

JPL Power Systems for Current Planned Missions Space Power Workshop 2007

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April 24-27, 2007



Jet Propulsion Laboratory
California Institute of Technology

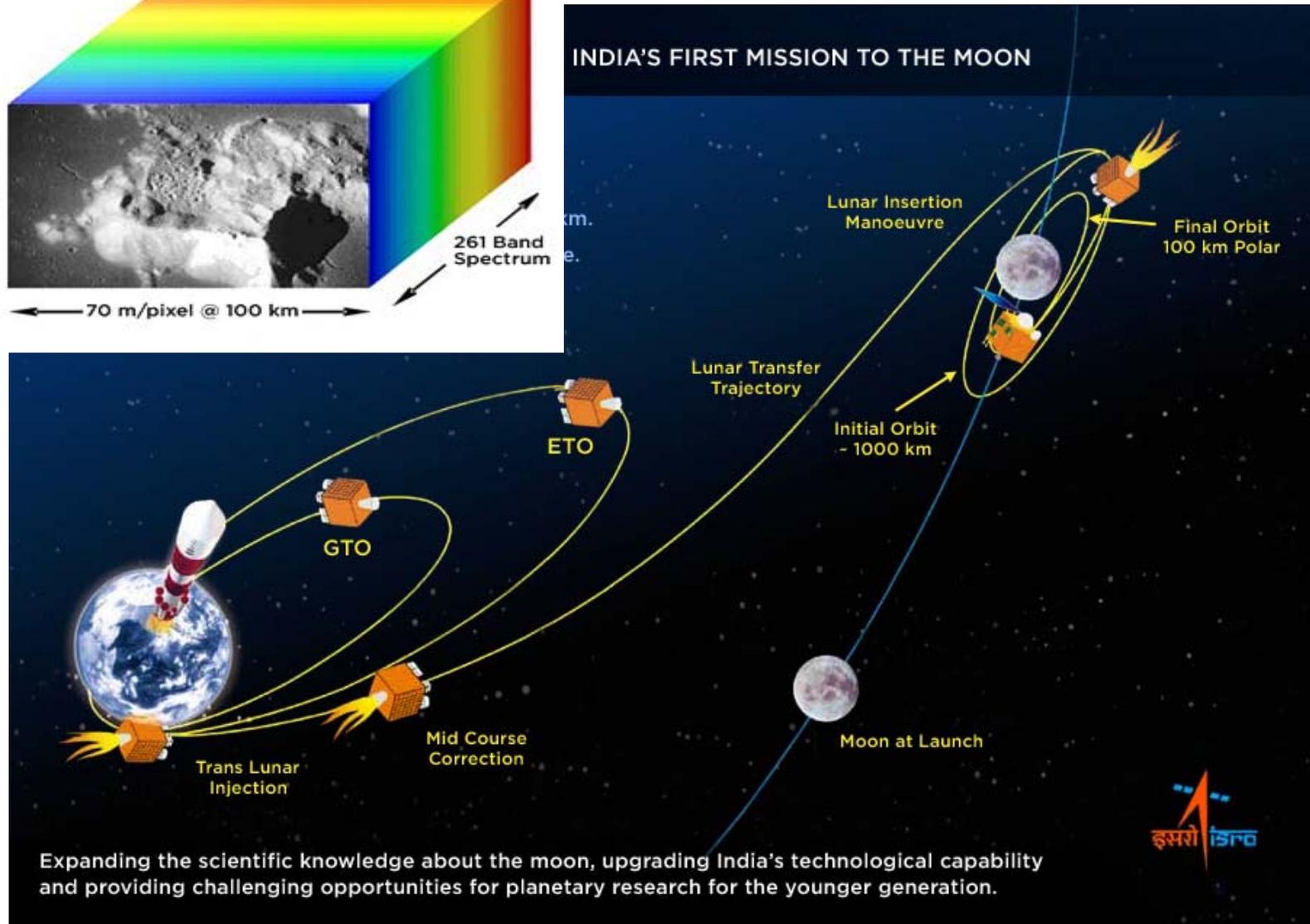
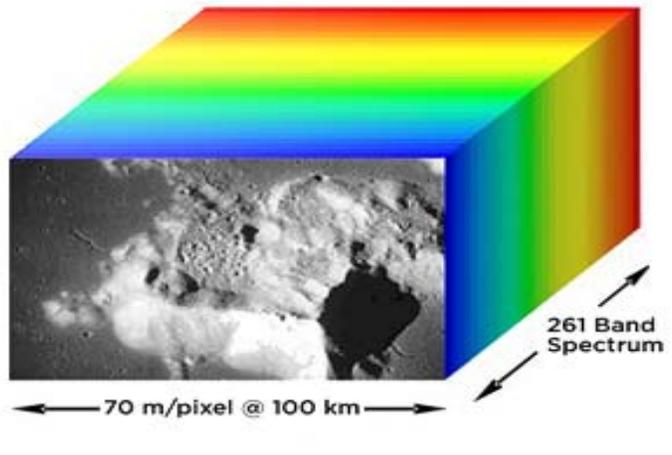
JPL Missions

- Future Missions
 - MMM: Moon Mineralogy Mapping
 - SIM: Space Interferometry Mission
 - ST-8 New Millennium – Space Technology - 8
 - Aquarius Ocean Salinity Mapping Orbiter
 - OSTM Ocean Surface Topology Mission
 - Dawn: Asteroid Rendezvous Mission - SEP
 - Phoenix: Mars Scout Lander Mission
 - Juno: Solar Powered Jupiter Orbiter
 - OCO: Earth orbiting carbon observatory
 - Kepler: Planet finder observatory
 - Hershel: Far infrared/sub-millimeter Telescope
 - WISE: Wide-field Infrared Survey Explorer
 - MSL: Mars Science Laboratory – Rover
- Table of Current Missions and Instruments

Moon Mineralogy Mapper Fact Sheet

- Launch Date: 2007
- Objective: High spectral resolution imaging spectrometer
- Partners: One of two contributed instruments to India's first mission to the Moon - Chandrayaan-1
- Unique Features: Will characterize and map the mineral composition of the Moon
- Power Source: Solar
- Energy Storage: Made in India?
- Driving Requirements: GTO to Lunar 1000 - 100 km orbit
- Planned Lifetime: 2 Years

Moon Mineralogy Mapper



Space Interferometry Mission Fact Sheet

- Launch Date: Proposed 2015
- Objective: Space-based 9-meter baseline optical Michelson interferometer operating in the visible waveband Detecting planets down to planets a few times as massive as Earth.
- Partners: JPL Led-Mission, JPL Instrument
- Unique Features: Metrology requirements orders of magnitude beyond the state of the art
- Power Source: Solar Powered
- Energy Storage: TBD
- Driving Requirements: Trailing Earth Orbit (TBR)
- Planned Lifetime: 2 Years

Space Interferometry Mission Parameters

Baseline - 9 m

Wavelength range - 0.4 - 0.9 μ m;

Telescope Aperture - 0.3 m diameter

Astrometric Field of Regard - 15° diameter

Astrometric Narrow Angle Field of Regard - 1° diameter (2° oval)

Detector - Si CCD

Orbit - Earth-trailing solar orbit

Science Mission Duration - 5 years

Wide Angle Astrometry - 4 μ as mission accuracy (goal)

Narrow Angle Astrometry - 1 μ as single measurement accuracy (goal)

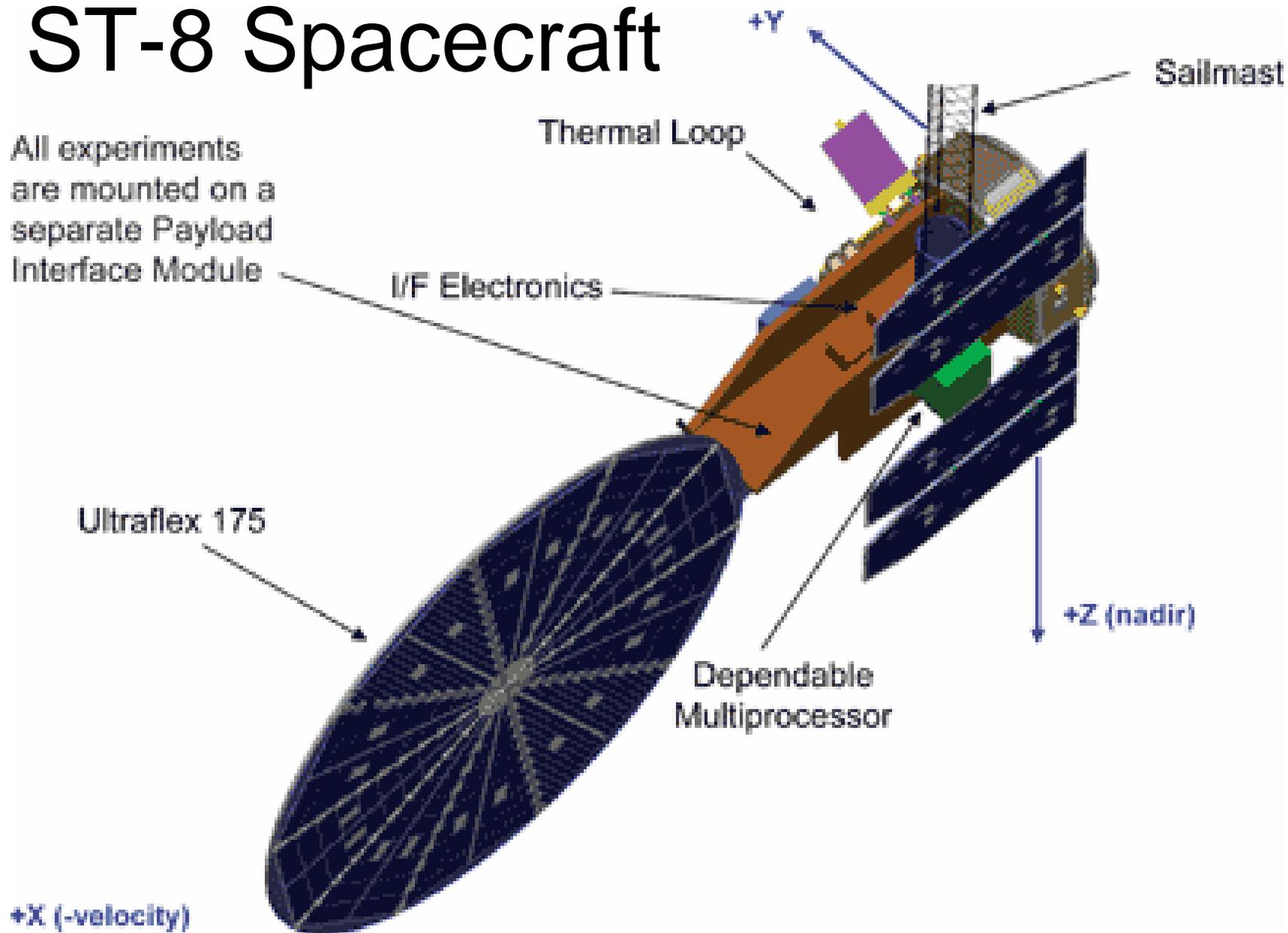
Limiting Magnitude - 20 mag (goal)

