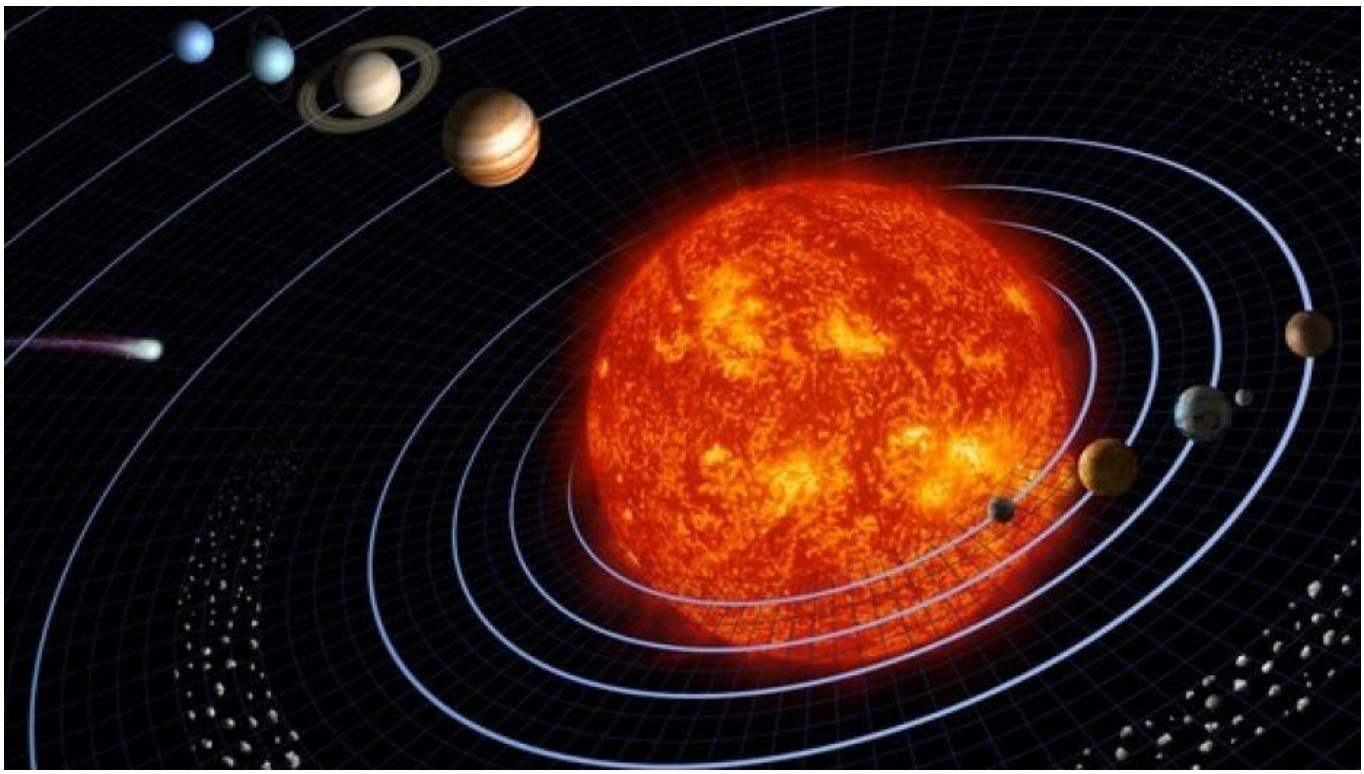
# canopus

## Monthly Newsletter of the Johannesburg Centre of ASSA



(NASA/JPL)

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

**Wednesday, OCTOBER 11 2017**

**Speaker: Chris Stewart**

**Topic: Stellafane – One ATMer's Pilgrimage**

## Upcoming Events:

## Public viewing:

**Friday: 13 OCTOBER 2017 & Friday: 27 OCTOBER 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 22 OCTOBER 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/

## PREPARING FOR THE 11TH. ASSA SYMPOSIUM 2018:

It has belatedly been brought to my attention that the Argus Cycle Tour will take place on Sunday, March 11, 2018! Whilst this would normally not affect our Astronomical pursuits, this does have some serious repercussions! The cyclists who take part often plan their participation 1 year ahead and this in turn means that travel to, and accommodation in, Cape Town could be a problem.

