October 24, 2015
Muharram 10, 1437
Volume 5, Issue 43

Astronomy & Physics News

Department of Physics—United Arab Emirates University
Weekly Scientific News Compiled by Dr. Ilias Fernini

INTERNATIONAL YEAR OF LIGHT 2015

Inside this issue:

Exciting breakthrough in 2-D lasers: Researchers demonstrate atomically thin excitonic laser 1

Milky Way photo with 46 billion pixels 1

Scientists gain insight into origin of tungsten-ditelluride's magnetoresistance 2

Physicists experimentally realize a quantum Hilbert hotel 2

Physicists learn how to control the movement of electrons in a molecule 2

Seeing Starspots: The Curious Case of XX Trianguli 3

Halloween Asteroid a Treat for Radar Astronomers 3

NASA Goddard Scientist Gives 'Outlaw' Particles Less Room to 3

Cosmic 'Death Star' is destroying a planet 4

Researchers develop new method for scaling up quantum devices 4

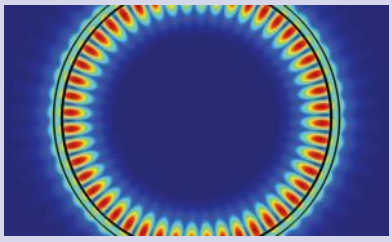
Final kiss of 2 stars heading for catastrophe 4

Exciting breakthrough in 2-D lasers: Researchers demonstrate atomically thin excitonic laser

An important step towards next-generation ultra-compact photonic and optoelectronic devices has been taken with the realization of a two-dimensional excitonic laser. Scientists with the U.S. Department of Energy (DOE)'s Lawrence Berkeley National Laboratory (Berkeley Lab) embedded a monolayer of tungsten disulfide into a special microdisk resonator to achieve bright excitonic lasing at visible light wavelengths.

"Our observation of high-quality excitonic lasing from a single molecular layer of tungsten disulfide marks a major step towards two-dimensional on-chip optoelectronics for high-performance optical communication and computing applications," says Xiang Zhang, director of Berkeley Lab's Materials Sciences Division and the leader of this study.

Zhang, who also holds the Ernest S. Kuh Endowed Chair at the University of California (UC) Berkeley and is a member of the Kavli Energy NanoSciences Institute at Berkeley (Kavli ENSI), is the corresponding author of a paper describing this research in the journal Nature Photonics. The paper is titled "Monolayer ...Read More...



In the whispering gallery mode of a 2-D excitonic laser made from a monolayer of tungsten disulfide and a microdisk resonator, the localization of the electric field at the edges of the resonator helps promote a high Q factor with low power consumption. Credit: Xiang Zhang, Berkeley Lab

Milky Way photo with 46 billion pixels

Astronomers at the Ruhr-Universitat Bochum have compiled the largest astronomical image to date. The picture of the Milky Way contains 46 billion pixels. In order to view it, researchers headed by Prof Dr Rolf Chini from the Chair of Astrophysics have provided an online tool. The image contains data gathered in astronomical observations over a period of five years.

For five years, the astronomers from Bochum have been monitoring our Galaxy in the search of objects with variable brightness. Those objects may, for example, include stars in front of which a planet is passing, or multiple systems where stars orbit each other and which obscure each other every now and then.

In his PhD thesis, Moritz Hackstein is compiling a catalogue of such variable objects of medium brightness. For this purpose, the team from the Chair of Astrophysics takes pictures of the southern sky night after night. To this end, they use the telescopes at Bochum's university observatory in the Atacama Desert in Chile. More than 50,000 new variable objects, which had hitherto not been recorded in databanks, have been discovered by the researchers so far. 268 individual images make up the photo of the Milky Way ...Read More...

A small section of the Milky Way photo showing Eta Carinae. Image courtesy Lehrstuhl fur Astrophysik, RUB. For a larger version of this image please go here.

