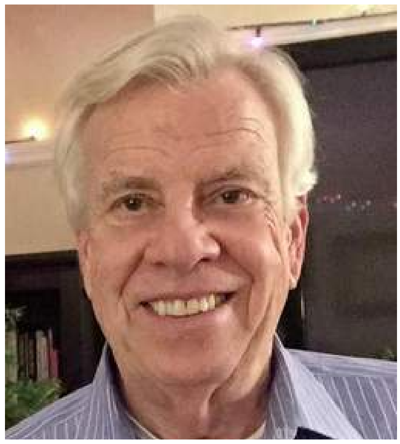
October, 2024 Volume 76 Issue 2

PAStimes

A Publication of the Phoenix Astronomical Society

Stu's Views

- Stu Brackney, President PAS



Hi everyone. Our Fall season of events is well underway. Lectures, star parties and of course your monthly newsletter, the PAStimes. Our "you must register" approach to all events allows us to alert you if there are changes to the event you wish to attend. To view the entire year's schedule got to: **PAS Event Calendar and Registration Site**

Speaking of the PAStimes, your astute editor Richard Meyers reminds all of us to send him editor@pasaz.org your images, stories and now advertisements for items you wish to sell. Of course all should be related to our fun hobby, astronomy. The PAStimes is not only emailed to you directly, but also published on our public website.

Your public website, www.pasaz.org is loaded with lots of information, especially awesome links to other websites regarding Arizona locations to visit either online or in person.
Here is another link: https://spacetourismguide.com/stargazing-arizona/

Your telescope loaner program continues to make available, for free, to members various telescopes and high-end eyepieces. Interested in borrowing...send an email to telescope@pasaz.org. Our loaner program allows you to have hands-on experience with a telescope prior to investing your hard-earned money in the purchase of a scope.

Finally, we are still looking for people who already own a telescope, know how to use it, and can participate in public presentations explaining our hobby and the night sky. You will be paid for your efforts in this program. If you feel qualified send an email to startours@pasaz.org and express your interest. If you like PAS, tell a friend and engage your family in our events. We have student memberships too.

Clear skies everyone, the stars belong to you...Stu

In This Issue

October Upcoming Events

October 2024 brings our normal schedule of events.
3th –PAS Member -Only Social
5th- Public Star Party- Bronco Trailhead
24th- Telescope Workshop-PVCC Main Campus

November 2024
2nd - Public Star Party- Apache Wash Trailhead Park
7th-Monthly Lecture Series - New development in the field of adaptive optics (AO)
21th- Telescope Workshop-PVCC Main Campus
30th- Public Star Party- Bronco Trailhead

December 2024
5th-Monthly Lecture Series - Dr. David Williams, Arizona State University
19th- Telescope Workshop-PVCC Main Campus
28th - Public Star Party- Apache Wash Trailhead Park

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 Series

A free pizza social for members on Thursday October 3rd at 7:00 p.m

We have a special gift for someone...a free 10" Dobsonian telescope. Every member attending will receive a free raffle ticket. The winner drawn gets the scope. How can you beat that, free food and a free telescope!

Orion SkyQuest XT10 10" Dobsonian Telescope
• Big 10" (254mm) aperture reflector telescope gathers loads of light for bright views of nebulas, galaxies, star clusters, and close-up study of the Moon and planets
• Stable support provided by the wooden Dobsonian telescope base and CorrecTension adjustment knobs keep the telescope optical tube balanced in any viewing position
• Simple Dobsonian point-and-view ease of use plus IntelliScope smarts equals a reflector telescope for a lifetime
• Includes 2" Crayford focuser, two 1.25" Sirius Plossl telescope eyepieces (25mm and 10mm), a 9x50 right-angle correct-image finder scope, eyepiece rack, collimation cap, and Starry Night software
Member Price: $300 / Non-Member Price: $500

September Lecture

Juno Mission Update - Detailed Summary of presentation by Dr. Steve Levin

The Juno mission, launched by NASA in August 2011, reached Jupiter in July 2016 with the goal of studying the gas giant's internal structure, atmosphere, and magnetic environment to better understand the formation of Jupiter and its impact on the solar system. Juno's groundbreaking findings have reshaped our understanding of gas giants and planetary formation. https://www.pasaz.org/lecture-series-videos#h.uuvn0u42x7v

Key Discoveries

1. Jupiter's Core: Fuzzy and Extended-One of the most surprising findings from Juno was the discovery of Jupiter's diffuse, or "fuzzy," core. Unlike the solid, compact core that scientists once expected, Juno's gravitational data revealed a large, extended region of heavy elements spread out within the planet. This suggests Jupiter either suffered a massive impact during its early formation or underwent gradual mixing of elements, challenging previous theories of how gas giants form.

