Houston Astronomical Society

December, 2013

GuideStar

December, 2013

Volume 31, #12

At the December 6 Meeting

Seeing the Impossible:

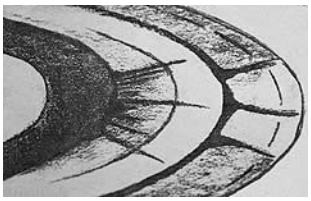
The Unsolved Mystery of Saturn's Spokes

Stephen O'Meara

Author, writer for *Astronomy* magazine

When the young Stephen O'Meara observed and sketched radial spokes in the rings of Saturn in the 70's his observation was dismissed as an optical illusion. It wasn't until the Voyager space probe sent back, in 1979, photographs of the spokes that the observation was confirmed. What are the spokes and why do they occur? Stephen O'Meara will tell us.

Stephen O'Meara is a monthly columnist for *Astronomy* magazine, and the author of numerous books including *The Messier Objects, The Caldwell Objects, The Herschel 400 Observing Guide,* and *The Secret Deep.* He has regularly been a featured presenter at the Texas Star Party after staying up all night observing from the pristine west Texas skies.



Saturn ring spokes as sketched by Stephen O'Meara

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

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

Highlights:

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.

"Jupiter's Moons" — Debbie Moran

See page 15 for more information

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.

Officers & Past President

President: Bill Pellerin C:713-598-8543
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Education..... Debbie Moran.....
Field Tr./Obsg ..... Steve Fast..... 713-898-2188
Novice..... Debbie Moran
Observatory ..... Mike Edstrom
Program ..... Brian Cudnik..... H:832-912-1244
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Welcoming..... Vacant
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Ad-Hoc Committee Chairpersons

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AL Awards..... Doug McCormick .....
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Urban Observing .. Mike Rao..... 832-689-4584

Advisors

Dr. Reginald DuFour, Rice Univ.
Dr. Lawrence Pinsky, U. of H.
Dr. Lawrence Armendarez, U. of St. Thomas

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.

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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

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. 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-mailbill.leach@nhmccd.edu. Web site: 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

GuideStar deadline for the January issue is December 15th

President's Message

by Bill Pellerin, President

What's Going on with the HAS?

- **Election of officers for 2014 —** The nominations from our nominating committee are:

  President: Bill Pellerin
  Vice President: Rene Gedaly
  Secretary: Bill Flanagan
  Treasurer: Don Selle
  Director-at-large: Ash Alashqar
  Director-at-large: Brian Cudnik
  Director-at-large: John Haynes
  Director-at-large: Mark Holdsworth
  Director-at-large: Bram Weisman
  Telescope: Allen Wilkerson
  Field Trip and Observing: Steve Fast
  Program: Brian Cudnik
  Publicity: Bram Weisman
  Novice: Debbie Moran
  Audit: Scott Mitchell
  Observatory: Mike Edstrom
  Education: Debbie Moran
  Welcoming: open

  Nominations from the floor will be taken on the night of the meeting. If you wish to nominate someone other than yourself you must confirm in advance that the person you nominate is willing to serve in the office for which he or she will be nominated.

  We did not have enough members attending the November meeting to hold the election (due to bylaws quorum requirements), so the election will be held at the December meeting

- **Bylaws & Articles of Incorporation changes —** The bylaws and Articles of Incorporation changes needed to establish our non profit status with Colorado County (home of the HAS observing site) will be voted on at the December meeting. See page 6 of this *GuideStar* for the text of these amendments. Due to the lack of a quorum these could not be voted on at the November meeting.

- **General bylaws review in progress —** A bylaws review process has begun by a special ad-hoc committee headed by Scott Mitchell. There are a number of issues to be addressed in this review, including revising the quorum requirements, the elimination of any obsolete committees, and a general clarification of the document.

- **Budget —** The budget for 2014 will be formally adopted at the January board meeting and will be based on a recommendation from our treasurer, Don Selle. The board doesn't anticipate any significant change from the 2013 budget.

- **Bob's Dream and the Observatory Founders recognition project —** You can read about the Bob's Dream project in the Observatory Corner article in this issue. This will be funded by donations dedicated for that work.
  The Observatory Founders project will be funded from HAS general revenues to establish signs and plaques recognizing members who have made a significant contribution of time and effort to the establishment of the observatory. There will also be recognition of discoveries made at the HAS site and members who have achieved AL Master Observer status.

Cheers,

..Bill Pellerin

President

December/January

Calendar

Date	Time	Event
December		
2	6:21 p.m.	New Moon
6	7:00 p.m.	HAS Novice Meeting, U of H
	8:00 p.m.	HAS General Meeting, U of H
9	9:12 a.m.	Moon at first quarter
13		Geminid meteors peak
17	3:28 a.m.	Full Moon
21	11:11 a.m.	Winter Solstice
22	3:00 p.m.	Ursid meteors peak
25		Christmas Day
	7:49 a.m.	Moon at last quarter
26	4:00 p.m.	Comet C/2012 S1 ISON nearest to Earth
January, 2014		
1	5:15 a.m.	New Moon
3	7:00 p.m.	HAS Novice Meeting, U of H
	8:00 p.m.	HAS General Meeting, U of H
2		Prime Night, Columbus Site
7	9:40 p.m.	Moon at first quarter
15	10:53 p.m.	Full Moon
23	11:20 p.m.	Moon at last quarter
25		Prime Night, Columbus Site
30	3:39 p.m.	New Moon

Send calendar events to Doug McCormick - skygazer10@sbcglobal.net

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

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.

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

Follow the *GuideStar* on Twitter at:

GuideStar_HAS

Join Facebook and look for:

Houston Astronomical Society

Starline

Call 832-go4-HAS0 (**832-464-4270**) for the latest information on the meeting and other information about activities within the HAS.

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.

Observations... of the editor

by Bill Pellerin, GuideStar Editor

Winter Solstice

The winter solstice occurs on December 21, 2013 at 11:11 a.m. (CST). This is the day of the most darkness. Sunset in Houston will be at 5:27 p.m., but, unfortunately on that date moonrise is at 9:29 p.m. with the moon at 83% illumination. So, the Sun is out of the sky but the Moon is in the sky.

