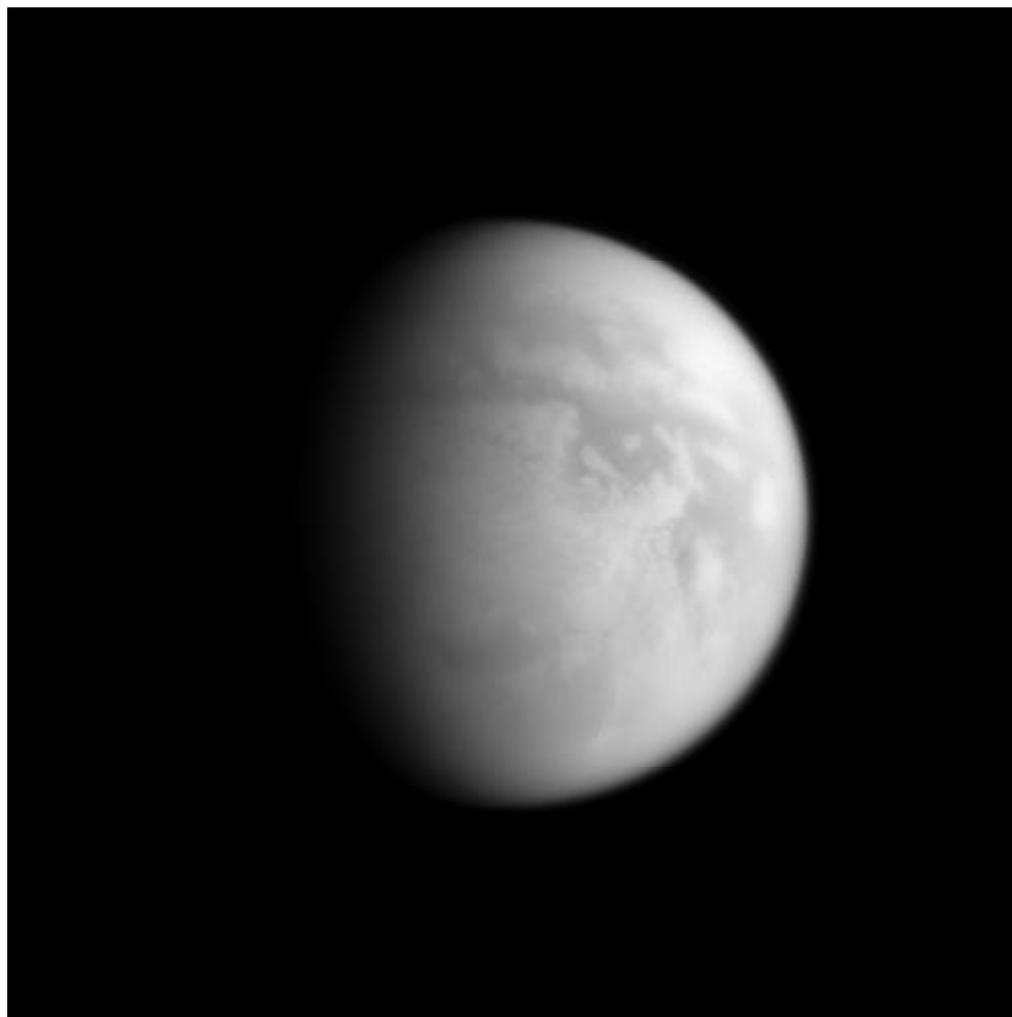


C A S S I N I



TITAN **110TI(T54)** MISSION DESCRIPTION

May 1, 2009

Jet Propulsion Laboratory
California Institute of Technology

Cover image: [Titan's Murky South Pole](#)

April 27, 2009

This Cassini spacecraft image affords a view of Titan's south polar region, an area home to one of Titan's hydrocarbon "lake districts."

