Volume 49 Number 6 June 2023

The Celestial Mechanic

The Official Newsletter of the Astronomy Associates of Lawrence

Coming Events

Monthly Meeting
June 25, 2023, 7:00PM
Baker Wetlands Discovery Center

Public Observing
June 25, 2023, 8:00PM
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

On Saturday evening, May 20th we held our second annual combined AAL/KU Department of Physics and Astronomy Star Party at Baker Wetlands Discovery Center. It started out clear but unexpected clouds from the south began encroaching even before it was fully dark. That, and the fact that we were competing with graduation parties, kept the attendance low. We discussed rethinking the date for next year's Wetlands Star Party.

Lawrence City Band starts its South Park summer concert series on the Wednesday following Memorial Day. The dates we will be observing following the concerts are:

Wednesday, May 31

Wednesday, June 14

Wednesday, June 28

Wednesday, July 12

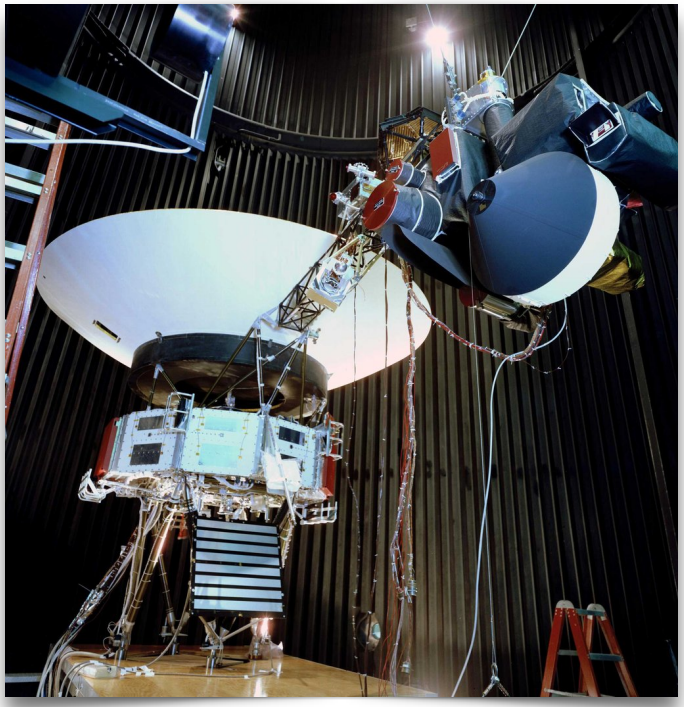
Observing will follow the conclusion of the concerts at approximately 9:00 PM each of these evenings. We will be setting up in the grassy area to the south of the Community Building, on the west side of Massachusetts Street. Should any of the concert be moved indoors due to heat or inclement weather, the observing session for that evening will be cancelled.

Hope you can make it out to some of our summer events.

NASA's Voyager Will Do More Science With New Power Strategy

JPL, April 26, 2023

The plan will keep Voyager 2's science instruments turned on a few years longer than previously anticipated, enabling yet more revelations from interstellar space.



The Voyager proof test model, shown in a space simulator chamber at JPL in 1976, was a replica of the twin Voyager space probes that launched in 1977. The model's scan platform stretches to the right, holding several of the spacecraft's science instruments in their deployed positions.

Launched in 1977, the Voyager 2 spacecraft is more than 12 billion miles (20 billion kilometers) from Earth, using five science instruments to study interstellar space. To help keep those instruments operating despite a diminishing power supply, the aging spacecraft has begun using a small reservoir of backup power set aside as part of an onboard safety mechanism. The move will enable the mission to postpone shutting down a science instrument until 2026, rather than this year.

Voyager 2 and its twin Voyager 1 are the only spacecraft ever to operate outside the heliosphere, the protective bubble of particles and magnetic fields generated by the Sun. The probes are helping scientists answer questions about the shape of the heliosphere and its role in protecting Earth from the energetic particles and other radiation found in the interstellar environment.

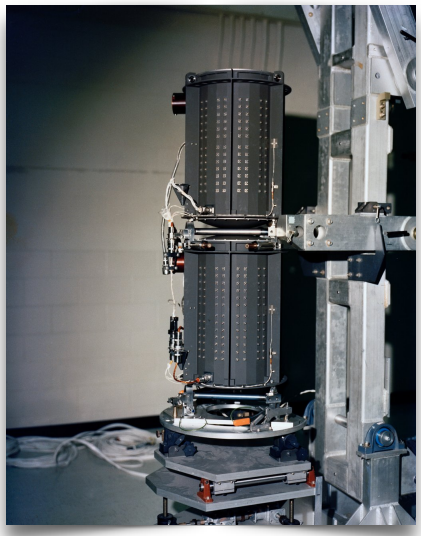
"The science data that the Voyagers are returning gets more valuable the farther away from the Sun they go, so we are definitely interested in keeping as many science instruments operating as long as possible," said Linda Spilker, Voyager's project scientist at NASA's Jet Propulsion Laboratory in Southern California, which manages the mission for NASA.

