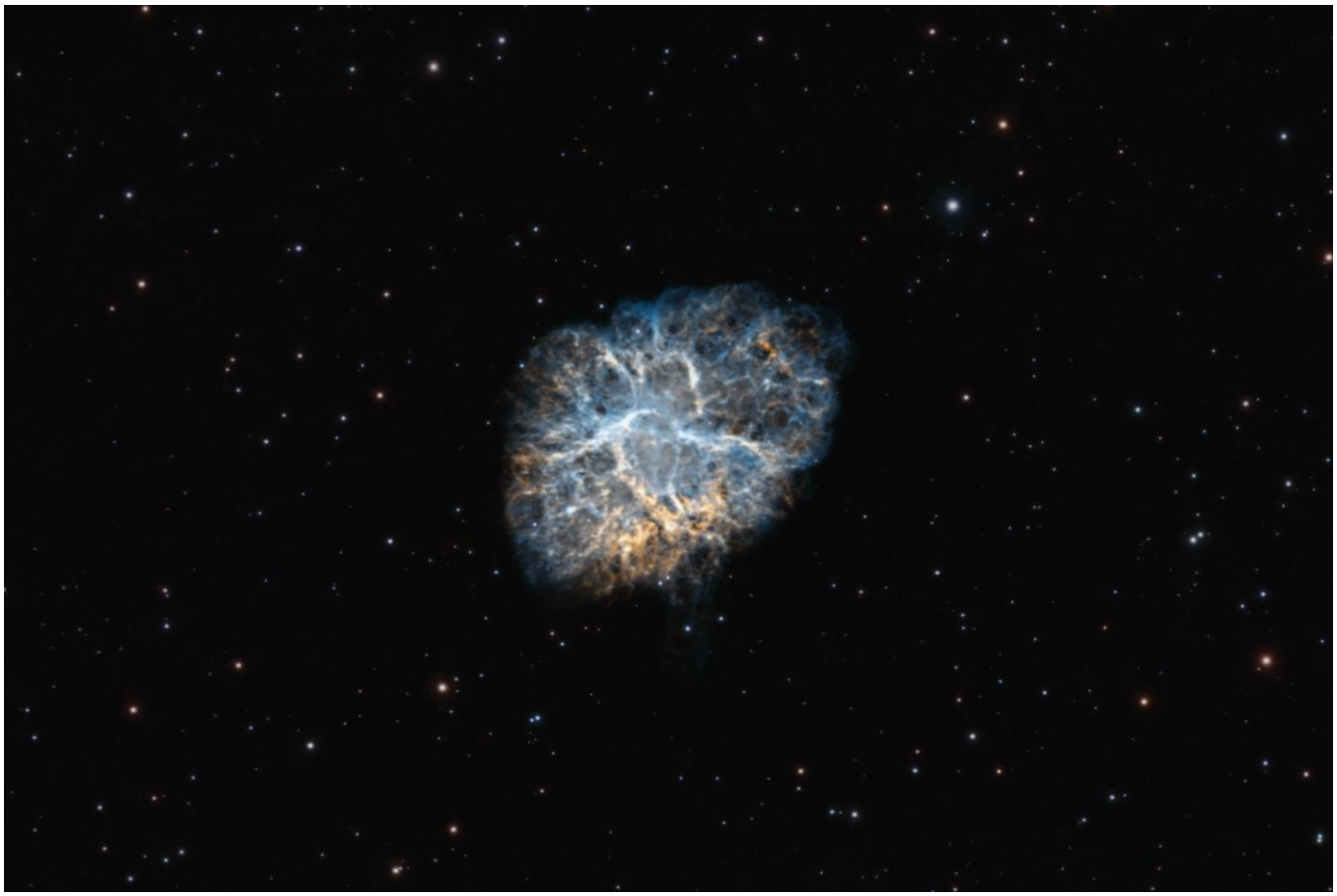
SkyWAAtch

The Newsletter of Westchester Amateur Astronomers

March 2023



Crab Nebula by Steve Bellavia

Messier 1 (NGC 1952) in the constellation Taurus is one of the highlights of the night sky. It's the only Messier object that was created since human beings started looking systematically a the night sky. It is the remnant of a supernova that exploded in 1054 AD. At magnitude 8.4, it's visible with binoculars under a moderately dark sky. Frequently photographed, its gaseous tendrils are expanding at a rate of 1500 km/sec (0.5% *c*). It was given the appellation "Crab" by Lord Rosse, who observed it in 1842 with a telescope smaller than his famous 72-inch "Leviathan of Parsonstown." Ever since then, it has been slightly bewildering to observers, few of whom would agree with Rosse that it looks like a crab. It's rather more like the "Oyster Nebula," we think. The central neutron star, a pulsar, is magnitude 16 and so only visible in the very largest amateur telescopes or on images.

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Our club meetings are held at the David Pecker Conference Room, Willcox Hall, Pace University, Pleasantville, NY, or on-line via Zoom (the link is on our web site, www.westchesterastronomers.org).

WAA March Meeting

Friday, March 10 at 7:30 pm

David Pecker Conference Room
Willcox Hall,
Pace University, Pleasantville, NY

Artificial Intelligence and its use in Astronomy

Marwan Gebran, PhD
Chairman of Physics, St. Mary's College, Notre Dame, Indiana

Artificial Intelligence applications have been used extensively in astronomy over the last decade. This is mainly due to the large amount of data that are recovered from space and ground-based observatories. In the era of big data, the use of automated tools is essential. Dr. Gebran will introduce the most used techniques in Machine and Deep Learning that astronomers are using and show some of their applications. He will present some of his on the use of neural networks for classifying stellar spectra.

Dr. Gebran received a PhD in Astrophysics in 2007 from Montpellier University, France in 2007. He was a post-doctoral fellow in Barcelona working on calibration of the Gaia space telescope. He received a Fulbright grant to work at Columbia University in 2018, and then Joined the Department of Chemistry and Physics at Saint Mary's College in fall 2021.

Also In This Issue

WAA April Meeting

Friday, April 14 at 7:30 pm

David Pecker Conference Room
Willcox Hall,
Pace University, Pleasantville, NY

Or on-line via Zoom

Starquakes

Christopher Lindsay
Department of Astronomy, Yale University

Starway to Heaven

Ward Pound Ridge Reservation,
Cross River, NY

March 18 (rain/cloud date March 25)

New Members

Christopher Abbamont	Goldens Bridge
Marc R. Favreau	Greenwich
Jeffrey Gilleski	Stamford
Curtis Jones	North Salem
Naveen Rajdev	Scarsdale
Jonathan Suarez	Port Chester
Thomas Cullinan	Yonkers
Sunny Turner	Katonah
Jill Wandrey Cerino	Hastings on Hudson

Renewing Members

Rob & Melissa Baker	West Harrison
Richard Bronstein	Bedford
Everett Dickson	Dobbs Ferry
Louise Gantress	Mt. Kisco
Robbins Gottlock	Sleepy Hollow
Thomas Haeberle	Glendale
Tim Holden	White Plains
The Maida Family	Portchester
Anthony Mancini	Pleasantville
John Markowitz	Ossining
Hans Minnich	Mahopac
William Sawicki	Bronx
Karen Seiter	Larchmont
Jude Stenson	New Rochelle
Joseph Trerotola	Bethany

