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Astronomy & Physics Weekly News

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Top News

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Astronomers saw the first mass eruption from a star that's not the sun

I SPY On the sun, flares such as this one are often followed by an eruption of plasma and charged particles. Astronomers have now seen the first such coronal mass ejection from another star.

The coronal mass ejection was as massive as scientists expected, but less energetic.

For the first time, a stellar eruption called a coronal mass ejection has been spotted fleeing a distant star.

Such outbursts of plasma and charged particles are well-known on the sun, and commonly follow a burst of light called a solar flare (SN Online: 4/17/15). Astronomers had detected flares on other stars, but never a corresponding coronal mass ejection, or CME, until now. The discovery could have implications for the prospects for life on planets in other star systems.

The ejection in question relates to a flare that was actually detected 10 years ago, from a giant star called HR 9024 about 450 light-years from Earth. The star is about three times as massive as the sun and 10 times as wide.

Astronomer Costanza Argiroffi of the University of Palermo in Italy and colleagues found evidence of the star's outburst using a new method for analyzing data taken with the Chandra X-ray Observatory, Argiroffi told the Cool Stars 20 meeting on August 2.

Argiroffi's team detected material moving up and down a loop of plasma extending from the star's surface during the flare by measuring certain X-rays' Doppler shift — the change in the wavelengths of the X-rays as material moved toward or away from the Earth. The researchers saw more material moving away from the star after the flare had stopped, and interpreted the observation as a coronal mass ejection.

"People have looked for this for a long time, and this is the first time this has been seen," says astrophysicist Julián Alvarado-Gómez of the Harvard-Smithsonian Center for Astrophysics in Cambridge, Mass., who was not involved in the work.

The ejection contained about 1 billion trillion grams of material, which is about what scientists expected based on estimates that extrapolated from the sun's ..Read More...

Study finds flaw in emergent gravity

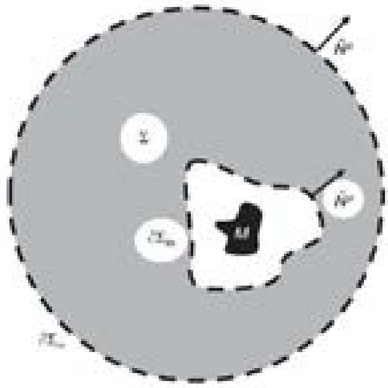


Illustration of a three-dimensional hypersurface. Credit: Wang and Braunstein. Published in Nature Communications

In recent years, some physicists have been investigating the possibility that gravity is not actually a fundamental force, but rather an emergent phenomenon that arises from the collective motion of small bits of information encoded on spacetime surfaces called holographic screens. The theory, called emergent gravity, hinges on the existence of a close connection between gravity and thermodynamics.

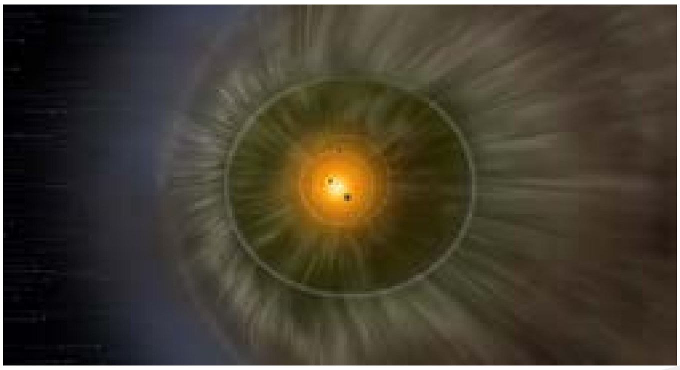
Emergent gravity has received its share of criticism, however, and a new paper adds to this by showing that the holographic screen surfaces described by the theory do not actually behave thermodynamically, undermining a key assumption of the theory.

Zhi-Wei Wang, a physicist at Jilin University in Changchun, China, and Samuel L. Braunstein, a professor of quantum computational science at the University of York in the UK, have published their paper on non-thermodynamic surfaces in a recent issue of Nature Communications.

