ASTRONOMICAL SOCIETY OF SOUTHERN AFRICA

Durban 'nDaba

Monthly Newsletter of the Durban Centre - September 2022

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Member Submissions Disclaimer

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Chairman's Chatter

September 2022

Dear ASSA members.

What a fantastic time to be alive. We are planning to go back to the moon. Sadly, the Artemis launch, the exciting moment we all had been waiting for was cancelled not once but twice due to fuel leaks and faulty sensors. The next potential date set for launch will be 19 September 2022. See the write-up of the failed launches of Artemis 1 on page 29.

Next year will see us hosting another astronomy course. Should anyone like to participate by either providing material for the course or hosting one of the modules please feel free to contact one of our committee members and we will gladly add you to our list. If there is any cross material that you would like to see during the astronomy course, please also send us an e-mail and we will try and accommodate.

We receive inquiries quite often about the types of telescopes one would need to purchase for viewing the heavens above. We do have a lovely article in our indaba giving you ten pieces of information that you would need to consider before making that first purchase. I do encourage you to look at page 11 for more information if you are in the market.

An interesting article has been published regarding The Big Bang Theory. I am sure this will start some great, lively debate. Pease read the article on page 16.

An interesting article is featured on page 31 of the Double Asteroid Redirection Test, commonly known as the DART. This test run for the redirection of possible dangerous asteroids heading for our planter, is due to take place on the 26 September which can be viewed on line. Detail of which can be found on page 31.

Zane Robertson has sent us a very interesting link for kids wanting to learn more about astronomy. This website has space and solar system resources as well as word games for Young Astronomers. Please see the link https://word.tips/space-solar-system-games/ We will also add this link to our website resource page. A very big thank you for sharing this with us Zane!

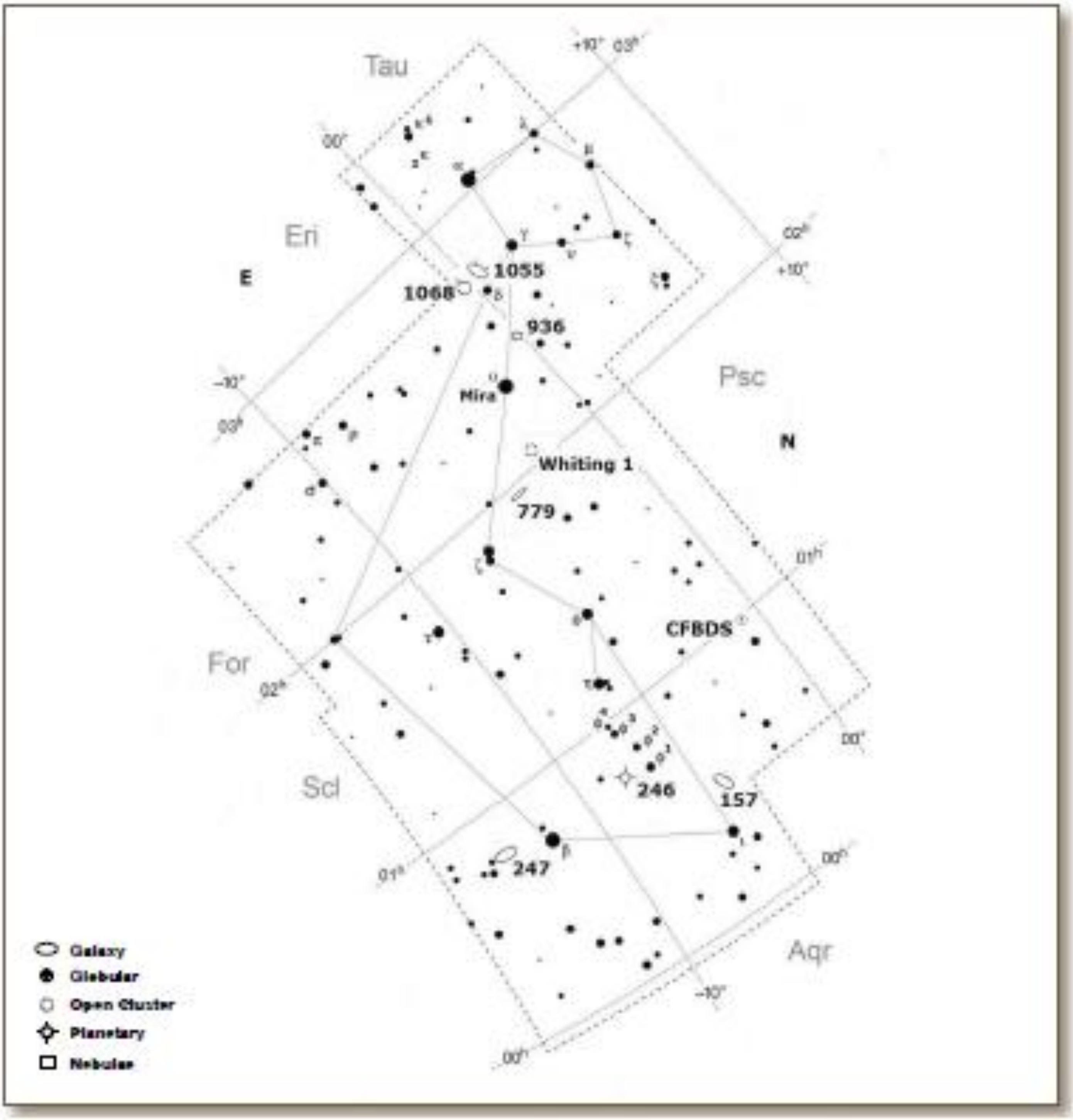
Following which NASA has a page on https://www.nasa.gov/stem/highereducation/index.html under the tab *NASA Audiences* - which is also aimed at Young Astronomers of various grades. These may be of interest to your Young Astronomers helping advance their interest in astronomy.

We are urgently looking for a someone to take over the position of Treasurer. Please, if anyone would volunteer to take over this portfolio , we would be extremely grateful.

As always, stay safe and wishing you all many clear skies for the New Year.
Amith Rajpal.

Astronomy Delights: Cetus
A Monster Whale

By Magda Streicher

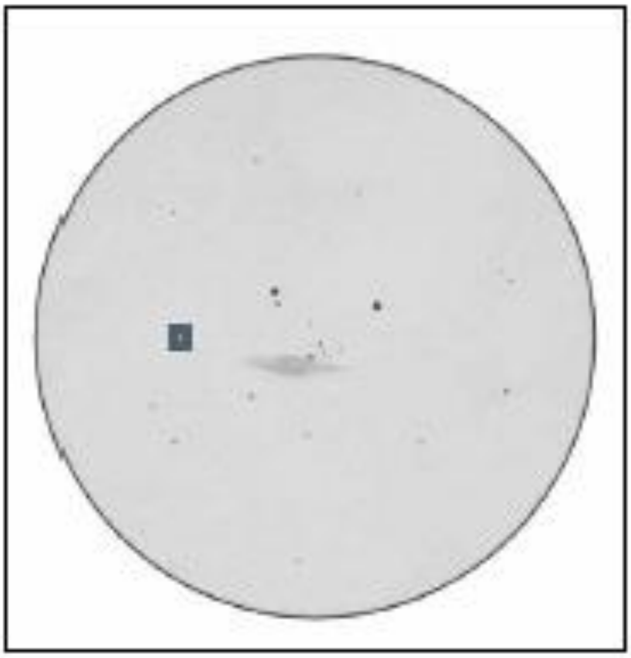


ABOVE: The constellation of Cetus

...Cetus

The Cetus constellation is situated in the northern part of the sky and ranked as the 4th largest among the documented 88 constellations. Cetus in mythology represents the sea monster sent to kill the princess Andromeda, but legends also point a finger of concern to Draco, another northern hemisphere constellation. The constellation occupies a part of sky that houses mainly galaxies and, sadly, few known clusters or nebulae; but it is famously situated at the south pole of the Milky Way.

About 5 degrees from the Taurus border in the north-eastern corner of Cetus, magnitude 2.5 alpha Ceti also known as Menkar appears to be the watchful eye of the whale. The lovely red-orange giant star can be appreciated through binoculars as a double star with a magnitude 5.6 visible partner, but it is not a physical companion of alpha Ceti.



The magnitude 4 delta Ceti star points the way barely 35′ east to **NGC 1055**, one of the most outstanding objects to be found in this constellation. The galaxy displays a soft elongated east-west oval with the middle part slowly brightening to an intense glow. With averted vision the eastern part displays a fade-out tip and is a fraction shorter. The western section in turn, is somewhat slimmer with a defined tip and a small triangle of magnitudes 12 to 13 stars on the northern edge. With higher magnification the dusty dark lane is clearly visible as a thin hairline. This star city forms a nice triangle a few arc-minutes to the south of two similar stars, a slightly yellow magnitude 6.7 and a plain cream-white magnitude 7.5, which also pairs with a magnitude 10 star. It is a very exceptional star field that rounds off this showpiece galaxy in a very distinctive way. Towards the east is NGC 1072, a very faint northsouth edge-on galaxy, which is a real challenge to search out.

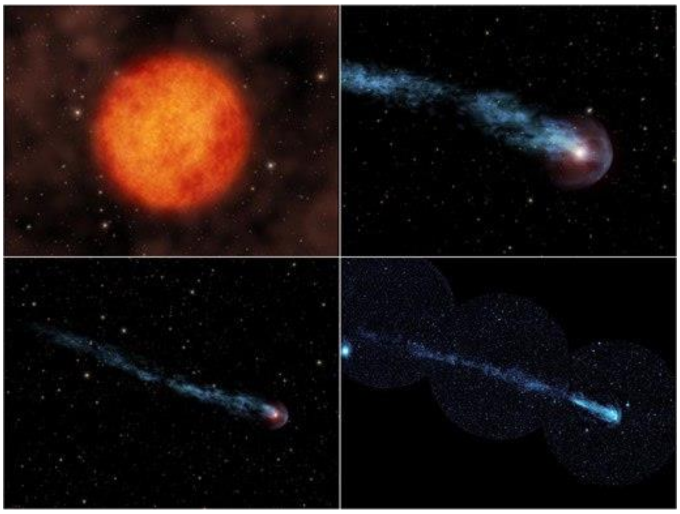
Another galaxy, quite different in shape and impression, is the well-known **NGC 1068** better known as Messier 77, half a degree south from NGC 1055, and the only Messier object in the constellation Cetus. NGC 1068 is a peculiar Seyfert galaxy displaying a misty appearance with a roundish shape and a very bright star-like nucleus.

...Cetus

With a mottled brightness of about magnitude 8.9, one gets the impression of a faint globular cluster rather than a galaxy. Higher magnification, however, reveals soft, barely visible, wisps of nebulosity around the edge. The galaxy is just west of a magnitude 9 foreground star giving the impression of two eyes in the dark of night. Even the stars in the field play the game in pairs, which is quite pleasing. This Seyfert system, which exhibits unusually intense and variable ultraviolet emissions from a tiny star-like nucleus, is probably the sign of gas spinning into a supermassive black hole. It was also one of the first galaxies found to have a large red shift, thus implying that it was receding rapidly along our line of vision. The spiral structure in M77 was first noted by the Earl of Rosse.

RIGHT: NGC 1068 – M77 – Photograph: Dale Liebenberg

The collar on the mighty whale's neck indicates the famous magnitude 6.5 red giant star omicron Ceti, better known as Mira, which means "the wonderful", a name bestowed on it in 1662 by Johannes Hevelius (1611–1687). The star undergoes actual pulsations in size and brightness and varies from as dim as magnitude 9 to as bright as magnitude 3 to 4 and even as high as magnitude 2. The Greek astronomer Hipparchus became the first person to spot the star's light, but recognition as a variable star was credited to David Fabricius (1564–1617), who spotted it rising in 1596 and again in 1609. The cycle is now estimated to be 11 months or close to the value of 332 days. In 2007 astronomers imaged Mira's, ultraviolet smoke trail of about 2 degrees long left behind its 30 000 years of travel through space. Mira's comet-like tail stretches a startling 13 light-years across the sky. Mira, known as a Mira-type star, appeared in Johann Bayer's 17th-century catalogue, where it was assigned the Greek letter omicron. The astronomer William Herschel refers to Mira as a star with a deep garnet colour. A magnitude 12 companion star can be found with a separation of 74.7 and position angle (PA) of 90°. Another lovely red magnitude 9 star can be seen north-east of Mira, which lends a special effect. However, the system was previously identified as multiple in the Hipparcos Input Catalogue.



ABOVE: Mira—Image : Cyprus Astronomy Organisation

An easy way to find objects is to look out for triangles among the stars. **NGC 936** is situated west in a long, thin triangle with the star's delta and omicron Ceti. The galaxy appears to be just a faint, roundish glow lying south of a group of four stars. Higher magnification offers no improvement of the view with any sign of the fainter companion galaxies either. The area is packed with galaxies, but if you want to search for them you will need really high magnification, a very dark, transparent sky and a lot of patience.

...Cetus

Globular clusters are concentrated old stellar groups that can be found in the outer Milky Way disc. **WHITING 1** was found on a survey done by A. Whiting, G. Hau and M. Irvan at the Cerro Tololo Inter-American Observatory in 2002 that identified it as a compact cluster of blue stars which could possibly be a very young globular cluster due to an abundance of low metals. The object was later classified as an open cluster only about 5 billion years old. This object is situated 4 degrees west of Mira, but do not expect to make an observation of this very faint and illusive object.

RIGHT: Whiting 1 – Photograph: Sky.com

Sarah Francis Whiting, (1847-1927) was an American physicist and astronomer. At the beginning of the 20th century, a group of women known as the Harvard Observatory Computers under supervision of Edward Pickering helped revolutionize the science of astronomy to map the universe. While doing graduate work Whiting and Annie Connon, who devised a System for classifying stars, also conducted experiments on x-rays.

These women, referred to as “computers,” were the only way that Pickering could achieve his goal of photographing and cataloguing the entire night sky.

Left: Sarah Frances Whiting Pencil Sketch: Kathryn van Schalkwyk

Further south, towards the middle part of the constellation is **NGC 779**, a relatively bright, quite large, thin ray of light in an elongated north-south direction, with a bright stellar nucleus. Again, you need very dark, transparent skies and relatively high magnification to spot this galaxy, as is the case, sadly, with most of this category objects.

Quite outstanding are the three stars eta, iota and beta Ceti, that form the tail part of the graceful mighty whale, which can be easily identified in the south-western part of the constellation.

Right: NGC 779 Image: Sloan Digital Sky Survey

...Cetus

Another special galaxy **NGC 247** can be found 2 degrees south of the magnitude 2 beta Ceti also known by the name Diphda. The spindle in a north-south direction is quite outstanding against the background star field with a relatively bright nucleus. With careful observation and higher magnification, distinct markings and perhaps a few star points can be spotted on the dusty surface. NGC 247 belongs to the Sculptor Group of Galaxies and is about 7 million light-years distant.

LEFT: NGC 247 – Photograph: Dieter Willasch

RIGHT: NGC 246 – Photograph: Dieter Willasch

Situated in the middle area of the constellation is a very exceptional planetary nebula which truly creates an unusual impression. **NGC 246** is well known as one of Cetus's special jewels, and is indeed out of the ordinary. The planetary nebula displays a smoky round-disk that engulfs four foreground stars, with the hot central star very obvious. Filters will bring out a knotty structure on the planetary surface, which sometimes refers to in the appearance of a human skull. If you want only one object that is worth a visit, then you need not look any further. The very faint galaxy NGC 255 is situated only 30' to the north.

The galaxy **NGC 157** is situated virtually on the western tip of the whale's fin just slightly north-east of the star iota Ceti. The galaxy lies in a northeast to south-west direction and displays a quite prominent nucleus covered in haziness. With larger backyard telescopes and really high magnification it is possible to spot perhaps a few markings on the surface if you are fortunate to have transparent dark skies.