*Titan's south pole is illuminated to the right of the terminator near the bottom of the visible disk. The dark area near the bottom, in Titan's mid-southern latitudes, is Mezzoramia. The wider, darker region near the equator is named Senkyo. A "lake district" (see *Changes in Titan's Lakes*) containing what scientists believe are lakes of hydrocarbons has been found surrounding Titan's south pole.*

Lit terrain seen here is on the Saturn-facing side of Titan (5,150 kilometers, or 3,200 miles across). North on Titan is up and rotated 27 degrees to the right. The image was taken with the Cassini spacecraft narrow-angle camera on Feb. 15, 2009 using a spectral filter sensitive to wavelengths of near-infrared light centered at 938 nanometers. The view was acquired at a distance of approximately 1.2 million kilometers (746,000 miles) from Titan and at a Sun-Titan-spacecraft, or phase, angle of 55 degrees. Image scale is 7 kilometers (4 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

Just under 16 days since its previous visit, Cassini returns to Saturn's largest moon for the mission's fifty-fifth targeted encounter with Titan. The closest approach to Titan occurs on Tuesday, May 5 at 2009-125T22:54:15 spacecraft time at an altitude of 3,200 kilometers (~2,000 miles) above the surface and at a speed of 5.8 kilometers per second (~13,000 mph). The latitude at closest approach is 14.1 degrees S and the encounter occurs on orbit number 110.

This encounter is set up with two maneuvers: an apoapsis maneuver on April 27, and a Titan approach maneuver, scheduled for May 2. T54 is the third flyby in a series of eleven inbound encounters and the tenth Titan encounter in Cassini's Solstice Mission. It occurs just under four days before Saturn closest approach.

View of SATURN from CASSINI
2009 MAY 05 22:55:00 UTC
45.0° field of view



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-54 SCIENCE HIGHLIGHTS

- **CIRS** conducts vertical sounding of composition, and temperature and aerosol mapping at low latitudes.
- **VIMS** On the inbound, the phase angle is much larger than 90 degrees and VIMS ridealong observations will provide information on Titan's atmosphere composition. After C/A, VIMS will observe the South Pole region and will look for variations at the surface and in the atmosphere. High resolution images at less than 5 km/pixel will allow us to image places that may be lakes. Then VIMS will monitor the tropical clouds in the Southern hemisphere.
- **ISS** will acquire high-resolution imaging of Titan's trailing hemisphere at high southern latitudes and will ride along with VIMS 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. Sun obscures ENA.
- **MAG**: T54 is another flank-out, post-dusk, high altitude flyby that will be a good complement to T52 and T53 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.

