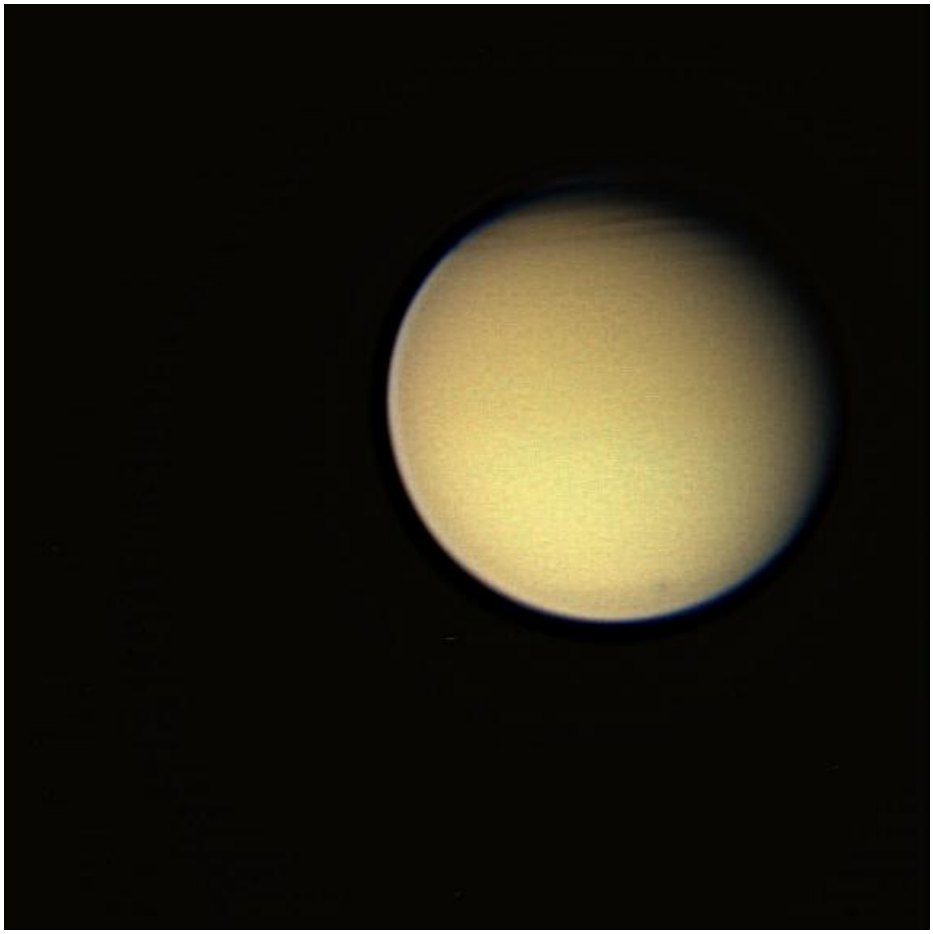
C A S S I N I



T I T A N 036TI(T22)
MISSION DESCRIPTION

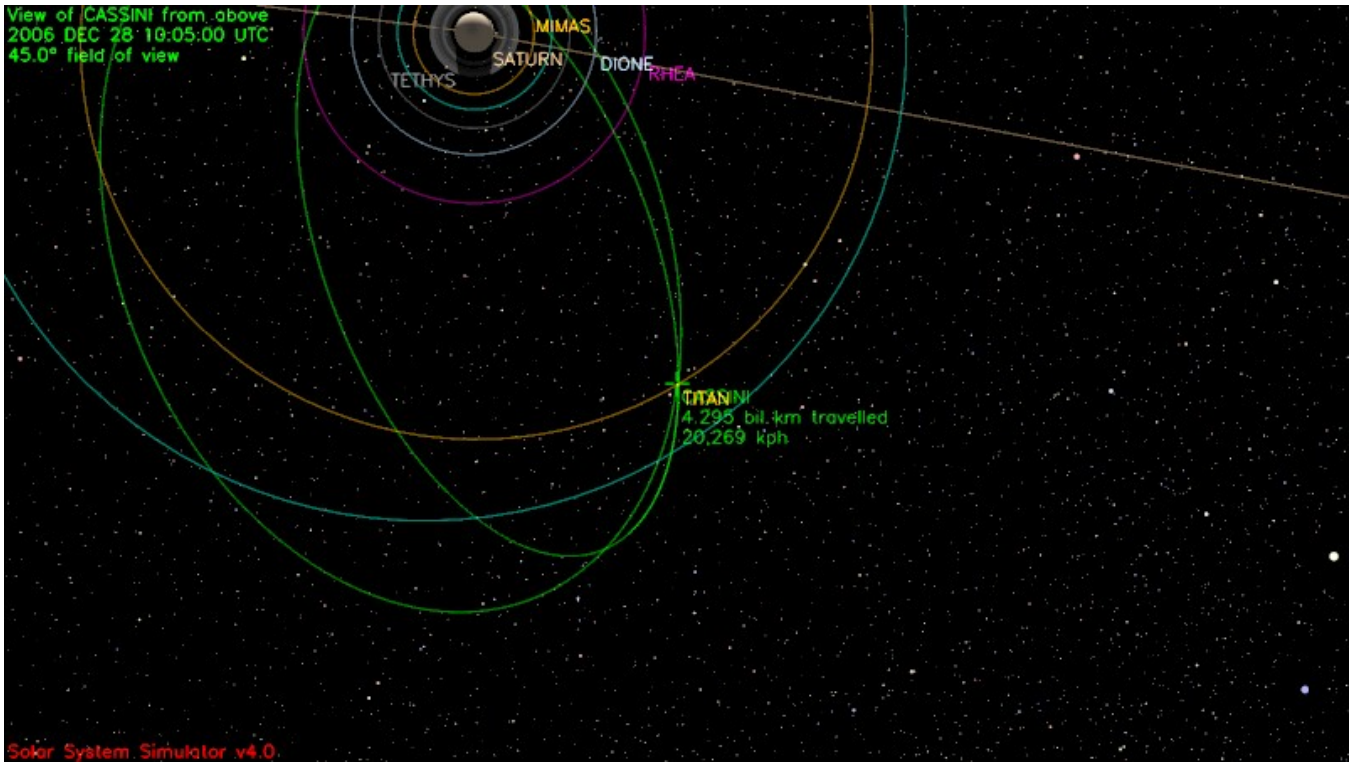
December 2006

Jet Propulsion Laboratory
California Institute of Technology

1.0 OVERVIEW

Just 16 days after Titan-21, Cassini returns to Titan for its twenty-third targeted encounter. The closest approach to Titan occurs on Thursday, December 28, at 2006-362T10:05:22 spacecraft time (December 28 at 2:05AM Pacific Time) at an altitude of 1300 kilometers (~812 miles) above the surface and at a speed of 5.9 kilometers per second (13,200 mph). The latitude at closest approach is 40.2° N and the encounter occurs on orbit number 36.

This encounter is set up with two maneuvers: an apoapsis maneuver on December 20, and an approach maneuver, scheduled for December 25. This inbound encounter occurs about 3 days before Saturn closest approach.



1.1 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 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.

1.2 TITAN-22 SCIENCE HIGHLIGHTS

- The RSS observations will track the spacecraft from Earth before, during, and after Titan closest approach. RSS will obtain Doppler and ranging data to help deduce details of Titan's gravity field. Also, RSS will attempt to determine the existence of an internal ocean by measuring the dynamic Love number, k2, of Titan.

