ASTRONOMY CLUB OF TULSA

OBSERVER

September 2023

Bringing Stars to the eyes of Tulsa since 1937

Editor – John Land

“Witch’s Broom Nebula” NGC 6960 by Tim Gilliland

Telescope - Stellarvue SVX127D with SBIG ST-8300M on an Astro-Physics 1100GTO mount Filters - Astrodon H-alpha 5nm · Astrodon OIII 3nm
Twelve 1800 second exposures with each filter June 13 – 24, 2022

NGC 6960 is the western portion of the Veil Nebula in Cygnus. The bright star in the image is 52 Cygni in the western wing of the constellation Cygnus – the swan. The Veil Nebula is the expanding remnant of a supernova that exploded 5,000 to 8,000 years ago. Distance estimates lie between 1,400 and 2,600 light years.

Astronomy Club Events **Check our website AstroTulsa.com events section for updates**

Observatory Stargazing Nights

Two types of Observatory nights. During the Summer Months they are scheduled on a Friday.
If weather is poor on Friday, we will try again on Saturday if the weather improves.

Our GUESTS & Members nights are open to anyone. We do ask guests to try to RSVP.
Large groups need to make separate arrangements.

Members Only Nights are Open to members and their family
Details, Times and Direction Maps are posted on our Website

https://www.astrotulsa.com/events

Observatory Stargazing Nights

Friday Sept 8 7:00 PM Guest and Members Night –
Guest requested to RSVP -

Friday Sept 15 7:00 PM Members Only night
Open to our members and their immediate family

Astronomy Club Meeting - THURSDAY Sept 28 - 7:00 PM - IN PERSON club meetings.
At Jenks High School planetarium 105 E B Jenks OK - Guests Welcome
Note: We are meeting on a Thursday due to schedule conflicts on all September Fridays

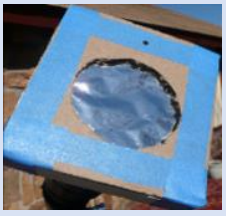
SATURDAY Oct 7 7:00 PM Guest and Members Night –
Guest requested to RSVP -

Friday Oct 13 7:00 PM Members Only night
Open to our members and their immediate family

On Saturday Oct 14 we have a 78 % Partial Solar eclipse in Tulsa
Eclipse begins 10: 25 AM Maximum 11:51 AM Ends 1:24 PM

Our club is planning two locations for the public to come enjoy the eclipse.
Details of the locations will be posted soon.

We will need several club volunteers at both locations. You don't have to have a solar telescope to volunteer. Or you may want to organize a neighborhood or family viewing session near your home.



You MUST have certified Safe Solar viewing filters for all phases of the eclipse ! These can be the solar viewing cards the club is selling or eclipse glasses available from RELIABLE sources.
Learn how to make your own safe telescope solar filter in our August newsletter

President's Message
John Land

The summer started out busy for our club. The weekend of June 9, 10 & 11 we hosted a conference for the MidStates region of the Astronomical League. We had 81 registered guests from 11 clubs and 7 states. Our guests enjoyed a number of presentations about a variety of topics. We also enjoyed visiting and meeting new friends at our Friday Star-BQ, midday lunch and Saturday evening banguet. We had many compliments from our guests. You can see the full list of presenters and conference schedule at https://www.msral2023.org/ The 2024 conference will be in Omaha, NE June 7-9. Their preliminary plans can be seen at https://msral2024.org/
I hope several of our members will considering including it in their summer plans.

As September opens many of our members will be headed out west to the week-long Okie-Tex Star party Sept 8 – 16 to enjoy one of the darkest sky in the Midwest. I'm sure they are all hoping for a break in this extended summer heat wave. Here in Tulsa we will be looking forward to earlier sunsets, longer nights and cooler temperatures as the Autumnal Equinox arrives on Sept 22nd

The media promotion of the Perseid meteor stimulated a lot of reguests to visit our observatory and also resulted in several new members. I would like to encourage our members both or existing members and new members to become involved in helping with our events. The best way to learn is by doing and being mentored by others. As mentioned above we have opportunities to help with the October eclipse. Helpers are always welcome at our observatory nights. We have a need for young people with social media skills to help with our Public Facebook page to make regular postings of club events and interesting sky events, astronomy news. Our website needs a review of it older content and updating information.

Each October we elect new officers and board members. I would encourge those of you that have been in the club more than a year to consider becoming more involved in the club. Expecially our younger members who can bring fresh new ideas and skills to move our club forward .

Let us continue our 85+ years of

"Bringing Stars to the Eyes of Tulsa since 1937"

John Land - President

The expanding Universe: 100 years later

The first observational evidence showing the Universe is expanding is 100 years old now: In the 1910's astronomer Vesto Slipher of Lowell Observatory was studying the spectra of "Spiral Nebula". His observations showed the majority of them were moving away from us. Their true distance and nature as independent galaxies was still unknown. In 1923 Edmund Hubble was using the 100-inch Hooker telescope to study novae in M 31. He noted that a few of them dimmed and brightened in repeating cycles. Realizing that these were Cephid variables whose absolute magnitude could be determined from timing their variation cycles. This allowed him to determine that they were indeed far beyond our local galaxy. He began looking for Cephids in other galaxies to measure their distance. Using these newly determined distances and combining them with the spectral measurements of their space velocity, evidence began to evolve that the more distance the galaxy the faster it was moving away. The Universe was Expanding ! The debate is how fast? 67 km/s/Mpc or 73 km/s/Mpc. For more information see

Expanding Universe turns 100 and New JWST on the Hubble expansion rate

Mpc stands for Mega Parsec = 3.26 million light years

Click on these images to links on the Internet

CLEAR OUTSIDE

Tulsa National Weather Service

***** The NEW CLEAR OUTSIDE icon above is a link to an extensive site showing cloud cover %, Seeing, Transparency, Moon Phase, Temp in ^{O} C and many other useful tools**

GOT A NEW TELESCOPE? Here are some sites to help you get started with you telescope.

