Lunar Librarian Newsletter
October 2008

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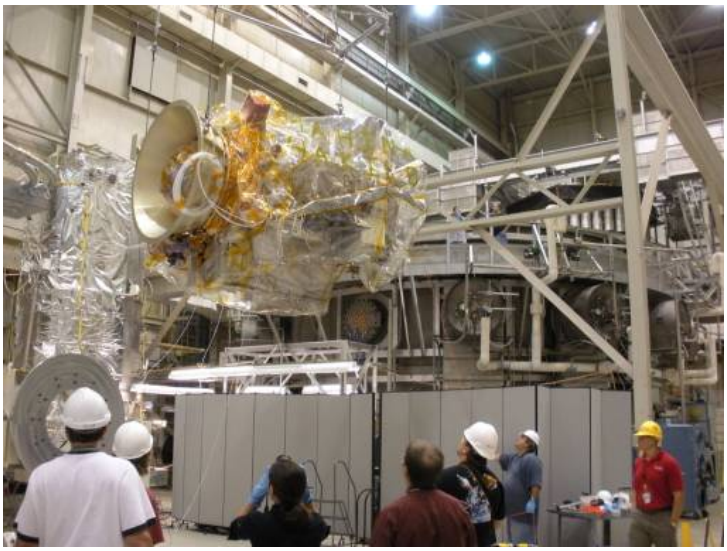
LRO News

The EMI testing went well in September. We demonstrated that the spacecraft can transmit and receive radio signals without causing any interference to the instruments, and no signals from the launch vehicle will cause any problems with LRO systems. Since that time, we have loaded some new software, run through our functional, verified all our safing sequences, and cleaned up various odds and ends. The Orbiter is finally ready for the last of the environmental tests - thermal vacuum. On October 16th, we moved the Orbiter into the chamber. We still have a lot of preparation work before we can start the test.



In the image to the right is the Orbiter, with the Z-axis down (its nominal attitude while in orbit around the moon) just before the team lowered it into the thermal vacuum chamber. On the side of the protective bag, you can see the words "Mahina Hakilo", since LRO will observe the moon. (Our deputy project manager comes from Hawaii.)

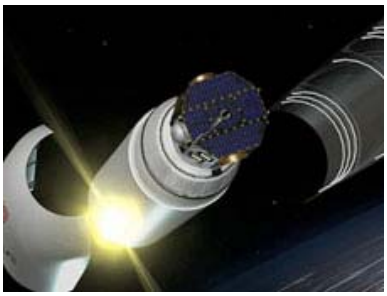
The Orbiter, to the right, looks pretty small as it is lowered into the large thermal vacuum chamber.

The LRO Team:

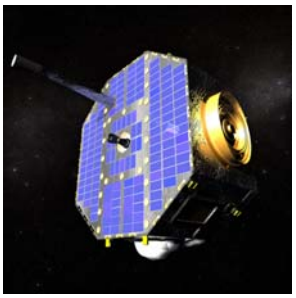
Here's a group shot of the LRO team here at NASA Goddard in Greenbelt, MD.

NASA News

IBEX Launches



On October 19, NASA launched Interstellar Boundary Explorer (IBEX) from the Kwajalein Atoll, a part of the Marshall Islands in the Pacific Ocean. The two-year mission of IBEX will image and map dynamic interactions taking place in the outer solar system.



"IBEX will let us make the first global observations of the region beyond the termination shock at the very edges of our solar system. This region is critical because it shields out the vast majority of the deadly cosmic rays that would otherwise permeate the space around the Earth and other planets," says Dr. David J. McComas, IBEX Principal Investigator (PI) from the Southwest Research Institute (SwRI) in San Antonio, Texas. "IBEX will let us visualize our home in the galaxy for the first time and explore how it may have evolved over the history of the solar system. Ultimately, by making the first images of the interstellar boundaries neighboring our solar system, IBEX will provide a first step toward exploring the galactic frontier."

For more information on IBEX, please see http://www.nasa.gov/mission_pages/ibex/index.html

Chandrayaan to orbit the Moon

Chandrayaan (meaning "Lunar Craft" in ancient Sanskrit) is an Indian Space Research Organization spacecraft launched October 22, 2008. This is an unmanned mission to orbit the Moon. Like LRO, this mission contains a lunar orbiter and an impactor. Both LRO and Chandrayaan have an instrument in common. MiniSAR, [single aperture radar (SAR)] is similar to mini-RF. This instrument will be searching for lunar polar ice.

The other instrument provided by NASA is the Moon Mineralogy Mapper (M3). "M^3 is a state-of-the-art imaging spectrometer that will provide the first map of the entire lunar surface at high spatial and spectral resolution, revealing the minerals of which it is made.

Scientists will use this information to answer questions about the Moon's origin and development and the evolution of terrestrial planets in the early solar system. Future astronauts will use it to locate resources, possibly including water that can support exploration of the Moon and beyond."

