Volume 29 Issue 10

October 2015

# The Observer

## East Valley Astronomy Club

2014 All-Arizona Star Party

### Upcoming Events:

*Local Star Party - October 3*

*Public Star Party - October 9*

*All Arizona Star Party - October 9-10*

*EVAC Monthly Meeting - October 16*

*Check out all of the upcoming club events in the Calendars on page 17*

### Inside this Issue:



## EVAC This Month

*by Claude Haynes*

Clear Skies for the next seven days!!!! How long has it been since we heard that forecast? Hopefully our Monsoon has dwindled, and we will all get back to dusting off our telescopes for a night of viewing. A great opportunity is the All Arizona Star Party on the weekend of October 9 - 10. Join us at the Hovatter Road airfield site for a fun time with your fellow astronomers. I know that some of you actually arrive before or stay later. Officially the weekend kicks off at 5pm on Friday with a potluck under the tent. Bring something to share, and enjoy a chance to relax. Saturday afternoon begins at 4pm with our annual Temperance Union Happy Hour. Share a soda in the hopefully not-so-hot desert. The Doorless Prize Raffle begins at 4:45, followed by a Taco Dinner at 5pm. Sunset is around 6pm, so by about 11 you should be ready for a cup of coffee or cocoa in the hospitality tent. Details are on the EVAC website. It is always a great chance to observe and converse with friends.

Our October meeting speaker is Bernard Miller. His beautiful astro-photos grace our website, and this is your chance to find out how these wonderful images are taken

# EVAC This Month

*Continued from page 1*

and processed. Don't forget that we still need to put together a slate of EVAC officers for 2016. Many of the current positions are term limited, so we do need a good number of people to step up and lead the organization. Please let me know if you are interested, before I hunt you down and beg.

Finally, thanks to everyone who helped on the GRCO remodel project. Check out the article in this Observer for some more information and photos.

Keep looking up.

Claude

# If It's Clear…

## *by Fulton Wright, Jr. Prescott Astronomy Club*

October 2015

Celestial events (from Sky & Telescope magazine, Astronomy magazine, and anywhere else I can find information) customized for Prescott, Arizona. All times are Mountain Standard Time.

All month, if you are up around 5:30 AM, you can watch a dance of Venus, Jupiter, Regulus, and Mars. Look low in the East for various alignments. Around the middle of the month, very low, you might spot Mercury as it vainly attempts to join the group.

On Friday, October 2, before sunrise, you can see the first of three double shadow transits on Jupiter this month. Here is the schedule:
04:13 AM Jupiter rises with Callisto's shadow on it.
05:02 AM Astronomical twilight (some light in the East) starts.
05:27 AM Io's shadow falls on Jupiter (2 shadows).
05:31 AM Nautical twilight (many stars still visible) starts.
06:00 AM Civil twilight (only a few bright stars visible) starts.
06:01 AM Io moves in front of Jupiter.
06:25 AM Sunrise.
06:31 AM Callisto's shadow leaves Jupiter.
All this happens low in the East.

Also Friday morning, October 2, if you want an observing challenge, the Moon occults Aldebaran. Disappears on bright limb at 6:45 AM, reappears on dark limb 7:29 AM. Why the challenge? Sunrise is 6:25 AM.

On Sunday, October 4, the Moon is at last quarter phase and rises at 11:56 PM.

On Thursday, October 8, you might see some Draconid meteors. These slow moving meteors are predicted to be to put on a puny display, but you never know. Occasionally they have been flashy. Face toward the head of Draco (north), start after dark, and keep your fingers crossed.

On Monday, October 12, it is new Moon, and you have all night to hunt for faint fuzzies.

On Sunday, October 18, before sunrise, you can see the second (and best) of three double shadow transits on Jupiter this month. Here is the schedule:
03:25 AM Jupiter rises with Ganymede's shadow on it.
03:43 AM Io's shadow falls on Jupiter (2 shadows).
04:30 AM Io moves in front of Jupiter.
04:53 AM Ganymede moves in front of Jupiter.
05:06 AM Ganymede's shadow leaves Jupiter.
05:14 AM Astronomical twilight (some light in the east) starts.
05:43 AM Nautical twilight (many stars still visible) starts.
05:58 AM Io's shadow leaves Jupiter.
06:12 AM Civil twilight (only a few bright stars visible) starts.
06:38 AM Sunrise.
06:47 AM Io moves from in front of Jupiter.
All this happens low in the east.

On Tuesday, October 20, the Moon is at first quarter phase, and sets at 12:06 AM (Wednesday).

On Sunday, October 25, before sunrise, you can see the third of three double shadow transits on Jupiter this month. This time, both Io's and Ganymede's shadows fall on Jupiter at 5:36 AM. Io moves in front of Jupiter at 6:29 AM.

On Monday, October 26, the full Moon rises at 5:30 PM (13 minutes before sunset) spoiling any chances of seeing faint fuzzies for the night.

