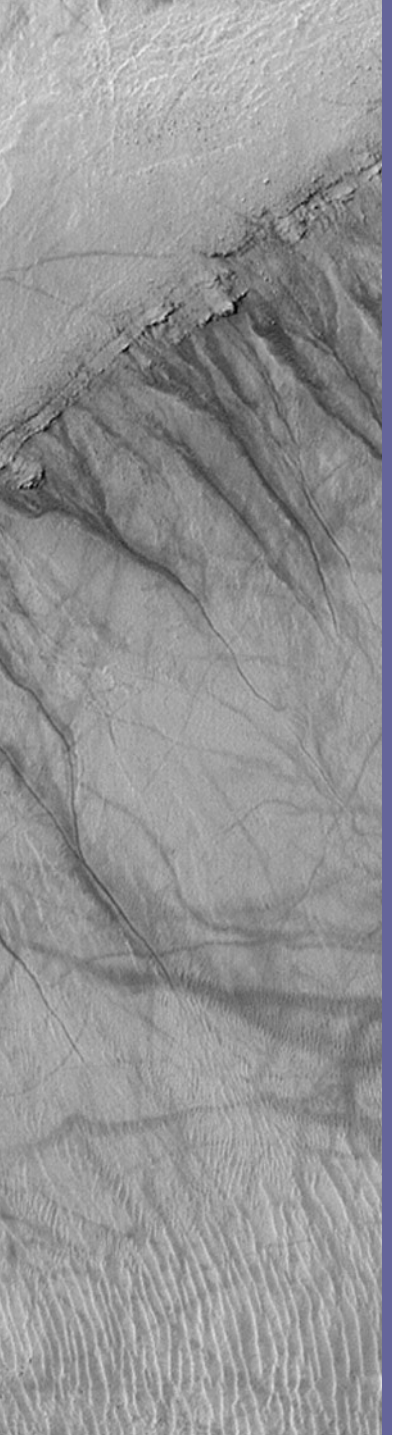


Mars Science Laboratory

Flight Computer Needs

RAD750 Workshop

Joe Snyder

June 6-7, 2005

Outline

- Mission Overview
- Science Instruments
- Flight System
- Anticipated Basic Requirements
- Possible Requirements
- Anticipated Procurement Timeline

Mission Overview

- Overall MSL science objective:
  - Explore and quantitatively assess a local region on the Mars surface as a potential habitat for life, past or present
- Launch: August – November 2009
- Entry-Descent-Landing: August – December 2010
- Surface Operations: One Mars year = 687 Earth days
  - MER requirement was 90 days
- Launch in 2011 is under consideration

Science Investigations and Principal Investigators

- **Mars Science Laboratory Mast Camera**
  - Michael Malin, Malin Space Science Systems. Multi-spectral, stereo imaging at lengths ranging from kilometers to centimeters, high-definition video.
- **ChemCam: Laser Induced Remote Sensing for Chemistry and Micro-Imaging**
  - Roger Weins, Los Alamos National Laboratory. Ablate surface coatings from materials at standoff distances of up to 10 meters and measure elemental composition of underlying rocks and soils.
- **Mahli: Mars HandLens Imager**
  - Kenneth Edgett, Malin Space Science Systems. Image rocks, soil, frost and ice at resolutions 2.4 times better, and with a wider field of view, than the Microscopic Imager on the Mars Exploration Rovers.
- **Alpha-Particle-X-ray-Spectrometer**
  - Ralf Gellert, Max-Planck-Institute for Chemistry, Germany. Determine elemental abundance of rocks and soil.

