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IT Support Issam Jami

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After 15 years on Mars, it's the end of the road for Opportunity

The Opportunity rover, seen here taking a shadow selfie early in its mission, trekked more than 45 kilometers across the Martian surface in the last 15 years before finally giving up the ghost.

Opportunity has finally run out of, well, opportunities. After weeks of trying to revive the veteran Mars rover in the wake of a blinding dust storm, NASA has given up on ever hearing from it again.

After one last failed attempt to reach Opportunity February 12, NASA officials announced the end on February 13. "I was there with the team as these commands went out into the deep sky," Thomas Zurbuchen, the associate administrator of NASA's Science Mission Directorate, said in a news conference at the Jet Propulsion Laboratory in Pasadena, Calif. "I learned this morning that we had not heard back, and our beloved Opportunity remains silent. It is therefore that I am standing here with a sense of deep appreciation and gratitude that I declare the Opportunity mission as complete, and with it the Mars Exploration Rover mission as complete."

Opportunity landed on Mars in January 2004 for a mission that was supposed to last 90 Martian days. Its twin rover, Spirit, had landed three weeks earlier on the other side of the planet.

Spirit succumbed to a stuck wheel in 2010. But Opportunity kept going. Over 15 years, the rover found abundant evidence that water once flowed and pooled on the Red Planet's surface. It also shattered records for planetary exploration and shaped Mars missions for years to come.

But on June 10, 2018 — 5,111 Martian days into its 90-day mission — Opportunity went silent, caught in a massive planetwide dust storm. At first, the rover team hoped Opportunity could ride out the storm and wake up when the skies cleared. But it didn't.

A few final, Hail Mary attempts to reach Opportunity also failed. The rover's internal clock may have stopped keeping accurate time, which could mean Opportunity was burning through its battery instead of going into a deep sleep mode at night, says mission engineer Bill Nelson of JPL.

On February 2, the rover team started sending the rover frequent commands to reset its clock. .....Read More...

Running an LED in reverse could cool future computers

In a finding that runs counter to a common assumption in physics, researchers at the University of Michigan ran a light emitting diode (LED) with electrodes reversed in order to cool another device mere nanometers away.

The approach could lead to new solid-state cooling technology for future microprocessors, which will have so many transistors packed into a small space that current methods can't remove heat quickly enough.

"We have demonstrated a second method for using photons to cool devices," said Pramod Reddy, who co-led the work with Edgar Meyhofer, both professors of mechanical engineering.

The first—known in the field as laser cooling—is based on the foundational work of Arthur Ashkin, who shared the Nobel prize in Physics in 2018.

The researchers instead harnessed the chemical potential of thermal radiation—a concept more commonly used to explain, for example, how a battery works.

"Even today, many assume that the chemical potential of radiation is zero," Meyhofer said. "But theoretical work going back to the 1980s suggests that under some conditions, this is not the case."

The chemical potential in a battery, for instance, drives an electric current when put into a device. Inside the battery, metal ions want to flow to the other side because they can get rid of some energy—chemical potential energy—and we use that energy as electricity. .....Read More...
From Chelyabinsk to Cuba: The meteor connection

Trajectory of the meteor falling over Cuba on February 1, 2019, as reconstructed by a team of Colombian astronomers.

The scientific team that used YouTube videos to determine the trajectory of the Chelyabinsk meteor used the same method to track the trajectory of the bright meteor that crossed the sky over Cuba on February 1.

On February 1, 2019, a bright meteor crossed the sky over Cuba in the middle of the day. The phenomenon, followed by a smoke trail (a characteristic cloud left by a meteor burning up in the atmosphere) and a sonic boom, was witnessed by thousands of locals and tourists in the region of Pinar del Río (western side of the island).

Almost at the same time of the impact, a cruise ship was leaving Havana Harbor and on board, Rachel Cook, an American tourist and vlogger, was making a timelapse of the undocking process. Without knowing it, she was recording one of the few videos known to date of the falling meteor. Meanwhile, about 250 miles (400 km) away, in Ft. Myers, Florida, a webcam of the EarthCam network was filming the midday activities on the beach. Luckily, the camera was aimed in the right direction to record the meteor.