# The Backyard Astronomer

*by Bill Dellinges (October 2015)*

**Peculiarities in the October Skies**

I suppose any month's night sky has its idiosyncrasies. So let's look around at a few of October's oddities. Looking south, the sky is occupied by water related constellations: Capricornus, Pisces Austrinus, Aquarius, Cetus and Pisces. The area is sometimes referred to as the Watery Constellations. One explanation for this "sea" of stars had been that the winter solstice was located here years ago and thus would have been the rainy season. A new interesting view on that was an article in the March 2015 issue of Sky and Telescope by Craig Crossen. He suggests in the article that early creators of the constellations, like the Sumerians and Babylonians residing in what is now Iraq, conceived these watery star patterns in recognition of the Persian Sea and the Euphrates River which were so crucial to their commerce.

Since we have water on the brain, take a look at Delphinus the Dolphin currently crossing the meridian. Two of its main stars Alpha and Zeta Delphini are named Sualocin and Rotanev. Greek? Arabic? No. It was apparently a ruse perpetrated by Niccolo Cacciatore, assistant to G. Piazzi at the Palermo Observatory in Sicily, Italy. Piazzi discovered the first asteroid Ceres in 1801. The star names are Cacciatore's Latinized name Nicolaus Venator spelled backwards. While here, check out the lovely double star Gamma Delphini (AB mags 4.4, 5.2, sep 9.4"). In the same field spy another double, Struve 2725 (AB 7.5, 8.2, 6.1").

The benchmark star pattern for autumn is the constellation Pegasus, The Flying Horse, with its distinctive Great Square asterism. The autumn and spring skies are relatively devoid of bright stars as we're looking away from the plane of the Milky Way (at least looking south along the meridian). Thus it's helpful that the Great Square's second magnitude stars are conspicuous. Each side of the Square can be helpful in identifying the only other two bright stars below Pegasus. A line running down the right side of the Square guides you slightly farther south, 45 degrees, to Fomalhaut in Pisces Astrinus. There are a number of faint stars within the Square. In particular, there are two fourth magnitude stars in its upper right hand corner. If you have dark skies and good eyesight, you should be able to detect them. Sidebar: The upper left hand star in the Square has technically belonged to Andromeda since 1928 when the International Astronomical Union formalized constellation names and boundaries making it Alpha Andromedae. Until then, the star had been shared with Andromeda and Pegasus. It still retains the name Alpheratz, aka Sirrah - it is not uncommon for stars to have two or more names considering the long convoluted history of the constellations.

Aquarius, The Water Carrier is a faint and difficult constellation to find. It took me years to be comfortable in tracking it down. Let me tell you my secret. If you accept this mission, you'll need dark skies and a star atlas. Since it rambles all over the place, I break it down into thirds. Working west to east I first find four stars forming a crooked square above Capricornus. The stars are Beta, 3, Epsilon and Nu Aquarii. This will be a job in itself! For the next third, use second magnitude Beta and Alpha Aquarii (the only two bright stars in Aquarius) as a line to the asterism "The Water Jar," a four star propeller looking affair, probably the most distinctive part of the constellation (again, that's saying something!). Let's get our bearings so far. The first third was Aquarius's body. The second was the jar the water spills out of. Now for the grand finale. From the Water Jar (or Propeller) go southeast about 15 degrees to Lambda Aquarii. This star sits atop a faint and messy circlet of stars below it shaped like a potato with a dent on its eastern side. This last third is the water falling out of the Water Jar. Congratulations, you have identified Aquarius! (Are you still awake?).

Have you found it frustrating to split Epsilon Lyrae, the Double-Double in Lyra? A decent telescope in even fair seeing conditions should do the job. But perhaps your scope is optically challenged in some way. No worries. Close by is a faux Double-Double that will ease your grief. I call it the "Poor Man's Double-Double." Two unrelated doubles stars, Struve 2470 and 2474 lie east of Lyra's parallelogram. The pairs are only 10 arc minutes apart and each pair is easily split in my 70mm Ranger at 26x. The primaries are magnitude 6.6 and secondaries 8.7. Computer people: SAO 67879. Starhoppers: Follow a line from Zeta and Delta the same distance to Iota. Go south 1.5 degrees. Impress your friends and hope they don't notice that unlike Epsilon, these two doubles have similar position angles.

Facing north, take a look at the bowl of the Little Dipper. It's a handy reference to gage magnitudes 2 through 5. Beta is magnitude 2.1, Gamma 3, Zeta 4.29 and Eta 4.95. How cool is that ?! You can do the same with t he 4 stars making up

# The Backyard Astronomer

*Continued from page 3*

the head of Draco, 2.2, 2.8, 3.7 and 4.9. Have you ever noticed that a line perpendicular to the line connecting the end bowl stars of Ursa Minor and extended about 10 degrees away from the bowl takes you to the star Thuban in Draco? This was the North Star around 2500 B.C. when the Egyptian pyramids were being built. Precession has moved celestial north to less than a degree from Polaris (of course that's why we call it Polaris – the pole star). This point will continue on through Cepheus, skimming Cygnus and Lyra and returning to generally the same area where it is now in 25,800 years. This 47 degree circle (think twice the Earth's axial tilt of 23.45 degrees) isn't perfectly repeated due to gravitational effects from other planets in the Solar System.

