



PAStimes

A Publication of the Phoenix Astronomical Society



Photo by Ruza Sabelija

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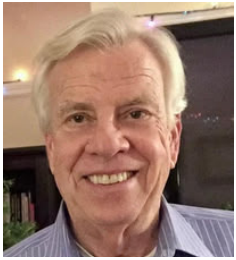
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**EVENT
REMINDER**

| 1 – Monthly Lecture Series | 3 – Star Party | 3 – Telescope Workshop
| 17- Book Club | 26 – ASIG Meeting



Hi everyone. Our busy year has begun, with the recent awesome lecture by Mark Johnston on our sun and the Star Party celebrating the International Observe the Moon event. Much more is coming your way.

Coming soon:

1. We're planning an online shop where proud PAS members can purchase T-shirts, coffee mugs, hats, and other items featuring our logo and astronomical images.
2. We're planning PAS-sponsored astronomy site visits, both in-state and possibly out of state.
3. We redesigned our pasaz.org website. It may not take you out of this solar system—but it will look fantastic and offer light-years of information!

Our Telescope Loaner Program is alive and well. We have an easy to operate solar scope if you are interested. Plus, the board, for the loaner program, has ordered the new Seestar S50 Pro! Our automatic scopes, the Dwarfs and Seestars - are in high demand, but members need to remember we do have an awesome 8" Dobsonian with an excellent eyepiece kit. Interested: telescope@pasaz.org.

Our monthly lectures over the years have included scientists, astronomers, professors, PAS members, and much more. If you have an idea for our lecture series, please reach out to: markjohnston@pasaz.org

- October 4: Saturn shines all night long during its opposition, making it an ideal target for small telescopes or binoculars.
- October 8–9: The Draconids meteor shower peaks, offering a brief display of shooting stars

Stuart Brachney



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UPCOMING EVENTS THIS MONTH



1
THUR

MONTHLY LECTURE SERIES
The Pandora Mission and Exoplanets



3
SATURDAY

TELESCOPE WORKSHOP
101 What to Buy



3
SATURDAY

PUBLIC STAR PARTY
Join lunar observers around the world in learning about lunar science and exploration, making celestial observations of the Moon.



17
SATURDAY

BOOK CLUB
Einstein's Monsters: The Life and Times of Black Holes by Chris Impey



26
MON

ASIG/ASTROIMAGING
Spectroscopy

**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.

OCTOBER LECTURE



Speaker:

Dániel Apai, PhD



Topic:

Exploring New Worlds in Space: From Clay Tablets to NASA's Pandora Space Telescope and Beyond

Modern science is opening a fascinating window on worlds around other stars. Ground- and space-based telescopes are now discovering new planets at an accelerating pace. Precise measurements provide important clues on the atmospheric compositions of many extrasolar planets, including planets that may be habitable. Our team recently completed NASA's latest exoplanet telescope, Pandora, which is now in full science operations. In this talk, I will provide the latest updates on the science program and progress of Pandora. I will also highlight our ongoing Nautilus Space Observatory project, which offers a bold vision for the future of exoplanet exploration.



Speaker bio:

Dániel Apai is Professor of Astronomy, Planetary Sciences, and Optical Sciences at The University of Arizona. His primary research interests lie in the fields of exoplanets, astrobiology, and innovative optical systems and architectures for space observatories. Apai earned his Ph.D. in Astrophysics from Heidelberg University. He worked in the Space Telescope Science Institute's Science Policy Group on the Hubble Space Telescope mission before joining the University of Arizona faculty in 2011. At UA, Dr. Apai leads the NASA-funded Alien Earths astrobiology project that focuses on understanding the formation and habitability of nearby planetary systems. He is Co-Investigator, and UA lead of the NASA Pandora Space Telescope, and leads large projects to decipher the atmospheres of exoplanets and brown dwarfs. Dr. Apai is Fellow of the American Association for the Advancement of Sciences and Fellow of the Explorers Club.



Telescope Workshop - Operating Your Telescope

Sign up each month and schedule directly with one of our experienced teachers.

This year, we're updating the way we organize workshops to offer greater flexibility for everyone.

Instead of scheduling a single workshop date, we will open a monthly sign-up event on the first day of each month.

Once the monthly sign-up opens, participants can choose a time and coordinate directly with one of our experienced teachers. This approach gives you more opportunities to find a session that works with your schedule while still receiving the same thoughtful, personalized guidance.

Please check back at the beginning of each month to reserve your spot. We look forward to working with you!



Link to the workshop - <https://bookwhen.com/pas-eventcalendar/e/ev-sywuj-2026090119000>



The Sun is Stranger Than You Think

by Mark Johnston



Chasing the Sun: A Solar Observing Deep Dive

Mark Johnston gave a talk on solar observing and imaging, drawing on decades of experience and his newly published book, which spent ten weeks at #1 in its Amazon category. His central point: unlike a nebula or star cluster, which looks the same every time you observe it, the sun changes noticeably in as little as thirty minutes. "It never looks the same twice," he said.

NO, IT'S NOT ON FIRE- The Sun isn't burning – it's a ball of hydrogen so hot it exists as plasma, a state where electrons and protons separate into a charged soup. Johnston compared it to a stovetop element on full blast: glowing red, but not on fire.

PROMINENCES, FILAMENTS, AND FLARES- Filaments are plasma structures seen against the sun's disk; the same structures seen on the limb are called prominences. Flares are different entirely – bursts of energy from magnetic reconnection beneath the surface. Flares are energy; prominences and filaments are matter.

Prominences fall into two categories: quiescent (slow, stable, lasting days to weeks) and active (fast, often gone within hours). Rarer forms – tornado, loop-arcade, and horn prominences – Johnston has seen only a handful of times in years of observing.

SEEING THE SUN IN DIFFERENT LIGHT

- White light shows the photosphere – sunspots, granulation, light bridges.
- Hydrogen-alpha (656.28 nm) reveals the chromosphere – prominences, filaments, fibrils.
- Calcium-K (393 nm, deep violet) highlights the strongest magnetic fields, though it's better suited to imaging than visual observing.

A 2023 Journal of Neuroscience study found structure is often easier to discern in inverted (light-on-dark) images – part of why many solar and medical images are flipped for clarity. NASA does something similar with its Solar Dynamics Observatory imagery, assigning colors to wavelengths purely to aid interpretation.



MYTHS WORTH RETIRING

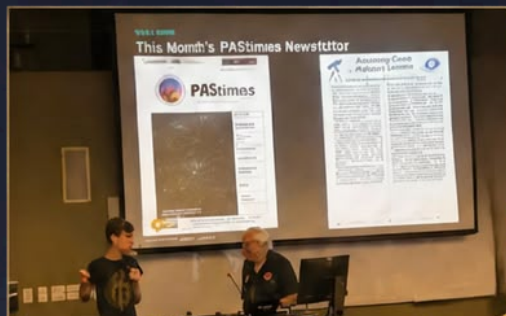
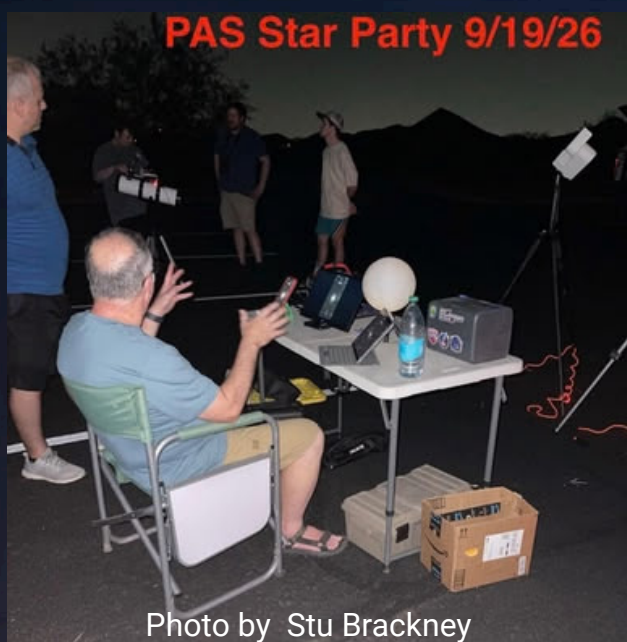
- Best viewing time is 1-5 hours after sunrise, not midday, before ground heat distorts the image.
- A bigger telescope isn't always better in turbulent air.
- Refractors are generally preferred over reflectors for solar work, since image quality matters more than light-gathering power.
- A broadband solar filter costs about the same as a good eyepiece.
- Solar minimum doesn't mean nothing to see – Johnston shared dramatic prominences from near minimum and years past the 2024 maximum.