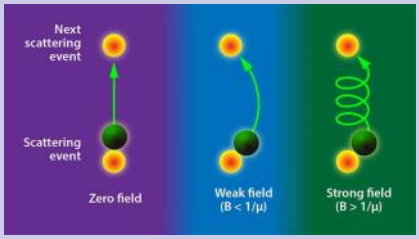
Scientists gain insight into origin of tungsten-ditelluride's magnetoresistance

Scientists recently discovered that tungsten ditelluride (WTe2) is electronically three-dimensional with a low anisotropy. Anisotropy reflects the change in properties of a material when the direction of the current or the applied magnetic field is varied.

Similar to graphite consisting of weakly bound graphene layers, WTe2 is a layered material that could be reduced to few layers in thickness or a monolayer and be used in making nanoscale transistors in other electronics. The material was originally thought to be two-dimensional in nature because of the ease with which its layers could be separated.

WTe2 has been the subject of increased scientific interest since a 2014 research study outlined its unusual magnetoresistance, which is the ability of a material to change the value of its electrical resistance when subjected to an external magnetic field. This particular finding "is interesting in its own right because it shows that the mechanical and electrical properties of a material are not always as closely linked as we may assume," wrote Kamran Behnia, director of quantum matter research at Le Centre National de la Recherche Scientifique in Paris, in an opinion piece on the latest research discovery about WTe2 published in journal Physics, which provides news and commentary on select papers from American Physical Society journals.

Researchers also discovered that the anisotropy of WTe2 varies and displays the magnetoresistance behavior of the Fermi liquid ...Read More...



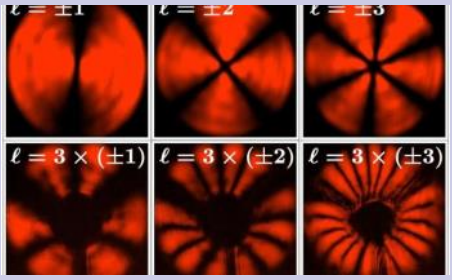
A team of researchers from Argonne's Materials Science Division and Northern Illinois University, working collaboratively with researchers at Argonne's Center for Nanoscale Materials, report two new findings on WTe2: (1) WTe2 is electronically 3-D with a mass anisotropy as low as 2, and (2) the mass anisotropy varies with temperature and follows the magnetoresistance behavior of the Fermi liquid state. The results not only provide a general scaling approach for the anisotropic magnetoresistance but also are crucial for correctly understanding the electronic properties of WTe2, including the origin of the remarkable "turn-on" behavior in the ...

Physicists experimentally realize a quantum Hilbert hotel

In 1924, the mathematician David Hilbert described a hotel with an infinite number of rooms that are all occupied. Demonstrating the counterintuitive nature of infinity, he showed that the hotel could still accommodate additional guests. Although clearly no such brick-and-mortar hotel exists, in a new paper published in Physical Review Letters, physicists Václav Potoček, et al., have physically realized a quantum Hilbert hotel by using a beam of light.

In Hilbert's thought experiment, he explained that additional rooms could be created in a hotel that already has an infinite number of rooms because the hotel manager could simply "shift" all of the current guests to a new room according to some rule, such as moving everyone up one room (to leave the first room empty) or moving everyone up to twice their current room number (to create an infinite number of empty rooms by leaving the odd-numbered rooms empty).

In their paper, the physicists proposed two ways to model this phenomena—one theoretical and one experimental—both of which use the infinite number of quantum states of a quantum system to represent the infinite number of hotel rooms in a hotel. The theoretical proposal uses the infinite number of energy levels of a particle in a potential well, and the experimental demonstration uses the infinite number of orbital angular momentum states of light. ...Read More...



