"The Southern Cross"

The Hermanus Astronomy Centre Newsletter

MAY 2023

MONTHLY MEETING

Our **April** meeting was held on **Monday 17th**. Presented by **Prof Piet Meintjes** of the University of the Free State, he addressed us on

"Cosmic Power Stations: Fast Rotating Stars".

We had a close look at the unique properties of super dense compact neutron stars, the remnants of massive stars that exploded as supernovae. The dense core of the exploding star is essentially all that remains of the initial star. Prof Meintjes explored the evolution of stars, explaining why and how these super dense objects form. We examined their properties, especially the fast rotation and enormous magnetic fields and the consequences for particle acceleration and high energy emission. We then saw how these objects were discovered and are studied across the whole electromagnetic spectrum.

To refresh our memories, and for those who were not fortunate enough to join us on the virtual presentation, herewith the link: https://www.youtube.com/watch?v=2Pe5brbQlDo

And then we had a surprise and most welcome visit from our long-time friend **Amanda Sickafoose** who brought along colleague **Dr Sanlyn Buxner** of Tucson, Arizona.

On Wednesday 26th April, Sanlyn treated us to a presentation, physical at Onrus Manor and virtual on Zoom. The topics of her talk were

"Celebrating Amateur Astronomers and the Diverse Roles of Community Scientists"

concerning amateur astronomers who not only engage in their personal interests but provide outreach events and engage in important research activities. Interviews with 53 individuals from across the spectrum of amateur astronomy highlighted the complexity of how amateur astronomers engage as independent explorers, outreach agents and researchers.

And

"Meet Zoë: Testing Rover Science Autonomy in the Field".

The Toolbox for Research and Exploration (TREX) is a node of NASA's Solar System Exploration Research Virtual Institute (SSERVI) which develops tools and research methods for exploration of airless bodies such as our Moon and Martian moons and asteroids that are coated in fine-particulate dust in order to prepare for human missions.

Again if you were not able to participate, we shall send you the link in due course.

The next monthly meeting is scheduled for **Monday 15th May**: **Tim Cooper** presents *"Meteors"*.

2023 meeting dates for your diaries: May 15, June 19, July 17, August 14, September 18, October 16, November 20. (Monthly Meetings are scheduled for the third Monday of every month, subject to load shedding). No meeting is normally planned for December unless otherwise advised.

SPECIAL INTEREST GROUP ACTIVITIES

Cosmology

(the first Monday of each month)

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

At the meeting on **3rd April**, we watched episode 7- *Why is the Universe Perfect?*

https://www.youtube.com/watch?v=lR9r7_MweK8&list=PLROBLlvnR7BEF9b1NOvRf_zhboibmywJb&index=7

The next Cosmology meeting is scheduled for **4th May,** episode 8 - *Why Is The Universe Out Of Balance?*

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

Astrophotography

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

Tuesday 4th April. **Derek Duckitt** demonstrated **Siril** (updated) and the new "**Astrosurface**" software.

The YouTube link - https://www.youtube.com/watch?v=Tsz64EFf5c8

For further information, please contact Deon Krige: krige.deon44@outlook.com .

Study Group

(The last Monday of each month)

Our last meeting was on **27th March**. In this meeting we watched two YouTube videos on **Geothermal Energy.** The first by **Sabine Hossenfelder** https://youtu.be/l6UGpaKnkS0

And then by **Matt Ferrell**: https://youtu.be/g8sjdOjNxIE .

Next up is **29th May**. Although yet to be confirmed, the topic will most likely concern the thorny subject of **Time Travel**.

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

Stargazing

No Hermanus Astronomy Centre events are currently planned but we shall let you know when a suitable evening is scheduled.

Future Trips

No outings are planned at present.

Website

A Face Book analysis of visitors:

767 followers. From **Cape Town** 26%, **Overstrand** 10%, **Hermanus** 7%, with smatterings from **Pretoria**, **Sandton** and **Kleinmond**. Also visits from US, UK, Australia, France, Germany, Malaysia, New Zealand, Colombia, United Arab Emirates, Ireland, Singapore, Israel, Ghana, India and Hungary. 26% from South Africa, the rest from the rest of the world. Interesting!

