Skylights

Newsletter of the Astronomical Society of Northern New England

Sept 2020

Member of NASA's Night Sky Network

Astronomical League

ASNNE MISSION

ASNNE is an incorporated, non-profit, scientific and educational organization with three primary goals:

1) To have fun sharing our knowledge and interest with others.

2) To provide basic education in astronomy and related sciences to all who are interested.

3) To promote the science of Astronomy.

What's Up In September

By Bernie Reim

The month of September always marks the beginning of autumn for us in the northern hemisphere. That will happen on Tuesday morning the 22nd at 9:31 a.m. EDT this year. There are only two days each year that the sun will rise due east and set due west and this will be one of them. The other one is the vernal equinox half a year later.

Within a couple of days of the equinoxes the days and nights are exactly 12 hours long for everyone on Earth except for the poles. That is because we travel around the sun in a slightly elliptical orbit and we are tilted at 23.5 degrees now. However, that tilt is constantly and slowly changing over a 41,000 year time period. The maximum obliquity we reach is 24.5 degrees and the minimum is 22.1 degrees. It is currently diminishing towards the 22.1 degrees, which we will reach again in about 20,000 years. Without that tilt there would be no seasons and life on earth would probably never have evolved much past hunter-gatherer tribes because our climate would become stratified. If we did not have a moon no higher life forms may have evolved on earth at all since the gravitational forces between the earth and moon stabilize all those cycles along with creating stronger tides and good circulation in our oceans to make them suitable for life without getting too extreme.

The other two continually and slowly changing cycles that contribute to the formation and dissolution of ice ages are the changing eccentricity of our orbit around the sun over 100,000 years and the 26,000 year precession of the equinoxes. Those 3 together are called the Milankovitch cycles named after the Serbian engineer who discovered them in the 1930's. Right now our north star is Polaris but it will be Vega, the brightest star in the summer triangle in 13000 years.

We will soon get cooler and crisper nights that will make for great viewing of the night sky this month. There are many good highlights this month that include the four brightest planets all near their best for the year, Mars doubling in brightness to outshine Jupiter, a very close conjunction of the moon and Mars, and another comet close to Comet Neowise.

Jupiter and Saturn are already up before sunset and then Mars rises by 9:30 as the month begins and by 8:30 at the end of the month. Then Venus still rises about 3 am in Gemini in the winter hexagon each morning this month as it is getting farther ahead of us in our respective orbits. Mercury is the only one that can only manage a poor appearance towards the end of the month in the evening sky. Look for our first planet to pass within just one degree of Spica in Virgo, near where Comet Neowise was a couple of weeks ago.

Both Jupiter and Saturn end their retrograde motions this month and go back to their normal eastward treks across our skies. That will happen on the 12th for Jupiter and the 29th for Saturn. After that notice that Jupiter will be slowly closing the 8 degree gap currently between them. That will continue for the entire season of autumn and on the winter solstice they will reach their closest

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What's Up "*Continued from page 1*"

conjunction in about 400 years at less than one tenth of a degree apart, easily visible in the same field of view in a telescope. Usually each planet is quite a treat and a learning experience by itself, but just one season from now, they will look like a great double planet.

I recently showed these two showcase planets along with several other celestial favorites to a small group of people through my telescope. The moon was a slender crescent with earthshine and we saw about 10 Kappa Cygnid meteors over the course of a couple of hours. This is a minor shower and I did not expect to see any of them, so that was a nice surprise. We also saw several satellites, which were expected because they are now launching 120 new satellites every month, 60 at a time. Then we watched the Cygnus arm leading us right into the center of our Milky Way galaxy below Sagittarius and Scorpius slowly become more defined as the night got darker and remained crystal clear after the moon set soon after sunset.

Jupiter is about half as far away as Saturn and is 15 times brighter than the ringed planet. Jupiter is about half a billion miles away, or 42 minutes at the speed of light. They are both getting slightly fainter and farther away now, but they are still brighter and closer than usual since they are not too far past their oppositions.

Mars is a different story. The red planet will double in brightness this month to outshine Jupiter as it gets considerably closer and brighter as we rapidly catch up with it in our orbits. That will happen on October 6 of next month when Mars will reach a close opposition and rise right at sunset. You can already see some detail on the Martian surface in an average telescope and that will improve dramatically throughout this month and next as long as no planet-wide dust storms obscure its surface from view as often happens near its opposition because it is also getting closer to the sun. You can expect to see some dark markings on its surface, one or both of its polar icecaps, and even some of its thin atmosphere.

Watch carefully on the night of September 5 around 11pm as the waning gibbous moon will pass just half a degree below Mars. It will even occult the planet in Central America and parts of South America. The other nice lunar conjunctions this month are Venus and the moon on the morning of the 14th, Jupiter and the moon on the evening of the 24th, and Saturn and the moon the next evening.

There is another comet now that will be visible in our evening sky in Libra and Scorpius this month and next. It will not be as bright as NEOWISE was, but it should reach 9th magnitude by the 26th, when it will be at perihelion or closest to the sun for this orbit. It is called 88P/Howell and was discovered back in August of 1981 by Ellen Howell. It orbits the sun every 5.5 years, so it is nothing like NEOWISE which will not return again for nearly 7,000 years

Comet Howell was the target of a proposed NASA mission in 2017, but it did not make the cut. That was called CORSAIR, which stands for comet rendezvous, sample acquisition, investigation and return. We did successfully land a spacecraft named Philae, part of the Rosetta Mission, on Comet Churymov-Gerasimenko in November of 2014. Then we also smashed a probe named Deep Impact into Comet Tempel 1 on July 4 of 2005. It created a crater 150 meters in diameter on this comet and released a large dust cloud that was carefully analyzed to learn more about the nature of comets. It is ironic that comets have been hitting the earth for billions of years, but this is the first time that humans could actually hit a comet.

Sept 2. Full moon is at 1:23 a.m. EDT. This would normally be the famous Harvest moon if it occurred within 2 weeks of the equinox, but this one is too early and is therefore simply called the corn moon, similar to last month's moon, which was green corn or grain.

Sept. 3. On this day in 1976 Viking 2 landed on Mars. It was preceded by Viking 1 in July of that year. We had landed some earlier missions on Mars in the early 1970's, but they both failed. Only about half of the Mars missions were successful. 3 different ones were just launched this summer to reach Mars in early 2021. NASA launched Perseverance which will deploy the first Martian drone when it lands, which will be quite a challenge to fly in the thin Martian atmosphere, which is only about 1% of ours on Earth.

Sept.5. The moon and Mars will be less than half a degree apart in Pisces this evening by 11 pm. They will rise together and then get even closer. Mars will be occulted by the moon in some parts of the world.

Sept.9. Mars starts its retrograde or westward motion today.

Sept.10. Last quarter moon is at 5:27 a.m.

Sept. 11. Neptune will reach opposition in Aquarius tonight at 7.8 magnitude. It will be 4 hours away at the speed of light, which is nearly 3 billion miles.

Sept.14. The moon and Venus will be 5 degrees apart in the morning sky.

