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The Celestial Mechanic

The Official Newsletter of the Astronomy Associates of Lawrence

Coming Events

Monthly Meeting
October 30, 2022, 7:00PM
Baker Wetlands Discovery Center

Public Observing
October 30, 2022, 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

Fall has officially arrived, and the school year is well underway. For our September Club Meeting, David Corea, a Graduate Research Assistant at the KU ExoLab, discussed some of the research he is doing on isotope abundances in dwarf stars G,K,M stars. It was interesting to hear that he has been able to record some of the first oxygen isotope measurements in Sun-like stars. He also outlined his plans to expand the database of oxygen isotope measurements beyond the 6 stars he has currently been studying.

Following the meeting, we had a great turnout for our public observing. We shared views of Jupiter and Saturn, and several deep sky objects. We were also able to watch the train of Starlink satellites that were launched the day before from Cape Canaveral.

There are several events coming up in October. On Thursday, October 13th the next "Telescope Night at KU" will take place. In September, the Physics & Astronomy Department debuted their new portable planetarium, to a large crowd!

The following Thursday, October 20th, AAL will be participating in an Orionids Meteor Shower event hosted by Baker Wetlands Discovery Center. Bring a comfy chair and come watch meteors with us!

On Sunday, October 23rd, AAL will have a table at the upcoming "Moon Mysteries" event at the KU Museum of Natural History, which takes place from Noon-1:30PM that day.

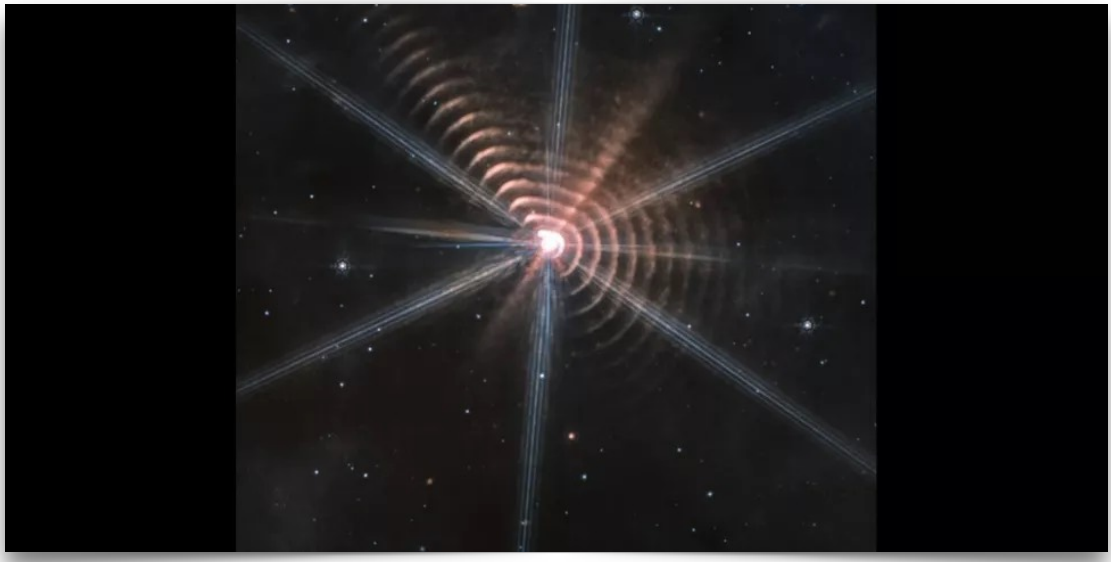
Finally, on Sunday, October 30th, we will have our Monthly Club Meeting, with a presentation entitled Astrophotography: The Basics, Software, and Application" by AAL's own Parker Lessig. Parker has contributed several awesome images that have graced our facebook page. If you haven't seen them, you should go look. This meeting will be followed, weather permitting, by public observing.

If you can assist with any of these events, let us know. If not, please feel free to stop by and chat.

Clear skies to all!

Mysterious rings in new James Webb Space Telescope image puzzle astronomers

Concentric ripples surrounding a distant star have a strange, squarish shape.



The James Webb Space Telescope captured the star WR 140 surrounded by strange concentric shells.

By Tereza Pultrarova

SPACE.COM, SEPTEMBER 1, 2022

The James Webb Space Telescope captured mysterious concentric rings around a distant star that astronomers are still working to explain.

The image, taken in July, was released on Twitter by citizen scientist Judy Schmidt, prompting a torrent of comments and head-scratching. It shows a star known as WR140 surrounded by regular ripple-like circles that gradually fade away. The circles, however, are not perfectly round, but have a somewhat square-like feel to them, prompting speculations about possible alien origins.

