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Astronomy & Physics News

Department of Applied Physics— University of Sharjah
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Inside this issue:

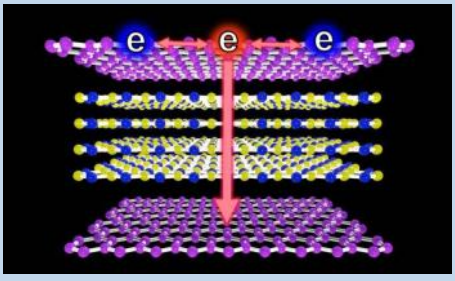
Watching electrons cool in 30 quadrillionths of a second

Two University of California, Riverside assistant professors of physics are among a team of researchers that have developed a new way of seeing electrons cool off in an extremely short time period.

The development could have applications in numerous places where heat management is important, including visual displays, next-generation solar cells and photodetectors for optical communications.

In visual displays, such as those used in cell phones and computer monitors, and photodetectors, which have a wide variety of applications including solar energy harvesting and fiber optic telecommunications, much of the energy of the electrons is wasted by heating the material. Controlling the flow of heat in the electrons, rather than wasting this energy by heating the material, could potentially increase the efficiency of such devices by converting excess energy into useful power.

The research is outlined in a paper, "Tuning ultrafast electron thermalization pathways in a van der Waals heterostructure," published online Monday (Jan. 18) in the journal Nature Physics. Nathan Gabor and Joshua C.H. Lui, assistant professors of physics at UC Riverside, are ...Read More...

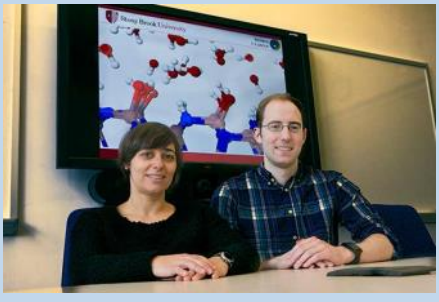


An illustration showing single layers of graphene with thin layers of insulating boron nitride that form a sandwich structure. Credit: Qiong Ma

Ice-like phonons in liquid water discovered

For more than 100 years, scientists have debated what the underlying molecular structure of water is, and the common view has been that H2O molecules are either "water-like" or "ice-like." Now through computer simulation conducted at the Institute for Advanced Computational Science (IACS) at Stony Brook University, researchers can illustrate that the structure and dynamics of hydrogen bonding in liquid water is more similar to ice than previously thought. The finding, published in Nature Communications , changes the common understanding of the molecular nature of water and has relevance to many fields, such as climate science and molecular biophysics, and technologies such as desalinization and water-based energy production.

In condensed matter physics, phonons are considered to be a solid-state phenomenon and can be visualized as collective vibrations that propagate through a material. More precisely, a phonon is the fundamental quantum mechanical unit of lattice vibration. Optical phonons are a type of phonon that interact with electromagnetic radiation. These can be visualized as peaks in the infrared absorption spectrum in ice….Read More...



Daniel Elton and Marivi Fernandez-Serra used computer simulation models of water developed at Stony Brook's Institute for Advanced Computational Science to discover its molecular properties are similar to ice.

New finding may explain heat loss in fusion reactors

One of the biggest obstacles to making fusion power practical - and realizing its promise of virtually limitless and relatively clean energy - has been that computer models have been unable to predict how the hot, electrically charged gas inside a fusion reactor behaves under the intense heat and pressure required to make atoms stick together.

The key to making fusion work - that is, getting atoms of a heavy form of hydrogen called deuterium to stick together to form helium, releasing a huge amount of energy in the process - is to maintain a sufficiently high temperature and pressure to enable the atoms overcome their resistance to each other. But various kinds of turbulence can stir up this hot soup of particles and dissipate some of the intense heat, and a major problem has been to understand and predict exactly how this turbulence works, and thus how to overcome it.