EQUIPMENT AVAILABLE THROUGH THE CLUB

PAS members can borrow solar-filtered telescopes – including a hydrogen-alpha scope (APSK) – for free, or use the club's SeeStar, which has its own solar filter.

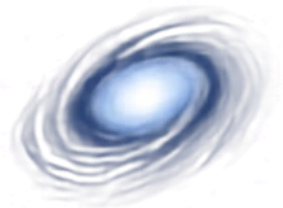
OutReach Events

Star Tours & Outreach events September
19th Empower college prep
19th International Observe the Moon Night
(30 attendees and 13 Scopes)





My Views on Galactic Superclusters' Evolution



by Mike Marron

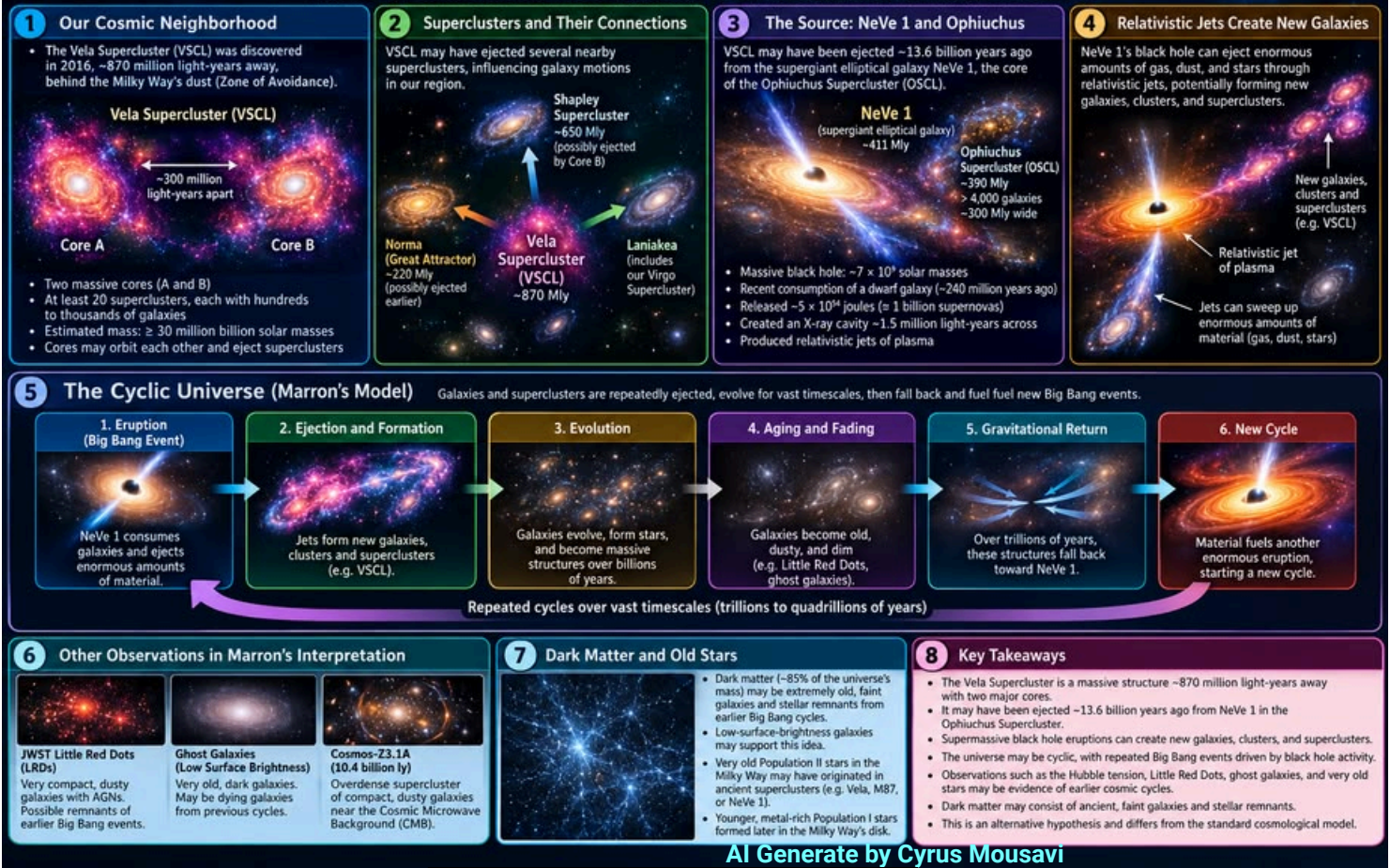
The Vela Galactic Superclusters (VSCL) was discovered in 2016, only ~870 million light years away hidden behind the obscuring dust of our galaxy in what is known in astronomy as the Zone of Avoidance (ZoA) where galactic observations have to be done in the infrared, radio, or microwave. The VSCL is two supermassive galactic walls ~300 million light years (Mly) apart with discernible central supergiant elliptical galaxies labeled Core A and Core B composed of at least 20 very massive galactic superclusters each with hundreds to thousands of associated elliptical, spiral and dwarf galaxies. It is currently estimated to be at least 30 million billion solar masses. Apparently VSCL's cores A and B orbit each other while spewing galactic superclusters. The supermassive giant elliptical of Core B may have 'recently' ejected the (so far) similarly sized massive Shapley Galactic Supercluster now ~650 Mly away, discovered in 1930's. Before that, it could have blown off the Norma (Great Attractor, 1986) supercluster, ~220 Mly away. Even before that it may have made much of Laniakea (which includes our Virgo supercluster) because VSCL is faster than the rest of the local superclusters and VSCL's Core B clearly passed nearby to all of us. While each mentioned supercluster gravitationally contributes to our galaxy's peculiar velocity of 631 km/s, VSCL at ~870 Mly is contributing a strong pull of ~50 km/s. Vela's core A is trailed by the Columba, Lepus, Apus, Perseus and Pisces superclusters. The peculiar velocities of local galactic clusters led to the discovery of galactic gravity basins. First thought to be the Great Attractor (1986 Norma), then the Shapley Attractor, but the greatest gravity basin turned out to be the Vela Attractor. Evidently all were moving away from the Great Repeller thought at that time to be the Ophiuchus Void (OV). When VSCLs were discovered in 2016 they had the strongest peculiar velocity away from the

OV but oddly this 'empty' Great Repeller was also drawing galaxies back into it.

