L.A.S.
Lima Astronomical Society

STAR GAZER

Night Sky Network
Astronomy clubs bringing the wonders of the universe to the public

Member of the Astronomical League and the NASA Night Sky Network

November 2022

Lima Astronomical Society • PO Box 201 • Lima, OH 45802

Schoonover Observatory • 670 N. Jefferson St. • Lima, OH 45801

SOCIETY NEWS AND EVENTS

MONTHLY MEETINGS

Board Meeting – November 4 @ 7:00 p.m.
Members Meeting – November 4 @ 8:00 p.m.
Held at Schoonover Observatory

Program and Observing

An astronomy-related video or presentation will be provided along with open discussion. A telescope will be set up for observing (weather-dependent).

ANNOUNCEMENTS & UPDATES

The first 2023 officer nominations were made at the October meeting. Nominations will continue during the November and December meetings, with the election being held at the December meeting after nominations close.

No additional information has been obtained about equipment that disappeared during the August burglary at Schoonover Observatory. Club leadership is working on solutions to replace the stolen equipment, and additional security measures are now in place.

The new operating agreement between the club and the City of Lima has been signed by the club and delivered to the Mayor's office. Additional information on this will be discussed at the November meeting.

The third launch attempt of NASA's Artemis program will be held on November 14, with the launch window beginning at 12:07a.m. Eastern time. The observatory may be open for a launch watch event. Keep an eye on social media for details as we have not yet confirmed this event.

UNDER THE DOME

The club participated in STEAM on the Quad at OSU Lima on September 25. The annual event hosts a variety of organizations that aim to increase interest in the sciences for grades K-8. Some of the exhibits were a hands-on comparison of the mass of the planets, demonstrations of the scale distance of the Earth to the Moon, a comparison between different types of telescopes, a "birthday stars chart", and a wide-variety of age-appropriate educational materials that families could take home.

On October 1, the club co-hosted International Observe the Moon Night with JAMPD at Kendrick Woods. David Humphreys held an in-depth presentation on the Moon using JAMPD's new mobile display system.

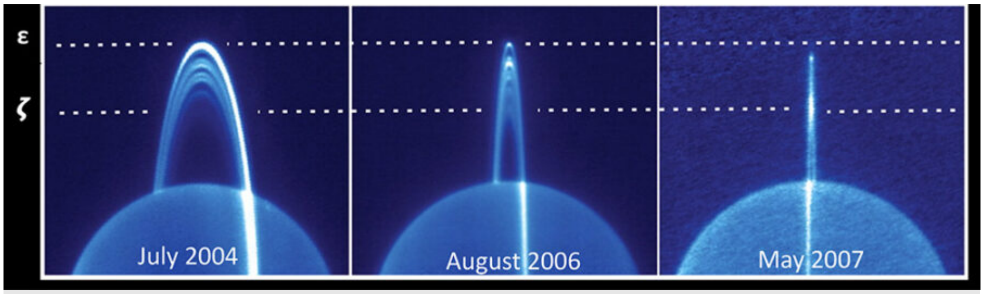
Lima Astro brought telescopes for observing, and some attendees brought their telescopes as well. Aside from a few clouds, it was a star party with good observing and a few meteor sightings mixed in.

Visit us on the web: LimaAstro.com Follow us on Facebook: Lima Astronomical Society

This edition of the *Star Gazer* was compiled by Joshua Crawford.
Please forward comments, suggestions, or to unsubscribe/subscribe to this newsletter to crajos@gmail.com.

AMATEUR FINDS NEW IMAGES OF URANUS' RINGS IN 35-YEAR-OLD DATA

SkyAndTelescope.org



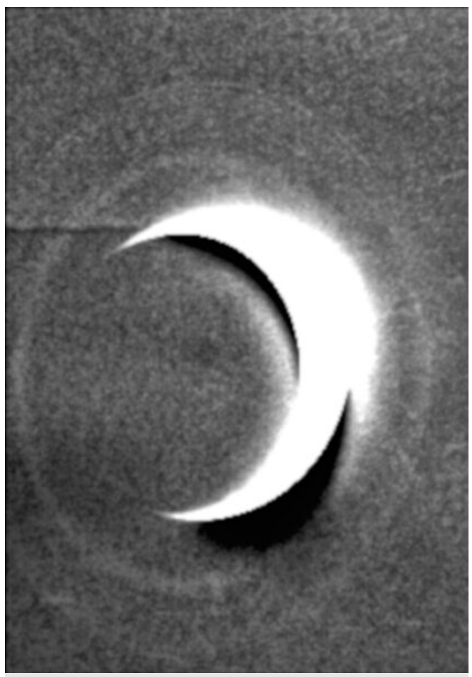
These images, taken by the Keck Observatory in 2007, showed a new ring around Uranus, designated zeta (ζ). The ring was only visible during certain times due to the changing angle of the Sun's illumination.

Only two Voyager 2 images contain clear views of Uranus' dusty ring system — or so we thought. Since Voyager 2's 1986 flyby, only ground-based telescopes have yielded views of the rings. Images taken by the W. M. Keck Observatory in 2007 suggested that one of the ice giant's dusty rings, the inner zeta ring, might have changed in brightness and position since 1986.