For more information please visit:
Chandrayaan: http://www.isro.org/Chandrayaan/htmls/home.htm
MiniSAR: http://www.nasa.gov/mission_pages/Mini-RF/main/index.html
Moon Mineralogy Mapper: http://m3.jpl.nasa.gov/

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!

NASA Spacecraft Finds the Sun is Not a Perfect Sphere
Scientists using NASA's RHESSI spacecraft have measured the roundness of the sun with unprecedented precision, and they find that it is not a perfect sphere. During years of high solar activity the sun develops a thin "cantaloupe skin" that significantly increases its apparent oblateness.
http://science.nasa.gov/headlines/y2008/02oct_oblatesun.htm?list907815

Mercury as Never Seen Before
Yesterday, NASA's MESSENGER spacecraft flew past Mercury, capturing high-resolution images of the innermost planet's previously unseen landscape. Amazing first photos are arriving at Earth now.
http://science.nasa.gov/headlines/y2008/07oct_firstresults.htm?list907815

Liquid Mirror Telescopes on the Moon
A team of internationally renowned astronomers and opticians may have found a way to make 'unbelievably large' telescopes on the Moon. http://science.nasa.gov/headlines/y2008/09oct_liquidmirror.htm?list907815

The Day the World Didn't End
Last month when scientists switched on the Large Hadron Collider, the world did not come to an end. In today's story, a particle physicist explains why not--and why Earth is safe from black holes when the collider is reactivated in the months ahead. http://science.nasa.gov/headlines/y2008/10oct_lhc.htm?list907815

Gamma-ray Bursts: The Mystery Continues
More than four decades after they were discovered, gamma-ray bursts continue to mystify astrophysicists. Next week, experts from 25 countries will converge on Huntsville, Alabama, to discuss and debate clues to the biggest explosions since the Big Bang itself.
http://science.nasa.gov/headlines/y2008/16oct_grboverview.htm?list907815

Discovered: A New Kind of Pulsar
NASA's Fermi Gamma-ray Space Telescope has discovered a new kind of pulsar that hints at a previously unsuspected population of stars waiting to be found in the Milky Way.
http://science.nasa.gov/headlines/y2008/17oct_gammaraypulsar.htm?list907815

Brief Mystery: What are Short Gamma-ray Bursts?
A curiously short-lived type of gamma-ray burst has astronomers puzzled. Leading experts discuss the clues at today's 6th Gamma-ray Burst Symposium in Huntsville, Alabama.
http://science.nasa.gov/headlines/y2008/20oct_briefmystery.htm?list907815

The Oddball Hosts of Gamma-ray Bursts
Cosmic explosions known as gamma-ray bursts are curiously picky about where they explode. Shunning spiral galaxies like the Milky Way, gamma-ray bursts prefer to 'go off' in oddball star systems that astronomers are just beginning to understand.
http://science.nasa.gov/headlines/y2008/21oct_oddballs.htm?list907815

The Case of the Missing Gamma-ray Bursts
A group of gamma-ray bursts at the edge of the Universe has gone missing. This week, researchers have gathered to discuss their whereabouts at a special meeting on gamma-ray mysteries.
http://science.nasa.gov/headlines/y2008/22oct_missinggrbs.htm?list907815

Halloween Sky Show
The planets are gathering for spooky sunset sky show on Oct. 31st. Read today's story to find out where to look. http://science.nasa.gov/headlines/y2008/28oct_halloweensky.htm?list907815

Magnetic Portals Connect Earth to the Sun
Researchers have discovered 'magnetic portals' forming high above Earth that can briefly connect our planet to the Sun. Not only are the portals common, one space physicist contends they form twice as often as anyone had previously imagined. http://science.nasa.gov/headlines/y2008/30oct_ftes.htm?list907815

Librarian News

LRO's EPO team has been on the move again. This time we headed south to Kennedy Space Center (KSC) to give a workshop to Florida and Georgia librarians. As with previous workshops, the librarians became familiar with the LRO mission, the Moon, and activities related to them both.

As in previous workshops, this group of librarians went on a 'field trip'. We had a rare opportunity to go to the shuttle launch pads. At the time, there was not only one, but two shuttles. This was just a few days after the Hubble Space Telescope servicing mission was postponed. The reason for two shuttles is Endeavour was the rescue shuttle for Atlantis. If something should happen, Atlantis would not have enough fuel to make it to the Space Station.

We also had the opportunity to go into the Vehicle Assembly Building (VAB).

Links of the Month…

- SPACE PHOTOS, NASA While everyone is looking at the Phoenix mission and its photos, look at this one from the Mars Reconnaissance Orbiter. Very cool - that view clearly shows that earth and moon are being illuminated by the same (distant) source and analyzing it might help dispel some phase of the moon misconceptions. http://mars.jpl.nasa.gov/mro/spotlight/20080310a.html

- COSMIC JOURNEY, Cosmic Journey set to Song, a humorous view of many deep space issues. http://dingo.care2.com/cards/flash/5409/galaxy.swf

- GROUNDWATER MODEL, “The groundwater model is made by the students of UW-Stevens Point and is used as an educational tool to demonstrate how water and contaminants move through aquifers, various soil structures and watersheds.” http://www.uwsp.edu/stuorg/awra/h2omodel.html

Monthly Activity

How do you tell time in space?