Again, because of the ZoA the supermassive Ophiuchus Supercluster (OSCL) at 390 Mly wasn't recognized until 2020, since its 1985 discovery had been misclassified as a planetary nebula of the Milky Way. VSCL may have been ejected 13.6 Gya from the Supergiant Elliptical Galaxy NeVe 1 only ~411 Mly away, which is the supermassive core of a ~300 Mly wide OSCL with >4,000 galaxies which may be mistakenly classified as part of our Laniakea Supercluster. Bright local galactic flows are gravitationally bound to the ejected VSCL and dim galactic back flows seem to be gravitationally attracted to the OSCL. The supermassive black hole at the center of NeVe 1 ate a dwarf galaxy ~240 Mya that took millions of years to go down but has released a relativistic jet of 5×10^{54} Joules of energy equivalent to about a billion supernovas. The OSCL eruption is called the most energetic event since the last Big Bang having consumed ~270 million solar masses with an output, during the event, equivalent to 5 to 10 gamma ray bursts every day for millions of years. Randomly, across the entire current universe, one gamma ray burst per day releases a star's entire lifetime of energy in only a few seconds. Current estimates for the mass of the supermassive black hole ($\sim 7 \times 10^9$ solar masses) and the host galaxy NeVe 1 indicate both should have been destroyed — yet they survived this blast, indicating NeVe 1 has a lot of invisible mass. The relativistic jets of plasma have cleared an x-ray cavity of 1.5×10^6 ly from NeVe 1 and pushed the contents into the intracluster medium. NeVe 1's recently erupted relativistic jet has swept up an elliptical galaxy worth of gas, dust, and stars.

Mike Marron's Model: A Cyclic Universe Driven by Supermassive Black Holes

A simplified visual overview of Marron's ideas about galactic superclusters, their origins, and the repeating cycle of the universe.

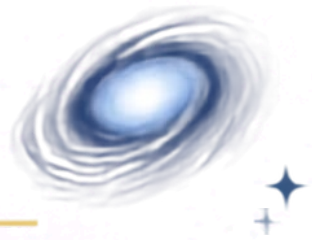


AI Generate by Cyrus Mousavi

The black hole at the center of NeVe 1 may be the center of the universe where micro bangs continue to eject enough gas to create new galaxies. OSCLs that are in decaying orbits around NeVe 1 may be the nearly dead galactic superclusters quadrillions of years old gravitationally returned to the universe's center from earlier Big Bang events. This could mean nearby OSCL is the greatest basin of dark matter in the universe. If NeVe 1 were to eat a dead spiral galaxy, it could eject enough material that each of its antipodal jets becomes giant elliptical galaxies. These galaxies then grow massive central black holes with their own antipodal jets that then surround themselves with galactic clusters of elliptical, spiral and dwarf galaxies. For NeVe 1 to eat any of Ophiuchus's dying central giant elliptical galaxies, it must first absorb the orbiting galactic superclusters, a Big Bang event lasting over a billion years. The bright galaxies that surround NeVe 1 (and us) are associated with the current Big Bang, but billions of light years away, Hubble Tension reveals evidence of earlier Big Bangs, not Dark Energy.

Hubble Tension arises because the local universe has a H_0 of ~ 74 km/s/Mpc while the so-called Early (distant) Universe has $H_0 \sim 68$ km/s/Mpc. Greater distances also appear to show older, dustier, darker galaxies that have Active Galactic Nucleus (AGN) supermassive black holes.

Trillions of years ago a Big Bang event could have ejected the galaxies now found nearest the Cosmic Microwave Background (CMB) radiation. The cores of these ultra-dense galaxies were first observed by JWST in 2023 as Little Red Dots (LRD) less than 500 ly across that proved to be AGNs deeply shrouded in evolved metallic dust. In 2026 the LRDs were shown to be compact galaxies with billions to trillions of very dim stars. Just inside the CMB in 2026 Cosmos-Z3.1A was revealed to be an overdense supercluster of these compact, nearly dead, very dusty supermassive galaxies with AGN supermassive black holes similar in scale to the Shapley or Vela Superclusters.



Presumably dark galaxies beyond our current Big Bang's radiation sphere eventually reach individual gravitational apexes and fall back into gargantuan elliptical orbits around NeVe 1. Since 1986 galaxies blacker than the background intergalactic space were found by Malin and some bear his name (Malin 1, 2, and 3), otherwise known as Low Surface Brightness (LSB) galaxies or ghost galaxies. XLSSC 122 at 10.4 Gly is an abnormally mature massive galactic supercluster with a huge dense dark matter core that is also a strong gravitational lens but so far, the nearest LSB galaxy is NGC 4395 only 14 Mly away and much easier to study. The entire universe could be littered with the dying stars of earlier Big Bang events, which explains dark matter accounting for ~85% of the universe's unseen mass.

Our stars may trace our Milky Way's ancestry starting with the Methuselah star, which might be older than our Big Bang, possibly from the supergiant elliptical NeVe 1. VSCL's supergiant elliptical Core B could be the origin of ancient Population II (Pop II) stars of 13.6 to 12 Gya now feeding Sagittarius A. The core giant elliptical of our Virgo Supercluster M87 may have contributed to the Milky Way's orbiting low-metal globular clusters along with the disk's Pop II stars of 12 to 10 Gya. Heavy-metal Pop I stars of less than 10 Gya were born in the Milky Way's dusty disk.



X-ray: NASA/CXC/NRL/S. Giacintucci et al.; XMM: ESA/XMM-Newton; Radio: NCRA/TIFR/GMRT; IR: 2MASS/NASA/NSF

The physics behind how plasma magnetotail jets are created and what they create can be read online from the <http://www.pasaz.org> website under Lecture Videos. Go to Member's Presentations to find Planetary Tails of Plasma, Stellar Tails of Plasma, and then the Galactic Tails of Plasma lectures. Exquisitely detailed astronomical autobiographies are revealed whenever jets are found.

John Locke wrote, "New opinions are always suspected, and usually opposed, without any other reason but because they are not already common."

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The Space Age Generation - A Book Review



by Mike Cawley

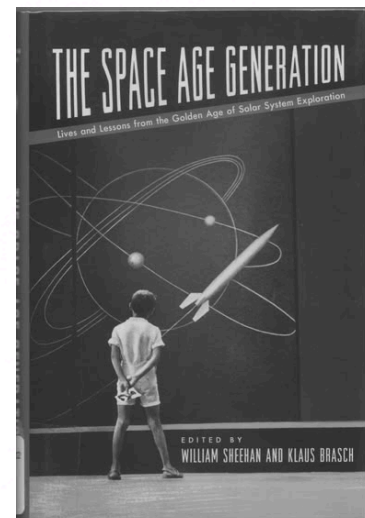
What piqued your interest in astronomy? Was it the first time you looked through a telescope, read a science fiction book, went to a museum, or watched a memorable astronomical event? This engaging book addresses how 13 individuals were inspired to pursue careers in astronomy, aeronautics, data analysis, or NASA management—all fields which have furthered mankind's knowledge of the Solar System. Some individuals became mappers; others specialized in data reduction from the dozens of new space missions which explored the moon, planets, and sun. Still others pursued planetary science or worked in NASA management.

Before the 1950s, man's knowledge of space was limited to what was acquired through visual or spectral observations and film photography from behind the curtain of atmosphere surrounding the Earth. Science fiction authors' imaginations suggested what it might be like if we could actually travel "out there." Evidence of civilization's fascination with the stars was preserved in books, maps, and various structures and would teach us and fuel our curiosity about the night sky.

