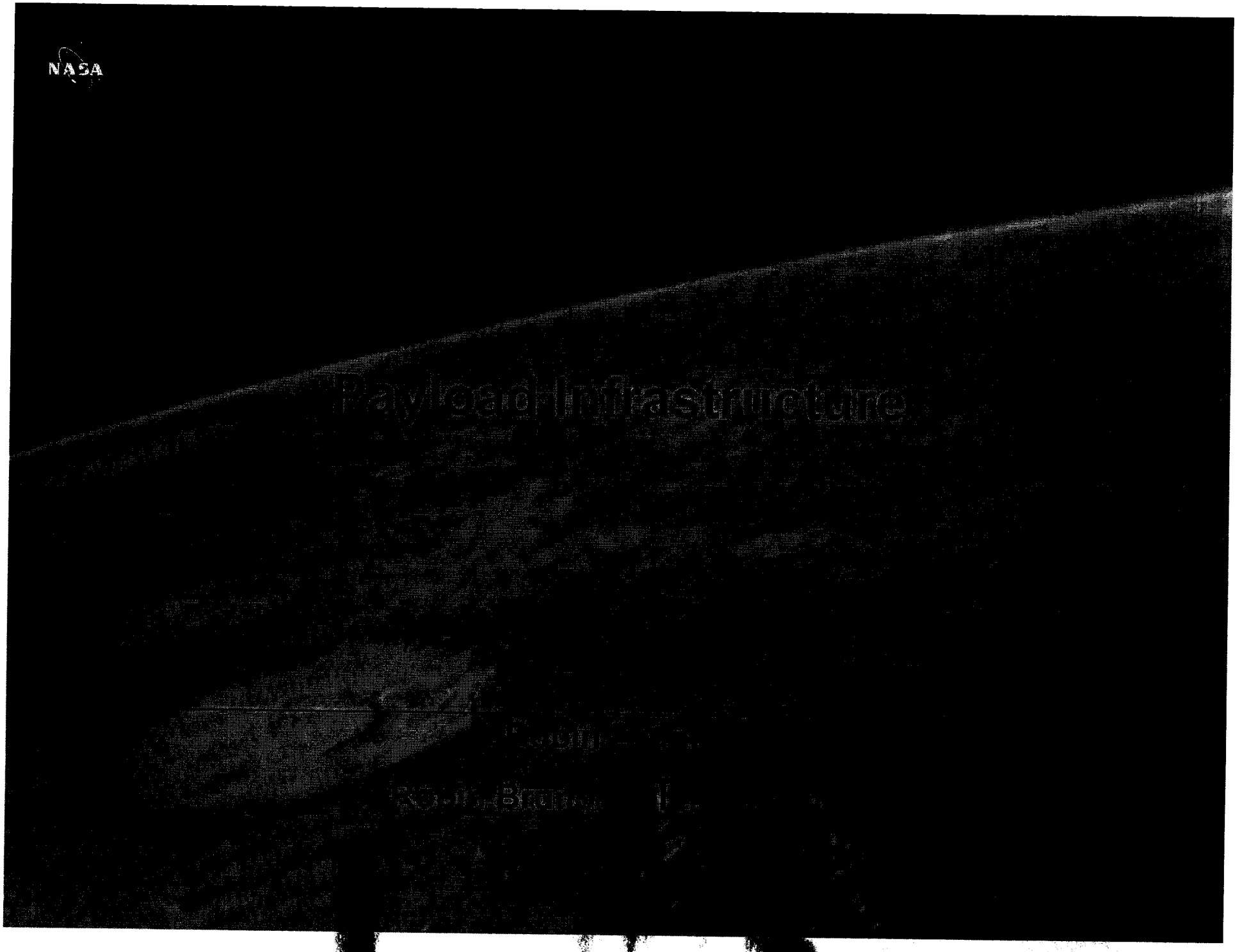
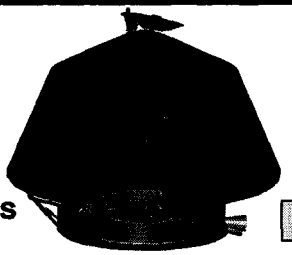
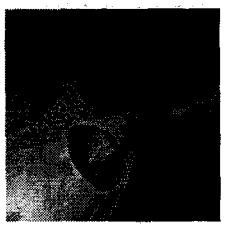