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

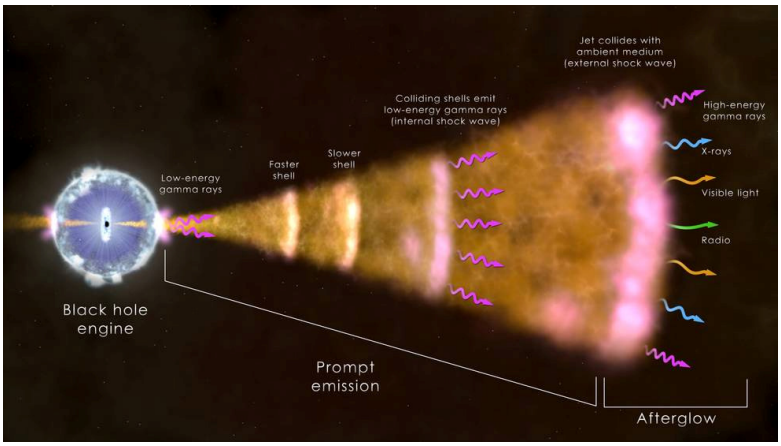
(compiled by Pieter Kotzé)

NASA Missions Study What May Be a 1-In-10,000-Year Gamma-ray Burst

On Sunday, Oct. 9, 2022, a pulse of intense radiation swept through the solar system so exceptional that astronomers quickly dubbed it the BOAT – the brightest of all time.

The source was a gamma-ray burst (GRB), the most powerful class of explosions in the universe.Gamma-ray bursts are the most luminous explosions in the cosmos. Astronomers think most occur when the core of a massive star runs out of nuclear fuel, collapses under its own weight, and forms a black hole, as illustrated in this animation. The black hole then drives jets of particles that drill all the way through the collapsing star at nearly the speed of light. These jets pierce through the star, emitting X-rays and gamma rays (magenta) as they stream into space. They then plow into material surrounding the doomed star and produce a multiwavelength afterglow that gradually fades away. The closer to head-on we view one of these jets, the brighter it appears. The burst triggered detectors on numerous spacecraft, and observatories around the globe followed up. After combing through all of this data, astronomers can now characterize just how bright it was and better understand its scientific impact.

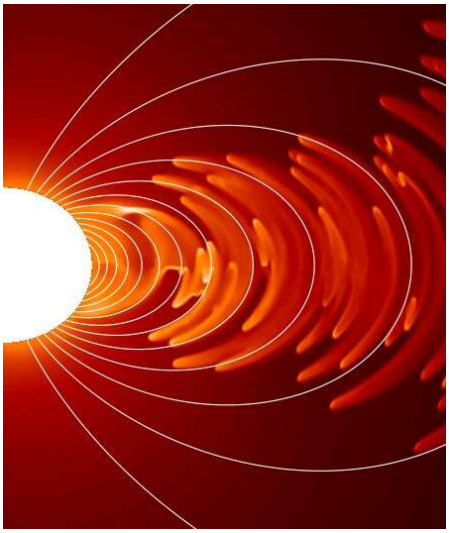
"GRB 221009A was likely the brightest burst at X-ray and gamma-ray energies to occur since human civilization began," said Eric Burns, an assistant professor of physics and astronomy at Louisiana State University in Baton Rouge. He led an analysis of some 7,000 GRBs – mostly detected by NASA's Fermi Gamma-ray Space Telescope and the Russian Konus instrument on NASA's Wind spacecraft – to establish how frequently events this bright may occur. Their answer: once in every 10,000 years.



This illustration shows the ingredients of a long gamma-ray burst, the most common type. The core of a massive star (left) has collapsed, forming a black hole that sends a jet of particles moving through the collapsing star and out into space at nearly the speed of light. Radiation across the spectrum arises from hot ionized gas (plasma) in the vicinity of the new-born black hole, collisions among shells of fast-moving gas within the jet (internal shock waves), and from the leading edge of the jet as it sweeps up and interacts with its surroundings (external shock).

Credit: NASA's Goddard Space Flight Center

https://www.nasa.gov/feature/goddard/2023/nasa-missions-study-what-may-be-a-1-in-10000-year-gamma-ray-burst



Magnetic fields in multiple star systems with at least one giant, hot blue star are more common than previously thought

The magnetosphere is a region of space surrounding an astronomical object in which charged particles are affected by that object's magnetic field. The white lines represent the magnetic field lines forming the magnetosphere. The Magnetic poles are on the top and on the bottom of

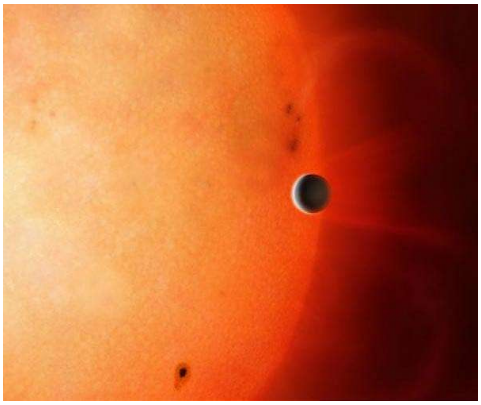
the star on the left. The brighter colour is used for higher density distribution of the gas. A gas disk is visible as the concentration of the gas density distribution in the (magnetic) equatorial plane. Credit: AIP/M. Küker

Astronomers from the Leibniz Institute for Astrophysics Potsdam (AIP), the European Southern Observatory (ESO), and the MIT Kavli Institute and Department of Physics have discovered that magnetic fields in multiple star systems with at least one giant, hot blue star, are much more common than previously thought by scientists. The results significantly improve the understanding of massive stars and their role as progenitors of supernova explosions. The findings are published in the journal *Monthly Notices of the Royal Astronomical Society*.

