Volume 31 Issue 12

December 2017

The Observer

The Winter Shower - APOD December 27, 2014, Jia Hau

Upcoming Events:

Local Star Party - December 11

EVAC 30th Anniversary Party - December 15

Deep Star Party - December 16

Check out all of the upcoming club events in the Calendars on page 19.

Inside this Issue:

EVAC This Month

by Don Wrigley

The winter solstice will be upon us soon, and that means long nights of observing that can get pretty cold. Don't forget to pack plenty of warm clothes when you do go out to observe. Arizona's mild winter days can make you forget how cold it can get when the sun goes down.

This year our annual holiday party will be held at the home of our vice-president, Claude Haynes, instead of the library due to the Riparian After Dark event. It will be catered by EVAC, so no need to bring anything (unless you want a special beverage to imbibe). Email Claude at vp@evaconline.org so we can get an accurate count of attendees. The menu is Italian (but not pizza) and should be a fun time. The date is December 15 and the feast begins at 7:00pm. This party is our celebration of the 30th anniversary of EVAC, and we want to end the year in a festive way.

December marks the end of my two years as EVAC president. It has been a privilege to have served in this capacity and for me a great source of personal pride. My heartfelt thanks go to all those who helped make my job a lot easier and my best wishes to all the new officers and board member. Without your contribution the club could not continue to function.

Don Wrigley

EVAC 30th Anniversary Party
by Claude Haynes

End the year with fun and food on December 15th at 7:00pm to celebrate 30 years of the East Valley Astronomy Club. The party is at the home of Claude Haynes instead of the Library this year. The food is provided by EVAC, so there is nothing for you to bring but yourself and spouse, special friend or guest. The menu is Italian (but not pizza), and include drinks and dessert. So that we can get an accurate count, please send an email to vp@evaconline.org with the number of people attending. An email reply will be sent with additional information.

If It's Clear…
by Fulton Wright, Jr. Prescott Astronomy Club

December 2017

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.

I am planning to retire from writing this column at the end of 2017. (This is the last one.) I started this in 1997 so it has been 20 years. I wish you all clear skies.

For the comet hunters among you, check out Sky & Telescope, December 2017, p. 42, although it doses't put on a very good show.

On Sunday, December 3, it is full Moon, so no hunting for faint fuzzies tonight. Instead, direct your attention to the bright ray system centered on Tycho which can be found many places on the Moon. Not only is it a "super" Moon (somewhat closer than usual) but also you have 2 nights to check it out (Saturday and Sunday). See Astronomy Magazine, December 2017, p.37 for an article about it.

On Tuesday, December 5, starting about 6:30 AM, you can see 3 of Jupiter's moons clustered together on the upper right side of the planet. Only Ganymede is to the lower left. Look low in the south-east for the planet (magnitude -2) and follow the dance till daylight interferes.

On Sunday, December 10 you can catch a shadow on Jupiter. Here is the schedule:
At 4:35 AM Jupiter rises with Io's shadow already on it.
At 4:54 AM Io itself moves in front of the planet.
At 5:56 AM Astronomical Dawn begins (light appears in the East).
At 6:21 AM Io's shadow leaves the planet.
At 6:27 AM Nautical Dawn begins (many stars start to fade).
At 6:58 AM Civil Dawn begins (only a few stars are visible).
At 7:04 AM Io itself moves from in front of the planet.
At 7:26 AM the Sun rises.

If you want to see Io's shadow fall on Jupiter, observe the planet at 6:06 AM on December 17.
If you want to see Europa's shadow on Jupiter, the planet rises with the shadow having just fallen the planet at 3:50 AM on December 25 (Merry Christmas).

On Sunday, December 10, the Moon is at last quarter phase and rises at 1:15 AM (Monday).

The night of Wednesday, December 13, after midnight (Thursday), you might see some Geminid meteors.

If It's Clear...

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The Moon rises at 4:06 AM (Thursday) but is only 12% illuminated. Under dark skies you might see 120 meteors/hour. Look for slow, bright meteors radiating from the direction of the constellation Gemini. My standing offer is dinner for anyone who dresses too warmly. The December issues of Sky & Telescope and Astronomy have articles on p. 48 & 37 respectively.

On Sunday, December 17, it is new Moon, so you have all night to hunt for faint fuzzies.

On Thursday, December 21, it is the winter solstice in the northern hemisphere and you have the longest night of the year.

On Saturday, December 23, you can catch a minimum of Algol for about an hour on either side of 6:00 PM.

The Backyard Astronomer

by Bill Dellinges (December 2017)

A Void Called Camelopardalis

First off, it's not a camel. It's a giraffe. The constellation was created by Dutch astronomer Petrus Plancius in 1613. The name refers to a time when the giraffe was thought to look like a creature with the head of a camel and body spots of a leopard (Latin camelus – camel + leopardus – leopard). The constellation is located between Cassiopeia and Ursa Major and has no star brighter than magnitude 4.0, requiring a very dark sky to identify. Why create such a faint constellation? Because all the brighter stars had been used up for constellations as described in Ptolemy's Almagest in 150 A.D. Granted, a few were pretty faint, like Cancer, Pisces, Aquarius, etc., but the Sun traveled through those areas of the night sky and thus "astronomers" of the time were forced to configure something there to complete the zodiac. In the northern skies there were still a few voids here and there between constellations and some astronomers took advantage of that and created, perhaps out of desperation or their amusement, faint constellations like Johannes Hevelius' Lacerta, Lynx (you need the eyes of a lynx to see it), Vulpecula, Canes Venatici, Leo Minor, Scutum and Sextans.

Before moving on to deep sky objects in Camel land, a trivia question: There are two constellations amongst the 88 whose spelling does not change when used in the possessive form (Bootis, Cygni, Lyrae, etc.). Camelopardalis is one. What is the other? (Answer at end).

