NIGHTFALL

A PUBLICATION OF THE HUACHUCA ASTRONOMY CLUB

JUNE 2024

WELCOME OUR NEW MEMBERS

Erwin Haynes of Tombstone joined the club at the Kartchner Star Party in May. Douglas Gann of Sonoita also joined in May. Aimee Hodgin and family of Sierra Vista joined at the June Kartchner Star Party. Welcome, we are glad you joined.

KARTCHNER CAVERNS 50TH ANNIVERSARY

It will be 50 years this November since the caverns were discovered by Gary Tenen and Randy Tufts. (read the history here:

https://azstateparks.com/kartchner/explore/park-history).

As part of their celebration (and to highlight astronomy at the park) we will be holding several extra star parties this year. We are scheduling star parties for September 7, October 5 and a date in November to be announced.

PATTERSON OBSERVATORY 20TH ANNIVERSARY

The Patterson Observatory officially opened on September 11, 2004. The observatory is owned by the University South Foundation and operated by HAC volunteers. The foundation is planning an anniversary celebration to be held on the evening of September 5, before the regular September Public Night observing session. If you have any ideas for the celebration or wish to be involved in the planning of this event, please contact Ted Forte.

GETTING THE MOST FROM YOUR CLUB MEMBERSHIP.

You can enhance your astronomy club experience by upping your level of participation. Here are some things to think about:

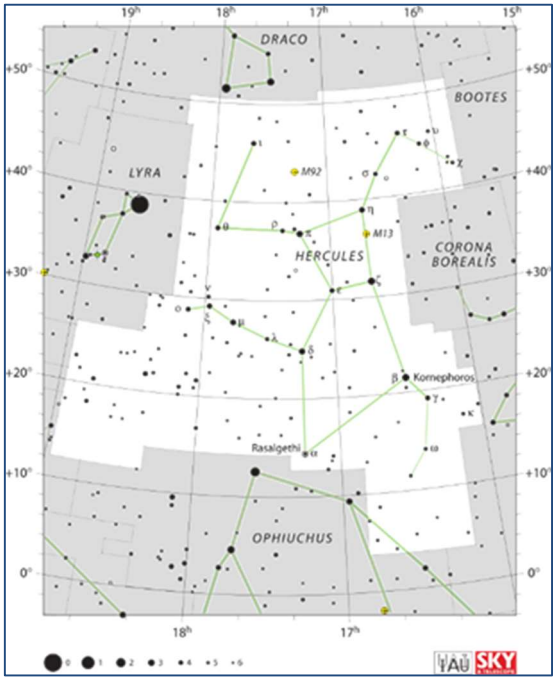
- Join the Hacastro group on groups.io to stay informed and interact with your fellow HAC members. To join send an email to main+subscribe@HACAstro.groups.io
- Attend our monthly meetings. We have exciting guest speakers and the meetings are fun and informative. Come out, show your face and meet your club-mates.
- Become a volunteer at the Patterson Observatory. All HAC members are welcome and encouraged to get more involved with operations at Patterson. Contact Ted Forte
- Do outreach. Outreach is one of the more rewarding activities that amateur astronomers conduct. You don't need to be an expert; you just need to show up and share your enthusiasm for astronomy. HAC typically does 3 to 5 outreach events each month, there's more than enough opportunity to get involved.
- Attend the club star parties. We try to have member star parties as often as possible and do at least two public observing events at Kartchner each year. Come on out – they are fun! Think about hosting your own star party or just invite some club members over to observe with you.
- Check out the observing programs of the Astronomical League. As a HAC member, you are also a league member – the observing programs are one of the most important benefits of league membership. See: https://www.astroleague.org/alphabeticobserving/
- Submit articles for the Nightfall Newsletter.
- If you are on Facebook, participate on our page: https://www.facebook.com/HuachucaAstronomyClub
- Step up and volunteer to serve on the board – either as an officer or member at large.