Sept.17. New moon is at 7:01 a.m.

Sept.22. Autumn starts at 9:31 a.m. EDT.

Sept. 23. First quarter moon is at 9:56 p.m. On this day in 1846 J. Galle discovered Neptune. It has only completed one orbit since then because it takes 165 years for Neptune to orbit the sun.

Sept. 24. The moon is near Jupiter this evening.

Sept. 25. The moon is near Saturn this evening.

Sept. 25. The zodiacal light will be visible as a faint pyramid of light in the east about two hours before dawn.

Moon Phases

Sept 2
Full

Sept 10
Last Quarter

Sept 17
New

Sept 23
First Quarter

Moon Data

Sept 2
Neptune 4° north of Moon

Sept 6
Mars 0.3° south of Moon

Moon at apogee

Uranus 3° north of Moon

Sept 14
Venus 4° south of Moon

Sept 18
Moon at perigee

Mercury 6° south of Moon

Sept 25
Jupiter 1.6° north of Moon

Saturn 2° north of Moon

OBSERVER'S CHALLENGE* – Sept, 2020

by Glenn Chaple

Veil Nebula – Supernova *Remnant in Cygnus (Mag: 6.9, Size: 3.5° X 2.7°)*

A few degrees south and slightly east of the 2nd magnitude star epsilon (ε) Cygni is a large wreath-shaped nebula known as the Cygnus Loop. Two of the Loop's brightest portions form what is more commonly known as the Veil Nebula.

William Herschel discovered the eastern part of the Veil on the evening of September 5, 1784 and captured its westerly partner two nights later. He catalogued them as H14 5 and H15 5 - the 14th and 15th of his Class 5 (Very Large Nebulae) objects. Today, they are identified by the New General Catalog designations NGC 6992/5 and NGC 6960, respectively.

The best way to find the Veil Nebula is to arm your scope with a low-power, wide-field eyepiece and point it towards the 4th magnitude star 52 Cygni. This yellow-orange K-type giant is a foreground star that lies near the center of the western Veil. Once you've spotted it, continue peering into the eyepiece as you gently nudge your scope about 3 degrees eastward and slightly north. The eastern Veil should come into view. Both portions of the Veil Nebula may be glimpsed with small-aperture scopes from dark sky areas. During the 1981 Stellafane Convention in Springfield, VT, I captured the western Veil with a 3-inch f/10 reflector and both eastern and western Veils with a 4 1/8-inch f/4.2 RFT (Edmund Astroscan).

More recently, I viewed the Veil from my backyard in suburban north-central Massachusetts (limiting magnitude 5.5). It was barely visible with a 4½-inch f/8 reflector and still faint through a 10-inch f/5 reflector. Both scopes needed an assist from an O-III filter and (even better) an Orion UltraBlock narrowband filter.

The Veil Nebula presents a variety of Observer's Challenges. It is said to be visible with the unaided eye with the help of an O-III filter and extremely dark skies. In his book Cosmic Challenge, Phil Harrington reports seeing the eastern Veil and (with difficulty!) the western Veil with 10X50 binoculars. Can you match these feats? Again, don't bother trying if you live in a light-polluted area. Owners of small-aperture scopes are encouraged to try their luck with the Veil. Having seen it with my 3-inch reflector, I'm going to challenge my observing skills by tackling it with a 60mm (2.4-inch) refractor. Mario Motta's close-up images of the eastern and western Veil reveal their complex filamentary structure. Can you capture this visually with a medium to large aperture scope?

Three portions of the Cygnus Loop not mentioned in this article are Pickering's Triangle, located a degree northeast of the western Veil, and NGC 6974 and NGC 6979, the most northerly portions of the Cygnus Loop. All appear in the accompanying wide-field image of the Cygnus Loop, taken by Doug Paul. What size telescope (and which filter) will give you a visual sighting?

The Cygnus Loop is a supernova remnant, the result of a supermassive star that suffered an explosive death some 5,000 to 10,000 years ago. Recent GAIA parallax measurements of stars imbedded in the Cygnus Loop gases indicate a distance of 2400 light years, suggesting a true diameter of 130 light years.

**The purpose of the Observer's Challenge is to encourage the pursuit of visual observing. It is open to everyone who is interested. If you'd like to contribute notes, drawings, or photographs, we'll be happy to include them in our monthly summary. Submit your observing notes, sketches, and/or images to Roger Ivester (rogerivester@me.com). To find out more about the Observer's Challenge or access past reports, log on to rogerivester.com/category/observers-challenge-reports.*

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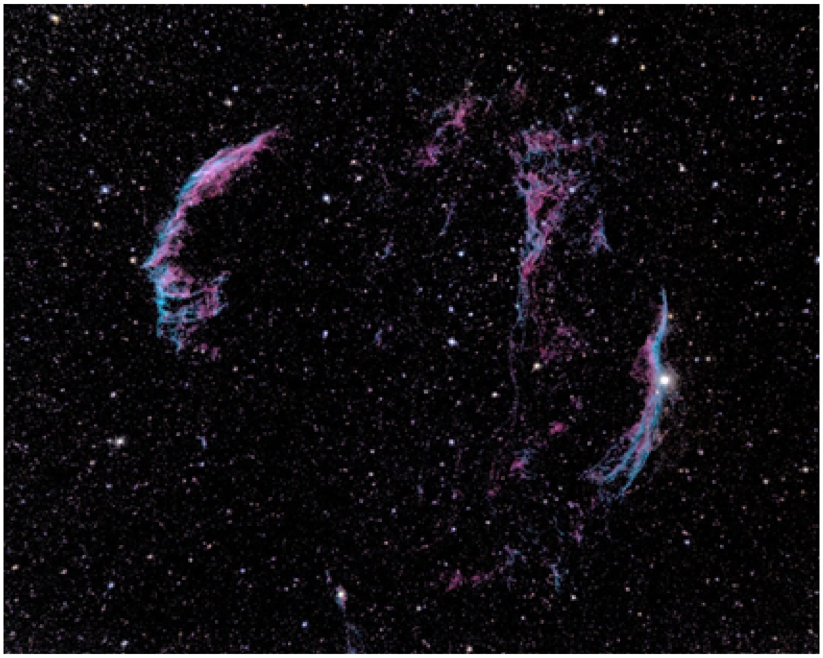
Finder Chart for the Veil Nebula

(Stellarium and Sky and Telescope)

Images of the Veil Nebula



Cygnus Loop Image by Doug Paul (ATMoB) taken with Canon 6D, 400mm f/2.8 (143mm (5.6 inch) aperture), ISO 1600, 51 subs x 2 min = 1.7 hr total exposure, 1/4 scale. North is up.

