100 Million Stars in the Andromeda galaxy.

April 18, 2015
Volume 5, Issue 16

Astronomy & Physics News

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Weekly news from around the world compiled by Dr. Ilias Fernini

INTERNATIONAL YEAR OF LIGHT 2015

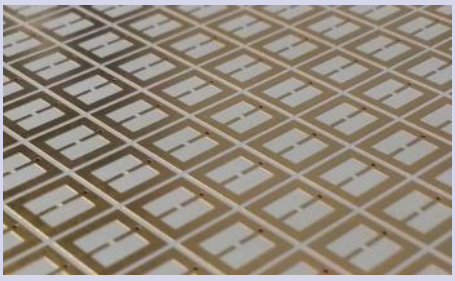
Inside this issue:

Harvesting energy from electromagnetic waves

For our modern, technologically-advanced society, in which technology has become the solution to a myriad of challenges, energy is critical not only for growth but also, more importantly, survival. The sun is an abundant and practically infinite source of energy, so researchers around the world are racing to create novel approaches to "harvest" clean energy from the sun or transfer that energy to other sources.

This week in the journal Applied Physics Letters, from AIP Publishing, researchers from the University of Waterloo in Canada report a novel design for electromagnetic energy harvesting based on the "full absorption concept." This involves the use of metamaterials that can be tailored to produce media that neither reflects nor transmits any power—enabling full absorption of incident waves at a specific range of frequencies and polarizations.

"The growing demand for electrical energy around the globe is the main factor driving our research," said Thamer Almoneef, a Ph.D. student. "More than 80 percent of our energy today comes from burning fossil fuels, which is both harmful to our environment and unsustainable as well. In our group, we're trying to help solve the energy crisis by improving the efficiency of electromagnetic energy-harvesting systems."...***Read More***...



The metasurface used for collecting electromagnetic energy is shown. Credit: O.Ramahi/U.Waterloo

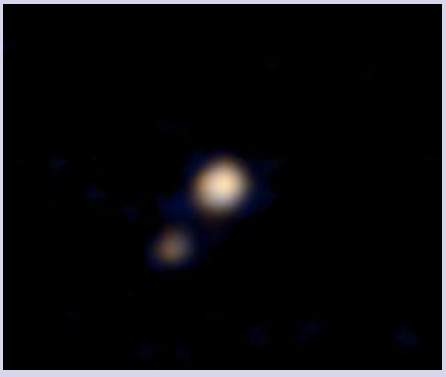
NASA's New Horizons Nears Historic Encounter with Pluto

NASA's New Horizons spacecraft is three months from returning to humanity the first-ever close up images and scientific observations of distant Pluto and its system of large and small moons.

"Scientific literature is filled with papers on the characteristics of Pluto and its moons from ground based and Earth orbiting space observations, but we've never studied Pluto up close and personal," said John Grunsfeld, astronaut, and associate administrator of the NASA Science Mission Directorate at the agency's Headquarters in Washington.

"In an unprecedented flyby this July, our knowledge of what the Pluto systems is really like will expand exponentially and I have no doubt there will be exciting discoveries."

The fastest spacecraft ever launched, New Horizons has traveled a longer time and farther away - more than nine years and three billion miles - than any space mission in history to reach its primary target….***Read More***...



This image of Pluto and its largest moon, Charon, was taken by the Ralph color imager aboard New Horizons on April 9, 2015, from a distance of about 71 million miles (115 million kilometers). It is the first color image ever made of the Pluto system by a spacecraft on approach.

Graphene pushes the speed limit of light-to-electricity conversion

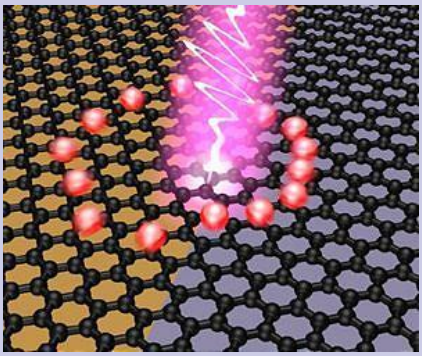
The efficient conversion of light into electricity plays a crucial role in many technologies, ranging from cameras to solar cells. It also forms an essential step in data communication applications, since it allows for information carried by light to be converted into electrical information that can be processed in electrical circuits.

