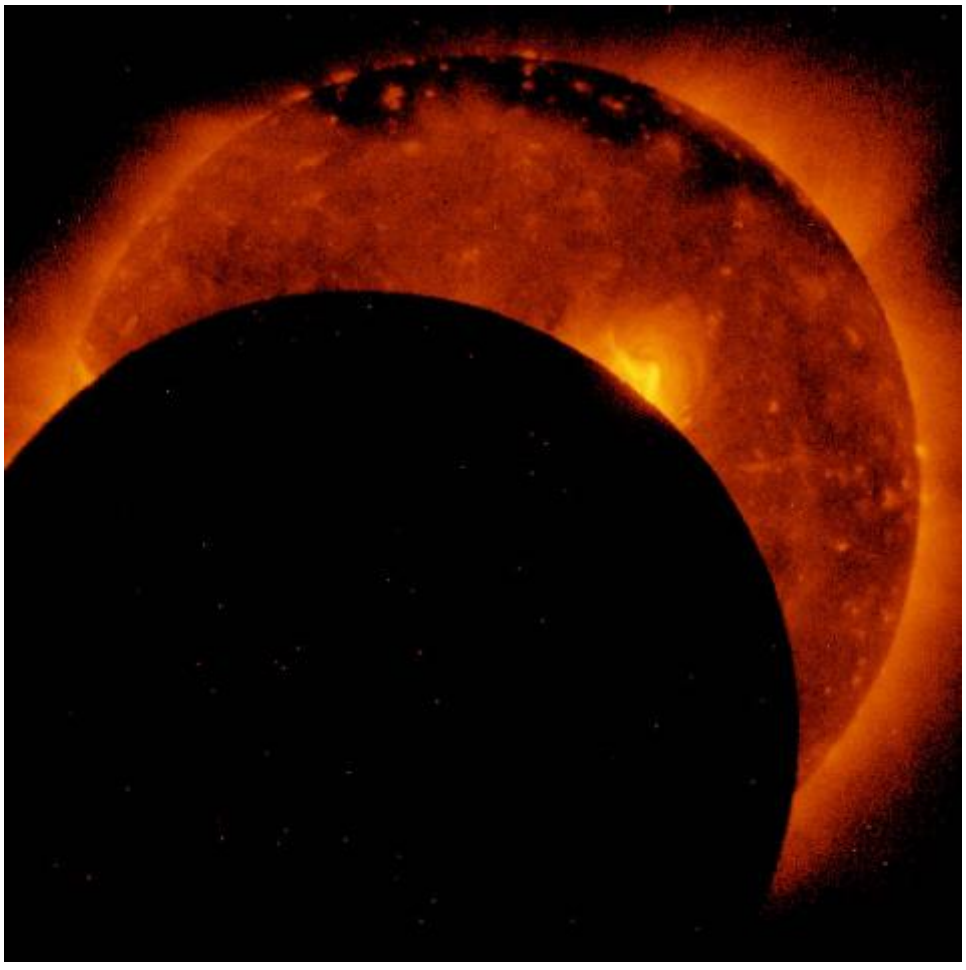
canopus

Monthly Newsletter of the Johannesburg Centre of ASSA



https://www.nasa.gov/image-feature/goddard/2017/hinode-satellite-views-aug-21-eclipse

Next meeting at Johannesburg Observatory, 18a Gill St, Observatory

Wednesday, SEPTEMBER 13 2017
Speaker : Heystek Grobler - HartRAO
Topic:Introduction to Radio Astronomy

Upcoming Events:

Public viewing:

Friday: 08 SEPTEMBER 2017 & Friday: 22 SEPTEMBER 2017
Please watch the website for updates, cancellations or changes.

- **Public Viewing :** Weather permitting
- **Venue:** Johannesburg Observatory, 18a Gill St, Observatory
- **Time: 19h00 - 22h30**
- **Binocular observing is encouraged. Please bring your pair.**

Contact :

Jerome Jooste (072 985 8764)
Notifications are posted on Facebook (https://www.facebook.com/assajhb), assajhb@yahoo.com and Twitter @JoosteJerome on the viewing day.

Our next monthly Braai and Sky takes place on:

- **Date:** Sunday 24 SEPTEMBER 2017
- **Time:** 16h30
- **Location:** Jhb. Observatory, Top of the hill at the Herbert Baker Library. Map.
- **Topic:** Whats Up – a detailed overview of some objects.
- **Donation**: R20 pp for the fire wood. Children under 15 free.

IMPORTANT NOTICES

All Visitors to the Observatory must fill in an indemnity form, on each occasion of your visit.
The forms are available from the ASSAJhb coordinator at the event or can be downloaded from the link on the website.
Completed forms must be handed to the ASSAJHB coordinator.

http://astronomyjhb.co.za/download/93979/

ERRATUM:

The editor apologises for the error in information stated.
Canopus August 2017: **STAYING AWAKE FOR COMET C/2015 D4 (BORISOV):**
"The data collected will be of scientific interest and will be collated by Professor Tim Cooper ."
An incorrect title was allocated to Tim Cooper the above should read: "The information was collated by Tim Cooper.

THE SUN IN SEPTEMBER 2017:

Date	Sunrise	Sunset	Length of day
01/09/2017	06:20	17:55	11:35:03
03/09/2017	06:18	17:56	11:37:58
15/09/2017	06:05	18: 01	11:55:53
22/09/2017	05:57	18:03	12:06:34
30/09/2017	05:49	18:06	12:18:52

SPRING EQUINOX: 21/22 SEPTEMBER

Once again, September is here and we in the Southern Hemisphere celebrate our Sprimg Season as the sun crosses the celestial equator on Friday 22 September at 20:02 UTC.
This noticeably brings cloudy weather and our much hoped for summer rainfall. Sadly we notice our chances of doing practical astronomy becoming erratic again. Time moves on , years go by, but our seasons, always on time, never change. This brings us to a Solar Analemma. A solar Analemma is a graph that shows the position of the sun

in the sky at a single location and at the same time of the day throughout a Gregorian year.

SUN ANALEMMA:

If one takes a picture of the Sun from the same spot at the same time every day for a year, one will see that it follows the shape of a slightly oblong figure 8, with one loop broader than the other. This is called the Sun's Analemma curve.

Earth orbits around the Sun on an elliptical path. Earth also revolves around the Sun on a slant; it has an axial tilt of around 23.4 degrees. These two factors combine to generate the figure 8 Analemma curve.

If one looked at the Sun at the same time each day, from the same place, would it appear at the same location in the sky? If the Earth were not tilted, and if its orbit around the Sun were perfectly circular, then, yes, it would. However, a combination of the Earth's tilt at 23.5 degree and its slightly elliptical orbit combine to generate this figure "8" pattern of where the Sun would appear at the same time throughout the year. The pattern is called an analemma.

The Sun will appear at its highest point in the sky, and highest point in the analemma, during summer. In the winter, the Sun is at its lowest point. The in-between times generate the rest of the analemma pattern.

Analemmas viewed from different Earth latitudes have slightly different shapes, as do analemmas created at different times of the day. Analemmas on the other planets have different shapes entirely!

/www.timeanddate.com/astronomy/solar-analemma.html

The Analemma Curve

FLEETING MOMENTS:

On August 21, 2017 many people in America enjoyed seeing fleeting moments of a total solar eclipse. For some, their first sighting in a lifetime, for others, another never to be forgotten moment.
A total solar eclipse was visible over the continent of United States, from Lincoln Beach,Oregon, to a city called Charleston in South Carolina.
A total eclipse was seen above Madras in Oregon while a partial eclipse was seen over the entire North America.
It was great excitement for Americans but the importance came about by the fact that this eclipse was visible overland for a period of about 90 minutes. Because the Earths surface is mostly ocean, solar eclipses are invariably only visible overland for a very short time and sometimes not at all. NASA scientists have therefore had a wonderful opportunity to do a lot of research.

