

Cassini and MER Telecom

Mark M. Schaefer

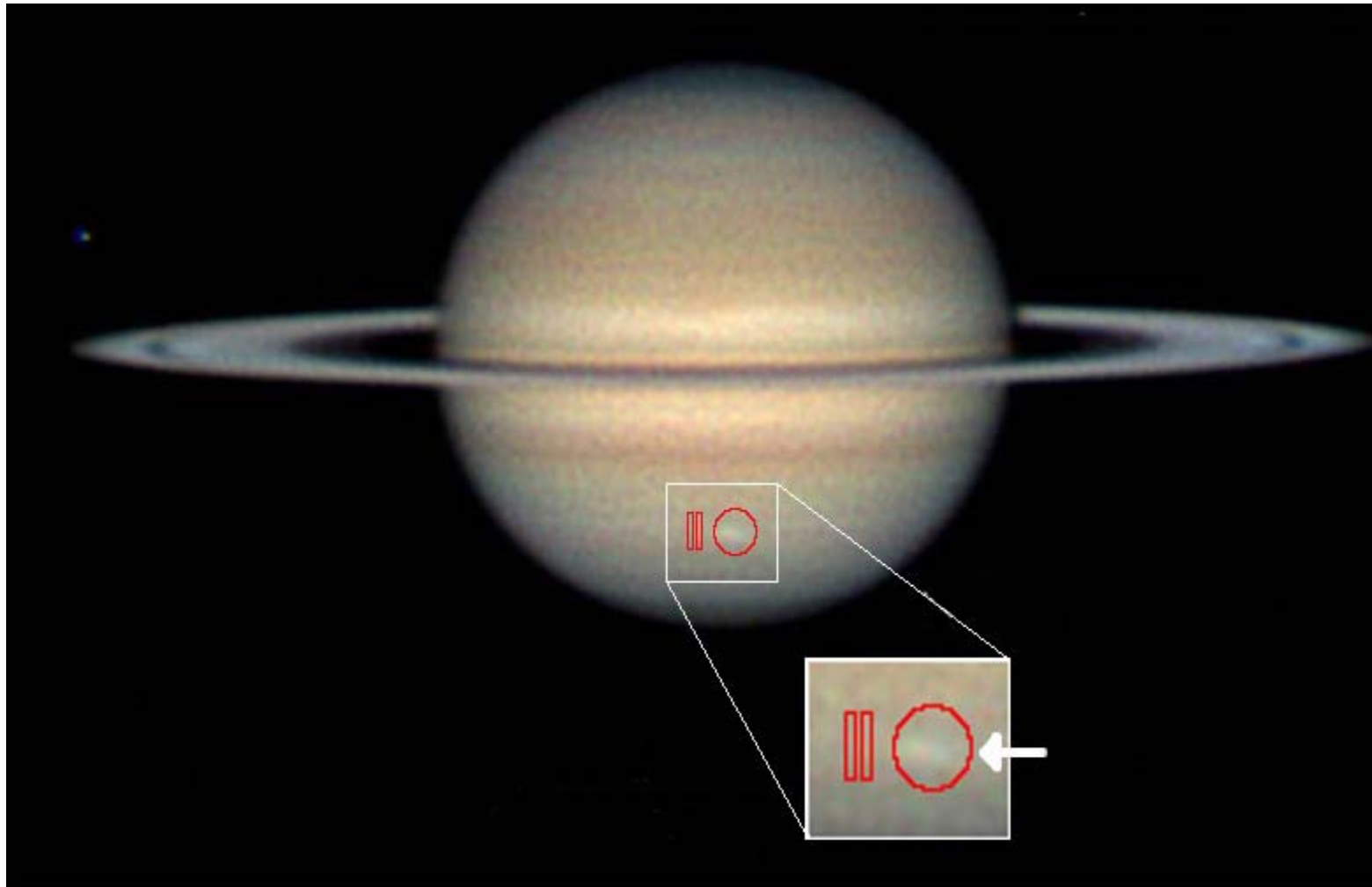
WB6CIA

Jet Propulsion Laboratory

SARA Monthly Meeting

5/5/2010

Cassini and MER Telecom

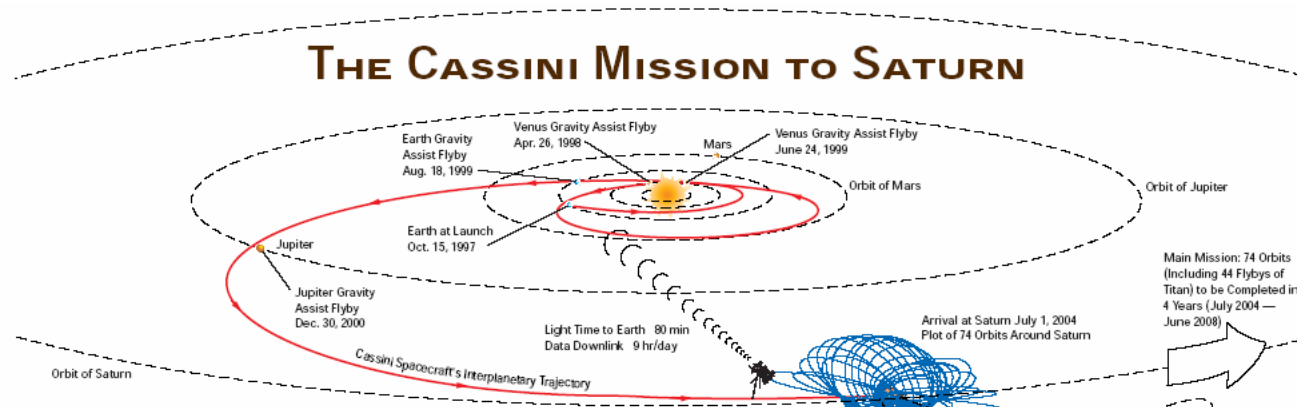


Cassini Launch Oct 15, 1997 Extended Mission to 2020

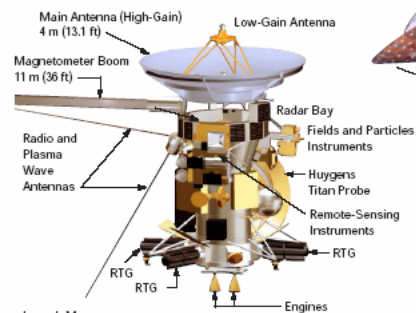


Jet Propulsion Laboratory
California Institute of Technology

Cassini and MER Telecom



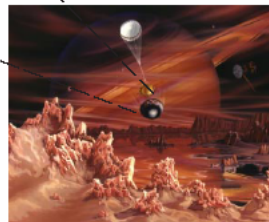
THE CASSINI SPACECRAFT



- Launch Mass
 - Spacecraft — 2,442 kg (5,384 lb)
 - Propellant — 3,132 kg (6,905 lb)
 - Total Mass — 5,574 kg (12,288 lb)
- Propulsion: Two engines, 445 Newton (100 lb) thrust each
- Electrical Power Source: Three radioisotope thermoelectric generators (RTGs)
- Optical Remote-Sensing Instruments: Will determine temperatures, chemical composition, structure, and chemistry of Saturn, its rings, moons, and their atmospheres; will measure the mass and internal structure of Saturn and its moons; will photograph Saturn, its rings, and moons in visible, near-infrared, and ultraviolet wavelengths.
- Radar: Will map Titan and measure heights of surface features.
- Field and Particles Instruments: Will map the magnetic field of Saturn; detect charged particles and plasmas; study interactions between solid bodies and the solar wind; investigate ice and dust, plasma waves, and radio waves.

HUYGENS TITAN PROBE

Touchdown on Titan — Nov. 27, 2004



- During 3 hours of science observation and measurements, the Huygens Probe instruments will:
- Collect aerosols for chemical analysis.
 - Make spectral measurements and take pictures of Titan's surface and atmosphere.
 - Measure wind speeds using the Doppler effect.
 - Identify constituents in atmosphere.
 - Measure physical and electrical properties of the atmosphere.
 - Measure physical properties of the solid or liquid surface of Titan.

CASSINI PARTNERS

The Cassini mission is a joint effort of the National Aeronautics and Space Administration (NASA), European Space Agency (ESA), and Italian Space Agency (ASI). The mission is managed for NASA by the Jet Propulsion Laboratory, California Institute of Technology. Partners include the U.S. Air Force (USAF), Department of Energy (DOE), and academic and industrial participants from 19 countries.

SATURN

- Diameter: 120,660 km (74,975 mi)
- Density: 0.69 g/cm³
- Length of Day: 10 hr 40 min
- Length of Saturn Year: 29.42 Earth Years
- Rings: 7
- Moons: 18
- Composition of Atmosphere:
 - Hydrogen (H₂)
 - Helium (He)
 - Methane (CH₄)
 - Ammonia (NH₃)
 - and numerous other hydrocarbons

TITAN

SATURN'S LARGEST MOON

- Distance to Saturn: 1,221,850 km (759,200 mi)
- Diameter: 5,150 km (3,199 mi)
- Density: 1.82 g/cm³ (equivalent to 1.82 times the density of water)
- Surface Temperature: -181 °C (-294 °F)
- Surface Pressure: 1.5 bars (approximately 1.5 times surface pressure at sea level on Earth)
- Composition of Atmosphere:
 - Nitrogen (N₂)
 - Methane (CH₄)
 - and other hydrocarbons and nitriles

World Wide Web (WWW): <http://www.jpl.nasa.gov/cassini>

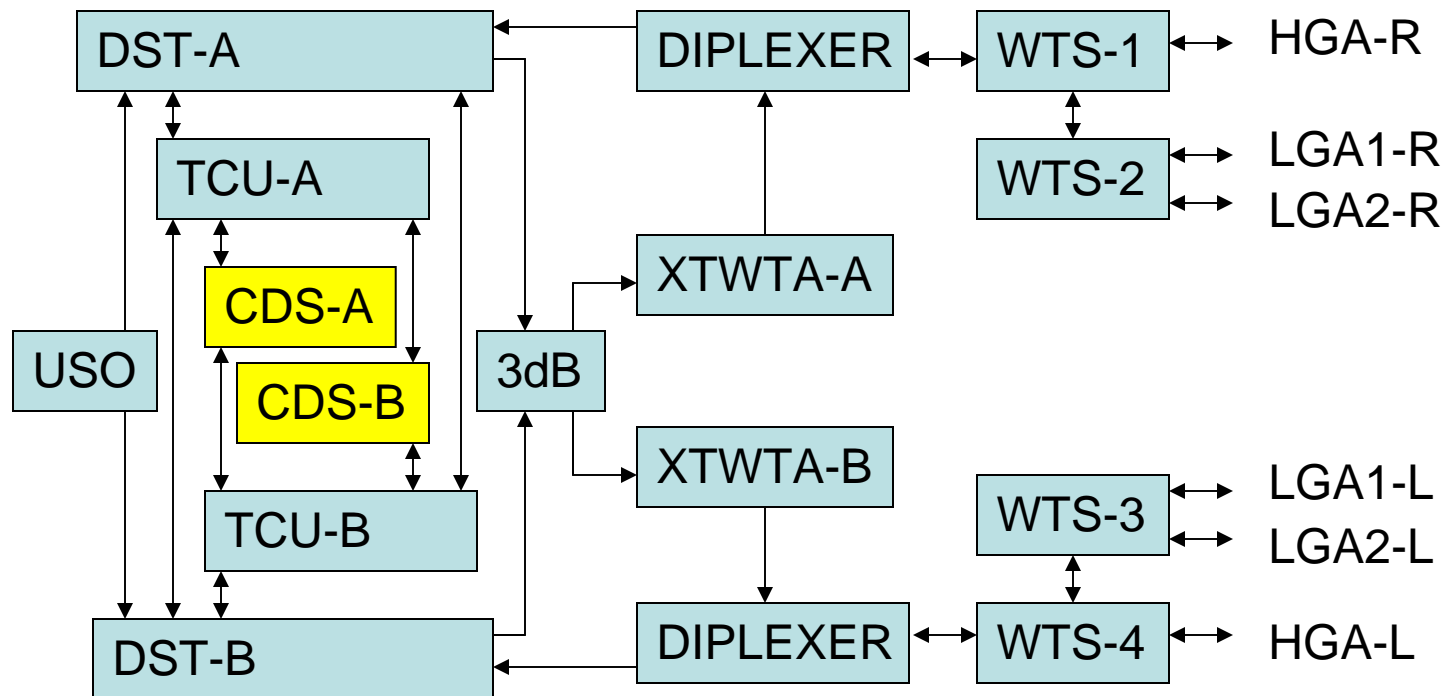


National Aeronautics and Space Administration
Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California
JPL 400-843 10/99



