

# GuideStar



January, 2016

Volume 35, #1

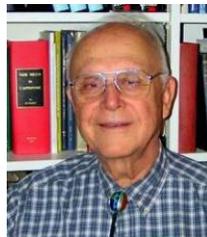
## *At the January 8 Meeting*

*Note: This is the second Friday to avoid a conflict with the New Year's Day holiday*

### ***Astronomy on the Margins: The Role of Amateurs and Women in the Invention of Astrophysics***

***Dr. Tom Williams, HAS Member***

In the first three quarters of the 19<sup>th</sup> century, amateur astronomers in the British Isles and the United States led development of the new discipline of astrophysics. Thereafter, amateurs continued to contribute to astrophysics, as women began to make their presence felt through their significant refinements to spectroscopy and photometry. After 1890, the roles of both amateurs and women declined relatively speaking as professional astronomers finally sensed the scientific potential of astrophysics and philanthropy provided them tools that were well beyond the financial means of any amateurs. This presentation will describe that ebb and flow in the development of astrophysics by astronomers who were otherwise marginalized in the science of astronomy.



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#### 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.

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

**Novice meeting: ..... 7:00 p.m.**

**Bill Pellerin / Walt Cooney - "Variable Stars & New Discoveries"**

**See page 13**

**General meeting:..... 8:00 p.m**

***See last page for directions  
and more information.***



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

**The *GuideStar* is the winner of the 2012 Astronomical League Mabel Sterns Newsletter award.**

## 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.

### Officers

President	Rene Gedaly	president@astronomyhouston.org
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### Advisors

Dr. Reginald DuFour	Rice University
Dr. Lawrence Pinsky	University of Houston
Dr. Lawrence Armendarez	University of St. Thomas

### Annual Dues and Membership Information

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:

You can join (or renew at the organization web site, [www.astronomyhouston.org](http://www.astronomyhouston.org). Click the 'Join HAS' Tab.

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.

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## ***Other Meetings...***

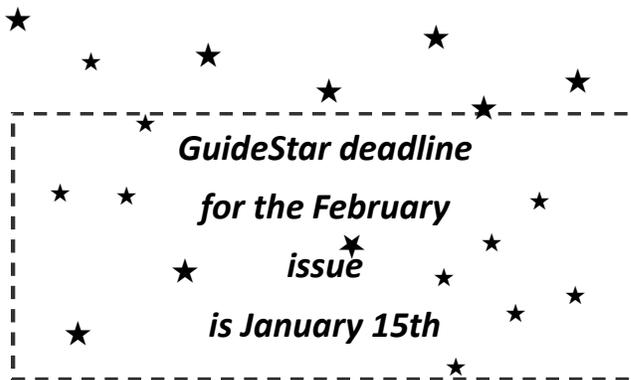
**Johnson Space Center Astronomical Society** meets in the the Lunar and Planetary Institute on the 2nd Friday of each month. Web site: [www.jscas.net](http://www.jscas.net)

**Fort Bend Astronomy Club** meets the third Friday of the month at 8:00 p.m. at the Houston Community College Southwest Campus in Stafford, Texas  
[http://www.fbac.org/club\\_meetings.htm](http://www.fbac.org/club_meetings.htm).

Novice meeting begins at 7:00 p.m., regular meeting begins at 8:00 p.m. Website:  
<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



## ***Check the web site: www.astronomyhouston.org***

The HAS website not only has news and information about our society, but also a variety of features to manage your membership and connect with other club members. Current members can post photos, trade gear, pay dues, manage discount magazine subscriptions, swap stories in the forum, and more.

Questions about the site? Need a hand to get your account set up?

Contact [webmaster@astronomyhouston.org](mailto:webmaster@astronomyhouston.org).

***The HAS web site is the winner of the 2012 Astronomical League award for excellence.***

## President's Message

by Rene Gedaly, President

How many women members would you imagine we have? Take a guess. Fifty? One hundred? As of this writing there are 167 members who are women or girls. I bet some of you can remember when the entire membership hovered around that number. Ninety-five of those 167 are associate members. Looking over the list, we have some very active and supportive associates. Thank you all so much.

### **For many women membership is primary**

That leaves 72. Seventy-two of us are non-associate female members: regular, student, and sustaining. We're at the novice and membership meetings, at the dark-sky site for prime- and novice nights, we're active contributors on the HAS Facebook group, we give talks, participate in outreach, and take leadership positions. A lot of us are arm-chair amateurs. By choice? Or waiting in the wings?

### **Proceedings of the Amateur-Professional Partnerships in Astronomy conference**

The web is a wonderful thing. Formulate a good search and all manner of reliable information pops up. I came across an interesting paper entitled *Involving More Women in Amateur Astronomy* by Mary Lou Whitehorne. "There

are two primary reasons there are fewer women than men in amateur astronomy," she says: "sociological and biological."

The paper was delivered at the Amateur-Professional Partnership in Astronomy conference held in 2000 so it's a little dated. For example, there *are* more women involved in amateur astronomy, at least at HAS. But the sociological reason for *continued* participation is still relevant: "Amateur astronomy is a hobby and comes after family and career commitments." The same can be said for men, of course. We all struggle to find that balance between work and family and treasured avocation.

### **Biology is destiny?**

As for the biological reason, Whitehorne mentions the lack of bathroom facilities. Happily that's not a problem for us. We even have a bunkhouse. But speaking of that bunkhouse—so beautifully remodeled by Ana and Don Taylor and crew—I know from personal experience that if a woman takes one of the beds, the men will not enter.

Makes sense. But when I rejoined HAS in 2009, I was determined to make use of the dark-sky site this time around. However, I soon realized I was left with the option of, in effect, kicking the men out of the bunkhouse and sometimes the chartroom, or camping in my car. I've done all three and in no option did I feel entirely comfortable.

### **A trade-off**

One of the most difficult decisions I've ever made, no exaggeration, was to forgo the purchase of a fully outfitted 15" Ultra Compact Obsession telescope so that I could get myself a little travel trailer to park at the dark site. Now I have a place to sleep after a good night's observing without taking more space than my fair share. I'm still lusting after that Obsession though.