We have seen there are unique things associated with celestial delights in the October skies. It makes one wonder what secrets the other eleven months hold!

# This Old Observatory

*by Claude Haynes*

The project began last spring on Astronomy Day as Dave Coshow and I sat in the observatory for solar viewing. Between visitors we had a chance to chat, and in the harsh daylight it became apparent that we kept the lights off at night for more than dark adaptation. The observatory had become cluttered with nine years of accumulated "stuff". The rolling plastic cabinet and wooden bookcase just didn't contain enough storage space, and the storage we had wasn't well configured. From that conversation, we took an inventory of what we had and drew up a list of what we needed.

We ended up building a bookcase with hinged doors for cleaning supplies, a second bookcase with plastic containers for commonly used items and a folding lid to store filters, a cabinet to store two new portable easels, a large cabinet with a folding lid for storing framed posters, and a surround for the refrigerator. Curved shelves with frames now hold the artwork, and the eyepiece case was replaced with a spice rack inspired box with a drawer for each eyepiece.

The final item was the installation of a new pier that enables us to raise and lower the height based upon the observer. This will give us much more flexibility with handicap visitors, children, and objects at the zenith. We are grateful to the Town of Gilbert Parks and Recreation Department for the purchase of the pier, and to Hunter Contracting for the donation of its installation.

Thanks to all the observatory staff that helped with this project, but a special debt is owed to Don Wrigley. Few friends would answer the phone to spend more than one day at my garage to build cabinets when it was 108 degrees. Don crafted the individual drawers for the eyepieces, and engineered the new folding easels.

Here are a few photos, but stop by the observatory for a visit – or to volunteer to join the staff. It is now an even better place to observe and educate.

# This Old Observatory

*Continued from page 4*



**Last Quarter Moon on October 4 at 17:06**

**New Moon on October 12 at 20:06**

**First Quarter Moon on October 20 at 16:31**

***Full Moon on October 27 at 08:05**

# Review of Lunt Engineering 16x70 Binoculars

*by Bill Dellinges (September 13, 2015)*

I had been waiting many years for 15x or 16x70 binocular to appear on the market that had long enough eye relief such that with eyepiece cups folded down, I could see all or most of the full field with eye glasses on. Until recently the best eye relief I had found in this size binocular was 18mm and that failed to meet my needs. Of course I could take my eyeglasses off and refocus any binocular regardless of eye relief, but I prefer to observe with glasses on so I can switch back and forth quickly between the binocular and seeking my next target in the sky.

This year, 2015, Lunt Engineering (www.luntengineering.com), a subsidiary of the Lunt Solar Systems company, makers of H-Alpha solar telescopes (www.luntsolarsystems.com), has introduced a line of binoculars including a 16x70 model with 20mm of eye relief. Specs are:
Real field: 4.1 degrees. Apparent field: 65.6 degrees.
Exit pupil: 4.4mm. Close focus: 33 feet.
Bak 4 prisms. Fold down eyecups.
Individual eyepiece focusing. Fully multicoated optics.
Tripod adaptable (adapter incl.) Nitrogen purged.
Water proof. Magnesium body.
Weight: 4.24 pounds/68 ounces.
Made in China. Price $369. 1 year warranty.

I purchased this binocular based on the specs, especially the long eye relief. I was somewhat concerned about the relatively low price and their being made in China. I was delightfully surprised upon opening the box to see a well made, good looking binocular. The build quality is quite impressive. Coatings show a smooth consistent blue – purple color. The inter-pupillary adjustment, though somewhat stiff, is manageable and at least will not change once set. The individual eyepiece focusing is firm and not likely to change once set. I found setting them at the zero line set the focus perfectly for my glasses. The outer covering looks more impressive than its ad photograph and has that wrinkle look I like found on my Fujinon 10x70 FMT. Due to the summer monsoon season here in Arizona, I've only had a few hours of observation to assess the optics. But that has been enough to demonstrate to me the optics are close to being on par with other high end binoculars like my Fujinon 10x70 and certainly better than the similarly priced Chinese 15x70 I once owned imported by a high end American refractor company. Star images remained sharp to about 70% away from center before showing slight flaring. Only at about the last 20% do the star images seriously degrade. Not bad for this price point.

Having been used to a 10x70 binocular, I was stunned by the views of the moon and deep sky objects of this 16x70. I was quite surprised what a difference 6 power made! When comparing the views between the 16x70 and 10x70 everything in the former just knocked me out. I had always thought the 10x70 was a wonderful binocular but now realized what I had been missing all these years – everything was bigger and brighter (I didn't buy the Fujinon 16x70 years ago because of their stingy 12mm eye relief). The Moon displayed sharp, rich detail. The Pleiades were stunning, filling a third of the field, its dimmer stars conspicuous. Orion's Sword was breathtaking, as was the Double Cluster in Perseus. The Lunt's 20mm eye relief does allow me, with eyecups folded down, to see about 90% of its 4.1 degree field. Oddly, even without glasses, it was difficult to see the field stop. I attribute this, rightly or wrongly, on its 65.6 apparent field, so wide that I was getting a Nagler type of experience; that is, the apparent field is so generous one has trouble seeing the field stops – not necessarily a bad thing. Still, the bottom line is that I really enjoy looking through these binoculars with or without glasses. In short, I highly recommend this binocular. Note: Due to its 16 power, you will definitely need to use these binoculars on a tripod.

