

Mission Objectives

Theme: Characterize environmental threats to human exploration

MEPAG IV Goals

“Safe On Mars” Document

- Missions will help us to understand:
 - The radiation environment produced by GCR (Galactic Cosmic Radiation) and SPE (Solar Particle Events) and their interaction with surface particles
 - The chemical toxicity of the regolith
 - The chemical, physical and mechanical characteristics of the dust and regolith (including distribution and composition of minerals, rocks, and soils)
 - The Martian climate and atmosphere

Science Measurement Objectives

Mission Design

- Two separate missions
 - EMPHASIS: Exploration to Mars for Preparation of Human Arrival with Science done In Situ
 - SPHERE: Scientific Preparation for Human Exploration and Return to Earth

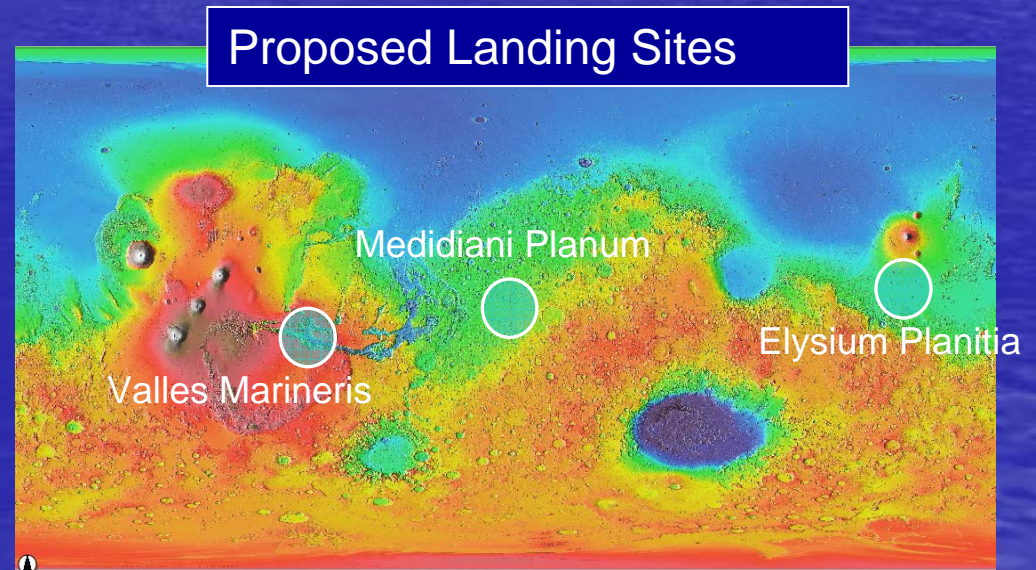
Mission Design

- SUBSYSTEMS

- Launch
- Instrumentation
- Structures
- EDL: Entry, Descent and Landing
- Power
- GN&C: Guidance, Navigation and Control
- C&DH: Computing and Data Handling
- Telecom
- Propulsion
- Thermal
- Costing

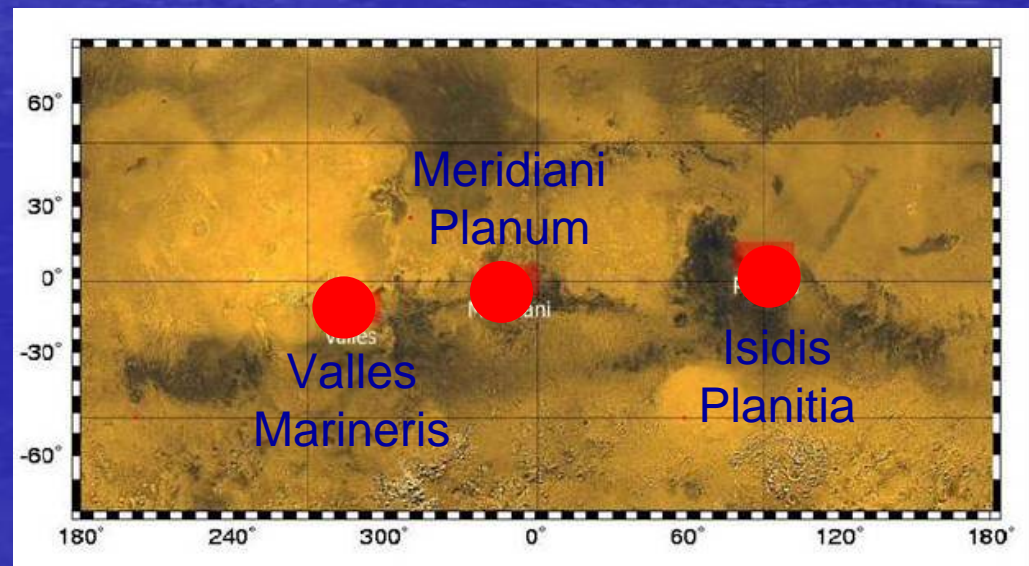
Sphere Mission Overview

- Three identical tumbleweed-like devices launched in Oct. 2011 from a single Delta II
- Nine instruments conduct remote & in-situ measurements
- Tumbleweed traverse capacity up to 100s of km
- Arrive in Aug. 2012 at three distinct sites within +/- 30° latitude, mean MOLA or below
- EDL reminiscent of Beagle 2
- Operational life: 1 year
- Cost: < \$500 Million



