SkyWAAtch

The Newsletter of Westchester Amateur Astronomers

October 2020

Pelican Nebula (IC 5070 and 5067) by Olivier Prache

Imaged from Olivier's observatory in Pleasantville. Borg 101ED and ZWO ASI071MC one-shot-color camera using an Optolong L-Enhance filter. Three hours of five-minute subs (unguided) and a bit of work with PixInsight.

WAA October Meeting

Friday, October 2 at 7:30 pm

On-line via Zoom

Intelligent Nighttime Lighting: The Many Benefits of Dark Skies

Charles Fulco

Science educator Charles Fulco will discuss the methods and many benefits of reducing light pollution, including energy and tax dollar savings, health benefits and of course seeing the Milky Way again. Invitations and log-in instructions will be sent to WAA members via email.

Starway to Heaven

Ward Pound Ridge Reservation, Cross River, NY

Scheduled for Oct 10th (rain/cloud date Oct 17). On-site screening, masks and social distancing required.

WAA Members: Contribute to the Newsletter!
Send articles, photos, or observations to
waa-newsletter@westchesterastronomers.org

Editor: Larry Faltz
Assistant Editor: Scott Levine
Almanac Editor: Bob Kelly
Editor Emeritus: Tom Boustead

Also In This Issue

3	Almanac (Bob Kelly)
5	Member Profile
6	In the Naked Eye Sky (Scott Levine)
7	Keplerian Orbital Elements (Robin Stuart)
11	Observing Report (Steve Bellavia)
12	Fire and Astronomy (Larry Faltz)
14	Deep Sky Object of the Month
15	Mars in October
16	IC 1295 Challenge (Larry Faltz)
20	Images by Members
25	Research Finding of the Month
26	Equipment Classified

WAA November Meeting

Friday, November at 6 7:30 pm

On-line via Zoom

BLACK HOLES: Not so black?

Willie Yee

Recent years have seen major breakthroughs in the study of black holes, including the first image of a black hole from the Event Horizon Telescope and the detection of black hole collisions with the Laser Interferometer Gravitational-wave Observatory. Dr. Yee, a NASA Solar System Ambassador and Past President of the Mid-Hudson Astronomical Association, will review the basic science of black holes and the myths surrounding them, and present the recent findings of these projects.

Call: 1-877-456-5778 (toll free) for announcements, weather cancellations, or questions. Also, don't forget to visit the WAA website.

New Members

Elizabeth Coppola	Mt. Kisco
Charles Fulco	Millsboro, DE
Jennifer Gileno	Brewster
Balavenkatesh Kanna	Scarsdale
Steve Tinsley	Scarsdale

Renewing Members

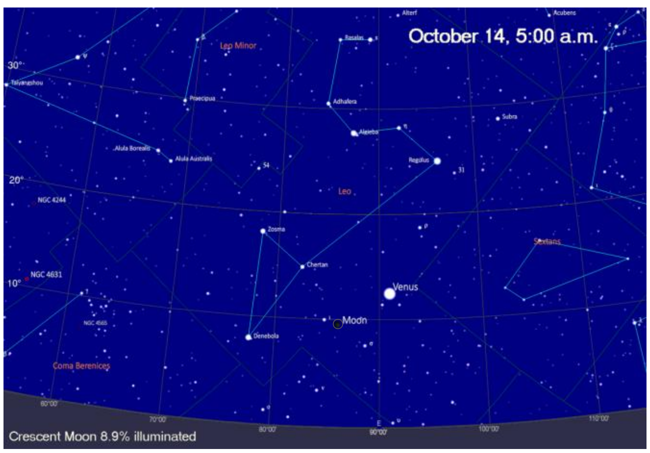
Walter Chadwick	Cold Spring
Peter Germann	Katonah
Kim Hord	Dobbs Ferry
Jeffrey Jacobs	Rye
Penny Kelly	Wappingers Falls
John Lasche	Hastings on Hudson
Emmanouil Makrakis	Scarsdale
Beth Propper and Ava Rubin	Irvington
Neil Roth	Somers
William Rothman	Bronxville
Alan Struth	Irvington
Harry Vanderslice	Copake
Cliff Wattley	Danbury, CT
Roger Woolcott	Brewster

ALMANAC For October 2020
Bob Kelly, WAA VP for Field Events

Full	3Q	New	1Q	Full
10/1	10/9	10/16	10/23	10/31

Boo! Fear the change from daylight time to standard time late Halloween night! Sunday, November 1st at 2 a.m. we'll "fall back" to 1 a.m. and lose the "extra" hour of morning darkness we've been using to be dazzled by the light of Venus. Sunrise moves from 7:25 a.m. EDT on the 31st to 6:26 a.m. EST on the 1st.

There are two full **Moons**[1] this month, on the 1st and then on 31st, just in time for Halloween. Both will look a tad[2] smaller than usual as the Moon is farthest from Earth on the 3rd and the 30th. The full Moon on the 30th is the smallest for 2020.



I've never been a big fan of almanacs that list close encounters between the Moon and faint objects. It's fun to know **Pluto** is 2.4 degrees from the Moon on the 22nd, but the Moon's glare drowns out faint objects nearby. We can use the Moon as a pointer to bright objects. Our Moon passes Venus in the morning on the 13th/14th, scooting under Leo. The moon is a sliver, rising due east just after 4 a.m., preceded by Venus. After flipping to the evening sky, the 24-hour-old Moon hides low with Mercury on 17th. Luna sits between Jupiter and Saturn on the 22nd. Mars gets two visits from the Moon, on the 2nd and 29th. These can be good photo ops. In other close encounters, Venus and Regulus are less than a degree apart on the 2nd.

My favorite lunar phase is when the Moon is up all morning. This month the best view is on the morning of the 8th. See it before sunrise, or see it in the morning sunlight, high up in our sky. We get another chance to peek across Mare Orientale during the crescent Moon phase before sunrise on the 13th.

The evening sky hosts **Mercury** through the 20th. Mercury gets a good 26 degrees from the Sun on the 1st, only 2 degrees from its greatest possible elongation, but it doesn't gain much altitude. It's a better view from the southern hemisphere. Check out the Solar and Heliospheric Observatory's (SOHO)[3] view of Mercury when it is in conjunction, between us and the Sun, on the 25th.

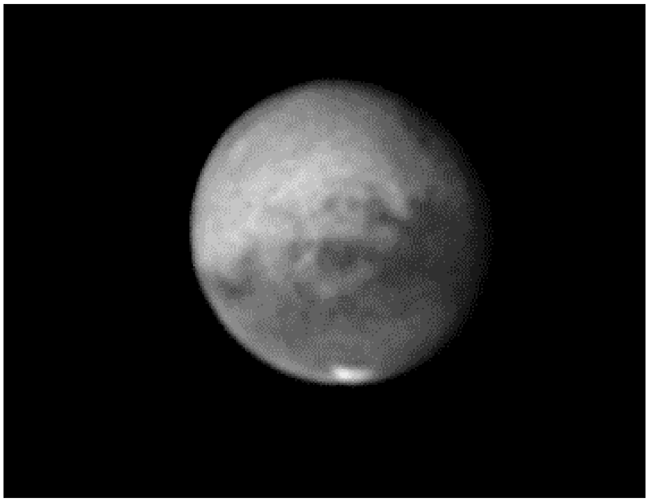
Venus is in the morning sky, its brightness fading somewhat but still brilliant at magnitude -4.0. It's about 1 AU distant, moving away from us and appearing more gibbous in telescopes. The morning star is starting its cycle toward the Sun from our view, elongation decreasing from 40 to 35 degrees this month. There's still plenty of room to follow it into daylight. I was surprised how small it was in the scope; it's a third smaller than Mars.

The long-awaited 2020 opposition of **Mars** is on the 13th, following its closest approach on the 6th. Mars rises at sunset, but it gains altitude rapidly, putting those other outer planets to shame. Peaking at magnitude -2.6, it's now the second-brightest planet in our skies. At opposition, it will be around 0.42 astronomical units (AU), about 39 million miles, from us. No other planet gets closer to Earth for the rest of 2020. I guess Mars didn't get the social distancing memo. Use any good telescope to see a tiny disk with mostly subtle shadings. It'll still have more surface detail than you can see on any other planet. Future oppositions will be farther away from Earth than this one. See page 9 of the September 2020 SkyWAAtch for Mars observing hints.

[1] The second full moon of the month is commonly referred to as a "Blue Moon." For a full explanation of this appellation, see page 10 of the September 2015 SkyWAAtch.

[2] A tad, in this case, is about 2 arc minutes, or about 6% of an average Moon size.

[3] https://www.nasa.gov/mission_pages/soho/the-sun-daily/index.html

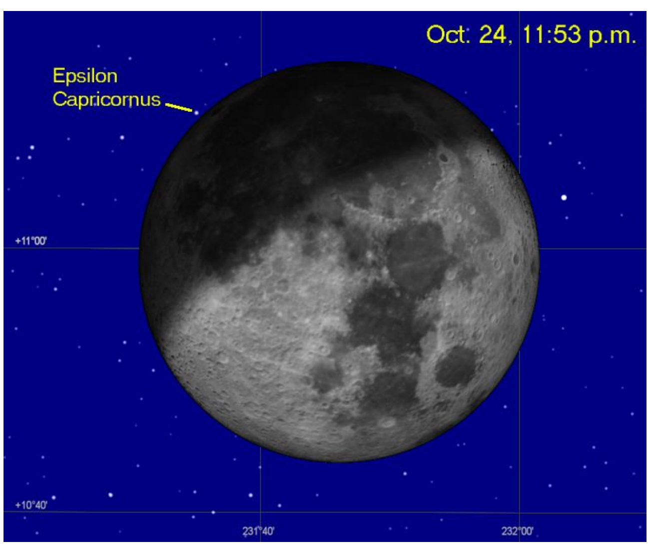


Mars on September 20th (8” SCT, 2X Barlow) (LF)

Jupiter peaks at 26 degrees altitude at 6:40 p.m. EDT at mid-month. **Saturn** follows to peak in the southern sky a half-hour after its big brother. Jupiter and Saturn are moving closer to each other as they approach the Great Conjunction on December 21st.

Uranus reaches opposition on the 31st. It’ll peak at magnitude +5.7. Have you seen it without optical aid? Don’t try on a night when the Moon is pointing to it (yeah, actually on the 31st!). Let us know what color you see in a telescope. Knowing that the north pole of Uranus is tipped 50 degrees toward us and the planet appears to roll on its side might help you envision subtle bands in the planet’s atmosphere.

Neptune is already up after sunset in Aquarius.



The best **lunar occultation** of the month is when the Moon’s dark limb blocks out magnitude +4.6 Epsilon Capricornus on the 24th, at 11:54 p.m. EDT. The leading edge of the Moon will be at only 11 degrees elevation, in the southwest. You’ll need a telescope of binoculars to see the star.

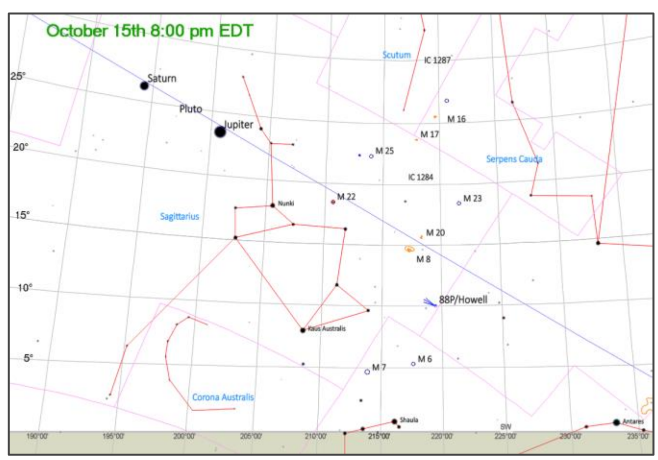
We have two **meteor showers** ahead of us this month: The Orionids may produce 10 to 20 meteors an hour at their maximum on the morning of the 21st. That will be a Moon-free morning. These are fast meteors, ejecta from Comet 1P/Halley (yes, *that* Halley). Gone are the days (e.g., 2006-2009) when the peak rates rivaled the Perseids. The Draconids will peak on the 8th at 1 a.m., the but last quarter Moon will drown out the 10 or so meteors per hour.

The new **solar cycle** is underway, meaning the Sun may climb out of its deep solar minimum. No sunspots have been reported since mid-August, however. But they’re coming.

