

July 28, 2009

Cassini-Huygens Mission to Saturn 5th Anniversary

Mission Overview

Huygens and Cassini

The Scientists and the Machines



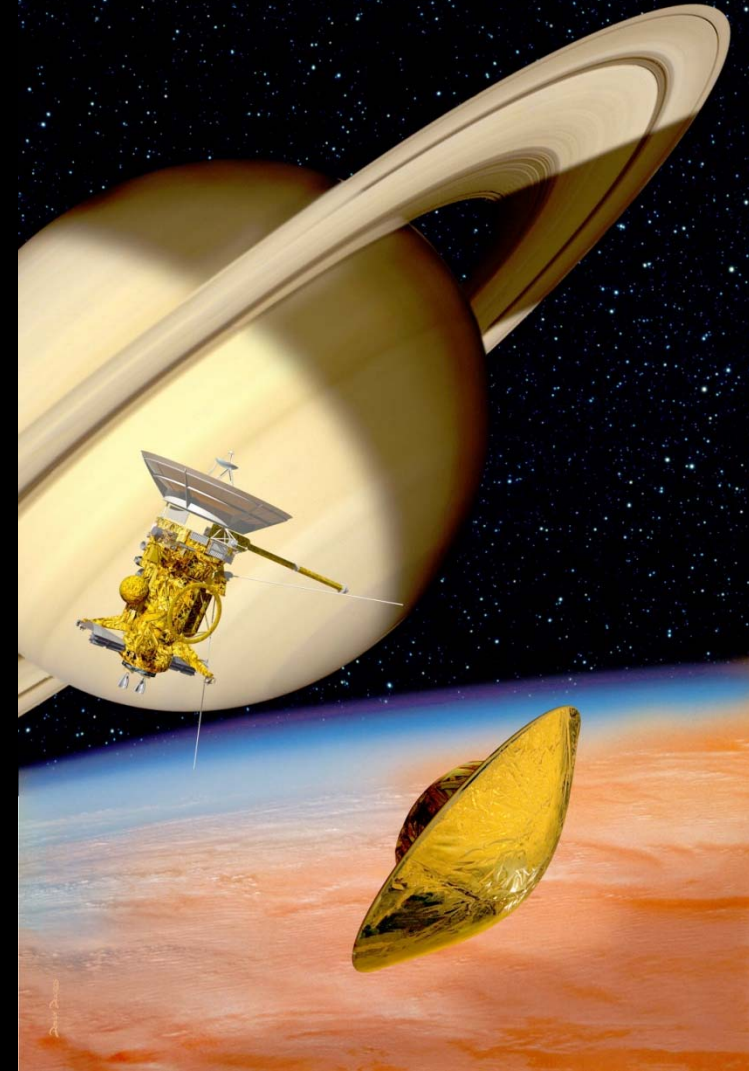
Christiaan Huygens

Christiaan Huygens (1629-1695) Dutch scientist, who discovered the true nature of Saturn's rings, and in 1655, Titan

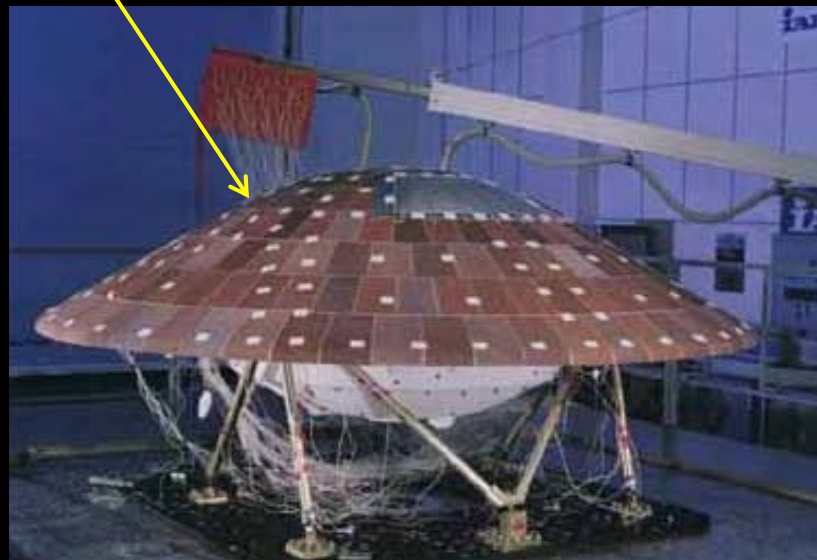


Giovanni Domenico Cassini

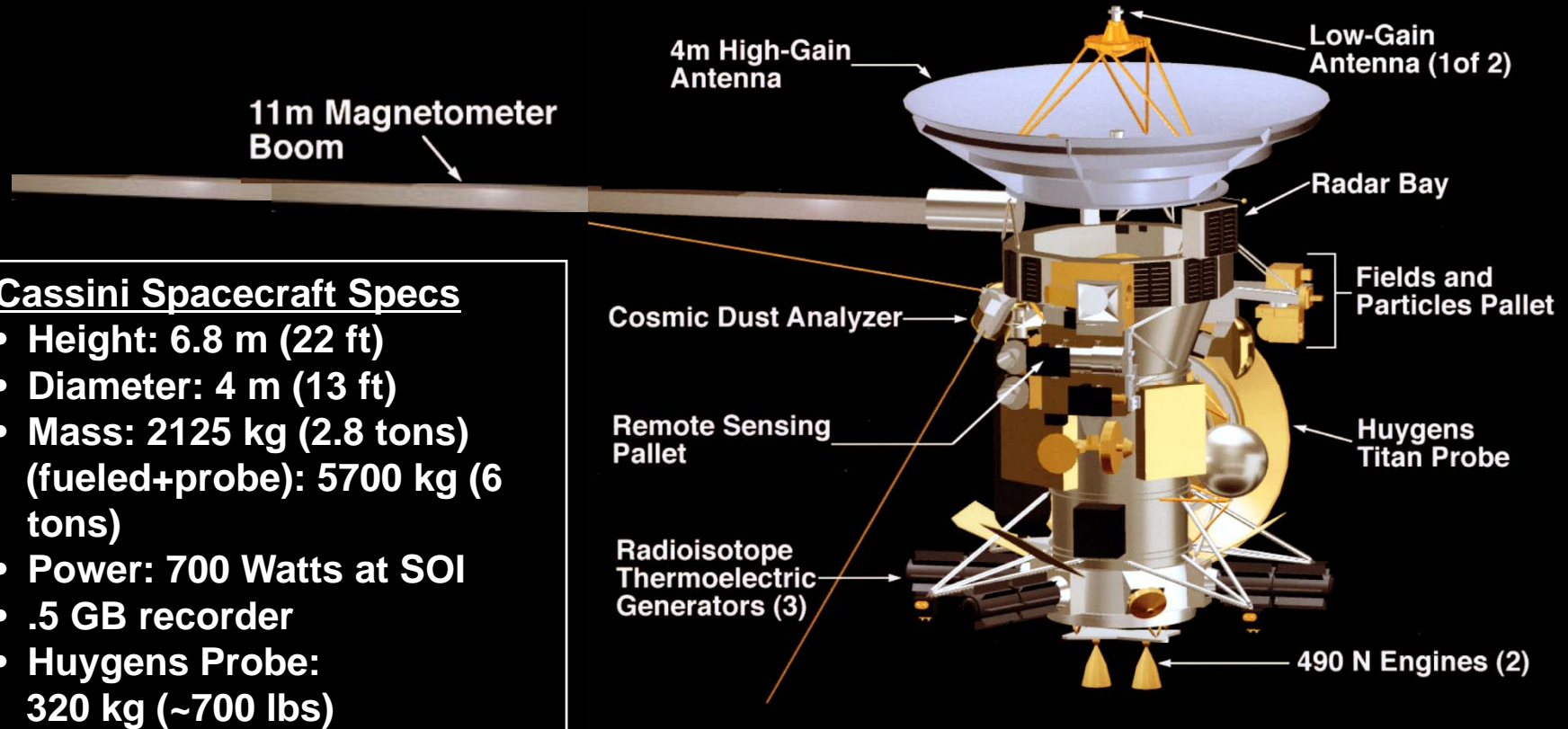
Giovanni Domenico Cassini (1625-1712), Italo-French astronomer, who discovered several of Saturn's satellites: Iapetus, Rhea, Tethys and Dione. In 1675, he discovered what is today called "Cassini Division" the gap in-between the two main rings of Saturn



