VILLAGES STAR

Newsletter of The Villages Astronomy Club

Volume 6, Number 6
June 2025

Club Website:
http://vlgastroclub.org/

Facebook:
https://www.facebook.com/groups/vlgastroclub/

UPCOMING EVENTS

Space Academy, June 2nd, 6:30pm
Truman Rec Ctr, 2705 Canal St.

This month features a video by Sean Carroll on The Smooth Expanding Universe, as well as a speaker on Multiverses, and current topics in astronomy research. Presented by Ken Katta and JB Smith.

Observers' Workshop, June 2nd, 8pm
Truman Rec Ctr Pavilion, 2705 Canal St.

Learn to use your binoculars or telescope to see the sky! Get advice and guidance from experienced astronomers. Learn how to show the sky to the public, take advantage of accessories and techniques to make your observing more fun and more effective.

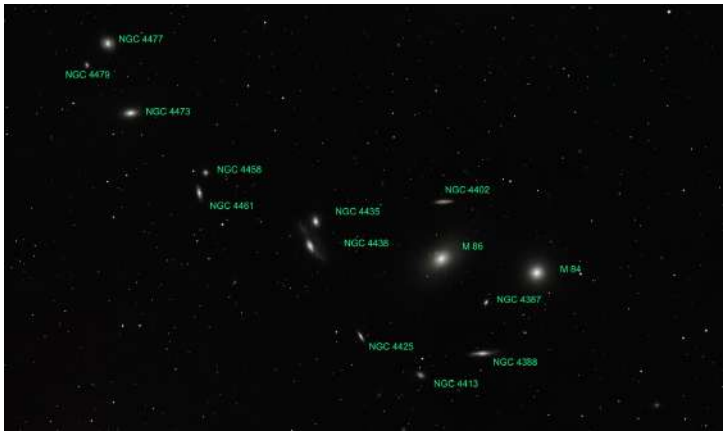
Your Club Officers & Directors

President	Mark Graybill
Vice President	Ken Katta
Secretary	Randy Gilbert
Treasurer	Linda Meng
Space Academy	Toni Graybill
Public Relations	Jeffrey Kahler, Sr.
Directors	Craig Henry
	Burt Salk, Bob Averitt

Newsletter Contact: saundby@gmail.com

Executive Directors' Meeting, June 6th, 11am
Fishhawk Rec Center, 2318 Buttonwood Run

All members welcome to our monthly planning meeting. This month we'll finalizing plans for Camp Villages, and be planning our fall speaker schedule and our winter/spring event schedule.



Markarian's Chain by member Craig Henry

General Meeting, June 17th, 6:30pm:
NASA Ambassador Anne Holland,
"Comets, Asteroids, and Meteors"

Join us at Laurel Manor Rec Center, 1985 Laurel Manor Drive, at 6:30pm for a presentation by NASA Ambassador Anne Holland on the composition and scientific importance of the small objects in our solar system and what they tell us about how it was formed, and what we do today to use what falls to Earth in science, and how we may protect ourselves from impacts.

Learn what each of these objects is made of, and how they differ.

Leesburg Library, June 19th, 4pm:
Telescopes and Astronomy. 100 E. Main St.

The Leesburg library will be kicking off its Library Telescope program with a presentation on

Telescopes and Astronomy. Our president, Mark Graybill, will be speaking on behalf of the Fruitland Park Astronomy Group at this event as the library initiates a program to allow local families to check out a telescope and learn to use it with support from telescope donor John Shaw, who will be supporting the telescopes for two Lake County libraries.

Fruitland Park Astronomy Group, June 21st, 5pm, 300 Shiloh Rd, Fruitland Park

Join us for an evening of observing and astronomy talk with the Fruitland Park Astronomy Group! Come to Cales Soccer Field in Fruitland Park, 300 Shiloh Road (at the corner of Shiloh Road and Dixie Avenue, north of the Fruitland Park water tower.) Enter on Shiloh Road (some GPS's will guide you to the Dixie Avenue entrance.) Gate opens at 5pm. We will stay as late as conditions permit and people are interested in observing. Bring power if required. You can set up off your tailgate.

Public is welcome to this event, no Villages ID required! Bring family and friends to view the evening sky with our astronomers!

Setting Up for an Evening's Observing in Fruitland Park. Image by Mark Graybill

Camp Villages, June 25th, 10am, Homestead Recreation Center

Volunteers will be providing a program on space and astronomy for Campers and their grandparents at Homestead. If you would like to be involved, contact Randy Gilbert or attend our Executive Directors' Meeting on June 6th to volunteer & learn our presentations.

EAA Meeting, June 25th, Homestead Astronomy Park, 8 pm, weather permitting.

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 Electronically Assisted Astronomy (EAA).

See Calendar at End of Newsletter, before star chart.

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

NEWS

Hubble Reaches 35th Anniversary

Image released to celebrate 35 years of Hubble Space Telescope. NASA image.

Launched on board the Space Shuttle Discovery on mission STS-31 on April 24th, 1990, Hubble is celebrating 35 years in orbit. A NASA page celebrating the 35 years of Hubble's operation in space has a picture gallery and e-book of images and information about Hubble that can be found at the following address: Hubble's 35th Anniversary - NASA Science

Hubble's Pre-History

In the early 1970s space telescope test missions, the Orbiting Astronomical Observatory 1, 2, and 3 (OAO-1, OAO-2 and OAO-3) demonstrated the usefulness of telescopes orbiting outside Earth's atmosphere for observations of frequencies of light that can't get through the atmosphere, and the clarity of images that can be achieved from space without weather, light pollution, or other earthly effects. OAO-1 lasted only 3 days before failure, but OAO-2 lasted beyond its 1 year mission, and OAO-3 lasted from 1973 to 1981.

Planning began in 1972 on the design of a new highly capable astronomical observatory that could be serviced by the Space Shuttle, then in design with plans for flight in 1976. The space observatory, called the Large Space Telescope, was planned to have a mirror 3 meters in diameter, and a chamber at its base that could be pressurised to allow astronauts to service the telescope in a shirt-sleeve environment. It would allow for multiple instruments to obtain data off the primary optics, with the ability to change out the instruments as well as the controls, batteries, and other support systems.

