The ASTERISM

as' ter ism ~ a recognizable pattern of stars
con stel la' tion ~ an internationally designated area of the sky

Volume XXV No. 3 **December 2013**

What's Inside…

Note: Use bookmark panel in Adobe Reader.

Yutu

A new desk-sized rover has begun exploring the Moon. Launched two weeks ago by the Chinese National Space Administration, the Chang'e 3 spacecraft landed on the Moon yesterday and deployed the robotic rover. Yutu, named for a folklore lunar Jade Rabbit, has a scheduled three-month mission to explore several kilometers inside the Sinus Iridum (Latin for "Bay of Rainbows") impact crater. Yutu's cameras and spectrometers will investigate surface features and composition while ground penetrating radar will investigate deep soil structure. Chang'e 3 achieved the first soft Moon landing since the Soviet Union's Luna 24 in 1976, and Yutu is the first lunar rover deployed since the USSR's Lunokhod 2 in 1973. Pictured below, Yutu was imaged from its lander yesterday soon after rolling onto the Moon.

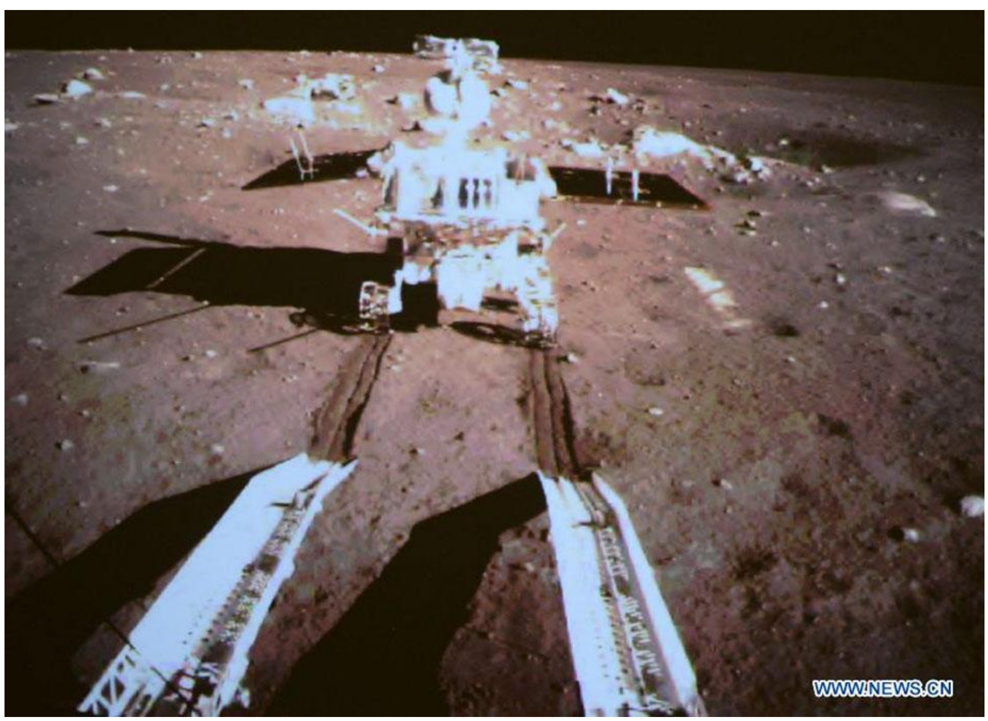


Image curtesy of Chinese National Space Administration, Xinhuanet, www.news.cn, NASA

GENERAL MEMBERSHIP MEETING DECEMBER 20, 2013

ROY SMITH THEATER - UCC CAMPUS 8:00 p.m.

50 Years of Stargazing: Solar and Stellar Cycles Research at Lowell Observatory
Dr. Jeff Hall, Director

Appearance by SKYPE

For sixty years, astronomers at Lowell Observatory have studied the variations of the Sun and stars like it, examining their activity cycles to get a better idea of the Sun's long-term envelope of variability, providing an astronomical perspective on natural forcing of climate change. Jeffrey Hall will discuss the long-running programs at Lowell, their essential results, and prospects for the future as Lowell brings online its new 4.3-meter Discovery Channel Telescope.

PLEASE JOIN US!!!

New Members

Amateur Astronomers, Inc. welcomes the following new members to our club during the month of December:

Scott Gerum of Edison, NJ
Sue Lamothe of Plainfield, NJ
Jofet Hernandez of Jersey City

We hope you enjoy using Sperry Observatory and all the opportunities available to you as a member such as seminars, lectures, training, observing, and research. Our Qualified Observer course is a great place to start. It is equivalent to a college-level introduction to Astronomy, and it includes hands-on training on our 24-inch reflecting telescope. For this and other opportunities, check the **Club Activities** section of the website.

