

# Astronomy & Physics Weekly News

Dept. of Applied Physics & Astronomy - University of Sharjah

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## SCASS ACTIVITIES:

**- Saturday's Monthly Lecture**

**(Oct. 01, 2016 - 18:00 - 19:00)**

**Multiwavelength Astronomy**



**This Week's Sky at a Glance,**

**Sep. 24-30**

## Scientists confirm the universe has no direction



File Image.

The universe is not spinning or stretched in any particular direction, according to the most stringent test yet.

Looking out into the night sky, we see a clumpy universe: planets orbit stars in solar systems and stars are grouped into galaxies, which in turn form enormous galaxy clusters. But cosmologists assume this effect is only local: that if we look on sufficiently large scales, the universe is actually uniform.

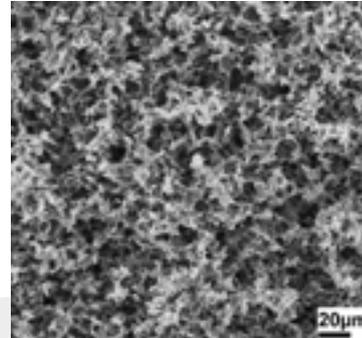
The vast majority of calculations made about our universe start with this assumption: that the universe is broadly the same, whatever your position and in whichever direction you look.

If, however, the universe was stretching preferentially in one direction, or spinning about an axis in a similar way to the Earth rotating, this fundamental assumption, and all the calculations that hinge on it, would be wrong. Now, scientists from University College London and Imperial College London have put this assumption through its most stringent test yet and found only a 1 in 121,000 chance that the universe is not the same in all directions. Oldest light in the universe

To do this, they used maps of the cosmic microwave background (CMB) radiation: the oldest light in the universe created shortly after the Big Bang. The maps were produced using measurements of the CMB taken between 2009 and 2013 by the European Space Agency's Planck satellite, providing a picture of the intensity and, for the first time, polarisation (in essence, the orientation) of the CMB across the whole sky.

Previously, scientists had looked for patterns in the CMB map that might hint at a rotating universe. The new study considered the widest possible range of universes with preferred directions or spins and determined what patterns these would create in the CMB. A universe spinning about an axis, for example, would create [...Read More...](#)

## Breakthrough in materials science: Kiel research team can bond metals with nearly all surfaces



The targeted etching process of "nanoscale-sculpturing" roughens the upper layer of metal (here aluminium, 20 µm = 0.02 mm), thereby creating a 3-D structure with tiny hooks. A surface treated with this process can inter-lock like a three-dimensional puzzle with the surfaces of almost all other materials, forming unbreakable bonds. With this method, it is even possible to create bonds between aluminum and copper. CREDIT: Melike Baytekin?Gerngross

Through this "nanoscale-sculpturing" process, metals such as aluminium, titanium, or zinc can permanently be joined with nearly all other materials, become water-repellent, or improve their biocompatibility. The potential spectrum of applications of these "super connections" is extremely broad, ranging from metalwork in industry right through to safer implants in medical technology. Their results have now been published in the prestigious journal *Nanoscale Horizons* of the Royal Society of Chemistry.

"We have now applied a technology to metals that was previously only known from semiconductors. To use this process in such a way is completely new," said Dr. Jurgen Carstensen, co-author of the publication. In the process, the surface of a metal is converted into a semiconductor, which can be chemically etched and thereby specifically modified as desired.

"As such, we have developed a process which - unlike other etching processes - does not damage the metals, and does not affect their stability," emphasised Professor Rainer Adelung, head of the "Functional Nanomaterials" team at the Institute for Materials Science. Adelung stressed the importance of the discovery: "In this way, we can permanently connect metals which could previously not be directly joined, such as copper and aluminium."

