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Astronomy & Physics Weekly News

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Top News

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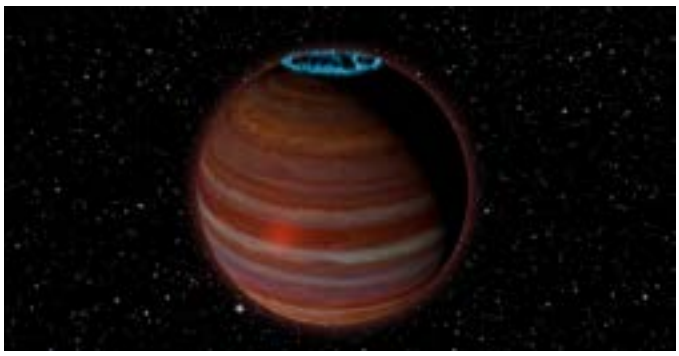
VLA detects possible extra-solar planetary-mass magnetic powerhouse



Credit: Chuck Carter, NRAO/AUI/NSF

Astronomers using the National Science Foundation's Karl G. Jansky Very Large Array (VLA) have made the first radio-telescope detection of a planetary-mass object beyond our Solar System. The object, about a dozen times more massive than Jupiter, is a surprisingly strong magnetic powerhouse and a "rogue," traveling through space unaccompanied by any parent star.

"This object is right at the boundary between a planet and a brown dwarf, or 'failed star,' and is giving us some surprises that can potentially help us understand magnetic processes on both stars and planets," said Melodie Kao, who led this study while a graduate student at Caltech, and is now a Hubble Postdoctoral Fellow at Arizona State University.

Brown dwarfs are objects too massive to be considered planets, yet not massive enough to sustain nuclear fusion of hydrogen in their cores—the process that powers stars. Theorists suggested in the 1960s that such objects would exist, but the first one was not discovered until 1995. They originally were thought to not emit radio waves, but in 2001 a VLA discovery of radio flaring in one revealed strong magnetic activity.

Subsequent observations showed that some brown dwarfs have strong auroras, similar to those seen in our own Solar System's giant planets. The auroras seen on Earth are caused by our planet's magnetic field interacting with the solar wind. However, solitary brown dwarfs do not have a solar wind from a nearby star to interact with. How the auroras are caused in brown dwarfs is unclear, but the scientists think one possibility is an orbiting planet or moon interacting with the brown dwarf's magnetic field, such as what happens between Jupiter and its moon Io.

The strange object in the latest study, called SIMP J01365663+0933473, has a magnetic field more than 200 times stronger than Jupiter's. The object was originally detected in 2016 as one of five brown dwarfs the scientists studied with the VLA to gain new knowledge about magnetic fields and the mechanisms by which some of the coolest such objects can produce strong radio emission. Brown dwarf masses are notoriously ..Read More...

The brightest celestial object in the early universe has been spotted

Astronomers spied a jet of plasma spewing from a faraway galaxy. They say this ultra-luminous celestial object could help them understand the universe's early beginnings.Robin Dienel / Carnegie Institution for Science

A faraway galaxy is blasting out the brightest radio emissions ever detected from 13 billion light-years away, and astronomers say this ultra-luminous celestial object — what's known as a quasar — could unlock clues about our universe's early beginnings.

Astronomers at the Carnegie Institution for Science and the National Radio Astronomy Observatory (NRAO) spied a jet of plasma spewing from the newfound quasar using a network of 10 radio telescopes across the U.S. and the U.S. Virgin Islands known as the Very Long Baseline Array. They detailed their discovery in a pair of papers published online July 9 in The Astrophysical Journal and The Astrophysical Journal Letters.

"This is the most detailed image yet of such a bright galaxy at this great distance," Emmanuel Momjian, an astronomer at the NRAO and one of the scientists who observed the quasar, said in a written statement.

Quasars are distant galaxies with supermassive black holes active in their cores. The Milky Way does not have a quasar because the supermassive black hole at the center of our galaxy is "dormant," Eduardo Bañados, a Carnegie-Princeton fellow at the Observatories of the Carnegie Institution for Science and the astronomer who first spotted the quasar, told NBC News MACH in an email.

