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Astronomy & Physics Weekly News

Dept. of Applied Physics & Astronomy - University of Sharjah
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Top News

Asteroid Day
June 30, 2018
A week of Activities

IT Support Issam Jami
Designed by Mohamed Bakir

New model predicts that we're probably the only advanced civilization in the observable universe

According to a new theory argued by Anders Sandberg, Eric Drexler and Toby Ord, the answer to the Fermi Paradox may be simple: humanity is alone in the universe. Credit: ESA/Gaia/DPAC

The Fermi Paradox remains a stumbling block when it comes to the search for extra-terrestrial intelligence (SETI). Named in honor of the famed physicist Enrico Fermi who first proposed it, this paradox addresses the apparent disparity between the expected probability that intelligent life is plentiful in the universe, and the apparent lack of evidence of extra-terrestrial intelligence (ETI).

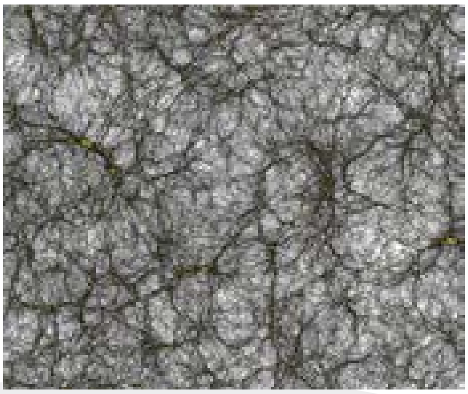
In the decades since Enrico Fermi first posed the question that encapsulates this paradox ("Where is everybody?"), scientists have attempted to explain this disparity one way or another. But in a new study conducted by three famed scholars from the Future of Humanity Institute (FHI) at Oxford University, the paradox is reevaluated in such a way that it makes it seem likely that humanity is alone in the observable universe.

The study, titled "Dissolving the Fermi Paradox", recently appeared online. The study was jointly-conducted by Anders Sanberg, a Research Fellow at the Future of Humanity Institute and a Martin Senior Fellow at Oxford University; Eric Drexler, the famed engineer who popularized the concept of nanotechnology; and Tod Ord, the famous Australian moral philosopher at Oxford University.

For the sake of their study, the team took a fresh look at the Drake Equation, the famous equation proposed by astronomer Dr. Frank Drake in the 1960s. Based on hypothetical values for a number of factors, this equation has traditionally been used to demonstrate that – even if the amount of life developing at any given site is small – the sheer multitude of possible sites should yield a large number of potentially observable civilizations.

This equation states that the number of civilizations (N) in our galaxy that we might able to communicate can be determined by multiplying the average rate of star formation in our galaxy (R*), the fraction of those stars which have planets (fp), the number of planets that can actually support life (ne), the number of planets that will develop life (fl), the number of planets that will ..Read More...

Researchers Find Last of the Universe's Missing Ordinary Matter



A simulation of the cosmic web, diffuse tendrils of gas that connect galaxies across the universe.

Researchers at the University of Colorado Boulder have helped to find the last reservoir of ordinary matter hiding in the universe.

Ordinary matter, or "baryons," make up all physical objects in existence, from stars to the cores of black holes. But until now, astrophysicists had only been able to locate about two-thirds of the matter that theorists predict was created by the Big Bang.

In the new research, an international team pinned down the missing third, finding it in the space between galaxies. That lost matter exists as filaments of oxygen gas at temperatures of around 1 million degrees Celsius, said CU Boulder's Michael Shull, a co-author of the study.

The finding is a major step for astrophysics. "This is one of the key pillars of testing the Big Bang theory: figuring out the baryon census of hydrogen and helium and everything else in the periodic table," said Shull of the Department of Astrophysical and Planetary Sciences (APS).

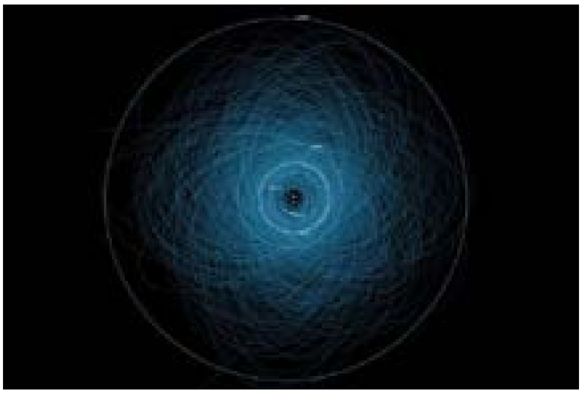
The new study, which appears today in Nature, was led by Fabrizio Nicastro of the Italian Istituto Nazionale di Astrofisica (INAF) - Osservatorio Astronomico di Roma and the Harvard-Smithsonian Center for Astrophysics.