"Emergent gravity has very strong claims: that it can explain things like dark matter and dark energy, but also reproduce the decades of work coming out of regular general relativity," Wang told Phys.org. "That last claim is now knocked on its head by our work, so emergent gravity proponents will have their work cut out for themselves in showing consistency with the huge canon of observational results. We've set them back, not necessarily knocked them out."

In the cosmological context, surfaces refer generally to any two-dimensional area in spacetime. Some of these surfaces, such as the horizons of black holes and other objects, are confirmed to be thermodynamic. For black hole horizons, this has been known since the 1970s, since the very laws that define black hole mechanics are directly analogous to the laws of thermodynamics. This means that black hole horizons obey thermodynamic principles such as energy conservation and having a positive temperature and entropy. ..Read More...

NASA Spotted a Vast, Glowing 'Hydrogen Wall' at the Edge of Our Solar System



The sun moves through the galaxy encases in a bubble formed by its own solar wind. In front of the sun, galactic debris builds up, inlcuding hydrogen. Credit: Alder Planetarium/NASA

There's a "hydrogen wall" at the edge of our solar system, and NASA scientists think their New Horizons spacecraft can see it.

That hydrogen wall is the outer boundary of our home system, the place where our sun's bubble of solar wind ends and where a mass of interstellar matter too small to bust through that wind builds up, pressing inward. Our host star's powerful jets of matter and energy flow outward for a long stretch after leaving the sun — far beyond the orbit of Pluto. But at a certain point, they peter out, and their ability to push back the bits of dust and other matter — the thin, mysterious stuff floating within our galaxy's walls — wanes. A visible boundary forms. On one side are the last vestiges of solar wind. And on the other side, in the direction of the Sun's movement through the galaxy, there's a buildup of interstellar matter, including hydrogen.

And now NASA researchers are pretty sure that New Horizons, the probe that famously skimmed past Pluto in 2015, can see that boundary.

What New Horizons definitely sees, the researchers reported in a paper published Aug. 7 in the journal Geophysical Research Letters, is some extra ultraviolet light — the kind the researchers would expect such a wall of galactic hydrogen to produce. That replicates an ultraviolet signal the two Voyager spacecraft — NASA's farthest-traveling probes, which launched in the late 1970s — spotted all the way back in 1992. [Images: Dust Grains from Interstellar Space]

However, the researchers cautioned, that signal isn't a sure sign that New Horizons has seen the hydrogen wall, or that Voyager did. All three probes could have actually detected the ultraviolet light from some other source, emanating from much deeper in the galaxy, the researchers wrote.

But Alice, the instrument on board New Horizons responsible for this finding, is much more sensitive ...Read More...

Young star caught devouring its own planet for the very first time

Astronomers have long theorized that newly formed stars can occasionally consume their planets, but until now, they have never observed such a feeding frenzy. This artist's concept illustrates the destruction of a young planet around a star, which can knock material directly into the star itself. NASA/CXC/M. Weiss

Astronomers generally agree that planets form out of the massive disks of leftover debris that surround most newborn stars. As these disks of gas and dust orbit their stars, small clumps of material coalesce, ultimately growing larger and larger until they eventually reach planetary status. However, not all planets make it that far. Sometimes, two nascent planets catastrophically collide — and stars apparently do not mourn their dead.

In a study published July 18 in The Astronomical Journal, a team of researchers announced they may have, for the first time ever, witnessed a star feeding on the leftover remains of one such planetary collision. These novel observations not only show that a star can devour its own planets, but also bring astronomers one step closer to fully understanding how planets form — or in this case, are destroyed.