Blue, so-called O-type stars belong to the most massive stars in our universe with masses of more than 18 times that of our sun. While they are rare, they are so hot and luminous that four of the 90 brightest stars visible from Earth belong to this category. They are of extraordinary importance because they drive energetic physical processes that affect the structure of entire galaxies and chemically enrich the region between the stars. Regions of active star formation, like the spiral arms of a galaxy, or in galaxies that are in the process of colliding or merging, are where these stars are typically located. Such massive stars are of particular interest for magnetic studies because they end their evolution explosively as a supernova, leaving behind a compact object, such as a neutron star or a black hole, as a remnant.

https://phys.org/news/2023-03-magnetic-fields-multiple-star-giant.html

JWST confirms giant planet atmospheres vary widely



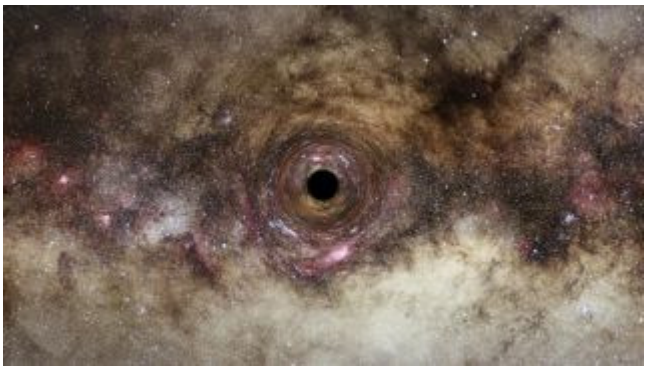
An international team of astronomers has found the atmospheric compositions of giant planets out in the galaxy do not fit our own solar system trend.

Using NASA's James Webb Space Telescope (JWST), the researchers discovered that the atmosphere of exoplanet HD149026b, a 'hot Jupiter' orbiting a star comparable to our sun, is super-abundant in the heavier elements carbon and oxygen - far above what scientists would expect for a planet of its mass.

These findings, published in "High atmospheric metal enrichment for a Saturn-mass planet" in Nature on March 27, provide insight into planet formation.The giant planets of our solar system exhibit a nearly perfect correlation between both overall composition and atmospheric composition and mass, said Jacob Bean, professor of astronomy and astrophysics at the University of Chicago and lead author of the paper. Extrasolar planets show a much greater diversity of overall compositions, but scientists didn't know how varied their atmospheric compositions are, until this analysis of HD149026b - also known as Smertrios.Smertrios is super-enriched compared to its mass, Lunine said: "It's the mass of Saturn, but its atmosphere seems to have as much as 27 times the amount of heavy elements relative to its hydrogen and helium that we find in Saturn".

https://www.spacedaily.com/reports/JWST_confirms_giant_planet_atmospheres_vary_widely_999.html

The largest black hole ever discovered can fit 30 billion suns.



Astronomers discovered the largest black hole ever seen thanks to its ability to bend light.(Image credit: ESA/Hubble, Digitized Sky Survey, Nick Risinger (skysurvey.org), N. Bartmann)

Astronomers have just discovered what may be the largest black hole known to date.