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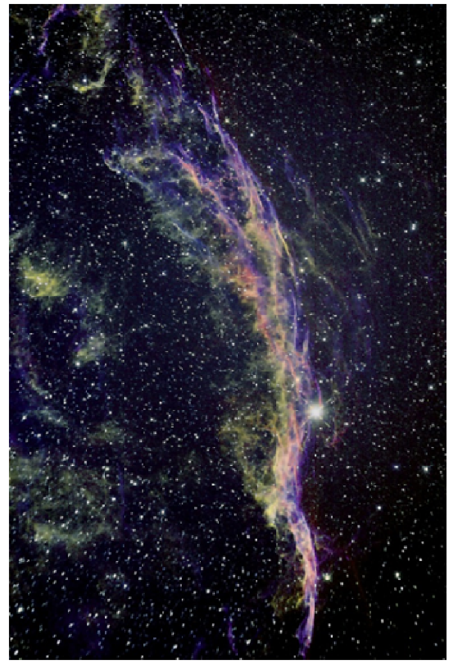
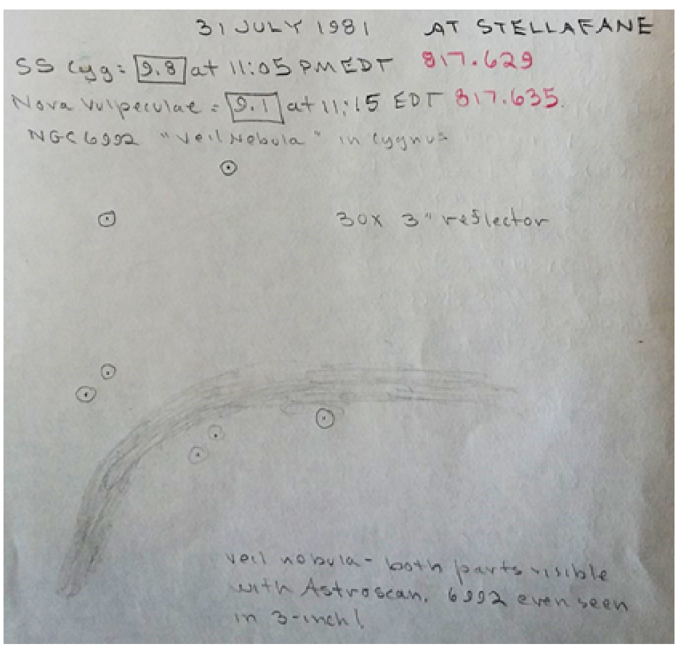
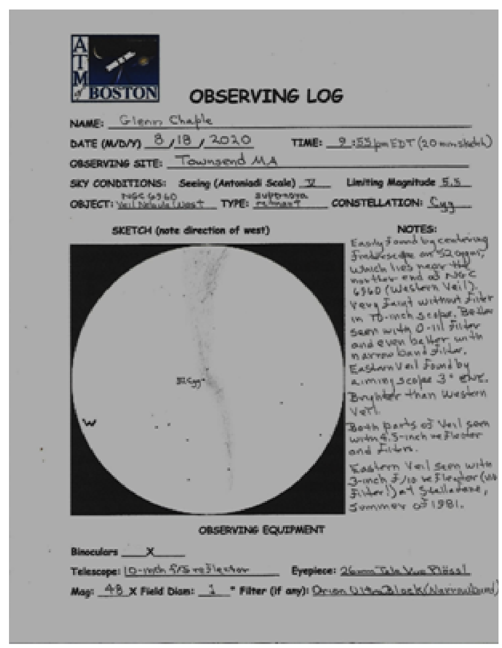


(L) Veil Nebula East (NGC 6992/5) (R) Veil Nebula West (NGC 6960) Images by Mario Motta, MD (ATMoB) taken with 8-inch F/8 RC; Veil East, 1.5 hours Ha, 1 hour each S2 and O3 filters; Veil West, 1 hour each of Ha, and O2, and 30 min S3 filters. North is up.





(L) Veil Nebula East, as seen with 3-inch f/10 reflector at 30X (R) Veil Nebula West, as seen with 10-inch f/5 reflector at 48X. Sketches by Glenn Chaple (ATMoB)

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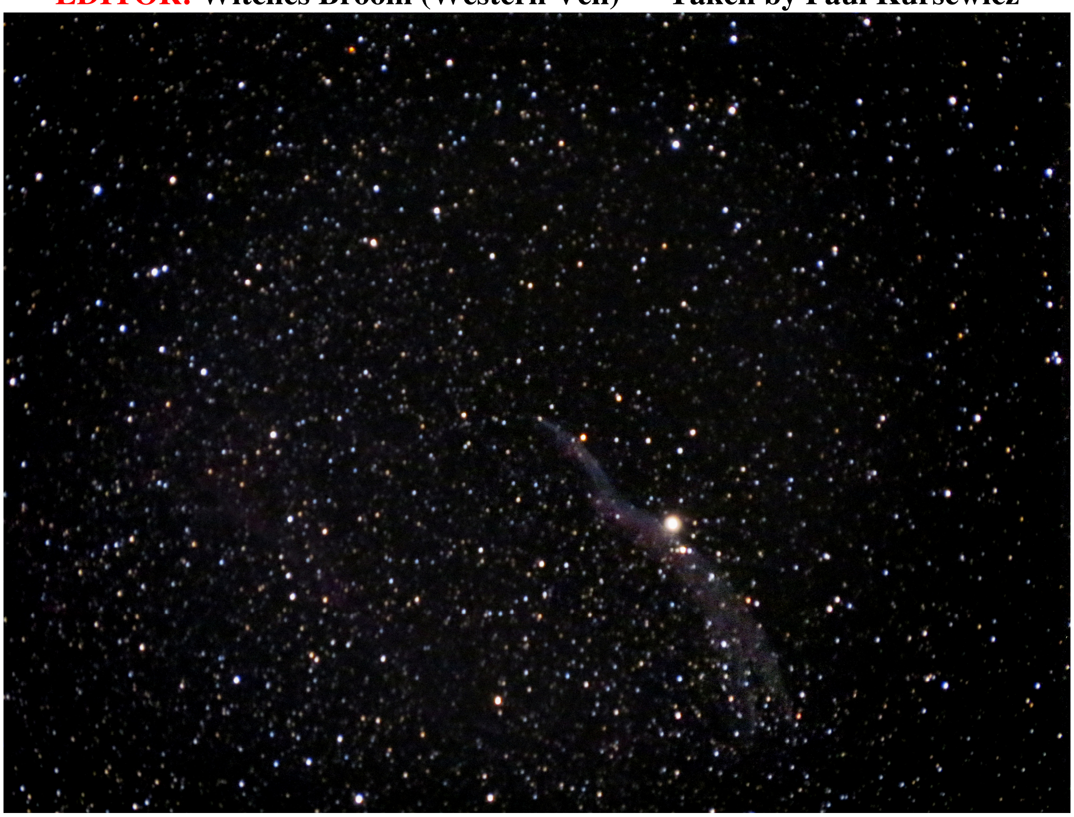
EDITOR: Veil Nebula — Taken by Paul Kursewicz

Canon Powershot SX50 HS, JPEG mode, FL 410mm, ISO 1600, 5 x 4 min each, 8-9-16.

