

THE OBSERVER



Galaxies Away - APOD February 8, 2007
Image Credit: NASA, ESA, Hubble Heritage Team

From the Desk of the President

by Tom Mozdzen

For your new year's resolution, one might resolve to start working on an observing award. At our last meeting, Wayne Thomas talked about the fun of completing an observing program. Be sure to browse the [various programs](#) to find one that you would think would be enjoyable to complete. Start checking those objects off to earn the satisfaction of completing the list and to take home an award.

If you were looking to get more involved with the club, we have two activity types that you might consider:

Opportunity 1: This month is one of the busiest months for outreach

events. If you can give Lynn Young and his crew a hand for any of the events, please let him know. Bringing a scope or being a knowledge resource would be helpful. If you plan to assist, please contact him at events@evaonline.org. The February events are on-line on the [calendar](#) and are summarized on the next page.

Opportunity 2: Claude Haynes is always looking for more help at the Observatory on Friday and Saturday nights. No experience necessary – the only requirement is an enjoyment of assisting people enjoy the wonders of the night sky, many who have never looked through an eyepiece. Task

UPCOMING EVENTS:

- EVAC Star Party - February 2*
 - EVAC Public Star Party - February 8*
 - EVAC Meeting - February 15*
 - EVAC Star Party - February 23*
- Check out all of the upcoming club events in the Calendars on page 13.*

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From the Desk of the President

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complexity ranges from counting the number of visitors to operating the telescope. If you are willing, there is a job for your experience level.

As discussed at the January meeting, we are looking into shirts and hats decorated smartly with our EVAC logo. Stay tuned for more details and let us know your interest level in such items.

February 23rd is ASU's Open House day, 1-6 pm. There are a variety of activities and exhibits across the Tempe Campus, including an exhibit about the upcoming [ASU led Psyche mission](#) to a metal asteroid. Click [here to explore the many choices \(page 1 of 8\)](#).

EVAC General Meeting Notes for January 2019

by Marty Pieczonka

Tom Mozdzen opened the meeting by introducing EVAC's Executive Officers, Board Members and Administrative Officers. After welcoming several visitors, Tom summarized the club's 2018 accomplishments which included:

- Bylaws Enhanced
- Policy and Procedures Document created and posted
- Successful Auction
- Insurance Fidelity Bond obtained
- Two signature CDs for our savings account money
- Facebook pages for EVAC and GRCO
- GRCO had over 17,000 visitors – listed as "A place to see when visiting Gilbert"
- Lynn Young and the Outreach group had 32 events reaching over 4,000 people

Brooks Scofield reported that the club was in very good financial shape and indicated that we will have a budget surplus for 2019. He also reported that we have 137 members a 20 percent increase from 2016.

Claude asked for volunteers to help out with the January 20th eclipse. He is also still looking for more volunteers for Friday and Saturday evenings at the observatory. Contact Claude if you can help out.

Bill Peters gave a member presentation on observing near-earth asteroids and auroras. Wayne Thomas, EVAC's Observing Programs Coordinator gave a talk on our Observing Programs and urged members to go to our website to try out one or more of the programs.

It is our goal to feature top notch speakers at our monthly meetings, and we welcome suggestions from our members. Please contact Rob Baldwin if you have a topic or speaker you'd like to recommend. Rumor has it that we will have Paul Davies on tap later in the year, who is about to publish his latest book titled, "The Demon in the Machine." If you are not familiar with Paul Davies, I suggest a Google search, and I believe you will then agree that he would be a very interesting speaker.

See you at the February meeting.

