Lunar Librarian Newsletter
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LRO News

NEXT NASA MOON MISSION COMPLETES MAJOR MILESTONE – Press Release
http://www.nasa.gov/home/hqnews/2008/dec/HQ_08-335_LRO_Thermal_Complete.html

GREENBELT, Md. -- NASA's Lunar Reconnaissance Orbiter, or LRO, has successfully completed thermal vacuum testing, which simulates the extreme hot, cold and airless conditions of space LRO will experience after launch. This milestone concludes the orbiter's environmental test program at NASA's Goddard Space Flight Center in Greenbelt, Md.

The orbiter will carry seven instruments to provide scientists with detailed maps of the lunar surface and increase our understanding of the moon's topography, lighting conditions, mineralogical composition and natural resources. Data returned to Earth from the Lunar Reconnaissance Orbiter will be used to select safe landing sites, determine locations for future outposts and help mitigate radiation dangers to astronauts. The spacecraft will spend at least a year in a low, polar orbit approximately 30 miles above the lunar surface while the instruments work together to collect detailed information about the moon's environment.

The thermal vacuum testing on the spacecraft took about two months. The orbiter, which was built at Goddard, was subjected to the extreme temperature cycles of the lunar environment as engineers conducted simulated flight operations.

"We have cooked LRO, frozen it, shaken it, and blasted it with electromagnetic waves, and still it operates," said Dave Everett, LRO mission system engineer at Goddard. "We have performed more than 2,500 hours of powered testing since January, more than 600 of that in vacuum."

The first two checks were the spin and vibration tests. The spin test determined the spacecraft's center of gravity and measured characteristics of its rotation. During vibration testing, engineers checked the structural integrity of the spacecraft aboard a large, shaking table that simulated the rigorous ride the orbiter will encounter during liftoff aboard an Atlas rocket.

Next, the orbiter was subjected to acoustics testing. The bagged spacecraft was placed near wall-sized speakers that simulate the noise-induced vibrations of launch. Following acoustics testing, LRO underwent tests that simulated the orbiter's separation from the rocket during launch. The spacecraft also underwent electromagnetic compatibility testing to ensure internal and external electrical signals do not interfere with its critical functions.

"It was less than one year ago that LRO was a myriad collection of parts not yet delivered to our clean room," said Craig Tooley, LRO project manager at Goddard. "This truly is a significant accomplishment -- a hard earned milestone. It is a humbling and awe-inspiring experience to work with the LRO team."

LRO will be shipped to NASA's Kennedy Space Center in Florida in early 2009 to be prepared for its April 24 launch aboard an Atlas V rocket. Accompanying the spacecraft will be the Lunar Crater Observation and Sensing Satellite, a mission that will impact the moon's surface in its search for water ice.

LOLA – The Laser Altimeter

by Lora Bleacher

The Lunar Orbiter Laser Altimeter (LOLA) is one of six instruments on the Lunar Reconnaissance Orbiter (LRO) spacecraft, which is scheduled to launch on April 24, 2009. LOLA will provide a precise global topographic map of the Moon's surface. This data will aid in the selection of safe sites for future lunar landings and exploration by humans. LOLA will also image permanently shadowed regions in craters at the Moon's poles to look for surface ice, a resource that could be useful to future lunar explorers.

LOLA will operate by sending a single laser pulse through a diffractive optical element that will split the laser into 5 beams (Fig. 1). It will then measure how long it takes for the beams to hit the Moon's surface and bounce back ("range"). It will also measure the change in spread of the returned beams ("surface roughness") and their change in energy ("surface reflectance"). The slope of the Moon's surface will also be determined thanks to the two-dimensional aspect of LOLA's beam pattern.

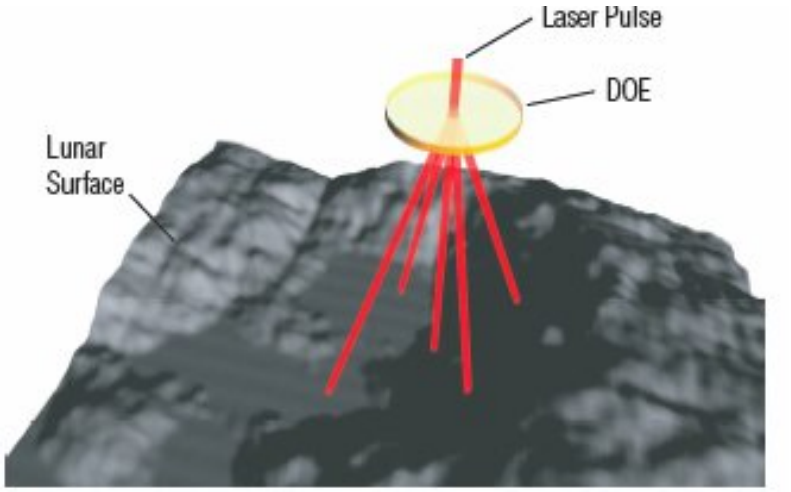


Figure 1. A single laser pulse will be split into 5 beams that will strike the Moon's surface and bounce back.