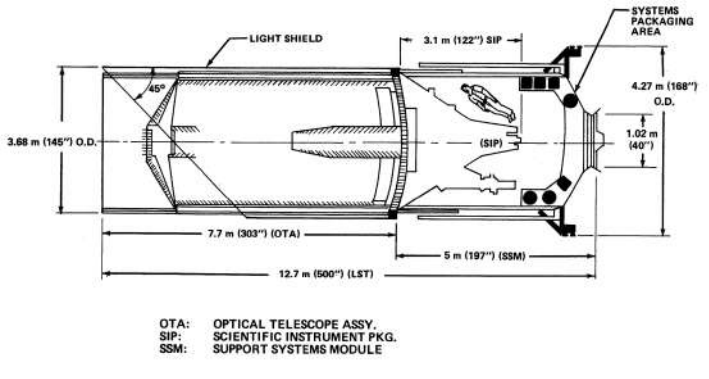


Figure IV-2. Basic LST elements.

Large Space Telescope, 1973, Note Docking Adapter at Rear. NASA image.

From https://ntrs.nasa.gov/api/citations/19730009723/downloads/19730009723.pdf

In 1974, however, all space funding outside of Space Shuttle and a few science missions was canceled, including funding for the Large Space Telescope. In 1977, the project was resumed with European participation after strong lobbying efforts from the astronomical community including personal meetings between astronomers and Congressional officeholders, letter writing campaigns, and a public campaign.

Plans for the pressurizable section were dropped in the new version during development, however, and eventually the mirror size was decreased to 2.4 meters to reduce overall mission costs. Not stated at the time was that this was done to take advantage of the same mirror production facilities that were used to produce optics for spy satellites.

Originally intended for launch in 1983, delays to the Shuttle Program pushed the first launch from 1976 to 1981, which also delayed the manifest of payloads. Finally, launch for the Hubble Space Telescope was set for October, 1986.

Disaster

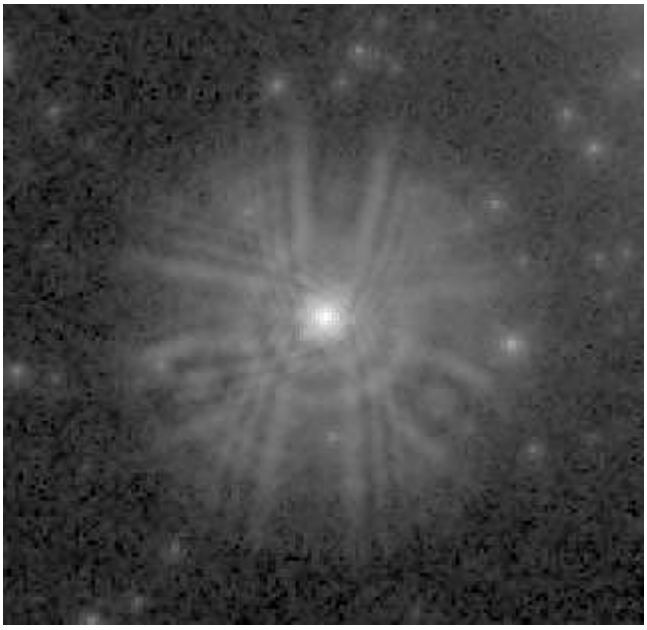
In January 1986 the Space Shuttle Challenger disaster occurred, throwing the entire launch schedule and future plans for Shuttle in disarray. The completed Hubble Space Telescope was placed into storage, adding significant cost to the mission even before its launch, as well as the need to re-test and re-check many of its systems before flight.

After Shuttle flights resumed, and many missions were moved off of the Shuttle to the newly resumed Titan and Atlas launch vehicles, Hubble was briefly considered for launch on a Titan 34D (a close relative to the Titans that the Large Space Telescope was intended to be launched on), but in the end, the changes that would be required and the high public profile of the mission meant that it should be launched on Shuttle.

The launch date was set for 1990. While the delay was disappointing, it gave developers time to complete the ground control software for

the mission, which even in 1990, was barely ready.

Disaster 2



Star Image from Hubble's Wide Field Planetary Camera (WFPC) after launch in 1990, revealing the severe distortion from Hubble's flawed primary mirror. NASA image.

After a widespread public relations campaign around the launch of Hubble, which had become NASA's most expensive science mission (a dubious honor that it still holds to this day), it became clear that Hubble's optics were flawed.

Analysis of star image which should have appeared as points of light with faint Airy Rings around them revealed that the outer part of Hubble's mirror was shaped improperly. It was too flat, by 1 part in 11000 of an inch. While this doesn't sound like much, its effect on Hubble's images was disastrous. The very expensive space telescope, whose costs had grown at each phase of development, construction, and launch, which had been billed as the best observatory ever built, produced images that were worse than those of far less expensive and more easily serviced ground observatories.

Investigation revealed that a testing instrument at manufacturer Perkin-Elmer had been improperly adjusted, resulting in the incorrect optical form of the main mirror. Further, a later optical test, called the "end to end test" which would have tested all the optics after assembly, had been cancelled to reduce program costs. That test would have revealed the flaw.

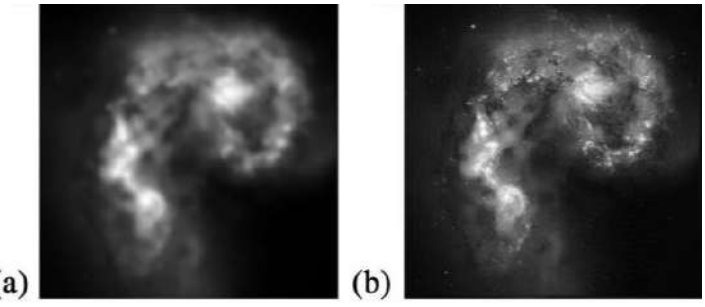
To add insult to injury, the backup mirror, produced by Kodak, had a correct form. If that mirror had been selected for flight, rather than the Perkin-Elmer mirror, the problem would never had occurred.

Overnight, Hubble became the public image of a failure. It was featured in late night talk show monologues, comedy films, and went from being a symbol of technical excellence to a symbol of incompetence and overexpensive technical overreach.

