

# The Celestial Mechanic

The Official Newsletter of the Astronomy Associates of Lawrence

## COMING EVENTS

### Discovering Pluto

**THURSDAY, FEB. 03**

**6:30 - 9:30 PM**

**Kansas Union Ballroom**

### PUBLIC OBSERVING

**8:30 - 9:30 PM**

**Kansas Union**

### Regular Schedule

**SUNDAY Feb. 27**

**8:00 - 9:30**

**Prairie Park Nature Center**

#### President:

Rick Heschmeyer  
rcjbm@sbcglobal.net

#### University Advisor:

Dr. Bruce Twarog  
btwarog@ku.edu

#### Webmaster:

Gary Webber  
gwebber@ku.edu

#### Observing Clubs

Doug Fay  
dfay@ku.edu

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#### Report from the Officers:

Our annual end-of-year celebration went off without a hitch. Everyone went home with a door prize following a fascinating talk on the newest technology telescope, the LSST, which should help define the future of observational astronomy once it becomes operational in 2014 (? Maybe?). It's data-generating capacity is unprecedented and will open up temporal studies of entire classes of objects that are either poorly understood or haven't been discovered yet, despite well-founded expectations for their existence.

Speaking of observing, common sense won out over enthusiasm and our last public observing session was cancelled as the wind-chill temperatures dropped to single dig-

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#### ALCON 2011 - Bryce Canyon National Park Utah June 29 - July 2, 2011

The Astronomical League is pleased to announce that ALCon 2011 will be held during the dark of the moon from June 29 through July 2, 2011 at Ruby's Inn which is near the entrance to Bryce Canyon National Park. Along with the talks and workshops given during the day, nightly dark sky observing will be offered at Rainbow Point. Bryce Canyon National Park features some of the darkest skies in the United States. Naturally, the League will hold a nightly public star gaze at the Bryce Canyon Visitor's Center for both park visitors and ALCon attendees.

This year, we will be under the stars for our conference! The League is trying something new for 2011: the League and the host club, the Salt Lake Astronomical Society (SLAS), will share equally in the planning and in the hosting of the conference. You may remember the ALCon that the SLAS hosted in 2002. They did an outstanding job and the League looks forward to working with them again for the 2011 event.

All of the activities, except for observing, will be held at Ruby's Inn. They are giving a fantastic room rate of \$80 per night, including taxes. Those rates have also been extended both before and after ALCon so that they apply from June 25 through July 9. However, there will be a limited number of rooms available on these extended dates, so please be sure to reserve them early. Booking for the ALCon room rates ends on June 4, or when the block is full. So that you don't miss out, you may use the link on the ALCON 2011 web page to reserve your room now!

Throughout ALCon, astronomy vendors from across the USA will display their latest products. In addition, a silent auction and a raffle will be held. A special workshop will be held for Scouts who are interested in earning their Astronomy badge. Planning is ongoing, so watch this web site (<http://alcon.astroleague.org/>) for updates. On Saturday, the Astronomical League will hold its annual gala banquet. Awards will be presented honoring both young astronomers and young-at-heart astronomers.

The co-Chairs of ALCon 2011 are Terry Mann, past President of the Astronomical League, and Lowell Lyon of the Salt Lake Astronomical Society. Please start making plans to attend now. We hope to see you there!

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its. Our next public observing session will be part of the Discovering Pluto event on Thursday, Feb. 03, after the presentation by Michael Byers. We will return to our normal schedule on Sunday Feb. 27 at Prairie Park Nature Center.

It's that magic time of the year, i.e. our annual dues collection. We normally collect dues once per year in January. If you joined the club in the last few months, don't worry, you're fine. The rest of you should be receiving your annual notice over the next few weeks.

Our next major club event is the Discovering Pluto celebration which you've all been harassed about already. Hope you can make it and enjoy a little of Kansas and KU astronomical history. Have a great new year and may all your skies be clear.

Dear AAL Club Members— as you may already know, as members of the AAL you are also members of the Astronomical League. Their web site is <http://www.astroleague.org/> and it often contains informative items about amateur astronomy and public events. The column below recently appeared on the site and may be of interest to those of you asked by others about where to start in observing the sky. Depending upon the time and money you wish to invest, the answer will differ greatly. Here's one response.