Perhaps the most interesting thing in Camelopardalis is the asterism Kemble's Cascade, a string of 7th and 8th magnitude stars stretching three degrees northwest to southeast terminating at the open star cluster NGC 1502. Try a 16x70 binocular with a 4 degree field to see its full length while keeping the stars bright. You can find it by drawing a line from Algol (Beta Persei) through Mirphak (Alpha Persei) and on again 2 ½ times that distance. Fortunately, there are three 4th magnitude stars close by to catch your attention. Those with Goto telescopes can simply hit NGC 1502, enjoy that open star cluster, then backtrack north up the Cascade's string of stars.

NGC 1502: is a fine small open cluster of about 30 stars 3,000 light years away. The two bright stars at its center are the double star Struve 485. A 70mm refractor will split it at 26x. AB Mag 7.0, 7.0, Sep 17.9", Pa 304 degrees, spec BO.

NGC 1501: Less than two degrees south of NGC 1502 is a magnitude 11.5 planetary nebula. In an 11" telescope with an OIII nebula filter, the 52" planetary is large but quite dim; no doubt to its great distance of 3,900 light years. The best view was at 165x (215x dimmed the object too much). The nebula's surface brightness was not uniform, but exhibited a hint of mottling. There was no sign of its magnitude 14.4 central star.

NGC 2403: Only 12 million light years away, this is the brightest galaxy in the constellation. It's located in the far western part of Camelopardalis close to the snout of Ursa Major. In a semi light polluted sky, an 11" telescope shows this magnitude 8.5 galaxy as a faint elongated smudge. There is a very faint foreground star on each end of the galaxy, which helps to frame the galaxy. This spiral is probably a fine sight in a larger telescope in a dark sky.

Beta Camelopardalis is the brightest star in Camelo-

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pardalis and a wide double star. A 9x50 finder will split it. The primary is yellow and the secondary too dim to see any color (to this observer). AB 4.1, 7.4, 83", 210 degrees, GO1. SAO 13351.

32 Camelopardalis (Struve 1694) is another double star in the extreme far east sector of the Giraffe's abode - even further east than NGC 2403. This double star is practically in Ursa Minor's domain being only 2 ½ degrees from that constellation's border. It can be found on a line one third of way from Polaris to Kochab and slightly east (or away from U. Minor). It can be difficult to see naked eye. The double is comprised of almost equal magnitude stars, reminiscent of Kuma in Draco but tighter. An 8x50 binocular shows it as a figure 8. It can be split in 10x70's, a 70mm refractor or 28x100 binoculars. It's interesting to note this star is very close to the track laid down by precession which determines which star is our North Star at any given time. According to Ian Ridpath, the Chinese used this star as their North Star in 417 (A.D.) and referred to it as the Pivot Star. AB 5.3, 5.8, 21.5", 326 degrees, A1 V, AO IV.

Sidebar: The first general meeting of the International Astronomical Union took place in 1922. Among other concerns, they whittled down the over 100 constellations to an official 88. Belgian astronomer Eugene Delporte was asked to design official boundary lines for those 88 constellations. His completed task was published in 1930. Thinking back to those wonderful images of mythological characters and creatures depicted in the star atlases of 1600 – 1800, we see that our giraffe stretches from his hips in the east near Kemble's Cascade to his head way over to the west near 32 Camelopardalis. We might imagine the Giraffe asking, "Monsieur Delporte, please be generous in allotting me enough space in the sky, as my neck is very long!"

Answer to trivia question – Puppis.

Neutron Star Mergers, Gamma Ray Bursts and Kilonova

by Henry Dejonge IV

Introduction

It has been known from satellite detections since the 1960's that gamma ray bursts, (GRBs) come in basically two flavors, either long, (over 2 seconds) or short, (2 seconds or less). These are the most powerful known explosions in our universe except for the Big Bang, (BB) and are detected about once per day from earth in random directions. The main event causing long GRBs is thought to be core collapse supernova, (CCSN) while the short GRBs are thought to primarily come from the merger of compact binaries like neutron stars, (NS) with black holes, (BH), or NS-NS mergers, or perhaps even small BH-BH mergers. It is likely that all the causes for both long and short GRBs are still not fully understood.

We will briefly discuss in this paper the short GRBs and kilonova, primarily formed by NS-NS and NS-BH mergers. We will also discuss the formation of elements, many unique, from such mergers. The kilonova event is the brief, (generally less than 1 week) infrared and optical part of these mergers which is potentially detectable from earth along with the gravitational wave part, (not deeply discussed in this paper). These two events are distinct from any beaming or jet like behavior and may offer us a brief preview and opportunity for better pinpointing, confirming, and understanding, the merger itself. Until recently the kilonova event was only suspected to exist and was not directly detected in conjunction with a NSM event.

Since the merger of stellar sized BHs is expected to produce little or no detectable electromagnetic, (EM) signal due to the lack of baryonic matter in the vicinity, kilonova since they mainly involve NS, may well be one of the most valuable EM signals in our universe to study such events along with any corresponding GW. LIGO is expected to detect many more NSM and BH mergers in the coming years, however the BH mergers may be somewhat lacking in EM signal traces like kilonova.

Neutron star mergers and GRB

Neutron star mergers, (NSM) are defined as either neutron star-neutron star, (NS-NS) mergers or neutron star-black hole, (NS-BH) mergers. I am sure that throughout the cosmos NS also merge with a variety of other objects like stars, planets, and such but we will focus on classical NSM events. They are predicted to be a significant source of gravitational wave, (GW) detections in the near future. Currently the model of NSM is the best proposed answer for most short GRB.

Figure 1: Artistic view of a NS-NS merger

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by Henry Dejonge IV

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As we mentioned, long GRB are thought to be primarily due to hypernova, while short GRB are thought to be from the merger of small compact objects like NSM or BH mergers. It is thought that the main difference between short and long GRB is the lifetime of the central engine, (the BH and the accretion disk). In a few cases there have been GRB that show the strong, long GRB signatures but lack the associated electromagnetic signatures of a typical long GRB and are also not found in the same type of galaxies. These unique events have suggested a new type of GRB called a "long-short" burst. The debate continues on about the true nature of all GRB.

