"The Southern Cross"

HERMANUS ASTRONOMY CENTRE NEWSLETTER

JULY 2022

Monthly Meeting

(Third Monday of each month)

20th June:Prof. Martin Snow presented *"The Ups and Downs of the Solar Cycle."*

Professor Martin Snow, of SANSA, gave us a description of the whirls and twirls of the Sun's mighty ball of plasma. He described how this turbulence creates the magnetic field, signposted as sunspots at the surface, and distributes energy to kick-start and maintain life on our planet and then out to the far reaches of the solar system. He detailed the intensity cycles of the field and its relationship to our weather patterns. The slides accompanying his talk were delightfully punctuated by cats, butterflies and even a polar bear perched atop an iceberg.

Members who were unable to attend the meeting may see the presentation on You Tube: https://youtu.be/ckmyi5AlCMY

Coming up on 18th July - Dr Nicolas Erasmus presents *"Observations Characterising Asteroids using Telescopes located in Sutherland."*

2022 meeting dates: For your diaries - The monthly meetings of 2022 are scheduled as follows: 18 July, 15 August, 19 September, 17 October and 21 November. Unless otherwise advised, all our meetings are virtual using Zoom, commencing 18.30.

Special Interest Group activities

Cosmology

(the first Monday of each month)

6th June:*"What would it take to make a black hole? And what's a black hole laser?"*– **Sabine Hossenfelder**.

https://www.youtube.com/watch?v=avwY1OBhaBk&list=PLSxD1jsHtqy6ZdjKvcSuJ_oBk4dYOM4Dj&index=8&t=1s

"Image of SgrA Black Hole Revealed! Here's What We Know"*–**Anton Petrov**https://www.youtube.com/watch?v=PPlYyZZS4Fw&list=PLSxD1jsHtqy6ZdjKvcSuJ_oBk4dYOM4Dj&index=9

4th July: topic to be advised in due course.

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

Astrophotography

(Second Monday of each month)

Our meeting, scheduled for **Monday 13thJune**, was cancelled as we had no requests for a topic.

Coming up:11th July, this meeting will only take place in accordance with members' wishes.For further information, please contact Deon Krige: deonk@telkomsa.net

Study Group

(The last Monday of each month)

27thJune:
Topics: 1. Graphine Superconductor Capacitor breakthrough is FINALLY Here

2. Why this Accidental Battery Breakthrough Matters

3. Evidence that Life Started on Earth Much Earlier than We Thought

25th July: the topic will be advised in due course.
For further information, please contact Peter Harvey: petermh@hermanus.co.za

Stargazing

Stargazing, the one activity actually benefitting from loadshedding! No Stargazing is currently planned but we shall let you know as soon as a suitable evening is scheduled.

Other activities

Educational outreach: Mick Fynn, assisted by others including HAC members, has been leading weekly tours of the solar system model on the Cliff Path commencing every Thursday at 11.00 at the **Tourism Centre** (Old Railway Station). Tourism staff are keen to market and publicise this new addition to Hermanus attractions.

Future Trips

No outings are being planned at present.

GEARING'S POINT ASTRONOMY EDUCATION DISPLAY (GPAED)

"GEARING'S POINT ASTRONOMY EDUCATION DISPLAY (GPAED)
Since the last summary a major curved ball has emerged in the form of a Site Plan which is required by both the Overstrand Municipality (as owner of the site) and the local Heritage committee (as a heritage site). We were not aware of this requirement before. The site has been land-surveyed and the Site Plan based on this survey has been submitted to the municipality.
With reference to the previous summary the first step of Science Editing has been completed.
The first round of graphic designs of the edited tablets is almost complete. These tablets are now being carefully reviewed to ensure terminology and grammatical (capital letters, italics) consistency on all. The initial round focussed on individual tablets rather than overall consistency. This process should be complete by the end of July.
With regard to the third step of chemical etching of B&W text and Perspex printing of colour diagrams, a sample tablet is in the process of being fabricated. This will be reviewed and amended or approved as appropriate before proceeding to the production phase. The completion deadline of 31st August is unchanged.
This same deadline is also applicable to the local pre-casting of the mounting slabs and casting of the reinforced foundations onto which the mounting slabs will be affixed.
Installation *in situ* is still scheduled for September.
The project team of Pierre, Deon and Derek have indeed forfeited the luxury of any idle moments but are still managing to stick to the original schedule, albeit with considerable effort"