NASA
Payload Infrastructure

Mission Architecture



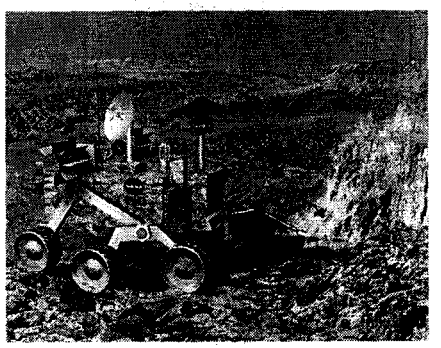
CRUISE/APPROACH
- Dumb cruise stage: uses rover avionics
- Type-I or II transfer
- 5-6 course corrections
- Optical nav for approach
- Separation @ entry – 10 min
- No carrier deflection
- Arrival Dates July – Oct 2010
- Latitude Capability 60 deg S to 83 deg N

ENTRY/DESCENT/LANDING
- Guided entry, 2 parachutes and Viking Engines for descent
- Pallet or Sky-Crane landing system
- Comm provided by UHF link to orbiting asset and/or DTE X-band
- EDL data used for science
- Regional Hazard Detection & Avoidance using Phased Array Terrain Radar
- No Sun/Earth elevation constraints yet
- Arrival prohibited within +/- 30 days of solar conjunction
- Altitude Capability: <2.5km

