100 Million Stars in the Andromeda galaxy.

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Astronomy & Physics News

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Weekly news from around the world compiled by Dr. Ilias Fernini

Inside this issue:

Breakthrough brings optical data transport closer to replacing wires

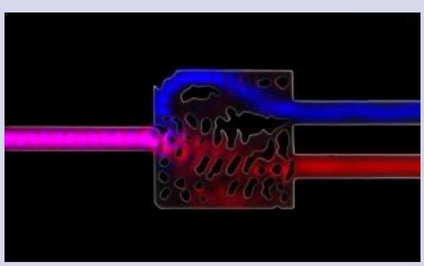
Stanford electrical engineer Jelena Vuckovic wants to make computers faster and more efficient by reinventing how they send data back and forth between chips, where the work is done.

In computers today, data is pushed through wires as a stream of electrons. That takes a lot of power, which helps explain why laptops get so warm. "Several years ago, my colleague David Miller carefully analyzed power consumption in computers, and the results were striking," said Vuckovic, referring to electrical engineering Professor David Miller. "Up to 80 percent of the microprocessor power is consumed by sending data over the wires - so called interconnects."

In a Nature Photonics article whose lead author is Stanford graduate student Alexander Piggott, Vuckovic, a professor of electrical engineering, and her team explain a process that could revolutionize computing by making it practical to use light instead of electricity to carry data inside computers.

Proven technology

In essence, the Stanford engineers want to miniaturize the proven technology of the Internet, which moves data by beaming photons of light through fiber optic threads...***Read More***...



Infrared light enters this silicon structure from the left. The cut-out patterns, determined by an algorithm, route two different frequencies of this light into the pathways on the right. This is a greatly magnified image of a working device that is about the size of a speck of dust. Credit: Alexander Piggott

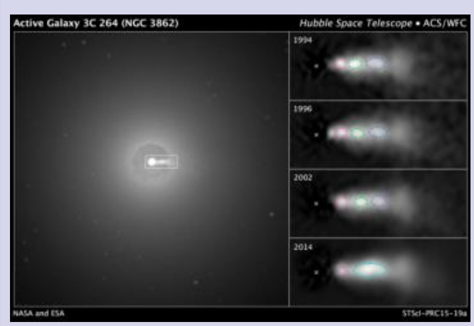
Hubble Captures a Collision in a Black Hole's "Death Star" Beam

Even the Empire's planet-blasting battle station has nothing compared to the immense energy being fired from the heart of NGC 3862, a supermassive black hole-harboring elliptical galaxy located 300 million light-years away.

And while jets of high-energy plasma coming from active galactic nuclei have been imaged before, for the first time activity within a jet has been observed in optical wavelengths, revealing a quite "forceful" collision of ejected material at near light speeds.

Using archived image data acquired by Hubble in 1994, 1996, and 2002 combined with new high-resolution images acquired in 2014, Eileen Meyer at the Space Telescope Science Institute (STScI) in Baltimore, Maryland identified movement in visible clumps of plasma within the jet emitted from the nucleus of NGC 3862 (aka 3C 264). One of the outwardly-moving larger clumps could be seen gaining on a slower, smaller one in front of it and the two eventually collide, creating a shockwave that brightens the resulting merged mass dramatically.

Such a collision has never been witnessed before, and certainly not thousands of light-years out from the central supermassive ...***Read More***...



Activity within a jet from NGC 3862 observed with Hubble over 20 years. Credit: NASA, ESA, and E. Meyer (STScI).

Spiraling laser pulses could change the nature of graphene

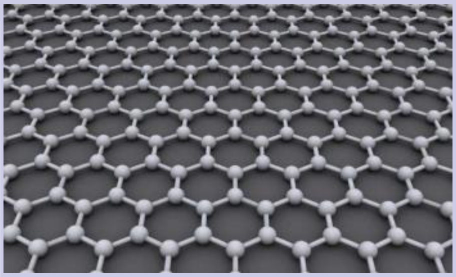
A new study predicts that researchers could use spiraling pulses of laser light to change the nature of graphene, turning it from a metal into an insulator and giving it other peculiar properties that might be used to encode information.

