



OBSERVER

FEBRUARY 2020

Bringing Stars to the eyes of Tulsa since 1937

Editor - John Land



Image of Double Cluster in Perseus by Bill Collier

This image is the product of nine stacked 120 sec exposures with a Canon XSi Rebel camera through a Meade LX70 R6 6 inch f5 Newtonian at prime focus guided with st80 Orion 3 inch refractor with PHD.

The location was Natural Falls State Park, OK on Oct 17, 2017.

The image above was processed with PixInsight software. On page 6 you can see a previous version of this photo using the same input exposures but processed with generic free software.

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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.

FEBRUARY				
SIDEWALK ASTRONOMY	1ST Q	SAT, FEB 1	18:00	BASS PRO
PUBLIC NIGHT	LAST Q	SAT, FEB 15	17:30	OBSERVATORY
MEMBERS' NIGHT	NEW	FRI, FEB 21	18:00	OBSERVATORY
TELESCOPE WORKSHOP		SAT, FEB 29	10:30 - 14:30	TASM Planetarium
SIDEWALK ASTRONOMY	1ST Q	SAT, FEB 29	6 PM - 9 PM	TASM Planetarium
MARCH				
GENERAL MEETING		FRI, MAR 6	19:00	JENKS PLANETARIUM
OBSERVATORY WORKDAY		SAT, MAR 7	9:30 AM >	OBSERVATORY
DST BEGINS	FULL	SUN, MAR 8		
PUBLIC NIGHT		SAT, MAR 14	19:00	OBSERVATORY
ST PATRICK'S DAY	LAST Q	TUE, MAR 17		
JENKS P Sch SPRING BREAK		MON, MAR 16 - FRI, MAR 20		
VERNAL EQUINOX		THU, MAR 19		
MEMBERS' NIGHT		FRI, MAR 20	19:30	OBSERVATORY
MESSIER MARATHON	NEW	SAT, MAR 21	TBA	TUVA
OBSERVATORY WORKDAY		SAT, MAR 28	9:30 AM >	OBSERVATORY



Telescope 101 Workshop



Rescheduled for **Saturday Feb 29, 2020 from 10:30 AM to 2:30 PM**
Guests will need to reregister for this new date.
At the Tulsa Air & Space Museum Planetarium

Registration is required to reserve your time slot
Register OnLine at <http://www.TulsaMuseum.org/events>

Or Call 918-834-9900 to reserve your spot

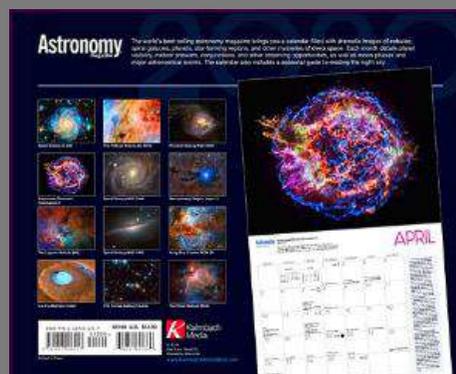
Note: Registration page will not be active until early February.

Saturday Feb 29 **evening Star Party at TASM 6:00 to 9:00 PM**

Open to Public and Workshop guests –
so bring your telescope back and try it out.

Got a brand-new telescope, or maybe an old one gathering dust...that you need some help learning to use? Be sure to bring all accessories and manuals that come your with telescope. Due to demand for this event, we have a limited number reservations available.

A limited number of **2020 Astronomy Magazine Wall Calendars** are still available to be picked up a club meeting. If you would like to reserve one, please email at 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



PRESIDENT'S MESSAGE

BY TAMARA GREEN



Hey Y'all,

Sadly, our January Telescopes 101 workshop was cancelled due to slick and dangerous roads.

BREAKING NEWS: Workshop is rescheduled for Saturday Feb 29th Details to follow.

Our upcoming events we have for February that we will need volunteers for are as follows:

Sidewalk Astronomy on Saturday, Feb. 1, at Bass Pro, starting at 6:00 PM.

Public Night on Saturday, Feb. 15, at the Observatory, starting at 5:30 PM.