Again, welcome to AAI!

Irene Greenstein, Membership Chair

STAR PARTY
SPERRY OBSERVATORY
FRIDAY JANUARY 10
FEBRUARY 7
at 7:30 p.m.

MEMBER ONLY STAR PARTY
JENNY JUMP STATE PARK
HOPE, NJ
SATURDAY JANUARY 4,
AND FEBRUARY 1, 7:30PM

Stewart's Skybox

by Stewart Meyers

2013 has seen the demise of the first two space missions devoted to discovering planets around other stars – COROT and Kepler. This column will look at these two spacecraft.

The Transit System

There are several methods that can be used to find planets orbiting other stars. One method, the first to actually yield results, involves studying a star's spectrum at high precision to look for a regular shift in the position of the dark lines in the spectrum. This shift is caused by a change in velocity of the star. As a planet orbits a star, it exerts a tiny gravitational pull on the star. This pull causes the velocity changes.

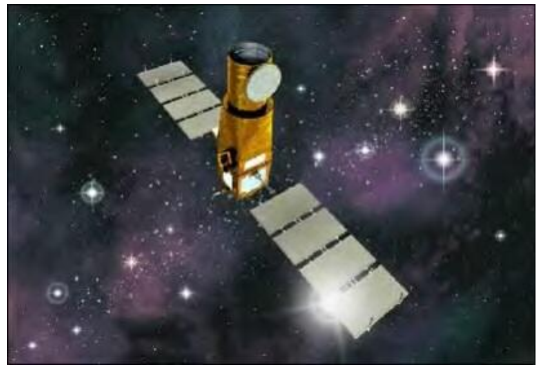
Another method, which has only met with limited success, is microlensing. Microlensing takes advantage of the fact that a massive object can curve light that passes close by it. Seen from a distance, this causes the distant star whose light is being curved to appear slightly brighter as long as the massive object is in a position to deflect light. This effect is large for galaxies, but small for stars. It is even smaller for extrasolar planets.

However, there is one simple method. If the plane of the extrasolar system is properly aligned in relation to the plane of our solar system, the extrasolar planets will appear to pass in front of their parent star as seen from our solar system. As we know from the transits of Venus across the Sun, a transiting planet will block a tiny fraction of the light of its sun for a period of time that repeats once an orbit. The effect is small, though. A planet the size of Jupiter will reduce the light of a sun-like star by about 1%. Smaller planets would produce correspondingly smaller light reductions.

Since the planes of star systems are randomly distributed, one has to look at a large number of stars in order to have a realistic chance of seeing a transit. On top of that, the stars have to be observed continuously to look for a transit. Also, the light of the star must be precisely measured. These kind of observations are difficult from Earth's surface due to the presence of our atmosphere and its effects on seeing, as well as the day/night cycle, the rising and setting of stars, and the changeable weather. Therefore, scientists realized that this method would work best from spacecraft.

COROT

The first transit detecting space mission to launch was COROT (COnvection, ROtation, and planetary Transits), which was operated by the European Space Agency (ESA). Not coincidentally, the name also honors 19th century French artist Jean-Baptiste-Camille Corot.



Artist depiction of the COROT spacecraft (http://sci.esa.int/science-e-media/img/c5/i_screenimage_29381.jpg)

COROT consisted of a telescope with a 27 cm mirror (about 11 inches) with a 1.1 meter focal length (about 44 inches). As suggested by the name, COROT's mission was not just to look for extrasolar planets, but also to detect vibrations and other disturbances in stars. Study of such vibrations in our Sun have yielded much information about the solar interior, making this an area of great scientific interest.

Launch date was December 27th, 2006 and was handled by the Russians from their facility in Khazakhstan. COROT went up without a hitch and entered into a polar orbit at about 900 km altitude (561 miles). This orbit allowed COROT to observe two regions of the sky for 150-day periods.

Despite the limitations posed by the small aperture as well as its Low Earth Orbit (LEO), COROT did rack up a number of discoveries during the mission. It found at least 23 star systems including one with multiple planets. COROT-7b was the first confirmed rocky planet to be detected. However with a year lasting only 20.5 hours, it is far from Earth-like.

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Also, COROT-24 was the first system to have two transiting planets. COROT also made the first detection of planets in a binary system, though they were orbiting only one of the stars. While COROT's list of discoveries may not seem impressive, one has to consider the aperture and orbital limitations as well as the fact that the COROT science team refused to publish any information on exoplanet candidates until they were confirmed.

COROT also made a number of discoveries about stars as well. The parameters of several binary stars were refined as a result of COROT's detailed measurements of their eclipses. And by studying the variations in starlight caused by a star's vibrations, a number of discoveries have been made about the behavior of such variable star types as Beta Cepheids and Be stars. COROT also improved our understanding of stars in their extreme youth (observations of NGC 2264 in Monoceros) and old age (studies of the vibrations of red giant stars).