On October 4, 1957, man finally reached out beyond the Earth to start a new phase of exploration. Generally, the Space Age is considered have begun with the launch of Sputnik. Fueled by the rivalry between two nations, scientific advancements and knowledge came at a quick pace beginning with that single satellite in space and culminated with the landing of a man on the moon just twelve years later.

Inspired by the unprecedented reader response to an article titled "A Golden Age of Amateur Astronomy" in the November 2021 issue of Sky and Telescope, this book is a compilation written by 13 individuals who were inspired to pursue a career in this new field of endeavor. Each chapter covers how that individual became interested in astronomy or science and follows their career path from its beginning to their retirement. All of the contributors "came of age" during the rise of space exploration and all used their wide range of talents to further the cause. As an example of how their endeavors furthered the cause, early mapping efforts to locate a spot for a lunar landing required the expertise of artists and photographers to compile data from lunar probes for training and testing purposes. A background in chemistry enabled a few individuals to study and explore planetary chemistry using the information provided by the many probes sent out to various bodies in our solar system.

Edited by William Sheehan and Klaus Brasch and published by the University of Arizona Press, this book is a great window into the lives of a few of the thousands of people who have worked in the new field that was born right before our eyes and continues to grow today.





October Skies: An Observing Ladder from the Pleiades to Stephan's Quintet



by William Finch

October is a month of change in the night sky. The familiar stars of summer are slipping toward the western horizon, while the constellations of autumn are taking control of the east and south. Pegasus and Andromeda are prominent, Cassiopeia and Perseus climb higher as the evening goes on, and Taurus begins bringing the Pleiades into the eastern sky.

It is also an excellent month for learning how different kinds of astronomical objects behave. Some are bright enough to ignore city lights. Others disappear almost completely when the sky becomes gray with light pollution. A few demonstrate an important lesson in observational astronomy: an object's listed magnitude does not always tell you whether it will be easy to see.

The targets below are arranged approximately from easiest to hardest. They include objects for the unaided eye, binoculars, and telescopes.

October's Hunter's Moon

The Moon is not included in our observing list because its appearance and position change considerably from one October to another. It does, however, have an interesting connection to the season.

The Farmers' Almanac traditionally calls October's full Moon the Hunter's Moon. The name dates back centuries. By this point in autumn, crops had been harvested, vegetation was dying back, and animals had fattened themselves in preparation for winter. Open fields made game easier to spot, while the bright Moon provided extra light for hunters after sunset.

The Hunter's Moon is also the full Moon that follows the Harvest Moon. This creates an occasional exception to the name. The Harvest Moon is whichever full Moon occurs closest to the autumn equinox. Usually that happens in September, but when it occurs in October, that October full Moon is called the Harvest Moon instead.

Other traditional names associated with October include the Falling Leaves Moon, Travel Moon, First Frost Moon, and Sanguine Moon. These names reflect the changing leaves, seasonal travel, approaching winter, and the hunting season rather than anything physically different about the Moon.

The Pleiades, M45 – A Cluster You Can See Without Help

Viewable with: naked eye, binoculars, or telescope (wide-field view preferred)

By October evenings, the Pleiades are returning to the eastern sky. Early in the month you may have to wait until later in the evening, but they become increasingly convenient as October progresses.

To the naked eye the cluster looks like a tiny dipper. Most people can see six or seven stars under a reasonably dark sky, although eyesight and sky conditions make a large difference. Binoculars transform the group. Dozens of blue-white stars appear, spread across a wide field. The Pleiades have a combined apparent magnitude of about 1.6 and are among the easiest star clusters to see without optical aid. Because the cluster is so large, binoculars or a telescope at low power give the most pleasing view. Too much magnification may show only part of the cluster at one time.

Light pollution reduces the number of visible stars, but the cluster itself survives surprisingly well. This is a good target from a city backyard.



Mizar and Alcor – The Big Dipper's Eyesight Test

Viewable with: naked eye, binoculars, or telescope (moderate magnification reveals more)

Look at the bend in the handle of the Big Dipper and you will find Mizar. If your eyesight and sky conditions are reasonably good, look closely and you may notice a second, fainter star next to it. That star is Alcor.

Mizar and Alcor have been used as an eyesight test for centuries. Separating the two with the unaided eye is not particularly difficult from a decent sky, but it is a fun challenge for someone seeing them for the first time.

Binoculars make the pair obvious.

A telescope adds another surprise. Mizar itself separates into two bright stars. What looked like one naked-eye star next to Alcor becomes a pair of stars of its own.

The system is actually even more complicated than it appears through a backyard telescope. Several of the stars involved have companions that can only be detected with more advanced methods.

Mizar and Alcor are excellent objects for light-polluted skies. City lights have very little effect on them.

The Perseus Double Cluster – Two Clusters for the Price of One

Viewable with: naked eye under dark skies, binoculars, or telescope (wide-field view preferred)

Between Cassiopeia and Perseus lie two large star clusters, NGC 869 and NGC 884. Together they are known as the Perseus Double Cluster.

Under a dark sky, sharp-eyed observers can see the pair without optical aid as a faint hazy patch. Binoculars are where the view becomes interesting. Both clusters appear in the same field as two dense swarms of stars.

A telescope at low power gives an especially attractive view because both clusters can be framed together while still revealing many more stars than binoculars.

Higher magnification reveals still more individual stars, including several orange and reddish ones mixed among the blue-white members.

The two clusters are roughly 7,500 light-years away and contain hundreds of young stars.

The Perseus Double Cluster holds up reasonably well against light pollution because we are looking at hundreds of individual stars rather than a faint, diffuse cloud. Binoculars may struggle from the brightest city centers, but a telescope can still provide a rewarding view.

The Andromeda Galaxy, M31 – Another Galaxy with Your Own Eyes

Viewable with: naked eye under dark skies, binoculars, or telescope (low power and a wide field preferred)

October is one of the best times of year to look for the Andromeda Galaxy. It is high in the autumn sky and easy to reach by star-hopping from the Great Square of Pegasus or Cassiopeia.

At a good dark-sky location, M31 appears to the unaided eye as a small fuzzy oval. What you are actually detecting is primarily the bright central region of a galaxy about 2.5 million light-years away.

Binoculars make M31 much easier and begin to reveal its elongated shape. A telescope at low power is also an excellent choice because Andromeda is much larger in the sky than most people expect.

Do not expect the dramatic spiral galaxy shown in photographs. Human night vision normally sees a bright core surrounded by an increasingly faint glow.

Light pollution is important here. The central glow can survive suburban skies, especially through binoculars or a telescope, but the large outer portions of the galaxy disappear quickly. From a dark location, M31 seems dramatically larger.



The ET Cluster, NGC 457 – A Little Figure in the Sky

Viewable with: binoculars or telescope (low to moderate power preferred)

Cassiopeia contains one of the most entertaining star clusters to show someone who is new to astronomy.

NGC 457 is often called the ET Cluster because many observers think its stars resemble the alien from the movie E.T. Others call it the Owl Cluster, with two bright stars forming the owl's eyes and the remaining stars outlining its wings and body.

Once someone sees the shape, it can be difficult to unsee it.

Binoculars reveal the cluster, but a small telescope makes the pattern much easier to recognize. Low to moderate magnification usually works best because enough surrounding space remains visible to appreciate the entire figure.

Unlike many galaxies and nebulae, NGC 457 holds up fairly well under light pollution. Some of the fainter stars disappear, but the basic shape remains visible from many suburban locations.

