Volume 27 Issue 10

October 2013

The Observer

East Valley Astronomy Club

Upcoming Events:

All-Arizona Star Party - October 4-5

Public Star Party - October 11

Astronomy Day - October 12

General Meeting - October 18

Local Star Party - October 26

Check out all of the upcoming club events in the Calendars on page 8

Inside this Issue:

The Backyard Astronomer
Let the Observing Season Begin
by Bill Dellinges

This past summer had to be longest, cloudiest, hottest, most humid summer I can recall here in the Valley of the Furnace. What a bummer.

Except for five nights at the Grand Canyon Star Party and one freak clear night in August, my astronomical activities were relegated to club meetings and turning pages of Sky and Telescope and Astronomy magazines. On an occasional clear morning I could gaze naked eye on the wondrous winter sky rising in the east as I fought rattlesnakes and vermin while retrieving my newspaper. I even dreamt one night I was roller shaking on the rings of Saturn. It was pretty bad.

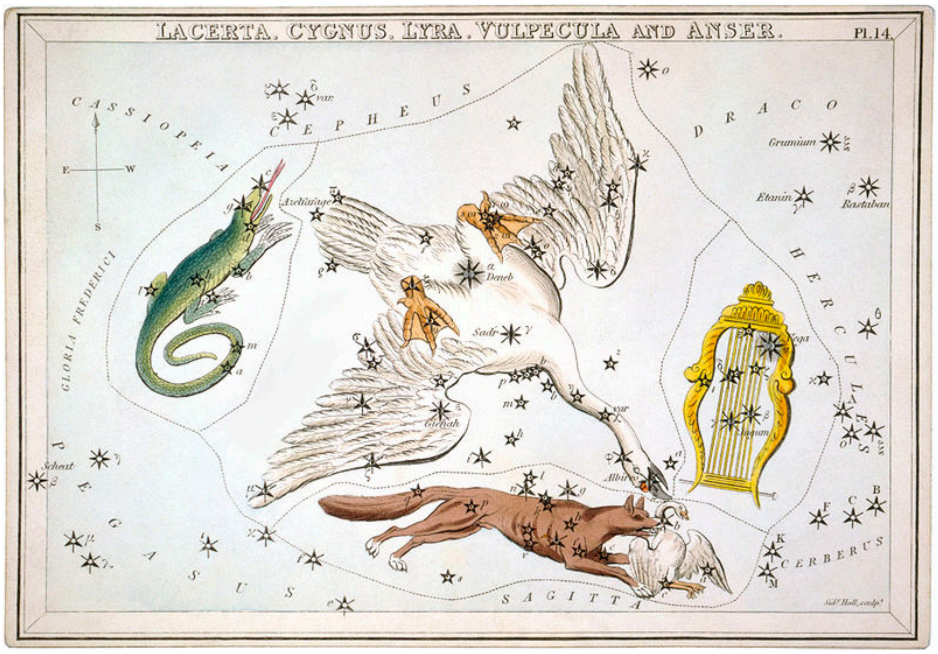
But that’s all behind us now (for the most part). If you can still remember how to operate your telescope, let’s take a look at what the fall night skies offer.

Surprisingly, summer constellations are still overhead. The beginning of October sees Cygnus the Swan just passing through the meridian. In Greek mythology Cygnus was a friend of Phaethon, the

Continued on page 2

The Backyard Astronomer

Continued from page 1 son of the Sun God Helius. One day Helius reluctantly agreed to allow his son to drive the chariot that carried the sun across the sky. Phaethon lost control of the chariot, and the sun began burning the Earth. Zeus, king of Gods, was forced to hurtle a thunderbolt at Phaethon and the chariot. They plunged to Earth like a shooting star, smashing into the River Eridanus. Cygnus, having seen the tragedy, leaped into the river in a vain attempt to save his friend.



Zeus thought Cygnus looked like a swan swimming and diving and took pity on him. After Cygnus died of grief, Zeus placed him in the sky as a swan. You could say it was Cygnus' swan song.

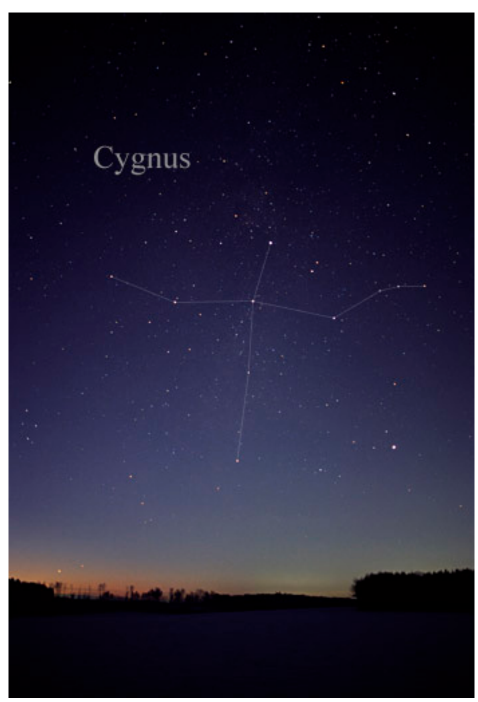
The star Albireo represents the head of the Swan. It's probably the most popular double star in the heavens. Legions of stargazers have observed this beautiful gold and blue pair and shared it with the public. It's easily resolvable in any telescope and can even be split in 10x70 binoculars. The Milky Way runs through Cygnus, so it's loaded with interesting objects like M29, M39 (star clusters), NGC 6826 (the "Blinking Planetary Nebula), the huge North American Nebula near Deneb (a mass of stars and nebulae), NGC 6960/79/92-95 (the Veil Nebula, a supernova remnant), and many double stars such as 61 Cygni, the first star whose distance of 11 light years was determined by Friedrich Bessel in 1838. Omicron 1 and the optical component of 30 Omicron form the interesting red, white, and blue triple star James Mullaney calls the "Patriotic Star." Be sure not to miss M27 in nearby Vulpecula, perhaps the best planetary nebula in the sky. Good luck finding it if you don't have a GOTO telescope! Old school star-hoppers can find it by sliding three degrees north of Gamma Sagittae. You are familiar with Sagitta the Arrow, right?