Getting Started with Your New Telescope
https://skyandtelescope.org/astronomy-news/getting-started-with-your-new-telescope-2/

Astronomy for Beginners | Night Sky Facts, FAQs & Resources
https://skyandtelescope.org/astronomy-information/

What to Know Before Buying a Telescope
kyandtelescope.org/astronomy-news/what-to-know-before-buying-a-telescope/

See Website Observation Station for a collection of Interactive Sky Watching Tools
Moon phases - Sun rise & Set - Make your own custom interactive sky chart and more
Great website for printable Finder Charts of Solar System objects https://in-the-sky.org/

September - Moon Phases - - 3rd Q Sep 6 - - New Sep 14 - - 1st Q Sep 22 - - Full Sept 29

The Full moon of Sept 29 marks the last of the four Supermoons in a row. July 3, Aug 1 & 30

SEPTEMBER PLANETS – SATURN reached opposition on August 27 thus Saturn will be well placed for observing in September. Due to it location in Aquarius it only reaches a maximum altitude when it transits. Since Saturn's rings will be edge on in 2025, in 2023 we view them at a shallow angle. JUPITER is still a prominent planet in the morning sky it transits at 4:30 AM mid-month. By late month it rises in the east around 9:30 PM. MARS still hangs low in west at sunset continuing to barely outpace the Sun. It doesn't reach superior conjunction behind the Sun until Nov. 17. VENUS rapidly emerges in the morning sky. Brave early risers can enjoy views of its crescent phase as it emerges from inferior conjunction. MERCURY also joins the morning sky hanging low in the east before sky. Its maximum morning elongation 18 degrees from the sun occurs on September 22nd.

The Moon is near Saturn Aug 30, Jupiter Sept 4 & 5 , Venus Sept 11, Mars Sep 16 and Saturn again on Sept 26

SOLAR ECLIPSES are coming to Tulsa – Oct 14 -78 % - April 8 - 95 %
Plus, the April 8, 2024 event will be a **Total Solar Eclipse** over a long path from SW Texas, SE OKLA, Central Arkansas and extending on to Maine.
Our Astronomy Club is selling certified safe Eclipse Viewing Cards –

Caution Advised – in 2017 many unsafe glasses were sold online

Note: from my experience the sun viewer card mounted inside a cardboard picnic plate works much better than the paper glasses. Especially for younger elementary kids and anyone with glasses. Also, the sun viewing plate is more durable and can be handed from one person to another easily. John Land

Where and when to see the October 2023 annular eclipse | Astronomy.com
https://www.astronomy.com/observing/where-and-when-to-see-the-october-2023-annular-eclipse

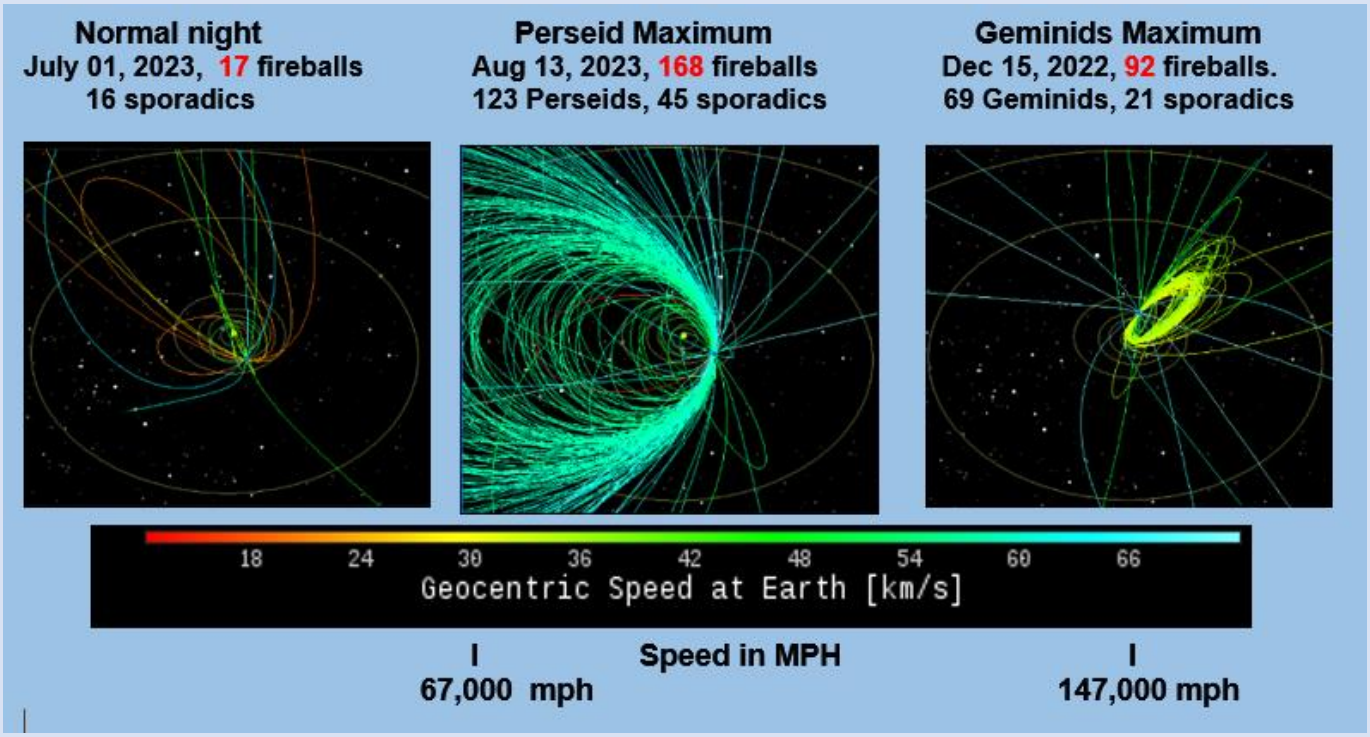
The Perseid Meteor shower occurred the weekend of Aug 11 – 13 this year. Unfortunately, of our Tulsa viewers were dealing with one of our Heat Alert days for our August 11 observing night which clouded up by 10:30. Saturday brought rain with cloudy nights.

