Volume 50 Number 10 October 2024

# The Celestial Mechanic

The Official Newsletter of the Astronomy Associates of Lawrence

## Coming Events

**Monthly Meeting**
**October 27, 2024, 7:00PM**
**Baker Wetlands Discovery Center**

**Public Observing**
**October 27, 2024, 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

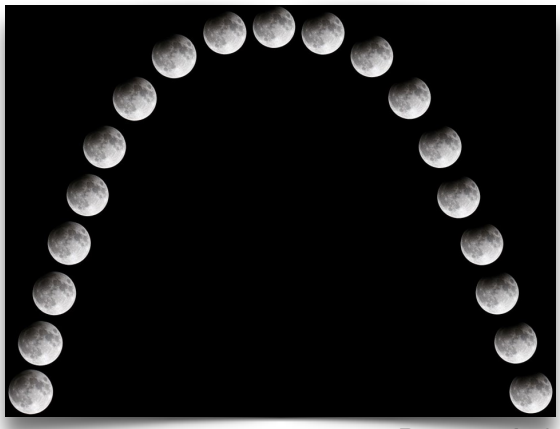
Earlier this year news reports started circulating about an impending eruption of the recurrent nova T Coronae Borealis. As of this writing, we are all patiently awaiting this once-in-a-lifetime event. We will keep everyone informed if anything changes through our facebook page and by email. Fingers crossed we won't be waiting too much longer! While we wait for T Cor Bor, both Saturn and Neptune are well placed for observing, as both reached opposition in September.

How many people went out to view the partial lunar eclipse on September 17th? A few AAL members viewed the eclipse from the parking lot at Baker Wetlands Discovery Center, and we were joined by a few members of the public. I have included a mosaic of the eclipse from the start through maximum eclipse taken by Rick and Clare Heschmeyer.

At our September club meeting, Rick Heschmeyer talked about the "smart" telescope revolution. Still in its infancy, these telescopes are providing a great way for people to get started in the hobby as well as an alternative for learning astrophotography. It will be exciting to see where this category of telescopes will take the hobby in the years to come.

KU's Alex Polanski, the Percival Lowell Postdoctoral Fellow at Lowell Observatory, has started a project to catalog and digitize KU's collection of historic glass photographic plates. He will give the club an update on the project at our October Club Meeting, on Sunday, October 27. The meeting will start at 7 pm and will be followed by public observing (weather permitting). We are looking forward to having Alex talk to the club again.

Speaking of KU, the Telescope Nights at KU program has been started again, this time with both telescope observing outside Malott Hall and Planetarium shows in Slawson Hall. Telescope Observing starts at 7:30pm and the planetarium shows will take place at 7:30 pm and 8:00 pm. The dates for the fall nights are Thursday October 10th, Thursday November 7th, and Thursday December 5th. Rain or shine, the planetarium shows will still run!



Clear Skies!

# An Astronomer Has Found the Hardest Evidence Yet for the Elusive Planet Nine

By Darren Orf

POPULARMECHANICS, MAY 1, 2024

- Scientists have been searching for a ninth planet to explain the orbital eccentricities of Uranus and Neptune (and dwarf planets like Sedna and Pluto) for more than a century.
- For the past decade, one of the leading theories attempting to explain these oddities is that an extremely far-flung planet that we have yet to detect could be orbiting the Sun.
- Now, one of Planet Nine's leading proponents has extensively compared models—both including the planet and not including the planet—and reportedly found strong statistical evidence for its existence.

Over the course of millennia, scientists have made some pretty big strides in figuring out how our Solar System ticks. Putting the Sun in the center was a big help (thanks Copernicus), and discovering distant planets such as Uranus and Neptune—while discounting other *phantom* planets such as Vulcan—helped describe some of our system's strange orbital anomalies.

But while there's certainly been progress, the work is far from over—especially because wobbles in the orbits of our far flung ice giants (along with dwarf planets like Pluto and Sedna) suggest there's something out there that we're still missing.

A fair number of explanations have been put forth to try and understand this unexplained "wobble," including undiscovered belts, a grapefruit-sized primordial black hole, or even (more controversially) a misunderstanding of astrophysics. However, the leading theory is that far beyond the orbit of Neptune lies another planet that is causing these orbital perturbations—Planet Nine.

One of the main proponents of this idea is Caltech's Konstantin Batygin, who (along with colleague Mike Brown) revealed what was described as a "road map" for a finding a proposed ninth planet that's roughly five times the size of an Earth—an icy super-Earth or a mini-Neptune—in 2016. Fast forward eight years, and Batygin is back with even more evidence that a ninth planet is the most likely explanation for the orbital data gathered throughout the Solar System.