October skies offer two fine globular star clusters conveniently located on the meridian, M15 in Pegasus and M2 in Aquarius. M15 can be easily found following a line four degrees northwest of Theta and Epsilon Pegasi (the winged horse's neck and snout). M2, though nearby, is trickier. It's five degrees almost due north of Beta Aquarii or two thirds of the way on a line from Epsilon Pegasi to Beta Aquarii.

You want galaxies? The king of galaxies presents itself high in the eastern sky in early fall. M31, the Andromeda Galaxy, and its two attendant companion galaxies M32 and NGC 205 (aka M110) are a naked eye system in dark skies mainly due to their closeness – about 2.5 million light years. They are wonderful objects but you'll need a wide field of view (about 1.5 degrees) to get them all in, so use low power. Other fainter galactic specimens to inspect these evenings are NGC 7331 in Pegasus, M33 in Triangulum, and NGC 891 in Andromeda, a notoriously faint edge-on galaxy requiring dark skies and large aperture.

Still hungry for more after your summer hiatus? Try the planetary nebulae NGC 7662 (Blue Snowball) in Andromeda and NGC 6543 (Cat's Eye) in Draco. The Double Cluster in Perseus, NGC 884/869, has to be in the top ten best objects in the sky. Other double stars begging your attention ("Look at me, look at me!") are the quadruple 8 Lacertae (SAO 72509), Gamma Delphini (SAO 106475) and Gamma Andromedae (SAO 37734).

This is also an excellent time to observe Uranus and Neptune. Finder charts for these planets are on page 50 of the October 2013 issue of Sky and Telescope. Let the night games begin.



Looking for that perfect weekend activity?

Why not resolve to getting involved?

Contact Dave Coshow to join the staff at GRCO

Email: grco@evaconline.org

New Moon on October 4 at 17:35

First Quarter Moon on October 11 at 16:03

Full Moon on October 18 at 16:39

Last Quarter Moon on October 26 at 16:42

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Webcam imaging made easy! **Time lapse**

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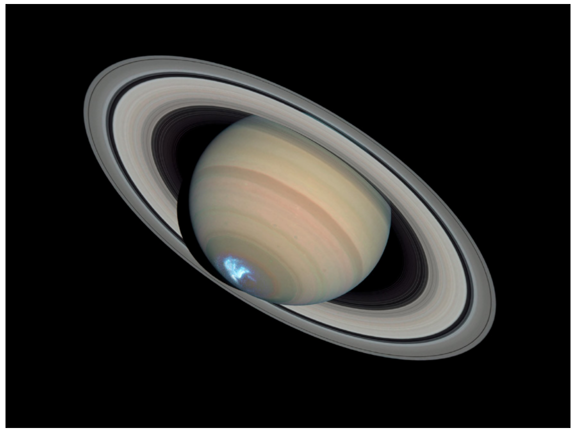

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Upcoming Meetings

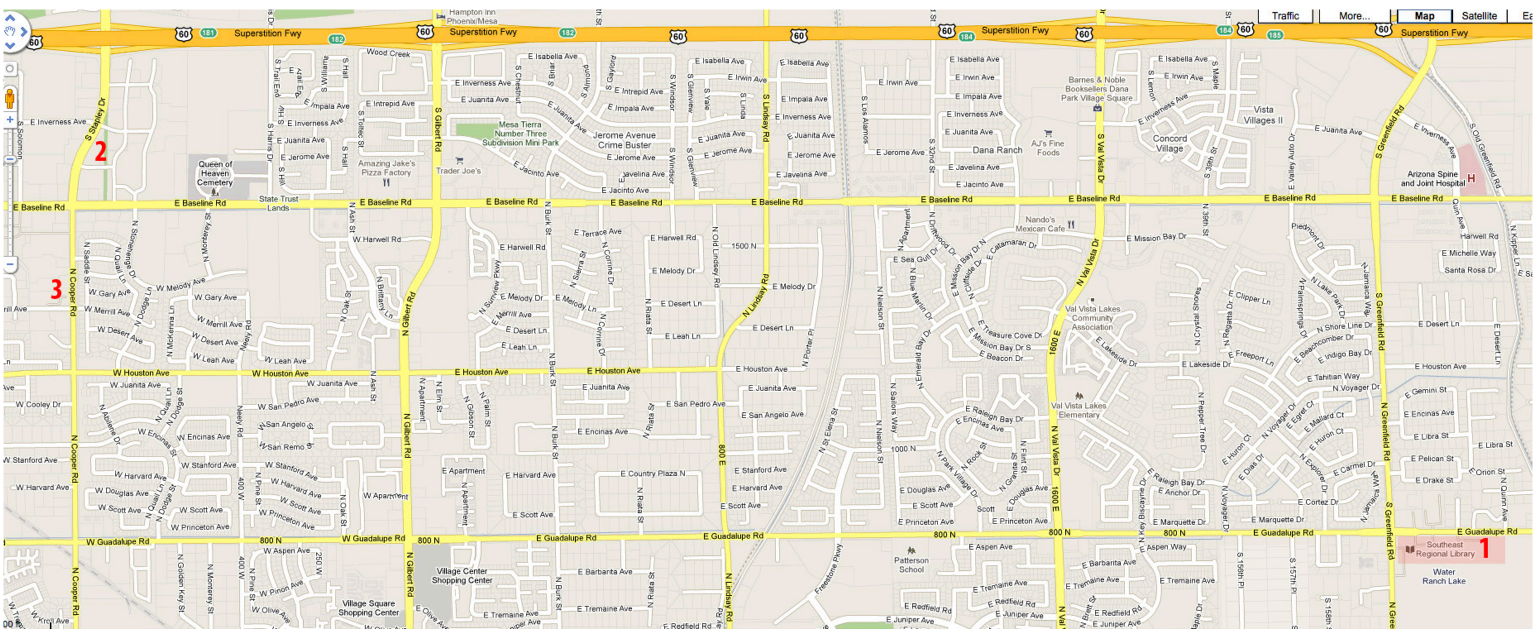
October 18
November 15
Holiday Party - TBD
January 17
February 21
March 21

The monthly general meeting is your chance to find out what other club members are up to, learn about upcoming club events and listen to presentations by professional and well-known amateur astronomers.