Researchers have a good idea of where to find most of the ordinary matter in the universe - not to be confused with dark matter, which scientists have yet to locate: About 10 percent sits in galaxies, and close to 60 percent is in the diffuse clouds of gas that lie between galaxies.

In 2012, Shull and his colleagues predicted that the missing 30 percent of baryons were likely in a web-like pattern in space called the warm-hot intergalactic medium (WHIM). Charles Danforth, a research associate in APS, contributed to those findings and is a co-author of the new study.

To search for missing atoms in that region between galaxies, the international team pointed a ...Read More...

Unconfirmed near-Earth objects



A diagram of the orbits of many known Near Earth Objects. Astronomers have estimated that about 18 percent of reported NEOs have been unable to have confirmation observations. Credit: NASA

Near-Earth objects (NEOs) are small solar system bodies whose orbits sometimes bring them close to the Earth, potentially threatening a collision. NEOs are tracers of the composition, dynamics and environmental conditions throughout the solar system and of the history of our planetary system. Most meteorites come from NEOs, which are thus one of our key sources of knowledge about the solar system's development. Because some of them are easier to reach with spacecraft than the Moon or planets, NEOs are potential targets for NASA missions. The total number of known NEOs exceeds 18000. The discovery rate has risen rapidly recently, driven by in part the 1998 mandate of Congress to identify 90 percent of NEOs larger than 1 km (in 2005 Congress, recognizing the danger posed even by smaller NEOs, extended the mandate to sizes as small as 140 meters.)

The importance of NEOs for science and safety has emphasized the need for accurate statistics of the population - but there is a problem. The discovery process for NEOs requires distinguishing between known and unknown targets, and then following up previously unknown targets to measure their orbits. The catalog of orbital elements of known NEOs, their size-frequency distribution, as well as the region of sky visited by telescopes, all serve as inputs for deriving debiased population models. But many NEOs are spotted and reported, but follow-up observations are not done.

CfA astronomers Peter Vereš, Matthew Payne, Matthew Holman, Gareth Williams, Sonia Keys, and Ian Boardman (all are affiliated with the Minor Planet Center at the CfA) and a colleague have analyzed the NEO reports from 2013 to 2016; in this over 170,000 objects (including comets) were reported as likely candidates. By tracking down the list of candidates submitted to the minor Planet Center and using statistical tools, the scientists estimate that about 18 percent of all NEO candidates remain unconfirmed. They point to several reasons including delays in reporting the detection; the object is moving, and the scientists found that delaying the initial report from two to ten hours results in doubling the number ..Read More...

Globular clusters might be younger than we thought

The Milky Way globular cluster Omega Centauri contains stars that are currently estimated to be between 10 billion and 12 billion years old. ESO/INAF-VST/OmegaCAM; Acknowledgement: A. Grado, L. Limatola/INAF-Capodimonte Observatory

Globular clusters are spherical associations of old stars, thought to have formed during the earliest days of our universe, nearly 14 billion years ago. They contain some of the oldest stars in our galaxy, and the same appears true for other galaxies as well. But new research led by astronomers at the University of Warwick is now challenging this belief, showing that globular clusters may be a full 4 billion years younger than previously thought. Published May 24 in Monthly Notices of the Royal Astronomical Society, the paper states that globular clusters may be closer to 9 billion years in age than the previously measured value of 13 billion years.

How did this age discrepancy arise? The age of globular clusters has long been determined by studying the light from their stars. Astronomers compare the properties of the integrated (total) light received from globular clusters with templates of starlight produced by stars of different ages and types. (It's worth noting that at one point, these models showed that globular clusters were older than the universe, so this wouldn't be the first time astronomers have updated their age estimates for these objects.)

This new study takes a different approach, using new models called Binary Population and Spectral Synthesis (BPASS) models, which take into account the effects of binary stars and how the evolution of binary systems – which are known to be common – affects the light received from globular clusters. The idea is this: interactions between binary stars can change the properties of the starlight emitted by one star as elements from its atmosphere are stripped away by the gravity of a companion. When taken into account these binary interactions could make the starlight coming from globular clusters look more like the older templates used by astronomers to determine stellar age, prematurely aging the cluster.