Instead of swallowing matter into its swirling black mass, about 10 percent of quasars shoot radio emissions almost as fast as the speed of light into space. The quasar, called PSO J352.4034-15.3373, is one of these unique celestial objects — and one of the brightest.

Faraway quasars have been discovered before, and even brighter ones have been observed, but none have been both so distant and so bright, according to Zoltan Haiman, a professor of astronomy at Columbia University in New York City, who was not involved with ..Read More...

Tiny Blue Crystals Show Evidence of the Sun's Active Youth

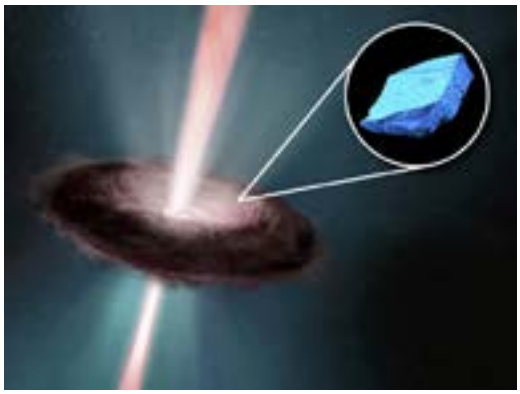


Illustration of the early solar disk, with an inset image of a blue hibonite crystal, one of the first minerals to form in the Solar System. © Field Museum, University of Chicago, NASA, ESA, and E. Feild (STScI)

Scientists studying microscopic minerals found in a meteorite have discovered evidence of the feistiness of the toddler Sun.

By observing young stars, scientists have long guessed that the Sun had been active in its youth. Now, crystals in a meteorite provide direct evidence of the Sun's energetic past.

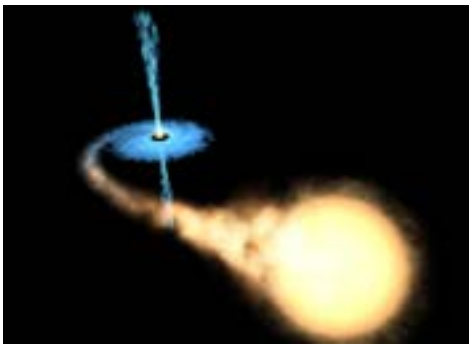
The Sun formed about 4.6 billion years ago from a spinning disk of gas and dust that probably extended beyond the present-day solar system. The disk started at out temperatures higher than 1700K (1,500°C or 2,700°F), but then it cooled, allowing the gas to solidify. Some matter aggregated to form planets, but some remained clumped into smaller rocks.

One fragment of such a rock was the Murchison meteorite, which landed in Murchison, Australia, on September 28, 1969. The meteorite has been a treasure trove for scientists since its discovery. Now Levke Kööp (University of Chicago) and colleagues have discovered that tiny blue hibonite crystals inside the meteorite paint a picture of the Sun's beginnings. The results appear in Nature Astronomy.

Using a mass spectrometer at ETH Zurich, Switzerland, the scientists reanalyzed the meteorite's hibonite crystals, many of which are less than 100 microns across. Hibonite, a mineral made of calcium, aluminum, and oxygen, solidifies at about 1700K and formed early in the solar system's history. But high-energy protons and helium nuclei emitted by the active young Sun fragmented some of the atoms making up the hibonite, turning them into smaller atoms such as neon and helium. These atoms remained trapped in the hibonite lattice for billions of years.

Because neon and helium are inert gases, they don't tend to interact with other atoms or molecules, so their quantity in the hibonite hasn't changed since ..Read More...

A Rapidly Spinning Black Hole with a Warped Disk



Artist's impression of an X-ray binary, in which a black hole orbits with a companion star that feeds it. The black hole in this illustration has both an accretion disk and jets.
ESA/NASA/Felix Mirabel

An X-ray telescope recently installed on the International Space Station has been improving our view of distant high-energy sources, one object at a time. Now, this telescope has provided a detailed look at a black hole feeding off its companion star.