**How does the "nanoscale-sculpturing" process work exactly?** The surfaces of metals consist of many different crystals and grains, some of which are less chemically stable than others. These unstable particles can be specifically removed from the surface of a metal by a targeted etching. The top surface layer is roughened by the etching process, creating a three-dimensional surface [...Read More...](#)

## Physicists reveal the role of diffusion in the early Universe



Abstraction on a theme "Helium in the early Universe" Image source - MIPT PR team

Scientists from the Space Research Institute of the Russian Academy of Sciences (IKI RAS), the Moscow Institute of Physics and Technology (MIPT), and the Max Planck Institute for Astrophysics (MPA) have shown that diffusion of gas particles during the formation of the first structures in the early Universe could have impacted the relative abundance of helium and hydrogen in the first galaxies. According to their calculations, the diffusion-induced element abundance changes are comparable to the precision of current cosmological measurements.

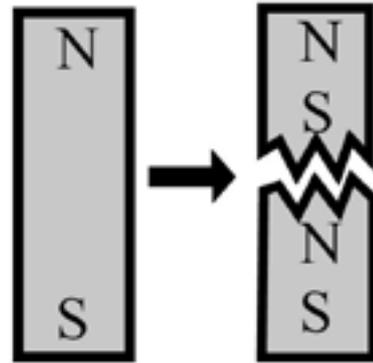
This means that the observed hydrogen and helium abundance may differ from theoretical predictions. The research was published in the Monthly Notices of the Royal Astronomical Society.

The scientists want to know what role diffusion played in the formation of the first stars and galaxies. The reason for their heightened interest is that the accuracy of direct measurements of primordial elements abundance has been steadily improving.

To describe the state of the Universe during all stages of its development, physicists assign values to the so-called cosmological parameters. Among them are the Hubble parameter, which determines the rate of expansion of the Universe, and the parameters that specify the matter and dark energy content in the Universe. The values of these parameters vary with time.

Knowing their right values for the different stages of the evolution of the Universe would allow physicists to arrive at a correct cosmological model and peer billions of years into the past or into the future. Techniques have been developed to compute the value of the cosmological parameters with a high degree of precision. One of these techniques is the direct observation of primordial elements abundance. This allows scientists to determine the baryon-to-photon ratio, which reveals [...Read More...](#)

## Many theories predict existence of magnetic monopoles, but experiments have yet to see them



It is impossible to make magnetic monopoles from a bar magnet. Credit: Wikipeda/CCO

If you chop a magnet in half, you end up with two smaller magnets. Both the original and the new magnets have "north" and "south" poles.

But what if single north and south poles exist, just like positive and negative electric charges? These hypothetical beasts, known as "magnetic monopoles," are an important prediction in several theories.

Like an electron, a magnetic monopole would be a fundamental particle. Nobody has seen one yet, but many—maybe even most—physicists would say monopoles probably exist.

"The electric and magnetic forces are exactly the same force," says Wendy Taylor of Canada's York University. "Everything would be totally symmetric if there existed a magnetic monopole. There is a strong motivation by the beauty of the symmetry to expect that this particle exists."

### Dirac to the future

Combining the work of many others, nineteenth-century physicist James Clerk Maxwell showed that electricity and magnetism were two aspects of a single thing: the electromagnetic interaction.

But in Maxwell's equations, the electric and magnetic forces weren't quite the same. The electrical force had individual positive and negative charges. The magnetic force didn't. Without single poles—monopoles—Maxwell's theory looked asymmetrical, which bugged him. Maxwell thought and wrote a lot about the problem of the missing magnetic charge, but he left it out of the final version of his equations. Quantum pioneer Paul Dirac picked up the monopole mantle in the early 20th century. By Dirac's time, physicists had discovered electrons and determined they were indivisible particles, carrying a [...Read More...](#)

## Pluto's 'heart' sheds light on a possible buried ocean



Pluto's famous "heart," half of which was created by an ancient impact, offers clues about a possible subsurface ocean. Credit: NASA/APL/SwRI

Ever since NASA's New Horizons spacecraft flew by Pluto last year, evidence has been mounting that the dwarf planet may have a liquid ocean beneath its icy shell. Now, by modeling the impact dynamics that created a massive crater on Pluto's surface, a team of researchers has made a new estimate of how thick that liquid layer might be.

