Monthly Newsletter of the Johannesburg Centre of ASSA

https://www.nasa.gov/multimedia/imagegallery/image_feature_2134.html

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

Wednesday, May 10 2017
Speaker :
Topic:

Upcoming Events:

Public viewing:

Friday: 5 MAY 2017 & 19 MAY 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)
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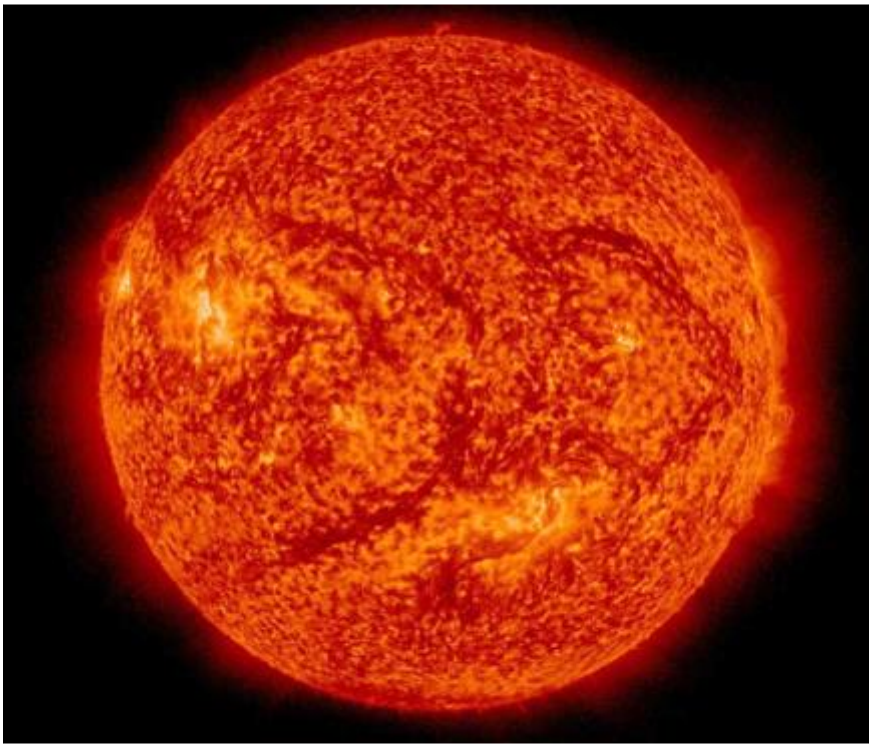
Gary Els (082 389 2250)
Notifications are posted on Facebook (https://www.facebook.com/assajhb), assajhb@yahoo.com and Twitter @JoosteJerome on the viewing day.

Our next monthly Braai and Sky takes place on:

- **Date:** Sunday 28 MAY 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.

THE SUN IN MAY 2017:

Date	Sunrise	Sunset	Length of day
01/05/2017	06:31	17:37	11:06:12
08/05/2017	06:35	17:33	10:57:42
15/05/2017	06:39	17:29	10:50:03
22/05/2017	06:42	17:26	10:44:16
29/05/2017	06:46	17:24	11:37:53



https://www.timeanddate.com/sun/south-africa/johannesburg

Twilight, Dawn, and Dusk

Twilight is the time between day and night when there is light outside, but the sun is below the horizon.

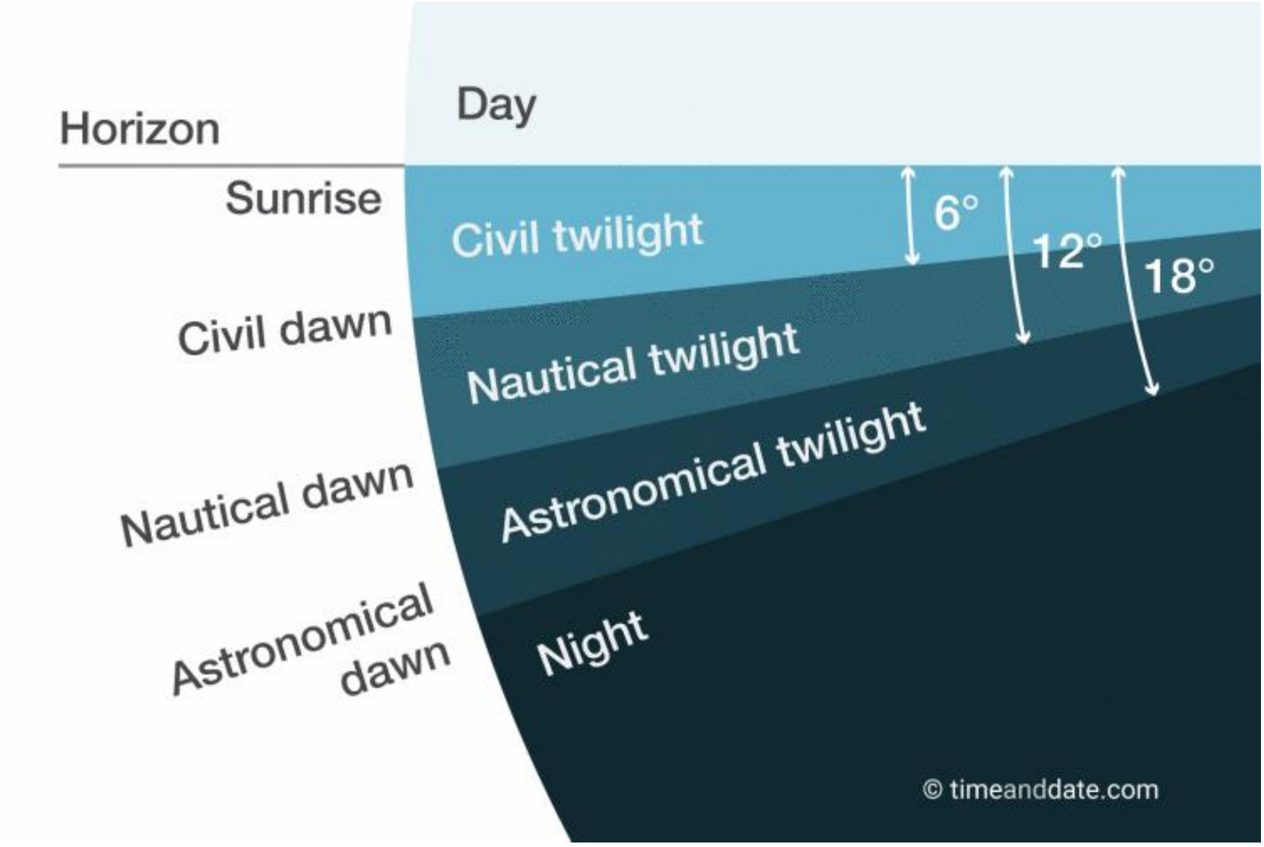
Canopus May 2017

Each day begins at dawn and that is the time we call morning twilight, each evening when the sunsets at dusk, that is evening twilight.

