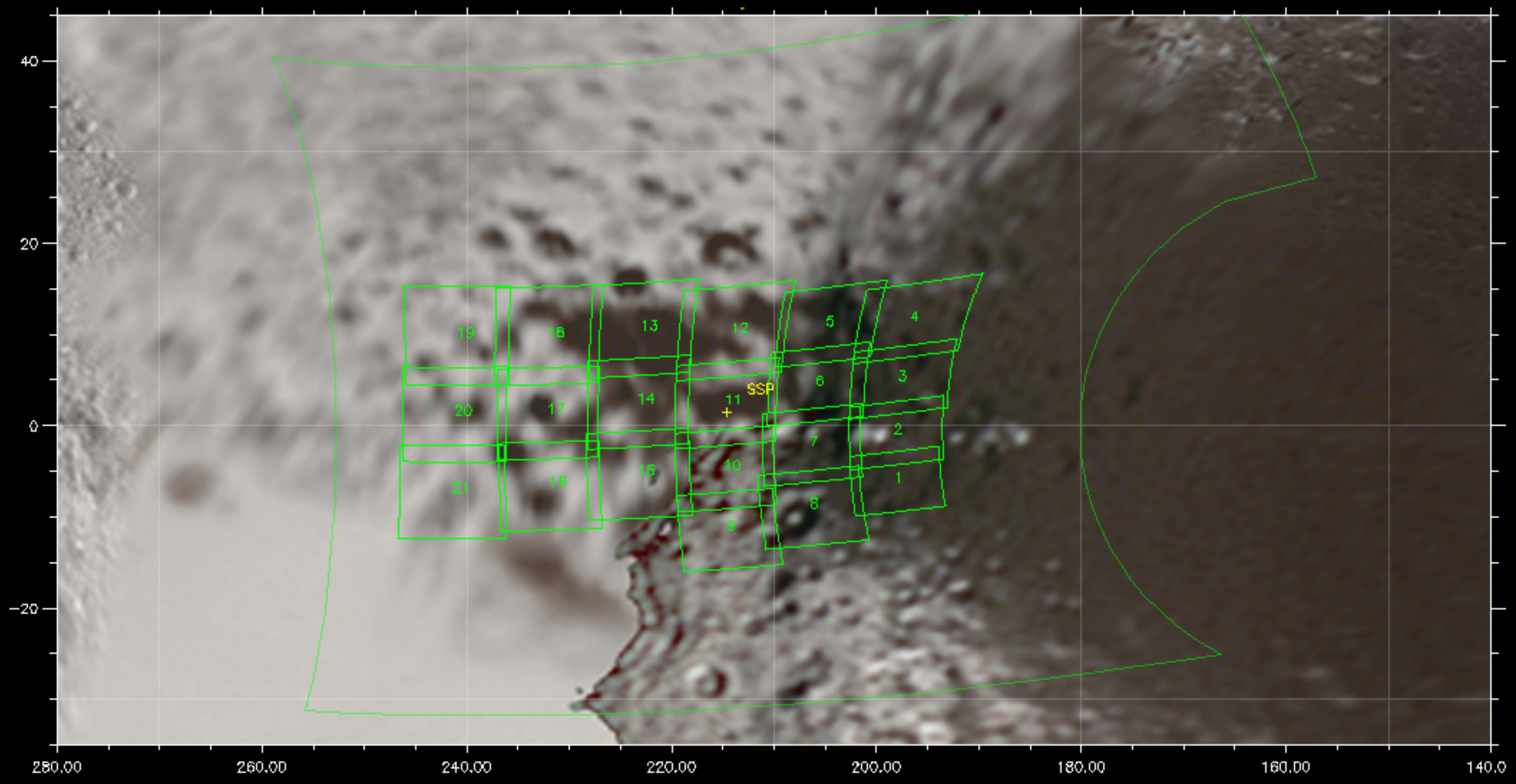
10 Sep 2007: Iapetus Targeted Flyby

Observation planning ISS: Freie Universität and DLR Berlin



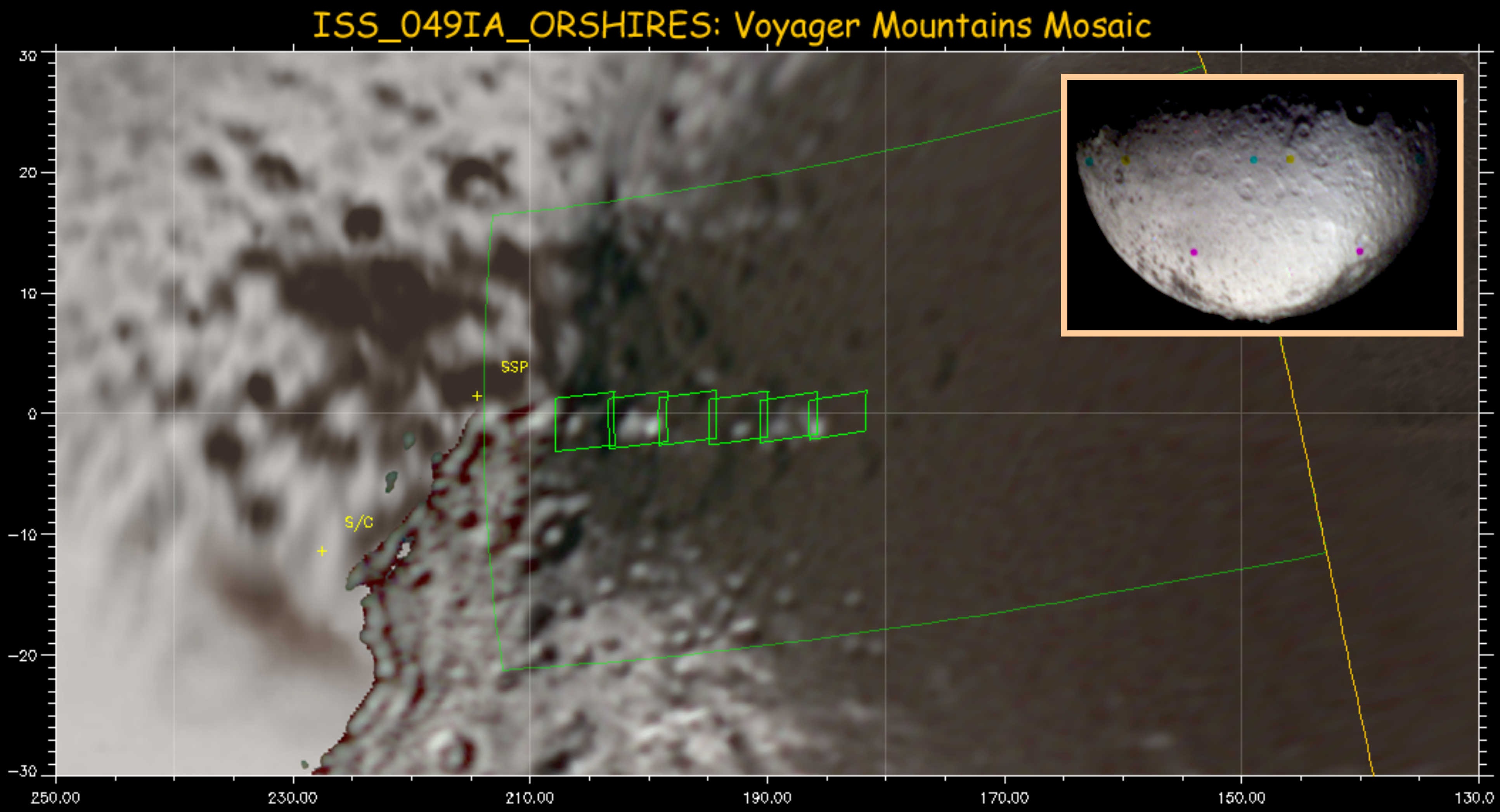
10 Sep 2007: Iapetus Targeted Flyby

Observation planning ISS: Freie Universität and DLR Berlin



10 Sep 2007: Iapetus Targeted Flyby

Observation planning ISS: Freie Universität and DLR Berlin



See upcoming DPS, AGU, JPL party after flyby, JPL raw images archive, etc. for real pictures...

UVIS Science at Iapetus

C. J. Hansen, A. Hendrix

24 August 2007

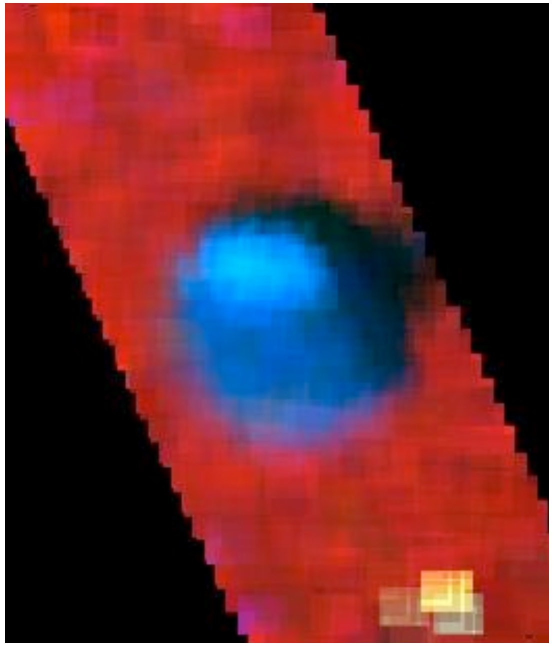
Iapetus Science Questions

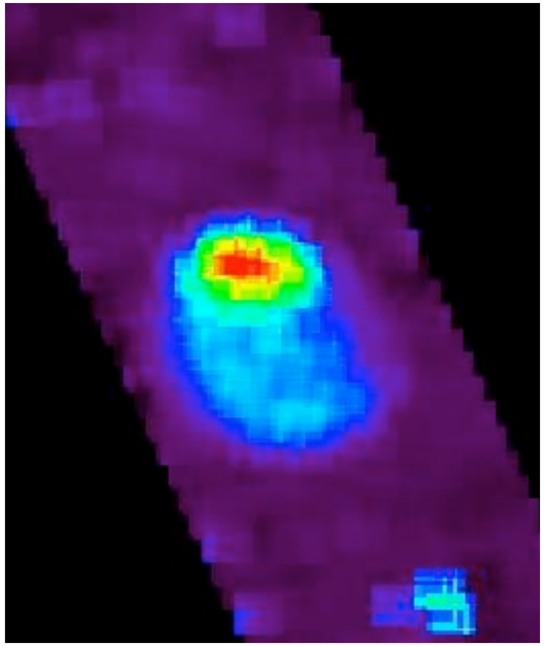
- The dramatic albedo difference between the dark and bright sides of Iapetus has been attributed to endogenic or exogenic processes – but which is it? Is Iapetus sweeping up dark material coming from Phoebe or Hyperion?
- How similar is the composition of the dark side of Iapetus to Phoebe? To Hyperion?
- What is the distribution of water on Iapetus' surface? How do the dark and bright sides of Iapetus compare?
- Does Iapetus have a tenuous atmosphere?

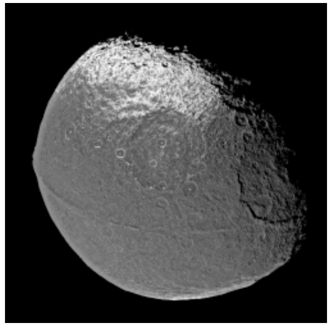
What do we know now, from the Rev 00C flyby? What do we expect to learn?

The results we are showing today are from A. R. Hendrix and C. J. Hansen, "The Albedo Dichotomy of Iapetus measured at UV Wavelengths", accepted in Icarus (2007)

UVIS Views of Iapetus on the Rev 00C Flyby



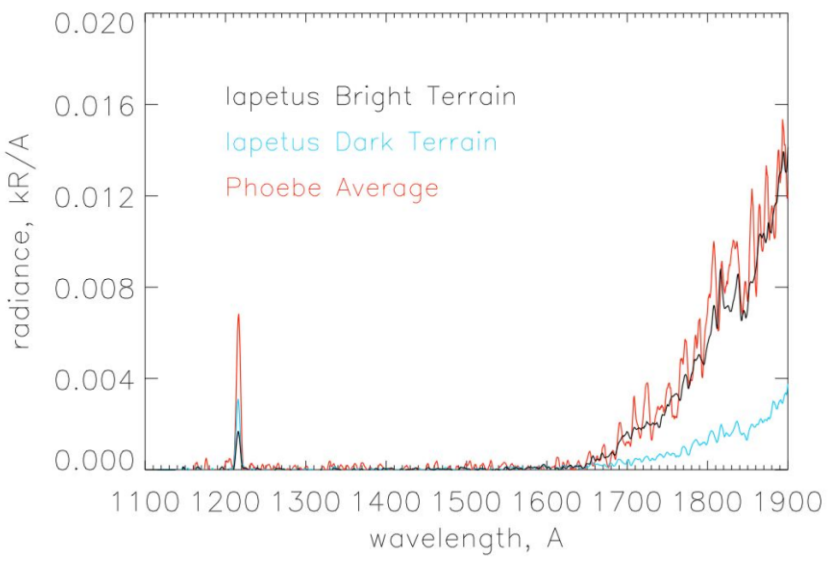


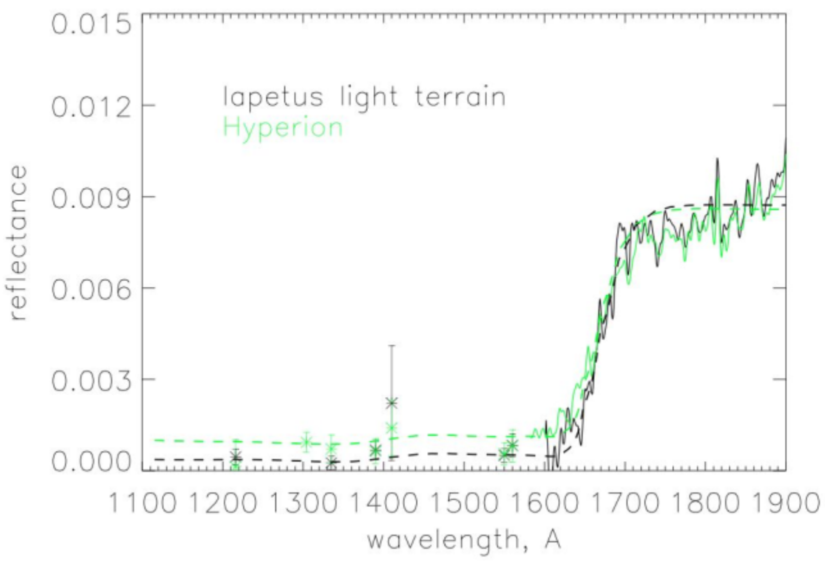


Flyby was primarily on Iapetus' dark side but bright polar region was also imaged

Surface Composition and Volatile Migration

- Is material from Phoebe or Hyperion coating the dark side of Iapetus?
- How similar is the composition of the dark side of Iapetus to Phoebe? To Hyperion?

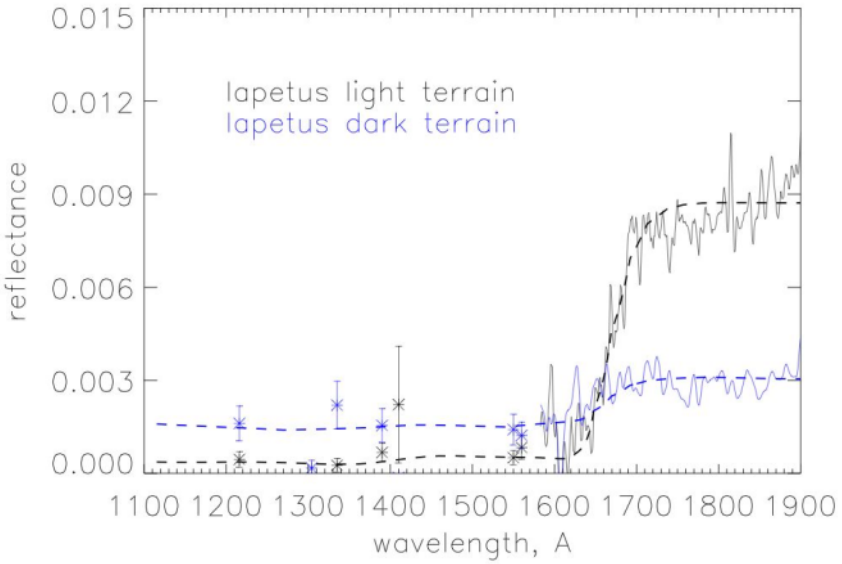




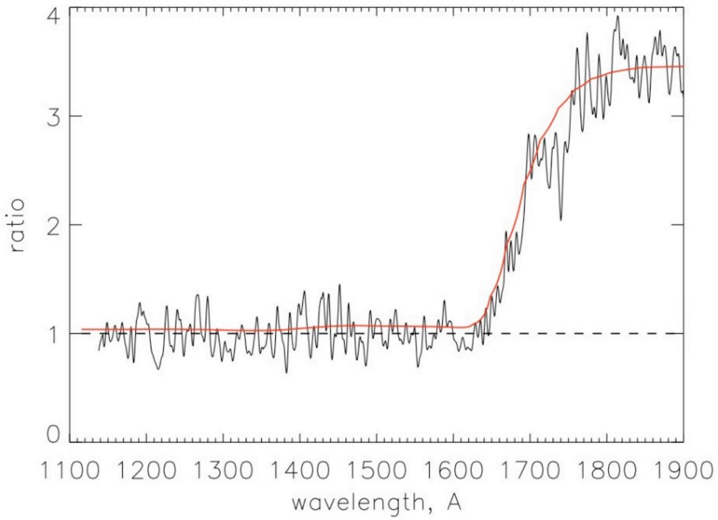
The dark side of Iapetus doesn't look like Phoebe or Hyperion.

