

“The Southern Cross”



Hermanus Astronomy Centre Newsletter

NOVEMBER 2022

MONTHLY MEETING

17th October – Prof Roger Deane - "Horizon Telescope and the Imaging of Black Holes".

The instrument – The Event Horizon Telescope (EHT), a global web of antennae comprising a wide-base interferometer.

The people – Roger joined the 300+ scientists of the EHT Collaboration from 80 institutions on 5 continents, convened in 2018 in the Netherlands.

The quest – to image the super massive black hole at the centre of our galaxy, Sagittarius A*, 27 000 light years away.

In May of this year, the first image of this black hole was announced in the world media with much fanfare. He explained the use of the “Black Hole Shadow” and the bending and capturing of light involving, in his words, “very messy astrophysics” in the vicinity of the object. Also imaged was the supermassive black hole at the centre of M87, an elliptical galaxy 55 million light years distant, an object appearing, from Earth, the size of a donut on the moon.

To view the video recording of the meeting, visit https://youtu.be/_fH_ksPjjYE .

Next: 28th November – Pierre de Villiers- “Gearing’s Point Astronomy Education Display”

(this meeting has been rescheduled due to the risk of stage 2 load shedding)

2022 meeting dates: For your diaries – the last monthly meeting for the year is as above. There will be no meeting in December.

SPECIAL INTEREST GROUP ACTIVITIES

Cosmology

(the first Monday of each month)

This is a series of 17 videos titled “Cosmology, The History of the Universe”, to be spread over a period of time.

3rd October –The History of the Universe–*Why did time start going forward?*

Next 7th November - The History of the Universe- *Is There One All Powerful SUPERFORCE Controlling The Universe?*

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

Astrophotography

(The second Monday of each month)

10th October: no meeting held.

Next: 12th December. This meeting will only take place in accordance with group members' wishes. For further information, please contact Deon Krige: krige.deon44@outlook.com

Study Group

(The last Monday of each month)

26th September: 1. *Quantum Leaps take time* and 2. *FusionReactor to make electricity by 2024*

Next 31st October: *Almost Human: How New Discoveries from South Africa Change Our View of Human Origin.* <https://www.youtube.com/watch?v=nkxOBmFeCcU>

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 if a suitable evening is scheduled.

FutureTrips

No outings are planned at present.

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

GEARING'S POINT ASTRONOMY EDUCATION DISPLAY (GPAED)

From Pierre De Villiers:

GPAED progress for October is very brief.

All the mounting slabs have been installed, almost half of the educational information tablets have been received from Dowd Engravers and the first few have been installed. The Analemmatic Sundial & Cardinal Directions Sunrises/sets tablets have been installed flush with the paving. The former is particularly worth a visit to Gearings Point.



The attached photo shows a Haitian tourist spending a few minutes reading all the information on the first educational tablet that was installed (the Solar System) within two minutes of its installation!

Completion will be during the second half of November after receipt of the last info tablets and the special epoxy required for their fixing to the mounting slabs.

ASTRONOMY NEWS

(compiled by Pieter Kotzé)

November 2022

Asteroid's origins determined using sample return analysis



The Hayabusa2 spacecraft sampled the surface twice: once on Feb. 21, 2019, and again on July 11, 2019. The first sampled the undisturbed surface, the second sampled the regolith excavated by the artificial impact created earlier during the mission. This study examined grains from both sample sites, providing samples that can really provide insight into Ryugu's evolution. In addition, finer-grained powder samples less than 1 millimeter in size from both sample collection chambers were examined using reflectance spectroscopy techniques.

The first analysis of samples from the asteroid Ryugu returned to Earth by the Japan Aerospace Exploration Agency's Hayabusa2 spacecraft offers new insights into Ryugu's formation history.

Laboratory analysis of 17 individual grains from the samples collected by Hayabusa2 found CO₂-bearing water in an iron-nickel sulfide crystal, indicating the parent body formed in the outer Solar System. The mineralogy and petrology of the samples indicate the parent body

formed in the region of the early Solar System where water and carbon dioxide existed as solids, farther than 3 to 4 times the distance from the Sun to Earth, possibly even beyond the orbit of Jupiter. This was followed by scattering inward to the main asteroid belt, to the current orbital position of the Polana and Eulalia asteroid families, which are about 2.5 times the distance from the Sun to Earth, The Polana and Eulalia asteroid families are the potential parent families of Ryugu based on orbital dynamical calculations of Ryugu's origin.

https://www.spacedaily.com/reports/Asteroids_origins_determined_using_sample_return_analysis_999.html

https://www.spacedaily.com/reports/Analysis_of_particles_of_the_asteroid_Ryugu_delivers_surprising_results_999.html

https://www.spacedaily.com/reports/Beams_of_muons_used_to_analyze_the_elemental_composition_of_Asteroid_Ryugu_samples_999.html

Asteroid that formed Vredefort crater bigger than previously believed



An impactor--most likely an asteroid--hurtled toward Earth about two billion years ago, crashing into the planet near present-day Johannesburg, South Africa. The impactor formed Vredefort crater, what is today the biggest crater on our planet. Using updated simulation data, University of Rochester researchers discovered the impactor that formed Vredefort crater was much larger than previously believed.

