"The Southern Cross"

The Hermanus Astronomy Centre Newsletter

AUGUST 2023

MONTHLY MEETINGS

(normally scheduled for the **1st Monday** of each month, the day and date may change from time to time according to the Hermanus load shedding status and/or according to venue availability for a physical meeting)

Our last meeting was held on **Monday 17th July**.

Prof Markus Böttcher presented ***The Violent Universe: Gamma-Ray Astronomy and South Africa's and Namibia's Role.***

We have the unbelievable luck to have been dropped in a minuscule corner of spacetime, able to watch at a safe distance from grandstand seats through unbelievable instruments, the dramatic and at times terrifying opera that is the evolving Universe. Prof Böttcher walked us through the instrumentation and the people in South Africa and Namibia who make this possible.

Don't miss this recording: https://www.youtube.com/watch?v=Ci4Mf2AAwbE

Our next meeting, *rescheduled* for **Monday 14th August** (loadshedding), will be presented by **Prof Du Toit Strauss:**

Title: ***Cosmic rays and space travel***

Abstract: One of the major space weather hazards for human spaceflight, especially deep-space missions, is radiation from cosmic rays. These high-energy charged particles are accelerated in astrophysical systems, such as supernova explosions, but also during violent phenomena at the Sun, and then fill the entire inner heliosphere. Here, they present a radiation risk to humans and other technological systems. In this talk I will introduce cosmic rays, how they are accelerated, how they travel through the turbulent interplanetary medium, and how we can mitigate their harmful effects to make space travel safe and sustainable

Prof Du Toit Strauss, Centre for Space Research, North-West University, South Africa. R. Du Toit Strauss received his Ph.D. in physics from the North-West University, South Africa, where he is currently a professor in physics. For his PhD he studied the transport of cosmic rays through the turbulent interplanetary medium using a combination of particle transport and large scale heliospheric MHD models. Since then, he has focussed primarily on simulating the transport of solar energetic particles through the inner heliosphere but has a general interest in the propagation of charged particles through turbulent plasmas (both from a theoretical and simulation perspective). On the experimental side he is leading the South African neutron

monitor programme and has initiated, amongst others, a programme to characterize the radiation environment, at aviation altitudes, over Southern Africa. He is an alumnus of the Fulbright and Alexander von Humboldt associations and holds an adjunct position at the Department of Space Science at the University of Alabama in Huntsville, USA. His primary research interests involve the modelling of cosmic-ray propagation through the turbulent heliosphere.

SPECIAL INTEREST GROUP ACTIVITIES

Cosmology

(normally scheduled for the **1st Monday** of each month, the day and date may change from time to time according to the Hermanus load shedding stage)

This is a series of 17 videos entitled "COSMOLOGY, THE HISTORY OF THE UNIVERSE", a 17 part series.

At the meeting on **July 3rd**, we watched episode 10 – ***Why is Gravity so Weak?***

https://www.youtube.com/watch?v=4IxuXuLbMoQ&list=PLROBLlvnR7BEF9b1NOvRf_zhboibmywJb&index=10

The next Cosmology meeting is scheduled for **Thursday August 3rd**, "COSMOLOGY, THE HISTORY OF THE UNIVERSE", episode 11 – ***Was the Universe Born from Nothing?***

Classical physics is deterministic and ticks like clockwork but quantum physics is concerned with probabilities. Denis Sciama, one of the fathers of modern cosmology, was presenting a lecture during which one Edward P Tyron was heard to mutter, "Maybe the universe is a quantum fluctuation". But was he just joking?
At absolute zero, quantum mechanics ensures the electrons keep jiggling. So the dead stars sit there for *eternity.*
Join us for another superbly presented episode of this series, acclaimed by cosmologists, professional and amateur alike.

For further information, please contact Derek Duckitt: derek.duckitt@gmail.com

Astrophotography

This SIG is scheduled for the 2nd Monday of each month as requested by group members.

For further information, contact Deon Krige: krige.deon44@outlook.com and please keep an eye on our website calendar and e-mail notices and invites.

Study Group

Currently scheduled for the **last Monday** of each month.

Scheduled for **Monday July 31st**, **Pierre de Villiers** will lead a discussion centred on the James Webb Space Telescope.

For further information, please contact Peter Harvey: petermh@hermanus.co.za

Moonwatch

The first quarter Moon on Wednesday was our original plan but the weather did not play our game. However, on Thursday July 27th, one day after the first quarter, we enjoyed a most successful Moonwatch session at Gearing's Point. In fine but chilly conditions, twenty-three people, including twelve from Lukhanyo School, used telescopes to examine the waxing Moon at 60% phase.