The study, led by Brown University geologist Brandon Johnson and published in *Geophysical Research Letters*, finds a high likelihood that there's more than 100 kilometers of liquid water beneath Pluto's surface. The research also offers a clue about the composition of that ocean, suggesting that it likely has a salt content similar to that of the Dead Sea.

"Thermal models of Pluto's interior and tectonic evidence found on the surface suggest that an ocean may exist, but it's not easy to infer its size or anything else about it," said Johnson, who is an assistant professor in Brown's Department of Earth, Environmental and Planetary Sciences. "We've been able to put some constraints on its thickness and get some clues about composition."

The research focused on Sputnik Planum, a basin 900 kilometers across that makes up the western lobe the famous heart-shaped feature revealed during the New Horizons flyby. The basin appears to have been created by an impact, likely by an object 200 kilometers across or larger.

The story of how the basin relates to Pluto's putative ocean starts with its position on the planet relative to Pluto's largest moon, Charon. Pluto and Charon are tidally locked with each other, meaning they always show each other the same face as they rotate. Sputnik Planum sits directly on the tidal axis linking the two worlds. That position suggests that the basin has what's called a positive mass anomaly—it has more mass than average for Pluto's icy crust. As Charon's gravity pulls on Pluto, it would pull proportionally more on areas of higher mass, which would tilt the planet until Sputnik Planum became aligned with the tidal axis. [...Read More...](#)

## NASA iTech Fosters Technology Needed for Journey to Mars



File Image.

NASA is seeking innovative technology for the agency's future exploration missions in the solar system and beyond, including the Journey to Mars, from other U.S. government agencies, academia, the aerospace industry and the public through the new iTech initiative.

NASA's iTech initiative is a yearlong effort to find innovative ideas through a call for white papers that address challenges that will fill gaps in five critical areas identified by NASA as having a potential impact on future exploration.

The technology areas are: radiation protection; life support systems in space; astronaut crew health; in-space propulsion; and the ability to achieve very high-resolution measurements of key greenhouse gases.

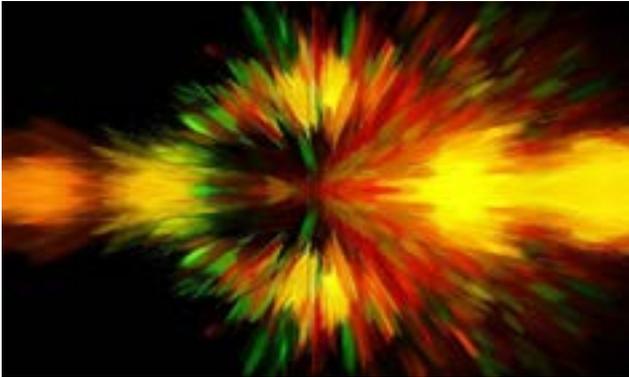
"NASA has programs to address the agency's current exploration goals, but we want to also include non-traditional innovators we haven't heard from before," said Kira Blackwell, Innovation program executive within NASA's Office of the Chief Technologist in Washington. "NASA's iTech is a collaborative effort with other agencies, universities, industry and the public to help us reach mutually beneficial technology goals."

The iTech initiative is open to U.S. citizens, universities, organizations and businesses. The call for papers opens Sept. 21 and closes Oct. 17. A panel of subject matter experts will review the papers and down-select the top 10 finalists based on their relevance and potential impact in the technology topic areas.

The top 10 finalists will be invited to present their solutions at the NASA iTech Forum at NASA Headquarters in Washington from Dec. 5-8. As part of the forum, top innovators will have the opportunity to discuss their work with industry participants and explore new technology development partnerships.

NASA iTech is an initiative by the Office of the Chief Technologist and managed by the National Institute of Aerospace (NIA) in Hampton, Virginia. NIA will [...Read More...](#)

## Physicists retrieve 'lost' information from quantum measurements



Credit: CCO Public Domain

Typically when scientists make a measurement, they know exactly what kind of measurement they're making, and their purpose is to obtain a measurement outcome. But in an "unrecorded measurement," both the type of measurement and the measurement outcome are unknown.

Despite the fact that scientists do not know this information, experiments clearly show that unrecorded measurements unavoidably disturb the state of the system being measured for quantum (but not classical) systems. In classical systems, unrecorded measurements have no effect.