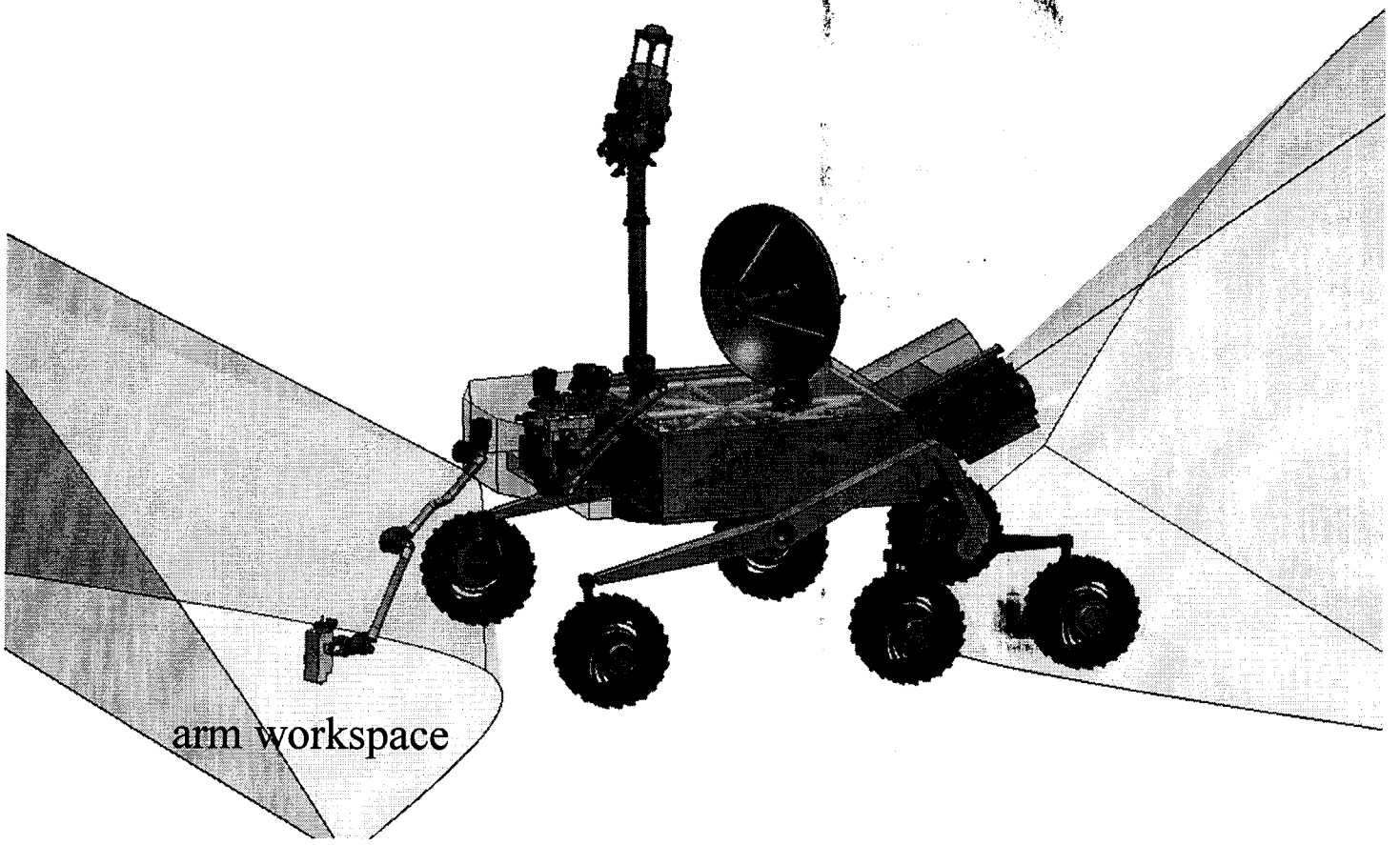


LAUNCH
- October 2009
- Delta IV/ATLAS V
- 5-m fairing

SURFACE MISSION
- 600-900 kg rover
- 500 Sol lifetime
- 3-5 km mobility
- 75 kg science payload
- Radioisotope Power Source
- Surface Avionics used for all 3 mission phases



MSL Rover Configuration – Preliminary



Arm workspace is defined by the Hazcam pair overlapping field of view. Hazcams are mounted ~1.0 m above the ground, 10 cm apart, oriented 30 degrees down from the rover plane, 120 degree field of view

Strawman Payload