"I think it's just nature doing something that is simple, but when we look at it from only one viewpoint it seems impossible, at first, to understand that it is a natural phenomenon," Schmidt told Space.com in an email. "Why is it shaped the way it is? Why is it so regular?"

Mark McCaughrean, an interdisciplinary scientist in the James Webb Space Telescope Science Working Group and a science advisor to the European Space Agency, called the feature "bonkers" in a Twitter thread.

"The six-pointed blue structure is an artifact due to optical diffraction from the bright star WR140 in this #JWST MIRI image," he wrote. "But red curvy-yet-boxy stuff is real, a series of shells around WR140. Actually in space. Around a star."

He noted that WR140 is what astronomers call a Wolf-Rayet star, which have spat much of their hydrogen into space. These objects are also surrounded by dust, he added, which a companion star is sculpting into the strange shells.

Astronomers will know more soon thanks to a scientific paper currently under review about this mysterious phenomenon.

"Yes, those nested 'squircular' rings are real," Ryan Lau, an astronomer at NOIRLab and principal investigator of the project that acquired the observations, replied to the Twitter thread. "Our paper on this has been submitted so please stay tuned for the full story."

WR140, located some 5,600 light-years away from Earth in the constellation Cygnus, is a so-called variable star that periodically dims and brightens. Whether the star's variability has anything to do with the mysterious ripples remains to be seen.

The image, however, demonstrates the power of the $10 billion James Webb Space Telescope, the most powerful observatory ever sent to space, which has been hailed for its revolutionary infrared vision and superkeen eye. ☀

NASA'S HUBBLE FINDS SPIRALING STARS, PROVIDING WINDOW INTO EARLY UNIVERSE

Hubblesite, September 8 2022

SUMMARY

RESEARCHERS FIND THE SPIRAL MAY BE FEEDING STAR FORMATION IN A NEARBY STELLAR NURSERY

Stars are the machines that sculpt the universe, yet scientists don't fully know how they form. To understand the frenzied "baby boom" of star birth that occurred early in the universe's history, researchers turned to the Small Magellanic Cloud, a satellite galaxy of the Milky Way. This nearby galaxy has a simpler chemical composition than the Milky Way, making it similar to the galaxies found in the younger universe, when heavier elements were more scarce. This allows it to serve as a proxy for the early universe.

Two separate studies – the first with the Hubble Space Telescope, and the second with the European Southern Observatory's Very Large Telescope – recently came to the same conclusion. Using different methods, the independent teams found young stars spiraling into the center of a massive star cluster called NGC 346 in the Small Magellanic Cloud. This river-like motion of gas and stars is an efficient way to fuel star birth, researchers say. The teams' results show that the process of star formation in the Small Magellanic Cloud is similar to that in our own Milky Way.

Nature likes spirals — from the whirlpool of a hurricane, to pinwheel-shaped protoplanetary disks around newborn stars, to the vast realms of spiral galaxies across our universe.

Now astronomers are bemused to find young stars that are spiraling into the center of a massive cluster of stars in the Small Magellanic Cloud, a satellite galaxy of the Milky Way.

The outer arm of the spiral in this huge, oddly shaped stellar nursery called NGC 346 may be feeding star formation in a river-like motion of gas and stars. This is an efficient way to fuel star birth, researchers say.

The Small Magellanic Cloud has a simpler chemical composition than the Milky Way, making it similar to the galaxies found in the younger universe, when heavier elements were more scarce. Because of this, the stars in the Small Magellanic Cloud burn hotter and so run out of their fuel faster than in our Milky Way.

Though a proxy for the early universe, at 200,000 light-years away the Small Magellanic Cloud is also one of our closest galactic neighbors.

Learning how stars form in the Small Magellanic Cloud offers a new twist on how a firestorm of star birth may have occurred early in the universe's history, when it was undergoing a "baby boom" about 2 to 3 billion years after the big bang (the universe is now 13.8 billion years old).

The new results find that the process of star formation there is similar to that in our own Milky Way.

Only 150 light-years in diameter, NGC 346 boasts the mass of 50,000 Suns. Its intriguing shape and rapid star-formation rate has puzzled astronomers. It took the combined power of NASA's Hubble Space Telescope and the European Southern Observatory's Very Large Telescope (VLT) to unravel the behavior of this mysterious-looking stellar nesting ground.