Twilight occurs when Earth's upper atmosphere scatters and reflects sunlight which illuminates the lower atmosphere producing beautiful coloured skies in the morning and evening.

According to astronomers, there are three stages of twilight, namely Civil,Nautical and Astronomical twilight. These stages are based on calculations of the sun's elevation which is the angle that the geometric centre of the sun makes with the horizon.

Different degrees of twilight



Civil twilight: Occurs when the Sun is less than 6 degrees below the horizon. In the evening, it begins at sunset and ends when the Sun reaches 6 degrees below the horizon.

Civil dusk: Is the moment when the geometrical centre of the Sun is 6 degrees below the horizon in the evening.

Civil twilight is the brightest form of twilight It is then still quite light enough to work outside without the use of other lighting. Only the brightest celestial objects can be observed by the naked eye during this time. Like Venus when she is our evening star.

Nautical twilight: Occurs when the geometrical centre of the sun is between 6 degrees and 12 degrees below the horizon. This twilight period is less bright than civil twilight and manmade light is required to work outside.

Nautical twilight came about many years ago when wind sailing vessels were still used and sailors found their way by stars. The first stars to be seen with the naked eye in the evening gave the time the name of nautical twilight.

Astronomical twilight: Occurs when the Sun is between 12 degrees and 18 degrees below the horizon.

Astronomical dawn is the time when the geometric centre of the Sun is at 18 degrees below the horizon, at any time before this, the sky is completely dark.

Astronomical dusk is the instant when the geometric centre of the Sun is at 18 degrees below the horizon. After this point, the sky is dark.

The time length of twilight depends on the latitude. The Equator and the Tropical regions have shorter periods of twilight as compared to the latitudes going toward the poles.

https://www.timeanddate.com/astronomy/different-types-twilight.html

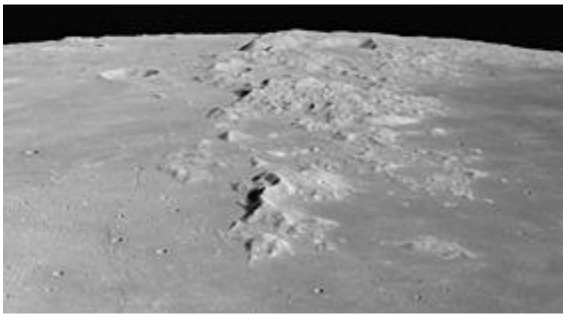
THE MOON IN MAY 2017:

Date	Moonrise	Moonset	
01/05/2017	11:29	22:38	
03/05/2017	18:10	-	1st. Quarter
10/05/2017	05:58	17:34	Full Moon
19/05/2017	-	13:02	3rd. Quarter
25/05/2017	05:59	17:25	New moon

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

Or moon phases and times are based on the Gregorian calendar. This is also known as the Western Calendar. Pope Gregory X111 introduced this calendar.

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



Oblique view facing north from 106 km altitude of the southern Montes Caucasus, from Apollo 15
https://en.wikipedia.org/wiki/Montes_Caucasus

The lunar highlight this month, according to the *Sky Guide South Africa 20,* is the Montes Caucasus. This is a mountain range some 536 km. and reaching a height of 3.6km. It is best seen 6 days after New moon and 5 days after Full moon.

Wikipedia provides the following information:

Montes Caucasus is a rugged range of mountains in the northeastern part of the Moon. It begins at a gap of level surface that joins the Mare Imbrium to the west with the Mare Serenitatis to the east, and extends in an irregular band to the north-northeast to the western side of the prominent crater Eudoxus. The range forms the northwestern boundary of the Mare Serenitatis. It forms a continuation of the Montes Apenninus range to the southwest.

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

NEW MOON CAN ALSO BE A SUPERMOON:

If one said that only a full moon could be a super moon, that would be incorrect.

Interestingly, it is known that when New moon occurs there is no moon; and if it is a clear night we are all greatly satisfied when it comes to star gazing. We know we will not see a new moon because the new moon rises when the sunrises. It is a daytime occurrence, setting when the sun sets.

Another factor is that new moon passes between sun and Earth. New moon is normally too close to the suns glare to even be visible during the day. Yet, as with full moon, new moon can come close to Earth as well.

The astronomical term for a supermoon is a perigee full moon or perigee new moon.

Normal moons do affect the ocean tides, so the perigee moons have the same effect but with much more influence. Thus, the Spring tides climb exceptionally high and the Neap tides on the same day, drop very low.

http://earthsky.org/tonight/first-supermoon-of-2017-on-april-26#tides

CASSINI DIVES BETWEEN SATURN AND RINGS:

By Eleanor Imster in Space | **April 29, 2017**

On April 27, 2017, NASA announced that the Cassini spacecraft was back in contact with Earth after its successful first-ever dive between the planet Saturn and its rings the day before. The spacecraft is now in the process of beaming back science and engineering data collected during its historic dive.

As it dove through the gap, Cassini came within about 1,900 miles (3,000 km) of Saturn's cloud tops and within about 200 miles (300 km) of the innermost visible edge of the rings.

Cassini has begun began what mission planners call its Grand Finale during which the spacecraft loops Saturn approximately once per week, making a total of 22 dives between the rings and the planet. Cassini's next dive through the gap is scheduled for Tuesday (May 2, 2017).

The spacecraft, which is almost out of fuel, is on a trajectory that will eventually plunge it into Saturn's atmosphere – ending its mission – on September 15, 2017.

According to a NASA statement:

The gap between the rings and the top of Saturn's atmosphere – a region that has never been explored – is about 1,500 miles (2,000 km) wide. The best models for the region suggested that if there were ring particles in the area where Cassini crossed the ring plane, they would be tiny, on the scale of smoke particles. The spacecraft zipped through this region at speeds of about 77,000 mph (124,000 kph) relative to the planet, so small particles hitting a sensitive area could potentially have disabled the spacecraft.

As a protective measure, the spacecraft used its large, dish-shaped high-gain antenna (13 feet or 4 meters across) as a shield, orienting it in the direction of oncoming ring particles. This meant that the spacecraft was out of contact with Earth during the ring-plane crossing, which took place at 2 a.m. PDT (5 a.m. EDT) on April 26. Cassini was programmed to collect science data while close to the planet and turn toward Earth to make contact about 20 hours after the crossing.

