May 07, 2016
Rajab 29, 1437
Volume 6, Issue 19

Astronomy & Physics News

Dept. of Applied Physics & Astronomy — University of Sharjah

Weekly Scientific News Compiled by Dr. Ilias Fernini

UNIVERSITY OF SHARJAH جامعة الشارقة

Inside this issue:

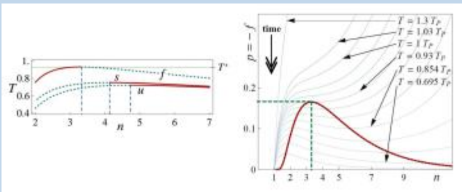
Why is space three-dimensional?

The question of why space is three-dimensional (3D) and not some other number of dimensions has puzzled philosophers and scientists since ancient Greece. Space-time overall is four-dimensional, or (3 + 1)-dimensional, where time is the fourth dimension. It's well-known that the time dimension is related to the second law of thermodynamics: time has one direction (forward) because entropy (a measure of disorder) never decreases in a closed system such as the universe.

In a new paper published in EPL, researchers have proposed that the second law of thermodynamics may also explain why space is 3D.

"A number of researchers in the fields of science and philosophy have addressed the problem of the (3+1)-dimensional nature of space-time by justifying the suitable choice of its dimensionality in order to maintain life, stability and complexity," coauthor Julian Gonzalez-Ayala, at the National Polytechnic Institute in Mexico and the University of Salamanca in Spain, told Phys.org.

"The greatest significance of our work is that we present a deduction based on a physical model of the universe dimensionality with a suitable and reasonable scenario of space-time. ...Read More...



Researchers propose that the three dimensions of space may have been "frozen in" during the early moments of the universe. (Left) The Helmholtz free energy density (f) reaches its maximum value at a temperature T = 0.93, which occurs when space had n = 3 dimensions. (s and u represent entropy density and internal energy density, respectively.) (Right) Transitions to different dimensions cannot occur below a temperature of 0.93, corresponding to three dimensions. Credit: Gonzalez-Ayala et al. ©2016 EPL

Three potentially habitable worlds found around nearby ultracool dwarf star

Astronomers using the TRAPPIST telescope at the European Southern Observatory's (ESO) La Silla have discovered three planets orbiting an ultracool dwarf star just 40 light-years from Earth. These worlds have sizes and temperatures similar to those of Venus and Earth and are the best targets found so far for the search for life outside the solar system. They are the first planets ever discovered around such a tiny and dim star.

A team of astronomers led by Michaël Gillon of the Institut d'Astrophysique et Géophysique at the University of Liège in Belgium have used the Belgian TRAPPIST telescope to observe the star 2MASS J23062928-0502285, now also known as TRAPPIST-1. They found that this dim and cool star faded slightly at regular intervals, indicating that several objects were passing between the star and Earth. Detailed analysis showed ...Read More...

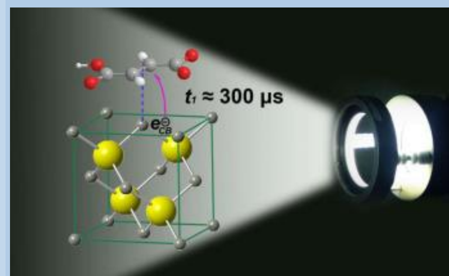
This artist's impression shows an imagined view from the surface of one of the three planets orbiting an ultracool dwarf star just 40 light-years from Earth that were discovered using the TRAPPIST telescope at ESO's La Silla Observatory. These worlds have sizes and temperatures similar to those of Venus and Earth and are the best targets found so far for the search for life outside the solar system. They are the first planets ever discovered around such a tiny and dim star.

Photocatalytic reductions occur in slow time scales

With the increasing need for renewable fuels scientists have attempted to harvest abundant sunlight while simultaneously reducing CO2. However, the process is generally inefficient and many aspects needed for improvement remain unknown. Chemists at the University of Kentucky have now contributed new knowledge to explain how sunlight energy is stored in chemical bonds creating energy rich molecules from depleted ones. The stable photocatalyst generates organic fuels with a rate of production that depends on the time spent on the surface by precursor molecules.