Six scientists were aboard the ISS satellite, International Space Station, transiting the Sun at roughly five miles per second during a partial solar eclipse, seen from from Ross Lake, Northern Cascades National Park, Washington.
Termed Expedition 52 the following astronauts were on board: NASA astronauts Peggy Whitson, Jack Fischer, and Randy Bresnik; Russian cosmonauts Fyodor Yurchikhin and Sergey Ryazanskiy; and ESA (European Space Agency) astronaut Paolo Nespoli. Only six people witnessed the umbra from space.
The space station crossed the path of the eclipse three times as it orbited above the continent of United States at an altitude of 150 kms (250 miles). The scientists did not get to see the total eclipse but while they passed by, they did a lot of research and photographic work which will be collated and used by scientists back on earth.

Because of the time this eclipse path has taken overland, NASA Scientists have taken this opportunity to study the Earth - Sun interaction. The ground based observations will augment and complement the satellite based observations and test new instruments.

The moon blocks out the suns brightness. Artificially, scientists use a coronagraph, this has a disc to block out the light of the sun.
The moon blocks out the sun's overwhelmingly bright face, revealing the relatively faint solar atmosphere, called the corona.
Scientists use an instrument called a coronagraph. This makes use of a disk to block out the light of the sun – to create an artificial eclipse. However, a phenomenon called diffraction blurs the light near the disk in a coronagraph, making it difficult to get clear pictures of the inner parts of the corona. Thus, total solar eclipses remain the only opportunity to study these regions in clear detail, in visible light.
In many ways, these inner regions of the corona are the missing link in understanding the sources of space weather.
Total solar eclipses are truly invaluable in our quest to understand the Sun-Earth connection.

In Madras, Oregon, a team of NASA scientists led by Nat Gopalswamy at NASA's Goddard Space Flight Center in Greenbelt, Maryland, pointed a new, specialized polarization camera at the Sun's faint outer atmosphere, the corona, taking several-second exposures at four selected wavelengths in just over two minutes.
Their images captured data on the temperature and speed of solar material in the corona. To date, these measurements can only be obtained from Earth-based observations during a total solar eclipse.

While American citizens enjoyed the hype and excitement of the occasion, NASA Scientists have been, were and will be busy collating and examining all information gathered for the benefit of all on planet Earth.

https://www.nasa.gov/image-feature/iss-transit-during-a-partial-solar-eclipse-2017
https://www.nasa.gov/feature/goddard/2017/eclipse-2017-nasa-supports-a-unique-opportunity-for-science-in-the-shadow
https://www.nasa.gov/feature/goddard/2017/studying-the-sun-s-atmosphere-with-the-total-solar-eclipse-of-2017

total solar eclipse gives scientists a rare opportunity to study the lower regions of the sun's corona. These observations can help us understand solar activity, as well as the unexpectedly high temperatures in the corona. Image via NASA/S. Habbal, M. Druckmüller and P. Aniol.

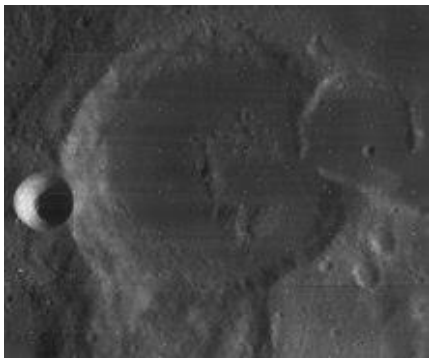
THE MOON IN SEPTEMBER 2017:

Date	Moonrise	Moonset	
01/09/2017	12:50	1:26	
06/09/2017	17:36	06:19	Full Moon
13/09/2017	00:18	11:47	last quarter
20/09/2017	06:09	17:39	New Moon
28/09/2017	11:27	00:09	first quarter

https://www.timeanddate.com/moon/phases/south-africa/johannesburg

A LUNAR HIGHLIGHT: GUTENBERG

Gutenberg is a lunar crater that lies along the west edge of Mare Fecunditatis, in the eastern part of the visible Moon. it is named after Johann Gutenberg. To the north is Lubbock, to the southeast is the crater Goclenius, and also to the southeast are Magelhaens and Colombo. To the west-southwest is the crater Gaudibert, across the Montes Pyrenaeus that run south from Gutenberg.



Lunar Orbiter 4 image

The rim of Gutenberg is worn and eroded, most notably in the east where it is broken by the overlapping crater, Gutenberg E. This crater in turn has gaps in its southeast and southwest rims, forming a passage to the lunar mare to the east. There are also clefts and valleys in the southern rim where it joins Gutenberg C. The crater Gutenberg A intrudes into the southwest rim.

The floors of Gutenberg and Gutenberg E have been flooded in the past by lava, forming a relatively flat plain across the bottom. This surface is broken across the northeast by a pair of clefts that form a part of the Rimae Goclenius. These extend northwest from the Goclenius region. The central rise of Gutenberg is a semi-circular range of hills that are the most prominent in the south, and the concave part lies open to the east. The floor is otherwise not marred by any significant craters.

https://en.wikipedia.org/wiki/Gutenberg_(crater)

MOON FOLKLORE:

Pliny the Elder, the first-century Roman naturalist, stated in his Natural History that the Moon "replenishes the earth; when she approaches it, she fills all bodies,when she recedes she empties them."

Folklore is rich among farmers, given their close ties to Earth and her natural rhythms. Natural rhythms which have become a very wide subject in the science of cosmology, a part in the study of the science of astronomy today.

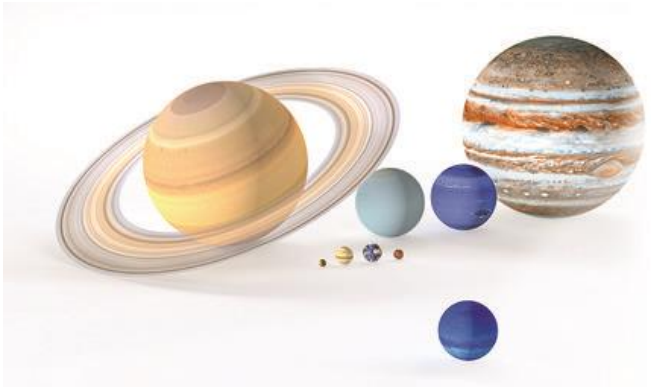
During those early times people were studying the stars, gathering information about the seasons. Studying signs and times from the sun and similarly guiding their lives by living with the phases of the moon.

These are some of the things one should do at certain times to be in tune with these natural rhythms and thus ensure a rich return.

- Fence posts should be set in the dark of the Moon to resist rotting. Ozark lore says that fence posts should always be set as the tree grew. To set the root end upward makes a short-lived fence.
- Don't begin weaning when the Moon is waning.
- Castrate and dehorn animals when the Moon is waning for less bleeding.
- Slaughter when the Moon is waxing for juicier meat.
- Crabbing, shrimping, and clamming are best when the Moon is full.
- Best days for fishing are between the new and full Moon. Interestingly, today one has a fishing calendar to see the best dates for fishing.
- Set eggs to hatch on the Moon's increase, but not if a south wind blows.
- Plant annual flowers and vegetables that bear crops above ground during the light, or waxing, of the Moon: from the day the Moon is new to the day it is full.

The 1994 Old Farmer's Almanac

https://www.almanac.com/content/gardening-moon-calendar



Optimism for an unseen Neptune-like planet in our solar system may be dimmed by the discovery of a new batch of distant worlds.

http://www.sciencemag.org/news/2017/06/new-haul-distant-worlds-casts-doubt-planet-nine

Some find reason to believe that Planet Nine really does exist and some do not agree. Presented here are cases for and against:

CALTECH RESEARCHERS FIND EVIDENCE OF A REAL NINTH PLANET:

This is what was originally available on : 20/1/2016

Caltech researchers have found evidence of a giant planet tracing a bizarre, highly elongated orbit in the outer solar system. The object, which the researchers have nicknamed Planet Nine, has a mass about 10 times that of Earth and orbits about 20 times farther from the sun on average than does Neptune (which orbits the sun at an average distance of 2.8 billion miles). In fact, it would take this new planet between 10,000 and 20,000 years to make just one full orbit around the sun.

