

# GuideStar



May, 2012  
Volume 30, #5

## At the May 4 Meeting

### TSP Roundup

Steve Goldberg

### Science Fair Winners

Richard Nugent

Everybody's favorite program is on the night of the first meeting following the Texas Star Party.



We get to hear about and see what went on at the TSP, whether we were there or not and enjoy listening to the HAS Science Fair winners tell us about their projects. These kids do amazing work.

In addition we'll have our regular 2-minute drills, our novice presentation, information about upcoming events, and more.



The Houston Astronomical Society is a member of the Astronomical League.

#### Highlights:

President's Message	3
Sir William Huggins—Spectroscopist	6
John Haynes—Dedicated Observer	9
AstroLeague Observing at Columbus	13
NASA Studies a Comet	14
Y Dwarfs: Because They're Cool	15
Moon Dance	18

#### HAS Web Page:

<http://www.AstronomyHouston.org>

See the *GuideStar's* Monthly Calendar of Events to confirm dates and times of all events for the month, and check the Web Page for any last minute changes.

#### Schedule of meeting activities:

All meetings are at the University of Houston Science and Research building. See the inside back page for directions to the location.

Novice meeting: ..... 7:00 p.m.  
Nebulae: Clouds in Space — Bill Pellerin  
General meeting: ..... 8:00 p.m

See last page for directions and more information.

## The Houston Astronomical Society

The Houston Astronomical Society is a non-profit corporation organized under section 501 (C) 3 of the Internal Revenue Code. The Society was formed for education and scientific purposes. All contributions and gifts are deductible for federal income tax purposes. General membership meetings are open to the public and attendance is encouraged.

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### Dues and Membership Information

Annual Dues:Regular .....\$36  
 Associate.....\$6  
 Sustaining .....\$50  
 Student .....\$12  
 Honorary..... N/C

All members have the right to participate in Society functions and to use the Observatory Site. Regular and Student Members receive a subscription to *The Reflector*. *The GuideStar*, the monthly publication of the Houston Astronomical Society is available on the web site. Associate Members, immediate family members of a Regular Member, have all membership rights, but do not receive publications. Sustaining members have the same rights as regular members with the additional dues treated as a donation to the Society. *Sky & Telescope* and *Astronomy* magazines are available to members at a discount.

**Membership Application:** Send funds to address shown on last page of *GuideStar*. Attention - Treasurer, along with the following information: Name, Address, Phone Number, Special Interests in Astronomy, Do you own a Telescope? (If so, what kind?), and where you first heard of H.A.S.

## Table of Contents

3	.....President's Message
4	.....May/June Calendar
5	.....Observations of the Editor
6	.....Sir William Huggins
9	.....John Haynes - Dedicated Observer
13	.....Highlights from the April Meeting .....AstroLeague Observing at Columbus
14	.....NASA Studies a Comet
15	.....Y Dwarfs: Because They're Cool
17	.....Observatory Corner
18	.....Moon Dance

## Other Meetings...

**Johnson Space Center Astronomical Society** meets in the the Lunar and Planetary Institute on the 2nd Friday of each month. Web site: [www.jscas.net](http://www.jscas.net)

**Fort Bend Astronomy Club** meets the third Friday of the month at 8:00 p.m. at the First Colony conference Center. Novice meeting begins at 7:00, regular meeting begins at 8:00. Web site: <http://www.fbac.org>

**North Houston Astronomy Club** meets at 7:30 p.m. on the 4th Friday of each month in the Teaching Theatre of the Student Center at Kingwood College. Call 281-312-1650 or E-mail [bill.leach@nhmccd.edu](mailto:bill.leach@nhmccd.edu). Web site: [www.astronomyclub.org](http://www.astronomyclub.org)

**Brazosport Astronomy Club** meets the third Tuesday of each month at the Brazosport planetarium at 7:45 p.m. The Brazosport planetarium is located at 400 College Boulevard, Clute, TX, 77531. For more information call 979-265-3376

## President's Message

by Gordon Houston, President

### Hello HAS,

**The May Basic Observational Astronomy course** will start the Monday after our May 4th meeting, which means that you still have time to decide to attend. The dates are May 7<sup>th</sup> and May 14<sup>th</sup>, both Mondays. The course will be at the HEB at Bunker Hill and I-10, in their Community Room, which is an outside entrance. The course, coupled with the Urban Observing, has been a success. Besides helping novices make that first step, the Urban observing is a time for club member interaction and fellowship. The ultimate goal is to give the basic observing skills to new members and give them the confidence to go to our Columbus observatory. **Rene Gedaly** has offered to lead a final piece of the puzzle and **will be helping new observers work on Astronomical League observing programs** at the Columbus observatory. Look for her announcements of the monthly dates in the *GuideStar*.

**We are a volunteer organization and that is what makes the Houston Astronomical Society run.** I want to thank all those who contribute to our cause. It is important that we continue to bring in new members, as they are the lifeblood of perpetuating any entity. I first want to recognize the Two Minute Drill observing tip presenter in March, Don Selle, Richard Nugent, and Justin McCollum, and for April John Haynes and Hal McKinney. I especially want to thank our new Membership Chairman, Steve Fast for his excellent efforts in producing our new name tags and taking on this very important role. He will have an immediate impact. Many other leaders on our leadership team work hard and all should be listed here. Why not see if you can help in some small capacity on a committee or function!!!

**The Texas Star Party was a great event this year,** which made the fact that I had to shorten my time I had planned to stay, even more difficult. The weather and conditions were better than some of the recent events. The post event communications I have seen, would say it was one of the best in years. Houston Astronomical Society members play a key role in planning, organizing, and delivering TSP. The years of dedication to this event by some individuals, are typically either not known or underappreciated by those who attend. **I want to specifically recognize Amelia and Steve Goldberg** for their years of dedication and thank them for it. Their efforts stand out among all others.

**The big solar events that are happening in the next 5 or so weeks, makes this a special time to be an amateur astronomer.** I have heard many who are traveling to see the annular eclipse on May 20<sup>th</sup>. Unfortunately, it will not be seen here, as the path of the

eclipse ends out in west Texas. There is a partial lunar eclipse the morning of June 4<sup>th</sup>, which we will be able to observe about half of the eclipse before sunrise, but the big event is the next day, June 5<sup>th</sup>. **This is the transit of Venus, which will be spectacular.** I have reserved pavilion number 6, which is just south of our Urban Observing site, starting at 3:00PM. I hope to transition this into an Urban Observing night, getting access till midnight. Put this date on your calendar. Now is the time to be preparing your solar filters. You won't see this again in your lifetime. Be there.

**Finally, I want to recognize Bill Pellerin for his long years of service as our *GuideStar* editor.** It is our best communication tool. Take time to let Bill know you appreciate his efforts.