How to Spot Black Holes

Stellar-mass black holes lurk throughout our galaxy – but their darkness makes them understandably difficult to spot. Because these small beasts don't emit light, we have few observations of the stellar-mass black holes around us, limiting what we can learn about these mysterious objects and their behavior.

One way that we can observe such black holes is if they exist in an X-ray binary, a binary consisting of a black hole and a donor star. In X-ray binaries, material that is siphoned off the donor star goes to feed the black hole, forming an accretion disk around the black hole as it falls in. As the material in the accretion disk spirals inwards, it radiates strongly in X-rays – resulting in emission that we can observe, even though the black hole itself emits no radiation.

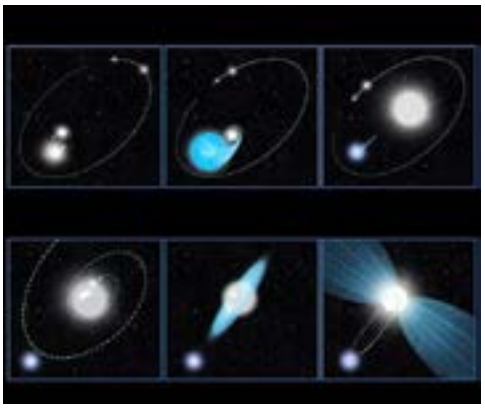
But what is the structure of this accretion disk? How far in toward the black hole does it extend? How fast does the black hole spin at its center? These are among the many questions to which scientists are still seeking answers. In a new study, astronomer Jon Miller (University of Michigan) and collaborators present new views of an X-ray binary that may provide some clues.

Eyes on a New X-Ray Source

Miller and collaborators present new observations of the X-ray binary MAXI J1535-571 made with the Neutron Star Interior Composition Explorer (NICER), an X-ray telescope recently installed on board the International Space Station.

NICER's observations indicate that the black hole in this binary is likely spinning very rapidly – at more than 99% of the maximum possible speed! The light ..Read More...

Astronomers Uncover New Clues to the Star That Wouldn't Die



t takes more than a massive outburst to destroy the mammoth star Eta Carinae, one of the brightest known stars in the Milky Way galaxy. About 170 years ago, Eta Carinae erupted, unleashing almost as much energy as a standard supernova explosion.

What happens when a star behaves like it exploded, but it's still there?

About 170 years ago, astronomers witnessed a major outburst by Eta Carinae, one of the brightest known stars in the Milky Way galaxy. The blast unleashed almost as much energy as a standard supernova explosion.

Yet Eta Carinae survived.

An explanation for the eruption has eluded astrophysicists. They can't take a time machine back to the mid-1800s to observe the outburst with modern technology.

However, astronomers can use nature's own "time machine," courtesy of the fact that light travels at a finite speed through space. Rather than heading straight toward Earth, some of the light from the outburst rebounded or "echoed" off of interstellar dust, and is just now arriving at Earth. This effect is called a light echo. The light is behaving like a postcard that got lost in the mail and is only arriving 170 years later.

By performing modern astronomical forensics of the delayed light with ground-based telescopes, astronomers uncovered a surprise. The new measurements of the 19th-century eruption reveal material expanding with record-breaking speeds up to 20 times faster than astronomers expected. The observed velocities are more like the fastest material ejected by the blast wave in a supernova explosion, rather than the relatively slow and gentle winds expected from massive stars before they die.

Based on this data, researchers suggest that the 1840s eruption may have been triggered by a prolonged stellar brawl among three rowdy sibling stars, which destroyed one star and left the other two in a binary system. This tussle may have culminated with a violent explosion when Eta Carinae devoured one of its two companions, rocketing more than 10 times the mass of our Sun ..Read More...

There's Not Enough CO2 To Terraform Mars

Lockheed Martin's Mars Base Camp is part of a vision to bring astronauts to the Red Planet. But to enjoy living there longterm, many scientists have long dreamed of altering the planet's atmosphere. Lockheed Martin

Mars might not have the right ingredients to terraform into our planetary home away from home - even with the recent discovery of liquid water buried near its south pole.

