100 Million Stars in the Andromeda galaxy.

July 25, 2015
Shawwal 09, 1436
Volume 5, Issue 30

Astronomy & Physics News

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

INTERNATIONAL YEAR OF LIGHT 2015

Inside this issue:

Hawking launches biggest-ever search for alien life

British cosmologist Stephen Hawking on Monday launched the biggest-ever search for intelligent extraterrestrial life in a $100-million (92-million-euro), 10-year project to scan the heavens.

Russian Silicon Valley entrepreneur Yuri Milner, who is funding the Breakthrough Listen initiative, said it would be the most intensive scientific search ever undertaken for signs of alien civilisation.

"In an infinite universe, there must be other occurrences of life," Hawking said at the launch event at the Royal Society science academy in London.

"Somewhere in the cosmos, perhaps, intelligent life may be watching.

"Either way, there is no bigger question. It's time to commit to finding the answer, to search for life beyond Earth.

"It is important for us to know if we are alone in the dark."

The project will use some of the biggest telescopes on Earth, searching far deeper into the universe than before for radio and laser signals.

"Breakthrough Listen takes the search for intelligent life in the universe to a completely new level," said Milner, a former physicist. ...***Read More***...

File Image.

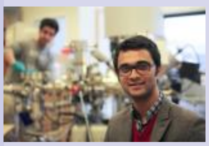
Rock paper fungus: How X-ray imaging of rocks will save papers of the past

Believe it or not: X-ray works a lot better on rocks than on paper. This has been a problem for conservators trying to save historical books and letters from the ravages of time and fungi. They frankly did not know what they were up against once the telltale signs of vandals such as Dothidales or Pleosporales started to spot the surface of their priceless documents.

Now Diwaker Jha, an imaging specialist from Department of Chemistry, University of Copenhagen, has managed to adapt methods developed to investigate interiors of rocks to work on paper too, thus getting a first look at how fungus goes about infesting paper. The findings are published in the Journal of Analytical Atomic Spectrometry.

This is good news for paper conservators and others who wish to study soft materials with X-ray tomography. "Rocks are easy because they are hard. The X-ray images show a very good contrast between the solid and the pores or channels, which are filled with low density materials such as air or fluids. In this case, however, paper and fungi, both are soft and carbon based, which makes them difficult to distinguish", says Diwaker.

Diwaker Jha is a PhD student in the NanoGeoScience group, which is a part of the NanoScience Center at Department of Chemistry. He investigates methods to improve imaging techniques used by chemists and physicists to investigate how fluids move in natural porous materials. At a recent conference, he was ...***Read More***...



Diwaker Jha, an imaging specialist from Department of Chemistry, University of Copenhagen, has managed to get a first look at how fungus goes about infesting paper. This is good news for conservators trying to save historical books and letters.

Credit: Jes Andersen/University of Copenhagen

Spintronics just got faster

In a tremendous boost for spintronic technologies, EPFL scientists have shown that electrons can jump through spins much faster than previously thought.

Electrons spin around atoms, but also spin around themselves, and can cross over from one spin state to another. A property which can be exploited for next-generation hard drives. However, "spin cross-over" has been considered too slow to be efficient. Using ultra-fast measurements, EPFL scientists have now shown, for the first time, that electrons can cross spins at least 100,000 times faster than previously thought. Aside for its enormous implications for fundamental physics, the finding can also propel the field of spintronics forward. The study is published in Nature Chemistry.

The rules of spin

Although difficult to describe in everyday terms, electron spin can be loosely compared to the rotation of a planet or a spinning top around its axis. Electrons can spin in different manners referred to as "spin states" and designated by the numbers 0, 1/2, 1, 3/2, 2 etc. During chemical reactions, electrons can cross from one spin state to another, for example, from 0 to 1 or 1/2 to 3/2.

Spin cross-over is already used in many technologies, for example, optical light-emitting devices (OLED), energy conversion systems and cancer phototherapy. Most prominently, spin cross-over is the basis of the fledgling field of spintronics. The problem is that spin cross-over ..Read More...

