Highlights of the May Sky...

- - - 1st - - -

DAWN: Venus and Saturn are less than 4° apart low above the east-southeastern horizon.

- - - 2nd - - -

DUSK: A waxing gibbous Moon is about 2° to the lower left of Pollux in Gemini.

- - - 3rd - - -

DUSK: The Moon is about 1¼° above Mars, which is adjacent to the Beehive Cluster (M44) in Cancer.

- - - 4th - - -

First Quarter Moon @ 9:52 am EDT

- - - 5th - - -

DUSK: A waxing gibbous Moon is about 3° left of Regulus in Leo.

PM: The Eta Aquariid meteor shower is predicted to peak at 11pm EDT.

- - - 10th - - -

AM: The Moon is about 1° below Spica, in Virgo, as they sink toward the west-southwestern horizon.

- - - 12th - - -

Full Moon @ 12:56 pm EDT

- - - 13th - - -

PM: A waning gibbous Moon and Antares are only ½° apart when they rise in the southeast.

- - - 20th - - -

Last Quarter Moon @ 7:59 am EDT

- - - 22nd - - -

DAWN: A waning crescent Moon is nearly 4° to the upper right of Saturn in the east-southeast.

- - - 23rd - - -

DAWN: The Moon, Saturn, and Venus form an arc.

- - - 26th - - -

New Moon @ 11:02 pm EDT

- - - 29th - - -

DUSK: A waxing crescent Moon is just under 5° below Pollux.

- - - 31st - - -

PM: The Moon is 4° to the right of Mars in the west.

Prime Focus

A Publication of the Kalamazoo Astronomical Society

★ ★ ★ May 2025 ★ ★ ★

This Month's KAS Events

General Meeting: Friday, May 2 @ 7:00 pm

Kalamazoo Area Math & Science Center • See Page 10 for Details

Observing Session: Saturday, May 3 @ 9:00 pm

Kalamazoo Nature Center • Visit Observing Page for Details

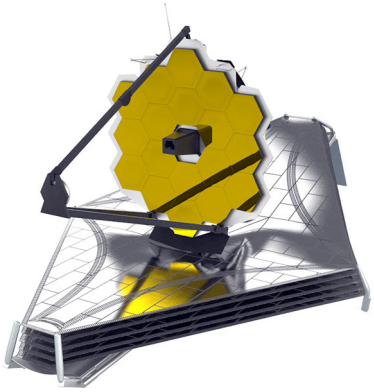
Board Meeting: Sunday, May 18 @ 5:00 pm

Held on Zoom • All Members Welcome

Observing Session: Saturday, May 24 @ 9:00 pm

Kalamazoo Nature Center • Visit Observing Page for Details

Inside the Newsletter. . .



Observations by Richard S. Bell

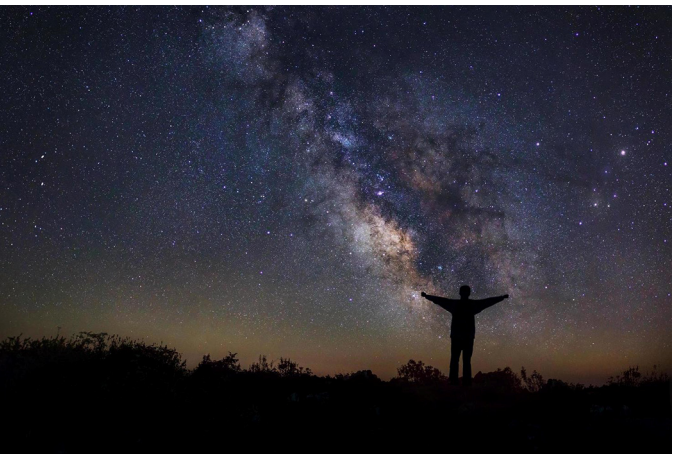
I'm depressed! Last month, we were only able to conduct one of the three scheduled activities. Poor weather forced us to cancel both observing sessions. Cold and cloudy skies have also prevented me from heading out under the stars on my own.

It's a well-known fact that the weather plays a significant role in our mood. Seasonal affective disorder (SAD), a form of depression that follows a seasonal pattern, affects us more during the fall and winter months and then tends to subside in the spring and summer. Researchers link it to changes in sunlight and its effects on the brain, particularly concerning serotonin and melatonin production.

I would like to propose a similar form of depression that keenly affects amateur astronomers: Lack of Stargazing Syndrome (LOSS). As with SAD, the weather plays a big role in LOSS, but our hectic work and family schedules are also a factor. The late-night hours of stargazing are just not conducive to everyday life.

Being surrounded by nature on a warm, sunny day can do wonders for both your mental and physical health. The same is true for being under a star-filled sky with the Milky Way gracefully arcing from horizon to horizon.

Research shows that feeling a sense of awe can do wonders for your overall health. Few things in life are more awe-inspiring than staring up at a dark, starry sky. It all has to do with that sense of wonder that comes with looking up to the heavens. Some scientists associate awe with emotions such as joy and love, which are essential for human survival. Awe can calm our minds, and realizing just how small we are can make us feel a closer connection to our fellow humans and the world as a whole.



