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Astronomy & Physics Weekly News

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Top News

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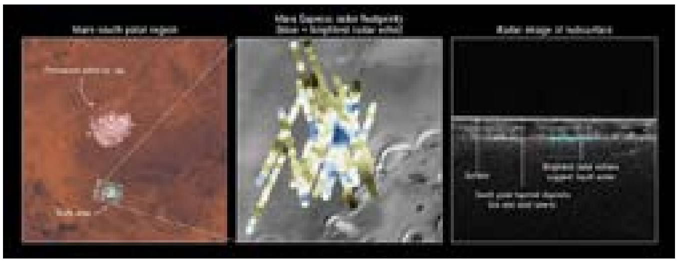
Liquid Water on Mars! Really for Real This Time (Probably)



The Mars Express orbiter has used radar signals bounced through underground layers of ice to find evidence of a pond of water buried below the south polar cap. Find more information on this image here. Context map: NASA / Viking; THEMIS background: NASA / JPL-Caltech / Arizona State Univ.; MARSIS data: ESA / NASA / JPL / ASI / Univ. Rome; R. Orosei et al 2018

A radar instrument on one of the oldest operational Mars orbiters has discovered possible evidence of present-day liquid water on Mars.

Liquid water on Mars? Again? Yes, again. The announcement came at a press briefing held by the Italian Space Agency in Rome, concerning a paper published today in Science.

How is today's water-on-Mars hoopla different from all of the past announcements? In brief: the evidence is from a new instrument, examining a new location on Mars, and it's the first place we've seen evidence for a present-day body of water that is liquid and stays liquid. For years.

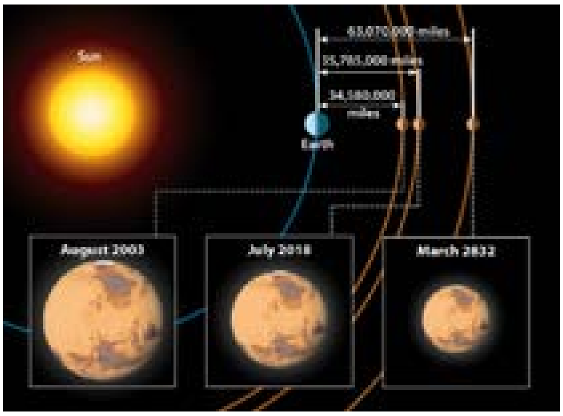
Probably.

The report comes from the European Space Agency's Mars Express, the second-oldest spacecraft still operating at Mars. It's best known for the beautiful color stereo images from its High Resolution Stereo Camera, but today's results come from a different instrument, the Mars Advanced Radar for Subsurface and Ionosphere Sounding (MARSIS). To explain the water story, I'll need to explain the instrument.

MARSIS transmits radio waves at Mars using a pair of booms, each 20 meters long, which extend on each side of Mars Express. The radio waves bounce off of Mars, and MARSIS measures the time it takes for the waves to travel there and back. Naturally, MARSIS detects strong reflections from the planet's surface.

But the long radio waves from the 40-meter antenna can actually penetrate as many as 5 kilometers into the Martian surface and reflect off of interesting things below. Subsurface boundaries between layers of different properties – boundaries between rock and soil, or rock and ice, or clean ice and dusty ice – can also serve as radio reflectors. So MARSIS may detect multiple echoes from each radio pulse. It pulses many times along its ground track, building up a 2-dimensional view of the subsurface called a "radargram." The bulk of MARSIS's results from Mars Express's 15 years ..Read More...

Get Outside And See Mars At Its Brightest



Although a bit farther and smaller than it appeared in 2003, Mars in 2018 will appear much larger than during its worst opposition, more than 800 years from now. Astronomy: Roen Kelly

It's been 15 years since the Red Planet was this close and this big. Set up your scope, and take advantage of Mars at opposition.

Planetary observing hits a high point this summer as Mars dominates the evening sky. Dust off your scope, because this is the year to observe the Red Planet. It hasn't been this big and bright since 2003, and it won't be again until September 2035.

So, excitement is building. For readers new to Red Planet mania, astronomers' interest peaks during times called oppositions, when Mars lies opposite the Sun from our perspective on Earth. This year's opposition occurs July 26 or 27, depending on where you live. Let me explain.