Finding the time scale for the effective transfer of reducing electrons in a photocatalyst capable of reducing species containing double bonds or CO2 is not an easy task. What is needed is a reducing electron that is generated upon excitation of a photocatalyst by the energy from sunlight. This reducing electron needs to be successfully transferred to the precursor molecule that yields the organic fuel. In laboratories, this has been achieved with several catalysts and modified materials; however, industrial implementation will require large yield improvements for this technology to be useful in the future.

Ruixin Zhou and Marcelo Guzman from the Environmental Chemistry Group at the University of Kentucky in Lexington, have developed a new approach to understand the complexity of the problem. The scientists have created a method to study the time scale that charge carriers remain active during illumination of a model zinc sulfide (ZnS) semiconductor suspended in water. As a result they have reported the ...Read More...



Artwork by Ruixin Zhou to depict the transfer of conduction band electrons to fumaric acid occurs in a few hundred microseconds

An experiment seeks to make quantum physics visible to the naked eye

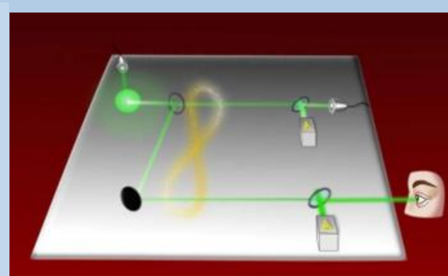
Predictions from quantum physics have been confirmed by countless experiments, but no one has yet detected the quantum physical effect of entanglement directly with the naked eye. This should now be possible thanks to an experiment proposed by a team around a theoretical physicist at the University of Basel. The experiment might pave the way for new applications in quantum physics.

uantum physics is more than 100 years old, but even today is still sometimes met with wonderment. This applies, for example, to entanglement, a quantum physical phenomenon that can be observed between atoms or photons (light particles): when two of these particles are entangled, the physical state of the two particles can no longer be described independently, only the total system that both particles form together.

Despite this peculiarity, entangled photons are part of the real world, as has been proven in many experiments. And yet no one has observed entangled photons directly. This is because only single or a handful of entangled photons can be produced with the available technology, and this number is too low for the human eye to perceive these photons as light.

Entangled photons amplified 100-fold

Nicolas Sangouard, a theoretical physicist at the University of Basel, together with two quantum physicists from Delft, Netherlands...Read More...



Photon pairs are produced with a source (green point). A photon from each pair is emitted upwards; the other is directed into a semi-transparent mirror (black circle). Following the mirror, the photon exists in two entangled states (symbolized by the yellow figure of eight). The photon is then detected by a detector (top right) or by the eye of the human observer (bottom right). In order for the photons to be detectable by the human eye, they are amplified by laser beams (boxes with yellow ...

New method could offer more precise treatment for corneal disease

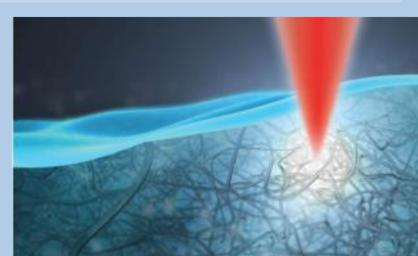
Researchers have developed a new light-based technique that selectively stiffens tissue in the cornea and might one day offer improved treatment for eye problems caused by weakened corneal tissue.

In The Optical Society's journal for high impact research, Optica, the researchers detail their new technique for strengthening the cornea by precisely crosslinking the collagen fibers that make up corneal tissue. They also demonstrate a specialized microscopy approach that measures tissue stiffness without disturbing untreated areas.

"Because light has the ability to probe deep inside tissue, we're using that property to both go inside and change mechanical properties of tissue and to measure those changes so that we can understand how the tissue changed and visualize it noninvasively," said Sheldon J.J. Kwok, Massachusetts General Hospital Wellman Center for Photomedicine, first author of the paper.

Making crosslinking more precise

Disease can cause the cornea, the clear dome-shaped layer that covers the front of the eye, to gradually weaken until pressure in the eye causes it to bulge and leads to vision problems. A corneal transplant may eventually be necessary as the condition, known as keratoconus, ...Read More….