Although the information in unrecorded measurements appears to be completely lost, in a paper published recently in EPL, Michael Revzen and Ady Mann, both Professors Emeriti at the Technion-Israel Institute of Technology, have described a protocol that can retrieve some of the lost information.

The fact that it is possible to retrieve this lost information reveals new insight into the fundamental nature of quantum measurements, mainly by supporting the idea that quantum measurements contain both quantum and classical components.

Previously, analysis of quantum measurement theory has suggested that, while a quantum measurement starts out purely quantum, it becomes somewhat classical when the quantum state of the system being measured is reduced to a "classical-like" probability distribution. At this point, it is possible to predict the probability of the result of a quantum measurement.

As the physicists explain in the new paper, this step when a quantum state is reduced to a classical-like distribution is the traceable part of an unrecorded measurement—or in other words, it is the "lost" information that the new protocol retrieves. So the retrieval of the lost information provides evidence of the quantum-to-classical transition in a quantum measurement. [...Read More...](#)

## Towards quantum Internet: Researchers teleport particle of light six kilometres



Wolfgang Tittel, professor in the Department of Physics and Astronomy at the University of Calgary. Credit: Riley Brandt, University of Calgary

What if you could behave like the crew on the Starship Enterprise and teleport yourself home or anywhere else in the world? As a human, you're probably not going to realize this any time soon; if you're a photon, you might want to keep reading.

Through a collaboration between the University of Calgary, The City of Calgary and researchers in the United States, a group of physicists led by Wolfgang Tittel, professor in the Department of Physics and Astronomy at the University of Calgary have successfully demonstrated teleportation of a photon (an elementary particle of light) over a straight-line distance of six kilometres using The City of Calgary's fibre optic cable infrastructure. The project began with an Urban Alliance seed grant in 2014.

This accomplishment, which set a new record for distance of transferring a quantum state by teleportation, has landed the researchers a spot in the prestigious Nature Photonics scientific journal. The finding was published back-to-back with a similar demonstration by a group of Chinese researchers.

"Such a network will enable secure communication without having to worry about eavesdropping, and allow distant quantum computers to connect," says Tittel.

### Experiment draws on 'spooky action at a distance'

The experiment is based on the entanglement property of quantum mechanics, also known as "spooky action at a distance"—a property so mysterious that not even Einstein could come to terms with it.

"Being entangled means that the two photons that form an entangled pair have properties that are linked regardless of how far the two are separated," explains Tittel. "When one of the photons was sent over to City Hall, it remained entangled with the photon that stayed at the University of Calgary." [...Read More...](#)

## ALMA uncovers secrets of Giant Space Blob



This rendering shows a snapshot from a cosmological simulation of a Lyman-alpha Blob similar to LAB-1. This simulation tracks the evolution of gas and dark matter using one of the latest models for galaxy formation running on the NASA Pleiades supercomputer. This view shows the distribution of gas within the dark matter halo, colour coded so that cold gas (mainly neutral hydrogen) appears red and hot gas appears white. Embedded at the centre of this system are two strongly star-forming galaxies, but these are surrounded by hot gas and many smaller satellite galaxies that appear as small red clumps of gas here. Lyman-alpha photons escape from the central galaxies and scatter off the cold gas associated with these satellites to give rise to an extended Lyman-alpha Blob. Credit: J.Geach/D.Narayanan/R.Crain

An international team using ALMA, along with ESO's Very Large Telescope and other telescopes, has discovered the true nature of a rare object in the distant universe called a Lyman-alpha blob.

Up to now astronomers did not understand what made these huge clouds of gas shine so brightly, but ALMA has now seen two galaxies at the heart of one of these objects and they are undergoing a frenzy of star formation that is lighting up their surroundings. These large galaxies are in turn at the centre of a swarm of smaller ones in what appears to be an early phase in the formation of a massive cluster of galaxies. The two ALMA sources are expected to evolve into a single giant elliptical galaxy.