Dates and numbers

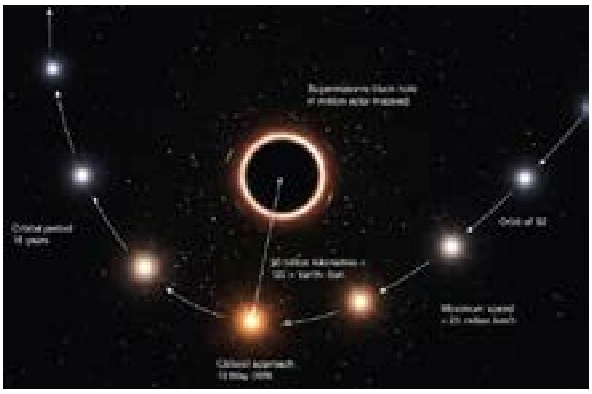
The moment of opposition occurs at 5h13m Universal Time on the 27th. In the United States, that's 1:13 a.m. EDT. If you observe from the Mountain or Pacific time zones, the date of opposition will be the 26th.

Then, a scant four days later, Mars reaches its closest point to Earth. An opposition happens every 780 days (minus 1 hour 26 minutes 24 seconds, to be exact). But each closest approach to Earth is not really, well, closest because Earth's and Mars' orbits are not circular, so the distance between our two worlds changes from one opposition to the next.

During a distant opposition, Mars can lie more than 60 million miles (97 million kilometers) away. Contrast that with a nearby opposition that places Mars less than 35 million miles (56 million km) from Earth.

For observing purposes, it all comes down to apparent diameter. Astronomers use angular measurement to describe how large a celestial object appears. A planet's angular size can change a lot. Mars varies in size at opposition from a minimum of 13.8" to a maximum of 25.1". And its maximum brightness at each close ...Read More...

Star Swings Around Black Hole, Tests Gravity



This artist's impression shows the path of star S2 took as it swung by the supermassive black hole at the center of the Milky Way. As the star approached the black hole, its light had to fight the black hole's immense gravitational field. The light lost energy in the process, causing the star's color to shift slightly to the red (exaggerated here for effect). Object sizes are not to scale.
ESO / M. Kornmesser

Astronomers have seen a star's light redden as it passed our galaxy's central black hole, just as general relativity predicts.

Scientists have Einstein right where they want him.

Today in Garching, Germany, Reinhard Genzel (Max Planck Institute for Extraterrestrial Physics, Germany) and his colleagues announced that they have detected the shift in a star's light caused by the extreme gravity of the black hole at the center of our galaxy. This change, called gravitational redshift, is one of the long-sought confirmations that Einstein's master framework of gravity correctly describes how the universe works.

As I detail in our upcoming September issue, roughly three dozen bright stars huddle very close around the supermassive black hole in the Milky Way's heart. Both Genzel's team and a second led by Andrea Ghez (University of California, Los Angeles) have been observing this cluster of stars for more than two decades, using the stars' orbits to calculate the mass of the unseen thingamajig lurking among them. It's this work that gives us our estimate of the black hole's mass: about 4 million times that of the Sun, all contained within a radius 8% the size of Earth's trek around our star.

The brightest member of this troupe of stars is called S2. It's a 7-million-year-old massive, bluish B-type star that weighs about as much as a dozen Suns combined. It finishes its racetrack course around the black hole every 16 years. During its closest approach it comes closer to the black hole than any other star yet detected: about 120 a.u., or four times Neptune's distance from the Sun. Its latest pass was earlier this year in May.

S2's flyby enables two tests of general relativity. The first is the gravitational redshift, a preliminary detection of which is announced today. In Einstein's ..Read More...

Andromeda Collided with Galactic Sibling Billions of Years Ago

The Andromeda Galaxy features with its oddly compact satellite galaxy, M32 (fuzzball below Andromeda's disk). Astronomers now suspect that M32 may be the remains of a massive galaxy that interacted with Andromeda between 5 billion and 2 billion years ago. Lorenzo Comolli

A new study says our neighbor galaxy's big stellar halo and stellar evolution are due to a major collision that ended 2 billion years ago.