PSIG Strawman Payload Instruments and Infrastructure

Analytical Lab (Sample Inlets)

- 3-4 instruments

Contact Suite (arm mounted)

- 2-3 instruments

Mast Mounted Instruments

- Science cameras
- Spectrometer

PSIG Strawman Payload Infrastructure Elements

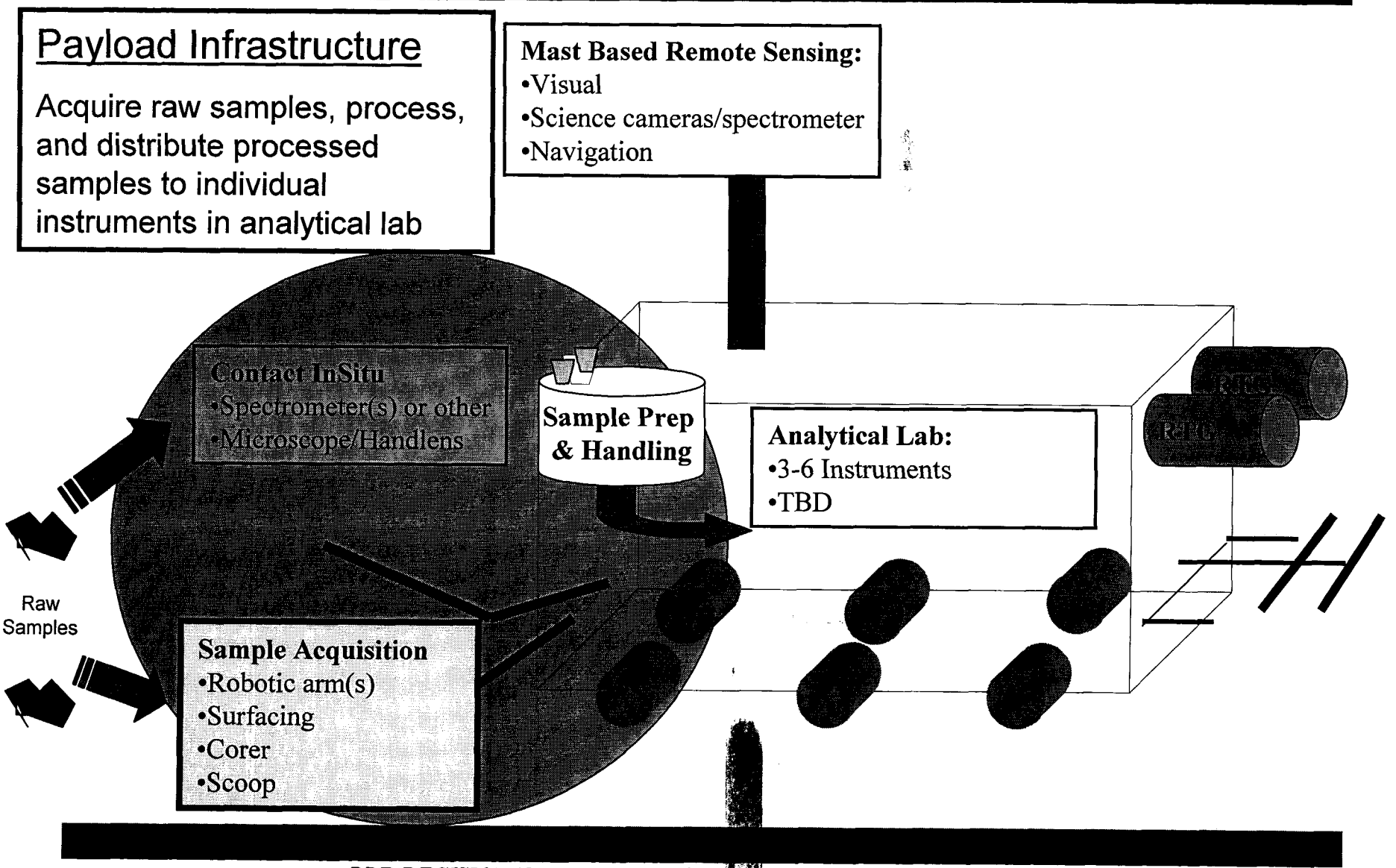
- **Primary Arm – 5 DOF**
  - **Surface Abrasion Tool**
  - **Corer**
  - *Science contact instrument*
- **Secondary Arm – 5 DOF**
  - **Scoop**
  - *Science contact instrument*
- **Sample Processing and Distribution**

