Longmont Astronomical Society

February 2024

North America Nebula
by David Elmore

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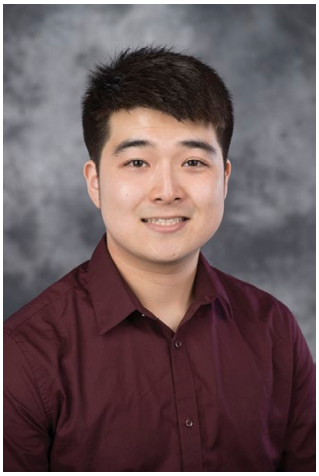
Next LAS Meeting February 15 at 7 pm

"All Good Things Must Come to an END (eccentric disk)" by Tatsuya Akiba

Abstract

From humans to super massive black holes, many objects in the universe get a boost or a "kick" from certain phenomena. In the case of humans like me, the boost usually comes from caffeine or the pressure of a deadline. Super massive black holes, on the other hand, can get a kick by emitting gravitational waves anisotropically - which means not the same way in every direction - during the merger of two black holes. Super massive black holes lurk at the center of most galaxies and are usually surrounded by a dense region of stars called a nuclear stellar cluster. When these black holes receive a kick, the surrounding star cluster rearranges itself into a lopsided, eccentric disk. These eccentric disks are fairly abundant in the universe: our neighboring galaxy, Andromeda, hosts an eccentric disk in its nucleus for instance. In this talk, I will present results from a series of N-body simulations which show the formation and evolution of eccentric disks after a kick gets imparted on the central super massive black hole. I will show that eccentric disks are able to produce tidal disruption events - which are when stars get ripped apart due to the super massive black hole's tidal gravity - with extreme efficiency. These tidal disruption events (and more!) can be used as observational signatures to follow-up future gravitational wave events and to look for these kicked super massive black holes!

Bio



I am Tatsuya Akiba, an astrophysics Ph.D. candidate at the University of Colorado Boulder (expected to graduate in May, 2025). I currently work with Professor Ann-Marie Madigan on gravitational dynamics of various scales: from planetary systems around white dwarfs to star clusters around super massive black holes. I graduated from Truman State University with B.S. degrees in physics and mathematics before joining CU Boulder. Since then, I have won several research awards/fellowships including the Raynor L. Duncombe Student Research Prize (from the Division on Dynamical Astronomy) and the Dissertation Completion Fellowship (from the CU Boulder graduate school). I am also passionate about teaching and public outreach: I have served as a Lead Graduate Student Fellow for the Center for Teaching and Learning in the past and I am currently the instructor for an introductory Python course in the CU Boulder astrophysics department.

The meeting will be at the First Evangelical Lutheran Church, 803 Third Avenue, Longmont, CO 80501. The speaker is planning on presenting in person. If you cannot attend the in-person meeting, it will be available on Zoom.

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 Davis. 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.

Contents

On the front cover is David Elmore's image of the familiar Heart and Soul as well as the Double cluster in the upper left. On the lower right are a couple of planetary nebulae, the larger of the two is Sh2-200. Sh2-195, very faint, above the tail of the running Bison a little over half way between it and the Heart. Taken with his Borg55FL 200mm focal length F/3.6 telescope, Antlia Ha/OIII and SII/Hb filters, and an ASI 2400MC one-shot color camera from his observatory at Dark Sky New Mexico.

Planets in February

Mercury

Mercury is not visible this month.

Venus

Venus is visible in the morning sky low in the southeast. It is about -3.9 magnitude in apparent brightness and the disk is about 12 arc sec across.

Mars

After about mid-month Mars is very low in the southeast below Venus. It is a difficult object to see with a small scope. It is magnitude +1.3 in brightness and only 4.4 arc sec across. Mars opposition is January 15, 2025.

Jupiter

Jupiter is high up in southwest after sunset. It is magnitude -2.4 as the month begins at -2.2 at end; the apparent disk size decreases from 40 to 36 arc seconds. The following are favorable times to view the Great Red Spot at mid transit this month (above 20° altitude):

- Feb 1 at 9:38 pm at altitude 32°
- Feb 4 at 7:09 pm at alt 38°
- Feb 9 at 6:19 pm at alt 60°
- Feb 11 at 7:58 pm at alt 44°
- Feb 13 at 9:38 pm at alt 24°
- Feb 16 at 7:09 pm at alt 50°
- Feb 18 at 8:48 pm at alt 31°
- Feb 21 at 6:19 pm at alt 55°
- Feb 23 at 7:58 pm at alt 37°
- Feb 28 at 7:08 pm at alt 44°

Saturn

Saturn is visible very low in the WSW after sunset. It will disappear from our view into the bright twilight after the 8th. It is magnitude 1.0 in brightness and the disk is 16 arc sec across.

Uranus

Uranus is high in the southwest after sunset in constellation Aries. It is magnitude 5.8 in apparent brightness and the disk is around 3.5 arc sec across.

Neptune

Neptune is very low in the west after sunset in the constellation Pisces. It disappears from our view about the 17th. It is magnitude 7.9 at 2.2 arc sec across.

Lunar Phases in February

- Third quarter: February 2 at 4:19 pm
- New moon: February 9 at 4:00 pm
- First quarter: February 16 at 8:02 am
- Full moon: February 24 at 5:32 am

Meteor Showers in February

The alpha-Centaurids is a minor meteor that peaks the night of February 7-8. Expect maybe 6 per hour from a dark location.

Showpiece Objects in February

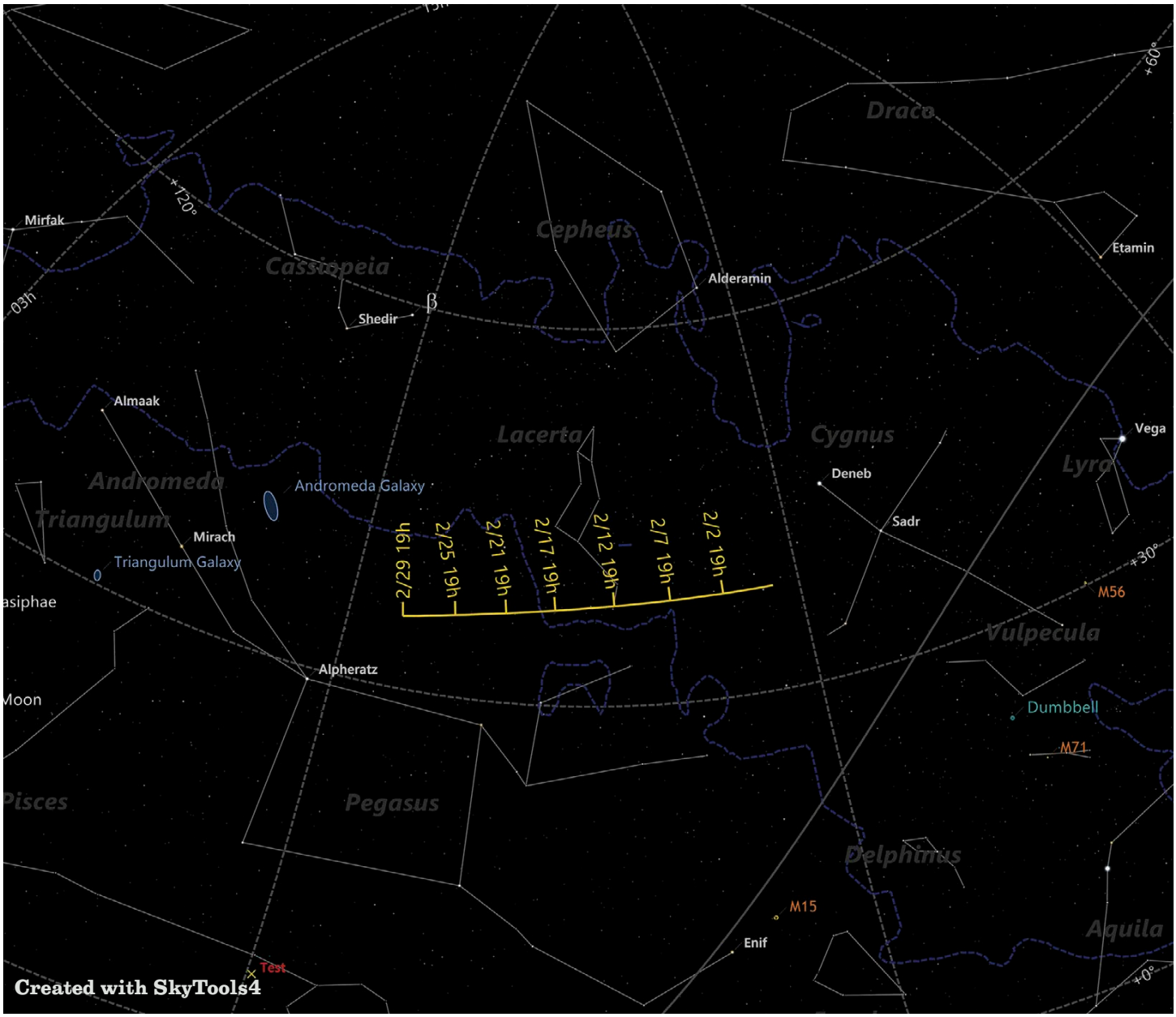
Some early evening showpiece objects for mid February:

- Bubble Nebula, NGC 7635 in Cassiopeia, mag 11
- M52, NGC 7654 open cluster in Cassiopeia, mag 6.8
- Andromeda Galaxy, M31 in Andromeda, mag 4.3
- Pacman Nebula, NGC 281, in Cassiopeia, mag 7.4
- Heart Nebula, SH 2-190, in Cassiopeia, mag 6.5
- Soul Nebula, IC 1848, in Cassiopeia, mag 6.5
- Maia Nebula, NGC 1432, in Taurus, mag 3
- California Nebula, NGC 1499, in Perseus, mag 5
- NGC 1931 nebula in Auriga, mag 11.2
- Crab Nebula, M1, Super nova remnant in Taurus, mag 8.4
- Horsehead Nebula, Barnard 31, in Orion, mag 16.5
- Flame Nebula, NGC 2024, in Orion, mag 10
- Rosette Nebula, NGC 2237, in Monoceros, mag 9
- Cone Nebula, NGC 2264 in Monoceros, mag 3.9
- Thor's Helmet, NGC 2259 in Canes Major, mag 11.4

Comet 12P/Pons-Brooks by Gary Garzone on Jan 29

Comet 12P/Pons-Brooks in February

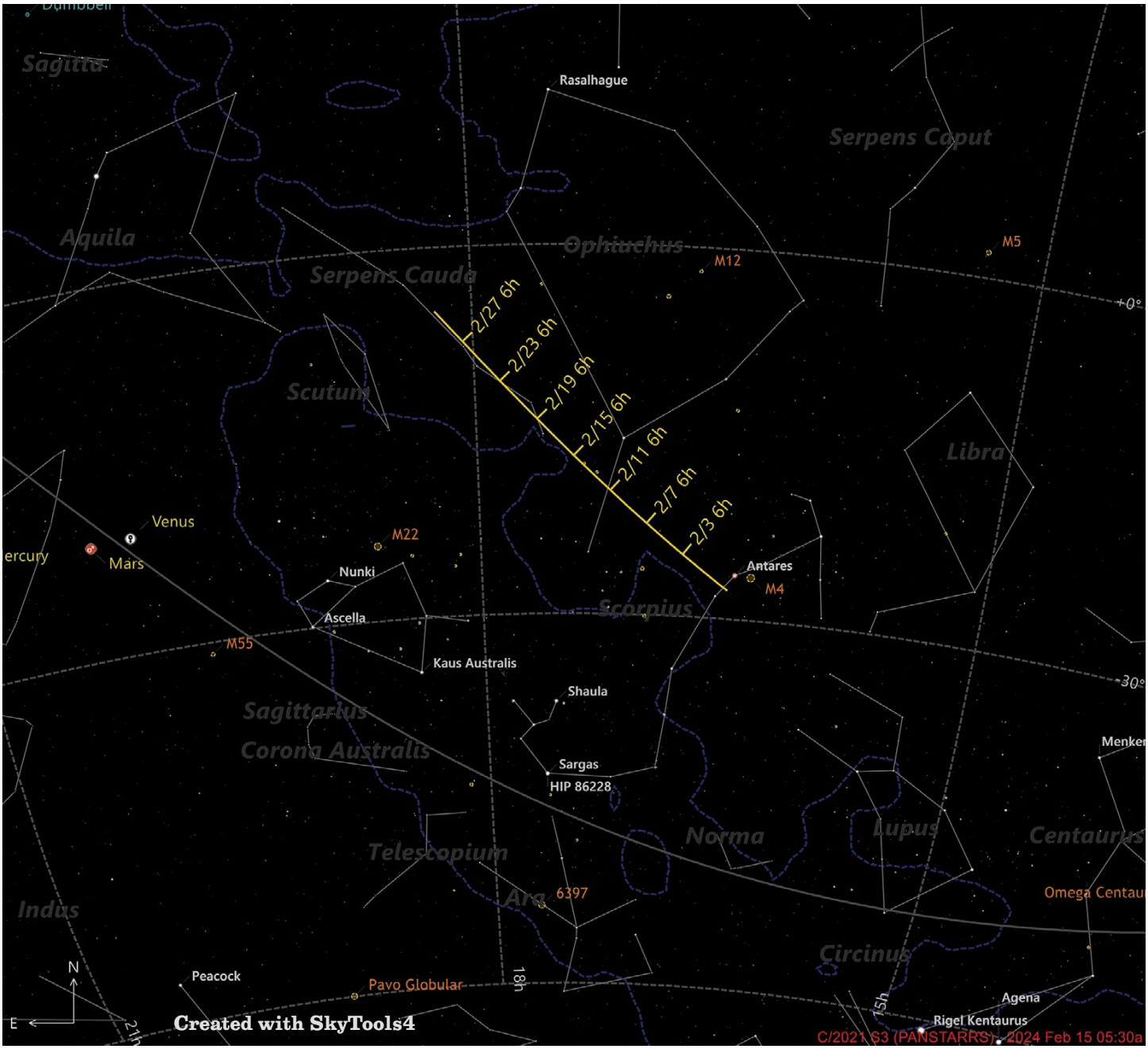
Comet 12P was discovered on July 12, 1812 by Jean-Louis Pons at the Marseilles Observatory. It was recovered in 1888 by William Brooks an American astronomer at his own observatory in Phelps, NY. Brooks discovered 27 comets in his lifetime -- second only to Pons who discovered 37. 12P is a periodic comet with an orbital period of 71 years. It is now magnitude 8.1 in brightness with a 4 arc min wide coma; it currently in constellation Cygnus. It should brighten to around magnitude 7 by the end of February.