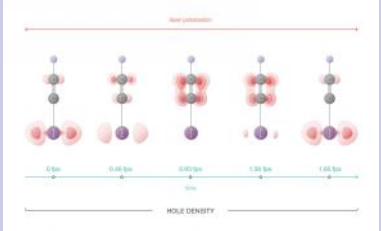
When the light "petals" (quantum states with an infinite number of values representing the infinite number of hotel rooms) in the top row are multiplied by 3, the number of petals in the bottom row is tripled—analogous to "tripling infinity." Credit: Václav Potoček, et al. ©2015 American Physical Society

Physicists learn how to control the movement of electrons in a molecule

Researchers have, for the first time, been able to track the movement of an electron in a molecule in real time and have demonstrated that these processes can be controlled. In the future, this will make it possible to directly control the progress of chemical reactions and biological processes and obtain a desired result literally at the touch of a button. The findings of the study have been published in the journal Science.

The authors of the study, experimentalists led by Prof. Dr. Hans Jakob Wörner from the Swiss Federal Institute of Technology (ETH Zurich) and theoreticians from Russia, Denmark, Belgium and Canada, including Oleg Tolstikhin from MIPT, are investigating what is known as "attophysics," the study of events with attosecond time resolution, i.e. a billionth of a billionth of a second (10-18 of a second).

Using methods of attophysics, the researchers are trying to track the ultrafast movement of electrons in molecules, or more precisely, the restructuring of their electron shells. These processes are the key to understanding chemical and biochemical reactions, as it is the "redistribution" of electrons that is involved in the formation of new chemical bonds. The group led by Wörner previously conducted a series of decisive experiments demonstrating the possibility of such observations ...Read More….



Electron density in a molecule. Credit: Moscow Institute of Physics and Technology

Seeing Starspots: The Curious Case of XX Trianguli

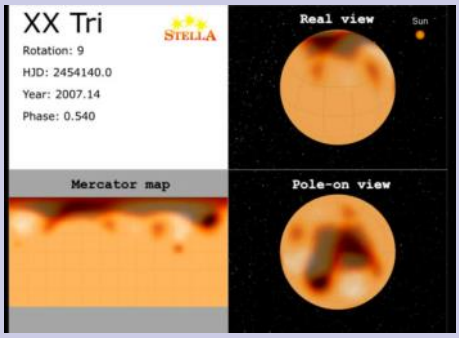
Ever wonder what happens on the surface of other stars?

An amazing animation was released this week by astronomers at the Leibniz Institute for Astrophysics (AIP) in Potsam Germany, showing massive sunspot activity on the variable star XX Trianguli (HD 12545). And while 'starspot' activity has been seen on this and other stars before, this represents the first movie depicting the evolution of stellar surface activity beyond our solar system.

"We can see our first application as a prototype for upcoming stellar cycle studies, as it enables the prediction of a magnetic-activity cycle on a dramatically shorter timescale than usual," says Leibniz Institute for Astrophysics Potsdam astronomer Andreas Kunstler in a recent press release.

The images were the result of a long term analysis of the star carried out using the twin STELLA (STELLar Activity) robotic telescopes based on Tenerife in the Canary Islands. The spectroscopic data was gathered over a period of six years, and this video demonstrates that, while other stars do indeed have sunspot cycles similar to our Sun, those of massive stars such as XX Tri are much more intense than any we could imagine here in our own solar system.

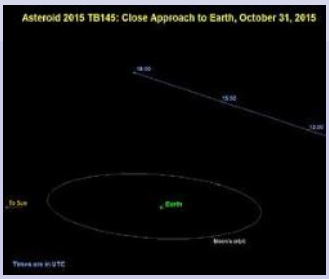
Even the largest and closest of stars have a minuscule angular diameter –measured in milliarcseconds (mas, our 1/1,000ths of an arc second)—in size. For example, we know from lunar occultation timing experiments that the bright star Antares at 550 light years distant and 5 times the radius of our ...Read More...



A screenshot of the bizarre surface of XX Tri Image credit: The Leibniz Institute for Astrophysics Potsdam (AIP). Click here to see the video.