Our annual **Messier Marathon is scheduled for Saturday, March 21 at TUVA**. I will be getting with Ron and Maura, our gracious hosts for the past many years, very soon to iron out the details. Again, I will be leading the caravan to TUVA on that day. There will be a potluck and group photo, and then the marathon fun will begin! I will be sending out a Messier Marathon packet very soon, along with more details about the marathon and caravan. Please note that the Messier Marathon is a members-only event and is NOT open to the public. If you have any questions about the event, contact me at astrotulsa.pres@gmail.com

We will be co-hosting the **MidStates Astronomy Convention - MSRAL 2020** with Broken Arrow Sidewalk Astronomers! MSRAL will be from **Friday, June 12 thru Sunday, June 14**. **We really need volunteers to help with this event** as well. This will be the first time in 17 years that MSRAL has been in the Tulsa area, so we want to make this one a huge success! To volunteer, please contact me by email at astrotulsa.pres@gmail.com or Peggy Walker by email at email4peg@yahoo.com

In order to get our Observatory ready for MSRAL, we will need to have a couple of workdays. I will get with James Taggart to discuss these workdays and what needs to be done to get it MSRAL ready. We will need all the help we can get! I will be sending out more info on what days / times once we get those ironed out. There is a lot of work to be done, so the more helping hands we have, the better! I will do my best to select dates on which it won't be too cold or hot to work.

Clear Skies,

Tamara Green

BREAKING NEWS – At our January Board meeting it was decided to hold **Observatory Clean Up and Work Days on Saturday March 7 and Saturday March 28**. **Starting at 9:30 AM** or as soon as you can come.

INSIDE - we have lots of cleaning and rearranging to do as well as some painting in the restroom area walls and floor.

OUTSIDE: We need to trim and clean up the fence line. Cut down some of the brush and trees. Especially sweep up debris on the paved parking area next door.

Bring Work Gloves, Cloths and Tools – Weed Trimmers – Manual Pruners – Wide Brooms – Paint Brushes. Etc. - Chain Saws

To volunteer - Contact our Observatory Manager James Taggart

- astrotulsa.obs@gmail.com

February Sky Happenings



The Planets Venus and Mercury are putting on a good show in the western sky after sunset. You can't miss **Venus** blazing at magnitude -4.2 in western sky. The best time to view Venus in your telescope is before twilight ends to reduce the contrast between the planet and that sky. **Mercury** is putting on its best evening. Look for it low in the WSW 30 mins after sunset. Look for a -1.0 golden "star" about 10 degrees above the horizon. You may want to use binoculars to locate it and then look for it naked eye. Mercury reaches its greatest elongation on Feb 10th.

Mars, Jupiter and Saturn are hanging out in the predawn sky in the SE. Mid-February Mars rises about 4:00 AM - Jupiter at 5:00 AM and Saturn at 5:40 AM Sunrise is 7:14 AM

On **Mars Occultation Feb 18th** Get outside by **5:30 AM** and look for Mars to the lower left of the waning crescent moon. Although you can see them naked eye, use your binoculars or low power telescope to watch as the moon slips closer to Mars, finally occulting it about 5:45 AM Mars won't reemerge on the other side until about 7:15 AM after sunrise. The moon will be near Jupiter on Feb. 19 and Saturn Feb. 20



Why is Betelgeuse Dimming?

Orion is the most recognized winter constellation familiar to the public and as well as astronomers. It contains two of the 10 brightest stars as well as other 5 other stars brighter than 2nd magnitude. The jewel of the Orion stars is the bright orange star Betelgeuse in its upper right shoulder. Betelgeuse is a super red giant star 500 light years away. It gets its reddish color from its relatively cool temperature of 3,100 Kelvin. Our sun is 5,780 K. Despite its cooler surface it is 9,000 times visually brighter than our sun. If you include its infrared energy its total luminosity is 100,000 times larger. So why is it so much brighter? It's SIZE. Averaging around 650 times the Sun's diameter! Placed in our solar system its outer surface would reach 3.4 AU encompassing most of the asteroid belt.

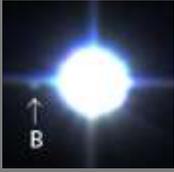
However Betelgeuse is behaving strangely this winter. Since Sept it has dimmed from 10th brightest star at 0.5 mag to 21st place at 1.5 mag in January. That's 2.5 x dimmer – noticeably dimmer to the naked eye.

Betelgeuse is an aging star that pulsates in size from 500 to 900 times the size of the sun this accounts for some of the magnitude change. But this recent dip is significantly more. So go out and take a look for yourself.