Jet Propulsion Laboratory
California Institute of Technology

Cassini and MER Telecom



Cassini Radio Frequency Subsystem X-Band Telecom Block Diagram



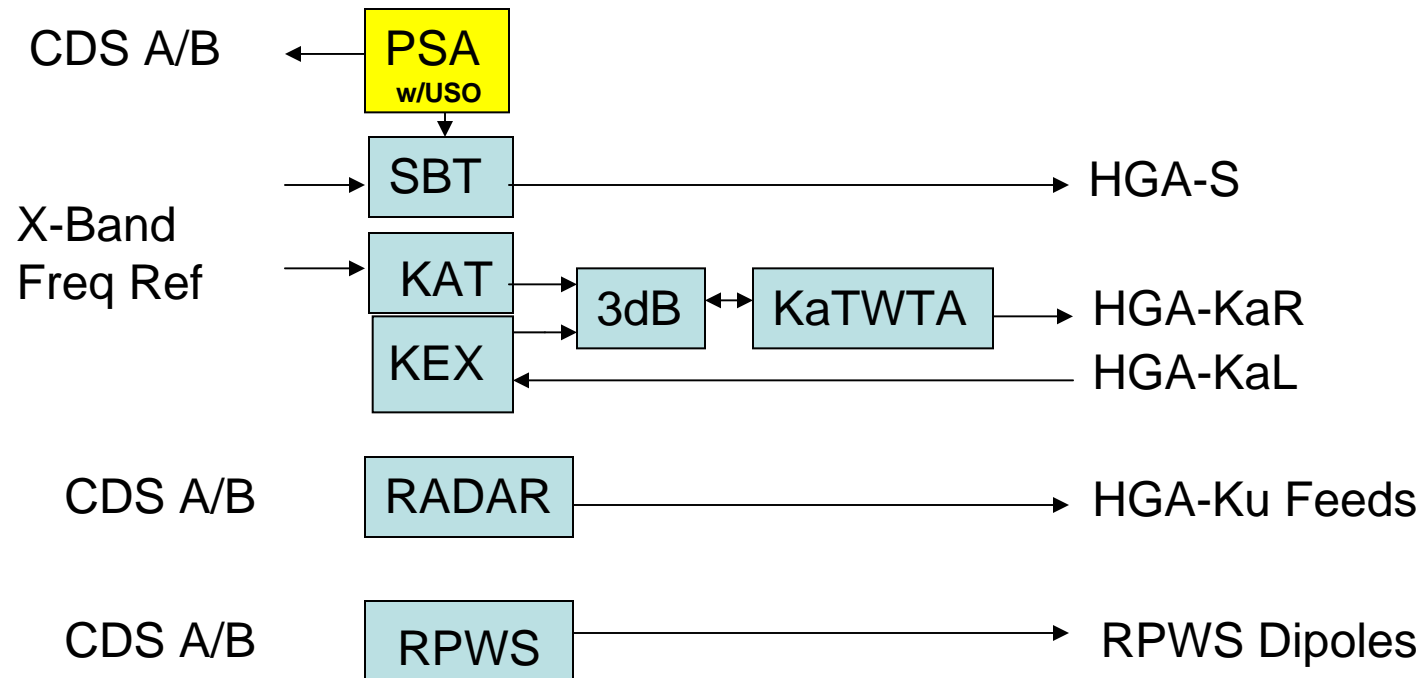
Jet Propulsion Laboratory
California Institute of Technology

Cassini and MER Telecom

CDS – Command and Data Subsystem
DIPLEXER – TR Filters
DST – Deep Space Transponder
HGA – High Gain Antenna for S/Ku/X/Ka with Right and Left Circular Polar Feeds
KAT – Ka-Band Translator
KaTWTa – Ka-Band Traveling Wave Tube Amplifier
KEX – Ka-Band Exciter
LGA – X-Band Low Gain Antennas 1 and 2 with RCP and LCP feeds
PSA – Probe Support Equipment
RADAR – Ku Band Radar for Titan
RPWS – Radio Plasma Wave Subsystem
SBT – S-Band Transmitter
TCU – Telemetry Control Unit
USO – Ultra Stable Oscillator
WTS – Waveguide Transfer Switch
XTWTa – X-Band Traveling Wave Tube Amplifier

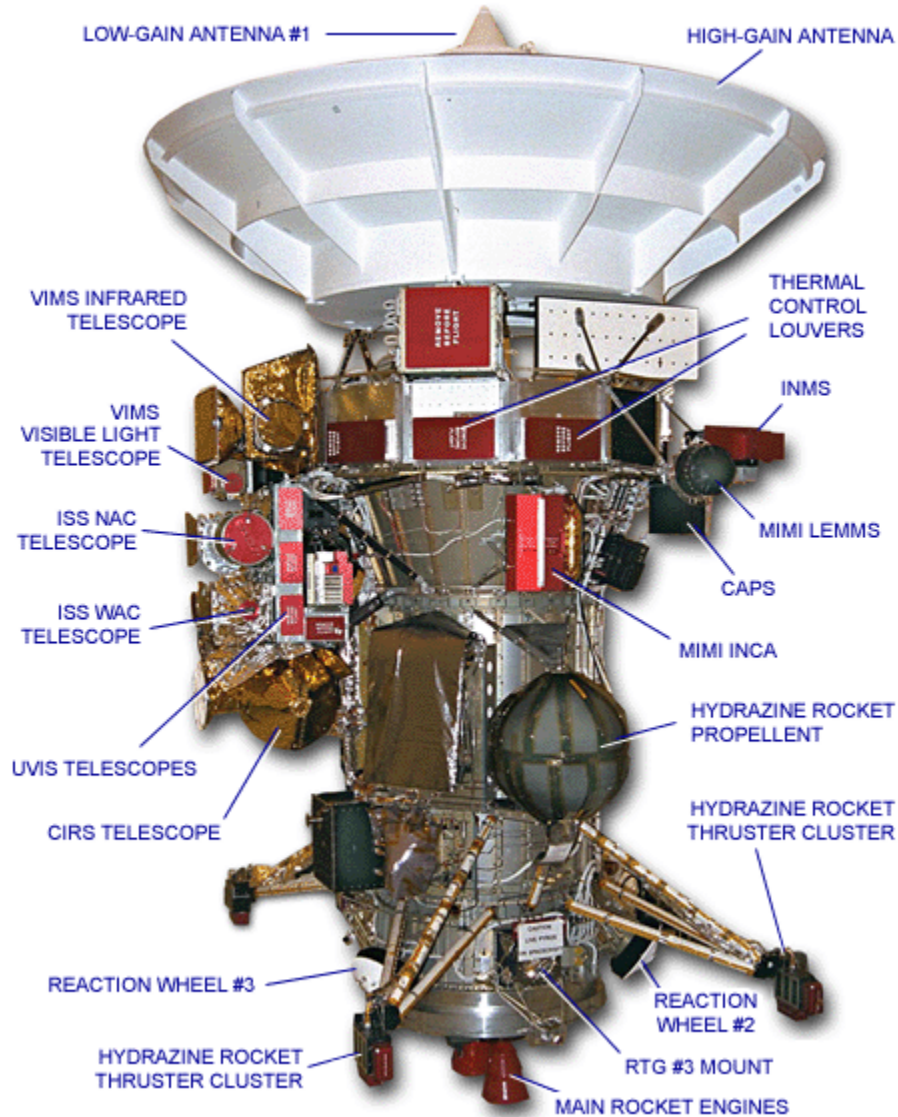


Cassini and MER Telecom



Cassini Radio Frequency Instrument Subsystem Ku-Band RADAR Radio Plasma Wave Subsystem Block Diagrams

Cassini and MER Telecom



Cassini

**RFS and RFIS are
behind Thermal Control
Louvers**

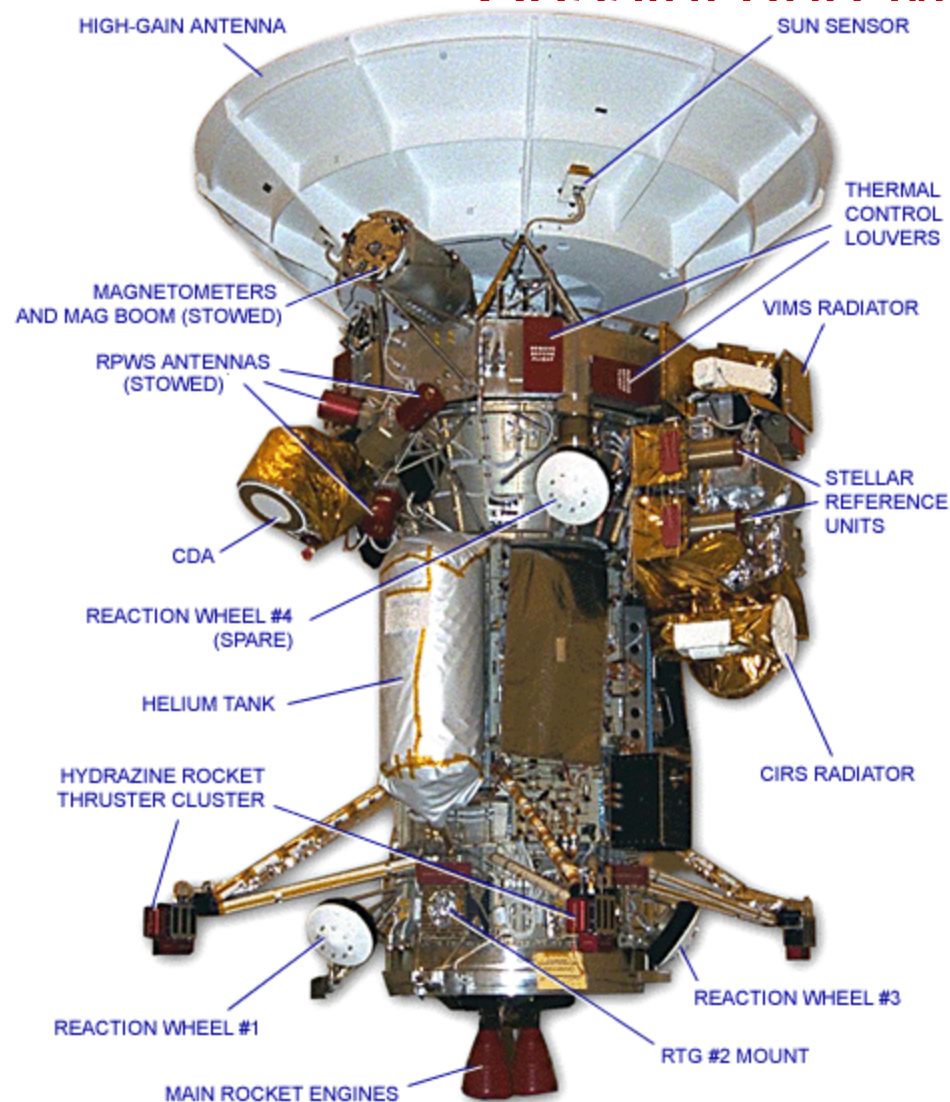
**HGA and LGA1 is on
Top
LGA2 is on top of
Thruster**



Jet Propulsion Laboratory
California Institute of Technology

Cassini and MER Telecom

Cassini backside



Jet Propulsion Laboratory
California Institute of Technology

Cassini and MER Telecom



Cassini Solar Thermal Vacuum Test in 25 ft Chamber



Jet Propulsion Laboratory
California Institute of Technology

Cassini and MER Telecom



Cassini

Assembly Test and Launch Operations at Kennedy Space Center Payload Hazardous Servicing Facility