This the 2-D ultra-fast UV spectroscopy set-up at EPFL's Laboratory of Ultrafast Spectroscopy, used to carry out the measurements in this study. Photo: Alain Herzog/EPFL

Researchers demonstrate first realization of invisible absorbers and sensors

The manipulation of light has led to many applications that have revolutionized society through communications, medicine and entertainment. Devices consuming the energy of electromagnetic radiation, such as absorbers and sensors, play an essential role in the using and controlling of light.

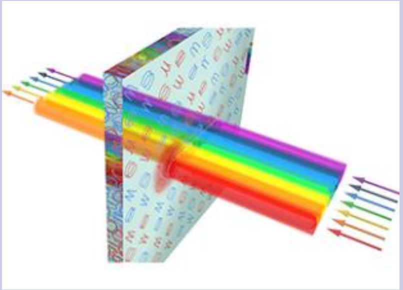
The researchers at the Aalto University Department of Radio Science and Engineering have demonstrated the first realization of absorbers that do not reflect light over a wide range of frequencies. All previous absorbers at other frequencies were either fully reflective, as mirrors, or the range of low reflection was very narrow.

“These absorbers are completely transparent at non-operational frequencies,” concludes re-.searcherViktar Asadchy.

While maintaining efficient absorption of light of the desired frequency, all conventional absorbers strongly interact with the radiation of other frequencies, reflecting it back and not letting it pass through. As a result, they create a reflected beam as well as a perceptible shadow behind and become detectable.

The designed and tested structures are able to absorb and sense the light of one or several desired frequency spectra, while being invisible and undetectable at other frequencies.

The research has proven that such an unparalleled operation can only be achieved with the use of structural inclusions whose electric ..***Read More***..



An array of helical elements absorbs radiation of a certain frequency while casting no shadow in light over a range of other frequencies.

A step closer to understanding superconductivity with large international collaboration

Superconductors that could transport electricity without a loss of energy would save billions of dollars and have a considerably smaller environmental impact than other options.

A large international collaboration has identified a new iron-based compound that demonstrates superconductivity on one-dimensional ladders of iron atoms. Until recently, superconductivity in iron-based compounds had only been observed in iron pnictides on two-dimensional square lattices.

In a paper published today in the prestigious journal Nature Materials, Hiroki Takahashi from Nihon University and co-authors from Japan, China and Australia, including ANSTO's Instrument Scientist and adjunct A/Prof of University of Sydney Max Avdeev, revealed that barium iron sulphide ($BaFe_2S_3$) exhibits superconductivity under pressure (11 GPa) at a temperature below 14 degrees K. Other collaborators on the paper included researchers from the Tohoku University, University of Tokyo, National Institute for Materials Science, and Toyota Physical and Chemical Research Institute (Japan) and Jilin University (China).

The iron-based materials share similarities with a large class of copper-based materials, cuprates that first demonstrated superconductivity at high temperature. The superconductivity in cuprates occurs most commonly on two-dimensional square planes but has also been found in quasi-one-dimensional ladder structures….***Read More***...

Scientists are a step closer to understanding superconductivity that could make electricity transmission more efficient.

Kepler Mission Discovers Bigger, Older Cousin to Earth

NASA's Kepler mission has confirmed the first near-Earth-size planet in the "habitable zone" around a sun-like star. This discovery and the introduction of 11 other new small habitable-zone candidate planets mark another milestone in the journey to finding another "Earth."

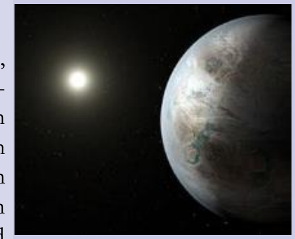
The newly discovered Kepler-452b is the smallest planet to date discovered orbiting in the habitable zone - the area around a star where liquid water could pool on the surface of an orbiting planet - of a G2-type star, like our sun. The confirmation of Kepler-452b brings the total number of confirmed planets to 1,030.

