



# OBSERVER

NOVEMBER 2019

*Bringing Stars to the eyes of Tulsa since 1937*

*Editor – John Land*



*Over 500 Astronomy Enthusiasts came to the high prairie for a weeklong celebration of Starlight at the 2019 Okie-Tex Star Party  
These Photos by Adam Koloff*

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## *Astronomy Club Events*

Details at <http://astrotulsa.com/Events.aspx>

**Be sure to check the Website for Weather Cancellations before coming.**

<b>NOVEMBER</b>				
ANNUAL DINNER MEETING	1ST Q	SAT, NOV 2	5:30 PM	JENKS PLANETARIUM
<b>DAYLIGHT SAVING TIME ENDS</b>		<b>SUN, NOV 3</b>		
SIDEWALK ASTRONOMY	Full	SAT, NOV 9	4:30 PM	BASS PRO
<b>Mercury Solar Transit</b>		<b>MON, NOV 11</b>	7:00:00 AM to Noon	
PUBLIC NIGHT	3rd Q	SAT, NOV 23	4:30 PM	OBSERVATORY
MEMBERS' NIGHT	New	FRI, NOV 29	5:00 PM	OBSERVATORY
MEMBERS' BACKUP NIGHT	New	SAT, NOV 30	5:00 PM	OBSERVATORY
<b>DECEMBER</b>				
GENERAL MEETING		FRI, DEC 6	7:00 PM	JENKS PLANETARIUM
SIDEWALK ASTRONOMY		SAT, DEC 7	4:00 PM	BASS PRO
PUBLIC NIGHT		SAT, DEC 21	4:30 PM	OBSERVATORY
<b>WINTER SOLSTICE</b>		<b>SUN, DEC 22</b>		
MEMBERS' NIGHT		FRI, DEC 27	5:15 AM	OBSERVATORY
MEMBERS' BACKUP NIGHT		SAT, DEC 28	5:15 PM	OBSERVATORY

**ASTRONOMY CLUB OF TULSA welcomes our 2020 Officers and Board members**

**President – Tamara Green      Vice President – Daniel Smith**  
**Secretary – Jerry Cassity      Treasurer      -- John Newton**

**Board members – Dennis Berney, Michael Blaylock, Richard Brady**  
**John Land, James Taggart, Skip Whitehurst**

# PRESIDENT'S MESSAGE

BY TAMARA GREEN



Hey Y'all!

I cannot believe how fast this year has flown by! The Holiday Season is almost here!

We have our **Annual Dinner Meeting coming up very soon! It will be on Saturday, November 2**, in the Conference Room down the hall from the Jenks Planetarium. Same as last year. It starts at 5:30 PM. **Cost is \$ 12 per person** this year, and the dinner is being catered by Carrabba's! Plus, the club will be providing drinks, and there will be a dessert potluck, so if you want to, you can bring a dessert to share! We also have an exciting raffle planned! So plan to bring some cash to buy raffle tickets. Please remember that this dinner is **ONLY** for Astronomy Club of Tulsa members and their families, and is **NOT** open to the public.

We only have a few more events this year at which volunteers will be needed. Saturday, November 9 is our Sidewalk Astronomy at Bass Pro, starting at 4:30 PM, Saturday, November 23 is our Public Night at the Observatory, starting at 4:30 PM, Friday, December 6 is our last General Meeting at the Jenks Planetarium for 2019, starting at 7:00 PM, Saturday, December 7 is our last Sidewalk Astronomy at Bass Pro for 2019, starting at 4:00 PM, and our last Public Night at the Observatory for 2019 will be on Saturday, December 21, starting at 4:30 PM.

Do NOT forget to turn your clocks back on Sunday, November 3! Daylight Saving Time ends.

2020 is fast approaching. We have great events in the works, including MSRAL 2020! If you are interested in volunteering to help make our Midstates event successful and memorable, please contact me at [astrotulsa.pres@gmail.com](mailto:astrotulsa.pres@gmail.com) or Peggy Walker at [email4peg@yahoo.com](mailto:email4peg@yahoo.com). I hope that MSRAL 2020 will be a grand event that will be fun for all!

