Night Sky Network
Astronomy clubs bringing the wonders of the universe to the public

L.A.S.
Lima Astronomical Society

STAR GAZER

Member of the Astronomical League
and the NASA Night Sky Network

June 2022

Lima Astronomical Society • PO Box 201 • Lima, OH 45802 Schoonover Observatory • 670 N. Jefferson St. • Lima, OH 45801

SOCIETY NEWS AND EVENTS

Upcoming Events

MONTHLY MEETINGS

Board Meeting – June 3 @ 7:00 p.m.
Members Meeting – June 3 @ 8:00 p.m.
Held at Schoonover Observatory

Program / Observing

Kick-off of the 2022 Summer Viewing Program.

SUMMER VIEWING PROGRAM
JUNE 3, STARTING AT 9:00PM

The Lima Astronomical Society's summer viewing begins in June. Every Friday night at dusk (near 9:00pm), Schoonover Observatory will be open to the public. Join us for discussions about astronomy and space, learn about the constellations, and observe through the primary telescope in the observatory dome.

We welcome people of all ages a chance to see a close-up view of the beauty of the night sky. Weather permitting, we regularly view the planets, nebulae, star clusters, and galaxies.

Need help with your telescope? Bring it with you and let us give you a hand!

We recommend dressing appropriately for the weather at the time of your visit, as the dome is not climate-controlled.

Please note, our primary telescope is on the second floor of the observatory, and climbing a short flight of stairs will be necessary to enter the dome.

Under the Dome

On April 25, the Society had a speaker series and display at the Armstrong Air & Space Museum in Wapakoneta, Ohio. Original member, Earl Lhamon, spoke on the history of astronomy in Allen County. Michael Ritchie and David Humphreys represented the Society and provided outreach to visitors.

The STEAM Day event was held at the South Science and Technology Magnet school in Lima on May 4. 175 students, teachers, and parents were in attendance. The Society provided a wide array of astronomy-related materials and hands-on displays. Michael Ritchie presented a telescope donated by the Society to the school's science department and astronomy club.

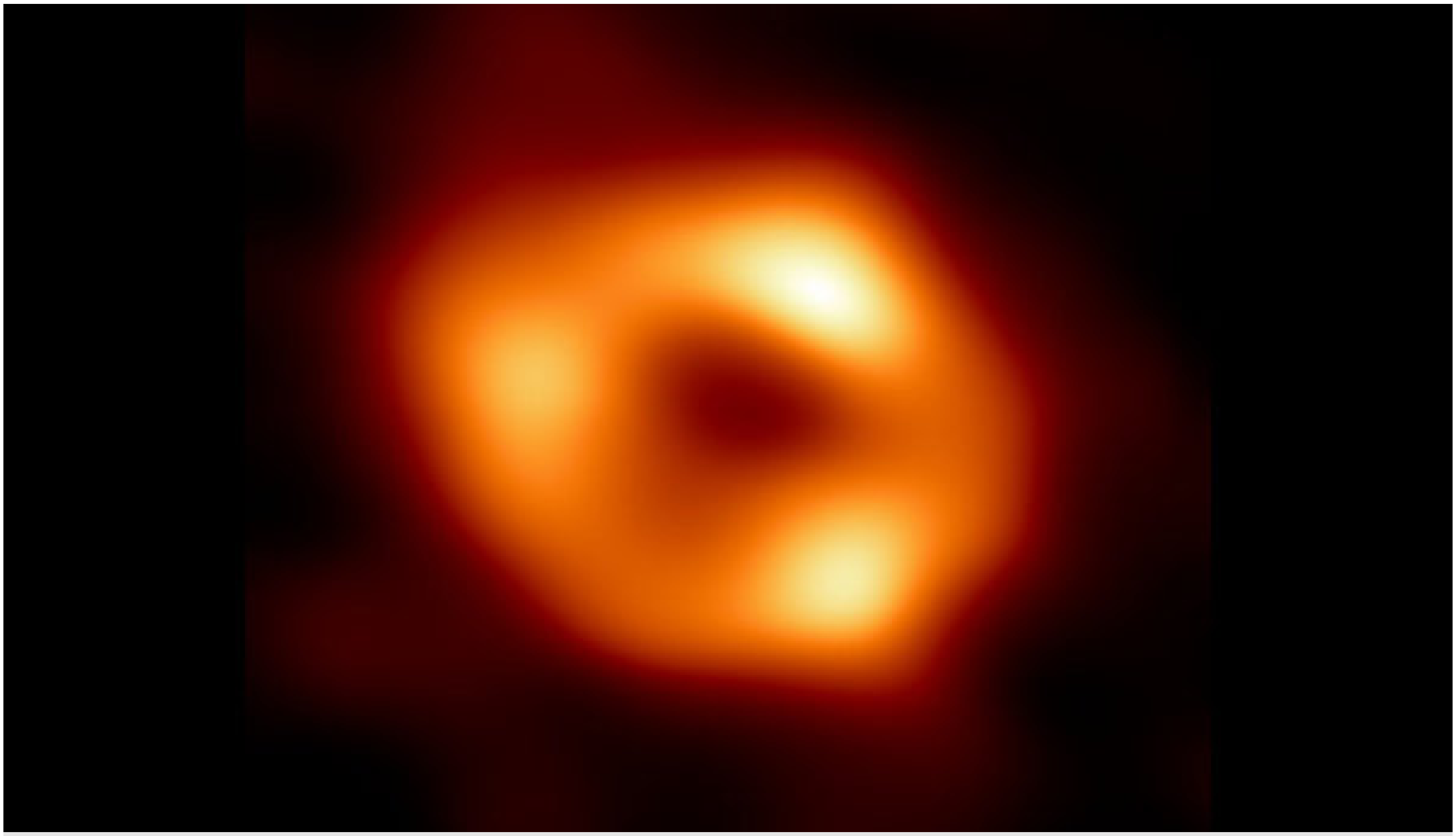
You can now find the previous edition of this newsletter on the Lima Astro website at limaastro.com/stargazer. Active members receive the current edition as soon as it is available. Links to the Night Sky Network have been added, and we've updated the Astronomy Links page at limaastro.com/astronomy-links. We suggest you take a look!