Tom Mozdzen

Tom reminded the membership that February is a very busy month for outreach and asked the membership to help out whenever they could. The dates and times are:

- Tues 5th 6:30 Kyrene de la Mariposa
- Wed 6th 6:30 C. O. Greenfield
- Thurs 7th 6:30 Navarette Elementary
- Sat 9th 6:00 Mesquite High School
- Mon 11th 7:00 Chandler Gilbert C.C.
- Wed/Thurs TBD NASA Grant Meeting at
- 13th & 14th Tempe Mission Palms
- Thurs 21st 5:00 Knox Gifted Academy
- Mon 25th 7:00 Chandler Gilbert C.C.
- Tues 26th 6:00 Hughes Elementary
- Wed 27th 6:30 Ryan Elementary
- Thurs 28th 6:00 Pomeroy Elementary

Our featured speaker was our Club President – Dr. Tom Mozdzen. Tom's presentation described what happened at the earliest epochs of the universe when the first stars and galaxies formed. He talked about the strength of the central black holes and their interactions with cold clouds of primordial hydrogen and then covered a paper his group at ASU published last March in the Journal "Nature". The paper described the first measurements of small variations in the Cosmic Microwave Background that puts solid constraints on some processes occurring at Cosmic Dawn. "Physics World", a publication based in the UK, included it in their top ten science breakthroughs of the year, based on the measurements being independently confirmed.

The Backyard Astronomer

by Bill Dellings (January 2019)

The First (and last) Northern Hemisphere Annual Deep Sky Academy Awards

Since the Academy Awards are presented this month, let us stargazers have a little fun with our own awards. The six categories are: Galaxies, Emission Nebulae, Planetary Nebulae, Globular Star Clusters, Open Star Clusters and Double Stars. The five nominees in each category are:

Galaxies: **M-31** (Andromeda), **M81** ("Bode's Galaxy"- Ursa Major), **M82** ("Cigar Galaxy"- Ursa Major), **M-51** ("Whirlpool Galaxy"- Canes Venatici), **NGC 253** ("Silver Coin Galaxy"- Sculptor).

Emission Nebulae: **M-8** ("Lagoon"- Sagittarius), **M-17** ("Swan"- Sagittarius), **M-20** ("Trifid"- Sagittarius), **M-42** (Orion Nebula), **NGC 2237** ("Rosette"- Monoceros).

Planetary Nebulae: **M-27** ("Dumbbell"- Vulpecula), **M-57** ("Ring"- Lyra), **NGC 2392** ("Eskimo"- Gemini), **NGC 3242** ("Ghost of Jupiter"- Hydra), **NGC 6826** ("Blinking"- Cygnus).

Globular Star Clusters: **M-2** (Aquarius), **M-5** (Serpens), **M-13** (Hercules), **M-15** (Pegasus), **M-22** (Sagittarius).

Open Star Clusters: **M-7** (Scorpio), **M-11** ("Wild Duck"- Scutum), **M-35** (Gemini), **M-44** ("Beehive"- Cancer), **M-45** ("Pleiades"- Taurus).

Double Stars: **Albireo** (Cygnus), **Epsilon Lyrae** ("The Double-Double"), **Beta Monocerotis** (Triple), **Gamma Velorum** (Triple), **Epsilon Bootis** (Izar or Pulcherrima – "Most Beautiful").

May I have the envelope please? And the winners are:

Galaxy..... **M-31** (The Andromeda Galaxy).

Emission Nebula.....**M-42** (The Orion Nebula).

Planetary Nebula..... **M-27** (The Dumbbell Nebula in Vulpecula).

Globular star Cluster..... **M-13** (Hercules).

Open Star Cluster.....**M-45**. (The Pleiades in Taurus).

Double Star.....**Albireo** (Cygnus).

NEW MOON ON FEBRUARY 4 AT 16:04

FIRST QUARTER MOON ON FEBRUARY 12 AT 17:26

FULL MOON ON FEBRUARY 19 AT 10:54

LAST QUARTER MOON ON FEBRUARY 26 AT 06:28

Wormholes

by Henry DeJonge

Awhile back I was wondering about wormholes again and if they were still being talked about in scientific circles. Upon investigating the scientific literature, I was surprised that perhaps now more than ever, they were being widely investigated, discussed very seriously, and even considered to be possibly detectable in the near future! Here is a very brief and light overview, (as they are mathematically complex) of some of the current thinking about these wild and strange "objects".

Wormholes were thought about and discussed soon after Karl Schwarzschild discovered his exact, static black hole, solution to Einstein's equation in 1916, and the metric "g" which is the solution to Einstein's Equation:

$$R_{\mu\nu} - \frac{1}{2}Rg_{\mu\nu} + \Lambda g_{\mu\nu} = \frac{8\pi G}{c^4}T_{\mu\nu}$$

became more deeply associated with curvature.