Jet Propulsion Laboratory
California Institute of Technology

Cassini and MER Telecom



Cassini
Ready for Launch atop
Titan IVB with
Centaur Upper Stage



Jet Propulsion Laboratory
California Institute of Technology

Cassini and MER Telecom



**Cassini
Roll out to Pad
Then
Launch!**



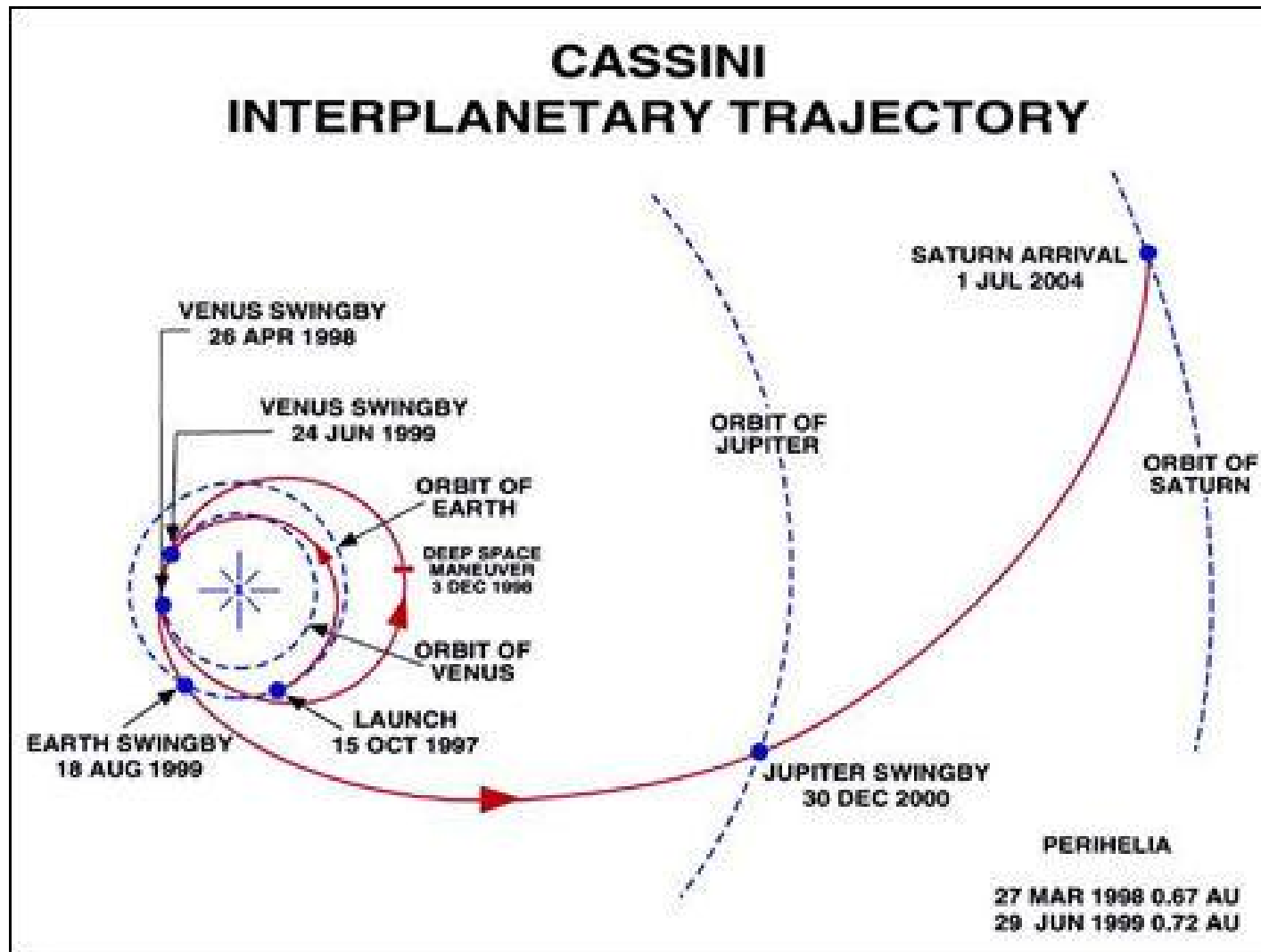
Jet Propulsion Laboratory
California Institute of Technology

Cassini and MER Telecom



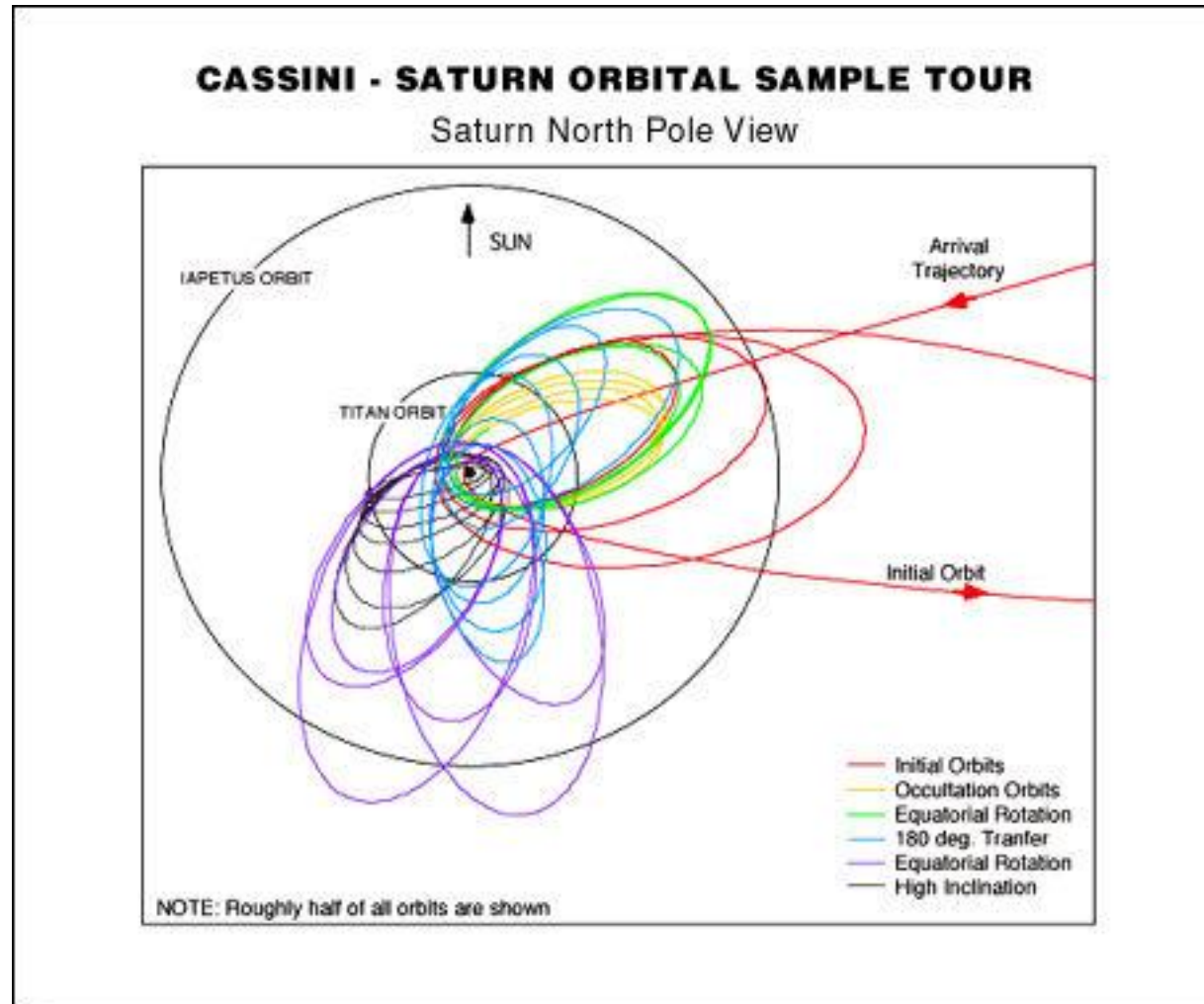
Jet Propulsion Laboratory
California Institute of Technology