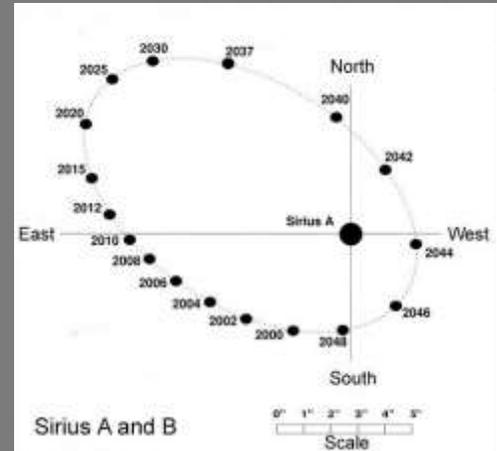
Since the star is 15 to 17 times the mass of the Sun it will probably end its days in a spectacular supernova bright enough to see in the daytime for a few months. There's been some hype in the media about Betelgeuse, but remember the life cycle of stars is measured in millions of years. To read what scientists are saying about the star, go to <https://www.skyandtelescope.com/observing/fainting-betelgeuse/>

Take the Sirius Challenge

The brightest star in the winter sky is the **-1.44 mag Sirius** in the constellation Canis Major. Look for it to the lower left of Orion. Sirius is also the closest easily visible from the Oklahoma lying a mere 8.58 light years away. Astronomers had deduced Sirius likely had a companion nearby as early as 1844 but it was not observed visually until 1862. Today we know that its companion is a + 8.4 mag white dwarf star. A white dwarf is a stellar corpse on a star whose core has run out of fusion fuel. Without the heat of fusion firing its core to hold up its outer layers, gravity causes the remaining mass to collapse down to about the size of the Earth with a density of about 25 tons per cubic inch. Sirius' companion Sirius B nick named the "Pup" has a mass similar to the Sun.



Sirius A and B orbit each other with a period of about 50 years with an average distance of about 20 AU. Observing the "Pup" is a real challenge due to the glare of Sirius A so nearby and the small separation angle between the pair. Due to their eccentric orbit the next few years present a good opportunity to try to see the "Pup". Currently their separation is about 10" - about 1/4 the apparent diameter of Jupiter. Various tricks are suggested for finding it. Placing Sirius A just out of view - making an occulting mask in the focal plane. If you're using a reflector it needs to be well collimated with clean optics. Look for the "Pup" near the diffraction spikes. I have seen it once in the later 70's using an 8" f 8 reflector. The links below offers suggestions for meeting the Sirius challenge. If you are successful send me an email describing your adventure.



<https://www.skyandtelescope.com/observing/sirius-b-a-new-pup-in-my-life/>

<https://florin.myip.org/blog/how-see-sirius-b>

Comparison Images of Double Cluster in Perseus



Bill Collier offers this comparison of his Double Cluster shots processed with different software.

For the jollies I have attached my recent redo of the double cluster in Persus astrophoto. I bought PixInsight over Christmas and spent much of the holiday learning and using it. It is fairly formidable to learn to use, but Warren A. Keller's Inside PixInsight book was the magic key for me. Once I got it somewhat figured out, and used it, the results are very stunning. It is easily the best package out there, nothing else compares to it. Two jpg astrophotos are attached. One is the best I could do with DeepSkyStacker (DSS) and GIMP (Generic IMImage Processing shareware) on the double clusters. The second one is the exact same set of photo files redone with only PixInsight to stack and process the photos. I am happy as a lark over the software and recommend it to anyone with the courage to plunge into its use. Buy the Keller book if you do.



Tulsa – Perth Astronomical Cooperation



2019 Annual Report

BY BRAD YOUNG

CONTINUING SUCCESS THE OPPORTUNITY TO USE A REMOTE PROFESSIONAL GRADE TELESCOPE IN PERTH, AUSTRALIA FOR CITIZEN SCIENCE CONTINUED IN 2019. ROGER GROOM OF THE PERTH OBSERVATORY CONTINUES TO SUPPORT ME AND MAINTAIN THE TELESCOPE, ALONG WITH A BUNCH OF OTHER VOLUNTEERS THAT ARE DEDICATED TO KEEPING THE RESOURCES AT THE PERTH OBSERVATORY IN ACTION. REMEMBER, THE ONLY THING KEEPING YOU FROM DOING THE SAME THING IS, WELL, YOU. THE **ASTRONOMICAL LEAGUE (AL) NOW HAS A PROGRAM (CITIZEN SCIENCE) THAT RECOGNIZES YOUR WORK IN SUPPORT OF ASTRONOMY VIA YOUR OWN OBSERVATIONS AND/OR REVIEWING IMAGES AND DATA RECORDED BY OTHERS [NO EQUIPMENT NEEDED EXCEPT A PHONE OR COMPUTER]**. YOU CAN HELP INCREASE OUR UNDERSTANDING OF THE UNIVERSE WE LIVE IN BY GETTING INVOLVED AND REPORTING WHAT YOU FIND. THE PROJECTS RANGE FROM REVIEWING DATA ON AN APP, REQUIRING MINIMAL ASTRONOMY EXPERIENCE OR KNOWLEDGE, TO INDEPENDENT RESEARCH GRADE WORK USING YOUR OWN OR REMOTE