ST-8 Mission Fact Sheet

- Launch Date: 2009
- Objective: New Millennium Program, Space Technology 8 will space validate four new subsystem-level technologies.
- Partners: JPL Led-Mission, JPL Instrument
- Unique Features:
 - Dependable Multiprocessor: (COTS)-based computing architecture
 - UltraFlex 175: A deployable blanket solar array system
 - SAILMAST Ultra Lightweight Boom technology
 - MLHP Thermal Loop: A miniature thermal management system Power
- Source: Conventional Solar Array
- Energy Storage: TBD
- Driving Requirements: 1300 Km / 98 degree LEO
- Planned Lifetime: 7 months

ST-8 Spacecraft

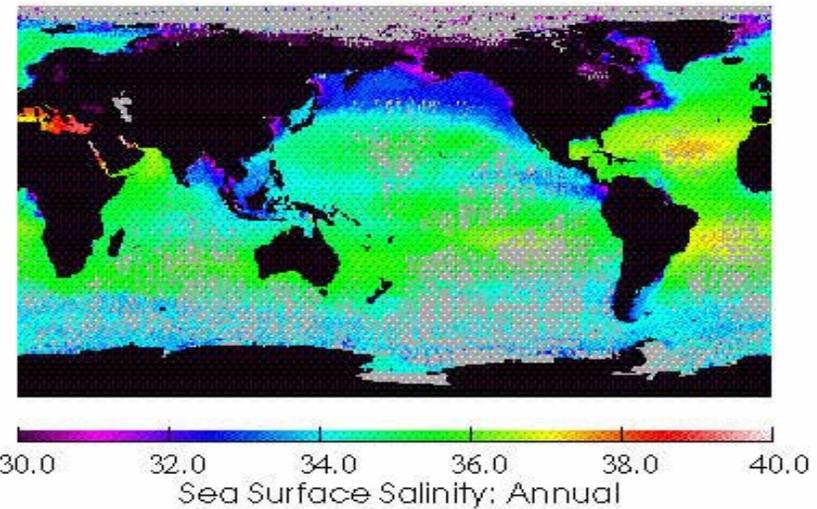
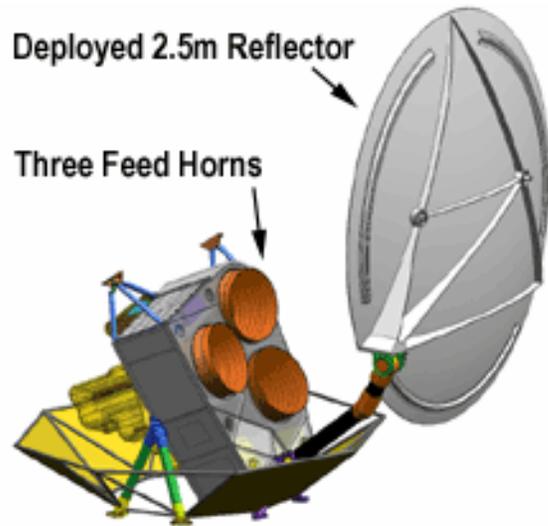
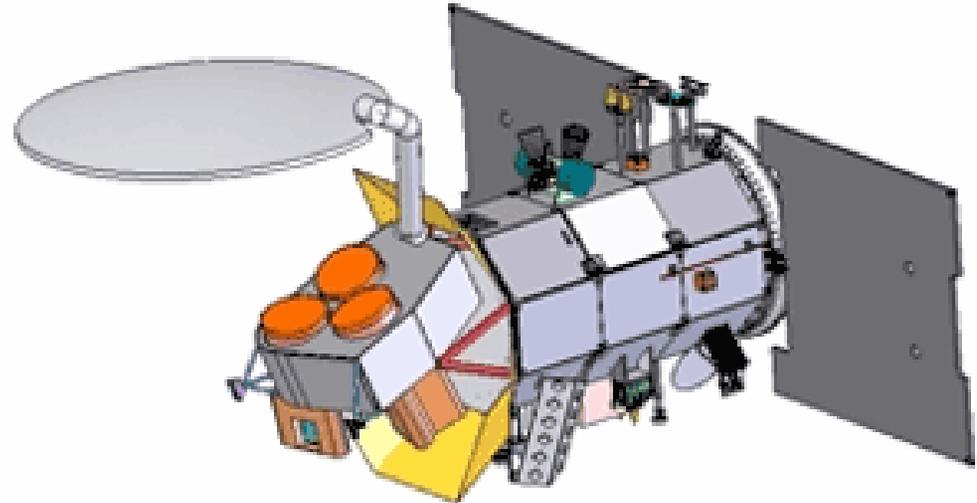
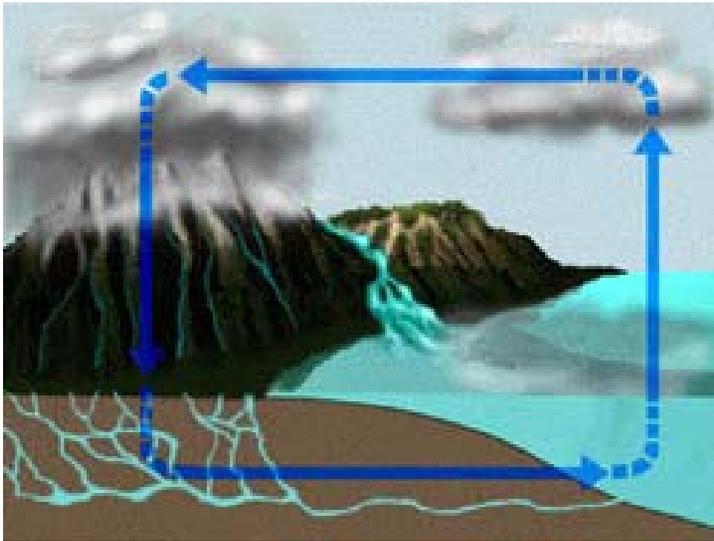
All experiments are mounted on a separate Payload Interface Module



Aquarius Mission Fact Sheet

- Launch Date: March 2009
- Objective: First-ever global maps of salt concentration in the ocean surface
- Partners
 - JPL Contributed Instrument onto Satellite built by Space Agency of Argentina (Comisión Nacional de Actividades Espaciales, CONAE)
 - GSFC Role - TBD
- Unique Features: Bus voltage increased by adding additional cells into battery and array
- Power Source: Solar Powered
- Energy Storage: Nickel-Cadmium (TBR)
- Driving Requirements: LEO
- Planned Lifetime: 3 Years

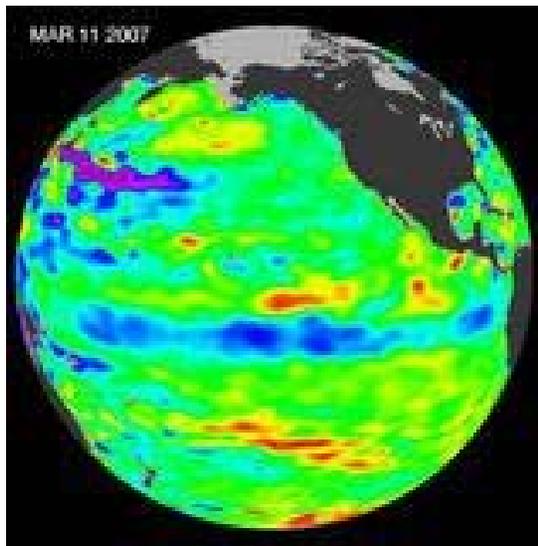
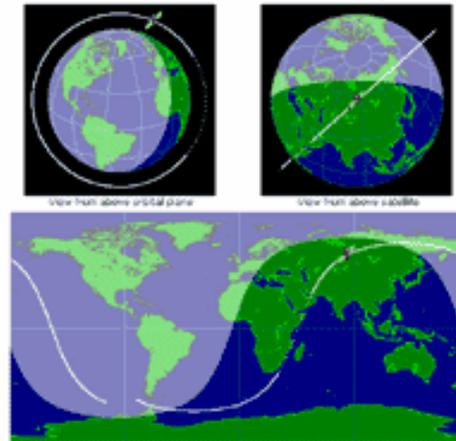
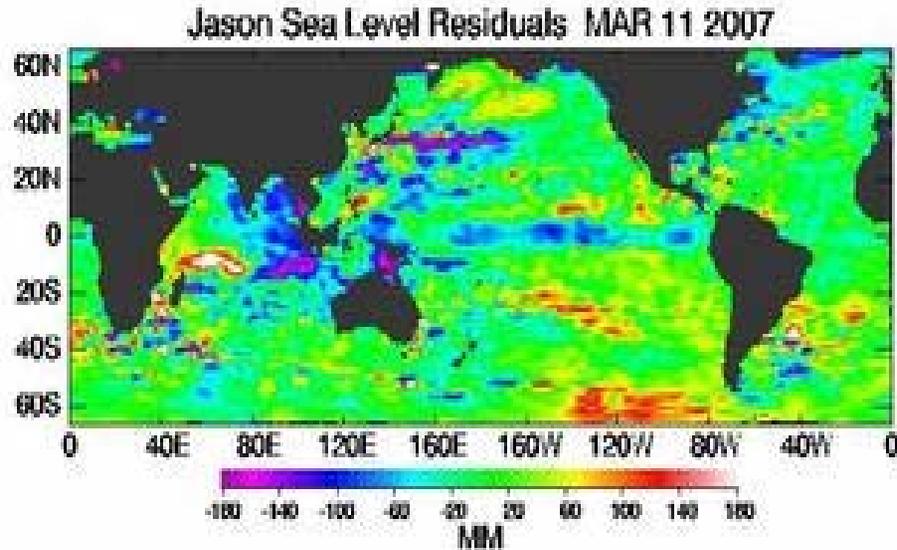
Aquarius Spacecraft



OSTM Mission Fact Sheet

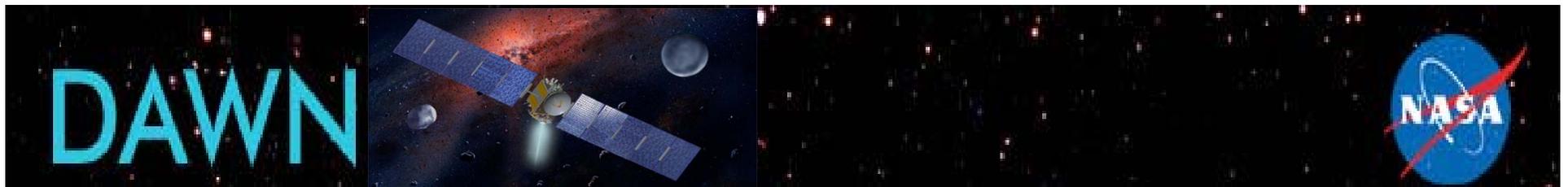
- Launch Date: June 2008
- Objective: OSTM / Jason-2 is a follow-on to the Jason-1 and TOPEX missions, equaling or bettering 3.3 cm resolution in sea height measurements
- Partners: CNES spacecraft bus and operations, JPL Instrument contributions
Mission Operations: NOAA, EUMETSAT
- Unique Features: Moving this capability into operational state with NOAA Operations
- Power Source: Solar Powered
- Energy Storage: Nickel-Hydrogen (TBR)
- Driving Requirements: High Inclination LEO
- Planned Lifetime: 3 Years