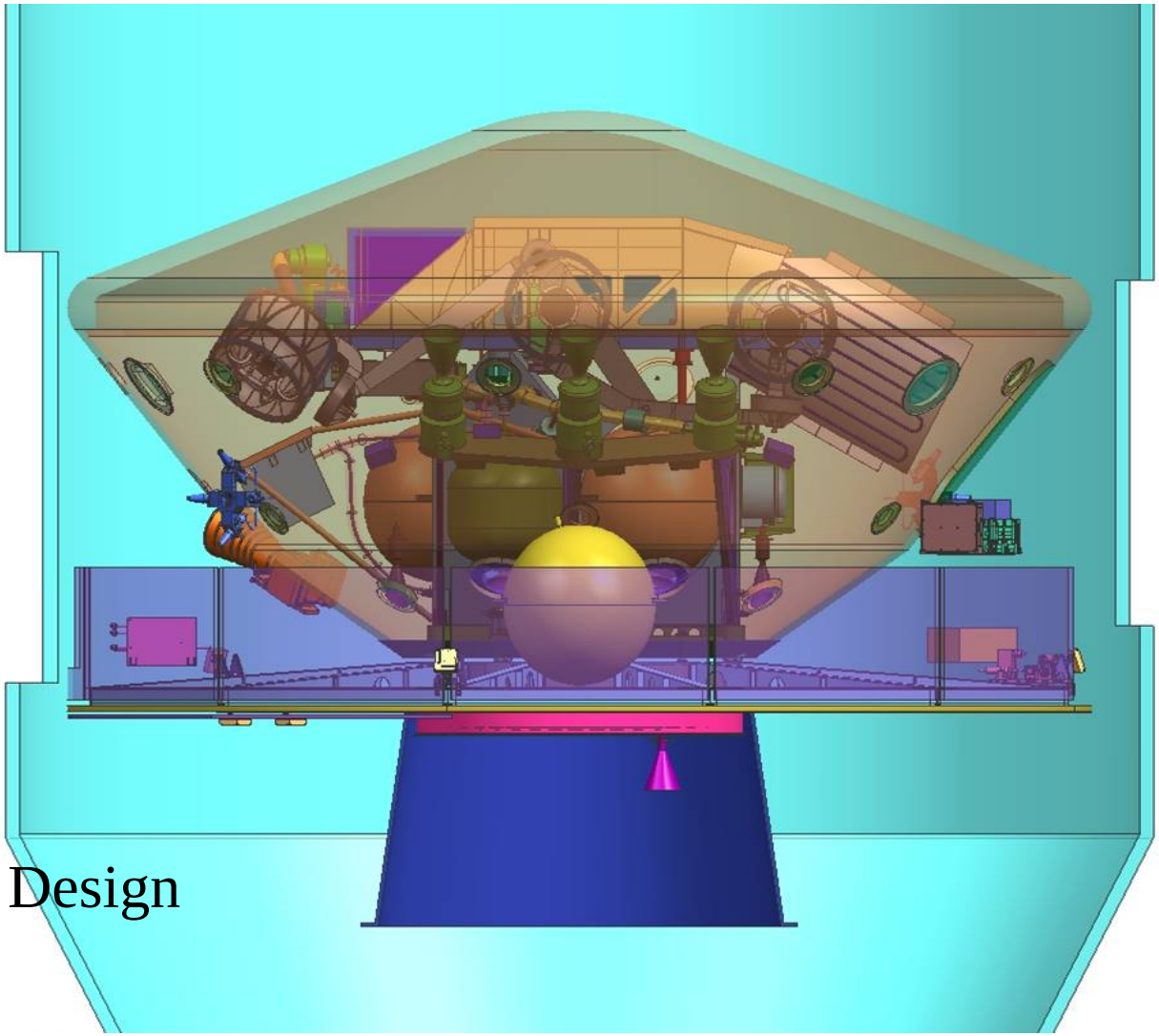
Science Investigations and Principal Investigators

- **CheMin: X-ray Diffraction/X-ray Fluorescence instrument for definitive mineralogical analysis**
  - David Blake, NASA's Ames Research Center. Identify and quantify all minerals in complex natural samples such as basalts, evaporites and soils.
- **Radiation Assessment Detector**
  - Donald Hassler, Southwest Research Institute. Characterize the broad spectrum of radiation at the surface of Mars, an essential precursor to human exploration of the planet.
- **Mars Descent Imager**
  - Michael Malin, Malin Space Science Systems. Produce high-resolution color-video imagery of the descent and landing phase, providing geological context information, and allowing for precise landing-site determination.