Graphene is an excellent material for ultrafast conversion of light to electrical signals, but so far it was not known how fast graphene responds to ultrashort flashes of light.

ICFO researchers Klaas-Jan Tielrooij, Lukasz Piatkowski, Mathieu Massicotte and Achim Woessner led by ICFO Prof. Frank Koppens and ICREA Prof. at ICFO Niek van Hulst, in collaboration with scientists from the research group led by Pablo Jarillo-Herrero at MIT and the research group led by Jeanie Lau at UC Riverside, have now demonstrated that a graphene-based photodetector converts absorbed light into an electrical voltage at an extremely high speed.

The study, entitled "Generation of photovoltage in graphene on a femtosecond timescale through efficient carrier heating", has recently been published in Nature Nanotechnology.

The new device that the researchers developed is capable of converting light into electricity in less than 50 femtoseconds (a twentieth of a millionth of a millionth of a second). To do this, the researchers used a combination of ultrafast pulse-shaped laser excitation and highly sensitive electrical readout….***Read More***...



This is an illustration of ultrafast photovoltage creation after light absorption at the interface of two graphene areas with different Fermi energy. Image courtesy ICFO/Achim Woessner (Image courtesy Achim Woessner).

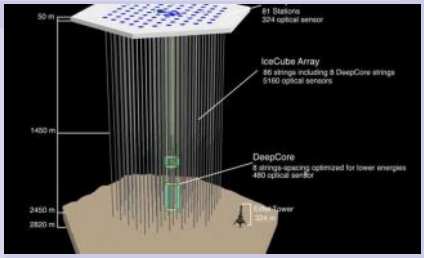
Detector at the South Pole explores the mysterious neutrinos

Neutrinos are a type of particle that pass through just about everything in their path from even the most distant regions of the universe. The Earth is constantly bombarded by billions of neutrinos, which zip right through the entire globe, houses, animals, people – everything. Only very rarely do they react with matter, but the giant IceCube experiment at the South Pole can detect when there is a collision between neutrinos and atoms in the ice using a network of detectors. New research results from the Niels Bohr Institute, among others have measured the neutrinos at the South Pole and have calculated some of the physical properties of the otherwise exotic and poorly understood particles. The results are published in the scientific journal Physical Review D.

Neutrinos are among nature's most abundant particles. Their number far exceeds the number of atoms in the entire universe – yet we know little about them. Neutrinos are a type of particle created in the Big Bang and are also produced in the Sun's interior and in violent events like supernovae, which are exploding stars. Neutrinos are also called 'ghost particles' because they basically do not interact with matter, but pass undisturbed through everything in their path.

Instruments at the South Pole

Researchers from 44 institutions in 12 countries are part of an international project, IceCube at the South Pole to study the mysterious particles with the strange properties. IceCube is an enormous particle detector located deep in the ...***Read More***...



IceCube is comprised of a cubic kilometer of ice, which is densely packed with optical modules. The detector is located deep below the surface - – it starts 1½ km below the ice and ends at the bottom at a depth of 2½ km. The instruments in the detector are comprised of 86 cables each with 60 digital Optical Modules (extremely sensitive light sensors). Credit: IceCube Collaboration

Light in a spin: Researchers demonstrate angular accelerating light

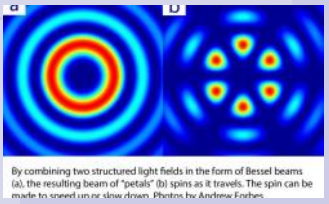
Light must travel in a straight line and at a constant speed, or so the laws of nature suggest. Now, researchers at the University of the Witwatersrand in Johannesburg have demonstrated that laser light traveling along a helical path through space, can accelerate and decelerate as it spins into the distance.

This is the first time that angular acceleration has been observed with light, and is therefore likely to lead to new applications using these structured light fields.

The results are contained in a research paper by Professor Andrew Forbes from the Wits School of Physics and his collaborators[1], published online this week in the journal, Physical Review A. Titled: Accelerated rotation with orbital angular momentum modes, the work has also been selected as a highlighted paper by the editors.