*Ad astra,*

*..Gordon Houston*

*President HAS*



## Observations... of the editor

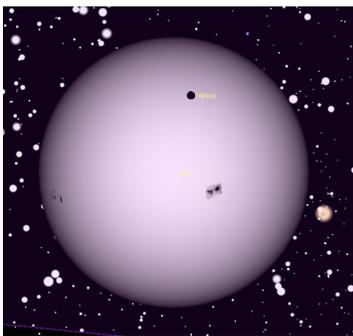
by Bill Pellerin, GuideStar Editor

### Venus Transit, June 5

If you miss this one, you won't see another one, that's for sure. The next one is in 2117, one hundred and five years from now. I am going to make the effort to get to a clear sky location and see the transit.

The basics: A Venus transit is when the planet Venus crosses the face of the sun. It's like an eclipse, except that Venus is much smaller than the sun and will show up as a black circle. This occurs rarely because the orbits of the Earth and of Venus are not in perfect alignment, so the geometry of the Earth/Venus/sun has to be just right.

So, what's the transit going to look like from Houston? First contact is just after 5:00 p.m. and the sun is at an azimuth of 276 degrees and an altitude of 39 degrees. Second contact will be about a quarter hour later (look for the ink drop), and the sun's altitude will have dipped to 35 degrees. Sunset is at 8:20 p.m. on that date, at which point Venus will be about halfway through its transit of the sun.



*Transit of Venus at sunset from Houston*

*From theSkyX*

According to the [transitofvenus.nl](http://transitofvenus.nl) web site there is a 48% chance of clouds in Houston on that date. The website includes a lot more information on the transit and is a great resource if you plan to see it.

Also, the site includes a lot of historical information about the transit of Venus. I'll just say here

that the transit of Venus was used to determine the distance to the sun and the scale of the solar system, so the Venus transit has a lot of scientific importance.

### Urban Observing

I went to the Urban Observing event on April 12 at Bear Creek Park. The skies weren't very clear; they were hazy, in fact. That doesn't mean that we didn't have a good time, we did. Gordon Houston counted 9 telescopes and 14 people and there were plenty of objects to look at through the hazy sky. Jupiter and its four moons, our moon, Venus, Castor (double star), Algeiba (double star), Mizar (triple star) and several Messier objects. I recommend that you shake the dust off your urban telescopes and bring it out to the next event.

If you are an experienced observer you can help those who are new to observing get started and if you are a newbie, you can get some help. Don't know how to operate your telescope? Bring it out and we'll figure it out together.

### What a week!

Whether you were at the Texas Star Party or near home (on the Texas gulf coast), the weather this weekend (4/21-4/22) could not have been better. Thursday, April 19, started clear, got quite hazy, then cleared again late. The 20th and the 21st were excellent. Early morning storms on the morning of the 20th gave way to great skies that evening. The moon cooperated by being out of the sky, and the nighttime temperatures were just right (perhaps a bit cool for me). The seeing wasn't the best, but that's to be expected when a cool front blows through.

I hope you had a chance to take advantage of these outstanding weather conditions.

*Until next time...*

*clear skies and new moons!*

*..Bill*

# Sir William Huggins

## -The Herschel of Spectroscopy

by Don Selle

In the middle of the nineteenth century, the development and application of the two new technologies photography and spectroscopy lead to a sea change in the science of astronomy. Photography was useful in that as a result of long exposures, fainter objects could be recorded than could be seen by the eye. In addition, the photograph made permanent record of the observation, and the photographs could be easily measured and compared.

As important an innovation as photography has been to the study of astronomy, spectroscopy has been even more

significant. Spectroscopy opened up a new way to observe astronomical objects and enabled astronomers to probe their chemical make-up and to determine their physical properties in a way that no other tool could. In a photograph, only the position and intensity of the source can be measured. With spectroscopy, the light from the source could be decomposed, and its composition recorded and measured. When understood, the information added by spectroscopy allows conclusions to be drawn about the chemical make-up and physical properties of the source. So great was the impact of spectroscopy and photography that astronomers of the time referred to the "new astronomy" in their writings.

At the forefront of the new astronomy was a talented and dedicated amateur, Sir William Huggins (1824-1910). During the period from the early 1860s through the 1880s, Huggins would be a leading pioneer of the new astronomy, developing new techniques and instruments with which would open many new avenues of fruitful research. During this period he published many observations and papers describing his discoveries, and he quickly rose in prominence within the inner circle of the astronomical and scientific community of London. Huggins numerous accomplishments during this period lead R. A. Proctor the leading



popularizer of Victorian era astronomy to dub him "the Herschel of the spectroscope".

Huggins was born to a family with an established business as silk mercers and linen drapers. By all accounts Huggins had a keen interest in the sciences from an early age. He attended the City of London school, but due to pressures of the family business (or as likely the fact that the family was not of the rich upper class) he was unable to attend University.

Throughout his youth and early adulthood, Huggins had a serious interest in astronomy, acquiring for £15 his first telescope at age 18. Shortly after his thirtieth birthday, Huggins was elected a Fellow of the Royal Astronomical Society. Through this association, and also through his membership in the Royal Microscopical Society, Huggins began to establish relationships with many of London's science elite. Many were professionals, doctors and astronomers, but many more were amateurs like himself.

In the mid 1850s, the family sold the business and moved just outside of London. The house was at the top of the hill and had a large garden in the back which would be a good place for Huggins to conduct his astronomical research. Shortly after the move, the senior Huggins died leaving Sir William sole heir.

In 1856 at the age of 32, Huggins contracted for the construction of an observatory behind the home and acquired an 8 inch Alvin Clark refractor. Thereafter, Huggins committed himself to a life in astronomy and to the pursuit of establishing himself with the scientific elite of London.

As a fellow of the Royal Astronomical Society, Huggins undertook the research programs of the Society. "In addition to engaging in the usual tasks of timing celestial events and mapping celestial objects, Fellows of the RAS, the majority

*(Continued on page 7)*

(Continued from page 6)

of amateurs, pursued a variety of observational projects including such things as searching for new asteroids and planetary satellites, locating and observing double stars, noting changes on planetary surfaces, counting and mapping sunspots, and documenting coincident solar and terrestrial phenomena ' <sup>1</sup>

Initially Huggins observations were of an opportunistic nature. As he interacted with prominent members of the RAS he began to work more towards a research agenda. Initially he embraced the research program of the established astronomy community and was an active observer with several observations published in the Monthly Notices of the RAS.

Eventually Huggins became frustrated with the repetitive nature of this research agenda which was set by others and began to look around for a new program, one by which he could direct his own interest and answer questions of his own. At the same time, the two technologies of photography and spectroscopy were leading to new understandings of the nature of terrestrial matter.

In 1814 Joseph Fraunhofer, a talented German optician, telescope and instrument maker, well known for recreating Isaac Newton's optical experiments with a prism and sunlight, added a small telescope to Huggins' observatory to examine the spectra more closely. He discovered that rather than being continuous as Newton described, the solar spectrum contained many fine dark lines. It was the work of two other Germans, Kirchhoff and Bunsen forty five years later who put together the fact that these lines, and the spectral lines of metals heated in a flame were two aspects of the same phenomena, and that the solar spectral lines could be used to determine the chemical make-up of the sun.