Science Investigations and Principal Investigators

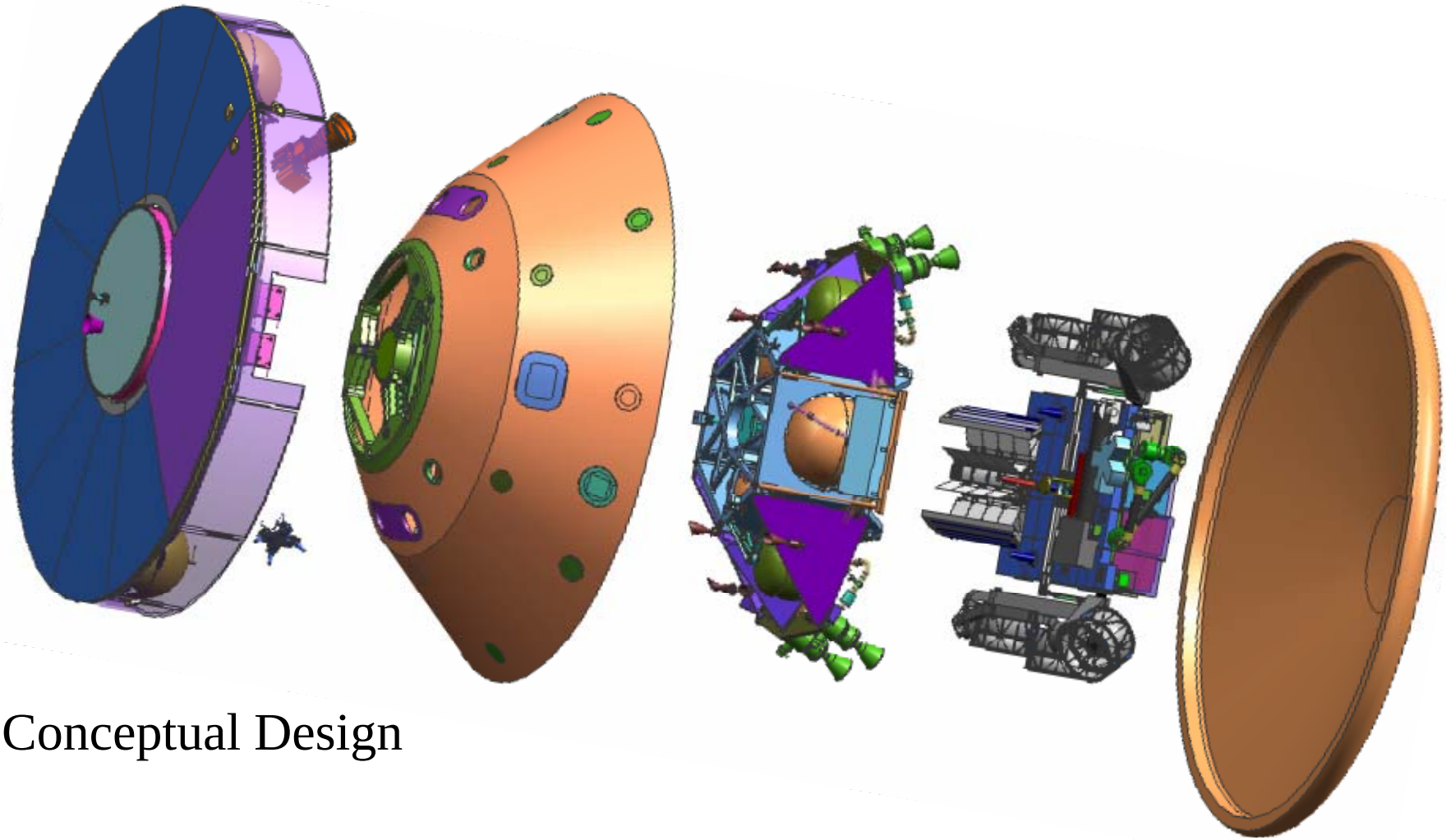
- **Sample Analysis at Mars with an integrated suite consisting of a gas chromatograph mass spectrometer, and a tunable laser spectrometer**
  - Paul Mahaffy, NASA Goddard Space Flight Center. Perform mineral and atmospheric analyses, detect a wide range of organic compounds and perform stable isotope analyses of organics and noble gases.
- **REMS: Rover Environmental Monitoring Station**
  - Luis Vázquez, Centro de Astrobiología (CSIC-INTA), Spain.