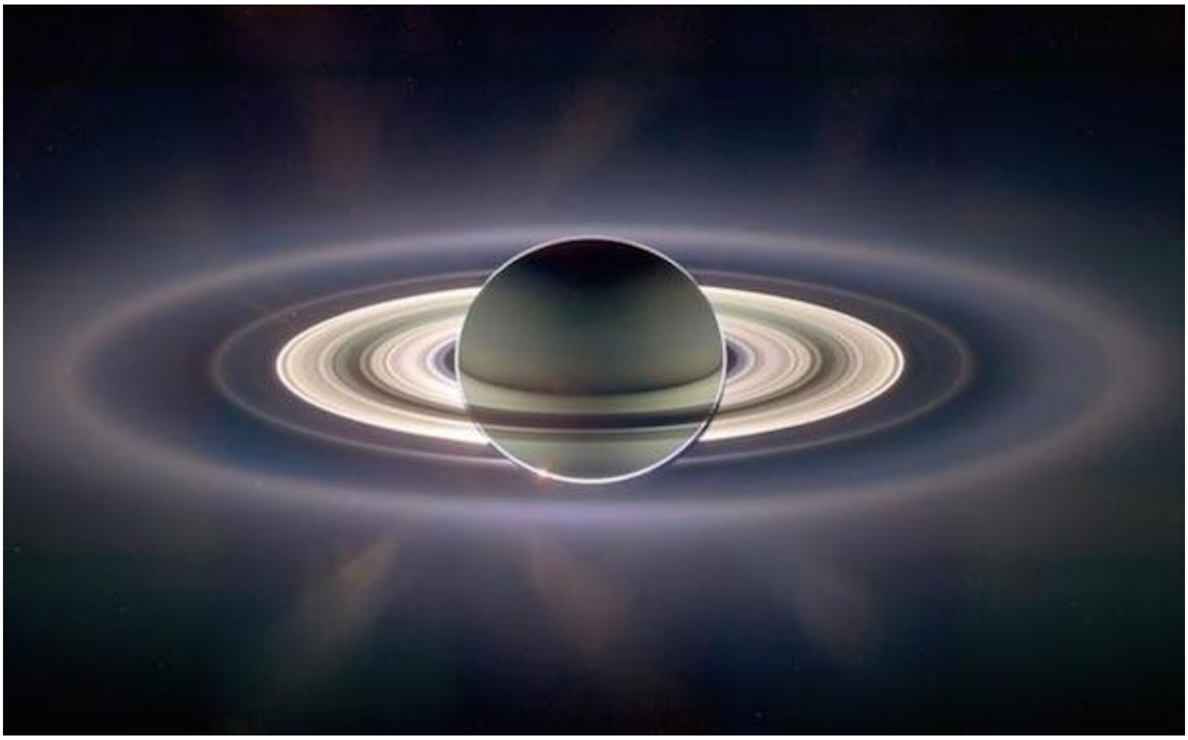
Cassini Project Manager Earl Maize of NASA's Jet Propulsion Laboratory in Pasadena, California, said in a statement:

I am delighted to report that Cassini shot through the gap just as we planned and has come Bottom line: As part of its Grand Finale, NASA's Cassini spacecraft made the first-ever dive through the narrow gap between the planet Saturn and its rings on April 26, 2017. It will make a total of 22 such dives before ending its mission by plunging into Saturn itself in September, 2017.out the other side in excellent shape.

http://earthsky.org/space/cassini-dives-between-saturn-and-its-rings?utm_source=EarthSky+News&utm_campaign=48993cc8b5-EarthSky_News&utm_medium=email&ut

Additional Note:

According to news from NASA the Cassini spacecraft came across unusual atmospheric occurrences during its first dive between the rings and the main gas body of Saturn. Scientists are studying the structure of the rings and the atmosphere before Cassini makes its' final plunge into Saturn's atmosphere.



https://saturn.jpl.nasa.gov/science/rings/

PLANETS IN MAY 2017:

Mercury: In the Southern hemisphere we shall see Mercury in the morning sky in late May and June, 2016.

Venus: remains as a very bright light rising in the east in the early morning hours.

Mars: Mars is not yet visible and will only be seen again around mid-June.

Jupiter: Jupiter is plainly visible to the naked eye in the early evening, Jupiter is the third brightest object in the Sky.

Saturn: rises in the early evening and can be observed through out the night.

Uranus: is a small dot on the eastern horizon. Not visible to the naked eye.

Neptune: is too close to the sun to be clearly seen this month.

https://www.nasa.gov/sites/default/files/thumbnails/image/nh-jupiterflyby.jpg

COMETS, METEORS AND ASTEROIDS:

COMETS:

On the whole, we do not get to see Comets that often. At best comets are unpredictable but PanStarrs C/2015 ER61 is predicted to be visible around 9 May.

METEORS:

Eta Aquarids:

The next major meteor shower of the year, the Eta Aquarids, occurs between late April and mid-May, peaking around May 5-6. It is best seen from the Southern Hemisphere, though observers in the Northern Hemisphere can also enjoy a sparser display. Meteoroids in the Eta Aquarids are remnants from Halley's Comet. The radiant for this shower lies in the constellation Aquarius.

http://earthsky.org/astronomy-essentials/earthskys-meteor-shower-guide

ASTEROIDS:

Asteroids are rocky fragments left over from the formation of the solar system about 4.6 billion years ago. Most asteroids orbit the sun in a belt between Mars and Jupiter.

Scientists think there are probably millions of asteroids, ranging widely in size from hundreds of kilometres across to less than one kilometre (a little more than one-half

Occasionally, asteroids' orbital paths are influenced by the gravitational tug of planets, which cause their paths to alter. Scientists believe stray asteroids or fragments from earlier collisions have slammed into Earth in the past, playing a major role in the

https://www.jpl.nasa.gov/asteroidwatch/asteroids-comets.phpevolution of our planet.

CONSTELLATIONS:

Our winter skies hold many different constellations. The Southern Hemisphere does not have a pole star but is famous for the Southern Cross or Crux.
Crux, the Southern Cross, is not only the smallest constellation and one of the most distinctive. It is circumpolar and is visible in our skies the whole year through, excepting for a few weeks in late spring/early summer

There is Scorpius rising in the east followed by Sagittarius, Capricornus, Aquila and Aquarius while in the western sky we have Virgo, Corvus and Hydra.

Possibly our most magnificent winter constellation is Scorpius. The clarity of this venomous creature spreading some distance in the sky is remarkable.
Centred just behind its' head is the leader star, Antares. This star has two nicknames. Sometimes known as 'the heart of Scorpio' and also as 'the rival of Mars'. This is because Antares is a huge red supergiant, 330 light years away.
Antares is 7500 times as luminous as the sun and is set in the sky with two companions, Tau Scorpii and Sigma Scorpii or Alniyat.
At the curl of the tail of Scorpius lies two open clusters: M6 the 'butterfly cluster' and M7 while not far from Antares lies M4 and M80 two globular clusters.
In the sting of Scorpius's tail lies two bright stars Lambda or Shaula and Upsilon or Lesath.