***The Astronomical Curmudgeon - Bill Pellerin***

**Telescopes, not binoculars for newcomers** - I've seen it said many times – 'The best telescope for a newcomer is a pair of binoculars'. I disagree. The best telescope for a newcomer is, well, a telescope. At public star parties do the people who look through your telescope get excited about dim galaxies or about dim smudges of light? Of course not. You do, because you understand what you're looking at.

The public gets excited about what they are seeing when it is nice and bright, and when you have a good story to tell about it. Saturn, Jupiter, and the Moon are the 'wow' objects for public star parties. After those, bright clusters (the Pleiades), a nice asterism (the coathanger) or a colorful double star (Albireo) are great public star party objects. The telescope market has changed in the last few years and there are now quite a few choices of telescopes that are inexpensive. In fact you can get a 3" reflector with two eyepieces and a finder for under \$50. With this, and other inexpensive telescopes the owner can see Saturn's rings, the moons of Jupiter, the craters on the moon, and many bright nebulae and clusters. For more money, the number of choices grows substantially and there is a wide range of options for telescopes that cost a few hundred dollars. Binoculars will show an observer clusters and bright galaxies, but unless they are on a mount it will be difficult to get views of the objects that newcomers want to see. Image stabilized binoculars are terrific, but expensive. We know, because we've done public star parties, what newcomers want to look at; we need to recommend the tools that allow them to see those objects. Binocular observing is for amateurs who have some observing experience and who can marvel at the binocular views because they understand the object.

**Go-to Telescopes** - Perhaps the arguments about go-to telescopes versus manual telescopes are over. I hope so. I understand the value of learning our way around the sky – constellation names, relative positions, bright stars, etc., but I also understand that observing time is precious and often hard to come by. Most of us who are amateurs must squeeze in observing when free time, clear skies, and new, or near new moons all coincide.

Those of us who have been in amateur astronomy a while have found objects in the sky by star-hopping and I don't expect the practice to go away any time soon. Some observers enjoy the hunt; they like the process of looking for the object themselves. Nobody wants to take that opportunity away from them, but for those of us who are comfortable with technology, who don't enjoy the process of manually finding an object in the sky and who want to let the technology do the work, go-to telescopes are a great

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## ABOUT THE ASTRONOMY ASSOCIATES OF LAWRENCE

The club is open to all people interested in sharing their love for astronomy. Monthly meetings are typically on the second Friday of each month and often feature guest speakers, presentations by club members, and a chance to exchange amateur astronomy tips. Approximately the last Sunday of each month we have an open house at the Prairie Park Nature Center. Periodic star parties are scheduled as well. For more information, please contact the club officers: our president, Rick Heschmeyer at [rcjbm@sbcglobal.net](mailto:rcjbm@sbcglobal.net), our webmaster, Gary Webber, at [gwebber@ku.edu](mailto:gwebber@ku.edu), or our faculty advisor, Prof. Bruce Twarog at [btwarog@ku.edu](mailto:btwarog@ku.edu). Because of the flexibility of the schedule due to holidays and alternate events, it is always best to check the Web site for the exact Fridays and Sundays when events are scheduled. The information about AAL can be found at

<http://www.ku.edu/~aal>.

Copies of the *Celestial Mechanic* can also be found on the web at

<http://www.ku.edu/~aal/celestialmechanic>



### **Maffei 2: The Hidden Galaxy**

Maffei 2 is the poster child for an infrared galaxy that is almost invisible to optical telescopes. Foreground dust clouds in the Milky Way block about 99.5% of its visible light, but this infrared image from NASA's Spitzer Space Telescope penetrates this dust to reveal the galaxy in all its glory. The astronomer Paolo Maffei first noted this as a mysterious smudge on a near infrared photographic plate in 1968. Four years later he identified the strange object to be a galaxy, now named after him. This discovery was made in the infancy of infrared astronomy and it would take many technological innovations in the following decades to allow astronomers to study obscured objects like this one in detail.

