INTERNATIONAL YEAR OF LIGHT 2015

100 Million Stars in the Andromeda galaxy.

September 19, 2015
Dhu'l Hijjah 05, 1436
Volume 5, Issue 38

Astronomy & Physics News

Department of Physics—United Arab Emirates University
Weekly Scientific News Compiled by Dr. Ilias Fernini

Inside this issue:

You're not irrational, you're just quantum probabilistic: Researchers explain human decision-making with physics theory

The next time someone accuses you of making an irrational decision, just explain that you're obeying the laws of quantum physics.

A new trend taking shape in psychological science not only uses quantum physics to explain humans' (sometimes) paradoxical thinking, but may also help researchers resolve certain contradictions among the results of previous psychological studies.

According to Zheng Joyce Wang and others who try to model our decision-making processes mathematically, the equations and axioms that most closely match human behavior may be ones that are rooted in quantum physics.

"We have accumulated so many paradoxical findings in the field of cognition, and especially in decision-making," said Wang, who is an associate professor of communication and director of the Communication and Psychophysiology Lab at The Ohio State University.

"Whenever something comes up that isn't consistent with classical theories, we often label it as 'irrational.' But from the perspective of quantum cognition, some findings aren't ...Read More...

Credit: Rice University

New support for converging black holes in Virgo

Earlier this year, astronomers discovered what appeared to be a pair of supermassive black holes circling toward a collision so powerful it would send a burst of gravitational waves surging through the fabric of space-time itself.

Now, in a study in the journal Nature, astronomers at Columbia University provide additional evidence that a pair of closely orbiting black holes is causing the rhythmic flashes of light coming from quasar PG 1302-102.

Based on calculations of the pair's mass--together, and relative to each other--the researchers go on to predict a smashup 100,000 years from now, an impossibly long time to humans but the blink of an eye to a star or black hole. Spiraling together 3.5 billion light-years away, deep in the Virgo constellation, the pair is separated by a mere light-week. By contrast, the closest previously confirmed black hole pair is separated by 20 light-years.

"This is the closest we've come to observing two black holes on their way to a massive collision," said the study's senior author ...Read More...

Columbia researchers predict that a pair of converging supermassive black holes in the Virgo constellation will collide sooner than expected. Above, an artist's conception of a merger. Image courtesy P. Marenfeld/NOAO/AURA/NSF.

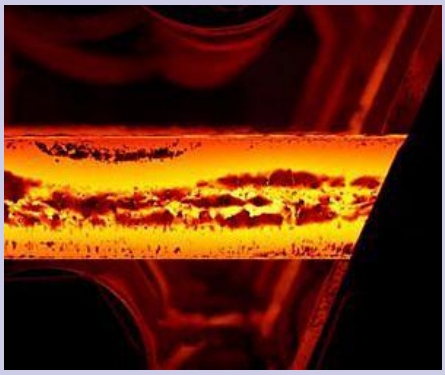
Indications of the origin of the Spin Seebeck effect discovered

The recovery of waste heat in all kinds of processes poses one of the main challenges of our time to making established processes more energy-efficient and thus more environmentally friendly. The Spin Seebeck effect (SSE) is a novel, only rudimentarily understood effect, which allows for the conversion of a heat flux into electrical energy, even in electrically non-conducting materials. A team of physicists at Johannes Gutenberg University Mainz (JGU), the University of Konstanz, TU Kaiserslautern, and the Massachusetts Institute of Technology (MIT) have now succeeded in identifying the origin of the Spin Seebeck effect.

By the specific investigation of the material- and temperature-dependence of the effect, the German and American researchers were able to show that it exhibits a characteristic length scale attributable to its magnetic origin. This finding now allows for the advancement of this long-time controversial effect in terms of first applications. The resulting research paper was published in the scientific journal Physical Review Letters, with a fellow of the JGU-based Graduate School of Excellence "Materials Science in Mainz" (MAINZ) as first author.

The Spin Seebeck effect represents a so-called spin-thermoelectric effect, which enables the conversion of thermal energy into electrical energy. Contrary to conventional thermoelectric effects it also enables the recovery of heat energy in magnetic insulators in combination with a thin metallic layer.

Owing to this characteristic, it was ...Read More...