Halloween Asteroid a Treat for Radar Astronomers

NASA scientists are tracking the upcoming Halloween flyby of asteroid 2015 TB145 with several optical observatories and the radar capabilities of the agency's Deep Space Network at Goldstone, California. The asteroid will fly past Earth at a safe distance slightly farther than the moon's orbit on Oct. 31 at 10:05 a.m. PDT (1:05 p.m. EDT). Scientists are treating the flyby of the estimated 1,300-foot-wide (400-meter) asteroid as a science target of opportunity, allowing instruments on "spacecraft Earth" to scan it during the close pass.
Asteroid 2015 TB145 was discovered on Oct. 10, 2015, by the University of Hawaii's Pan-STARRS -1 (Panoramic Survey Telescope and Rapid Response System) on Haleakala, Maui, part of the NASA-funded Near-Earth Object Observation (NEOO) Program. According to the catalog of near-Earth objects (NEOs) kept by the Minor Planet Center, this is the closest currently known approach by an object this large until asteroid 1999 AN10, at about 2,600 feet (800 meters) in size, approached at about 1 lunar distance (238,000 miles from Earth) in August 2027. "The trajectory of 2015 TB145 is well understood," said Paul Chodas, manager ...Read More...



This is a graphic depicting the orbit of asteroid 2015 TB145. The asteroid will safely fly past Earth slightly farther out than the moon's orbit on Oct. 31 at 10:05 a.m. Pacific (1:05 p.m. EDT and 17:05 UTC). Image courtesy NASA/JPL-Caltech. For a larger version of this image please go here.

NASA Goddard Scientist Gives 'Outlaw' Particles Less Room to Hide

Studying the highest-energy particles in the cosmos provides scientists with a way to test how well they understand the cutting edge of physics. Recently, scientists using a giant particle detector at the South Pole have set records for the highest-energy observations of mysterious subatomic entities called neutrinos. If neutrinos happen to be traveling faster than light, a feat that violates Einstein's relativity theory but is allowed by some newer rival theories, these measurements provide a way to determine how far they're pushing the speed limit.

"A foundational tenet of relativity is what physicists call Lorentz invariance," explained Floyd Stecker, a theorist in the Astrophysics Science Division at NASA's Goddard Space Flight Center in Greenbelt, Maryland. "This includes the notion that light traveling in a vacuum sets a cosmic speed limit that cannot be exceeded by any matter or information."

But some versions of theories designed to replace general relativity, such as string theory and loop quantum gravity, predict possible exceptions. The highest-energy neutrinos offer a way to determine how big any faster-than-light loophole may be.

Neutrinos are among the least understood fundamental particles. Each second, about 100 trillion of them pass through our bodies, but they interact with matter so infrequently that even at this rate catching a single event in a human-sized detector would take decades. Neutrinos are produced in Earth's atmosphere by the impact of cosmic rays and ...Read More...

The IceCube Laboratory at Amundsen-Scott South Pole Station, Antarctica, sits atop a cubic kilometer of clear ice instrumented with thousands of sensors designed to catch flashes of light from neutrino interactions. Image courtesy Dag Larsen, IceCube/NSF.

Physics Department

College of Science - United Arab Emirates University
POB 15551
Al-Ain
United Arab Emirates

Phone: 00-971-3-7136336
Fax: 00-971-3-713-6909
E-mail: physics@uaeu.ac.ae

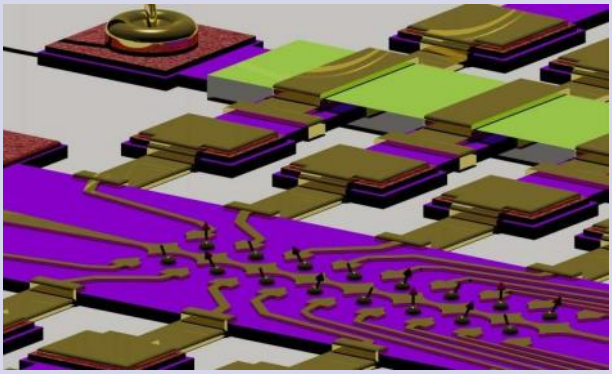
http://www.cos.uaeu.ac.ae/en/departments/physics/index.shtml