Cassini Orbiter & Huygens Probe



Cassini Spacecraft



Cassini Spacecraft Specs

- Height: 6.8 m (22 ft)
- Diameter: 4 m (13 ft)
- Mass: 2125 kg (2.8 tons)
(fueled+probe): 5700 kg (6 tons)
- Power: 700 Watts at SOI
- .5 GB recorder
- Huygens Probe:
320 kg (~700 lbs)

Cassini Instruments:

Optical Remote Sensing (ORS)

CIRS: Composite Infrared Spectrometer
ISS: Imaging Science Subsystem
UVIS: Ultraviolet Imaging Spectrograph
VIMS: Visual and Infrared mapping Spectrometer

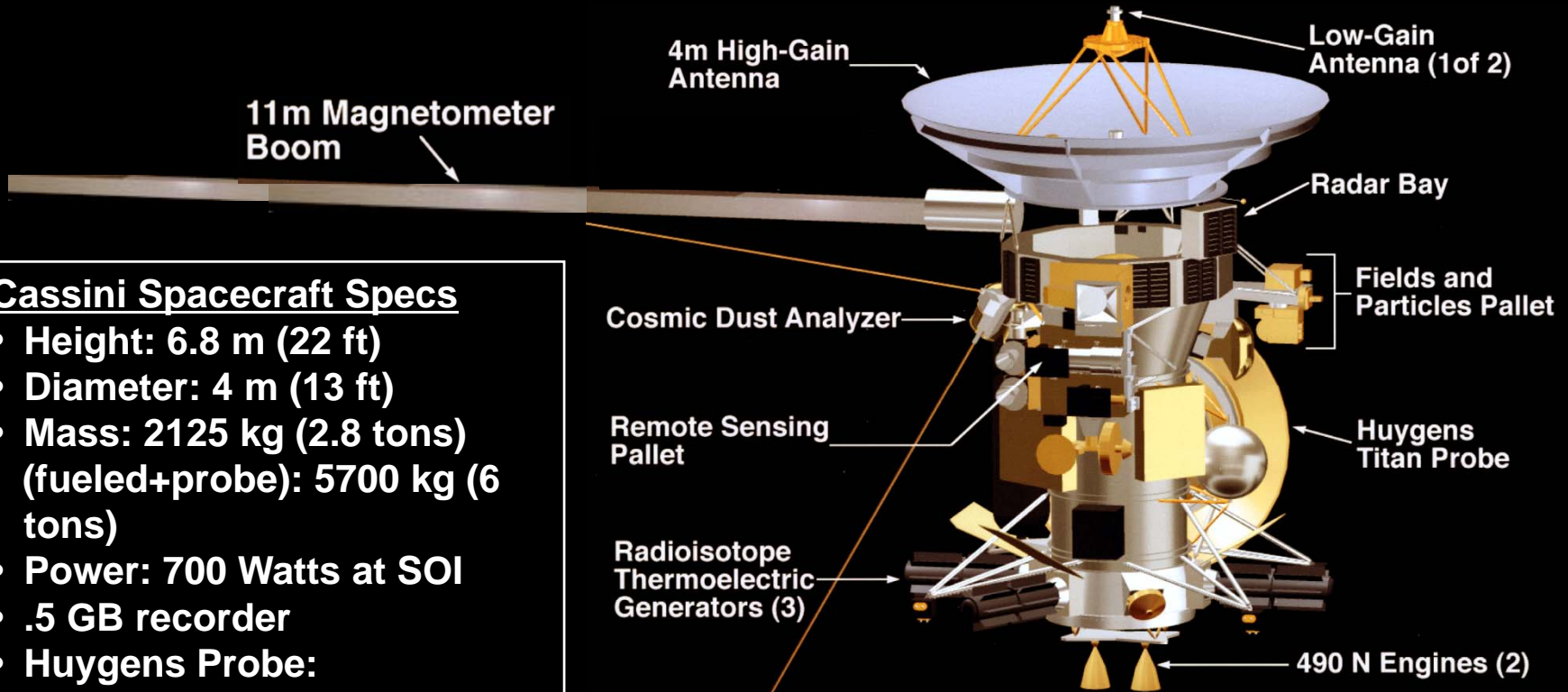
Microwave Remote Sensing

RADAR: Cassini Radar
RSS: Radio Science Subsystem

Magnetospheric and Plasma Science (MAPS)

CDA: Cosmic Dust Analyzer
INMS: Ion and Neutral Mass Spectrometer
MAG: Dual Technique Magnetometer
MIMI: Magnetospheric Imaging Instrument
RPWS: Radio and Plasma Wave Science

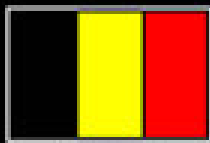
Cassini Spacecraft



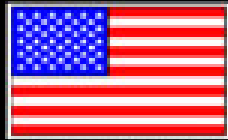
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BELGIUM



