May 2010

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May's Meeting

The next meeting of S*T*A*R will be on Thursday, May 6th, 2010 and will feature Dr. Ken Kremer who will speak about "LRO & LCROSS: America Returns to the Moon". All are welcome. The meeting will begin promptly at 8:00pm at the Monmouth Museum on the Brookdale Community College campus.

Editor's Corner

Many thanks to Rob Nunn and Randy Walton for contributing to this month's Spectrogram.

Reminder to pay membership dues $25/individual, $35/family. Donations are appreciated. Make payments to our treasurer Rob Nunn at a club meeting or mail a check payable to S*T*A*R Astronomy Society Inc to:

S*T*A*R Astronomy Society
P.O. Box 863
Red Bank, NJ 07701

June Issue

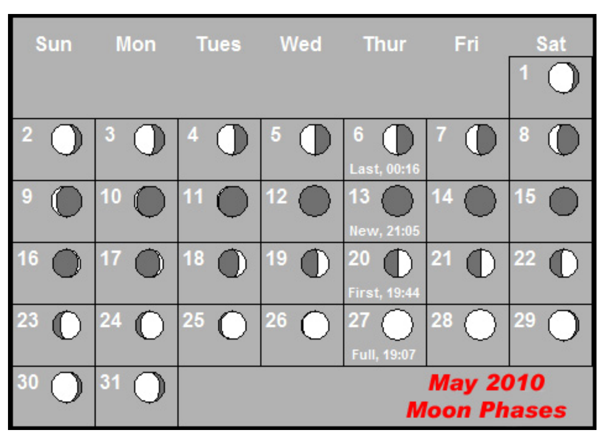
Please submit articles and contributions for the next *Spectrogram* by May 26.
Please email to fowler@verizon.net.

Calendar

- May 6, 2010 – "LRO & LCROSS: America Returns to the Moon" presented by Dr. Ken Kremer
- Jun 3, 2010 – Annual Business Meeting

Got Pix? Like to Write?

Have you been out observing with your friends? Have you made any great astro-images? How about a story and pictures of your latest ATM project? If you have anything you'd like to share, email fowler@verizon.net and let us know what you've got!



S*T*A*R
P.O. Box 863
Red Bank, NJ 07701
On the web at:
http://www.starastronomy.org

Edited by: Bob Fowler

April Meeting Minutes

The April 1, 2010 meeting of S*T*A*R Astronomy club began at 8:00 p.m. The meeting was attended by about 45 people. President Nancy McGuire chaired the meeting and began by presenting the agenda and greeting five first-time attendees. Several of the new attendees own telescopes, and hope to improve their observing skills.

Nancy then introduced the speaker for the evening. Al Witzgall is an optician who has built devices used in space telescopes. Al presented a fascinating survey of space telescopes – from the first ideas about putting telescopes in space, to plans for an array of mirrors at one of Jupiter's Lagrangian points. He discussed the purposes of the telescopes and the discoveries made with them. His description of the error made in figuring the Hubble mirror and the method used to correct the error elicited a number of comments and questions. He noted ingenious uses being made of devices that are no longer able to serve their original purposes. The Mars Spirit Rover, for example, is being used to detect seismic activity now that it is stuck in sand. By imaging a star, ground vibrations show up as apparent motion in the image. His talk was an excellent overview of the types of studies being performed and the progress of technology that has occurred over the last 60 years.

Following the talk Robert Katz presented the object of the month, the elliptical galaxy M87 in Virgo. M87 is noted for its large number of globular clusters, more than 10,000 by some estimates.

Coming events include star parties and Earth Day. Dave Britz asked for volunteers to help with a star party at Nut Swamp Elementary School on April 22. Gavin Warnes will have a solar telescope at Bayonet Farm on April 25 for Earth Day, and could use some assistance. Rich Gaynor announced plans for a star party tentatively scheduled for June 2. Because of the very late onset of darkness at that time of year, the date could be changed.

Following the break, Ahmad Jrad reported on plans for observing at Dorbrook Park on the two nights following the meeting (April 2 and 3). Those who arrive early should have a good view of Mercury. Ahmad suggested that an observing night could be devoted to helping beginners learn to use telescopes and methods for finding objects.

Steve Rich asked for advice on finding information on the club web site. Discussion revealed that a number of members have some difficulty using the web site, and it was suggested that a demonstration of its use might be helpful. If an internet connection can be arranged, a demonstration might be given at the business meeting.