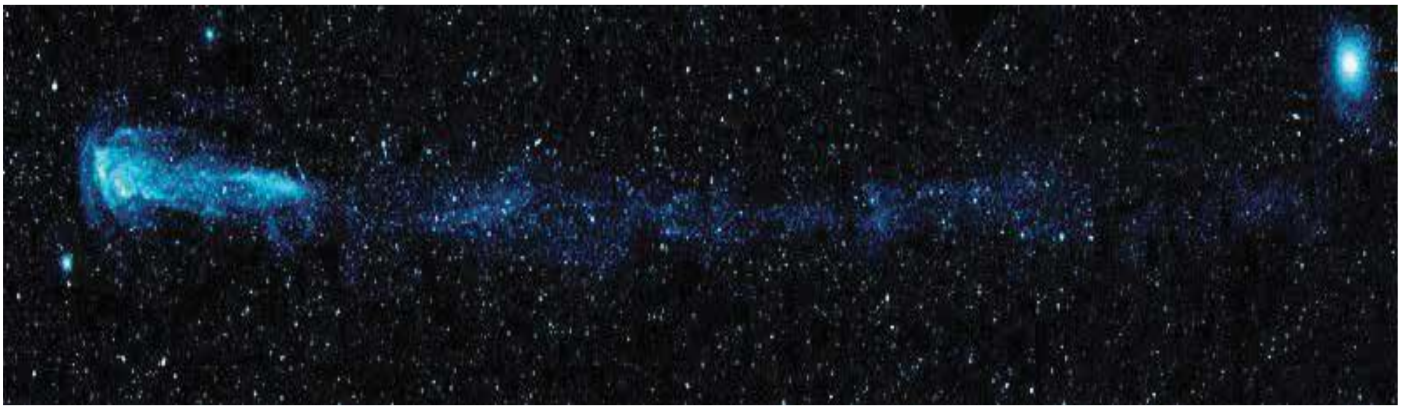
LEFT: NGC 157 Image: Cloudy Nights

...Cetus

The Canada-France Brown Dwarf Survey (CFBDS) has found the coolest brown dwarf yet, not even 350° Celsius – cool enough to show ammonia in its spectrum. This star, known as **CFBDS J005910.90-011401.3**, has now been put into a new proposed spectral class of Type-Y stars and is situated about 40 light-years away in the constellation Cetus. The special star is situated in the far northwest of the constellation, a degree north-east of the galaxy NGC 307, but spare yourself the effort of looking for it.

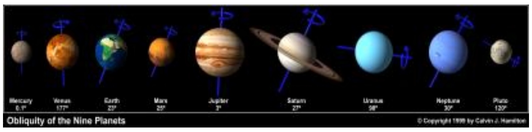
Why not swim with the monster whale and discover some of the special objects sharing the waves in the sea of Cetus.

OBJECT	TYPE	RA	DEC	MAG	SIZE
NGC 157	Galaxy	00h34m.8	-08°24′.0	10.4	4.1′×2.4′
NGC 246	Planetary Nebula	00h47m.0	-11°53′.0	8	225″
NGC 247	Galaxy	00h47m.1	-20°46′.0	9.2	19′×5.5′
CFBDS J005910.90 -011401.3	Type-Y Brown Dwarf Star	00h59m.1	-01°14′.1	18	*
NGC 779	Galaxy	01h59m.7	-05°58′.0	11.2	3.4′×1.2′
WHITING 1	Cluster	02h02m.9	-03°15′.1	20+	1′
NGC 936	Galaxy	02h27m.6	-01°09′.4	10.2	5.7′×4.6′
NGC 1055	Galaxy	02h41m.8	+00°26′.0	10.6	7.3′×3.3′
NGC 1068 Messier 77	Galaxy	02h42m.7	-00°01′.0	8.9	8.2′×7.3′



ABOVE: Omicron Ceti (Mira) appears as a small white dot in the bulb-shaped structure at left, and is moving from right to left in this view. The large blue dot at right is a star that is closer to us than Mira. – Photograph: Wikimedia

At the Eyepiece



September 2022 by Ray Field

The Sun reaches Spring Equinox for the Southern Hemisphere on the 23rd.

The Moon is First quarter on the 3rd, Full on the 10th, Last quarter on the 17th and New on the 25th. The Moon is near Antares on the 3rd, occults Phi Sagittararii on the 5th, occults Nunki (sigma Sagittarius) on the 6th and the Moon is near Saturn on the 8th. The Moon is near Jupiter on the 11th, near Uranus on the 15th (need binoculars), near the Pleiades and the Hyades on the 16th, near Mars on the 17th, near Pollux on the 20th, Regulus on the 23rd, near Spica on the 27th and near Antares again on the 30th. Although Mercury and Venus will be near the New Moon on the 25th, they will be too close to the Sun to be seen.

Mercury is too close to the Sun for observation this month and Venus is difficult to see this month in the morning sky as it is too close to the Sun.

Mars rises about 01:30 on the 1st and at about 23:30 on the 30th. It is visible to the naked eye as a brightish orange-red coloured "star-like" object. Mars is visible in Taurus this month and on the 1st it is between the Pleiades and Aldebaran. In a telescope one of the two polar ice caps should be visible at high magnification. I have seen them with a 6inch Newtonian reflector. Mars will be closest to the Earth on the 8th December this year, when it will be a very bright object.

Jupiter is very prominent in the morning sky. The Moon is near Jupiter on the 10th, 11th and 12th, early in the evening sky and Jupiter is at opposition on the 26th, when it rises at sunset and sets at sunrise. It is in the constellation on Cetus the sea monster. Looking North it is above and to the right of the square of Pegasus and almost overhead.

Saturn, the ringed planet, is in Capricornus, and is visible nearly all night. By the month's end it sets at about 04:00. Saturn is easily visible to the naked eye and like Jupiter, Saturn is a "gas-giant" and slightly oval in shape. Its large moon, Titan, with about the same diameter as the planet Mercury, is easily visible as a little "star" near to the planet even in a small telescope. The Moon is near Saturn on the 8th.

Uranus, the 7th major planet from the Sun, is near the Moon on the 15th. Under perfect viewing conditions it is just visible to the naked eye. Like Jupiter and Saturn, Uranus is a "gas giant".

Neptune is fainter than Uranus, needing at least binoculars to be seen. It is in Aquarius all year. For more details on Neptune see page 79 of ASSA Sky Guide 2022.

Comet C/2017 K2 may become visible in binoculars in September in Scorpius as per ASSA Sky Guide 2022, page 85.

No meteor showers, observable from Southern Africa, are given in the table on page 86 of ASSA Sky Guide 2022.

The starry sky from Durban for September 2022. The Southern Cross has past its highest and is sinking in the Southwest. The bright star Achernar opposite the South Celestial Pole to the Southern Cross is rising in the Southeast. Achernar is the 9th brightest star in the sky. Halfway between Achernar and the S.C.P. is the Small Magellanic Cloud with can be seen from a very dark location with the naked eye or binoculars. On the edge of the S.M.C. is the splendid globular cluster 47 Tucana or NGC104, the second brightest globular cluster in the sky. Scorpius is starting to sink towards the West, but Sagittarius is still well placed in its rich area of the Milky Way, for observation. The bright star Fomalhaut is almost overhead for Durban and the Square of Pegasus is rising low over the Northeast with Messier 31, the Andromeda galaxy, following it to its lower right. The two bright stars of Grus the crane are visible above Achernar.

References include ASSA Sky Guide 2022, Philips Planisphere for 35°S, Sir Patrick Moore's Stars of the Southern Skies and Norton's Star Atlas and Handbook.

Ten Things to Know and Do Before You Buy a Telescope

By Brian Ventrudo

Binoculars are inexpensive, simple and easy to use, and yet bring in thousands of objects within our own Milky Way Galaxy and beyond.

Every stargazer should own a pair.

But there may come a time when you want to see more, when you want to see objects brighter and bigger and farther way. That's when you want to consider a telescope.

A short word of advice here first…

Many beginners who buy a telescope before learning the basics of what to see in the sky (and how to see it) usually get frustrated and give up astronomy before they barely get started. It's like someone who wants to learn to sail starting out on a 40-foot three-masted schooner. It's just too complicated and it leads to frustration. By learning a little background first, new stargazers can make their experience with their first telescope rewarding, and quite frankly, life changing (in a good way).

So how do you know if you're ready to buy and use a telescope? Here's a subjective list of 10 things you need to know and do before you take the leap into telescopic observing:

1. **Learn the Main Stars and Constellations.** To get the most enjoyment out of visiting a big and interesting city like London or New York, it's a huge help to learn the names and layout of the main streets and public squares. So it is with the night sky. Before you try to find anything with a telescope, you will find it extremely useful to know at least dozen or more bright stars and ten or so major constellations.

2. **Learn the Layout of the Sky.** Know the main points on the celestial sphere: the horizon, zenith, meridian, location of the north (or south) pole, the celestial equator, and the ecliptic.

3. **Start with Binoculars.** Learn and practise finding and seeing things through binoculars, especially the Moon, Jupiter, and bright "deep-sky objects" like the Orion Nebula, Andromeda Galaxy, and the Pleiades. It takes practice to look through an eyepiece, and binoculars, with their low magnification and wide field of view, are much more forgiving than a telescope.

4. **Try a Someone Else's Telescope.** Before you spend your own hard-earned money, look through someone else's telescope and get a feel for how much (and how little) you can see. Many beginners are surprised to see only 0.5 to 1 degree of the sky at a time… it's a little like looking at the sky through a drinking straw. You can try a friend's telescope, or attend a star party held by a local astronomy club. If possible, have someone help you find and see a faint object in a telescope to get an idea of what to expect. A star party or public astronomy event is a perfect place to look through several types of telescopes to see what works best for your budget and interests before you buy.

…Buying a Telescope

5. **Learn the Main Types of Telescopes**. When absolute beginners think of a telescope, they usually think of a long white tube with a lens at the top and an eyepiece at the bottom. That's a *refractor*, one of several main types of modern telescope. There are several more types, and each has its own advantages and disadvantages. Learn the main types of telescopes and their pros and cons, and remember: there is no one perfect telescope. star party or public astronomy event is a perfect place to look through several types of telescopes to see what works best for your budget and interests before you buy.

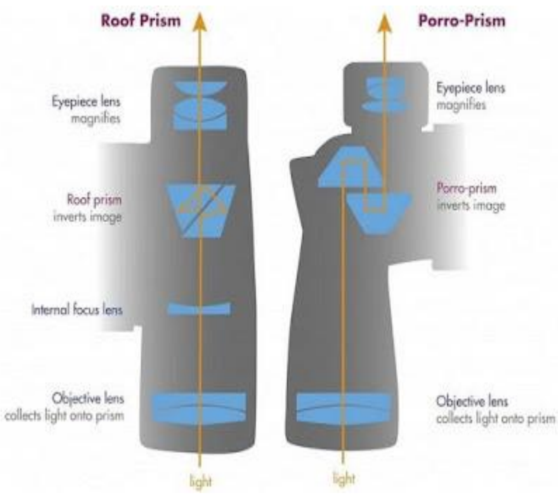
6. **Study the Key Features of Telescopes.** Learn the main features and specifications of telescopes. Things like focal length, aperture, focal ratio, chromatic aberration, and so forth, influence what you can see with a scope. These concepts sound intimidating, but they are not so hard. Before you spend, learn. Knowledge is power.

7. **Find an Observing Location.** Determine where you will observe the night sky with your telescope and how you will get your telescope to that site. There's no use getting a big monster scope if you have to wrestle it down the stairs of an apartment building every night. And the best choice of telescope will be different for an observing in the heart of a large city compared to one in a rural location.

8. **Select a Place to Store Your Scope.** Figure out where you will store your telescope. It needs a clean dry place that's conveniently located to let you move the scope out to your observing site.

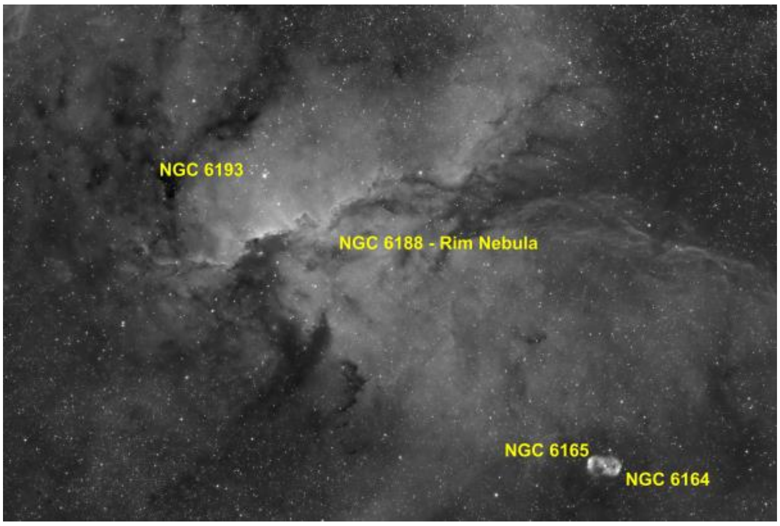
9. **Consider Your Observing Interests.** What do you wish to observe with your telescope? Just the Moon and planets? Faint fuzzies like nebulae and galaxies? Birds and mountains? A little of everything? If you just want to see the Moon and bright planets once in a while, you need far less telescope than if you're bound and determined to look at faint galaxies and star clusters, for example

10. **Save Your Money.** Count your pennies… and decide how much you can spend on a telescope. As a rule of thumb, don't get a new scope that costs less than US$300-$400 (in North America). You will be disappointed with the quality. Save a little more and stick with binoculars for now.



Cover Image - The Fighting Dragons of Ara

by John Gill



NGC 6193 (also known as Caldwell 82) is open cluster containing 27 stars in the constellation Ara, visible to the unaided eye. NGC 6193 lies at the center of the Ara OB1 association, which extends over a square degree. The cluster is associated with (and provides the energizing radiation for) neighboring regions of the nebulosity NGC 6188.

NGC 6188 (also known as the Rim Nebula) is an emission nebula located about 4,000 light years away in the constellation Ara. The bright open cluster NGC 6193, is responsible for a region of reflection nebulosity within NGC 6188.

NGC 6188 is a star forming nebula, and is sculpted by the massive, young stars that have recently formed there – some are only a few million years old. This spark of formation was probably caused when the last batch of stars went supernova.

NGC 6164 and NGC 6165 is a bipolar emission nebula of about 4 light-years across that lies some 4,200 light-years away in the southern constellation of Norma. It is approaching us at approximately 53.9 kilometers per second.

Its symmetric gaseous shroud and faint halo surround the blue, young, central star HD 148937, the brightest member of a triple star system orbiting around each other, which fierce stellar winds – of about 8 million kilometers per hour – created this nebula. This hot, luminous O-type star is some 40 times as massive as the Sun and just 3 to 4 million years old. In another 3 to 4 million years the massive star will end its life in a supernova explosion.

The extensive halo makes it similar in appearance to planetary nebulae – the gaseous shrouds surrounding dying Sun-like stars. Expanding into the surrounding interstellar medium, the material in this halo is likely from an earlier outburst of the central star, about 4000 years ago.

