



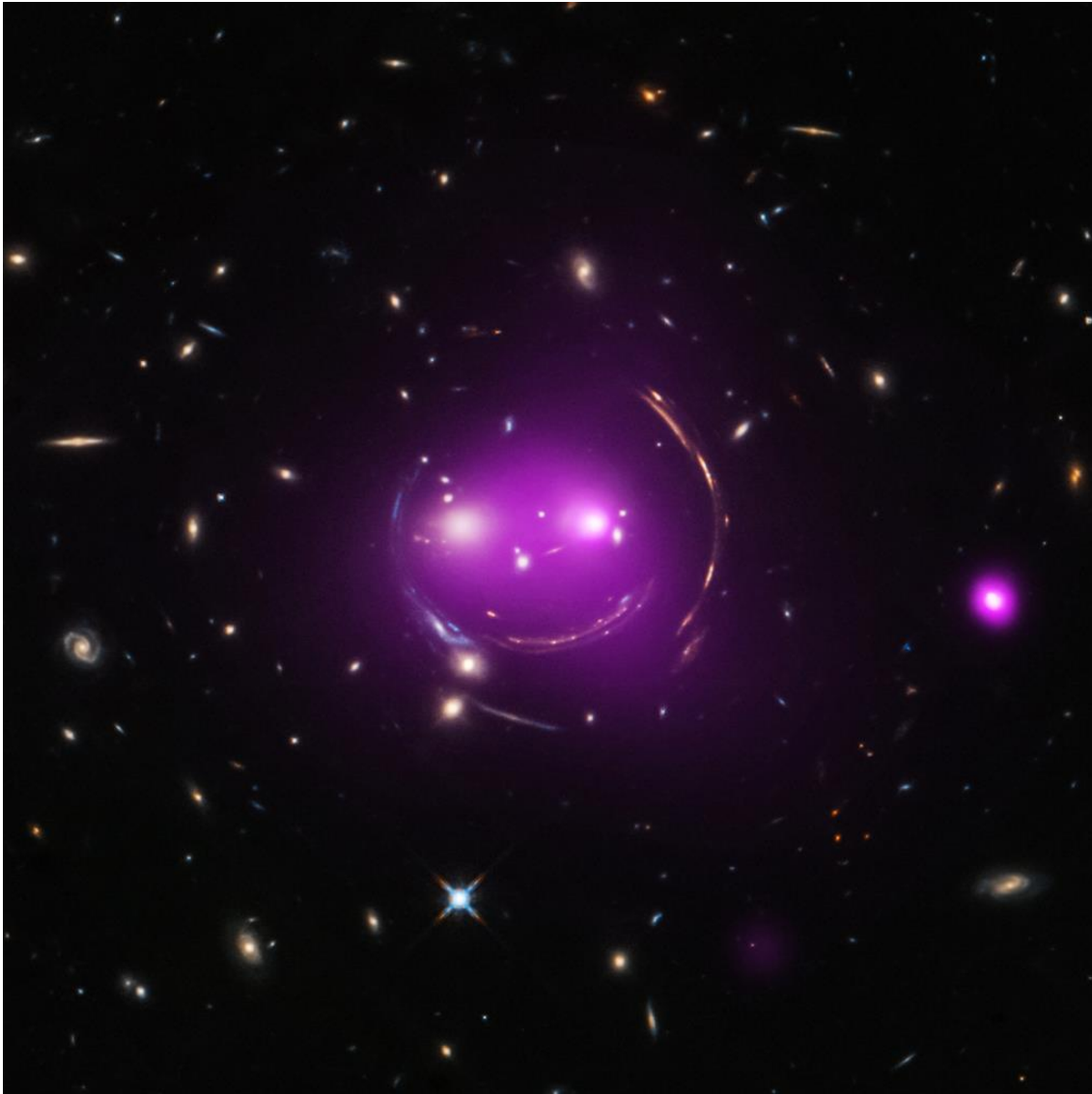
East Rand Astronomy Club

The Universe Is In Us



Interstellar News

November 2019



Gravity's Grin

Image Credit: X-ray - NASA / CXC / J. Irwin et al. ; Optical - NASA/STScI

Explanation: Albert Einstein's general theory of relativity, published over 100 years ago, predicted the phenomenon of gravitational lensing. And that's what gives these distant galaxies such a whimsical appearance, seen through the looking glass of X-ray and optical image data from the Chandra and Hubble space telescopes. Nicknamed the Cheshire Cat galaxy group, the group's two large elliptical galaxies are suggestively



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framed by arcs. The arcs are optical images of distant background galaxies lensed by the foreground group's total distribution of gravitational mass. Of course, that gravitational mass is dominated by dark matter. The two large elliptical "eye" galaxies represent the brightest members of their own galaxy groups which are merging. Their relative collisional speed of nearly 1,350 kilometres/second heats gas to millions of degrees producing the X-ray glow shown in purple hues. Curiouser about galaxy group mergers? The Cheshire Cat group grins in the constellation Ursa Major, some 4.6 billion light-years away

<https://apod.nasa.gov/apod/>

THE EDITORS PIECE.

We have November and December to go before the year 2019 ends.

East Rand Astronomy Club opened its doors in July 2019. It was winter and I remember thinking and hoping that people will turn up.

That very cold night we had clear skies and very attentive, excited visitors, nine in all.

A few months onward in time, we are averaging about 38 members per meeting.

November will be our last meeting for 2019.

In December we are having a social "bring and braai" on Saturday 7 December to be held under the Lapa in a very relaxed and friendly atmosphere. From late afternoon to evening. All are welcome.

