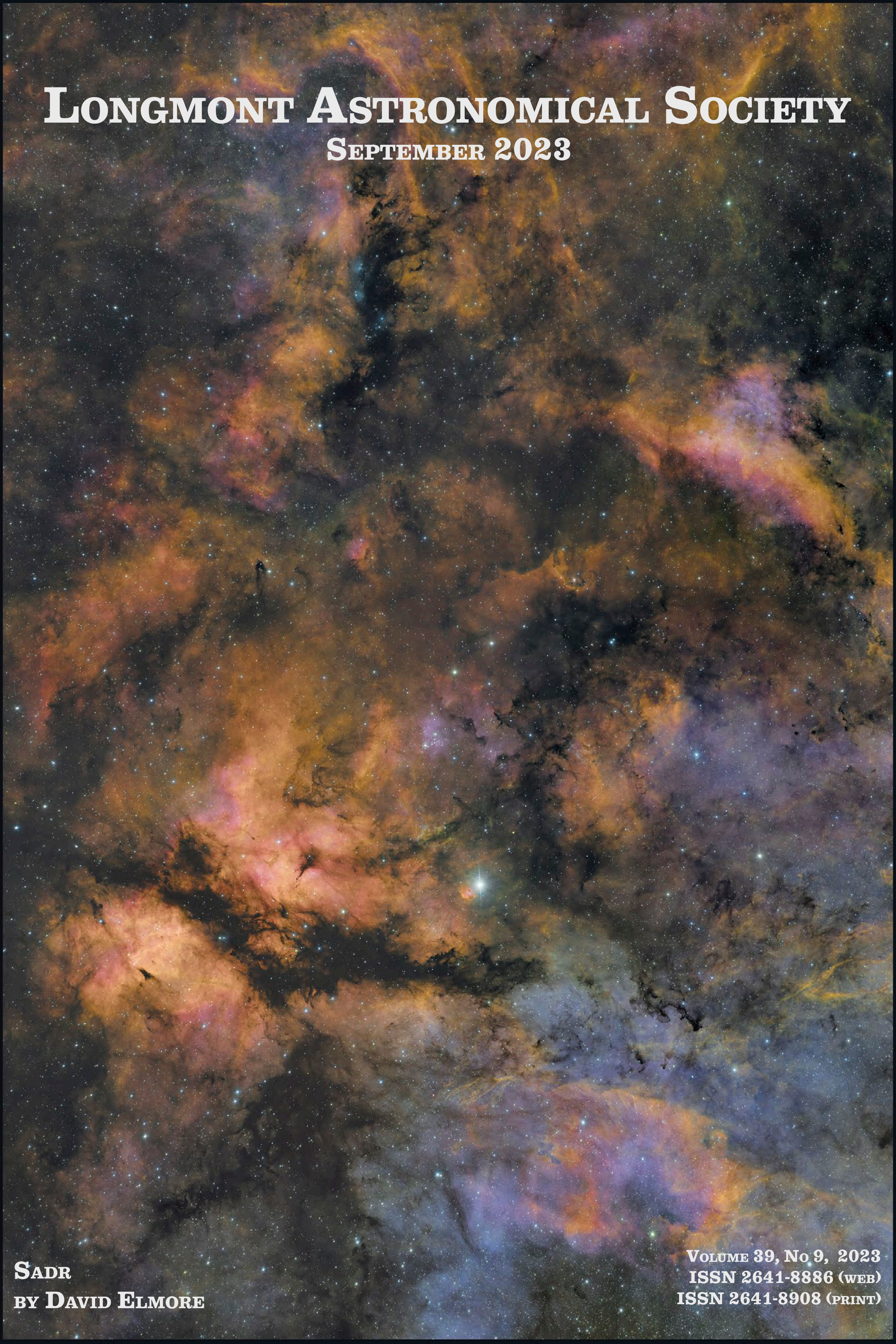
Longmont Astronomical Society

September 2023



Sadr
by David Elmore

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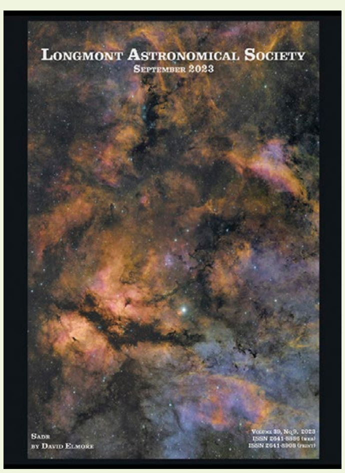
LAS Meeting Thursday, September 21 at 7 pm
Tatsuya Akiba

The speaker for the meeting will be Tatsuya Akiba, a Ph. D. Candidate in Astrophysics from the University of Boulder. Their presentation will be either on the dynamics of stars around supermassive black holes or the dynamics of planetesimals around white dwarfs.

The meeting will be at the First Evangelical Lutheran Church, 803 Third Street, Longmont, CO. If you can not attend in person you may attend by Zoom video conference; the Zoom invitation will be sent out by email about a week before the meeting.

Front Cover: Sadr by David Elmore



Sadr region is busy with molecular clouds, emission, and reflection nebulae. Narrowband rendering with Red a mixture of Hydrogen alpha and Sulfur II, Green Sulfur II and Oxygen III, and Blue Oxygen III. Exposures were 11 in Ha, 10 OIII, and 10 SII. Borg107FL refractor, ASI6200MMPro camera, and Chroma 3nm filters.

Back Cover: Lion Nebula by Martin Butley

Sh2-132 is a faint emission nebula located in the constellation of Cepheus. Exposures were 8.3 hrs Ha, 2.7 hrs SII, and 2.8 hrs OIII filters. Scope was Takahashi FSQ 130, ZWO ASI 6200 camera, and Astrophysics Mach2 mout.

LAS Officers and Board Members in 2023

Vern Raben, President
Hunter Morrison, Vice President
Eileen Hall-McKim, Secretary
Bruce Lamoreaux, Treasurer

Board Members:
David Elmore, Gary Garzone,
Mike Hotka, Brian Kimball, and Tally O'Donnell

Appointed Positions 2023

Sarah Detty, Webmaster; Bruce Lamoreaux, Library Telescope Coordinator; Bill Tschumy, Public Outreach Coordinator;
Vern Raben, Newsletter Editor; Eileen Hall-McKim, Newsletter Archives;

Contents

About LAS

The Longmont Astronomical Society Newsletter ISSN 2641-8886 (web) and ISSN 2641-8908 (print) is published monthly by the Longmont Astronomical Society, P. O. Box 806, Longmont, Colorado. Newsletter Editor is Vern Raben. Our website URL is https://www.longmontastro.org and the webmaster is Sarah Detty. The Longmont Astronomical Society is a 501 c(3), non-profit corporation which was established in 1987.

The Longmont Astronomical Society is affiliated with the Astronomical League (https://www.astroleague.org). The Astronomical League is an umbrella organization of amateur astronomy societies in the United States.

Planets in September

Mercury

Mercury becomes visible in morning twilight about mid month. It brightens from magnitude 0.7 to -1.1; the disc decreases from 8.3 arc sec to 5.7 arc sec on the 30th.

Venus

Venus is about 30 degrees above the east horizon in the morning sky around 6 am. It is magnitude -4.5 in brightness all month. It decreases from 50 arc sec across to 32 arc sec this month.

Mars

Mars is not visible this month.

Jupiter

Jupiter and GRS by Gary Garzone on Aug 27

Jupiter is in the constellation Aries. It is around magnitude -2.8 in brightness and disc is about 46 arc sec across. It will be at opposition on November 2nd. The following are good times to view the Great Red Spot (GRS) at mid transit:

- Sept 1 at 1:21 am, altitude 35°
- Sept 3 at 3:00 am altitude 54°
- Sept 5 at 4:38 am altitude 66°
- Sept 6 at 12:29 am altitude 29°
- Sept 7 at 6:16 am altitude 60°
- Sept 8 at 2:07 am altitude 49°
- Sept 10 at 3:46 am altitude 64°
- Sept 10 11:37 pm altitude 23°
- Sept 12 at 5:24 am altitude 64°
- Sept 13 at 1:15 am altitude 43°
- Sept 15 at 2:53 am altitude 61°
- Sept 17 at 4:32 am altitude 66°
- Sept 18 at 12:23 am altitude 37°
- Sept 19 at 6:10 am altitude 54°
- Sept 20 at 2:01 am altitude 56°
- Sept 22 at 3:39 am altitude 66°
- Sept 22 at 11:30 pm altitude 31°
- Sept 24 at 5:17 am altitude 59°
- Sept 25 at 1:09 am altitude 51°
- Sept 27 at 2:47 am altitude 65°
- Sept 27 at 10:38 pm altitude 25°
- Sept 29 at 4:25 am altitude 62°
- Sept 30 at 12:16 am altitude 45°

Saturn

Saturn by Gary Garzone on Aug 27

Saturn is visible in the evening sky in constellation Aquarius. It is magnitude +0.5 in brightness and the disc is 19 arc sec across.

Uranus

Uranus maybe seen in the morning sky in constellation Aries. It is magnitude +5.7 in brightness and the disc is 3.6 arc sec across.

Neptune

Neptune is in constellation Pisces. It is magnitude +7.8 in brightness and the disc is 2.3 arc sec across.

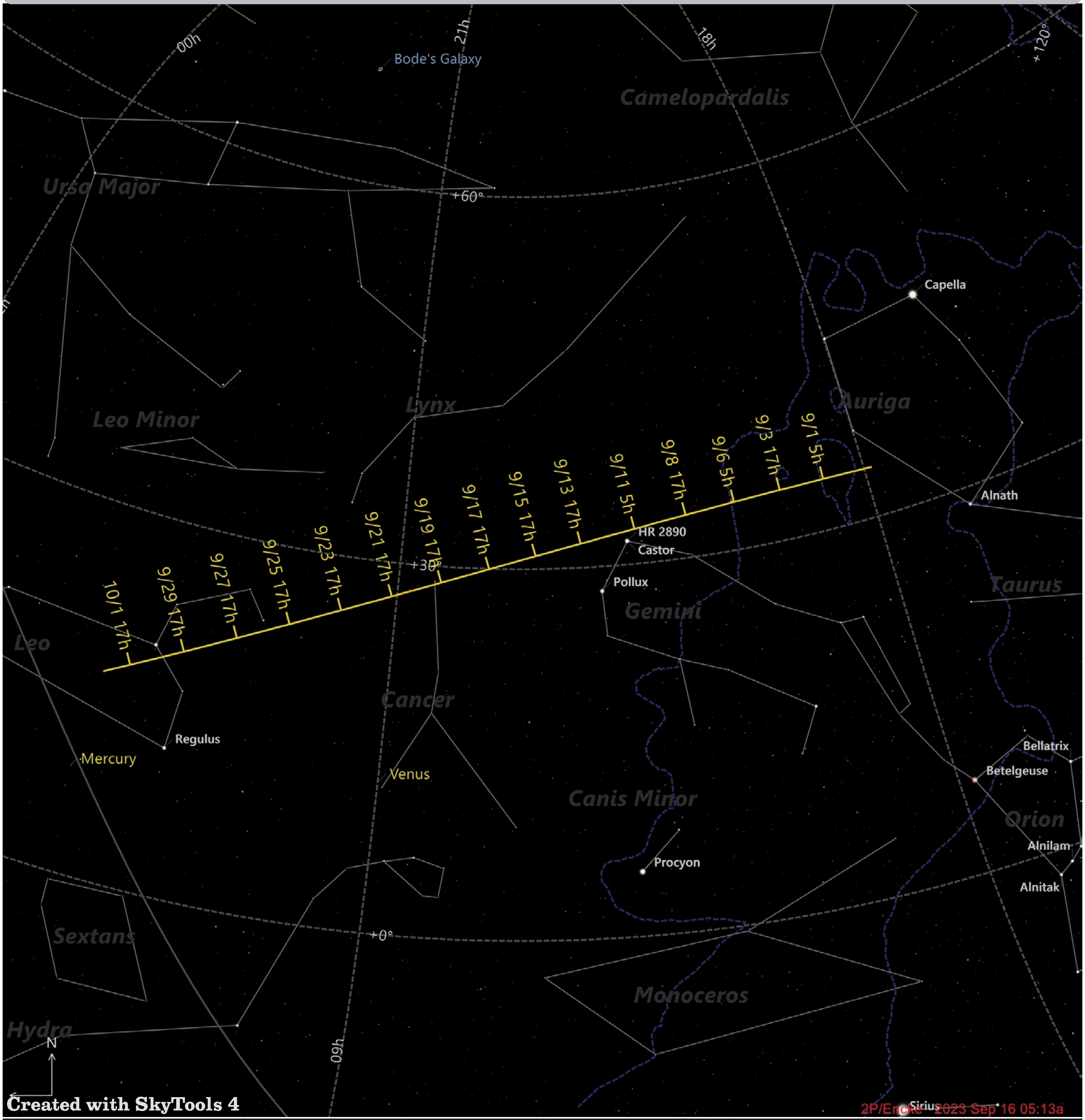
Lunar Phases in September

- Third quarter: September 6 at 4:22 pm
- New moon: September 14 at 7:41 pm
- First quarter: September 22 at 1:33 pm
- Full moon: September 29 at 3:59 am

Meteor Showers in September

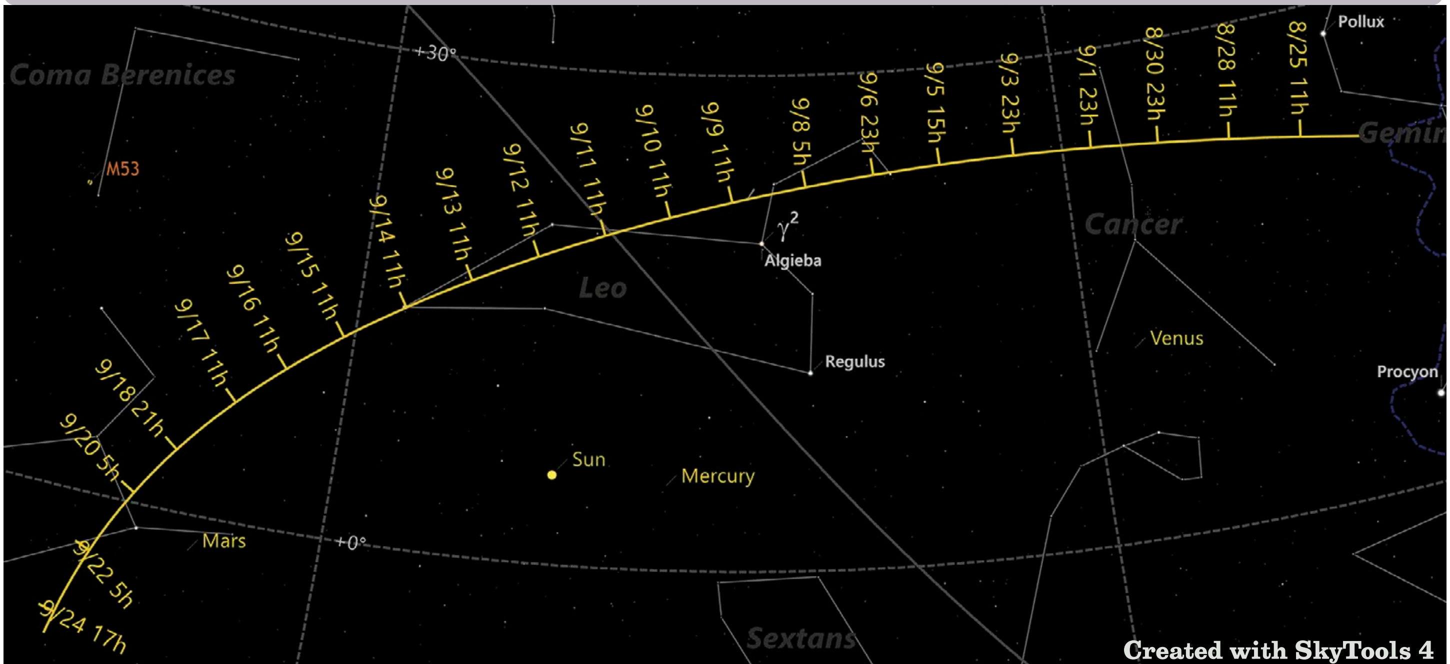
There are no major meteor showers in September. Even so from a dark location you may see sporadic meteors from various radiants in Aries and Taurus of maybe 20 per hour after midnight.