The **International Space Station** shines brightly as it sails over us across the evening skies through the 10th, and in the morning starting on the 20th.

The Association of Lunar and Planetary Observers calls Comet **C/2020 F3 NEOWISE** the “Really Good Comet of 2020”. I agree. It gave us a chance for some nice views and good photos, as seen in last month’s SkyWAAtch. NEOWISE will continue its rapid fade from 9th to 12th magnitude this month in Libra, not far from Mercury in the sky. Goodbye, and thanks.

Comet **88P/Howell** reached perihelion on the 28th of September. It’s near the horizon in Ophiuchus, at magnitude +9, passing through the Teapot’s cover later in the month.



Finder chart for Comet 88P/Howell on October 15th

Member Profile: Alex Mold

Home town: Salem MA

Family: Single at the moment

How did you get interested in astronomy? I was about five and was visiting my aunt near Flagstaff, Arizona. I was up late that night and my dad brought me outside to look at the stars. I have yet to see a sky as clear as it was that night.

Do you recall the first time you looked through a telescope? What did you see? I probably looked at some stars. I did not actually look through many telescopes until last year when I finally bought one. The first object I looked at with it was Jupiter and its moons.

What's your favorite object(s) to view? I love planets and moons. It is fascinating when I can see some surface coloration on the moons of Jupiter. I also really like comets, having seen one for the first time recently.

What kind of equipment do you have? I have a Celestron 70-mm refractor travel scope and an Orion 127-mm Mak-Cassegrain. I love both as they are easy to set up and have great optics. I also have an 8-24-mm zoom eyepiece that removes the hassle of changing lenses.

What kind of equipment would you like to get that you don't have? I am considering a planetary camera and/or a hydrogen alpha telescope. But I am happy with the telescopes I have at the moment.

Have you taken any trips or vacations dedicated to astronomy? Tell us about them. I lived in Grenada for two years and during that time I started to learn some of the constellations. Ir was during this time that I realized I wanted a telescope. There was also a funny vacation I took with some friends to the middle of nowhere in Maine. We drove eight hours to get there only for it to rain. Since then we've called any night "more stars than Maine." Last November I went to Cherry Springs, PA. That was actually the first time I saw the Orion Nebula and I could see a slight green coloration through the eyepiece.

Are there areas of current astronomical research that particularly interest you? I do not commonly read astronomical research, but I have a few textbooks from my college astronomy course that I occasionally glance at.

Do you have any favorite personal astronomical experiences you'd like to relate? For me, any night out is always great. My favorite "everything went wrong night" was actually my first star party when clouds blocked most viewing but there were so many fireflies illuminating the fog. It was such a pleasant surprise.

What do you do (or did you do, if retired) in "real life"? I am currently finishing my MD/MPH which should be finished by next year.

Have you read any books about astronomy that you'd like to recommend? *A Man on the Moon: The Voyages of the Apollo Astronauts* by Andrew Chaikin. It is actually my favorite book because of how well it is written and researched. I also liked *Rare Earth: Why Complex Life Is Uncommon in the Universe* by Peter D. Ward.

How did you get involved in WAA? I went to a star party in June 2019 and realized I found a reasonably dark place to use a telescope. I must have signed up in July of 2019.

What WAA activities do you participate in? I went to the annual meeting in September and I did a few outreach activities including the Transit of Mercury. Mostly I go to star parties and show people what I am looking at.

Besides your interest in astronomy, what other avocations do you have? I like reading and cooking. ■

In the Naked Eye Sky

Scott Levine

One of my favorite things to do under the night sky is to track down small groups of unrelated stars, pairs or trios usually, that I think look neat alongside each other. You're right: I'm great fun at parties.

I'm not talking about binary pairs, or even optical binaries like Mizar and Alcor, the stars-slash-vision-test near the end of the Big Dipper's handle.

An easy set you can check out in summer and fall are the dynamic duo of Altair and Tarazed, the two brightest stars in Aquila. And who can forget the excitement of staring out at Libra's flamboyantly named Zubenelgenubi and Zubeneschamali, as spring hands the night off to summer?

October is here now, and much of the southern sky seems dim and spare. This time of year, that patch of sky is filled in with the faint stars in the deep, dark ocean of the sky's water constellations: Aquarius, the water bearer, and Capricornus, that weird sea-goat thing. Even Mars is getting in on the fun and is taking a break from all the warring with some time spent fishing in Pisces.

That apparent emptiness, though, brings out another one of my favorite pairs of stars.

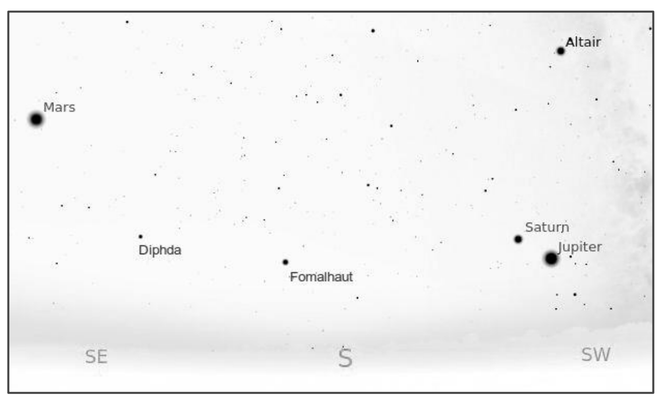
Fomalhaut is the southernmost first-magnitude star that we can see here in the northern hemisphere. From our point of view, it's always low in the sky, never more than about 20 degrees above the horizon. In mid-October, it culminates—reaches its highest point and is most visible—at around 10 PM.

From the Arabic for "Mouth of the Whale," even though Piscis Austinus represents the southern fish (not to be confused with Pisces, the directionally agnostic fish), Fomalhaut is a triple-star system about 25 light-years away and has a bit of an interesting history in the exoplanet game. In 2008, astronomers discovered what they thought was an exoplanet in a 1,700-year orbit around Fomalhaut, and eventually even directly imaged it. There's been some back-and-forth, though, about whether it's a planet at all.[1]

Speaking of whales, about 25 degrees to the east of Fomalhaut is Diphda, the brightest star in Cetus. Cetus is the mythological sea monster from whom Perseus saved Andromeda. The constellation's name comes from the same Latin root that gave us the word Cetacean, describing the order (*Cetacea*) of mammals that includes whales. Diphda's name comes from Arabic and means "frog." It's also called Deneb Kaitos, which, in keeping with the whale idea, means the "Whale's Tail." Diphda is about 95 light-years away and culminates a little higher than Fomalhaut, so maybe it will be a little easier for you to see.

To find the pair, just head out and look toward the south to find Mars in the southeast along with Saturn and Jupiter toward the southwest. The imaginary line between them is the ecliptic – the path the Sun takes across the sky, which also represents the plane of the solar system. Then look for the two brightest stars between that line and the horizon. Fomalhaut is sometimes called the "loneliest star" because there are no other bright stars near it. Cetus is a terrific sight alongside it.

This area may seem like a barren stretch of sky, but Fomalhaut and Diphda are worth looking for in the dark seas of the southern sky this month. I hope you'll have a look.



Scott Levine's astronomy blog, *Scott's Skywatch*, can be found at https://scottastronomy.wordpress.com/ or email him at astroscott@yahoo.com Scott's articles can also be seen in *Sky & Telescope*. His latest posting is https://skyandtelescope.org/astronomy-news/see-beyond-celestial-sphere-follow-these-lines-into-space/

[1] See the "Research Finding of the Month" in the June 2020 SkyWAAtch for more information.

The Keplerian Orbital Elements

Robin Stuart

Kepler's Laws of Planetary Motion

In 1609 the German astronomer and mathematician Johannes Kepler published the first two of his three laws of planetary motion. They utilized the meticulous astrometric observations made by Tycho Brahe at his observatory Uraniborg on the then-Danish Hven Island from 1576 to 1597. These laws state that

1. The planets follow paths that are ellipses, with the Sun at one focus.
2. A line drawn from the Sun to the planet sweeps out equal areas in equal time.

In 1619 Kepler added his third law

3. The ratio of the square of the orbital period to the cube of the semi-major axis is the same for all the planets.

Figure 1 shows an example of a possible elliptical orbit although for emphasis it is drawn far more eccentric than the actual orbits of any of the major planets. The Sun is at the point, *S*.

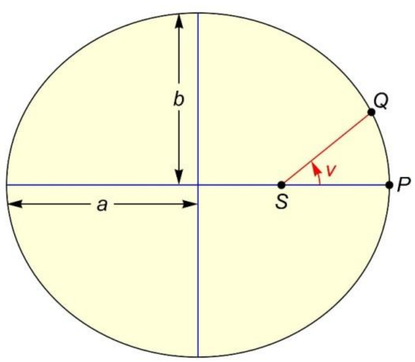


Figure 1: An elliptical orbit with semi-major axis, a, and semi-minor axis, b. The Sun, S, lies at a focus of the ellipse and the position of the planet is at point Q. The point P is the perihelion. The angle ∠PSQ is the true anomaly, ν.

The elegant simplicity of Kepler's laws belies their great power and reach. The semi-major axis of the Earth's is, by definition, 1 astronomical unit (AU) and its orbital period is 1 year. In these units, for all solar system bodies the ratio referred to in the 3rd law is also 1. In 1621 Kepler noted that his 3rd law also applied to the four Galilean satellites of Jupiter but with a different ratio.

In 1687 Isaac Newton showed that Kepler's laws follow from his own laws of motion and universal gravitation. As it turns out, the second law does not depend on the inverse square nature of gravity. It is a consequence of the conservation of angular momentum and is true for any central force. Newton's analysis yields an expression for the ratio in Kepler's 3rd law in terms the universal gravitational constant, *G*,[1] and the total mass of the system. This in turn allows the mass of any planet with satellites to be determined from observation, expressing it in units of the mass of the Sun.

Newton's laws describe the motions of the planets in terms of *differential equations*. To solve them it is necessary to specify a set of *initial conditions*. In principle, if at some time, t_0, you know the position $\vec{r}_0$ and velocity $\vec{v}_0$ of a body orbiting the Sun, then the equations can be used calculate the body's position at any time in the future. In fact this is precisely how the NASA's high precision ephemerides (https://ssd.jpl.nasa.gov/?ephemerides) are generated. The initial conditions for significant bodies are inputted into a massive simulation that "integrates the solar system." The resulting numbers are extremely accurate and can be used for piloting spacecraft or telling a GoTo mount where to point, but they are not very informative to a human being wishing to interpret the numbers. We do learn however that since the initial conditions are represented by the vectors $\vec{r}_0$ and $\vec{v}_0$ inthree-dimensional space (each having three components) an orbit has six degrees of freedom and requires six numbers to fully specify it.

Keplerian Orbital Elements

The *Keplerian Orbital Elements* are six numbers that specify all the properties of orbits that are consistent with Kepler's laws. They lend themselves much more readily to human understanding and interpretation. They can also be used to compute the positions of solar system bodies when very high precision is not required.

Keplerian Orbital Elements can be naturally divided into two groups of three values each. The first group describes the properties of the elliptical orbit itself and the location of the planet along it at some speci-

[1] For more on *G*, see "Weighing the Earth" in the December 2018 SkyWAAtch.

fied time. The other group describes the orientation of the ellipse in three-dimensional space.

Elliptical Orbits

Figure 1 shows an elliptical orbit with the Sun at a focus. The shape and size of the ellipse is given by the lengths of the semi-major and semi-minor axes, denoted *a* and *b* respectively. The eccentricity is defined as $e = \sqrt{1 - b^2/a^2}$ and is a measure of how flattened or elongated the ellipse is. Its value ranges from 0 for a circle up to 1. The Sun is at a focus of the ellipse, offset from the center by a distance $a \times e$.

In Figure 1 the point *P* is the perihelion or point of closest approach to the Sun. The angle ν, measured from perihelion to the planet, is called the true anomaly. It varies with the location of the planet in its orbit.

Clearly the quantities *a*, *e* and ν fully determine the size and shape of a planet's orbit and its position along it. The next step is to specify the spatial orientation of the orbit itself. This requires a well-defined reference system. By convention this is done with respect to the *plane of the ecliptic* and the direction of the *First Point of Aries*. The plane of the ecliptic is the plane defined by the Earth's orbit in space. The First Point of Aries is one of the two points where the ecliptic crosses the celestial equator. As viewed from the Earth, it is the direction of the Sun at the vernal equinox, in March.