Impact on Science: This discovery forced scientists to reconsider models of planetary formation, indicating that gas giants may form in a more chaotic and dynamic process than previously believed.

2. Atmospheric Dynamics: Cyclones and Deep Jet Streams-Juno's observations of Jupiter's atmosphere revealed far greater complexity than imagined:

Polar Cyclones: Juno discovered enormous cyclonic storms at Jupiter's poles, arranged in striking geometric patterns. These storms are stable and have persisted throughout the mission, yet their dynamics and longevity remain puzzling to scientists.

Jet Streams: Juno found that Jupiter's jet streams, the bands of strong winds that give the planet its iconic striped appearance, extend about 3,000 kilometers (1,900 miles) below the visible cloud tops. This depth indicates that the planet's atmospheric circulation is deeply connected to its interior structure, not just a surface phenomenon.

3. Lightning and "Shallow Lightning"-Juno provided new insights into the nature of lightning on Jupiter. Traditionally, lightning was expected to form deep within the planet's atmosphere, but Juno discovered shallow lightning in high-altitude clouds, where temperatures are too cold for liquid water.

Ammonia-Water Clouds: The shallow lightning occurs in clouds made of ammonia and water, where ammonia lowers the freezing point of water, enabling lightning to form at higher altitudes. This finding revealed a previously unknown layer of atmospheric chemistry in Jupiter's weather systems.

4. Magnetic Field and Auroras-Juno's study of Jupiter's magnetic field revealed that it is much stronger and more irregular than expected, with anomalies that suggest dynamic processes occurring deep within the planet's interior.

Irregular Magnetic Field: Jupiter's magnetic field is lopsided and uneven, with regions of intense magnetic strength in unexpected places. Understanding this irregularity is helping scientists refine models of planetary magnetospheres.

Auroras: Juno also helped us understand the planet's powerful auroras, which are different from Earth's. Unlike Earth's auroras, which are powered by solar wind, Jupiter's are driven by the planet's rapid rotation and intense magnetic field. This creates powerful electrical currents that generate light shows at the poles.

Technological Marvels of Juno

1. Solar-Powered Operation-Juno was the first spacecraft to rely on solar power at such a great distance from the Sun. Its three large solar panels, each 30 feet long, provided sufficient energy to operate in Jupiter's dim light, five times farther from the Sun than Earth. This marked a major engineering feat for long-term outer planet exploration.

2. Radiation Protection-Jupiter's radiation belts are among the most intense in the solar system, presenting a significant challenge for Juno. The spacecraft's vital electronics were housed in a specially designed titanium vault, which shielded them from the planet's intense radiation, allowing Juno to survive in this hostile environment.

Extended Mission: Exploration of Jupiter's Moons

Originally, Juno's mission was set to end in 2021, but its success prompted NASA to extend the mission to 2025. This extension enabled Juno to explore some of Jupiter's largest and most intriguing moons.

Ganymede: The largest moon in the solar system, Ganymede, was studied in detail by Juno. Flybys revealed new information about its icy surface and magnetic field, contributing to our understanding of icy moons.

Europa: Europa, a moon with a subsurface ocean, is one of the top targets for astrobiologists searching for life beyond Earth. Juno's observations of Europa's ice shell provided crucial data about the moon's surface features and potential habitability.

Io: Juno conducted flybys of Io, the most volcanically active body in the solar system. These close passes provided insight into how Jupiter's gravitational pull drives Io's extreme volcanic activity.

Public Engagement and Citizen Science

One of the standout features of the Juno mission was its strong engagement with the public through JunoCam, a visible-light camera included on the spacecraft for outreach rather than scientific purposes. The raw images taken by JunoCam were made available to the public, allowing citizen scientists and enthusiasts to process and enhance them. This effort brought in thousands of stunning images, showcasing Jupiter's beauty and inspiring the public to take part in the mission.

Citizen Science: JunoCam became an unprecedented success in public engagement, with individuals across the globe participating in image processing, demonstrating the power of involving the public in space exploration.

Scientific Implications for Gas Giants and Planetary Formation

Juno's findings have major implications for understanding the formation of gas giants, both in our solar system and beyond:

Fuzzy Core and Heavy Elements: The discovery of Jupiter's fuzzy core and the enrichment of heavy elements suggest that gas giants form in ways more complicated than previously thought. These results indicate that Jupiter may have formed farther from the Sun, accreting material from icy planetesimals before migrating inward to its current orbit.

Water Content: By studying Jupiter's water content, Juno helped test theories about planetary formation. The variation in water distribution across the planet has provided insights into how Jupiter accumulated its mass and suggests that the cold formation theory, where Jupiter formed farther from the Sun, may be more plausible.