Tracing the Origins of Meteor Fireballs

Each night the NASA all sky cameras record the brightest meteors. They then calculate their orbits to establish their origins. In the diagrams below, Mar's orbit is the outer of the 4 inner rings, the larger one is Jupiter and the partial arc Saturn. On any given dark night, a person can expect to see a few random Sporadic meteors as shown on the July image. During a meteor shower the Earth passes through a region of space debris that share a common orbit. The increased number of meteors appear to come from a common direction in the sky producing what we call a meteor shower. The center image shows the Perseid shower that peaks in August each year. The Perseids are remnants of Comet Swift-Tuttle which has a 133-year orbit extending well beyond Pluto. The right image shows the Geminid shower that peaks in December each year. These originate from the asteroid 3200 Phaethon which has a 1.4 year orbit period which is clearly visible from their much shorter orbit.

Great images of the Perseid Meteor Shower and Geminid Meteor Shower

Every night, a network of NASA all-sky cameras scans the skies above the United States for meteoritic fireballs. Automated software maintained by NASA's Meteoroid Environment Office calculates their orbits, velocity, penetration depth in Earth's atmosphere and many other characteristics. Daily results are presented on Spaceweather.com



Astronomy in the News -

Articles of random astronomy interest.
I have not reviewed all these articles – those from general media may contain less accurate information. My apologies for those that include Ads

Milky Way's glimmering arms revealed in stunning detail | Space
https://www.space.com/milky-way-arms-revealed-chemical-mapping

Best Camera settings for astrophotography
https://photographylife.com/best-camera-settings-for-astrophotography

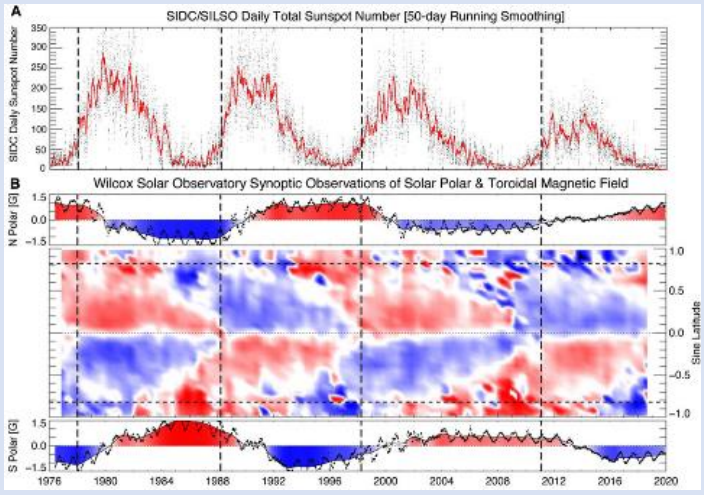
Parker Solar probe gets gravity boost from Venus sending it within 3.8 million miles from the Sun, speeding by at 430,000 miles per hour.
https://blogs.nasa.gov/parkersolarprobe/2023/08/

New Horizons Is Now So Far Away, It Can Measure The True Darkness of Space : ScienceAlert
https://www.sciencealert.com/new-horizons-is-now-so-far-away-it-can-measure-the-true-darkness-of-space

Webb Space Telescope Just Peered Deep Into the Famous Ring Nebula
https://www.inverse.com/science/jwst-ring-nebula-trio-of-images

Unlocking Einstein's Treasure Chest: Webb's Intriguing Insights Into the "El Gordo" Galaxy Cluster
https://scitechdaily.com/unlocking-einsteins-treasure-chest-webbs-intriguing-insights-into-the-el-gordo-galaxy-cluster/

I discovered this site - https://www.youtube.com/@SpaceOdditiesLive
The site has a wide selection of videos, Live interviews or recordings,
Live Space events (It had just covered the Moon landing of the India's spacecraft)
Even had a selection of video's called Astronomy A to Z
Most are in YouTube form. Might be worth checking out instead of watching reruns or political wrangling.