ACTIVITIES After a good year in 2018, and using the lessons learned from various activities, plans were made for 2019 Citizen Science activities. The involvement of the AL and other astronomy organizations as pro-am collaboration continues to grow and evolve. A general review of those plans and results, and specifically those projects using equipment at Perth, follows:

Plan for 2019 was

Activity	Planned Improvements	2019 Results
Target Asteroids	N/A	Observed and reported a few TA targets
Annual ISAC NEO search campaign (PAN-STARRS)	N/A	
Independent searches using imagery from Perth	Coordinate searches with Catalina Star Survey at SSO (Siding Spring Observatory)	Started collaboration with professor in Austria, and others in Poland. They elected not to move forward; I am currently reviewing data for possible publication in Minor Planet Bulletin
Recurrent nova and other enigmatic sources	Improve efficiency and reduce error	Done
Follow up GRB alerts from SWIFT	Identify contact and begin this effort	Not done
AAVSO time sensitive alerts and projects	Improve efficiency using AAVSO VPhot. Try other photometric filters, as needed.	Done
General surveys for extragalactic supernova	Not needed. Use Rochester site for alerts.	N/A
PHOTOMETRY OF ASTEROIDS TO DETERMINE ROTATIONAL PERIOD	Continue reports to IASC but expand to include MPC	Sending to MPC did not work out. IASC continues to receive and use.
SUPPORT SPACE BASED PROGRAMS		
Chandra Xray observatory	Continue as required	Done
Hubble	Continue as required	Done
SWIFT	Identify contact and begin this effort	Not done
NEOWISE	Continue as required	No activity
Geographically advantageous imaging:(2)	Continue as required	Done
Test images, self-training	Complete	N/A

Plan for 2020 is

Activity	Overall Status	Perth Specific Status
• Support NEO search and monitor programs including:		
o Target Asteroids	Continued imaging of select asteroids to support future missions.	48 image runs for 7 targets
o Annual ISAC NEO search campaign	2019 campaign completed with team	N/A
o Collaboration with European observers to determine asteroid rotational periods	Completed imaging - publish periods and determine 2020 plans	56 image runs on 2 specific targets as requested (Note 1)
• Support of AAVSO variable star observation from Southern Hemisphere, with emphasis on:		
o Recurrent nova / other enigmatic sources	Continuing per AAVSO cadence	471 photometry reports 68 targets
o AAVSO time sensitive alerts and projects	Per AAVSO alerts and bulletins	4 targets
o Long period variables (Note 3)	Continuing per AAVSO cadence	4 targets
o Spectroscopy	Per AAVSO alerts and bulletins	Just starting - reviewing images
• Support of space-based programs	Chandra Xray and Hubble	5 targets
• Geographically advantageous imaging:	Southern latitude, longitude range	2-3 targets
• <u>TruSat</u> Satellite Tracking (Note 4)	Observing priority items	484 points on 124 items
1. Total of 1,077 images provided to collaborators and Target Asteroids team, including special request on NEO flybys.		
2. Occasional images of comets, minor planets, and other transitory targets less visible from other geographical locations		
3. High priority items (unobserved too long) as identified by LPV Observing Section of AAVSO. Started in December.		
4. New citizen science program, uses phone app driven, worldwide, crowdsourced tracking of satellites and provide blockchain secured data transparency.		

JUST FOR FUN If you've ever considered doing Citizen Science work, the opportunities are growing all the time. You can do anything from simple image analysis on your phone when you're bored, to highly technical work such as searching for planets around other suns (exoplanets) and watching out for Near Earth Objects that may be hazardous to Earth.

A new citizen science resource, TruSat, will be the subject of another article and a presentation at our club's **March 6 general meeting**. TruSat (developed by ConsenSys Space) is a crowd sourced satellite orbit determination project with a phone app user interface and global scope and involvement. As the Advisory Consultant for ConsenSys Space, I have been involved since very early in the project, on the satellite tracker (user) side of development. Stay tuned...

The Astronomical League (you're automatically a member if a member of the Astronomy Club of Tulsa) has recently begun a Citizen Science Program which encourages involvement and has certificates of achievement just like the other observing programs. Check it out at [AL Citizen Science Program](#). Even if you don't pursue the certification, this is a great resource for CSA (Citizen Science Activities).

