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The Celestial Mechanic

The Official Newsletter of the Astronomy Associates of Lawrence

Coming Events

Monthly Meeting
No July Meeting
Baker Wetlands Discovery Center

Public Observing
No July Observing
Baker Wetlands Discovery Center

Club Officers
President
Rick Heschmeyer email

AICOR
William Winkler email

NSN Coordinator
Howard Edin email

Faculty Advisor
Dr. Jennifer Delgado email.

Newsletter Editor
Chuck Wehner email

Inside This Issue

Report From the Officers

By Rick Heschmeyer

Welcome to Summer! The summer solstice is behind us and hot temperatures have arrived.

Our first City Band Concert observing session in South Park, on May 31, had to be cancelled as the concert was moved indoors due to rain. Our next session on June 14 was a success, but with limited attendance. Our third session was cancelled again, this time due to heat on June 28.

Our final City Band Concert session in South Park for 2023 will take place on July 12, weather permitting.

Our regular monthly club meeting schedule will begin again on Sunday, August 27 at Baker Wetlands Discovery Center. Meeting will start at 7 PM, observing will start 8 PM.

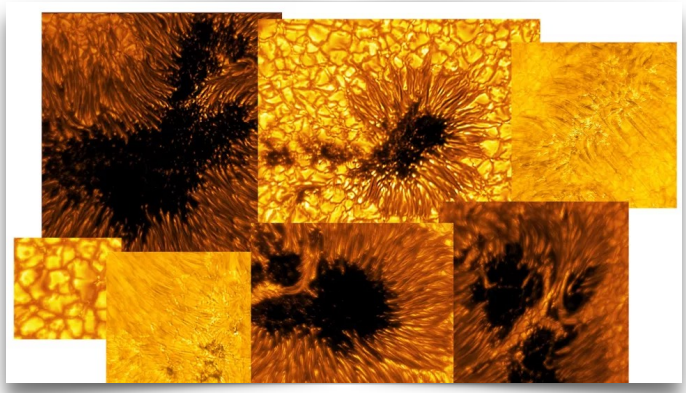
Hope to see everyone soon, and hope that the remainder of your summer is enjoyable.

Keep looking up!

See amazing new sun photos from the world's largest solar telescope

By Sharmila Kuthunur
SPACE.COM, MAY 24, 2023

The images capture rare views of decaying sunspots.

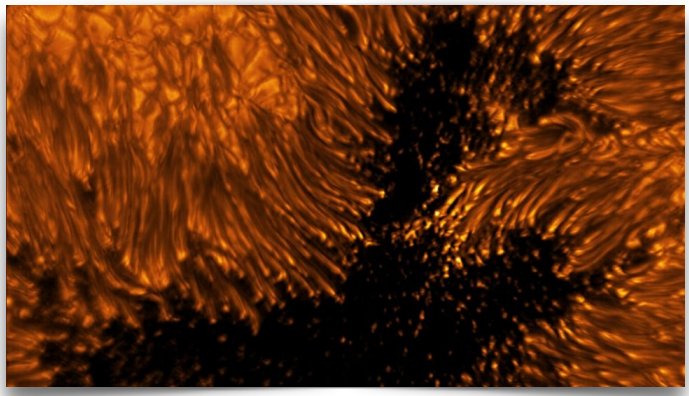


This mosaic of new solar images produced by the Inouye Solar Telescope was released on May 19, 2023. The mosaic previews solar data taken during the telescope's first year of operations during its commissioning phase. Images include sunspots and quiet-sun features.

The world's largest solar telescope has captured fine features on the sun in remarkable detail, including rare glimpses of decaying sunspots.

Perched atop a mountain on the Hawaiian island of Maui, the Daniel K. Inouye Solar Telescope (DKIST) has been eyeing the sun for the past year, collecting high-resolution data about the activity, or lack thereof, in the sun's three-layered atmosphere. Using this data, scientists hope to answer some of the biggest questions about the sun, like why its outer atmosphere, or corona, is much hotter than its visible surface and how its magnetic fields abruptly reshape and blast out powerful jets of plasma from the solar atmosphere.

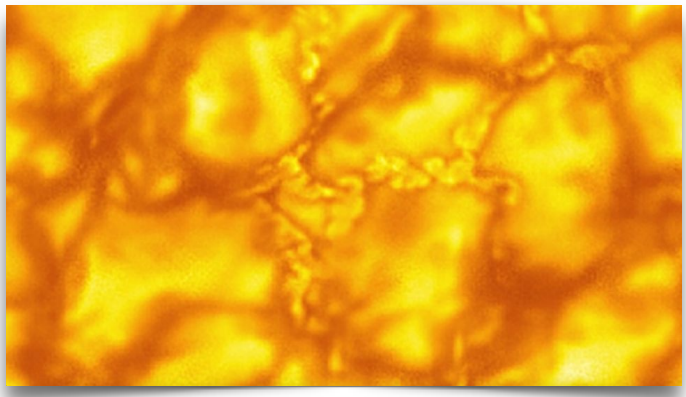
A newly released DKIST mosaic features granular views of Earth-size sunspots on the "sun's surface," which is really its lowest atmospheric layer called the photosphere. Sunspots are dark, relatively cool patches where strong magnetic fields reside, betraying the homes of future flares and disruptive coronal mass ejections.



This image by the Daniel K. Inouye Solar Telescope reveals the fine structures of a sunspot in the photosphere. Within the dark, central area of the sunspot's umbra, small-scale bright dots, known as umbral dots, are seen. The elongated structures surrounding the umbra are visible as bright-headed strands known as penumbral filaments.