But it was hard to be sure, because Keck's and Voyager's points of view were so different. Keck can only see the rings illuminated directly by the Sun, like a full Moon, because Earth is near the Sun; the Voyager photos showed the rings from the other side, lit up like dust motes in a sunbeam.

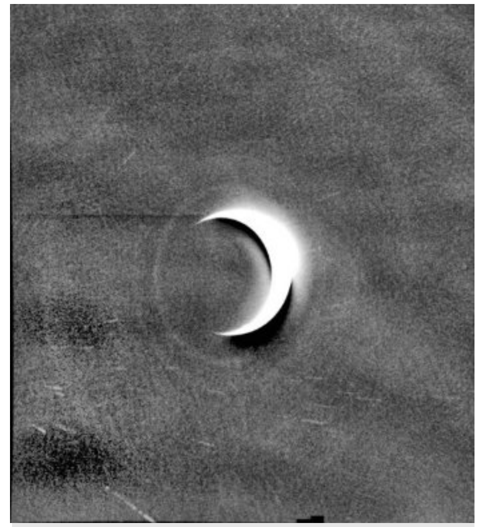
Then Ian Regan, an image-processing enthusiast, asked himself: If there are so many Voyager lookback images of dusty rings at Jupiter, Saturn, and Neptune, why not Uranus? About a year ago, he went to the NASA Planetary Data System (PDS) archives to see if there were more Uranus ring images than had been previously known.

By stacking and enhancing a large set of images using free software tools, he discovered three very faint rings not previously observed in the 35-year-old data: the outermost "mu" ring, which he describes as "a narrow sheet of dust sandwiched between the lambda and delta rings," and the elusive and enigmatic zeta ring. The latter, he says, is "a broad sheet of dust discovered during the flyby in a single frame shuttered near closest approach."



In this newly reprocessed Voyager 2 image, Ian Regan got his first look at the zeta ring around Uranus, which shows up a faint circle outside the crescent planet.

Regan shared his newly processed data on Twitter. Southwest Research Institute planetary scientist Tracy Becker, who follows Regan on Twitter, forwarded the images to rings scientist Matthew Hedman (University of Idaho), who is not on Twitter. At the Division for Planetary Sciences meeting on October 3rd, Hedman showed the images in a talk coauthored by Regan and Becker, along with a few others. The team now realizes that the zeta ring is visible in additional Voyager images, Hedman said.



In this wider view, three rings around Uranus become visible, designated (from inside out) zeta, lambda, and mu.

"These data not only confirm that the location of the peak brightness in the zeta ring did indeed change between 1986 and 2007," he added, "but also indicate that the total amount of material in this ring also changed substantially over that time."

These new observations make Uranus' ring system appear more similar to those of the other giant planets than it had previously, helping make sense of theories of ring system formation and evolution.

The topic of dust in the Uranus ring system isn't only an academic one. With a future mission to Uranus receiving priority in the latest planetary science decadal survey, engineers must consider practical questions of how to navigate a spacecraft safely around the Uranus system. We need to know where dust is — and especially, if it's moving to different distances from Uranus over time — to find safe passage across the ring plane, twice each orbit.

Regan's dusty find in dusty data will protect our future mission to Uranus.

Want to Give It a Try?