CHANGE OF NIGHTFALL EDITOR

With this issue, Cindy Shomenta has produced her last newsletter. We thank her for her years of service and welcome Vince Sempronio as our new newsletter editor starting in July . Contact Vince at nightfall@hacastronomy.org

Constellation Exploration by Penny Brondum

Since we did the Virgo, the Virgin last month, let's turn our attention this month to the Strongman of the summer sky, Hercules named after Hercules, the Roman mythological hero which was adapted from the Greek hero Heracles or the Sumerian hero Gilgamesh. Hercules was one of the 48 constellations listed by the second-century astronomer Ptolemy, and it remains one of the 88 modern constellations today. It is the fifth-largest of the modern constellations and is the largest of the 50 which have no stars brighter than apparent magnitude +2.5. It does have several double and binary stars visible in small amateur telescopes. Fifteen stars in Hercules are known to be orbited by extrasolar planets.



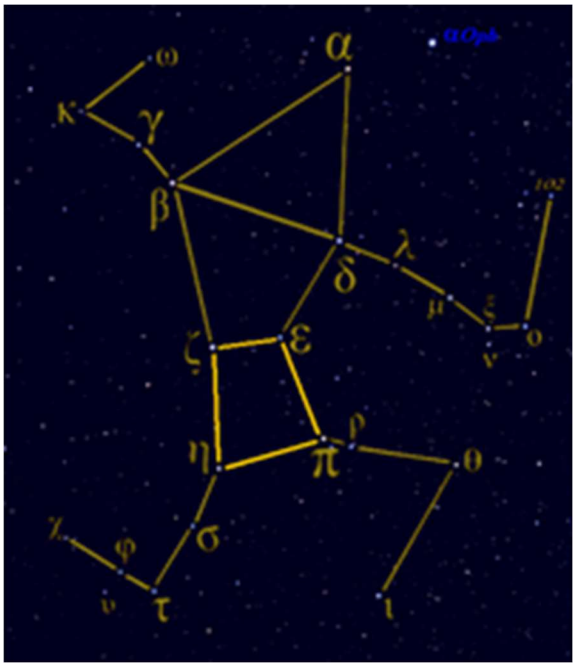
Hercules contains two bright globular clusters: M13, the brightest globular cluster in the northern hemisphere, and M92. It also contains the nearly spherical planetary nebula Abell 39.

M13, visible to both the naked eye and binoculars, is a globular cluster of the 6th magnitude that contains more than 300,000 stars and is 25,200 light-years from Earth. It is also very large, with an apparent diameter of over 0.25 degrees, half the size of the full moon; its physical diameter is more than 100 light-years. Individual stars in M13 are resolvable in a small amateur telescope.

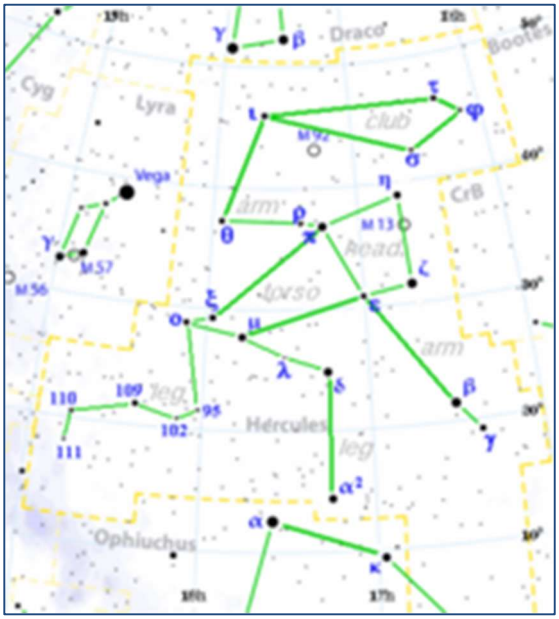
M92 is a globular cluster of magnitude 6.4, 26,000 light-years from earth. It is a Shapley class IV cluster, indicating that it is quite concentrated at the center; it has a very clear nucleus. M92 is visible as a fuzzy star in binoculars, like M13; it is denser and smaller than the more celebrated cluster. Considered, prior to the James Webb Space Telescope recent discoveries, the oldest globular cluster known at 14 billion years of age.

The Hercules–Corona Borealis Great Wall, the largest structure in the universe, is in Hercules.