"What we show in this paper is that not only is Planet Nine up to the task, moreover it's that the … orbital distribution that the Planet Nine model predicts is perfectly consistent with what we see in the data," Batygin said on the podcast *Event Horizon*. "Conversely, a Solar System without a Planet Nine can be ruled out with a confidence of five sigma [a.k.a. a statistical discovery]."

In the latest paper, currently uploaded to the preprint server arXiv, the researchers plugged in known celestial forces—from planets, stars, and the Milky Way itself—and ran multiple simulations, some of which included a Planet Nine (P9) and some of which did not. They found that the P9-inclusive simulations more accurately reflected what astronomers see in the Solar System, which means that some planetary body (possibly around 400 to 800 time further from the Sun than Earth) has avoided our gaze for millennia.

And for good reason. At such an astronomical distance, the presumed faintness of the planet would make it incredibly difficult to detect, even using telescopes like PanSTARRS or the upcoming Vera C. Rubin Observatory. But Planet Nine's elusive nature isn't its only problem. If the planet did exist, it would be on an extremely strange trajectory around the Sun—so strange, in fact, that some astronomers say it

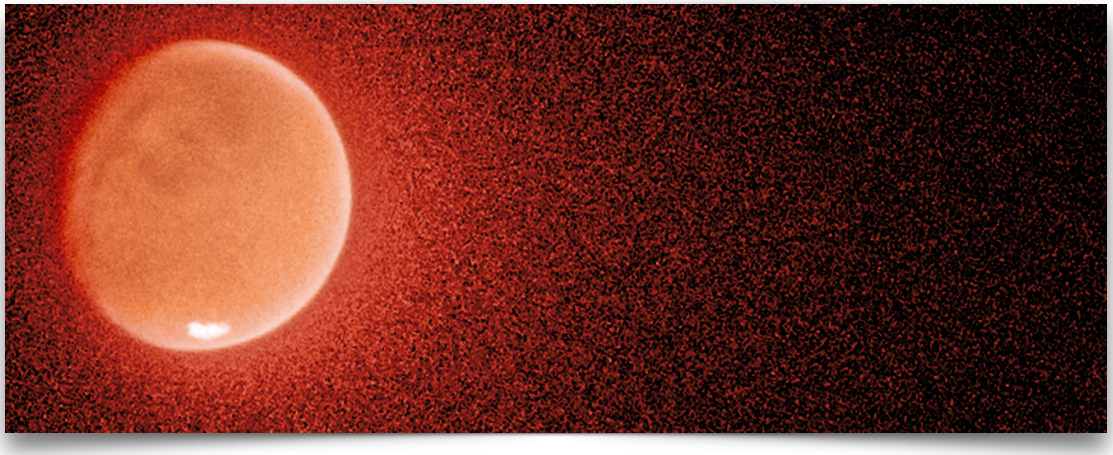
could challenge our understanding of planetary science.

Simply put, there is just too much about our own Solar System we *still* don't know to be certain of one solution over another. However, when the Vera C. Rubin Observatory goes online sometime in 2025, one of its missions will be providing unprecedented clarity into what lurks beyond Neptune, potentially revealing 10 times as many Solar System objects as are known today.

For centuries, astronomers have been shining a flashlight, hoping to stumble upon a cosmic mystery in the darkness. Hopefully when the Vera C. Rubin Observatory finally arrives, it'll be like turning on a light switch. ☀

# NASA's Hubble, MAVEN Help Solve the Mystery of Mars' Escaping Water

HUBBLESITE, SEPTEMBER 5, 2024




## Summary

Results upend the classical picture that scientists previously held

What happened to the water that once covered Mars? Scientists know that some went deep underground, but where is the rest? Evidence shows that some water molecules broke into atoms, which rise through the Martian atmosphere and escape into space. By combining data from Hubble and MAVEN, a team measured the number and current rate of escaping hydrogen atoms.

They discovered that the escape rates of hydrogen and "heavy hydrogen," called deuterium, change rapidly when Mars is close to the Sun. This upended the classical picture that scientists previously had, where these atoms were thought to slowly diffuse upward through the atmosphere to a height where they could escape. Extrapolating the escape rate backwards through time helped the team to understand the history of water on the Red Planet.


