Temecula Valley Astronomer

The monthly newsletter of the Temecula Valley Astronomers June 2020

Events:

Virtual meeting via Zoom on 1 June at 7PM. Join your fellow astronomers for What's Up and a Mission Highlight. Virtual refreshments provided by each participant. Watch your club email for meeting ID and password.

Until we can resume our monthly meetings, you can also interact with your astronomy associates on Facebook or by posting a message to our mailing list.

SpaceX Crew Dragon awaiting its 27 May 2020 Demo-2 Launch

WHAT'S INSIDE THIS MONTH:

Send newsletter submissions to Mark DiVecchio <markd@silogic.com> by the 20th of the month for the next month's issue.

Like us on Facebook

General information:
Subscription to the TVA is included in the annual $25 membership (regular members) donation ($9 student; $35 family).

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Cosmic Comments
by President Mark Baker

I truly enjoy what we at TVA do within the Club and our communities to inspire, edify, and educate, but I sometimes wonder if the rewards are more inclusive than exclusive. At least until I receive so much positive daily feedback about your contributions to the effort…

During this "lockdown", many of you have filled your evenings looking up, looking deeper, and imaging awe inspiring celestial objects that you probably would not have done in "normal" life… we have shared comets, asteroids, Supernovae, Lunar images, Omega Centauri and other fuzzies, ISS flyovers, and so on that our friends and neighbors just don't witness as a rule. And they are very appreciative, I can affirm…

Every person, regardless of age or education, that we encourage to look up and ponder helps make the world a better place… they will ask questions and seek answers, even if it's just one time and one particular subject. We need to wonder… that is how humanity truly progresses!!!

Again, as I oft repeat ad nauseum perhaps… Science is not stagnant, nor is it dead or dying. Humans continue to press into the nether reaches of understanding, and we TVA members get to be on the front lines… either individually, or as a collective, we have opportunities to "share the wealth" within our communities and be rewarded with the Ooh's, Aah's, and even AHA's!!! Just because we promote looking up and wondering…

As always, here's to what you do for each other and the world around us… I am most blessed and thankful indeed!!

Clear, Dark Skies my Friends…

Looking Up Redux
compiled by Clark Williams

from these sources:
SeaSky.org
Wikipedia.com
in-the-sky.org
The American Meteor Society, Ltd.
cometwatch.co.uk
NASA.gov
TVA App (2.0.1296)
FullAndNewMoon App (2.0)
Starry Night Pro Plus 7 (7.6.3.1373)
SkySafari 6 Pro (6.1.1)
Stellarium (0.18.2)
timeanddate.com/astronomy
https://www.fourmilab.ch/earthview/pacalc.html

ALL TIMES ARE LOCAL PACIFIC TIME (PDT / PST) UNLESS NOTED OTHERWISE

Times are given in 24-hour time as: (hh is hours, mm minutes, ss seconds)
- hh:mm:ss or hhmmss
- hhmm+ (time of the next day)
- hhmm− (time of the previous day)
- hhmm (seconds not shown)
- yyyymmddThhmmss (Full date as: year month day Time separator hours minutes seconds)

Moon Phases for the month by phase:

Saturday	**the 20th**	**@ 2342 FIRST QTR in GEMINI**
Friday	**the 5th**	**@ 1213 FULL in OPHIUCHUS**
Friday	**the 12th**	**@ 2324 THIRD QTR in AQUARIUS**
Saturday	**the 20th**	**@ 2342 NEW in ORION**
Sunday	**the 28th**	**@ 0116 First QTR in VIRGO**

Apogee comes on 2020-06-15 @ **1758 – 405,596 km (252,026 mi)**
Perigee comes on 2020-06-03 @ **2038 – 364,365 km (226,406 mi)**

2020 has: (12) new moons, (13) 1st Qtr moons, (13) Full moons, (12) 3rd Qtr moons
(1) Blue moon and (0) Black moons

Daylight Savings: Starts: 2020-Mar-08 : Ends: 2020-Nov-01

Luna: Luna is waxing gibbous on the 1st of the month. 82% illuminated Luna is transiting at **2133** setting by **0334+**. Luna by mid-month is a waning crescent, 24% illuminated. Rising early at **0246** and setting in the afternoon at **1556**. By the-end-of-the-month Luna is again waxing gibbous, 80% illuminated transiting at **2146** and setting by **0246+**.

Highlights: (distilled from**: SeaSky.org** and **Clark's planetary Orrey** program[s]**)**

June 4 - Mercury at Greatest Eastern Elongation. The planet Mercury reaches greatest eastern elongation of 23.6 degrees from the Sun. This is the best time to view Mercury since it will be at its highest point above the horizon in the evening sky. Look for the planet low in the western sky just after sunset.

June 5 - Full Moon. The Moon will be located on the opposite side of the Earth as the Sun and its face will be will be fully illuminated. This phase occurs at 19:12 UTC. This full moon was known by early Native American tribes as the Strawberry Moon because it signaled the time of year to gather ripening fruit. It also coincides with the peak of the strawberry harvesting season. This moon has also been known as the Rose Moon and the Honey Moon.