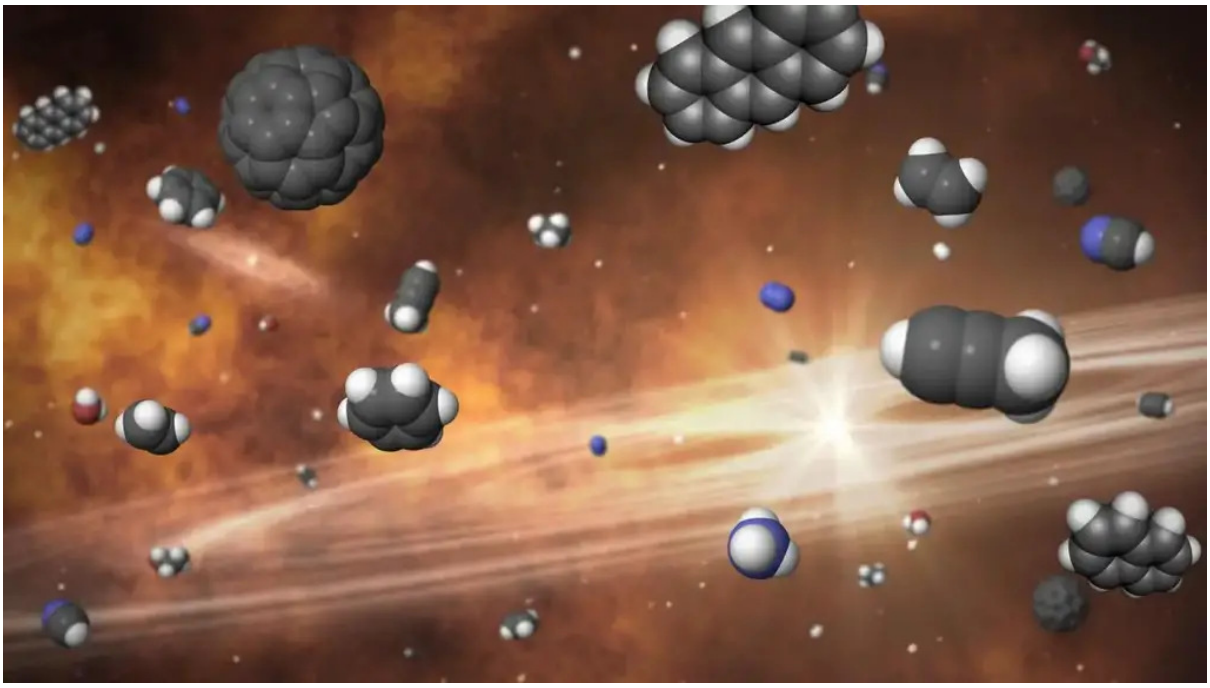
The giant black hole has a mass of 30 billion suns and sits at the center of a galaxy located hundreds of millions of light-years from Earth. Astronomers call the cosmic monster an ultramassive black hole, as opposed to the usual galactic supermassive black holes that weigh anywhere between a few million to a few billion solar masses.

Astronomers discovered the black hole during observations of a galaxy located farther away from Earth than the one centered around the monster black hole, while using the gravity of the foreground galaxy to magnify the background object. This effect, known as gravitational lensing, is a result of gravity bending the light around extremely massive objects. Serving as nature's own telescope, gravitational lensing frequently helps astronomers to increase the magnification of objects too distant to be properly visible to human-made telescopes.

This particular black hole, which is roughly 30 billion times the mass of our sun, is one of the biggest ever detected and on the upper limit of how large we believe black holes can theoretically become, so it is an extremely exciting discovery," James Nightingale, an astrophysicist at Durham University in the U.K. and lead author of the new study, said in a statement.

https://www.space.com/largest-known-black-hole-discovered-through-gravitational-lensing

Galactic Revelations: Molecular Precursors of Life Discovered in the Perseus Cloud



Artistic composition of a "soup" of prebiotic molecules around a protoplanetary disc. Credit: Gabriel Pérez Díaz (IAC)

A study led by the researcher Susana Iglesias of the Instituto de Astrofísica de Canarias has detected the presence of large quantities of complex organic molecules in one of the nearest star-forming regions to the Solar System. The results of this have been published in the journal *Monthly Notices of the Royal Astronomical Society***.**The scientists have discovered the presence of numerous prebiotic

molecules in the star formation region IC348 of the Perseus Molecular Cloud, a young star cluster some 2-3 million years old. Some of these biological molecules are considered essential building bricks for the construction of more complex molecules such as amino acids, which formed the genetic code of ancient micro-organisms, and brought about the flourishing of life on Earth.

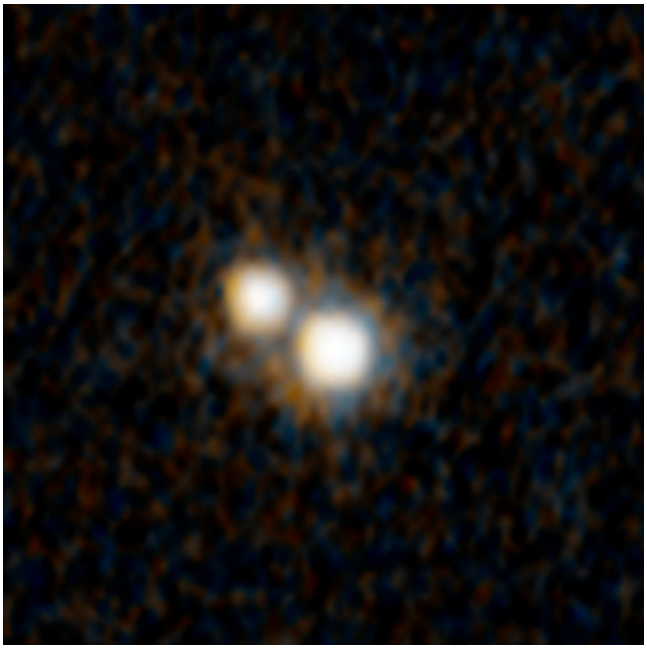
https://scitechdaily.com/galactic-revelations-molecular-precursors-of-life-discovered-in-the-perseus-cloud/

Hubble Unexpectedly Finds Double Quasar in Distant Universe

The early universe was a rambunctious place where galaxies often bumped into each other and even merged together. Using NASA's Hubble Space Telescope and other space and ground-based observatories, astronomers investigating these developments have made an unexpected and rare discovery: a pair of gravitationally bound quasars, both blazing away inside two merging galaxies. They existed when the universe was just 3 billion years old.

