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Dept. of Applied Physics & Astronomy - **University of Sharjah**
Compiled by **Dr. Ilias Fernini**

مركز الشارقة لعلوم الفضاء والفلك
Sharjah Center for Astronomy & Space Sciences

Top News

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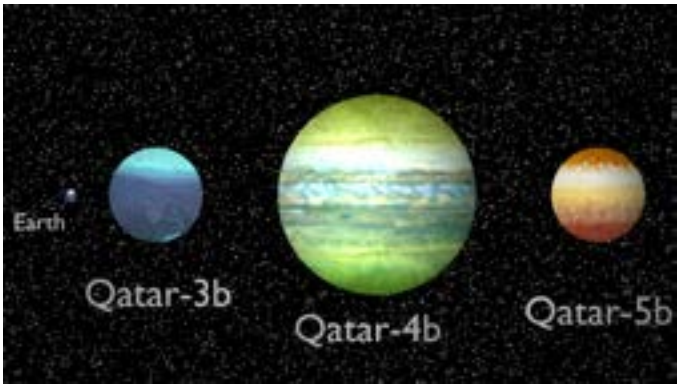
Astronomers discover three 'Qatar' exoplanets



Artist's impression of the newly discovered planets Qatar-3b, Qatar-4b and Qatar-5b. Credit: QNA

An international team of astronomers has discovered three new exoplanets using a Qatar-based planet-searching survey. The newly discovered gas giant exoworlds belong to the so-called "hot Jupiter" family of planets and were designated Qatar-3b, Qatar-4b and Qatar-5b. The findings were presented in a paper published June 23 on arXiv.org.

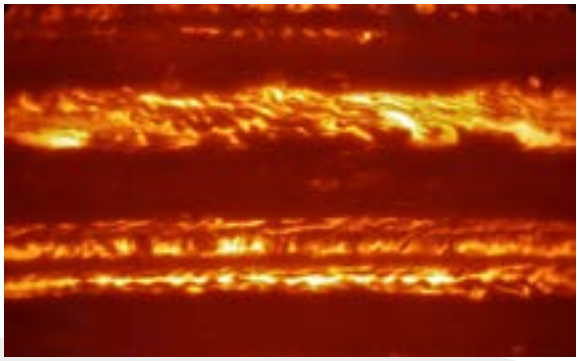
The planets were identified by the Qatar Exoplanet Survey (QES), operated by the Qatar Environment and Energy Research Institute (QEERI), which is part of Hamad Bin Khalifa University (HBKU) in Doha, Qatar. The survey utilizes a robotic wide-field camera system located in New Mexico to search for gas giant planets that transit relatively bright host stars. The project proved its planet-searching capabilities in 2010 and 2011 when it detected the Qatar-1b and Qatar-2b exoplanets.

Recently, an international group of astronomers, led by Khalid Al-Subai, QEERI's acting executive director, spotted three new planetary transits via QES. The scientists also conducted follow-up spectroscopic observations to determine the physical characteristics of the newly detected planets. For this purpose, they employed the Tillinghast Reflector Echelle Spectrograph (TRES) at the Fred L. Whipple Observatory on Mount Hopkins, Arizona and the 1.23m Zeiss Telescope at the Calar Alto Observatory in Spain.

The three detected planets are typical "hot Jupiters"—gas giant planets similar in characteristics to the solar system's biggest planet. These have orbital periods of less than 10 days and high surface temperatures, as they orbit their parent stars very closely. In the case of the three new alien worlds discovered by QES, the equilibrium temperature ranges from 1,400 to 1,700 K.

"We report the discovery of Qatar-3b, Qatar-4b, and Qatar-5b, three new transiting planets identified by the Qatar Exoplanet Survey. The three planets belong to the hot Jupiter family," the scientists wrote in the paper. According to the research, Qatar-4b is the biggest and ...Read More...

Very Large Telescope Images of Jupiter prepare us for Juno arrival



In preparation for the arrival of Juno, the ESO's released stunning IR images of Jupiter, taken by the VLT. Credit: ESO

Launching back in 2011, NASA's Juno mission has spent the past five years traversing the gulf that lies between Earth and Jupiter. When it arrives (in just a few days time!), it will be the second long-term mission to the gas giant in history. And in the process, it will obtain information about its composition, weather patterns, magnetic and gravitational fields, and history of formation.