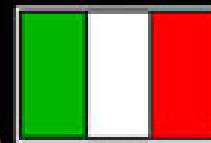
UNITED STATES



FRANCE



GERMANY



ITALY



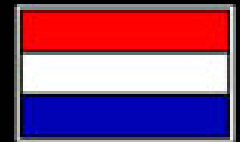
DENMARK



UNITED KINGDOM



SWITZERLAND



NETHERLANDS



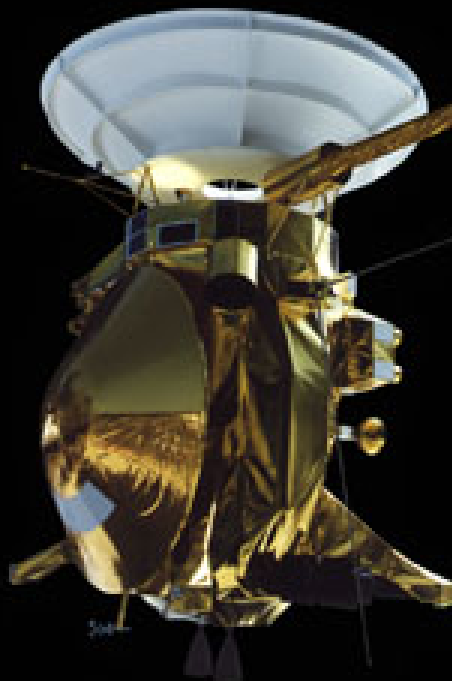
CZECH REPUBLIC



AUSTRIA

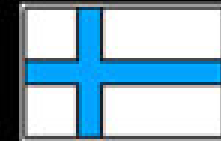


SPAIN

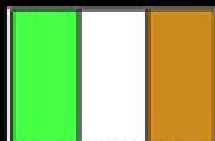


INTERNATIONAL
PARTICIPATION IN

CASSINI
SATURN ORBITER AND
HUYGENS TITAN
PROBE



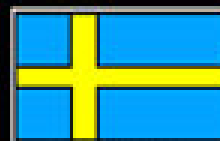
FINLAND



IRELAND



HUNGARY



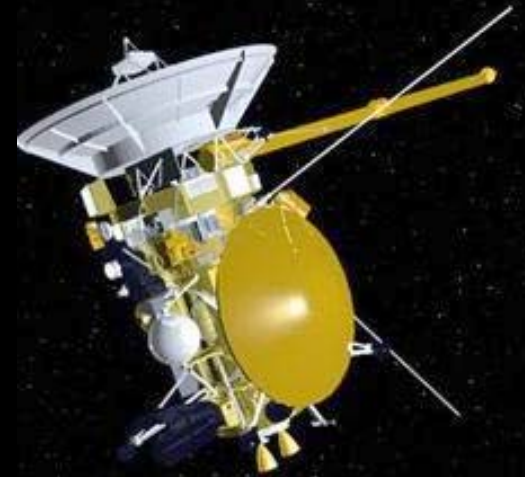
SWEDEN

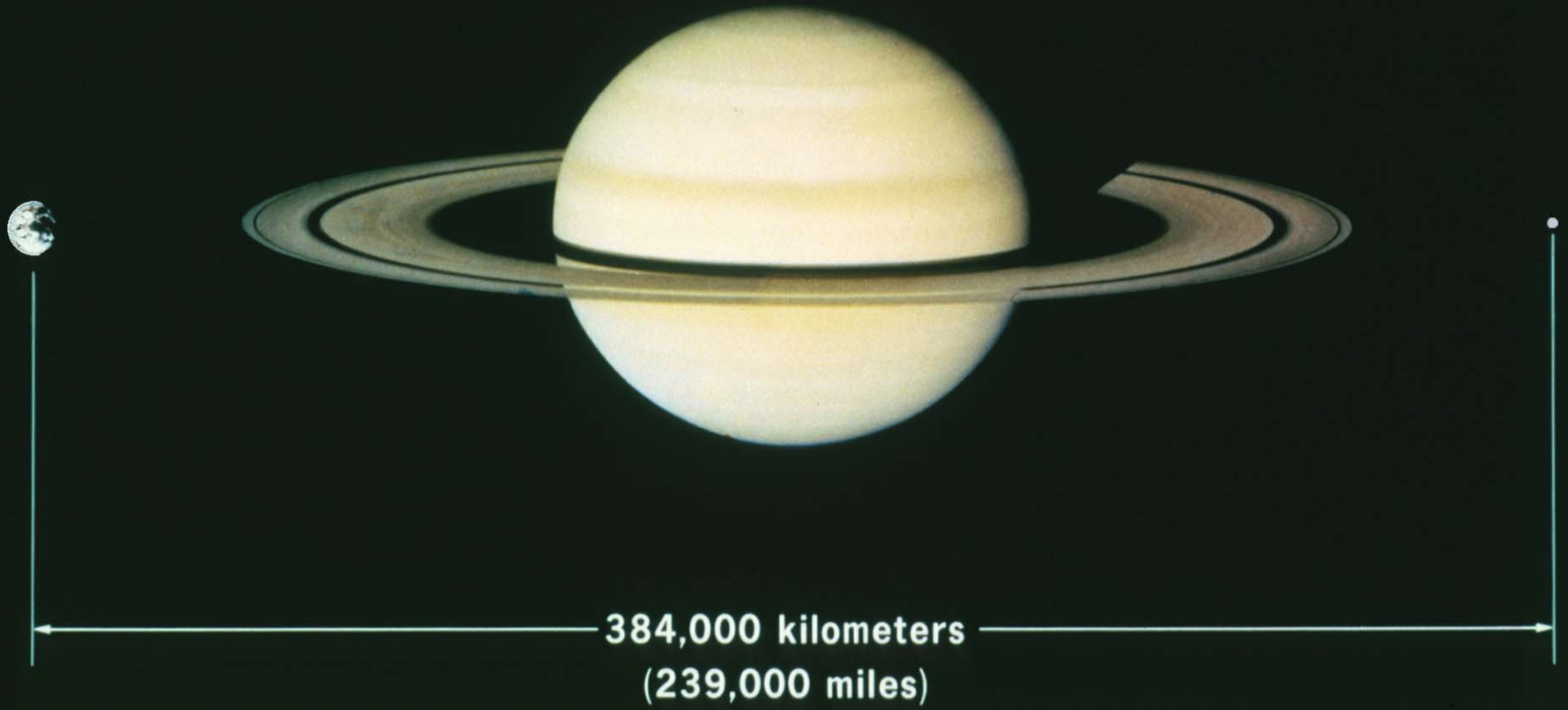


NORWAY

Numbers

- 1 Cassini-Huygens
- 5 Scientific disciplines
 - Saturn, Titan, Rings, Icy Satellites, Magnetosphere
- 18 Instruments (12 Orbiter)
- 27 Investigations
- 30 Project Science Group (PSG) Executive
- ~80-100 Scientists at PSG Plenary session
- ~270 Scientists on Investigation Teams (more than half are in Europe)
 - Does not include science associates and postdocs





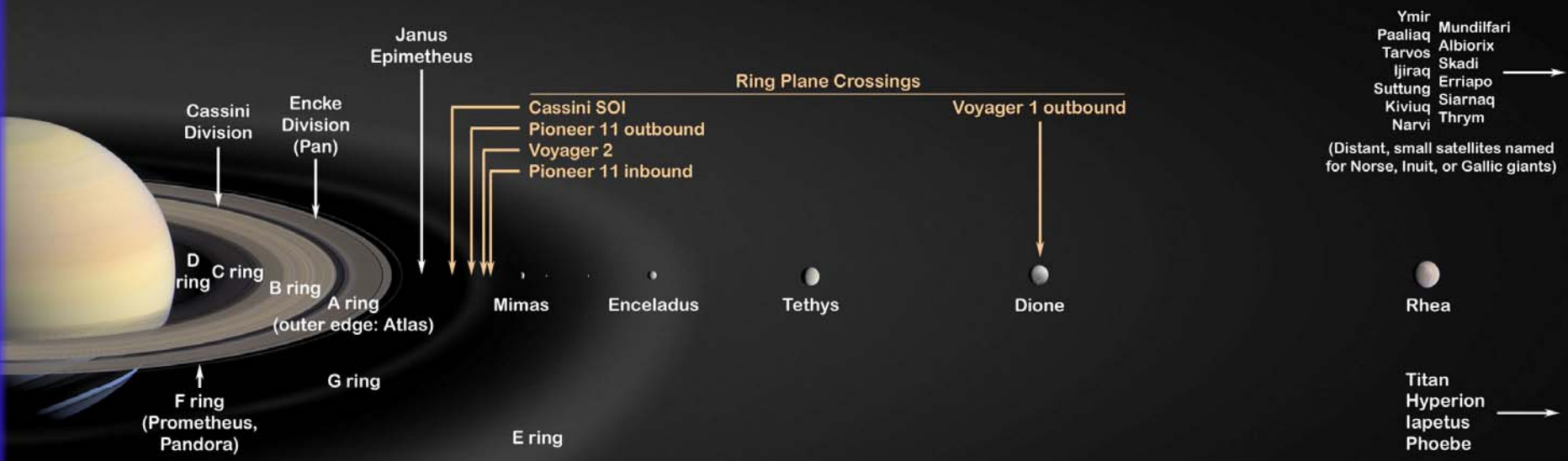
384,000 kilometers

(239,000 miles)

THE SATURNIAN SYSTEM



All bodies are to scale except for the eight small, starred (*) bodies whose sizes have been exaggerated by a factor of 5.