This makes the ET Cluster an excellent star-party object.

M15 – A Ball of Ancient Stars

Viewable with: binoculars or telescope (higher magnification helps resolve stars)

M15 is a globular cluster in Pegasus. Unlike the loose young stars of the Pleiades, a globular cluster is a dense, roughly spherical swarm containing enormous numbers of old stars.

At magnitude 6.2, M15 can be detected in binoculars as a small fuzzy spot.

A telescope shows a bright center surrounded by a softer halo. Increasing magnification and aperture begins to resolve individual stars around the cluster's outer edges.

Moderate light pollution does not destroy M15 as quickly as it does a galaxy because the cluster has a bright, concentrated core.

Darker skies and more aperture are needed if the goal is to resolve many individual.

M103 – A Small Jewel in Cassiopeia

Viewable with: binoculars under decent skies or telescope (moderate power preferred)

M103 is a compact open cluster in Cassiopeia. It is much smaller than the Perseus Double Cluster or the Pleiades, and binoculars may show little more than a small group of stars. A telescope is where M103 becomes more interesting.

One of its attractions is the mixture of star colors. Several bright blue-white stars contrast with a noticeably orange or reddish star in the cluster.

M103 does not overwhelm the eyepiece with hundreds of stars. Its appeal is more subtle. It looks like a small collection of gems packed into a surprisingly tight area.

Moderate magnification generally gives a better view than very low power.

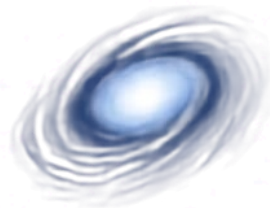
Light pollution removes some of the fainter background stars, but the brighter members remain visible. That makes M103 a reasonable suburban target and another good object to pair with NGC 457 while observing Cassiopeia.

The Ring Nebula, M57 – Small, Faint, but Surprisingly Cooperative

Viewable with: telescope (moderate magnification preferred)

The Ring Nebula is a planetary nebula in Lyra, the glowing shell left behind by a dying Sun-like star.

Despite the name, a planetary nebula has nothing to do with planets. Early telescope observers gave these objects the name because some looked round and vaguely planet-like through small telescopes.



Lyra is moving west during October, so M57 is best observed earlier in the evening.

The object has an apparent magnitude of about 8.8, yet it is easier to observe than that number might suggest. M57 is tiny and its light is concentrated into a small area.

At low magnification it may appear only as a small fuzzy point. With moderate magnification, the darker center becomes apparent and the famous ring shape emerges.

This is where surface brightness starts to matter. A compact magnitude-8.8 nebula can sometimes be easier to see than a much brighter galaxy whose light is spread across a huge area.

M57 is therefore a surprisingly good suburban telescope target.

The Saturn Nebula, NGC 7009 – Tiny but Bright

Viewable with: telescope (moderate to high magnification preferred)

Aquarius contains another planetary nebula, NGC 7009, better known as the Saturn Nebula.

The name comes from its appearance. Larger telescopes can reveal small projections on either side of the nebula that reminded early observers of Saturn and its rings.

At magnitude 8.0 it is relatively bright for a deep-sky object, but it is extremely small.

At low magnification it can look almost like a slightly fuzzy star. Increasing the power reveals a tiny oval or bluish-green disk.

Because its light is concentrated into such a small area, NGC 7009 can withstand a fair amount of light pollution.

Finding it is often harder than actually seeing it.

The Dumbbell Nebula, M27 – Large and Bright

Viewable with: binoculars under dark skies or telescope (low to moderate power works well)

The Dumbbell Nebula in Vulpecula is another planetary nebula and one of the best examples in a small telescope.

It lies in the part of the summer sky that is moving toward the west in October, so observe it early.

M27 has an apparent magnitude around 7.5 and is substantially larger than the Ring Nebula.

At low power the nebula stands out as a broad gray glow. Increasing the magnification can reveal more of the shape that gave the object its nickname.

Under a very good sky, binoculars can detect it. Under suburban skies, a telescope is a much safer choice.

An OIII or UHC-type nebula filter can noticeably improve the contrast.

Caroline's Rose, NGC 7789 – A Cluster Made of Faint Stars

Viewable with: telescope (wide-field view preferred)

Cassiopeia contains many open clusters, but NGC 7789 is one of the most impressive.

It was discovered by Caroline Herschel and is often called Caroline's Rose because curving chains of stars can give the impression of overlapping petals.

The difficulty comes from the stars themselves. NGC 7789 contains many stars, but most are fairly faint.

A low-power telescope can provide a beautiful view under a dark sky because the entire cluster fits comfortably in the field. Increasing aperture reveals progressively more of its faint stars.

A small telescope may initially show only a grainy glow. Increasing aperture turns that mist into hundreds of points.



This is an object where light pollution does real damage. Each increase in sky brightness erases some of the cluster's fainter members.

Dark adaptation and averted vision can make a substantial difference.

The Sculptor Galaxy, NGC 253 – Bright Galaxy, Bad Geography

Viewable with: binoculars under dark skies or telescope (low power preferred)

NGC 253 is one of the brightest galaxies available to amateur observers. In October it is well placed during the evening, but North American observers have a geographic problem: Sculptor is far south.

From Arizona, southern California, Florida, Texas, and the Gulf states, the galaxy can be a very good target.

From the northern United States and southern Canada it stays low in the southern sky, where atmospheric haze and light pollution are often worst.

The galaxy appears as a long, narrow glow. A telescope at low power works quite well because NGC 253 is a large galaxy. Under dark skies, lower magnification can make its elongated shape easier to recognize.

A clear southern horizon matters almost as much as telescope size.

The Triangulum Galaxy, M33 – The Magnitude Trap

Viewable with: naked eye under exceptional skies, binoculars, or telescope (low power and a wide field preferred)

M33 is one of the most educational objects in the autumn sky because its numbers are misleading.

Its apparent magnitude is about 5.7. That sounds bright enough to be an easy binocular object and perhaps even a naked-eye target.

Under exceptional conditions, it is.

Yet many beginners have difficulty finding M33 even with a telescope.

The reason is its enormous apparent size. Its light is spread thinly across a large section of sky.

M33 is an excellent example of an object where a low-power, wide-field telescope view can be better than high magnification. Keeping the galaxy's glow concentrated and leaving plenty of surrounding sky in the field can make it easier to recognize.

Light pollution is M33's enemy. In a bright suburb it may simply disappear.

Nebula filters do not help. The cure is darker sky.

The Helix Nebula, NGC 7293 – Huge, Nearby, and Ghostly

Viewable with: binoculars under excellent skies or telescope (low power and a wide field preferred)

The Helix Nebula in Aquarius is one of the closest planetary nebulae to Earth. It is also enormous in apparent size.

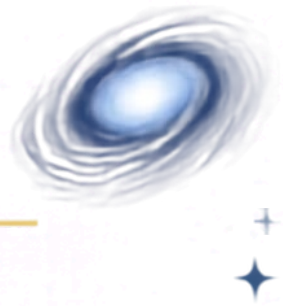
That size is precisely what makes it difficult.

The Helix is a large, diffuse glow. Under genuinely dark skies it can be detected in binoculars.

A telescope at low power is particularly useful because the Helix covers so much sky. Keeping the entire nebula comfortably within the field makes its faint circular glow easier to recognize. October is a good time to observe it, although observers farther north need a clear southern horizon.

An OIII filter can transform the view.

In a light-polluted city, the Helix can be frustrating even in a fairly large telescope. Under a dark desert sky, it can suddenly become obvious.