So, stargazing can be good for your health. There are many mental benefits, such as stress reduction. The calm quiet of the night sky helps slow your thoughts and lowers cortisol levels. It can boost your mood because stargazing often sparks feelings of awe and wonder, which are linked to increased happiness and life satisfaction. Stargazing also encourages mindfulness. It pulls you into the present moment, promoting a meditative state. Spending time in natural darkness and away from screens can help reset your circadian rhythm, improving sleep quality.

There are multiple physical benefits to stargazing as well. First, you're spending more time outdoors. If you stargaze in a park or natural setting, you get fresh air and sometimes light exercise from walking to a good spot. The relaxation of stargazing can lead to reduced blood pressure and heart rate.

Finally, stargazing can lead to better social and emotional health. For one, it strengthens connections. Doing it with friends or a community group fosters bonding and shared experience. I assume that's why many of you joined the Kalamazoo Astronomical Society! And, perhaps most obviously, stargazing stimulates curiosity. Learning about constellations, the solar system, and the universe engages your brain and can spark lifelong learning.

Now that warmer weather is finally here, cases of SAD will decline. We'll get to walk on trails, go biking, and even do some gardening. Don't forget about LOSS, though. Take a trip to a dark-sky site and join your fellow members at the Kalamazoo Nature Center for a Public Observing Session when the weather and your schedule allow. It's like a natural therapy session—without the price tag!

April Meeting Minutes

KAS President Richard Bell opened the society's general meeting on April 4, 2025, at 7:05 pm EDT. An estimated 37 members and guests were in attendance at the Kalamazoo Area Mathematics & Science Center, while another 37 people (or so) joined us virtually on Zoom.

In his President's Report, Richard listed upcoming outreach opportunities, including the Rock & Gem Show on May 3rd and 4th. Volunteers are needed to staff a table indoors and share views of the Sun outside if it's clear.

A training session for Owl Observatory is scheduled for Saturday, April 11th. (UPDATE: It has been postponed and will be rescheduled sometime in May.) Members should contact us if they are interested in learning to use the 16-inch Ashby Telescope.

Our friends from the Muskegon Astronomical Society have invited us to their swap meet on Saturday, May 17th, from 10am to 2pm. It will be held at their observatory, located at the Muskegon Wastewater Facility. Anyone interested in selling astronomically related goods should bring their own table. The swap meet will be postponed to May 31st in case of bad weather.

Richard gave everyone a heads-up that *Gadget Night* will be held at the general meeting on June 6th this year. Be sure to have your astronomically themed doodads, doohickeys, and devices ready by that time!

Next year marks the Kalamazoo Astronomical Society's 90th anniversary. Richard said he would welcome suggestions for special guest speakers to celebrate this momentous occasion.

Our guest speaker for the evening was Dr. Nicolle Zellner, a professor of physics at Albion College. This is Dr. Zellner's third appearance at a KAS meeting. She previously spoke to our group in 2007 and 2012. The title of her latest presentation for the KAS was *To the Moon! What We Know and Why We're Going Back*.

Dr. Zellner started her presentation with some basic lunar facts. The Moon is 238,854 miles away, making it our nearest planetary neighbor. With a diameter of 2,159.2 miles, it is ¼ Earth's size, and it has ⅙ Earth's gravity.

Today, we take it for granted that the Moon's surface is covered in impact craters. Dr. Zellner reminded us that the idea was once controversial. Ralph Baldwin, a planetary scientist from Grand Rapids, was one of the first to promote this idea in the late 1940s.

The Moon has no atmosphere, but water has been discovered in a frozen state. It's mostly concentrated at the poles, deep within craters where the Sun never shines.

The Moon has a very unique origin. When astronomers try to determine the origin and evolution of objects in the solar system, they think about them in terms of angular momentum.

With an inclination of 5.1°, it's clear the Moon couldn't have formed in orbit around Earth. If it did, it would orbit within Earth's equatorial plane, like all of Jupiter's major moons do. Earth could have captured the Moon from elsewhere in the solar system, but the angular momentum argument doesn't support that supposition.

To understand the history of the Moon (and beat the Russians), twelve Americans walked on its surface between 1969 and 1972. Eleven of them were former test pilots, while the other was a geologist (Jack Schmitt on Apollo 17). Their voyage to the Moon each took about 2.5 days, and all landing sites were on the nearside.

In all, the Apollo astronauts returned more than 800 lbs. of lunar samples to Earth. These helped reveal that the Moon is lifeless but holds many secrets about the solar system's early years.

One of the discoveries confirmed with lunar samples was that the Moon had volcanic activity in the past. In fact, the lunar maria visible most prominently on the nearside are the result of volcanic activity due to large impacts 3.2 to 3.7 billion years ago. Studies released within the past couple of months suggest the Moon was volcanically active as recently as 120 million years ago.