About two billion years ago, an impactor hurtled toward Earth, crashing into the planet in an area near present-day Johannesburg, South Africa. The impactor--most likely an asteroid--formed what is today the biggest crater on our planet.

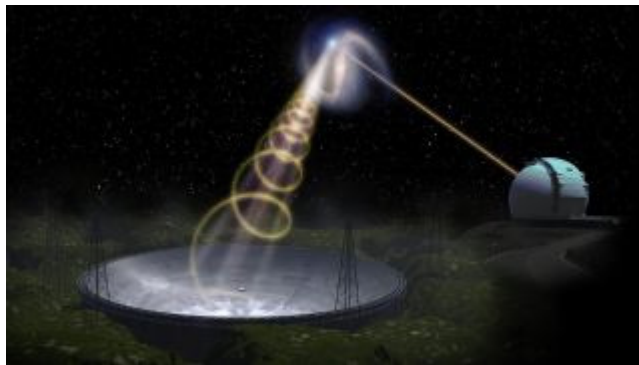
Scientists have widely accepted, based on previous research, that the impact structure, known as the Vredefort crater, was formed by an object about 15 kilometers (approximately 9.3 miles) in diameter that was travelling at a velocity of 15 kilometers per second. But according to new research from the University of Rochester, the impactor may have been much bigger--and would have had devastating consequences across the planet. These current estimates are based on new geological evidence and measurements estimating that the structure's original diameter would have been between 250 and 280 kilometers (approximately 155 and 174 miles) during the time of the impact. Results showed that an impactor would have to be much

larger-about 20 to 25 kilometers-and traveling at a velocity of 15 to 20 kilometers per second to explain a crater 250 kilometers in size. This means the impactor that formed the Vredefort crater would have been larger than the asteroid that killed off the dinosaurs 66 million years ago, forming the Chicxulub crater.

https://www.spacedaily.com/reports/Asteroid_that_formed_Vredefort_crater_bigger_than_previously_believed_999.html

Repeating fast radio burst with weird magnetic field challenges magnetar explanation

New observations are challenging a hypothesis about what produces these energetic bursts of radio waves.



An artist's depiction of the Five-hundred-meter Aperture Spherical radio Telescope detecting a fast radio burst coming from a distant barred spiral galaxy. (Image credit: Jingchuan Yu)

A repeating fast radio burst (FRB) with a changeable, polarized magnetic field has deepened the mystery of what produces these enigmatic millisecond-long bursts of radio waves from deep space. Although nobody knows what produces FRBs, highly magnetic [neutron stars](#) called magnetars, which are the most magnetic objects known in existence, are the chief suspects, at least for the repeating FRBs. Now, new observations of a repeating FRB cataloged as FRB 20201124A has placed the magnetar hypothesis under the microscope, and found some inconsistencies. Among those bursts were some new, puzzling discoveries. Notably, for the first 36 days of observation, the strength of the [magnetic field](#) in the immediate vicinity of the FRB source varied. Then, for the next 18 days, it remained constant, before disappearing. There was also strong circular polarization (describing the direction of oscillation of the radio waves) in the radio signals, and oscillating linear and circular polarization, as well as variations in the angle of the polarization depending on the wavelength. None of these behaviours had ever been witnessed in an FRB.

<https://www.space.com/fast-radio-burst-weird-magnetic-field>

Mysterious ripples in the Milky Way were caused by a passing dwarf galaxy



stock illustration only

Using data from the Gaia space telescope, a team led by researchers at Lund University in Sweden has shown that large parts of the Milky Way's outer disk vibrate. The ripples are caused by a dwarf galaxy, now seen in the constellation Sagittarius, that shook our galaxy as it passed by hundreds of millions of years ago. Our cosmic home, the Milky Way, contains between 100 and 400 billion stars. Astronomers believe that the galaxy was born 13.6 billion years ago, emerging from a rotating cloud of gas composed of hydrogen and helium. Over billions of years, the gas then collected in a rotating disk where the stars, such as our sun, were formed. By using data from the European space telescope Gaia, the research team was able to study a much larger area of the Milky Way's disk than was previously possible. By measuring how strong the ripples are in different parts of the disc, the researchers have begun to piece together a complex puzzle, providing clues about Sagittarius' history and orbit around our home galaxy.