As we previously mentioned in last month's newsletter, the observatory has been underoing some reorganization. We've now added a new literature rack and a new beverage & snack cart! Drinks and snacks are always available for a $1.00 donation.

Members and visitors should also note that the original telescope that was built by members has been reassembled and is on display. If you have never seen this, we invite you to come to the next meeting and hear the story behind the construction and the members that built it.

ASTRONOMERS UNVEIL IMAGE OF THE MILKY WAY'S CENTRAL BLACK HOLE

[Sky & Telescope]



This is the first image of Sgr A, the supermassive black hole at the center of our galaxy. It's the first direct visual evidence of the presence of this black hole. Scientists with the Event Horizon Telescope (EHT) created the image by combining data from eight radio observatories across the planet to form a single "Earth-sized" virtual telescope.*

EHT Collaboration

Scientists with the Event Horizon Telescope project unveiled the first image of the black hole at the heart of our galaxy.

That black hole, Sagittarius A*, packs the mass of 4 million Suns into a region smaller than Mercury's orbit around our star. Sgr A* is a "gentle giant" among black holes, grazing on a thin trickle of gas that reaches it from the winds of stars clustered in the galactic center. The infalling gas emits only a few hundred times as much energy as our Sun, so at 26,000 light-years away, Sgr A* is anything but bright.

But it's also the closest supermassive black hole to Earth, and it's our galaxy's dark heart, making it an irresistible target. Astronomers have spent decades edging closer to the black hole's event horizon, that infamous point of no return. They've watched stars whiz around on orbits that revealed the invisible object's mass and caught flares as the gas trickle lit up.

However, this is the first time that we can see the black hole — or, rather, its silhouette. Just like the iconic 2019 image of the black hole at the center of the elliptical galaxy M87, Sgr A*'s image shows a fuzzy ring of light encircling a dark center. The light is radio emission and comes from electrons in the gas that swirls around the black hole; the dark center is where light comes too close to Sgr A* and plunges past the event horizon, never reaching us and leaving a "shadow" where the black hole is.

When EHT astrophysicist Feryal Özel (University of Arizona) unveiled Sgr A*'s image in D.C., the room burst into applause. This was the moment so many of us had waited for: We have finally met our black hole face to face.

How to Take a Black Hole's "Photo"

More than 300 people, working at 80 institutions in various countries, contributed to making this image a reality. Astronomers observed Sgr A* over five nights in April 2017, during the same observing run that brought us the M87* image. They used eight radio telescopes at six sites, spread from Arizona to the South Pole and Hawai'i to Spain, to create a planet-size virtual telescope. This technique, called very long baseline interferometry (VLBI), combines the data from pairs of telescopes to achieve the resolution that would be possible if we had a radio dish as large as the distance between them.

The key with VLBI, however, is not just having a single big virtual dish. Each pair's distance, or baseline, probes a different scale: Long baselines tell us about the fine structure of the object observed, whereas short baselines tell us about the big features. To even begin to fill in the image we're trying to see, we need a variety of baselines, and more is definitely better.

Reconstructing the shadow's image required collecting incredible amounts of data — 3½ petabytes in this case, the equivalent of 100 million TikTok videos, quipped Vincent Fish (MIT Haystack Observatory) during the press conference. These data can't simply be emailed (imagine that error message!). Instead, observers save the information to hard drives and physically fly them to sites in Germany and Massachusetts, where the data are correlated, perfectly synched within trillionths of a second.

Gas whips around Sgr A* in only a few minutes, compared to the days that gas takes to circuit M87*, which is roughly 1,500 times larger. That means that Sgr A* doesn't sit patiently for its portrait: Its image is constantly changing, the thin, turbulent gas flow burbling and gurgling, Özel said. Furthermore, we look at Sgr A* through the dusty plane of the Milky Way, which blurs the image as though we were looking through frosted glass. All of this makes it difficult to take what amounts to an hours-long exposure.

The team used some of the most sophisticated computer algorithms ever written to reconstruct the image. Even so, Sgr A* proved daunting. As they had with M87*, members split into multiple teams, each using its own methods to reconstruct an image from the data. Last time, all the teams fairly quickly had an image, and they all agreed remarkably well. This time, the teams were stumped — many images showed a ring, but not all. It was so unclear what was going on that people didn't even want to show their images, said computer scientist Katie Bouman (Caltech), who co-led the imaging effort. "That's really what we have spent years trying to figure out," she explained.

To solve the conundrum, scientists simulated different images and unleashed their algorithms on the mock data, to learn how their methods reacted to different situations. Finally, they were confident that indeed they do detect a ring, and always of the same size: about 50 microarcseconds wide, exactly as Einstein's theory of gravity predicts.

What the reconstructed images don't agree on is the bright knots dotting the ring. Knots are natural, due to the tangled magnetic fields threading a black hole's tutu of hot gas. But the knots in the Sgr A* images move depending on which reconstruction you use, and they tend to line up along the directions with more telescopes, Özel warned. "We don't trust the knots that much," she said.

Eerily Calm

Sgr A* proved less variable than expected. EHT scientists had prepared a library of more than 5 million simulated images to compare with the results, combining possible scenarios with what previous observations have told us, such as the weak rate at which the black hole slurps down gas. None of them matched how Sgr A* behaved.

During the five days the EHT observed, the gas flow was surprisingly calm. "To my mind, that is one of the most interesting things that we learned," mentioned theorist Dimitrios Psaltis (University of Arizona).