Exoplanetary Science: Juno's discoveries are also helping scientists interpret data from exoplanets, especially the many gas giants detected orbiting other stars. The findings provide a template for understanding the atmospheres, magnetospheres, and internal dynamics of these distant worlds.

Conclusion: The Legacy of Juno

The Juno mission has been transformative in its contributions to planetary science. It has challenged long-standing models of gas giant formation, revealed the complexity of Jupiter's atmosphere and magnetic field, and offered new insights into the planet's moons. With its extended mission, Juno continued to deliver groundbreaking data, and its legacy will shape our understanding of not only Jupiter but also gas giants throughout the universe.

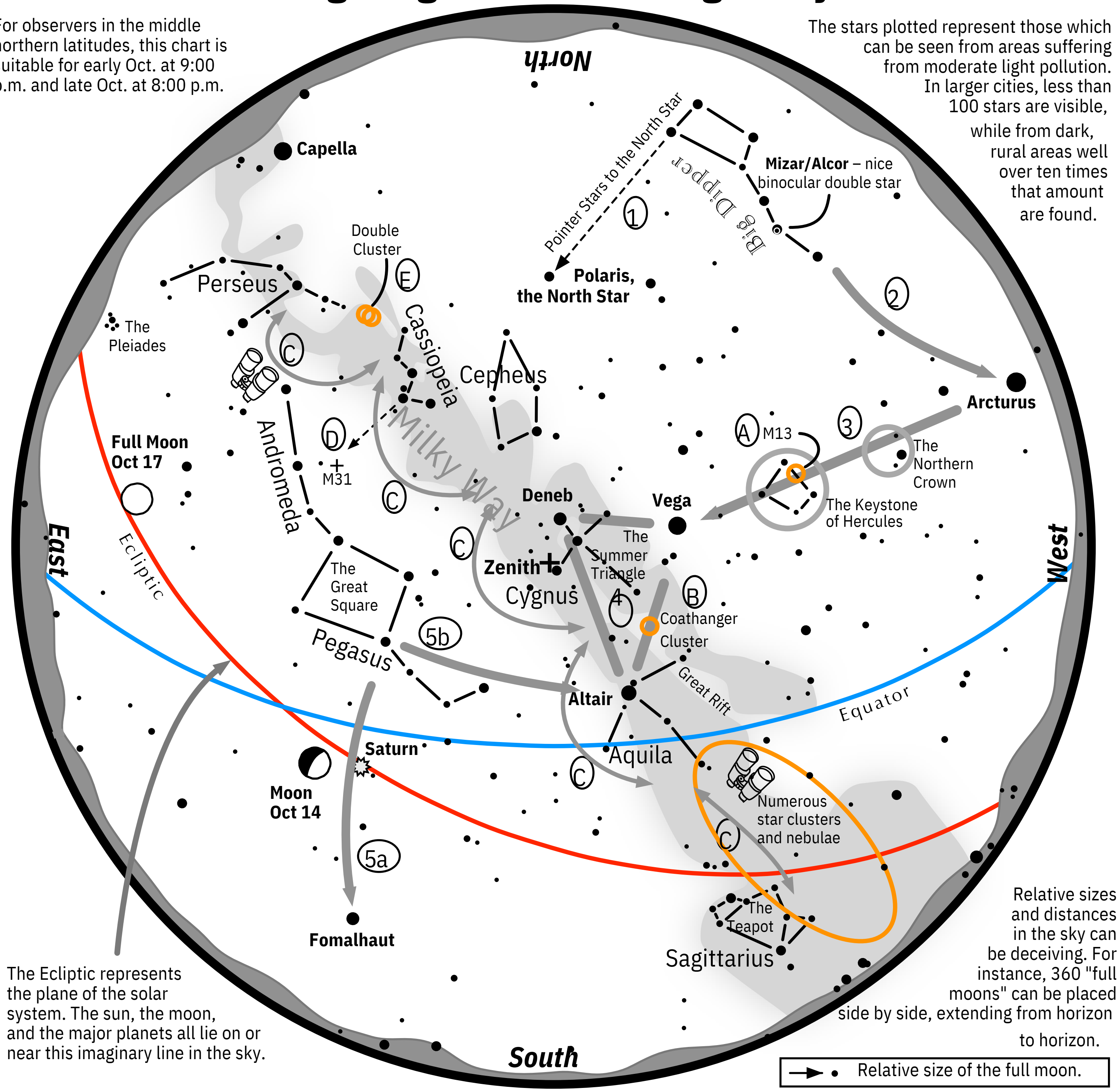
As we look forward, the mission's data will continue to be analyzed, offering even more revelations in the years to come.

Juno's journey will undoubtedly influence future missions, helping scientists refine their understanding of planetary systems both within and beyond our solar system.

Navigating the October Night Sky

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

The stars plotted represent those which can be seen from areas suffering from moderate light pollution. In larger cities, less than 100 stars are visible, while from dark, rural areas well over ten times that amount are found.



