Volume 5, Number 10
October 2024

Club Website:
http://vlgastroclub.org/
Facebook:
https://www.facebook.com/groups/vlgastroclub/

Club Officers & Directors

President	Mark Graybill
Vice President	Ken Katta
Secretary	Randy Gilbert
Treasurer	Linda Meng

Newsletter Contact
saundby@gmail.com
(please include TVAstro in subject line)

Annual Membership Dues

September wa the beginning of a new year for The Villages Astronomy Club, so annual dues of $15 are due if you have not paid them yet. Dues may be paid at our General Meeting on September 17th, or at Space Academy beginning with our October meeting on October 7th.

Your dues not only allow us to provide the benefits of membership in The Astronomical League as a member society, but also to cover the operating costs of our club.

UPCOMING EVENTS

EAA Meeting, October 2nd, Homestead Astronomy Park, 7:00pm

Join us at Homestead Astronomy Park for an evening of observing with smart telescopes! Owners of smart scopes or scopes with smart controllers are welcome as are those who are interested in learning more about the options to get started in Electronically Assisted Astronomy (EAA).

We will open the park before sunset for setup, and open late if weather permits.

Trifid Nebula (M20) in Sagittarius
Image by member John Keller
Seestar S50, 20 minutes
Taken from Cales Field, Fruitland Park

Exec Directors' Meeting, Oct 4th, 11am

All members are welcome at our Executive Directors' Meetings, where our directors plan and prepare for future events and meeting. We have a busy schedule planned for the new year including

Starry Starry Nights in December. The executive directors' meetings are held at Fishhawk Recreation Center, 2318 Buttonwood Way, in the card room, from 11am to 12pm.

Space Academy, October 7th, 6:30pm

Space Academy will feature a video presentation and discussion about the expansion of the universe, and how we know it's happening. We will also present topics on current research in astrophysics.

Meeting begins at 6:30pm at Truman Rec Center, 2705 Canal Street.

Telescope Workshop, October 7th, 7:30pm

Join us to learn how to use or select a telescope, share your knowledge, and get a look at the sky, weather allowing.

NGC7293, The Helix Nebula (aka The Eye of God Nebula) by member Craig Henry.
Seestar S50, 50m of 10s frames, processed with WBPP and Pixinsight.

General Meeting, Oct 15th, 6:30pm:
The Astronomical League by Maynard Pittendreigh

Join us at Laurel Manor Recreation Center, 1985 Laurel Manor Drive, for this month's presentation on The Astronomical League by Maynard Pittendreigh, Executive Secretary of The Astronomical League.

Learn about the League's programs and benefits, and how to take advantage of them to support yourself in the hobby. Also learn how the League supports our club and its activities and publications.

October 19th, 5pm:
Fruitland Park Astronomy Group

The Fruitland Park Astronomy Group meets for an evening of observing and talk on the third Saturday of the month every month, conditions allowing. The meeting is at the Cales Soccer Field in Fruitland Park at 300 Shiloh Road (at the corner of Shiloh Road and Dixie Avenue, north of the Fruitland Park water tower.) Enter on the gate at Shiloh Road (some GPS's will guide you to the Dixie Avenue entrance, come around the corner to the open gate on Shiloh.) The Villages Astronomy Club members and the public are welcome. Gate opens at 5pm

Scopes can be set up directly off of tailgates onto pavement, or taken further into the park to avoid lights. Bring power if needed.

Calendar: https://vlgastroclub.org/calendar/

NEWS

First Commercial Spacewalk on Polaris Dawn

Polaris Dawn, the first in a series of missions to expand human capabilities in space, launched on September 10th, 2024 after a series of events and weather delayed its launch from earlier in the summer. Once aloft, work toward its many ambitious objectives began immediately.

Polaris Dawn Crew in Orbit
This image trasferred to the ground from a high altitude orbit using Starlink laser communications technology, a first. Polaris Program image.

Upon reaching orbit, the capsule's air immediately began reducing its pressure and reducing the nitrogen content of the air in preparation for the spacewalk to be performed on Day 3 of the mission. This gave the crew 2 days of atmospheric adaptation to allow nitrogen to be removed from their bloodstream to prevent a case of the bends from the 5lb pressure pure oxygen atmosphere they would be breathing in their space suits during the spacewalk.

Normal atmospheric pressure on Earth is 14.7 lbs of pressure, with about 21% oxygen and 78% nitrogen. While oxygen is required for life, nitrogen is an inert gas, and its expansion in the body when external pressure is reduced causes the bends. This is the same effect that can affect divers who rise from deep dives in the ocean in the same way as they rise from higher pressures to lower ones at the surface.

On Polaris Dawn, they reduced the cabin pressure over time, rapidly reducing the nitrogen content of the air to give the nitrogen in the astronauts' bodies to come out of their bloodstream to prevent this problem. On the ISS, spacewalkers go through a pure oxygen prebreath cycle of several hours inside the airlock and their suit. The transition is shorter, but more intense.

High Flight

During this two day warmup for the space walk, both the capsule and the crew were busy. The capsule launched into an elliptical orbit with a high point of 750 miles altitude, and a low point of about 120 miles. This already put the mission above the highest Shuttle flight apogee of 386 miles, reached during STS-31, the launch of the Hubble Space Telescope. The prior Inspiration 4 flight aboard SpaceX Dragon had reached an altitude of 350 miles.

Then the Dragon capsule used its Draco thrusters to raise its peak altitude to 870 miles over a series of firings. This put the crew at the highest Earth orbit of a crew ever achieved, besting the Gemini 11 altitude record of 850 miles set in 1966 by Pete Conrad and Dick Gordon.

This is also the farthest from the Earth that any astronaut has been since the Apollo 17 mission that went to the Moon in 1972.

Polaris Dawn astronauts Anna Menon and Sarah Gillis have also set the record for women, travelling farther from the Earth than any woman ever has before.

Still from video of Polaris Dawn reaching 870 mi (1400km) altitude during its record-breaking flight. Video here: https://x.com/SpaceX/status/1833734681545879844/video/1

The prior record holder was astronaut Kathryn Thornton, at 380 miles, aboard Space Shuttle flight STS-61, the first Hubble Space Telescope servicing mission.

Kathryn Thornton, Prior Women's Altitude Record Holder, at 380 miles, December 1983.

The Hubble missions were the Space Shuttle's highest altitude flights due to the requirement that the space telescope be relatively unaffected by heat reflected and radiated by the Earth.

Anna Menon (left) and Sarah Gillis, new women's altitude record holders. 850 miles, Sept 2024.