Ocean Surface Topography Mission



Dawn Fact Sheet

- Launch Date: June 20, 2007
- Objective: Visit asteroids, Ceres and Vesta
- Partners: JPL, OSC, UCLA, LANL, MPS, DLR, ASI
- Unique Features: Solar Electric Propulsion
- Power Source: 11 KW Triple-Junction Rigid Array
- Energy Storage: Nickel-Hydrogen CPV with bypass
- Driving Requirements: Power into IPS versus solar range
- Planned Lifetime: 10 Years

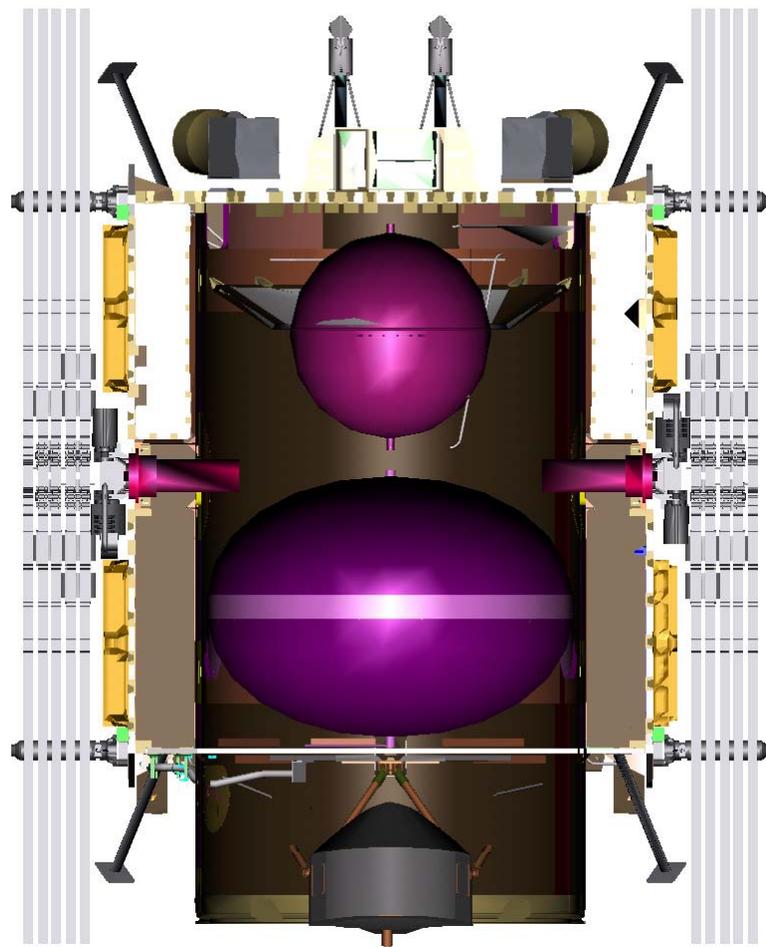


Dawn Spacecraft with 5 panel, 11 KW Dutch Space Solar Arrays

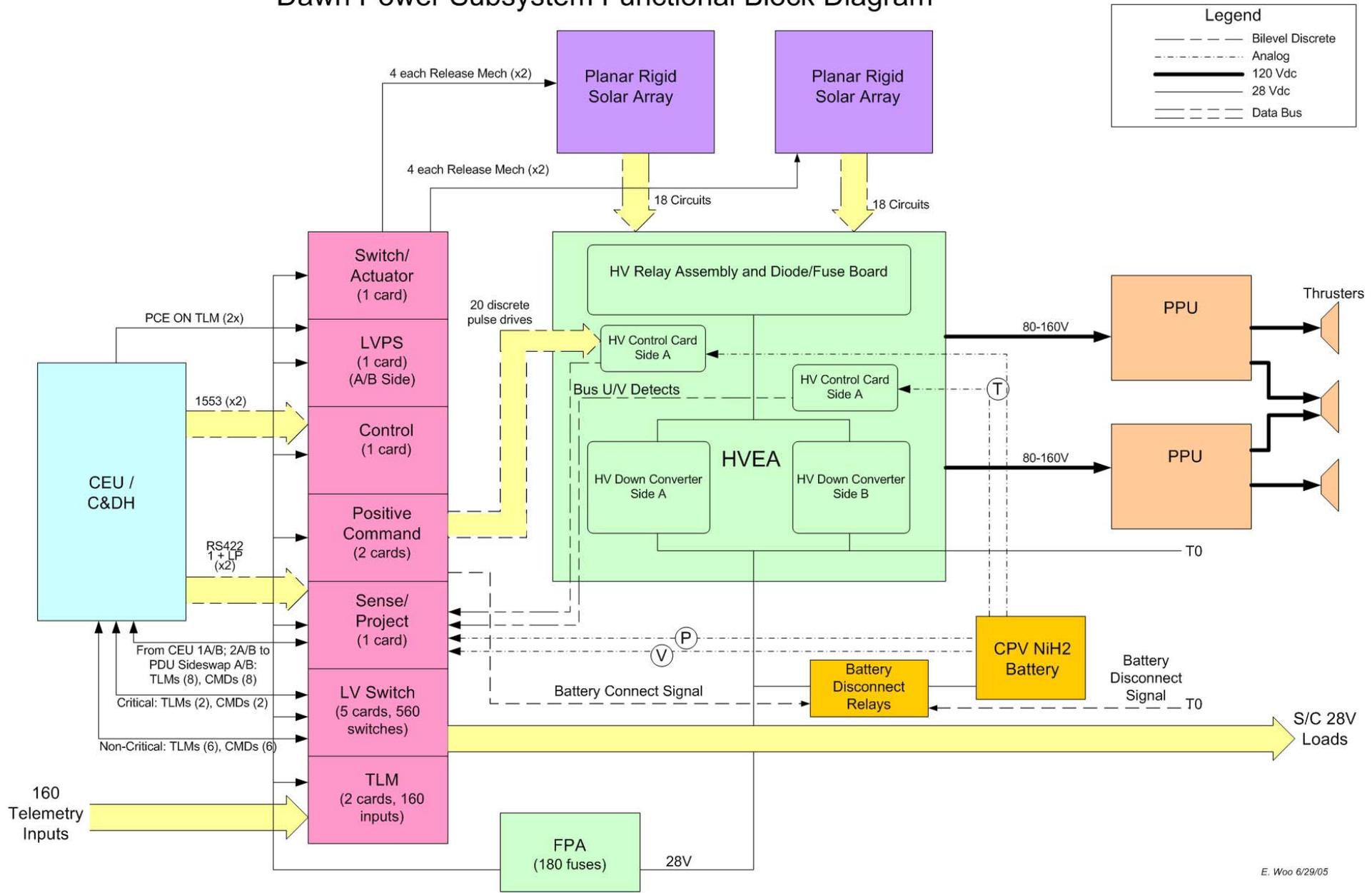


Dawn Spacecraft Configuration

External View Cut-away View



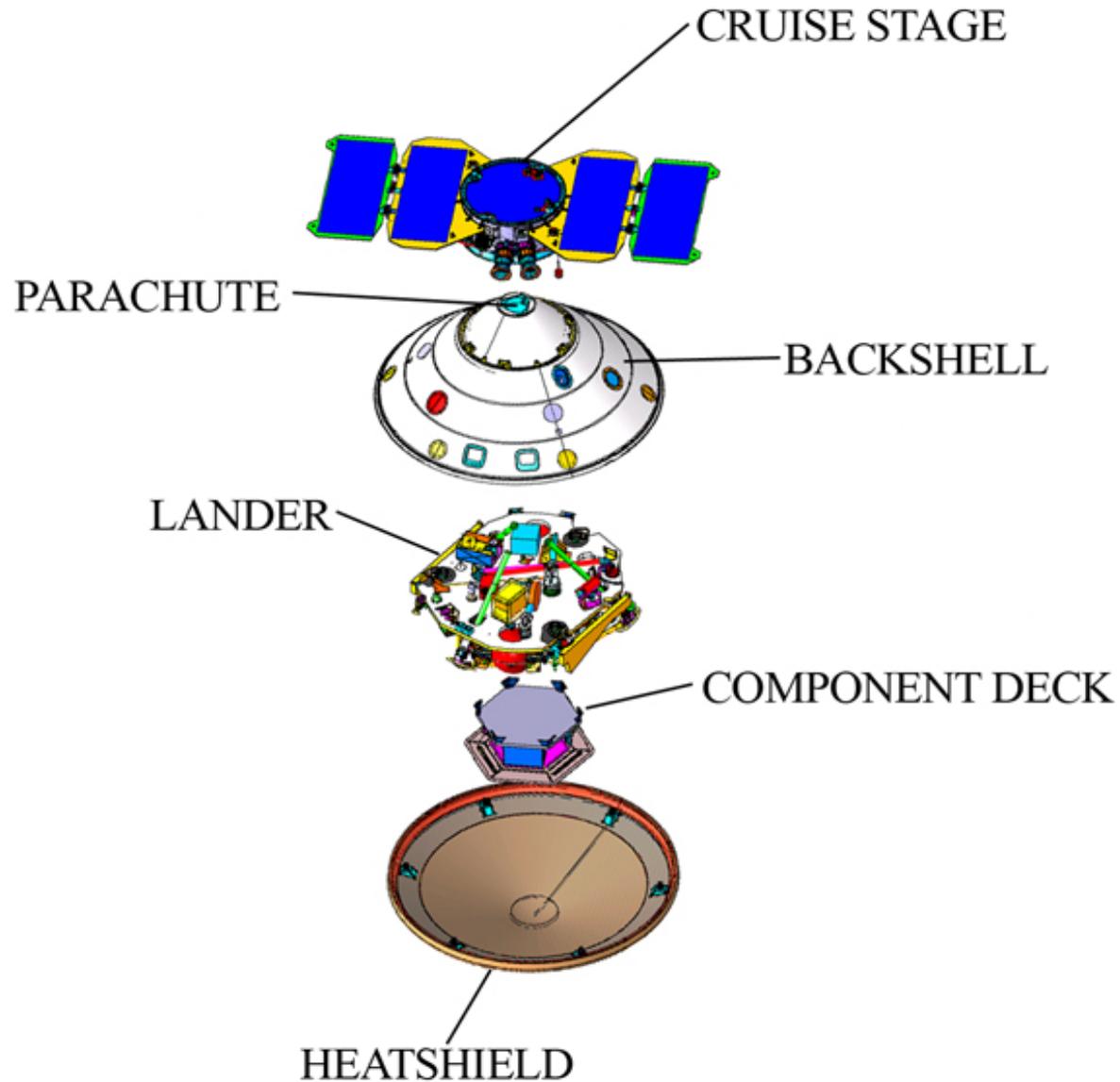
Dawn Power Subsystem Functional Block Diagram