June 5 - Penumbral Lunar Eclipse. A penumbral lunar eclipse occurs when the Moon passes through the Earth's partial shadow, or penumbra. During this type of eclipse the Moon will darken slightly but not completely. The eclipse will be visible throughout most of Europe, Africa, Asia, Australia, the Indian Ocean, and Australia. (NASA Map and Eclipse Information)

June 20 - June Solstice. The June solstice occurs at 21:43 UTC. The North Pole of the earth will be tilted toward the Sun, which will have reached its northernmost position in the sky and will be directly over the Tropic of Cancer at 23.44 degrees north latitude. This is the first day of summer (summer solstice) in the Northern Hemisphere and the first day of winter (winter solstice) in the Southern Hemisphere.

June 21 - New Moon. The Moon will located on the same side of the Earth as the Sun and will not be visible in the night sky. This phase occurs at 06:42 UTC. This is the best time of the month to observe faint objects such as galaxies and star clusters because there is no moonlight to interfere.

June 21 - Annular Solar Eclipse. An annular solar eclipse occurs when the Moon is too far away from the Earth to completely cover the Sun. This results in a ring of light around the darkened Moon. The Sun's corona is not visible during an annular eclipse. The path of the eclipse will begin in central Africa and travel through Saudi Arabia, northern India, and southern China before ending in the Pacific Ocean. A partial eclipse will be visible throughout most of eastern Africa, the Middle East, and southern Asia. (NASA Map and Eclipse Information) (NASA Interactive Google Map)

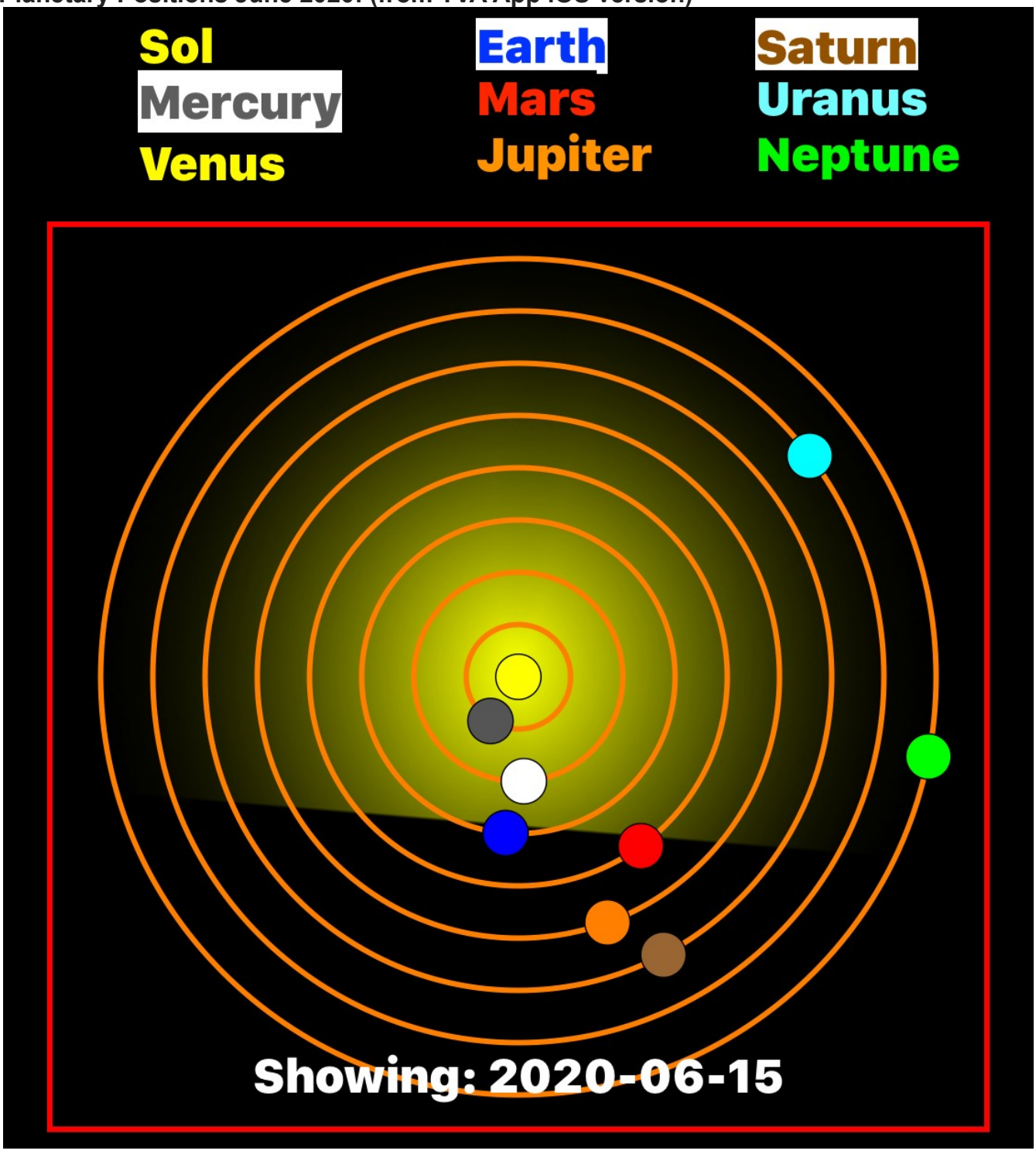
Algol minima: (All times Pacific Time)