As the Earth's axis of rotation slowly *precesses* about the pole of the ecliptic, the direction of the First Point of Aries migrates westward along the ecliptic plane at a rate of about 1.4° per century. In fact it currently lies in the modern constellation of Pisces some 30° away from where it was when defined by Hipparchus in 129 BC! Consequently the reference directions conventionally used to define the orientation of an orbit in space vary with time. For complete precision, therefore, they need to be assigned a "date stamp". This is the *epoch of the coordinate system* and at present J2000.0 is the standard.

Figure 2 shows a planet's orbit as it is located in 3D space. The gray disc represents the plane of the ecliptic and the direction of the first point of Aries is indicated by the symbol ♈. Three angles *i*, Ω and ω parameterize the orbit's orientation. The inclination *i* gives the tilt of the planet's orbital plane relative to the ecliptic. The inclination of the Earth's orbit is zero by definition. The ascending node, denoted ☊, is the point in its orbit where the planet crosses the plane of the ecliptic when moving from south to north, hence "ascending". Its direction measured from the First Point of Aries is called the *longitude of the ascending node*, Ω. The *argument of perihelion*, ω, specifies how far around the orbit the perihelion point, *P*, lies from the ascending node.

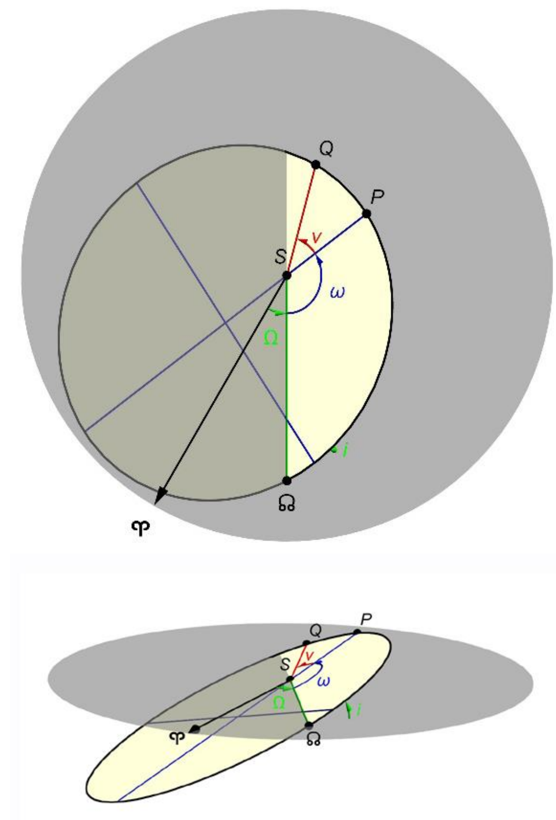


Figure 2: Two views, from different vantage points, of the elliptical orbit of Figure 1 oriented in space with respect to the plane of the ecliptic, represented in gray, and the direction of the First Point of Aries, ♈. The ascending node, ☊, is the point where the orbit crosses plane of the ecliptic. The longitude of the ascending node, Ω, is the angle ∠♈S☊ measured in the plane of the ecliptic. The argument of perihelion, ω, is the angle ∠☊SP and is measured in the orbital plane as is the true anomaly, ν. The inclination, i, specifies the orbit's tilt with respect to the ecliptic.

Given the six quantities *a*, *e*, ν, *i*, Ω and ω at some time or *epoch*, τ, the location of the planet in space can now be computed. Combine this with the corresponding calculation for the Earth and you know where to find it in the sky.

All the major planets orbit in nearly circular orbits close to the plane of the ecliptic. Orbital eccentricities, e, range from 0.07 for Venus to 0.2 for Mercury. Mercury's orbital inclination, around 7°, is the greatest of the planets. A table of solar system inclinations and orbital eccentricities is given on page 10.

The orbital elements are constants with the exception of the true anomaly ν, which is zero at perihelion and increases with time as the planet moves around its orbit. To calculate a planet's position at a different epoch, only the true anomaly needs to be updated. As can be gleaned from Kepler's second law, the time dependence of ν is fairly complicated. To simplify matters, a quantity called the *mean anomaly* at epoch, M_0, is quoted instead. This advances at a uniform rate in time from 0° at perihelion toward 360° at the completion of one orbit. The formula for calculating the mean anomaly M at time t is

$$M = M_0 + n(t - \tau) = M_0 + \frac{360°}{a^{½}}(t - \tau)$$

where n is the planet's *mean motion* (360° divided its orbital period). In the equation, Kepler's 3rd law has been used to eliminate the period in favor of a. From M and the eccentricity, e, standard procedures allow ν to be computed.[2]

A quick look at NASA's Solar System Dynamics website https://ssd.jpl.nasa.gov/?sb_elem reveals that the quoted orbital elements for asteroids are indeed a, e, i, M_0, ω and Ω. Additional redundant quantities such as the orbital period may also be given.

These elements could be used to describe the orbits for the major planets as well but instead, a different set of six values, a, e, i, L_0, ϖ and Ω, are quoted. The new elements, *mean longitude at epoch* L_0 and *longitude of perihelion* ϖ, are simply related to M_0 and ω through the relations

$$\varpi = \omega + \Omega \quad \text{and} \quad L_0 = M_0 + \omega + \Omega = M_0 + \varpi.$$

The justification for adopting these parameters appears to be lost in the mists of time. The elements, L_0 and ϖ are constructed by adding together angles that lie in different planes and therefore cannot have any real geometric significance. They only become meaningful for orbits that lie in the ecliptic plane, i = 0. This is approximately true for the major planets and may be what motivated this rather baroque convention.[3] Tables that list these orbital elements along with the formulas needed to compute planetary positions from them can be found at https://ssd.jpl.nasa.gov/txt/aprx_pos_planets.pdf.

Comets can follow very elongated elliptical orbits with periods of thousands of years. The semi-major axis a and mean anomaly at epoch M_0 provide little useful insight into the nature of the orbit which we only observe near to the Sun. For these transitory visitors it is more meaningful to replace a and M by the perihelion distance q and time or *epoch of perihelion* passage T_0. Of course two sets of parameters furnish the same information but the latter is in a form that is easier for human interpretation. They are related by

$$a = \frac{q}{1 - e}$$

$$M = \frac{360°}{a^{½}}(t - T_0) = 360°\left(\frac{1 - e}{q}\right)^{\frac{3}{2}}(t - T_0)$$

Osculating Elements

In practice no body in the solar system executes the perfectly elliptical orbit in the manner described Kepler's three laws. The mutual gravitational tug between the Sun's cohort of planets and their satellites, among other effects, give rise to perturbations that cause orbits and corresponding orbital elements to slowly change over time. The orbital elements quoted by the sources referenced above are *osculating elements,* from the Latin *osculare* meaning "to kiss". Osculating elements are quoted for a particular *epoch*, τ, that specifies the instant in time at which they are exactly valid. The precise position $\vec{r}_0$ and velocity $\vec{v}_0$ of the body can be computed at the epoch using Kepler's laws. Over a time interval around the epoch the orbital elements provide an approximation to the true position with decreasing accuracy as the interval increases.

Parabolic and Hyperbolic Orbits

The foregoing discussion has described elliptical orbits that apply to objects that are gravitationally bound to the Sun do not have sufficient total energy to escape its grip and fly off into interstellar space. Objects that originate from outside the solar system

[2] The procedures involve solving "Kepler's Equation" for the eccentric anomaly, E, which can then be used to compute ν via a closed form expression.

[3] The author thanks George Kaplan for suggesting this as the possible background.

do not travel on closed elliptical orbits around the Sun but rather follow hyperbolic trajectories. A parabolic orbital is transitional between elliptic and hyperbolic. These three types of orbits are all special cases of *conic sections,* so named for their classical geometrical representation. All three types have the Sun at a focus and can be characterized by an eccentricity, e, and perihelion distance, q. As noted earlier, for elliptical orbits, $e < 0$. For hyperbolic and parabolic orbits, $e > 0$ and $e = 0$ respectively. 'Oumuamua in 2017 and Comet Borisov in 2019 betrayed their interstellar identities by having orbital eccentricities of 1.2 and 3.4 respectively and so received the designations 1I and 2I from the International Astronomical Union (IAU) where "I" stands for "Interstellar."

The calculation of the position of a body in a parabolic or hyperbolic orbit from Keplerian Orbital Elements is formally rather similar to the elliptical case. For hyperbolic orbits there is a parameter, M, analogous to the mean anomaly but it lacks an obvious geometric interpretation.

The reader interesting in learning more how ephemerides are calculated for the various types of orbits is directed to J. Tatum's article *The calculation of comet ephemerides*, Journal of the Royal Astronomical Society of Canada **76** (1982) 157-167. http://articles.adsabs.harvard.edu//full/1982JRASC..76..157T/0000157.000.html. An excellent reference on the topic of orbital elements and all things astronomical is W. M. Smart's *Textbook on Spherical Astronomy*, https://archive.org/details/SphericalAstronomy.

		Inclination	Eccentricity
Terrestrials	Mercury	7.01°	0.206
	Venus	3.39°	0.007
	Earth	0	0.017
	Mars	1.85°	0.093
Gas giants	Jupiter	1.31°	0.048
	Saturn	2.49°	0.056
	Uranus	0.77°	0.046
	Neptune	1.77°	0.01
Minor planets	Pluto	17.14°	0.248
	Ceres	10.62°	0.075
	Pallas	35.06°	0.231
	Vesta	5.58°	0.088

The Editor adds:

With the orbital elements of all of the planets and other major solar system bodies already programmed into our hand controls and planetarium programs, why might we need to know orbital elements today, besides knowing the basics of celestial mechanics?

Software such as *Cartes du Ciel* allows to you easily download the most recent orbital elements for comets and asteroids, the bodies most likely to be perturbed gravitationally and thus need periodic updating. The data is kept by NASA and the Minor Planet Center at the Harvard-Smithsonian Center for Astrophysics. But if you wanted to find the position of a *very* minor planet that's not included in the routine download,[4] you can manually input the six values.

For example, in July 2019 the author Dava Sobel was the guest at the Medomak Astronomy Retreat in Maine. Dava and I were classmates from 2nd to 12th grade and I was asked to introduce her to the attendees. I figured it would be nice not only to mention that she had an asteroid named after her, *30935 Davasobel*, but to see if it was visible.

To get the information, you go to the NASA/JPL Solar System Dynamics web site.[5] You put in the name of the target and select a couple of display and calculation options. A table is generated with the elements that Robin described in his article (you have to find them among some other parameters).

```
JPL/HORIZONS              30935 Davasobel (1994 AK1)        2019-Jul-18 20:28:51
Rec #:   30935 (+COV) Soln.date: 2018-Oct-03_18:52:10    # obs: 844 (1994-2018)

IAU76/J2000 helio. ecliptic osc. elements (au, days, deg., period=Julian yrs):

  EPOCH=  2456504.5 ! 2013-Jul-31.00 (TDB)         Residual RMS= .28594
   EC= .1175060784127907   QR= 1.679933039510956   TP= 2456205.1619869592
   OM= 294.1596445030986   W=  230.7945409248801   IN= 27.8160541612363
   A= 1.903619955239479    MA= 112.3299517404463   ADIST= 2.127306870968003
   PER= 2.62651            N= .375261222           ANGMOM= .023569609
   DAN= 2.02796            DDN= 1.74754            L= 161.4739486
   B= -21.1977372          MOID= .74545199         TP= 2012-Oct-04.6619869592

Asteroid physical parameters (km, seconds, rotational period in hours):
   GM= n.a.                RAD= 1.204              ROTPER= 3.9769
   H= 14.5                 G= .150                 B-V= n.a.
                           ALBEDO= .581            STYP= n.a.
```

In *Cartes du Ciel*, you simply add an asteroid to the database. A dialog box appears in which you enter the data generated by the web program. Note that the values are good to between 13 and 15 significant digits!

CdC plotted the asteroid's exact position in Andromeda. The only problem with finding Dava's asteroid that night was that the tiny 1.2-km body was fainter than 18th magnitude! ■

[4] *Cartes du Ciel* defaults to downloading about 5000 asteroids and 1100 comets. Newly discovered comets are added to the MPC's list soon after detection.
[5] https://ssd.jpl.nasa.gov/horizons.cgi

Observing Report: Orient Point, August 9, 2020 Steve Bellavia

Editor's Note: Steve joined WAA after giving a talk at our March 2019 meeting. An aerospace engineer, he has been at Brookhaven National Laboratory since 1992 and is the principal mechanical engineer on the camera sub-system for the Large Synoptic Survey Telescope (now the Vera Rubin Telescope) in Chile. Steve is a prolific astrophotographer (you've seen a number of his fine images in recent issues of SkyWAAtch), a skilled telescope maker with several Stellafane awards and a member of several amateur astronomy organizations. He works closely with the Custer Institute on Long Island's North Fork. His darkest local sky is at Orient Point, the easternmost tip of the North Fork.