Tech Specs:

Telescope: APM 107/700
Reducer: .75 Focal reducer
Mount: Celestron CGX mount
Camera: QHY268m camera
Filters
Ha : 40x150" (1h 40') (gain: 80) @ -10°C
Sii : 20x150" (0h 50') (gain: 90) @ -10°C
Oiii: 30x150" (1h 15') (gain: 80) @ -10°C
Calibration: 430 Frames (Flats, darks and dark flats)
Integration Time: 3h 45' mins
Software
N.I.N.A.
PixInsight

Table of Contents - Image

By Brigitte Kruger

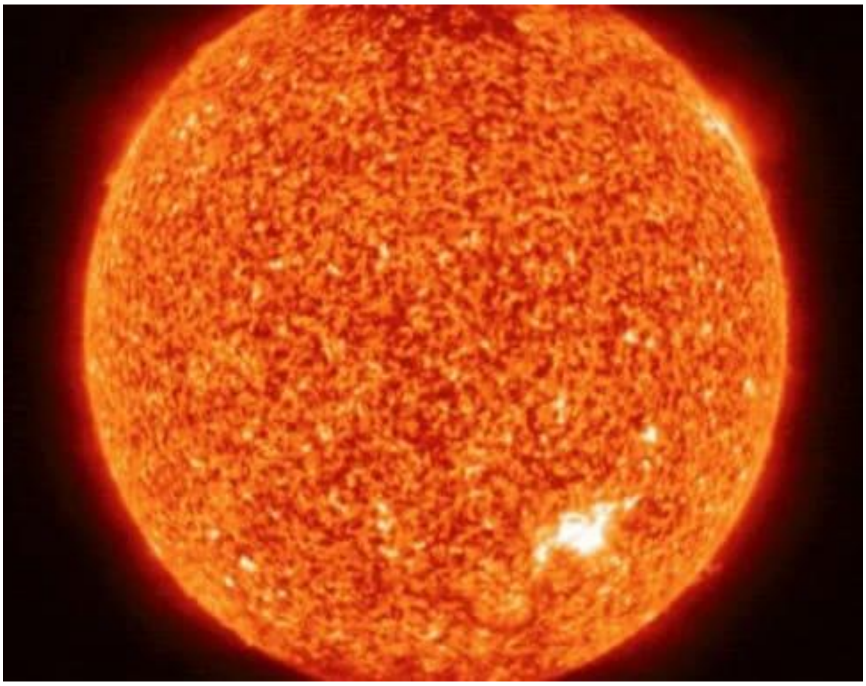
This image of the Supermoon was taken on 12th August 2022 at 19:07 by local Durban resident Brigitte Kruger from her home.

Specs:
Weather : Cloudy
Camera: Canon Powershot SX530 HS
Settings: F8 / ISO400
Lens: 4 - 215mm
Aperture: 6

The Editor would like to thank Brigitte for allowing us permission to feature her photo in the 'nDaba.

The Sun is Dying: Here's how long it has before exhausting its fuel

A new study has estimated the sun's evolutionary process will continue for billions of more years before it runs out of its fuel and turns into a red giant. It has revealed the past and future of the sun, how the sun will behave at what stage and when it will enter the dusk of its life



LEFT: Photograph released by The European Space Agency (ESA) on July 16, 2020, shows an image of the Sun, roughly halfway between the Earth and the Sun.

The sun is very likely going through its middle age, a recent study published in June this year by the European Space Agency (ESA), based on the observations from its Gaia spacecraft, has revealed.

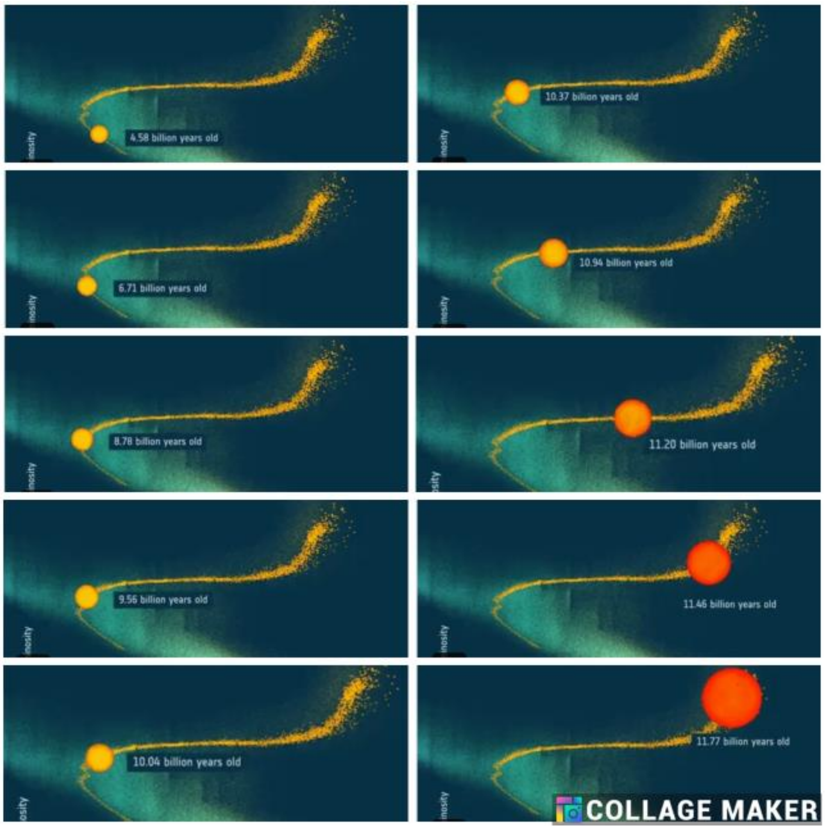
The ESA's Gaia telescope has revealed information that could help determine when the sun will die, which was formed around 4.57 billion years ago.

The study has estimated the sun's evolutionary process to continue for billions of more years before it runs out of its fuel and turns into a red giant. The study has revealed the past and future of the sun, how the sun will behave at what stage and when it will enter the dusk of its life.

However, it will not be the case forever. The sun will eventually die. The information by ESA's Gaia observatory has also revealed the process of its decay.

"As the hydrogen fuel runs out in its core, and changes begin in the fusion process, we expect it to swell into a red giant star, lowering its surface temperature in the process."

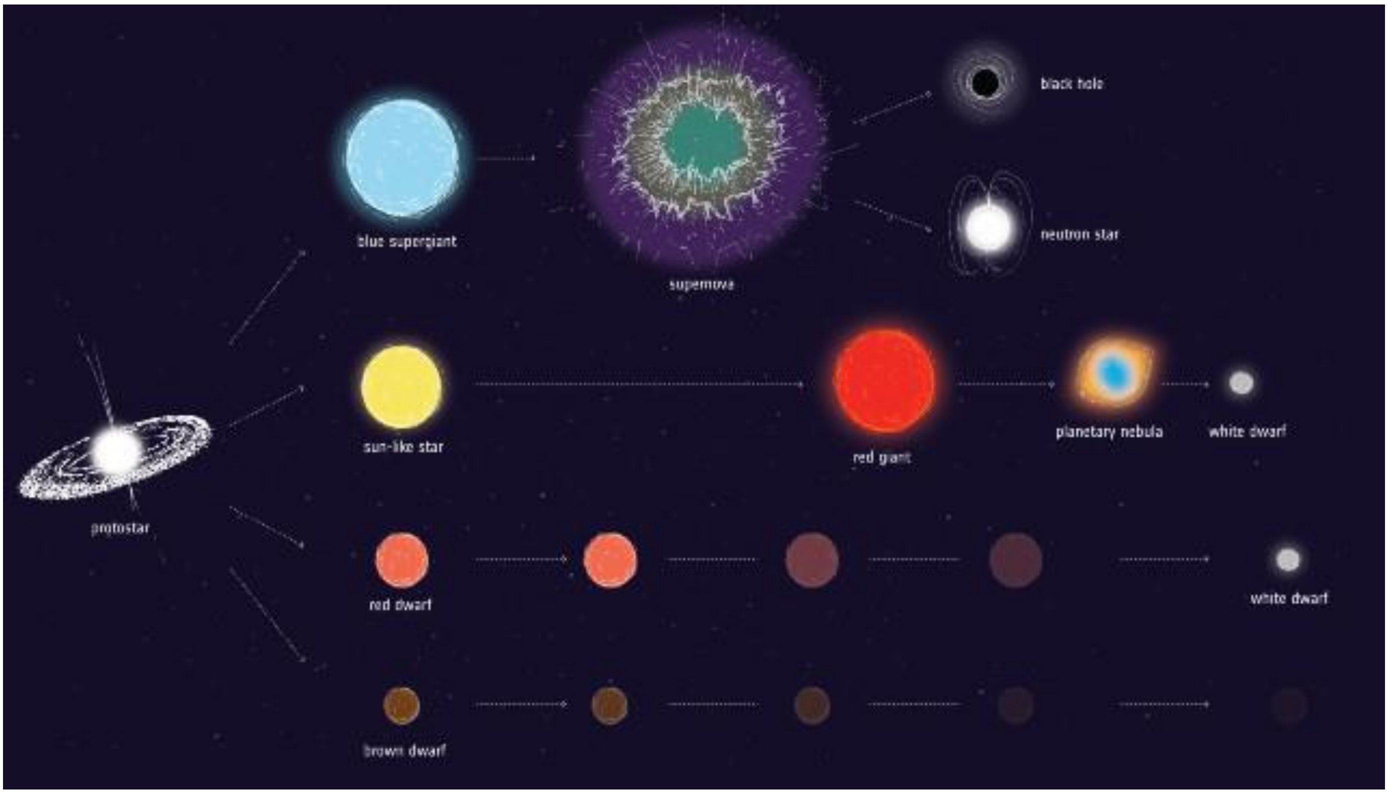
Exactly how this happens depends on how much mass a star contains and its chemical composition.



ABOVE: Watch the Gif on Twitter https://twitter.com/i/status/1557656750102179840

To deduce this, astronomer Orlagh Creevey, Observatoire de la Côte d'Azur, France, and collaborators from Gaia's Coordination Unit 8, and colleagues combed the data looking for the most accurate stellar observations that the spacecraft could offer.

...The Sun is Dying



ABOVE: Stellar evolution. ESA

“We wanted to have a really pure sample of stars with high precision measurements,” says Orlagh.

When will the Sun die?

The study found that the sun will reach a maximum temperature of approximately 8 billion years of age, before starting to cool down and increase in size.

“It will become a red giant star around 10–11 billion years of age. The Sun will reach the end of its life after this phase, when it eventually becomes a dim white dwarf.”

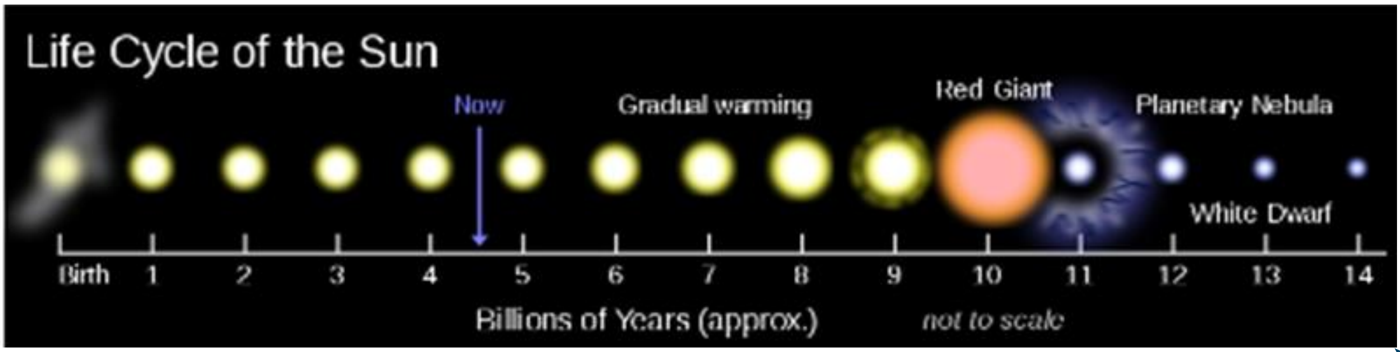
A white dwarf is a former star that has exhausted all its hydrogen that it once used as it central nuclear fuel and lost its outer layers as a planetary nebula.

"If we don't understand our own Sun – and there are many things we don't know about it – how can we expect to understand all of the other stars that make up our wonderful galaxy,” Orlagh said.

By identifying similar stars to the sun, but this time with similar ages, the observational gap can be bridged in how much we know about the sun compared to other stars in the universe.

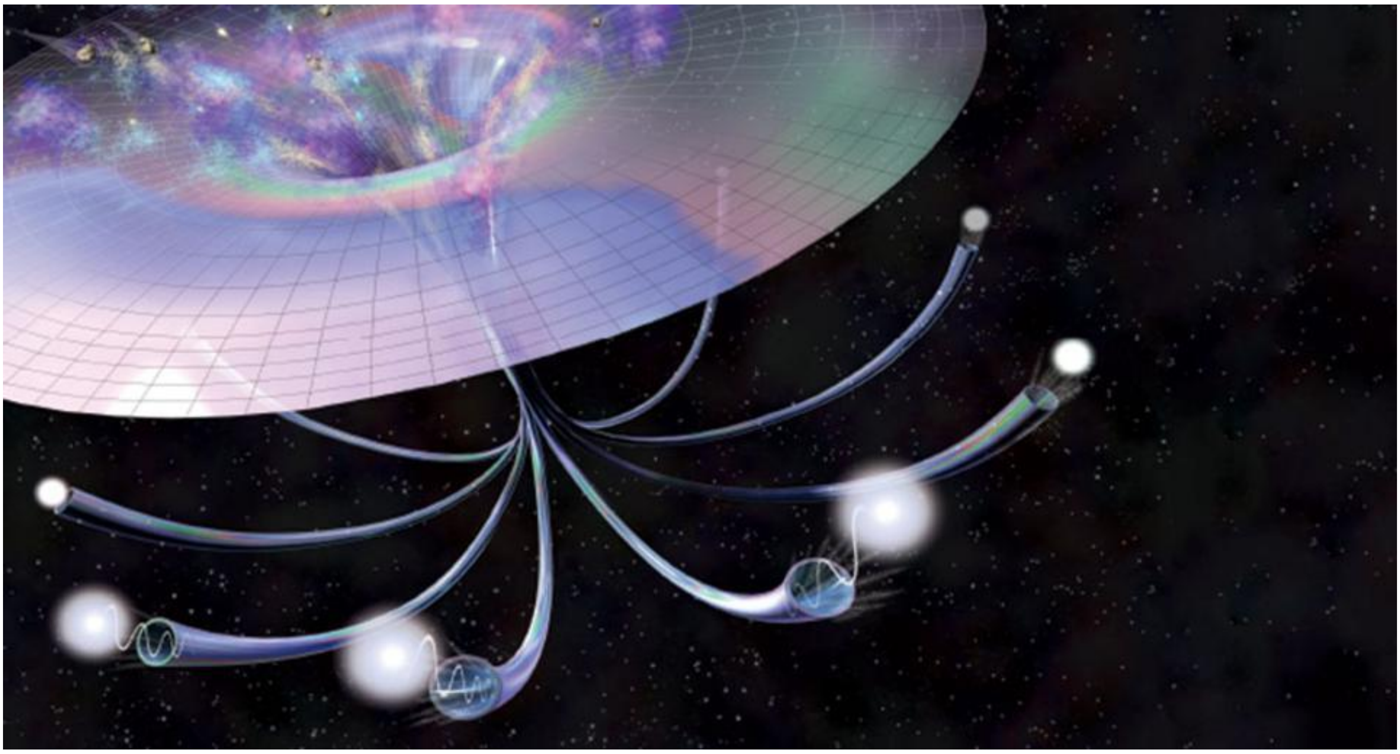
To identify these ‘solar analogues’ in the Gaia data, Orlagh and colleagues looked for stars with temperatures, surface gravities, compositions, masses and radii that are all similar to the present-day Sun. They found 5863 stars that matched their criteria.

https://www.firstpost.com/explainers/the-sun-is-dying-heres-how-long-it-has-before-exhausting-its-fuel-11064101.html



The Big Bang No Longer Means What it Used to

As we gain new knowledge, our scientific picture of how the Universe works must evolve. This is a feature of the Big Bang, not a bug.



ABOVE: From a pre-existing state, inflation predicts that a series of universes will be spawned as inflation continues, with each one being completely disconnected from every other one, separated by more inflating space. One of these "bubbles," where inflation ended, gave birth to our Universe some 13.8 billion years ago, where our entire visible Universe is just a tiny portion of that bubble's volume. Each individual bubble is disconnected from all of the others, and each place where inflation ends gives rise to its own hot Big Bang.

The idea that the Universe had a beginning, or a "day without a yesterday" as it was originally known, goes all the way back to Georges Lemaître in 1927.

Although it's still a defensible position to state that the Universe likely had a beginning, that stage of our cosmic history has very little to do with the "hot Big Bang" that describes our early Universe.

Although many laypersons (and even a minority of professionals) still cling to the idea that the Big Bang means "the very beginning of it all," that definition is decades out of date. Here's how to get caught up.