RFI elements

Mast Instrument Elevation Platform

- NavCam
- *Science cameras*
- *Spectrometer*
- UHF antenna
- Fish Eye Camera

Context Sketch – PSIG Strawman Payload



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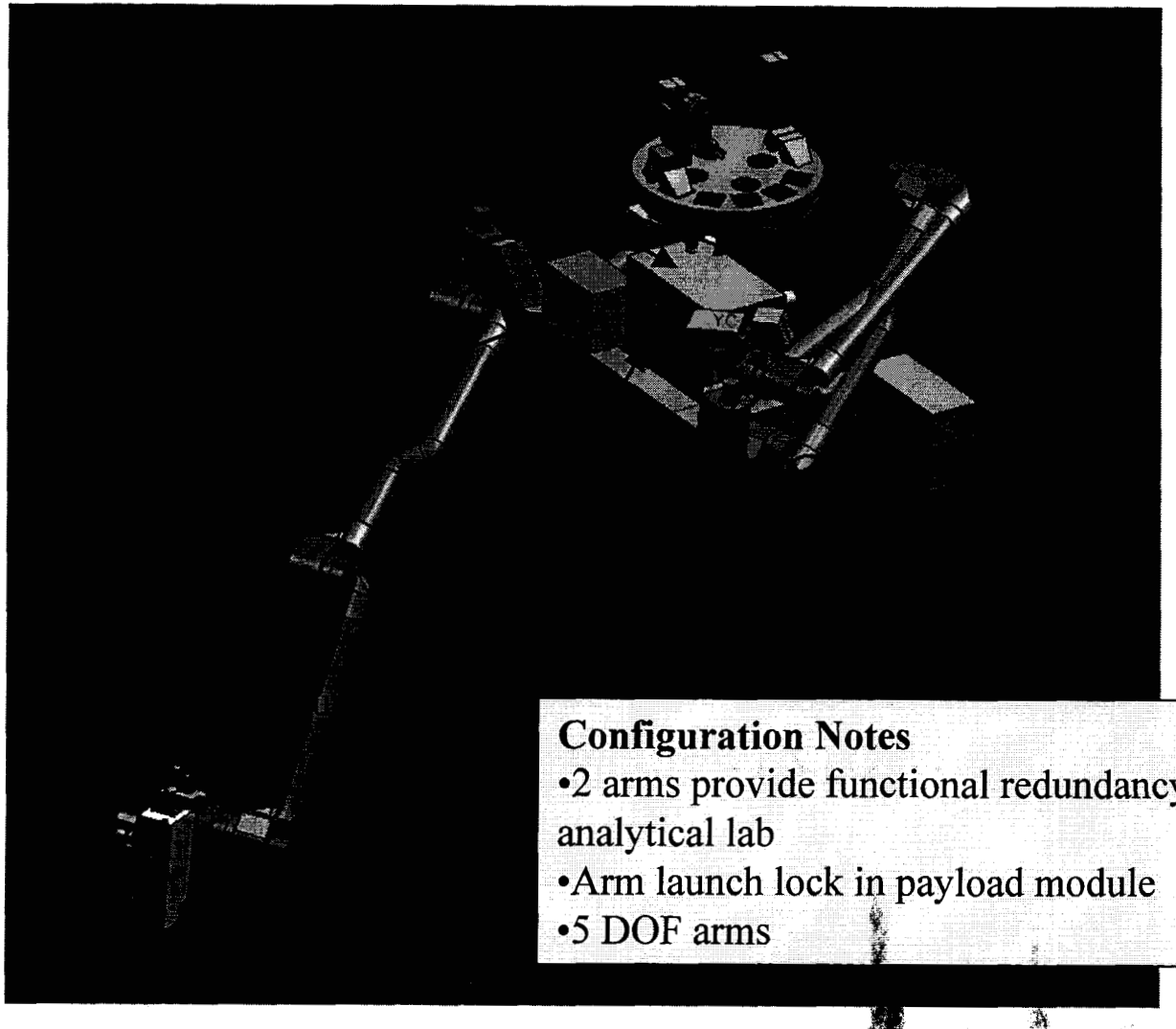
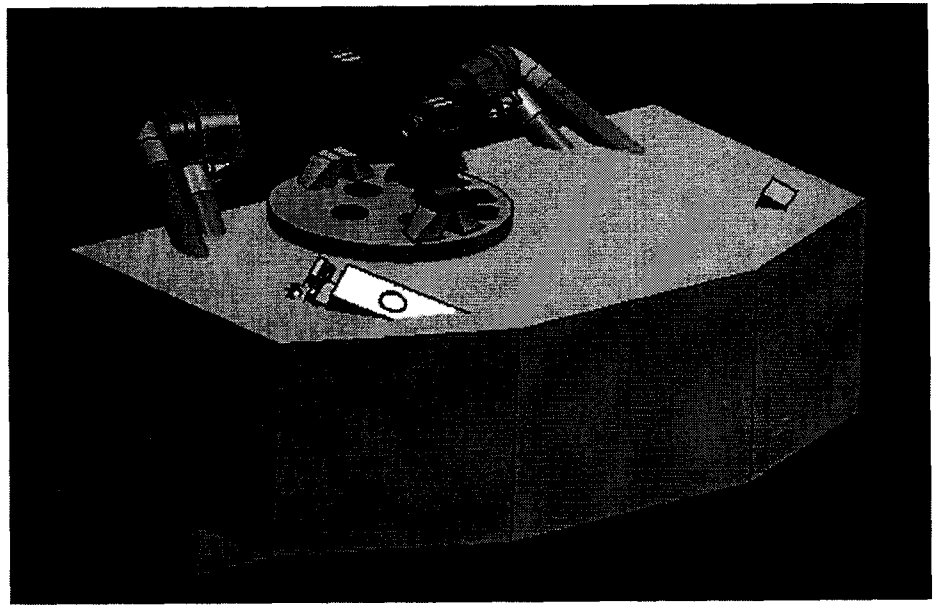
Strawman Configuration