Our next meeting will be 5 February 2020, so do keep a look out for details in *Interstellar*.

Looking forward to science missions in 2020? We have the interest of the ESA-JAXA BepiColombo space craft on a long journey to Mercury, it will make two flybys passing close to Venus in October 2020, a year after it was launched (18 October 2019).

The Mars Rover Exploration is high on the NASA science list. Missions designed to find out if life ever existed on Mars.

Astronomy and Astrophysics will study dark matter, black holes, galaxies, stars exo-planets and so much more. For astronomy hobbyists, an optical adventure into space.

At least, in the last two decades, studies have changed the way we see the Universe dramatically. More than 3800 planets have been discovered orbiting distant stars. Black holes are now known to be present at the centre of most galaxies, including the Milky Way Galaxy. The age, size and shape of the universe has been mapped, based on the primordial radiation left by the big bang. It has been learned and now understood that most of the matter in the Universe is dark and invisible, and the Universe is not only expanding, but accelerating in an unexpected way.



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In Astronomy science, exciting times are ahead, so do join us for another year of learning more about our Universe.

Looking beyond the clouds!

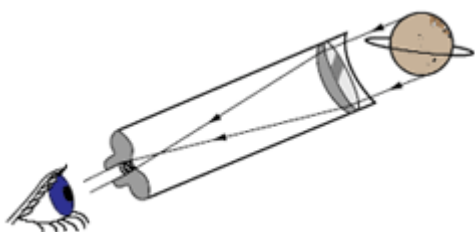
OUR NEXT MEETING:

WHERE: Marachelle Country Estate.

WHEN: 6 November 2019 – 7pm for 7:30pm.

SPEAKER: Gerard And Madeleine Bloemhof

SUBJECT: My Telescope Making Experiences



SUNRISE AND SUNSET TIMES IN NOVEMBER 2019:

<u>DATE</u>	<u>SUNRISE</u>	<u>SUNSET</u>
1/11/2019	5:17	18:23
08/11/2019	5:13	18:28
15/11/2019	5:09	18:33
22/11/2019	5:07	18:38
29/11/2019	5:06	18:44

<https://www.timeanddate.com/moon/south-africa/benoni?month=11&year=2019>

A VIOLENT TEMPER:



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Our sun has an extreme violent temper! It is violently explosive, and this temper is called a Solar Flare.

If one was able to look at the sun, one would see a solar corona and chromosphere surrounding it and plasma flow within.

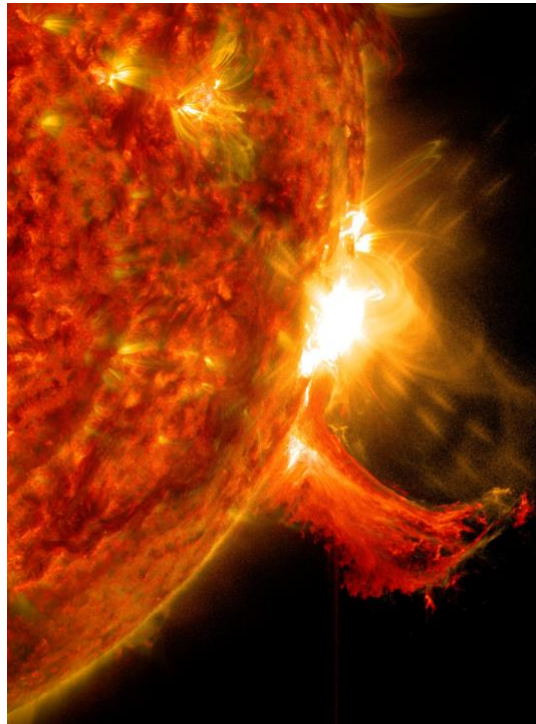
Plasma is a fundamental state of matter in which an ionized gaseous substance becomes highly electrically conductive to the point that long-range electric and magnetic fields dominate the behaviour of the matter. As a matter of interest other fundamental states are: solid, liquid, and gas.

The sun is not a smooth red ball, but, has emission waves of extreme heat all the time, through plasma on the sun; heating it to millions of kelvins, accelerating the resulting electrons, protons and heavier ions to very near to the speed of light.

Most flares occur around sunspots where intense magnetic fields emerge from the sun's surface. Most solar flares take days to build up their energy and a very short time to release it. This usually happens around what we call black spots on the sun

When emissions interact with a planet the effects are dependant on whether the planet has a magnetic field and an atmosphere as in the case of Earth. For example, the aurora is caused by charged particles entering near the poles, creating those beautiful cascading colours referred to as the Northern Lights. One also finds the Southern Lights in areas near the South Pole. For observational purposes, New Zealand, South Island would be a good place to visit.

https://en.wikipedia.org/wiki/Solar_flare



NASA's Solar Dynamics Observatory captured this image of a solar flare on Oct. 2, 2014. The solar flare is the bright flash of light on the right limb of the sun. A burst of solar material erupting out into space can be seen just below it.



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A solar flare erupted on the right side of the sun on Oct. 2, 2014, while a cloud of solar material just below was flung out into space.

Image Credit:

NASA/SDO/ Wiessinger

THE MOON IN NOVEMBER 2019:

	MOON RISE	MOONSET	MOON PHASE
04/11/2019	11:30	00:32	Third Quarter
12/11/2019	18:30	05:10	Full Moon
19/11/2019	00:05	11:12	First Quarter
26/11/2019	04:57	18:36	New Moon

<https://www.timeanddate.com/moon/south-africa/benoni?month=11&year=2019>

WHAT DOES MAN WANT TO DO WITH THE MOON?