Most other galaxies the size of Maffei 2 had been cataloged for over a century. Had it not been hidden behind dust lanes in our own galaxy it may well have been one of the entries in the famous 18th century catalog of bright deep sky objects compiled by Charles Messier. This Spitzer image clearly shows the unusual structure of Maffei 2. The strong central bar and asymmetric spiral arms help identify why the galaxy also harbors a starburst in its very core. Such dramatic bursts of star formation occur when massive amounts of dust and gas are driven into the center of a galaxy, often by gravitational interactions that create barred spiral structures in its disk.



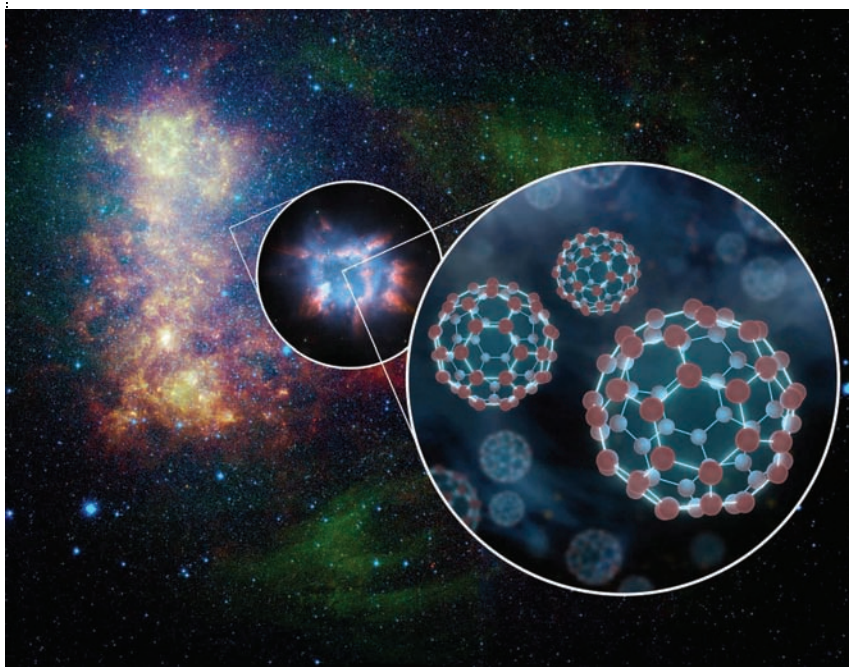
## Astronomers Stumble onto Huge Space Molecules

By Trudy E. Bell and Tony Phillips

Deep in interstellar space, in a the swirling gaseous envelope of a planetary nebula, hosts of carbon atoms have joined together to form large three-dimensional molecules of a special type previously seen only on Earth. Astronomers discovered them almost accidentally using NASA's Spitzer Space Telescope.

"They are the largest molecules known in space," declared Jan Cami of the University of Western Ontario, lead author of a paper with three colleagues published in *Science* online on July 22, 2010, and in print on September 3. Not only are the molecules big: they are of a special class of carbon molecules known as "fullerenes" because their structure resembles the geodesic domes popularized by architect Buckminster Fuller. Spitzer found evidence of two types of fullerenes. The smaller type, nicknamed the "buckyball," is chemical formula  $C_{60}$ , made of 60 carbon atoms joined in a series of hexagons and pentagons to form a spherical closed cage exactly like a black-and-white soccer ball. Spitzer also found a larger fullerene, chemical formula  $C_{70}$ , consisting of 70 carbon atoms in an elongated closed cage more resembling an oval rugby ball.

Neither type of fullerene is rigid; instead, their carbon atoms vibrate in and out, rather like the surface of a large soap bubble changes shape as it floats through the air. "Those vibrations correspond to wavelengths of infrared light emitted or absorbed—and that infrared emission is what Spitzer recorded," Cami explained.



*Superimposed on a Spitzer infrared photo of the Small Magellanic Cloud is an artist's illustration depicting a magnified view of a planetary nebula and an even further magnified view of buckyballs, which consist of 60 carbon atoms arranged like soccer balls.*

Although fullerenes have been sought in space for the last 25 years, ever since they were first identified in the laboratory, the astronomers practically stumbled into the discovery. Co-author Jeronimo Bernard-Salas of Cornell University, an expert in gas and dust in planetary nebulae, was doing routine research with Spitzer's infrared observations of planetary nebulae with its spectroscopy instrument. When he studied the spectrum (infrared signature) of a dim planetary nebula called Tc 1 in the southern-hemisphere constellation of Ara, he noticed several clear peaks he had not seen before in the spectra of other planetary nebulae.