The results, published May 11 in Nature Communications, pave the way for experiments that create and control new states of matter with this specialized form of light, with potential applications in computing and other areas.

"It's as if we're taking a piece of clay and turning it into gold, and when the laser pulse goes away the gold goes back to clay," said Thomas Devereaux, a professor at the Department of Energy's SLAC National Accelerator Laboratory and director of the Stanford Institute for Materials and Energy Sciences (SIMES), a joint SLAC/Stanford institute.

"But in this case," he said, "our simulations show that we could theoretically change the electronic properties of the graphene, flipping it back and forth from a metallic state, where electrons flow freely, to an insulating state. In digital terms this is like flipping between zero and one, on and off, yes and no; it can be used to encode information in a computer memory, for instance. What makes this cool and interesting is that you could make electronic switches with light instead of electrons."

Devereaux led the study with Michael Sentef, who began the work as a ...***Read More***...



This illustration depicts the structure of graphene, which consists of a single layer of carbon atoms arranged in a honeycomb pattern. A new simulation suggests that spiraling pulses of polarized laser light could change graphene's nature, turning it from a metal to an insulator. Led by researchers at SLAC and Stanford, the study paves the way for experiments that create and control new states of matter with this specialized form of light. Credit: AlexanderAIUS via Wikimedia Commons

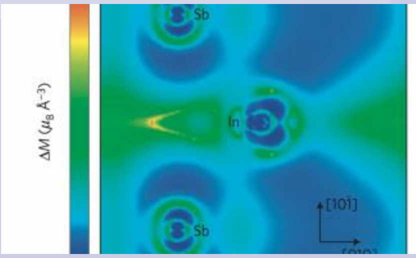
Researchers prove magnetism can control heat, sound

Phonons—the elemental particles that transmit both heat and sound—have magnetic properties, according to a landmark study supported by Ohio Supercomputer Center (OSC) services and recently published by a researcher group from The Ohio State University.

In a recent issue of the journal Nature Materials, the researchers describe how a magnetic field, roughly the size of a medical MRI, reduced the amount of heat flowing through a semiconductor by 12 percent. Simulations performed at OSC then identified the reason for it—the magnetic field induces a diamagnetic response in vibrating atoms known as phonons, which changes how they transport heat.

"This adds a new dimension to our understanding of acoustic waves," said Joseph Heremans, Ph.D., Ohio Eminent Scholar in Nanotechnology and a professor of mechanical engineering at Ohio State whose group performed the experiments. "We've shown that we can steer heat magnetically. With a strong enough magnetic field, we should be able to steer sound waves, too."

People might be surprised enough to learn that heat and sound have anything to do with each other, much less that either can be controlled by magnets, Heremans acknowledged. But both are expressions of the same form of energy ...***Read More***...



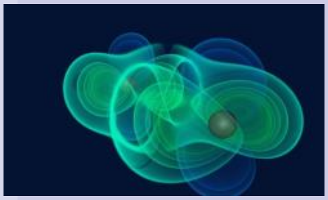
A team led by Ohio State's Wolfgang Windl, Ph.D., used OSC's Oakley Cluster to calculate acoustic phonon movement within an indium-antimonide semiconductor under a magnetic field. Their findings show that phonon amplitude-dependent magnetic moments are induced on the atoms, which change how they vibrate and transport heat. Credit: OSU

How researchers listen for gravitational waves

A century ago, Albert Einstein postulated the existence of gravitational waves in his General Theory of Relativity. But until now, these distortions of space-time have remained stubbornly hidden from direct observation. At the Max Planck Institute for Gravitational Physics in Hanover, researchers are on the trail of this phenomenon with the GEO600 detector. At the heart of the installation is a laser.

Isaac Newton strolled not through paradise, but through an English park. He nevertheless had a run-in with an apple - or to be more precise: it hit Newton on the head. Or did it roll in front of his feet? Difficult to say. There is some doubt as to whether there is any truth in the story of the falling apple. But like most legends, it is at least a good fabrication. Henry Pemberton told it for the first time in 1728 in his biography of the famous physicist.
Fact is that the University of Cambridge was closed from 1665 to 1666 because of the plague and the professor had a lot of time on his hands to contemplate. In any case, the encounter with the apple proved fruitful for Newton. It is said to have made him think that one and the same physical phenomenon was behind the motion of a stone tossed into the air, the orbit of the Moon around the Earth, and the motion of an apple falling to the ground: gravity.