Lukhanyo scholars listen intently to the Moon lecture delivered by Pierre de Villiers

The excitement of the attendees at this function, the first observation gathering our centre has held since lock-down days, was clearly evident from the buzz amongst the crowd as we gazed through each of the four telescopes in turn, comparing images and drawing and photographing what we saw.

We also found time to look at a few stars such as the **α Centauri** double.

Image captured on mobile phone through a telescope by Londie of Lukhanyo School.

Future Trips

No outings are planned at present.

Website

Please check our website calendar for HAC scheduled events: https://www.hermanusastronomy.co.za

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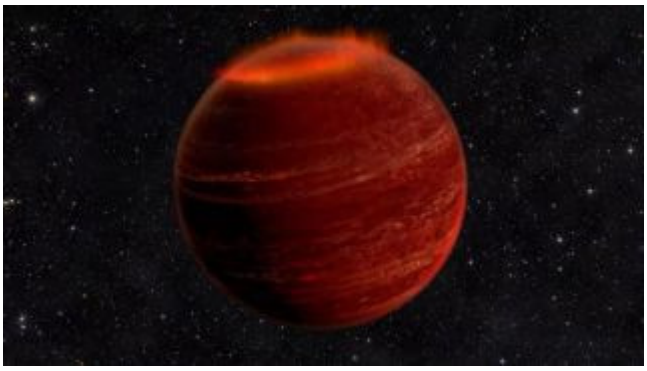
(compiled by Pieter Kotzé)

Bizarre object hotter than the sun is orbiting a distant star at breakneck speed

Scientists have discovered a weird celestial object that's blurring the line between planet and star.



An illustration of a brown dwarf - a hot, massive object that blurs the lines between planet and star --- in a distant star system. (Image credit: NASA Goddard)

A weird, super-hot celestial body is breaking records and challenging astronomers' understanding of the boundary between stars and planets.

The object, called WD0032-317B, is a brown dwarf — a type of bright, gaseous "protostar." Brown dwarfs typically have a similar atmospheric composition to Jupiter but are 13 to 80 times larger. At that mass, these objects begin to fuse hydrogen isotopes in their cores. However, they aren't quite massive enough to spark the kind of full self-sustaining stellar fusion that powers stars like our sun. Brown dwarfs usually burn at around 4,000 degrees Fahrenheit (2,200 degrees Celsius). That's fairly cool compared with most stars, whose surface temperatures reach about 6,700 F (3,700 C).

But WD0032-317B, which is 1,400 light-years from Earth, is not like most brown dwarfs. In a paper published to the preprint database arXiv and accepted by the journal Nature Astronomy, researchers measured the object's surface temperature and found it was a blistering 13,900 F (7,700 C). That's hot enough for the molecules in its atmosphere to fall apart into their component atoms. It's also several thousand degrees hotter than the surface of our sun.

https://www.space.com/object-hotter-than-sun-orbiting-distant-star

Dark nebula dominates gorgeous new view of Orion constellation

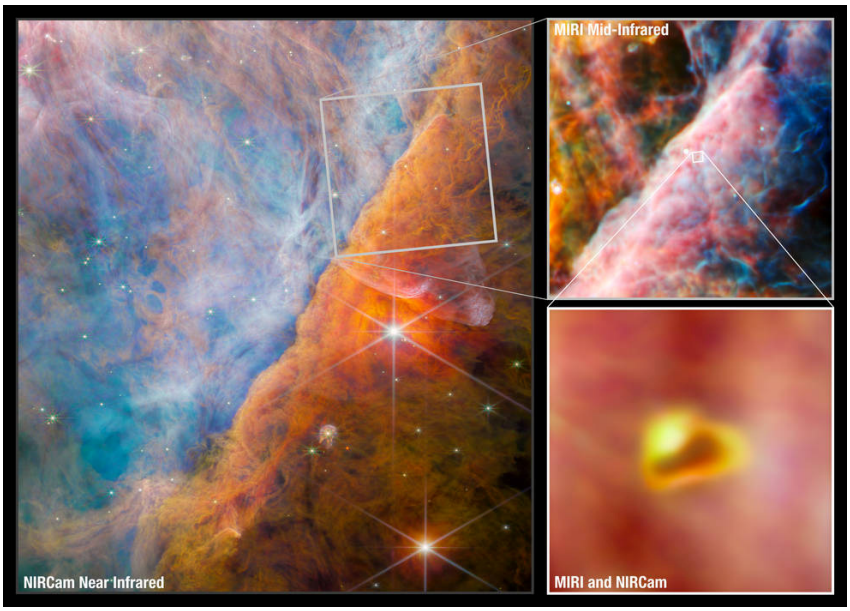
Dark, billowing clouds sweep across this stunning photo of a large star-forming area of the Orion constellation. These dense interstellar clouds of gas and dust comprise a dark nebula, formally known as LDN 1622. Dark nebulas are so named because their thick interstellar dust obscures light from nearby stars and other neighboring objects, according to a statement from the U.S. National Science Foundation's (NSF) NOIRLab.