Research published Monday in Nature Astronomy puts a kibosh on the idea of terraforming Mars. At the heart of the study is carbon dioxide. Carbon dioxide, a greenhouse gas, is abundant on Mars — its thin atmosphere is made of the stuff, and the white stuff we often see on the surface is dry ice, not snow. CO2 is even trapped in the rocks and soil.

That abundance has long fueled visions of a fantasy future where all that trapped carbon dioxide is released, creating a thicker atmosphere that warms the planet. SpaceX founder Elon Musk has even proposed nuking Mars to make this happen.

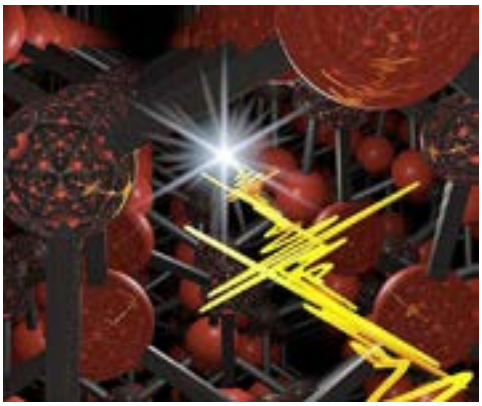
But in this new study, veteran Mars expert Bruce Jakosky of the University of Colorado Boulder and Christopher S. Edwards of Northern Arizona University, surveyed how much carbon dioxide is available for terraforming the Red Planet. They combined Martian CO2 observations from various missions — NASA's MAVEN atmospheric probe, the European Space Agency's Mars Express orbiter, as well as NASA's Odyssey and the Mars Reconnaissance Orbiter. The results throw shade on the dreams of futurists.

Terraforming Schemes

The paper looks at two approaches that have been discussed. In the first, humans simply raise Mars' atmospheric pressure until space colonists can walk around with a breathing apparatus instead of the full astronaut pressure suit used in spacewalks. The other scenario looks at creating an atmosphere that allows liquid water on the surface and roughly breathable air.

Either scenario needs plenty of CO2. And ... there's just not enough. The polar caps are actually quite shallow deposits of carbon dioxide, and even exhausting all of Mars' existing CO2 resources still creates just 15 millibars of the atmospheric pressure — on Earth, roughly ..Read More...

Extreme conditions in semi-conductors



File illustration only

Scientists from the University of Konstanz and Paderborn University have succeeded in producing and demonstrating what is known as Wannier-Stark localization for the first time. In doing so, the physicists managed to overcome obstacles that had so far been considered insurmountable in the field of optoelectronics and photonics. Wannier-Stark localization causes extreme imbalance within the electric system of crystalline solids.

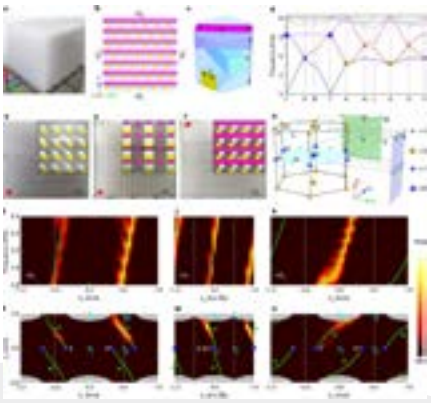
"This fundamental effect was predicted more than 80 years ago. But it has remained unclear ever since whether this state can be realized in a bulk crystal, that is, on the level of chemical bonds between atoms", says Professor Alfred Leitenstorfer, Professor of Experimental Physics at the University of Konstanz. Analogues of the effect have so far been demonstrated only in artificial systems like semiconductor superlattices or ultracold atomic gases.

In a bulk solid, Wannier-Stark localization can only be maintained for an extremely short period of time, shorter than a single oscillation of infrared light. Using the ultrafast laser systems at the University of Konstanz, Wannier-Stark localization has now been demonstrated for the first time. The experiment was conducted in a high-purity gallium arsenide crystal grown at ETH Zurich using epitaxial growth. The research results were published in the scientific journal Nature Communications on 23 July 2018.