I have always maintained that there are no problems, only solutions, so if you are planning to attend the Symposium, decide now and then for:

- local delegates this should make no difference,
- delegates who want/need to drive to Cape Town make sure you book your accommodation* as soon as possible – check the website given on the Symposium website,
- and delegates who are going to fly to Cape Town, book your flights and accommodation* as soon as possible – flights may well be cheaper now!

* Accommodation; it would make sense to stay with family or friends.

There is a small change to the programme – instead of a Public Lecture on the Friday evening/night there will be a visit to the new digital Planetarium in the Iziko Museum – currently the world's most advanced one in the world.

As we have not yet finalized the costs, simply register on the website in the meantime; knowing how many delegates there are will help us a lot in planning the finer details of the Symposium.

Notice for the first call for papers will be sent out on Monday, 16 October so that the final programme can be drawn up, and by knowing the number of delegates will help us get a better idea for the registration fee – which we

intend to reduce to a minimum. If funding permits, presenters could be subsidized.

Please remember that in 2020 we will be celebrating the SAAO's 200th Anniversary, and there will be preparatory Historical section planning meeting immediately before, and attached to, Symposium 2018; some might want to attend both.

ASSA Symposium 2018 can accommodate about 80 delegates; make sure of your place by registering early, for what I believe will be a memorable and rewarding Symposium with some significant spin-offs and enrichments.

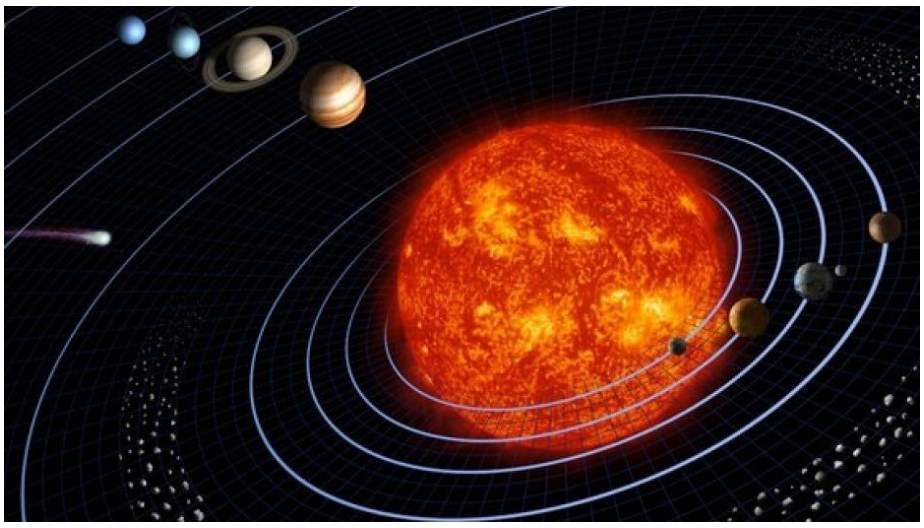
I look forward to seeing many of you in Cape Town, at the SAAO, in March 2018

Case Rijsdijk
Chair LOC

## Q: Is the Earth in danger of being hit by a meteor?

**A:** The Earth has always been subject to impacts by comets and asteroids, although big hits are very rare. The last big impact was 65 million years ago, and that led to the extinction of the dinosaurs. Today NASA astronomers are carrying out a survey called the Spaceguard Survey to find any large near-Earth asteroids long before they hit. We have already determined that there are no threatening asteroids as large as the one that killed the dinosaurs. All this work is done openly with the discoveries posted every day on the NASA Near-Earth Object Program Office website, so you can see for yourself that nothing is predicted to hit Earth.

https://www.nasa.gov/topics/earth/features/2012.html



(NASA/JPL)