Anna and Sarah also share the distinction of being the first SpaceX employees to fly in space. Though they and thousands of their compatriots at SpaceX have enabled the flights of others and thousands of satellites, no other employees of the company have ever flown in space (while employees. SpaceX has employed retired astronauts, particularly in their Dragon development program.)

Medical Monitoring

Possibly the most important, though least visible part of the Polaris Dawn flight was the medical testing and monitoring that occurred during the flight.

Part of the flight's objectives were to perform tests on problems that spaceflight causes to the human body that have been seen with astronauts on the ISS, as well as on flights in high radiation environments outside and through the Earth's Van Allen belts.

The orbit that Polaris Dawn flew through caused them to pass through a particularly high energy region of the space around Earth, known at the South Atlantic Anomaly (SAA). In this area, near South America, the Earth's magnetic field is unusually weak, which results in high space radiation levels at altitudes far lower than elsewhere. While the Van Allen belts are typically 3000 miles above the Earth, at the SAA they dip down to only 120 miles.

In the early days of spaceflight, many satellites were lost due to the effects of the SAA on their electronics. Since then, satellite electronics have to be specially designed to be hardened against these effects to ensure a long life for the craft.

During Polaris Dawn, the capsule was flown through the SAA intentionally, to simulate the radiation environment of deep space. With medical officer Anna Menon monitoring the levels of radiation and its effects on the crew, multiple tests on visual acuity, response times and control of movements, and other tests were performed to gauge the effects of the environment on the crew to inform future missions to the Moon and Mars.

"Gold Contacts" will make high accuracy measurements of eye shape and adaptation during zero G. Polaris Program image.

Among the other tests is a contact lens that measures the adaptation of the astronaut's eyes to zero G conditions. Past astronauts, particularly those who have been in space for long periods, have reported loss of visual acuity during spaceflight. Some have suffered a permanent loss of visual acuity. This experiment will allow the Polaris Dawn crew to get high accuracy measurements on the changes to the eye's shape during the early days of zero G flight. The Polaris Dawn mission carried a slate of 64 different experiments from 61 different science institutions. Learn more by clicking on the institution logos on this page: https://polarisprogram.com/science-research/

The Space Suit

Enabling the space walk on this mission is the development of a completely new space suit by SpaceX. SpaceX's prior space suit is not suitable for exposure directly to space. It is a variety of space suit known as an IVA suit (Intra-Vehicular Activity), designed for use only inside a spacecraft. It is capable of protecting its wearer against the effects of loss of atmosphere in the capsule's cabin, but does not allow anything but the most rudimentary movement and activity in a zero atmosphere environment. It is intented as a sort of life preserver, but is not a work suit.

An EVA suit (Extra-Vehicular Activity) by contrast is designed to allow movement and activity in zero pressure environments, and to protect its wearer against the hazards that exist outside the spacecraft. On the ISS and the Shuttle, different suits are worn during launch and landing (the IVA suits) and during spacewalks

(EVA suits.)

The SpaceX suit, by contrast, can perform both tasks. Normally EVA suits are too bulky and awkward to be worn inside a spacecraft. The SpaceX suit has been developed to be compact enough and mobile enough to be worn during launch and landing. This also reduces the need for extra cargo space to be used to transport the EVA suit as a separate suit to and from orbit.

Astronauts Kidd Poteet and Jared Isaacman go through decompression sickness awareness training in preparation for the Polaris Dawn flight. Polaris program image by John Kraus

While IVA suits allow some movement even in reduced pressure environments by being close-fitting, they do not allow for a full range of motions by astronauts. Space suits have to be designed to try to maintain a constant volume as much as possible, otherwise the pressure difference between the inside and outside will make it inflate to its maximum volume and hold it in spite of the strength and movement of the astronaut wearing it. An astronaut can't do much work if the pressure of their suit pushes them into a starfish shape and holds them there.

While IVA suits allow for some control by assuming that the astronaut is confined to a chair inside the spacecraft--which not only limits their movement to the upper body, but also gives them the chair to act against as a leverage point, an EVA suit doesn't have that luxury.

So EVA suits are designed with joints that each move in only a single axis. This means that many normal human movements are impossible, as many of our joints are able to move in multiple axes at once--most notably our shoulders and spine.

Preparing for Space Suit Tests Inside the Altitude Chamber at NASA. Polaris Program image.

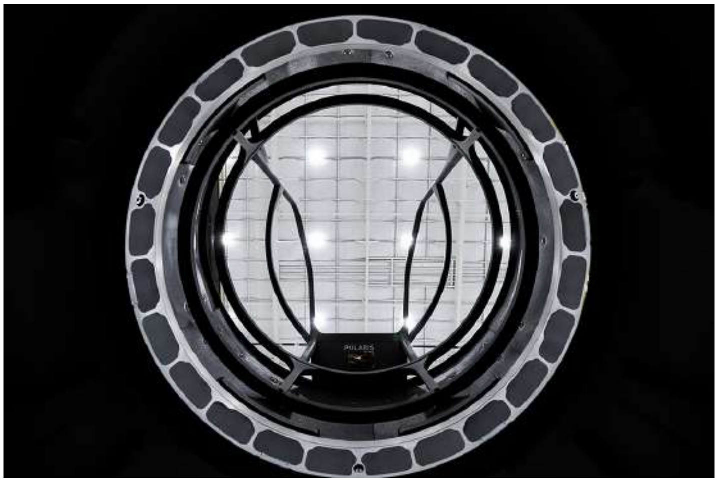
The SpaceX EVA suit's shoulders, for example, only allow a limited amount of rotational movement. The suit adds some additional movement through rotation in the upper arm of the suit. A large part of an astronaut's training for EVA involves teaching them how to move with the suit, and to not fight the suit's limitations, which would cause rapid fatigue and prevent them from doing things as their body is normally used to doing them.

Astronaut Sarah Gillis is SpaceX's lead of space operations, and she manages astronaut training for SpaceX. She has been key in development of the SpaceX EVA space suit, and was one of the spacewalkers who emerged from the capsule during the spacewalk.

The primary purpose of the spacewalk was to evaluate the suit and its mobility, with the findings of this flight feeding into future design changes and iterations of the suit, with the plan to produce a suit suitable for more ambitious flights in the future.

Skywalker

Aware that a space suit is only half of what it takes to be productive during an EVA in space, Sarah Gillis and her team developed the "Skywalker", a mobility aid for the astronauts to use during their spacewalk. It would not only provide them with the ability to control their movements effectively in zero G, but also to perform measurements of the flexibility of the suit.



