Celestial Observer

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CCAS member Dave Majors took this photo of the Southern Pinwheel Galaxy (M83). This image is part of his recently completed 6-year project to capture images of all 110 objects in the Messier catalog! Located in the constellation Hydra, M83 is one of the brightest spiral galaxies visible and can be viewed with binoculars. This image is a stack of 57, three-minute exposures.

CCAS Has Resumed In-Person Star Parties!

Our star parties are held on the weekend closest to the new moon (when possible) and in conjunction with certain holidays.

The next star party is June 25th at

Santa Margarita Lake Park (SMLP).

Find out more here:
CentralCoastAstronomy.org/star-parties/

Summer Solstice

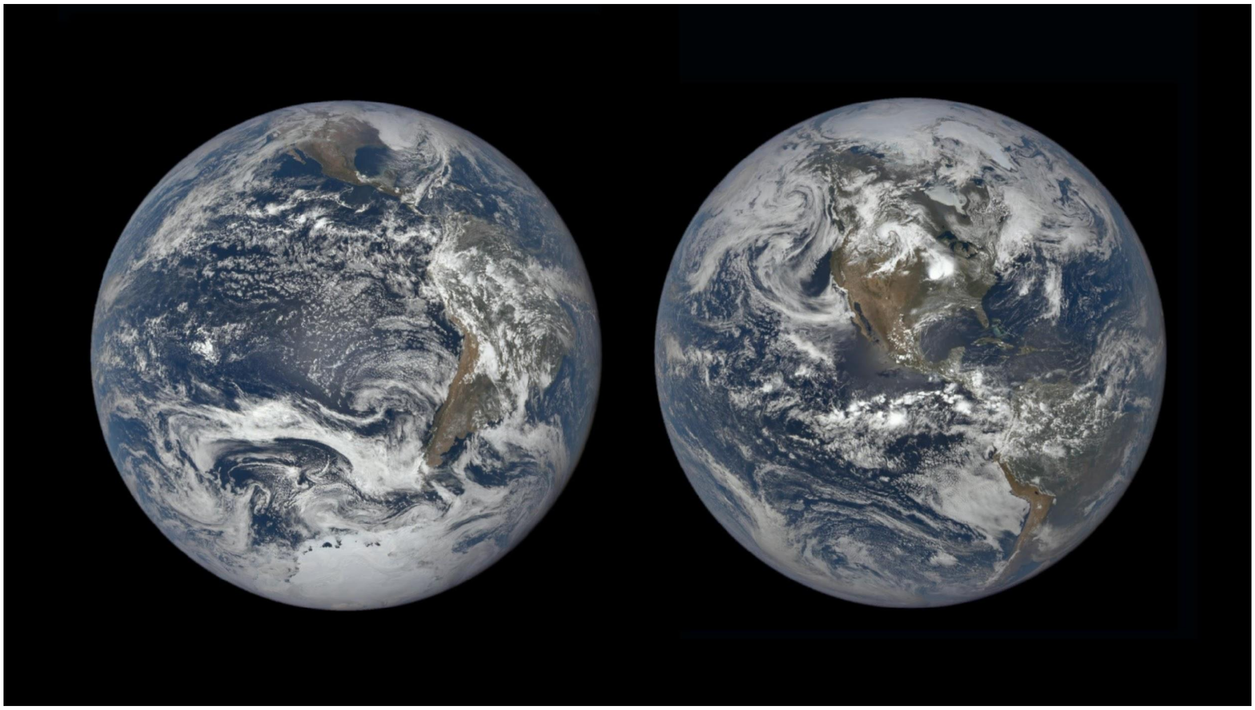
Tuesday, June 21st - 2:13am PST

Celebrate the first day of Summer! On this day, the Sun will reach its most Northerly point in the sky and we will experience the longest day and shortest night of the year.