Cassini Equinox Mission Tour

- 2.25 year duration (1 July 2008 – 1 Oct. 2010)
 - Saturn Equinox in August 2009
- Driven by scientific requirements
- Equinox tour produces the maximum scientific return possible with Cassini-Huygens spacecraft
- Similar in intensity to Prime Mission



Cassini Mission Overview

Four-Year Prime Tour + Two-Year Extended Mission (Proposed), July 2004 - July 2010

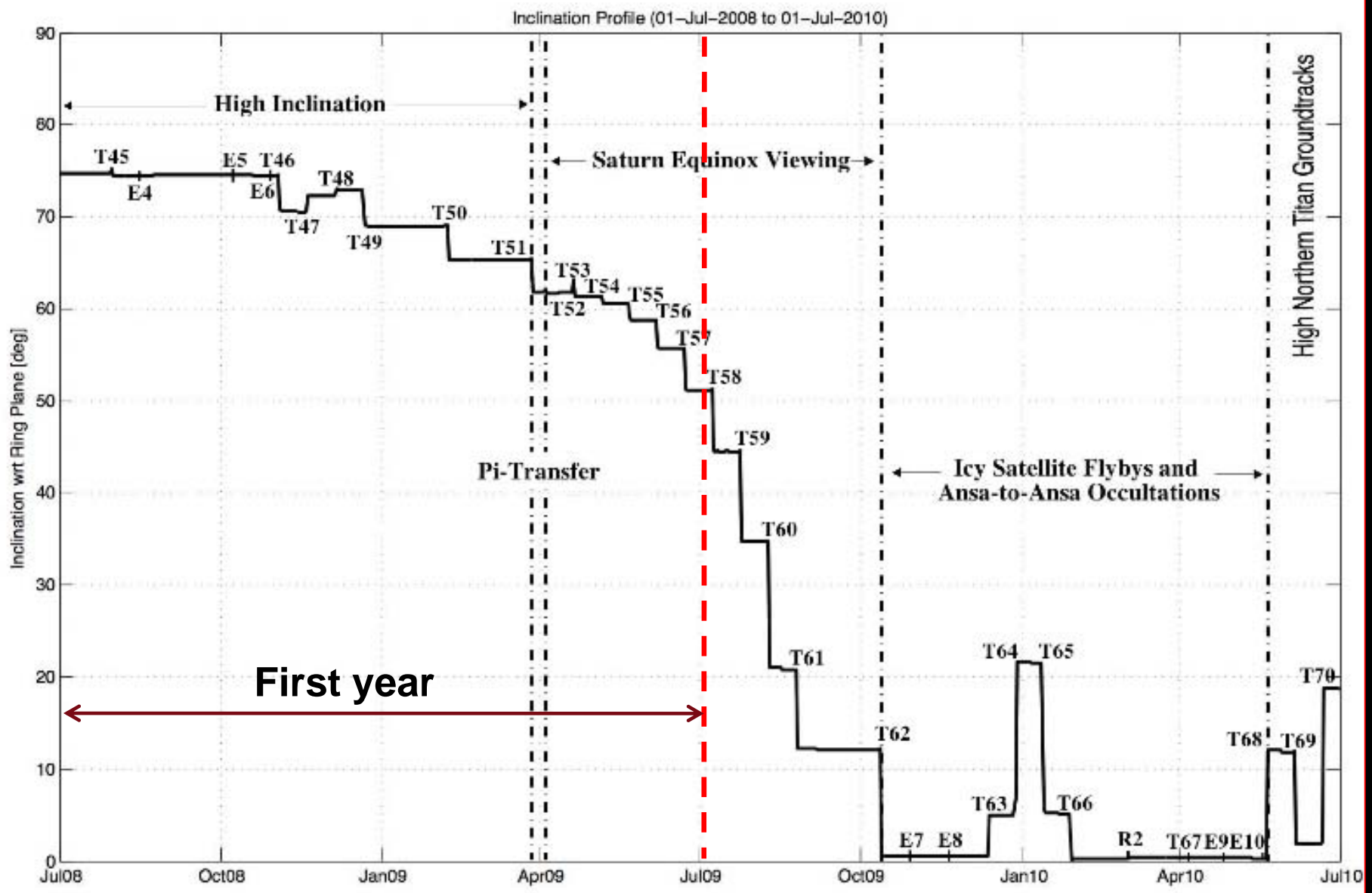
Extended Mission



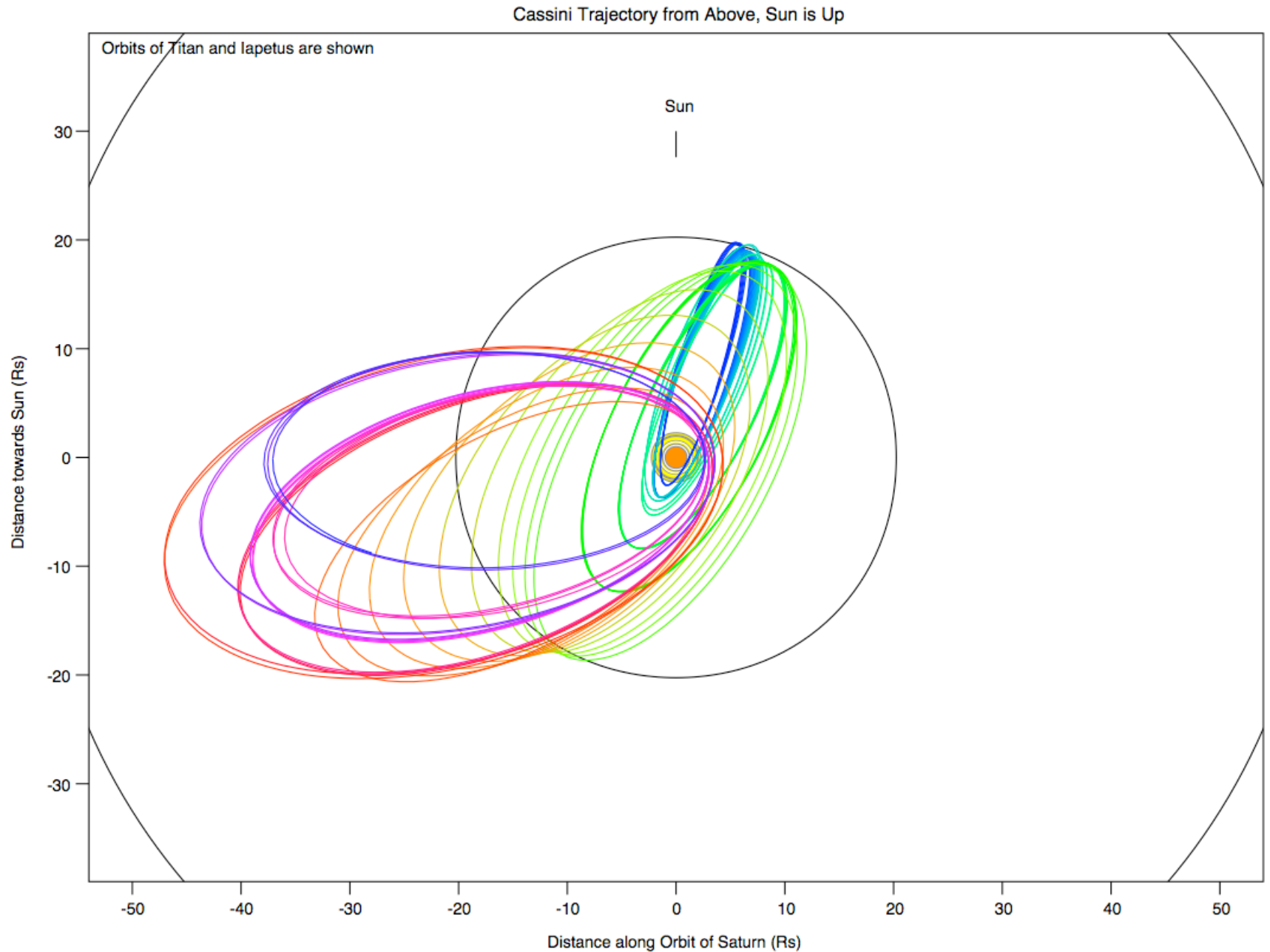
Equinox Mission Overview

- 26 Titan flybys
 - 7 dusk encounters, 3 high northern groundtracks, a mid-tail wake crossing, numerous “quality” RSS occultations, separate solar and earth equatorial occultations
- 7 Enceladus flybys less than 2050 km
 - 2 at 25 km, 2 at 100 km, and the others at 250, 1810, and 2030 km
- Additional Icy/Rocky satellite flybys
 - 1 Dione at 500 km (downstream wake flyby), 1 Rhea at 100 km, and 1 Helene at 1500 km
- Inclined two months post-equinox campaign
 - 21.8 degrees at equinox, and 13.2 deg., 25-Aug - 12-Oct
- Three ansa-to-ansa ring/Saturn RSS occultations
- High number of mid-latitude northern hemisphere Saturn occultations, although a lack of high northern occultations.
- 5 equatorial targeted Saturn periapsis passages (i.e. no targeted/pseudo-targeted icy satellite flybys)
- 28 spacecraft orbits with inclination > 64.3 degrees (not including T44-to-T45 4:9 transfer)