The Editor encourages other WAA members to submit observing reports to SkyWAAtch.

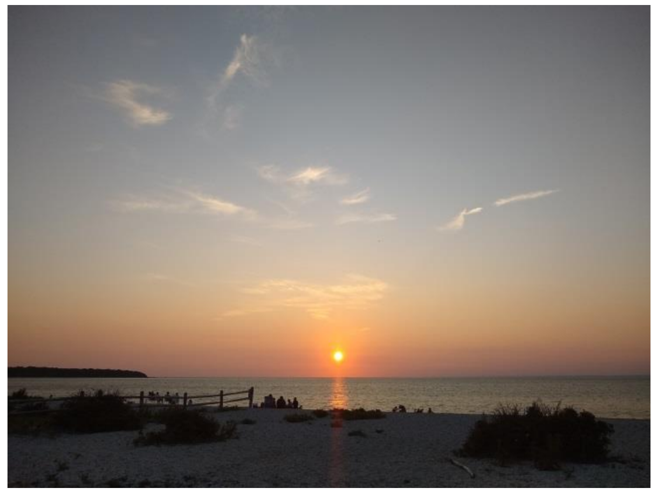
I decided to leave all the cameras, computers, and my tracking mount at home, and instead grabbed the mighty little Celestron C5 SCT ("Boomer") and my Explore Scientific Twilight I alt-az mount. The only thing electrical was the dew strip and the light for the reticle in the unity magnification reflex sight.

I used three eyepieces:

- 9-mm 1.25" Zhumell planetary: 55 deg AFOV (139X , 0.4 degrees actual FOV)
- 25-mm 2.0" Explore Scientific: 70 deg AFOV (50X, 1.4 degrees actual FOV)
- 32-mm 2.0" Arcturus: 70 deg AFOV (39X, 1.8 degrees actual FOV)

I tried using my Televue 17-mm Nagler, but it made everything too dim because of its small exit pupil.

Although seeing was predicted to be "below average," it was better than that, perhaps 4/5. The transparency was also predicted to be "below average," and that proved to be the case. Although I could see the Milky Way, it looked more like how it would look from home, not the usual Orient Point clarity.



Sunset at Orient Point, August 9th

I started in astronomical twilight with Jupiter, aligning my finderscope on it and then looking through the scope. Jupiter had that classic balanced view: two moons on one side (Io, Ganymede) and two on the other (Europa, Callisto), spread out evenly in a perfect straight line. I tried to identify the moons visually, and when I got home and checked on Stellarium I was happy to see I named them correctly. I could easily see the planet's equatorial and temperate belts and a hint of blue festoon. The image was extremely steady.

I then went onto Saturn. It was at a lower altitude, and although the rings and disk were sharp, it was tough to make out Cassini's division. I could see 2 moons, which Stellarium later told me were Titan and Rhea.

Before it was fully dark, I went on to stars, double stars and star clusters, observing at 39X: Albireo, the Coathanger (Brocchi's cluster, Collinder 399), Mizar A/B & Alcor, Nu Draconis (Kuma), Herschel's Garnet star (Mu Cephei), NGC 457 (ET, or Owl Cluster), the Wild Duck Cluster (M11).

My first deep sky objects after twilight ended were globular clusters, starting at 39X and then 50X: M3, M13, M92, M4, M22, NGC 6642 (Tadpole cluster).

I then went on to nebulae, also trying an OIII filter on them: the Ring (M57), Dumbbell (M27) and the Swan (M17). The Swan (or Omega) nebula was the best object of the night, both with and without the OIII filter. Then I looked at the Eastern Veil (NGC 6992) and Western Veil (NGC 6960), both at 39X, but I wish I could have gone even lower in magnification. Then I looked at the Saturn nebula (NGC 7009), tough to find as always. It looks like a star at low power. At 50X you can see an oval green shape, looking similar to the Cat's Eye nebula.

And then on to some galaxies. In Ursa Major, I viewed the cluster of M81-M82-NGC 3077. Fainter NGC 3077 was very difficult to see due to the poor transparency. The group was in the “bad” part of the sky for Orient Point, towards ferry lights to the north. I also looked at the Andromeda galaxy (M31) and NGC 7331 (Deer Lick) in Pegasus.

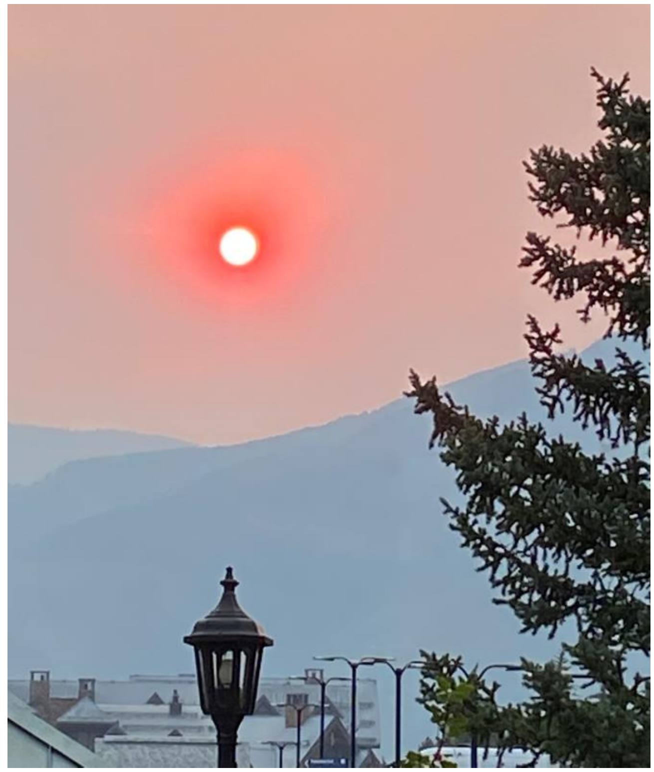
I finished the night searching for the Helix nebula, just before a spectacular orange-red gibbous 20-day Moon rose around 11:15 pm, but I did not find it. When Fomalhaut essentially disappeared to the naked eye, I realized that the transparency had really degraded, especially to the South. From Cherry Springs, I can easily spot the Helix nebula with binoculars. (To me, it looks similar to M33).

Mars was still in the trees when I packed up, so I didn’t get to observe it this night. ■

Steve’s image of the Belt of Venus at sunset from Orient Point on May 20, 2020

Fire and Astronomy

In mid-August, a fire near Glenwood Springs, Colorado filled the air many miles away with sun-blocking particulates, reddening the sky and the sun’s disk, as captured with a cell phone camera by Fred Pack.



Late-summer fires have devastated forests and grasslands throughout the American west. Last year’s Paradise fire in California destroyed 11,000 homes and wiped out an entire town. Lightning strikes from summer “monsoon” storms easily ignite trees and brush dried out from years of climate change exacerbated drought. Even prosaic human activity, like a “gender reveal party” with a “smoke generating pyrotechnic device,” as reported in September, can start a conflagration.

Lick Observatory surveilance camera showing fires approaching on the next hillside, August 20, 2020.

This year's western fires are an order of magnitude greater than last year's, covering an area larger than the entire state of New Jersey and causing destruction, mass evacuations and many deaths

Almost all the professional observatories in the U.S. are on dry western mountains prone to forest fires. A fire nearly reached the Lick Observatory in the mountains east of San Jose in late August. Mount Wilson, near Pasadena, is threatened as of this writing. Three years ago the Frye fire on Mt. Graham in Arizona came perilously close to destroying the Large Binocular Telescope and the Vatican Observatory telescope. Palomar has had some close calls as well.

Frye Fire in June 2017, from the Large Binocular Telescope. Kevin Newton, Tucson.com

In 2011, we were at the summit (8585 ft.) of the Fred Lawrence Whipple Observatory (the largest field installation of the Smithsonian Astrophysical Observatory) at Mt. Hopkins, about 40 miles south of Tucson. As we stood outside the 6.5-meter MMT, the largest telescope on the mountain, a fire started about 25 miles to the south, just over the US-Mexico border. We could see flames even at that distance. Within an hour a thick blanket of smoke obscured the landscape. Fortunately, most of the pollution pushed to the southeast, so when we came back down the mountain to the visitor's center (at 4230 ft.) for dinner and an evening of observing, the sky was reasonably transparent. But a slight aroma of burning cellulose garnished our star party.

April 2011. From Mount Hopkins, looking south (L) and southeast and hour and half later (R). The smoky haze can be seen covering the landscape.

Particulates can reduce sky transparency dramatically many miles away from the fire. Some parts of the centerline of the August 21, 2017 total solar eclipse had less-than-fully-transparent skies and the odor of burning trees permeated the air. Elyse and I had been in Butte, Montana the week before the eclipse. Fires in the mountains 80 miles away made the atmosphere thick with soot. Fortunately, a few days later our view of totality from Victor, Idaho, 180 miles south of Butte, was not affected.

Smoke from this year's massive western fires blanketed the whole country during the second week of September. What should have been "bluebird" skies in Westchester on September 14th-16th were merely pale blue at the zenith and dull grey at the horizon. At Ward Pound Ridge Reservation on the night of the 14th, second magnitude Polaris was barely visible and most deep sky objects were either pale ghosts of their true selves, or not visible at all, even in the Mallincam. The SQM registered 19.62, not the expected 20.45 (the best we can do at Pound Ridge, considering we're 39 miles from Times Square).

We often think that astronomers out west have it made: two hundred clear, dry nights a year, high elevation, few lights. A local forest fire, of which there have been an extraordinary number this year, puts the facilities of professional observatories at considerable risk, not to mention everyone's property and personal safety. And given the intensity of the fires this season, even thousands of miles away atmospheric transparency can be severely degraded. (LF)

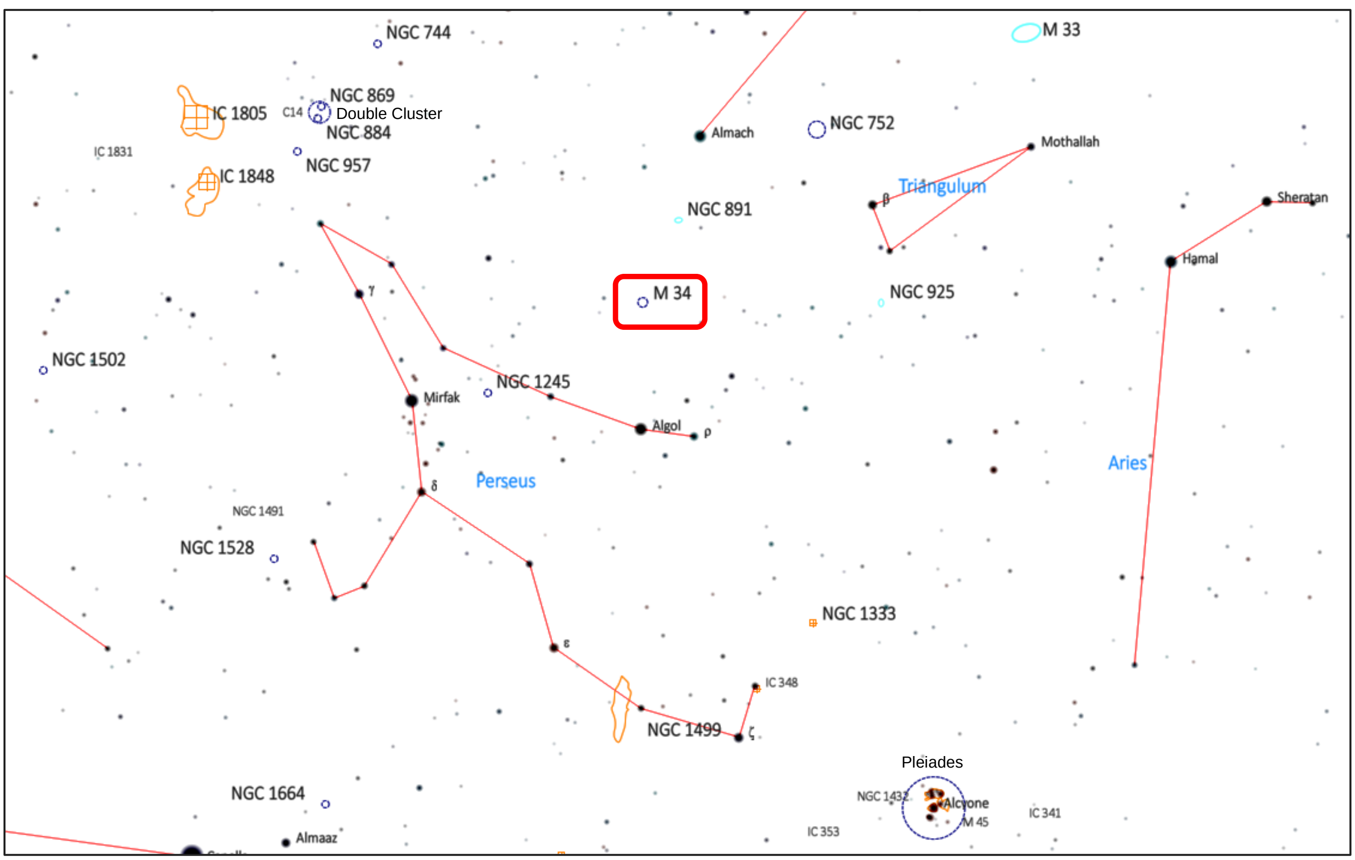
October Deep Sky Object of the Month: Messier 34