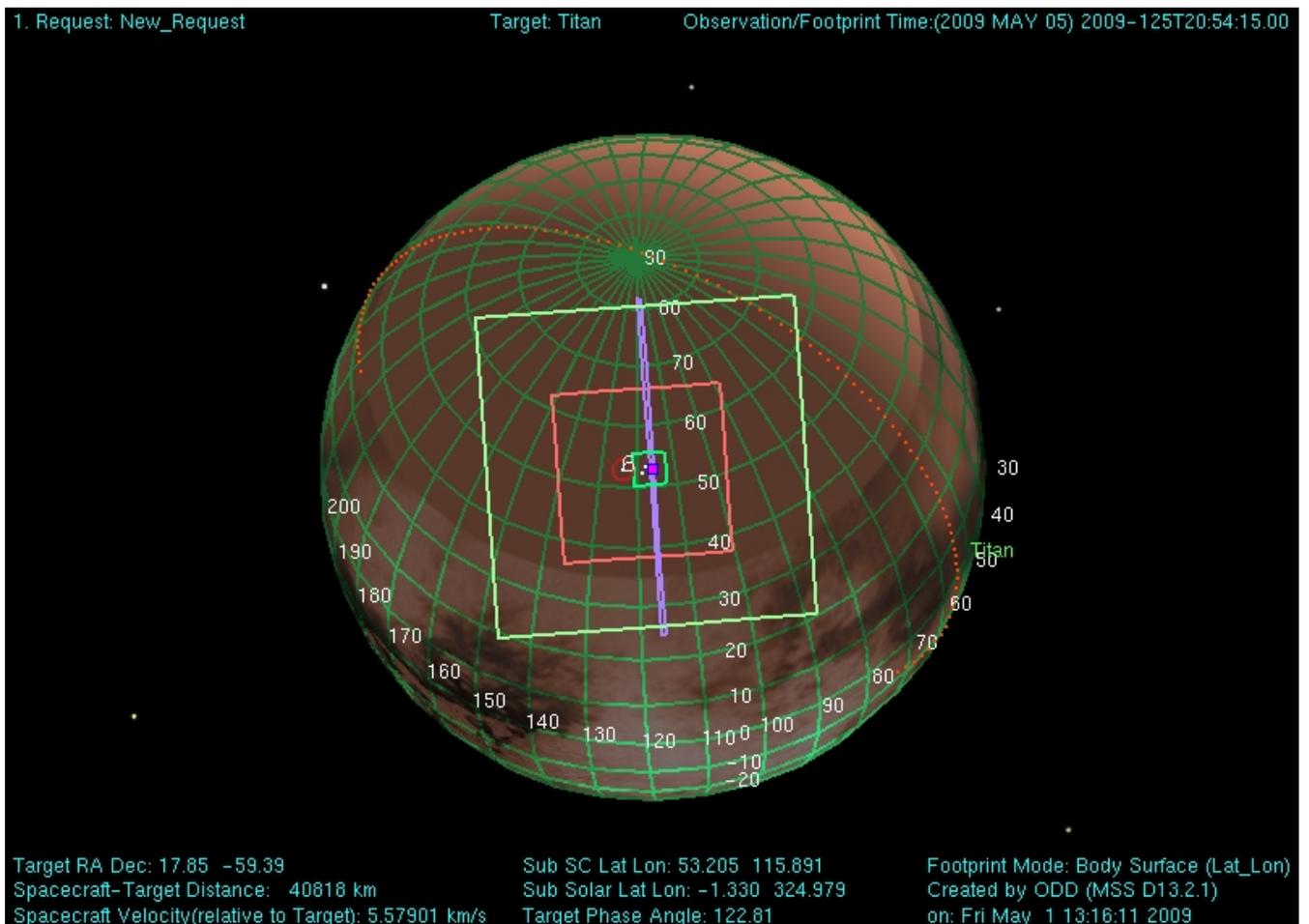
SAMPLE SNAPSHOTS

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