Nancy McGuire asked club members to consider moving the meeting starting time to 7:30. A vote on changing the time will be held at the business meeting June 3. Nancy also mentioned a suggestion to make meetings appealing to more members. A display or discussion running concurrently with the talk might be useful for children or those interested in learning observing methods. She suggested as possible topics use of a planisphere, or a demonstration on the parts of a telescope and how a telescope is set up.

Steve Rich suggested that those who join the club late in the year be offered a reduced price.

The 50/50 drawing was won by Dennis Oleary, who donated his $11 winnings to the club.

The meeting adjourned about 10:40.

Are you a S*T*A*R Member?

S*T*A*R is the proud owner of a monstrous 25" Dobsonian Obsession reflector – which members can gain access to!

Meetings are the first Thursday of each month, except July and August, at 8:00 PM at the Monmouth Museum on the Brookdale Community College campus. Meetings generally consist of lectures and discussions by members or guest speakers on a variety of interesting astronomical topics. S*T*A*R is a member of United Astronomy Clubs of New Jersey (UACNJ), the Astronomical League (AL), and the International Dark Sky Association (IDA).

Memberships: ( )Individual....$25 ( ) Family...$35

Name_______________________________________

Address_____________________________________

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Hubble Celebrates 20 Years of Astonishing Discoveries

Steven Siceloff - NASA's John F. Kennedy Space Center

Space shuttle Discovery roared into orbit April 24, 1990, with a most precious cargo, NASA's Hubble Space Telescope. In the two decades since, teams of astronauts working from other shuttles repaired the orbiting eye on the universe and extended its abilities far beyond what was thought possible for longer than many thought realistic. Hubble, named for groundbreaking astronomer Edwin Hubble, repaid the commitment with some of the most dazzling images the world has seen, along with fresh data that answered a wealth of questions and led to many new ones. The telescope's observations allowed astronomers to set the age of the universe at about 13.7 billion years with a high degree of certainty.

"I never believed in 1990 that the Hubble would end up this great," said Ed Weiler, NASA associate administrator for the Science Mission Directorate and chief scientist for the Hubble program when it launched. "It's changed a lot of thinking and it's changed a lot of what I learned 30 years ago in grad school."

Hubble's discoveries stretch over most aspects of astronomy, but its highlights include proving massive black holes exist and defining the age of the universe. It also proved the existence of something no one has seen -- dark energy. "Nobody ever knew it existed before Hubble," said Jon Grunsfeld, an astronaut and astronomer who worked on Hubble during two shuttle missions.

The telescope's most unique element, though, is its orbit -- a perch so high above the planet that its pictures are not warped or distorted by the air currents, moisture and other effects from Earth's atmosphere.

"It's that extreme clarity that gives us the feeling we've traveled out into space to see these objects," Grunsfeld said. "It really is our time machine."

From more than 300 miles in space, Hubble looked back in time, showing astronomers what embryonic galaxies looked like almost 14 billion years ago. In some cases, Hubble's instruments picked up light that left stars only 600 million years after the Big Bang. "We're seeing the universe as it was perhaps as a toddler," Grunsfeld said.

An image that is perhaps Hubble's most famous, known as the Hubble Deep Field, was made when the telescope was pointed at a small sliver of space in the constellation Ursa Major, which appeared black and empty. Hubble found it brimming with young galaxies and stars in a kind of photographic time capsule from the universe. Astronomers called it a baby picture of space.

The Hubble Ultra Deep Field built on that image in 2003 and 2004 when it used new instruments to pick out galaxies in another section of the sky which would have been too faint for Hubble's previous equipment to detect.

"We always discover things that we never even imagine," Grunsfeld said. "The universe is always more interesting than we give it credit for."

This Hubble photo is of a small portion of one of the largest-seen star-birth regions in the galaxy, the Carina Nebula. Towers of cool hydrogen laced with dust rise from the wall of the nebula. The pillar is also being pushed apart from within, as infant stars buried inside it fire off jets of gas that can be seen streaming from towering peaks. Credit: NASA, ESA, and M. Livio and the Hubble 20th Anniversary Team (STScI)

Some of the most notable discoveries were almost lost because Hubble was launched with a tiny flaw in its main mirror. Although the mirror was ground too flat by less than the width of a human hair, that was enough to throw off the focus.

"Little did we know we were launching a telescope that had a mirror that was slightly misshapen," Weiler said. "But we found a way to fix it, which we did, which the astronauts did, in 1993 and for the past 17 years Hubble's been filling the textbooks with new science." Starting with STS-61 in 1993, five teams of astronauts worked on the telescope from the space shuttle. The first installed a set of small mirrors that acted like a contact lens to clarify Hubble's vision. Since then, new instruments have been added, along with new components. Taken together, the servicing missions added years to Hubble's life.