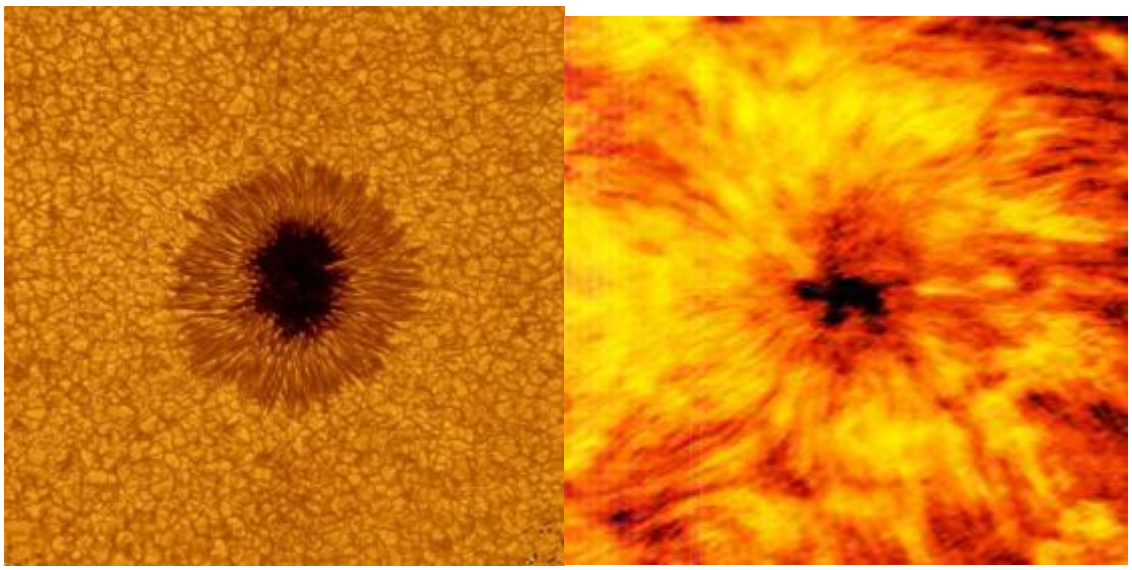
## THE SUN IN OCTOBER 2017:

| Date | Sunrise | Sunset | Length of day |
|---|---|---|---|
| 01/10/2017 | 05:48 | 18:10 | 11:35:03 |
| 03/10/2017 | 06:18 | 17:56 | 11:37:58 |
| 15/10/2017 | 06:05 | 18: 01 | 11:55:53 |
| 22/10/2017 | 05:57 | 18:03 | 12:06:34 |
| 30/10/2017 | 05:49 | 18:06 | 12:18:52 |

## SUNSPOTS AND THE SUN:

Sunspots appear as large black spots on the surface of the Sun. Scientifically, that is described as an appearance of a phenomena on the Sun's photosphere. These areas have the appearance of spots darker than the surrounding areas. They are darker because they are much cooler areas and they are much cooler because of the intense magnetic fields in them.

Most sunspots are found in two bands on the sun, just north and south of an imaginery middle band within a latitude of 30 degrees north and south. equater. They usually appear in pairs of opposite magnetic polarity.



https://www.space.com/14736-sunspots-sun-spots-explained.html ALMA observes a giant sunspot at 1.25 mm wavelength

Sunspots are enormous, exceptionally strong magnetic storms on the surface of the Sun, which in turn, can affect the Earth's weather.

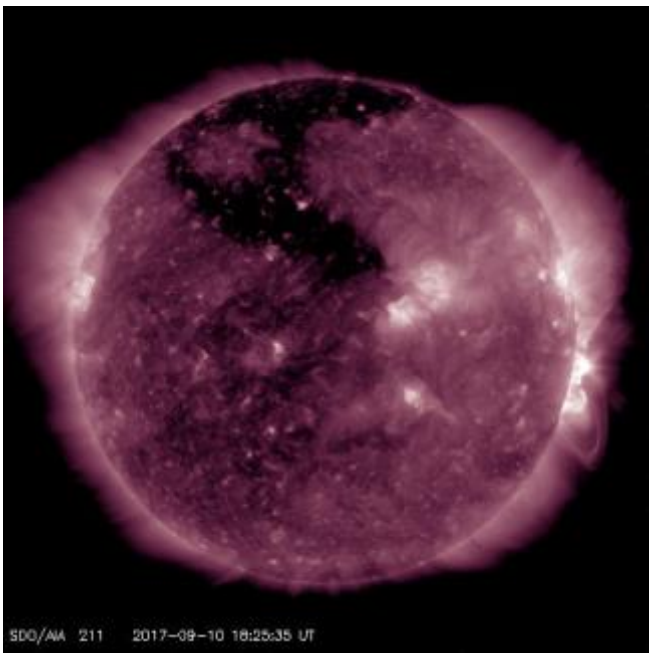
Solar Flares are strong flashes of light energy, described as a sudden flash of increased Sun's brightness observed near the surface of the Sun, or powerful bursts of radiation.