ALMANAC For March 2023

Bob Kelly, WAA VP of Field Events


Bob Kelly


Full 3/7

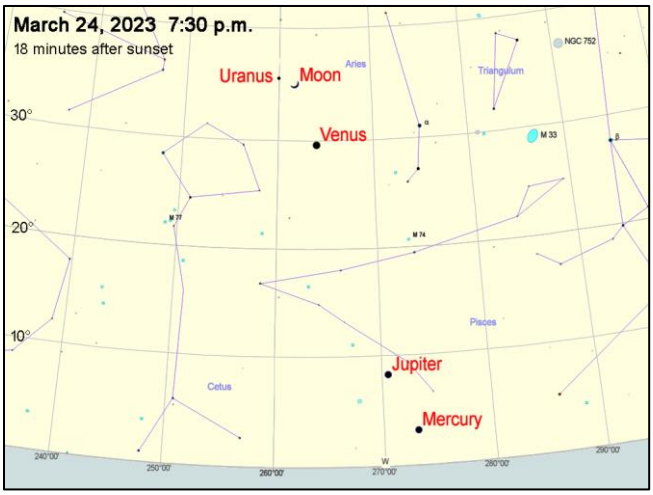

3Q 3/14


New 3/21


1Q 3/28

Venus is the beacon in the western sky that starts our evening viewing and attracts our attention to her fellow travelers across the Solar System. Venus starts the month paring with **Jupiter** on the 1st and 2nd. At magnitudes -3.9 for Venus and – 2.1 for Jupiter, they are the two brightest planets in our sky. They will get a lot of attention from even the most casual observers, anyone with a clear view to the western sky after sunset.

Venus and the **Moon** make a beautiful close pair on the evening of the 23rd and 24th. They are closest during the morning hours our time on the 24th, visible on the other side of the Earth, but still a nice scene the evening before and after.



Venus is a very bright pointer to nearby **Uranus**, a finger width or two away on the 30th and 31st. Venus gets more than 30 degrees away from the Sun this month. The second planet is still very tiny and has a gibbous phase, looking slightly out of round in a telescope. Can you see it in the daytime? It may be found trailing well behind the **Sun** in the early afternoon.

Mars continues its residency as a red jewel in the Winter Hexagon. Mars stands out since it is a disk, as contrasted with stars being points of light. So at magnitude +0.7 Mars may actually look brighter than similarly bright Betelgeuse at +0.5 and Aldebaran at +0.9. Mars starts out March as the closest planet to Earth. Mercury and Venus are closest and second closest by the end of the month.

Mercury leaves the morning sky, sliding into conjunction behind the Sun on the 17th. The swift planet joins Jupiter late in March, hard to find in bright twilight as Jupiter leaves the evening sky. The very new Moon passes Jupiter on the 22nd, a challenging event to see.

Saturn leaves the house of the Sun, but it's too soon to see it in the morning sky. The ringed planet passes Mercury on its way out on the 2nd.

Ceres, the first asteroid to be discovered, is at opposition in March. You'll need binoculars to see this magnitude +7 speck at a distance of 149 million miles. Peak brightness occurs at mid-month. At least 10 Messier Catalog objects are in the area of the sky near Ceres, in the constellation Coma Berenices.

Orion leads the charge down into the evening twilight, seemingly pulling the Milky Way and Sirius down into the western sky after sunset.

The **International Space Station** is brilliant in the morning sky through the 11th; then in the evening sky from the 14th onward. The ISS could have a lovely overflight overhead the evening of the first WAA star party of the year on the 18th.

Tiangong is easily visible most evenings from the 8th through the 21st. Check closer to the 18th to see if Chinese space station has a pass a few minutes after the ISS during the star party. Space station orbits are adjusted to avoid debris or just to regain altitude, so predictions this far out can be very different from what happens.

The **March Equinox** is on 20th at 4:24 p.m. EDT. The length of day and night are equal a couple of days before, on the 17th.

Daylight Savings Time starts at 2 a.m. on Sunday, March 12th.

After a three-year hiatus due to Covid, the Northeast Astronomy Forum will take place on Saturday, April 15th and Sunday April 16th at the usual venue, Rockland Community College in Suffern, NY. NEAF is probably the largest and most well-attended amateur astronomy event in the world. After two Covid-19-related cancellations, last year's show also had to be canceled because the vendors were unable to provide inventory. This year it looks as if many product lines have returned to pre-pandemic levels. The show is going to feature a lot of new equipment as many manufacturers have used the hiatus to develop innovative new devices, telescopes and accessories. As usual, there will be speakers, special events, solar viewing if the weather cooperates, raffles, door prizes and lots of valuable information about all things astronomical. It's a gearhead's paradise, but there's something there for anyone interested in any aspect of astronomy as well as a chance to socialize with other enthusiasts.

The ticket prices are $38 for one day and $69 for two days. You can find out more about the show at https://www.neafexpo.com/. The Northeast Astronomy Imaging Conference will take place on the Thursday and Friday preceding NEAF. Information is at https://www.neafexpo.com/neaic.

Once again WAA will have a booth at the show. WAA members who volunteer to staff the booth for an hour will receive a year's extension of their membership. An email was sent to members in February explaining our scheduling process. We'll put out a final schedule a couple of weeks before the show. If you have any specific questions, email Larry Faltz at outreach@westchesterastronomers.org.

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Here are a few photos of the WAA booth at previous NEAFs.

More Movie Telescopes

Uma Thurman plays a young woman who just happens to have superpowers in *My Super Ex-Girlfriend*, a rather slight rom-com from 2006 directed by Ivan Reitman (*Stripes*, *Ghostbusters*), co-starring Luke Wilson, with Anna Faris and Eddie Izzard in supporting roles. Thurman's character has major personal problems: she is incredibly neurotic, possessive and controlling. Wilson meets and beds her early in the film. But he splits up with her, making her crazed and leading to a number of humorous (if humiliating to Wilson) forms of retribution. In one of her many fits of anger, she hurls his car into outer space, and then comes to his apartment to force him to see it through his telescope. We wonder if this is what gave Elon Musk the idea of putting his Tesla coupe into orbit.

While channel surfing, we passed this scene from a 1986 Sylvester Stallone shoot-em-up, *Cobra*. For a brief moment, we see a small refractor in the background. Stallone is about to eat a slice of pizza he's taken out of the refrigerator (which he then cuts with…scissors!). We can't tell you if the telescope plays a more important role in the plot. Tough guy Stallone grunted his way through this scene and we concluded the movie was unwatchable, so we bailed.

Northern Sights — Robin Stuart

On February 14, Saint Valentine granted a rare clear moonless night above my home in Eustis, Maine. After imaging the Great Nebula in Orion (M42) and the Rosette Nebula, I planned to move on to take a deep field of the M8/M82 region starting shortly after midnight and ending just before moonrise around 3 a.m. During that period these galaxies would be high above the north celestial pole. The entire sequence had been programmed in N.I.N.A. and required only that I take flat frames at the outset and put the covers on the telescope when finished. On rising around 2:30 a.m. I found that my plans had been subject to some unexpected interference, as can be seen as a red cast at the bottom left corner of resulting image. The source of the interference was the aurora borealis that could be seen glowing in the north.