Comet 2P/Encke



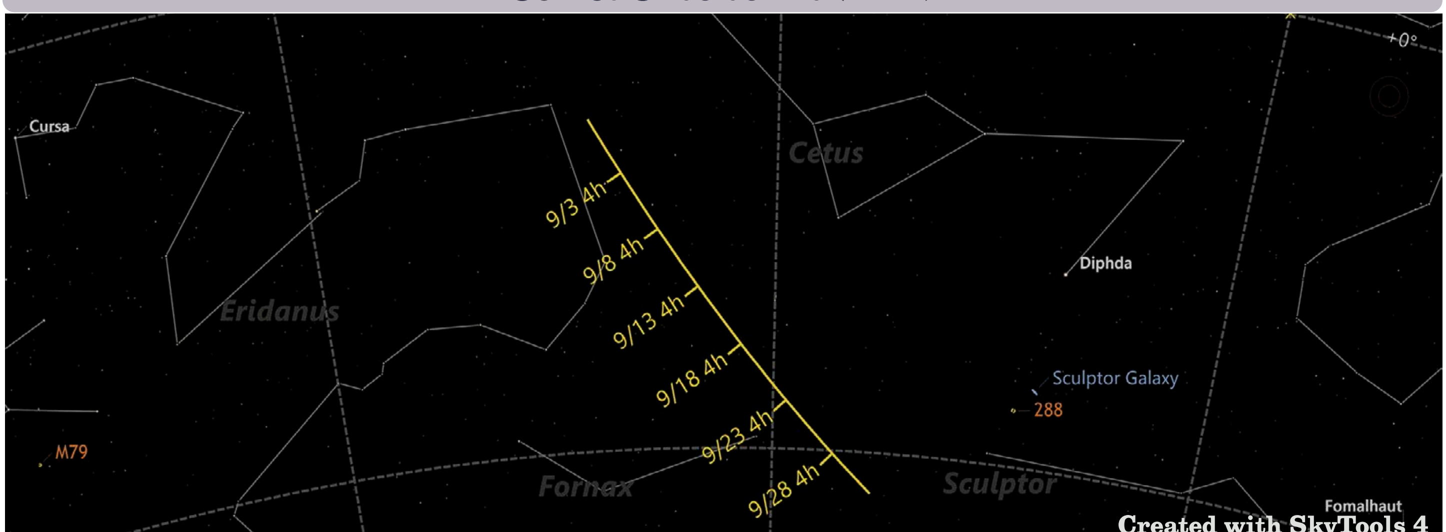
Date	Optimal time	RA	Dec	Constellation	Magnitude	Size (arc min)
Sept 1	4:54 am	06h24m38.2s	+34°05’18”	Auriga	11.4	2.5
Sept 7	5:02 am	07h08m49.0s	+33°30’09”	Gemini	10.5	2.8
Sept 13	5:10 am	07h58m02.9s	+31°39’46”	Gemini	9.7	2.9
Sept 19	5:19 am	08h50m12.0s	+28°15’46”	Cancer	8.8	3.0
Sept 25	5:28 am	09h42m18.4s	+23°16’31”	Leo	7.9	3.1
Sept 30	5:38 am	10h23m53.7s	+18°07’59”	Leo	7.1	3.0

Comet C/2023 E1 (ATLAS)



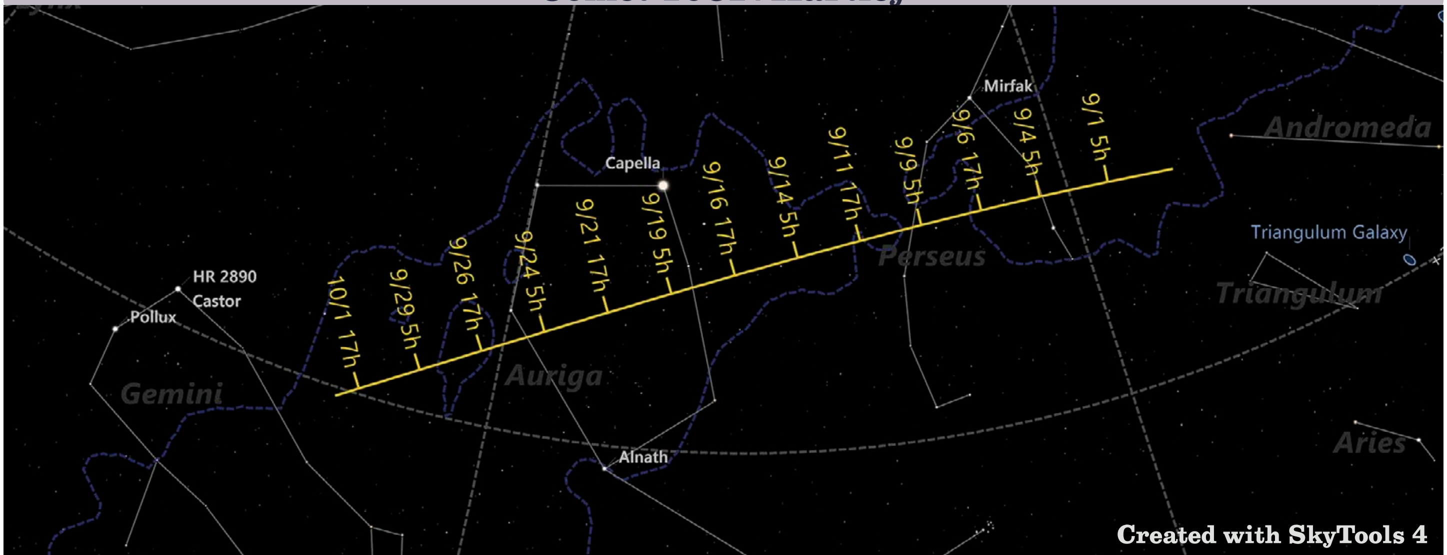
Date	Optimal time	RA	Dec	Constellation	Magnitude	Size (arc min)
Sept 1	5:17 am	08h56m04.6s	+24°00'28"	Cancer	6.2	5.2
Sept 7	5:33 am	10h09m44.9s	+23°05'25"	Leo	4.5	6.0
Sept 13	7:51 pm	11h39m47.4s	+15°50'14"	Leo	2.7	6.2
Sept 19	7:40 pm	12h43m17.8s	+01°23'14"	Virgo	2.8	5.2

Comet C/2020 V2 (ZTF)



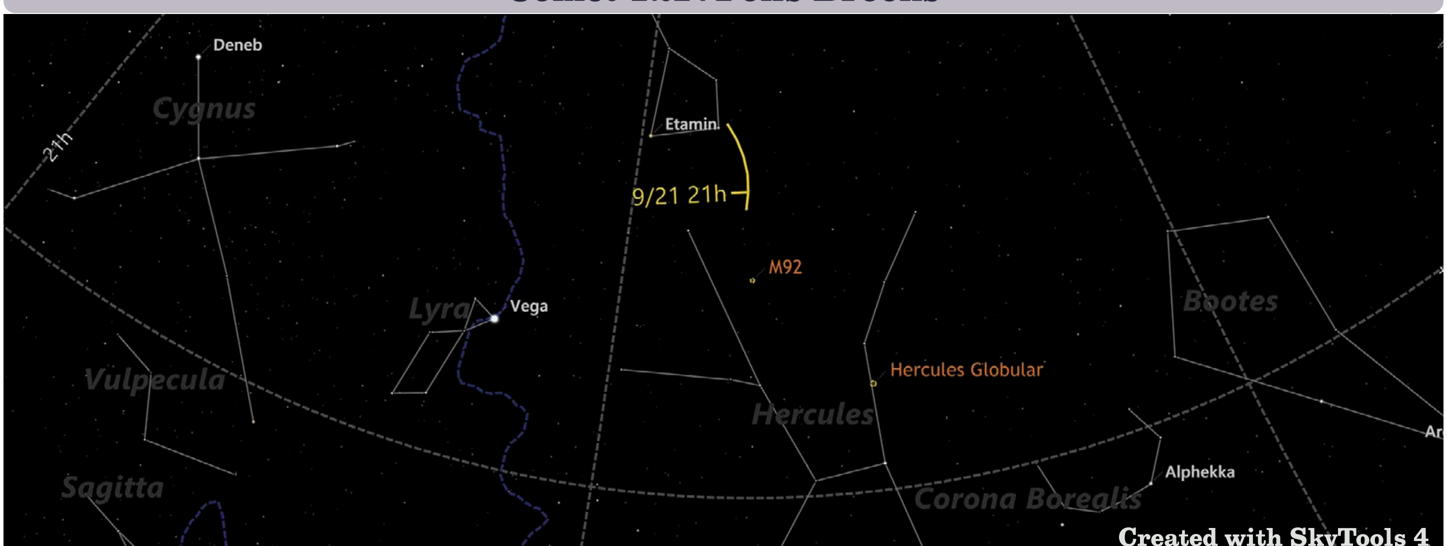
Date	Optimal time	RA	Dec	Constellation	Magnitude	Size (arc min)
Sept 1	4:51 am	02h42m35.2s	-12°30'32"	Cetus	9.9	5.3
Sept 7	4:22 am	02h31m58.3s	-16°38'01"	Cetus	9.9	4.4
Sept 13	3:47 am	02h19m30.4s	-20°49'47"	Cetus	9.9	4.4
Sept 19	3:09 am	02h05m15.6s	-24°56'50"	Fornax	10.0	4.4
Sept 25	2:53 am	01h49m25.5s	-28°49'54"	Fornax	10.1	4.4
Sept 30	1:57 am	01h35m24.8s	-31°45'25"	Sculptor	10.1	4.3

Comet 103P/Hartley



Date	Optimal time	RA	Dec	Constellation	Magnitude	Size (arc min)
Sept 1	4:52 am	02h55m50.9s	+42°51’42”	Perseus	11.1	2.5
Sept 7	4:52 am	03h43m13.5s	+43°04’46”	Perseus	10.7	2.7
Sept 13	5:01 am	04h32m49.8s	+41°47’38”	Perseus	10.4	2.9
Sept 19	5:10 am	05h20m49.1s	+38°57’12”	Auriga	10.1	3.0
Sept 25	5:17 am	06h04m06.0s	+34°49’24”	Auriga	9.9	3.0
Sept 30	5:27 am	06h35m32.0s	+30°43’43”	Auriga	9.9	3.0

Comet 12P/Pons-Brooks



Date	Optimal time	RA	Dec	Constellation	Magnitude	Size (arc min)
Sept 1	8:58 pm	17h24m50.9s	+51°56’47”	Draco	11.6	1.6
Sept 7	9:01 pm	17h21m46.5s	+50°56’35”	Draco	11.5	1.6
Sept 13	8:49 pm	17h19m54.0s	+49°53’38”	Hercules	11.4	1.6
Sept 19	8:38 pm	17h19m11.1s	+48°49’03”	Hercules	11.3	1.7
Sept 25	8:24 pm	17h19m35.2s	+47°43’59”	Hercules	11.2	1.7
Sept 30	8:06 pm	17h20m44.0s	+46°50’06”	Hercules	11.1	1.7

Bright Nebula in September

- M27 “Dumbbell Nebula” in Vulpecula, mag 7.1
- NGC 281 “Pacman” in Cassiopeia, mag 7.4
- NGC 6888 “Crescent” in Cygnus, mag 7.4
- NGC 7023 “Iris” in Cepheus, mag 7.2
- NGC 7380 in Cepheus, mag 7.2
- IC 1396 “Elephant Trunk” in Cepheus, mag 5.6
- IC 5146 “Cocoon” in Cygnus, mag 7.2
- Caldwell 9 “Cave” in Cepheus, mag 7.7

Galaxies in September

- M31 “Andromeda Galaxy”, in Andromeda, mag 3.3
- M32 elliptical galaxy in Andromeda, mag 7.9
- M33 galaxy in Triangulum, mag 5.8
- M101 “Pinwheel Galaxy” in Ursa Major, mag 8.4
- M110 in Andromeda, mag 8.1
- NGC 6946 “Fireworks” in Cygnus, mag 8.9

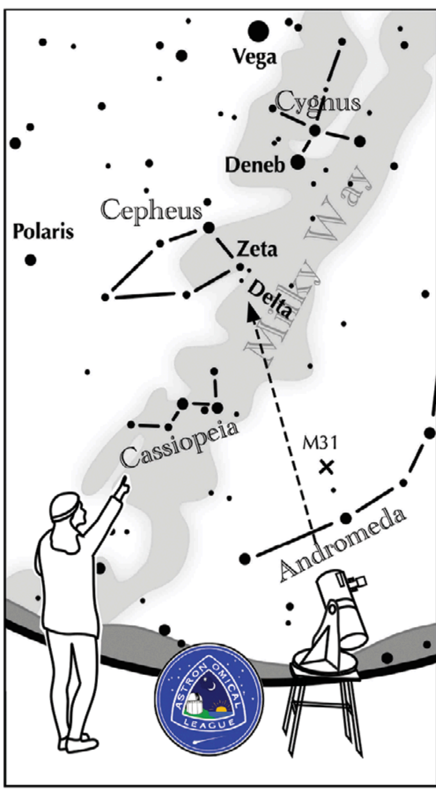
Globular Clusters in September

- M2 in Aquarius, mag 6.5
- M13 “Hercules Cluster” in Hercules, mag 5.8
- M14 in Ophiuchus, mag 5.8
- M15 in Pegasus, mag 6.2
- M56 in Lyra, mag 8.3
- M71 in Sagitta, mag 8.2
- M92 in Hercules, mag 6.4
- NGC 6712 in Scutum, mag 8.1
- NGC 6760 in Aquila, mag 8.9
- M14 in Ophiuchus, mag 7
- NGC 6934 in Delphinus, mag 8.8

Planetary Nebula in September

- M27, Dumbbell Nebula in Vulpecula, mag 7.1
- NGC6572 in Ophiuchus, mag 8.0
- NGC6543, Cat’s Eye Nebula in Draco, mag 8.1
- NGC7027 in Cygnus, mag 8.5
- M57, Ring Nebula in Lyra, mag 8.8
- NGC6210 in Hercules, mag 8.8
- NGC 7009 “Saturn Nebula” in Aquarius, mag 7.8
- NGC 7662 “Blue Snowball” in Andromeda, mag 8.3

ASTRONOMICAL LEAGUE Double Star Activity



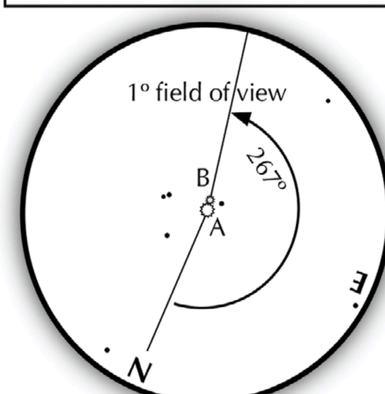
Other Suns: Delta Cephei

How to find Delta Cephei on a September evening

Face northeast and find bright Deneb, the northernmost star of Cygnus. It is nearly overhead. Between Deneb and the "W" shaped Cassiopeia lies the house-shaped constellation Cepheus. Find Zeta, the lower left star of the "house." Dimmer Delta shines just below it.

Suggested magnification: >20x
Suggested aperture: >2 inches

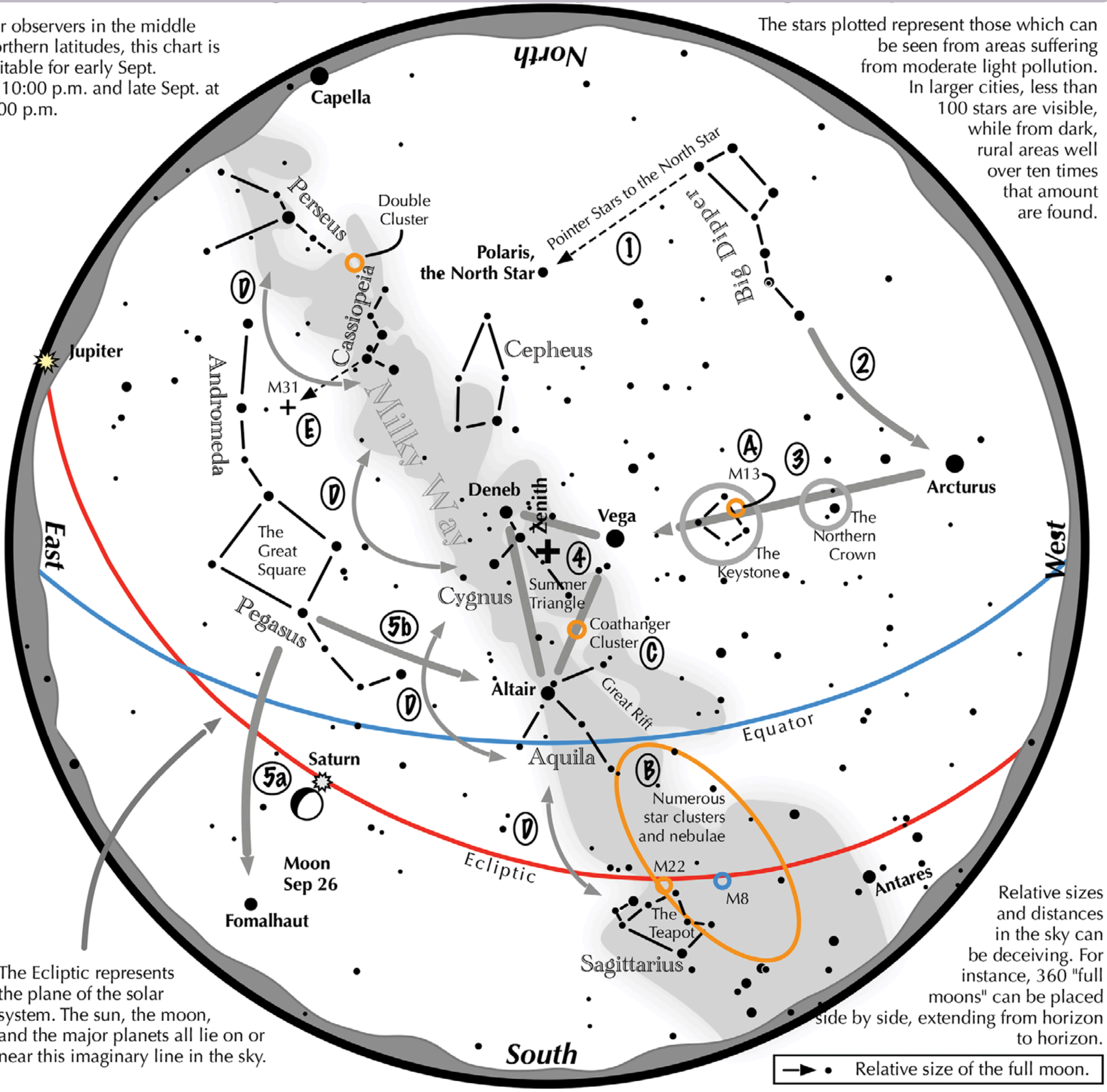
Beta Capricorni
A-B separation: 41 sec
A magnitude: 4.2
B magnitude: 6.1
Position Angle: 191°
A & B colors:
yellow, blue



Navigating the mid September Night Sky by John Goss

For observers in the middle northern latitudes, this chart is suitable for early Sept. at 10:00 p.m. and late Sept. at 9:00 p.m.