If you're considering using remote telescope imaging systems, I experience with a few institutional and all the major commercial services. Contact **Brad Young** (allenb_young@yahoo.com) to discuss any of these subjects. Consider adding your astronomy efforts to the Astronomy Club of Tulsa (TUPAC) team!

ACKNOWLEDGEMENTS Thanks again to Roger Groom of Perth Observatory, for providing the service, maintaining the equipment, and answering many questions. I look forward to working with him again in 2020 and expanding my CSA to include spectroscopy and perhaps more asteroid photometry and rotational determination.

TUPAC

Tulsa – Perth Astronomical Cooperation

By Brad Young

I forgot last year to thank Michael Hotka and Vic Grossi, my teammates from “Route 66 Rocks Again”, one of the highly successful measuring teams from the last 3 IASC NEO search events. This year’s campaign fell right amongst my 2 wrist surgeries within a month, so they had to do all the writing and real work. Thanks to Dolores Hill for inviting us to get involved searching for NEO objects and helping determine what asteroids should be mapped and visited. After the official campaigns are over, she has directed me to other targets useful to the Osiris-REX and Target Asteroids programs. These were usually imaged at Perth, especially those poorly placed for us up north.

This year, I have, as said above, gotten to work with the TruSat developers: Brian Israel, Chris Lewicki, Michael Deal, and Kim Macharia. I am excited to help them; their approach has been to make satellite tracking a more approachable activity for all, while promoting a safer orbital environment. Perth has been an invaluable resource for satellite observation in a longitude swath not covered by other equipment. Most of all my wife and kids have been a great help as I transitioned from corporate cog to a much more satisfying endeavor.

Other CSA Resources and Ideas:

<https://www.trusat.org/>

<https://science.nasa.gov/citizenscience>

<http://iasc.cosmosearch.org/index.html?>

<https://www.astroleague.org/content/citizen-science-program>

Starlight, Star Bright – Or - Too Many Satellites tonight?

By John Land

Occasionally I'm asked why I love astronomy. My answer usually includes how my mother and I used to go outside to watch THE satellite go over. There was only one easily visible then. A bright 10 story tall shiny balloon called [Echo I](#) in the early 1960's. It was a passive communications satellite that could bounce microwave signals across the Atlantic or the United States for a few minutes as it crossed over. It was soon replaced by active commercial communications satellites called Telstar. Thus began the era of



Space X Starlink satellites was spotted in Darbyshire

worldwide communications via space satellites. Today we frequently see them moving silently overhead during observing sessions – one maybe two visible for a few minutes and then they are gone.

Sunday evening Dec 22, I went outside to set up my telescope mount and align it toward our 2nd magnitude north star, Polaris. I noticed just below Polaris an equally bright satellite passing just below it. Then another and Another and **Another** ! This went on for several minutes a string of satellites about 10 degrees apart moving from the W to NE. Member Brad Young saw the same train of satellites again before dawn the next morning. What we witnessed was a line of Spacelink satellites put into orbit by the Space X Corporation. These were launched Nov 11 – the 3rd set since May of 2019. (A 4th launch was made the last week of January 2020)

Disclaimer: I'm no expert on this topic. The majority of the information comes from a 2020 **March Sky & Telescope** article which will be noted by [S&T](#) Also an informative [YouTube video blog](#) describing the Commercial advantages and logistics of the SpaceX Starlink satellite system denoted by **YTv**



^ **YTv**

S&T SpaceX has begun launching a mega-constellation of 1,584 Starlink satellites into 24 orbit plain – 66 per plain. They have also applied to the FCC to move the same number of satellites into 72 orbit plains. The satellites are designed to provide Broad Ban Internet service to the many rural or 3rd world regions that have no service.

Costing \$ 300 K, each of the 500 lb satellites are planned for a final orbit of 340 miles. (ISS orbits @ 250 mi) At that altitude they should have a downlink coverage of a circle about 300 miles in diameter. (Okla. Is about 310 miles wide) To provide worldwide coverage the satellites communicate with each other using 5 lasers. They use Krypton Ion thrusters to maneuver to higher orbits and also to avoid collisions with other satellites or space debris.

How bright will these satellites be? Shortly after each launch they are easily visible to the naked eye at 2nd mag or so. At their planned orbit - amateur astronomers who specialize in observing satellites have measured their magnitude at around 6th mag. While not visible from urban areas they will be visible from dark sky sites loved by astronomers. Also astrophotographers will likely encounter them in many of their photo sessions. Requiring them to reject exposures or use software to try to remove the satellite streaks.