Mars was once a very wet planet as is evident in its surface geological features. Scientists know that over the last 3 billion years, at least some water went deep underground, but what happened to the rest? Now, NASA's Hubble Space Telescope and MAVEN (Mars Atmosphere and Volatile Evolution) mission are helping unlock that mystery.

"There are only two places water can go. It can freeze into the ground, or the water molecule can break into atoms, and the atoms can escape from the top of the atmosphere into space," explained study leader John Clarke of the Center for Space Physics at Boston University in Massachusetts. "To understand how much water there was and what happened to it, we need to understand how the atoms escape into space."

Clarke and his team combined data from Hubble and MAVEN to measure the number and current escape rate of the hydrogen atoms escaping into space. This information allowed them to extrapolate the escape rate backwards through time to understand the history of water on the Red Planet.

### Escaping Hydrogen and "Heavy Hydrogen"

Water molecules in the Martian atmosphere are broken apart by sunlight into hydrogen and oxygen atoms. Specifically, the team measured hydrogen and deuterium, which is a hydrogen atom with a neutron in its nucleus. This neutron gives deuterium twice the mass of hydrogen. Because its mass is higher,

deuterium escapes into space much more slowly than regular hydrogen.

Over time, as more hydrogen was lost than deuterium, the ratio of deuterium to hydrogen built up in the atmosphere. Measuring the ratio today gives scientists a clue to how much water was present during the warm, wet period on Mars. By studying how these atoms currently escape, they can understand the processes that determined the escape rates over the last four billion years and thereby extrapolate back in time.

Although most of the study's data comes from the MAVEN spacecraft, MAVEN is not sensitive enough to see the deuterium emission at all times of the Martian year. Unlike the Earth, Mars swings far from the Sun in its elliptical orbit during the long Martian winter, and the deuterium emissions become faint. Clarke and his team needed the Hubble data to "fill in the blanks" and complete an annual cycle for three Martian years (each of which is 687 Earth days). Hubble also provided additional data going back to 1991 – prior to MAVEN's arrival at Mars in 2014.

The combination of data between these missions provided the first holistic view of hydrogen atoms escaping Mars into space.

**A Dynamic and Turbulent Martian Atmosphere**

"In recent years scientists have found that Mars has an annual cycle that is much more dynamic than people expected 10 or 15 years ago," explained Clarke. "The whole atmosphere is very turbulent, heating up and cooling down on short timescales, even down to hours. The atmosphere expands and contracts as the brightness of the Sun at Mars varies by 40 percent over the course of a Martian year."

The team discovered that the escape rates of hydrogen and deuterium change rapidly when Mars is close to the Sun. In the classical picture that scientists previously had, these atoms were thought to slowly diffuse upward through the atmosphere to a height where they could escape.

But that picture no longer accurately reflects the whole story, because now scientists know that atmospheric conditions change very quickly. When Mars is close to the Sun, the water molecules, which are the source of the hydrogen and deuterium, rise through the atmosphere very rapidly releasing atoms at high altitudes.

The second finding is that the changes in hydrogen and deuterium are so rapid that the atomic escape needs added energy to explain them. At the temperature of the upper atmosphere only a small fraction of the atoms have enough speed to escape the gravity of Mars. Faster (super-thermal) atoms are produced when something gives the atom a kick of extra energy. These events include collisions from solar wind protons entering the atmosphere or sunlight that drives chemical reactions in the upper atmosphere.

**Serving as a Proxy**

Studying the history of water on Mars is fundamental not only to understanding planets in our own solar system but also the evolution of Earth-size planets around other stars. Astronomers are finding more and more of these planets, but they’re difficult to study in detail. Mars, Earth and Venus all sit in or near our solar system's habitable zone, the region around a star where liquid water could pool on a rocky planet; yet all three planets have dramatically different present-day conditions. Along with its sister planets, Mars can help scientists grasp the nature of far-flung worlds across our galaxy. ☀

# How bright is the universe's glow? Study offers best measurement yet

Sciencenews, sep 3, 2024

Scientists have traveled to the edges of the solar system, virtually, at least, to capture the most accurate measurements to date of the faint glow that permeates the universe -- a phenomenon known as the cosmic optical background.

The new study, published Aug. 28 in *The Astrophysical Journal*, draws on observations from NASA's New Horizons spacecraft, which whizzed past Pluto in 2015 and is now nearly 5.5 billion miles from Earth. The research seeks to answer a deceptively simple question, said co-author Michael Shull, an astrophysicist at the University of Colorado Boulder.