Date	Optimal time	RA	Dec	Constellation	Magnitude	Size (arc min)
Feb 1	6:44 pm	21h27m48.3s	+38°22'04"	Cygnus	8.1	3.6
Feb 7	6:50 pm	21h53m38.2s	+38°17'25"	Cygnus	7.9	3.7
Feb 13	6:57 pm	22h21m03.9s	+38°01'15"	Lacerta	7.6	3.8
Feb 19	7:02 pm	22h49m52.7s	+37°29'26"	Lacerta	7.4	3.9
Feb 24	7:06 pm	23h14m43.1s	+36°47'54"	Andromeda	7.2	4.0
Feb 29	7:12 pm	23h40m04.1s	+35°50'24"	Andromeda	7.0	4.1

Comet C/2021 S3 (PANSTARRS) in February

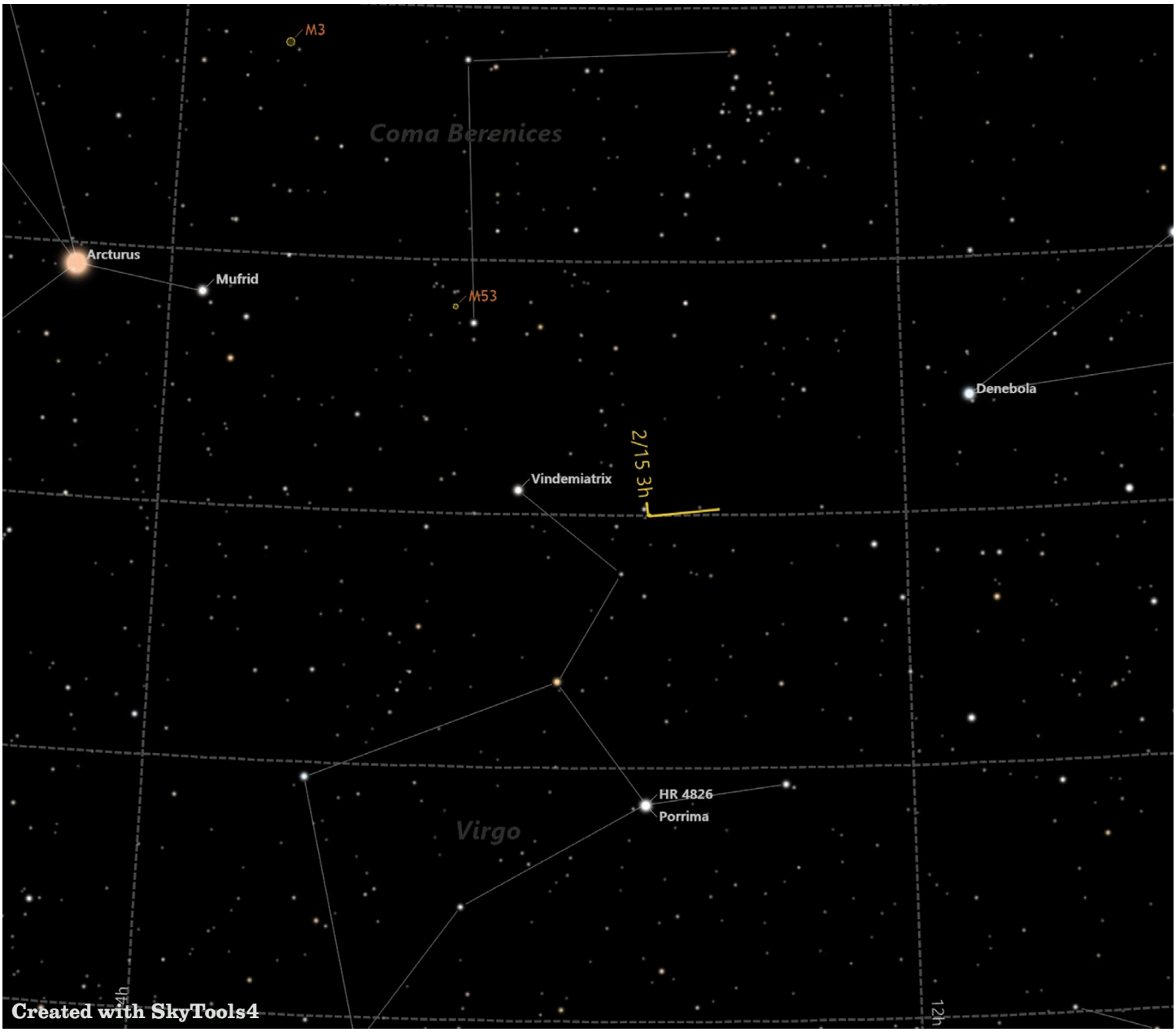
The Pan-STARR1 and Pan-STARRS-2 1.8 meter diameter telescopes are both located near the summit of Haleakala on the Island of Maui. The Pan-STARRS1 telescope is equipped with a 1.4 billion pixel digital camera. The camera on Pan-STARRS2 is 1.5 billion pixels. C/2021 S3 is now magnitude 10 in brightness in constellation Scorpius.



Date	Optimal time	RA	Dec	Constellation	Magnitude	Size (arc min)
Feb 1	5:46 am	16h46m36.3s	-25°35'07"	Scorpius	9.9	1.4
Feb 7	5:39 am	17h06m20.3s	-21°57'40"	Ophiuchus	9.8	1.4
Feb 13	5:31 am	17h25m27.7s	-17°53'52"	Ophiuchus	9.8	1.5
Feb 19	5:23 am	17h43m55.9s	-13°25'17"	Serpens	9.7	1.5
Feb 24	5:18 am	17h58m48.6s	-09°24'34"	Ophiuchus	9.7	1.5
Feb 29	5:09 am	18h13m11.7s	-05°11'11"	Serpens	9.6	1.6

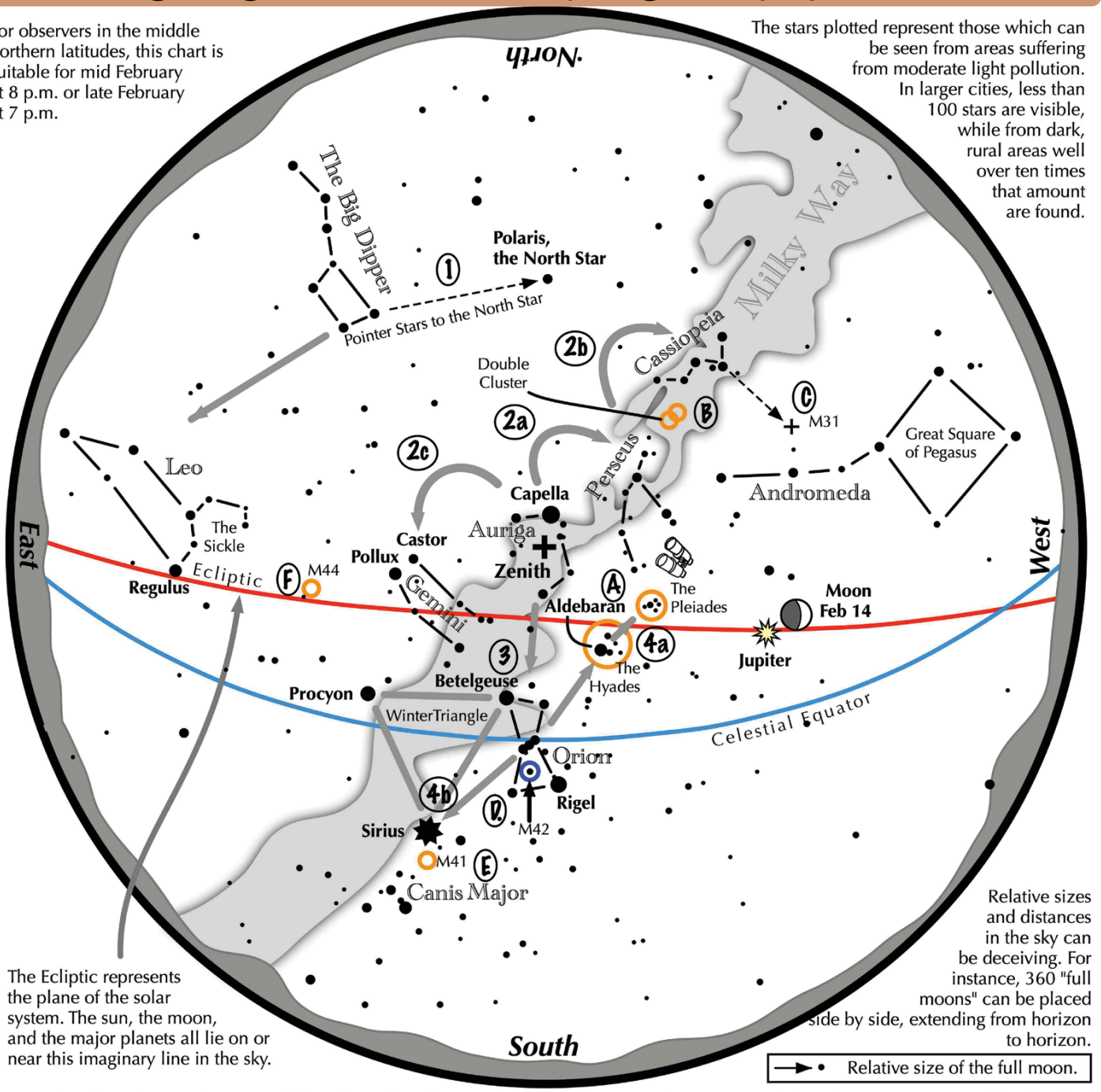
Comet 62P/Tsuchinshan in February

Comet 62P/Tsuchinshan was discovered on Jan 1, 1965 at the Purple Mountain Observatory near Nanjing, Ziangsu Province, People Republic of China. 62P is now in constellation Virgo and is 9.2 magnitude in brightness with a 5 arc min coma. It will be visible until about Feb 24.



Date	Optimal time	RA	Dec	Constellation	Magnitude	Size (arc min)
Feb 1	3:37 am	12h36m24.1s	+09°54'55"	Virgo	9.2	5.1
Feb 7	3:27 am	12h40m33.9s	+09°48'52"	Virgo	9.6	5.0
Feb 13	3:04 am	12h42m21.7s	+09°49'48"	Virgo	10.1	5.0
Feb 19	4:49 am	12h41m57.7s	+09°55'29"	Virgo	10.5	4.9
Feb 24	5:13 am	12h40m10.0s	+10°01'56"	Virgo	10.9	4.8
Feb 29	11:19 pm	12h37m28.1s	+10°08'06"	Virgo	11.4	4.7

Navigating the mid February Night Sky by John Goss



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

1. Above the northeast horizon rises the Big Dipper. Draw a line from its two end bowl stars upwards to the North Star.
2. Face south. Overhead twinkles the bright star Capella in Auriga. Jump northwestward along the Milky Way first to Perseus, then to the "W" of Cassiopeia. Next jump southeastward from Capella to the twin stars of Castor and Pollux in Gemini.
3. Directly south of Capella stands the constellation of Orion with its three Belt stars, its bright red star Betelgeuse, and its bright blue-white star Rigel.
4. Use Orion's three Belt stars to point northwest to the red star Aldebaran and the Hyades star cluster, then to the Pleiades star cluster. Travel southeast from the Belt stars to the brightest star in the night sky, Sirius, a member of the Winter Triangle.

Binocular Highlights

A: Examine the stars of two naked eye star clusters, the Pleiades and the Hyades.
B: Between the "W" of Cassiopeia and Perseus lies the Double Cluster.
C: The three westernmost stars of Cassiopeia's "W" point south to M31, the Andromeda Galaxy, a "fuzzy" oval.
D: M42 in Orion is a star forming nebula. **E:** Look south of Sirius for the star cluster M41. **F:** M44, a star cluster barely visible to the naked eye, lies southeast of Pollux.

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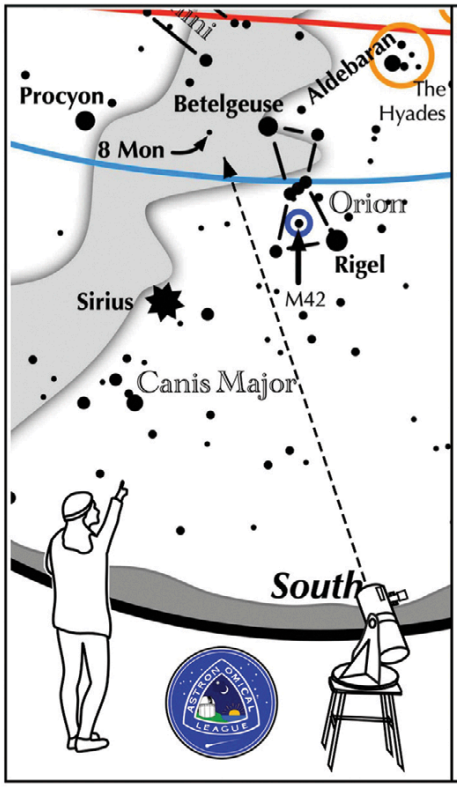
ASTRONOMICAL LEAGUE Double Star Activity



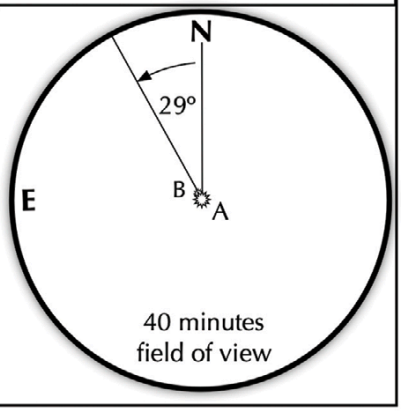
Other Suns: Epsilon (8) Monocerotis

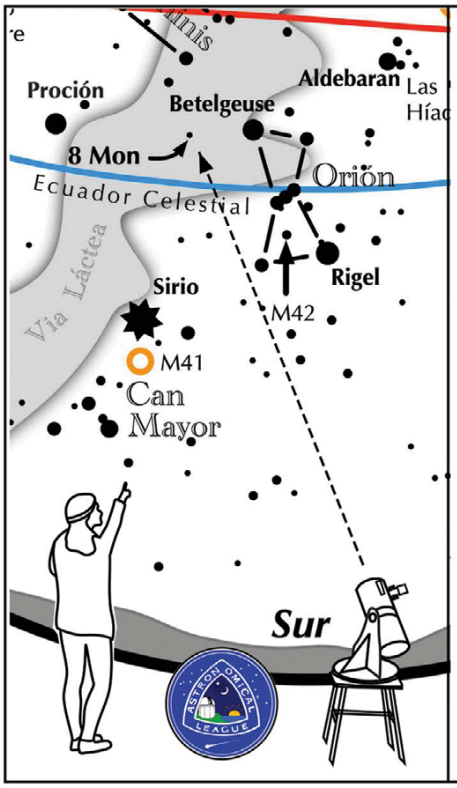
How to find Epsilon Monocerotis on a February evening

Face south. Look for the Winter Triangle stars of Betelgeuse and Procyon. Epsilon Monocerotis is about 1/3 between Betelgeuse and Procyon. It is a 4.3 magnitude star so dark skies are needed to spot it.

Suggested magnification: >20x
Suggested aperture: >3 inches

Epsilon (8) Mon
A-B separation: 12 sec
A magnitude: 4.4
B magnitude: 6.6
Position Angle: 29°
Colors:
white
lilac





Otros Soles: Epsilon (8) Monocerotis

Cómo encontrar a Epsilon Monocerotis en una tarde de Febrero

Mira hacia el sur. Busque las estrellas del Triángulo de Invierno de Betelgeuse y Proción. Es una estrella de magnitud 4,3 por lo que se necesitan cielos oscuros para detectarla.