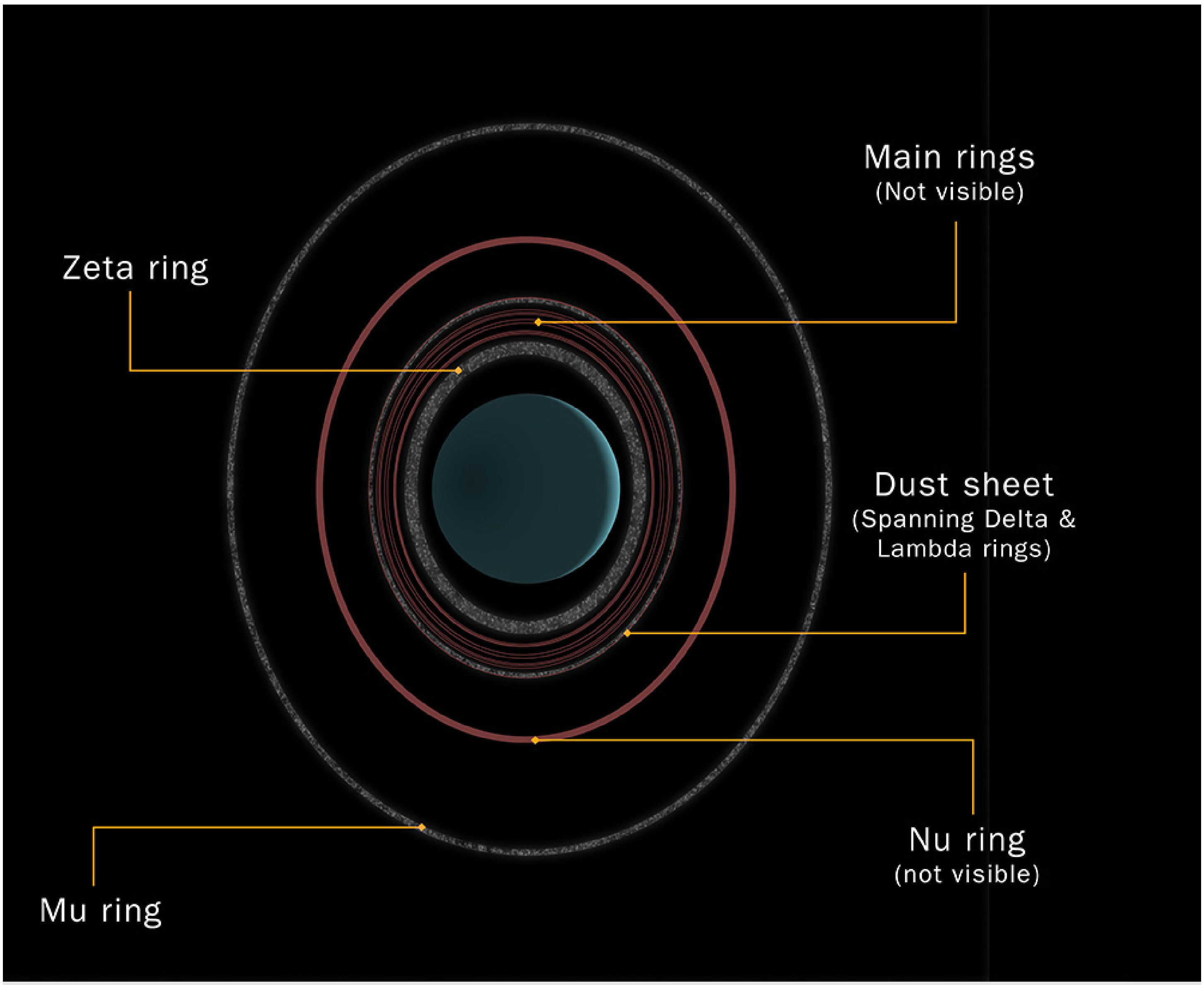
For readers interested in replicating what Regan did, or exploring the datasets for themselves, Regan kindly shared the following information about his processing:

I began digging through the [OPUS PDS portal](), looking for frames that might reveal even a marginal detection of the rings with some intensive image processing. The dataset I downloaded was a series of 164 Voyager ISS wide-angle frames, taken between 1986-01-26 (T18:01:33.00) and 1986-01-28 (T22:49:33.00), most of which were shuttered via the Clear filter.

I converted the calibrated Voyager frames using Bjorn's IMG2PNG applet, then begin feeding them through my own script in ImageJ: This is a semi-automated process that removes stripes and noise before geometrically rectifying each frame to account for the vidicon-induced distortion. Importing the frames into Paint Shop Pro, I used the spacecraft-planet distance information in the PDS metadata to resize the frames to a common scale, rendering Uranus the same size in all images.

Returning to ImageJ, I used the StackReg plugin to center the overexposed crescent of Uranus in each frame. The final step was to co-add (or sum) all 164 frames, producing a 32-bit greyscale final image product, with an integration time of 4 minutes, 51 seconds. At this point, I stretched the image as far as I could push it, and in doing so, revealed a faint band encircling Uranus. At first, I thought I had made a mistake—this 'band' was far too close to the planet to be any of the main rings that were discovered in 1977. However, a check on Wikipedia revealed I had stumbled across the elusive and enigmatic zeta ring: a broad sheet of dust discovered during the flyby in a single frame shuttered near closest approach.

Further stretching and processing revealed two other rings: the outermost mu ring, and [the zeta ring,] a narrow sheet of dust sandwiched between the lambda and delta rings.



This schematic diagram shows the whole Uranus ring system. ***Ian Regan***

SECRETS OF SATURN'S RINGS REVEALED BY THE SUN

[EarthSky.org]

Are Saturn's rings young, relative to the rest of the solar system? Did they form via the destruction of an icy satellite or comet? Are they a permanent feature of Saturn? Or will they someday cease to be? On October 18, 2022, astronomers announced a new study that's helping them probe the secrets of Saturn's rings. The astronomers used data from 41 solar occultations, events in which Saturn's rings passed in front of the sun as seen from NASA's Cassini spacecraft. This craft orbited Saturn from 2004 to 2017.

The observations provide clues as to the particle size distribution and composition of the rings. And those data, in turn, let astronomers deepen their understanding of how the rings formed, as well as what their ultimate fate might be.

The researchers – from the Southwest Research Institute, the University of Central Florida and the University of Colorado-Boulder – published their peer-reviewed findings in the December 2022 (Volume 388) edition of the journal Icarus.

Secrets of Saturn's rings

Scientists want to better understand the origins of Saturn's ring system. For example, how old are the rings? How did they form? Stephanie Jarmak from the Southwest Research Institute (SwRI) is the lead author of the new study. She said:

> *For nearly two decades, NASA's Cassini spacecraft shared the wonders of Saturn and its family of icy moons and signature rings, but we still don't definitively know the origins of the ring system. Evidence indicates that the rings are relatively young and could have formed from the destruction of an icy satellite or a comet. However, to support any one origin theory, we need to have a good idea of the size of particles making up the rings.*

Solar occultations help reveal secrets of Saturn's rings

To conduct the new study, astronomers used data from Cassini's Ultraviolet Imaging Spectrograph (UVIS). Previously, while Cassini was still orbiting Saturn, the UVIS observed the rings while also looking at the sun. Since the instrument was looking through the rings, the particles would partly block the light coming from the sun. This is known as a solar occultation. UVIS could then measure the optical depth of the particles.

