



Lunar Librarian Newsletter

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LRO News

We moved the Orbiter out of the vacuum chamber and back to the clean room on December 22nd. We are now running through the Orbiter comprehensive performance test (CPT), comparing results to the CPT we ran before environmental testing, making sure the environments did not change anything. As of 4am today, we completed the propulsion performance test, with everything looking fine. We will pick back up with the testing on January 2nd. Happy New Year to all!



Here is the Orbiter being lifted out of the thermal vacuum chamber.

Here is the Orbiter back in the clean room. The purge lines provide clean nitrogen, keeping contaminants and oxygen out of the sensitive instruments.



To Protect and Enable Living Things on the Moon

By Nick Gross

The goal of the LRO mission is to explore the lunar environment searching for hazards and resources. Many instruments on LRO are designed to search for flat landing sites with few obstructions and near resources such as water ice. The Cosmic Ray Telescope for the Effects of Radiation (CRaTER) instrument is designed to search for another type of hazard, radiation.

Since the beginning of the American Space Program with Explorer I in 1958, it was known that the radiation levels in space are significantly higher than those on Earth. At the surface of the Earth we are protected from most of this radiation by the Earth's magnetic field and the atmosphere. The Earth's magnetic field deflects most of the charged energetic particles coming from space away from the Earth. For the most part, long term human space flight on the Space Shuttle, the MIR Space Station, and the International Space Station has been confined to within a few hundred miles of the Earth's surface, well inside the protective magnetic field. The astronauts of the Apollo program who ventured outside of the Earth's magnetic field to the Moon were

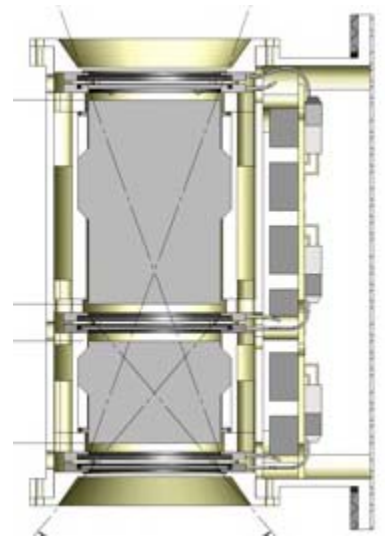


only exposed for a few days and no major radiation events occurred at that time. For the planned return to the moon in the next decade, the schedule calls for much longer missions with much longer exposures for the astronauts and we have limited knowledge of the effects of such long term exposure. The CRaTER instrument will help to increase our understanding of these effects.

Located on the leading edge of the LRO spacecraft - the CRaTER primary investigator, Harlan Spence calls CRaTER the LRO hood ornament - the telescope will detect particles both coming from deep space and coming directly from the Moon. The instrument is composed of three pairs of detectors separated by Tissue Equivalent Plastic (TEP), see cross section to the right. Each pair of detectors consists of a low energy (thick) detector and a high energy (thin) detector. As a particle passes through the instrument it deposits energy into the TEP. By comparing the energy measured by the detectors on each side of the plastic we can measure how much energy was left in the TEP. Since the total instrument length is about the distance from the front to the back of a human torso the results can be used to estimate how much energy would be deposited in an astronaut's body. The results from CRaTER will be used to estimate the effective radiation exposure for astronauts on or near the moon. It will also be used to help test the computer models used to estimate these radiation levels. In this way we CRaTER will fulfill its motto:

"Luna ut nos animalia tueri experiri possimus."

(In order that we might be able to protect and enable living things on the Moon.)



NASA News

NASA Goddard to Investigate the Stormy Moon 01.28.09

Bill Steigerwald NASA GSFC

<http://www.nasa.gov/centers/goddard/news/topstory/2009/dream.html>

NASA's Lunar Science Institute selected a proposal to investigate the sun's influence on the Moon submitted by NASA's Goddard Space Flight Center in Greenbelt, Md. The basic science research supports NASA's human exploration of the Moon.



"Many people think of the Moon as dead, but if you look with a different pair of glasses – at the atomic level – it is very active," said Dr. William Farrell of NASA Goddard, Principal Investigator for the proposal, called the Dynamic Response of the Environment at the Moon (DREAM).