"On the 20th anniversary year of the discovery that proved other suns host planets, the Kepler exoplanet explorer has discovered a planet and star which most closely resemble the Earth and our sun," said John Grunsfeld, associate administrator of NASA's Science Mission Directorate at the agency's headquarters in Washington. "This exciting result brings us one step closer to finding an Earth 2.0."

Kepler-452b has a diameter 60 percent larger than Earth and is considered a super-Earth-size planet. While its mass and composition are not yet determined, previous research suggests that planets the size of Kepler-452b have a good chance of being rocky.

While Kepler-452b is larger than Earth, its 385-day orbit is only 5 percent longer. The planet is 5 percent farther from its parent star, Kepler-452, than Earth is from the sun. Kepler-452 is 6 billion years old, 1.5 billion years older than our sun, has the same temperature, and is 20 percent brighter, with a diameter 10 percent larger.

"We can think of Kepler-452b as an older, bigger cousin to Earth, providing an opportunity to understand and reflect upon Earth's evolving environment," said Jon Jenkins, Kepler data analysis lead at NASA's Ames Research Center in Moffett ...***Read More***...



This artist's concept depicts one possible appearance of the planet Kepler-452b, the first near-Earth-size world to be found in the habitable zone of star that is similar to our sun. Image courtesy NASA Ames/JPL-Caltech .

Deja-vu, new theory says dark matter acts like well-known particle

A new theory says dark matter acts remarkably similar to subatomic particles known to science since the 1930s. We owe a lot to dark matter - it is the thing keeping galaxies, stars, our solar system, and our bodies intact. Yet no one has been able to observe it, and it has often been regarded as a totally new exotic form of matter, such as a particle moving in extra dimensions of space or its quantum version, super-symmetry.

Now an international group of researchers has proposed a theory that dark matter is very similar to pions, which are responsible for binding atomic nuclei together. Their findings appear in the latest Physical Review Letters, published on July 10.

"We have seen this kind of particle before. It has the same properties - same type of mass, the same type of interactions, in the same type of theory of strong interactions that gave forth the ordinary pions. It is incredibly exciting that we may finally understand why we came to exist," says Hitoshi Murayama, Professor of Physics at the University of California, Berkeley, and Director of the Kavli Institute for the Physics and Mathematics of the Universe at the University of Tokyo.

The new theory predicts dark matter is likely to interact with itself within galaxies or clusters of ...***Read More***...

This is an artist's impression of dark matter distribution. Left image assumes conventional dark matter theories, where dark matter would be highly peaked in small area in galaxy center. Right image assumes SIMPs, where dark matter in galaxy would spread out ...

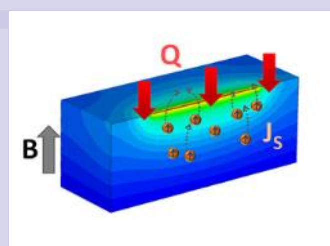
Magnetic material unnecessary to create spin current

It doesn't happen often that a young scientist makes a significant and unexpected discovery, but postdoctoral researcher Stephen Wu of the U.S. Dept. of Energy (DOE)'s Argonne National Laboratory just did exactly that. What he found—that you don't need a magnetic material to create spin current from insulators—has important implications for the field of spintronics and the development of high-speed, low-power electronics that use electron spin rather than charge to carry information.

Wu's work upends prevailing ideas of how to generate a current of spins. "This is a discovery in the true sense," said Anand Bhattacharya, a physicist in Argonne's Materials Science Div. and the Center for Nanoscale Materials (a DOE Office of Science user facility), who is the project's principal investigator. "There's no prediction of anything like it."

Spin is a quantum property of electrons that scientists often compare to a tiny bar magnet that points either "up" or "down." Until now scientists and engineers have relied on shrinking electronics to make them faster, but now increasingly clever methods must be used to sustain the continued progression of electronics technology, as we reach the limit of how small we can create a transistor. One such method is to separate the flow of electron spin from the flow of electron current, upending the idea that information needs to be carried on wires and instead flowing it through insulators.