Our meetings are held on the third Friday of each month at the Southeast Regional Library in Gilbert. The library is located at 775 N. Greenfield Road; on the southeast corner of Greenfield and Guadalupe Roads. Meetings begin at 7:30 pm.

All are welcome to attend the pre-meeting dinner at 5:30 pm. We meet at Old Country Buffet, located at 1855 S. Stapley Drive in Mesa. The restaurant is in the plaza on the northeast corner of Stapley and Baseline Roads, just south of US60.

Visitors are always welcome!



2 Old Country Buffet
1855 S. Stapley Drive
Mesa, Az. 85204

1 Southeast Regional Library
775 N. Greenfield Road
Gilbert, Az. 85234

October 2013

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
		1	2	3	**4**	**5**
6	7	8	9	10	**11**	**12**
13	14	15	16	17	**18**	19
20	21	22	23	24	25	**26**
27	28	29	30	31		

October 4-5 - All-Arizona Star Party

October 11 - Public Star Party & SkyWatch at Riparian Preserve

October 12 - Astronomy Day

October 18 - General Meeting at SE Library

October 26 - Local Star Party

November 2013

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
					1	**2**
3	4	5	6	7	**8**	9
10	11	12	13	**14**	**15**	16
17	18	19	**20**	21	22	**23**
24	25	26	27	28	29	**30**

November 2 - Deep Sky Observing Night

November 8 - Public Star Party & SkyWatch at Riparian Preserve

November 14 - Biscayne Bay Star Party

November 15 - General Meeting at SE Library

November 20 - Arcadia Neighborhood Learning Center Star Party

November 23 - Local Star Party

November 30 - Deep Sky Observing Night

East Valley Astronomy Club -- 2013 Membership Form

Please complete this form and return it to the club Treasurer at the next meeting or mail it to EVAC, PO Box 2202, Mesa, Az, 85214-2202. Please include a check or money order made payable to EVAC for the appropriate amount.

IMPORTANT: All memberships expire on December 31 of each year.

Select one of the following:

☐ New Member ☐ Renewal ☐ Change of Address

New Member Dues (dues are prorated, select according to the month you are joining the club):

☐ **$30.00 Individual** January through March

☐ **$35.00 Family** January through March

☐ **$22.50 Individual** April through June

☐ **$26.25 Family** April through June

☐ **$15.00 Individual** July through September

☐ **$17.50 Family** July through September

☐ **$37.50 Individual** October through December

☐ **$43.75 Family** October through December

Includes dues for the following year

Renewal (current members only):

☐ **$30.00 Individual** ☐ **$35.00 Family**

Name Badges:

☐ **$10.00** Each (including postage) Quantity: _______

Name to imprint: ______________________________

Total amount enclosed: [ ]

Please make check or money order payable to EVAC

☐ Payment was remitted separately using PayPal ☐ Payment was remitted separately using my financial institution's online bill payment feature

---

Name: [ ] Phone: [ ]

Address: [ ] Email: [ ]

☐ Publish email address on website

City, State, Zip: [ ] URL: [ ]

How would you like to receive your monthly newsletter? (choose one option):

☐ Electronic delivery (PDF) *Included with membership* ☐ US Mail **Please add $10 to the total payment**

Areas of Interest (check all that apply):

☐ General Observing ☐ Cosmology

☐ Lunar Observing ☐ Telescope Making

☐ Planetary Observing ☐ Astrophotography

☐ Deep Sky Observing ☐ Other

Please describe your astronomy equipment:

Would you be interested in attending a beginner's workshop? ☐ Yes ☐ No

How did you discover East Valley Astronomy Club? [ ]

PO Box 2202
Mesa, AZ 85214-2202
www.evaconline.org

All members are required to have a liability release form (waiver) on file. Please complete one and forward to the Treasurer with your membership application or renewal.

Liability Release Form

In consideration of attending any publicized Star Party hosted by the East Valley Astronomy Club (hereinafter referred to as "EVAC") I hereby affirm that I and my family agree to hold EVAC harmless from any claims, liabilities, losses, demands, causes of action, suits and expenses (including attorney fees), which may directly or indirectly be connected to EVAC and/or my presence on the premises of any EVAC Star Party and related areas.

I further agree to indemnify any party indicated above should such party suffer any claims, liabilities, losses, demands, causes of action, suits and expenses (including attorney fees), caused directly or indirectly by my negligent or intentional acts, or failure to act, or if such acts or failures to act are directly or indirectly caused by any person in my family or associates while participating in an EVAC Star Party.

My signature upon this form also indicates agreement and acceptance on behalf of all minor children (under 18 years of age) under my care in attendance.

EVAC only recognizes those who are members or invitees and who also have a signed Liability Release Form on file as participants at an EVAC Star Party.