That was my trade-off. What trade-offs, I wonder, are the other women members having to make?

### **A solution**

Amelia Goldberg finishes her three part series covering the dark site in this issue of the *GuideStar*. It's written from the perspective of a long-time member, a master observer... and a woman. I won't steal her thunder, but take a look at her article. She reports on a possible solution to both the sociology and biology problems of would-be women observers—thanks to some forward-thinking, fair-minded men and women.

### **Keep Looking Up**

..Rene Gedaly

President



# January/February Calendar



Date	Time	Event
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## January

1	11:31 p.m.	Last Quarter Moon
4		Quadrantids meteors peak in early AM
8	7:00 p.m.	HAS Novice Meeting, U of H
	8:00 p.m.	HAS General Meeting, U of H
9	7:31 p.m.	New Moon
		Prime Night, Columbus
16	5:27 a.m.	First Quarter Moon
23	2:00 p.m.	HAS Leadership & Board Meetings, Moran residence
	7:46 p.m.	Full Moon
31	9:29 p.m.	Last Quarter Moon

## February

5	7:00 p.m.	HAS Novice Meeting, U of H
	8:00 p.m.	HAS General Meeting, U of H
6		Prime Night, Columbus
8	8:40 a.m.	New Moon
15	1:47 a.m.	First Quarter Moon
22	12:20 p.m.	Full Moon

Send calendar events to Doug McCormick - [skygazer10@sbcglobal.net](mailto:skygazer10@sbcglobal.net)

For the latest information on club events, go to <http://www.astronomyhouston.org/>

## HAS Board Meeting

HAS Board meetings are scheduled regularly (see the calendar, above). All members are invited to attend these meetings, but only board members can vote on issues brought before the board. Meetings are held at the Houston Arboretum at 7:00 p.m. on the date specified.



★ Follow the *GuideStar* on Twitter at:

★ [\*GuideStar\\_HAS\*](#)

★ Join Facebook and look for:

★ [\*Houston Astronomical Society\*](#)

★ *Starline*

★ Call 832-go4-HASO (832-464-4270) for the latest information on the meeting and other information about activities within the HAS.

## ★ Event Notification or Cancellation

★ HAS uses [RAINEDOUT.NET](http://RAINEDOUT.NET) to communicate late breaking updates about our various events. . Message delivery is via text messaging and e-mail. There are several ways to subscribe. If you would like to receive these notices via text messaging directly to your phone, subscribe to any of the sub-groups which interest you as follows:

★ To receive text messages, send any or all of the following (one at a time) to **84483**

★ You will receive a confirmation message back for each successful enrollment.

Text Message	Alerts about...
OUTREACH	Public Outreach Events
STARPARTY	Members Only Star Parties (HAS observing site)
URBAN	Urban Observing Events
MEETINGS	HAS Meetings

★ You may also enroll your phone numbers or individual e-mail addresses via the website:

★ Here's a shortened link to get you there: <http://goo.gl/evrGsR>

★ For more information, please visit [www.RainedOut.net](http://www.RainedOut.net).

★ RainedOut notices will also automatically be sent to our e-mail list. Note that regular e-mail list conversations are not part of RainedOut communications and will not be sent to your phone as part of this service. Instructions to sign up for the e-mail list (a great way to keep your finger on the pulse of the club) are found here:

★ <http://www.astronomyhouston.org/about/email-list>.



## ***The Most Popular HAS Member Benefit The HAS Dark Site—Part 3, What's In Store for the Future***

***By Amelia Goldberg***

**W**e have seen so much growth in our club over the past several years, not only in membership but also out at our dark site. Our membership is the highest it has ever been with 600+ members. We have seen the huge success of the private observatory project. We see site use increasing with more and more members showing up on prime nights and many members out there during the week.

Most of us are aware of the plan to build more private observatories. But what else needs to be accomplished to make our dark site a state-of-the-art facility? What's in the works for the coming year? What can we do to help make those plans a reality?

Actually, there is a lot that we can do. Club growth is a good thing but it does require our help, be it physical help or monetary help. Observatory Chairman, Mike Edstrom, has a vision of twelve additional RV sites on the west side of the property, a road to access them, water and power for them, and a parking lot to the north of the new private observatory field. That's a tall order but all of it is really needed. As with the current RV sites, these new sites will pay for themselves in the long run. However, it takes cash now to get the infrastructure in place. The Board will not fund the entire project so donations from our members will really be needed to cover some of the cost. Mike hopes to get all of this planned, funded and accomplished in 2016.

Another item in Mike's vision is a new bunkhouse for women. It's needed and it's fair to our growing number of women and women with young families who want to observe. Unlike the RV sites and private observatories, the bunkhouse will not pay for itself since no

rent is charged for its use. If we build it ourselves, we can probably do it for about \$4k in materials. We'd really like to get the female membership involved in the construction of the bunkhouse. I know that Rene and I are not the only gals who know how to use a hammer, saw or paint brush. Let's show the guys what we can do.

The f/7 telescope in the observatory building needs a new mount with GOTO capability. The Board has approved money to have this done. We have purchased and installed new dual speed focusers for both the f/7 and f/5 telescopes using money from this year's budget.

All donations to the building and upkeep of the dark site are greatly appreciated. All of your personal time and effort, helping in any way you can, is valued by the club. There are so many ways to help, even if it's just donating some of your time. We can all be part of what's happening at the dark site. We can all be proud that we helped to make it what it is.

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### ***Novice Presentation—January 8, 2015***

## ***Variable Stars & New Discoveries***

***By Debbie Moran***

**2**016 brings us a couple of HAS presidents who will contribute to this year's Novice topics. **On January 8th**, we will have our long awaited talk about variable star observing from recent past president and long time *GuideStar* editor Bill Pellerin who will tell you everything you wanted to know about why some stars vary in brightness and why astronomers watch them, and Walt Cooney who will fill us in on his recent discoveries of two previously unknown variables at the dark site. Many astronomers enjoy watching changing phenomena in the sky and variable stars certainly fall in this category. This is one area where amateurs can do real science.