Such spots have dark central regions known as umbra where magnetic fields are the strongest. These sunspot centers are surrounded by elongated filamentary regions called penumbra, which are seen in the new images as "bright-headed strands," DKIST team members wrote in an image description published on Friday (May 19).

To capture these images, DKIST used a powerful camera called the Visible-Broadband Imager, which was the first instrument to come online when the telescope became operational and is capable of clicking high-resolution images of the photosphere and the chromosphere. The telescope captured countless "dark, fine threads" in the chromosphere, which are a result of abundant magnetic field activity from below, scientists say.



In this image by the Daniel K. Inouye Solar Telescope, the fine structure of the quiet sun is observed at its surface or photosphere. Heating plasma rises in the bright, convective "bubbles" (granules), then cools and falls into the dark, intergranular lanes.

Sunspots do not exist forever; they last for roughly a week and grow in number and shrink as the sun

progresses through its 11-year activity cycle. The latest DKIST images show a sunspot that "will eventually break apart," revealed by a light bridge stretching across a sunspot's umbra.

Numerous umbral fragments are seen near another sunspot, whose presence reveals "a sunspot that's lost its penumbra," DKIST team members wrote in the image description. "It is extraordinarily rare to capture the process of a penumbra forming or decaying." ☀

NASA's Hubble Hunts for Intermediate-Sized Black Hole Close to Home

Hubblesite, may 23, 2023

A Dark Central Mass is Lurking at the Hub of a Glittering Stellar Island

Gravitational traps in space, black holes, come in different sizes. Or more correctly, different masses, because they are all infinitely small. The first black hole ever discovered, in 1971, weighed in at 21 times our Sun's mass. It was formed by the explosion and collapse of a star. Examples of a completely different class of black hole were identified in the 1960s-1970s. They weighed in at millions to billions of times our Sun's mass. Like all supermassive black holes, those monsters dwell in the center of major galaxies.

So, black holes can be super-big or super-small. The missing link is an intermediate-mass black hole, weighing roughly 100 to 1,000 times our Sun's mass. A handful have been found in other galaxies. Perhaps they are on the road to growing into supermassive black holes.

The cores of globular star clusters are hunting grounds for intermediate-mass black holes. They are smaller than galaxies and should have correspondingly smaller black holes. Over 150 of these snow-globe-shaped collections of hundreds of thousands of stars orbit our Milky Way galaxy, like artificial satellites whirling around Earth. Searches for intermediate-mass back holes in these clusters have been elusive. The suspected central black hole can't be directly observed, of course. Astronomers gather circumstantial evidence by watching stars swarming around the black hole, like bees around a hive. Based on their speeds, the invisible central mass can be calculated using straightforward Newtonian laws of physics.

Tracking the stars is meticulous work that's cut out for the Hubble Space Telescope's sharp resolution and longevity. Astronomers looking through over a decade of Hubble observations of the nearby globular star cluster Messier 4 calculated there is a very dense central object of about 800 solar masses. It is so compact, the observations tend to rule out alternative theories as to what's happening in the heart of the cluster.

Astronomers using NASA's Hubble Space Telescope have come up with what they say is some of their best evidence yet for the presence of a rare class of "intermediate-sized" black hole that may be lurking in the heart of the closest globular star cluster to Earth, located 6,000 light-years away.

Like intense gravitational potholes in the fabric of space, virtually all black holes seem to come in two sizes: small and humongous. It's estimated that our galaxy is littered with 100 million small black holes (several times the mass of our Sun) created from exploded stars. The universe at large is flooded with supermassive black holes, weighing millions or billions of times our Sun’s mass and found in the centers of galaxies.

A long-sought missing link is an intermediate-mass black hole, weighing in somewhere between 100 and 100,000 solar masses. How would they form, where would they hang out, and why do they seem to be so rare?

Astronomers have through a variety of observational techniques. Two of the best candidates — 3XMM J215022.4−055108 , which Hubble helped discover in 2020, and HLX-1, identified in 2009, reside in dense star clusters in the outskirts of other galaxies. Each of these possible black holes has the mass of tens of thousands of suns, and may have once been at the centers of dwarf galaxies. NASA's Chandra X-ray observatory has also helped make many possible intermediate black hole discoveries, including a large sample in 2018.

Looking much closer to home, there have been a number of suspected intermediate-mass black holes detected in dense globular star clusters orbiting our Milky Way galaxy. For example, in 2008, Hubble astronomers announced the suspected presence of an intermediate-mass black hole in the globular cluster Omega Centauri. For a number of reasons, including the need for more data, these and other intermediate-mass black hole findings still remain inconclusive and do not rule out alternative theories.

Hubble's unique capabilities have now been used to zero in on the core of the globular star cluster Messier 4 (M4) to go black-hole hunting with higher precision than in previous searches. "You can't do this kind of science without Hubble," said Eduardo Vitral of the Space Telescope Science Institute in Baltimore, Maryland, lead author on a paper to be published in the Monthly Notices of the Royal Astronomical Society.

Vitral's team has detected a possible intermediate-mass black hole of roughly 800 solar masses. The suspected object can't be seen, but its mass is calculated by studying the motion of stars caught in its gravitational field, like bees swarming around a hive. Measuring their motion takes time, and a lot of precision. This is where Hubble accomplishes what no other present-day telescope can do. Astronomers looked at 12 years' worth of M4 observations from Hubble and resolved pinpoint stars.

His team estimates that the black hole in M4 could be as much as 800 times our Sun's mass. Hubble's data tend to rule out alternative theories for this object, such as a compact central cluster of unresolved stellar remnants like neutron stars, or smaller black holes swirling around each other.