^ **YTv**

Professional astronomers are greatly concerned. The Large Synoptic Survey Telescope (LSST) currently under construction will be taking 10 degree wide images with a 3.2 gigapixel camera. Every 3 days it will survey the entire sky visible from its location in Chile. Part of its mission is to identify asteroids that could potentially strike Earth. Since it is designed to take images down to 16th mag Each satellite trail will totally saturate large segments of many images.

SpaceX is not the only competitor in this multi-billion dollar adventure. A company called OneWeb is already launching 648 larger satellites into 745 mile high orbits. France & other countries also have plans for similar ventures.



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!

Betelgeuse and the Crab Nebula: Stellar Death and Rebirth **By David Prosper**

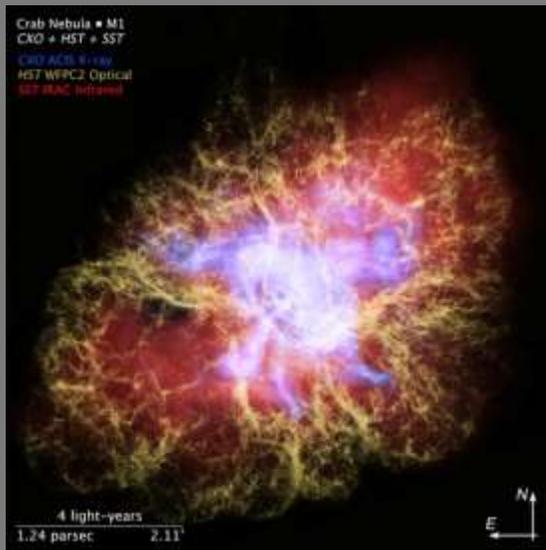
What happens when a star dies? Stargazers are paying close attention to the red giant star **Betelgeuse** since it recently dimmed in brightness, causing speculation that it may soon end in a brilliant supernova. While it likely won't explode quite yet, we can preview its fate by observing the nearby **Crab Nebula**.

Betelgeuse, despite its recent dimming, is still easy to find as the red-hued shoulder star of Orion. A known variable star, Betelgeuse usually competes for the position of the brightest star in Orion with brilliant blue-white Rigel, but recently its brightness has faded to below that of nearby Aldebaran, in Taurus. Betelgeuse is a young star, estimated to be a few million years old, but due to its giant size it leads a fast and furious life. This massive star, known as a supergiant, exhausted the hydrogen fuel in its core and began to fuse helium instead, which caused the outer layers of the star to cool and swell dramatically in size. Betelgeuse is one of the only stars for which we have any kind of detailed surface observations due to its huge size – somewhere between the diameter of the orbits of Mars and Jupiter - and relatively close distance of about 642 light-years. Betelgeuse is also a “runaway star,” with its remarkable speed possibly triggered by merging with a smaller companion star. If that is the case, Betelgeuse may actually have millions of years left! So, Betelgeuse may not explode soon after all; or it might explode tomorrow! We have much more to learn about this intriguing star.

The **Crab Nebula** (M1) is relatively close to Betelgeuse in the sky, in the nearby constellation of Taurus. Its ghostly, spidery gas clouds result from a massive explosion; a supernova observed by astronomers in 1054! A backyard telescope allows you to see some details, but only advanced telescopes reveal the rapidly spinning neutron star found in its center: the last stellar remnant from that cataclysmic event. These gas clouds were created during the giant star's violent demise and expand ever outward to enrich the universe with heavy elements like silicon, iron, and nickel. These element-rich clouds are like a cosmic fertilizer, making rocky planets like our own Earth possible. Supernova also send out powerful shock waves that help trigger star formation. In fact, if it wasn't for a long-ago supernova, our solar system - along with all of us - wouldn't exist! You can learn much more about the Crab Nebula and its neutron star in a new video from NASA's Universe of Learning, created from observations by the Great Observatories of Hubble, Chandra, and Spitzer: bit.ly/CrabNebulaVisual

Our last three articles covered the life cycle of stars from observing two neighboring constellations: Orion and Taurus! Our stargazing took us to the “baby stars” found in the stellar nursery of the Orion Nebula, onwards to the teenage stars of the Pleiades and young adult stars of the Hyades, and ended with dying Betelgeuse and the stellar corpse of the Crab Nebula. Want to know more about the life cycle of stars? Explore stellar evolution with “The Lives of Stars” activity and handout: bit.ly/starlifeanddeath .