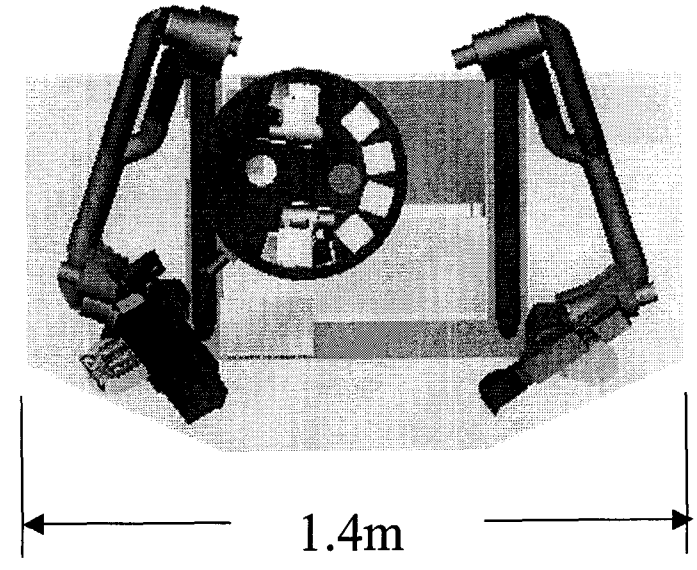


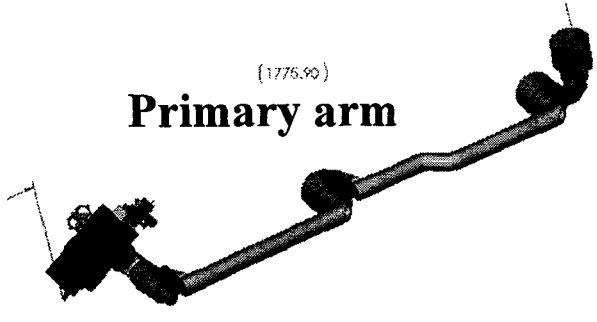
Configuration Notes

- 2 arms provide functional redundancy for sample delivery to the analytical lab
- Arm launch lock in payload module
- 5 DOF arms

Payload Volume







	MSL
Aft Arm length, mm	760
Fore Arm length, mm	634
Maximum Reach*, mm	1776

Arm Mechanisms

- Electronics, motors, backdrive brakes & initial gear stages from the JPL Motor Technology Development task
- Final gear stages, output bearings, main structure, stops, output resolver, launch lock systems (except actual actuation device), mobilization locks, seals and cable management systems will be developed by the arm activity
  - General arm concept, mechanism design methodology and test methods to be common across all joints, launch locks and the overall arms
  - At least one arm will be able to pass coax and/or large diameter optical fiber
  - Final gear stages or stage will have high load anti-backlash features
- Similarity of arms will allow software and control methods developed for one arm to be used on the other.

Example Sample Acquisition, Processing, and Distribution Scenario

Identified Target

Contact Suite Placement, in situ
Place secondary arm
Contact suite evaluation
Stow secondary arm
Place primary arm
Contact suite evaluation
Science Decision Point
Surface Abrasion
Contact suite evaluation
Stow primary arm
Place secondary arm
Contact suite evaluation
Science Decision Point

Sample Acquisition - Coring
Stow secondary arm
Place primary arm
Core Acquistion
Transfer core to triage area
Contact suite evaluation
Stow primary arm
Place secondary arm
Contact suite evaluation
Stow secondary arm
Science Decision Point

Infrastructure Maintenance

Bit Changeout

Clean Surface abrasion device teeth

Close/Open dust covers

Sample Processing and Distribution
Deliver sample to rock crusher
Process sample
Particles >1 mm released to observation bin
Place primary arm
Contact suite evaluation
Stow primary arm
Place secondary arm
Contact suite evaluation
Science Decision Point
Stow secondary arm
Sample delivery to Instrument 1
Science Decision Point
Sample delivery to Instrument 2
Science Decision Point
•
•

Key Requirements - *Preliminary*

1. **> 45 Core samples 5-15 mm diam, 100 mm length**
2. **> 45 RAT operations, 50mm diam, 5mm depth**
   - Coring and abrading operations on materials with hardness and compressive strength of Basalt and softer
3. **> 11 Rock samples, 4-5 cm side**
4. **> 11 Regolith samples, 10-15 gms**
5. **Processed sample particles 5 gms of particles 1mm and less with ≥ 200 mg of particles < 50 μm**
6. **Sample temperature maintained at ≤ surface ambient + 5 °C or at its temperature prior to extraction + 20 °C**
7. **Sample acquisition and processing at up to 20 ° rover tilt**
8. **Arm placement accuracy ≤ 1cm**
9. **Arm placement within Hazcam workspace and to the payload module sample evaluation/processing area.**
10. **Cross contamination < 0.5% by mass – sample residue passed to the subsequent sample after cleaning steps are completed**
11. **System Power < 140 W continuous**
12. **Payload infrastructure Energy allocation < 400 average W-hrs per Sol**

Payload Infrastructure Key Attributes *Preliminary*

- Control and processing can be either centralized or distributed.
- Path planning to prevent collisions with rover and terrain.