Pros: Very good optics and build quality for the price (55% the cost of a Fujinon 16x70). A very nice well padded carrying case.

Cons: Rubber caps for objective lenses that fit within lens housing (I prefer hard plastic caps over the lens housing). Open accessory pocket in case can catch on binocular as its being placed in case. Poor documentation and no indication of place of manufacture.

# Dark Stars and Cosmology

*by Henry DeJonge IV*

**Introduction**

For many years I have been wondering exactly how dark matter or DM might influence stellar formation, evolution, and cosmology. It is something that I have not found a lot of specific information about or discussions on floating about until recently. So after deciding to investigate this topic somewhat more seriously, it turns out that there is now quite a bit more information and discussion about these ideas than in the past. This is primarily due to advances in theoretical physics, better detection and observational methods, and experimentation such as the LHC which is bringing us closer to a better understanding of the standard model, DM, (if it exists) and many other concepts that in the past were considered a bit strange, (supersymmetry, multiverse, multiple dimensions, string theory, etc.). Although still not mainstream stellar theory textbook material, the role of DM in astrophysics is beginning to open up and become more widely discussed. Here are some updates and thoughts on the matter in regards to stellar evolution and cosmology. We will mainly focus on the WIMP model of DM which is the most accepted and discussed to date-however it is still not proven by any means.

For a brief review, DM was first discussed in the 1930s by Fritz Zwicky to help explain the faster than predicted rotation rates of galaxies in clusters. That is they seemed to move faster than calculated from the observable matter in the clusters, implying that perhaps some unseen matter may be about. This unexplained phenomena was also observed in the 60s by Vera Rubin in studying galaxy rotation rates. The outermost stars seemed to have the same rotational velocity as the innermost stars implying that some unseen matter may be causing this effect. Astronomers expected that the rotation rates of galaxies in clusters and stars in galaxies would follow a Keplerian law like our solar system whereby the further away planets from the sun have a slower orbital velocity than the inner planets.

Since then astronomers have observed other signs of this missing visible matter in observations of the CMB, gravitational lensing, and in galactic collisions. Assuming that there is no other viable explanation for these behaviors, (such as MOND, etc.) the conclusion is that there is some mysterious dark matter in our Universe that has yet to be detected. It is also believed that this dark matter does not interact or couple with the electromagnetic force or strong nuclear force. It feels only the weak force and the gravitational force, which explains why it is called "dark" matter. Current research is focused on finding out what this matter may consist of, its properties, and influences.

**Dark Matter as WIMPS**

The strongest candidates, (or models) for the as yet unknown dark matter, (DM) are WIMPS, or Weakly Interacting Massive Particles. Particles such as neutralinos which arise out of supersymmetry are a main constituent of WIMPS. Remember that DM is thought to interact with the Universe via gravitational attraction and the weak nuclear force only. It would normally then dissipate energy very poorly if at all. Another interesting feature is according to many DM models WIMPs are thought to be their own antiparticle and thus would annihilate each other upon contact.

One of the main reasons WIMPs are thought to be such an excellent candidate for DM is that their calculated relic abundance that exists today, (based upon the weak interaction coupling strength) is about 25%. This is also the predicted amount of DM density in the Universe today along with about 5% ordinary matter and 70% DE. This connection has been called the "WIMP miracle". Some other reasons for the WIMP model popularity is that WIMPs come up in many particle theories that do not necessarily even pertain to DM, especially in regards to supersymmetry and that WIMPs also come up in many extradimensional theories.

We will briefly discuss dark stars and cosmological effects of DM according to the WIMP models in general but will not discuss DM models in depth as that is another paper or book

entirely.

DM in the early Universe may have drastically altered and shaped the formation of the first stars in the Universe also called Pop III stars. It is thought that the first stars of any type to form in our Universe did so in DM halos or mini-halos, (primordial regions of about 85% DM and about 15% baryonic matter) with masses of 100,000 to 10,000,000 solar masses. These stars formed in huge gas clouds within comprised up of both baryonic, (ordinary) matter and DM, with the baryonic matter made up of mainly H gas.

# Dark Stars and Cosmology

*Continued from page 7*

DM is thought to influence primal star formation in possibly three ways. One is that DM would help gravitationally attract all matter to begin initial star formation and fusion. Second is that if DM proves to be comprised up of a new type of particle, (s) then it may also be or contain its own anti-particle and thus when they come in contact it would cause annihilation and release energy as well as the usual standard model particles, (electrons, neutrinos and photons primarily). This is particularly true if DM is made up of WIMPS. Thirdly DM could also have an influence on early star formation whether or not it is self-annihilating by weakly interacting with baryonic matter in elastic collisions and slowly releasing energy.