_______________________________________ ____________

Please print name here ***Date***

____

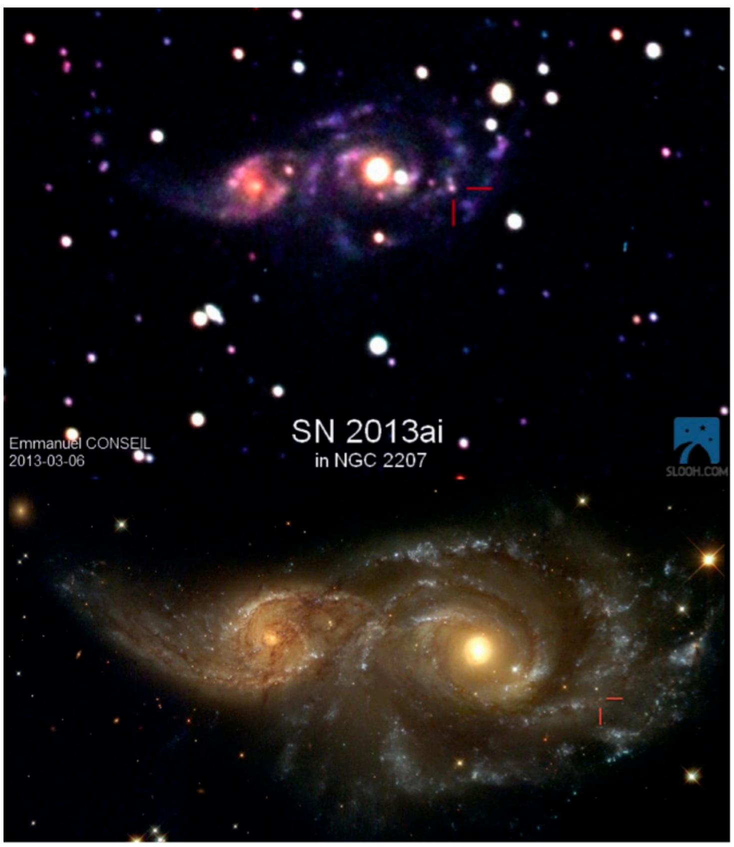
Please sign name here

PO Box 2202
Mesa, AZ 85214-2202
www.eastvalleyastronomy.org

How to Hunt for Your Very Own Supernova

by Dr. Ethan Siegel

In our day-to-day lives, stars seem like the most fixed and unchanging of all the night sky objects. Shining relentlessly and constantly for billions of years, it's only the long-term motion of these individual nuclear furnaces and our own motion through the cosmos that results in the most minute, barely-perceptible changes.



SN 2013ai, via its discoverer, Emmanuel Conseil, taken with the Slooh.com robotic telescope just a few days after its emergence in NGC 2207 (top); NASA, ESA and the Hubble Heritage Team (STScI) of the same interacting galaxies prior to the supernova (bottom).

Unless, that is, you're talking about a star reaching the end of its life. A star like our Sun will burn through all the hydrogen in its core after approximately 10 billion years, after which the core contracts and heats up, and the heavier element helium begins to fuse. About a quarter of all stars are massive enough that they'll reach this giant stage, but the most massive ones -- only about 0.1% of all stars -- will continue to fuse leaner elements past carbon, oxygen, neon, magnesium, silicon, sulphur and all the way up to iron, cobalt, and, nickel in their core. For the rare ultra-massive stars that make it this far, their cores become so massive that they're unstable against gravitational collapse. When they run out of fuel, the core implodes.

The inrushing matter approaches the center of the star, then rebounds and bounces outwards, creating a shockwave that eventually causes what we see as a core-collapse supernova, the most common type of supernova in the Universe! These occur only a few times a century in most galaxies, but because it's the most massive, hottest, shortest-lived stars that create these core-collapse supernovae, we can increase our odds of finding one by watching the most actively star-forming galaxies very closely. Want to maximize your chances of finding one for yourself? Here's how.

Pick a galaxy in the process of a major merger, and get to know it. Learn where the foreground stars are, where the apparent bright spots are, what its distinctive features are. If a supernova occurs, it will appear first as a barely perceptible bright spot that wasn't there before, and it will quickly brighten over a few nights. If you find what appears to be a "new star" in one of these galaxies and it checks out, report it immediately; you just might have discovered a new supernova!

This is one of the few cutting-edge astronomical discoveries well-suited to amateurs; Australian Robert Evans holds the all-time record with 42 (and counting) original supernova discoveries. If you ever find one for yourself, you'll have seen an exploding star whose light traveled millions of light-years across the Universe right to you, and you'll be the very first person who's ever seen it!

Read more about the evolution and ultimate fate of the stars in our universe: http://science.nasa.gov/astrophysics/focus-areas/how-do-stars-form-and-evolve/.

While you are out looking for supernovas, kids can have a blast finding constellations using the Space Place star finder: http://spaceplace.nasa.gov/starfinder/.

If It's Clear...

by Fulton Wright, Jr.
Prescott Astronomy Club

Celestial events (from Sky & Telescope magazine, Astronomy magazine, and anywhere else I can find information) customized for Prescott, Arizona. Remember, the Moon is 1/2 degree or 30 arc minutes in diameter. All times are Mountain Standard Time.

Keep looking for Comet C/20012 S1 (ISON) this month. See Astronomy Magazine, September 2013, p. 42 & 50; and October 2013, p. 50 for details. Sky & Telescope, September 2013. p. 50 also has an article.

On the night of Wednesday, October 2, starting after midnight (Thursday), you can see a number of events with Jupiter's moons. Here is the schedule:
11:54 PM Jupiter rises.
12:41 AM Ganymede moves in front of the planet.
01:10 AM Io's shadow falls on the planet.
02:25 AM Io moves in front of the planet.
03:22 AM Io's shadow leaves the planet.
03:43 AM Ganymede moves from in front of the planet.
04:26 AM Europa appears from behind the planet.
04:38 AM Io moves from in front of the planet.

On Thursday, October 3, Uranus is at opposition and visible all night. Any night within a week or two of this date would be a good time to check out the magnitude 5.7, 3.7 arc-second planet.

On Friday, October 4, it is new Moon and you have all night to hunt for faint fuzzies.

On Thursday, October 10, in the evening, you can see the Moon pass in front of a star cluster, M 25. The bad news is the cluster will be very low at the time of the occultations. Here is a schedule:
07:00 PM (approx) The sky is dark enough to see the cluster and the Moon.
10:04 PM The Moon starts to occult brighter stars.
10:18 PM Most of the brighter stars are hidden.
10:50 PM The Moon and cluster set.