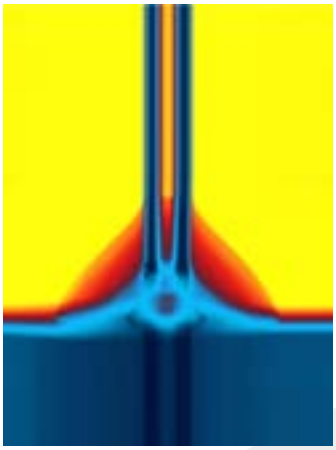
With just days to go before this historic rendezvous takes place, the European Southern Observatory is taking the opportunity to release some spectacular infrared images of Jupiter. Taken with the Very Large Telescope (VLT), these images are part of a campaign to create high-resolutions maps of the planet, and provide a preview of the work that Juno will be doing in the coming months.

Using the VTL Imager and Spectrometer for mid-Infrared (VISIR) instrument, the ESO team – led by Dr. Leigh Fletcher of the University of Leicester – hopes that their efforts to map the planet will improve our understanding of Jupiter's atmosphere. Naturally, with the upcoming arrival of Juno, some may wonder if these efforts are necessary.

After all, ground-based telescopes like the VLT are forced to contend with limitations that space-based probes are not. These include interference from our constantly-shifting atmosphere, not to mention the distances between Earth and the object in question. But in truth, the Juno mission and ground-based campaigns like these are often highly complimentary.

For one, in the past few months, while Juno was nearing in on its destination, Jupiter's atmosphere has undergone some significant shifts. Mapping these is important to Juno's upcoming arrival, at which point it will be attempting to peer beneath Jupiter's thick clouds to discern what is going on beneath. In short, the more we know about Jupiter's shifting atmosphere, the easier it will be to interpret the Juno data. ...Read More...

New material can switch stiction and wetting



Wetting and static friction depend on the surface. Credit: TU Wien

TU Wien (Vienna), KU Leuven and the University of Zürich have discovered a robust surface whose adhesive and wetting properties can be switched using electricity. This remarkable result is featured on the cover of Nature magazine.

When rain falls on a lotus leaf, the leaf doesn't get wet. Thanks to its special structure, the water drops roll off without wetting the surface. Artificial materials can be made water-repellent, too. It is, however, extremely challenging to produce a surface with switchable wetting. Now, a research team from TU Wien, KU Leuven and University of Zürich has managed to manipulate a surface of a single layer of boron nitride in such a way that it can be switched back and forth between states with high and low wetting and adhesion.

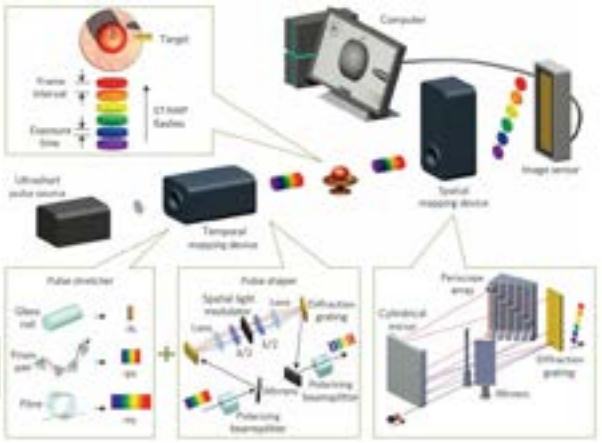
Hexagons making waves

"One of the most interesting physical properties of a surface is its stiction or static friction," says Stijn Mertens (Institute of Applied Physics at the Vienna University of Technology, and associated with KU Leuven in Belgium). "This force has to be overcome for an object on the surface to start sliding."

The nanostructure of the surface determines its stiction to a large extent: the details of the contact between the surface and another object (for example, a drop of liquid) depend on the geometry of its atoms and other properties. This in turn is crucial for adhesion, stiction and wetting. The relationship between stiction and wetting, however, is so far only poorly understood.