A dark star, (DS) would be made up of mostly baryonic matter but with a large portion of DM as well, in which the self-annihilation of DM, (as is present in most WIMP models) provides the main counter force to that of gravity instead of nuclear fusion as in normal stars. These stars can remain in equilibrium for extended periods of time and may have been the most common type of the first stars formed in the Universe.

Any internal heat generated by DM annihilation could delay or even stop the gravitational contraction of the cloud and slow star formation in these early stars. The radiation released by this self-annihilation of DM would not be strong enough to stop the accretion of most matter though, thus allowing the protostar to continue growing, as these early DS would also accrete additional DM, (with regular matter) as it is brought in via gravitational attraction and nuclear capture.

The energy efficiency of WIMP annihilation is about 65% while the energy efficiency for fusion is about 1%-thus it would not take a lot of DM to heat up a dark star. The DM content of a DS could have been about 1/10 of 1% of the mass of the star and still be enough to power the star for millions to billions of years. Only after the DM was finished with its work could ordinary fusion take over as the main energy source. However despite the name these early stars were not dark in the ordinary sense as the DM provided interior heat and the stars did shine, (albeit with an abundance of radiation in the IR).

It is still unknown what the rate of DM annihilation would be and how much DM could possibly be contained and absorbed by the young stellar core. These parameters are essential to understanding their potential stellar evolutionary effects and role in cosmology. These early dark stars are thought to be very massive, (growing from 1 solar mass up to thousands or maybe even millions of solar masses) very puffy, (say 2AU-10 AU) and with a relatively low surface temperature, (say 10,000 degrees K).

A regular star of much larger mass than our sun burns a lot hotter and has a much higher surface temperature, (say 50,000 degrees K) and uses other mechanisms to limit its accretion and thus growth when compared to a dark star. DS would be much larger than average for normal matter dominated Pop III stars which would be in the range of hundreds of solar masses. These DS may even be so large as to collapse directly into BHs and become the precursors or seeds of SMBH, (or galactic cores) although this idea is still much contested. Their role and interactions in binary or greater systems is also very speculative and could perhaps influence their evolution dramatically.

Some think that these dark stars could live up to 500 Myr as relatively cool and diffuse objects prior to any main sequence star formation, (if at all). There is probably a range of DM contained in dark stars and thus there would be a range of their protostellar lifetimes and main sequence beginnings. Some may not even be able to become a main sequence star due to not having the internal temperatures and pressure to initiate fusion. Their ongoing rate of DM capture, (by gravity and energy loss via elastic collisions with ordinary matter) would also influence their main sequence evolution.

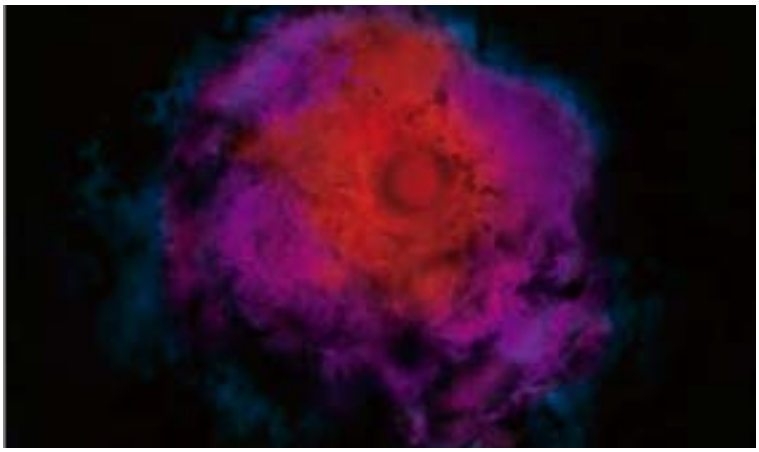


Figure 2. Artistic version of a DS in the IR, although they would also shine in the visible.

These early dark stars could have been very massive and bright and may be detectable with the new James Webb Space Telescope, (JWST) soon to be launched in 2018. It is also possible that we might be able to detect some DM activity still present in the dense cores of large galaxies also, where there are very high densities of matter in general. These potentially DM heated white dwarfs and neutron stars in galactic centers and in globular clusters are commonly called “WIMP burners”.

In summary then for primordial dark stars it is thought that they form in DM halos, begin accreting matter as their interiors heat up due to DM self-annihilation and/or weak interactions with baryonic matter, allowing them to grow for longer times

*Continued from page 8*

than ordinary stars. They become very massive, before the DM heating period expires and gravity with normal high temperature fusion takes over to begin heating up these unusually massive young stars in a more "normal" fashion. As mentioned perhaps they do not begin fusion at all and instead collapse directly into a BH. Some calculations show that if the DS is about 150,000 solar masses, fusion is not able to stop the gravitational collapse and this may happen immediately after the DM heat ceases to sustain the DM star and a BH is formed. Future study of BHs may help resolve these ideas.