Ampliación sugerida: >20x,
Apertura sugerida: >75 mm

Epsilon (8) Mon
A-B separación: 12 sec
A magnitud: 4.4
B magnitud: 6.6
PA: 29°
Colores:
blanca
lila

LAS January 18 Meeting Notes by Eileen Hall-McKim

I. Introduction

The January LAS monthly meeting was held in-person and by zoom on January 18th at the Longmont Lutheran Church, 20 members attended in-person, 20 attended by zoon. Due to technical difficulties we did not have introductions of attending members this month.

II. Meeting Presentation

Our guest speaker for the January meeting was Dr. Kevin France, a professor at the Laboratory for Atmospheric and Space Physics (LASP) and in the Department of Astrophysical and Planetary Sciences (APS) at University of Colorado, Boulder. He is an expert on space instruments for astrophysics and the study of extra-solar planets. He has led approximately 10 NASA rocket and small satellite missions at LASP, works extensively with the Hubble Space Telescope and is engaged with the development of NASA's future observatories to find habitable planets beyond the solar system.

The Hunt for the Pale Blue Dot: Science, Technology and People for NASA's Search for Habitable Planets

In the past three decades, astronomers have discovered more than 5,000 extra-solar planets, changing our understanding of Earth's place in the Universe. We are now poised to begin the search for Earth-like planets orbiting Sun-like stars, our first true attempt to find "Earth 2.0" and to conduct a census of nearby stars to understand how common life is beyond the solar system. In this presentation, Dr. France will discuss work ongoing at NASA and the University of Colorado LASP to advance this search. Dr. France will talk about NASA's upcoming "life finder" mission, the Habitable Worlds Observatory, and discuss the projects CU is undertaking today to enable this mission. As examples, he will focus on the CUTE small satellite that is studying evaporating planets around nearby stars, how CU rocket missions are advancing instrument technology, and how students are incorporated into these activities to train and mentor the scientists and engineers that will lead NASA's search for habitable planets over the next two decades.

In 1948 the University of Colorado organized the "Upper Atmosphere Lab" (UAL) to develop pointing controls for captured World War II rockets to be used for scientific research.

In 1953 was the first successful launch of a rocket for science to observe the Sun's ultraviolet radiator above Earth's atmosphere. This success led to the spin-off of Ball Aerospace in 1956.

In 1963, UAL was renamed the Laboratory for Atmospheric and Space Physics. In 1967 LASP built an ultraviolet spectrometer which flew past Venus on Mariner 5. Similar instruments later studied Mars on Mariner 6, Mariner 7, and Mariner 9.

In 2009 the Institute's students and professionals conducted operations for NASA's famous Kepler mission which discovered hundreds of Earth-size and smaller planets in or near the habitable one in our region of the Milky Way galaxy.

In 2013 MAVEN (Mars Atmosphere and Volatile Evolution) mission was launched from Cape Canaveral, Florida to decipher Mars' atmospheric history. LASP is the lead institute for MAVEN, which is still operating on Mars right now, and continues to be one of the lab's largest missions.

In 2015 LASP got back into the astronomy area, after not doing astronomy for about 35 years.

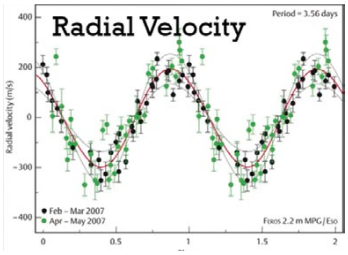
LASP- built the Venetia Burney Student Dust Counter for NASA's New Horizons mission which flew past Pluto in 2015, LASP became the world's first (and only) academic institution to send an instrument to every planet in our solar system and beyond.

The First Images of an Inhabited "Exo"planet – Earth rise over the Lunar Surface (we are one among many!)

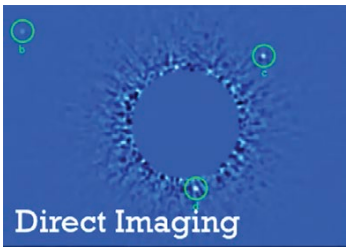
Thanks to Kepler and a number of other techniques, in the last years we have discovered 5,566 confirmed extra-solar planets to date – planets orbiting stars outside the solar system. When we say confirmed we mean those that have multiple pieces of evidence that tell us that is actually a real planet. We probably have twice that number of candidates, but not all have been confirmed.

We have found exoplanets in three ways:

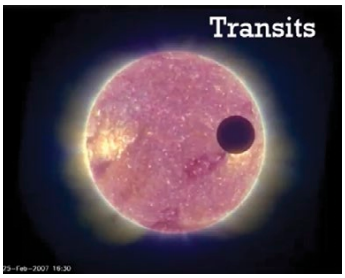
- Radial Velocity – Beginning in the 1990's we started finding giant planets orbiting close to stars. We call them "Hot Jupiters". These were found with Radial Velocity techniques. By watching the gravitational tug of a giant planet on a star, can see the stars spectrum wobble over time because of that interaction, this characteristic signature can measure the presence of planets



- Direct Imaging – Occasionally we take pictures of other planetary systems; this is smallest of these different techniques but will be the most important one in the future as we will see further in this talk



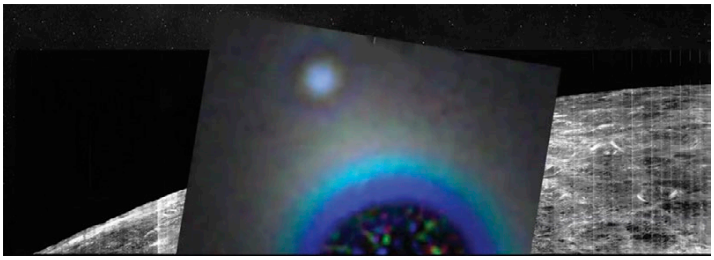
- Transits – The one that has really been the workhorse in this is what Kepler does; basically when the planet passes between us and the star, it blocks some of the starlight, the star gets fainter as the planet transits in front and basically this allows us to determine there is a planet there and how big that planet is, also if there is an atmosphere around the planet, we can study the atmosphere



- We went from Earth being the only exoplanet, to now thousands; that is a ~200 fold increased in the number of known planets compared to when the first transiting planet found in 1999. This fundamentally changed our view of Earth's place in the Universe
- If you do the statistics we now think that, on average, nearly every star hosts one planet. There are probably some that have none and we definitely know some have multiple planets around them

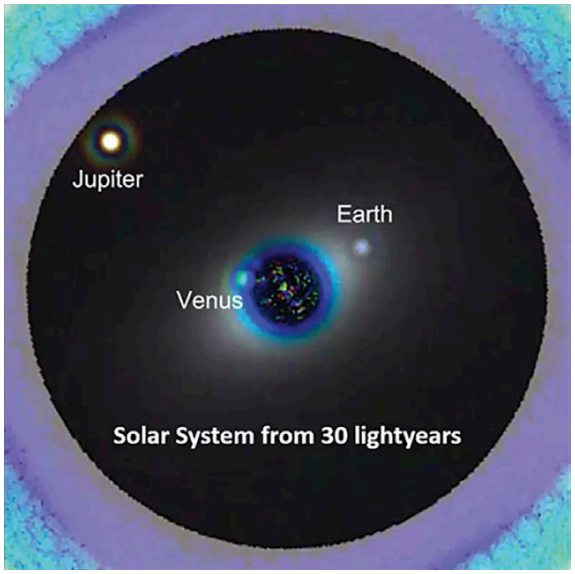
NASA's 20 Year Goal: The "Pale Blue Dot"

The "Key Goal" in all of astrophysics according to National Academy of Science is finding the next "Pale Blue Dot" in the next 20 years. So we want to move from the above image to something that looks like this (below).



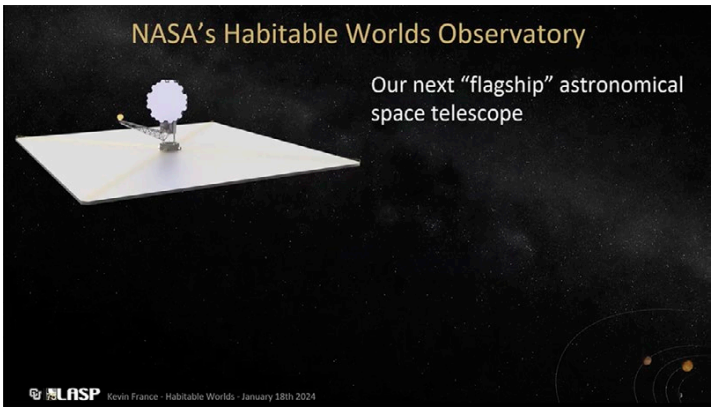
In the last two years NASA has started the process to make this possible. Lets talk about what that path is, how we will know if it is really Earth 2.0, and what we are doing today to lay the groundwork to make this possible.

Example of chronographic image of another star, using Earth as example



You can see the problem of taking pictures of other solar systems is blocking out the super bright light from the host star. The contrast between Earth and the star it is going around is about 10 billion to 1. To see these planets actually orbiting another star, we have to block out 10 billion stellar photons for every one photon we can capture from Earth. This is real hard! What we are going to do is improve the chronographic instruments we have access to today in order to do really high contrast starlight suppression, effectively getting rid of all the bright starlight. Then we can see the faints planet going around it. How are we going to do this? With NASA's Habitable Worlds Observatory.

NASA's Habitable Worlds Observatory



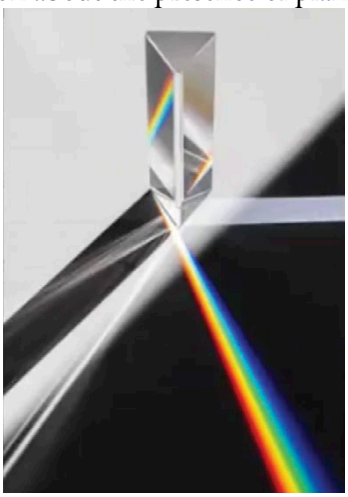
NASA's next "flagship" astronomical space telescope (after ROMAN). This was No. 1 recommendation from the National Academy of Sciences, in past year NASA has started program office, first science and technical groups now getting started. Will be like a "super" Hubble Space Telescope, many of same features, but unique thing it will have is a chronographic instruments on board to allow to search for other planets. The main scientific research goals of the Habitable Worlds Observatory include:

- Search 100 nearby star systems for habitable planets
- Study the solar-system with planetary probe-like images
- Understand the history of our Universe

The goal focused on in this talk is the real science driver for Habitable Worlds Observatory: *Searching 100 nearby star systems for habitable planets*

As we look at the previous image with starlight suppressed center, it gives us information about the presence of planets but does not tell us if these planets are Earth-like or harbors life. To do that we need to go one step farther and not just isolate planet but need to take its spectrum.

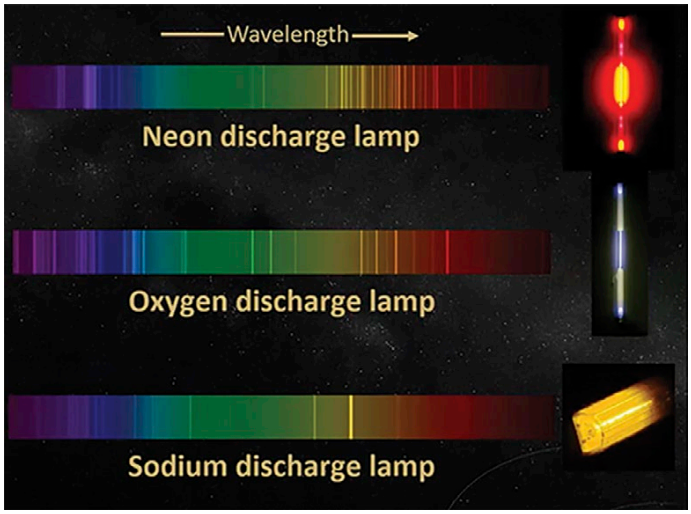
- Spectroscopy is the analysis of patterns in the "disperser" light of an object; taking white light from an element, dispersing it though



Prism is a common dispemser

some kind of prism or grating and studying the bands of light in that spectrum

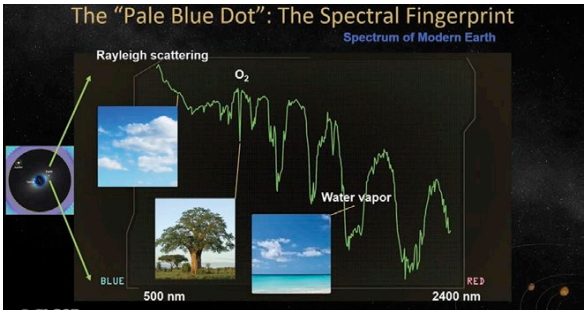
- Every element and molecule has a unique spectrum (like a fingerprint), so we can use spectroscopy to measure what distant objects are made of Examples:
- Some of the things we can do with spectroscopy: identify what is in atmosphere, maybe what kind of surface features, possibly presence of clouds and what clouds are made of, but key is isolating planet with chronograph and take the spectrum of it



The "Pale Blue Dot": the Spectral Fingerprint: What will we be looking for?

A spectrum of modern Earth, representative of what we will be looking for

- Blue end of spectrum looking for blue sky (Rayleigh Scattering), the pale blue dot
- Molecular oxygen, probably the single strongest bio-signature (sign of active biology) on surface of Earth
- Presence of water vapor – water vapor alone does not mean an inhabited planet but we think that it may be one of prerequisites for Earth-like atmosphere
- Methane- look for more complex molecule - suggests biomass of larger animals
- This is why we want to take a spectrum so we can determine if it is this a good place for life to form and is there possibly life there right now?



NASA's Habitable Worlds Observatory – building a working plan

This is a very large project, for scale: the working plan for the Habitable World's is to build a laboratory about the size of a Boeing 757; and it needs to be able to block out 10 billion photons for every one planet photon; this is hard!

- We can't build this today, not only do we not have the financial resources, we do not have the technology and we do not know enough about the stellar and planetary systems we are going to look at
- These are long projects, probably not going to launch until early 2040's so most of people at NASA today will not be working when this launches, so how do we build a workforce with scientist and engineers interested in sticking around for a project that take 20 years to complete?
- For reference LASP is one of eight academic universities involved in this project, so this is why we are leaning into this. So will talk today about projects we are doing at LASP to lay the groundwork for HWO and doing small things now that we think will enable this type of capability in the future

What are exoplanets atmospheres made of and are they stable for billions of years?

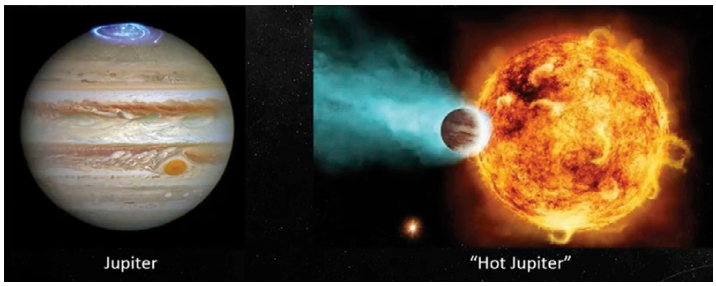
We are going to want to know what these exoplanets atmospheres are made of. There is a great example of this right here in our solar system; Earth and Mars are similar in size and distance from Sun, but vastly different atmosphere composition, and huge difference in stability of those atmospheres and Venus also completely different.