"When we launched it in 1990, we were hoping to get 10 to 15 years out of it," Weiler said. "We're now talking about the 20th anniversary, so we're talking about five years of dividends on our investment, and we should be able to get at least another five years and maybe another seven, eight or nine years."

Astronomers were not the only ones pleased with the life extension. The 12 1/2-ton space telescope reached into the mind and spirit of the general public in an unprecedented way. Images from the telescope have made their way onto stamps, album covers and even into art exhibits.
"I think the unique thing about the Hubble is that it's truly brought science to the general public, especially the school kids," Weiler said. "It's still the most powerful telescope that humans have the ability to use and it has been since it was launched."As much as Hubble became a cornerstone for astronomy, it was also the first element of NASA's Great Observatories program which produced four telescopes that looked at the different kinds of light in the universe. The Hubble was designed to see visible light, which is the same light people see. So Hubble's pictures show the universe as it appears to the human eye.

An image of the galaxy NGC 4603, taken by the Hubble Space Telescope in 1996 and 1997. Astronomers measured this galaxy to determine its distance to be 108 million light years. It was the most distant galaxy used in Hubble's key project to determine the age of the universe. Photo credit: NASA

The Compton Gamma Ray Observatory launched in 1991 to detect gamma ray bursts, some of the most energetic particles known. The Chandra X-Ray Observatory was launched in 1999 and surveyed the universe for invisible x-rays. Lastly, the Spitzer Space Telescope went into space in 2003 to look at the cooler heart of space, including dust clouds that are the nursery for stars. The Spitzer was the only NASA “Great Observatory” not launched on a shuttle. Instead, it rode a Delta II.

None of the observatories was meant to study space by themselves. Astronomers instead used one telescope's findings to study it with the others to form a nearly complete picture of a celestial place across the spectrum of light. Ground-based telescopes, which continue to grow in size and sophistication, are also used to study or confirm findings.

The Hubble Space Telescope was last seen by human eyes on STS-125, the last serving mission by a space shuttle. The astronauts installed new instruments and components so the telescope can continue operating for years to come. Photo credit: NASA

Although there won't be any more servicing missions by the shuttle, Weiler and Grunsfeld said the telescope is ready to make more discoveries.

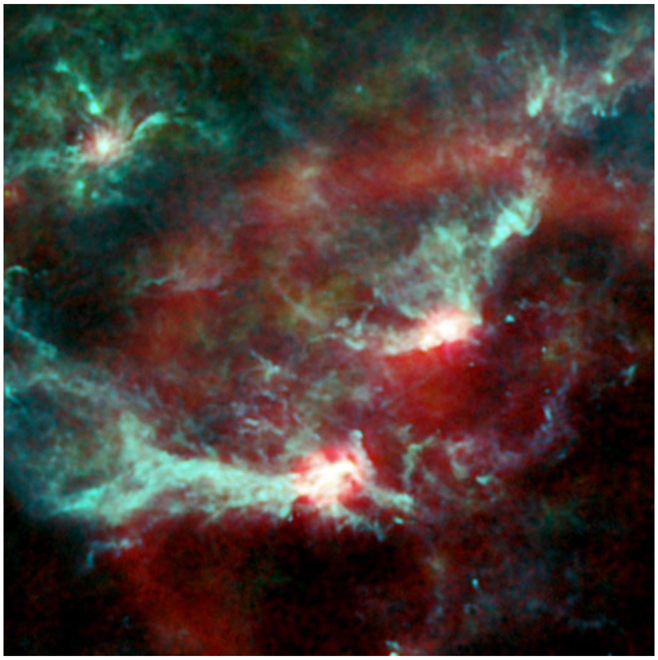
"The telescope still looks in great shape," Grunsfeld said. "It's just a thrill to work on what is by many measures the most productive scientific instrument ever created by humans."

Planck Sees a Cold and Stormy Orion

The big hunter in the sky is seen in a new light by Planck, a European Space Agency mission with significant NASA participation. The long-wavelength image shows most of the constellation Orion, highlighting turbid clouds of cold material, where new stars are being stirred into existence.

The Planck mission is busy surveying the whole sky at longer wavelengths of light than we can see with our eyes, ranging from infrared to even longer-wavelength microwaves. It is collecting ancient light from when the universe was very young, less than half a million years old, telling us about the birth and fate of our universe. In the process, the mission is gathering data on our Milky Way galaxy that astronomers are using to see through cold pools of gas and dust, which block visible-light views of star formation.

