LCROSS Mission Update
by Robert Henry

Due to a phenomenally successful LCROSS mission, it is now known with certainty that the Moon can no longer be thought of as a dry, barren wasteland.

Initial analysis of the data returned by the Lunar CRater Observation and Sensing Satellite, or LCROSS, indicates that it definitely uncovered water when it impacted the permanently shadowed areas of the Cabeus crater near the moon's south pole on Oct. 9, 2009.

When the Centaur upper stage rocket, shepherded by LCROSS from Earth, impacted the moon it created a two-part debris plume. Initially, there was a high-angle plume of fine dust and vapor quickly followed by a lower angle curtain of heavier ejecta. It has, quite literally, been billions of years since any of this material has seen sunlight.

Vast quantities of hydrogen have been known to exist at the lunar poles for a long time and some scientists have speculated that its source was water. Now the LCROSS findings indicate that not only does water exist at the lunar poles, but that it exists in greater quantities than previously thought.

The importance of these water-ice reservoirs, held in suspended animation for billions of years in permanently shadowed regions near the lunar poles, is two-fold and is of enormous importance. Much like ice core samples taken near the poles here on Earth, they may reveal key information about the evolution of our solar system. In addition, they would prove to be an invaluable resource in future long term lunar exploration and settlement.

Since the Centaur and LCROSS impacts, NASA scientists have been working feverishly to analyze the huge amount of data returned by LCROSS, concentrating on the data from the onboard spectrometers. Spectrometers examine light emitted or absorbed by material and can identify its composition.

By comparing known spectral signatures of water and other materials to the spectrometer readings taken of the impact, scientists have ruled out any other possible conclusion … they hit water!

Scientists have also found confirmation of these findings in emission lines found in the ultraviolet spectrum attributable to hydroxyl, a product of the break-up of water by sunlight.

Although the full analysis of the vast amounts of data returned by LCROSS may take quite some time to complete, it is certain that, in the end, it will reveal many more closely guarded secrets of the moon than just the presence of water.

Mars Photography
by Jim Fullerton

Earth is catching up with Mars again, so get your cameras ready! The atmosphere in Kansas is not usually steady during the Winter months. Frequent frontal passages help to insure that there are winds at the surface and aloft. This situation causes images seen through telescopes to look very unsteady. Astronomers call that situation "poor seeing".

You can still get decent or even good images when the seeing is not good. The use of high ISO speeds reduces the exposure time, which increases the chances that an image will occur during a moment of steady, or steadier, atmospheric conditions. By high ISO speeds, I mean 800 (minimum), 1600, or 3200 if your camera (or film) permits it. Exposure times will depend on the ISO speed. Since Mars only occupies a small part of the frame, you will need to set the exposure time manually.

Because of the need to take several images to increase the chances that at least one will be recorded with little atmospheric blurring, I recommend that digital camera users set their exposure mode (sometimes called 'Drive Mode') to Continuous or Multiple images. Set the exposure time, focus as best you can, then hold the shutter or release switch down for a few seconds to record several images. Change the exposure time and repeat that twice.

If you have image stacking software, you can combine the best images. Digital camera users should take color images. You can separate the red and green from blue to enhance or suppress some features. Martian surface details tend to appear better in red, while desert areas and dust storms appear bright in yellow (that's red plus green, in Light Color arithmetic!). The polar caps and clouds appear brighter in blue light (color minus red minus green).

This should be enough to get you started. Good luck shooting Mars!
From the Director

As 2009 fades into the past, it is time to see what the sky will bring us in 2010. The year starts out with Mars a little over 68 million miles away. That distance will decrease until January 27th when Mars will "only" be 62 million miles away. This is quite a bit farther than the August 27, 2003 closest approach of 35 million miles. After January 27th the distance between Earth and Mars will increase.

This is not one of Mars' closest approaches. However, Mars will be close enough for us to have a decent view of it through the telescope and it will be part of our programs through the end of March. However the best views will be a couple of weeks before and after January 27th.