The Ecliptic represents the plane of the solar system. The sun, the moon, and the major planets all lie on or near this imaginary line in the sky.

Relative sizes and distances in the sky can be deceiving. For instance, 360 "full moons" can be placed side by side, extending from horizon to horizon.

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.

Chasing the Northern Lights: My Adventure in Comox
by Richard Meyers

On a clear, 55°F evening in Comox, British Columbia, I found myself standing on the waterfront of the Salish Sea, beneath a vast, star-studded sky. The excitement of witnessing the Northern Lights kept me wide awake despite the mild temperature. Far from city lights and surrounded by the gentle sounds of the sea, I was ready to experience one of the most elusive natural spectacles: the Aurora Borealis.

I had prepared meticulously, fueled by my fascination with the science behind auroras. I knew that the Northern Lights were caused by charged particles from the sun interacting with Earth's magnetic field. These particles, mostly electrons and protons, collide with gases in the atmosphere, creating vibrant, shimmering lights that dance across the night sky.

Monitoring Sunspot Activity A key element of my preparation was tracking **sunspot activity**, a crucial driver of auroras. Sunspots are darker, cooler regions on the surface of the sun caused by magnetic disturbances. They are often associated with heightened solar activity, including solar flares and coronal mass ejections (CMEs), both of which release significant amounts of charged particles into space. When these particles reach Earth, they interact with our planet's magnetic field, creating the auroras. More sunspots often indicate more frequent solar storms and, consequently, a greater likelihood of vivid auroras.

During the weeks leading up to my trip, I monitored sunspot numbers through **SpaceWeatherLive.com**. Higher sunspot activity generally corresponds with more intense and frequent auroras. Luckily, I found that solar activity had been on the rise, with several active sunspot regions generating solar flares and CMEs. This increased solar output gave me hope that the auroras would be particularly strong during my viewing.

Solar Wind, Hemispheric Power, and Geomagnetic Activity In addition to tracking sunspots, I accessed the latest solar and geomagnetic data using SpaceWeatherLive.com, which provided real-time updates on the conditions affecting aurora visibility. I was aware that the intensity of the auroras is influenced by solar wind, geomagnetic activity, and hemispheric power. Hemispheric power refers to the amount of energy entering the Earth's upper atmosphere from geomagnetic activity. A higher hemispheric power value, typically measured in gigawatts (GW), increases the likelihood of auroras being visible over a wider area. When the hemispheric power exceeds 30 GW, auroras can often be seen further south, beyond their usual polar locations.

I also kept track of solar wind conditions, knowing that the solar wind, a stream of charged particles emitted by the sun, carries the sun's magnetic field. During periods of heightened solar activity, such as solar flares or CMEs triggered by sunspots, the solar wind intensifies, leading to more spectacular auroras. CMEs, in particular, involve massive bursts of solar wind and magnetic fields, greatly enhancing the auroras.

In addition to monitoring the Kp index, a scale from 0 to 9 that measures geomagnetic activity, I also checked real-time updates from a local BC aurora Facebook group. The group provided live reports from other skywatchers in the area, allowing me to fine-tune my timing and location based on their sightings and advice. This real-time feedback kept me informed of any sudden changes and made me feel part of a broader community of aurora chasers.

The Kp index of 3 or higher indicated a good chance of seeing auroras, and values above 5 signaled strong geomagnetic storms. These storms occur when the solar wind interacts with Earth's magnetic field, resulting in more intense auroras.

Another crucial factor was the Bz component of the interplanetary magnetic field (IMF). When Bz was negative, it allowed more solar particles to enter Earth's magnetosphere, enhancing the auroras. Conversely, positive Bz would suppress auroral activity. I knew that the auroral oval, a ring around the geomagnetic poles where auroras typically occur, expands during geomagnetic storms. The expansion of this oval, combined with high hemispheric power and sunspot activity, was key to increasing the chances of seeing the auroras in Comox, which sits below the usual auroral zone.

Capturing the Lights In pursuit of the perfect aurora-viewing spot, I had chosen the secluded waterfront along the Salish Sea to avoid light pollution, ensuring that even the faintest lights would be visible. The clear sky and the promising aurora forecast added to my anticipation. With the help of SpaceWeatherLive.com, my aurora forecasting app showed a high Kp index, strong hemispheric power, and a favorable Bz component, indicating excellent conditions for viewing. With my

Nikon D7200** camera set up—a DSLR with a wide-angle lens, aperture wide open, ISO between 1600 and 3200, and an exposure time of **3 to 15 seconds** depending on the aurora's activity—I was ready. Capturing the auroras required precise settings: a wide aperture to gather more light, a high ISO to pick up the dim glow without too much noise, and a carefully timed shutter speed to balance light and clarity. As I waited, the sky began to come alive. The first hints of green appeared, gradually intensifying into vivid displays of green, pink, and red. The auroras flowed across the sky like liquid ribbons, their colors pulsating with magnetic energy.