Lyman-alpha blobs (LABs) are gigantic clouds of hydrogen gas that can span hundreds of thousands of light-years and are found at very large cosmic distances. The name reflects the characteristic wavelength of ultraviolet light that they emit, known as Lyman-alpha radiation. Since their discovery, the processes that give rise to LABs have been an astronomical puzzle. But new observations with ALMA may now have now cleared up the mystery.

One of the largest Lyman-alpha blobs known, and the most thoroughly studied, is SSA22-Lyman-alpha Blob 1, or LAB-1. Embedded in the core of a huge cluster of galaxies in the early stages of formation, it was the very first such object to be discovered - in 2000 - and is located so far away that its light has taken about 11.5 billion years to reach us. [...Read More...](#)

## Feeding a Mars mission: the challenges of growing plants in space



Illustration only.

Plants will play a critical role in the survival of human beings on long-duration space missions, such as a mission to Mars. However, as a paper published in *Botany Letters* shows, many challenges need to be addressed if astronauts are to successfully grow enough food on board spacecraft and on other planets.

Lucie Poulet and colleagues from the University of Clermont-Ferrand, Auvergne outline in their review that while healthy plants can be grown in space, the long-term effects of the space environment on plant growth and reproduction are not yet well known.

Since the 1960s, experiments conducted in space stations and research rockets have shown that plants can grow normally in microgravity provided factors such as confinement, lack of ventilation and elevated radiation levels are taken into account.

However, microgravity can reduce cell growth, alter gene expression and change the pattern of root growth - all aspects which critically affect plant cultivation in space.

Seeds produced in orbit also seem to have different composition and developmental stages from seeds grown on Earth. As well as affecting the performance and nutritional content of space seeds, this could damage the flavour of plants produced in space, which might become a problem for crews reliant on plant-based diets during long space missions.

While there appears to be no major obstacle to plant growth in space, large-scale tests for food production in reduced gravity are still lacking, and a number of viable technologies for space agriculture need to be developed.

These include efficient watering and nutrient-delivery systems, precise atmospheric controls for temperature, humidity and air composition, and low-energy lighting which could include sun collection systems that take advantage of sunlight on the surface of planets and moons. Selecting the right crops to grow in space is also essential. Given the limited amount of room available on [...Read More...](#)

## Hubble finds planet orbiting Entropy pair of stars



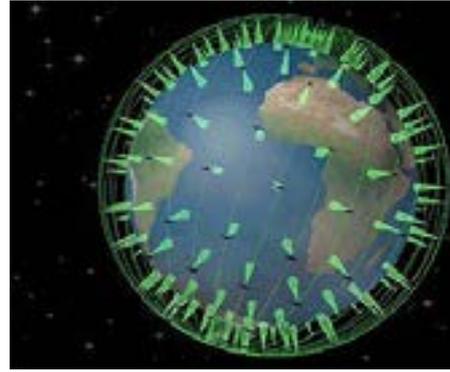
This artist's illustration shows a gas giant planet circling a pair of red dwarf stars. The Saturn-mass planet orbits roughly 300 million miles from the stellar duo. The two red dwarf stars are a mere 7 million miles apart. The illustration is based on Hubble Space Telescope observations that helped astronomers confirm the existence of a planet orbiting two stars in the system OGLE-2007-BLG-349, located 8,000 light-years away. The system is too far away for Hubble to photograph the planet. Instead, its presence is inferred from gravitational microlensing. This phenomenon occurs when the gravity of a foreground star bends and amplifies the light of a background star that momentarily aligns with it. The particular character of the light magnification can reveal clues to the nature of the foreground star and any associated planets. The Hubble observations represent the first time such a three-body system has been confirmed using the gravitational microlensing technique. Credit: NASA, ESA, and G. Bacon (STScI).

Two's company, but three might not always be a crowd – at least in space. Astronomers using NASA's Hubble Space Telescope, and a trick of nature, have confirmed the existence of a planet orbiting two stars in the system OGLE-2007-BLG-349, located 8,000 light-years away towards the center of our galaxy.

The planet orbits roughly 300 million miles from the stellar duo, about the distance from the asteroid belt to our sun. It completes an orbit around both stars roughly every seven years. The two red dwarf stars are a mere 7 million miles apart, or 14 times the diameter of the moon's orbit around Earth.