Launch Configuration



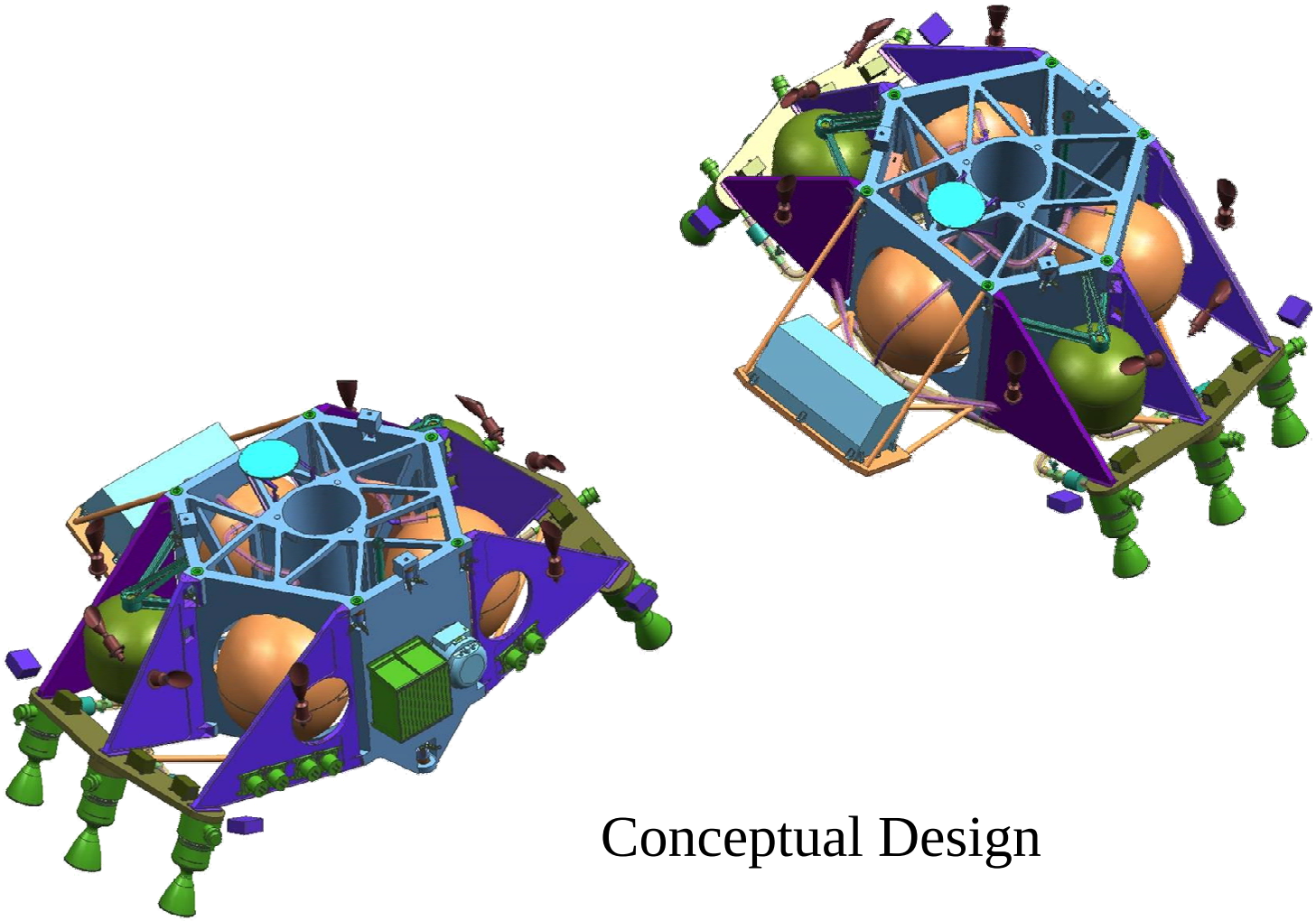
Conceptual Design

S/C Exploded



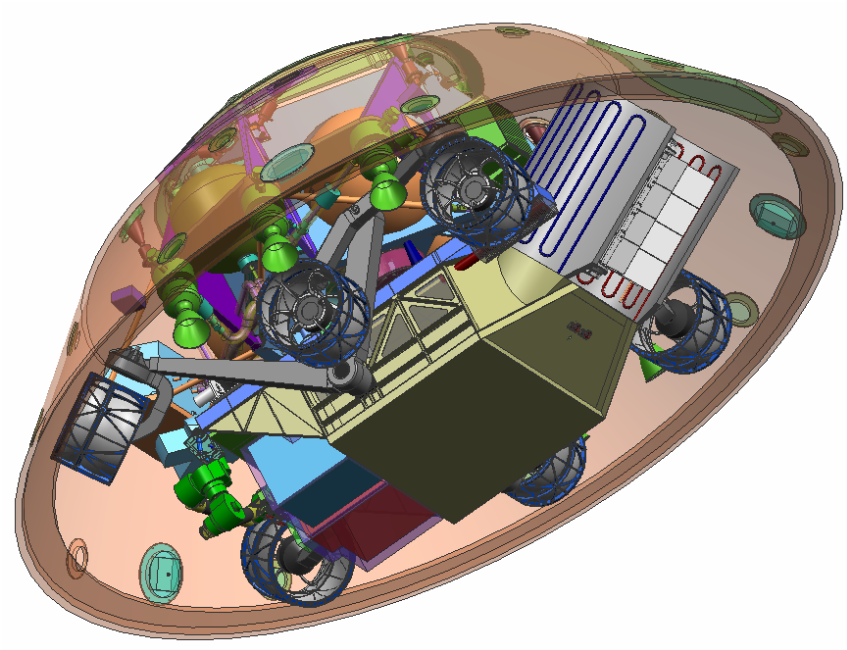
Conceptual Design

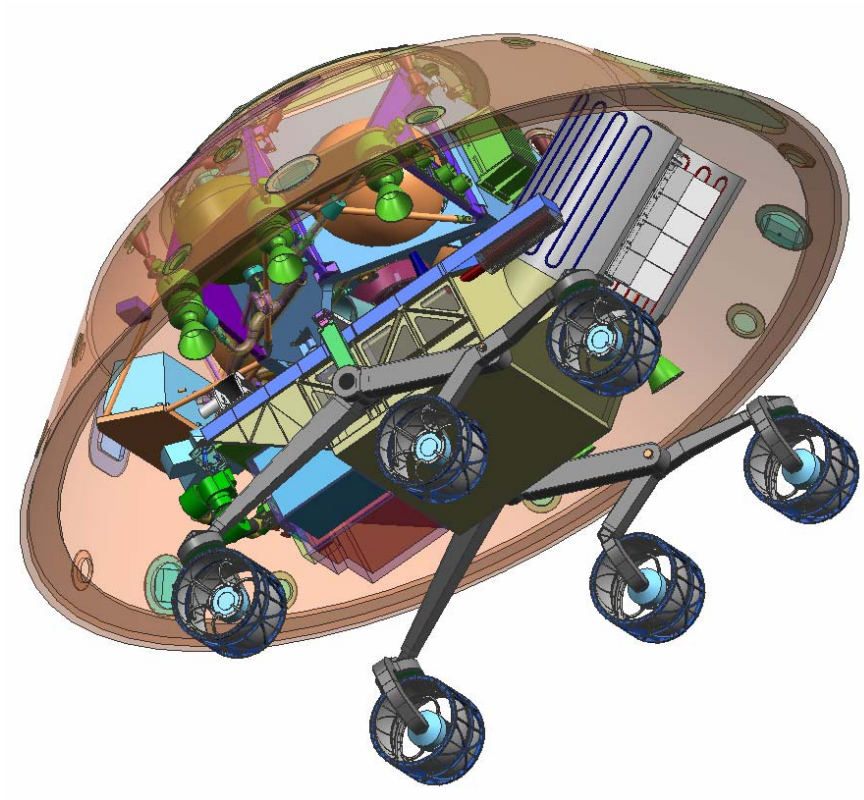
Descent Stage



Conceptual Design

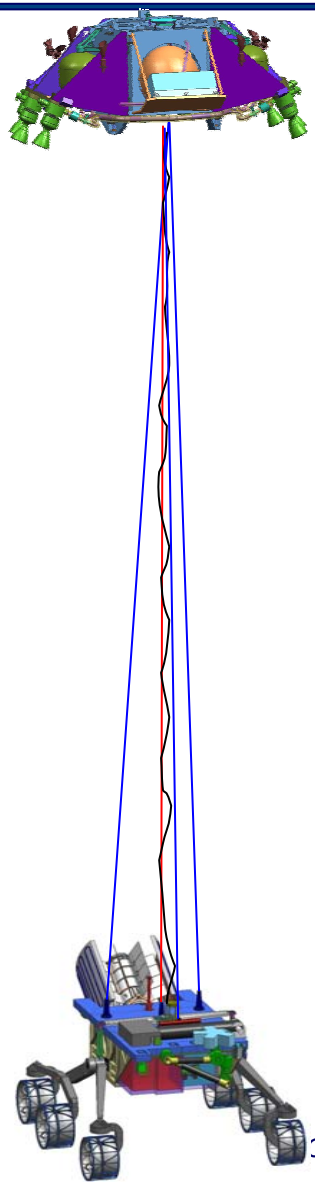
Under Chute Stowed/Deployed

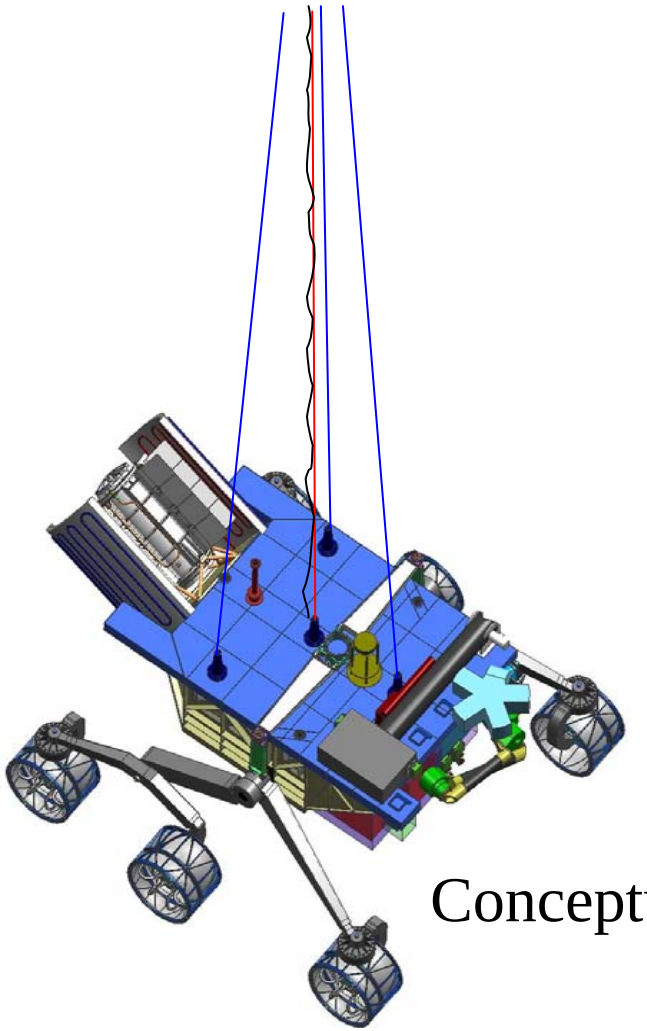




Conceptual Design

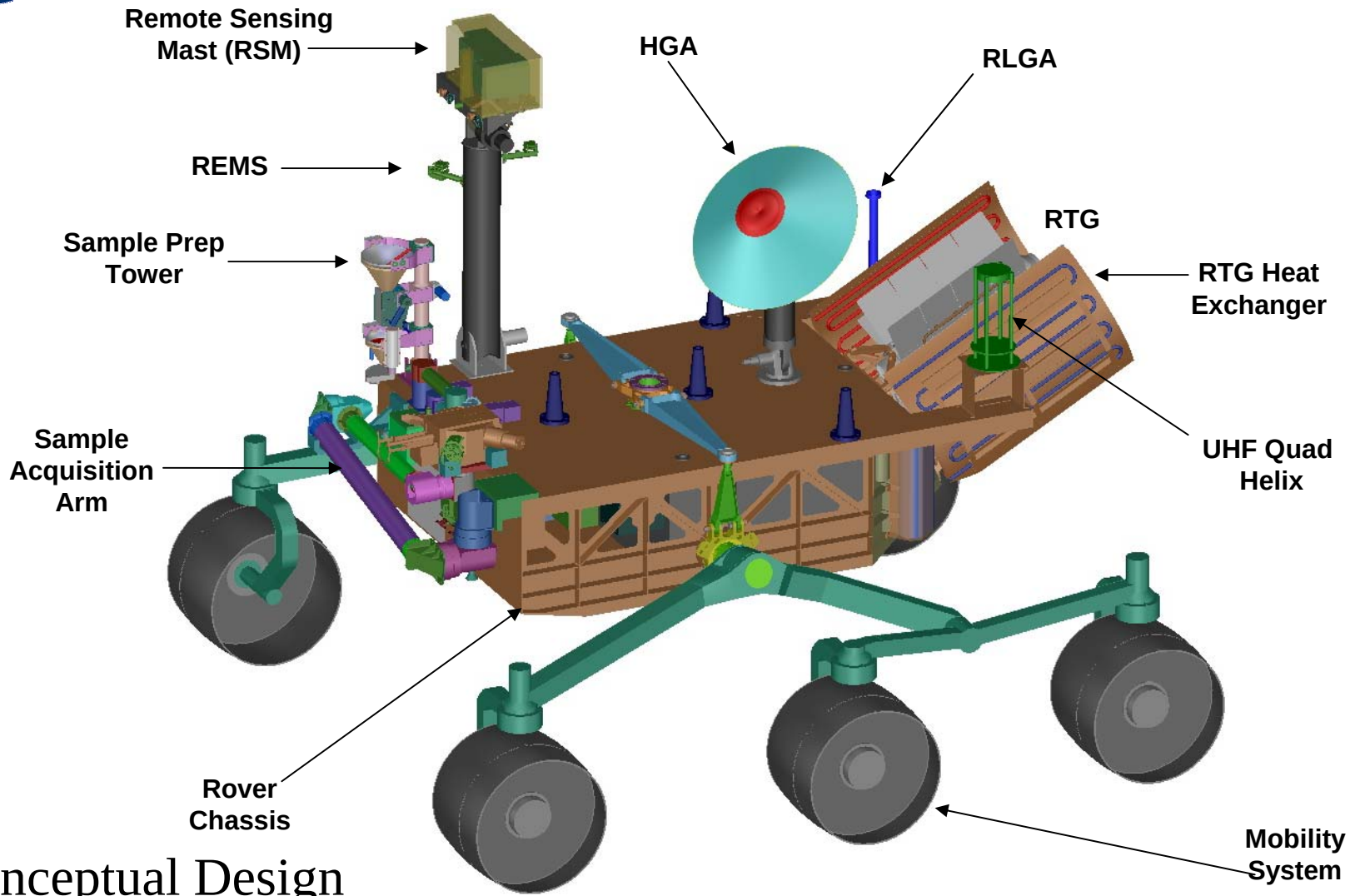
DRL & Bridle Subsystem Components





Conceptual Design

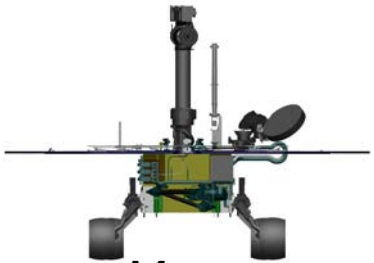