Also, there will be changes for the Okie-Tex Star Party for 2020. The Oklahoma City Astronomy Club is raising funds for a new building to be built at Camp Billy Joe that will house vendors and guest speakers, in order to get rid of the big circus tent that we have eaten and listened to speakers in. Tent rentals go up each year and are not exactly well climate controlled. The new building will provide heat and air, bathrooms, and nice views of the Mesa. Any and all donations will be gladly accepted by them. If you are interested in helping the OKCAC build this new building, you may do so by either sending your donation check or money order to:

Oklahoma City Astronomy Club

P.O. Box 22804

Oklahoma City, OK 73123-1804 – be sure to make your check or money order payable to OKCAC or Oklahoma City Astronomy Club, and put "CBJ Building" in the memo line;

Or, you can make your donation via PayPal. Their website has a "Donate" button.

I know this is for another club, but many of our own members go to Okie-Tex every year, I and Owen included, and I'm sure that those of you who go to Okie-Tex will appreciate the new building as much as we will! How do you all feel about the possibility of the Astronomy Club of Tulsa making a donation to OKCAC? Let me know !

Also, the start and end days of OTSP will change. They are going to try something new. Instead of starting on a Saturday and ending on a Sunday, they are going to start it on a Friday and end on a Saturday, giving their volunteers and guests an opportunity to be home on that Sunday to rest up for their work weeks following the star party. **The dates for 2020 will be Friday, September 11 through Saturday, September 19.** Owen and I personally think this is a fantastic idea, as he has to be at work before dawn on Mondays, and this will give us an opportunity to unload the truck and put our stuff away in a nice, leisurely manner and rest up for our own work weeks!

I hope that each and every one of you have a very happy Thanksgiving and whichever December/Winter holiday you celebrate. Keep yourselves and your families safe and happy!

See you all soon! *Clear Skies, Tamara Green*



A limited number of **2020 Astronomy Magazine Wall Calendars** are here and are now available to be picked up a club meeting. If you would like to reserve one, please email at [astrotulsa.tres@gmail.com](mailto:astrotulsa.tres@gmail.com), and let me know how many you would like. Otherwise, they will be available on a first come, first served basis at our upcoming events. Calendars are available for \$10.00 each

### MIRA REACHES MAXIMA

The long period variable Mira is putting on a good show in Cetus. During its long 333-day cycle this pulsating red giant spends much of this time dimmer than 9<sup>th</sup> magnitude. Now near maxima it is a naked eye object brighter than 3<sup>rd</sup> magnitude. Its easy to identify in binoculars by its reddish hue.

Full details at [Autumn Comets, Mira's Eye](#)



**BREAKING NEWS** – [Saturn gets 20 more Moons](#) – topping Jupiter at 82  
Taking suggestions to give them names. Deadline Dec 6, 2019

**Asteroid Hygiea May Be the [Smallest Dwarf Planet](#) in the Solar System**

# Daniel's Deep Sky Dozen by Daniel Smith

Many times when we have an opportunity to use our telescopes under clear skies, we often look at the same objects. We all have favorites that we never tire from observing. However, there are many things in the night sky that we need not ignore. An observing list can be useful to challenge us to look at new objects, or even the familiar objects in a different way. Every month, the ACT newsletter will begin featuring an observing list of ten items to find. I encourage you to look at this list every month and see if you can observe all ten objects. Keep a written record of everything you find including the month/year of the newsletter list, the objects you found that month, the date/time, instrument used, and whether you used GOTO or not. Using GOTO is acceptable, but I challenge you to find these objects on your own (finders such as red dots, telrads, finder scopes, etc. are acceptable). Certain objects will have observation instructions. Recognition will be given to individuals who complete a certain number of these lists. Clear Skies and Good Luck!

**In order to check off the first five objects, you must try to locate them with the naked eye first and then through binoculars or telescope.**

## EASY

1. M45 Pleiades LOCATION: TAURUS
2. M31 Andromeda LOCATION: ANDROMEDA
3. NGC 869 Double Cluster LOCATION: PERSEUS
4. Mizar / Alcor Double Star LOCATION: URSA MAJOR

## CHALLENGING – may use telescope

5. Mizar A / Mizar B Double Star LOCATION: URSA MAJOR
6. M27 Dumbell Nebula LOCATION: VULPECULA
7. M57 Ring Nebula LOCATION: LYRA
8. M33 Pinwheel LOCATION: TRIANGULUM
9. NGC 6826 Blinking Planetary LOCATION: CYGNUS

The Blinking Planetary nebula is a fun object to view. Try to see the star in the center of the planetary nebula. When you see the star, the nebula will seem to disappear.