Recovery

The images were so poor that even many serious amateur astrononomer observatories were capable of obtaining better images, creating a terrible embarassment for NASA. But at least at first they were able to use software as a stopgap.

By carefully modeling the nature of the distortion of the images, they were able to write software that would correct the distorted images, providing at least some of the detail that Hubble should have been able to deliver. Called "deconvolution", they used digital filters applied to the images.



Hubble Space Telescope Image before (left) and after (right) deconvolution. These techniques are widely used in signal analysis and computer graphics today with commodity computers. Some classes in the techniques still use the original Hubble images as example projects.

While the process was computationally demanding at the time, it would be the only way to obtain decent images from Hubble until a plan could be produced to provide a hardware correction for Hubble's flaws, then obtain the funding and support servicing.

While the corrected images still fell short of Hubble's promise, and the rapidly growing capabilities of ground based telescopes, they at least allowed Hubble to perform scientifically useful observations toward its key objectives.

Servicing Mission 1

The first servicing mission to Hubble had been planned for 1993 even before its optical problems were discovered. But now greater pressure was placed on that mission to deliver a fix for Hubble as well as to correct any other issues with the telescope.

Having a mission already in work eased the discussion about whether to abandon Hubble as a failure or to repair it, but many in Congress and the scientific community were unsupportive, particularly in light of the advances in ground based observing, which was applying adaptive optics techniques after their declassification from military uses, allowing ground based observatories to produce images as sharp as those from Hubble, even after repair.

The mission would be do-or-die for Hubble.

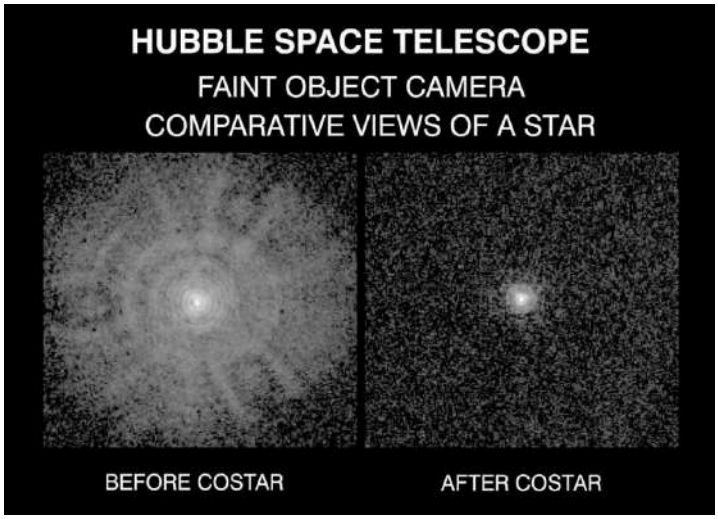
Kathryn Thornton guides COSTAR toward installation in Hubble while aboard the Remote Manipulator. Thomas Akers is at left. NASA image.

NASA's fix for Hubble involved replacing the High Speed Photometer instrument with a new device known as COSTAR, which would extend an optical corrector into the light path between the telescope's optics and most of its instruments to return the image to proper focus.

One instrument, the Wide Field Planetary Camera, was replaced entirely with its own corrective optics.

Other equipment had failed as well, complicating the servicing mission. Prior preparation for the mission had been intensive, including operational testing of spacewalk procedures, changes to the spacesuit gloves, changes to spacecraft illumination and attitude during repairs to manage heat, development and testing of over 100 new tools, as well as the repair parts themselves.

The repair mission launched on December 2nd, 1993, the crew replaced solar panel components, controller parts, swapped out the instruments, and returned to Earth on December 13th. NASA got to work, and one month later declared the repairs a success.



Images released after Hubble Servicing Mission 1 showing results of the improvements to Hubble's optics. NASA image.

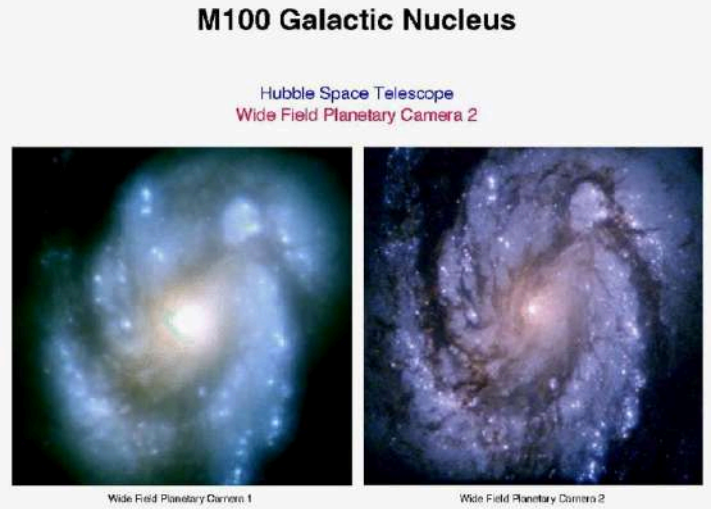
Getting Down to Science

Since the servicing mission, Hubble has been performing the breakthrough science it was built to do. Its days of being seen as a failure by

the public are so far behind us that few remember it any more. As it has aged, several times it has managed to avoid cessation of operations, either due to malfunctions or lack of support.

Some of the key science objectives that were studied early in Hubble's career were:

1. Determination of the Hubble Constant to 10%.
2. A Medium-Deep Survey of Intergalactic Space.
3. Study of the Intergalactic Medium.



Before and After Images of Galaxy M100. NASA.

Its study of the material in the space between galaxies would tell us about the density of matter in the universe, and the distribution of matter. This would help scientists understand the total mass of the universe, as well as whether the universe is an open system, that will expand forever, or a closed system, where the expansion will slow, stop, then begin to collapse.

The survey of intergalactic space was an opportunistic use of Hubble's WFPC2 while other instruments would be observing other targets. This would give views that presaged the later Deep Field images that would take an even deeper look at the cosmos and the distribution of galaxies.