Think of watching waves on the beach, he explains. Waves come in at the same speed, thanks to planet-scale gravitational tides, but how big the waves are depends on things like the wind and sea conditions that day. EHT astronomers expected big waves for Sgr A* — perhaps so big that they wouldn't be able to take a decent long-exposure picture. "We predicted the storm, and we got a beautiful sunny day," he says.

What that means, the team doesn't know yet. It might be that magnetic fields in the gas aren't as tangled as expected, or that they mix more gently than forecasted with the electrons that emit the radio waves. Nor do we know yet if this is a permanent or temporary condition. Future observations and analyses may reveal what the magnetic fields are doing.

A second notable result is that Sgr A* is lying on its side. Although the team hasn't determined how fast the black hole spins, they can tell it is spinning and that we're essentially looking down on Sgr A*'s head — the angle between our line of sight and the black hole's rotation axis is less than 30°. Previous observations of hotspots around Sgr A*, using the GRAVITY instrument on the Very Large Telescope Interferometer in Chile, also indicated this arrangement.

This is not as surprising as you might think. Instinctively, we might expect that the black hole in the heart of a spiral galaxy would have its spin axis aligned with that of the galaxy. But a black hole's orientation depends on how the black hole grew. Mergers with other black holes could cause a jumble of spin tilts, and for less active black holes like Sgr A* there's no hefty gas stream to force the black hole into a particular orientation. Observations of feebly accreting black holes in distant spiral galaxies have also revealed a range of orientations, said Geoff Bower (Institute of Astronomy and Astrophysics, Academia Sinica, Taipei).

The Next Phase

This is just the beginning for the EHT. The team has yet to analyze data from subsequent observing campaigns, having spent all their time cracking the 2017 data's complexities. They're also ramping up for the next-generation Event Horizon Telescope (ngEHT), for which between now and 2030 they hope to add 10 more dishes scattered across the planet, boosting the number of baselines.

They're also expanding beyond 230 GHz — the radio frequency of these images — to 345 GHz, which will improve images' resolution by 50%. And perhaps most evocatively, they're going to make movies, revealing how the black holes' silhouettes change over time. M87*'s debut will come first, since it sits more quietly than Sgr A*. But in a decade, we may be watching videos of gas swirling around the black hole at the heart of our galaxy.

And when we do, what face will Sgr A* make at us?

HOW WEBB WILL EXPLORE OUR OWN SOLAR SYSTEM

EarthSky.org

We are getting closer and closer to when NASA's Webb telescope will begin observing the universe. NASA announced in a new blog post from Thaddeus Cesari on May 19, 2022, that they're in the final phases of commissioning. Webb images and other data will be unprecedented, even better than from Hubble. Webb will study distant stars, galaxies, exoplanets and other cosmic objects and phenomena. But, did you know that it can also observe objects within our own solar system? Webb will be able to look at planets, moons, asteroids and comets, too!

Once the final phases of commissioning the science instruments are complete, Webb can start to track these objects. It will observe them with extreme precision as they move across the background stars. In doing so, the telescope can obtain images and spectra of those objects.

Tracking test successful

Along with the other instrument commissioning, the Webb team just finished its first test of Webb's tracking capabilities. And it was a success! Now, a variety of deep-space objects will be tracked in additional testing. The NASA blog post quoted Heidi Hammel, a Webb scientist specializing in solar system observations:

I am really excited about Webb's upcoming first year of science operations! I lead a team of equally excited astronomers eager to begin downloading data. Webb can detect the faint light of the earliest galaxies, but my team will be observing much closer to home. They will use Webb to unravel some of the mysteries that abound in our own solar system.

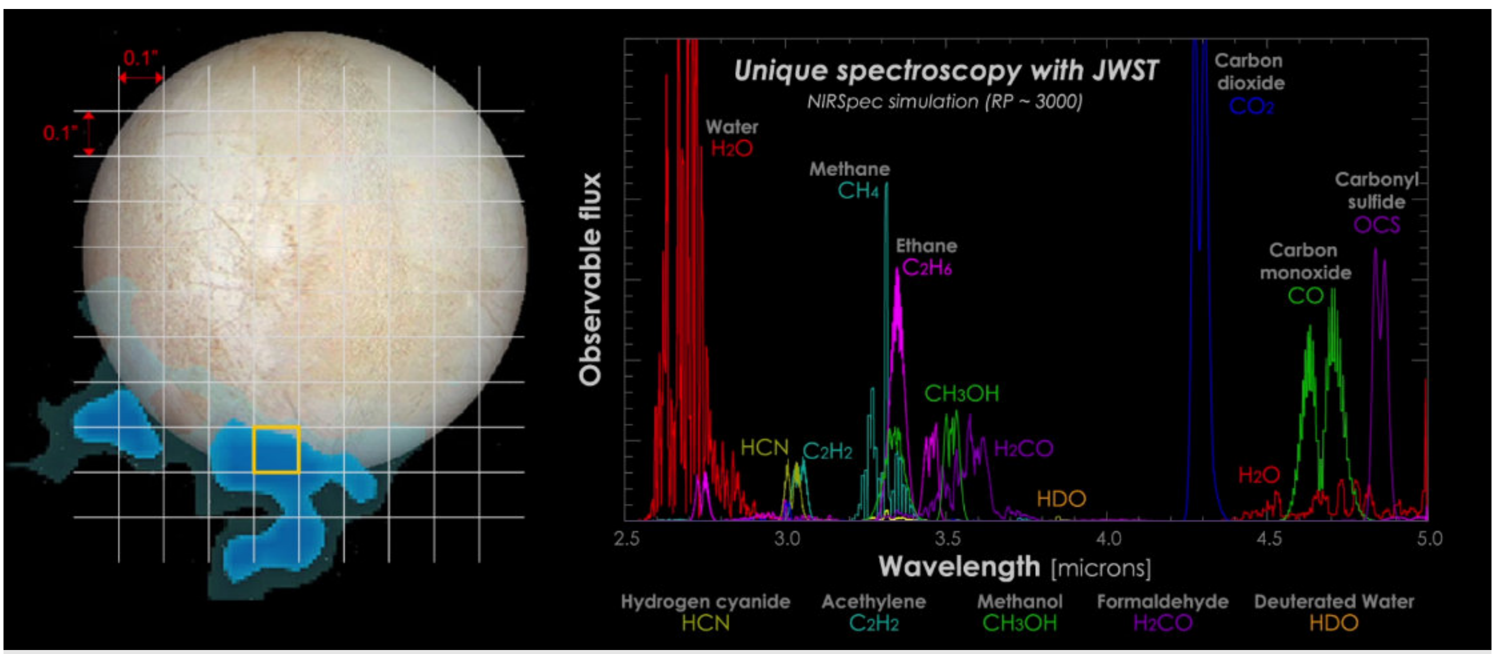
We have been planning for Webb observations for over 20 years, and that has gone into overdrive now that we are launched, deployed, and focused! I'll note that nearly all of my team's solar system data will be freely available to the broad planetary science community immediately. I made that choice to enable more science discoveries with Webb in future proposals.