"Determining ages for stars has always depended on comparing observations to the models which encapsulate our understanding of how stars form and evolve," said lead author Elizabeth Stanway of the University of Warwick's Astronomy and Astrophysics Group in a ..Read More...

Giant dust storm engulfs Opportunity rover

Opportunity and its sister rover, Spirit, landed on the martian surface in 2004. NASA/JPL/Cornell University, Maas Digital LLC

NASA's Curiosity Mars rover has enjoyed major headlines lately with some new discoveries that bring us one step closer to the detection of ancient life on Mars. But while Curiosity is enjoying this well-earned moment in the spotlight, its fellow rover and older cousin, Opportunity, has fallen silent. Opportunity is smack dab in the middle of a massive dust storm blanketing at least one-quarter of the Red Planet, alone under dark skies as dust blots out the precious sunlight the rover needs for power.

The storm was not a complete surprise; Mars is now entering a dust-storm season, as planetary scientists have expected. Martian dust storms range from small — less than 1,200 miles (1,930 kilometers) across — to much rarer huge, planet-spanning storms that can cover one-third to one hundred percent of the surface.

This particular storm was first detected May 30 by NASA's Mars Reconnaissance Orbiter (MRO). At the time, it was about 620 miles (1,000km) from Opportunity, but the rover's team began developing contingency plans in case the storm advanced. It did — by June 6, dust had begun obscuring the sunlight needed for the rover's solar panels to churn out power, dropping the rover's capacity to carry out extended tasks. Over the course of two days, Opportunity's ability to generate energy dropped by half. That level dropped by half again in a single day. On June 10, the rover transmitted data back to Earth showing the opacity of Mars' atmosphere (a measure of dust) was currently twice as high as had ever been measured previously on the planet.

The rover has been silent since then, and team members have been unable to communicate with it after June 10. An attempt to reach the rover on June 12 was met with silence. The team is now assuming Opportunity has gone to sleep, waiting out the storm until the atmosphere clears and it can once again charge its power supply. While "asleep" — in what engineers call low power fault mode — all of the rover's systems, save a mission clock, are off. The clock will periodically wake the rover to determine whether the batteries have collected enough charge (which will happen once the solar panels are again ...Read More...

New and improved way to find baby planets

An artist's impression of protoplanets forming around a young star, courtesy of NRAO/AUI/NSF; S. Dagnello

New work from an international team of astronomers including Carnegie's Jaehan Bae used archival radio telescope data to develop a new method for finding very young extrasolar planets. Their technique successfully confirmed the existence of two previously predicted Jupiter-mass planets around the star HD 163296. Their work is published by The Astrophysical Journal Letters.

Of the thousands of exoplanets discovered by astronomers, only a handful are in their formative years. Finding more baby planets will help astronomers answer the many outstanding questions about planet formation, including the process by which our own solar system came into existence.

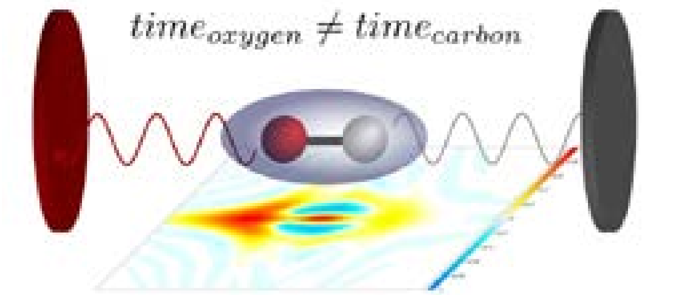
Young stars are surrounded by rotating disks of gas and dust from which planets are formed. The 60 radio telescope antennae of the Atacama Large Millimeter/submillimeter Array, ALMA, have been able to image these disks with never-before-seen clarity.

The research team - including lead author Richard Teague and co-author Edwin Bergin of the University of Michigan, Tilman Birnstiel of the Ludwig Maximilian University of Munich, and Daniel Foreman-Mackey of the Flatiron Institute - used archival ALMA data to demonstrate that anomalies in the velocity of the gas in these rotating protoplanetary disks can be used to indicate the presence of giant planets.

Other techniques for finding baby planets in the disks surrounding young stars are based on observations of the emission coming from a disk's dust particles. But dust only accounts for 1% of a disk's mass, so the team decided to focus instead on the gas that comprises 99% of a young disk.