This light energy shoots off the Sun's surface into space at the speed of light. These Flares are usually accompanied by, coronal mass ejection, known as CME.
It is known that harmful radiation from a flare cannot pass through Earth's atmosphere to physically affect beings on Earth. However, they do disturb the atmosphere where GPS communication signals travel.
The Northern Lights or an Auroral display also occurs when a giant cloud of gas from the sun, a CME, collides with Earth's magnetic field.

During August 2017, a northern hemispherepolar coronal hole on the sun caused minor G1 geomagnetic storm conditions which lasted for four days. Then in September, the sun showed extreme activity from the same polar coronal hole, but in a southern extension facing Earth. In 13 and 14 September the NOAA SWPC watched a G2 geomagnetic storm down grading down to a G1 storm. This geomagnetic storm is the kind of space weather which makes the magnetic fields surrounding Earth compress and release. The moving magnetic fields cause and unstable environment, setting charged particles moving and starting electric currrents.
Some particles trapped near Earth were released and these in turn triggered reactions in the upper atmosphere in which oxygen and nitrogen molecules released photons of light resulting in a beautiful aurora

The see how the current solar flares affected Earth visit NOAA's Space Weather Prediction Center at http://spaceweather.gov, the U.S. government's official source for space weather forecasts, alerts, watches and warnings.

Credits: NASA's Goddard Space Flight Center/Scott Wiessinger
www.nasa.gov/feature/goddard/2017/active-region-on-sun-continues-to-emit-solar-flares