Hammel is also Vice President for Science at the Association of Universities for Research in Astronomy (AURA).

Why Webb is needed

Webb is the most powerful space telescope ever built. Which is why, of course, it will provide unsurpassed views of the universe. But why is it needed to study the solar system, when there are robotic spacecraft already doing so?

The answer is that astronomers use telescopes as a complement to the spacecraft missions. For example, as Hammel noted, they can spot other objects that a spacecraft might not be able to. A good example is when scientists used Hubble to find the next target for the New Horizons mission to Arrokoth. This was the next object in the Kuiper Belt that New Horizons visited, long after it flew past Pluto in 2015. And now, scientists are using telescopes to look for additional future targets for New Horizons, as well.



This is a simulation of spectroscopy results of the plumes on Europa, as seen by Webb. While this is a simulation, the real data should be just as detailed.

Image via NASA-GSFC/ SVS/ Hubble Space Telescope/ Stefanie Milam/ Geronimo Villanueva.

Also, there are some objects where no spacecraft has visited recently or will be visiting in the near future. The planets Uranus and Neptune are prime examples. The Voyager 2 probe made the last in-situ observations of both worlds in the late 1980s. Webb will look at these planets and their moons in great detail. In particular, the telescope will be able to analyze the chemistry of the upper atmosphere of Uranus.

In addition, Webb will observe smaller objects like asteroids, including ones in the Kuiper Belt.

Solar system mysteries

As Cesari quoted Hammel:

Our solar system has far more mysteries than my team had time to solve. Our programs will observe objects across the solar system: We will image the giant planets and Saturn's rings; explore many Kuiper Belt objects; analyze the atmosphere of Mars; execute detailed studies of Titan; and much more! There are also other teams planning observations; in its first year, 7% of Webb's time will be focused on objects within our solar system.

Europa's plumes

One of the most exciting solar system targets is Europa's possible water vapor plumes. Webb can take spectroscopic measurements of the plumes, providing clues as to conditions in the subsurface ocean (or possible lakes in the crust). This is similar to how the Cassini spacecraft sampled the plumes of Saturn's moon Enceladus and analyzed them. Hammel said:

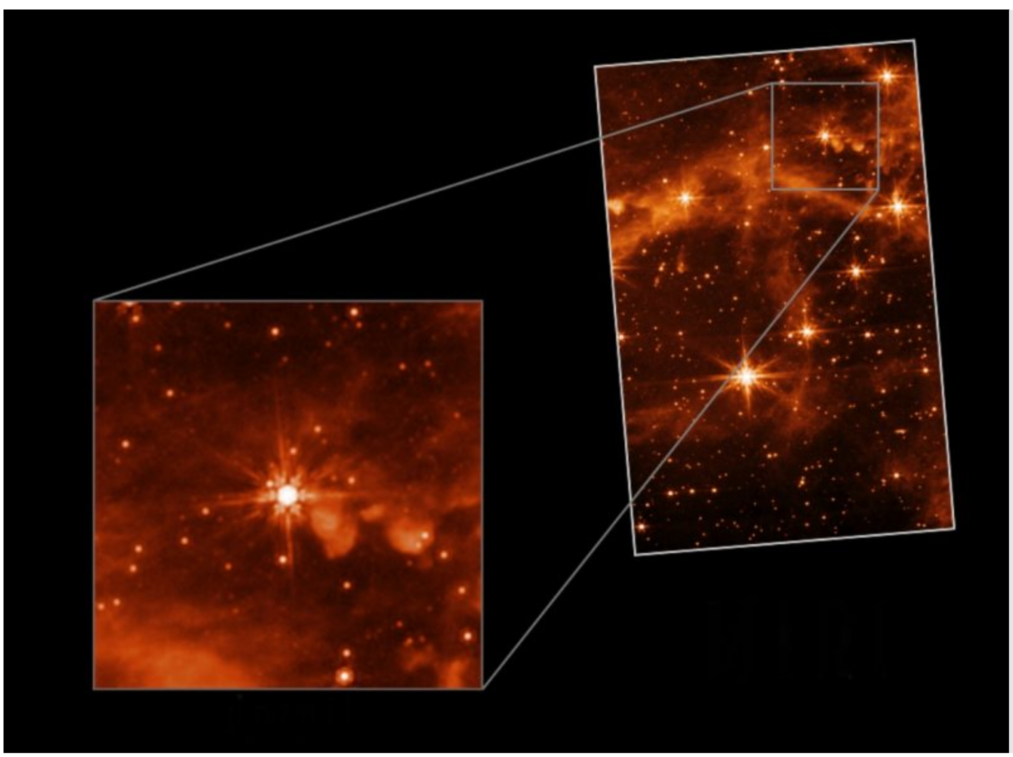
One exciting and challenging program we plan to do is observe ocean worlds. There's evidence from the Hubble Space Telescope that Jupiter's moon Europa has sporadic plumes of water-rich material. We plan to take high-resolution imagery of Europa to study its surface and search for plume activity and active geologic processes. If we locate a plume, we will use Webb's spectroscopy to analyze the plume's composition.