**In February**, our current president Rene Gedaly will talk about light

pollution and new considerations as we enter the era of LED lighting. She hopes to take this message to The Woodlands and the Columbus area to help protect the night skies for our site as well as surrounding residents. Come hear what you can do to light for visibility while being sensitive to human and animal health and the night sky and learn how to educate others.

## Observations... of the editor

by Bill Pellerin, GuideStar Editor

### Happy New Year

I'm looking forward to presenting the novice presentation in January... on variable stars. Several HAS members are variable star enthusiasts, and there are lots of good things to say about the activity.

- Highly accessible — anybody can do this beginning with unaided eye or binocular observations. Large telescopes are not required.
- You're making a real contribution to science by monitoring the activities of variable stars.
- Easy — you'll see at the presentation how easy it is to get started.

I hope to see you there.

### Texas Star Party Registration

The 2016 Texas Star Party will be held on May 1-8 at the Prude Guest Ranch near Fort Davis, TX. The web site is now available to sign up and to request accommodation on the ranch. All the details on how to do this are at the site: [www.texasstarparty.org](http://www.texasstarparty.org).

Be aware that signing up for the event is not the same as signing up for accommodation. You have to do both.

### The Importance of Fitness (for Astronomy)

I recently read an article in the newspaper about how fitness affects your overall health and well being. It was by a cellist in the Houston Symphony who is obliged to play 200 or so performances a year.

I believe it, even though I'm not a physical fitness fanatic. Even doing relatively ordinary things (for us) like loading a telescope in the car, driving to the HAS dark site, unloading it, setting it up and using it don't sound physically taxing, a bit of physical fitness goes a long way toward facilitating those activities.

I'm reminded of all this because I'm a member of the YMCA system and I go there a few times a week to work on the weight machines and attend a stationary bicycle (spin) class. At the 'Y' there are the 'regulars' who show up regularly and do whatever it is they do.

This time of the year, though, we see the 'New Year's Resolution' folks who show up in January and February and who, by March, are nowhere to be found.

A fitness program is a lifelong endeavor, it's not a once-in-a-while activity.

For me, I think it makes me better at everything else that I do, including observing. I have a bit more stamina, a bit more muscle mass, and a bit more flexibility (not my strong suit) for setting up and taking down telescope equipment.

You don't have to be a marathon runner, a long distance cyclist, or a champion weight lifter to benefit.

I'm no expert, and don't begin a program on my say-so. Consult with your health and fitness experts and figure out what works for you.

A friend of mine once said that, 'physical fitness doesn't make a task easy, it makes it possible'.

My personal best wishes to all of you for a happy 2016. I hope we all get a lot of observing opportunities in the new year.

*Until next time...*

*clear skies and new moons!*

*..Bill*

## Just Looking

### A GuideStar Interview by Clayton L. Jeter

## Larry Wadle—Master Observer



I've known Larry Wadle, a longtime HAS member, for as long as I have been a member (1985). By reading his Bio below, you will note that this guy has done it all in amateur astronomy. In fact, Larry has completed and earned the prestigious Astronomical Leagues "Master Observer" award.

By reading this interview, you'll discover that Larry has a lot to say about his passion in astronomy. Here's Larry...



Larry Wadle in the authors telescope repair shop in Brenham, TX  
"ADVANTAGE Telescope Repair"

### The Larry Wadle bio...

I had my first introduction to astronomy when I was 4 years old. My grandmother showed me the stars and told me all about the night all the stars fell out of the sky (I presume she was referring to the Great Leonid Meteor Shower of November 13, 1833). Her Mother had told her about that night and I could easily visualize those 5-pointed stars I saw on the U. S. flag hitting the ground and breaking into many pieces. After a few nights with my grandmother, I was hooked on astronomy.

From there I read science books, especially astronomy books, in fact, all three of the astronomy books in my hometown library. At 10 years old, I built a 1" f/60 refractor and saw the Moon for the first time through a telescope. At the urging of my mathematics teacher, I built a 5" f/10 reflector when I was 15 years old, found a small star atlas showing a few star clusters and galaxies like M13 and M31 and observed them.

Along with my major in mathematics at UT- Austin, I minored in astronomy and physics, was a grader for my astrophysics professor and

taught an astronomy laboratory using the 9.25" refractor telescope on top of the Physics Building.

I did very little observing from 1958 until 1975 while raising a family and moving from Austin to Los Angeles to Houston to New York and back to Houston.

I joined the HAS in 1975 and have served as Publicity Chairman, Secretary and Board member as well as serving on several ad hoc committees such as the HAS Dark Site Observatory location committee in 1979.

I credit Amelia Goldberg and Barbara Wilson for starting my serious observing when they chaired the HAS Novice meetings in 1996 and stressed planning, organizing, observing and documenting all observations. I used some of these observations to win my first Astronomical League Club Certificate in 2007, the Universe Sampler, that was an outgrowth of these Novice meetings. I continued organized observing via the Astronomical League Clubs, earned a Master Observer Award and hold 16 certificates and pins. I hope to qualify for 4 more certificates bringing my total to 20 over the next few years.

I am currently a member of the British Astronomical Association, the Webb Society, the AAVSO and a Fellow of the Royal Astronomical Society and while living in England in the early 1980s, I was a member of the Guildford Astronomical Society, our twinned society. I also served on the University of Texas Astronomy Department and McDonald Observatory Board of Visitors for 5 years from 1989 - 1994.

### The Larry Wadle interview...

**Clayton:** Hi again Larry. It's such a pleasure to interview one of our very own society members.

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*(Continued from page 8)*

When reading the above detailed Bio of yours, it was obvious of your interest in astronomy. So where does this passion and energy come from?