Phoebe and Hyperion spectra are far more similar to the bright side of Iapetus.

Surface Composition and Volatile Migration (cont.)



(a)

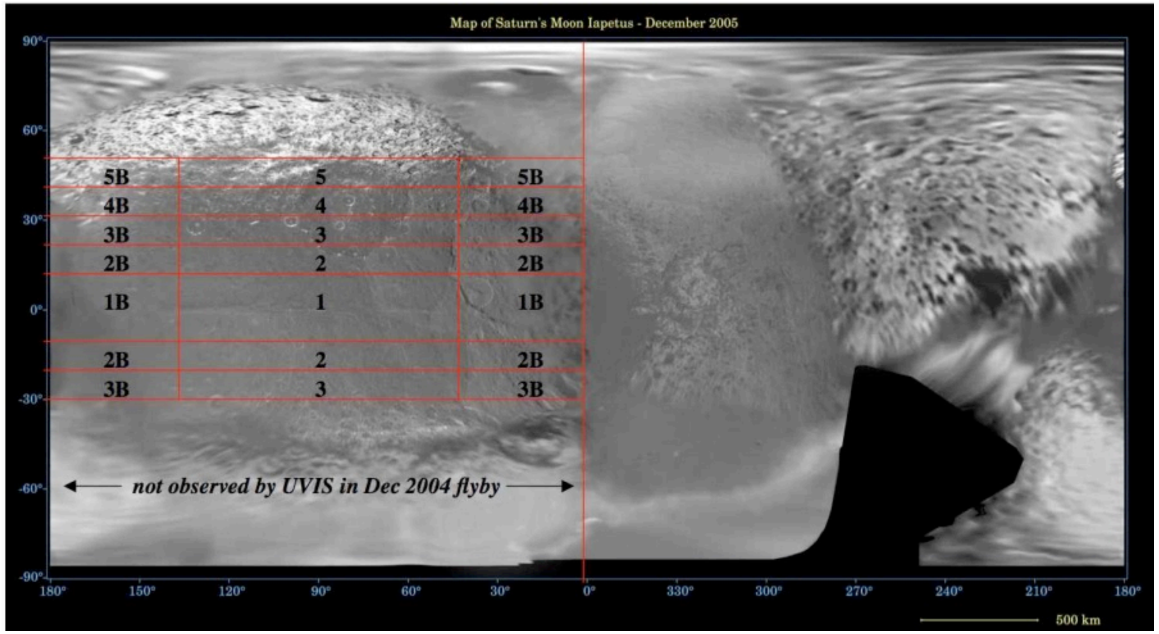


(b)

The big difference between the bright and dark terrains at UV wavelengths is directly attributable to the quantity of water on the surface

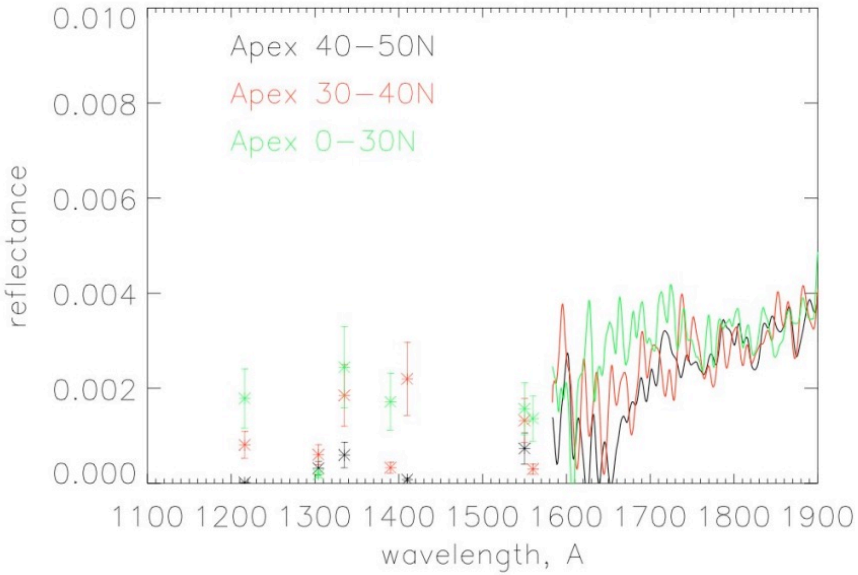
Plot b shows the ratio of the bright to dark terrain, with the spectrum of water over-plotted

Surface Composition and Volatile Migration (cont.)



UVIS data was binned by latitude: 0 - 30 N, 30 - 40 N, and 40 - 50 N

Water is present at even the lowest latitudes, although much reduced in quantity



The bright cold poles will be cold traps for volatiles - the presence of water ice at all implies that the process coating Iapetus' dark side is ongoing…

Vapor pressure at 110 K = 5.9 x 10^{-14} torr

Vapor pressure at 130 K = 1.8 x 10^{-10} torr

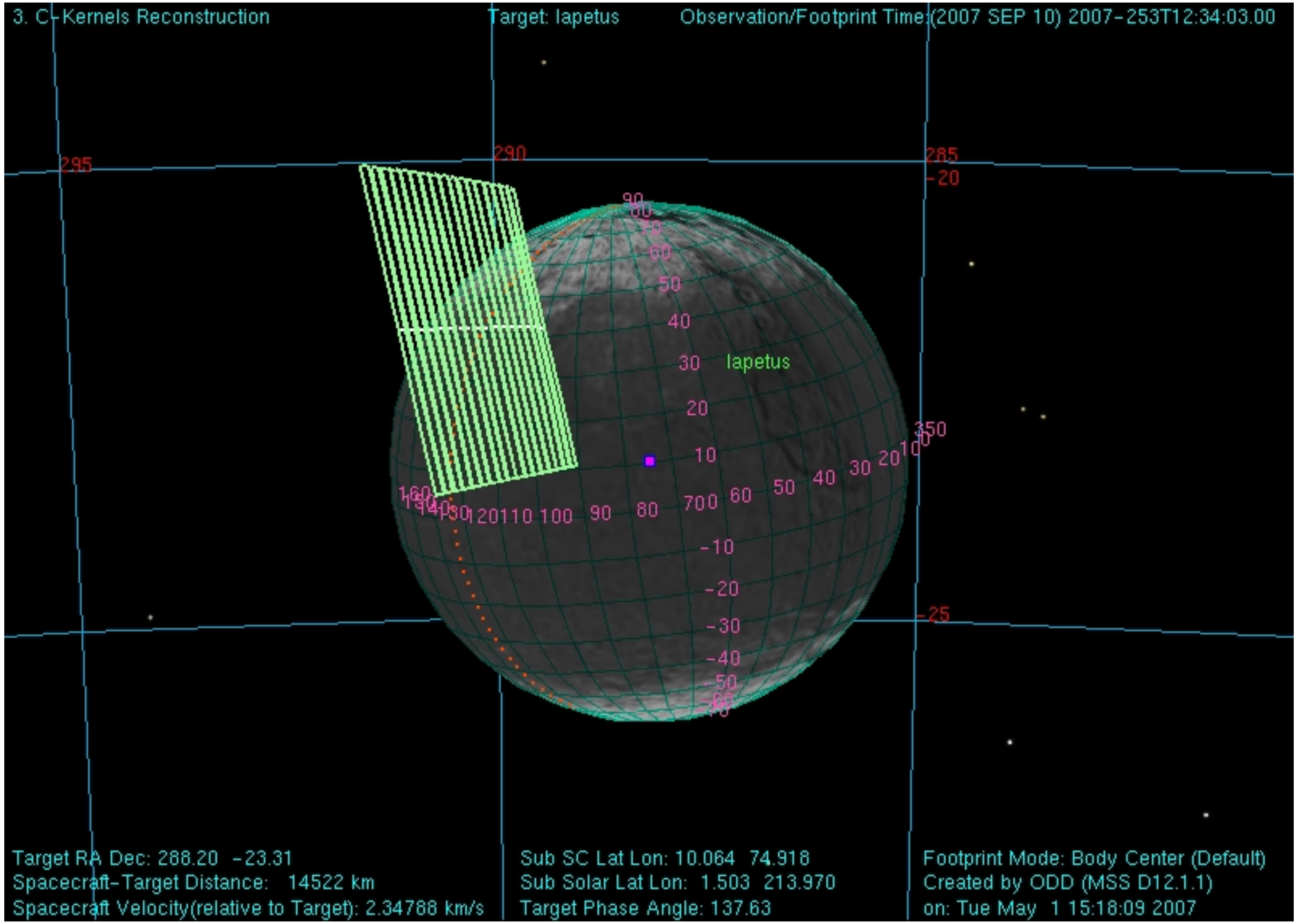
Surface Age and Evolution

General

- The surface albedo of Saturn's icy satellites is affected by radiation darkening and surface chemistry, and thus will vary with the amount of time a surface unit has been exposed to the magnetosphere's radiation and high energy particles. Leading / trailing side asymmetries are expected.
  - Also determined by nature of interactions (e.g. Ganymede's radiation exposure is affected by its own internal magnetic field)
- Surface microstructure will be investigated via the phase function.

Iapetus

- Iapetus, Phoebe and Hyperion all orbit mostly outside Saturn's magnetosphere (except for time in the magnetotail), thus provide the important end cases of primarily exposure to the solar wind
- UVIS uv albedo maps and phase curves will be produced. We will look for uv albedo differences that correlate to geologic ages derived from the imaging data and analyze deviations between our data and crater counts that might suggest more recent modification to the exposed surface skin



3. C-Kernels Reconstruction
Target: Iapetus
Observation/Footprint Time:(2007 SEP 10) 2007-253T12:34:03.00
Iapetus
Target RA Dec: 288.20 -23.31
Spacecraft-Target Distance: 14522 km
Spacecraft Velocity(relative to Target): 2.34788 km/s
Sub SC Lat Lon: 10.064 74.918
Sub Solar Lat Lon: 1.503 213.970
Target Phase Angle: 137.63
Footprint Mode: Body Center (Default)
Created by ODD (MSS D12.1.1)
on: Tue May 1 15:18:09 2007

Tenuous Atmospheres / Exospheres

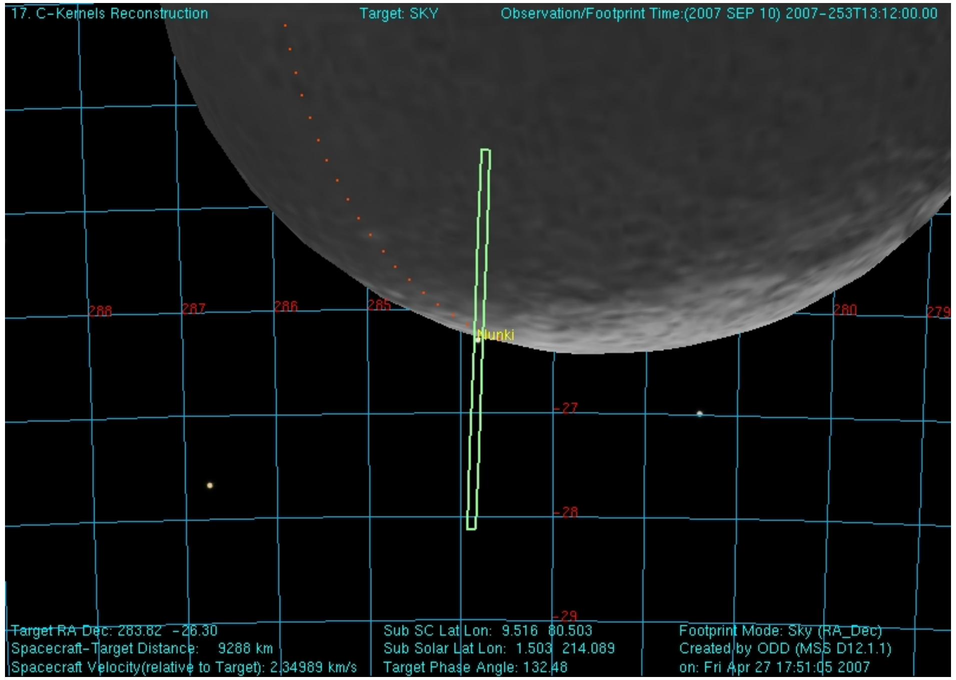
General

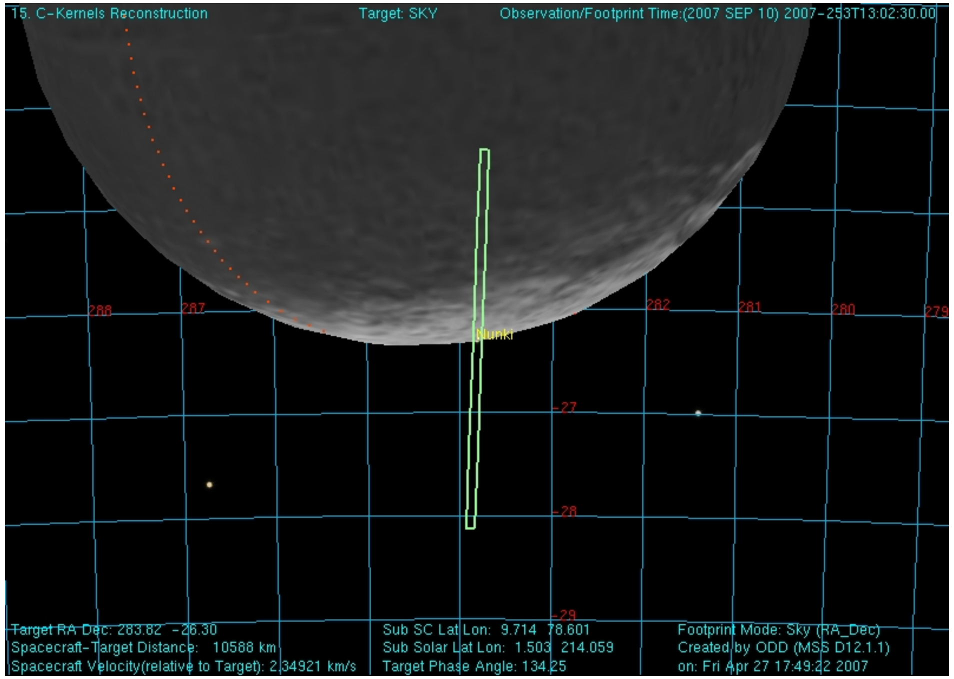
- Molecules are sputtered and sublimated from the surfaces of the icy satellites. By determining the composition of these exospheres we may determine surface composition.
- Gases could be from volatile eruptive activity

Iapetus

- Stellar occultation of sigma Sgr
- UVIS spectra will be examined for emission features such as 130.4 and 135.6 nm (atomic and molecular oxygen), 149.3 nm (atomic nitrogen), etc.

Stellar Occultation of sigma Sgr





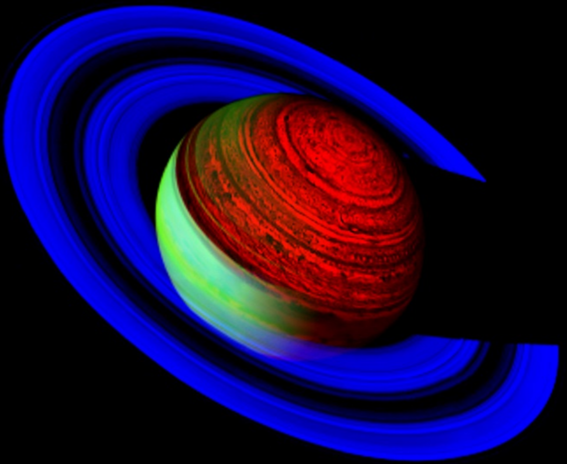
VIMS Preview of the September, 2007 Iapetus Fly-By

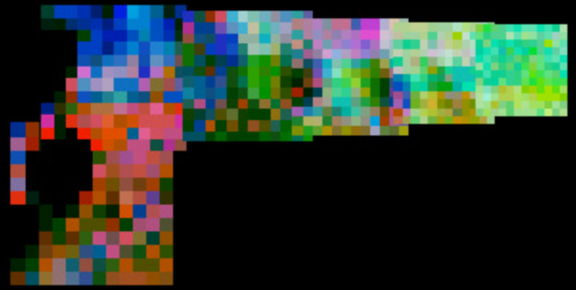
Roger N. Clark and the VIMS Team

SOST

August 24, 2007

V1.0

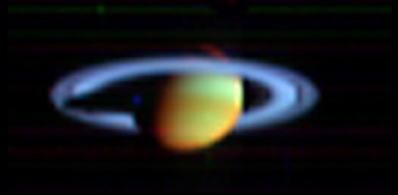




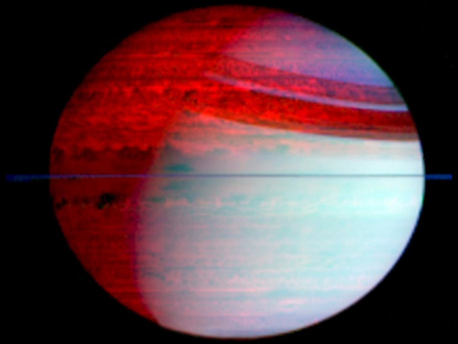
RGB Mineral Map:
Red =CO2 at 4.26 microns
Green = 1-micron albedo
Blue = 2-micron Ice

VIMS

Visual and Infrared Mapping Spectrometer



- 0.35 to 5.2 microns in 352 wavelengths
- IFOV: 0.5 x 0.5 mrad (standard)
  - (0.5 mrad = 1.7 arc-minutes)
- High resolution IR: 0.5 x 0.25 mrad
- High resolution VIS: 0.17 x 0.17 mrad
- Images up to 64 x 64 pixels square.