File image

Physicists develop key component for terahertz wireless

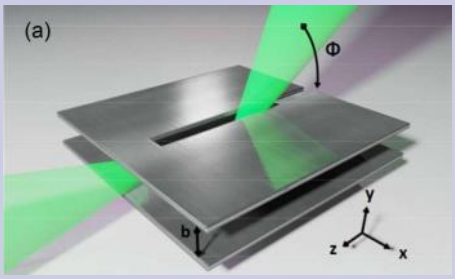
Terahertz radiation could one day provide the backbone for wireless systems that can deliver data up to one hundred times faster than today's cellular or Wi-Fi networks. But there remain many technical challenges to be solved before terahertz wireless is ready for prime time.

Researchers from Brown University have taken a major step toward addressing one of those challenges. They've developed what they believe to be the first system for multiplexing terahertz waves. Multiplexers are devices that enable separate streams of data to travel through a single medium. It's the technology that makes it possible for a single cable to carry multiple TV channels or for a fiber optic line to carry thousands of phone calls at the same time.

"Any terahertz communications application is going to need some form of multiplexing and demultiplexing," said Daniel Mittleman, professor of engineering at Brown and senior author of a paper describing the new device. "This is, to our knowledge, the first time anyone has demonstrated a viable strategy for multiplexing in the terahertz range."

The research was published September 14 in Nature Photonics.

Today's cellular and Wi-Fi networks rely on microwaves to carry voice conversations and data. But the increasing demands for data transfer are quickly becoming more than ...Read More...



All communications networks need some form of multiplexing -- the ability to send multiple data streams through a single medium. Researchers from Brown have used a leaky wave antenna to separate terahertz waves by frequency. The work provides a viable multiplexing and demultiplexing strategy for future terahertz data networks, which have the potential to deliver data many times faster than today's cellular or Wi-Fi networks. Credit: Mittleman Lab / Brown University

Most precise test of Lorentz symmetry for the photon finds that the speed of light is indeed constant

The laws of physics are the same no matter which direction you're facing or how fast you're moving—it's such an intuitive concept that most people probably don't know that it has a name: Lorentz symmetry. Over the past several decades, physicists have been testing Lorentz symmetry at ever-higher degrees of precision, as violations of the foundational property are predicted by a number of proposals that aim to unify the two major theories of modern physics: general relativity and the standard model of particle physics.

Now in a new paper, physicists have reported the most precise test to date of Lorentz symmetry for the photon by looking for variations in the speed of light, but have found no violations. The study, by Moritz Nagel at the Humboldt-University of Berlin, Stephen Parker at The University of Western Australia, and their coauthors, is published in a recent issue of Nature Communications.

Although the term "Lorentz symmetry" is named for the Dutch physicist Hendrik Lorentz and the fact that it is a symmetry of spacetime, it may be better thought of as a property about relativity, and in fact it is a cornerstone of ...Read More...

(Left) Photo of the orthogonal sapphire crystal mount, with (right) simulations of the electromagnetic resonant mode patterns. A frequency variation in the resonance would indicate a variation in the speed of light. Credit: Stephen R.

A shy galactic neighbor

The Sculptor Dwarf Galaxy, pictured in this new image from the Wide Field Imager camera, installed on the 2.2-metre MPG/ESO telescope at ESO's La Silla Observatory, is a close neighbour of our galaxy, the Milky Way. Despite their close proximity, both galaxies have very distinct histories and characters. This galaxy is much smaller and older than the Milky Way, making it a valuable subject for studying both star and galaxy formation in the early Universe. However, due to its faintness, studying this object is no easy task.

The Sculptor Dwarf Galaxy - also known as the Sculptor Dwarf Elliptical or the Sculptor Dwarf Spheroidal - is a dwarf spheroidal galaxy, and is one of the fourteen known satellite galaxies orbiting the Milky Way. These galactic hitchhikers are located close by in the Milky Way's extensive halo, a spherical region extending far beyond our galaxy's spiral arms.

As indicated by its name, this galaxy is located in the southern constellation of Sculptor (constellation) and lies about 280 000 light-years away from Earth. Despite its proximity, the galaxy was only discovered in 1937, as its stars are faint and spread thinly across the sky.