The stars plotted represent those which can be seen from areas suffering from moderate light pollution. In larger cities, less than 100 stars are visible, while from dark, rural areas well over ten times that amount are found.



The Ecliptic represents the plane of the solar system. The sun, the moon, and the major planets all lie on or near this imaginary line in the sky.

Relative sizes and distances in the sky can be deceiving. For instance, 360 "full moons" can be placed side by side, extending from horizon to horizon.

Navigating the mid September night sky: Simply start with what you know or with what you can easily find.

1 Extend a line north from the two stars at the tip of the Big Dipper's bowl. It passes by Polaris, the North Star.

2 Follow the arc of the Dipper's handle. It intersects Arcturus, the brightest star in the September evening sky.

3 Nearly overhead shines a star of similar brightness as Arcturus, Vega. Draw a line from Arcturus to Vega. It first meets "The Northern Crown," then the "Keystone of Hercules." A dark sky is needed to see these two dim stellar configurations.

4 The stars of the summer triangle, Vega, Altair, and Deneb, shine overhead.

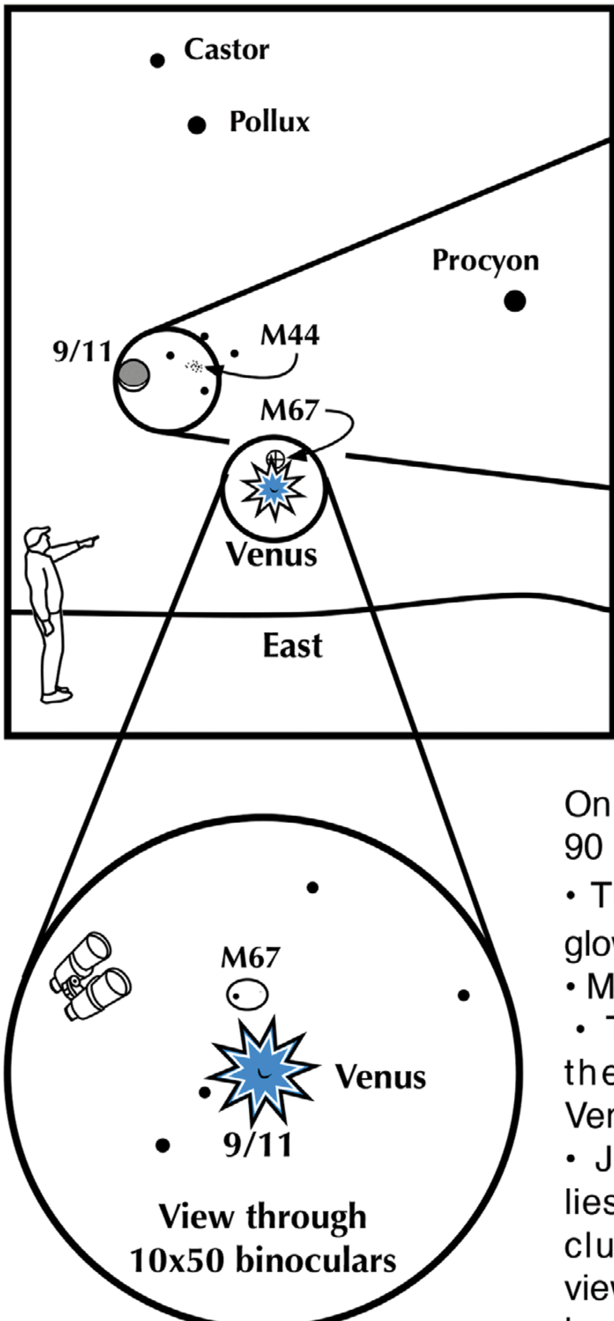
5 The westernmost two stars of the Great Square, which lies high in the east, point south to Fomalhaut. The southernmost two stars point west to Altair.

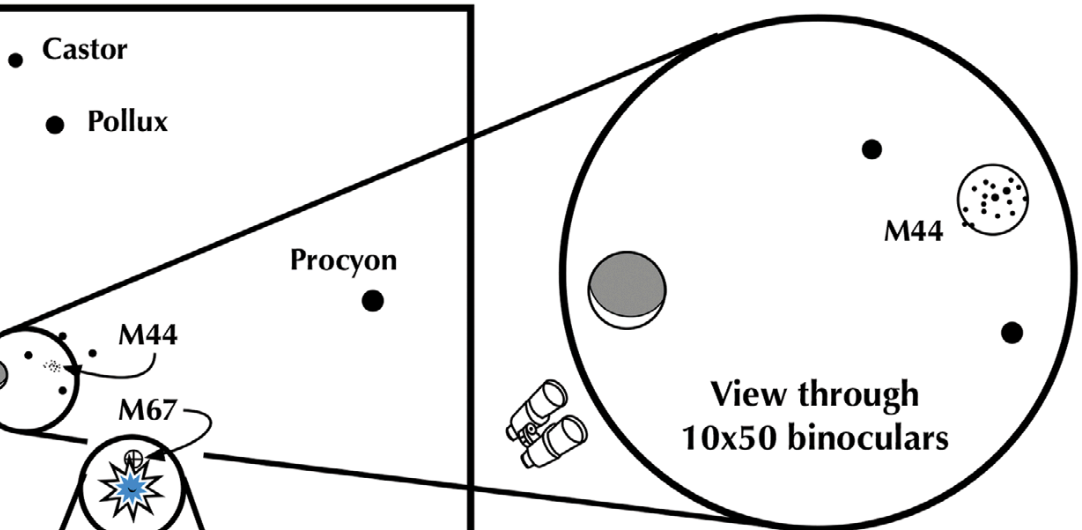
Binocular Highlights

A: On the western side of the Keystone glows the Great Hercules Cluster.
B: Between the bright stars Antares and Altair, hides an area containing many star clusters and nebulae.
C: 40% of the way between Altair and Vega, twinkles the "Coathanger," a group of stars outlining a coathanger.
D: Sweep along the Milky Way for an astounding number of faint glows and dark bays, including the Great Rift.
E: The three westernmost stars of Cassiopeia's "W" point south to M31, the Andromeda Galaxy, a "fuzzy" oval.

Astronomical League *www.astroleague.org/outreach; duplication is allowed and encouraged for all free distribution.*

If you can see only one celestial event in the morning this September, see this one.

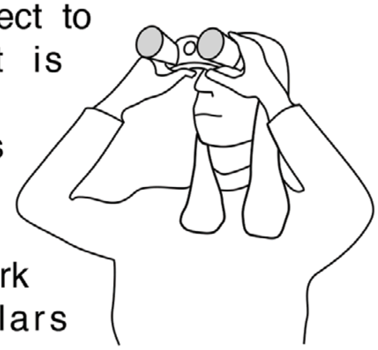




Moon visits M44, Venus visits M67

On the morning of Sep 11, look to the east 90 minutes before sunrise.

- The crescent moon, full with earthshine, glows left of M44, the Beehive cluster.
- M44 can easily be seen in binoculars.
- The dazzling object to their lower right is Venus.
- Just above Venus lies another star cluster, M67. If viewed from a dark location, binoculars should reveal its fuzzy presence.
- If the binoculars are securely mounted, the tiny crescent of Venus should be barely discerned amid the planet's glare.



ASTRONOMICAL LEAGUE

ALCon

30 years ago August 1993

From the President, Bob Spohn
"We had another nice public observing session at Dawson Park. There weren't as many people as last time, but those that were there stayed longer. La Luna kept the sky rather bright, but we managed to pluck a few jewels to view. Sky conditions were very favorable at times for Saturn, and we took full advantage of it – beautiful! Don't forget the upcoming New Moon Star Party this Saturday, the 8th at Deadman!"

Bob noted that as he was writing his "The View from Up Here" column for the newsletter on Sept. 13 it was snowing!

20 years ago August 2003

Jim Crane announced that Brian Kimball received a certificate last month for observations of all the Messier Objects, and two months ago, Andrew Plank received a certificate for his observations of Double Stars.

Bob announced that we collect aluminum cans for the telescope project. LAS member gather together and make mirrors and build 6"& 8" telescope to be used as educational tools for local schools.

Mike Hotka presented "Astronomy for Beginners" an intro to telescope selection & observing.

Video documentary by Mike Hotka – This program is a documentary about club members and their effort to view and take pictures of Mars. It starts out with Ray Warrens's presentation from last month's meeting and progresses to show pictures from Gary Garzone, Brian Kimball, Tim Brown and some of my sketches. It runs about 38 minutes and was a blast to put together.

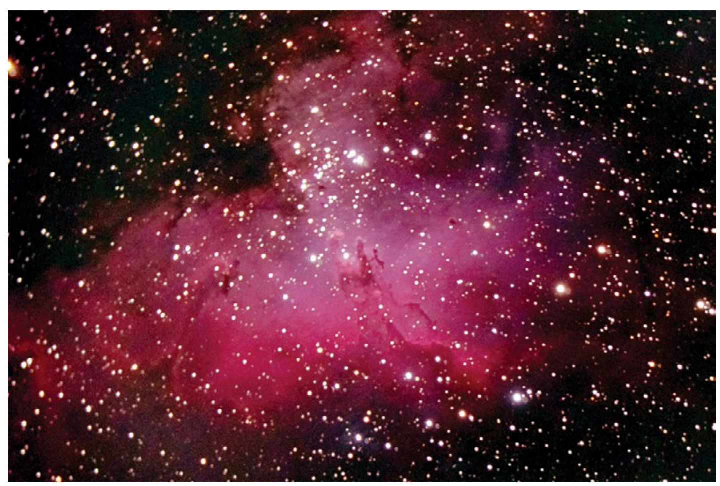
Bob Spohn announced that there will be a huge star party at the Tri-City of Dacono/Firestone/Frederick on September 20th. We will set up at the Saddleback Golf Course. There will need to be more advertising on this, but it promises to be big. We are also adding to our membership pool from Fort Lupton.

10 years ago August 2013

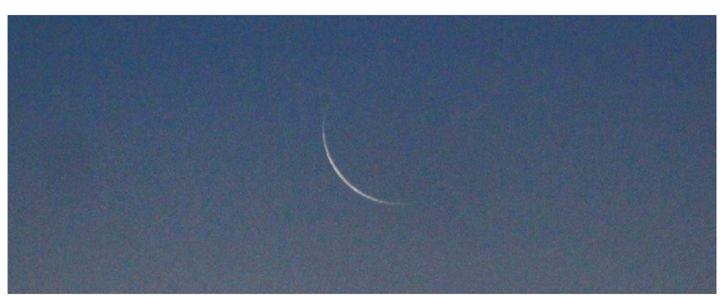
From the President, Bill Tschumy
Our speaker next month will be Stephen Albers and he is giving a two-part talk:

- Part I: Comet Ephemerides with Geometry and Visibility Info
- Part II: Simulated All-Sky Images Compared with the LAS All-Sky Camera

Just like your backyard when you were a kid – the skies of Fox Park by Gary Garzone



Jim Pollock's first picture of the Eagle Nebula



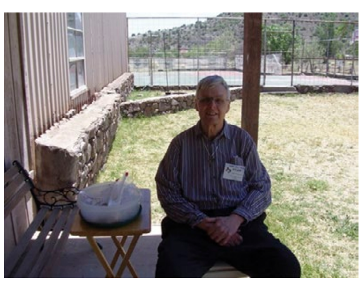
Lefty Harris image of 34 hour old crescent moon

How it all began?
by Mike Hotka

In 1983, my family and I moved from San Antonio to Garland, TX. A short time after that, I learned of the Texas Astronomical Society and became a member.

In the process of moving our belongings to Garland, I decided to get my 12.5" f/8 Newtonian telescope operational. I made the primary and secondary mirrors removable from the tube and built a collapsible Dobsonian mount to help transport this telescope to dark sky sites. Many of you might remember my black and white, hexagon tube telescope:

I would haul my 12.5" telescope out to TAS's dark sky site, set it up and swing it around, looking for this and that. But I had no real plan of what I wanted to observe. I just looked at whatever I could find.



At some point in my early observing attempts, John Wagoner took notice of me. John was the Texas Star Party observing coordinator for years. He could be seen sitting outside the meeting hall door every afternoon. John saw an opportunity to help a new amateur astronomer. He not only introduced me to the Astronomical League's Observing Clubs, as they were called in those days, but he taught me how to observe the night sky. I made my first observation for an Astronomical League Observing Club on July 12, 1986. This was M57 for the Messier Observing Club. I think John knew that I would like these Observing Clubs from that moment on. And he was right! He set the observing hook so deep in me, I continue to complete these Observing Programs today.

I recently completed my 63rd Astronomical League (AL) Observing Program (OP). It is a program called the Solar Neighborhood (SNH). You can review the program's web page on the Astronomical League's website by clicking this URL Solar Neighborhood Observing Program - Astronomical League (astroleague.org) . All the stars that need to be observed are within 10 parsecs (32.6 light years) of our sun.

As is the case with all the OPs I have completed, I learned new concepts and information about our astronomy hobby from this one also. I was amazed to learn that many of the bright stars in our night sky are this close to our sun. I also liked the fact that there was a list of these stars to observe. All you need to do is to choose 100 stars from the master list of stars to observe. Then go out and record your observations.

A list of objects to observe gives a natural structure to your observing outings. You know what you are going to observe before you go out. You have an order to the objects you will observe. This makes the planning for your outings simple. All you must do is to go to the dark sky site and have fun.

The list of objects/activities that the ALOPs have is what draws me to complete so many of these OPs. All I need to consider when trying to decide which ALOP to start next is what kinds of objects I would like to observe. Then find the ALOP that will provide of list of these objects to observe.

Then there is the educational aspect of some of the ALOPs that caught my eye. The Spectroscopy OP is a case of this. I've always been interested in the spectra of stars. This OP taught me how to capture the spectra of stars and deep sky objects and then how to process the raw images to show the spectral features. The Lunar Evolution OP is another one I chose because of the educational aspect of identifying craters on the lunar surface and determining which lunar epic they were created in. I find the ah-ha moments of these kinds of OPs very illuminating.

I use the Standard Edition of Sky Tools 4 (ST4) to help organize all my observing lists. This includes an observing list of the SNH stars brighter than magnitude 14.0 from the master list. When you have your laptop at your telescope in the field, ST4 shows the order to observe these stars on your list. With hot key shortcuts, star fields can be displayed, aiding you in identifying the star field the SNH star is in and then the star itself.

You need to sketch the star field, showing the SNH star's position amongst about 5 other stars in the field of view. The sketching requirement will show the Program's Coordinator you actually saw the SNH star. I enjoy sketching at the eyepiece, which made this OP more fun for me.

In the past, I've heard people comment that if an OP has a sketching requirement, they won't do it. You don't need to be an artist like Rembrandt to create a sketch. You are not being graded on your artistic ability. With patience, you can make a sketch that resembles the view in the eyepiece.

In addition to observing SNH stars naked eye, with binoculars (I used my 10x50 binoculars) and then using a telescope (I used my 8" f/6 Newtonian), there are three additional exercises that I found very educational.

One exercise was to sketch Barnard's Star over a years' time. In my sketches, I was able to detect a tiny bit of movement of this star. I was amazed my sketches revealed this.

Another exercise was to make an occulting eyepiece and try to see the Pups of Sirius (Sirius B) and Procyon (Procyon B). With the occulting eyepiece I created, I was able to easily see both Pups for the first time ever. Another amazing result of this OP for me.

As anyone who knows me, I love lists of objects to observe. Many ALOPs have more objects on their master list of objects than are required to be observed to complete the OP. It is always the case that once I complete the required number of observations for these OPs, I will look at the rest of the objects on the master list for fun. I want to see why the OP's creator chose these objects for the program. I also see so many more objects that if left to my own accord, I would not observe them because I wouldn't know they exist.

