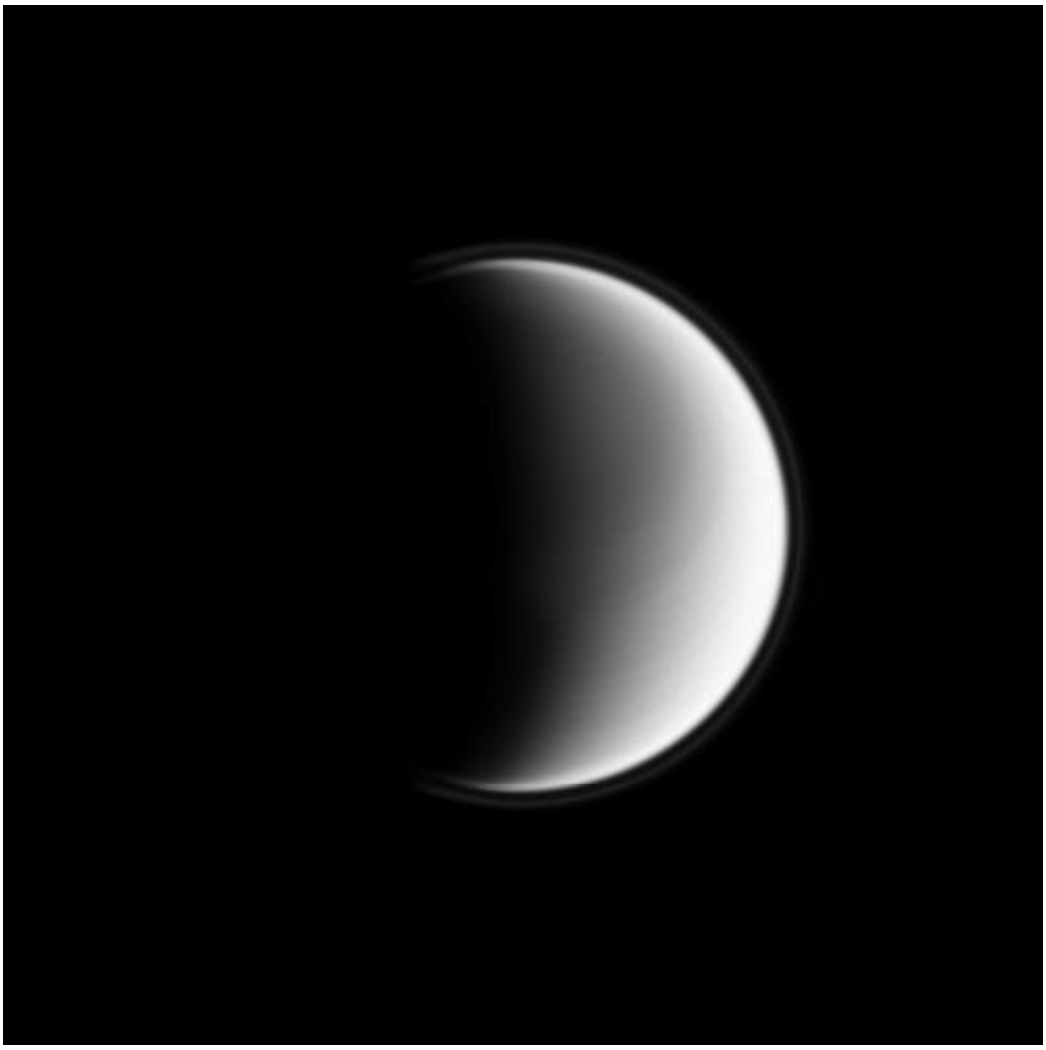
C A S S I N I



T I T A N **1 1 1 T I (T 5 5)** MISSION DESCRIPTION

May 21, 2009

Jet Propulsion Laboratory
California Institute of Technology

Cover image: Hazy Halo

May 5, 2009

The Cassini spacecraft reveals Titan's upper-most atmospheric hazes, creating the appearance of a halo around Saturn's largest moon.

For a color view of the atmosphere's upper layers from another viewing geometry, see Hazy Ring of Titan's Sky.

Also visible in this image are hints of atmospheric banding around Titan's north pole. The north pole lies near the terminator about a quarter of the way inward from planet's limb at the top of this image. To learn more about the northern bands, see Northern Bands.

Most of the lit terrain seen here is on the anti-Saturn side of Titan (5,150 kilometers, or 3,200 miles across). The image was taken in visible violet light with the Cassini spacecraft wide-angle camera on March 27, 2009. The view was acquired at a distance of approximately 196,000 kilometers (122,000 miles) from Titan and at a Sun-Titan-spacecraft, or phase, angle of 106 degrees. Image scale is 12 kilometers (7 miles) per pixel.