Theoretically NSM feature at least three distinct channels for matter ejection. During a merger event, part of the total mass gets unbound by gravitational torques and hydrodynamic processes ("dynamic ejecta"). When the accretion disk expands, the recombination of free nuclei into other particles as well as the viscous heating, release enough energy to evaporate matter from the accretion disk at later times ("evaporating disk"). In addition to this, a smaller amount of mass is ejected in a neutrino-driven core wind if no BH is formed. Here, gravitational binding energy is released in form of mainly electron neutrinos and anti-neutrinos with substantial, luminosities of about 1053 erg/s and energies of approximately 10 to 15 MeV. Due to neutrino absorption, matter is driven away from the neutron star merger remnant ("neutrino-driven wind"). The exact contribution of heavy elements produced in these three channels is still under much debate and investigation. It has also been suggested that perhaps not all NSM events produce a GRB.

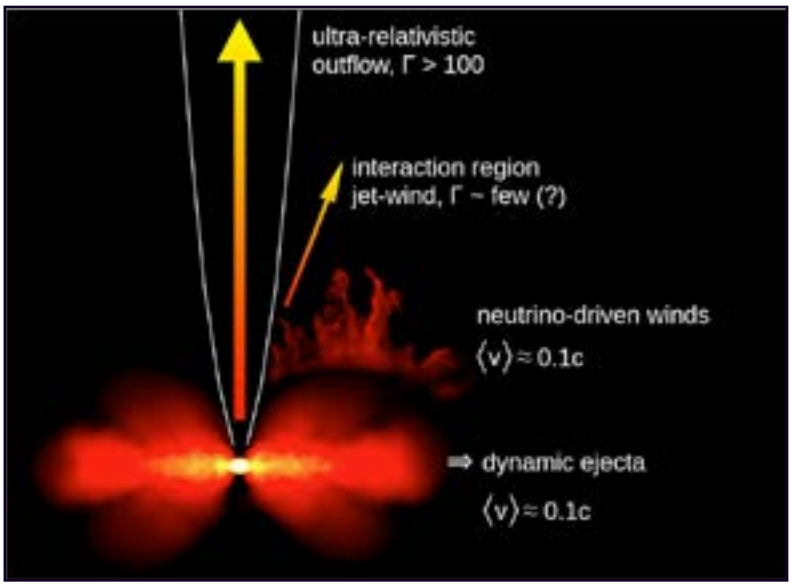

Figure 2: Artistic view of 3 channels for mass ejection in a NSM event

In addition, the "kick" from these NSM can affect the speed of any BH formation, (currently thought to be on the order of 100ms) and also affects the resultant GRB signals, both in duration and location. It is thought that some of these extreme kick velocities can propel the NSM remnant far away from the original event, perhaps even out of the galaxy in which it originally occurred, (hyper velocity). The exact percentage of NSM that produce either a BH, (most likely) or a remnant NS, (less likely) is still under debate. It is hoped that future observations, especially spectrally of the associated kilonova event, should be able to clear this up.

Neutron Star Mergers, Gamma Ray Bursts and Kilonova

by Henry Dejonge IV

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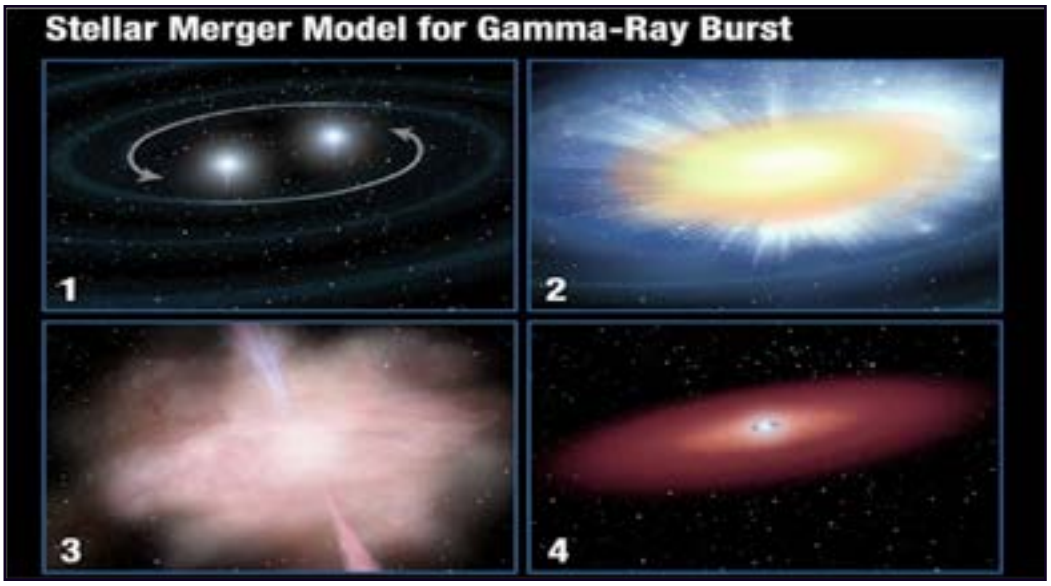

Figure 3: An artistic model of a NSM event with picture #3 depicting the kilonova

It is interesting to note that theoretical calculations indicate a difference in elemental production outflow in NSM depending upon how much, (if any) matter is initially ejected and how much is used a bit later in the accretion disk. These differences can also account for the total time of the kilonova, magnitude, and spectral output, (color). The two resulting environments are not the same. Thus the kilonova event is a good diagnostic indicator of the physical properties of the merger mainly due to the abundances and distributions of heavy elements produced. However just like the unified AGN theory, the geometry of the merger, (and what geometry we see from Earth) also affects the properties.

According to theory in the case of a classical binary NSM, which is expected to take on the order of 100,000,000 years from its inception, a torus like accretion disk is formed around the newly formed BH right after the merger, (which happens in milliseconds). This may produce an ultra-relativistic jet(s) along its rotation axis thus forming a short gamma ray burst, (GRB). The material in this jet is primarily relativistic heavy r-process nuclei. However we observe a NSM event as a short GRB usually only if the direction of the ejection, (jet or jets) intersects our path in space and is detected. The kilonova byproduct on the other hand is composed up of non-relativistic, heavy r-process nuclei, is generally more symmetric, and is thought to be present in almost all such NSM events.