That would be exciting, and the data would be valuable to have before the Europa Clipper probe arrives there. Europa is a fascinating world, and scientists think its subsurface ocean may be quite habitable.

TRAPPIST-1: habitable worlds?

Webb will be fully tested and ready for science observations this summer. And speaking of solar systems, one of its most exciting early targets will be the seven Earth-sized planets in the TRAPPIST-1 system. All of them are rocky and close in size to Earth. Could any of them support life?

Bottom line: The greatly anticipated Webb telescope will be able to observe objects in our own solar system, as explained in a new NASA blog post. While primarily studying distant stars, galaxies, exoplanets and other cosmic objects and phenomena, it will also be able to look around our own neighborhood, as well.



Webb took a series of images during its sharpness check for science instrument commissioning, including these (still frame from video). Even though these are still just test images, the detail in them is incredible. The images show a portion of the Large Magellanic Cloud, a small, irregular satellite galaxy of the Milky Way.

Image via NASA/ Goddard Space Flight Center/ YouTube.

SOLSTICE SHADOWS

DAVID PROSPER - NIGHT SKY NETWORK

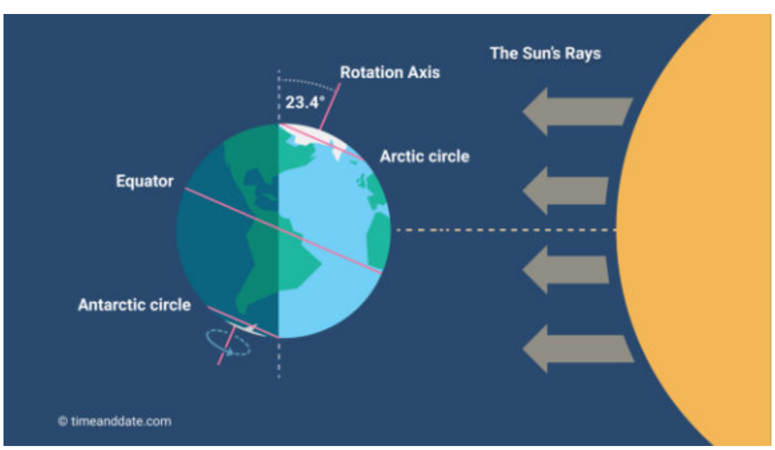
Solstices mark the changing of seasons, occur twice a year, and feature the year's shortest and longest daylight hours - depending on your hemisphere. These extremes in the length of day and night make solstice days more noticeable to many observers than the subtle equality of day and night experienced during equinoxes. Solstices were some of our earliest astronomical observations, celebrated throughout history via many summer and winter celebrations.