What is Wannier-Stark localization?
If we tried to picture the atoms of a crystal, it would have to be as a three-dimensional grid composed of small beads that repel each other and are only kept together by rubber bands. The system remains stable as long as the rubber band is as strong as the repulsion is. If this is the case, the beads neither move closer to each other, nor do they move away from each other - the distance between them remains about the same.

Wannier-Stark localization occurs when the rubber bands are removed abruptly. It is the electronic state that happens at the precise moment in time when the rubber bands have already gone but the beads still remain in place: The chemical bonds that hold the crystal together have been suspended. ...Read More...

An artificial material that has negative refraction and no reflection



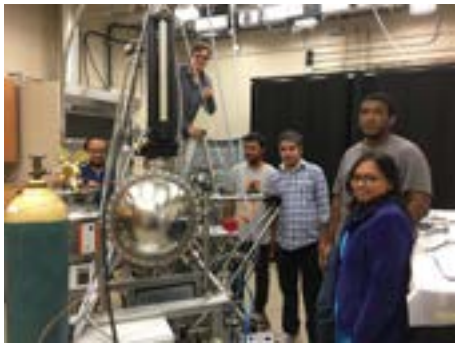
The Weyl phononic crystal and topologically protected SAWs. a, An image of the experimental sample. b, Schematic top view of the trilayer-based sample. XZ1, YZ1, XZ2 and YZ2 label the four side surfaces. c, Geometry of the unit cell, with a = h = 3b = 29.4 mm. d–f, Front views of the three surfaces XZ1, YZ1, and XZ2, respectively. At each surface, the red star denotes the position of a point-like sound source for experimentally generating one-way chiral SAWs and the coloured segments in the insets indicate the fine structures of the surface termination. g, Bulk band dispersions simulated along high-symmetry directions. The coloured lines represent the lowest three bands. h, The first bulk Brillouin zone of the Weyl phononic crystal and associated projected surface Brillouin zones. The coloured spheres in g and h label Weyl points with different topological charges. i–k, Simulated SAW dispersions (green lines) at $k_z = 0.5\pi/h$ for the three side surfaces XZ1, YZ1 and XZ2, respectively, agree very well with our measurements (bright colours in the colour scale, which represents the Fourier transformation of the measured pressure field). l–n, The corresponding EFCs in the extended surface Brillouin zones, simulated and measured at the Weyl frequency of 5.75 kHz. The grey regions display the projected bulk bands, the blue spheres label the projected Weyl points K and K′ , and the green arrows indicate the directions of the SAW group velocities. Credit: Nature (2018). DOI: 10.1038/s41586-018-0367-9

A team of researchers with members from Wuhan University and the University of Texas has created an artificial material that offers both negative refraction and no reflection. In their paper published in the journal Nature, the group describes their material, how it was made, and possible uses for it. Baile Zhang with Nanyang Technological University offers a News & Views piece on the work done by the team in the same journal issue.

As most kids learn in school, when light rays strike a body of water, some are bent by the water, while others are reflected. Baile notes that in such situations, the incident and refracted rays wind up on opposite sides of the surface of the water—which opticians describe as the norm. He also notes that this is what happens with virtually all materials in nature. But he also notes that theory suggests that it should be possible to create materials that violate the norm. In this new effort, the researchers have created just such a material.

The researchers report that they made the new material by first studying the properties of a ...Read More...

Team discovers a first-of-its-kind material for the quantum age



Madhab Neupane and his research team with the in-house ARPES system. From left to right: Gyanendra Dhakal (Graduate student), Klauss Dimitri (Undergraduate student), Md Mofazzel Hosen (Graduate student), Madhab Neupane, Christopher Sims (Graduate student), Firoza Kabir (Graduate student) Credit: University of Central Florida

A UCF physicist has discovered a new material that has the potential to become a building block in the new era of quantum materials, those that are composed of microscopically condensed matter and expected to change our development of technology.

Researchers are entering the Quantum Age, and instead of using silicon to advance technology they are finding new quantum materials, conductors that have the ability to use and store energy at the subatomic level.