"Is the sky really dark?" said Shull, professor emeritus in the Department of Astrophysical and Planetary Sciences.

Space may look black to human eyes, but scientists believe that it's not completely dark. Since the dawn of the cosmos, trillions of galaxies containing countless stars have formed and died, leaving behind an imperceptibly faint light. Think of it as the night light in space.

Shull and the team, led by Marc Postman at the Space Telescope Science Institute in Baltimore, calculated just how bright that glow is. Their findings suggest that the cosmic optical background is roughly 100 billion times fainter than the sunlight that reaches Earth's surface¬ -- far too faint for humans to see with the naked eye.

The results could help scientists shine a light on the history of the universe since the Big Bang.

"We're kind of like cosmic accountants, adding up every source of light we can account for in the universe," Shull said.

**Into the dark**

It's a type of number crunching that has captured the imagination of scientists for nearly 50 years, he added.

Shull explained that, after decades of research, astrophysicists think they have a pretty good idea of how the cosmos evolved. The first galaxies formed during an epoch known as the Cosmic Dawn several hundred million years after the Big Bang. The starlight from galaxies in the distant universe reached its brightest point about 10 billion years ago and has been dimming ever since.

Precise measurements of the cosmic optical background could help scientists confirm whether this picture of the cosmos makes sense -- or if there are mysterious, as-of-yet-undiscovered objects casting light into space.

Taking those kinds of measurements, however, isn't easy, especially not from Earth.

Earth's neighborhood is teeming with tiny grains of dust and other debris. Sunlight glints off this mess, washing out any signals that might be coming from the cosmic optical background.

"A metaphor I use is if you want to see the stars, you need to get out of Denver," Shull said. "You have to go way out, right to the northeast corner of Colorado where all you have ahead of you are South Dakota and Nebraska."

New Horizons has given scientists a once-in-a-lifetime opportunity to do something similar in space.

**Cosmic accounting**

The mission has uniquely Colorado origins. Alan Stern, who studied as a graduate student at CU Boulder under Shull and former Senior Research Associate Jack Brandt, leads the New Horizons mission. He's currently based at the Southwest Research Institute in Boulder, Colorado. The spacecraft also carries the Student Dust Counter, an instrument designed and built by students at CU Boulder's Laboratory for Atmospheric and Space Physics (LASP).

Over the course of several weeks in summer 2023, the researchers pointed New Horizons' Long Range Reconnaissance Imager (LORRI) at 25 patches of sky.

Even at the edge of the solar system, the team still had a lot of extra light to contend with. The Milky Way Galaxy, for example, sits within a halo that, like our solar system, gathers dust.

"You can't get away from dust," Shull said. "It's everywhere."

He and his colleagues estimated how much light that halo could generate, then subtracted it from what they were viewing with LORRI. After getting rid of additional sources of light, the team was left with the cosmic optical background.

In scientific terms, that background amounts to about 11 nanowatts per square meter per steradian. (A steradian is a patch of sky with a width about 130 times the diameter of the moon).

Shull said that this value lines up well with how many galaxies scientists believe should have formed since the Big Bang. Put differently, there don't seem to be any strange objects, such as exotic kinds of particles, out there in space producing a lot of light. But the researchers can't rule out such anomalies completely.

The team's measurements are likely to be the best estimates of the universe's glow for a long time. New Horizons is using its remaining fuel supplies to pursue other scientific priorities, and no other missions are currently heading toward those cold and dark corners of space.

"If they put a camera on a future mission, and we all wait a couple of decades for it to get out there, we could see a more exact measurement," Shull said. ☀

# The bubbling surface of a distant star was captured on video for the 1st time ever

By Sharmila Kuthunur
SPACE.COM, SEPTEMBER 12, 2024

'It is spectacular that we can now directly image the details on the surface of stars so far away.'

Astronomers have gotten the first-ever detailed views of turbulent activity in a star other than our own sun.

A time-lapse video released Wednesday (Sept. 11) shows enormous gas bubbles roiling on a nearby star called R Doradus, a red giant about 300 times bigger than our sun that lies roughly 180 light-years away, in the southern constellation Dorado. Like a boiling soup on a stovetop, the star's scorching material erupts on its surface in bubbles, which astronomers estimate swell to a whopping 75 times our sun's size.


These best-yet images of the nearby star R Doradus show giant plasma bubbles 75 times bigger than our sun rising and sinking on its surface.