The researchers, Konstantin Batygin and Mike Brown, discovered the planet's existence through mathematical modeling and computer simulations but have not yet observed the object directly.

"Although we were initially quite skeptical that this planet could exist, as we continuedto investigate its orbit and what it would mean for the outer solar system, we becomeincreasingly convinced that it is out there," says Batygin, an assistant professor of planetary science. "For the first time in over 150 years, there is solid evidence that the solar system's planetary census is incomplete." Batygin and Brown

http://www.caltech.edu/news/caltech-researchers-find-evidence-real-ninth-planet-49523

The mythical "Planet X" might be real, and scientists are calling it "Planet Nine."

Astronomers have found evidence for a planet 10 times more massive than Earth in the far outer solar system, orbiting about 20 times farther from the sun than distant Neptune does.

"This would be a real ninth planet," one of the researchers, Mike Brown of the California Institute of Technology (Caltech) in Pasadena, said in a statement. "There have only been two true planets discovered since ancient times, and this would be a third. It's a pretty substantial chunk of our solar system that's still out there to be found, which is pretty exciting."

https://www.space.com/31670-planet-nine-solar-system-discovery.html

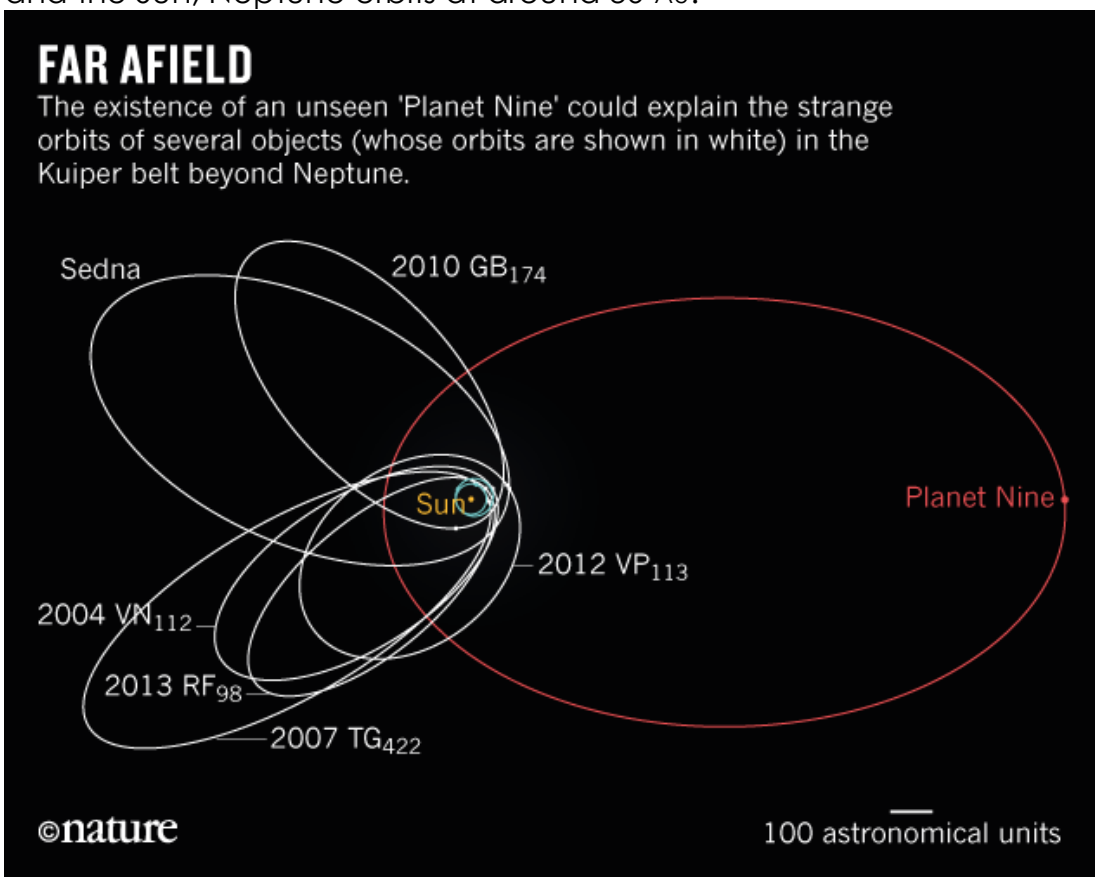
SOLAR SYSTEM SURVEY CASTS DOUBT ON MYSTERIOUS PLANET NINE:

This is what was known June 2017

An analysis of four icy bodies discovered in the outer Solar System reveals no sign that they are being influenced by a large, unseen planet lurking beyond Neptune. The finding chips away at a line of evidence for a 'Planet Nine' proposed in 2014 on the basis of the clustering of objects in a region called the Kuiper belt, argues a team of astronomers in a paper first posted on the arXiv preprint server on 16 June.

The objects were found by researchers leading the Outer Solar System Origins Survey (OSSOS), which is studying the region of space beyond Neptune. The bodies that piqued the astronomers' interest dwell in the outer reaches of the Kuiper belt.

Using the 3.6-metre Canada-France-Hawaii telescope on Mauna Kea, Hawaii, the team found four bodies that orbit the Sun in enormous ellipses at least 250 astronomical units (AU) wide. An AU is equivalent to the distance between Earth and the Sun; Neptune orbits at around 30 AU.



large-orbit bodies have been spotted so far, including the four found by OSSOS.

Arguments for Planet Nine are based on the clustering of six of those previously known large-orbit objects. Studies by two other research teams, which drew on multiple astronomical surveys, found that the six bodies were arranged in two groups. Both teams suggested that the gravity of an unseen planet, perhaps ten times Earth's mass, had shepherded the objects into those curious arrangements.

Scientists agree that the astronomical surveys that spotted those six bodies weren't perfect, says Cory Shankman, an astronomer at the University of Victoria in Canada and the lead author of the latest study. Each had to contend with reduced visibility due to bad weather in some seasons, and the fact that it's easier to see Kuiper belt objects away from the plane of the Milky Way. Such factors can lead astronomers to spot more bodies in certain parts of the sky than in others, even when the objects are actually distributed evenly, says Shankman. It's possible to account for such biases using statistical methods, but most of the previous surveys didn't report doing so.

The OSSOS team argues that the biases could have led to false indications of clustering. "They were building this entire argument around six objects with

unknown biases in how they were detected," says astronomer Samantha Lawler at the National Research Council Canada in Victoria, "which is a very dangerous game to play."

Three of the objects found by OSSOS appeared to be in the two previously identified clusters. But when the study authors accounted for the fact that their survey preferentially spotted bodies in certain parts of the sky at certain times of year, the evidence for clustering disappeared, says Shankman.

The unknown biases in previous surveys do weaken the case for a Planet Nine at the size and distance proposed, says Renu Malhotra, an astronomer at the University of Arizona in Tucson. However, she adds, the OSSOS team has not proved that these biases actually enhance the appearance of clustering among distant Kuiper belt objects, so its paper does little to change the debate.

Scott Sheppard, an astronomer at the Carnegie Institution for Science in Washington DC and part of the team that first suggested the presence of an unseen planet, agrees. Even with the new data, the best explanation for the odd grouping of Kuiper belt objects is a planet, he says.

And even if previous surveys had issues, they could still have spotted evidence for the existence of a massive planet, says Konstantin Batygin, an astronomer at the

California Institute of Technology in Pasadena and a member of the other team that proposed the existence of Planet Nine.