Stephan's Quintet – The October Challenge

Viewable with: medium-to-large telescope under dark skies (moderate magnification preferred)

For observers who have worked through the easier targets, Pegasus offers a much more serious challenge: Stephan's Quintet.

This famous grouping appears to contain five galaxies close together. Four are physically associated hundreds of millions of light-years away. The fifth is a much nearer foreground galaxy that simply happens to lie in the same direction.

Do not expect anything resembling the photographs.

Through an amateur telescope, the galaxies appear as extremely faint little smudges.

A telescope around 10 inches in aperture can begin to make the group possible under an excellent sky, but 12 to 16 inches makes the attempt far more reasonable.

Dark adaptation, patient use of averted vision, and low sky brightness are more valuable here than a very wide field of view.

From a brightly illuminated suburb, this is an extremely difficult target. Dark skies make far more difference than adding a little extra telescope aperture.

Why the Order Is Not Simply a Magnitude List

October's observing targets demonstrate why astronomers should be cautious when comparing apparent magnitudes.

The Andromeda Galaxy is bright because it produces a tremendous amount of light, but most of that light is spread across a large area.

M33 is even more extreme.

The Helix Nebula is large and bright enough in total light to sound easy, yet that light is diluted across an enormous patch of sky.

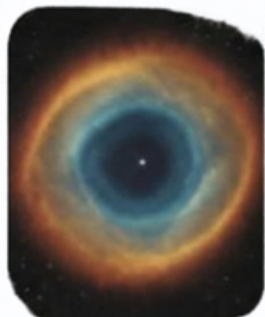
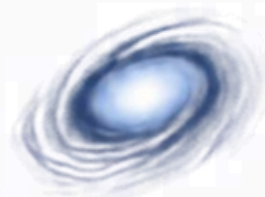
The Ring Nebula and Saturn Nebula present the opposite situation. They are numerically fainter, but their light is concentrated into tiny disks. Against a bright suburban sky, that concentration can make them easier to detect than supposedly brighter galaxies.

This is also why the right telescope setup depends on the target. Large objects such as the Pleiades, Andromeda Galaxy, M33, and the Helix Nebula benefit from low power and a broad field of view. Tiny objects such as the Ring Nebula and Saturn Nebula generally benefit from more magnification.

Double stars present another useful contrast. Bright pairs such as Albireo, Almach, and Mizar remain excellent targets when light pollution has made galaxies nearly invisible.

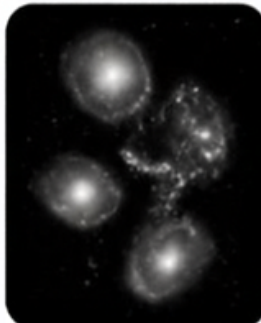
Star clusters behave differently again. Light pollution eliminates their faintest stars one by one rather than washing out a continuous glow.

That is why experience at the eyepiece eventually becomes more useful than simply reading a magnitude number from a chart.



The Helix Nebula NGC 7293

The Helix Nebula is huge, nearby, and ghostly. It is one of the nearest planetary nebulae to Earth and spans a large area of sky. Its faint outer halo benefits from dark skies, low power, and an OIII filter.



Stephan's Quintet

Stephan's Quintet is an extremely faint galaxy group in Pegasus. It rewards observers with a view that reveals structure and interaction, but only under dark skies, with patience, and using a medium-to-large telescope.



A Concise Observing Sequence

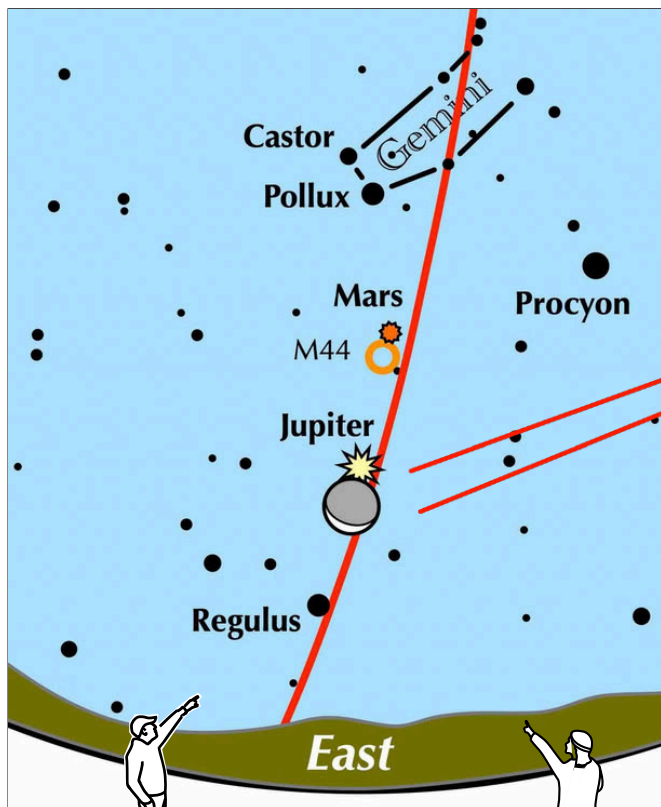


- 1** Begin with the Pleiades and Mizar and Alcor.
- 2** Move to the Perseus Double Cluster and Andromeda.
- 3** Explore Cassiopeia targets and colourful double stars.
- 4** Visit M15, then the Ring Nebula, the Saturn Nebula, and M27.
- 5** Seek out Caroline's Rose, NGC 253, and M33.
- 6** Find the Helix Nebula, the vast, ghostly eye in Aquarius.
- 7** End with Stephan's Quintet in Pegasus, the ultimate test of your sky.

***Objects you cannot quite see
may teach you the most about
your telescope, your sky, and your eyes.***

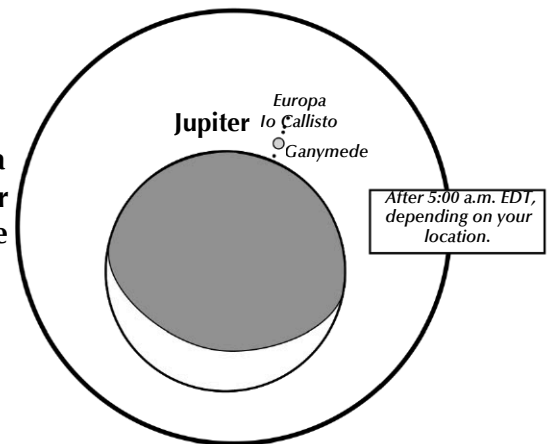


In the early morning of October 6, try this challenge:



**View low in the east
on October 6
2 hours before sunrise**

**View through a
very low power
telescope**



Moon occults Jupiter for the eastern US. For the rest of us, it lies very close to Jupiter

On the morning of October 6, the moon appears very close to Jupiter.

For those in the eastern half of the US, the planet and its Galilean satellites fully emerge from occultation after 5:00 a.m. The exact time depends on observing location.

Those in the western US see Jupiter immediately next to the dark edge of the crescent moon.

About 5:35 a.m. EDT, Ganymede's shadow begins transiting the planet. It lasts until 9:15 a.m. EDT. Its exit can be seen by west coast telescope users.

And Mars can be found approaching the Beehive star cluster.