Two-photon collagen crosslinking can selectively stiffen parts of the corneal tissue and might one day offer improved treatment for diseases that weaken corneal tissue. Credit: Seok-Hyun Yun, Massachusetts General Hospital Wellman Center for Photomedicine

Astronomers Spy a Massive Supernova in a Nearby Galaxy

A giant star that exploded 30 million years ago in a galaxy near Earth had a radius prior to going supernova that was 200 times larger than our sun, according to astrophysicists at Southern Methodist University, Dallas.

The sudden blast hurled material outward from the star at a speed of 10,000 kilometers a second. That's equivalent to 36 million kilometers an hour or 22.4 million miles an hour, said SMU physicist Govinda Dhungana, lead author on the new analysis.

The comprehensive analysis of the exploding star's light curve and color spectrum have revealed new information about the existence and sudden death of supernovae in general, many aspects of which have long baffled scientists.

"There are so many characteristics we can derive from the early data," Dhungana said. "This was a big massive star, burning tremendous fuel. When it finally reached a point its core couldn't support the gravitational pull inward, suddenly it collapsed and then exploded."

The massive explosion was one of the closest to Earth in recent years, visible as a point of light in the night sky starting July 24, 2013, said Robert Kehoe, SMU physics professor, who leads SMU's astrophysics team.

The explosion, termed by astronomers Supernova 2013ej, occurred in the M74 galaxy near the Milky Way. The explosion was equal in energy output to the simultaneous detonation of 100 million of the Earth's suns...Read More..

The M74 galaxy, where the supernova was spotted. Adam Block / Mount Lemmon SkyCenter / University of Arizona

Second ExoMars mission moves to next launch opportunity in 2020

On 14 March 2016, the Roscosmos State Corporation and the European Space Agency (ESA) launched the jointly-developed ExoMars 2016 interplanetary mission, comprising the Trace Gas Orbiter (TGO) and the Schiaparelli lander, on a Proton rocket from Baikonur, thus marking the first phase in the European-Russian ExoMars cooperation programme.

The success achieved by Russian and European experts involved in ExoMars 2016 is the result of long and fruitful cooperation. The ExoMars 2016 spacecraft are due to arrive at Mars in October 2016.

The second ExoMars mission involves a Russian-led surface platform and a European-led rover, also to be launched on a Proton from Baikonur. Russian and European experts made their best efforts to meet the 2018 launch schedule for the mission, and in late 2015, a dedicated ESA-Roscosmos Tiger Team, also including Russian and European industries, initiated an analysis of all possible solutions to recover schedule delays and accommodate schedule contingencies. The Tiger Team presented its final report during a meeting of the Joint ExoMars Steering Board ...Read More...

File Image

Geochemical detectives use lab mimicry to look back in time

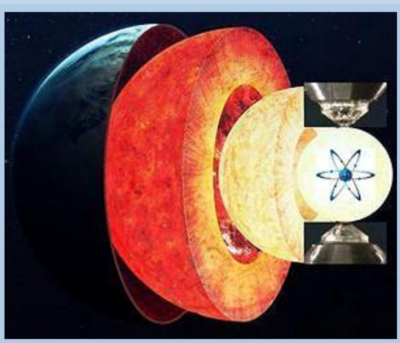
New work from a research team led by Carnegie's Anat Shahar contains some unexpected findings about iron chemistry under high-pressure conditions, such as those likely found in the Earth's core, where iron predominates and creates our planet's life-shielding magnetic field.

Their results, published in Science, could shed light on Earth's early days when the core was formed through a process called differentiation - when the denser materials, like iron, sunk inward toward the center, creating the layered composition the planet has today.

Earth formed from accreted matter surrounding the young Sun. Over time, the iron in this early planetary material moved inward, separating from the surrounding silicate. This process created the planet's iron core and silicate upper mantle. But much about this how this differentiation process occurred is still poorly understood, due to the technological impossibility of taking samples from the Earth's core to see which compounds exist there.