VIMS Iapetus Science

Identification of minerals and other materials
on the surface of Iapetus.

Mapping the abundance, and grain sizes of
surficial materials.

Grain-Size Mapping

Reflectance from 0.35 to 5.2 microns

Phase function

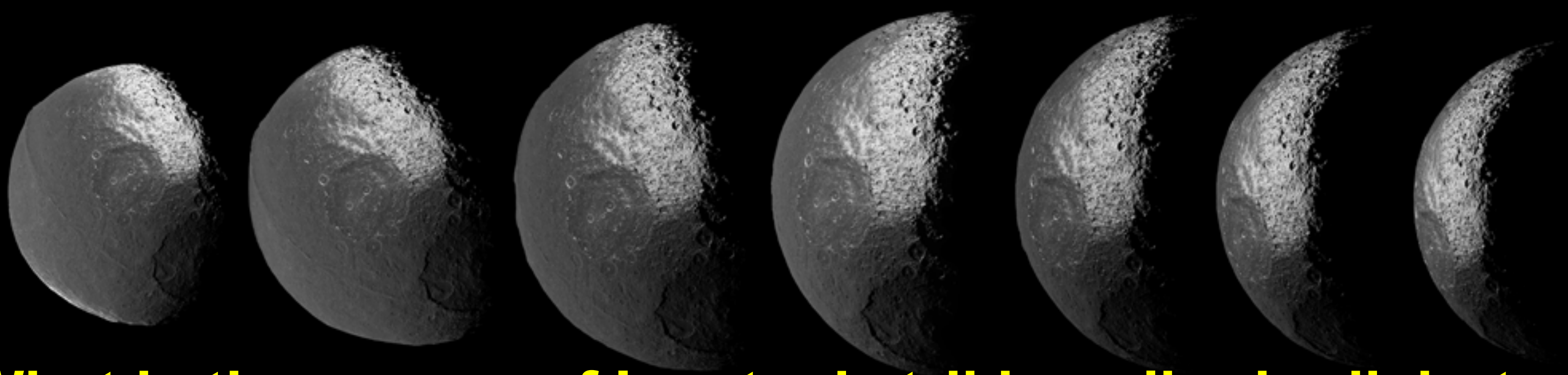
surface microstructure

Bond albedo

Temperatures > 120K (5-micron emission)

Measure Ice temperatures down to 60K and less

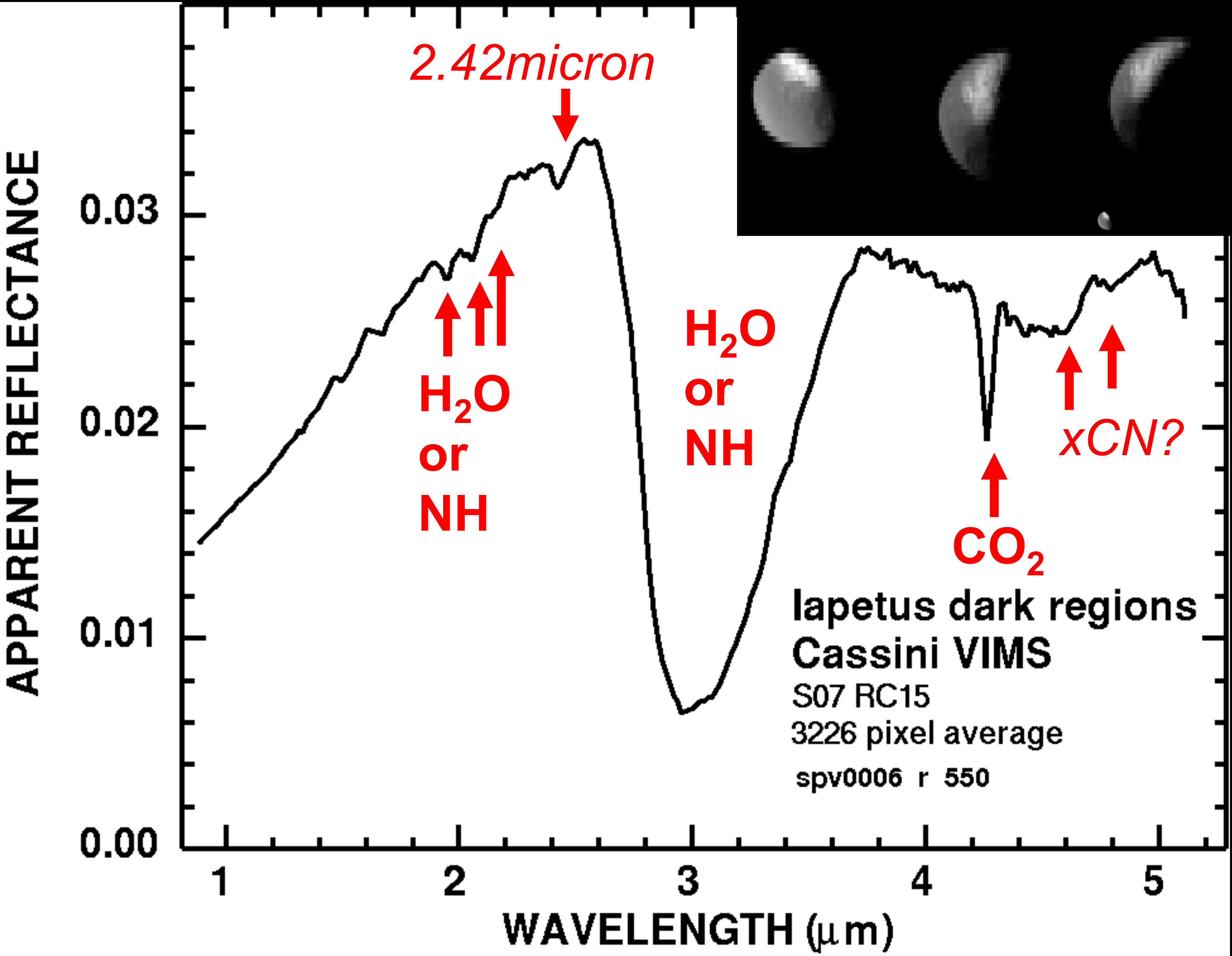
(New capability under development using
temperature dependent shape changes in the
reflection spectra of ice.)



- What is the source of Iapetus' striking albedo dichotomy?
  - Iapetus' leading hemisphere is dark (~4%) and reddish
  - Iapetus' trailing hemisphere is bright (~60%) and contains water ice
  - VIMS evidence points to exogenic origin (Clark *et al*, 2007)
- Endogenic or Exogenic source?
- Phoebe? Hyperion? Titan (tholins)? Comet Dust?

  Probably external to the Saturn system (Clark *et al*., 2007)

  But are there multiple sources, including endogenic?
- What is the composition of the dark material and are there variations in composition?
  - E.g. are there local deposits of different compounds?
    - If so, what are the origins?
- What is the source of the 3 different CO_2 absorption band positions/shapes?

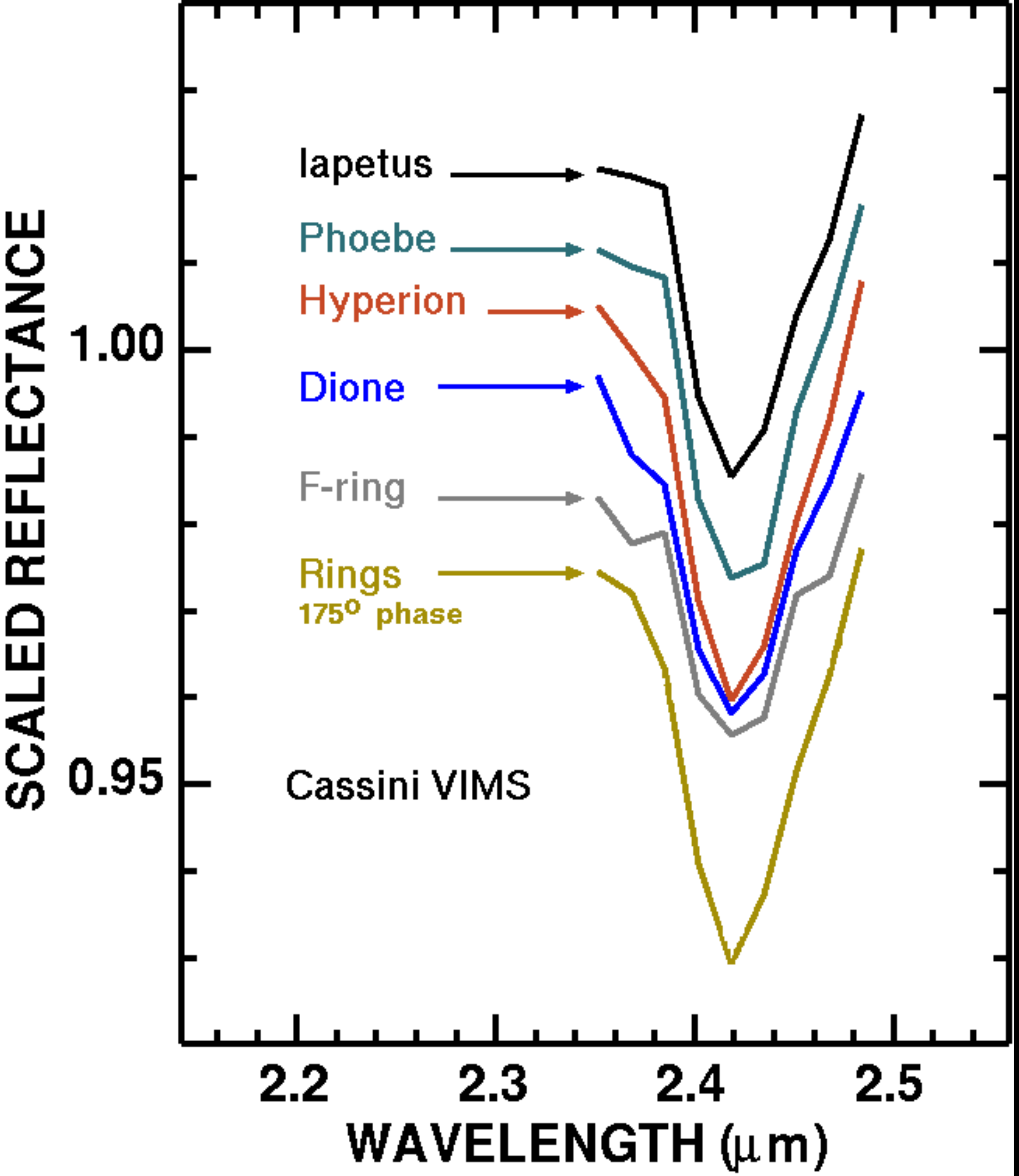


2.42micron
H2O or NH
H2O or NH
CO2
xCN?
Iapetus dark regions
Cassini VIMS
S07 RC15
3226 pixel average
spv0006 r 550
APPARENT REFLECTANCE
0.00
0.01
0.02
0.03
1
2
3
4
5
WAVELENGTH (μm)

VIMS observes a 2.42-micron feature throughout the Saturn system.

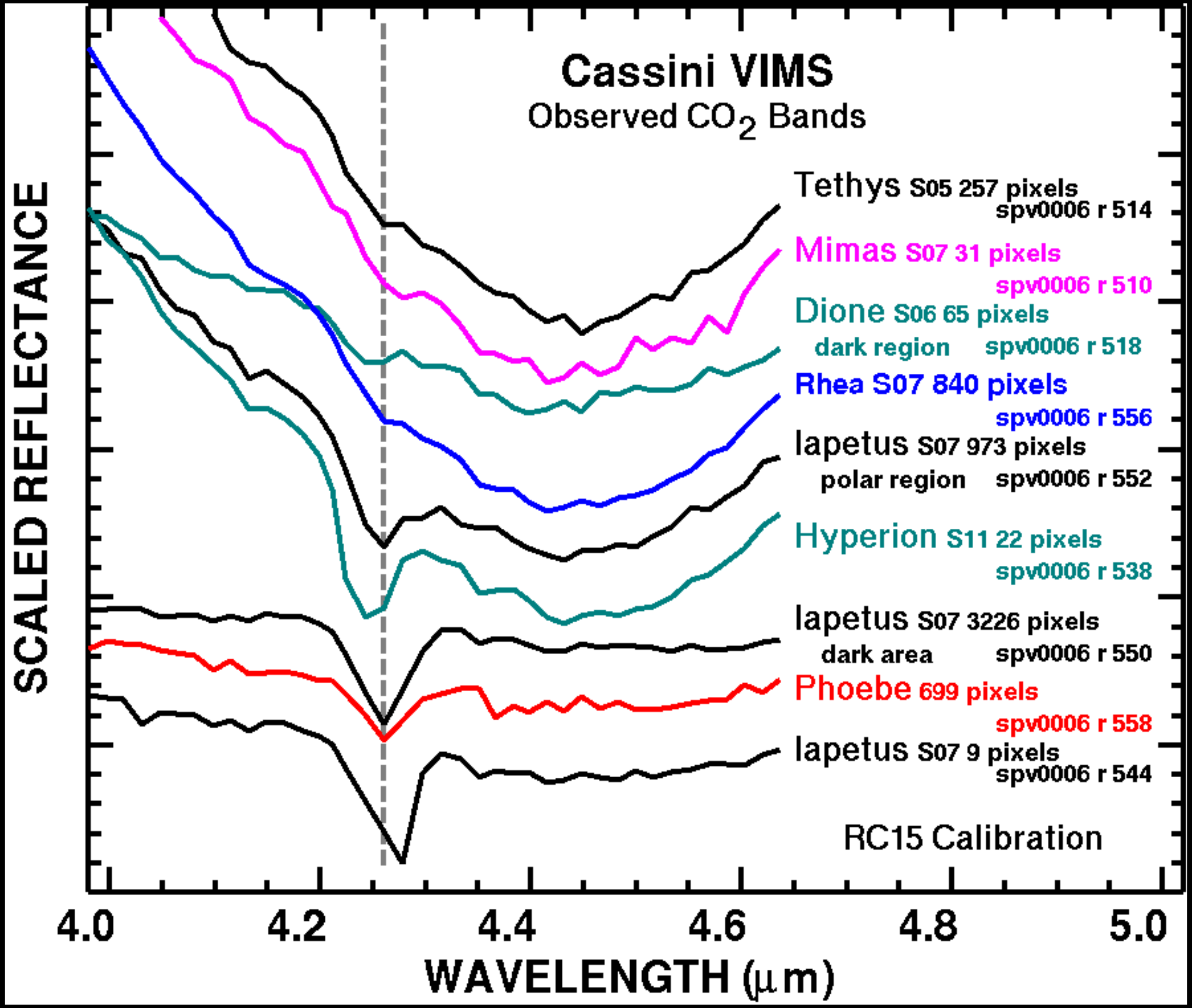
What is the origin?

The Iapetus rev 49 fly-by is the only opportunity in the Cassini mission to resolve in detail surface features that may shed light on the origin of the 2.42-micron feature seen in dark material.