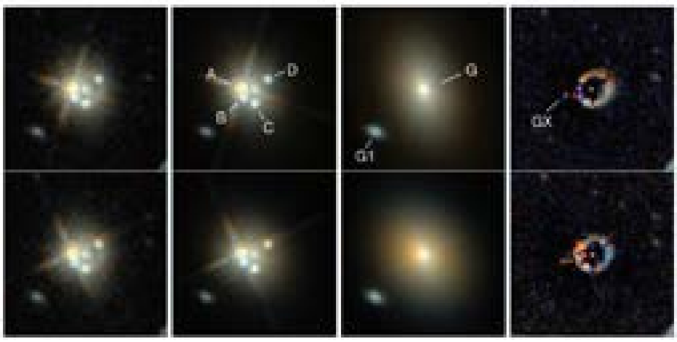
A large galaxy M32 crashed into Andromeda Galaxy billions of years ago, a study says, affecting the evolution of both galaxies forever. The new study – published in Nature Astronomy – suggests the merger affected the halo of stars and globular clusters around Andromeda's disk, as well as the pace of the galaxy's star formation.

ndromeda is the largest member of the Local Group of galaxies near the Milky Way, a spiral galaxy located about 2.5 million light-years away. Its proximity motivated researchers Richard D'Souza (University of Michigan and Vatican Observatory) and Eric Bell (University of Michigan) to understand its evolution. The researchers pulled information about how Andromeda-size galaxies came together from two independent, large-scale simulations, Illustris and C13. Specifically, they were interested in how Andromeda's stellar disk came to be so thick: It's 2,600 light-years high, eight times thicker than the Milky Way's thin disk, even though it's only twice as wide.

The simulations showed that such a massive stellar disk only forms after a large galactic collision, which plays out over billions of years. Andromeda's stellar disk has a high metallicity, or abundance of elements heavier than hydrogen and helium, which suggests that it was a massive, metal-rich galaxy that crashed into Andromeda. The two would have started interacting 5 billion years ago, with disrupting effects continuing until 2 billion years ago.

The researchers conclude that M32, an oddly compact galaxy in orbit around Andromeda, is most likely what's left of the galaxy that hit Andromeda. The researchers call the parent galaxy M32p and suggest that it was similar in mass to the Milky Way with a low-mass bulge in its center. Researchers had wondered for years why M32 contained so many stars in such a small volume, D'Souza says. If a collision reformed this galaxy long ..Read More...

Highly magnified gravitationally lensed red quasar detected by astronomers



Color combined HST WFC3/IR F125W and F160W images of W2M J1042+1641 over two visits along with output from a morphological analysis with galfit (Peng et al. 2002). Credit: Glikman et al., 2018.

Astronomers have discovered a highly magnified, gravitationally lensed quasi-stellar object (QSO). The newly found quasar, designated W2M J104222.11+164115.3, is dust-reddened, and exhibits a significant flux anomaly. The finding is reported in a paper published July 14 on the arXiv pre-print server.

Quasars are active galactic nuclei of very high luminosity, emitting electromagnetic radiation observable in radio, infrared, visible, ultraviolet and X-ray wavelengths. They are among the brightest and most distant objects in the known universe, and serve as fundamental tools for numerous studies in astrophysics as well as cosmology.

Some quasars are obscured by dust as they transition from a heavily dust-enshrouded phase to typical, unobscured QSOs, which reddens their light. Finding quasars during such a transition could help astronomers better understand the processes of galaxy evolution and star formation.

A group of astronomers led by Eilat Glikman of the Middlebury College in Middlebury, Vermont, has conducted a search for red quasars by analyzing the available data from the WISE and 2MASS (W2M) surveys. They were selecting objects based on their infrared colors, which resulted in identifying 40 red QSOs.

Among the newly found objects was one quasar designated W2M J104222.11+164115.3 (W2M J1042+1641 for short). This QSO interested the researchers as it was more luminous than any other known radio-quiet quasar and implied extreme properties suggestive of gravitational lensing.

"In this paper, we report the discovery of a quadruply lensed, radio-quiet red quasar discovered in a search for red quasars using WISE color selection and no radio criterion," the paper reads. In order to get more detailed information about W2M J1042+1641, Glikman's team also analyzed observational data of this ...Read More...

Researchers discover thin gap on stellar family portrait

The European Space Agency's Gaia mission has produced the richest star map of our galaxy to date. Credit: Satellite: GaiaCopyright: ESA/Gaia/DPAC

A thin gap has been discovered on the Hertzsprung-Russell Diagram (HRD), the most fundamental of all maps in stellar astronomy, a finding that provides new information about the interior structures of low mass stars in the Milky Way Galaxy, according to a study led by astronomers at Georgia State University.