When Huggins learned of this in the early 1860s, he was already receptive to using the new ideas to extend astronomical research. In his own words from a retrospective written at the end of his career Huggins tells us:

*"I soon became a little dissatisfied with the routine character of ordinary astronomical work, and in a vague way sought about in my mind for the possibility of research upon the heavens in a new direction or by new methods. It was just at this time ... that the news reached me of Kirchhoff's great discovery of the true nature and the chemical constitution of the sun from his interpretation of the Fraunhofer lines. This news was to me like the coming upon a spring of water in a dry and thirsty land.*

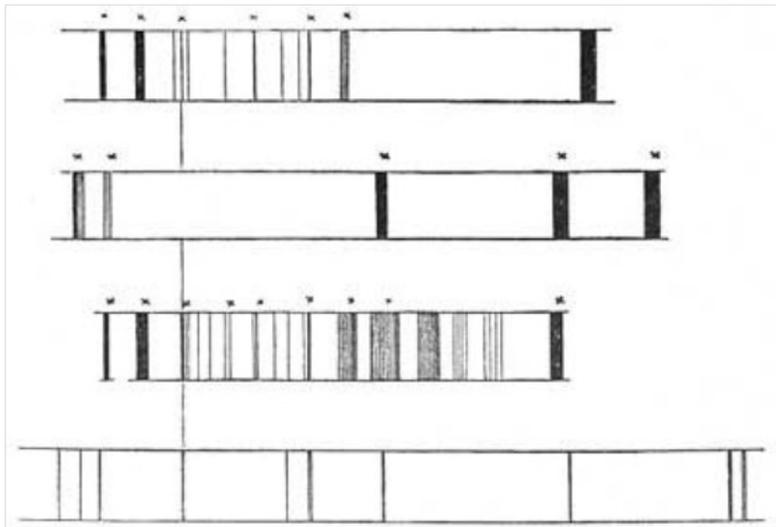
*Here at last presented itself the very order of work for which in an indefinite way I was looking -- namely, to extend his novel methods of research upon the sun to the other heavenly bodies. A feeling as of*

*inspiration seized me: I felt as if I had it now in my power to lift a veil which had never before been lifted;... behind which lay the unknown mystery of the true nature of the heavenly bodies."* <sup>2</sup>

Huggins was one of the first to apply the techniques used to identify and determine the make-up of terrestrial materials to the stars and various other astronomical bodies. The spectra observed had to be correlated with spectra from known materials, hence the laboratory setting near the telescope. As a result Huggins transformed the observatory into a chemical laboratory with all of the equipment and chemicals in use in one, plus the telescope and instruments of astronomy.

Huggins was aided greatly in his early research by his neighbor W. Allen Miller a professor of chemistry at Kings College and an already accomplished spectroscopist. The adaptation of the spectrographic method to astronomy though was all Huggins effort.

In February 1863, Huggins and Miller



*Schematic drawing of the spectra of (from top to bottom) Aldebaran, Sirius, Betelgeuse, and the sun, by William Huggins and William Allen Miller [from Proc. Roy. Soc. 12 (1863): 444]*

presented their first observations to the RAS which included the descriptions and sketches of the spectra of several bright stars. These observations would continue

(Continued on page 8)

(Continued from page 7)

through the 1870s as astronomers world wide began to try to understand the composition of the stars and to group them into categories. This work would set the foundations for the understanding of the physics of stars, their source of energy and their evolution on the “main sequence”, research which would occur approximately fifty years later.

In addition to his work on stars, Huggins would also turn his Spectroscope on the nebulae. On August 29, 1864, Huggins was the first to determine that some nebulae emitted bright line spectra indicating they were of a hot gaseous nature when he observed the planetary nebula NGC 6543 with his spectroscope. He would also continue on to show that all nebulae are not the same, when he measure the spectra of the Andromeda “nebula” declaring its spectrum more star like in nature. Huggins would go on to measure the spectra of over 70 nebulae and determined that about one third were of a gaseous nature and the rest of a stellar nature.

At the time he did this, the nature of the nebulae was still uncertain. While the fact of the difference between the gaseous and stellar nebulae would be a critical fact in proving that “island universes” (what we now call galaxies) exist, the fact was erroneously used to support the leading theory of the day that the nebulae were new solar systems caught in the act of evolving and were thus part of the Milky Way.

In 1868, Huggins was also the first to suggest that the Doppler principle could be used in the measurement of stellar spectra to determine their velocity in the line of sight. The Doppler principal states that the wave length of a sound or of light is shifted lower (towards the red end of the spectrum for light) in proportion to the speed of the source moving away from the observer and shifted higher (blue shift) if the source is moving towards the observer. While it would be nearly twenty years before this measurement could be confidently made (by Vogel) the technique has been used to determine the distance to the stars, the discovery of unseen binary stars, the discovery of exoplanets and even the discovery of the expansion of the universe.

As influential as Huggins was in establishing the new astronomy, today his name is hardly as familiar as his more famous predecessor. Anyone with more than a passing interest in astronomy will have been introduced to Sir William Herschel (1738-1822), an enthusiastic amateur, who did much to advance and improve the telescope as an instrument for the observation of what we now call the deep sky. In doing so, Herschel won several awards and honors and achieved international acclaim. He was highly regarded by his peers, in astronomy and other sciences.

Huggins too was a prime mover in changing and expanding the science of astronomy. He too would win several important awards and honors, an international reputation and the respect of his peers. In fact it can be argued that Huggins surpassed Herschel in this regard, as he not only won numerous prizes and medals but was elect to the Presidency of the Royal Society, a position he held for five years. Membership in the Royal Society alone was a signal honor, to take its helm as president

was to be seated at the pinnacle of the scientific world.

So why is it that most people with an interest in astronomy are relatively unfamiliar with Huggins?

Perhaps Huggins was a victim of his own press. In his retrospective memoirs, he presented himself as a dedicated worker toiling in the advancement of knowledge, rather than as a pioneering genius. Perhaps it is because Huggins discovered no new law or principle, but applied those of others in new and creative ways. Perhaps it was due to the major changes that were taking place in the world of science during his lifetime, where the paradigm of science conducted by wealthy amateurs was being replaced by the paradigm of professional science, with the victors discouraging and downplaying the role of amateurs. Perhaps while he was less constrained by convention when he moved all towards the “New Astronomy” his unconventional approach would be used to diminish accounts of his influence once he had passed.

Whatever the cause, astronomy – and particularly we amateur astronomers have much to celebrate in the life and work of Sir William Huggins. The astronomy and astrophysics of the twentieth century could not have happened without the tools and techniques that Huggins pioneered.

Maybe we as amateur astronomers should take the lead to rekindle the flame that lights the contributions that Huggins, a successful and dedicated amateur has made to astronomy. Anyone interested in an observing award – the Huggins 100?

Note 1: Eclecticism, Opportunism, and the Evolution of a New Research Agenda: William and Margaret Huggins and the Origins of Astrophysics – PhD thesis by Barbara J. Becker - 1993

Note 2: William Huggins, "The New Astronomy: A Personal Retrospect," *The Nineteenth Century* (1897) as quoted in numerous accounts.