Besides, clustering is only one line of evidence for Planet Nine, he says. Discoveries of Kuiper belt objects that aren't tethered to Neptune, and others with orbits nearly perpendicular to those of most Solar System objects, are most easily explained by the presence of a large planet in the outer Solar System, Batygin adds.

What will ultimately resolve the Planet Nine question, says Malhotra, is more data from current and future telescopes. "We are really working at the margins of what's technically feasible with the outer Solar System observations," she says. "We're really pushing the boundaries of what's possible to detect."

https://www.nature.com/news/solar-system-survey-casts-doubt-on-mysterious-planet-nine-1.22177
http://www.sciencemag.org/news/2017/06/new-haul-distant-worlds-casts-doubt-planet-nine
NATURE International science weekly journal.

PLANETS IN SEPTEMBER 2017:

Mercury: Will be a little difficult to spot but it can be seen low on the horizon.

Venus: Venus is brightly beautiful in our early morning sky.

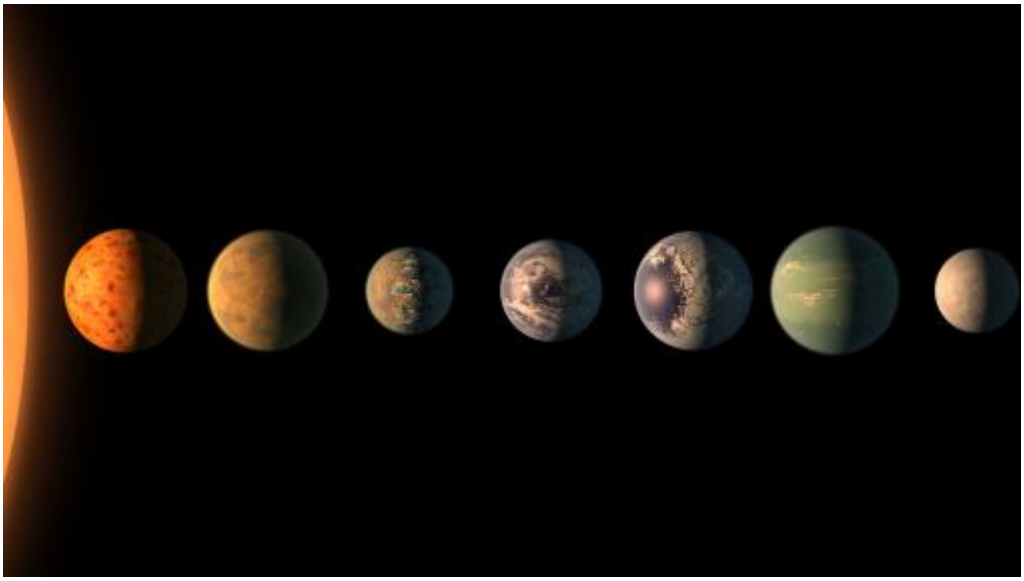
Mars: The rusty red planet is not having a bright and best year this year as it reaches its aphelion only around October 7 when it will be about 249 kms. From the sun and 378 kms. From Earth.

Saturn: Travelling westward across the night sky from dusk until dawn. The Queen of the Night is still beautifully visible in the night sky, until before midnight. Soon she will be gone so absorb her beauty while you can.

Jupiter: Our largest planet and a friend to all night travellers. Its magnificent silver-white brilliance is easily spotted in the western sky in the early evening. Like Saturn she is departing our hemisphere ver soon.

Uranus: Of average visibility. Can be spotted using a telescope.

Neptune: blueish in colour almost on the horison, quite difficult to see.



NASA COUNTS DOWN FINAL MONTH OF CASSINI'S TOUR OF SATURN:

NASA's Cassini orbiter sailed through the tenuous outermost reaches of Saturn's atmosphere without trouble Monday 14 August, performing the first of five close swings nearer to the planet than any previous spacecraft before a final dive Sept. 15 to end the probe's nearly 20-year mission.

The plutonium-powered spacecraft made its closest brush to Saturn yet, close enough to require the activation of its chemical rocket thrusters to keep it stable.

Cassini typically uses spinning gyro-like wheels buried inside the spacecraft to control its orientation with momentum shifts, but engineers were not sure the wheels were strong enough to counteract aerodynamic forces as the orbiter ploughed through Saturn's outer atmosphere.

The spacecraft came closest to Saturn at around 0422 GMT (12:22 a.m. EDT) Monday, and Cassini transmitted a radio signal nearly 24 hours later confirming it survived the flyby. NASA announced Tuesday that the first of five such dips into Saturn's atmosphere was successful.

Cassini had used its rocket thrusters during many of the craft's flybys of Saturn's largest moon Titan, which has its own dense atmosphere.

"Cassini's Titan flybys prepared us for these rapid passes through Saturn's upper atmosphere," said Earl Maize, Cassini project manager at NASA's Jet Propulsion Laboratory in Pasadena, California, before Monday's flyby. "Thanks to our past

experience the team is confident that we understand how the spacecraft will behave at the atmospheric densities our models predict."

The spacecraft will soar less than 1,100 miles (1,770 kilometres) above Saturn's cloud tops on each of its last five orbits, then spiral out beyond the rings to make successive egg-shaped loops around the planet.

Made mostly of hydrogen and helium, Saturn's atmosphere of golden haze sits above dense inner core scientists believe is made of rock and ice. One of the prime goals of Cassini's final months is to make measurements of Saturn's gravity and magnetic fields, data that could render an estimate of the core's size.

Depending on the density of Saturn's atmosphere at Cassini's flyby altitude, ground controllers could command the probe to conduct "pop-up" or "pop-down" manoeuvres to fly farther or closer to the planet on the next four dives.

Cassini's instruments were programmed to directly measure particles of Saturn's atmosphere during Monday's flyby.

"As it makes these five dips into Saturn, followed by its final plunge, Cassini will become the first Saturn atmospheric probe," said Linda Spilker, Cassini project scientist at JPL. "It's long been a goal in planetary exploration to send a dedicated probe into the atmosphere of Saturn, and we're laying the groundwork for future exploration with this first foray."

Scientists have concepts for a future dedicated probe to descend into Saturn's atmosphere to measure winds, density, and composition deep below the planet's cloud tops. Cassini will give researchers a taste.

Cassini's radar was expected to conduct sounding measurements to reveal the large-scale structure of Saturn's atmosphere in a region hidden from the view of conventional cameras.

"Its radar will peer deep into the atmosphere to reveal small-scale features as fine as 16 miles (25 kilometres) wide — nearly 100 times smaller than the spacecraft could observe prior to the grand finale," NASA said in a press release.

The final phase of Cassini's mission has already produced one surprising discovery. The space between Saturn and its rings is emptier than scientists expected, with Cassini detecting fewer impacts of tiny dust particles than predicted.