The Cassini-Huygens mission is a cooperative project of NASA, the European Space Agency and the Italian Space Agency. Credit: NASA/JPL/Space Science Institute

1.0 OVERVIEW

Barely less than 16 days since its previous visit, Cassini returns to Saturn's largest moon for the mission's fifty-sixth targeted encounter with Titan. The closest approach to Titan occurs on Thursday, May 21 at 2009-141T21:26:41 spacecraft time at an altitude of 965 kilometers (~600 miles) above the surface and at a speed of 6.0 kilometers per second (~13,400 mph). The latitude at closest approach is 22 degrees S and the encounter occurs on orbit number 111.

This encounter is set up with two maneuvers: an apoapsis maneuver on May 13, and a Titan approach maneuver, scheduled for May 18. T55 is the fourth flyby in a series of eleven inbound encounters and the eleventh Titan encounter in Cassini's Solstice Mission. It occurs just over three days before Saturn closest approach.


View of SATURN from CASSINI
2009 MAY 21 21:30:00 UTC
45.0° field of view
JUPITER
NEPTUNE
Solar System Simulator v4.0
IAPETUS

ABOUT TITAN

If Titan were a planet, it would likely stand out as the most important planet in the solar system for humans to explore. Titan, the size of a terrestrial planet, has a dense atmosphere of nitrogen and methane and a surface covered with organic material. It is Titan that is arguably Earth's sister world and the Cassini-Huygens mission considers Titan among its highest priorities.

Although it is far colder and lacks liquid water, the chemical composition of Titan's atmosphere resembles that of early Earth. This, along with the organic chemistry that takes place in Titan's atmosphere, prompts scientists to believe that Titan could provide a laboratory for seeking insight into the origins of life on Earth. Data from the Huygens probe, which touched down on Titan's surface in January 2005, and the Cassini orbiter has shown that many of the processes that occur on Earth also apparently take place on Titan – wind, rain, volcanism, tectonic activity, as well as river channels, and drainage patterns all seem to contribute in shaping Titan's surface. However, at an inhospitable -290 degrees Fahrenheit (-179 degrees Celsius), the chemistry that drives these processes is fundamentally different from Earth's. For example it is methane that performs many of the same functions on Titan that water does on Earth.

The Huygens probe landed near a bright region now called Adiri, and photographed light hills with dark river beds that empty into a dark plain. It was believed that this dark plain could be a lake or at least a muddy material, but it is now known that Huygens landed in the dark region, and it is solid. Scientists believe it only rains occasionally on Titan, but the rains are extremely fierce when they come.

Only a small number of impact craters have been discovered. This suggests that Titan's surface is constantly being resurfaced by a fluid mixture of water and possibly ammonia, believed to be expelled from volcanoes and hot springs. Some surface features, such as lobate flows, appear to be volcanic structures. Volcanism is now believed to be a significant source of methane in Titan's atmosphere. However, there are no oceans of hydrocarbons as previously hypothesized. Dunes cover large areas of the surface.

The existence of oceans or lakes of liquid methane on Saturn's moon Titan was predicted more than 20 years ago. Radar and imaging data from Titan flybys have provided convincing evidence for large bodies of liquid. With Titan's colder temperatures and hydrocarbon-rich atmosphere, these lakes and seas most likely contain a combination of liquid methane and ethane (both hydrocarbons), not water.

The Cassini-Huygens mission, using wavelengths ranging from ultraviolet to radio, is methodically and consistently revealing Titan and answering long-held questions regarding Titan's interior, surface, atmosphere, and the complex interaction with Saturn's magnetosphere. While many pieces of the puzzle are yet to be found, with each Titan flyby comes a new data set that furthers our understanding of this world as we attempt to constrain scenarios for the formation and evolution of Titan and its atmosphere.