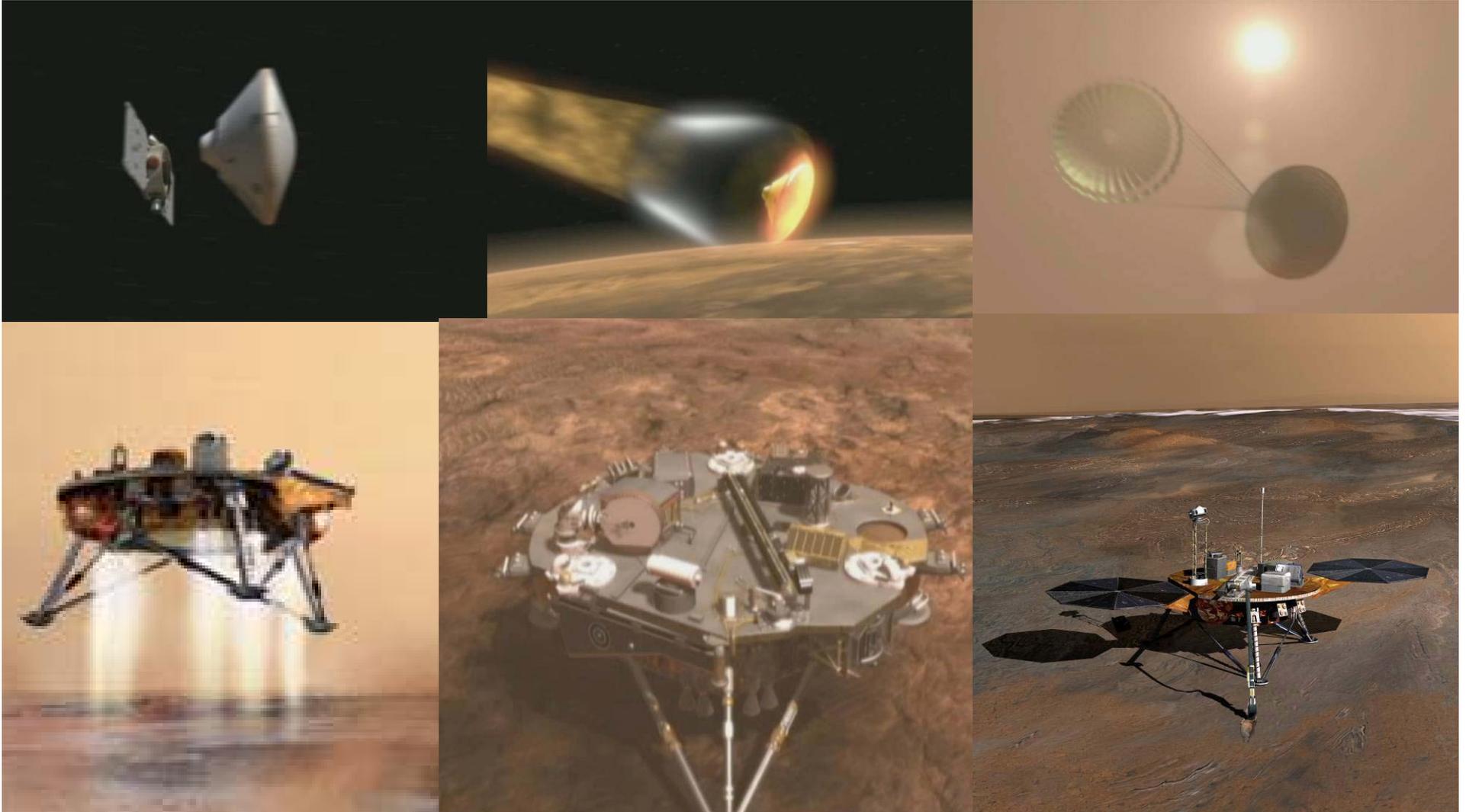
Phoenix Fact Sheet

- Launch Date: August, 2007
- Objective: Dig to 1.6 meter depth looking for water at Mars polar cap
- Partners: JPL, LMA Denver, Max Planck Institute, University of Arizona
- Unique Features: 2 meter arm for digging
- Power Source: Ultraflex Solar Arrays, ATK / Able
- Energy Storage: Lithium Ion - Lithion
- Driving Requirements: Power for Digging and Telecom
Solar Array Performance
- Planned Lifetime: Not intended to survive Winter

Phoenix Spacecraft Configuration by Element



Phoenix Entry Descent and Landing Sequence (EDL)

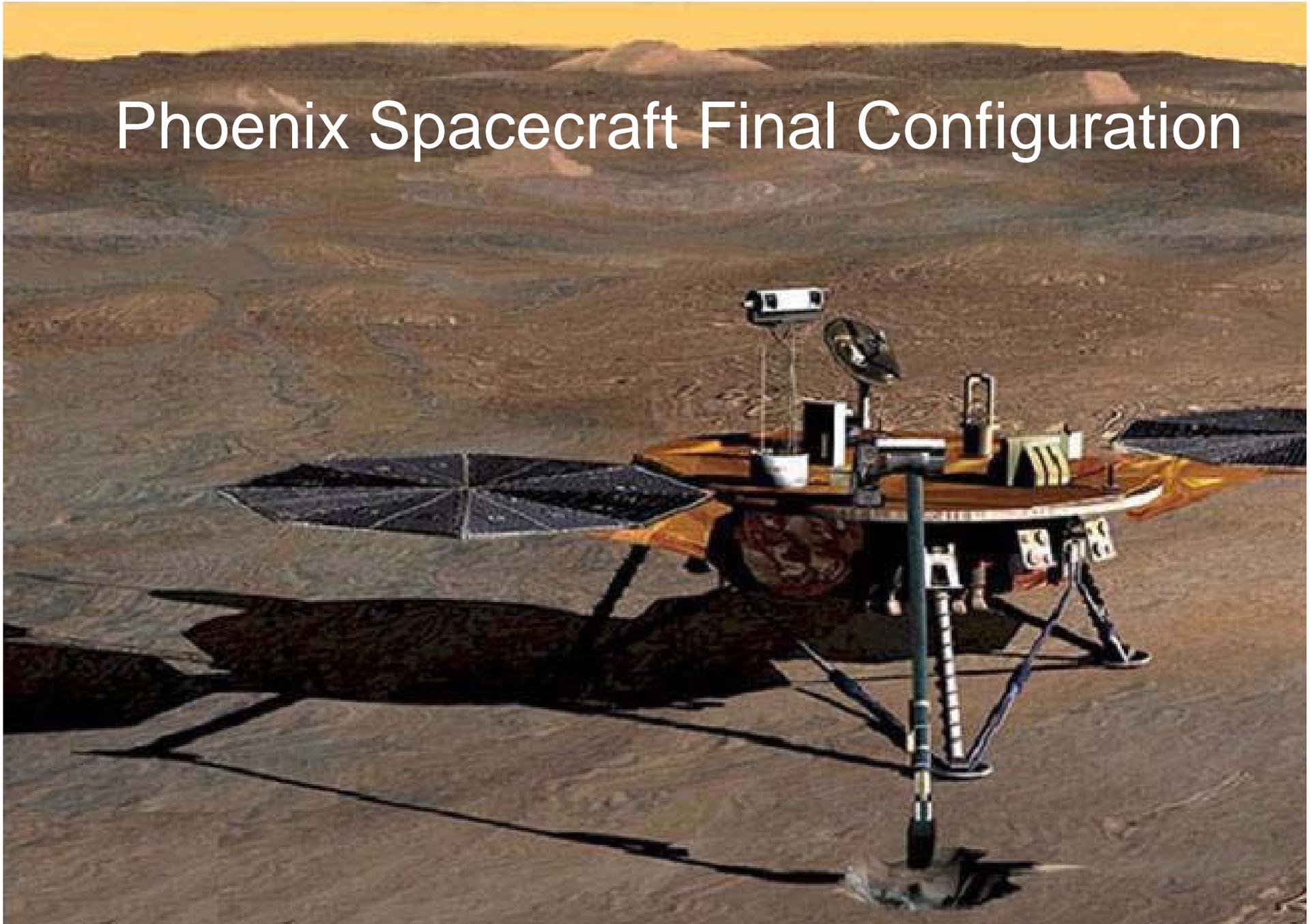


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Phoenix Spacecraft Final Configuration



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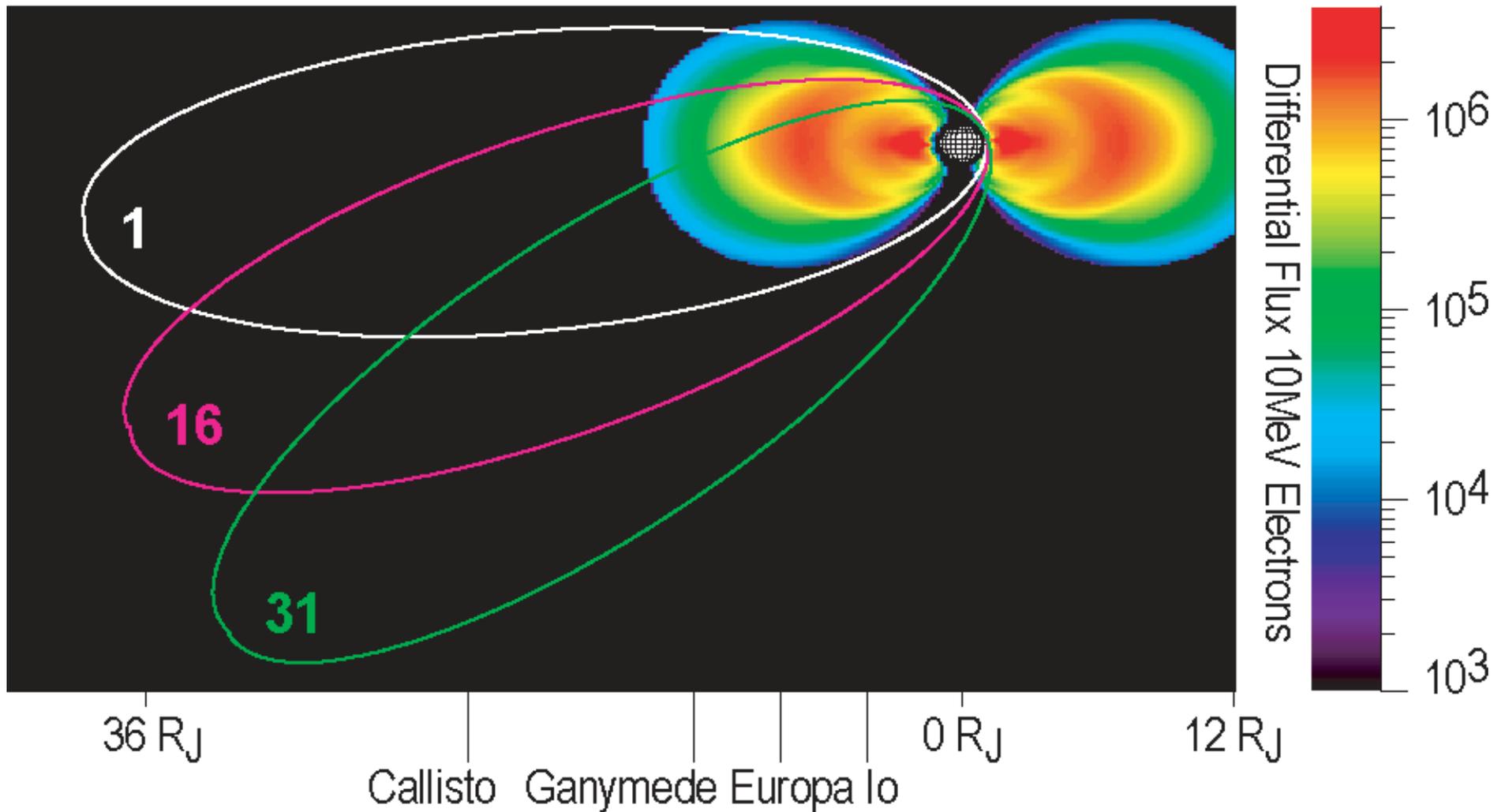
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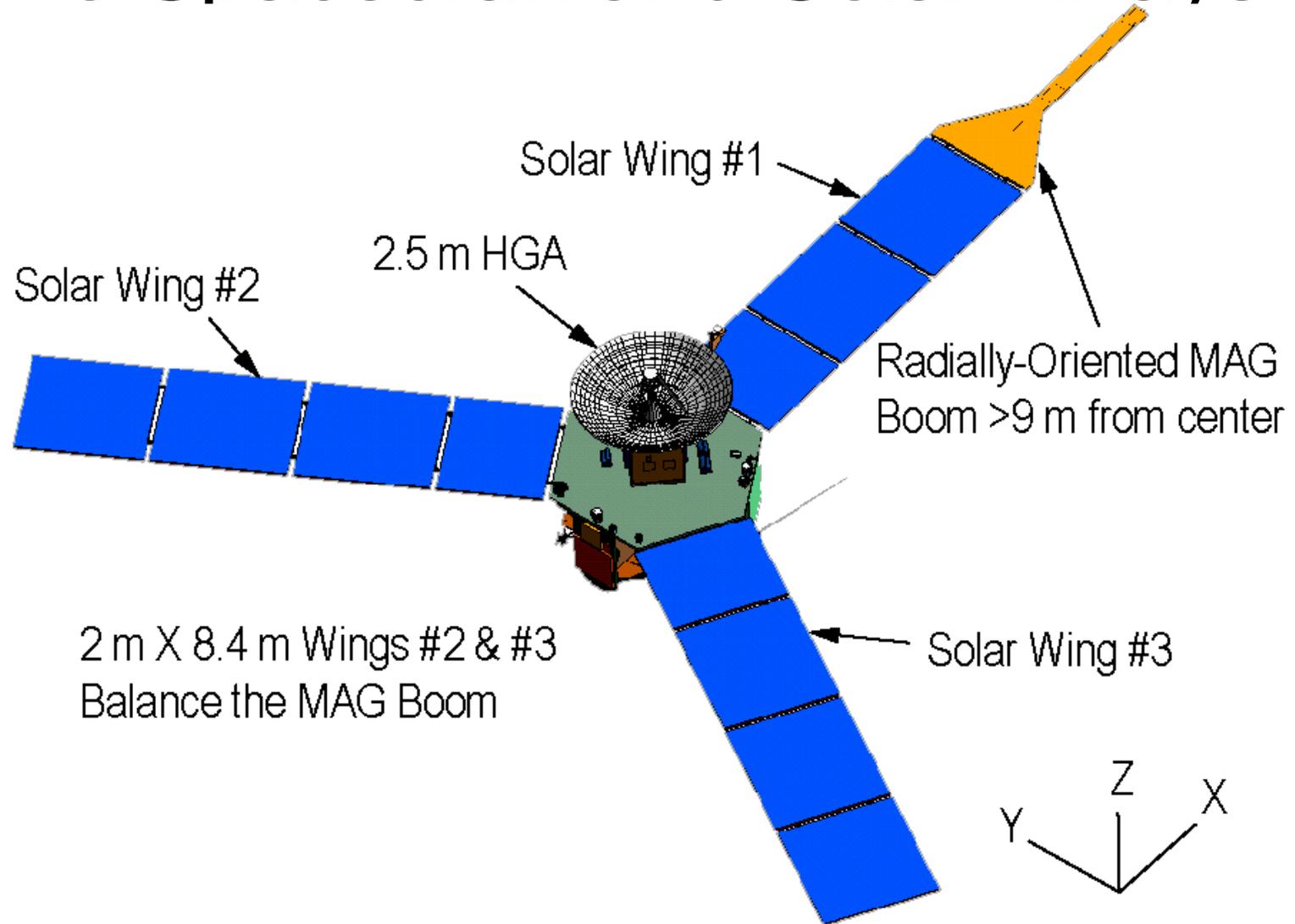
Juno Fact Sheet