The top image is a stack of 16 10-minute exposures (2 hours 40 minutes total) through a TeleVue NP127 refractor with a ZWO ASI2600MC one-shot color camera. Apart from the striking spiral M81 (Bode's Galaxy) in the center and M82 (Cigar Galaxy) at right, there are quite a number of smaller, fainter galaxies captured in the frame. The largest of these is NGC 3077 at top left. It is a member of the *M81 Group* which is centered at a distance 3.6 megaparsecs, making it one of the closest to our own Local Group of galaxies.

The lower image shows the aurora borealis and was taken looking due north at 2:40 a.m. EST. This is a 15 second exposure with a Canon 60Da DSLR at ISO 3200 through a 15-mm lens at f/3.5.

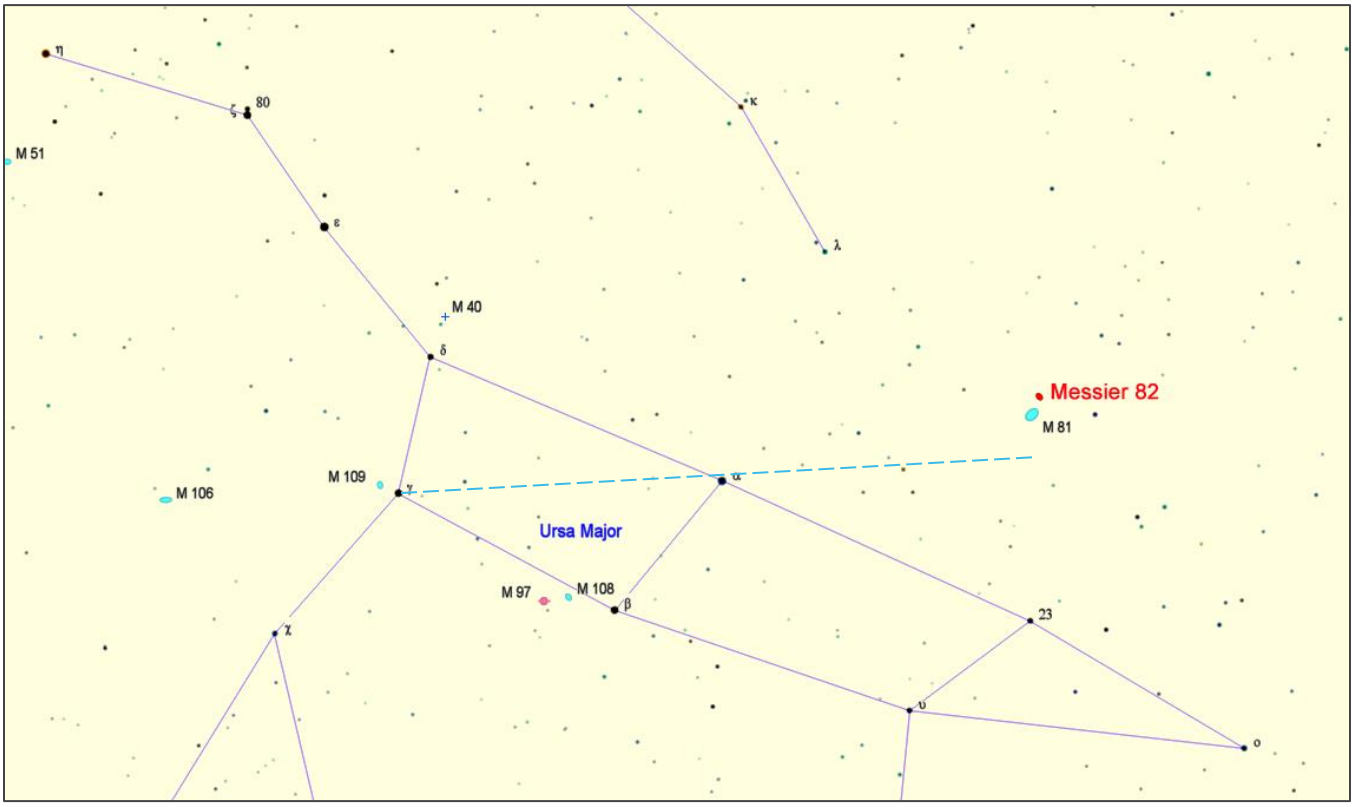
Deep Sky Object of the Month: Messier 82

Messier 82	
Constellation	Ursa Major
Object type	Star-burst galaxy
Right Ascension J2000	9h 55m 54.0s
Declination J2000	+69° 41’ 00”
Magnitude	8.4
Size	10.5 x 5.1 arcminutes
Distance	12 billion light years
NGC designation	3034
Other names	Cigar Galaxy
Discovery	Bode 1774

As Robin Stuart noted on page 6, this is a good time to see M82 and its larger companion M81. Almost all telescopes can see these two objects when they are well-placed, as they are in the spring. The dust band across the center of M82 can be appreciated in larger amateur telescopes; images reveal the red glow of hydrogen excited by the burst of star formation resulting from its interaction with the larger M82. The two galaxies are about 37 arcminutes apart (center-to-center) and so can be captured in a single eyepiece field if the magnification is not too high. It’s one of our favorite sights.

Visibility for Messier 82			
22:00 EST/EDT	3/1	3/15	3/31
Altitude	60° 01’	59° 49’	61° 23’
Azimuth	11° 59’	12° 44’	02° 01’

A line between γ Uma (Phecda) and α Uma (Dubhe) extended an equal distance to the northeast (the dotted line in the map) gets you reasonably close to M81 &M82, a good way to find them in binoculars.



The Astronomer at the Museum: The Orrery — Larry Faltz

Joseph Wright of Derby (1734-1797) *A Philosopher Giving that Lecture on an Orrery, in which a Lamp is put in the Place of the Sun* (c. 1768) Oil on canvas, 17 5/8 x 23 1/2 inches. Yale Center for British Art, New Haven, CT

On a visit to the Yale Center for British Art in December, we found this painting by the noted 18th-century British artist Joseph Wright of Derby (yes, that's the name he's known by). It is the artist's version of a larger, full color oil in the Derby Museum in England's East Midlands, which has a large collection of his work. The monochrome ("grisaille") study was made by the artist as a guide for engravers. A 1768 edition of mezzotints by London printmaker William Pether enjoyed wide circulation. Wright had a scientific bent and was a member of the Lunar Society of Birmingham, a pro-Enlightenment discussion group. While primarily a landscape and portrait painter, he made several paintings about scientific subjects.

In the 18th and 19th centuries, scientific lectures and demonstrations were popular in England. After the establishment of the Royal Society in 1660 and the Royal Observatory at Greenwich in 1675, there was an explosion interest of science and technology, no

The original oil painting in the Derby Museum, England.

doubt further propelled by the achievements of Newton in the second half of the 17th century and the invention and deployment in British industry of the steam engine at the beginning of the 18th. Once perfected by James Watt in 1764, the steam engine brought on the Industrial Revolution, with all of its progress and problems.

The arrangement and motions of the bodies of the solar system has been part of the educational curriculum since the time of the Greeks but Nature's design was misunderstood until Copernicus and Galileo. By the end of the 17th century there was little doubt that the planets revolved around the Sun and that gravity was the force that governed planetary motions.

