
Lunar Precursor Robotics Program
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LPRP Program Description

The goal of the LPRP is to undertake robotic lunar exploration missions that will return data to advance our knowledge of the lunar environment and allow United States (US) exploration architecture objectives to be accomplished earlier and with less cost through application of robotic systems. LPRP will also reduce risk to crew and maximize crew efficiency by accomplishing tasks through precursor robotic missions, and by providing assistance to human explorers on the Moon.

Objectives

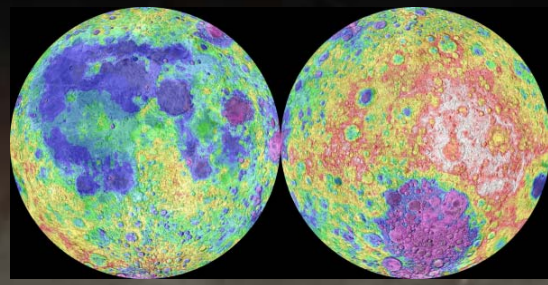
Starting no later than 2008, initiate robotic missions to the Moon to prepare and support future human exploration activities.

Customer

ESMD Advanced Capabilities Division
Constellation Program

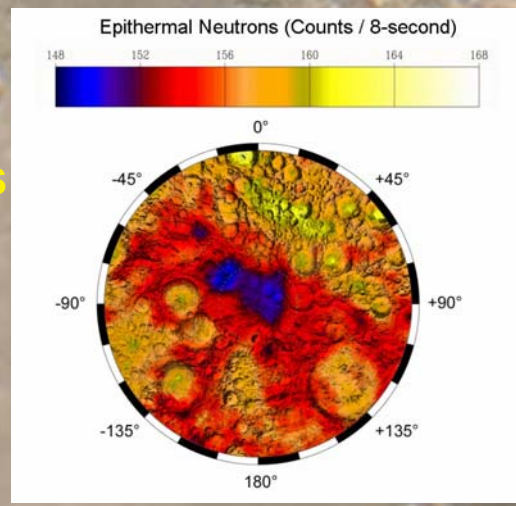
LPRP Status

- Newly Reconstituted Program will do the following:
  - Manage LRO, LCROSS
  - Manage new Lunar Mapping Project
  - Manage (and execute) Education and Public Outreach task for Robotics
  - Support Lunar Architecture Studies
  - Support Human Lander Constellation technology development



- At the present time, no new missions are being considered for the near term
  - No hard requirements surfaced from LAT
  - No funding available to perform new missions

- On-going work
  - Definition of Human Lander Technology and Architecture Study Efforts
    - Support to Lander, Ares 5, and Surface Systems
  - Lunar Mapping Formulation (requirements and product architecture strategy)

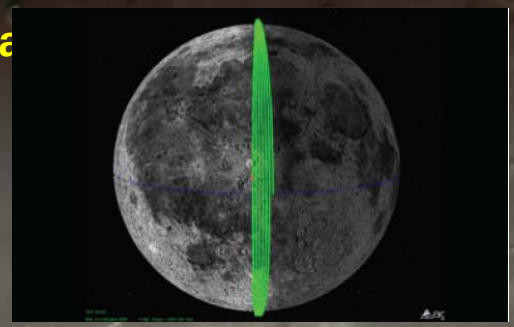


Lunar Reconnaissance Orbiter

Lead Center: GSFC

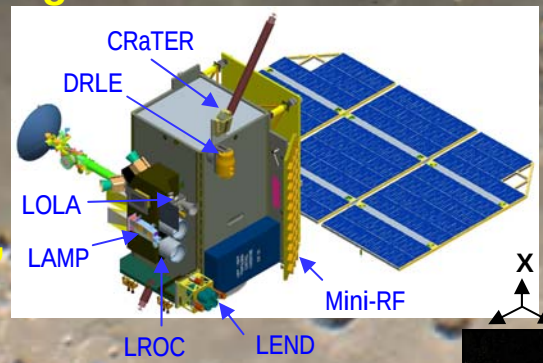
Launch: October 31, 2008

Mission Description: One year mission in a 50 km pola
Lunar orbit, 3-axis stabilized, primarily nadir pointed



Mission Objectives:

- Characterize lunar radiation environment, biological impacts, and potential mitigation
- High resolution global, three-d geodetic grid of the Moon
- Resources at the Moon's poles
- High spatial resolution addressing elemental composition, mineralogy, and Regolith characteristics



Polar Mapping Phase,
50 km Altitude
Circular Orbit,
At least 1 Year

Project Manager: Craig Tooley/GSFC

Organizations: NASA GSFC (LOLA),
Boston University (CRaTER), Arizona State University (LROC),
Russia Institute for Space Research (LEND), Southwest Research
Institute (LAMP), UCLA (DIVINER)