- Our terrestrial planets are similar in ways but all have vastly different outcomes. Are the exoplanet's atmospheres stable over long periods of time? If not, unfavorable for long-term possibility for habitable conditions

How can we measure this on exoplanets?

We can't look at the atmosphere of Earth size exoplanets because they are too small and we do not have the technology, but we can look at giant planets, we can even build small instruments to look at these.

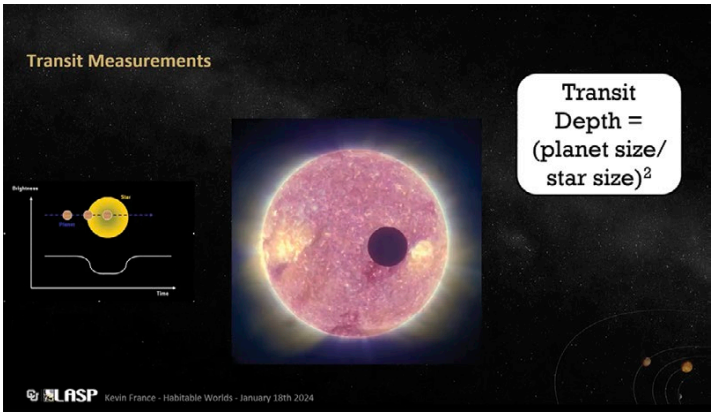
- Right now we can study large Jupiter, Saturn and Neptune size planets
- The first extra solar planets we found were these very large "Hot Jupiter" planets, that are very similar to Jupiter except that they orbit much closer to their host star, even much closer than Mercury is to the Sun



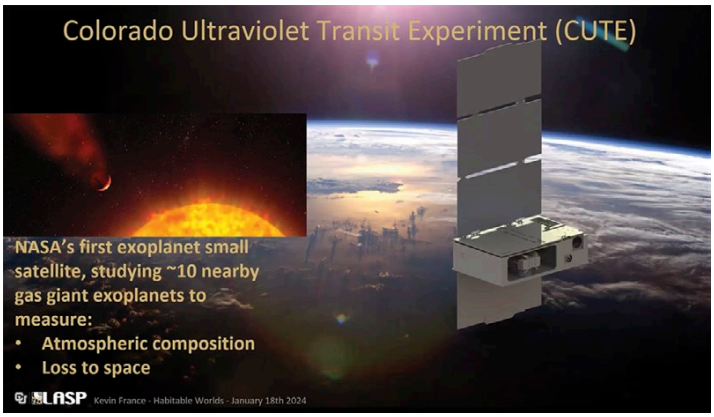
Transit Measurements

Done by taking pictures of the planet as it transits across the star, light from the star get dimmer as the planet goes in front of it as shown in light curve.

- We can measure the size of the planet by how much of the stellar surface is being blocked by the planet (transit depth) how Kepler found all the planets and sizes
- Also information from spectra of transiting planets of "hot Jupiters"
- We can take this one step further if the planet has an atmosphere; we can take a spectrum and study the light as it passes through and can infer: what is the atmosphere composition, its temperature, is it flowing out, escaping to space?

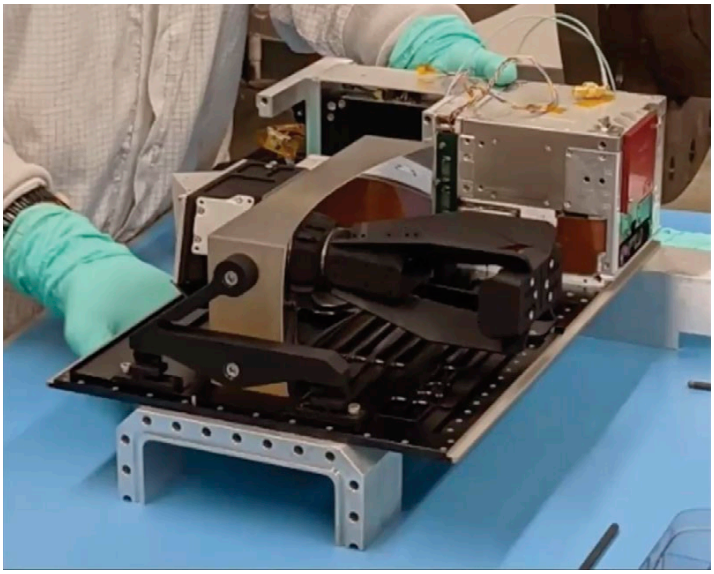


Colorado Ultraviolet Transit Experiment (CUTE)

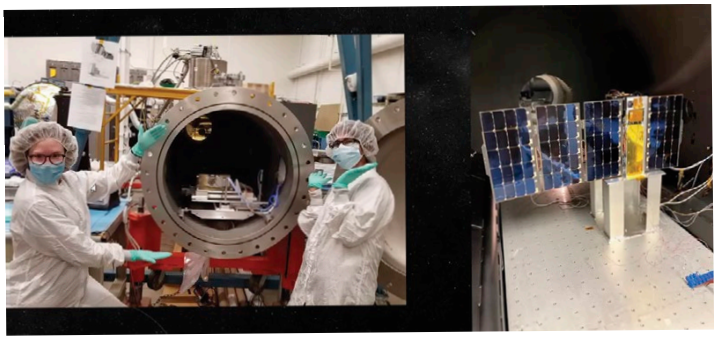


We can't study Earth-size planets because they are too small and signals too weak but we can study large ones. We can build small instruments to do this.

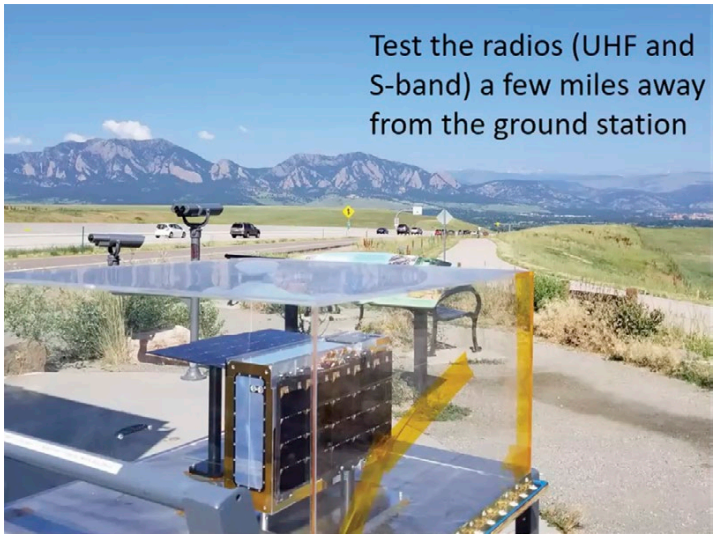
- CUTE is NASA's first exoplanet small satellite
- It is flying right now; it was launched in 2021. It is operated by students at CU.
- It is a pathfinder mission laying scientific groundwork and studying giant planet atmospheres
- Developing tools for lower cost, with students involved
- Designed to study ~10 nearby gas giant exoplanets to measure:
  – Atmospheric composition
  – Are those atmospheres being lost to space?



- Small space telescope ~ 20 cm length - 8 cm height (about the size of a cereal box- cost $5Million)
- Build and test the instrument all at CU, test in a vacuum



- We do all of our own testing, doing command and operations from rooftop of CU Research Campus
- Test the radios (UHF and S-band) a few mile away from ground station off Highway 36



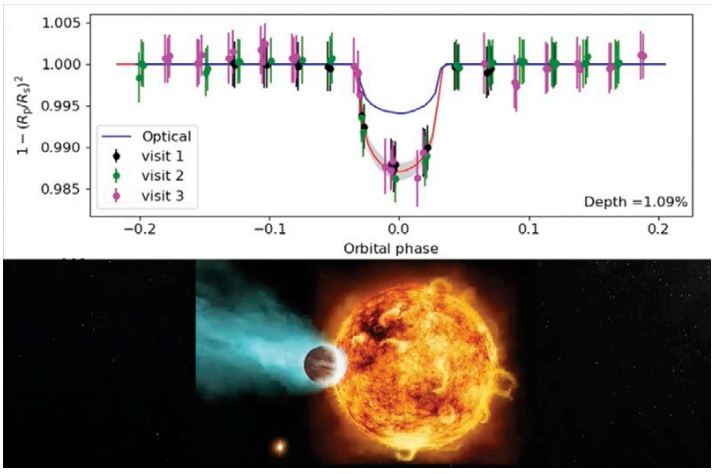
- In interest of being cost effective we drove the instrument ourselves to the California coast Vandenberg SFB, CA. Satellite being installed; two box shapes near bottom

- Were a secondary payload with NASA's LANDSTAT-Climate Observing Mission

Launched in September 2021

- First of its kind mission
- 20 student employed both graduate and undergraduate
- 10 peer reviewed papers
- Demonstration for the next gen of NASA small satellites

What are we seeing with the CUTE instrument



- Transits of Exoplanet - Wasp 189B light curve
- Blue Curve – how deep the transit is in optical wavelengths, CUTE observes in Ultraviolet
- Transits are twice as deep in ultraviolet light, this is telling us the planet is blocking out twice as much light: is physically bigger at certain wavelengths than others
- CUTE not only measures light curve but is a spectrometer, so we can understand what is happening and through spectrometry found high ionized magnesium in the atmosphere

What we found is there is lots of Mg in the upper atmosphere, if fact so much that we know now that the atmosphere is not gravitationally bound to the planet any more. If you could take a picture would probably see a cometary tail of Mg ions coming out of this planet. So what is going on? We think because the "hot Jupiters" are so close to the host star, they are getting baked and losing atmosphere so fast everything is coming out; as hydrogen and helium

come out - drags heavy elements also with it, can see iron streaming out, we are seeing a concrete example of a "hot Jupiter" planet actively evaporate, very unexpected results so early in study!! CUTE is still operating from CU Campus today.

NASA's Habitable Worlds Observatory - The technology we need to make this possible

There is a number of different technical aspects we need for this mission that we don't have the ability to just buy today. One of them is that high contrast chronograph to block out the starlight to see the planets, but another thing is to develop the types of telescopes we need.
Something that is being worked on at LASP as part of NASA's sounding rocket program.

- LASP leads NASA's Suborbital Rocket Program

Sounding rocket missle at White Sands Missile Ramge

- Doing modern experiments derived from early experiments on V2s
- Sub-orbital rockets - goes up into atmosphere for about 15 minutes and then comes back down and is recovered

Rockets as testbeds for new technologies

The Habitable Worlds Observatory requires next generation:

- Telescope coatings – we are working to make mirrors shinier, if you can make a shinier mirror it can be smaller = less expensive, making smaller, better mirrors
- Light-collecting sensors
- Advanced optical designs – how to build spectrometers you need to do the things
- Also do science – Unique measurements of ultraviolet radiation from the alpha Centauri A+B system to study how the ultraviolet radiation to study impacts the climate and atmosphere of exoplanets

High Above, Down Under – Australian Sounding Rocket Campaign

NASA put together first Southern Hemisphere sounding rocket campaign in twenty years last year. Southern Hemisphere stars, cannot be seen at White Sands Rocket Range so went to Australia. Took two rockets down there to very remote Australian back country. Took three days to get there, were there about a month. They built a launch range for us so we could access the dark skies.

- Right before our launch the winds picked up and would possibly stop the launch
- Thirteen minutes left on time window allowed for launch
- We were able to countdown to launch 3 minutes and hold to see if weather cooperated at last minute it did!! Like magic it cleared and we launched.

We were testing mirror coatings to make telescope mirrors better on this launch. It worked and were able to be used, and be flight qualified; it was a great success in the end!!!

Graduate students finishing their Ph.D on rockets get to choose outfits for going out to recover the missile.

Training NASA Future Leaders in Space Sciences

Dr. Kevin France has presented to us an exciting look into NASA's future mission to advance our knowledge of the Universe, with the big-picture of finding Earth-like, habitable planets outside our solar system. NASA's Habitable Worlds Observatory working plan is in development and the University of Colorado's (LASP) is one of the leading universities engaged in developing this mission. The University laboratory staff and students are working today to: carry out the precursor science work studying these planetary systems such as the work done with Colorado Ultraviolet Transit Experiment (CUTE), develop and testing the technology (rockets) to make these instruments possible, and train the student scientists and engineers who will be in charge of these missions over the next 20 or so years.

Further discussion followed Dr. France's presentation with questions and comments from LAS members: Is the Habitable Worlds Observatory going to be an ultraviolet observatory? What do we think is the range of exoplanet sizes that is the right size to be habitable? What happens if it becomes to big? What will be the field of view? Do you envision having optical capabilities? What is the resolution of the spectrometer? Where is it going to be parked? Do you envision an unfolding type of mirrors like the James Webb? With the Habitable World Observatory are you going to be measuring the spectrum of the planets as they transit the star or are you going to manage them as individual bodies with the chronograph? Did any astronomers look at the atmosphere of Venus in the recent transit? On the hundred systems you are going to look at, how are you going to pick those? Are we only going to look at stars like our Sun? Do we expect to find many planets with 3-5 or more planets to each star? Are any stars on the list binary? Do you know exactly what the telescope is going to look like yet? When watching the dip when a transit occurs, how do you know the mass of the planet to know where on the surface the transit is going to go across?

Full meeting recordings are available on the members portal at https://members.longmontastro.org/

Year 2023 Review by Vern Raben

Meetings in 2023:

- Thanks to Marty and Bruce we arranged for in-person meeting space at the First Evangelical Lutheran Church in Longmont
- We held 11 meetings in 2023: 9 were both in-person and Zoom, 2 were Zoom only
- Attendance has been good; total of 293 people attended our meetings in 2023. Average of 16 in person and 13.5 on Zoom

Presentations in 2023:

We had some great presentations last year -- thanks to Hunter for arranging them all!