How? In general, the particles absorb and scatter the light from the sun. The amount of light blocked tells scientists the optical depth of the particles. This data provided clues as to both the size and composition of the particles. Jarmak said:

> *Given the wavelength of the light coming from the sun, these observations gave us insight into the smallest particle sizes with Saturn's rings. UVIS can detect dust particles at the micron level, helping us understand the origin, collisional activity and destruction of the ring particles within the system.*

Clues about planetary formation

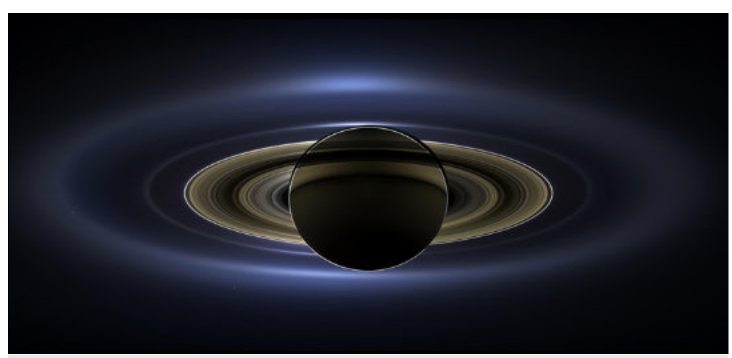
By observing the sun's light passing through the rings at various angles, the researchers can also learn more about the ring system's overall structure. In addition, those findings can also be applied to planet formation in general, too. As Jarmak explained:

> *Ring systems around giant planets also provide test beds for investigating fundamental physical properties and processes in our solar system in general. These particles are thought to result from objects colliding and forming in a disk and building up larger particles. Understanding how they form these ring systems could help us understand how planets form as well.*

Saturn's lost moon Chrysalis

Last month, scientists at UC Berkeley said that Saturn's rings likely formed when a former moon about the size of Iapetus, dubbed Chrysalis, broke apart after getting too close to Saturn. Ultimately, whatever was left of Chrysalis, that didn't fall into the atmosphere of Saturn itself, became the rings. Moreover, computer simulations showed that Saturn's largest moon Titan destabilized the orbit of Chrysalis, causing it to plunge too close to the planet.

A previous study in 2019 suggested that Saturn's rings are likely less than 100 million years old. While Saturn may be the jewel of the solar system now, it wasn't always!



Here we see Saturn's rings backlit by the sun. Cassini took this iconic image on July 19, 2013. Cassini looked through the rings toward the sun, and the particles in the rings created occultations. **Image via NASA/ JPL-Caltech/ SSI.**

CEPHEUS: A HOUSE FIT FOR A KING

DAVID PROSPER - NIGHT SKY NETWORK

Sometimes constellations look like their namesake, and sometimes these starry patterns look like something else entirely. That's the case for many stargazers upon identifying the constellation of Cepheus for the first time. These stars represent Cepheus, the King of Ethiopia, sitting on his throne. However, many present-day observers see the outline of a simple house, complete with peaked roof, instead – quite a difference! Astronomers have another association with this northern constellation; inside its borders lies the namesake of one of the most important types of stars in modern astronomy: Delta Cephei, the original Cepheid Variable.

Cepheus is a circumpolar constellation for most observers located in mid-northern latitudes and above, meaning it does not set, or dip below the horizon. This means Cepheus is visible all night long and can be observed to swing around the northern celestial pole, anchored by Polaris, the current North Star. Other circumpolar constellations include Cassiopeia, Ursa Major, Ursa Minor, Draco, and Camelopardalis. Its all-night position for many stargazers brings with it some interesting objects to observe. Among them: the "Garnet Star" Mu Cephei, a supergiant star with an especially deep red hue; several binary stars; several nebulae, including the notable reflection nebula NGC 7023; and the "Fireworks Galaxy" NGC 6946, known for a surprising amount of supernovae.

Perhaps the most famous, and certainly the most notable object in Cepheus, is the star Delta Cephei. Its variable nature was first discovered by John Goodricke, whose observations of the star began in October 1784. Slightly more than a century later, Henrietta Leavitt studied the variable stars found in the Magellanic Clouds in 1908 and discovered that the type of variable stars represented by Delta Cephei possessed very consistent relationships between their luminosity (total amount of

This historical diagram from Henrietta Leavitt's revolutionary publication shows the luminosity of a selection of Cepheid Variables on the vertical axis, and the log of their periods on the horizontal axis. The line drawn through these points shows how tight that relationship is between all the stars in the series. From Henrietta Leavitt and Edward Pickering's 1912 paper, "Periods of 25 Variable Stars in the Small Magellanic Cloud," a copy of which can be found at: ***https://ui.adsabs.harvard.edu/abs/1912HarCi.173....1L/abstract***