"Stars are the machines that sculpt the universe. We would not have life without stars, and yet we don't fully understand how they form," explained study

leader Elena Sabbi of the Space Telescope Science Institute in Baltimore. "We have several models that make predictions, and some of these predictions are contradictory. We want to determine what is regulating the process of star formation, because these are the laws that we need to also understand what we see in the early universe."

Researchers determined the motion of the stars in NGC 346 in two different ways. Using Hubble, Sabbi and her team measured the changes of the stars' positions over 11 years. The stars in this region are moving at an average velocity of 2,000 miles per hour, which means that in 11 years they move 200 million miles. This is about 2 times the distance between the Sun and the Earth.

But this cluster is relatively far away, inside a neighboring galaxy. This means the amount of observed motion is very small and therefore difficult to measure. These extraordinarily precise observations were possible only because of Hubble's exquisite resolution and high sensitivity. Also, Hubble's three-decade-long history of observations provides a baseline for astronomers to follow minute celestial motions over time.

The second team, led by Peter Zeidler of AURA/STScI for the European Space Agency, used the ground-based VLT's Multi Unit Spectroscopic Explorer (MUSE) instrument to measure radial velocity, which determines whether an object is approaching or receding from an observer.

"What was really amazing is that we used two completely different methods with different facilities and basically came to the same conclusion, independent of each other," said Zeidler. "With Hubble, you can see the stars, but with MUSE we can also see the gas motion in the third dimension, and it confirms the theory that everything is spiraling inwards."

But why a spiral?

"A spiral is really the good, natural way to feed star formation from the outside toward the center of the cluster," explained Zeidler. "It's the most efficient way that stars and gas fueling more star formation can move towards the center."

Half of the Hubble data for this study of NGC 346 is archival. The first observations were taken 11 years ago. They were recently repeated to trace the motion of the stars over time. Given the telescope's longevity, the Hubble data archive now contains more than 32 years of astronomical data powering unprecedented, long-term studies.

"The Hubble archive is really a gold mine," said Sabbi. "There are so many interesting star-forming regions that Hubble has observed over the years. Given that Hubble is performing so well, we can actually repeat these observations. This can really advance our understanding of star formation."

The teams' findings appear Sept. 8 in The Astrophysical Journal.

Observations with NASA's James Webb Space Telescope should be able to resolve lower-mass stars in the cluster, giving a more holistic view of the region. Over Webb's lifespan, astronomers will be able to repeat this experiment and measure the motion of the low-mass stars. They could then compare the high-mass stars and the low-mass stars to finally learn the full extent of the dynamics of this nursery. ☀

Surprise finding suggests 'water worlds' are more common than we thought

Sciencenews, september 8, 2022

Analysis finds evidence for many exoplanets made of water and rock around small stars

Summary: A new study suggests that many more planets may have large amounts of water than previously thought--as much as half water and half rock. The catch? All that water is probably embedded in the rock, rather than flowing as oceans or rivers on the surface.

Water is the one thing all life on Earth needs, and the cycle of rain to river to ocean to rain is an essential part of what keeps our planet's climate stable and hospitable. When scientists talk about where to search for signs of life throughout the galaxy, planets with water are always at the top of the list.

A new study suggests that many more planets may have large amounts of water than previously thought -- as much as half water and half rock. The catch? All that water is probably embedded in the rock, rather than flowing as oceans or rivers on the surface.

"It was a surprise to see evidence for so many water worlds orbiting the most common type of star in the galaxy," said Rafael Luque, first author on the new paper and a postdoctoral researcher at the University of Chicago. "It has enormous consequences for the search for habitable planets."

Planetary population patterns

Thanks to better telescope instruments, scientists are finding signs of more and more planets in distant solar systems. A larger sample size helps scientists identify demographic patterns -- similar to how looking at the population of an entire town can reveal trends that are hard to see at an individual level.

Luque, along with co-author Enric Pallé of the Institute of Astrophysics of the Canary Islands and the University of La Laguna, decided to take a population-level look at a group of planets that are seen around a type of star called an M-dwarf. These stars are the most common stars we see around us in the galaxy, and scientists have catalogued dozens of planets around them so far.

But because stars are so much brighter than their planets, we cannot see the actual planets themselves. Instead, scientists detect faint signs of the planets' effects on their stars -- the shadow created when a planet crosses in front of its star, or the tiny tug on a star's motion as a planet orbits. That means many questions remain about what these planets actually look like.

"The two different ways to discover planets each give you different information," said Pallé. By catching the shadow created when a planet crosses in front of its star, scientists can find the diameter of the planet. By measuring the tiny gravitational pull that a planet exerts on a star, scientists can find its mass.