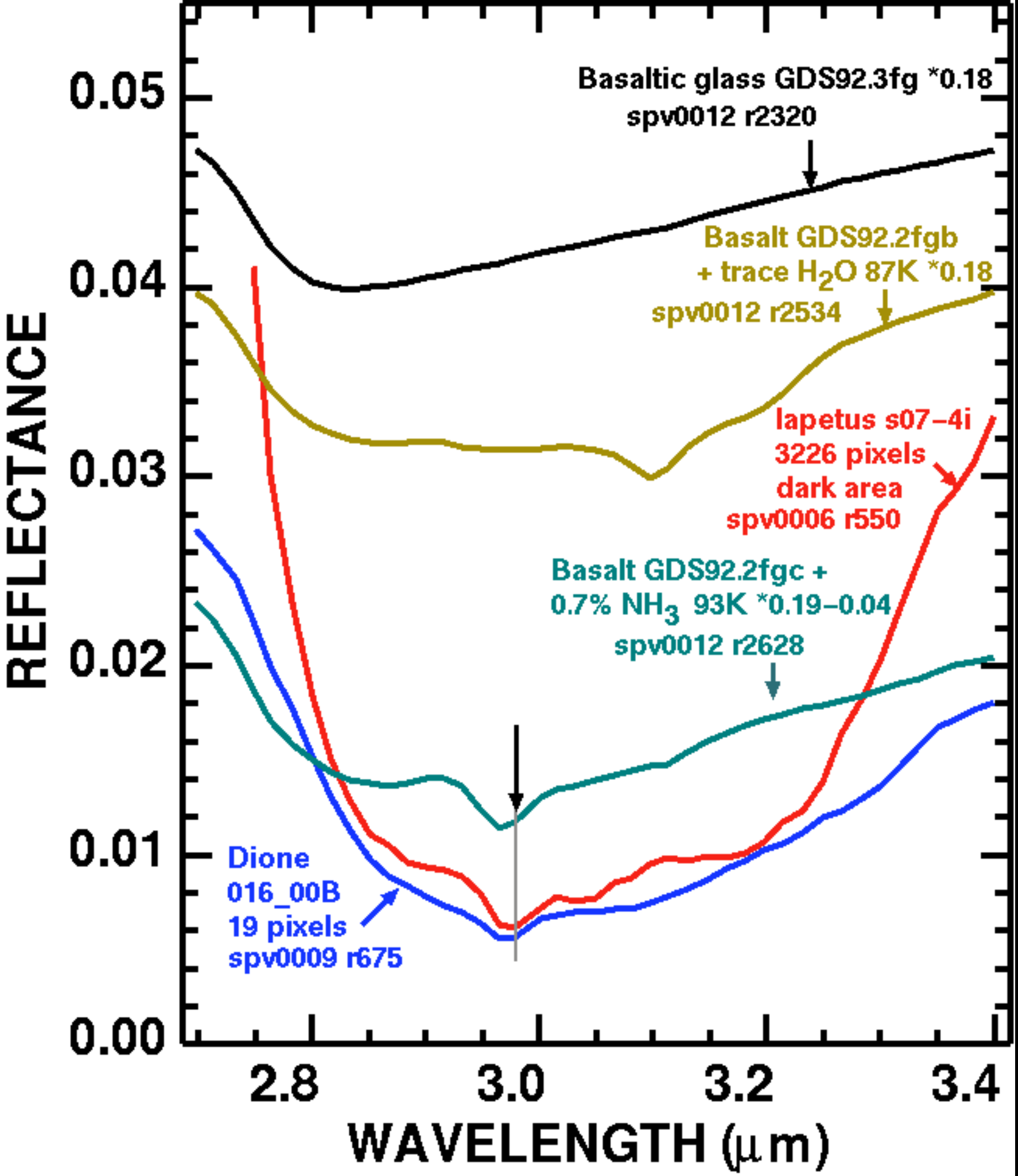
VIMS observes The greatest diversity in CO_2 band positions on Iapetus.

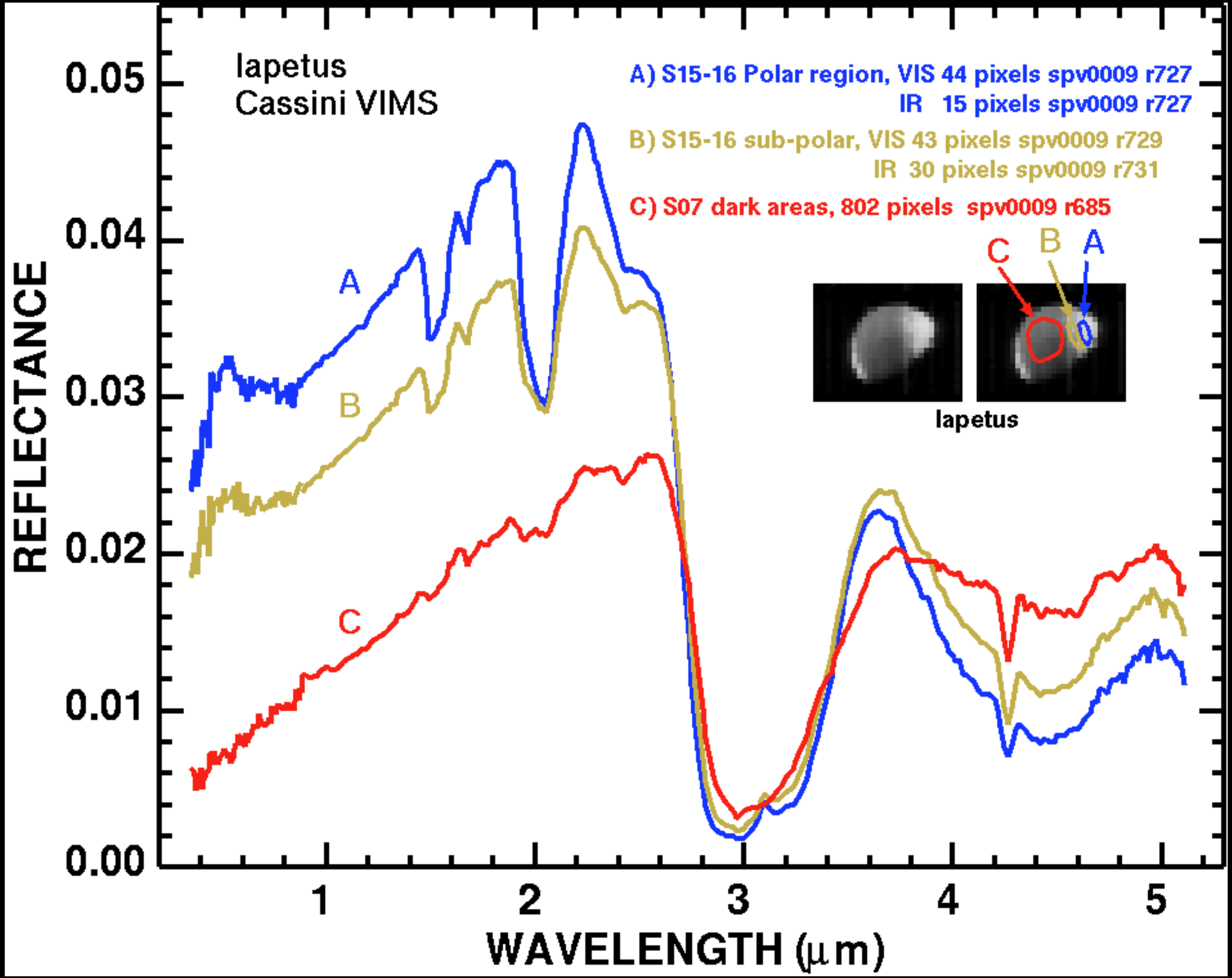
The close Iapetus rev 49 fly-by provides the highest resolution opportunity in the Cassini mission to map and understand these absorptions.



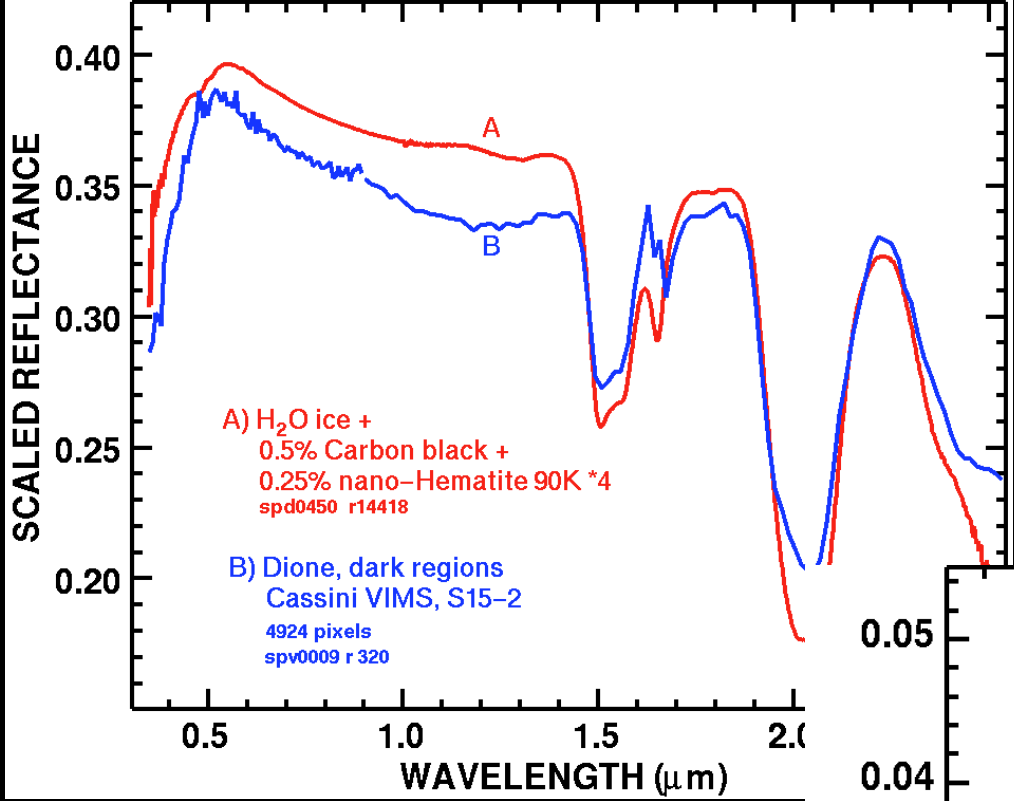
VIMS has tentatively detected trace ammonia on Iapetus (and Dione).

VIMS will map this absorption on Iapetus in the rev 49 fly-by to help determine its extent and origin.

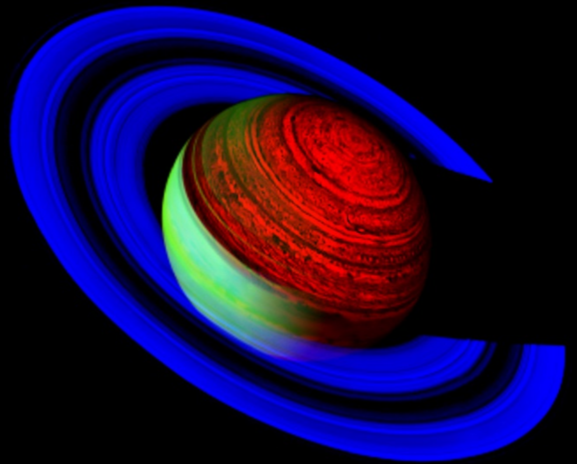


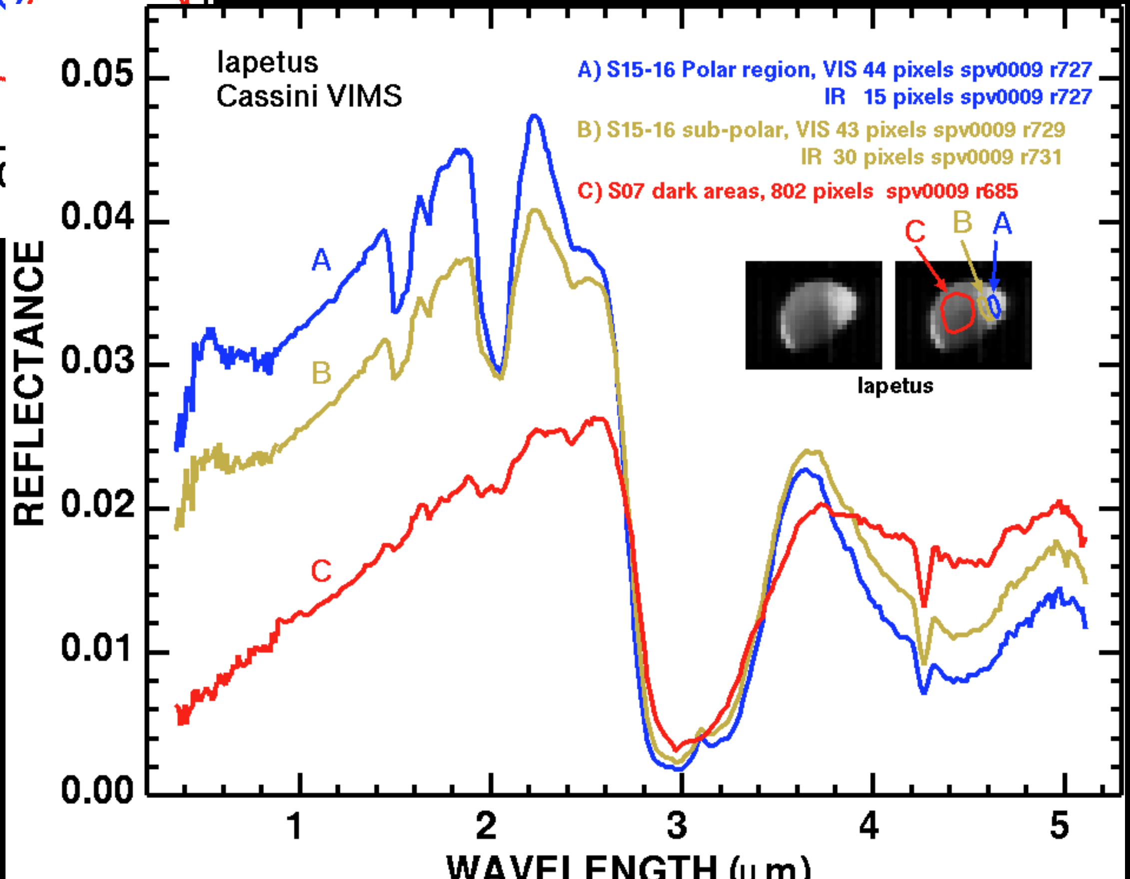


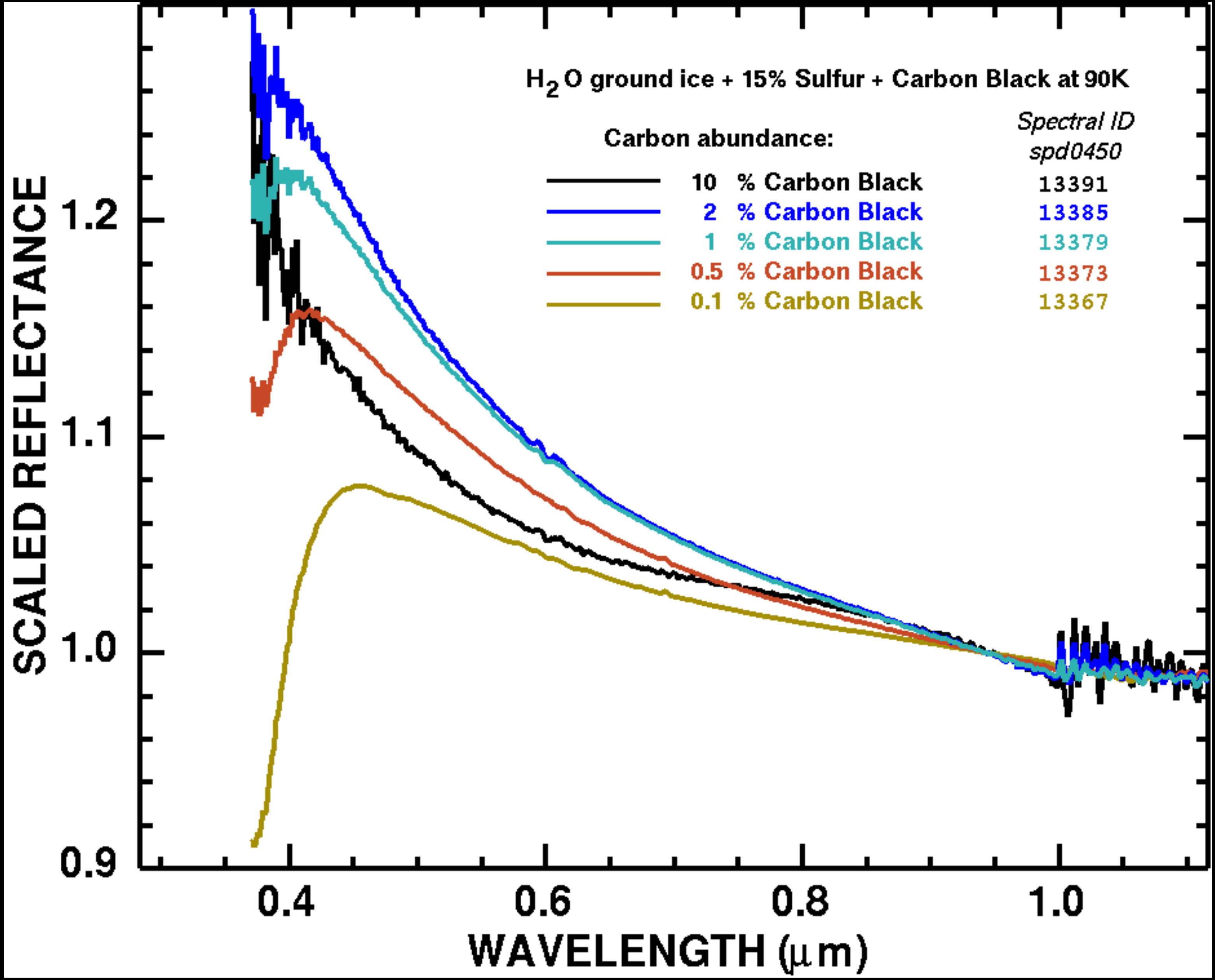
- Rayleigh scattering causes a blue peak caused by small amounts of particles <0.5-micron in diameter.
- VIMS will map the magnitude and distribution of the Rayleigh effect.