## Just Looking

### A GuideStar Interview by Clayton L. Jeter

## John Haynes—Dedicated Observer



John Haynes is one of those guys that you wished all club members were like. 'Key Word' describing John Haynes: Dedicated. He's our very own H.A.S. society's keeper of the loaner telescopes. Believe me when I tell of all the work and time that goes into this job. I had that task for seven (7) years in the past. Whew...what a job! I really admire John for all of this work. But wait... there's more. This guy works out at the Columbus site on a regular basis, attends all board meetings, and is visible at almost all of the club star parties. Another 'Key Word' describing John: Busy!

In this month's interview, we are going to take a peek at one of our very own and figure out where he gets all of his energy and passion. Here's Johnny...



#### The John Haynes bio...

I developed an interest in astronomy from a very early age. Some of my fondest early memories are spending time with my father in our back yard in the High Desert of California where we had nearly pristine dark skies. When I was six, I remember sitting down on the couch with my father on nine or so

successive Tuesday nights and watching the original PBS airing of Carl Sagan's Cosmos series.

Though I didn't pursue a career in astronomy, I did take a college course in the subject. At the end of the course I was shocked when the professor asked me "Did you actually learn anything in this course? It seems to me you could have taught it yourself!" I actually did learn quite a bit from the course, but it made me realize then that astronomy was more than just a casual interest of mine: it was something of a passion.

Unfortunately, I never really found or made the time to be more active in my interest until a few years ago. Shortly after my father's death, I purchased my first telescope - a cheap 114mm Meade I found on Craigslist. I then decided to join the Houston Astronomical Society to join others that share my interests and

passion.

Since joining, I have become a very active member and enjoy the benefits of our Columbus dark site where I am trying to teach myself the complex art of astrophotography. On cloudy nights I spend time working on the loaner scope equipment I manage for the club, cleaning, repairing, upgrading, and generally tweaking the scopes that members are welcome to check out.

#### The John Haynes interview...

**Clayton:** John, it's really great to have you take the time and tell us about your love of astronomy and this driving passion that you have for observing the night skies. Why the interest in astronomy in the first place?

**John:** I blame it on my dad. My dad always had an interest in astronomy. He got me started. Where I grew up in the desert of California, the skies were usually clear and pretty dark (darker than Columbus when we originally moved there in the 70's). By the time I left in the early 90's, the skies were noticeably more light polluted, but still better than a lot of places. I can't tell you how many nights I spent in the back yard laying on a blanket with a pair of binoculars.

I really think it was when I accidentally found M4 for the first time, just looking around the sky with binoculars, that I realized just how much was out there to see.

**Clayton:** Do you think that by becoming involved in astronomy, it has somehow changed a direction in your life?

(Continued on page 10)

*(Continued from page 9)*

**John:** Yes. Not that I was living a rudderless existence before, but it's given me something that I can really pour my interest into. It never gets boring. It also merges several of my interests: astronomy, computers, and tinkering with and fixing things.

**Clayton:** Tell us all about the equipment that you use. Are you a die-hard visual observer, astrophotographer, or a little of both?

**John:** I'm slowly trying to learn the arcane art of astrophotography, but I do both.

My main telescope is an old Meade 2080 tube (the one you cleaned up for me rather nicely, I might add) that I got off Craigslist for \$100. I pulled it off the old fork mount it came with and mated it up with a CG-5 I got off Astromart. I've added to that an 80mm Vernonscope that I bought off another club member, which gives me a wide-field view (and really replaces the mediocre finder the 2080 came with).

You'll find a lot of my stuff is heavily modified, often rather crudely, by me. I'm an astronomer on a budget. Unfortunately, there's no Scope Depot, so I have to make do with stuff I get at Home Depot or Lowes and hack to make it work. So far, rather successfully. I'm particularly proud of the mounting rings I made for the 80mm. They cost me about \$15 total... as opposed to \$50 to \$75 for some cheaper rings on Astromart or Cloudy Nights.

As for my imaging... I've been using that scope, but at F/10, getting good images is a challenge. Same thing with the C14 at Columbus. I'm looking to pick up either a good focal reducer or just get a dedicated scope for photography. Astro-Tech makes a great 8" Newtonian astrograph for under \$500. It's on my wish list. My camera is a Nikon D5000. I was using a D3000, but it doesn't have the live view and extended control capability, so I upgraded. Now I need good software to control it... but that's another problem.

With all this stuff, a trip out to Columbus really loads me down (I actually traded in my old car, which was near the end of its life anyway, on a small SUV so I'd have space to carry my equipment!). One club member at Columbus one night asked if I was retaking satellites and threatened (jokingly) to notify the NSA about my nefarious activities!

Of course, being the loaner scope guy gives me access to all sorts of other toys as well... and that's not to mention the stuff in the observatory in Columbus. All told, I'm pretty happy with the toys I get to play with... but I always crave more!

**Clayton:** When planning an observing session for an upcoming evening, what atlas or electronic program do you use? Do

you use more than one?

**John:** I use a few things. First off, I like the online interactive star chart (and other tools) that you can view on Sky and Telescope's website. Free is always good! I also have Google SkyMap on my android phone and tablet, which is pretty useful. For more serious planning, I use Sky Tools. I bought the pro version when we had the club discount a couple years back and love it. And, sometimes, I just use a good old handy copy of the Peterson Field Guide to Stars and Planets.

**Clayton:** Curious... how did you find H.A.S.? Are you a member of another club also?

**John:** I'm HAS only. One club is enough for me, though I'm sure those other clubs are great. I found HAS by doing a web search, of course -- anyone who knows me knows I'm a real computer geek. When I bought my 114mm scope, I figured it would be a good idea to connect with others who share my interests. So I did a quick search and HAS is what came up. When I saw the loaner program and the observatory in Columbus, I knew this was the group for me!

**Clayton:** When I was the HAS telescope loaner chairperson a decade ago, I was always busy receiving and checking out the scopes from our inventory. I learned a lot about scope repair because many times the scopes were returned broken or not in a working order. Do you find this to be true now? How about storing returned scopes? Is your garage full?

**John:** I hate to say it, but there really isn't a lot of loaner activity these days. Sometimes I'll go two or three months or so without someone checking out or returning a scope. And sometimes it's a challenge to connect with people to loan out or take in equipment. I hope that this will change as we grow. As for repair and storage... wow... yeah... I've spent a lot of time tweaking things. Especially with donated equipment. Right now I'm working on mating up a donated 8" Newtonian with a CG-5 that was donated separately. Tthe

*(Continued on page 11)*

(Continued from page 10)

mount the 8" came with was fine, but the CG-5 is GoTo, which will give the loaner program a second GoTo scope, which I think we need. The tweaking and modifying and all that is a lot of fun, and I learn a lot from it.