As is the case with this OP, there are many more SNH stars on the master list than the 10 naked eye, 20 binocular and 70 telescopic stars that need to be observed. While I was waiting for the final observation of Barnard's Star, I observed more of these beautifully colored, most of them red, stars. At the time I submitted my observations to the Program's Coordinator for their review, I had looked at 148 SNH stars telescopically, twice the number of telescopic observations required by the program. I still have a dozen more SNH stars to see before I turn my full attention to another one of my ST4 lists to observe.

To see what I submitted to Marie Lott, the SNH OP's Coordinator, see my results web page by clicking this URL: https://www.mikehotka.com/Cert Logs/SNH/SNH_Observations.html .

This is a very easy OP to do. The stars are easy to find in the sky. The learning aspect of this OP is outstanding. An alternative to visually observing and sketching these SNH stars, this OP can be completed by imaging the SNH stars, ergo both visual observers and imagers can have fun learning about these stars and completing this OP.

Secretary Notes Thursday, August 17, 2023
by Eileen Hall-McKim

I. Introduction

The August LAS in-person/hybrid monthly meeting was held on August 17th at the Longmont Lutheran Church. President Vern Raben began the meeting with a self-introduction by all members attending in-person and those on zoom. Fourteen members attended in-person, 14 attended via zoom.

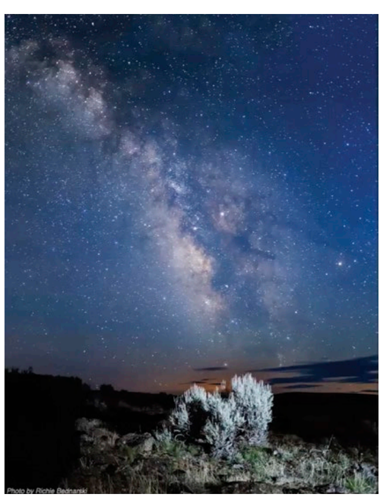
II. Meeting Presentations

This evening we have two presentations: the main presentation is "Gravitational Waves - Observing the Dark and the Bright" by Dr. Carl Haster, followed by "Comet C/2023 P1 (Nishimura)" by Paul Robinson; and finally Vern Raben will show us the ultimate telescope to take to a star party, the "Ford Deuce Telescope"

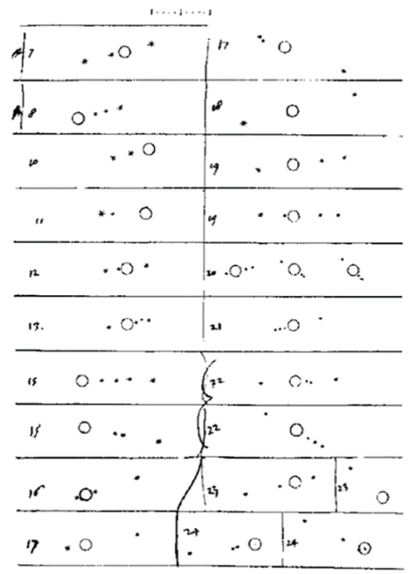
Our guest speaker for the August meeting is Dr. Carl Haster, an Assistant Professor of Astrophysics at the University of Nevada, Las Vegas. Before this, he was a Postdoctoral Associate at the LIGO (Laser Interferometer Gravitational Observatory) Laboratory and the Kavli Institute for Astrophysics and Space Research at MIT and a CITA Postdoctoral Fellow at the Canadian Institute for Theoretical Astrophysics. See full bio at: https://cjhaster.com/

Gravitational Waves
Observing the Dark and the Bright

For the last few years we have been able to observe gravitational waves- ripples in space-time itself- originating from the most extreme astronomical objects and processes in the Universe. In this presentation, Dr. Haster will both introduce the concepts of gravitational waves and describe what our current set of observations can tell us about the nature of Black Holes, stellar evolution and even gravitation itself.



What can we learn about the universe both the dark side and the bright side of the universe using non-traditional astronomy? What and how do we observe? Starting from the beginning of human history, people have observed the sky, more recently telescopes were used, eventually being able to create photographs.



- In 1610 Galileo pointed a telescope towards Jupiter, he noticed objects seemingly going around Jupiter and did a few weeks of observations in January, documenting the Moons of Jupiter
- In 1840, once the camera is invented, John Draper, one of first to use a camera for astronomy purposes, took a photograph of the Moon
- In ~1910s Victor Hess first recorded astronomical observation in a balloon, of not just light but particles streaming in from the universe on to us, confirming the existence of cosmic rays

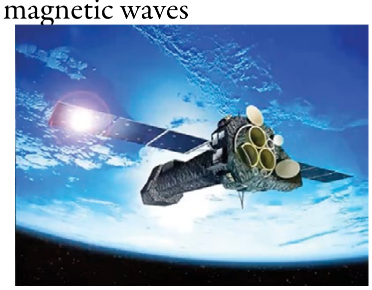
Across the Electromagnetic spectrum – we can learn a lot of astronomical information by looking at different wavelengths

- Radio Telescope – long wavelength

- Infrared Astronomy – best we have now is JWST

- Optical Astronomy – in the wavelength that humans can see

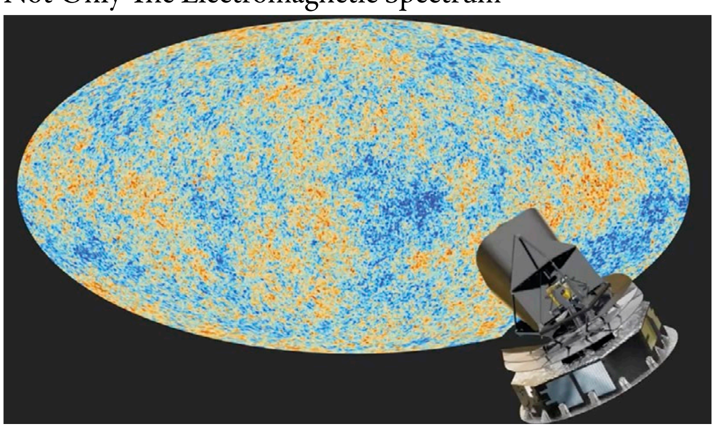
- Space-Based Telescope – short-length – X-rays, electro-magnetic waves



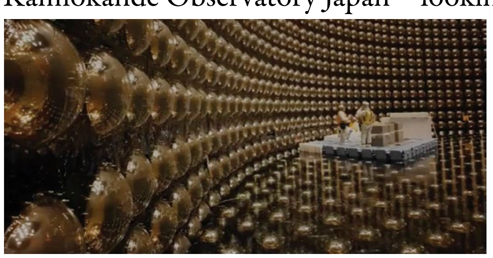
- Gamma Rays Space Telescope, Fermi Space Telescope

Most of these instruments generate pictures, but there are observations that capture even more information, one of best examples is the Cosmic Microwave Background which shows the first electromagnetic radiation created in the Universe has been observed by the Planck satellites, tells us much about our cosmological history.

Not Only The Electromagnetic Spectrum



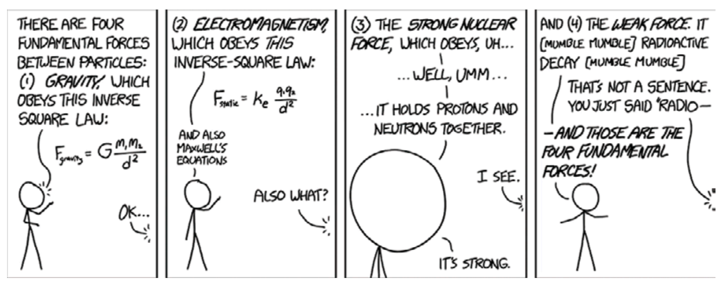
- Kamiokande Observatory Japan – looking for neutrinos



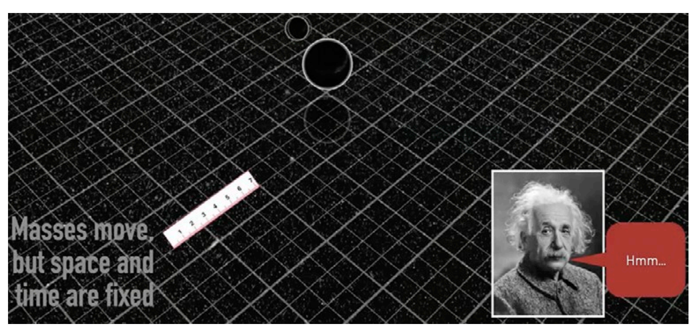
- Cosmic Rays Observatory in South America- tries to detect fundamental particles

Gravitation

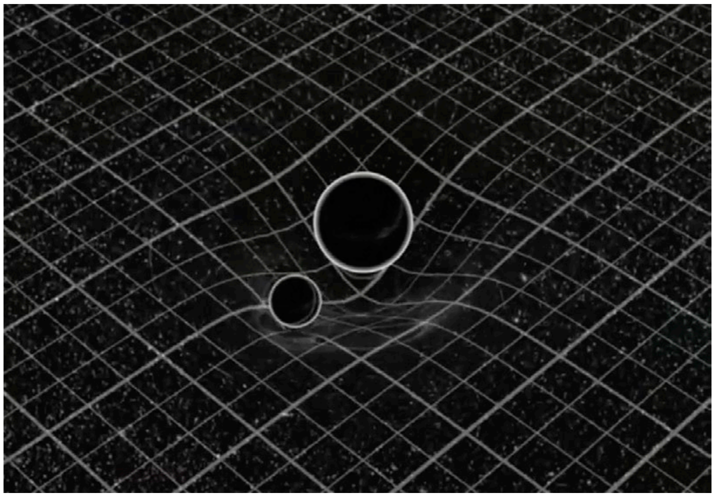
But what we are going to look closely at in this talk is gravitation, and how we can use small variations in gravitation itself to see what that can tell us about the Universe.



- Fundamental forces: Gravity, Electromagnetism, Strong Nuclear Force, Weak Force
- Newton's Gravity- the force between two objects; described orbits, how objects fell to the ground, doesn't technically give reason for why gravity exists



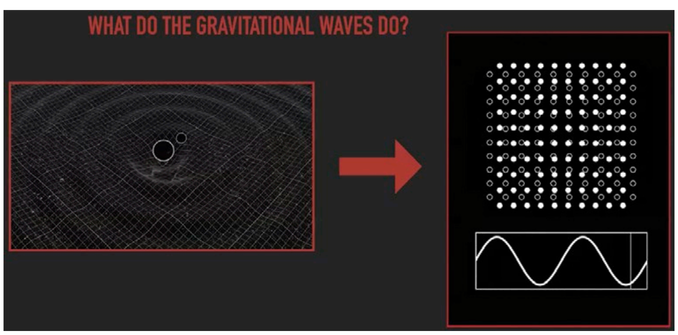
- Albert Einstein later describes as not only force between objects but a symptom of more fundamental process in the Universe, can squeeze and stretch not fixed, something with some mass can create "dimple in space-time"



- Dr. Haster displayed an animation of Earth and Sun rolling around and warping of space-time
- John Wheeler "Space tells matter how to move, Matter tells space how to curve"
- Gravity and space-time work in the same way, these ripples in space-time create waves moving, propagating out, these ripples are what we call gravitational waves

What do the Gravitational Waves Do?

- Gravitation waves will stretch and squash space-time in the pattern shown in diagram sinusoidal wave on the bottom

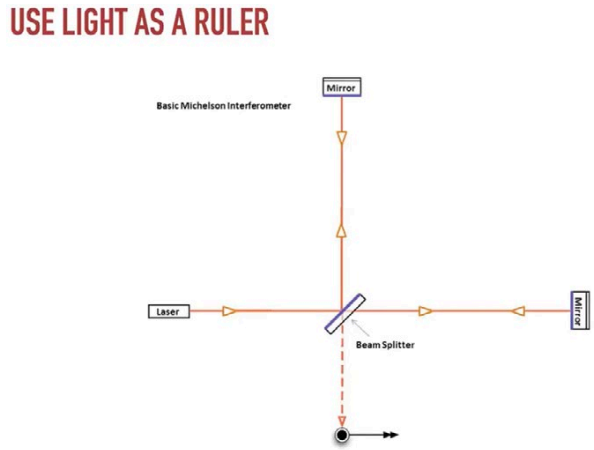


- Created by everything in the universe - so anything moving in relation to anything else will create gravitational waves
- Problem is GWs are minuscule – a fraction of a fraction of the size of an atom – and also incredibly weak, only able to detect the ones from most violent and most extreme events in the universe

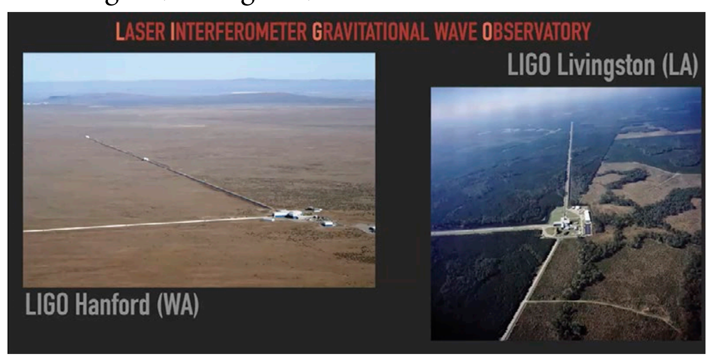
Observing Gravity

There are fractions of fractions of measurements coming from even the most extreme events, so to observe at all, we need the most precise measurements in human history to be able to detect the minuscule variations in distances, needed to measure variations in space or time.

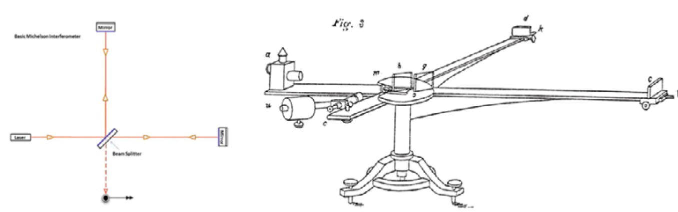
- Need most precise ruler we can create – most precise and constant thing we know of is light itself, a way of doing this is done by creating an interferometer



- In order to do these observations, must build observatories as big as possible
- Two detectors in U.S., both belong to LIGO, Hanford, Washington; Livingston, Louisiana

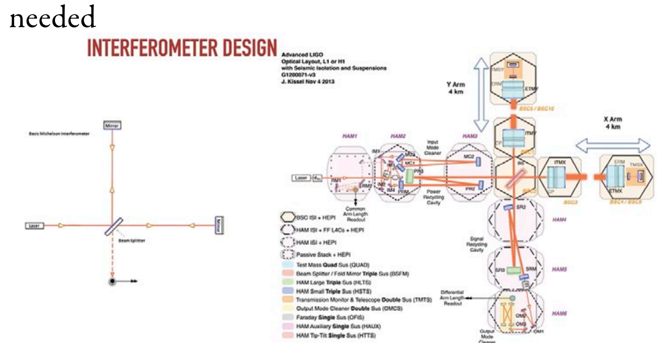


- Interferometer Design



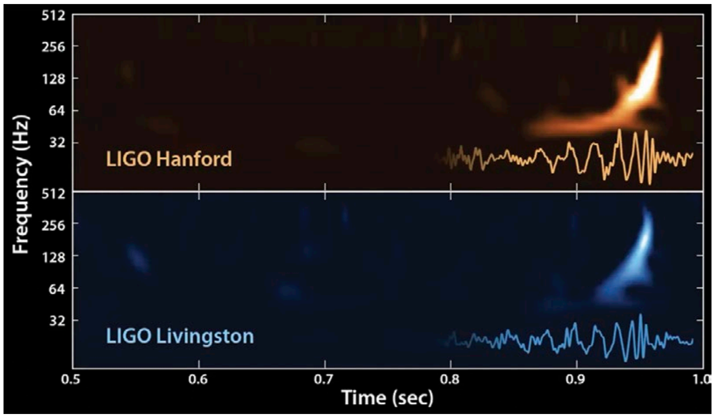
Original design from 1881 Michaelson

- LIGO design more than a trillion x more sensitive has been able to get to the measurement precision that is needed

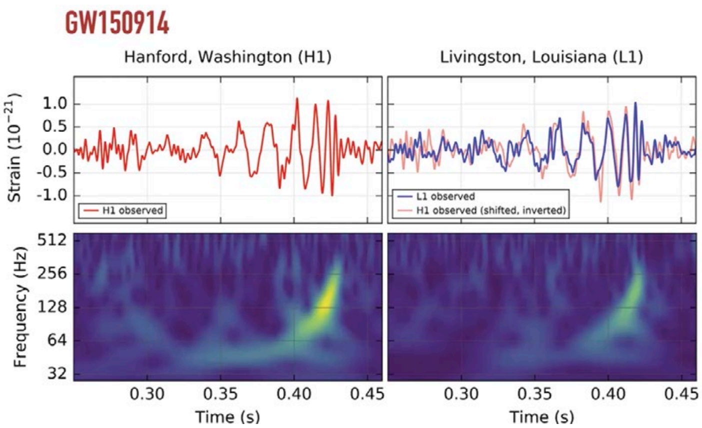


Have we actually made an observation? Yes!