Volcanic rocks help us learn more about the composition and temperature of the Moon's interior. Radioactive dating methods can be used to determine when eruptions occurred. This data helps us reveal how the Moon solidified over time from its core to the surface.

Breccias, rocks made up of fragments of broken rock cemented together

under pressure, help us understand the impact rate on the Moon.

One of the biggest discoveries to come from the Apollo lunar samples was the Moon's origin. Samples containing materials like iron, cobalt, nickel, phosphorus, and sulfur (and their isotopes in particular) were almost a "dead match" for the same isotopes and elements on Earth.

This led to the large-impact hypothesis, which says that a Mars-sized body smashed into the proto-Earth and ejected debris into a disk around Earth, forming the Moon. The denser elements fell into Earth, while the less dense materials went into the Moon's formation. Computer simulations have helped confirm this idea.

The Moon's farside was finally revealed by robotic and manned missions that went into lunar orbit. One of the most notable differences between the nearside and farside is color (at least in grayscale images). Highland regions are brighter in appearance as they contain elements like calcium and aluminum. Darker areas, the maria, contain iron and titanium.

There are fewer maria on the farside and it has more impact craters. Both sides of the Moon received an equal number of impacts, but many craters were erased during the formation of the maria. Due to the Moon being tidally locked with Earth, gravitational forces helped make the crust on the nearside thinner. This made it easier for lava to reach the surface and erode much of the nearside's early cratering.

Lunar samples that were returned to Earth were "bone dry." The Apollo samples contained trace amounts of water, which scientists attributed to spacecraft contamination. However, scientists have detected frozen water in permanently shadowed areas at the Moon's north and south poles, as previously noted. The Moon's axial tilt is only 1.5°, which means sunlight never reaches the floors of many impact craters in these regions.

Dr. Zellner's research area is related to understanding the impact rate of the Earth-Moon system and what kind of organic materials may have been delivered to an early Earth. Erosion on Earth makes it difficult to study its very early history. This is much easier to do on the Moon since its only forms of erosion (mostly micrometeorite impacts) are much slower.

Overall, the impact rate on the Moon has steadily declined since it formed about 4.53 billion years ago. But around 3.9 billion years ago, there was a massive increase in impacts known as the Late Heavy Bombardment or lunar cataclysm. One idea as to the cause is the migration of Jupiter and Saturn from their initial orbits.

Ways to determine the time-varying impact flux on the Moon include studying samples such as crystalline melts in Apollo samples, crystalline melt clasts in meteorites, zircons (on Earth and the Moon), and lunar impact glasses (Dr. Zellner's specialty).

Regolith, the pulverized lunar surface that resembles sticky brown talcum powder, contains lunar impact glasses. A high-temperature event melts regolith, forming these glasses. Lunar glasses tell a story about where they are based on their composition. They can also determine their formation date by measuring the amount of potassium that has decayed into argon.

Space agencies in Europe, China, India, Japan, and the USA have an interest in sending more robotic and even human missions to the Moon.

There is already plenty of evidence of water, which could help sustain exploration of the lunar surface. Clementine detected the presence of water in the shadowed regions of the South Pole in 1994. Lunar Prospector (1999) detected cool neutrons that bounced off of hydrogen atoms. Other missions that detected water in the 2000s include Chandrayaan -1, Cassini, and Deep Impact.

The Moon offers abundant resources that are easier to mine than those on Earth. Some of these include titanium, iron, gold, platinum, silver, lithium, rubidium, strontium, and rhodium. The farside of the Moon is an ideal location for radio astronomy and cosmology research since there is little interference from human communication systems.

Other recent and ongoing missions to the Moon include Lunar Prospector, which launched in 1998 and has discovered new craters; GRAIL, which measured gravity anomalies; and LADEE, which helped us understand the atmospheric and dust environment of the Moon.

The key to future missions is both international and commercial collaboration due to the enormous expense of sending lunar probes to the Moon. Today, an Apollo-style mission would cost about $180 billion. NASA's current budget is only $25 billion.

Dr. Zellner mentioned the recent robotic lunar missions, including Astrobotic's Peregrine Mission 1 (2024), Intuitive Machines 1 (Odysseus) (2024), and Firefly Aerospace's Blue Ghost 1 (2025).

NASA hopes to return humans to the Moon with the Artemis program. Artemis II will circle the Moon no later than April 2026. Artemis III is scheduled to land humans on the Moon no later than mid-2027.

Thanks to Pete Mumbower for providing snacks during the break. Mike Sinclair volunteered to bring snacks to the May meeting.

Under observing reports, Joe Comiskey was able to watch Venus gradually disappear from the evening sky while visiting family in Arizona. Dave Woolf observed galaxies in the Virgo cluster with his C14. Mike Dupuis recently enjoyed a view of the waxing crescent Moon. Pete Mumbower has been imaging the galaxy NGC 2903 in Leo from his backyard observatory.

In astronomical news, new data suggests that dark energy is NOT constant and may be weakening. Astronomers used the Dark Energy Spectroscopic Instrument (DESI), an incredibly powerful instrument capable of observing 5,000 galaxies simultaneously, at Kitt Peak National Observatory.