Though COROT did outlast its 2-1/2 year base mission, it was not immortal. On November 2nd, 2012, COROT lost the ability to transmit data to Earth. Despite months of effort, the problem could not be resolved and COROT was retired in June of 2013. It will eventually fall out of orbit.

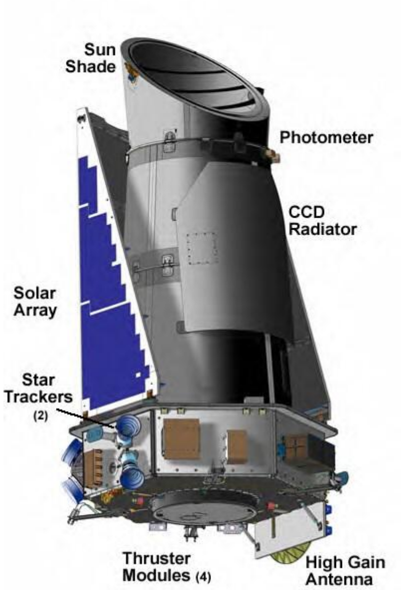

Illustration of the Kepler spacecraft (http://kepler.nasa.gov/images/mws/FlightSgmntBodypointLbld.jpg)

Kepler

NASA's transit detecting satellite was named in honor of Johannes Kepler, who came up with the three laws of orbital motion. Kepler was a much different spacecraft than COROT. It has a 1.4-meter (55 inch) mirror, though Kepler's aperture was stopped down to .95 meters (37.4 inches). It features a 95-megapixel camera made up of 42 CCDs.

Kepler was launched on March 7, 2009. Unlike COROT, which was placed in Earth orbit, Kepler was placed in a solar orbit that allowed it to trail Earth. This avoided the negative effects of being in Earth orbit, such as Earth getting in the way of the observations, day/night cycling for the solar panels, stray light, and gravitational effects. Also, Kepler was designed to stare at one part of the sky, an area covering parts of the constellations of Cygnus, Lyra, and Draco. This area was chosen due to the presence of the Milky Way, which maximized the number of potential targets, but it was an area of the Milky Way that was not too dense with stars that would cause problems with detections.

This approach has yielded abundant results. The most recent report from NASA (as of late October 2013), lists Kepler as having discovered 167 confirmed extrasolar planets with 3,538 extrasolar planet candidates, as well as 2,165 new eclipsing binary star systems. The confirmed Kepler planets are interesting lot. One of these, Kepler-16b, orbits both stars of a binary system, reminding some in the mainstream media of Tatooine from the "Star Wars" franchise. However, Kepler-16b is planet like Saturn in terms of mass and likely properties. Then there is KOI-500, a star system in miniature with five planets orbiting within one-twelfth of an astronomical unit (AU – 1 AU is the Earth-Sun distance) of the parent star, and. But the extrasolar planets that draw the most interest are the ones that are close to Earth in size and orbit within what is deemed to be the habitable zone of their parent star. Kepler has found a number of extrasolar planets that were close in this regard, but further analysis disqualified them. It appears that there are now some candidates that fit the bill. It should be interesting to see if they survive the confirmation progress.

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Stewart's Skybox

by Stewart Meyers

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With the large number of candidates, it has become possible to work out how common certain sizes of extrasolar planets are. In the early days of the field, it seemed that planets the mass of Jupiter or larger were the most common. But this was due to limitations in the detection methods (mainly measuring radial velocity variations in stars, a method that would favor heavy planets orbiting close to their stars). But with the Kepler results, it seems that the frequency of extrasolar planets peaks around the size of Neptune. As most astronomical objects become more common the smaller they are, it is expected that extrasolar planets should fit the pattern and eventually, as more data is released from the Kepler mission, this should be seen in the distribution plots.

Kepler was doing so well in its mission that the funding was extended to 2016. However, in April of 2013, Kepler lost a second reaction wheel (a powered gyroscope that controlled the pointing of the spacecraft). A first one had failed earlier in the mission. Up until July, NASA had hoped they could restart the earlier failed wheel. In August, NASA announced that the wheels were beyond salvage. But there was a possibility that Kepler could be repurposed. Suggestions have included searching for extrasolar planets via microlensing, asteroid detection, or salvaging the mission by electronically compensating for any drift caused by the loss of the reaction wheels. NASA's search for proposals is ongoing as of this writing and there is no clear indication when a final decision will be reached.

