UPDATE ON THE LUNAR RECONNAISSANCE ORBITER: THE INSTRUMENT SUITE AND MISSION. G. Chin[1,*], A. Bartels[1], S. Brylow[2], M. Foote[3], J. Garvin[1], J. Kaspar[4], J. Keller[1], I. Mitrofanov[5], K. Raney[6], M. Robinson[7], D. Smith[1], H. Spence[8], P. Spudis[6], S. A. Stern[9], M. Zuber[1], [1]Goddard Space Flight Center, Greenbelt, MD 20771, [2]Malin Space Science Systems, San Diego, CA 92121, [3]Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109, [4]Massachusetts Institute of Technology, Cambridge, MA 02139, [5]Russian Federal Space Agency Institute for Space Research, Moscow, Russia 117997, [6]The Johns Hopkins University Applied Physics Laboratory, Laurel MD 20723, [7]Arizona State University, Tempe, AZ 85287, [8]Boston University, Boston, MA 20201, [9]Southwest Research Institute, Boulder, CO 78228

Introduction: The Lunar Reconnaissance Orbiter (LRO) is the first of a series of missions intended to pave the way for eventual return of humans to the Moon. It is a spacecraft that will carry a payload of scientific instruments that have high heritage in solar system science investigations; but for this mission are focused on exploration, the search for safe landing sites, and for locating exploitable resources. LRO is part of NASA's Lunar Precursor Robotic Program (LPRP), formulated in response to the President's Vision for Space Exploration, which calls for the robotic exploration of the moon by 2008, the return of humans by 2014. The spacecraft is scheduled to launch in October of 2008.

This presentation updates the progress of the development of the mission. LRO project recently held its comprhensive design review as well as have the instrument teams. The LRO payload includes six instrument as well as technogy demonstration project. They are:

Lunar Orbiter Laser Altimeter (LOLA): LOLA will determine the global topography of the lunar surface at high resolution, measure landing site slopes, surface roughness, and search for possible polar surface ice in shadowed regions. PI, David Smith, NASA Goddard Space Flight Center, Greenbelt, MD.

LOLA Objectives:

1. Global Geodetic Lunar Topography.
2. Characterize Polar Region Illumination.
3. Image Permanently Shadowed Regions.
4. Contribute to the assessment of meter-scale features to facilitate landing-site selection.
5. Identify surface polar ice, if present.

Lunar Reconnaissance Orbiter Camera (LROC): LROC will acquire targeted narrow angle images of the lunar surface capable of resolving meter-scale features to support landing site selection, as well as wide-angle images to characterize polar illumination conditions and to identify potential resources. PI, Mark Robinson, Arizona State University, Tempe, Arizona.

LROC Objectives:

1. Landing site identification and certification, with unambiguous identification of meter-scale hazards.
2. Mapping of permanent shadows and sunlit regions.
3. Meter-scale mapping of polar regions.
4. Repeat observations to enable derivation of meter-scale topography.
5. Global multispectral imaging to map ilmenite and other minerals.
6. Global black and white morphology base map.
7. Characterize regolith properties.
8. Determine recent small impactor rates by re-imaging regions photographed with the Apollo Panoramic Camera (1-2 meter m/pixel).

Lunar Exploration Neutron Detector (LEND): LEND will map the flux of neutrons from the lunar surface to search for evidence of water ice, and will provide space radiation environment measurements that may be useful for future human exploration. PI, Igor Mitrofanov, Institute for Space Research, and Federal Space Agency, Moscow.

LEND Objectives:

1. Determine hydrogen content of the subsurface at the polar regions with spatial resolution of 10km and with sensitivity to concentration variations of 100 parts per million (ppm) at the poles.
2. Characterization of surface distribution and column density of possible near-surface water ice deposits in the Moon's polar cold traps.
3. Global mapping of Lunar neutron emissions at an altitude of 30-50 km above Moon's surface, with a spatial resolution of 5 km (pixel radius) at the spectral range of thermal energies up to 15 MeV.

Diviner Lunar Radiometer Experiment (DLRE): DLRE will chart the temperature of the entire lunar surface at approximately 500 meter horizontal scales to identify cold-traps and potential ice deposits. PI, David Paige, University of California, Los Angeles.