- Launch Date: 2010
- Objective: Look Jupiter's water abundance and core structure via fields
- Partners: JPL, LMA Denver, SWRI
- Unique Features: Radiation: (1MeV Equiv.)
3.9*E14 for Vmp, with RDM of 2
6.9*E14 for Imp, with RDM of 2
- Power Source: 1st Solar Powered S/C to Jupiter
- Energy Storage: Lithium Ion
- Driving Requirements: 5+ AU Range, Spin Stabilized
- Planned Lifetime: 8 Year Lifetime

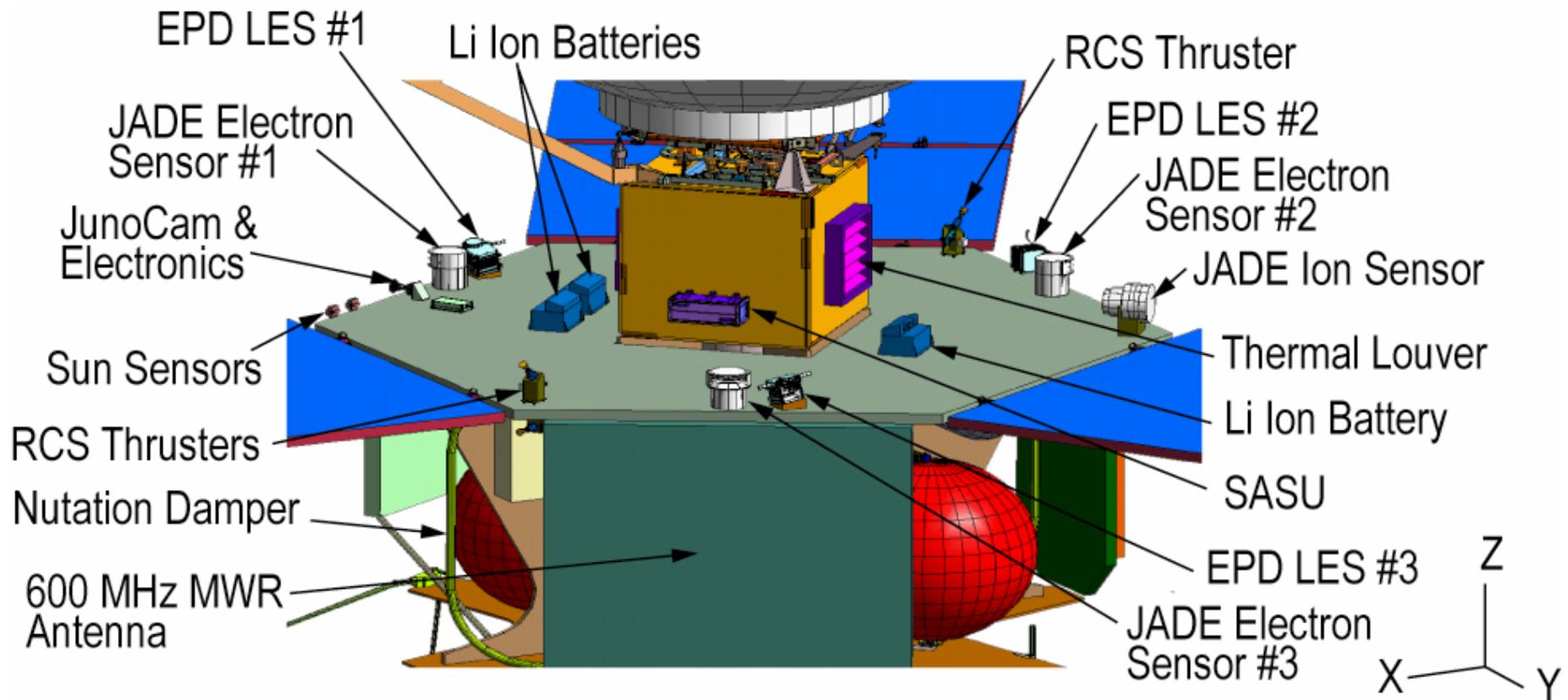
Radiation Belts and Juno Orbit

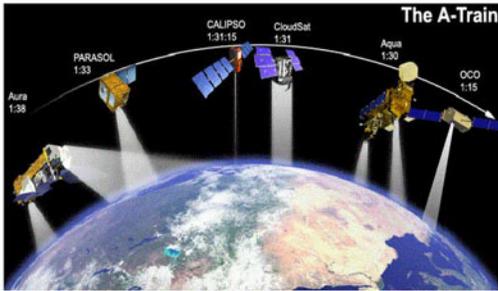


Juno Spacecraft and Solar Arrays

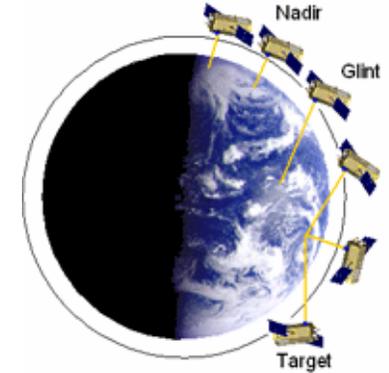


Spacecraft Details



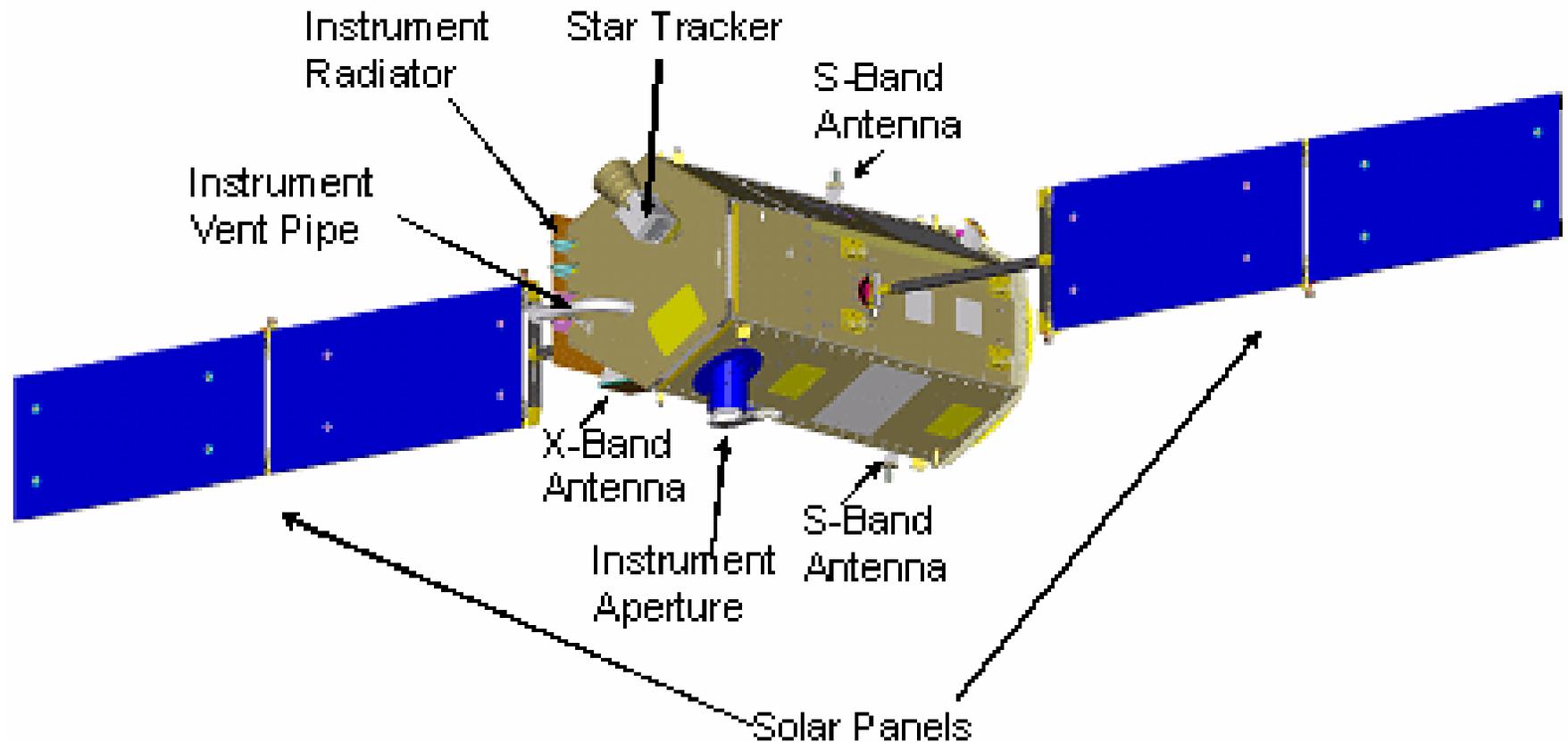


OCO Fact Sheet



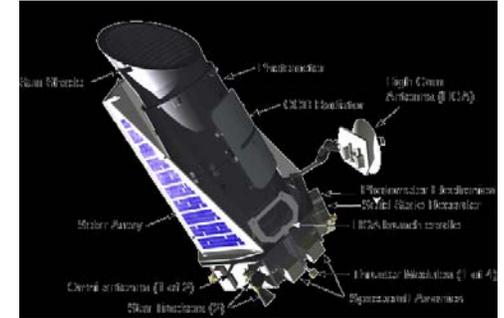
- Launch Date: Month, Year
- Objective: Study of Earths CO₂ Cycle
- Partners: JPL, OSC, Hamilton Sundstrand
- Unique Features:
 - LeoStar-2 Bus,
 - Fourier Transform Near Infrared Spectrometers (3 bands)
- Power Source: Solar Powered
- Energy Storage: Nickel-Cadmium
- Driving Requirements: LEO; Nadir, Glint & Target Modes
- Planned Lifetime: 3 Years (TBR)

OCO Configuration





Kepler Fact Sheet



- Launch Date: 2008
- Objective: Search for Earth-like planets monitoring 100,000 stars looking for line of sight crossings
- Partners: JPL, Ball Aerospace, Ames
- Unique Features: 42 CCD focal plane
- Power Source: Solar Powered
- Energy Storage: Lithium-Ion; 18650 (8S:16P)
- Driving Requirements: 42 inch telescope