This is the logo for the DREAM project. **Credit:** NASA

"The Sun is constantly throwing energy and matter into space – radiation and a million-mile-per-hour stream of electrically charged particles called the solar wind. If you put an object in the path of this stuff, such as the Moon, that object will get hit and react. This reaction to inflowing solar matter includes surface erosion of gas and dust. There are also other subtle reactions, like the electrostatic charging of the lunar surface and any object on the surface that can be a concern for human explorers. All these effects are enhanced during a solar storm when the sun temporarily spews out a greater amount of energy and matter," said Farrell.

The award, one of seven announced by NASA Headquarters January 9, allocates five million dollars for four years of research beginning this April. The researchers will build advanced computer simulations to explore the interactions between the sun and the Moon, especially emphasizing the lunar surface reaction to intense solar storms and impacts from microscopic meteorites and larger objects. "One of our roles will be to provide modeling support to scientists examining data from NASA's lunar science missions, such as the Lunar Reconnaissance Orbiter. There are always surprises in science, and our computer models can help them understand unexpected results or choose among competing theories," said Farrell.

DREAM researchers will study many ways the sun influences the Moon, but some interactions will be of special interest to human explorers: solar storms, the electric charging of lunar dust, and the erosion of potential resources at the poles.

Solar storms are caused by powerful events on the sun, like billion-ton eruptions of gas called coronal mass ejections or explosions equivalent to million-megaton nuclear bombs called solar flares. The reaction of the lunar surface to such events will be studied closely by the DREAM team because they present significant hazards to unprotected astronauts. First, the storms have intense radiation that can cause human sickness. Second, they could make the surface electrostatic charging more intense, as they generate strong solar winds along with more intense solar ultraviolet and X radiation. Models of solar storms and their effects on the lunar surface will be developed and applied in the project.

The Moon is blanketed in a layer of dust formed by countless impacts from microscopic meteorites. The dust is jagged, like shards of glass, because the Moon's atmosphere is too thin to blow it around and grind it smooth like wind does to sand on Earth. Lunar dust might cause health problems if astronauts inhale it, and it

could damage sensitive equipment. Solar wind and radiation give dust at the lunar surface an electric charge, so it becomes "clingly", as frustrated Apollo astronauts noted. The DREAM researchers will see if there are places and times where this electrostatic charging is especially severe – like during a solar storm.

Some scientists believe there may be deposits of water as ice, or hydrogen, a component of water, in the bottoms of lunar craters at the poles. These areas may be in permanent shadow and thus extremely cold and able to store ice or hydrogen for billions of years if it was somehow transported there, perhaps gradually deposited by the solar wind or suddenly as vapor from a comet impact. If such deposits exist and it is practical to mine them, they could be a valuable resource because it costs about \$50,000 per pound to deliver anything, including water, from Earth to the Moon. However, these potential deposits are also exposed to the space environment at the poles, including micro-meteoroid bombardment and solar ion impacts that act to erode the resources. DREAM investigators will run models to see how significant this resource erosion could be, especially during storm periods when there is more energy and matter released from the sun. The team will also calculate how rapidly vapor from a comet impact or hydrogen from the solar wind could migrate to the lunar poles.

Scientists at Goddard will collaborate with partners at the University of California at Berkeley, University of Maryland, College Park and Baltimore County, Johns Hopkins Applied Physics Lab, Laurel, Md., NASA Ames Research Center, Moffett Field, Calif., Boston University, New Mexico State University, Las Cruces, University of Colorado, Boulder, Hampton University, Hampton, Va., SETI Institute, Mountain View, Calif., and Space Science Applications Incorporated, Lanham, Md. The Lunar Science Institute is based at and managed by NASA Ames. The institute is supported by the Science Mission Directorate and the Exploration Systems Mission Directorate at NASA Headquarters in Washington.

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>!

