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:

A 'movie' of ultrafast rotating molecules at a hundred billion per second

Can you imagine how subnano-scale molecules make an ultrafast rotation at a hundred billion per second? Do the ultrafast rotating subnano-scale molecules show a wave-like nature rather than particle-like behavior? The Japanese research team led by Professor Yasuhiro Ohshima at the Tokyo Institute of Technology, and Dr Kenta Mizuse at the Institute for Molecular Science, National Institutes of Natural Sciences, successfully took sequential "snapshots" of ultrafast unidirectionally rotating molecules at a hundred billion per second.

To visualize such an ultrafast molecular rotation, the team developed a Coulomb explosion imaging setup with regulating rotational direction by a pair of time-delayed, polarization-skewed laser pulses.

In the sequential "snapshots", the team successfully reported high-resolution direct imaging of direction-controlled rotational wave packets (RWPs) in nitrogen molecules, and the quantum wave-like nature was successfully observed. The result will guide more sophisticated molecular manipulations, such as an ultrafast molecular "stopwatch"….***Read More***….

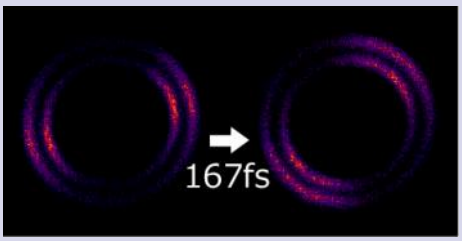


Image 1: "Snapshots" of ultrafast rotating nitrogen molecules at a hundred billion per second. Credit: IMS/NINS

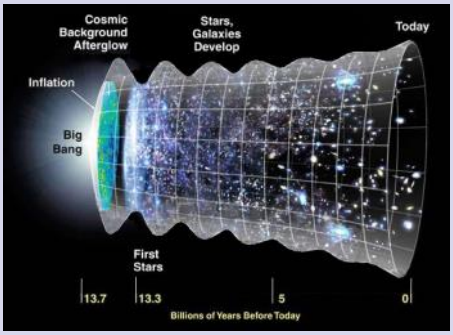
Is our universe ringing like a crystal glass?

Two physicists at the University of Southern Mississippi – Lawrence Mead and Harry Ringermacher – announced on June 26, 2015 that our universe might not only be expanding outward from the Big Bang, but also oscillating or "ringing" at the same time. TheAstronomical Journal published their paper on this topic in April.

As many know, scientists today believe our universe – all space, time and matter – began with the Big Bang some 13 billion years ago. Since then, the universe has been expanding to the size it is today. Yet, the universe as a whole has self-gravity, which tries to pull all the matter – all the stars, gas, galaxies, and mysterious dark matter – back together. This internal gravitational pull slows down the universe's expansion. Mead said in a statement from Southern Miss:

The new finding suggests that the universe has slowed down and speeded up, not just once, but 7 times in the last 13.8 billion years, on average emulating dark matter in the process.

*The ringing has been decaying and is now very small – much like striking a crystal glass and hearing it ring down...****Read More****...*



Artist's concept of an oscillating or 'ringing' universe. Image via NASA, via University of Southern Mississippi

New method of quantum entanglement vastly increases how much information can be carried in a photon

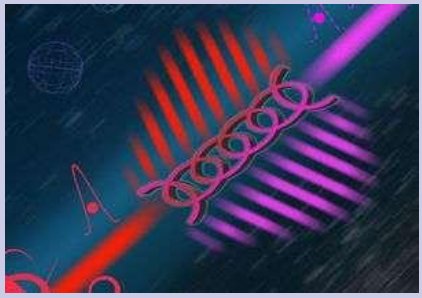
A team of researchers led by UCLA electrical engineers has demonstrated a new way to harness light particles, or photons, that are connected to each other and act in unison no matter how far apart they are —a phenomenon known as quantum entanglement.

In previous studies, photons have typically been entangled by one dimension of their quantum properties—usually the direction of their polarization.