The traditional visualization imagines alpha Hercules as Hercules's head; its name, Rasalgethi, literally means "head of the kneeling one" in Arabic. Hercules's left hand then points toward Lyra from his shoulder with his left leg is stepping on Draco's head, the dragon/snake who Hercules has vanquished and perpetually gloats over for eternities.



An alternative way to connect the stars of the constellation Hercules, suggested by H.A. Rey in which the "Keystone" becomes Hercules's head.



According to Gavin White, the Greek constellation of Hercules is a distorted version of the Babylonian constellation known as the "Standing Gods" (MUL.DINGIR.GUB.BA.MESH). White argues that this figure was, like the similarly named "Sitting Gods", depicted as a man with a serpent's body instead of legs (the serpent

element now being represented on the Greek star map by the figure of Draco that Hercules crushes beneath his feet).

The earliest Greek references to the constellation do not refer to it as Hercules. They knew it as Engonasin, or “the kneeling one.” It was Eratosthenes who identified the kneeler as Heracles, standing over the dragon that guarded the garden of the Hesperides. Or as a man bent to his task or simply a man “on his knees” and is a conflation of the two Babylonian constellations of the Sitting and Standing Gods.

The story connecting Hercules with the constellation is recounted by Dionysius of Halicarnassus:

On his way back to Mycenae from Iberia having obtained the Cattle of Geryon as his tenth labour Heracles came to Liguria in North-Western Italy where he engaged in battle with two giants, Albion and Bergion or Dercynus. The opponents were strong; Hercules was in a difficult position so he prayed to his father Zeus for help. With the aegis of Zeus, Heracles won the battle. It was this kneeling position of Heracles when praying to his father Zeus that gave the name "the Kneeler" and Hyginus

Hercules is also sometimes associated with Gilgamesh, a Sumerian mythological hero. In Chinese astronomy, the stars that correspond to Hercules are located in two areas: the Purple Forbidden enclosure and the Heavenly Market enclosure. Arab translators of Ptolemy named it in Arabic: 'the player'.

Whether it is Hercules, Gilgamesh or the Kneeler it takes a bit of imagination to see a man upside-down kneeling on the head of a serpent. What is easier to find is the Keystone asterism creating a trapezoidal-shape to begin exploring all that Hercules has to offer. So, before the rains of Monsoon arrive, get out and explore “The Strongman” of the summer sky.

Science at the Patterson May 2024

By Vince Sempronio

Recently, Ted Forte, Tom Kaye, and I did a tune-up on the 20” R/C telescope at the Patterson Observatory. Ted and I cleaned the primary mirror using the distilled water method. This involved tilting the scope to orient the mirror perpendicular to the floor. We then loaded up the bottom of the mirror cell with old towels from home to help absorb any dripping water. The mirror got an initial rinse with distilled water, then a spritz with a VERY dilute soap solution, followed again by many rinses using distilled water. Eventually we were satisfied, and the mirror was free of dust. We used a hair dryer to help clear off any remaining water.

The next step was to collimate the primary mirror. Tom helped as he had prior knowledge, having collimated the scope in the past. To aid the collimation, we made use of the camera I use for occultations. We imaged an out of focus star to do the rough adjustments, eventually doing the final tweaks on an in-focus star. The scope now produces nice diffraction spikes when a star is in focus.

The scope now performs better optically, providing better images for both visual and scientific work.

Occultations with a 20” telescope.

I’ve observed 40 occultations (to date) so far in 2024, some of which were acquired using the 20” at the Patterson Observatory. I’ll highlight a couple of accomplishments.

On the evening of May 14th, the shadow paths of two asteroids intersected over Sierra Vista, including the Patterson Observatory. Shown is the map of one path. The path width is close to the actual diameter of the asteroid, in this case, 36km. The green line is the centerline of the path. The path of an event is very much like the path associated with a Solar eclipse. If you are inside the path, you will see, in this case, an occultation. Unlike a solar eclipse, a far away star is casting a shadow of an asteroid on the ground. We can’t see the shadow, because the light from the star is too dim for our eyes to perceive it. The blue lines on the map represent the predicted width of the shadow. The red lines are error bars which are present when the estimation of the actual path is not considered accurate. The telescope inside the dome is not portable, so only the events with paths that pass directly over the observatory can be observed.