The new image shows one such region in our Milky Way, where stars are actively bursting to life. The much-photographed Orion nebula is the bright spot to the lower center. The bright spot to the right of center is around the Horsehead Nebula, so called because at high magnifications a pillar of dust resembles a horse's head. The whole view covers a square patch of sky equivalent to 26 by 26 moons.



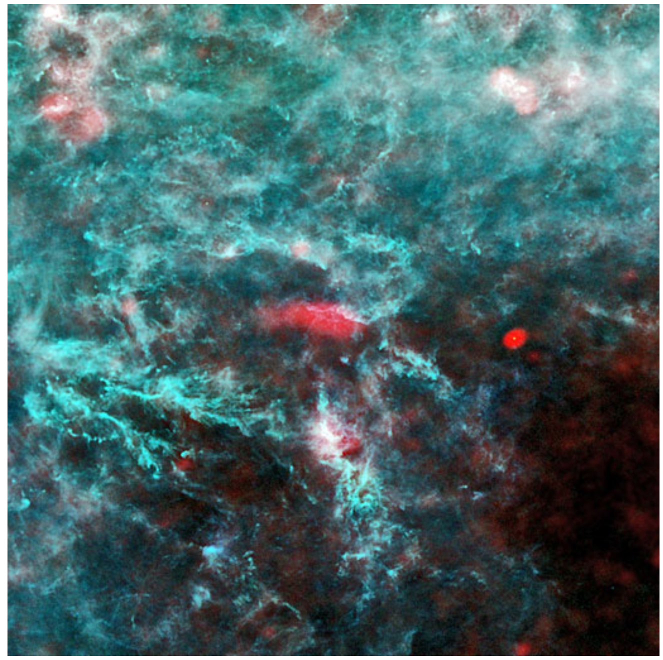
An active star-formation region in the constellation Orion, as seen by Planck. This long-wavelength image covers a square region of 13 by 13 degrees (which is equivalent to 26 by 26 full moons). It is a three-color combination constructed from three of Planck's nine frequency channels: 30, 353 and 857 gigahertz. The giant red arc of Barnard's Loop is thought to be the blast wave from a star that blew up inside the region about two million years ago. The bubble it created is now about 300 light-years across. Image credit: ESA/LFI & HFI Consortia

"Because Planck is mapping the whole sky, we can capture mosaics of huge regions of the Milky Way," said Charles Lawrence, the NASA project scientist for Planck at NASA's Jet Propulsion Laboratory in Pasadena, Calif. "We are seeing the coldest material in star-forming regions, where stars are at the very earliest stages of formation."

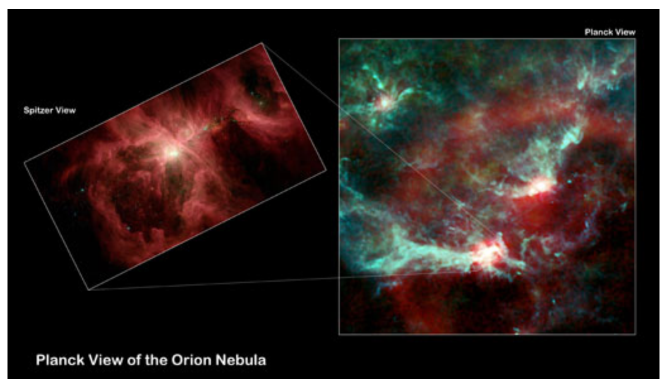
The giant red arc of Barnard's Loop is thought to be the blast wave from a star that blew up inside the region about two million years ago. The bubble it created is now about 300 light-years across.

The picture shows light resulting from two different types of sources. At the lowest frequencies, Planck primarily maps emission from ionized gas heated by newly formed hot stars. At higher frequencies, Planck maps the meager heat emitted by extremely cold dust. This can reveal the coldest cores in the clouds, which are approaching the final stages of collapse, before they are reborn as full-fledged stars.

Planck is a European Space Agency mission, with significant participation from NASA. NASA's Planck Project Office is based at JPL. JPL contributed mission-enabling technology for both of Planck's science instruments. European, Canadian, U.S. and NASA Planck scientists will work together to analyze the Planck data.