Just as a graph can be made of people with different heights and weights, astronomers compare stars using their luminosities and temperatures. The HRD is a "family portrait" of the stars in the Galaxy, where stars such as the Sun, Altair, Alpha Centauri, Betelgeuse, the north star Polaris and Sirius can be compared. The newly discovered gap cuts diagonally across the HRD and indicates where a crucial internal change occurs in the structures of stars. The gap outlines where stars transition from being larger and mostly convective with a thin radiative layer to being smaller and fully convective.

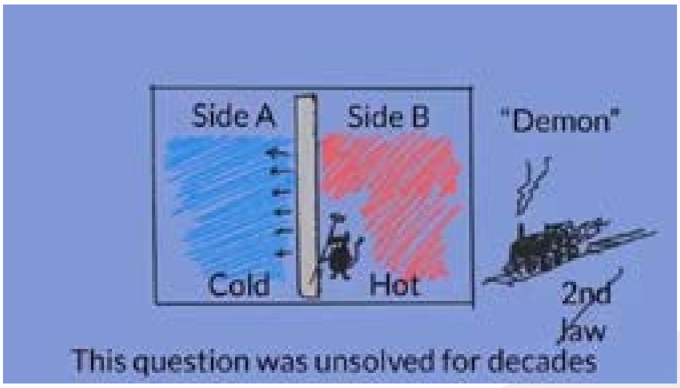
Radiation and convection are two ways to transfer energy from inside a star to its surface. Radiation transfers energy through space, and convection is the transfer of energy from one place to another by the movement of fluid.

The researchers estimate that stars above the gap contain more than about one-third the mass of the Sun, and those below have less mass. Because different types of stars have different masses, this feature reveals where different types of interior structures are on the HRD. The gap occurs in the middle of the region of "red dwarf" stars, which are much smaller and cooler than the Sun, but compose three of every four stars in the solar neighborhood. The findings are published in the journal The Astrophysical Journal Letters.

"We were pretty excited to see this result, and it provides us new insights to the structures and evolution of stars," said Dr. Wei-Chun Jao, first author of the study and a staff astronomer in the Department of Physics and Astronomy at Georgia State.

In 2013, the European Space Agency (ESA) launched the Gaia spacecraft to make a census of the stars in the Milky Way Galaxy and to create a ..Read More...

Researchers find quantum 'Maxwell's demon' may give up information to extract work



Credit: Washington University in St. Louis

Thermodynamics is one of the most human of scientific enterprises, according to Kater Murch, associate professor of physics in Arts & Sciences at Washington University in St. Louis. "It has to do with our fascination of fire and our laziness," he said. "How can we get fire"—or heat—"to do work for us?"

Now, Murch and colleagues have taken that most human enterprise down to the intangible quantum scale—that of ultra low temperatures and microscopic systems—and discovered that, as in the macroscopic world, it is possible to use information to extract work.

There is a catch, though: Some information may be lost in the process.

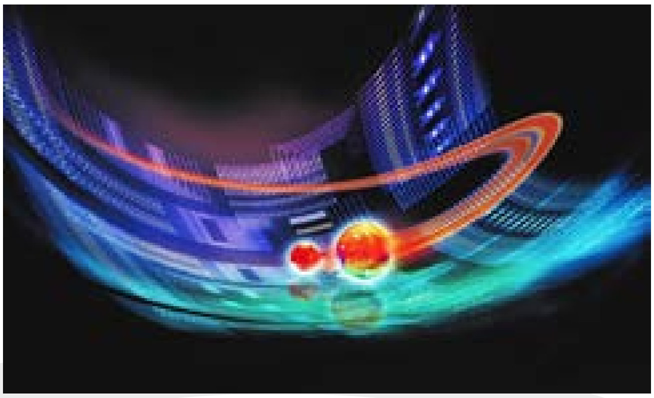
"We've experimentally confirmed the connection between information in the classical case and the quantum case," Murch said, "and we're seeing this new effect of information loss."

The results were published in the July 20 issue of Physical Review Letters.