After this date the Sun is moving north in the sky and will continue to do so for the next 6 months, until the summer solstice. It's time to enjoy some cool, long, dark skies!!

Custom Made or Mass Produced?

Do you want something that's custom made or made on a production line? Generally, I'll take something off a production line instead of something that's a one-of-a-kind or a few-of-a-kind item. I hold this position for the same reason that I hold off (usually) on purchasing a product just after it has been released to the market.

Why? As manufacturers deliver products to the market some of the early deliveries have problems that weren't identified in their testing process. Sometimes these can be corrected, but sometimes they can't and the early adopters are obliged to live with the, usually minor, deficiencies of the first production run. A company that makes custom products is one for which each product that goes out the door is the first production item of that product.

What's more likely to be reliable, the one-millionth car made by a major manufacturer or the first car made by a custom manufacturer? I'd say the millionth item off a production line is likely to be more reliable.

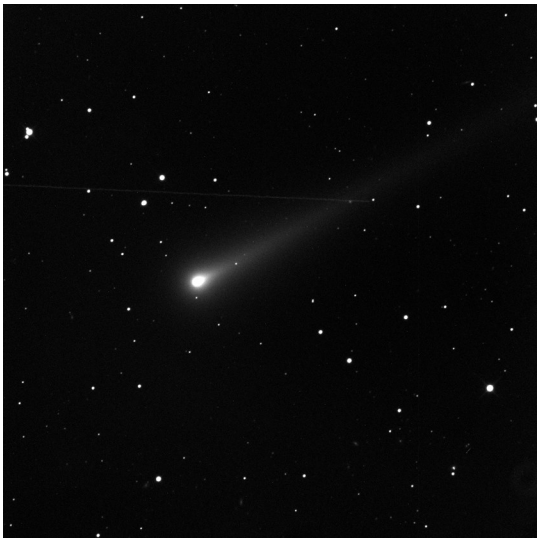
I recently upgraded this computer (the one I'm using for the *GuideStar*) from Windows 8 to Windows 8.1, but I didn't do so when 8.1 first became available. I waited for 8.1 to 'cook' in the marketplace for a while. I read reports about the product and waited for minor problems to be sorted out. By the time I upgraded, the upgrade process was quite smooth even though I held my breath while the upgrade was being installed.

The astronomy market is filled with products that have a relatively small installed base, are created by a single person or a small group of people, and are mostly supported by user groups of various kinds. The good news is that these are often low-risk products. Sometimes, in the case of software, the purchase price is free. There's something of a risk that the creator of the product will go out of business and will eliminate any support on the product. For the user, the risk is that he or she will be left with an unusable product with no support available. Often there is another free product to replace the first one. Larger companies can go out of business as well, leaving product owners in the lurch. The market for astronomy goods is certainly smaller than the market for automobiles but I want to buy from a business that's stable, has been producing the product for a while, and which has a good history of customer support.

Until next time...

clear skies and new moons!

..Bill



Comet ISON

Mark Williams — from his observatory in the Texas Hill Country

Just Looking

A *GuideStar* 'Laugh' by Clayton L. Jeter

Clayton's Top 10 Astronomical Nightmares

10. Any moonless, cloudy night!

9. Celestron declares bankruptcy!

8. The AL mandate all lists must be completed using only star hopping!

7. Invest in silly dim red lights, unable to read a star chart for the life of me, for 45 years only to be told green is the wave of the future!

6. Go observing with a buddy at Brazos Bend State Park only to discover while unpacking his gear he left the OTA at home!

5. Have a dust devil sit over my telescope at TSP!

4. Comet Kohoutek!

3. Wildcatters still searching for oil/gas near the Columbus observing site!

2. Carpooling to Okie-Tex with someone who gets homesick midweek!

….*and the number one nightmare*…

1. Being beaten at the Texas 45 observing program by Steve Fast!

Clear skies always…

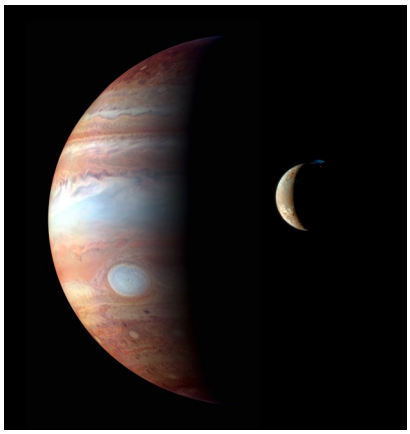
*Clayton is an avid SCT visual observer and a longtime member of the **H**ouston **A**stronomical **S**ociety. Contact him at:*

Novice Presentation December, 2013

Jupiter and Galileo: Observing Jupiter and its Moons

By Debbie Moran

In honor of Jupiter being well placed in December and January, come hear a talk called "Jupiter and Galileo: Observing Jupiter and its Moons." Jupiter is one of the most interesting planets to observe because it is always changing, even from minute to minute. In this talk, I will cover Jupiter's major features, its rotation rate, how to identify and observe the four Galilean moons and how to know when interesting events are happening such as moon transits and occultations, eclipses, shadow transits and Red Spot transit.



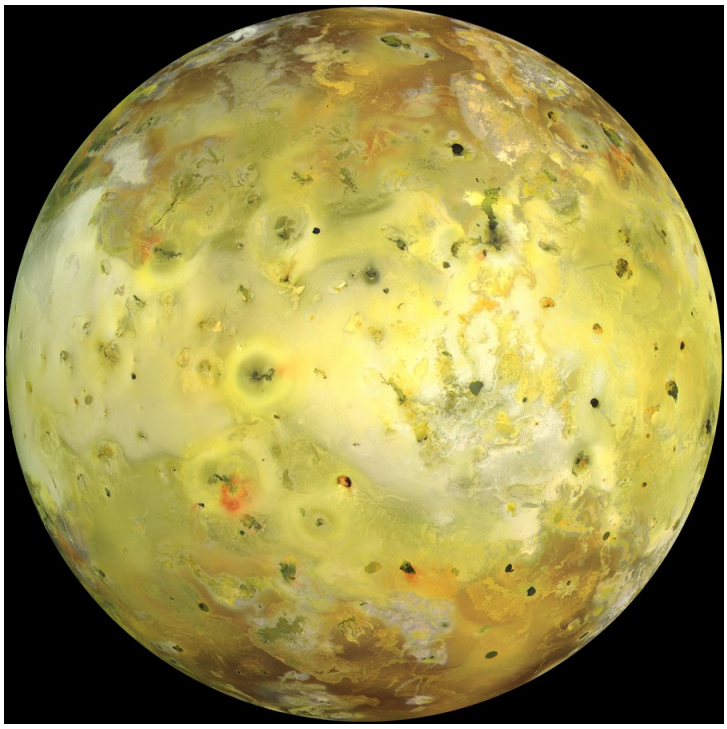
Jupiter
Credit: NASA

The Most Volcanically Active Place is Out-of-This-World!