Cassini and MER Telecom

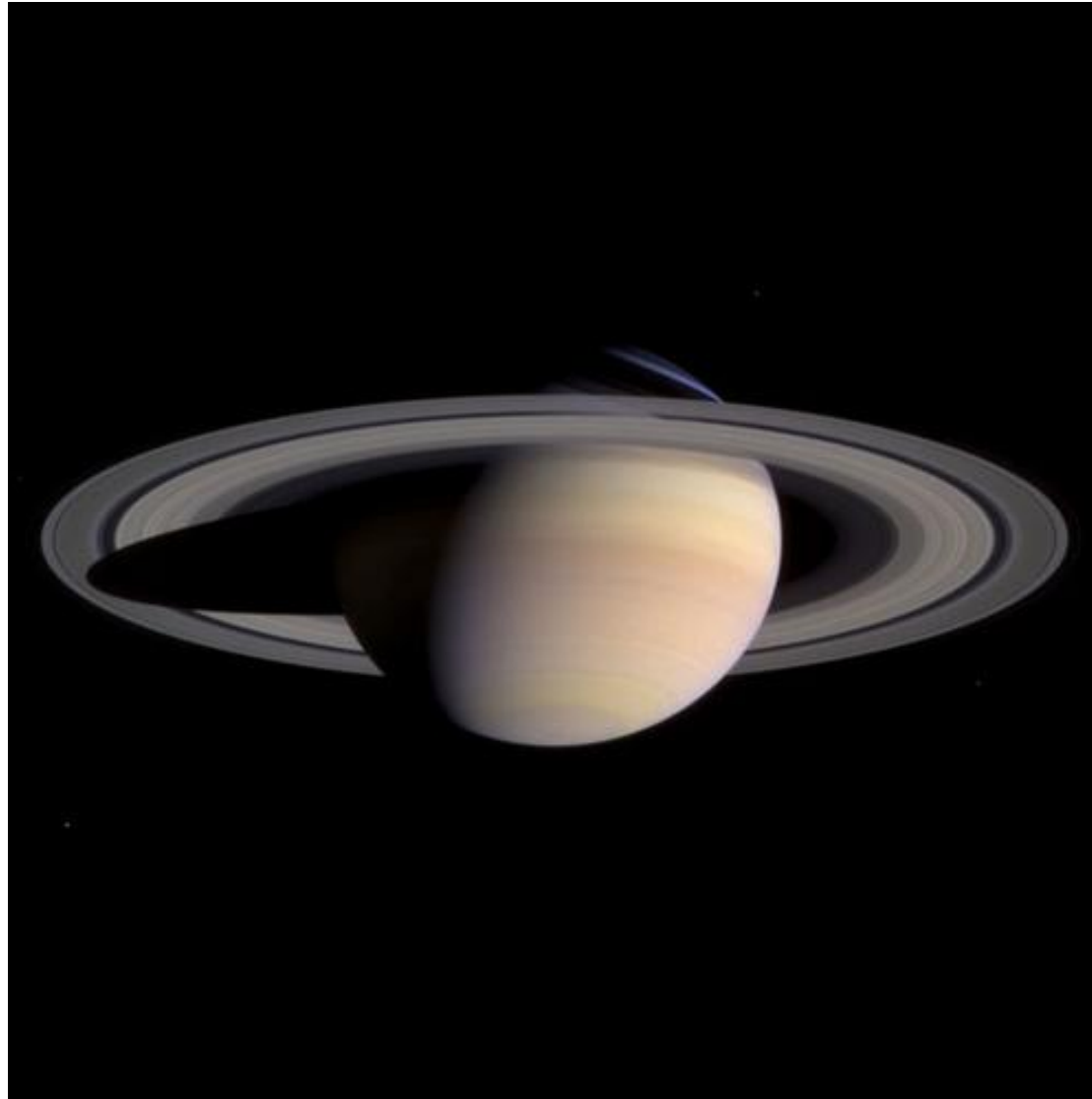


Jet Propulsion Laboratory
California Institute of Technology

Cassini and MER Telecom

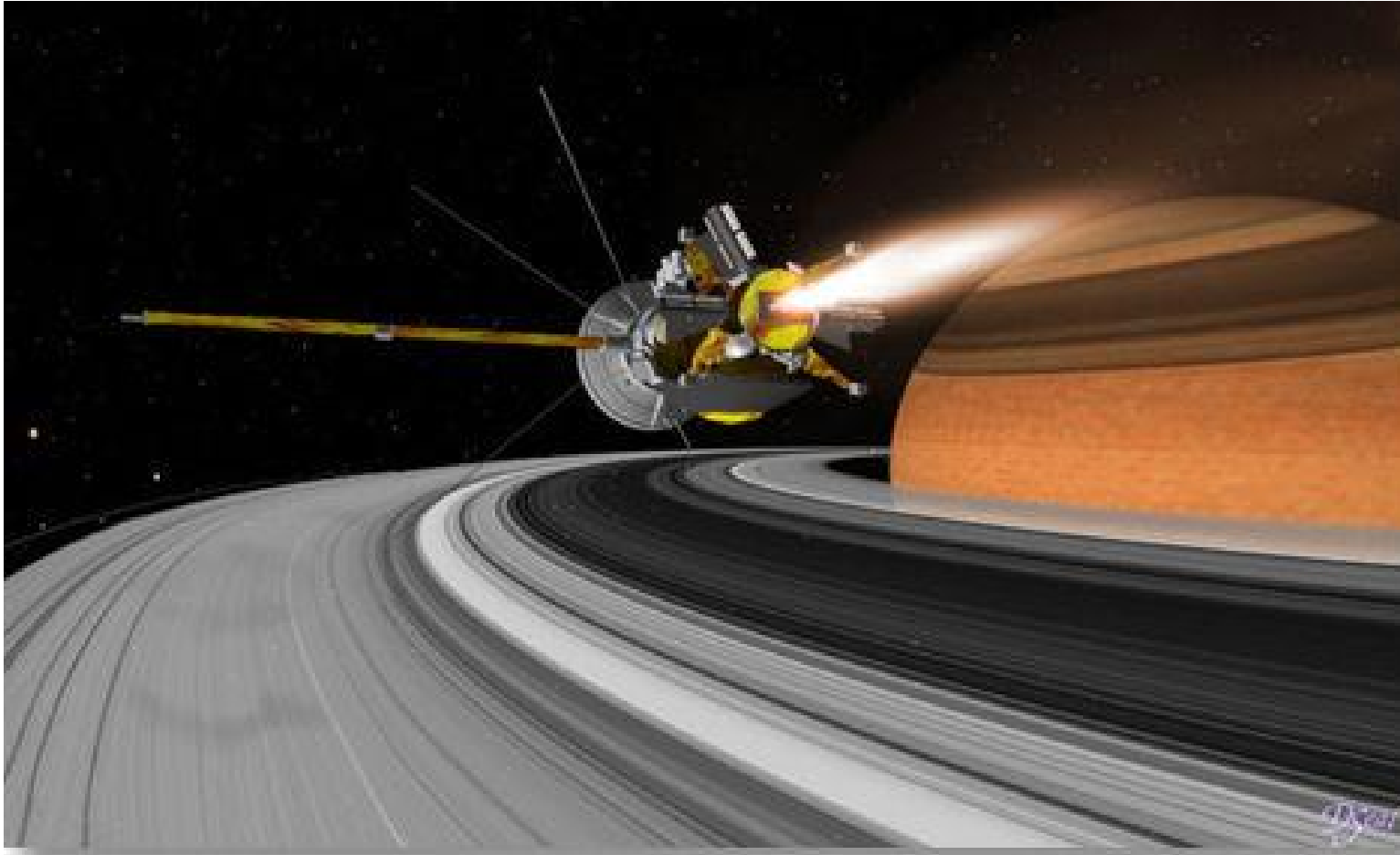


Cassini and MER Telecom



Jet Propulsion Laboratory
California Institute of Technology

Cassini and MER Telecom



SOI

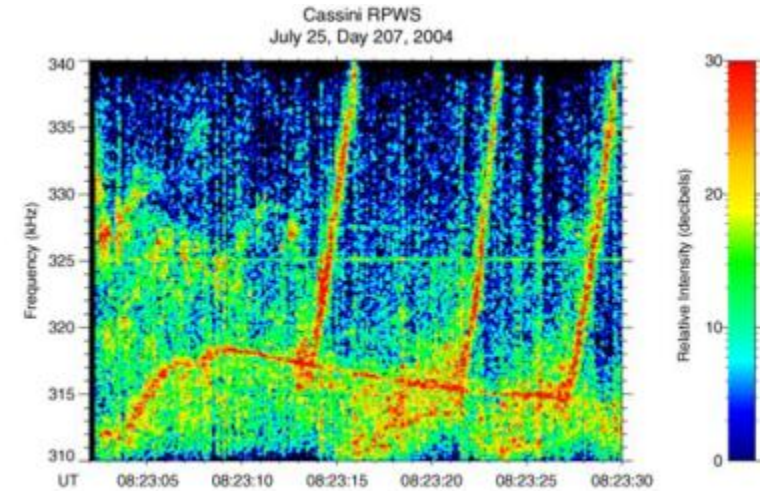
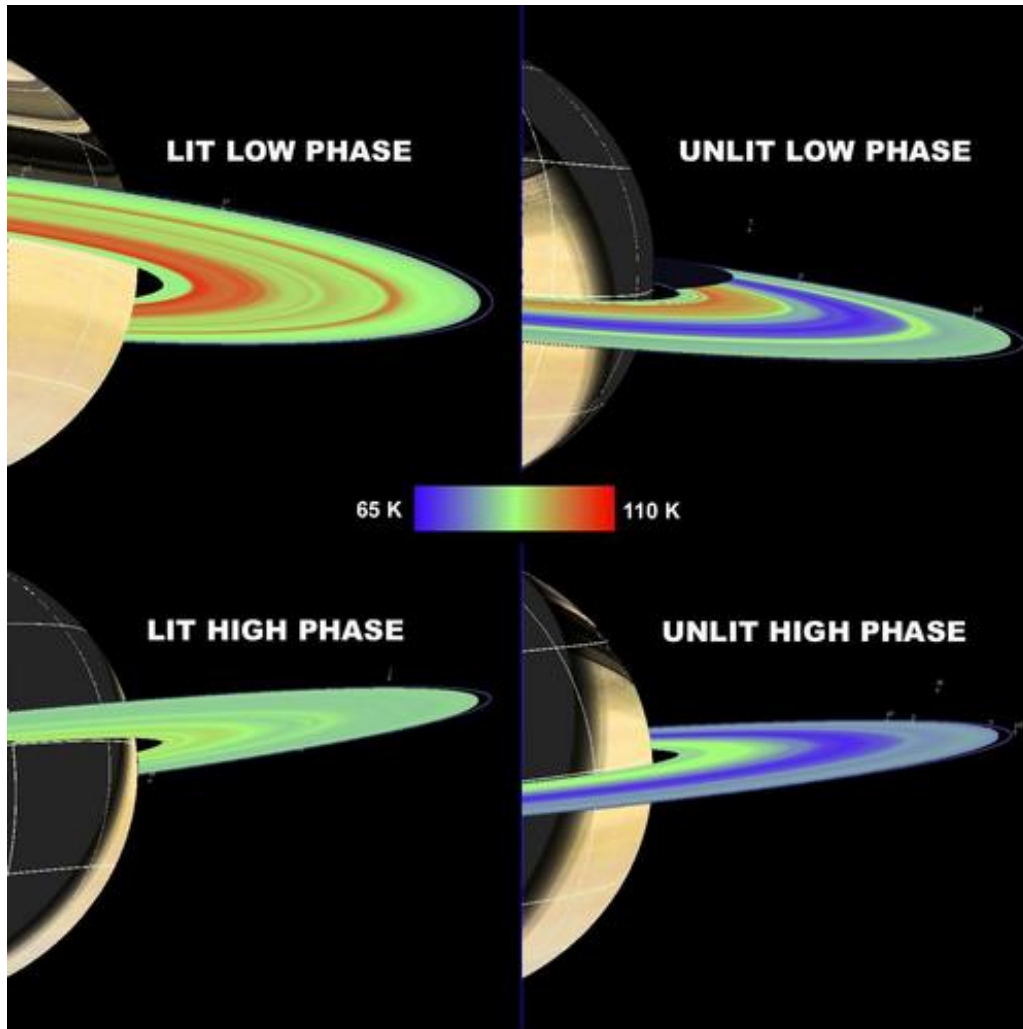


Jet Propulsion Laboratory
California Institute of Technology

17

MMS – WB6CIA

Cassini and MER Telecom

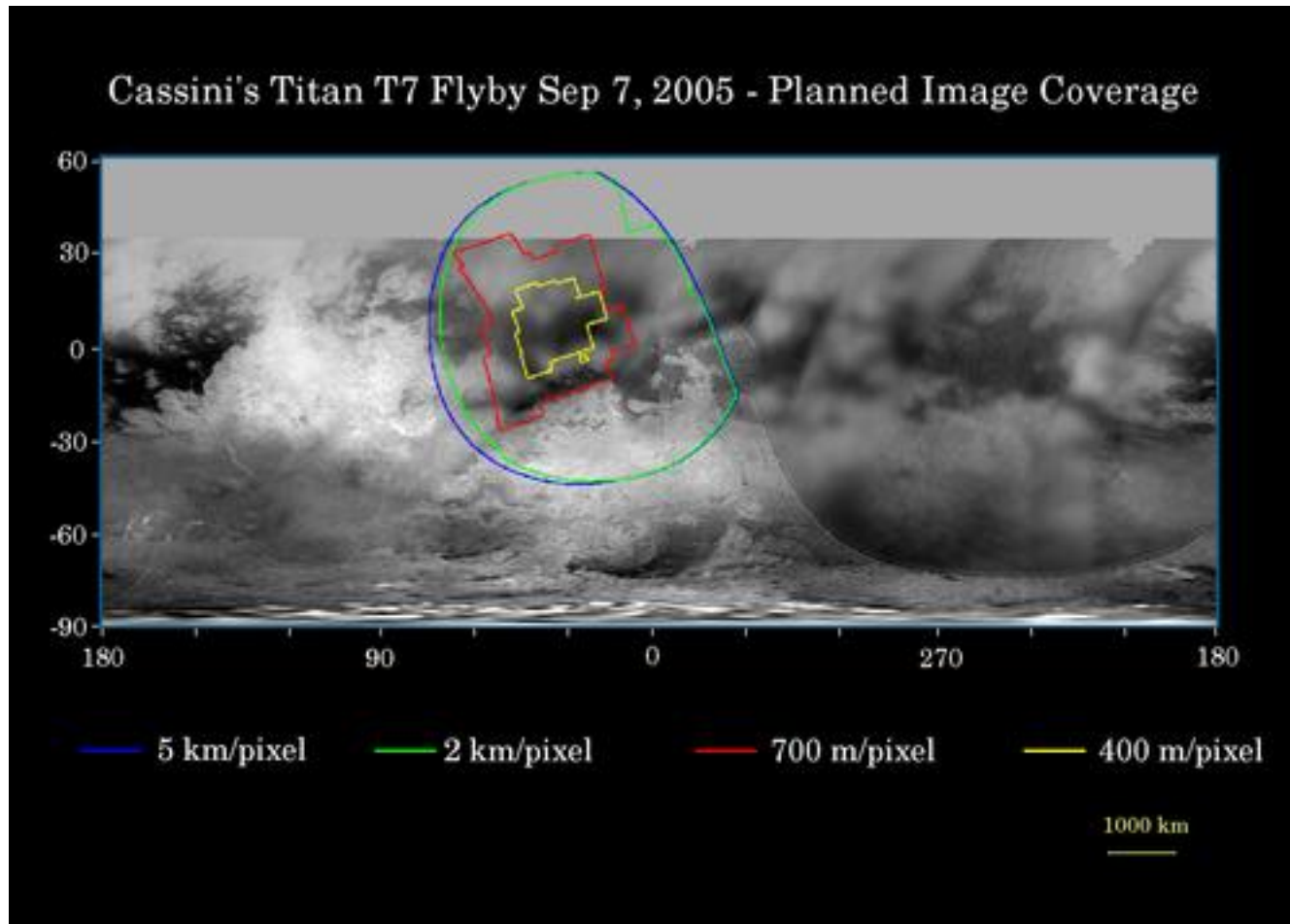


Cassini
Science



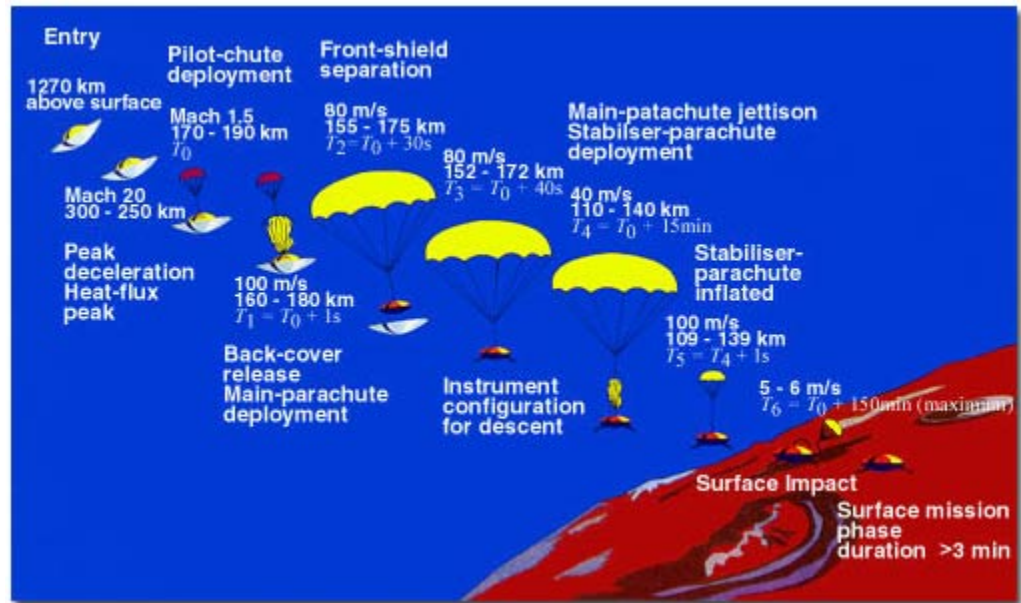
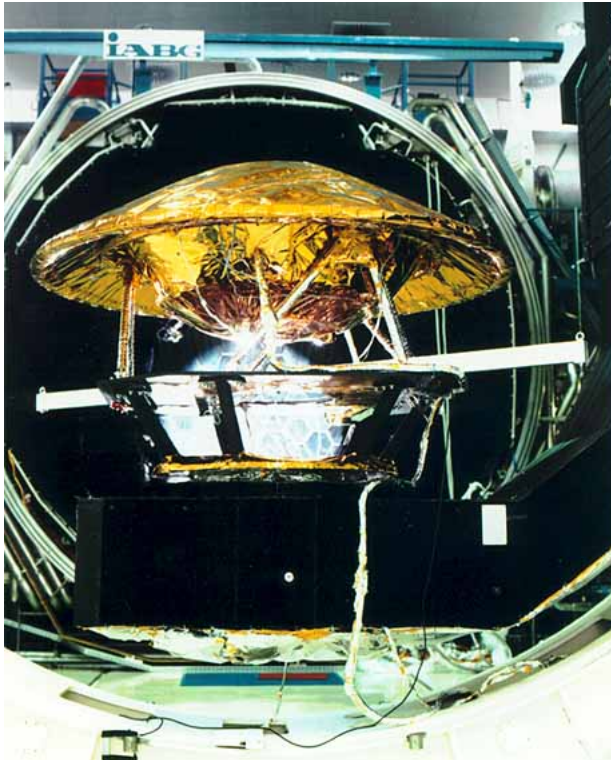
Jet Propulsion Laboratory
California Institute of Technology