06/02/2020	1156
06/05/2020	0845
06/08/2020	0534
06/11/2020	0223
06/13/2020	2311
06/16/2020	2000
06/19/2020	1649
06/22/2020	1338
06/25/2020	1026
06/28/2020	0715

Sun and Moon Rise/Transit/Set Times

		Rise	Transit	Set
06/01/2020	Sun	053756	124703	195622
	Moon	153126	213349	033405+
06/15/2020	Sun	053638	124930	200228
	Moon	021854	083842	150138
06/30/2020	Sun	054036	125253	200503
	Moon	153540	211130	024643+

Planets:
Planetary Positions June 2020: (from TVA App iOS version)



- **Mercury:** Mercury is an evening object in the beginning of the month. It is illuminated at 42% and 0.34 apparent magnitude. Mercury sets by **1956** with the sunset preceding at **1956**. There will be an 82% illuminated Moon about 106° eastward along the ecliptic. You should be able to

get a good view of Mercury before it sets. On the 4th Mercury is at freatest eastern elongation. The Moon will be nearly FULL at 96% illumination. So good luck By mid-month the Winged Messenger is not setting until **2118** with Sol Sol preceding at **2002**. On the 30th Mercury is only 4° from the Sun so don't even try.

- **Venus:** Is the Evening Star in the beginning of the month. Venus **is about 2°** away fron the Sun on the first. By mid-month Venus has become the morning star. She rises at **0436** followed by Sol an hour later. is setting at **2203**. By the 30th Venus is rising at **0339**. followed by sunrise at **0540.**
- **Mars:** Mars is an early morning object on the 1st of the month. Mars rises at **0128** on the first. Sunrise is not until **0537**. There will be a 74% illuminated Moon but it is 152° westward along the ecliptic. By mid-month Mars is rising at **0058**. End-of-month finds the Warrior rising at **0025**. So if you're a night-owl or an early riser the Red Planet is coming back into view.
- **Jupiter:** Jupiter is an evening object on the first of the month rising at **2254** and transiting at **0358+**. Ol' Jove is also only about 2° from Pluto which rises at 2249. By mid-month Jove is rising at **2155**. On the 26th at about **2116** Jupiter and Pluto will have an angular separation of 0° 44' 46". Now there is a photo-op. Pluto and Jupiter will remain close through to the end of the month. Come the end of month Jupiter is peaking above the horizon by **2050**. Jupiter will now be preceeding Pluto's rise time.
- **Saturn:** Saturn is trailing Jupiter and Pluto; rising about **2311** on the 1st. Saturn by mid month is rising by **2213** and is within 5° of Jupiter and 6° of Pluto. By the end-of-the-month Saturn is rising at **2111**.
- **Uranus:** On the first Uranus doesn't rise until **0350**. The apparent magnitude is 5.87 so we're on the ragged edge of being naked-eye visible. Sunrise follows at **0537** and the Moon has set so you have some good viewing opportunities. By the ides Uranus is rising at **0257** with a 30% illuminated waxing crescent Moon hanging 21° westward. End of the month and the "sky god" is rising at **0200** while as the Moon sets in the west at **0209**. Sunrise won't come until **0540** so you have plenty of time for viewing.
- **Neptune:** Neptune is leading the Uranus and trailing Maes. Neptune and Mars are only 7° 59' apart, rising at **0143** in the beginning of the month. There is a 74% illuminated Moon 160° westward of Neptune. You should be able to squeeze in a peek if you're up by that hour. By the 15th Neptune is rising at **0049**. By the end of the month Neptune is rising at **2346**. The Moon is 121° 47' westward with 81% illumination.
- **Pluto:** Pluto rises by **2249** on the first of the month with an 83% illuminated Moon hanging rather high in the sky. By mid-month Pluto is rising by **2153** and is very cloe to Jupiter (see Jupiter above). By the 30th Pluto is rising at **2053**.

Asteroids:

- Still a dearth of asteroids. I searched for asteroids in 2020 with a reasonable magnitude; say less than or equal to +10 in June there is nothing except the regulars: Juno, Vesta. Hebe, Eros and Herculina. So consult your local planetarium software or try: https://www.asteroidsnear.com/year?year=2020

Meteors:

- There just aren't any this month.

- See Highlights above for more details. (SeaSky.org) (American Meteor Society)

Comets: come in various classifications:

- 1) Short Period comets – further broken down into:
  - Halley Type: The Halley Types are believe to come from the Kuiper Belt and have periods in excess of 20-years.
  - Jupiter Type: The Jupiter types have a period less than or equal to 20-years.
  - Short period comets June have a near circular orbit or an elliptical orbit. The latter being far more common.
- 2) Long Period comets – thought to originate from the Oort cloud these comets have periods of over 200 years and have random inclinations around the celestial sphere.