"Just as the material graphene consists of only one layer of carbon atoms, our boron nitride—which contains as many boron as nitrogen atoms—has a thickness of only one atomic layer," explains Thomas Greber from the Physics Institute at the University of Zürich. ...Read More...

Japanese universities develop new world's fastest camera



Schematic of STAMP. Credit: (c) Nature Photonics (2014) doi:10.1038/nphoton.2014.163

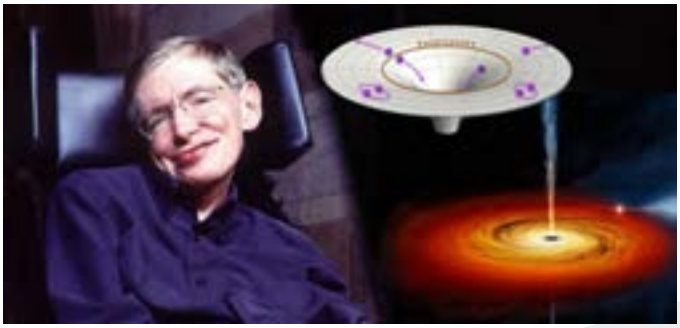
Researchers working at two universities in Japan have jointly developed what is being described as the world's fastest camera. A photo-device with a frame interval of 4.4 trillion frames per second. In their paper published in the journal Nature Photonics, the team describes how their camera works, its capabilities and the extensive work that went into its creation.

High speed cameras allow researchers and everyday people alike the ability to see things that they wouldn't be able to otherwise, from slowdown of sports play to mechanical processes. Prior to the announcement in Japan, the fastest cameras relied on what's known as a pump-probe process—where light is "pumped" at an object to be photographed, and then "probed" for absorption. The main drawback to such an approach is that it requires repetitive measurements to construct an image. The new camera is motion-based femtophotography, performing single-shot bursts for image acquisition, which means it has no need for repetitive measurements. It works via optical mapping of an object's spatial profile which varies over time. Its abilities make it 1000 times as fast as cameras it supersedes. In addition to the extremely high frame rate, the camera also has a high pixel resolution (450 × 450).

Developed by a joint team of researchers from Keio University and the University of Tokyo, the camera is set to capture images of things and events that until now have not been impossible. With technology the team has named Sequentially Timed All-optical Mapping Photography, or STAMP for short, the camera is poised to be used to capture chemical reactions, lattice vibrational waves, plasma dynamics, even heat conduction, which the researchers note occurs at approximately a sixth the speed that light travels.

The joint team has been working on development of the camera over the course of three years—plans ...Read More...

Professor Stephen Hawking intends to map the known universe



In honor of Dr. Stephen Hawking, the COSMOS center will be creating the most detailed 3D mapping effort of the Universe to date. Credit: BBC, Illus.: T.Reyes

Back in 1997, a team of leading scientists and cosmologists came together to establish the COSMOS supercomputing center at Cambridge University. Under the auspices of famed physicist Stephen Hawking, this facility and its supercomputer are dedicated to the research of cosmology, astrophysics and particle physics – ultimately, for the purpose of unlocking the deeper mysteries of the Universe.

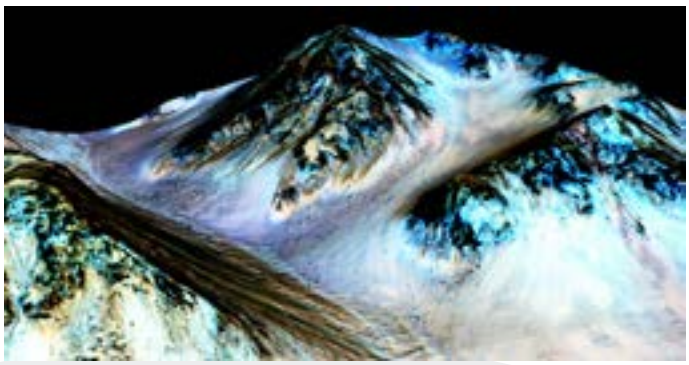
Yesterday, in what was themed as a "tribute to Stephen Hawking", the COSMOS center announced that it will be embarking on what is perhaps the boldest experiment in cosmological mapping. Essentially, they intend to create the most detailed 3D map of the early universe to date, plotting the position of billions of cosmic structures including supernovas, black holes, and galaxies.