LDN 1622 is located 1,300 light-years from Earth in the nearby Orion complex, a star-forming region teeming with young stars. It is located near the plane of our Milky Way galaxy close to the belt and sword of the Orion constellation. The recent image was taken using the Nicholas U. Mayall 4-meter Telescope at the Kitt Peak National Observatory (KPNO) in Arizona, which is operated by NOIRLab (formally the National Optical-Infrared Astronomy Research Laboratory).

A dark nebula known as LDN 1622, captured using the Mosaic-3 instrument on the Nicholas U. Mayall 4-meter Telescope at the Kitt Peak National Observatory (KPNO) in Arizona. (Image credit: KPNO/NOIRLab/NSF/AURA/T. A. Rector. Image processing: T.A. Rector (University of Alaska Anchorage/NSF's NOIRLab), M. Zamani (NSF's NOIRLab) & D. de Martin (NSF's NOIRLab))

https://www.space.com/dark-nebula-orion-constellation-photo

Webb Makes First Detection of Crucial Carbon Molecule

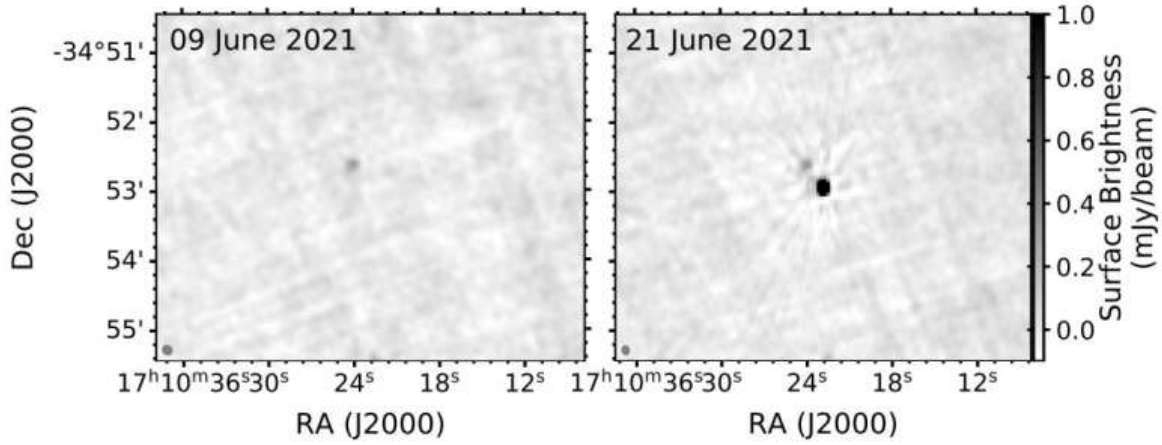


These Webb images show a part of the Orion Nebula known as the Orion Bar. The largest image, on the left, is from Webb's NIRCam (Near-Infrared Camera) instrument. At upper right, the telescope is focused on a smaller area using Webb's MIRI (Mid-Infrared Instrument). At the very center of the MIRI area is a young star system with a protoplanetary disk named d203-506. The pullout at the bottom right displays a combined NIRCam and MIRI image of this young system.Credits: ESA/Webb, NASA, CSA, M. Zamani (ESA/Webb), and the PDRs4All ERS Team

A team of international scientists has used NASA's James Webb Space Telescope to detect a new carbon compound in space for the first time. Known as methyl cation (pronounced cat-eye-on) (CH_3^+), the molecule is important because it aids the formation of more complex carbon-based molecules. Methyl cation was detected in a young star system, with a protoplanetary disk, known as d203-506, which is located about 1,350 light-years away in the Orion Nebula. Carbon compounds form the foundations of all known life, and as such are particularly interesting to scientists working to understand both how life developed on Earth, and how it could potentially develop elsewhere in our universe. The study of interstellar organic (carbon-containing) chemistry, which Webb is opening in new ways, is an area of keen fascination to many astronomers.

https://www.nasa.gov/feature/goddard/2023/webb-makes-first-detection-of-crucial-carbon-molecule

Astronomers discover an extremely intermittent radio pulsar



MeerKAT images of the position of PSR J1710−3452 on June 9, 2021 (left) and June 21, 2021 (right). Credit: Surnis et al., 2023.