When you look away from the center star, the nebula will reappear!

10. NGC 1023 Galaxy LOCATION: PERSEUS



## 11 & 12. DIFFICULT

### NGC 185 / 147 PAIR Galaxies LOCATION: CASSIOPEIA

NGC 185 Mag 9.21 RA 00 h 40.1 m Dec + 48° 27'

NGC 147 Mag 9.68 RA 00 h 34.3 m Dec + 48° 37'

You must observe both of these galaxies in the same view.

**Image from the Free phone app – SkyPortal by Celestron  
Just one of the many aides to finding these objects**

**Looking for Observing Forms for all occasions** – Here are a couple of resources

**American Association of Amateur Astronomers** <http://www.astromax.org/aa02801.htm>

This one has explanations of terms like transparency and seeing and other tips for recording your observations. It also has links to many of the Astronomical League Observing Certificates.

**The Belt of Venus** by sketching artist, Jeremy Perez – has numerous observing form templates  
<http://www.perezmedia.net/beltofvenus/templates.html>

New Website / App to help decide what Oklahoma's fickle weather is up to. Should you load up your scopes and head out to dark skies or stay home and read a good book.

It has much more information of interest to astronomers than typical weather sites. Below is the sky prediction for our recent public night Oct 19. The day started with clouds and rain with just a slight hope of clearing late. It was still cloudy in town as we left to open up but as predicted it cleared for a great night of observing.

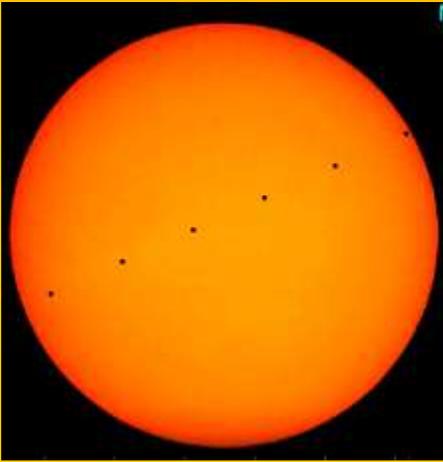
Another website I like to use is the **GOES EAST** weather satellite images. It takes images in 16 wavelengths every 5 mins and can show an up to an 8 hour ( 96 images ) loop of what the clouds are doing. [GOES EAST Southern Plains](#) shows all of OK & TX and parts of NM, KS, AR & LA

 Good To Stargaze™    FAQs    Apps    Hobbies    Language    Like    Share    Regis											
Saturday 2019-10-19: Sunrise 07:52, Sunset 16:42, Moonrise 22:07, Moonset 12:55											
Time	Wind	Wind Chill	Humidity	Precip Prob	Cloud Cover	Visibility	Seeing	Transparency	Moonlight	Planets	Good To Stargaze?
19:00	6 mph	65°F	69%	-	30%	10 miles	1.5	0.2	☾ -	Me V J S N	no
20:00	6 mph	63°F	76%	-	25%	10 miles	1.4	0.2	☾ -	J S U N	yes
21:00	6 mph	61°F	80%	2%	18%	10 miles	1.6	0.2	☾ -	J S U N	yes
22:00	6 mph	59°F	82%	2%	13%	10 miles	1.7	0.2	☾ -	S U N	yes
23:00	6 mph	57°F	83%	-	12%	10 miles	1.7	0.2	☾ -	S U N	yes
00:00	5 mph	56°F	83%	-	16%	10 miles	1.8	0.2	☾ 54%	U N	yes
01:00	5 mph	55°F	85%	-	17%	10 miles	1.8	0.2	☾ 54%	U N	yes
02:00	4 mph	53°F	86%	-	20%	10 miles	1.8	0.2	☾ 53%	U N	yes
03:00	3 mph	52°F	87%	1%	25%	10 miles	1.8	0.2	☾ 53%	U N	yes
04:00	3 mph	51°F	88%	1%	29%	10 miles	1.8	0.2	☾ 53%	U N	no
05:00	2 mph	50°F	90%	1%	31%	10 miles	1.9	0.2	☾ 53%	U	no
06:00	2 mph	49°F	91%	1%	32%	10 miles	1.8	0.2	☾ 52%	U	no
07:00	2 mph	48°F	93%	1%	32%	10 miles	1.9	0.2	☾ 52%	Ma U	no