In the 1930s work by Einstein and Rosen, and the 1950-60s by work of many others, made use of the introduction of a new coordinate systems, (for example Kruskal-Szekeres) into the Schwarzschild metric which produced new ideas such as white holes and wormholes. These ideas were further investigated by such people as John Wheeler, Roger Penrose, Charles Misner, and Kip Thorne. In fact, Wheeler and Misner coined the term "wormhole" in a paper in 1957. Basically, the change of coordinates creates a "new" metric solution that highlights certain features of the spacetime and in the Schwarzschild case connects two planes via a "throat" aka the Einstein-Rosen bridge, (as imaged below in Figure 1).

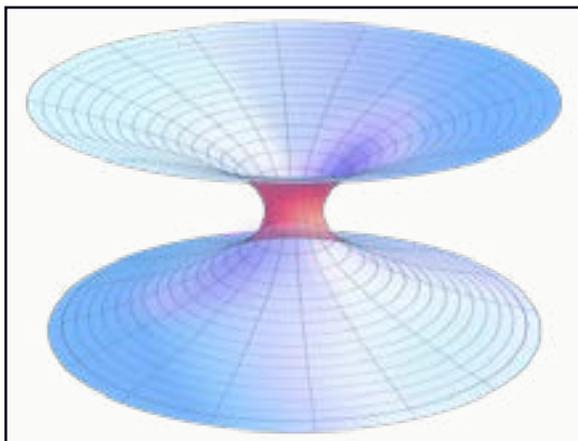


Figure 1. Einstein-Rosen Bridge

Wormholes are now considered part of a new class of potential, (theoretical) objects called ECOs-for exotic compact objects, which also include such objects as gravastars, naked singularities, and firewalls. Interestingly there had also been discussions of "drainholes" in our Universe in the 1970s-basically a topological hole in our spacetime, (to where?). In addition, the exciting new era of gravitational wave astronomy has re-kindled many ideas that were formerly thought of as too far-fetched or imaginary. Spectral analysis of a gravitational wave is an example that may help to open more doors in the future and possibly be able to detect some of these ECOs.

What are they?

Wormholes are simply hypothetical routes through spacetime; they act as a tunnel which connects two different regions of the same spacetime or two different spacetimes, (in a multi-verse). The literature is basically devoted to establishing their existence and feasibility and does not dwell deeply upon how they could be made. You do not necessarily need a black hole, (BH) to make a wormhole and in a well-accepted view of quantum spacetime structure, wormholes are actually created, (and destroyed) in the "quantum foam" on a continual basis. If they are already somehow present in our Universe maybe there is a way to harness them?

Topologically they can be described as a folding in the spacetime fabric, as depicted in Figure 2 below. Wormholes have been studied in higher than 4 dimensions by scientists such as Hawking since the 1970s, (they can sometimes be more probable in higher dimensional theories). Using the topological principle of homotopy, which can be defined as a continuous deformation of one continuous function to another, it has been shown mathematically that wormholes can be deformed by gravitational tidal effects as well as deformed and reduced to lower dimensions, (subspaces)! For instance, think of a wormhole that forms in 5 dimensions but then reduces to our "usual" 4. As an example of homotopy, think of a waving flag that changes in the wind but is topologically equivalent to a rectangle at all times, the way it is "imbedded" in 3-dimensional space varies with time.

Wormholes

Continued from page 4

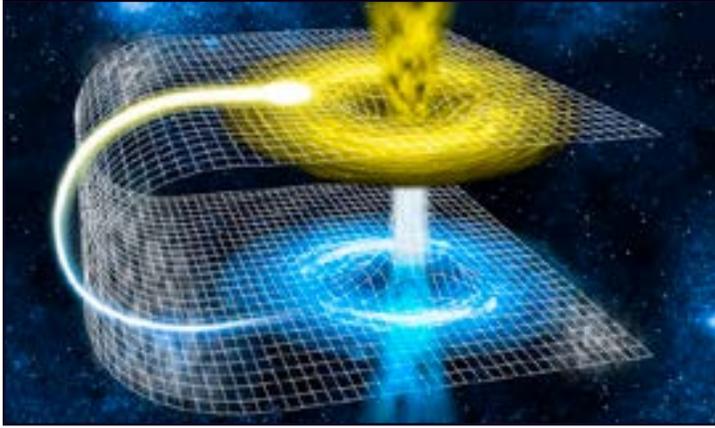


Figure 2. Topological artistic image of a wormhole.