Using the MeerKAT telescope, an international team of astronomers has serendipitously discovered a new pulsar. The newfound object, designated PSR J1710−3452, turns out to be an extremely intermittent radio pulsar. The finding was reported June 19 on the pre-print server *arXiv*. Pulsars are highly magnetized, rotating neutron stars emitting a beam of electromagnetic radiation. They are usually detected in the form of short bursts of radio emission; however, some of them are also observed via optical, X-ray and gamma-ray telescopes.

https://phys.org/news/2023-06-astronomers-extremely-intermittent-radio-pulsar.html

The gravitational wave background of the universe has been heard for the 1st time

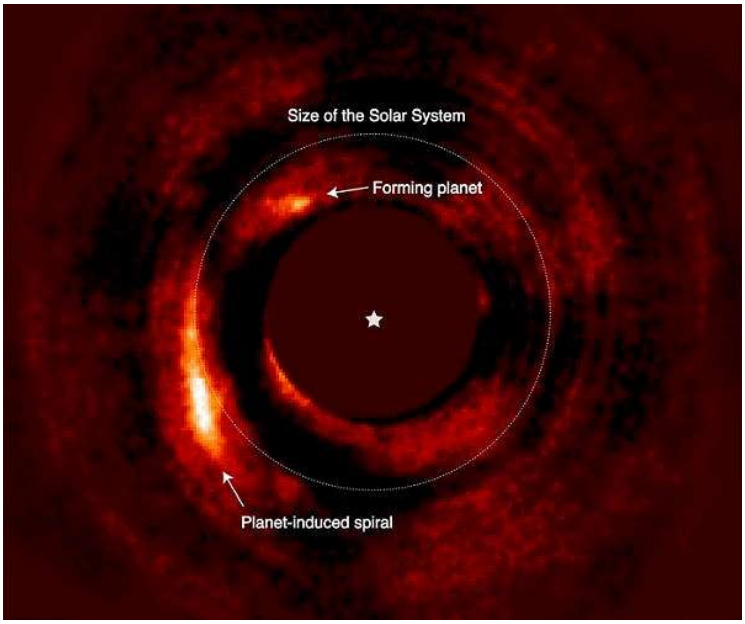
In a historic first, astronomers have detected low-frequency gravitational waves using a galaxy-sized antenna of millisecond pulsars in the Milky Way. Astronomers have heard the faint hum of gravitational waves echoing throughout the universe for the first time.

For nearly a decade, scientists have been hunting for the gravitational wave background, a faint but persistent echo of gravitational waves thought to have been set off by events that took place soon after the Big Bang and the mergers of supermassive black holes throughout the cosmos. While such a background was long theorized by physicists and sought by astronomers, signals of gravitational waves that make up that background have been hard to detect due to being faint, in addition to vibrating at decade-long timescales. Now, long-term observations have finally confirmed their presence.

Artist's interpretation of an array of pulsars being affected by gravitational ripples produced by a supermassive black hole binary in a distant galaxy. (Image credit: Aurore Simonnet for the NANOGrav Collaboration)

https://www.space.com/gravitational-wave-background-universe-1st-detection

A surprise chemical find by ALMA may help detect and confirm protoplanets

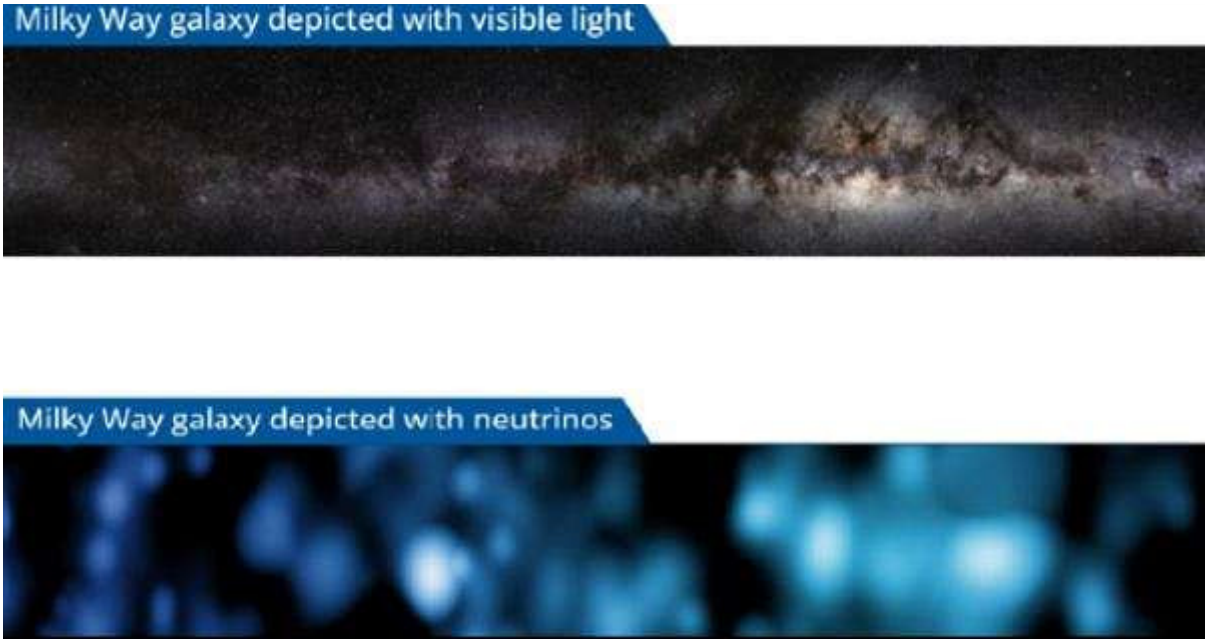


HD 169142 is a young star located in the constellation Sagittarius.