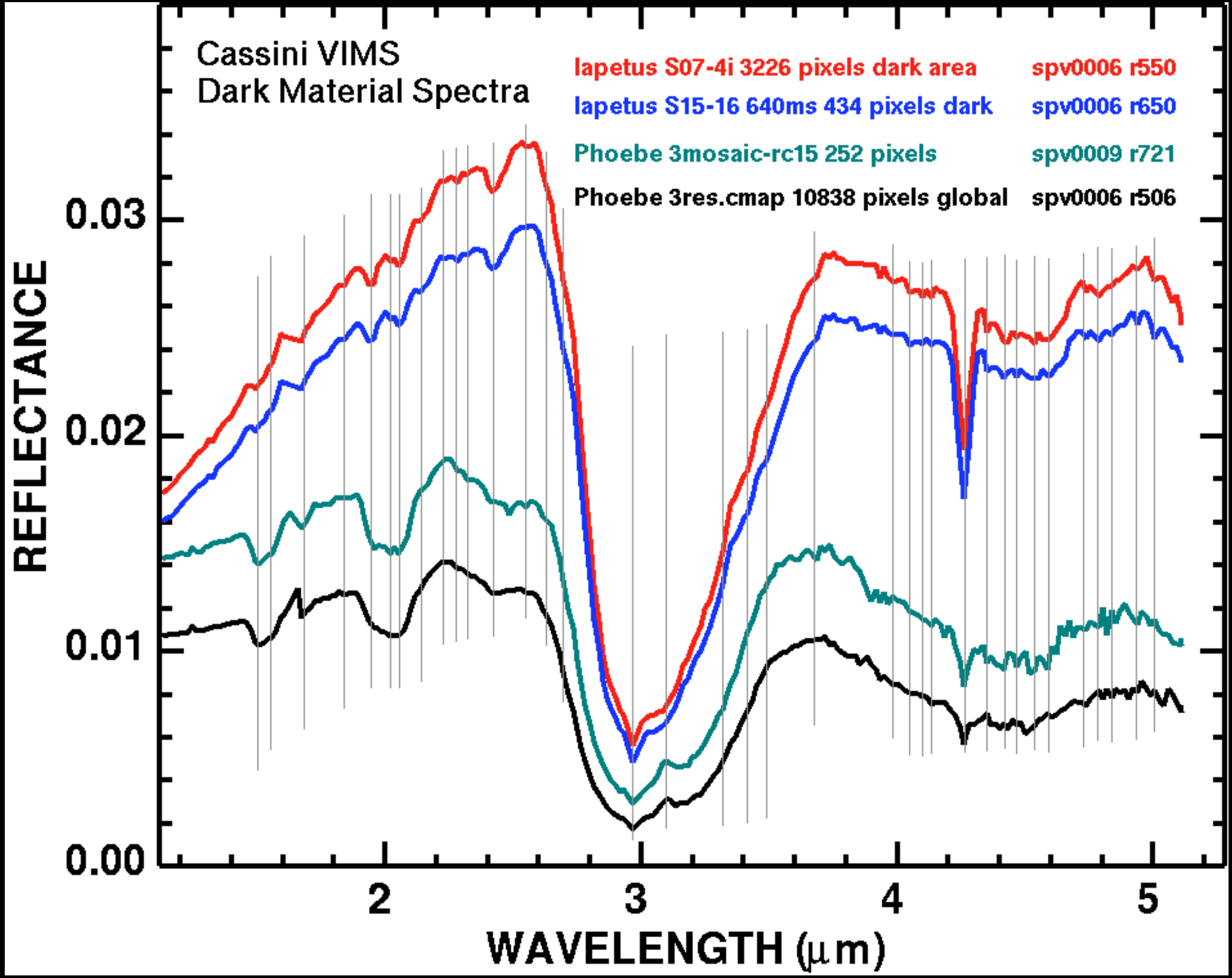
Rayleigh scattering is observed on Dione, Phoebe, Hyperion, the rings and other satellites.





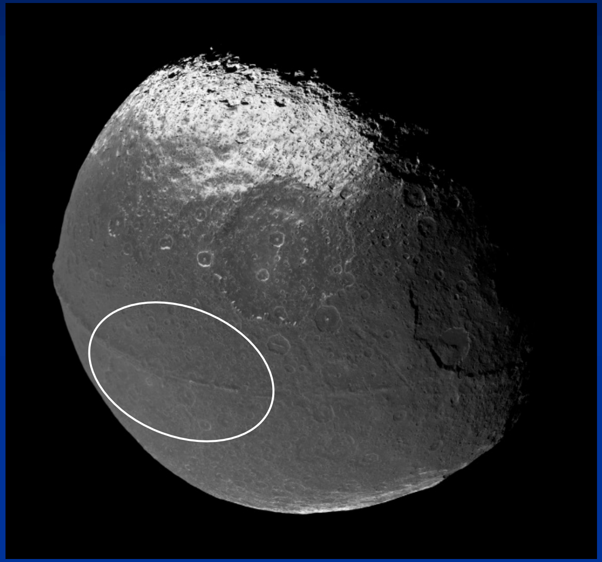


Rayleigh scattering is observed in laboratory samples, both constructed and naturally occurring terrestrial rocks.

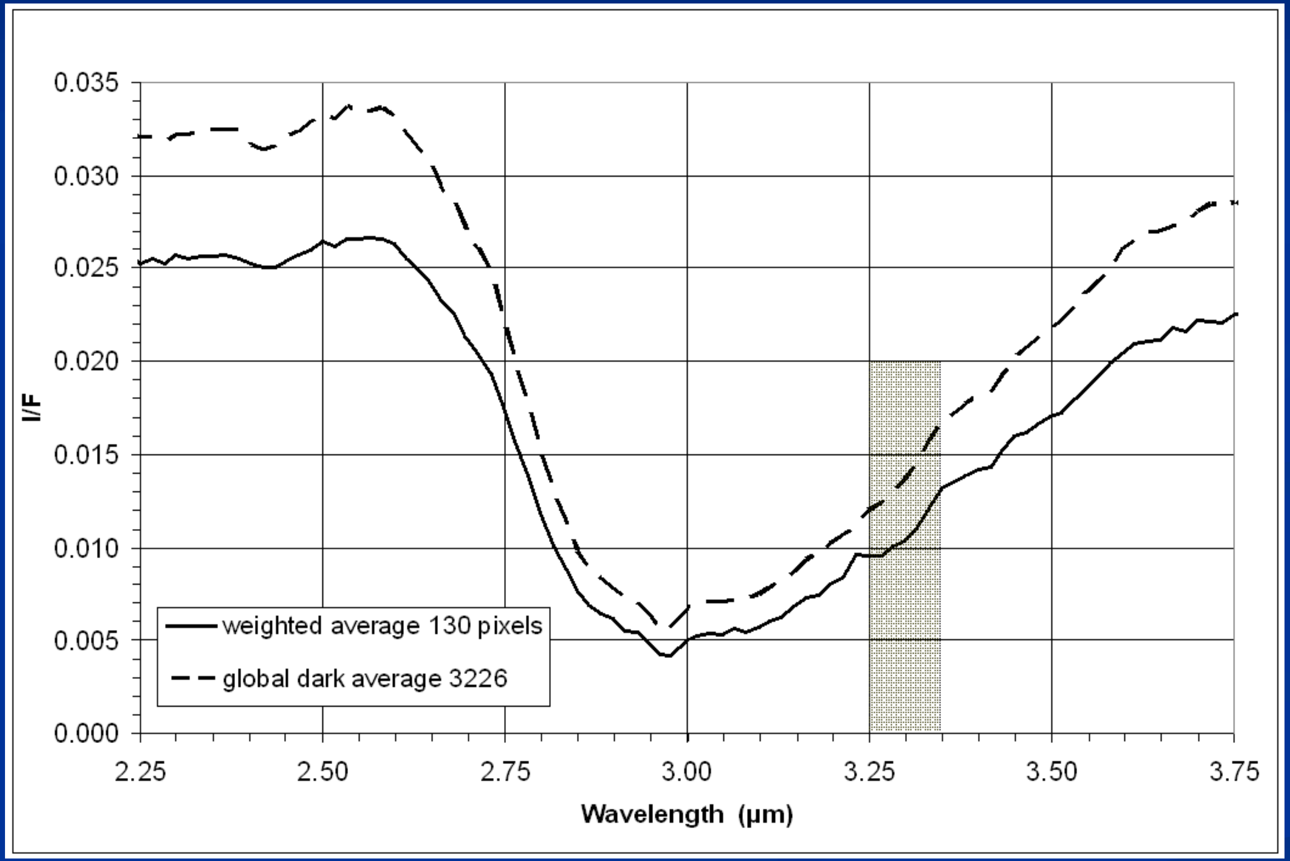


VIMS observes a vast array of absorptions common to both Iapetus and Phoebe. The rev 49 fly-by will allow higher S/N definition of the features and potential to isolate different compounds in smaller outcrops.

Aromatic and Aliphatic Material on Iapetus: Results from the *Cassini* VIMS Investigation

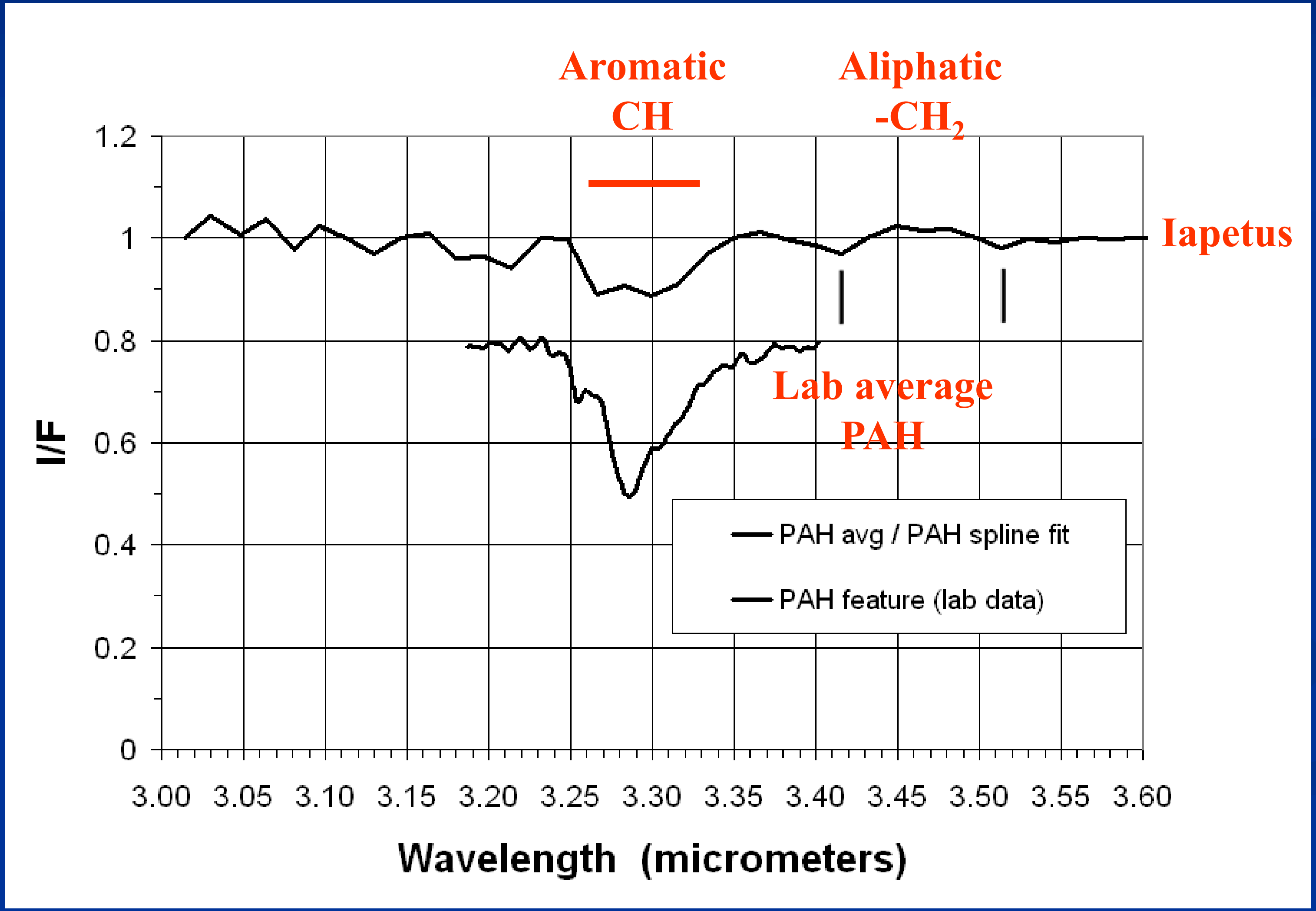


Leading hemisphere of Iapetus (diameter 1440 km). Albedo ~0.07. Density 1.1 g cm^{-3}.

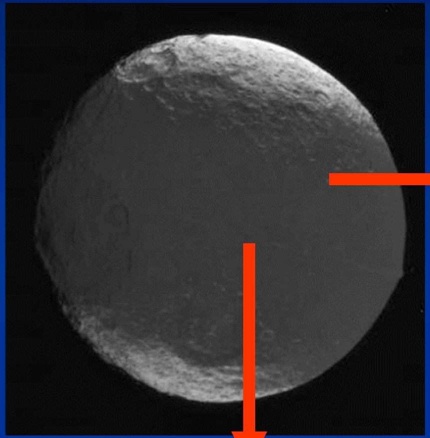


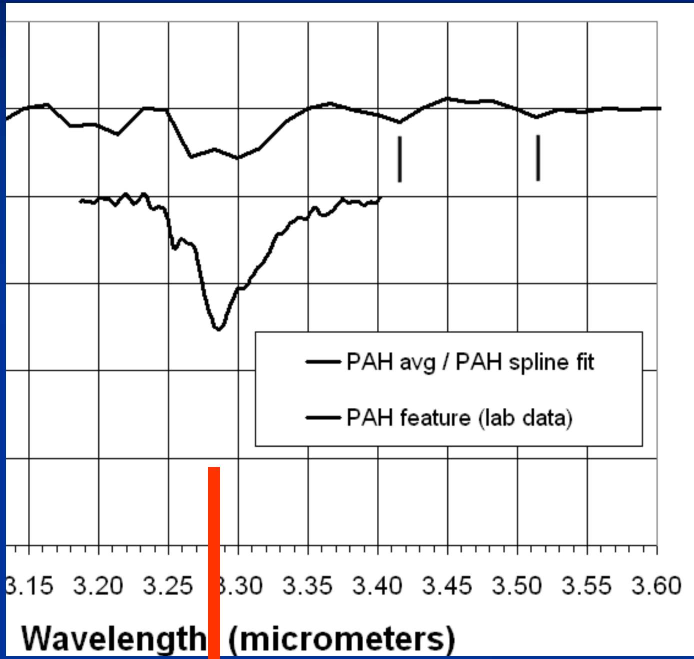
D. P. Cruikshank and the VIMS Team, Abstract DPS Sept. 2005.
Paper in press Icarus (special Cassini issue)

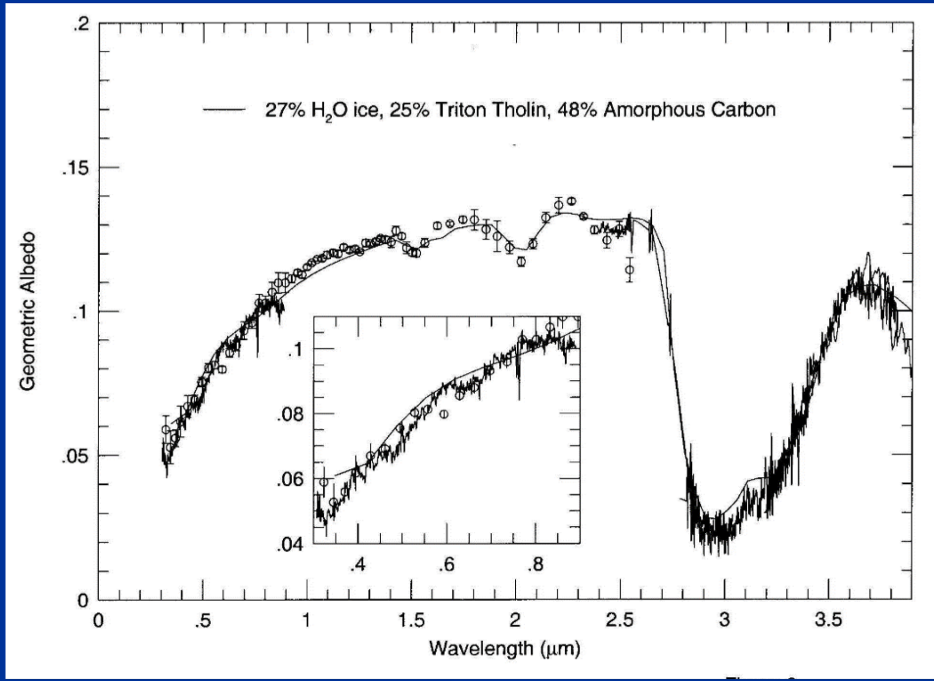
6-sigma detection of PAH on Iapetus low-albedo hemisphere