Assistant Professor Madhab Neupane has spent his career learning about the quantum realm and looking for these new materials, which are expected to become the foundation of the technology to develop quantum computers and long-lasting memory devices. These new devices will increase computing power for big data and greatly reduce the amount of energy required to power electronics.

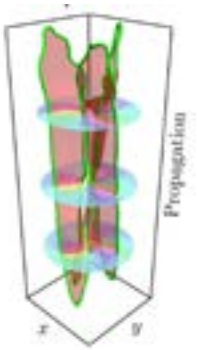
Big companies recognize the potential and they are investing in research. Microsoft has invested in its Station Q, a lab dedicated solely to studying the field of topological quantum computing. Google has teamed up with NASA on a Quantum AI Lab that studies how quantum computing and artificial intelligence can mesh. Once the quantum phenomena are well understood and can be engineered, the new technologies are expected to change the world, much like electronics did at the end of the 20th century.

Neupane's discovery, published today in Nature Communications is a big step in making that reality happen.

"Our discovery takes us one step closer to the application of quantum materials and helps us gain a deeper understanding of the interactions between various quantum phases," Neupane said.

The material Neupane and his team discovered, Hf2Te2P—chemically composed of hafnium, tellurium and phosphorus—is the first material that has multiple ...Read More...

Scientists find holes in light by tying it in knots



Experimentally measured polarisation singularity trefoil knot. Credit: University of Bristol

A research collaboration including theoretical physicists from the University of Bristol and Birmingham has found a new way of evaluating how light flows through space—by tying knots in it.

Laser light may appear to be a single, tightly focused beam. In fact, it's an electromagnetic field, vibrating in an ellipse shape at each point in space. This multidirectional light is said to be 'polarised'.

The effect can be seen with polarised sunglasses, which only allow one direction of light to penetrate. By holding them up to the sky and rotating them, viewers will see darker and brighter patches as light flowing in different directions appears and disappears.

Now, scientists have been able to use holographic technology to twist a polarised laser beam into knots.

Professor Mark Dennis, from the University of Bristol's School of Physics and University of Birmingham's School of Physics and Astronomy, led the theoretical part of the research.

He said: "We are all familiar with tying knots in tangible substances such as shoelaces or ribbon. A branch of mathematics called 'knot theory' can be used to analyse such knots by counting their loops and crossings.

"With light, however, things get a little more complex. It isn't just a single thread-like beam being knotted, but the whole of the space or 'field' in which it moves.

"From a maths point of view, it isn't the knot that's interesting, it's the space around it. The geometric and spatial properties of the field are known as its topology."

In order to analyse the topology of knotted light fields, researchers from universities in Bristol, Birmingham, Ottowa and Rochester used polarised light beams to create structures known as 'polarisation singularities'. Discovered by Professor John Nye in Bristol over 35 years ago, polarisation singularities occur at points where ...Read More...

The venusian facelift

This global map of Venus, created using radar data, uses simulated color to bring out small-scale structure on the surface of the planet.
NASA/JPL

New evidence overthrows scientists' current Venus surface formation theory.

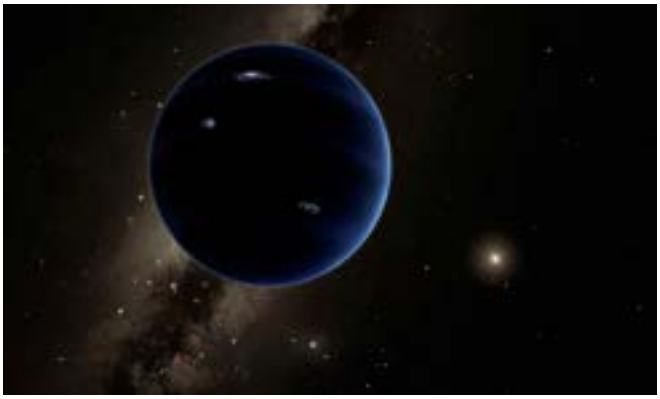
Hidden below 15 miles of clouds, Venus' stifled surface looks much different – much younger – than its nearby terrestrial brethren. While Mars and the Moon are pockmarked by thousands of craters, Venus' features are no older than 250 million to 750 million years. Some think this is the result of an abrupt re-paving of the Venusian surface that occurred when life on Earth was just beginning to sprout fins. New research published March 25 in the Journal of Geophysical Research, however, discounts this theory, favoring instead a different explanation – perhaps that Venus' hundreds of volcanoes are the likely culprit behind the crater-less carpet.