How can they exist?

One of the main reasons that wormholes are thought not to exist is that they would violate the null energy condition, (NEC) which is often central in general relativity, (GR). This cannot be violated by the ordinary understanding of matter in our Universe-however by considering "exotic matter" this difficulty can be overcome. The NEC basically says that the energy density of matter is non-negative for any observer. It has to do directly with restraints on the components of the matter-energy tensor and is a "natural assumption" so that we are not discussing unrealistic physical universes. However, this restraining assumption of normal matter is often relaxed to allow for more exploration into solutions of Einstein's equation like wormholes.

Structurally, the throat of the wormhole is a surface of minimal area that connects the two regions while the two mouths are most likely spheroidal. The problem has always been the stability of such a wormhole. The matter distribution that retains the open throat cannot be realistic, as normal matter cannot do the trick, thus the need for exotic matter or other solutions. Essentially, the inside of the wormhole throat would need to be filled up with this exotic matter in order to be stable and traversable.

Likewise, in many GR theories, the no-go theorem says that a stable, static, spherically symmetric wormhole solution is forbidden, so that one must invoke nonstandard theories, (like scalar-tensor theories) which allow exotic matter usually in a "healthy" way. In some of these non-

standard theories (sometimes aligned with string theories) they also show that our Universe can bounce, (which relates to the big bang) and often show that the wormhole has a vanishing mass. Most theories assume that wormholes are symmetric with respect to their throats, however more complex theories can assume that they are asymmetrical.

In another paper it discussed that the need for exotic matter could be eliminated if one introduces torsion into Einstein's equation. This is basically saying that the geodesics are allowed to enter into other dimensional planes instead of being confined onto a single "fixed" spacetime, as usually in GR the torsion is equal to zero. Having a non-zero torsion allows more degrees of freedom to both matter and spacetime which can allow wormholes to exist without exotic matter. As an example of torsion, think of a helix, (DNA or a multi-story airport parking lot entrance/exit ramp) which has a constant curvature and a constant, nonzero, torsion. This idea to eliminate the need for exotic matter though seems to be valid only under certain conditions and is still highly debated.

Interestingly, it was shown by Wheeler and Fuller in the early 1960s that causality is preserved in general when traversing wormholes-that is you cannot go back and eliminate your existence, (also according to Hawking) or take a longer and shorter route to the same destination and violate the laws of physics.

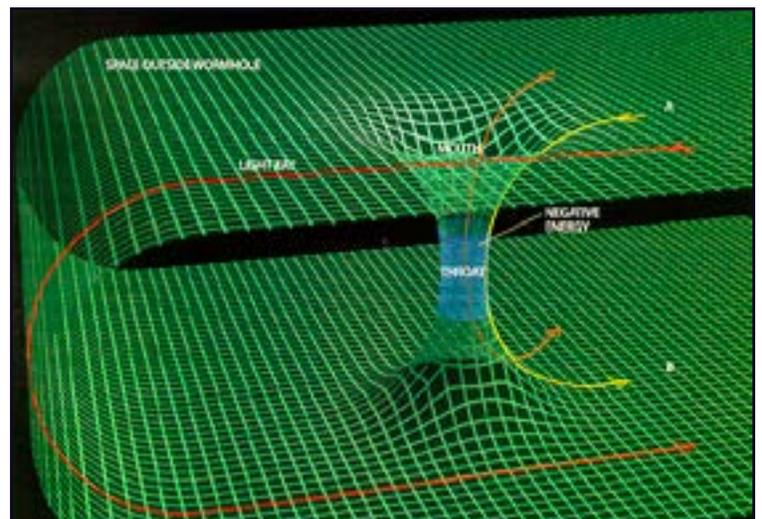


Figure 3. Diagram of wormhole with major parts shown.

