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INTERNATIONAL YEAR OF LIGHT 2015

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Takaaki Kajita and Arthur McDonald share 2015 Physics Nobel

The Royal Swedish Academy of Sciences announced on Tuesday that the 2015 Nobel Prize in Physics is to be awarded to Takaaki Kajita of Tokyo University and Arthur McDonald of Queen's University in Kingston, Ontario.

After photons, neutrinos are the most abundant particle in the universe. Their ubiquity, however, comes with an infinitesimal propensity to react with matter. Every second, trillions of neutrinos—some created in the Big Bang, some spewing from distant supernovas, some emanating from inside the Sun—stream through our bodies without our noticing.

Detecting neutrinos is hard. Measuring their mass and some other properties is harder still. Kajita's and McDonald's teams designed, built, and ran huge experiments that sought to determine one of the most important neutrino properties of all: whether the particle oscillates among its three flavors—electron, muon, and tau.

Kajita was team leader at the Super-Kamiokande neutrino observatory, which is located near the city of Hida, 250 kilometers northwest of Tokyo. McDonald directed the Sudbury Neutrino Observatory, which is 400 km north of Toronto.

The affirmative and conclusive confirmations from the two facilities, obtained ...Read More...

Takaaki Kajita and Arthur McDonald

Where to look for life

Powerful telescopes are coming soon. Where exactly shall we point them? Astronomers with the University of Washington's Virtual Planetary Laboratory have created a way to compare and rank exoplanets to help prioritize which of the thousands discovered warrant close inspection in the search for life beyond Earth.

The new metric, called the "habitability index for transiting planets," is introduced in a paper accepted for publication in the Astrophysical Journal by UW astronomy professors Rory Barnes and Victoria Meadows, with research assistant and co-author Nicole Evans.

"Basically, we've devised a way to take all the observational data that are available and develop a prioritization scheme," said Barnes, "so that as we move into a time when there are hundreds of targets available, we might be able to say, 'OK, that's the one we want to start with.'"

The Kepler Space Telescope has enabled astronomers to detect thousands of exoplanets, those beyond our solar system - far more than can be investigated one by one. ...Read More...

UW astronomers Rory Barnes and Victoria Meadows of the Virtual Planetary Laboratory have created the "habitability index for transiting planets" to compare and rank exoplanets based on their likelihood of being habitable. Image courtesy Rory Barnes.

Fusion reactors 'economically viable' say experts

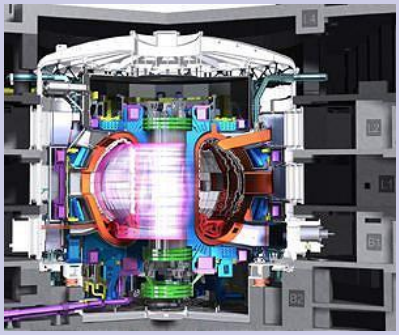
Fusion reactors could become an economically viable means of generating electricity within a few decades, and policy makers should start planning to build them as a replacement for conventional nuclear power stations, according to new research.

Researchers at Durham University and Culham Centre for Fusion Energy in Oxfordshire, have re-examined the economics of fusion, taking account of recent advances in superconductor technology for the first time. Their analysis of building, running and decommissioning a fusion power station shows the financial feasibility of fusion energy in comparison to traditional fission nuclear power.

The research, published in the journal Fusion Engineering and Design, builds on earlier findings that a fusion power plant could generate electricity at a similar price to a fission plant and identifies new advantages in using the new superconductor technology.

Professor Damian Hampshire, of the Centre for Material Physics at Durham University, who led the study, said: "Obviously we have had to make assumptions, but what we can say is that our predictions suggest that fusion won't be vastly more expensive than fission."

Such findings support the possibility that, within a generation or two, fusion reactors could offer an almost unlimited supply of energy without contributing to global warming or producing hazardous products on a significant scale...Read More...



This is an illustration of a tokamak with plasma. Image courtesy ITER Organization.

Semiconductor nanoparticles show high luminescence in a polymer matrix

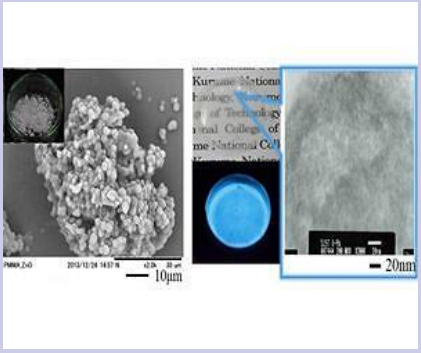
Semiconductor nanocrystals known as quantum dots (QDs) are increasingly being used as photoluminescent materials in bio-imaging, photonics, and optoelectronic applications. However, these QDs must have stable photoluminescence properties to be used in these applications. Photoluminescence stability of QDs is achieved by chemically modifying the surface of the QDs.