- Jan 19 Open Forum
  - Bill Tschumy: "Measuring Variable Stars"
  - Eileen Hall-McKim : "New research on the age of the magnetic field of Mars"
  - Stephen Garretson: "Creating HOO Images in Pixinsight"
- Feb 16 Spectroscopy: "Using Light to Determine Star & Planet Composition" by Dr. Ben Burke
- Mar 16 "The Angry Red Planet" by Martin Butley
- April 20 "Our Universe: What is the Universe? What does it contain? What is its history? Its future?" by Dr. Jeremy Darling
- May 18 "Living in the Golden Age of Solar Physics" by Prof Maria Kazachenko
- June 15 "Life and Climate on Mars: Past, Present and Future" by Dr. Bruce Jakosky
- July 20 open forum of member presentations
  - "Stonehenge in Broomfield" by Mike Hotka
  - "Easy Analemma, or How to Make an Analemma in 52 Easy Steps." by Ellen Steiner
  - Discussion of image of a Wolf-Rayet Star in Cygnus, WR134, by Marting Butley
  - "A simulation sequence of morning twilight of the All-Sky at DSNM by Steven Albers
- Aug 17 "Gravitational Waves - Observing the Dark and the Bright" by Dr. Carl Haster,
  - "Comet C/2023 P1 (Nishimura)" by Paul Robinson
  - "Ford Deuce Telescope" by Vern Raben
- Sept 21 "Europa Clipper: Voyage to an Ocean Moon." by Dr. John Spencer
  - "Cloud Forecasts" by Bill Tschumy
- Oct 19 "Astro-photography, some Astro-physics. Astro-art, and Accidental Discoveries" by David Elmore
- Nov 16 "The Cloud Bases are Dark Out Here" by Dr. Bob Grossman

Member Images in 2023

- Shared 552 images
- Minimum was 27 per month
- Maximum was 101 per month
- Average was 1.5 per day
- Thanks to Stephen, Tally, Marty, M. J., Rolando, David, Jim P., Gary, Eddie, Brian K., Brian S., Shawn, and Paul for sharing amazing images and expertise

Newsletters:

- Twelve newsletters were published 2023 -- total page count was 440.

Thanks to Eileen for doing the monthly speaker notes and the newsletter archive. Thanks to Mike Hotka for his new series of articles on visual observing.

Club Calendar:

- We put out another great calendar with some of the fabulous member images. All 75 copies we ordered were sold; the publisher sent two extra -- we sold those too!

Website:

- Website was moved from WildApricot to Squarespace by Sarah Getty (now Davis) -- that was lots and lots of work -- thanks Sarah!
- Sarah has added lots of content
- Member portal was setup to handle membership renewals, etc. -- the Squarespace membership option was not adequate

Public Outreach:

- Apr 15 - Hunter did talk at Sandstone Ranch and there was a Star Party in the visitor center parking area
- Apr 21 - Rabbit Mountain Star Party (canceled)
- Apr 22 - Coalton Trail Head in Superior for Boy Scouts (canceled)
- May 19 - Rabbit Mountain (canceled)
- June 24 - Rabbit Mountain (20 attended, 7 scopes)
- July 21 - Rabbit Mountain
- Aug 11 - Superior, Coalton Trail Head (Perseid meteor shower -- cloudy but 44 attended anyway)
- Sept 1 - Rabbit Mountain
- Sept 15 - Rabbit Mountain (30 attended, 9 scopes)
- Oct 7 Solar Event for Louisville Library (hundreds attended)
- Oct 14 Louisville Library Partial Solar Eclipse (hundreds attended)
- Oct 20 - Rabbit Mountain
- Nov 17 - Erie Elementary (hundreds attended)

Thanks to Bill Tschumy for all the work he did in coordinating with Boulder County, City of Louisville, and City of Superior. Also for sending out all the announcements and recruiting volunteers.

III. Business Report by Bruce Lamoreaux

Longmont Astronomical Society

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

LAS Treasurer's Report - Bruce Lamoreaux **1/18/2024**

Main Checking Account (xxx-1587)

Begin Balance:	$ 9,400.00	**12/4/2023**
Deposits:	$ 1,080.00	Membership, Calendars, Magazine
Expenses:	$ (1,150.00)	Bank Charges, Meeting Room, Magazine
Current Balance:	**$ 9,330.00**	**1/4/2024**

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

Past Balance:	$ 8,200.00	**10/23/2023**
Interest:	$ -	
Balance:	**$ 8,200.00**	**12/29/2023**

Telescope Fund (xxx-0165)

Past Balance:	$ 1,100.00	**11/29/2023**
Deposits:	$ -	
Expenses:	$ -	
Balance	**$ 1,100.00**	**12/28/2023**

Petty Cash

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

Total Assets	**$ 18,680.00**	$ (55.00) Down from December

Active Membership:	**106**
Student Membership:	**0**
Total	**106**

LAS 2024 Election

Thank you to all 2023 officers:

- Vern Raben - president (I guess he did okay)
- Hunter Morrison - vice president. He did a marvelous job finding and scheduling speakers the past year. It takes time to find, select, and contact potential speakers; multiple emails to each to get them scheduled for a particular meeting
- Bruce Lamareuax - treasurer. He has done an excellent job maintaining the club's roster of members and bank accounts since he became treasurer in 2020. He pays our bills, files our taxes with the IRS, and also handles our insurance.
- Eileen Hall-McKim - secretary. She writes an amazing, excellent summary of the speaker presentations and records of our meetings. She also goes back through the newsletter archives and writes about some of the interesting things she finds each month.

All current officers were nominated to serve again in 2024, the motions seconded, and they were elected by acclimation.

Thank you to the members of the 2023 board of directors:

- David Elmore, Gary Garzone, Mike Hotka, Brian Kimball, and Tally O'Donnell

All were nominated again for these positions for 2024, the motions seconded, and all were elected by acclimation.

Thank you to all who served in appointed positions:

- Sarah Davis - webmaster. Sarah spent many, many hours moving content from our previous website hosted by Wild Apricot to the new one Squarespace. She has done a great job adding content, member images, and keeps it up to date.
- Bill Tschumy - outreach coordinator. He has spent lots of time talking, emailing and arranging, and doing the paper work for star party events with Boulder County Parks, Superior, Louisville Library, and Erie Elementary.
- Bruce Lamoreaux - library telescope coordinator. He coordinates with area libraries and maintains the telescopes the club donated to them.
- Eileen Hall-McKim and Vern Raben - newsletter
- Mike Hotka - writes a monthly column for the newsletter about visual observing techniques; he is also on the exec board.

"When Technology Fails" by Mike Hotka

In this continuing series of articles, I want to discuss contingency plans. When I am having trouble with my smart phone, you will often hear me say, "Technology is wonderful when it works!". Those of us who are engineers, can make a living figuring out why specific technology is not working and getting it fixed for the end user.

When I first got started in observational astronomy, I would find the objects I wanted to observe by a method called star hopping. Star hopping is a skill of navigating the night sky to find objects by using only the stars.

Today, the amateur astronomer has several technological options available that can help them find objects in the sky. One such technology I use is called Digital Setting Circles (DSC). DSC is system that has a small computer that receives signals of where the telescope is pointing from encoder devices that are fixed to each movable axis of the telescope. After telling the DSC computer where two stars are at the beginning of the observing session (the initial alignment process), you can enter object designations, like M51 on the DSC's display, and the DSC computer will show you how to manually move your telescope to center the object in your eyepiece. I use two different kinds of DSC, one is called the Sky Commander™ and the other is called the Argo Navis™.

I have my observing lists for the outing loaded into my Standard Edition of SkyTools 4 (ST4) (SkyTools 4 Standard Edition (skyhound.com)).

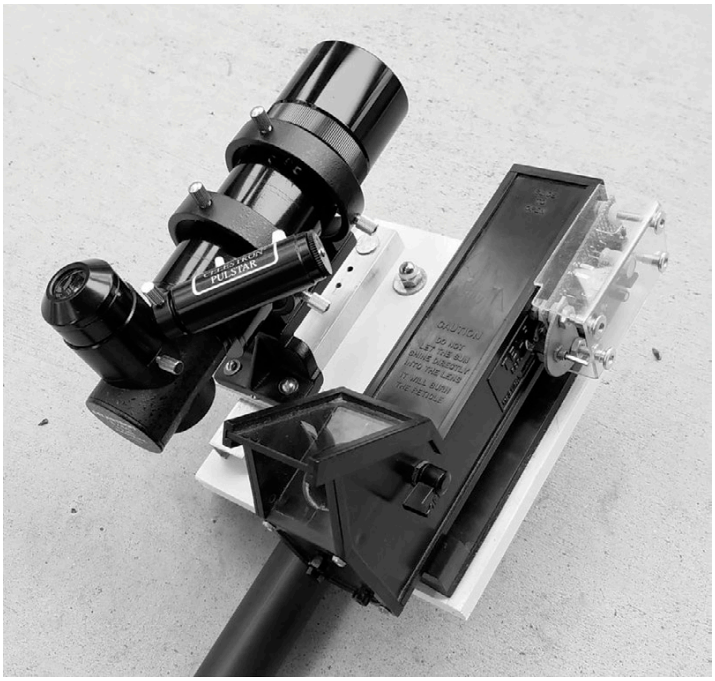
I am set for an evening of observing.

If all this technology works all night, I can view and record many objects on my observing list(s). But as useful as this combination of technology is to help me observe, if any one component of it fails, then what do you do? If this happens, there are choices that determine what you do next:

1. waste valuable observing time troubleshooting the problem in the dark with a red flashlight if you are not observing alone,
2. pack up your gear and go home,
3. continue to observe by implementing contingency plans you pre-developed before this outing.

If your DSC system is failing to find objects, I immediately turn it off and back on again and do another 2-star alignment. After this alignment, I tell the DSC to find a nearby Messier objects. If the Messier objects is not in the eyepiece after moving the telescope to it, I turn off the DSC again. I unplug and plug back in the (RJ11) telephone style connector into each encoder device. This can shine up the contacts to make the signals from the encoders reach the computer. I turn on the DSC, and repeat the alignment process and try to find the nearby Messier object. If the Messier object is not in the eyepiece this third time, I turn off the DSC and star hop to the objects on my list for the rest of the night.

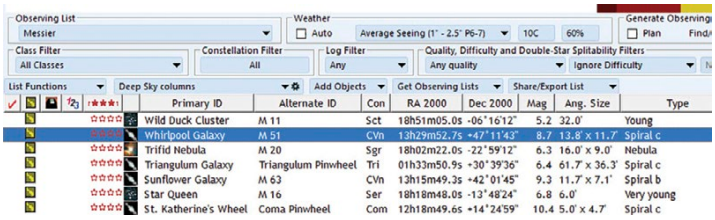
Star hopping is the process of moving from an easy to find bright star, through dimmer star fields until the object is reached and is in the eyepiece. Two useful pieces of equipment that I use to star hop with is a Telrad™ and an 8x50 finder scope with an illuminated cross hair reticle.



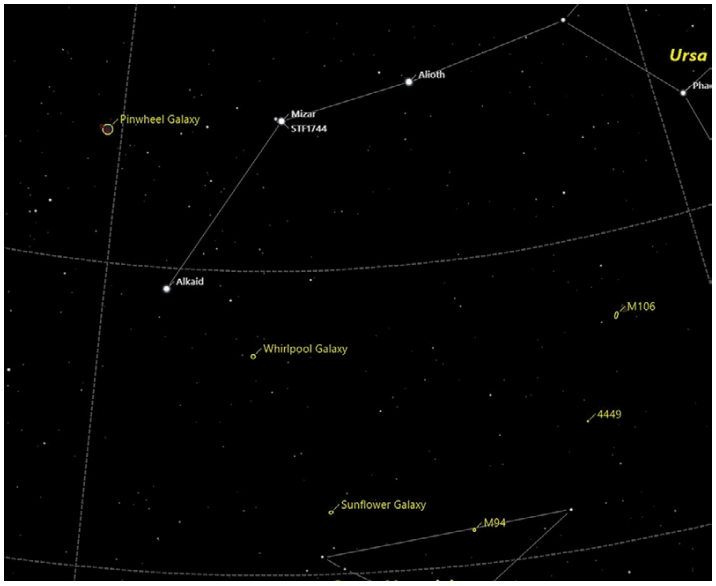
This platform is attached to the rocker box of my telescope and keeps these finder scopes at an ideal position for me to use, regardless of where the telescope is pointing in the sky.

I start each observing session by aligning the Telrad™ and the finder scope with the optical axis of my telescope. That means when you look at a bright star that is centered in the Telrad™, it will also be centered in the finder scope and the eyepiece of your telescope. Then I can do the 2-star alignment of my DSC.

To star hop to M51, I would highlight M51 on my ST4 display and hit the 'A' character.



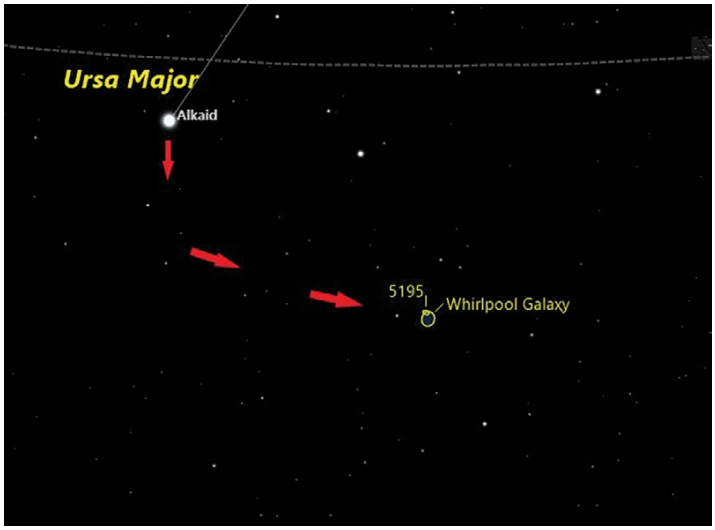
This brings up an all sky display.



Zooming in on this window makes the area of the sky between the end star (Alkaid) of the handle of the Big Dipper and M51. This shows the many fainter stars in this area of the sky. These fainter stars are easily seen in my 8x50 finder scope.

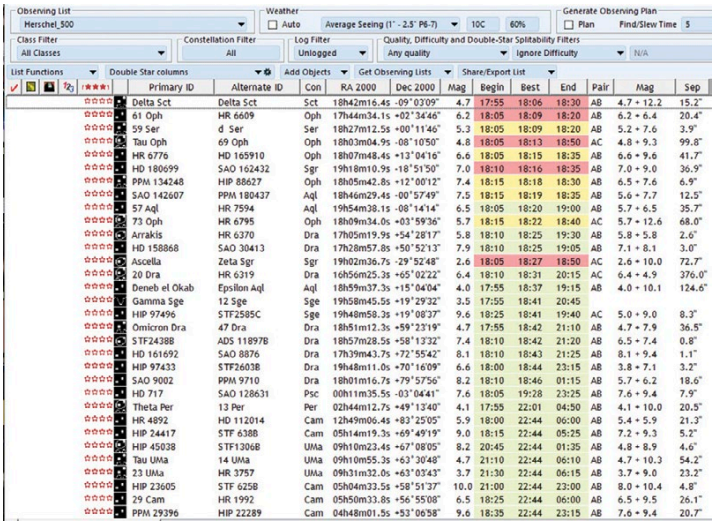
An asterism is a group of stars that forms a pattern. I look for asterisms that form a triangle or a chain of stars. These are easy to spot in the 8x50 finder scope.

Start by using the Telrad™ and centering Alkaid in the eyepiece's field of view. Then move to the 8x50 finder scope with the illuminated reticle on. Move the scope down and center the cross hairs of the finder scope in the center of the triangle of stars below Alkaid. Next, move the telescope to have the cross hairs centered on the larger triangle of stars to the right of the current asterism. Then move the telescope more to the right of the brighter star seen to the left of M51. Returning to the eyepiece, M51 should now be somewhere in the field of view.



If you laptop computer fails, I always have a printed list of the objects I plan to observe with me. I screen capture all the pages of the object list(s) I plan to observe from the main ST4 display screen. I print them out on 8 x 11 inch paper. This is my backup list in case this condition occurs.