"It is spectacular that we can now directly image the details on the surface of stars so far away," Behzad Bojnodi Arbab, a doctoral student at the Chalmers University of Technology in Sweden and a co-author of a new study about the observations, published Wednesday in the journal Nature, said in a statement. Thanks to the latest images, astronomers can now "observe physics that until now was mostly only observable in our sun," Arbab added.

The video is pieced together from the best-ever images of the star's chaotic surface, which were captured by a network of radio telescopes in Chile called the Atacama Large Millimeter/submillimeter Array, or ALMA for short. The images show the plasma bubbles, which are driven by heat rising from the star's core, crashing on its surface so violently that they appear to slightly deform the star.

Related: Meet ALMA: Amazing photos from the giant radio telescope array

"We had never expected the data to be of such high quality that we could see so many details of the convection on the stellar surface," study lead author Wouter Vlemmings, a professor at Chalmers University of Technology, said in the statement.

From the latest snapshots of R Doradus, which ALMA captured from early July to August of last year, Vlemmings and his colleagues estimate the star's plasma bubbles rise and fall on a one-month cycle, which is faster than the timeline followed by similar convective cells abundant on our sun's surface.

"We don't yet know what is the reason for the difference," said Vlemmings.

Though R Doradus is incredibly bloated, its mass is similar to that of our sun. So study team members suspect the star reflects how our sun will look in about five billion years, when it will enter its red giant phase by ballooning up to the point of swallowing Mercury and Venus.

"It seems that convection changes as a star gets older in ways that we don't yet understand," said Vlemmings.

Previous ALMA observations showed that R Doradus is spinning at least two orders of magnitude faster than expected for a red giant. In the new study, Vlemmings and his team ruled out the possibility that the high spin is an illusion created by the star's boiling surface, a hypothesis that was recently put forth by a different team of astronomers studying Betelgeuse, another red giant in the constellation Orion known to spin 100 times faster than expected.

Vlemmings and his colleagues argue that R Doradus' rotation rate is much longer than the one-month cycle they found its convective bubbles to operate in, thus ruling out the odds of telescopes being tricked by such a chance alignment of gas bubbles. ☀

# Orion Telescopes & Binoculars

By Sean Walker

SKY&TELESCOPE, JULY 12, 2024

Rumors are swirling after two former giants in the astronomy industry closed their doors earlier this week.

Optronic Technologies, Inc., better known to backyard astronomers as the parent company of both Orion Telescopes & Binoculars and Meade Instruments, has shut its offices and storefront in Watsonville, California. Sources have told Sky & Telescope that all of the staff were let go at the end of the business day on Tuesday, July 9th, although it's unclear whether the company will pursue bankruptcy protection.

Until Tuesday, Meade operated a manufacturing plant in Tijuana, Mexico, where most of its telescopes and electronics are produced. For much of its five decades in business, Meade Instruments was one of the world's largest designers and manufacturers of telescopes and accessories for amateur astronomers, particularly with its line of Schmidt-Cassegrain telescopes and variations on that design. The company had worked closely with independently owned and operated retailers that serve both casual and advanced amateur astronomers.

Orion Telescopes & Binoculars made a name for itself in the late 1990s as a source of quality gear for the budget-minded amateur astronomer. Some of its popular scopes include the ShortTube 80 and the StarBlast 4.5 Astro Reflector Telescope.

Shortly after Optronic Technologies won a 2019 antitrust lawsuit against Sunny Electronics, Meade's parent company at the time, Meade Instruments filed for Chapter 11 bankruptcy protection. The company was subsequently purchased by Optronic Technologies in 2021. But Optronic encountered supply-chain challenges following the COVID-19 pandemic.

As of July 12th, both Meade's and Orion's websites are still active and accepting orders. Sky & Telescope editors have reached out to senior staff members to comment; neither Meade nor Orion has issued an official announcement. We will update this story as new information become available.

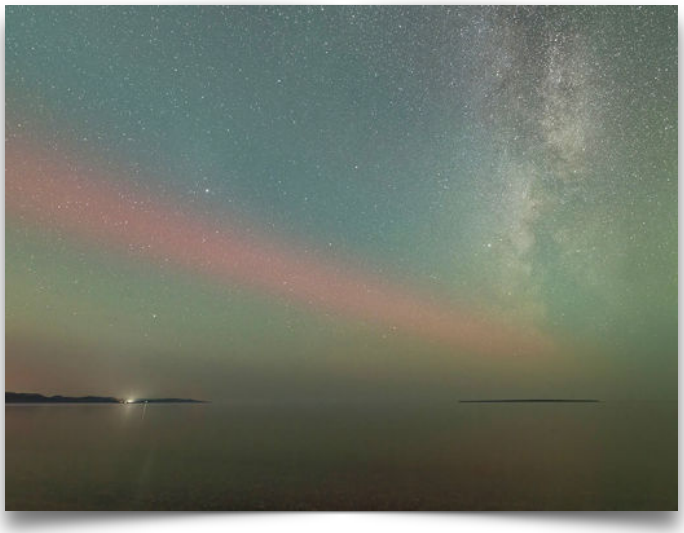
On July 31, Orion's website has gone offline. ☀