Follow-ups

The next planet-detecting mission will be TESS (Transiting Exoplanet Survey Satellite). This satellite will be equipped with four wide-angle telescopes. Unlike Kepler's solar orbit, TESS will have an unusually eccentric Earth orbit that will keep it outside the Earth's magnetic field most of the time. At perigee (every 13.7 days), it will then transmit data to Earth. TESS will be an all-sky survey and concentrate on stars much brighter than Kepler observed. Whether TESS will be a worthy successor to Kepler or weak shadow will have to wait until 2017, the expected launch date.

Regardless, COROT and Kepler have greatly expanded the science of extrasolar planets. With the large amount of Kepler data that hasn't even been analyzed yet, who knows what strange new worlds lie waiting to be known?

☆☆☆

There will be no access to Sperry Observatory from December 25 through January 9, 2014.

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MEMBERSHIP DUES

Regular Membership:	$21
Sustaining Membership:	$31
Sponsoring Membership:	$46
Family Membership:	$5
First Time Application Fee:	$3
Sky & Telescope:	$32.95
Astronomy subscription:	$34

(Subscription renewals to *S&T* can be done directly. See "Membership-Dues" on website for details.)

AAI Dues can be paid in person to our Membership Chair, or by mail to: AAI, PO Box 111, Garwood, NJ 07027-0111

DOME DUTY

Dec	20	Team D
Jan	10	Team B
Jan	17	Team C
Jan	24	Team D
Jan	31	Team E
Feb	7	Team A

FRIDAYS AT SPERRY

Jan 10, 2014 and Feb 7, 2014
What's Up? A Down to Earth Sky Guide Kathy Vaccari
Space Missions Briefing
Bill Whitehead
"Highlights of the Sky for 2014"
Alan P. Witzgall **Only January**

Jan 24, 2014
TBA

Jan 31, 2014
Women That Found Modern Astronomy
Alan P. Witzgall

Feb 14, 2013
Black Holes
Bill Whitehead

All schedules above were accurate at time of publication. Please check www.asterism.org for latest information (click on "Club Activities")

The next **General Membership Meeting** is the third **Friday, January 20, 2014.** Our speaker is **Dr. Emily Rauscher,** Princeton University her topic is **Predicting Exotic Weather on Extra-Solar Planets**

PLEASE JOIN US!

Theater in the Sky

by Ron Ruemmler

January 2014 is a wonderful month for planet watchers. The **Moon** has lovely conjunctions with each of the five classical planets, visiting **Venus** twice, once in the evening then four weeks later in the morning.

Every 1.6 years **Venus** swings between the **Earth** and the **Sun** moving from the evening into the morning sky. The last time this happened was in June 2012 when the planet actually transited across the face of the **Sun**. This month's inferior conjunction misses the **Sun** by a full 5 degrees to the north. This means that for a few days around the 12th it is theoretically possible the see **Venus** both in the morning and in the evening!

Since **Venus** turns its dark side toward the **Earth** at this time, it is only now that you can see it as a very thin crescent. Optical aid of some kind is needed. When the **Moon** is near on the 28th, it can be used to follow the planet until the **Sun** rises and claim a daylight sighting of **Venus**!

The other conjunctions are also exceptional. **Jupiter** is just past its opposition from the **Sun** and at its brightest. **Mars** is just above Spica which, in turn, is very close to the right of the **Moon**. **Saturn** skims along just to the upper left of the **Moon**. And, finally, at -0.6 magnitude, **Mercury** is having an unusually bright elongation from the **Sun** as the tiny crescent **Moon** sweeps by back in the evening sky on the last day of the month

January (times are PM unless noted)

1 Wed 6:14 AM	First New **Moon**
2 Thu 5:10	Very thin crescent **Moon** upper left of **Venus**
4 Sat 7:00 AM	Perihelion; **Earth** nearest to **Sun** (91,406,673 miles)
4 Sat 7:20 AM	Latest sunrise of 2014
5 Sun	**Jupiter** at opposition from **Sun**, visible all night
7 Tue 10:39	First Quarter **Moon**
11 Sat 7:00 AM	**Venus** passes into the morning sky
11 Sat 6:20	Aldebaran lower left of **Moon**
12 Sun 6:20	Aldebaran upper right of **Moon**
14 Tue 5:50	**Jupiter** upper left of **Moon**
15 Wed 5:50	**Jupiter** directly above **Moon**
15 Wed 11:52	Full **Moon**
23 Th 5:45 AM	**Moon**-Spica-**Mars** triplet (see text)
24 Fr 12:19 AM	Last Quarter **Moon**
25 Sa 5:45 AM	**Saturn** very close upper left of fat crescent **Moon**
28 Tu 6:10 AM	Thin crescent **Moon** upper right of **Venus**
29 W 6:10 AM	Very thin crescent **Moon** lower left of **Venus**
30 Th 4:39	Second New **Moon**
31 Fri 5:55	**Mercury** upper left of very thin crescent **Moon**