The Skywalker EVA Mobility Tool
Shown looking up from the capsule inside.
Polaris Program image.

Acting as both a sort of ladder and foot restraint, the Skywalker is a first step in developing general purpose EVA mobility tools for spacewalks. Based on prior work by NASA going all the way back to Buzz Aldrin's Gemini 13 flight, it will be tested to see if vertical or horizontal bars are easier to use, check the span between its rungs against the movement limits of the spacesuit, and its utility for sideways movement and providing foot restraints for free movements of the arms.

Astronaut Training on the Skywalker Using a Zero G Simulation Harness. Polaris Program image.

The Spacewalk

Jared Isaacman becomes the first EVA commercial space walker as he emerges from the Dragon spacecraft. SpaceX image.

On flight day 3 came the big event for Polaris Dawn. After 2 days of eliminating nitrogen from their bloodstreams, the crew donned their space suits and evacuated the atmosphere from the Dragon spacecraft.

This was the first time that a Dragon spacecraft had been evacuated in orbit. Even back to the earliest Dragon cargo vehicle that flew on December 8th of 2010, no Dragon has ever flown in space without a full pressure atmosphere sealed into it. While Dragon had been tested, and had some modifications performed, in vacuum chambers on Earth for this flight, it has never been opened to space while in space before.

Sarah Gillis Emerges from the Dragon Capsule on Her Spacewalk. SpaceX image.

Because the Dragon has no airlock, the entire capsule and all 4 crew were exposed to the vacuum of space, and dependent on their new SpaceX suits to protect them. Thus, all 4 crew were participating in the spacewalk. Only 2 of the crew, Commander Jared Isaacman and Mission Specialist Sarah Gillis, performed EVA activities, however.

Each one emerged from the spacecraft in turn, using the Skywalker to do so. Special measures were taken to protect them from space debris during the flight. The nose cover of the Dragon capsule was positioned in the direction of forward motion relative to the spacewalker (prograde direction), to act as a shield against possible debris, and the timing and altitude of the spacewalk were selected to reduce the risk of encountering debris.

In early August, a Chinese Long March 6A rocket's upper stage exploded in orbit, creating a large new cloud of space debris that posed a significant risk to the Polaris Dawn mission. As a result of the increased risk, the Polaris Dawn launch time, orbital profile, and spacewalk altitude had to be strictly controlled to avoid encountering this debris. Since a piece of debris would strike at many times the velocity of a rifle bullet, even one small piece of debris striking the craft or the spacewalker could be disastrous.

Jared Isaacman's Emerges into Open Space SpaceX image.

Each of the two spacewalkers spent about 20 minutes outside the craft. During that time, they evaluated the movement of the space suit's joints, the span of reach they had with the suit on, the ease of moving using the Skywalker in different ways, and they had a few moments in which to enjoy the few and say a few words on the experience.

The spacewalks occurred while they were at altitudes between 200 and 435 miles above Earth. During the spacewalks, viewers on the ground were treated to views from the space walkers' helmets, the cameras on the capsule's nose cover, and from inside the capsule itself.

Sarah's spacewalk was supported by Anna inside the capsule, managing Sarah's umbilical cord and monitoring her condition, and Jared was supported similarly by Kidd.

The Violin Performance

On September 13th, Mission Specialist Sarah Gillis performed a musical number in space on violin which was combined with performances from around the world on the ground. This beautiful piece, Rey's Theme, composed by John Williams for Star Wars: The Force Awakens, was transmitted using Starlink satellite technology to get the highest audio fidelity possible. John Williams himself met with the crew prior to flight, approving of their use of his music and assisting them in preparing for the performance.

Sarah Gillis, Performing Rey's Theme in Orbit SpaceX image.

The performance itself recalls a piece of art that Elon Musk shared years ago, foretelling the nature of entertainment on the way to Mars aboard Starship, where he posited that the future colonists would be bringing their own talents and capabilities with them not only for technical needs in establishing a base on Mars, but also for their own betterment and enlightenment through art and music.

Violin Concerto Aboard Starship in Earth Orbit Artist's Concept shared by Elon Musk (to much media derision) in 2018.

Watch the full performance here (Seriously, ***watch this!***): https://x.com/PolarisProgram/status/1834557770374296010

Book Reading from Space

Like Isaacman's prior flight, Inspiration 4, this flight supported fundraising for the St. Jude Childrens' Hospital. As part of that effort, Anna Menon has published a children's book with all procedes from sales benefitting St. Jude's.

She performed a reading of the book from orbit, which raised awareness and funds for the hospital. During the reading, she is joined online by her husband and children on Earth.

Anna Menon Reading Kisses from Space in Space. SpaceX image.

The book, Kisses from Space, is available here:

https://t.co/uGm5pVJPGI

See the orbital book reading here: https://x.com/PolarisProgram/status/1834021877821661188

Meet the Crew

Polaris Dawn Crew, placing their mission patch sticker on the capsule simulator at SpaceX

Jared "Rook" Isaacman, Mission Commander

Previously flew as Inspiration 4 commander, and is CEO of Shift4, an electronic payment processing company. Founded Draken International to train pilots for military forces.

Scott "Kidd" Poteet, Mission Pilot

Retired Lieutenant Colonel with the USAF, former test pilot and Thunderbird, Mission Director of Inspiration 4.

Sarah Gillis, Mission Specialist

Lead Space Operations Engineer at SpaceX, and Manager of Astronaut Training. Planned to be a classical violinist, but NASA's Joe Tanner convinced her to get an aerospace education. She went on to assist SpaceX in designing the Crew Dragon, participating in early human-in-the-loop testing of the craft. She has trained all the astronauts who have flown aboard Dragon.

Anna Menon, Medical Officer

Lead Space Operations Engineer at SpaceX, former biomedical flight controller for NASA, currently serves as crew communicator and emergency response officer at SpaceX Mission Control.

Here is the Polaris Dawn mission website: https://polarisprogram.com/dawn/

First Polar Orbit Crew Flight: Fram-2

Fram-2 crew: Eric Philips, Jannicke Mikkelsen, Chun Wang, and Rabea Rogge. Fram-2 image.

Currently scheduled for Dec 2024, Fram-2 is a private crewed spaceflight that will be the first time that humans have gone into a polar orbit at an inclination of 90 degrees.

Previously, the highest inclination reached by a human was by Soviet Cosmonaut Valentina Tereshkova aboard Vostok-6, the first flight of a woman in space. Vostok-6 reached an inclination of 65 degrees from the equator.

