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Many galaxies contain enormous amounts of molecular gas in small areas near their nuclei. Highly condensed molecular gas is a birthplace of lots of stars. Moreover, it is considered to closely relate to activities of galactic nuclei. Therefore, it is important to investigate the physical state and chemical properties of molecular gas at galaxy centers …

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The entire genomes of 91 human sperm from one man have been sequenced by Stanford University researchers. The results provide a fascinating glimpse into naturally occurring genetic variation in one individual, and are the first to report the whole-genome sequence of a human gamete — the only cells that become a child and through which …

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Mathematicians at UC Davis have come up with a new way to crinkle up the fabric of space-time — at least in theory. ”We show that space-time cannot be locally flat at a point where two shock waves collide,” said Blake Temple, professor of mathematics at UC Davis. “This is a new kind of singularity in …

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‘Seeds’ of Massive Black Holes Found at the Center of the Milky Way Galaxy

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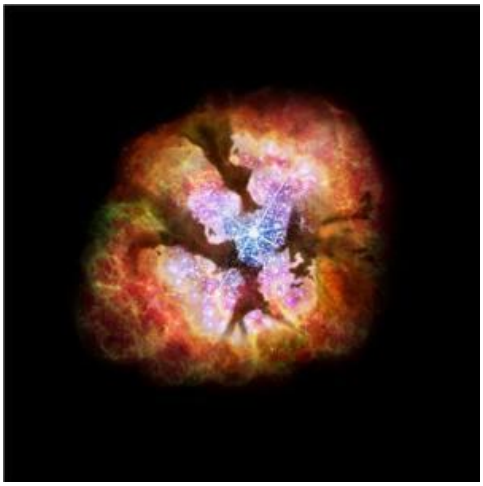

A conceptual image of the newly discovered “large star cluster buried in dust.” It is considered that IMBHs are formed at the center of the cluster. (Credit: Copyright Keio University)

Many galaxies contain enormous amounts of molecular gas in small areas near their nuclei. Highly condensed molecular gas is a birthplace of lots of stars. Moreover, it is considered to closely relate to activities of galactic nuclei. Therefore, it is important to investigate the physical state and chemical properties of molecular gas at galaxy centers through observation. To obtain detailed observation data, it is best to survey the center of the Milky Way Galaxy in which our solar system exists. The research team observed emission lines at

wavelengths of 0.87 mm, emitted from carbon monoxide molecules in an area of several degrees that includes the center of the Milky Way Galaxy. The ASTE 10 m telescope in the Atacama Desert (4,800 meters above sea level) of Chile was used for observation. More than 250 hours in total were spent on the prolonged observation from 2005 to 2010.

The research team compared this observation data with data of emission lines at wavelengths of 2.6 mm, emitted from carbon monoxide molecules in the same area, which were obtained using the NRO 45m Telescope (Note: 1). When intensity values of emission lines at different wavelengths, emitted from carbon monoxide molecules, are compared, it is possible to estimate temperature and density of molecular gas. In this way, the research team succeeded in drawing detailed distribution maps of “warm, dense” molecular gas of more than 50 degrees Kelvin and more than 10,000 hydrogen molecules per cubic centimeter at the center of the Milky Way Galaxy for the first time ever.

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Entire Genetic Sequence of Individual Human Sperm Determined

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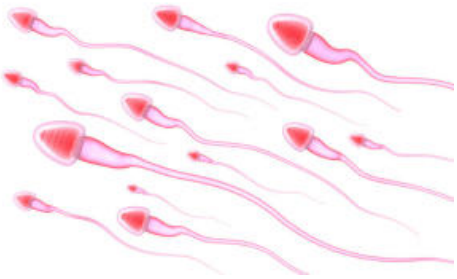

Every sperm cell looks essentially the same, with that characteristic tadpole appearance. But inside, sperm cells carry differences within their genes — even cells from the same man. Now, researchers provide a detailed picture of how the cell's DNA varies in a new study published in the July 20, 2012 issue of the Cell Press journal Cell. The techniques used could be helpful for understanding male reproductive disorders or, when applied to other areas of research, for characterizing normal and diseased cells in the body. (Credit: iStockphoto/Alexandr Mitiuc)

The entire genomes of 91 human sperm from one man have been sequenced by Stanford University researchers. The results provide a fascinating glimpse into naturally occurring genetic variation in one individual, and are the first to report the whole-genome sequence of a human gamete — the only cells that become a child and through which parents pass on physical traits. "This represents the culmination of nearly a decade of work in my lab," said Stephen Quake, PhD, the Lee Otterson Professor in the School of Engineering and professor of bioengineering and of applied physics. "We now have devices that will allow us to routinely amplify and sequence to a high degree of accuracy the entire genomes of single cells, which has far-ranging implications for the study of cancer, infertility and many other disorders."