Cassini conducted its final orbit adjustment with its on-board thrusters July 15, and the spacecraft is now on a collision course with Saturn A long-distance flyby of Titan on Sept. 11 will naturally nudge Cassini on a trajectory to fall into Saturn. The spacecraft will be crushed by Saturn's atmosphere and will burn up, with the final

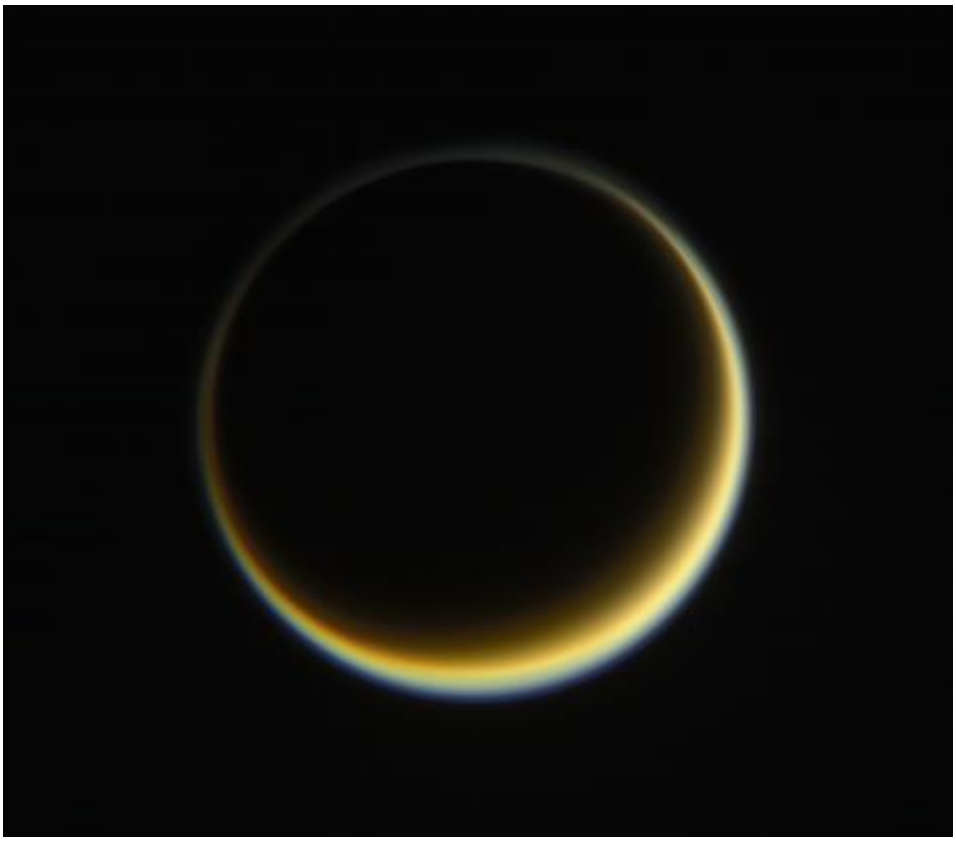
radio signal from Cassini expected to arrive on Earth around 8 a.m. EDT (1200 GMT; 5 a.m. PDT) on Sept. 15.

Running low on fuel, Cassini has explored Saturn and its moons for more than 13 years. The robotic explorer launched Oct. 15, 1997, from Cape Canaveral on top of a Titan 4 rocket, and entered orbit around Saturn on June 30, 2004, after a 2.2 billion-mile (3.5 billion-kilometres) interplanetary journey.

Cassini deployed the European Space Agency's Huygens lander for a descent to the surface of Titan in 2005.

Since its arrival, Cassini has circled Saturn almost 300 times, collected detailed imagery of Saturn's atmosphere and mysterious hexagonal polar vortex, explored its rings in minute detail, and observed 49 of Saturn's 62 known moons with close and long-range flybys.

Originally designed for a four-year tour of Saturn, the nearly $3.3 billion mission has far outlived its original lifetime, producing stunning imagery of the planet and documenting seasonal changes as the gaseous world completed almost half of one 29-year orbit around the sun.

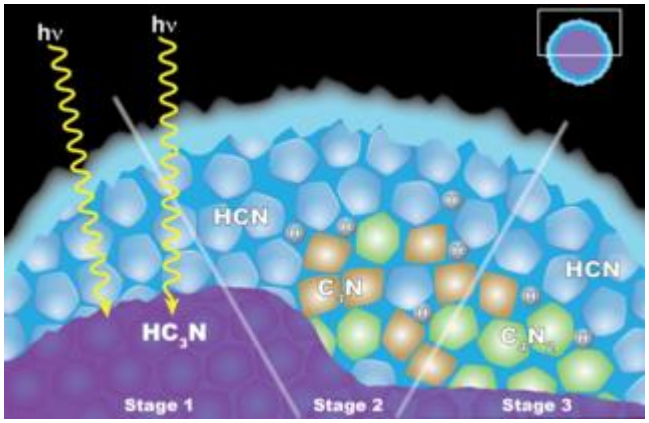


NASA's Cassini spacecraft looks toward the night side of Saturn's moon Titan in a view that highlights the extended, hazy nature of the moon's atmosphere. During its long mission at Saturn, Cassini has frequently observed Titan at viewing angles like this, where the atmosphere is backlit by the Sun, in order to make visible the structure of the hazes. Cassini took this image May 29 with its narrow-angle camera. Credit: NASA/JPL-Caltech/Space Science Institute

NASA SCIENTISTS FIND 'IMPOSSIBLE' CLOUD ON TITAN AGAIN:

UPDATE AUGUST 4 2017

The puzzling appearance of an ice cloud seemingly out of thin air has prompted NASA scientists to suggest that a different process than previously thought -- possibly like the one seen over Earth's poles -- could be forming clouds on Saturn's moon Titan.



Scientists from NASA's Cassini mission think the appearance of a cloud of dicyanoacetylene (C4N2) ice in Titan's stratosphere is explained by "solid-state" chemistry taking place inside ice particles. The particles have an inner layer of cyanoacetylene (HC3N) ice coated with an outer layer of hydrogen cyanide (HCN) ice. (Left) When a photon of light penetrates the outer shell, it can interact with the HC3N, producing C3N and H. (Centre) The C3N then reacts with HCN to yield (right) C4N2 and H. Another reaction that also yields C4N2 ice and H also is possible, but less likely. Credits: NASA's Goddard Space Flight Centre

Located in Titan's stratosphere, the cloud is made of a compound of carbon and nitrogen known as dicyanoacetylene (C_4N_2), an ingredient in the chemical cocktail that colours the giant moon's hazy, brownish-orange atmosphere.

Decades ago, the infrared instrument on NASA's Voyager 1 spacecraft spotted an ice cloud just like this one on Titan. What has puzzled scientists ever since is this: they detected less than 1 percent of the dicyanoacetylene gas needed for the cloud to condense.

Recent observations from NASA's Cassini mission yielded a similar result. Using Cassini's composite infrared spectrometer -- or CIRS, which can identify the spectral fingerprints of individual chemicals in the atmospheric brew -- researchers found a large high-altitude cloud made of the same frozen chemical. Yet, just as Voyager found, when it comes to the vapor form of this chemical, CIRS reported that Titan's stratosphere is as dry as a desert.

"The appearance of this ice cloud goes against everything we know about the way clouds form on Titan," said Carrie Anderson, a CIRS co-investigator at NASA's

Goddard Space Flight Centre in Greenbelt, Maryland, and lead author of the study.

The typical process for forming clouds involves condensation. On Earth, we're familiar with the cycle of evaporation and condensation of water. The same kind of cycle takes place in Titan's troposphere -- the weather-forming layer of Titan's atmosphere -- but with methane instead of water.

A different condensation process takes place in the stratosphere -- the region above the troposphere -- at Titan's north and south winter poles. In this case, layers of clouds condense as the global circulation pattern forces warm gases downward at the pole. The gases then condense as they sink through cooler and cooler layers of the polar stratosphere.

Either way, a cloud forms when the air temperature and pressure are favorable for the vapor to condense into ice. The vapor and the ice reach a balance point -- an equilibrium -- that is determined by the air temperature and pressure. Because of this equilibrium, scientists can calculate the amount of vapor where ice is present.

"For clouds that condense, this equilibrium is mandatory, like the law of gravity," said Robert Samuelson, an emeritus scientist at Goddard and a co-author of the paper.

But the numbers don't compute for the cloud made from dicyanoacetylene. The scientists determined that they would need at least 100 times more vapor to form an ice cloud where the cloud top was observed by Cassini's CIRS.