No astronaut (or cosmonaut or taikonaut) has ever been able to see the Earth's poles directly, except for distant views by the Apollo astronauts when near the Moon.

Fram-2 is named after the polar exploration ship Fram, which traveled the farthest north and south of any ship in its time, and carried Fridtjof Nansen and Roald Amundsen on their polar journeys.

Sailing Ship Fram at sea. Fram is the strongest hulled wooden ship ever built, to stand up to the ice in polar regions. Fram Museum image.

Jannicke Mikkelsen is vehicle commander, and she is a videographer specializing in filming in extreme environments including space, underwater, and in polar regions. She was behind the science fiction film Stowaway and has been a pioneer in VR film technology. She participated with astronaut Terry Virts on the One More Orbit circumglobal flight as a payload specialist.

Rabea Rogge will be the first German woman in space when she makes this flight, serving as a mission specialist.

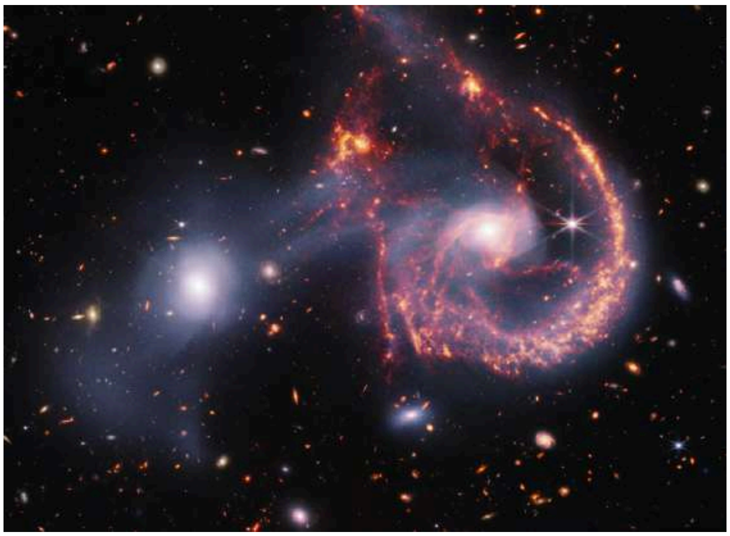
Chun Wang is mission commander, and is providing primary funding for the mission. He is a cryptocurrency billionaire and entrepreneur, born in China and now living in Malta.

Eric Philips will serve as vehicle pilot, and is an Australian polar explorer who, along with Jon Muir, was the first Australian to ski to both the north and south poles.

The flight is scheduled to take place near the winter solstice in December to provide the best possible views of Antarctica during the mission. The mission duration is expected to be 3 to 5 days.

Additional information on the flight's objectives and crew is available on the FRAM Museum website: https://frammuseum.no/blog/2024/08/13/first-human-spaceflight-to-earths-polar-regions/

Webb Studies Galaxy Collision



This JWST image of an interacting galaxy pair known as Arp 107 had provided researchers with further information about the effects of galaxy collisions and mergers. The detail that JWST can achieve with such images provides specific information on the results of the interaction to a very low level of detail.

In this image, we see the results of a collision by an elliptical galaxy (left) with a spiral galaxy. While the pair has been studied previously with the Spitzer Space Telescope (an earlier infrared scope, and one of the four Great Observatory space telescopes along with Hubble (visible light), Chandra (x-ray), and Compton (gamma ray) telescopes, never before has it been imaged in this degree of detail or with such contrast.

The JWST image shows the white chain of material that connects the two galaxies, previously unseen. It also shows the details of the star formation that the collision triggered in the spiral galaxy, occuring in the red and orange areas in this image.

Galaxy "collisions" are not physical collisions, because the stars that make up the galaxies are so widely spread that they do not collide with each other. However, the gravitational effects of one galaxy passing through another can create a "splash" effect, such as is seen in this image, resembling a material collision.

Close-up of the "splash" region in the Spiral Galaxy. NASA/STScI image.

The gravitational effects of galactic interactions will usually start a chain reaction of star formation wherever there is gas an dust available to form stars. Spiral galaxies typically have large quantities of gas and dust available to form new stars, whereas elliptical galaxies tend to be older and have very little remaining gas and dust free in space that can create new stars. Normally elliptical galaxies will tend to "redden" as they age, with brighter, more short lived stars dying while more long-lived red stars continue their stellar lives.

Sometimes an elliptical galaxy can pick up gas and dust from an interaction with another galaxy, causing a new round of star formation in an otherwise aged galaxy.

Arp 107 is at a distance of 465 million light years in the constellation of Leo Minor (the Little Lion, between Leo and Ursa Major.)

Visit the JWST website for the full story, here:
https://webbtelescope.org/contents/news-releases/2024/news-2024-132

IN THE SKY THIS MONTH

Please also refer to the sky map on the last page of the newsletter.

The Moon:
New Moon, October 2nd
1st Quarter, October 10th
Full Moon, October 17th
Last Quarter, October 24th
New Moon, November 1st

Comet Tsuchinshan-ATLAS. NASA image.

Comet Tsuchinshan-ATLAS starts the month in the pre-dawn sky, then rises into the evening sky after spending a week behind the Sun. At the start of the month it will be visible briefly before dawn very low in the eastern sky just before sunrise. It will be difficult to catch it in the brief time between when it rises and the bright sunshine of the rising sun washing out the sky. Its peak brightness is projected to be on October 5th, somewhere between magnitudes 0 and 1, when it is even closer to the Sun.

It will be very difficult to catch the comet on this date, though binoculars and a good sense of where it lays in the sky will help, along with a clear eastern horizon in the predawn sky. [Ed: In my attempts to date, low clouds have always blocked the comet even if the rest of the sky was clear.]

The comet will begin to appear in the dusk sky starting on October 11th. For the first few days it will be similarly difficult to see in the light of the setting sun, but it rises rapidly away from the Sun into the night sky. By the 15th or 16th it should be well away from the Sun and visible low in the west-southwestern sky after sunset. Unfortunately, the comet will also be dimming rapidly during this time, coming off its peak brightness. Once again, binoculars and a finder chart will help you see it. One found in binoculars, it will be easier to make out by eye.

The comet should be visible, though dimmer, throughout the month as it makes its way from Virgo through Serpens and Ophiuschus.

Even though the possibilities of seeing the comet at its brightest are slim, keep an eye on it as comets frequently have sudden, unexpected brightenings.