EDITOR: Witches Broom (Western Veil) — Taken by Paul Kursewicz



Canon Powershot SX50 HS, RAW mode, f/3.5, FL 721mm, ISO 1200, 8 x 3 min 30 sec, 8-2-19

Principal Meteor Showers in 2020

January 4
Quadrantids

April 22
Lyrids

May 6
Eta Aquarids

July 30
Delta Aquarids

August 12
Perseids

October 9
Draconid

October 21
Orionids

November 9
Taurids

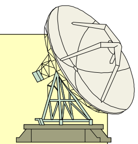
November 18
Leonids

November 26
Andromedids

December 14
Geminids

December 22
Ursids

Note: Dates are for maximum



Got any News?
Skylights Welcomes Your Input.

Here are some suggestions:

Book reviews -- Items for sale -- New equipment -- Ramblings -- Star parties -- Observing -- Photos.

Our Club has Merchandise for Sale at: **www.cafepress.com/asnne**



All money raised goes to our operating fund.
Any design can be put on any item.

Contact David Bianchi **dadsnorlax@yahoo.com** for further details.

RED ALERT — Downward Pointing Lasers

NASA is planning to use (or is already using) downward pointing lasers which are mounted on their spacecrafts. For those of us who look at the night sky through a telescope, or a pair of binoculars, this is a potential hazard. If a laser beam enters our instrument at the very time we are viewing, eye injury or blindness could occur. Contact physicist, Dr. Jennifer Inman, jennifer.a.inman@nasa.gov and tell her your concerns about this perilous issue. Why should we have to live in fear each time we look into a telescope or a pair of binoculars? This is unacceptable!

This article is distributed by NASA Night Sky Network

The Night Sky Network program supports astronomy clubs across the USA dedicated to astronomy outreach. Visit nightsky.jpl.nasa.org to find local clubs, events, and more!

Summer Triangle Corner: Altair

By David Prosper

Altair is the final stop on our trip around the Summer Triangle! The last star in the asterism to rise for Northern Hemisphere observers before summer begins, brilliant Altair is high overhead at sunset at the end of the season in September. Altair might be the most unusual of the three stars of the Triangle, due to its great speed: this star spins so rapidly that it appears "squished."

A very bright star, Altair has its own notable place in the mythologies of cultures around the world. As discussed in our previous edition, Altair represents the cowherd Niulang in the ancient Chinese tale of the "Cowherd and the Weaver Girl." Altair is the brightest star in the constellation of Aquila the Eagle; while described as part of an eagle by ancient peoples around the Mediterranean, it was also seen as part of an eagle by the Koori people in Australia! They saw the star itself as representing a wedge-tailed eagle, and two nearby stars as his wives, a pair of black swans. More recently one of the first home computers was named after the star: the Altair 8800.

Altair's rapid spinning was first detected in the 1960s. The close observations that followed tested the limits of technology available to astronomers, eventually resulting in direct images of the star's shape and surface by using a technique called *interferometry*, which combines the light from two or more instruments to produce a single image. Predictions about how the surface of a rapidly spinning massive star would appear held true to the observations; models predicted a squashed, almost "pumpkin-like" shape instead of a round sphere, along with a dimming effect along the widened equator, and the observations confirmed this! This equatorial dimming is due to a phenomenon called *gravity darkening*. Altair is wider at the equator than it is at the poles due to centrifugal force, resulting in the star's mass bulging outwards at the equator. This results in the denser poles of the star being hotter and brighter, and the less dense equator being cooler and therefore dimmer. This doesn't mean that the equator of Altair or other rapidly spinning stars are actually dark, but rather that the equator is dark in comparison to the poles; this is similar in a sense to sunspots. If you were to observe a sunspot on its own, it would appear blindingly bright, but it is cooler than the surrounding plasma in the Sun and so appears dark in contrast.

As summer winds down, you can still take a Trip Around the Summer Triangle with this activity from the Night Sky Network. Mark some of the sights in and around the Summer Triangle at: bit.ly/TriangleTrip. You can discover more about NASA's observations of Altair and other fast and furious stars at nasa.gov.

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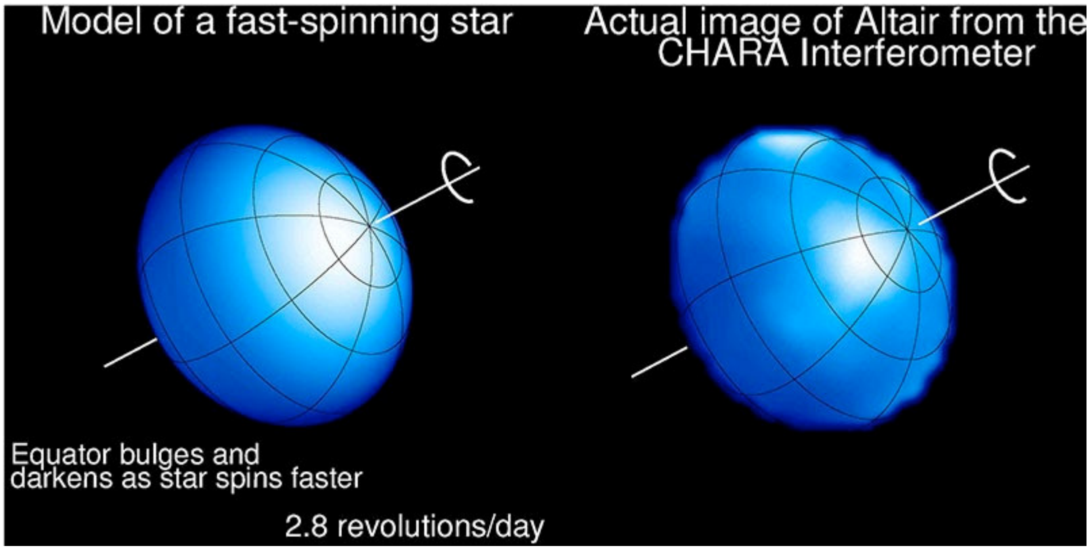
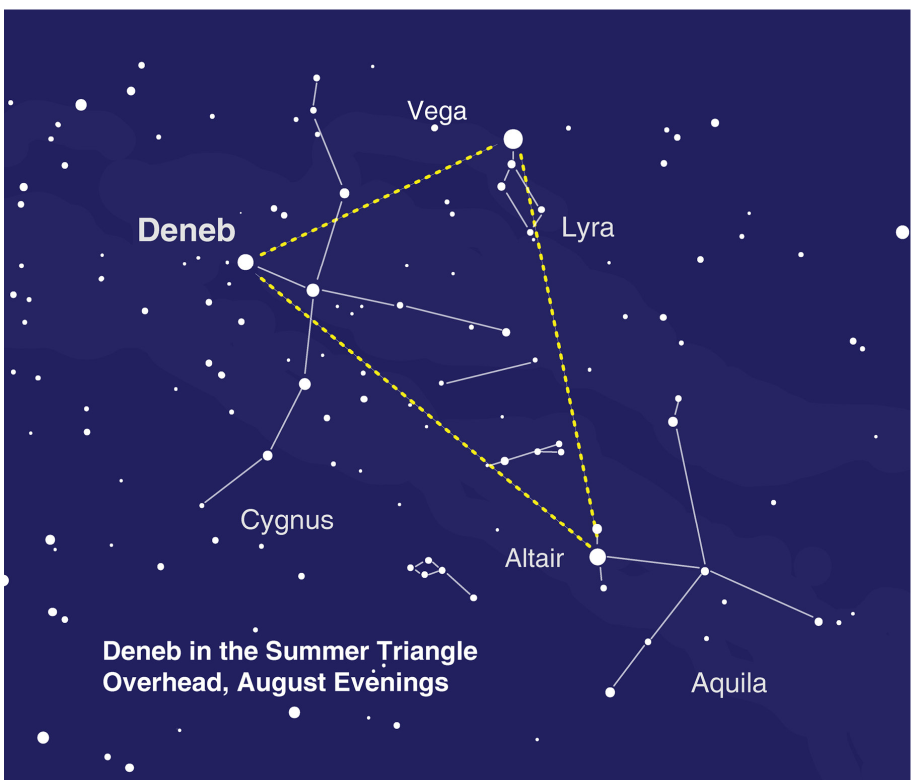