1.1 TITAN-55 SCIENCE HIGHLIGHTS

- **RADAR:** The SAR swath sweeps down across the Shangri-La dunefields and into high Southern latitudes. This begins a sequence of near-parallel SAR swaths HiSAR north of Xanadu and over southern polar regions.
- **INMS:** On T55, INMS will be riding with RADAR, obtaining unique nightside coverage at low Southern latitudes. This flyby provides unique coverage for the outer flank of the magnetospheric interaction region.
- **CIRS:** Surface temperature mapping; continued composition integrations and stratospheric temperature maps.
- **VIMS:** On the inbound leg, the phase angle is much larger than 90 degrees and VIMS ridealong observations will provide information on Titan's atmospheric composition. After closest approach, VIMS will observe the South Pole region riding along with CIRS far from Titan. Only cloud monitoring will be possible.
- **ISS** will acquire a full-disk mosaic of eastern Tsegihi at high southern latitudes and ride along with CIRS to monitor clouds.
- **UVIS** will obtain an image cube of Titan's atmosphere at EUV and FUV wavelengths by sweeping its slit across the disk. These cubes provide spectral and spatial information on nitrogen emissions, H emission and absorption, absorption by simple hydrocarbons, and the scattering properties of haze aerosols. This is one of many such cubes gathered over the course of the mission to provide latitude and seasonal coverage of Titan's middle atmosphere and stratosphere.
- **MIMI** measures energetic ion and electron energy input to Titan's atmosphere.
- **MAG**: T55 is another flank-out, post-dusk flyby, with a minimum altitude of 1000 kilometers. Therefore, the measurements will provide a description of the draping and the pileup of the external magnetic field around Titan on the nightside hemisphere. It will be also a good complement to T52, T53 and T54 in order to characterize the background field for a similar local time with respect to Saturn and different SKR longitudes.
- **RPWS** will measure thermal plasmas in Titan's ionosphere and surrounding environment; search for lightning in Titan's atmosphere; and investigate the interaction of Titan with Saturn's magnetosphere.