Power to the Probes

Both Voyager probes power themselves with radioisotope thermoelectric generators (RTGs), which convert heat from decaying plutonium into electricity. The continual decay process means the generator produces slightly less power each year. So far, the declining power supply hasn't impacted the mission's science output, but to compensate for the loss, engineers have turned off heaters and other systems that are not essential to keeping the spacecraft flying.

With those options now exhausted on Voyager 2, one of the spacecraft's five science instruments was next on their list. (Voyager 1 is operating one less science instrument than its twin because an instrument failed early in the mission. As a result, the decision about whether to turn off an instrument on Voyager 1 won't come until sometime next year.)

In search of a way to avoid shutting down a Voyager 2 science instrument, the team took a closer look at a safety mechanism designed to protect the instruments in case the spacecraft's voltage – the flow of electricity – changes significantly. Because a fluctuation in voltage could damage the



Each of NASA's Voyager probes are equipped with three radioisotope thermoelectric generators (RTGs), including the one shown here. The RTGs provide power for the spacecraft by converting the heat generated by the decay of plutonium-238 into electricity.

instruments, Voyager is equipped with a voltage regulator that triggers a backup circuit in such an event. The circuit can access a small amount of power from the RTG that's set aside for this purpose. Instead of reserving that power, the mission will now be using it to keep the science instruments operating.

Although the spacecraft's voltage will not be tightly regulated as a result, even after more than 45 years in flight, the electrical systems on both probes remain relatively stable, minimizing the need for a safety net. The engineering team is also able to monitor the voltage and respond if it fluctuates too much. If the new approach works well for Voyager 2, the team may implement it on Voyager 1 as well.

"Variable voltages pose a risk to the instruments, but we've determined that it's a small risk, and the alternative offers a big reward of being able to keep the science instruments turned on longer," said Suzanne Dodd, Voyager's project manager at JPL. "We've been monitoring the spacecraft for a few weeks, and it seems like this new approach is working."

The Voyager mission was originally scheduled to last only four years, sending both probes past Saturn and Jupiter. NASA extended the mission so that Voyager 2 could visit Neptune and Uranus; it is still the only spacecraft ever to have encountered the ice giants. In 1990, NASA extended the mission again, this time with the goal of sending the probes outside the heliosphere. Voyager 1 reached the boundary in 2012, while Voyager 2 (traveling slower and in a different direction than its twin) reached it in 2018.

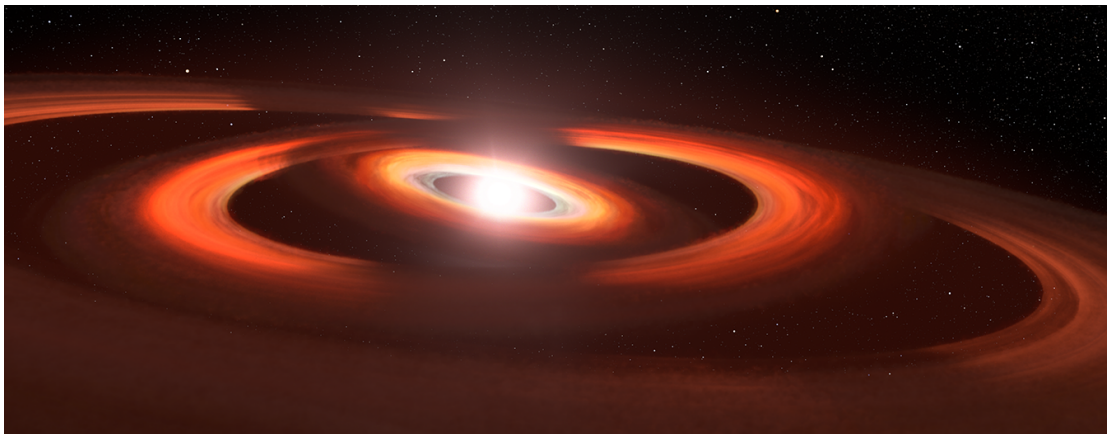
More About the Mission

A division of Caltech in Pasadena, JPL built and operates the Voyager spacecraft. The Voyager missions are a part of the NASA Heliophysics System Observatory, sponsored by the Heliophysics Division of the Science Mission Directorate in Washington.

For more information about the Voyager spacecraft, visit: https://www.nasa.gov/voyager ☀

HUBBLE FOLLOWS SHADOW PLAY AROUND PLANET-FORMING DISK

HUBBLESITE, MAY 4, 2023



UNSEEN NEWBORN PLANETS ARE STIRRING UP DUST AROUND A YOUNG STAR

Our universe is so capricious it sometimes likes to play a game of hide and seek. In 2017, astronomers were surprised to see a huge shadow sweeping across a disk of dust and gas encircling the nearby young star TW Hydrae. The shadow is cast by an inner disk of dust and gas that is slightly tilted to the plane of the outer disk. The shadow can only be clearly seen because the system is tilted face-on to Earth, giving astronomers a bird's-eye view of the disk as the shadow sweeps around the disk like a hand moving around a clock.