**Larry:** I have always been interested in science from my first look at the stars. From the first grade when I learned to read, I read comic books like Captain Marvel, Superman, Green Hornet, Captain America and Batman. These magazines were full of current and future science in addition to keeping up with World War II activities in science. I was surrounded by science and technology and I was very interested in it. I also had a mentor in a friend who was 3 or 4 years older than me. My parents also supported me in any project that I wanted to do although they had little knowledge of science. On a vacation trip to West Texas when I was 10 years old, my Dad made sure we visited McDonald Observatory.

**Clayton:** Since the 1940's, what's some of the major changes that you have seen in amateur astronomy?

**Larry:** The 6" reflector was the most used telescope by amateurs. The mirror could be ground and polished by amateurs and sent off for aluminizing. Building a scope with an 8" mirror was beyond the capability of most amateurs and 8" blanks were few and far between. And I can't recall a single commercial business that made scopes. The 6" mirrors were made from ship port hole glass. Amateur telescope making was a much bigger hobby than astronomical observing. Nowadays, few amateurs build and most observe since there is a strong market for scopes of all sizes and capability.

**Clayton:** What's been your favorite telescope through the many that you have owned?

**Larry:** The Obsession 25" for the best images and the Meade LX200 12" GOTO GPS for ease of use.

**Clayton:** What's your take on trying to save our night skies from our ever encroaching light pollution?

**Larry:** Sadly, I don't think we can save our night skies due to increasing population centers. We can slow down the loss by better lighting but we can't save the skies except in low to no population areas of the Earth.

**Clayton:** Tell us a bit about observing in the U.K.

**Larry:** Observing in the UK was a real challenge. First, most street lighting was high pressure sodium so in or near population centers, the sky was yellow. Second, the dreary, wet weather and constantly changing cloud cover required me to start and stop observing throughout the night at the whim of cloud cover. But perseverance by me and other amateurs allowed significant observing to take place.

Not getting to observe as often as I would have liked, led me to

another related hobby -- collecting antique telescopes and other brass scientific instruments such as microscopes, micrometers, etc.

**Clayton:** I know you are great friends with Brian States, a member of the Guildford astronomy club in England. I remember the HAS and Guildford clubs twinned back in 1986. How did that come about...and do we still communicate with that club?

**Larry:** Twinning, in general, is popular in England, for example, clubs, cities, etc. Brian proposed that the GAS and HAS twin so that our members could make use of the 6-hour difference in our time and longitude to allow some observations, like a variable star, to be observed for longer periods at a time. I proposed twinning to the HAS Board and they agreed. To my knowledge, we have never cooperated on a project.

**Clayton:** Tell us about a typical observing session when working towards your Master Observers Award sometime back. What was your favorite AL program?

**Larry:** I don't think there was ever a typical observing session. I started at all times of the night and quit at various times. I used 7 different scopes and 3 different pairs of binoculars observing from a 3.5" Questar to the 25" Obsession. My favorite AL program was the Double Star because I used the Celestron MicroGuide Eyepiece and the Darbinian bi-filar micrometer to not only observe the doubles, but measure the position angle (PA) and separation (Sep). And for the binaries, I computed what the PA and Sep should have been at the date I observed. I then compared the actual to my computation to see how good my measurements were, and I did pretty well.

**Clayton:** You're now a Master observer, where would you like to see your

*(Continued on page 10)*

*(Continued from page 9)*

own astronomy go now?

**Larry:** My observing is now driven by the AL Clubs, comets, Early Moons, solar eclipses, transits and unexpected events. My goal is to observe objects for 20 AL Clubs and report them.

**Clayton:** Think you might like to travel in space one day? Where to?

**Larry:** No, time has passed me by. However, I did work in the space industry for 6 months, beginning just 4 months after the Russians flew Sputnik and loved the work but we didn't care for Los Angeles. That's where I entered the computer science field and remained in it and computer management with Shell Oil and Research for 29 years.

**Clayton:** This might be a tough question to answer. What would you have done differently in years past in your amateur astronomy quests?

**Larry:** Not a thing, I'm perfectly satisfied with my astronomical interests and accomplishments. Although, I wish I had joined the HAS in 1958 when we moved to Houston instead of 17 years later in 1975.

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

**Larry:** Get a pair of 7x50 or 11x80 binoculars, learn the sky with all the constellations and observe with the naked eye and binoculars first. Before buying a scope, use loaner scopes from the HAS

or go to our Dark Site and observe with other member's scopes and compare them and pick one to buy that suits you best.

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

**Larry:** [beslar@consolidated.net](mailto:beslar@consolidated.net)

**Clayton:** Thanks Larry for taking the time to share your interest and thoughts within our HAS newsletter, the *GuideStar*. We wish you luck with all of your astronomy interests. It's been a real pleasure chatting with you here. Take care Larry...

**Larry:** Thanks Clayton, I enjoyed it too.

**Clayton:** Clear skies always...

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

## 2016 HAS Dues...

**Make it easy for the incoming Membership Committee team and for the HAS Treasurer** (our friend, Don Selle) by paying your 2016 dues on the web site or in person at the January meeting. Being a member of the Houston Astronomical Society is the best bargain in amateur astronomy today. No kidding. For your dues you get:

- Access to a 18 acre observing site west of Houston. Including the right to rent space for your own observatory or to rent space for your camper. There are pads for you to use to set up your telescope, a bunk house for your rest and many other amenities. This alone is worth the price!
- A telescope loaner program -- borrow a HAS telescope and try observing for yourself. No charge. Contact our loaner 'scope chair for more information (see page 2). Look on the web site for the inventory of telescopes owned by the HAS.
- A monthly novice meeting, site orientation meeting, and general meeting with speakers of interest. Access to meeting videos on the HAS web site (members only).
- Voting privileges — Being a member means your voice is heard on issues that affect you including picking our leadership team, bylaws changes, meeting date changes, and so on.