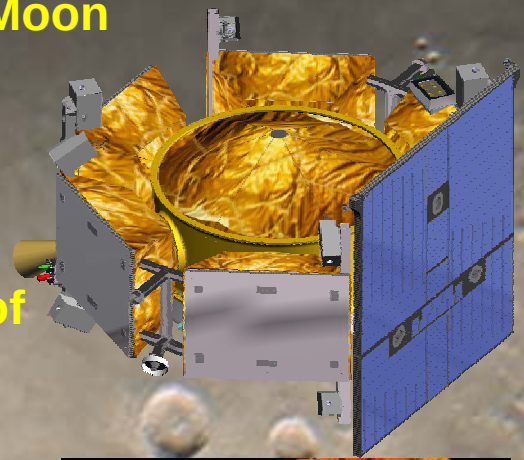
Nominal End of ESMD Mission: February 2010

Lunar Crater Observation and Sensing Satellite

Lead Center: Ames

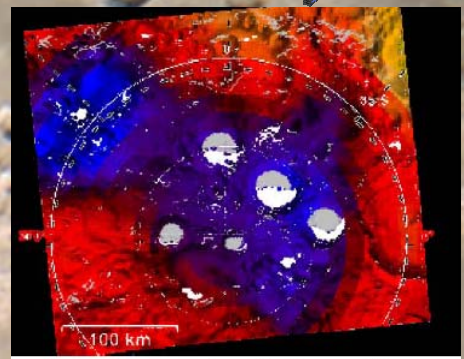
Launch: October 31, 2008

Mission Description: Co-manifested with LRO, LCROSS spacecraft is an impactor into a polar crater looking for water ice. The shepherding spacecraft releases Centaur upper stage to watch it impact the Moon before it also impacts



Mission Objectives:

- Image the ejecta cloud
- Measure the form and concentration of water
- Measure ejecta composition
- Measure other volatiles in the ejecta

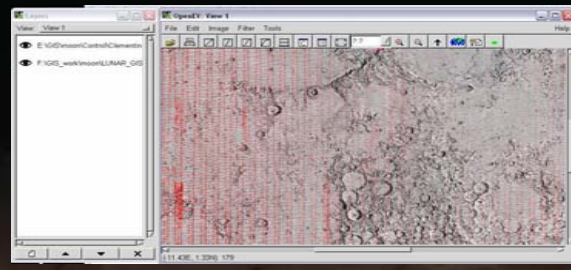


Lunar Prospector Hydrogen Map
(Maurice et la., 2003)

Project Manager: Dan Andrews/ARC

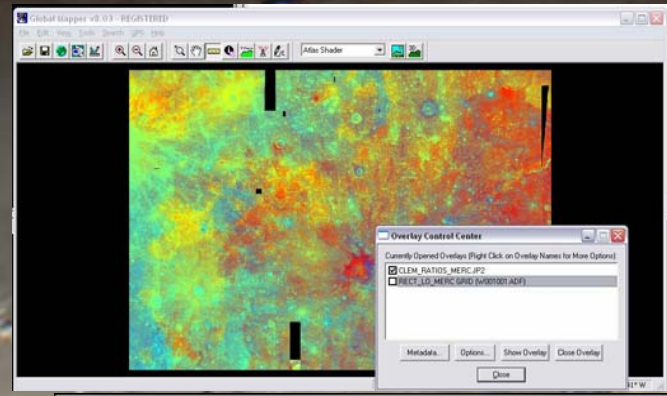
Organizations: NGST (Spacecraft)

Lunar Mapping Project (New)



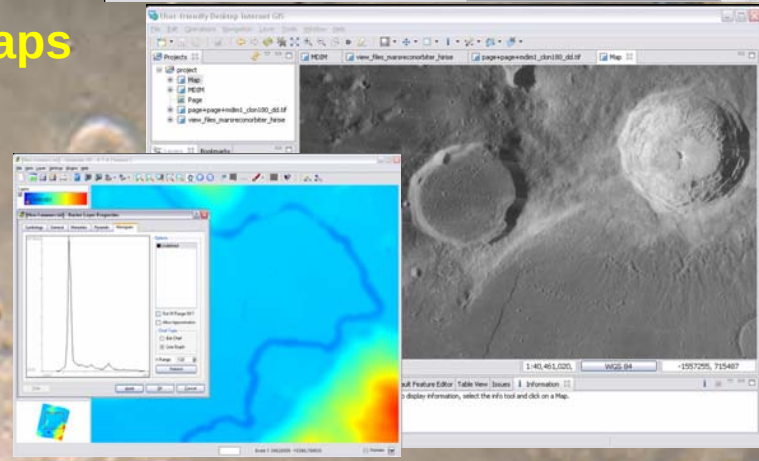
Lead Center: MSFC

Project Description: Produce various lunar maps, tools, models, and displays from LRO and other lunar International Missions to support the Constellation engineers responsible for developing the Lunar elements as part of the VSE



Objectives (tentative):

- Lunar lighting, temperature, maps
- Geo-registered global and local image maps
- Digital Elevation Models
- Rock abundance and surface roughness
- Resource Maps
- Geographical Information System



Formulation Manager: Mark Nall/MSFC

Organizations: ESMD/Constellation Modeling, SMD, Constellation Environments Group, GSFC, Ames, USGS, JPL, CRREL Constellation engineering, Constellation Program Science, EPO, MSFC, APL