The extremely fast flow, formation, and density of the baryonic matter combined with the extremely high neutrino flux in NSM lead to the production of heavy nuclei generally from upwards of atomic weight 90, up to thorium and uranium. These nuclei are also mainly radioactive with short half-lives thus generating a tremendous amount of radioactive heat causing vast amounts of electromagnetic radiation. This includes both visible and infrared radiation, (aka the kilonova signature). As bright as they appear they are still 100-1000 times less bright than a SN.

The heavy nuclei and other remnants are driven out mainly by the BH outflow jets and mass loss from the torus accretion disk, (20-30% of the torus mass) as well as driven out by neutrino winds, (about 1% of the torus mass). The neutrino winds are usually very fast forming and dissipate quickly while the accretion disk outflows take longer to grow and last for a relatively longer time. In comparison, remember that well over 95% of the energy in a CCSN is given off by neutrinos-we see only a percent or so in the EM regions-still enough to outshine an entire galaxy for a short period.

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Theoretically a NS-NS merger can also form a hyper massive neutron star, (HMNS) for a short period before collapsing into a BH. This can temporarily exceed the approximately 2.4 solar mass limit to a spinning NS, (bringing it up to about 2.7 solar masses). This formation will affect the length of the GRB, spectral signature, r-process elemental production, and produce a host of additional possible consequences.

Kilonova

During the process of merger these NSM events involve all the fundamental forces of nature and are a primary source of GW. Their neutron rich environments are unique in the universe and these explosive events are considered to be a major source of heavy elements in our universe. The neutron rich ejecta environment directly after a NS-NS or BH-NS merger causes a rich nucleosynthesis via rapid neutron capture, (r-process) which forms many rare heavy elements, (isotopes) like gold and platinum. The unstable isotopes undergo a rapid, supernova like, nuclear decay process within the ejecta that create a tremendous amount of heat and can be detected in the IR and sometimes visible wavelengths, which is called the kilonova, (aka Li-Paczynski macronova). This generates an electromagnetic counterpart to the GW, (gravitational wave) of the merger which is unique and detectable, thus marking in a sense such phenomena. The peak brightness and spectral color temperature of the kilonova will be primarily dependent on the density, (opacity) and composition of the ejecta material, the mechanisms produced, as well as on the type of objects interacting.

The first kilonova was detected a few years ago in 2013 and is called GRB130603B. It had a total ejecta of a few hundredths of a solar mass. It had a near IR signature aftermath, (after the GRB) that corresponded to a predicted kilonova. As of 2015 there had only been 2 potential detections of kilonova, however this began a more serious search that continues today and is growing.

There are roughly calculated to be anywhere between 0.2 and 300 kilonova events a year detectable by LIGO, (via GW) in the coming years and about 8 such events a year within our own galaxy. An even smaller fraction of these will be seen as short GRB. Thus the search is on in earnest.

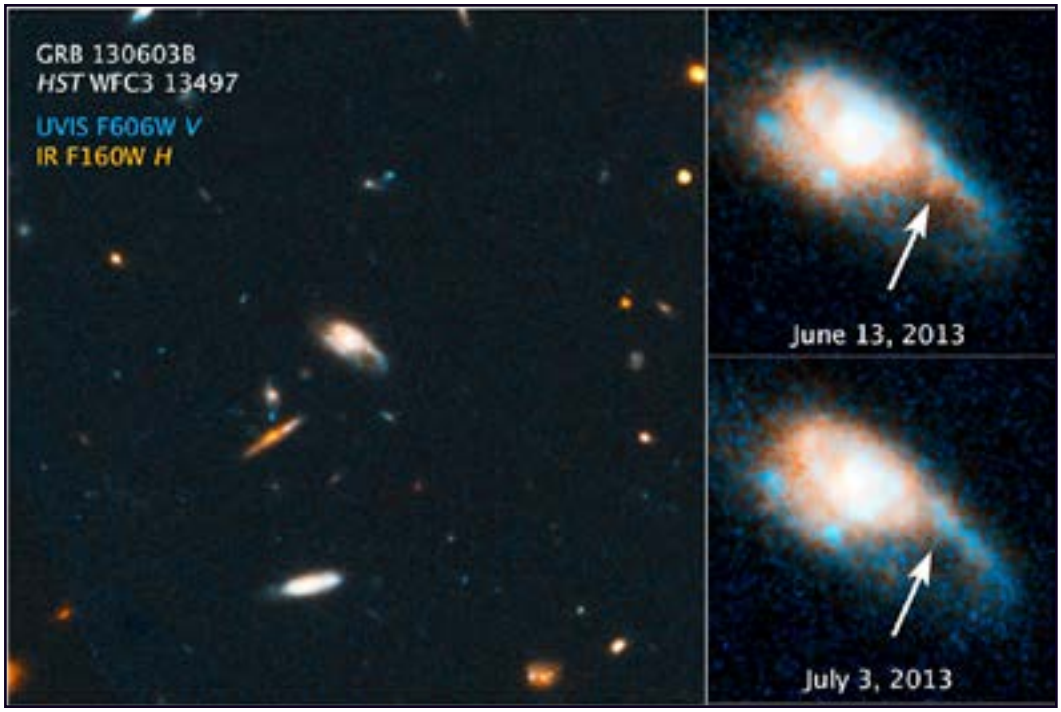

Figure 4: An HST view of the first detected kilonova

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In comparison, NSM that involve only NS are believed to be more often associated with kilonova as a NS-BH merger may have far less baryonic matter involved, although this type of merger may spew out more material under certain circumstances that a NS-NS merger. However the NS-BH merger will most likely produce a more collimated jet of material and be more luminous, (perhaps bluer as well). Remember that typically around a BH about 25% of the accretion disk torus material can be ejected via outflows. In the future it may be possible to spectrally distinguish between the two types of NSM, especially using a multispectral, (and GW) approach.