The arrangement of the solar system in the ecliptic plane can be represented in a drawing, but that shows its state only at one particular time. An orrery is a mechanical device that uses gears to show the positions and relative motions of the planets around the Sun. It's a kind of clock of the solar system, far more informative than a static drawing.

The Antikythera mechanism (100 BC?) calculated the positions of the planets and may have been an orrery. The first working mechanical plantary model to come down to us was made in 1348 by the Paduan clockmaker Giovanni Dondi, who was responsible for the large astronomical clock in the Torre dell' Orologico in Padua (see the August 2022 SkyWAAtch, page 18). His free-standing weight-driven clock, called an *Astrarium*, displayed the rotation of the Moon, Sun and planets around the stationary Earth. The original Astrarium was lost, but Dondi left a complete set of plans and several reproductions have been made. We saw one at the University of Padua on our trip in May 2022.

Dondi's Astrarium, Padua

Although the "Copernican" (heliocentric) orrery is often cited as being an English invention of the first decade of the 18th century, this isn't correct. In 1629, the Dutch philosopher and scientist Isaac Beeckman, a heliocentrist and friend of Descartes, wrote,

> He who wishes to do the same [referring to an armillary sphere] for the planets as is done for the fixed stars, let him make for himself a sphere of iron copper filaments, in which all the planets are distant from one another according to true proportion, either fixed in circles or in straight lines; and let the Sun (if it seems) be the center, and let the fixed stars be fixed in the macrocosm.
>
> Having arranged these in this way, you will be able to display the sky for any moment as it really is, and to see clearly all the phenomena of the world, which are difficult to comprehend by thinking alone; the uneducated will look at these things with great pleasure, and they will have no difficulty understanding those things which now they cannot grasp in any way.
>
> I intend to make this sphere, and a sufficiently large one, at some time. I think that Archimedes, according to an edition of Hero, made one like this and covered it with glass, but by no means [was it] perpetually movable. The common people, however, marveled at this instrument of his more than reality, and said that it was equal to the great world in all things.

Beeckman's acquaintance, the prolific cartographer and globemaker Willem Janszoon Blaue, made several orreries and was granted a patent in 1634. The base of his device has a celestial map with star positions by Tycho Brahe, taken from *Institutiones Astronomicae Geographicae* by Adriaan Metius, one of the most popular astronomy books of the day. A copy is seen on the table in Jan Vermeer's painting *The Astronomer*. See the January 2011 SkyWAAtch, page 3) for a bit more on this famous work.

Willem Janszoon Blaue: Orrery (Tellurium) (1634) Dutch National Maritime Museum, Amsterdam

Blaue's orrery was driven by a crank. There are at least four of these orreries still in existence, all given

an updated star chart in 1650, 12 years after Blaue's death. One of them, now in the Museum - Natural History Collection in Waldenburg, Germany, was modified around 1690 with a spring-driven clockwork drive.

(L) Sphaera Copernicana, (R) Orrery within the Sphaera

Another mechanical model of the solar system, the *Sphaera Copernicana*, was made by in the 1650's by Andreas Bösch of Limburg for Duke Friedrich III of Gottorp in Schleswig-Holstein, near Germany's border with Denmark. It is now on display at the Danish Museum of Natural History at Frederiksborg Castle, 20 miles north of Copenhagen. This device is an armillary sphere with zodiacal constellation figures mounted on the metalwork. A mechanical Copernican solar system orrery sits within it, the gears plainly visible. On top of the sphere is a small globe that moves in Ptolemaic fashion, perhaps a bone thrown to those few in the Duke's court who had not yet been fully won over by heliocentrism.

Leiden Sphere

In 1670, clockmaker Steven Tracy built a mechanical solar system for the mayor of Rotterdam. The device, known as the *Leiden Sphere*, has a band with zodiac figures along the ecliptic. It is on display in Leiden at the Rijksmuseum Boerhaave, which holds one of the world's most important scientific and medical history collections. A three-dimensional anaglyph image of the device can be viewed at https://is.gd/LeidenSph.

In 1703, the great astronomer, telescope maker and heliocentrist Christiaan Huygens published details of a mechanical device that that he said he built thirty years earlier. He calculated the gearing necessary to reproduce the solar ("tropical") year of 365.242 days. The device itself no longer exists. Englishmen George Graham and Thomas Tompion made a mechanical orrery in 1704 possibly based on Huygen's information. The History of Science Museum at Oxford has an orrery made by Graham and Tompion dated 1710. It displays the Sun, Earth and Moon, with the Earth rotating on its own axis at the proper inclination.

Orrery by Graham and Tompion from 1710. History of Science Museum, Oxford, UK

John Rowley, a London instrument maker, was commissioned in 1713 to make versions of the Graham and Tompion device for Prince Eugene of Savoy and Charles Boyle, 4th Earl of Orrery. The Earl, an intellectual, classist, writer, soldier and statesman, had been elected to Fellowship in the Royal Society in 1706. His collection of scientific instruments now resides in the London Science Museum. Somehow the Duke's name stuck to the device. It could have just as easily been called a "savoy," but such are the vagaries of history.

Rowley's orrery for the Earl of Orrery, 1713. Science Museum, London

Orreries of greater or lesser sophistication and accuracy have been made since then. Perhaps the most elaborate is the grand orrery that was presented to King George II in 1733 by clockmaker Thomas Wright of London, who had modified and improved it from an unknown maker.

The Grand Orrery for King George II by Thomas Wright, 1733. Science Museum, London

Standing on a wooden pedestal, this large (three feet in diameter) intricate machine shows, the Sun, Earth and Moon, all the classical planets the Galilean satellites of Jupiter and the five moons of Saturn that were known at the time. All of the planets and moons are geared and move in appropriate synchrony, powered by a hand crank. This orrery, or one based on it, is the model for the one in Joseph Wright of Derby's painting.

A 1740 orrery by Thomas Wright. Like the grand orrery, it was made for George II. Science Museum, London.

A similar grand orrery is displayed in the Harvard Collection of Historic Scientific Instruments in Cambridge. It was constructed between 1776 and 1788 by Boston clockmaker Joseph Pope, with contributions by several other artists, among them the silversmith Paul Revere. This device has an interesting history. It was nearly complete when a fire in Boston reached Pope's workshop. The orrery was saved from the flames at the last moment. Fellows of the American Academy of Arts and Sciences investigated the device, noting "While the ingenuity of the artist displayed in the workmanship pleases, the plan itself so perfectly executed, excites admiration." They suggested that Harvard College purchase the orrery. Pope wanted the then-enormous sum of £450, which Harvard felt was too high, so the Academy petitioned the General Court of Massachusetts to hold a public lottery to raise the funds. The lottery returned £71 above the purchase price, money that was used for additional scientific equipment at Harvard.

Elyse at the Grand Orrery, Harvard, January 2020

A device showing just the motions of the Earth/Moon system around the Sun is properly termed a *tellurium.* An *orrery* shows the inner planets (Mercury and Venus), while a *grand orrery* shows all the known planets and their satellites. Sometimes the term *planetarium* is used, but we now usually reserve that word for a domed chamber in which images of the stars and planets are projected. *Orrery* has taken its place as the generic term for all mechanical devices that show planetary motion around the Sun, even if restricted to the Earth/Moon system. One of the challenges for orrery makers after 1781 was to include Uranus and to include Neptune after 1845. From

1930 to 2006, a true grand orrery would properly include Pluto although the IAU has simplified modern grand orrery construction by demoting Pluto.