One explanation suggested early on was that the vapor might be present, but Voyager's instrument wasn't sensitive enough in the critical wavelength range needed to detect it. But when CIRS also didn't find the vapor, Anderson and her Goddard and Caltech colleagues proposed an altogether different explanation. Instead of the cloud forming by condensation, they think the C_4N_2 ice forms because of reactions taking place on other kinds of ice particles. The researchers call this "solid-state chemistry," because the reactions involve the ice, or solid, form of the chemical.

The first step in the proposed process is the formation of ice particles made from the related chemical cyanoacetylene (HC_3N). As these tiny bits of ice move downward through Titan's stratosphere, they get coated by hydrogen cyanide (HCN). At this stage, the ice particle has a core and a shell comprised of two different chemicals. Occasionally, a photon of ultraviolet light tunnels into the frozen shell and triggers a series of chemical reactions in the ice. These reactions could begin either in the core or within the shell. Both pathways can yield dicyanoacteylene ice and hydrogen as products.

The researchers got the idea of solid-state chemistry from the formation of clouds involved in ozone depletion high above Earth's poles. Although Earth's stratosphere has scant moisture, wispy nacreous clouds (also called polar stratospheric clouds) can form under the right conditions. In these clouds, chlorine-bearing chemicals that have entered the atmosphere as pollution stick to crystals of water ice, resulting in chemical reactions that release ozone-destroying chlorine molecules.

"It's very exciting to think that we may have found examples of similar solid-state chemical processes on both Titan and Earth," said Anderson.

The researchers suggest that, on Titan, the reactions occur inside the ice particles, sequestered from the atmosphere. In that case, dicyanoacetylene ice wouldn't make direct contact with the atmosphere, which would explain why the ice and the vapor forms are not in the expected equilibrium.

"The compositions of the polar stratospheres of Titan and Earth could not differ more," said Michael Flasar, CIRS principal investigator at Goddard. "It is amazing to see how well the underlying physics of both atmospheres has led to analogous cloud chemistry."

The findings are published in the journal Geophysical Research Letters.

The Cassini-Huygens mission is a cooperative project of NASA, ESA (European Space Agency) and the Italian Space Agency. NASA's Jet Propulsion Laboratory, a division of Caltech in Pasadena, manages the mission for NASA's Science Mission Directorate, Washington. JPL designed, developed and assembled the Cassini orbiter. The CIRS instrument was built by Goddard

https://www.nasa.gov/feature/goddard/2016/nasa-scientists-find-impossible-cloud-on-titan-again

https://imagine.gsfc.nasa.gov/features/cosmic/images/cobe_milkyway.jpg

A Chain in the Sky:

By Magda Streicher

Winter in South Africa is probably one of the most favourable times to try and sniff out, so to speak, the faintest of deep sky objects. The winter air is usually clean, crispy-clear and ideal for exploring galaxies in more than one of the several constellations visible at this time of the year. Dress up snugly and warmly, make yourself a flask of coffee and get down to seeking out those faint, misty "clouds" that are, in fact, galaxies. Virgo is a well-known constellation, which we sometimes tend to give a wide berth, yet it is a treasure chest of deep-sky objects that are relatively easy to find.

Markarian's Chain of galaxies is situated within the northern outskirts of Virgo close to the boundary with the constellation Coma Berenices. The Russian Benjamin Markarian, who first noted this string of galaxies, named it "the chain". What makes this chain special is that Messier 86 and Messier 84, two elliptical star cities that rule the area, are easy to find within it. Several galaxies can be found in this 1.6-degree chain of galaxies stretching from northeast to southwest. The chain, running with galaxies NGC 4388, a lovely spindle, the faint IC 3303 and NGC 4387 at the southern point. Fainter galaxies just to the north point the way westward to M84 (NGC 4374), which is slightly fainter and smaller than M86 (4406), 16' to the east, the chain's largest elliptical galaxy with NGC 4387 situated between them. Very special are NGC 4435 and NGC 4438, situated barely 22' northeast of M86, a pair of galaxies nicknamed The Eyes by Leland Copeland. A pair of fainter galaxies, NGC 4458 and NGC 4461, can be spotted further northeast, with NGC 4473 and NGC 4477 marking the northern end of the chain.

Join all these links of the chain and explore the infinite heart of the Virgo Cluster of Galaxies.

Name	Object	RA:	DEC:	Magnitude	Size
NGC 4374 Messier 84	Galaxy	12h25m.1	+12°53'02"	9.1	6.7'x6.1'
NGC 4406 Messier 86	Galaxy	12h26m.2	+12o57'02"	8.9	9.8'x6.3'

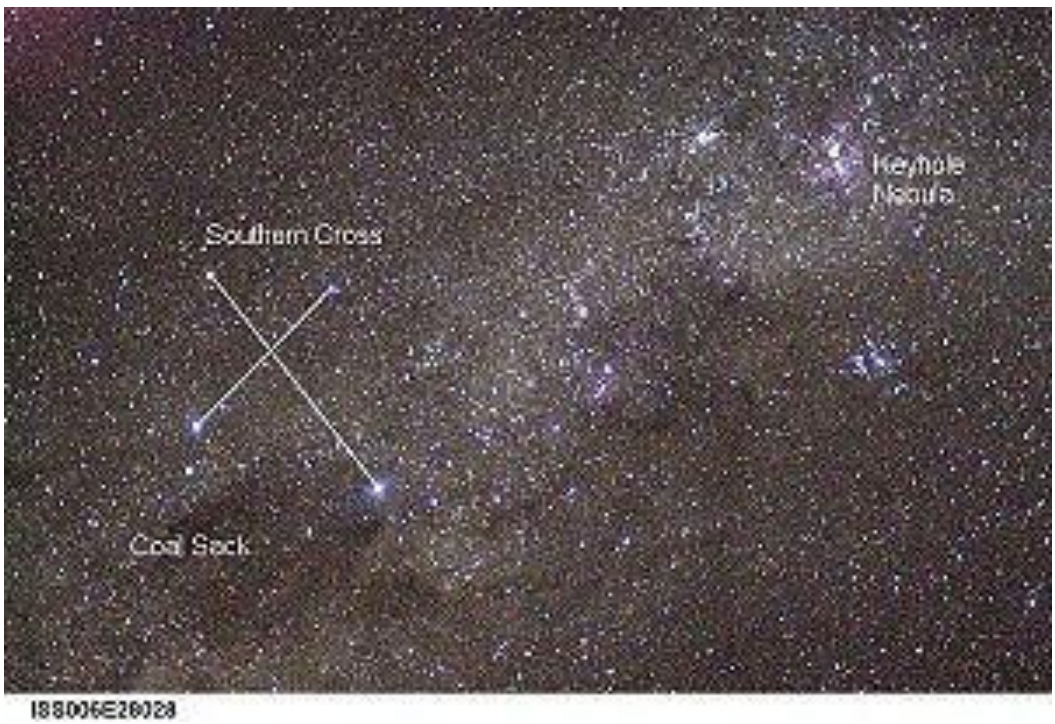
CONSTELLATIONS:

As spring arrives in the southern hemisphere our Milky Way star fields of Ophiuchus, Sagittarius and Scorpius descend in the west. Libra, ahead of Scorpius, departs the western horizon at the end of August.

While bidding them farewell for a time, we welcome Cetus, the sea monster, with its renowned variable star, Omicron Ceti perhaps better known as Mira the wonderful. Being a variable, it changes colour regularly over a period of 11 months. The last brightness peak that it had, was around February 2017.

Also rising in the East we have the constellation Eridanus with its very bright star Achernar and hanging almost directly above it is a bright star called Formalhaut in constellation Piscis Austrinus. Lying close by from east to west are Aquarius and Capricornus while lower down lies one of our bird constellations, Grus, with its bright star Alnair.

Andromeda, Cygnus and Pegasus grace our northern horizon presenting trickles of excitement at viewing the start our spring night skies.



COMETS, ASTEROIDS AND METEORITES:

There are no prospects for observing meteor showers for the month of September, at least, not favourable in the Southern Hemisphere.