Astronomy News (compiled by Pieter Kotzé)

New discovery about distant galaxies: Stars are heavier than we thought

A team of University of Copenhagen astrophysicists has arrived at a major result regarding star populations beyond the Milky Way. The result could change our understanding of a wide range of astronomical phenomena, including the formation of black holes, supernovae and why galaxies die. Since 1955, it has been assumed that the composition of stars in the universe's other galaxies is similar to that of the hundreds of billions of stars within our own - a mixture of massive, medium mass and low mass stars. But with the help of observations from 140,000 galaxies across the universe and a wide range of advanced models, the team has tested whether the same distribution of stars apparent in the Milky Way applies elsewhere. The results demonstrate that stars in distant galaxies are typically more massive than those in our local neighbourhoods, and that the farther away the researchers look, the more massive the average stars become.

https://www.spacedaily.com/reports/New_discovery_about_distant_galaxies_Stars_are_heavier_than_we_thought_999.html

A new origin story for King Tut's meteorite dagger

The iron dagger of Tutankhamun with its gold sheath.

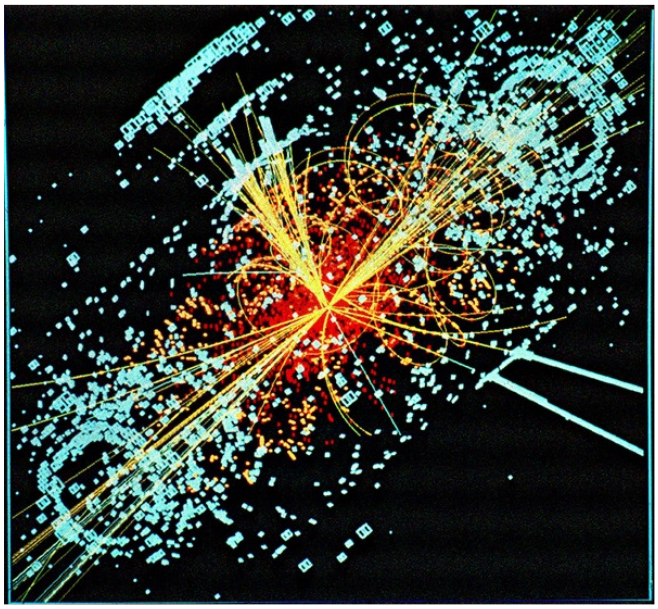
Daniela Comelli/Egyptian Museum in Cairo

When archaeologists peered inside Tutankhamun's tomb

for the first time in the early 1920s, they found antechambers packed to the brim with thousands of artifacts: statues, furniture, jewellery, clothes, chariots, paintings. Among these possessions was an iron dagger — just over one foot in length and crafted from an iron meteorite — that would puzzle researchers for nearly a century. The Iron Age, a period when people across Europe, Asia and Africa began making tools from iron ore through a process called smelting, is generally thought to have begun no earlier than 1200 B.C. — some 150 years after King Tut's death. Takafumi Matsui, director of the Chiba Institute of Technology's Planetary Exploration Research Center in Japan, and his colleagues visited the weapon at the Egyptian Museum of Cairo in 2020 But their chemical analyses of the dagger's blade and gold hilt, combined with historical knowledge of ancient manufacturing techniques, now cast doubt on whether it was crafted in ancient Egypt at all. Instead, Matsui and his colleagues propose that the king of the nearby Mitanni empire gave the dagger to King Tut's grandfather as a wedding gift. The bar for wedding gifts has certainly been raised.