By Dr. Ethan Siegel

NASA Space Place

Volcanoes are some of the most powerful and destructive natural phenomena, yet they're a vital part of shaping the planetary landscape of worlds small and large. Here on Earth, the largest of the rocky bodies in our Solar System, there's a tremendous source of heat coming from our planet's interior, from a mix of gravitational contraction and heavy, radioactive elements decaying. Our planet consistently outputs a tremendous amount of energy from this process, nearly three times the global power production from all sources of fuel. Because the surface-area-to-mass ratio of our planet (like all large rocky worlds) is small, that energy has a hard time escaping, building-up and releasing sporadically in catastrophic events: volcanoes and earthquakes!



Io. Image credit: NASA / JPL-Caltech, via the Galileo spacecraft.

Yet volcanoes occur on worlds that you might never expect, like the tiny moon Io, orbiting Jupiter. With just 1.5% the mass of Earth despite being more than one quarter of the Earth's diameter, Io seems like an unlikely candidate for volcanoes, as 4.5 billion years is more than enough time for it to have cooled and become stable. Yet Io is anything but stable, as an abundance of volcanic eruptions were predicted before we ever got a chance to view it up close. When the Voyager 1 spacecraft visited, it found no impact craters on Io, but instead hundreds of volcanic calderas, including actual eruptions with plumes 300 kilometers high! Subsequently, Voyager 2, Galileo, and a myriad of telescope observations found that these eruptions change rapidly on Io's surface.

Where does the energy for all this come from? From the combined tidal forces exerted by Jupiter and the outer Jovian moons. On Earth, the gravity from the Sun and Moon causes the ocean tides to raise-and-lower by one-to-two meters, on average, far too small to cause any heating. Io has no oceans, yet the tidal forces acting on it cause the world itself to stretch and bend by an astonishing **100 meters** at a time! This causes not only cracking and fissures, but also heats up the interior of the planet, the same way that rapidly bending a piece of metal back-and-forth causes it to heat up internally. When a path to the surface opens up, that internal heat escapes through quiescent lava flows and catastrophic volcanic eruptions! The hottest spots on Io's surface reach 1,200 °C (2,000 °F); compared to the average surface temperature of 110 Kelvin (-163 °C / -261 °F), Io is home to the most extreme temperature differences from location-to-location outside of the Sun.

Just by orbiting where it does, Io gets distorted, heats up, and erupts, making it the most volcanically active world in the entire Solar System! Other moons around gas giants have spectacular eruptions, too (like Enceladus around Saturn), but no world has its surface shaped by volcanic activity quite like Jupiter's innermost moon, Io!

Learn more about Galileo's mission to Jupiter: http://solarsystem.nasa.gov/galileo/.

Kids can explore the many volcanoes of our solar system using the Space Place's Space Volcano Explorer: http://spaceplace.nasa.gov/volcanoes

Kids Outreach & Public Star Parties

By Bram Weisman, coordinator

Name: Hyde Elementary School Family Science Night
Date/Time: 12/10/2013 5:30 PM - 7:30 PM
Type: Star Party during school Family Science Night. School will be having other science related information, activities, and science fair awards.
Number of visitors expected: 300
Location: Hyde Elementary School, 3700 E. FM 518 (Deke Slayton Hwy), League City, TX 77573

Name: The Houston Arboretum ISON Comet watching
Leader: Bill Flanagan
Type: Mostly Adults – Arboretum Members. A morning at the Arboretum
Date: Saturday MORNING, 12/14/2013
Time: 5:00 – 8:00 AM
Location: Houston Arboretum, 4501 Woodway Drive

Details – especially times – are subject to change

Notice of Vote to Revise Bylaws and Articles of Incorporation -- 12/6/2013

Notice is hereby given that a resolution to amend the bylaws and articles of incorporation of the Houston Astronomical Society (HAS) will be presented to the membership for voting at the December 6, 2013 General Membership meeting. The purpose of the amendments is to help secure the tax exempt status of the HAS for county, state and Federal taxation. This notice has been sent to all members by email, been sent to list server subscribers by email, and has been posted on the HAS Web Site

Proposed Amendment to the Bylaws of the Houston Astronomical Society:

Article XIII: Upon the dissolution of the corporation, the distribution of all property in the corporation will be in the following priority in accordance with the Texas Business Organizations Code or its successor: [a] all liabilities and obligations of the corporation shall be paid, satisfied and discharged; [b] property held by the corporation on a condition requiring return, transfer, or conveyance because of the winding up, dissolution, or termination shall be returned, transferred or conveyed in accordance with that requirement; and [c] the remaining property shall be distributed only for tax exempt purposes to one or more organizations that are exempt under Section 501(c)(3) of the Internal Revenue Code or described by Section 170[c][1] or [2] of the Internal Revenue Code as provided in a plan of distribution adopted by the corporation under Texas Business Organizations Code.

Proposed Amendment to the Articles of Incorporation of the Houston Astronomical Society:

Article Nine
Article IX: Upon the dissolution of the corporation, the distribution of all property in the corporation will be in the following priority in accordance with the Texas Business Organizations Code or its successor: [a] all liabilities and obligations of the corporation shall be paid, satisfied and discharged; [b] property held by the corporation on a condition requiring return, transfer, or conveyance because of the winding up, dissolution, or termination shall be returned, transferred or conveyed in accordance with that requirement; and [c] the remaining property shall be distributed only for tax exempt purposes to one or more organizations that are exempt under Section 501(c)(3) of the Internal Revenue Code or described by Section 170[c][1] or [2] of the Internal Revenue Code as provided in a plan of distribution adopted by the corporation under Texas Business Organizations Code.