The printed page(s) will resemble (following image) the ST4 display screen for the observing list being displayed.



I can now enter the object designations, via RA and Dec coordinates in most cases of the above example, into my DSC and ask the DSC to show me how to move my telescope to the object.

In many areas of our country, dew can be an issue that can stop an observing session if you are not prepared. To keep my laptop dry, I bought a medium moving box from Walmart and painted the exterior of it to help shed dew water. This keeps my laptop dry from dew.

I also have a small piece of 10 mil thick, transparent poly plastic that I can lay over my notes and papers on my observing table to keep them dry from the effects of dew. When I am ready to write an observation in my logbook or make a sketch, I can easily remove this plastic and replace it when I am done writing or sketching.

I've also invested in the Kendrick Dew Removal System (https://www.kendrickastro.com/dew_controllers.html#StandardDualChannelController). I can plug the dew controller into my 12V portable battery I take with me. Then affix the heating pads to my eyepiece, Telrad™ and 8x50 finder scope objective and eyepiece (https://www.kendrick-astro.com/dew_finderheaters.html). I have a 9V secondary mirror heater to keep that mirror warm.

The third contingency plan is make sure you take enough layers of clothes with you so if the temperature does drop through the course of the night, you can put on additional clothes to remain comfortable. I learned this lesson the hard way. One night in August, I was observing at about 9,000 feet in elevation. The day time temperature was over 90°. All I took with me to wear for the weekend were shorts and t-shirts. All I brought with me to stay warm at night was a light jacket. That night, the temperature plummeted to below 40°. I froze that night wearing shorts, a t-shirt and the light jacket. One time at that same location, the temperature dropped below 32° . The dew that had settled on the wooden tube of my telescope was now a layer of ice. So be prepared to stay comfortable wherever you go observing.

With all the articles I have written, you now have my process to prepare, execute and complete observing outings. Next month I will start to discuss Astronomical League Observing Programs you might consider doing.

30 Years Ago 1994

President, Bob Noble; The meeting was started by Vice President, Jim Sharp. Jim discussed details from prior officer meeting. Our non-profit organization status is being reviewed. This is particularly important given some observatory opportunities we may have at Boulder High School and Mike Fuches. Grant opportunities are being researched for use in this project.

John White received his honorary Messier observing certificate. Bob Ross gave a presentation on his current lunar dome project.

20 Years Ago 2004

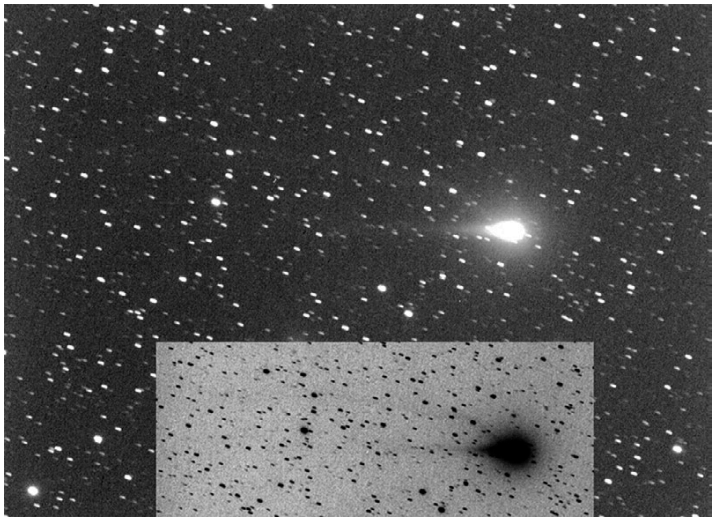
From the President, Bob Spohn:
2003 was a very good year for LAS. We would like to maintain the momentum for 2004. We have a new INTERNET domain for LAS: http://longmontastro.org. We would like to have a push for more AL observing certificates in 2004. We gained many new members and LAS funds have increased. LAS is on a roll! We would like to keep it up: We want to have lots of fun in 2004. Webmaster, Steve Albers is moving website to new server and domain.

Newsletter Editor:
Philippe distributed 20 copies of the January newsletter. Highlights include solar eclipse report by Karen, 2004 banquet pictures and comments, an "astrophotographic corner" to showcase some member's work. He ran out of space in this edition, skipping
"constellation of the month" this month only.

Pawnee was awesome again by Gary Garzone
We had 12 people show up at Pawnee for another great clear and dark night. Seeing was best in long time, Saturn everybody had at highest powers, Jeff White was at 3mm on 3000mm focal length which means over 1000x on Saturn before it started to look bad. He took lots of Saturn shots and we should be getting some pictures back from him soon I hope. It was very cold, about 20°, but we all were dressed for it and stayed up until almost 2 am before the cold did mirrors in with frost build up. Comet was easy to find and pretty bright with short tail, about 8th magnitude. Jupiter was pretty good along with NGC4565, edge on favorite, and so many more to name. I hope some of my digital Saturn and Jupiter pictures come out.

Bye Gary

Saturn from Pawnee Grasslands by Jeff White



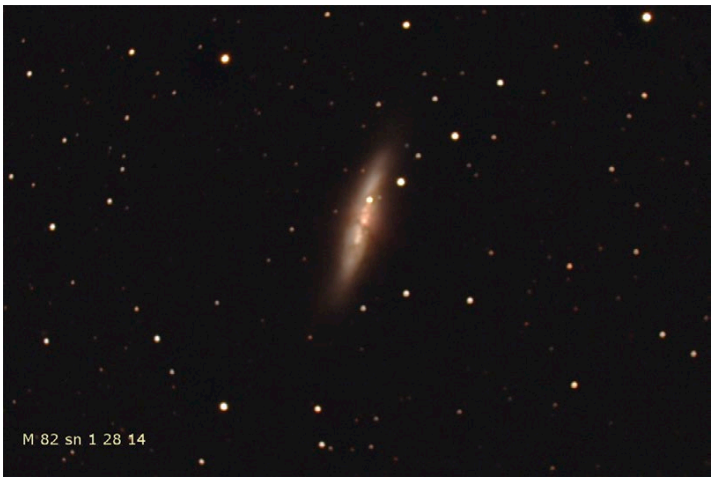
Comet by TomTeeters in 2004

10 Years Ago 2014

The January LAS meeting was held at Johnny Carinos in Longmont. This was our annual business meeting to elect officers for 2014 and to adopt changes to the LAS constitution and By-Laws.

2014 Officers are: President: Vern Raben, Vice-President: Gary Garzone, Treasurer; Mike Fellows, Secretary: Will Thornburg. Board Members: Bob Spohn, Brian Kimball, Leigh Pearson.

10 Years Ago 1994 - continued



Supernova 2014J on Jan 28, 2014 in M82 by Gary Garzone

NGC1950 by Brian Kimball in 2014

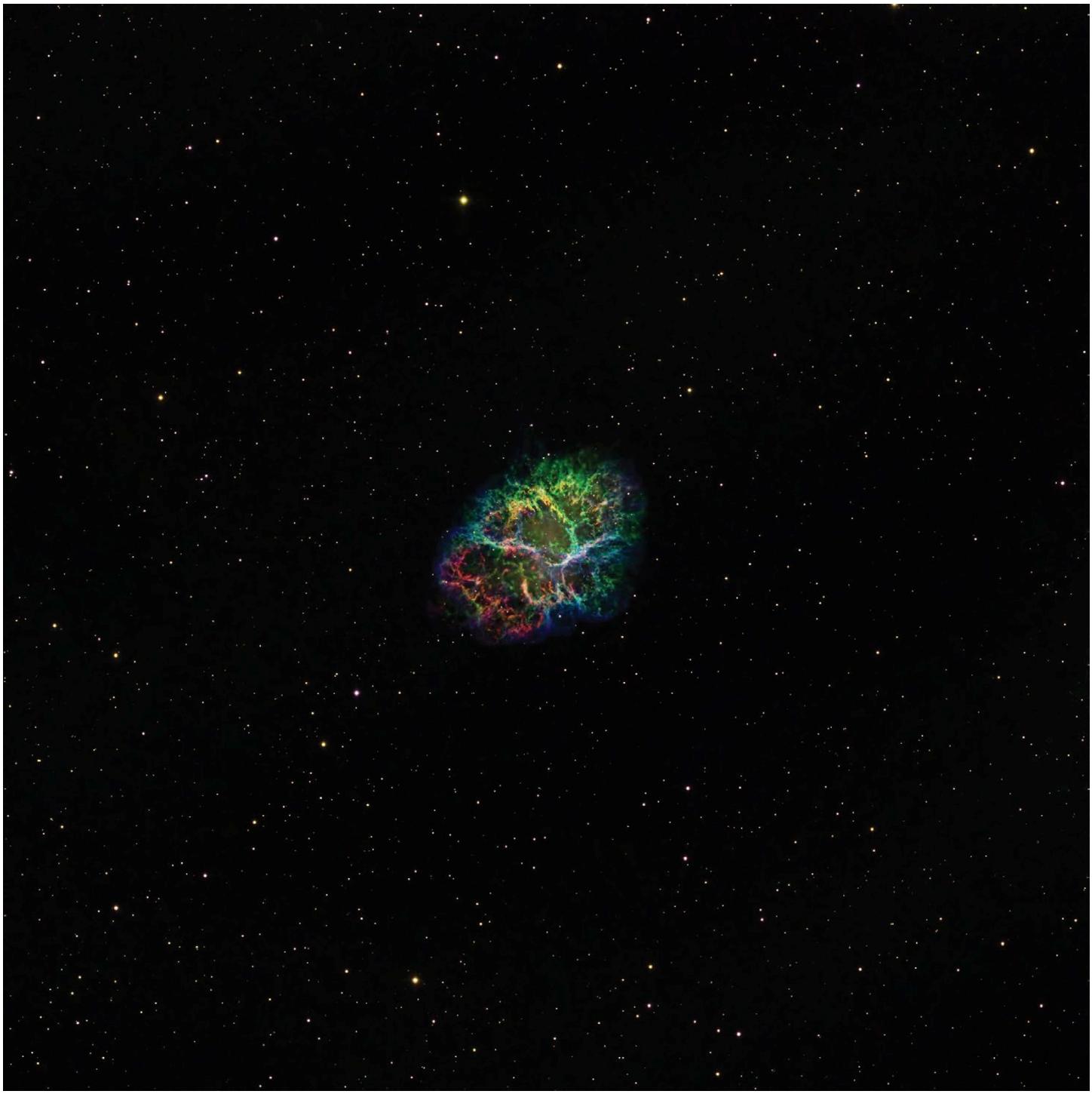
In Gary's shot above, the supernova is the bright spot above the center of the galaxy. The type IA supernova was spotted on Jan 21st by astronomer Steve Fossey and four undergraduate students at the University College London. It peaked on Feb 2nd at magnitude 9.75.

Messier 42 Orion Nebula by Brian Kimball in 2014

The Orion Nebula (also known as Messier 42, M42, or NGC 1976) is a diffuse nebula situated south of Orion's Belt in the constellation of Orion. It is one of the brightest nebulae, and is visible to the naked eye in the night sky. M42 is located at a distance of 1,344 ± 20 light years and is the closest region of massive star formation to Earth. The M42 nebula is estimated to be 24 light years across. It has a mass of about 2000 times the mass of the Sun. Older texts frequently refer to the Orion Nebula as the Great Nebula in Orion or the Great Orion Nebula.

NGC1950/1785 by Brian Kimball: Herschel discovered NGC 1750 in 1785. 78 years later d'Arrest observed a nearby cluster, which was cataloged as NGC 1746. It is likely that both observed the same cluster, and simply recorded different positions; but there are differing interpretations (1) that NGC 1750 is only the southeastern portion of NGC 1746, or (2) that the two are the same cluster, and should have the same designation. Given Herschel's earlier observation, if (2) is correct both should be called NGC 1750; but common usage is to call them NGC 1746, which is backward from their order of discovery. There is also another cluster, NGC 1758, just to the northeast of NGC 1746/1750, but is physically unrelated to them (being about 500 light years more distant), and just happens to be in nearly the same direction. (Presuming that NGC 1750 is only part of NGC 1746, its apparent size is about 25 by 12 arc min.)