"When he came to me," recounted Cami, an astrophysicist who specializes in molecular chemistry, "I immediately and intuitively knew it I was looking at buckyballs in space. I've never been that excited!" The authors confirmed his hunch by carefully comparing the Tc 1 spectrum to laboratory experiments described in the literature.

"This discovery shows that it is possible—even easy—for complex carbonaceous molecules to form spontaneously in

space," Cami said. "Now that we know fullerenes are out there, we can figure out their roles in the physics and chemistry of deep space. Who knows what other complex chemical compounds exist—maybe even some relevant to the formation of life in the universe!"

Stay tuned!

Learn more about this discovery at <http://www.spitzer.caltech.edu>. For kids, there are lots of beautiful Spitzer images to match up in the Spitzer Concentration game at <http://spaceplace.nasa.gov/en/kids/spitzer/concentration>.

# DISCOVERING PLUTO

Celebrating Kansan  
**CLYDE TOMBAUGH**  
and the discovery of Pluto

An Evening with

**MICHAEL BYERS**

Author of Percival's Planet - A Novel

**6:30pm**

Guided Display by the KU Astronomy Department

**7:30pm**

Presentation begins:

Introduction by Steven A. Hawley, KU Professor of  
Physics & Astronomy, former NASA Astronaut

Michael Byers Presentation

**Thursday, February 3, 2011**  
**6:30 - 9:30 pm** » **Kansas Union Ballroom**



*Co-sponsored by KU Bookstore, KU Memorial Unions, KU Department of Physics & Astronomy, KU Hall  
Center for the Humanities, and The Commons*

## Hubble Supernova Bubble Resembles Holiday Ornament HST Press Release

This colorful creation was made by combining data from two of NASA's Great Observatories. Optical data of SNR 0509-67.5 and its accompanying star field, taken with the Hubble Space Telescope, are composited with X-ray images from the Chandra X-ray Observatory. The result shows soft green and blue hues of heated material from the X-ray data surrounded by the glowing pink optical shell, which shows the ambient gas being shocked by the expanding blast wave from the supernova. Ripples in the shell's appearance coincide with brighter areas of the X-ray data.

The Type Ia supernova that resulted in the creation of SNR 0509-67.5 occurred nearly 400 years ago for Earth viewers. The supernova remnant and its progenitor star reside in the Large Magellanic Cloud (LMC), a small galaxy about 160,000 light-years from Earth. The bubble-shaped shroud of gas is 23 light-years across and is expanding at more than 11 million miles per hour (5,000 kilometers per second).



Data from Hubble's Advanced Camera for Surveys, taken in 2006 with a filter that isolates light from glowing hydrogen, were combined with visible-light images of the surrounding star field that were taken with Hubble's Wide Field Camera 3 in 2010. These data were then merged with X-ray data from the Chandra X-ray Observatory taken with the Advanced CCD Imaging Spectrometer (ACIS) in 2000 and 2007.

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"This planet reveals the astounding diversity of worlds out there," said Nikku Madhusudhan of the Massachusetts Institute of Technology, Cambridge, lead author of a report in the Dec. 9 issue of the journal *Nature*. "Carbon-rich planets would be exotic in every way -- formation, interiors and atmospheres."

It's possible that WASP-12b might harbor graphite, diamond, or even a more exotic form of carbon in its interior, beneath its gaseous layers. Astronomers don't currently have the technology to observe the cores of exoplanets, or planets orbiting stars beyond our sun, but their theories hint at these intriguing possibilities.

The research also supports theories that carbon-rich rocky planets much less massive than WASP-12b could exist around other stars. Our Earth has rocks like quartz and feldspar, which are made of silicon and oxygen plus other elements. A carbon-rich rocky planet could be a very different place.