By combining the two measurements, scientists can get a sense of the makeup of the planet. Perhaps it's a big-but-airy planet made mostly out of gas like Jupiter, or a small, dense, rocky planet like Earth.

These analyses had been done for individual planets, but much more rarely for the entire known population of such planets in the Milky Way galaxy. As the scientists looked at the numbers -- 43 planets in all -- they saw a surprising picture emerging.

The densities of a large percentage of the planets suggested that they were too light for their size to be made up of pure rock. Instead, these planets are probably something like half rock and half water, or another lighter molecule. Imagine the difference between picking up a bowling ball and a soccer ball: they're roughly the same size, but one is made up of much lighter material.

Searching for water worlds

It may be tempting to imagine these planets like something out of Kevin Costner's *Waterworld:* entirely covered in deep oceans. However, these planets are so close to their suns that any water on the surface would exist in a supercritical gaseous phase, which would enlarge their radius. "But we don't see that in the samples," explained Luque. "That suggests the water is not in the form of surface ocean."

Instead, the water could exist mixed into the rock or in pockets below the surface. Those conditions would be similar to Jupiter's moon Europa, which is thought to have liquid water underground.

"I was shocked when I saw this analysis -- I and a lot of people in the field assumed these were all dry, rocky planets," said UChicago exoplanet scientist Jacob Bean, whose group Luque has joined to conduct further analyses.

The finding matches a theory of exoplanet formation that had fallen out of favor in the past few years, which suggested that many planets form farther out in their solar systems and migrate inward over time. Imagine clumps of rock and ice forming together in the cold conditions far from a star, and then being pulled slowly inward by the star's gravity.

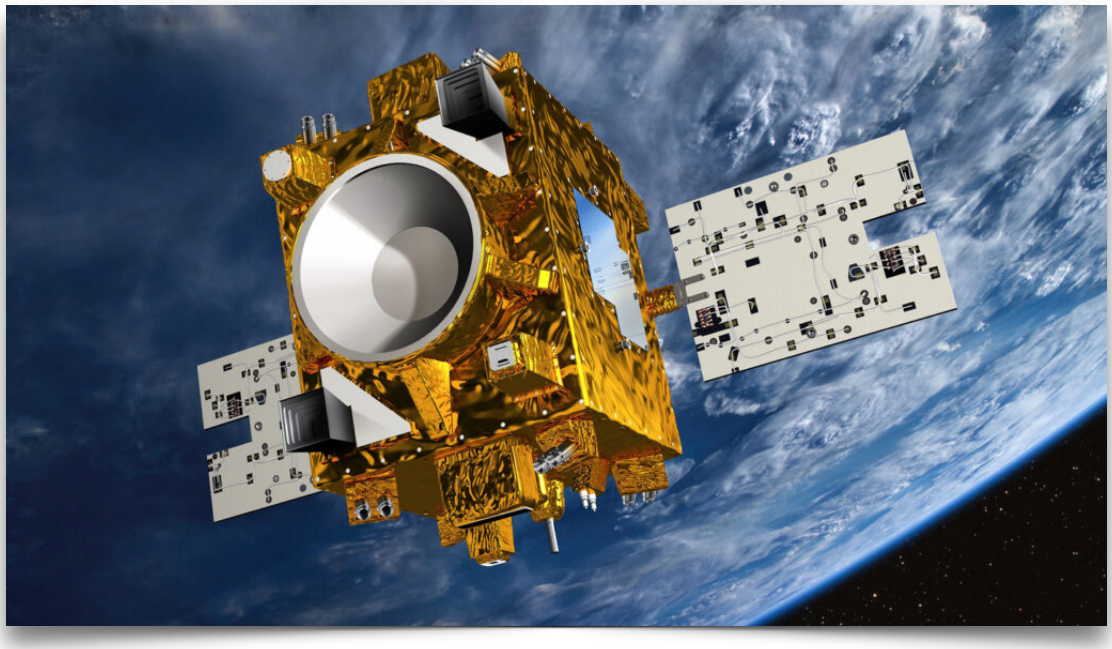
Though the evidence is compelling, Bean said he and the other scientists would still like to see "smoking gun proof" that one of these planets is a water world. That's something the scientists are hoping to do with JWST, NASA's newly launched space telescope that is the successor to Hubble. ☀

Falling objects in orbit show Einstein was right — again

An experiment provides the most precise confirmation yet of a key tenet of general relativity

By James R. Riordon

Sciencenews, september 14, 2022



Gravity doesn't discriminate. An experiment in orbit has confirmed, with precision a hundred times greater than previous efforts, that everything falls the same way under the influence of gravity.