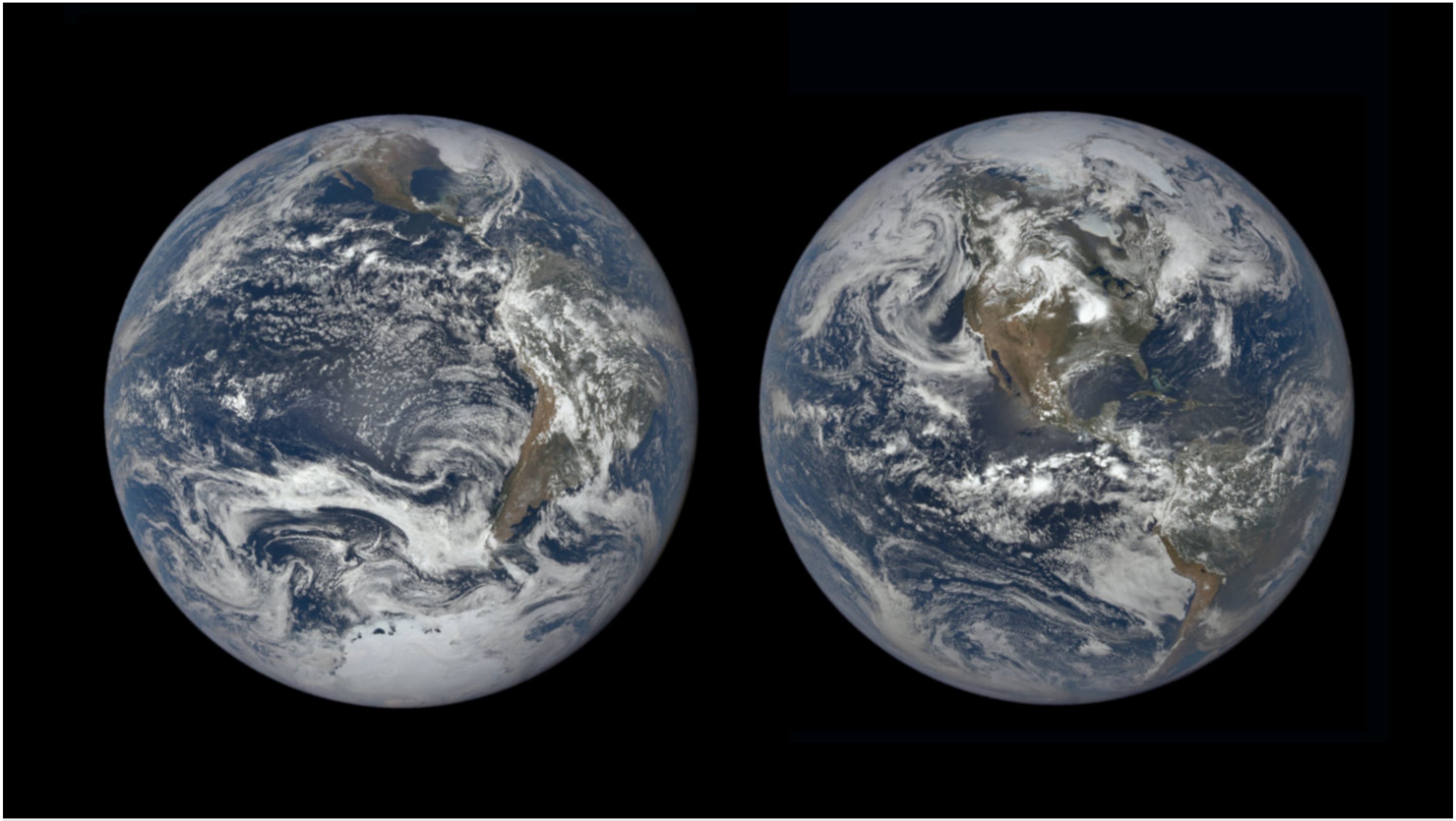
Solstices occur twice yearly, and in 2022 they arrive on June 21 at 5:13 am EDT (9:13 UTC), and December 21 at 4:48pm EST (21:48 UTC). The June solstice marks the moment when the Sun is at its northernmost position in relation to Earth's equator, and the December solstice marks its southernmost position. The summer solstice occurs on the day when the Sun reaches its highest point at solar noon for regions outside of the tropics, and those observers experience the longest amount of daylight for the year. Conversely, during the winter solstice, the Sun is at its lowest point at solar noon for the year and observers outside of the tropics experience the least amount of daylight- and the longest night – of the year. The June solstice marks the beginning of summer for folks in the Northern Hemisphere and winter for Southern Hemisphere folks, and in December the opposite is true, as a result of the tilt of Earth's axis of rotation. For example, this means that the Northern Hemisphere receives more direct light from the Sun than the Southern Hemisphere during the June solstice. Earth's tilt is enough that northern polar regions experience 24-hour sunlight during the June solstice, while southern polar regions experience 24-hour night, deep in Earth's shadow. That same tilt means that the Earth's polar regions also experience a reversal of light and shadow half a year later in December, with 24 hours of night in the north and 24 hours of daylight in the south. Depending on how close you are to the poles, these extreme lighting conditions can last for many months, their duration deepening the closer you are to the poles.

While solstice days are very noticeable to observers in mid to high latitudes, that's not the case for observers in the tropics - areas of Earth found between the Tropic of Cancer and the Tropic of Capricorn. Instead, individuals experience two "zero shadow" days per year. On these days, with the sun directly overhead at solar noon, objects cast a minimal shadow compared to the rest of the year. If you want to see your own shadow at that moment, you have to jump! The exact date for zero shadow days depends on latitude; observers on the Tropic of Cancer (23.5° north of the equator) experience a zero shadow day on the June solstice, and observers on the Tropic of Capricorn (23.5° south of the equator) get their zero shadow day on December's solstice. Observers on the equator experience two zero shadow days, being exactly in between these two lines of latitude; equatorial zero shadow days fall on the March and September equinoxes.

There is some serious science that can be done by carefully observing solstice shadows. In approximately 200 BC, Eratosthenes is said to have observed sunlight shining straight down the shaft of a well during high noon on the solstice, near the modern-day Egyptian city of Aswan. Inspired, he compared measurements of solstice shadows between that location and measurements taken north, in the city of Alexandria. By calculating the difference in the lengths of these shadows, along with the distance between the two cities, Eratosthenes calculated a rough early estimate for the circumference of Earth – and also provided further evidence that the Earth is a sphere!

Are you having difficulty visualizing solstice lighting and geometry? You can build a "Suntrack" model that helps demonstrate the path the Sun takes through the sky during the seasons; find instructions at stanford.io/3FY4mBm. You can find more fun activities and resources like this model on NASA Wavelength: science.nasa.gov/learners/wavelength. And of course, discover the latest NASA science at nasa.gov.