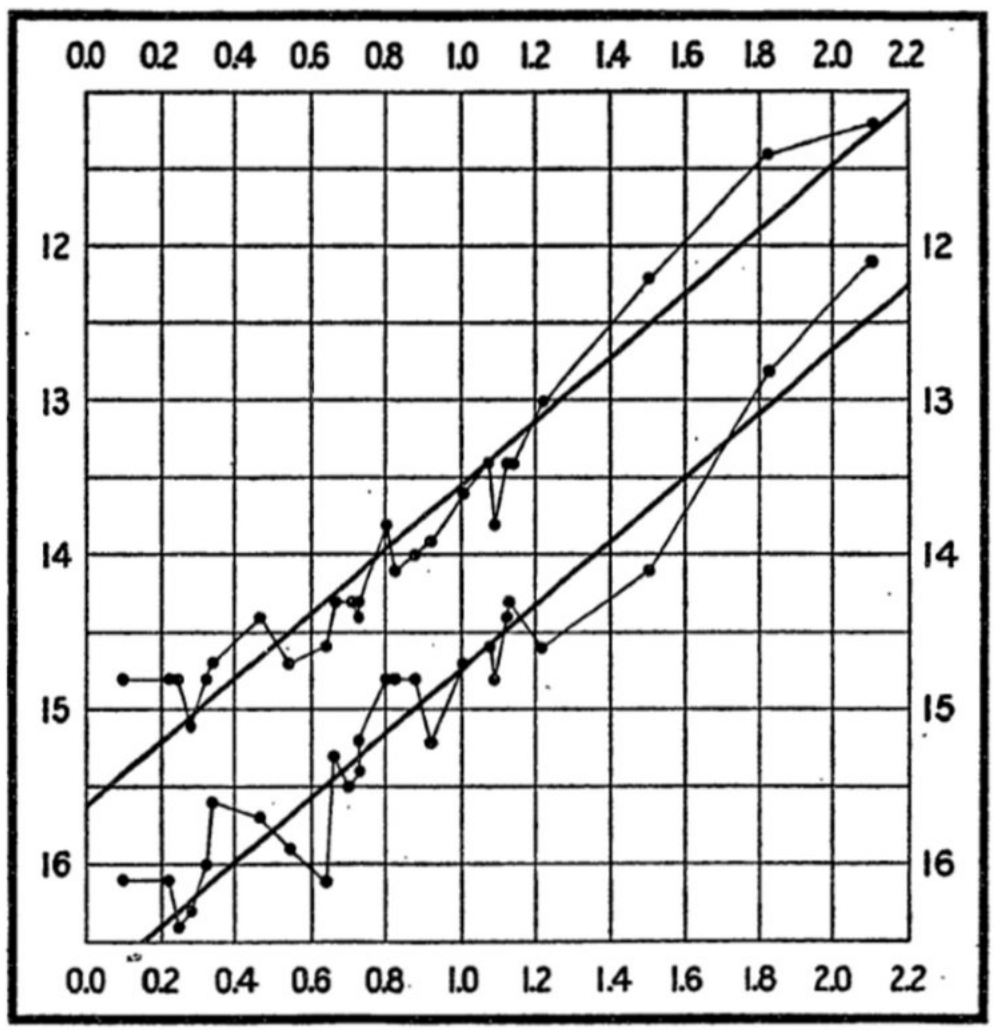
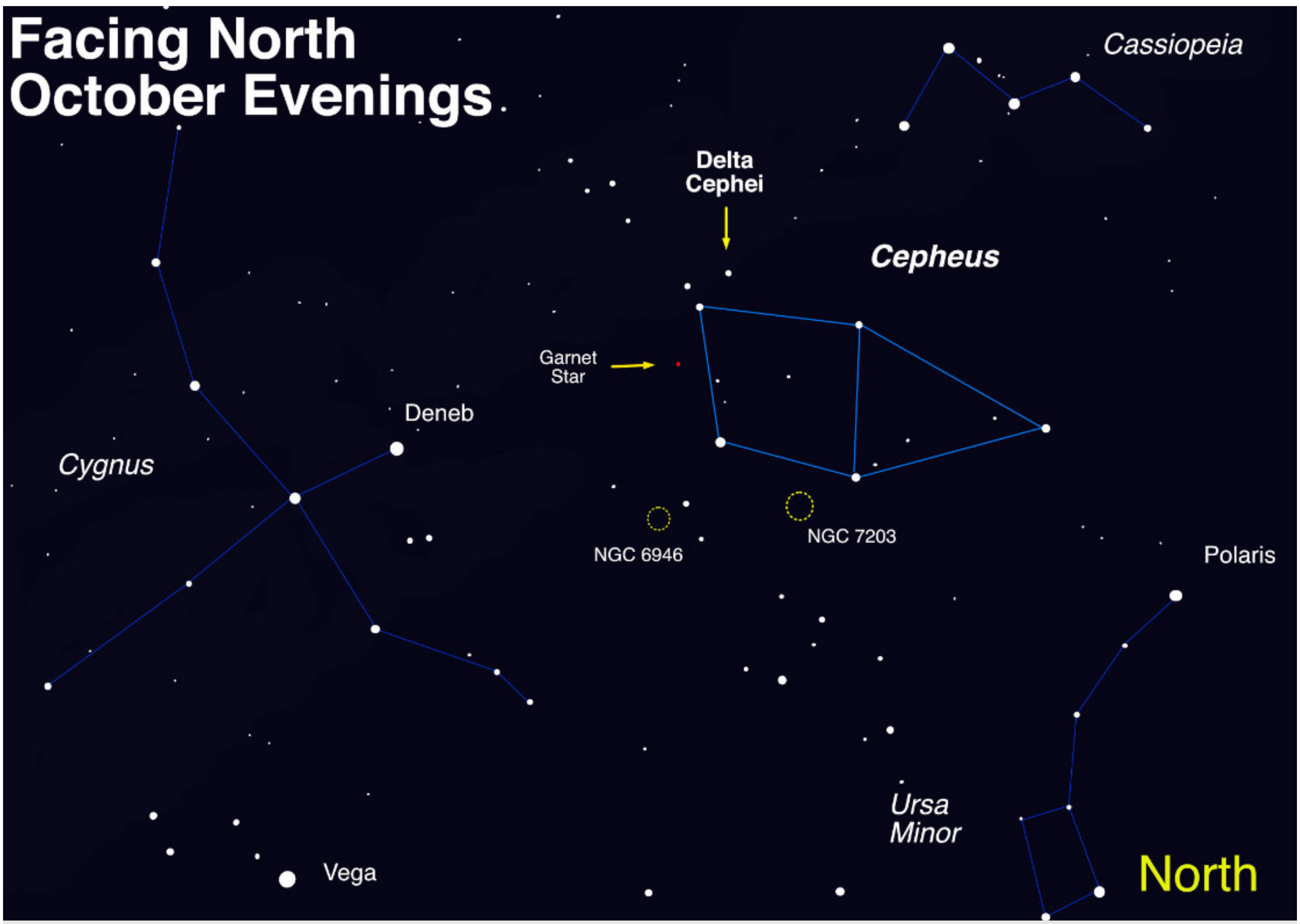