However, chemical modification of the surface typically requires large amounts of organic solvents that are harmful to the environment. To solve this problem, many researchers have attempted to synthesize polymer-nanoparticle composites by using supercritical fluid (SCF)-based technology.

Supercritical CO2 has emerged as the most extensively studied SCF medium, because it is readily available, inexpensive, nonflammable, and environmentally benign.

Toyohashi Tech researchers in cooperation with researchers at the National Institute of Technology, Kurume College have investigated the formation of nanostructured material using supercritical CO2.

They have demonstrated the formation of composite nanoparticles of luminescent ZnO QDs and polymer by dispersion polymerization in supercritical CO2. As a result of the supercritical-CO2-assisted surface modification of QDs, the QDs were well dispersed in the polymer matrix and showed high luminescence...Read More...



Polymer-ZnO nanoparticle QDs by dispersion polymerization in supercritical CO2 are shown. Image courtesy Toyohashi University Of Technology.

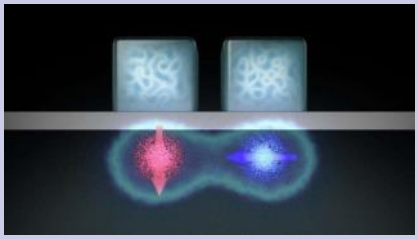
Crucial hurdle overcome in quantum computing

The significant advance, by a team at the University of New South Wales (UNSW) in Sydney appeared on Oct. 05 in the international journal Nature.

"What we have is a game changer," said team leader Andrew Dzurak, Scientia Professor and Director of the Australian National Fabrication Facility at UNSW.

"We've demonstrated a two-qubit logic gate - the central building block of a quantum computer - and, significantly, done it in silicon. Because we use essentially the same device technology as existing computer chips, we believe it will be much easier to manufacture a full-scale processor chip than for any of the leading designs, which rely on more exotic technologies. "This makes the building of a quantum computer much more feasible, since it is based on the same manufacturing technology as today's computer industry," he added.

The advance represents the final physical component needed to realise the promise of super-powerful silicon quantum computers, which harness the science of the very small - the strange behaviour of subatomic particles - to solve computing challenges that are beyond the reach of even today's fastest supercomputers...Read More...



Artist's impression of the two-qubit logic gate device developed at UNSW. Each electron qubit (red and blue in the image) has a 'spin', or magnetic field, indicated by the arrows. Metal electrodes on the surface are used to manipulate the qubits, which interact to create an 'entangled' quantum state. Credit: Tony Melov/UNSW

New Horizons Finds Blue Skies and Water Ice on Pluto

The first color images of Pluto's atmospheric hazes, returned by NASA's New Horizons spacecraft last week, reveal that the hazes are blue. "Who would have expected a blue sky in the Kuiper Belt? It's gorgeous," said Alan Stern, New Horizons principal investigator from Southwest Research Institute (SwRI), Boulder, Colorado. The haze particles themselves are likely gray or red, but the way they scatter blue light has gotten the attention of the New Horizons science team.

"That striking blue tint tells us about the size and composition of the haze particles," said science team researcher Carly Howett, also of SwRI. "A blue sky often results from scattering of sunlight by very small particles. On Earth, those particles are very tiny nitrogen molecules. On Pluto they appear to be larger - but still relatively small - soot-like particles we call tholins."

Scientists believe the tholin particles form high in the atmosphere, where ultraviolet sunlight breaks apart and ionizes nitrogen and methane molecules and allows them to react with each other to form more and more complex negatively and positively charged ions. When they recombine, they form very complex macromolecules, a process first found to occur in the upper atmosphere of Saturn's moon Titan.

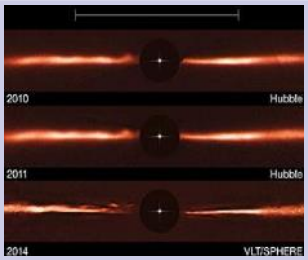
The more complex molecules continue to combine and grow until they become small particles; volatile gases condense and coat their surfaces with ice frost before they have time to fall through the atmosphere to the surface, where they add to Pluto's red coloring.

In a second major finding, New ...Read More...

NASA's New Horizons captured this high-resolution enhanced color view of Charon just before closest approach on July 14, 2015. The image combines blue, red and infrared images taken by the spacecraft's Ralph/Multispectral Visual Imaging Camera (MVIC); the colors are processed to best highlight the variation of surface properties across Charon.