Earth trailing orbit
- Planned Lifetime: 4 Years

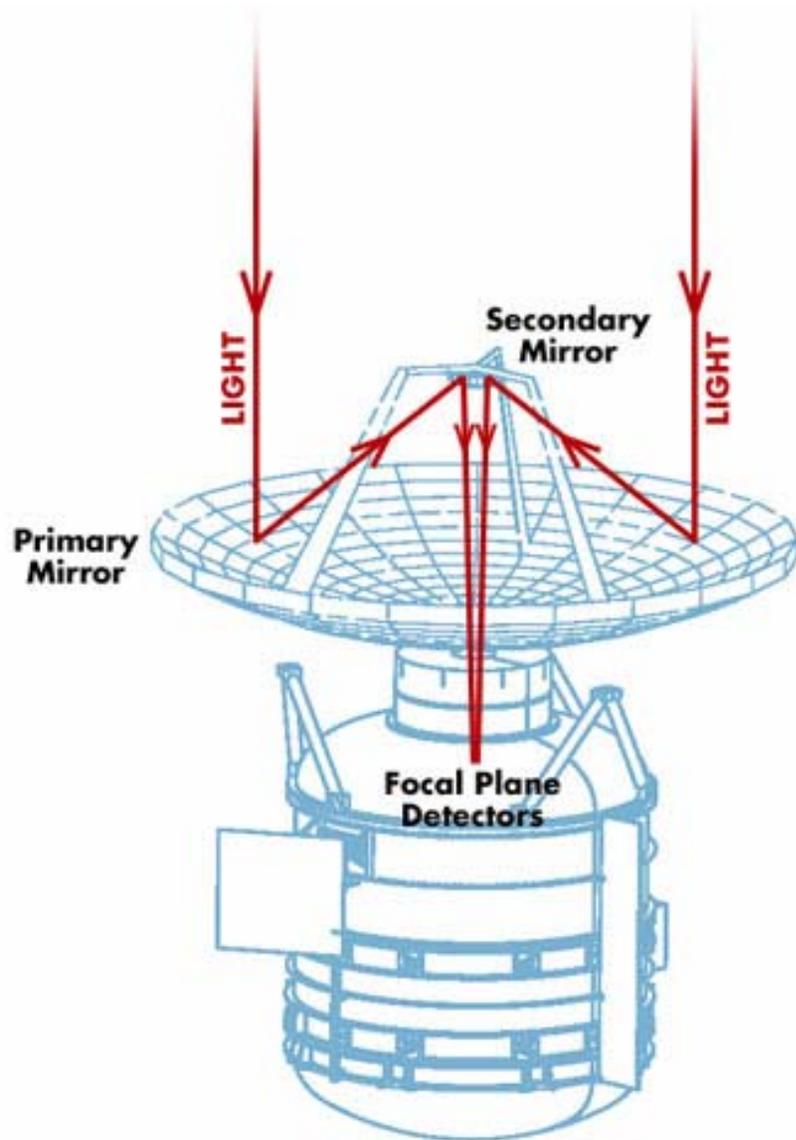


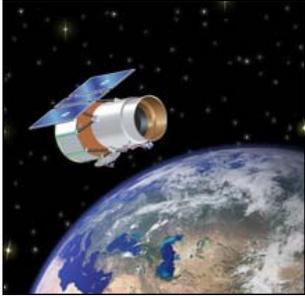
Herschel Fact Sheet



- Launch Date: 2007
- Objective: Observe in full 60-670 μm range
- Partners: JPL, Ball Aerospace, ESA, CIT
- Unique Features: 3.5 Meter Aperture is largest diameter Space Telescope
SiC Mirror cooled to 80K
- Power Source: Solar Powered (1KW)
- Energy Storage: Nickel-Hydrogen (TBR)
- Driving Requirements: Earth-Sun L2 Orbit
Shared Ride with Planck
- Planned Lifetime: 3 Years

Herschel Configuration





WISE Fact Sheet

- Launch Date: June, 2009
- Objective: Mid-Infrared Survey of entire sky
3-25 μm
- Partners: JPL, Ball, SDL, UC Berkeley, CIT
- Unique Features: 40 cm aperture, Solid H₂ Cryostat
- Power Source: Solar Powered
- Energy Storage: Nickel-Hydrogen (TBR)
- Driving Requirements: 500 km sun-synch LEO
- Planned Lifetime: 0.5 Years

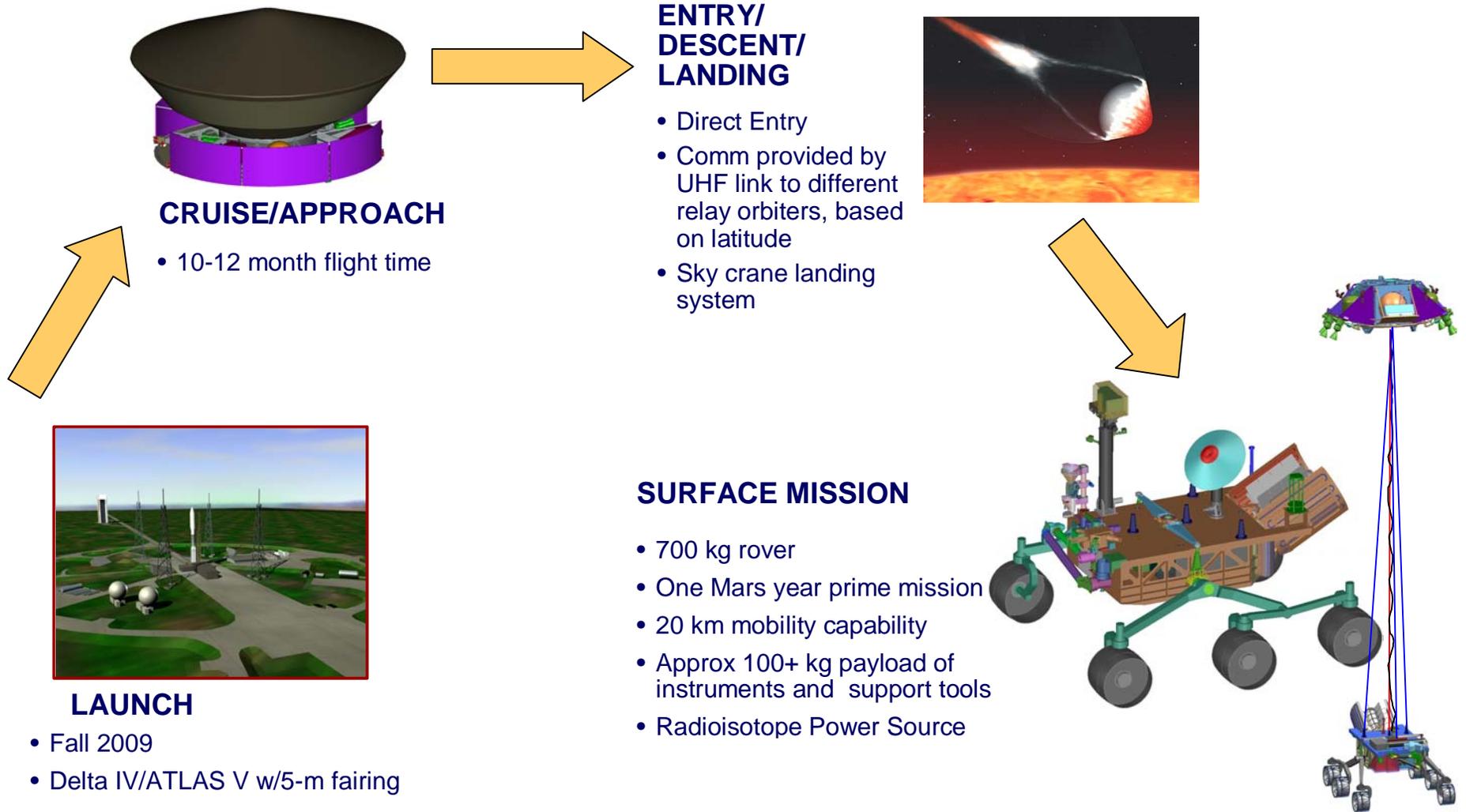


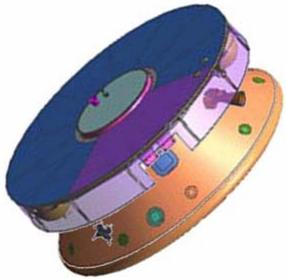
MSL Fact Sheet



- Launch Date: Fall 2009
- Objective: Search for Evidence of Life on Mars using Sample Analysis
- Partners: JPL + International Instruments
- Unique Features: Precision Landing – Sky Crane
Extended Operating Latitudes
- Power Source: One MMRTG:
Multi-Mission Radioisotope
Thermoelectric Generator
- Energy Storage: Dual Lithium Ion
- Driving Requirements: Single MMRTG ~ 100 W
- Planned Lifetime: Two+ Earth Years Capability