Find out more here:
TimeAndDate.com/calendar/summer-solstice.html

Solstice Shadows

by David Prosper for NASA Night Sky Network



These images from NASA's DSCOVR mission shows the Sun-facing side of Earth during the December 2018 solstice (left) and June 2019 solstice (right). Notice how much of each hemisphere is visible in each photo; December's solstice heavily favors the Southern Hemisphere and shows all of South America and much of Antarctica and the South Pole, but only some of North America. June's solstice, in contrast, heavily favors the Northern Hemisphere and shows the North Pole and the entirety of North America, but only some of South America.
Credit: NASA/DSCOVR EPIC
Source:https://www.nasa.gov/image-feature/goddard/2021/summer-solstice-in-the-northern-hemisphere

Solstices mark the changing of seasons, occur twice a year, and feature the year's shortest and longest daylight hours - depending on your hemisphere. These extremes in the length of day and night make solstice days more noticeable to many observers than the subtle equality of day and night experienced during equinoxes. Solstices were some of our earliest astronomical observations, celebrated throughout history via many summer and winter celebrations.

Solstices occur twice yearly, and in 2022 they arrive on June 21 at 5:13 am EDT (9:13 UTC), and December 21 at 4:48pm EST (21:48 UTC). The June solstice marks the moment when the Sun is at its northernmost position in relation to Earth's equator, and the December solstice marks its southernmost position. The summer solstice occurs on the day when the Sun reaches its highest point at solar noon for regions outside of the tropics, and those observers experience the longest amount of daylight for the year. Conversely, during the winter solstice, the Sun is at its lowest point at solar noon for the year and observers outside of the tropics experience the least amount of daylight- and the longest night – of the year. The June solstice marks the beginning of summer for folks in the Northern Hemisphere and winter for Southern Hemisphere folks, and in December the opposite is true, as a result of the tilt of Earth's axis of rotation. For example, this means that the Northern Hemisphere receives more direct light from the Sun than the Southern Hemisphere during the June solstice. Earth's tilt is enough that northern polar regions experience 24-hour sunlight during the June solstice, while southern polar regions experience 24-hour night, deep in Earth's shadow. That same tilt means that the Earth's polar regions also experience a reversal of light and shadow half a year later in December, with 24 hours of night in the north and 24 hours of daylight in the south. Depending on how close you are to the poles, these extreme lighting conditions can last for many months, their duration deepening the closer you are to the poles.

While solstice days are very noticeable to observers in mid to high latitudes, that's not the case for observers in the tropics - areas of Earth found between the Tropic of Cancer and the Tropic of Capricorn. Instead, individuals experience two "zero shadow" days per year. On these days, with the sun directly overhead at solar noon, objects cast a minimal shadow compared to the rest of the year. If you want to see your own shadow at that moment, you have to jump! The exact date for zero shadow days depends on latitude; observers on the Tropic of Cancer (23.5° north of the equator) experience a zero shadow day on the June solstice, and observers on the Tropic of Capricorn (23.5° south of the equator) get their zero shadow day on December's solstice. Observers on the equator experience two zero shadow days, being exactly in between these two lines of latitude; equatorial zero shadow days fall on the March and September equinoxes.

There is some serious science that can be done by carefully observing solstice shadows. In approximately 200 BC, Eratosthenes is said to have observed sunlight shining straight down the shaft of a well during high noon on the solstice, near the modern-day Egyptian city of Aswan. Inspired, he compared measurements of solstice shadows between that location and measurements taken north, in the city of Alexandria. By calculating the difference in the lengths of these shadows, along with the distance between the two cities, Eratosthenes calculated a rough early estimate for the circumference of Earth – and also provided further evidence that the Earth is a sphere!