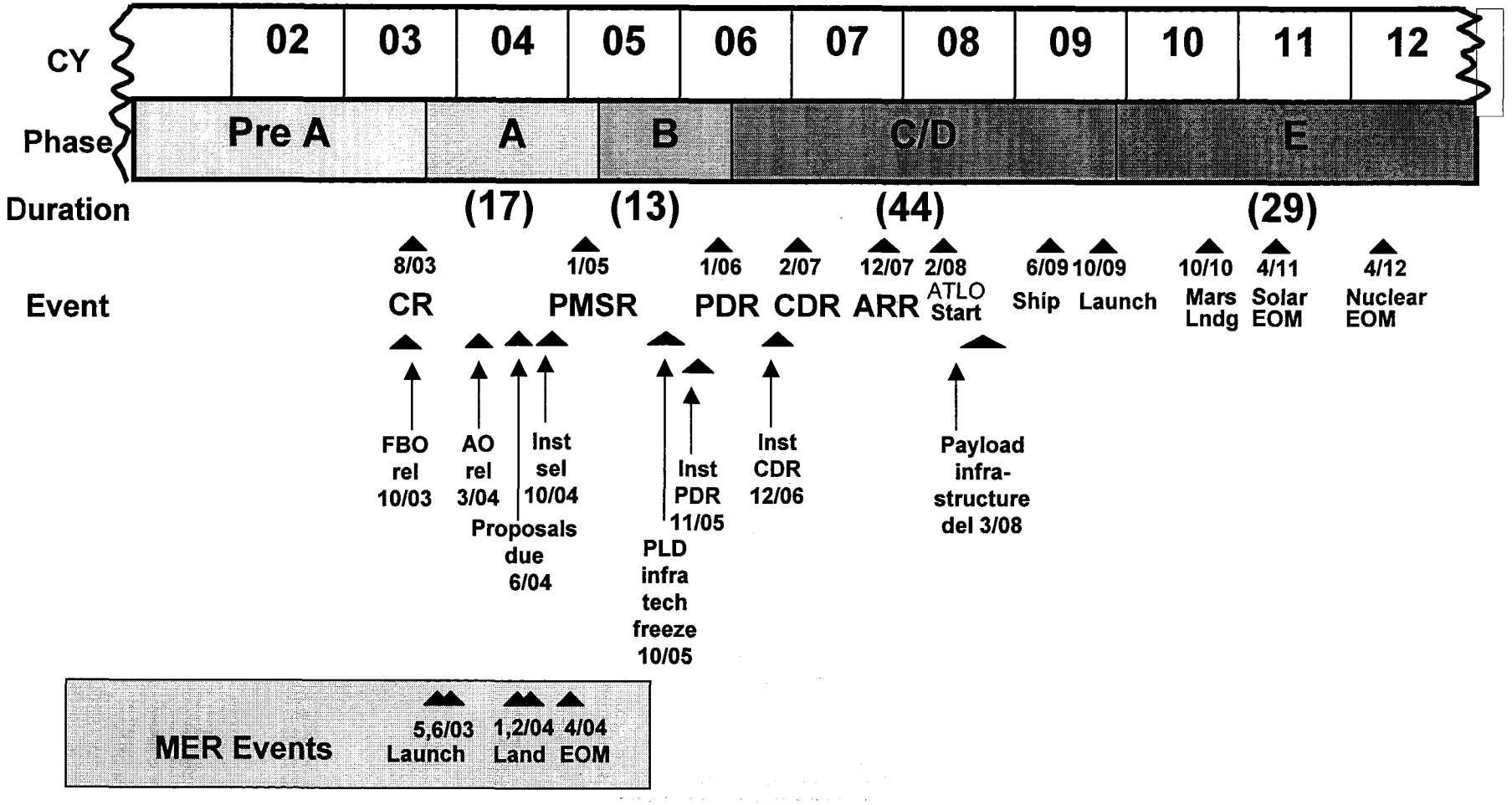
  The arm activities include path planning for arm placement to sample acquisition sites and to points on the payload module for evaluation or start of processing
- Automated arm activities within the defined workspace
- Control and limit contact forces between tools and instruments and the terrain.

  Sensors are required to monitor the contact forces during instrument observations and during sample acquisition.
- Capability to evaluate samples with the arm mounted (contact suite) instruments in up to four states

  1) at target identification, 2) after surface abrasion, 3) after coring, and 4) after processing.
- Capability to terminate the sample evaluation at different stages.

  Keep the ability to dispose of the sample at any point of the evaluation and processing sequence if the sample is determined to be of little interest.

MSL Project Master Schedule



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