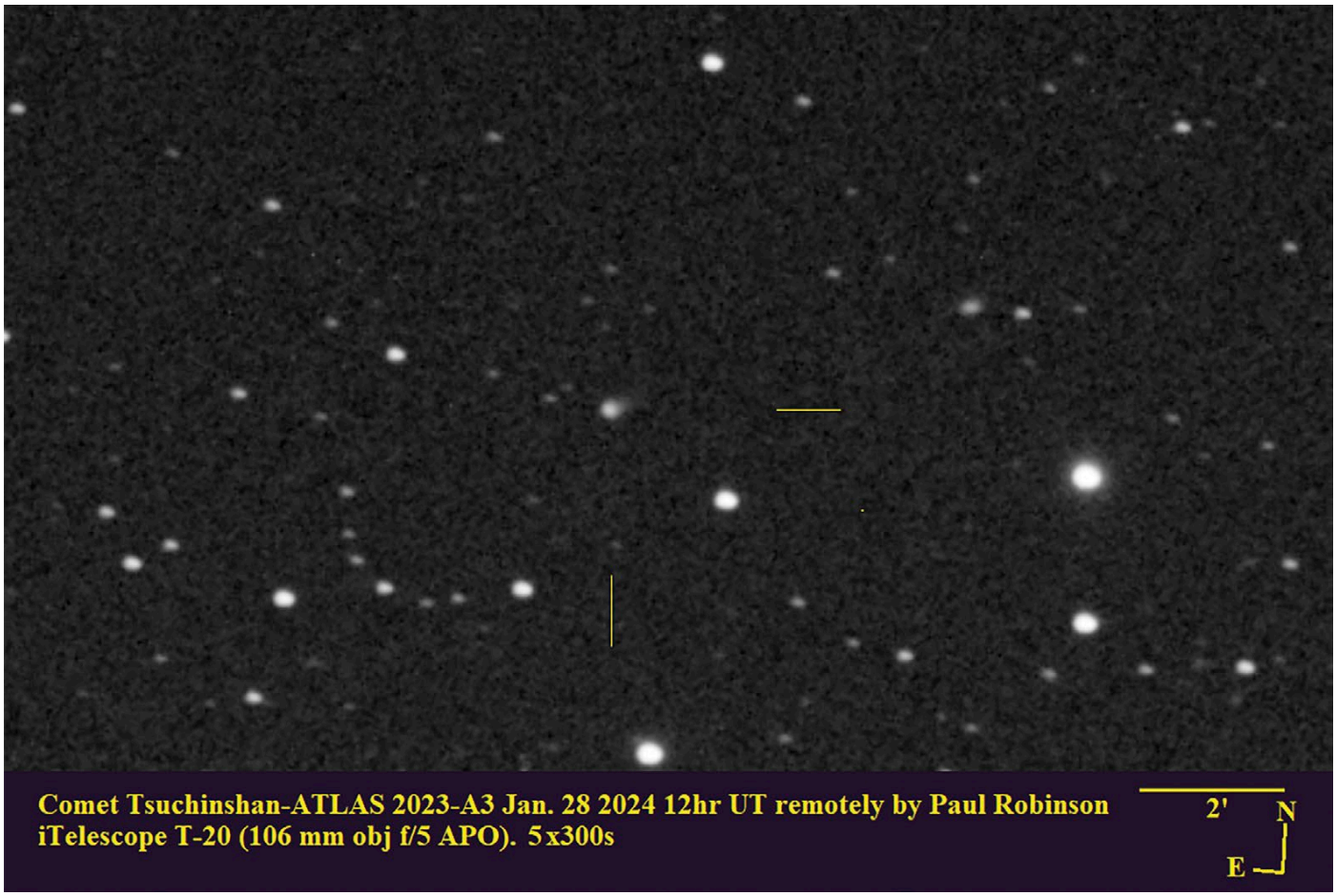
M45 by Mike Lewis in 2014



Messier 1 by Eddie Hunnell on Jan 27

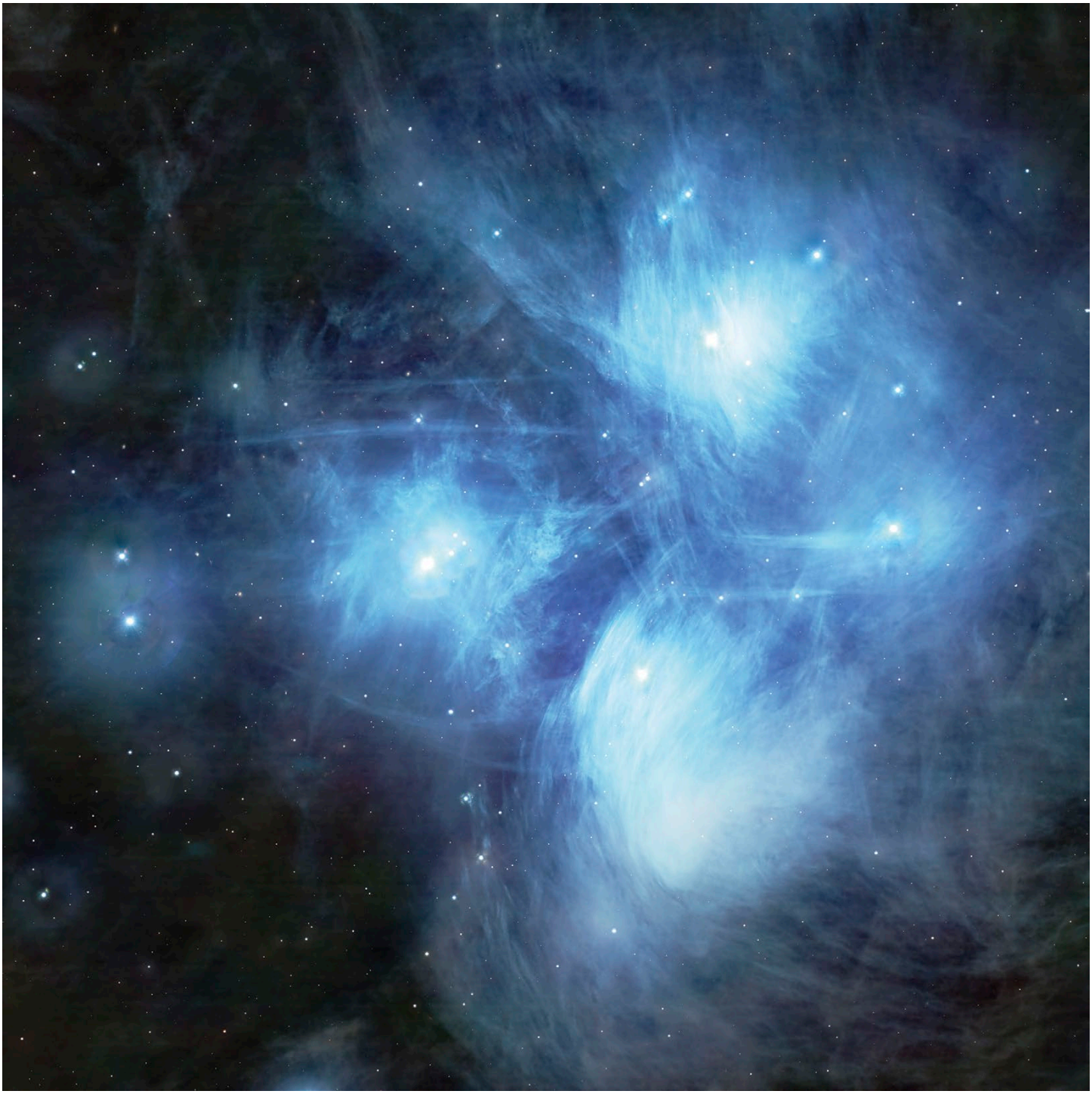
Here is an image Eddie captured with a remote telescope at "Telescope.Live" of the Crab Nebula. The images they had were SHO. He used the X tools in processing. The camera was a FLI CCD camera and the subs are all 300 seconds.

M42 by Eddie Hunnell on Jan 21



M1 by Gary Garzone on Jan 29

NGC 891 by Gary Garzone on Jan 29



M45, Pleiades by Jim Pollock on Jan 11

This was shot on Jim's 14 inch EdgeHD at f/2 with HyperStar and an L-Pro filter into a ZWO 6200mc OSC camera. This is 113 frames of 300sec which is 9.4 hours of one-shot-color (OSC) imaging on the ZWO 6200mc. Processing used the new gradient removal tool, graXpert,

Running Man by Jim Pollock on Jan 14

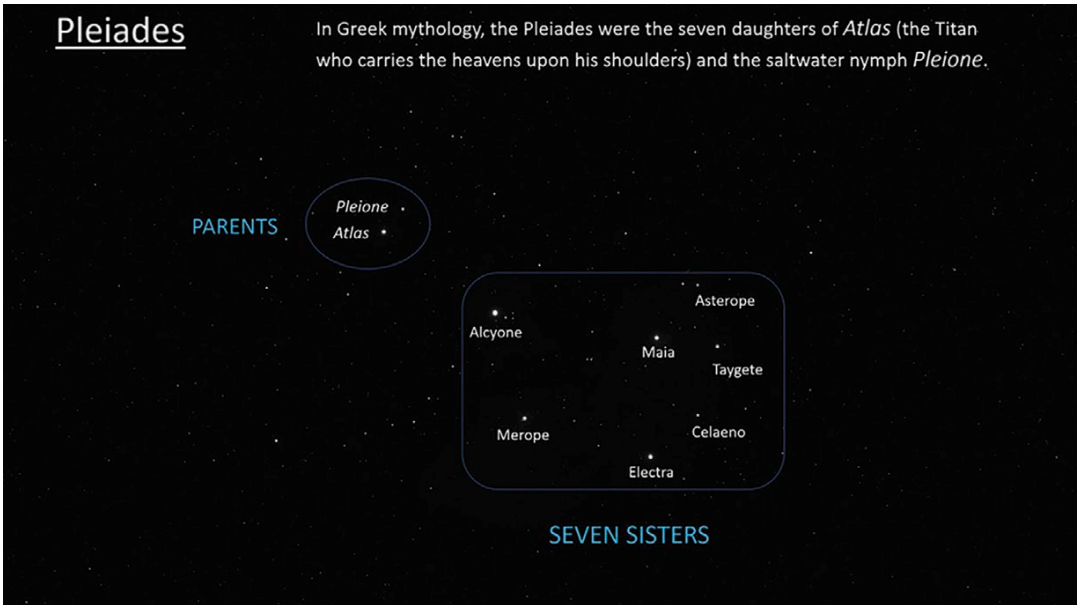
Taken with 11" EdgeHD at f/2 with Hyperstar. 99 frames of 180sec or about 5 hours of exposure. L-Extreme Filter... which is great for the emission nebulosity in M42 but not so good for the reflective nebulosity of Running Man

M 45, Pleiades by Martin Butely on Jan 7

Taken from Hygiene with a Takahashi FSQ 130 on a Mach2 mount with an ASI6200 camera. LRGB 4.5 hours integration.

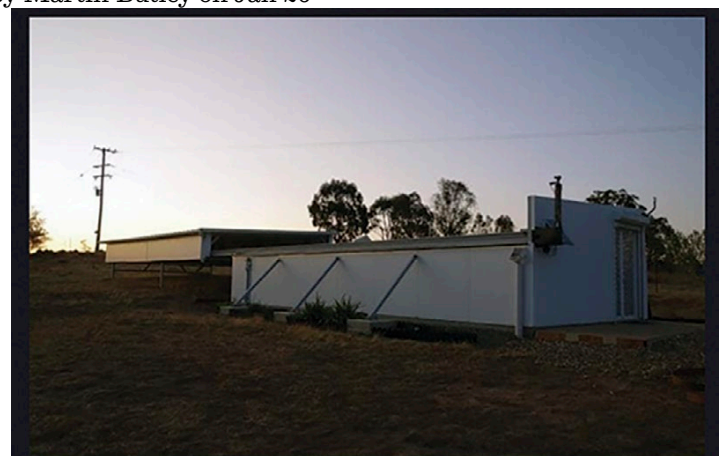
M45 is a gravitationally bound open cluster of more than 1000 stars that are about 430 light years from Earth.

The "Pleiades" (from Greek Mythology) references only seven of these stars – the seven sisters. These are the daughters of Atlas, the Titan who carries the heavens upon his shoulders, and the saltwater nymph Pleione. Atlas and Pleione, in addition to their offspring Maia, Electra, Alcyone, Taygete, Asterope, Celaeno and Merope, all form part of M45. Pleione is considered a protectress of sailing. Her daughters guided Odysseus on his quest. Merope is the wife of Sisyphus, which may explain why she is embedded in a veil of tears (NGC 1435). The Hyades, half-sisters of the Pleiades and also in Taurus, are daughters of Atlas and Aethra.



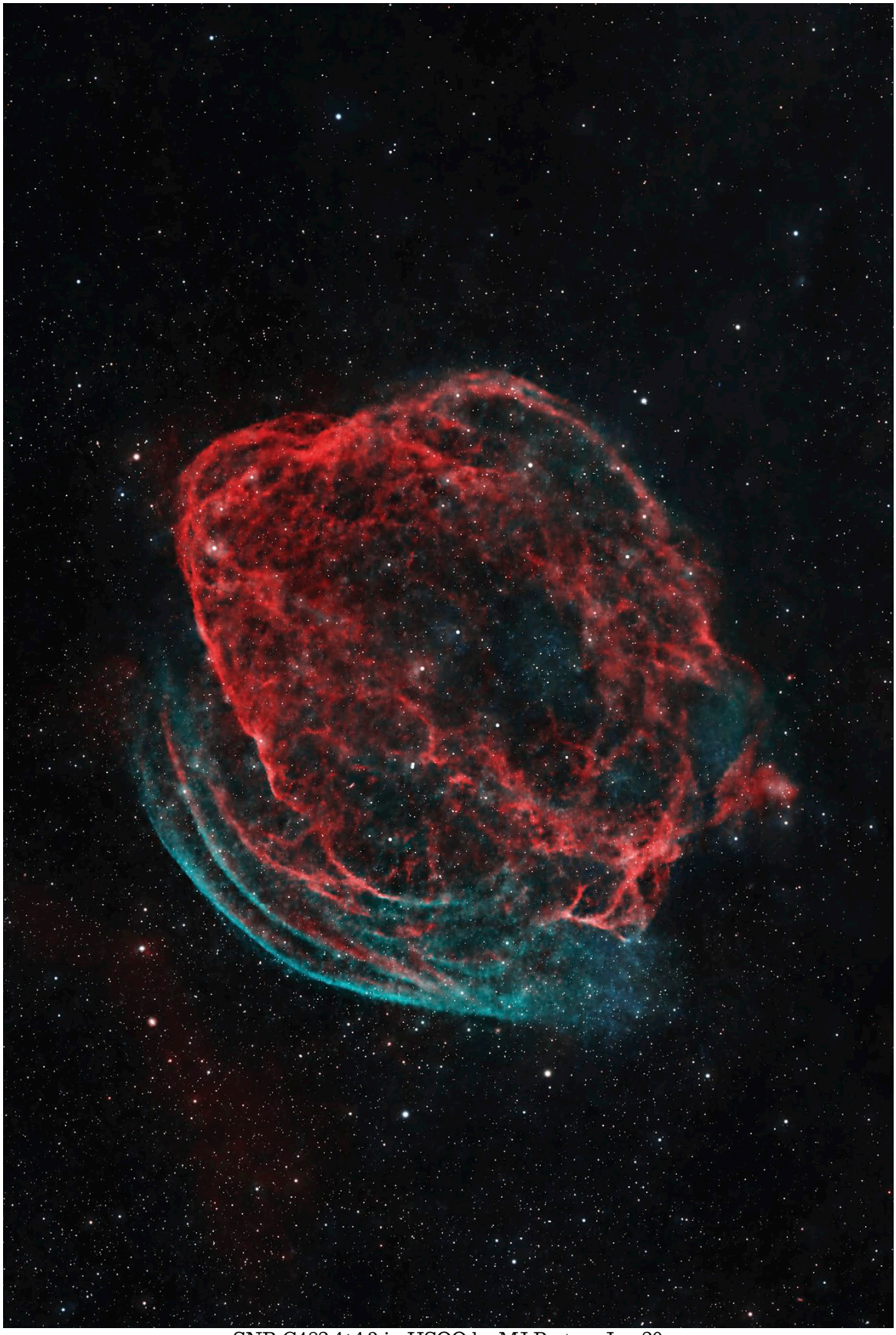
Small Magellanic Cloud by Martin Butley on Jan 26

Image data from Heaven's Miror telescope located in the outskirts of Yass in New South Wales, Australia processed by Martin Butley. Total integration time is 26 hrs and 36 min of 10 min subs in with red, green, blue, and luminance Astrodon filters. Marty notes that because the LMC is so close, it is possible to resolve individual stars. If care is not taken during processing, many of the fainter stars maybe removed as background noise with NoiseX.