The finding is the most stringent test yet of the equivalence principle, a key tenet of Einstein's theory of general relativity. The principle holds to about one part in a thousand trillion, researchers report September 14 in *Physical Review Letters*.

The idea that gravity affects all things equally might not seem surprising. But the slightest hint otherwise could help explain how general relativity, the foundational theory of gravity, meshes with the standard model of particle physics, the theoretical framework that describes all fundamental particles of matter. General relativity is a classical theory that sees the universe as smooth and continuous, whereas the standard model is a quantum theory involving grainy bits of matter and energy. Combining them into a single theory of everything has been an unfulfilled dream of scientists extending back to Einstein (*SN: 1/12/22*).

"The equivalence principle is the most important cornerstone of Einstein's theory of general relativity," says Sabine Hossenfelder, a physicist with the Frankfurt Institute for Advanced Studies in Germany who was not involved in the study. "We know [it] eventually has to be altered because it cannot in its present form take into account quantum effects."

To help search for potential alterations, the MICROSCOPE experiment tracked the motion of nested metal cylinders — a 300-gram titanium outer cylinder and a 402-gram platinum inner one — as they orbited the Earth in near-perfect free fall. Any difference in the effect of gravity on the respective cylinders would cause them to move relative to each other. Small electrical forces applied to bring the cylinders back into alignment would have revealed a potential violation of the equivalence principle.

From April 2016 to October 2018, the cylinders were shielded inside a satellite that protected them from the buffeting of solar winds, the minuscule pressure that sunlight exerts and the residual atmosphere at an orbital altitude of a little over 700 kilometers high.

By performing the experiment in orbit, the researchers could compare the free fall of two different materials for extended periods without the confounding effects of vibrations or of objects nearby that could exert gravitational forces, says Manuel Rodrigues, a MICROSCOPE team member and physicist with the French aerospace lab ONERA in Palaiseau. "One of the lessons learned by MICROSCOPE is … that space is the best way to get an important improvement in the accuracy for this kind of test."

Over its two-and-a-half-year mission, MICROSCOPE found no sign of cracks in the equivalence principle, the new study reports. The finding builds on a

previous interim report from the experiment that found the same thing, but with less precision (*SN: 12/4/17*).

Some physicists suspect that limits to the equivalence principle may never turn up in experiments, and that Einstein will perpetually be proven right.

Even 100 times greater precision from a follow-up MICROSCOPE 2 mission, tentatively planned for the 2030s, is unlikely to reveal an equivalence principle breakdown, says Clifford Will, a physicist at the University of Florida in Gainesville who is not affiliated with the experiment. “It really is still this basic idea that Einstein taught,” he says. What we see as the force of gravity is actually the curvature of spacetime. “Any body simply moves along the path in Earth’s spacetime,” whether it’s made of dense platinum, lighter titanium or any other material.

But even if physicists never prove Einstein wrong, Hossenfelder says, experiments like MICROSCOPE are still important. “These tests aren’t just about the equivalence principle,” she says. “They implicitly look for all other kinds of deviations, new forces and so on,” that aren’t part of general relativity. “So really it’s a multiple-purpose, high-precision measurement.”

Now that the mission is complete, the MICROSCOPE satellite will slowly spiral out of orbit. “It’s difficult to bet where in 25 years it will fall down,” Rodrigues says. Along with a reference set of platinum cylinders on board, “it’s [a] couple of millions of euros [in] platinum.” Where that precious platinum metal will land is anyone’s guess, but the gravity that pulls it down will tug on the titanium just as hard, to one part in a thousand trillion at least. ☀

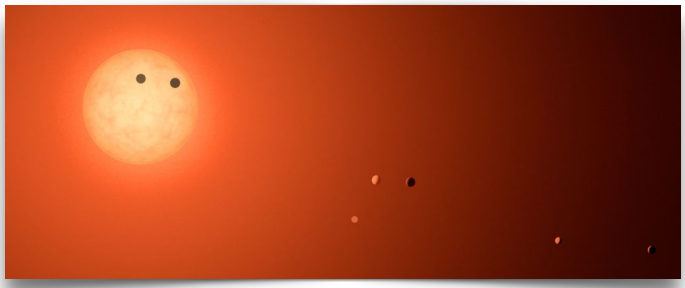
This Trait of Red Dwarf Star Systems Could Help Us Resolve The Red Sky Paradox

By Michelle Starr

Sciencealert, september 19, 2022

There's something very peculiar about Earth, aside from all the organisms crawling all over it. It's our star, the Sun, that's weird: It's a yellow dwarf.