**Jupiter & Venus** have a close evening conjunction low in SW  
 Nov 22 -25    Nov 23 below    Thin Crescent Moon joins Nov 28

**Mercury before Dawn**  
 Sunday Nov 24





**Transit of Mercury - Nov. 11, 2019**  
**6:37 AM to 12:04 PM CST**  
**Sunrise is about 6:56 AM CST**

**If weather permits telescopes are planned at Jenks High School and Tulsa Air & Space Museum - Check website for details in November.**

On Monday November 11 the planet Mercury will pass directly in front of the sun. This event is called a solar transit and occurs when the planet crosses an intersection ( Node ) of its orbit as it crosses the plane of Earth's orbit ( Ecliptic ) A transit is only visible when the Earth and planet are directly in line with a node. – Inferior conjunction.

Diagram details at <http://www.eclipsewise.com/oh/tm2019.html>

**Details of Sun's Position as seen from Tulsa during the Transit**

<https://www.timeanddate.com/eclipse/in/usa/tulsa>

See a Full Animation at – <https://www.shadowandsubstance.com/?p=142>

*“The transit or passage of a planet across the face of the Sun is a relatively rare occurrence. As seen from Earth, only transits of Mercury and Venus are possible. There are approximately 13 transits of Mercury each century.*

The next Mercury Transits are in Nov 2032 & 2039 are not visible from the US.

Next Transits visible from Tulsa are **May 7, 2049** followed by May 10, 2062 and Nov 11, 2065



#### **SAFELY OBSERVING A SOLAR TRANSIT**

Since you are observing the Sun to do so safety you must have **SAFE FULL SPECTRUM FRONT SOLAR** filter for your telescopes or binoculars. Due to the small size of Mercury the Eclipse Glasses you may have used for the eclipse of 2017 will not be enough.

You'll need a Full Spectrum Solar Filter that attaches snugly to the **FRONT** of a telescope or binoculars. ( *NOT one that screws in an eyepiece that can overheat and shatter* )

Filters can be purchased commercially, or you can build one yourself.

These are made from a specially coated material that reflects **99.99 %** of the sun's light plus Infrared and Ultraviolet energy.

Details to **BUILD A SAFE SOLAR FILTER** for your telescope, binoculars or camera

Can be seen in our March 2017 newsletter. [http://astrotulsa.com/CMS\\_Files/201703.pdf](http://astrotulsa.com/CMS_Files/201703.pdf)

John Land has a limited amount of this material available

Contact him at [Tulsaastrobiz@gmail.com](mailto:Tulsaastrobiz@gmail.com)



Twenty-Nine of our members attended Okie-Tex 2019 Above is the TULSA Scopes Row



Top - L-R - Don Bradford - Zoe Smith - Dennis Berney  
Bottom - Ed and Denna Underhill - Jerry Cassity Center - John Land Lower Rt



Everyone Loves the meals from Jody's Catering in Boise City, OK  
 Bottom Right – Looking for Bargains at the Swap Meet



Steve Chapman with award for most attended Okie-Tex events



Cory Suddarth – Collimates Binoculars  
 Suddarth Optical Repair of Henryetta, OK  
<https://suddarthoptical.com/>

# TREASURER'S and MEMBERSHIP Report

BY JOHN NEWTON



As Oct 22, 2019, the Astronomy Club of Tulsa has **151 members. Including 35 new members.** Welcome to new members – **Eric & Jennifer Heckenbach and Michael Ward.** Hello and welcome to ACT! We look forward to seeing you at our meetings and at other club event gatherings. Also, a special 'Thank You!' goes out to our long term members for their continued membership, commitment to the club and support.

## Accounts as of Oct 22, 2019 -

Checking: \$ 6,112.97

Savings: \$ 5,782.60

Investments: \$ 24,496.99 (Value tends to fluctuate with markets).

The club now has PayPal available for you to start or renew memberships and subscriptions using your credit or debit cards. Fill out the registration form at <http://astrotulsa.com/page.aspx?pageid=16> Click Submit and you will be given the choice of either **mailing in your dues** with a check or using **PayPal** which accepts most major credit cards. A modest processing fee is added to PayPal transactions.

You may also renew your membership or join at one of our club events using your credit card by seeing one of our officers. We can take payments with the Square card reader. A small fee is also added on to these transactions.