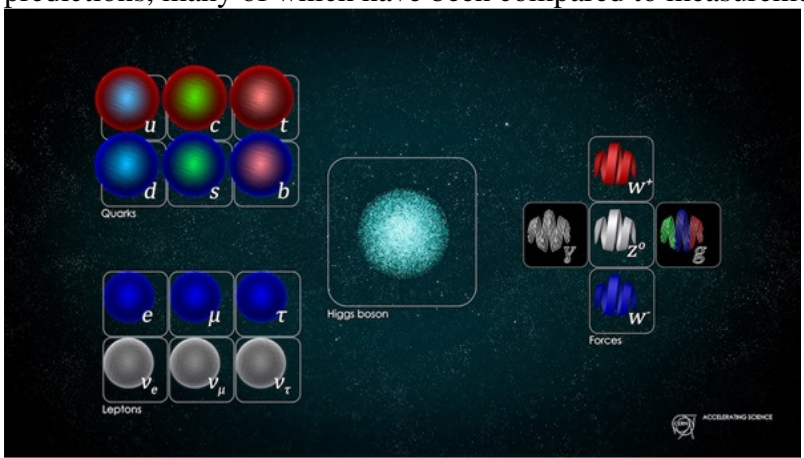
https://astronomy.com/news/2022/05/a-new-origin-story-for-king-tuts-meteorite-dagger

What is the Standard Model of particle physics, and why are scientists looking beyond it?



This is a simulated data model of a particle collision in the Large Hadron Collider at CERN. CERN; Lucas Taylor

For the past half century or so, a theory known by the understated name of the Standard Model has dominated the field of particle physics. This theory provides us with a detailed description of the 17 known fundamental particles, telling us how they should each behave and interact. Since its introduction, this theory has turned out to be astoundingly successful. From the mathematical structure of the Standard Model, physicists have been able to make thousands of precise predictions, many of which have been compared to measurements performed at particle colliders. And, in almost every case, these predictions have turned out to be right.



The Standard Model explains how 17 fundamental particles in particle physics behave and interact, but it doesn't explain everything. In particular, a force-carrying particle for gravity has not been found. The entities described by the Standard Model include 12 particles known as fermions, and 5 called bosons. By any reasonable measure, the Standard Model has been a staggering success. It was used to predict that particles like the Higgs boson and the top quark must exist — long before they had been observed in any experiment. Simply put, it is the most empirically successful theory in the history of science. Crucially, the Standard Model does not account for the existence of gravity. Despite considerable effort, we still don't know how to self-consistently include gravity in our theories of particle physics. For starters, we haven't been able to find a force-carrying particle for gravity, or a so-called graviton. Luckily gravity has negligible effect on the microworld that particle physicists explore. But that means that the macro effects of gravity aren't covered by the Standard Model. Furthermore, cosmologists have found that our universe contains vast quantities of dark matter and dark energy, neither of which can be explained by anything in the Standard Model. It also doesn't explain why we exist in a matter-dominated universe. In theory, the Big Bang should have created equal amounts of matter and antimatter — yet nearly everything we see today is made of matter. Something must have tipped that balance, but we have no idea what.

https://astronomy.com/news/2022/05/what-is-the-standard-model-of-particle-physics

Earthbound space dust comes from solar system's edge

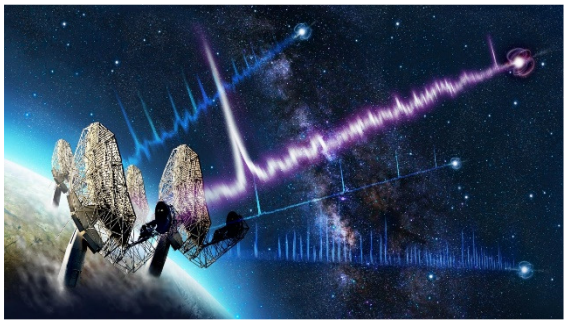
A new study confirms that much of the dust that makes up the zodiacal cloud originates from the Kuiper belt, more than 2 billion miles from Earth.