Wormholes

Continued from page 5

How could they be detected?

One idea about how to detect a wormhole is to look at the gravitational wave, (GW) spectroscopic signature of a GW interacting with a wormhole, (or another ECO). The idea is that the wormhole may act like an interferometer of sorts or an echo chamber and this interaction, (the echoes) could be detected. This is especially true for traversable wormholes. In the future we might also expect to detect that the GW polarization is different for various types of wormholes and this may help to fine tune our understanding.

Another possible way to detect a wormhole is by its gravitational lensing, (GL) signature. Most wormholes are computed to have a symmetric throat which implies it has a photon sphere like around a BH or NS, which captures the light entering it and forces it to move as in an orbit, (still possible to escape though). The gravitational lensing signature, (and the GW signature) of a wormhole would also be different if the throat was not spherically symmetric or if the wormhole was rotating. In some cases, there may or may not even be a photon sphere, which would also affect the GL signature. Some wormhole models have multiple photon spheres not necessarily right at the throat, while others have extended throats. As to help avoid confusion one possible way to tell the difference between BH and wormhole would be that the photon sphere is generally smaller for the wormhole than the BH. See figure 4 below.

As to where wormholes might be found, it has been thought that wormholes might exist in both the outer regions of the galactic halo and in the central parts of the halo. This idea is very dependent upon what dark matter, (DM) model you choose. However, this also opens the potential location of wormholes to basically all large spiral galaxies. One possible galaxy that is being considered is ultra-diffuse galaxy Dragonfly 44 in the Coma cluster, as it is thought to have about a 99% DM abundance which could prompt a wormhole in its DM halo according these theories.

What about the future

As we have seen there seems to be more than one way to make a wormhole! In 1988 Thorne and Morris introduced



Figure 4. Artistic conception of wormhole.

the idea of a traversable wormhole, one that does not contain an event horizon. This idea was something completely different than the earlier ideas about wormholes and has stimulated research into these ideas ever since. They are exact solutions to Einstein's equation that allow the "viewers" to travel from one spacetime to another, (and possibly live!).

Since wormholes are exact solutions to Einstein's equations, in order to investigate them you can usually just make up a metric and then derive the mass/energy conditions for its existence or make up the mass/energy conditions and then solve for the metric that goes along with the spacetime conditions. By analyzing these solutions researchers have come up with a variety of interesting, creative, and potential possible descriptions for wormholes and their geometry. The trick is finding what may be realistic and then searching for their signs of existence. The Einstein equations are extremely difficult to solve and only by making many simplifying assumptions can they be solved exactly with any hope of a realistic solution and identifying potential observational aspects.

Wormholes are still fascinating to investigate and ponder, they may be tied to distance shortcuts in spacetime, doorways to other universes, time machines, or even agents in quantum entanglement. Their study and possible detection could provide us with a deeper

Wormholes

Continued from page 6

understanding of spacetime including topological defects, matter and energy properties, and of course quantum gravity. Since Einstein's GR has been so successful both in theory and observations it may be really difficult to justify the search for wormholes due to their existence problems in GR.

In the future with better instruments, longer timeframes of observations, and new technology, the strong gravitational regime will be explored more in depth and hopefully will shed light on GR, (and possible variations), quantum gravity, wormholes and other ECOs.



TO: Astronomy Clubs
FROM: Starlight Instruments
DATE: 01-28-19
RE: Starlight Instruments

My name is Wayne Schroeder from Starlight Instruments, which is the manufacturer of the Feather Touch focusers and the Howie Glatter laser collimators and accessories.

Starlight Instruments has implemented a rewards program for astronomy clubs in which the club members will receive a 10% discount if their order is greater than \$1,500. Astronomy club members can "pool" their orders together to have the order exceed \$1,500, if needed. For each order that is placed in excess of \$1,500, a 10% discount will be applied to their order. Orders can be placed via phone at 260-244-0020, emailed to wayne@starlightinstruments.com or can be placed through the website.

When orders are placed through the website in the payment section, there is a box labeled "coupon", the club member placing the order will need to type in the coupon

code "club 10" and it will automatically discount the order by 10%. This discount will expire on 04-30-19.