LOLA was built at NASA's Goddard Space Flight Center on the heritage of two other laser altimeters, the Mars Orbiter Laser Altimeter (MOLA) and the Mercury Laser Altimeter (MLA). MOLA was on the Mars Global Surveyor spacecraft that launched in 1996. It collected topographic data of Mars until 2001. To learn more about MOLA, visit http://mola.gsfc.nasa.gov/index.html. LOLA will have 3-5 times greater vertical accuracy than MOLA and will collect 32 times more measurements. MLA is currently onboard the MESSENGER spacecraft, which launched in 2004 and will go into orbit around Mercury in 2011. To learn more about MLA, visit http://messenger.jhuapl.edu/instruments/MLA.html.

To learn more about LOLA, visit http://lro.gsfc.nasa.gov/lola/.

NASA News

40th Anniversary of Apollo 8

This holiday season marks the 40th anniversary of America's first orbit around the Moon. On December 21, 1968, Apollo 8 was launched into space by a three-stage Saturn V rocket. On board were astronauts Frank Borman, Mission Commander, James A. Lovell Jr., Command Module Pilot, and William A. Anders, Lunar Module Pilot. This mission took 7 days to complete and 10 trips around the Moon.

The mission objectives, as stated at: http://www-pao.ksc.nasa.gov/history/apollo/apollo-8/apollo-8.htm, were achieved:

> *Demonstrate crew/space vehicle/mission support facilities during manned Saturn V/CSM mission. Demonstrate translunar injection, CSM navigation, communications, and midcourse corrections. Assess CSM consumables and passive thermal control. Demonstrate CSM performance in cislunar and lunar orbit environment. Demonstrate communications and tracking at lunar distances. Return high-resolution photographs of proposed Apollo landing sites and locations of scientific interest.*

On Christmas Eve, 1968, these astronauts made a live television broadcast from lunar orbiter. The broadcast can be viewed at: http://nssdc.gsfc.nasa.gov/planetary/lunar/apollo8_xmas.html. "Lovell said, "The vast loneliness is awe-inspiring and it makes you realize just what you have back there on Earth." They ended the broadcast with the crew taking turns reading from the book of Genesis."

Thanks for getting us on our journey to other worlds.

Science News

NASA Science News has published several articles last month. Please follow the links to read the full stories. Check out our RSS feed at http://science.nasa.gov/rss.xml!

Return of the Leonids
Astronomers from Caltech and NASA are predicting a near-storm of Leonids in 2009 based on a surprising outburst of meteors just two weeks ago.
http://science.nasa.gov/headlines/y2008/04dec_leonids2009.htm?list907815

Biggest Full Moon of the Year
Not all full Moons are the same. This Friday's is the biggest and brightest full Moon of the year.
http://science.nasa.gov/headlines/y2008/09dec_fullmoon.htm?list907815

The Incredible Journey of the James Webb Space Telescope
From humble beginnings in a Utah beryllium mine to the most advanced laboratories in the world, the mirrors of NASA's next great observatory are taking an incredible journey to space.
http://science.nasa.gov/headlines/y2008/10dec_mirror.htm?list907815

Solar Flare Surprise
Solar flares are supposed to obliterate everything in their vicinity, yet one of the most powerful flares of the past 30 years has done just the opposite, emitting a beam of pure and unbroken hydrogen atoms. Researchers think this strange event could yield vital clues to the inner workings of solar flares.
http://science.nasa.gov/headlines/y2008/15dec_solarflaresurprise.htm?list907815

Giant Breach in Earth's Magnetic Field Discovered
NASA's five THEMIS spacecraft have discovered a breach in Earth's magnetic field ten times larger than anything previously thought to exist. The size of the opening and the strange way it forms could overturn long-held ideas of space physics. http://science.nasa.gov/headlines/y2008/16dec_giantbreach.htm?list907815

Saturn's Crazy Christmas Tilt
The planet Saturn is doing something rare and beautiful this holiday season.
http://science.nasa.gov/headlines/y2008/22dec_crazytilt.htm?list907815

NASA's Gift to Mr. Claus
True story: NASA technology saves Claus from a disaster at sea! Christmas (and the sport of fishing) may never be the same. http://science.nasa.gov/headlines/y2008/24dec_sport.htm?list907815

Librarian News

The LRO EPO team will soon be sending out the request for information pertaining to LRO's launch. As of right now, the official launch date is **April 24, 2009**. Please note this *may change*.