The image on the right was created using optical interferometry: the light from four telescopes was combined to produce this image of Altair's surface. Image credit: Ming Zhao. More info: bit.ly/altairvsmodel



Altair is up high in the early evening in September. Note Altair's two bright "companions" on either side of the star. Can you imagine them as a formation of an eagle and two swans, like the Koori?

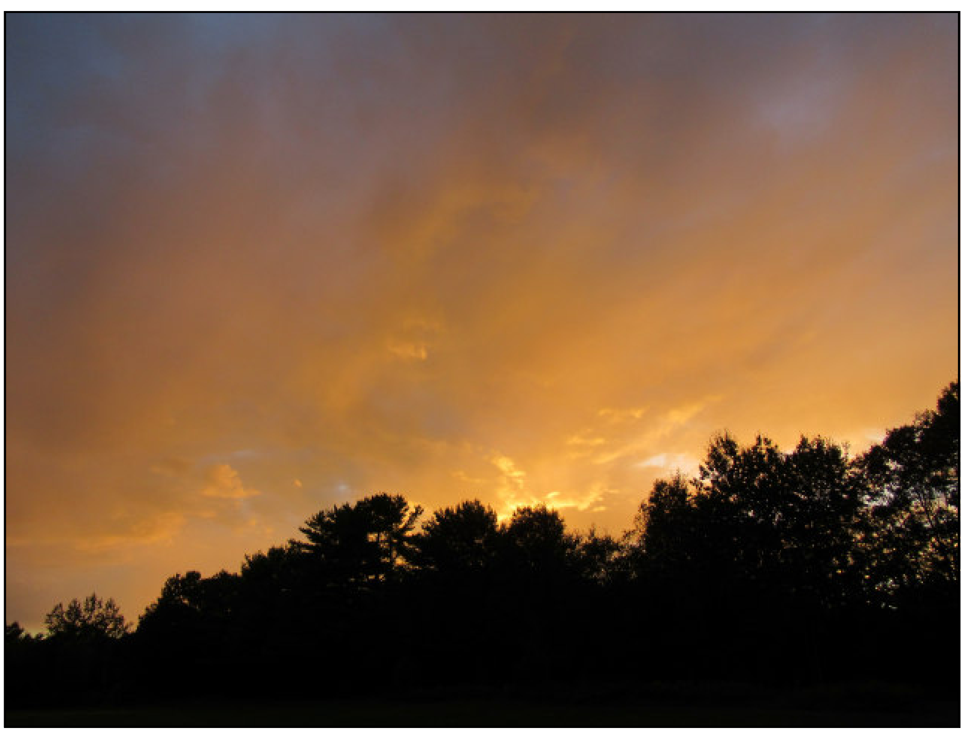
Point and Shoot Camera Astroimaging (no telescope)

Canon Powershot SX620 HS

Image & write-up submitted by Paul Kursewicz

Rainbow over Starfield 8-18-20. It was too big to take in with only one picture.

Sunset over Starfield 8-18-20



Satellite Constellations 1 Workshop

By Paul Kursewicz

The National Science Foundation's NOIRLab and AAS, with support from NSF, hosted a Satellite Constellations 1 (SATCON1) workshop from June 29 to July 2, 2020. The first two days were open to the public. So I registered, and was accepted to participate in the ZOOM two day workshop. There were over 260 participants: astronomers, satellite operators, dark-sky advocates, policy-makers, and other stakeholders and interested parties to discuss, understand, and quantify the impacts of large satellite constellations on astronomy and the human experience of the night sky. The goal is to work collectively toward effective solutions to mitigate those impacts and to publish them in a white paper. The following is my report and take-away from the workshop. I kept it as brief as I could.

Day 1, June 29: Reports of the Observation and Simulations Working Groups.

Observation Workshop:

The goals here is tracking satellites and predicting their positions; and obtaining accurate magnitudes of satellites no matter where their are in the night sky. To do that involves many different and complicated factors, too many for me to list here. So in brief, astronomers need to know exactly where the satellite is in the sky at any given time; how it's orientated, and its size. While some of this information can be had from the US Space Command, the most reliable information was obtained from SpaceX.

There are two possible methods for imaging satellites. One option is to track on the satellite and streak the background stars. This method results in higher sensitivity for detecting the satellite but requires a mount capable of accurately tracking a satellite which is difficult for fast moving (2 degrees per second) LEO objects. At this time this method has been abandoned, its too difficult. The second option is to track sidereally and catch the satellite as it flies through the FOV. This results in a streaked satellite. A streaked satellite image contains time domain information which shows how the brightness of a satellite changes over time. This is only a short time duration so it is not particularly useful for characterizing the reflectance of a satellite but can capture the change in brightness from a **specular glint**. Think of a glint as a flare. When a satellite flares it greatly increases its brightness, and this is extremely bad for CCD cameras. Astronomers need to know exactly when a glint will appear and then take the necessary precautions (if they can).

There are currently five individual astronomical observatories that are being used to track and image constellation satellites. Processing satellite images for photometric measurements presents a number of challenges. Depending on the observational method, either the satellite or the background stars will be streaked. Streaked sources complicate photometric processing and require either manual intervention or sophisticated algorithms to identify the streaks. One complication with streaked sources is overlap between sources and background sources. To obtain the magnitude of a satellite you need to compare it to a comparison star. This then gives the differential magnitude between the LEO (Low Earth Orbiting) satellite and the comparison stars, which in turn give the magnitude of the satellite.

Back in January SpaceX launched a satellite which they darkened. This was called **Darksat**. The objective of the observations was to measure the reduction in reflective brightness of Darksat as a function of wavelength. The observations were in coordination with astronomers observations, to obtain magnitude measurements of a standard Starlink LEO satellite and Darksat across a wide wavelength range, from the optical to NIR. As the chart below shows, the effectiveness of the darkening treatment reduces with increasing wavelength and both Darksat and STARLINK-1113 show increases in reflective brightness with increasing wavelength.

