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Monthly Newsletter

PAStimes

A Publication of the Phoenix Astronomical Society

PARADISE VALLEY COMMUNITY COLLEGE
A MARICOPA COMMUNITY COLLEGE

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September 16, 2026

Stuart Brackney
Phoenix Astronomical Society, Inc.

Phoenix, AZ 85255-5878

Dear Stuart,

On behalf of the college, thank you for your generous contribution to the PVCC Student Success Scholarship/Support Fund. Your commitment to investing in students and their education makes a meaningful and lasting impact on our campus community.

Because of your generosity, we are able to provide students with greater access to educational opportunities, reduce financial barriers, and support their academic success. Scholarships funded by donors like you allow students to focus more fully on their studies, personal growth, and future goals.

Your investment in our students is an investment in the future. You are empowering students to reach their full potential, which in turn strengthens their families and our entire community. We are deeply grateful for your partnership and your belief in our students.

We truly appreciate your role in helping our students succeed.

Sincerely,

Dr. Jana Schwartz
President

Thank you so very much for your ongoing support! We appreciate you!



MARICOPA COMMUNITY COLLEGES
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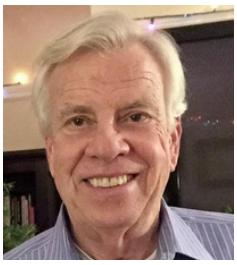
Navigating the Night Sky

Celestial Showcase

EVENT REMINDER

| 5 – Lecture | 8 – Dark Sky | 14 – Workshop 101 & Star Party | 17 – Book Club | 23 – ASIG

Stu's Views



Mother Nature is still giving us her clouds and rain, but that should not stop us in our pursuit to learn and see more about our cosmos. A few updates for you:

1. Loaner Telescope Program: in addition to having five automatic scopes, two Dobsonians, one solar and a brand-new refractor, we now have a 9.25" Celestron NexStar Evolution Schmidt-Cassegrain telescope. This donated "goto" is a magnificent scope with some fine add-on features. It will be available for "members only" on 1 November.

2. DarkSky Star Party set for Nov 8th. PLEASE read carefully, this event is not at our Apache location. Located one hour southeast of PVCC, Picket Post is a great place to hone your night viewing skills under some dark skies. Please register on our Bookwhen event calendar (bookwhen.com/pas-event-calendar) for more information.

3. NEW LOOK: your WWW.PASAZ.ORG website has a new look, featuring a variety of new resources and information. Designed by our own PAStimes Editor, Richard Meyers, you should visit it more often as it is constantly updated.

4. FREE Lectures: a friendly reminder, PAS provides to members and the public extraordinary lectures on the campus of PVCC. They are also simultaneously broadcast online. These lectures are free. Go to our website under "events" to see what is scheduled. Tell a friend!

5. HELP: your Board is asking for some of you to volunteer. If that is you, contact president@pasaz.org, thank you so much!
   a. A CPA/accountant
   b. Internet webmaster

6. Coming soon: a place for you to purchase PAS logo items, shirts, mugs, gifts.

Stuart Bradney



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UPCOMING EVENTS THIS MONTH



1 SUN

TELESCOPE WORKSHOP

Operating Your Telescope, 7 pm



5 THUR

MONTHLY LECTURE SERIES

Galaxies, 7 pm



14 SATURDAY

WORKSHOP 101 & STAR PARTY

Workshop 101 – What to Buy at 5:30 pm, followed by the Local Public Star Party at 6:30 pm.



17 SATURDAY

BOOK CLUB

Hyperspace by Michio Kaku



23 MON

ASIG/ASTROIMAGING

Deep-Sky Imaging (Charles Bracken), 7 pm

MORE INFORMATION

For more information and to register for these events, go to the PAS Event Calendar and Registration Site. It is important to register for all events. In case of an event change or cancellation, you will be notified via email.

THIS MONTH'S LECTURE



Speaker:
Dave Eicher, Editor Emeritus Astronomy Magazine "Galaxies"

Topic:
Galaxies

Bright matter in the cosmos is organized into some 100 billion galaxies, and perhaps many more. This talk will explore the nature of galaxies from the Local Group to the edge of the observable universe.

Speaker bio:

David J. Eicher is an author, editor, and prominent popularizer of astronomy who spent over 40 years at Astronomy magazine, serving as its Editor-in-Chief from 2002 to 2025 before becoming Editor Emeritus. He has written or co-authored more than 30 books on space and history, including Galaxies: Inside the Universe's Star Cities and Cosmic Clouds 3-D (with Brian May). A prolific speaker and deep-sky observing expert, Eicher was honored by the International Astronomical Union with the naming of Asteroid 3617 Eicher for his contributions to the public understanding of science.

Dark Sky Star Party - Picket Post Trailhead

Join the Phoenix Astronomical Society for a special dark sky star party on Sunday, November 8, at Picket Post Trailhead! Dark-sky star parties take us farther away from city lights, offering darker skies and better conditions for observing the night sky and enjoying astrophotography. This location offers Bortle 4 skies, with dark views toward the south and east, making it a great opportunity to explore the cosmos away from the city glow.

Location Details:
Date: Sunday, November 8
Sunset: 5:29 PM
Site: Picket Post Trailhead
Access: Paved roads most of the way, with a short dirt-road turnoff leading to a large dirt parking area with restrooms

Link to signup - https://bookwhen.com/pas-event-calendar/e/ev-s3ao7-20261108173000

RECAP OF LAST MONTH'S LECTURE

Exploring New Worlds in Space

by Dániel Apai



From Clay Tablets to NASA's Pandora Space Telescope and Beyond

Dr. Dániel Apai, Professor of Astronomy, Planetary Sciences, and Optical Sciences at the University of Arizona, opened with the earliest known map of the world: a Babylonian clay tablet from the 6th century BC, found in modern-day Iraq. It puts Babylon at the center, ringed by an ocean, and it is wildly inaccurate -- but it shows that people have long tried to capture the whole universe around them. Today even schoolchildren can name the continents and planets, he noted, yet few of us can name the five nearest stars, and the planets orbiting them remain largely unknown.

HUNTING PLANETS FROM THE GROUND

Apai began by using the European Southern Observatory's Very Large Telescope in Chile to image every star within about 24 light years, searching for giant planets. Ground-based telescopes struggle to find small, Earth-like planets next to bright stars, so he turned to the transit method: watching for the slight dimming as a planet crosses its star. That dip reveals the planet's size, its orbital period and, through Kepler's laws, its distance and temperature.

To stare at nearby stars night after night, he helped launch EDEN (Exo-Discovery and Exploration Network) with the Vatican Observatory. EDEN used over 1,200 nights on telescopes in Arizona, Spain, Italy and Taiwan before ending its five-year run about three years ago. One result, published in Nature, confirmed an Earth-size planet in the three-planet LP 791-18 system. Tugged by its larger neighbors, it is likely squeezed enough to drive constant volcanism.

PANDORA: STUDYING PLANET ATMOSPHERES

To search for water and other gases, astronomers study starlight filtering through a planet's atmosphere during transit. But starspots and flares can mask those signals -- a problem Apai's group predicted would limit the James Webb Space Telescope. NASA's answer was Pandora, a small 45 cm infrared space telescope built to measure that stellar contamination.

- Launched in January 2026 on a SpaceX Falcon 9 with 44 other satellites, into a sun-synchronous twilight orbit about 600 km up.
- Mission operations run from the University of Arizona campus -- "the little Houston for Pandora."
- After six months of commissioning, full science operations began in August. First results are expected in a few months.