Check out NASA's most up to date observations of supernova and their remains at nasa.gov

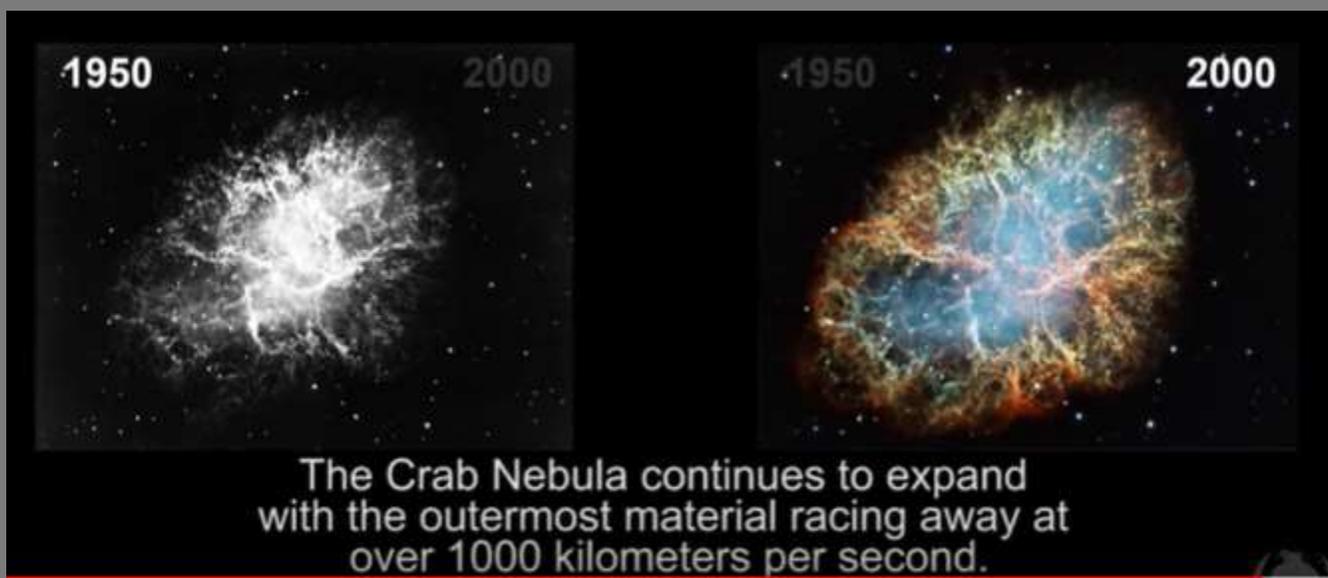


This image of the Crab Nebula combines X-ray observations from Chandra, optical observations from Hubble, and infrared observations from Spitzer to reveal intricate detail. Notice how the violent energy radiates out from the rapidly spinning neutron star in the center of the nebula (also known as a pulsar) and heats up the surrounding gas. More about this incredible “pulsar wind nebula” can be found at bit.ly/Crab3D Credit: NASA, ESA, F. Summers, J. Olmsted, L. Hustak, J. DePasquale and G. Bacon (STScI), N. Wolk (CfA), and R. Hurt (Caltech/IPAC)
Spot Betelgeuse and the Crab Nebula after sunset! A telescope is needed to spot the ghostly Crab.

The Crab Nebula also known as M 1 continues to expand at an astounding rate of 1000 Km / sec or 621 mi / sec **That’s 2,235,600 miles per hour**
 It is now over 6 light years across and still growing at the rate of about 1 AU in 3 days.

For an informative video go to <https://www.youtube.com/watch?v=iL12jNBwSec>

The Link below is a video of these two images overlapping to compare the expansion
<https://www.youtube.com/watch?v=S5GEQt-ypOI>



TREASURER'S and MEMBERSHIP Report

BY JOHN NEWTON



As Jan 24, 2020, the Astronomy Club has **155 members**

Welcome to new members – **Shanna Norwood, Dean Jones, Jared Thompson, Mary Lyn Jasinski, and Carol Gruhn.**

We look forward to seeing you at our meetings and at 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 Jan 24, 2020

Checking: \$ 6,628.71

Savings: \$ 5,783.33

Investments: \$ 26,201.58 (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

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

Sky & Telescope is \$ 33 per year 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.**

Astronomy Club of Tulsa – 2019 Annual Budget Report
By Club Treasurer – John Newton