My patience and preparation paid off as I captured stunning images of the auroras, each exposure revealing a new facet of the lights' beauty. The experience was deeply rewarding, a perfect blend of scientific understanding and natural wonder. Under the mild night sky on the waterfront of the Salish Sea, I marveled at the breathtaking dance of the Aurora Borealis, feeling a profound connection to the universe

I Finally Found M51!
By Leah Sapir

When I got my first telescope 25 years ago, one of the first things I did was to get a few books for beginning astronomers, describing interesting things I could see with my new telescope. But I quickly found that most of the objects that are supposed to be "easy to find in suburban areas" were totally invisible to me!

My location is around Bortle 7-8. It is a suburban-type neighborhood, but we do have street lights, as well as "skyglow" from central Phoenix. My limiting magnitude is about 3.8. It is very rare that I have an opportunity to travel to a dark sky site.

With my 6" dob, I was able to see nice views of the planets, and lots of star clusters; but very few galaxies or nebulas. Just the Andromeda galaxy (bright core only – no spiral arms or companion galaxies visible), the Orion nebula in winter, and the Lagoon nebula in summer. I followed the "star-hopping" instructions in the books, and I knew from the pattern of stars in the eyepiece that I had reached the right location – but the galaxy or nebula that was supposed to be there was simply invisible. It was very frustrating.

So it was with great interest that I read the series of articles by Phil Hoppes about the "Seestar S50", published right here in PasTimes in April-June of this year. At around the same time, a member of another group I belong to shared pictures that he had taken with the Seestar's competitor, Dwarf 2.

Ordinarily, when people have asked me about using a "goto" telescope, I always tell them that it is more important to learn the sky – to be able to find the major constellations, and to know where to point their telescope. Instead of just "going to" individual objects, it's better to "take the scenic route" and know not just the name of the object you are looking at, but also where it is.

But these two new models of "smart telescope" were not just "goto" telescopes. They promised something that I didn't think was possible: they could cut through the skyglow, and they could find and even photograph all those objects that I had wanted to see through my telescope, and until now were invisible to me. Was it possible? It really sounded too good to be true.

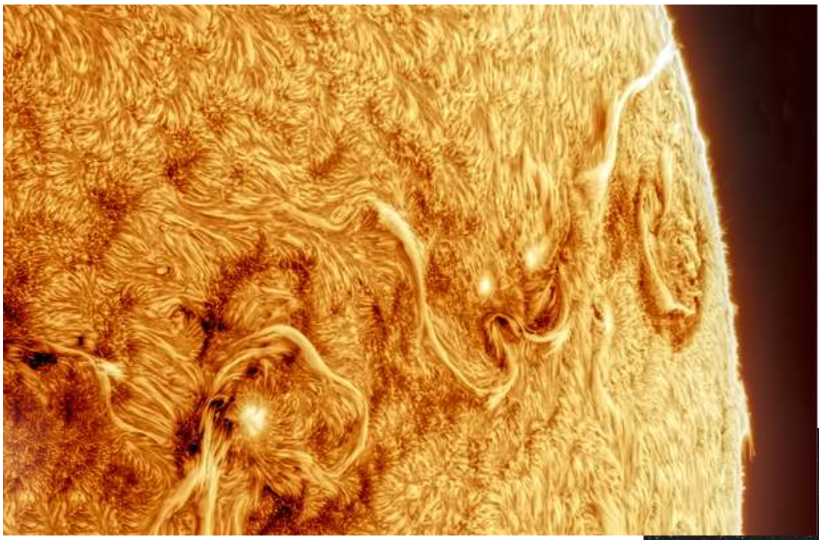
But I corresponded a little with Phil and with the one who was using Dwarf 2, and they confirmed that these "smart scopes" could do it. I also read online reviews comparing the two models, and I chose the Seestar. And I was not disappointed! It basically fulfilled a 25-year dream: to be able to see all the deep sky objects that the books described, that until now had simply been invisible to me.

And not only that, but it shows them in greater detail than a backyard telescope can. That is because this is astrophotography. In general, a telescope collects light from faint, distant objects and bring it to a focus. The resolution of the telescope – its ability to show detail – depends on the amount of light it collects. We can think of the photons (the "particles" of light) like raindrops falling on a sidewalk. The more raindrops fall, the more spaces on the sidewalk will be filled in. And the more photons the telescope collects, the more details will be filled in.