Occultation of (279) Thule

The first event of the evening involved asteroid (279) Thule. Thule is a member of a group of asteroids that orbit near the outer edge of the main asteroid belt and was the first asteroid discovered to have a semi-major axis greater than 4 AU. It was discovered in 1888 in Vienna Austria by Johann Palisa, a prolific asteroid hunter who found 122 in his lifetime. Thule and its orbital companions make up the Thule Dynamic Group and all are in a 4:3 orbital resonance with Jupiter. These asteroids take almost 9 years to orbit the Sun. Thule is quite large at ~125km across.

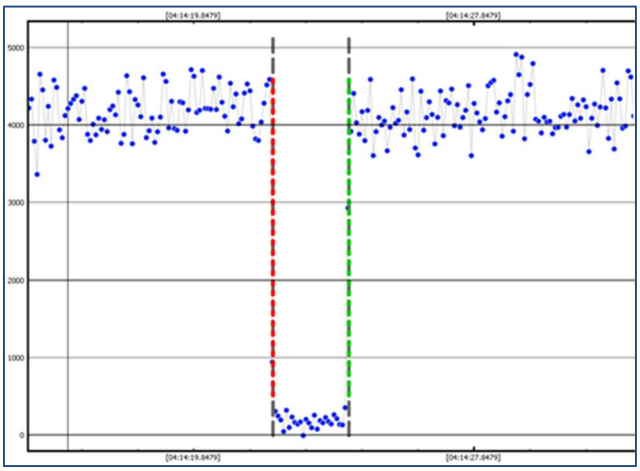
Path of 125km asteroid (279) Thule, 20240515 0414 UT

Keep in mind that when observing occultations, we usually can’t see the asteroid on camera, most are too small and dim to see with the equipment I use. This is a good thing.

When observing occultations, we are interested in the timings of when the asteroid passes in front of a distant star. There are two events, a disappearance and a reappearance. If the asteroid is too bright, the difference in the brightness between the star and the asteroid is reduced, making it difficult to tell when the event occurred.

At the time of the occultation, the magnitude of Thule was (17.1). The magnitude of the star is the critical factor, in this case, the star was magnitude (12.1). 12.1 is an easy target, I routinely observe stars this dim using an 8" telescope. I could have observed this event with my 8" SCT, but since I was going to be using the 20" at the Patterson later in the evening for another event, I decided it would be more convenient to use the 20" for both.

The star of this event (pun intended) was TYC 1390-01300-1. It is in the constellation Cancer at 6,340 light years distant. It is a known spectroscopic binary star. This star is an easy target in the 20" scope and the resulting light curve was one of the best I've ever captured. We measure the quality of light curves by its Signal to Noise Ratio (SNR). The SNR of this event was 13, a very high value for this type of observation. So, what does this light curve represent? The graph has time going from left to right, and the intensity of the star (as recorded by the camera) is on the vertical axis. The intensity is a calculated term and doesn't directly measure the magnitude of the star. For sake of brevity, I'll save the explanation of how the camera works for another time. The blue dots at the top of the screen are the combined light of the star and the asteroid. The graph is only seconds of time of the total event. I usually record for 1 or 2 minutes. At the resolution of the camera, the star and asteroid are basically merged, but when the asteroid passes in front of the star (red vertical line), the light from the star disappears and the only light left is coming from the asteroid or, the background sky brightness. Notice that the blue dots between the red and green lines don't quite get to zero? This tiny difference is the background sky and camera noise. When the asteroid moves out from in front of the star (green line), the light from the star once again is visible and the intensity returns to normal. The vertical wiggles in the intensity of the blue dots are caused by atmospheric effects.