Their new technique focuses on the motion of the gas, probing radial pressure gradients in the gas to see the shape of the perturbations - like swirls and eddies in a rocky streambed - allowing astronomers to make a more precise determination of the masses and locations of any planets embedded in the disk. ...Read More...

The photoelectric effect in stereo



Depending on whether the electron is close to the oxygen or to the carbon atom, the laser pulse will eject it more or less quickly. That difference can now be precisely measured. Credit: ETH Zurich

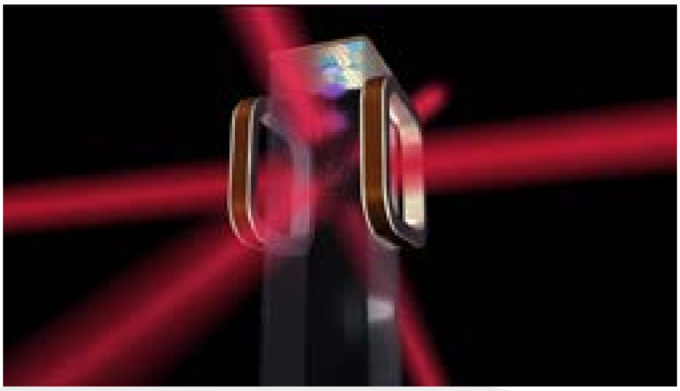
In the photoelectric effect, a photon ejects an electron from a material. Researchers at ETH have now used attosecond laser pulses to measure the time evolution of this effect in molecules. From their results they can deduce the exact location of a photoionization event.

When a photon hits a material, it can eject an electron from it provided it has enough energy. Albert Einstein found the theoretical explanation of this phenomenon, which is known as the photoelectric effect, in Bern during his "year of wonders" 1905. That explanation was a crucial contribution to the development of quantum mechanics, which was under way at the time, and it earned him the Nobel Prize in Physics in 1921. An international team of physicists led by Ursula Keller at the Institute for Quantum Electronics of the ETH Zurich has now added a new dimension to the experimental investigation of this important effect. Using attosecond laser pulses they were able to measure a tiny time difference in the ejection of the electron from a molecule depending on the position of the electron inside the molecule.

"For quite some time, people have studied the time evolution of the photoelectric effect in atoms", says Ph.D. student Jannie Vos, "but very little has so far been published on molecules." That is mainly due to the fact that molecules are considerably more complex than single atoms. In an atom, the outermost electron moving around the atomic nucleus is essentially catapulted out of its orbit. In a molecule, by contrast, two or more nuclei share the same electron. Where it is located depends on the interplay between the different attractive potentials. Exactly how the photoelectric effect happens under such conditions could only now be studied in detail.

To do so, Keller and her co-workers used carbon monoxide molecules, which consist of two atoms - one carbon and one oxygen atom. Those molecules were exposed to an extreme ultraviolet laser pulse that only lasted for a few attoseconds. (An attosecond is the billionth part of a billionth of a second). The energy of the ultraviolet photons ripped an electron out of the ...Read More...

Space station experiment will create the coldest spot in the universe



NASA's Cold Atom Laboratory will use lasers to cool atoms to ultra-cold temperatures.NASA

More than 250 miles above Earth, a suitcase-size device aboard the International Space Station will soon be used to chill atoms to just a hair above absolute zero, creating the coldest spot in the universe and possibly shedding new light on some of the biggest mysteries in physics.

The Cold Atom Laboratory (CAL) device is designed to help scientists study the strange behavior of atoms at ultra-low temperatures — in this case, 10 billion times colder than the frigid vacuum of space.

At these temperatures, atoms clump together to form what scientists call a Bose-Einstein condensate. This exotic form of matter — neither solid nor liquid nor gas — allows scientists to observe the weird world of quantum mechanics, a somewhat mind-bending branch of physics that describes how matter behaves on the smallest scales.

Strange things can happen in the quantum world — for example, a single particle can exist in two places at once — and scientists are hopeful that CAL will help them understand why. "As you cool atoms colder and colder, they become more quantum," said Robert Thompson, a CAL project scientist at NASA's Jet Propulsion Laboratory in Pasadena, California.

Bose-Einstein condensates have been created in labs on Earth, but the inexorable pull of gravity makes it hard to study them for more than fractions of a millisecond. In the space station's microgravity environment, Thompson said, the condensates float to give scientists up to 10 seconds to study them.