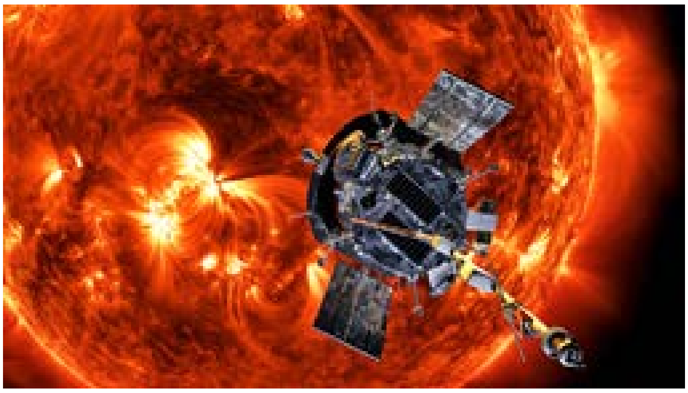
"Computer simulations have long predicted that planets can fall into a young star, but we have never before observed that," said lead author Hans Moritz Günther, a researcher at MIT's Kavli Institute for Astrophysics and Space Research, in a press release. "If our interpretation of the data is correct, this would be the first time that we directly observe a young star devouring a planet or planets."

X-ray specs

To carry out the study, the researchers used NASA's Chandra X-ray Observatory to observe the peculiar star RW Aur A — the largest of a pair of young, low-mass stars in the RW Aur system. The star, which is only 10 million years old and located some 450 light-years from Earth, has drawn astronomers attention since 1937, thanks in large part to the mysterious dimming episodes it experiences.

Every few decades for over 80 years, astronomers watched as the star would fade for about a month before brightening back up again. However, in 2011, astronomers noticed the star dimmed for about six months before returning to its baseline brightness. ..Read More...

How NASA will shield solar probe from crazy heat



Artist's concept of the Parker Solar Probe spacecraft approaching the sun. The mission will provide new data on solar activity and make critical contributions to our ability to forecast major space-weather events that impact life on Earth. Image via NASA.

The Parker Solar Probe, expected to launch Saturday (Aug. 11, 2018), will get closer to the sun than any spacecraft in human history. How will the spacecraft withstand the heat?

A heat shield you can scorch with a blowtorch until it glows red on one side and still comfortably touch on the other will protect a NASA probe flying to within 4 million miles (6.4 million km) of the sun's surface.

The shield is the culmination of years of work by engineers to solve what they call the "thermal problem" of the soon-to-launch Parker Solar Probe. "Thermal problem" is a shorthand way of referring to the extraordinary complications of a record-breaking dive directly into our star's outer atmosphere, or corona.

While the probe orbits the sun and records data with onboard instruments, its thermal protection system will shield the spacecraft from heat more intense than any spacecraft has ever experienced. Combined with a water-powered cooling system, the thermal protection system will keep the majority of the probe's instruments at about 85 degrees Fahrenheit (29.4 degrees C) – the equivalent of a nice summer day – while the TPS itself endures a temperature of 2,500 degrees Fahrenheit (1,371 degrees C).

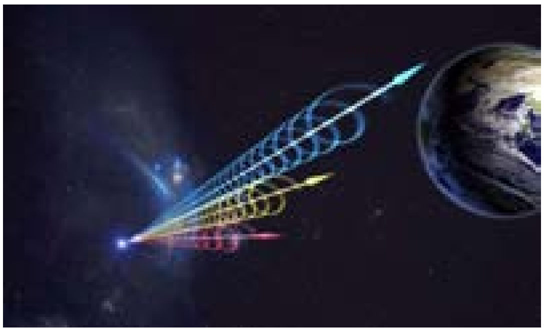
Without the thermal protection system, there's no probe.

Elisabeth Abel is TPS thermal lead at the Johns Hopkins University Applied Physics Laboratory. She said:

This was the technology that enabled us to do this mission – to enable it to fly. It's going to be incredibly exciting to see something you put a lot of energy and hard work into, to see it actually fly. It's going to be a big day.

The Parker Solar Probe is expected to launch Saturday, August 11, 2018, from Kennedy Space Center in Cape Canaveral. (Its launch window opens Saturday, August 11, and runs through August 23.) ...Read More...

Astronomers discover new, enigmatic fast radio burst



Fast Radio Bursts are brief but powerful and as-yet-unexplained bursts of radio energy originating from deep space. Image via Jingchuan Yu/Beijing Planetarium, NRAO.