If there’s one hallmark inherent to science, it’s that our understanding of how the Universe works is always open to revision in the face of new evidence. Whenever our prevailing picture of reality — including the rules it plays by, the physical contents of a system, and how it evolved from its initial conditions to the present time — gets challenged by new experimental or observational data, we must open our minds to changing our conceptual picture of the cosmos. This has happened many times since the dawn of the 20th century, and the words we use to describe our Universe have shifted in meaning as our understanding has evolved.

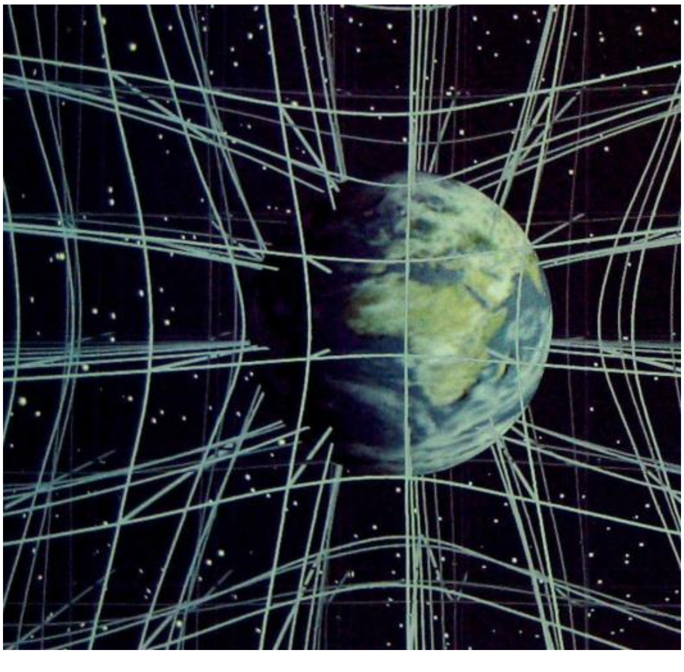
...The Big Bang

Yet, there are always those who cling to the old definitions, much like linguistic prescriptivists, (who refuse to acknowledge that these changes have occurred. But unlike the evolution of colloquial language, which is largely arbitrary, the evolution of scientific terms must reflect our current understanding of reality. Whenever we talk about the origin of our Universe, the term “the Big Bang” comes to mind, but our understanding of our cosmic origins have evolved tremendously since the idea that our Universe even had an origin, scientifically, was first put forth. Here’s how to resolve the confusion and bring you up to speed on what the Big Bang originally meant versus what it means today.

LEFT Fred Hoyle was a regular on BBC radio programs in the 1940s and 1950s, and one of the most influential figures in the field of stellar nucleosynthesis. His role as the Big Bang’s most vocal detractor, even after the critical evidence supporting it had been discovered, is one of his longest-enduring legacies. Image: BBC

The first time the phrase “the Big Bang” was uttered was over 20 years after the idea was first described. In fact, the term itself comes from one of the theory’s greatest detractors: Fred Hoyle, who was a staunch advocate of the rival idea of a Steady-State cosmology. In 1949, he appeared on BBC radio and advocated for what he called the perfect cosmological principle: the notion that the Universe was homogeneous in both space *and time*, meaning that any observer not only anywhere but *anywhen* would perceive the Universe to be in the same cosmic state. He went on to deride the opposing notion as a “hypothesis that all matter of the universe was created in one *Big Bang* at a particular time in the remote past,” which he then called “irrational” and claimed to be “outside science.”

But the idea, in its original form, wasn’t simply that all of the Universe’s matter was created in one moment in the finite past. That notion, derided by Hoyle, had already evolved from its original meaning. Originally, the idea was that the Universe *itself*, not just the matter within it, had emerged from a state of non-being in the finite past. And that idea, as wild as it sounds, was an inevitable but difficult-to-accept consequence of the new theory of gravity put forth by Einstein back in 1915: General Relativity.

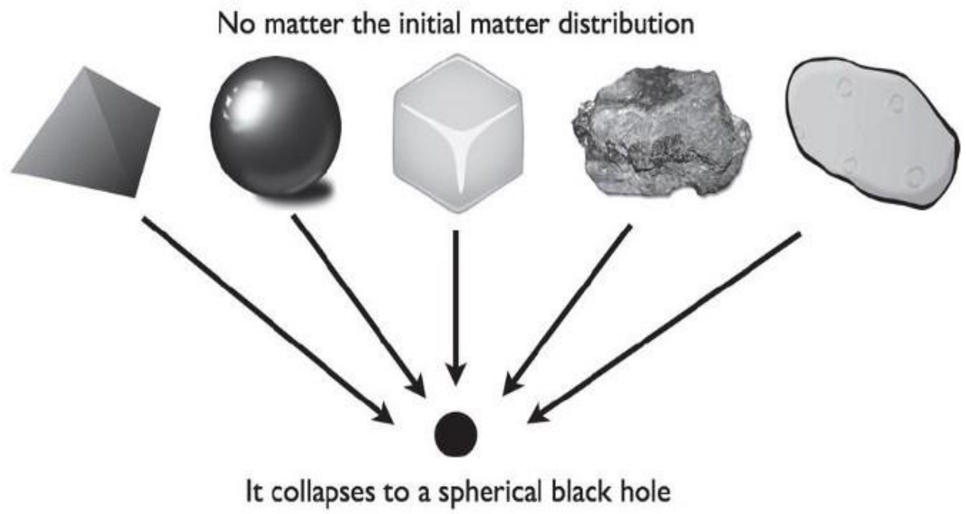


RIGHT: Instead of an empty, blank, three-dimensional grid, putting a mass down causes what would have been ‘straight’ lines to instead become curved by a specific amount. In General Relativity, we treat space and time as continuous, but all forms of energy, including but not limited to mass, contribute to spacetime curvature. The deeper you are in a gravitational field, the more severely all three dimensions of your space is curved, and the more severe the phenomena of time dilation and gravitational redshift become.

...The Big Bang

When Einstein first cooked up the general theory of relativity, our conception of gravity forever shifted from the prevailing notion of Newtonian gravity. Under Newton's laws, the way that gravitation worked was that any and all masses in the Universe exerted a force on one another, instantaneously across space, in direct proportion to the product of their masses and inversely proportional to the square of the distance between them. But in the aftermath of his discovery of special relativity, Einstein and many others quickly recognized that there was no such thing as a universally applicable definition of what "distance" was or even what "instantaneously" meant with respect to two different locations.

With the introduction of Einsteinian relativity — the notion that observers in different frames of reference would all have their own unique, equally valid perspectives on what distances between objects were and how the passage of time worked — it was only almost immediate that the previously absolute concepts of "space" and "time" were woven together into a single fabric: spacetime. All objects in the Universe moved through this fabric, and the task for a novel theory of gravity would be to explain how not just masses, but all forms of energy, shaped this fabric that underpinned the Universe itself.

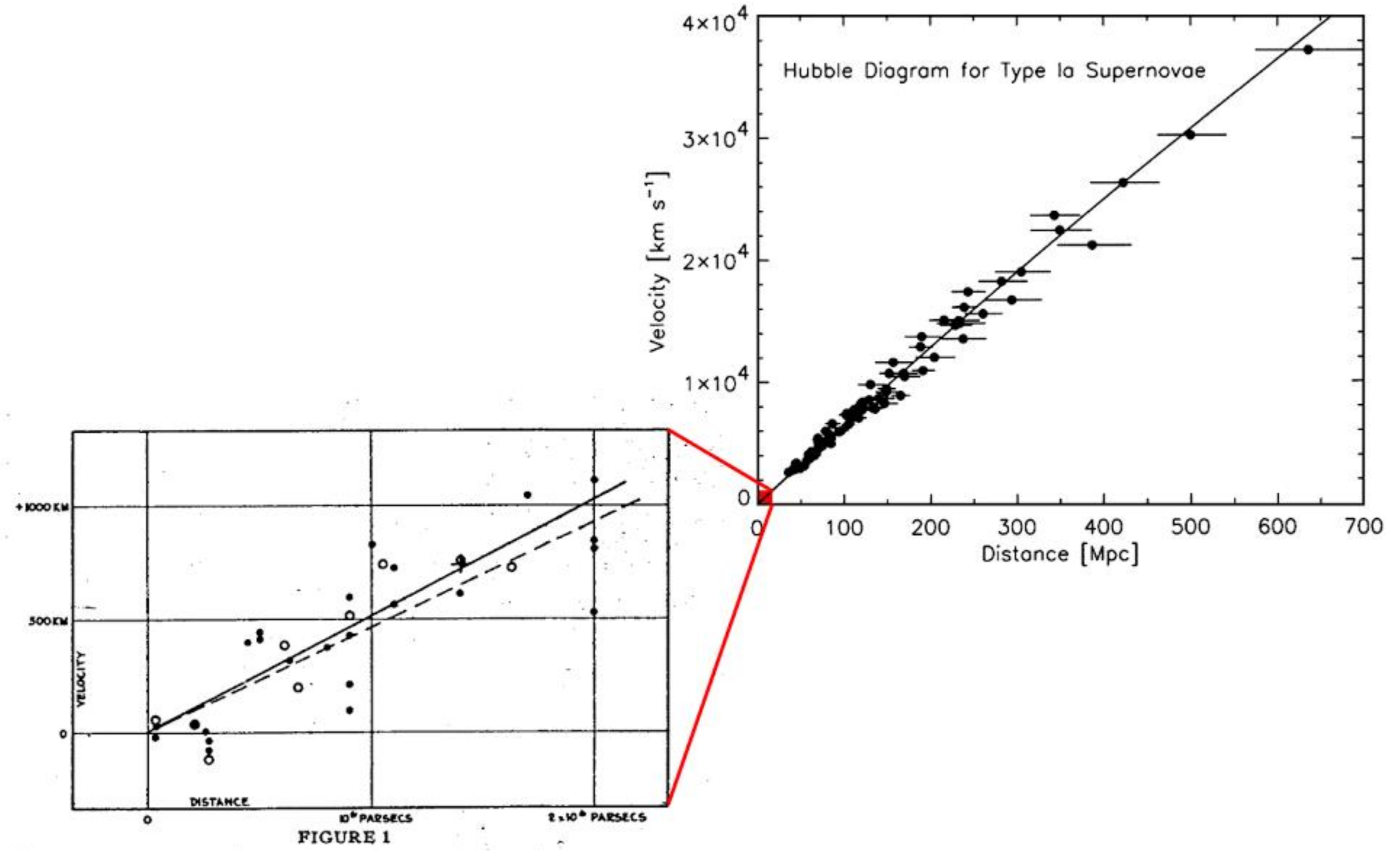


LEFT: If you begin with a bound, stationary configuration of mass, and there are no non-gravitational forces or effects present (or they're all negligible compared to gravity), that mass will always inevitably collapse down to a black hole. It's one of the main reasons why a static, non-expanding Universe is inconsistent with Einstein's General Relativity. Credit: E. Siegel / Beyond the Galaxy

Although the laws that governed how gravitation worked in our Universe were put forth in 1915, the critical information about how our Universe was structured had not yet come in. While some astronomers favored the notion that many objects in the sky were actually "island Universes" that were located well outside the Milky Way galaxy, most astronomers at the time thought that the Milky Way galaxy represented the full extent of the Universe. Einstein sided with this latter view, and — thinking the Universe was static and eternal — added a special type of fudge factor into his equations: a cosmological constant.

Although it was mathematically permissible to make this addition, the reason Einstein did so was because without one, the laws of General Relativity would ensure that a Universe that was evenly, uniformly distributed with matter (which ours seemed to be) would be unstable against gravitational collapse. In fact, it was very easy to demonstrate that any initially uniform distribution of motionless matter, regardless of shape or size, would inevitably collapse into a singular state under its own gravitational pull. By introducing this extra term of a cosmological constant, Einstein could tune it so that it would balance out the inward pull of gravity by proverbially pushing the Universe out with an equal and opposing action.

...The Big Bang



ABOVE: Edwin Hubble's original plot of galaxy distances versus redshift (left), establishing the expanding Universe, versus a more modern counterpart from approximately 70 years later (right). In agreement with both observation and theory, the Universe is expanding, and the slope of the line relating distance to recession speed is a constant. Credit: E. Hubble; R. Kirshner, PNAS, 200

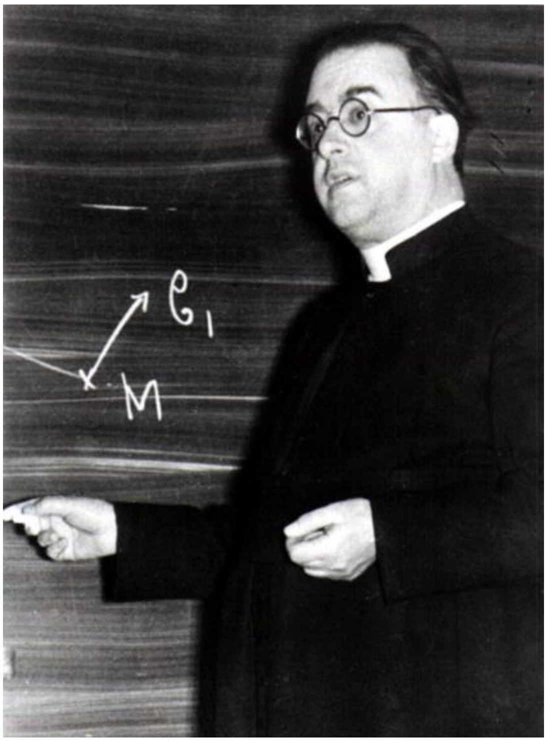
Two developments - one theoretical and one observational - would quickly change this early story that Einstein and others had told themselves.

In 1922, Alexander Friedmann worked out, fully, the equations that governed a Universe that was isotropically (the same in all directions) and homogeneously (the same in all locations) filled with any type of matter, radiation, or other form of energy. He found that such a Universe would never remain static, not even in the presence of a cosmological constant, and that it must either expand or contract, dependent on the specifics of its initial conditions.

In 1923, Edwin Hubble became the first to determine that the spiral nebulae in our skies were not contained within the Milky Way, but rather were located many times farther away than any of the objects that comprised our home galaxy. The spirals and ellipticals found throughout the Universe were, in fact, their own "island Universes," now known as galaxies, and that moreover - as had previously been observed by Vesto Slipher - the vast majority of them appeared to be moving away from us at remarkably rapid speeds.

In 1927, Georges Lemaître became the very first person to put these pieces of information together, recognizing that the Universe today is expanding, and that if things are getting farther apart and less dense today, then they must have been closer together and denser in the past. Extrapolating this back all the way to its logical conclusion, he deduced that the Universe must have expanded to its present state from a single point-of-origin, which he called either the "cosmic egg" or the "primeval atom."