Just a couple of minutes after the event, social networks, especially Instagram and Twitter, received a flood of dozens of videos and pictures taken from Cuba, most of them showing the smoke trail left by the meteor. One of those videos was particularly interesting. It was recorded in one of the main streets of the city of Pinar del Río, and showed dozens of people in the street contemplating the remnant cloud in awe (see the video here). Although the video does not show the meteor, it was full of details about the place and time when it was recorded.

These events recalled the Chelyabinsk meteor of February 2013, when a super bolide, 400 times brighter than the Cuba meteor (according to NASA data released a few days after the Cuba impact), hit the atmosphere over a populated area in western Russia. The Chelyabinsk meteor was the first event of its kind witnessed by humans in almost a century.

Only a couple of days after the Chelyabinsk impact, a team of astronomers of the Institute of Physics read more...

A radioactive metal may stifle the formation of water worlds

Planets that form in regions with high levels of aluminum may be left with dry materials leading to Earth-like planets, while those in aluminum-light environments may stay wet and form ocean worlds. Roger Thibau

Because it can dry out the building blocks of planets before they merge, radioactive aluminum may play a major role in determining whether a world ends up wet or not.

While we tend to think that Earth’s oceans make it a watery planet, it’s actually only a tiny fraction of a percent of water by mass. Looking out into the universe, it’s clear water is more common than our own planet implies. Some exoplanets can have half their mass as water. So, what causes some planetary systems to stay wet, while others dry out? The answer might be aluminum.

Tim Lichtenberg is the lead author of a new study published Feb. 11, in Nature Astronomy. He says that large amounts of Al-26, a radioactive form of aluminum, can heat up and dry out the large boulders, some 5 to 50 miles across (called planetesimals), that collide to form planets.

As a result, the amount of aluminum a young system has could be a predictor of what types of planets will evolve there.

Location and size matter

All stars tend to heat and dry out material – from pebbles to planetesimal – that orbits closer than what’s called the snow line. Beyond the snow line, ice sticks around and gets incorporated into planets, which can then keep that ice and eventually turn it into water, even if they later migrate closer to the Sun. For instance, our own Earth keeps water trapped under its atmosphere, while Mars, farther out, lost its water. Both are now inside the snow line, but probably formed farther out.

Aluminum heating only matters to planetesimals of a certain size. Small pebbles don’t have enough Al-26 to cause any heating. Full-size planets may be able to hang onto their water through other methods – like having an atmosphere. But aluminum heating would affect all planetesimals in the unlucky size range, no matter how close or far they are from their Sun. Missing water

A good example of this effect in action might be the TRAPPIST-1 exoplanet system. TRAPPIST-1 has seven rocky planets circling a dim red dwarf star. ...Read More...
Gravitational waves will settle cosmic conundrum

Measurements of gravitational waves from ~50 binary neutron stars over the next decade will definitively resolve an intense debate over how fast our universe is expanding, find an international team including UCL and Flatiron Institute cosmologists.

The cosmos has been expanding for 13.8 billion years and its present rate of expansion, known as the Hubble constant, gives the time elapsed since the Big Bang.

However, the two best methods used to measure the Hubble constant do not agree, suggesting our understanding of the structure and history of the universe - called the 'standard cosmological model' - may be wrong.

The study, published in Physical Review Letters, shows how new independent data from gravitational waves emitted by binary neutron stars called 'standard sirens' will break the deadlock between the measurements once and for all.

"The Hubble Constant is one of the most important numbers in cosmology because it is essential for estimating the curvature of space and the age of the universe, as well as exploring its fate," said Professor Hiranya Peiris (UCL Physics and Astronomy).

"We can measure the Hubble Constant by using two methods - one observing Cepheid stars and supernovae in the local universe, and a second using measurements of cosmic background radiation from the early universe - but these methods don't give the same values, which means our standard cosmological model might be flawed."

The team developed a universally applicable technique which calculates how gravitational wave data will resolve the issue.

Gravitational waves are emitted when binary neutron stars spiral towards each other before colliding in a bright flash of light that can be detected by telescopes. Indeed, UCL researchers were involved in detecting the first light from a gravitational wave event in August 2017.

Binary neutron star events are rare but invaluable in providing another route to track how the universe is expanding. Read More...