The zodiacal cloud as seen from Earth.

When you notice that faint glow of reflected sunlight in the dark sky just before dawn and after twilight, you're actually looking at the zodiacal dust cloud. The dust envelops our inner solar system and up to 30,000 tons of its particles spiral into Earth's atmosphere every year, according to some estimates. This dust was long thought to come from collisions in the main asteroid belt as well as among Jupiter-family comets — with little chance of particles reaching Earth from the Kuiper belt, a doughnut-shaped region beyond the orbit of Neptune that contains comets, asteroids and other icy objects. In a recent study published in *Nature Astronomy*, however, researchers discovered dust particles from the zodiacal cloud that originated from the farthest reaches of our solar system.

https://astronomy.com/news/2022/05/earthbound-space-dust-comes-from-solar-systems-edge

Strange Radio-Emitting Neutron Star Discovered in Stellar Graveyard



Artist impression of the 76s pulsar (in magenta) compared to other more rapidly spinning sources. Credit: Danielle Futselaar

An international team of astronomers has discovered a strange radio-emitting neutron star**, which rotates extremely slowly, completing one rotation every 76 seconds.**

The team of researchers says it is an unusual discovery as it resides in the neutron star graveyard where they do not expect to see any radio emission at all. The discovery was made using the MeerKAT radio telescope in South Africa and published in the journal, *Nature Astronomy* on May 30, 2022. The study was led by members of the ERC-funded MeerTRAP (More Transients and Pulsars) group at The University of Manchester. The source was initially found from a single flash, or pulse, by the MeerTRAP instrument whilst piggybacking on imaging observations being led by a different team, ThunderKAT. MeerTRAP and ThunderKAT then worked closely together to puzzle out its origin. Combining the data from the two teams, it was then possible to confirm the pulsations and get an accurate position for the source, enabling detailed and more sensitive follow-up observations. The team thinks it could belong to the theorized class of ultra-long period magnetars with extremely strong magnetic fields. It is therefore likely that there are many more of these very slowly spinning sources in the Galaxy which has important implications for how neutron stars are born and age. The majority of pulsar surveys do not search for periods this long and so we have no idea how many of these sources there might be. In this case, the source was bright enough that we could detect the single pulses with the MeerTRAP instrument at MeerKAT.

https://scitechdaily.com/strange-radio-emitting-neutron-star-discovered-in-stellar-graveyard/