Messier 34	
Constellation	Perseus
Object type	Open Cluster
Right Ascension J2000	2h 42m 05.0s
Declination J2000	+42° 45' 42""
Magnitude	5.2
Size	25 arc-minutes
Distance	1,450 LY
NGC designation	1039
Caldwell number	14

This cluster contains perhaps 100 stars, of which at least 19 are white dwarfs. M34 also contains a number of double stars. One of the brightest, Struve 44, has magnitude 8.4 and 9.1 components separated by 1.4". The brightest star in the field is actually a foreground star, not a member of the 100 million year-old cluster. M34 was discovered in 1654 by Giovanni Batista Hodierna and first observed by Charles Messier on August 25, 1764. Amazingly, Messier didn't catalog the nearby Double Cluster, just 15 degrees away.

Visibility for October			
10:00 pm EDT	10/1/20	10/15/20	10/31/20
Altitude	46° 92'	56° 68'	68° 11'
Azimuth	67° 15'	71° 50'	75° 37'

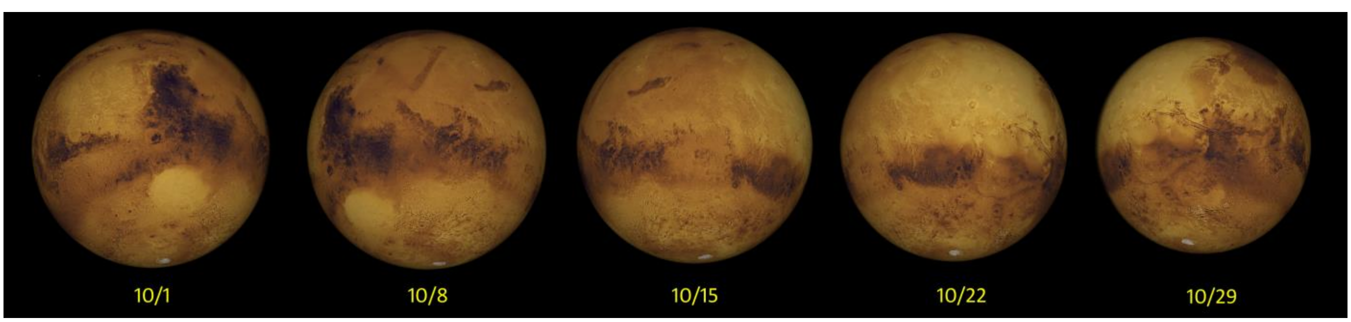
While you're in the area, look at the beautiful yellow (mag 2.5) and blue (mag 5) double star Almach (Gamma Andromedae). The components are separated by 10 arc-seconds. It's a mini-Albireo.



Observing Mars in October 2020

The closest approach of Mars to Earth until 2035 will be on October 6. During October, the red planet crosses the meridian at the times indicated for that night in the table below. At meridian transit, the planet will be at 54° 55’ elevation on October 1st and 54° 34’ on October 31st, in other words, nearly at the same height in the sky and good for viewing and imaging.

Date	Day	Magnitude	Diameter (arcseconds)	Illumination	Elevation at 10:00 p.m. EDT	Meridian Transit (Mars at highest altitude, 180° S)
10/1/2020	Thu	-2.5	22.5	0.99	+28°51'	1:45
10/2/2020	Fri	-2.5	22.5	0.99	+29°43'	1:40
10/3/2020	Sat	-2.5	22.5	0.99	+30°34'	1:35
10/4/2020	Sun	-2.5	22.5	0.99	+31°25'	1:30
10/5/2020	Mon	-2.6	22.6	1	+32°16'	1:25
10/6/2020	Tue	-2.6	22.6	1	+33°07'	1:20
10/7/2020	Wed	-2.6	22.5	1	+33°57'	1:14
10/8/2020	Thu	-2.6	22.5	1	+34°47'	1:09
10/9/2020	Fri	-2.6	22.5	1	+35°37'	1:04
10/10/2020	Sat	-2.6	22.5	1	+36°26'	0:59
10/11/2020	Sun	-2.6	22.4	1	+37°14'	0:54
10/12/2020	Mon	-2.6	22.4	1	+38°02'	0:48
10/13/2020	Tue	-2.6	22.3	1	+38°49'	0:43
10/14/2020	Wed	-2.6	22.3	1	+39°35'	0:38
10/15/2020	Thu	-2.6	22.2	1	+40°21'	0:33
10/16/2020	Fri	-2.6	22.1	1	+41°05'	0:28
10/17/2020	Sat	-2.5	22.0	1	+41°49'	0:22
10/18/2020	Sun	-2.5	21.9	1	+42°32'	0:17
10/19/2020	Mon	-2.5	21.8	1	+43°13'	0:12
10/20/2020	Tue	-2.5	21.7	1	+43°54'	0:07
10/21/2020	Wed	-2.4	21.6	1	+44°33'	0:02
10/22/2020	Thu	-2.4	21.4	0.99	+45°12'	23:52
10/23/2020	Fri	-2.4	21.3	0.99	+45°49'	23:47
10/24/2020	Sat	-2.4	21.2	0.99	+46°25'	23:42
10/25/2020	Sun	-2.3	21.0	0.99	+46°59'	23:37
10/26/2020	Mon	-2.3	20.9	0.99	+47°33'	23:32
10/27/2020	Tue	-2.3	20.7	0.99	+48°05'	23:27
10/28/2020	Wed	-2.2	20.5	0.99	+48°35'	23:23
10/29/2020	Thu	-2.2	20.4	0.99	+49°05'	23:18
10/30/2020	Fri	-2.2	20.2	0.98	+49°33'	23:13
10/31/2020	Sat	-2.1	20.0	0.98	+49°59'	23:09
11/1/2020	Sun	-2.1	19.9	0.98	+50°24'	22:04



View of Mars at 10:00 pm on the dates indicated. Relative sizes are accurate. (Made with Cartes du Ciel)

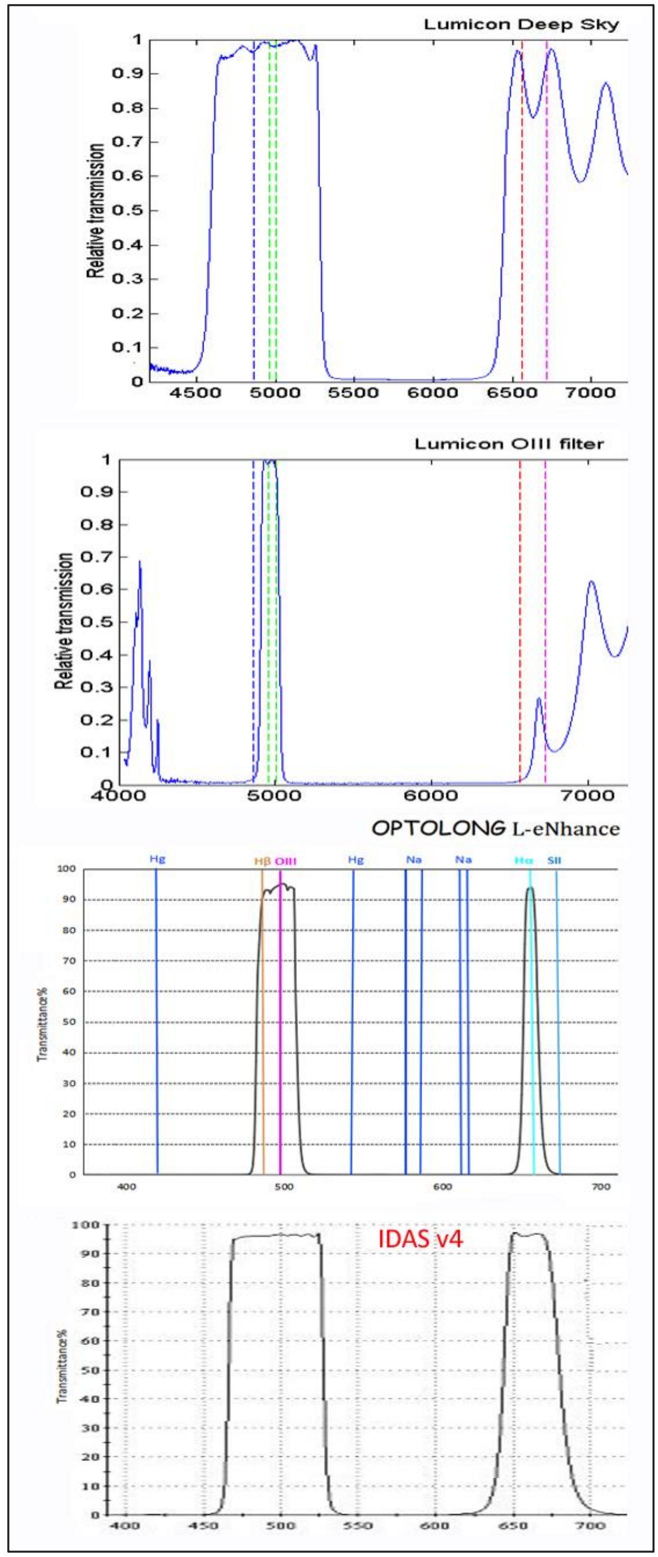
See the September 2020 SkyWAAtch for observing tips, including use of filters.

IC 1295: A Challenging Planetary in Scutum Larry Faltz

One of the regular attendees at the Medomak Astronomy Retreat and Symposium in Maine is a physician from Hershey, Pennsylvania who observes with a 22-inch computerized go-to Dobsonian that was custom-made for him in Australia. Robert brings the scope up in a small U-Haul type trailer hooked to the back of his SUV. After he rolls the scope down a ramp into viewing position, the trailer serves as his office: there's a desk, a chair, a red lamp, sky charts and a computer. Robert is a very experienced visual observer who has logged literally thousands of hours in dark skies in the US and in Australia. Call out any NGC number, and he can tell you what the object is, where it is, and what's around it. We were called over to his scope throughout the night to see 16th magnitude galaxies in Abell and Hickson clusters.

Two years ago, he gave us a special treat. He showed us NGC 6712 in Scutum, a 9.85-magnitude globular cluster 26.4 thousand light-years distant. It looked wonderful, but then he threw an OIII filter into the optical path, and out popped the planetary nebula IC 1295. It's a 12.7 (V) or 15.0 (B) magnitude round blue ball, just 23 arc-minutes from the cluster. It was essentially invisible without the filter.

It helps to use filters on planetary nebulas because most of their light comes from the "forbidden line" of doubly-ionized oxygen at 500.7 nm (with a second line at 495.6 nm) and hydrogen alpha (656.28 nm).[1] The contrast between the nebula and the background sky increases as you suppress wavelengths that aren't emitted by the object. Regular "light pollution rejection" filters are moderately good, "deep sky" ones even better, and OIII filters best of all. But the filtering comes at a price: total light transmission is reduced, so you trade brightness for contrast. That's not much of a problem with 22 inches of aperture, but for smaller apertures the OIII can sometimes be too severe. In my 8" SCT, the views of the Ring, Dumbbell, Owl and Cat's Eye nebulas seem optimal with an intermediate Lumicon "Deep Sky" filter; the OIII makes them a little too dim for my old eyes. If you have a large enough aperture, the OIII will be a great choice for many planetaries. Here are some filter spectra, lined up to compare their bandpasses.