In the new study, researchers demonstrated that they could slice up and entangle each photon pair into multiple dimensions using quantum properties such as the photons' energy and spin. This method, called hyperentanglement, allows each photon pair to carry much more data than was possible with previous methods.

Quantum entanglement could allow users to send data through a network and know immediately whether that data had made it to its destination without being intercepted or altered. With hyperentanglement, users could send much denser packets of information using the same networks.

The research, published today in Nature Photonics, was led by Zhenda Xie, a research scientist in the lab of Chee Wei Wong, a UCLA associate professor of electrical engineering who was the research project's principal investigator. Researchers from MIT, Columbia University, the University of Maryland and the National ...***Read More***...



Artist's conception of a quantum frequency comb. Credit: Nicoletta Barolin

Snake skin inspired surfaces smash records, providing 40 percent friction reduction

Snake skin inspired surfaces smash records, providing an astonishing 40% friction reduction in tests of high performance materials.

hese new surfaces could improve the reliability of mechanical components in machines such as high performance cars and add grist to the mill of engineers designing a new generation of space exploration robots.

A paper discussing this finding is published today in the Bioinspiration & Biomimetics journal.

The skin of many snakes and lizards has been studied by biologists and has long been known to provide friction reduction to the animal as it moves. It is also resistant to wear, particularly in environments that are dry and dusty or sandy.

Dr Greiner and his team used a laser to etch the surface of a steel pin so that it closely resembled the texture of snake skin. They then tested the friction created when the pin moved against another surface.

In dry conditions, i.e. with no oil or other lubricant, the scale-like surface created far less friction—40% less—than its smooth counterpart.

Lead researcher, Dr Christian Greiner said "If we'd managed just a 1% reduction in friction, our engineering colleagues would have been delighted; 40% really is a leap forward and everyone is very excited!"

Applications are likely to be in mechanical devices that are made to a micro or nano scale. ***Read More***...

Snakeskin. Credit: Jessica Paterson / Flickr 2009 - used under CC BY 2.0 license

Physicists shatter stubborn mystery of how glass forms

A physicist at the University of Waterloo is among a team of scientists who have described how glasses form at the molecular level and provided a possible solution to a problem that has stumped scientists for decades.

Their simple theory is expected to open up the study of glasses to non-experts and undergraduates as well as inspire breakthroughs in novel nanomaterials.

The paper published by physicists from the University of Waterloo, McMaster University, ESPCI ParisTech and Université Paris Diderot appeared in the prestigious peer-reviewed journal, Proceedings of the National Academy of Sciences (PNAS).

Glasses are much more than silicon-based materials in bottles and windows. In fact, any solid without an ordered, crystalline structure—metal, plastic, a polymer—that forms a molten liquid when heated above a certain temperature is a glass. Glasses are an essential material in technology, pharmaceuticals, housing, renewable energy and increasingly nano electronics.

"We were surprised—delighted—that the model turned out to be so simple," said author James Forrest, a University Research Chair and professor in the Faculty of Science. "We were convinced it had already been published."

The theory relies on two basic concepts: molecular crowding and string-like co-operative movement. Molecular crowding describes .***Read More***...

Credit: Lynn Greyling/ public domain

Can Planets Be Rejuvenated Around Dead Stars?

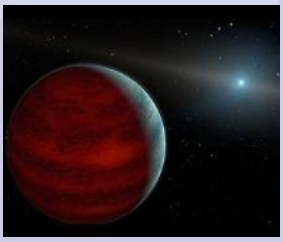
For a planet, this would be like a day at the spa. After years of growing old, a massive planet could, in theory, brighten up with a radiant, youthful glow. Rejuvenated planets, as they are nicknamed, are only hypothetical. But new research from NASA's Spitzer Space Telescope has identified one such candidate, seemingly looking billions of years younger than its actual age.

"When planets are young, they still glow with infrared light from their formation," said Michael Jura of UCLA, coauthor of a new paper on the results in the June 10 issue of the Astrophysical Journal Letters. "But as they get older and cooler, you can't see them anymore. Rejuvenated planets would be visible again."