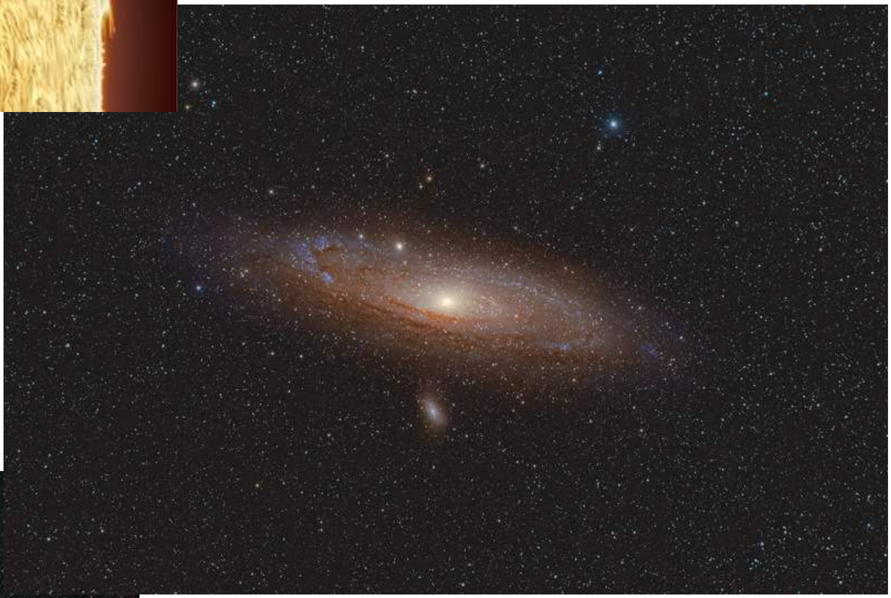
When we look through a telescope, the light that reaches our eye is just whatever amount of light is passing through the telescope at that moment. But with astrophotography, we can leave the shutter open for an extended time, and in this way to gather more light and more detail. The Seestar takes many 10-second images, discards any that didn't come out well, and automatically stacks the "good" ones for an extended exposure.

Of course, the views in the Seestar are not "professional quality". There are members of PAS who do very serious astrophotography in dark-sky sites, using equipment that cost thousands of dollars, and then afterwards spend hours in "post-processing" to improve the images, and their images are professional quality. Of course the Seestar @ $500 cannot compete with that. But, does it show objects that till now have been invisible to me? Can it do this from my own back yard? And does it show these objects in greater detail than my 6" telescope does at a dark sky site? Yes, yes, and YES!!!! I started to share the pictures with friends and family, including a description of each object, and got an enthusiastic response. So I decided to set up a whats app group and a blog to share the pictures and descriptions. You can find my blog at https://leah-astronomy.blogspot.com. For the whats app group, send me a message at astronomy-questions@pasaz.org and I will send you the join link.