Quake is the senior author of the research, published July 20 in *Cell*. Graduate student Jianbin Wang and former graduate student H. Christina Fan, PhD, now a senior scientist at ImmuMetrix, share first authorship of the paper.

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Scientists Read Monkeys' Inner Thoughts: Brain Activity Decoded While Monkeys Avoid Obstacle to Touch Target

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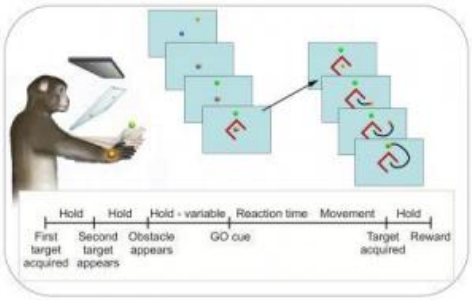

The obstacle-avoidance task is a variation on the center-out reaching task in which an obstacle sometimes prevents the monkey from moving directly to the target. The monkey must first place a cursor (yellow) on the central target (purple). This was the starting position. After the first hold, a second target

appeared (green). After the second hold an obstacle appeared (red box). After the third hold, the center target disappeared, indicating a “go” for the monkey, which then moved the cursor out and around the obstacle to the target. (Credit: Moran/Pearce)

Anyone who has looked at the jagged recording of the electrical activity of a single neuron in the brain must have wondered how any useful information could be extracted from such a frazzled signal. But over the past 30 years, researchers have discovered that clear information can be obtained by decoding the activity of large populations of neurons.

Now, scientists at Washington University in St. Louis, who were decoding brain activity while monkeys reached around an obstacle to touch a target, have come up with two remarkable results.

Their first result was one they had designed their experiment to achieve: they demonstrated that multiple parameters can be embedded in the firing rate of a single neuron and that certain types of parameters are encoded only if they are needed to solve the task at hand.

Their second result, however, was a complete surprise. They discovered that the population vectors could reveal different planning strategies, allowing the scientists, in effect, to read the monkeys’ minds.

By chance, the two monkeys chosen for the study had completely different cognitive styles. One, the scientists said, was a hyperactive type, who kept jumping the gun, and the other was a smooth operator, who waited for the entire setup to be revealed before planning his next move. The difference is clearly visible in their decoded brain activity.

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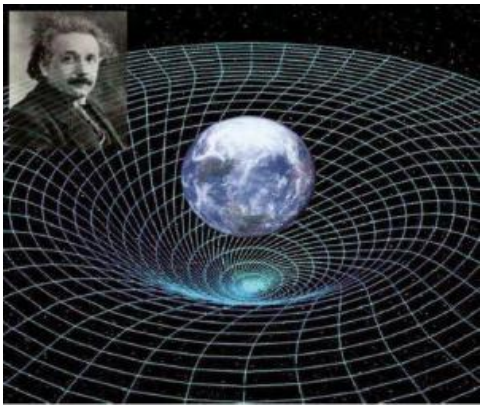

Illustration of twisted space-time around Earth. (Credit: NASA)

Mathematicians at UC Davis have come up with a new way to crinkle up the fabric of space-time — at least in theory. ”We show that space-time cannot be locally flat at a point where two shock waves collide,” said Blake Temple, professor of mathematics at UC Davis. “This is a new kind of singularity in general relativity.”

The results are reported in two papers by Temple with graduate students Moritz Reintjes and Zeke Vogler, respectively, both published in the journal *Proceedings of the Royal Society A*.

Einstein’s theory of general relativity explains gravity as a curvature in space-time. But the theory starts from the assumption that any local patch of space-time looks flat, Temple said.