NGC 247, Eye of the Needle galaxy by MJ Post on Jan 3

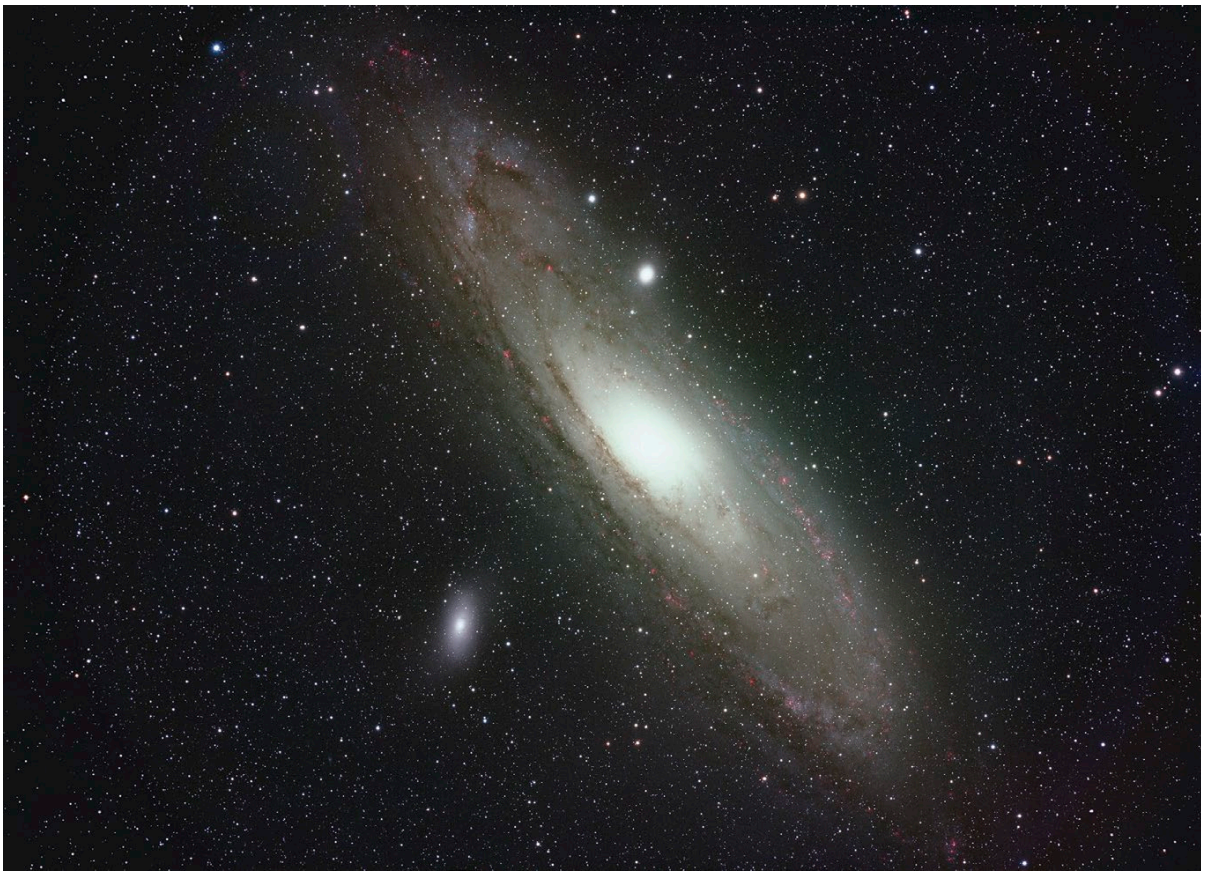
This is a rather large galaxy in Cetus the Whale. It is so named because of the asymmetric void of stars in its north region (left) and pointed southern section. Three hours total data with the OSC camera using the Luminance filter, and another hour with Radian's quad narrowband filter, adding back that filter's red channel into the mix to highlight the HII regions in the galaxy. From DSNM this past week using the CDK14 scope.



SNR G182.4+4.3 in HSOO by MJ Post on Jan 20

This super nova remnant is odd in its asymmetry and differences in structures produced by hydrogen and oxygen. Very little has been studied on this target optically, but radio astronomy studies indicate its age is 3800 years and distance is 10,000 l.y. This is an HOO rendition with SII and Ha sharing the red channel, and 30% SII added to OIII in the blue and green channels. Field of view is about 1.6 x 1.1 degrees.

SH 2-188, Shrimp in HSOO by MJ Post on Jan 19

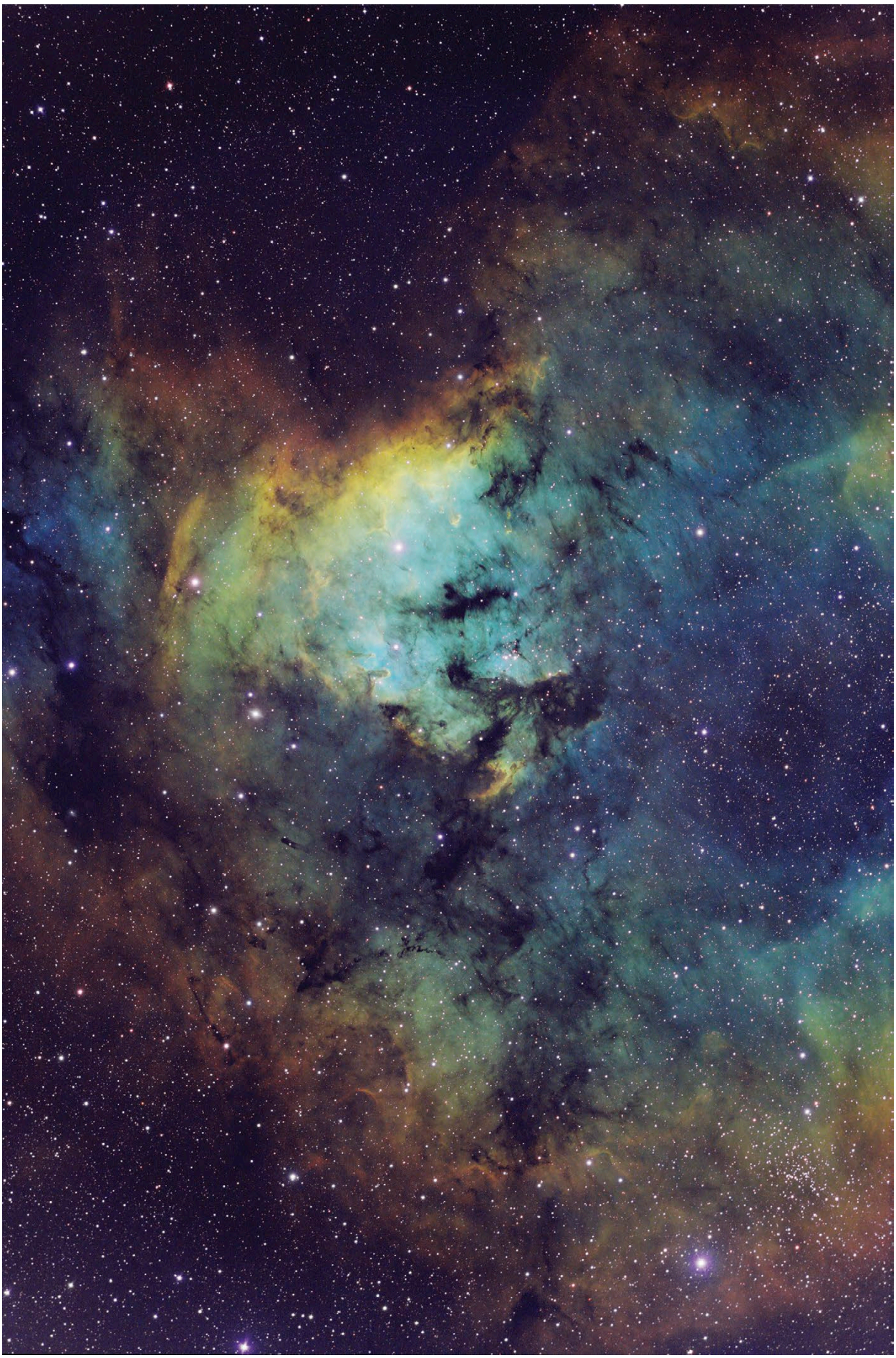


M31 in HaRGB by Tally O'Donnell on Jan 15

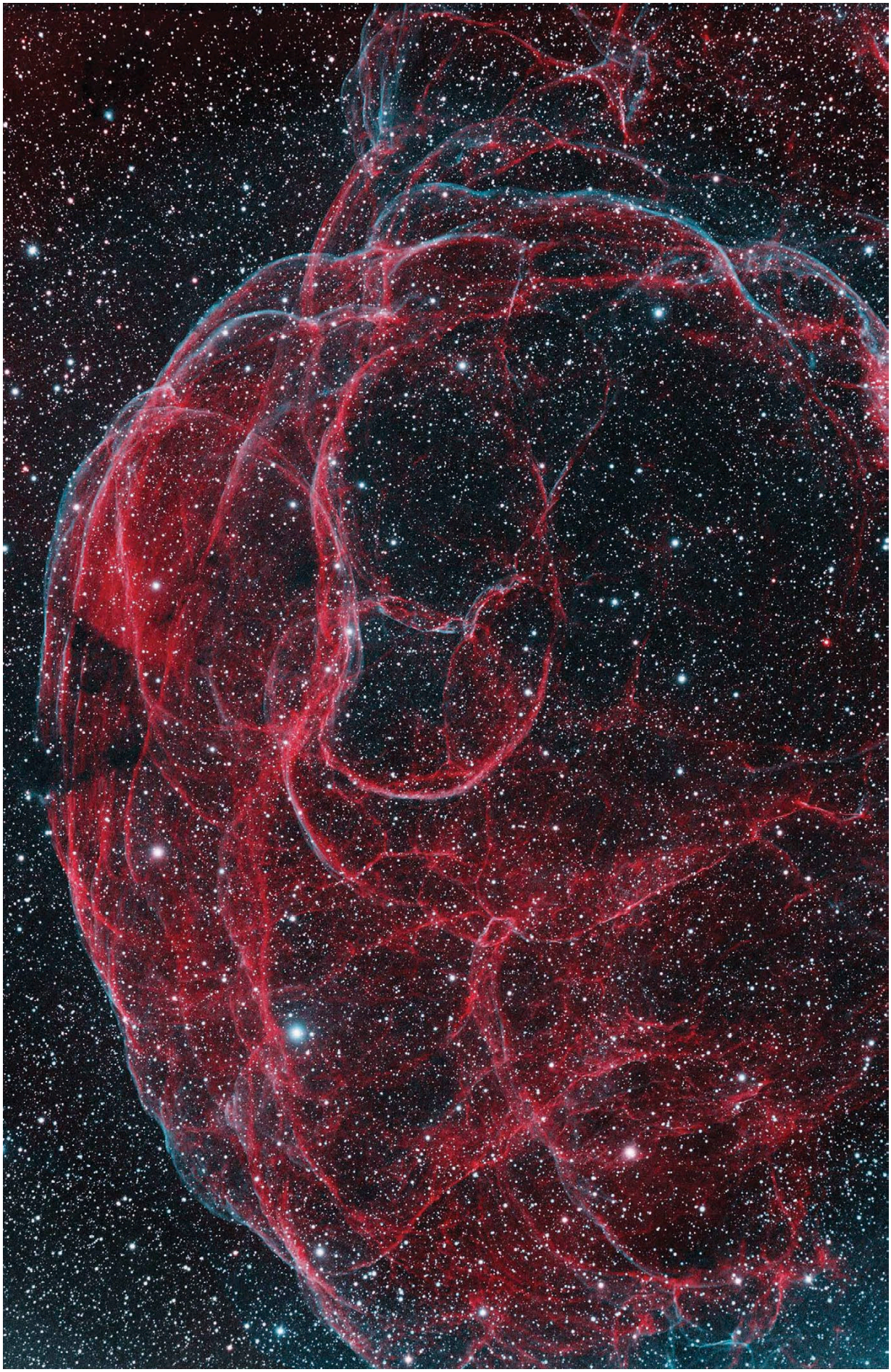
IC 410 by Rolondo Garcia on Jan 2

IC 405, Flaming Star by Rolando Garcia on Jan 12

Spider and Fly by Stephen Garretson on Jan 15



SH 2-171 in SHO by Tally O'Donnell on Jan 12



SH 2-240 in HOO by Tally O'Donnell on Jan 9

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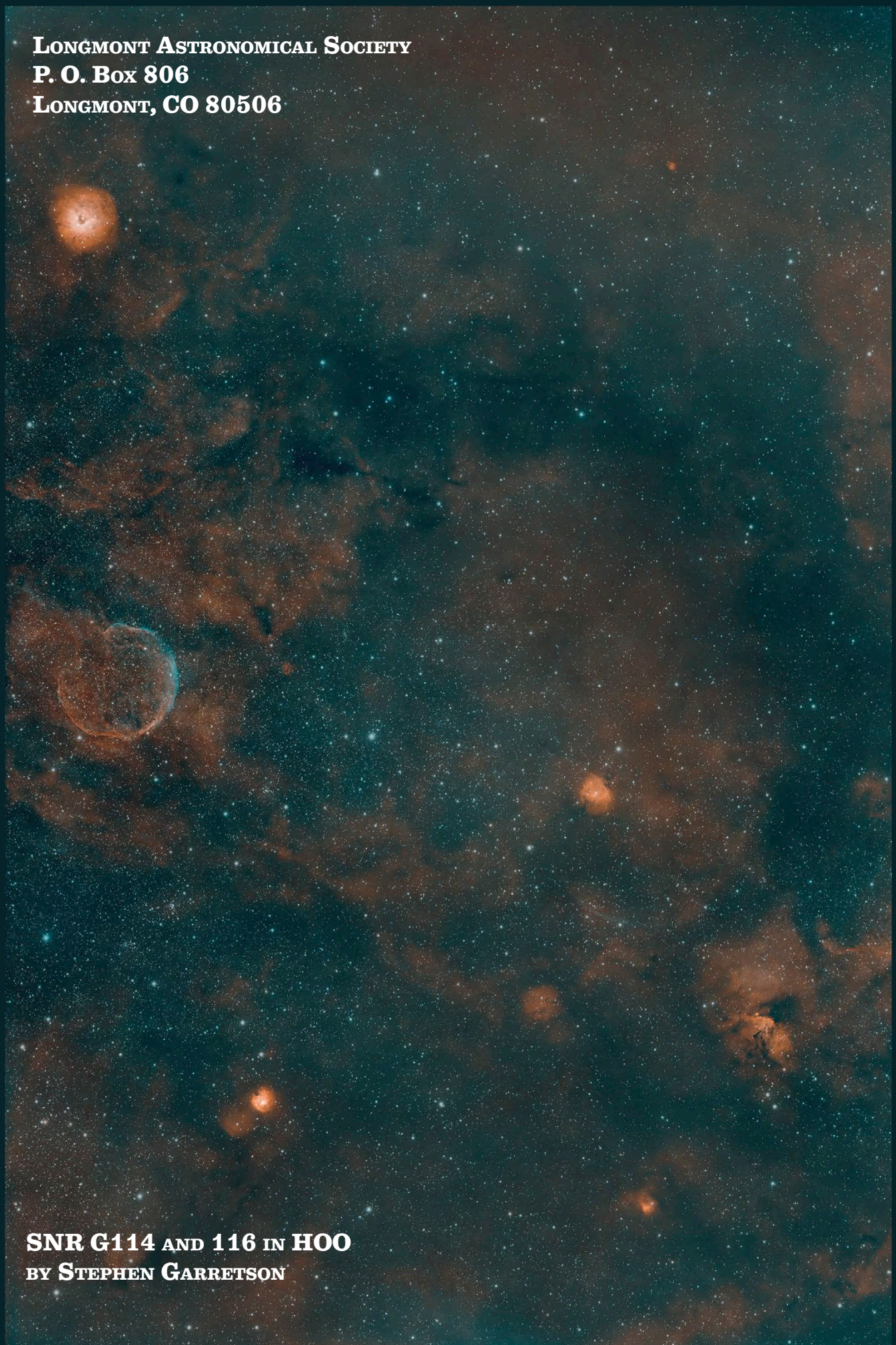

SNR G114 and 116 in HOO
by Stephen Garretson