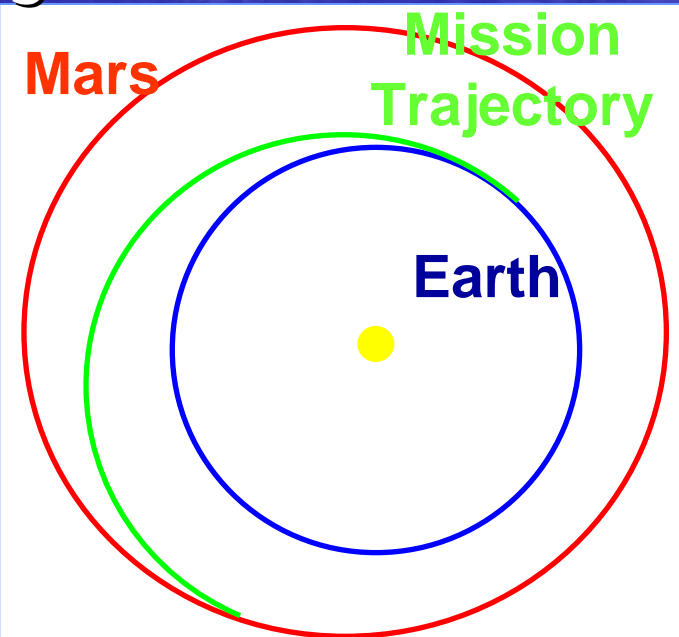
Emphasis Mission Overview

- Three identical Landers, One launch vehicle
 - Identical Instrument payloads
 - Individual Carriers & EDL
 - Three Launch Vehicle Adaptors (LVAs)
 - Three sites
- Class A-B Mission
- 2007 Technology Cutoff
- \$850 M - \$1 B (\$ 2004)

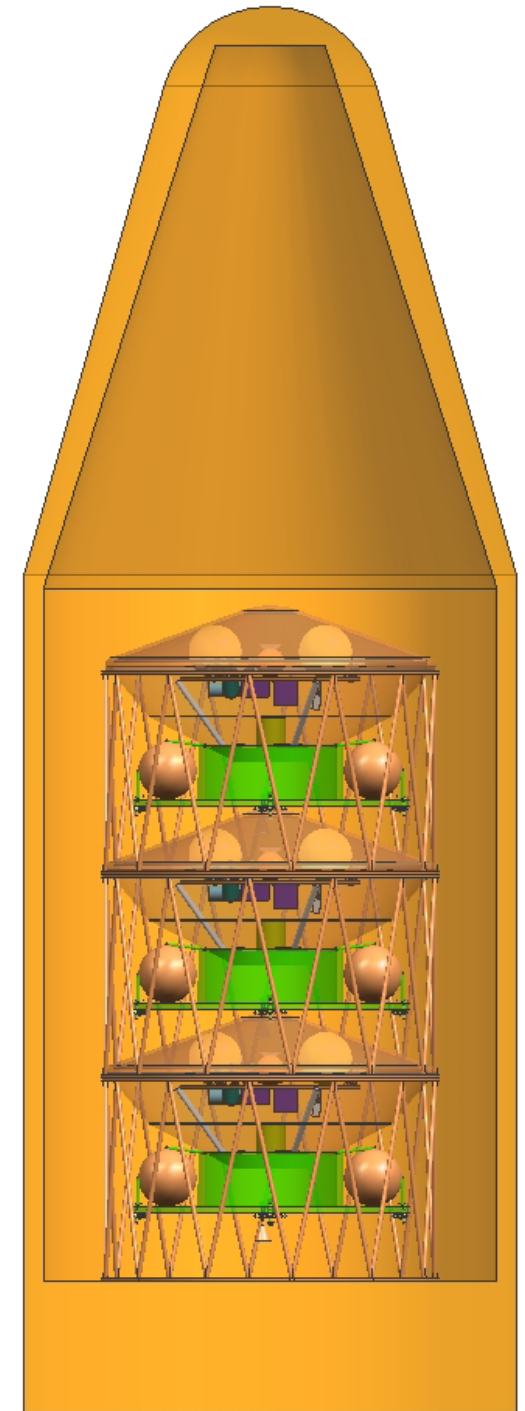
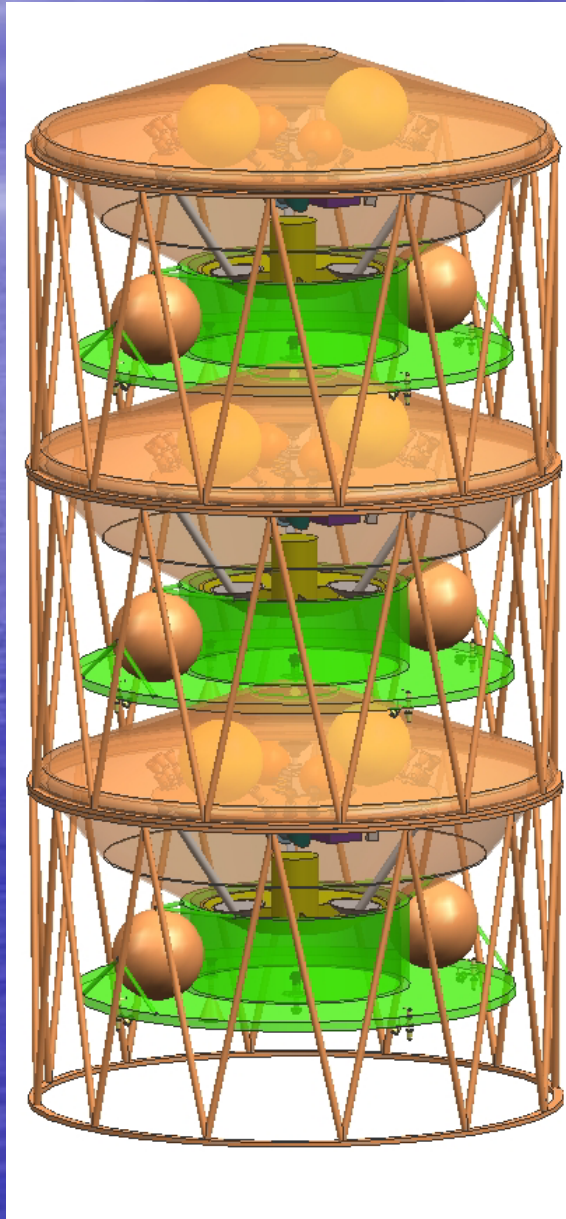