But a clock has two hands (hours and minutes) sweeping around at different rates. And, it turns out, so does TW Hydrae. Astronomers used Hubble to find a second shadow emerging from yet another inner disk, that is tilted to the two outer disks. So, the system looks increasingly complicated with at least three nested disks slightly tilted relative to each other. The disks are proxies for unseen planets around the star. Each planet is gravitationally pulling on material near the star and warping what would have been a perfectly flat, pancake-shaped disk if no planets were present. This is not a surprise because the planets in our solar system have orbital planes that vary in tilt by a few degrees from each other. TW Hydrae gives astronomers a ringside seat to how our solar system may have looked during its formative years.

The young star TW Hydrae is playing "shadow puppets" with scientists observing it with NASA's Hubble Space Telescope.

In 2017, astronomers reported discovering a shadow sweeping across the face of a vast pancake-shaped gas-and-dust disk surrounding the red dwarf star. The shadow isn't from a planet, but from an inner disk slightly inclined relative to the much larger outer disk – causing it to cast a shadow. One explanation is that an unseen planet's gravity is pulling dust and gas into the planet's inclined orbit.

Now, a second shadow – playing a game of peek-a-boo – has emerged in just a few years between observations stored in Hubble's MAST archive . This could be from yet another disk nestled inside the system. The two disks are likely evidence of a pair of planets under construction.

TW Hydrae is less than 10 million years old and resides about 200 light-years away. In its infancy, our solar system may have resembled the TW Hydrae system, some 4.6 billion years ago. Because the TW Hydrae system is tilted nearly face-on to our view from Earth, it is an optimum target for getting a bull's-eye-view of a planetary construction yard.

The second shadow was discovered in observations obtained on June 6, 2021, as part of a multi-year program designed to track the shadows in circumstellar disks. John Debes of AURA/STScI for the European Space Agency at the Space Telescope Science Institute in Baltimore, Maryland, compared the TW Hydrae disk to Hubble observations made several years ago.

"We found out that the shadow had done something completely different," said Debes, who is principal investigator and lead author of the study published in.

"When I first looked at the data, I thought something had gone wrong with the observation because it wasn't what I was expecting. I was flummoxed at first, and all my collaborators were like: what is going on? We really had to scratch our heads and it took us a while to actually figure out an explanation."

The best solution the team came up with is that there are two misaligned disks casting shadows. They were so close to each other in the earlier observation they were missed. Over time they've now separated and split into two shadows. "We've never really seen this before on a protoplanetary disk. It makes the system much more complex than we originally thought," he said.

The simplest explanation is that the misaligned disks are likely caused by the gravitational pull of two planets in slightly different orbital planes. Hubble is piecing together a holistic view of the architecture of the system.

The disks may be proxies for planets that are lapping each other as they whirl around the star. It's sort of like spinning two vinyl phonograph records at slightly different speeds. Sometimes labels will match up but then one gets ahead of the other.

"It does suggest that the two planets have to be fairly close to each other. If one was moving much faster than the other, this would have been noticed in earlier observations. It's like two race cars that are close to each other, but one slowly overtakes and laps the other," said Debes.

The suspected planets are located in a region roughly the distance of Jupiter from our Sun. And, the shadows complete one rotation around the star about every 15 years – the orbital period that would be expected at that distance from the star.

Also, these two inner disks are inclined about five to seven degrees relative to the plane of the outer disk. This is comparable to the range of orbital inclinations inside our solar system. "This is right in line with typical solar system style architecture," said Debes.

The outer disk that the shadows are falling on may extend as far as several times the radius of our solar system's Kuiper belt. This larger disk has a curious gap at twice Pluto's average distance from the Sun. This might be evidence for a third planet in the system.