To determine the Hubble Constant to within 10%, the Hubble Space Telescope was tasked with observations that would reduce the errors in calibrating the distances to remote objects used to measure distances in the universe. Different techniques are used for nearby galaxies versus remote galaxies. Hubble would be able to make higher precision observations of multiple objects to allow the scales between each to be correlated against each other.

At the time Hubble was designed, the Hubble Constant, that is, the measure of the rate of the universe's expansion, was barely constrained to within an order of magnitude. This is like having a speedometer that you can't tell if it's reading 10 MPH or 100MPH. The objective was to measure the Hubble Constant closely enough that that would be more like knowing the speed is somewhere between 45 MPH and 55 MPH.

This mission began even before the first repair mission. Hubble began using its fuzzy but fixable images to start finding Cepheid variables in galaxy M81, and measuring their periods and apparent brightness. These two numbers would give their actual brightness and actual distance, allowing us to get more accurate distances to M81 than ever before.

This would give us the distance to a galaxy outside the Local Group of galaxies with a high accuracy for the first time. The M81 Group is the closest galactic group to the Local Group of which the Milky Way is a part.

Hubble measurements of M81's distance: [HST Key Project Observation of M81 Cepheids - NASA Science]

In 1994, after the repair mission, Hubble moved its attention to M100, a galaxy in the Virgo Cluster, a more distant galactic group. [Hubble Space Telescope Measures Precise Distance to the Most Remote Galaxy Yet | STScI]

By building up a catalog of distances measured using Cepheid variables, Hubble was preparing the way for distance measurements using the other major way of measuring distances, a type Ia supernova. Unlike Cepheids, which are variable stars that shine continuously with varying brightness, supernovas cannot be

predicted (especially at intergalactic distances.) Rather, Hubble would build up distance measurements to nearby groups of galaxies, and when a type Ia supernova appeared in one of those groups, its distance could be measured because this type of supernova is always about the same brightness, so using its apparent brightness from Earth we can determine how far away it is by how much it has been dimmed by distance.

That measurement could then be compared with the Cepheid distance measurement to that galactic group, which could then be further refined by observing Cepheids in the specific host galaxy within that group, to give values from both measurements that could then be compared against each other and hopefully corrections to the distance estimation processes on both sides could be made to make them agree to within 10%.

Hubble went on to observe over 30 galaxies in 15 or 16 different galactic groups, depending on where some of the individual galaxies end up being relative to the galactic groups.

The Virgo Cluster of Galaxies. NASA/ESA image.

One of those galaxies was NGC 4639 in the Virgo Cluster, the galaxy that was host to SN 1990N. While Hubble was not able to make observations of the supernova itself and its light curve, ground telescopes had collected data, and Hubble was able to perform follow-up measurements of the galaxy to measure its distance using Cepheids. It conducted multiple observations of the galaxy from its launch to 1995 to refine its measurements. The measurements revealed that the Virgo Cluster was far deeper than previously suspected, spread over about four times as much space as thought.

Hubble Image of SN1994D in NGC 4526. ESA/Hubble image.

Finally, in 1994, Hubble Space Telescope had its first opportunity to observe a Type Ia supernova's light curve directly. In another galaxy in the Virgo Cluster, or, as was then determined, closer than the Virgo Cluster but aligned with it in the sky.

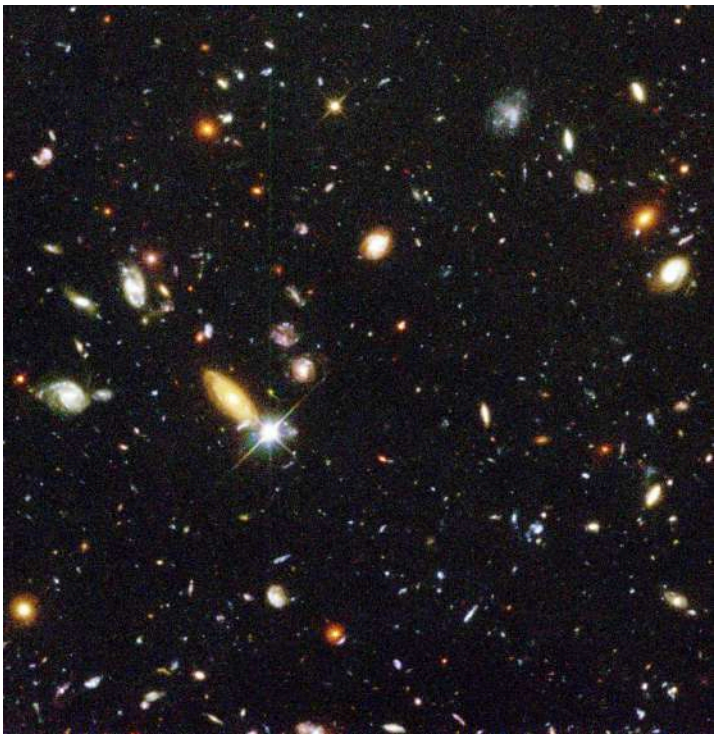
This gave scientists their first "zero point" measurement to align the distance scales between Cepheids and Type Ia supernovas. Here is a paper based on those observations: https://articles.adsabs.harvard.edu//full/1999A%26A...349..877D/0000885.000.html

Additional observations helped close the gap on the Hubble Constant. In 1990, when the Hubble Space Telescope was launched, the measurements varied from around 50 km/s per Megaparsec while others came in at 100 km/s per

Megaparsec. By the early 2000s, Hubble's data had reduced this uncertainty to 72 km/s per Megaparsec with an accuracy of +/- 8 km/s.

Thus Hubble was able to deliver on the first of its key missions.

Deep Fields



First Hubble Deep Field, 1995. NASA image.

Hubble's Deep Field images are now iconic views into the depths of the universe. They were, for many people, the first images that they saw that showed the vastness of the universe and the numbers of galaxies it contains.

The images also provide important scientific information, providing detailed images of large numbers of galaxies of different forms at different stages of their life, giving better understanding of how galaxies form and change.

Scientists had been skeptical of Hubble's ability to see galaxies that were not already visible to ground based telescopes, even among supporters of Hubble. In 1994, Robert Williams, director of the Space Telescope Science Institute, the organization that operates Hubble, decided to use discretionary observing time on Hubble under his control to produce a deep field image rather than wait for a proposal to come in, which would take time through approval, and then have the data held privately for a time after the observations and until publication.

