



JET

Journey to Enceladus and Titan

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LCPM-10, Low Cost Planetary Missions Conference,
California Institute of Technology, June 18 – 21, 2013

Outline

Focused Science Goals

Science Objectives Summary

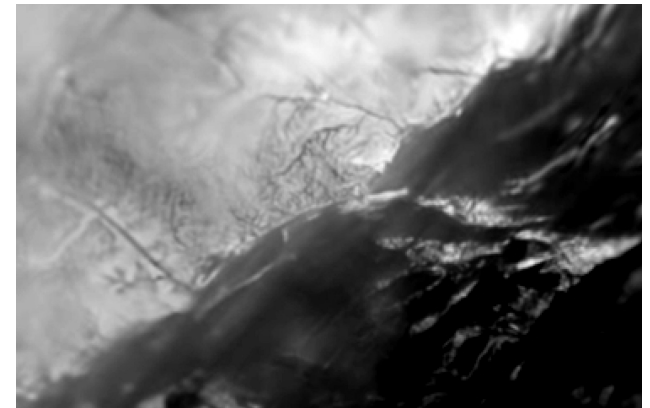
Two-instrument Payload

Mission Concept

Mission Design of Enceladus and Titan Flybys

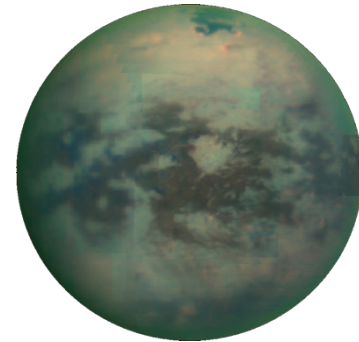
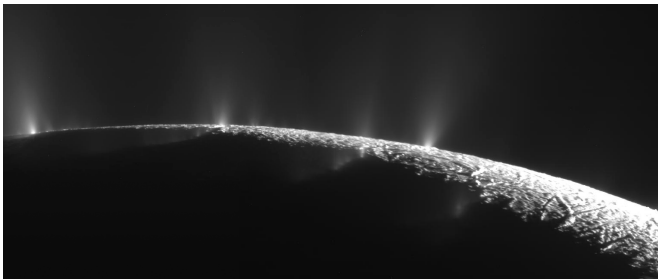
JET Conceptual Spacecraft

Summary

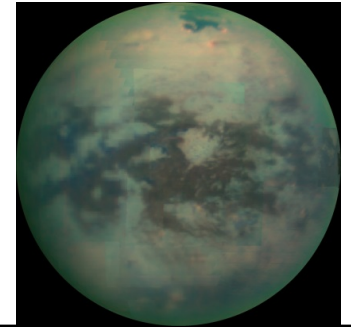
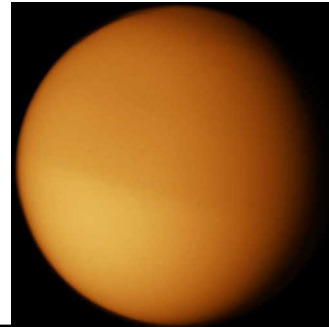
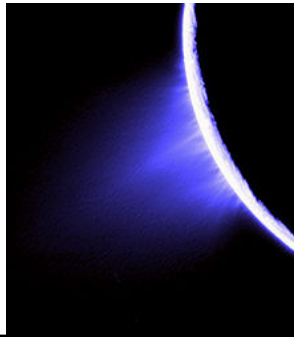
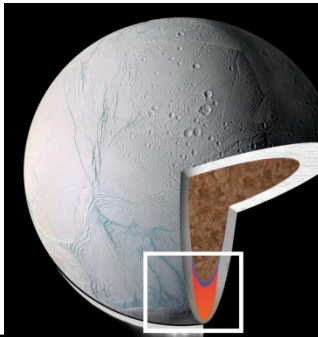


Focused Science Goals Leverage Cassini Discoveries

Assess the astrobiological potential of
Enceladus and Titan



Investigate the formation and
evolution of Enceladus and Titan



Enceladus

Titan

Composition and flux of material in the jets forming the plume

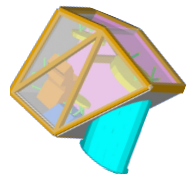
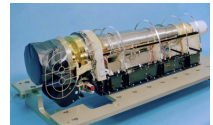
Characterization of the organic molecules in the upper atmosphere at different altitudes (> 900 km) and latitudes

Temperature maps of the faults, tectonics and interior dynamics

High resolution images for detailed study of features forming at different time-scales: dune fields, lakes, river networks, mountains, flows, impact craters