Member Astro Images

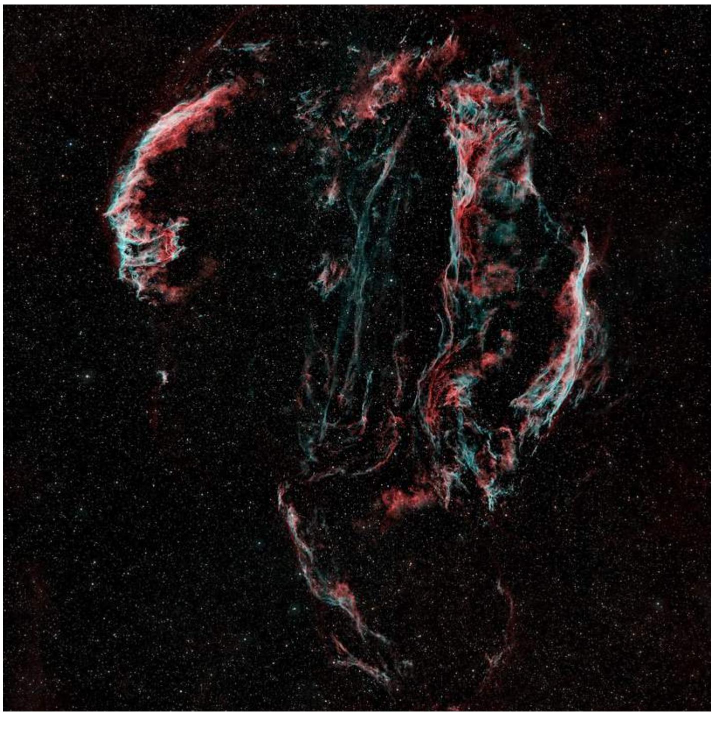


sun-mark johnston



andromeda galaxy-mark johnston

wizard nebula-mark johnston



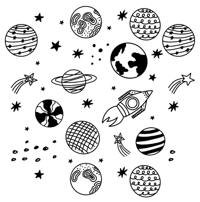
veil nebula ngc 6960-mark savan

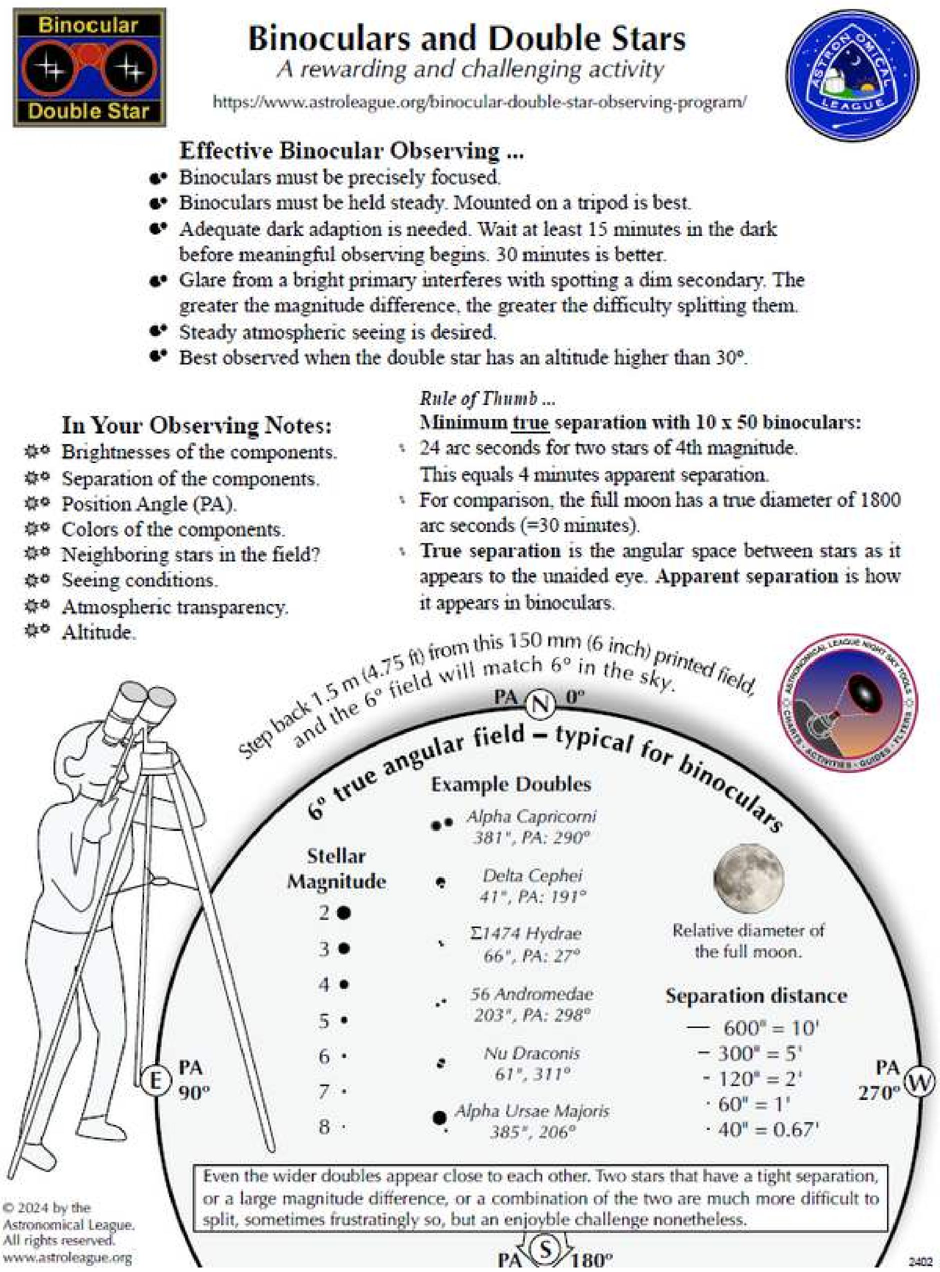
7 Telescope Targets for October

Each month, we feature 7 good targets for small telescopes that should be visible in the evening. For the month of September, the targets are:

1. **31 Cygni** – easy orange, blue, and white triple star
2. **Delta Cygni** – one side of the Northern Cross. Tight double star of uneven magnitudes
3. **NGC7000 North America nebula** – large emission nebula near Deneb. Try with binoculars from a darker site away from the city
4. **NGC6992 Eastern Veil nebula** – beautiful supernova remnant, opposite from Delta Cygni on other side of the constellation
5. **NGC6960 Western Veil nebula** – also known as the Witch's broom, part of the same supernova complex
6. **Mu Cephei Garnet star**- Red supergiant star in Cepheus. If it were in our solar system all planets up to Jupiter would be inside it
7. **Delta Cepheus** -Beautiful blue/yellow binary. One of the closest Cepheid variable stars to Earth

Cosmic Classroom (CC)





Helpful Astronomy Websites

by Mark Johnston

The following websites are great free resources to help you plan and enjoy your astronomy adventures

Astromart: astromart.com/
This is one of the top two sites for buying and selling used astronomy gear, product reviews, and forums where you can discuss any aspect of astronomy with other enthusiasts. A small fee is required.