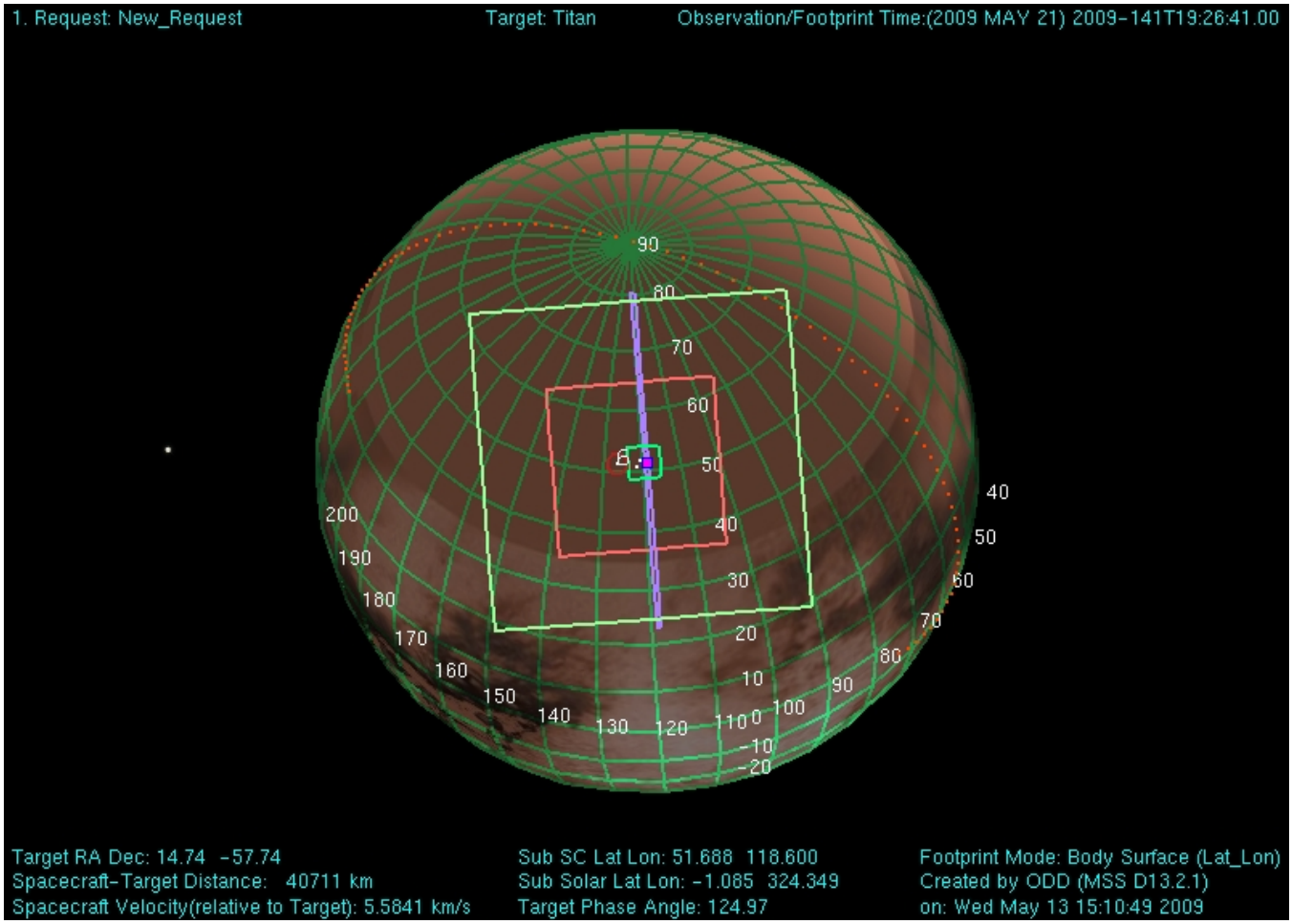
SAMPLE SNAPSHOTS

Three views of Titan from Cassini before, during, and after closest approach to Titan are shown below. The views are oriented such that the direction towards the top of the page is aligned with the Titan North Pole. The optical remote sensing instruments' fields of view are shown assuming they are pointed towards the center of Titan. The sizes of these fields of view vary as a function of the distance between Cassini and Titan. A key for use in identifying the remote sensing instruments fields of view in the figures is listed at the top of the next page.

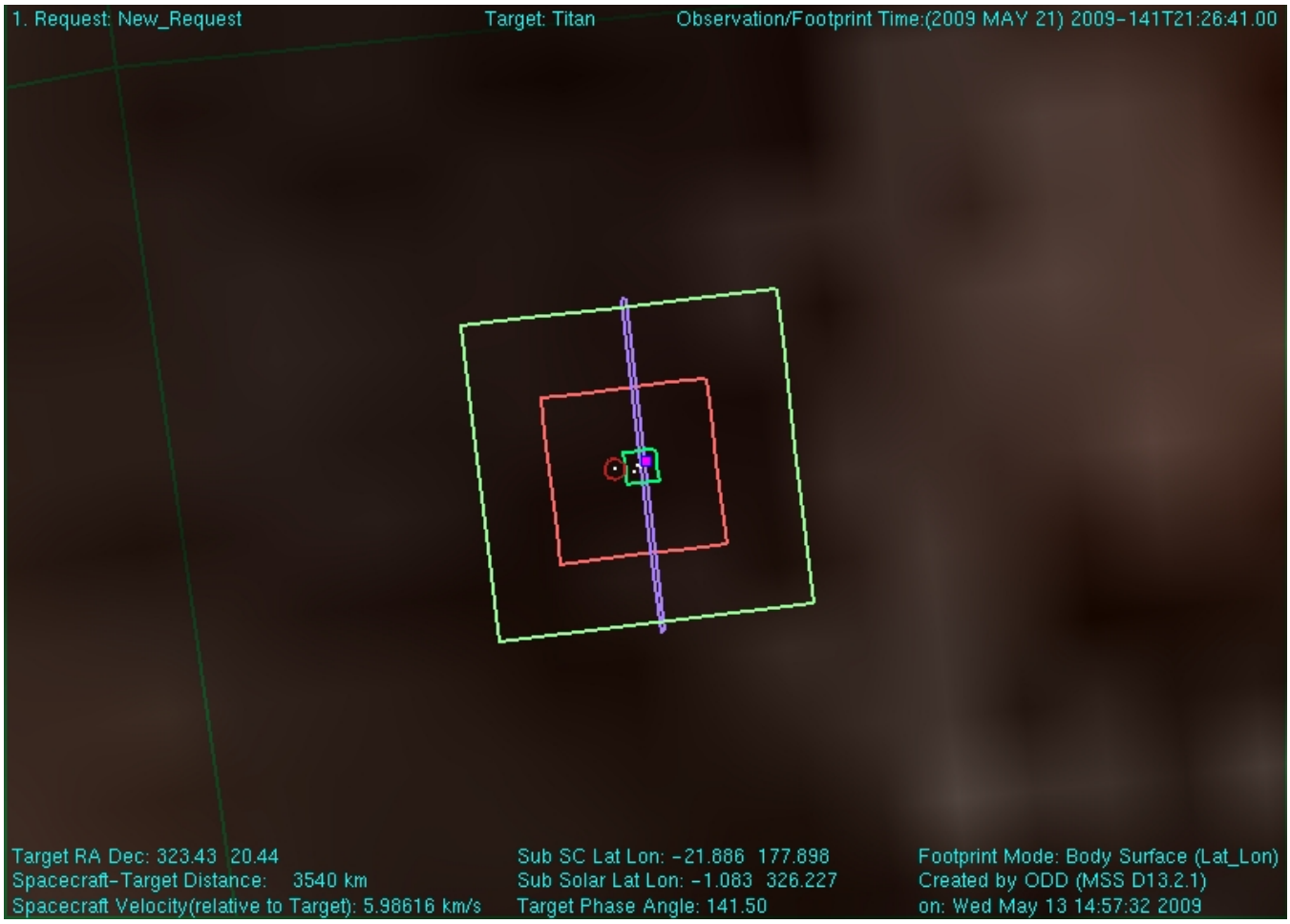
Key to ORS Instrument Fields of View in Figures