Light curve of (279) Thule, 20240515 0414 UT

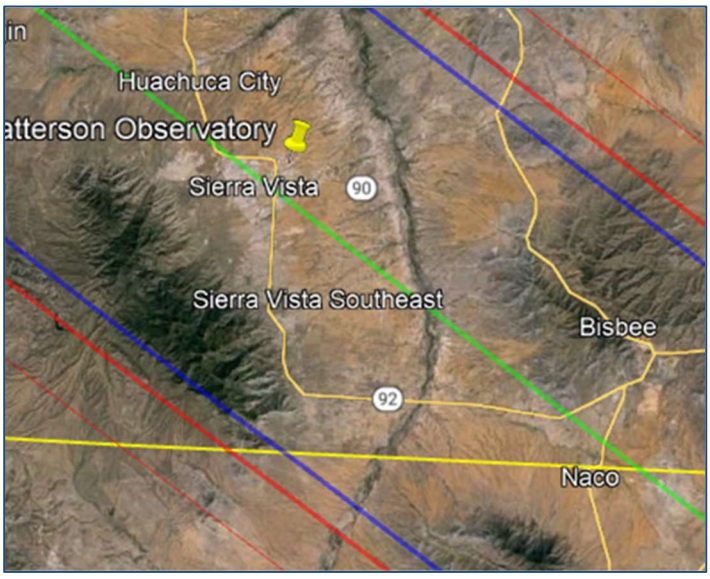
The difference in time between red and green lines is the measured duration of the event, which, in this case was 2.2 seconds. The estimated duration of the event was 5.0 seconds. Why the discrepancy?

Looking at the ground path for Thule, we can see that the Patterson is not close to the center line, in fact, it is a lot closer to the edge of the path. The further from the center line, the shorter the event will be. The path also could have shifted, though not much. The time estimates are not based on the actual shape of the asteroid. Some asteroids are not spheres, they can be elongated, sometimes in multiple axes. The 2.2 second event is well within the limits of estimation.

My observation was not the first of Thule, there have been 4 previous observed occultations involving 10 chords. A chord is one recorded observation. Some events have multiple observers. This is highly desirable as it provides a lot more information than data from a single observation.

Occultation of (2104) Toronto

A couple hours after the Thule event there was an occultation of asteroid (2104) Toronto. The asteroid was discovered in 1963 and is named after the University of Toronto. It was the first asteroid discovered at an observatory in Canada. Its diameter is 36km. It is a main belt asteroid located towards the far side of the main belt, though not as far away as Thule. It is considered a metallic type and rotates every 9 hours.

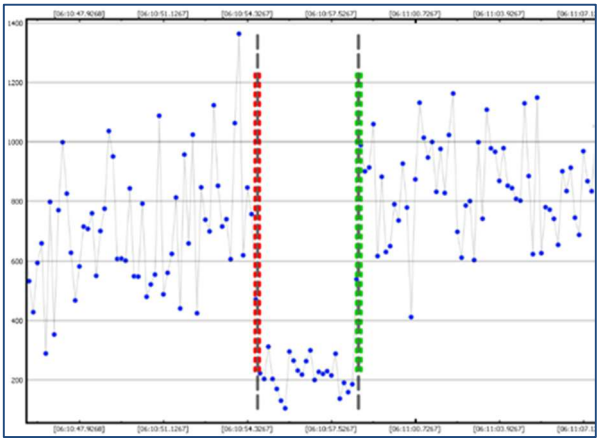


Path of 36km asteroid (2104) Toronto, 20240515 0610 UT

The star is UCA4 351-125486, in Sagittarius, shines at magnitude (13.4). It is ~900 light years away. The absolute magnitude of this star is +6.2, dimmer than our own Sun (+

The event was low in the south-east sky at 15 degrees altitude. This was not an easy event. Our skies are very unstable at low altitudes and being in the east, the star was rising, meaning it was even lower to the horizon when I

attempted to acquire it. Luckily, there were a few brighter (mag 9-11) stars in the field of view. The event was predicted to be 3.7 seconds long. The measured time was 3.6 seconds. The observing location for this event was very close to the center line, as shown on the map. Note the drop in light intensity was a lot less than with the Thule event. The magnitude of the asteroid was 17.1. Even with a shallower drop, it is easy to see where the event is.