A long-standing discrepancy between predictions and observed results in test reactors has been called "the great unsolved problem" in understanding the turbulence that leads to a loss of heat in fusion reactors. Solving this discrepancy is critical for predicting the performance of new fusion reactors such as the huge international collaborative project called ITER, under construction in France.

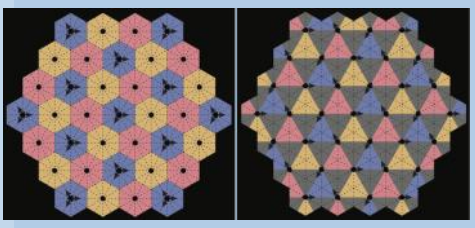
Now, researchers at MIT's Plasma Science and Fusion Center, in collaboration with others at the University of California at San Diego, General Atomics, and the Princeton Plasma Physics Laboratory, say that they have found the key. In a result so surprising that the ...Read More…

A view inside the Alcator C-Mod tokamak. Image courtesy of the Plasma Science and Fusion Center and MIT.

New type of animated crystal structure discovered

A trio of researchers has discovered what they are calling a new type of crystal, one that is always moving. In their paper published in the journal Physical Review Letters, Latham Boyle, Jun Yong Khoo, and Kendrick Smith describe how the idea for the crystal came about, how it was defined mathematically and whether they believe it could ever possibly exist in the real world.

Crystals are normally defined by their orderly arrangement, one that does not involve any moving parts, but that might change as a new class of crystal has been discovered that could ultimately lead to the discovery of real world crystals that exhibit the behavior that has now been theorized. The theory behind the new crystal arrangement came first from Boyle the team notes, he was studying the LISA Pathfinder project where three satellites have been launched to orbit the sun as a means for detecting gravitational waves. He wondered if adding a fourth satellite might not make more sense as it would allow for gathering more statistical informational about gravity waves if they were actually detected, e.g. their amplitude, polarization and direction. But as he thought about how the satellites would orbit, he found paths for all four that followed a highly dynamic symmetry—and that were a cousin to the tetrahedron. Later he discussed what he had found with his colleagues who devised a means for describing all possible symmetric orbits, which they called a swarm—where choreography was used as ...Read More...



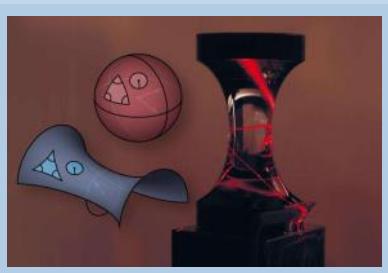
Dance diagram for math geeks. In these two-dimensional choreographic crystals, the arrows show directions of particles, arrayed initially on a triangular lattice, that move in straight lines from blue to yellow to pink. The configuration of highest "choreography" has the most rotations and reflections (combined with time shifts) that leave it unchanged (left, 12); the next highest choreography configuration has 6 (right). Credit: Physical Review Letters (2016).

Researchers investigate how light behaves in curved space

To investigate the influence of gravity on the propagation of light, researchers usually have to examine astronomical length scales and huge masses. However, physicists at Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU) and Friedrich Schiller University Jena have shown that there is another way. In a recent issue of the journal Nature Photonics they find the answers to astronomical questions in the laboratory, shifting the focus to a previously underappreciated material property - surface curvature.

According to Einstein's general theory of relativity, gravity can be described as the curvature of four-dimensional spacetime. In this curved space, celestial bodies and light move along geodesics, the shortest paths between two points, which often look anything but straight when viewed from the outside.

The team of researchers led by Prof. Dr. Ulf Peschel from Friedrich Schiller University Jena used a special trick to examine the propagation of light in such curved spaces in the laboratory. Instead of changing all four dimensions of spacetime, they reduced the problem to two dimensions and studied the propagation of light along curved surfaces. However, not all curved surfaces are the same. 'For example, while you can easily unfold a cylinder or a cone into a flat sheet of paper, it is impossible to lay the surface of a ...Read More...