**ALSO NOTE:** For our current members who are renewing their memberships, you can now go to a new link on the website to start your renewal process. On the home page, hover over the "Member" tab on the ribbon menu near the top of the page. Then select the "Membership Renewal" link and this will take to a page to fill out your information. Fill this out, submit it, then pay your dues by whatever method you choose.

**NEWS NOTE:** Both Sky & Telescope and Astronomy have free Digital subscriptions available with print subscriptions, or Digital subscriptions may be purchased separately. Details - Contact their websites

Membership rates for 2018 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.**

<http://www.astrotulsa.com/page.aspx?pageid=16>

**Magazine Subscriptions:** If your magazines are coming up for renewal, try to save the mailing label or renewal form you get in the mail. Forms are available on the club website.

**Astronomy is \$ 34 for 1 year, or \$ 60 for 2 years.** [www.astronomy.com](http://www.astronomy.com)

To get the club discount you must go through the club group rate.

**Sky & Telescope is \$ 33 per year** [www.skyandtelescope.com](http://www.skyandtelescope.com)

Sky & Telescope also offers a 10% discount on their products.

You may renew Sky & Telescope subscriptions directly by calling their number -**be sure to ask for the club rate.**

# Tracking and Identifying Anonymous ISON Satellites

**Long time Tulsa Astronomy Club member – Brad Young –  
shares how he observes lesser known satellites.**

Amateur satellite observers, including myself, rely on symbiotic relationships that involve observations based on predictions, followed by predictions based on observations, as derived by analysis with standard models. The key data derived in this process is the **3-line element** set or **TLE**. The TLE describes, at a certain point in time (epoch) the orbit of a satellite such that its state (position and velocity vector) at any other time can be estimated within limits of accuracy. A satellite position can then be predicted as a Right Ascension and Declination (RA/Dec) or Altitude and Azimuth (Alt/Az) in the sky, at a specific time of interest, if the observer's location in Latitude and Longitude (Lat/Long) is known.

The Russian based **ISON (International Scientific Optical Network)** provides a weekly update of a catalog listing manmade objects in Earth orbit for which no obvious match exists. The "ISON catalog" is maintained at <http://spacedata.vimpel.ru/>. As stated on that website, "Orbits with a period of over 200 minutes are mainly investigated, which basically include geostationary space objects and objects with large eccentricity orbits."

Using this resource, the services of remote telescopes, and the assistance of other amateurs involved in data analysis, radio tracking, and predictive methods, I have attempted over the last year to identify the "anonymous" objects of this catalog. In doing so, more than 50 objects have been identified beyond those previously matched with other sources, and only a few objects that have been regularly trackable remain unidentified.

## Artificial Satellites – Background

Artificial satellites in Earth orbit are described as one of three types (see Figure 1 below). Low Earth Orbit (LEO), Medium Earth Orbit (MEO), and High Earth Orbit (HEO). There are a few other types of satellites that orbit higher than the geosynchronous belt and the graveyard orbital range, but remain in orbit around the earth, not the sun. Lunar and planetary exploration vehicles, and some space observatories are in solar orbit.



**FIGURE ONE**

**ORBIT TYPE BY HEIGHT** [Source: Wikipedia]

## Satellite Tracking and Reporting by ISON and Others

All earth orbiting satellites are tracked by entities the world over. Perhaps the most important is the U.S. Joint **Space Operations Center (JSpOC)** that provides a wealth of technical information at its data portal <https://www.space-track.org/> about most objects on orbit. Its primary mission is Space Situational Awareness (SSA), a slate of products published to inform spacecraft operators of any collision dangers or other unforeseen problems. However, there are some satellites that are considered classified, and all or part of their data is not made public.

One of the other main entities that track satellites is ISON. As stated on the data portal, "OJSC Vimpel, which has a unique 40-years' experience in developing , testing and practical implementation of software for carrying out the various tasks associated with maintaining the catalog of artificial space objects...Hundreds of previously unknown space debris objects were found, including substantially large objects, that formed over decades of space activity, but which were not duly tracked by ground-based monitoring stations and as a result have been lost." This situation can come about from the many difficulties faced when tracking the tens of thousands of objects in orbit above us.