MSL Mission Overview





MSL Mass Allocations

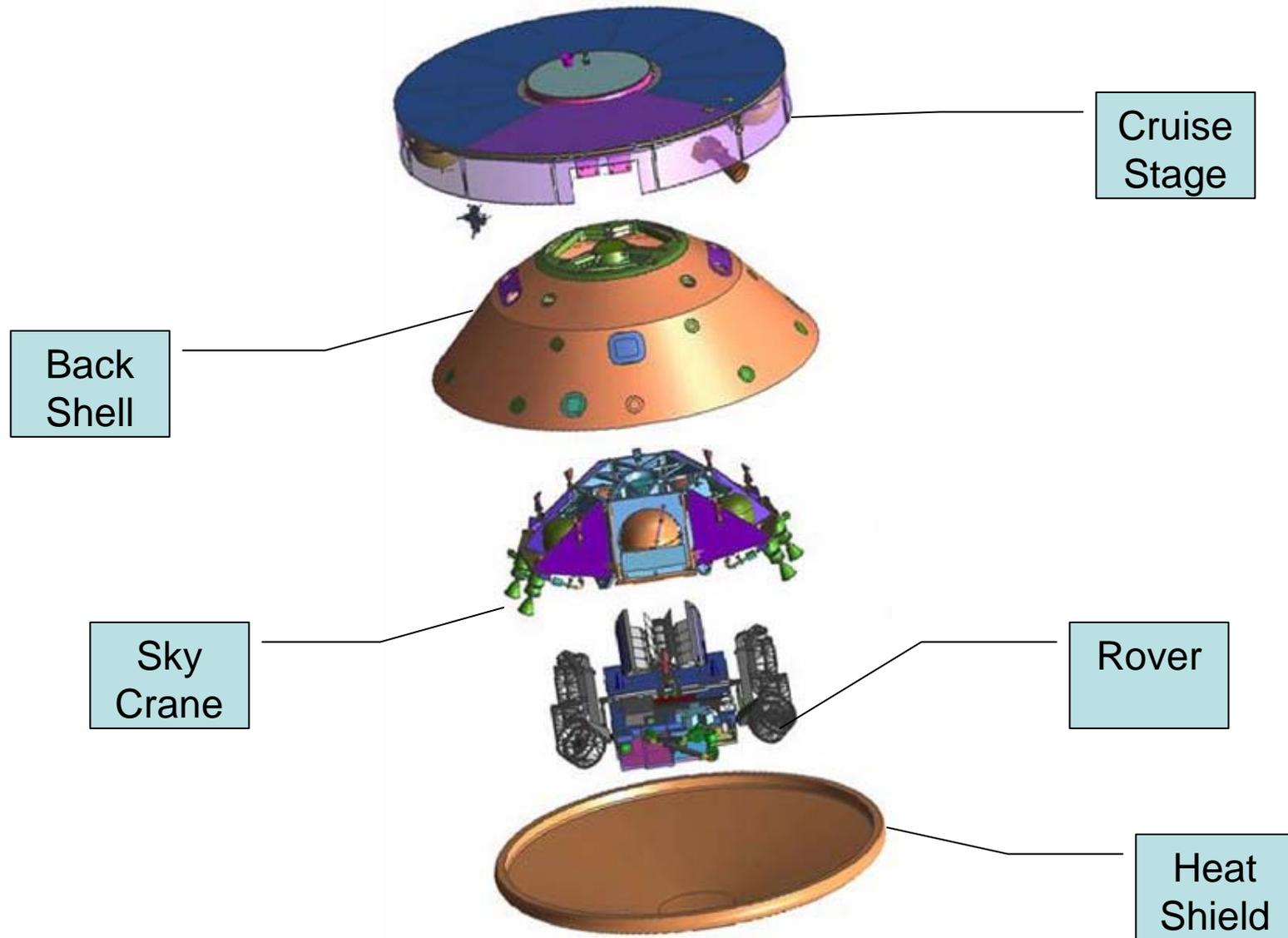


	Allocated Mass kg (lbs)	Cumulative Mass kg (lbs)
Rover	775 kg (1,708 lbs)	775 kg (1,708 lbs)
Descent stage (dry)	544 kg (1,199 lbs)	1,319 kg (2,908 lbs)
Aeroshell (Backshell + Heat Shield)	525 kg (1,157 lbs)	1,844 kg (4,065 lbs)
Heat Shield	78 kg (172 lbs)	820 kg (1,808 lbs)
Cruise Stage	400 kg (882 lbs)	2,244 kg (4,947 lbs)
Descent Stage Propellant	219 kg (483 lbs)	2,463 kg (5,430 lbs)

