The Mission

Rocket: Atlas 5 (AV-020)
Payload: LRO/LCROSS
Date: June 18, 2009
Times: 5:12, 5:22 and 5:32 p.m. EDT
Site: Complex 41, Cape Canaveral, Florida

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21st century lunar orbiter a precursor to human missions

BY JUSTIN RAY
SPACEFLIGHT NOW
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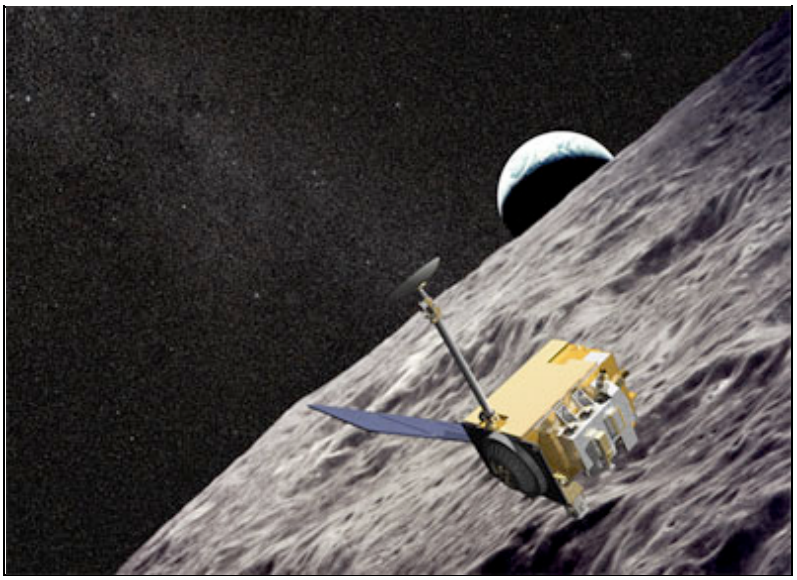
When the next generation of lunar astronauts step foot on the Moon in the years ahead, the definitive travel guide compiled by an instrument-laden spacecraft launching this week will detail the best and worst places to go and the risks the crews could face.

The Lunar Reconnaissance Orbiter is NASA's trailblazer to create detailed maps of the terrain, plot out potential landing sites, identify natural resources that could be exploited and characterize the radiation conditions that astronauts can expect.



Artist's concept of LRO in orbit around the moon. Credit: NASA

Four days after leaving the Earth, LRO will reach the Moon and ignite its engines for a nail-biting maneuver that amounts to a make-or-break moment in the $504 million mission.

The engine firing slows the spacecraft's speed and allows LRO to enter into orbit around the Moon. If all goes well, the satellite should swoop into an elliptical "commissioning orbit" of 30 by 216 kilometers (18.5 by 134 miles).

"Our most critical activity in this mission, we have do something just shy of an hour rocket burn to get captured into lunar orbit," said Craig Tooley, the LRO project manager. "Atlas sends us to the Moon too fast, really. What happens is we escape the Earth's gravity and you're headed toward the Moon. You actually have to do a significant propulsive burn to slow down and get captured by the Moon."

Ground controllers then spend about two months testing the orbiter's systems and instruments, as well as changing the altitude to the planned 50-kilometer (31-mile) circular polar orbit above the lunar surface.

Its first year of lunar studies will serve the needs of NASA's Exploration Systems Mission Directorate, the agency's organization overseeing development of the new Orion crew exploration spacecraft and Ares rockets for launching astronauts to the Moon. Two or three additional years of observations will be funded by the Science Mission Directorate.

"These information sets will be an important resource not only for explorers who want to return to the Moon but will also be invaluable for science. LRO is an important dual mission for exploration and science," said Rich Vondrak, LRO project scientist.

LRO was built in-house at NASA's Goddard Space Flight Center. As it sits atop the Atlas 5 rocket today, the satellite weighs about 4,225 pounds, which includes 1,980 pounds of fuel. The power-generating solar array and a high-speed communications antenna will be deployed once the craft is en route to the Moon.

A suite of seven instruments is mounted on the spacecraft's structure, poised to work in concert to produce a definitive atlas of the Moon that will guide future expeditions.


The LRO spacecraft sits atop LCROSS during final launch preparations. Credit: Ben Cooper/Spaceflight Now

"Almost 95 percent of the time, we will be looking nadir down at the Moon with all seven of our powerful instruments collecting data," said Tooley.

"These instruments are focused on three primary objectives. First, we want to identify safe landing sites. Then, we want to search for resources on the Moon. And finally, we want to get better insight into the space radiation environment and how it may be harmful to humans," Vondrak said.

"Each orbit maps out a narrow portion of the Moon and then as the Moon rotates underneath the LRO spacecraft we map out completely the surface of the Moon...Over the course of a month, we'll see all parts of the Moon and over the course of an entire year, we'll comprehensively map with high-resolution the lunar surface."