FIG. 2.

light emitted), and their pulsation period (generally, the length of time in which the star goes through a cycle of where it dims and then brightens). Once the period for a Cepheid Variable (or Cepheid) is known, its luminosity can be calculated by using the scale originally developed by Henrietta Leavitt, now called "Leavitt's Law.". So, if a star is found to be a Cepheid, its actual brightness can be calculated versus its observed brightness. From that difference, the Cepheid's distance can then be estimated with a great deal of precision. This revolutionary discovery unlocked a key to measuring vast distances across the cosmos, and in 1924 observations of Cepheids by Edwin Hubble in what was then called the Andromeda Nebula proved that this "nebula" was actually another galaxy outside of our own Milky Way! You may now know this object as the "Andromeda Galaxy" or M31. Further observations of Cepheids in other galaxies gave rise to another astounding discovery: that our universe is not static, but expanding!

Because of their importance as a "standard candle" in measuring cosmic distances, astronomers continue to study the nature of Cepheids. Their studies revealed that there are two distinct types of Cepheids: Classical and Type II. Delta Cephei is the second closest Cepheid to Earth after Polaris, and was even studied in detail by Edwin Hubble's namesake telescope, NASA's Hubble Space Telescope, in 2008. These studies, along with others performed by the ESA's Hipparcos mission and other observatories, help to further refine the accuracy of distance measurements derived from observations of Cepheids. What will further observations of Delta Cephei and other Cepheids reveal about our universe? Follow NASA's latest observations of stars and galaxies across our universe at nasa.gov.



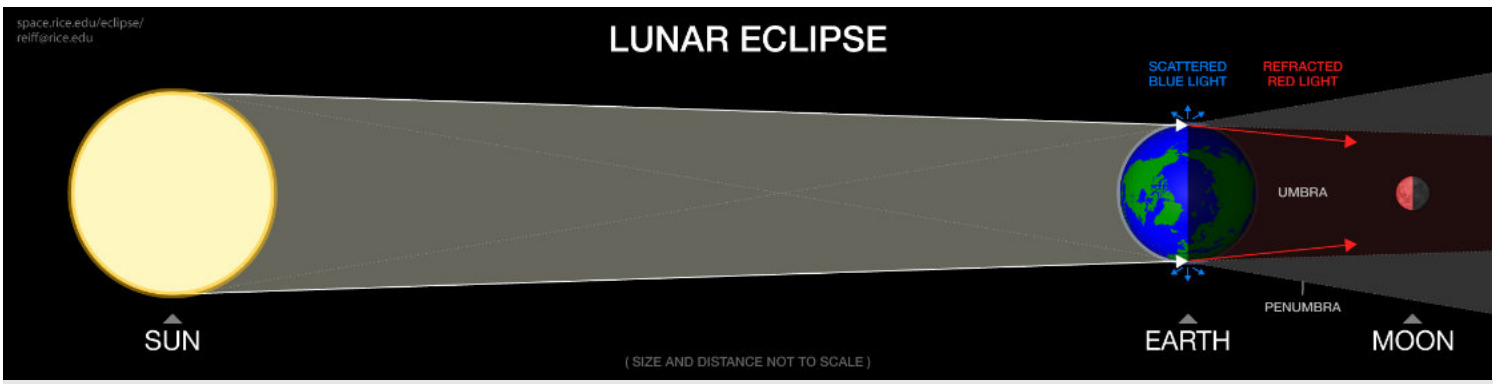
The stars of Cepheus are visible all year round for many in the Northern Hemisphere, but fall months offer some of the best views of this circumpolar constellation to warmly-dressed observers. Just look northwards!