Iapetus links tholins to specific, remotely sensed organic spectral absorption bands



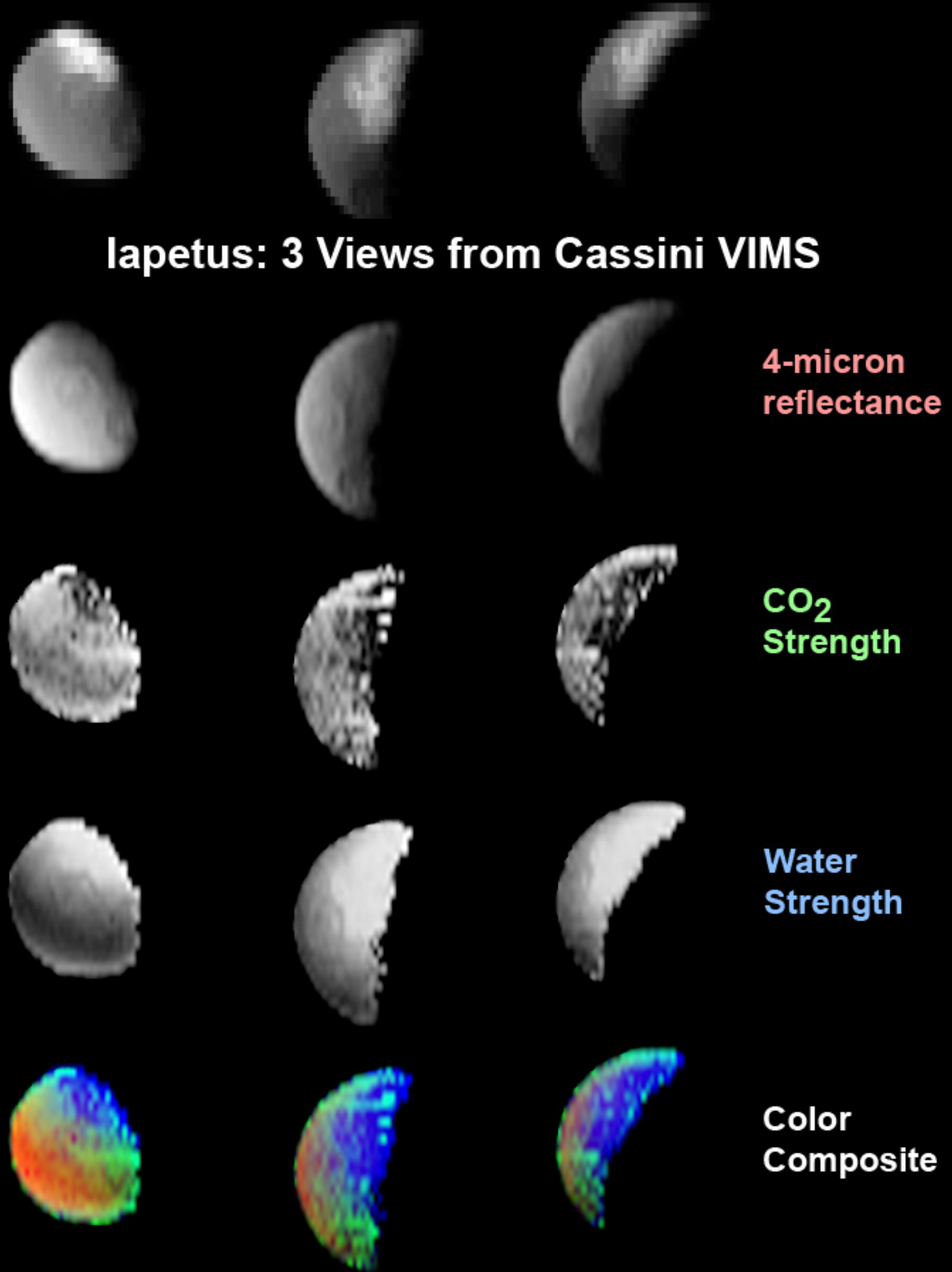




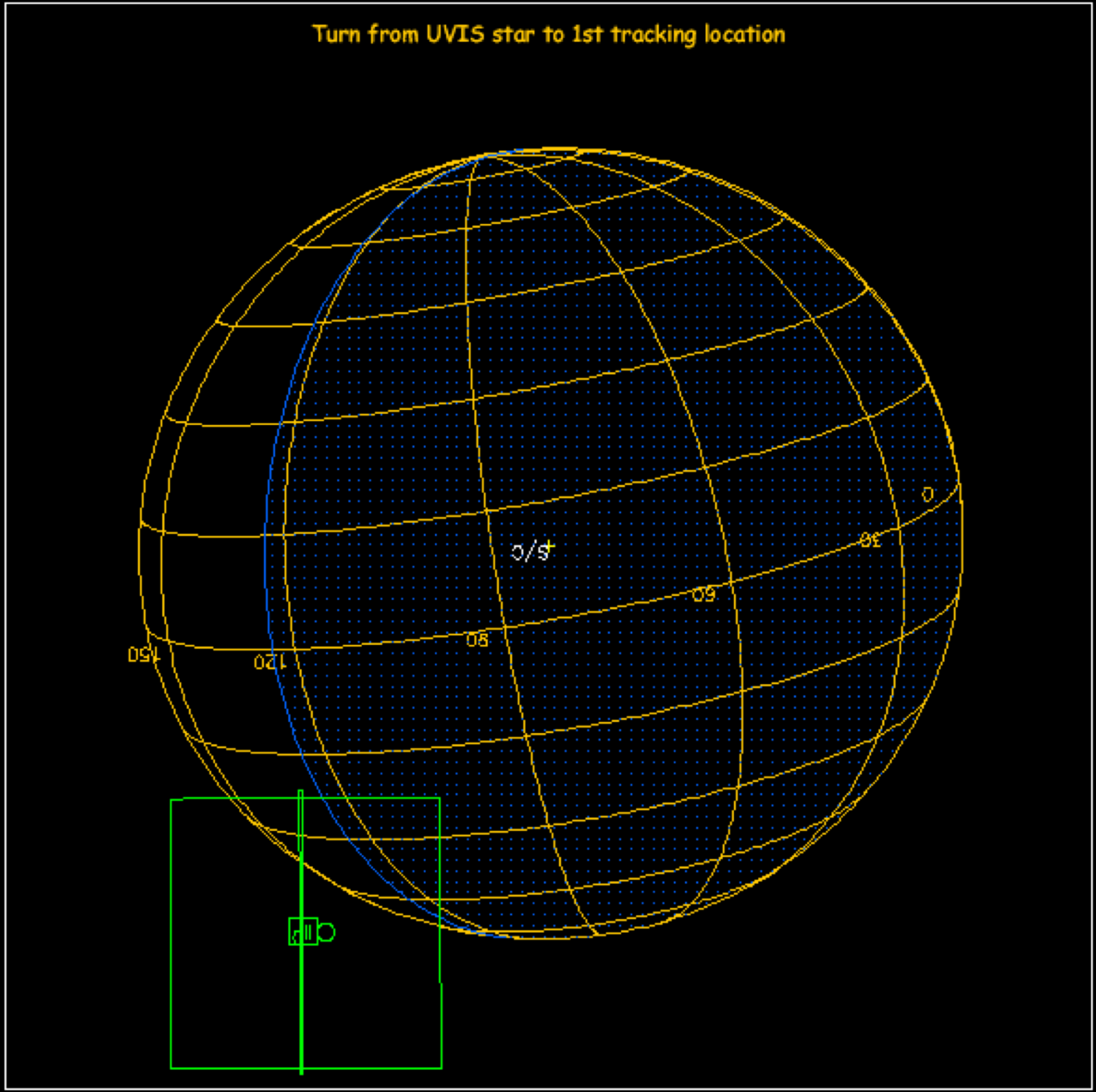
Tholin made by Bishun Khare

Current low spatial resolution VIMS maps show variable compositions across Iapetus.

The rev 49 fly-by will provide extraordinary detail.

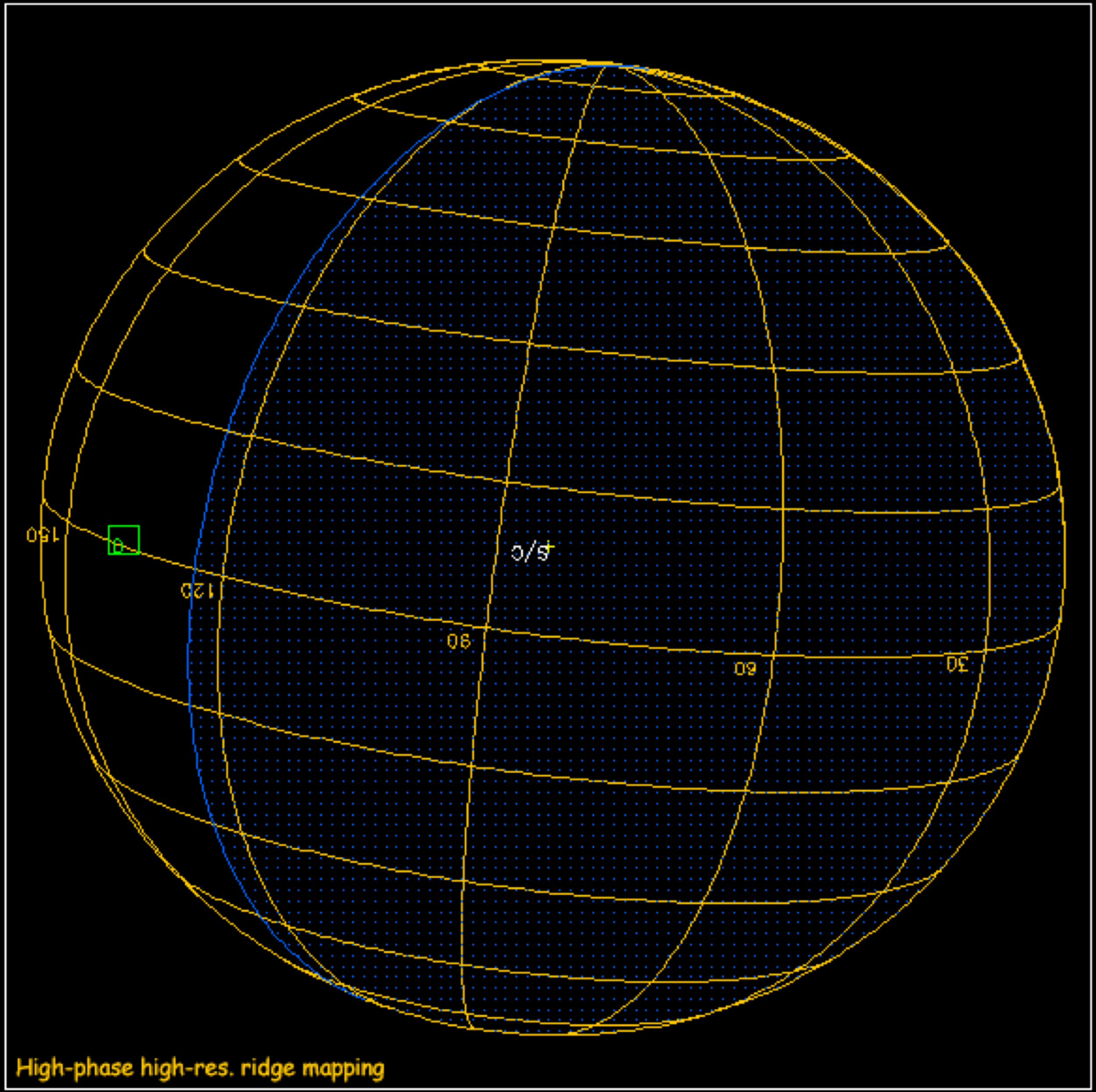


VIMS_049IA_ORSHIRES001



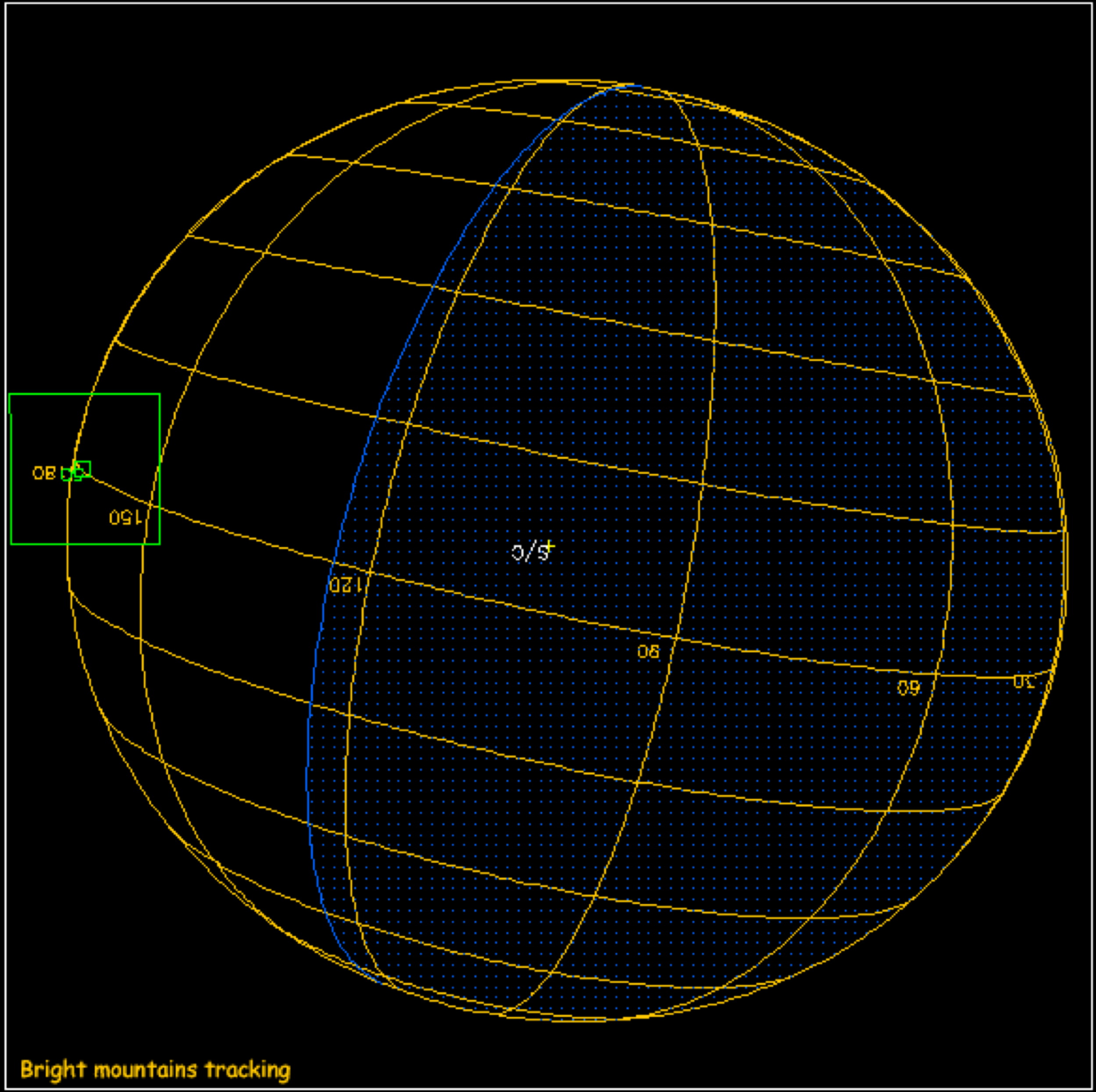
Start UTC : 2007 SEP 10 13:20:40.000, End UTC : 2007 SEP 10 13:20:40.000
FOV : ISS NAC, ISS WAC, CIRS FP1, CIRS FP3, CIRS FP4, UVIS FUV HI