...The Big Bang

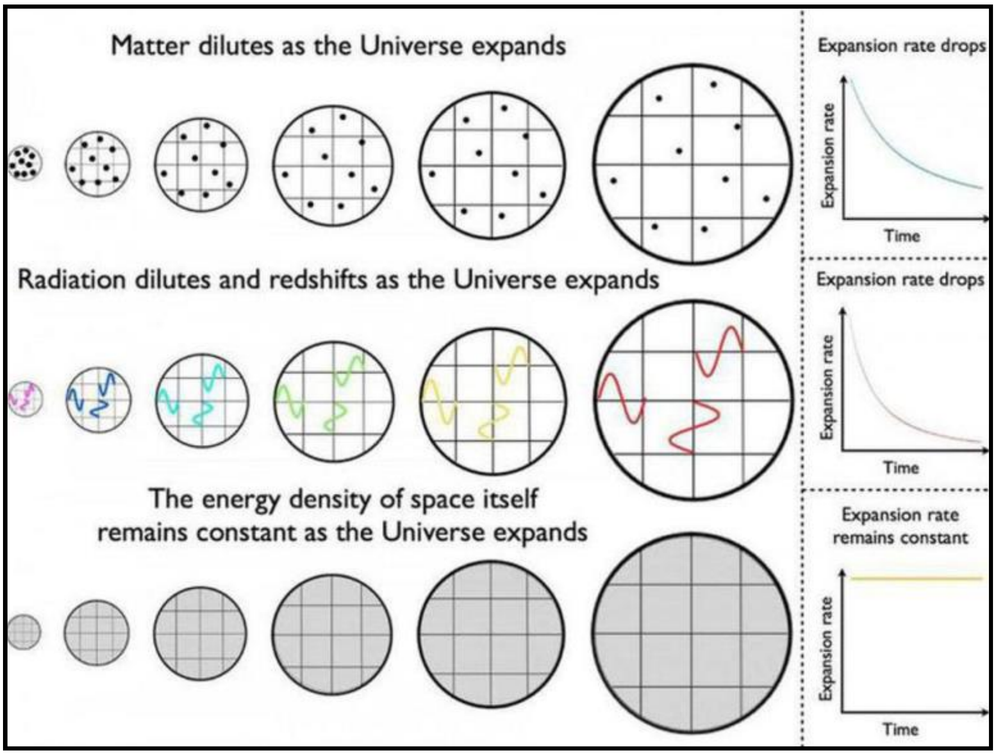


LEFT: This image shows Catholic priest and theoretical cosmologist Georges Lemaître at the Catholic University of Leuven, ca. 1933. Lemaître was among the first to conceptualize the Big Bang as the origin of our Universe within the framework of General Relativity, even though he didn't use that name himself. Credit: Public Domain

This was the original notion of what would grow into the modern theory of the Big Bang: the idea that the Universe had a beginning, or a "day without yesterday." It was not, however, generally accepted for some time. Lemaître originally sent his ideas to Einstein, who infamously dismissed Lemaître's work by responding, "Your calculations are correct, but your physics is abominable."

Despite the resistance to his ideas, however, Lemaître would be vindicated by further observations of the Universe. Many more galaxies would have their distances and redshifts measured, leading to the overwhelming conclusion the Universe was and still is expanding, equally and uniformly in all directions on large cosmic scales. In the 1930s, Einstein conceded, referring to his introduction of the cosmological constant in an attempt to keep the Universe static as his "greatest blunder."

However, the next great development in formulating what we know of as the Big Bang wouldn't come until the 1940s, when George Gamow — perhaps not so coincidentally, an advisee of Alexander Friedmann — came along. In a remarkable leap forward, he recognized that the Universe was not only full of matter, but also radiation, and that radiation evolved somewhat differently from matter in an expanding Universe. This would be of little consequence today, but in the early stages of the Universe, it mattered tremendously.



LEFT: While matter (both normal and dark) and radiation become less dense as the Universe expands owing to its increasing volume, dark energy, and also the field energy during inflation, is a form of energy inherent to space itself. As new space gets created in the expanding Universe, the dark energy density remains constant. Note that individual quanta of radiation are not destroyed, but simply dilute and redshift to progressively lower energies, stretching to longer wavelengths and lower energies as space expands.

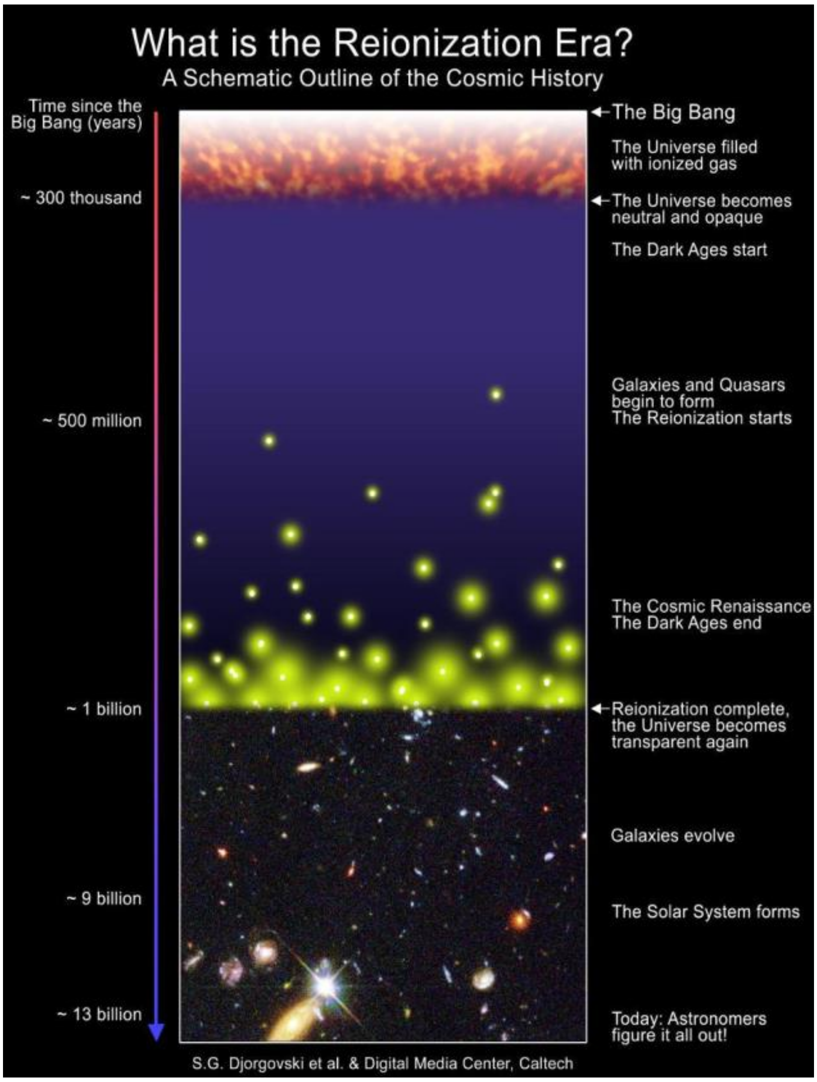
...The Big Bang

Matter, Gamow realized, was made up of particles, and as the Universe expanded and the volume that these particles occupied increased, the number density of matter particles would drop in direct proportion to how the volume grew.

But radiation, while also made up of a fixed number particles in the form of photons, had an additional property: the energy inherent to each photon is determined by the photon's wavelength. As the Universe expands, the wavelength of each photon gets lengthened by the expansion, meaning that the amount of energy present in the form of radiation decreases faster than the amount of energy present in the form of matter in the expanding Universe.

But in the past, when the Universe was smaller, the opposite would have been true. If we were to extrapolate backward in time, the Universe would have been in a hotter, denser, more radiation-dominated state. Gamow leveraged this fact to make three great, generic predictions about the young Universe.

1. At some point, the Universe's radiation was hot enough so that every neutral atom would have been ionized by a quantum of radiation, and that this leftover bath of radiation should still persist today at only a few degrees above absolute zero.
2. At some even earlier point, it would have been too hot to even form stable atomic nuclei, and so an early stage of nuclear fusion should have occurred, where an initial mix of protons-and-neutrons should have fused together to create an initial set of atomic nuclei: an abundance of elements that predates the formation of atoms.
3. And finally, this means that there would be some point in the Universe's history, after atoms had formed, where gravitation pulled this matter together into clumps, leading to the formation of stars and galaxies for the first time.



LEFT: Schematic diagram of the Universe's history, highlighting reionization. Before stars or galaxies formed, the Universe was full of light-blocking, neutral atoms that formed back when the Universe was ~380,000 years old. Most of the Universe doesn't become reionized until 550 million years afterwards, with some regions achieving full reionization earlier and others later. The first major waves of reionization begin happening at around ~200 million years of age, while a few fortunate stars may form just 50-to-100 million years after the Big Bang. With the right tools, like the JWST, we hope to reveal the earliest galaxies of all.
Credit: S.G. Djorgovski, Caltech Digital Media Centre

...The Big Bang

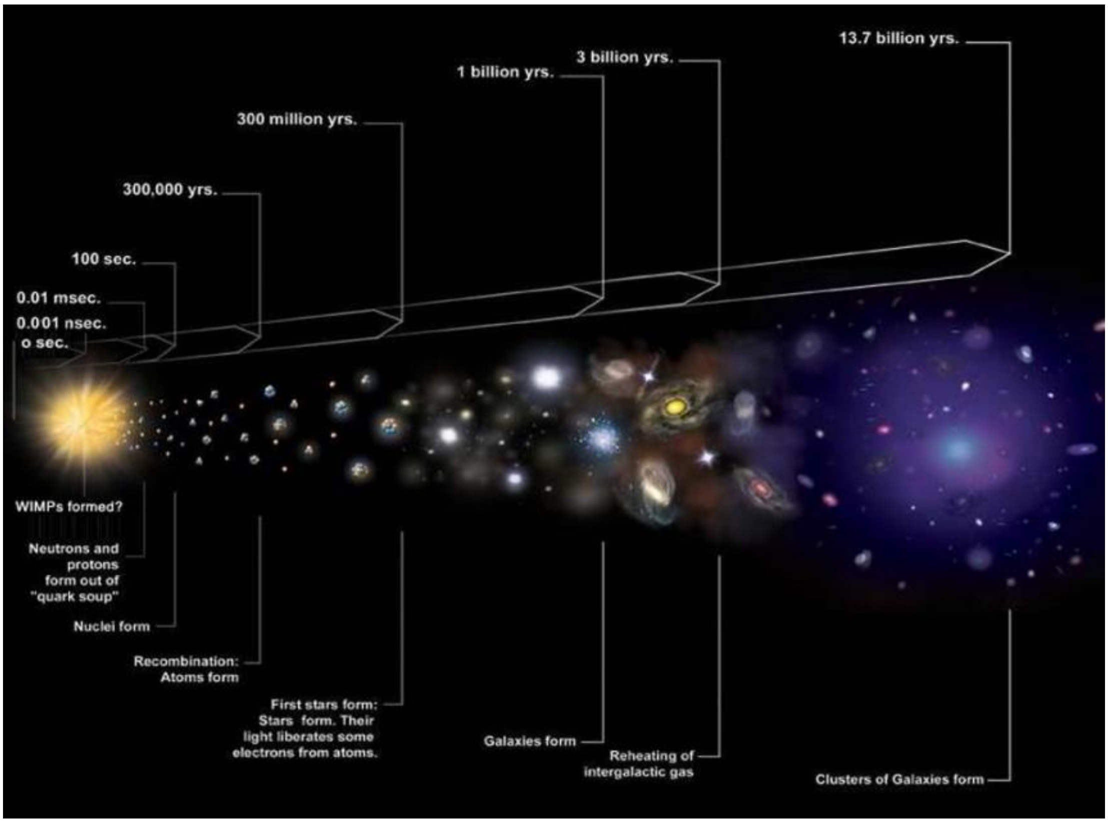
These three major points, along with the already-observed expansion of the Universe, form what we know today as the four cornerstones of the Big Bang. Although one was still free to extrapolate the Universe back to an arbitrarily small, dense state — even to a singularity, if you're daring enough to do so — that was no longer the part of the Big Bang theory that had any predictive power to it. Instead, it was the emergence of the Universe from a hot, dense state that led to our concrete predictions about the Universe.

Over the 1960s and 1970s, as well as ever since, a combination of observational and theoretical advances unequivocally demonstrated the success of the Big Bang in describing our Universe and predicting its properties.

- The discovery of the cosmic microwave background and the subsequent measurement of its temperature and the blackbody nature of its spectrum eliminated alternative theories like the Steady State model.
- The measured abundances of the light elements throughout the Universe verified the predictions of Big Bang nucleosynthesis, while also demonstrating the need for fusion in stars to provide the heavy elements in our cosmos.
- And the farther away we look in space, the less grown-up and evolved galaxies and stellar populations appear to be, while the largest-scale structures like galaxy groups and clusters are less rich and abundant the farther back we look.

The Big Bang, as verified by our observations, accurately and precisely describes the emergence of our Universe, as we see it, from a hot, dense, almost-perfectly uniform early stage.

But what about the "beginning of time?" What about the original idea of a singularity, and an arbitrarily hot, dense state from which space and time themselves could have first emerged?



LEFT: A visual history of the expanding Universe includes the hot, dense state known as the Big Bang and the growth and formation of structure subsequently. The full suite of data, including the observations of the light elements and the cosmic microwave background, leaves only the Big Bang as a valid explanation for all we see. As the Universe expands, it also cools, enabling ions, neutral atoms, and eventually molecules, gas clouds, stars, and finally galaxies to form. However, the Big Bang was not an explosion, and cosmic expansion is very different from that idea.

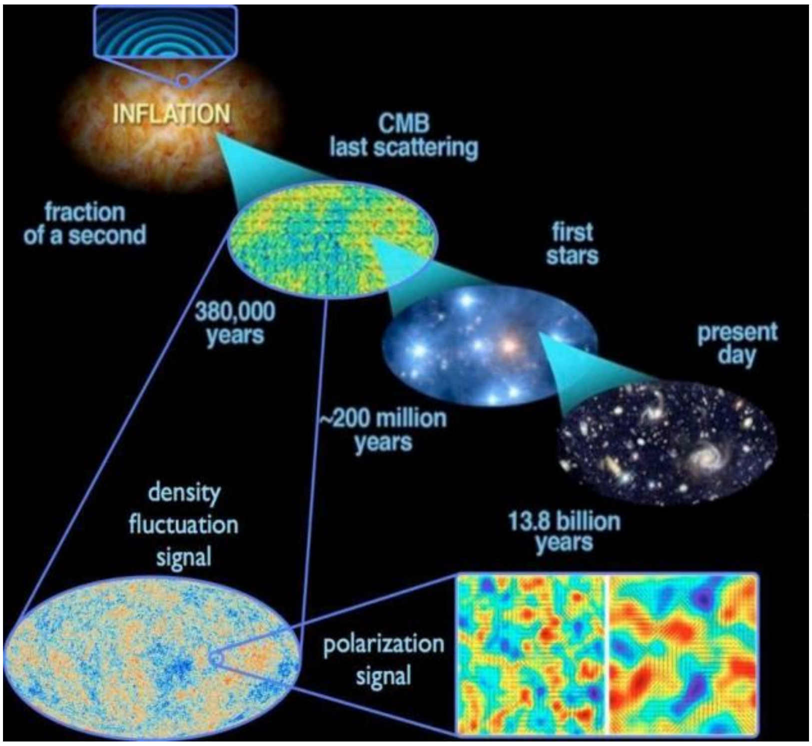
...The Big Bang

That's a different conversation, today, than it was back in the 1970s and earlier. Back then, we knew that we could extrapolate the hot Big Bang back in time: back to the first fraction-of-a-second of the observable Universe's history. Between what we could learn from particle colliders and what we could observe in the deepest depths of space, we had lots of evidence that this picture accurately described our Universe.

But at the absolute earliest times, this picture breaks down. There was a new idea — proposed and developed in the 1980s — known as cosmological inflation, that made a slew of predictions that contrasted with those that arose from the idea of a singularity at the start of the hot Big Bang. In particular, inflation predicted:

- A curvature for the Universe that was indistinguishable from flat, to the level of between 99.99% and 99.9999%; comparably, a singularly hot Universe made no prediction at all.
- Equal temperatures and properties for the Universe even in causally disconnected regions; a Universe with a singular beginning made no such prediction.
- A Universe devoid of exotic high-energy relics like magnetic monopoles; an arbitrarily hot Universe would possess them.
- A Universe seeded with small-magnitude fluctuations that were almost, but not perfectly, scale invariant; a non-inflationary Universe produces large-magnitude fluctuations that conflict with observations.
- A Universe where 100% of the fluctuations are adiabatic and 0% are isocurvature; a non-inflationary Universe has no preference.
- A Universe with fluctuations on scales larger than the cosmic horizon; a Universe originating solely from a hot Big Bang cannot have them.
- And a Universe that reached a finite maximum temperature that's well below the Planck scale; as opposed to one whose maximum temperature reached all the way up to that energy scale.

The first three were post-dictions of inflation; the latter four were predictions that had not yet been observed when they were made. On all of these accounts, the inflationary picture has succeeded in ways that the hot Big Bang, without inflation, has not.