Scientists using the Atacama Large Millimeter/submillimeter Array (ALMA) to study the protoplanetary disk around a young star have discovered the most compelling chemical evidence to date of the formation of protoplanets. The discovery will provide astronomers with an alternate method for detecting and characterizing protoplanets when direct observations or imaging are not possible. The results will be published in an upcoming edition of The Astrophysical Journal Letters. HD 169142 is a young star located in the constellation Sagittarius that is of significant interest to astronomers due to the presence of its large, dust- and gas-rich circumstellar disk that is viewed nearly face-on. Several protoplanet candidates have been identified over the last decade, and earlier this year, scientists at the University of Liege and Monash University confirmed that one such candidate- HD 169142 b- is, in fact, a giant Jupiter-like protoplanet.https://www.spacedaily.com/reports/A_surprise_chemical_find_by_ALMA_may_help_detect_and_confirm_protoplanets_999.html

https://www.spacedaily.com/reports/ALMA_digs_deeper_into_the_mystery_of_planet_formation_999.html

First 'ghost particle' image of Milky Way galaxy captured by scientists



Two images of the Milky Way galaxy. The top is captured with visible light and the bottom is the first-ever captured with neutrinos.

From visible starlight to radio waves, the Milky Way galaxy has long been observed through the various frequencies of electromagnetic radiation it emits. Scientists have now revealed a uniquely different image of

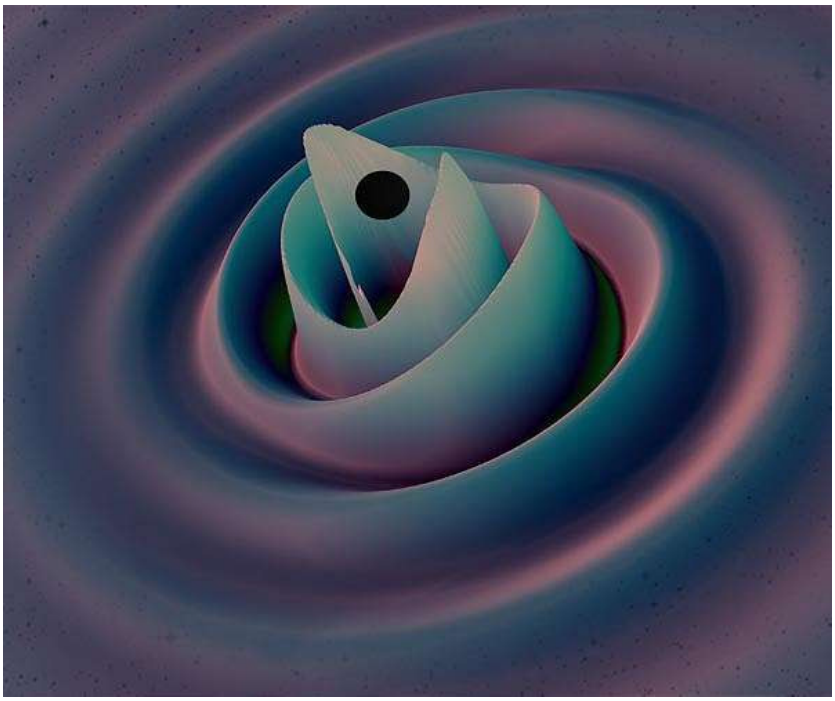
our galaxy by determining the galactic origin of thousands of neutrinos - invisible "ghost particles" which exist in great quantities but normally pass straight through Earth undetected. The neutrino-based image of the Milky Way is the first of its kind: a galactic portrait made with particles of matter rather than electromagnetic energy.The breakthrough was achieved by a collaboration of researchers using the U.S. National Science Foundation-supported IceCube Neutrino Observatory at NSF's Amundsen-Scott South Pole Station in Antarctica. The immense observatory detects the subtle signs of high-energy neutrinos from space by using thousands of networked sensors buried deep within a cubic kilometer of clear, pristine ice.
https://www.spacedaily.com/reports/First_ghost_particle_image_of_Milky_Way_galaxy_captured_by_scientists_999.html

https://www.spacedaily.com/reports/IceCube_shows_Milky_Way_galaxy_is_a_neutrino_desert_999.html

https://www.spacedaily.com/reports/Our_galaxy_seen_through_a_new_lens_Neutrinos_detected_by_IceCube_999.html