For Previous Issues, click Here

UAEU College of Science
جامعة الإمارات العربية المتحدة
United Arab Emirates University

Researchers develop new method for scaling up quantum devices

When it comes to fabricating complex quantum devices, one limitation is the number of wires available on the measurement systems that the quantum devices are built on. Typically, controlling just three or four quantum dots requires about 20 wires, which is the limit of many systems. In a new study, engineers have devised a method that in principle can control 14 quantum dots using 19 wires. This improvement provides a way to build larger arrays of quantum devices, which could be useful for scaling up quantum computers and quantum information processing systems. ..Read More...



3D artist impression of a large array of quantum devices in which charge is "locked" onto the electrodes, which allows each wire to act like multiple wires. Credit: R. K. Puddy, University of Cambridge

Cosmic 'Death Star' is destroying a planet

The Death Star of the movie Star Wars may be fictional, but planetary destruction is real. Astronomers have reported they have spotted a large, rocky object disintegrating in its death spiral around a distant white dwarf star. The discovery also confirms a long-standing theory behind the source of white dwarf "pollution" by metals.

"This is something no human has seen before," says lead author Andrew Vanderburg of the Harvard-Smithsonian Center for Astrophysics (CfA). "We're watching a solar system get destroyed."

The evidence for this unique system came from NASA's Kepler K2 mission, which monitors stars for a dip in brightness that occurs when an orbiting body crosses the star. The data revealed a regular dip every 4.5 hours, which places the object in an orbit about 520,000 miles from the white dwarf (about twice the distance from the Earth to the Moon). It is the first planetary object to be seen transiting a white dwarf. ...Read More...

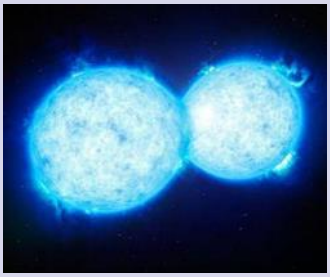
In this artist's conception, a Ceres-like asteroid is slowly disintegrating as it orbits a white dwarf star. Astronomers have spotted telltales signs of such an object using data from the Kepler K2 mission. It is the first planetary object detected transiting a white dwarf. Within about a million years the object will be destroyed, leaving a thin dusting of metals on the surface of the white dwarf. Image courtesy Mark A. Garlick.

Final kiss of 2 stars heading for catastrophe

Using ESO's Very Large Telescope, an international team of astronomers have found the hottest and most massive double star with components so close that they touch each other. The two stars in the extreme system VFTS 352 could be heading for a dramatic end, during which the two stars either coalesce to create a single giant star, or form a binary black hole.

The double star system VFTS 352 is located about 160 000 light-years away in the Tarantula Nebula [1]. This remarkable region is the most active nursery of new stars in the nearby Universe and new observations from ESO's VLT [2] have revealed that this pair of young stars is among the most extreme and strangest yet found.

VFTS 352 is composed of two very hot, bright and massive stars that orbit each other in little more than a day. The centres of the stars are separated by just 12 million kilometres [3]. In fact, the stars are so close that their surfaces overlap and a bridge has formed ...Read More...



This artist's impression shows VFTS 352 -- the hottest and most massive double star system to date where the two components are in contact and sharing material. The two stars in this extreme system lie about 160,000 light-years from Earth in the Large Magellanic Cloud. This intriguing system could be heading for a dramatic end, either with the formation of a single giant star or as a future binary black hole. Image courtesy ESO/L. Calcada