ISS_049IA_ORSHIRES001_VIMS



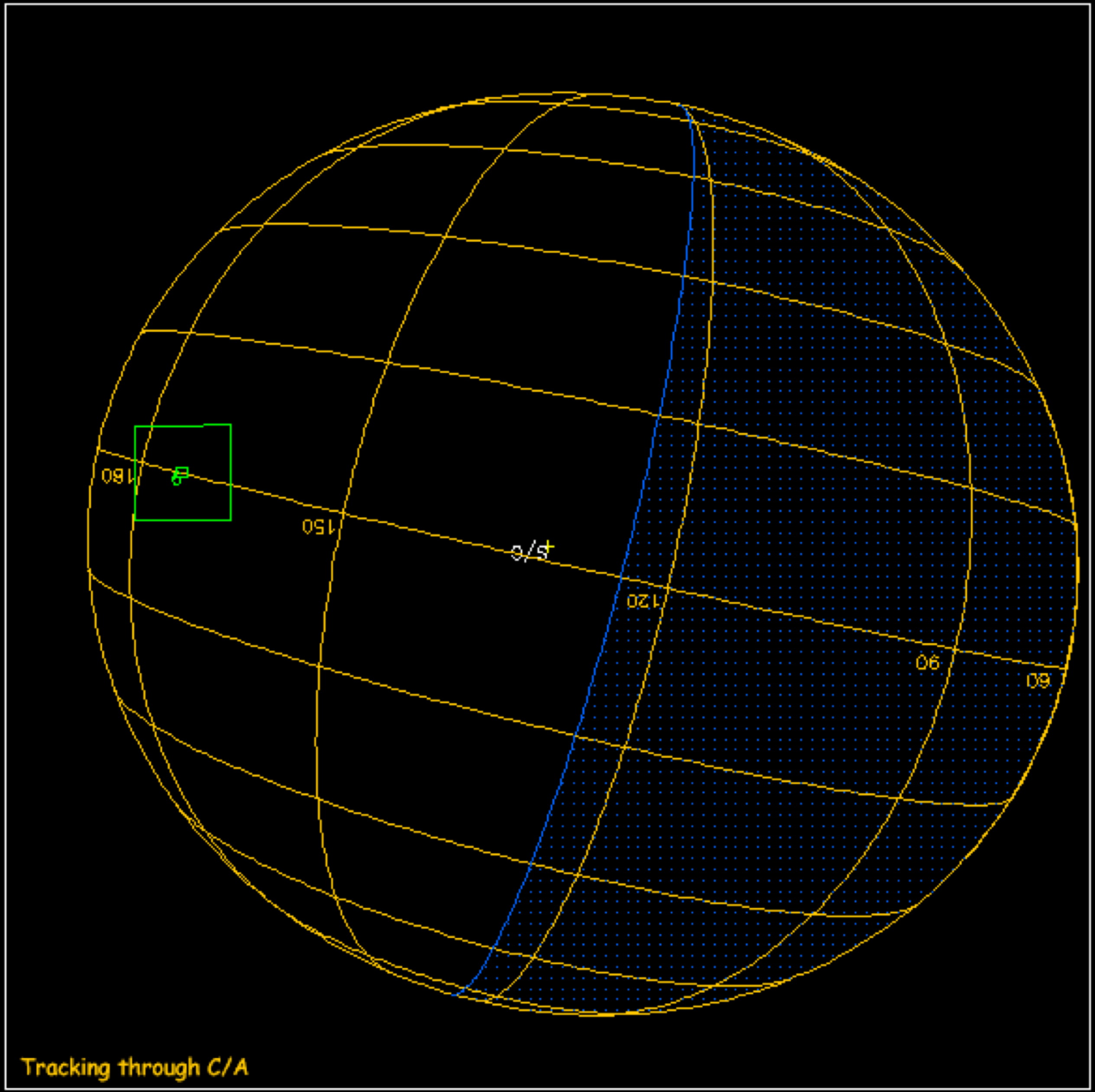
Start UTC : 2007–253T13:26:55.000, End UTC : 2007–253T13:26:55.000
FOV : ISS NAC

ISS_049IA_ORSHIRES001_VIMS



Start UTC : 2007 SEP 10 13:53:52.000, End UTC : 2007 SEP 10 13:53:52.000
FOV : ISS NAC, ISS WAC

ISS_049IA_ORSHIRES001_VIMS



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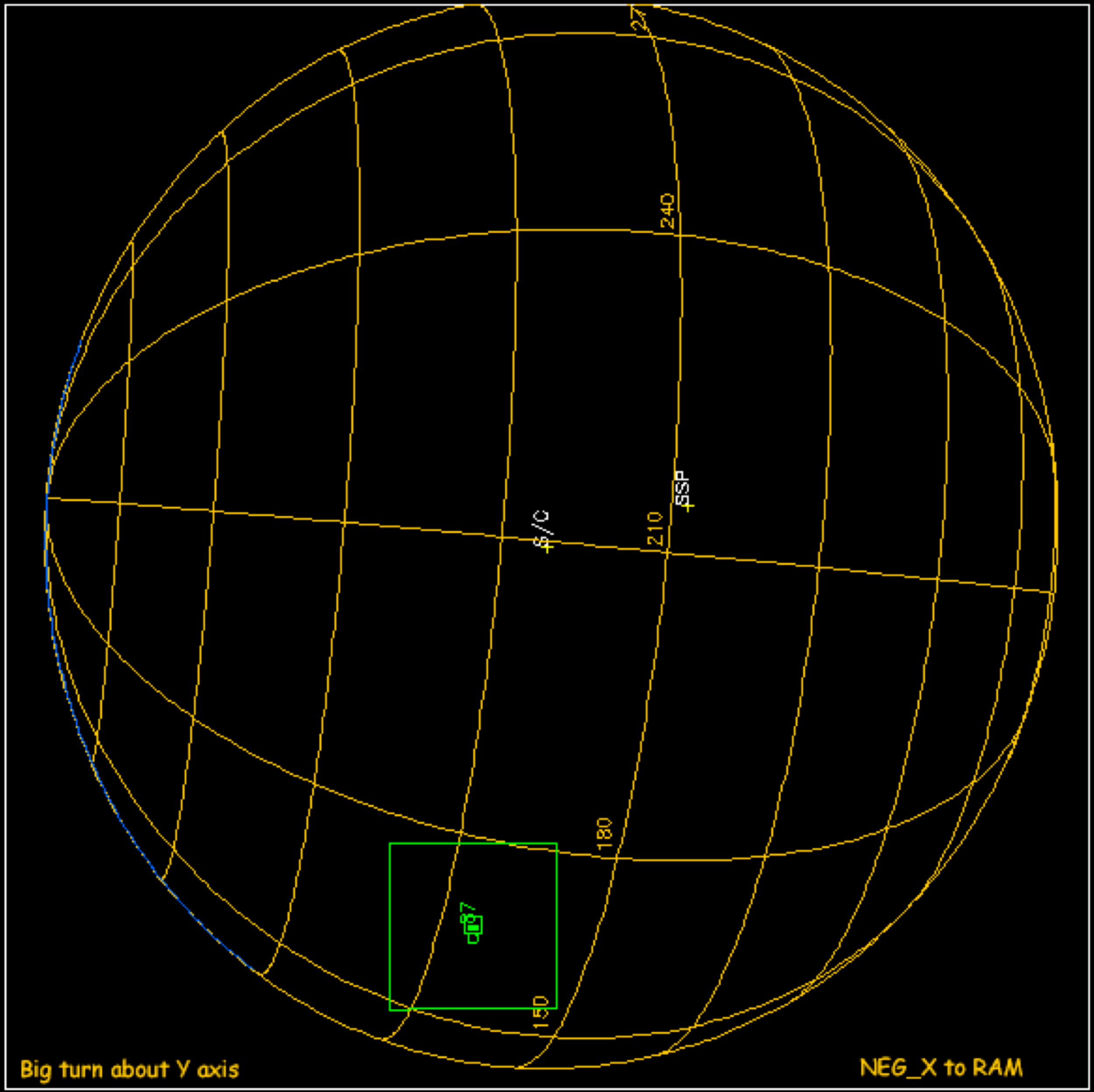
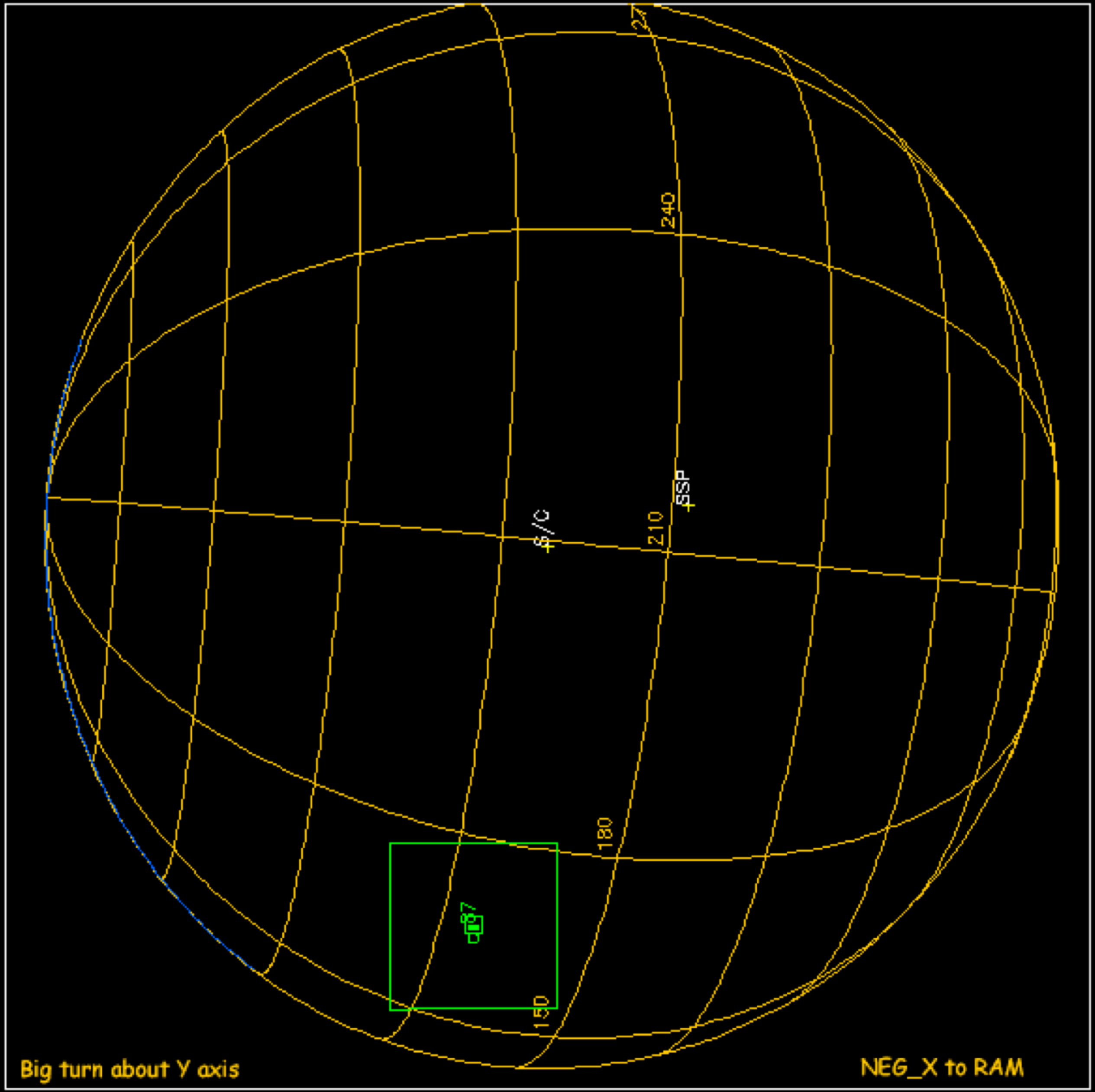
FOV : ISS NAC, ISS WAC

VIMS_049IA_ORSHIRES001



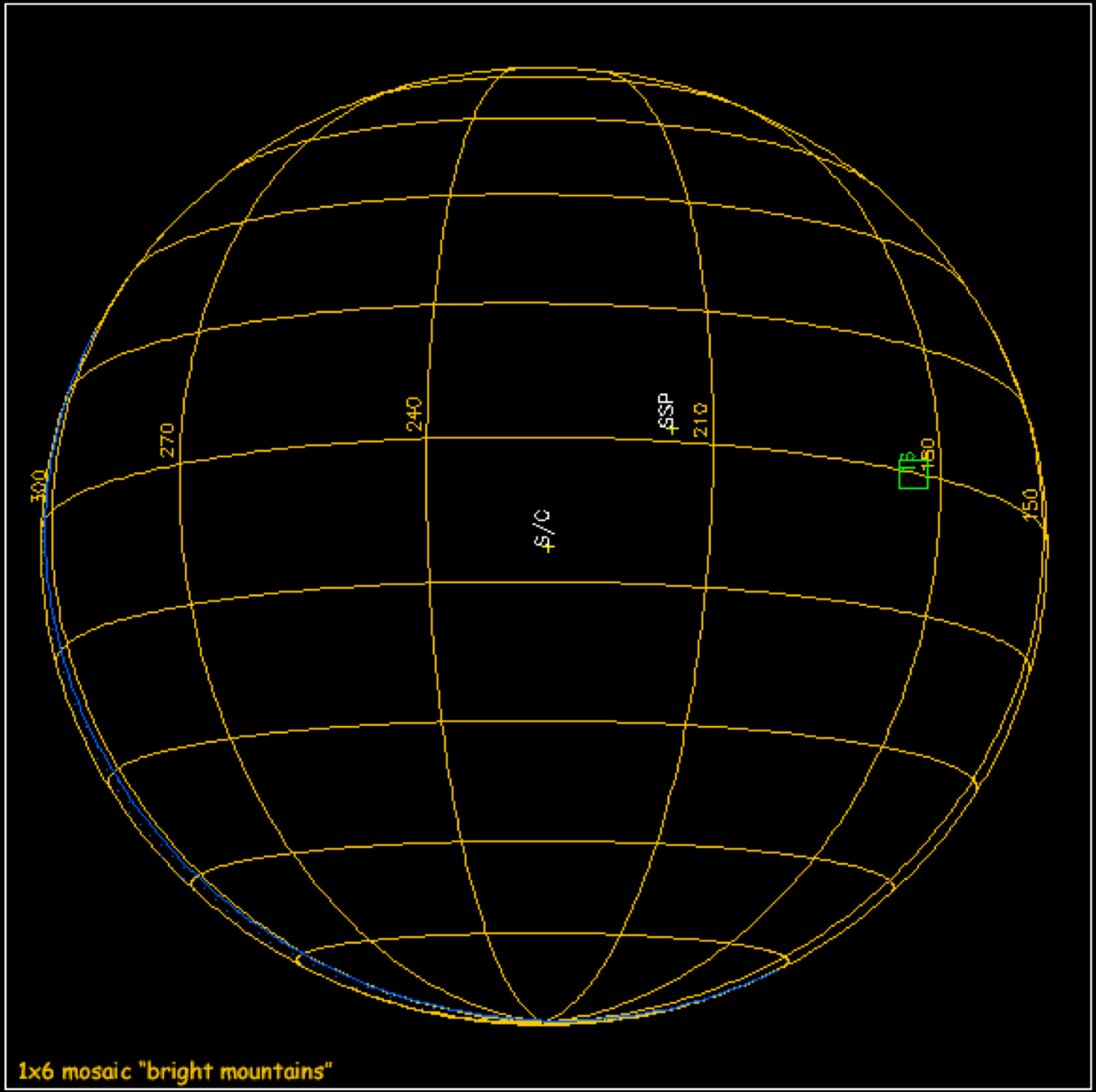
Start UTC : 2007 SEP 10 14:38:21.000, End UTC : 2007 SEP 10 14:38:21.000
FOV : ISS NAC, ISS WAC, CIRS FP1, CIRS FP3, CIRS FP4