A laser beam in an experiment propagates along the two-dimensional surface of a glass object shaped like an hourglass, curling once around the middle of the object. This is an example of an object with negative surface curvature (like a saddle, for example), in contrast to an object with positive surface curvature, such as a sphere. Credit: Vincent Schultheiß

Hubble gazes upon a host of dazzling diamonds

Single stars are often overlooked in favour of their larger cosmic cousins - but when they join forces, they create truly breathtaking scenes to rival even the most glowing of nebulae or swirling of galaxies. This NASA/ESA Hubble Space Telescope image features the star cluster Trumpler 14. One of the largest gatherings of hot, massive and bright stars in the Milky Way, this cluster houses some of the most luminous stars in our entire galaxy. Around 1100 open clusters have so far been discovered within the Milky Way, although many more are thought to exist. Trumpler 14 is one of these, located some 8000 light-years away towards the centre of the well-known Carina Nebula) .

At a mere 500 000 years old - a small fraction of the Pleiades open cluster's age of 115 million years - Trumpler 14 is not only one of the most populous clusters within the Carina Nebula, but also the youngest. However, it is fast making up for lost time, forming stars at an incredible rate and putting on a stunning visual display.

This region of space houses one of the highest concentrations of massive, luminous stars in the entire Milky Way - a spectacular family of young, bright, white-blue stars. These stars are rapidly working their way through their vast supplies of hydrogen, and have only a few million years of life left before they meet a dramatic demise and explode as supernovae. In the meantime, despite their youth, these stars are making a huge impact on their environment. They are literally making ...Read More...

This NASA/ESA Hubble Space Telescope image features the star cluster Trumpler 14. One of the largest gatherings of hot, massive and bright stars in the Milky Way, this cluster houses some of the most luminous stars in our entire galaxy. Image courtesy NASA and ESA, Jesus Maiz Apellaniz (Instituto de Astrofisica de Andalucia).

Dark 'noodles' may lurk in the Milky Way

Invisible structures shaped like noodles, lasagne sheets or hazelnuts could be floating around in our Galaxy radically challenging our understanding of gas conditions in the Milky Way. CSIRO astronomer and first author of a paper released in Science Dr Keith Bannister said the structures appear to be 'lumps' in the thin gas that lies between the stars in our Galaxy.

"They could radically change ideas about this interstellar gas, which is the Galaxy's star recycling depot, housing material from old stars that will be refashioned into new ones," Dr Bannister said.

Dr Bannister and his colleagues described breakthrough observations of one of these 'lumps' that have allowed them to make the first estimate of its shape. The observations were made possible by an innovative new technique the scientists employed using CSIRO's Compact Array telescope in eastern Australia.

Astronomers got the first hints of the mysterious objects 30 years ago when they saw radio waves from a bright, distant galaxy called a quasar varying wildly in strength. They figured out this behavior was the work ...Read More...

CSIRO's Compact Array in Australia is shown under the night lights of the Milky Way. Image courtesy Alex Cherney.

Predicting planets: The highs and lows

In the mid-19th century, astronomers hypothesized an extra planet in our solar system, orbiting between the Sun and Mercury.

Without ever seeing it, they calculated its orbit and named it Vulcan -- the only explanation, they thought, for small deviations in Mercury's own orbit.

But decades of searching yielded no proof, and finally in 1915, Albert Einstein's theory of relativity made sense of Mercury's strange behaviour in a way which obviated the need for Vulcan.

The search was abandoned.

Vulcan is only one of many planets wrongly predicted to exist in our solar system over the decades.

Nibiru, Tyche, and various versions of a "Planet X" beyond Neptune's orbit, excited the public imagination before fizzling out.

But in one very well-known case, mathematical modelling turned out to be right.

The existence of Neptune -- the eighth and furthest known planet from the Sun -- was deduced from a pull observed on the orbit of Uranus.