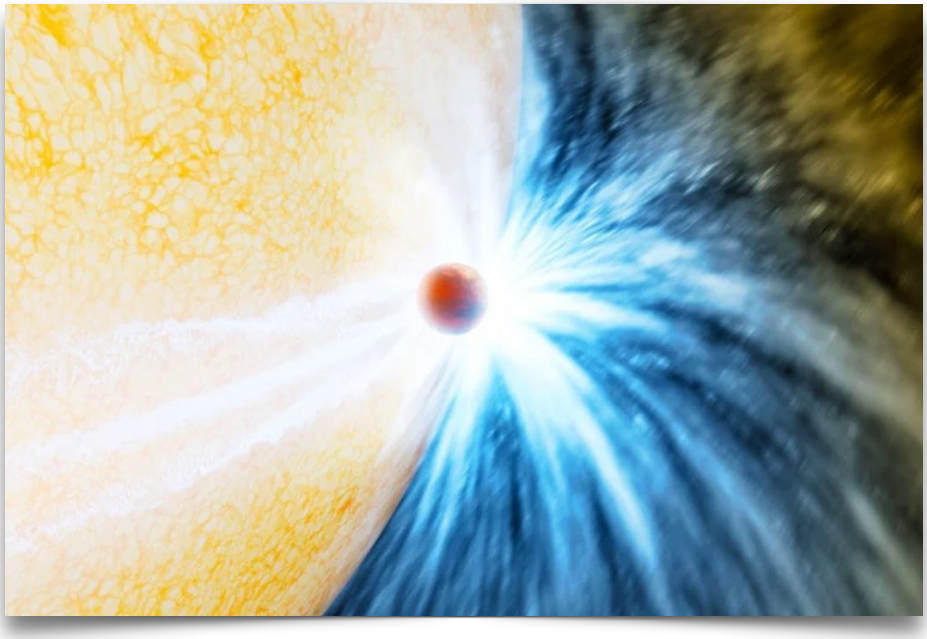
Any inner planets would be difficult to detect because their light would be lost in the glare of the star. Also, dust in the system would dim their reflected light. ESA's Gaia space observatory may be able to measure a wobble in the star if Jupiter-mass planets are tugging on it, but this would take years given the long orbital periods.

The TW Hydrae data are from Hubble's Space Telescope Imaging Spectrograph. The James Webb Space Telescope's infrared vision may also be able to show the shadows in more detail. ☀

“Made Me Fall Off My Chair”: Scientists Saw a Star Swallow a Planet for the First Time

By Ally Mauch

NICENEWS, MAY 8, 2023



In a scientific first, astronomers observed a star swallowing a planet as part of its dying process.

The researchers first spotted the outburst, which took place about 12,000 light-years away from Earth, in 2020, but it took several years for them to figure out what it was: a star running out of fuel, swelling to “a million times its original size,” and engulfing everything around it, including a nearby planet, per a press release from MIT.

The team used an infrared camera to look at the star, finding that the amount of energy expelled during the outburst indicated a planet, about the size of Jupiter, crashing into its star.

“That infrared data made me fall off my chair,” said Kishalay De, the lead author of the study outlining the findings.

They thought the outburst could have been from the star merging with another one, but reached their eventual star swallow conclusion by comparing their infrared data to that of NASA’s infrared space telescope. The compiled data helped determine the energy output of the star, which was “surprisingly small — about 1/1,000 the magnitude of any stellar merger observed in the past.“

“That means that whatever merged with the star has to be 1,000 times smaller than any other star we’ve seen,” De said. “And it’s a happy coincidence that the mass of Jupiter is about 1/1,000 the mass of the sun. That’s when we realized: This was a planet, crashing into its star.”

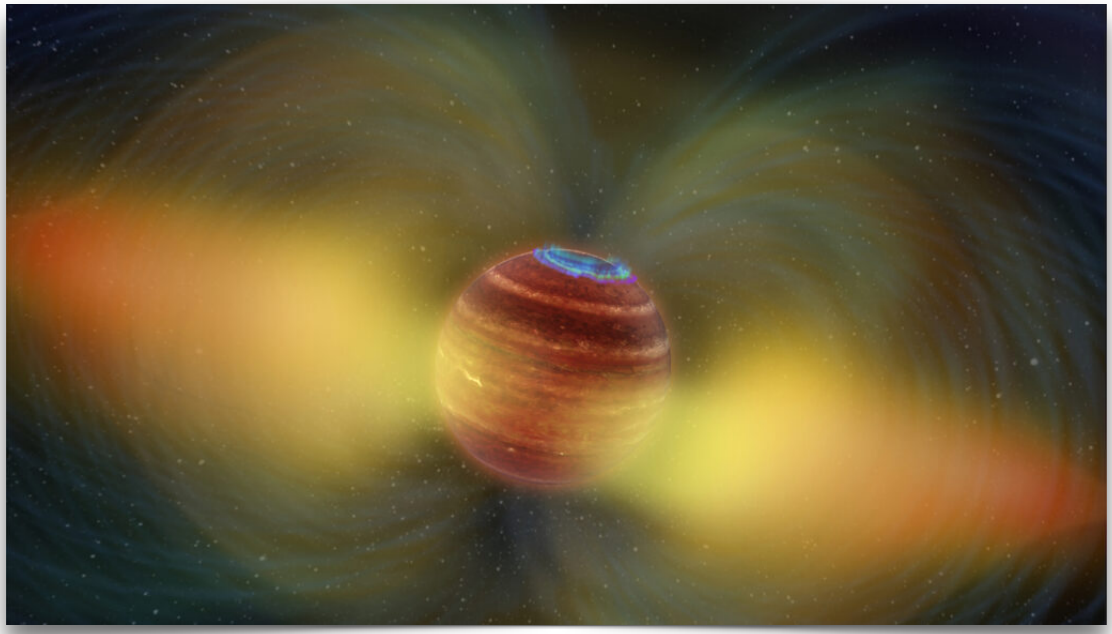
The findings do carry a bit of an ominous connotation: Many astronomers believe planet Earth will likely meet its end in the same way — getting swallowed by our star, the sun — but not for another 5 billion years, so there’s no need to fret. De likes to think of that faraway prospect as “poetic,“ he told *The Washington Post*.