A low activity, star-formation region in the constellation Perseus, as seen by Planck. This long-wavelength image covers a square region of 13 by 13 degrees (which is equivalent 26 by 26 full moons). It is a three-color combination constructed from three of Planck's nine frequency channels: 30, 353 and 857 gigahertz. Image credit: ESA/LFI & HFI Consortia



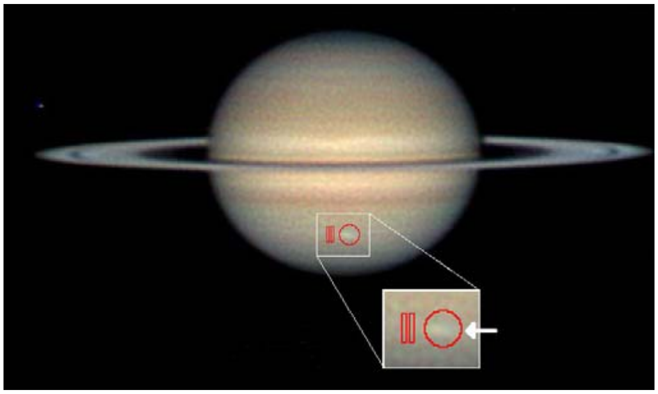
An active star-formation region in the constellation Orion, as seen by Planck. The callout shows a close up of the Orion nebula, captured by NASA's Spitzer Space Telescope. This long-wavelength image covers a square region of 13 by 13 degrees (which is equivalent to 26 by 26 full moons). It is a three-color combination constructed from three of Planck's nine frequency channels: 30, 353 and 857 gigahertz. Image credit: ESA/NASA/JPL-Caltech

Cassini and Amateurs Chase Storm on Saturn

With the help of amateur astronomers, the composite infrared spectrometer instrument aboard NASA's Cassini spacecraft has taken its first look at a massive blizzard in Saturn's atmosphere. The instrument collected the most detailed data to date of temperatures and gas distribution in that planet's storms.

The data showed a large, turbulent storm, dredging up loads of material from the deep atmosphere and covering an area at least five times larger than the biggest blizzard in this year's Washington, D.C.-area storm front nicknamed "Snowmageddon."

"We were so excited to get a heads-up from the amateurs," said Gordon Bjoraker, a composite infrared spectrometer team member based at NASA's Goddard Space Flight Center in Greenbelt, Md. Normally, he said, "Data from the storm cell would have been averaged out."



Amateur astronomer Christopher Go took this image of the storm on March 13, 2010. The arrow indicates the location of the storm and the red outlines show where Cassini's composite infrared spectrometer gathered data. Image credit: C.Go and NASA/JPL-Caltech/GSFC

Cassini's radio and plasma wave instrument and imaging cameras have been tracking thunder and lightning storms on Saturn for years in a band around Saturn's mid-latitudes nicknamed "storm alley." But storms can come and go on a time scale of weeks, while Cassini's imaging and spectrometer observations have to be locked in place months in advance.

The radio and plasma wave instrument regularly picks up electrostatic discharges associated with the storms, so team members have been sending periodic tips to amateur astronomers, who can quickly go to their backyard telescopes and try to see the bright convective storm clouds. Amateur astronomers including Anthony Wesley, Trevor Barry and Christopher Go got one of those notices in February and were able to take dozens of pictures over the next several weeks.

In late March, Wesley, an amateur astronomer from Australia who was actually the first person to detect the new dark spot caused by an impact on Jupiter last summer, sent Cassini scientists an e-mail with a picture of the storm.

"I wanted to be sure that images like these were being seen by the Cassini team just in case this was something of interest to be imaged directly by Cassini or the Hubble Space Telescope," Wesley wrote. Cassini scientists eagerly pored through the images, including a picture of the storm at its peak on March 13 by Go, who lives in the Philippines.

By a stroke of luck, the composite infrared spectrometer happened to be targeting the latitude of the storms. The instrument's scientists knew there could be storms there, but didn't know when they might be active.

Data obtained by the spectrometer on March 25 and 26 showed larger than expected amounts of phosphine, a gas typically found in Saturn's deep atmosphere and an indicator that powerful currents were dredging material upward into the upper troposphere. The spectrometer data also showed another signature of the storm: the tropopause, the dividing line between the serene stratosphere and the lower, churning troposphere, was about 0.5 Kelvin (1 degree Fahrenheit) colder in the storm cell than in neighboring areas.

Amateur astronomer Anthony Wesley obtained this image of a storm on Saturn from his backyard telescope in Murrumbateman, Australia, on March 22, 2010. He sent it to scientists working with NASA's Cassini spacecraft the next day. Image credit: A. Wesley

"A balloonist floating about 100 kilometers down from the bottom of Saturn's calm stratosphere would experience an ammonia-ice blizzard with the intensity of Snowmageddon," said Brigette Hesman, a composite infrared spectrometer team member who is an assistant research scientist at the University of Maryland. "These blizzards appear to be powered by violent storms deeper down - perhaps another 100 to 200 kilometers down - where lightning has been observed and the clouds are made of water and ammonia."