Sun-like stars are a minority in the Milky Way. It's estimated that fewer than 10 percent of the stars in our galaxy are G-type stars, like the Sun.



Artist's impression of the TRAPPIST-1 system, with seven exoplanets orbiting a red dwarf star.

The most abundant stars are those we can't even see with the naked eye: red dwarfs. They're only up to about half the mass of the Sun, cool, dim, and with the longest lifespans of any stars.

These stellar lightweights account for up to 75 percent of all the stars in the Milky Way. One would therefore think, statistically, that if life were to emerge anywhere, it would be on a planet around a red dwarf.

Yet here we are, with our yellow Sun. This discrepancy between expectation and reality is known as the Red Sky Paradox, and scientists have yet to figure it out.

A new paper, accepted into The Astrophysical Journal Letters and uploaded to preprint server arXiv while it undergoes peer review and publication, could have a clue.

Basically, it seems like it might be much harder for life as we know it to get started in red dwarf planetary systems – because they lack the asteroid and gas giant architecture to deliver the ingredients for life to Earth-like worlds.

The results could have implications for our search for life outside the Solar System, especially since exoplanets defined as "potentially habitable" are often found in orbit around red dwarf stars.

Red dwarfs, in some respects, are some of the most promising targets in our search for habitable worlds. Because they are so small, they burn through their hydrogen fuel much more slowly than Sun-like stars do.

They can hang around for potentially trillions of years – much longer than the estimated 10 billion-year lifespan of the Sun and even the 13.8 billion-year age of the Universe. This means there's more time available for life to emerge and potentially thrive.

Red dwarfs also represent an opportunity for our current detection methods. Because they burn so

slowly, they are cooler and dimmer than the Sun. This means that the habitable zone – the distance range from the star in which habitable temperatures can be found – is much closer. Recently, astronomers discovered an exoplanet in the habitable zone of a red dwarf star with an orbit of just 8.4 days.

But it seems like life's emergence and continued existence might be a tricky thing.

Previous studies have suggested that red dwarfs might not present the most hospitable environment. For example, such stars tend to be very active, frequently erupting with flares that would lash any close planets with radiation.

The authors of the new paper – astronomers Anna Childs, Rebecca Martin, and Mario Livio of the University of Nevada, Las Vegas – wanted to determine if red dwarf systems had enough of the ingredients that we think kick-started life on Earth.

Current studies suggest that asteroid and comet bombardment relatively late in the Solar System's youth altered Earth's crust in ways that made it more hospitable to life and delivered many of the chemical ingredients necessary for it.

Without an asteroid belt, therefore, the terraforming and chemical delivery systems for life are significantly reduced.

Models suggest that the formation of a stable asteroid belt, and late asteroid bombardment, requires the presence of a gas giant beyond a distance from the star known as the snow line, beyond which volatile compounds condense into solid ice. This is because such a gas giant can gravitationally interact with the asteroid belt, causing instabilities that pelt asteroids inwards towards the habitable zone.

So the researchers looked at red dwarf systems to see if they could find one of these gas giants.

There are currently 48 red dwarf stars with confirmed, rocky exoplanets orbiting in the habitable zone. Of these, 27 have more than one exoplanet. Of that group, 16 have mass measurements for the exoplanets in the system.

Defining a gas giant as a planet between 0.3 and 60 times the mass of Jupiter and calculating the position of the snow line for those systems, the team went looking for gas giants.

They found that none of the systems with a rocky, Earth-like planet in the habitable zone had a known gas giant as well.

Statistically, the team calculated, that there is a population of giant exoplanets orbiting red dwarf stars beyond the snow line. This means that, theoretically, red dwarf stars can have asteroid belts.

It's just that none of the known red dwarf systems with habitable zone rocky worlds are likely among that category, suggesting that red dwarf planetary system architecture can be wildly different from the Solar System we know and love.

There are a lot of assumptions at play. For example, maybe asteroid impacts aren't all that important. Maybe life on red dwarf exoplanets doesn't look at all like life on Earth. Maybe we're overestimating the significance of the habitable zone.

However, based on our current knowledge and understanding of life, things aren't looking great for red dwarf planets.

"The lack of giant planets in the (so far) observed systems containing habitable zone exoplanets suggests that these systems are unlikely to harbor an asteroid belt and the mechanism required for late-stage asteroid delivery to the habitable zone," the researchers write.

"Therefore, if asteroid impacts are indeed necessary for life, it is unlikely that the observed planets in the habitable zone harbor life."