Of all the planets, Mars is the one that most often fails to live up to people's expectations of how it should appear through the telescope. Their most common comment is about how small it appears, another is the lack of detail that can be seen.

Mars looks small through the telescope, because Mars is small to begin with. Although Jupiter is on the order of ten times farther away than Mars, it is also twenty one times larger. So even though it is farther away, Jupiter appears bigger through the telescope.

On a night when the atmosphere is nice and steady, dark surface markings and a white polar cap can be seen. However even a little atmospheric turbulence obscure their view. In addition, almost everyone has seen satellite pictures of Mars and those images stick in people's minds and influence what they expect to see.

That said, there is still something about seeing Mars first-hand. So find a night during the last half of January or first half of February when the stars do not appear to be twinkling and come on out to the Observatory and take a look at Mars! After you've seen Mars you will be able to explore a number of exhibits about Mars. One of which explains why this closest approach of Earth and Mars is not that close.

Last, but certainly not least, I want to express our appreciation and gratitude to the volunteer Explainers that have been helping out with our public programs, in some cases for a number of years. I would also like to welcome two new Explainers – Stephen Zenner and Patrick Bergkamp. All of the explainers help us meet our mission of bringing astronomy to the people of south-central Kansas. Thank you!

May 2010 bring clear skies!

Lake Afton Public Observatory Quarterly Newsletter

Office Address / Phone
1845 Fairmount, Wichita, KS 67260-0032
(316) 794-8995

Observatory Address / Phone
MacArthur Rd. at 247th Street West
(316) 978-3191

Program Information Line
(316) WSU-STAR

Web Address
http://webs.wichita.edu/lapo

Staff:
Director ............... Greg Novacek
Program Manager .............. Robert Henry
Student Assistant ............. Jeanette Bergkamp
Secretary ................. Susan Emerson

Volunteers:

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IN THE SKY

The winter sky is one of the best to behold and this winter there will be many sights to see, if you can stand the cold.

Mars rules the winter sky, rising around 9 p.m. in January. By March it will be nearly overhead just after sunset. On March 24, the waxing Moon encounters Mars. They will be visible nearly overhead.

Jupiter leaves the evening sky this winter, disappearing below the horizon in early February. But before that happens, look for it to encounter a thin crescent moon on January 17. For a treat, get out your good pair of binoculars, hold them steady, and try to find the moons around Jupiter. Go back out each evening and you can watch them change positions in relation to the planet.

Saturn will encounter the waning moon on the morning of January 6th. Look for it in the constellation Virgo, about halfway between Regulus and Spica. The planet enters the evening sky by mid-March, rising in the eastern sky around sunset.

Mercury makes a brief appearance in the evening sky this winter. It will be in the evening sky from mid-March through mid-April. Look for it low in the west just after sunset to see it best.

In early March, Venus joins the evening sky. On March 16, look for the thin crescent moon to be near Venus, low in the western sky, just above the horizon. Then as the month progresses, watch as Mercury joins it in the evening sky, approaching a little closer every evening.

Later in March, around sunset, begin to watch the sky as four planets make their appearance, spanning the evening sky. From east to west, are Saturn, Mars, Venus, and Mercury. The nearly full moon will be amongst the planets, also, so Mars may be harder to see.

Early risers will get some treats this winter too! January 6 brings a waning moon next to the planet Saturn in the pre-dawn sky. Then, on the mornings of January 11 and February 7, you can see the waning crescent moon as it moves past M4 and Antares in the constellation Scorpio. Late March will show both Jupiter and Saturn in the early morning sky. Look to opposite horizons to see both planets as they guard the morning sky just before sunrise.

Have fun and stay warm!
We would like to thank all our new and renewing members. Your membership helps the Observatory continue to provide the wonderful programs and exhibits available to the public every weekend.

Anne and Daniel Gillis
Pamela Mingauw
C.W. Robertson
And all those who choose not to have their names listed!