Art museums and history of science museums are filled with 18th and 19th century orreries, many intended for an upscale clientele. The Metropolitan Museum of Art has just one orrery on display. It was made in 1790 by Louis Thouverez, who was clockmaker to the Duke of Orleans. Thouverez' career was cut short by another device whose genesis was considered to be scientific, the guillotine.

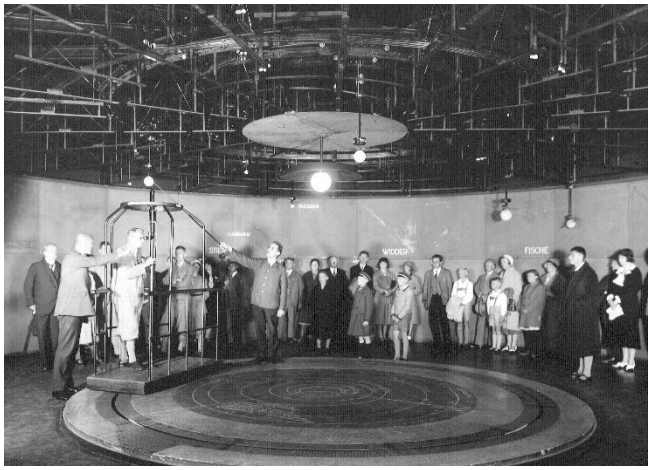
Thouverez orrery

Most of us have encountered simple table-top orreries during our early educational years. We see the actual planets in the sky, though. Why not put an orrery overhead?

The Eise Eisinga Planetarium

Between 1774 to 1781, Eise Eisinga, a Dutch wool comber and amateur astronomer, built an orrery on the ceiling of his living room in the town of Franeker, in Friesland, the northern part of the Netherlands. The pendulum-driven Eise Eisinga Planetarium is built to a scale of 1 mm=1 million km. The planets and the Moon revolve around the Sun on wooden gears and shafts at their actual rates (Saturn takes 29 years to circle the ceiling). It still works. Willem I, Prince of Orange and first King of the Netherlands, purchased the house and turned it into a museum. It's by far the oldest working planetarium in the world. As an aside, the great astronomer Jan Oort was born in Franeker although he moved to Leiden at the age of three.

German industrialist Oskar von Miller was director of Bavaria's largest electrical company, AEG, and was primarily responsible for electrifying southern Germany. He wanted to establish a national technical museum that would include displays about astronomy. He was advised by the noted German astronomer and pioneering astrophotographer Max Wolf, who was also interested in outreach and education. Wolf encouraged Miller to build a mechanical model of the night sky. Light pollution, for which in a sense Miller was responsible through his commercial ventures, was already making stargazing difficult in Munich. The Copernican Planetarium at Munich's Deutsche Museum, constructed in 1913, was a room-sized orrery. Rather than seeing the solar system only from the outside, as all previous orreries required, the viewer could see the planets from Earth's perspective. One mounted a platform representing the Earth to view the lighted planets through a periscope whose objective was in the model's ecliptic plane.



The Copernican Planetarium in Munich

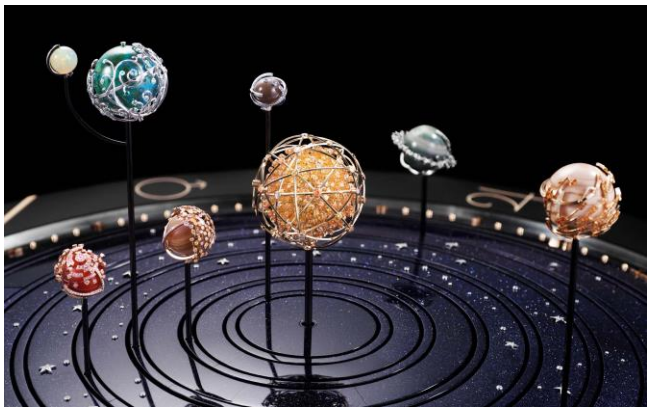
It was a clever design but inefficient, since only one viewer at a time could have the proper experience. The Copernican Planetarium was destroyed in the allied bombing of Munich in 1944.

The Copernican planetarium was reproduced, without the complication of a moving observer and a periscope, in the Copernican Room on the first floor of the original Hayden Planetarium, constructed in 1935, As many of us experienced in our youth, when

the sky show was about to begin attendees were admitted to the room, which was below the actual star theater. The ceiling orrery had lighted spheres for the planets and their satellites. A disembodied voice introduced the solar system, after which the audience went upstairs to the actual sky show, with its live docent controlling the miraculous Zeiss projector.

The Copernican Room at the Hayden Planetarium

Orreries are available for purchase, ranging from the cheap and simple to the expensive and elaborate. An internet search reveals a startling number of designs. Expensive modern grand orreries often include Uranus and Neptune, and one even has Pluto. There's a two-foot diameter version of Wright's grand orrery for King George II that can be yours for $18,000.

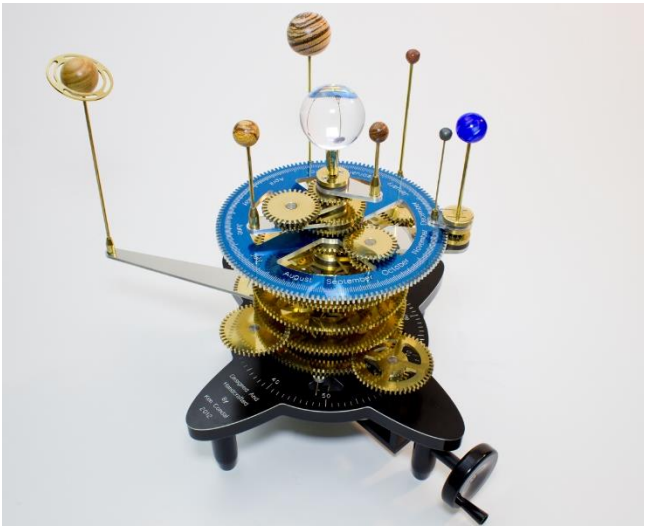


Van Cleef and Arpels *Planétarium Automaton*

In 2022, the Parisian jewelry house Van Cleef and Arpels announced the *Planétarium Automaton*. It has gold and gem encrusted planets (up to Saturn, whose rings are made of gold and diamonds) and even a comet. Alas, the 26-inch diameter chiming, musical perpetual clock *cum* orrery is not a scientific or educational device but only an *objet d'art*: "Every second planet moves in the opposite direction to their (*sic*) natural orbit, bringing a fairy-tale poetry to the ensemble" says the description. Conservation of angular momentum, anyone? The price is "on request." Expect to pay several million dollars for this over-the-top toy. Read about it and watch fantastic videos at https://is.gd/vcabauble and https://is.gd/vcayt.

On-line you can find plans and kits for do-it-yourself orreries using paper, foamboard, plywood, 3D printing and even Legos. Add diamonds if you wish.