Forbes, who joined the Wits School of Physics in March this year, is heading up the new Structured Light Laboratory that focuses on creating custom light fields using digital holograms. The research group creates complex light that exhibits interesting physical properties, which they exploit for a range of applications.

Previously, Forbes and his collaborators have shown that light could be made to spin. In this recent work they demonstrated the first realisation of angular accelerating light and showed that light could also be made to accelerate and decelerate. This acceleration can be controlled with a single parameter that is ..***Read More***..



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NASA Chief Scientist: We'll Find Proof of Alien Life by 2025

While scientists have long suspected that we may not be alone in the universe, they've never had concrete evidence. But top NASA officials say that may not be the case much longer. In less than a decade, we may at last find alien life.

Our image of the solar system has changed dramatically over the last few years. Many worlds which were once thought to be dry and cold are now believed to contain liquid water, the most crucial element for life as we know it. Vast oceans exist beneath the ice on Europa and Ganymede, two of Jupiter's moons, and the Curiosity rover has found organic molecules on Mars.

All of this suggests that life could be more common than previously thought.

"I think we're going to have strong indications of life beyond Earth within a decade, and I think we're going to definitive evidence within 20 to 30 years," NASA chief scientist Ellen Stofan said Tuesday during a panel discussion. "We know where to look. We know how to look."

Former astronaut John Grunsfeld, associate administrator for NASA's Science Mission Directorate, agreed with those estimates.

"I think we're one generation away in our solar system, whether it's on an icy moon or on Mars, and one generation [away] on a planet around a nearby star," he said during the discussion.

Looking beyond our own solar system, the Kepler space telescope is searching for signs of habitable worlds. Since its launch in 2009, the spacecraft has confirmed two key things: nearly every star in the universe is orbited by planets, and most of those planets are rocky, like Earth and Mars.

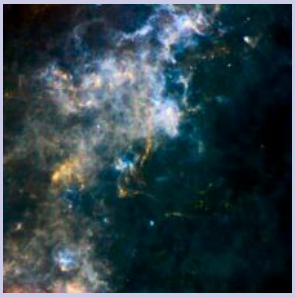
In reference to just how much water is present in the galaxy...***Read More***...

File Image

Stars: A Day in the Life

There is something about them that intrigues us all. These massive spheres of gas burning intensely from the energy of fusion buried many thousands of kilometers deep within their cores. The stars have been the object of humanity's wonderment for as far back as we have records. Many of humanity's religions can be tied to worshiping these celestial candles. For the Egyptians, the sun was representative of the God Ra, who each day vanquished the night and brought light and warmth to the lands. For the Greeks, it was Apollo who drove his flaming chariot across the sky, illuminating the world. Even in Christianity, Jesus can be said to be representative of the sun given the striking characteristics his story holds with ancient astrological beliefs and figures. In fact, many of the ancient beliefs follow a similar path, all of which tie their origins to that of the worship of the sun and stars.

Humanity thrived off of the stars in the night sky because they recognized a correlation in the pattern in which certain star formations (known as constellations) represented specific times in the yearly cycle. One of which meant that it was to become warmer soon, which led to planting food. The other constellations foretold the coming of a colder period, so you were able to begin storing food and gathering firewood. ..***Read More***….



Embryonic Stars amid molecular clouds
Credit: ESA/NASA/JPL-Caltech

Physics community to discuss latest results of the Alpha Magnetic Spectrometer experiment

The Alpha Magnetic Spectrometer (AMS) collaboration will present today the latest results in its quest to understand the origin of cosmic rays and dark matter. These intriguing results will be shared and discussed during the "AMS days" starting on April 15 at CERN, with many of the world's leading theoretical physicists and principal investigators of some of the major experiments exploring the field of cosmic-ray physics. The main objective of this scientific exchange is to understand the interrelation between AMS results and those of other major cosmic-ray experiments and current theories.

"I am very pleased that so many of the world's leading scientists are interested in AMS results and are coming to CERN for this meeting," said AMS spokesperson Samuel Ting.