Launch and Trajectory Overview

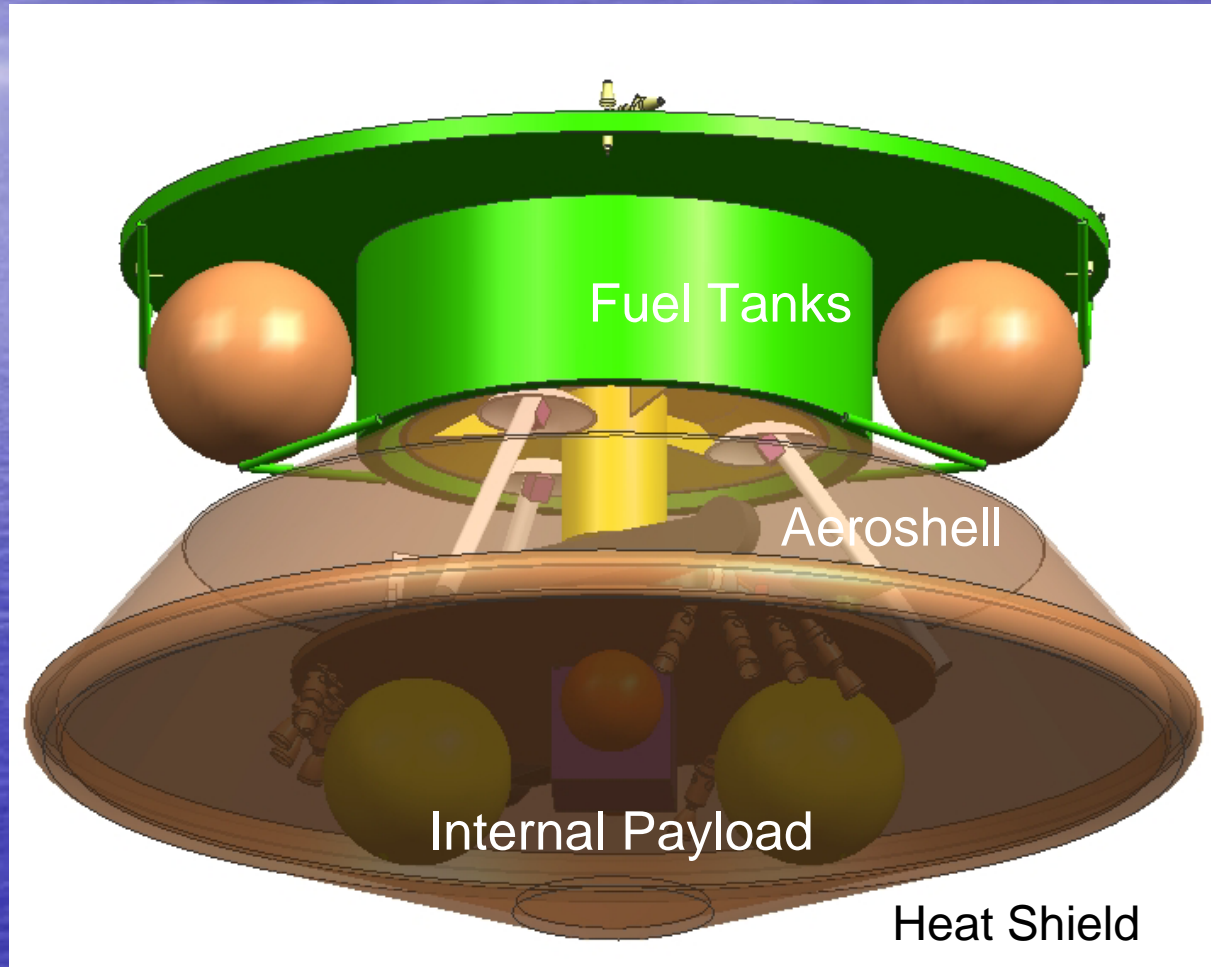
- Launch:
 - 21 Day Launch Window: Oct 31-Nov. 20, 2011
 - Nominal Launch Date: October 31, 2011
 - Kennedy Space Center
 - DLA $\approx 22.9^\circ$
- Type II Trajectory Direct to Mars
 - $C_3 \approx 9.5 \text{ km}^2/\text{s}^2$
 - $V_\infty(\text{arrival}) \approx 2.8 \text{ km/s}$
- Arrival:
 - Spacecraft 1: Aug 17
 - Spacecraft 2: Aug 31
 - Spacecraft 3: Aug 24