Illustration created with assistance from Stellarium

NOVEMBER 8 - TOTAL LUNAR ECLIPSE

On Tuesday, November 8 a total lunar eclipse will occur. This will be the second total lunar eclipse for 2022. Refer to the table below for eclipse visibility in the Lima area. Keep in mind the eclipse will be ending just at moonset.

EVENT	UTC TIME	Time in Lima	Visible in Lima	Moon Altitude
Penumbral Eclipse begins	Nov 8 at 08:02:15	Nov 8 at 3:02:15 am	Yes	+45°27'31.0"
Partial Eclipse begins	Nov 8 at 09:09:12	Nov 8 at 4:09:12 am	Yes	+33°37'23.3"
Full Eclipse begins	Nov 8 at 10:16:39	Nov 8 at 5:16:39 am	Yes	+21°21'04.5"
Maximum Eclipse	Nov 8 at 10:59:11	Nov 8 at 5:59:11 am	Yes	+13°41'10.4"
Full Eclipse ends	Nov 8 at 11:41:36	Nov 8 at 6:41:36 am	Yes	+06°15'27.9"
Partial Eclipse ends	Nov 8 at 12:49:03	Nov 8 at 7:49:03 am	No, below the horizon	–
Penumbral Eclipse ends	Nov 8 at 13:56:09	Nov 8 at 8:56:09 am	No, below the horizon	–



What is a lunar eclipse?

A lunar eclipse occurs when the Moon passes into the Earth's shadow for a period of time. A total lunar eclipse means the entire face of the Moon will be within the Earth's shadow. A partial eclipse means only a portion of the Moon will be covered by the darkest part of Earth's shadow.

Did you know?

Lunar eclipses can only occur during a Full Moon? The Sun, Earth, and Moon must all be in alignment for a lunar eclipse to occur. These alignments only occur during a Full Moon and New Moon, but not every one of them! The Moon orbits the Earth at a slight tilt, so alignments only happen occasionally.

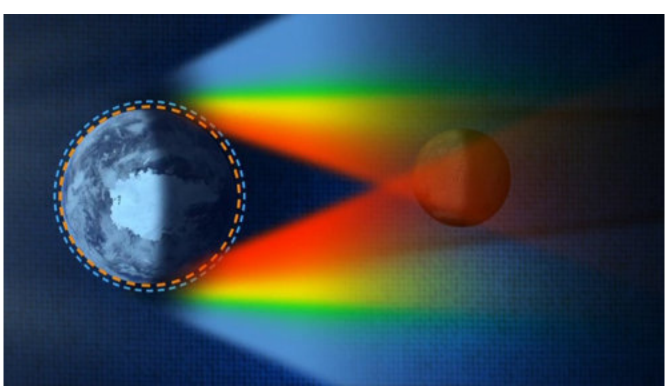
ECLIPSE PHASES

Penumbral Eclipse - The Moon is in the softer edge of the Earth's shadow. The Moon is slightly dimmer, but not eclipsed.

Partial or Umbral Eclipse - The Moon is entering or leaving the Earth's umbral shadow. The Umbra is the darkest part of the shadow.

Full Eclipse - The Moon is completely within the darkest part of the Earth's shadow.

From start to finish, the eclipse on November 8 occurs over a period of nearly 6-hours. The total eclipse occurs for approximately 85-minutes.



Why does the Moon appear red during a total lunar eclipse?

A phenomenon called Rayleigh Scattering. It's what makes our skies blue and our sunsets orange and red. When the Sun is overhead, we see blue light throughout the sky. But when the Sun is setting, sunlight must pass through more atmosphere and travel farther before reaching our eyes. The blue light from the Sun scatters away, and longer-wavelength red, orange, and yellow light pass through. During a lunar eclipse, the Moon turns red because the only sunlight reaching the Moon passes through Earth's atmosphere. The more dust or clouds in Earth's atmosphere during the eclipse, the redder the Moon will appear.

OBSERVING LISTS

Top ten deep-sky objects for November	
M31	M110
M32	NGC 40
M33	NGC 253
M76	NGC 457
M103	NGC 752

Top ten binocular objects for November	
M31	NGC 253
M33	NGC 457
M103	NGC 654
NGC 225	NGC 663
NGC 288	NGC 752

Challenge deep-sky object for November
IC 59
IC 59 is a Reflection Nebula in Cassiopeia. It is situated close to the northern celestial pole and, as such, it is visible for most part of the year from the northern hemisphere. Apparent Magnitude: 13.33 Surface Brightness: 17.32