Thus, the middle of the 17th century marks the beginning of the history of gravitation – the force which reaches into the furthest corners of the universe and keeps the world together. Put more precisely: ...***Read More***...



Cosmic collision: Gravitational waves are generated when black holes encircle each other and even collide – simulated here on a computer. Credit: MPI for Gravitational Physics / Institute for Theoretical Physics, Frankfurt / Zuse Institute Berlin

Hawaii governor says Thirty Meter Telescope has right to continue

Hawaii Gov. David Ige this week announced his support for continuing construction of the controversial Thirty Meter Telescope (TMT) at Mauna Kea, a dormant volcano that is already home to many other large telescopes. Mauna Kea is considered a sacred mountain by many native Hawaiians and protests over its use by astronomers, which have gone on for decades, intensified in April, 2015 as construction on the TMT was set to begin. Those protests caused the $1.5-billion TMT project to come a standstill last month, after dozens of people were arrested blocking construction vehicles. At a press conference on Tuesday (May 26, 2015), Ige said the project has the right to proceed. However, he laid out some new rules, which include removing one-quarter of the existing 13 telescopes on Mauna before TMT starts operating in the mid-2020s. Ing said of the TMT:

I do not doubt that they did more than any previous telescope project to be a good neighbor.

And he also said:

The University of Hawaii must do a better job in its stewardship of the mountain.

According to Nature on May 27, the first telescope at Mauna Kea to be dismantled will be the Caltech Submillimeter Observatory, whose closure was announced in 2009. It was already expected to begin a dismantling process later this year. Meanwhile, none of the other 12 telescopes had immediate plans to shut down. Peter Michaud, a spokesman for the Gemini Observatory based in Hilo, Hawaii told Nature:

This is all new to us. Until we learn more about it, we're not really able to say much of anything.

According to the Huffington Post, Ige also said he will ask the..***Read More***...

Artist's concept of the Thirty Meter Telescope.

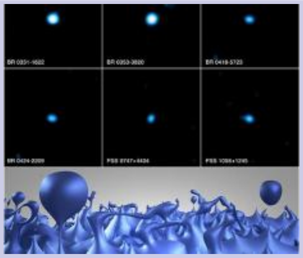
NASA telescopes set limits on space-time quantum 'foam'

A team of scientists has used X-ray and gamma-ray observations of some of the most distant objects in the universe to better understand the nature of space and time. Their results set limits on the quantum nature, or "foaminess," of spacetime at extremely tiny scales.

This study combines data from NASA's Chandra X-ray Observatory and Fermi Gamma-ray Space Telescope along with ground-based gamma-ray observations from the Very Energetic Radiation Imaging Telescope Array (VERITAS).

At the smallest scales of distance and duration that we can measure, spacetime—that is, the three dimensions of space plus time—appears to be smooth and structureless. However, certain aspects of quantum mechanics, the highly successful theory scientists have developed to explain the physics of atoms and subatomic particles, predict that spacetime would not be smooth. Rather, it would have a foamy, jittery nature and would consist of many small, ever-changing, regions for which space and time are no longer definite, but fluctuate.

"One way to think of spacetime foam is if you are flying over the ocean in the airplane, it looks completely smooth. However, if you get low enough ...***Read More***...



A new study combining data from NASA's Chandra X-ray Observatory and Fermi Gamma-ray Telescope, and the Very Energetic Radiation Imaging Telescope Array (VERITAS) in Arizona is helping scientists set limits on the quantum nature of ...

Large Hubble survey confirms link between mergers and supermassive black holes with relativistic jets

In the most extensive survey of its kind ever conducted, a team of scientists have found an unambiguous link between the presence of supermassive black holes that power high-speed, radio-signal-emitting jets and the merger history of their host galaxies. Almost all of the galaxies hosting these jets were found to be merging with another galaxy, or to have done so recently. The results lend significant weight to the case for jets being the result of merging black holes and will be presented in the Astrophysical Journal.