A finder chart for the comet is at:
https://in-the-sky.org/findercharts.php?obj=CK23A030&duration=28

The comet can also be followed on the Comet Observation Database (COBS) for current news and information from other observers:
https://cobs.si/comet/2410/

Saturn reached opposition last month, and will remain bright this month as the showpiece of our October sky. Now visible high in the evening sky at dusk, it will be setting at about 1:30am at month end.

Saturn will reach a conjunction with The Moon on October 14th, with about 3.5 degrees between them. Fortunately Saturn will be bright enough to stand up to the Moon's glare at magnitude 0.7, but most of the rest of the sky will be washed out.

The rings will appear ever narrower as tim moves toward next March's ring-plane crossing, when Earth moves through the plane of Saturn's rings, making them appear to disappear briefly.

Look forward to this event next March 23rd, and enjoy the enhanced view of Saturn's satellites during the time that Saturn's rings aren't so bright.

Saturn finder chart:
https://in-the-sky.org//data/object.php?id=P6

Astrophotographer Damian Peach's guide to observing Saturn:
https://www.damianpeach.com/sat_best.htm

Venus is our evening star this month, rising slowly higher into the dusk sky through the course of the month. It brightens slightly over the course of the month, going from magnitude -3.9 to -4.0. It will be in a gibbous (more than half-full) phase through the month, diminishing slightly toward half as Venus is in a tail-chase with Earth, coming up from behind us as we both go around the Sun.

Venus online finder chart:
https://in-the-sky.org//data/object.php?id=P2

Neptune is in the evening sky at sunset, in Pisces near Cetus, the Whale. At magnitude 7.7 it takes binoculars or a telescope to see it, but when seen at any magnication from 20x and above it will appear to be non-stellar. It usually shows a blue or green extended starlike appearance, depending on the quality of the sky, and at magnifications over 100x it can show a disk.

Neptune finder chart:
https://in-the-sky.org//data/object.php?id=P8

Uranus and Jupiter are at opposite ends of Taurus, with Uranus in the body of the Bull, near the Pleiades, and Jupiter between the horns of the Bull. Uranus rises first, at about 9pm at the start of the month, and 6:30pm at month's end. Jupiter rises at about 10pm at the start of the month, and about 8pm at month end.

Uranus shines at magnitude 5.7 this month, making it a good target for binoculars or a small scope. The wide field view of binoculars may be able to capture both the Pleiades and Uranus in the same field of view.

Jupiter is magnitude -2.6 as it brightens, and shows a disk that's a massive 44 arcseconds across. Sharp images from refractors or long focal ratio reflectors/catadioptrics should be able to pick out the bands and zones as well as weather patterns on the disk of Jupiter.

Jupiter will continue to get bigger and brighter through the year as it heads toward its opposition on December 7th, the date for our Starry Starry Night this fall.

Jupiter observing information:
https://in-the-sky.org//data/object.php?id=P5

Online finder chart for Uranus:
https://in-the-sky.org//data/object.php?id=P7

Mars coyly rises before midnight through the month due to Earth coming up from behind it in our orbits around the Sun this month. We will catch up with it and pass it in December. For now, Mars will remain a late night and early morning object at a bright magnitude 0.3. Its disk is 13 arcsec across, making it large enough to see large and medium sized surface features at medium to high powers.

Online observing information for Mars:
https://in-the-sky.org//data/object.php?id=P4

Mercury lays close to the Sun, setting before full darkness throughout the month. At the end of the month it may be possible to catch it low in the western sky at sunset. Binoculars will make it easier, but wait until the Sun is below the horizon.

Mercury online viewing chart:
https://in-the-sky.org//data/object.php?id=P1

Deep Sky October is an inflection month between the galactic core views we get in summer to views "forward" within the Milky Way that we get in winter. Summer objects are still visible early in the evening, with Winter objects rising later. Catch the Scorpion at sunset and Orion before midnight this month. See the Lagoon and Trifid Nebulas and the Great Orion Nebula in the same evening!

More information on sky events this month:
https://in-the-sky.org/

Redshift--What's It All About?

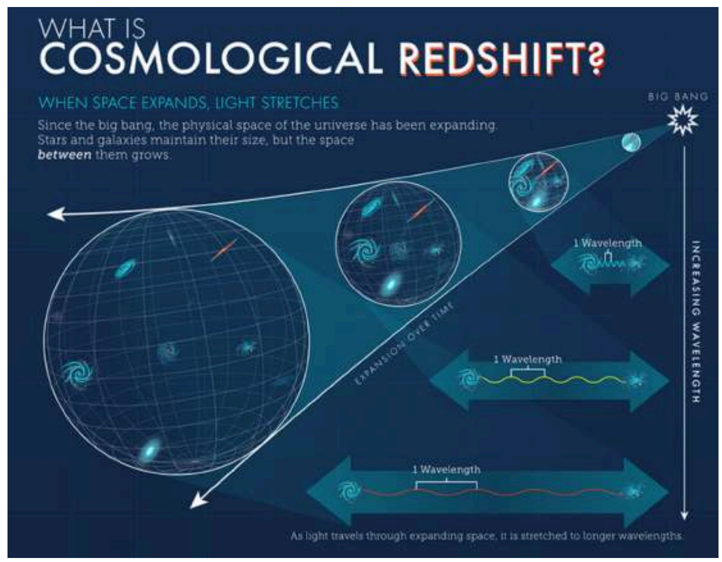
by LtCol Kenneth S Katta, USAF(RETIRED)

In the recent issue of *Sky and Telescope* (October 2024), there is an article on Redshift. It was an attempt to provide an understanding of what Redshift is and its significance to the field of Astrophysics. Redshift comes up frequently in reference to objects in the distant universe. I will attempt to provide a further explanation of the usefulness of Redshift in measuring distances to deep sky celestial bodies.

There are two different redshifts. There is the Cosmological Redshift and the Gravitational Redshift. A cosmological redshift is caused by the expansion of space itself, meaning as the universe expands, light waves from distant objects are stretched, causing them to appear redder, while a gravitational redshift occurs when light loses energy as it escapes a strong gravitational field, resulting in a shift towards the red end of the spectrum due to the influence of gravity; essentially, cosmological redshift is related to the overall expansion of the universe, while gravitational redshift is specific to the gravitational pull of a massive object like a star or black hole. Since the Cosmological Redshift has greater significance in the understanding of Cosmology and Gravitational Redshift is a consequence of the equivalence principle of General Relativity, I will focus on the Cosmological Redshift.