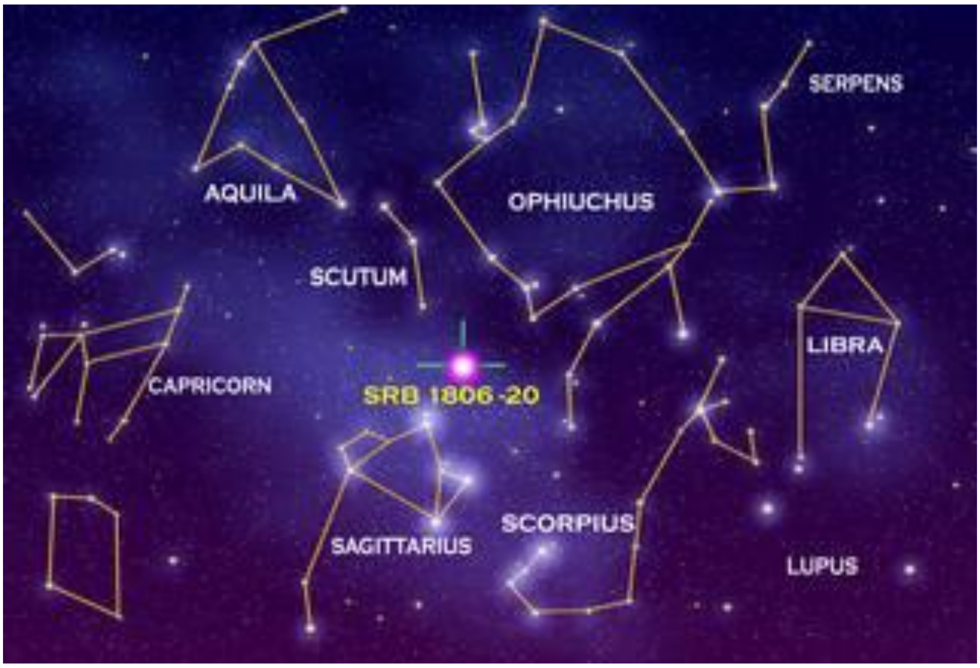
Under very clear dark night skies. The kind that we have in the winter months. One of the finest features is our Milky Way a long stretch or arc of star clouds running roughly south east to north west. A beautiful ribbon of milky cloud with millions of stars and clumps of dark gas and dust creating dark secrets untold, more intrigue and mystery than any mystery story told on Earth. The stars are in the densest clusters in the constellations Scorpius and Sagittarius right overhead in our winter months.

To the east of Scorpius and near the overhead point in winter lies Sagittarius, the Archer. While Saggitarius is full of clusters and nebulae it also contains more Messier objects than any other constellation. Beautiful gaseous nebulae are M20 known as the Trifid and M8 the Lagoon nebula while all around there are so many starfields to observe.

Very close to Sagittarius and underneath Telescopium, if one looks carefully, one can see a little semicircle of stars. This is known as Corona Australis, the Southern Crown.

Truly, our winter skies are brimful of magnificent viewing and imaging objects, many of which are well worth staying ot in the cold for. So good advice would be to dress warmly, have a hot beverage nearby and spend your nights enjoying the little miracles of the southern hemisphere winter skies.

Star maps are easily available on the Internet, for example: **www.skymaps.com**



Some constellations look like people or animals. Sagittarius looks like a teapot.
Credits: NASA

https://www.nasa.gov/audience/forstudents/k-4/dictionary/Constellation.html

News | **April 20, 2017**

PLANET HUNTERS NAMED IN TIME'S TOP 100 MOST INFLUENTIAL PEOPLE:

Three extraordinary planet-hunters have been recognized by TIME Magazine as this year's top 100 most influential people: Natalie Batalha from NASA's Ames Research Centre in California's Silicon Valley; Michael Gillon from the University of Liège in Belgium; and Guillem Anglada-Escudé from the Queen Mary University in London.

"It is truly exciting to see these planet-hunters among the other movers and the shakers of the world," said Paul Hertz, Astrophysics division director at NASA Headquarters in Washington. "These scientists have transformed the world's understanding of our place in the universe, and NASA congratulates them for their well-deserved recognition."

Natalie Batalha is the project scientist for NASA's Kepler mission, the agency's first dedicated planet-seeking mission tasked to determine whether worlds around other stars are common by looking for telltale dips in a star's brightness caused by crossing, or transiting, planets. Thanks to Kepler, some scientists believe there is at least one world around every star in the sky. To date, Kepler has found more than 2500 planets, including a "bigger, older cousin" to Earth. In total, the Kepler spacecraft has found nearly 5,100 possible planets. Batalha is the first woman at NASA to receive the Time 100 designation. Read more about Batalha's accomplishments.

Michael Gillon led the research that discovered seven Earth-size planets around TRAPPIST-1, a nearby ultra-cool dwarf star, approximately 40 light years away. He is the principal investigator of the TRAPPIST ("The Transiting Planets and Planetesimals Small Telescope") project, a pair of telescopes in Chile and Morocco. In 2016, Gillon and colleagues announced three planets around TRAPPIST-1. Following up with NASA's Spitzer Space Telescope and ground-based telescopes, Gillon and colleagues revealed in 2017 that there are actually seven planets around the star. Three of the seven worlds of TRAPPIST-1 are in the habitable zone, but any of them could have liquid water. The TRAPPIST-1 planets are some of the best targets for NASA's upcoming James Webb Space Telescope to look for signs of habitability. Gillon is also the project leader and principal investigator of SPECULOOS, an upcoming ground-based telescope project for which TRAPPIST is the prototype. Read more about the TRAPPIST-1 discovery

Guillem Anglada-Escudé led the research team who discovered Proxima b, a roughly Earth-sized exoplanet orbiting at a distance from its star that would allow temperatures mild enough for liquid water to pool on its surface. Proxima b orbits our nearest neighbouring star Proxima Centauri just over four light-years from Earth. Proxima is the smallest member of a triple star system known as Alpha Centauri and is the closest star to Earth, besides our own sun. Read more about the European Southern Observatory-led Proxima b discovery.

Anglada-Escude's research spans the realm of astrobiology, the study of the origin, evolution, distribution, and future of life in the universe. From 2009 to 2013, Anglada-Escude participated in a research study to learn more about life's chemical and physical evolution, from the interstellar medium, through planetary systems, to the emergence and detection of life. Learn more about the five-year research study supported by the NASA Astrobiology Institute.

NASA's search for distant worlds continues with the Transiting Exoplanet Survey Satellite (TESS) launching in 2018, which will find new planets the same way Kepler does, but right in the stellar backyard of our solar system, covering 400 times the sky area. Webb will also launch in 2018, and peer into possible atmospheres of distant worlds to look for chemical hints of life.

NASA's Jet Propulsion Laboratory, Pasadena, California, manages the Spitzer Space Telescope mission for NASA's Science Mission Directorate, Washington. NASA's Kepler mission is managed by NASA's Ames Research Centre in the Silicon Valley. JPL managed Kepler mission development.