As for storage... yeah... that's an issue too. I'm working on it though. First off, I need to sell off some of this stuff that's really not loaner material. I have a C-11 with a Losmandy G-11 (doesn't have the Gemini GoTo, but does have digital setting circles) Its great equipment... but the loaner program is more focused on beginners and really needs to be more portable equipment. This is neither easily portable, nor a beginner's instrument. The club will be better served when I can sell this off and use the funds to buy a couple of those nice GoTo dobs that Orion makes, or a couple decent 6" or 8" GoTo SCT's from Celestron and Meade. I'd really like to completely overhaul the entire inventory... but finding buyers for a lot of this stuff is tricky. Not a lot of people are interested in the 14" Juno that I put on Astromart... not for \$4,000... and probably not even for \$3,000... but I'm very hesitant to reduce it more than that and squander the resource. I think that this will change when the economy picks up, but for now, I need to find homes for some of these scopes... or to add members to the Loaner Scope Committee (of which I'm the chairman and only member currently!) to help out with storage.

Dilemmas, dilemmas...

**Clayton:** Have you ever completed an Astronomical League observing program and received an award? Got a favorite object when looking up?

**John:** I'm sad to say that I haven't actually completed any yet. I'm about halfway through my Messiers and Binocular Messiers. But photography takes up a lot of my time these days, endlessly tweaking and testing my setup. I hope to actually finish them this year, maybe in March or April when they're all visible in a single night. I also have preliminary plans for a pet-project to get images of all of the Messier objects... but I need to really get my technique down first.

Favorite object? Hmm... I have a few. M4... I was blown away the first time I saw it and figured out what it was. I love globulars... they're just so fascinating... thousands, tens and hundreds of thousands of ancient stars in a tight knot... they're fascinating to me. I also love M31 and M42... they're always fun to view when they're up. But my absolute favorite is probably M51. One of these days I'll get my imaging down and get a good picture of the Whirlpool!

**Clayton:** How would you like to see your own astronomy grow? What's new on your horizon?

**John:** Imagery... and more imagery. I'm playing around with autoguinding now. I think I've got it figured out, but haven't

quite gotten a chance to test my setup. It's a real challenge, balancing the scopes, the cameras, the mounts, and the software (not to mention getting it to run on Vista or XP or 7 or whatever... ugh!). I'm hoping to get out to Columbus really soon to see what happens when I put this all together!

**Clayton:** Ever been to the Texas Star Party or any of the other large star parties in the U.S.? Any plans to make one this year?

**John:** No, but I really want to!. Work keeps me extremely busy and doesn't offer a lot of extended vacation time or funds to travel to these events. I am, unfortunately, in a very pivotal position where I work... it's very hard to get away. But we've done some reorganization recently and I'm hoping that I'll get a chance to hit TSP in 2013. I'd really also love to go to Stellafane in Vermont. I lived in Vermont for 8 years and miss the state terribly (sorry, Texas!), and hitting Stellafane would be great – spend time with friends and the stars. Perhaps that's another thing for 2013.

**Clayton:** It seems in recent years that the younger people are not that interested in amateur astronomy, or any of the sciences. How can we turn this around?

**John:** I ponder this all the time. I worry as well. As wonderful as Hubble has been for science, and some of the other big scopes like the LBT and Keck, the images they produce are simply not what you see in the eyepiece. I think that a lot of younger people look through the eyepiece at a fuzzy smudge and say 'so what?' They don't quite grasp what they're really seeing and, quite frankly, I'm not sure they have the attention span to stick with it. I don't mean to sound down on ALL young people... there definitely are some who have the patience and focus and interest. But I don't think nearly as many young people do anymore. Even people my own age group don't seem to have the interest. If people in my age range, who are

(Continued on page 12)

(Continued from page 11)

having and raising kids, don't have the interest to pass on to their kids like my dad did with me, then where are they going to get it from?

How do we change this? More education! I'm a firm believer that education is the answer to most, if not all, the world's problems. For HAS, this means more star parties, more talking to kids. That's all I've got.

**Clayton:** Do you have any helpful advice to pass on to observers just starting out in astronomy?

**John:** Learn your constellations and bright stars... learn your way around the sky. And learn to star-hop. If you can't star hop, at least a little, you can get easily frustrated. Besides, some of the more interesting things I've seen I've found while star hopping. And don't worry about the equipment... get a good pair of binoculars! And borrow a loaner scope!

**Clayton:** Is there an email address that you have that another Houston Astronomical Society member could contact you for an additional question or two?

**John:** Well, since I'm the loaner guy, its [Loanerscopes@astronomyhouston.org](mailto:Loanerscopes@astronomyhouston.org), or you can get me on one of my personal addresses. I've got so many (I did mention I'm a computer geek right?), but the easiest is probably my Gmail: [henryv1598@gmail.com](mailto:henryv1598@gmail.com) (the Henry V comes from my obsession with Shakespeare, not with murdering wives!)

**Clayton:** Thanks John for taking the time to share your interest and thoughts within our newsletter, the *GuideStar*. We wish you luck with all of your astronomy interests. Keep up the great services that you provide for our membership.

**John:** I'm honored you'd consider me for the interview... you've interviewed some pretty big movers and shakers in the past, so I was a bit blown away when you asked me! Thank you!

**Clayton:** Clear skies always,

**John:** Clear skies to you as well!



*M65 and M66 monochrome taken 4/21/12.  
ATIK 320E camera on German equatorial mount.  
Telescope is a 4" refractor. 10 minute exposure.*

*Bill Pellerin*

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*Clayton L. Jeter is an avid visual observer and a longtime member of the Houston Astronomical Society. Contact him at: [stonebloke@gmail.com](mailto:stonebloke@gmail.com)*

## ***Highlights from the April Meeting***

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***By Doug McCormick, Secretary***

- New name tags were distributed to all present who had paid their membership dues for this year. HAS President, Gordon Houston, recognized Steve Fast for his work creating the new name tags.
- HAS Vice President, Bill Pellerin, previewed the April edition of the GuideStar Newsletter
- Gordon welcomed the new members and visitors present at the meeting.
- Novice Chair, Justin McCollum, gave the comet report.
- Observatory Chair, Bob Rogers, reminded members that the site combination will change on April 5<sup>th</sup>. To get the new combination, members must have attended the site orientation training and be current on their membership dues. Bob also related that the entrance gate at the Columbus site has been successfully recessed so people don't have to leave their vehicle in the road while opening the gate.
- Steve Goldberg related that the 2012 Texas Star Party was just around the corner. For those interested in going in 2013, registration will open on the TSP website around November 1, 2012.
- Speaker Chair, Brian Cudnik, introduced the speaker for the evening, Brian H. Day of the NASA Lunar Science Institute. Brian delivered his presentation entitled, "The New Moon: What we're learning from the New Robotic Explorers."

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### ***Coming Soon:***

## ***AstroLeague Observing Program at Columbus***

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This June, HAS will begin a new observational astronomy program, this one located in Columbus and coordinated by Rene Gedaly.

Once a month Rene will be at the dark site working on her astronomical league programs and she invites other observers to join her to work on their clubs at the same time.