Thank Your Lucky Numbers for the Stars

The Constants of Nature and Life in Our Universe

By Don Selle, Observatory Chair

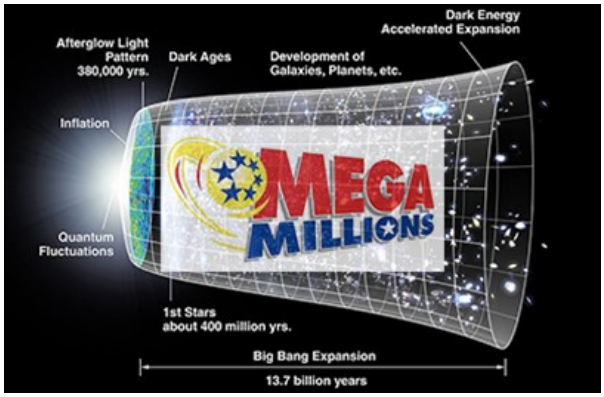
> *"I do not feel like an alien in this universe. The more I examine the universe and study the details of its architecture, the more evidence that I find that the universe in some sense must have known that we were coming."*[1]
>
> ***Freman Dyson,***

I don't play the lottery very often, but when I do, I make sure that four of the numbers on my pick 6 ticket are 18 36 13 and 7, because these numbers (actually 1836 and 137) are the luckiest numbers in the universe. They've paid off from the beginning. Without them, nothing you know or see would be the same.

The numbers 1836 and 137 are two of a handful of pure numbers called the dimensionless physical constants. They are derived from the measured values of the fundamental constants of nature. These constants, like the ***G*** strength of gravity, ***c*** the speed of light, ***e*** the unit of electrostatic charge, and the masses of the proton m_p and mass of the electron m_e are critical to defining the universe and everything in it, including us.

"We have learnt that our existence exploits many peculiar coincidences between the values of the constants of Nature, and that the observed values of the constants fall within some very narrow windows of opportunity for the existence of life. " [1] Change some of them by just a few percent and life and intelligence as we know it could never have evolved.

Take for example the structure of the physical bodies in the universe. It turns out that the density (weight to volume) of just about all of them are the same within less than factor of 10, and that density is the same as the density of an atom. When plotted on a graph, they pretty closely fit a straight line.



The density of an atom is strongly influenced by the balance between the force of gravity, and the electrostatic force. Imagine what might happen if this balance were changed. The size of atoms would be completely different. Stars might be more compact and hence hotter, or so diffuse that they could not fuse hydrogen to generate energy. Chemistry as we know it would be changed in ways that could potentially be harmful to life, and planets might not form for life to cling to.

Another example is the rate of expansion of the universe. Our measurements tell us that it is very close to the point at which it may continue to expand forever, or that the expansion might eventually be slowed and stopped by gravity and collapse back into a fiery Big Crunch. The expansion is governed by the strength of the force of gravity and the contents of the universe that are affected by gravity.

We also know that we are at a point in time about 13.7 billion years after the Big Bang and for much of that time, gravity has restrained the expansion of the universe. It has also taken that long for our type of life and intelligence to evolve in the universe. First the stars had to form, then over the next 10 billion or so years, the chemical elements were cooked up in them in sufficient quantities to support the chemistry necessary for our type of life. Three and a half billion years after that, life finally has finally been able to evolve intelligence capable of looking at the stars and understanding them.

If the force of gravity was altered to be sufficiently stronger, or more stuff was created, the expansion would have slowed much quicker than it has, and the Big Crunch occurred before life and intelligence (as we know it) evolved. If gravity were weaker or less stuff created, the expansion would have been so fast, that stars and galaxies might not have formed and

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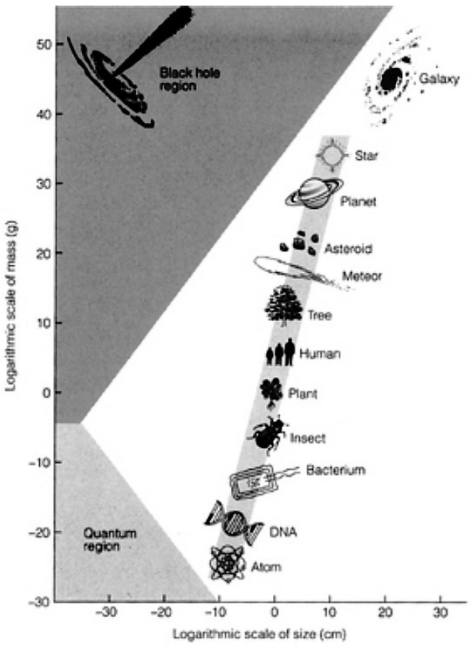
life would never have had a chance. It seems we sit on the knife's edge.

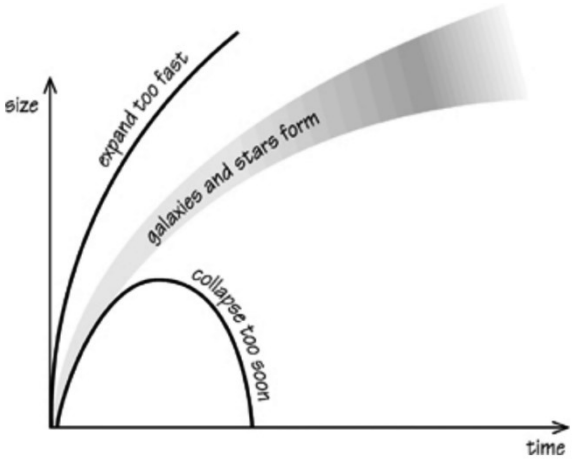
In order to understand how a handful of numbers could be so important, we need to understand what they are and where they came from. For some reason, the universe we live in seems to be governed by a relatively small number of mathematical equations (or laws). These equations describe how matter is constituted and how it reacts and changes over time. Just why the universe should be like this is a mystery.