Equinox Mission Inclination Profiles

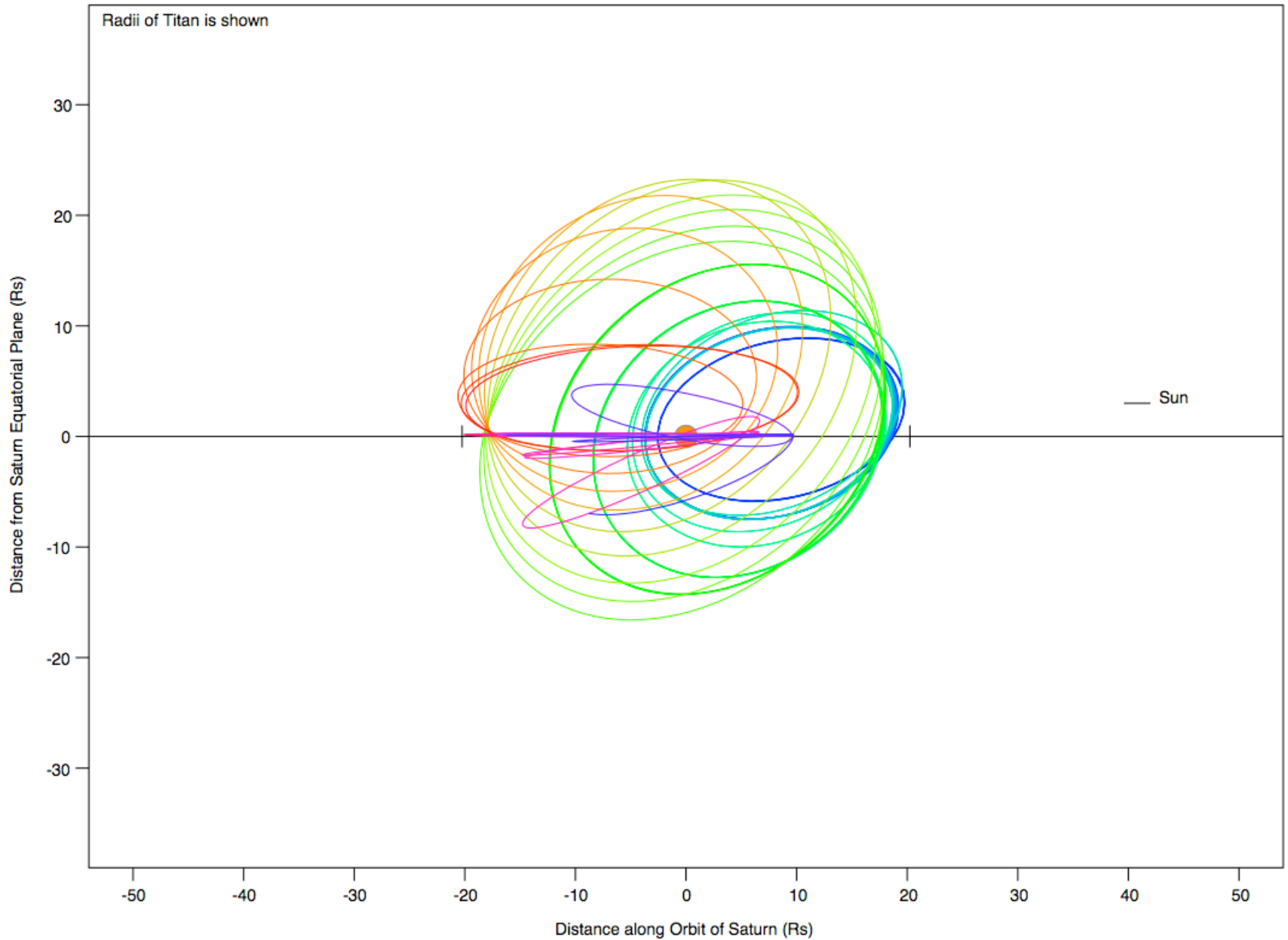


Petal Plot



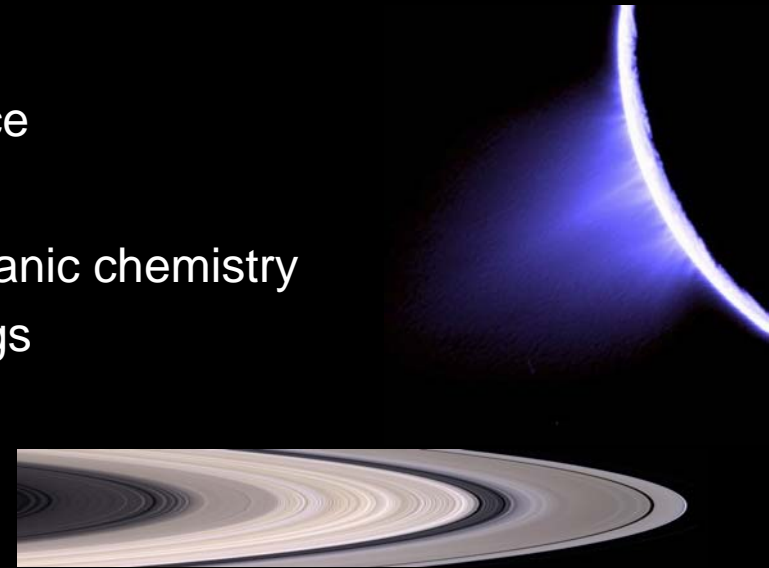
Petal Plot

Cassini Trajectory, in Equatorial Plane, Sun to Right

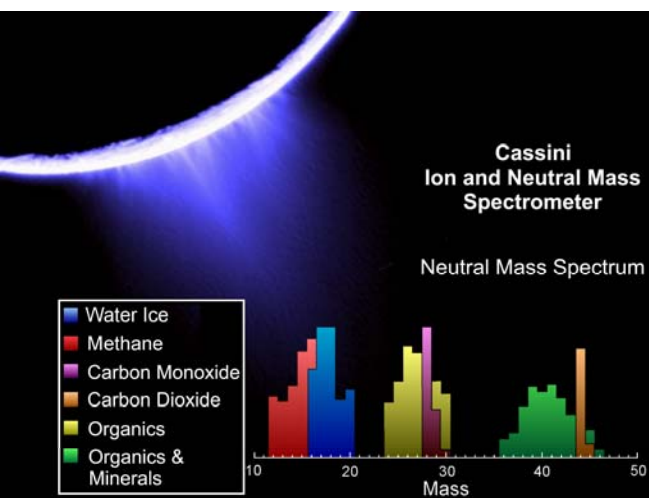
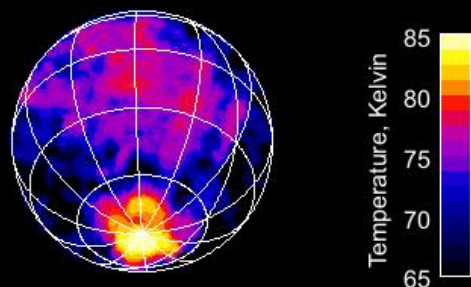
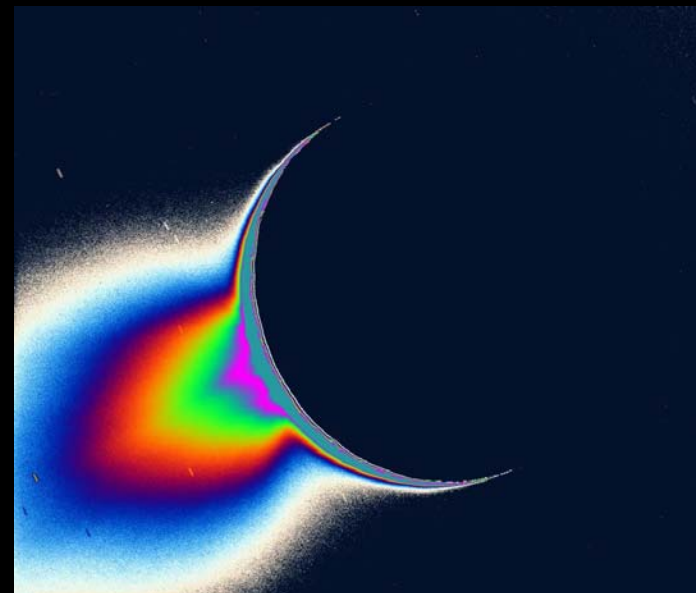
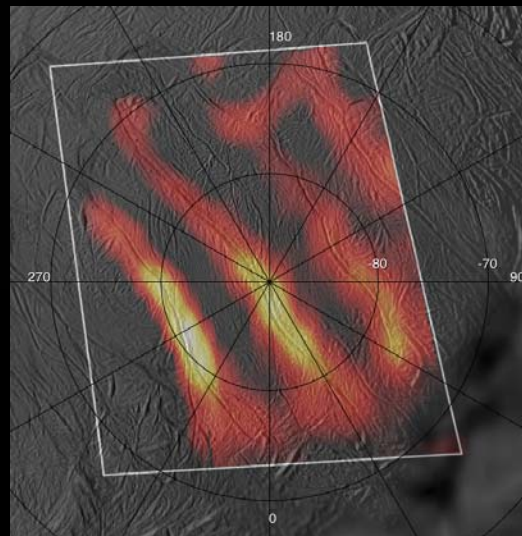
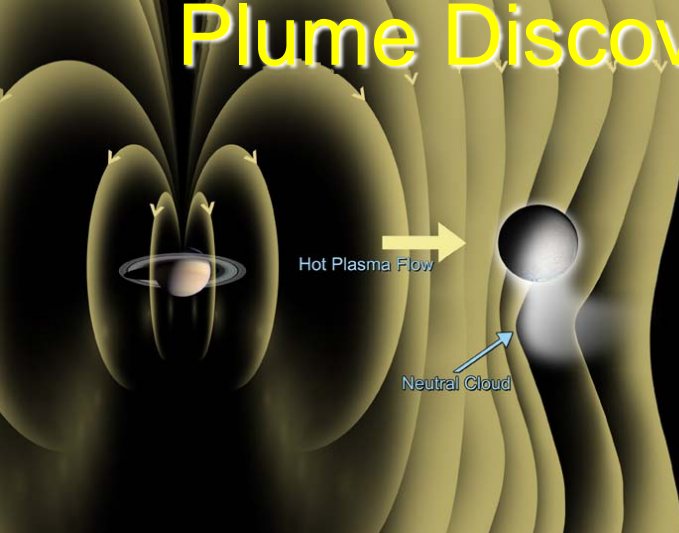


Equinox Scientific Objectives

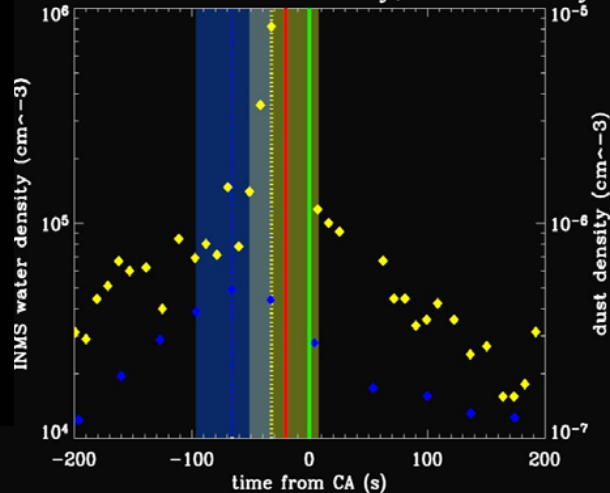
- **New discoveries**
 - Enceladus' plumes, Titan's complex surface
- **Theoretical advances**
 - Importance of Titan and Enceladus for organic chemistry
 - Dynamics of satellites imbedded in the rings
 - Satellite geophysics (e.g. Iapetus ridge)
- **New opportunities, temporal and spatial**
 - New seasons for Saturn and Titan
 - New ring event: Equinox (August 2009) is prime opportunity for ring discoveries
 - New places to explore in Saturn's huge magnetosphere
- **Address incomplete AO objectives**
 - Titan Radar coverage increases from 22% to 30%
- **Gather information needed for future missions**
 - Spatial and temporal coverage for Titan and Enceladus