Light curve of (2104) Toronto

Two events in one night are not uncommon, even when observing from the same location. My record for this was back in June 2023 when I observed three events near Kartchner State Park. One of those events led to the discovery of a binary star. On the evening of New Year's Eve, 2023, I observed 4 events, though I had to drive around to 4 different locations to do so. What a night!

The Bucket List June 2024

by Vince Sempronio

This column highlights interesting non-seasonal nighttime, and sometimes daytime sky events that the reader may not be aware of and may wish to observe. I'll cover one-off events that are special, rare, or uncommon.

This month, we'll include another feature in this column, the "OBJECT OF THE MONTH". This will not replace the "TERM OF THE MONTH", but I'll include one or the other or sometimes both. I'll highlight a celestial object that I hope you find interesting.

OBJECT OF THE MONTH

Rotating ellipsoidal variables.

This class of close binary variable stars is the topic this month. As an example, we'll discuss the brightest representative in our night sky, the star Spica.

Spica is the brightest star in the constellation Virgo, and the 16th brightest star in the sky, but it isn't a star that most people can point out in the sky. In June, it culminates near 9pm (local time) at the beginning of the month and 8pm near the middle of the month. To find Spica, look south after evening twilight, about 45 degrees above the horizon. Another way to locate Spica is to follow the handle of the big dipper from the bowl and "arc" around to the bright star Arcturus. Continue the arc to "spike" to Spica.

Credit: Prof. Dr. Bilsen Beşergil

Spica is 250 light years away and shines at magnitude 0.97, or does it? Spica is slightly variable, sometimes slipping to magnitude 1.04. But the reason for this variability is one reason that Spica is so interesting. When we observe Spica, we aren't looking at just one star, we are seeing the combined light of two stars. Yes, Spica is a double star, but not just any double star. The two stars are so close to each other that we only know they are there by examining their spectra. The two stars orbit each other every 4 days, separated by less than the distance between our Sun and Mercury. The closeness of the two stars causes their shared gravity to distort the shape of both stars into what is referred to as a rotating ellipsoidal variable. The two stars don't eclipse each other from our perspective, but the distortion of their shapes causes the total light to vary slightly as they orbit each other. An artist representation is shown. Both components are very hot B-type stars, with the larger of the two around 10 times as massive as the sun with a diameter 7 times larger. This component is large enough to become a Type II supernova, and at 250 light years, it is one of the closest stars to earth that will end its existence as a supernova. This isn't expected to happen for at least a million years. The dimmer of the two stars is 4 times the mass of the sun and is 3-4 times the dimeter.

There are many other examples of this type of star, but Spica is by far the brightest.

Worldwide, we are entering a "season" of Spica occultations by the Moon in 2024 and 2025, and fortunately, there is one

occurring next month (July 2024). Stay tuned for more information about this spectacular naked eye event!

IN THE SKY

The planets still elude observations in the evening sky with only Saturn returning to the evening sky by mid- month, though it will still only rise near midnight. Observing near sunrise will offer the best opportunity for planetary enthusiasts.

June 2nd, 4am. The thin crescent moon hangs over the planet Mars, 9 degrees closer to the horizon. Saturn is much further away to the upper right.

June 4th, 5am. Jupiter and Mercury are very close together in the East just before sunrise. Their separation is less than half the moon's width and will make a very nice eyepiece or camera target.

June 20th. This is the date, this year, of the northern solstice. Don't forget to check your backyard Stonehenge replicas for accuracy.

June 22nd. Full Moon. This month's full moon is called the "Strawberry Moon". The name comes from the time of year that corresponds to the harvest time, in the northern hemisphere of fruits like strawberries. Of course, the names of Full Moons varies from culture to culture around the world.