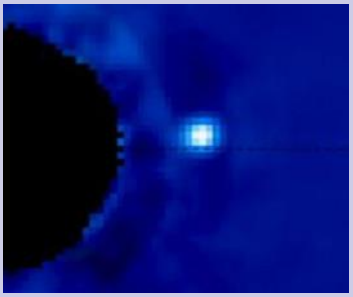
Although difficult to pick out, the Sculptor Dwarf Galaxy was among the first faint dwarf galaxies found orbiting the Milky Way. The tiny galaxy's shape intrigued astronomers at the time of its discovery, but nowadays dwarf spheroidal galaxies play a more important role in allowing astronomers to dig deeply into the Universe's past.

The Milky Way, like all large galaxies, is thought to have formed from the build-up of smaller galaxies during the early days of the Universe. If some of these small galaxies still remain today, they should now ...Read More...

The Sculptor Dwarf Galaxy, pictured in new image from the Wide Field Imager camera, installed on the 2.2-meter MPG/ESO telescope at ESO's La Silla Observatory, is a close neighbor of our galaxy, the Milky Way. Despite their proximity, both galaxies have very distinct histories and characters. This galaxy is much smaller, fainter and older than the Milky Way and appears here as a cloud of faint stars filling most of the picture. Image courtesy ESO.

Watching an exoplanet in motion around a distant star

A team of astronomers has given us our best view yet of an exoplanet moving in its orbit around a distant star. A series of images captured between November 2013 to April 2015 shows the exoplanet b Pic b as it moves through 1 0.5 years of its 22-year orbital period.
First discovered in 2008, b Pic b is a gas giant planet ten to twelve times the mass of Jupiter, with an orbit roughly the diameter of Saturn's. It is part of the dynamic and complex system of the star b Pictoris which lies over 60 light-years from Earth. The system includes comets, orbiting gas clouds, and an enormous debris disk that in our Solar System would extend from Neptune's orbit to nearly two thousand times the Sun/Earth distance.
Because the planet and debris disk interact gravitationally, the system provides astronomers with an ideal laboratory to test theories on the formation of planetary systems beyond ours.
Maxwell Millar-Blanchaer, a PhD-candidate in the Department of Astronomy and Astrophysics, University of Toronto, is lead author of a paper to be published September 16th in the Astrophysical Journal. The paper describes observations of the b Pictoris system made with the Gemini Planet Imager (GPI) instrument on the Gemini South telescope in Chile.
"The images in the series represent the ...Read More…



Watch a video of the orbit here.

Cassini Finds Global Ocean in Saturn's Moon Enceladus

A global ocean lies beneath the icy crust of Saturn's geologically active moon Enceladus, according to new research using data from NASA's Cassini mission. Researchers found the magnitude of the moon's very slight wobble, as it orbits Saturn, can only be accounted for if its outer ice shell is not frozen solid to its interior, meaning a global ocean must be present.

The finding implies the fine spray of water vapor, icy particles and simple organic molecules Cassini has observed coming from fractures near the moon's south pole is being fed by this vast liquid water reservoir. The research is presented in a paper published online this week in the journal Icarus.

Previous analysis of Cassini data suggested the presence of a lens-shaped body of water, or sea, underlying the moon's south polar region. However, gravity data collected during the spacecraft's several close passes over the south polar region lent support to the possibility the sea might be global. The new results - derived using an independent line of evidence based on Cassini's images - confirm this to be the case.

"This was a hard problem that required years of observations, and calculations involving a diverse collection of disciplines, but we are confident we finally got it right," said Peter Thomas, a Cassini imaging team member at Cornell University, Ithaca, New York, and lead author of the paper. Cassini scientists analyzed more than seven years' worth of images of Enceladus taken by the spacecraft, which has been orbiting Saturn since mid-2004. They carefully mapped the positions of features on Enceladus - mostly craters - across hundreds ...Read More...

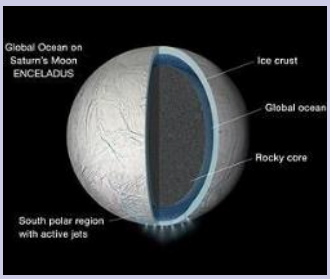


Illustration of the interior of Saturn's moon Enceladus showing a global liquid water ocean between its rocky core and icy crust. Thickness of layers shown here is not to scale. Image courtesy NASA/JPL-Caltech.