In particular, AMS is presenting unexpected new results on the antiproton/proton ratio in the cosmic rays, and on the proton and helium fluxes. Pre-existing models of ordinary cosmic rays cannot explain the AMS results. These new observations may provide important information on the understanding of cosmic-ray production and propagation. It is possible that the results may be explained by new astrophysical sources or new acceleration and propagation mechanisms, and the latest AMS results are also consistent with dark matter collisions.

"Unexplained results are stimulating for the physics community, whether you are a theorist or an experimentalist. This means that we may be at the door of a new discovery, or of a new mystery," said CERN Director General Rolf Heuer.

The latest AMS measurements of the positron fraction ...***Read More***...

An artist's concept of the Alpha Magnetic Spectrometer installed on the International Space Station.

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UAEU College of Science

جامعة الإمارات العربية المتحدة
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The Physics Department cordially invites you to the seminar:

Contact Glow Discharge Electrolysis for the Synthesis of Micro- and Nano-systems

Dr. Anis Allagui
Sustainable & Renewable Energy Department,
University of Sharjah

Abstract

Several sections in the cell current behavior of a two-electrode configuration setup can be identified when a linear voltage sweep is applied. The mean-field characteristic shape reveals two regions with positive conductance, interrupted by a region of negative conductance manifesting itself in the abrupt change of current transport with the applied voltage. This is due to the transitional appearance/disappearance of a space charge structure consisting of a self-organized gas film in parallel with glow discharge volume surrounding the working electrode. This talk will cover the main physical, chemical, spectrochemical, and electrical properties of plasma micro-discharge phenomena, that has found numerous technological applications in recent years. In particular, we will show the micro-machining/structuring of non-conductive surfaces (glass, ceramics) with the submerged micro-plasma, as well as its use for the synthesis of nano-sized materials.

Thursday, April 23rd 2015 @ 12:00 (Noon), Room F1-2119

All are Welcome!

Major advance in artificial photosynthesis poses win-win for the environment

A potentially game-changing breakthrough in artificial photosynthesis has been achieved with the development of a system that can capture carbon dioxide emissions before they are vented into the atmosphere and then, powered by solar energy, convert that carbon dioxide into valuable chemical products, including biodegradable plastics, pharmaceutical drugs and even liquid fuels.

Scientists with the U.S. Dept. of Energy (DOE)'s Lawrence Berkeley National Laboratory (Berkeley Lab) and the Univ. of California (UC) Berkeley have created a hybrid system of semiconducting nanowires and bacteria that mimics the natural photosynthetic process by which plants use the energy in sunlight to synthesize carbohydrates from carbon dioxide and water. However, this new artificial photosynthetic system synthesizes the combination of carbon dioxide and water into acetate, the most common building block today for biosynthesis.

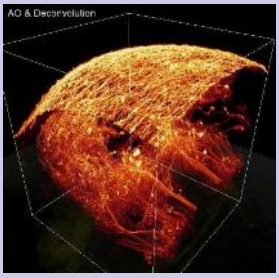
"We believe our system is a revolutionary leap forward in the field of artificial photosynthesis," says Peidong Yang, a chemist with Berkeley Lab's Materials Sciences ..***Read More***…

Cross-sectional SEM image of the nanowire/bacteria hybrid array used in a revolutionary new artificial photosynthesis system.

Technique takes cues from astronomy and ophthalmology to sharpen microscope images

The complexity of biology can befuddle even the most sophisticated light microscopes. Biological samples bend light in unpredictable ways, returning difficult-to-interpret information to the microscope and distorting the resulting image. New imaging technology developed at the Howard Hughes Medical Institute's Janelia Farm Research Campus rapidly corrects for these distortions and sharpens high-resolution images over large volumes of tissue.

The approach, a form of adaptive optics, works in tissues that do not scatter light, making it well suited to imaging the transparent bodies of zebrafish and the roundworm Caenorhabditis elegans, important model ...***Read More***...



This image is a frame grab from a video showing imaging from an adaptive optics (AO) microscope operating in two-photon excitation (TPE) mode. Imaging shows a membrane-labeled subset of neurons in the brain of a living zebrafish embryo. This image shows what one would see with adaptive optics (AO) and deconvolution turned on.