Is there an interest in going to live on the moon?

Earth is to humans as Aliens are to space.

Humankind is extremely interested in its history and history repeating itself. It is interesting to note. Fifty years ago Apollo 11 landed on the moon in the Sea of Tranquility.

This year the Israelis, the Indians and the Chinese have sent missions to the Moon. Be they successful missions or not, man has made a repeated effort.

Early in the 20th. Century, humankind raced tragically, attempting to reach the South Pole, then the South Pole was left alone for fifty years. Is man racing to get to the moon fifty years after the first attempt?

David Parker, director of human and robotic exploration for the European Space Agency. Sees the parallel and notes, "Antarctica was opened up by technological advances – motorised vehicles, air transport, radio, and other developments – that are mirrored in the new sciences of machine learning, sensor technology and robotics. These promise to transform lunar colonisation in one crucially important way: by reducing the need for the continual presence of humans in hostile environments. We are now approaching that stage with our exploitation of the moon."

For the time being we still have the moon in our telescopic sights and we can make the most of studying the moon from Earth, for the very reason it is hostile to mankind, there being: no gravity, no seasons, no water. Ideally not ideal.



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Robin McKie Observer science editor Sat 6 Jul 2019 18.56 BST

<https://www.theguardian.com/science/2019/jul/06/everyones-going-to-the-moon-again-apollo-11-50th-anniversary>

MOON ROCKS, LOTS OF THEM, 50 YEARS LATER

Over four years, the Astronauts on six Apollo missions collected 2,196 moonrock samples, now broken into about 140,000 pieces. A total weight of about 382 kilograms. In the years that have past NASA still holds about 85% of those rocks which are used in purposes of science.

The American Government arranged for the US States and territories, together with 135 countries, to receive a few tiny lunar samples. Some of which could be lost or mislaid today.

Scientific experiments and research could have destroyed some samples, but today, what is left is kept in storage and used in laboratories.

<https://www.space.com/where-are-nasa-apollo-moon-rocks.html>



NASA+pictures+of+moonrocks&client=firefox-b-d&tbm=isch&source=iu&ictx=1&fir=meV8oHepSVnatM%253A%252CmqxA1nuOejjazM%252C_&vet=1&usg=A14_-kTWYjLQEFip4aFCi0BKWwCzgK7MqA&sa=X&ved=



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THE PLANETS:



A note to remember:

All planets visible to the unaided eye look like stars. Planets visible to the unaided eye include Mercury, Venus, Earth, Mars, Jupiter and Saturn.

Looking through a telescope, Uranus and Neptune are visible as tiny discs. Pluto always remains looking like a star in even the largest amateur telescope.

The beauties, like Saturn and Jupiter are great eye-catchers for planetary photography but, far more than that, just looking at them through a good telescope and eyepiece conveys such amazement and pleasure.



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Mercury: is the innermost planet in the solar system, orbiting the Sun at a distance of 0.387 AU once every 88 days. This month, Mercury is visible in our morning skies, using a telescope, it is very small and not easy to spot.



Venus: Is visible in our morning sky this month. Venus orbits the Sun faster than the Earth, so it will either appear in the sky in the West in the evening or rise before the Sun in the East.



Earth: Astronomers and astrophysicists study physics on Earth. They are the people who decipher the meaning of the signals in radio astronomy which reads space by sound.

The effects of climate change are evident in most regions on Earth. There is a mountain in northern Sweden, the Kebnekaise Mountain. The icy mountain's southern peak was the tallest in the country. It has melted so much the mountain is no longer the tallest but the second tallest,



Mars: The Red Planet resembles our own Earth in many ways. It is made of rock, plus it has an atmosphere and weather systems. Mars has two tiny moons, named Phobos and Deimos. They are probably asteroids captured by Mars. In November 2019, Mars will be more easily viewed from the Northern Hemisphere and Southern tropics than at temperate latitudes in the Southern Hemisphere. it becomes visible in the morning sky before dawn in October 2019, and then gradually becomes more easily visible and brightens as it heads towards its next closest approach to Earth.



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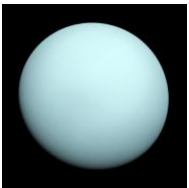
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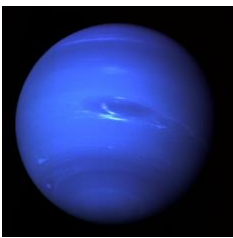
Jupiter: Jupiter has spent a long time in our night sky and is still very prominent in the early evening sky, shining brilliantly. One can see it in the south-west as soon as the sky darkens. Southern hemisphere observers get the best views because Jupiter's far southerly declination means it climbs higher in the sky. Travelling very close to each other Jupiter and Antares, the brightest star in constellation Scorpius



Saturn: Is very easy to see through out the month from nightfall to dawn. It follows close behind Jupiter and though it is not as bright as Jupiter it is still easy to find. Jupiter has lost the race! 20 new moons have been found orbiting Saturn. This brings the ringed planet's total number of moons to 82, Jupiter only has 79.



Uranus: When Uranus and Neptune are visible, they normally appear as tiny discs. In our Solar system, Uranus is different in that its axis of spin is tilted by 98 degrees. This means it spins on its side.



Neptune: Neptune is difficult to see and appears in the sky as a tiny blueish disc.