According to detailed observations of a tiny, remote galaxy with the James Webb Space Telescope, the Epoch of Reionization started much earlier than most cosmologists had thought possible — a mere 330 million years after the Big Bang.

Scientists analyzing pulverized rock onboard the Curiosity rover have found the largest organic compounds on the Red Planet to date. The molecules found are decane, undecane, and dodecane, which are made up of 10, 11, and 12 carbons, respectively. These molecules are thought to be fragments of fatty acids that were preserved in the sample.

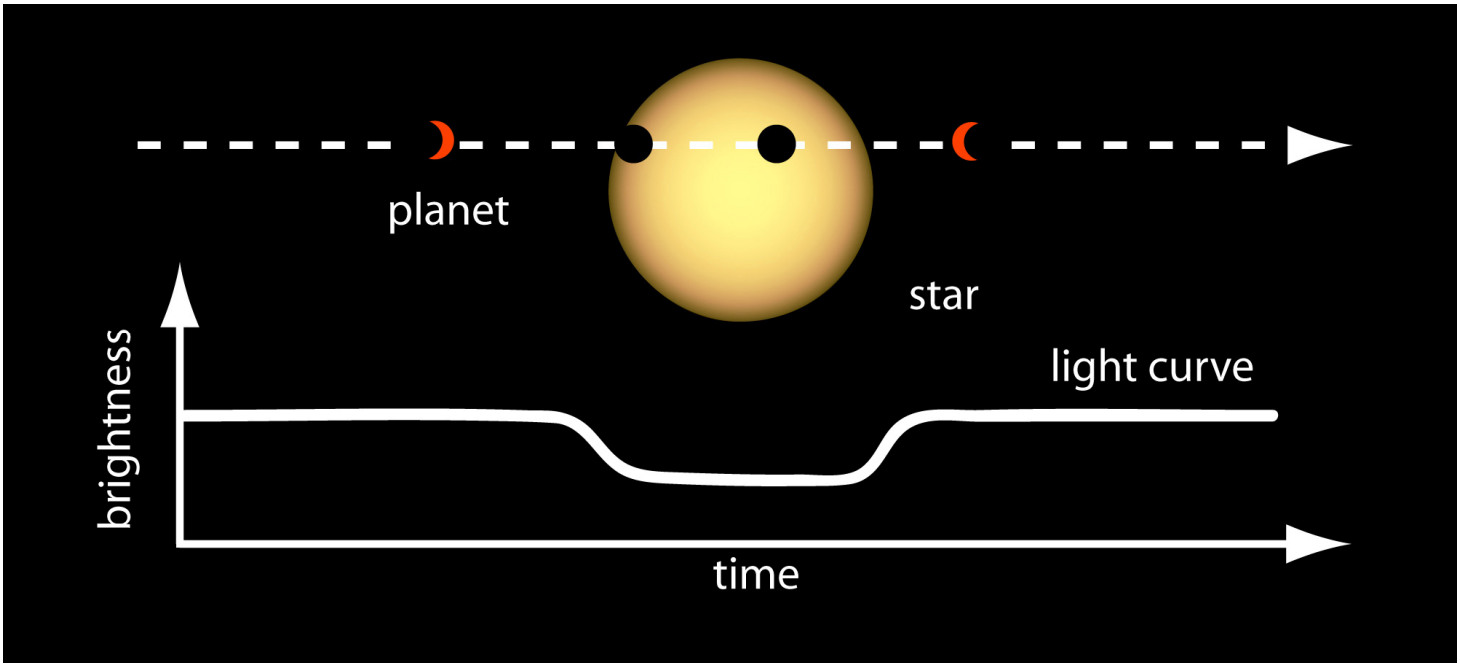
After discussing upcoming events, the meeting concluded at 8:55 pm.

How Do We Find Exoplanets?

by **Dave Prosper** | updated by **Kat Troche**

Astronomers have been trying to discover evidence that worlds exist around stars other than our Sun since the 19th century. By the mid-1990s, technology finally caught up with the desire for discovery and led to the first discovery of a planet orbiting another sun-like star, Pegasi 51b. Why did it take so long to discover these distant worlds, and what techniques do astronomers use to find them?

angle is just slightly askew, there will be no transits. Even in our solar system, a transit is very rare. For example, there were two transits of Venus visible across our Sun from Earth in this century. But the next time Venus transits the Sun as seen from Earth will be in the year 2117 – more than a century from now, even though Venus will have completed nearly 150 orbits around the Sun by then!