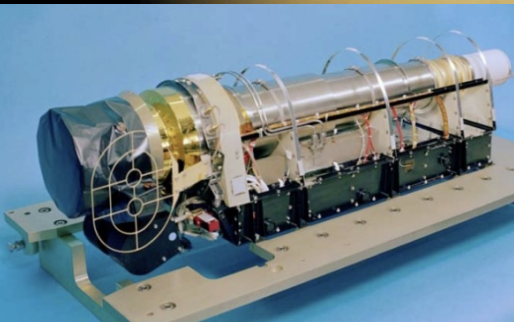
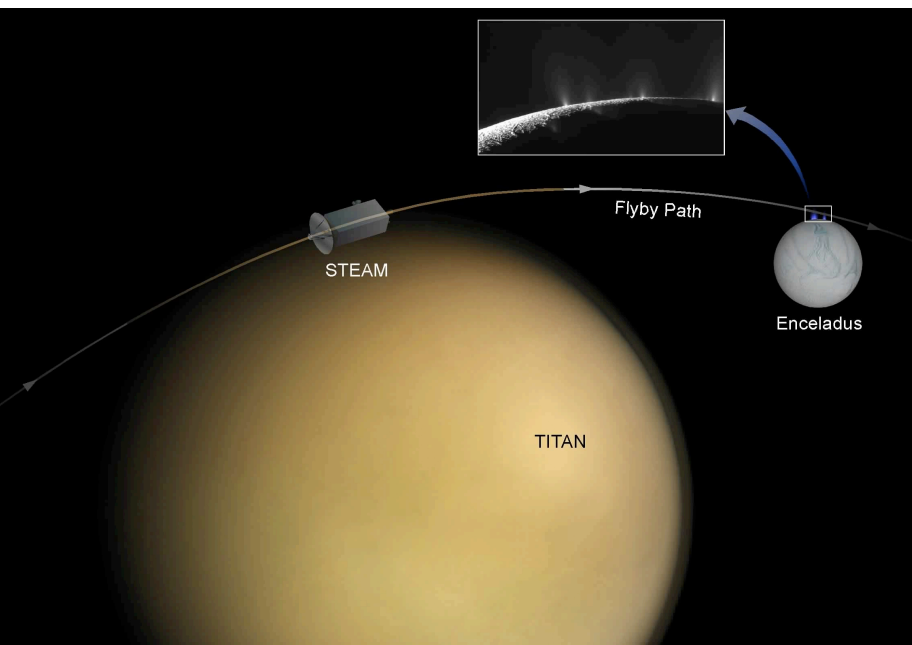
Focused Payload of Two Instruments

- STEAM: mass spectrometer characterizes complex organic molecules with a 10× larger mass range, 100× higher resolution, and 1000× better sensitivity than Cassini
- TIGER: Infrared camera images the heat of Enceladus' fractures and exploits four windows through Titan's haze
- No Field-of-View conflict – simplifies system design and operations





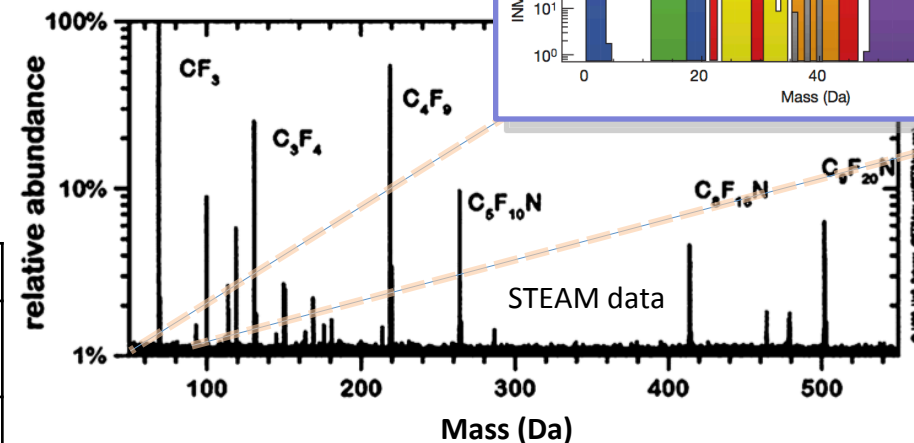
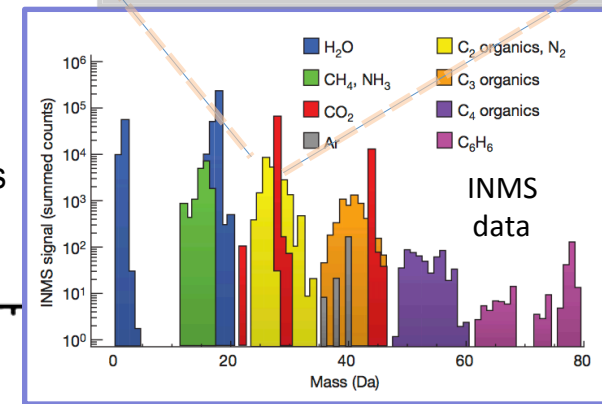
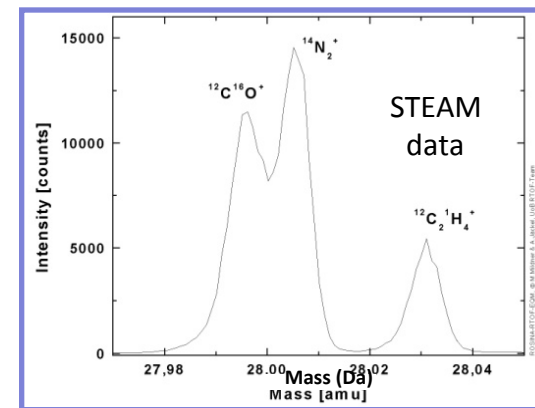
STEAM characterizes the composition of the jets and plume emerging from Enceladus, and the chemical composition of Titan's upper atmosphere.