Instrument Field of View	Depiction in Figure
ISS WAC (imaging wide angle camera)	Largest square
VIMS (visual and infrared mapping spectrometer)	Next largest pink square
ISS NAC (imaging narrow angle camera)	Smallest green square
CIRS (composite infrared spectrometer) – Focal Plane 1	Small red circle near ISS_NAC FOV
UVIS (ultraviolet imaging spectrometer)	Vertical purple rectangle centered within largest square

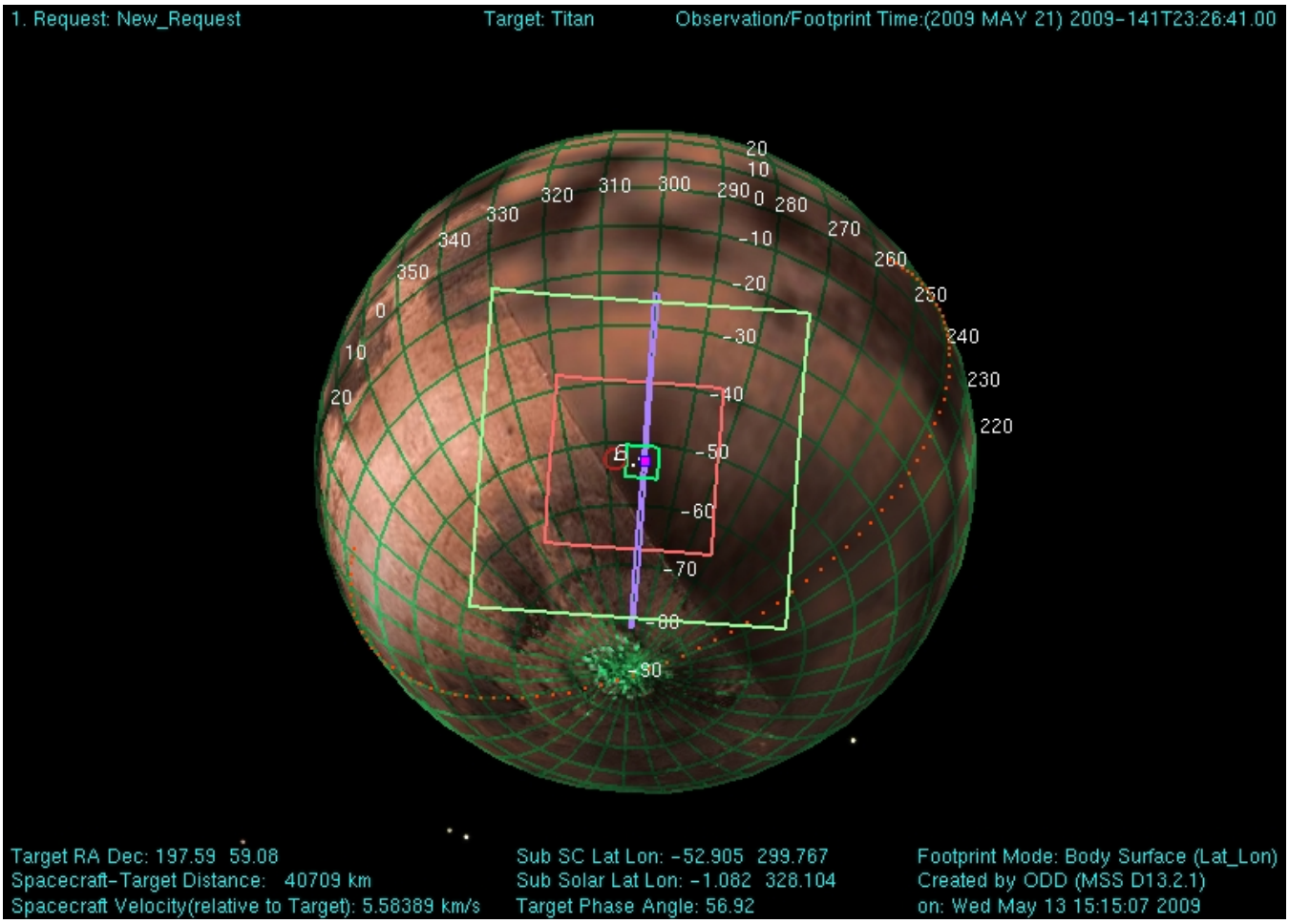
View of Titan from Cassini two hours before Titan-55 closest approach