Starlight Instruments is an avid supporter of outreach programs, so we want to help your club and its members out by offering our parts at a discount. You can view our products at www.starlightinstruments.com

Starlight Instruments and the Howie Glatter laser collimators are known around the world for their top of the line quality, fit and feel.

Please feel free to contact me if you have any questions or comments.

Regards

Wayne Schroeder

Find Out What's Happening – Join EVAC-Announce List

If you would like to receive email announcements about EVAC meetings and activities, please join the EVAC–Announce mailing list. Click on the link below to subscribe. Enter your full email address in the box titled User Options and press OK. You will receive a confirmation email. Your privacy is respected by EVAC and we will never sell your email address, or use it for non-club relevant solicitations. This mailing list is designed for communication from EVAC, and does not enable users to respond to the message. If you wish to contact club officers, please use the list on the Contact-Us tab. To subscribe to the EVAC–Announce mail group click: <http://www.freelists.org/list/evac-announce>. To unsubscribe use the same link, enter your email address and select Unsubscribe from the “Choose An Action” list. Another list that may be of interest is AZ-Observing. To subscribe click <http://www.freelists.org/list/az-observing>.

EVAC also has a Facebook Group where members may share ideas, photos, and Astronomy related information. To join: [EVAC Facebook Group](#).

The Gilbert Rotary Centennial Observatory (GRCO) also has a Facebook Group where members may share ideas, photos, and Astronomy related information. To visit, please click on [Gilbert Rotary Centennial Observatory - GRCO](#).

Looking for that perfect weekend activity?

Why not resolve to getting involved?

Contact Claude Haynes to join the staff at GRCO

Email: grco@evaconline.org



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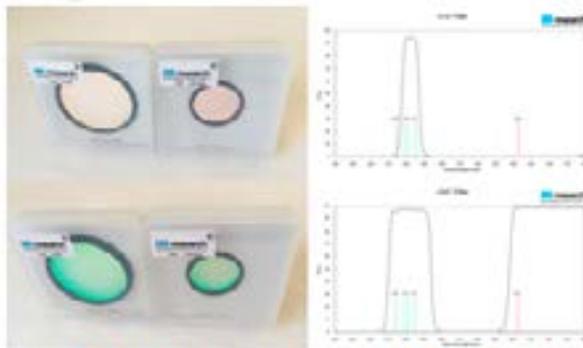
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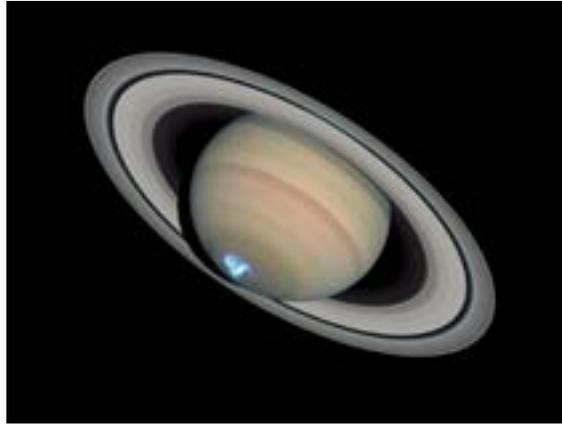
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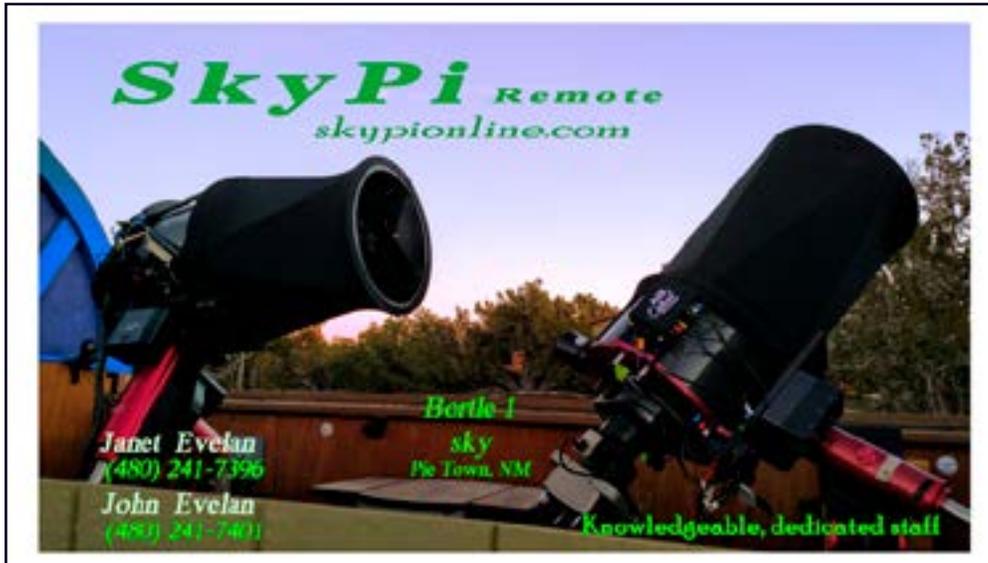
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Upcoming Meetings