# How Will We Image a Black Hole?

by Ethan Siegel

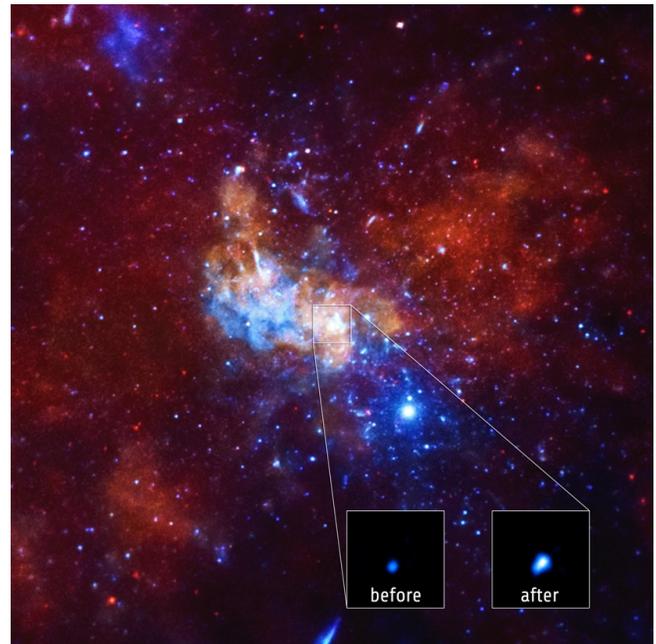


One hundred years ago, Albert Einstein first put forth his theory of General Relativity, which laid out the relationship between spacetime and the matter and energy present within it. While it successfully recovered Newtonian gravity and predicted the additional precession of Mercury's orbit, the only exact solution that Einstein himself discovered was the trivial one: that for completely empty space. Less than two months after releasing his theory, however, the German scientist Karl Schwarzschild provided a true exact solution, that of a massive, infinitely dense object, a black hole.

One of the curious things that popped out of Schwarzschild's solution was the existence of an event horizon, or a region of space that was so severely curved that nothing, not even light, could escape from it. The size of this event horizon would be directly proportional to the mass of the black hole. A black hole the mass of Earth would have an event horizon less than a centimeter in radius; a black hole the mass of the sun would have an event horizon just a few kilometers in radius; and a supermassive black hole would have an event horizon the size of a planetary orbit.

Our galaxy has since been discovered to house a black hole about four million solar masses in size, with an event horizon about 23.6 million kilometers across, or about 40 percent the size of Mercury's orbit around the sun. At a distance of 26,000 light years, it's the largest event horizon in angular size visible from Earth, but at just 19 micro-arc-seconds, it would take a telescope the size of Earth to resolve it – a practical impossibility.

But all hope isn't lost! If instead of a single telescope, we built an array of telescopes located all over Earth, we could simultaneously image the galactic center, and use the technique of VLBI (very long-baseline interferometry) to resolve the black hole's event horizon. The array would only have the light-gathering power of the individual telescopes, meaning the black hole (in the radio) will appear very faint, but they can obtain the resolution of a telescope that's the distance between the farthest telescopes in the array! The planned Event Horizon Telescope, spanning four different continents (including Antarctica), should be able to resolve under 10 micro-arc-seconds, imaging a black hole directly for the first time and answering the question of whether or not they truly contain an event horizon. What began as a mere mathematical solution is now just a few years away from being observed and known for certain!



*Image credit: NASA/CXC/Amherst College/D.Haggard et al., of the galactic center in X-rays. Sagittarius A\* is the supermassive black hole at our Milky Way's center, which normally emits X-ray light of a particular brightness. However, 2013 saw a flare increase its luminosity by a factor of many hundreds, as the black hole devoured matter. The event horizon has yet to be revealed.*

*Note: This month's article describes a project that is not related to NASA and does not suggest any relationship or endorsement. Its coverage is for general interest and educational purposes.*

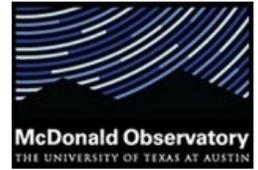
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# The Mystery of 'Born Again' Stars

By: UT McDonald Observatory



## Texas Astronomer Solves Mystery of 'Born Again' Stars with Hubble Space Telescope.

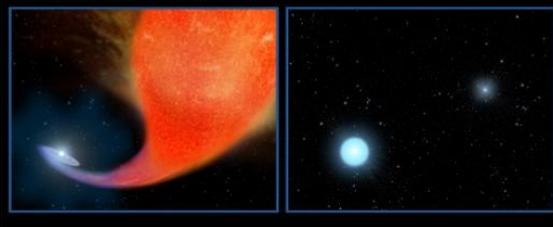
7 December 2015

AUSTIN — University of Texas astronomer Natalie Gosnell has used Hubble Space Telescope to better understand why some stars aren't evolving as predicted. These so-called "blue stragglers" look hotter and bluer than they should for their advanced age. It's almost as if they were somehow reinvigorated to look much younger than they really are.

Though blue stragglers were first identified 62 years ago, astronomers have yet to converge on a solution for their odd appearance. The most popular explanation among several competing theories is that an aging star spills material onto a smaller companion star. The small star bulks up on mass to become hotter and bluer while the aging companion burns out and collapses to a white dwarf – a burned out cinder.

To test this theory Gosnell's team conducted a survey of the open star cluster NGC 188 that has 21 blue stragglers. Of those, she found that

### Birth of a Blue Straggler Star



*Left: A normal star in a binary system gravitationally pulls in matter from an aging companion star which has swelled to a bloated red giant that has expanded to a few hundred times of its original size.*

*Right: After a couple hundred million years the red giant star has burned out and collapsed to the white dwarf that shines intensely in ultraviolet wavelengths. The companion star has bulked up on the hydrogen siphoned off of the red giant star to become much hotter, brighter and bluer than it was previously.*

*Credit: NASA/ESA, A. Feild (STScI)*

straggler binaries, and indicate two-thirds of blue stragglers form through mass transfer.

"This was really great," Gosnell says. "Until now there was no concrete observational proof, only suggestive results," Gosnell said. "It's



*Dr. Natalie Gosnell, W.J. McDonald Postdoctoral Fellow*

seven had white dwarf companions, by identifying their ultraviolet glow that is detectable by Hubble.