THE FUTURE: NAUTILUS

Apai's next goal is surveying hundreds or even thousands of planets for signs of life. With Starship making launches cheaper and more frequent, his Nautilus project envisions fleets of 8 m space telescopes that use thin, flat diffractive lenses, molded much like car windshields, instead of mirrors. A large mirror takes two to four years to make; the planned lens press could turn one out every two days, at far less weight and cost. The University of Arizona is now building the world's largest facility for producing them, supported by the Heising-Simons and Gordon and Betty Moore Foundations.

Q&A HIGHLIGHT

Asked how astronomers would recognize life, Apai explained that life transforms entire planets, as oxygen from photosynthesis changed Earth. The hope is to detect combinations such as oxygen, water vapor and methane. Since telescopes can't get closer, they must be bigger to collect more light.

Star Tours & OutReach Events



3rd Star Party
3rd CIVANNA
9th Arcosanti
21st Toll Brothers
26th Edward Jones
28th International Dark Sky Discovery Center



Photo by
Chris Ford



Photo by
Alessandro Cavallaro

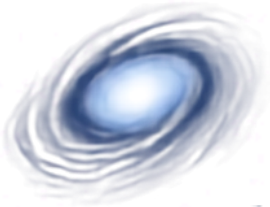


Photo by
Alessandro Cavallaro



Photo by
Alessandro Cavallaro

Black Holes: The Universe's Most Extreme Personalities



by Cyrus Mousavi

Black holes are the rock stars of astrophysics: mysterious, destructive, glamorous, and surrounded by rumors. They bend space, slow time, swallow light, shred stars, collide violently, and occasionally force physicists to admit that their best theories do not get along nearly as well as advertised. And contrary to the name, a black hole is not really a hole. It is an object so dense that gravity has effectively slammed the exit door shut.

STELLAR BLACK HOLES

A massive star spends most of its life balancing gravity with the outward pressure generated by nuclear fusion. Eventually the fuel runs out, the internal support collapses, and gravity takes over. If the remaining core is massive enough, it collapses into a black hole. These stellar-mass black holes typically contain several to tens of times the mass of the Sun, packed into a region only tens or hundreds of kilometers across. Nature apparently invented extreme compression long before humans invented ZIP files.

SUPERMASSIVE BLACK HOLES

At the centers of most large galaxies lurk supermassive black holes containing millions or billions of solar masses. Our Milky Way hosts Sagittarius A*, weighing about four million Suns. M87's central black hole is vastly larger, weighing billions of solar masses. In 2019 it became the first black hole whose shadow was directly imaged. The puzzle is how these monsters became enormous so early in cosmic history. Perhaps they grew from smaller black holes by feeding and merging. Perhaps enormous clouds of primordial gas collapsed directly into massive black-hole seeds. Probably both mechanisms occurred. The universe rarely limits itself to one method of causing trouble.

INTERMEDIATE-MASS BLACK HOLES

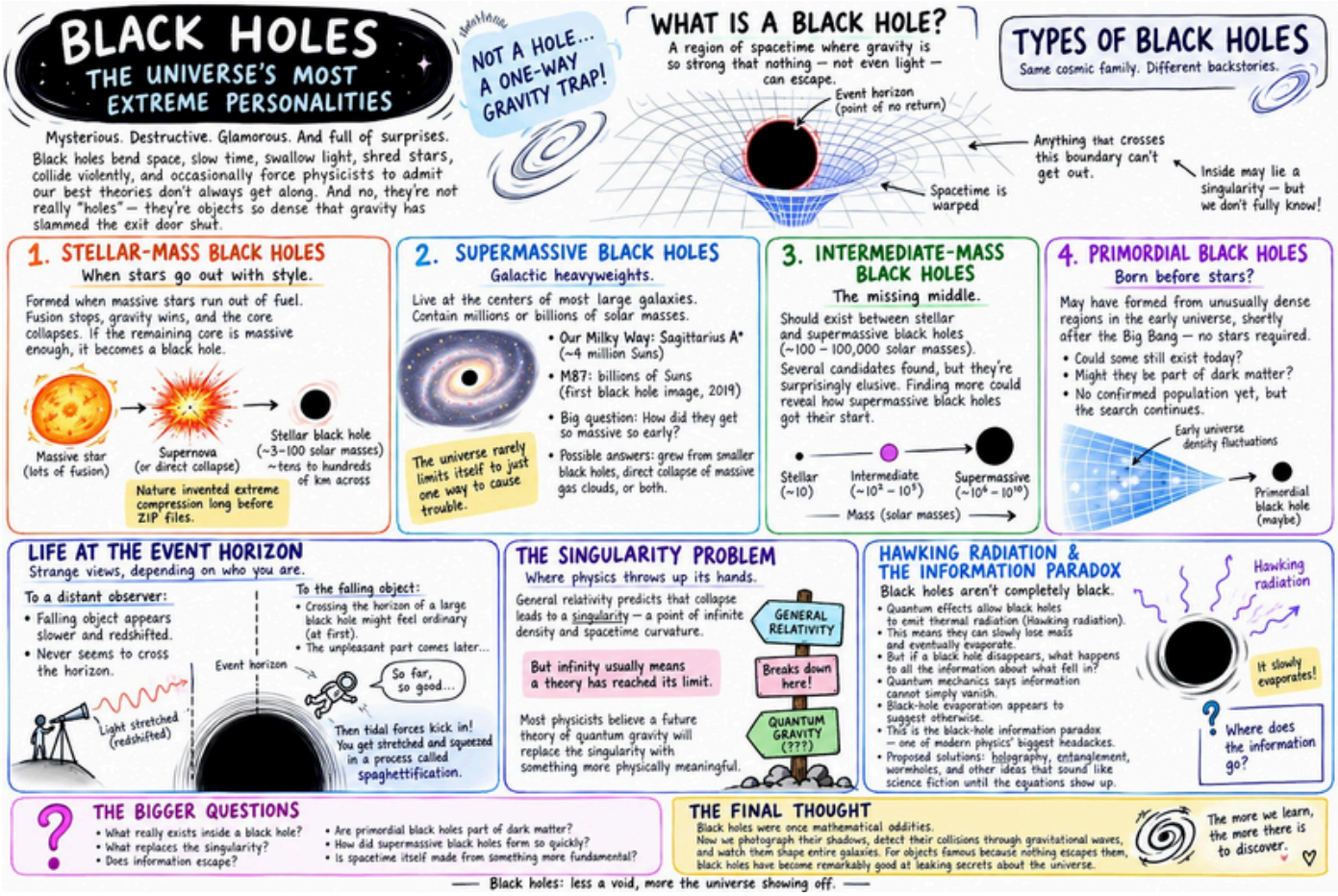
Between stellar and supermassive black holes should exist intermediate-mass black holes weighing hundreds to hundreds of thousands of Suns. Astronomers have identified several promising candidates, but this population remains surprisingly elusive. Finding more could reveal how supermassive black holes got their start.

PRIMORDIAL BLACK HOLES

Now things get stranger. Some theories suggest that unusually dense regions shortly after the Big Bang could have collapsed directly into black holes. These primordial black holes would predate stars and galaxies. Some scientists have investigated whether they might even account for part of the mysterious dark matter surrounding galaxies. So far, none has been conclusively identified.

CROSSING THE EVENT HORIZON

The event horizon is the famous point of no return. Once something crosses it, no signal traveling at or below the speed of light can escape. To a distant observer, an object falling toward the horizon appears increasingly redshifted and slowed. To the falling object, however, crossing the horizon of a sufficiently massive black hole might initially feel completely ordinary. The unpleasant part arrives later. Tidal gravity can eventually stretch an unfortunate traveler lengthwise while squeezing them sideways. Physicists call this spaghettification. Apparently even cosmic death deserves good branding.