So he started the project immediately, seeking an area of space that was free of galaxy clusters and intervening Milky Way stars, gas, and dust. It needed to be observable without interference from the Earth that Hubble orbits for long periods of time.

Finally, area area in Ursa Major that's about the size of a pin head held at arm's length was chosen, and the imaging campaign started. 342 images were taken over 10 days from December 18, 1995 to December 28th.

The result was the image at left, which shows many new galaxies that had never been seen by ground based telescopes. Scientists studied the image, and by using the individual color images that made up the final image, they were able to see which galaxies had the most reddened light, and were therefore oldest in the image. By doing so they identified galaxies that were farther, and therefore older, than any that had ever been seen before.

And thus the Hubble Space Telescope demonstrated its ability to perform its second objective, providing science with views deeper into the universe than ever before and populating the "Cosmic Zoo" with a wide variety of galaxy types.

The Intergalactic Medium

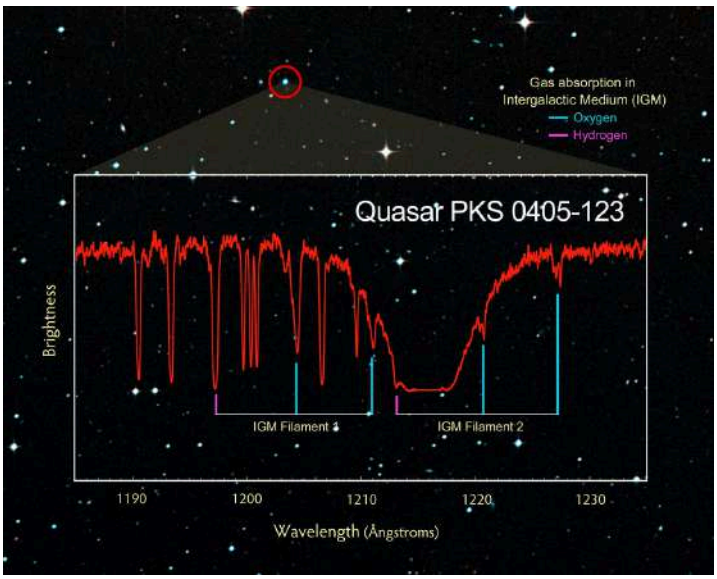
The final third of Hubble's Key Missions that led to its design and launch was its ability to answer open questions at the time about the nature of the space between galaxies, where was the "missing mass" that appeared to make galaxies rotate faster than they should, and how numerous were stars and other matter in the space between galaxies. No ground based instrument was able to obtain the necessary data, so part of Hubble's justification was to do this work.

This aspect of Hubble's mission has had less public attention, since it is performed using spectroscopy rather than through images. Hubble probes the space between galaxies by studying the spectra of quasars, which are bright and very distant. The effects of the space on their light between their host galaxy and our own gives scientists the insight they need into the space between the galaxies.

Two spectrographs were included in Hubble's original instrument suite, the Faint Object Spectrograph (FOS) and the Goddard High Resolution Spectrograph (GHRS). Both were replaced during the second servicing mission to Hubble, with the Space Telescope Imaging Spectrograph (STIS) assuming their duties.

The Faint Object Spectrograph can be seen in the National Air & Space Museum today: [Spectrograph, Faint Object, Hubble Space Telescope (FOS)]

Using its spectrographs, HST gave scientists their first looks at intergalactic "rogue" stars, discovered intergalactic clouds of hydrogen that absorb light between galaxies, and provided data on the Big Bang and forces that shaped the distribution of matter in the universe.



Graphic of Intergalactic Medium (IGM) Observations by Hubble Space Telescope. NASA/ESA image.

Quasar Absorption Lines at High Redshifts: https://www.stsci.edu/stsci/meetings/shst2/jannuzib.html

An Aging Hubble Space Telescope

Hubble has had five servicing missions during its life, lasting well beyond its original projected life thanks to continuous updates to its instruments and support systems.

The missions are numbered as 1, 2, 3A, 3B, and 4 because the third mission grew so large that it was split into two missions. This also allowed the STIS instrument to be removed, repaired, and reinstalled.

Astronaut Micheal Good works on Hubble during Shuttle flight STS-125, Servicing Mission 4 in 2009. NASA/ESA image.

Hubble has five instrument bays. Currently, four of the five instruments in its bays are still operational, with only the NiCMOS spectrograph offline since 2008. Hubble has had many of its systems upgraded that were never designed to be replaced.

Once work started on the James Webb Space Telescope, originally known as the Next Generation Space Telescope, the hope was that Hubble would last long enough for both instruments to operate at the same time, allowing cross-comparisons of their data, cross calibration of their instruments for improved data accuracy, as well as mutual observations in each space telescope's frequency band--Hubble in visible light and JWST in the infrared.

As JWST's own flight receded further and further into the future and Hubble's systems grew older and less reliable, it looked like that was becoming an impossible hope. But while it has gone offline a few times, and there have been many problems fought and overcome, Hubble made it. It lasted long enough for JWST to take its place in space beside it, and to perform observations alongside Webb.

Hubble Space Telescope. NASA/ESA image.

An Uncertain Future

Some things never change. Uncertainties over the future of Hubble seem to have always been there. Currently, there is no means for reboosting HST back to a higher orbit. Previously, the Space Shuttle was used to boost Hubble, to the highest points that the Shuttle ever reached. But Shuttle has been out of service for a decade, and Hubble's current orbit will only be stable for another couple of years.

Using a SpaceX Dragon to perform a reboost and possibly a servicing mission to Hubble to further extend its life has been proposed. NASA decided not to support such a flight in 2023, citing potential risks to the telescope and to astronauts. The proposed mission would have been privately funded by Jared Isaacman, currently nominated to be NASA's next administrator.

Hopefully, Hubble can be reboosted, at least, and possibly serviced one last time. That would allow its science to continue. And perhaps that would provide the time necessary for Starship to develop to the point where it could be used to return Hubble from space, so that it could be given a permanent home in a museum rather than left to fall back into the atmosphere and be destroyed.

Video:
Can SpaceX's Dragon Give Hubble New Life?