# Earth's Ring Current is Leaking

By Jeffery Dixon

SPACEWEATHER.COM, SEPTEMBER 14, 2024

During the strong (G3) geomagnetic storm of Sept. 12th, Jeffery Dixon looked up from the Agawa Bay in Ontario, Canada, and saw a red band stretching across the sky. It was a sign that Earth's ring current had sprung a leak:



"I'm not sure if it was aurora, STEVE or airglow," says Dixon.

Actually, none of the above. Dixon photographed an SAR arc. SAR arcs were discovered in 1956 at the beginning of the Space Age. At first, researchers didn't know what they were and unwittingly gave them a misleading name: "Stable Auroral Red arcs." However, they are not auroras; the red glow comes from Earth's ring current system.

Yes, Earth has rings. Unlike Saturn's rings, which are vast disks of glittering ice, Earth's rings are made of electricity--a donut-shaped circuit carrying millions of amps around our planet.During strong geomagnetic storms, thermal energy from the rings can leak onto the atmosphere below, imprinting a red glow among the auroras.

On Sept. 12th, SAR arcs were seen from many locations including Pennsylvania, Germany, California and Colorado. Browse the gallery for more. ☀

# The Backyard Observer, October 2024

By Rick Heschmeyer

**CAPRICORNUS**

This month's feature constellation, Capricornus, is one of the ancient zodiacal constellations, representing a part-fish, part-goat sea goat. It is sometimes said to represent the Greek god, Pan. The constellation's origins date back at least 3500 years to Mesopotamia.

While the constellation is not as small as last month's feature constellation, the diminutive Delphinus, Capricornus is still the smallest of all the zodiacal constellations. As such, while surrounded by several deep sky objects of interest, Capricornus itself is only home to one Messier object.

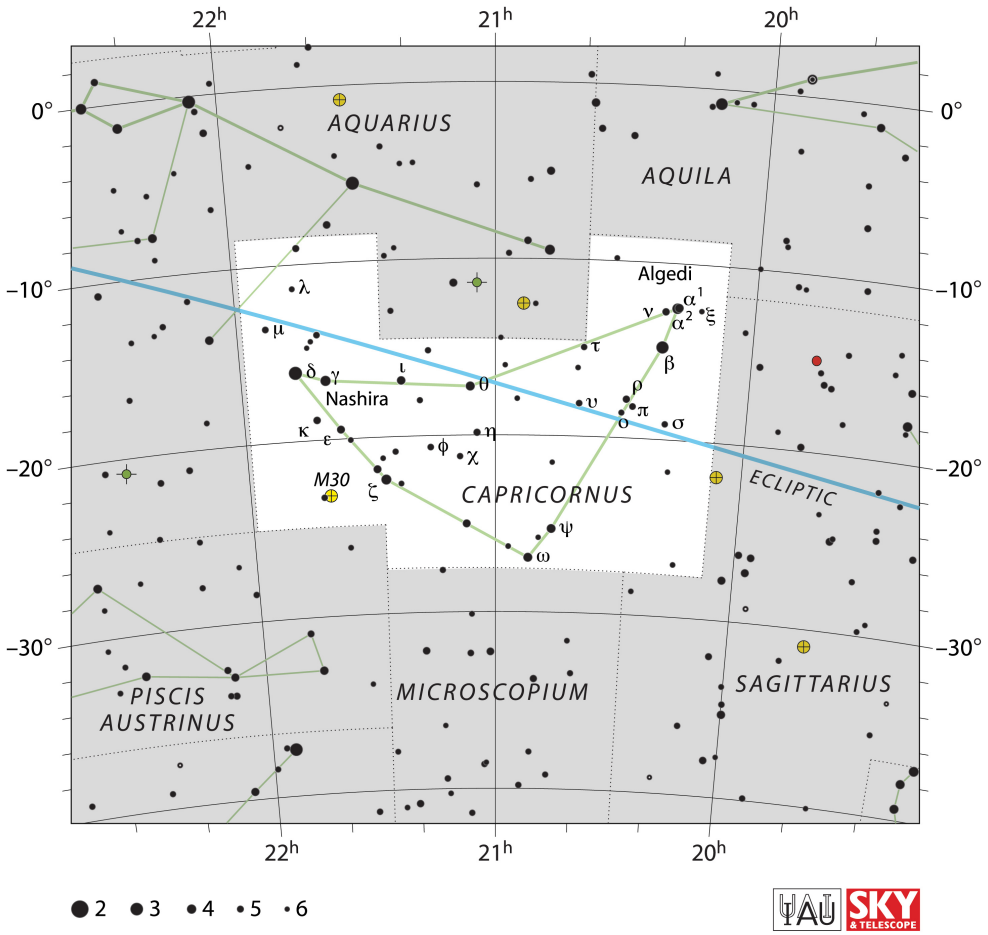
To find Capricornus draw a line from Vega, in Lyra, through Altair, in Aquila to find this arrowhead-shaped constellation. On the eastern edge of the constellation lies its brightest star Delta Capricorni, also known as Deneb Algebi. Although it appears to be a single star, Deneb Algebi is actually four stars too close to separate even with telescopes. The magnitude 2.8 star system is 39 light years from Earth.