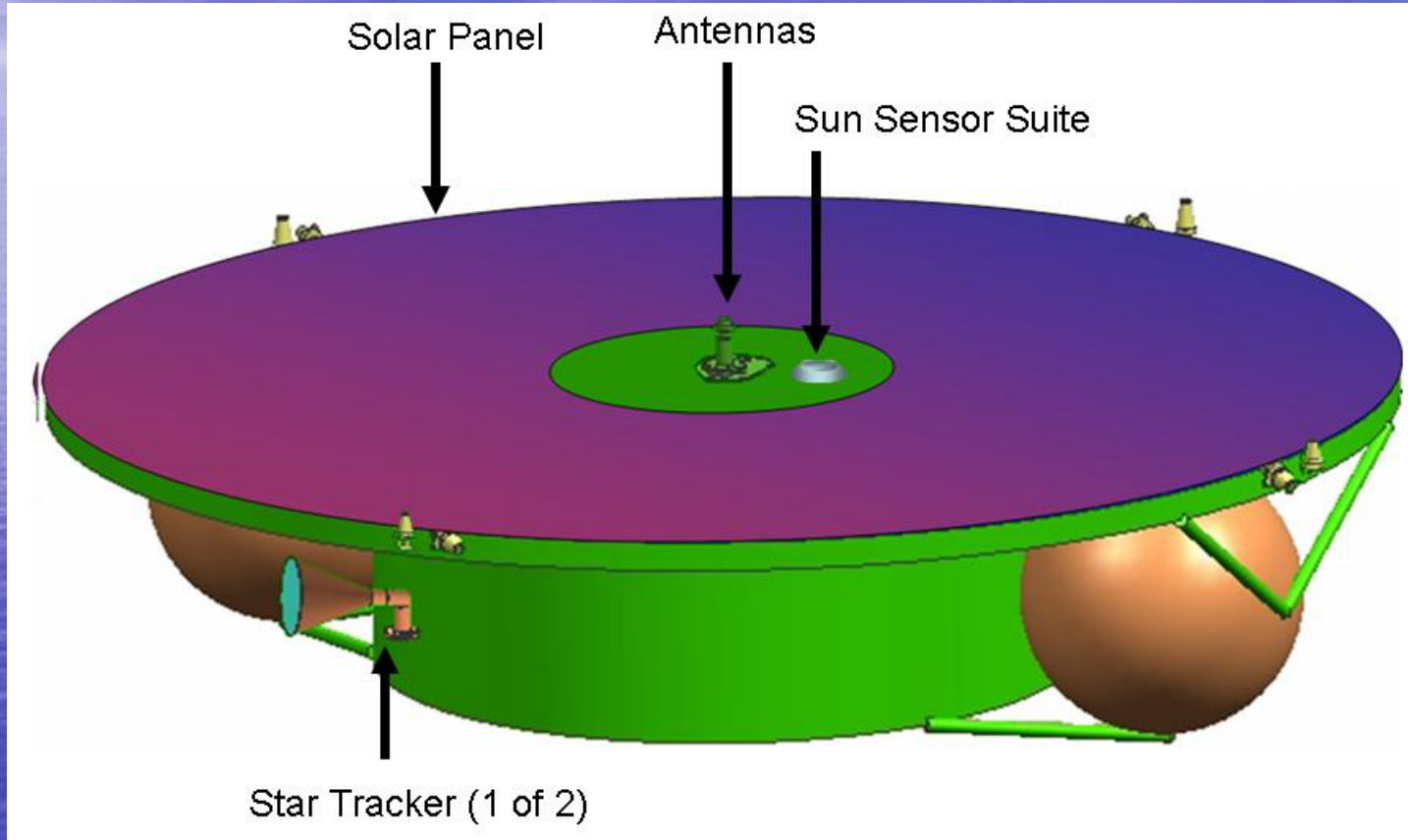
Launch Configuration



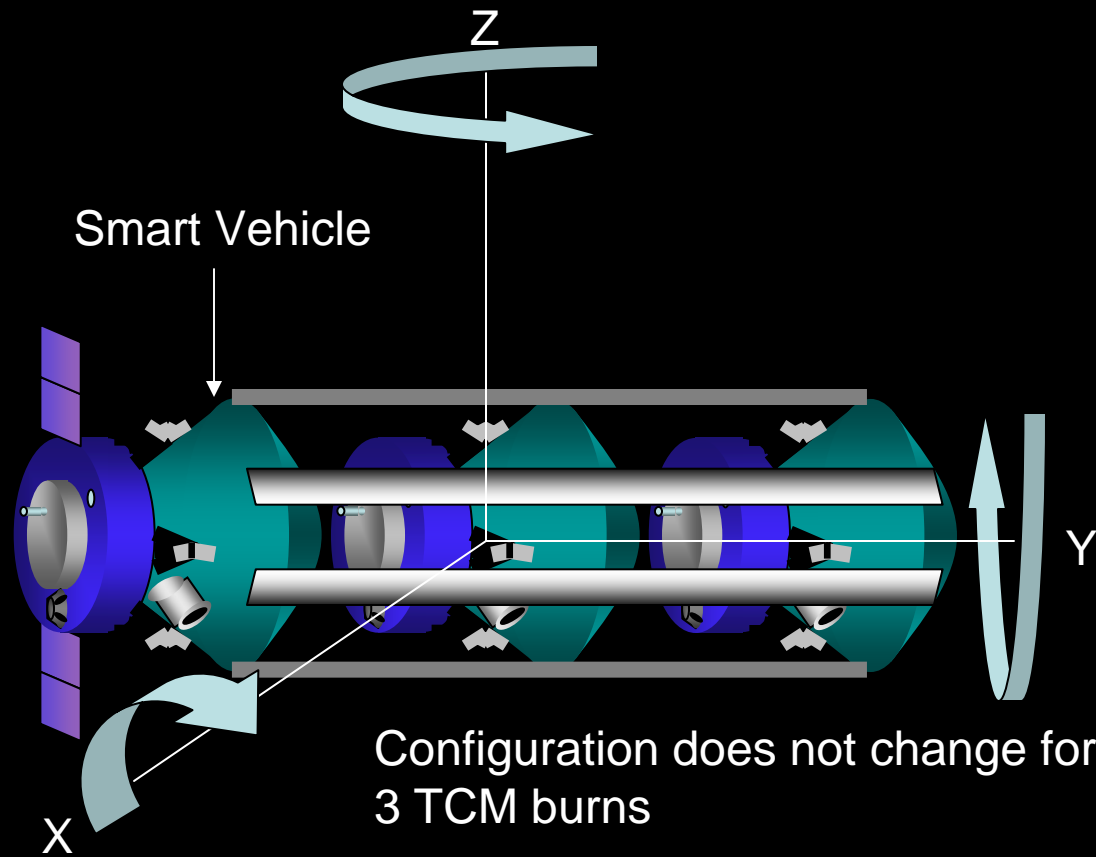
Cruise Configuration



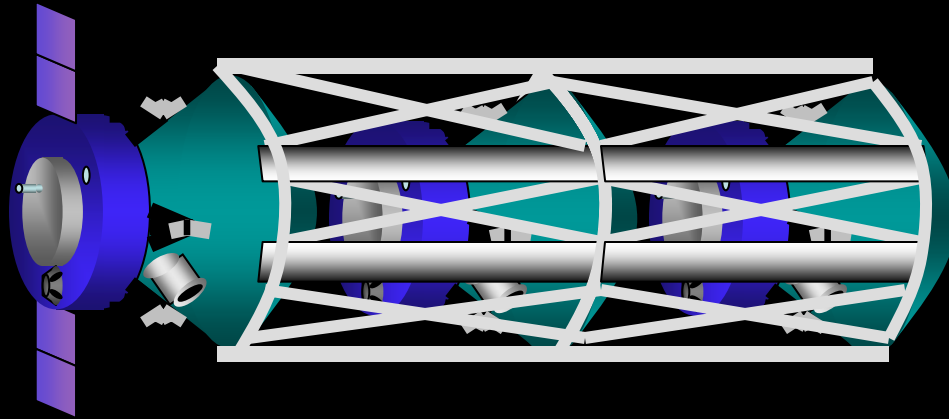
Cruise Configuration