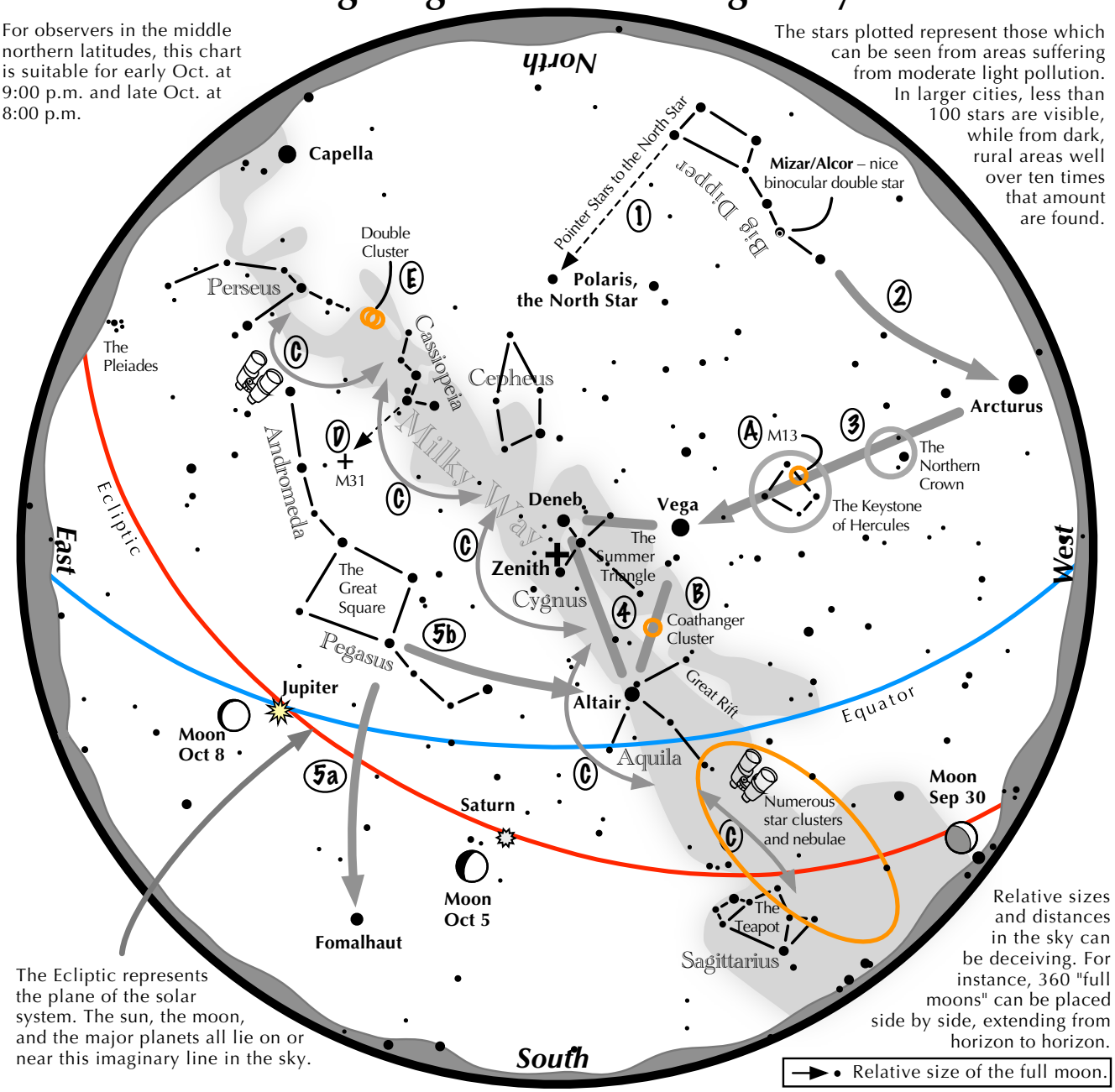
And, in turn, that might be at least partially why our home planet isn't orbiting one of these cranky little red stars.

The research has been accepted into The Astrophysical Journal Letters and is available on arXiv. ☀

Navigating the October Night Sky

For observers in the middle northern latitudes, this chart is suitable for early Oct. at 9:00 p.m. and late Oct. at 8:00 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.