In addition to helping scientists gain a better understanding of quantum weirdness, the CAL experiments could point to new laws of physics.

"As far as we can tell, quantum mechanics underlies all of physics, but it violates human intuition and common sense in many ways," Todd Brun, a professor of electrical engineering at the University of Southern California who isn't involved with CAL, told NBC News ...Read More...

Einstein proved right in another galaxy

Hubble Space Telescope imaging of the gravitational lens ESO325-G004. Credit: NASA, ESA, Hubble Heritage Team (STScI / AURA).

An international team of astronomers have made the most precise test of gravity outside our own solar system.

By combining data taken with NASA's Hubble Space Telescope and the European Southern Observatory's Very Large Telescope, their results show that gravity in this galaxy behaves as predicted by Albert Einstein's general theory of relativity, confirming the theory's validity on galactic scales.

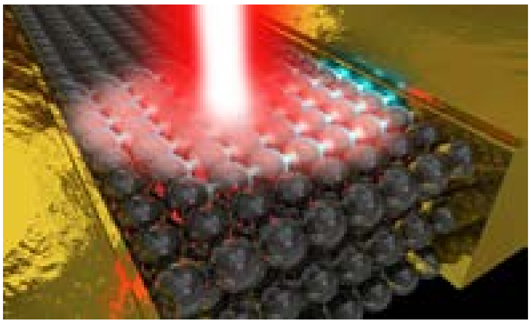
In 1915 Albert Einstein proposed his general theory of relativity (GR) to explain how gravity works. Since then GR has passed a series of high precision tests within the solar system, but there have been no precise tests of GR on large astronomical scales.

It has been known since 1929 that the Universe is expanding, but in 1998 two teams of astronomers showed that the Universe is expanding faster now than it was in the past. This surprising discovery—which won the Nobel Prize in 2011—cannot be explained unless the Universe is mostly made of an exotic component called dark energy. However, this interpretation relies on GR being the correct theory of gravity on cosmological scales. Testing the long distance properties of gravity is important to validate our cosmological model.

A team of astronomers, led by Dr. Thomas Collett of the Institute of Cosmology and Gravitation at the University of Portsmouth, used a nearby galaxy as a gravitational lens to make a precise test of gravity on astronomical length scales.

Dr. Collett said: "General Relativity predicts that massive objects deform space-time, this means that when light passes near another galaxy the light's path is deflected. If two galaxies are aligned along our line of sight this can give rise to a phenomenon, called strong gravitational lensing, where we see multiple images of the background galaxy. If we know the mass of the foreground galaxy, then the amount of separation between the multiple images tells us if General Relativity is the correct theory of gravity on galactic scales." A few hundred strong gravitational lenses are known, but most are too distant ...Read More...

Laser bursts generate electricity faster than any other method



The group of Ignacio Franco, assistant professor of chemistry and physics clarified how ultrafast laser pulses can be used to distort the properties of matter and generate electrical currents faster than in any traditional way along tiny, nanoscale, electrical circuits. The magnitude and direction of the currents can be manipulated simply by varying laser parameters. "This is a wonderful example of how differently matter can behave when driven far from equilibrium," Franco says. Credit: University of Rochester illustration / Michael Osadciw

ake a glass thread a thousand times thinner than a human hair. Use it as a wire between two metals. Hit it with a laser pulse that lasts a millionth of a billionth of a second.

Remarkable things happen.

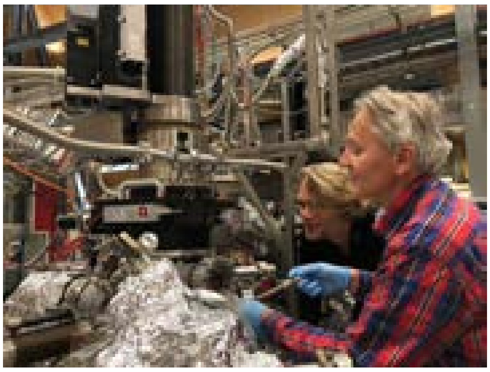
The glass-like material is transformed ever so briefly into something akin to a metal. And the laser generates a burst of electrical current across this tiny electrical circuit. It does so far faster than any traditional way of producing electricity and in the absence of an applied voltage. Further, the direction and magnitude of the current can be controlled simply by varying the shape of the laser—by changing its phase.