NASA Solar System Exploration pictures



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THE CONSTELLATIONS IN NOVEMBER:



Cassiopeia

Toucana the toucan,

The phoenix

www.constellation-guide.com/constellations-by-month

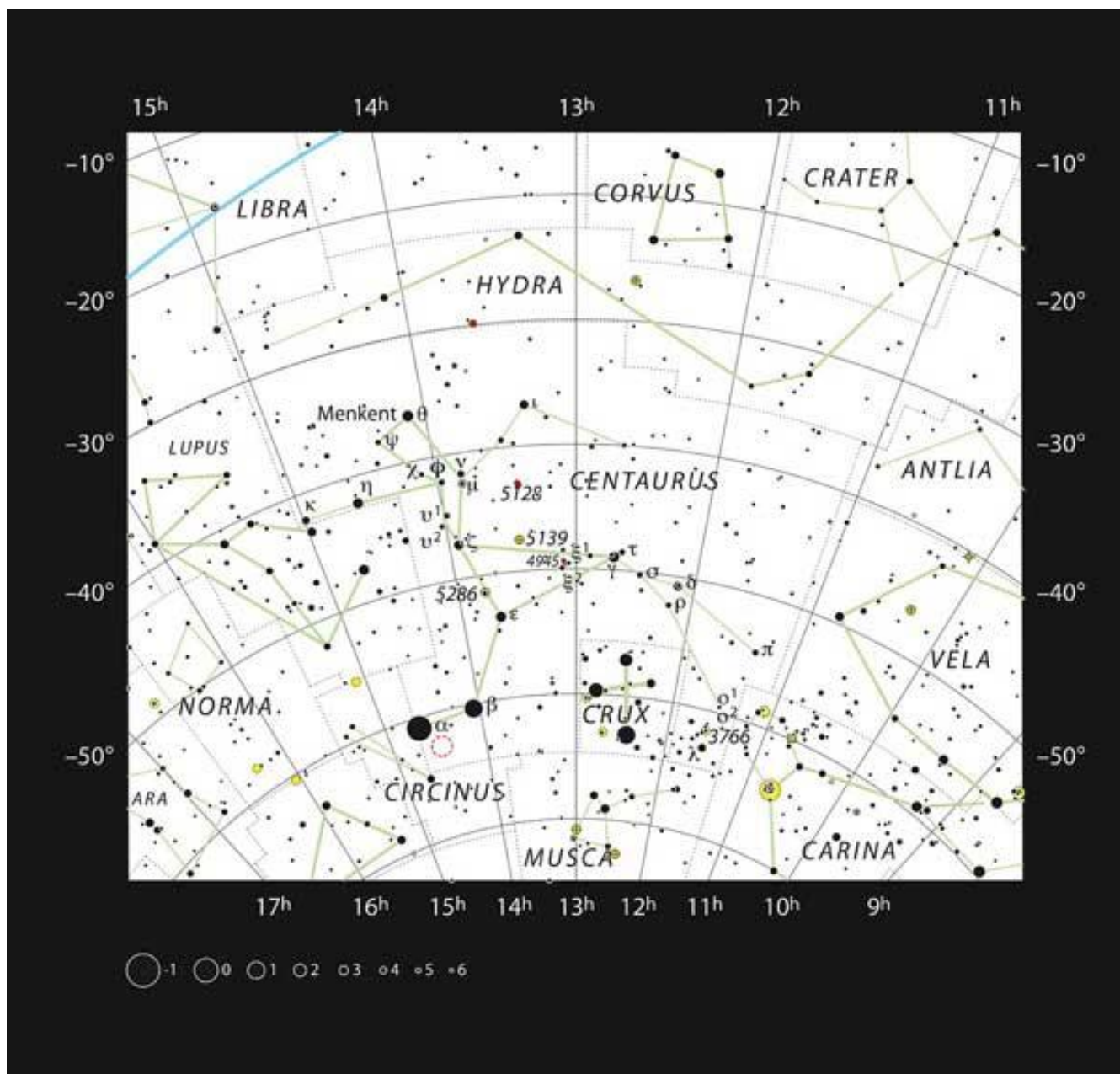
It is easy to think of November as being an Africa month. Mythically, Andromeda was the Princess of Ethiopia. Cassiopeia the Queen of Ethiopia and mother of Andromeda. Ethiopia was home to King Solomon's Mines as well. What history, fame and fortune that country held so long ago. Today the Imperial Family claims descent from a child born to King Solomon and the Queen of Sheba.

The southern constellations Phoenix and Tucana, along with the nearby Pavo and Grus, are known as the "Southern Birds."

For us, the constellation Cassiopeia lies in the north above and a little to the right of Pegasus and Andromeda and appears as a "W" stretched and lying on its side containing M103 and M52. Cassiopeia circumnavigates the North Pole thus it is not always easy to see definitely not below -20 Degrees. We are roughly at -26 degrees. The five bright stars that form the W are Epsilon, Delta, Gamma, Alpha and Beta Cassiopeia.

Pisces is also in the sky and a beautiful face-on spiral galaxy called M74 can be found there.

There are other constellations in the sky in November, but some contain only faint stars. TUC 47, in Tucana, the Toucan, needs a mention too as does NGC362. The Small Magellanic Cloud is also a sight to be visited this month



The Alpha Centauri systems lies in the Southern Hemisphere constellation of Centaurus.
ESO / IAU and Sky & Telescope



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IMAGE: A GHOST IN THE PLEIADES

By: European Space Agency. Dated: 28 October 2019



<https://phys.org/news/2019-10-image-ghost-pleiades.html>

The nebula near Merope was discovered in 1890 by E.E. Barnard using the 36-inch telescope at the Lick Observatory in California.