Using numerical models to see how material in the planet's mantle circulates, the results found that the planet couldn't have undergone what is called mobile' lid convection – a process where the surface rapidly sinks into the interior and is replaced by a fresh, crater-free surface. The results will help scientists understand how Venus evolved and may even help us understand how the planet's runaway atmosphere came to be.

Earth and Venus formed during the same time and they have near-identical sizes, but any similarities end there. While Earth's atmosphere is primarily nitrogen, Venus' is almost entirely poisonous carbon dioxide. Most of the venusian surface is a landscape of smooth volcanic plains, some of which may still be active. Astronomers have long argued how Venus' topography arose. Was it an abrupt mobile-lid convention event, or a continual surface renewal by active volcanoes?

Problem one: The offset
In a mobile-lid convention event, the lithosphere – the crust – sinks to settle along the core-mantle boundary. As the mass moves inward, it falls unevenly, leaving some areas thicker than others. So if a sudden ...Read More...

Planet Nine: 'Insensitive' Term Riles Scientists



Artist's impression of the hypothetical Planet Nine, a roughly Neptune-mass world that may lie undiscovered in the outer solar system. Credit: R. Hurt (IPAC)/Caltech

Don't call it Planet Nine.

That nickname for the big world that may lurk unseen in the far outer solar system doesn't show the proper amount of respect to the discoverer of the original ninth planet, Pluto, a group of researchers argues in a new message to their colleagues.

The International Astronomical Union (IAU) famously reclassified Pluto as a "dwarf planet" in 2006. That decision remains highly controversial today, as made clear by the new note, which appeared in the July 29 issue of the Planetary Exploration Newsletter.

The message, titled "On the Insensitive Use of the Term 'Planet 9' for Objects Beyond Pluto," reads:

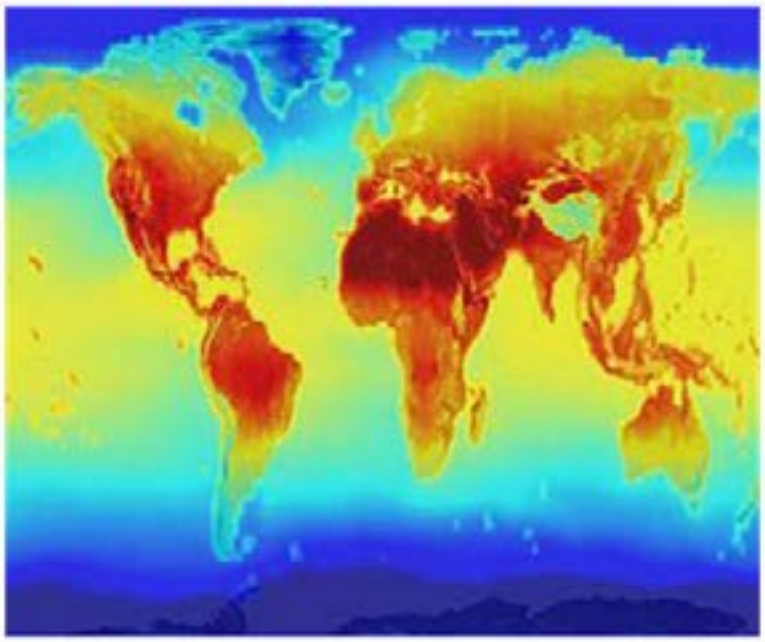
"We the undersigned wish to remind our colleagues that the IAU planet definition adopted in 2006 has been controversial and is far from universally accepted. Given this, and given the incredible accomplishment of the discovery of Pluto, the harbinger of the solar system's third zone – the Kuiper Belt – by planetary astronomer Clyde W. Tombaugh in 1930, we the undersigned believe the use of the term 'Planet 9' for objects beyond Pluto is insensitive to Professor Tombaugh's legacy.