Meteorite bears the imprint of a supernova from before the solar system was born

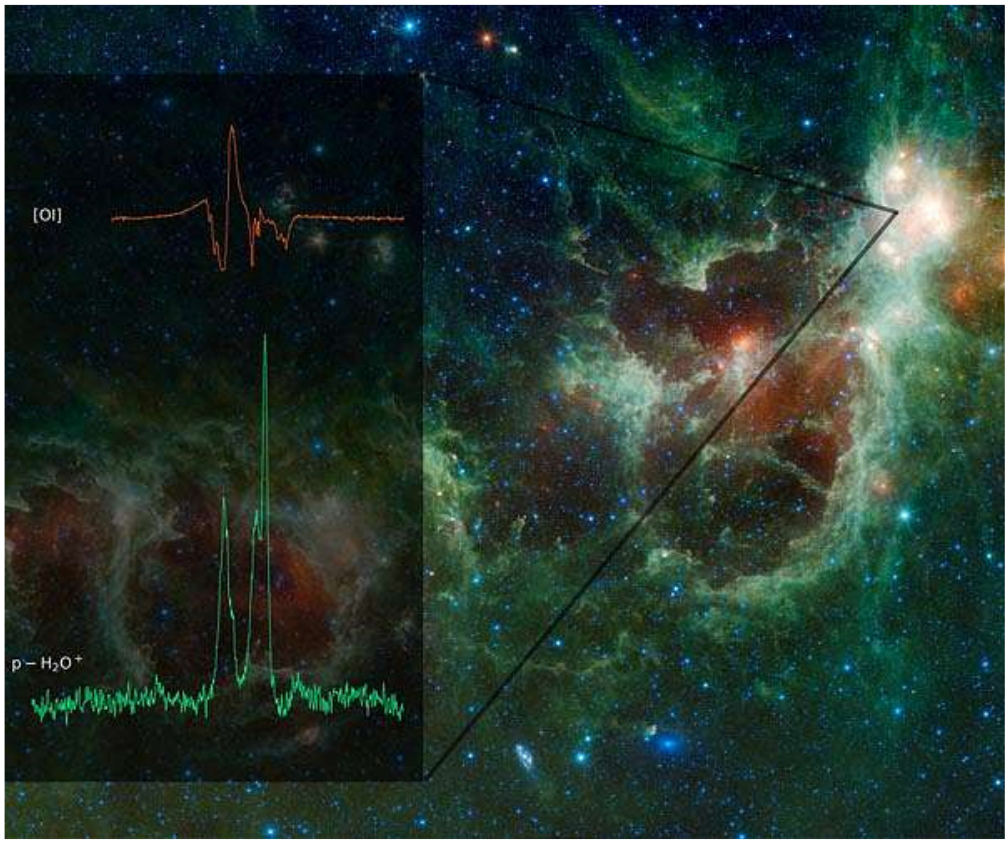
A fragment of the unusual meteorite named Hypatia, measuring just a few centimeters across. Elements in this meteorite indicate they may have come from a white dwarf supernova. Photo: Roman Serra

A very strange meteorite found in western Egypt in 1996 may have tiny pieces of the debris from a supernova in it, and not just any supernova but one created by the explosion of a white dwarf, the remnant core of a once Sun-like star. If so, this would be the first evidence of a relatively nearby supernova of that kind that occurred before the Sun and planets were born. The stone is called Hypatia, and right away it was seen

to be an oddball. That type of meteorite is called *carbonaceous chondrite*. These generally have a high carbon content, and many contain chondrules, which are tiny, generally roundish grains of material that formed early on in the process that formed the Sun, planets, asteroids, and everything else in our solar system. In fact, the abundance of an isotope of xenon in Hypatia indicates it formed less than 40 million years after the solar nebula started to collapse. It will be the first direct evidence of a nearby white dwarf supernova that occurred sometime before our planet even formed.

https://www.syfy.com/syfy-wire/bad-astronomy-hypatia-meteorite-linked-to-a-white-dwarf-supernova