Isometric View



Conceptual Design

Rover Evolution

S



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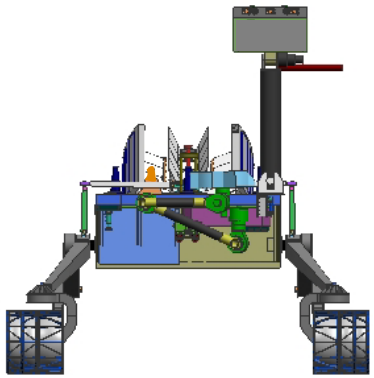
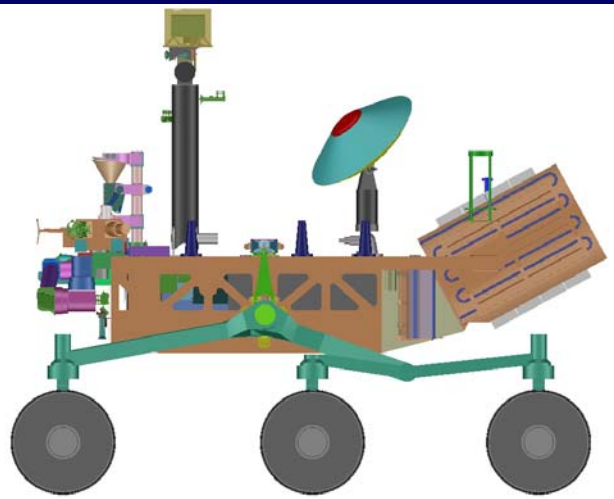


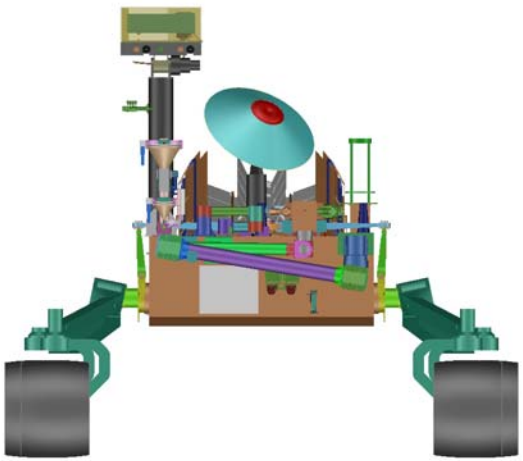
M

Conceptual Design

Rover Size Comparison



JPL 2009 MSL Rover



Flight Computer on MSL

- Flight System has two “Compute Elements”
  - Descent CE
    - Cruise Operations
    - Entry-Descent-Landing (EDL) Operations
  - Rover CE
    - Mars Surface Operations