ESTIMATES ONLY Local time 2100 PDT

C/2020 F8 (SWAN), comet in Auriga

June 01 Mag: 6.9 Rises: 0422 Sets: 2212 comet in Auriga

June 15 Mag: 9.2 Rises: 0457 Sets: 2117 comet in Auriga

June 30 Mag: 11.2 Below Horizon comet in Auriga

C/2017 T2 (PANSTARRS)

June 01 Mag: 8.3 Always above horizon comet in Ursa Major

June 15 Mag: 8.5 Rises: 0831 Sets: 0537+ comet in Ursa Major

June 30 Mag: 8.8 Rises: 1013 Sets: 0315+ comet in Canes Venatici

249P/LINEAR

June 01 Mag 12.5 Rises: 0902 Sets: 2245 comet in Gemini

June 15 Mag: 11.4 Below Horizon comet in Gemini

June 30 Mag: 11.5 Below Horizon comet in Auriga

C/2019 U6 (Lemmon)

June 01 Mag 11.5 Below Horizon comet in Canis Major

June 15 Mag: 10.9 Rises: 1020 Sets: 2114 comet in Hydra

June 30 Mag: 10.8 Rises: 1040 Sets: 2235 comet in Sextans

C/2019 N1 (ATLAS)

June 01 Mag 14.3 Always above the Horizon comet in Draco

June 15 Mag: 14.1 Always above the Horizon comet in Ursa Major

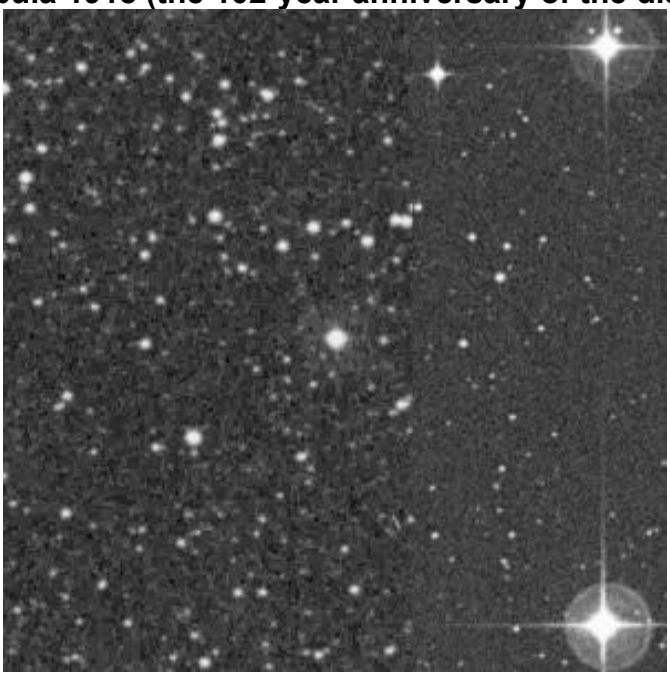
June 30 Mag: 13.9 Always above the Horizon comet in Ursa Major

Deep Sky:

Notes:

L/Z abbreviation for ALT/AZ
R/D abbreviation for Right Ascension/Declination
α is right ascension
δ is declination
In each case, unless otherwise noted, you should look for the following on or about the 15th Day of June 2020 at 2100 PDT and you will have about 20 minutes of viewing time total.

- **The Victory Nebula 1918 (the 102-year anniversary of the discovery)**



V603 Aquilae (or Nova Aquilae 1918) was a bright nova first observed (from Earth) in the constellation Aquila in 1918. It is a binary system, comprising a white dwarf and donor low-mass star in close orbit to the point of being only semidetached. The white dwarf sucks matter off its companion, which has filled its Roche lobe, onto its accretion disk and surface until the excess material is blown off in a thermonuclear event. This material then forms an expanding shell, which eventually thins out and disappears.