Fast radio bursts – aka FRBs – are brief, powerful, puzzling bursts of radio waves from deep space. Now astronomers have detected a new and even more unusual type of FRB.

Fast radio bursts (FRBs) are one of the most recent, and puzzling, discoveries yet in astronomy. They are powerful, but very brief, bursts of radio waves from deep space. They've been relatively rare so far, but astronomers continue to study them as they're discovered. On August 1, 2018, astronomers used the Astronomer's Telegram to report on another FRB, just detected, which is a little different from previous ones studied by astronomers.

They detected the new FRB the morning of July 25, using a state-of-the-art radio telescope in the mountains of British Columbia (the Canadian Hydrogen Intensity Mapping Experiment or CHIME). The telescope has been in operation for only about a year and has been used to find several FRBs prior to this one. The astronomers labeled the new discovery as FRB 180725A after the year, month and day it was detected. It was found to be transmitting in radio frequencies as low as 580 megahertz, nearly 200 MHz lower than any other FRBs ever detected. Patrick Boyle, author of the Astronomer's Telegram report and a project manager at CHIME told Live Science on August 3:

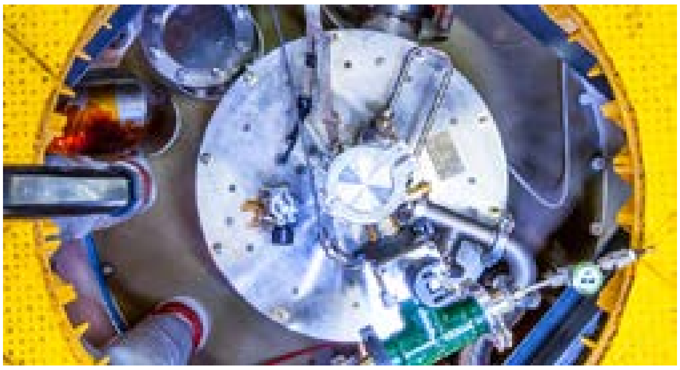
These events have occurred during both the day and night, and their arrival times are not correlated with known on-site activities or other known sources.

The fact that this FRB was of such low frequency indicates that the burst was extremely bright, originating from a very powerful source.

Several other low-frequency bursts have reportedly been detected by CHIME, since FRB 180725A, as well.

So just what are FRBs? As with the discovery of any unusual cosmic phenomena, there is a lot of debate and speculation. They are reminiscent of pulsars, but are extremely brief in duration (only a few milliseconds) and emit an incredible amount of energy in that short time. Some postulated origins include supernovas, supermassive black holes or other sources of intense ..Read More...

Strange metals are even weirder than scientists thought



MAGNETIC PERSONALITY Scientists used a powerful magnet (shown) to reveal the odd behavior of strange metals in strong magnetic fields.

A new insight could help researchers better understand high-temperature superconductors.

Curiouser and curiouser: Strange metals are getting a little stranger.

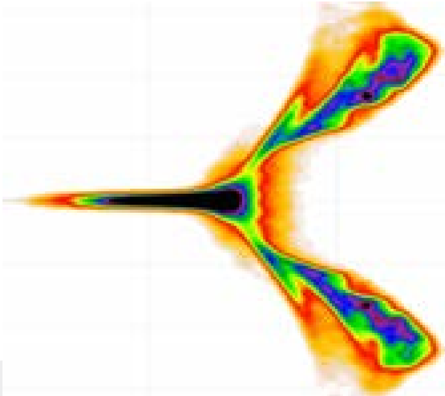
Normal metals such as copper and aluminum are old hat – physicists have a strong grasp on the behavior of the electrons within. But strange metals behave in mysterious ways, and researchers have now uncovered an additional oddity. A type of strange metal called a cuprate behaves unexpectedly when inside a strong magnetic field, the team reports in the Aug. 3 Science.