NASA Night Sky Notes May 2024

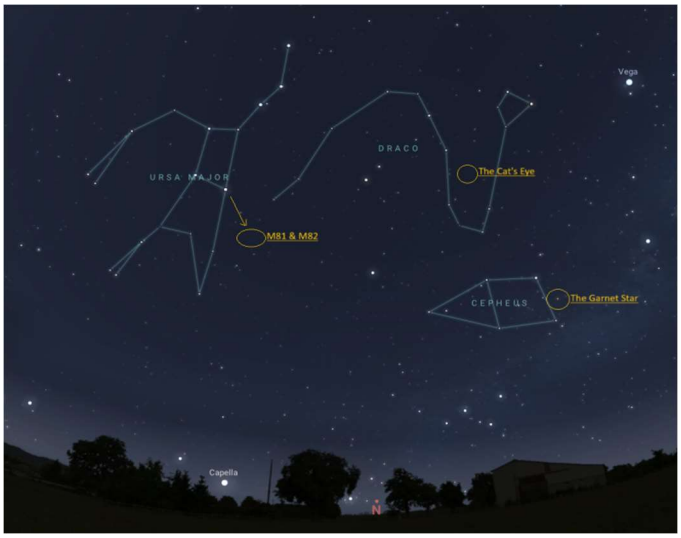
This article is distributed by NASA Night Sky Network

The Night Sky Network program supports astronomy clubs across the USA dedicated to astronomy outreach. Visit nightsky.jpl.nasa.org to find local clubs, events, and more!

Constant Companions: Circumpolar Constellations, Part III

By Kat Troche

In our final installment of the stars around the North Star, we look ahead to the summer months, where depending on your latitude, the items in these circumpolar constellations are nice and high. Today, we'll discuss Cepheus, Draco, and Ursa Major. These objects can all be spotted with a medium to large-sized telescope under dark skies.



From left to right: Ursa Major, Draco, and Cepheus. Credit: Stellarium Web.

- **Herschel's Garnet Star:** Mu Cephei is a deep-red hypergiant known as The Garnet Star, or Erakis. While the star is not part of the constellation pattern, it sits within the constellation boundary of Cepheus, and is more than 1,000 times the size of our Sun. Like its neighbor Delta Cephei, this star is variable, but is not a reliable Cepheid variable. Rather, its brightness can vary anywhere between 3.4 to 5.1 in visible magnitude, over the course of 2-12 years.

This composite of data from NASA's Chandra X-ray Observatory and Hubble Space Telescope gives astronomers a new look for NGC 6543, better known as the Cat's Eye nebula. This planetary nebula represents a phase of stellar evolution that our sun may well experience several billion years from now. Credit: X-ray: NASA/CXC/SAO; Optical: NASA/STScI

- **The Cat's Eye Nebula:** Labeled a planetary nebula, there are no planets to be found at the center of this object. Observations taken with NASA's Chandra X-

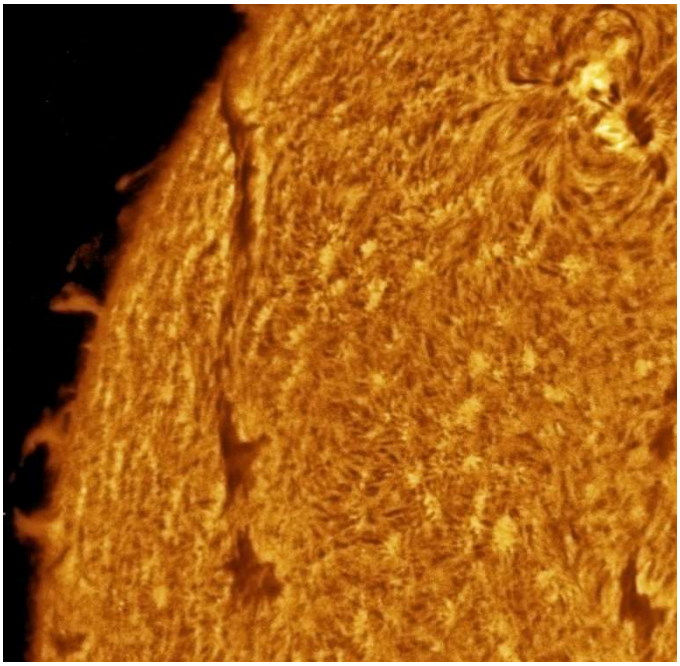
ray Observatory and Hubble Space Telescopes give astronomers a better understanding of this complex, potential binary star, and how its core ejected enough mass to produce the rings of dust. When searching for this object, look towards the 'belly' of Draco with a medium-sized telescope.