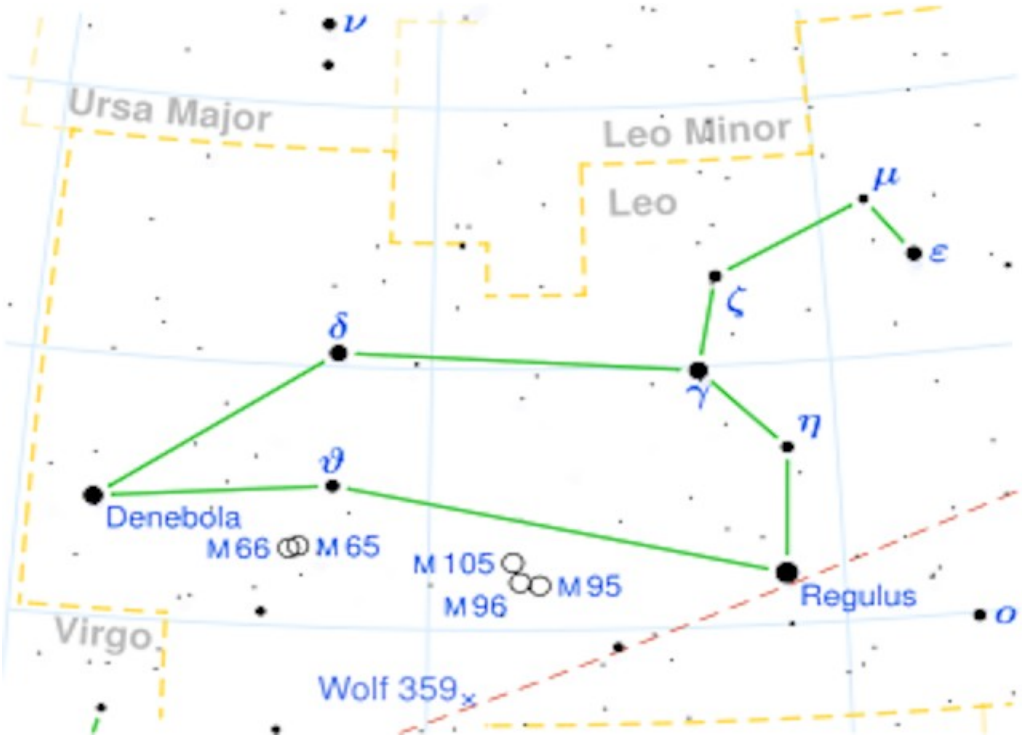
First seen by Zygmunt Laskowski, a medical professor and amateur astronomer, and then confirmed on the night of 8 June 1918 by the UK amateur astronomer Grace Cook, The nova is estimated at between 784 to 839 light years distance from Earth. Nova Aquilae reached a peak magnitude of −0.5; it was the brightest nova recorded in the era of the telescope. It was brighter than all stars but Sirius and Canopus. Tycho's and Kepler's supernovae were brighter, but both occurred before the invention of the telescope. Originally a star system with a magnitude of

11.43, it took twelve days to fade three magnitudes and then 18.6 years to fade to quiescence. In 1964 Robert P. Kraft ascertained that it was a binary system, recently determined to be true for several other novae at the time.

The star system has settled to an average apparent magnitude of 11.4 since the 1940s, fading by around 1/100 of a magnitude per decade. Spectroscopic analysis conducted by Arenas and colleagues indicated the system consisted of a white dwarf of about 1.2 times as massive as the sun, with an accretion disk, and a companion star with about 20% of the Sun's mass. This second star is most likely a red dwarf. The two stars orbit each other approximately every 3 hours 20 minutes. (Wikipedia)

- Wolf 359

By Klaus Hohmann, http://astrofotografie.hohmann-edv.de/ - Klaus Hohmann, Public Domain, https://commons.wikimedia.org/w/index.php?curid=792444



Leo_constellation_map.png: Torsten Bronger.derivative work: Kxx (talk) - Leo_constellation_map.png, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=10840142

Wolf 359 is a red dwarf star located in the constellation Leo, near the ecliptic. At a distance of approximately 7.9 light years from Earth, it has an apparent magnitude of 13.54 and can only be seen with a large telescope. Wolf 359 is one of the nearest stars to the Sun; only the Alpha Centauri system (including Proxima Centauri), Barnard's Star and the brown dwarfs Luhman 16 and WISE 0855−0714 are known to be closer. Its proximity to Earth has led to its mention in several works of fiction.

Wolf 359 is one of the faintest and lowest-mass stars known. At the light-emitting layer called the photosphere, it has a temperature of about 2,800 K, which is low enough for chemical compounds to form and survive. The absorption lines of compounds such as water and titanium(II) oxide have been observed in the spectrum. The surface has a magnetic field that is stronger than the average magnetic field on the Sun. As a result of magnetic activity caused by convection, Wolf 359 is a flare star that can undergo sudden increases in luminosity for several minutes. These flares emit strong bursts of X-ray and gamma ray radiation that have been observed by space telescopes. Wolf 359 is a relatively young star with an age of less than a billion years. Two planetary companions are suspected but as yet no debris disks have been unmasked.

For those of you who are science fiction fans, Wolf 359 has been used in many books/films/TV/Radio: See: (WIKIPEDIA) Wolf 359 is sometimes confused by sci-fi fans for the star Wolf 336 referenced in the Movie “Arrival” (1996)

June is great for both viewing and imaging. Spend some time outside with your scope. Spring is here.

For now – Keep looking up.

Astro Rambles
Or As Long As I am Confined to Quarters I May As Well Spend Money
by Chuck Dyson

I am hoping against hope that this July 4th will really be our Independence Day and we can actually get back to having regular meetings and outreach programs again; but though I am hoping I ain't holding my breath.

Assuming that we will sometime this year be doing outreach star parties again, I am determined to improve and upgrade my observing equipment for the upcoming season. My trusty old Vixen Porta II mount has been slowly giving up the ghost after only about fifteen years of use. Some of those years were very hard on the mount because it's claimed max weight limit was 20 pounds, it was actually happiest with optical tubes of up to 10 pounds, and I would mount two scopes on it, an 80 mm refractor and a PST solar scope for white light and H-alpha viewing of the sun. In order to get two scopes on the Porta II I had to hang an "L" shaped bracket off of the main bearing and then attach the two scopes to the bracket, this was obviously not a balanced load and stressed the mount to its max.