AI Generated by Cyrus Mousavi

THE SINGULARITY: WHERE PHYSICS THROWS UP ITS HANDS

General relativity predicts that gravitational collapse can lead to a singularity where spacetime curvature becomes infinite. Physicists strongly suspect this does not literally describe nature. Instead, the singularity may simply mark the point where Einstein's theory stops working and quantum gravity must take over. Unfortunately, we do not yet possess a complete theory of quantum gravity.

HAWKING RADIATION AND THE INFORMATION PROBLEM

Stephen Hawking discovered that quantum effects allow black holes to emit radiation and slowly evaporate. Wonderful. Except now there is a problem. If a black hole disappears, what happens to all the information describing everything that fell into it? Quantum mechanics insists that information cannot simply vanish. Black-hole evaporation appears to suggest otherwise.

This is the famous black-hole information paradox, one of modern physics' biggest headaches. Possible solutions involve holography, entanglement, wormholes, and other ideas that sound suspiciously like science fiction until equations appear.

THE GREATEST JOKE OF ALL

Black holes were once considered mathematical oddities. Today we photograph their shadows, detect their collisions through gravitational waves, and watch them influence the evolution of galaxies. Yet their deepest mysteries remain unanswered. What really exists inside? What replaces the singularity? Does information escape? Is spacetime itself made from something more fundamental? For objects famous because nothing escapes them, black holes have become remarkably good at leaking secrets about the universe.

A Thousand Galaxies Hang on a Harvard Circular

by Richard Meyers

On March 3, 1912, Harvard College Observatory Circular No. 173 was published—three pages, a data table, and two small graphs. It did not make much noise at the time. The author was listed in the third person: "The following statement has been prepared by Miss Leavitt." The director, Edward C. Pickering, signed it.

Henrietta Swan Leavitt had been working at the observatory since 1893, part of a group of women hired to measure and catalog stars from photographic plates. They were called "computers"—the word meant something different then, a person who computes—and they were paid around twenty-five cents an hour. It was painstaking work, and Leavitt was very good at it. Her particular assignment was the Small Magellanic Cloud, a faint smudge in the southern sky that we now know is a satellite galaxy of the Milky Way, sitting about 200,000 light-years away.

Within the Cloud, she tracked Cepheid variable stars—a class of stars that brighten and dim in regular cycles, swelling and contracting over periods of days or weeks. The prototype, Delta Cephei in the northern constellation Cepheus, had been watched by amateur astronomers since John Goodricke first timed its variations in 1784. What Leavitt noticed, working through plate after plate, was that the brighter Cepheids took longer to complete their cycles. This wasn't a coincidence—it was a remarkably consistent relationship, and because all the stars in the Small Magellanic Cloud lie at approximately the same distance from Earth, differences in apparent brightness had to reflect real differences in intrinsic luminosity. The longer the period, the more luminous the star. The physical explanation, rooted in stellar structure theory, would come much later. What Leavitt had in 1912 was the pattern itself, plotted cleanly on two small graphs.

WHAT THE PATTERN MADE POSSIBLE

The data table in Circular 173 lists 25 Cepheids with periods ranging from 1.25 days to 127 days. It is spare and precise—Harvard Number, brightness at maximum, brightness at minimum, epoch, period, residuals from the fitted line. The kind of table you could spend a long time with and still find something new to look at. Astronomer Ejnar Hertzsprung calibrated the relationship against nearby Cepheids in 1913, attaching actual distance values to the scale.

Source: Leavitt, H.S., Harvard College Observatory Circular 173 (1912).

Now if you could find a Cepheid anywhere in the sky and time its pulsations, you could work out how luminous it truly was—and from that, how far away it had to be. Edwin Hubble used that calibration in 1923 to measure the distance to the Andromeda Nebula. He found it was roughly one million light-years away, later refined to about 2.5 million—so far beyond the boundaries of our own galaxy that the argument about whether it was a nearby gas cloud or a separate star system altogether was effectively settled. It was a separate star system. There were others. A great many others, it turned out.

Leavitt died in December 1921, of cancer, at fifty-three. In 1925, Swedish mathematician Gösta Mittag-Leffler reportedly considered nominating her for a Nobel Prize, only to learn she had been gone for four years. Nobel Prizes are not awarded posthumously, so that was the end of it. Historians are careful to note that a formal nomination may never have actually been submitted, but the spirit of the story is accurate enough: the recognition arrived after she could receive it.

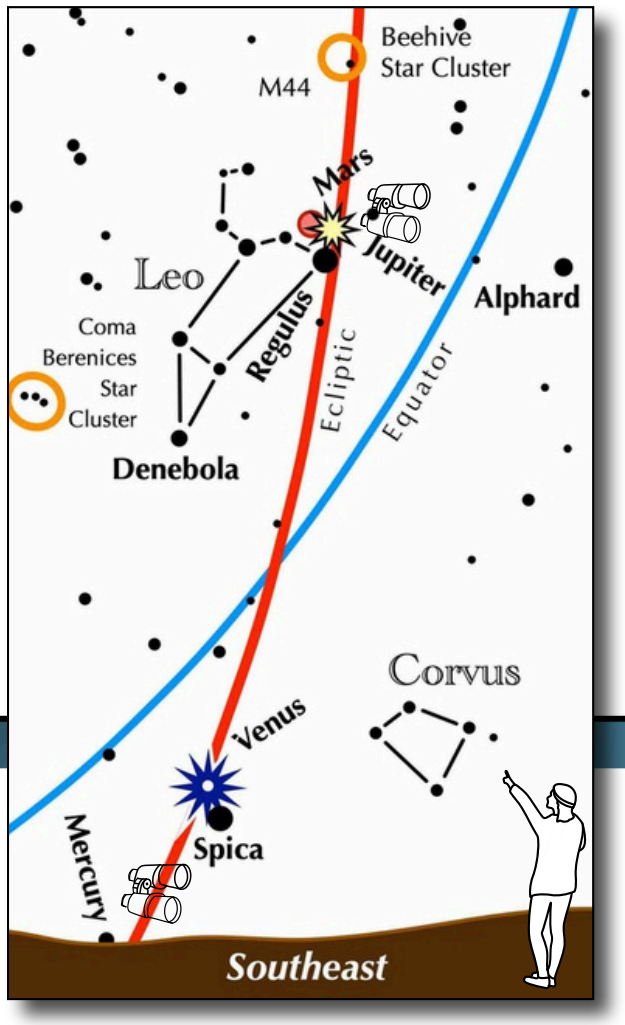
WATCHING IT HAPPEN FROM YOUR BACKYARD

One thing I find genuinely satisfying about Leavitt's discovery is that you don't need a research observatory to participate in the same basic enterprise. Delta Cephei itself—the star the whole class is named for—varies between magnitude 3.5 and 4.4 on a 5.37-day cycle, which means you can follow it with your naked eye or a pair of binoculars by comparing it against nearby stars of known brightness. Eta Aquilae and Zeta Geminorum are similarly bright and accessible. The AAVSO (American Association of Variable Star Observers) provides comparison star charts for all of these, along with an online database where your magnitude estimates are archived alongside professional observations. It's a genuinely useful contribution, not just a learning exercise.

If you have a GoTo mount and a camera, you can go further—building light curves by imaging a Cepheid repeatedly over several nights and plotting brightness against time until the characteristic asymmetric pulsation curve emerges from the data. It takes patience more than anything else. Which is, when you think about it, exactly what Leavitt brought to the problem: patience, and the willingness to sit with a stack of glass plates until the pattern revealed itself.