This map will be created using the facility's supercomputer, located in Cambridge's Department of Applied Mathematics and Theoretical Physics. Currently, it is the largest shared-memory computer in Europe, boasting 1,856 Intel Xeon E5 processor cores, 31 Intel Many Integrated Core (MIC) co-processors, and 14.5 terabytes of globally shared memory.

The 3D will also rely on data obtained by two previous surveys – the ESA's Planck satellite and the Dark Energy Survey. From the former, the COSMOS team will use the detailed images of the Cosmic Microwave Background (CMB) – the radiation leftover by the Big Ban – that were released in 2013. These images of the oldest light in the cosmos allowed physicists to refine their estimates for the age of the Universe (13.82 billion years) and its rate of expansion.

This information will be combined with data from the Dark Energy Survey which shows the expansion of the Universe over the course of the last 10 billion years. From all of this, the COSMOS team will compare the early ... Read More...

Salts on Mars could pose unseen hazards to explorers



NASA/JPL-Caltech/Univ. of Arizona

It's a major component of solid rocket propellants. It allows water to exist as liquid on Mars, despite atmospheric pressure at the Martian surface being roughly 0.6 percent that on Earth. It also can be broken down to release oxygen that astronauts and future colonists in a Mars settlement could breathe.

It's called perchlorate and it's abundant on Mars -10,000 times more abundant in Martian dirt than in soils and sands of Earth. That may sound like a good thing, considering the useful properties of perchlorate, but there's also a flip side.

Being a negative ion, perchlorate (ClO_4^-) forms various salts, but it has detrimental health effects. Potassium perchlorate is used as a drug to treat certain forms of hyperthyroidism (overactive thyroid). But exposure to environmental perchlorate causes the opposite of hyperthyroidism, namelyhypothyroidism – an underactive thyroid.

It would be devastating for Martian colonists.

An Ubiquitous Chemical Solves Two Mysteries

Perchlorate is all over the Martian surface. In 2009, NASA's Phoenix lander identified perchlorate in the Martian dirt pretty much everywhere it looked. Then, last September, NASA's Mars Reconnaissance Orbiter demonstratedvery high concentrations of perchlorate salts within recurring slope lineae (RSL), features on the planet's surface that were formed from relatively recent water flows. The finding solved a mystery of how Martian water could be liquid long enough to change the landscape.

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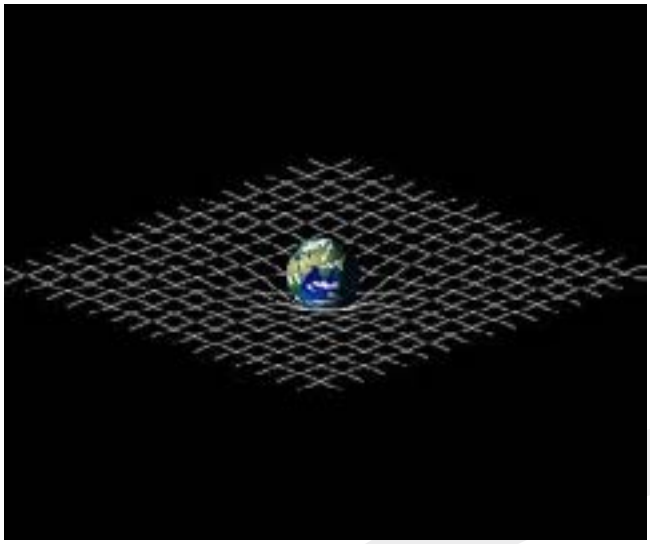
Because of the thin atmosphere, pure water on the Red Planet can persist only as ice or vapor, depending on the temperature. But dissolved salts change the physical chemistry, enough that subsurface liquid water can emerge from time to time and stick around as lakes and streams. ..Read More...

Scientists model universe with Full General Relativity



While simulations of the universe and the structures within it have been the subject of scientific discovery for decades, these codes have made some simplifications or assumptions. These two codes are the first to use Einstein's complete theory of general relativity to account for the effects of the clumping of matter in some regions and the dearth of matter in others.