A singularity is a patch of space-time that cannot be made to look flat in any coordinate system, Temple said. One example of a singularity is inside a black hole, where the curvature of space becomes extreme.

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Potent New Compound Virtually Eliminates HIV in Cell Culture

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A natural compound can virtually eliminate human immunodeficiency virus (HIV) in infected cells in cell culture. The compound defines a novel class of HIV anti-viral drugs endowed with the capacity to repress viral replication in acutely and chronically infected cells. (Credit: © alexskopje / Fotolia)

A new study by scientists on the Florida campus of The Scripps Research Institute shows, in cell culture, a natural compound can virtually eliminate human immunodeficiency virus (HIV) in infected cells. The compound defines a novel class of HIV anti-viral drugs endowed with

the capacity to repress viral replication in acutely and chronically infected cells. The HIV/AIDS pandemic continues to affect 34 million individuals worldwide, including more than 3 million children, according to the World Health Organization. Current treatment involves the use of several antiretroviral drugs, termed Highly Active Antiretroviral Therapy (HAART), which can extend the life expectancy of HIV-positive individuals and decrease viral load without, however, eradicating the virus.

“We know that there are reservoirs of HIV that aren’t being eliminated by current treatment and that keep replenishing the infection,” said Susana Valente, a Scripps Research biologist who led the study. “Viral production from these cellular reservoirs that harbor an integrated viral genome is not affected by current antiretroviral drugs, which only stop novel rounds of infection. The compound in the current study virtually eliminates all viral replication from already-infected cells where HIV hides.”

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Magma World: NASA’S Spitzer Finds Evidence for an Exoplanet Smaller Than Earth

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Artist's impression of UCF-1.01, an exoplanet candidate that is two-thirds the size of Earth. (Credit: Courtesy NASA/JPL-Caltech)

Astronomers using NASA's Spitzer Space Telescope have detected what they believe is a planet two-thirds the size of Earth. The exoplanet candidate, called UCF-1.01, is located a mere 33 light-years away, making it possibly the nearest world to our solar system that is smaller than our home planet. Exoplanets circle stars beyond our sun. Only a handful smaller than Earth have been found so far. Spitzer has performed transit studies on known exoplanets, but UCF-1.01 is the first ever identified with the telescope, pointing to a possible role for Spitzer in helping discover potentially habitable, terrestrial-sized worlds.

"We have found strong evidence for a very small, very hot and very near planet with the help of the Spitzer Space Telescope," said Kevin Stevenson from the University of Central Florida in Orlando. Stevenson is lead author of the paper, which has been accepted for publication in *The Astrophysical Journal*. "Identifying nearby small planets such as UCF-1.01 may one day lead to their characterization using future instruments."

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Neanderthals in Northern Spain Had Knowledge of Plants' Healing Qualities, Study Reveals

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A researcher at work in El Sidrón Cave. (Credit: CSIC Comunicación)

An international team of researchers, led by the Universitat Autònoma de Barcelona and the University of York, has provided the first molecular evidence that Neanderthals not only ate a range of cooked plant foods, but also understood its nutritional and medicinal qualities. Until recently Neanderthals, who disappeared between 30,000 and 24,000 years ago, were thought to be predominantly meat-eaters. However, evidence of dietary breadth is growing as more sophisticated analyses are undertaken.

Researchers from Spain, the UK and Australia combined pyrolysis gas-chromatography-mass spectrometry with morphological analysis of plant microfossils to identify material trapped in dental calculus (calcified dental plaque) from five Neanderthals from the north Spanish site of El Sidrón.

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Do Dolphins Think Nonlinearly?

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Dolphins in the Atlantic.
(Credit: © chri_spa / Fotolia)

Research from the University of Southampton, which examines how dolphins might process their sonar signals, could provide a new system for human-made sonar to detect targets, such as sea mines, in bubbly water. When hunting prey, dolphins have been observed to blow ‘bubble nets’ around schools of fish, which force the fish to cluster together, making them easier for the dolphins to pick off. However, such bubble nets would confound the best human-made sonar because the strong scattering by the bubbles generates ‘clutter’ in the sonar image, which cannot be distinguished from the true target.

Taking a dolphin’s sonar and characterising it from an engineering perspective, it is not superior to the best human-made sonar. Therefore, in blowing bubble nets, dolphins are either ‘blinding’ their echolocation sense when hunting or they have a facility absent in human-made sonar.