“It’s somewhat poetic in that all of that we see around us, all the stuff that we’ve built around us, this will all be burned in a flash when the Sun decides to evolve and become puffy in 5 billion years,” he explained.

For now, though, scientists and astronomers are celebrating the historic observation. “For decades, we’ve been able to see the before and after,” De added in the press release. “Before, when the planets are still orbiting very close to their star, and after, when a planet has already been engulfed, and the star is giant. What we were missing was catching the star in the act, where you have a planet undergoing this fate in real-time. That’s what makes this discovery really exciting.” ☀

The first radiation belt outside the solar system has been spotted

Such belts can help reveal details about a cosmic body's insides and environment



A Jupiter-sized object outside the solar system has a radiation belt (illustrated) about 10 million times as bright as the ones around Jupiter.

By Lisa Grossman
Sciencenews, May 15, 2023

For the first time, astronomers have spotted a band of radiation surrounding an object outside our solar system.

A belt of energetic electrons encircles a Jupiter-sized body about 18 light-years from Earth, astronomers report May 15 in *Nature*. As the electrons move, they radiate radio waves. Such radiation belts give insight into the shape of a cosmic object's magnetic field, its interior structure and maybe even whether it has moons.

In our solar system, every planet with a worldwide magnetic field has radiation belts. Earth has the Van Allen belts, rings of electrons captured from the sun (*SN: 3/19/14*). Jupiter's radiation belts get most of their particles from the volcanic moon Io. In these cases, the planet's magnetic field traps electrons in a bubble around the planet, like fireflies in a jar.

To find similar belts outside the solar system, astronomer Melodie Kao and colleagues observed a Jupiter-sized object called LSR J1835+3259 with a network of 39 radio dishes spanning from Hawaii to Germany. Together, the dishes effectively created a radio telescope about as wide as Earth, letting the team zero in on the object's environment.

The team spotted a belt that looks a lot like those of Jupiter's but 10 million times as bright, says Kao, of the University of California, Santa Cruz. The object is nearly 80 times as massive as Jupiter, making it either a diminutive star or a massive brown dwarf, a dim starlike body not hefty enough to sustain hydrogen fusion.

One big mystery is where the electrons come from. The object doesn't orbit a star, and it doesn't seem to emit flares. A volcanic satellite would fit the bill, Kao says, but that's still speculative.

Knowing that LSR J1835+3259 has a radiation belt will help researchers interpret data from exoplanets in the future, even if astronomers can't see such belts directly.

"Exoplanet magnetism is truly at its infancy," Kao says. "Until we can characterize exoplanet magnetic fields, we'll miss entire segments of their life stories." ☀

The Milky Way galaxy may be a different shape than we thought

By Robert Lea

SPACE.COM, MAY 15, 2023

The shape of our galaxy may reveal a history of collisions with other galaxies or even galactic clusters.

Illustration of our galaxy, the Milky Way.

New measurements suggest that the Milky Way galaxy may have a different shape than we thought.

Over the past few years, astronomers have increasingly discovered that galaxies seem to come in three main shapes: Elliptical, irregular and spiral. The majority of known galaxies that fit in this last category seem to have two prominent "arms" that branch out and split into lesser arms.

But the traditional portrayal of the Milky Way is that of a galaxy with four major spiral arms extending out from a thick centralized bulge of stars. This makes our spiral galaxy stand out as an extremely rare outlier with an odd shape that must have some very unique properties to grant it four major arms.

That portrayal could be wrong, however. A team of astronomers has published new research that suggests we have been wrong about the shape of the Milky Way for decades, with our galaxy instead having two main arms just like its contemporary spiral galaxies.

The revelation that could reshape our understanding of the Milky Way came about when space scientists with the Chinese Academy of Sciences based at the

Purple Mountain and National Astronomical Observatories analyzed multiple sources of astronomical data to get a better understanding of our galaxy's true shape.

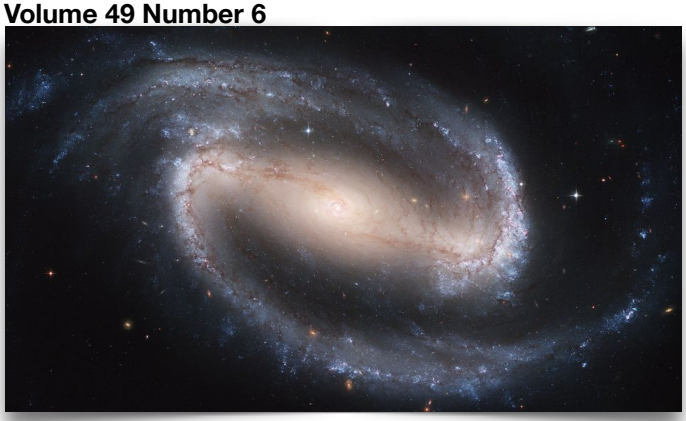
"In spite of much work, the overall spiral structure morphology of the Milky Way remains somewhat uncertain," the astronomers wrote in a paper describing their research and conclusions. "In the last two decades, accurate distance measurements have provided us with an opportunity to solve this issue."