Strange metals are "really one of the most interesting things to happen in physics" in recent decades, says theoretical physicist Chandra Varma of the University of California, Riverside, who was not involved with the research. The theory that explains the behavior of standard metals can't account for strange metals, so "a completely new kind of fundamental physics" is needed.

The metallic curios' idiosyncrasies relate to their resistivity – how difficult it is for electric current to flow through them. As scientists crank up a strange metal's temperature, its resistivity increases in lockstep: Double the temperature and you double the resistivity. That's unusual: In most metals, the change in resistivity is more complex. For example, at low temperatures, the resistivity of a normal metal like copper would hardly change as the temperature inched up.

Strange metals' behavior flouted the norms of physics, attracting scientists' attention. The materials were "poking in our eye much more than other materials," says physicist Arkady Shekhter of the National High Magnetic Field Laboratory in Tallahassee, Fla. So he and colleagues studied how the cuprate behaved in extremely strong magnetic fields, up to almost 2 million times the strength of Earth's magnetic field. ...Read More...

Mini antimatter accelerator could rival the likes of the Large Hadron Collider



Simulation of groups of positrons being concentrated into a beam and accelerated. Credit: Aakash Sahai

Researchers have found a way to accelerate antimatter in a 1000x smaller space than current accelerators, boosting the science of exotic particles.

The new method could be used to probe more mysteries of physics, like the properties of the Higgs boson and the nature of dark matter and dark energy, and provide more sensitive testing of aircraft and computer chips.

The method has been modelled using the properties of existing lasers, with experiments planned soon. If proven, the technology could allow many more labs around the world to conduct antimatter acceleration experiments.

Particle accelerators in facilities such as the Large Hadron Collider (LHC) in CERN and the Linac Coherent Light Source (LCLS) at Stanford University in the United States, speed up elementary particles like protons and electrons.

These accelerated particles can be smashed together, as in the LHC, to produce particles that are more elementary, like the Higgs boson, which gives all other particles mass.

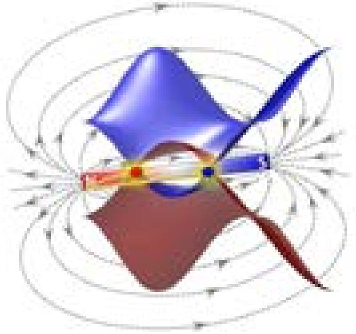
They can also be used to generate X-ray laser light, such as in the LCLS, which is used to image extremely fast and small process, like photosynthesis.

However, to get to these high speeds, the accelerators need to use equipment that is at least two kilometres long. Previously, researchers at Imperial College London had invented a system that could accelerate electrons using equipment only meters long.

Now a researcher at Imperial has invented a method of accelerating the antimatter version of electrons—called positrons—in a system that would be just centimetres long.

The accelerator would require a type of laser system that currently covers around 25 square metres, but that is already present in many physics labs.Dr. Aakash Sahai, from the Department of Physics at Imperial ...Read More...

The marriage of topology and magnetism in a Weyl system



Weyl semimetal with time reversal symmetry broken. The red and blue spheres represent one pair of Weyl points with opposite chirality, which are generated by the intrinsic magnetic moment. The yellow curve is the Fermi arc terminated at this pair of Weyl points. The magnetic moments are schematically described by the magnetic field. Credit: MPI CPfS

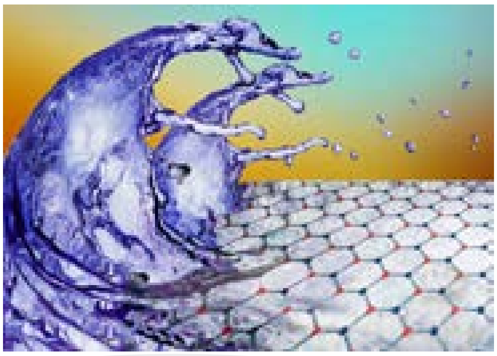
Topology is a global aspect of materials, leading to fundamental new properties for compounds with large relativistic effects. The incorporation of heavy elements gives rise to non-trivial topological phases of matter, such as topological insulators, Dirac and Weyl semimetals. The semimetals are characterized by band-touching points with linear dispersion, similar to massless relativistic particles in high energy physics.