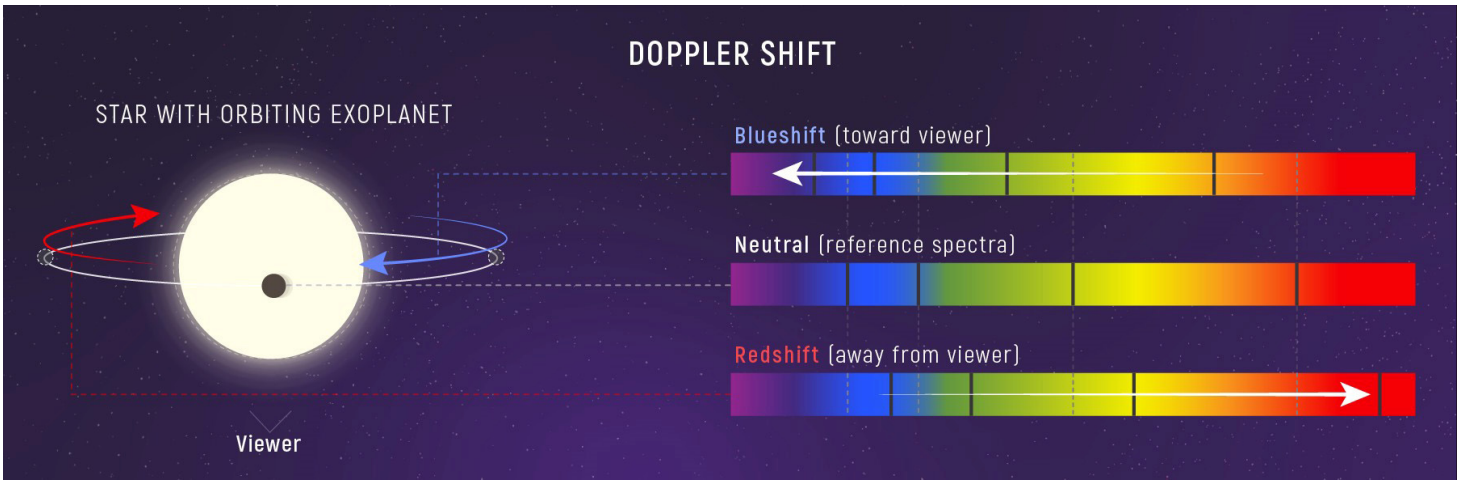
A planet passing in front of its parent star creates a drop in the star's apparent brightness, called a transit. Exoplanet Watch participants can look for transits in data from ground-based telescopes, helping scientists refine measurements of the length of a planet's orbit around its star. Credit: NASA's Ames Research Center

The Transit Method

One of the most famous exoplanet detection methods is the **transit method**, used by Kepler and other observatories. When a planet crosses in front of its host star, the light from the star dips slightly in brightness. Scientists can confirm a planet orbits its host star by repeatedly detecting these incredibly tiny dips in brightness using sensitive instruments. If you can imagine trying to detect the dip in light from a massive searchlight when an ant crosses in front of it, at a distance of tens of miles away, you can begin to see how difficult it can be to spot a planet from light-years away! Another drawback to the transit method is that the distant solar system must be at a favorable angle to our point of view here on Earth – if the distant system's

The Wobble Method

Spotting the Doppler shift of a star's spectra was used to find Pegasi 51b, the first planet detected around a Sun-like star. This technique is called the **radial velocity or "wobble" method.** Astronomers split up the visible light emitted by a star into a rainbow. These spectra, and gaps between the normally smooth bands of light, help determine the elements that make up the star. However, if there is a planet orbiting the star, it causes the star to wobble ever so slightly back and forth. This will, in turn, cause the lines within the spectra to shift ever so slightly towards the blue and red ends of the spectrum as the star wobbles slightly away and towards us. This is caused by the blue and red shifts of the planet's light. By carefully measuring the



As a planet orbits a star, the star wobbles. This causes a change in the appearance of the star's spectrum called Doppler shift. Because the change in wavelength is directly related to relative speed, astronomers can use Doppler shift to calculate exactly how fast an object is moving toward or away from us. Astronomers can also track the Doppler shift of a star over time to estimate the mass of the planet orbiting it. Credit: NASA, ESA, CSA, Leah Hustak (STScI)

amount of shift in the star's spectra, astronomers can determine the size of the object pulling on the host star and if the companion is indeed a planet. By tracking the variation in this periodic shift of the spectra, they can also determine the time it takes the planet to orbit its parent star.

Direct Imaging

Finally, exoplanets can be revealed by **directly imaging** them, such as this image of four planets found orbiting the star HR 8799! Space telescopes use instruments called **coronagraphs** to block the bright light from the host star and capture the dim light from planets. The Hubble Space Telescope has captured images of giant planets orbiting a few nearby systems, and the James Webb Space Telescope has only improved on these observations by uncovering more details, such as the colors and spectra of exoplanet atmospheres, temperatures, detecting potential exomoons, and even scanning atmospheres for potential biosignatures!