THIS MONTH IN ASTRONOMY

- Nicolaus Copernicus observes a lunar eclipse on November 5, 1500.
- Wolfgang Schuler independently discovers Tycho's Supernova on November 6, 1572.
- Cornelius Gemma independently discovers Tycho's Supernova on November 9, 1572.
- Tycho Brahe observes Tycho's Supernova on November 11, 1572.
- SN 1604 (Kepler's Supernova) becomes visible to the unaided eye on October 9, 1604.
- Nicolas-Claude Fabri de Peiresc makes the first telescopic observations of M42 (the Orion Nebula) on November 26, 1610.
- Jan de Munck discovers Comet C/1743 X1 (the Great Comet of 1744) on November 29, 1743.
- Captain James Cook observes a transit of Mercury from New Zealand on November 9, 1769.
- William Herschel discovers the ring galaxy NGC 922 on November 17, 1784.
- E.E. Barnard discovers the emission nebula NGC 281 (the Pacman Nebula) on November 16, 1881.
- The first photograph of a meteor was taken on November 26, 1885.
- The minor planet/comet 2060 Chiron or 95P/Chiron was discovered by Charles Kowal on November 1, 1977.

"PILLARS OF CREATION"

JAMES WEBB SPACE TELESCOPE, NEAR INFRARED

November 2022 Astronomy Events Calendar

Sun	Mon	Tues	Wed	Thurs	Fri	Sat
		1 **First quarter Moon** Saturn 4° N of Moon	2	3 **Double shadow transit on Jupiter** **Juno 1.0 ° N of Moon, occultation**	4 **LAS Meeting @ 8pm** **Jupiter 2° N of Moon** Neptune 3° N of Moon	5 S. Taurid meteors peak
6 ***Daylight Saving Time Ends***	7	8 **Full Moon** **Total Lunar Eclipse** **Uranus 0.8° S of Moon, occultation** Mercury in superior conjunction	9 Mercury at descending node **Uranus at opposition**	10	11 **Mars 2° S of Moon**	12 N. Taurid meteors peak
13	14 **Pollux 1.7° N of Moon** Moon at apogee	15	16 **Last quarter Moon**	17	18 Leonid meteors peak	19 Mercury at aphelion
20	21 Venus at descending node	22	23 **New Moon**	24 Jupiter stationary Pallas stationary	25	26 Moon at perigee
27	28	29 Saturn 4° N of Moon	30 **First quarter Moon**			

ASTRONOMY CALENDAR TERMINOLOGY

Aphelion – The point in the orbit of a planet, asteroid, or comet at which it is furthest from the Sun.

Apogee – The point in the orbit of the Moon, planet, or satellite at which it is furthest from the Earth.

Ascending Node – The point along a planet's orbit where it crosses the ecliptic (Earth's orbital plane) from S to N.

Conjunction – When the Moon or a planet appears especially close to another planet or bright star.

Descending Node – The point along a planet's orbit where it crosses the ecliptic (Earth's orbital plane) from N to S.

Elongation – The angular distance the Moon or a planet is from the Sun. Mercury and Venus are best seen when at "greatest" elongation, and will appear at their highest position above the horizon before sunrise or sunset.

Heliocentric Latitude – The longitude of a heavenly body, as seen from the Sun's center (the Sun is at the center in the heliocentric model of the solar system). Essentially, if you could stand in the center of the Sun and draw a plane straight out in front of you (this would be 0.0°), heliocentric latitude is the number of degrees above or below that plane where the planet appears.

Inferior Conjunction – When a planet (Mercury or Venus) passes between the Earth and the Sun.

Occultation – When the Moon or a planet passes directly in front of a more distant planet or star. (*Occult, as a verb, means to obscure the view of an object*).

Opposition – When a planet or asteroid is directly *opposite* the Sun in the sky. Just like the Full Moon, a planet will appear brighter and fully lit during this time.

Perigee – the point in the orbit of the Moon, planet, or satellite at which it is nearest to the Earth.

Perihelion – the point in the orbit of a planet, asteroid, or comet at which it is closest to the Sun.

Superior Conjunction – When a planet (Mercury or Venus) passes behind the Sun, out of our view.

Transit – When a smaller object passes in front of a larger object. Such as when Mercury or Venus pass in front of the Sun, silhouetting them against the disc; or when one of Jupiter's Galilean moons pass in front of the planet.

Zodiacal Light – Sunlight that is reflected off celestial dust that is concentrated in the plane of the Solar System. It appears as a faint glow in the sky extending from the horizon in late winter/early spring, and requires the darkest skies to be observed. In the darkest sky conditions, zodiacal light can cast very faint shadows.

Examples

Mars 1.1° S of Moon, occultation

On this night, Mars would appear in the sky very close to the Moon - only 1.1 degrees away from it. At a point during this night the Moon would pass in front of Mars, hiding it from view.

Double shadow transit on Jupiter

On this night, two of Jupiter's Galilean moons will cast shadows on the surface of Jupiter simultaneously, appearing as two dark discs moving across the face of the planet. If you were standing on the surface of Jupiter as one of these shadows passed over, you would witness a solar eclipse.

Mercury greatest elongation E

On this night, Mercury will be at a point in its orbit where it appears highest in the sky. From our point of view, this is the furthest apart Mercury and the Sun will appear from each other. E or W indicate which side of the Sun the planet appears on in its orbital cycle, and can also tell you when to look for Mercury. The planet can be found in the evening sky during the greatest elongation E, and in the morning sky in the greatest elongation W.