Quasars are bright objects powered by voracious, supermassive black holes blasting out ferocious fountains of energy as they engorge themselves on gas, dust, and anything else within their gravitational grasp.

"We don't see a lot of double quasars at this early time in the universe. And that's why this discovery is so exciting," said graduate student Yu-Ching Chen of the University of Illinois at Urbana-Champaign, lead author of this study.



A Hubble Space Telescope photograph of a pair of quasars that existed when the universe was just 3 billion years old. They are embedded inside a pair of colliding galaxies. The quasars are separated by less than the size of a single galaxy. Quasars are powered by voracious, supermassive black holes blasting out ferocious fountains of energy as they engorge themselves on gas, dust, and anything else within their gravitational grasp. The black holes will eventually merge.

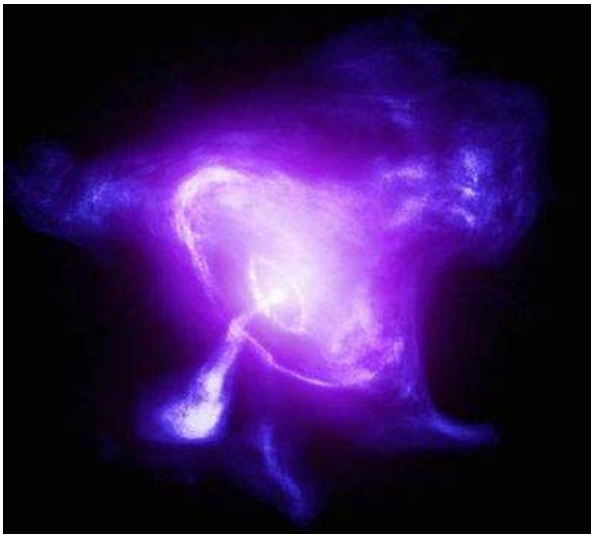
Credits: NASA, ESA, Yu-Ching Chen (UIUC), Hsiang-Chih Hwang (IAS), Nadia Zakamska (JHU), Yue Shen (UIUC)

This was a needle-in-haystack search that required the combined power of NASA's Hubble Space Telescope and the W.M. Keck Observatories in Hawaii. Multi-wavelength observations from the International Gemini Observatory in Hawaii, NSF's Karl G. Jansky Very Large Array in New Mexico, and NASA's Chandra X-ray Observatory also contributed to understanding the dynamic duo. And, ESA (European Space Agency)'s Gaia space observatory helped identify this double quasar in the first place.

"Hubble's sensitivity and resolution provided pictures that allow us to rule out other possibilities for what we are seeing," said Chen. Hubble shows, unequivocally, that this is indeed a genuine pair of supermassive black holes, rather than two images of the same quasar created by a foreground gravitational lens. And, Hubble shows a tidal feature from the merging of two galaxies, where gravity distorts the shape of the galaxies forming two tails of stars.

https://www.nasa.gov/feature/goddard/2023/hubble-unexpectedly-finds-double-quasar-in-distant-universe

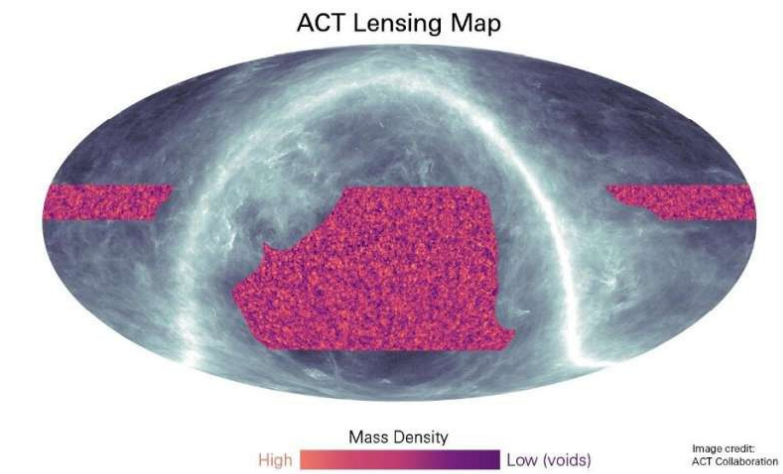
Historic nebula seen like never before with NASA's IXPE