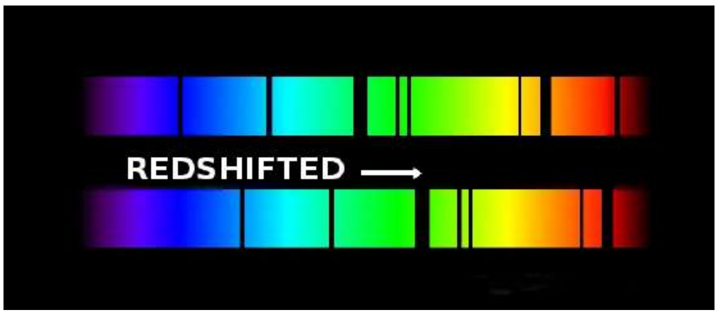
The Cosmological Redshift has to do with a change in the wavelength of a spectral line of light emitted by an body, such as a star. This observation is measured by a device called a spectrometer. This device takes a beam of light from the star and breaks it up into its individual wavelengths. The brightness of the individual wavelength line indicates its amplitude or intensity. But how is this related to Redshift?

You may have heard of the Doppler Effect. The Doppler Effect describes the change in the frequency an observer detects in a signal coming from a moving source. In 1842 the Austrian physicist Christian Doppler showed that as a source of sound moves through a medium, such as air, the wavelength is compressed in the forward direction and expanded in the backward direction. This change in wavelength of any type of wave caused by the motion of the source or the observer is called a Doppler shift. The important factor Doppler deduced was that the difference between the wavelength observed for a moving source of sound and the wavelength measured in the laboratory for a reference source at rest is related to the radial velocity, the component of the velocity directly toward or away from the observer. You may recall the siren of a police car passing you seems to decrease in pitch as it zooms by.



NASA Image.

Doppler correctly predicted that the phenomenon would apply to all waves and,in particular, suggested that the varying colors of stars could be attributed to their motion with respect to the Earth. Before this was verified, it was found that stellar colors were primarily due to a star's temperature, not its motion. Only later was Doppler vindicated by verified redshift observations. It was French physicist, Hippolte Fizeau in 1848 who noted the shift in spectral lines seen in stars as being due to the Doppler effect. In 1868, British astronomer William Huggins was the first to determine the velocity of a star moving away from the Earth by the method. The light from a star that's moving away from us decreases in frequency, which means its wavelength increases. Longer wavelengths are redder than shorter ones. Thus a shift toward the red (lower frequency) end of the Electromagnetic Spectrum is known as redshift.milarly, light from a star moving toward us would be blueshifted to shorter wavelengths. All the light from a source shifts redward or blueward by the same fraction. The relationships between wavelength and radial velocity is given in Figure 1. You can also see how wavelength is related to red shift, z.



Spectrum Lines Shifted Toward the Red End of the Spectrum. NASA Image.

But to determine the size of that shift you need precise measurements of specific known wavelengths of absorption or emission in the source's spectrum. This can be the spectral lines of the elements that make up the star or celestial body under consideration as measured in the laboratory. A comparison is made of the difference in wavelength position of that particular element from the star.

Although we can't directly measure the current proper distance of a galaxy, Redshift provides a means to determine this distance. But why is it necessary to know this distance? Redshift provides astrophysicists a means to determine the age of the Universe in addition to other parameters. Redshift is a measure of velocity. But redshift came to mean more than an object's velocity in the early 20th century just about when astronomers realized that the universe is expanding. The Cosmological Redshift has to do with the expansion of the universe while the Doppler Redshift has to do with the motion of the object in question.

It was determined that every distant galaxy appears to be speeding away from Earth, with more distant galaxies having a faster recession velocity than nearer galaxies. But it is the space between Earth and distant galaxies that's expanding. Thus a more distant galaxy has a higher recession velocity, and thus a higher cosmological redshift.

Arthur Eddington, British astronomer,physicist and mathematician, used the term “red-shift” as early as 1923. And Vesto Slipher, American astronomer, performed the first measurements of radial velocities for galaxies. Slipher was the first to discover that distant galazies are redshifted, thus providing the first empirical basis for the expansion of the universe. He was also the first to relate redshifts to velocity. Astronomers then realized the universe is expanding.

But it was Edwin Hubble's 1923 discovery of Cepheid variable stars in the Andromeda nebula M31 that allowed him to estmate its distance and size. And in 1929 Hubble announced he had found a roughly linear relation between redshift and distance. The linear relation between redshift and distance can be written in the form: $cz=H d$, where H is called the Hubble constant, z is the redshift, c is the velocity of light and d is the distance to the celestial object under consideration. T
he relationship is called the Hubble Law.

Hubble interpreted the observed redshift of galaxies as being a Doppler shift due to their radial velocity away from Earth. Because the values of z in Hubble's analysis were all small, $z<0.004$, he was able to use the classical, nonrelativistic relation for the Doppler shift, $z=v/c$, where v is the radial velocity of the galaxy. Hubble's initial result on the expansion of the universe was based on the observation of twenty-four galaxies. For each galaxy it was necessary to measure the velocity and the distance, so that the dependence of velocity on distance could be determined. The velocities were determined by careful measurements of the spectra of the light from the galaxies. The velocities of the distant galaxies were measured accurately by their redshifts. But determining the distances was much more problematic. Figure 1 illustrates the non relativistic relationship.

A variety of methods are used to measure distances, each appropriate to a different range of distances. The various methods have overlapping reimes of validity. So each method is used to calibrate the next in a sequence of steps called the cosmic distance ladder. But the uncertainties tend to compound with distance. This makes it difficult to estimate the uncertainties.

Equation for Redshift

The equation to calculate redshift (z) is:

$$z = \sqrt{\frac{1 + \frac{v_r}{c}}{1 - \frac{v_r}{c}}} - 1 = \frac{\lambda_{\text{observed}}}{\lambda_{\text{emitted}}} - 1$$

where:

v_r is the object's velocity toward or away from us

λ_{emitted} is the wavelength the object emits

$\lambda_{\text{observed}}$ is the wavelength astronomers observe

Figure 1- The nonrelativistic relation between radial velocity and redshift.

But using the distance ladder, Hubble measured distances of what was known then as extragalactic nebulae. They were later termed galaxies. The plot of the velocities and distance is shown in Figure 2. Hubble concluded from this data that the recession velocity of a distant galaxy as measured by the redshift is proportional to the distance. This plot shows that the universe is not static but expanding. It should be pointed out that a galaxy's recessional velocity is not due to its motion through space; instead the galaxy is being carried along with the surrounding space as the universe expands. A galaxy's cosmological redshift is produced by the expansion as the wavelength of the light emitted by the galaxy is stretched along with the space through which the light travels.It is important to realize that although the universe is expanding this does not mean that the orbits of planets are affected. Gravitationally bound systems, like the solar system, do not participate in the universal expansion. Therefore the sizes of planetary systems and galaxies have not changed because of the expansion of space.