The Cassini-Huygens mission is a cooperative project of NASA, the European Space Agency and the Italian Space Agency. JPL, a division of the California Institute of Technology in Pasadena, manages the mission for NASA's Science Mission Directorate, Washington, D.C. The Cassini orbiter and its two onboard cameras were designed, developed and assembled at JPL. The composite infrared spectrometer team is based at NASA's Goddard Space Flight Center, Greenbelt, Md., where the instrument was built.

'This Planet Tastes Funny,' According to Spitzer

PASADENA, Calif. - NASA's Spitzer Space Telescope has discovered something odd about a distant planet -- it lacks methane, an ingredient common to many of the planets in our solar system.

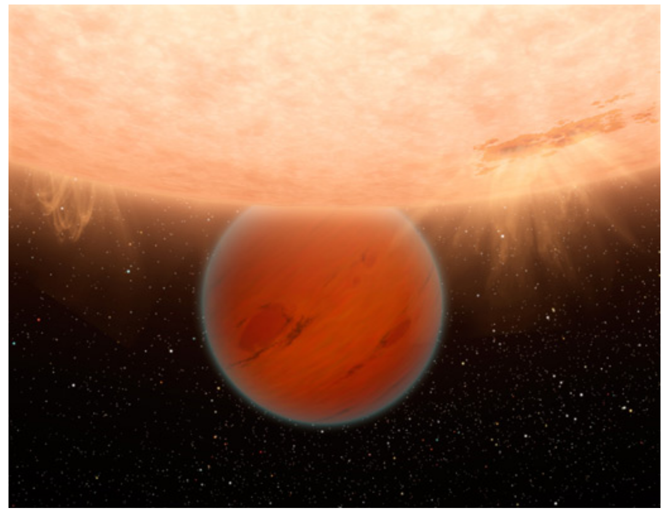
"It's a big puzzle," said Kevin Stevenson, a planetary sciences graduate student at the University of Central Florida in Orlando, lead author of a study appearing tomorrow, April 22 in the journal Nature. "Models tell us that the carbon in this planet should be in the form of methane. Theorists are going to be quite busy trying to figure this one out."

The discovery brings astronomers one step closer to probing the atmospheres of distant planets the size of Earth. The methane-free planet, called GJ 436b, is about the size of Neptune, making it the smallest distant planet that any telescope has successfully "tasted," or analyzed. Eventually, a larger space telescope could use the same kind of technique to search smaller, Earth-like worlds for methane and other chemical signs of life, such as water, oxygen and carbon dioxide.

"Ultimately, we want to find biosignatures on a small, rocky world. Oxygen, especially with even a little methane, would tell us that we humans might not be alone," said Stevenson.

"In this case, we expected to find methane not because of the presence of life, but because of the planet's chemistry. This type of planet should have cooked up methane. It's like dipping bread into beaten eggs, frying it, and getting oatmeal in the end," said Joseph Harrington of the University of Central Florida, the principal investigator of the research.

Methane is present on our life-bearing planet, manufactured primarily by microbes living in cows and soaking in waterlogged rice fields. All of the giant planets in our solar system have methane too, despite their lack of cows. Neptune is blue because of this chemical, which absorbs red light. Methane is a common ingredient of relatively cool bodies, including "failed" stars, which are called brown dwarfs.