How might a planet reclaim the essence of its youth? Years ago, astronomers predicted that some massive, Jupiter-like planets might accumulate mass from their dying stars. As stars like our sun age, they puff up into red giants and then gradually lose about half or more of their mass, shrinking into skeletons of stars, called white dwarfs. The dying stars blow winds of material outward that could fall onto giant planets that might be orbiting in the outer reaches of the star system.

Thus, a giant planet might swell in mass, and heat up due to friction felt by the falling material. This older planet, having cooled off over billions of years, would once again radiate a warm, infrared glow.

The new study describes a dead star, or white dwarf, called PG 0010+280. An undergraduate student on the project, Blake Pantoja, then at UCLA, serendipitously discovered unexpected infrared light around this star while searching through data from NASA's Wide-field Infrared Survey Explorer, or WISE. Follow-up research led them to Spitzer observations of the star, taken back in 2006, which also showed the excess of infrared light....***Read More***...



This artist's concept shows a hypothetical "rejuvenated" planet -- a gas giant that has reclaimed its youthful infrared glow. NASA's Spitzer Space Telescope found tentative evidence for one such planet around a dead star, or white dwarf, called PG 0010+280 (depicted as white dot in illustration). Image courtesy NASA/JPL-Caltech.

37 Years after Its Discovery, Pluto's Moon Charon Is Being Revealed

In June 1978, U.S. Naval Observatory astronomer James Christy noticed something unusual. He was studying highly magnified photos of Pluto, and Pluto wasn't round. A small bump marred one side of blurry Pluto.

That bump turned out to be Pluto's largest moon, Charon, whose discovery Christy (working with late colleague Robert Harrington), made on June 22, 1978. Like Pluto in 1930, Charon was found using photographic plates taken in Flagstaff, Arizona.

Thirty-seven years later, Charon is about to be revealed by NASA's New Horizons mission. As New Horizons draws closer by nearly a million miles a day, every observation of it brings new knowledge about this mysterious moon - a world far larger than even the largest asteroid, Ceres.

"Even though Pluto and Charon are partners, they are known to be quite different in appearance and composition. As New Horizons reveals them in far greater detail than ever before possible, we hope to find out why that's so," says Alan Stern, New Horizons principal investigator from Southwest Research Institute, Boulder, Colorado….***Read More***...

In this clip from "Plutopalooza," at California Academy of Sciences on April 25, 2015, science teacher Randy Monroe tells the story of how his stepfather, James Christy, discovered Pluto's moon Charon.

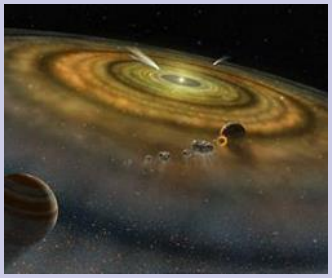
Supercomputer model shows planet making waves in nearby debris disk

A new NASA supercomputer simulation of the planet and debris disk around the nearby star Beta Pictoris reveals that the planet's motion drives spiral waves throughout the disk, a phenomenon that causes collisions among the orbiting debris. Patterns in the collisions and the resulting dust appear to account for many observed features that previous research has been unable to fully explain.

"We essentially created a virtual Beta Pictoris in the computer and watched it evolve over millions of years," said Erika Nesvold, an astrophysicist at the University of Maryland, Baltimore County, who co-developed the simulation. "This is the first full 3-D model of a debris disk where we can watch the development of asymmetric features formed by planets, like warps and eccentric rings, and also track collisions among the particles at the same time."

In 1984, Beta Pictoris became the second star known to be surrounded by a bright disk of dust and debris. Located only 63 light-years away, Beta Pictoris is an estimated 21 million years old, or less than 1 percent the age of our solar system.

It offers astronomers a front-row seat to the evolution of a young planetary system and it remains one of the closest, youngest and best-studied examples today. The disk, which we see edge on, contains rock and ice fragments ranging in size from objects larger than houses to grains as small as smoke particles. It's a younger version of the Kuiper belt at the fringes of our own planetary system….***Read More***...