February 15

March 15

April 19

May 17

June 21

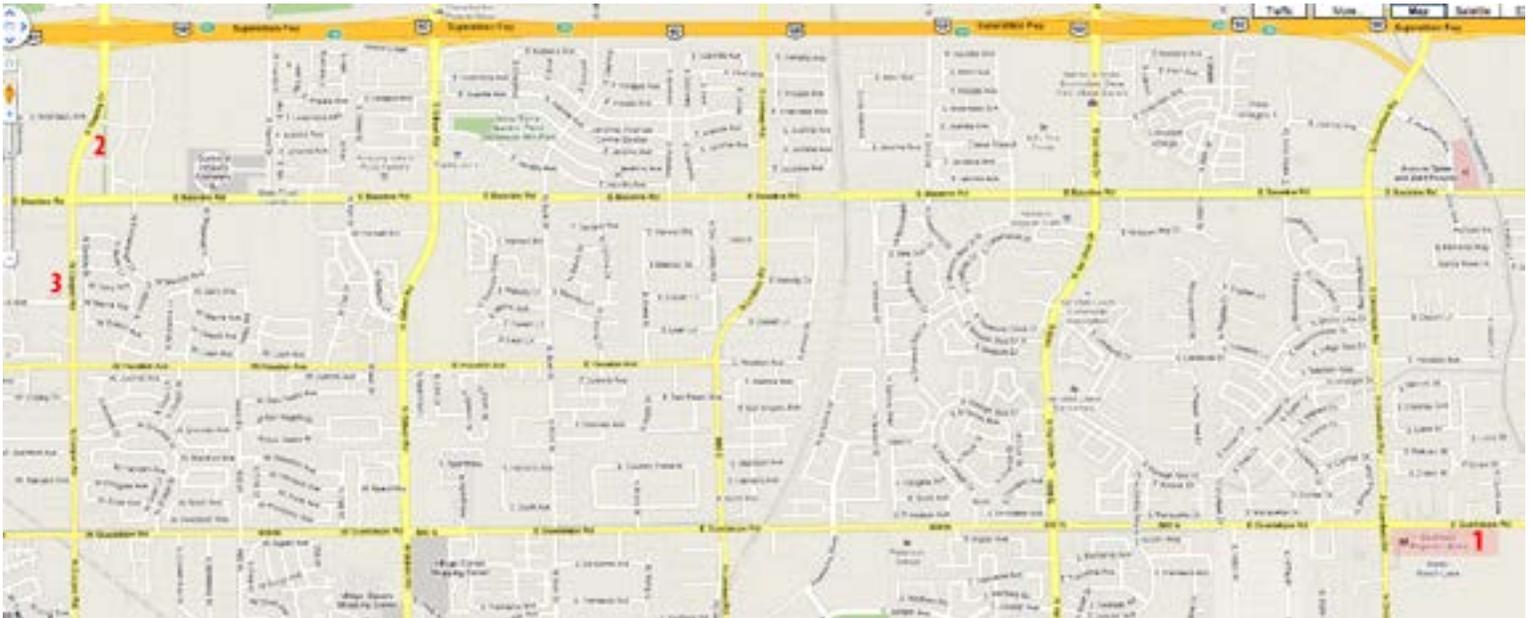
July 19

August 16

The monthly general meeting is your chance to find out what other club members are up to, learn about upcoming club events and listen to presentations by professional and well-known amateur astronomers.