Most of us are familiar with the 11-year cycle of sunspot activity as illustrated by the top graph. New research is revealing an additional underlying 17-year cycle. 11 years vs. 17 years. 1 cycle vs. 2 cycles. What difference does it make?
"The Extended Solar Cycle may be telling us something crucial about what's happening deep inside the sun where sunspot magnetic fields are generated," says McIntosh. "It poses significant challenges to prevalent dynamo theories of the solar cycle."

https://spaceweather.com/archive.php?view=1&day=12&month=12&year=2022

Effect of Upgrades to Starlink Generation 2 Satellites on Visual Brightness

By Brad Young and Jay Respler

Introduction

The rise of large constellations of small communication satellites in low-Earth orbit (LEO) over the last four years has, with it, led to concerns about the effect on space situational awareness, ground-based visual and radio astronomy and the effect on the health and well-being of the natural world, including humans. Several studies have published the measurable effects of these concerns, and several more studies are ongoing. The issue has brought efforts, including new laws, to retool the licensing process for LEO in a new era of hundreds of thousands of small satellites instead of hundreds of large objects.

Specifically, the authors have concentrated their efforts on observing, reporting, and publishing data on the prototype Blue Walker 3 from AST Space Mobile, and the still-growing OneWeb and StarLink constellations. The aim of this article is to present new observations of the initial Gen 2 Starlink satellites and discuss how their brightness is likely to contribute to the ongoing impact on optical astronomical observations.

On 2023 Feb 27, the first of the Gen 2 Starlink satellites was launched into orbit. This initial slate of 22 satellites were not the ``final" version of the Gen 2 design, but a modified Gen 1 payload that was an interim step in design, referred to as Gen 1.5. Visual observations conducted after the group reached operational orbit suggested that these satellites would be particularly bright, as expected with a larger object compared to the Gen 1 design. They also had a blue color not seen previously, due to a new material selected by SpaceX specifically for reduction of optical brightness.

Background

Operators of these megaconstellations have begun to launch their satellites ranging from prototypes to second generation designs. Understanding the effects on all stakeholders requires two steps: measuring the evolving threats and monitoring the engineering mitigation for effectiveness. SpaceX has the largest number of satellites in orbit currently and is the earliest major entrant. Early reports on the deleterious effects of their satellites on astronomy led to engineering changes in orbital parameters and design to reduce their reflectivity. With Gen 1, the original, smaller Starlink satellites, changes included orbital height adjustment, a visor (VisorSat) and special coating (DarkSat). This study looks at the reduction in optical brightness reached in the upgrade to Gen 2, where significant design changes were made to accommodate a larger object. A summary of the changes incorporated by SpaceX may be found here.
SpaceX is aware of the significant effect of solar phase angle on these long, flat satellites and instituted a policy of operating in a "shark fin" attitude that minimizes reflection of sunlight to Earth. However, this angle changes often throughout the orbit and must also adapt to any orbital changes. Many of the observed satellites that were suddenly bright on one pass were occasionally dim on a later pass with similar geometry, indicating the small room for error that this "knife's edge" mode allows.

Methods

All the data used for this analysis is visual magnitude, determined by using the methods below. The observations were performed by:

- Jay Respler, a dedicated satellite observer who has logged hundreds of brightness reports on Starlinks and OneWeb payloads since the first launches.
- Brad Young, who has reported on 90% of the Starlinks in orbit and has seen more than 9,000 unique objects in orbit visually, resulting in over 40,000 reports.

Visual observations were undertaken from 2023 Mar 16 to Jul 25 from sites near Tulsa OK, and Monroe NJ, USA. In most cases, hand-held binoculars were used. To perform visual observations, the following steps are performed. First, pass predictions are obtained for the observer's site. At a minimum, the location, expected time of observation, and the limiting magnitude an experienced observer can reliably see must be known, bearing in mind that moving objects may appear dimmer visually. Observable passes at low elevation, in deep twilight, or at unfavorable phase angles are discarded.

Next, suitable comparison stars are chosen to provide brightness measurements. The timing, location, and brightness of newly launched satellites often differ significantly from available pass predictions. Sufficiently bright comparison stars to enable magnitude estimation are selected for the appropriate stage of twilight, and alternate stars chosen in case the satellite pass was off track or early/late. All comparison star magnitudes are from the extended Hipparcos catalog.

Finally, the objects are observed as they pass the selected comparison stars, so a direct comparison can be made and immediately recorded. Any significant brightness variation (flashing or flaring) was also recorded at that time. Although brightness variations are not used for determining standard magnitudes, they may still provide useful space situational awareness information.

Discussion

Initially, as with Gen 1 launches, the objects were quite bright, easily seen naked eye at as bright as mag +1. After a period of a few weeks and with more observations, many of the objects from the first launch were found to be dim. Eventually, many of the Gen 1.5 and especially the Gen 2 satellites were dimmed to the point where they could not be seen by a visual observer using binoculars.

However, continued observation showed that the dimness was not always permanent. Occasionally a payload would become naked eye brightness again, and then return to dimness, or remain bright. Refer to Figures 1-4, that describe the observed corrected magnitude of the Starlinks Gen 1.5 and Gen 2.
The corrected magnitude is the apparent magnitude of the satellite, correcting the distance to 1000 km. Due to the complexity of modeling the shape of the Starlinks and unknown albedo and scattering behavior, a simpler model provides a way to compare differential brightness. No attempt is made to determine standard magnitude using phase angle; only range is considered. Therefore, this paper does not determine a standard magnitude for any of these satellites. Comparison to the target maximum brightness set by the IAU (International Astronomical Union) of magnitude 7.2 is based on the range corrected magnitude in this study. The light curve of the payloads in shark fin mode are nearly flat across most of the pass through the sky, so this approximation should be acceptable for the purpose here.