The interplay of symmetry, relativistic effects and, in magnetic materials, the magnetic structure, allows for the realization of a wide variety of topological phases through Berry curvature design. The Berry curvature describes the entanglement of the valence and conduction bands in an energy band structure. Weyl points and other topological electronic bands can be manipulated by various external perturbations like magnetic fields and pressure, which results in exotic local properties such as the chiral or gravitational anomaly and large topological Hall effects, concepts which were developed in other fields of physics such as high energy physics and astrophysics.

Weyl semimetals require broken inversion crystal symmetry or time-reversal symmetry (via magnetic order or an applied magnetic field). So far, no intrinsic magnetic Weyl semimetals with Weyl nodes close to the Fermi energy have been realized. In the recent study, scientists from the Max Planck Institute for Chemical Physics of Solids in Dresden, in collaboration with the Technische Universität Dresden, scientists from Beijing, Princeton, Oxford, and others found evidence for Weyl physics in the magnetic shandites $Co_3Sn_2S_2$. The family of shandite crystals contains transition metals on a quasi two-dimensional Kagome lattice that can give rise to magnetism. One of the most interesting is $Co_3Sn_2S_2$, which has the highest magnetic ordering temperature within this family and in which the magnetic moments on the Co atoms are aligned in a direction perpendicular to the Kagome plane.

The observation of the quantum anomalous Hall effect at room temperature would allow for novel computing technologies including quantum computing. ...Read More...

Scientists solve open theoretical problem on electron interactions



The open problem was what controlled the velocity of the electron liquid (shown as a wavy waterfront). The findings show that it is the frozen antiferromagnetism on the honeycomb lattice that sets this velocity by slowing it down as the two interact. Credit: Yale-NUS College

Yale-NUS Associate Professor of Science (Physics) Shaffique Adam is the lead author of a recent work that describes a model for electron interaction in Dirac materials, a class of materials that includes graphene and topological insulators, solving a 65-year-old open theoretical problem in the process. The discovery will help scientists better understand electron interaction in new materials, paving the way for developing advanced electronics such as faster processors. The work was published in the peer-reviewed academic journal Science on 10 August 2018.

Electron behaviour is governed by two major theories—the Coulomb's law and the Fermi liquid theory. According to Fermi liquid theory, electrons in a conductive material behave like a liquid—their "flow" through a material is what causes electricity. For Dirac fermions, the Fermi liquid theory breaks down if the Coulomb force between the electrons crosses a certain threshold—the electrons "freeze" into a more rigid pattern which inhibits the "flow" of electrons, causing the material to become non-conductive.

For more than 65 years, this problem was a mathematical curiosity, because Dirac materials where the Coulomb threshold was reached did not yet exist. Today, however, we routinely make use of quantum materials for applications in technology, such as transistors in processors, where the electrons are engineered to have desired properties, including those that push the Coulomb force past this threshold. But the effects of strong electron-electron interaction can only be seen in very clean samples.

In the work immediately following his Ph.D., Associate Professor Adam proposed a model to describe experimentally available Dirac materials that were "very dirty," meaning they contain a lot of impurities. However, in the years that followed, newer and cleaner materials have been made, and the older theory no longer worked.

In this latest work, titled "The role of electron-electron interactions in two-dimensional Dirac ...Read More...