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Heart of a Distant Quasar Observed With Unprecedented Sharpness: Sharpness Two Million Times Finer Than Human Vision

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This is an artist's impression of the quasar 3C 279. Astronomers connected the Atacama Pathfinder Experiment (APEX), in Chile, to the Submillimeter Array (SMA) in Hawaii, USA, and the Submillimeter Telescope (SMT) in Arizona, USA, for the first time, to make the sharpest observations ever, of the center of a distant galaxy, the bright quasar 3C 279. Quasars are the very bright centres of distant galaxies that are powered by supermassive black holes. This quasar contains a black hole with a mass about one billion times that of the sun, and is so far from Earth that its light has taken more than 5 billion years to reach us. The

team were able to probe scales of less than a light-year across the quasar — a remarkable achievement for a target that is billions of light-years away. (Credit: ESO/M. Kornmesser)

An international team of astronomers has observed the heart of a distant quasar with unprecedented sharpness, two million times finer than human vision. The observations, made by connecting the Atacama Pathfinder Experiment (APEX) telescope [1] to two others on different continents for the first time, is a crucial step towards the dramatic scientific goal of the "Event Horizon Telescope" project [2]: imaging the supermassive black holes at the centre of our own galaxy and others. Astronomers connected APEX, in Chile, to the Submillimeter Array (SMA) [3] in Hawaii, USA, and the Submillimeter Telescope (SMT) [4] in Arizona, USA. They were able to make the sharpest direct observation ever [5], of the centre of a distant galaxy, the bright quasar 3C 279, which contains a supermassive black hole with a mass about one billion times that of the Sun, and is so far from Earth that its light has taken more than 5 billion years to reach us. APEX is a collaboration between the Max Planck Institute for Radio Astronomy (MPIfR), the Onsala Space Observatory (OSO) and ESO. APEX is operated by ESO.

The telescopes were linked using a technique known as Very Long Baseline Interferometry (VLBI). Larger telescopes can make sharper observations, and interferometry allows multiple telescopes to act like a single telescope as large as the separation — or "baseline" — between them. Using VLBI, the sharpest observations can be achieved by making the separation between telescopes as large as possible. For their quasar observations, the team used the three telescopes to create an interferometer with transcontinental baseline lengths of 9447 km from Chile to Hawaii, 7174 km from Chile to Arizona and 4627 km from Arizona to Hawaii. Connecting APEX in Chile to the network was crucial, as it contributed the longest baselines.

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Mechanisms That Allow Embryonic Stem Cells to Become Any Cell in the Human Body Identified

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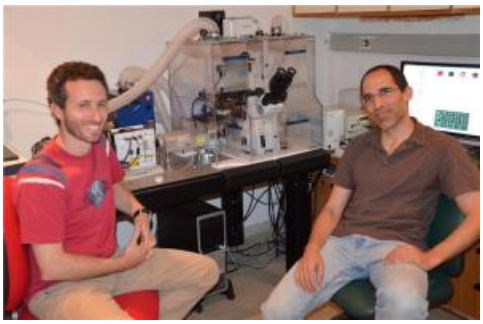

Stem cell researchers PhD student Shai Melcer (left) with Dr. Eran Meshorer at the Hebrew University of Jerusalem. (Credit: Eran Meshorer)

New research at the Hebrew University of Jerusalem sheds light on pluripotency — the ability of embryonic stem cells to renew themselves indefinitely and to differentiate into all types of mature cells. Solving this problem, which is a major challenge in modern biology, could expedite the use of embryonic stem cells in cell therapy and regenerative medicine. If scientists can replicate the mechanisms that make pluripotency possible, they could create cells in the laboratory which could be implanted in humans to cure diseases characterized by cell death, such as Alzheimer's, Parkinson's, diabetes and other degenerative diseases.

To shed light on these processes, researchers in the lab of Dr. Eran Meshorer, in the Department of Genetics at the Hebrew University's Alexander Silberman Institute of Life Sciences, are combining molecular, microscopic and genomic approaches. Meshorer's team is focusing on epigenetic pathways — which cause biological changes without a corresponding change in the DNA sequence — that are specific to embryonic stem cells.

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