"A carbon-dominated terrestrial world could have lots of pure carbon rocks, like diamond or graphite, as well as carbon compounds like tar," said Joseph Harrington of the University of Central Florida, in Orlando, who is the principal investigator of the research.

Carbon is a common component of planetary systems and a key ingredient of life on Earth. Astronomers often measure carbon-to-oxygen ratios to get an idea of a star's chemistry. Our sun has a carbon-to-oxygen ratio of about one to two, which means it has about half as much carbon as oxygen. None of the planets in our solar system is known to have more carbon than oxygen, or a ratio of one or greater. However, this ratio is unknown for Jupiter, Saturn, Uranus, and Neptune. Unlike WASP-12b, these planets harbor water -- the main oxygen carrier -- deep inside their atmospheres, making it hard to detect.

WASP-12b is the first planet ever to have its carbon-to-oxygen ratio measured at greater than one (the actual ratio is most likely between one and two). This means the planet has excess carbon, some of which is in the form of atmospheric methane.

"When the relative amount of carbon gets that high, it's as though you flip a switch, and everything changes," said Marc Kuchner, an astronomer at NASA Goddard Space Flight Center, Greenbelt, Md., who helped develop the theory of carbon-rich rocky planets but is not associated with the study. "If something like this had happened on Earth, your expensive engagement ring would be made of glass, which would be rare, and the mountains would all be made of diamonds."

Madhusudhan, Harrington and colleagues used Spitzer to observe WASP-12b as it slipped behind its star, in a technique known as secondary eclipse, which was pioneered for exoplanets by Spitzer. These data were combined with previously published observations taken from the ground with the Canada-France-Hawaii Telescope at Mauna Kea, Hawaii. Madhusudhan used the data to conduct a detailed atmospheric analysis, revealing chemicals such as methane and carbon monoxide in the planet's atmosphere.

WASP-12b derives its name from the consortium that found it, the Wide Angle Search for Planets. It is 1.4 times as massive as Jupiter and located roughly 1,200 light-years away from Earth. This blistering world whips around its star in a little over a day, with one side always facing the star. It is so close to its star that the star's gravity stretches the planet into an egg-like shape. What's more, the star's gravity is siphoning mass off the planet into a thin disk that orbits around with it.