On Friday, October 11, at 11:56 PM, the first quarter Moon sets. From 9:32 PM to 10:40 PM there is a rare triple shadow on Jupiter. Unfortunately for us in Arizona, Jupiter is below the horizon at that time. Drat!

On Tuesday and Wednesday, October 15 and 16, between 2:30 AM and 6:00 AM, you can see Regulus, Mars, and comet ISON lined up. The distance (about 1 degree) and direction from the star to the planet is the same as from the planet to the comet.

On Thursday, October 17, after 3 AM, you can see some events with Jupiter's moons. Here is the schedule:
03:33 AM Ganymede's shadow falls on Jupiter.
04:18 AM Europa enters Jupiter's shadow and disappears.
04:57 AM Io's shadow falls on Jupiter. (2 shadows)
05:15 AM Astronomical twilight starts.
05:44 AM Nautical twilight starts.
06:12 AM Io moves in front of Jupiter.
06:13 AM Civil twilight starts.
06:28 AM Ganymede's shadow leaves Jupiter.

On Friday, October 18, at 5:45 PM (7 minutes before sunset) the full Moon rises. It will just be coming out of a penumbral eclipse. Look for a slight darkening of the lower right limb.

Also on the night of Friday, October 18, you can see some events with Jupiter's moons. While you are watching Jupiter for events, notice that Ganymede and Callisto are near each other to the west of the planet. Here is the schedule:
10:57 PM Jupiter rises.
11:02 PM Europa's shadow falls on Jupiter.
11:25 PM Io's shadow falls on Jupiter. (2 shadows)
12:40 AM Io moves in front of Jupiter.
01:15 AM the two shadows straddle the great red spot.
01:36 AM Europa moves in front of Jupiter.
01:37 AM both shadows leave Jupiter at the same time.
02:53 AM Io moves from in front of Jupiter.
04:16 AM Europa moves from in front of Jupiter.

Around Friday, October 25, between 2:30 AM and 6:00 AM, comet ISON will be south of the galaxy trio of M 95, M 96, and M 105. Unfortunately, the gibbous Moon will also be in the sky.

On Saturday, October 26, between midnight and sunrise, you can see some events with Jupiter's moons. Here is the schedule:
01:19 AM Io's shadow falls on Jupiter. (1 shadow)
01:37 AM Europa's shadow falls on Jupiter. (2 shadows)
02:32 AM Io moves in front of Jupiter.
03:30 AM Io's shadow leaves Jupiter. (1 shadow left)
04:09 AM Europa moves in front of Jupiter.
04:14 AM Europa's shadow leave Jupiter. (0 shadows)
04:44 AM Io moves from in front of Jupiter.

On the night of Saturday, October 26, at 12:04 AM (Sunday), the third quarter Moon rises.

Dwarfs, Dwarfs, Everywhere Dwarfs

by Henry De Jonge IV

Introduction

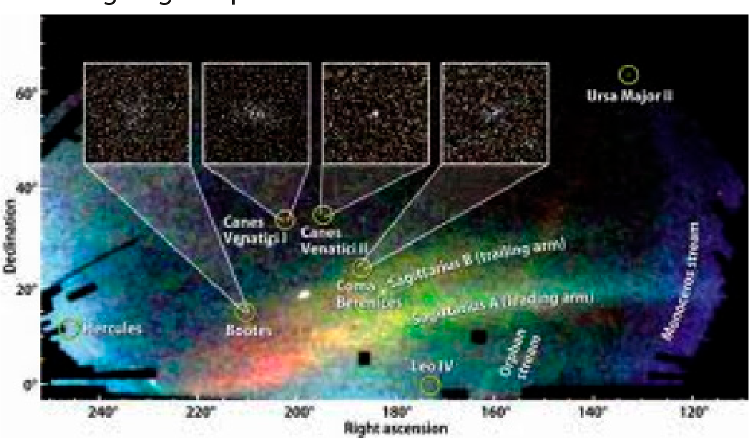
In the literature and in books there are discussed many kinds of dwarf objects including but not limited to red dwarfs, white dwarfs, brown dwarfs, dwarf stars, black dwarfs, dwarf planets, dwarf galaxies, M dwarfs, G dwarfs, dwarf novae, Y dwarfs, carbon dwarfs, blue dwarfs, etc. and the list goes on. However there are 3 main classifications of dwarf objects- galaxies, stars, and planets. I am sure that if something is of the right size in a category it may be called a dwarf object, however we will just briefly discuss the 3 main classifications and hopefully better clarify this hodgepodge and understand some of these unique yet numerous objects.

Dwarf Galaxies

The largest dwarf astronomical objects and the most common type of galaxy in our Universe are dwarf galaxies. They contain a few billion stars or less, consisting of about 1 billion solar masses which is about 1% of the Milky Way's mass. They are usually of a small spherical shape or small elliptical shape and are commonly found around larger galaxies, sometimes in small groups.

Interestingly enough it was recently discovered that the oldest dwarf galaxies we see which are about 9-10 billion years old, most often show very high rates of star formation. This ranges from 1 to 10 solar masses worth of new stars a year and indicates that they would double their mass approximately every 10 million years. This may indicate that dwarf galaxies we see today formed in a star burst model early on in the history of our Universe. They are also considered to be one of the building blocks of larger galaxies.

For example it is known that our Milky Way is currently absorbing several dwarf galaxies and that this process has been ongoing for quite awhile.



Dwarf galaxies around the Milky Way

Dwarf Stars

Our sun is actually considered to be a very small star when compared to the largest stars, although sun sized stars are much more common than their larger cousins. In fact the sun is considered to be a yellow dwarf star when compared to most main sequence stars. Dwarf stars can be classified up to 20 times larger than our sun and 20,000 times brighter. A star must burn H in its center by definition but yet the smallest dwarf stars barely manage to do so and glow a cool shade of red, hence they are called red dwarfs.