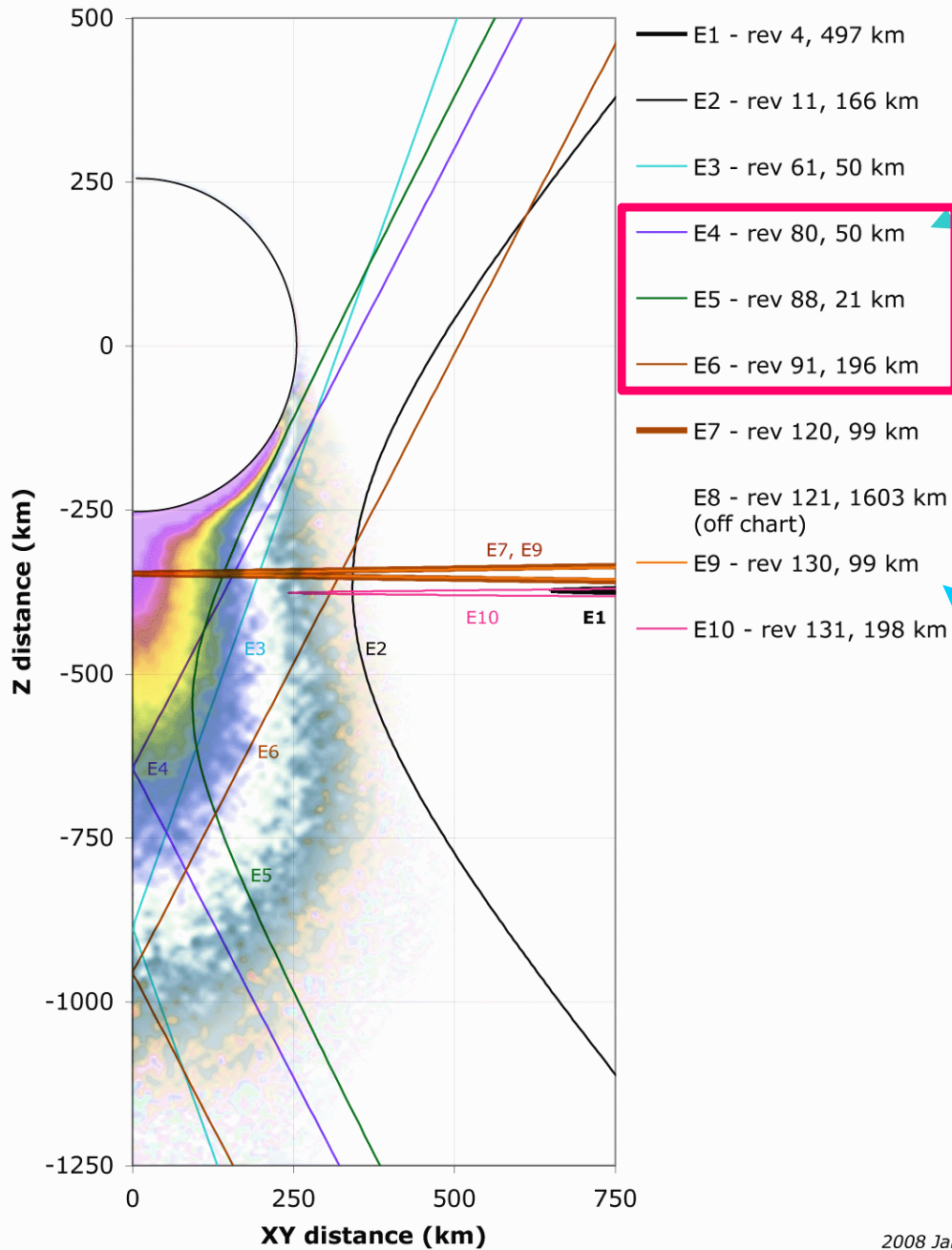
Plume Discovery through Interdisciplinary Science



Enceladus- Water Density, Dust density



Cassini's Enceladus Encounters



7 Enceladus flybys

E4 - E10

3 in past year

Titan: Complex surface, atmosphere and organics

detached haze

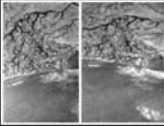
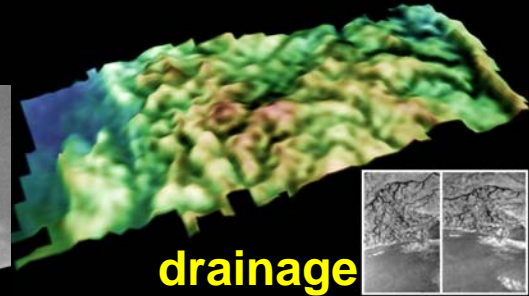