Scientists launched a telescope search, and the planet was detected within days.

On Wednesday, a duo of astronomers in the US said they hope to have found a another planet beyond Neptune's orbit -- a giant with about ten times the mass of Earth.

Dubbed Planet Nine, it would perfectly explain the peculiar, clustered motion of ...Read More...

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Sharjah Center for Astronomy and Space Sciences. II - The Planetarium

The planetarium system is hosted under a dome of more than 18 meters in diameter, large enough to accommodate 200 visitors. The projection system is made of a set of high-precision digital projectors equipped with the most advanced MegaStar projector. It can display nearly 10 million celestial bodies. Other projectors help to display the planets around the sun in a very beautiful space environment. The planetarium computer system comes with UniView, a sophisticated software specifically designed to show the different astronomical shows.

In terms of shows, the planetarium is loaded with 10 beautiful shows that can take the visitor up to the outer visible edges of the universe. Among the shows, we can mention: "Deen al-Qayyima" (The Correct Religion" a documentary show written by His Highness Sheikh Sultan. The documentary tells the story of how the universe was created by Allah Almighty from the moment of the Big Bang, and also tells the story of the Prophet Muhammad (PBUH). For more information on the planetarium shows, check the website "www.scass.ae".

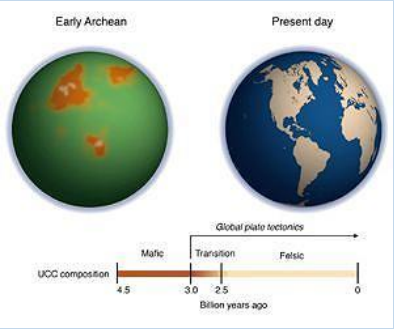
Prof. Hamid Al Naimiy, Chancellor of the University of Sharjah. Image Source—The National

New study zeros in on plate tectonics' start date

Earth has some special features that set it apart from its close cousins in the solar system, including large oceans of liquid water and a rich atmosphere with just the right ingredients to support life as we know it. Earth is also the only planet that has an active outer layer made of large tectonic plates that grind together and dip beneath each other, giving rise to mountains, volcanoes, earthquakes and large continents of land.

Geologists have long debated when these processes, collectively known as plate tectonics, first got underway. Some scientists propose that the process began as early as 4.5 billion years ago, shortly after Earth's formation. Others suggest a much more recent start within the last 800 million years.

A study from the University of Maryland provides new geochemical evidence for a middle ground between these two extremes: An analysis of trace element ratios that correlate to magnesium ...Read More...



The image at left depicts what Earth might have looked like more than 3 billion years ago in the early Archean. The orange shapes represent the magnesium-rich proto-continents before plate tectonics started--although it is impossible to determine their precise shapes and locations. The ocean appears green due to a high amount of iron ...

Advanced Civilizations Could Thrive in Chaotic Star Clusters

In the search for alien civilizations, scientists have largely ruled out regions of space known as globular clusters, deemed too chaotic to sustain life. According to a new study, these may, in fact, be the best places to look.

One of the most mind-boggling aspects of space is the vast emptiness of the void. Mercury may seem unbearably close to our Sun, but there remain nearly 36 million miles between our star and its nearest planet. Our nearest galactic neighbor, Andromeda, is so far away that it will take five billion years for it to crash into the Milky Way - even though the enormous celestial object is rushing toward us at some 670,000 miles per hour.

This cosmic emptiness, however, is not uniform across the known universe. Huddled in the galactic outskirts are tightly-packed collections of stars known as globular clusters. Some, like Messier 80, contain hundreds of thousands of stars packed within a relatively small amount of space.

Globular clusters have largely been ruled out by scientists looking for signs of extraterrestrial life, as being inhospitable for the evolution of an intelligent civilization. But a new study led by Rosanne Di Stefano of the Harvard-Smithsonian Center for Astrophysics finds ...Read More..