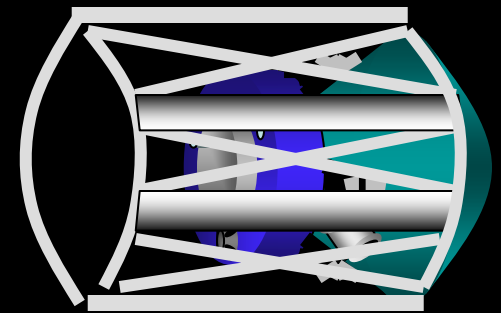
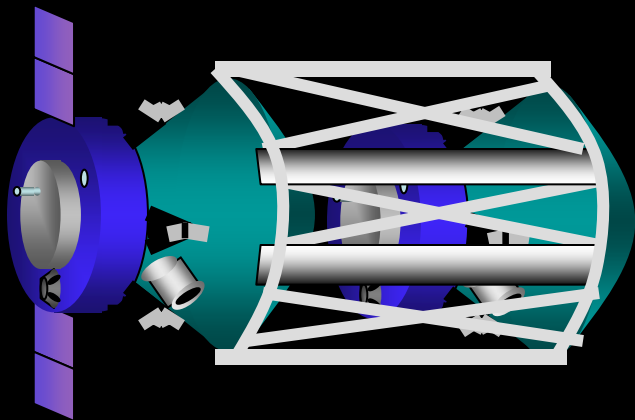
ACS Cruise Configuration



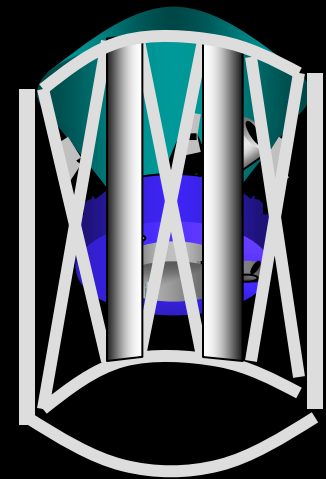
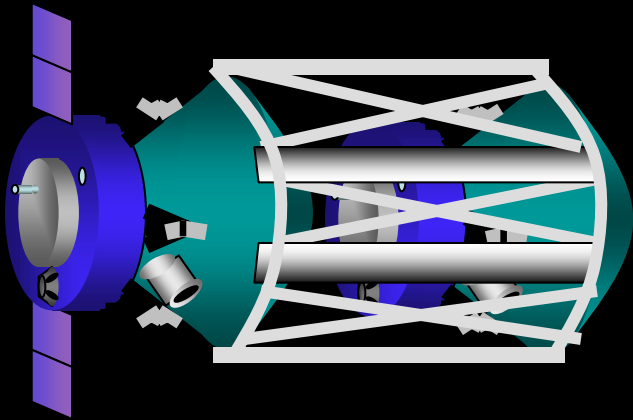
Cruise Separation