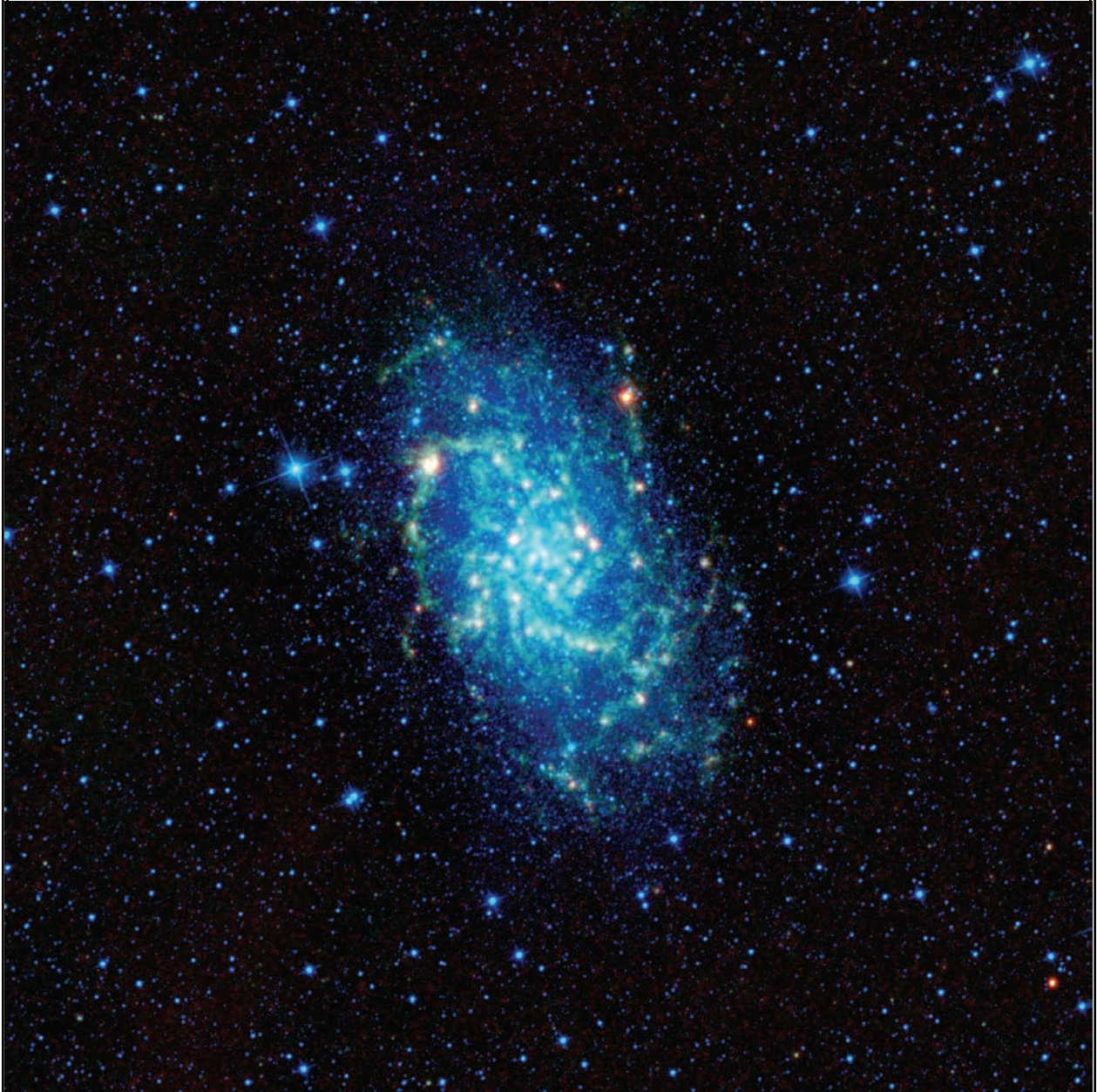
The Spitzer data also reveal more information about WASP-12b's temperature. The world was already known to be one of the hottest exoplanets found so far; the new observations indicate that the side that faces the star is 2,600 Kelvin, or 4,200 degrees Fahrenheit. That's more than hot enough to melt steel.

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the center of M33. It would be difficult to deduce this lack of activity in the core by only looking a visible light image, where the core appears to be the brightest feature. This infrared image also shows that the galaxy is surprisingly bigger than it appears in visible light. The cold dust seen by WISE extends much further out from the core than anticipated. The bright yellow-orange 'blobs' scattered throughout M33 are areas where stars are forming at an especially intense rate. The largest one in the spiral arm to the upper left has its own name, NGC 604. It's an H II region -- an area of gas that is being heated and ionized by powerful young stars recently born inside of it. The Orion Nebula is an example of a nearby H II region within our own Milky Way Galaxy. NGC 604, however, is the largest such region in the entire Local Group of galaxies. It is over 40 times larger than the Orion Nebula and much brighter. If NGC 604 were at the same distance from Earth as the Orion Nebula it would be the brightest object in the night sky (besides the Moon). M33 is over 50,000 light years across (about half the size of the Milky Way). Because it is so close it appears quite large to us, covering a piece of sky nearly 4 times bigger than the full Moon. Its relatively low surface brightness makes it difficult for human eyes to see, however. Even so, under exceptionally dark skies it can be seen with the unaided eye, making it one of the furthest objects visible without a telescope. These images were made from observations by all four infrared detectors aboard WISE. Blue and cyan represent infrared light at wavelengths of 3.4 and 4.6 microns, which is primarily light from stars. Green and red represent light at 12 and 22 microns, which is primarily light emitted from warm dust.

## WISE Spies a Galactic Neighbor

WISE Press Release



This image captured by NASA's Wide-field Infrared Survey Explorer, or WISE, shows one of our closest neighboring galaxies, Messier 33. Also named the Triangulum Galaxy (after the constellation it's found in), M33 is one of the largest members in our small neighborhood of galaxies -- the Local Group. The Local Group consists of about 30 galaxies that are gravitationally bound and travel together through the Universe. M33 is the third largest member of the Local Group, dwarfed only by the Andromeda Galaxy (M31) and our very own home galaxy, the Milky Way.