In the early universe the formation of dark stars would be dominant due to the high density of DM, however in the Universe today normal stellar origins would be dominant. In particular the early DM stars would have formed in the centers of DM halos where the stars today usually form in the low DM density regions of the spiral arms of galaxies, albeit some do from in the centers of galaxies where the DM density would be higher.

**Dark Matter and Cosmology**

After the Universe cooled down enough to form atoms and allow thermal photons to scatter, (the CMB) a dark period of time existed, (about z = 1,100) until sources of ionizing radiation such as stars, were formed in early galaxies, (about z = 30 or 200 My after the BB) and re-ionized the neutral H gas in intergalactic space, which still remains to this day. This was completed by about z = 7. These first stars, (normal matter dominated) are thought to have been considerably more massive than the "normal" stars formed today. They are expected to be as large as 100-300 solar masses, as without metals for more effective cooling, the H and He primordial clouds could form much larger stars, also called Pop III stars.

Dark stars would have a different structure and evolution than the first Pop III stars and also have a different radiative output which could affect the re-ionization epoch. This effect could show up in the CMB. Another factor in their evolution is that the DM particles, (again especially if WIMPS) would interact weakly with other standard model particles and thus slowly release energy, (as mentioned) even without self-annihilation. Basically DM would cause the core of these DS to contract and remain relatively cool thus prolonging the protostellar phase of the star. During this prolonged time the stellar mass could accrete even more matter than usual, (since the star is cooler) and thus become more massive than normal for a large Pop III star.

However the much larger, super massive, DS, (larger than regular Pop III stars) are thought to be prime candidates for the creation of the early SMBHs in the Universe. The rapid formation of these SMBHs, (mainly residing in the centers of galaxies today) in the early universe is still a mystery as there seems to not have been enough time since the beginning of the universe for such giants to form and exist in the super large sizes they have today, (hundreds of millions and billions of solar masses). Of course this is based upon our present understanding of cosmology and BH dynamics.

Super massive DS or SMDS, (millions of solar masses) should be detectable by the JWST, (especially in the mid IR bands) as individual stars but super large Pop III stars would still not be detectable. It is also suspected that these SMDS would pulsate over the order of days to years and that these pulsations may be detectable by the JWST, whereas large Pop III stars or primordial galaxies would not be detectable due to their relative weakness and noise in the IR bands used by the JWST telescope. Perhaps these suspected pulsating SMDS could become a standard candle of the future. Such detections would also help justify the WIMP model of DM.

In terms of galactic evolution we have just "learned" that DM seems to have less friction than expected as it does not seem to slow down when colliding galaxies interact. Thus DM seems to interact with itself much less than previously thought and this is another key in unlocking its current fundamental form and structure. How this interaction may have changed over the history of the Universe, (if at all) is also a question. It should be possible in the future to determine the extent of dark star influence on the early Universe by analyzing the CMB. Parameters such as the optical depth and anisotropy may give us clues

Figure 3. BH in the galactic center formed via DM contraction

There is another interesting puzzle that DM may help to solve in cosmology and that is that the number of so far detected pulsars in the extremely dense center of our galaxy is far less that what most models predict. One possible explanation is that if DM is comprised up of particles that are not their own antimatter particles, (say an antisymmetric WIMP model) then the DM may just collect in the interiors of primordial stars via gravitational attraction without causing any heat. If this occurs

# Dark Stars and Cosmology

*Continued from page 9*

then these protostars could collect enough DM very quickly and collapse directly into a BH bringing the rest of the protostar with it. These numerous stellar sized BH would not necessarily be visible to us as they float about the center of our galaxy, or were perhaps flung out of the center region long ago. Thus the missing or "destroyed" pulsars.

However there are other possible explanations that do not require DM which are being investigated such as we simply have not detected what is actually there, (very plausible in my opinion). Perhaps pulsars in the galactic center may be invisible from earth due to the highly charged local environment that any pulsar beam would have to travel thru on its way to earth. We have also not observed any correlation with the age of pulsars and their distance from the core of our galaxy which might be present if they lived shorter lives nearer the center. The better detection and understanding of pulsars and how they might interact with DM may help shed some light on DM in the future.

Since we do not know what DM is, (or if it exists) or all its properties, (such as mass or interaction coupling strengths) that it may have, the formation of enormous dark stars and the resulting SMBHs is still very theoretical.

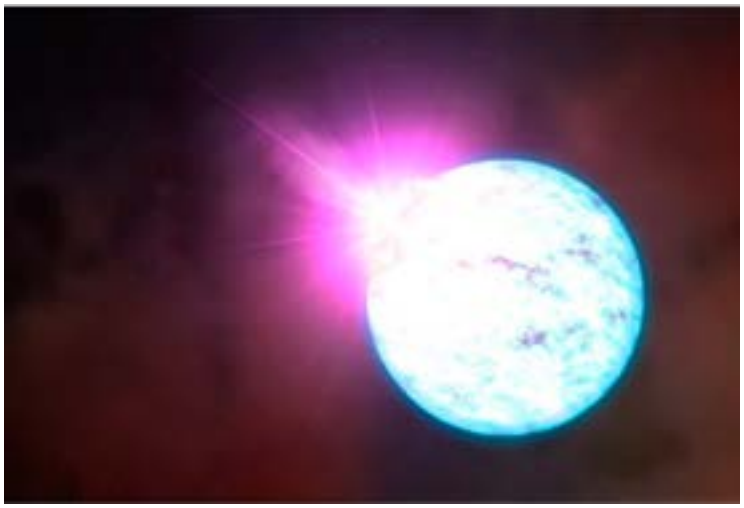


Figure 4. Drawing of a pulsar in the galactic center.