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

For Previous Issues, click Here

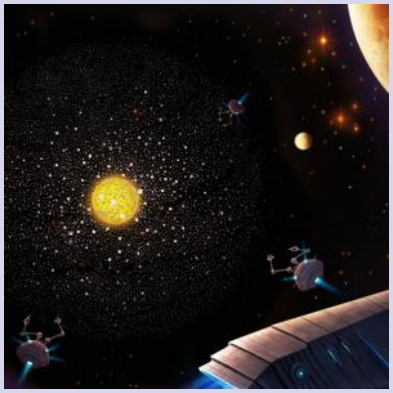
UAEU College of Science
جامعة الإمارات العربية المتحدة
United Arab Emirates University

No nearby advanced civilizations, astronomer says

It's a derivative of Murphy's Law that just when you say something cannot happen, it will happen. So I was excited today (September 15, 2015) when I saw that Michael Garrett, general director of the Dutch astronomy research foundationASTRON, had released a statement saying in no uncertain terms that:

… Advanced civilizations are very rare or entirely absent from the local universe.

Garrett pointed out that sensitive new telescopes now permit astronomers to detect waste heat expected to be a signature of a certain kind of advanced alien civilization known as a Kardashev Type III civilization. Such advanced alien beings – on an exoplanet(s) in our galaxy or a nearby galaxy – would be capable of harnessing enormous energies on the scale of the galaxies themselves. Garrett has used radio observations of candidate galaxies, and he now says he has ...Read More...

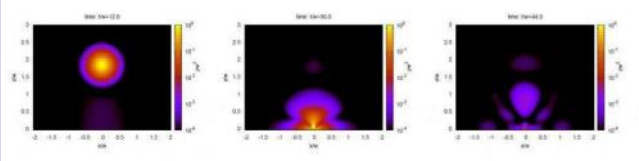


Artist's concept of the activities of a Kardashev Type III civilization. Such a civilization would encapsulate the energy of stars by so-called Dyson spheres or swarms. The resulting waste heat products such a galactic scale enterprise would produce, should be detectable by today's telescopes, according to astronomer Michael Garrett of ASTRON.

Dark matter hiding in stars may cause observable oscillations

Dark matter has never been seen directly, but scientists know that something massive is out there due to its gravitational effects on visible matter. One explanation for how such a large amount of mass appears to be right in front of our eyes yet completely invisible by conventional means is that the dark matter is hiding in the centers of stars.

In a new study, physicists have investigated the possibility that large amounts of hidden mass inside stars might be composed of extremely lightweight hypothetical particles called axions, which are a primary dark matter candidate. The scientists, Richard Brito at the University of Lisbon in Portugal; Vitor Cardoso at the University of Lisbon and the Perimeter Institute for Theoretical Physics in Waterloo, Ontario, Canada; and Hirotada Okawa at Kyoto University and ...Read More...

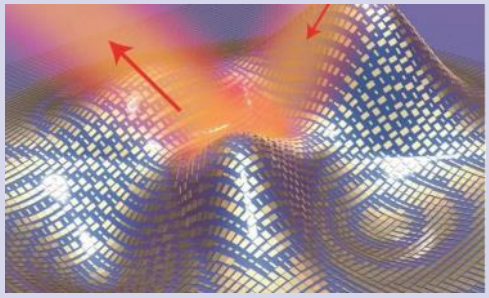


This sequence shows snapshots of a star's density when two dark matter cores collide, where the x-axis is the plane of collision (only half the space is shown, but the remaining space can be obtained by symmetry). Although the final configuration is more compact and massive than the original, the star does not collapse into a black hole because it ejects some of its mass, slowing down its growth so that it remains stable. Credit: Brito, et al. ©2015 American Physical Society

Making 3-D objects disappear: Researchers create ultrathin invisibility cloak

A 3-D illustration of a metasurface skin cloak made from an ultrathin layer of nanoantennas (gold blocks) covering an arbitrarily shaped object. Light reflects off the cloak (red arrows) as if it were reflecting off a flat mirror. Credit: Xiang Zhang group, Berkeley Lab/UC Berkeley.

Working with brick-like blocks of gold nanoantennas, the Berkeley researchers fashioned a "skin cloak" barely 80 nanometers in thickness, that was wrapped around a three-dimensional object about the size of a few biological cells and arbitrarily shaped with multiple bumps and dents. The surface of the skin cloak was ...Read More…



A 3-D illustration of a metasurface skin cloak made from an ultrathin layer of nanoantennas (gold blocks) covering an arbitrarily shaped object. Light reflects off the cloak (red arrows) as if it were reflecting off a flat mirror. Credit: Xiang Zhang group, Berkeley Lab/UC Berkeley