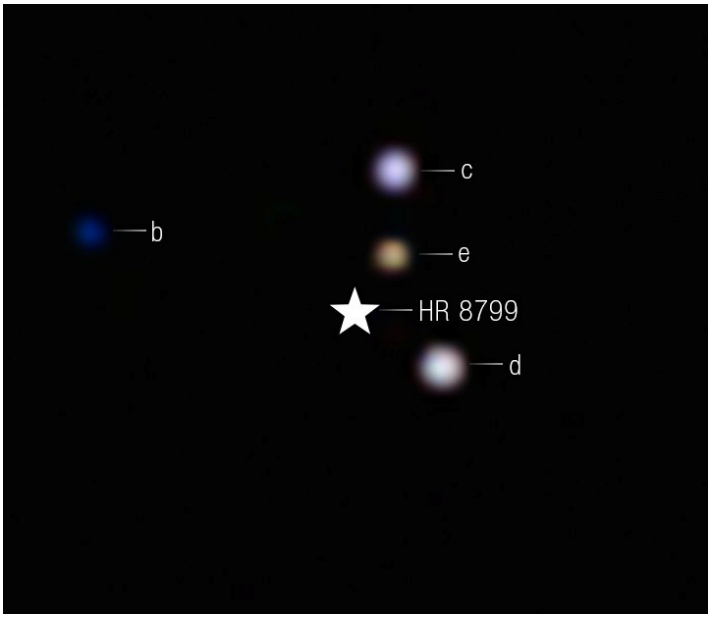
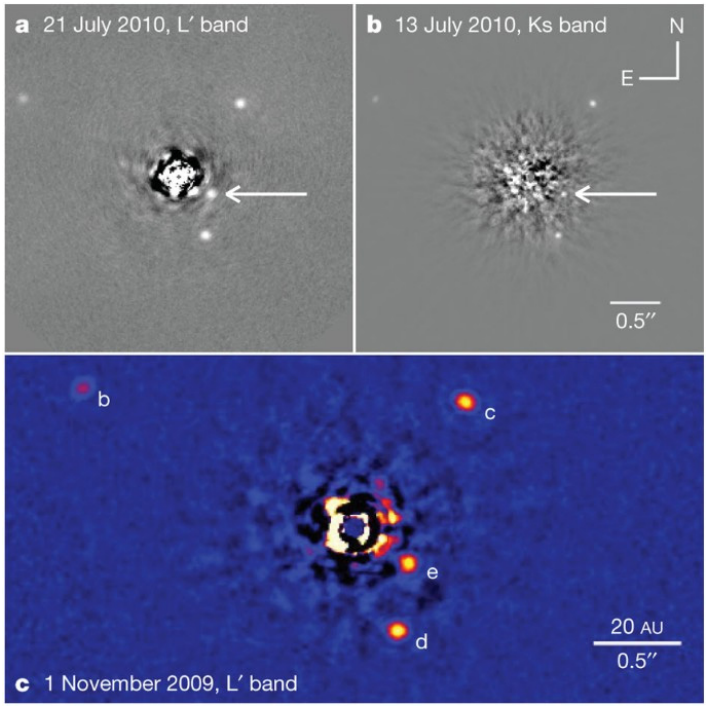


Image taken by the James Webb Space Telescope of four exoplanets orbiting HR 8799. Credit: NASA, ESA, CSA, STScI, Laurent Pueyo (STScI), William Balmer (JHU), Marshall Perrin (STScI)