With this approach, some trends in the behavior of the new generation satellites are shown. Whatever transitory changes were made with Gen 1.5, many of that set did not perform as well as the “true” Gen 2 payloads. Two graphs show the typical outcomes so far for Gen 1.5. Note that not all the observed satellites are included in the data, only enough to show the trends but remain readable. Also, a few of the ranges are estimates due to the short life of elements with initial orbital raising and the inherent lag in dissemination of elements for these objects.

Gen 1.5 has several payloads as of July 30, 2023, that have not met the criteria of a range corrected magnitude of 7.2. The first graph shows examples of payloads successfully mitigated to the recommended parameter. The next graph shows examples of objects that, so far, have remained brighter than desired.

Gen 2 satellites have been more consistent in making the mag 7.2 mark; examples of these are shown in the third graph, and the last graph shows examples of the Gen 2 that did not meet it. The behavior of the satellites may indicate that the orbit modifications and positioning for Gen 1.5 were more elaborate than those needed to line out Gen 2. This may be indicative of an operator learning curve to maximize brightness reduction, or there may be reasons for this behavior that have little to do with brightness mitigation. It is an active situation – there are still many new Gen 2 groups that have had only a few observations. Those payloads are in the early stages of reaching final orbit and were not included here.
Further study is needed to determine what patterns emerge and what explanations may predict behavior. Monitoring by the astronomy community would be most efficiently accomplished by crowd sourcing the effort to amateurs. Although SpaceX has made great progress in reducing the brightness of a new, larger Starlink, we see already, through hundreds of observations, that there are still bright Gen 2 objects at final orbital height.

Path Forward

The International Astronomical Union recommendation is that the maintained brightness on-station of a satellite is not to exceed magnitude 7.2. Satellites such as Starlink Gen 2 could also present an additional source of noise for radio astronomy, since radio quiet zones, in which radio telescopes operate, do not automatically limit satellite emissions. This can be a particular issue for telescopes like the NRO at Green Bank which observe at or close to frequencies normally used by devices served by satellites. The planned constellation of thousands of such satellites over the next decade may necessitate more research into effective strategies to protect upcoming ground-based telescopes and surveys such as the Extremely Large Telescope (ELT) or the Vera C. Rubin Observatory's Legacy Survey of Space and Time (LSST).
Despite many efforts by the aerospace industry, policy makers, astronomers, and the community at large, the trend to make substantially larger, and brighter satellites seems to persist. Regulatory intervention could help ensure operators critically assess the impact of their satellites on the space environment before launch.

Communication with SpaceX confirmed that mitigation had included both design modifications to the satellites (the final Gen 2 set), and changes in attitude and other spatial adjustments after orbit was achieved. In a few cases, signal to the satellite had been lost, and this caused a delay in the mitigation, explaining the behavior seen from the ground. However, not all the behavior is explained by this alone; it may be a case where vigilance is required by the operator in maintaining the spacecraft attitude or other parameters.

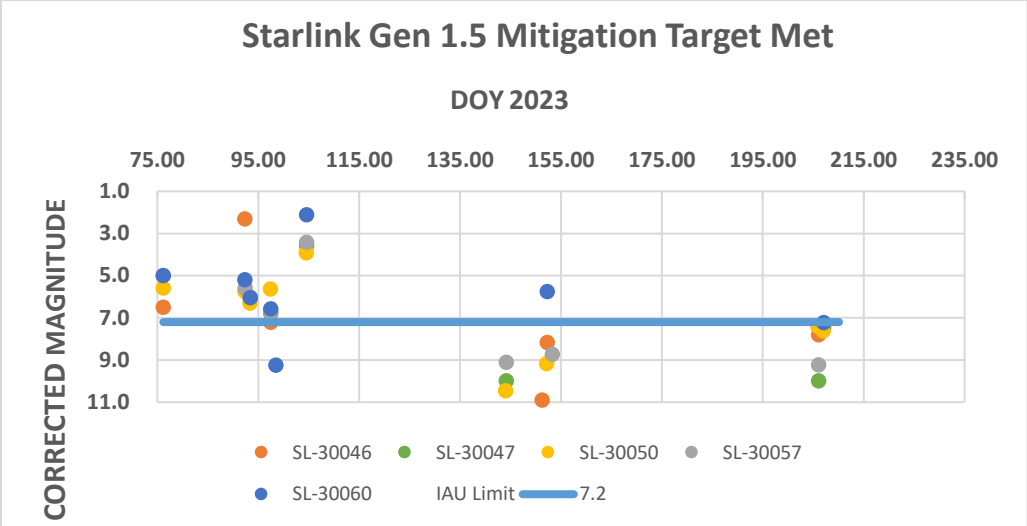
A proactive industry-led solution is investment in engineering solutions that allow payloads as large as the Gen 2 Starlinks to be operated without causing unmanageable issues with optical and radio astronomy. From the observations on the Starlink Gen 2 satellites, it appears that SpaceX has found ways to meet the IAU recommendations on optical brightness. Further study, as more of this portion of the constellation is launched, will help ensure the concerns of all stakeholders are met.

Acknowledgements

Brad Young [ORCID 0000-0001-6268-7790], is an affiliated member of the IAU Centre on the Protection of the Dark and Quiet Sky from Satellite Constellation Interference and would like to acknowledge their invaluable assistance in understanding the more technical aspects of the mitigation strategies employed by SpaceX.