Like the Urban Observing program, the chief goal of the Astronomical League Observing program is to get out and observe in the company and support of other HAS members.

Currently Rene is working on both the telescope and binocular messier clubs and the Universe Sampler program and hopes to earn certificates for each of these within the coming year.

You can earn yours, too.

Dates and other details will be posted on the website forums and list server.

# NASA Helps Europe Study a Comet – Up Close and Personal

By Dr. Tony Phillips

NASA Space Place

Europe's Rosetta spacecraft is on its way to intercept comet 67P/Churyumov-Gerasimenko. Comets have been intercepted before, but this mission is different. Rosetta aims to make history by landing a probe on the comet's surface while the mother ship orbits overhead.

"Rosetta is the European equivalent of a NASA flagship mission," explains Claudia Alexander, project scientist for the U.S. Rosetta Project at NASA's Jet Propulsion Laboratory. "It will conduct the most comprehensive study of a comet ever performed."

Rosetta's payload contains 21 instruments (11 on the orbiter, 10 on the lander) designed to study almost every aspect of the comet's chemistry, structure, and dynamics. Three of the sensors were contributed by the U.S.: Alice (an ultraviolet spectrometer), IES (an ion and electron sensor), and MIRO (a microwave sounder).

The main event of the mission will likely be the landing. The 100-kg lander, which looks a bit like a cross between NASA's old Viking Mars landers and a modern microsatellite, will spend two weeks fastened to the comet's icy surface. The European-built probe will collect samples for analysis by onboard microscopes and take stunning panoramic images from ground level.

"First the lander will study the surface from close range to establish a baseline before the comet becomes active," explains Alexander. "Then the orbiter will investigate the flow of gas and dust around the comet's active, venting nucleus."

Rosetta's sensors will perform the experiments that reveal how the chemicals present interact with one another and with the solar wind. Alice and MIRO detect uncharged atoms and molecules, while IES detects the ions and electrons as the solar wind buffets the nucleus.

One problem that often vexes astronomers when they try to study comets is visibility. It's hard to see through the dusty veil of gas

billowing away from the heated nucleus. The microwaves MIRO detects can penetrate the dust, so MIRO can see and measure its target molecules even when other instruments can't.

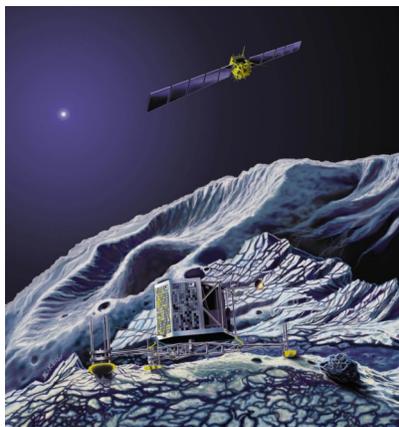
MIRO is one of several experiments focused on the comet's structural properties. It will determine the comet's dielectric constant, emissivity, and thermal conductivity to determine whether it is made of a powdery loose material, has a detectable layer of loose material, or is hard as rock.

"We want to find out whether comets have retained material from when the solar system formed," says Alexander. "If the ancient materials are still there, we can get an idea of what conditions were like at the dawn of the solar system."

Rosetta enters orbit in 2014. Stay tuned for updates!

Check out "Comet Quest," the new, free iPhone/iPad game that has you operating the Rosetta spacecraft yourself. Get the link at [spaceplace.nasa.gov/comet-quest](http://spaceplace.nasa.gov/comet-quest).

*This article was provided by the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration.*



*Rosetta's lander Philae will eject from the spacecraft, touch down on the comet's nucleus, and immediately fire a harpoon into the surface to anchor itself so it won't drift off in the weak gravity.*

## Y Dwarfs: Because They're Cool

By Curtis Williams, Professor Astronomy, <http://blog.professorastronomy.com/>

That little green dot in the center of the picture below/right may not look like much, but it is, in fact, one of the first absolutely definitive members of a predicted type of brown dwarf, the "spectral class Y" dwarfs. It was discovered by astronomers using data from the Wide-field Infrared Survey Explorer, a satellite mission that scanned the entire sky in the infrared wavelengths of light during 2010. The star above has a temperature of about 25 degrees Celsius, or roughly 80 degrees Fahrenheit -- measurably cooler than the endless summer heat here in Texas. The discovery was announced recently by the WISE team, and an official journal article announcing the discovery has been accepted for publication in the *Astrophysical Journal*. Even cooler than the brown dwarf is the fact that this paper was headed up by a good friend of mine, Michael Cushing (now a new faculty member at the University of Toledo).

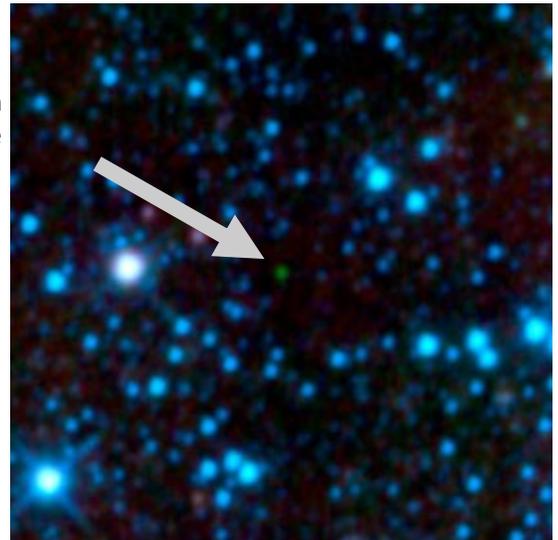
First, some quick background and definitions. Stars like the sun shine because they are giant nuclear fusion reactors, with most fusing hydrogen into helium. This process releases a lot of energy and can last for a long time - the sun's lifetime is about 10 billion years. In stars that are smaller (less massive) than the sun, the fusion reactions still occur, but at a lesser rate, because the star is cooler and the hydrogen a bit more lethargic. This trend continues until you get to stars that are about 8% of the sun's mass. Since these stars fuse hydrogen so slowly, they may actually survive for thousands of billions of years (i.e., trillions of years), even though they don't have as much hydrogen fuel as the sun does.

Objects less massive than 8% the sun's mass simply are too cold to perform hydrogen fusion. There are a few uncommon nuclear reactions that can occur and keep the object warm for a few million years, but those reactions quickly flicker and die. Without energy from nuclear reactions, the "failed star" will begin to cool off and slowly fade away. These objects are called *brown dwarfs*.

Smaller yet, at about 1.5% the mass of the sun, objects can never perform fusion reactions at all. Many astronomers refer to these tiny objects as planets, although there is no physical law that says these things must orbit stars (a condition some astronomers think is necessary to call something a planet). Jupiter, although a whopping big planet in our Solar System, is only 0.1% the mass of the sun, 15 times less massive than this limit. Although some books and people may refer to Jupiter as a "failed star", it never came close to doing any type of nuclear fusion and so being a brown dwarf, let alone sustaining nuclear fusion like stars do. Calling Jupiter a "failed star" is, in my opinion, like calling my house cat a tiger. It may look and act like a little tiger, but it's a different animal. Anyway, I digress.