https://www.spacedaily.com/reports/Mysterious_ripples_in_the_Milky_Way_were_caused_by_a_passing_dwarf_galaxy_999.html

Potential first traces of the first stars



This artist's impression shows a field of Population III stars as they would have appeared a mere 100 million years after the Big Bang. Astronomers may have discovered the first signs of their ancient chemical remains in the clouds surrounding one of the most distant quasars ever detected

Astronomers may have discovered the ancient chemical remains of the first stars to light up the Universe. Using an innovative analysis of a distant quasar observed by the 8.1-meter Gemini North telescope on Hawai'i, operated by NSF's NOIRLab, the scientists found an unusual ratio of elements that, they argue, could only come from the debris produced by the all-consuming explosion of a 300-solar-mass first-generation star. The very first stars likely formed when the Universe was only 100 million years old, less than one percent its current age. These first stars - known as Population III - were so titanically massive that when they ended their lives as supernovae they tore themselves apart, seeding interstellar space with a distinctive blend of heavy elements. Despite decades of diligent searching by astronomers, however, there has been no direct evidence of these primordial stars, until now.

[https://www.spacedaily.com/reports/Potential first traces of the first stars 999.html](https://www.spacedaily.com/reports/Potential_first_traces_of_the_first_stars_999.html)

Jupiter's Atmosphere is Surprisingly Hot

Jupiter doesn't heat itself through mechanisms like nuclear fusion. Its interior is heated through its own weight, squeezing the interior through hydrostatic equilibrium, and its surface is heated mostly by the Sun. Since Jupiter only gets about 4% of the light per square meter that Earth gets, you'd expect its upper atmosphere to be pretty cold. Traditional models estimate it should be about -70 degrees Celsius. But recent measurements show the upper atmosphere is over 400 degrees Celsius, and in the polar regions as much as 700 degrees Celsius.



Temperature measurements of Jupiter's upper atmosphere. Credit: James O'Donoghue

With such little sunlight reaching Jupiter, how can its atmosphere be so warm? The team found it has to do with Jupiter's aurora. On Earth, we have aurora all the time. More popularly known as the northern lights, this glow of the upper atmosphere occurs when ions from the solar wind get caught in Earth's magnetic field and strike our atmosphere at high speed. Jupiter's magnetic field is much stronger than Earth's, and so Jupiter's aurora can be much more intense. So intense that it can heat Jupiter's upper atmosphere.

<https://www.universetoday.com/157817/jupiters-atmosphere-is-surprisingly-hot/>

<https://www.sciencealert.com/a-planet-sized-heatwave-has-been-found-in-jupiters-atmosphere>

Explosive Neutron Star Merger Captured in Millimeter Light for the First Time



In a first for radio astronomy, scientists have detected millimeter-wavelength light from a short-duration gamma-rayburst. This artist's conception shows the merger between a neutron star and another star (seen as a disk, lower left) which caused an explosion resulting in the short-duration gamma-ray burst, GRB 211106A (white jet, middle), and left behind what scientists now know to be one of the most luminous afterglows on record (semi-spherical shock wave mid-right). While dust in the host galaxy obscured most of the

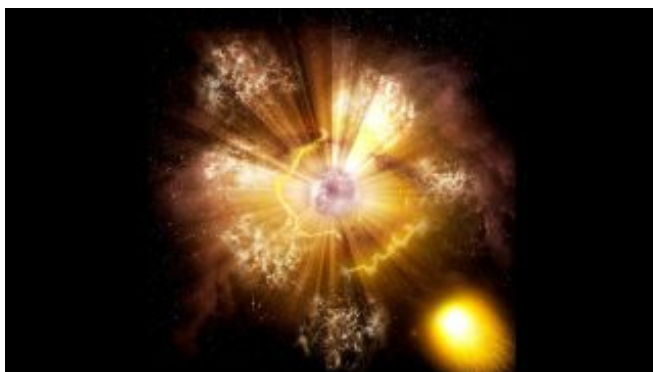
visible light (shown as colors), millimeter light from the event (depicted in green) was able to escape and reach the Atacama Large Millimeter/submillimeter Array (ALMA), giving scientists an unprecedented view of this cosmic explosion. From the study, the team confirmed that GRB 211106A is one of the most energetic short-duration GRBs ever observed. Credit: ALMA (ESO/NAOJ/NRAO), M. Weiss (NRAO/AUI/NSF)

For the first time, researchers have captured millimeter-wavelength light from an intense explosion brought on by the merger of a neutron star and another star using the Atacama Large Millimeter/submillimeter Array (ALMA), an international observatory operated by the US National Science Foundation's National Radio Astronomy Observatory (NRAO). The scientists also determined that this burst of light was one of the most powerful short-duration gamma-ray bursts ever observed, producing one of the most luminous afterglows ever recorded. The findings were recently published in *The Astrophysical Journal Letters*.