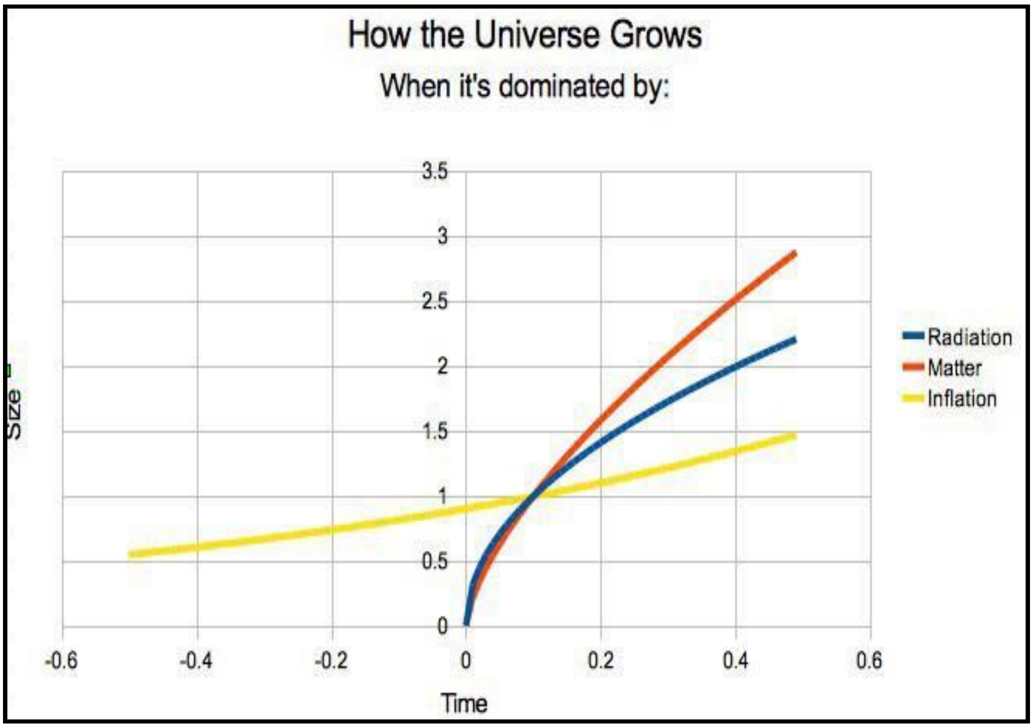
RIGHT: The quantum fluctuations that occur during inflation get stretched across the Universe, and when inflation ends, they become density fluctuations. This leads, over time, to the large-scale structure in the Universe today, as well as the fluctuations in temperature observed in the CMB. New predictions like these are essential for demonstrating the validity of a proposed fine-tuning mechanism, and to test (and potentially rule out) alternatives.

Credit: E. Siegel; ESA/Planck and the DOE/NASA/NSF Interagency Task Force on CMB research

...The Big Bang

During inflation, the Universe must have been devoid of matter-and-radiation and instead contained some sort of energy - whether inherent to space or as part of a field - that didn't dilute as the Universe expanded. This means that inflationary expansion, unlike matter-and-radiation, didn't follow a power law that leads back to a singularity but rather is exponential in character. One of the fascinating aspects about this is that something that increases exponentially, even if you extrapolate it back to arbitrarily early times, even to a time where $t \rightarrow -\infty$, it never reaches a singular beginning.

Now, there are many reasons to believe that the inflationary state wasn't one that was eternal to the past, that there might have been a pre-inflationary state that gave rise to inflation, and that, whatever that pre-inflationary state was, perhaps it did have a beginning. There are theorems that have been proven and loopholes discovered to those theorems, some of which have been closed and some of which remain open, and this remains an active and exciting area of research.



LEFT: Blue and red lines represent a "traditional" Big Bang scenario, where everything starts at time t=0, including spacetime itself. But in an inflationary scenario (yellow), we never reach a singularity, where space goes to a singular state; instead, it can only get arbitrarily small in the past, while time continues to go backward forever. Only the last minuscule fraction of a second, from the end of inflation, imprints itself on our observable Universe today.

But one thing is for certain.

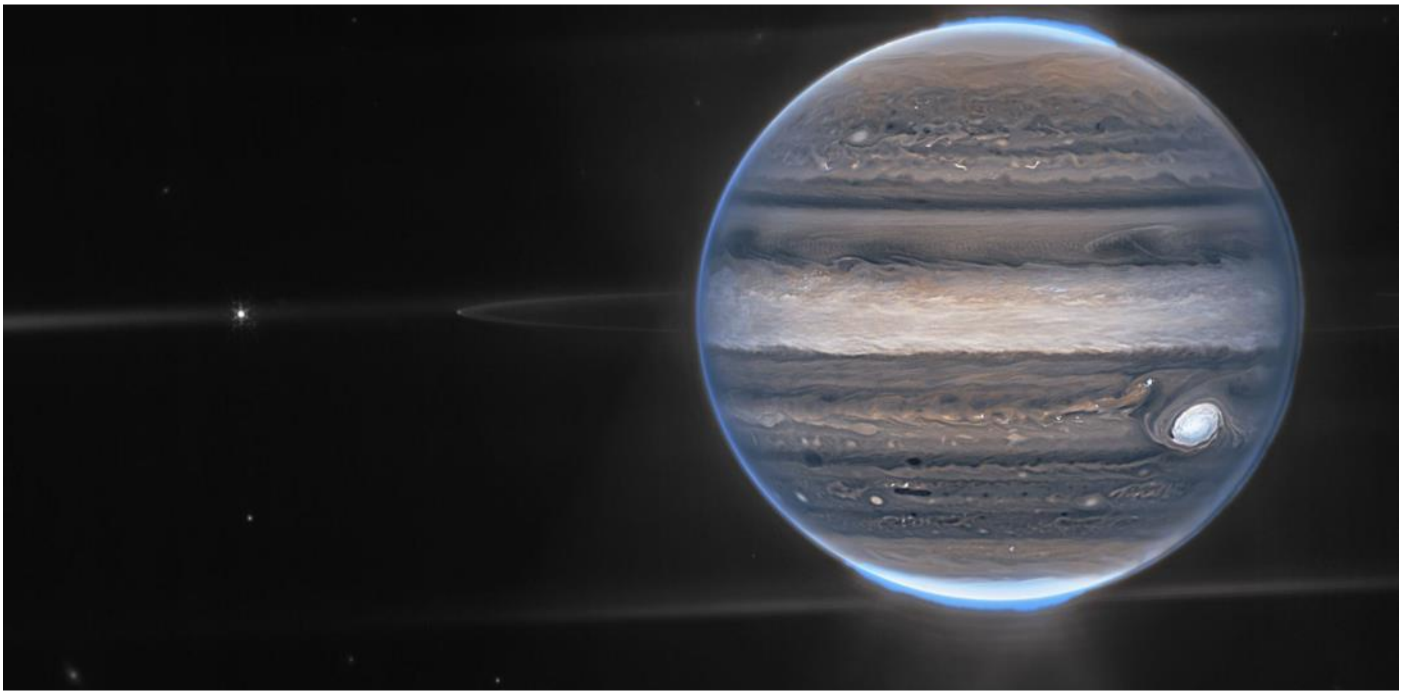
Whether there was a singular, ultimate beginning to all of existence or not, it no longer has anything to do with the hot Big Bang that describes our Universe from the moment that:

- inflation ended,
- the hot Big Bang occurred,
- the Universe became filled with matter and radiation and more,
- and it began expanding, cooling, and gravitating,

eventually leading to the present day. There are still a minority of astronomers, astrophysicists and cosmologists who use "the Big Bang" to refer to this theorized beginning and emergence of time-and-space, but not only is that not a foregone conclusion anymore, but it doesn't have anything to do with the hot Big Bang that gave rise to our Universe. The original definition of the Big Bang has now changed, just as our understanding of the Universe has changed. If you're still behind, that's ok; the best time to catch up is always right now.

https://bigthink.com/starts-with-a-bang/big-bang-meaning/

Webb Telescope Sees Jupiter and Its Auroras in a New Light



ABOVE: The James Webb Space Telescope's NIRCam imager produced this composite image of the Jupiter system using orange and cyan filters. The image shows Jupiter's auroras as bright rims at the poles. The planet's rings and two of its moons, Amalthea and Adrastea, are also visible. Credit: NASA, ESA, CSA, Jupiter ERS Team; image processing by Ricardo Hueso (UPV/EHU) and Judy Schmidt

NASA’s James Webb Space Telescope is designed to probe the farthest frontiers of the universe, but newly released images of Jupiter prove that the observatory can also bring fresh perspectives to more familiar celestial sights.

The infrared images reveal Jupiter’s polar auroras and its faint rings as well as two of its moons - plus some galaxies in the far background. The planet’s Great Red Spot is there as well, but because it’s seen through three of JWST’s specialized filters, it looks white rather than red.

JWST’s new perspective should give scientists a better sense of how the complex Jupiter system is put together.

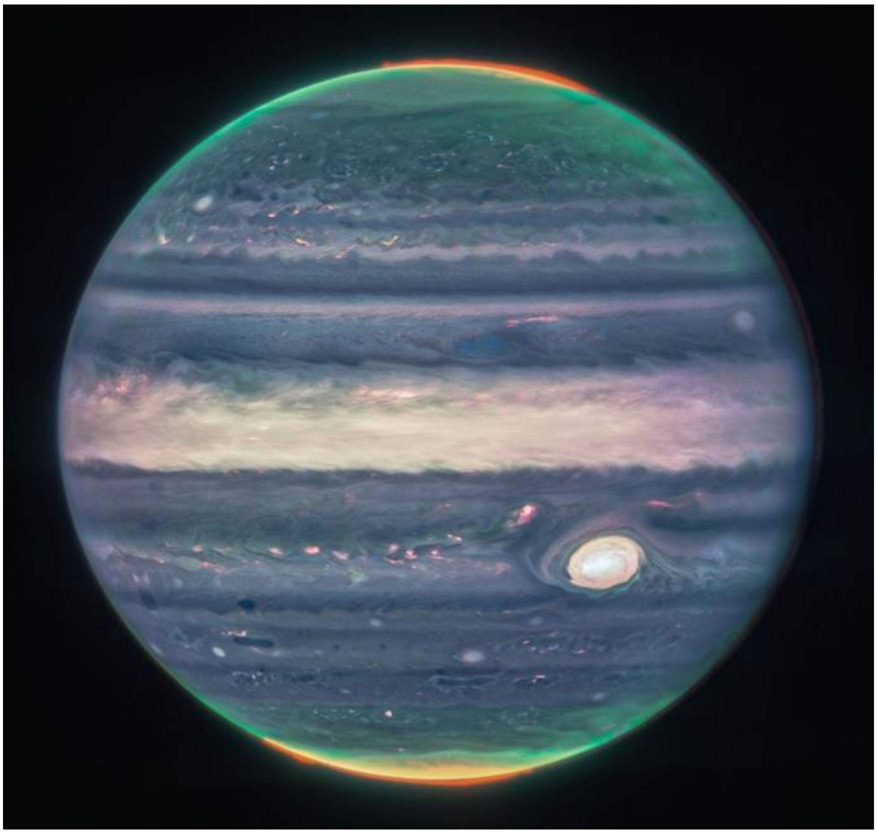
“We hadn’t really expected it to be this good, to be honest,” astronomer Imke de Pater, professor emerita of the University of California at Berkeley, said today in a NASA image advisory. “It’s really remarkable that we can see details on Jupiter together with its rings, tiny satellites, and even galaxies in one image.”

De Pater led the observations of Jupiter with Thierry Fouchet, a professor at the Paris Observatory, as part of an international collaboration for JWST’s Early Release Science program.

The two images released today come from the telescope’s Near-Infrared Camera, or NIRCam. JWST’s instruments are specialized to observe in infrared wavelengths because those wavelengths can reveal phenomena that would go unseen in visible wavelengths. For these pictures, the infrared readings have been translated into colors that range from red (for shorter wavelengths) to blue (for longer wavelengths).

JWST’s wide-field view, created using two infrared filters, shows two of Jupiter’s dozens of moons, Amalthea and Adastrea, as points of light to the left of the planet. Adastrea seems to be embedded in Jupiter’s ring system, which looks brighter in infrared than it does in visible light.

...Jupiter and Its Auroras in a New Light



A three-filter image of Jupiter is more colorful: It shows the auroras and the light reflected by lower clouds and upper hazes in reddish hues. Hazes swirling around the poles are shown in yellow and greens. The light reflected by Jupiter's primary cloud cover is depicted in shades of blue that are dappled with bright spots. The Great Red Spot is pinkish-white.

This NIRCam composite image of Jupiter was created using three filters – F360M (red), F212N (yellow-green), and F150W2 (cyan), Credit: NASA, ESA, CSA, Jupiter ERS Team; image processing by Judy Schmidt.

The brightness here indicates high altitude – so the Great Red Spot has high-altitude hazes, as does the equatorial region," Heidi Hammel, JWST interdisciplinary scientist for solar system observations and vice president for science at AURA, said in today's image advisory. "The numerous bright white 'spots' and 'streaks' are likely very high-altitude cloud tops of condensed convective storms."

JWST's team collaborated with a citizen scientist named Judy Schmidt to translate the telescope's infrared data into the images released today. Schmidt, who hails from Modesto, Calif., has no formal educational background in astronomy. But she got hooked on processing image data from the Hubble Space Telescope a decade ago when she won third prize in the European Space Agency's "Hubble's Hidden Treasures" competition.

"Something about it just stuck with me, and I can't stop," she said. "I could spend hours and hours every day."

Just last month, the JWST team featured an image of the spiral galaxy M74 that was processed by Schmidt.

The wide-field image of Jupiter also drew upon the expertise of Ricardo Hueso, who studies planetary atmospheres at the University of the Basque Country in Spain.

The $10 billion NASA telescope, which was launched last Christmas with support from ESA and the Canadian Space Agency, is just getting started on an observational campaign that should last at least five years — and almost certainly much longer. JWST has already produced what's considered the deepest infrared view of the universe captured to date, plus fresh looks at an exoplanet, a planetary nebula, a galaxy cluster, a star-forming region and the colorful Cartwheel Galaxy. Check out Universe Today's JWST archive for the full array.
https://www.universetoday.com/category/james-webb-space-telescope/

https://www.universetoday.com/157261/webb-telescope-sees-jupiter-and-its-auroras-in-a-new-light/

JWT Latest Photo - Tarantula Nebula

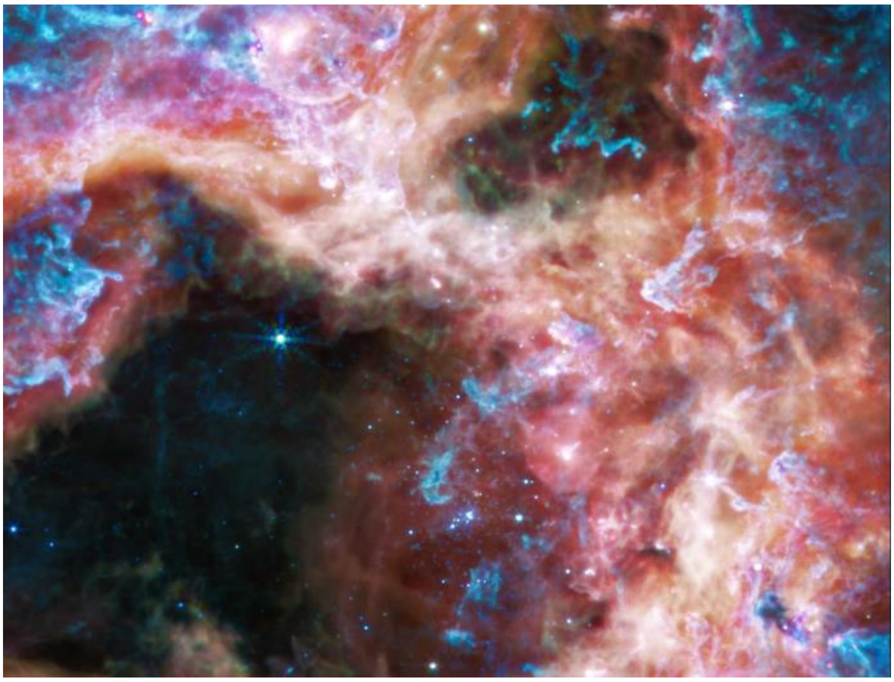
ABOVE: In this mosaic image stretching 340 light-years across, Webb's Near-Infrared Camera (NIRCam) displays the Tarantula Nebula star-forming region in a new light, including tens of thousands of never-before-seen young stars that were previously shrouded in cosmic dust. Credit: NASA, ESA, CSA, STScI, Webb ERO Production Team

The cycle of star formation is on display in this nearby nebula. Webb's MIRI instrument captures protostars nestled deep in clouds of gas and dust, still gathering mass.