But the universe hasn't always expanded at the same rate it does now. To understand the evolution of the expansion rate we can go backward in time using observations of stars, supernovae, or other standard candles, or move forward in time starting with the universe's first light-the Big Bang's afterglow that is now seen as the cosmic microwave background (CMB) which was discovered=.

In astronomy these standard candles are objects with known luminosity that can be used to measure the distance to other objects. They are used as rungs on the cosmic distance ladder as a tool for measuring the distance to galaxies. These standard candles are utilized for distances too large to measure using parallax. Light sources which are farther away appear fainter because the light is spread outy over a greater area. If we know low luminous a source really is, then we can estimate its distance from how bright it appears from Earth. The relationship is known as the inverse square law. The larger the distance, the smaller the power that we measure. There are several types of standard candles- Cepheid variable stars which are a special type of star with a luminosity which varies on a regular cycle which variability is closely linked to its luminosity, and Type 1A Supernovae which occur when massive stars explode at the end of their lives. Astronomers who turn to standard candles, may

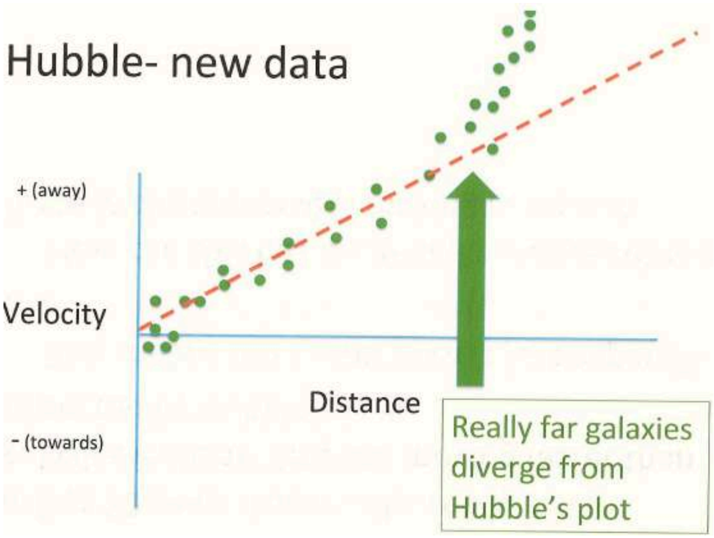


Figure 2- Recessional Velocity of Galaxies vs Distance with updated data.

observe the brightness of certain supernovae in distant galaxies. They know how bright these supernovae are intinsically, so they can determine how far away they must be in order to look as faint as they do. We can then connect their distances with their measured redshifts as seen in Figure 3. You can see from the plot that the redshift increases the fainter the star is which indicates it is further back in time.

But the expansion of space makes distance a difficult notion to define. Yet lookback time can be used as a proxy for distance. It tells us how old the universe was when the light we observe was emitted. While redshift and lookback time increase in lockstep for nearby objects, when we look farther out into the universe, changes in redshift correlate to smaller and smaller jumps in lookback time as shown in Figure 4. To see the universe's first light (CMB) emitted 380,000 years after the Big Bang would require seeing a redshift of about 1100. But even lookback time requires translating from redshift in a way that depends on our obserevations of the universe. However, the relationship between redshift and any measure of distance or time relies on a complete understanding of cosmic history that we will never acquire.

So professional astronomers generally prefer to use redshifts rather than distances or lookback times. Redshift is a quantity we can obtain straight from a galaxy's spectrum. It is observable and easily measured. It is a physical measurement that remains valid even if our cosmological theories are revised.

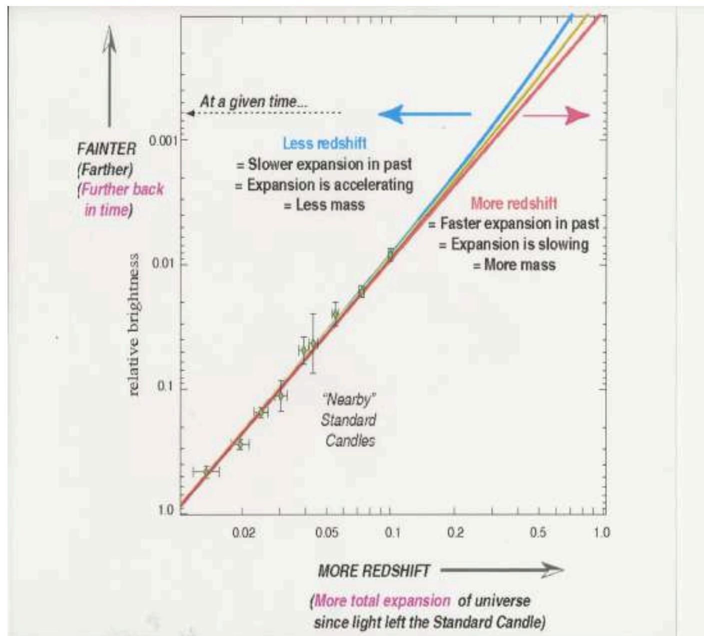


Figure 3-Plot of Relative Brightness vs Redshift

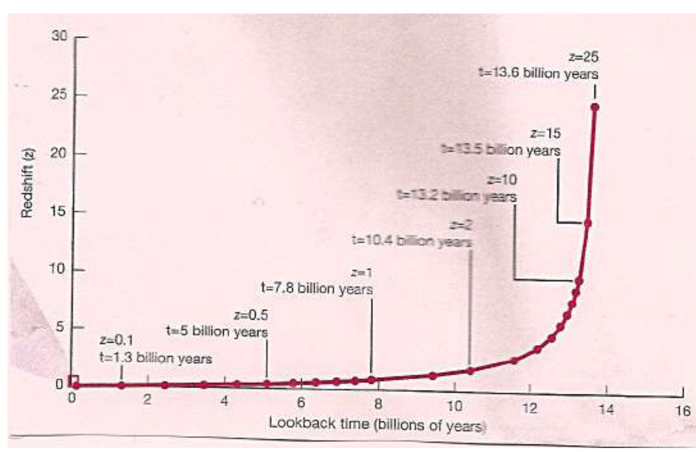


Figure 4-This plot shows the relationship between

redshift and lookback time based on the Hubble Constant (H)=69.6km/s/Mpc, matter density(Ω)=28.6%, and dark energy density(Ώvac)=71.4%.