<https://scitechdaily.com/explosive-neutron-star-merger-captured-in-millimeter-light-for-the-first-time/>

Mysterious high-speed gas cloud in space might be the result of an explosive stellar death

These high-velocity clouds have puzzled astronomers for decades.



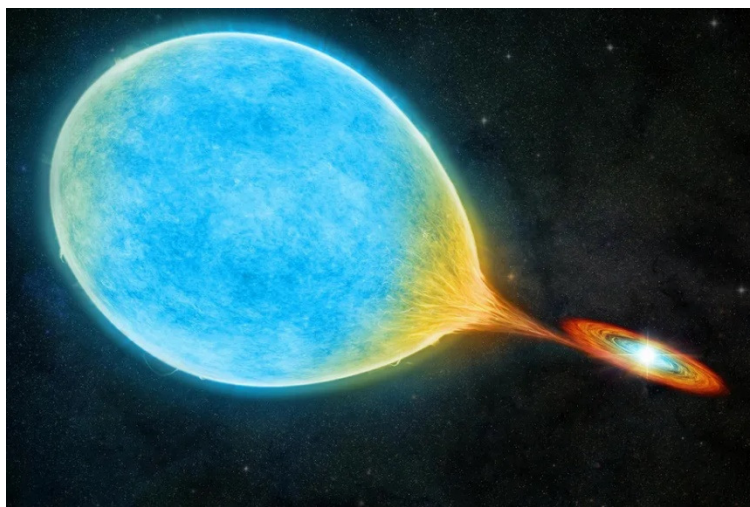
The supernova that created the neutron star companion of 56 UrsaeMajoris and set the M1 gas cloud moving at incredible speeds.(Image credit: Leslie Proudfit)

A mysterious, ultrafast cloud may be the result of the explosive stellar death that birthed a neutron star 100,000 years ago and around 532 light-years away, new research reveals. High-

velocity clouds (HVCs) are concentrations of hydrogen gas that often dwell in large complexes. They are remarkable because of their incredible velocities, which don't fit within the regular rotation speed of the [Milky Way](#). The new research may provide insight into the origins of HVCs, which have puzzled scientists for decades. That means the Milky Way could be replete with many similar stellar remnants that have gas features with remarkable velocities but that lack a bright companion star to aid in their identification. As such, the origins of HVCs are likely to remain a subject of intense debate for astronomers; MI may become one of the only objects of this kind to have a definitive history and well-defined distance attributed to it.

<https://www.space.com/high-velocity-clouds-supernova-ursae-majoris>

Confirming a Decades-Old Prediction: Astronomers Discover a “Cataclysmic” Pair of Stars



An artist's illustration shows a white dwarf (right) circling a larger, sun-like star (left) in an ultra-short orbit, forming a “cataclysmic” binary system. Credit: M.Weiss/Center for Astrophysics | Harvard & Smithsonian

In our galaxy, nearly half of the stars are solitary like the sun. The other half comprises stars that circle other stars, in pairs and multiples, with orbits so tight that some stellar systems could fit between Earth and the moon. Astronomers at MIT and other institutions have now discovered a stellar binary, or pair of stars, with an extraordinarily short orbit. In fact, they appear to circle each other every 51 minutes. The system seems to be one of an elusive class of binaries known as a “cataclysmic variable,” in which a star like our sun orbits tightly around a white dwarf — a hot, dense core of a burned-out star. The system resides about 3,000 light years from Earth, in the Hercules constellation. The newly discovered system, which the team has tagged ZTF J1813+4251, is a cataclysmic variable with the shortest orbit detected to date.