Now a University of Rochester researcher—who predicted laser pulses could generate ultrafast currents along nanoscale junctions like this in theory—believes he can explain exactly how and why scientists succeeded in creating these currents in actual experiments.

"This marks a new frontier in the control of electrons using lasers," says Ignacio Franco, assistant professor of chemistry and physics. He has collaborated with Liping Chen, a postdoctoral associate in his group, and with Yu Zhang and GuanHua Chen at the University of Hong Kong on a computational model to recreate and clarify what happened in the experiment. This work funded by Franco's NSF CAREER award is now published in Nature Communications.

"You will not build a car out of this, but you will be able to generate currents faster than ever before," Franco says. "You will be able to develop electronic circuits a few billionths of a meter long [nanoscale] that operate in a millionth of a billionth of a second [femtosecond] time scale. But, more importantly, this is a wonderful example of how differently matter can behave when driven ...Read More...

Controlling magnetic spin with electric fields



Hugo Dil and Juraj Krempasky at the Paul Scherrer Institut. Credit: H. Dil/EPFL

EPFL physicists have found a way to reverse electron spins using electric fields for the first time, paving the way for programmable spintronics technologies.

Spintronics is a field of physics that studies the spin of electrons, an intrinsic type of magnetism that many elementary particles have. The field of spintronics has given rise to technological concepts of "spintronic devices," which would run on electron spins, rather than their charge, used by traditional electronics.

In order to build programmable spintronic devices we first need to be able to manipulate spins in certain materials. So far, this has been done with magnetic fields, which are not easy to integrate into everyday applications.

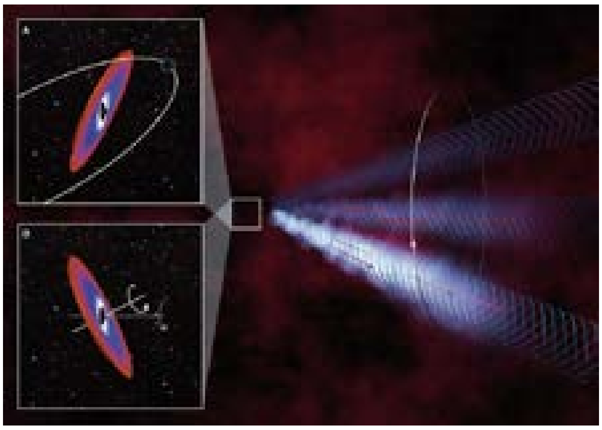
In a new set of experiments, an international team of physicists led by Hugo Dil at EPFL have now demonstrated the ability to control what they call "the spin landscape" using electric fields. They accomplished this in a new class of materials based on germanium telluride (GeTe), which is the simplest ferroelectric material operating at room temperature.

The scientists used a technique called spin- and angle-resolved photoemission spectroscopy (SARPES), which can measure the spin of electrons, and has been perfected by Dil's lab. By combining SARPES with the possibility to apply an electric field, the physicists demonstrate electrostatic spin manipulation in ferroelectric α-GeTe and multiferroic (GeMn)Te.

In addition, the scientists were able to follow the spins' switching pathway in detail. In (GeMn)Te, the perpendicular spin component switches due to electric-field-induced magnetization reversal. This provides firm evidence of magneto-electric coupling, which opens up the possibility of programmable semiconductor based spintronics.

"Our previous work showed that magnetic fields can control spins in these materials," says Dil. "And now we've shown that spin manipulation is also possible using electric fields. Our experimental findings open up a promising path to only use electric fields in a spintronics ...Read More...

The Rosetta stone of active galactic nuclei deciphered



Artist's impression of the central region of the active galaxy OJ 287 with a preceding jet. The precession could either be caused by a binary black hole (Inset A) or by a mis-aligned accretion disk (Inset B). Credit: © Axel M. Quetz/MPIA Heidelberg

A galaxy with at least one active supermassive black hole – named OJ 287 – has caused many irritations and questions in the past. The emitted radiation of this object spans a wide range – from the radio up to the highest energies in the TeV regime. The potential periodicity in the variable optical emission made this galaxy a candidate for hosting a supermassive binary black hole in its centre. The object was thus labeled a Rosetta stone of active galactic nuclei expressing the hope that this object could be a prototypical object and once deciphered, could explain fundamental properties of active black holes in general. Now an international team of astronomers led by Max Planck researchers has discovered that the active galactic nucleus of OJ 287 generates a smoothly precessing jet on a timescale of about 22 years. The precession of the jet observed could also explain the variability in the radiation of the galaxy. This detection solves many riddles at once and provides a key to understanding variability in active galactic nuclei.