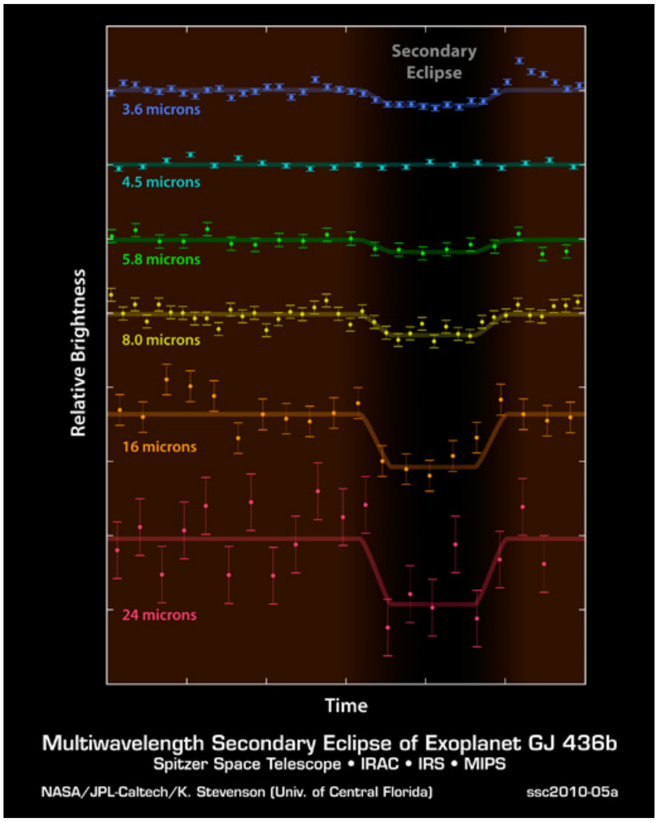
An unusual, methane-free world is partially eclipsed by its star in this artist's concept. NASA's Spitzer Space Telescope has found evidence that a hot, Neptune-sized planet orbiting a star beyond our sun lacks methane -- an ingredient common to many planets in our own solar system. Models of planetary atmospheres indicate that any world with the common mix of hydrogen, carbon and oxygen, and a temperature up to 1,000 Kelvin (1,340 degrees Fahrenheit) should have a large amount of methane and a small amount of carbon monoxide. The planet illustrated here, called GJ 436b is about 800 Kelvin (or 980 degrees Fahrenheit) - it was expected to have methane but Spitzer's observations showed it does not. The finding demonstrates the diversity of exoplanets, and indicates that models of exoplanetary atmospheres need to be revised. Credit: NASA/JPL-Caltech

In fact, any world with the common atmospheric mix of hydrogen, carbon and oxygen, and a temperature up to 1,000 Kelvin (1,340 degrees Fahrenheit) is expected to have a large amount of methane and a small amount of carbon monoxide. The carbon should "prefer" to be in the form of methane at these temperatures.

At 800 Kelvin (or 980 degrees Fahrenheit), GJ 436b is supposed to have abundant methane and little carbon monoxide. Spitzer observations have shown the opposite. The space telescope has captured the planet's light in six infrared wavelengths, showing evidence for carbon monoxide but not methane.

"We're scratching our heads," said Harrington. "But what this does tell us is that there is room for improvement in our models. Now we have actual data on faraway planets that will teach us what's really going on in their atmospheres."

GJ 436b is located 33 light-years away in the constellation Leo, the Lion. It rides in a tight, 2.64-day orbit around its small star, an "M-dwarf" much cooler than our sun. The planet transits, or crosses in front of, its star as viewed from Earth.



These plots from NASA's Spitzer Space Telescope show light from a distant planet, GJ 436b, and its star, as measured at six different infrared wavelengths. Astronomers use telescopes like Spitzer to measure the direct light of distant worlds, called exoplanets, and learn more about chemicals in their atmospheres. The technique involves measuring light from an exoplanet and its star before, during and after the planet circles behind the star. (The technique only works for those planets that happen to cross behind and in front of their stars as seen from our point of view on Earth.) When the planet disappears behind the star, the total light observed drops, as seen by the dips in these light curves. This same measurement is repeated at different wavelengths of light. In this graph, the different wavelengths are on the vertical axis, and time on the horizontal axis. Those dips in the total light tell astronomers exactly how much light is coming from the planet itself. As the data demonstrate, the amount of light coming off a planet changes with different wavelengths. The differences are due to the temperature of a planet as well as its chemical makeup. In this case, astronomers were able to show that GJ 436b lacks the common planetary ingredient of methane. Credit: NASA/JPL-Caltech/UCF

Spitzer was able to detect the faint glow of GJ 436b by watching it slip behind its star, an event called a secondary eclipse. As the planet disappears, the total light observed from the star system drops -- this drop is then measured to find the brightness of the planet at various wavelengths. The technique, first pioneered by Spitzer in 2005, has since been used to measure atmospheric components of several Jupiter-sized exoplanets, the so-called "hot Jupiters," and now the Neptune-sized GJ 436b.

"The Spitzer technique is being pushed to smaller, cooler planets more like our Earth than the previously studied hot Jupiters," said Charles Beichman, director of NASA's Exoplanet Science Institute at NASA's Jet Propulsion Laboratory and the California Institute of Technology, both in Pasadena, Calif. "In coming years, we can expect that a space telescope could characterize the atmosphere of a rocky planet a few times the size of the Earth. Such a planet might show signposts of life."

This research was performed before Spitzer ran out of its liquid coolant in May 2009, officially beginning its "warm" mission.