This ghostly image shows what can happen when an interstellar cloud passes too close to a star. Barnard's Meropos Nebula, also known as IC 349, is a cloud of interstellar gas and dust traveling through the Pleiades star cluster at a relative speed of 11 kilometres per second. It is passing close to the star Merope, located 0.06 light years away from the cloud, which is equivalent to about 3,500 times the distance between the Earth and the sun. This passage is disrupting the nebula and creating the wispy effect seen in the image.

Merope is located just out of the frame at the top right. Light from the star is reflected from the surface of the cloud, which illuminates it to become what astronomers call a reflection nebula. The beams of light at the upper right from the star are an effect produced by the telescope but the eerie wisps of light from the lower left to upper right are real.



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Astronomers believe that radiation pressure from the star is acting like a sieve to separate dust particles of different sizes. As the nebula approaches Merope, the starlight decelerates dust particles, but the small particles slow down more than the large particles. As an effect, the almost straight lines that are reaching out towards Merope in this view are made of large particles, whereas smaller-sized particles lag behind to create the wispy structure on the lower left.

The nebula will continue its approach towards Merope over the next few thousand years and will eventually move past the star, if it survives. Studying the nebula's interaction with the star is important as it provides a chance to observe interstellar material in an unusual situation and learn more about interstellar dust.

<https://phys.org/news/2019-10-image-ghost-pleiades.html>

THE NIGHT SKIES IN NOVEMBER:

As Taurus and Orion rise in our north-eastern skies Andromeda and Pegasus are clearly visible to us, Andromeda for a short while, low in the north while Perseus just skims the northern horizon. Our summer constellations have arrived in our skies and we look forward to as many cloudless nights as possible.

The Pleiades, also known as the Seven Sisters and Messier 45, are an open star cluster containing middle-aged, hot B-type stars located in the constellation of Taurus. It is among the nearest star clusters to Earth and is the cluster most obvious to the naked eye in the night sky. The Pleiades were sometimes said to be nymphs in the train of Artemis. They were said to be half-sisters of the seven Hyades. The Hyades pattern is another star cluster, near the Pleiades stars.

Orion is probably the most important in our summer skies, commanding so much of our interest and our night sky. For the astro-photographer, Orion presents much to photograph and one can spend many a night doing just that. Orion's companion is Sirius the brightest star, also known as the Dog Star, visible from about October to May, is directly in line with Canopus the second brightest star and a leading star hopping guide to the southern constellations and the star system Alpha Centauri, closest to Earth at just 3.47AU distant.

From NASA Science we learn that stars are:" the most widely recognized astronomical objects. They represent the most fundamental building blocks of galaxies. The age, distribution, and composition of the stars in a galaxy trace the history, dynamics, and evolution of that galaxy. Moreover, stars are responsible for the manufacture and distribution of heavy elements such as carbon, nitrogen, and oxygen, and their characteristics are intimately tied to the characteristics of the planetary systems that may coalesce about them.



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Stars are born within the clouds of dust and scattered throughout most galaxies. Turbulence deep within these clouds gives rise to knots with sufficient mass that the gas and dust can begin to collapse under its own gravitational attraction. As the cloud collapses, the material at the centre begins to heat up. It is this hot core at the heart of the collapsing cloud and known as a protostar, that will one day become another star." Part of the collapsing star becomes part of a new star and much of the remaining dust and scattered bits becomes planets, asteroids or comets. There might be remains that just remain as space dust too. Scientists today talk of a 'light echo' which they study and this provides new insight into powerful and massive stars which they detect are about to detonate.

Like our own sun, average stars become, as we know them, white dwarfs. They are very old stars and very faint, because they are so small and cannot produce a source of energy. Thus, they gradually cool down and just fade away.

A white dwarf may become what is called a Nova if it forms in a binary or multiple star system. If it is close enough to a companion star. By gravity, it may drag matter or hydrogen, from the binary onto its surface layer. When enough hydrogen has been accumulated on the surface a burst of nuclear fusion occurs. The white dwarf then brightens considerably and expels the material and start collecting again. However it might collapse and explode completely and so becomes a supernova.

The "big reds" in our skies are stars such as Betelgeuse in Orion, the ninth brightest star in our sky. Antares in Scorpius. Spica, 240 light years from Earth and the brightest star in constellation Virgo.

The last bright supernova was SN 1987A, located in the Large Magellanic Cloud, about 168,000 light years away. Even though it was far, it exploded with so much energy it was visible to the unaided eye. That one wasn't even in our galaxy.

Eta Carinae, located about 8,000 light years from us, is a blue supergiant roughly 120 times the mass of the Sun, and it's ready to explode in the next few hundred thousand years. Which, from the Universe's perspective is any moment now.

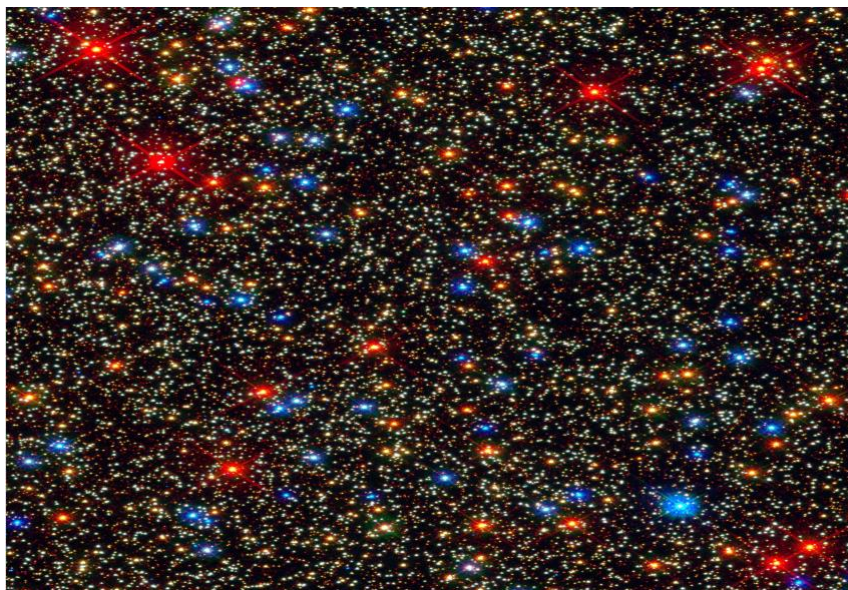
The average distance between any two stars in the Omega Centauri's cluster's crowded core is only about a third of a light-year, roughly 13 times closer than our Sun's nearest stellar neighbour, Alpha Centauri. Although the stars are close together, WFC3's sharpness can resolve each of them as individual stars.