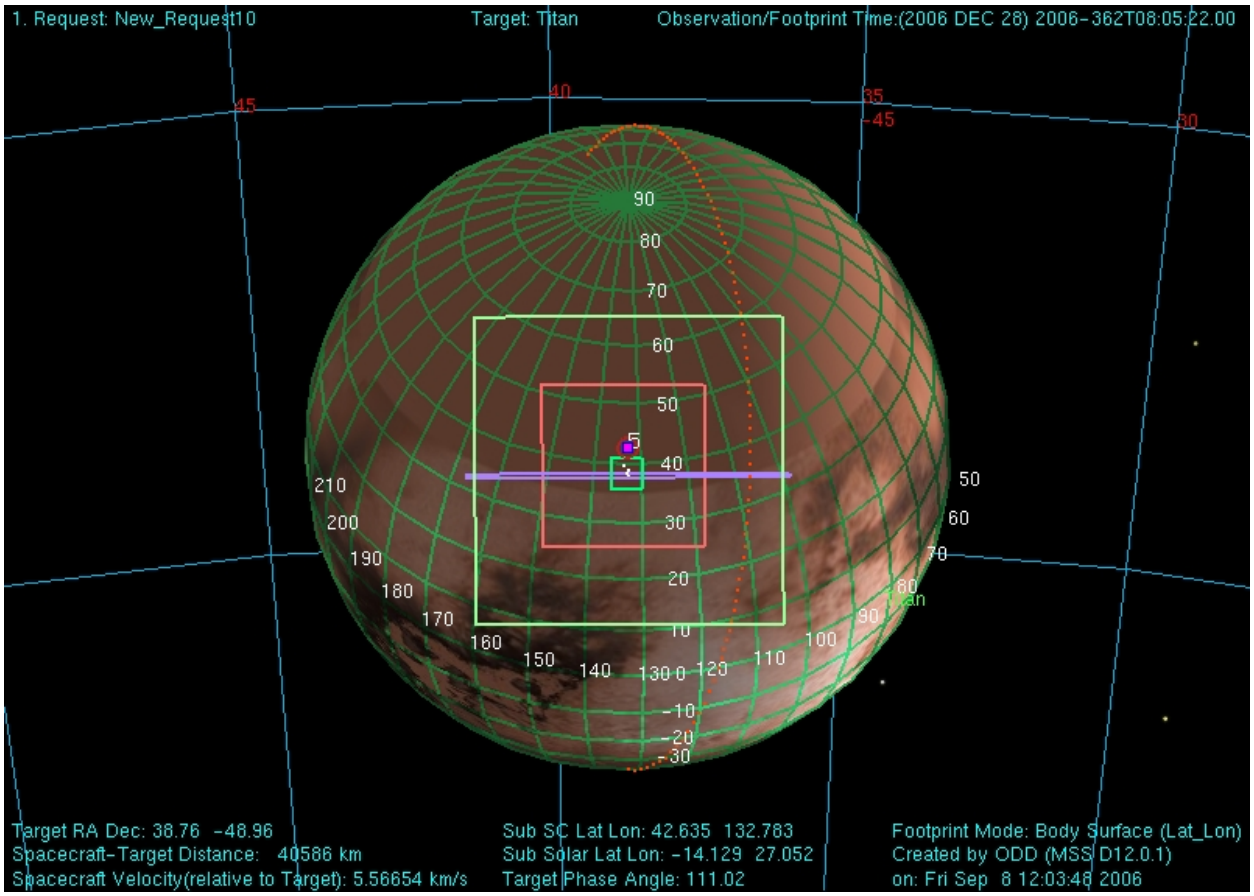
- CIRS: T22 is a far-infrared focused flyby for CIRS, featuring two surface temperature maps and two composition integrations. The former aim to detect surface temperature variations in a window region near 500 cm-1 (20 micron), while the latter are designed to map the spatial variation of CO, H2O, and HCN via far-infrared rotational lines.
- ISS: High resolution coverage of Tsegihi.

1.3 SAMPLE SNAPSHOTS

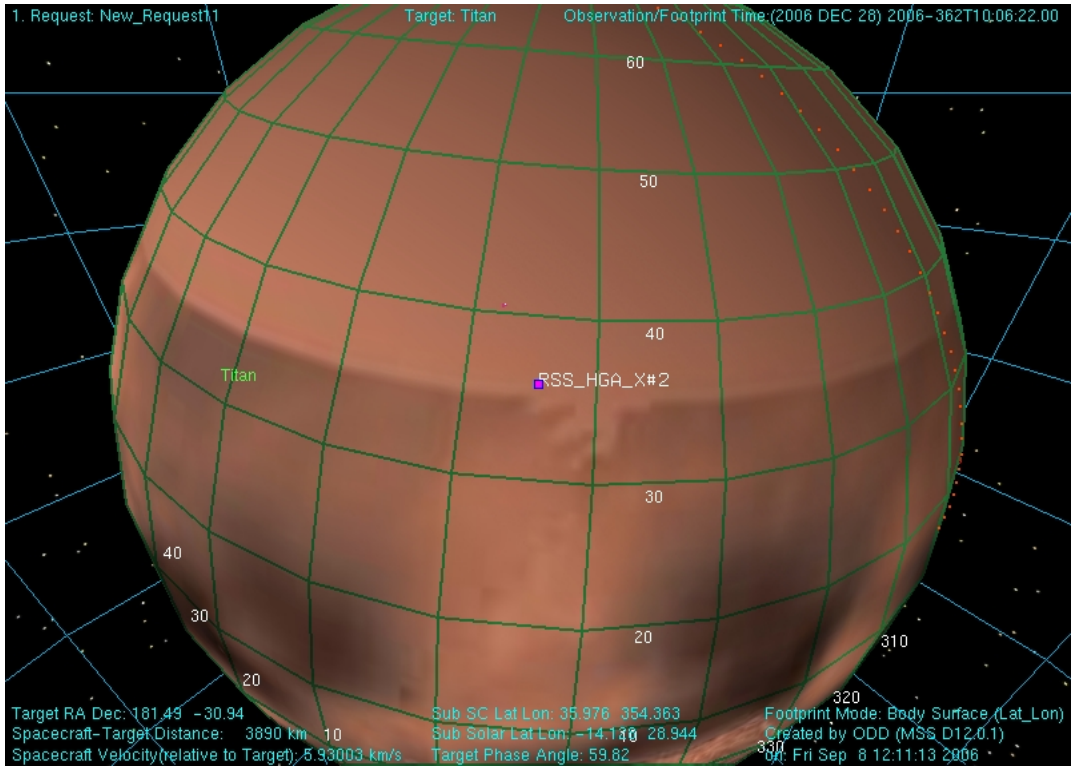
Three views of Titan from Cassini before, during, and after closest approach to Titan are shown below. The views are oriented such that the direction towards the top of the page is aligned with the Titan North Pole. The optical remote sensing instruments' fields of view are shown assuming they are pointed 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