Other authors include: Sarah Nymeyer, William C. Bowman, Ryan A. Hardy and Nate B. Lust from the University of Central Florida; Nikku Madhusudhan and Sara Seager of the Massachusetts Institute of Technology, Cambridge; Drake Deming of NASA's Goddard Space Flight Center, Greenbelt, Md.; and Emily Rauscher of Columbia University, New York.

JPL manages the Spitzer Space Telescope mission for NASA's Science Mission Directorate, Washington. Science operations are conducted at the Spitzer Science Center at Caltech. Caltech manages JPL for NASA.

In the Eyepiece

Here is a list of objects for this month. This is reproduced from www.skyhound.com with the kind permission of its creator and author of SkyTools Greg Crinklaw.

Object(s)	Class	Con	RA	Dec	Mag
Izar	Multiple Star	Bootes	14h44m59.2s	+27°04'27"	2.4
Xi Boo	Multiple Star	Bootes	14h51m23.4s	+19°06'02"	4.5
44 Boo	Multiple Star	Bootes	15h03m47.4s	+47°39'15"	4.8
M 3	Globular Cluster	Canes Venatici	13h42m11.8s	+28°22'24"	6.3
NGC 5466	Globular Cluster	Bootes	14h05m27.7s	+28°31'49"	9.2
39 Boo	Multiple Star	Bootes	14h49m41.3s	+48°43'15"	5.7
M 53	Globular Cluster	Coma Berenices	13h12m56.2s	+18°09'56"	7.7
Pi 1 Boo	Multiple Star	Bootes	14h40m43.6s	+16°25'06"	4.5
Whirlpool (M51)	Galaxy	Canes Venatici	13h29m52.4s	+47°11'41"	8.9
The Pinwheel (M101)	Galaxy	Ursa Major	14h03m12.5s	+54°20'53"	8.3
NGC 5474 & Co.	Galaxies near M101	Ursa Major	14h05m01.4s	+53°39'45"	11.3
NGC 5529	Galaxy	Bootes	14h15m34.2s	+36°13'35"	12.7
IC 5217	Planetary nebula	Lacerta	22h23m55.7s	+50°58'00"	12.6
NGC 5774 & 5775	Galaxy Pair	Virgo	14h53m42.6s	+03°34'55"	12.8
NGC 5371	Galaxy	Canes Venatici	13h55m39.8s	+40°27'43"	11.5
Hickson 68	Galaxy Group	Canes Venatici	13h53m40.9s	+40°19'41"	10.5
NGC 5634	Globular Cluster	Virgo	14h29m38.1s	-05°58'42"	9.5
NGC 5053	Globular Cluster	Coma Berenices	13h16m28.2s	+17°41'44"	9.0
Arp 84	Interacting Galaxies	Canes Venatici	13h58m38.0s	+37°25'28"	12.1
IC 972	Planetary Nebula	Virgo	14h04m26.0s	-17°13'41"	14.9
UGC 7321	Superthin Galaxy	Com	12h17m34.1s	+22°32'26"	14.1

Coordinates are epoch 2000.0

2010 May Celestial Events

supplied by J. Randolph Walton (Randy)

Day	Date	Time (EDT)	Event
Thu	6	00:15	**Last Quarter Moon**
		02:02	Moon Rise
		03:00	**Eta Aquarid meteors peak (ZHR=60)**
Sat	8	02:15	Mars Sets
		02:50	Moon Rise
		03:45	Jupiter Rises
		04:05	Saturn Sets
		05:20	Mercury Rises
		20:02	Sunset
		22:25	Venus Sets
Thu	13	20:10	Moon Set
		21:04	**New Moon**
Sat	15	02:00	Mars Sets
		03:20	Jupiter Rises
		03:40	Saturn Sets
		05:00	Mercury Rises
		05:45	Sunrise
		20:08	Sunset
		22:17	Moon Set, crescent Moon below Venus
		22:40	Venus Sets
Sun	16	22:40	Venus Sets, crescent Moon above Venus
		23:12	Moon Set
Thu	20	12:21	Moon Rise
		19:43	**First Quarter Moon**
Fri	21	19:00	**Lunar Straight Wall visible**
Sat	22	01:40	Mars Sets
		03:00	Jupiter Rises
		03:10	Saturn Sets
		04:45	Mercury Rises
		14:43	Moon Rise
		20:15	Sunset
		22:50	Venus Sets
Thu	27	19:07	**Full Moon**
		20:28	Moon Rise
Sat	29	01:15	Mars Sets
		02:30	Jupiter Rises
		02:40	Saturn Sets
		04:35	Mercury Rises
		05:35	Sunrise
		20:21	Sunset
		22:16	Moon Rise
		22:57	Venus Sets