Sixteen Tons of Moondust

Sledgehammer-toting scientists are "bustin' rocks" to make the finest possible simulated lunar regolith (a.k.a. fake moondust) in support of NASA's return to the Moon.

http://science.nasa.gov/headlines/y2009/07jan_sixteentons.htm

The Biggest Full Moon of the Year: Take 2

The biggest full Moon of 2009 is coming this weekend. It's a 'perigee Moon' as much as 30% brighter than lesser Moons we'll see in the months ahead. Get ready for moonlight!

http://science.nasa.gov/headlines/y2009/08jan_bigmoon2009.htm

Giant Rockets Could Revolutionize Astronomy

NASA's next great Moon rocket promises to do more than land astronauts on the Moon. In its spare time, it could revolutionize the science of astronomy.

http://science.nasa.gov/headlines/y2009/14jan_rocketastronomy.htm

Winter Wonder Rocket Movie

The last place you'd expect to find icicles is around the rim of a scalding hot and thundering rocket engine. Yet an engine being used by NASA to develop technologies for next-generation lunar landers has been

caught producing icicles of unlikely beauty. Watch the process in action in today's story from Science@NASA. http://science.nasa.gov/headlines/y2009/15jan_cece.htm

Discovery Reveals Mars Is Not a Dead Planet

A team of NASA and university scientists has discovered 'substantial plumes' of methane floating through the atmosphere of Mars. The discovery indicates Mars is either biologically or geologically active. http://science.nasa.gov/headlines/y2009/15jan_marsmethane.htm

Severe Space Weather--Social and Economic Impacts

A new NASA-funded study details what might happen to our modern, high-tech society in the event of a 'super solar flare' followed by an extreme geomagnetic storm. Some of the conclusions might surprise you. http://science.nasa.gov/headlines/y2009/21jan_severespaceweather.htm

NASA Sees the Dark Side of the Sun

NASA's twin STEREO spacecraft are giving astronomers an over-the-horizon look at the 'dark side' of the Sun. This new perspective could lead to important advances in space weather forecasting and solar physics research. http://science.nasa.gov/headlines/y2009/23jan_darkside.htm



Librarian News

Dr. Nick Gross from BU just finished 6 professional development programs for children's librarians of the public libraries in the 6 regions around Massachusetts. A total of 145 librarians participated from about the state. The summer reading program at the libraries will be "Blast of with Summer" focusing on space related topics. His presentation focused on the LRO mission and drew activities from both the LRO Education page (<http://lunar.gsfc.nasa.gov/education.html>) and the Lunar and Planetary Institute website (<http://www.lpi.usra.edu/education/explore/LRO/activities/>). Several other researchers from BU gave short presentations on their work.



Links of the Month...

- ACME MAPPER, Acme Mapper, This is a convenient and powerful mapping program that lets you switch between standard Google Map views, topo maps, Nexrad and more. <http://mapper.acme.com/>
- SNOWFLAKES AS YOU'VE NEVER SEEN THEM BEFORE, New Scientist, "These snowflake photos were taken by Kenneth Libbrecht of CalTech, using a specially-designed snowflake photomicroscope. They show real snow crystals that fell to earth in northern Ontario, Alaska, Vermont, the Michigan Upper Peninsula, and the Sierra Nevada mountains of California. <http://www.newscientist.com/gallery/dn16170-snowflakes>

- NASA IMAGES, NASA, Find a recently released, comprehensive collection of some of the most famous images compiled by NASA and its affiliates. <http://www.nasaimages.org/index.html>
- LEARNING SCIENCE, Depending on the content that you are teaching, you will find many K-2 appropriate science resources at this line... When you click the content area...for example "EARTH SCIENCE" the resources are listed under K-4 standards. <http://www.learningscience.org/>

Monthly Activity

BUILD YOUR OWN 3D GLASSES!

<http://stereo.gsfc.nasa.gov/classroom/glasses.shtml>

Materials

- Oaktag (sturdy poster board)
- Scissors
- Clear tape
- Basic pattern for glasses (Download PDF 72KB)
- Sheets of red and blue acetate (available at art supply stores)

Step 1

Cut out the sample pattern (including eyeholes) for your 3D glasses and tape the sides to the center section. You now have your stencil for the actual glasses.

Step 2

Trace the stencil on the oaktag or sturdy poster board. Cut the glasses out making sure to also cut out the eyeholes.

Step 3

Tape the red (left) and blue (right) acetate pieces to cover the eyeholes. Make sure to cut the acetate pieces a little larger than the opening for the eyes. DO NOT get tape on parts of the acetate visible through the eyehole.

Hints

1. You can decorate the glasses using any materials on hand. Encourage students to be as creative as possible!
2. The pattern provided is just one possible style. Vary the outer shape of the glasses to make them unique.
3. Take a picture of the whole class wearing their glasses. Or, even better, use the class wearing their glasses as the subject of your 3D photo!