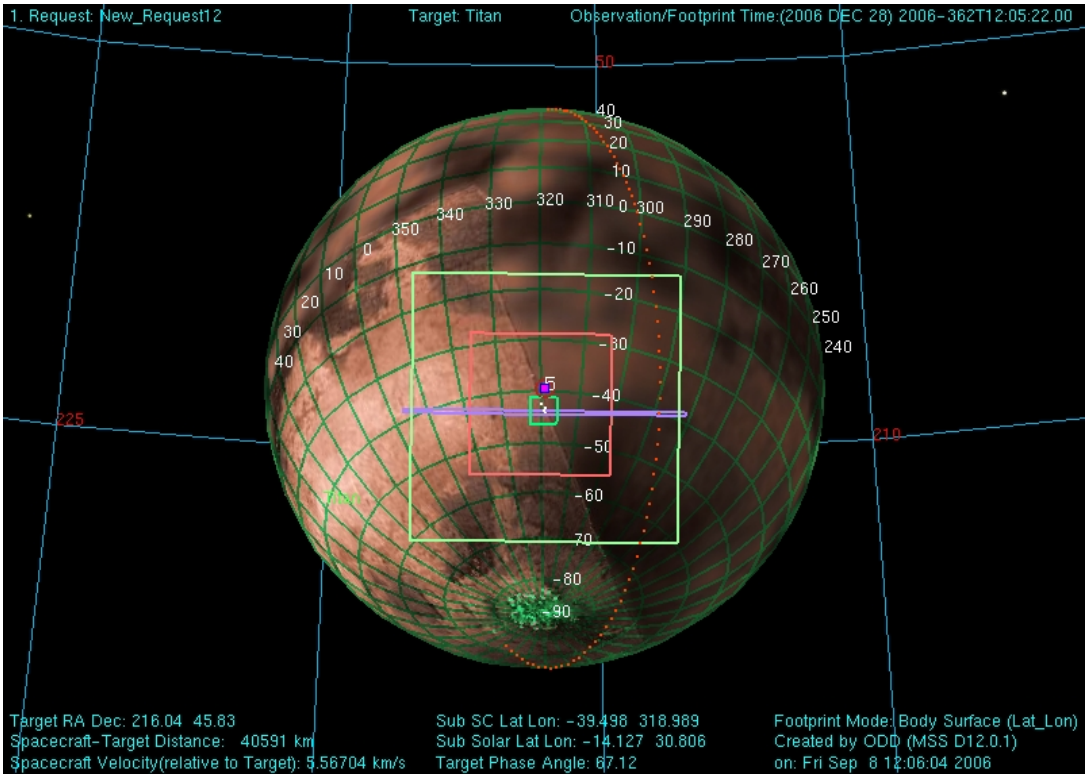
Instrument Field of View	Depiction in Figure
ISS WAC (imaging wide angle camera)	Largest square
VIMS (visual and infrared mapping spectrometer)	Next largest pink square
ISS NAC (imaging narrow angle camera)	Smallest green square
CIRS (composite infrared spectrometer) – Focal Plane 1	Small red circle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