Astronomers reveal evidence of universe's 'background hum'

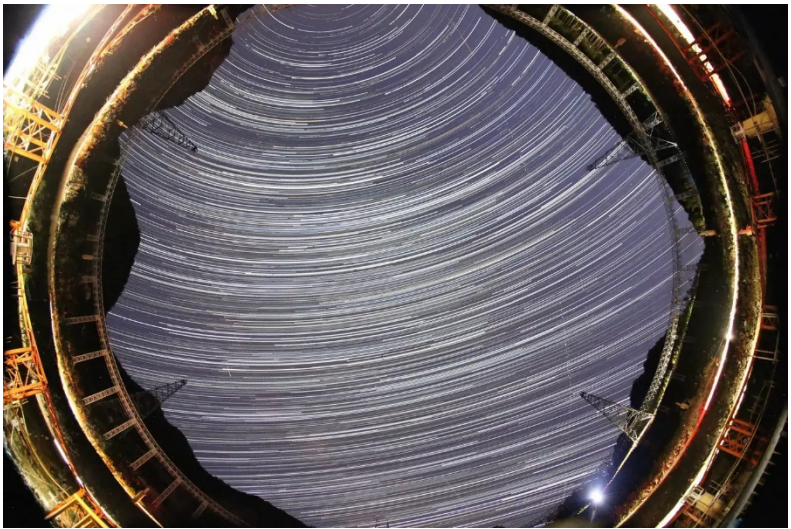
Astronomers across the world announced that they have found the first evidence of a long-theorised form of gravitational waves that create a "background hum" rumbling throughout the universe. The breakthrough -- made by hundreds of scientists using radio telescopes in North America, Europe, China, India and Australia after years of work -- was hailed as a major milestone that opens a new window into the universe.



surfing the continuum...

First predicted by Albert Einstein more than a century ago, gravitational waves are ripples in the fabric of the universe that travel through everything at the speed of light almost entirely unimpeded. Their existence was not confirmed until 2015, when the US and Italian observatories detected the first gravitational waves created by two black holes colliding. These "high-frequency" waves were the result of a single violent event that sends a strong, short burst rippling towards Earth.

https://www.spacedaily.com/reports/Astronomers_reveal_evidence_of_universes_background_hum_999.html



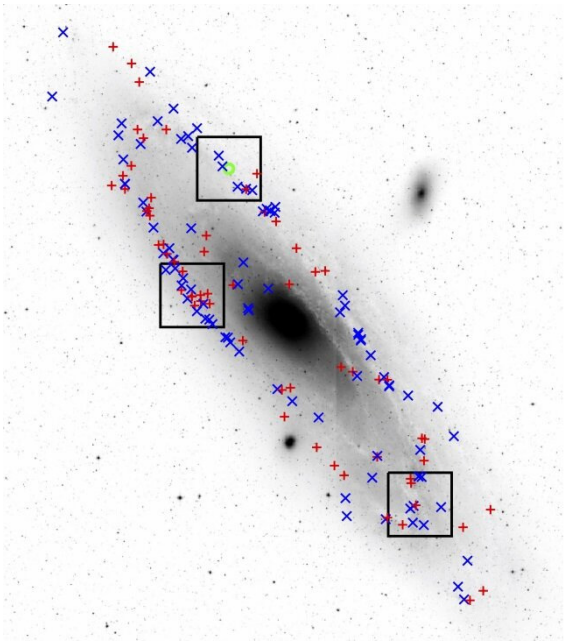
Probing the Universe's Secrets: Key Evidence for NanoHertz Gravitational Waves

FAST helps find key evidence for the existence of nanohertz gravitational waves with its high sensitivity. Credit: Image by NAOC of CAS

The Chinese Pulsar Timing Array (CPTA) collaboration has identified evidence of

nanohertz gravitational waves **using the Five-hundred-meter Aperture Spherical Radio Telescope (FAST). Despite their shorter data set, their high sensitivity yielded results comparable to other international groups. This discovery is pivotal in understanding the Universe's structure and behavior of supermassive black holes, paving the way for future exploration of gravitational waves.** A group of Chinese scientists has recently found key evidence for the existence of nanohertz gravitational waves, marking a new era in nanohertz gravitational wave research. https://scitechdaily.com/probing-the-universes-secrets-key-evidence-for-nanohertz-gravitational-waves/