To create a current of spins in insulators, scientists have typically kept electrons stationary in a lattice made of an insulating ferromagnetic material, such as yttrium iron garnet (YIG). When they apply a heat gradient across the material, the spins begin ..***Read More***…



Typically when referring to electrical current, an image of electrons moving through a metallic wire is conjured. Using the spin Seebeck effect (SSE), it is possible to create a current of pure spin (a quantum property of electrons related to its magnetic moment) in magnetic insulators. However, this work demonstrates that the SSE is not limited to magnetic insulators but also occurs in a class of materials known as paramagnets.

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

جامعة الإمارات العربية المتحدة
United Arab Emirates University

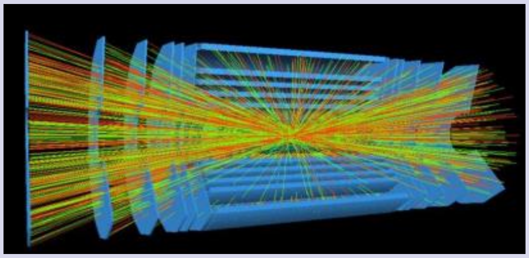
Exploring the Higgs boson's dark side

In 2012 CERN's Large Hadron Collider (LHC) discovered the Higgs boson, the 'missing piece' in the jigsaw of particles predicted by the Standard Model.

Last month, after two years of preparation, the LHC began smashing its proton beams together at 13 Trillion electron Volts (TeV), close to double the energy achieved during its first run.

'We do not know what we will find next and that makes the new run even more exciting,' Daniela Bortoletto of Oxford University's Department of Physics, a member of the team running the LHC's ATLAS experiment, tells me. 'We hope to finally find some cracks in the Standard Model as there are many questions about our universe that it does not answer.'

One of the big questions concerns dark matter, the invisible 'stuff' that astrophysicists estimate makes up over 80% of the mass of the Universe. As yet nobody has identified particles of dark matter although physicists think it could be the lightest supersymmetric (SUSY) particle. ...***Read More***...



Tic toc: Why pendulums swing in harmony

Almost 350 years ago, Dutch inventor and scientist Christiaan Huygens observed that two pendulum clocks hanging from a wall would synchronise their swing over time.

What causes the phenomenon has led to much scientific head-scratching over the centuries, but no consensus to date. On Thursday, a study in the Nature journal Scientific Reports proposed a solution: the pendulums transfer energy to one another through sound pulses. A pair of Portuguese scientists hypothesised that these pulses might move from clock to clock, perturbing the swing of the pendulums and eventually causing them to synchronise.

They developed a complex mathematical model before conducting experiments with a pair of clocks attached to a rail fixed to a wall. The theoretical predictions and simulation matched, they found. "We could... verify that the energy transfer is through a sound pulse," co-author Luis Melo from Lisbon University's physics department told AFP by email.

This not only solves "an old, fundamental problem," it also boosts understanding of other types of oscillators, he said. Huygens is credited with making the first pendulum clock in 1656—...***Read More***...

In 1665, the scientist reported observing a strange phenomenon—two clocks hanging from the same structure would start swinging in unison, though in opposite directions

Researchers feed white blood cells micro-lasers causing them to produce light

A team of researchers working at the University of St Andrews in Scotland has found a way to place a laser inside a living human cell. In their paper published in the journal Nano Letters, the team describes their technique and the ways in which the new procedure may be used for future medical applications.

Scientists have been working with lasers based on single cells for a number of years, but until now, all of them required optical resonators that were actually larger than the cell—in this new effort the researchers used a resonator so small that it was able to fit inside the cell. The point of such research is to create fluorescing cells in living organisms, which would allow researchers to track them as they go about their business, and that would offer insight into such things as how cancer cells get their start.

In this new effort, the researchers have expanded on prior research where green fluorescent proteins (normally found in jellyfish) were introduced into human cells and then light was ...***Read More***...