Small molecules have big impacts in interstellar clouds

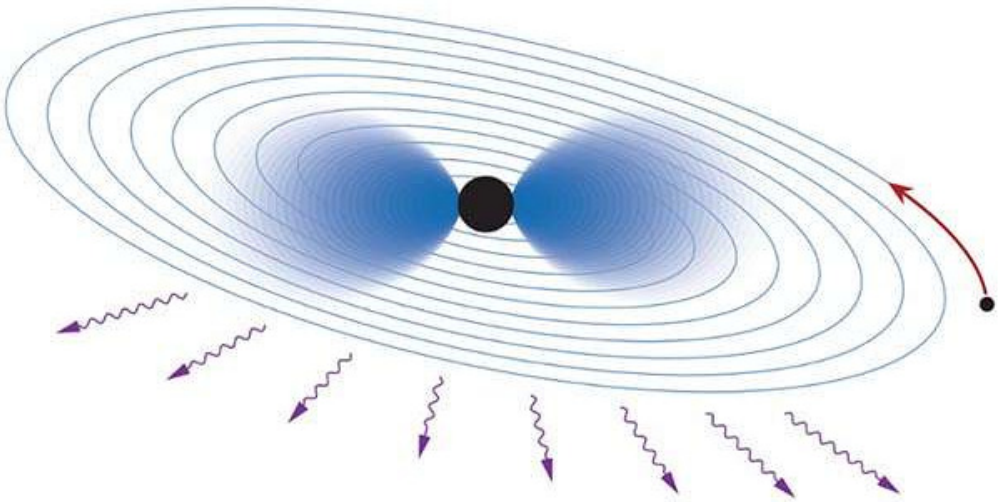


W3, one of the 25 Milky Way regions the HyGAL project will study, is seen as the glowing white area in the upper right of this image of the Heart and Soul Nebulae, taken by NASA's Wide-field Infrared Survey Explorer (WISE). SOFIA looked at the abundances of six hydride molecules in W3, the spectra of two of which are shown in the box at left. Image credit: Nebulae: NASA/JPL-Caltech/UCLA; Spectra: Jacob et al.

"One of the key goals, when you think about modern astronomy, considers the life cycle of molecular material," said Arshia Jacob, an astronomer at Johns Hopkins University. Diffuse atomic gas becomes dense molecular gas, which ultimately forms stars and stellar systems, and continues to evolve over time. Though astronomers understand much of this process, there are a lot of missing pieces. By studying six hydrides, which are molecules or molecular ions in which one or more hydrogen atoms are bound to a heavier atom through shared electron pairs, Jacob and her collaborators hope to better understand how molecular clouds form and evolve. Hydrides are useful to astronomers because they are very sensitive tracers of different phases of the interstellar medium, and their chemistry is relatively straightforward. Moreover, hydride observations provide measurements of the amount of material present.

https://www.spacedaily.com/reports/Small_molecules_have_big_impacts_in_interstellar_clouds_999.html

Detecting new particles around black holes with gravitational waves

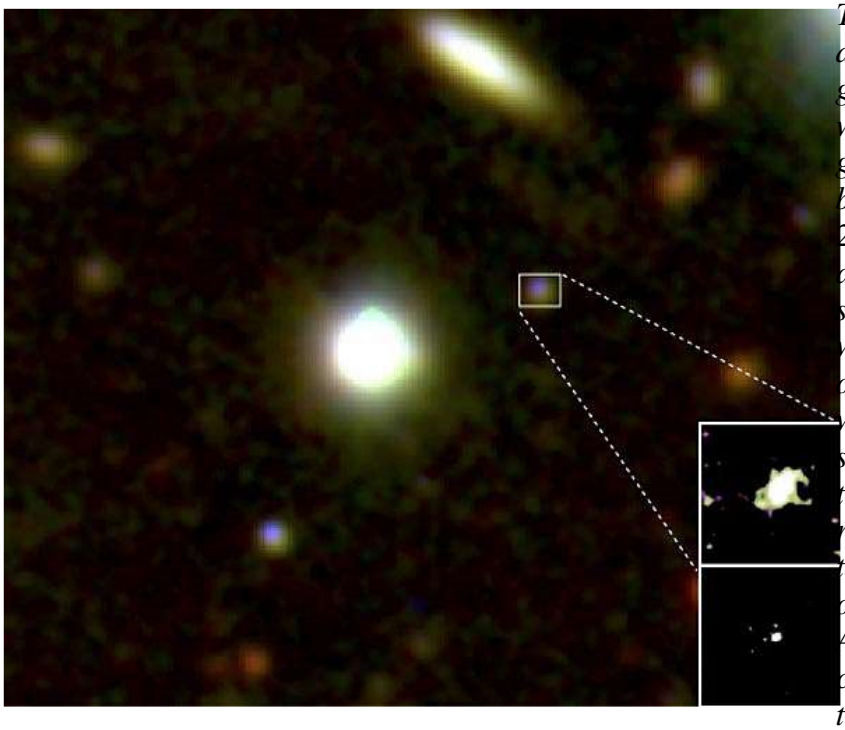


An atom in the sky. If new ultralight particles exist, black holes would be surrounded by a cloud of such particles that behaves surprisingly similar to the cloud of electrons in an atom. When another heavy object spirals in and eventually merges with the black hole, the gravitational atom gets ionized and emits particles just like electrons are emitted when light is shone onto a metal.