Of the remaining 14 of the 21 blue stragglers, a further seven show evidence of so-called mass transfer between stars in other ways. Gosnell said she believes these are older white dwarf-blue

the first time we can place limits on the fraction of blue stragglers formed through mass transfer."

This discovery sheds light on the physical processes responsible for changing the appearance of 25 percent of evolved stars. Gosnell's work, which closes gaps in our understanding of how stars age, is published in the current issue of *The Astrophysical Journal*.

The problem came to light because in recent years, astronomers have been able to make a complete and accurate census of stars in a number of open star clusters, Gosnell said.

"Open clusters really are the best laboratory for the study of stellar evolution," Gosnell said. "They have a simple stellar population." The stars in a cluster form at the same time and from the same materials, she explained.

The cluster population studies revealed that up to a quarter of the oldest stars "are not evolving

like we think they're supposed to," Gosnell said. Stars that astronomers expected to become red giants (like Aldebaran, the eye of Taurus, the bull) instead became "blue stragglers," unexpectedly bright, blue stars with a host of strange characteristics.

Gosnell wanted to find out what happened to them. So she, along with Bob Mathieu at the University of Wisconsin-Madison and



*McDonald Observatory astronomer Natalie Gosnell and her team used the open star cluster NGC 188 as a laboratory to study stellar evolution.*

*Credit: Digitized Sky Survey 2 (STScI/AURA, Palomar/Caltech, and UKSTU/AO)*

# Early Galaxies Make More Stars

By: UT McDonald Observatory



A study published in today's *Astrophysical Journal* by University of Texas at Austin assistant professor Steven Finkelstein and colleagues reveals that galaxies were more efficient at making stars when the universe was younger. The announcement explains the team's discovery, announced in the journal's September 1 issue, that there are a lot more bright, highly star-forming galaxies in the early universe than scientists previously thought.

"This was an unexpected result," Finkelstein said. "It has implications for galaxy formation at the earliest times" in the universe.

For both studies, his team used galaxy observations from Hubble Space Telescope's CANDELS survey, of which he is a team member. Hubble's largest survey to date, CANDELS stands for Cosmic Assembly Near-infrared Deep Extragalactic Legacy Survey.

Today's finding stems from studies of about 8,000 CANDELS galaxies seen at times ranging from 0.75 to 1.5 billion years after the Big Bang (that is, between redshift four and redshift seven). As the universe is a little less than 14 billion years old, this corresponds to only the first five to 10 percent of the history of the universe.

The team deduced the rate of star formation in these galaxies from the Hubble images, by noting their brightness in ultraviolet light, and then correcting this measurement depending on how much light-absorbing dust the galaxy contains.



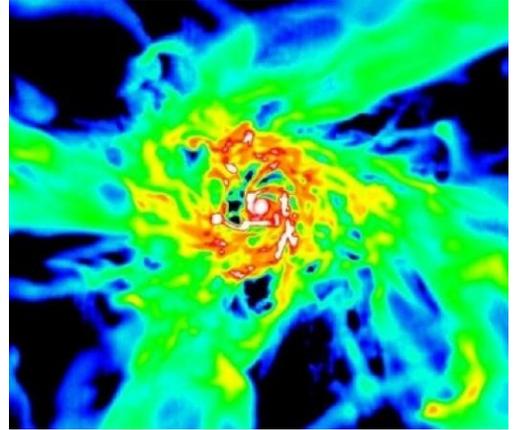
*Steven Finkelstein is an assistant professor in the Department of Astronomy at The University of Texas at Austin. Credit: UT-Austin*



*This image shows a region of the CANDELS GOODS-South field, which is one of the fields used in [this study](#). This image combines data taken from Hubble Space Telescope's optical and near-infrared cameras, and contains galaxies at a range of distances. The larger galaxies are relatively close by, while the smallest specks hail from the earlier universe. Some of the smallest dots in this image are those used in this study; their light is coming from 0.5 to 1.5 billion years after the Big Bang.*

*Credit: NASA, ESA, A. Koekemoer and the CANDELS science team*

The dust estimation comes from the Hubble images, too. The redder a galaxy is, the dustier it is.



*This illustration shows the gas density in a simulated galaxy at about 1 billion years after the Big Bang (redshift 6) with properties similar to those of the galaxies in a Hubble Space Telescope study released today. This includes an efficient rate of turning gas into stars. The simulated galaxy is being fed by streams of cold gas (green and yellow) flowing in along filaments from the cosmic web. This fuels the star formation occurring in the regions with the densest gas in this galaxy (red and white), mostly in the galaxy's center but also in clumps around it. The gas in this galaxy has shrunk to a compact, star-forming "blue nugget" with a violently unstable, clumpy disk.*

*Animation is available here: [https://youtu.be/aDZNe\\_RvVl0](https://youtu.be/aDZNe_RvVl0)*

*Credit: Avishai Dekel, Nir Mandelker, Daniel Ceverino, Joel Primack, and the VELA simulation team*

Investigating the highly star-forming galaxies further, they compared the mass in stars in these galaxies to the theoretically predicted rate at which galaxies grow their mass in the early universe. They found higher masses than predicted, implying that galaxies are more efficient at turning gas into stars in the early universe than they are today.

There could be a couple of different reasons why, Finkelstein said.

*(Continued on page 14)*

*(Continued from page 12)*

their collaborators, designed a study using Hubble Space Telescope's Advanced Camera for Surveys to try to differentiate between three theories of how these stars became blue stragglers.

The theories included: collisions between stars in the cluster (with debris coalescing to form a blue straggler), the merger of two of the stars in a triple star system, or mass transfer between two stars in a binary pair.

In a binary pair of stars, the larger star will evolve faster, Gosnell said. That star becomes a red giant. A red giant is so bloated that the outermost layers of gas on its surface are only tenuously held by the star's gravity. They can be pulled off by the gravity of the companion star. This is mass transfer.