<https://science.nasa.gov/astrophysics/focus-areas/how-do-stars-form-and-evolve>
NASA, ESA, and the Hubble SM4 ERO Team



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NASA's Hubble Space Telescope snapped this panoramic view of a colorful assortment of 100,000 stars residing in the crowded core of a giant star cluster. This is one of the first images taken by the new Wide Field Camera 3 that was installed aboard Hubble in May 2009 during Servicing Mission 4, which can snap sharp images over a broad range of wavelengths.

Image Credit: NASA

ASTEROIDS, COMETS AND METEORS FOR 2019:

November is a quiet month for meteorite activity in the southern hemisphere. Mostly we will see the Southern Taurids. It will be new moon on 26/11/2019 so the chance to see more is there.

Comets do not like to be tied down by dates and times, therefore it is best not to have expectations since they are quite volatile objects.

Orionids	Oct 02 – Nov 07	Oct 21	23
Southern Taurids	Oct 01 – Nov 25	Nov 05	5
Northern Taurids	Oct 01 – Nov 25	Nov 12	5
Leonids	Nov 10 – Nov 23	Nov 18	15+
Puppis/Velids	Dec 01 – Dec 15	Dec 07	10
Geminids	Dec 07 – Dec 17	Dec 14	120
Ursids	Dec 17 – Dec 26	Dec 23	10



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Comet McNaught, the Great Comet of 2007, grew a spectacularly long and filamentary tail. The magnificent tail spread across the sky and was visible for several days to Southern Hemisphere observers.

<https://www.astrobio.net/image-of-the-day/the-magnificent-tail-of-comet-mcnaught-2/>

COSMOLOGY:

THE FATE OF OUR UNIVERSE:



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In history, a long time ago, Earth was thought to be flat. Aristarchus was one of the first to believe in a heliocentric Universe. We have passed through history, of early astronomers from around the world, the ancient Greeks struggled to understand the universe. Thales, often called the father of Greek science and mathematics, asked questions about the universe that were not based on the actions of gods or demons. It is said that Thales provided the bridge between the world of myth and the world of reason. He used the astronomical records of the Babylonians and Egyptians to accurately predict a solar eclipse in the sixth century BC. Thales believed the Earth was flat and floated on water like a log. Aristotle, thought Earth was the centre of the Universe and that the Sun, Moon, planets, and all the fixed stars revolved around it. Aristotle's ideas were widely accepted by the Greeks of his time. The exception, a century later, was Aristarchus, one of the earliest believers in a heliocentric universe.

The first astronomer to make truly scientific maps of the heavens, Claudius Ptolemaeus (better known as Ptolemy of Alexandria), came along 300 years later. Like most astronomers before him, he believed the Sun, Moon, and other planets circled the Earth. He thought that each space body moved in a small circle (an epicycle) that was itself orbiting Earth. This explained why planets sometimes appeared to travel backward in the sky. The Earth-centred view of the universe was widely accepted for about 1500 years. It was not seriously challenged until 1543, when the Polish monk Nicolaus Copernicus suggested that the Sun was at the centre of the universe. Because the Church taught that the Earth was central, Copernicus' theory was regarded as heresy. His published theory, met with great hostility from the Church. The two events most responsible for eventual acceptance of Copernicus' views were: Tycho Brahe's precise observations of the sky and Galileo's use of the telescope.

The beginnings of modern astronomy, as a science, can be attributed to Galileo and Sir Isaac Newton; a follow-on of all past information. Sir Isaac Newton was born the day Galileo died.

Our knowledge has passed through the Steady State Theory. The steady-state theory was first proposed by Sir James Jeans in the 1920s, but it really got a boost in 1948 when it was reformulated by Cosmologists: Fred Hoyle, Thomas Gold, and Hermann Bondi. (1948).

The Steady-state theory, in cosmology, is a view that the universe is always expanding but maintaining a constant average density, with matter being continuously created to form new stars and galaxies at the same rate that old ones become unobservable as a consequence of their increasing distance and velocity of recession.

In 1965 Penzias and Wilson studying radio astronomy found the predicted "afterglow", evidential proof that the Universe did begin with a hot Big Bang!

NASA'S COBE Satellite measured this radiation (afterglow) in detail, all the detail and measurements were consistent with the Big Bang Theory.

The Cosmic Background Explorer, also referred to as Explorer 66, was a satellite dedicated to cosmology, which operated from 1989 to 1993. Its goals were to investigate



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the cosmic microwave background radiation of the universe and provide measurements that would help shape our understanding of the cosmos. The purpose of the Cosmic Background Explorer (COBE) mission was to take precise measurements of the diffuse radiation between 1 micrometer and 1 cm over the whole celestial sphere.