All physical structures in the universe are governed by the ratio of the strength of gravity and electrostatic forces.

That this is so is not disputed. These equations are the very bedrock of science and engineering. Using them with the proper inputs, and the appropriate values constants of nature, we can solve problems and make specific predictions about what we should find.

It could be that this is due to a deep property of nature, that the universe is actually organized based on these mathematical "laws", or it could just be an artifact of how we think. Regardless of the cause, we know this to be true because it works every time with predictions which are accurate to whatever level of precision we can measure.



Expansion of the Universe

These mathematical relationships or theories have been assembled into a model we call the Big Bang model of cosmology. It helps us describe how our universe has evolved from the very earliest times to the present. They can also be used to calculate what the universe was like at different times in its history. On their own, however, these equations are sterile expressions of pure logic.

It is the constants, or more specifically their numerical value, that give us the ability to describe the form and size of the world we experience. It is the values of these constants of nature that breathe life into the formulas of physics and in a sense it is these numbers which define the universe we find ourselves in.

As important as the constants of nature are, however, why they have the values they do is still a mystery to us. They cannot be calculated from first principles, and we do not know for sure if they really are constant, or if they change very slowly with time. We can only measure them to greater and greater levels of accuracy, hoping that at some point, we will find a new theory which defines them. "Yet while we have become skilled at measuring the values of these constant quantities, our inability to explain or predict their values shows how much we have still to learn about the inner workings of the Universe."[2]

As physics and cosmology developed in the late 19th and early 20th centuries, scientist began to become interested in the constants of nature themselves. Where did they come from, and why did they have the values they did. In several cases, this type of investigation led to key breakthroughs in understanding and to new and better physical theories. As physicists probed, many began to realize how these constants were interrelated and how finely tuned they had to be in order to render the universe we live in.

Albert Einstein did more than anyone else to establish the basis of modern physics. He did so by developing the theories of Special and General Relativity for which he is most famous, and he also laid much of the groundwork that was necessary for the development of Quantum Mechanics. Einstein had a strong belief that the universe was lawful in nature and that a small set of basic principles, what he called a "unified field

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theory" would be found that described it. He believed that this theory would tie together the fundamental forces of nature in a structure that was both self-consistent and elegant.

Einstein was very interested in the constants of nature, as he saw in them a potential path to help him find his unified field theory (what now might be called a theory of everything) and he felt that exploring why the constants of nature had the values they do might just guide his search. "Einstein was not really happy for there to be any free constants like this at all. He realized that the search for the ultimate theory was a process of finding better and better theories which superseded the previous one. At present, our theories are provisional and so there are a number of constants of nature appearing in then which we just have to measure… He expected that his unified theory would determine the values of the constants like ***e, G*** and ***c*** in terms of pure numbers that could be calculated as accurately as one wished."[3]

In a letter to Ilse Rosenthal-Schneider, a student and friend of his, Einstein summed up his thoughts on the how the constants of nature would be intertwined with his unified field theory:

"… one could put it like this: A theory which in its fundamental equations explicitly contains a non-basic constant would have to be somehow constructed from bits and pieces which are logically independent of each other; but I am confident that this world is not such that so ugly a construction is necessary for its theoretical comprehension"[5]

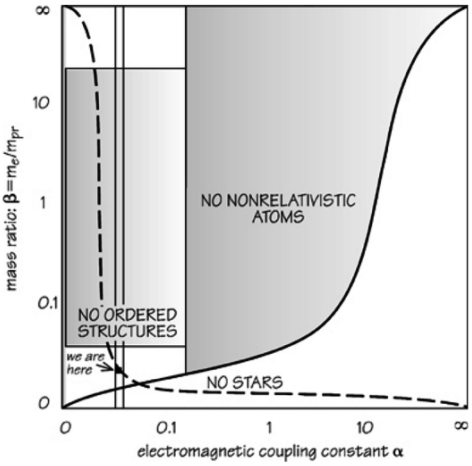
Einstein and Eddington

Towards the end of his life, Einstein labored to develop his unified field theory, hoping to among other things, determine how the constants of nature obtained their values, and "whether God could have made the world in different way". Try as he might, he would not make the breakthrough he envisioned.

Einstein was not the only scientist to look towards understanding why the constants of nature are as we find them might provide a path to a "theory of everything". Arthur Eddington, was a contemporary of Einstein's a prominent cosmologist and popularizer of General Relativity. At one point he was cited as one of only three people in the world who truly understood Relativity.

Eddington became fascinated by the constants of nature. He used the constants ***G*** , ***c*** , ***e, m_p*** ,***m_e*** and Planck's constant ***h*** which is the "quantum of action"[5] all of which are measured in units (i.e. c = 186,000 miles per hour). These he arranged so that the units cancelled each other and left only pure numbers.

These are the dimensionless constants of nature[6], numbers like 1836 which describes the ratio of the mass of the proton compared to the mass of the electron, and 137 which is called the fine structure constant, and measures how strongly the electrostatic force effects physical systems. Eddington also used the ratio of the strength of the electromagnetic force to the force of gravity (a very large number ~ 10^{39}) as well as a very large number



We exist in a very small window, change the physical constants by a small amount and the universe we know would cease to exist.

(~10^{80}) he calculated representing the total number of hydrogen atoms in the universe.

His approach to describing the values of these dimensionless constants, he called his Fundamental Theory, was almost purely philosophical and numerological. This suited his personality, and he was known to hold the belief that given a complete theory of everything, all of astronomy, the existence of stars and galaxies, could be deduced astronomers living on a planet covered eternally by clouds. In practice much of his exploration was done by finding ways to calculate the dimensionless constants first then later trying to find valid physical reasons for why the calculations would work.