Cassini and MER Telecom



Jet Propulsion Laboratory
California Institute of Technology

Cassini and MER Telecom



Huygens Probe

Dual Channel S-Band Transmitter to Cassini Orbiter

Cassini Probe Support Equipment

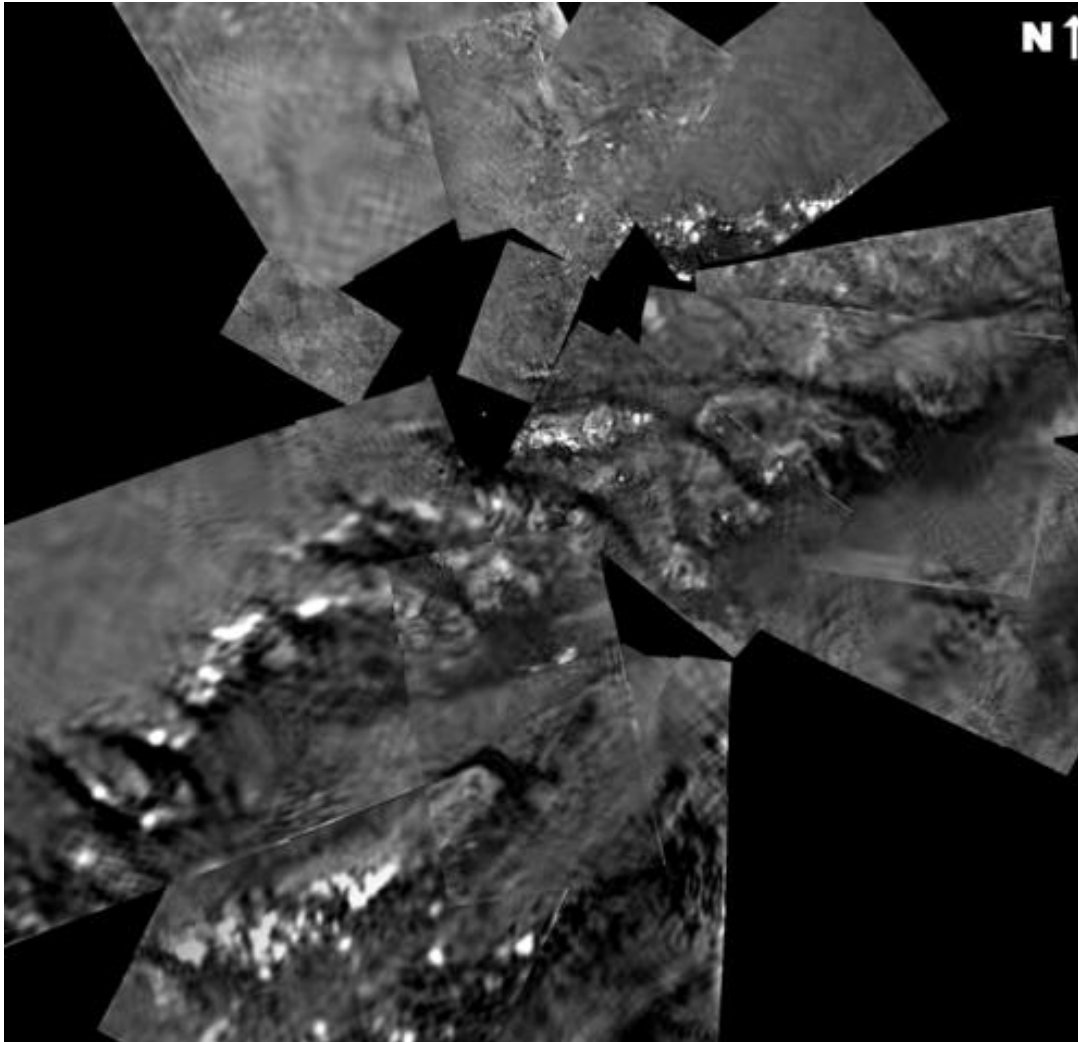
Dual S-Band Receivers with one USO for Doppler Wind Experiment

USO not commanded On missed some photos. Ground Stations able to reconstruct Doppler. S/C trajectory redesigned for Doppler to match Receiver's narrow Symbol Loop