Research teams on both sides of the Atlantic have shown that precise modeling of the universe and its contents will change the detailed understanding of the evolution of the universe and the growth of structure in it.

One hundred years after Einstein introduced general relativity, it remains the best theory of gravity, the researchers say, consistently passing high-precision tests in the solar system and successfully predicting new phenomena such as gravitational waves, which were recently discovered by the Laser Interferometer Gravitational-Wave Observatory.

The equations of general relativity, unfortunately, are notoriously difficult to solve. For the past century, physicists have used a variety of assumptions and simplifications in order to apply Einstein's theory to the universe.

On Earth, that's something like averaging the music made by a symphony. The audience would hear a single average note, keeping the overall beat, growing generally louder and softer rather than the individual notes and rhythms of each of the orchestra's instruments.

Wanting details and their effects, U.S. and European teams each wrote computer codes that will eventually lead to the most accurate possible models of the universe and provide new insights into gravity and its effects.

While simulations of the universe and the structures within it have been the subject of scientific discovery for decades, these codes have made some simplifications or assumptions. These two codes are the first to use Einstein's complete theory of general relativity to account for the effects of the clumping of matter in some ...Read More...

Seeds of supermassive black holes could be revealed

The study combined simulations from the EAGLE project - which aims to create a realistic simulation of the known universe inside a computer - with a model to calculate gravitational wave signals.

Gravitational waves captured by space-based detectors could help identify the origins of supermassive black holes, according to new computer simulations of the universe.

Scientists led by Durham University's Institute for Computational Cosmology ran the huge cosmological simulations that can be used to predict the rate at which gravitational waves caused by collisions between the monster black holes might be detected.

The amplitude and frequency of these waves could reveal the initial mass of the seeds from which the first black holes grew since they were formed 13 billion years ago and provide further clues about what caused them and where they formed, the researchers said.

The research is being presented at the Royal Astronomical Society's National Astronomy Meeting in Nottingham, UK. It was funded by the Science and Technology Facilities Council, the European Research Council and the Belgian Interuniversity Attraction Poles Program.

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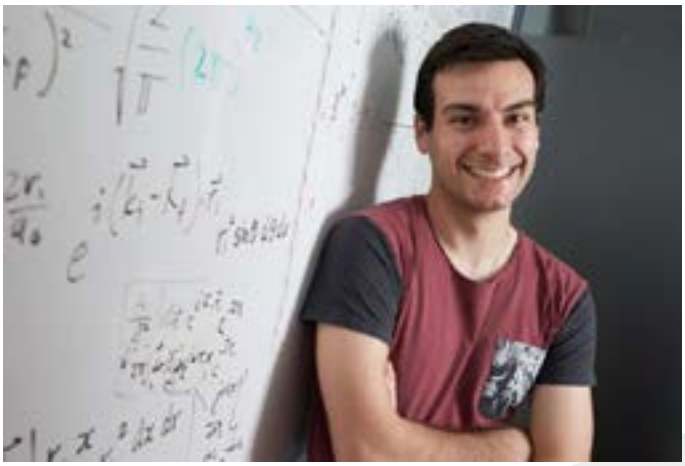
Two detections of gravitational waves caused by collisions between supermassive black holes should be possible each year using space-based instruments such as the Evolved Laser Interferometer Space Antenna (eLISA) detector that is due to launch in 2034, the researchers said. In February the international LIGO and Virgo collaborations announced that they had detected ...Read More...

New model predicts once-mysterious chemical reactions



Mark Zammit, of Los Alamos' Physics and Chemistry of Materials group, is part of a team that developed a theoretical model to forecast the fundamental chemical reactions involving molecular hydrogen. Credit: Curtin University

A team of researchers from Los Alamos National Laboratory and Curtin University in Australia developed a theoretical model to forecast the fundamental chemical reactions involving molecular hydrogen (H2), which after many decades and attempts by scientists had remained largely unpredicted and unsolved.