Preliminary Observational Data

See body of paper for discussion.


Starlink Gen 1.5 Mitigation Target Met
DOY 2023
75.00
95.00
115.00
135.00
155.00
175.00
195.00
215.00
235.00
CORRECTED MAGNITUDE
1.0
3.0
5.0
7.0
9.0
11.0
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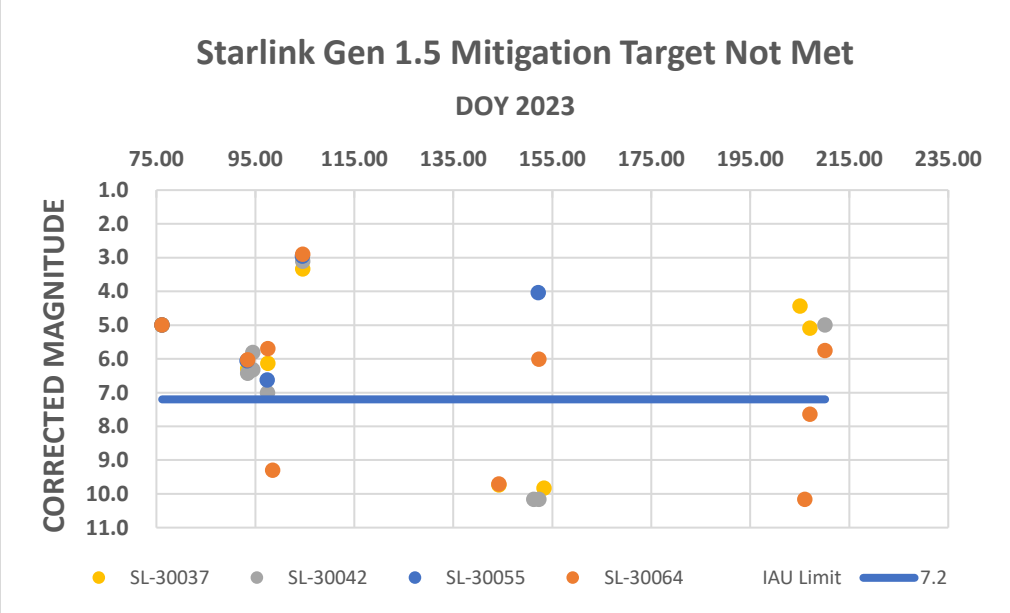
SL-30047
SL-30050
SL-30057
SL-30060
IAU Limit
7.2


Starlink Gen 1.5 Mitigation Target Not Met
DOY 2023
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CORRECTED MAGNITUDE
1.0
2.0
3.0
4.0
5.0
6.0
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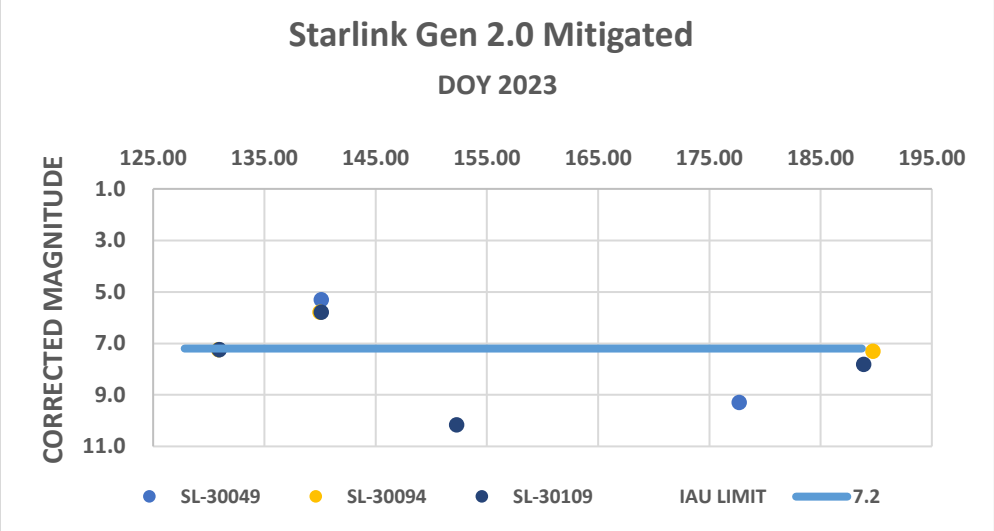
IAU Limit
7.2