As the gas is siphoned off by the partner, the red giant is left with only its core, making it into a white dwarf. The partner — initially the less massive of the pair, but now the heavier one — becomes a blue straggler.

Gosnell's method is limited by the fact that it will not detect white dwarfs that have cooled down enough so that they don't glow in UV light detectable by Hubble, she said. That means that only those white dwarfs formed in the last 250 million years (youngsters, astronomically speaking) are detectable.

Knowing more about how these stars form is important because astronomers use their assumptions to model the stellar populations of distant galaxies (where the light from all the stars blends together). "You don't want to be ignoring 25 percent of the evolved stars" in those galaxies, Gosnell said.

Such models are important because distant galaxies figure into many different types of cosmological studies. Right now, Gosnell said, "the

models have a lot of room for improvement."

"If we tweak the way models treat mass transfer, that would bring the observations and theory together," Gosnell said. "They would agree. And we can use this to inform our understanding of unresolved stellar populations" — that is, those stars in galaxies so far away that all their light is blended together.

Gosnell plans to continue studying these stars using the 2.7-meter Harlan J. Smith Telescope at McDonald Observatory and its IGRINS spectrograph to constrain the number of blue stragglers that could form through mergers in triple systems.

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**Science Contact:**

Dr. Natalie Gosnell, W.J. McDonald Postdoctoral Fellow, UT Austin McDonald Observatory.

*Courtesy The University of Texas at Austin McDonald Observatory, publisher of StarDate magazine*  
<http://stardate.org/magazine>

*(Continued from page 13)*

First, as the universe has been expanding outward since the Big Bang, at earlier times everything in the universe was packed closer together, including the gas in galaxies. Dense gas is the material that makes stars, so perhaps these galaxies simply had more of it.

Second: feedback. "No galaxy is 100 percent efficient at turning gas into stars," Finkelstein said, explaining that there are several mechanisms inside galaxies that can cause some of the gas to not form stars. These include things like the massive explosions called supernovae, winds from massive stars, and active supermassive black holes that can heat their surrounding gas. Altogether, these barriers to star formation collectively are called "feedback." Finkelstein said that galaxies at earlier times may experience less feedback, and so may form stars more readily.

He anticipates that these bright galaxies in the early universe can be

studied in greater detail with the forthcoming James Webb Space Telescope (JWST), the infrared successor to Hubble, which will launch in 2018. Future studies with JWST should provide a better understanding of star formation in early galaxies.

**Science Contact:**

Dr. Steven Finkelstein  
 The University of Texas at Austin

*Courtesy The University of Texas at Austin McDonald Observatory, publisher of StarDate magazine*  
<http://stardate.org/magazine>

## Shallow Sky Object of the Month

# Beta ( $\beta$ ) Aur—An Eclipsing Binary

By Bill Pellerin, GuideStar Editor

**Object:**  $\beta$  Aur  
**Class:** Eclipsing Binary Star  
**Constellation:** Auriga  
**Magnitude:** 1.89 to 1.98  
**Period:** 3.96 days  
**R.A.:** 5 h 59 m 32 s (2000 coordinates)  
**Dec:** 44 deg 56 min 51 sec  
**Size/Spectral:** A2, 9100 degrees K  
**Distance:** 82.1 ly  
**Optics needed:** Unaided eye or small telescope

The schemes for naming stars can be confusing. The Bayer designation consists of the letters of the Greek alphabet (normally in order of brightness) and the genitive (possessive) name of the constellation. The designation  $\beta$  Aur is typical of a Bayer designation.

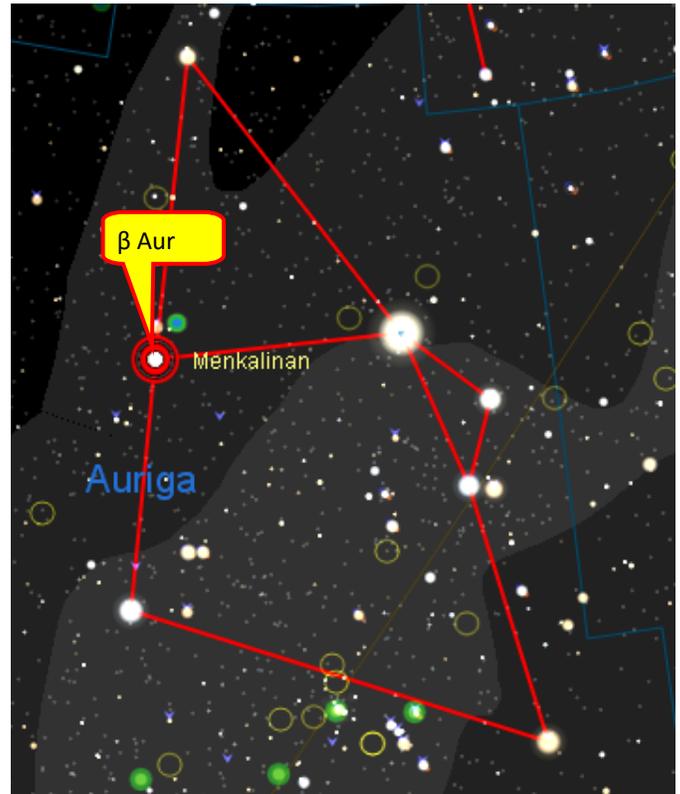
Variable stars typically have a letter R, S, T, U and so on, and then the genitive name of the constellation, such as R Aur. R Aur turns out to be an unrelated Mira variable that changes from about 7th magnitude to about 14th magnitude.

That said,  $\beta$  Aur is an eclipsing variable that only drops about .1 magnitude (at the limit of being able to detect visually) every 3.96 days. Given the color of the two stars that comprise this double you'd be correct to assume that these are large stars, and given the period of the orbit you know that they're very close to each other.

What else can you know from these simple observations? Well, it's clear that we earthlings are not on a direct line to the orbital plane of these two stars. If we were, the dip in magnitude during an eclipse would be larger than we observe it to be. So, we're only seeing a partial eclipse of the two stars.