Seismic data show that in addition to iron, there are "lighter" elements present in the core, but which elements and in what concentrations they exist has been a matter of great debate. This is because as the iron moved inward toward the core, it interacted with various lighter elements to form different alloyed compounds, which were then carried along with the iron into the planet's depths.

New work from a research team led by Carnegie's Anat Shahar contains some unexpected findings about iron chemistry ...Read More...



An illustration of how laboratory techniques can tell scientists like Anat Shahar and her team about how elements such as iron behave under the extreme pressures found in the Earth's core. Background image courtesy of Vadim Sadovski. Image courtesy of Vadim Sadovski. Additional imagery courtesy of Anat Shahar.

Dept. of Applied Physics & Astronomy

College of Sciences - University of Sharjah
POB 27272 - Sharjah
United Arab Emirates
Phone: *00-971-6-5050351*
Email: *physics@sharjah.ac.ae*

Sharjah Center for Astronomy and Space Sciences
Sharjah
United Arab Emirates
Phone: *00-971-6-5166000*
Website: *www.scass.ae*
E-mail: *planetarium@scass.ae*

Mercury Transit of May 09, 2016

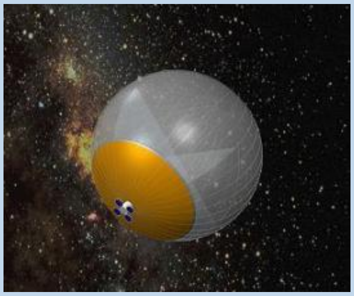
SCASS First Anniversary Celebration May 07, 2016

Ballooning Expectations: New Approach for Astronomy

Decades ago when he was in grade school, Christopher Walker stepped outside with his father to see the NASA all-aluminized Echo balloon cross the nighttime sky in Earth's orbit. That early space spectacle stuck with him, he explains, and unknowingly, was a reflection on his future.

Fast forward several decades. Today, Walker is a professor of Astronomy and an associate professor of Optical Sciences and Electrical Engineering at the University of Arizona in Tucson. Walker's winning NASA Innovative Advanced Concept (NIAC) Phase II proposal in 2014 investigated the prospect for a 33-foot - suborbital large balloon reflector, or LBR for short.

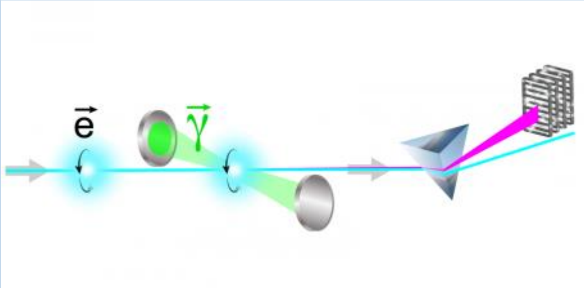
Scanning the universe - Looking up from a height of some 120,000 feet above the Earth, the sensor-laden LBR can serve as a telescope. Walker's telescope would consist of an inflatable, half-aluminized spherical reflector deployed within a much larger, carrier stratospheric balloon, about the size of a football field. The outer balloon would double as a protective structure or radome once it is ...Read More...



A preliminary illustration of a 20-30 meter telescope, the space-based Large Balloon Reflector called the TeraHertz Space Telescope (TST) for probing the evolution of the universe through cosmic time. Image courtesy Christopher Walker.

Getting a better measure of spin with diamond

Diamonds are one of the most coveted gemstones. But while some may want the perfect diamond for its sparkle, physicists covet the right diamonds to perfect their experiments. The gem is a key component in a novel system that enables precision measurements that could lead to the discovery of new physics in the sub-atomic realm—the domain of the particles and forces that build the nucleus of the atom. Explorations of this realm require unique probes with just the right characteristics, such as the electrons that are ...Read More...



Jefferson Lab's Hall C Compton Polarimeter measures the polarization of the CEBAF electron beam just before it reaches the experiment. The electrons collide with laser light -- some of the electrons are knocked of their nominal path and are separated from the main beam by a dipole. The dipole acts on the electrons in a manner similar to the way a prism acts on light, separating out the slower-moving electrons that came from collisions with the laser. These slower electrons are then counted in a detector, which allows the determination of the polarization. Credit: Jefferson Lab