### Challenges Involved with Cataloging Earth Orbiting Objects

Besides the ever-growing number of satellites, spent rocket bodies, fairings, etc. that is expected from space exploration and use, there is an ever-growing amount of debris. Unplanned debris is caused by collisions between spacecraft, both accidental and purposeful, explosions or other violent disintegration of existing objects, and the occasional strange mishap such as the tool kit once lost by a spacewalking astronaut. Since even the smallest debris can cause catastrophic damage to operational satellites or manned missions, it is imperative that spacecraft operators are aware of any objects that may threaten their assets (Space Situational Awareness).

In addition, although the optical imaging equipment, radio signal receivers, and radar now used for tracking these objects are extremely sensitive, all have limits of resolution. Small objects, especially as orbital height increases, are, as one would expect, more difficult to track.

Analysis of observations with standard mathematical models has long been the tool used to generate predictions of where to search for each object to maintain a current catalog. As with all models based on empirical data, these have their limitations in accuracy, precision and scope. Smaller objects, such as debris, also present issues with predicting changes to their orbits, due to their typically high area to mass (A/m) ratio. And, because their origin is often unknown, the radar profile or optical characteristics (brightness fluctuations) may be difficult to model, as the material may range in type from a piece of flat solar panel to a chunk of cylindrical metal tank. There are many perturbations that occur to the orbits of all artificial satellites. These include relatively consistent gravitational and relativistic effects due to the egg-like shape of the earth and the pull of the moon. But other variables, such as the drag of the atmosphere on LEO objects, and the pressure of solar wind, must themselves be predicted by observation and modeling (e.g. space weather). Although the models and technology behind orbital mechanics and predictive methods is mature and robust, there is still a constant need for the latest data from many sources, all compiled together to improve prediction accuracy.

### Seesat and the Seeds of This Project

In the end, there are a large, ever growing number of objects that appear in the ISON catalog as published by JSC Vimpel. Most of the objects have been identified with either unclassified targets that are already reported by JSpOC, or classified missions. ISON reports its matches via the *datefirst.txt* file, updated regularly at the JSC Vimpel data site.

TLEs for the classified missions are available primarily due to the efforts of a small group known as Seesat, a unique global association of amateur satellite trackers. Originating from the legacy of the Moonwatch Program of the dawn of space exploration, this group consists of dedicated citizen scientists, many with decades of experience in a niche field. As with the scientific institutions, militaries and corporations, Seesat members observe objects based on predictions and submit positional reports. Analysts use orbital models to generate updated predictions from the reported data, completing the circle.

Regarding the ISON catalog, many previously unidentified objects have been recently matched with objects tracked by hobbyists. This success was due to the concerted efforts of the orbital analysts of Seesat. But, as is often seen with large repositories of data, there were many remaining objects regularly followed by ISON but not identified with any known satellite.

Beginning a little more than a year ago, I set out to try to identify more objects by imaging these objects myself. The purpose was to determine if any of the remaining catalog objects would be candidates for tracking by the amateur community. I also hoped to match some of these objects with either known unclassified or classified objects already appearing in the amateur list of targets.

This proved to be as rewarding and demanding a project as I have enjoyed in forty years as an amateur astronomer. I had no experience with imaging until 2016, when I began citizen science efforts such as Target Asteroids and variable star photometry (AAVSO). By building on those experiences, using remote telescopes, and the feedback of my fellow Seesat enthusiasts, I began addressing a set of goals.

In February 2019, I provided to Seesat an early version of this article, detailing the work done and what might lay ahead for further study. This final article presents a conclusive report of what has been accomplished, and how amateur tracking of ISON objects should mature from here. The details of the methods, results, and analysis appear in the following sections.