Starlink Gen 2.0 Mitigated
DOY 2023
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155.00
165.00
175.00
185.00
195.00
CORRECTED MAGNITUDE
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3.0
5.0
7.0
9.0
11.0
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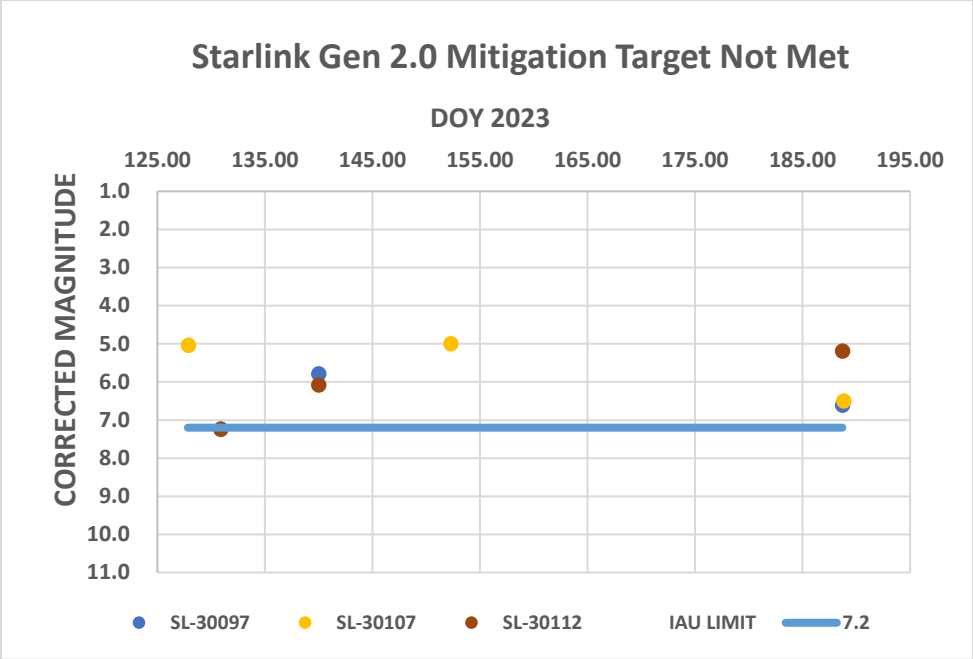
IAU LIMIT
7.2



References:
"Megaconstellation Satellites: Practical Ways Amateurs Can Help" Reflector, March 2022, p. 25
Dark and Quiet Skies Working Groups Reports II UN Office for Outer Space Affairs, edited by Connie Walker and Piero Benvenuti
"Reclaiming Space: Progressive and Multicultural Visions of Space Exploration", edited by James S.J. Schwartz, Linda Billings, and Erika Nesvold
"Second Generation Starlinks Satellites" monograph by SpaceX
"Hubble Telescope Faces Threat From SpaceX and Other Companies' Satellites" New York Times, Mar 2, 2023, accessed Aug 1, 2023
Observational data posted at see-sat mailing list archives and Brad Young's website

Associate Treasurer Report
Mike Blaylock

As of August 24, we had 213 members 38 New members for 2023
We welcome this month's newest members – **Charles Crawford, Natalya Balandran, Mary Ellen Solon, Cynthia Cervantes, Valerie Pinamonti, Liz Heldmann, Steven Neil, Laura Enlow, Ethan Franklin, Erica Kirkendall. Hello and welcome to ACT !**

Have you changed you Contact Information? Email, Phone, Postal Address ?
Please help us to maintain our records by sending an email to AstroTulsa.Tres@gmail.com

Accounts as of August 24, 2023

Checking:	**$ 2,172**	Note: In June we paid our Astronomical League due $ 1,025
Savings:	**$ 2,792**	and in July Liability Insurance of $ 2,425
Investments:	**$ 31,960**	(Value tends to fluctuate with markets).

You can JOIN or RENEW memberships or magazine subscriptions ONLINE using ANY MAJOR CREDIT CARD.
The transactions are processed through PayPal but you Do Not need a PayPal account.
Fill out the registration form at **https://www.astrotulsa.com/join**
Click Submit and you will be given the choice of either MAILING in your dues with a check or paying online with most major credit cards. A modest processing fee is added to online transactions.

Membership rates for **2023** are as follows:
Adults: $ 45 per year, includes Astronomical League Membership.
Sr. Adult: $ 35 per year for those 65 or older, includes Astro League Membership.
Students: $ 30 with League membership; Students: $ 25 without League membership.
Additional Family membership: $ 20 with voting rights and League membership.
$ 15 with voting rights but without League Membership.
The regular membership allows all members in the family to participate in club events but only ONE Voting Membership and one Astronomical League membership.

Join Online – Add or renew magazine subscriptions. https://www.astrotulsa.com/join

MAGAZINE SUBSCRIPTION RATES and PROCESS has CHANGED !

You can get a discount rate as a Astronomy Club member. However, you will need to do so directly using their discount rate web links. Both Sky & Telescope and Astronomy have options for DIGITAL as well as PRINT subscriptions.

For club member's Discount subscription rates to **Sky and Telescope magazine**
go to **this page**
For club member's Discount subscription rates to **Astronomy magazine**
go to **this page**
Use the DISCOUNT RATE LINKS above instead of their regular subscription pages to MAKE or RENEW your subscription.

Looking Beyond the Stars

Brian Kruse

Looking up in awe at the night sky, the stars and planets pop out as bright points against a dark background. All of the stars that we see are nearby, within our own Milky Way Galaxy. And while the amount of stars visible from a dark sky location seems immense, the actual number is measurable only in the thousands. But what lies between the stars and why can't we see it? Both the Hubble telescope and the James Webb Space Telescope (Webb) have revealed that what appears as a dark background, even in our backyard telescopes, is populated with as many galaxies as there are stars in the Milky Way.