A brief look at LRO's instruments:

- CRATER: A radiation sensor that continuously measures the energetic particles from the Sun and cosmic rays that reach the spacecraft to characterize the radiation environment around the Moon.

- Diviner: Remotely sense the lunar surface to generate temperature maps of the Moon.

- LAMP: A see-in-the-dark instrument that will search for surface frost and peer into permanently shadowed craters to look for ice.

- LEND: A Russian detector to gauge the hydrogen content of the Moon's surface and subsurface in fine

detail. The hydrogen could be water ice.

- LOLA: This laser altimeter will probe the Moon's topography and create precise maps of potential landing sites.

- LROC: Three-camera package for detailed narrow- and wide-angle imaging.

- Mini-RF: Synthetic aperture radar technology demonstrator to probe polar regions for evidence of water ice.

"LRO will bring new eyes to the Moon, and with these new eyes we will see new views of the Moon," Vondrak said.

NASA has selected 100 regions of high interest that will get extra attention from the collective instrument power of LRO, Vondrak said. While the craft's lasers measure topography and slopes, the temperature mapper will point out dangerous fields of rocks and the high-resolution imagery will reveal craters and large boulders.

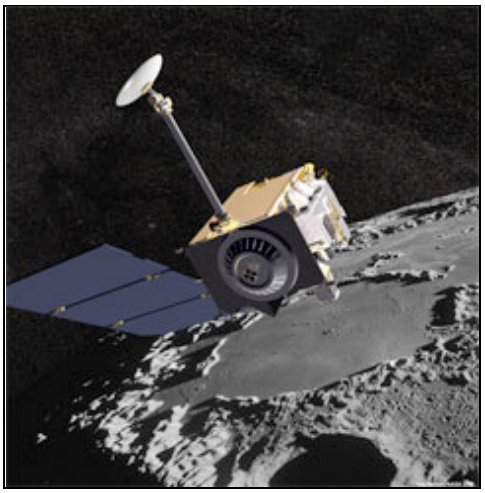
"Imaging will show dramatic landscapes and areas of interest down to one-meter resolution," said Doug Cooke, associate administrator of NASA's Exploration Systems Mission Directorate.

LRO's narrow-angle cameras can see objects roughly a meter in size. The wide-angle camera will image the entire Moon at a scale of 100 meters in seven colors.

Given the available bandwidth for downlinking the pictures back to Earth, only about 10 percent of the lunar surface will be imaged in high-resolution during a year's time. But that imagery promises to be the sharpest NASA has ever obtained from lunar orbit, said Mike Wargo, Exploration program's chief lunar scientist.

"That instrument is going to be taking thousands of images of the surface," he said, adding that diverse locales will be targeted for detailed imaging. "Those locations represent a range of topographies and slopes and lighting conditions that will allow our mission planners to be able to design our landers and design our approaches for landing so that we can be both safe and effective."

"As its name says, LRO is all about doing reconnaissance at the Moon. Reconnaissance, specifically, to bring us back the data and the information we need to plan and execute the human return to the Moon," said Tooley.



Artwork shows the LRO spacecraft soaring over the Moon. Credit: NASA

"An inevitable question I get is 'why do we need LRO? Haven't we done this?' And, indeed, of course, we've been to the Moon. But when we went to the Moon for Apollo, we went to the equatorial regions and we intentionally planned to not stay for very long. And even at the onset of our renewed commitment to send human beings to the Moon back in 2004, we knew then if we were going to go to the Moon with the more ambitious goals we have now of staying longer and perhaps establishing outposts, we were going to go to a different place. Those places are almost inevitably going to be the poles, and those areas of the Moon we actually have very sparse information.

"We actually have much better maps of Mars than we have of our own Moon's polar regions. So the job of filling out that information set, making that atlas complete for planning safe and fruitful return to the Moon -- that job fell to LRO."

The lunar poles are attractive destinations for astronauts and LRO will help paint the picture of what humans can expect to find there. Could there be water ice stored in low, dark craters available for harvesting? Could high regions nearly continuously illuminated by the Sun promise plentiful solar power?

The Apollo missions targeted equatorial sites. LRO's mission will help the next generation of human expeditions broaden their options of landing locations.

"Right now, our knowledge of the polar regions is very inadequate. The purpose of LRO is to expand the understanding that we have about the equatorial regions to the entire Moon," Vondrak said.

"If we were going today to the poles as opposed to the equatorial regions, our knowledge of where things are is only good to about 30 kilometers, which if you were planning to fly in and planning your trajectories, that's not the kind of resolution you want for where the boulders are, where the craters are, only to be discovered as you approach and guide yourself in," Tooley added.

"We would also not know where the most advantageous places to go. When we go back, we want to go to the places that look interesting, the places where we know there's peaks of eternal light, where we know those resources are (because) we've identified them."

"What we're about is taking us all back to the Moon," said Cathy Peddie, LRO's deputy project manager.

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