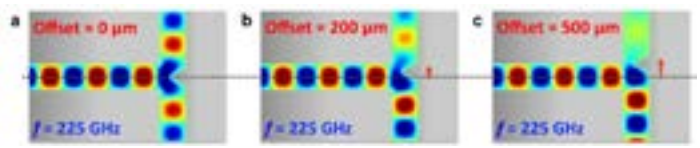
"Chemical reactions are the basis of life so predicting what happens during these reactions is of great importance to science and has major implications in innovation, industry and medicine," said Mark Zammit, a post-doctorate fellow in the Physics and Chemistry of Materials group at Los Alamos National Laboratory. "Our model is the first to very accurately calculate the probability of fundamental electron-molecular hydrogen reactions."

Zammit and the team conducted research into the fundamental chemical reactions of atoms and molecules to better understand the physics and chemistry of materials. This work is part of Los Alamos' Nuclear and Particles Future science pillar, which supports the Lab in its national security mission by integrating nuclear experiments, theory and simulation to understand and engineer complex nuclear phenomena.

Molecular hydrogen—two hydrogen atoms bound together—is the most abundant molecule in the universe. It is present in interstellar space and in the atmospheres of gas giants. It is used industrially in the production of fossil fuels, cleaning products and plasmas. It also has therapeutic potential in human organs.

In interstellar space, solar winds (a source of electrons) collide with gas clouds of H2, which then emit light. This light carries vital information about past events in the universe. To decipher this information, scientists look at the underlying chemical reaction that took place, which is relatively simple—an electron colliding with H2. ...Read More...

Researchers develop key power-splitting component for terahertz waves



One of the most basic components of any communications network is a power splitter that allows a signal to be sent to multiple users and devices. Researchers from Brown University have now developed just such a device for terahertz radiation -- a range of frequencies that may one day enable data transfer up to 100 times faster than current cellular and Wi-Fi networks. Credit: Mittleman lab / Brown University

One of the most basic components of any communications network is a power splitter that allows a signal to be sent to multiple users and devices. Researchers from Brown University have now developed just such a device for terahertz radiation—a range of frequencies that may one day enable data transfer up to 100 times faster than current cellular and Wi-Fi networks.

"One of the big thrusts in terahertz technology is wireless communications," said Kimberly Reichel, a post-doctoral researcher in Brown's School of Engineering who led the device's development. "We believe this is the first demonstration of a variable broadbrand power splitter for terahertz, which would be a fundamental device for use in a terahertz network."

The device could have numerous applications, including as a component in terahertz routers that would send data packets to multiple computers, just like the routers in current Wi-Fi networks.

The new device is described in the Nature journal Scientific Reports.

Today's cellular and Wi-Fi networks rely on microwaves, but the amount of data that can travel on microwaves is limited by frequency. Terahertz waves (which span from about 100 to 10,000 GHz on the electromagnetic spectrum) have a higher frequency and therefore the potential to carry much more data. Until recently, however, terahertz hasn't received much attention from scientists and researchers, so many of the basic components for a terahertz communications network simply don't exist.

Daniel Mittleman, a professor in Brown's School of Engineering, has been working to develop some of those key components. His lab recently developed the first system for terahertz multiplexing and demultiplexing—a method of sending multiple signals through a single medium and then separating them back out on the other side. Mittleman's lab has also produced a new type of lens for focusing terahertz waves. ...Read More...

Hubble reveals stellar fireworks in 'skyrocket' galaxy

In this NASA Hubble Space Telescope image, a firestorm of star birth is lighting up one end of the diminutive galaxy Kiso 5639. The dwarf galaxy is shaped like a flattened pancake, but because it is tilted edge-on, it resembles a skyrocket, with a brilliant blazing head and a long, star-studded tail. Credit: NASA, ESA, and D. Elmegreen (Vassar College), B. Elmegreen (IBM's Thomas J. Watson Research Center), J. Sánchez Almeida, C. Munoz-Tunon, and M. Filho (Instituto de Astrofísica de Canarias), J. Mendez-Abreu (University of St. Andrews), J. Gallagher (University of Wisconsin-Madison), M. Rafelski (NASA Goddard Space Flight Center), and D. Ceverino (Center for Astronomy at Heidelberg University)

Fireworks shows are not just confined to Earth's skies. NASA's Hubble Space Telescope has captured a spectacular fireworks display in a small, nearby galaxy, which resembles a July 4th skyrocket.