For more information, visit:

http://time.com/collection/2017-time-100/4742707/natalie-batalha-guillem-anglada-escude-michael-gillon/

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https://www.jpl.nasa.gov/news/news.php?feature=6823

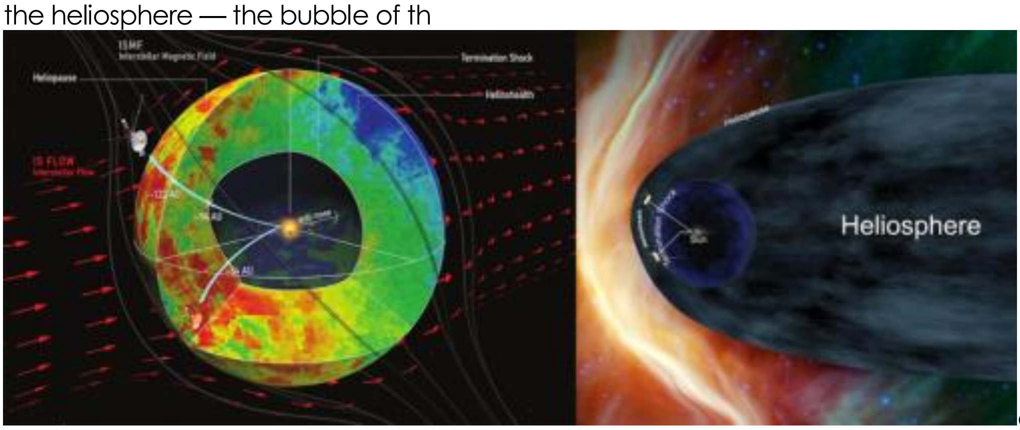
NASA'S CASSINI, VOYAGER MISSIONS SUGGEST NEW PICTURE OF SUN'S INTERACTION WITH GALAXY:

New data from NASA's Cassini mission, combined with measurements from the two Voyager spacecraft and NASA's Interstellar Boundary Explorer, or IBEX, suggests that our sun and planets are surrounded by a giant, rounded system of magnetic field from the sun — calling into question the alternate view of the solar magnetic fields trailing behind the sun in the shape of a long comet tail.

The sun releases a constant outflow of magnetic solar material — called the solar wind — that fills the inner solar system, reaching far past the orbit of Neptune. This solar wind creates a bubble, some 23 billion miles across, called the heliosphere. Our entire solar system, including the heliosphere, moves through interstellar space. The prevalent picture of the heliosphere was one of comet-shaped structure, with a rounded head and an extended tail. But new data covering an entire 11-year solar activity cycle show that may not be the case: the heliosphere may be rounded on both ends, making its shape almost spherical. A paper on these results was published in Nature Astronomy on April 24, 2017.

"Instead of a prolonged, comet-like tail, this rough bubble-shape of the heliosphere is due to the strong interstellar magnetic field — much stronger than what was anticipated in the past — combined with the fact that the ratio between particle pressure and magnetic pressure inside the heliosheath is high," said Kostas Dialynas, a space scientist at the Academy of Athens in Greece and lead author on the study.

New data from NASA's Cassini, Voyager and Interstellar Boundary Explorer missions show that the heliosphere — the bubble of th



e sun's magnetic influence that surrounds the inner solar system — may be much more compact and rounded than previously thought. The image on the left shows a compact model of the heliosphere, supported by this latest data, while the image on the right shows an alternate model with an extended tail. The main difference is the new model's lack of a trailing, comet-like tail on one side of the heliosphere. This tail is shown in the old model in light blue.

Credits: Dialynas, et al. (left); NASA (right)

An instrument on Cassini, which has been exploring the Saturn system over a decade, has given scientists crucial new clues about the shape of the heliosphere's trailing end, often called the heliotail. When charged particles from the inner solar system reach the boundary of the heliosphere, they sometimes undergo a series of charge exchanges with neutral gas atoms from the interstellar medium, dropping and regaining electrons as they travel through this vast boundary region. Some of these particles are pinged back in toward the inner solar system as fast-moving neutral atoms, which can be measured by Cassini.

"The Cassini instrument was designed to image the ions that are trapped in the magnetosphere of Saturn," said Tom Krimigis, an instrument lead on NASA's Voyager and Cassini missions based at Johns Hopkins University's Applied Physics Laboratory in Laurel, Maryland, and an author on the study. "We never thought that we would see what we're seeing and be able to image the boundaries of the heliosphere."

Many other stars show tails that trail behind them like a comet's tail, supporting the idea that our solar system has one too. However, new evidence from NASA's Cassini, Voyager and Interstellar Boundary Explorer missions suggest that the trailing end of our solar system may not be stretched out in a long tail. From top left and going counter clockwise, the stars shown are LLOrionis, BZ Cam and Mira.
Credits: NASA/HST/R.Casalegno/GALEX

Because these particles move at a small fraction of the speed of light, their journeys from the sun to the edge of the heliosphere and back again take years. So when the number of particles coming from the sun changes — usually as a result of its 11-year activity cycle — it takes years before that's reflected in the amount of neutral atoms shooting back into the solar system.

Cassini's new measurements of these neutral atoms revealed something unexpected — the particles coming from the tail of the heliosphere reflect the changes in the solar cycle almost exactly as fast as those coming from the nose of the heliosphere.

"If the heliosphere's 'tail' is stretched out like a comet, we'd expect that the patterns of the solar cycle would show up much later in the measured neutral atoms," said Krimigis.

But because patterns from solar activity show just as quickly in tail particles as those from the nose, that implies the tail is about the same distance from us as the nose. This means that long, comet-like tail that scientists envisioned may not exist at all — instead, the heliosphere may be nearly round and symmetrical.

A rounded heliosphere could come from a combination of factors. Data from Voyager 1 show that the interstellar magnetic field beyond the heliosphere is stronger than scientists previously thought, meaning it could interact with the solar wind at the edges of the heliosphere and compact the heliosphere's tail.

The structure of the heliosphere plays a big role in how particles from interstellar space — called cosmic rays — reach the inner solar system, where Earth and the other planets are.

"This data that Voyager 1 and 2, Cassini and IBEX provide to the scientific community is a windfall for studying the far reaches of the solar wind," said Arik Posner, Voyager and IBEX program scientist at NASA Headquarters in Washington, D.C., who was not involved with this study. "As we continue to gather data from the edges of the heliosphere, this data will help us better understand the interstellar boundary that helps shield the Earth environment from harmful cosmic rays."

By Sarah Frazier
NASA's Goddard Space Flight Center, Greenbelt, Md.

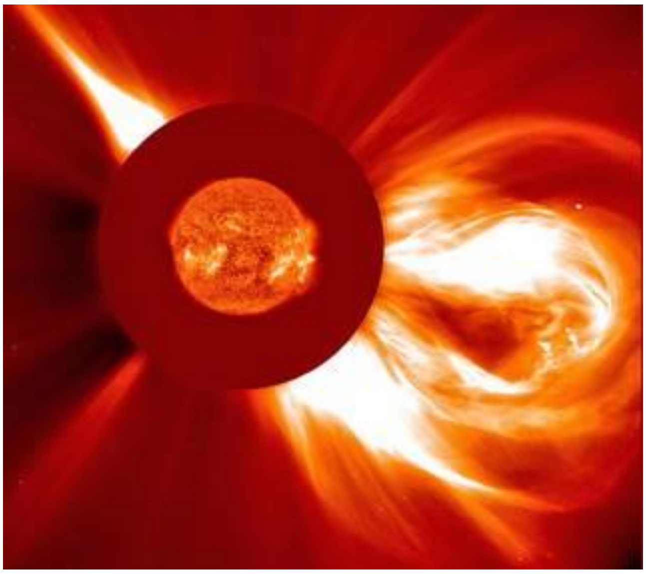
Last Updated: April 24, 2017
Editor: Rob Garner

https://www.nasa.gov/feature/goddard/2017/nasa-s-cassini-voyager-missions-suggest-new-picture-of-sun-s-interaction-with-galaxy