Making a classical orrery from scratch requires modern metal-working machinery and the know-how to plan, design, cut and assemble brass gears and other metal parts. On YouTube, machinist Ken Zeamon, using the powerful gear design software Gearotic, shows how the gear train is organized (https://is.gd/zeamon). Zeamon's web site zeamon.com has complete plans and detailed construction videos for making the orrery. After seeing these videos, I can only marvel at how clockmakers of the past, with pen and paper and without sophisticated, computerized machine tools, were able to construct their elegant brass-geared devices.



Zeamon's orrery

The mechanical orrery is still very useful to teach basic concepts of the solar system. For the modern astronomer, it's been replaced by software. Programs such as SkySafari and TheSky allow you to animate the solar system and observe it from any location at any time. Seeing model planets and moons rotate around a miniature Sun gives new learners a more intuitive perspective, though. For experienced astronomers it's a delicious atavistic treat. ■

Images by Members

The Double Cluster by Rick Bria

The beautiful Double Cluster delights both beginners and experienced observers. Rick made this image with the Mary Aloysia Hardey's Televue 85 refractor and a Canon 60Da DSLR. He stacked 106 60-second images. The field of the image is 2.08 x 1.34 degrees

Rick writes:

> The Double Cluster is located 7000 light years away in the constellation Perseus. Like all star clusters, the Double Cluster formed long ago from the collapse of giant clouds of gas and dust. Each cluster contains about 200 stars of varying sizes and temperatures.
>
> The year 2022 has seen dramatic changes in **PixInsight** Image processing software. An important new processing module, **Spectra Photometric Color Calibration**, produces precise astronomical image colors. This accuracy would not be possible without the latest Gaia star catalog data release. The catalog contains about 1½ billion stars measured by the European Space Agency's Gaia satellite. The Gaia star catalog lists a star's position, proper motion, and spectral color to an accuracy exceeding any previous catalog. Image processing software using the Gaia catalog data can now represent broadband color astronomical images with superior color.
>
> Check out the color of the stars in this Double Cluster image. I won't say this is a **true color** astronomical image. There will always be obstacles obtaining **true color**. But Spectra Photometric Color Calibration is an amazing new tool on the road to true color.

The Double Cluster is a pair of open clusters, listed as NGC 869 [left] and NGC 884 [right] which are close together in the constellation Perseus. Their centers are about half a degree apart.

Christmas Eve Conjunction by Steve Bellavia

Steve captured the triangle of the waxing crescent Moon, Mercury and Venus in the gloaming at 5:16 p.m. on December 24th from New Suffolk on Peconic Bay in eastern Long Island. He used a Canon DSLR with a Sigma 70-300 Zoom lens at 70 mm. The Sun had set at 4:29 p.m.

Here's the data for these three objects:

Object	Altitude	Airmass	Magnitude	Phase
Moon	3° 35'	13.4	-3.73	3.4%
Mercury	5° 42'	9.3	-0.3	91%
Venus	2° 29'	17.2	-3.9	21%

The Moon-Venus separation is 6.5°, Moon-Mercury separation 4.5° and Mercury-Venus separation 4.25°.

The airmass is the thickness of the atmosphere at any given elevation, relative to the zenith, at which it is 1.0. At the horizon the airmass is approximately 38. Determining the actual amount of atmospheric extinction is more complicated than just estimating the atmospheric thickness. Factors such as the elevation of the observer, the density of particulates, the amount of ozone, atmospheric temperature and other subtle effects must be taken into account. In addition, there are effects on the apparent position of the object because of refraction. The formulas are complex but calculations are always approximations. Atmospheric extinction and refraction vary by wavelength, the latter phenomenon called "atmospheric dispersion," often seen by amateurs when looking at planets near the horizon. A bluish tinge is seen at the top of the object and a reddish tinge at the bottom. [ZWO makes a filter that attempts to compensate for dispersion with two thin prisms that can be moved across each other.] All these factors must be considered by research telescopes that are observing objects near the horizon. And of course the more atmosphere there is, the greater the challenge to the seeing as thermal turbulence disrupts wavefronts.

In the case of this conjunction, just enjoy Steve's lovely photograph.

Comet C/2022 E3 ZTF by Steve Bellavia

Steve imaged the comet on February 8th, just one week after its closest approach to Earth, a distance of 42 million km (26 million miles). It reached magnitude 5 at closet approach and was about 6 when this image was obtained. Steve wrote: "I went to Orient Point to observe and image the comet. This was by far the best view I have had with binoculars. (Celestron Skymaster Pro 15x70). I could easily see the fan-shaped tail and the coma was huge. I had not seen any evidence of a tail until tonight. I also viewed it on many other nights, closer to the reported 'peak' but it was much better tonight." The gas and ion tails are visible in the image.

The green color, visible on photographs and perhaps in very large telescopes (but not with the naked eye as apparently hyped by the media), is due to diatomic carbon, C_2. This unstable compound is found in carbon vapor. It is highly chemically reactive and can polymerize to form fullerenes. The green color comes from a particular configuration of electron energy levels, the triplet state, that emits a photon with a wavelength of 518 nm when the electron drops to a lower energy.

His image that evening shows the comet close to Iota Aurigae, common name Hassaleh, a 2.69 magnitude K3 star. The field is 1.98 x 1.32 degrees. As usual, Steve posts detailed technical information on Astrobin, for this image go to https://www.astrobin.com/18581m/. He also posted a series of images that document the rotation of the comet's tail as it moved through the sky. See https://www.astrobin.com/dxkpr1/. Steve also made a nice video about the comet that can be seen at https://www.youtube.com/watch?v=EiGPHMaIG34.

From light-polluted Westchester, the Editor viewed the comet the same night with an 8-inch SCT. Visually it was a fuzzy asymmetric blob with a brighter, star-like coma.

It is thought that the comet, which originated in the Oort Cloud, had an orbital period of about 50,000 years, but its outbound orbit can't be accurately predicted, and it may very well be ejected from the solar system.

The Pleiades by Olivier Prache

Olivier collected data over two nights, for a total of 7.5 hours, with a Celestron RASA-8. The Pleiades are moving through a dust cloud that the stars encountered long after they were born. This image shows a substantial amount of light-reflecting dust beyond the periphery of the cluster. The whole Pleiades-Hyades region in Taurus, as well as in surrounding constellations, is embedded in the Taurus Molecular Cloud, the nearest star-forming region to Earth. For more on the Pleiades, see the February 2021 Sky*WAA*tch, page 15.