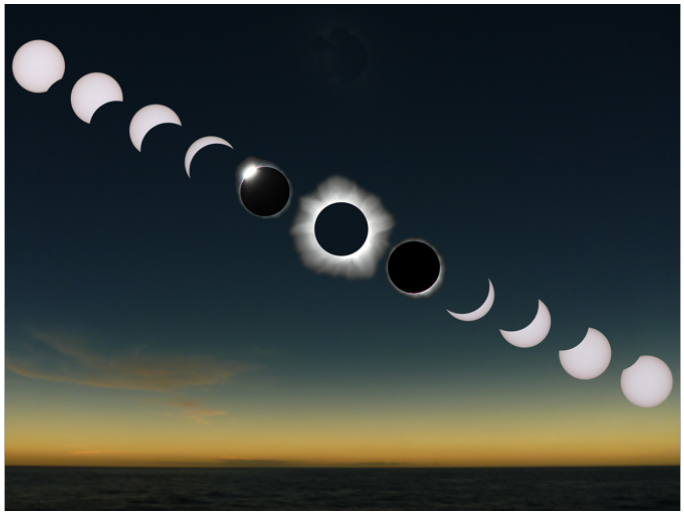
Navigating the October night sky: Simply start with what you know or with what you can easily find.

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 intersects Arcturus, the brightest star in the early October evening sky.
3. 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.
4. Nearly overhead lie the summer triangle stars of Vega, Altair, and Deneb.
5. High in the east are the four moderately bright stars of the Great Square. Its two southern stars point west to Altair. Its two western stars point south to Fomalhaut.

Binocular Highlights

A: On the western side of the Keystone glows the Great Hercules Cluster, a ball of 500,000 stars. **B:** 40% of the way between Altair and Vega, twinkles the "Coathanger," a group of stars outlining a coathanger. **C:** Sweep along the Milky Way for an astounding number of fuzzy star clusters and nebulae amid many faint glows and dark bays, including the Great Rift. **D:** The three westernmost stars of Cassiopeia's "W" point south to M31, the Andromeda Galaxy, a "fuzzy" oval. **E:** Between the "W" of Cassiopeia and Perseus lies the Double Cluster.

Become a NASA Partner Eclipse Ambassador!



NIGHTSKYNETWORK, SEPTEMBER 1, 2022

Make a difference in your community while celebrating solar science: apply now to become an official **NASA Partner Eclipse Ambassador!**

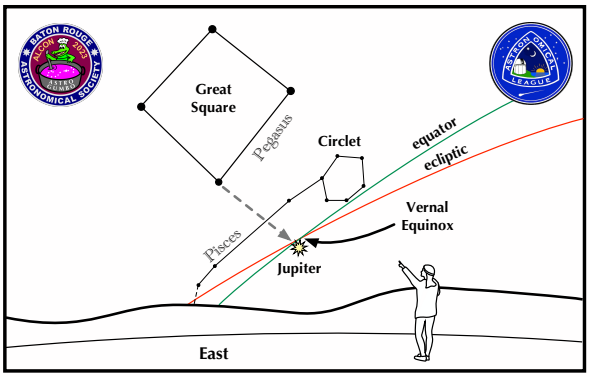
In 2023 and 2024, both an annular and total solar eclipse will each cross the United States. Through an exciting new partnership Eclipse Ambassadors Off the Paths, NASA is partnering amateur astronomers with undergraduate students to engage 500 underserved communities off the central paths of the eclipses - get your community prepared *before the eclipses arrve*!

Partner with a local undergraduate student and train together virtually in a three week workshop. Learn new tools and techniques for explaining eclipses and inspiring awe. Then, engage your community with effective outreach **before the eclipse**! You will receive a toolkit full of materials to enhance your outreach, including hands-on activities and hundreds of safe solar viewing glasses!

As a NASA Partner, you will be recognized for your commitment to public astronomy engagement with a special badge and certificate. You will be supported by a dedicated team at the Astronomical Society of the Pacific to get you partnered with local organizations serving underserved communities and helping everyone enjoy the wonder and science of solar eclipses, everywhere!

Learn more and apply today at **eclipseambassadors.org** ☀

If you can see only one celestial event in the evening this October, see this one.



Jupiter lies at the Vernal Equinox

- Look in the east–southeast 90 minutes after sunset during October.
- Choose an evening when no bright moon is in the sky, such as one after October 12.
- Jupiter shines brightly above the horizon very near the location of the vernal equinox – the sun's position on March 21.
- Jupiter also acts as a good guide in finding the six dim stars of the "Circlet" of Pisces. This odd stellar grouping really does take on the shape of a flattened circle. Dark skies are needed to see this interesting asterism.
- Jupiter will not be in the same location next year, as it will have moved eastward approaching the Pleiades. However, the Circlet will always lie immediately south of the Great Square. So, once you meet it, these stars will be a celestial friend greeting you in the same sky location this time every year.

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.