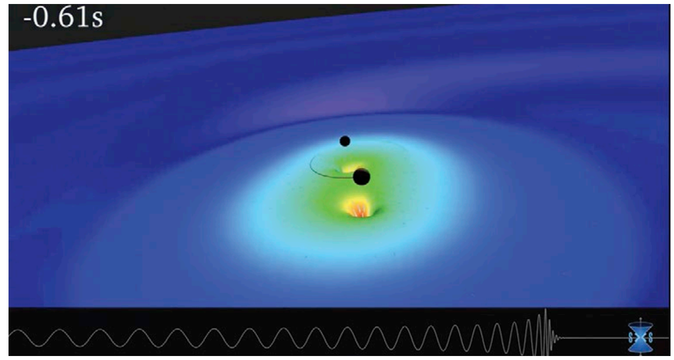
- Visualization of the data from the two LIDO detectors. Actual sound can be heard data played out as it is "chirp" that is a very clear signature of extremely exiting astrophysics happening somewhere in the Universe causing the space-time to vibrate just enough to be able to be detected

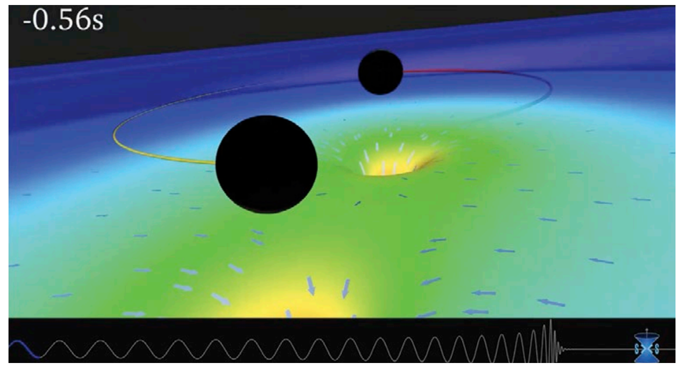


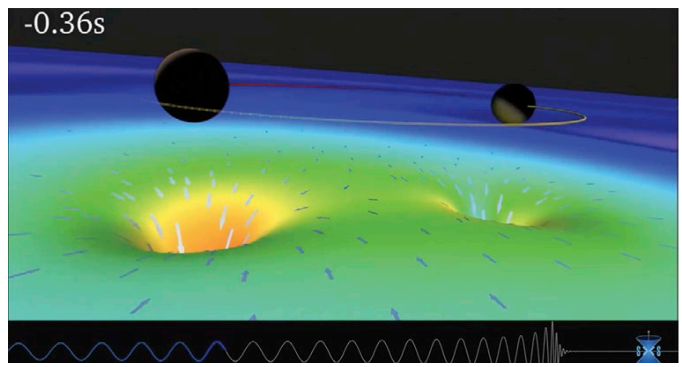
- Observed first gravitational event on Sept. 14, 2015 named GW150914

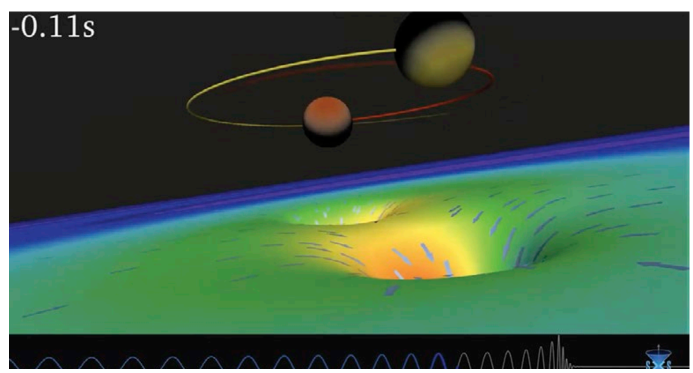


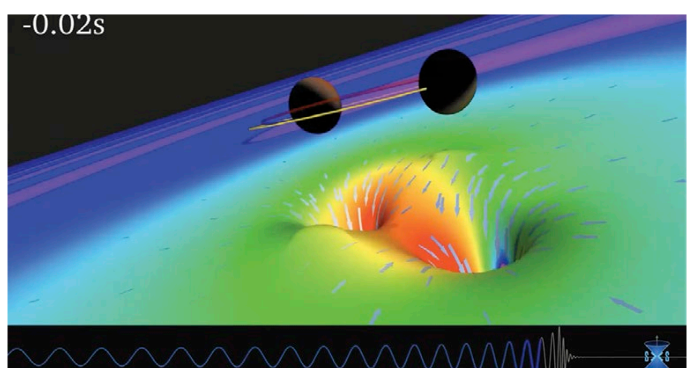
- Data on bottom is data signature, on top is the actual time series data printed out
- Data from two detectors create overlap as seen in graph on top right
- Believe this observation to be a merger of two objects out in the Universe, data gives an idea of the size of the binary orbits
- Analysis of these charts and working backwards through theories of gravitation to determine what kind of object could generate this signal – by far most probably astronomical candidate; the merger of two black holes in binary orbit around each other, predicted from astrophysics, that they will merge into one new black hole
- Objects orbiting each other, infinite space-time curvature below, eventually come sufficiently close enough together to merge, all this information about this behavior is encoded in the gravitational wave





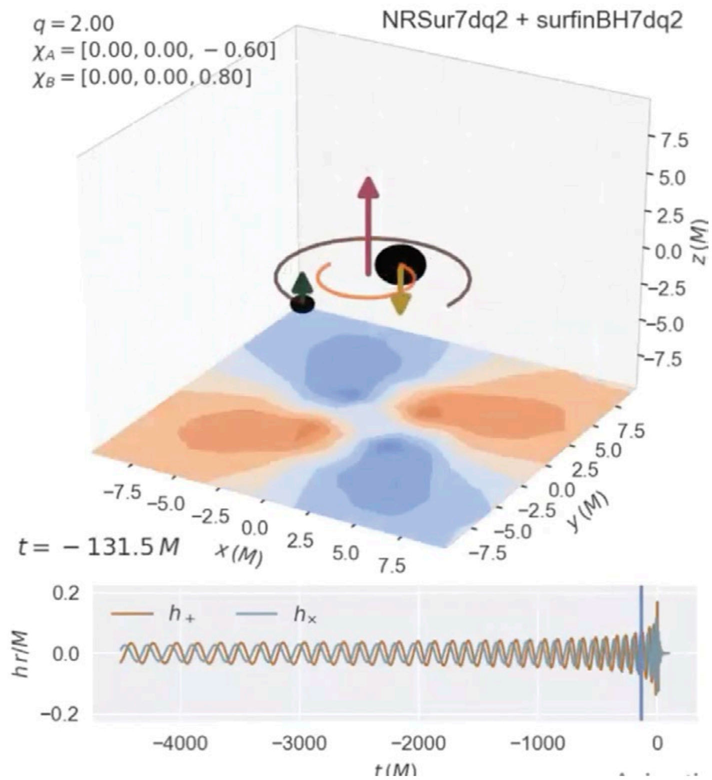






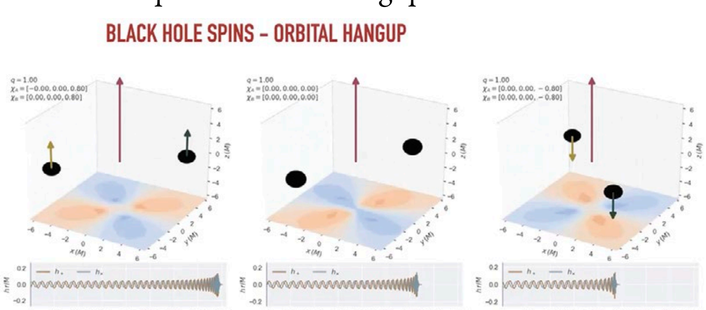
- Can learn more about the properties of the objects themselves, masses of the two black holes, properties of how they are rotating, how the spins behave in respect to each other can tell a lot about the history of black holes and how they were formed

Black Hole Spins



- Black holes can rotate, similar to how Earth is rotating around its axis
- The gravitational field around rotating BHs is so extreme that it will actually drag space-time in their vicinity around them
- This impacts how rotating BHs interact with nearby objects through gravitation
- Size and orientation of spins of BHs in a binary will have big effects on the orbit, and the emitted gravitational waves
- Once the two BHs have merged then the resulting BH will also have some spin

Black Hole Spins - Orbital Hangup



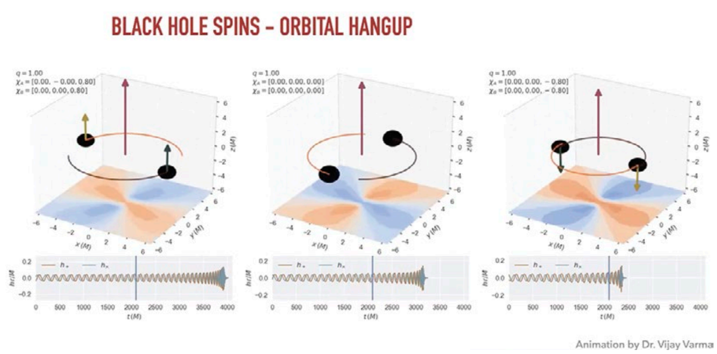
Credit: Dr. Vjay Varma

- More interestingly, depending on the orientation of the two BH spins, the in-spiraling orbit will behave in different ways
- If two BHs are pointed upwards (left) means that the angular momentum of the BHs is pointing in the same direction as the angular momentum of the overall binary orbit, this will cause a different result than if the BHs are completely non-spinning (center) or pointed downward (right)
- As shown in graph below each diagram, the one on the right finished much more quickly
- Therefore, the length of a signal we actually see in our detector can give us an idea about the directions of the BH spins, and tell us much about the origin of the black holes themselves

How To Make A Gravitational Wave Merger

We have seen the merger of two BHs, the BH binary had to form somehow in the beginning.

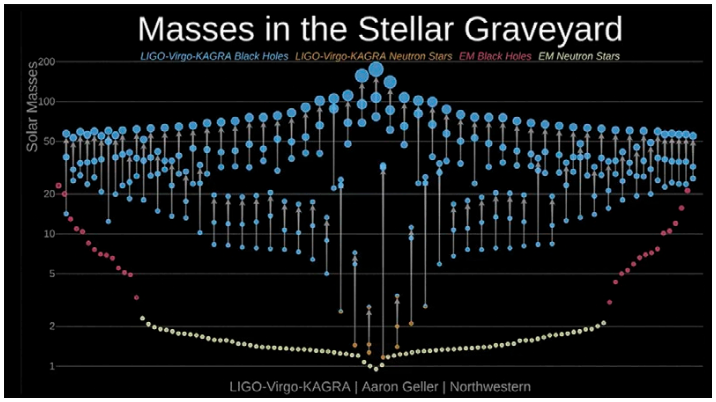
Many stars are born in binaries and as they evolve, if they are massive enough will form two black holes and if a supernova explosion does not separate the binary, the binary evolves over billions of years. Another way binaries can form is in places in the Universe where the density of stars (and Black Holes) is very high



- Galactic center
- Globular clusters or other stellar cluster environments
- In these places single, and binary objects can come close enough to each other to interact gravitationally – very chaotic!
- Good way to create tighter binary orbits and efficient at making GW mergers

Difference between these two formations channels is; in direct binaries formations you expect the stars and the BHs to be rotating along the same axis, whereas through this dynamical formation, such as in a globular cluster, there is no reason the two object would have any alignment to each other. Instead complete random spin orientations, so if we were able to distinguish the two populations from each other, would be able to say more or less precisely what the evolutionary history of the binaries were.

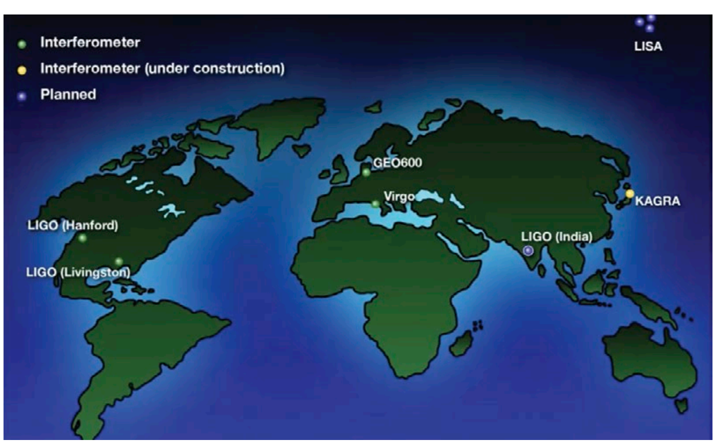
Masses in the Stellar Graveyard – Depiction of Black Holes and Neutron Stars Observed



- Blue: LIGO-Virgo-KAGRA Black Holes observed through GW
- Orange: Neutron Stars Observed through GW
- Red: EM Black Holes - Observed through electromagnetic observation
- Yellow: EM Neutron Stars - Observed though electromagnetic observation
- In terms of BHs many more observations now made through GW
- Now enough of population observed that can make statements about the more likely formation channels out in the universe
- Still lots of work in stellar evolution to do in coming years

Localizing A Gravitational Wave

Just because we can observe a gravitational wave does not necessary mean we know where it came from. Currently GW observatories are more or less only directional, we can see a GW coming from the entire sky and also the other side of the Earth, but the only real way of localizing anything is to have as large as network as possible and then using triangulation to work backwards to pinpoint where it came from.

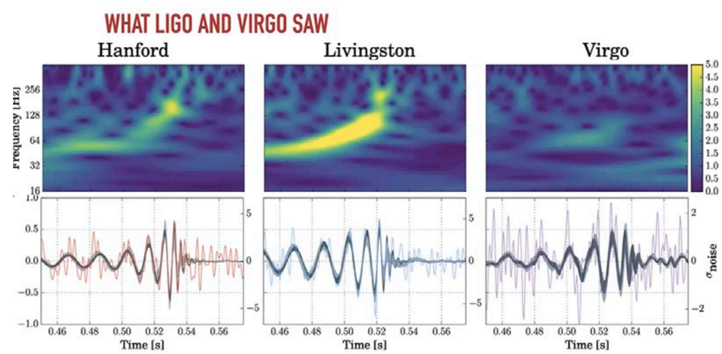


Interferometer detectors we have now:

- LIGO (Hanford, WA), LIGO (Livingston, LA), Virgo (Pisa, Italy), GEO600 (Europe)

- Two detectors in Europe GEO600 – not used much for astrophysics
- Interferometer under construction: KAGRA, Japan has come on line recently
- Interferometer Planned: LIGO (India) in the next couple years
- All observations of GWs so far have been with the two U.S. LIGO detectors and Virgo (Italy)

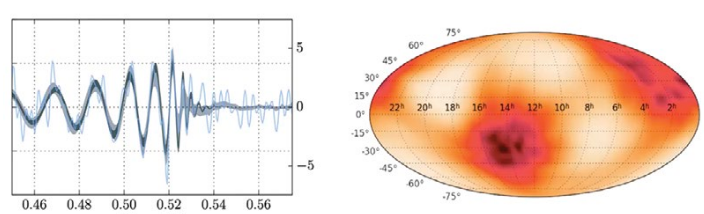
What LIGO and VIRGO saw from August 2017



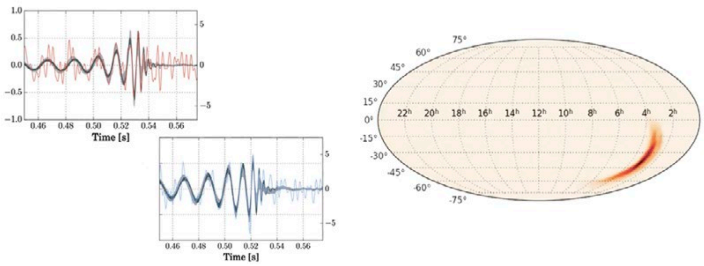
- First observation made with the three-detectors network
- On Top: time frequency plot; the more yellow the more GW power we have observed
- On Bottom: the data stream in color; in black the part of data we believe is the actual GW

More Detectors Are Better

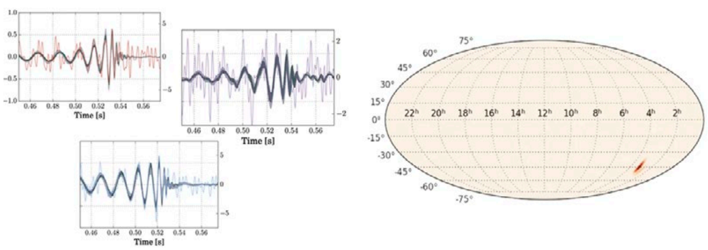
This depiction was made with three detectors, but if we had only been observing with one detector at a time our capability of locating anything in the sky would have been very poor.