Nineteen new Wolf-Rayet stars discovered in the Andromeda galaxy



Locations of known WRs in M31 as well as new fields observed in this survey. The blue ×s represent WN stars while the red +s represent WC stars from Neugent et al (2012). The green circle is the reddened WR discovered by Shara et al (2016). The three fields observed in this survey with LMI are denoted by black boxes. Credit: Neugent et al, 2023

Using the 4.3-m Lowell Discovery Telescope (LDT), astronomers Kathryn F. Neugent and Philip Massey, have observed the nearby Andromeda galaxy. In result, they detected 19 new Wolf-Rayet stars in this galaxy. The finding was reported in a paper published June 22 on the pre-print server *arXiv*. Wolf-Rayet (WR) stars are extremely hot and very luminous stars with strong, broad helium emission lines. Observations show that WRs are massive stars at an advanced stage of stellar evolution and losing mass at a very high rate. To date, only a few hundred such stars have been discovered, mostly in the Milky Way.

https://phys.org/news/2023-06-nineteen-wolf-rayet-stars-andromeda-galaxy.html

New research puts age of universe at 26.7 billion years, nearly twice as old as previously believed

Credit: CC0 Public Domain

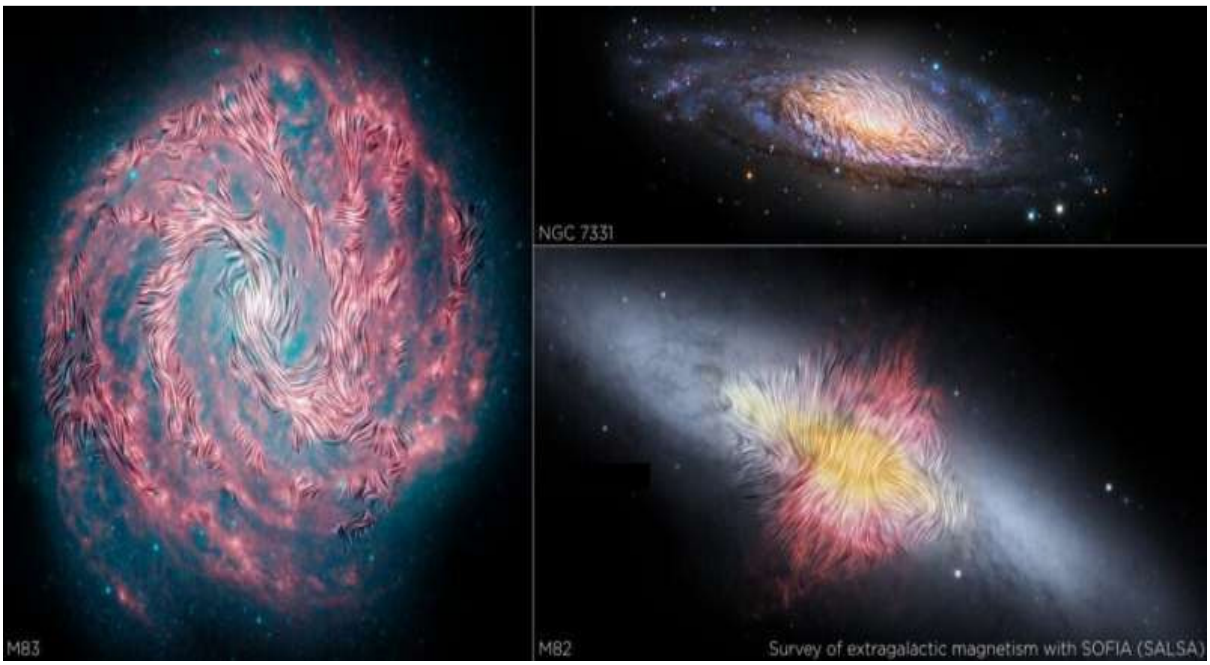
Our universe could be twice as old as current estimates, according to a new study that challenges the dominant cosmological model and sheds new light on the so-called "impossible early galaxy problem."

The work is published in the journal *Monthly Notices of the Royal Astronomical Society*. "Our newly-devised model stretches the galaxy formation time by a several billion years, making the universe 26.7 billion years old, and not 13.7 as previously estimated," says author Rajendra Gupta, adjunct professor of physics in the Faculty of Science at the University of Ottawa. For years, astronomers and physicists have calculated the age of our universe by measuring the time elapsed since the Big Bang and by studying the oldest stars based on the redshift of light coming from distant galaxies. In 2021, thanks to new techniques and advances in technology, the age of our universe was thus

estimated at 13.797 billion years using the Lambda-CDM concordance model. However, many scientists have been puzzled by the existence of stars like the Methuselah that appear to be older than the estimated age of our universe and by the discovery of early galaxies in an advanced state of evolution made possible by the James Webb Space Telescope. These galaxies, existing a mere 300 million years or so after the Big Bang, appear to have a level of maturity and mass typically associated with billions of years of cosmic evolution. Furthermore, they're surprisingly small in size, adding another layer of mystery to the equation. Zwicky's tired light theory proposes that the redshift of light from distant galaxies is due to the gradual loss of energy by photons over vast cosmic distances. However, it was seen to conflict with observations. Yet Gupta found that "by allowing this theory to coexist with the expanding universe, it becomes possible to reinterpret the redshift as a hybrid phenomenon, rather than purely due to expansion."

