INTERNATIONAL YEAR OF LIGHT 2015

100 Million Stars in the Andromeda galaxy.

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Department of Physics—United Arab Emirates University
Weekly news from around the world compiled by Dr. Ilias Fernini

Inside this issue:

Congratulations

Congratulations for the promotions of the Colleagues Drs. Abada Abdessamad, Saleh Thaker to the rank of full professor and El Hadi Sadki to the rank of associate professor. We wish them all the best.

Prof. Abada Abdessamad

Prof. Saleh Thaker

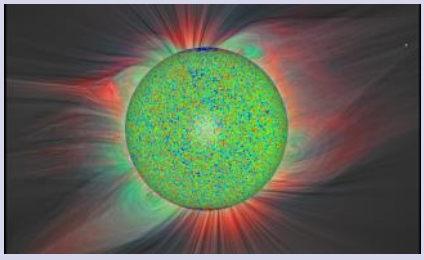
Dr. El Hadi Sadki

Trio create model to explain massive heat in the Sun's corona

A trio of researchers, two with Ecole Polytechnique and the other with Université Paris, all in France, has created a computer model that is meant to show how it is that so much heat is in the sun's corona. In their paper published in the journal Nature, Tahar Amari, Jean-François Luciani and Jean-Jacques Aly describe their model, how it came about and why they think it is accurate.

For some time space scientists have been perplexed by research results that show the sun's corona is millions of degrees hotter than its surface. In this new effort, the researchers built a model that describes how that might occur and then offer some evidence to back up their claims.

Scientists know that on the sun's surface, rotating areas of gas create what are known as dynamos—where plasma causes charges to come about. In their model, the researchers suggest that when such dynamos "dump" their energy, it causes small eruptions to come about on the surface, allowing energy to dissipate out to the corona. The team describes their model as resembling a mangrove forest. The roots of the trees represent surface magnetic fields—energy makes its way up the trees and dissipates near the ...***Read More***...



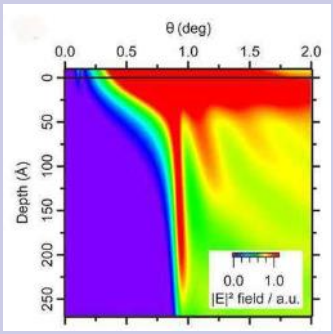
Solar disk image taken in 2011 with large scale atmosphere during as visible during an eclipse in 2008. Credit: Tahar Amari / Centre de physique théorique.CNRS-Ecole Polytechnique.FRANCE & Eclipse S.Habbal and M. DruckMuller.

Researchers decode interface switching effects in ferroelectric memories

The nanoscale device community has shown great interest in exploiting the unique properties of ferroelectric materials for encoding information. But the circuitry for reading information stored in the polarization of these materials has prohibited its adaptation to extremely small scales. Now, researchers at Berkeley Lab and the Soleil Synchrotron in Paris have developed a new technique that provides key information for an alternative decoding method, where better understanding will help to fully harness the properties of these devices.

"By doing photoelectron spectroscopy in a near-total-reflection geometry, we can selectively change the depth of emission of the electrons, as well as create standing waves that sweep through the sample, thus providing a new tool for investigating buried interfaces," says Chuck Fadley, a physicist at Berkeley Lab's Materials Sciences Division, who led this work. "The basic idea for such near total reflection work goes back to our 1977 proof-of-concept study, but the method can now be fully exploited with modern synchrotron radiation sources and instrumentation."

Manuel Bibes, of the CNR/Thales Laboratory in Paris, who synthesized the samples studied, says "The NTR method is an exciting new development because it provides quantitative information on the local charge density at the interface without the need for specific lithography or specimen preparation. NTR is thus a fast, efficient and versatile tool, ideal for systematic ..***Read More***...