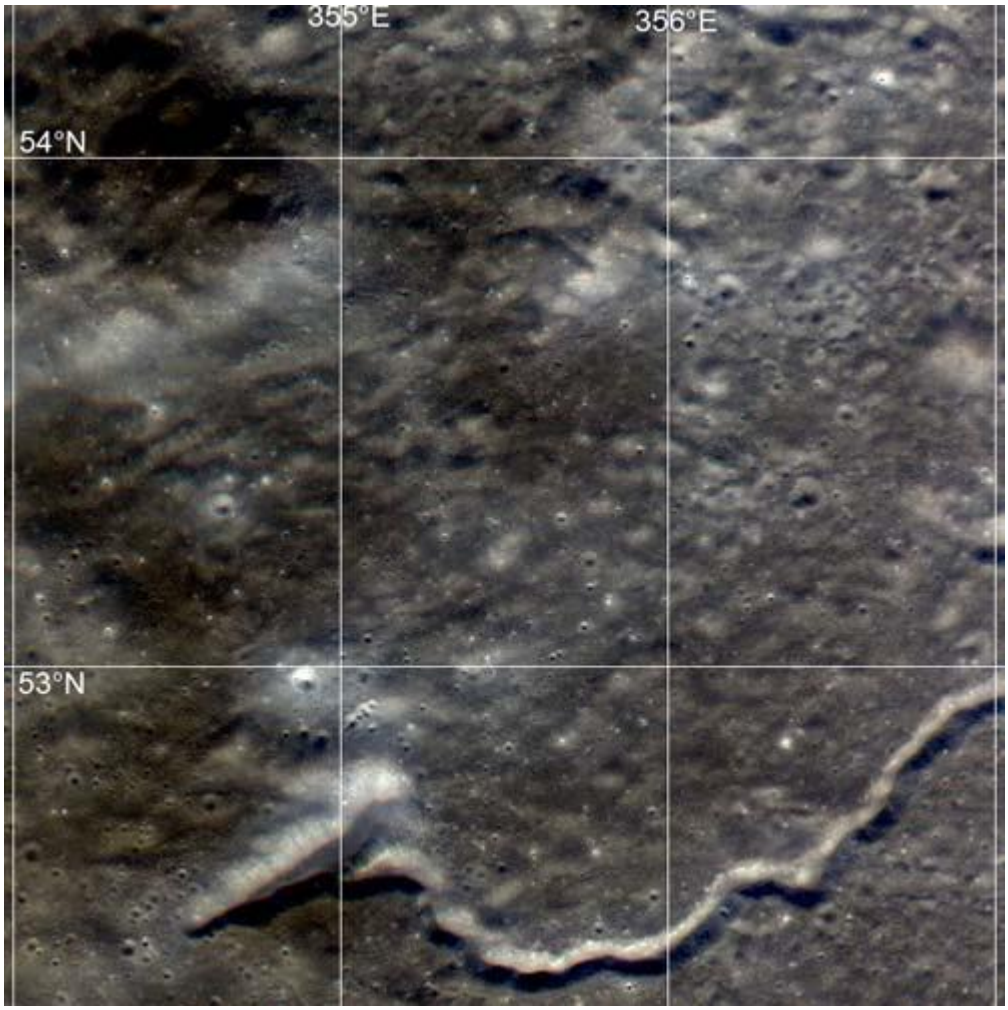

https://www.spaceweatherlive.com/en/news/view/308/20170911-coronal-hole-faces-earth.
/www.nasa.gov/content/goddard/how-the-sun-causes-an-aurora

## THE MOON IN OCTOBER 2017:

| Date | Moonrise | Moonset | |
|---|---|---|---|
| 01/10/2017 | 14:08 | 02:51 | |
| 05/10/2017 | 17:58 | 05:35 | Full Moon |
| 12/10/2017 | 00:12 | 11:18 | last quarter |
| 19/10/2017 | 05:24 | 18:04 | New Moon |
| 28/10/2017 | 11:57 | 00:46 | first quarter |

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

## THE MOONS CRATER CALLED PLATO:




https://www.nasa.gov/mission_pages/LRO/multimedia/lroimages/lroc-201000202-platocrater.html

## A CRATER CALLED PLATO:

To an untrained eye this area would possibly appear to be uninteresting. However,if humans think of living on the moon then this would be a region of first exploration. To explore a possible pyroclastic deposit. Radar studies of this region, along with spectroscopic evidence from the US Clementine mission indicate, that this region may be covered with pyroclastic materials.

Pyroclastic deposits are potentially some of the most valuable resources to support human lunar habitation. Processing pyroclastic materials can provide relatively easy access to oxygen and water for future lunar explorers. Human exploration of this location will enable access to these important resources, as well as provide key insights into the nature of these pyroclastic materials and the possible source regions of these volcanic eruptions.

https://www.nasa.gov/mission_pages/LRO/multimedia/lroimages/lroc-201000202-platocrater.html

## PLANETS IN OCTOBER 2017:

**Mercury:** During October, Mercury has sunk back into the Sun's glare and is lost to view.

**Venus:** is brightly beautiful in our early morning sky. Venus continues to be a brilliant "morning star", shining at magnitude -3.9, making it the brightest object in the night sky after the Moon.

**Mars:** Having spent a couple of months on the far side of the Sun, Mars is slowly becoming visible in the morning sky.

**The surface of Mars**

**Saturn:** After all the excitement and history that Saturn has made just recently, the ringed planet is still high in the sky during the early evening, for southern

hemisphere observers. Shining at a magnitude of about 0.5. The rings are now nearly open as wide as they can be, as viewed from Earth.

NASA picture of Saturn

**Jupiter:** Giant planet Jupiter is now heading towards the end of its current apparition and you will find it low in the southwestern sky as soon as it gets dark, setting by mid-evening. It shines as -1.7 magnitude, showing its four main, Galilean moons, Io, Europa, Ganymede and Callisto.

NASA picture of Jupiter

**Uranus:** At a magnitude around 5.7, the planet is just too faint to see with the unaided eye in moonlit, or light-polluted skies.

**Neptune:** Is an outer planet, another ice giant like Uranus. Neptune is very faint, being much further away. If one knows where to look it is not difficult to find with a magnitude of 7.82 in the constellation Aquarius.