The current concern today is the ultimate fate of the Universe:

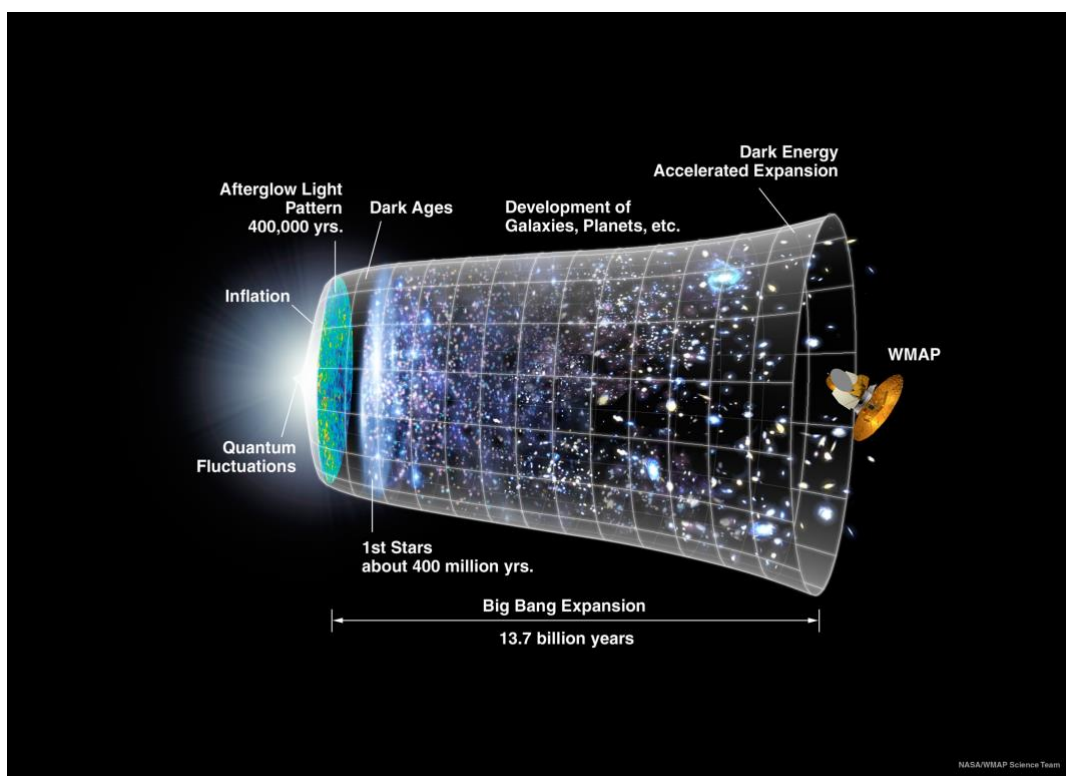
1. Will the Universe expand at an accelerated rate forever?
2. Will the universe expand to a certain size and then stop?
3. Will the Universe at a certain time, stop and collapse, or, stop and collapse slowly?

Recent scientific studies have shown the Universe to be about 13.7 billion years old.

By studying supernova data as well as cosmological data, scientists say the Universe is filled with an, unidentified energy which they have named dark energy.

This dark energy is causing the expansion of the Universe to accelerate, so the cosmological inference is that: if these observations and analyses are proven correct, the Universe could continue to expand forever.

<https://www.britannica.com/science/steady-state-theory>



NASA+cosmology+pictures&tbn=isch&source=univ&client=firefox-b-d&sa=X&ved=2ahUKEwiYs6qNhabIAhXkUhUIHYboCZ



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This bundle of bright stars and dark dust is a dwarf spiral galaxy known as NGC 4605, located around 16 million light-years away in the constellation of Ursa Major (The Great Bear). This galaxy's spiral structure is not obvious from this image, but NGC 4605 is classified as an SBC type galaxy — meaning that it has sprawling, loosely wound arms and a bright bar of stars cutting through its centre.

A CURTAIN OF DARKNESS AND SILENCE:

According to the theories of physics, if we were to look at the Universe one second after the Big Bang, what we would see is a 10-billion- degree sea of neutrons, protons, electrons, anti-electrons (positrons), photons, and neutrinos. Then, as time went on, we would see the Universe cool, the neutrons either decaying into protons and electrons or combining with protons to make deuterium, an isotope of hydrogen. As the Universe continued to cool, it would eventually reach the temperature where electrons combined with nuclei to form neutral atoms. All matter in the universe is made of tiny building blocks called atoms.

Protons are a type of subatomic particle with a positive charge. Protons are bound together in an atom's nucleus as a result of the strong nuclear force. Neutrons are a type of subatomic particle with no charge, they are neutral.

Electrons are a type of subatomic particle with a negative charge. Protons are also a type of subatomic particle, they have a positive charge and they are bound together in the nucleus of an atom by a very strong nuclear force.



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The third particle type is known as a neutron. As their type, neutron, describes, they are neutral particles with no charge, they are bound into the atom's nucleus as a result of strong nuclear force. Neutrons and protons are much more massive than electrons.

The positive charge on a proton is equal in magnitude to the negative charge on an electron. Therefore, a neutral atom must have an equal number of protons and electrons or, vice versa, In order to be neutral, an atom must have the same number of electrons and protons.

After the Big Bang when the free electrons were absorbed to form neutral atoms, from being opaque, the Universe suddenly became transparent. Those photons known as the afterglow of the Big Bang are also known as cosmic background radiation and can be observed by scientists today.