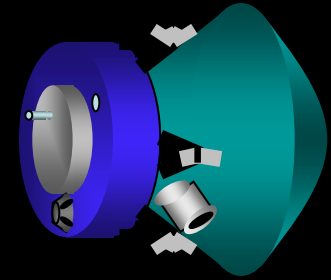
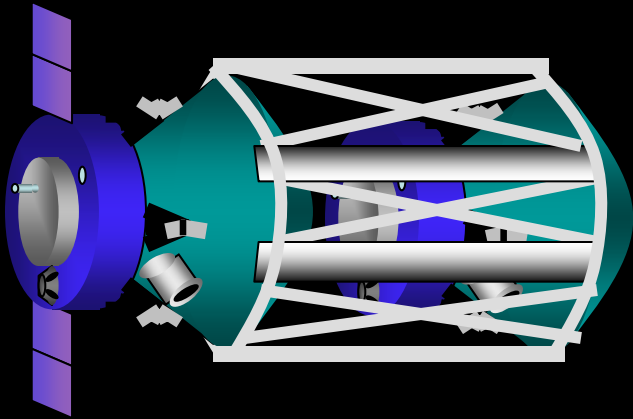
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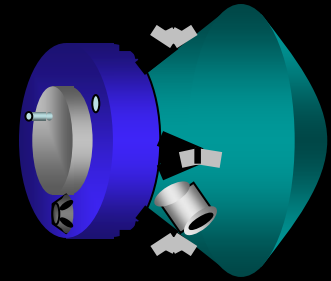
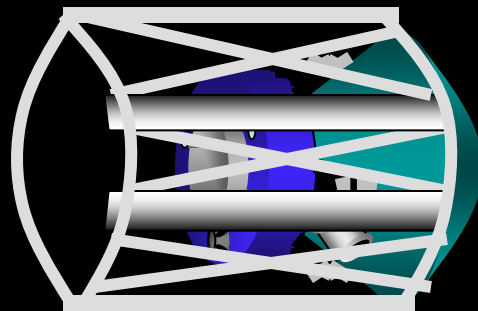
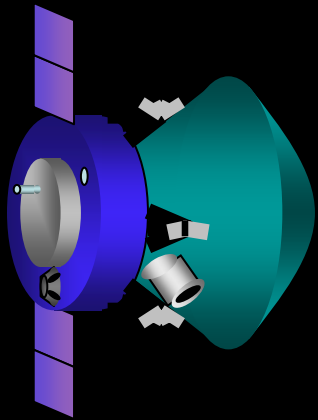
Cruise Separation



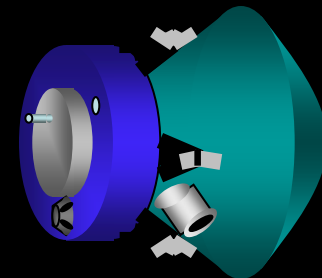
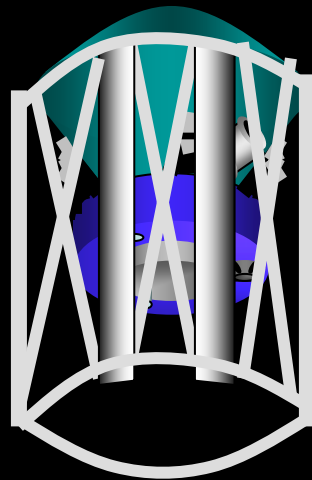
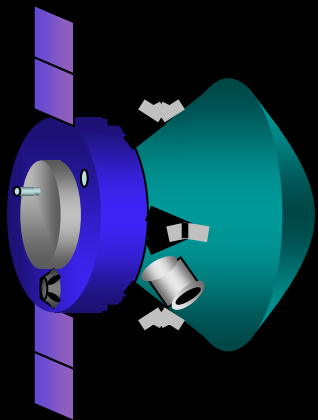
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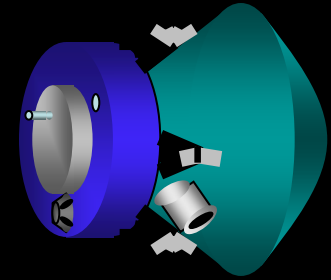
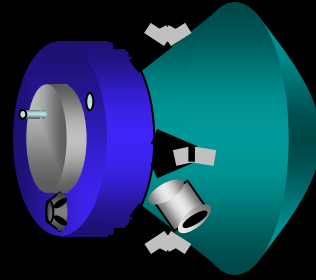
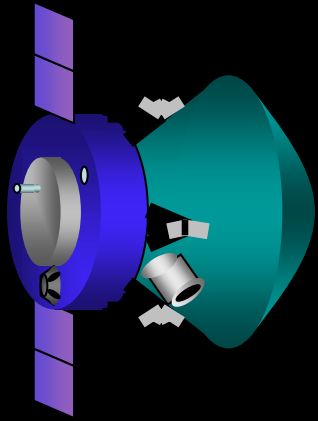
Cruise Separation