Starlink	Sloan g' Magnitude (475.4 nm)	Sloan r' Magnitude (620.4 nm)	Sloan i' Magnitude (769.8 nm)	NIR J-band Magnitude (1250 nm)	NIR Ks-band Magnitude (2150 nm)
1113	5.33 ± 0.05	4.88 ± 0.05	4.41 ± 0.04	3.93 ± 0.01	3.62 ± 0.02
1130 (Darksat)	6.10 ± 0.04	5.52 ± 0.07	4.94 ± 0.05	4.25 ± 0.01	3.87 ± 0.02

Table 1: *Normalised magnitude measurements of STARLINK-1113 and 1130 (Darksat). Sloan g' (Tregloan-Reed et al. 2020, A&A, 637, L1). NIR, Sloan r' and Sloan i' (Tregloan-Reed in Preparation).*

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Goals and Expectations:

The ultimate goal is to accurately measure the brightness of LEO satellites such as Starlink and determine what are the effects of particular **mitigation efforts**. To obtain accurate measurements more telescopes are needed. Involving citizen scientists could greatly increase the number and locations of telescopes. Amateur astrophotographers with high-end telescope systems should have little difficulty in imaging the Starlink satellites. In fact the smaller, but wider FOV telescopes commonly used by amateurs are better suited to image Starlink satellites compared to large professional telescopes.

Simulations Workshop:

This workshop was extremely technical and incorporated many charts, graphs, and math. So I will not be able to share detais here. Simulations of the visibility of various large satellite constellations have been done by six groups. They define visibility in a geometric sense as the satellite is above the horizon (or a given elevation) and in sunlight while the observatory is in darkness.

All simulations agree on the following conclusions:

● Only a small fraction of the satellites will be visible at any observatory at any one time, typically around 5%.

○ Higher altitude constellation shells will have a greater fraction visible (7-8%), lower altitude a smaller fraction (-4%).

○ Most of these satellites appear at low elevation over the horizon (typically 50% below 10deg).

● The number of satellites visible is a strong function of their orbital inclination, peaking at a latitude close to the inclination.

● Satellites enter the shadow of the Earth some time after sunset, and re-emerge some time before sunrise. While in the shadow, they are not visible.

○ Typically, about half the satellites visible are still illuminated at the end of the astronomical twilight. More for higher satellites, less for lower satellites.

○ Higher altitude constellations (say at 1200 km) will be visible longer past astronomical twilight and into the darkest part of the night. Some satellites from higher altitude constellations can be visible all night long in summer.

○ For any constellation at 550 km and higher, there will be satellites visible past astronomical twilight at any time of year. How long depends on altitude and time of year. ● The constellation with the greatest impact for any observatory in terms of the number of satellites visible will be one at higher altitude and with an orbital inclination close to the latitude of the observatory.

● For some constellation architectures at 550 km and higher, the number of satellites visible between nautical twilight (Sun at -12 deg elevation) and astronomical twilight (Sun at -18 deg elevation) is unchanged from the number visible at sunset. Falloff in the number visible does not occur until after astronomical twilight begins in some cases, particularly at elevations greater than 30 degrees. Yet this bright sky time is most important for Near Earth Object surveys (killer asteroids) and multi-messenger astronomy (gravitational waves), and detection of comets.

● The largest uncertainty in our simulations is the number of satellites being launched. Who is going to launch what, when, and where? Not all constellations have to submit public filings with the US Federal Communications Commission (FCC). Beside computing the global number of satellites visible over a specific altitude, it is also necessary to determine the details of their distribution over the sky.

Optical and infrared astronomy will be seriously impacted by the launch of tens of thousands of new bright satellites being launched over the next decade. The purpose of the simulations working group was to quantify the challenge to observational astronomy by estimating the number of such satellites, when and where in the sky they would be visible, and how bright they could be. According to detailed orbital plans filed with the US Federal Communications Commission (FCC) in 2020, three of the largest proposed constellations are from SpaceX (Starlink), OneWeb, and Amazon/Kuiper. If completed in full, the total of new satellites from these three constellations alone would be 85,488 satellites!

"Continued on page 13 "

Constellation	Altitudes (km)	Inclinations (deg)	# of satellites
Amazon/Kuiper	590 - 630	33.0 - 51.9	3,236
OneWeb	1200	40.0 - 87.9	47,844
SpaceX (Starlink)	328 - 614	30.0 - 148.0	34,408

Note that for the high-altitude OneWeb constellations there will always be satellites in the sky throughout the night. It is calculated that at mid-night 400 satellites are high in the sky and illuminated.

Day 2, June 30: Reports of the Mitigation and Metrics Working Groups.

Mitigation Workshop:

We report on efforts to mitigate the effects of low earth orbit (LEO) satellite constellations on optical astronomy research generally. Broadly speaking, mitigation options include fewer satellites, fainter satellites, smaller satellites, satellites visible in a smaller fraction of the night-time, high-precision satellite attitude information, improved scheduling capabilities for observatories, improved image processing capabilities, and novel sensors for the future.

The main recommendations of the Mitigations WG are:

- Darken satellites in all phases of the orbit, including launch, parking orbit, final orbit and decay.
- Darken satellites to >7th mag. Incorporate corresponding 44W/sr radiance in the satellite design process. 8th magnitude goal.
- Fewer satellites.
- Satellites on orbits as low as possible. No satellites at 1200 km.
- High accuracy orbit data.
- App for LEOsat position-time prediction for observers.
- Advanced algorithms for avoidance of bright satellites.
- Predictive model for satellite brightness vs orbit relative to observatory.
- Support for end-end simulations of broad science impact by research community.

With tens of thousands of LEOsats, we find that generally **no combination of mitigations can completely avoid the impacts of the satellite trails** on the science programs of the coming generation of optical astronomy facilities. These facilities are designed to probe the dark sky in new ways for dynamic events, very low amplitude and low S/N phenomena, and to unprecedented faintness. They will require fewer and fainter LEOsats to realize their scientific potential.

Crosstalk:

Because of the way that many CCD cameras in professional observatories are designed, a satellite streak in the field of view will create electronic Crosstalk. This crosstalk is unavoidable and has a multiplicative effect on the satellite streak, causing the bright linear satellite streaks to have sixteen faint "echo" streaks for every satellite trail in all affected CCDs. Mitigation for removing these “ghost” trails would require that the satellite be fainter than about 7th magnitude.

Darkening Satellites:

SpaceX darkened a satellite back in January 2020, called “**Darkstat**.” They actually painted the bright white surfaces (not the solar panels) with black paint. As a result, DarkSat was about 1 mag fainter than four bright siblings from the same launch, but still 0.9 magnitudes brighter than the 7th mag threshold. SpaceX has now abandoned this kind of darkening. Turns out that darkening of these white surfaces with black paint created internal heat and was messing up the electronics incorporated inside the satellite. And this heat was not the result of sunlight hitting the surface, but because of earthshine.