The activity is from **NASA's Kids Science News Network™**
http://ksnn.larc.nasa.gov/activity/activity.cfm?unit=clock&concept=&enterprise=biological%20and%20physical%20research&title=How%20do%20you%20tell%20time%20in%20space?

Why Trilaterate

PURPOSE

To understand how a GPS determines your location

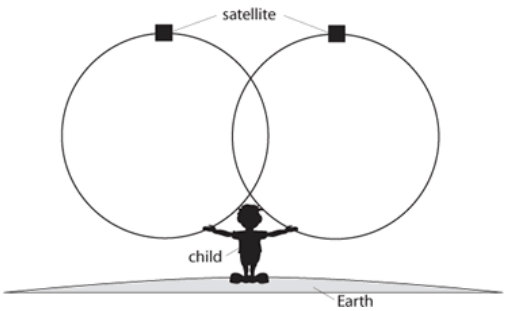
Background information: http://ksnn.larc.nasa.gov/webtext.cfm?unit=clock

MATERIALS

- computer with Internet access
- pencil and paper

PROCEDURE

1. Ted Tunes is traveling the world and space and you are challenged to locate him. You are provided a Global Positioning System (GPS) with 6 satellites and you will use sets of three satellites on a computer simulation to determine where in the world (or space) is Ted Tunes.
2. First you need to know how a GPS can locate Ted. We will explain the process by working on a plane because three dimensions is harder to visualize. The ideas we will use are very similar to those used by an actual GPS in three dimensional space. If you know Ted's distance from three satellites you can determine where he is by trilateration.
    a. From one satellite, draw a circle of radius equal to Ted's distance from that satellite. Ted will be somewhere on that circle. But where?
    b. Draw another circle from a second satellite of radius equal to Ted's distance from that new satellite. Usually the two circles will intersect at two points (can you think of other posibilities?). But which point is Ted's location?



    c. Finally, draw a third circle from a third satellite of radius equal to Ted's distance from that third satellite. That circle will intersect one of the two points and locate Ted. That is trilateration.
3. In the computer simulation, you need to click on Ted for his GPS to send you his distances from three satellites. Then you enter those distances in boxes on the upper left for the appropriate satellites. The satellites are each a different color - green, blue, red, purple, orange, and black - and they are sometimes called g,b,r,p,o,bk for short. Once you have entered the three

distances, then click the start/reset button to let the computer know the new distances and erase any old lines. Finally, click on the trilaterate button for the appropriate satellite group. For example, if your satellites were green, blue, and red, then click the "trilaterate gbr" button. To stop the trilateration click the appropriately labeled stop button. Don't worry about writing these directions down, they appear on the computer simulation.

4. Write down Ted's distances and the color for the three satellites you are given. If he is on the Earth, then write down the country. You may have to look up the country in an atlas. If Ted is in space, you can get his coordinates by using the locator dot described in the simulation. Write down his coordinates in space. The units used in the simulation are the computer screen's natural units called pixels. Each pixel is very roughly 100 kilometers. The satellites aren't drawn to scale, they would actually be much higher up off the screen.
5. To get another problem, just click on Ted again. Each time you click, you get a new randomly selected problem.
6. The computer simulation uses Squeak. First you have to download the Squeak plugin at **Squeakland** (http://www.squeakland.org/) by clicking on **GET SQUEAK!** and following the directions. Then click on **the Squeak simulation** (http://www.squeakland.org/project.jsp?http://www.pcs.cnu.edu/~rcaton/gps.012.pr) to locate Ted. Wait for the orange navigator tab to appear at the lower left, which indicates the simulation has completely downloaded, before you start.
7. In three dimensional space you need four satellites to determine Ted's location. From the first satellite you draw a sphere. Ted is somewhere on the sphere. Draw another sphere from the second satellite. The two satellites intersect in a circle. Draw a third sphere from the third satellite and that intersects the circle in two points. Fianlly use the fourth satellite to determine which of the points is Ted's location. This is harder to visualize and that is why we use the plane simulation. You can see a good three dimensional **demo** (http://www.trimble.com/gps/triangulating1.html) on the Internet.

CONCLUSIONS

1. Explain in your own words why you need three satellites to determine Ted's location.
2. What if the three satellites lie on a straight line? Can you tell where Ted is? Try it in the simulation. You can move three of the satellites to lie on a straight line. Move them close to the Earth so the circles aren't too large and click on Ted until you get smaller distances around 100 units.
3. Can you think of situations where trilateration won't work? What could you change to make it work?