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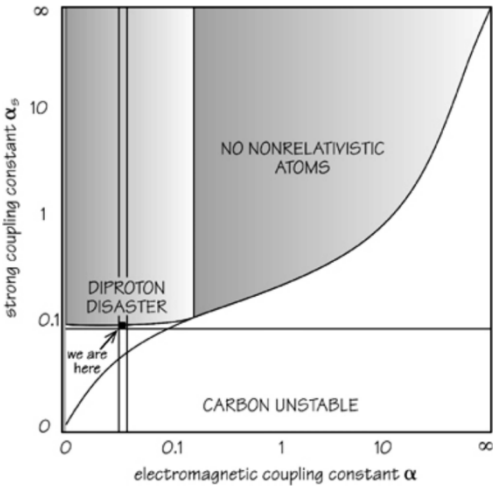
Eddington was never very successful at developing his Fundamental theory. In fact as he got older, his explanations became more obtuse and even mystical. This brought him much opposition, with some of his contemporaries becoming so dismissive that they even mocked him. This story told by physicist Sam Goudsmit[7] is typical.

" the great Arthur Eddington gave a lecture about his alleged derivation of the fine structure constant from fundamental theory….After the discussion, Goudsmit went to his friend and mentor Kramers and asked him, "Do all physicists go off on crazy tangents when they grow old? I am afraid. Kramers answered, No Sam, you don't have to be scared. A genius like Eddington may perhaps go nuts but a fellow like you just gets dumber and dumber."

Others took a different approach. The fact that there are a handful of physical constants lead directly to questions about whether they were fixed or could they have had different values? What would happen if some of them were changed?

It is in this research, and in the research into the synthesis of the chemical elements done by Gamow, Hoyle and others that it became clear how finely tuned the physical constants of our universe are, and how unlikely life would be if they were changed even slightly. Struggling with understanding how carbon might be created in stars, Hoyle realized that a previously unknown and uncalculated resonant energy state of the carbon nucleus had to exist, or carbon could not be created. If carbon could not be created, then we would not be here to know the difference.

On his first trip to the United States he met Willey Fowler an atomic physicists with whom he would collaborate. He was able to convince Fowler and others there to test for this resonant state of the carbon nucleus. After only a few weeks of work, this energy state, which is so critical to the creation of Carbon in stars was found to exist, at just the energy level Hoyle had predicted. "According to Fowler, "we then took Hoyle very seriously.' Further experiments showed that any nucleus that broke down into helium nuclei {like carbon does} could also be made from them, opening the way to the formation of many more elements"[8].



The creation of carbon in stars is possible due to the fine tuning of the strong and electromagnetic forces.

This resonant state is governed by the interaction between the electromagnetic and strong nuclear forces. Unless the ratio is within a very narrow band, "the biologically vital elements like carbon would not exist and there would not be any organic chemists. They would be unable to hold themselves together. If we increase the {strong coupling constant} by just 4 percent there is a potential disaster a new nucleus… can now exist which allows very fast direct nuclear reactions…. Stars would rapidly exhaust their fuel and collapse to degenerate states or black holes"[9]. The chemistry that we rely on for the existence of life would be drastically altered with a small change in one of the constants of nature. The consequences for life would be devastating.

The fact that the constants are so finely tuned begs the question why? Several theories have been put forth, including Intelligent Design, the unique universe, and the multiverse. All are on the forefront of enquiry where science and philosophy overlap.

It is easy to jump directly to some sort of "intelligent design", but scientists are loathe to accept such an explanation. It seems too much like the explanation "and then a miracle occurs" and seems to leave the question open, unanwered.

The unique universe is the universe that Einstein and Eddington were trying to explain. In it, a theory of everything will be found (string and M theory?) and that theory will explain why the constants are as we find them. Theories of a multiverse, propose that an infinite number of parallel universes exist, each with its own set of physical constants. Some will support life and mind while others will be sterile and unrecognizable.

No matter which road finally proves to lead to the answer, the fact that we exist and can ask these questions must be a part of the answer. Freeman Dyson explains it well "I conclude from the existence of these accidents of physics and astronomy that the universe is an unexpectedly hospitable place for living creatures to make a home

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Observatory Corner

By Mike Edstrom, Observatory Committee Chairman

Bob's Dream

Our good friend Bob Rogers, HAS Observatory Chairman from 2007 to his untimely death in 2013, had dreamed of an observatory for HAS that was setup to assist members to try their hand at astrophotography at the beginners level before jumping in with their own equipment.

At the July HAS Board meeting the board asked Steve Goldberg to setup an ad hoc committee to bring to the board an idea of how to honor Bob Rogers for his dedication to the Columbus Dark Site.

At the September HAS Board meeting Steve reported that the committee has unanimously suggested that the board authorized the Observatory Committee to build an observatory on one of the new private observatory pads and equip it with all that is needed to do basic astrophotography and name the observatory after Bob.

We have decided that the observatory will need the following equipment:

- An 8' dome – which has been purchased
- A laptop – this has been donated
- We need to raise funds for the following:
- A mount equal to a CGEMDX or iOptron 45M approx. $1,800.00
- Scopes - 2ea. 80mm refractors (1 to image and 1 to guide) approx. $1,200.00
- Cameras – 1ea. Guide camera and 1ea. Modified DSLR Approx. $2,000.00
- Software - $1,500.00

Your contributions to this fund will be greatly appreciated. To contribute please make a check out to HAS with a note that donation is for Bob's Dream and send it to 2006 Ottawa Ln. HOUSTON 77043.

By paypal or credit card:

Send email with donation amount to has.treasurer@ymail.com. I will send a paypal invoice for the donation amount which can be paid either by cc or paypal.

Thank you,

Mike Edstrom

medst22531@msn.com

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in. Being a scientist, trained in the habits of thought and language of the twentieth century rather than the eighteenth, I do not claim that the architecture of the universe proves the existence of God. I claim only that the architecture of the universe is consistent with the hypothesis that mind plays an essential role in its functioning"[10].

Notes: Figures in black and white are from *The Constants of Nature* by John D. Barrow.