A team of astronomers using the NASA/ESA Hubble Space Telescope's Wide Field Camera 3 (WFC3) have conducted a large survey to investigate the relationship between galaxies that have undergone mergers and the activity of the supermassive black holes at their cores.

The team studied a large selection of galaxies with extremely luminous centres—known as active galactic nuclei (AGNs)—thought to be the result of large quantities of heated matter circling around and being consumed by a supermassive black hole. Whilst most galaxies are thought to host a supermassive black hole, only a small percentage of them are this luminous and fewer still go one step further and form what are known as relativistic jets. The two high-speed jets of plasma move almost with the speed of light and stream out in opposite directions at right angles to the disc of matter surrounding the black hole, extending thousands of light-years into space. The hot material within the jets is also the origin of radio waves….***Read More***...

This artist's impression illustrates how high-speed jets from supermassive black holes would look. These outflows of plasma are the result of the extraction of energy from a supermassive black hole's rotation as it consumes the disc of swirling material that surrounds it. These jets have very strong emissions at radio wavelengths. Credit: ESA/Hubble, L. Calçada

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جامعة الإمارات العربية المتحدة
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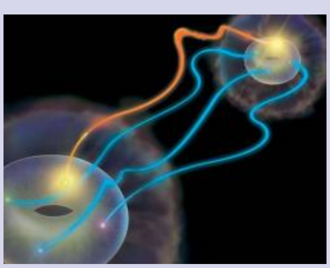
End of Academic Year Dinner
&
Farewell Party to
Drs. Said Mostafa & Tarik Ali, and Mr. Mohamed Al-Shaer

Donuts, math, and superdense teleportation of quantum information

Putting a hole in the center of the donut—a mid-nineteenth-century invention—allows the deep-fried pastry to cook evenly, inside and out. As it turns out, the hole in the center of the donut also holds answers for a type of more efficient and reliable quantum information teleportation, a critical goal for quantum information science.

Quantum teleportation is a method of communicating information from one location to another without moving the physical matter to which the information is attached. Instead, the sender (Alice) and the receiver (Bob) share a pair of entangled elementary particles—in this experiment, photons, the smallest units of light—that transmit information through their shared quantum state. In simplified terms, Alice encodes information in the form of the quantum state of her photon. She then sends a key to Bob over traditional communication channels, indicating what operation he must perform on his photon to prepare the same quantum state, thus teleporting ***...Read More...***

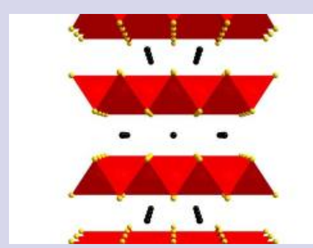


In superdense teleportation of quantum information, Alice (near) selects a particular set of states to send to Bob (far), using the hyperentangled pair of photons they share. The possible states Alice may send are represented as the points on …..

Linking superconductivity and structure

Superconductivity is a rare physical state in which matter is able to conduct electricity—maintain a flow of electrons—without any resistance. It can only be found in certain materials, and even then it can only be achieved under controlled conditions of low temperatures and high pressures. New research from a team including Carnegie's Elissaios Stavrou, Xiao-Jia Chen, and Alexander Goncharov hones in on the structural changes underlying superconductivity in iron arsenide compounds—those containing iron and arsenic. It is published by Scientific Reports.

Although superconductivity has many practical applications for electronics (including scientific research instruments), medical engineering (MRI and NMR machines), and potential future applications including high-performance power transmission and storage, and very fast train travel, the difficulty of creating superconducting materials prevents it from being used to its full potential. As such, any newly discovered superconducting ability is of great interest to scientists and engineers...***Read More...***



Tetragonal crystal structure of $NaFe_2As_2$, courtesy of Alexander Goncharov. Sodium (Na) is represented by the black balls, iron (Fe) by the red balls, and arsenic (As) by the yellow balls. Courtesy of Alexander Goncharov. Credit: Alexander Goncharov