Astrometry.net: https://nova.astrometry.net/
This site will take any astronomy image you send it (galaxy, starfield, nebula, etc) and then tell you what it is and where it is in the sky.

Astronomy Tools: astronomy.tools/calculators/field_of_view/
This site has a lot of capabilities but I use it primarily to figure out how a target (e.g. the Helix nebula) will look in my eyepiece or astronomy camera. You pick your scope, camera, eyepiece and target and the site does the rest.

Astrospheric: www.astrospheric.com/
Probably the best short term astronomy weather forecasting tool, providing predictions of clouds, transparency and seeing.

Clear Sky Charts: www.cleardarksky.com/
Excellent source of astronomy seeing conditions forecast. Also a great tool for finding observing sites with lower light pollution.

Cloudynights: www.cloudynights.com/
This is one of the top two sites for buying and selling used astronomy gear, product reviews, and forums where you can discuss any aspect of astronomy with other enthusiasts. Free.

Dark site finder: darksitefinder.com/map/
Great website for finding a dark observing location.

Heavens above: heavens-above.com/
Top site for predicting naked eye observations of satellites. See when the ISS is visible in your neighborhood!

Jupiter transits: shallowsky.com/jupiter/
For anyone with a small telescope, this is a great site. You can find out when the Great Red Spot and Jupiter's satellite transits are visible.

Solar Dynamic Observatory (SDO): https://sdo.gsfc.nasa.gov/data/
Find out how the Sun looks right now, at various wavelengths. If you own a solar telescope, this site coupled with Astrospheric is all you need to plan fabulous solar observing!

Telescopius: telescopius.com/
This site is very helpful in planning an observing evening. It will tell you when any particular target is rising and setting and when is the best time to observe it. This allows you to sequence your observing in a planned manner.

This is a first come, first served offer.
Review the list. Decide what you want.
Email stuartbrackney@pasaz.org what you want.
He will set up a day/time for you to come to his location to purchase.
Bring your check payable to Phoenix Astronomical Society or cash … no credit cards please.

<u>Celestron 6" F/4 Newtonian Astrograph Telescope</u>

• Fast 6"-aperture reflector lets you take short exposures with bright, high-resolution results
• Precise 2" dual-speed (10:1) linear-bearing Crayford focuser lies 7" back in the optical tube to block stray light and boost contrast
• Orion-exclusive steel reinforcement plate under focuser eliminates flexure with heavy imaging gear attached
• Compact 22.5" length and light 12.7 lb. assembled weight doesn't require an enormous mount
• Includes two heavy-duty hinged tube rings, 8x50 finder scope, dovetail mounting bar, and more

Member Price: $250 / Non-Member Price: $400

<u>Orion 8" F/4 Newtonian Astrograph Telescope</u>

• Affordable 8"-class Newtonian telescope optimized for wide-field astrophotography
• The 200mm (7.9") aperture f/4 parabolic primary mirror is made from high-quality BK7 glass with enhanced aluminum coatings to provide >92% reflectivity for bright, vivid images
• Compact and lightweight at just 28" long and 16 lbs., can be supported on a mid-sized equatorial mount.
• Includes 8x50 finder scope, hinged tube rings, 12V DC cooling accelerator fan, and a quick-collimation cap. A coma corrector (sold separately) is recommended for optimal flat-field performance.

Member Price: $350 / Non-member Price: $600

<u>Orion SkyQuest XT10 10" Dobsonian Telescope</u>

• Big 10" (254mm) aperture reflector telescope gathers loads of light for bright views of nebulas, galaxies, star clusters, and close-up study of the Moon and planets
• Stable support provided by the wooden Dobsonian telescope base and CorrecTension adjustment knobs keep the telescope optical tube balanced in any viewing position
• Simple Dobsonian point-and-view ease of use plus IntelliScope smarts equals a reflector telescope for a lifetime
• Includes 2" Crayford focuser, two 1.25" Sirius Plossl telescope eyepieces (25mm and 10mm), a 9x50 right-angle correct-image finder scope, eyepiece rack, collimation cap, and Starry Night software

Member Price: $300 / Non-Member Price: $500

<u>Various Filters – 1.25"</u>

• Red
• Yellow
• Blue
• Green
• Multiple O3 filters

Member Price: $100 / Non-Member Price: $200