The international team included Eric Lutz of the University of Stuttgart; J. J. Alonzo of the University of Erlangen-Nuremberg; Alessandro Romito of Lancaster University; and Mahdi Naghiloo, a Washington University graduate research assistant in physics.

That we can get energy from information on a macroscopic scale was most famously illustrated in a thought experiment known as Maxwell's Demon. The "demon" presides over a box filled with molecules. The box is divided in half by a wall with a door. If the demon knows the speed and direction of all of the molecules, it can open the door when a fast-moving molecule is moving from the left half of the box to the right side, allowing it to pass. It can do the same for slow particles moving in the opposite direction, opening the door when a slow-moving molecule is approaching from the right, headed left. ...Read More...

World-first quantum computer simulation of chemical bonds using trapped ions



Artist's impression of lithium hydride molecule approaching its ground state energy. Credit: Harald Ritsch/IQOQI Innsbruck

An international group of researchers has achieved the world's first multi-qubit demonstration of a quantum chemistry calculation performed on a system of trapped ions, one of the leading hardware platforms in the race to develop a universal quantum computer.

The research, led by University of Sydney physicist Dr. Cornelius Hempel, explores a promising pathway for developing effective ways to model chemical bonds and reactions using quantum computers. It is published today in the prestigious Physical Review X of the American Physical Society.

"Even the largest supercomputers are struggling to model accurately anything but the most basic chemistry. Quantum computers simulating nature, however, unlock a whole new way of understanding matter. They will provide us with a new tool to solve problems in materials science, medicine and industrial chemistry using simulations."

With quantum computing still in its infancy, it remains unclear exactly what problems these devices will be most effective at solving, but most experts agree that quantum chemistry is going to be one of the first 'killer apps' of this emergent technology.

Quantum chemistry is the science of understanding the complicated bonds and reactions of molecules using quantum mechanics. The 'moving parts' of anything but the most-simple chemical processes are beyond the capacity of the biggest and fastest supercomputers.

By modelling and understanding these processes using quantum computers, scientists expect to unlock lower-energy pathways for chemical reactions, allowing the design of new catalysts. This will have huge implications for industries, such as the production of fertilisers.

Other possible applications include the development of organic solar cells and better batteries through improved materials and using new insights to ...Read More...

New materials undergo solid-liquid phase transitions at room temperature

By using light to switch the phase of the new photoswitchable materials, the researchers could spatially control the solid and liquid regions in a single material. The photomask of the buffalo is 2.5 x 2.5 cm. Credit: Worrell et al. Published in Nature Communications

Researchers have developed the first materials that can permanently change from solid to liquid, or vice versa, when exposed to light at room temperature, and remain in the new phase even after the light is removed. The researchers also demonstrated that the light can be used to draw liquid designs in a solid material or solid designs in a liquid material, creating stable materials that are part solid and part liquid. The new materials have potential applications for 3-D printing, molding, and on-demand recycling, among other uses.

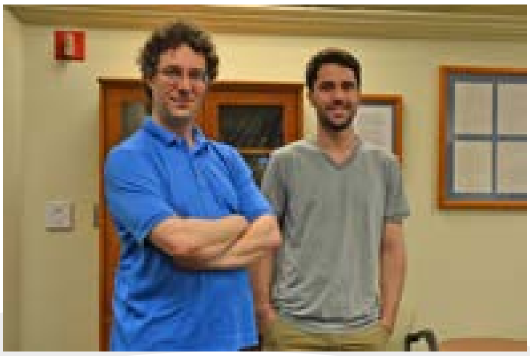
The researchers, led by Brady Worrell, Christopher Bowman, and coauthors at the University of Colorado, Boulder, have published a paper on the materials with photoswitchable phases in a recent issue of Nature Communications.

As we see in everyday life, conventional materials switch phases due to changes in temperature or pressure. For example, solid ice can be turned into liquid water by heating or—less commonly—by increasing the pressure (a higher pressure lowers the melting point, causing the ice to melt at colder temperatures than normal).

Certain polymers, however, are permanently solid—even when exposed to extreme changes in temperature or pressure, they never become liquid. These materials, which are called covalently cross-linked polymers, can be modified so that an external stimulus such as light or heat causes them to switch from solid to liquid. However, this is only a temporary change, in which the polymer reverts back to its solid form as soon as the stimulus is removed.