## Scope of the Study

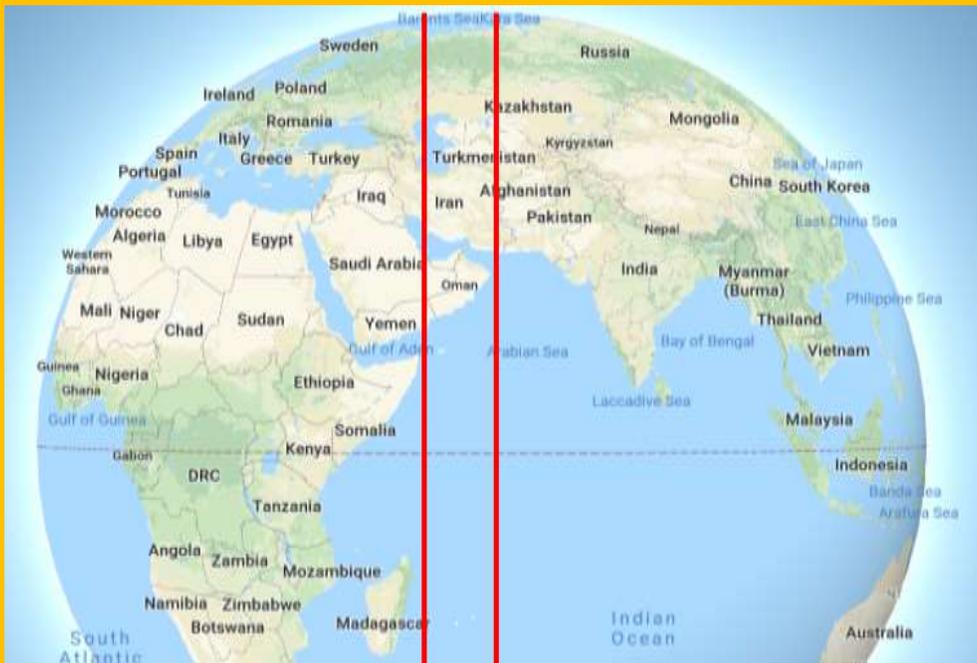
Among the hundreds of ISON objects are most of the classified satellites cataloged (as *classfd.tle*) and tracked by Seesat. Through the arduous efforts of many observers and analysts, most of the *classfd.tle* objects were correlated with ISON objects prior to this study. However, there remained a fair number of objects being routinely tracked by ISON that were reported to have standard magnitudes of 8.0 or brighter. This indicated these objects might be independently monitored by hobbyists, and perhaps identified. I had been observing ISON objects but had not systematically approached tracking them. I developed an unidentified ISON target list, widened my approach with global remote imaging, and set these goals:

1. *Identify more of these anonymous ISON objects using the Space-Track and Seesat TLE files*
2. *Determine which objects are consistently trackable using equipment available to amateurs*
3. *Identify origin of objects that are trackable but do not directly correlate with known objects*

## Methods

### Object Selection

Objects were selected based on several factors. Generally, objects with a standard magnitude of 8.0 or higher (therefore dimmer) were excluded. Stationary objects were restricted by the longitude ranges observable by the equipment available, though with the addition of the Perth Observatory, only longitudes 48° to 56° E were invisible (see Figure 2 below). Several objects have been lost by ISON or I have decided to drop them from my study because of multiple failures in recovering them. Objects that were previously included in *classfd.tle* in number ranges 90XXX have also been removed from the active list, as they are already available for hobbyist tracking. Although I had previously seen several objects before beginning this study, I rejected all previous tracking due to a lack of complete records and consistent approach.



**FIGURE TWO**  
**LONGITUDINAL COVERAGE OF REMOTE IMAGERY**  
*Approximate; only areas between red lines are not available*

### Predictions

The weekly updates provided at the JSC Vimpel data portal are osculating Keplerian elements. Members of Seesat provided a program (*cvelems.exe*) that converts these to TLE format. By maintaining a data file (*cvnames.txt*) of identified objects, the TLE set can be kept up to date as more correlations are made. Then, prediction of targets of interest proceeds as normal.

### Imaging

Images of the RA/Dec expected at a certain time are made, using the remote telescope system of the site most likely to acquire the target. None of the professional level systems used herein can track satellites based on a TLE, whereas amateur scopes using systems like Argo Navis currently can do so. Therefore, a set of exposures or wide field imaging is used in case of inaccuracies in the telescope plan or TLE. Then, the images are examined for trails, indicating an object that moved during the short (typically 20-60 second) exposures.

**Read all of Brad's Article with Data tables at - [http://satobs.org/seesat\\_ref/misc/ison\\_study.pdf](http://satobs.org/seesat_ref/misc/ison_study.pdf)**

**From Here**

What the results above represent to me is the potential for amateur satellite observers to act in an important citizen science role to provide a niche service to increase the level of Space Situation Awareness by data mining between sources of orbital data. Identification of unknown objects is an exciting and challenging effort that many may find onerous. However, much like any other systematic exercise, the reward may be as much in approaching the problem and executing the plan as in the specific results.