    - “Background” activities during Cruise and EDL
  - Anticipate one flight computer board in each CE
    - Assuming same type computer board in each CE
- Flight computer is not yet selected

Anticipated Basic Requirements

- CompactPCI Interface
  - 3.3 V
  - 33 MHz
- Form Factor: 6U or smaller
- Compute Element Assembly Temperature
  - Design/Qual: -35 to +75 C
  - Flight Acceptance: -25 to +55 C
- Radiation: TBD
- Parts Program: Class S or equivalent

Desired Capabilities

- MSL has not fully elaborated the requirements in the following areas. The following partial list encompasses desired flight computer capabilities
  - 512 MBytes EDAC protected DRAM
    - Support multiple instrument data streams, large dataset manipulation, and staging of science/eng telemetry before telecom sessions
  - 32 Mbytes EEPROM (or other onboard non-volatile memory)
    - Support storage of multiple Software Images and Critical Parameter Storage
  - 200 MIPS Processor Speed (“real world” performance)
    - Support multiple threads while meeting critical real time deadlines
  - Protected Boot Capability
    - Support for hardware selection among multiple boot images
  - Latest Board Support Package
    - VxWorks 6.0 or Integrity 5.0.4
  - 512 KBytes Level 2 Cache
  - 1 onboard DMA engine
  - Automatic DRAM Scrubbing
    - Minimize impact on Cache hits

Anticipated Acquisition Timeline

- NASA launch date decision expected [tbd]
- Selection process [tbd]
- PT delivery: 10/06 to 2/08 for 7 units
- Flight delivery: 10/07 to 4/08 for 5 units