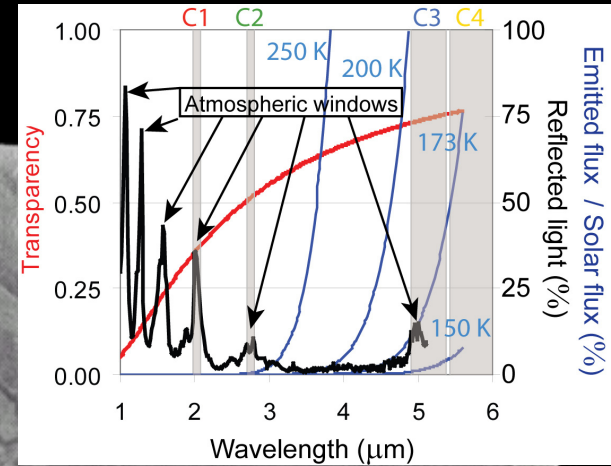
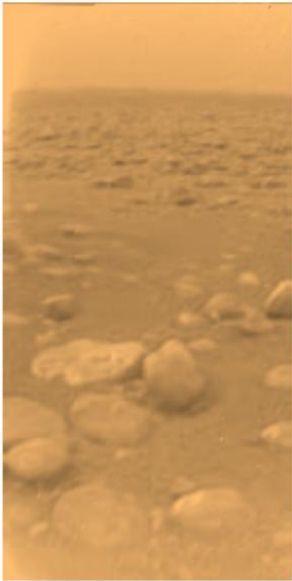


The stored ROSETTA flight spare

Mass	18.6 kg
Power Demand: Average	<25 W
FOV	10° x 40°
Spectral Range	1-300 Da and 18-1000 Da channels

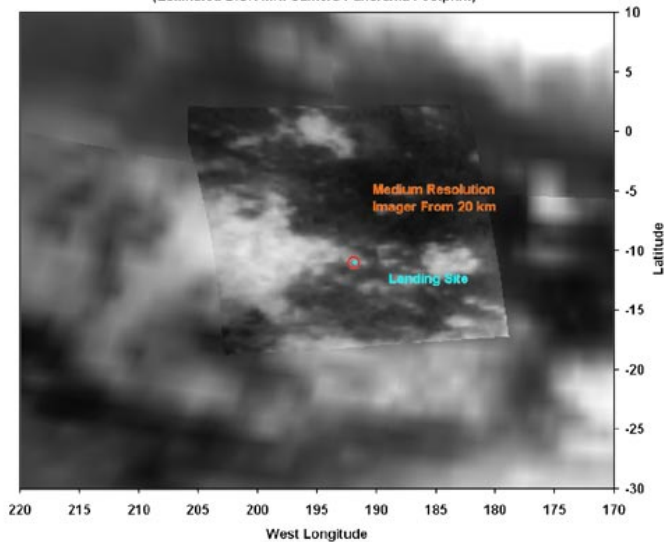
STEAM's **mass resolution** (far right) and **mass range** (below), both **exceed the Cassini INMS** capability (right) by over an order of magnitude. The Cassini INMS data reveal interesting, but ambiguous chemistry in Enceladus' plume. STEAM will reach **1000 Da** and be able to differentiate compounds at the level of $m/\Delta m = 4000$.