Another blow for the dark matter interpretation of the galactic centre excess

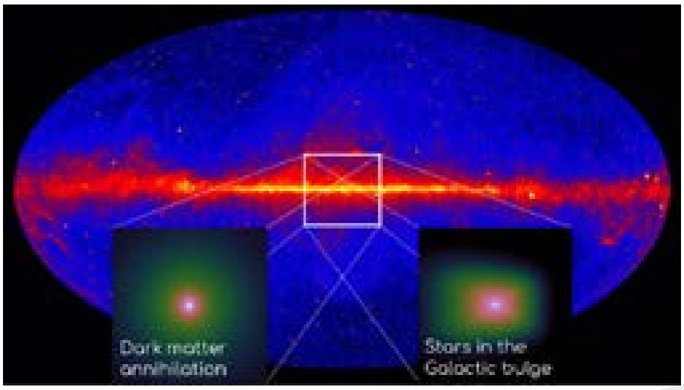


Figure 1: Observed gamma ray emission from the Galactic disk, with the bulge region indicated. The insets show the expected profiles of excess radiation coming from dark matter and stars respectively. The researchers were able to show that the stars profile matches the measurements much better than the dark matter profile. Credit: Christoph Weniger, University of Amsterdam/FermiLAT

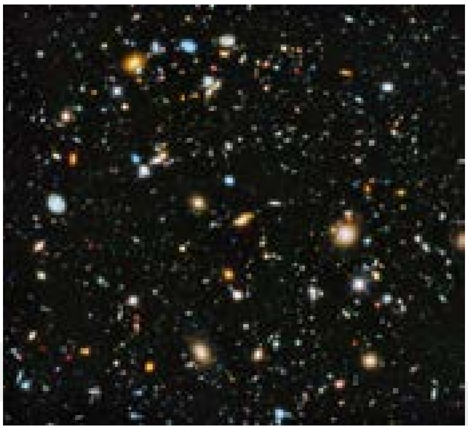
For almost 10 years, astronomers have been studying a mysterious diffuse radiation coming from the centre of our galaxy. Originally, it was thought that this radiation could originate from the elusive dark matter particles that many researchers are hoping to find. However, physicists from the University of Amsterdam and the Laboratoire d"Annecy-le-Vieux de Physique Théorique have now found further evidence that rapidly spinning neutron stars are a much more likely source for this radiation. Their findings are published today in Nature Astronomy.

Observations of gamma-ray radiation from the galactic centre region with the Fermi Large Area Telescope have revealed a mysterious diffuse and extended emission. Discovered almost 10 years ago, this emission generated a lot of excitement in the particle physics community, since it had all the characteristics of a long-sought signal from the self-annihilation of dark matter particles in the inner galaxy. Finding such a signal would confirm that dark matter, which has so far has only been observed through its gravitational effects on other objects, is made out of new fundamental particles. Moreover, it would help to determine the mass and other properties of these elusive dark matter particles. However, a recent study shows that arguably the best astrophysical interpretation of the excess emission is a new population in the galactic bulge of thousands of rapidly spinning neutron stars called millisecond pulsars, which have escaped observation at other frequencies up to now.

Where there are stars, there is radiation

"Understanding in detail the morphology [the location and shape] and spectrum [the combined frequencies] of the excess emission is of vital importance for discriminating between the dark matter and astrophysical interpretations of the galactic centre excess radiation," ...Read More...

The universe's rate of expansion is in dispute – and we may need new physics to solve it



Colorful view of universe as seen by Hubble in 2014. Credit: NASA, ESA, H. Teplitz and M. Rafelski (IPAC/Caltech), A. Koekemoer (STScI), R. Windhorst (Arizona State University), and Z. Levay (STScI)

Next time you eat a blueberry (or chocolate chip) muffin consider what happened to the blueberries in the batter as it was baked. The blueberries started off all squished together, but as the muffin expanded they started to move away from each other. If you could sit on one blueberry you would see all the others moving away from you, but the same would be true for any blueberry you chose. In this sense galaxies are a lot like blueberries.

Since the Big Bang, the universe has been expanding. The strange fact is that there is no single place from which the universe is expanding, but rather all galaxies are (on average) moving away from all the others. From our perspective in the Milky Way galaxy, it seems as though most galaxies are moving away from us – as if we are the centre of our muffin-like universe. But it would look exactly the same from any other galaxy – everything is moving away from everything else.

To make matters even more confusing, new observations suggest that the rate of this expansion in the universe may be different depending on how far away you look back in time. This new data, published in the Astrophysical Journal, indicates that it may time to revise our understanding of the cosmos.