The team assessed data from a new generation of space instruments that can better measure the distance to individual stars which allowed them to measure the distances to around 200 stars and start putting together a map of the Milky Way. They then added data from the European Space Agency (ESA)'s Gaia space telescope which precisely observes the movement of stars and their location in relation to Earth.

In particular, the astronomers honed in on hot and massive stars called OB stars in the Gaia data. Because these stars are short-lived they move very little during their main-sequence hydrogen-burning lifetime which makes them useful for mapping purposes. Data collected from 24,000 OB stars was added to the map as were Gaia observations of over 1,000 open galactic clusters.

This led the astronomers to suggest that the Milky Way is a barred spiral galaxy with just two main arms extending from this dense central bar.

"Using the precise locations of very young objects, for the first time, we propose that our galaxy has a multiple-arm morphology that consists of two-arm symmetry," they wrote. "The Norma and Perseus Arms are likely the two symmetric arms in the inner Milky Way. As they extend from the inner galaxy to the outer



NGC 1300, a barred spiral galaxy with two arms, photographed by the Hubble Space Telescope.

parts, they bifurcate, and connect to the Centaurus and Sagittarius Arms, respectively."

At the outskirts of the Milky Way, the astronomers write, are distant and fragmented irregular arms that are not connected to the central bulge of the galaxy where the majority of its stars are located. The fragmentation of spiral arms may have been caused by our galaxy colliding with other galaxies or even galactic clusters in its ancient history.

The team of astronomers concluded that this new model of the Milky Way's shape could provide an alternative basis for future studies of galactic structure. They add that more details should be revealed by further observations of nearby radio sources taken by multiple telescopes that would allow their distances from Earth to be calculated, and by improved data from the Gaia spacecraft. Gaia launched in 2013 and is expected to observe the universe for at least another two years until 2025. ☀

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Here is the first direct look at Neptune's rings in more than 30 years

Astronomers haven't seen the dark rings since Voyager 2 flew past in 1989

By Christopher Crockett

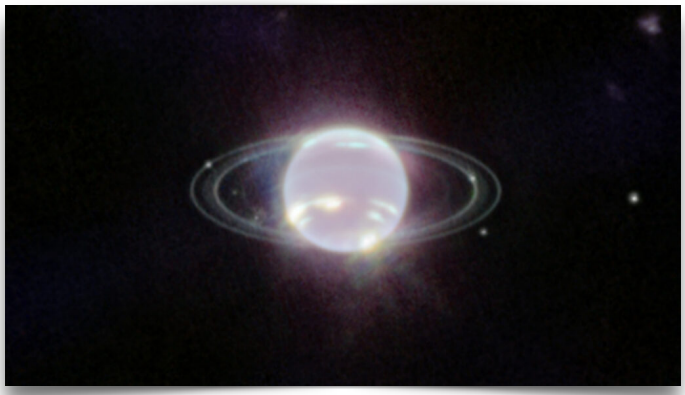
SCIENCENEWS, SEPTEMBER 23, 2022

Humankind is seeing Neptune's rings in a whole new light thanks to the James Webb Space Telescope.

In an infrared image released September 21, Neptune and its gossamer diadems of dust take on an ethereal glow against the inky backdrop of space. The stunning portrait is a huge improvement over the rings' previous close-up, which was taken more than 30 years ago.

Unlike the dazzling belts encircling Saturn, Neptune's rings appear dark and faint in visible light, making them difficult to see from Earth. The last time anyone saw Neptune's rings was in 1989, when NASA's Voyager 2 spacecraft, after tearing past the planet, snapped a couple grainy photos from roughly 1 million kilometers away (*SN: 8/7/17*). In those photos, taken in visible light, the rings appear as thin, concentric arcs.

As Voyager 2 continued to interplanetary space, Neptune's rings once again went into hiding — until July. That's when the James Webb Space Telescope, or JWST, turned its sharp, infrared gaze toward the planet from roughly 4.4 billion kilometers away (*SN: 7/11/22*).



Neptune and its rings glow in infrared light in this image from the James Webb Space Telescope.

Neptune itself appears mostly dark in the new image. That's because methane gas in the planet's atmosphere absorbs much of its infrared light. A few bright patches mark where high-altitude methane ice clouds reflect sunlight.