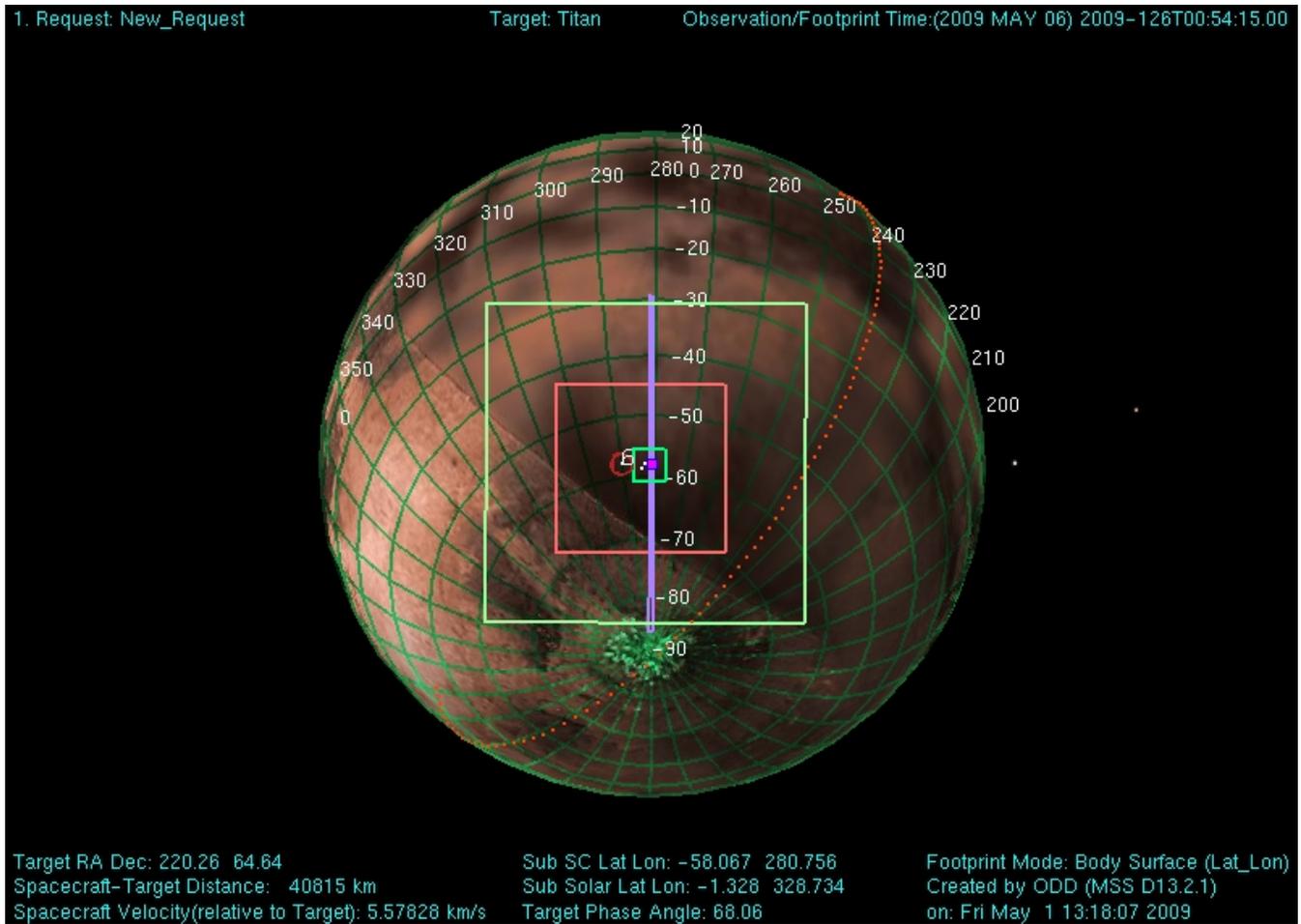
View of Titan from Cassini two hours before Titan-54 closest approach