"We have good confidence that we have a very tiny region with a lot of concentrated mass. It's about three times smaller than the densest dark mass that we had found before in other globular clusters," said Vitral. "The region is more compact than what we can reproduce with numerical simulations when we take into account a collection of black holes, neutron stars, and white dwarfs segregated at the cluster's center. They are not able to form such a compact concentration of mass."

A grouping of close-knit objects would be dynamically unstable. If the object isn't a single intermediate-mass black hole, it would require an estimated 40 smaller black holes crammed into a space only one-tenth of a light-year across to produce the observed stellar motions. The consequences are that they would merge and/or be ejected in a game of interstellar pinball.

"We measure the motions of stars and their positions, and we apply physical models that try to reproduce these motions. We end up with a measurement of a dark mass extension in the cluster's center," said Vitral. "The closer to the central mass, more randomly the stars are moving. And, the greater the central mass, the faster these stellar velocities."

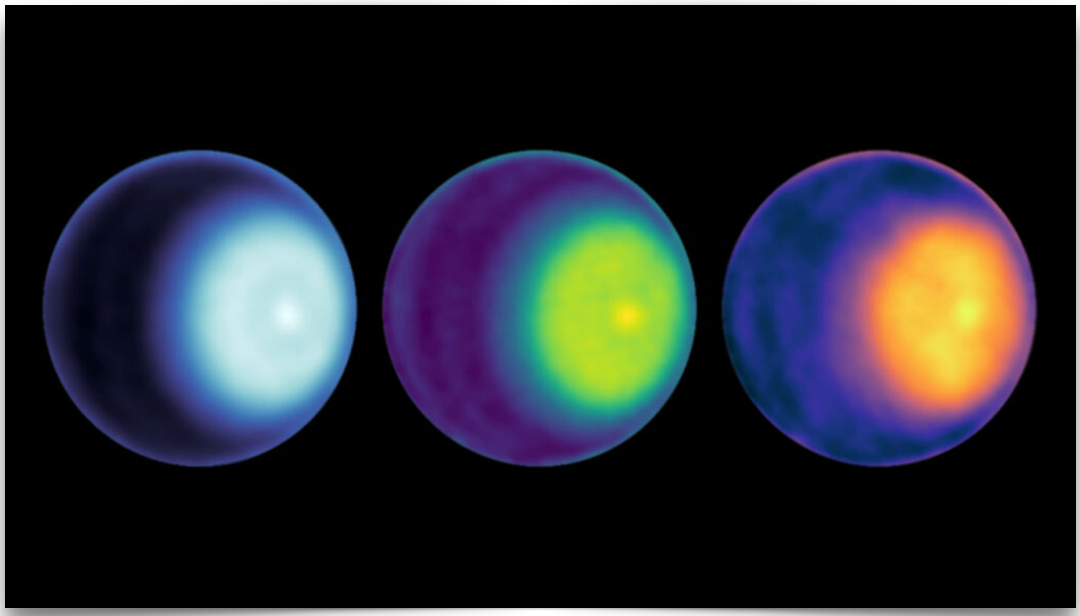
Because intermediate-mass black holes in globular clusters have been so elusive, Vitral cautions, "While we cannot completely affirm that it is a central point of gravity, we can show that it is very small. It's too tiny for us to be able to explain other than it being a single black hole. Alternatively, there might be a stellar mechanism we simply don't know about, at least within current physics."

The Hubble Space Telescope is a project of international cooperation between NASA and ESA. NASA's Goddard Space Flight Center in Greenbelt, Maryland, manages the telescope. The Space Telescope Science Institute (STScI) in Baltimore, Maryland, conducts Hubble and Webb science operations. STScI is operated for NASA by the Association of Universities for Research in Astronomy, in Washington, D.C. ☀

A cyclone has been spotted swirling over Uranus' north pole for the first time

The ice giant joins most other solar system planets, which have wild weather at their poles

By Allison Gasparini
Sciencenews, June 12, 2023



A cyclone at the north pole of Uranus appears as a bright spot in these false-color images of the planet taken at three different wavelengths of radio waves.

Though it looks like a smooth, solid, pale blue orb, there's more going on beneath the clouds of Uranus than meets the eye.

A polar cyclone has been spotted at the planet's north pole, researchers report in the May 28 *Geophysical Research Letters*. Observed with radio telescopes, the find is the first direct evidence of a cyclone on Uranus. A previous spacecraft flyby hinted at a similar storm at the planet's south pole.

"It's really exciting to see this polar structure come into view," says Michael Roman, a planetary scientist at the University of Leicester in England who was not involved with the research. The observations "show a rather unique structure that we simply have never been able to study before."

In 1986, NASA's Voyager 2 spacecraft revealed winds at the center of Uranus' south pole were moving faster than those in neighboring areas and were rotating. This evidence pointed to something dynamic like a cyclone occurring at the pole. But the spacecraft's instruments weren't sensitive enough to confirm the storm.

In recent years, as the north pole of Uranus turned more toward Earth, scientists were able to probe the other side of the ice giant, where they spotted similar hints of a swirling storm. Using the Very Large Array radio observatory in New Mexico, planetary scientist Alex Akins and colleagues probed the temperature under the clouds for more atmospheric clues. "What we saw with the VLA was kind of the last piece of [evidence]," says Akins, of the Jet Propulsion Laboratory in Pasadena, Calif.

New thermal emission observations from 2021 and 2022 show a spot on the north pole where the gas beneath the clouds is warmer and drier than its surroundings, suggesting the presence of a low-pressure region in the midst of those spinning winds. "These contrasts look similar to what we see in hurricanes on Earth," Akins says.

Excluding Mercury, all the planets in our solar system have now been observed to host some kind of swirling air mass at their poles (*SN: 10/14/08*).