NOTE: In a very recent talk, (11/8/17) given by renowned cosmologist Joe Silk on intermediate mass black holes, (IMBH) he suggested that there are potentially many IMBH gobbling up white dwarfs, (among other things). I asked about whether or not such an event would produce a kilonova signature and he replied that they most likely would as well. Thus we may be able to find more of the elusive IMBH by also searching for specific kilonova signatures, especially in dwarf galaxies.

Formation of elements

One of the most important findings regarding these NSM , (kilonova) events is their relationship to the production of many heavy elements. It is known that about 50% of all elements that exist heavier than Fe are produced in explosive stellar environments. This involves both slow, (s-process) and rapid neutron capture and has been understood from a physics point of view for decades, however all the exact mechanisms and astrophysical sites where this happens have been somewhat of a mystery.

There are 2 main types of neutron capture called slow neutron capture, (s-process) and rapid neutron capture, (r-process). The r-process of stellar nucleosynthesis is used to explain the production of many stable (and some long-lived radioactive) neutron-rich nuclides heavier than iron that are observed in stars as well as in the solar system. The r-process involves a rapid and intense flux of neutrons. Seed nuclei absorb the neutrons successively and evolve into heavier nuclei as well as undergo radioactive decay. The r-process remains the most complex nucleosynthetic process from both an astrophysics as well as nuclear-physics point of view.

NSM events are responsible for both stable and radioactive heavy elements. Some of the main elements produced in NSM, (kilonova) events include gold, (Au), platinum, (Pu), Thorium, (Th), and Uranium, (U). For example Europium, (Eu) is thought to be one of the purest r-process formed elements in the solar system. The abundances of these elements can be observed in the ISM as well as in stars. However the exact formation mechanisms of many elements is still debated, as are the relative influences in metal abundances in galaxies and the ISM produced by the NSM process Vs the CCSN process.

Currently it is thought that SN explosions and NSM are the main sources of such heavy elements, with SN being more frequent and numerous yet producing relatively small amounts, while NSM are less frequent but produce much larger amounts of such elements. The combined ejecta of both processes explains very well the metal abundances of elements with atomic weight over 90 and to a lesser extent the elements with atomic weight below 90 to about 50. However these 2 events are not thought to be the only way these elements can be formed, (for example consider TZOs). Basically there are still some unknowns as to exactly how all the elements we know of are produced, (despite what we were taught in school).

Both types of neutron processes are found in core collapse supernova, (CCSN) and in kilonova; however the r process dominates the kilonova event and is predicted to produce much more of the heavier r-process elements. As we mentioned, CCSN alone cannot account for all the elements heavier than Fe. Just imagine the excess of neutrons made in NSM encounters and the r-process becomes much more believable, (for me at least).

Neutron Star Mergers, Gamma Ray Bursts and Kilonova

by Henry Dejonge IV

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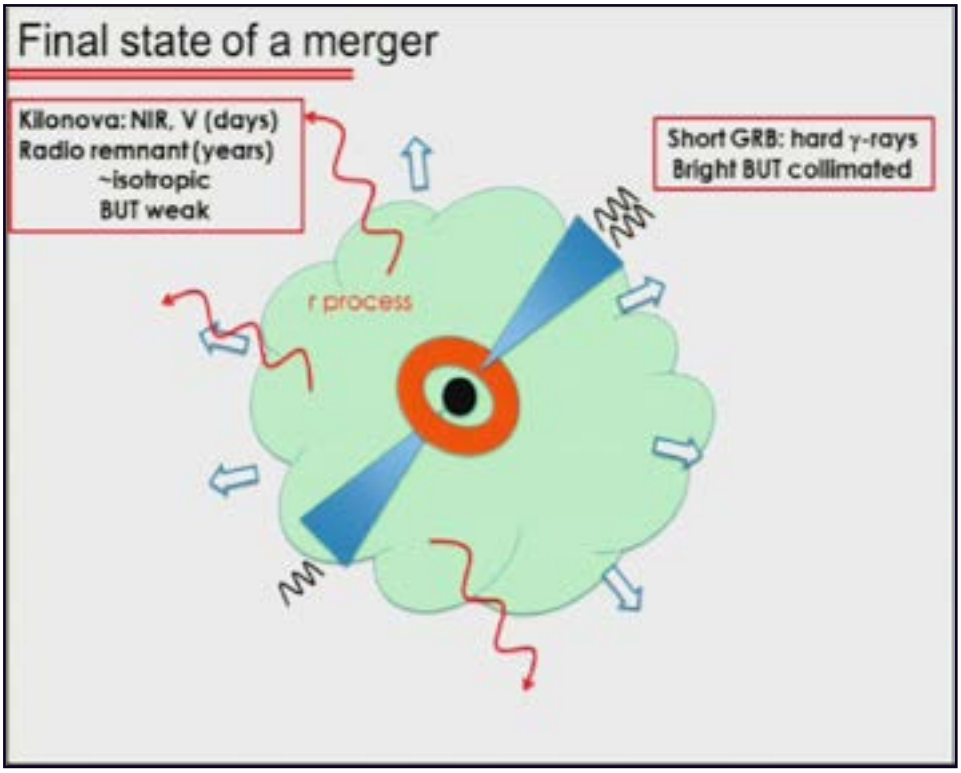

Figure 5: An illustration of the r-process ejecta from a NS-NS merger

These heavy elements from CCSN and kilonova go out into our universe and enrich galaxies, future generations of stars, and eventually find their way into smaller bodies such as planets, (and ourselves). It is believed that from a "typical" NSM event about 1/10,000 to 1/100,000 of the mass of the sun would be made free to roam the Universe. It is also thought that NSM and CCSN together can explain almost all the metal abundances, especially of elements with atomic weights over 140, in galaxies via galaxy growth thru mergers. Combining galactic outflows and other complex features, this forms a basic step in the model of galactic chemical evolution, (GCE).