VIMS_049IA_ORSHIRES001

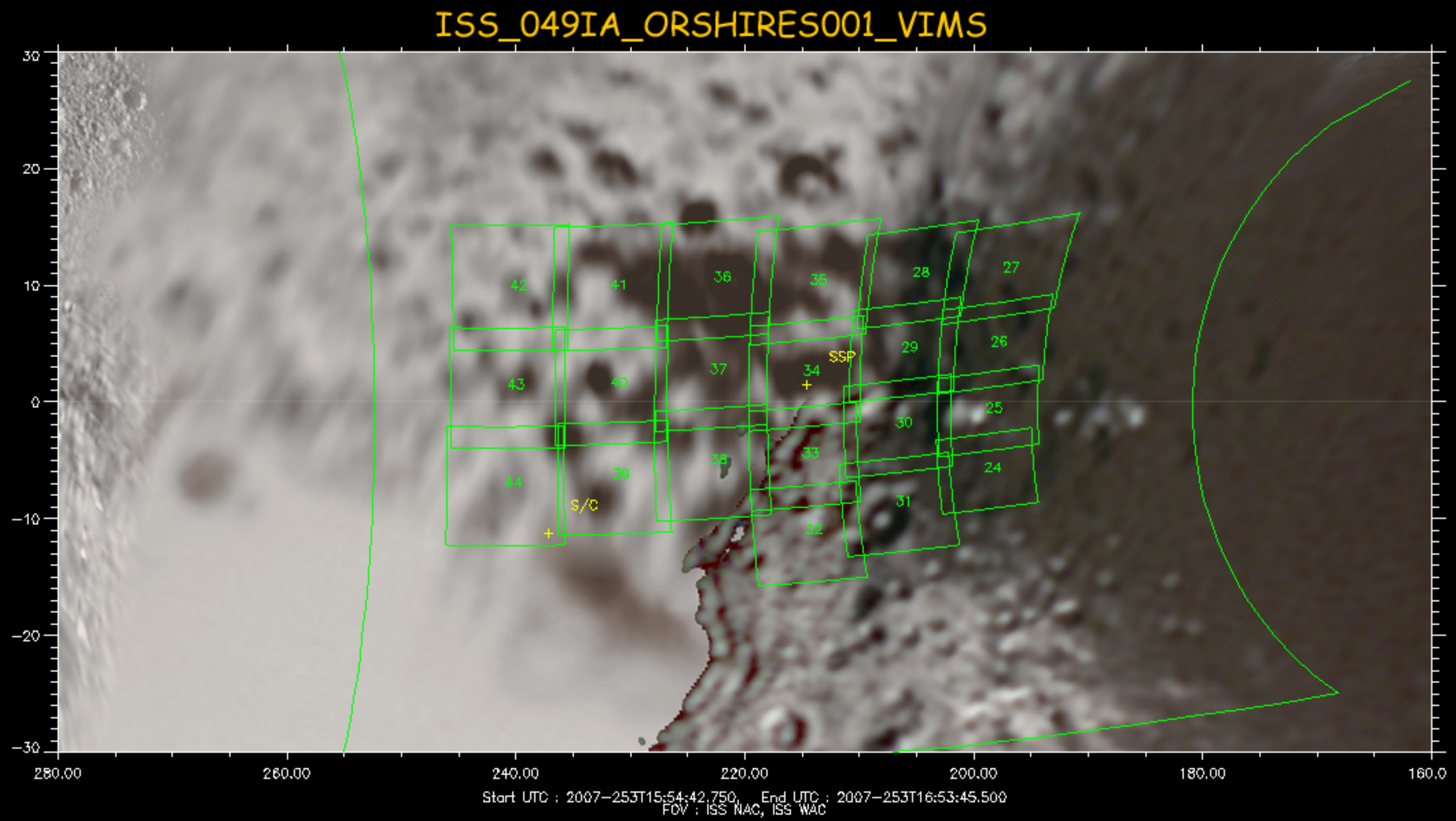


Start UTC : 2007 SEP 10 14:38:21.000, End UTC : 2007 SEP 10 14:38:21.000
FOV : ISS NAC, ISS WAC, CIRS FP1, CIRS FP3, CIRS FP4

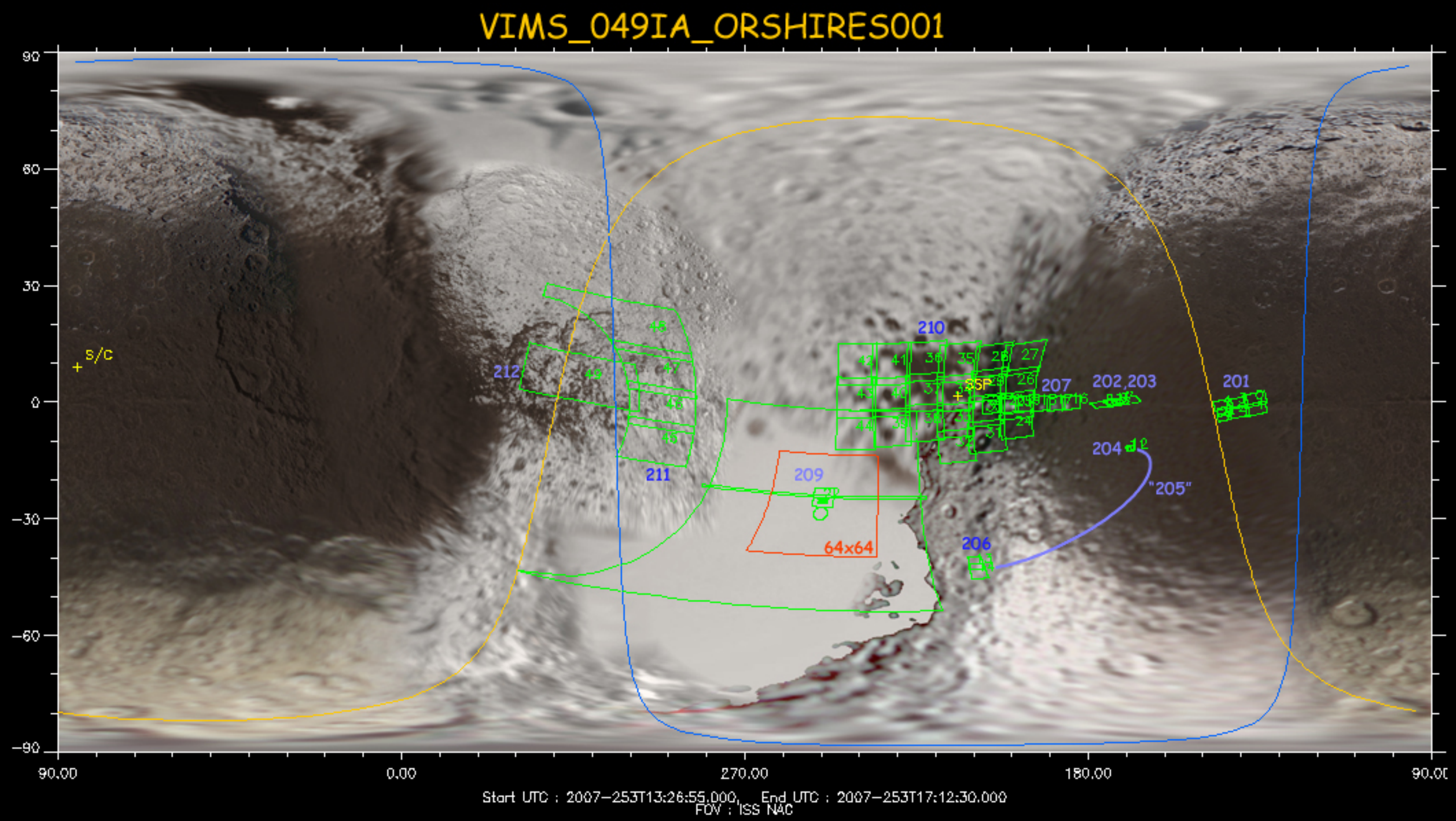
ISS_049IA_ORSHIRES001_VIMS



Start UTC : 2007–253T15:03:56.750, End UTC : 2007–253T15:03:56.750
FOV : ISS NAC



ISS_049IA_ORSHIRES001_VIMS
30
20
10
0
−10
−20
−30
280.00
260.00
240.00
220.00
200.00
180.00
160.0
42
41
36
35
28
27
43
40
37
34
SSP
29
26
30
25
44
39
38
33
31
24
S/C
32
Start UTC : 2007−253T15:54:42.750, End UTC : 2007−253T16:53:45.500
FOV : ISS NAC, ISS WAC



The rev 49 fly-by will provide extraordinary detail.

VIMS Iapetus Science

Identification of minerals and other materials on the surface of Iapetus.

Mapping the abundance, and grain sizes of surficial materials.

Grain-Size Mapping

Reflectance from 0.35 to 5.2 microns

Phase function

surface microstructure

Bond albedo

Temperatures > 120K (5-micron emission)

Measure Ice temperatures down to 60K and less
(New capability under development using temperature dependent shape changes in the reflection spectra of ice.)

IAPETUS PREVIEW MEETING

August 24, 2007

Nicole Rappaport, the Gravity Discipline
Group of the Cassini Radio Science Team,
Aseel Anabtawi, and Ruaraidh Mackenzie

IAPETUS AND PREVIOUS FLYBYS

- IAPETUS
  - Semi-major axis = 3.561 x 10^6 km
  - Orbital period = 79.33 days
  - Eccentricity = 0.0284
  - Mean radius = 718 km
- TWO PREVIOUS CASSINI FLYBYS
  - 17 October 2004
    - C/A at 1.11 x 10^6 km
    - SEP = 87º
    - v_{rel} = 3.7 km/s
  - 31 December 2004
    - C/A at 1.23 x 10^5 km
    - SEP = 165°
    - v_{rel} = 2.0 km/s

ROUGH ORDER OF MAGNITUDE CALCULATIONS

The picture can't be displayed.

$$\Delta v \approx \frac{GM}{b^2}\frac{b}{v} \Rightarrow \frac{\sigma_{GM}}{GM} \approx \left|\frac{\sigma_V}{\Delta v}\right| + \left|\frac{\sigma_b}{b}\right|$$

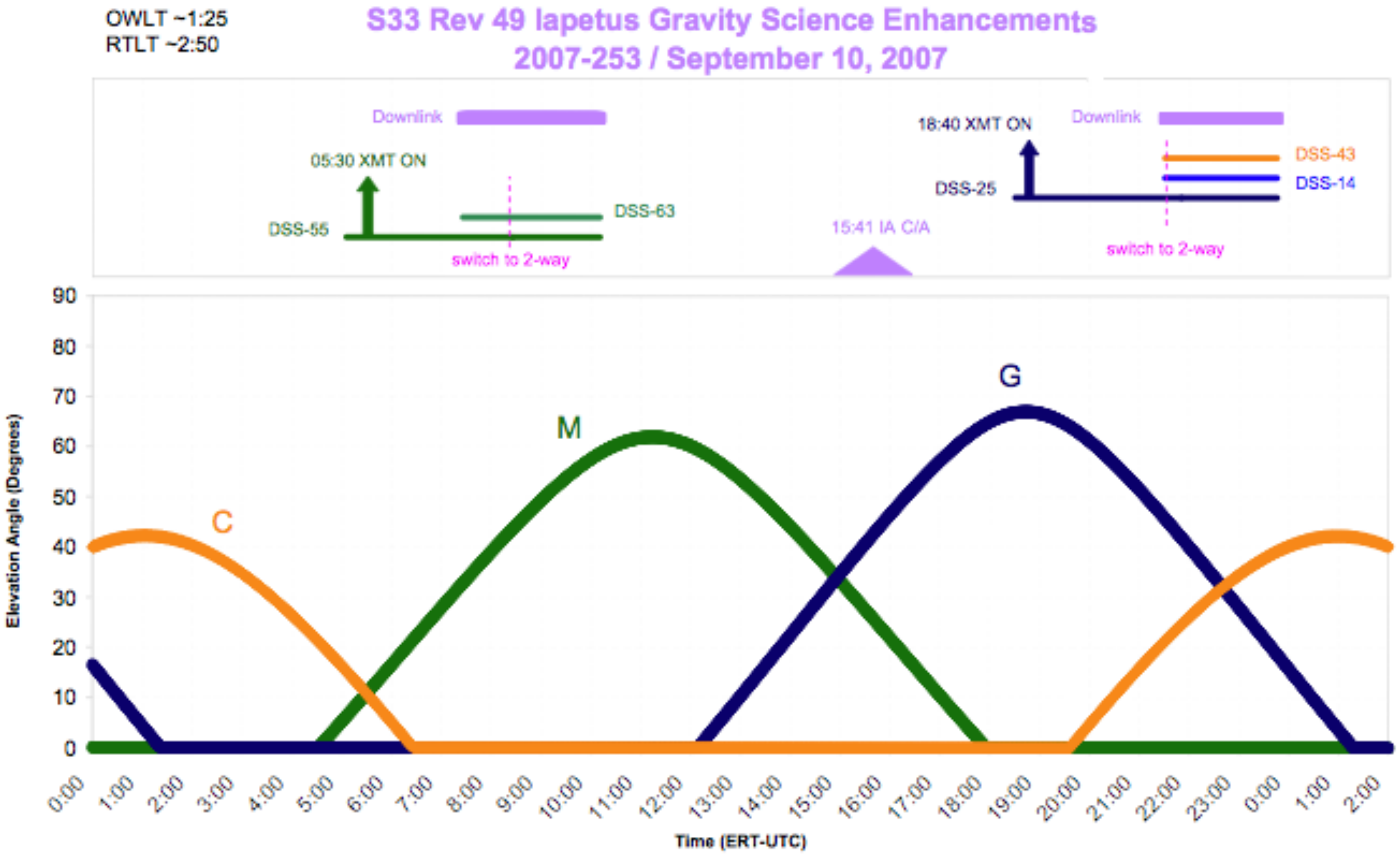
	$\sigma_v/\Delta v$	σ_b/b
Flyby #1	5×10^{-4}	5×10^{-5}
Flyby #2	2.3×10^{-5}	5×10^{-4}

This assumes σ_b = 50 km. In flyby #2 σ_b/b is the dominant uncertainty.

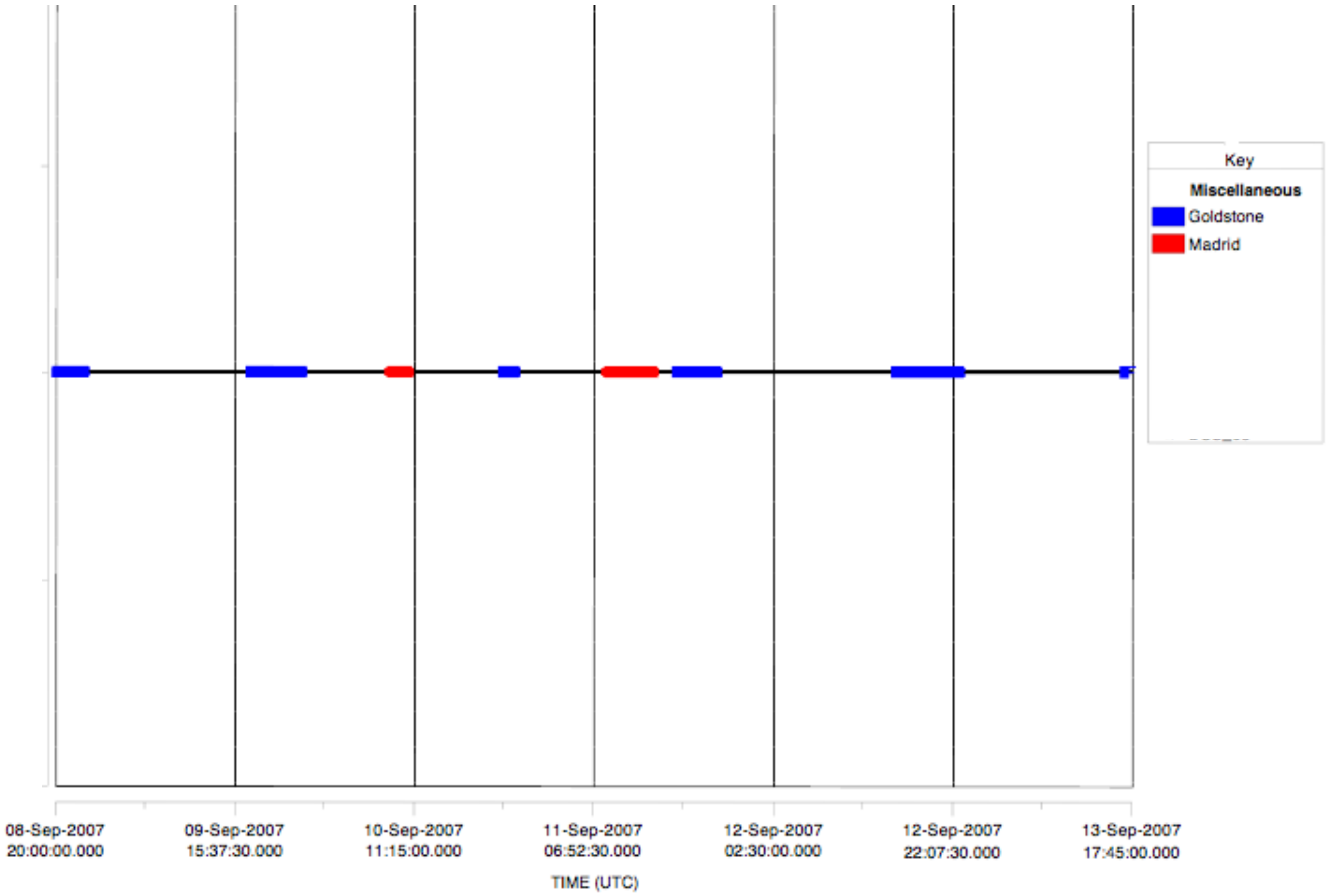
GRAVITY SCIENCE RESULTS

- VOYAGER DETERMINATION
  - GM = 106 +/- 10 km^3/s^2 (Campbell & Anderson 1989)
- CASSINI RSS DETERMINATION
  - GM=120.2064 +/- 0.0631 km^3/s^2

THE GRAVITY FLYBY OF SEPTEMBER 10, 2007



SCHEDULED PASSES BETWEEN MANEUVERS



CONCLUSIONS

- The Cassini Gravity Group is now working in collaboration with the Navigation Team (R. MacKenzie) and with geophysicists.
- The NAV and RSS Teams have compared their analysis of Rhea in detail and combined their approaches to obtain improved values. The X/Ka band Doppler and AMC corrections are preferred to X/X data and standard corrections are used whenever possible.
- A conservative estimate is that we will improve the accuracy of the mass determination by more than a factor of two.