The Amazing Solar Dynamics Observatory
by Jim Fullerton

If all goes well, in early 2010, NASA will launch the Solar Dynamics Observatory, or SDO. It has a battery of instruments designed to monitor the Sun at multiple wavelengths, at high speed and at high resolution. SDO is designed to help us understand how the Solar magnetic field is produced and how its energy is transferred through the Sun and into space. It will also measure the "surface" velocities at the top of the Convection Zone. By studying long sequences of these data, Solar astronomers can detect oscillations and patterns of oscillations. These provide clues to the activity in the interior of the Sun.

The launch could not come at a better time because SDO is designed to study the Sun during LOW activity. Without the interference of active regions, it is much easier to "look" inside the Sun to detect and infer conditions within the Convection Zone of the sun.

SDO has three primary instrument packages:

The Helioseismic and Magnetic Images (HMI) will provide full-disk coverage at better resolution than SOHO.

The Atmospheric Imaging Assembly (AIA) will take images of the Sun's atmosphere ten times a second, at multiple wavelengths. Its resolution will be 50% greater than STEREO, which takes an image every three minutes, and 75% greater than SOHO, which takes an image every 12 minutes at best.

The Extreme Ultraviolet Variability Experiment (EVE) will measure Solar ultraviolet variability with greater precision and frequency than previous or current satellites. Data from a variety of previous satellites indicate that the solar irradiance, in watts per square meter, dips by 0.02% in visible wavelengths but by a comparatively large 6% in the extreme ultraviolet! Read the summary of a successful modeling of Earth surface temperatures during the Maunder Minimum that connects Solar UV irradiance to climate at: http://earthobservatory.nasa.gov/IO/11212 to get a better idea of what extreme ultraviolet data could tell us.

Here are a few of the scientific goals of the Solar Dynamics Observatory:
1. What drives the quasi-periodic solar activity cycle?
2. How is the magnetic energy of an active region produced, concentrated and dispersed?
3. How do the variations in extreme ultraviolet relate to the magnetic activity cycle?
4. What magnetic field patterns lead to coronal mass ejections, flares and filament eruptions?

Want to read more about the SDO? Take a look at the following websites.
http://science.nasa.gov/headlines/y2009/20oct_eve.htm

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"We were warned," is a tagline for the movie 2012, referring to the upcoming end of the Mayan calendar on December 21, 2012 and other doomsday prophecies. The movie portrays a small group of people desperately trying to survive apocalyptic scenarios as they develop all over the world. The movie is full of action sequences and narrow escapes of unnatural natural disasters, as well as scientific jargon and theories. However, like the special effects, the science of the movie has been altered for the sake of more convenient and dramatic storytelling.

The movie opens with a remarkable alignment of our solar system’s planets. This alignment was briefly mentioned later in the film as the cause of volatile activity in the Sun, and it appears to have no other effect on the movie. A very nice close up view of the active surface of the Sun accompanies it. In truth, no such planetary alignment will occur in the next few years or in the near future.

Another interesting scientific development is the reversal of Earth's magnetic poles. This development is highlighted by the shifting of the Earth's crust in the film as the new South Pole is noted to hover somewhere over Wisconsin, which had moved into the Arctic Circle.

Earth's magnetic poles are thought to reverse polarity about every 400,000 years, so this notion is not unheard of and some scientists believe the next switch is overdue. But in the movie, the change happens suddenly and without warning, so it loses validity. The switching of the Earth's magnetic poles is thought to be a process that takes thousands of years and would not occur within the course of a long plane flight, as portrayed in the movie.

When the first warning signs of the Earth's impending doom appear, a news anchor is seen reporting on the disasters and commenting on the public response, citing leaders of different religious movements who claim that it is the end of days. She refers to the increased solar activity to support their claim. The scientists in the movie believe the Sun is the cause of the chaos as well. Neutrinos, they explain to moviegoers, emitted in record amounts are heating Earth’s core, and leading to the current problem.

This ignores the fact that neutrinos rarely interact with normal matter and therefore could not heat Earth’s core. In fact, trillions of neutrinos pass through your body every second with no ill affects. The increase in solar output is not feasible either, fictional planetary alignment or not.