The term dwarf star was first used in 1906 to distinguish certain stars in spectral categories that were either much brighter or much dimmer than our sun and has expanded from there. Basically any main sequence star of luminosity class V can be called a dwarf star. The cooler a star and its atmosphere the more molecular compounds and condensates are formed thus influencing the spectra and enabling better dwarf classification and detection.

Red Dwarfs

Red dwarf stars are the most common star in our galaxy, comprising about 75% of the total number of stars. Besides being the most common type of star in our Galaxy they are probably the most common type of star in the Universe. They are essentially low mass main sequence stars. It is estimated that they number at least 75 billion in the Milky Way alone. They are smaller, cooler, and fainter than our sun and difficult to image. The closest red dwarf to us is Proxima Centauri, a type M5 red dwarf at magnitude 11.05.

Due to their small size and low H fusion rate they live much longer than larger stars. The less massive a star the longer it's life span. Some estimates suggest that a red dwarf star with 0.16 solar masses would spend about 2.5 trillion years on the main sequence! The rate of H burning, (fusion) is very slow, so slow in fact that primordial red dwarfs with less than 0.8 solar masses are still on the main sequence. It is estimated that red dwarfs with masses of about 0.1 solar masses can burn H for over 10 trillion years.

Red dwarfs emit most of their light in the IR unlike the visible light of the sun. Young red dwarf stars can often emit strong flares of UV light, (flare stars) however in general they emit very little light in the UV. They are known to have sunspots on them like our sun. If a red dwarf has a mass of over 0.25 solar masses then it may become a red giant, which eventually evolves into a blue dwarf before becoming a white dwarf.

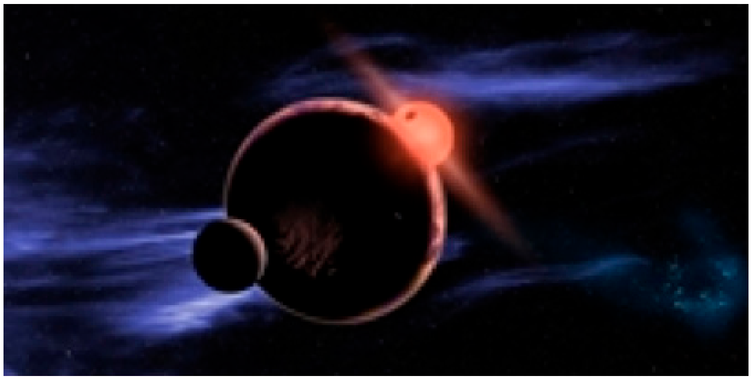
An average red dwarf is only about 1/3 as large and 1/1,000 as luminous as our sun. Their surface temperatures are in the range of 5,700-5,900 degrees F, (3,100-3,300 degrees C) or as low as 2,300 degrees K, where as our sun has a surface temperature of 10,000 degrees F, (5,500 degrees C) or 5,800 degrees K. As noted they are very low mass stars and thus have low interior temperatures compared our sun. They can have a luminosity as low as1/10,000 of that of the sun up to about 10% of the luminosity of the sun.

Interestingly enough it has been estimated from recent Kepler data that about 6% of red dwarf stars have habitable earth like, (sized) planets and the closest one could be about 13 ly distant. Additional data from Kepler

Continued on page 12

Dwarfs, Dwarfs, Everywhere Dwarfs

Continued from page 11 and other studies estimate that 40% of red dwarf stars have super sized earths in their "habitable zones" where liquid water could exist on their surface, while just 17% of yellow dwarf stars like the sun have earth sized planets in these zones.



Artist's drawing of a habitable planet with 2 moons orbiting a red dwarf star

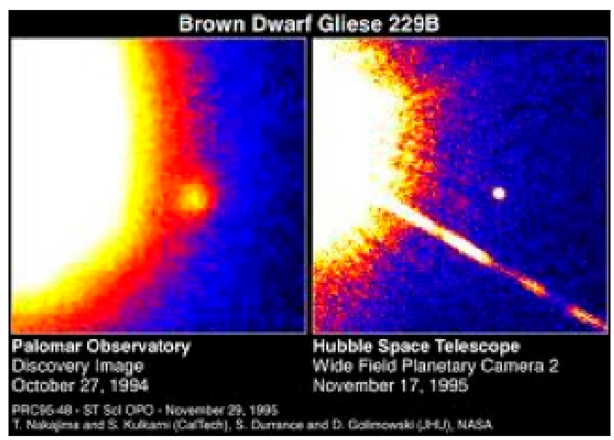
Brown Dwarfs

Even smaller than red dwarfs are the brown dwarfs-star wannabes that are in between stars and planets-yet not massive enough to generate H fusion in their cores. Brown dwarfs are also classified as T dwarfs although the T dwarf class is often referred to the lowest temperature brown dwarfs. Brown dwarfs and other very low mass stars can shrink to about 0.1 times the radius of the sun. Their surface temperatures can go as low as 700 degrees K. The temperature of a massive brown dwarf can reach 2,800 K which is near that of a small red dwarf, (recall that our sun has a surface temperature of 5,800 K) while that of a very small brown dwarf can be about 300 K. The lowest surface temperature of a main sequence star is about 1,800 K.

The core of a brown dwarf can resist the gravitational contraction of the surrounding mass via degenerate electron pressure but not with H fusion power. Brown dwarfs will continue to cool over time due to a lack of a stable, (H burning) energy source. However they can sometimes generate heavy H, (deuterium) fusion in their cores but never go beyond this to the higher densities and temperatures required to generate H fusion on a sustainable basis as do stars. Some data suggests that a few brown dwarfs may go into H fusion mode very briefly before cooling back sufficiently to heavy H fusion. Brown dwarfs that are above 0.013 solar masses are thought to be able to burn heavy H for a short period, (a hundred million years or less) early on but this is not sufficient to halt gravitational collapse since the amount of heavy H is quite low to begin with. It takes an internal temperature of over 3,000,000 degrees K to sustain H burning in a star.