## PEACE IN HEAVEN:

By Magda Streicher

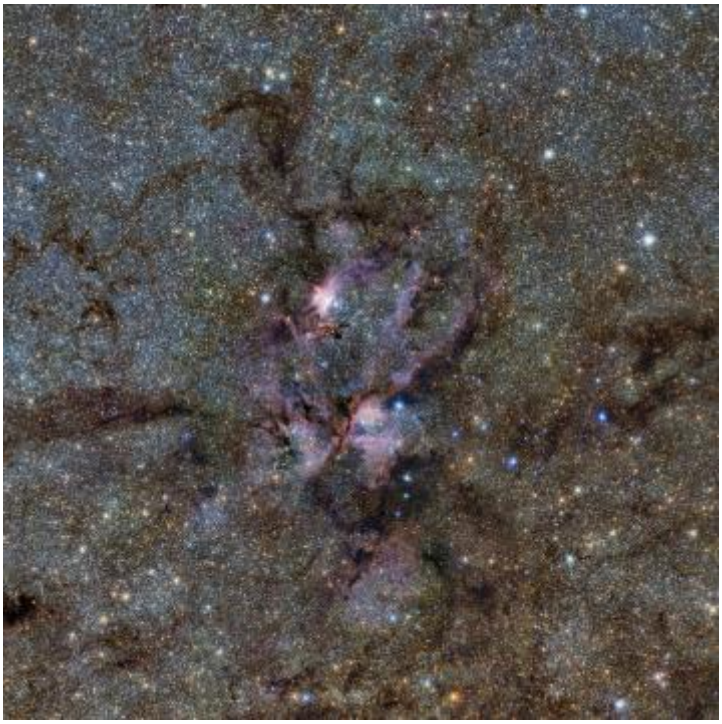
For us humans, Earth is the beginning and the end of life as we know it, but also a place where conflict dominates, with just little patches of peace and calmness here and there.

During a dark, pristine night filled with stars and an unseen sense of peace enfolding, I do an observation of the War en Peace Nebula, NGC 6357, which is located within the Scorpius constellation. The view that greets me through the eye-piece of the telescope is a scene one could almost describe as soaked through with nebulous gases formed by gravitation and magnetic fields. Bright stars peek through the faint filaments – some of the most massive stars ever discovered – situated within the open cluster Pismis 24. The brightest star in the area shining through the mist is the magnitude 7 (HD 157528), which is also a double star. However, Pismis 24 also contains some fainter stars, displaying a smaller patch covered in nebulosity. Marie Paris Pismis de Recilas, whose name this stars bear, was a Turkish-Mexican astronomer of Armenian descent who became the first woman to get a PhD from the science faculty of Istanbul University.

The Pismis cluster may be the peace factor among the stormy clouds. But if you're wondering, the best way is to have a look for yourself. As Auke Slotegraaf describes it: ..very moody image... troubled... tumultuous....

There is also NGC 7252, the so-called Atoms for Peace Galaxy in Aquarius, which happens to be the product of two large galaxies that once collided. The turbulent pair, now joined, spans 666 000 light-years and are more or less 220 million light-years away. So there you have it: peace in heaven and war on earth.

| OBJECT | TYPE | RA | DEC | MAG | SIZE |
|---|---|---|---|---|---|
| | | | | | |
| NGC 6357 | Diffuse Nebula | 17h24m.7 | -34°12'.1 | 4-5 | 50'x40' |
| Pismis 24 | Open Cluster | 17h25m.2 | -34°24'.0 | 9.6 | 4' |



http//www.scitechdaily.com/images/the-stellar-nursery-known-as-NGC-6357.jpg

Located around 8000 light-years away in the constellation of Scorpius (The Scorpion), NGC 6357 — sometimes nicknamed the Lobster Nebula [1] due to its appearance in visible-light images — is a region filled with vast clouds of gas and tendrils of dark dust. These clouds are forming stars, including massive hot stars which glow a brilliant blue-white in visible light.

https://scitechdaily.com/new-vista-image-of-stellar-nursery-ngc-6357/

## CHARLES MESSIER:

**Charles Messier**

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

**Charles Messier**, was a French Astronomer whose work on the discovery of comets led to the compilation of a catalogue of deep sky objects known today as the *Messier Catalogue of Nebulae and Star Clusters*. Messier was born in Lorraine, France on June 26, 1730. His father died when he was 11, and since he was the tenth of twelve children he had very little opportunity for education. He developed an interest in astronomy as a boy after he saw the brilliant six-tailed comet of 1744. He was eventually hired as a draftsman by Joseph-Nicholas de l'Isle, Astronomer to the French Navy. During this time, he learned to use astronomical instruments. He became a skilled observer, and was later promoted to clerk at the Marine Observatory at the Hotel de Cluny in Paris.