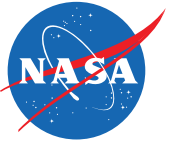


VIMS spectra of Titan revealed a major surprise: the surface is visible in several atmospheric windows

Cassini VIMS Titan Ta Base Map and Huygens DISR Image Coverage (Estimated DISR MRI Camera Panorama Footprint)



JET could get Huygens resolution on 15% of Titan's surface 10 times better resolution than Cassini radar images with an infrared camera from ~0.7 – ~6 micron peering through the haze

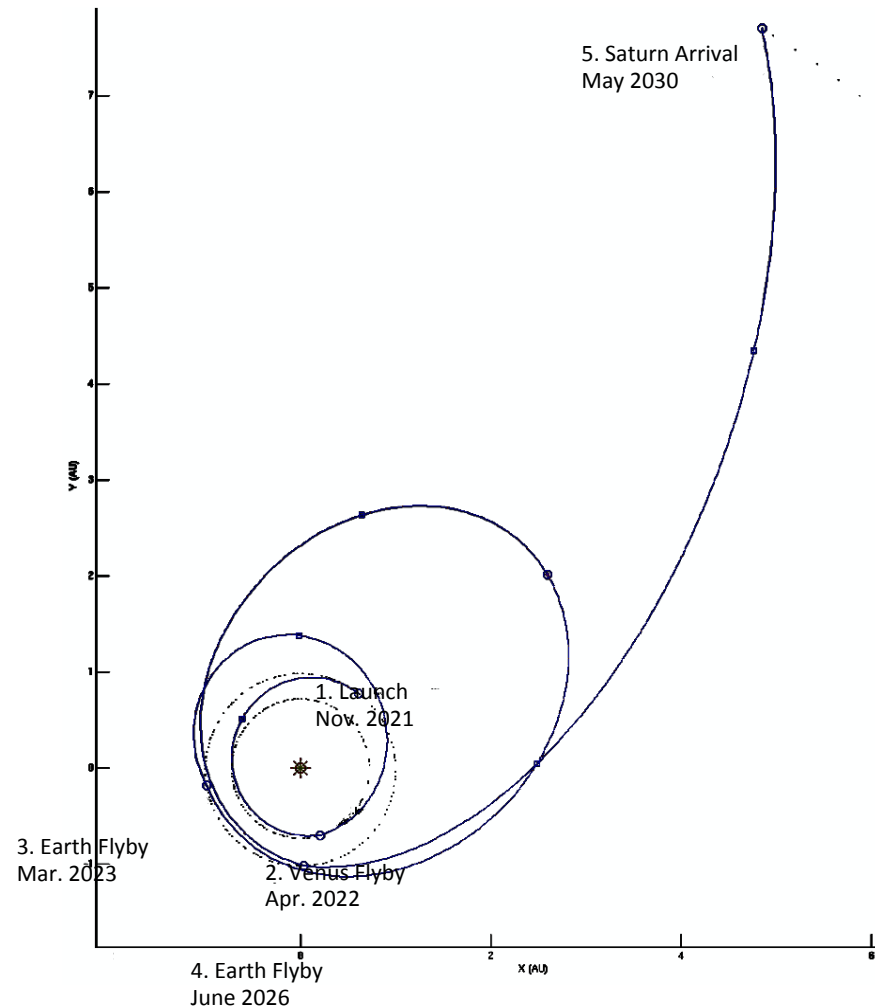


Mission Concept Overview

- Intermediate launch vehicle (Atlas V 4XX for example)
- 2 ASRGs for power and waste heat utilization
- 2 instrument payload optimized for Enceladus and Titan science objectives
- Hibernation during most of trip to Saturn
- Enceladus and Titan flybys from Saturn orbit using Cassini mission design techniques