1. Freeman Dyson, as quoted in The Anthropic Cosmological Prinicple, Tippler and Barrow pg 318
2. John D. Barrow *The Constants of Nature* Vintage Books, 2002 pg 197
3. Ibid. pg 18
4. Ibid. pg. 39
5. Planck's constant is called the quantum of action because it is the minimum (quantum) amount that a dynamic physical system can be changed. It is a very small number 6.26×10^{-34} and has the units of Joules sec (energy seconds). Properties of a system like energy or angular momentum cannot change smoothly but must change in steps of this size. It is the constant that gives the world its "graininess" and defines the "quantum uncertainty" of the world.
6. According to Wikipedia there are 26 currently known dimensionless physical constants.
7. As quoted in Barrow *The Constants of Nature*, pg 79
8. Jane Gregory – Fred Hoyles Universe, Oxford University Press 2005, pg 74
9. Barrow pg 130.
10. Freeman Dyson – Disturbing the Universe, Basic Books 1979, pg 251

Will This New Technology Transform Astronomy?

By Monica Young, Sky & Telescope, www.skyandtelescope.com

Astronomy is ready for the next generation of detectors, and superconductors are at the heart of the coming revolution.

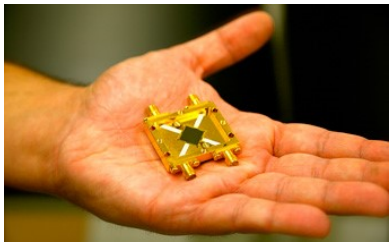
Back in my former life, I was an X-ray astronomer. While optical astronomy charged ahead with camera technology that benefitted from commercial investment (hello, smartphones), the X-ray detectors I worked with were of a more "homebrew" variety (really good homebrew).

If I point an X-ray telescope at, say, a distant quasar for a few hours, I might get a few hundred photons if I'm lucky. Compare that with an optical image, where the same quasar might emit *millions* of photons. As a professor of mine once joked, X-rays are so few and far between, they should have names: "Look, there go Peter, Jill, and Harry."

Despite the challenges of X-ray astronomy, telescopes like Chandra have an advantage: when they take a picture, they get a spectrum and a light curve for free.

NASA

But, paradoxically, there's a benefit to that. Using detectors aboard telescopes such as ESA's XMM-Newton or NASA's Chandra, you really can get to know each individual photon — if not its name, then at least its energy and arrival time. In more scientific jargon, take an X-ray image, and you get both a low-resolution spectrum and a light curve for free.



ARCONS is a superconducting photon detector consisting of a 2,024-pixel (44 x 46) array sensitive to UV, optical, and near-infrared light.

Spencer Bruttig

Typical optical telescopes can't do that. They use charge-coupled devices (CCDs), like the digital camera in your smartphone, to capture photons. But a CCD image is just an image — to put together a light curve, you would need to take multiple images, and to split the light by wavelength would require a spectrometer.

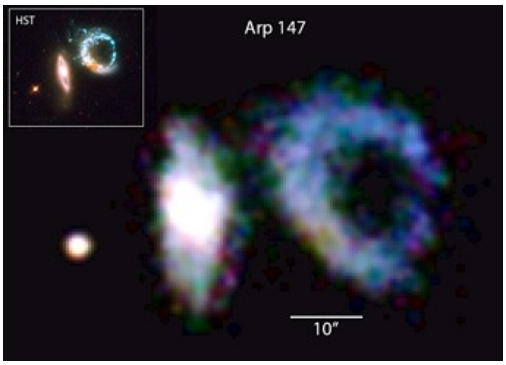
Now that may be changing. A new technique is emerging called integral field spectroscopy, in which optical detectors use various methods to grab a spectrum at the same time that they take a picture. Among the newest instruments is the Array Camera for Optical to Near-infrared Spectrophotometry (ARCONS), developed by Ben Mazin (University of California, Santa Barbara) and colleagues.

ARCONS transforms visible-light and near-infrared telescopes into multitaskers, measuring the energy (to a few percent or better) and arrival time (to within a microsecond) of each photon. And though the technology is still in its infancy, a 2,024-pixel array is already taking images on the Palomar 200-inch telescope.

Semi vs. Super

The difference between ARCONS and CCDs is due to the difference between superconductors and semiconductors. When a single photon enters a semiconductor-based camera, it unleashes a single electron, which is shuffled along until it reaches the end of the row. The detector counts up the electrons in each pixel to create an image.

But in ARCONS, a single photon unleashes not a single electron, but a cascade of thousands of them. And when the detector



This mosaic of interacting galaxies Arp 147 was created from 36 pointings, each covering a 20" x 20" field of view, taken with ARCONS on the Palomar 200-inch telescope. The inset shows the same field of view from the Hubble Space Telescope. But unlike Hubble's image, the ARCONS image contains within it a spectrum and a light curve.

Large photo: ARCONS. Inset: NASA / ESA /

counts electrons, it sees not just how many there are, but also when they arrived and with what energy. This is possible because at

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the heart of ARCONS is a superconductor, a material that lives in the weird world of quantum physics. Normally, electrons repel each other, but in certain materials cooled to a fraction of a degree above absolute zero, electrons can form incredibly weak bonds called Cooper pairs. The material has to stay cold enough to calm the electrons' thermal wiggles; any disturbance, such as a single intruding photon, can break the pairs and unleash a cascade of electrons — and it's this flood of electrons that ARCONS picks up.

ARCONS is revolutionary, too, in that its electrons don't march out of the detector in single file to be counted. Instead, each pixel tallies its own electrons, then the detector collects all the pixels' information by sweeping them from the outside with carefully tuned microwaves.

The external sweep allows the superconductor to stay barely above absolute zero while the surrounding electronics remain at room temperature. And a supercold detector is a huge plus because it means that it has virtually no "dark noise," the false photons CCD cameras see even when the shutter is closed. (If you've ever closed your eyes in a dark room, you'll notice it's never completely dark — your eyes have dark noise, too.)

Detector of the Future

"It is really a complete switch of technologies," Mazin says. "The switch really opens up a whole new world of possibilities, just like the switch 30 years ago from film to semiconducting detectors."

One of those possibilities is the direct detection of exoplanets, a task made extraordinarily difficult by the huge contrast between the faint planet and its much brighter star. Mazin's team already has the funding to build a new ARCONS-like detector designed to work with Palomar's Project 1640. The detector's ability to capture images and spectra simultaneously, plus its low noise level, will help catch the "firefly near the searchlight."