Name	Value	Comment
SIMPLE	T	file does conform to FITS standard
BITPIX	16	number of bits per data pixel
NAXIS	2	number of data axes
NAXIS1	1080	length of data axis 1
NAXIS2	1920	length of data axis 2
EXTEND	T	FITS dataset may contain extensions
COMMENT		FITS (Flexible Image Transport System) format is defined in 'A and Astrophysics', volume 376, page 359; bibcode: 2001A&A...
BZERO	32768	offset data range to that of unsigned short
BSCALE	1	default scaling factor
CREATOR	'ZWO Seestar S50'	Capture software
PRODUCER	ZWO	Powered by ZWO
BIAS	471	Correction from bias
XORGSUBF	0	Subframe X position in binned pixels
YORGSUBF	0	Subframe Y position in binned pixels
FOCALLEN	250.	Focal length of telescope in mm

ASIG: What's Inside a FITS File? by Richard Meyers



What's Actually Inside a FITS File?

If you've spent any time capturing deep-sky images, you've probably noticed your camera saves files ending in .fit or .fits instead of the usual .jpg. That's not an accident — it's a format built specifically for astronomy, and understanding what's inside it explains a lot about why astrophotography processing works the way it does.

A format built for science, not snapshots:

FITS stands for Flexible Image Transport System, and it's been the standard way astronomers exchange image data since the format was first standardized in 1981, though the underlying approach had been in informal use even earlier. It was developed by the IAU FITS Working Group specifically to let observatories trade data with each other, and it remains the most commonly used digital file format in astronomy today. Every major observatory and space telescope — Hubble, Chandra, the big ground-based surveys — still uses it.

Two parts: a header and a data array

A FITS file is really just two things stacked together: a plain-text header full of metadata, followed by the raw pixel data itself. The header stores everything about how the image was taken as simple keyword-value pairs anyone can read, even without special software. The data portion is just a grid of numbers, one per pixel, straight off the sensor.

That second part is the key difference from a JPEG. A JPEG has already been compressed and stretched for viewing — detail is thrown away to make the file smaller, and the brightness has been squeezed to look good on a screen. A FITS file keeps the raw, linear sensor data untouched, usually at 16-bit or 32-bit precision instead of a JPEG's 8-bit. That means a FITS file can hold vastly more dynamic range — the difference between the faintest wisp of a nebula and the bright core of a star — without losing information to compression.

A closer look: what's actually in the header

The header is made up of short, standardized keywords (up to eight characters each) paired with values — think of it as a structured list of facts about the image, not free-form text. Some of these are required by the FITS standard itself; others are added by capture software like N.I.N.A. or ASIAIR. A few of the most useful ones you'll run into:

Keyword	What it records	Example value
OBJECT	Name of the target imaged	M31
DATE-OBS	Date and time the exposure started (UTC)	2026-09-24T04:12:33.5
EXPTIME	Exposure length in seconds	180.000
FILTER	Filter used, if any	Ha
CCD-TEMP	Sensor temperature at capture, in °C	-10.0
GAIN	Camera gain setting	100
IMAGETYP	Type of frame - light, dark, bias, or flat	LIGHT
INSTRUME	Camera or instrument model	ZWO ASI2600MM
TELESCOP	Telescope or optics used	Celestron EdgeHD 8
NAXIS1	Image width in pixels	6248
NAXIS2	Image height in pixels	4176
BITPIX	Bit depth of each pixel	16

Every one of these fields is plain text — you can open a FITS file in a basic text editor and read the header at the top before hitting the binary pixel data, no special decoder needed just to see how an image was taken.

Why this matters for calibration:

Calibration means subtracting the noise pattern in a dark frame from your light frame, pixel by pixel. That only works if the numbers are real sensor readings — which is exactly what FITS preserves and JPEG doesn't.

For example, say one pixel in your light frame reads 523 (mostly starlight, plus some noise). The same pixel in your master dark reads 47 (just sensor noise, no light). Subtract them, and you're left with 476 — a cleaner, closer estimate of the actual light that hit that pixel.

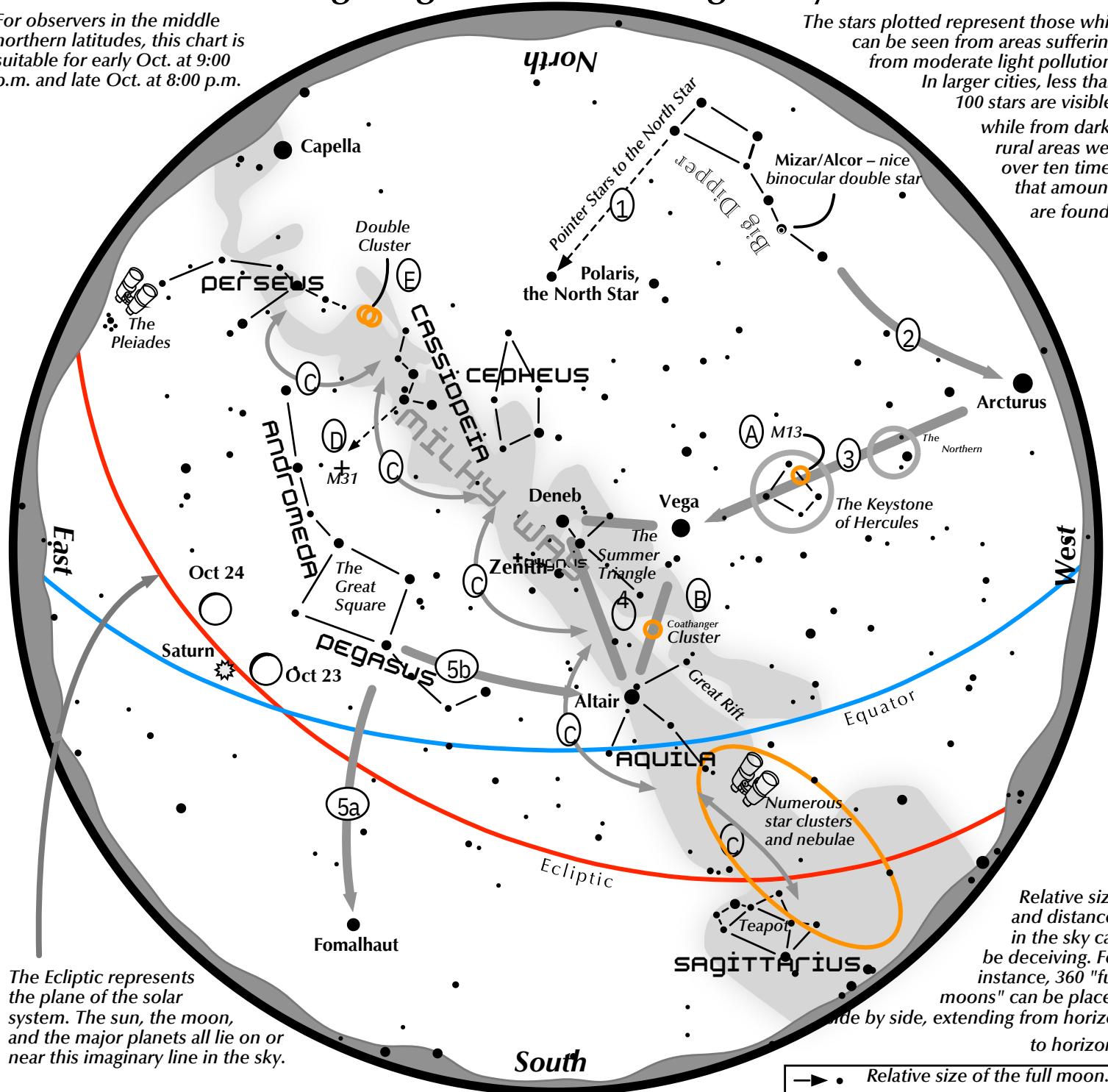
A JPEG could never do this. By the time an image is saved as a JPEG, those original numbers have already been compressed and rescaled to look good on screen — so "523" in one file and "47" in another wouldn't line up to anything meaningful anymore. FITS keeps the raw numbers intact, so the math still works.