NASA has released a free ebook of Hubble images called Hubble's Beautiful Universe. It can be downloaded in PDF and EPUB formats here:
Hubble's Beautiful Universe - NASA Science

35 Years of Hubble Images, online gallery:
35 Years of Hubble Images - NASA Science

Starship Flight Test 9

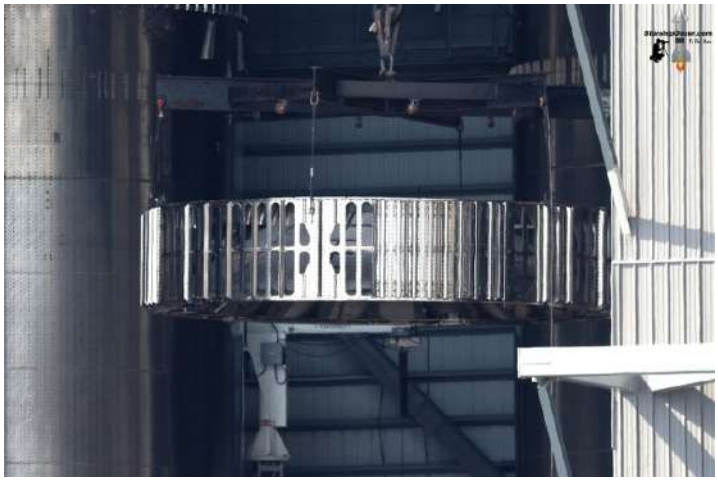
Starship launched into space successfully on May 27th, 2025 for its ninth flight test as a fully stacked vehicle. The flight features the first re-use of a booster vehicle, Booster 14, previously flown and caught on flight test 7. The booster included 29 previously flown engines out of 33, one of those making its third flight. This being its second flight, the Super Heavy booster bore the designation Booster 14-2.

At 7:37pm EDT the booster lit its engines to produce 16.5 million pounds of thrust, lifting off successfully with Starship 35 on top. The engines performed flawlessly, carrying the Starship to stage separation where it went on toward space.

The booster's own flight continued with a series of intentionally risky tests performed by SpaceX to improve the efficiency of booster recovery. Because of the nature of these tests, SpaceX did not plan to catch Booster 14 after this test, but expected to lose the booster to a hard landing in the Gulf.

The first of these tests was changes to the hot-staging ring, the protective cap on the booster that keeps it from being damaged when the Starship fires up its six engines while still attached to the booster. In the past, the pressure from the hot staging has caused the booster to flip in random directions relative to Starship and its return path to the launch pad.

The hot staging ring for this flight was modified to have some of the vent panels covered to control the direction of the flip by having Starship's engines give a push against the blocked panels. This would cause it to flip up, over and back, which reduces the amount of propellant required to return to the launch pad compared to flipping in other directions.



Booster 14-2 Hot Staging Ring. Image by @StarshipGazer on X.

The modified ring did its job, the booster successfully flipped up and over to begin its boostback burn toward the coast. While for this flight the intention was to not return all the way, this will provide a good start to later boostbacks of boosters that are caught by the launch tower.

As Starship 35 continued to fly toward

space, Booster 14-2 went into its next phase of return flight testing. It rotated in its flight path to provide a “high angle of attack”, turning more side-on to its direction of motion rather than flying end-on as it has done in the past. This gives it more aerodynamic resistance, slowing it faster and to a lower velocity.

Booster 14-2 flies back after its second launch, stressing itself in a deep dive into the atmosphere. SpaceX image.

If the vehicle could take the stress, it would again allow SpaceX to conserve propellant for a catch in the future. It seemed to take the unpowered part of the flight well. Next came the propulsive part of the test.

A shorter, more powerful burn would be another way to conserve propellant for a booster recovery, along with developing the ability of allowing a middle ring engine to cover for a failed center engine. Booster 14-2 fired its engines for the initial burn, and at this point the booster broke up, ending Booster 14-2’s flight.

SpaceX obtained a lot of data on the flight dynamics of the Super Heavy booster well outside the flight regimes tested to date. This will improve future boostbacks and catches of boosters.

Starship 35

Starship 35 is a new generation of Starship, known as Starship version 2 or Starship v.2. The Starships on flight tests 1 through 6 were all Starship v.1, and some of those were able to fly into space on a trajectory that allowed them to re-enter and perform soft landings in the Indian Ocean.

Flights 7 and 8 flew prior Starship v.2 models. Neither successfully made it to space and engine cutoff. Each one was lost shortly before engine cutoff, and re-entered over the Caribbean and Atlantic after being destroyed by their flight termination systems.

Flight 8’s Starship 34 re-enters over the Bahamas on March 6th, 2025. Image by @victoronx.

Despite the similar timings, SpaceX has confirmed that each failure was unique. Flight 7’s failure was caused by oscillations caused by

changes to the pipelines in the Starship v.2's propellant system, that broke late in the flight, causing a fire inside the rocket that led to its loss of control and eventual destruction.

Flight 8, however, had one of the three center engines on the Starship explode, knocking out the other two center engines and one of the outer vacuum engines. Since only the center engines are able to gimbal to control the angle of the spacecraft, the remaining two vacuum engines produced unbalanced thrust that caused Starship 34 to enter a tumble until its flight termination system destroyed it.

Starship's 6 engines. The smaller engines in the center provide guidance by gimbaling--moving to direct their thrust in one direction or another. The larger outer three do not move, but are more efficient in a vacuum thanks to their larger engine bells. Image by Elon Musk.

Flight 9's Starship 35 had design changes resulting from the two prior failures. Internal changes to supports and piping to prevent the oscillation problems of Flight 8, and extra protection around the engines to prevent one from damaging the others, as well as improvements to their installation to avoid the problems that led to Flight 8's explosion.

Now it was time for Starship 35 to prove that a v.2 Starship could make it to space.

Starship 35 coasts in space following SECO, Second Engine Cut Off. SpaceX image.

Starship 35 made it to space, surpassing flights 7 and 8. However, all was not well. A leak in the propellant system caused pressure drops that prevented Starship from using its attitude control system rockets, which use the same propellants as the main rockets, drawn off of gas at the top of the propellant tanks. Also, the leak was causing the spacecraft to begin to tumble.