The Porta II mount had two qualities that endeared it to me. First the elevation and azimuth axis were moved by slow motion knobs and this made it very easy to reposition the object being viewed between people, I actually became quite proficient at the re-centering maneuver and could do it in just three to four seconds . The second thing that I liked about the Porta II is that being a non-powered mount the drift rate effectively set the time that any one person could be at the eyepiece and if the line to view was long I would switch to a higher powered eyepiece and the viewing time got shorter, no long waits here folks.

I do have two GoTo German equatorial mounts that I could use but it seems that we are doing a high percent of our school programs on school nights and in the winter we have about ninety minutes of observing time and in the spring and fall about only an hour of observing before the parents decide that it's time to go. This causes me to question if I want to spend the time and effort to set-up then star align a GoTo system, of course the at least two star alignment exercise will cut into that actual observing experience and then in an hour tear it all down. Time to look for a new Altazimuth mount.

As long as we are upgrading our mount we may as well address another problem that I have encountered when viewing from the school yards. It has come to my attention that even the "dark" school yards are not actually dark and this becomes a great challenge to the average poor little finder scope. I have a varied selection of finder scopes some of which are actually of very good quality. All, however, are defeated by the average school yard light pollution. Not being able to locate any object in the sky except the Moon and Planets with even a good 9X50 finder scope either severely limits what one may look at or means one will spend an insanely long period of time locating a deep sky object by using the main scope at low power as a finder scope. Thus another goal I set for myself was to come up with a finder scope that could possibly work in the school yard environment.

Peter, Paul, and Mary in their song titled **Puff the Magic Dragon** has a line that goes "*Dragons live forever but not so little boys*". In astronomy one easily transforms this line into "tripods live forever but not so equatorial heads" and thus I have acquired a wonderful selection of tripods over the years. Yes, I hate throwing out anything that could be useful. By good fortune one of these tripods is a Meade LXD-75; a wonderful medium duty mount that is still marketed under different names today.

So, my final goal was to find a scope larger than 50 mm diameter that could be used as a finder scope. An altazimuth head with a healthy load capacity that would mount two scopes, a finder and a main, in parallel. And finally, the altazimuth head need to fit onto the LXD-75 tripod that I already owned. Internet here I come.

The first item that I decided to purchase was the finder scope and luck was with me as Orion Telescopes had almost exactly what I was looking for. The Orion GoScope a beginners 80 mm refractor with a focal length of 350mm on a Dobson type mount. The scope itself is on a Vixen type mounting block so it will attach to any system. With the scope, I purchased an Orion Expanse 20 mm eyepiece. This eyepiece has a 66-degree FOV and a 23.5 field stop in it. What this all means is I have a scope the gives me a 17.5 magnification view of the sky and 3.8 degree field of view. There are two ways of calculating your field of view and they both give me the same number on this scope, not bad.

The scope is an ode to plastic but it works and because of the short focal length and the wide FOV of the eyepiece the image that it produces is not the sharpest but acceptable in the center 60% of the view, on the outer 80% of the view the stars look more like bug splats on a car window instead of points of light. The big question: will it work? I took the scope out into the backyard and went after the globular M3 because it is in a section of the sky that doesn't have a lot of guide stars and one needs it find it by guide scope or spend a frustrating amount of time looking for it in the main scope, personal experience. Line up the scope with the supplied red dot finder, sweep the area for about 20 seconds and BINGO! Success and easier than I had hoped. Let's start looking for that mount.

Only the OPT store had altazimuth mounts capable of holding two telescopes in their inventory and only one of them the Losmandy at $995 had the slow motion controls but it came with a tripod that I did not want. Another, the Vixen Castor mount at $219, came without a tripod but no slow motion knobs. My third option, the Explore Scientific Twilight II mount at $499, had a tripod and no slow motion knobs; so, no way to this one. Great I have three options and don't want any of them, is there no hope?

Fortunately shopping on the internet means that products that are not sold in the USA are available. One of those products is the Skywatcher SkyTee-2 altazimuth mount at $333 shipped from the UK. The mount is rated for 15 kg on each side, has slow motion knobs, and can be purchased without a tripod. The mount was ordered with standard shipping, estimated delivery 15 days, and was delivered four days later - very glad that I didn't pay for expedited shipping. Upon unboxing I discovered there was no California prop 65 sticker telling me that the mount could cause cancer and there were no lawyer written disclaimers nor assembly instructions but as assembly was simply bolting on a Vixen style clamp bar and screwing the

counter weight bar into the round hole none were needed and it was refreshing to deal with a manufacturer who assumed that I was smarter than the average pollywog and could work these things out for myself, and I did.

The mount fit perfectly onto my old LXD-75 tripod and after clamping my 80mm finder scope and my 114mm (4.5 inch) refractor onto the head I was ready to go, the clouds on the other hand, had another opinion. Eventually the clouds relented, and I was able to test out the new system.