In conclusion, I would like to acknowledge the following organizations in this effort:

JSC Vimpel    Seesat    Perth Observatory

My hope is that this type of approach will foster open exchange of data, encourage amateur satellite tracking, and provide in some small way, an increase in our scientific knowledge. This project has been enlightening for me, as I had to learn or expand several astronomical skills and had the opportunity to work with some very experienced people whose proficiency in a very narrow field is astounding. I hope that this article has shed light on the exciting opportunities that await all amateur astronomers in the field of satellite observing.

Anyone who is interested in observing satellites using visual or imaging techniques, or has questions or comments, may contact me at [allenb\\_young@yahoo.com](mailto:allenb_young@yahoo.com)



**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](http://nightsky.jpl.nasa.org) to find local clubs, events, and more!

## **The Messenger Crosses the Sun: Mercury Transit Nov. 11, 2019** **By David Prosper**

Did you know that there are two other objects in our skies that have phases like the Moon? They're the inner planets, found between Earth and the Sun: Mercury and Venus. You can see their phases if you observe them through a telescope. Like our Moon, you can't see the planets in their "new" phase, unless they are lined up perfectly between us Earthlings and the Sun. In the case of the Moon, this alignment results in a solar eclipse; in the case of Mercury and Venus, this results in a transit, where the small disc of the planet travels across the face of the Sun. Skywatchers are in for a treat this month, as Mercury transits the Sun the morning of November 11!

You may have seen the transit of Venus in 2012; you may have even watched it through eclipse glasses! However, this time you'll need a solar telescope to see anything, since eclipse glasses will only reveal the Sun's blank face. Why is that? Mercury is the smallest planet in our solar system, and closer to the Sun (and further away from Earth) during its transit than Venus was in its 2012 transit. This makes Mercury's disc too small to see without the extra power of a telescope. Make absolutely certain that you view the transit via a telescope equipped with a safe solar filter or projection setup. Do NOT combine binoculars with your eclipse glasses; this will instantly burn a hole through the glasses – and your eyes! While most people don't have solar telescopes handy, many astronomy clubs do!

What a fun opportunity to see another planet during the day! This transit is expected to last over five hours. Folks on the East Coast will be able to watch the entire transit, weather permitting, from approximately 7:35 am EST until around approximately 1:04 pm EST. Folks located in the middle of North America to the west coast will see the transit already in progress at sunrise. The transit takes hours, so if your weather is cloudy, don't despair; there will be plenty of time for skies to clear! You can find timing details and charts via eclipse guru Fred Espenak's website:

<http://www.eclipsewise.com/oh/tm2019.html>

Mercury's orbit is small and swift, and so its position in our skies quickly changes; that's why it was named after the fleet-footed messenger god of Roman mythology. In fact, if you have a clear view of the eastern horizon, you'll be able to catch Mercury again this month! Look for it before dawn during the last week of November, just above the eastern horizon and below red Mars. Wake up early the morning of November 24th to see Mars, the Moon, and Mercury form a loose triangle right before sunrise.

Discover more about Mercury and the rest of our solar system at [nasa.gov](http://nasa.gov)

You are invited to come join us to learn more about  
Astronomy and view the wonderful sights in the night sky.

Check our Events Page of Dates [Link to Events Page](#)



During the school year our club holds a  
**Monthly General Club meetings** at  
**Jenks Public Schools Planetarium**  
**205 East B St, Jenks, OK**  
**Located North of the intersection of**  
**1st and B St**  
**Meetings begin at 7:00 PM**

Take the elevator to the 3<sup>rd</sup> floor.

[Click for Google Map Link](#)

**2019** See the [Fall Planetarium Show Schedule](#)  
Then click the **Date Column** to sort them by show date



## Sidewalk Astronomy Night

East side of Bass Pro in Broken Arrow near the lake.  
101 Bass Pro Drive, Broken Arrow, OK

[Click Map Link here](#)

On a Saturday evening near the 1<sup>st</sup> Quarter moon Astronomy Club volunteers set up telescopes to share views of the moon, planets and other bright objects. It's a come and go event where shoppers and restaurant goers get a chance to experience glimpses of the universe with their own eyes.



## 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.

### **PUBLIC OBSERVING NIGHT** on a Saturday

This event is open to individuals and families.  
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. [Link to Events Page](#)  
[Click for Observatory Map](#)

CAUTION: **DO NOT** use GPS it will likely send you on some nearly impassible back roads.

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