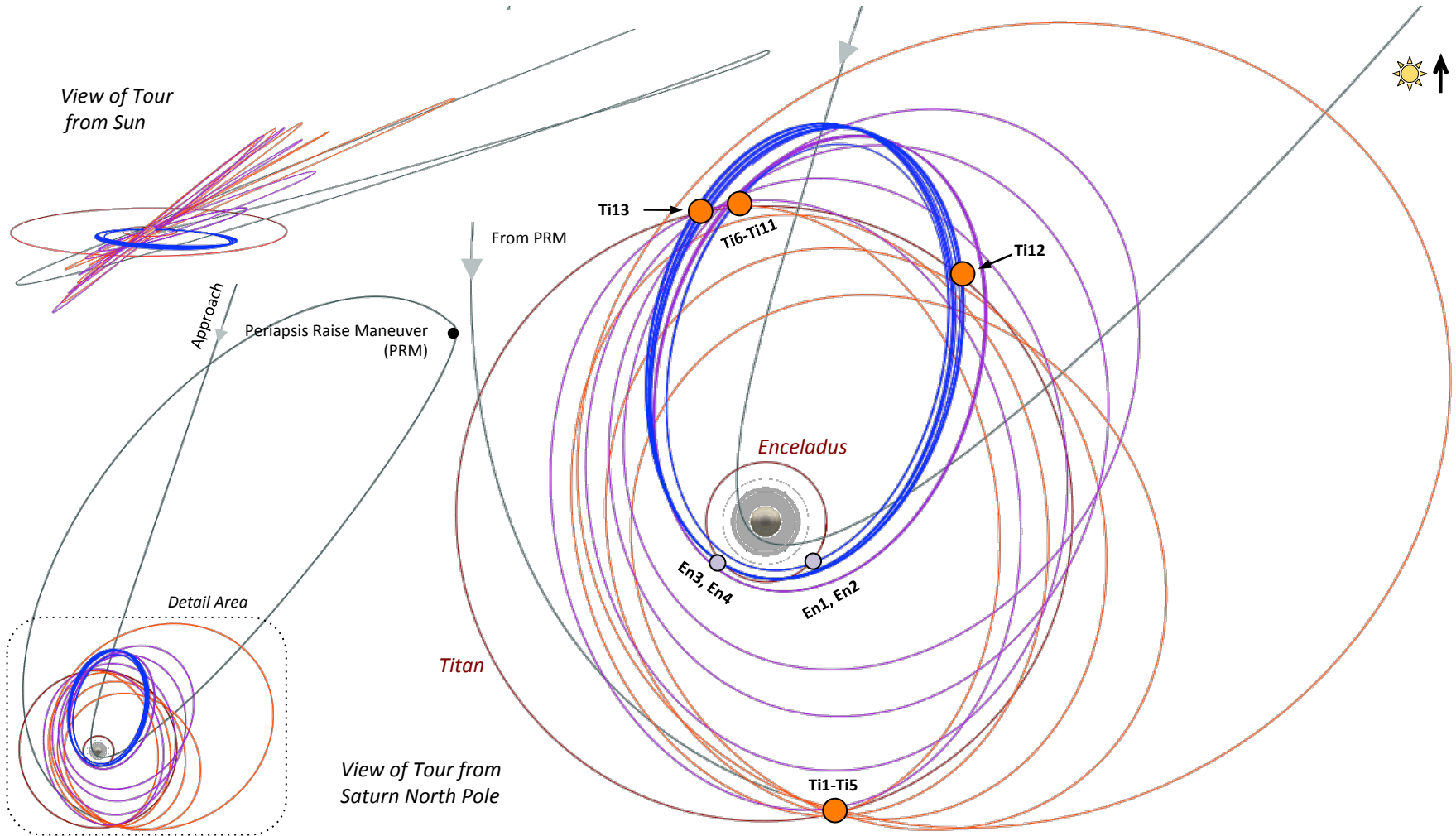
Proposed JET Trajectory to Saturn

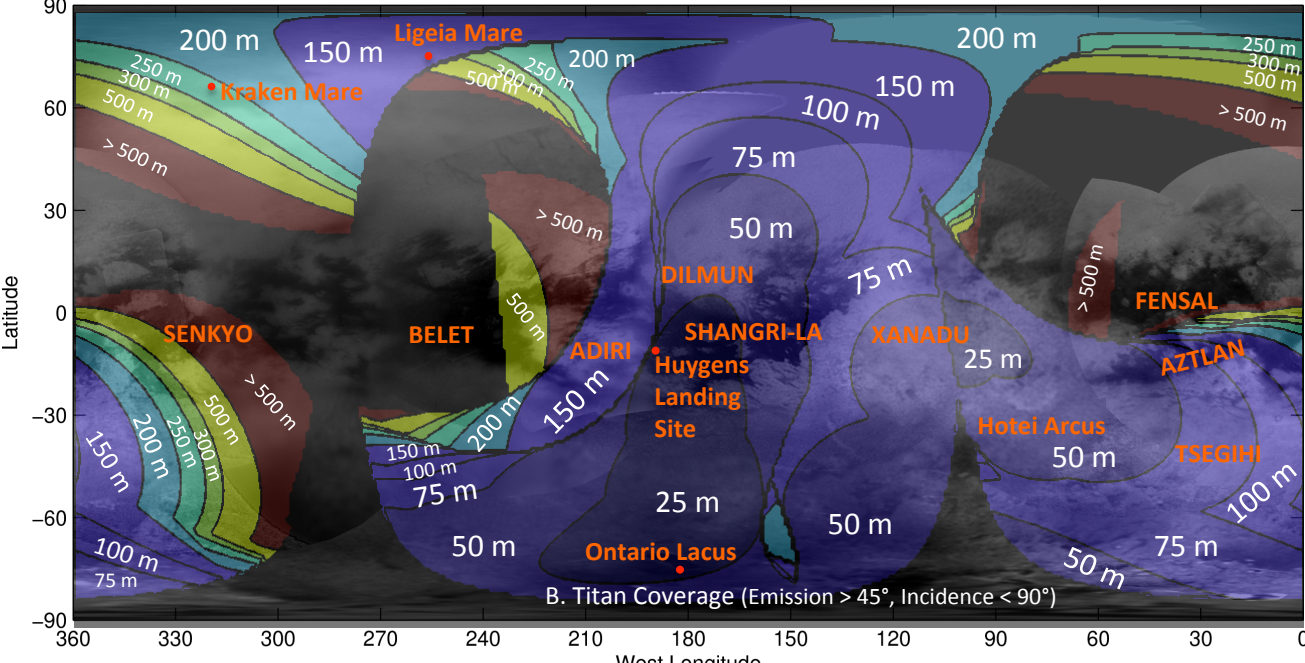
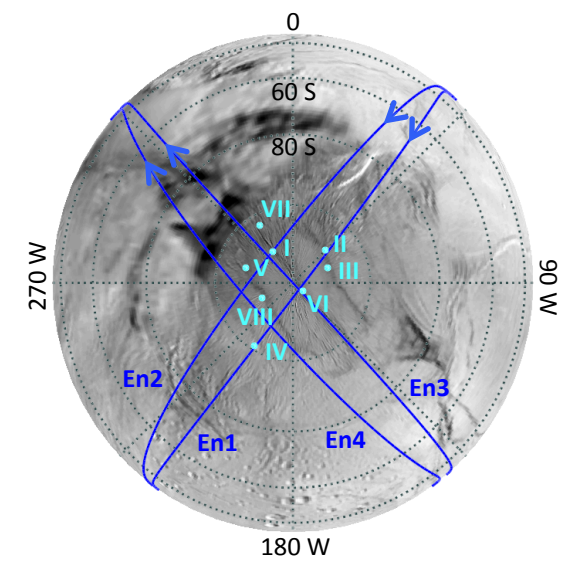
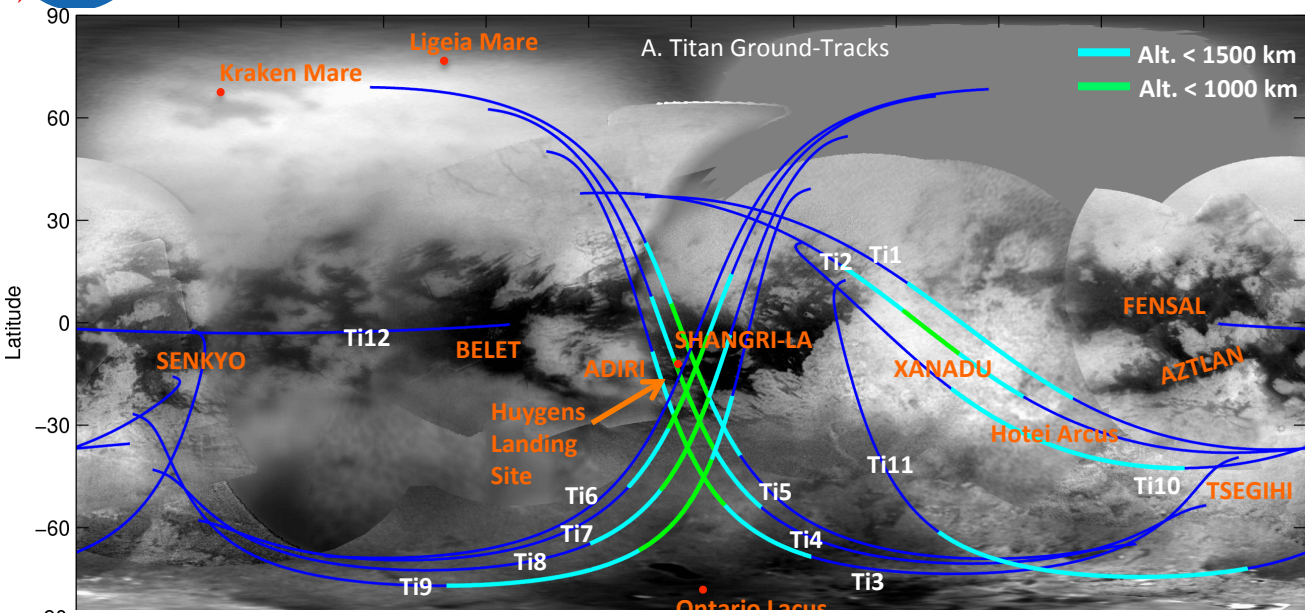
- JET would reach Saturn in 8.5 years using a Venus-Earth-Earth Gravity Assist trajectory
 - Operations cost would be kept low during the interplanetary cruise by placing the spacecraft into a hibernation mode
 - Multiple, similar Saturn trajectories exist in the early 2020s