Check out the latest MOON posters from LPI: http://www.lpi.usra.edu/education/moon_poster.shtml

Links of the Month…

- Moon posters from LPI: http://www.lpi.usra.edu/education/moon_poster.shtml
- NASA's Earth Observatory: http://earthobservatory.nasa.gov/
  The Earth Observatory's mission is to share the images, stories, and discoveries about climate and the environment that emerge from NASA's Earth system science research, including its satellite missions, in-the-field research, and computer models.
- CNN's Space Spotlight for the end of December 2008:
  http://www.cnn.com/2008/TECH/space/12/30/space.spotlight/index.html.

Monthly Activity

Seeing the Invisible Moon Mineralogy Mapper Education website at http://m3.cofc.edu

Students observe the colors of the visible spectrum and detect invisible infrared electromagnetic radiation.

What's Needed

- 1 Diffraction grating
- 1 Overhead projector
- Masking tape
- Scissors

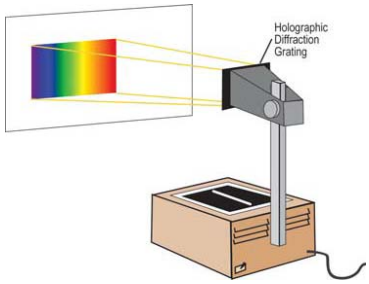
Audio Photocell Detector

- Solar cell or photocell
- Amplifier/speaker (with battery if needed)
- Audio cable with 1/8-inch mini-plug on one end
- 2 jumper cables with alligator clips on both ends
- Small handheld fan

Getting Started

Set up the overhead projector so that it projects onto a light surface in a dark room. Place two halves of a sheet of dark construction paper on the projector's glass plate so there is a ¼-inch-wide slit between them through which light passes. Tape the sheets in place.

Place a sheet of diffraction grating in front of the projector head. Adjust the grating and projector until one or two spectra appear clearly on the wall. Tape the grating in place.



Build the audio photocell detector. Plug the 1/8-inch mini-plug into the "input" of the amplifier. Clip a jumper cable to one of the leads on the photocell, and clip the other end of the jumper cable to one of the leads of the audio cable. Use the second jumper cable to connect the other lead from the photocell to the other lead of the audio cable.

What to Do

- Invite the students to describe what they know about light. What happens when light passes through a prism? How does a rainbow form? Invite them to describe or define terms they use, such as white light, visible light, frequency, wavelength, colors, reflect, refract, and absorb.
- Turn on the overhead projector and explain that you are using a diffraction grating to break up the white light from the projector into the colors that make up white light — its spectrum. The diffraction grating acts like a prism. Ask a student to place pieces of masking tape on the wall where the red light begins and ends. Do the other students think the marks are in the "right" place? If not, why not? Each of us detects variations in colors differently, so students may have different opinions on where the tape should be.
- Show the students the photocell detector/amplifier and switch it on. Demonstrate that the amplifier/speaker emits noise when the photocell is placed in front of a light, such as the projector light, and that the noise is louder when the light is interrupted by a small fan (the instrument is sensitive to changes in light levels). Slowly pass the photocell in front of the spectrum on the wall, holding the fan in front of the photocell. Which colors or wavelengths of light can the photocell detect? Are there any visible colors that it cannot detect? It does not detect the violet light as easily as the other colors. What happens to the detector when it is moved beyond the red light? Can it still detect light? What type of light could that be? The photocell can "see" (detect) infrared light.

Wrapping Up

Ask the students which parts of the electromagnetic spectrum our eyes detect. We can see the visible light — red, orange, yellow, green, blue, and violet.

Are there parts of the spectrum we cannot see? We cannot see infrared light, and other types of radiation such as X-rays, ultraviolet light, or radio waves.

In what way could looking at objects with different parts of the electromagnetic spectrum — those invisible to the human eye — provide useful information?

X-rays provide information about the inside of our body and ultraviolet light is used to detect clues at crime scenes. Scientists detect electromagnetic radiation from stars to learn about their origin and condition. Spectrometers onboard spacecraft orbiting planets and our Moon collect electromagnetic radiation reflected from the surface, allowing scientists to learn about the composition.

For a more extensive lesson plan, and for related lessons, please visit the Moon Mineralogy Mapper Education website at http://m3.cofc.edu.