DLRE Objectives:

1. Map Global Day/Night Surface Temperature
2. Characterize Thermal Environments for Habitability
3. Determine Rock Abundances Globally and at Landing Sites

4. Identify Potential Polar Ice Reservoirs
5. Map Variations in Silicate Mineralogy

Lyman-Alpha Mapping Project (LAMP): LAMP will map the entire lunar surface in the far ultraviolet. LAMP will search for surface ice and frost in the polar regions and provide images of permanently shadowed regions illuminated only by starlight. PI, Alan Stern, Southwest Research Institute, Boulder, Colorado.

LAMP Objectives:

1. Identify and pinpoint surface exposed frost in Permanently Shadowed Regions (PSRs).
2. Map all permanently shadowed regions with resolutions down to 100m.
3. Demonstrate the feasibility of natural starlight and Lyman-Alpha (α) sky-glow illumination for future lunar surface mission applications.
4. Assay the lunar atmosphere and its variability.

Cosmic Ray Telescope for the Effects of Radiation (CRaTER): CRaTER will investigate the effect of galactic cosmic rays on tissue-equivalent plastics as a constraint on models of biological response to background space radiation. PI, Harlan Spence, Boston University, Massachusetts.

CRaTER Objectives:

1. Measure and characterize the Linear Energy Transfer (LET) spectra of galactic and solar cosmic rays (particularly above 10 MeV) in the deep space radiation environment most critically important to the engineering and modeling communities to assure safe, long-term human presence in space.
2. Develop a simple, compact, and comparatively low-cost instrument, based on previously flown instruments, with a sufficiently large geometric factor to measure LET spectra and its time variation globally in the lunar orbit.
3. Investigate the effects of shielding by measuring LET spectra behind different amounts and types of areal density materials, including tissue-equivalent plastic.
4. Test models of radiation effects and shielding by verifying/validating model predictions of LET spectra with LRO measurements, using high-quality galactic cosmic rays (GCR) and solar energetic protons (SEP) spectra available contemporaneously with ongoing/planned NASA (ACE, STEREO, SAMPEX) and other agency spacecraft (NOAA-GOES).

Mini Radio-Frequency Technology Demonstration (Mini-RF): The Mini-RF primary purpose is technical demonstration in the lunar environment of a unique miniaturized multi-mode radar observatory. Its synthetic aperture radar (SAR) imaging modes are most relevant to the scientific and exploratory roles of LRO. The mini-RF SAR baseline modes include: two frequencies – S-band (13 cm) and X-band (4 cm); two resolutions – baseline (150 m/75-m pixels) and zoom (15 m/7.5-m pixels); and dual-polarization – transmit on one and receive on like and orthogonal polarizations. The nominal incidence is 45° side-looking; swath widths vary by mode from ~ 4 km to ~ 6 km. The primary data products will be multi-mode Stokes parameters (or their primitives), which will be a major step forward in space-based radar astronomy (Raney 1998, 2006). In addition, there is an experimental two-pass interferometric mode (single polarization), and the possibility of bistatic radar experiments. The instrument mass is about 12 kg, and the antenna measures 1.8 m long and 0.6 m high.

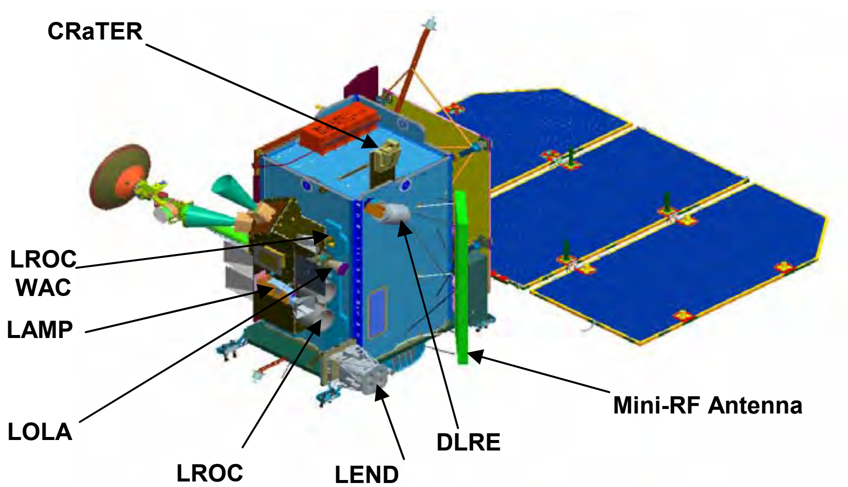

Figure 1 The LRO instrument suite will be accommodated on an instrument deck and on the body of the LRO spacecraft. The rigid solar arrays are shown deployed.