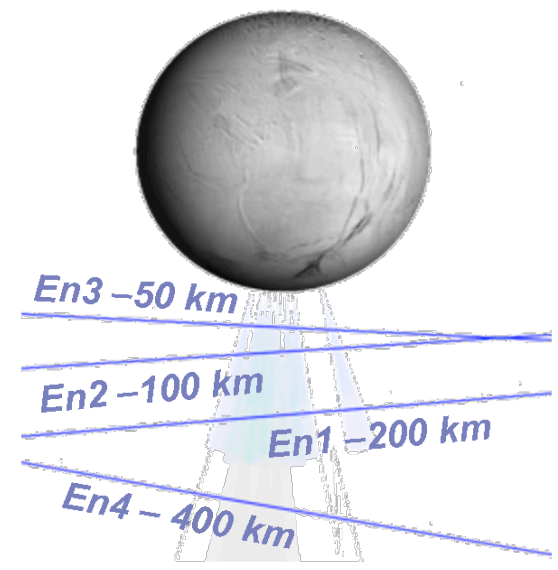
Example JET Science Tour

JET's science orbit would consist of 12 Titan Flybys and 4 passages through the Enceladus plume during a 2 year Saturn tour



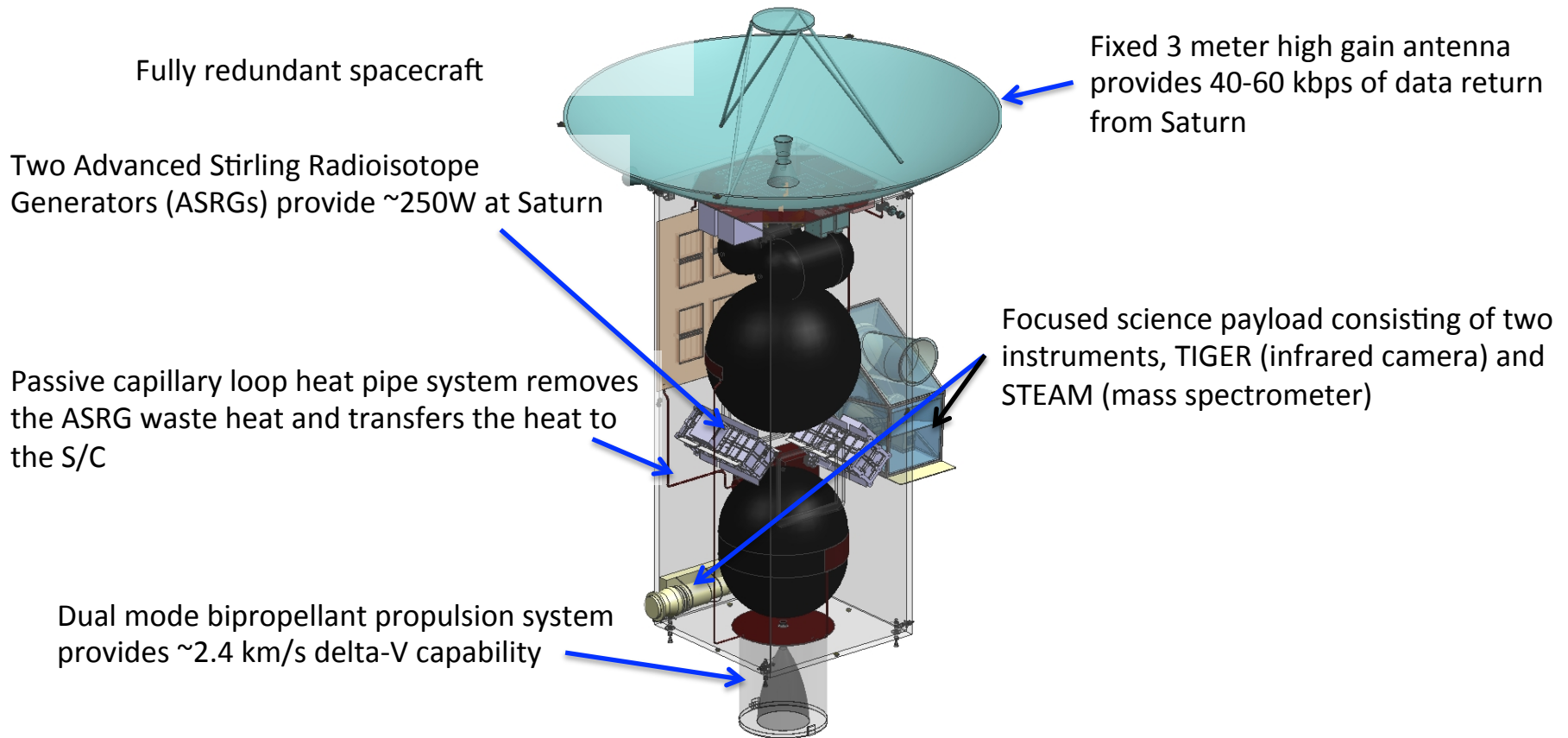


D. Enceladus Plume Penetration



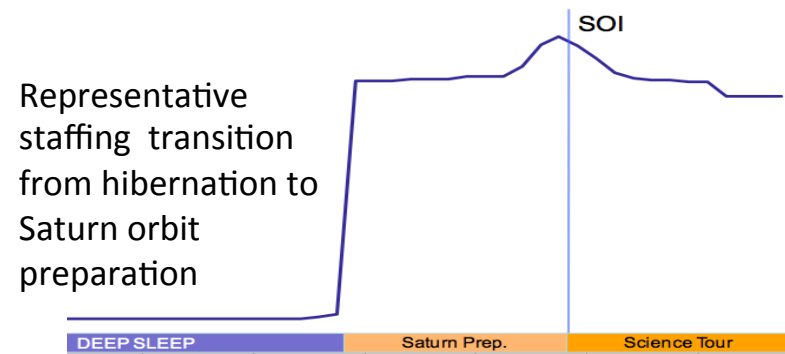
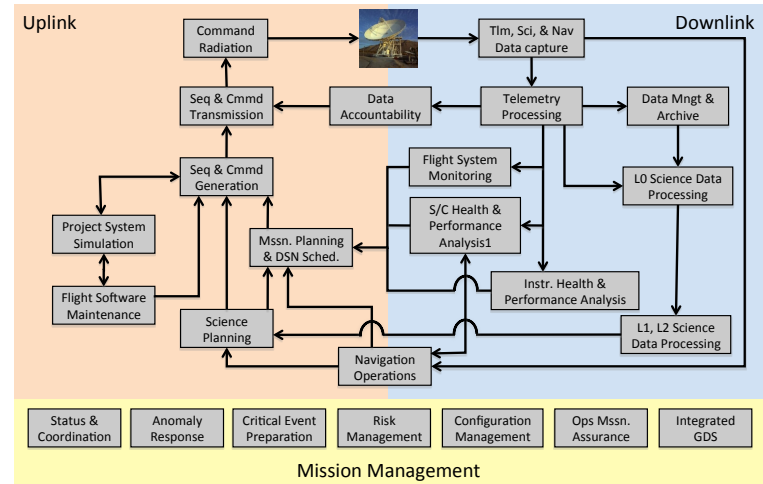
JET Conceptual Spacecraft

The JET mission would provide a platform to demonstrate and characterize ASRG technology while obtaining high value science



Low Cost, Low Risk Operations

- Use low risk hibernation during cruise periods ala EPOXI with beacon
- Retain key spacecraft personnel
- Cross trained mission operations team
- Team members perform multiple roles
- Standard deep space ground and spacecraft operations teams, procedures, and software





Summary

- Cassini has made amazing discoveries of jets and a plume at Enceladus
- Cassini also discovered IR windows that can see through the haze to Titan's surface
- JET could follow up on these amazing discoveries with a 2 instrument payload and, enabled by 2 ASRGs, yield high value Discovery-class science return