Clouds of ultralight particles can form around rotating black holes. A team of physicists from the University of Amsterdam and Harvard University now show that these clouds would leave a characteristic imprint on the gravitational waves emitted by binary black holes. Black holes are generally thought to swallow all forms of matter and energy surrounding them. In a publication that appeared in Physical Review Letters this week, a team consisting of UvA physicists Daniel Baumann, Gianfranco Bertone, and Giovanni Maria Tomaselli, and Harvard University physicist John Stout, suggest that the analogy between ordinary and gravitational atoms runs deeper than just the similarity in structure. They claim that the resemblance can in fact be exploited to discover new particles with upcoming gravitational wave interferometers.

https://www.spacedaily.com/reports/Detecting_new_particles_around_black_holes_with_gravitational_waves_999.html

An Unexpected Gamma Ray Burst



This image depicts the galaxy in which the gamma-ray burst GRB 200826A and its supernova were observed, which is shown in the rectangle to the right of centre. At the centre of the image, the bright star which was monitored to correct for atmospheric perturbations with adaptive optics. The two inserts on the lower right show the galaxy in greater detail as observed in the infrared with the Large Binocular Telescope (LBT) using the adaptive optics of the SOUL system. The top insert shows the host galaxy whereas the supernova can be seen in the lower insert, where the contribution of the galaxy has been subtracted from a reference image taken about 5 months afterwards. This composite image combines observations obtained from LBT and Telescopio Nazionale Galileo (TNG) with archival data from the Gemini telescope.

An international group led by INAF researchers have confirmed that the gamma-ray burst GRB 200826A, which lasted less than two seconds - typical of short bursts - is associated with the explosion of a massive star, which is typical of long gamma-ray bursts. The study, involving also several universities and research institutes in Italy, is primarily based on data collected with the Large Binocular Telescope in Arizona, USA. The observations made the first ever use of adaptive optics to observe a supernova associated with a gamma-ray burst. Classifying gamma-ray bursts - rapid phenomena amongst the most energetic in the Universe - on the basis of their duration is the most commonly adopted approach by the astronomical community. However, recent observations have shown that this classification is not sufficient to uniquely reveal the nature of the progenitor that originated the burst. A new study, led by Andrea Rossi, a researcher at the Italian National Institute of Astrophysics (INAF), has shown that the gamma-ray burst GRB 200826A, first observed in 2020, is associated with a supernova, i.e. the explosion of a massive star, unlike other short gamma-ray bursts.

https://www.spacedaily.com/reports/An_Unexpected_Gamma_Ray_Burst_999.html

Asteroid Ryugu contains material older than the planets, among the most primitive ever studied on Earth

JAXA personnel inspect Hayabusa2's return capsule against the red soil of the Woomera Prohibited Area in Australia on Dec. 5. (Image credit: JAXA)

The asteroid Ryugu contains some of the most primitive material ever studied in a laboratory on Earth, dating back to just 5 million years after the formation of the solar system, according to an analysis of samples retrieved by Japan's Hayabusa2 mission. Because it is so old, it is made of the same stuff that formed the planets. The Japan Aerospace Exploration Agency's Hayabusa2 spacecraft launched in December 2014 and arrived at asteroid Ryugu in 2019. It retrieved two small samples of regolith, amounting to 5.4 grams, from the asteroid. As such, it is made up of the ingredients that formed the solar system 4.5 billion years ago. The findings support previous research that also concluded that Ryugu was made of primitive material, but until now it wasn't known just how old it was.

https://www.space.com/asteroid-ryugu-sample-older-than-planets

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