View of Titan from Cassini 2 hours before Titan-22 closest approach



View of Titan from Cassini at Titan-22 Closest Approach



View of Titan from Cassini 2 hours after Titan-22 closest approach

The T22 timeline is as follows:

Cassini Titan-22 Timeline - December 2006

Colors: yellow = maneuvers; blue = geometry; pink = T22-related; green = data playbacks

Orbiter UTC	Ground UTC	Pacific Time	Time wrt T22	Activity	Description
328T16:30:00	Nov 24 17:41	Fri Nov 24 09:41 AM	T22-33d18h	Start of Sequence S26	Start of Sequence which contains Titan-22.
346T12:10:00	Dec 12 13:21	Tue Dec 12 05:21 AM	T22-15d22h	Descending Ring Plane Crossing	
349T10:37:00	Dec 15 11:48	Fri Dec 15 03:48 AM	T22-12d23h	Ascending Ring Plane Crossing	
359T05:34:00	Dec 25 06:45	Sun Dec 24 10:45 PM	T22-03d05h	OTM #85 Prime	Titan-22 minus 3 day targeting maneuver.
360T05:19:00	Dec 26 06:30	Mon Dec 25 10:30 PM	T22-02d05h	OTM #85 Backup	
361T14:19:00	Dec 27 15:30	Wed Dec 27 07:30 AM	T22-19h46m	Turn cameras to Titan	
361T14:49:00	Dec 27 16:00	Wed Dec 27 08:00 AM	T22-19h16m	Deadtime	15 minutes long; used to accommodate changes in flyby time
361T15:04:22	Dec 27 16:15	Wed Dec 27 08:15 AM	T22-19h01m	Titan Atmospheric Observations	Obtain information on the structure of Titan's stratosphere
362T01:35:22	Dec 28 02:46	Wed Dec 27 06:46 PM	T22-08h30m	Titan Gravity Field Determination	RSS Doppler and ranging data.
362T04:357:22	Dec 28 05:46	Wed Dec 27 09:46 PM	T22-05h30m	Titan atmospheric Observations	Obtain information on surface & tropopause temperatures.
362T07:35:22	Dec 28 08:46	Thu Dec 28 12:46 AM	T22-02h30m	Titan Gravity Field Determination	RSS Doppler and ranging data.
362T10:05:22	**Dec 28 11:16**	**Thu Dec 28 03:16 AM**	**T22+00h00m**	**Titan-22 Flyby Closest Approach Time**	**Altitude = 1300 km (812 miles), speed = 5.9 km/s (13,200 mph); low phase inbound, 62 deg phase at closest approach, high phase outbound**
362T11:35:22	Dec 28 12:46	Thu Dec 28 04:46 AM	T22+01h30m	ISS Imaging	NAC regional map.
362T13:35:22	Dec 28 14:46	Thu Dec 28 06:46 AM	T22+03h30m	Titan Atmospheric Observations	Obtain information on surface & tropopause temperatures.
362T15:35:22	Dec 28 16:46	Thu Dec 28 08:46 AM	T22+05h30m	Titan Gravity Field Determination	RSS Doppler and ranging data.
362T18:35:22	Dec 28 19:46	Thu Dec 28 11:46 AM	T22+08h30m	Titan Atmospheric Observations	Obtain information on trace constituents in Titan's stratosphere.
362T21:05:22	Dec 28 22:16	Thu Dec 28 02:16 PM	T22+11h00m	Deadtime	13 minutes 38 seconds long; used to accommodate changes in flyby time
362T21:19:00	Dec 28 22:30	Thu Dec 28 02:30 PM	T22+11h14m	Turn to Earth-Line	
362T21:19:00	Dec 28 22:30	Thu Dec 28 02:30 PM	T22+11h14m	Begin Playback of T22 Data	Madrid 34M
363T03:54:00	Dec 29 05:05	Thu Dec 28 09:05 PM	T22+17h49m	Continue Playback of T22 Data	Goldstone 70M
363T06:49:00	Dec 29 08:00	Fri Dec 29 12:00 AM	T22+20h44m	End Playback of T22 Data	
365T05:18:00	Dec 31 06:29	Sat Dec 30 10:29 PM	T22+02d19h	Saturn Periapse	Saturn periapse, r = 9.8 Rs, lat= -44 deg, phase = 31 deg

1.4 FLYBY GEOMETRY

A flyby geometry table is not available for T-22.

1.5 PLAYBACK TIMELINE

A playback timeline is not available for T-22.