<https://scitechdaily.com/confirming-a-decades-old-prediction-astronomers-discover-a-cataclysmic-pair-of-stars/>

The Largest Known Star In The Universe Makes The Sun Look Like A Grain Of Rice



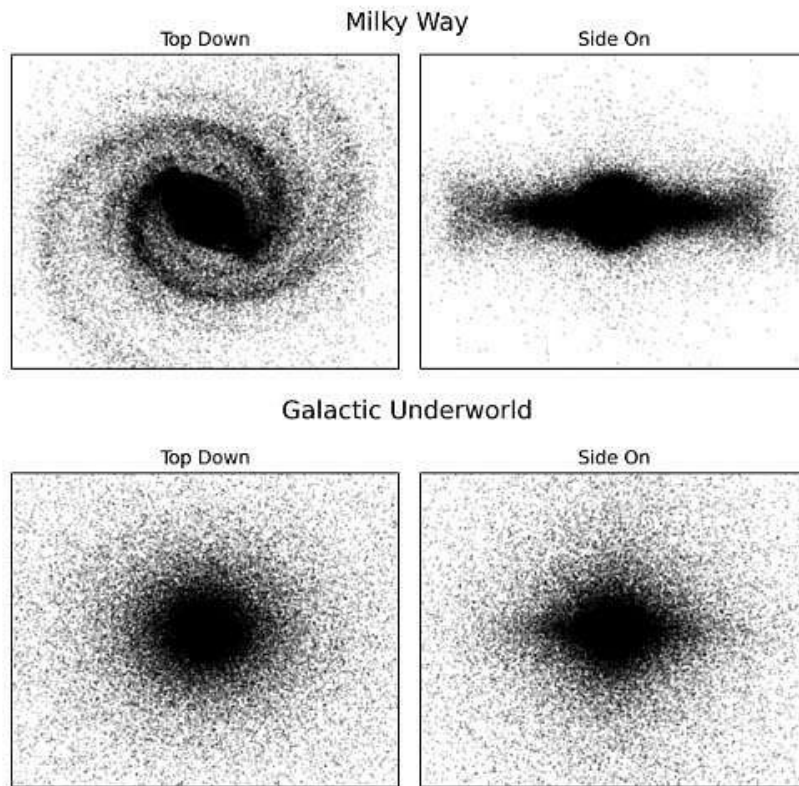
Nestled in the Large Magellanic Cloud, a nebula located just outside the Milky Way Galaxy, lies what may be the largest known star in the entire Universe. This star, named R136a1, is located around 150,000 light years from Earth (via Phys.org). R136a1 was originally discovered 60 years ago by a team of astronomers at Pretoria's Redcliffe

Observatory, who published their findings in the Monthly Notices of the Royal Astronomical Society in October of 1960.

New research of R136a1 was published in August of this year after a team of astronomers led by Venu Kalari of the Gemini Observatory studied the cluster in which it is located. They were able to take pictures of the star, allowing them to make new estimates about its size. Their findings, which were published in The Astrophysical Journal, shed new light on the star, which may be representative of how the largest stars in the Universe behave.

https://www.grunge.com/1037717/the-largest-known-star-in-the-universe-makes-the-sun-look-like-a-grain-of-rice/?utm_campaign=clip

Milky Way's graveyard of dead stars found



Point-cloud chart of the visible Milky Way galaxy (top) versus the galactic underworld

The first map of the 'galactic underworld' - a chart of the corpses of once massive suns that have since collapsed into black holes and neutron stars - has revealed a graveyard that stretches three times the height of the Milky Way, and that almost a third of the objects have been flung out from the galaxy altogether.

https://www.spacedaily.com/reports/Milky_Ways_graveyard_of_dead_stars_found_999.html

NASA kicked asteroid off course in test to save Earth



NASA

celebrated exceeding expectations during a mission to deflect a distant asteroid, in a sci-fi like test of humanity's ability to stop an incoming cosmic object from devastating life on Earth. The fridge-sized Double Asteroid Redirection Test (DART) impactor deliberately smashed into the moonlet asteroid Dimorphos on September 26, pushing it into a smaller, faster orbit around its big brother Didymos, NASA chief Bill Nelson announced. That changed its orbital period by four percent, or 32 minutes -- from 11 hour 55 minutes to 11 hours 23 minutes, bettering an expectation of 10 minutes.

[https://www.spacedaily.com/reports/NASA_kicked_asteroid_off_course_in_test_to_save Earth_999.html](https://www.spacedaily.com/reports/NASA_kicked_asteroid_off_course_in_test_to_save_Earth_999.html)