A stellar flare 10 billion times more powerful than those on the Sun

The Hawaii-based James Clerk Maxwell Telescope (JCMT) has discovered a stellar flare 10 billion times more powerful than the Sun’s solar flares, a history-making discovery that could unlock decades-old questions about the origin of our own Sun and planets, giving insight into how these celestial bodies were born.

"A discovery of this magnitude could have only happened in Hawaii," said Dr. Steve Mairs, astronomer and lead investigator of the team that discovered the stellar flare.

"Using the JCMT, we study the birth of nearby stars as a means of understanding the history of our very own solar system. Observing flares around the youngest stars is new territory and it is giving us key insights into the physical conditions of these systems. This is one of the ways we are working toward answering people’s most enduring questions about space, time, and the universe that surrounds us."

The JCMT Transient Survey team recorded the 1,500-year-old flare using the telescope’s state-of the art high-frequency radio technology and sophisticated image analysis techniques. Identified by astronomer Dr. Steve Mairs, the original data was obtained using the JCMT’s supercooled camera known as “SCUBA-2,” which is kept at a frigid -459.5 degrees Fahrenheit.

The flare is thought to be caused by a disruption in an intense magnetic field actively funneling material onto a young, growing star as it gains mass from its surroundings. The event occurred in one of the nearest star-forming regions to the Earth, the Orion Nebula. It lasted only a matter of hours.

Located near the summit of Maunakea, the JCMT is the largest and only telescope in the northern hemisphere capable of making this type of discovery. The stellar flare observation was made as part of a monthly tracking program from researchers from around the world who use the JCMT to observe nearly 1,000 nearby stars in the earliest stages of their formation. Read More...
NASA Will Launch a New Space Telescope in 2023 to Investigate the Universe

Come 2023, NASA will have a new eye tracking the heavens and looking to solve some of the greatest scientific mysteries we know of.

That’s thanks to a newly approved mission called Spectro-Photometer for the History of the Universe, Epoch of Reionization and Ices Explorer and nicknamed SPHEREx. The instrument is designed to tackle two key questions: how the universe evolved and how common some crucial building blocks of life are across our galaxy.

“I’m really excited about this new mission,” NASA Administrator Jim Bridenstine said in a statement. “Not only does it expand the United States’ powerful fleet of space-based missions dedicated to uncovering the mysteries of the universe, it is a critical part of a balanced science program that includes missions of various sizes.”

The SPHEREx instrument will be able to gather optical and near-infrared light from a mind-bogglingly large number of sources: more than 100 million stars in the Milky Way itself and more than 300 million other galaxies. It will manage to tackle two different but equally fundamental questions in those two different purviews.

All told, SPHEREx will scan through the whole sky and gather data in 96 different wavelengths of light. Within our Milky Way galaxy, SPHEREx will map water and organic molecules, which are both fundamental ingredients for life as we know it. And beyond our galaxy, it will look back into the very first moments of our universe. Scientists will be able to use its data to prioritize observing targets for other future space telescope missions, including the James Webb Space Telescope and the Wide Field Infrared Survey Telescope.

“This amazing mission will be a treasure trove of unique data for astronomers,” Thomas Zurbuchen, associate administrator for NASA’s Science Mission Directorate, said in the same statement. “It will deliver an unprecedented galactic map containing ‘fingerprints’ from the first moments in the universe’s history. And we’ll have new clues to one of the greatest mysteries in science.”

Engineers develop room temperature, two-dimensional platform for quantum technology

Researchers at the University of Pennsylvania’s School of Engineering and Applied Science have now demonstrated a new hardware platform based on isolated electron spins in a two-dimensional material. The electrons are trapped by defects in sheets of hexagonal boron nitride, a one-atom-thick semiconductor material, and the researchers were able to optically detect the system’s quantum states.

Quantum computers promise to be a revolutionary technology because their elementary building blocks, qubits, can hold more information than the binary, 0-or-1 bits of classical computers. But to harness this capability, hardware must be developed that can access, measure and manipulate individual quantum states.