Stars and brown dwarfs are classified based on their surface temperatures. When we take a spectrum of a star, we split its light up into its component colors. The different elements and molecules present at the surface of a star each have a sort of bar code in the spectrum, so we can tell what a star is made out of by looking at the spectrum.

But the elements we see depend not just on how much of that element is present, but also how hot the star is. For example, about 90% of the sun's atoms are hydrogen atoms, but the sun's spectrum is dominated by bar codes from elements like iron, magnesium and calcium, elements that make up less than 1% of the sun's atoms.



For stars hotter than the sun, like the bright star Sirius, we see mostly hydrogen in the spectrum. For stars even hotter yet, we see mostly helium. But all stars are nearly identical to the sun in composition -- it's the temperature that makes the huge differences in the spectrum.

About 100 years ago, a group of women astronomers at Harvard College Observa-

(Continued on page 16)

*(Continued from page 15)*

tory devised a system for classifying the spectra of stars by using a letter for each type of spectrum, starting with "A", "B", and so on up to "Q". Each letter stood for a spectrum that was dominated by different elements. The system was developed before astronomers understood that the star's temperature was important. Once the temperature effects were figured out, the spectral types were simplified and re-arranged to the now-familiar "O B A F G K M" sequence. O stars are very hot, while M stars are the coolest true stars around.

Brown dwarfs were first discovered in the 1980s and 1990s. Young brown dwarfs are still hot from their formation and the tiny amounts of nuclear fusion that they can perform, and so have temperatures that give them M type spectra. But as astronomers discovered more and more brown dwarfs, they began to find some with cooler spectra that looked quite different from the spectra of M stars. In 1999, Caltech astronomer Davy Kirkpatrick organized these brown dwarfs into two new spectral types.

After careful consideration of possible names for these new spectral types, he and his collaborators settled on the letters "L" and "T", being two of the only three letters left that would not be confusing. L-type brown dwarfs, the next class cooler than M stars, show strong features of molecules like iron hydride and atoms such as sodium and potassium in their spectra.

As a brown dwarf cools further, methane will form in its atmosphere and become a strong feature in the spectrum. Since these spectra look much different, they are a different spectral type, the "T"-type brown dwarfs. Until recently, all known brown dwarfs were spectral type "L" and "T", which covered temperatures down to about 500 Kelvin (about 230 Celsius, or about 450 degrees Fahrenheit) -- much cooler than stars, but still fairly toasty by human standards. As a comparison, the planet Jupiter has a temperature of about -150 Celsius, or what my grandmother would call "boo cold".

The third remaining spectral type letter, "Y", Kirkpatrick suggested to be used for the coolest possible brown dwarfs, those with temperatures below about 500 K. At these temperatures, ammonia can form and become strong in the spectrum. While a few cool brown dwarfs that might have been "Y"-type had been discovered and described, there has been vigorous debate over whether these really were a different spectral class.

Then along came WISE. WISE is a telescope that looks in the infrared and is optimized to find things with temperatures close to room temperature (or colder). WISE has therefore found numerous asteroids and comets, and it was expected to find many brown dwarfs. Brown dwarfs don't give off much visible light, but shine in the infrared. Once the WISE team identified candidate cold brown dwarfs, they went to some of the largest existing ground-based telescopes like Magellan and Keck to get spectra. After all, if you are going to be claiming to find a new spectral type, you better have a spectrum to prove it.

The spectra tell the tale. There does indeed appear to be some ammonia visible in the spectra of these WISE brown dwarfs, and there are other substantial differences with the coolest T dwarfs. So, it seems very likely that these cool brown dwarfs are indeed "Y" dwarfs, fulfilling a prediction made over a decade ago. And the temperatures of these stars are around 300 to 500 Kelvin, or from room temperature up to a few hundred degrees. The coolest of the confirmed Y dwarfs, with the typical astronomically inscrutable name of WISE 1828+2650 (the green dot in the photo at the top of this post), has a surface temperature of about 80 degrees Fahrenheit, very comfortable for humans!

Don't start making vacation plans to visit WISE 1828+2650 yet, though. First, like all stars and brown dwarfs, WISE 1828+2650 is made entirely of gas and has no "surface" on which you could stand. And even if there were some sort of platform on which you could stand in the 80-degree atmosphere, the force of gravity would be 10 to 100 times that on Earth -- not exactly pleasant. And, as if that weren't bad enough, like all stars, WISE 1828+2650 is composed almost entirely of hydrogen and helium, so there wouldn't be enough oxygen to breathe.

Could there be cooler brown dwarfs out there? Quite possibly. We don't know exactly how fast brown dwarfs cool off, but small brown dwarfs can cool to 300 Kelvin in 5 to 10 billion years, less than the age of the Universe. "Planets" obviously can get much colder yet, like Jupiter at its frigid 125 Kelvin. But the oldest, largest brown dwarfs may not have had enough time to get this cold yet. So, the green dot in the picture at the top of this article could be one of the coolest stars in the sky, in more ways than one.

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*This content distributed by the  
AAVSO Writer's Bureau*

# Observatory Corner

By Bob Rogers, Observatory Chairman

*Hello everyone.*

On Saturday, March 24<sup>th</sup>, several volunteers came out to the site to complete the North Fence replacement by recessing the entrance gate so nobody has to park on the road at that blind corner. The volunteers who showed up were Dana Lindstrom, Lee Gibson, Steve Fast, Allen Wilkerson, Ralph Walker, Matt Lindstrom and David Masera. These guys pulled out the old gate and installed the new gate in



about 5 hours of time. They did a wonderful job and were rewarded with Astronomical hamburgers cooked by yours truly. I want to thank Dana Lindstrom for the donation of the 2 gates that helped with the cost of all this.



On another note, later that night, quite a crowd of astronomers showed up to do some viewing under clear skies. We even had some high school kids (future members?) in the Observatory doing some viewing. What amazed everyone was that the Obser-

servatory roof had opened and nobody had noticed it due to it being so quiet while opening. I want to thank John Hiatt and Allen Wilkerson for all the hard work that was put into getting the roof to working smoothly again.

And the work goes on ....

I **do need** to remind everyone that we need to start filling out Log Reports at the site so I can give this information to the Fondren Foundation. The property is on a 99 year lease and part of the Lease agreement is that HAS needs to report every year to the Fondren Foundation that the Property is being used. The Log Reports are located in the box in the middle of the field. Just open the cover, fill out the report and then slide it into the slot that is in the inside of the cover and then close the box. It is very important that everyone fill out a Log Report so that we are showing that the Observing site is being used. Your help on this is very much appreciated.