Circular 173 is available through the NASA Astrophysics Data System if you want to read it. Three pages is not very long for something that changed how we understand the size of everything.

In the early mornings around November 15-18, try this activity:



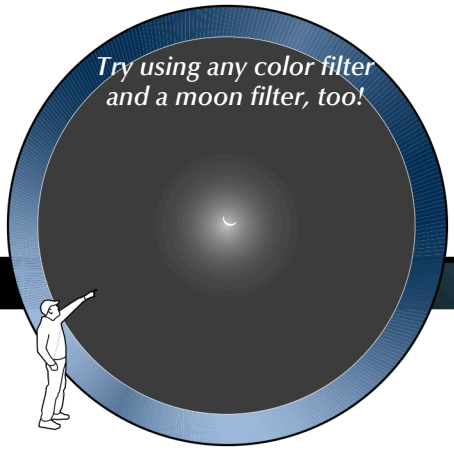
Count the bright celestial wonders strung along the ecliptic

1. Red Mars meets bright Jupiter high in the southeast ninety minutes before sunrise. Grouped with them is the brightest star in Leo, Regulus.

2. Much nearer the southeastern horizon shines brilliant Venus sitting just above the bright star Spica.

3. 40 minutes before sunrise, little Mercury pops above the horizon, far below Venus. Binoculars help spot it in the bright twilight.

Grab a quick look at **Venus** *through any telescope. Its beautiful, thin, and brilliant crescent awaits! As the mornings pass, the crescent grows smaller, but thicker.*



View in the southeast
on November 15-18
90 minutes before sunrise

What a great way to start your day!

Tonight's Targets: A Labor of Love for a Computer Geek

by Toby Patton

Hello fellow star gazers and astro imagers. My name is Toby Patton and I am a former software developer. I retired about 4 years ago after spending 24 years contracted to the Navy working out of Puget Sound Naval Shipyard in Bremerton, Washington.

About the time I retired my wife and I moved from Gig Harbor, WA to Fountain Hills, AZ. Since leaving the land of clouds and rain my interest in astronomy returned, so I purchased a large Dobsonian telescope. But it wasn't long before I wanted to take pictures of the night sky. I had some experience with astro photography back in the 1980s when we lived in Orange County, California. Back then I used hypersensitized black and white film and hand-guided exposures while peering through an illuminated reticle for hours. Anybody remember those days?

As you may know, picking a target for our hobby is not always easy, especially if you are interested in objects that are in the optimal location in the sky for your location and date. I suppose there are a lot of tools out there already to help with that, including applications like Stellarium, but I had an idea.

Even after a career of 40 years in tech, I still love to write software, so it was not long before I started thinking about working on an application to help me figure out what to image. I started with the basic premise that I wanted objects that would pass the meridian of my location near midnight. Those are the objects that are in the optimal part of the sky for an all-night run. In addition to picking a desirable right ascension, I wanted to pick objects with an optimal declination from my location. And of course you want to be imaging near the new moon, so I added a calculation to show when the moon would rise and set.

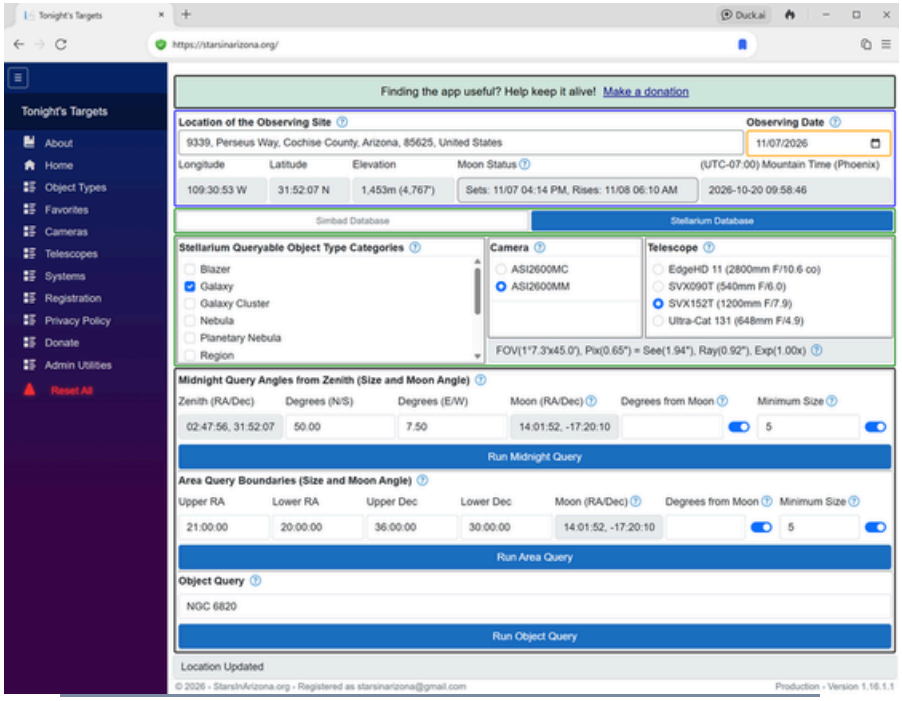
As the application grew, I added features like being able to configure equipment and then compare different combinations for factors like field of view and exposure ratios. When a friend of mine, Phil Hoppes, mentioned he considers the angle from the moon when making a selection, I thought that was a neat idea, so I added the object's moon angle into the picture.

While Tonight's Targets is a work in progress, I do find it useful. The basic workflow starts with adding a location. The location can be anywhere in the world. It may be a place you plan to visit hundreds or thousands of miles away or it might be your back yard. When you enter a location the application uses a geo locating service to get the longitude and latitude and another service to get the elevation. You can add multiple locations, and it will remember up to 10. Then update the calendar to the date you plan to be imaging. Once the date has been set the Moon Status field will show the rise and set times. It may have a red border if the date is not within a few days of new moon. That is just an FYI.

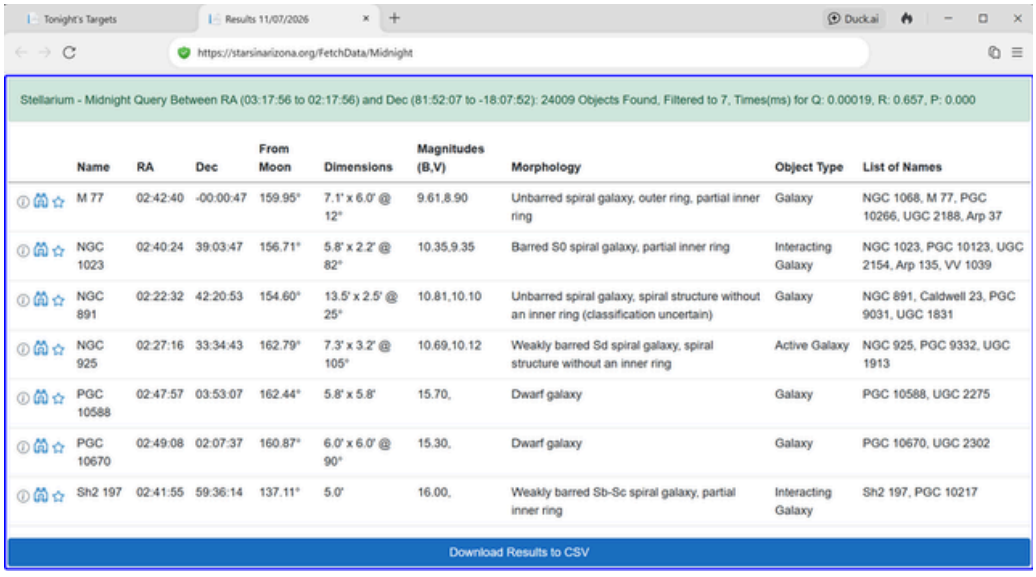
When I first developed the application, I used the Simbad database of objects, which is maintained by the Centre de Données Astronomiques de Strasbourg. Recently I added the 1.1 million object database that is provided by Stellarium. I think it is a bit easier to use. Your choice. At this point you should consider modifying the Telescopes and Cameras pages to reflect the gear you have or the gear you wish you had. You can then select combinations of equipment on the home page. You can now pick the class of objects you are interested in and add a distance from the Moon (if applicable) and maybe a minimum object size (the toggle to the right enforces this; if set, it will filter out objects that do not have a size in the database, otherwise they will be included).