Jet Propulsion Laboratory
California Institute of Technology

Cassini and MER Telecom



TITAN
Via Huygens
Descent Camera



Jet Propulsion Laboratory
California Institute of Technology

Cassini and MER Telecom



Deep Space Network

70 Mtr Dish
also 35 mtr dishes
in
Goldstone
Madrid
Cambera



Jet Propulsion Laboratory
California Institute of Technology

Cassini and MER Telecom

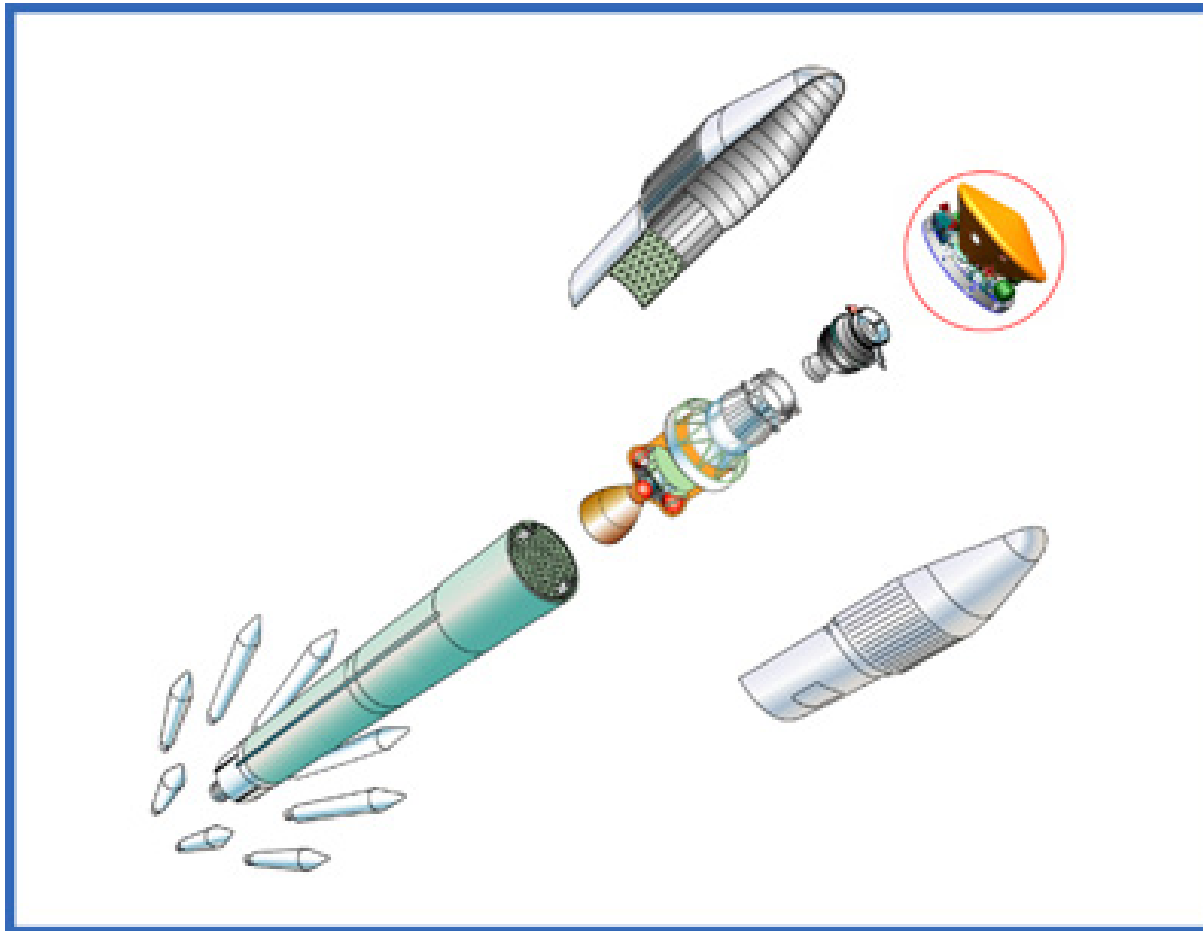


Mars Exploration Rover Spirit and Opportunity



Jet Propulsion Laboratory
California Institute of Technology

Cassini and MER Telecom

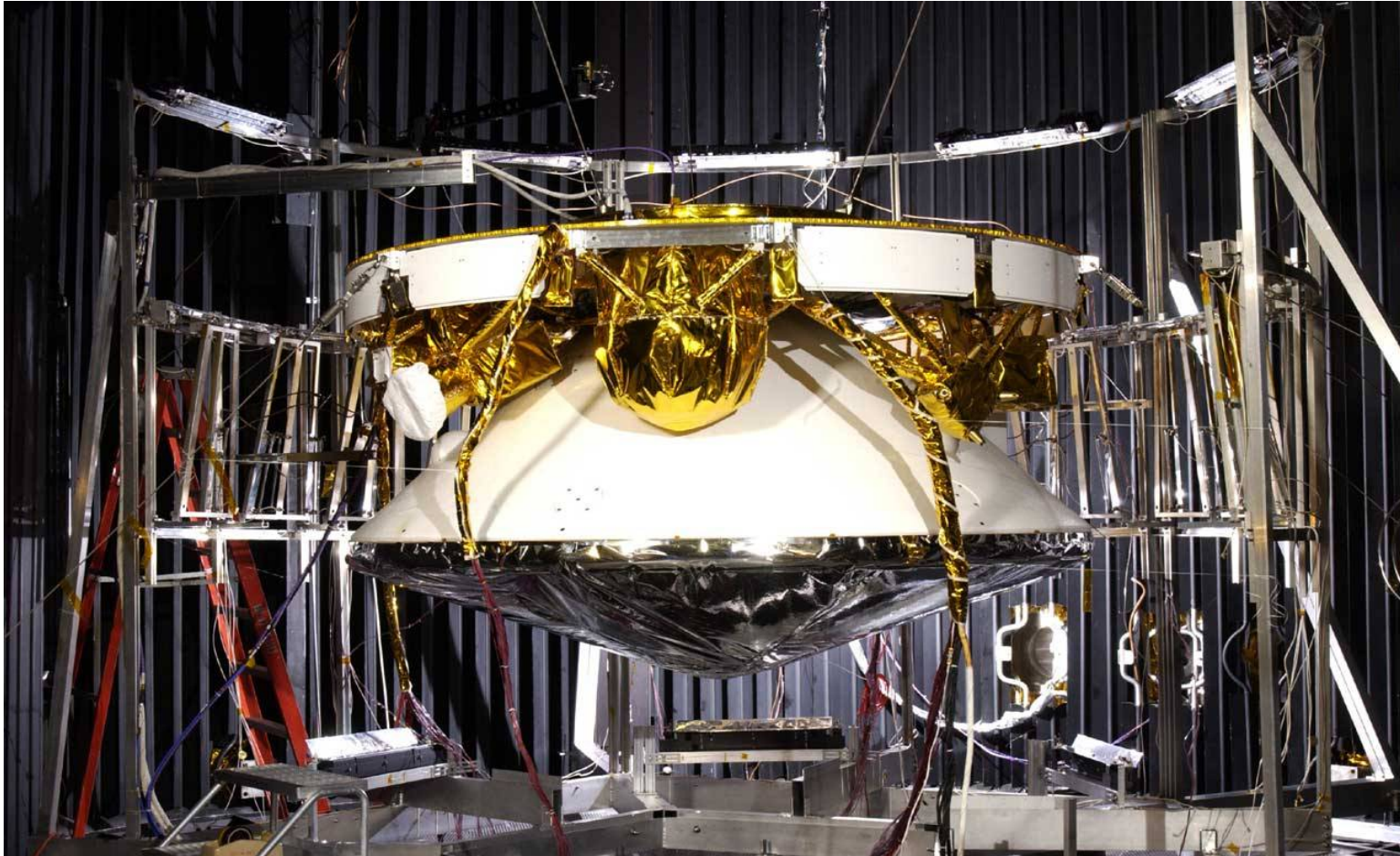


MER Separations from Delta II



Jet Propulsion Laboratory
California Institute of Technology

Cassini and MER Telecom

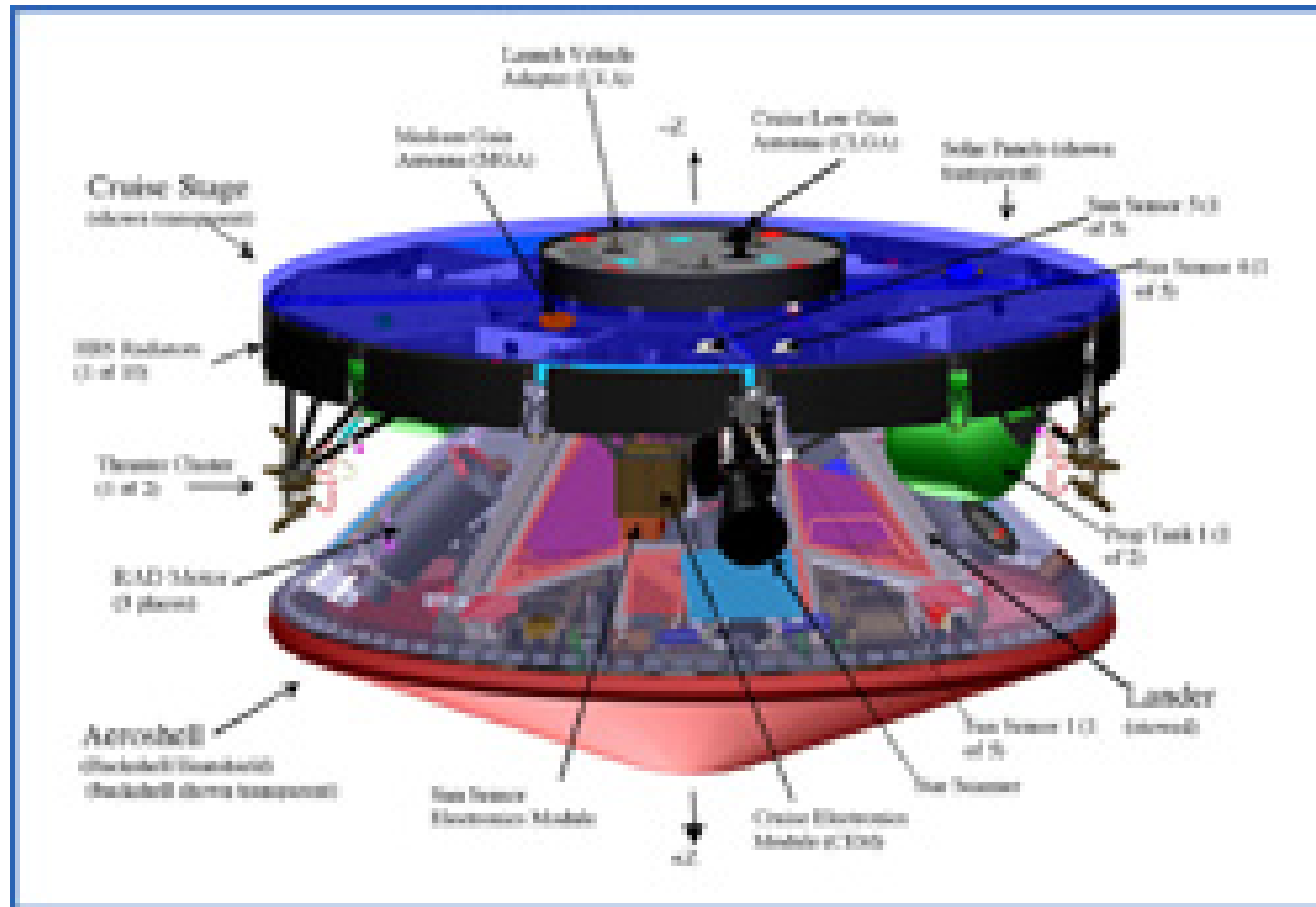


MER Cruise Configuration



Jet Propulsion Laboratory
California Institute of Technology

Cassini and MER Telecom

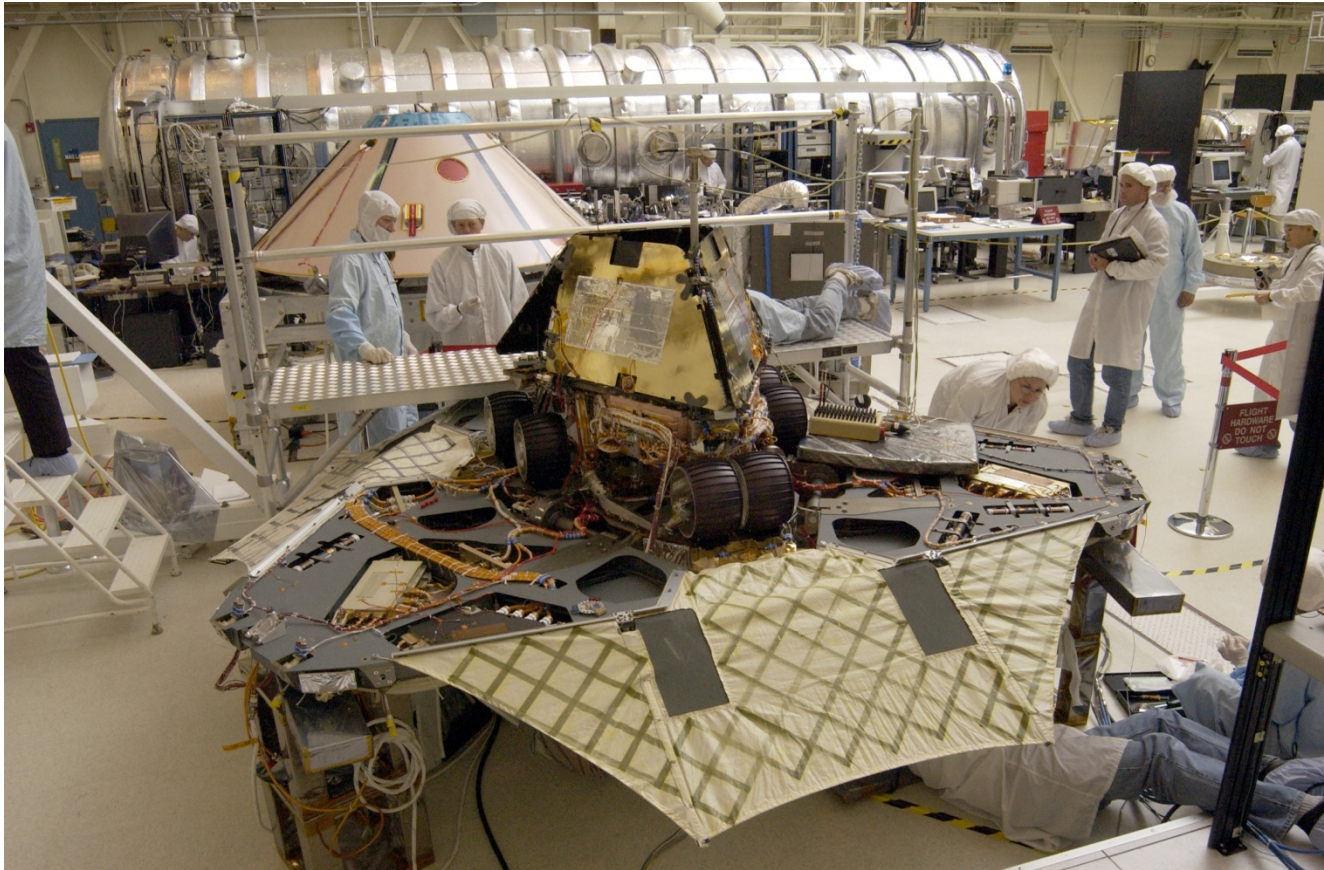