Cruise Separation



Cruise Separation



ACS Instruments

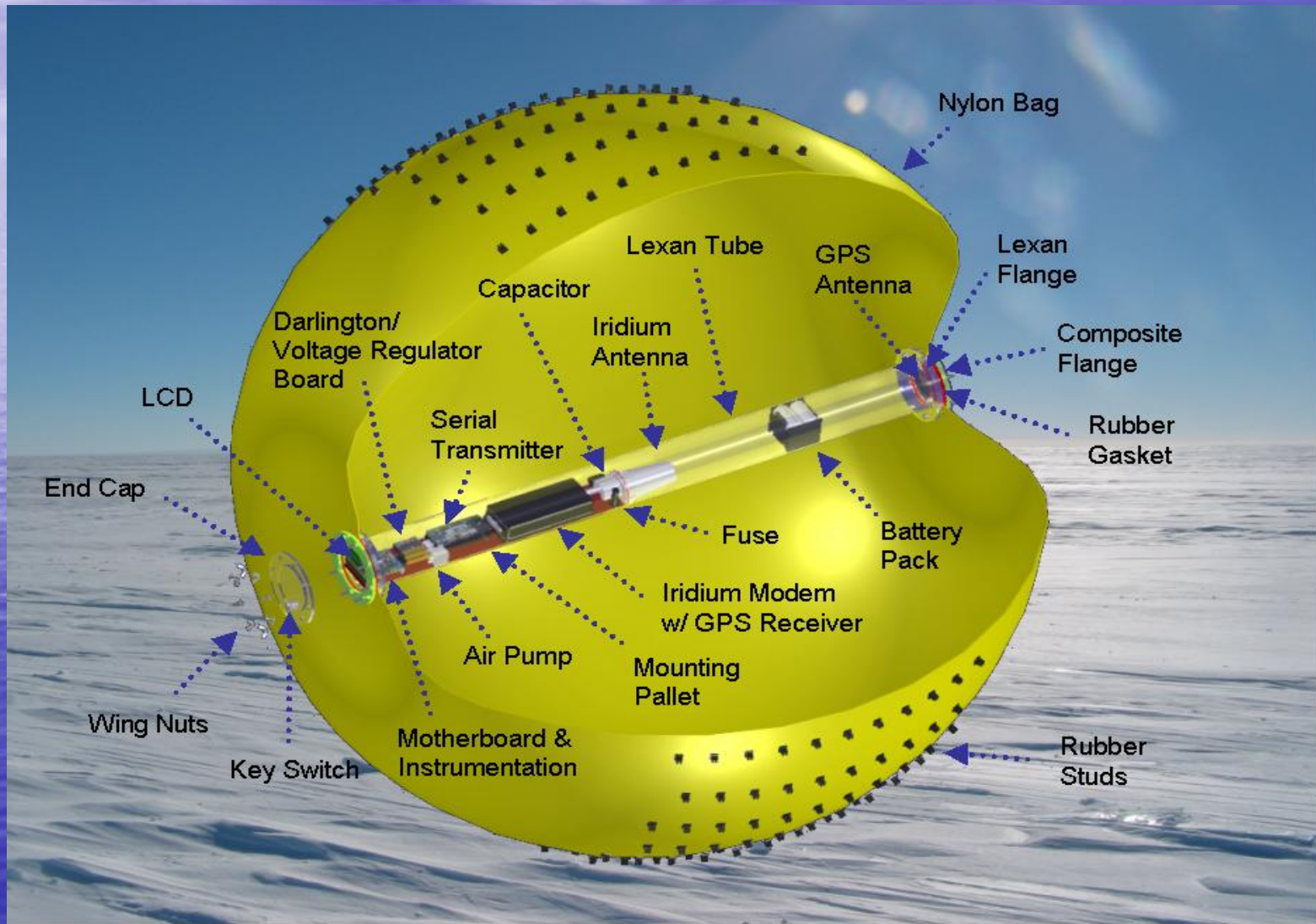
Current Technology

Instrument	quantity	Type	Mass (kg)	Power (W)	Volume (cm)	TRL
Star Tracker	2	Ball CT-633	2.50	9.00	13.5 DIA x 14.2	7.00
Sun Sensor	8.00	Adcole	0.04	0.02	4.23 x 4.23 x 5.51	7.00
MIMU	2.00	Honeywell MIMU	4.70	32.00	7203 cm ³	7.00
Radar Altimeter	1.00	HG9550	4.5	35	8.89 x16 x 22	7
		total/craft	19.22	117.16		
		overall total	57.66	351.48		

Upcoming Technology

Instrument	quantity	Type	Mass (kg)	Power(W)	Volume (cm)	TRL
Star Tracker	2	JPL APS	0.042	0.07	4.23 x 4.23 x 5.51	4
Sun Sensor	8	JPL Micro	0.008	0.025	1.7 x 1.2 x .4	3
IMU	2	HG1940	0.50	1.95	32.77 cc	3.00
Radar Altimeter	1.00	HG9550	4.5	35	8.89 x16 x 22	7
		total/craft	5.65	39.24		
		overall total	16.94	117.72		