Researchers at the University of Pennsylvania’s School of Engineering and Applied Science have now demonstrated a new hardware platform based on isolated electron spins in a two-dimensional material. The electrons are trapped by defects in sheets of hexagonal boron nitride, a one-atom-thick semiconductor material, and the researchers were able to optically detect the system’s quantum states.

The study was led by Lee Bassett, assistant professor in the Department of Electrical and Systems Engineering, and Annemarie Exarhos, then a postdoctoral researcher in his lab.

Fellow Bassett Lab members David Hopper and Raj Patel, along with Marcus Doherty of the Australian National University, also contributed to the study.

It was published in the journal Nature Communications, where it was selected as an Editor’s Highlight.

There are number of potential architectures for building quantum technology. One promising system involves electron spins in diamonds: these spins are also trapped at defects in diamond’s regular crystalline pattern where carbon atoms are missing or replaced by other elements. The defects act like isolated atoms or molecules, and they interact with light in a way that enables their spin to be measured and used as a qubit.

These systems are attractive for quantum technology because they can operate at room temperatures, unlike other prototypes based on ultra-cold superconductors or ions trapped in vacuum, but working with bulk diamond presents its own challenges.

Read More...
Photons reveal a weird effect called the quantum pigeonhole paradox

Two pigeons can sit comfortably in two holes, but add a third bird and they'll have to share. But three quantum particles can occupy two states without any having the same state, scientists have shown.

Quantum pigeons don't like to share.

In keeping with a mathematical concept known as the pigeonhole principle, roosting pigeons have to cram together if there are more pigeons than spots available, with some birds sharing holes. But photons, or quantum particles of light, can violate that rule, according to an experiment reported in the Jan. 29 Proceedings of the National Academy of Sciences.

The pigeonhole principle states that, if three pigeons are roosting in two holes, one hole must contain at least two birds. Though seemingly obvious, the idea helps define the fundamentals of what numbers are and what it means to count things. But in the quantum realm, scientists had predicted that three “pigeons” — technically, quantum particles — could squeeze into two holes without any one particle sharing a hole with another, in what's known as the quantum pigeonhole effect.

The “quantum pigeonhole effect challenges our basic understanding... So a clear experimental verification is highly needed,” study coauthors Chao-Yang Lu and Jian-Wei Pan, physicists at the University of Science and Technology of China in Hefei, wrote in an e-mail. “The quantum pigeonhole may have potential applications to find more complex and fundamental quantum effects.”

In the study, three photons took the place of the pigeons. Rather than crowding the photons into holes, the researchers studied the polarization of the particles, or the orientation of the photons’ wiggling electromagnetic waves, which can be either horizontal or vertical. Since there were three photons and two polarizations, standard math would suggest that at least two must have had the same polarization. When the scientists compared the particles’ polarizations, the team found that no two particles matched, verifying that the quantum pigeonhole effect is real.

The mind-bending behavior is the result of a combination of already strange quantum effects. The photons begin the experiment in an odd kind of limbo called a superposition, meaning they are polarized both horizontally and vertically at the same time. When two photons'...Read More...

Machine learning reveals hidden turtle pattern in quantum fireworks

Two years ago, physicists at the University of Chicago were greeted with fireworks—atoms shooting out in jets—when they discovered a new form of quantum behavior. But the patterns underlying the bright jets were difficult to pick out from the noise.

Instead, the scientists took an approach new to the field: machine learning. By running the data through a pattern recognition algorithm, they identified that the paths of the atoms formed a distinctive shape that looks a bit like a turtle—which helped tease out the physics behind it. The results, published Feb. 1 in Science, improve our understanding of quantum dynamics and offer an innovative way to study quantum phenomena.

"In understanding complex quantum dynamics, we start to be limited by our intuition, but machine learning could be a new tool for understanding such systems," said lead author Cheng Chin, a professor of physics at the University of Chicago and a pioneer in using ultracold experiments to study the quantum phenomena that underlie the behavior of the smallest particles and the universe.

In the original study, Chin’s lab cooled particles down to nearly absolute zero until they all condensed into the same quantum state, called a Bose-Einstein condensate. Next, they applied a magnetic field, and were surprised to see atoms shooting out in bright jets.

But the exact pattern was hard to tease out among the noise. Graduate student Lei Feng, the first author on the new study, developed a machine-learning algorithm to search the results for patterns and correlations that human eyes don't always see.