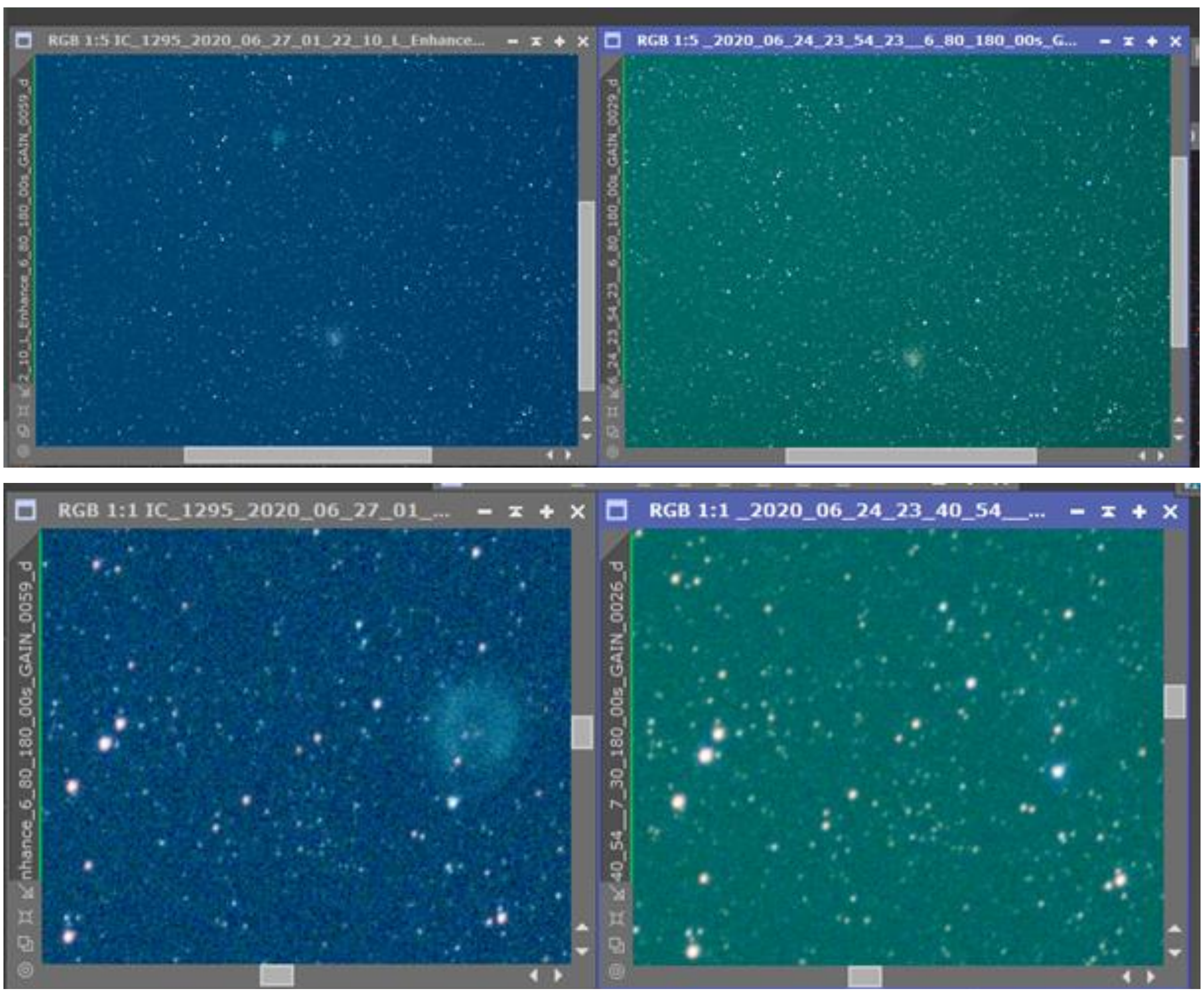


[1] For more on planetary nebulas and what a "forbidden" spectral line means, see the October 2015 SkyWAAtch.

It occurred to me that with the increasing number of imagers in WAA, it might be interesting to explore the value of filtering on IC 1925. So I sent an email to the club members who were avid imagers asking whether it might be possible for them to obtain images of this object with and without filters. A number of them reminded me that they use color cameras and so something as radical as an OIII filter would not give a good image.

Olivier Prache compared the effects of a simple IR-cut filter with an Optolong L-Enhance tri-band filter. This filter has been growing in popularity since it passes both the blue OIII and red Hα (656.28 nm) while suppressing everything else. That means that for planetaries that have a lot of Hα like the Ring and Owl you'll get both colors, and for pure hydrogen objects like the Eagle or Swan the red will come through.

Olivier used a Borg 101ED F/6.4 refractor and ZWO ASI071MC One-Shot-Color camera to image IC 1295 and NGC 6712 from Pleasantville in late June. The field was fairly low and Olivier noted that it was "right over the White Plains illuminated summer skies." He compared non-stacked three-minute captures with either of the two filters. Olivier notes, "The tri-band filter is an impressive performer. IC 1295 could be readily seen on raw three-minute frames without any processing, whereas with the just the IR filter one has to know it is there to glimpse it."

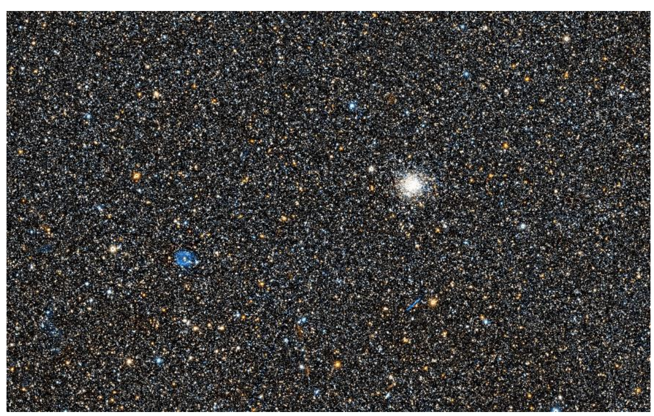


Top left is the three-minute frame with the tri-band filter. Top right is the three-minute frame with the IR filter. Both images have been debayered but not calibrated or processed. IC 1295 is towards the top center of the upper images. To see it on the IR filter image, a higher magnification is needed (bottom pair of images). The blueish background of the tri-band image would disappear after calibration and background neutralization.

Maury Rosenthal images from his backyard in Yonkers, an even tougher place to fight light pollution than Pleasantville. He imaged through a Borg 71 FL and ZWO ASI 1600 MC one-shot color camera, using an IDAS-v4 filter, similar to the L-Enhance filter but not quite as restrictive in its transmission around the OIII and Hα lines, as seen in the filter plots on page 16. Maury countered sky glow by stacking 1700 eight-second exposures, acquired over three nights. His ability to coax faint objects from light-polluted skies with small scopes is quite remarkable.

Here are two images that I pulled from the CDS, the Strasbourg astronomical Data Center web site.

Sloane Digital Sky Survey (SDSS) (2.5 meter telescope)



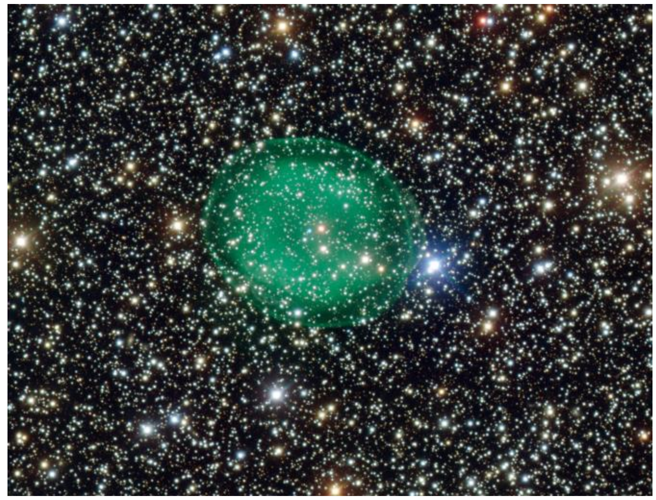
PANSTARRS DR1 image (1.8-meter telescope)

Although some PN’s can radiate X-rays, the globular cluster is a stronger source of X-rays than the nebula, as seen from this overlay of the SDSS image with an image of the identical field from the Swift X-ray spacecraft’s Burst Alert Telescope (BAT). This instrument is designed for two purposes: to respond quickly to X-ray bursts, and to collect hard X-ray survey data.

IC 1295 was discovered by Truman Stafford (1836-1901) when he was at Dearborn Observatory in Chicago in the 1860’s. A Harvard-educated astronomer, he became Field Memorial Professor Astronomy and director of the Hopkins Observatory at Williams College in 1876.[1] Stafford was a child calculating prodigy. At the age of nine, a local priest asked him to multiply 365,365,365,365,365,365 by itself. In less than a minute, Truman gave the correct answer of 133,491,850,208,566,925,016,658,299,941,583,225 without using a paper or pencil. (Excel rounds off the result after 15 digits!)

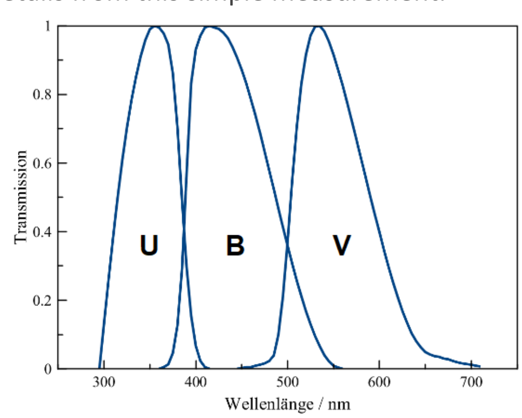
IC 1295 was identified as a planetary nebula in 1919 by Heber Curtis at Lick Observatory in California. The nebula is about 3,300 light-years from Earth, diameter about 1.5 arc-minutes. This is about half the size of the Ring Nebula. Its appearance suggests there were at least two outbursts, the first projecting a thin outer shell, followed by a larger outburst to fill it.

IC 1295 was the Las Vegas Astronomical Society’s monthly “observing challenge” for August 2018, unbeknownst to me until I started writing this article. Sixteen amateurs from around the world submitted observing reports, images and sketches, which you can see at https://tinyurl.com/IC1295reports.



Very Large Telescope image, Cerro Paranal, Chile

The discrepancy between the B and V magnitudes of IC 1295 (2.3) is dramatic. PN’s vary widely in the ratio of B to V magnitudes, which are determined by photometry through standard filters. The OIII line is right at the overlap of sensitivity of the B and V filters, so small changes in the atomic makeup of the nebula will influence the B and V magnitudes. The Ring Nebula, M57, has a B-mag of 9.7 and a V mag of 8.8, for a difference of 0.9, while the Dumbbell (M27) has a B-mag of 7.6 and a V-mag of 7.4, a difference of only 0.2. The difference in the two magnitudes is the “color index.” For stars this can be used to derive the star’s temperature because the light essentially follows a blackbody radiation curve, but since PN’s shine by fluorescence you can’t say much about the chemical details from this simple measurement. ■



Spectral ranges of U, B and V bands for magnitude and color index determination.

[1] The Field Memorial professorship is now held by the eminent solar astronomer and astronomy textbook author Jay Pasachoff (a Bronx Science graduate, by the way, like quite a few WAA’ers, including the Editor). The Hopkins Observatory was restored in the late 1990’s. It is the oldest extant observatory in the United States. It houses a seven-inch Clark refractor (1852).

Images

Upper left:

A third quarter Moon caught WAA Vice President for Field Events **Bob Kelly's** eye on August 10th. The tree was obviously spared by Tropical Storm Isaias, which passed through Westchester on August 4th, leaving many WAA'ers in the dark for up to seven days.