- One detector – not very useful, only indicated broad area of universe, we can say GW from that patch of the sky, can say came from this half of the sky

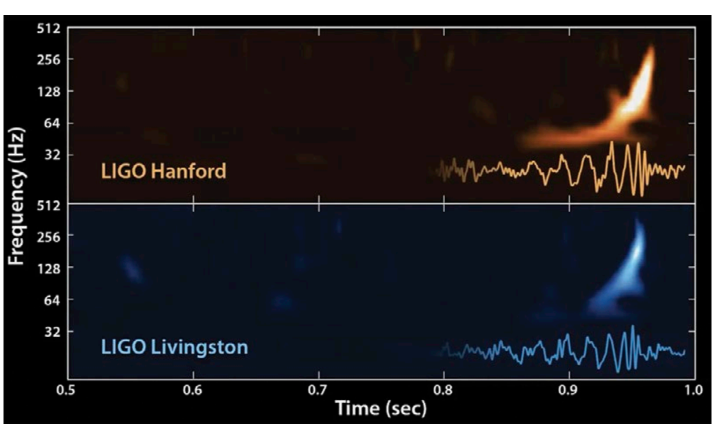


- Two detectors – a much improved narrower field of location to a couple hundred square degrees

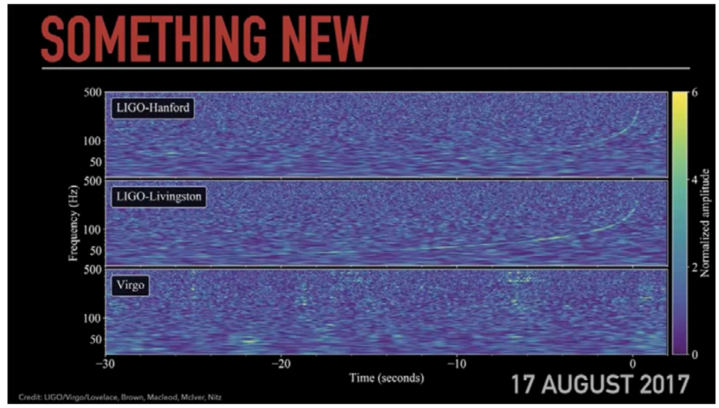


- Three detectors – adding in the third detector, Virgo; a much more narrow area of indicated location, this is best chance of localizing GWs source in the sky

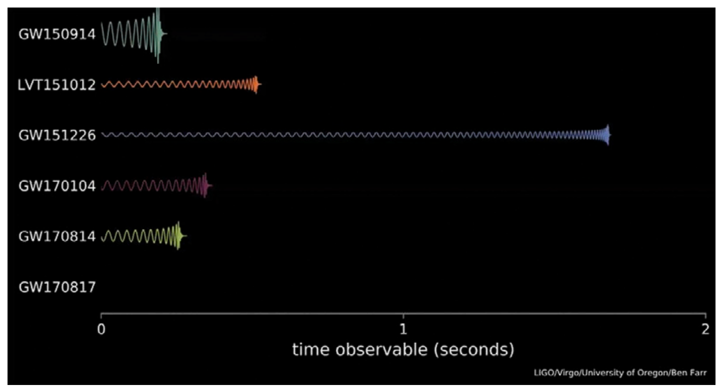
See this animation once again, where we hear in a fraction of second this first gravitation wave observation we made. Emphasis here is that all of the observation information we get is contained in fraction of a second (.2 millisecond)



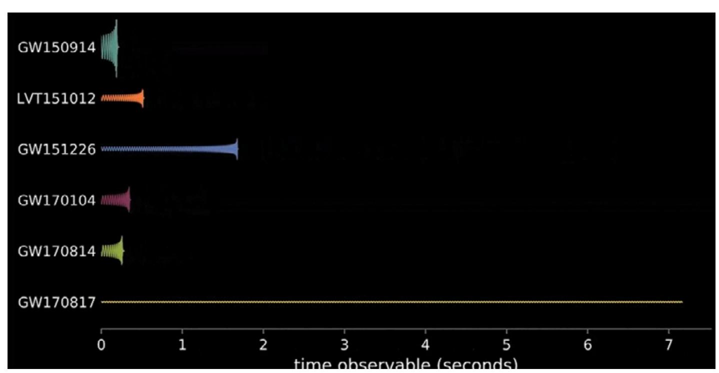
On August 17, 2017 – LIGO Saw Something Completely New - GW 170817



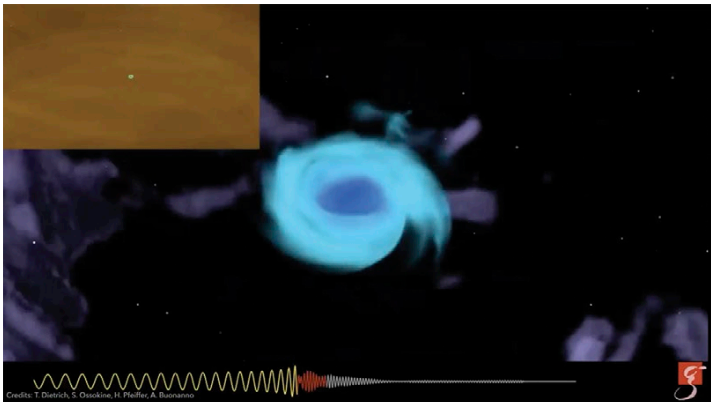
- Observed merger of two neutron stars
- Time frequency presentation of data; middle plot, notice line that covers most of plot now, so now the x-axis covers 30 seconds, whereas information on GW observed in few seconds, this new data information can be observed for a couple minutes



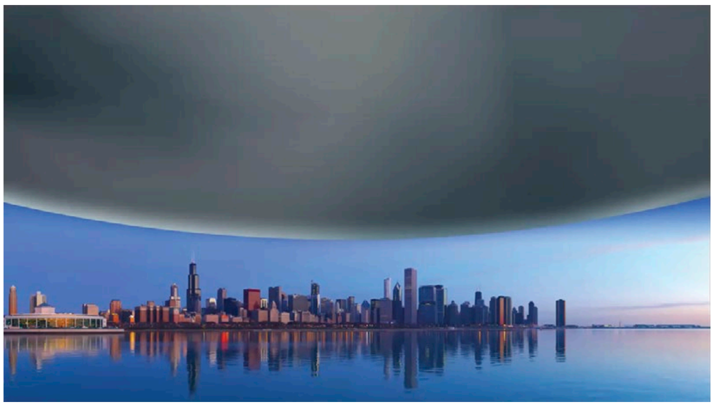
Now extended to several minutes with the GW170817 event



- Neutron stars have actual material, structure, and are made up of matter; also means this can be torn apart much more than black holes
- In slide from animation of merger of two neutron stars, you can see where they are actually deformed



Neutron stars are quite small for being astrophysical objects. Image shows Chicago to scale with neutron stars about 8 miles in radius



But within that radius contains mass equivalent of our Sun or 1.5 X the mass of the Sun. Neutron stars are the most extreme types of object that can form in the Universe, before it eventually needs to collapse into a black hole.

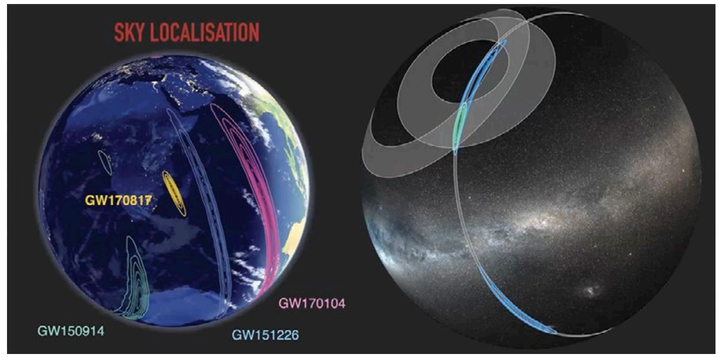
GW170817 Observations – New Information We Learned From Event

- First detection of a Binary Neutron Star coalesce
- Gravitational wave observation
- With a coincident short Gamma Ray Burst
- And an observed optical kilo-nova counterpart
- Plus X-ray and radio afterglows

Provided Many New and Very Exciting Direct Insights

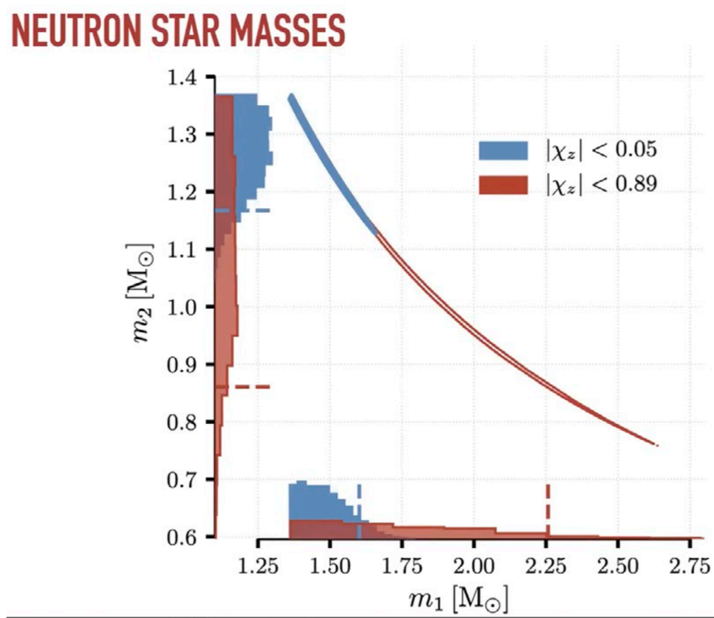
- Can tell us a lot of the properties of dense matter
- Gave us an origin of sGBRs which we did not know before
- Provided us a measurement of the speed of gravity, effectively the speed of light
- Gave us an origin of r-process elements (large fraction of all the products in the periodic table)
- Gave us a measurement of the Hubble constant H0
- Allowed us to do new and exciting cosmology!

Sky Localizations



With our three GW observatories, we are able to constrain the potential sky position to only 10 kilometers or so, which for us is very small.

Neutron Star Masses



By following this minutes-long signal in our data, we were able to put extremely tight constraints on the masses of the two NSs. Blue and red in diagram indicate different assumptions how quickly the two NSs can rotate. Generally, we can constrain the masses of the two NSs to be ~1 ½ solar masses.

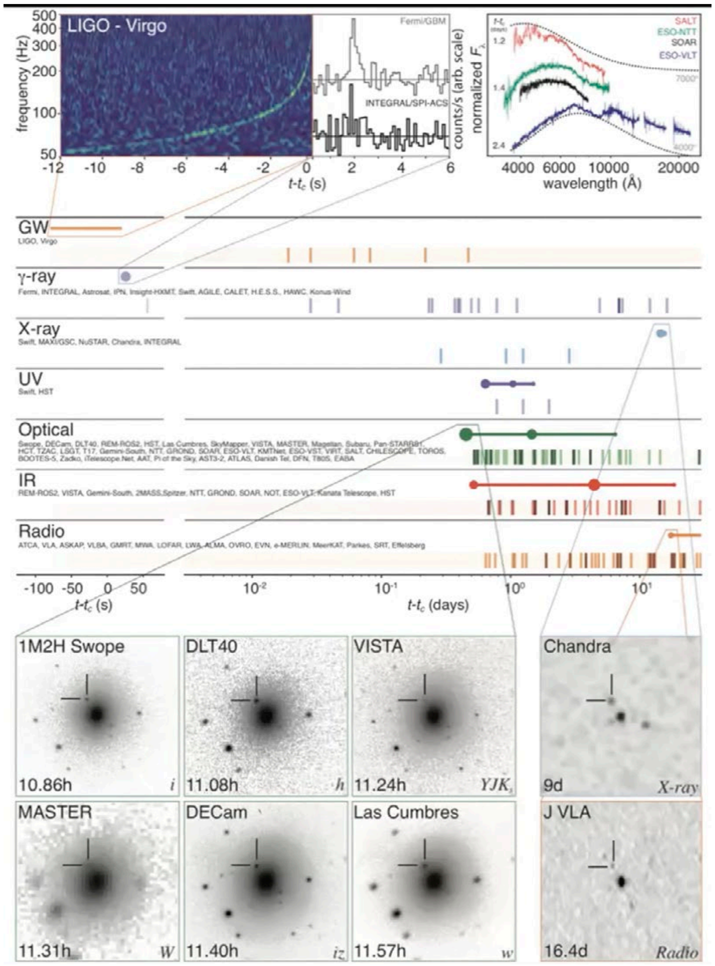
Multi-messenger Observations

This system was observed from the three GW observatories on the earth, but in addition, also observed in the electromagnetic spectrum by collaborators from all over the world

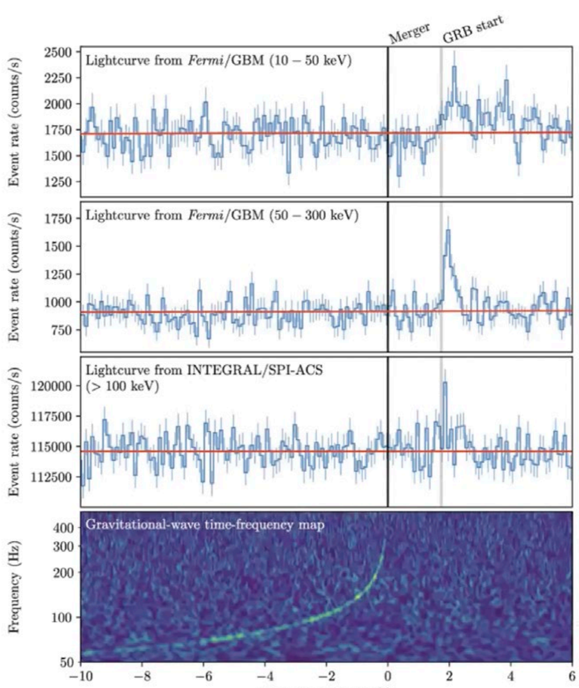
- Observed in basically every wavelength, this observation campaign brought together all the professional astronomers in the world contributing in some way to this study in global collaboration
- Summary of observational campaign; from a paper that

gave the details of the observational campaign, in the days following the NS merger

- System observed in every wavelength across the entire electromagnetic spectrum and in gravitational waves

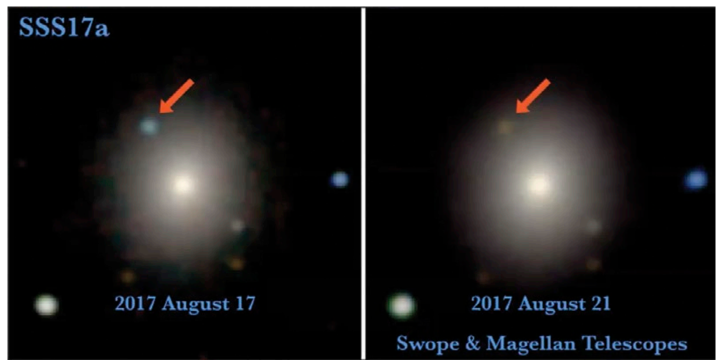


Coincident Short Gamma Ray Burst Image

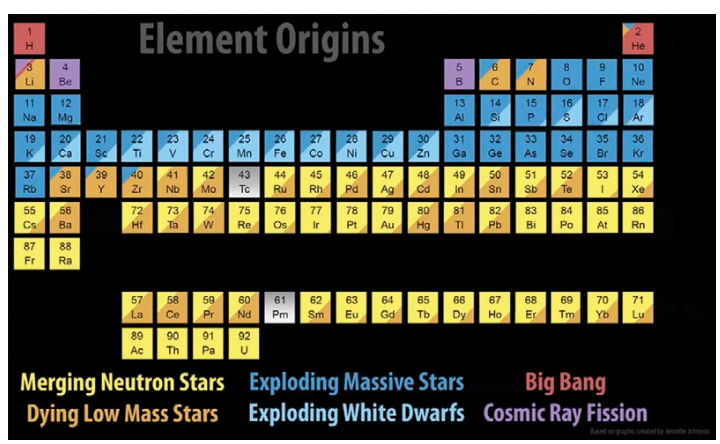


- GRB observed by Fermi and Integral Space Telescopes
- Important take away here is there is a connection between GW signals and Short Gamma Ray Bursts, especially binary neutron star mergers
- Short GRBs have been observed regularly for a couple decades, but we didn't technically know what their origin was, but now we do
- Also, given that these two signals, the GW and the sGRB arrived on the Earth after having travelled a few hundred million light years, within a few seconds of each other and then gave us a direct measurement of the relative speed of light and gravity
- Gravity and light appears to be traveling at the same speed

Optical Detection of Kilo-nova

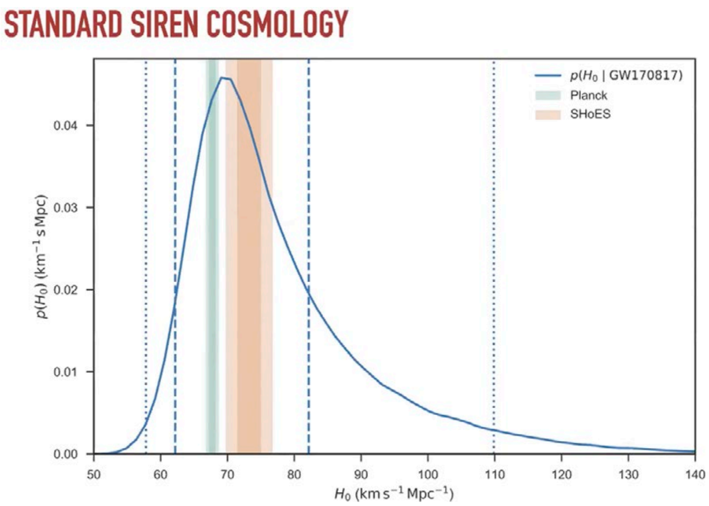


- In addition there was a detection of an optical signal, which was theorized prior to this observation to be a Kilo-nova, slightly bigger than traditional Nova, not as bright as a Supernova, somewhere in between, but observation very exciting, first unambiguous observation of a Kilo-nova and also a connection to this binary NS merger
- These types of mergers had been predicted to be one of the main ways the Universe has of creating heavy elements
- Everything shown in yellow is expected to be formed inside these types of mergers, most of heavy elements are formed in this way, most of the gold and other metals



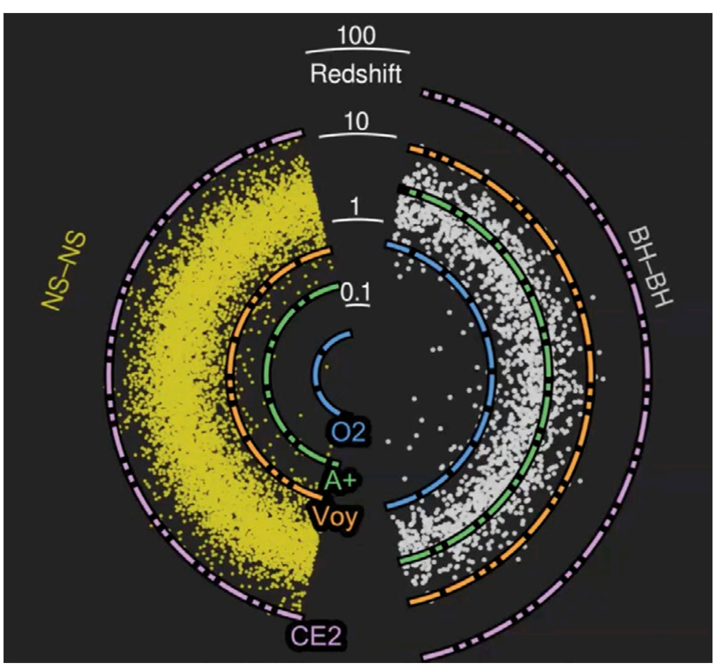
Galaxy Association

The fact that we have been able to make this association with our GW source and this host galaxy also means we can use the observation of the galaxy to make a measurement of the redshift of the galaxy. Then the GW provides the direct distance to the source, so now we have an independent measurement of the redshift and the distance, so you have everything you need to do Cosmology.