- **Bode's Galaxy and the Cigar Galaxy:** Using the arrow on the star map, look diagonal from the star Dubhe in Ursa Major. There you will find Bode's Galaxy (Messier 81) and the Cigar Galaxy (Messier 82). Sometimes referred to as Bode's Nebula, these two galaxies can be spotted with a small to medium-sized telescope. Bode's Galaxy is a classic spiral shape, similar to our own Milky Way galaxy and our neighbor, Andromeda. The Cigar Galaxy, however, is known as a starburst galaxy type, known to have a high star formation rate and incredible shapes. This image composite from 2006 combines the power of three great observatories: the Hubble Space Telescope imaged hydrogen in orange, and visible light in yellow green; Chandra X-Ray Observatory portrayed X-ray in blue; Spitzer Space Telescope captured infrared light in red.

Up next, we celebrate the solstice with our upcoming mid-month article on the Night Sky Network page through NASA's website!

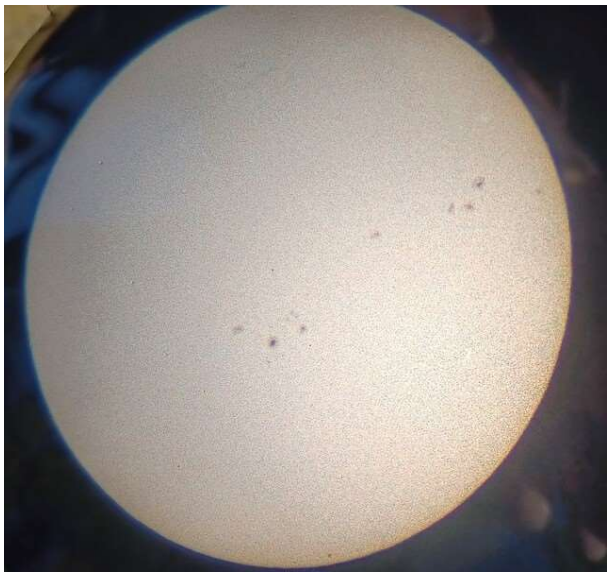
NCG 4654 by Glen Sanner

M101 by Michael Borland



Solar Prominence by Max Mirot

Pictures from HAC Astro



Sunspots by Karen Madtes

NCG 660 by Glen Sanner

Comet A3 Tsuchinshan-ATLAS by Rik Hill

Supernova 2024gy in NGC 4216 by Rik Hill

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HAC Jun-Jul Calendar of Events

SU	MO	TU	WE	TH	FR	SA
2 June	**3**	**4**	**5**	**6** 6:38 AM	**7**	**8** Solar SaturdayS.V. Library 10 AM
9	**10**	**11**	**12**	**13** 11:18 PM Public Night at Patterson 8:00 PM	**14**	**15**
16	**17** Italian Exchange Students 8pm	**18**	**29**	**20** Patterson Open House for Bus at Twilight 5-7 PM	**21** 7:08 PM HAC Meeting Room A102 Downtown 7PM	**22**
23	**24**	**25**	**26**	**27** School Field Trip at Patterson, 9-11 AM	**28** 3:53 PM Italian Exchange Students 8PM	**29**
30	**1 July**	**2**	**3**	**4** 	**5** 3:57 PM Ceres Opposition	**6**
7	**8**	**9**	**10**	**11**	**12**	**13** 3:49 PM
14	**15**	**16**	**17**	**18**	**19** HAC Meeting Room A102 Downtown 7PM	**20**
21 3:17 AM	**22**	**23** Pluto Opposition	**24**	**25**	**26**	**27** 7:52 PM
28 Delta Aquariid meteors	**29** Delta Aquariid meteors	**30** Delta Aquariid meteors	**31**	**Aug 1**	**2**	Huachuca Astronomy Club of Southeastern Arizona

All times local MST
Join HacAstro to keep up to date with all of the Huachuca Astronomy Club events
Send an email to: HACAstro+subscribe@groups.io