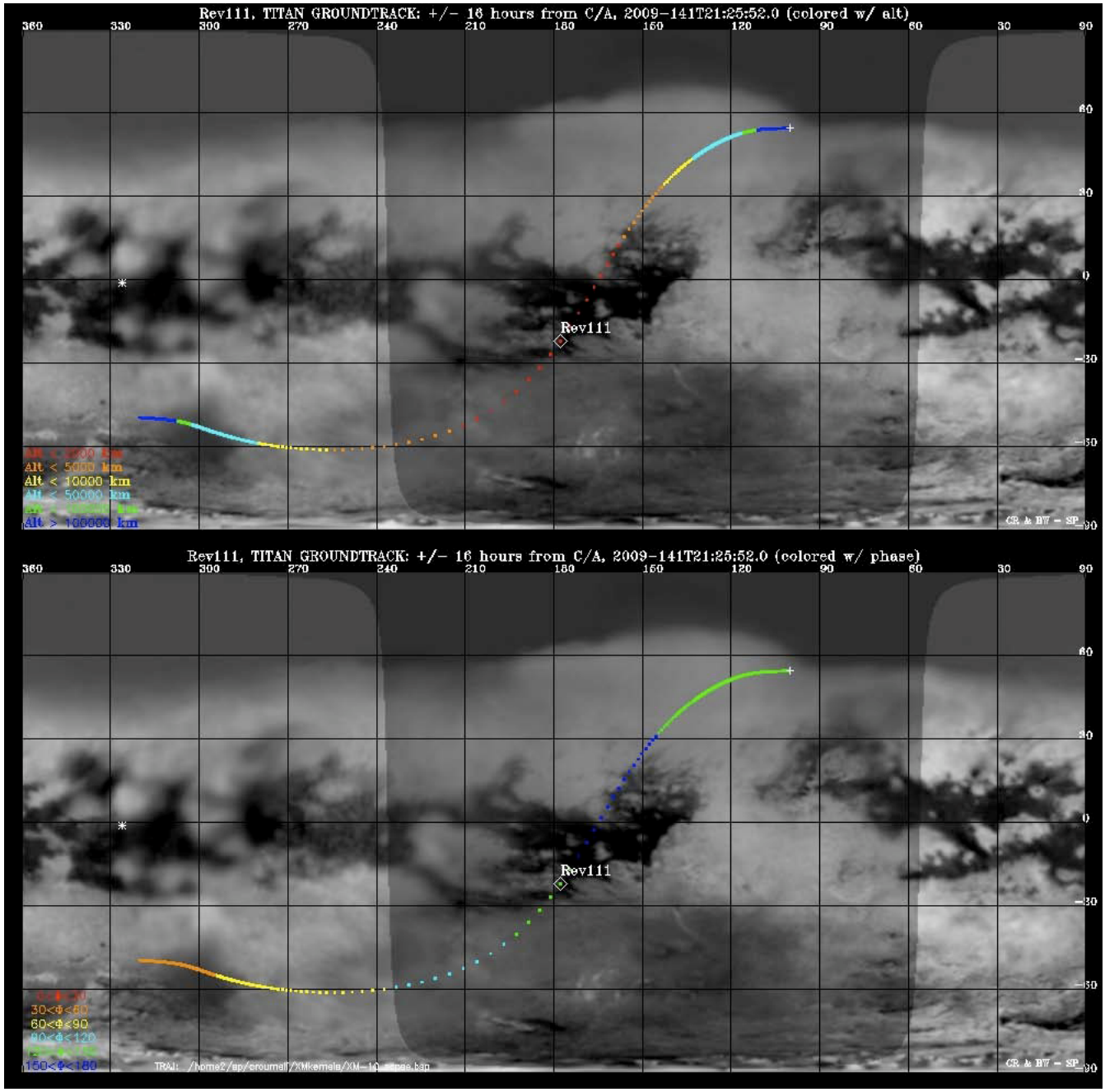
View of Titan from Cassini at Titan-55 closest approach