Akins plans to continue to observe the cyclone to see how it changes. Previous observations from 2015 suggest it is growing stronger. Researchers wouldn't expect Uranus' atmospheric circulation to change on such a relatively short timescale, Akins says, so a continued strengthening of the storm would suggest there's more to learn about how the planet's atmosphere works.

In 2022, experts brought together by the National Academies of Sciences, Engineering, and Medicine recommended NASA send a probe to Uranus (*SN: 4/20/22*). "The more we can learn about Uranus as we begin to plan a mission," Roman says, "the better we can focus our planning for that mission." ☀

Key building block for life found at Saturn's moon Enceladus

SwRI helped find evidence for phosphorus in the liquid water ocean beneath the moon's icy surface

SCIENCENEWS, JUNE 14, 2023

"In 2020 (published in 2022), we used geochemical modeling to predict that phosphorus should be abundant in Enceladus' ocean," said Glein, a leading expert in extraterrestrial oceanography. He is a co-author of a paper in the journal Nature describing this research. "Now, we have found abundant phosphorus in plume ice samples spraying out of the subsurface ocean."

The Cassini spacecraft discovered Enceladus' subsurface liquid water and analyzed samples in a plume of ice grains and gases erupting into space from cracks in the moon's icy surface. Analysis of a class of salt-rich ice grains by Cassini's Cosmic Dust Analyzer showed the presence of sodium phosphates. The team's observational results, together with laboratory analogue experiments, suggest that phosphorus is readily available in Enceladus' ocean as phosphates.

Phosphorus in the form of phosphates is vital for all life on Earth. It is essential for the creation of DNA and RNA, energy-carrying molecules, cell membranes, bones and teeth in people and animals, and even the sea's microbiome of plankton. Life as we know it is simply not possible without phosphates.

"We found phosphate concentrations at least 100 times higher in the moon's plume-forming ocean waters than in Earth's oceans," Glein said. "Using a model to predict the presence of phosphate is one thing, but actually finding the evidence for phosphate is incredibly exciting. This is a stunning result for astrobiology and a major step forward in the search for life beyond Earth."

One of the most profound discoveries in planetary science over the past 25 years is that worlds with oceans beneath a surface layer of ice are common in our solar system. Such worlds include the icy satellites of the giant planets, such as Europa, Titan and Enceladus, as well as more distant bodies like Pluto. Worlds like Earth with surface oceans must reside within a narrow range of distances from their host stars to maintain the temperatures that support surface liquid water. Interior ocean worlds, however, can occur over a much wider range of distances, greatly expanding the number of habitable worlds likely to exist across the galaxy.

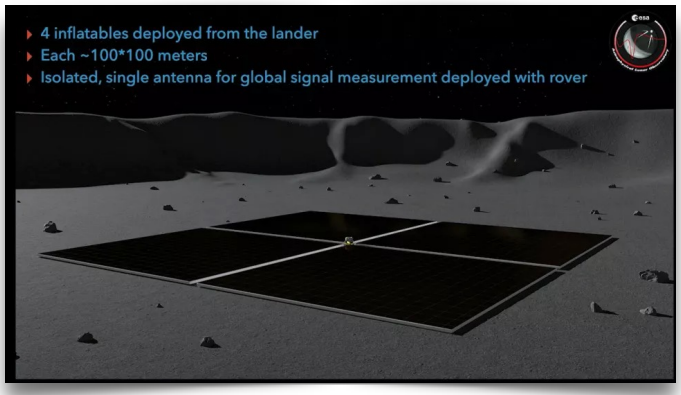
"Geochemical experiments and modeling demonstrate that such high phosphate concentrations result from enhanced phosphate mineral solubility, in Enceladus and possibly other icy ocean worlds in the solar system beyond Jupiter," Glein said. "With this finding, the ocean of Enceladus is now known to satisfy what is generally considered to be the strictest requirement for life. The next step is clear -- we need to go back to Enceladus to see if the habitable ocean is actually inhabited." ☀

Inflatable moon telescope could peer into universe's Dark Ages

By Tereza Pultarova

SPACE.COM, JUNE 16, 2023

'It's like an inflatable mattress on the moon.'



Dutch astronomer Marc Klein Wolt presented the concept at the Astronomy from the Moon conference in London earlier this year.

European scientists are developing an inflatable radio telescope concept that could do groundbreaking science on the moon.

The idea, based on a recent feasibility study by engineers at the European Space Agency (ESA), proposes an array of radio antennas printed on the superlight space-blanket material kapton that would travel to the moon folded inside the planned

European Large Logistics Lander, also known as Argonaut.

"You fold up the system, then you push gas into it and you inflate it. It's like an inflatable mattress on the moon," Marc Klein Wolt, a radio astronomer at Radboud University in Nijmegen, the Netherlands, who leads the ESA Astrophysical Lunar Observatory science team, said at the Astronomy from the Moon conference in London earlier this year.

Astronomers are interested in building a radio telescope on the far side of the moon, as the region is free of the radio noise generated by technology on Earth. Unlike Earth, the moon has no atmosphere that would absorb radio waves, which makes it a convenient place for their detection. In addition to that, during the two-week lunar night, the far side of the moon is also protected from the radio clatter of the sun. All these factors combined make the moon "the most radio-quiet place in the solar system," Klein Wolt said.

A telescope placed in this region would therefore be able to detect signals that cannot be studied from Earth's surface. And some of these signals are rather precious, as they could allow astronomers to peek into the first few hundred million years in the life of the universe before the first stars and galaxies began to form.