Once upon a space-time, a cosmic creation story unfolded: thousands of never-before-seen young stars spotted in a stellar nursery called 30 Doradus, captured by NASA's James Webb Space Telescope. Nicknamed the Tarantula Nebula for the appearance of its dusty filaments in previous telescope images, the nebula has long been a favorite for astronomers studying star formation. In addition to young stars, Webb reveals distant background galaxies, as well as the detailed structure and composition of the nebula's gas and dust.

At only 161,000 light-years away in the Large Magellanic Cloud galaxy, the Tarantula Nebula is the largest and brightest star-forming region in the Local Group, the galaxies nearest our Milky Way. It is home to the hottest, most massive stars known. Astronomers focused three of Webb's high-resolution infrared instruments on the Tarantula. Viewed with Webb's Near-Infrared Camera (NIRCam), the region resembles a burrowing tarantula's home, lined with its silk. The nebula's cavity centered in the NIRCam image has been hollowed out by blistering radiation from a cluster of massive young stars, which sparkle pale blue in the image. Only the densest surrounding areas of the nebula resist erosion by these stars' powerful stellar winds, forming pillars that appear to point back toward the cluster. These pillars contain forming protostars, which will eventually emerge from their dusty cocoons and take their turn shaping the nebula.

JWT - Tarantula Nebula



LEFT: At the longer wavelengths of light captured by its Mid-Infrared Instrument (MIRI), Webb focuses on the area surrounding the central star cluster and unveils a very different view of the Tarantula Nebula. Credit: NASA, ESA, CSA, STScI, Webb ERO Production Team

Webb's Near-Infrared Spectrograph (NIRSpec) caught one very young star doing just that. Astronomers previously thought this star might be a bit older and already in the process of clearing out a bubble around itself. However, NIRSpec showed that the star was only just beginning to emerge from its pillar and still maintained an insulating cloud of dust around itself. Without Webb's high-resolution spectra at infrared wavelengths, this episode of star formation in action could not have been revealed.

The region takes on a different appearance when viewed in the longer infrared wavelengths detected by Webb's Mid-infrared Instrument (MIRI). The hot stars fade, and the cooler gas and dust glow. Within the stellar nursery clouds, points of light indicate embedded protostars, still gaining mass. While shorter wavelengths of light are absorbed or scattered by dust grains in the nebula, and therefore never reach Webb to be detected, longer mid-infrared wavelengths penetrate that dust, ultimately revealing a previously unseen cosmic environment.

One of the reasons the Tarantula Nebula is interesting to astronomers is that the nebula has a similar type of chemical composition as the gigantic star-forming regions observed at the universe's "cosmic noon," when the cosmos was only a few billion years old and star formation was at its peak. Star-forming regions in our Milky Way galaxy are not producing stars at the same furious rate as the Tarantula Nebula and have a different chemical composition. This makes the Tarantula the closest (i.e., easiest to see in detail) example of what was happening in the universe as it reached its brilliant high noon. Webb will provide astronomers the opportunity to compare and contrast observations of star formation in the Tarantula Nebula with the telescope's deep observations of distant galaxies from the actual era of cosmic noon.

Despite humanity's thousands of years of stargazing, the star-formation process still holds many mysteries – many of them due to our previous inability to get crisp images of what was happening behind the thick clouds of stellar nurseries. Webb has already begun revealing a universe never seen before, and is only getting started on rewriting the stellar creation story.

The James Webb Space Telescope is the world's premier space science observatory. Webb will solve mysteries in our solar system, look beyond to distant worlds around other stars, and probe the mysterious structures and origins of our universe and our place in it. Webb is an international program led by NASA with its partners, ESA (European Space Agency) and the Canadian Space Agency.

NASA's Artemis 1 - Launch Delayed - Again

Artemis long awaited launch was called off yet again. NASA's new moon rocket sprang another dangerous fuel leak Saturday 24th August, forcing launch controllers to call off their second attempt to send the crew capsule into lunar orbit with test dummies on Monday 29th August.

The first attempt earlier in the week was marred by escaping hydrogen, which leaks were elsewhere on the most powerful 398 meter rocket, ever built by NASA. After Tuesday 30th August, a two-week launch blackout period kicked in. Extensive fuel leak repairs would require that the rocket be hauled off the pad and back into it's hangar, pushing the flight into October.

Launch director Charlie Blackwell-Thompson and her team tried to plug Saturday's leak the way they did the last time: stopping and restarting the flow of super-cold liquid hydrogen in hopes of removing the gap around a seal in the supply line. They tried that twice, in fact, and also flushed helium through the line. But the leak persisted. Blackwell-Thompson finally halted the countdown after three to four hours of futile effort.

NASA wants to send the crew capsule atop the rocket around the moon, pushing it to the limit before astronauts get on the next flight. If the five-week demo with test dummies succeeds, astronauts could fly around the moon in 2024 and land on it in 2025. Astronauts last walked on the moon in 1972, 50 years ago, during the Apollo program.

After days of stormy weather, the weather cooperated early Saturday 3rd September, as the launch team began loading nearly 1 million gallons of fuel into the Space Launch System rocket. But minutes into the operation, hydrogen fuel began seeping from the engine section at the bottom of the rocket, violating safety rules.

During the Monday's launch attempt, hydrogen fuel escaped from elsewhere in the rocket. Technicians tightened up the fittings over the past week, but Blackwell-Thompson cautioned that she wouldn't know whether everything was tight until Saturday's fueling.

Even more of a problem on Monday, a sensor indicated one of the rocket's four engines was too warm, but engineers later verified it actually was cold enough. The launch team planned to ignore the faulty sensor this time around and rely on other instruments to ensure each main engine was properly chilled.

Mission managers accepted the additional risk posed by the engine issue as well as a separate problem: cracks in the rocket's insulating foam. But they acknowledged other problems - like fuel leaks - could prompt yet another delay.

The next launch window for Artemis 1 runs from Sept. 16 - Oct. 4 and Oct. 17 - Oct. 31. With September 19th being the current proposed date.

The $4.1 billion test flight is the first step in NASA's Artemis program of renewed lunar exploration, named after the twin sister of Apollo in Greek mythology

Artemis - years behind schedule and billions over budget—aims to establish a sustained human presence on the moon, with crews eventually spending weeks at a time there. It's considered a training ground for Mars.

https://fortune.com/2022/09/03/nasa-artemis-moon-rocket-failure-to-launch-mars/, https://www.space.com/news/live/nasa-artemis-1-moon-mission-updates

Asteroids

August was a busy month with 4 asteroids, all more than 30 m (100 feet) in size, passing by Earth, which NASA had marked that not any of those asteroids were a potential threat.

Saturday - August 27, 2022 - Asteroid NEO 2022 QQ4
The Asteroid NEO 2022 QQ4 travelled at 7 kilometers per second which is about 25,000 kmph. It was said to be close to 110 feet in diameter. According to NASA, the asteroid NEO 2022 QQ4 will next return to Earth on August 18, 2131.

Sunday - August 28, 2022 - Asteroid NEO 2022 QP3
This asteroid flew past Earth at a distance of 5.51 million kilometers. At 33.5 m (110 ft), this asteroid is similar in size to Asteroid NEO 2022 QQ4. This asteroid travelled at a speed of 8 kilometers per second which is around 29,000 kmph. The Asteroid NEO 2022 QP3 will next return to Earth on August 16, 2025.

Monday - August 29, 2022
Asteroid 2022 QX4
This asteroid's first recorded visit was in 1977. It is a 42.6 m (140 ft) space rock and is the largest one among the other 3 that flew past Earth. This asteroid will next return to Earth on September 9, 2026.

Asterid 2017 BU
This asteroid was first spotted on January 19, 2017. This time, this 30 m (100 ft) large asteroid flew past the Earth at a distance of 6.5 million kilometers traveling at a speed of 25,000 kmph. It will next return to Earth after 29 years on February 5, 2051.

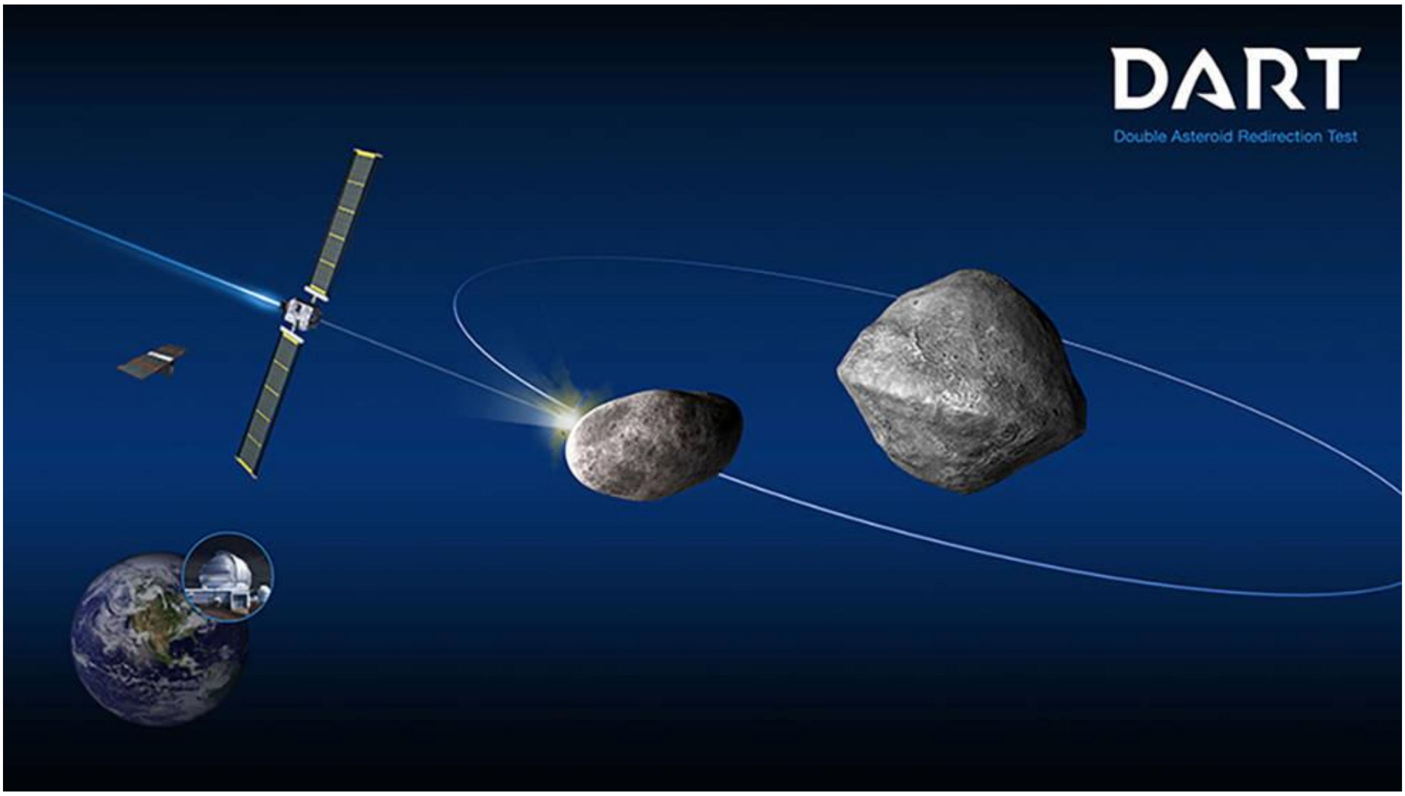
Monday - September 7, 2022
Asteroid 2022 RR1
This asteroid was first spotted on September 04, 2022; belonging to the Apollo group. It makes one orbit around the Sun in 628 days. The aphelion (farthest point from the Sun) of the asteroid 2022 RR1 orbits is 289 million kilometers, and the perihelion (nearest point to the Sun) is 140 million kilometers. The asteroid 2022 RR1 (about the size of a school bus) flew past Earth on September 07 at 02:33 at a distance of 732 thousand kilometers from Earth at a speed of 29412 kilometers per hour

Monday - September 7, 2022
Asteroid 2022 QB22
This humongous 55 meter (180 feet) wide asteroid, nearly half the size of a large commercial aircraft, just missed earth hurtling by at a staggering speed according to NASA. The asteroid is large enough to end all life and cause annihilation on the planet if it made surface impact on Earth. Although it passed at a safe distance from Earth, it caused the agency worries due to the extremely close distance that it passed by Earth,

August this year saw over 40 NEO asteroids pass Earth with September following suit with a predicted similar number.

https://www.dnaindia.com/science/report-4-asteroids-all-more-than-100-feet-in-size-head-towards-earth

NASA's Double Asteroid Redirection Test (DART)



The DART mission was launched at 10:20 p.m. USA local time on Nov. 23, 2021, (1:20 a.m. EDT, or 0620 GMT Nov. 240 atop SpaceX Falcon 9 rocket from the Space Launch Complex 4 at the Vandenberg Space Force Base in California. Rocket shown BELOW.

The primary objective of the mission, is to assess kinetic impact as a method for redirection of any future asteroids found to be on a trajectory to impact Earth

The Double Asteroid Redirection Test (DART) mission is designed to

1 - Evaluate the impact technique by striking an asteroid with a spacecraft at high relative velocity and observing the resulting change in orbit.

2 - Measure the resulting asteroid deflection, by targeting the secondary member of a binary NEO and measuring the resulting changes of the binary orbit;

3 - Study hypervelocity collision effects on an asteroid, validating models for momentum transfer in asteroid impacts.

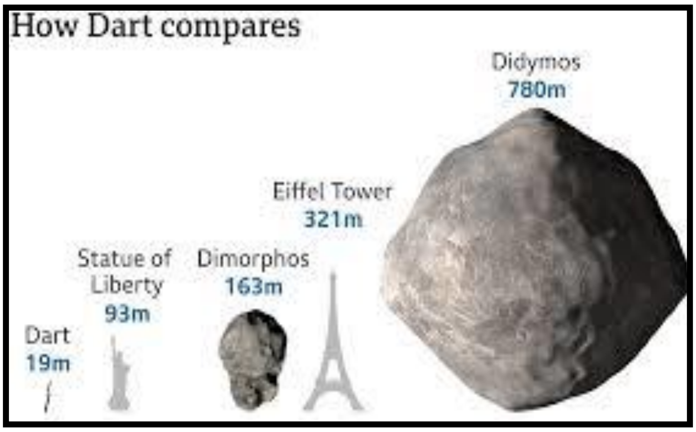
The test involves flying the DART spacecraft at high relative velocity into the smaller of two asteroids that are co-orbiting in a binary pair, and using Earth-based observations before and after the impact to study the effects on the orbit.

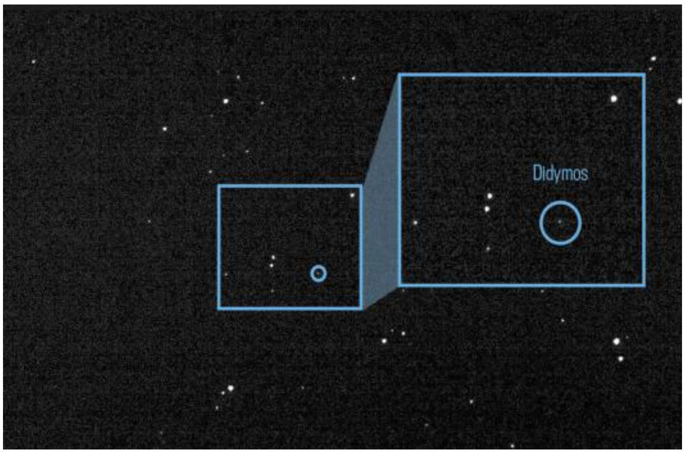
The DART spacecraft heads towards the binary S-type asteroid system 65803 Didymos, consisting of the primary, Didymos with a body diameter of about 780 m (2,560 feet), and the secondary orbiting moonlet, Dimorphos which is approximately 163 meters (525 feet), across.