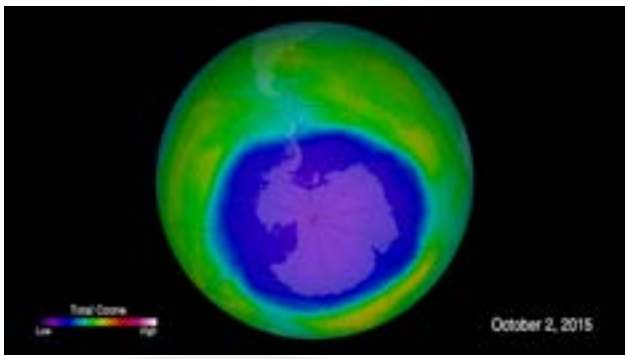
A firestorm of star birth is lighting up one end of the diminutive galaxy Kiso 5639. The dwarf galaxy is shaped like a flattened pancake, but because it is tilted edge-on, it resembles a skyrocket, with a brilliant blazing head and a long, star-studded tail.

Kiso 5639 is a rare, nearby example of elongated galaxies that occur in abundance at larger distances, where we observe the universe during earlier epochs. Astronomers suggest that the frenzied star birth is sparked by intergalactic gas raining on one end of the galaxy as it drifts through space.

"I think Kiso 5639 is a beautiful, up-close example of what must have been common long ago," said lead researcher Debra Elmegreen of Vassar College, in Poughkeepsie, New York. "The current thinking is that galaxies in the early universe grow from accreting gas from the surrounding neighborhood. It's a stage that galaxies, including our Milky Way, must go through as they are growing up."

Observations of the early universe, such as Hubble's Ultra Deep Field, reveal that about 10 percent of all galaxies have these elongated shapes, and are collectively called "tadpoles." But studies of the nearby universe have turned up only a few of these unusual galaxies, including Kiso 5639. The development of the nearby star-making tadpole galaxies, however, has lagged behind that ...Read More...

Scientists observe first signs of healing in the Antarctic ozone layer



A false-colour image showing ozone concentrations above Antarctica on Oct. 2, 2015. Credit: NASA/Goddard Space Flight Center

Scientists at MIT and elsewhere have identified the "first fingerprints of healing" of the Antarctic ozone layer, published today in the journal Science.

The team found that the September ozone hole has shrunk by more than 4 million square kilometers—about half the area of the contiguous United States—since 2000, when ozone depletion was at its peak. The team also showed for the first time that this recovery has slowed somewhat at times, due to the effects of volcanic eruptions from year to year. Overall, however, the ozone hole appears to be on a healing path.

The authors used "fingerprints" of the ozone changes with season and altitude to attribute the ozone's recovery to the continuing decline of atmospheric chlorine originating from chlorofluorocarbons (CFCs). These chemical compounds were once emitted by dry cleaning processes, old refrigerators, and aerosols such as hairspray. In 1987, virtually every country in the world signed on to the Montreal Protocol in a concerted effort to ban the use of CFCs and repair the ozone hole.

"We can now be confident that the things we've done have put the planet on a path to heal," says lead author Susan Solomon, the Ellen Swallow Richards Professor of Atmospheric Chemistry and Climate Science at MIT. "Which is pretty good for us, isn't it? Aren't we amazing humans, that we did something that created a situation that we decided collectively, as a world, 'Let's get rid of these molecules'? We got rid of them, and now we're seeing the planet respond."

Solomon's co-authors include Diane Ivy, research scientist in the Department of Earth, Atmospheric and Planetary Sciences, along with researchers at the National Center for Atmospheric Research in Boulder, Colorado, and the University of Leeds in the U.K. ...Read More...

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Sharjah Center for Astronomy & Space Sciences
Sharjah Center for Astronomy and Space Sciences
Sharjah, United Arab Emirates
Phone: 00-971-6-5166000
Website: www.scass.ae
E-mail: scass@scass.ae

جامعة الشارقة
UNIVERSITY OF SHARJAH
College of Sciences - University of Sharjah
POB 27272 - Sharjah, United Arab Emirates
Phone: 00-971-6-5050351
Email: physics@sharjah.ac.ae