Hubble's challenge

Cosmologists characterise the universe's expansion in a simple law known as Hubble's Law (named after Edwin Hubble – although in fact many other people preempted Hubble's discovery). Hubble's Law is the observation that more distant galaxies are moving away at a faster rate. This means that galaxies that are close by are moving away relatively slowly by comparison.

The relationship between the speed and the distance of a galaxy is set by "Hubble's Constant", which is about 44 miles (70km) per second per Mega ... Read More...

Special Read:

Perseids are peaking this weekend!

Perseids - Montana - John Ashley - 2016

The composite image above – from John Ashley at Glacier National Park in Montana, in 2016 – perfectly captures the feeling of standing outside as dawn is approaching, after a peak night of Perseid meteor-watching. As viewed from anywhere in the Northern Hemisphere, the Perseids' radiant point is highest at dawn, and so the meteors rain down from overhead.

When is the peak of the Perseid meteor shower in 2018? The best mornings will likely be August 12 and 13. The morning of August 11 is worth trying, too, as the Perseids are known to rise gradually to their peak. The best news is, in 2018, the moon is gone from the night sky! The peak may bring 50 to 60 – or more – meteors per hour, assuming you've given yourself optimum conditions for meteor-watching.

Those optimum conditions are simple to attain. Go to a country location, far from city lights. And watch during the hours between late evening (around midnight) and dawn.

Can't get out of town? Then go to the darkest sky you can find near you (a beach? a park?) as late at night as you can. Situate yourself in the shadow of a tree or building, if there are lights around. Look up, and hope for the best! Who knows ... you might catch a shooting star.

The fact is, this weekend is wonderful for meteor-watching. Enjoy it! We won't have such gloriously moon-free nights for the Perseids again until 2021.

Can you watch the shower in the evening hours? From the Northern Hemisphere, you might see a smattering of Perseid meteors in the evening (assuming you're watching in a dark sky). Plus, mid-evening is the best time of night to try to catch an earthgrazer, which is an elongated, long-lasting meteor that travels horizontally across the sky. Earthgrazers are rare but most memorable if you're lucky enough to spot one.

What if you're in the Southern Hemisphere? From the Southern Hemisphere, the first meteors – and possible earth-grazers – won't be flying until midnight or the wee hours of the morning.

In either the Northern or the Southern Hemisphere, the greatest number of meteors streak the sky in the few hours before dawn.

The Perseid meteors happen around this time every year, as Earth in its orbit crosses the orbital path of Comet Swift-Tuttle. Dusty debris left behind by this comet smashes into Earth's upper atmosphere, lighting up the nighttime as fiery Perseid meteors. The meteors start out slowly in the evening hours, begin to pick up steam after midnight and put out the greatest numbers in the dark hours before dawn. ..Read More...

Dhu'l Hijjah 1439 AH Crescent Report

Basic Astronomical Information about the observations of the crescent of Dhu'l Hijjah 1439 AH:

	Aug. 112018	Aug. 12, 2018
New Moon	13:57	--
Sunset (Azimuth)	18:56 (287⁰)	18:56 (287⁰)
Moonset (Azimuth)	19:06 (287⁰)	19:55(282⁰)
Moon's Altitude	1.9⁰	12.2⁰
Lag Time ((Minutes)	10	59
Age (Hrs, Min)	05h	29h

Summary:

A difficult setting for the crescent to be observed on Aug. 11 with the naked eye because of its age. We should expect the first day of Dhu'l Hijjah 1439 AH to be on Monday Aug. 13, 2018.

This Week's Sky at a Glance - Aug. 11-17, 2018

Aug 11	Sa	13:46	Partial Solar Eclipse (Not visible from UAE
		13:57	New Moon)
Aug 13	Mo	04:44	Perseid Shower: ZHR = 90
Aug 14	Tu	17:35	Moon-Venus: 6.4° S
Aug 17	Fr	14:38	Moon-Jupiter: 4.8° S
		19:59	Venus Elongation: 45.9° E

Beautiful sunset near Cap Rouge (Cherchell - Algeria) with long light columns spreading onto the sky.