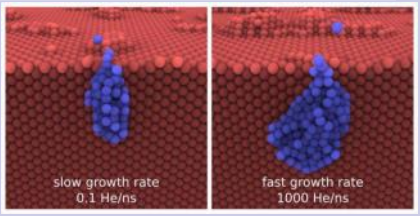
A new X-ray based technique for studying buried interfaces reveals that the more the incident angle increases, the deeper the X-rays penetrate the system, allowing for depth-resolved analysis of the system.

Fusion researchers use Titan supercomputer to burst helium bubbles

Scientists look to the stars when it comes to developing clean, virtually limitless energy. Though humanity understands how stars power themselves—nuclei of hydrogen and its isotopes fuse together in extreme conditions, releasing bursts of energy in the process—they have been unable to replicate this massive fusion process on Earth in a way practical for power production.

As part of a Scientific Discovery through Advanced Computing (SciDAC) project, a partnership between the US Department of Energy's (DOE's) Advanced Scientific Computing Research Leadership Computing Challenge and Fusion Energy Sciences programs, researchers are using the Oak Ridge Leadership Computing Facility's (OLCF's) Titan supercomputer to try to get closer to producing sustainable fusion for electricity.

The project, led by Brian Wirth, a researcher with the University of Tennessee and DOE's Oak Ridge National Laboratory, brings researchers from various organizations together to work on different aspects of the ITER experimental fusion reactor under construction in southeastern France. An international collaboration, ITER will be by far the largest fusion reactor ever built. Participating countries hope the reactor will serve as proof of concept for future fusion power plants….***Read More***...



Using their ParRep method on the Titan supercomputer, Los Alamos National Laboratory researchers were able to simulate the surface morphology for helium bubbles growing inside of a fusion reactor's divertor wall for two different growth stages. The combination of Titan and the ParRep method completed simulations in 30 minutes that would have taken months using traditional molecular dynamics approaches. Credit: Luis Sandoval, Arthur Voter, Blas Uberuaga, and Danny Perez

Engineers develop a computer that operates on water droplets

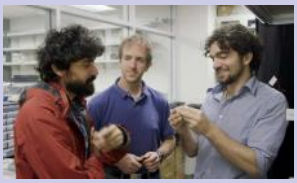
Computers and water typically don't mix, but in Manu Prakash's lab, the two are one and the same. Prakash, an assistant professor of bioengineering at Stanford, and his students have built a synchronous computer that operates using the unique physics of moving water droplets.

The computer is nearly a decade in the making, incubated from an idea that struck Prakash when he was a graduate student. The work combines his expertise in manipulating droplet fluid dynamics with a fundamental element of computer science – an operating clock.

"In this work, we finally demonstrate a synchronous, universal droplet logic and control," Prakash said. Because of its universal nature, the droplet computer can theoretically perform any operation that a conventional electronic computer can crunch, although at significantly slower rates. Prakash and his colleagues, however, have a more ambitious application in mind.

"We already have digital computers to process information. Our goal is not to compete with electronic computers or to operate word processors on this," Prakash said. "Our goal is to build a completely new class of computers that can precisely control and manipulate physical matter. Imagine if when you run a set of computations that not only information is processed but physical matter is algorithmically manipulated as well. We have just made this possible at the mesoscale."

The ability to precisely control droplets using fluidic ..***Read More***...



Stanford Assistant Professor Manu Prakash, left, and graduate students Jim Cybulski and Georgios Katsikis developed the water drop computer.

Atmospheric signs of volcanic activity could aid search for life

Planets with volcanic activity are considered better candidates for life than worlds without such heated internal goings-on.

Now, graduate students at the Univ. of Washington have found a way to detect volcanic activity in the atmospheres of exoplanets, or those outside our solar system, when they transit, or pass in front of their host stars.

Their findings, published in Astrobiology, could aid the process of choosing worlds to study for possible life and even one day help determine not only that a world is habitable, but in fact inhabited.

Volcanism is a key element in planetary habitability. That's because volcanic outgassing helps a planet maintain moderate, life-inviting temperatures, regulating the atmosphere by cycling gases such as carbon dioxide between the atmosphere and the mantle.