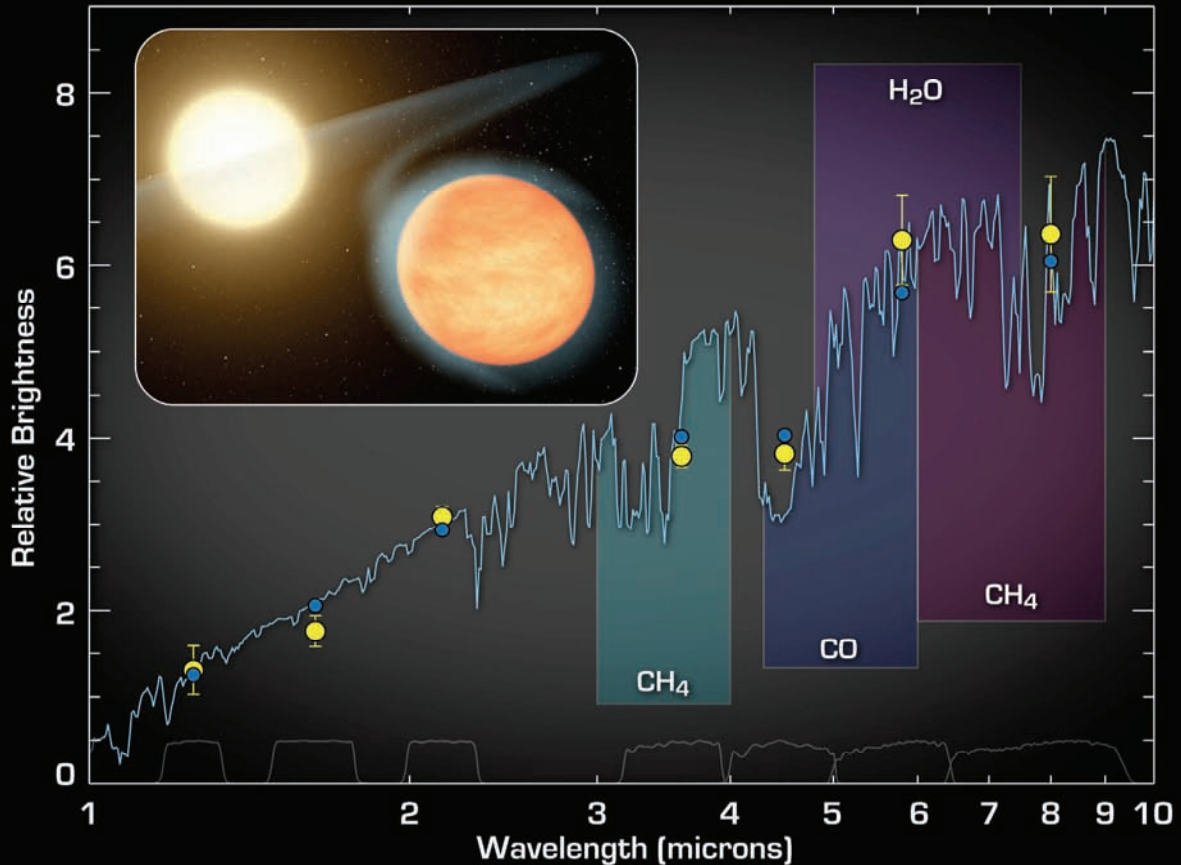
M33 is extremely close as far as galaxies go, residing only 3 million light years away. Its proximity, along with it being conveniently tilted towards Earth (about 54 degrees to the line of sight), make it very easy for astronomers to study in detail. The infrared images that WISE produces contribute to astronomers' overall understanding of a variety of processes happening in the galaxy. Areas in the spiral arms that are hidden behind dust in visible light shine through brightly in infrared light, showing where clouds of cool gas are concentrated. Star-forming regions are easy to spot in infrared (green and red areas in this image). Notice that there isn't a lot of star formation occurring near

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## Signature of a Carbon-Rich Planet