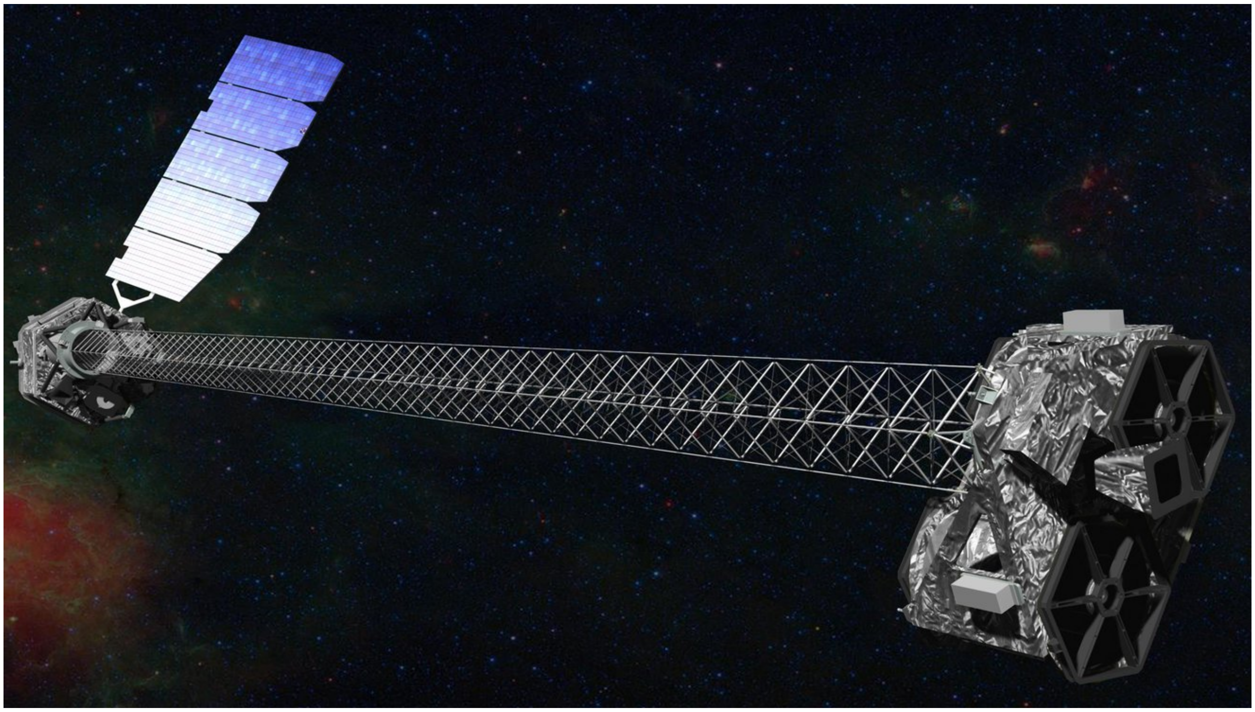
Are you having difficulty visualizing solstice lighting and geometry? You can build a "Suntrack" model that helps demonstrate the path the Sun takes through the sky during the seasons; find instructions at stanford.io/3FY4mBm. You can find more fun activities and resources like this model on NASA Wavelength: science.nasa.gov/learners/wavelength. And of course, discover the latest NASA science at nasa.gov.

This article is distributed by

NASA Night Sky Network

NASA's NuSTAR Mission Celebrates 10 Years Studying the X-Ray Universe

by NASA/JPL



NASA's NuSTAR space telescope, shown in this illustration, features two main components separated by a 30-foot (10-meter) mast, sometimes called a boom. Light is collected at one end of the mast and is focused along its length before hitting detectors at the other end. Credit: NASA/JPL-Caltech

After a decade of observing some of the hottest, densest, and most energetic regions in our universe, this small but powerful space telescope still has more to see.

NASA's Nuclear Spectroscopic Telescope Array (NuSTAR) is turning 10. Launched on June 13, 2012, this space telescope detects high-energy X-ray light and studies some of the most energetic objects and processes in the universe, from black holes devouring hot gas to the radioactive remains of exploded stars. Here are some of the ways NuSTAR has opened our eyes to the X-ray universe over the last decade.

Seeing X-Rays Close to Home

Different colors of visible light have different wavelengths and different energies; similarly, there is a range of X-ray light, or light waves with higher energies than those human eyes can detect. NuSTAR detects X-rays at the higher end of the range. There aren't many objects in our solar system that emit the X-rays NuSTAR can detect, but the Sun does: Its high-energy X-rays come from microflares, or small bursts of particles and light on its surface. NuSTAR's observations contribute to insights about the formation of bigger flares, which can cause harm to astronauts and satellites. These studies could also help scientists explain why the Sun's outer region, the corona, is many times hotter than its surface. NuSTAR also recently observed high-energy X-rays coming from Jupiter, solving a decades-old mystery about why they've gone undetected in the past.

Illuminating Black Holes

Black holes don't emit light, but some of the biggest ones we know of are surrounded by disks of hot gas that glow in many different wavelengths of light. NuSTAR can show scientists what's happening to the material closest to the black hole, revealing how black holes produce bright flares and jets of hot gas that stretch for thousands of light-years into space. The mission has measured temperature variations in black hole winds that influence star formation in the rest of the galaxy. Recently, the Event Horizon Telescope (EHT) took the first-ever direct images of the shadows of black holes, and NuSTAR provided support. Along with other NASA telescopes, NuSTAR monitored the black holes for flares and changes in brightness that would influence EHT's ability to image the shadow cast by them.