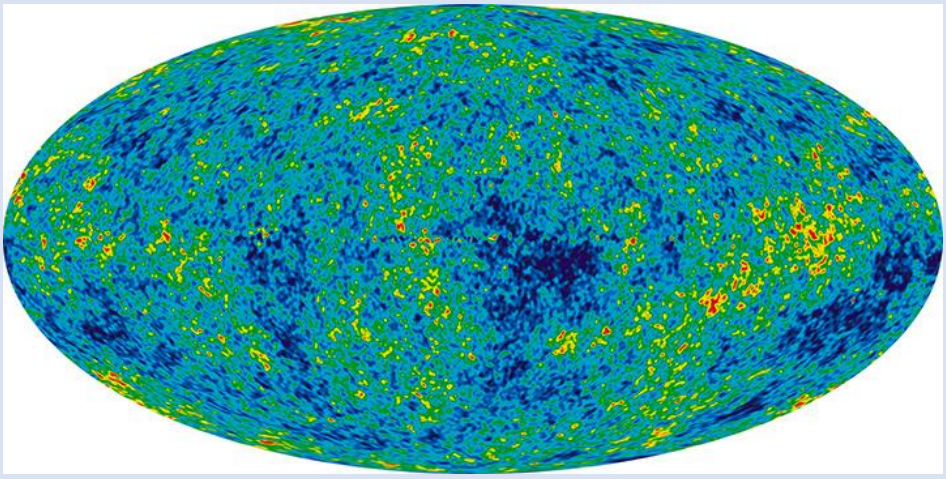
So, why is the night sky dark and not blazing with the light of all those distant galaxies? Much like looking into a dense forest where every line of sight has a tree, every direction we look in the sky has billions of stars with no vacant spots. Many philosophers and astronomers have considered this paradox. However, it has taken the name of Heinrich Wilhelm Olbers, an early 19th century German astronomer. Basically, Olbers Paradox asks why the night sky is dark if the Universe is infinitely old and static – there should be stars everywhere. The observable phenomenon of a dark sky leads us directly into the debate about the very nature of the Universe – is it eternal and static, or is it dynamic and evolving?

It was not until the 1960s with the discovery of the Cosmic Microwave Background that the debate was finally settled, though various lines of evidence for an evolving universe had built up over the previous half century. The equations of Einstein's General Theory of Relativity suggested a dynamic universe, not eternal and unchanging as previously thought. Edwin Hubble used the cosmic distance ladder discovered by Henrietta Swan Leavitt to show that distant galaxies are moving away from us – and the greater the distance, the faster they're moving away. Along with other evidence, this led to the recognition of an evolving Universe.

The paradox has since been resolved, now that we understand that the Universe has a finite age and size, with the speed of light having a definite value. Here's what's happening – due to the expansion of the Universe, the light from the oldest, most distant galaxies is shifted towards the longer wavelengths of the electromagnetic spectrum. So the farther an object is from us, the redder it appears. The Webb telescope is designed to detect light from distant objects in infrared light, beyond the visible spectrum. Other telescopes detect light at still longer wavelengths, where it is stretched into the radio and microwave portions of the spectrum. The farther back we look, the more things are shifted out of the visible, past the infrared, and all the way into the microwave wavelengths. If our eyes could see microwaves, we would behold a sky blazing with the light of the hot, young Universe – the Cosmic Microwave Background.

The next time you look up at the stars at night, turn your attention to the darkness between the stars, and ponder how you are seeing the result of a dynamic, evolving Universe.

NASA’s James Webb Space Telescope has produced the deepest and sharpest infrared image of the distant universe to date. Known as Webb’s First Deep Field, this image of galaxy cluster SMACS 0723 is overflowing with detail. This slice of the vast universe is approximately the size of a grain of sand held at arm’s length by someone on the ground. (Image Credit: NASA, ESA, CSA, STScI) https://bit.ly/webbdeep



The oldest light in the universe, called the cosmic microwave background, as observed by the Planck space telescope is shown in the oval sky map. An artist's concept of Planck is next to the map. The cosmic microwave background was imprinted on the sky when the universe was just 380,000 years old. It shows tiny temperature fluctuations that correspond to regions of slightly different densities, representing the seeds of all future structure: the stars and galaxies of today. (Image credit: ESA and the Planck Collaboration - D. Ducros) https://go.nasa.gov/3qC4G5q

You are invited to come join us to learn more about
Astronomy and view the wonderful sights in the night sky.
Check the EVENTS section at https://www.astrotulsa.com/

During the school year our club holds a
Monthly General Club meetings at
Jenks Public Schools Planetarium
105 East B St, Jenks, OK
Located North of the intersection of
1st and B St

Meetings begin at 7:00 PM

When you enter the building lobby,
take the elevator to the 3rd floor.
Click for Google Map Link

ASTRONOMY CLUB OBSERVATORY
Located on a hilltop about 25 miles SW of Tulsa
Features: classroom, restroom, dome with 14-inch telescope and an acre to set up your telescopes.

Weather permitting, we host two types of observing nights.

GUEST OBSERVING NIGHT – RSVP requested
This event is open to our Guest – both individuals and families as well as our regular members. Several of our club members set up telescope for public viewing.
***** Groups need to make separate arrangements.

MEMBERS OBSERVING NIGHT usually on a Friday near new moon
Reserved for club members and their families to allow them to pursue observing projects.
The Observatory is ONLY OPEN for SCHEDULED EVENTS.

Check the EVENTS section at https://www.astrotulsa.com/
Follow our map directions DO NOT USE GPS

Two Options for travel to the observatory

MOSTLY PAVED ROADS – Hwy 75 to 201st St S – through Mounds OK

Most DIRECT ROUTE – Hwy 75 to 241st St S – some coarse gravel & dirt roads

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2023 Summer Shows Go to Show Schedule
Click the Date Column to sort them by show date

Most Shows take place on
Tuesday evenings from 7:00 PM to 8:00 PM
a few on Saturday