Our meetings are held on the third Friday of each month at the Southeast Regional Library in Gilbert. The library is located at 775 N. Greenfield Road; on the southeast corner of Greenfield and Guadalupe Roads. Meetings begin at 7:30 pm.

Visitors are always welcome!



1 Southeast Regional Library
775 N. Greenfield Road
Gilbert, Az. 85234



FEBRUARY 2019

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28		

February 2 - EVAC Star Party

February 5 - Kyrene de la Mariposa

February 6 - C. O. Greenfield

February 7 - Navarette Elementary

February 8 - Public Star Party

February 9 - Mesquite High School

February 13-14 - ASU NASA Grant Meeting

February 15 - EVAC Monthly Meeting

February 21 - Knox Gifted Academy

February 23 - EVAC Star Party

February 25 - CGCC Star Party

February 26 - Hughes Elementary

February 27 - Ryan Elementary

February 28 - Pomeroy Elementary

MARCH 2019

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	28	19	20	21	22	23
24	25	26	27	28	29	30

March 5 - Red Mountain Ranch Elem.

March 8 - Public Star Party

March 9 - EVAC Star Party

March 15 - EVAC Monthly Meeting

March 9 - EVAC Star Party

East Valley Astronomy Club -- 2019 Membership Form

Please complete this form and return it to the club Treasurer at the next meeting or mail it to EVAC, PO Box 2202, Mesa, Az, 85214-2202. Please include a check or money order made payable to EVAC for the appropriate amount.

IMPORTANT: All memberships expire on December 31 of each year.

Select one of the following:	
<input type="checkbox"/> New Member	<input type="checkbox"/> Renewal
<input type="checkbox"/> Change of Address	
New Member Dues (dues are prorated, select according to the month you are joining the club):	
<input type="checkbox"/> \$30.00 Individual January through March	<input type="checkbox"/> \$22.50 Individual April through June
<input type="checkbox"/> \$35.00 Family January through March	<input type="checkbox"/> \$26.25 Family April through June
<input type="checkbox"/> \$15.00 Individual July through September	<input type="checkbox"/> \$37.50 Individual October through December
<input type="checkbox"/> \$17.50 Family July through September	<input type="checkbox"/> \$43.75 Family October through December
<i>Includes dues for the following year</i>	

Renewal (current members only):
<input type="checkbox"/> \$30.00 Individual <input type="checkbox"/> \$35.00 Family

Name Badges:
<input type="checkbox"/> \$10.00 Each (including postage) Quantity: _____
Name to imprint: _____

Total amount enclosed:

Please make check or money order payable to EVAC

Payment was remitted separately using PayPal Payment was remitted separately using my financial institution's online bill payment feature

Name: Phone:

Address: Email:

City, State, Zip:

The Observer is the official publication of the East Valley Astronomy Club. It is published monthly and made available electronically as an Adobe PDF document the first week of the month.

<input type="checkbox"/> General Observing <input type="checkbox"/> Cosmology <input type="checkbox"/> Lunar Observing <input type="checkbox"/> Telescope Making <input type="checkbox"/> Planetary Observing <input type="checkbox"/> Astrophotography <input type="checkbox"/> Deep Sky Observing <input type="checkbox"/> Other	
---	--

Would you be interested in attending a beginner's workshop? Yes No

How did you discover East Valley Astronomy Club?

**PO Box 2202
Mesa, AZ 85214-2202
www.evaconline.org**

All members are required to have a liability release form (waiver) on file. Please complete one and forward to the Treasurer with your membership application or renewal.

The Observer is the official publication of the East Valley Astronomy Club. It is published monthly and made available electronically as an Adobe PDF document the first week of the month. Please send your contributions, tips, suggestions and comments to the Editor at: news@evaonline.org. Contributions may be edited. The views and opinions expressed in this newsletter do not necessarily represent those of the East Valley Astronomy Club, the publisher or editor.

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Observatory Manager: Claude Haynes