The Hubble observations represent the first time such a three-body system has been confirmed using the gravitational microlensing technique. Gravitational microlensing occurs when the gravity of a foreground star bends and amplifies the light of a background star that momentarily aligns with it. The particular character of the light magnification can reveal clues to the nature of the foreground star and any associated planets.

The three objects were discovered in 2007 by an international collaboration of five different groups: Microlensing Observations in Astrophysics (MOA), the Optical Gravitational Lensing Experiment (OGLE), the Microlensing Follow-up Network (MicroFUN), the Probing Lensing Anomalies Network (PLANET), and the [...Read More...](#)



Constellations with hundreds of satellite are being proposed and developed.

"Entropy" is defined as a thermodynamic quantity representing the unavailability of a system's thermal energy for conversion into mechanical work. Many use this term to describe the degree of disorder or randomness in a system. A third definition is a lack of order or predictability with gradual decline into disorder.

The second law of thermodynamics tells us that entropy always increases as available useful work decreases. Some managers in the space community use this term to represent a loss of productivity, innovation and enthusiasm within an organization.

Let's take the space program as an example. At the dawn of space flight in 1957, there was no entropy associated with space exploration excitement and interest. Almost all available energy was used to innovate, develop, experiment and test space systems. This was an ideal system for advancing space exploitation.

A number of great and exciting things were accomplished in the beginning: the development of early communications satellites, the first planetary probes, men landing on the moon and returning safely, and the Space Shuttle. However, after the race to the Moon, enthusiasm and interest started to wane. Excitement and interest in the civil space arena started a long period of decline.

At the same time the level of bureaucracy within civil space organizations began to increase. The rate of entropy increase grew, even though the Space Shuttle and ISS programs were successful. In the meantime, the growth rate of entropy within national security space and commercial space was kept a low levels.

National security space participants are highly challenged and dedicated. Entropy growth is kept low by the required high levels of focus on the contested space environment that has evolved over the past 20 years. Low earth orbits are extremely congested traffic zones. Individual satellites and constellation crowd the heavens between the altitudes of 600 km and 1200 km above Earth. There are probably over 100 active national security satellites in this zone that are operated by several nation states, some of which are allies [...Read More...](#)

## This Week's Sky at a Glance, Sep. 24-30

<b>Sep 26</b>	06 Jupiter in conjunction with Sun (Local Time: 10:00)
<b>Sep 28</b>	Regulus 1.7°North of Moon (Local Time: 02:32)
<b>Sep 28</b>	Mercury at perihelion (Local Time: 19:00)
<b>Sep 28</b>	Mercury at greatest elongation: 18°W (Local Time: 23:16)
<b>Sep 29</b>	Moon at ascending node (Local Time: 02:06)
<b>Sep 29</b>	Mercury 0.7°North of Moon: occultation (Local Time: 14:42)

## SCASS Saturday Monthly Lecture - Oct. 01, 2016

<b>Lecture:</b>	Multiwavelength Astronomy
<b>Speaker:</b>	Dr. Ilias M. Fernini - UoS/SCASS
<b>Date:</b>	Oct. 01, 2016
<b>Time:</b>	18:00 - 19:00
<b>Location:</b>	SCASS Auditorium

## Prof. Hamid Al-Naimiy Meeting with SCASS Staff on Wed., Sep. 21, 2016

Prof. Hamid Al-Naimiy, the Chancellor of the University of Sharjah and the General Director of the Sharjah Center for Astronomy and Space Sciences met with the SCASS's staff members to discuss the center activities and latest news. Prof. Hamid reiterated the trust and the support of His Highness Sheikh Dr. Sultan bin Muhammad Al Qasimi, the Ruler of Sharjah, and Chairman of the Board and President of UoS, to the center. The main role of the center is to promote the astronomy and space sciences culture to the youth of the United Arab Emirates and their future integration in all space sciences research activities at the center.

Prof. Hamid took the occasion to distribute certificates of appreciation to all those who have contributed to the success of the first summer camp at SCASS.



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