"We further believe the use of this term should be discontinued in favor of culturally and taxonomically neutral terms for such planets, such as Planet X, Planet Next or Giant Planet Five."

Nearly three dozen researchers signed onto this message. They are: Paul Abell / Michael Allison / Nadine Barlow / James Bauer / Gordon Bjoraker / Paul Byrne / Eric Christiansen / Rajani Dhingra / Timothy Dowling / David Dunham / Tony L. Farnham / Harold Geller / Alvero Gonzalez / David Grinspoon / Will Grundy / George Hindman / Kampalayya M. Hiremath / Brian Holler / Stephanie Jarmak / Martin Knapmeyer / Rosaly Lopes / Amy Lovell / Ralph McNutt / Phil Metzger / Sripada Murty / Michael Paul / Kirby Runyon / Ray Russell ... Read More...

Special Read:

Greenhouse gases surge to new highs worldwide in 2017



Global temperature change - Wikipedia

Planet-warming greenhouse gases surged to new highs as abnormally hot temperatures swept the globe and ice melted at record levels in the Arctic last year due to climate change, a major US report said Wednesday.

The annual State of the Climate Report, compiled by more than 450 scientists from over 60 countries, describes worsening climate conditions worldwide in 2017, the same year that US President Donald Trump pulled out of the landmark Paris climate deal.

The United States is the world's second leading polluter after China, but has rolled back environmental safeguards under Trump, who has declared climate change a "Chinese hoax" and exited the Paris deal signed by more than 190 nations as a path toward curbing harmful emissions.

The 300-page report issued by the American Meteorological Society and the National Oceanic and Atmospheric Administration (NOAA) mentioned the word "abnormal" a dozen times, referring to storms, droughts, scorching temperatures and record low ice cover in the Arctic.

Here are its key findings:

- Greenhouse gas surge -

Last year, the top three most dangerous greenhouse gases released into Earth's atmosphere -- carbon dioxide, methane and nitrous oxide -- reached new record highs.

The annual global average carbon dioxide concentration at the Earth's surface climbed to 405 parts per million, "the highest in the modern atmospheric measurement record and in ice core records dating back as far as 800,000 years," said the report.

"The global growth rate of CO2 has nearly quadrupled since the early 1960s."

- Heat records -

The record for hottest year in modern times was set in 2016, but 2017 was not far behind, with "much-warmer-than-average conditions" across most of the world, it said. Annual record high temperatures were observed in Argentina, Bulgaria, Spain and Uruguay, while Mexico "broke its annual record for the fourth ..Read More...

Memories of SCASS Observations of the Longest lunar eclipse of the 21st century

Here are some memories of the July 27, 2018 lunar eclipse observations held at the Sharjah Center for Astronomy and Space Sciences. More than 1,000 persons turned in to see the spectacle using different telescopes and large binoculars set for the special occasion. The Sharjah observatory's team was on duty the whole night. Special thanks go to: Mr. Mohamed Talafha, Mr. Issam Abu-Jami, and all of the research assistants: Douae Nouichi, Yusra Mohamed Elkalyoubi, Mustafa Mohamed Elkalyoubi, Aisha Jasim Hassan Alzeraif Al-Ali, Anas Omar Mohamad Adwan Takwa Mohamed Dawdi, Mariam Abdisalam Ahmed, Ruhi Ahmed Moazzam Shaikh, Jahanzeb Rehman, Shahab Mohammad, Masa Basel, and Ridwan Mohamed Fernini. Also thanks to anyone from the SCASS administration who made this event a succesful one. Here are some pictures taken by Jahanzeb Rehman during the observations.












This Week's Sky at a Glance - Aug. 04-10, 2018

Aug 04	Sa	22:18	Last Quarter
Aug 06	Mo	22:35	Moon-Aldebaran: 1.1° S
Aug 09	Th	02:33	Moon North Dec.: 20.8° N
		05:59	Mercury Inferior Conj.
Aug 10	Fr	17:40	Moon Ascending Node
		22:05	Moon Perigee: 358100 km