"This is similar to looking at the flow of people moving at a train station," Cheng said. "At first it looks random, but if you observe carefully, you can find families traveling together, business people going to meetings and so forth.”

The algorithm picked out a correlation in a shape that resembles a turtle: a ring around a central source that forms the "shell;" four secondary points that appear like feet around it; and two extended points as the "head" and "tail.”

"If you see a particle going in one...Read More...
Where is the universe hiding its missing mass?

Credit: Chandra X-ray Center

Astronomers have spent decades looking for something that sounds like it would be hard to miss: about a third of the “normal” matter in the Universe. New results from NASA’s Chandra X-ray Observatory may have helped them locate this elusive expanse of missing matter.

From independent, well-established observations, scientists have confidently calculated how much normal matter—meaning hydrogen, helium and other elements—existed just after the Big Bang. In the time between the first few minutes and the first billion years or so, much of the normal matter made its way into cosmic dust, gas and objects such as stars and planets that telescopes can see in the present-day Universe.

The problem is that when astronomers add up the mass of all the normal matter in the present-day Universe about a third of it can’t be found. (This missing matter is distinct from the still-mysterious dark matter.)

One idea is that the missing mass gathered into gigantic strands or filaments of warm (temperature less than 100,000 Kelvin) and hot (temperature greater than 100,000 Kelvin) gas in intergalactic space. These filaments are known by astronomers as the “warm-hot intergalactic medium” or WHIM. They are invisible to optical light telescopes, but some of the warm gas in filaments has been detected in ultraviolet light.

Using a new technique, researchers have found new and strong evidence for the hot component of the WHIM based on data from Chandra and other telescopes.

“If we find this missing mass, we can solve one of the biggest conundrums in astrophysics,” said Orsolya Kovacs of the Center for Astrophysics | Harvard & Smithsonian (CfA) in Cambridge, Massachusetts. “Where did the universe stash so much of its matter that makes up stuff like stars and planets and us?”

Astronomers used Chandra to look for and study filaments of warm gas lying along the path to a quasar, a bright source of X-rays powered by a rapidly growing supermassive black hole. This quasar is located about 3.5 billion light years from Earth. If the WHIM’s hot gas component is associated with these filaments, some of the X-rays from the quasar would be absorbed by that hot gas. "Read More..."

What exactly is a black hole?

Credit: ESO/Gravity Consortium/L. Calçada

What is a black hole? In an article that has just appeared in the journal Nature Astronomy, LMU philosopher Erik Curiel shows that physicists use different definitions of the concept, depending on their own particular fields of interest.

A black hole is conventionally thought of as an astronomical object that irrevocably consumes all matter and radiation which comes within its sphere of influence. Physically, a black hole is defined by the presence of a singularity, i.e., a region of space, bounded by an ‘event horizon’, within which the mass/energy density becomes infinite, and the normally well-behaved laws of physics no longer apply. However, as an article in the January issue of the journal Nature Astronomy demonstrates, a precise and agreed definition of this ‘singular’ state proves to be frustratingly elusive. Its author, Dr. Erik Curiel of the Munich Center for Mathematical Philosophy at LMU, summarizes the problem as follows: “The properties of black holes are the subject of investigations in a range of subdisciplines of physics – in optical physics, in quantum physics and of course in astrophysics. But each of these specialties approaches the problem with its own specific set of theoretical concepts.”

Erik Curiel studied philosophy as well as theoretical physics at Harvard University and the University of Chicago, and the primary aim of his current DFG-funded research project is to develop a precise philosophical description of certain puzzling aspects of modern physics. “Phenomena such as black holes belong to a realm that is inaccessible to observation and experiment. Work based on the assumption that black holes exist therefore involves a level of speculation that is unusual even for the field of theoretical physics.” However, this difficulty is what makes the physical approach to the nature of black holes so interesting from the philosophical point of view. “The physical perspective on black holes is itself inextricably bound up with philosophical issues relating to ontological, metaphysical and methodological considerations,” says Curiel.