Watch Erika Nesvold and Marc Kuchner discuss how their new supercomputer simulation helps astronomers understand Beta Pictoris. Image courtesy of NASA's Goddard Space Flight Center.

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

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United Arab Emirates University

Iron: A biological element?

Think of an object made of iron: An I-beam, a car frame, a nail. Now imagine that half of the iron in that object owes its existence to bacteria living two and a half billion years ago. That's the upshot of a study published this week in the Proceedings of the National Academy of Sciences (PNAS). The findings have meaning for fields as diverse as mining and the search for life in space.

Clark Johnson, a professor of geoscience at the University of Wisconsin-Madison, and former postdoctoral researcher Weiqiang Li examined samples from the banded iron formation in Western Australia. Banded iron is the iron-rich rock found in ore deposits worldwide, from the proposed iron mine in Northern Wisconsin to the enormous mines of Western Australia.

These ancient deposits, up to 150 meters deep, were begging for explanation, says Johnson.

Scientists thought the iron had entered the ocean from hot, mineral-rich water released at mid-ocean vents that then ...***Read More***...

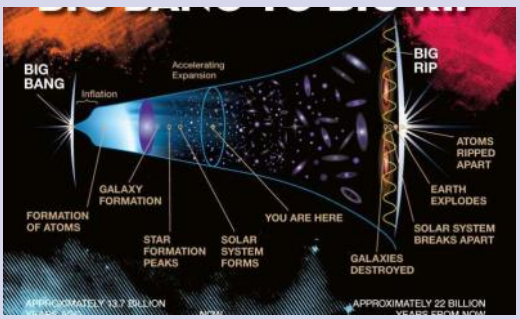
By studying iron extracted from cores drilled in rocks similar to these in Karijini National Park, Western Australia, UW-Madison researchers determined that half of the iron atoms had originated in shallow oceans after being processed by microbes 2.5 billion years ago. Image courtesy of Clark Johnson.

New model of cosmic stickiness favors 'Big Rip' demise of universe

The universe can be a very sticky place, but just how sticky is a matter of debate.

That is because for decades cosmologists have had trouble reconciling the classic notion of viscosity based on the laws of thermodynamics with Einstein's general theory of relativity. However, a team from Vanderbilt University has come up with a fundamentally new mathematical formulation of the problem that appears to bridge this long-standing gap.

The new math has some significant implications for the ultimate fate of the universe. It tends to favor one of the more radical scenarios that cosmologists have come up with known as the "Big Rip." It may also shed new light on the basic nature of dark energy…***Read More***...



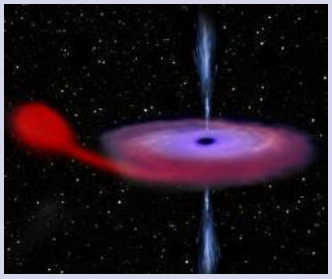
A time line of life of the universe that ends in a Big Rip. Credit: Jeremy Teaford, Vanderbilt University

Monster black hole wakes up after 26 years

Over the past week, ESA's Integral satellite has been observing an exceptional outburst of high-energy light produced by a black hole that is devouring material from its stellar companion. X-rays and gamma rays point to some of the most extreme phenomena in the Universe, such as stellar explosions, powerful outbursts and black holes feasting on their surroundings.

In contrast to the peaceful view of the night sky we see with our eyes, the high-energy sky is a dynamic light show, from flickering sources that change their brightness dramatically in a few minutes to others that vary on timescales spanning years or even decades.

On 15 June 2015, a long-time acquaintance of X-ray and gamma ray astronomers made its comeback to the cosmic stage: V404 Cygni, a system comprising a black hole and a star orbiting one another. It is located in our Milky Way galaxy, almost 8000 light-years away in the constellation Cygnus, the Swan…***Read More***...



Artist's impression of a black hole feasting on matter from its companion star in a binary system. Image courtesy ESA/ATG medialab.