For the Run Midnight Query command, you can set a degree north and south and a degree east and west (both from your zenith at midnight) which will return objects within those boundaries. The degrees east and west default to 7.5 which amounts to an hour centered on midnight. After running the query, you can pick an object using the icons on its left. The circle with an I in it will take you to an informational page with data returned from Simbad. The binocular will display the image using the Aladin service. The star icon will add the object to a favorites list. Use the Favorites list to record objects you would like to image from the given location at the given date. Here are some screen shots as an example:

I am using as my location the TAAA Chiricahua Astronomy Complex, which is about 220 miles south-east of Fountain Hills. For my date I selected the next star party weekend of November 7. I chose Stellarium as my database, Galaxy object types, and I want to force a galaxy size of at least 5 minutes.

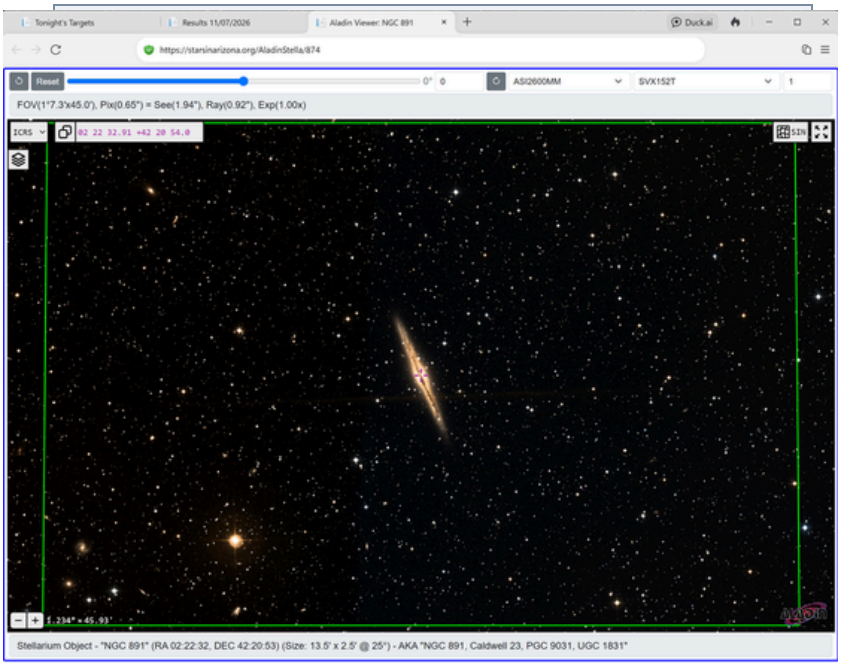


Here are the results. NGC 891 looks interesting, so I will click the binoculars.

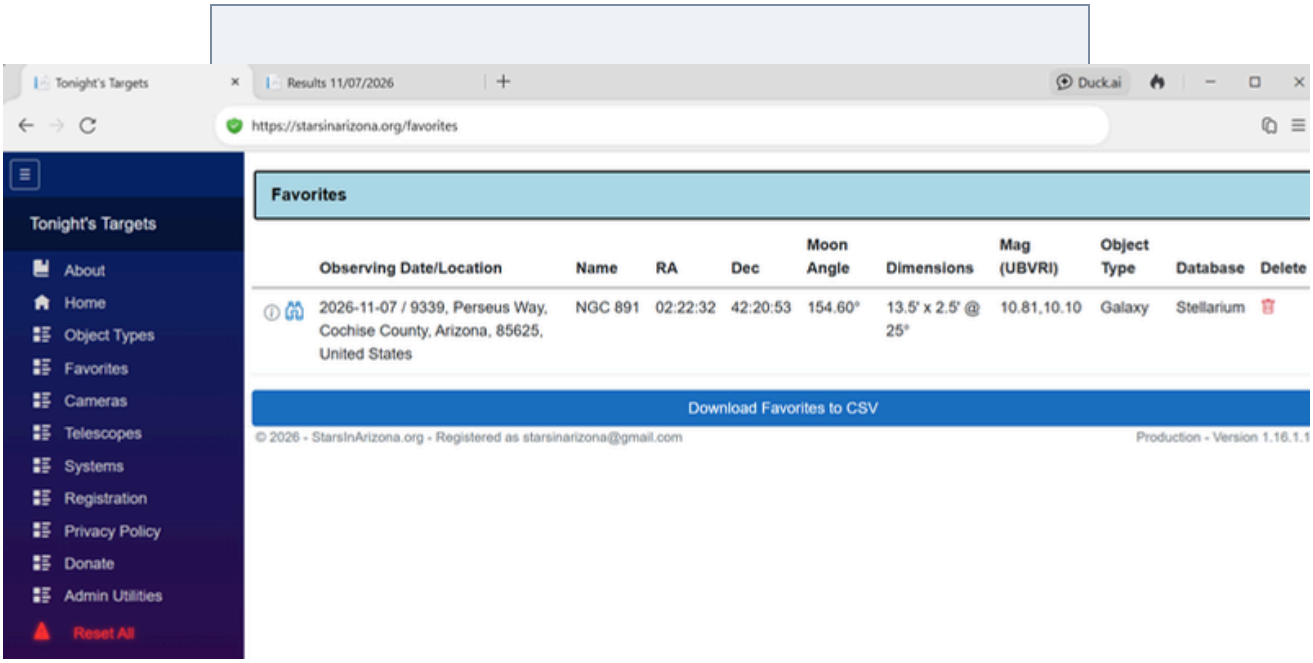


Name	RA	Dec	From Moon	Dimensions	Magnitudes (B,V)	Morphology	Object Type	List of Names
M 77	02:42:40	-00:00:47	159.95°	7.1' x 6.0' @ 12°	9.61,8.90	Unbarred spiral galaxy, outer ring, partial inner ring	Galaxy	NGC 1068, M 77, PGC 10266, UGC 2188, Arp 37
NGC 1023	02:40:24	39:03:47	156.71°	5.8' x 2.2' @ 82°	10.35,9.35	Barred S0 spiral galaxy, partial inner ring	Interacting Galaxy	NGC 1023, PGC 10123, UGC 2154, Arp 135, VV 1039
NGC 891	02:22:32	42:20:53	154.60°	13.5' x 2.5' @ 25°	10.81,10.10	Unbarred spiral galaxy, spiral structure without an inner ring (classification uncertain)	Galaxy	NGC 891, Caldwell 23, PGC 9031, UGC 1831
NGC 925	02:27:16	33:34:43	162.79°	7.3' x 3.2' @ 105°	10.69,10.12	Weakly barred Sd spiral galaxy, spiral structure without an inner ring	Active Galaxy	NGC 925, PGC 9332, UGC 1913
PGC 10588	02:47:57	03:53:07	162.44°	5.8' x 5.8'	15.70,	Dwarf galaxy	Galaxy	PGC 10588, UGC 2275
PGC 10670	02:49:08	02:07:37	160.87°	6.0' x 6.0' @ 90°	15.30,	Dwarf galaxy	Galaxy	PGC 10670, UGC 2302
Sh2 197	02:41:55	59:36:14	137.11°	5.0'	16.00,	Weakly barred Sb-Sc spiral galaxy, partial inner ring	Interacting Galaxy	Sh2 197, PGC 10217

Here is the Aladin view of NGC 891 framed for my Stellarvue SVX152 and ASI2600MM.