**Questions and Summary**

One question I have is what if DM has evolved since the BB as baryonic matter has, (for example in terms of antimatter). How would this affect the Universe and its evolution? There are theories of DM that explore this line of thought.

Currently the self-annihilation of DM which is assumed to be WIMPs is the main method of its possible detection. Astronomers are researching for DM annihilation remnants, (mainly neutrinos) or the small amounts of DM directly that may have been captured by our sun. Excessive gamma ray radiation and/or x-rays from the signature of DM capture and/or scattering off of baryonic nuclei or from self-annihilation is also being searched for today. Some think that excess positrons may also be an indication of DM presence.

In terms of detecting the very existence of DM, between direct detection, indirect detection, and colliders, DS may offer another method of verifying the existence of DM and WIMPS. However some argue that DS may not be able to form at all, that they would not accrete enough DM to influence any stars, and that any super massive DS would already have been detected by Hubble. It is hard to imagine a SMDS with a mass of a million or more solar masses! Perhaps in the future the HST would be able to detect SMDS but that is a work in progress.

Another possible method of DS, (DM) detection is to probe the diffuse metagalactic radiation field or MRF. The optical to infrared part of the local MRF is also known as extragalactic background light or EBL. The main contribution of this comes from integrated starlight and thermal dust emissions of all the cosmic epochs, therefore perhaps indicating the presence of DS and DM in the early Universe by its strength and spectral distribution as compared to models and future observations.

However most of this material presented is based upon the WIMP model of DM which remains to be proven. Some people believe that the period of substantial DM contribution to stellar formation was very brief, others contend that DM would not play much of a role in primordial stellar formation and evolution. Perhaps the interaction of normal matter dominated Pop III stars with DS in the early Universe caused the DM to be less effective, (say due to making less dense clouds of DM) in any stellar formation role, as most stars would have been formed in groups and in close proximity. Does DM inhibit such multiple stellar formations? Perhaps the role of DM heating is overblown and is much less effective, (if it occurs at all) than most models predict. What if DM is not comprised up of WIMPS at all?

Perhaps the role of DM in the early Universe is not as critical for individual stellar formation as may be thought, however the role of DM is still considered critical for galactic formation and the cosmic web. All these ideas and wonders are certainly fun to consider, imagine, and investigate! The search continues and we will "see".

## 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.

# *2015 All Arizona Star Party*

***October 9-10 Hovater Rd. Airfield***

***Friday - Potluck at 05:00 PM***

***(Bring something to share)***

***Saturday***

***Temperance Union Happy Hour at 4:00 PM***

***Raffle Drawing at 4:30 PM***

***Taco Dinner at 5:00 PM***

***Dinner is 5$ and***

***the raffle tickets are 1$ each or 6 for 5$***

***Coffee and snacks at 11:00 PM each Night***

***Please observe dark sky etiquette. Minimize extra light, and if you will be leaving early, please park closer to the exit.***

***Check the EVAC website for details.***

http://www.evaconline.org/aasp_2015.htm

***Looking for that perfect weekend activity?***

***Why not resolve to getting involved?***

***Contact Dave Coshow to join the staff at GRCO***

***Email: grco@evaconline.org***


Meade 10inch F/4 Schmidt Newtonian Telescope For Sale

Purchased in 2003, this Meade 10 inch F4 Schmidt-Newtonian is being offered by a gentleman who is no longer able to observe.

Please contact karenaramos@yahoo.com if interested. OTA has been stored inside. There is a pier with clock drive that has been outside and is included.

If interested, please contact Karen Ramos (karenaramos@yahoo.com)