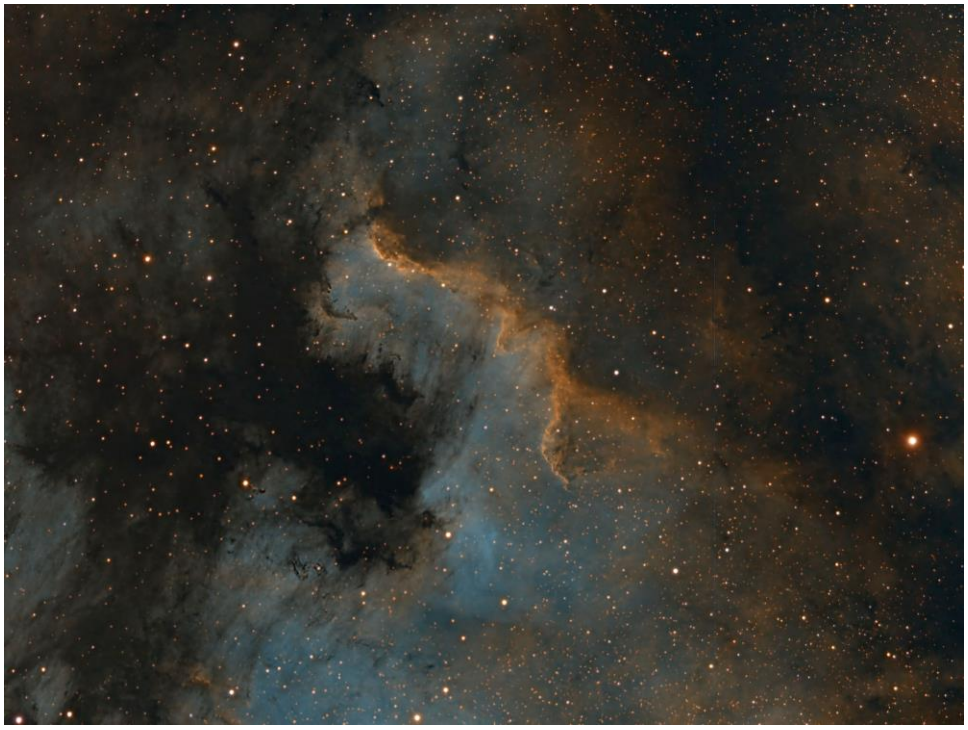
NGC 7541 & NGC 7537 by Steve Bellavia

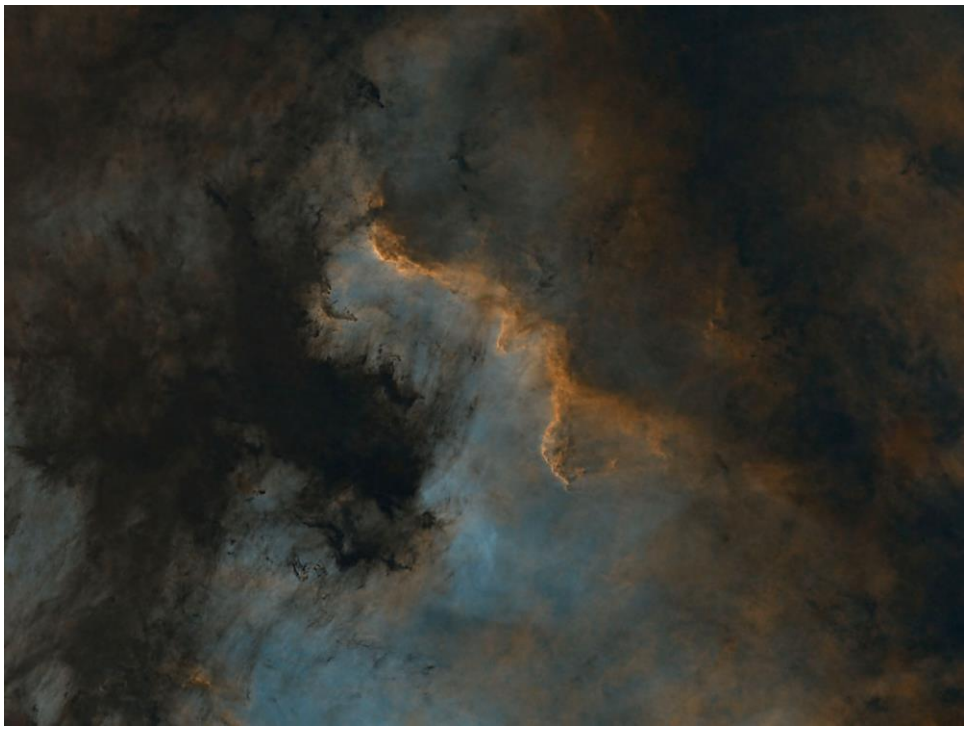
This pair of small spiral galaxies lies just off the "head" of the western fish of the constellation Pisces. NGC 7541 is magnitude 11.7, while the smaller NGC 7537 is magnitude 13.2. They are probably, but not certainly, a true pair, at a distance of 33 Mpc (107.5 light years).

TSO 115 mm refractor, ASI294MM camera, 4 hours of data through LRGB filters. Orient Point, NY.

The field size, cropped from Steve's original image, is 13.3 x 11.5 arcminutes (determined with plate solving on astrometry.net).

Cygnus Wall, With and Without Stars, by Bill Caspe





Stars sometimes seem annoying, flitting around subtle, colorful nebulas like so many mosquitos around a light. The Photoshop add-on StarEXterminator ($) or the standalone StarNet++ (free) removes stars, leaving the diffuse gases for closer observation.

Obviously this is nature as she never intended it, and it has both scientific and aesthetic rationales and criticisms. From a scientific standpoint, it allows us to see nebulas with less distraction. The image's three-dimensional quality seems somewhat more marked. From an aesthetic point of view, well, *chaçun à son goût.*

Your Editor's prefers, when possible, to present an astroimage in which the stars have been removed adjacent to the original processed image, as we've done here. It provides the most information and the most value.

The Cygnus Wall is the part of the North American Nebula that resembles Mexico and central America.

Bill does narrowband imaging from his backyard in Scarsdale, as well as at various star parties and retreats.

Two Galaxies by Arthur Miller

NGC 2775

[Caldwell 48]

Spiral galaxy in Cancer

Magnitude 10.4

Distance 67 million light years

Messier 101

[NGC 5457]

Spiral galaxy in Ursa Major

Magnitude 7.9

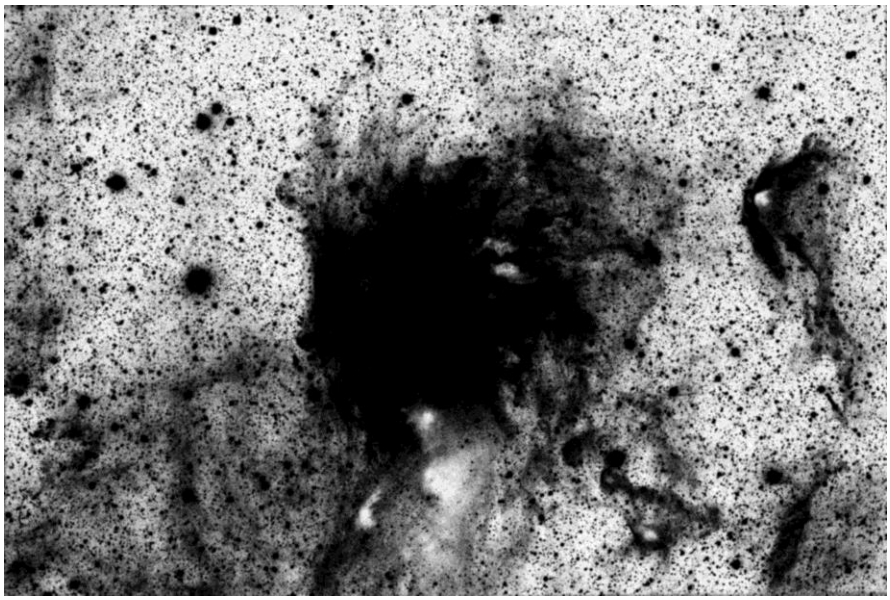
Distance 20.9 million light years

Imaged with an Celestron 11-inch SCT from Quail Creek, Arizona (south of Tucson).