I kind of like it, so back on the results tab I will click the star and add it to my favorites. Here is the Favorites page and the beginning of my imaging list for November.



A Final Word

The above is just a very quick run through of what Tonight's Targets is about. I hope you will take a few minutes to check it out. Please read the About page first thing. Thanks!

Tonight's Targets is a web application written in Microsoft Visual Studio using the C# language and MS Blazor web pages. It currently runs on Amazon Web Services (AWS) and is configured with minimum resources as I must pay a monthly fee, so if you experience slow response or the occasional disconnect, please bear with me.

NASA's Night Sky Network (NSN) distributes this article.
The NSN program supports astronomy clubs across the USA dedicated to astronomy outreach. Visit nightsky.jpl.nasa.gov to find local clubs, events, and more!

November's Night Sky Notes: Light-Day Away

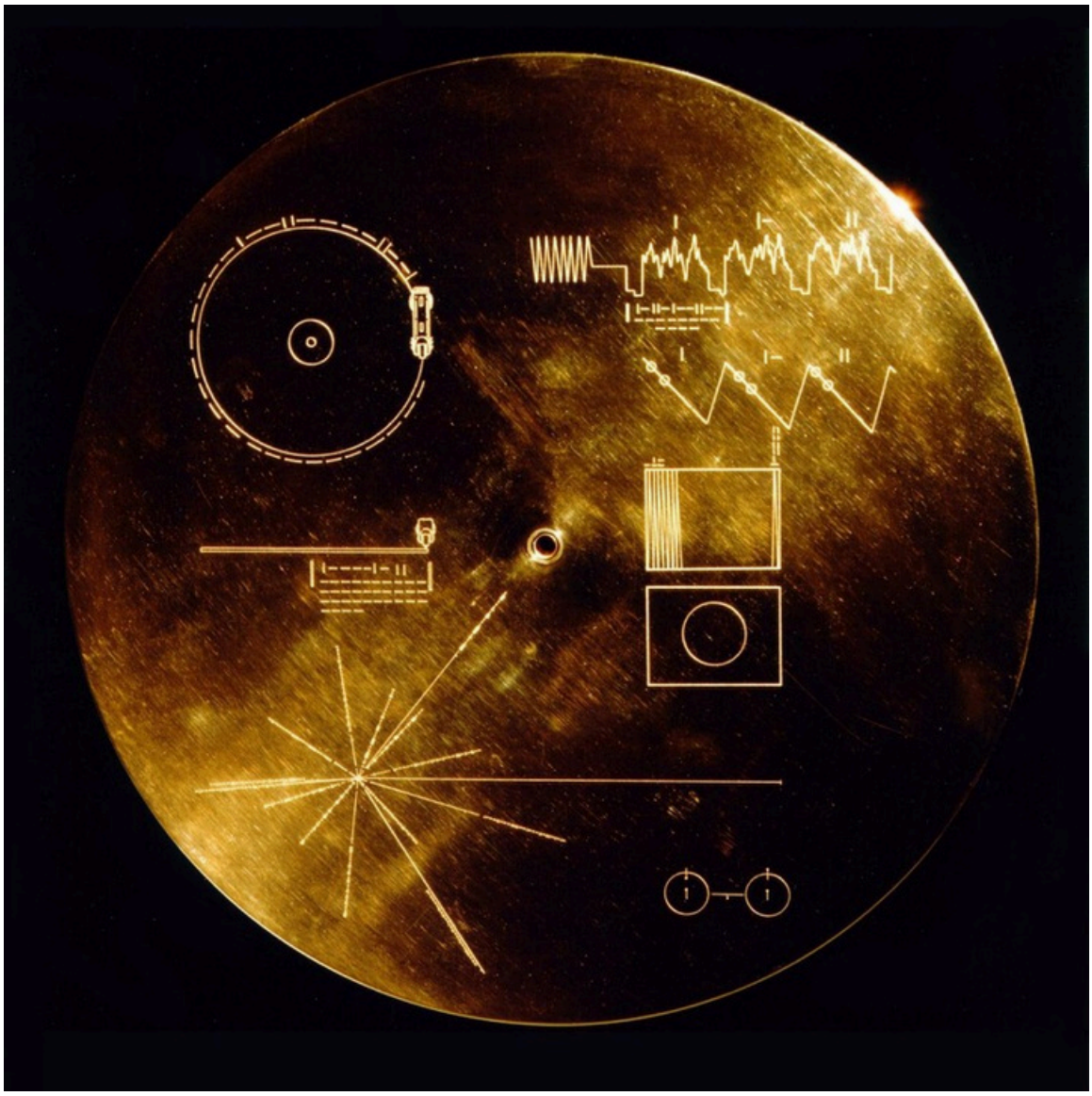
By KatTroche



A travel poster of The Grand Tour. Credit: NASA/JPL

Twin Travelers

In 1977, NASA launched twin spacecraft Voyager 1 and 2, taking advantage of a once-every-175- year planetary alignment of the four largest planets in our solar system: Jupiter, Saturn, Uranus, and Neptune. Using six gravity assists between them, this Grand Tour gave us up-close views of the gas and ice giants, including several moons. By the 1980s, the two probes went their separate ways at Saturn. As Voyager 2 continued toward Uranus and Neptune, Voyager 1 grabbed one more portrait of the solar system (excluding Mercury and Mars), including a final image of the pale blue dot we call home.



The Golden Record cover shown with its extraterrestrial instructions. Credit: NASA/JPL-Caltech