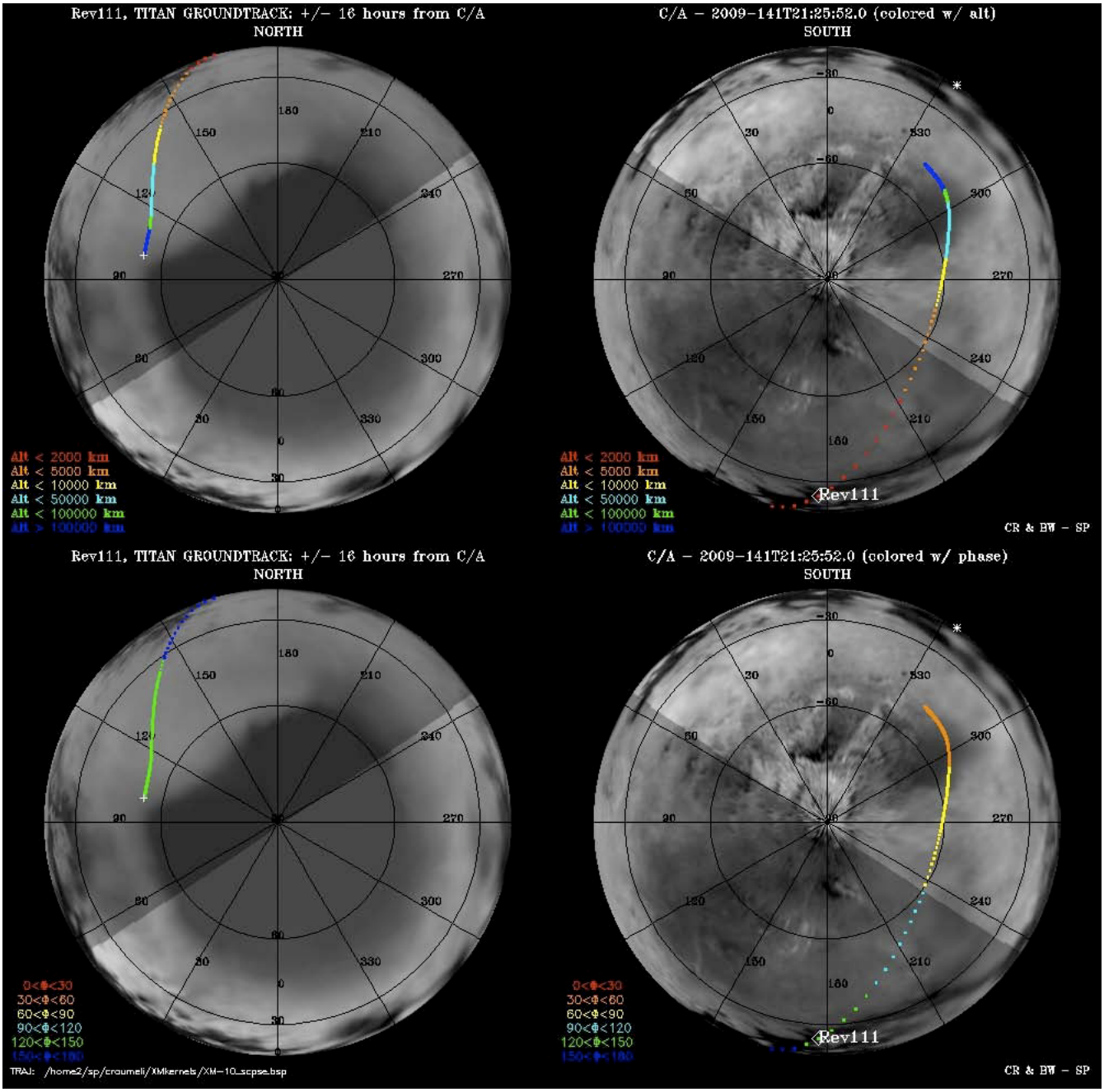
View of Titan from Cassini two hours after Titan-55 closest approach



Titan Groundtracks for T55: Global Plot



Titan Groundtracks for T55: Polar Plot



The T55 timeline is as follows:

Cassini Titan-55 Timeline - May 2009

Colors: yellow = maneuvers; blue = geometry;
pink = T55-related; green = data playbacks