The type of signal the lunar telescope would look for is what astronomers call the 21 centimeter emission line produced by atomic hydrogen, which permeated the universe in the first hundreds of millions of years after the Big Bang. The radiation that hydrogen atoms emit is initially in the microwave range of the electromagnetic spectrum, but since astronomers would be searching for it in the farthest reaches of the universe, they would be looking for hard-to-observe long radio waves. That's because the redshift effect caused by the accelerating expansion of the universe has stretched those microwaves before they reach us.

"To look for this type of radiation, you need to go to the far side of the moon so that you block the radiation that we produce ourselves and you have no atmosphere," Klein Wolt said. "Then you can map the hydrogen and trace it as it forms the first structures in the universe. You can look at different redshifts and make maps of the universe at certain moments in time and see the whole thing evolve."

Astronomers call this mysterious period in the history of the universe the Dark Ages and the Cosmic Dawn. Not even the famed James Webb Space Telescope, which has proved its powers in observing the most ancient galaxies, can see that far back.

A telescope on the far side of the moon is therefore on the list of the potential next big things in astronomy that the world's space agencies are currently considering. But such a project poses many challenges. First of all, technology doesn't exist yet that would enable humans to efficiently transport tens or hundreds of radio antennas to the moon.

The ESA feasibility study therefore analyzed how the Argonaut lunar lander, currently expected to make its debut moon visit in about 2030, could be used to deploy such an array.

With a carrying capacity of 1.5 metric tonnes (1.67 tons), Argonaut is designed to fit into the fairing of Europe's delayed heavy-lift rocket Ariane 6, which might perform its debut flight later this year. The study found that the Argonaut could comfortably deliver an array of 16 standard radio antennas to the moon in one go, but Klein Wolt said that would not be enough to provide the sensitivity and resolution needed to study the Dark Ages in sufficient detail. Hence the attempt to develop an inflatable array that could comprise many more antennas at a much lower mass.

"We could think about having the electronics on the other side [of the antenna] printed as well; we can even think about having solar panels printed in between the large open spaces," Klein Wolt said. "So then we have one deployment, and it becomes rather big. We have 32 by 32 elements, maybe even bigger, and we use the lander as the central unit, so everything is connected there to the lander."

The European team is currently working on antenna prototypes that could be tested directly on the moon in the future to help scientists understand how the dusty lunar environment affects their performance.

"We have several options of building prototypes and testing them," Klein Wolt said. "That's what we are working on today. It doesn't have to be [tested] on the far side; it could be a nearside mission, like the Apollo missions. There are plenty of options that we can explore."

There are other, more modest, nearer-term plans for astronomical observations from the moon's surface. Chinese scientists, for example, envision a mini-constellation of satellites orbiting the moon's equator, making radio measurements on the far side and sending data to Earth from the planet-facing side. They say they might be able to launch that mission in 2026. The NASA-led Lunar Surface Electromagnetics Experiment-Night (LuSEE-Night) pathfinder mission might make the first crude measurements of the Dark Ages signal from the lunar surface even a little earlier, in 2025. ☀

Look Up in the Sky - It's a Bird

By Theresa Summer
NIGHTSKY, JUNE 2023

Bird constellations abound in the night sky, including **Cygnus**, the majestic swan. Easy to find with its dazzling stars, it is one of the few constellations that look like its namesake and it is full of treasures. Visible in the Northern Hemisphere all summer long, there's so much to see and even some things that can't be seen. To locate Cygnus, start with the brightest star, **Deneb**, also the northeastern most and dimmest star of the Summer Triangle. The Summer Triangle is made up of three bright stars from three different constellations – read more about it in the September 2022 issue of Night Sky Notes. "Deneb'' is an Arabic word meaning the tail. Then travel into the triangle until you see the star **Albireo**, sometimes called the "beak star" in the center of the summer triangle. Stretching out perpendicular from this line are two stars that mark the crossbar, or the wings, and there are also faint stars that extend the swan's wings.

From light-polluted skies, you may only see the brightest stars, sometimes called the Northern Cross. In a darker sky, the line of stars marking the neck of the swan travels along the band of the **Milky Way**. A pair of binoculars will resolve many stars along that path, including a sparkling open cluster of stars designated **Messier 29**, found just south of the swan's torso star. This grouping of young stars may appear to have a reddish hue due to nearby excited gas.