SpaceX tried to perform some of its planned tests for space anyway, including opening the cargo door on Starship to launch 8 simulated new-generation Starlink satellites to test the delivery system for future flights. The simulators would have been intentionally put into a suborbital trajectory to let them re-enter without further action.

However, Starship was unable to open the cargo door more than a little bit. Whether this was because of ice caused by the propellant leak, stresses on Starship caused by the tumble, or other reasons is not yet known. SpaceX chose to

close the door completely.

As the leak and the tumble continued, a refire test of the Raptor engines in space was not conducted. This test is critical to allow Starship to go into orbit on a future flight, since it will need to refire its engines to de-orbit. In this case, SpaceX was likely concerned that the propellants were not settled in the tank properly, which could allow a bubble to enter the Raptor engines and cause an explosion.

The better approach to take without attitude control was to keep hands-off, allowing the vehicle to passively re-enter within its established hazard zone. SpaceX then commanded the ship to vent all its remaining propellant overboard to “passivate” the vehicle, to prevent an explosion on re-entry that could spread the debris over a larger area.

Starship 35 begins to melt and crumple during its last moments on re-entry. SpaceX image.

The Good and the Bad

While it was disappointing that Starship was unable to conduct many of the tests scheduled for this mission, most notably a test of its heatshield on re-entry, much new ground was broken with this test.

The first reflight of an orbital class rocket other than Falcon was accomplished, and valuable data toward improving the Super Heavy booster and its recovery was obtained. This information can not only be used on future boosters of the same class as Booster 14, but also in the design of the version 3 boosters, of which the first is under construction now for flight later this year.

For the first time, Starship version 2 made it to its engine cutoff in space. Unfortunately, other problems with the version 2 booster’s propellant systems prevented any other testing. With Elon Musk turning his attention back to SpaceX, we can expect rapid work and advancement on Starship soon.

IN THE SKY THIS MONTH

Also refer to the sky map on the last page.

The Moon:

1st Quarter, June 2nd
Full Moon, June 11th
Last Quarter, June 18th
New Moon, June 25th
1st Quarter, July 2nd

The Summer Solstice in June is a turning point of the year. The days go from getting longer to getting shorter. June 20th is the date of the equinox, with a day 13 hours and 59 minutes and 33 seconds long in The Villages. The latest end of evening twilight follows a few days later, on the 24th, and the latest sunset of the year falls on the 27th, at 8:31pm.

Binocular Highlight

Mercury enters the evening sky on June 6th, rising below Jupiter at magnitude -1.5. It continues to move higher each night, with a conjunction with Jupiter on June 8th. A pair of binoculars will catch the planets in the same field, separated by 3.7 degrees on the 6th, 3 degrees on the 7th, then at 2 degrees on the 8th, the

official date of the conjunction when Mercury passes north of Jupiter.

The time to view them will be limited each night, as they will set 25-30 minutes after sunset and the sky will not reach full darkness before they are gone!

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

Venus is a morning star this month, shining bright at magnitude -4.3. It reaches greatest elongation on May 31st (greatest distance from the Sun), rising at 4am. It will continue to rise at or before 4am through the month, standing high in the sky 2-1/2 hours before sunrise. It will be at half phase this month.

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

Mars is in Leo this month, visible starting at about 9pm and setting near 1am at the start of the month. At magnitude 1.4 it continues to dim as the distance from Earth grows. It will work its way toward the western horizon through the month, setting a bit earlier each night.

It will pass close to Regulus from the 16th to the 20th of this month, making a good view in binoculars or telescopes.

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

Jupiter starts the month low in the western sky at sunset, drawing nearer to the horizon with each passing day. At magnitude -1.9 it is still quite bright, but will be lost in the Sun's glare by mid-month on its way to its conjunction with the Sun on the 24th. It will reappear in the morning sky in July. Even when it is visible, this month and in July, views will be poor due its low altitude above the horizon. Views should improve in August, however.

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

Saturn is still near its ring plane crossing, and at an angle relative to the Sun where we can sometimes see shadows of its moons on its surface. On June 16th at 4:11am Titan's shadow will transit the surface of Saturn. The Villages is especially well positioned for this event, with Saturn high in the sky.

Saturn's rings now present their southern side to Earth, and will until the next ring-plane crossing. Presently, they are still at a low angle giving especially good views of the planet's surface.

Saturn will shine at magnitude 1 this month, and continue to rise earlier each night. Saturn will rise at about 12:30am at the end of the month, then enter the evening sky in July.

Saturn will have a **conjunction with Neptune** at the end of the month, with the two separated by about 2 degrees. They will be within 3 degrees all month, this would be a good time to see Neptune with binoculars using Saturn as your guide. See the finder chart at the following link to see where Neptune sits relative to Saturn on the night you're observing.

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

Astronomical League Solar System Observing Program: Solar System Observing Program - Astronomical League

Finding Clear Skies in June

Thunderstorms and evening clouds make observing a challenge in June. Clear nights are few or non-existent after sunset.

However, all is not lost during morning hours after midnight. Clouds will often clear as the air temperature falls after sunset, with dark skies most likely to be clear between 2am and 6am. If you want to see the summer constellations like Libra, Scorpius, and Sagittarius, early in the month will put them in the highest position in the sky, even after 2am. The Milky Way passes

through these constellations, up through Ophiuschus, Scutum, Aquila and Cygnus providing many bright deep sky objects for viewing or photography.

Outside the bright Moon on dates around full (the 11th), Virgo & Coma Berenices will be high enough to see their galaxy clusters.

If your schedule allows, the best times to see the sky at night in June will be in the early morning, during the darker phases of the Moon.

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

Attendees of the Camp Geneva Star Party on May 14th check out John Keller's Seestar 50.

Globular Cluster M3, 9 min. image by John Keller. Seestar 50 under so-so skies before full dark at Camp Geneva.

Club Calendar

Special events by The Villages Astronomy Club
Events not hosted by The Villages Astronomy Club
Notable dates with no event planned.