If you have a Randalls card, and have not done so, please have it coded for the Houston Astronomical Society. Our number is #6618. The Society gets 1% of the gross sales that members spend at Ran-



dalls. Randalls totals up the amount spent each quarter and will send us a check if the amount goes over \$2,500.00, otherwise the total roles over to the next quarter or zeros out at the end of the calendar year. So please link your Randalls card to the Houston Astronomical Society so that the society can benefit from this Randalls program. Our number is #6618. This is very easy to do, just go to the Courtesy Booth and tell the person there what you want to do.

If you have any suggestions or thoughts for the site, let me know.

Thanks,

*Bob Rogers*

Observatory Chairman  
281-460-1573  
siteworkerbob@hotmail.com

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**Trailer/RV spots available free for weekend use at the site.**  
Contact the Observatory Chairman, Bob Rogers [siteworkerbob@hotmail.com](mailto:siteworkerbob@hotmail.com) for more information

## Shallow Sky Object of the Month

# Moon Dance

**Object:** The Moon

**Class:** An event, actually a non-event

**Optics needed:** You can see the moon rise and set without optical aid.

### *Why this is interesting:*

We tend to think about the moon rising and setting each day. Most of us who like to get out and observe under dark skies are aware of moon rise and set times. I was just checking the weather reports for the week and noticed that on this coming Thursday (April 24), there's no moonset. How can that be?

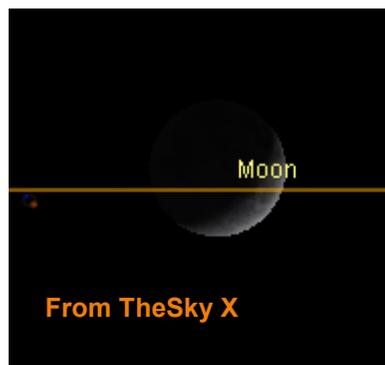
The moon appears to move to the west in the sky because of the eastward rotation of the earth. This is true with the stars, planets, the sun and all celestial objects.

But the moon, of all the major objects in the sky is one that, on its own, moves a significant distance eastward in the sky each day. We see evidence of this because of the change in phases of the moon. This movement changes the relative position of the earth / moon / sun system.

How far does the moon move across the sky every night? Things are never simple, but we can simplify this enough to come up with a good approximation. The lunar cycle (new moon to new moon) is 29.5 days. So, the moon makes a complete trip around the earth, relative to the sun, in 29.5 days. A complete trip is 360 degrees, so  $360 \text{ degrees} / 29.5 \text{ days} = 12.2 \text{ degrees} / \text{day}$ . The sky moves 360 degrees (relative to the sun) in 24 hours or 15 degrees per hour. So it's easy to determine how long it is between successive moonsets  $12.2/15 = .81$ , and  $.81 * 60 \text{ minutes of time} = 48.8 \text{ minutes}$ .

If the moonset time on day 1 is less than 48.8 minutes before midnight, there will be no moonset time on the next day. The moonset will occur early on day 3.

And, in fact, on this Wednesday, the 25th of April the set time is 11:52 p.m. On Thursday, the 26th, there is no moon set. Finally, on Friday at 12:37 a.m. the moon sets. If you ask about the difference in set time due to the movement of the moon it's 8 minutes + 37 minutes = 45 minutes, not far from our back-of-the-envelope calculation. Actual results depend on other things like the angle of the moonrise and moonset, whether the moon is



The moon setting just before midnight on May 25, 2012. From TheSkyX



The moon setting after midnight on May 27, 2012. From TheSkyX

at apogee or perigee, and probably some things that I haven't thought about.

The geometry of this is such that the 'no moonset' day occurs around first quarter and a 'no moonrise' day occurs around last quarter.

### **In May...**

May 9 — no moonrise this date. On May 8, the moonrise is at 23:10, and the next moonrise is on May 10 at 00:02 (local time).

May 26 — no moonset this date On May 25 moonset is at 23:58 and the next moonset is on May 27 at 00:36

*By the way... I've had to consult several resources to confirm these times. Some sources list moonset on May 26 at 23:58, which is not correct. The correct answer is that there is no moonset on May 26!*

So... check this out. Observe the moonset on May 25 and the next moonset on May 27. These will be 24 hours + 38 minutes apart by the clock, but two days apart by the calendar!

# Houston Astronomical Society

P.O. Box 20332

Houston, TX 77225-0332

## General Membership Meeting

The Houston Astronomical Society holds its regular monthly General Membership Meeting on the first Friday of each month, unless rescheduled due to a holiday or a conflict with other events at the University of Houston.

## Board of Directors Meeting

The Board of Directors Meeting is held on dates and at locations scheduled by the board. Information provided to *GuideStar* will be published. The meetings are open to all members of the Society in good standing. Attendance is encouraged.

## GuideStar Information

The H.A.S. *GuideStar* is published monthly by the Houston Astronomical Society. All opinions expressed herein are those of the contributor and not necessarily of Houston Astronomical Society. The monthly Meeting Notice is included herein. *GuideStar* is available on the HAS web site to all members of H.A.S., and to persons interested in the organization's activities. Contributions to *GuideStar* by members are encouraged. Electronic submission is helpful. Submit the article in text, MS-Word format via email [BillPellerin@sbcglobal.net](mailto:BillPellerin@sbcglobal.net). Copy must be received by the 15th of the month for inclusion in the issue to be available near the end of the same month. Or, bring copy to the General Membership Meeting and give it to the Editor, or phone to make special arrangements.

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The Houston Astronomical Society welcomes you to our organization. The HAS is a group of dedicated amateur astronomers, most of whom are observers, but some are armchair astronomers.

The benefits of membership are:

- Access to our 18 acre observing site west of Houston -- a great place to observe the universe!
- A telescope loaner program -- borrow a HAS telescope and try observing for yourself!
- A monthly novice meeting, site orientation meeting, and general meeting with speakers of interest.
- Opportunities to participate in programs that promote astronomy to the general public (such as Star Parties at schools)
- A yearly all-clubs meeting for Houston area organizations
- Meet other amateurs and share experiences, learn techniques, and swap stories

***You're invited to attend our next meeting.***

***You'll have a great time.***

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## ***Houston Astronomical Society***

### **Meeting on Friday, May 4, 2012**

**7:00 Novice Meeting, room 116 Science & Research 1 Bldg**

**8:00 General Meeting, room 117 Science & Research 1 Bldg**

### **University of Houston**

#### **Directions to meeting:**

#### **From I-45 going south (from downtown)**

- exit at Cullen Boulevard
- turn right on Cullen
- turn right into the parking lot (by the stadium)
- Science and Research is across the street (2nd building back)

#### **From I-45 going north (from NASA/Galveston)**

- exit at Cullen Boulevard
- turn left on Cullen
- turn right into the parking lot (by the stadium)
- Science and Research is across the street (2nd building back)

#### **Parking:**

There is Free Parking, **BUT DO NOT PARK IN ANY RESERVED PARKING SPACES AT ANY TIME.**

U of H parking enforcement will ticket your vehicle.

**UPDATE — Due to construction in the stadium parking lot, use entrances 15D and 15F. You can park in this area, but NOT in a RESERVED space.**