The next major trial for darkening a satellite was the launch of SpaceX’s **VisorSat** (Starlink-1436) which features, among other mitigations, a deployable sun shield that blocks sunlight from reaching the main satellite body. The VisorSat test satellite was launched on June 4th and is currently in the orbit raising phase to the parking orbit. So, no results yet on magnitudes.

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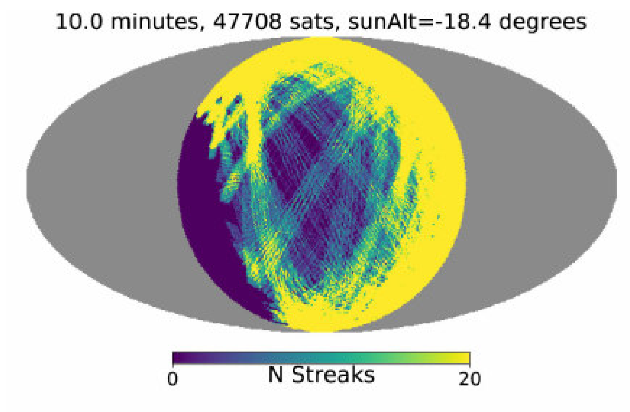
Laboratory measurements of LEOsats:

It is critical that satellite design include optical reflectance considerations from the beginning. We recommend that new LEOsat operators undertake a suite of laboratory BRDF measurements as part of their satellite design and development phase. This would be particularly effective if paired with a reflectance simulation analysis.



An alt-az plot of trails of 47,708 illuminated LEOsats over a 10 minute time period seen from Rubin Observatory. Zenith is at the center, North is up and East is left. The trails are bunched due to populating the orbital planes. The trail-free region (far left) is caused by Earth's shadow. Notice how small the windows are for viewing into space without Satellites crossing your path in a 10 minute period of time. Only very narrow imaging would prevail. Forget about wide-field imaging. Rubin Observatory is still under construction and nearing finish. It uses a "wide-field detector array." It will make a motion picture of the night sky over a 10 year period, reaching objects at 27 magnitude. It appears at this time that it's quest is in jeopardy.

Other Mitigations:

There are too many to be listed here in this newsletter. So, I will end it here.

Metrics Workshop:

The existing and planned constellations of communications and low-latency satellites in low-Earth orbit (LEO) fundamentally change the way astronomers can plan and execute observations. The condition that a given area on the nighttime sky can be observed without the passage of a sun-illuminated satellite will no longer routinely obtain. With tens of thousands of LEOsats, **no combination of mitigations can avoid the impacts of the satellite trails** on the science programs of the coming generation of optical astronomy facilities. Constellations at 1200 km can be visible all night, and will have negative consequences for nearly all observational programs. The purpose of this section is to provide some actionable metrics for the impacts and mitigation of those impacts from satellite constellations on astronomical observations.

Reflected Sunlight

The most common impact on astronomical observations will be the streaks of reflected sunlight imposed onto the focal surfaces of telescopes and instruments by the passage of satellites through the field of view during an exposure. Mitigations: Operators: Surface darkening, sun shielding, and possible attitude control consistent with power constraints to reduce effective reflectance. SpaceX Visorsat is the latest experiment to reach the needed limit, employing all three mitigation approaches.

Flares

Flares are specular reflections off of designed facets of the spacecraft. They can be many times brighter than the surface brightness limit above, leading to uncalibratable cross-talk or saturation. A usable astronomical exposure is incompatible with flare illumination. The expectation is that flares will be rare events. Mitigations: Operators: Potential to adjust attitude to avoid flares projecting along the ground track. Collaboration: Sufficiently accurate ephemerides of the flares themselves for pointing avoidance.

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Because of the length of this article I cannot cover everything in this workgroup. So I will limit myself here.

Scientific and Cultural Impact:

Depending on the number of satellites, their apparent brightness, and their orbital parameters, many astronomical research programs will be impacted severely enough to render them unfeasible.

Near-Earth asteroids and comets:

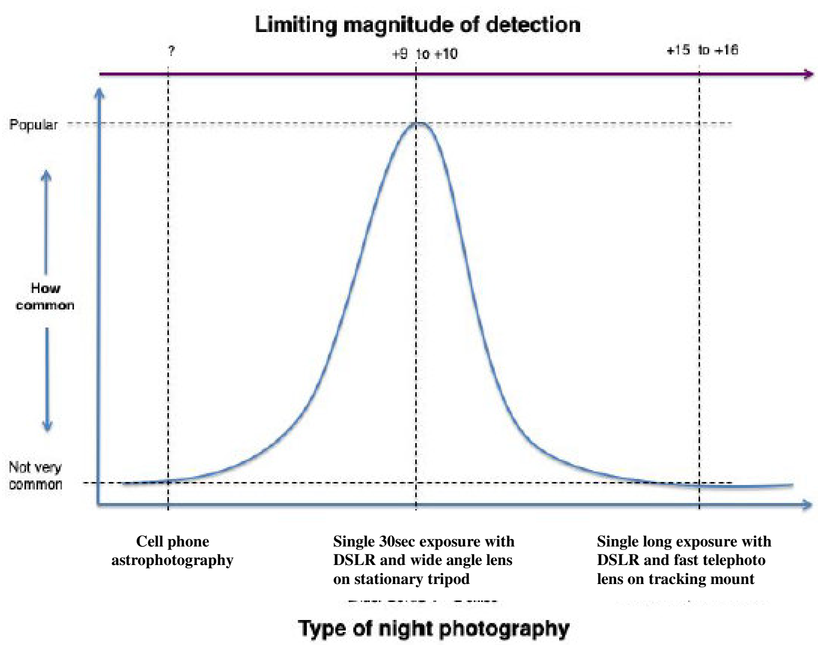
These surveys operate mostly in the twilight hours, when their targets are visible but also when satellites interference is the worst.

Concerns of the non-professional astronomy community and adjacent night-sky stakeholders:

This group of users of the night sky is impacted in ways that are as meaningful and significant as their professional counterparts. In addition to the scientific value of the night sky, there is cultural and social value that is difficult, if not impossible, to quantify in dollars. However, some of the same mitigation approaches that allay concerns of the professional astronomy community may well serve the interests of the non-professional user community.

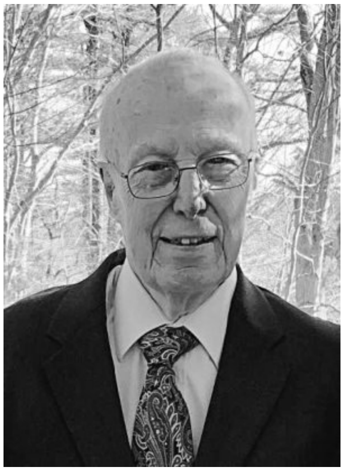
Wide-field astrophotographers:

Suffer the same problem as high-AΩ telescopes, albeit with considerably smaller apertures. A significant fraction of night photography is now done with wide-angle lenses that capture wide swaths of the sky. Also, most images are also created with relatively long shutter speeds ranging from 15-30 seconds for static cameras to many minutes on tracking mounts. Taken together, these two characteristics mean that visible satellite and airplane trails are already a nuisance in night photography. The current reality is that most night photography images will have a small satellite or airplane trail visible within them somewhere. And yet many night photography image opportunities are difficult or impossible to replicate, so asking photographers to just “try again” isn’t a particularly realistic solution.