There are also no known comet sightings predicted for September. Comets move at about the same speed as planets and do not shoot across the night sky in a flash as a meteorite (shooting star) would.

Comets travelling in the same plane as the planets may be forced or guided into elliptical orbits by the gravitational effects of large planets like Jupiter. These comets are called short period comets and usually arise from the Kuiper Belt. Their orbits are calculated and known, thus their return times can be calculated, not so with long period comets whose origins are in the Oort Cloud. Thus, long period comets are notably unpredictable.

Goldstone Radar Observations Planning: Asteroid 3122 Florence and 2001 QL142 :

3122 Florence:
3122 Florence (1981 ET3) was discovered by S. J. Bus at Siding Spring (Australia) in March 1981.
This asteroid is named in honour of Florence Nightingale (1820-1910), the founder of modern nursing.
With a diameter of about 4.3 km, Florence is among the largest near-Earth asteroids.
Among asteroids classified as "Potentially Hazardous," Florence ranks fourth in diameter after 53319 1999 JM8 (~7 km),4183 Cuno (5.6 km), and 3200 Phaethon (5.1 km).

Florence will approach within 0.047 au on **2017 September 1** when it will be a very strong radar target.
We are expecting signal-to-noise ratios sufficient for high-resolution imaging that places thousands of pixels on the object.

Florence has a rotation period of 2.36 h and a light curve amplitude of 0.2 magnitudes (Wisniewksi et al. 1997). That suggests a shape with a relatively low elongation. Pravec et al. (2006) found that ~2/3 of NEAs, with rotation periods this fast, it could have a satellite, but currently it is unknown if Florence is a

binary system. Warner (2016) points out a possible second period of 10.4 h in his light curve data but the evidence is not yet conclusive that Florence has a companion.
https://echo.jpl.nasa.gov/asteroids/Florence/Florence_planning.html
"If Florence has a satellite, then our chances of detecting it are excellent, and if so, then we plan to measure its motion to estimate the orbital parameters, mass, and density of the system". Goldstar Observationist

Multiple estimates of Florence's diameter are available. Here we adopt the most recent estimate of 4.35 km that was reported by Mainzer et al. (2011) from NASA's WISE spacecraft. Observations by Thomas et al. (2011) using NASA's Spitzer Space Telescope have yielded an albedo of 0.21 km that corresponds to a diameter of 4.4 km.
One of our principal objectives is to obtain radar images that can be inverted to estimate the 3D shape and dimensions of this asteroid to help calibrate the WISE and Spitzer measurements.
The 2017 encounter is the closest by this asteroid since 1890 and until after 2500. All the close encounters within 0.1 au occur from late August to early September when the asteroid is near its ascending node. The intervals between successive approaches < 0.1 au are often 40 yrs, 73 yrs, and 87 yrs.

Florence is classified as a "Potentially Hazardous Asteroid" by the Minor Planet Centre.

3122 Florence will detectable between Microscopium and Piscis Austrinus on the 1st. September. Passing safely by at over 18 times the Earth-Moon distance, it will be the closest it has been to Earth since 1890. It will not be visible to the naked eye only by amateur telescopes. It will not come this close again until the year 2500.

2001 QL142:

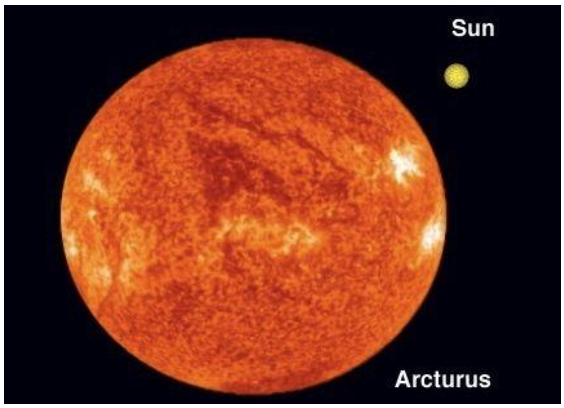
2001 QL142 was discovered by the LONEOS program near Flagstaff, AZ on 2001 August 24. Little is known about this object other than its absolute magnitude of 17.8, which suggests a diameter within a factor of two of about 900 meters.

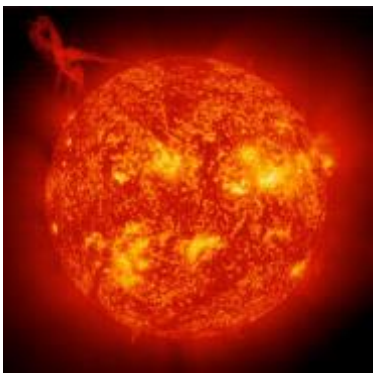
2001 QL142 will approach within 0.0583 au in mid-September 2017 when it will be detectable at Goldstone, possibly at rather modest SNRs, and when it could be a moderately strong imaging target at Arecibo.

The Minor Planet Centre has classified 2001 QL142 as a "Potentially Hazardous Asteroid."

https://echo.jpl.nasa.gov/asteroids/Florence/Florence_planning.html
SA Sky Guide Africa South

ARCTURUS AND THE SUN:




The sun.

http://forcetoknow.com/wp-content/uploads/2014/08/Arcturus-star-vs-Sun_forcetoknow.com_.jpg

Looking up at the old old star Arcturus in the north western sky, its position is a reminder that another spring is on its way, it is a reminder that all on Earth is as always,changing and growing; for that is life, in tune with the Universe and all within, above and beyond us.

Arcturus is an orange giant, a star approximately 37 light years from Earth, found in the constellation Bootes and visible in both hemispheres. Once upon a time Arcturus was possibly similar to our sun but it is now an old star and also possibly past its main period of life. Now, it is said that instead of fusing hydrogen in its core as our sun does, it is fusing helium which causes it to expand.

Arcturus is actually part of what scientists have named the Arcturus Stream which is a group of ancient stars moving at a different angle and faster than other stars in our galaxy. This stream is thought to be the left overs of a dwarf galaxy that collided with the Milky Way. About one million years from now Arcturus will be so far from Earth it will no longer be visible to the naked eye.

With a radius of around 18 million kms. Arcturus is about 26 times the size of the sun. A mass of 1.1 times that of the sun. With temperatures at 4000degrees centigrade it is about 73% as hot as the sun, but, because of its great size it emits at least up to 200 times more energy than our sun.
Arcturus is an evolved, red-giant star, a star very much like what our sun will be with an age of 7.1 billion years.
By contrast, our sun has an age of 4.6 billion years, a star separated in time from Arcturus by only 2.5 billion years. Arcturus has the equivalent mass of the sun but 170 times its luminosity, a result of its expansion to 25 solar radii, a natural

consequence of the transition to helium burning in its core, a process that is producing carbon and oxygen, the raw materials for new life and new worlds. Astronomically speaking, Arcturus is close in time and in space.

The sun is a yellow dwarf star full of hot glowing gases and its gravity holds our Solar System together, keeping everything within its orbit from the four rocky planets to the four gaseous giant planets; to the smallest particles of anything in its orbit. Electric currents in the sun generate a magnetic field that is carried out through the solar system by the solar wind that is a stream of electrically charged gas blowing away from the sun in all directions. With a radius of 695,508 kms., much smaller than Arcturus; it will still take 1.3 million Earths to fill it.

On planet Earth all this connection and interaction with the sun drives our life giving us seasons, a weather system, ocean currents and so much more that is of great importance for life and the future.This is why our sun is so special to us even though the Milky Way is also home to billions of stars that are suns.

We live in a universe which is vast and deeply humbling as we know from Carl Sagan, "Earth is but a tiny pale blue dot". It's a universe that, Sagan constantly reminded us, isn't about us. We're a granular element. Our presence may even be ephemeral—a flash of luminescence in a great dark ocean. Or perhaps we are here to stay, somehow finding a way to transcend our worst instincts, eventually becoming a galactic species. We could even find others out there, the inhabitants of distant, highly advanced civilizations—the Old Ones, as Sagan might put it.