SPHERE Lander Configuration



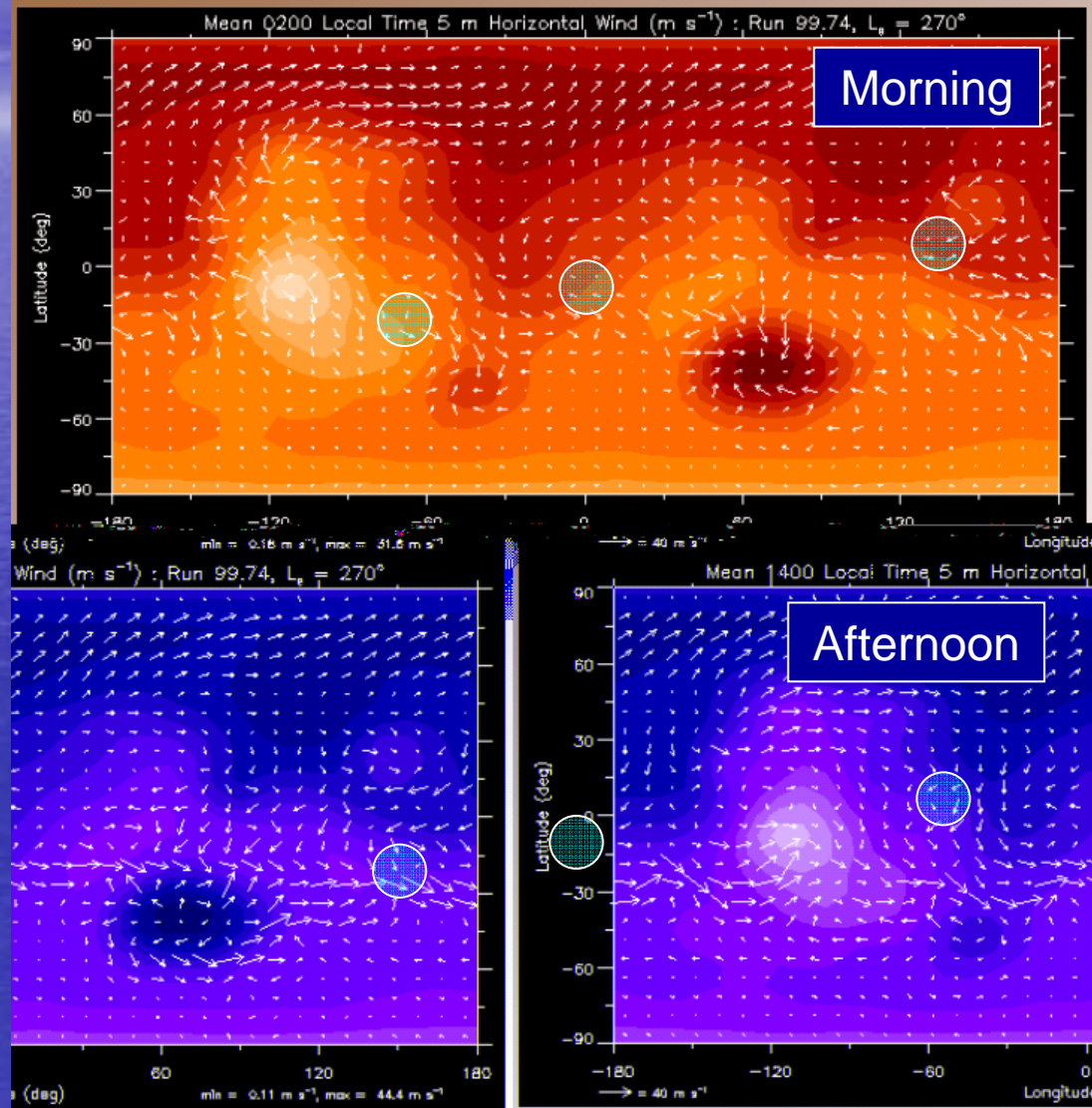
Global Wind Patterns, $L_s=270$

Mars General Wind:

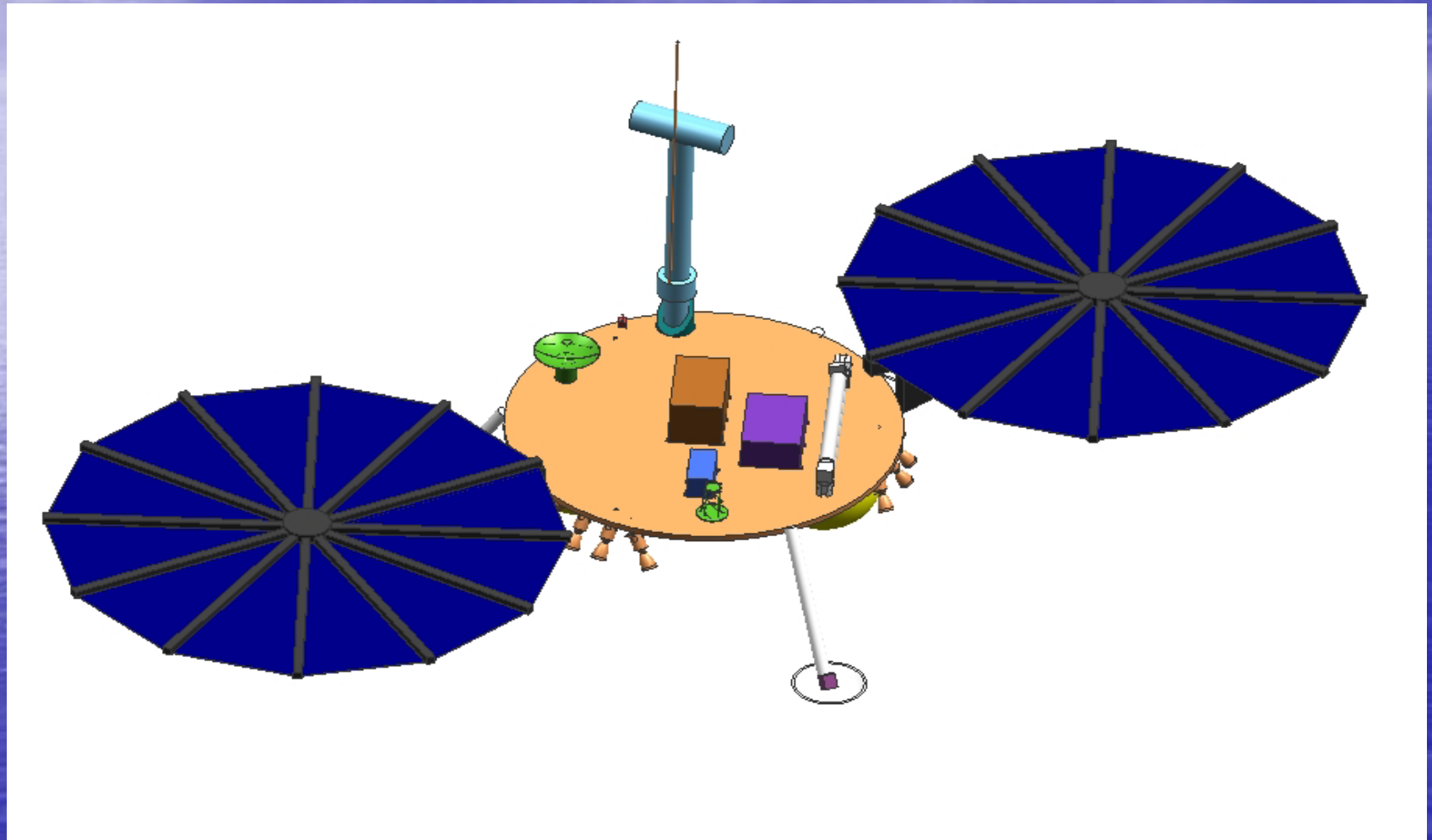
Ave: 2-7 m/s

Gusts: 10-20 m/s

Dust Storm: 25 m/s



EMPHASIS Lander Configuration



Summary

- Both mission studies were presented to JPL management
- Each mission study was documented in a report
- Cost analysis was performed by Team-X for both missions
- Both missions are now being considered for flight