Over the following weeks I have been able to test the system with three of my refractors; a 114mm/600mm focal length refractor, a 127mm/635mm focal length refractor, and a 152mm/988mm focal length refractor. My testing pattern is always the same. First the system is pointed at the star Arcturus and the two scopes are aligned. This is a little tricky because the FOV in the 80mm finder is about 3.8 degrees with no cross hairs so centering the star is approximate but the low power eyepieces used on all of the refractors yielded over a 2 degree FOV. After a little practice, Arcturus was always in the telescopes FOV when it had been centered in the finder scope.

My first stellar object was always the globular M3 because it is an extended object and has a lower surface brightness than a star, is high up in the sky, and in a guide star poor area. M3 was easily located in the 80mm finder scope on all the nights it was viewed and was always in the main scope eyepiece once centered in the finder. The viewing height of the main scope eyepiece was low but of acceptable height in the 114mm and the 127mm scopes but too low for practicable viewing by the public in the 152mm.

The second target was M13 in Hercules as it is low in the eastern horizon and buried in the haze. Even though there are two great guide stars, Mu and Zeta, near M13 they have not been reliably visible by eye but are discoverable in the finder scope and then a simple search pattern reveals M13 in the finder and then the main scope. As M13 was low in the sky the viewing height of the eyepiece on all three scopes was very acceptable and during one viewing session, with the 152mm scope, the magnification was pushed to 140X and with the slow motion controls I was easily able to keep the globular in the eyepiece for good viewing. Viewing sessions with the 152mm scope have revealed another problem, because of the length of the optical tube my arms can just barley reach the slow motion controls.

In conclusion - is the SkyTee-2 mount a grab-and-go mount? No, rather it is an easy to move and quick to assemble mount. However, because it is big and robust it allows the use of a full size scope as a finder that actually shows objects in the bright urban environment.

Unfortunately although the mount works with my old LXD-75 tripod, the 16 inch column extension that Skywatcher sells for the use of the mount with long barreled refractors is not compatible with the mount, I will be limited to my 127mm refractor for public events. I will be investigating, over the summer, with my 127mm Schmidt-Cassegrain scope the practicality of this type of scope on the mount and considering the purchase of a 152mm Schmidt-Cassegrain.

Because of the excellent design of the slow motion controls, the mount allows the use of moderately high power on objects and thus can be practical for use on planets, and yes, I have gotten up early on several mornings and viewed the planets. They were dead easy to find, no problem to track at the higher powers and quick to recenter for more viewing enjoyment.

Cheers, Chuck

Summer Triangle Corner: Vega
by David Prosper and Vivian White

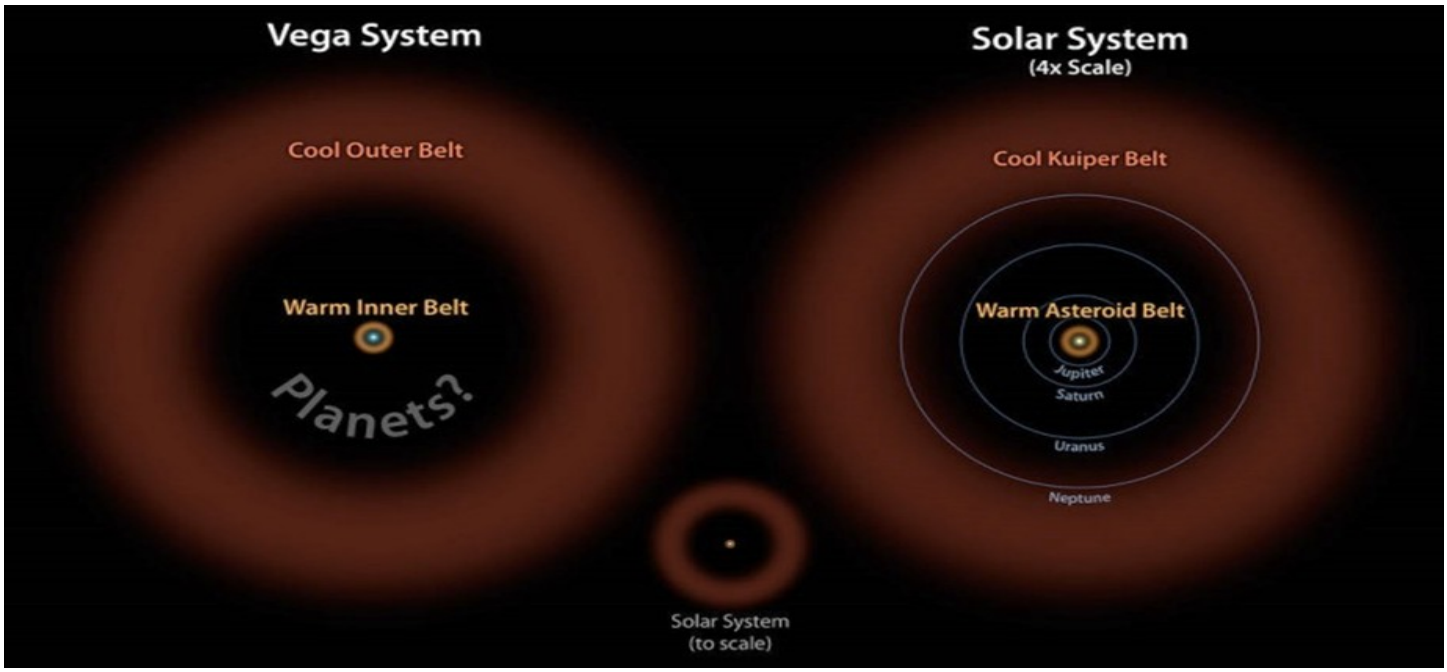
If you live in the Northern Hemisphere and look up during June evenings, you'll see the brilliant star **Vega** shining overhead. Did you know that Vega is one of the most studied stars in our skies? As one of the brightest summer stars, Vega has fascinated astronomers for thousands of years.