This image of the Crab Nebula combines data from NASA's Imaging X-ray Polarimetry Explorer (IXPE) in magenta and NASA's Chandra X-ray

On Feb. 22, 1971, a sounding rocket lifted off from Wallops Island, Virginia, with specialized sensors aimed at the Crab Nebula, a bright cosmic object 6,500 light-years away. In those days, before recovering physical tapes from the experiment, scientists first received scientific data on a strip chart recorder, a device that printed signals on paper. Astronomer Martin Weisskopf and his colleagues began their analysis on launch day by measuring the distance between signals using a ruler and pencil.IXPE data show that the Crab Nebula's magnetic field resembles that of the Vela Pulsar Wind Nebula, which is also donut-shaped. But at the Crab, scientists were surprised that areas of magnetic field turbulence were morepatchy and asymmetrical than expected.

New findings that map the universe's cosmic growth support Einstein's theory of gravity



Researchers used the Atacama Cosmology Telescope to create this new map of the dark matter. The orange regions show where there is more mass; purple where there is less or none. The typical features are hundreds of millions of light years across. The whitish band shows where contaminating light from dust in our Milky Way galaxy, measured by the Planck satellite, obscures a deeper view. The new map uses light from the cosmic microwave background (CMB) essentially as a backlight to silhouette all the matter between us and the Big Bang. "It's a bit like silhouetting, but instead of just having black in the silhouette, you have texture and lumps of dark matter, as if the light were streaming through a fabric curtain that had lots of knots and bumps in it," said Suzanne Staggs, director of ACT and Princeton's Henry DeWolf Smyth Professor of Physics. "The famous blue and yellow CMB image is a snapshot of what the universe was like in a single epoch, about 13 billion years ago, and now this is giving us the information about all the epochs since." Credit: ACT Collaboration

Modern cosmology dates back to the early 20th century, with the development of Albert Einstein's theory of general relativity. Now, researchers from the Atacama Cosmology Telescope (ACT) collaboration have created a ground-breaking new image that reveals the most detailed map of dark matter distributed across a quarter of the entire sky, extending deep into the cosmos. What's more, it confirms Einstein's theory of how massive structures grow and bend light, over the entire 14-billion-year life span of the universe.

The Atacama Cosmology Telescope in Northern Chile, supported by the National Science Foundation, operated from 2007–2022. The project is led by Princeton University and the University of Pennsylvania—Director Suzanne Staggs at Princeton,

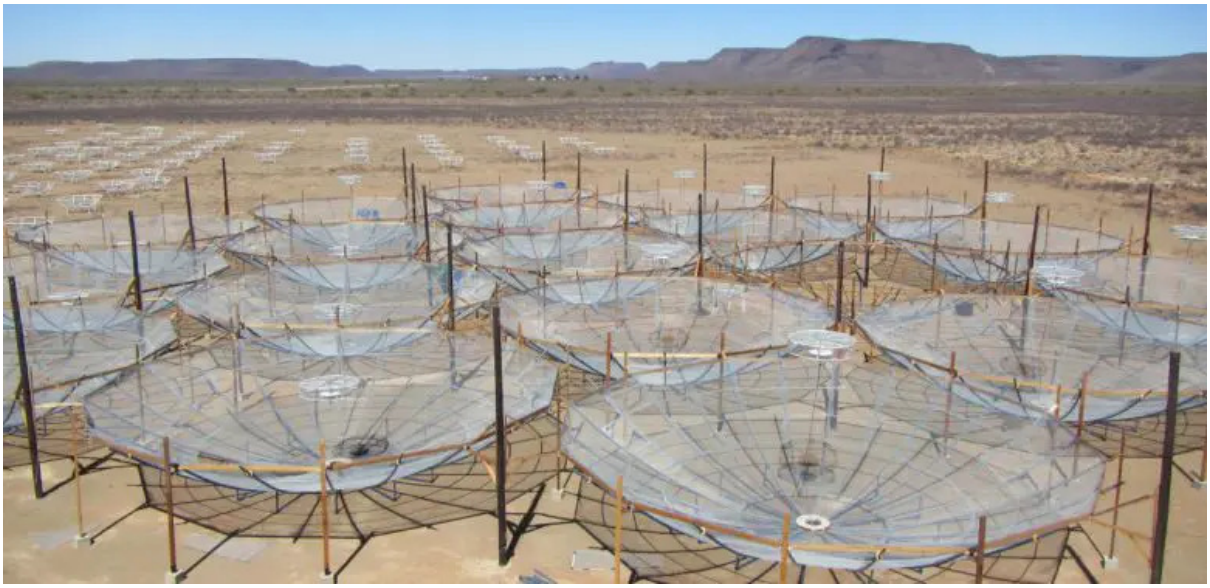
Deputy Director Mark Devlin at Penn—with 160 collaborators at 47 institutions. Credit: Mark Devlin, Deputy Director of the Atacama Cosmology Telescope and the Reese Flower Professor of Astronomy at the University of Pennsylvania. https://phys.org/news/2023-04-universe-cosmic-growth-einstein-theory.html

Unlocking the Secrets of the Early Universe: Scientists Double Sensitivity of HERA Radio Telescope

A collection of 350 radio telescopes located in the Karoo desert of South Africa is rapidly advancing towards the detection of the "cosmic dawn" – the period following the Big Bang when stars first lit up and galaxies started to flourish.