Playlist

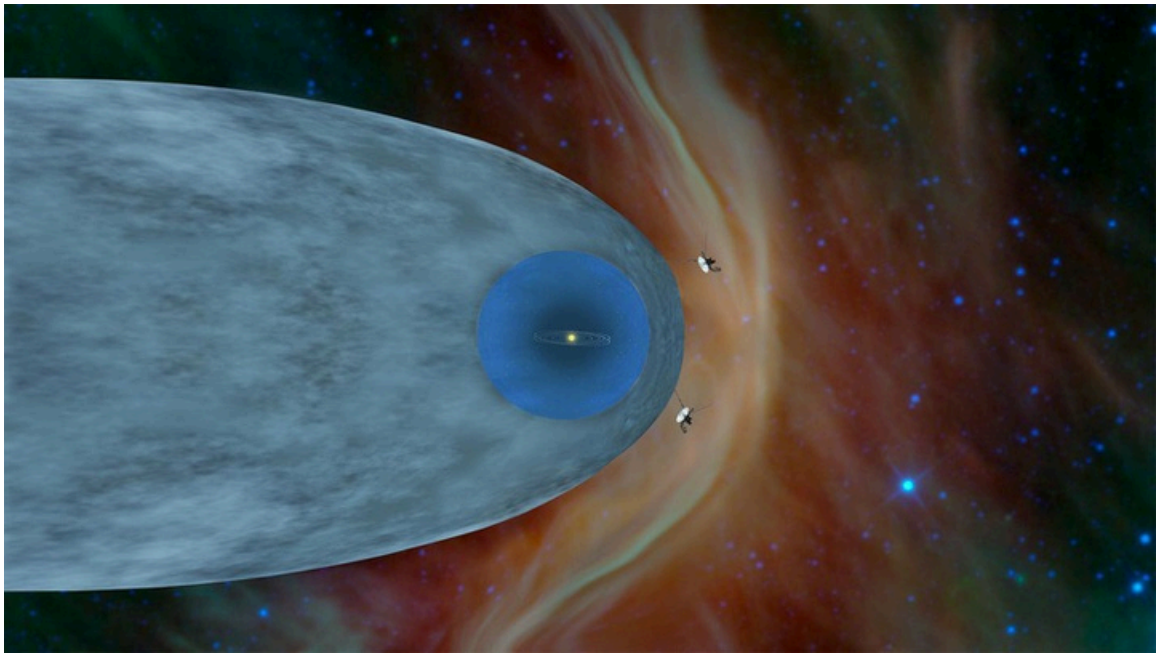
“Hello from the children of planet Earth.”

Every good road trip needs some music to match. In this case, each craft carries the Golden Record, a 12-inch phonograph record with spoken greetings in 55 languages, 27 musical tracks, 116 images, and other sounds from Earth. Each record is protected by an outer cover featuring etchings showing our Sun's location relative to 14 pulsars, along with instructions on how to play it. The design used various metals to protect the information encoded from space radiation: the record used copper and gold plating, and the cover used aluminum. The cover was electroplated

with an ultra-pure sample of the isotope uranium-238. Uranium-238 has a half-life of 4.468 billion years.

Are We There Yet?

Did you know that a light-minute is a measure of distance, not time? In August 2012 and November 2018, Voyager 1 and 2 crossed the heliopause, the boundary where the Sun's solar wind meets the interstellar medium. Using NASA's Deep Space Network, Earth communicates with both spacecraft and tracks each on its journey. At the time of this article, the Canberra antenna tracked Voyager 1 at 25.80 billion km, or just over 16 billion miles.



This illustration shows the positions of NASA's Voyager 1 and Voyager 2 probes outside the heliosphere, a protective bubble created by the Sun that extends well past Pluto's orbit. The red wave in front of the light blue heliopause is the bow shock. Credit: NASA/JPL-Caltech.

On November 18, 2026, 49 years after its launch, Voyager 1 will cross the one-light-day mark, 16.1 billion miles from the Sun. You may have heard the term *light-year* in your favorite sci-fi movie or show, or when stargazing and referring to an object outside of our solar system. This video best demonstrates the different distances between the inner solar system, outer solar system, and beyond, using light measurements. Additionally, track each Voyager spacecraft here.

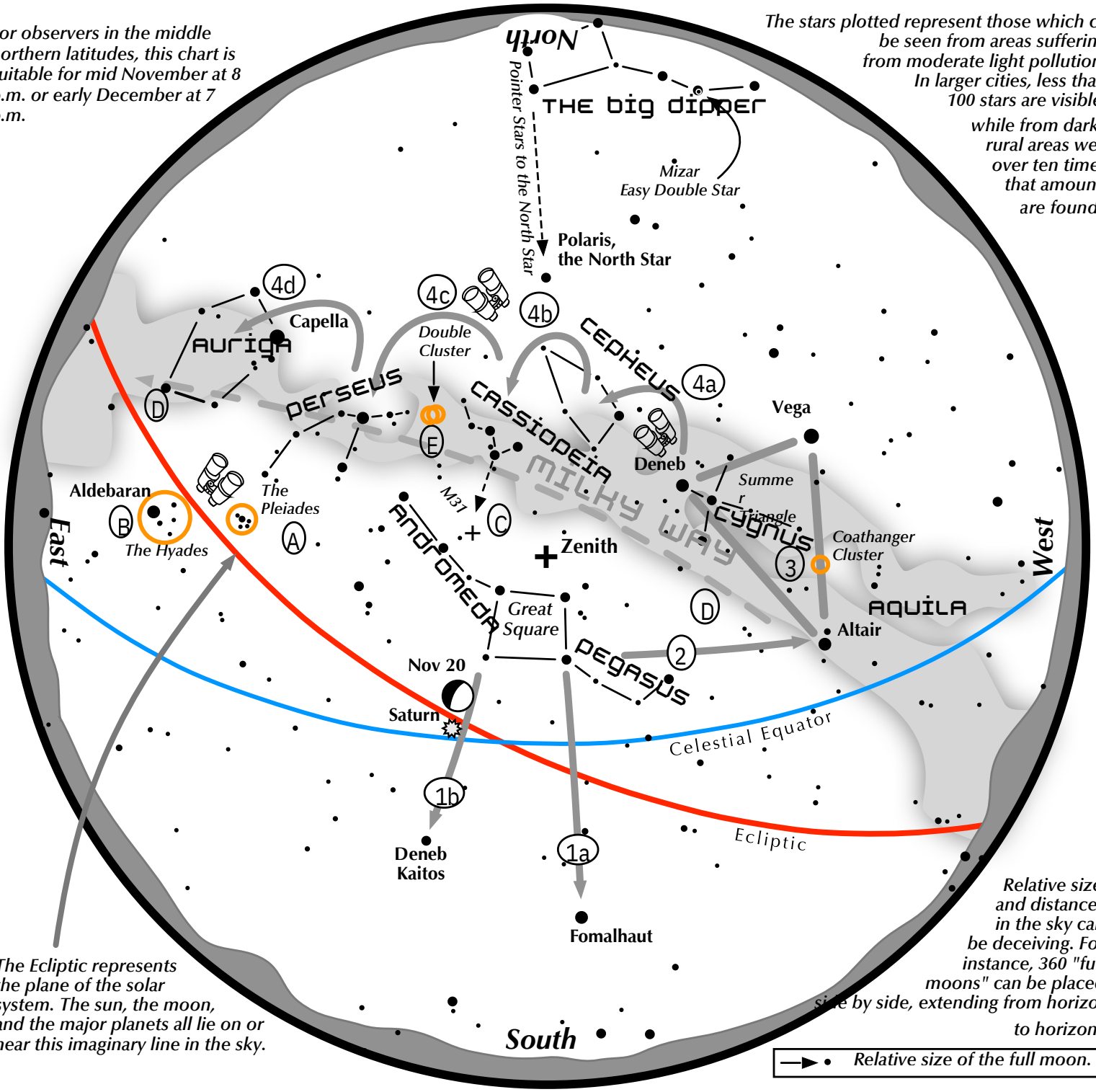
You can get a real understanding of what a gravity assist might be like with our Gravity Assist activity and learn what it's like to measure a "light minute" with our Measuring a Kid Minute activity guide!

Navigating the November Night Sky

2026

For observers in the middle northern latitudes, this chart is suitable for mid November at 8 p.m. or early December at 7 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 November night sky: Simply start with what you know or with what you can easily find.