While NASA states there is an expected solar maximum during the 2012-2014 time frame, it is not predicted to be anything unusual or dangerous. In fact the Sun is currently in one of the deeper solar minimums in recorded history.

It is also interesting to see how, even with the supposed large amount of activity from the Sun, the movie's satellites, cell phones and other sophisticated electronic equipment never once faltered in their performance and communicative abilities, even at the end. Large amounts of solar activity is known to create problems with cell phone signals, communication satellites, and other electronic equipment. Any solar activity on the scale shown in the movie, should have seriously crippled all of this equipment.

In conclusion, 2012 should be watched in order to see the special effects, how people choose – and do not choose – to die, and the destruction, dissolution, and disappearance of nearly everything that holds society together. It should not be viewed as a science lesson. If possible, put aside your previous scientific knowledge and try to enjoy the movie anyway.

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A New Day in Rocketry is Getting Ready to Launch

by Richard Kennedy

For over thirty years, the space shuttle has been the workhorse of travel to Earth orbit, but the era of the “space plane” is rapidly coming to a close. With just five shuttle missions remaining, NASA has entered the testing phase for the next generation of launch vehicles.

The new Ares rocket program is being designed to meet two objectives. The first is to replace the space shuttle as a transport between Earth and the International Space Station. The second is to aid the return of man to the Moon. In order to complete both of these objectives, NASA scientists and engineers have decided the most feasible approach is to design two similar launch platforms.

The first is the Ares I rocket which was successfully tested for the first time on October 28, 2009. The Ares I is designed as a crew and light supply transport. Essentially, it is intended to get astronauts off the ground and into Earth's orbit. The design of this rocket incorporates an upgraded solid booster first stage like the ones now used on the space shuttle. Once the solid booster has burned out and is released, a second hydrogen-oxygen fueled stage will accelerate the crew return capsule and its passengers into orbit where they can either dock with the space station or rendezvous with the second stage of a Ares V rocket for a trip to the Moon.

The Ares V is the second Ares platform. This heavy lift rocket will have the capability to launch over 200 tons of payload into orbit. Once in orbit, the second stage awaits a rendezvous with the crew and command module launched by an Ares I rocket before departing for the Moon. The second stage of the Ares V will propel the crew, command module, lunar surface module and supplies need for the lunar mission with a J2X hydrogen-oxygen fueled engine.

The solid rocket boosters falling away form the Ares V rocket. (NASA illustration)

The implementation of the Ares rockets will play a substantial role in the expansion of human exploration to the Moon, Mars and beyond. This next generation rocket opens the door to a new age of exploration, our expansion into the solar system and a better understanding of the universe around us.

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We are in a deep solar activity minimum. Spaceweather.com reported on November 29 that since 2004, there have been a total of 760 days without sunspots. Two hundred and forty-nine of those days occurred in 2009. A "typical" solar minimum, for solar activity in the past 200 year or so has been about 485 days without a sunspot. We are currently experiencing a so-called "century-class" solar minimum.

The last extended solar minimum was the Dalton, which lasted 40 years from 1790-1830. The current solar minimum has arguably lasted only five years so far, so we are nowhere close to a major historical minimum. Nevertheless, there are some interesting and conflicting data about that situation.

First, a standard definition of "sunspot number" must be used. Spaceweather.com has a link to a short article about the sunspot number. They report the Boulder, or Wolf, sunspot number. It combines individual spots and spot groups, then weights the result for the instrument used and the observing conditions. Generally, dividing the Boulder number by 15 will tell you how many spots you can see with a small telescope fitted with a proper solar filter. (Don’t try looking without one!)

The roughly periodic cycle of 11 years for sunspot numbers is actually half of a solar magnetic cycle. Regions of solar magnetic flux migrate over time, causing the overall solar magnetic field to "flip" near sunspot minima. The origins of this cycle are poorly understood, but the field of helioseismology is providing some valuable insights.