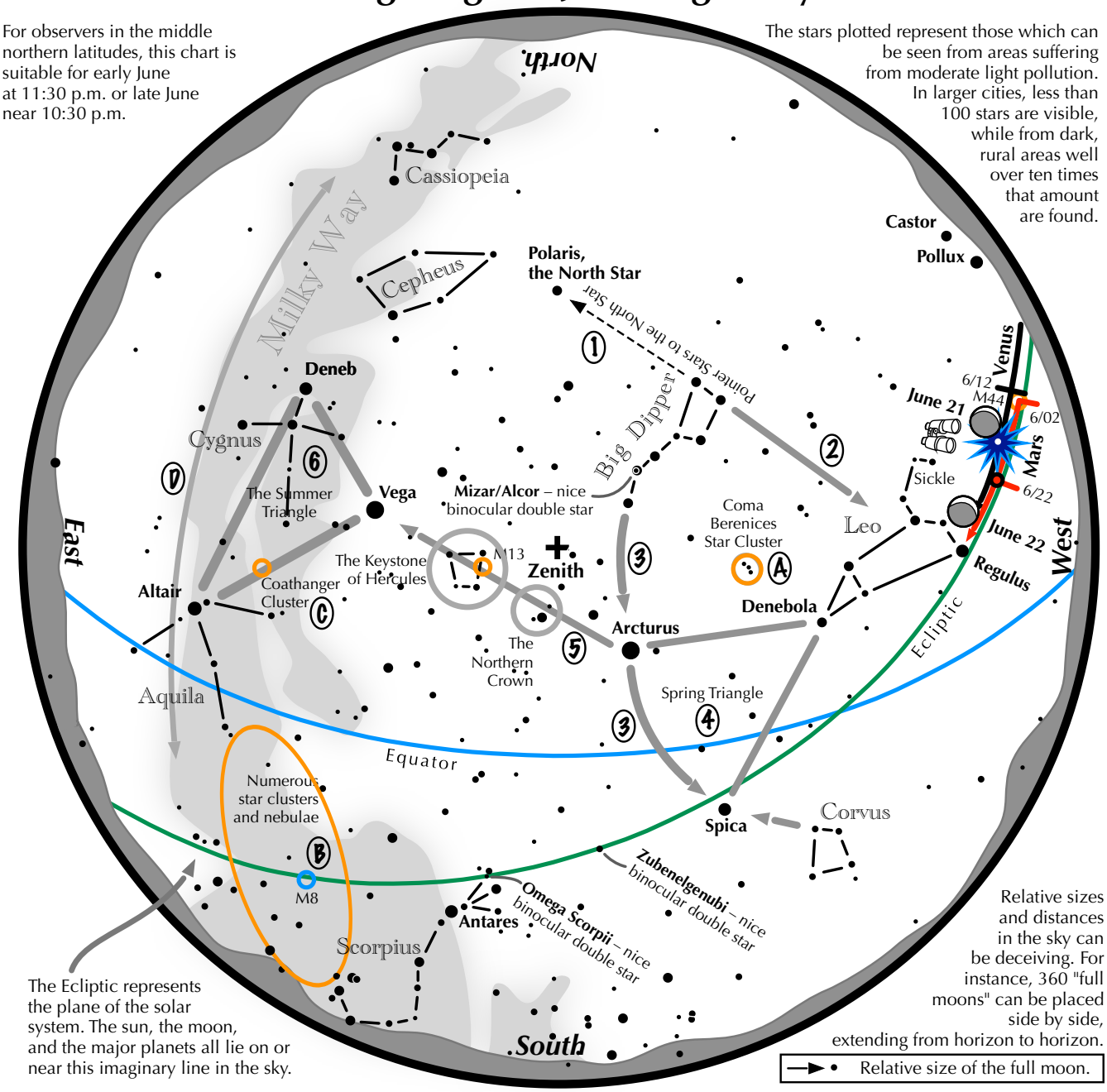
And then there are the ever-elusive rings. "The rings have lots of ice and dust in them, which are extremely reflective in infrared light," says Stefanie Milam, a planetary scientist at NASA's Goddard Space Flight Center in Greenbelt, Md., and one of JWST's project scientists. The enormity of the telescope's mirror also makes its images extra sharp. "JWST was designed to look at the first stars and galaxies across the universe, so we can really see fine details that we haven't been able to see before," Milam says.

Upcoming JWST observations will look at Neptune with other scientific instruments. That should provide new intel on the rings' composition and dynamics, as well as on how Neptune's clouds and storms evolve, Milam says. "There's more to come." ☀

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.