LPRP Strategic Status

- **NASA/ESMD is still formulating the near-term lunar robotic strategy**
- **Even though there are no ESMD robotic missions on the horizon, it does not mean that there is benefit that could be gained from Lunar International Missions**
- **There could also be interest in partnering with SMD if such a mission were to occur within SMD**
- **To support this, the Program is preparing a Lunar Information List**
  - **NOT a list of requirements; more a list of "Helpful Info To Have"**
  - **Will be worked with Constellation Users (and sanctioned by Constellation)**
  - **Contains a list of Information that would be of value to the Constellation Lunar segment designers and developers**
  - **List could be used in partnership with IP's or with a NASA/SMD mission**

LPRP Strategic Status

- **(Notional) Lunar Information List (not coordinated w/Constellation)**
  - **Dust characterization & mitigation**
  - **Landing site reconnaissance**
  - **Lunar model validation (tie to ground truth)**
  - **Local radiation measurement**
  - **Spacecraft charging evaluation**
  - **Regolith handling/site preparation**
  - **ISRU characterization and demonstration**
  - **Hydrogen form and location characterization**
  - **Lighting perspective (permanent low incidence at poles)**
  - **Technology Demonstration (next page)**

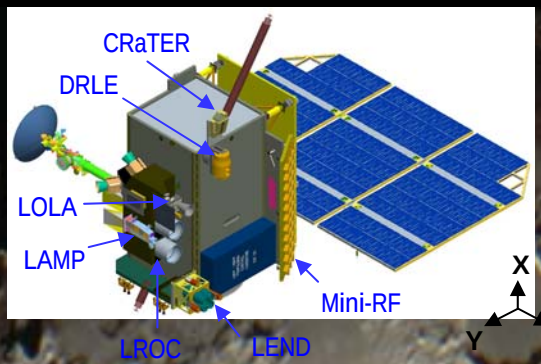
LPRP Strategic Status

- Technology demonstration
  - Communications (surface mobile comm)
  - Mechanisms (1/6G performance, dust impact on lifetime)
  - Materials (dust compatibility)
  - Thermal (surface influence, radiator dust exposure)
  - Navigation and guidance (Precision Landing)
  - Propulsion (system performance, plume interaction)
  - Mobility (traction, dust impact)
  - Power (Re-charging mobile robotic assets, fuel cell tech)
  - Avionics (Open architecture, Rad hard)
  - Cryo handling & storage (test demo)
  - ECLSS (water loop performance in 1/6g, dust filters)


BACKUP

LPRP-1 The Lunar Reconnaissance Orbiter

LRO Mission Overview



- Launch in late 2008 on a EELV into a direct insertion trajectory to the moon.
- On-board propulsion system used to capture at the moon, insert into and maintain 50 km mean altitude circular polar reconnaissance orbit.
- 1 year mission with extended mission options.
- Orbiter is a 3-axis stabilized, nadir pointed spacecraft designed to operate continuously during the primary mission.
- Investigation data products delivered to Planetary Data Systems (PDS) within 6 months of primary mission completion.

LRO Instrument Suite is a Robust Response to Exploration Requirements

INSTRUMENT	Key Data Products	Exploration Benefits	Science Benefits
CRaTER **Cosmic Ray Telescope for the Effects of Radiation**	Lunar and deep space radiation environment and tissue equivalent plastic response to radiation	Safe, lighter weight space vehicles. Radiation environment for human presence at the Moon and journeys to Mars and beyond.	Radiation boundary conditions for biological response . Map radiation reflected from lunar surface
DLRE **Diviner Lunar Radiometer Experiment**	500 m scale maps of surface temperature, albedo, rock abundance, and ice stability	Measures thermal environment in permanent shadow and permanent light, ice depth map	Source, history, migration and deposition of polar volatiles
LAMP **Lyman Alpha Mapping Project**	Maps of frosts and landforms in permanently shadowed regions (PSRs).	Locate potential water-ice on the surface, image shadowed areas, and map potential landing areas in PSRs	
LEND **Lunar Exploration Neutron Detector**	Maps of hydrogen in upper 1 m of Moon at 10 km scales, neutron albedo	Locate potential water-ice in lunar soil or concentrations of implanted hydrogen	
LOLA **Lunar Orbiter Laser Altimeter**	~25 m scale polar topography at < 10 cm vertical, global topography, surface slopes and roughness	Identify safe landing sites, image shadowed regions, map potential surface ice, improve gravity field model	Global topography and gravity for interior structure and geological evolution
LROC **Lunar Reconnaissance Orbiter Camera**	1000's of 50cm/pixel images, and entire Moon at 100m in UV, Visible. Illumination conditions of the poles.	Surface landing hazards and some resource identification including locations of near constant solar illumination	Tectonic, impact and volcanic processes, resource evaluation, and crustal evolution
Mini-RF *Technology Demonstrati*	X and S-band radar imaging and interferometry	Demonstrate new lightweight SAR and communication technologies, locate potential water-ice	Source, history, deposition of polar volatiles