Note: A light year is the distance light travels in one year, which is equal to 5,878,499,810,000 miles or 9,460,528,400,000 kilometers.

http://www.smithsonianmag.com/science-nature/why-carl-sagan-truly-irreplaceable-180949818/#Ljbw0mD2LGdUlSDt.99
https://www.space.com › Skywatching
htps://solarsystem.nasa.gov/planets/sun/indepth
https://www.solarsystemquick.com/universe/arcturus-star.htm

NASA'S SCIENTIFIC BALLOON PROGRAM REACHES NEW HEIGHTS:

For decades, NASA has released enormous scientific balloons into Earth's atmosphere, miles above the altitude of commercial flights. The Balloon Program is currently preparing new missions bearing sensitive instruments, including one designed to investigate the birth of our universe and another with ballooning origins that will fly on the International Space Station.

NASA's Primordial Inflation Polarization Explorer (PIPER), which will launch a series of test flights over the next few years, could confirm the theory that our nascent universe expanded by a trillion trillion (10^{24}) times immediately following the big bang. This rapid inflation would have shaken the fabric of space-time, generating ripples called gravitational waves. These waves, in turn, should have produced detectable distortions in the cosmic microwave background (CMB), the earliest light in the universe lengthened into microwaves today by cosmic expansion. The patterns will appear in measurements of how the CMB light is organized, a property called polarization. Discovering twisting, pinwheel-like polarization patterns in the CMB will prove inflation occurred and take astrophysicists back to the brink of the big bang.

While Albert Einstein's theories accurately describe gravity in today's dilated cosmos, these large-scale physical laws did not apply when our universe was still the size of a hydrogen atom. To reconcile this disparity, PIPER will map the entire sky at four different frequencies, differentiating between twisting patterns in the CMB (indicating primordial gravitational waves) and different polarization signals due to interstellar dust. To maintain sensitivity, the telescope will fly immersed in a bucket of liquid helium the size of a hot tub but much cooler — nearly 457 degrees below zero Fahrenheit (minus 272 degrees Celsius) and close to absolute zero, the coldest temperature possible.

The PIPER mission was designed, built and tested at NASA's Goddard Space Flight Centre in Greenbelt, Maryland, in collaboration with Johns Hopkins University in Baltimore, the University of British Columbia, Canada, the National Institute of Standards and Technology at Boulder, Colorado, and Cardiff University in Wales.

"We're hoping to gain insight into our early universe as it expanded from subatomic size to larger than a planet in less than a second," said Goddard's Al Kogut, PIPER's principal investigator. "Understanding inflation also augments our knowledge of high-energy particle physics, where the forces of nature act indistinguishably from one another."

From its new vantage point on the International Space Station's Japanese Experiment Module - Exposed Facility, the Cosmic Ray Energetics and Mass (ISS-CREAM) mission, shown in the inset illustration, will study cosmic rays to determine their sources and acceleration mechanisms.
Credits: NASA

While PIPER prepares to observe roughly 20 miles above Earth, the latest iteration of the Cosmic Ray Energetics and Mass (CREAM) experiment launched to the International Space Station in August. Although CREAM was balloon-borne during its seven prior missions, the new payload will take the technology past Earth's atmosphere and into space. Called ISS-CREAM, the experiment will directly sample fast-moving matter from outside the solar system, called cosmic rays, from its new vantage point on the Japanese Experiment Module Exposed Facility.

Cosmic rays are high-energy particles traveling at near the speed of light that constantly shower Earth. But precisely how they originate and accelerate through space requires more study, as does their abrupt decline at energies higher than 1,000 trillion electron volts. These particles have been boosted to more than 100 times the energy achievable by the world's most powerful particle accelerator, the Large Hadron Collider at CERN.

ISS-CREAM — about the size of a refrigerator — will carry refurbished versions of the silicon charge detectors and ionization calorimeter from the previous balloon missions over Antarctica. ISS-CREAM will contain two new instruments: the top/bottom counting detectors, contributed by Kyungpook National University in Daegu, South Korea, and a boronated scintillator detector to distinguish electrons from protons, constructed by a team from Goddard, Pennsylvania State University in University Park and Northern Kentucky University in Highland Heights.

The international collaboration, led by physicist Eun-Suk Seo at the University of Maryland, College Park, includes teams from numerous institutions in the United States as well as collaborating institutions in the Republic of Korea, Mexico, and France. Overall management and integration of the experiment was led by:

NASA's Wallops Flight Facility, on Virginia's Eastern Shore, under the direction of Linda Thompson, the CREAM project manager.

According to co-investigator Jason Link, a University of Maryland, Baltimore County research scientist working at Goddard, the evolution of the CREAM project demonstrates the power of NASA's Balloon Program as a developmental test bed for space instrumentation.

"A balloon mission can go from an idea in a scientist's head to a flying payload in about five years," Link said. "In fact, many scientists who design experiments for space missions get their start in ballooning. It's a powerful training ground for researchers and engineers."

As is true with any complex mission, things don't always go as planned. Such was the case for the Balloon Experimental Twin Telescope for Infrared Interferometer (BETTII) experiment, intended to investigate cold objects emitting light in the far-infrared region of the electromagnetic spectrum.

BETTII launched on June 8 from NASA's Columbia Scientific Balloon Facility in Palestine, Texas. Although nearly all the mission components functioned as they should, the payload detached from its parachute and fell 130,000 feet in 12 minutes as the flight ended the following day.

BETTII Principal Investigator Stephen Rinehart at Goddard estimates it will take several years to secure funding and rebuild the mission.

Designed, assembled, and tested at Goddard in collaboration with the University of Maryland, Johns Hopkins University, Cardiff University, University College London and the Far-Infrared Interferometric Telescope Experiment team in Japan, BETTII is designed to examine lower infrared frequencies with unprecedented resolution. While optical telescopes like Hubble cannot see stars shrouded by thick dust clouds, far-infrared observations pierce the veil, revealing how these objects form and evolve.

"BETTII is one of the more complex balloon experiments ever flown," Rinehart said. "As a research community, we understand that this risk is necessary for the scientific and technical progress we make with balloons."

After all, just as risk and failure go hand in hand, so do risk and reward.

https://www.nasa.gov/feature/goddard/2017/nasa-s-scientific-balloon-program-reaches-new-heights

SECOND HAND TELESCOPE FOR SALE:

Owner moving to a retirement village, no room for this item.

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MATTERS AND MUTTERS

By: Bruce Dickson

Subject: v2 - EAA

It's teatime in the **GWN** and my Earl Grey is steeping and cooling by my side. Time to tell you about my EAA adventure under an orange sky. To put this in context, unaided I can see Saturn and *maybe* Kaus Borealis (2.8m). Part of the problem is the BMO soccer field that was built a few years ago The owners have evidently not discovered the *off* switch.

Anyway, M8 is well beyond visible range so I decided to try with my guide camera. I installed a light pollution filter, then I ran the images.
This is my very first attempt at EAA I used my I used my 6" scope at about f/5 on its mount which has *very* rough polar alignment, an uncooled camera and free software. The image is as it came out the camera, onto my laptop.

The green is a measure of the operator's ineptitude while the drifting dots are hot pixels being mapped by the auto-alignment process.

It is far from my best image, but after 150 seconds integration, it does show more than from an urban environment with any scope. This is not such a bad thing. Maybe I'll try with a deep red filter rather than the LPF.

Anyway, that's EAA for you. Under a light polluted sky it's way better than the Mk 1 eyeball.
Telescope used polar mounted 6" f/4.7, Camera Starlight Xpress Ultrastar C, Exposure 10x 15sec.Image acquisition & real time processing with Starlight Live.

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