It has been only relatively recent in the last few years that NS-BH mergers (and some BH-BH mergers) could seriously be considered to be a major contributor in the formation of elements in our universe. We knew that SN events alone could not account for all the heavy element abundances in the universe and it was due to successful theoretical models of NSM events, (in particular involving the r-process) that turned attention to these events for a more complete explanation. Prior to this, (and a few actual observations!) the NSM theory had been around for many years, (since the 1970s) but was not taken seriously and considered quite exotic.

Neutron Star Mergers, Gamma Ray Bursts and Kilonova

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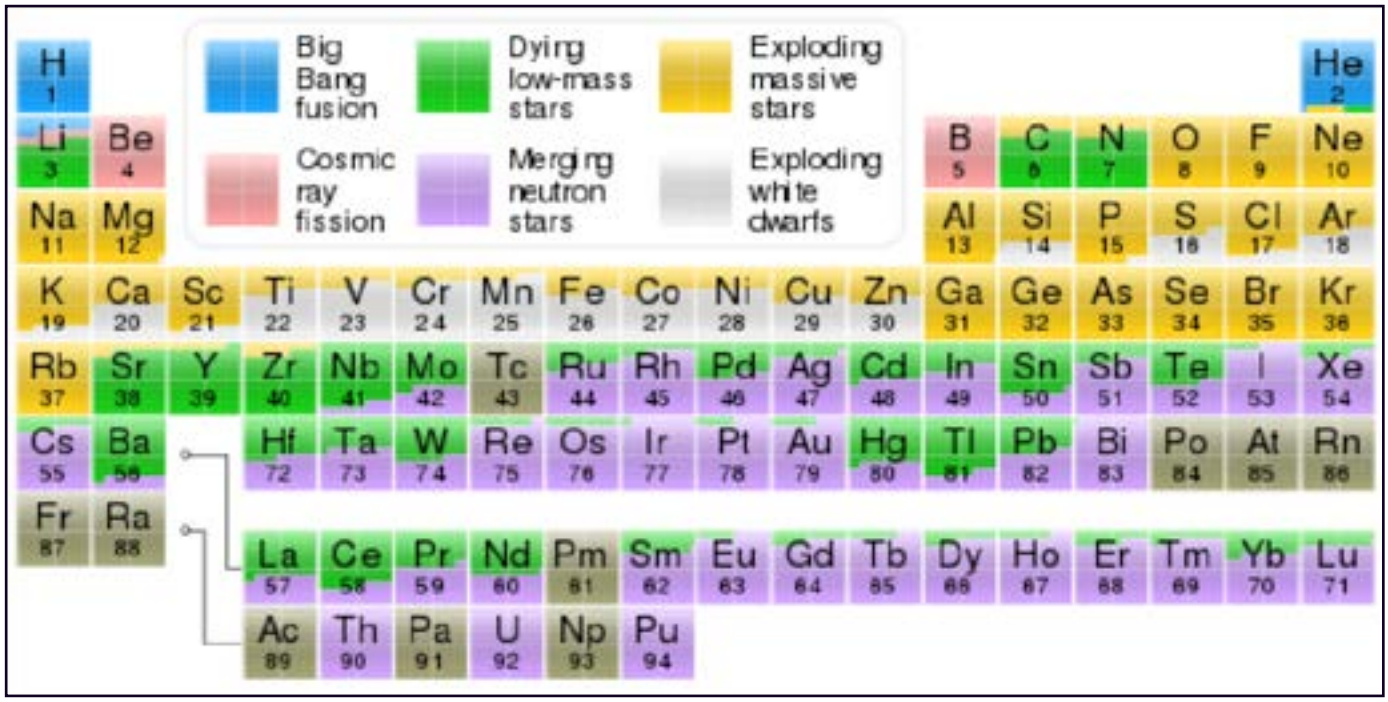

Figure 6: A quick guide to the sources of our elements, (not 100% completed yet-a work in progress)

The future

In the future NS-NS and BH-NS mergers should be detected by Advanced LIGO and other GW detectors and hopefully more associated kilonova events will also be detected. In one potential new application, if particular kilonova are found to have a common luminosity, they may well become another standard candle in the cosmic distance measuring and analysis arsenal of astronomers. There is also speculation that NSM could be a source of the rarely detected, mysterious, fast radio bursts, but that is a paper for another time.

PS-it was just announced that both gravitational and electromagnetic radiation has been detected in rapid succession for an explosive merging event for the first time. Data from the outburst fit well with a spectacular binary neutron-star death-spiral. The explosive episode was seen on August 17 in nearby NGC 4993, an elliptical galaxy only 130 million light years distant. Gravitational waves were seen first by the ground based LIGO and Virgo observatories. Seconds later the Earth-orbiting Fermi observatory detected gamma-rays, and hours after that Hubble and other observatories detected light throughout the electromagnetic spectrum.

Describing this NSM, first the hot neutron stars spiral in toward each other and emit gravitational radiation. As they merge, a powerful jet extends that drives the short-duration gamma-ray burst, followed by clouds of ejecta and, over time, an optical supernova-type episode which is the kilonova. This first coincident detection confirms that LIGO events can be associated with short-duration gamma-ray bursts. Such powerful neutron star mergers are thought to have seeded the universe with many heavy nuclei including the iodine needed for life and the uranium and plutonium needed for nuclear fission power. You may already own a souvenir of one of these explosions -- they are also thought to be the original creators of gold, (this underlined, copied, bulletin is courtesy of APOD 10/16/17). Please check out APOD for this date to view an excellent artistic video of this event.