Lead author Amit Misra, who has since graduated with a doctorate, said the project started in a UW astrobiology graduate seminar when a professor asked how one might detect plate tectonics—the grinding together and apart of huge slabs of a planet's surface—on faraway worlds.

Plate tectonics is considered an aid to the origin of life because it allows for the recycling of materials from the atmosphere to the planetary interior. Some scientists have even proposed that life on Earth began at sites created by tectonic plates.

The students studied various models trying to predict whether an exoplanet might have plate tectonics, but found little in scientific literature on how to directly detect tectonic plates. So they started brainstorming.

"I came up with the idea of looking at explosive volcanic eruptions as a proxy, or stand-in, for plate tectonics," Misra said. ...***Read More***...

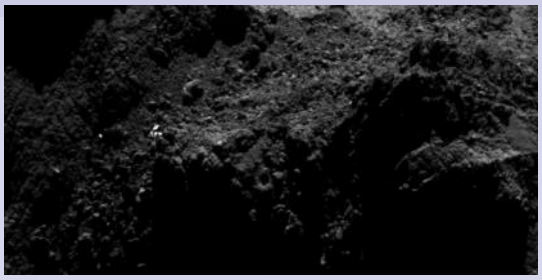
File image.

Rosetta team spots glint of light that could be comet lander

The European Space Agency says it may have caught a glimpse of its missing comet lander.

Philae became the first spacecraft land on a comet, but its exact location has been a mystery since it touched down on the surface of 67P in November. ESA said Thursday that scientists analyzed images and other data from the lander and mother ship Rosetta. They identified several possible locations including one bright spot described as "a good candidate for the lander."

Rosetta was unable to fly by the site for a closer look since December because the comet is releasing gas and dust as it nears the sun in the next months. Chances of finding Philae will be boosted if the lander gathers enough solar energy to wake up and send a signal….***Read More***...



Zooming in towards the current CONSERT ellipse, a number of bright dots are seen in the region. As only one (at most) of these could be the lander, the majority must be associated with surface features on the comet nucleus. Credits: ESA/Rosetta/MPS for OSIRIS Team MPS/UPD/LAM/IAA/SSO/INTA/UPM/DASP/IDA

Lonely galaxy lost in space

Most galaxies are clumped together in groups or clusters. A neighboring galaxy is never far away. But this galaxy, known as NGC 6503, has found itself in a lonely position, at the edge of a strangely empty patch of space called the Local Void.

The Local Void is a huge stretch of space that is at least 150 million light-years across. It seems completely empty of stars or galaxies. The galaxy's odd location on the edge of this never-land led stargazer Stephen James O'Meara to dub it the "Lost-In-Space galaxy" in his 2007 book, Hidden Treasures.

NGC 6503 is 18 million light-years away from us in the northern circumpolar constellation of Draco. NGC 6503 spans some 30,000 light-years, about a third of the size of the Milky Way.

This Hubble Space Telescope image shows NGC 6503 in striking detail and with a rich set of colors. Bright red patches of gas can be seen scattered through its swirling spiral arms, mixed with bright blue regions that contain newly forming stars. Dark brown dust lanes snake across the galaxy's bright arms and center, giving it a mottled appearance.

The Hubble Advanced Camera for Surveys data for NGC 6503 were taken in April 2003, and the Wide Field Camera 3 data were taken in August 2013.

...***Read More***...

NGC 6503, has found itself in a lonely position, at the edge of a strangely empty patch of space called the Local Void. The Hubble Advanced Camera for Surveys data for NGC 6503 were taken in April 2003, and the Wide Field Camera 3 data were taken in August 2013. Image courtesy NASA, ESA, D. Calzetti (University of Massachusetts), H. Ford (Johns Hopkins University), and the Hubble Heritage Team.