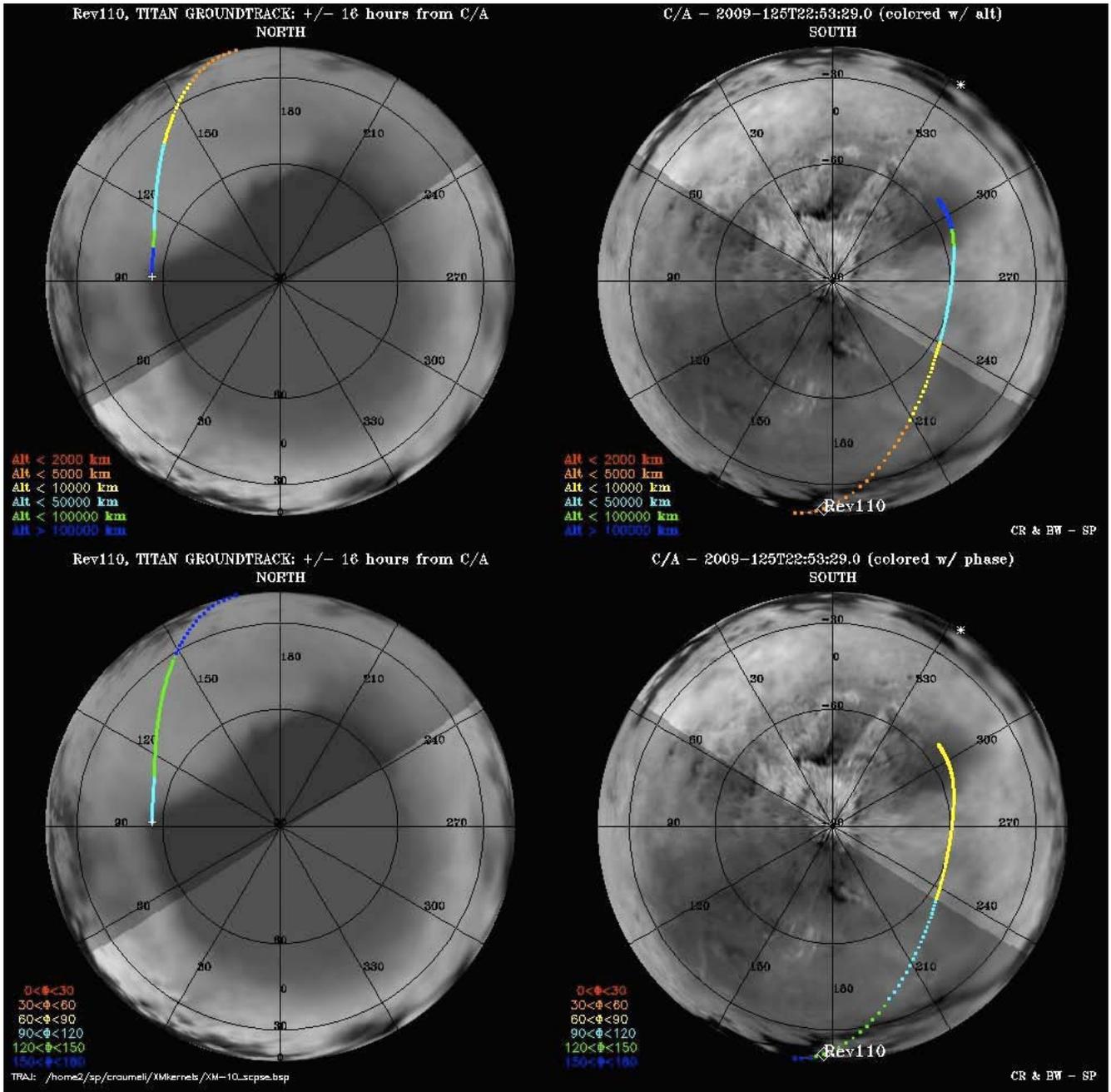
View of Titan from Cassini at Titan-54 closest approach



View of Titan from Cassini two hours after Titan-54 closest approach



Titan Groundtracks for T54: Polar Plot



The T54 timeline is as follows:

Cassini Titan-54 Timeline - May 2009

Colors: yellow = maneuvers; blue = geometry; pink = T54-related; green = data playbacks