Feb. 16, 2016

NASA Helps Power Grids Weather Geomagnetic Storms

Goddard space scientist Antti Pulkkinen researches space weather phenomena that affect power grids. In addition to developing systems that simulate where and when power grids will experience geomagnetically induced currents, Pulkkinen works with the power engineering community to help develop standards and guidelines to keep North American power grids stable during geomagnetic storms.
Credits: NASA's Goddard Space Flight Centre/Bill Hrybyk



A coronal mass ejection, or CME, erupts from the lower right of the sun in this composite image captured by ESA/NASA's Solar and Heliospheric Observatory on Dec. 2, 2003. When Earth-directed, CMEs can interact with Earth's magnetic field, creating a geomagnetic storm. These storms can strain power grids by inducing extra current in the system. NASA scientists are working to understand when and where these electric currents will be induced so they can provide more reliable warnings to power engineers.
Credits: ESA/NASA/SOHO

On March 9, 1989, a huge cloud of solar material exploded from the sun, twisting toward Earth. When this cloud of magnetized solar material – called a coronal mass ejection, or CME – reached our planet, it set off a chain of events in near-Earth space that ultimately knocked out power to the Canadian province Quebec for about nine hours. Though CMEs hit Earth often, those with the potential to shut down an entire power grid are rare – and scientists want to make sure that next time, we're prepared.

Because space weather can have – at its very worst – such significant consequences, scientists from NASA's Goddard Space Flight Centre in Greenbelt, Maryland, are creating models to simulate how space weather can impact our power grid. Scientists developing this next-generation project – called Solar Shield – have recently incorporated six test sites around the country, where they compare computer simulations of forecasted space weather impacts with the actual observations on the ground. Solar Shield, which combines research efforts from several agencies, is supported by the Department of Homeland Security Science and Technology directorate. Simulations – like those used by the Solar Shield project – can ultimately be used to improve operational space weather forecasts, such as those issued by NOAA's Space Weather Prediction Centre, the U.S. government's official source for space weather forecasts.

"We really want to create models that accurately show incoming space weather," said Antti Pulkkinen, a research astrophysicist at Goddard, and the lead of the Solar Shield project. "That way, space weather forecasters can provide the grid operators the information they need to know what's happening when they start seeing weird fluctuations in the power grid."

To create better protection for power grids, the Solar Shield project must take into account not just what's happening on Earth, but what's happening on the sun and in the space in between.

When the most intense CMEs and solar wind streams hit Earth's magnetic bubble, the magnetosphere, it can start to rattle violently, changing the strength and direction of the magnetic field in different places on Earth. But such severe geomagnetic storms, as they are called, only happen in certain circumstances.

"One of the problems we need to solve is predicting the direction of the magnetic field embedded in a CME," said Pulkkinen. "They only generate major storms within the magnetosphere if they're pointed opposite Earth's magnetic field when they hit – otherwise, it may give an initial punch and then just kind of fizzle."

If the storm is particularly strong, however, our power grids may need some protection. The quick-changing magnetic fields in the magnetosphere can create electric currents at Earth's surface, called geomagnetically induced currents, or GICs. Because much of our planet is criss-crossed with long metal structures – from oil pipelines beneath the surface to power lines yards above our heads – these electric currents have perfect, wire-like pathways that allow them to flow across long distances. For example, a powerful geomagnetic storm in 1859, known as the Carrington Event, caused GICs so strong that telegraph wires were unable to handle the huge amount of electricity, interrupting communications.

The consequences of GICs in modern power lines are more direct. To transmit power effectively, there must be the right combination of voltage and current in power lines. The extra current of GICs can disrupt this balance, possibly resulting in stressed transformers or voltage collapse. The GICs brought on by the March 1989 geomagnetic storm introduced so much extra current to the Quebec power grid that protective relays were tripped and the voltage collapsed.

To understand what space weather-situations cause the most intense GICs, scientists working on Solar Shield use CME measurements, solar wind observations, and other physical parameters to model the timing, location, and strength of the GICs. Using pictures of CMEs from a special type of instrument called a coronagraph – which blocks out the overwhelmingly bright disk of the sun, allowing us to see the comparatively faint atmosphere, known as the corona – they estimate the size, speed and direction of these CMEs, one of the driving forces behind geomagnetic storms. Measurements of fast solar wind streams currently come from NASA's Advanced Composition Explorer, or ACE, which resides between us and the sun at a distance of about a million miles from Earth. Solar wind data from NOAA's Deep Space Climate Observatory, launched in 2015, will replace ACE data later this year.

Scientists input their estimates of the characteristics of these solar events into computer models, which simulate when, where, and at what speed the solar material will strike Earth, as well as the location and strength of the resulting induced currents. The models that Solar Shield scientists use are tested and validated at the Community Coordinated Modeling Center, or CCMC, at Goddard. Once they have GIC simulations from the model, scientists compare them to measurements taken at six power substations around the U.S. By comparing the predicted characteristics with the actual characteristics of the GICs, scientists can improve the Solar Shield simulations.

With accurate advance warning, power engineers have quite a few options to protect the grid. With a day or two of notice, power grid companies can alter maintenance schedules to make sure that as many critical lines are up and running as possible. Even with just 20 minutes of lead time – which is how long it could take for a CME to travel from our advanced warning satellite to Earth, a distance of nearly a million miles – grid operators can take steps to prevent blackouts and damage. One such step is injecting reserve power into the system, helping to stabilize the system voltage.

As projects like Solar Shield help improve our space weather models, the hope is that forecasting will improve just as terrestrial weather forecasts have improved, and – like meteorologists who fine tune their warnings of hurricanes as the storm waxes and wanes – space weather prediction can provide highly accurate details on the force of any incoming solar storm.

For more information about space weather, visit:

https://www.nasa.gov/feature/goddard/2016/nasa-helps-power-grids-weather-geomagnetic-stormshttp://www.nasa.gov/sunearth

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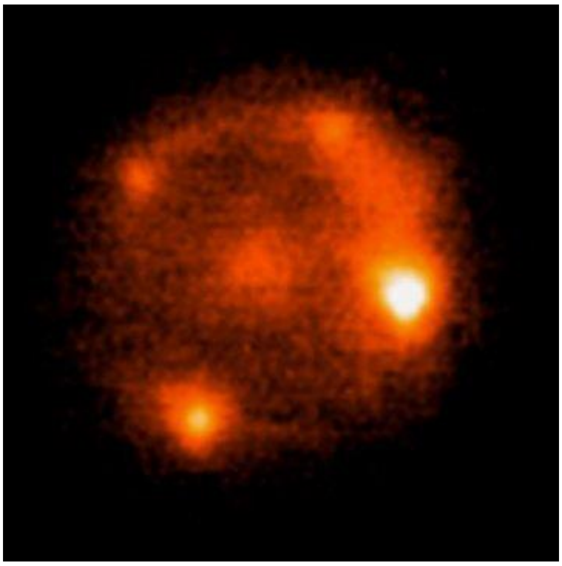
Editor: Rob Garner

RARE BRIGHTENING OF A SUPERNOVA'S LIGHT:

Rare brightening of a supernova's light
Astronomers find magnified 'standard candle' in the sky, leading the way to more precise measurements of the expansion rate of our universe.