Alpha Capricorni, also known as Algedi, is an easy to resolve double star with binoculars, in fact, given dark enough skies, can probably be resolved with the naked eye. Both are yellow giant stars. Alpha1 is itself a multiple star system as well.

Beta Capricorni, also known as Dabih, is also an easily split binocular double star. Beta is actually a quintuple star system, even though only two are visible in binoculars.

Messier 30, is a nice globular cluster of stars for small telescopes and binoculars, in which it will appear as a small hazy patch of light. The core of the cluster has collapsed making it dense and bright. The globular cluster is headed towards us in space at 113 miles per hour, but don't worry, M 30 is 27,000 light years away! It was discovered by Charles Messier on August 3, 1764.

While unavailable to most amateur telescopes there is an interesting group of galaxies in the western portion of the constellation called the Hickson Compact Group (HCG) 87. But search the internet and you will find some beautiful images of these four island universes with professional scopes, including the Hubble Space Telescope. The group lies a whopping 400 million light years from Earth.

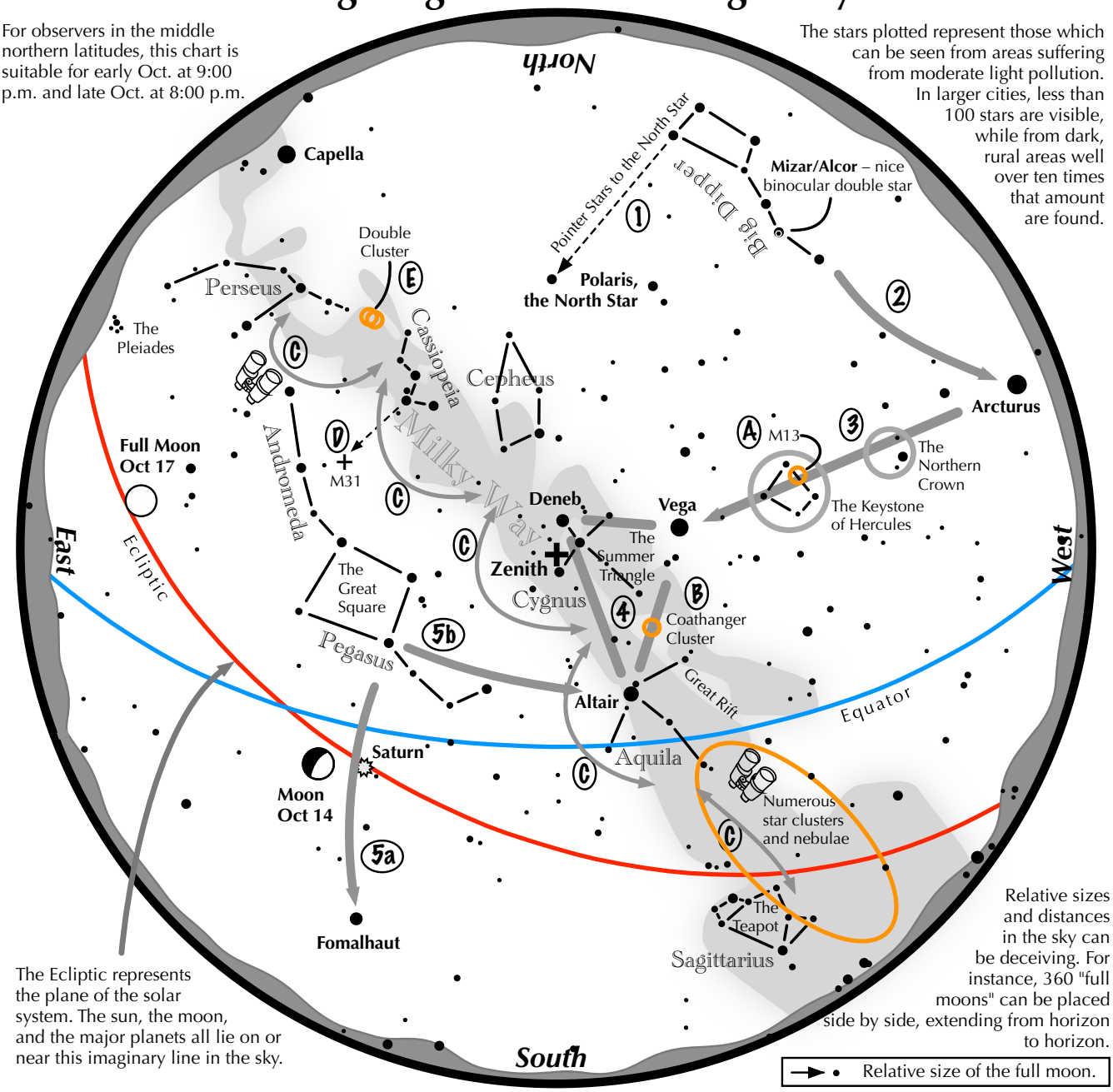



Until next month, keep looking up!

# 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.

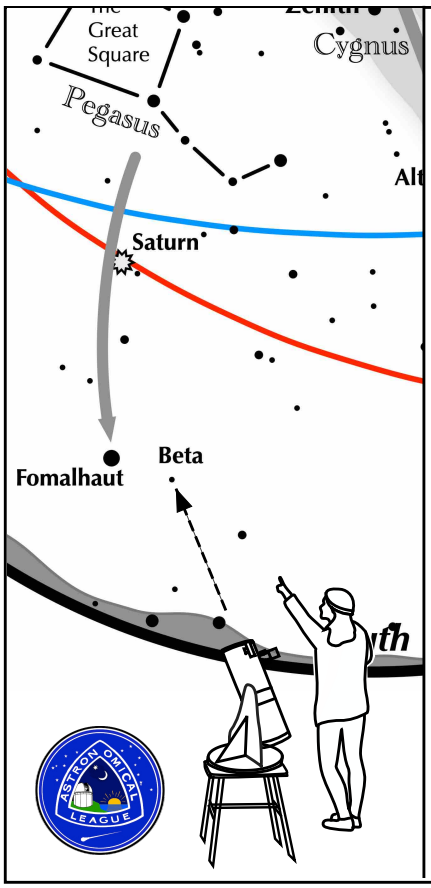
## Navigating the October night sky: Simply start with what you know or with what you can easily find.

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.

# ASTRONOMICAL LEAGUE Double Star Activity



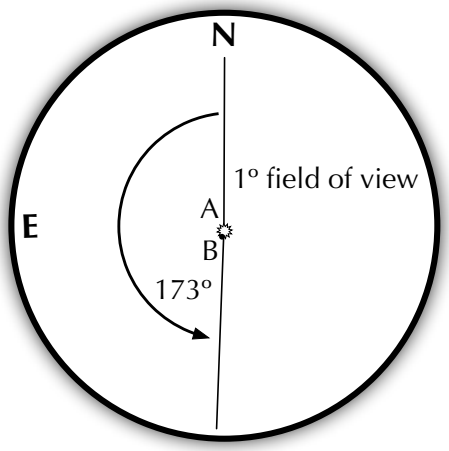

## Other Suns: Beta Piscis Austrini

### How to find Beta Piscis Austrini on an October evening

The two western stars of the Great Square point southward to the bright star Fomalhaut. One binocular field west lies 4.3 magnitude Beta Piscis Austrini.

**Beta Piscis Austrini**
A-B separation: 30 sec
A magnitude: 4.3
B magnitude: 7.1
Position Angle: 173°
A & B colors:
white, white

Suggested magnification: >20x
Suggested aperture: >2 inches




## About Astronomy Associates

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

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

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