MER Cruise Components



Jet Propulsion Laboratory
California Institute of Technology

Cassini and MER Telecom

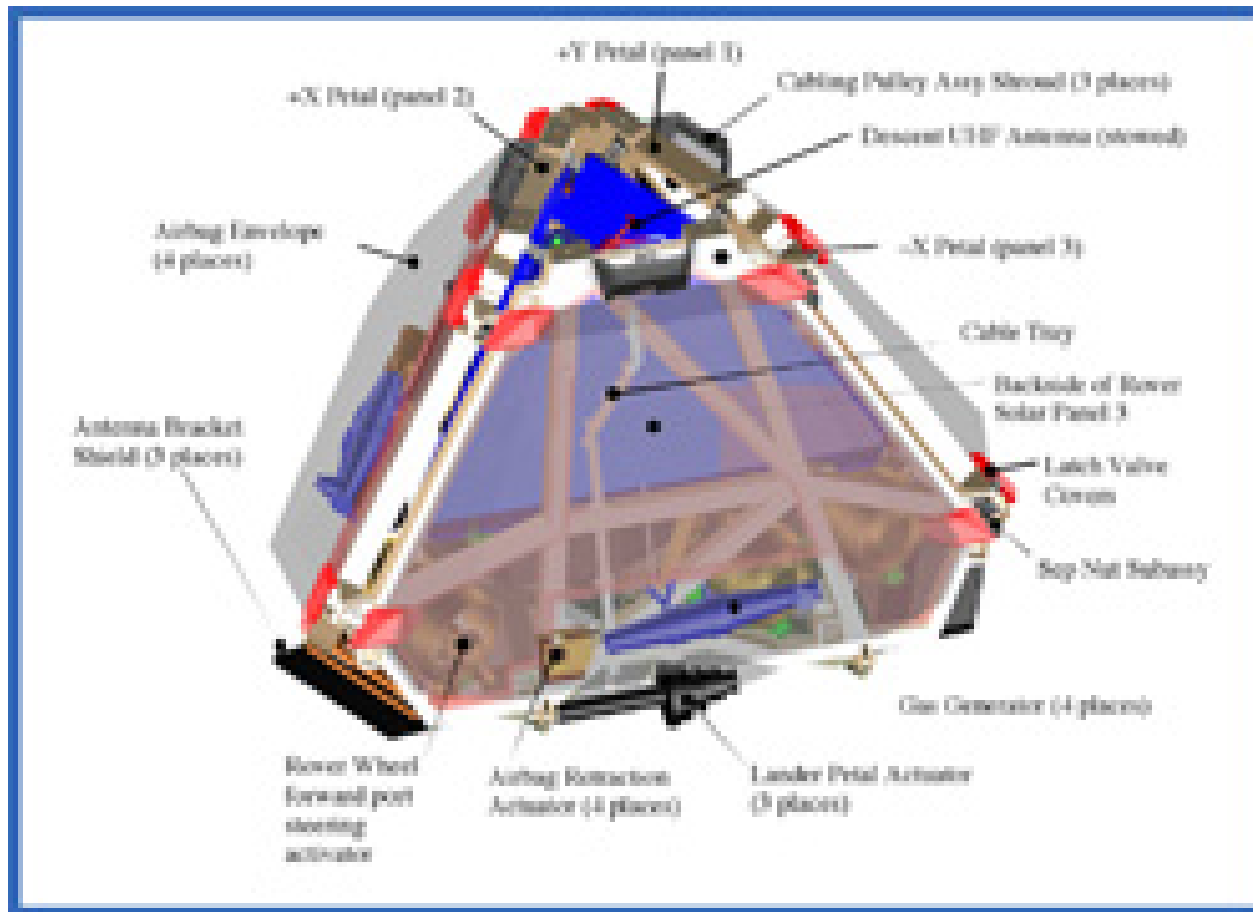


MER
Lander
Open with
Rover
enclosed



Jet Propulsion Laboratory
California Institute of Technology

Cassini and MER Telecom

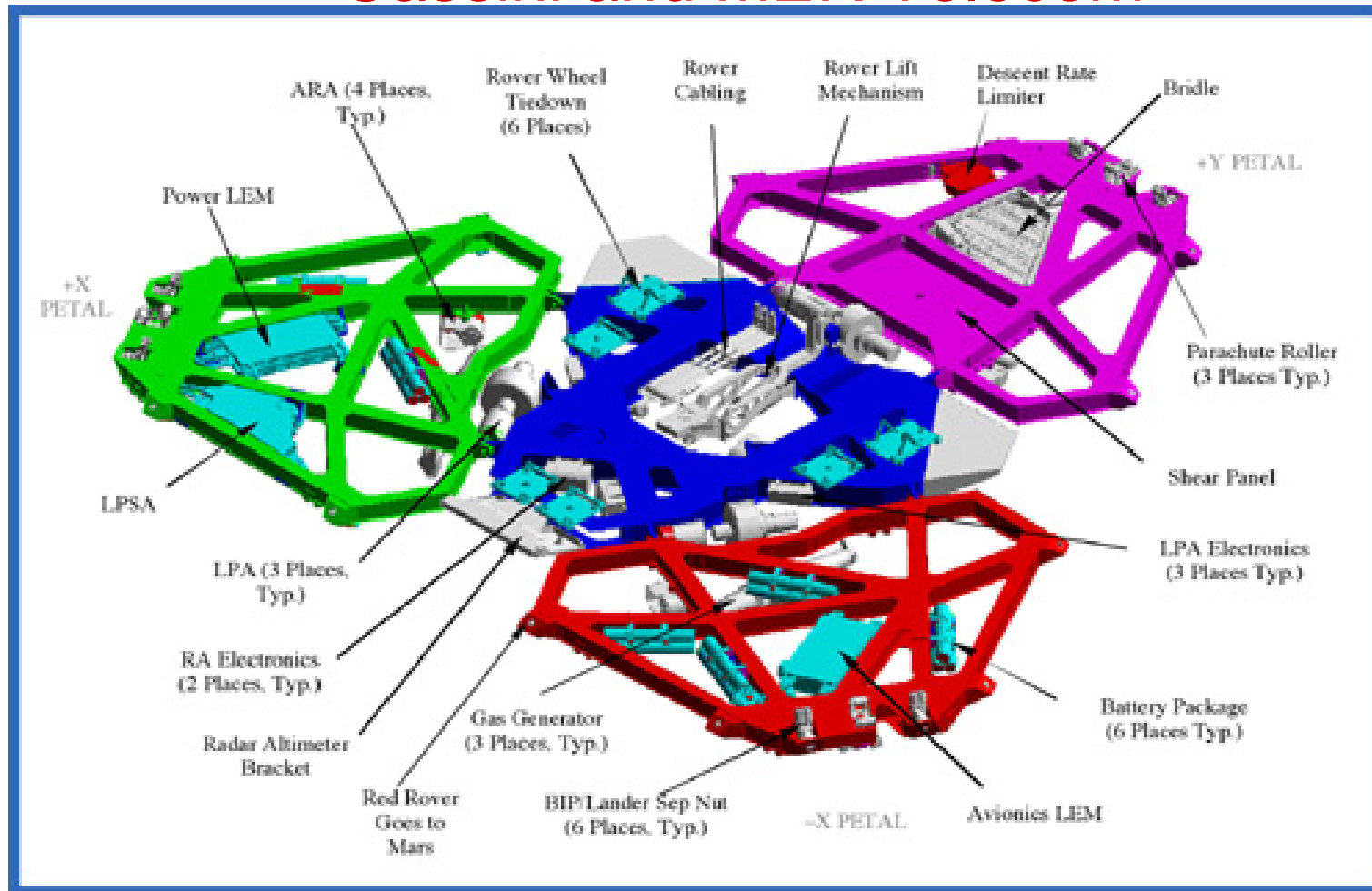


MER Lander Components



Jet Propulsion Laboratory
California Institute of Technology

Cassini and MER Telecom

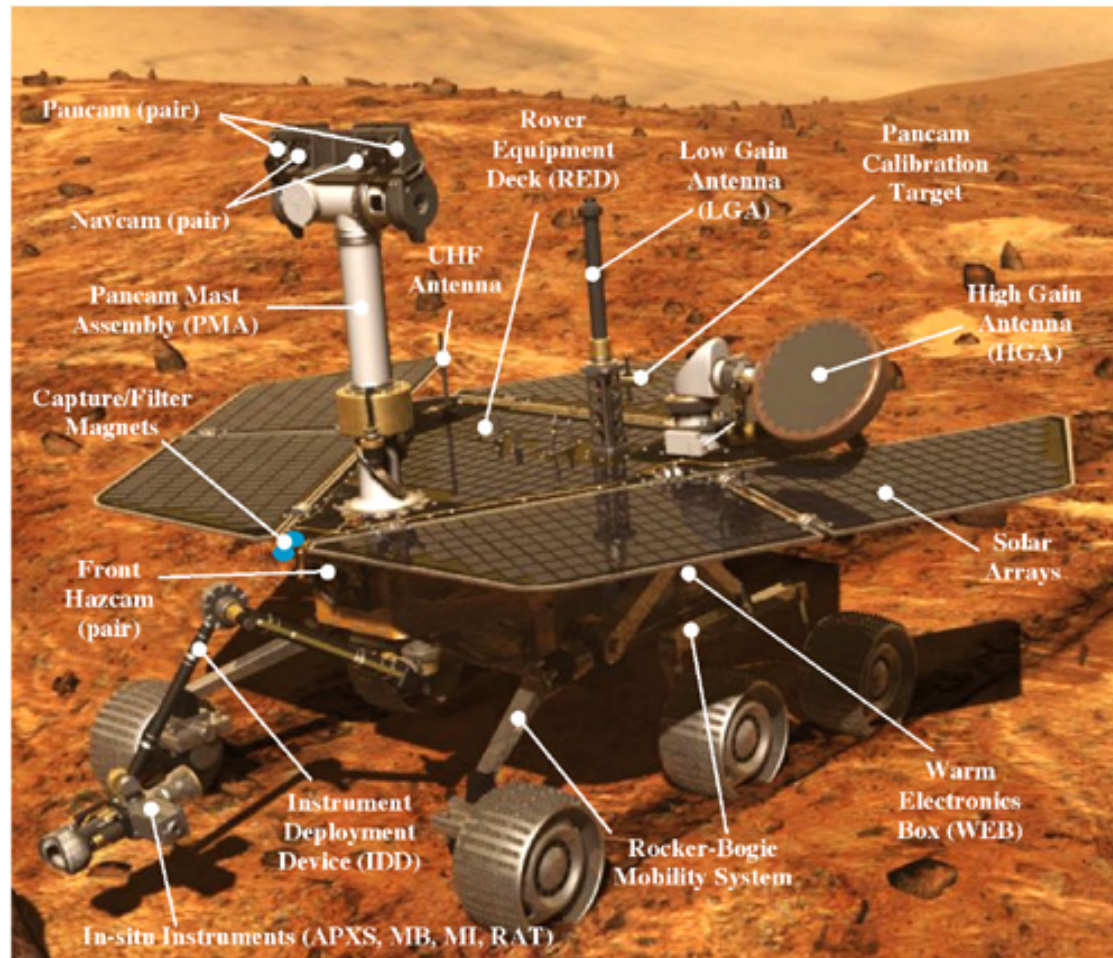


MER Open Lander Components



Jet Propulsion Laboratory
California Institute of Technology

Cassini and MER Telecom



MER Rover Exterior Components



Jet Propulsion Laboratory
California Institute of Technology

Cassini and MER Telecom

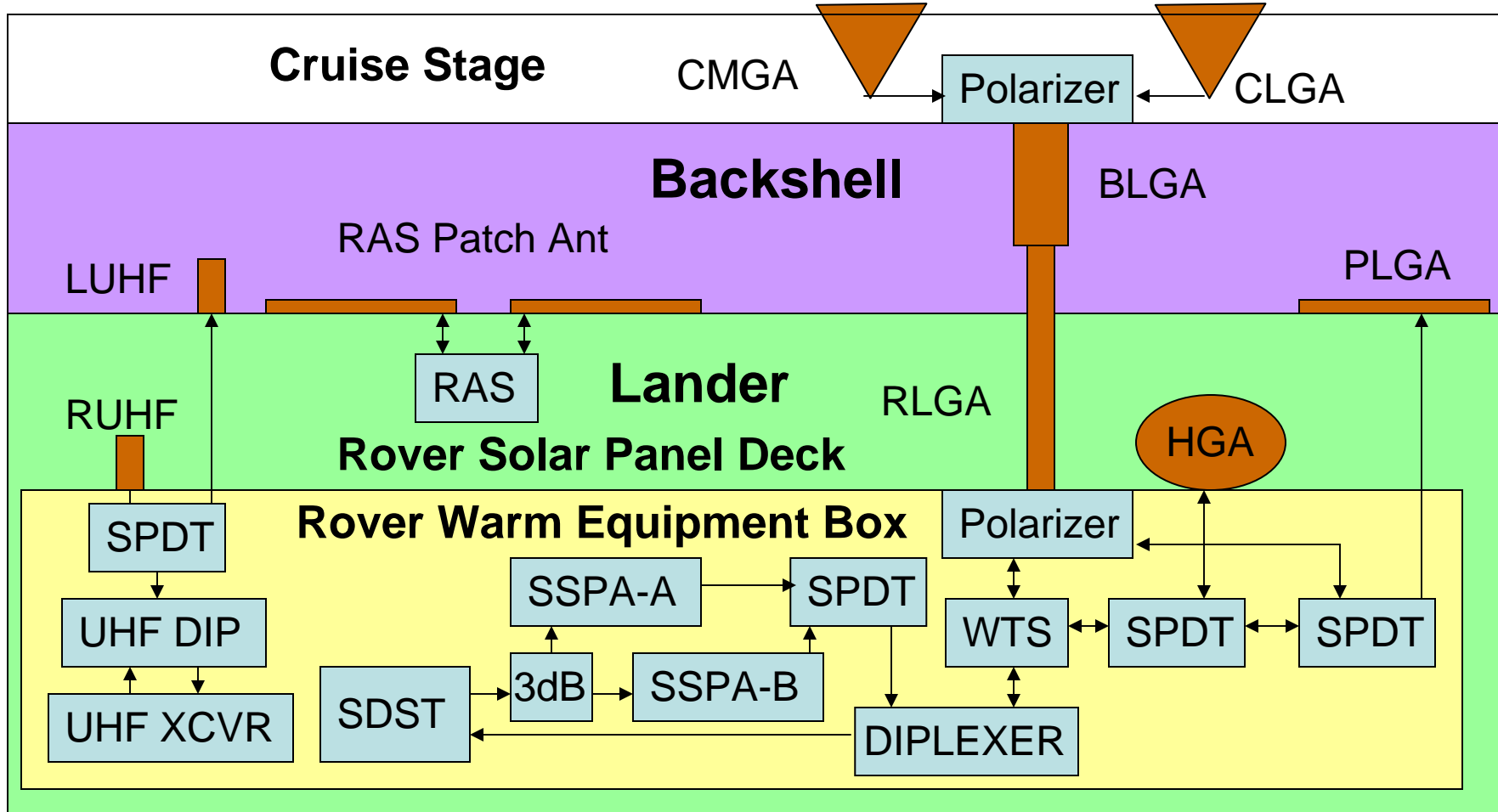


MER
Vs.
Pathfinder



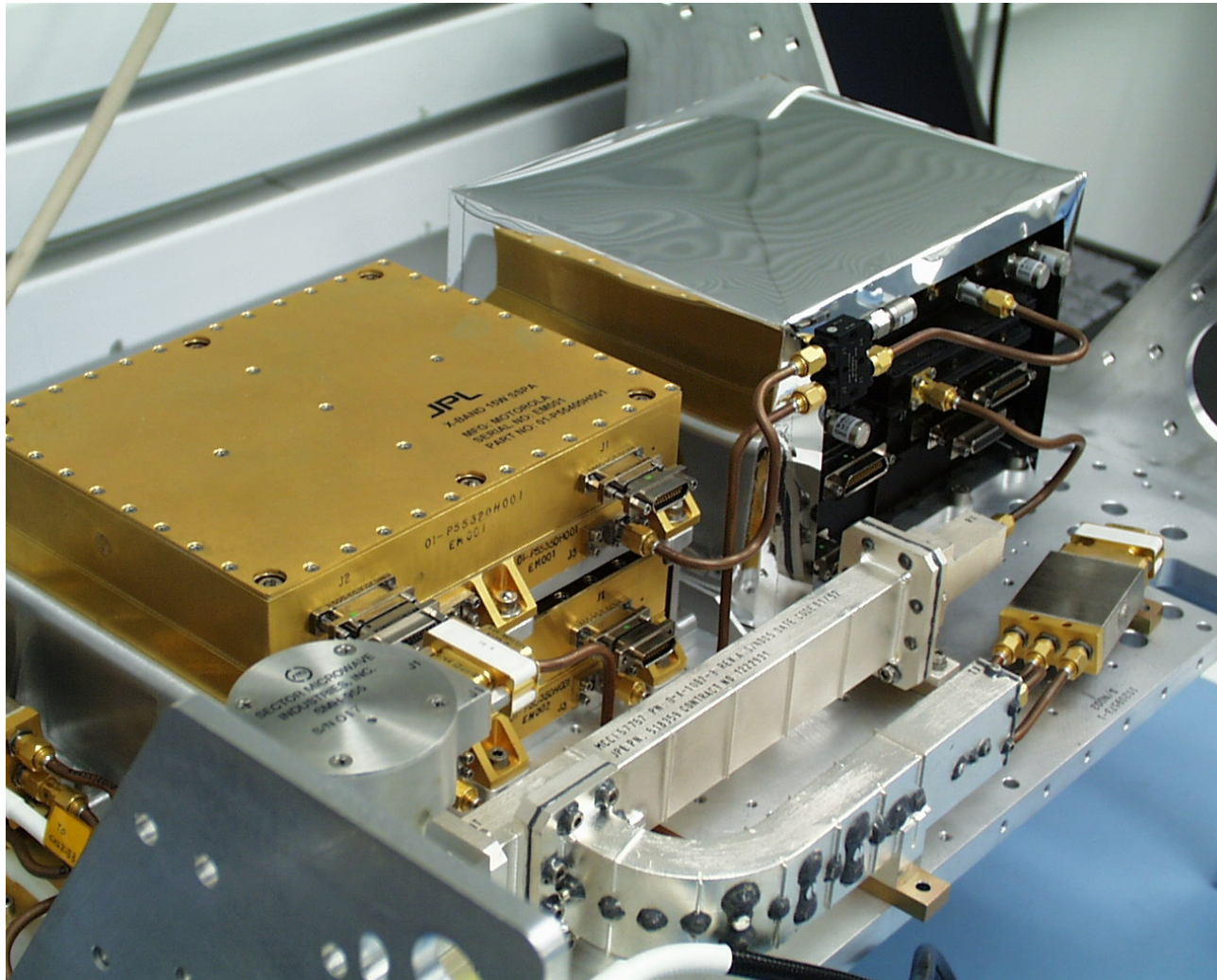
Jet Propulsion Laboratory
California Institute of Technology