Mysterious ripples found racing through planet-forming disc

Using images from the NASA/ESA Hubble Space Telescope and ESO's Very Large Telescope, astronomers have discovered never-before-seen structures within a dusty disc surrounding a nearby star. The fast-moving wave-like features in the disc of the star AU Microscopii are unlike anything ever observed, or even predicted, before now. The origin and nature of these features present a new mystery for astronomers to explore. The results are published in the journal Nature on 8 October 2015.
AU Microscopii, or AU Mic for short, is a young, nearby star surrounded by a large disc of dust. Studies of such debris discs can provide valuable clues about how planets, which form from these discs, are created.
Astronomers have been searching AU Mic's disc for any signs of clumpy or warped features, as such signs might give away the location of possible planets. And in 2014 they used the powerful high-contrast imaging capabilities of ESO's newly installed SPHERE instrument, mounted on the Very Large Telescope for their search - and discovered something very unusual.
"Our observations have shown something unexpected," explains Anthony ...Read More….



Using images from the NASA/ESA Hubble Space Telescope and ESO's Very Large Telescope, astronomers have discovered fast-moving wave-like features in the dusty disc around the nearby star AU Microscopii. These odd structures are unlike anything ever observed, or even predicted, before now. Image courtesy ESO, NASA and ESA.

Curiosity Rover Team Confirms Ancient Lakes on Mars

A new study from the team behind NASA's Mars Science Laboratory/Curiosity has confirmed that Mars was once, billions of years ago, capable of storing water in lakes over an extended period of time.

Using data from the Curiosity rover, the team has determined that, long ago, water helped deposit sediment into Gale Crater, where the rover landed more than three years ago. The sediment deposited as layers that formed the foundation for Mount Sharp, the mountain found in the middle of the crater today.

"Observations from the rover suggest that a series of long-lived streams and lakes existed at some point between about 3.8 to 3.3 billion years ago, delivering sediment that slowly built up the lower layers of Mount Sharp," said Ashwin Vasavada, Mars Science Laboratory project scientist at NASA's Jet Propulsion Laboratory in Pasadena, California, and co-author of the new Science article to be published Friday, Oct. 9.

The findings build upon previous work that suggested there were ancient lakes on Mars, and add to the unfolding story of a wet Mars, both past and present. Last month, NASA scientists confirmed current water flows on Mars.

"What we thought we knew about water on Mars is constantly being put to the test," said Michael Meyer, lead scientist for NASA's Mars Exploration Program at NASA ...Read More...

A view from the "Kimberly" formation on Mars taken by NASA's Curiosity rover. The strata in the foreground dip towards the base of Mount Sharp, indicating the ancient depression that existed before the larger bulk of the mountain formed. Image courtesy NASA/JPL-Caltech/MSSS.

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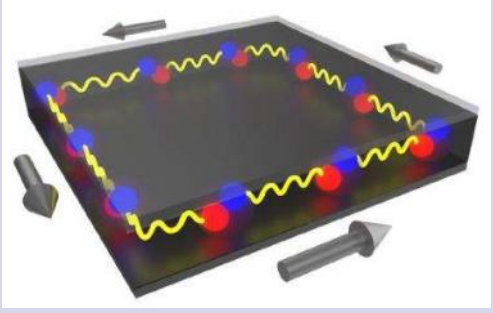
Astronomy Treat—Dance of the Planets October 09, 2015 (Click Here for a Time Lapse)

The topolariton, a new half-matter, half-light particle

A new type of "quasiparticle" theorized by Caltech's Gil Refael, a professor of theoretical physics and condensed matter theory, could help improve the efficiency of a wide range of photonic devices—technologies, such as optical amplifiers, solar photovoltaic cells, and even barcode scanners, which create, manipulate, or detect light.

Electrons traveling through the semiconductors used in modern computers lose energy via heat because of resistance. This is not the case with light signals, but there can be other causes of signal loss in light transmission, such as unwanted reflection and scattering of photons, or light particles. Refael says that a type of quasiparticle called the "topolariton" could reduce such signal degradation and enhance the stability of the photons as they move along the edges of semiconductors. He described topolaritons and their properties in a paper published in the July 2015 issue of the journal Physical Review X. ...Read More...



Perfectly accurate clocks turn out to be impossible

Can the passage of time be measured precisely, always and everywhere? The answer will upset many watchmakers. A team of physicists from the universities of Warsaw and Nottingham have just shown that when we are dealing with very large accelerations, no clock will actually be able to show the real passage of time, known as "proper time".

The ideal clock is merely a convenient fiction, as theorists from the University of Warsaw (UW) and University of Nottingham (UN) have shown. In a study published in the journal Classical and Quantum Gravity they demonstrate that in systems moving with enormous accelerations, building a clock that would precisely measure the passage of time is impossible for fundamental reasons...Read More...

Salvadore Dali has seen it in his dreams, now it is confirmed by physicists from the Faculty of Physics, University of Warsaw: ideal clock is a fiction. Credit: MoMA