One of NuSTAR's biggest accomplishments in this arena was making the first unambiguous measurement of a black hole's spin, which it did in collaboration with the ESA (European Space Agency) XMM-Newton mission. Spin is the degree to which a black hole's intense gravity warps the space around it, and the measurement helped confirm aspects of Albert Einstein's theory of general relativity.

Finding Hidden Black Holes

NuSTAR has identified dozens of black holes hidden behind thick clouds of gas and dust. Visible light typically can't penetrate those clouds, but the high-energy X-ray light observed by NuSTAR can. This gives scientists a better estimate of the total number of black holes in the universe. In recent years scientists have used NuSTAR data to find out how these giants become surrounded by such thick clouds, how that process influences their development, and how obscuration relates to a black hole's impact on the surrounding galaxy.

Revealing the Power of 'Undead' Stars

NuSTAR is a kind of zombie hunter: It's deft at finding the undead corpses of stars. Known as neutron stars, these are dense nuggets of material left over after a massive star runs out of fuel and collapses. Though neutron stars are typically only the size of a large city, they are so dense that a teaspoon of one would weigh about a billion tons on Earth. Their density, combined with their powerful magnetic fields, makes these objects extremely energetic: One neutron star located in the galaxy M82 beams with the energy of 10 million Suns.

Without NuSTAR, scientists wouldn't have discovered just how energetic neutron stars can be. When the object in M82 was discovered, researchers thought that only a black hole could generate so much power from such a small area. NuSTAR was able to confirm the object's true identity by detecting pulsations from the star's rotation – and has since shown that many of these ultraluminous X-ray sources, previously thought to be black holes, are in fact neutron stars. Knowing how much energy these can produce has helped scientists better understand their physical properties, which are unlike anything found in our solar system.

Solving Supernova Mysteries

During their lives, stars are mostly spherical, but NuSTAR observations have shown that when they explode as supernovae, they become an asymmetrical mess. The space telescope solved a major mystery in the study of supernovae by mapping the radioactive material left over by two stellar explosions, tracing the shape of the debris and in both cases revealing significant deviations from a spherical shape. Because of NuSTAR's X-ray vision, astronomers now have clues about what happens in an environment that would be almost impossible to probe directly. The NuSTAR observations suggest that the inner regions of a star are extremely turbulent at the time of detonation.

More About the Mission

NuSTAR launched on June 13, 2012. The mission's principal investigator is Fiona Harrison, chair of the Division of Physics, Mathematics, and Astronomy at Caltech in Pasadena, California. A Small Explorer mission managed by the agency's Jet Propulsion Laboratory in Southern California for NASA's Science Mission Directorate in Washington, NuSTAR was developed in partnership with the Danish Technical University (DTU) and the Italian Space Agency (ASI). The telescope optics were built by Columbia University, NASA's Goddard Space Flight Center in Greenbelt, Maryland, and DTU. The spacecraft was built by Orbital Sciences Corp. in Dulles, Virginia. NuSTAR's mission operations center is at the University of California, Berkeley, and the official data archive is at NASA's High Energy Astrophysics Science Archive Research Center. ASI provides the mission's ground station and a mirror data archive. Caltech manages JPL for NASA.

For more information on NuSTAR, visit:

www.nustar.caltech.edu

CCAS Contacts

President	Aurora Lipper
Vice President	Tom Frey
Treasurer	Lee Coombs
Secretary	Linnea Fritch
Outreach	Scott McMillian
Communication	Brian P. Cox

CCAS Information

Founded in 1979, the Central Coast Astronomical Society (CCAS) is an association of people who share a common interest in astronomy and related sciences.

Central Coast Astronomical Society
PO Box 1415
San Luis Obispo, CA 93406
Website: CentralCoastAstronomy.org
Facebook: facebook.com/CentralCoastAstronomicalSociety

Another one of Dave Majors' 110 Messier photos, this one features M86 (center). Located in the constellation Virgo and part of a group of galaxies, M86 is approximately 135,000 light-years across.