These objects offer clues as to exactly how stars form or do not form and are valuable to understand. They glow basically in the IR. The upper limit for a brown dwarf is about 0.075 solar masses or about 70-75 times the mass of Jupiter, (recall that the mass of the sun is equal to about 1,000 Jupiter masses) after which H fusion can take place in the core. The minimum mass is about 13 Jupiter masses. They were first discovered in 1995. There are hundreds so far discovered and about 15% - 20% of them are in binary systems. However this estimate is considered a lower limit due to our limited resolution. Interestingly these T dwarfs are a sort of bridge between stellar and planetary evolution, (and spectra as in a "hot Jupiter"). The classification schemes within the brown dwarf category usually involve spectral distinction in the near IR wavelength bands, (molecular bands).

They were initially called black dwarfs when first theorized in the 1960's but this term faded from use when the term brown dwarf was substituted in the 1970's. Dwarf stars can be distinguished since the spectrum of a brown dwarf will usually contain primordial Li which is converted in regular stars or by their surface temperature. The first binary brown dwarf was found in the Pleiades in the 1990's and is thought to be about 50 Jupiter masses with a surface temperature of less than 1,200 K. It also has a planet orbiting around it. Recent data from the Wide Field Infrared Survey Explorer found one brown dwarf for every 6 regular stars, much lower then the expected roughly equal numbers that astronomers had thought. Obviously more work needs to be done in this area.



The first T dwarf identified in 1995

White Dwarfs

White dwarfs are the remnants of sun like stars that have ended their lives and glow white hot with temperatures of hundreds of thousands of degrees. They are extremely dense and cool down over many billions of years, in fact most that are in existence today have will be cooling down longer than the Universe has existed to date. They eventually cool down into black dwarfs. They are typically composed up of degenerate C and O matter and have the potential to go SN, (Type 1A) if they accrete enough extra mass.

Black Dwarfs

These are the end stages of a white dwarf and it is thought that none currently exist in our Universe to date due to the extremely long cool down time of the *Continued on page 13*

Dwarfs, Dwarfs, Everywhere Dwarfs

Continued from page 12 white dwarfs. They are essentially white dwarfs that no longer emit noticeable light or heat. The time for this to occur is currently expected to be longer than the age of the Universe so that none are though to exist. Obviously they would be very hard to detect but like a BH they would be detectable via their gravitational interactions of nearby matter. Some estimates of the time it would take a white dwarf to cool down range from 10,000,000,000,000,000 to 10,000,000,000,000,000,000,000,000 years or perhaps longer.

M and L Dwarfs

These are stars between the regular O, B, A, F, G, K, main sequence (H burning) stars and the T dwarfs, (brown dwarfs). Unlike hot stars which usually peak in the visible region these dwarf stars peak in the near IR wavelengths. The M dwarfs are better defined in this wavelength range than the L dwarfs however. As for the L dwarfs they usually have a unique spectra especially in the optical bands that is a result of all the dust surrounding the little star. They typically are expected to have a radius of about 90% that of Jupiter. Mid to late M dwarfs stars are old low mass stars with masses between .085-.120 solar masses. Both of these types of stars also commonly experience stellar flares. These small stars can have very tightly wound magnetic fields that can cause such bursts although the exact mechanisms are not at all understood.

M dwarfs are very faint stars-so faint that it was only in the 1990's that we have studied them in depth and were able to image them. Due to their faintness in the lower optical bands, (due to their lower temperatures) the classification of these stars is usually done in the red wavelengths. M dwarf stars are thought to be likely candidates for habitable extra solar planets. In 2007 two such planets were found orbiting Gliese 581, one with a bit over 5 Earth masses.

Y Dwarfs

Thought to be the end stages of evolution for cold brown dwarf or T dwarf stars.

Blue Dwarfs

A class of very low mass stars that increase in temperature as they near the end of their lives, typically high mass red dwarfs.

Dwarf Novae

These are CV stars that undergo repeated outbursts or explosions that occur over relatively short time periods measured in days. They are basically a white dwarf star that has attracted enough material from a companion star, (or perhaps a passing gas cloud) via an accretion disk on its surface to go nova, (see a previous paper on these that discuss this in depth). They are classified into 3 main groups mainly on the basis of their optical properties which can vary from a couple of days to tens of days.

Dwarf Planets

These small planets are Pluto like in size and smaller and are basically very large asteroids that have a strong enough gravity to shape them into a spherical shape. They are not defined as planets or satellites but yet larger than small solar system bodies. The IAU defines a dwarf planet as a celestial body in direct orbit of the sun that is massive enough for its shape to be controlled by gravity, (spherical collapse) which has not cleared its orbital region of other bodies.

Thus these small planet like objects do not dominate their orbital zone like a regular planet although they can still have smaller objects orbit as moons. Our solar system is estimated to contain a couple of thousand of these objects. Some few recognized by the IAU include Pluto, Ceres, Haumea, Makemake, and Eris, (more massive than Pluto). Many hundreds of others can be assumed to be dwarf planets but are not known well enough to be sure under the definition of the IAU. This definition is still under some debate with many potential candidates in the wings while the search for these small, orbiting objects will continue. How many such spherical objects abound in our galaxy remains an open question but undoubtedly it is a huge number.

Conclusions

We have seen that the term dwarf can be applied to a wide range of objects. Some of the definitions are more exact than others, (like defining their spectra specifically in the stellar dwarf category) and there is sometimes some overlap between other definitions of objects. Usually though the term dwarf is used to signify a specific category of object in a continuum of descriptions and can be useful when specifying certain traits or sizes. We must also be aware of the fact that as some stars continue to cool down over time that their spectral classification will change and thus their dwarf classification may change. In the future more accurate and extended spectral data collection will enable us to better classify more stars and distinguish dwarf types as they evolve.