A group of scientists from North America, Europe, and South Africa has increased the sensitivity of the Hydrogen Epoch of Reionization Array (HERA) radio telescope by twofold. With this breakthrough, they aspire to uncover the secrets of the early universe.

Over the last couple of decades, teams from around the world have worked toward a first detection of radio waves from the cosmic dawn. While such a detection remains elusive, HERA's results represent the most precise pursuit to date," says Adrian Liu, an Assistant Professor at the Department of Physics and the Trottier Space Institute at McGill University.



The HERA radio telescope. Credit: Dave DeBoer

The array was already the most sensitive radio telescope in the world dedicated to exploring the cosmic dawn. Now the HERA team has improved its sensitivity by a factor of 2.1 for radio waves emitted about 650 million years after the Big Bang and 2.6 for radio waves emitted about 450 million years after the Big Bang. Although the scientists have yet to detect radio emissions from the end of the cosmic dark ages, their results provide clues about the composition of stars and galaxies in the early universe. So far, their data suggest that early galaxies contained very few elements besides hydrogen and helium, unlike our galaxies today. Today's stars have a variety of elements, ranging from lithium to uranium, that are heavier than helium.

https://scitechdaily.com/unlocking-the-secrets-of-the-early-universe-scientists-double-sensitivity-of-hera-radio-telescope/

Galactic Surprise: James Webb Space Telescope Unveils Hidden Companion Galaxy

Cornell University astronomers have discovered a companion galaxy while analyzing the first images of an early galaxy taken by NASA's James Webb Space Telescope (JWST). The newfound galaxy, estimated to be 1.4 billion years old, has already hosted multiple generations of stars, which was unexpected given its young age. The researchers were able to determine that the two galaxies are approximately the same distance from Earth and in the same neighbourhood, suggesting they may interact and potentially merge. The mature metallicity of these galaxies has led scientists to speculate that star formation must have been very efficient and started early in the universe.

While analyzing data from the first images of a well-known early galaxy taken by NASA**'s** James Webb Space Telescope **(JWST), Cornell University astronomers discovered a companion galaxy previously hidden behind the light of the foreground galaxy — one that surprisingly seems to have already hosted multiple generations of stars despite its young age, estimated at 1.4 billion years old.**Most surprising about these galaxies, considering their age and mass, was their mature metallicity – amounts of elements heavier than helium and hydrogen, such as carbon, oxygen and nitrogen – which the team estimated to be similar to our sun. Compared to the sun, which is about 4 billion years old and inherited most of its metals from previous generations of stars that had roughly 8 billion years to build them up, we are observing these galaxies at a time when the universe was less than 1.5 billion years old.

https://scitechdaily.com/galactic-surprise-james-webb-space-telescope-unveils-hidden-companion-galaxy/

James Webb photographed the infrared galaxy Arp 220, which is 1 trillion brighter than the Sun

The James Webb Space Telescope has captured an unusual galaxy. It's called Arp 220 and is known to be extremely bright.

Arp 220 is the result of a collision between two spiral galaxies that began about 700 million years ago. Located in the constellation Snake, 250 million light-years from Earth, it is the closest ultra-bright infrared galaxy to us.The collision of two spiral galaxies triggered a burst of star formation. Specifically, scientists found about two hundred massive clusters of stars in a region of cosmic dust 5,000 light years (5% of the Milky Way's dimeter). About a hundred supernova remnants in a region 500 light years across have also been discovered.

The cores of the merging galaxies are 1200 light years away from each other. The Hubble orbiting telescope was able to determine this. The object Arp 220 has a luminosity more than 1 trillion times larger than the Sun.