- Orange and green bands are inferred values of the Hubble Constant from observations of the early universe (green) and observations of a Supernova (orange)
- Though green and orange don't agree with each other, once we have more observations will be able to provide some preference to either of the measurements from the other

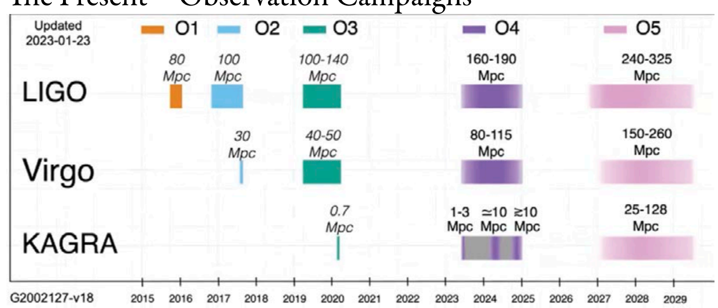
The Future – What It Will Bring In Terms Of Observations



The gray and yellow dots represent individual binary meagers out in the Universe. The distance away from the center is equivalent to the distance away from the Earth, represented in the form of redshift measurements. The different semi-circles represent out to how much distance we will be able to observe the respective GW source. With our current detectors and facilities, somewhere in between the green and the orange is probably the best we can do at this time.

- Now – observe some binary black holes, observe a few binary neutron stars
- With upgrades – observe most binary black holes, observes some binary neutron stars
- Future facilities – observe all binary black holes, observe all binary neutron stars
- If funded, future facilities coming online in 10-15 years, we will be able to observe all emerging binaries in the Universe as a whole, with observations of BBHs coming in every 15 minutes and BNS observations a few times per minutes
- That will be a lot of data and exciting observations, lots of work to be done to prepare

The Present – Observation Campaigns



The way we do these gravitational wave observation campaigns is that we have several observation runs to insure our detectors are as well behaved as possible. Then we keep in stable co-integration for a month or a year, accumulate observations, then shut down for a bit, make upgrades to our detectors and then do the whole thing all over again.

- Currently in our 4th observations run starting on May 24, 2023
- Have announced ~30 candidate observations so far
- Public alerts for potential EM counterparts follow-up, so if there is a counterpart, everyone can learn where we think it is
- https://observing.docs/ligo.org/plan/
- https://wiki.gw-astronomy.org/OpenLVEM
- Even with a reasonable telescope an amateur astronomer would have, you would have been able to observed this kilo-nova event, so signing up for these alerts can be exciting, if we send out an alert, everyone has a chance to participate

Observing Gravitation Waves
Gravitational waves are “ripples” in space-time caused by some of the most energetic and violent processes in the Universe. Everything moving in relations to anything else is creating gravitational waves, though most are too faint to detect. The gravitational waves that LIGO has detected are caused by some of the most cataclysmic events in the Universe- colliding black holes and merging neutron stars. LIGO can, and has, observed the space-time ripples from merging black holes and neutron star binaries. From each observation, the shape of the gravitational wave can tell us about the binary properties from which the gravitation wave originated. Black hole spins can tell us about the formation history of the binary. Neutron star mergers had been predicted to be one of the main ways the Universe has of creating heavy elements. From this information, we also learn about the evolution of stars across the Universe. Future global based multi-messenger observations will tell us even more. Detecting and analyzing the information carried by gravitational waves is allowing us to observe the Universe as never before and has created pathways to many new and exciting discoveries in physics, astronomy and astrophysics.

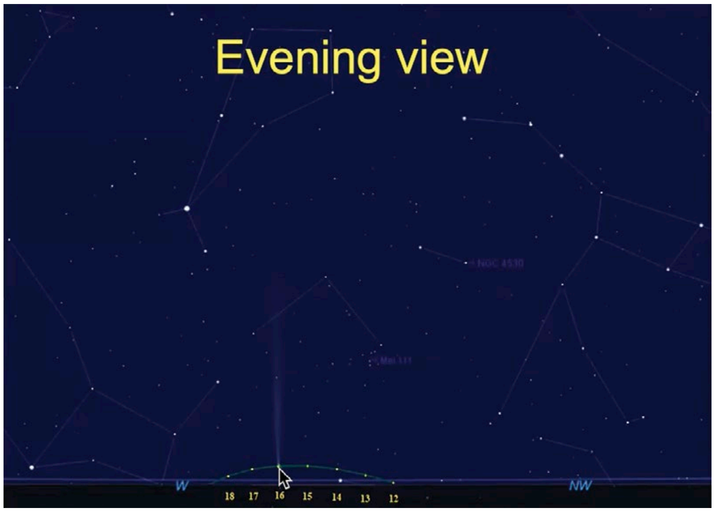
The presentation was followed by comments and questions of interest from LAS members.
“While only the most massive events in the universe are creating gravitational waves, would it be possible for something as simple as the moon to create these waves? Are these waves propagated in all directions in equal force – is the gravitational wave stronger for example in the orbital plane rather than above the plane? In viewing animations, notice of massive kick when object interacting become close, has been a lot of questions of possibility of what happens in a globular cluster, when stars are interacting with each other, through these interactions can stars go into a new trajectory? Can the number of black holes present in a globular cluster at any given moment be detected? Binaries that are turning into black holes these can cause a lot of chaos? Question of “deep wells” developing underneath merging of two black holes in animation. Is there a monetary spike with negative mass created at the time of merging or is it a numerical artifact? Unlike neutron stars, when black holes merge they do not give off massive burst of radiation at the time, so what would if feel like if a gravitational wave went through you?”

Comet Nishimura C/2023 P1
Paul Robinson

Paul is here to talk about the recently discovered comet, Nishimura Comet C/2023 P1. Currently it is a gas comet with just a very faint ion tail going off to the right, apparently 9th magnitude.

Some particulars
- Magnitude now 9, but uncertain (h0=9.0) some plots have a range of magnitudes, so uncertain how bright of a comet it is. Looks like it has just recently turned itself on, reason we are interested in it is as it reaches perihelion on Sept. 18th it will be 0.22 AU from the sun, which is quite bright, may reach 2nd magnitude, but low in the sky.
- Currently in eastern Gemini in the morning sky
- Perihelion 0.22 AU from sun, Sept. 18
- May reach 2nd magnitude
- We will see it low in morning, then evening

- In the morning September 13th, showing the tail now, you can see in the days prior to that it is sinking lower and lower in the east in the constellation Leo. Regulus is easy to see and will serve as a nice guidepost for it. Each day it gets lower, and it will be ~3rd magnitude as it is going through Leo. Down at the bottom you can see the sun, this view is in early twilight, so in the earlier days it will be in a dark sky.



- After it passes the sun, it will appear in the Evening Sky, and unfortunately, it will be even lower in the sky, and definitely not in a dark sky, at no point will it be in up in a dark sky in the evening, but it will be at 2nd magnitude perhaps.
- So if you have a really clear western horizon (not here) perhaps somewhere out east, and have binoculars or a telescope, you should be able to pick it out
- You can see on sky plot that between Sept.12-18th it moves towards the south
- You will be able to use Arcturus, Bootes and Spica as guides to help find it

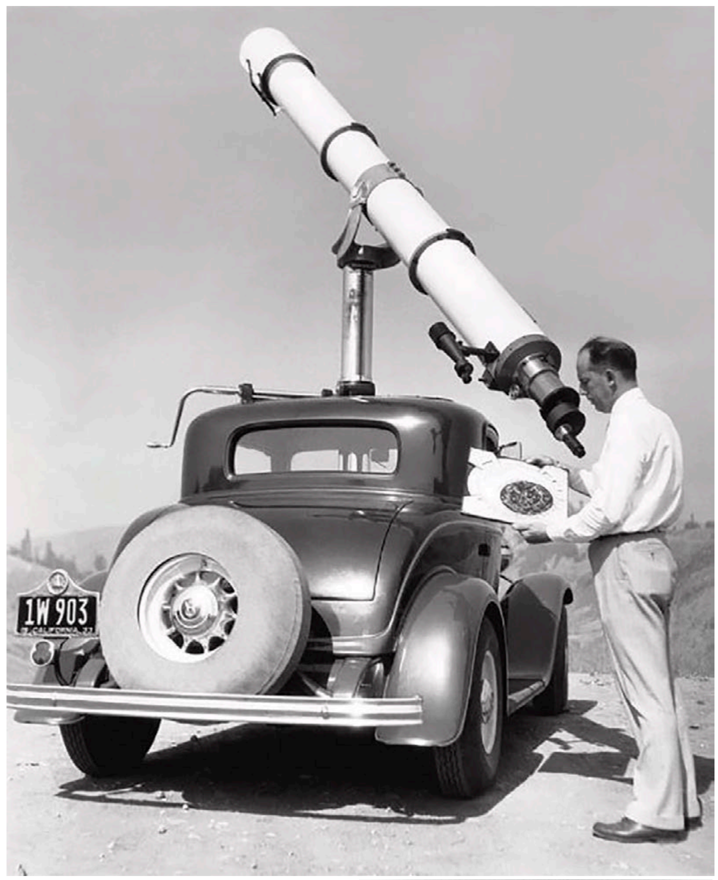
Old Business / New Business

Congratulations go out to LAS member Mike Hotka, recently awarded certificate for completing The Solar Neighborhood, an observing program of the Astronomical League. This is Mike's 63rd program that he has completed. He is now working on Astronomy Before The Telescope which he will complete over the next year. In this observing program he repeats some of the exercises of the giants in astronomy back before the telescope. He has made an astrolabe, played with equatorial sundial and quadrant, and used a Jacobs Staff to measure distances in the sky.

Upcoming Events:
- Boulder Open Space Program at Rabbit Mountain – September 15th
- Next meeting: September 21st, in-person and by zoom, Longmont Lutheran Church, 7:00 p.m.

The Ford Deuce Scope
Vern Raben

Vern shows us the ultimate telescope to take to a star party!
The Ford Deuce Telescope
Owned by a guy named Sheldon Stoody. He ran a welding company and got tired of repairing broken welding bits for the company that so he came up with a process for hardening those bids and made millions. So he bought a Carl Zeiss, Co telescope manufactured in Germany in the 1920s and mounted it on a 1932 Ford in 1933 at a cost of $7000.
- Telescope is a 9.5" (242mm) in diameter
- Focal length 141" (3.58 M) F/14.8
- Taken to star parties in Los Angeles in 30s and 40s
- Sold to Griffith Observatory in 1954



Treasurer Report
Bruce Lamareaux

Longmont
Astronomical Society

P.O. Box 806
Longmont, CO 80502-0806

LAS Treasurer's Report - Bruce Lamoreaux **8/17/2023**

Main Checking Account (xxx-1587)

Begin Balance:	$ 9,756.00	**7/5/2023**
Deposits:	$ 24.00	Membership
Expenses:	$ (620.00)	Bank Charges, AL Dues, Library Scope Parts
Current Balance:	**$ 9,160.00**	**8/3/2023**

2-Year Savings Account (xxx-1478) (matures 10/23/23)

Past Balance:	$ 8,155.00	**3/31/2023**
Interest:	$ 15.00	
Balance:	**$ 8,170.00**	**6/30/2023**

Telescope Fund (xxx-0165)

Past Balance:	$ 1,100.00	**5/30/2023**
Deposits:	$ -	
Expenses:	$ -	
Balance	**$ 1,100.00**	**6/29/2023**

Petty Cash

Past Balance:	$ 50.00
Deposits:	$ -
Expenses:	$ -
Balance	**$ 50.00**

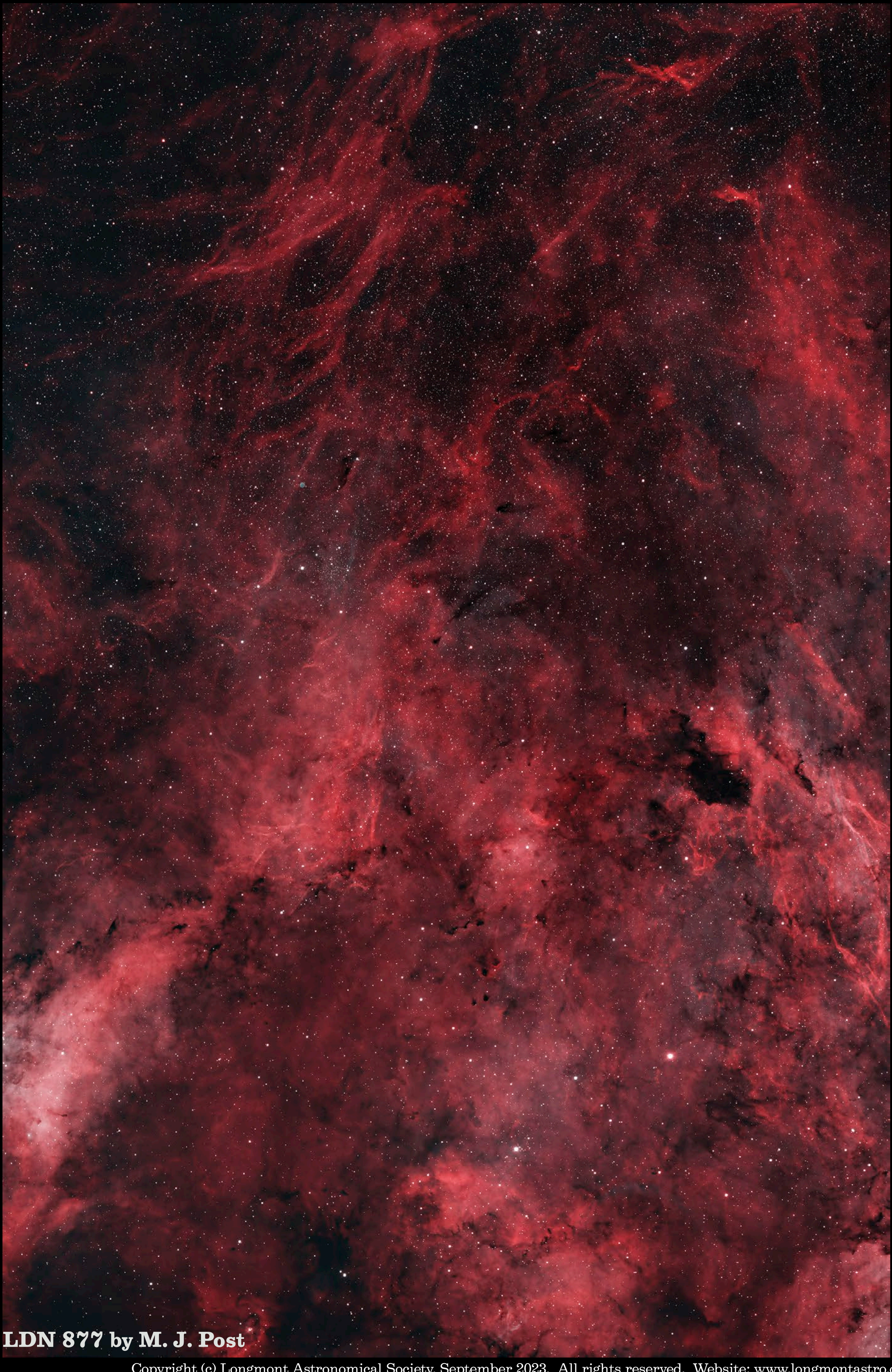
Total Assets **$ 18,480.00** $ (610.00) Down from last report

Active Membership:	**99**
Student Membership:	**2**
Total	**101**

The Heart Nebula by David Elmore was captured using a one shot color camera behind two different dual band filters. One transmits the usual Hydrogen-alpha (red) and Oxygen III (cyan). The other transmits Sulfur II (red) and Hydrogen-beta (cyan). Ten exposures were recorded, five with each of the filters. All exposures were 10-minutes. He used a mathematical technique to extract the 'pure' emission lines from the RGB images then recombined the four emission line images to create this color result. H tried to keep H-alpha red, and put Oxygen III and Hydrogen-beta on the green to blue side of the color wheel. Sulfur II also red is a problem so it wound up depicted as yellow.