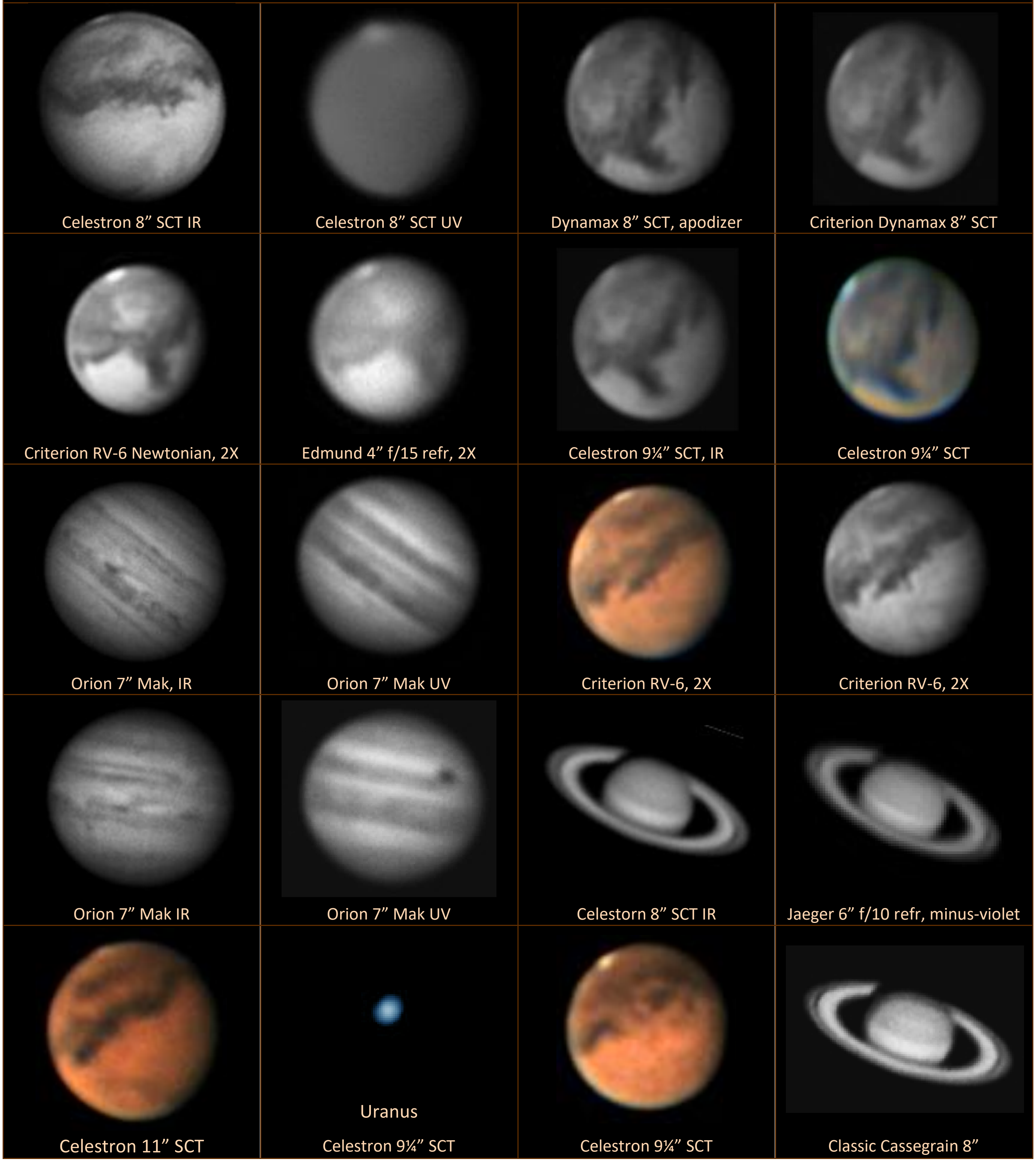
Lower left

Messier 92 is the "other" globular cluster in Hercules. **Steve Bellavia** captured it on July 31st with a 6" Celestron SCT and ZWO ASI533MC Pro camera. An 11.5-day old Moon (89% illuminated) was 70 degrees from the cluster.

Lower right

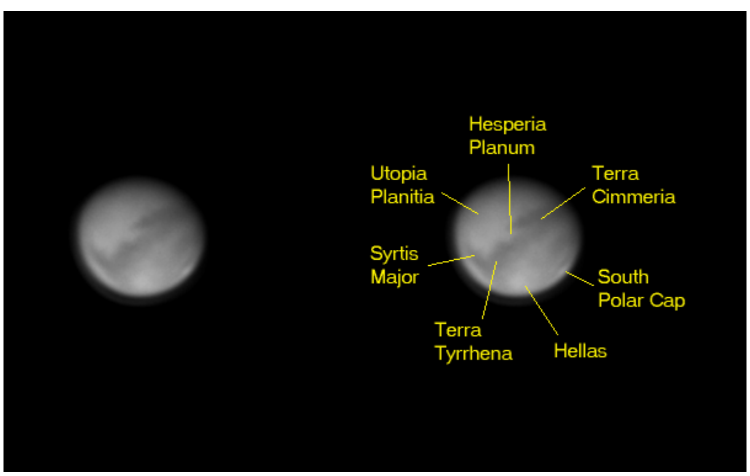
WAA President Paul Alimena and Newsletter Editor Larry Faltz were appropriately masked at the entrance to the September 12th Starway to Heaven public observing event (a.k.a. "star party"), which was held under required New York State Phase 4 reopening guidelines. Twenty-six members and guests participated. (Photo by Jordan Webber)

John Paladini's Scopes and Planets, September 2020



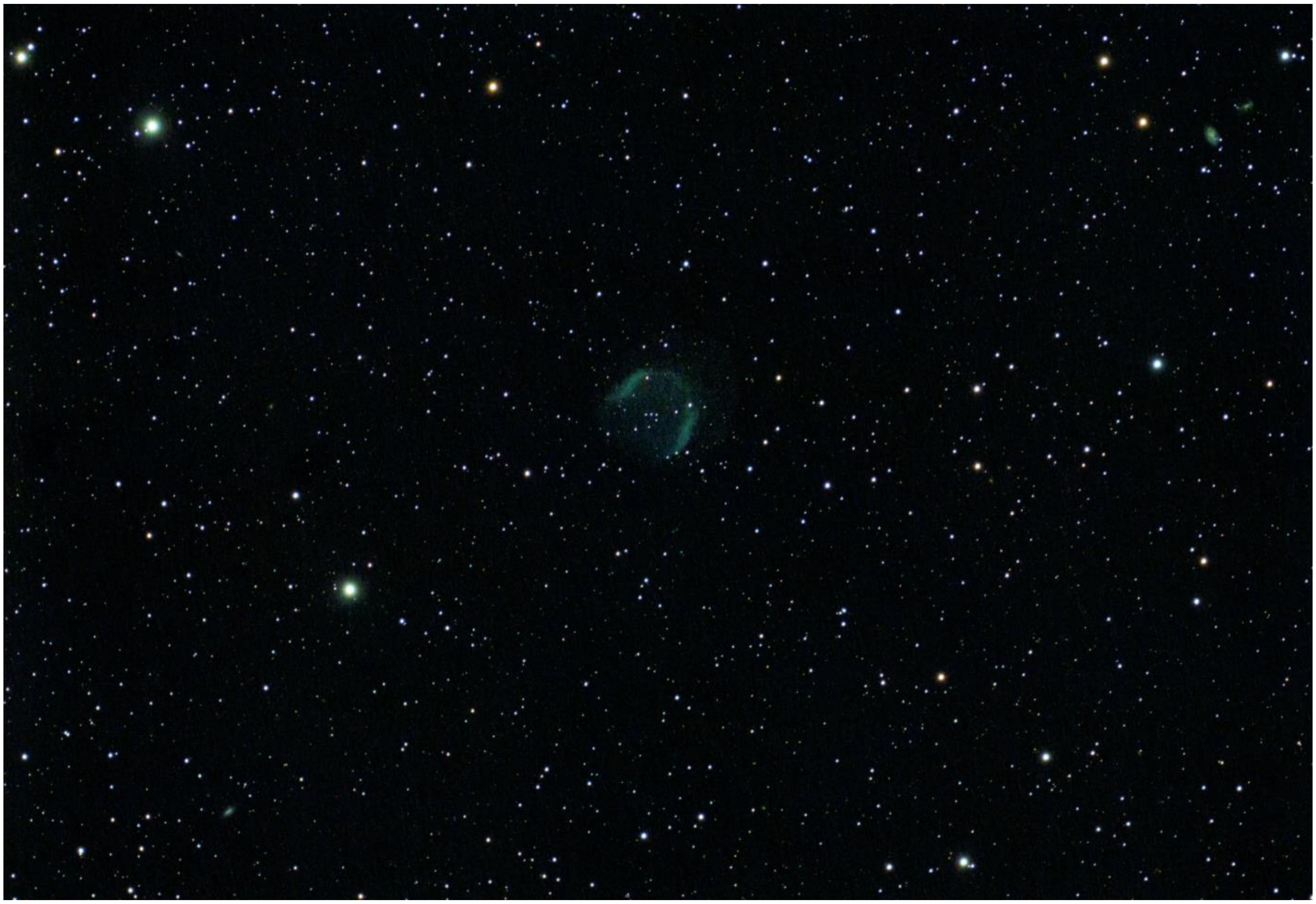
John has a lot of scopes! Images obtained on various nights in September from Mahopac. Cameras: ASI120MM, ASI120MC, Celestron NexImage (color). Parks, Aires SAFIX Barlows, Omega filters. John will explain what an "apodizer" is in the November issue of *SkyWAAtch*.

Larry Faltz captured the close conjunction of the Moon and Mars on September 6th at 12:20 a.m. with a Stellarvue 80-mm f/6 achromatic refractor (doublet) and Canon T3i DSLR. The exposure was 1/1250, ISO 800. The two bodies were only 40' 47" apart (center-to-center). The Moon was 33 degrees above the horizon.



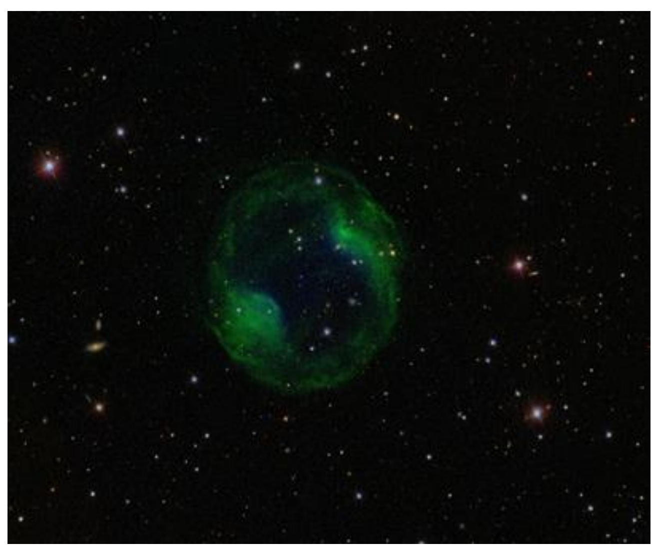
I also made a high magnification image of Mars that night at 2:10 a.m. with an Orion Apex 127 Maksutov and 2X Barlow, giving f/24.2 (3,080 mm focal length) and QHY 5L-II monochrome planetary camera. Best 250 of 1,000 frames, stacked with Autostakkaert!3, wavelets and de-noising in Registax 6.1, cropped. Mars was at 50 degrees elevation, 19.7" diameter, 93.2% illuminated, mag -1.9. I annotated the most prominent features. An image from later in the month with an 8" SCT is on page 4. (LF)

Jones-Emberson 1 by Gary Miller



This 14th magnitude planetary nebula in the constellation Lynx is also catalogued as PK 164+31.1 in the Perek-Kohoutek catalogue of planetaries, which was published in 1967. [The PK catalogue names its objects by their galactic coordinates, a peculiar choice.] The nebula is faint, but not small, with a diameter of about 6.3 arc-minutes. The central white dwarf is 16.5 magnitude. Its distance is about 1600 light-years. Gary imaged it at Ward Pound Ridge Reservation with his usual setup: 127-mm refractor, DSLR. two hours of exposure (three-minute subs).

In the upper right corner of Gary's image you can see NGC 2474/2475, a pair of interacting galaxies, magnitude 13.9, distance about 78 megaparsecs (254 million light-years). A number PGC galaxies, all fainter than 16th magnitude, can be seen on the close-up SDSS image. The SDSS telescope is 2.5 meters in aperture.