Orbiter UTC	Ground UTC	Pacific Time (PDT)	Time wrt T54	Activity	Description
122T15:02:00	May 02 16:16	Sat May 02 09:16 AM	T54-03d08h	OTM #193 Prime	Titan-54 targeting maneuver.
123T14:46:00	May 03 16:00	Sun May 03 09:00 AM	T54-02d08h	OTM #190 Backup	
125T07:16:00	May 05 08:30	Tue May 05 01:30 AM	T54-15h38m	Start of Sequence S50	Start of Sequence which contains Titan-54
125T07:16:00	May 05 08:30	Tue May 05 01:30 AM	T54-15h38m	Start of the TOST segment	
125T07:22:00	May 05 08:36	Tue May 05 01:36 AM	T54-15h32m	Turn cameras to Titan	
125T08:02:00	May 05 09:16	Tue May 05 02:16 AM	T54-14h52m	New waypoint	
125T08:02:00	May 05 09:16	Tue May 05 02:16 AM	T54-14h52m	Deadtime	9 minutes 47 seconds long; used to accommodate changes in flyby time
125T08:11:47	May 05 09:25	Tue May 05 02:25 AM	T54-14h43m	Titan atmospheric observations-CIRS	Obtain information on the thermal structure of Titan's stratosphere.
125T12:54:16	May 05 14:08	Tue May 05 07:08 AM	T54-10h00m	Titan surface observations-ISS	monitoring for surface/atmosphere changes; attempt to see surface color variations; monitor limb hazes, 1-3 km/px
125T13:54:16	May 05 15:08	Tue May 05 08:08 AM	T54-09h00m	Titan atmospheric observations-CIRS	Obtain vertical profiles of temperatures in Titan's stratosphere.
125T17:44:16	May 05 18:58	Tue May 05 11:58 AM	T54-05h10m	Turn cameras to new waypoint	
125T18:04:16	May 05 19:18	Tue May 05 12:18 PM	T54-04h50m	New waypoint	
125T18:04:16	May 05 19:18	Tue May 05 12:18 PM	T54-04h50m	Titan atmospheric observations-CIRS	Obtain information on surface & tropopause temperatures, and on tropospheric CH ₄ .
125T20:39:16	May 05 21:53	Tue May 05 02:53 PM	T54-02h15m	Titan atmospheric observations-CIRS	Vertical sounding of stratospheric compounds on Titan, including H ₂ O.
125T21:39:16	May 05 22:53	Tue May 05 03:53 PM	T54-01h15m	Titan atmospheric observations-CIRS	Limb scanning for aerosols.
125T22:09:16	May 05 23:23	Tue May 05 04:23 PM	T54-00h45m	Titan atmospheric observations-CIRS	Vertical temperature sounding of Titan's tropopause & stratosphere. Slow radial scans.
125T22:44:16	May 05 23:58	Tue May 05 04:58 PM	T54-00h10m	Titan atmospheric observations-CIRS	Hi-res closest approach science
125T22:38:14	May 05 23:52	Tue May 05 04:52 PM	T54-00h16m	Earth occultation	15 minute duration
125T22:40:22	May 05 23:54	Tue May 05 04:54 PM	T54-00h14m	Solar occultation	12 minute duration
125T22:54:15	May 06 00:08	Tue May 05 05:08 PM	T54+00h00m	Titan-54 Flyby Closest Approach Time	Altitude = 3244 km (~2,016 miles), speed =5.8 km/s (13,000 mph); 146 deg phase at closest approach
125T23:13:13	May 06 00:27	Tue May 05 05:27 PM	T54+00h19m	Descending Ring Plane Crossing	
125T23:19:16	May 06 00:33	Tue May 05 05:33 PM	T54+00h25m	Titan surface observations-ISS	monitoring for surface/atmosphere changes; attempt to see surface color variations; monitor limb hazes, 1-3 km/px
126T00:54:16	May 06 02:08	Tue May 05 07:08 PM	T54+02h00m	Titan atmospheric observations-UVIS	EUVFUV Imaging of Titan
126T07:54:16	May 06 09:08	Wed May 06 02:08 AM	T54+09h00m	Titan atmospheric observations-CIRS	Obtain information on CO, HCN, CH ₄ . Integrate on disk at airmass 1.5--2.0.
126T12:54:16	May 06 14:08	Wed May 06 07:08 AM	T54+14h00m	Titan surface observations-VIMS	Global map of Titan
126T21:21:16	May 06 22:35	Wed May 06 03:35 PM	T54+22h27m	Deadtime	14 minutes 44 seconds long; used to accommodate changes in flyby time
126T21:36:00	May 06 22:50	Wed May 06 03:50 PM	T54+22h42m	Turn to Earth-line	
126T22:16:00	May 06 23:30	May 06 16:30	T54+23h22m	Playback of T54 Data	Goldstone 70m