A Dusty Iris by Robin Stuart

Robin writes:

The Iris Nebula (NGC 7023) lies 1,400 light years away in the constellation of Cepheus. Light from the 7.3 magnitude star (HIP 103763) lying at its heart is reflected off tiny dust grains and takes on a bluish tint by the same Rayleigh scattering mechanism that makes the sky blue. The dust clouds are slightly brighter than the background sky and their extent is shown by the range mask (right) in which brightness levels above a specified cutoff are black. Although its visual magnitude is listed as 6.8, its size and low surface brightness can make it difficult to spot in a small telescope.



The image is a stack of 19 10-minute subframes, giving a total exposure of 3h 10m. It was taken in Eustis, Maine over three nights in October 2022 with a ZWO ASI2600MC camera on a Televue NP127 refractor.

Research Highlight of the Month

Farrah, D et al (19 authors), Observational Evidence for Cosmological Coupling of Black Holes and Its Implications for an Astrophysical Source of Dark Energy," *Astrophysical Journal Letters* 2023; 944 L31.doi:10.3847/2041-8213/acb704

By now you probably have heard about this remarkable paper, perhaps the first real observational result that (might) explain the nature of dark energy. It links two seemingly unrelated mysterious features of our universe: accelerated cosmic expansion and the internal structure of black holes. Theoretical physicists and cosmologists have recognized that the most commonly accepted formulations black hole structure don't fit with certain requirements of general relativity (GR). In particular, Kerr black holes, which contain a central singularity, appear to violate the requirement of GR for a boundary condition at infinity (see the May 2022 SkyWAAtch page 5 for a bit more on this). It's an obscure and complex criterion, but one that suggests that a black hole should not contain a singularity, an ugly phenomenon that physicists and cosmologists abhor. Papers dealing with this question are esoteric, mathematical and not very relevant to mainstream astronomy, which tends to focus on the behavior of black holes in normal space (creation, mergers) and most recently on imaging (M87, Sgr*).

At the same time, the accelerated expansion of the universe, first detected in 1998, has run up against its own theoretical wall. The best explanation is "dark energy," an inherent property of space, but beyond that we don't know its source or how it really works. The most obvious explanation, that it arises from the creation of virtual particles, is wrong by 120 orders of magnitude.

But what if the expansion of the universe and the inside of black holes were somehow coupled? This remarkable suggestion was tested by observing the size of black holes in elliptical galaxies from various epochs, going back as far as z=2.5, and extrapolating the results back even farther, to z=7. Using data from the WISE, SDSS and COSMOS galaxy surveys, the authors measured the masses of galactic central black holes. The black holes would not be enlarging by accretion, because star formation had stopped (a property of elliptical galaxies) and so no gas would be available for them to ingest. Corrected for size, ellipticals at lower red shifts should have similar mass central black holes as higher *z* ellipticals. They didn't. Their black holes were more massive.

The universe was expanding after the Big Bang, but there were no black holes until stars and galaxies first appeared around *t*=100 million years. When black holes finally did start forming, their interiors had to have the properties of space-time. The authors propose that the stress-energy (the source of the gravitational field in GR) in the interior of a black hole, and therefore its mass, is affected by external expansion. Big Bang expansion increases black hole stress-energy. The early black holes grow in mass and in doing so create a form of pressure that accelerates expansion outside the black hole, and that expansion ultimately further increases the black hole's mass. We see that as dark energy, but all the action is within the black hole. It's still pretty mysterious, and perhaps all that's been done is to move the true mystery inside the black hole's event horizon, where we can never hope to see it (but we could calculate it!). But it would get rid of the horrid singularity.

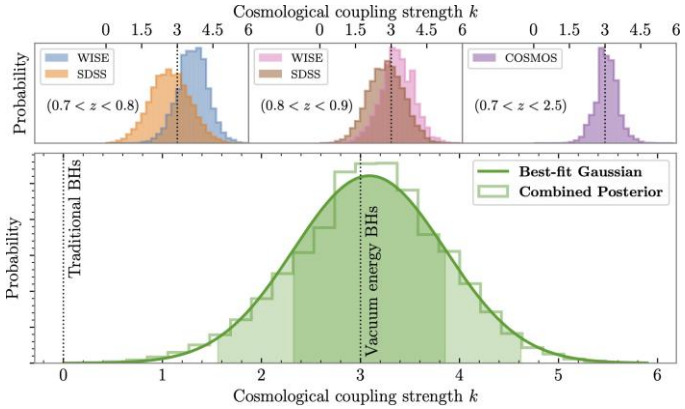


Fig 1 from the paper. The "coupling strength" *k* is a measure of the rate at which the mass of the black hole changes over time, as measured by looking at elliptical galaxies at different red shifts. It depends on the scale factor *a* (for more on the scale factor, see the December 2020 SkyWAAtch, page 11). A value of *k*=3 means the interior of the black hole contains vacuum energy. It would be zero if a singularity were present.

Member & Club Equipment for Sale

Item	Description	Asking price	Name/Email
Orion Starblast 6-inch reflector NEW LISTING	Orion's famous 6-inch f/5 table-top Dobsonian. reflector. All original with red-dot finder, 25-mm and 10-mm Orion Plossl eyepieces, hex wrenches, tube rings, mount, bolts, manual. Optics are pristine; tube has a couple of very minor blemishes. Orion's image is here.	$325	Larry Faltz lfaltzmd@gmail.com
Celestron 127-mm Maksutov-Cassegrain	f/11.8. Celestron's version of this compact, high-performing telescope. Great lunar/planetary scope. Excellent optical and cosmetic condition. Well cared for. OTA only. Image here.	$400 or best offer	Manish Jadhav manish.jadhav@gmail.com
Orion Short Tube 80mm refractor	2-element achromat f/5.0. Metal tube rings and dovetail for Vixen saddle. A classic travel scope. Excellent optical condition, and very good cosmetic condition. Diagonal and a 25mm Celestron eyepiece included. Image here.	$200 or best offer	Manish Jadhav manish.jadhav@gmail.com
Celestron Cometron telescope	Small, lightweight 114 mm f/4 reflector. Red dot finder, 25 mm eyepiece. Dovetail bar. A starter scope for a smart, interested child. No tripod: use a camera tripod. Excellent condition.	$50	WAA Ads@westchesterastronomers.org
Meade 8" SCT LX-80	Go-to mount, tripod. Tube wrapped in Reflectix for faster cooling. See https://is.gd/16F0Tv.	$600	Greg Borrelly gregborrelly@gmail.com
Celestron SE mount	No optical tube. Go-to alt-az mount and tripod. Can carry 12 lb payload or tube up to 17". Upgradeable hand control.	$300	Greg Borrelly gregborrelly@gmail.com
Celestron Binoviewer	Use both eyes with your telescope. Original case, with two 18-mm eye pieces.	$180	Greg Borrelly gregborrelly@gmail.com

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

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