Mysterious 'ancient heart' of the Milky Way discovered using Gaia probe

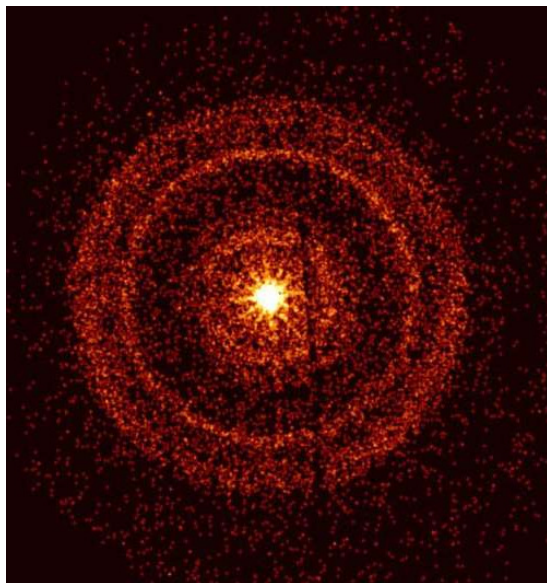


The Milky Way's central region, where Sagittarius and the group of ancient stars can be found, above Telluride, Canada. (Image credit: John Sirlin/Alamy Stock Photo)

Astrophysicists investigating the origins of the Milky Way may have discovered our galaxy's 'old heart' — the original, ancient nucleus around which all of its stars and planets grew. The collection of 18,000 of our galaxy's oldest stars are located in the constellation Sagittarius are from the Milky Way's protogalaxy — a primordial mass of gas and dust forming the first stars of a young galaxy — that is more than 12.5 billion years old. Accounting for an estimated 0.2% of our galaxy's total mass, the group is the kernel around which all of the Milky Way eventually grew, the researchers found. To discover the primordial group of stars, the astronomers drew on data from the European Space Agency's (ESA) Gaia observatory — a 3594-pound (1,630 kilograms) spacecraft launched in 2013 with the goal of creating the most detailed and accurate map of the Milky Way. With further study, the researchers hope the ancient heart can teach them even more about our galaxy's earliest years, such as the types of supernovas that must have exploded during the time of its creation to produce the proportions of early chemical elements we see today.

<https://www.livescience.com/milky-way-protogalaxy-discovered-by-gaia>

NASA's Swift and Fermi missions detect exceptional cosmic blast



Swift's X-Ray Telescope captured the afterglow of GRB 221009A about an hour after it was first detected.

Astronomers around the world are captivated by an unusually bright and long-lasting pulse of high-energy radiation that swept over Earth on Sunday, Oct. 9. The emission came from a gamma-ray burst (GRB)—the most powerful class of explosions in the universe—that ranks among the most luminous events known. On Sunday morning Eastern time, a wave of X-rays and gamma rays passed through the solar system, triggering detectors aboard NASA's Fermi Gamma-ray Space Telescope, Neil Gehrels Swift Observatory, and Wind spacecraft, as well as others. Telescopes around the world turned to the site to study the aftermath, and new observations continue. The signal, originating from the direction of the constellation Sagitta, had travelled an estimated 1.9 billion years to reach Earth. Astronomers think it represents the birth cry of a new black hole, one that formed in the heart of a massive star collapsing under its own weight. In these circumstances, a nascent black hole drives powerful jets of particles traveling near the speed of light. The jets pierce through the star, emitting X-rays and gamma rays as they stream into space. The light from this ancient explosion brings with it new insights into stellar collapse, the birth of a black hole, the behaviour and interaction of matter near the speed of light, the conditions in a distant galaxy—and much more. Another GRB this bright may not appear for decades.

<https://phys.org/news/2022-10-nasa-swift-fermi-missions-exceptional.html>

https://www.spacedaily.com/reports/Astronomers_are_captivated_by_brightest_flash_ever_seen_999.html