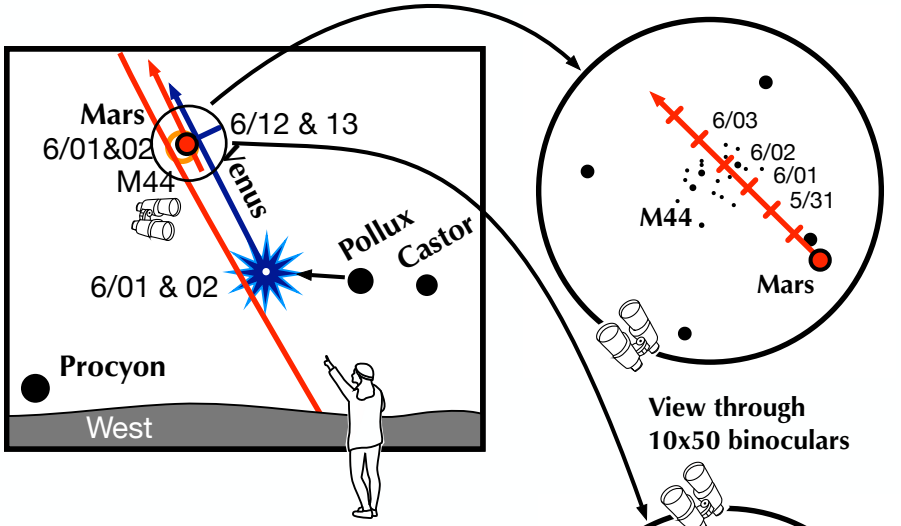
Navigating the June night sky: Simply start with what you know or with what you can easily find.

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.

A must see celestial planetary play: Two planets visit the Beehive

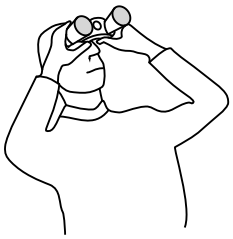


Beginning on June 1, look to the west-northwest 90 minutes after sunset.

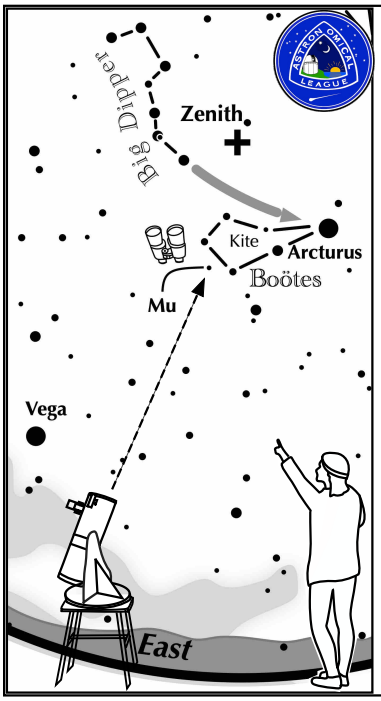
• The twin stars of Gemini, Castor and Pollux, will be found forming a horizontal bar low above the horizon.

• Brilliant Venus shines to their left effectively forming the very bright third member of a set of triplets!

• On the same evening and the next, red Mars slides in front of M44, aka the Beehive Star cluster, positioned above Venus. Use binoculars to find Mars sitting amid the many stellar bees.



• Ten nights later, it is Venus' turn to stay at the Beehive for two consecutive nights. The planet travels along the outskirts, farther from Beehive central than Mars moved. Again, bring out the binoculars. How does the glare of brilliant Venus affect the scene?



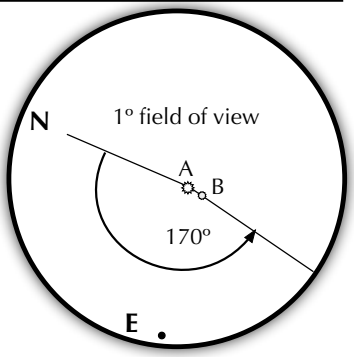
Other Suns: Mu Boötis

How to find Mu Boötis on a June evening

Look at the Big Dipper. Follow the curve of the handle until it intersects the bright star Arcturus. Follow the "kite" figure stretching to the left. The two top left stars of the kite form a triangle with Mu.

Mu Boötis
A-B separation: 110 sec
A magnitude: 4.3
B magnitude: 6.5
Position Angle: 170º
A & B colors: white

Suggested magnification: >30x
Suggested aperture: >2 inches



Use 10x50 binoculars to separate Mu Boötis.

BIENVENUE EN LOUISIANE! (WELCOME TO LOUISIANA!)

Join us for this unique and exciting amateur astronomy gathering!

ALCON 2023

July 26–29, 2023

Hilton Baton Rouge
Capitol Center Hotel
201 Lafayette Street
Baton Rouge, LA 70801

KEYNOTE SPEAKERS

- David Eicher–writer, editor-in-chief of *Astronomy Magazine*
- Fred Espenak–co-author of *Totality: The Great American Eclipses of 2017 and 2024*
- David Levy–author, comet hunter

FIELD TRIPS

- Irene Pennington Planetarium
- LIGO (Laser Interferometer Gravitational-Wave Observatory) Livingston*
- Louisiana State University Physics & Astronomy
- Highland Road Park Observatory

*Spaces are limited for this trip!

SPEAKERS ★ Pranvera Hyseni ★ Guy Consolmagno ★ Dan Davis ★ And many more!

Brought to Baton Rouge by the **Baton Rouge Astronomical Society**

★★ Registration is now open! Check ***alcon2023.org*** ★★

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.