Sloan Digital Sky Survey 9th Data Release image

Rebecca Jones and Richard M. Emberson announced the discovery of this nebula in the August 1939 issue of the Harvard College Observatory Bulletin. They first saw it on a photograph taken with the 16-inch Metcalf refractor at the Oak ridge Observatory, which was one of the facilities of the Smithsonian Astrophysical Observatory, operated by the Harvard-Smithsonian Center for Astrophysics. They followed up with photographs using the observatory's 61-inch Wyeth reflector (the largest telescope east of Texas), using Agfa Superpan Press Film[1] with and without a red filter. A "Miss Pimish" (whose actual identity may be completely lost to history) made a drawing that was reproduced in the note.

Miss Pimish's drawing

The Oak Ridge Observatory, in the town of Harvard, Massachusetts is only 25 miles northwest of the Harvard campus and just a mile from I-495. It operated from 1933 until August 19, 2005, when, overcome by light pollution, it was shuttered. Most of the telescopes are still there, including the Wyeth and a Clark refractor. The only activity is the Harvard Optical SETI program, utilizing an automated 1.8-meter telescope in a roll-off roof observatory. The telescope was donated by the Planetary Society in 2006. Optical SETI searches for laser pulses from distant exoplanets.

There is little detailed biographical information available about either Jones or Emberson. Rebecca Jones graduated from Mt. Holyoke College in 1927. She was at Lick Observatory and published several observing reports in the Lick journal. Then she was a Pickering Fellow at Harvard in 1935-6, working with Harlow Shapley. She and Shapley coauthored five papers based on meticulous manual identification and counting of faint galaxies on glass plates taken with the 16-inch refractor. Her notebooks (catalogued as 1933 but they may be from a couple of years later) were scanned and are available on the NASA/ADS web site. They are evidence of work that must have been mind-numbingly repetitive. In the 1940's she became the assistant to Columbia astronomy professor Wallace Eckert. Eckert was a pioneer in developing computers to do scientific work and can be considered one of the real founders of Columbia's computer department. He worked closely with Thomas J. Watson of IBM. Jones and Eckert automated the Star Measuring Engine, a device invented by Heber Curtis in 1927 to refine the positions of stars from photographic plates. Eckert and Jones authored *Faster, Faster: a simple description of a giant electronic calculator and the problems it solves* (McGraw-Hill, 1955). She married astronomer Boris Karpov in 1958, but died suddenly in 1966. Emberson was an MIT-trained physicist and engineer whose main affiliations were with the National Radio Astronomy Observatory (he was a project manager for the Green Bank Radio Observatory) and later with the Institute of Electrical and Electronics Engineers (IEEE), which makes an award in his honor each year. He passed away in 1985.

Rebecca Jones and Wallace Eckert at the Star Measuring Engine at Columbia, undated photograph

Jones apparently discovered another planetary nebula, Jones 1 in Pegasus (also called PN G104.2-29.6 and PN Jn 1), in 1941. In photographs it looks somewhat similar to Jones-Emberson 1, although its circumference is less complete. It's 5.3 arcminutes in diameter, B-magnitude 15.5, V-magnitude 15.62. I couldn't find the original report for this object.

--LF

[1] With a little on-line research we found that this film, popular through the 1940's, would have had an ISO equivalent of 150-200. It was considered "high speed."

Research Highlight of the Month

The discovery of the most UV-Lyα luminous star-forming galaxy: a young, dust- and metal-poor starburst with QSO-like luminosities. R. Marques-Chaves, J. Alvarez-Marquez, L. Colina, I. Perez-Fournon, D. Schaerer, C. Dalla Vecchia, T. Hashimoto, C. Jimenez-Angel, Y. Shu. arXiv:2009.02177 [astro-ph.GA], posted Sept. 4, 2020

The dynamics of early galaxies are still mysterious. Stars must form from cool gas, but then their radiation heats and ionizes the gas, shutting down the generation of new stars. Stellar evolution eventually creates dust. While there are subsequent generations of new stars, most galaxies run out of gas, both literally and figuratively. How these processes worked in the early universe is a key to understand the creation of galaxies in the first place.

A number of surveys have identified star-forming galaxies (SFGs) at high redshift (z > 2), such as Lyman break galaxies (LBGs) and Lyman-α emitters (LAEs). These galaxies have large amounts of neutral hydrogen that absorb photons from bursts of star formation. When an electron drops the ground state from its next highest orbital, it emits a photon at 1215.67 Å, in the ultraviolet. The Lyα line, so called, is red-shifted to visible or even infrared wavelengths by cosmic expansion. The spectra of these objects can reveal a wealth of information about their physical properties and evolution. The most efficient SFGs consume their gas quickly, implying short timescales of their luminous phases, and therefore they may not be very abundant. "The candle that burns twice as bright burns half as long," as the saying goes.

Using data from the Extended Baryon Oscillation Spectroscopic Survey, a group of astronomers from Spain, France and Japan studied SDSS J122040.72+084238.1, also called BOSS-EUVLG1. It is located in Virgo, although with redshift *z*=2.469 it is far more distant than the Virgo cluster itself. This "bright" (magnitude 21.0) source is neither a gravitationally lensed galaxy nor an active galactic nucleus (AGN) [it's listed in the SDSS as a quasar].

Spectroscopic measurements showed that the large luminosity of this galaxy arises from a large number of hot OB stars present in the first stages of an intense burst of star-formation. The authors claim that "BOSS-EUVLG1 is by far the most luminous, dust-poor star-forming galaxy discovered at any redshift" (see graph below). The star forming rate is about 1000 solar masses per year. In addition, the authors show that the period of intense star formation will be short-lived, the OB stars burning out in some tens of millions of years and hydrogen gas being replaced by dust (high in carbon). As a result, the object will appear fainter and redder. ■

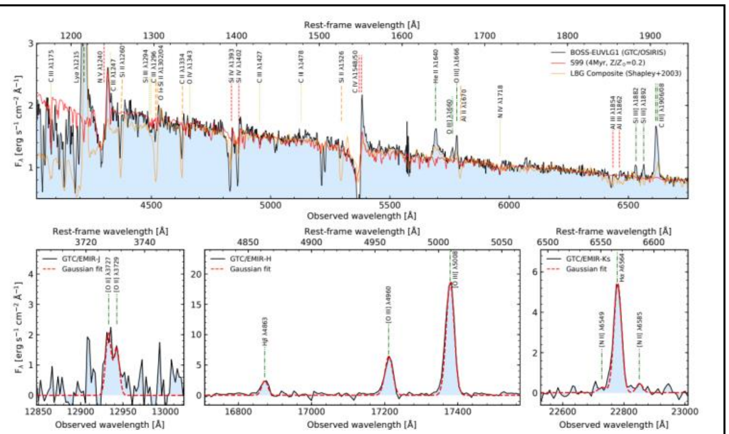


Figure 1. GTC rest-frame UV (up) and optical (down) spectra of BOSS-EUVLG1. Ticks mark the positions of main features associated with stellar P-Cygni wind lines (red) and photospheric absorption (yellow), nebular emission (green) and ISM absorption (orange). The best-fit S99 model with age of 4 Myr and $Z/Z_\odot$=1/5 is shown in red (E(B-V)=0.07). The $z \sim 3$ LBG composite at the redshift of BOSS-EUVLG1 is shown in orange

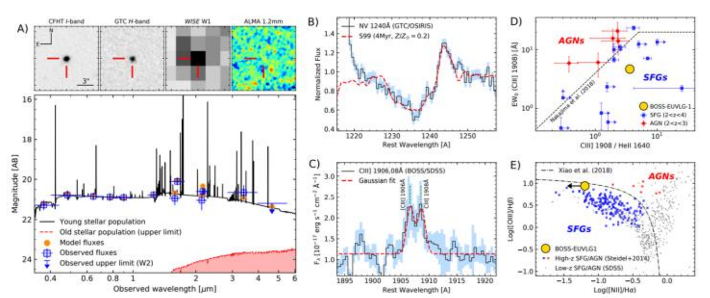


Figure 2. Summary of the main results. A: cutout images of BOSS-EUVLG1 (12″x12″) in selected bands from optical to mm (top) and best-fit SED of BOSS-EUVLG1, characterized by a young and intense burst of star formation (down); B) comparison of the normalized GTC spectrum (black) with the best-fit S99 model (4 Myr and $Z/Z_\odot$=1/5, dashed red) around the wind line N V; C: [C III] nebular emission as seen in the BOSS spectrum (black). The resolved lines have widths of ≃200 km s^{-1} FWHM; D and E: BOSS-EUVLG1 (yellow circle) in the rest-frame UV and optical line diagnostics

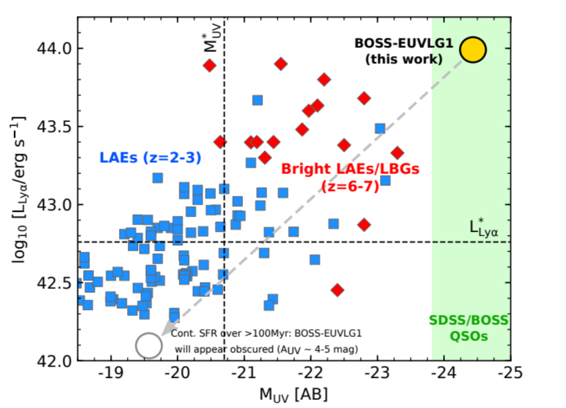


Figure 3 from Marques-Chaves, *et. al.*

Member & Club Equipment for Sale

Item	Description	Asking price	Name/Email
Meade LX-70 Equatorial Mount	Dual Axis Drive and Polar Scope - Brand New. Bought during the closeout sale of these mounts. Owner thought he might like to have a light GEM, but decided to stick with alt-az mounts. Set up once in the garage to be sure it all works, and it does, but never saw first light in the field. Price paid: $365.	$170	Eugene Lewis genelew1@gmail.com
Celestron Evolution single arm go-to mount for 6, 8 inch or 9.25 inch SCT or Maksutov	Celestron doesn't sell these separately from the optical tube. Built-in wifi for connection to tablet or phone with SkySafari or Celestron SkyPortal. High-performance worm gears and motors for excellent tracking accuracy and reduced gear backlash. Includes rechargeable lithium-ion battery for 10 hours of continuous observing.	$400	Eugene Lewis genelew1@gmail.com
Celestron rolling case	Fits SCT OTA's up to 11 inches and 8" NexStar or Evolution with single-arm fork mount. Excellent condition. Celestron item #94004, lists for $400 on their web site.	$150	Eugene Lewis genelew1@gmail.com
Celestron Orange Tube C8	A gem from the 1970's! WAA has had this scope in storage for a long time. Serial #25778-6. OTA, fork mount, 6x30 finder, 110v power cable. See the complete description in the August 2020 SkyWAAtch.	$300	WAA ads@westchesterastronomers.org
GSO 6'' reflector OTA	f/5 Newtonian. Tube rings and dovetail. 6x30 straight-through finder.	$200	Anthony Maida lvam1521@yahoo.com
Explore Scientific 102 Refractor OTA	Tube rings and dovetail. Finderscope.	$250	Anthony Maida lvam1521@yahoo.com
Vixen f/11 80mm Refractor OTA	Dual speed focuser. Tube rings and dovetail, no finderscope.	$75	Anthony Maida lvam1521@yahoo.com
Atco 60-mm f/15.1 refractor	A classic Japanese refractor from the early 1970s. Obtained from the original owner about five years ago. It was used only a few times, then stored for 40+ years. Current owner used it maybe seven times. Very good condition. Comes with three eyepieces and a 1.25" eyepiece adaptor star diagonal. Straight-through finder. Equatorial mount with slow-motion adjustment knobs (screws). Wooden tripod, metal tube. Everything is original.	$150	Robert Lewis lewis@bway.net
WANTED	One of our members, a retired professional frustrated by the ever-increasing light pollution in Westchester, wants to know whether there are any other WAA'ers who might be interested to participate in a group purchase of property somewhere in upstate New York to build a small observatory with warm room and living facilities.		Contact Bill Caspe wbcaspe@mindspring.com

Want to list something for sale in the next issue of the WAA newsletter? Send the description and asking price to ads@westchesterastronomers.org. Member submissions only. Please submit only serious and useful astronomy equipment. WAA reserves the right not to list items we think are not of value to members.

Buying and selling items is at your own risk. WAA is not responsible for the satisfaction of the buyer or seller. Commercial listings are not accepted. Items must be the property of the member or WAA. WAA takes no responsibility for the condition or value of the item, or for the accuracy of any description. We expect, but cannot guarantee, that descriptions are accurate. Items are subject to prior sale. WAA is not a party to any sale unless the equipment belongs to WAA (and will be so identified). Sales of WAA equipment are final. *Caveat emptor!*