June 2025

2 Space Academy 6:30pm, Observers' Workshop 8pm
6 Exec Meeting 11am Fishhawk Rec Center
17 General Meeting 6:30pm, Anne Holland, NASA Ambassador, "Comets, Asteroids, and Meteors", Laurel Manor 6:30pm
19 Leesburg Library Telescope Check Out Program Kick-off: "Telescopes and Astronomy", Leesburg Library, 4pm
21 Fruitland Park Observing, 5pm, 300 Shiloh St. Fruitland Park
25 CAMP VILLAGES 10am, Homestead Rec Center
25 EAA Meeting, Homestead Astronomy Park, 8pm

July 2025

4 Exec Meeting: Drafting Additional Backup Officers at Round Table Meetings?
7 Space Academy 6:30pm, Telescope Workshop 8pm
15 General Meeting, 6:30pm, Round Table
19 Fruitland Park Observing, 5pm, 300 Shiloh St. Fruitland Park
23 CAMP VILLAGES 10am, Homestead Rec Center
24 EAA Meeting, Homestead Astronomy Park, 7:45pm

August 2025

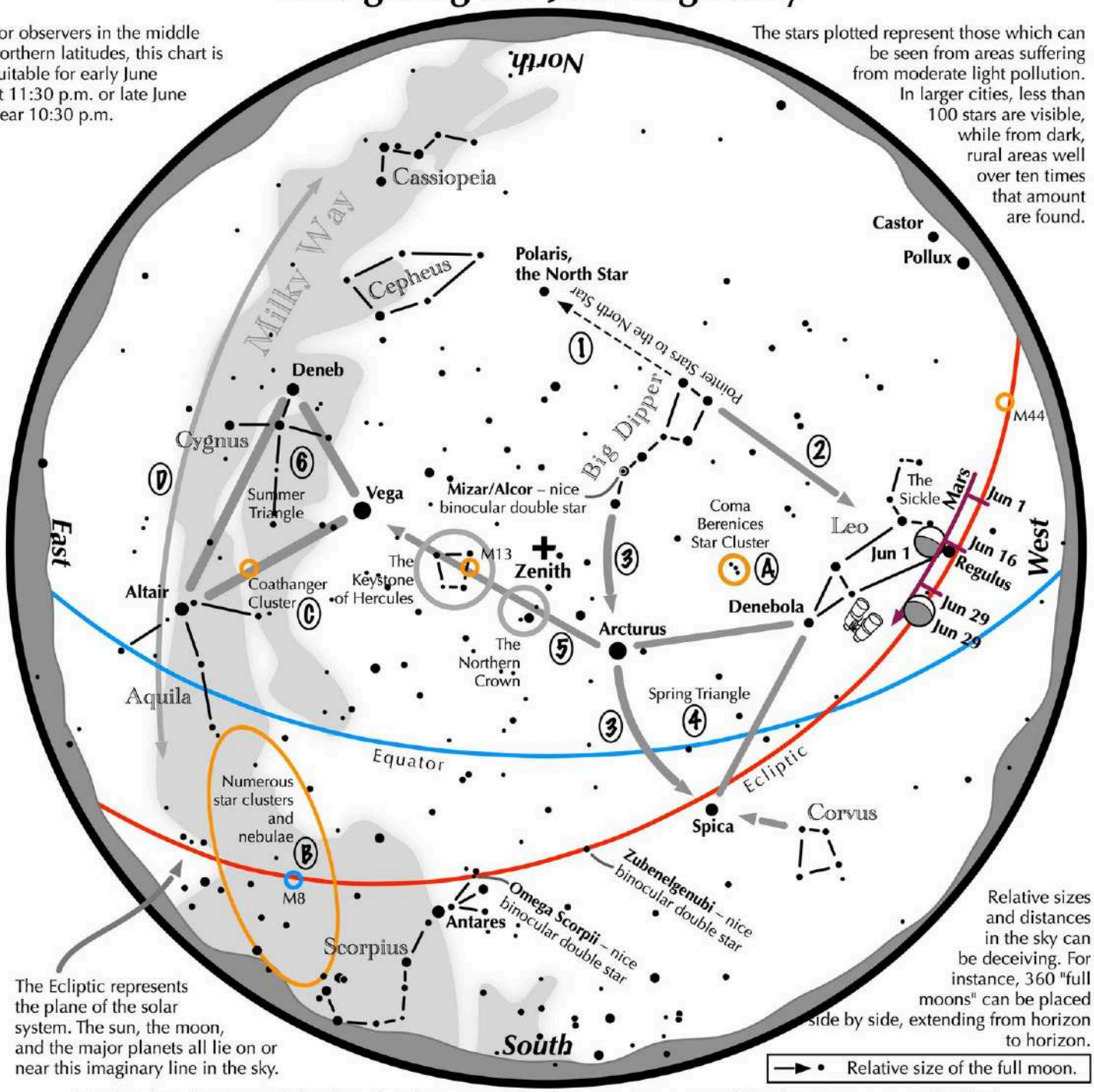
1 Exec Meeting, Fishhawk Rec Ctr, 11am
4 Space Academy 6:30pm, Telescope Workshop 8pm
16 Fruitland Park Observing, 5pm, 300 Shiloh St. Fruitland Park
19 General Meeting 6:30pm, Round Table: Resources
27 EAA Meeting, Homestead Astronomy Park, 7:30pm

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

Navigating the June Night Sky

For observers in the middle northern latitudes, this chart is suitable for early June at 11:30 p.m. or late June near 10:30 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 June 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. Draw another line in the opposite direction. It strikes the constellation Leo high in the west.
3. Follow the arc of the Dipper's handle. It first intersects Arcturus, the brightest star in the June evening sky, then Spica.
4. Arcturus, Spica, and Denebola form the Spring Triangle, a large equilateral triangle.
5. 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.
6. High in the east are the three bright stars of the Summer Triangle: Vega, Altair, and Deneb.

Binocular Highlights

A: Between Denebola and the tip of the Big Dipper's handle, lie the stars of the Coma Berenices Star Cluster.
B: Between the bright stars of Antares and Altair, hides an area containing many star clusters and nebulae.
C: 40% of the way between Altair and Vega, twinkles the "Coathanger," a group of stars outlining a coathanger.
D. Sweep along the Milky Way for an astounding number of faint glows and dark bays.