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

UAEU College of Science

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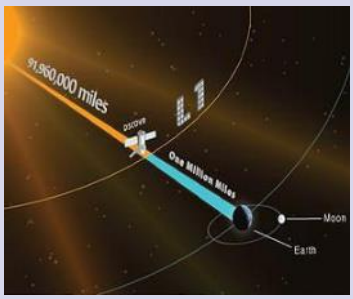
First US deep space weather satellite reaches final orbit

More than 100 days after it launched, NOAA's Deep Space Climate Observatory (DSCOVR) satellite has reached its orbit position about one million miles from Earth.

Once final instrument checks are completed, DSCOVR, which will provide improved measurements of solar wind conditions to enhance NOAA's ability to warn of potentially harmful solar activity, will be the nation's first operational space weather satellite in deep space. Its orbit between Earth and the sun is at a location called the Lagrange point 1, or L1, which gives DSCOVR a unique vantage point to see the Earth and sun.

Data from DSCOVR, coupled with a new forecast model set to come online in 2016, will enable NOAA's space weather forecasters to predict geomagnetic storm magnitude on a regional basis. Geomagnetic storms occur when plasma and magnetic fields streaming from the sun impact Earth's magnetic field….***Read More***...

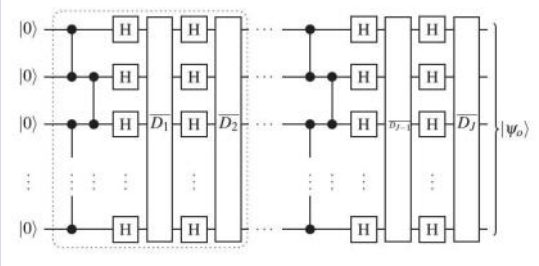


This artist's rendering shows the location of the DSCOVR spacecraft located one million miles between the Earth and the Sun. Image courtesy NASA.

Blind quantum computing method surpasses efficiency 'limit'

Demonstrating that limits were made to be broken, physicists have overcome what was previously considered to be a natural and universal limit on the efficiency of a quantum cryptography task called blind quantum computing. The new method offers significant efficiency improvements and, in some cases, requires exponentially fewer communication resources to implement than previous methods did.

The physicists, Carlos A. Pérez-Delgado and Joseph F. Fitzsimons at the Singapore University of Technology and Design, have published a paper on the improved blind quantum computing method in a recent issue of Physical Review Letters. Fitzsimons is also with the Centre for Quantum Technologies at the National University of Singapore….***Read More***...



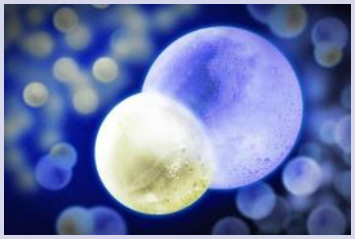
Blind quantum computation with teleportation protocol. The dotted-line square shows the repeating pattern of operations. Credit: Pérez-Delgado and Fitzsimons. ©2015 American Physical Society

At near absolute zero, molecules may start to exhibit exotic states of matter

The air around us is a chaotic superhighway of molecules whizzing through space and constantly colliding with each other at speeds of hundreds of miles per hour. Such erratic molecular behavior is normal at ambient temperatures.

But scientists have long suspected that if temperatures were to plunge to near absolute zero, molecules would come to a screeching halt, ceasing their individual chaotic motion and behaving as one collective body. This more orderly molecular behavior would begin to form very strange, exotic states of matter—states that have never been observed in the physical world.

Now experimental physicists at MIT have successfully cooled molecules in a gas of sodium potassium (NaK) to a temperature of 500 nanokelvins—just a hair above absolute zero, and over a million times colder than interstellar space. ...***Read More***...



MIT researchers have successfully cooled a gas of sodium potassium (NaK) molecules to a temperature of 500 nanokelvin. In this artist's illustration, the NaK molecule is represented with frozen spheres of ice merged together: the smaller sphere on the left represents a sodium atom, and the larger sphere on the right is a potassium atom. Credit: Jose-Luis Olivares/MIT