Here are links to two other studies using ARCONS:

Direct Detection of SDSS J0926+3624 Orbital Expansion with ARCONS

Exceptional Optical Enhancement Observed with ARCONS for Early Crab Giant Pulses

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Free Astronomy Resources

By Bill Pellerin, GuideStar Editor

There's a lot of excellent astronomy resources on the Intenet. Here are a few, and there are plenty more.

- *Sky and Telescope* magazine is offering free eBooks in PDF format at http://www.SkyandTelescope.com/eBook. There are only a few ebooks on the site for now but the collection will likely grow over time. You need to be able to sign in to the web site.
- Amazon has several astronomy books for the Kindle readers free on their web site. Check the Amazon web site.
- I've mentioned podcasts here in the past, and my favorite remains AstronomyCast available at AstronomyCast.com (or iTunes) and downloadable to your favorite device. There are over 300 episodes available and they're all free. Contributions are accepted.
- Autoguiding software is available free from http://www.starklabs.com/phdguiding.html. The software is called PHD Guiding and I haven't found anything better than this (yet). It doesn't require much fiddling around and it works beautifully. Contributions accepted.
- Not to be outdone, *Astronomy* magazine has a lot of free articles and resources at www.astronomy.com.
- Interested in finding satellites? Lots of web sites will help you do this, but check out www.heavens-above.com for predictions of satellite passes.
- Want to see data on your favorite variable star. It's available at www.AAVSO.org.

Shallow Sky Object of the Month

Gliese 445

Object: Gliese 445, HIP57544

Class: Star — the destination of Voyager 1

Constallation: Camelopardalis

Magnitude: 10.8

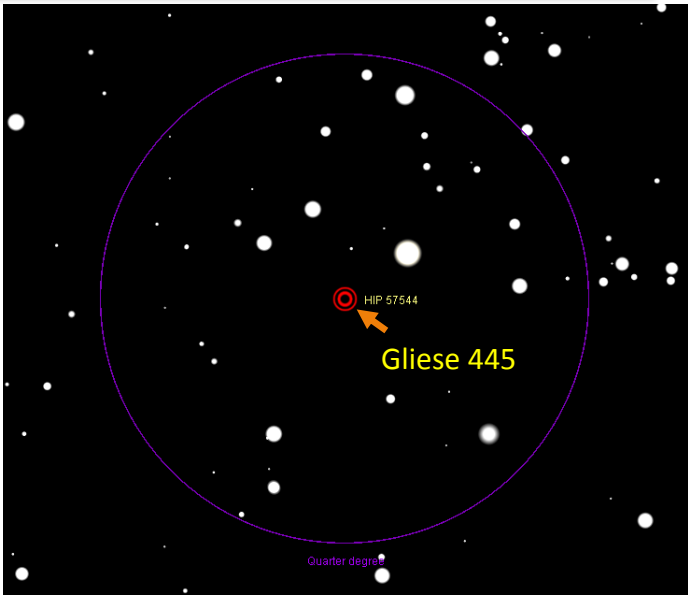
R.A.: 11 h 47 m 41.4 s

Dec: 78 deg 41 min 28.2 sec

Size/Spectral: M (red)

Distance: 17.6 ly

Optics needed: Telescope

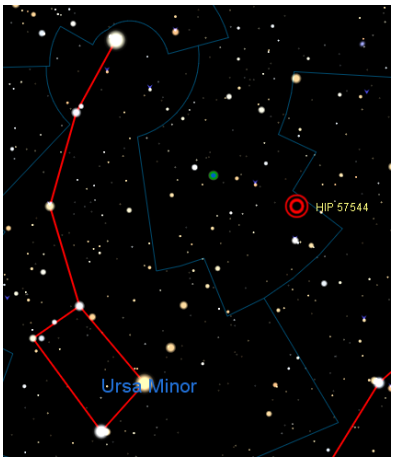


Gliese 445

Above: The circle is 15 arc minutes on the sky. North is up.

Right: Finder chart

Star charts generated by TheSkyX © Software Bisque, Inc. All rights reserved. www.bisque.com



Why this is interesting

Depending on how dark your sky is and how large your telescope is, this may be a difficult object for you to find.

You'll find it in the northern sky, just shy of 12 degrees south of Polaris. Note that the finder chart at the top-right corner of this page includes a 1/4 degree circle, so it's a fairly small field of view.

The software I use, TheSky X, does not identify the star by the name Gliese 445, but does show the location of the star by its other name HIP57544 (although, curiously, it does not show a star at that location). There is a photo of the region on this web site:

http://www.nasa.gov/mission_pages/voyager/multimedia/pia17461.html#.UokllPna9yU, and the location shown there is the same as is shown in the upper, detailed chart.

So, why would we want to take a look at this otherwise unremarkable star? It's because Voyager 1, the spacecraft that left our planet on September 5, 1977 and which flew by Saturn and Jupiter is now on a path toward this star. Right now, the spacecraft is about 127 AU from the Earth and it's the farthest any human-made object has ever gone. In *only* 40,000 years, Voyager 1 will pass 1.6 ly from the star. If we call a 'generation' 40 years (and there's some disagreement about what time-span constitutes a generation), it will arrive at the star in 1000 generations.

So, when you look at this star, you'll be looking in the direction of the departing Voyager 1 spacecraft. The proper motion of the star is such that it is approaching our solar system quite rapidly. By the time the Voyager 1 spacecraft passes by, the star will only be about 3.5 light years away from the Earth. It's fair to say that the spacecraft is approaching the star, and the star is approaching the spacecraft.

Voyager 1, you may recall, is the spacecraft that carries a disk, more like a phonograph record than a CD, with sounds and sights from our home planet. This disk was put together by a team led by Carl Sagan.

Gliese 445 is classified as a red dwarf star, and it's only about 1/3 the mass of our Sun. As a low mass star it will stay on the main sequence (in mid life) for a very long time.

Parking at the University of Houston Main Campus

For the monthly Houston Astronomical Society Meeting

The large-scale map at the right shows the location of the 15F parking lot, on the west side of Cullen Boulevard.

The detail map (below) was provided by the University of Houston Parking department to define the area 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.

From Google Maps

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. 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.

Houston Astronomical Society

Meeting on Friday, December 6, 2013

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 (past the parking garage)
- 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 (past the parking garage)
- 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.**