Date:
April 20, 2017
Source:
California Institute of Technology
Summary:
Astronomers have, for the first time, seen a cosmic magnification of the light from a class of supernova called Type Ia.



An international team of This is an image of the gravitationally lensed iPTF16geu Type Ia supernova taken in near-infrared with the W.M. Keck Observatory. The lensing galaxy visible in the centre has distorted and bent the light from iPTF16geu, which is behind it, to produce multiple images of the same supernova (seen around the central galaxy). The position, size and brightness of these images help astronomers infer the properties of the lensing galaxy.
Credit: W. M. Keck Observatory

Astronomers have, for the first time, seen a cosmic magnification of the light from a class of supernova called Type Ia. Type Ia supernovas -- often referred to as "standard candles" because of their well-known intrinsic brightness -- are frequently used by astronomers to accurately measure the expansion rate of our universe, as well as the amount of dark energy, which is thought to be accelerating this expansion.

Finding a magnified, or "gravitationally lensed," Type Ia supernova is like discovering a brighter candle with which to view the universe. The researchers say this discovery is the first of many to come, and that having a whole collection of similarly lensed Type Ia supernovas will lead to more precise measurements of our universe's most fundamental traits.

Gravitational lensing occurs when the gravity of a cosmic object, such as a galaxy, bends and magnifies the light of a more distant object. The effect can cause galaxies to appear strangely twisted, and even produce multiple images of the same object. While this phenomenon of gravitational lensing has been observed many times since the early 20th century, when it first was predicted by Albert Einstein, imaging a lensed Type Ia supernova has proven formidably difficult, until now.

In the new study, published April 21 in the journal *Science*, the researchers imaged the Type Ia supernova called iPTF16geu and found it duplicated into four different images.

"Resolving, for the first time, multiple images of a strongly lensed 'standard candle' supernova is a major breakthrough," says Ariel Goobar, a professor with the Oskar Klein Centre at the University of Stockholm, Sweden, and a lead author of the study. "Normally, when we view a lensed object, we don't know the intrinsic brightness of that object, but with Type Ia supernova, we do. This will allow us to better quantify and understand the phenomenon of gravitational lensing."

Goobar and his group are partners in two Caltech-led international scientific collaborations -- the intermediate Palomar Transient Factory (iPTF) and the Global Relay of Observatories Watching Transients Happen (GROWTH) project. The iPTF takes advantage of the Palomar Observatory and its unique capabilities to scan the skies and discover, in near real-time, fast-changing cosmic events such as supernovas. GROWTH manages a global network of researchers and telescopes that can swiftly perform follow-up observations to study these transient events in detail.

"I was baffled when I saw the initial data for iPTF16geu from the Palomar Observatory. It looked like a normal Type Ia supernova but it was much brighter than it should have been given its distance from us. The rapid follow up with more powerful facilities confirmed that we had stumbled upon an extremely interesting and rare event," says co-author Mansi Kasliwal (MS '07, PhD '11), the principal investigator of GROWTH and an assistant professor of astronomy at Caltech.

Within two months of detection, the team observed the iPTF16geu supernova with the NASA/ESA Hubble Space Telescope; the adaptive-optics instruments on the W.M. Keck Observatory atop Mauna Kea, Hawaii; and the VLT telescopes in Chile. Apart from producing a striking visual effect, capturing the image of a strongly lensed Type Ia supernova such as iPTF16geu is extremely useful scientifically. Astronomers can measure very accurately how much time it takes for the light from each of the multiple images of the supernova to reach us. The difference in the time of arrival can then be used to estimate with a high precision the expansion rate of the universe, known as the Hubble Constant.

Another unique advantage of lensed Type Ia supernovas is that they can be identified with relatively small telescopes, such as the 48-inch Samuel Oschin Telescope at Palomar Observatory, which was used to image the iPTF16geu supernova. Larger telescopes are in high demand, and equipped with narrow-field cameras that take too much time to routinely scan the sky. The iPTF project scanned one-fifteenth of the visible sky every night. Its successor, the Zwicky Transient Facility (ZTF), set to begin observing this summer, will scan the skies even faster, and is capable of covering the entire accessible sky every night. By scanning large swaths of the sky, astronomers can sift through thousands of cosmic objects to find rare events such as the lensing of a Type Ia supernova.

"I am blown away. When iPTF was conceived, we only dreamed of discovering such events. We knew they existed but we honestly did not expect to detect one! It bodes well for the iPTF's successor, ZTF," says Shri Kulkarni, John D. and Catherine T. MacArthur Professor of Astronomy and Planetary Science, who is the principal investigator of ZTF as well as director of the Caltech Optical Observatories.

"What's more, while ZTF is 10 times faster than iPTF, new facilities such as the national flagship Large Synoptic Survey Telescope (LSST) are 10 times faster than ZTF. Clearly, the discovery of iPTF16geu suggests a wealth of new science that will be made possible with the LSST," adds Kulkarni.

The study of iPTF16geu is already delivering interesting results. Using data from Keck and Hubble the team calculated that the lensing matter in the galaxy magnifying iPTF16geu has a mass up to 10 billion times that of the sun and a radius of nearly 3,000 light-years. Compared to other lensing objects, this is relatively tiny. Studies of unusual lensed objects like this give astronomers a new peek into gravitational lensing and may redefine what we know about the factors, such as dark matter and Einstein's general theory of relativity, that contribute to lensing.

"The discovery of iPTF16geu is truly like finding a somewhat weird needle in a haystack. It reveals to us a bit more about the universe, but mostly triggers a wealth of new scientific questions. That's why I love science and astronomy," says Rahman Amanullah, a research scientist at Stockholm University and a co-author on the study.

Story Source:

Materials provided by **California Institute of Technology**. Original written by Ivona Kostadinova. *Note: Content may be edited for style and length.*

Journal Reference:

1. A. Goobar et al. **iPTF16geu: A multiply-imaged gravitationally lensed Type Ia supernova**. *Science*, 2017 DOI: 10.1126/science.aal2729

California Institute of Technology. "Rare brightening of a supernova's light: Astronomers find magnified 'standard candle' in the sky, leading the way to more precise measurements of the expansion rate of our universe." ScienceDaily. 20 April 2017. <www.sciencedaily.com/releases/2017/04/170420141807.htm>.

https://www.sciencedaily.com/releases/2017/04/170420141807.htm

STAR OF THE WEEK – HADAR:

By Larry Sessions in Astronomy Essentials | Brightest Stars | **April 26, 2017**

Alpha and Beta Centauri are the southernmost bright stars in the large and sprawling constellation of Centaurus the Centaur. Both are near the famed Southern Cross, and all are roughly 30 degrees from the south celestial pole

Beta Centauri is very prominent as seen in Earth's Southern Hemisphere. It's bluish in colour, and bright (magnitude 0.61).