Spitzer Press Release

Astronomers have discovered that a huge, searing-hot planet orbiting another star is loaded with an unusual amount of carbon. The planet, a gas giant named WASP-12b, is the first carbon-rich world ever observed. The discovery was made



Exoplanet WASP-12b

NASA / JPL-Caltech / N. Madhusudhan (Princeton University)

Spitzer Space Telescope • IRAC

ssc2010-10a

This plot of data from NASA's Spitzer Space Telescope indicates the presence of molecules in the planet WASP-12b -- a super-hot gas giant that orbits tightly around its star. Spitzer measurements suggest this planet's atmosphere has carbon monoxide, excess methane, and not much water vapor. The results demonstrate that WASP-12b is the first known carbon-rich planet. Spitzer made these measurements as the planet circled behind the star, in an event called the secondary eclipse. The telescope collected the infrared light from the star and the planet, then just the star as the planet disappeared behind the star. This allowed astronomers to calculate the amount of infrared light coming solely from the planet. The observations were performed at four different wavelengths of infrared light. These data were then combined with previously reported measurements taken by the Canada-France-Hawaii Telescope atop Mauna Kea, Hawaii, at shorter infrared wavelengths to create this plot.

The yellow dots show the data, along with the observational uncertainties. The blue curve is a model of the planet's light, or spectrum, showing the fingerprints of chemicals in the atmosphere. The blue dots represent the blue model curve averaged to cover the same wavelengths as the data, as shown by the gray lines at the bottom of the plot.

using NASA's Spitzer Space Telescope, along with previously published ground-based observations.

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benefit to our observing program. Having the telescope mount find the object for me, once I've completed the initial alignment, is one of the great pleasures of modern technology. This capability is being incorporated into smaller and less expensive telescopes and is becoming more accessible to enthusiasts.

One variant of this is the 'push-to' telescope mount. With one of these, you enter the object name or coordinates into the telescope computer, and the device prompts you to move the telescope until, say, a pair of numbers equals 0. I have a mount like this, and it works just fine. The computer operates on a 9v battery (no external power supply or cables required) and allows me to find objects to look at with ease. The rate of change of technology is astounding. More and better technology is coming along all the time. I say, take advantage of it. Just because your ancestors had to hand-crank their automobiles to start them, and your parents had to look at maps (not a GPS) to find their way doesn't mean that you have to.

**Small Telescopes** - A friend of mine makes it his practice to use small telescopes, almost exclusively. For him, and for a lot of us, the portability and ease of setup of a small telescope outweighs the limitations of small aperture. There is an old saying in amateur astronomy, "The best telescope is the one you use the most". It is likely that the one you use the most will be the one that requires the least time to set up.

I have a small alt-az mount and a small refractor that I keep near my back door. When I want to do some quick, casual observing I open the back door, set the telescope and mount down (it can be carried in one hand) and I'm ready to go. With this setup I get good views of the large planets - Jupiter is up right now - and I can visit some bright objects quickly. I have the several books that list binocular objects that can be seen from urban skies. One of my favorites is Binocular Highlights by Gary Seronik of Sky and Telescope magazine. The book contains maps to find the objects, many of which are new to me, and most of which are bright enough to see in the city. The October, 2010 issue of Astronomy magazine has an article by Phil Harrington, 10 Top Autumn Binocular Treats, and the September, 2010 issue of Sky and Telescope magazine contains an article by Hugh Bartlett, Binocular Showpieces for Light-Polluted Skies. There also a S&T item each month by Gary Seronik called Binocular Highlight. All these objects will show well in a small telescope that you can set up quickly.

Am I contradicting myself? - I hope not. I'm recommending a telescope for a beginner over binoculars, but I'm also recommending binoculars or a small, easy-to-set-up telescope for experienced amateurs who want to do some quick observing. I'm recommending computer controlled (go-to) telescopes for more 'formal' observing sessions but not necessarily for informal sessions (quick looks from your back yard). Whatever you do, enjoy it and get out under the sky as much as you can.



**AAL**

Astronomy Associates of  
Lawrence

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University of Kansas  
Malott Hall  
1251 Wescoe Hall Dr, Room 1082  
Lawrence, KS 66045-7582