The findings are published in the journal Monthly Notices of the Royal Astronomical Society (2018 June 21).

It took a long time to decipher the Egyptian hieroglyphs, the inscriptions of the pyramids. It finally succeeded with the help of the so-called Rosetta Stone found in 1799. This stele was inscribed with three versions of the same text – one in Ancient Egyptian using hieroglyphic script, one in Demotic script, and the bottom one in Ancient Greek. Realizing that it is the same text, the enigmatic hieroglyphs could be deciphered and translated with the help of the ancient Greek language. This discovery opened up a whole new window to understand the ancient Egyptian culture. A research team now has deciphered the jet of a galaxy which has been named the Rosetta Stone of blazars. Blazars are active galactic nuclei where a central supermassive black hole is being fed.

The well-known galaxy OJ 287 at a distance of about 3.5 billion light years harbors at least one supermassive black hole weighing Millions to Billions of solar masses. The supermassive black hole is active ...Read More...

Special Read:

NASA reveals new plan to stop asteroids before they hit Earth

Artistic illustration of an asteroid approaching Earth. Dieter Spannknebel / Getty Images

NASA has updated its plans to deflect potentially hazardous Earth-bound asteroids — and none of them involve Bruce Willis.

The White House Office of Science and Technology Policy released a new report Thursday titled the "National Near-Earth Object Preparedness Strategy and Action Plan." The 18-page document outlines the steps that NASA and the Federal Emergency Management Agency will take over the next 10 years to both prevent dangerous asteroids from striking Earth and prepare the country for the potential consequences of such an event.

Officials with NASA, FEMA and the White House discussed the new asteroid-mitigation strategies in a teleconference with the media on Thursday. "An asteroid impact is one of the possible scenarios that we must be prepared for," Leviticus Lewis, chief of FEMA's National Response Coordination Branch, said on the teleconference, adding that a catastrophic asteroid strike is "a low-probability but high-consequence event" for which "some degree of preparedness is necessary."

"This plan is an outline not only to enhance the hunt for hazardous asteroids, but also to better predict their chances of being an impact threat well into the future and the potential effects that it could have on Earth," NASA's planetary defense officer Lindley Johnson said. Johnson added that the plan will help NASA "step up our efforts to demonstrate possible asteroid deflection and other mitigation techniques, and to better formalize across the U.S. government the processes and protocols for dissemination of the best information available so that timely decisions can be made."

Protecting Earth from incoming asteroids will be a huge job, but don't expect astronauts to do it, NASA said. "That's something relegated to the movies — it makes a good movie, but we do not see in our studies any technique that would require the involvement of astronauts," Johnson said, adding that all of NASA's proposed asteroid-deflection techniques "would all be done by robotic spacecraft." ...Read More...

This Week's Sky at a Glance
June 23-29, 2018

Jun 23	Sa	22:47	Moon-Jupiter: 4.6° S
Jun 25	Mo	01:37	Mercury-Pollux: 4.8° S
Jun 27	We	16:25	Saturn Opposition
Jun 28	Th	07:59	Moon-Saturn: 2° S
		08:53	Full Moon
		18:30	Moon South Dec.: 20.8° S

Asteroid Day
June 30, 2018
Daily Activities (June 24-30, 2018)

No.	Activity	June 24	June 25	June 26	June 27	June 28	June 29	June 30
1	Special Planetarium Show - (Kuiper, Oort...)	√	√	√	√	x		√
2	General Lecture - Space Debris (Special Video Presentation) – Time: 1:30 – 2:30 pm (Weekdays) / 6-7 pm (Saturday)	Marwan	Talafha	Salma	Rihan	x		Ilias
3	Asteroid Night Observation – Vesta Observation (7:15 – 9:00 pm) - Talafha / Ilias	√	√	√	√	√		√
4	Meteorite Quiz (Marwan – Salma)	√	√	√	√	x		√
5	Visit to SCASS Meteorite Center - (Lab. Research Team)	√	√	√	√	√		√
6	Visit to UAE Meteor Monitoring Network (SCASS) - (Lab. Research Team)	√	√	√	√	√		√
7	UFO Space Debris Simulations (SCASS) - (Lab. Research Team)	√	√	√	√	√		√