We have not covered the entire gamut of dwarf labeled objects herein but did hit a lot of them. However it is very interesting that for the most part these small dwarf objects of all types usually turn out to be the most common and numerous objects in our universe!

Dwarf planets, (some with moons) to scale with the Earth

The Deep Sky Object of the Month

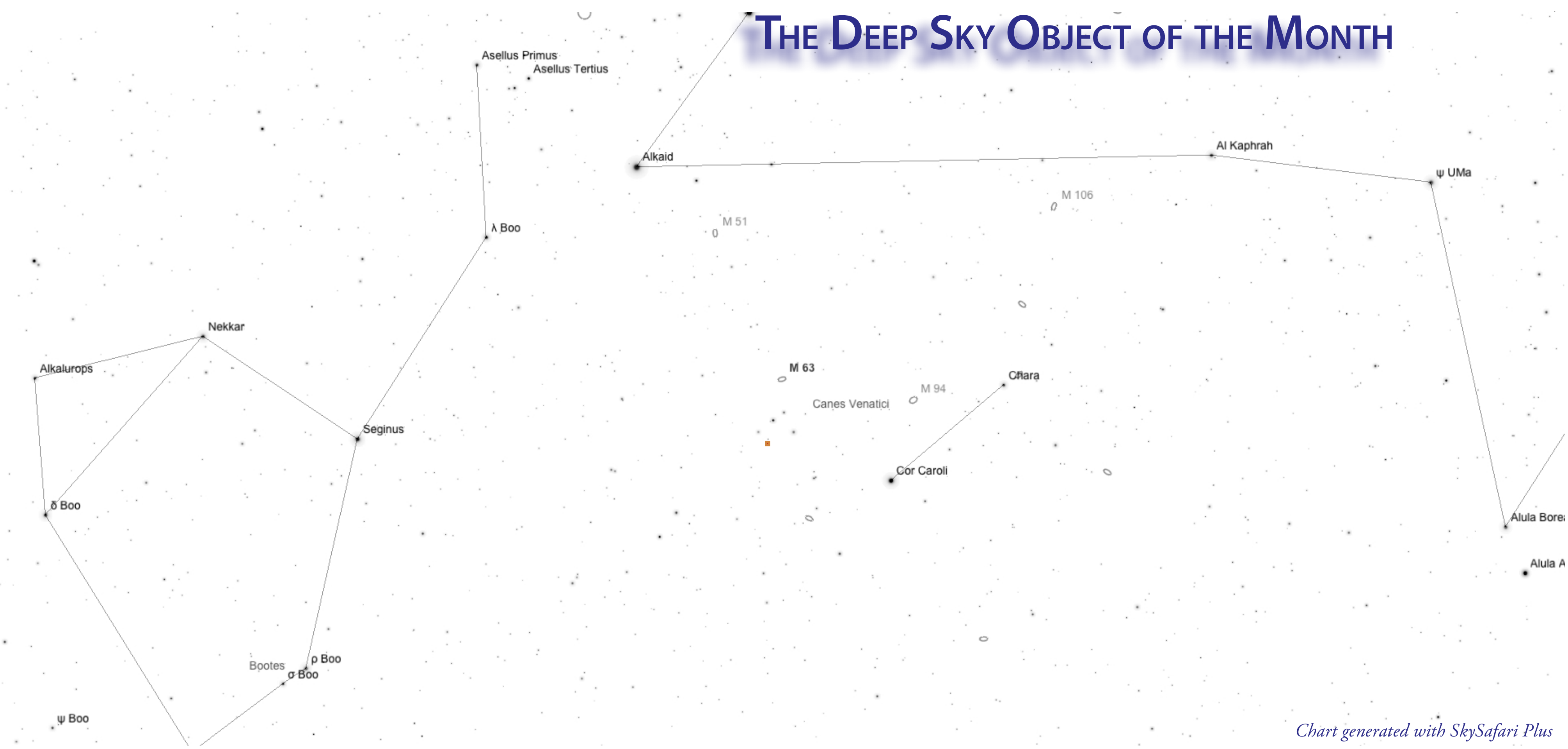


Chart generated with SkySafari Plus

M 63 was the very first discovery of Charles Messier's friend, Pierre Mechain, who caught it on June 14, 1779. On the same day, Charles Messier included it as the 63rd object in his catalog. The Sunflower galaxy is one of the earliest-recognized spiral galaxies, listed by Lord Rosse as one of the fourteen "spiral nebulae" known up to 1850.

Messier 63 has a visual magnitude of 8.6, and apparent dimensions of 10'x 6'. Its spiral pattern resembles a giant celestial sunflower: a large central hub surrounded by tightly wound spiral arms. M 63 has been classified as type Sb or Sc, displaying a patchy spiral pattern; its spiral features are in a multitude of short arcs rather than long well-defined arms.

The spiral arms show up as a grainy background, which brighten slowly from outward and then rapidly inward to the 6"-wide nuclear region, which is still grainy. Star forming regions can be traced all along the spiral arms on color photos.

The type I supernova 1971I was discovered in M 63 on May 25, 1971, and reached magnitude 11.8.

The distance to M 63 is about 37 million light years, and it has a diameter of some 90,000 light years. Although it appears 6° south of the Whirlpool Galaxy (M 51), it apparently forms a physical group with that galaxy and several others, known as the M 51 Group.

M63 (Sunflower Galaxy) Spiral Galaxy in Canes Venatici

RA: 13h 16m 26.04s Dec: +41° 57' 37.0" Size: 12.6' x 7.2' Magnitude: 8.60

As one of the many benefits to becoming an East Valley Astronomy Club member, we have the following telescopes available for monthly check-out to current EVAC members:

8 inch Orion manual Dobsonian
8 inch Orion Intelliscope Dobsonian
60mm Tasco Alt-Azimuth Refractor

For more information, or to check out one of these scopes, please talk to:

David Hatch
EVAC Properties Director
480.433.4217

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