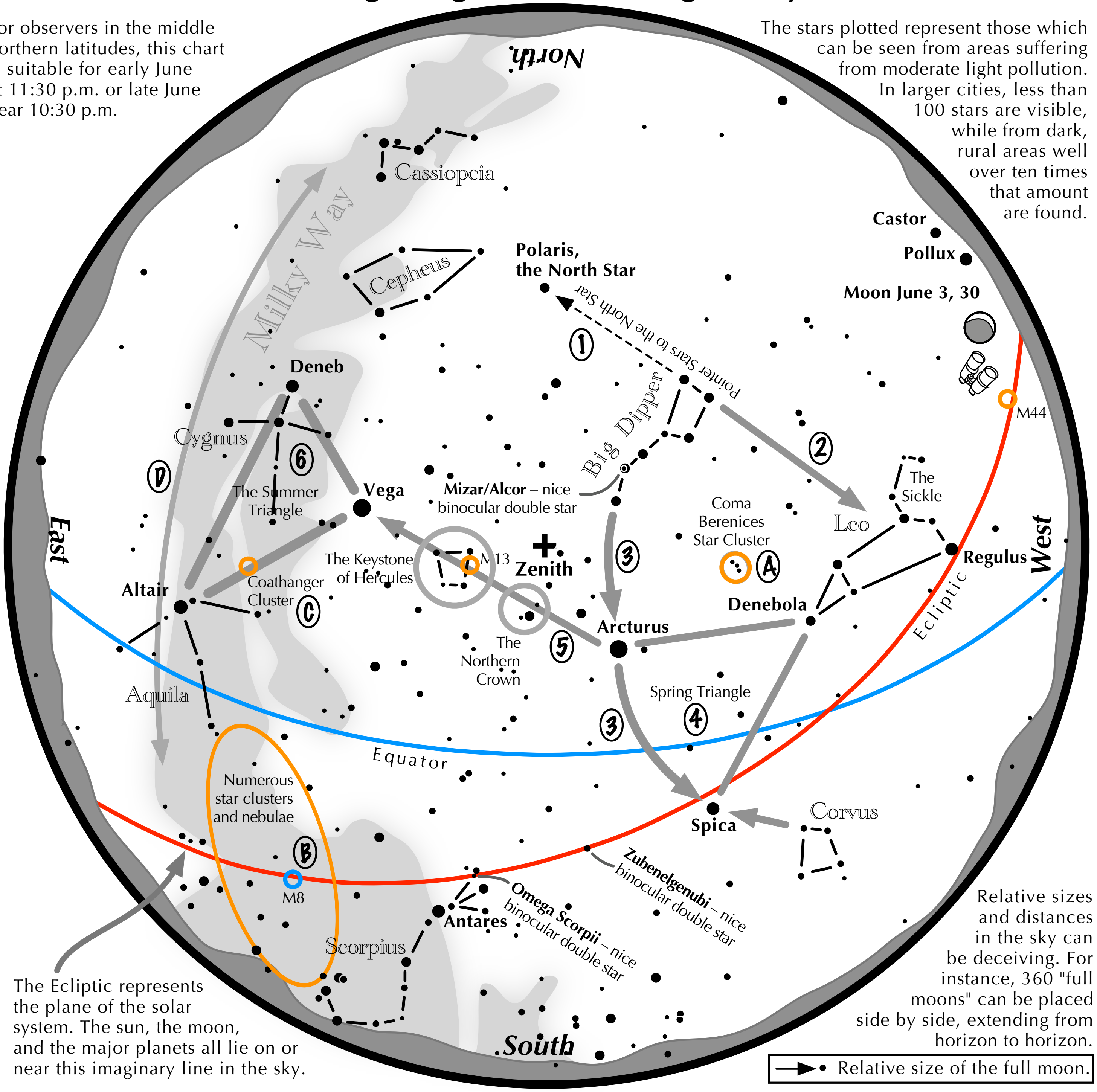
These images from NASA's DSCOVR mission shows the Sun-facing side of Earth during the December 2018 solstice (left) and June 2019 solstice (right). Notice how much of each hemisphere is visible in each photo; December's solstice heavily favors the Southern Hemisphere and shows all of South America and much of Antarctica and the South Pole, but only some of North America. June's solstice, in contrast, heavily favors the Northern Hemisphere and shows the North Pole and the entirety of North America, but only some of South America.

Credit: NASA/DSCOVR EPIC   Source: https://www.nasa.gov/image-feature/goddard/2021/summer-solstice-in-the-northern-hemisphere

Navigating the June Night Sky

For observers in the middle northern latitudes, this chart is suitable for early June at 11:30 p.m. or late June near 10:30 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 June 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. Draw another line in the opposite direction. It strikes the constellation Leo high in the west.
3. Follow the arc of the Dipper's handle. It first intersects Arcturus, the brightest star in the June evening sky, then Spica.
4. Arcturus, Spica, and Denebola form the Spring Triangle, a large equilateral triangle.
5. To the northeast of Arcturus shines another star of the same brightness, Vega. Draw a line from Arcturus to Vega. It first meets "The Northern Crown," then the "Keystone of Hercules." A dark sky is needed to see these two dim stellar configurations.
6. High in the east are the three bright stars of the Summer Triangle: 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 of Antares and Altair, hides an area containing many star clusters and nebulae.
C: 40% of the way between Altair and Vega, twinkles the "Coathanger," a group of stars outlining a coathanger.
D. Sweep along the Milky Way for an astounding number of faint glows and dark bays.

Astronomical League *www.astroleague.org/outreach; duplication is allowed and encouraged for all free distribution.*