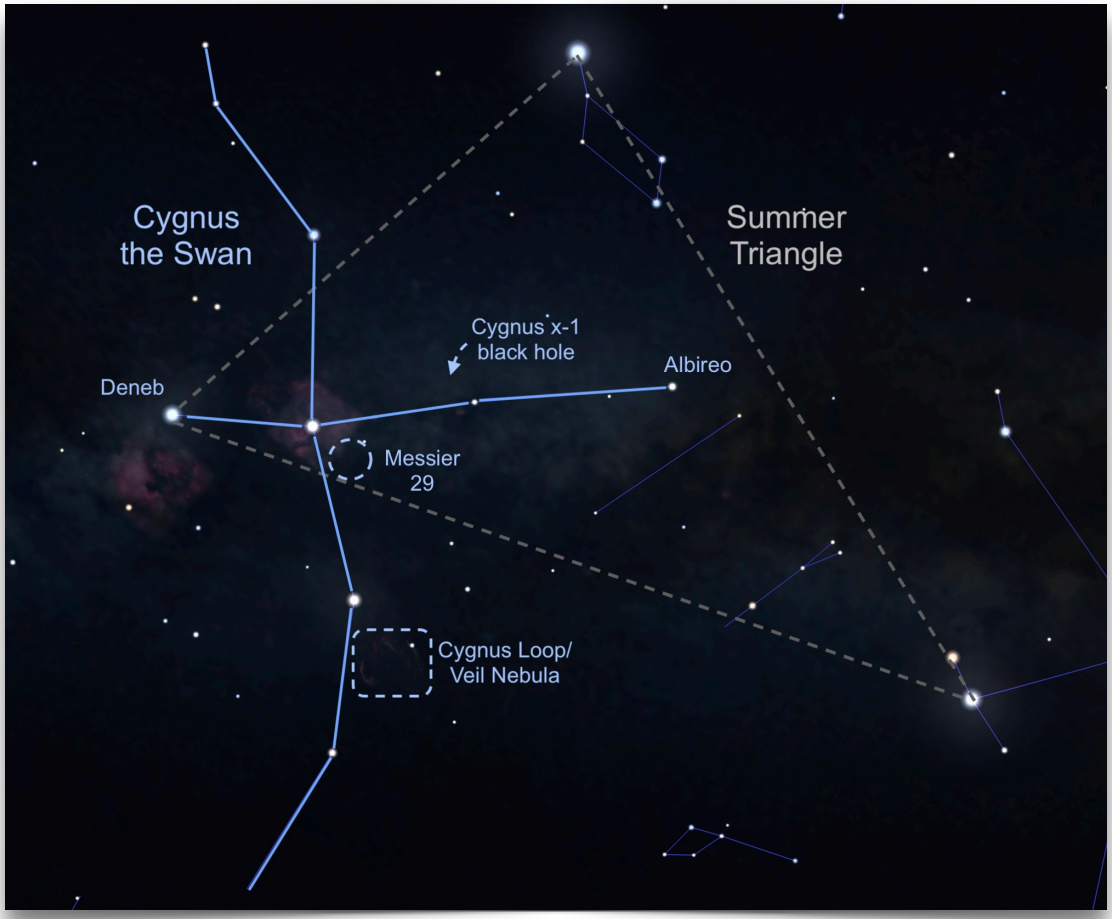
Let's go deeper. While the bright beak star Albireo is easy to pick out, a telescope will let its true beauty shine! Like a jewel box in the sky, magnification shows a beautiful visual double star, with a vivid gold star and a brilliant blue star in the same field of view. There's another marvel to be seen with a telescope or strong binoculars – the Cygnus Loop. Sometimes known as the **Veil Nebula**, you can find this supernova remnant (the gassy leftovers blown off of a large dying star) directly above the final two stars of the swan's eastern wing. It will look like a faint ring of illuminated gas about three degrees across (six times the diameter of the Moon).

Speaking of long-dead stars, astronomers have detected a high-energy X-ray source in Cygnus that we can't see with our eyes or backyard telescopes, but that is detectable by NASA's Chandra X-ray Observatory. Discovered in 1971 during a rocket flight, Cygnus x-1 is the first X-ray source to be widely accepted as a black hole. This black hole is the final stage of a giant star's life, with a mass of about 20 Suns. Cygnus x-1 is spinning at a phenomenal rate – more than 800 times a second – while devouring a nearby star. Astronomically speaking, this black hole is in our neighborhood, 6,070 light years away. But it poses no threat to us, just offers a new way to study the universe.

Check out the beautiful bird in your sky this evening, and you will be delighted to add Cygnus to your go-to summer viewing list. Find out NASA's latest methods for studying black holes at www.nasa.gov/black-holes. ☀

This article is distributed by NASA's Night Sky Network (NSN). The NSN program supports astronomy clubs across the USA dedicated to astronomy outreach.

Visit nightsky.jpl.nasa.gov to find local clubs, events, and more!



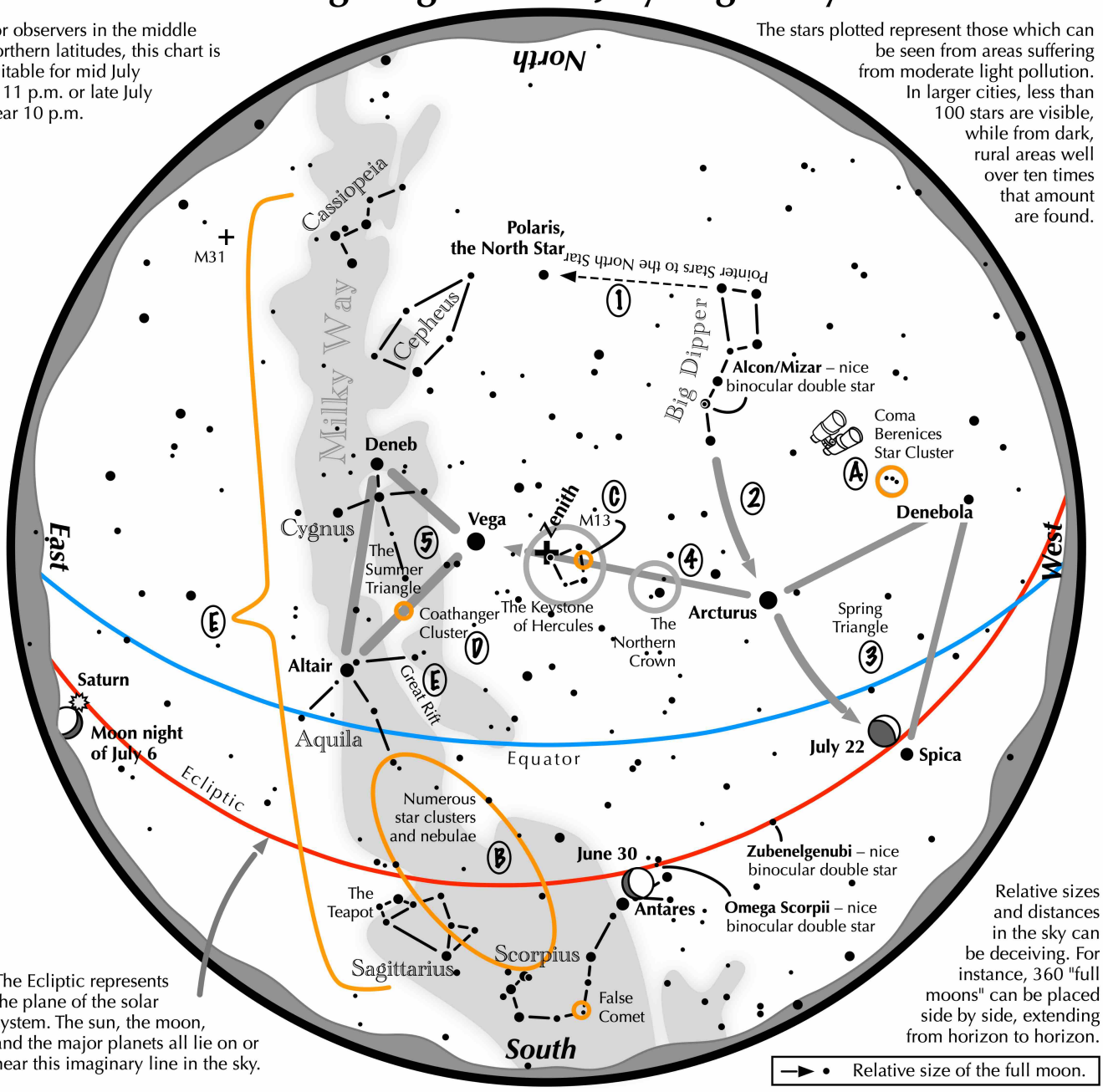
Look up after sunset during summer months to find Cygnus! Along the swan's neck find the band of our Milky Way Galaxy. Use a telescope to resolve the colorful stars of Albireo or search out the open cluster of stars in Messier 29. Image created with assistance from Stellarium: stellarium.org