Webb reveals new surprises on galaxy organic molecules near black holes

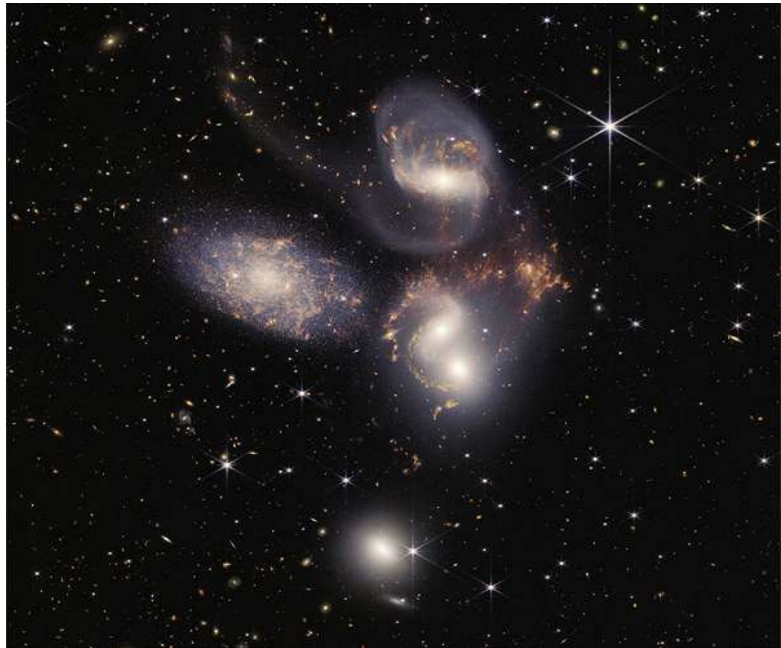
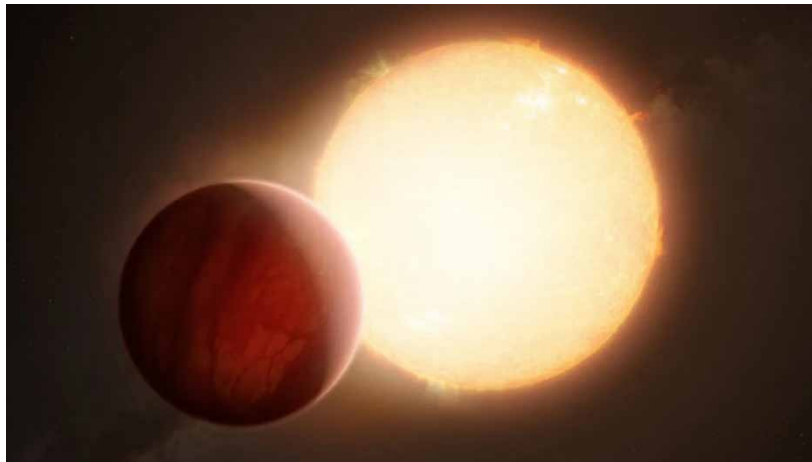


illustration only

Tiny dust molecules known as polycyclic aromatic hydrocarbons (PAHs) are among the most widespread organic molecules in the universe and important astronomical tools. For instance, they are considered to be fundamental buildingblocks of prebiotic compounds, which may have played a key role in the origin of life. PAH molecules produce extremely bright emission bands in the infrared region when they are illuminated by stars, enabling astronomers to not only trace star-formation activity, but also to use them as sensitive barometers of the local physical conditions. The study was based on spectroscopic data from the James Webb Space Telescope's MIRI which specifically measures light in the 5-28 micron wavelength range. The researchers then compared the observations with theoretical predictions for these molecules. Surprisingly, the results overturned those of previous studies that had predicted that PAH molecules would be destroyed in the vicinity of the black hole at the centre of an active galaxy. Instead, the analysis revealed that PAH molecules can actually survive in this region, even where very energetic photons could potentially rip them apart.

https://www.spacedaily.com/reports/Webb_reveals_new_surprises_on_galaxy_organic_molecules_near_black_holes_999.html