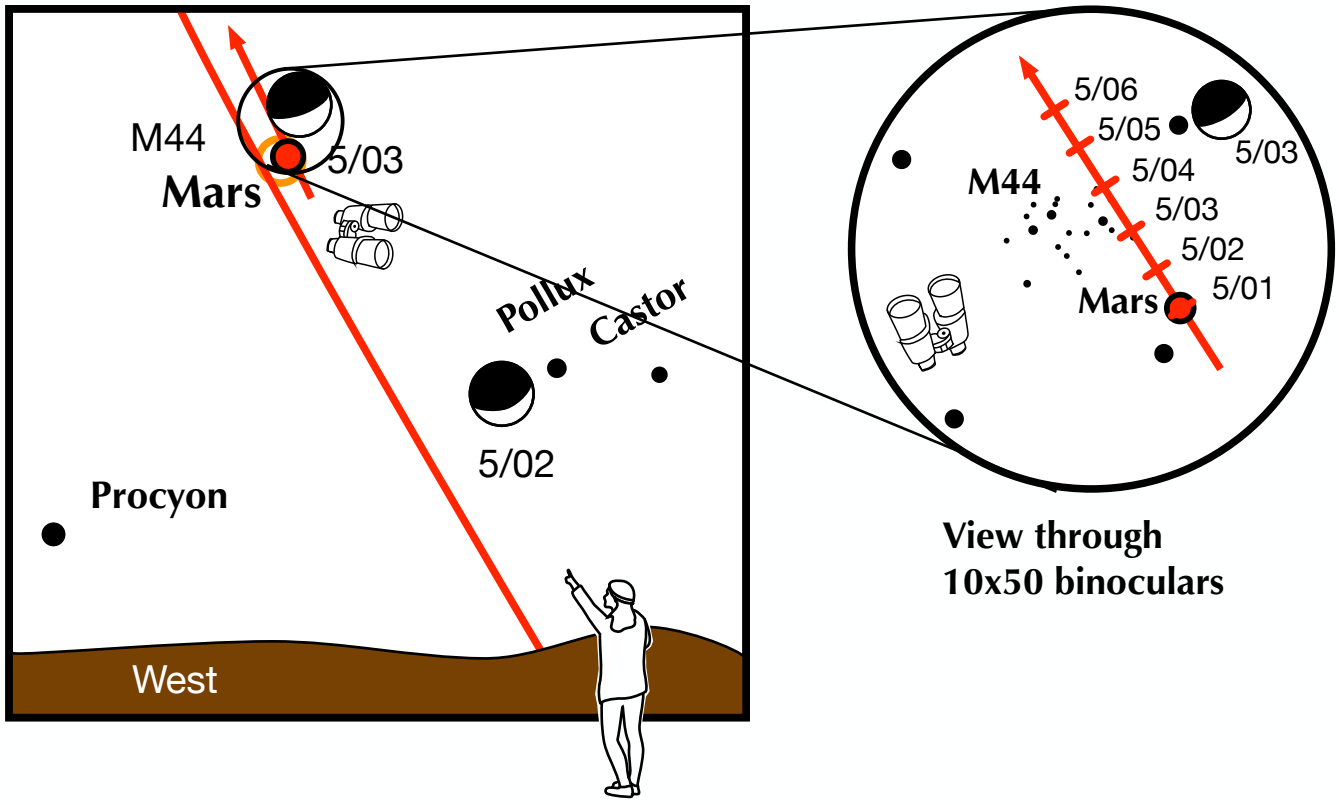


You can find more information and activities on NASA's Exoplanets page, such as the Eyes on Exoplanets browser-based program, The Exoplaneteers, and some of the latest exoplanet news. Lastly, you can find more resources in our News & Resources section, including a clever demo on how astronomers use the wobble method to detect planets!

The future of exoplanet discovery is only just beginning, promising rich rewards in humanity's understanding of our place in the Universe, where we are from, and if there is life elsewhere in our cosmos.

This article is distributed by NASA's Night Sky Network (NSN). Visit go.nasa.gov/nightskynetwork to find local clubs, events, and more!

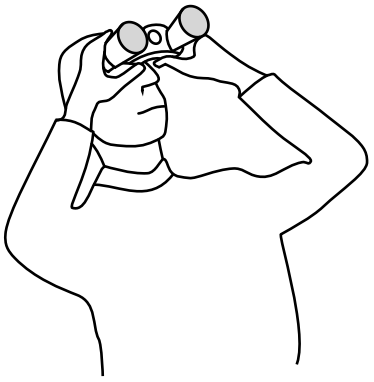
If you can see only one celestial event this month, see this one.



Beginning on May 1, look to the west-northwest 90 minutes after sunset.

• The twin stars of Gemini, Castor and Pollux, will be found forming a horizontal bar low above the horizon.

• On the following evening, the crescent moon moves near Pollux, almost forming a straight line with it and Castor.



• Red Mars slides toward M44, aka the Beehive Star cluster. Use binoculars to find Mars inching closer to the many stellar bees.

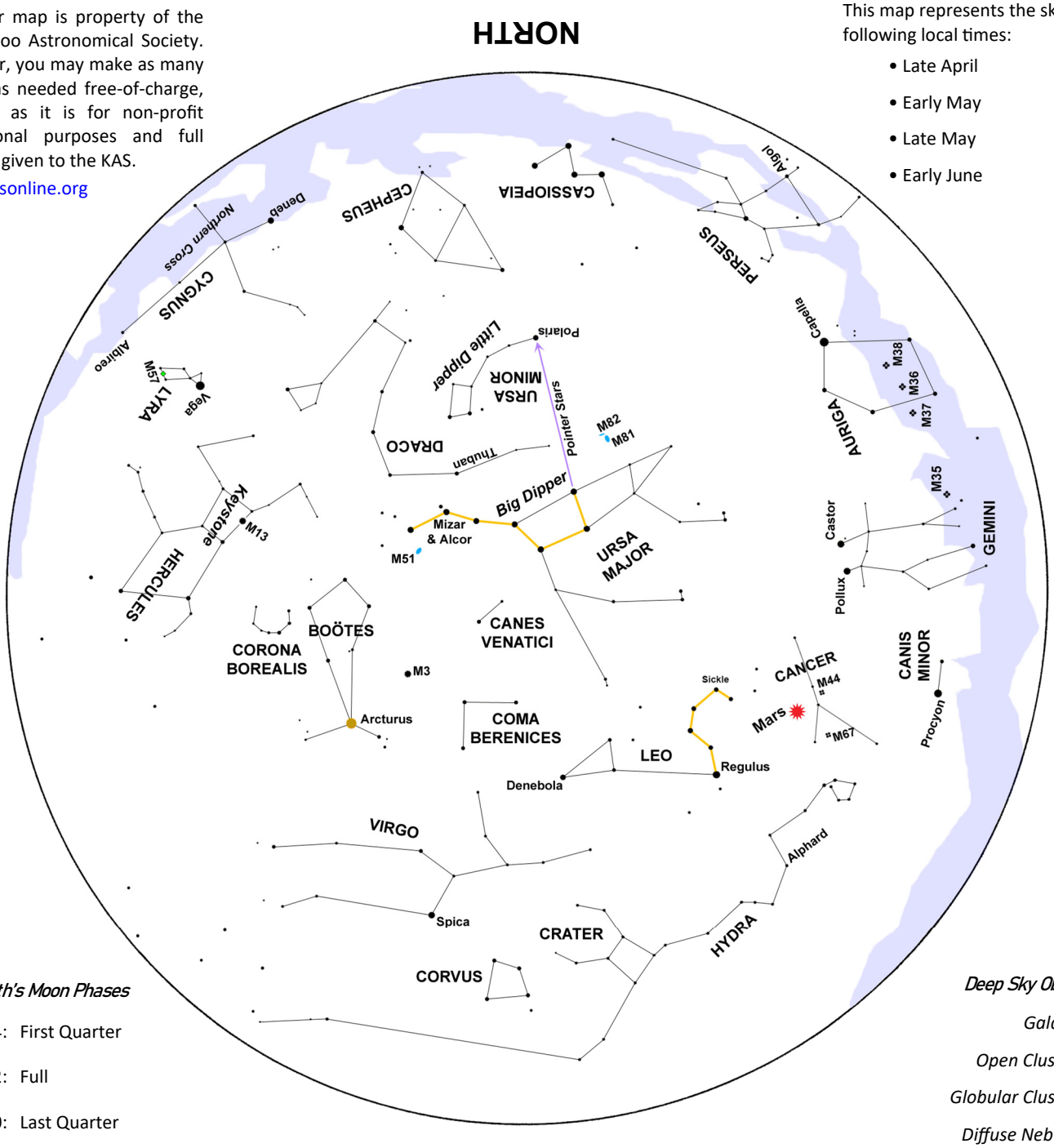
• On May 3, the thick crescent moon joins Mars sitting to the upper left of the red planet and above the bees.