Banking Summary - 2018 vs. 2019				
Category	Y'2018	Y'2019	Delta (Y'19-Y'18)	Notes/Comments:
INCOME REPORT				
Bumper Sticker Sales		41.95		
Calendar Sales- 2018	36.00	-	(36.00)	
Calendar Sales- 2019	(73.01)	55.00	128.01	
Calendar Sales- 2020		198.34	198.34	20 of 30 Calendars sold (at break even point!)
Calendar Sales	(37.01)	295.29	290.35	
Donation- General	646.79	898.88	252.09	Slight increase in general donations!
Donation- Group Event	146.00		(146.00)	Group events in 2019? No donations!
Donation- Raffle Tickets	487.00	356.92	(130.08)	Raffle ticket donations was down but still a boost
Donation- Star Party	613.83		(613.83)	Star Party events in 2019? No donations!
Donations	1,893.62	1,255.80	(637.82)	
Interest	1.70	2.89	1.19	Interest on Saving Acct
Bank Interest	1.70	2.89	1.19	
Astronomy Magazine paid-	494.03	664.79	170.76	
Sky & Tel Magazine paid	362.33	660.56	298.23	
Magazine Subscriptions (Income)	856.36	1,325.35	468.99	
Member Dinner Event	634.00	588.66	(45.34)	Annual Dinner Event - Attendance was off a little.
Membership- New	2,223.37	1,849.55	(373.82)	New ones off in 2019
Membership- Renewal	3,613.49	2,971.26	(642.23)	Renewals off in 2019
Memberships	6,470.86	5,409.47	(1,061.39)	Older members retiring!
TOTAL INCOME	9,185.53	8,288.80	(938.68)	

EXPENSES REPORT				
Annual Dinner - Food Caterer	554.75	554.75	-	
Annual Dinner - Room Reservation	300.00	200.00	(100.00)	Decrease in room cost
Dinner Expense	854.75	754.75	(100.00)	
Bank Fees	26.00	26.00	-	
Bank Fee	26.00	26.00	-	Checks refill
Magazine- Club Payment to Astron	629.99	632.00	2.01	
Magazine- Club Payment to Sky & T	461.20	659.00	197.80	
Magazine Subscriptions (Expense)	1,091.19	1,291.00	199.81	
Operating Expense- Astro League d	835.00	785.00	(50.00)	
Operating Expense- Events	243.61	500.75	257.14	
Operating Expense- Insurance	2,038.00	1,726.00	(312.00)	Insurance reduced 15%
Operating Expense- Misc Expense	106.38	70.00	(36.38)	
Operating Expense- Newsletter Pri	-	-	-	
Operating Expense- Observatory	5,015.69	444.24	(4,571.45)	
Water line Repaireak, tool rentals, plumbers, AC Unit replacement, shelving project, and finder scope				
Operating Expense- Post Office Box	140.00	154.00	14.00	
Operating Expense- Postage	28.79	-	(28.79)	
Operating Expense- Speaker Fee	200.00	110.83	(89.17)	
Operating Expenses	8,607.47	3,790.82	(4,816.65)	
Transfer	-	500.00	500.00	MSRAL Seed Funding
Utility Bills	-	500.00	500.00	
Utilities- Electric Co.	536.50	665.42	128.92	
Utilities- Water Co.	278.55	248.35	(30.20)	
Utility Bills	815.05	913.77	98.72	
TOTAL EXPENSES	11,394.46	7,276.34	(4,118.12)	
OVERALL TOTAL	(2,208.93)	1,012.46	3,179.44	
Need to improve income revenue while reducing expenses.				

Bank Accounts		
Checking:	1-Jan-19	\$ 5,787.30
	31-Dec-19	\$ 6,796.87
		\$ 1,009.57
Savings:	1-Jan-19	\$ 5,780.44
	31-Dec-19	\$ 5,783.33
		\$ 2.89

Total Investment Balance:	
1-Jan-19	\$ 21,637.56
31-Dec-19	\$ 25,592.53
	\$ 3,954.97
Increase:	18.28%
Market Fluctuation	

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 3rd 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 1st 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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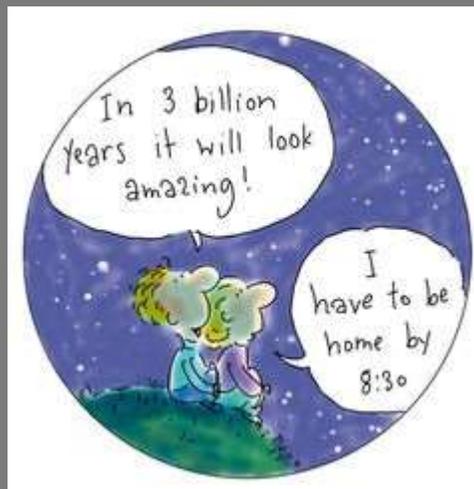
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NIGHT SKY NETWORK –
Open Position

WEBMASTER JENNIFER JONES



Tired of Jokes ReRUNS
Send in your Best Ones !

Riddle – When can you add 2 to 12
and the correct answer will be 1 ?

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