Alpha Centauri and Beta Centauri (Hadar) are sometimes called the Southern Pointer Stars. They point to the Southern Cross. The Southern Cross is distinctive but, if you're in the Southern Hemisphere and want to be sure you've found the Cross, these two stars can help you.

Meanwhile, for northern observers, there really are no good pointer stars to Alpha Centauri and Hadar. If you live far enough south to see them, you will need to look for them low on the southern horizon at exactly the right time. The right time might come, for example, at roughly 1 a.m. (local Daylight Saving time) in early May.

By early July, Hadar culminates (reaches its highest point) in the south by nightfall.

It also can be seen briefly in the predawn spring skies.

At any of these times, if you are a northern hemisphere observer at a latitude like that of the southernmost U.S., you might be able to glimpse Hadar making a tiny arc across your southern sky.

Hadar's history and mythology. The proper name of this star – Hadar – apparently derives from an Arabic word for *ground*, possibly referring to its nearness to the horizon as seen from low latitudes. Richard Hinckley Allen of the classic book *Star Names: Their Lore and Meaning* reports that other stars in Centaurus, including Alpha, may also have carried this title.

Beta Centauri is also sometimes called Agena (derived from Latin words *for the knee*), obviously referring to the anatomy of its classical depiction.

The Centaur itself was supposed to be the son of the god Chronos and a sea nymph. Uncharacteristically wise and just, this Centaur, often known as Chiron, was a favourite of Apollo and Diana and figures in some minor mythology of its own. Alpha and Beta Centauri share little in the classical mythology, although were often considered together. In Africa, they were named for two men who once were lions, and in Australian aboriginal myths they represented two brothers who hunted and killed a large emu called Tchingal. At one time in China they were known, according to Allen, as Ma Wei, the Horse's Tail.

Hadar science. Beta Centauri is not one star, but three. About a second of arc away the companion star, Beta Centauri B, poses a difficult telescopic sight. Analysis of the light from Beta Centauri B reveals that it is a very close binary star. Thus, the star seen as a single point of light to the human eye is in fact triple.

Hadar itself (Beta Centauri A) is a pair of B-class stars. The two stars have nearly identical masses and orbit each other over a period of 357 days. They are separated by a mean distance of roughly 4 Astronomical Units, that is, by 4 Earth-sun distances.

Meanwhile, about 100 Earth-sun distances away is Beta Centauri B (aka Hadar B).

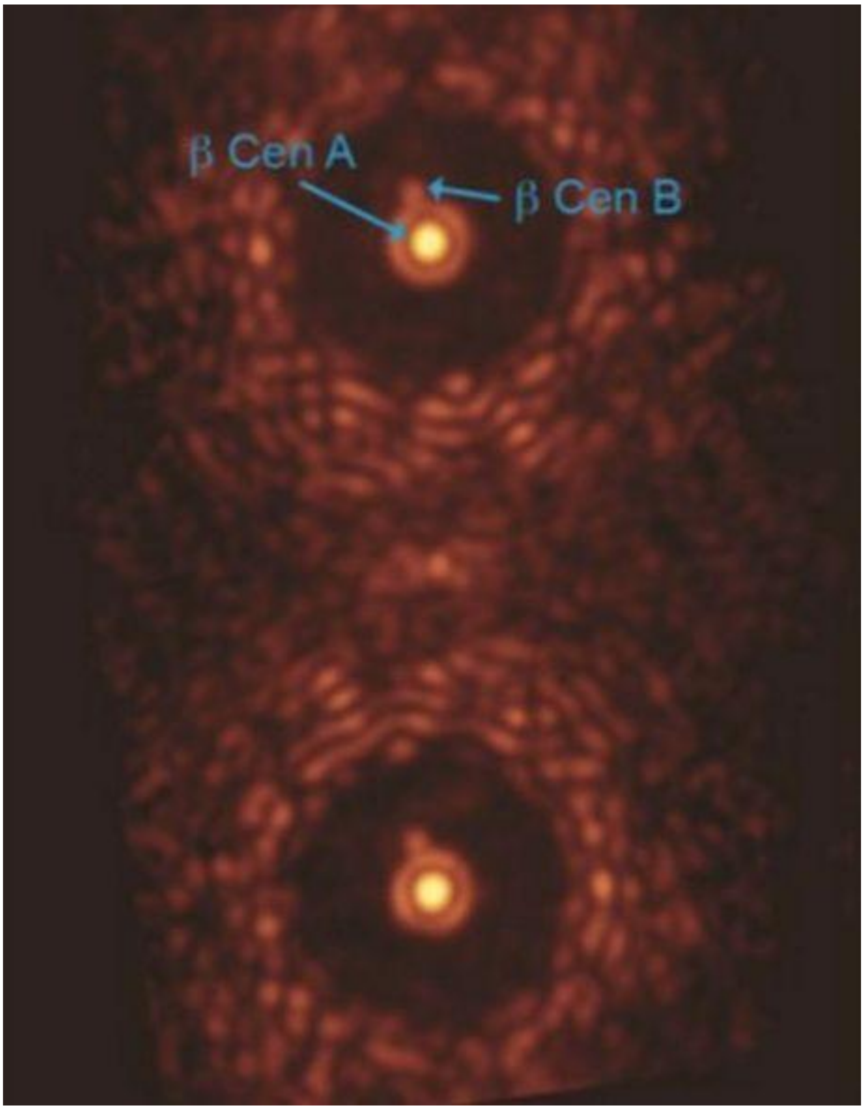
The two stars of Beta Centauri A are very hot and very large. Both are giant stars, not main sequence stars like our sun. Giants and super-giants have left the main sequence, and have entered the terminal stages of star-life. These stars may still have tens of millions of years left, but this is short by comparison to the billions of years a star like the sun spends in its adult life – that is, its life classified as a main sequence star.

Both stars we see as Beta Centauri A will likely someday explode as supernovae.

The three stars in the Beta Centauri system lie at a distance of about 400 light-years. When the two stars in Beta Centauri A binary do someday go supernova, they will be considered nearby supernovae.

Beta Centauri's position is RA:14h 03m 49s, dec:-60° 22′ 23″.

<u>Bottom line:</u> Hadar, aka Beta Centauri, joins Alpha Centauri in pointing to the Southern Cross. It's a triple system. Two of its stars will someday become nearby supernovae.



This is a double image of the star Beta Centauri taken through an experimental coronagraph. Both images of the star contain a dark region that covers the complete 360 degrees around the central star. In both cases, the binary companion to Beta Centauri is easily detected. Image via Leiden University, University of Arizona.

http://earthsky.org/brightest-stars/beta-centauri-hadar-southern-pointer-star

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