While the black hole Cygnus x-1 is invisible with even the most powerful Optical telescope, in X-ray, it shines brightly. On the left is the optical view of that region with the location of Cygnus x-1 shown in the red box as taken by the Digitized Sky Survey. On the right is an artist's conception of the black hole pulling material from its massive blue companion star.

Navigating the mid July Night Sky

For observers in the middle northern latitudes, this chart is suitable for mid July at 11 p.m. or late July near 10 p.m.

The stars plotted represent those which can be seen from areas suffering from moderate light pollution. In larger cities, less than 100 stars are visible, while from dark, rural areas well over ten times that amount are found.



The Ecliptic represents the plane of the solar system. The sun, the moon, and the major planets all lie on or near this imaginary line in the sky.

Relative sizes and distances in the sky can be deceiving. For instance, 360 "full moons" can be placed side by side, extending from horizon to horizon.

—► • Relative size of the full moon.

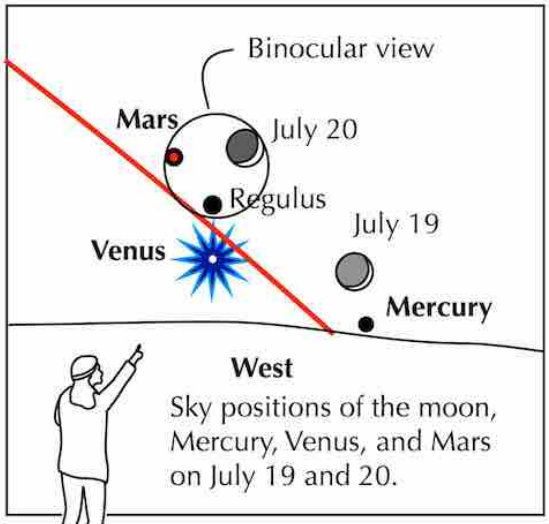
Navigating the mid July night sky: Simply start with what you know or with what you can easily find.

1. Extend a line north from the two stars at the tip of the Big Dipper's bowl. It passes by Polaris, the North Star.
2. Follow the arc of the Dipper's handle. It first intersects Arcturus, the brightest star in the July evening sky, then continues to Spica. Arcturus, Spica, and Denebola form the Spring Triangle, a large equilateral triangle.
3. To the northeast of Arcturus shines another star of similar brightness, Vega. Draw a line from Arcturus to Vega. It first meets "The
4. Northern Crown," then the "Keystone of Hercules." A dark sky is needed to see these two dim stellar configurations.
5. High in the East lies the Summer Triangle stars of Vega, Altair, and Deneb.

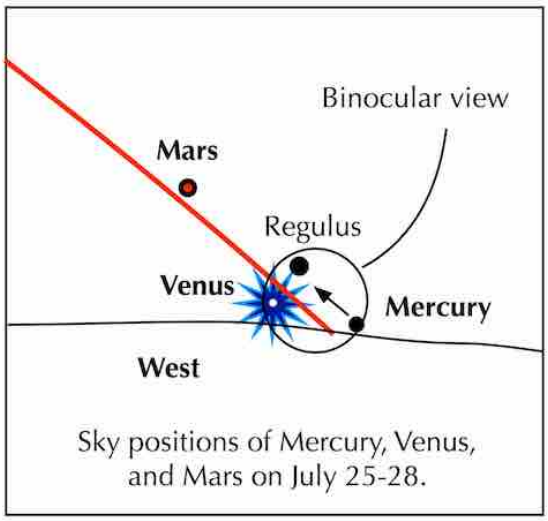
Binocular Highlights

A: Between Denebola and the tip of the Big Dipper's handle, lie the stars of the Coma Berenices Star Cluster.
B: Between the bright stars Antares and Altair, hides an area containing many star clusters and nebulae.
C: On the western side of the Keystone glows the Great Hercules Cluster, containing nearly 1 million stars.
D: 40% of the way between Altair and Vega, twinkles the "Coathanger," a group of stars outlining a coathanger.
E: Sweep along the Milky Way for an astounding number of faint glows and dark bays, including the Great Rift.