# Upcoming Meetings

October 16

November 20

December 18

January 15

February 19

March 18

April 15

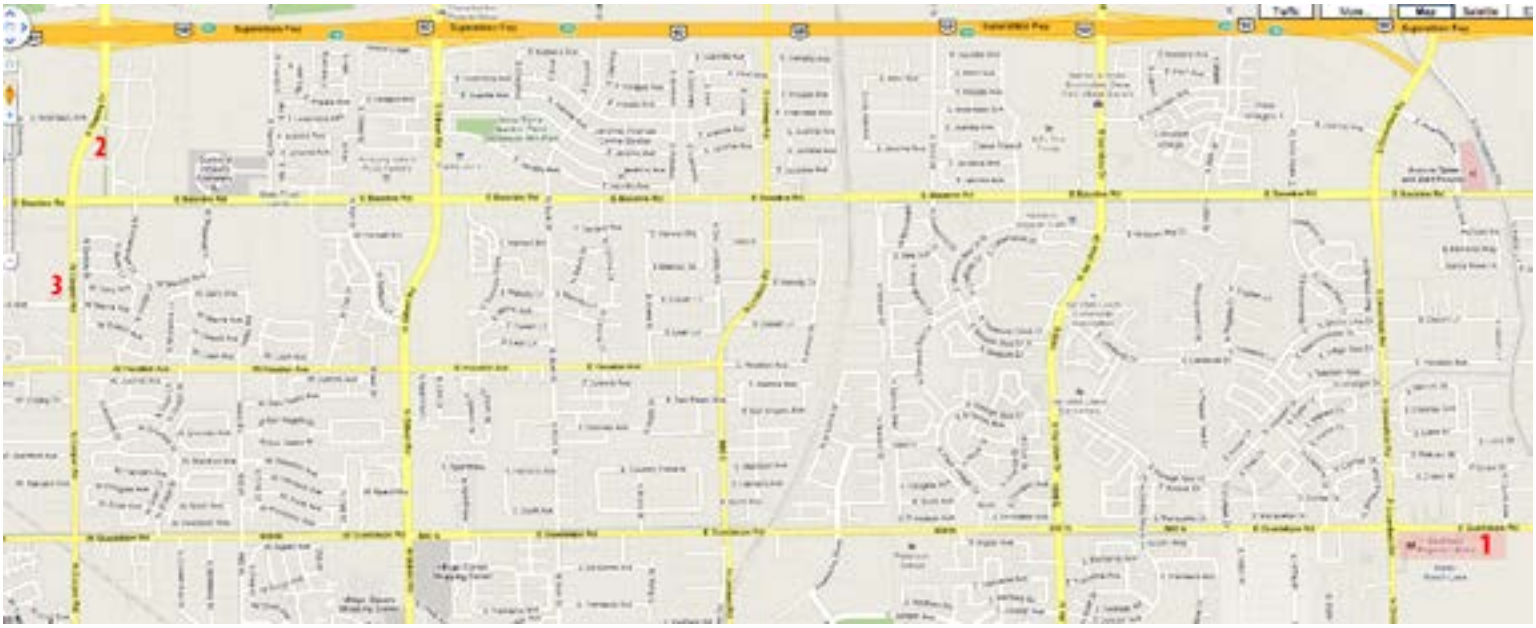
May 20

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.

All are welcome to attend the pre-meeting dinner at 5:30 pm. We meet at Old Country Buffet, located at 1855 S. Stapley Drive in Mesa. The restaurant is in the plaza on the northeast corner of Stapley and Baseline Roads, just south of US60.

***Visitors are always welcome!***




**2** Old Country Buffet
1855 S. Stapley Drive
Mesa, Az. 85204

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

# October 2015

| 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 | **29** | 30 | 31 |

**Oct 2** - Arizona Museum of Natural History

**Oct 3** - Local Star Party

**Oct 9** - Public Star Party

**Oct 9-10** - All Arizona Star Party

**Oct 16** - EVAC Monthly Meeting

**Oct 19** - CGCC Star Party

**Oct 29** - Shepherd Jr High

# November 2015

| 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 |
| 29 | 30 | | | | | |

**Nov 7** - Local Star Party

**Nov 10** - JO Combs Middle School

**Nov 12** - Apache Junction HS

**Nov 13** - Public Star Party

**Nov 14** - Deep Sky Party

**Nov 20** - EVAC Monthly Meeting

# East Valley Astronomy Club -- 2013 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:

☐ New Member ☐ Renewal ☐ Change of Address

**New Member Dues** (dues are prorated, select according to the month you are joining the club):

☐ **$30.00 Individual** January through March

☐ **$35.00 Family** January through March

☐ **$22.50 Individual** April through June

☐ **$26.25 Family** April through June

☐ **$15.00 Individual** July through September

☐ **$17.50 Family** July through September

☐ **$37.50 Individual** October through December

☐ **$43.75 Family** October through December

*Includes dues for the following year*

**Renewal** (current members only):

☐ **$30.00 Individual** ☐ **$35.00 Family**

**Name Badges:**

☐ **$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: ☐

☐ Publish email address on website

City, State, Zip: ☐ URL: ☐

How would you like to receive your monthly newsletter? (choose one option):

☐ Electronic delivery (PDF) *Included with membership* ☐ US Mail **Please add $10 to the total payment**

Areas of Interest (check all that apply):

☐ General Observing ☐ Cosmology

☐ Lunar Observing ☐ Telescope Making

☐ Planetary Observing ☐ Astrophotography

☐ Deep Sky Observing ☐ Other

Please describe your astronomy equipment:

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. Printed copies are available at the monthly meeting. Mailed copies are available to members for a slight surcharge to offset printing and mailing expenses.*

*Please send your contributions, tips, suggestions and comments to the Editor at: news@evaconline.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.*



*The East Valley Astronomy Club is a 501(c)(3) nonprofit charitable organization.*

www.evaconline.org



East Valley Astronomy Club
PO Box 2202
Mesa, Az. 85214-2202