In the new study, the researchers presented two new polymers, one which starts as a solid and can be converted into liquid, and the other which starts as a liquid and can be converted into a solid. The polymers are the first materials of any kind that can undergo a permanent phase change in response to a stimulus other than temperature or pressure (in this case, light). ...Read More...

New algorithm could help find new physics—inverse method takes wave functions and solves for Hamiltonians



Professor Bryan Clark and graduate student Eli Chertkov pose in the common room of the Institute for Condensed Matter. Credit: Siv Schwink, Department of Physics, University of Illinois at Urbana-Champaign

Scientists at the University of Illinois at Urbana-Champaign have developed an algorithm that could provide meaningful answers to condensed matter physicists in their searches for novel and emergent properties in materials. The algorithm, invented by physics professor Bryan Clark and his graduate student Eli Chertkov, inverts the typical mathematical process condensed matter physicists use to search for interesting physics. Their new method starts with the answer—what kinds of physical properties would be interesting to find—and works backward to the question—what class of materials would host such properties.

Inverse problem solving isn't a new technique in classical physics, but this algorithm represents one of the first successful examples of an inverse problem solving method with quantum materials. And it could make searching for interesting physics a more streamlined and deliberate process for many scientists. More physicists are working in condensed matter than any other subfield of physics—the rich diversity of condensed matter systems and phenomena provide ample unsolved problems to explore, from superconductivity and superfluidity to magnetism and topology. Experimentalists probe the macro-and microscopic properties of materials to observe the behavior and interactions of particles in materials under a strict set of controls. Theoretical condensed matter physicists, on the other hand, work to develop mathematical models that predict or explain the fundamental laws that govern these behaviors and interactions.

The field of theoretical condensed matter physics has the well-earned reputation for being esoteric and difficult for the lay person to decipher, with its focus on understanding the quantum mechanics of materials. The process of writing and solving condensed matter equations is extremely intricate and meticulous. That process generally starts with a Hamiltonian—a mathematical model that sums up the energies of all the particles in the system. ...Read More...

X-ray technology reveals never-before-seen matter around black hole

The black hole in Cygnus X-1 is one of the brightest sources of X-rays in the sky. The light near the black hole comes from matter siphoned off its companion star. Credit: NASA, ESA, Martin Kornmesser

In an international collaboration between Japan and Sweden, scientists clarified how gravity affects the shape of matter near the black hole in binary system Cygnus X-1. Their findings, which were published in Nature Astronomy this month, may help scientists further understand the physics of strong gravity and the evolution of black holes and galaxies.

Near the center of the constellation of Cygnus is a star orbiting the first black hole discovered in the universe. Together, they form a binary system known as Cygnus X-1. This black hole is also one of the brightest sources of X-rays in the sky. However, the geometry of matter that gives rise to this light was uncertain. The research team revealed this information from a new technique called X-ray polarimetry.

Taking a picture of a black hole is not easy. For one thing, it is not yet possible to observe a black hole because light cannot escape it. Rather, instead of observing the black hole itself, scientists can observe light coming from matter close to the black hole. In the case of Cygnus X-1, this matter comes from the star that closely orbits the black hole.

Most light that we see, like from the sun, vibrates in many directions. Polarization filters light so that it vibrates in one direction. It is how snow goggles with polarized lenses let skiers see more easily where they are going down the mountain – they work because the filter cuts light reflecting off of the snow.

"It's the same situation with hard X-rays around a black hole," Hiroshima University Assistant Professor and study coauthor Hiromitsu Takahashi said. "However, hard X-rays and gamma rays coming from near the black hole penetrate this filter. There are no such 'goggles' for these rays, so we need another special kind of treatment to direct and measure this scattering of light."

The team needed to figure out where the light was coming from and where it scattered. In order to make both of these measurements, they launched an X-ray ...Read More...

The structure of the Milky Way

Fire wheel: The Milky Way system, called galaxis, resembles a gigantic spiral with an estimated 200 billion stars. One of them is our sun. Credit: Robert Hurt/SSC/Caltech/JPL/NASA Robert Hurt

For thousands of years, people have been puzzling over the milky strip that extends across the entire firmament. In the modern era, Galileo Galilei discovered that this Milky Way consists of countless stars. However, it was not until the 20th century that astronomers succeeded in deciphering its form and its true nature.