...NASA's DART Mission

ABOVE: Image of asteroid 65803 Didymos and its orbiting moonlet Dimorphos Credit: ESA

BELOW: Image comparison of asteroid Didymos and its orbiting moonlet Dimorphos to Eiffel Tower Credit: NASA Credit: ESA



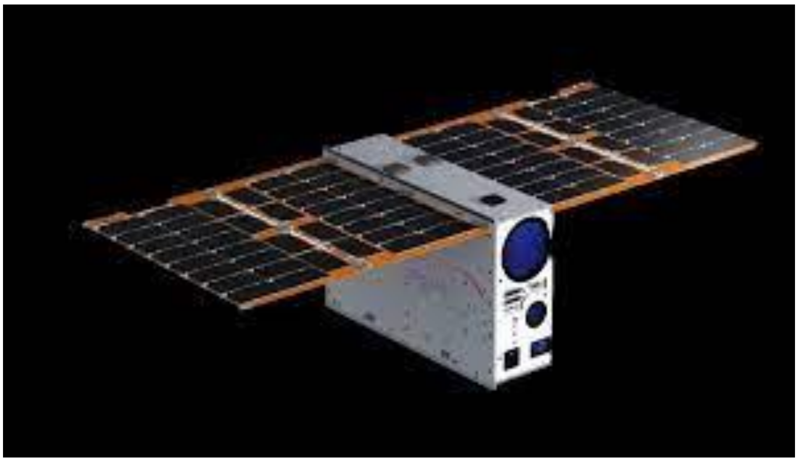


LFFT: Composite image by DRACO of the light from asteroid Didymos and its orbiting moonlet, on 2022-07-22 Credits: NASA JPL DART Navigation Team

NASA’s DART spacecraft recently got its first look at Didymos, the binary asteroid system which includes its target, Dimorphos.

This image was taken from a distance of about 32 million kilometres (20 million miles) away from DART. The Didymos system is still very faint, and navigation camera experts were uncertain whether DRACO would be able to spot the asteroid yet. But once the 243 images DRACO took during this observation sequence were combined, the team was able to enhance it to reveal Didymos and pinpoint its location.

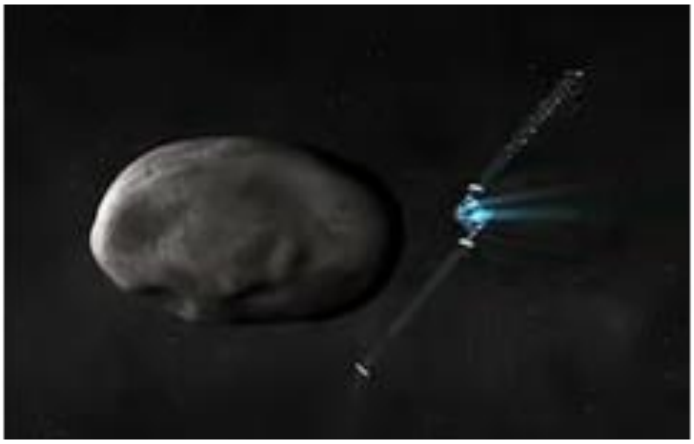
Using observations taken every five hours, the DART team will execute three trajectory correction maneuvers over the next three weeks, each of which will further reduce the margin of error for the spacecraft’s required trajectory to impact. After the final maneuver on Sept. 25, approx. 24 hours before impact, the navigation team will know the position of the target Dimorphos within 2 kilometers. From there, DART will be on its own to autonomously guide itself to its collision with the asteroid moonlet. DRACO has subsequently observed Didymos during planned observations on Aug. 12, Aug. 13 and Aug. 22.



DART carries the LICIA CubeSat, which will be released 2 days before the DART impact. LICIA Cube will perform a separation maneuver to follow behind DART and return images of the impact, the ejecta plume, and the resultant crater as it flies by. It will also image the opposite hemisphere from the impact.

LEFT: LICIA Cube CubeSat

...NASA's DART Mission



Although the team has already conducted a number of navigation simulations using non-DRACO images of Didymos, DART will ultimately depend on its ability to see and process images of Didymos and Dimorphos, once it too can be seen, to guide the spacecraft toward the asteroid, especially in the final four hours before impact. At that point, DART will need to self-navigate to impact successfully with Dimorphos without any human intervention. The spacecraft is scheduled to arrive at its target on **26 September 2022,** according to NASA officials.

At a high velocity, the spacecraft will smash into Dimorphos at approximately 6.58 km/sec with an impact mass of 560 kg. The final images returned 2 seconds before impact will have a resolution of 3 cm/pixel. The LICIA Cube will fly by about 3 minutes after impact, recording details of the impact plume and surfaces at resolutions up to 2 meters per pixel. After impact, Earth-based observations will continue in order to characterize the resulting change in orbit of Dimorphos induced by the impact. The distance to Earth at impact will be approximately 11.2 million km.

If successful, the spacecraft will alter the path of Dimorphos in its orbit around Didymos; just how much Dimorphos' orbit changes will be confirmed in the months and years after impact.

The ESA Hera mission is planned to fly by Didymos in 2024 for follow-up observations.to study the two asteroids in greater detail, including checking up on the impact crater and measuring the physical structure and chemical composition of the double worlds.

Here's how you can follow the action live.

- **Monday, Sept. 12**: NASA plans to host a hybrid media day at the Applied Physics Laboratory "focused on the technology enabling the DART spacecraft to autonomously navigate to and impact its target asteroid." We'll share more details about who is speaking and how to watch webcast events on NASA TV closer to the date, but events begin at 9 a.m. EDT (1300 GMT).
- **Thursday, Sept. 22:** NASA will hold a media briefing at 3 p.m. EDT (1900 GMT) at NASA Headquarters in Washington to discuss DART's final activities before impact. We'll share the speakers and the details about how to watch on NASA TV closer to the date.
- **Monday, Sept. 26:** Live coverage of DART's impact will start at 6 p.m. EDT (2200 GMT). You can see it live here at Space.com , on NASA TV and on the agency's website The public also can watch live on agency social media accounts on Facebook (opens in new tab), using the #NASASocial hashtag on Twitter and YouTube . Impact will occur at 7:14 p.m. EDT (2314 GMT).

https://www.space.com/nasa-dart-asteroid-impact-webcasts
https://www.space.com/didymos-asteroid-facts
https://nssdc.gsfc.nasa.gov/nmc/spacecraft/display.action?id=2021-110A
https://www.nasa.gov/feature/dart-sets-sights-on-asteroid-target
https://dart.jhuapl.edu/Gallery/

ASSA Durban Minutes of General Meeting

10 AUGUST - 19:30 via Zoom

1. **Welcome**

x Members were welcomed by Debbie Abel, standing in for Amith.

x Zoom sharing by Gerald de Beer, and the meeting was recorded.

2. **Presentation**

x Presentation by Nino Wunderlin, introduced by Pieter Strauss.

x The topic was: How to design and build a Rocket

3. **Present and Apologies**

x Several apologies tended via WhatsApp and email.

x 23 present, including guest speaker and also representatives of the Amateur Astronomical Society of Kenya as special guests.

4. **Treasurer's Report**

x Francois Zinserling presented finance report.; prepared by Corinne Gill.

ASSA DURBAN FINANCIALS 2022/08/10

Financials Meeting	Month	Current	Investment	Petty Cash
General Meeting	2022-08-10	R 31 134,87	R62 406.88	R 1 000,00

ASSA DURBAN - MEMBERS

Date	No off	Paid Members	Honoury	Removed
2022-08-10	138	52	4	0

ASSA DURBAN - RESIGNED

SURNAME	First Name	Title	Type	No off
Ainsworth / Alder	Howard & Laurienne	Couple	Family	2

5. **New Committee Portfolios**

- Fiona – nDaba editor
- Rowena – outreach
- Yesen - website

...Minutes of the Meeting

6. Confirmation of previous meeting minutes and matters arising

x AGM minutes accepted

7. **Events**

x Karkloof is hosting a night-hike and stargazing. Details to follow.

x Public viewing details are in nDaba

8. General

x The Debbie for chairing.

x Kenya gave a brief intro of their activities and had some questions of our activities.

x The next General Meeting will be held on **14th September 2022**

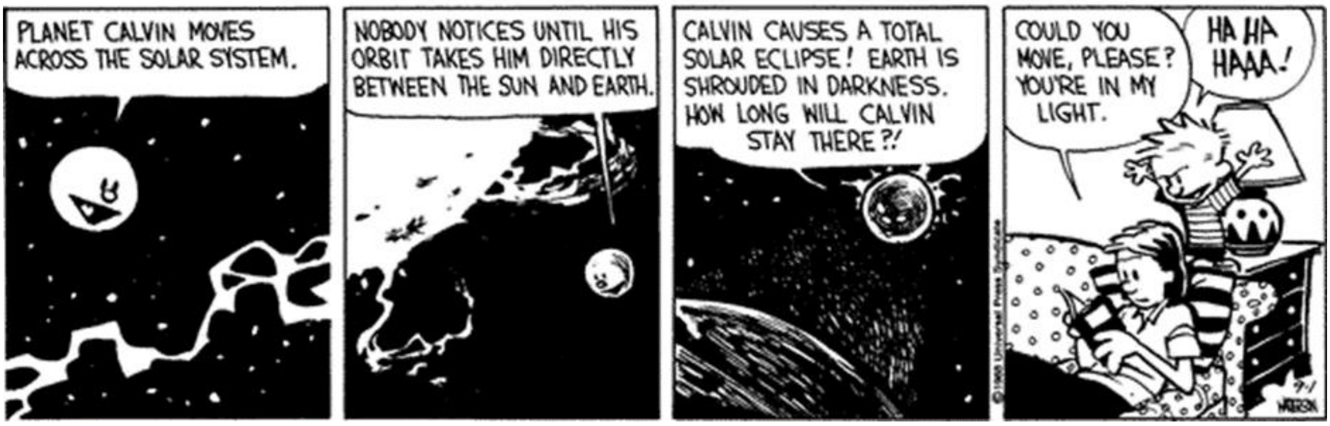
DURBAN ZOOM MEETING

Join Zoom meeting :

https://us02web.zoom.us/j/88037701479pwd=UU5xMUFjbWlVWUtMWTd1Y1l2ZDNQdz09

Meeting ID: 88037701479

Passcode: 297674



Public Viewing Roster ASSA Durban

Dome Master	Email	Assistant	Telescope Volunteer	Public Viewing

PUBLIC VIEWING:

Public viewing is on site at the Marist Brothers St Henry's School in the dome and around the pool area; usually the first Friday evening closest to the New Moon.

Please note there is a roster with a booking system. Once the number of telescopes are confirmed, Individuals will be contacted to confirm dates and times. Please book your place!!!

NOTIFY OBSERVATORY MANAGER:

Members interested in attending the above viewing evenings and/or becoming involved in assisting with the viewing evenings, please send your names to Alan Marnitz on cell number 082 305 9600, or via email: alan@astronomydurban.co.za

VOLUNTEERS REQUIRED:

Volunteers to please identify which role you are willing to assist with, Dome Master, Viewing Assistant or a Telescope Volunteer. After which, attendance will be confirmed and viewing dates will be announced.

Viewing Assistant - Learning about the new telescope, assisting with the viewing evenings, assisting viewing members as required.

Telescope Volunteers - Members willing to bring their telescopes to the viewing evenings to set up around the pool for public viewing.

VOLUNTEERS TUTORIAL:

Mike Hadlow to organise an afternoon / evening to train volunteers as Dome Masters and the use of the large telescope. Date to be confirmed and viewing dates will be announced ASAP.

Viewing Contact:	Phone	Email
Alan Marnitz	082 305 9600	alan@astronomydurban.co.za

Notice Board

MEETINGS:

- GENERAL MEETING to be held on **14 September 2022** at the school **@ 7:30pm.**
- PUBLIC VIEWING MEETINGS - please refer to website under the tab "Viewing and Events" for any updates with regards dates & public viewing, please click here: https://astronomydurban.co.za/events-viewing/

MNASSA:

- Monthly Notes of the Astronomical Society of Southern Africa.
- Available at www.mnassa.org.za to download your free monthly copy.

NIGHTFALL:

- Fantastic astronomy magazine. Check it out.
- Available from the ASSA website assa.saao.ac.za/about/publications/nightfall/

MEMBERSHIP FEES & BANKING:

- **Membership Subscriptions were due on the 2022-07-01 for the 2022-2023 financial year. PLEASE pay outstanding subscriptions.**
- **Please pay Subscription fees via EFT.**

Pay Fees Online

Membership fees indicated below:

Single Members:	**R 190:00**
Family Membership:	**R 230:00** for family membership.
Under 18 members:	Free
Cash/Cheques:	**Please note: NO cheques or cash will be accepted - Cash deposits incur bank charges**
Account Name:	**ASSA Natal Centre**
Bank:	**Nedbank**
Account No.	**1352 027 674**
Branch:	**Nedbank Durban North**
Code:	**135 226**
Reference:	**SUBS 22-23 SURNAME and FIRST NAME**
Proof of Payment:	treasurer@astronomydurban.co.za

SKY GUIDE 2023 - Limited number will be available !!!

- SKY GUIDES **Sill to be published**

RESIGNATIONS from ASSA:

Please send an email immediately notifying the Secretary at secretary@astronomydurban.co.za stating your wish to resign from the society.

COMMITTEE POSITIONS & CONTACTS:

Chairman	Amith Rajpal	Amith@astronomydurban.co.za
Vice Chair	Debbie Abel	Debbie@astronomydurban.co.za
Secretary	Francois Zinserling	Secretary@astronomydurban.co.za
Treasurer	Francois Zinserling	Treasurer@astronomydurban.co.za
Guest Speaker Liaison	Piet Strauss	Piet@astronomydurban.co.za
Observatory & Equipment	Alan Marnitz	Alan@astronomydurban.co.za
Observatory Assistant	TBC	
Publicity & Librarian	Claire Odhav	Claire@astronomydurban.co.za
Out-Reach - Public	Rowena Baldew	Rowena@astronomydurban.co.za
Out-Reach - Schools	Sihle Kunene	Sihle@astronomydurban.co.za
St. Henry's Marist College Liaison	Moya O`Donoghue	Moya@astronomydurban.co.za
'nDaba Editor	Fiona Khan	Fiona@astonomyduran.co.za
Website & Facebook	Yesen Givender	Yesen@astronomydurban.co.za

ELECTRONIC DETAILS:

- Website: www.astronomydurban.co.za
- Emails : AstronomyDurban@gmail.com
- Instagram: https://www.instagram.com/astronomydurban/
- Facebook: https://www.facebook.com/groups/376497599210326

Library Book Review - Beyond

The Astonishing Story of the First Human to Leave Our Planet and Journey into Space

Author - Stephen Walker
(4.7 out of 5 stars)

☆ ☆ ☆ ☆ ☆

On April 12, 1961, Russian cosmonaut Yuri Gagarin became the first person to leave Earth's orbit and travel into space, marking a significant milestone in the space race between the United States and the Soviet Union. In "Beyond: The Astonishing Story of the First Human to Leave Our Planet and Journey into Space" (Harper, 2021), author and documentary filmmaker Stephen Walker recounts intimate details of the months, and years, leading up to Gagarin's historic flight, revealing the true stories of the Soviet space program as the agency prepared to launch the first human into space — only weeks before American astronaut Alan Shepard's suborbital flight on May 5, 1961.

Walker also discusses the historical impact of Gagarin's flight and how it set the stage for NASA's Apollo program. ~ Samantha Mathew's on (space.com)

Looks like quite an interesting and informative book! Claire

For a full list of books, posters and puzzles on space, contact Claire, on 083 395 5160