For casual stargazers and people whose cultural and religious practices involve use of the night sky, a maintained brightness threshold at the limit of naked-eye detection for the majority of observers is sufficient. We recommend no brighter than visual magnitude +7 to be on the safe side, even though people with unusual visual acuity may see fainter, and the faint limit might be helped by atmospheric scintillation. This will of course not account for glints, although presumably that is a problem limited largely to twilight. However, I just learned that a mag +7 Sat at high altitude is more in focus, thus making it brighter, at +6 mag.

Obituary: Francis "Gerry" Gerard McAuliffe (ASNNE Club Member)



WELLS – Francis "Gerry" Gerard McAuliffe, 86, of Wells, formerly of Abilene, Texas, took his final flight from Earth on Thursday morning, August 20, 2020 at Frisbie Memorial Hospital in Rochester, N.H. He was born in Malden, Mass. on Sept. 4, 1933, the fourth son of John Walter and Amelia (Rose) McAuliffe.

Gerry graduated from Malden High School and attended Boston College. He entered the U.S. Air Force in 1954 and served his country for 20 years. Gerry was KC-135 tanker pilot and flew missions in the Vietnam War. Upon his retirement from the Air Force, he enrolled in McMurray College in Abilene, Texas, earning his bachelor's degree in accounting. For several years, he was an accountant for Pepsi Cola in Abilene. Following this, he became self employed as an IT specialist setting up computer systems. During his retirement, he was an active communicant of St. Mary's Church in Wells, where he served as the parish accountant for several years.

In his free time, he enjoyed astronomy, bass fishing, golf, and crossword puzzles. He was a member of the Astronomy Club and was a Hibernian. He became a late blooming "cat" person with the adoption of "Penny" who has been lovingly welcomed into his daughter's feline family

Gerry is predeceased by his loving wife of 63 years, Adrienne C. (Cluff) McAuliffe; two brothers, Eugene McAuliffe and Rev. Fr. Robert McAuliffe.

He will be lovingly remembered by his three daughters, Karen Robertson of Wells, Kathleen Smith and her partner Suni of Laguna Vista, Texas, and Kelli Spencer and her husband Louis of Benbrook, Texas, his two sons, Michael McAuliffe and his wife Sherri of Abilene, Texas and Kevin McAuliffe of Darien, Ga.; 12 grandchildren; and 15 great-grandchildren. He will also be missed by his brother, John W. McAuliffe of White Plains, N.Y.

A graveside service with military honors will be held on Tuesday, August 25, at 2 p.m. in Arundel Cemetery, Kennebunkport, with Rev. Fr. Fred Morse officiating.

To share a memory or leave a message of condolence, please visit Gerry's Book of Memories Page at http://www.bibberfuneral.com

Arrangements are in care of Bibber Memorial Chapel, 111 Chapel Road, P.O. Box 910, Wells, ME 04090.

Should friends choose, memorial donations in his name are encouraged to:

The American

Cancer Society

One Bowdoin Mill Island

Suite 300

Topsham, ME 04086

Club Meeting & Star Party Dates

Date	Subject	Location
September 18-20	**Starfest (Don’t forget to bring your mask)** **Our September Club Meeting will take place during Starfest Weekend and is not opened to the general public. No Club BBQ — BYO food and tools (grills available). TYO Trash. Might want to bring a chair and a table.** **Friday:** Starfield Observatory gates open in the am. Tent set-up in the afternoon. **Friday & Saturday:** Solar viewing during the day and night viewing all night. Campfire. **Saturday:** ***Peter Talmage*** memorial plaque hanging and official renaming to “Talmage Observatory at Starfield.” Raffle Table? Starting at **6:00 pm** “Tent Talks;” Bernie Reim’s “What’s Up;” Speakers/Topics; Show & Tell; Astro Shorts; Astro “B” Movie Theater.	Talmage Observatory at Starfield West Kennebunk, Me.
Last Month	At our Zoom meeting last month Bernie Reim gave his “What’s Up” talk. Following Bernie, Ian Durham gave his Constellation of the Month presentation on Aquarius.	
TBD	**Club/Public Star Party: Cancelled due to the Coronavirus**.	Talmage Observatory at Starfield West Kennebunk, Me.

Directions to ASNNE event locations

Directions to The New School in Kennebunck [38 York Street (Rt1) Kennebunk, ME]

For directions to The New School you can use this link to the ASNNE NSN page and then click on "get directions" from the meeting location. Enter your starting location to generate a road map with complete directions. It works great. http://nightsky.jpl.nasa.gov/club-view.cfm?Club_ID=137

Directions to Talmage Observatory at Starfield [Alewive Road, Kennebunk, ME]

From North:
Get off turnpike at exit 32, (Biddeford) turn right on Rt 111. Go 5 miles and turn left on Rt 35. Go 2 miles on Rt 35 over Kennebunk River to very sharp 90 degree left turn. The entrance to the Starfield Observatory site is at the telephone pole at the beginning of the large field on the left. Look for the ASNNE sign on the pole.

From South:
Get off the turnpike at exit 25 in Kennebunk. After toll both turn right on Rt 35. Go up over the turnpike and immediately turn right on Rt 35. About 4 miles along you will crest a hill and see a large field on your right. Continue until you reach the end of the field. Turn right into the Starfield Observatory site at the last telephone pole along the field. Look for the ASNNE sign on the pole. If you come to a very sharp 90 degree right turn you have just passed the field.

To join **ASNNE**, please fill out the below membership form. *Checks should be made payable to: Astronomical Society of Northern New England (A.S.N.N.E).* For more details, please visit our website: **http://www.asnne.org**

Astronomical Society of Northern New England
P.O. Box 1338
Kennebunk, ME 04043-1338

2020 Membership Registration Form

(Print, fill out and mail to address above)

Name(s for family): ____

Address: ____
City/State: ______________________________ Zip code: ________________________

Telephone # ____

E-mail: ____

Membership (check one):
Individual $35 _____ Family $ 40 _____ Student under 21 years of age $10 _____ Donation________

Total Enclosed____________

Tell us about yourself:
1. Experience level: Beginner____ Some Experience ____ Advanced______

2. Do you own any equipment? (Y/N) And if so, what types?

____

3. Do you have any special interests in Astronomy?

____

4. What do you hope to gain by joining ASNNE?

____

5. How could ASNNE best help you pursue your interest in Astronomy?

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6. ASNNE's principal mission is public education. We hold many star parties for schools and the general public for which we need volunteers for a variety of tasks, from operating telescopes to registering guests to parking cars. Would you be interested in helping?
Yes_____ No_____

7. ASNNE maintains a members-only section of its web site for names, addresses and interests of members as a way for members to contact each other. Your information will not be used for any other purpose. Can we add your information to that portion of our web site?

Yes_____ No_____