Cassini and MER Telecom



Mars Exploration Rover Telecommunication Subsystem

Cassini and MER Telecom

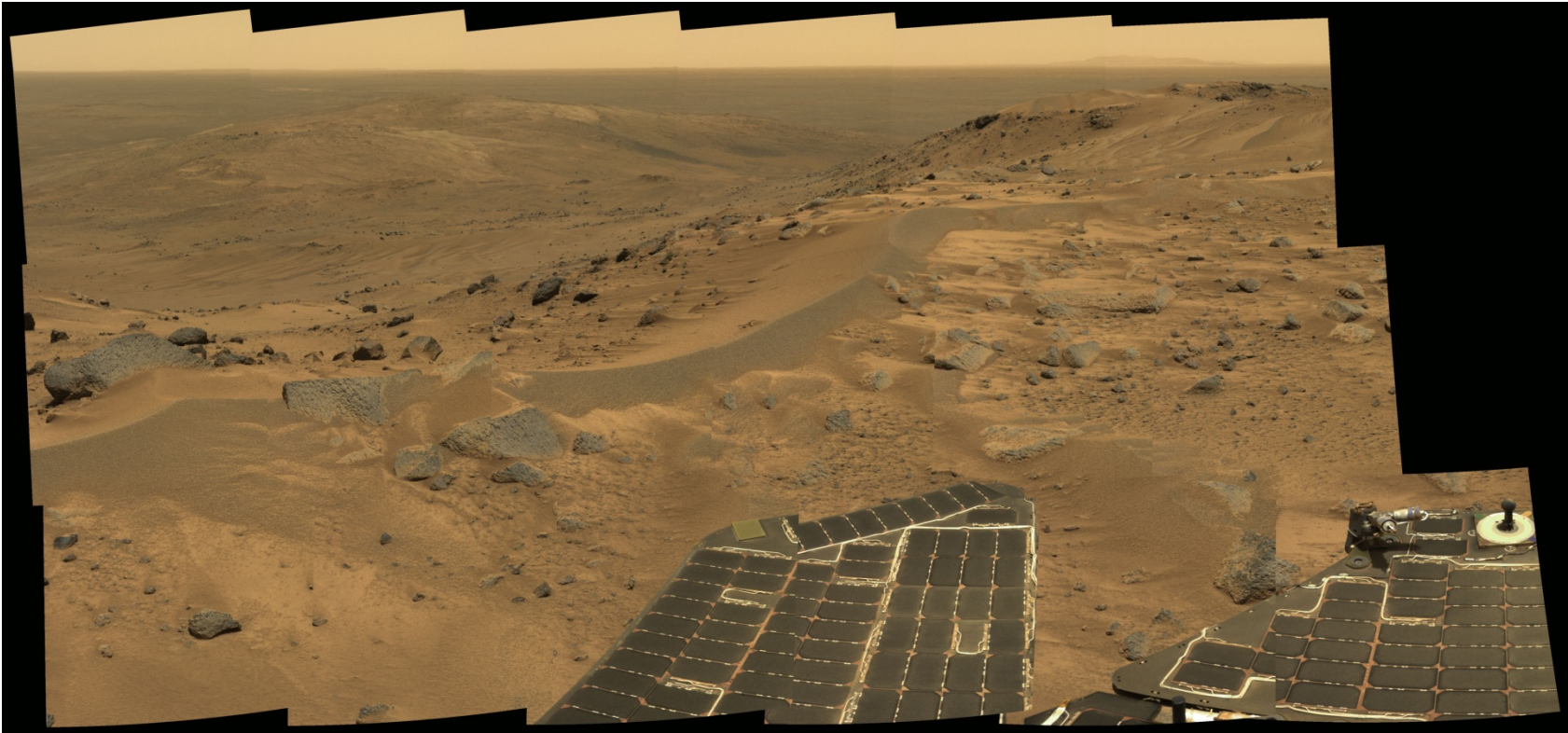


MER X-Band Telecom Hardware Installed on Test and Handling Fixture



Jet Propulsion Laboratory
California Institute of Technology

Cassini and MER Telecom

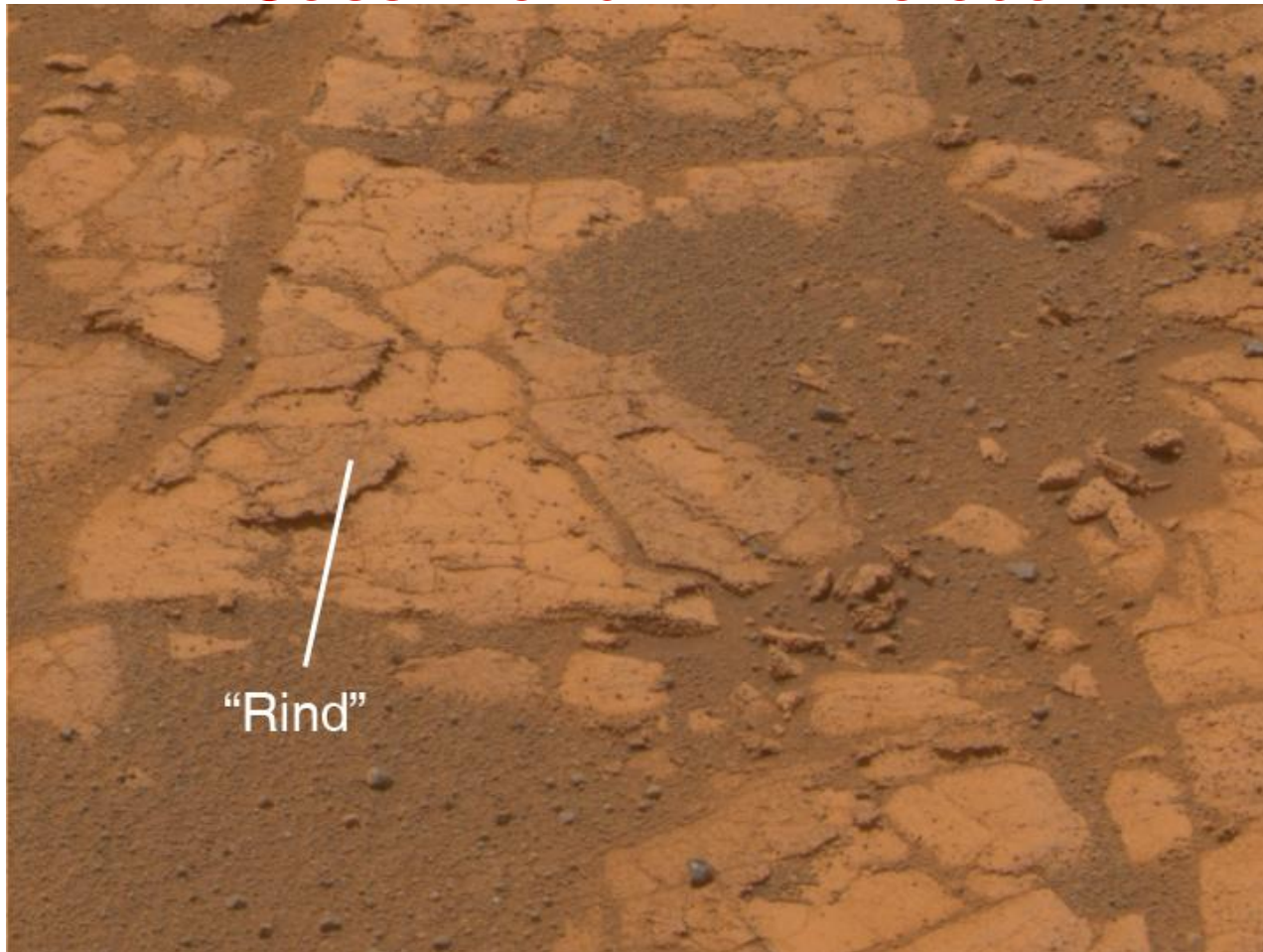


Typical Opportunity Photo



Jet Propulsion Laboratory
California Institute of Technology

Cassini and MER Telecom



Typical Spirit Photo



Jet Propulsion Laboratory
California Institute of Technology

Cassini and MER Telecom



Recent Opportunity Photo

Rock called Chocolate Hills the size of a loaf of bread

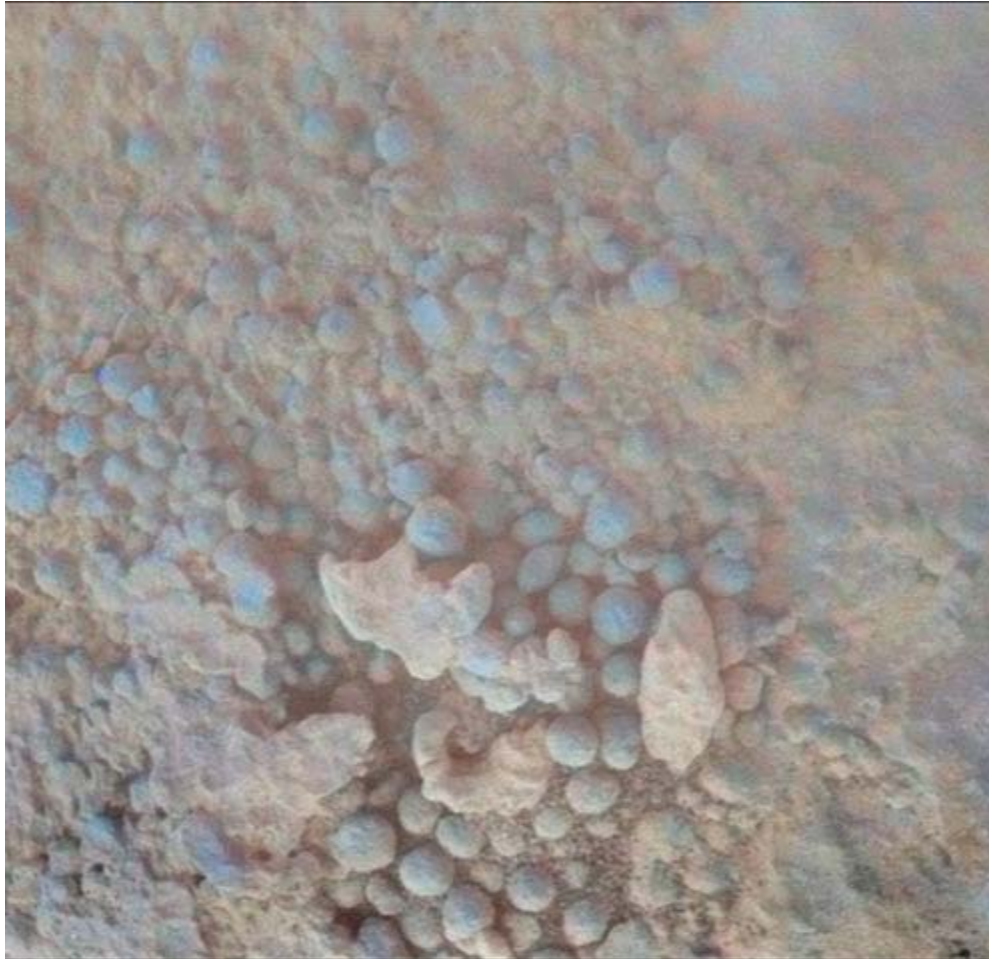


Jet Propulsion Laboratory
California Institute of Technology

36

MMS – WB6CIA

Cassini and MER Telecom



Recent Opportunity Photo 3cm wide
"Aloya" Blueberries on Chocolate Hills



Jet Propulsion Laboratory
California Institute of Technology

Cassini and MER Telecom



Latest Spirit Photo

Dug in for the winter - last transmission March 22



Jet Propulsion Laboratory
California Institute of Technology