Rare discovery: 2 supermassive black holes spotted on a collision course inside a galaxy merger

This artist's concept shows the brilliant glare of two quasars residing in the cores of two galaxies that are in the chaotic process of merging. The gravitational tug-of-war between the two galaxies ignites a firestorm of star birth. Quasars are brilliant beacons of intense light from the centers of distant galaxies. They are powered by supermassive black holes voraciously feeding on infalling matter. This feeding frenzy unleashes a torrent of radiation that can outshine the collective light of billions of stars in the host galaxy. In a few tens of millions of years, the black holes and their galaxies will merge, and so will the quasar pair, forming an even more massive black hole. Credit: NASA, ESA, Joseph Olmsted (STScI)

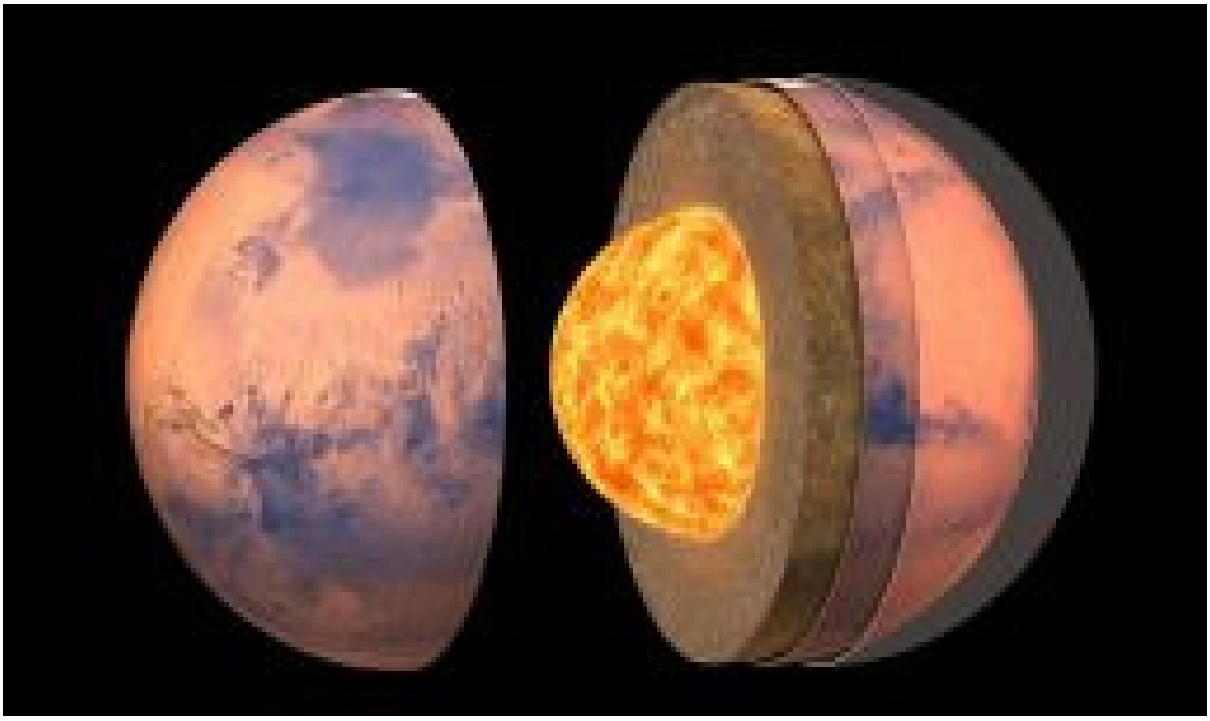
Galaxy mergers produce pairs of supermassive black holes (SMBHs), which may be witnessed as dual quasars if both SMBHs are rapidly accreting. The kiloparsec (kpc)-scale separation represents a physical regime sufficiently close for merger-induced effects to be important yet wide enough to be directly resolvable with the facilities currently available.

Astronomers in the early universe have discovered two actively feeding supermassive black holes, or quasars, that are only 10,000 light-years apart and on the approach of colliding massively.

https://www.techexplorist.com/rare-discovery-2-supermassive-black-holes-spotted-collision-course-galaxy-merger/58995/

NASA mission detects first seismic waves traveling through the center of Mars

When quakes rumbled on Mars and a meteorite smacked into the red planet during the past four years, NASA's InSight lander collected soundwaves that helped reveal secrets of the Martian interior.



NASA's Insight Lander reveals new data about Mars

During these events, InSight detected for the first time seismic waves traveling through the Martian core. Now, scientists have used the lander's data to determine that Mars has a liquid iron-alloy core that also includes lightweight elements such assulfur and oxygen, as well as smaller amounts of hydrogen and carbon.

Developing a greaterunderstanding of the Martian interior can help scientists learn more about how rocky planets such as Earth and Mars form, how the two planets differ, and the factors that help make other planets habitable for life.

Earth has a liquid outer core and a solid inner core, but the Martian core appears to be made entirely from liquid. Mars' core is also slightly denser and smaller than scientists believed, with a radius of approximately 1,106 to 1125 miles (1,780 to 1,810 kilometers).

https://edition.cnn.com/2023/04/24/world/mars-seismic-waves-scn/index.html

COMMITTEE MEMBERS

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