OBSERVING LISTS

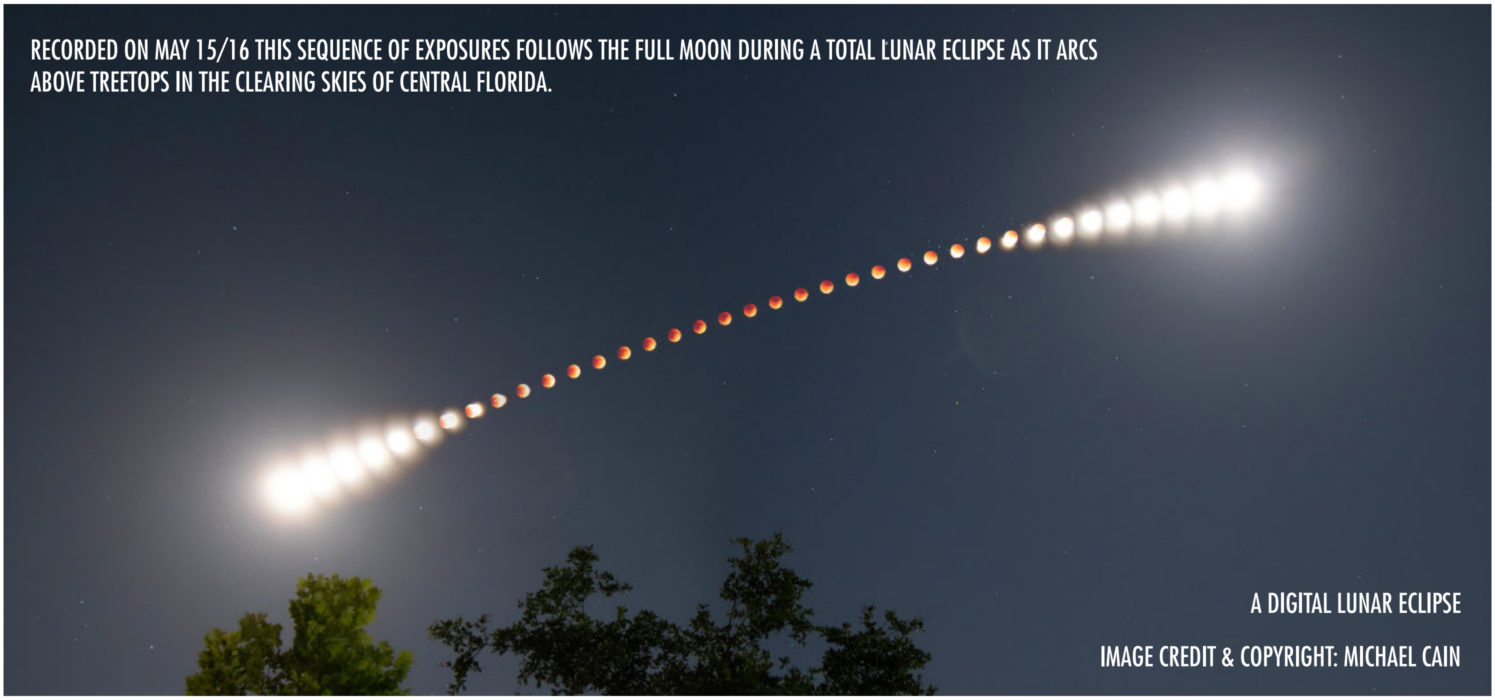
Top ten deep-sky objects for June	
M5	NGC 5689
M101	NGC 5746
M102	NGC 5813
NGC 5566	NGC 5838
NGC 5585	NGC 5907

Top five deep-sky binocular objects for June
M5
M101
M102
NGC 5466
NGC 5907

Challenge deep-sky object for June
Abell 2065 (galaxy cluster)
Abell 2065 is a highly concentrated galaxy cluster in the constellation of Corona Borealis containing over 400 member galaxies, the brightest of which are 16th magnitude. The cluster is more than one billion light-years from Earth.

THIS MONTH IN ASTRONOMY

- The British astronomer Edmund Halley discovered M13 on June 1, 1714.
- The French astronomer Nicolas Louis de Lacaille discovered the globular cluster M55 on June 16, 1752.
- A transit of the Sun by Venus was observed by Austrian, British, and French astronomers from various parts of the world on June 6, 1761.
- The French astronomer Charles Messier discovered the globular cluster M14 on June 1st, 1764, the emission and reflection nebula M20 (the Trifid Nebula) on June 5, 1764, and the open cluster M23 on June 20, 1764.
- The globular cluster M62 was discovered by Charles Messier on June 7, 1771.
- The French astronomer Pierre Méchain discovered his first deep-sky object, the spiral galaxy M63 (the Sunflower Galaxy), on June 14, 1779.
- The German/English astronomer William Herschel discovered the globular cluster NGC 6288 on June 24, 1784.
- Neptune was independently discovered by the British astronomer John Couch Adams on June 5, 1846.
- The Italian astronomer Giovanni Battista Donati discovered Comet C/1858 L1 (Donati), the first comet to be photographed, on June 2, 1858.
- A large storm on Saturn was observed by the American astronomer E. E. Barnard.
- The Tunguska event occurred on June 30, 1908.
- The largest known solar flare was recorded on June 27, 1984.
- The Georgian astronomer Givi Kimeridze discovered a Type Ia supernova in the spiral galaxy M58 on June 28, 1989.
- Namaka, a satellite of the dwarf planet Haumea, was discovered on June 30, 2005.
- Kerberos, Pluto's fourth satellite, was discovered by the Hubble Space Telescope team on June 28, 2011.



RECORDED ON MAY 15/16 THIS SEQUENCE OF EXPOSURES FOLLOWS THE FULL MOON DURING A TOTAL LUNAR ECLIPSE AS IT ARCS ABOVE TREETOPS IN THE CLEARING SKIES OF CENTRAL FLORIDA.

A DIGITAL LUNAR ECLIPSE

IMAGE CREDIT & COPYRIGHT: MICHAEL CAIN

June 2022 Astronomy Events Calendar

Sun	Mon	Tues	Wed	Thurs	Fri	Sat
			1 **Ceres 0.1° S of Moon**	**2** Moon at apogee	**3** **LAS Meeting @ 8pm** **Summer Viewing Program Begins** Mercury stationary	**4**
5 Saturn stationary	**6** Venus at greatest heliocentric lat. S	**7** **First quarter Moon**	**8**	**9**	**10** **Summer Viewing Program**	**11** **Venus 1.6° S of Uranus**
12	**13**	**14** **Full Moon** Moon at perigee **Large Tides**	**15**	**16** **Mercury greatest elongation W (23°)**	**17** **Summer Viewing Program** Mercury at greatest heliocentric lat. S	**18** Saturn 4° N of Moon
19 **Vesta 0.7° N of Moon**	**20**	**21** Mars at perihelion **Last quarter Moon** **June Solstice** Jupiter 3° N of Moon	**22** **Mars 0.9° N of Moon**	**23**	**24** **Summer Viewing Program** **Uranus 0.05° N of Moon**	**25**
26 **Venus 3° S of Moon**	**27** Mercury 4° S of Moon	**28** Neptune stationary	**29** **New Moon** Moon at apogee	**30**		