Navigating the October Night Sky

2026

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.

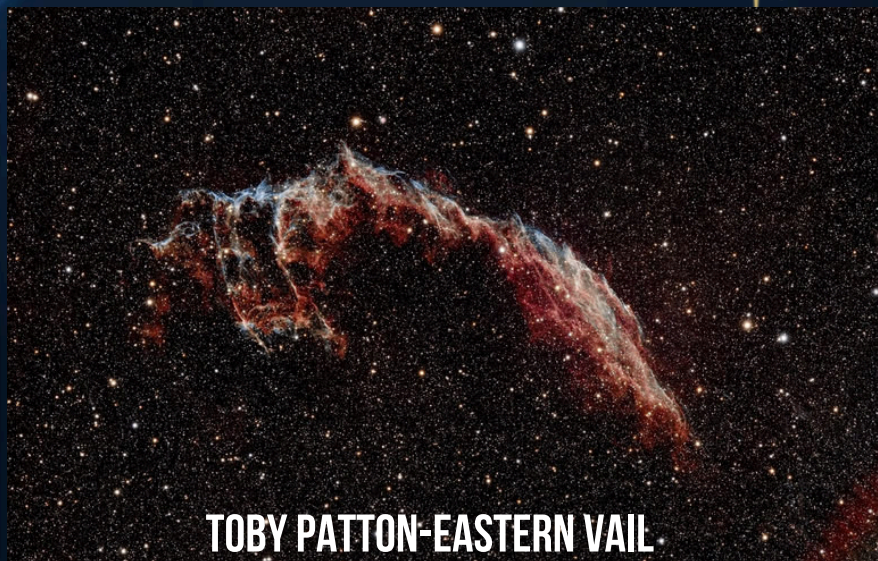
Binocular Highlights

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.

20



CELESTIAL SHOWCASE



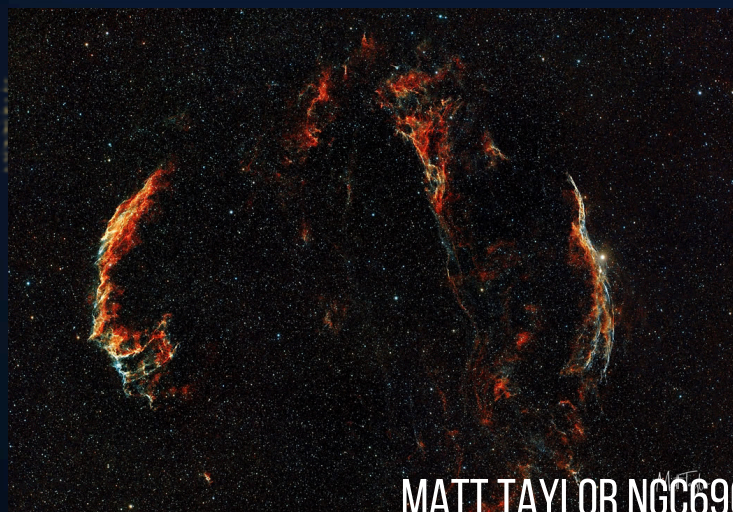
TOBY PATTON-EASTERN VAIL



MARK SAVAN -HOCKING 3



KRI MLAK--CYGNUS COMPLEX



MATT TAYLOR NGC6960 (LEFT) M31 (RIGHT)

Phoenix Astronomical Society Members Receive Exclusive DwarfLab 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.com/@dwarflabofficial>



Helpful Setup and Training Videos

Introducing the Dwarf Mini

<https://www.youtube.com.com/watch?v=eAEZleuGFDg>



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

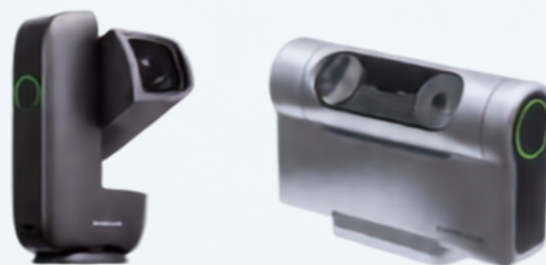
- All equipment must be collected from the PAS storage facility
- All items must be returned to the same facility by the agreed end date



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- Dwarf lab Mini

NEW- Dwarf Lab 3

NEW Askar 103 APO 103mm f/6.8 Triplet Refractor Telescope, with ioptron AZ Mount Pro and an advanced eyepiece kit

2 x ZWO SeeStar S50

Coronado Personal Solar Telescope (PST)

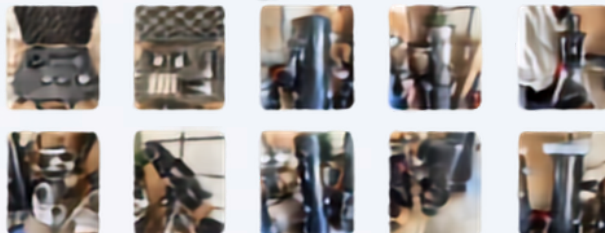
Orion SkyQuest XT-10 - 10' Dobsonian

Orion Skyquest XT-8 - 8' Dobsonian

Sky-Watcher – 10" Collapsible Motorized Dobsonian

Accessory Kit #4 - Advanced Observing

Accessory Kit #5 – 1.25" Eyepieces & filters





The 2026 Book Club

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

"Black holes are not the end — they are transformative engines in the story of the universe." — Chris Impey

Einstein's Monsters

The Life and Times of Black Holes
by Chris Impey
A Complete Guide in One Page

Bigger questions. Deeper understanding. A more magnificent universe.

From curious ideas to cosmic reality — black holes change everything.

1 A New Universe of Black Holes
How black holes changed our view of the cosmos

2 The Death of Stars, the Birth of Black Holes
How dying stars create stellar-mass black holes

3 Supermassive Black Holes
Giants at the hearts of galaxies

4 Gravitational Engines
Accretion disks, jets, and enormous power

5 The Lives of Black Holes
From birth to growth to cosmic influence

6 Black Holes as Tests of Gravity
Nature's laboratories for extreme physics

7 Seeing with Gravity Eyes
New ways to observe the invisible

8 Black Holes Don't Last Forever
Hawking radiation and the fate of black holes

Key Takeaways from the Book

- Black holes are real and detectable.
- They form naturally from stellar evolution and cosmic structure.
- They connect gravity, quantum mechanics, and cosmology.
- They shape galaxies and the large-scale universe.
- New observational windows (gravitational waves and images) are transforming our understanding.

Why It Matters

- Helps us understand our cosmic origins
- Reveals the interconnected nature of the universe
- Drives new technologies and discoveries
- Inspires wonder and bigger questions

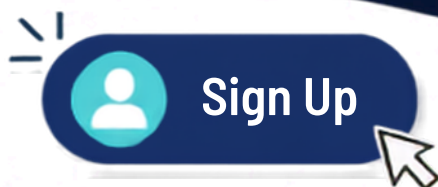
"In the depths of gravity, we find engines that light up the cosmos." — Chris Impey

AI Generate by Cyrus Mousavi

Some stars. New worlds. A deeper story.

JOIN OUR SOCIETY

EXPLORE. CONNECT. INSPIRE...



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.



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