Club Calendar

Yellow marks special events hosted by The Villages Astronomy Club
Blue marks events that are not hosted by The Villages Astronomy Club
Green Marks notable dates.

October 2024
2 EAA Meeting, 7:00pm
4 Exec Meeting 11am Fishhawk
7 Telescope Workshop 7:30pm/Space Academy 6:30pm
15 General Meeting, Maynard Pittendreigh--The Astronomical League, Laurel Manor 6:30pm
19 Fruitland Park Observing

November 2024
1 Exec Meeting 11am Fishhawk
3 DST Ends
4 Telescope Workshop TBA (7pm)/No Space Academy This Month (Elections in Studebaker Room)
6 EAA Meeting 5:15pm
16 Fruitland Park Observing
19 General Meeting: Drake Shepard, “Future Space Missions”, Laurel Manor 6:30pm

December 2024
2 Telescope Workshop 6pm/Space Academy 6:30pm
4 EAA Meeting, 5:15pm
5 Camp Geneva Star Party, ~40 kids expected
6 Exec Meeting 11am Fishhawk
7 Starry Starry Night, 7 day Moon, Sunset 5:24pm, Civil Twilight 5:54pm, Venus, Moon 38% sets 11:14p, Saturn, Jupiter. Observing 6:00 to 8:30pm Ever Everglades Rec Ctr
7 Jupiter at Opposition
14 Scout Leadership Star Party
17 General Meeting: Anne Holland, NASA Ambassador, “Comets, Asteroids, and Meteors”, Laurel Manor 6:30pm
21 Fruitland Park Observing

Club Calendar on the web:
https://vlgastroclub.org/calendar/

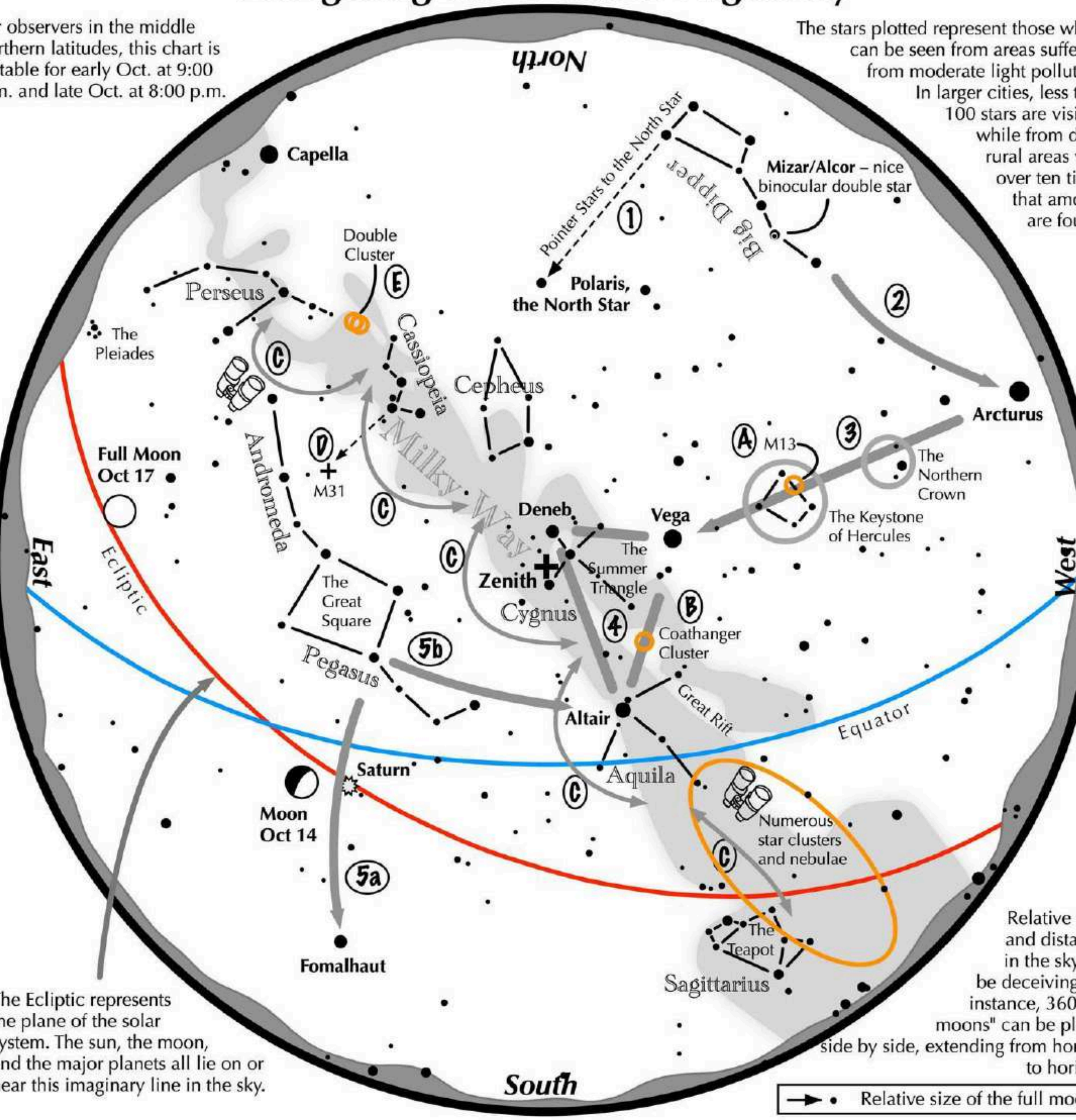
See Monthly Sky Chart Next Page

The Hidden Galaxy, by Craig Henry Seestar S50, 599 sub frames of 10sec, processed with Pixinsight and Windows Photo Editor. Labelled in GIMP.

Navigating the October Night Sky

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

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



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

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

Relative size of the full moon.

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

1 Extend a line north from the two stars at the tip of the Big Dipper's bowl. It passes by Polaris, the North Star.

2 Follow the arc of the Dipper's handle. It intersects Arcturus, the brightest star in the early October evening sky.

3 To the northeast of Arcturus shines another star of the same brightness, Vega. Draw a line from Arcturus to Vega. It first meets "The Northern Crown," then the "Keystone of Hercules." A dark sky is needed to see these two dim stellar configurations.

4 Nearly overhead lie the summer triangle stars of Vega, Altair, and Deneb.

5 High in the east are the four moderately bright stars of the Great Square. Its two southern stars point west to Altair. Its two western stars point south to Fomalhaut.

Binocular Highlights

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