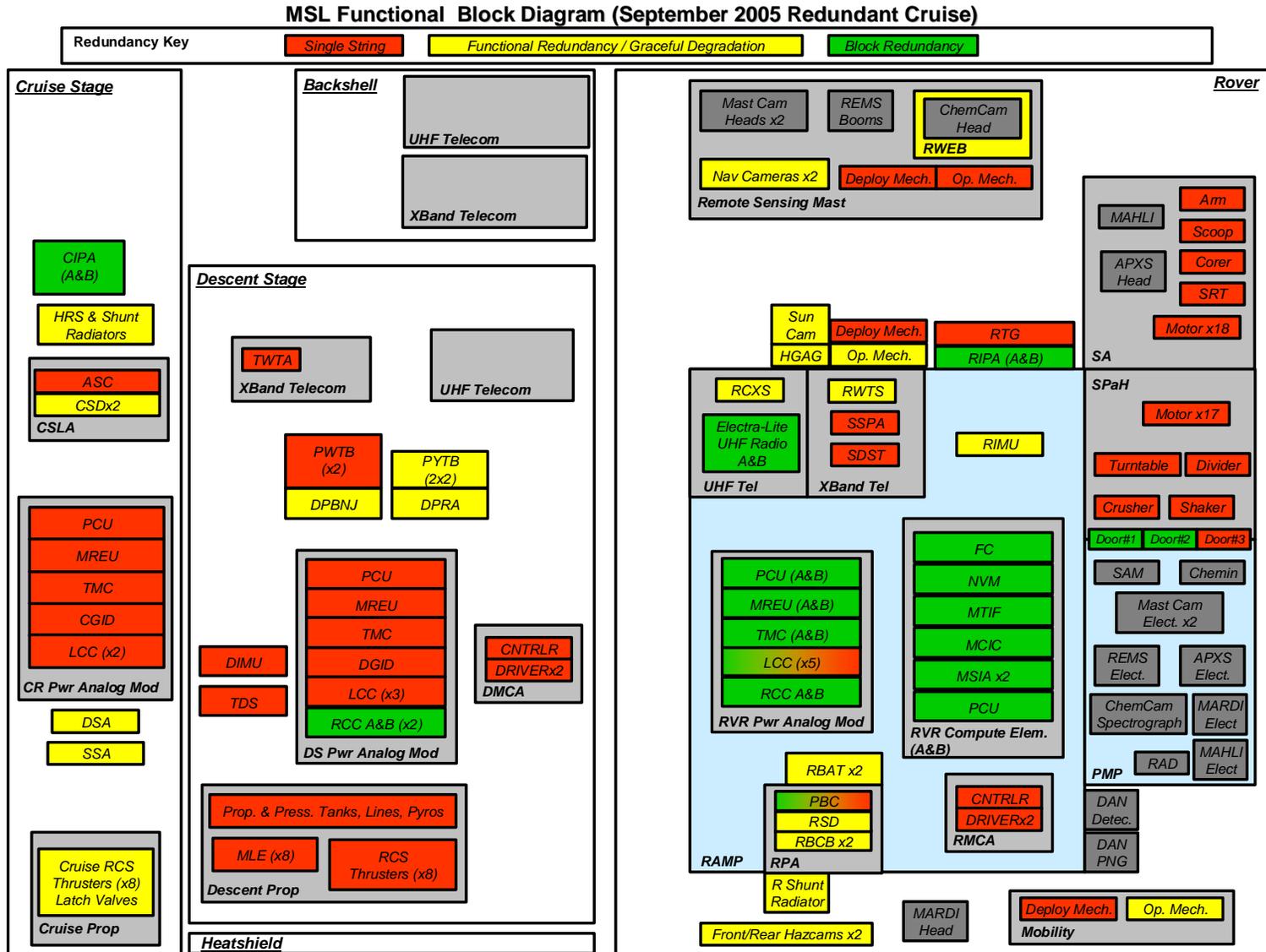
MSL Cruise Configuration



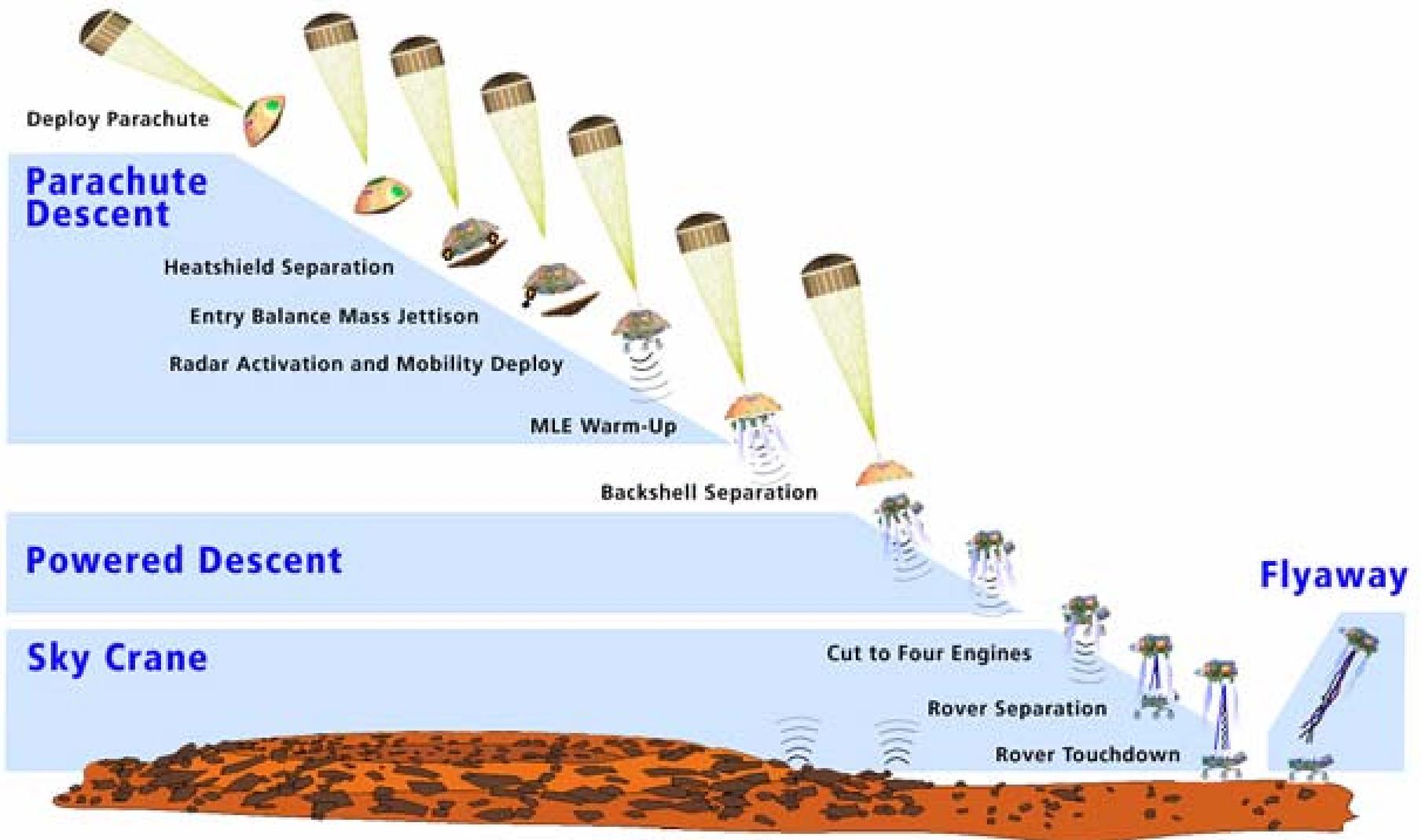
MSL Cruise Configuration



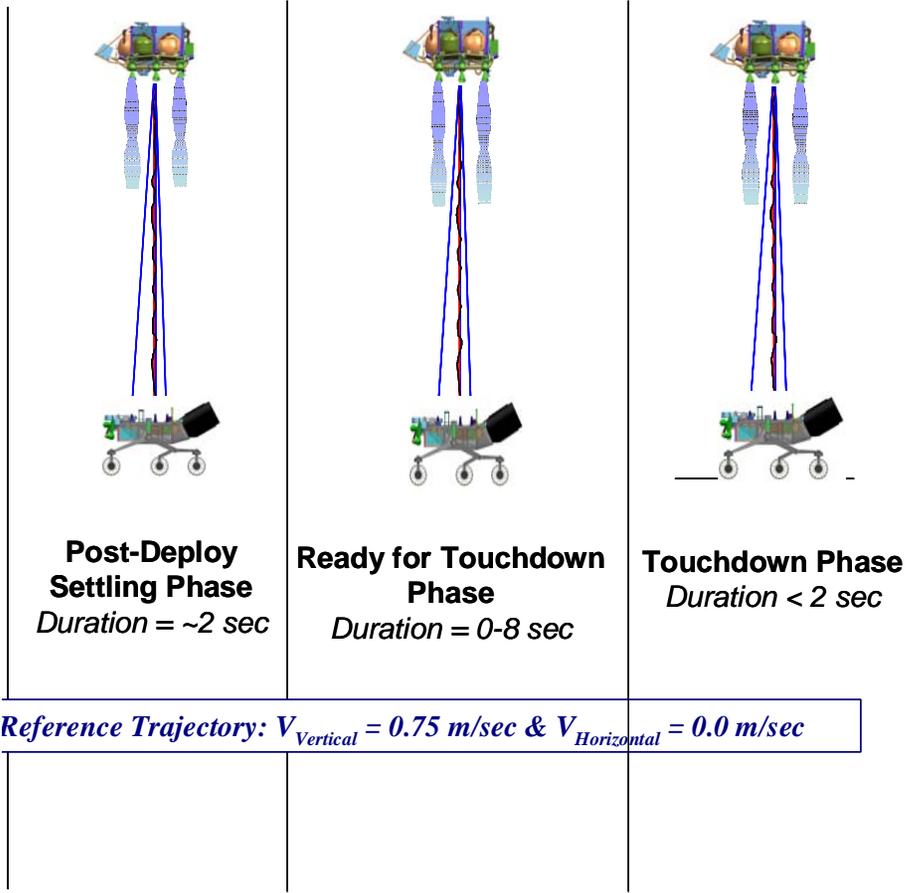
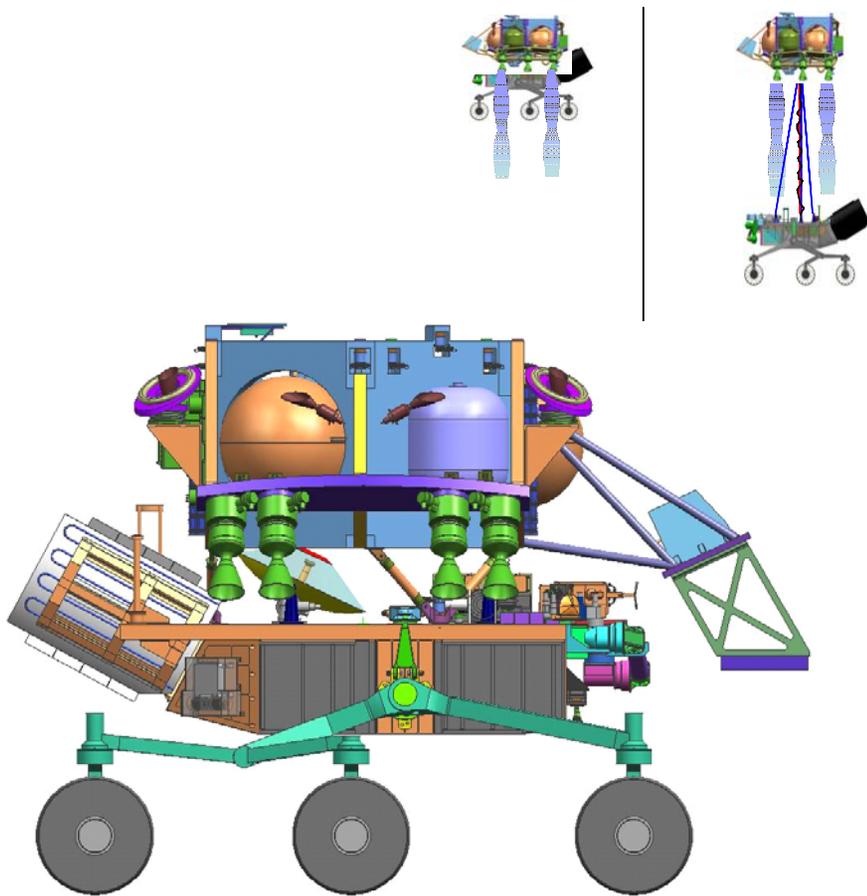
MSL Overall Block Diagram



MSL Descent Sequence



Sky Crane Deployment on Tether



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MSL Rover Configuration

Mast-mounted, on scan platform:

- MastCam (2 camera heads)
- ChemCam (mast unit)

Mast-mounted, below scan platform:

- REMS (2 "boomlets")

Payload Module (with sample inlets):

- SAM
- CheMin

Payload Module (no sample inlets):

- RAD
- APXS Electronics
- ChemCam Electronics
- MSSS Electronics (x4)
 - MAHLI Electronics
 - MastCam Electronics (x2)
 - MARDI electronics
- REMS Electronics

Arm Mounted:

- APXS Sensor Head
- MAHLI Camera Head

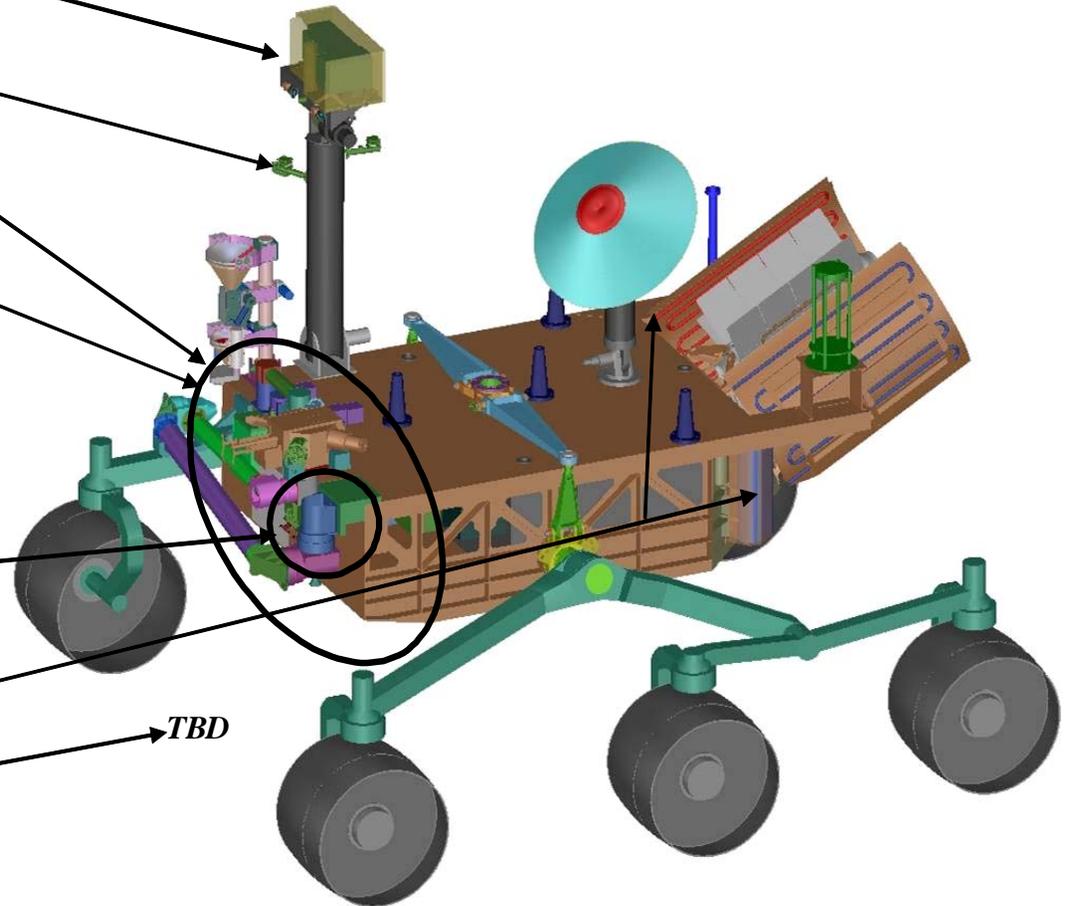
Rover Chassis (adjacent to RPS):

- DAN Digital Electronics
- DAN PNG

Miscellaneous

- Camera Calibration Target(s)
- APXS Calibration Target
- ChemCam Calibration Target
- REMS UV sensor

7/18/2005



Current Spacecraft and Instruments

Missions

Voyager Grand Tour
Ulysses solar polar mission
Wide Field and Planetary Camera
Mars Global Surveyor
Cassini-Huygens to Saturn
Stardust
Quick Scatterometer
Advanced Spaceborne Radiometer
Multi-angle Imaging Spectro-Radiometer
Active Cavity Irradiance Monitor Satellite
2001 Mars Odyssey
Genesis
Jason 1
Gravity Recovery and Climate Experiment
Atmospheric Infrared Sounder
Galaxy Evolution Explorer
Mars Exploration Rovers
Space Infrared Telescope Facility - Spitzer
The New Millennium Space Technology 6
Deep Impact Deep Impact
Deep Impact: Tempel 1 impactor
Mars Reconnaissance Orbiter
CloudSat

Launch(es)

August 20 and Sept. 5, 1977
October 6, 1990
April 24, 1990; Dec. 2, 1993
November 7, 1996
October 15, 1997
February 7, 1999
June 19, 1999
December 18, 1999
December 18, 1999
December 22, 1999
April 7, 2001
August 8, 2001
December 7, 2001
Mar. 17, 2002
May 4, 2000
April 28, 2003
June 10, 2003, July 7, 2003
August 25, 2003
December 2006
Jan. 12, 2005
Jan. 12, 2005
Aug. 12, 2005
Apr. 28, 2006