By analyzing the natural vibrations of the sun, scientists can deduce the activity in the Convection Zone that we cannot see directly. In the report posted at http://science.nasa.gov/headlines/y2009/17jun_jetstream.htm, Drs. Rachel Howe and Frank Hill of the National Solar Observatory (NSO) in Tucson, analyzed the solar "jet streams" as deep as 7,000 km inside the sun.

The researchers found that when the jet streams decrease to a solar latitude of 22 degrees, sunspot activity increases. While this does not tell us why sunspots form, it may be a plausible indicator of when they will form. The 22 degree latitude has been crossed, so if this correlation is reliable, sunspot activity should begin to increase. Meanwhile, at the NSO "ranch" in Tucson, Drs. Matt Penn and Bill Livingston have collected some interesting data on the strength of sunspot magnetic fields over the past 17 years. The baseline is not nearly long enough to tell us about typical solar cycles. But if you like sunspots, they do not have good news.

Their data covers most of two sunspot cycles, and the magnetic field strength has been declining through spot maxima and minima! (See the graph and a trend line above.)

So, whatever the Sun does over the next few years, we have a great opportunity to learn much more than we know right now. As with any scientific studies, some results may come early and some won't be agreed on or understood for several years. Solar minimum is turning out to be a fascinating time to study our closest star, Sol, the Sun!

Look for the related article on the Solar Dynamic Observatory, designed to watch the sun during periods of low activity.

From http://science.nasa.gov/headlines/y2009/03sep_sunspots.htm

Photography Programs
Have you ever wanted to take astronomical photographs of the planets, Moon, or stars? If so, join us for our special photography programs.

Bring your 35 mm single-lens reflex camera (the type with a removable lens) to take astronomical photographs using the Observatory's telescope. [Note that Automatic 35 mm cameras without a manual override cannot be used to take astronomical photos.]

If you do not have the proper camera, bring a USB flash drive instead. After you use the Observatory's digital SLR to take your pictures, we will transfer them to your flash drive for you to take home and print.
Observatory Hours
The Observatory is open every Friday and Saturday evening. Admission is $4.00 for ages 13 and over and $3.00 for ages 6 - 12. Children under 6 are admitted free. Observing through the telescope begins soon after the doors open. Program times are subject to change. Call the Observatory at (316) WSU-STAR to confirm programs and times or to check for weather-related cancellations.

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<th>January 4 - February 28</th>
<th>7:30-10:00 p.m.</th>
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CURRENT OBSERVATORY PROGRAMS

**Life Story of a Star**
January 8-9, 15-16 7:30-10:00 p.m.
February 5-6, 12-13 7:30-10:00 p.m.
March 5-6, 12-13 8:00-10:00 p.m.
Stars are born, live out their lives, and die. During this program you can use the observatory's 16-inch telescope to take a look at examples of the many stages in a star's life. We will also be looking at Mars as it makes its closest approach to Earth since December, 2007.

**Colonizing Space**
January 22-23, 29-30 7:30-10:00 p.m.
February 19-20, 26-27 7:30-10:00 p.m.
March 19-20, 26-27 8:00-10:00 p.m.
Have you ever wondered what it would be like to live on the Moon, Mars, or an Earth-like planet orbiting another star? During this program, we will examine these objects through the Observatory’s 16-inch telescope and discuss what it will take for man to achieve these goals.

**Photography Programs**
Mars ............ 10:00 p.m., Jan. 23
Mars ............ 10:00 p.m., Feb. 6
Orion Nebula (M42)* 10:00 p.m., Mar. 13
Bring your 35 mm or Digital SLR camera or flash drive and take pictures of what you see through the telescope.

*ISO 800 or faster speed film, telephoto lens, and cable release are required.
For all other programs ISO 400 or 800 color film and a cable release are recommended.

Lake Afton Public Observatory
1845 Fairmount
Wichita, KS  67260-0032

Become a Friend of the Lake Afton Public Observatory

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□ New Member □ Renewal □ I am interested in volunteering some of my time to the Observatory. □ Gift Membership