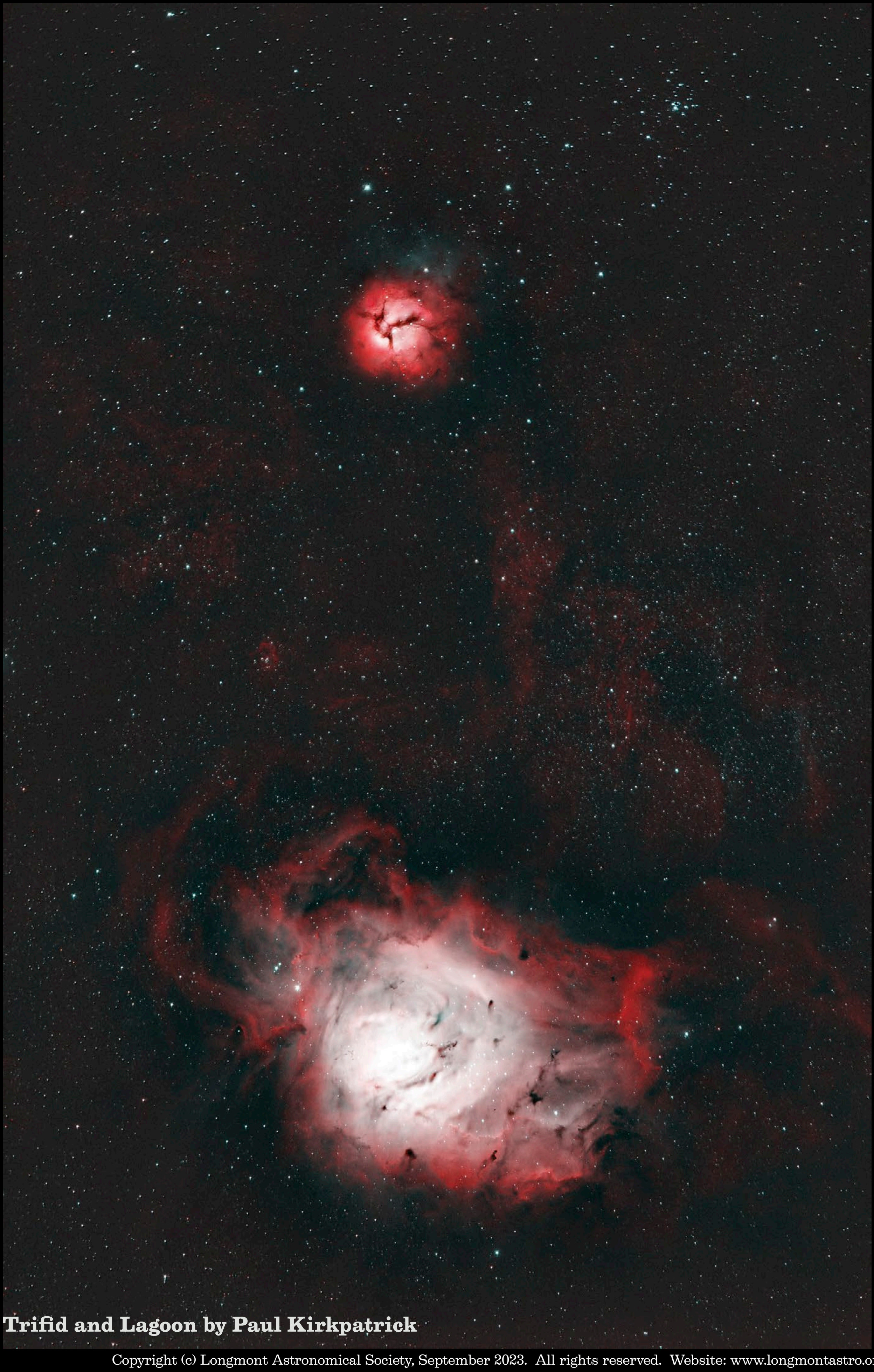
Vixen VSD100 F/3.8 quintuplet apochromat. Antlia dual band 5nm passband filters. iOptron GEM45/EC mount. Recorded the morning of 17 August from my observatory at Dark Sky New Mexico. Processed in PixInsight utilize Blur and Noise XTerminator processes.

LDN 877 (cropped) by M. J. Post



LDN 877 by M. J. Post

SH 2-68 Flaming Skull Nebula by M. J. Post



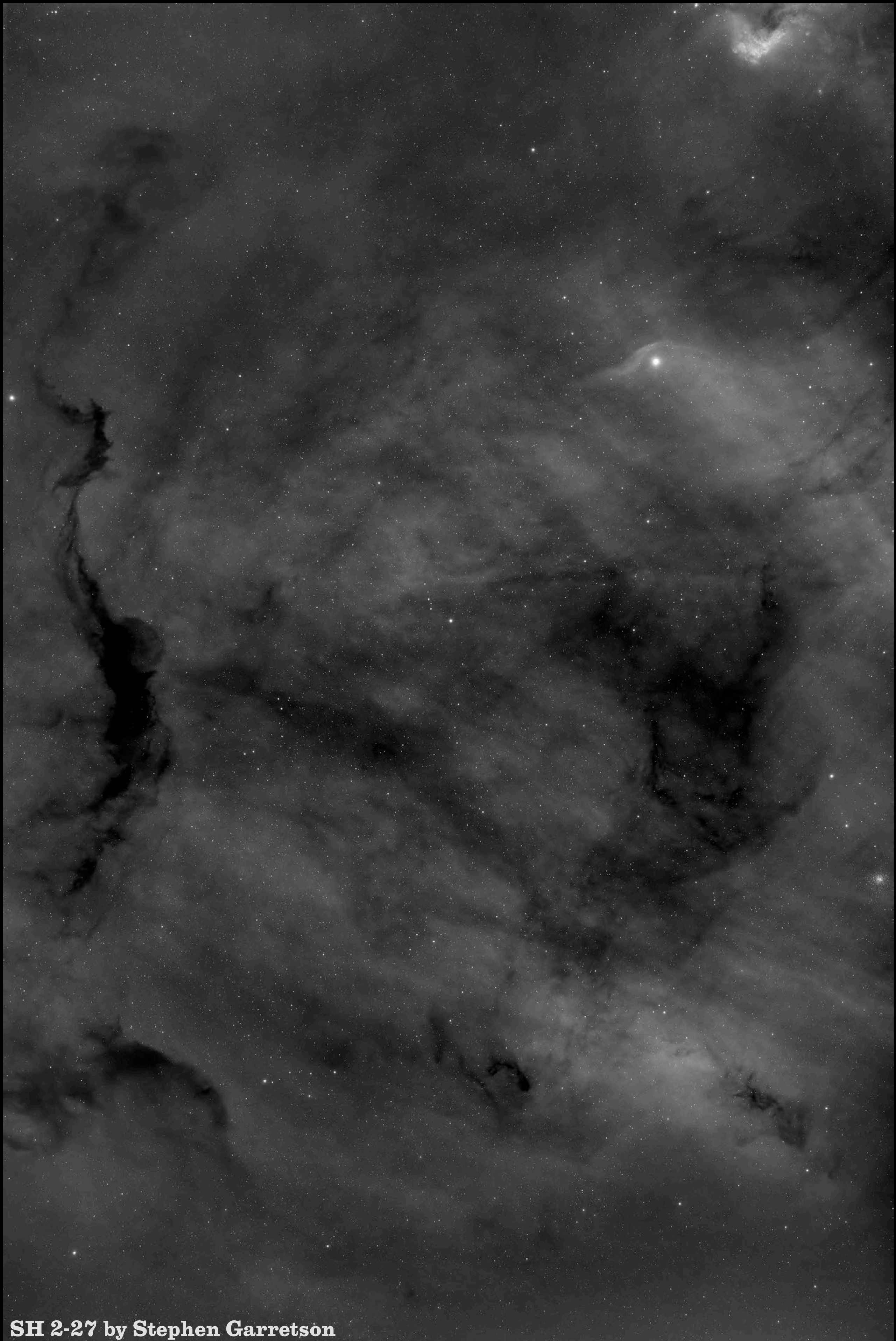
Trifid and Lagoon by Paul Kirkpatrick


IC 5146 Cocoon Nebula by Paul Kirkpatrick

NGC 6888 Crescent Nebula by Rolando Garcia

SH 2-134 by Stephen Garretson

SH 2-134 by Stephen Garretson



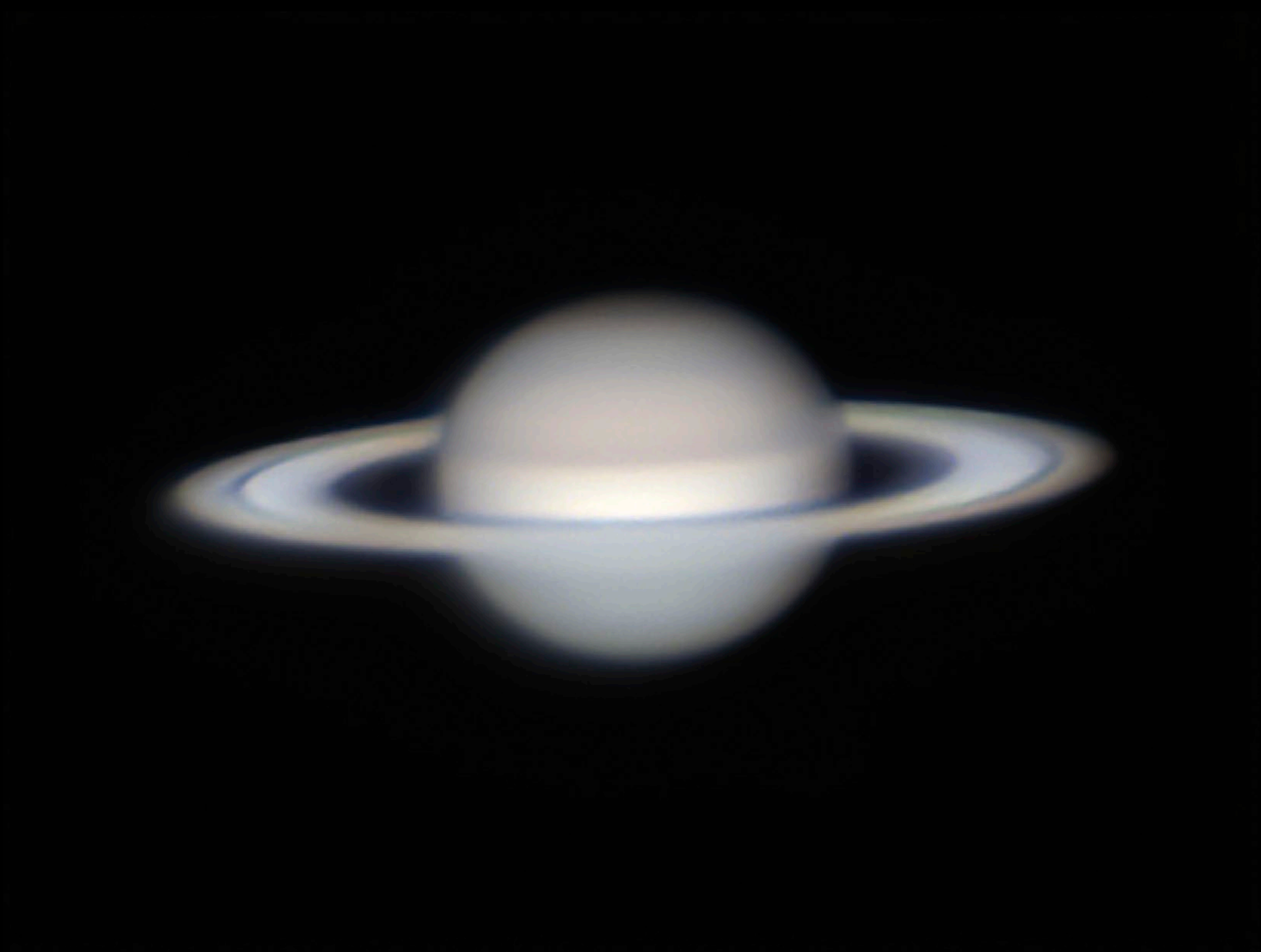
SH 2-27 by Stephen Garretson

M15 by Gary Garzone

Helix Nebula by Gary Garzone

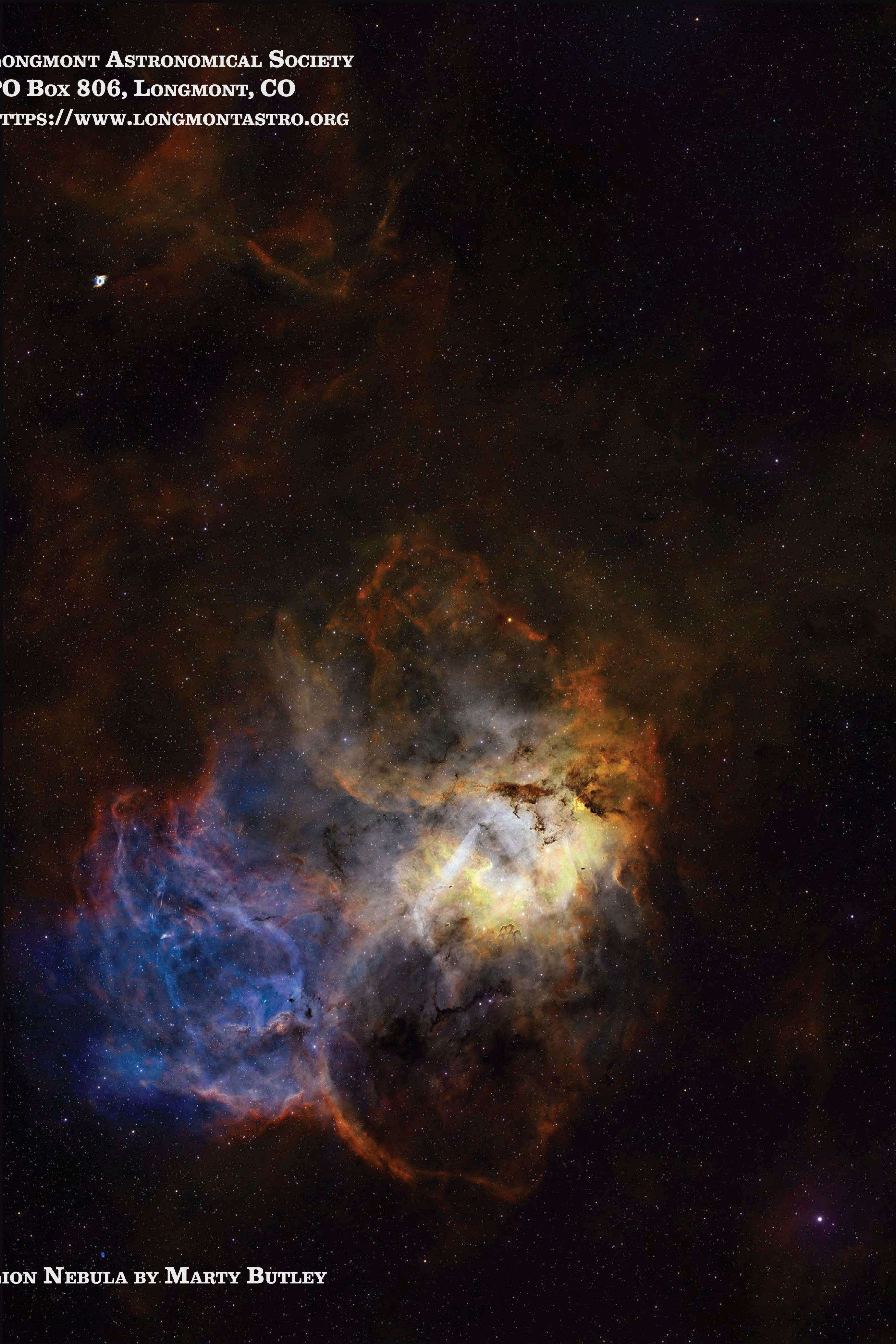
M33 by Gary Garzone


Perseid Meteor by Eric Bogatin



Saturn on August 30 by Vern Raben

Longmont Astronomical Society
PO Box 806, Longmont, CO
https://www.longmontastro.org



Lion Nebula by Marty Butley