Vega is the brightest star in the small Greek constellation of Lyra, the harp. It's also one of the three points of the large "Summer Triangle" asterism, making Vega one of the easiest stars to find for novice stargazers. Ancient humans from 14,000 years ago likely knew Vega for another reason: it was the Earth's northern pole star! Compare Vega's current position with that of the current north star, Polaris, and you can see how much the Earth's tilt changes over thousands of years. This slow movement is called **precession**, and in 12,000 years Vega will return to the northern pole star position.

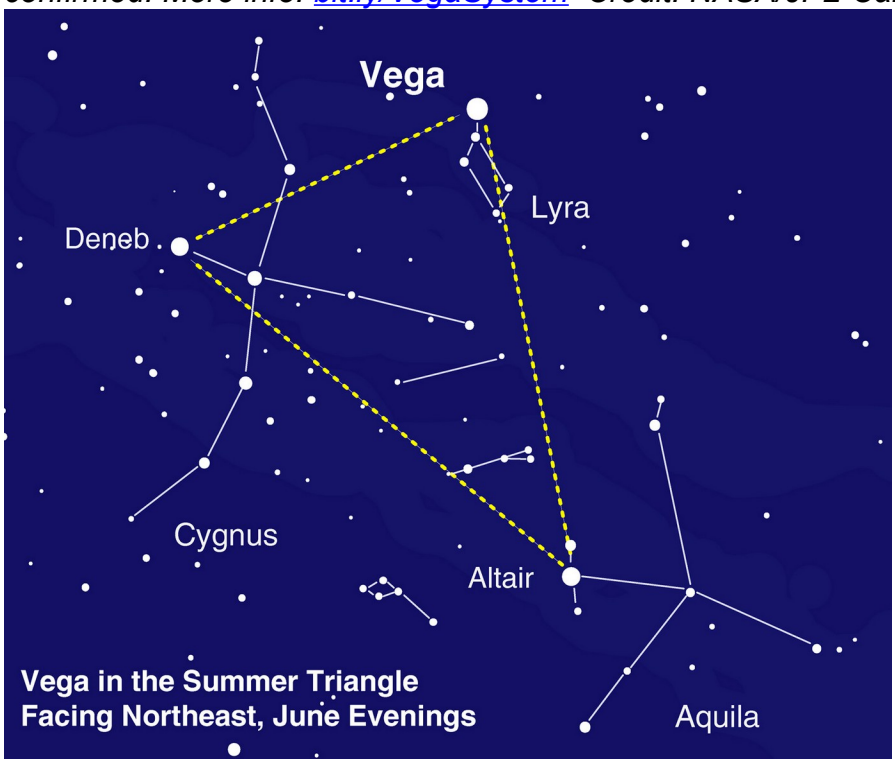
Bright Vega has been observed closely since the beginning of modern astronomy and even helped to set the standard for the current magnitude scale used to categorize the brightness of stars. Polaris and Vega have something else in common, besides being once and future pole stars: their brightness varies over time, making them **variable stars**. Variable stars' light can change for many different reasons. Dust, smaller stars, or even planets may block the light we see from the star. Or the star itself might be unstable with active sunspots, expansions, or eruptions changing its brightness. Most stars are so far away that we only record the change in light, and can't see their surface.

NASA's TESS satellite has ultra-sensitive light sensors primed to look for the tiny dimming of starlight caused by transits of extrasolar planets.Their sensitivity also allowed TESS to observe much smaller pulsations in a certain type of variable star's light than previously observed. These observations **of Delta Scuti** variable stars will help astronomers model their complex interiors and make sense of their distinct, seemingly chaotic, pulsations. This is a major contribution towards the field of astroseismology: the study of stellar interiors via observations of how sound waves "sing" as they travel through stars. The findings may help settle the debate over what kind of variable star Vega is. Find more details on this research, including a sonification demo that lets you "hear" the heartbeat of one of these stars, at: bit.ly/DeltaScutiTESS

Interested in learning more about variable stars? Want to observe their changing brightness? Check out the website for the American Association of Variable Star Observers (AAVSO) at aavso.org. You can also find the latest news about Vega and other fascinating stars at nasa.gov.



Vega possesses two debris fields, similar to our own solar system's asteroid and Kuiper belts. Astronomers continue to hunt for planets orbiting Vega, but as of May 2020 none have been confirmed. More info: bit.ly/VegaSystem Credit: NASA/JPL-Caltech



Can you spot Vega? You may need to look straight up to find it, especially if observing after midnight.

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The TVA is a member club of The Astronomical League.