huge cloud systems

mid-latitude streaks



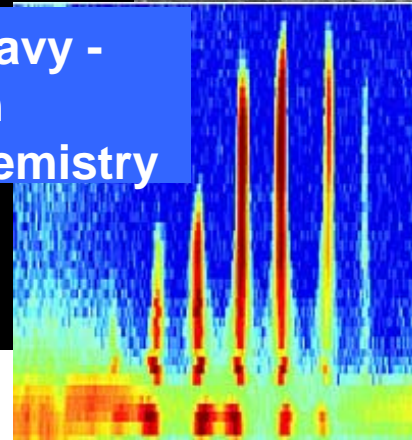
drainage channels



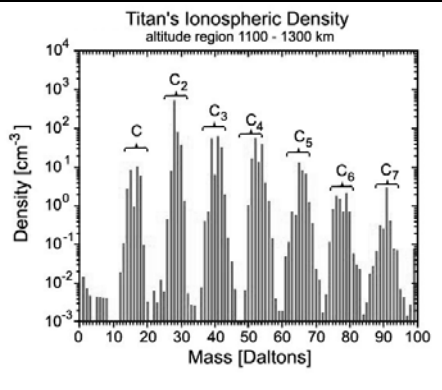
river channels



Heavy - ion chemistry

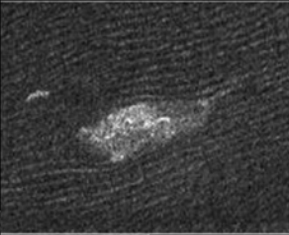


mountains

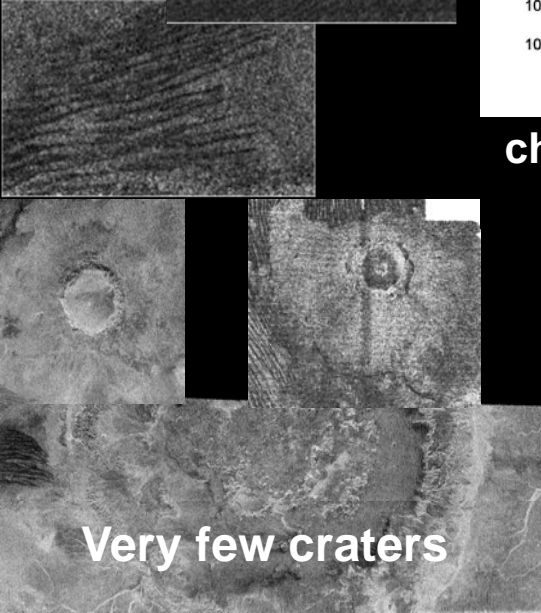


chemically complex atmosphere

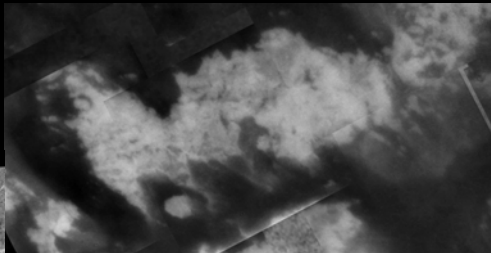
wind driven dunes



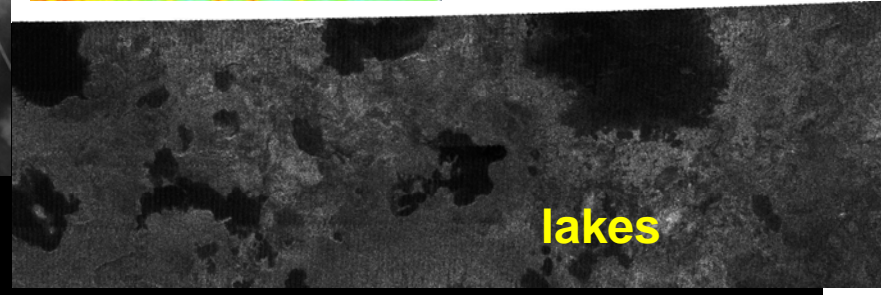
Very few craters



aeolian patterns

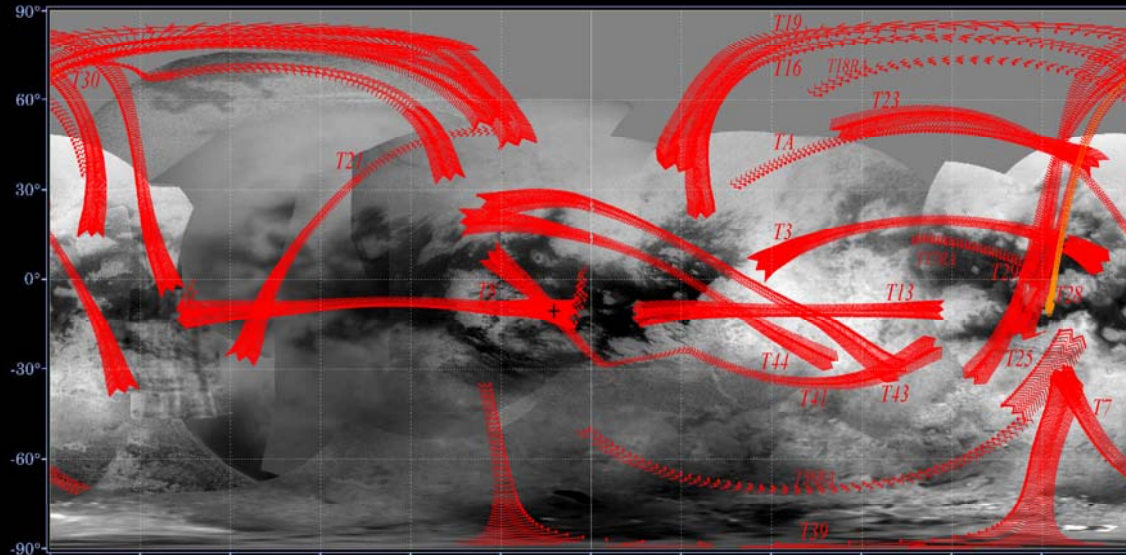


lakes

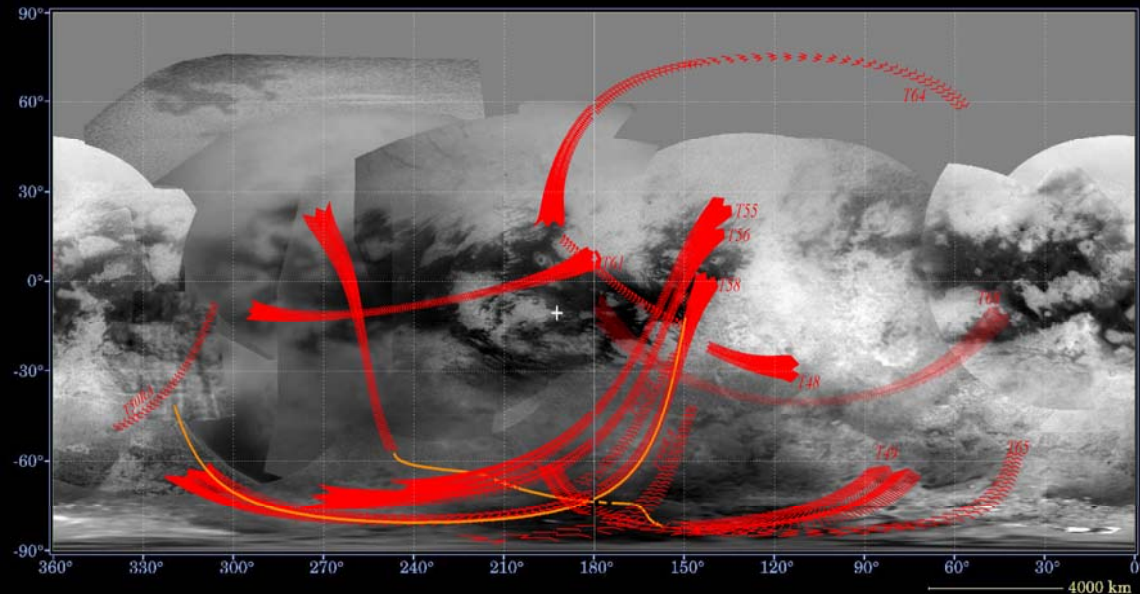


Radar coverage of Titan surface

Prime 22%



Equinox 8%





Tibor Balint

Gather information to support future missions

Equinox: May 14, 2025

Saturn Year

Summer Solstice: May 23, 2017

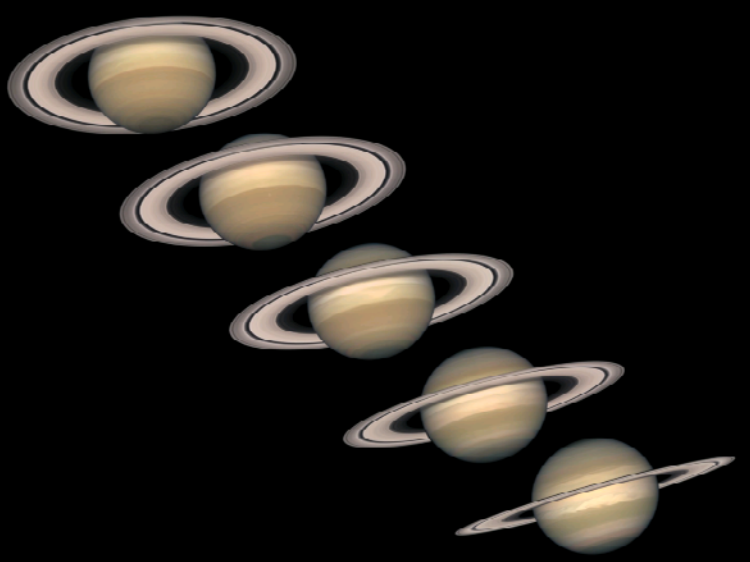
Winter Solstice: Oct 30, 2002

Equinox: Aug 9, 2009

Cassini Prime Mission

Equinox

Proposed XXM



Seasonal Declination of Sun/Earth