Orbiter UTC	Ground UTC	Pacific Time (PDT)	Time wrt T55	Activity	Description
125T07:16:00	May 05 08:32	Tue May 05 01:32 AM	T55-16d14h	Start of Sequence S50	Start of Sequence which contains Titan-55
138T13:45:00	May 18 15:01	Mon May 18 08:01 AM	T55-03d08h	OTM #196 Prime	Titan-55 targeting maneuver.
139T13:44:00	May 19 15:00	Tue May 19 08:00 AM	T55-02d08h	OTM #196 Backup	
141T06:14:00	May 21 07:30	Thu May 21 12:30 AM	T55-15h12m	Start of the TOST segment	
141T06:14:00	May 21 07:30	Thu May 21 12:30 AM	T55-15h12m	Turn cameras to Titan	
141T06:54:00	May 21 08:10	Thu May 21 01:10 AM	T55-14h32m	New waypoint	
141T06:54:00	May 21 08:10	Thu May 21 01:10 AM	T55-14h32m	Deadtime	15 minutes 49 seconds long; used to accommodate changes in flyby time
141T07:09:49	May 21 08:25	Thu May 21 01:25 AM	T55-14h17m	Titan atmospheric observations-CIRS	Obtain information on the thermal structure of Titan's stratosphere.
141T08:26:41	May 21 09:42	Thu May 21 02:42 AM	T55-13h00m	Titan surface observations-VIMS	Cloud mapping
141T12:26:41	May 21 13:42	Thu May 21 06:42 AM	T55-09h00m	Titan atmospheric observations-UVIS	Several slow scans across Titan's visible hemisphere to form spectral images
141T18:56:41	May 21 20:12	Thu May 21 01:12 PM	T55-02h30m	RADAR	Inbound scatterometry
141T20:14:41	May 21 21:30	Thu May 21 02:30 PM	T55-01h12m	Transition to thruster control	
141T20:15:41	May 21 21:31	Thu May 21 02:31 PM	T55-01h11m	RADAR	Inbound HiSAR
141T20:56:41	May 21 22:12	Thu May 21 03:12 PM	T55-00h30m	RADAR	Inbound altimetry
141T21:08:41	May 21 22:24	Thu May 21 03:24 PM	T55-00h18m	RADAR	Inbound and outbound SAR
141T21:11:06	May 21 22:27	Thu May 21 03:27 PM	T55-00h15m	Earth occultation	18 minute duration
141T21:12:01	May 21 22:28	Thu May 21 03:28 PM	T55-00h14m	Solar occultation	17 minute duration
141T21:26:41	**May 21 22:42**	**Thu May 21 03:42 PM**	**T55+00h00m**	**Titan-55 Flyby Closest Approach Time**	**Altitude = 965 km (~600 miles), speed =6.0 km/s (13,400 mph); 141 deg phase at closest approach**
141T21:44:41	May 21 23:00	Thu May 21 04:00 PM	T55+00h18m	RADAR	Outbound altimetry
141T21:46:45	May 21 23:02	Thu May 21 04:02 PM	T55+00h20m	Descending Ring Plane Crossing	
141T21:56:41	May 21 23:12	Thu May 21 04:12 PM	T55+00h30m	RADAR	Outbound HiSAR
141T22:16:41	May 21 23:32	Thu May 21 04:32 PM	T55+00h50m	Transition off of thruster control	
141T22:38:22	May 21 23:54	Thu May 21 04:54 PM	T55+01h12m	RADAR	Outbound scatterometry
141T23:56:41	May 22 01:12	Thu May 21 06:12 PM	T55+02h30m	Titan atmospheric observations-CIRS	Obtain information on surface & tropopause temperatures, and on tropospheric CH4. Scan or contiguous steps across disk.
142T02:26:41	May 22 03:42	Thu May 21 08:42 PM	T55+05h00m	Titan atmospheric observations-CIRS	Integrate on Titan's limb with arrays parallel to limb, paired detector mode, to maximize S/N for detection and characterization of of trace gas species and isotopes.
142T06:26:41	May 22 07:42	Fri May 22 12:42 AM	T55+09h00m	Titan atmospheric observations-CIRS	Obtain information on CO, HCN, CH4. Integrate on disk at airmass 1.5--2.0.
142T09:26:41	May 22 10:42	Fri May 22 03:42 AM	T55+12h00m	Titan surface observations-ISS	monitoring for surface/atmosphere changes; attempt to see surface color variations; monitor limb hazes, 1-3 km/px
142T11:26:41	May 22 12:42	Fri May 22 05:42 AM	T55+14h00m	Titan atmospheric observations-CIRS	Obtain information on the thermal structure of Titan's stratosphere.
142T19:26:41	May 22 20:42	Fri May 22 01:42 PM	T55+22h00m	Deadtime	52 minutes 18 seconds long; used to accommodate changes in flyby time
142T20:19:00	May 22 21:35	Fri May 22 02:35 PM	T55+22h53m	Turn to Earth-line	
142T22:04:00	May 22 23:20	May 22 16:20	T55+01d01h	Playback of T55 Data	Goldstone 34m
143T00:20:00	May 23 01:36	May 22 18:36	T55+01d03h	Playback of T55 Data	Goldstone 70m