According to what is known, a very short period immediately after the "Big Bang" the Universe must have experienced a gigantic burst of expansion called "Inflation". At that time the Universe must have been filled with an unstable form of unknown energy that was unevenly distributed in space. Therefore, how the Universe began, remains unanswered.

Today scientists from NASA and ESA are studying gravitational waves which it is inferred is the only form of study that may carry information about those times so long ago over which the curtain of darkness and silence still hangs, from the beginning of inflation.

Currently, the WM Keck Observatory believes there is a crisis in cosmology. A group of astronomers led by University of California, Davis, has obtained new data that suggests the universe is expanding more rapidly than predicted.

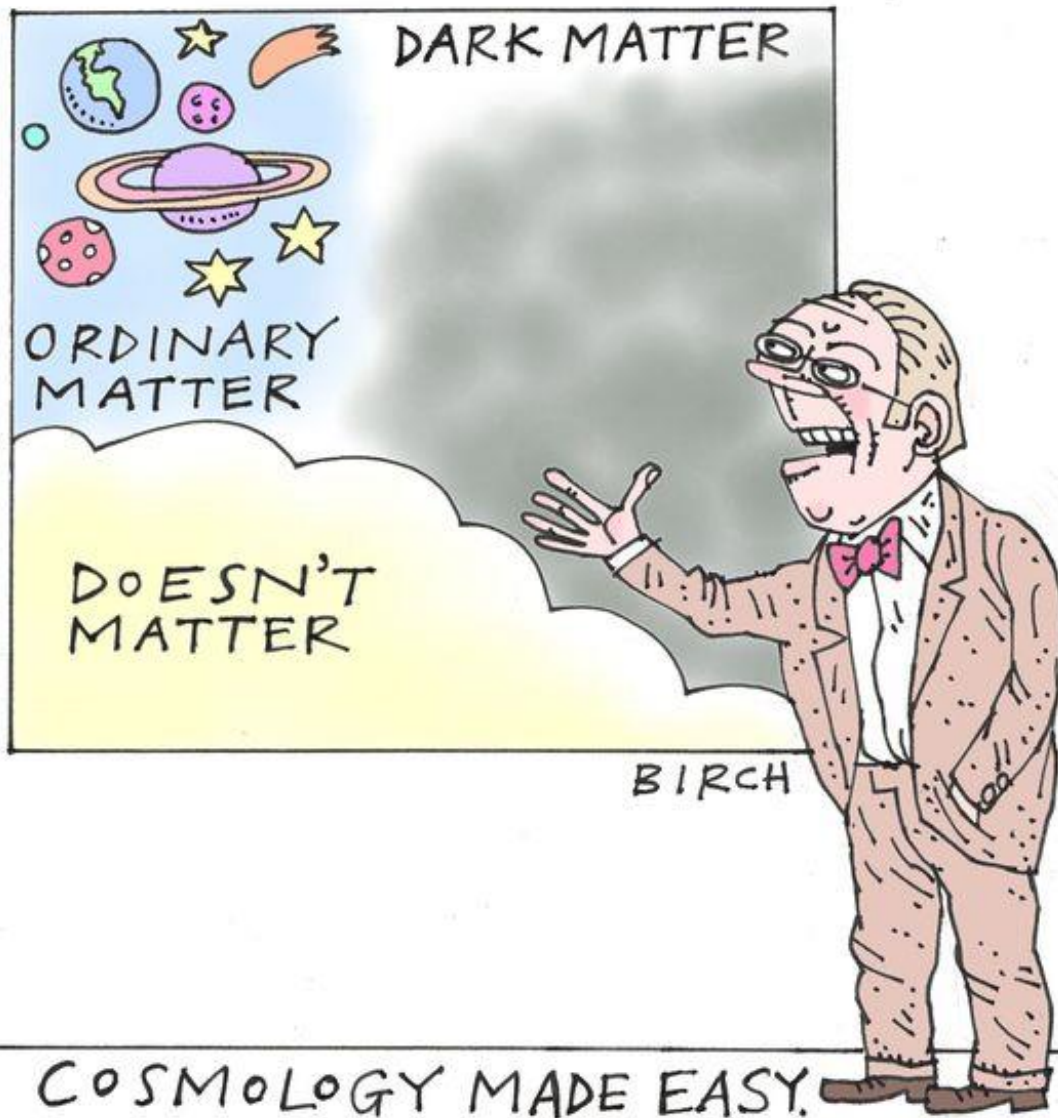
The team's new measurement of the Hubble Constant, or the expansion rate of the universe, involved a different method. They used NASA's Hubble Space Telescope (HST) in combination with W. M. Keck Observatory's Adaptive Optics (AO) system to observe three gravitationally lensed systems. This is the ground-based AO technology has been used to obtain the Hubble Constant.

To rule out any bias, the team conducted a blind analysis; during the processing, they kept the final answer hidden, even from themselves until they were convinced that they had addressed as many possible sources of error as they could think of. This is the first time ground-based Adaptive Optics technology has been used to obtain the Hubble Constant.

The unblinding revealed a value that is consistent with Hubble Constant measurements taken from observations of "local" objects close to Earth, such as nearby Type Ia supernovae or gravitationally-lensed systems; Chen's team used the latter objects in their blind analysis.

The team's results add to growing evidence that there is a problem with the standard model of cosmology, which shows the universe was expanding very fast early in its history,

then the expansion slowed down due to the gravitational pull of dark matter, and now the expansion is speeding up again due to dark energy, a mysterious force.



Cosmology Readers Digest.

<https://phy.digst.org/news/2019-10-crisis-cosmology-universe-rapidly-believed.html>