“Surprising” and “eye-opening” insights

During the preparation of his philosophical analysis of the concept of black holes for Nature Astronomy, the author spoke to physicists involved in a wide range of research fields. In the course of these "Read More..."
February 15, 1564. On this date, Italian astronomer, mathematician, and physicist Galileo Galilei was born. He is one of the first people on Earth to have aimed a telescope at the heavens, where he found – among many other things – phases for the planet Venus and four starry points of light orbiting the planet Jupiter. In Galileo’s time, educated people subscribed to the Aristotelian view that Earth lay fixed in the center of a more or less unchanging universe. Thus the discovery of moons orbiting Jupiter (now called the Galilean satellites) and revelation that Venus must orbit the sun, not the Earth, were considered heresy by the Roman Inquisition. In 1633, the Inquisition forced Galileo to recant. He spent the rest of his life under house arrest.

Afterwards, famously, he’s said to have said:

E pur si muove (and yet it moves).

The phrase is still used today as a retort, implying it doesn’t matter what you believe; these are the facts.

Galileo grew up in a musical family. In 1574, the family moved to Florence where 18-year-old Galileo began his education in a monastery. He was very successful in his studies, and began studying medicine at the University of Pisa. Due to financial problems, he was unable to finish his degree, but his years at the university were priceless. They introduced him to mathematics and physics, but most importantly, they introduced him to Aristotle’s philosophy.

Back then, if somebody wished to know about the universe, the way to do it was to read Aristotle’s works. As Dante had put it some centuries before, Aristotle is “the Master of those who know” (Dante, Inferno 4.131). In other words, at that time, knowledge was to philosophy what faith was to religion.

And so, in spite of not being able to complete his degree in medicine and become a university professor, Galileo still continued his studies of mathematics. He was able to get a few minor teaching positions for a living. After two years of hard work, he published La Bilancetta (The Little Balance), his first scientific book which gained him a reputation. The book commented upon the story of how the king of Syracuse asked Archimedes to verify whether his crown was made of pure gold or a lower-value mix of metals. Galileo presented an invention of his, the “little balance,” today called “hydrostatic balance,” that is used to make more accurate measurements of differences in density.

Read here about the King’s crown and Archimedes' other discoveries.

Galileo’s reputation was bruised after the publication of his Du Motu (On Motion), a study of falling objects, which showed his disagreement with the Aristotelian view about the subject.

In 1609, he heard word that in the Netherlands, an instrument had been invented that showed distant objects as if they were close by. Like many others, Galileo quickly figured out the mechanics of the spyglass, but later on he greatly improved the original design. He presented the Venetian State with an eight-powered telescope - a telescope that magnifies normal vision by eight times. His telescope earned him a doubling of his salary and a life tenure at Padua University.

Over the years, Galileo improved his telescope to magnify up to 20 times. Read More...
This Week’s Sky at a Glance - Feb. 16-22, 2019

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Pepperdine University Students from the United States Visit SCASS Feb. 14, 2019

A student delegation from Pepperdine University in Malibu California, United States, visited the Sharjah Center for Astronomy and Space Sciences (SCASS) at the University of Sharjah. During their visit, the students learned about the Center, its facilities and services such as the Planetarium and Space Exhibition, and research laboratories and initiatives. Dr. Ilias Fernini, Deputy General Director for SCASS’ Research Laboratories and Observatory, gave the students a brief about each of the Center’s laboratories and their ongoing projects. He introduced the Meteorite Center and its ongoing Meteor Monitoring Network project in collaboration with the UAE Space Agency, the Space Weather and Ionosphere Laboratory, the CubeSat Laboratory, and the Radio Astronomy Laboratory. He also briefed them about the future laboratories that will soon be added to SCASS such as the Artificial Intelligence Laboratory. The Center also has many public outreach programs that raise awareness and educate them about the space sciences and astronomy field. The visit to SCASS encouraged Pepperdine University’s students to pursue introductory courses in astronomy to expand their knowledge.

Pepperdine is a university committed to the highest standards of academic excellence and values, where students are nurtured for lives of purpose, service, and leadership. Consistently ranked as one of the most beautiful places to study, Pepperdine is where students are inspired to learn as they learn to motivate. Pepperdine University has approximately 73 top-ranked programs for graduate and undergraduate studies, with separate schools dedicated to business, education, and psychology, law, liberal arts, and public policy.