If you can see only one celestial show in the evening this July, see this one.



Sky positions of the moon, Mercury, Venus, and Mars on July 19 and 20.

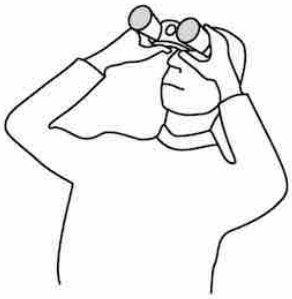


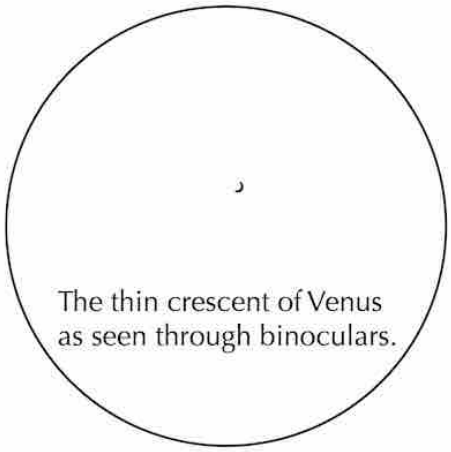
Sky positions of Mercury, Venus, and Mars on July 25-28.

All the rocky planets, all at once!

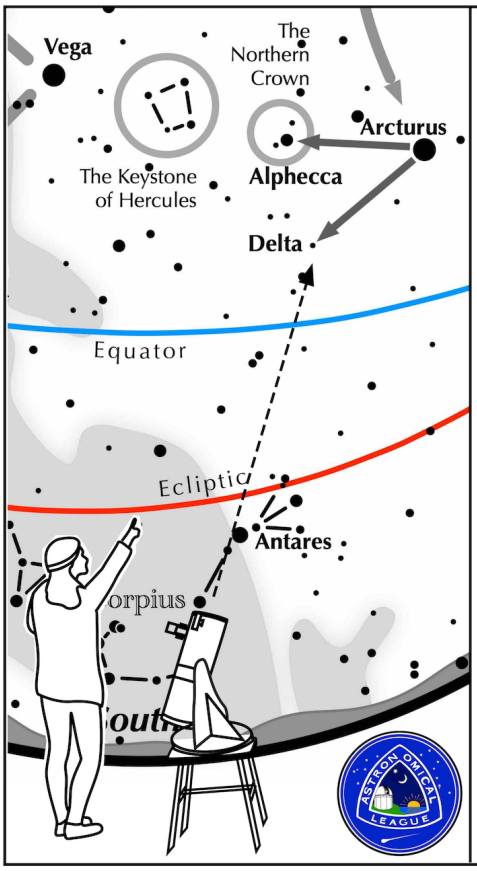
On the evenings of July 19 and 20, look towards the west 30 minutes after sunset.

- Brilliant Venus will be seen as a tiny crescent in steadily held binoculars.
- On the first evening, the thin crescent moon, full with earthshine, hangs above Mercury. The little planet might be lost in the bright twilight.
- On July 20, the moon forms a triangle with Regulus and Mars. Venus sinks below them. Mars, having lost its splendor from last fall, might be difficult to spot in the bright twilight. Binoculars will help.
- Mercury climbs somewhat higher over the remaining evenings in July. On July 28, it lies directly next to Regulus, which has dropped much closer to the horizon. Venus may lie too close to the horizon to be spotted. Because of their low alittude, very clear skies and a low horizon are needed to see this.




The thin crescent of Venus as seen through binoculars.

ASTRONOMICAL LEAGUE Double Star Challenge



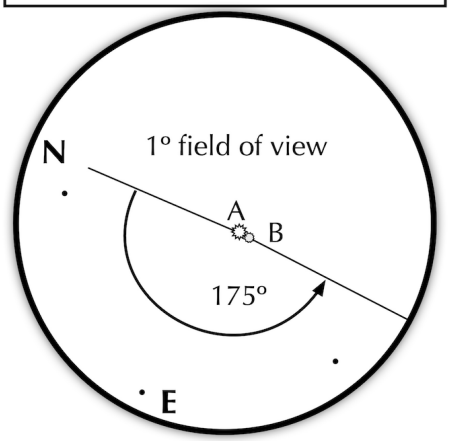
Other Suns: Delta Serpentis

How to find Delta Serpentis on a July evening

Find bright Arcturus, nearly overhead. To its northeast is a similarly bright star, Vega. One-third the distance between the two is Alphecca. Delta Serpentis lies the same distance from Arcturus as Alphecca, but to the southeast.

Delta Serpentis
A-B separation: 4 sec
A magnitude: 4.2
B magnitude: 5.2
Position Angle: 175°
A & B colors: white

Suggested magnification: >60x
Suggested aperture: >3 inches



About Astronomy Associates

The club is open to all people interested in sharing their love for astronomy. Monthly meetings are typically on the last Sunday of each month and often feature guest speakers, presentations by club members, and a chance to exchange amateur astronomy tips. These meetings and the public observing sessions that follow are scheduled at the Baker Wetlands Discovery Center, south of Lawrence. All events and meetings are free and open to the public. Periodic star parties are scheduled as well.

Because of the flexibility of the schedule due to holidays and alternate events, it is always best to check the Web site for the exact Sundays when events are scheduled.

Copies of the Celestial Mechanic can also be found on the web at newsletter.
Annual Dues for the club are: $12 for regular members; $6 for students Membership forms can be accessed at the club website form.