Neutron Star Mergers, Gamma Ray Bursts and Kilonova

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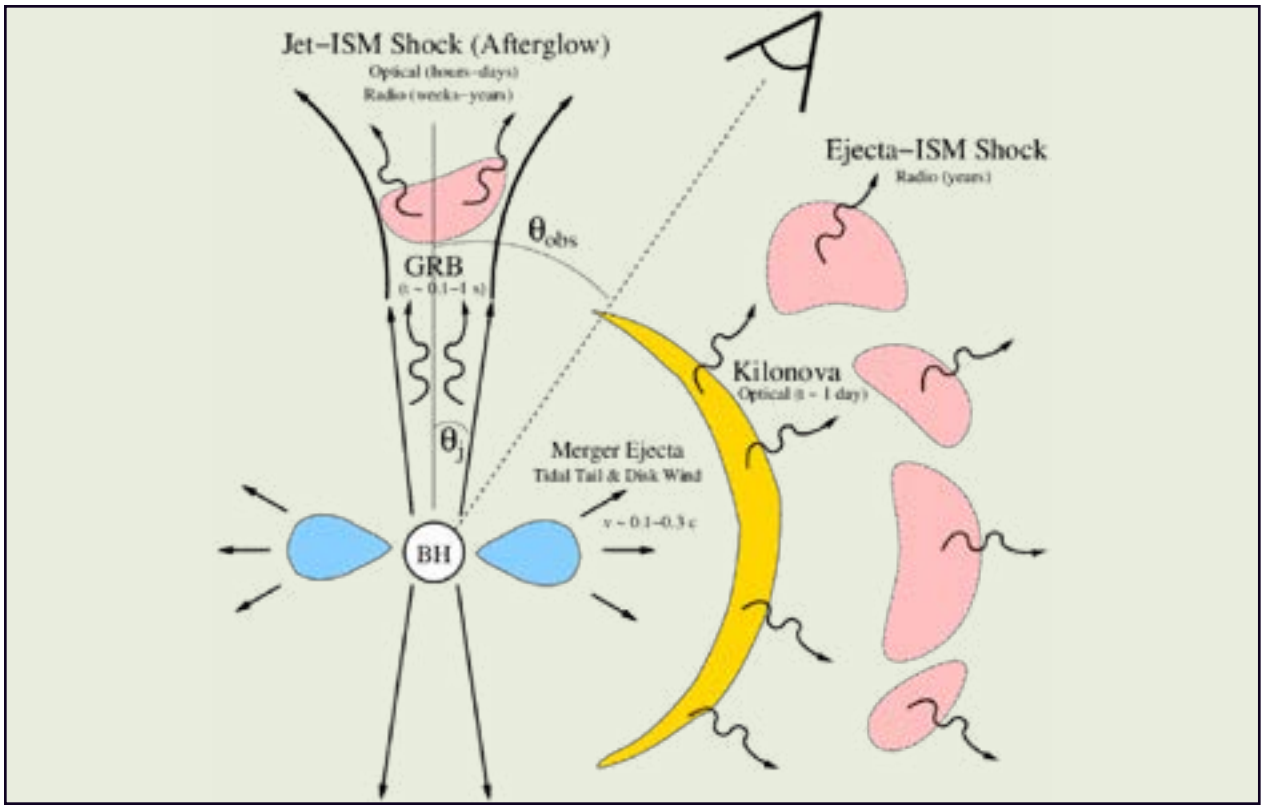

Figure 7: Schematic of a NSM event forming a BH

Summary

We have seen how the mergers of NSs and NS-BH enrich our universe with specific rare elements like gold and platinum. It is still amazing to me that such compact object interactions can produce elements that we use for many objects in our ordinary lives. What a connection! The discovery of an electromagnetic counterpart to these mergers gives us a way to pinpoint their locations and to be in a better position for future and deeper observations. This is an exciting realm of general relativity; (GR) that I think will be full of surprises and enlarge our understanding of our universe, GW astronomy, and fundamental concepts like spacetime.

The influence of magnetic fields is still early it its application to NSM events. Future observations should help with this question and others like determining the equation of state, (structure and properties) of NS, and their frequency and distribution in galaxies. Eventually the spectral analysis of the visible/ IR kilonova outputs should also be able to tell us what the original merger components were and the final outcome.

There is still much mystery about NSM processes and the resultant byproducts. What an amazing sight it would be to see the remains of a NSM in space-imagine the remains of a NS in pieces or chunks, or even as dust in an accretion disk while some of it is being sucked into a BH! To think this may be where most of our heavy metals come from here on earth is really cool. Imagine a NS being ripped apart as the gravitational tidal effects of a BH begin to take hold!

Even now we still do not know all the ways in which the heavy elements can be produced in our universe, (as in magnetohydrodynamically launched jets for example). The full understanding of the galactic chemical evolution and NSM elemental production still awaits discovery.

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To unsubscribe use the same link, enter your email address and select Unsubscribe from the "Choose An Action" list.

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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At I have a Takahashi Q-106 System for sale. It includes all the extras:

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. Large Pelican case

Much more. It is the best flat field astrograph and visual refractor combo available.

Please research the cost and make an offer. All considered.

Takahashi Q-106 Pictures

I'm very motivated to sell.

Thanks, Dan Gordon
az.dan.gordon@gmail.com

Classified Ads

10" Orion Dob. Hardly used, excellent condition. Complete with 2" Crayford focusser and extra large eyepiece holder.

No eyepiece or finder. Tube comes in original packing box. Too many scopes forces sale!

Cost new, $670. Asking $375.

Derek Youngson

derek.youngson@gmail.com

The camera was modified by Hap Griffin about 5 years ago and has ~8,150 shutter counts. It was purchased late 2011. Overall it's in good condition and has the latest Canon Firmware installed. A Custom White Balance and been set. Some example images can be seen at the URL below. If needed I can supply 100% cropped 'Dark Frames' images so you can examine the camera background noise.
E-mail me for additional information –
jimwaters@cox.net

For current 2017 EVAC members I will include a 21 day warranty period.