1. *Face south. Almost overhead lies the "Great Square" with four stars about the same brightness as those of the Big Dipper. Extend a line southward following the Square's two westernmost stars. The line strikes Fomalhaut, the brightest star in the south. A line extending southward from the two easternmost stars, passes Deneb Kaitos, the second brighest star in the south.*
2. *Draw a line westward following the southern edge of the Square until it strikes Altair, part of the "Summer Triangle."*
3. *Locate Vega and Deneb, the other two stars of the Summer Triangle. Vega is its brightest member, while Deneb sits in the middle of the Milky Way.*
4. *Jump along the Milky Way from Deneb to Cepheus, which resembles the outline of a house. Continue jumping to the "W" of Cassiopeia, then to Perseus, and finally to Auriga with its bright star Capella.*

Binocular Highlights

A and B: *Examine the stars of the Pleiades and Hyades, two naked eye star clusters.* **C:** *The three westernmost stars of Cassiopeia's "W" point south to M31, the Andromeda Galaxy, a "fuzzy" oval.* **D:** *Sweep along the Milky Way from Altair, past Deneb, through Cepheus, Cassiopeia and Perseus, then to Auriga for many intriguing star clusters and nebulous areas.* **E.** *The Double Cluster.*

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

CELESTIAL SHOWCASE



STEVE GLICK - WIDE FIELD VIEW OF THE CYGNUS AREA WITH THE CRAB NEBULA AT ITS CENTER ALONGSIDE THE CLOSEUP OF THE CRAB.



RICHARD SAUERBRUN-HEART NEBULA



MARK SAVAN-DARK SHARK NEBULA (LBN 535)



TOBY PATTON - EASTERN VEIL

Phoenix Astronomical Society Members Receive Exclusive Dwarf Labs Discount

Phoenix Astronomical Society Expands Member Loaner Inventory with Dwarf Labs Smart Telescopes

The Phoenix Astronomical Society is excited to announce a new partnership with Dwarf Labs and the addition of two innovative smart telescopes to our member loaner program!

Through the generosity of Dwarf Labs, PAS has received the following equipment:

- Dwarf 3 Smart Telescope
- Dwarf Mini Smart Telescope
- Dwarf EQ Tripod

These compact, portable smart telescopes combine imaging, tracking, and observing capabilities into an easy-to-use system controlled through a smartphone app. They are designed to help beginners and experienced astronomers alike explore the night sky, capture images of deep-sky objects, and enjoy astronomy with minimal setup.





Available Beginning July 2026

Both the Dwarf 3 and Dwarf Mini will be added to the PAS Loaner Program and will be available for checkout by PAS members

This exciting addition provides members with an opportunity to experience the latest generation of smart telescope technology before making a purchasing decision or simply to enjoy a new way of seeing the night sky.
Learn Before You Borrow. To help members get started, we encourage borrowers to review the following resources before using the equipment:

Dwarf Labs Official YouTube Channel
https://www.youtube.com/@dwarflabofficial

Helpful Setup and Training Videos
Introducing the Dwarf Mini
https://www.youtube.com/watch?v=eAEZIeuGFDg

Dwarf 3 User Interface Overview
https://www.youtube.com/watch?v=c3V0etziekY

Setting Up the Dwarf in EQ Mode
https://www.youtube.com/watch?v=KKZ6P60-Z8Y

In addition, YouTube contains many excellent tutorials and user experiences. Simply search for "Dwarf Smart Telescope" to find reviews, imaging demonstrations, setup guides, and observing tips.

Clear skies,

5% Discount available here on purchases:

Telescope Loan Program

PAS Telescope Loan Program- The PAS Telescope Loan Program gives active PAS members access to a range of donated telescopes and accessories. These instruments are intended to support both visual astronomy and astrophotography learning experiences.

Overview- Members can borrow from the full PAS telescope inventory. Equipment ranges from beginner-friendly setups to higher-value imaging systems, offering opportunities to explore different observing and imaging techniques.

Check-out Requirements

- Some telescopes require completion of a short training program before use
- Higher-value equipment may require credit card information as a security measure against loss or damage
- An accessory kit (eyepieces and supporting gear) is available for all loaner telescopes when needed

Loan Period

- Standard loan duration is up to one month
- Extensions may be granted in special cases upon request

Pickup & Return

- All equipment must be collected from the PAS storage facility
- All items must be returned to the same facility by the agreed end date

How to Request a Telescope

To check out a telescope, email telescope@pasaz.org with the following information:

- Your full name
- PAS membership status
- Preferred telescope (if known)
- Intended use (visual observing or astrophotography)
- Requested loan dates





NEW Celestron Evolution 9.25
NEW ZWO Seestar S50 PRO
Dwarf Mini
Dwarf 3
Askar 103 APO 103mm f/6.8 Triplet Refractor Telescope, with iOptron AZ Mount Pro and an advanced eyepiece kit

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2 x ZWO Seestar S50
Coronado Personal Solar Telescope (PST)
Orion SkyQuest XT-10 - 10” Dobsonian
Orion Skyquest XT-8 - 8” Dobsonian
Sky-Watcher – 10” Collapsible Motorized Dobsonian
Accessory Kit #4 - Advanced Observing
Accessory Kit #5 – 1.25” Eyepieces & filters









Book Club

For more information or to join, contact Cyrus at saeidmousavi@yahoo.com

Hyperspace by Michio Kaku

Subtitled “A Scientific Odyssey Through Parallel Universes, Time Warps, and the 10th Dimension,” Hyperspace is a classic, accessible tour of the idea that our universe may have more than three dimensions of space.

Physicist Michio Kaku follows the thread from the early Kaluza–Klein theory through superstrings, explaining how extra dimensions could unify the forces of nature and what that might mean for wormholes, time travel, and the origin of the universe.

No advanced math required—just curiosity and a willingness to think beyond the three dimensions we can see.

JOIN OUR SOCIETY

EXPLORE. CONNECT. INSPIRE...

Sign Up



Are you fascinated by the stars and eager to explore the wonders of the universe? Do you want to connect with like-minded individuals who share your passion for astronomy?

Hi everyone! Great news. Renewing your membership is quick and easy: just visit **www.pasaz.org**, look in the left index column for "Join Our Society," click it, and you're on your way.

NEW!

We now offer a year-round membership, which means you can join at **any time with no enrollment deadlines**, and you'll receive a full 12 months of benefits. If you have any questions, our Membership Manager is happy to help at **membership@pasaz.org**.



Benefits of PAS Membership

- Helping the Society accomplish its mission of astronomy outreach and education
- Contributing toward the Society's ability to provide college scholarships to astronomy students
- Participation on the Society's email distribution list
- Email receipt of the Society's monthly newsletter
- Participation in the Society's telescope loaner program
- Ability to serve as a teacher at the Society's telescope workshops
- Ability to serve as a mentor at the Society's star parties
- Ability to participate in the Astro Imaging Special Interest Group (ASIG)
- Ability to serve as a paid presenter in the Society's Star Tours program
- Opportunity to purchase used astronomical equipment at 50% off current value
- Access to club trips to the darkest Arizona sites and top observatories
- Connections with professional astronomers and researchers through guest lectures or workshops.
- Opportunities to hold leadership positions within the club, such as committee chairs or officers.

By becoming a member of the Phoenix Astronomical Society, you not only enhance your own astronomical journey but also contribute to a vibrant community that shares your passion. Together, let's explore the universe and inspire others to do the same.

Sign Up Now and Start Exploring the Cosmos with Us!

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Secretary Chris Ford — secretary@pasaz.org

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Star Tours Team 2026

These individuals have successfully met the qualifications to participate in Star Tours Events and receive compensation $$ for their services.

Mark Johnston
Ted Blank
Mark Savan
Andrew Stone Star Tours Manager*
Richard Sauerbrun
Stu Brackney
Roger Anzini
Peter Turner
Chris Ford
Ryder David
Alessandro Cavallaro
Richard Meyers
Damon Finell
Luke Douglas