https://phys.org/news/2023-07-age-universe-billion-years-previously.html

Revealing the invisible: Detecting variations in extragalactic magnetic fields



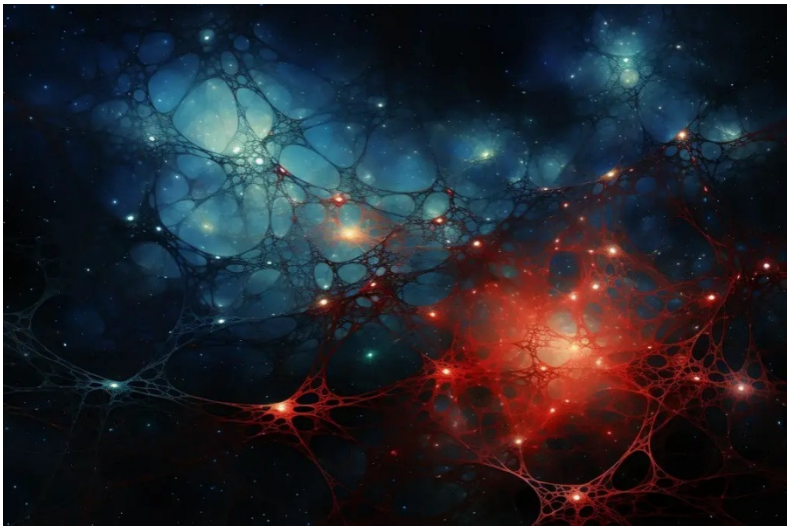
Wavy lines in these images of the galaxies M83, NGC7331, and M82 trace chaotic magnetic fields in the dense dust clouds of their star forming regions, as opposed to the calmer areas in between spiral arms and surrounding the galactic disks. The images are based directly on data from the Survey of ExtragALacticmagnetiSm with SOFIA (SALSA). Credit: M83: NASA/JPL-Caltech/E. Lopez-Rodriguez; NGC7331: NGC 7331: Adam Block/Mount Lemmon SkyCenter/University of Arizona/E. Lopez-Rodriguez; M82: M82: NASA/SOFIA/E. Lopez-Rodriguez; NASA/Spitzer/J. Moustakas et al.

Magnetic fields are common throughout the universe but incredibly challenging to study. They don't directly emit or reflect light, and light from all along the electromagnetic spectrum remains the primary purveyor of astrophysical data. Instead, researchers have had to find the equivalent of cosmic iron filings—matter in galaxies that is sensitive to magnetic fields and also emits light marked by the fields' structure and intensity.

In a new study published in *The Astrophysical Journal*, several Stanford astrophysicists have studied infrared signals from just such a material—magnetically aligned dust grains embedded in the cold, dense clouds of star-forming regions. A comparison to light from cosmic ray electrons that has been marked by magnetic fields in warmer, more diffuse material showed surprising differences in the measured magnetic fields of galaxies.

https://phys.org/news/2023-07-revealing-invisible-variations-extragalactic-magnetic.html

Astronomers Use Webb Telescope To Identify the Earliest Strands of the Cosmic Web



University of Arizona astronomers have identified a 3-million-light-year-long galactic filament from the early universe using the James Webb Space Telescope. The study also examined eight quasars and their influence on star formation, providing insights into the assembly and growth of supermassive black holes. (Cosmic web artist's concept.)

Using NASA's James Webb Space Telescope, a team of scientists led by University of Arizona astronomers has discovered a threadlike arrangement of 10 galaxies that existed just 830 million years after the Big Bang.Lined up like pearls on an invisible string, the 3-million-light-year-long structure is anchored by a luminous quasar – a galaxy with an active, supermassive black hole at its core. The team believes the filament will eventually evolve into a massive cluster of galaxies, much like the well-known Coma Cluster in the "nearby" universe. The results are published in two papers in *The Astrophysical Journal Letters*."This is one of the earliest filamentary structures that people have ever found associated with a distant quasar," said Feige Wang, an assistant research professor at the UArizona Steward Observatory and lead author of the first paper. Wang added that it is the first time a structure of this kind has been observed at such an early time in the universe and in 3D detail.

https://scitechdaily.com/astronomers-use-webb-telescope-to-identify-the-earliest-strands-of-the-cosmic-web/?expand_article=1

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