Canon Camera Pictures

Included items:

. Canon TC-80N3 Intervalometer	$135.49
. Canon CA-PS700 125VAC Power Adapter	$49.95
. Orion 12VDC Power Adapter	$119.00
. Canon RS-60E3 Remote Switch	$21.00
. Extra Canon LP-E8 Battery – 2ea total	$47.95
• SanDisk Extreme Plus 32Mbytes	$20.95
• Journey34 DSLR Shoulder Bag	$49.95
. Canon LP-E8 Charger	
• Canon T3i - S/N 072023005219	

Cost of included items is $440.75

Asking $350

Classified Ads

For Sale:

10" Meade LX-200GPS. This is the fast f6.3 - not the standard f10.0. It has Meade's UHTC Ultra High Transmission Coating, SMT upgrade and Peterson EZ-Clutch, EZ Focus, and Buck's Gears. The tripod has the "Springy Thing" springs on the mounting screw. An OPT 'scope saver' (larger than the scopetronix version) and both the standard length screw as well as the longer version for use with the scope saver. Includes Meade's 2" electric focuser with 1-1/4" and T adapters. A 1-1/4" disgonal and 40mm Plossl eyepiece are includes as is a 60mm finder scope.

Additional included options are a JMI Hardside Carrying Case for the scope and a Scopetronix soft side case for the tripod. A 115 VAC power, Kendrick Kwikfocus, 5 coloered visual filters and both narror band and wide band pollution filters. A Meade Pickback adpater is also included.

If the observer get more invloved in astro-photography a Meade Superwedge with Scopestuff Rosette knobs and stiffening rod is provided along with a Rigel nFocus focus controller.

If the observer gets even more seriously involved in astrophotography, two Losmandy "D" series dovetail bars are provided.

Using this scope and an SBIG ST-8300 camera over a two year period I was able to photograph all NGC and IC objects above -38 deg from my backyard in Chandler.

Asking price is $1500

If you have any questions please contact:
Bruce Barron - bbarron1@cox.net
he

Classified Ads

For Sale:

A Vixen mount with star book and through the mount align scope. The scope is a five inch refractor. With wooden carrying case.

Sale price $1,700.00

Frank Pino f.pino@mchsi.com 480-882-3485

Upcoming Meetings

December 15

January 19

February 16

March 16

April 20

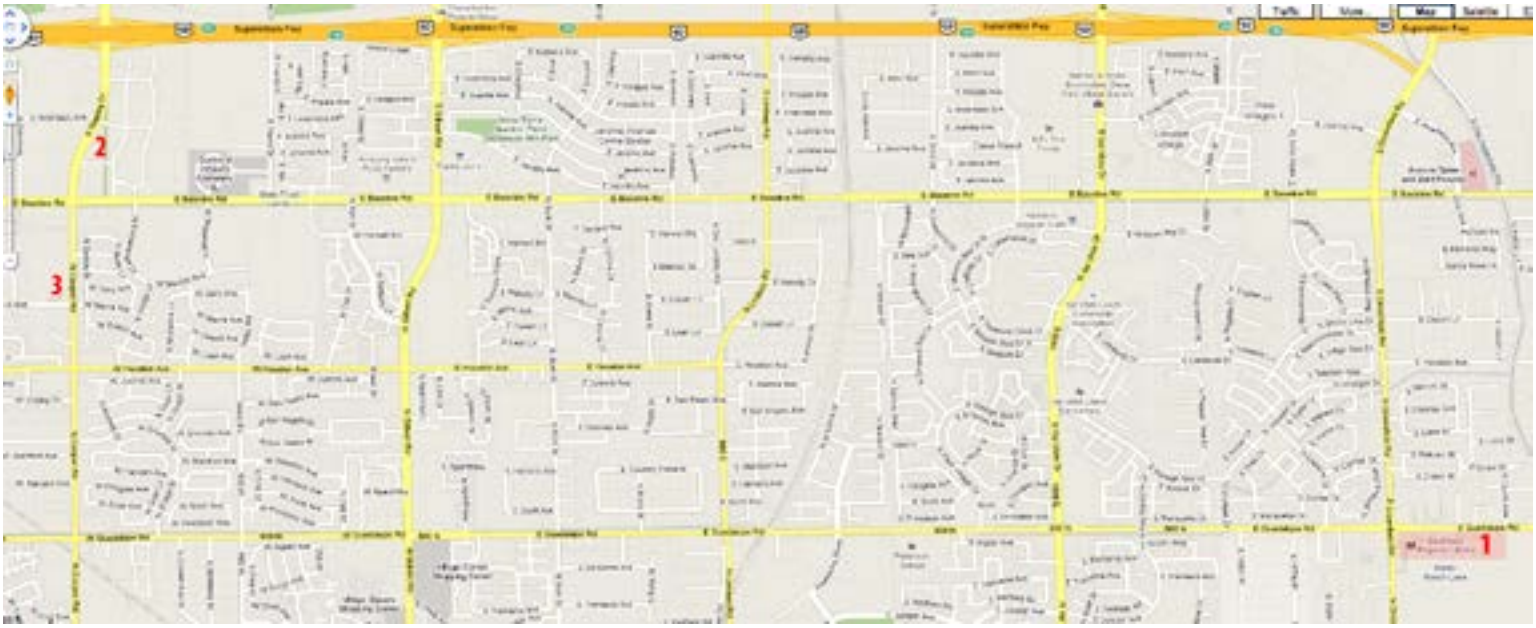
May 18

June 15

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

December 2017

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

December 9 - Local Star Party

December 15 - EVAC Holiday Party

December 16 - Deep Sky Star Party

January 2018

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**			

January 8 - Local Star Party

January 12 - Public Star Party

January 13 - Deep Sky Party

January 18 - Fulton Elementary

January 19 - EVAC Monthly Meeting

January 25 - Charlotte Patterson Elementary

January 31 - Kyrene Middle School

East Valley Astronomy Club -- 2017 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

☐ **$15.00 Individual** July through September

☐ **$17.50 Family** July through September

☐ **$22.50 Individual** April through June

☐ **$26.25 Family** April through June

☐ **$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

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Name: ☐ Phone: ☐

Address: ☐ Email: ☐

☐ Publish email address on website

City, State, Zip: ☐ URL: ☐

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.

☐ General Observing ☐ Cosmology

☐ Lunar Observing ☐ Telescope Making

☐ Planetary Observing ☐ Astrophotography

☐ Deep Sky Observing ☐ 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@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

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East Valley Astronomy Club
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