The most famous eclipsing variable star is Algol, the demon star, described in the November, 2006 *GuideStar*. Algol is so well known that *Sky & Telescope* magazine publishes a list of the predicted minima of Algol every month.

If you investigate variable stars you'll find they fall into many categories but the first fork in the road is whether the star is an eclipsing binary or an intrinsically variable (pulsating, usually) star. Eclipsing binary stars represent the first fork in the classification of variables and the easiest to understand. Intrinsically variable



Finder chart — north is up.

Star chart generated by TheSkyX © Software Bisque, Inc. All rights reserved.

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stars fall into many categories, identified (usually) by the 'prototype' star (one that well represents that category).

By mid January, this star crosses the meridian (i.e. transits) at 22:00 (10:00 p.m.), so it's very conveniently placed for viewing. Look due north.

That's not the whole story. There's a 14th magnitude companion to the pair that lies about 13 arc seconds away. It'd take a larger telescope and dark skies to see this one, though it may be hidden by the brightness of the two primary stars.

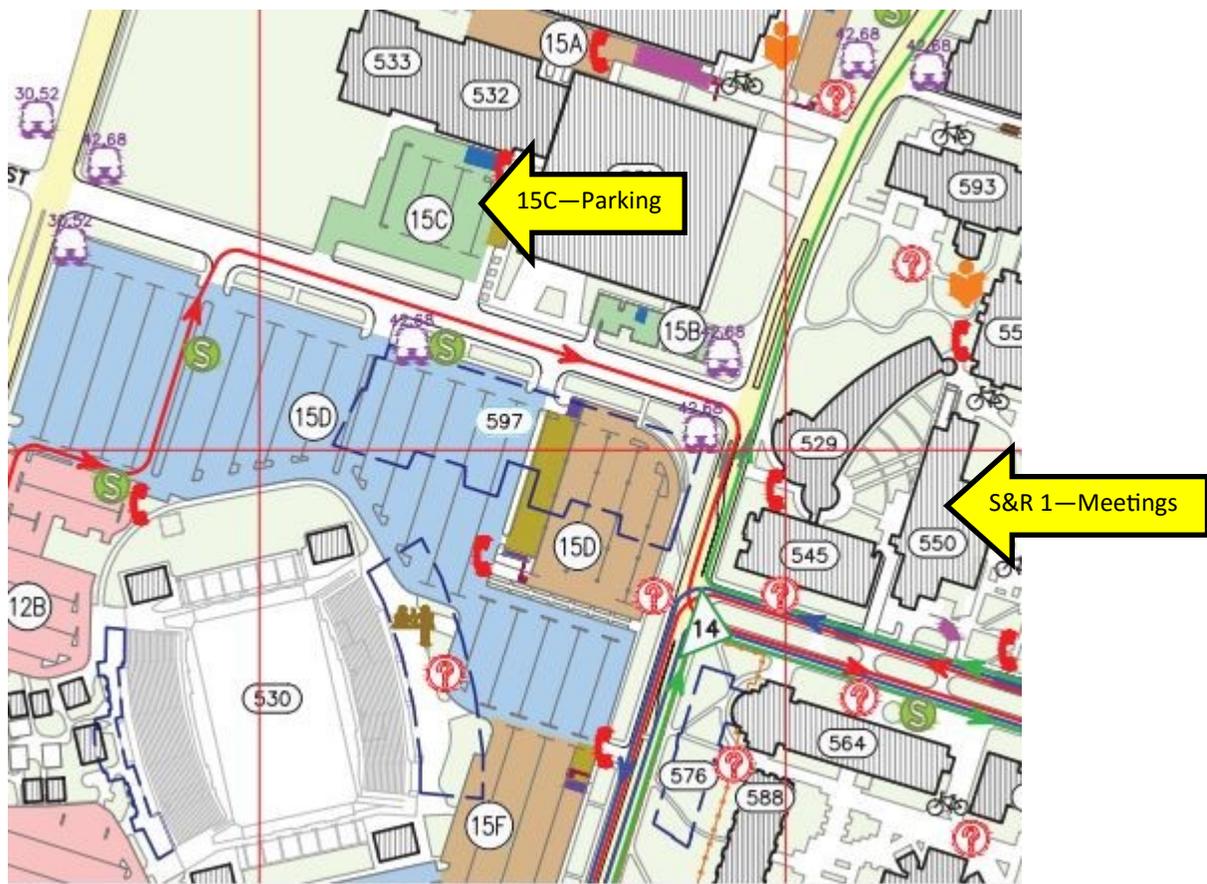
## ***Parking at the University of Houston Main Campus***

### ***For the monthly Houston Astronomical Society Meeting***

The map below shows the location of the 15C parking lot, west of Cullen Boulevard on Holman Street..

The map is from the University of Houston web site and identifies the lot that is available for parking while attending the Houston Astronomical Society monthly meeting. This parking is available from 6:30 p.m. until 10:00 p.m. on the Friday night of the HAS meeting (usually the first Friday of the month).

This parking is free. If you get a notice from the UH campus police on the night of the meeting, call the UH Security office and let them know that this area has been made available on HAS meeting night by the Parking Department.



# Houston Astronomical Society

P.O. Box 800564

Houston, TX 77280-0564

## 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, unformatted MS-Word format via email [GuideStar@astronomyhouston.org](mailto:GuideStar@astronomyhouston.org). 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.

Contact the editor for writing guidelines.

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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. Access to meeting videos on the HAS web site.
- 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.***

## ***Houston Astronomical Society***

**Meeting on Friday, January 8, 2016**

***NOTE: Second Friday to avoid conflict with New Year's Day***

**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 on Holman Street; the parking lot is past the Hofheinz Pavilion
- 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 on Holman Street; the parking lot is past the Hofheinz Pavilion
- Science and Research is across the street (2nd building back)

### **Parking:**

There is Free Parking. **See Parking map and detailed information on parking on the preceding page.**