• Over the next few evenings, the Red Planet moves past M44, leaving it on May 5.

May Night Sky

This map represents the sky at the following local times:

- Late April 12 am
- Early May 11 pm
- Late May 10 pm
- Early June Dusk



This Month's Moon Phases

- 4: First Quarter
- 12: Full
- 20: Last Quarter
- 26: New

Deep Sky Object Key

- *Galaxy*
- *Open Cluster*
- *Globular Cluster*
- *Diffuse Nebula*
- *Planetary Nebula*

Early risers with a clear view of the east-southeastern horizon should look for Venus and Saturn less than 4° apart shortly before dawn on May 1st. Mercury is about 16° to Venus' lower left, but it will be very difficult to spot.

A nearly first-quarter Moon will be about 1¼° above Mars on the evening of May 3rd. If you look at the pairing with binoculars, you'll spot a sparkling cluster of stars. It's the Beehive Cluster (M44) in Cancer.

A waxing gibbous Moon will be about 1° below Spica, Virgo's brightest star, on the morning of May 10th. Watch them descend toward the west-southwestern horizon.

The Moon, now in a waning gibbous phase, rises 1° to the lower right of Antares in the southeast on May 13th. Antares is the heart of the summer constellation Scorpius.

A waning crescent Moon will be a little over 4° to the upper right of Saturn starting an hour or two before sunrise on May 22nd. On the following morning, May 23rd, the Moon, Saturn, and Venus form a graceful arc. This is a sight that can only be enjoyed with the unaided eye.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May 24th
Galaxies of the Great Bear
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General Meeting Preview

Galaxies on the Edge

Using NASA's JWST to Learn How Galaxies Work

presented by

Prof. Chris Howk
University of Notre Dame

Galaxies like the Milky Way form stars from their gas. However, maintaining enough gas at the right conditions to make new stars involves a delicate balance between the ingestion of new gas from a galaxy's extended atmosphere and the expulsion of gas full of life-giving elements from its disk. Notre Dame astronomers are working to understand this balance better using NASA's James Webb Space Telescope. Prof. Howk will discuss how JWST achieves its groundbreaking sensitivity and the results of his own work with this remarkable observatory.

— About the Speaker —

Prof. Chris Howk is a professor in the University of Notre Dame's Department of Physics and Astronomy, where he teaches both astronomy and physics and mentors PhD students. Prof. Howk studied physics at Hanover College before getting his PhD in Astronomy at the University of Wisconsin. He worked previously to study the gas in the Milky Way and its nearest neighbors as part of NASA's Far Ultraviolet Spectroscopic Explorer mission while at The Johns Hopkins University. He subsequently worked as a research physicist at the University of California, San Diego's Center for Astrophysics and Space Science, where he worked to study the gas of galaxies in the early Universe. Prof. Howk joined Notre Dame in 2005. Prof. Howk has been at Notre Dame long enough that his son is now a student there, and he's studying physics.

Friday, May 2nd @ 7:00 pm EDT

Kalamazoo Area Math & Science Center

Use Dutton St. Entrance • Locked by 7:10 pm

Also held on Zoom • Click to Register