Astronomers detected the heaviest element yet in two exotic exoplanets



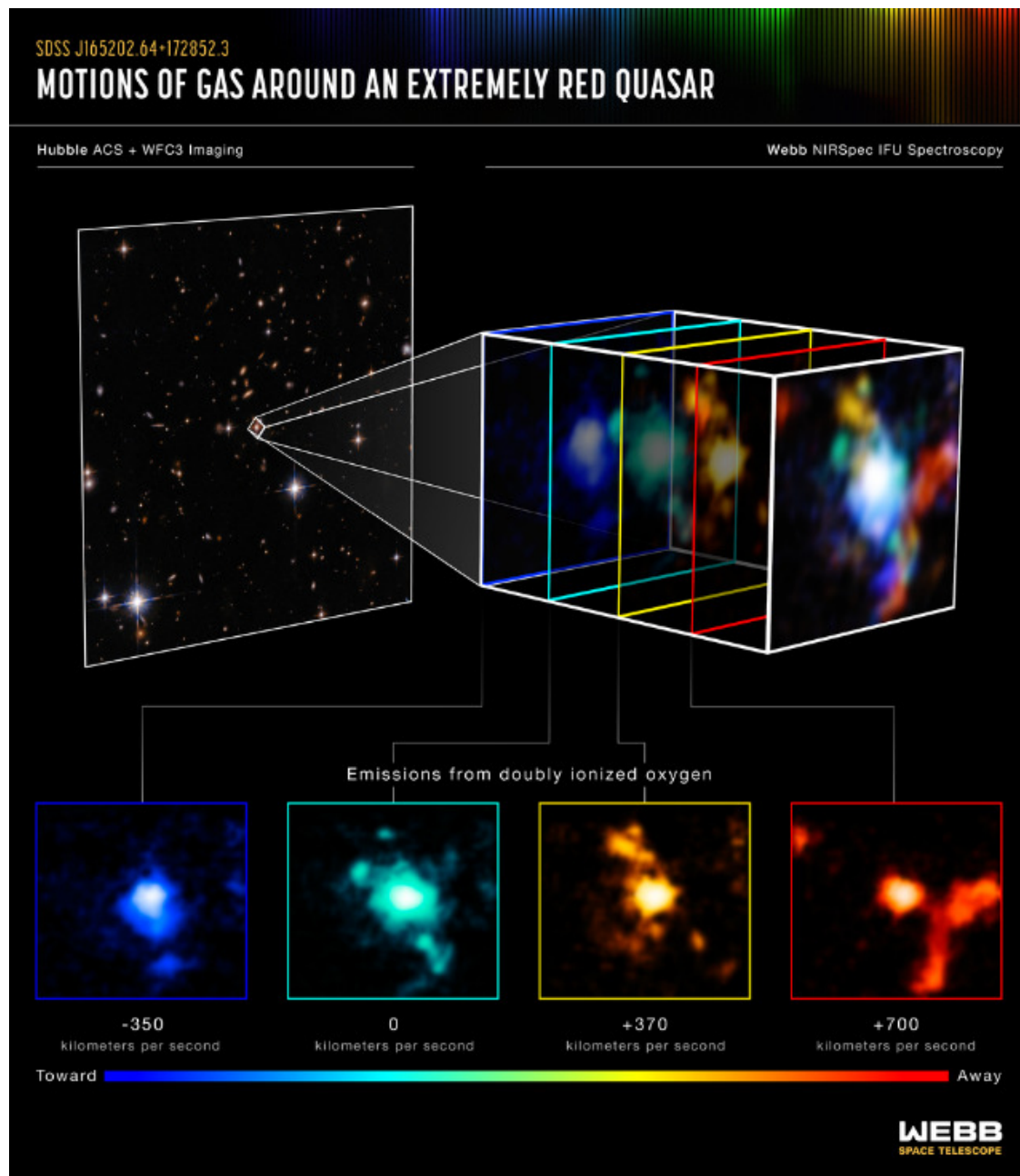
Aristo's impression of an ultra-hot Jupiter transiting its star.

Astronomers have discovered the heaviest element yet within the atmosphere of two blisteringly hot exoplanets where it rains liquid iron and gems from the skies. As if that was not enough, researchers have now detected barium in their upper atmosphere, making them even more unusual than previously thought. The two exoplanets, WASP-76 b and WASP-121 b, orbit stars outside our Solar System. They are categorized as ultra-hot Jupiter as they are similar in size to Jupiter, the largest planet in our solar system. But these exoplanets have incredibly hot surface temperatures well above 1,832 degrees Fahrenheit (1,000 degrees Celsius). The soaring temperatures on these exoplanets stem from the fact that each planet is located close to its host star, completing a single orbit in about one or two days. The sizzling temperature of the exoplanets gives these worlds their unusual characteristics, like how WASP-76 b is thought to experience showers of iron from the sky, while WASP-121b experience metal clouds and flurries of gems.

<https://interestingengineering.com/science/heaviest-element-two-exotic-exoplanets>

NASA's Webb Uncovers Dense Cosmic Knot in The Early Universe

Astronomers looking into the early universe have made a surprising discovery using NASA's James Webb Space Telescope: a cluster of massive galaxies in the process of forming around an extremely red quasar. The result will expand our understanding of how galaxy clusters in the early universe came together and formed the cosmic web we see today.



At left, the quasar SDSS J165202.64+172852.3 is highlighted in a Hubble Space Telescope image taken in visible and near-infrared light. The images on the right and at bottom present new observations from the James Webb Space Telescope in multiple wavelengths. They demonstrate the distribution and motions of gas within a newly observed galaxy cluster around the central quasar.

Credits: NASA, ESA, CSA, STScI, D. Wylezalek (Heidelberg Univ.), A. Vayner and N. Zakamska (Johns Hopkins Univ.) and the Q-3D Team

The quasar Webb explored, called SDSS J165202.64+172852.3, existed 11.5 billion years ago. It is unusually red not just because of its intrinsic red colour, but also because the galaxy's light has been redshifted by its vast distance. That made Webb, having unparalleled sensitivity in infrared wavelengths, perfectly suited to examine the galaxy in detail.

<https://www.nasa.gov/feature/goddard/2022/nasa-s-webb-uncovers-dense-cosmic-knot-in-the-early-universe>

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