"My third observation relates to the nature of the Milky Way (...) No matter which part of it one targets with the telescope, one finds a huge number of stars, several of which are quite large and very striking; yet, the number of small stars is absolutely unfathomable." These words were written in 1610 by a man who with his self-constructed telescope studied unknown lands that were not of this world. It was this work that earned him a place in history: Galileo Galilei.

The land that he described is literally out of this world, and the document bears the title Sidereus Nuncius ("Starry Messenger"). In it, the Italian mathematician and astronomer presents his observations of the satellites of Jupiter, the Earth's moon and also the Milky Way. Until then, their nature had remained a mystery, and had above all been the subject of mythology. The Greek natural philosopher Democritus had already claimed in the 5th century BC that the diffusely glowing strip in the sky – known by the African !Kung bushmen as the "backbone of the night" – consisted of countless weak stars.

Grindstone in the firmament

After the discovery made by Galilei, however, nearly 150 years would pass before this celestial structure would again became the subject of scientific study. Thomas Wright of County Durham believed that stars were arranged in a flat region similar to a grindstone, which extended over the entire sky. For him, the Milky Way was nothing other than the projection of this grindstone. The German philosopher Immanuel Kant seized on this theory – and came very close to discovering the truth. ...Read More...

Special Read:

Lunar Eclipses: What Are They & When Is the Next One?

This montage of images taken by skywatcher Kieth Burns shows the Dec. 20, 2010 total lunar eclipse. The photos won a NASA contest to become an official NASA/JPL wallpaper for the public. Credit: NASA/JPL-via Kieth Burns

Lunar eclipses occur when Earth's shadow blocks the sun's light, which otherwise reflects off the moon. There are three types — total, partial and penumbral — with the most dramatic being a total lunar eclipse, in which Earth's shadow completely covers the moon. The next lunar eclipse will be a total lunar eclipse on January 19, 2019.

Throughout history, eclipses have inspired awe and even fear, especially when total lunar eclipses turned the moon blood-red, an effect that terrified people who had no understanding of what causes an eclipse and therefore blamed the events on this god or that. Below, you'll find the science and history of lunar eclipses, learn how they work, and see a list of the next ones on tap.

When is the next lunar eclipse? The last lunar eclipse was on August 7, 2017. It was a partial lunar eclipse.

Here is a schedule of upcoming lunar eclipses:

Already Occurred - January 31, 2018: Total eclipse. Visible from Asia, Australia, Pacific Ocean, western North America.
Already Occured - July 27, 2018: Total eclipse. Visible from South America, Europe, Africa, Asia, Australia.
January 19, 2019: Total eclipse. Visible from North and South America, Europe, Africa.
July 16, 2019: Partial eclipse. Visible from South America, Europe, Africa, Asia, Australia.

NASA keeps a list predicting lunar eclipses until 2100. They also keep data about past lunar eclipses. During the 21st century, Earth will experience a total of 228 lunar eclipses, according to the space agency.

What is a lunar eclipse?

A lunar eclipse can occur only at full moon. A total lunar eclipse can happen only when the sun, Earth and moon are perfectly lined up — anything less than perfection creates a partial lunar eclipse or no eclipse at all. Some understanding of simple celestial mechanics explains how lunar eclipses work. ...Read More...

Longest lunar eclipse of the 21st century observed at SCASS

Because the Moon was near apogee (the most distant point in its orbit) around the July full Moon, the July 27 lunar eclipse was the longest lunar eclipse of the 21st century. This is because the Moon was moving slower in its orbit and just taking more time in the shadow. This past Friday night's lunar eclipse was more than 20 minutes longer than the last one, which occurred earlier this year on Jan. 31 and which lasted about one hour and 16 minutes. The next one, which is coming up on Jan. 21, 2019, will be 1 hour and 2 minutes.

As a tradition, the Sharjah Center for Astronomy and Space Sciences organized a special lunar eclipse observation for the public where more than 1,000 persons turned in to see the spectacle using different telescopes and large binoculars set for the special occasion. Besides the eclipse, there was an occasion to see four planets: Venus, Jupiter, Saturn, and Mars at its opposition.








This Week's Sky at a Glance - July 28 - Aug. 04

Jul 28	Sa	00:21	Full Moon
		00:22	**Total Lunar Eclipse**
		02:40	Moon Descending Node
		12:50	Delta Aquarid Shower: ZHR = 20
Aug 04	Sa	22:18	Last Quarter