The astronomer Edmund Halley had predicted that the comet of 1682 would return in late 1758 or early 1759. Using charts that had incorrectly been prepared by de l'Isle, Messier began searching for the comet with a small reflector telescope. He eventually located the comet on January 21, 1759, but de l'Isle initially refused to let Messier announce his discovery. From that time forward, Messier devoted his life to the search for comets.

In the following years, he discovered as many as 21 comets by 1798. While searching on August 28, 1758, Messier discovered a small nebulous (fuzzy) object in the constellation of Taurus. It is known today as the Crab Nebula, the remains of a supernova explosion. He decided to keep a listing of these objects so that they would not be mistaken for comets in the future. The Crab Nebula, also known now as M1, became the first entry in what would eventually become the most famous list of galaxies, nebulae and star clusters ever assembled. It is ironic that Messier became famous for this listing of "time-

wasting objects to avoid when comet hunting" and not for the comets he was seeking.

In 1759, Messier became the chief astronomer of the Marine Observatory. He was also elected to the Royal Society of London in 1764 as well as the Paris Academy of Sciences in 1770. King Louis XV gave Messier the nickname "Comet Ferret." During a seven-month period of searching for comets in 1764, Messier added 38 new objects to his list including M13 (the great globular cluster in Hercules), the Swan Nebula (M17) in Sagittarius and the Andromeda galaxy (M31). In January of the following year he logged M41, the open cluster southwest of Sirius. Messier determined the positions of the Orion Nebula (M42 and M43), the Beehive cluster (M44) and the Pleiades (M45) on March 4, 1769. Messier also began compiling reports of discoveries by other astronomers. In fact, only 17 of the 45 objects in the first instalment of Messier's catalogue published in 1774 were discovered by Messier himself. By 1780 the number of objects in his catalogue had increased to 80.

Messier made his last discovery in 1798. He continued to observe until he suffered a debilitating stroke. Two years later, on April 12, 1817 he died at the age of 86.

Today there are a total of 110 objects in the Messier catalogue. Seven of these objects were added in the twentieth century. M110, the last entry, was added in 1967. These are among the brightest deep sky objects in the sky, which makes them favourite targets for amateur astronomers. In fact, the "Messier marathon" has become somewhat of a rite of passage for amateur astronomers around the world. The goal it to see how many of the 100 objects can be located and viewed in a single night. The Messier catalogue contains the best deep sky objects visible in the northern hemisphere.

http://www.seasky.org/space-exploration/astronomers-charles-messier.html

## SOME MESSIER OBJECTS TO OBSERVE IN SPRING:

| CONSTELLATION | MESSIER NUMBERS | NAMES THE OBJECTS ARE ALSO KNOWN BY |
|---|---|---|
| Andromeda | M31, M32, M110 | M31- NGC 224 spiral galaxy, M32 – NGC 221 Eliptical dwarf galaxy, M110 a satellite galaxy of M31 |
| Aquarius | M2, M72, M73 | M2 – NGC 7089 globular cluster, M72 a globular cluster, M73 a system or asterism of 4 stars. |
| Capricornus | M30 | M30 – NGC7099 globular cluster |
| Cygnus | M29, M39 | M29 – NGC 6913 the cooling tower, M39 an open cluster. |
| Lyra | M56 & M57 | M56 – a globular cluster, M57 – the Ring Nebula. |
| Orion | M42, M43 M78 | M42 – Orion nebula, M43 part of Orion nebula, de Mairan's, a diffuse nebula |
| Pegasus | M15 | M15 – NGC 7078 Pegasus Globular Cluster |
| Taurus | M1, M45 | M1 – Crab Nebular, M45 Pleades |
| Triangulum | M33 | M33 – Triangulam galaxy also known as the Pinwheel spiral galaxy. |

A continuous list of Messier objects will appear in each *Canopus* at the times they appear in our skies.

# NEBULAE:

Nebulae are enormous clouds of dust and gas occupying the space between the stars. Some have pretty names to match their fascinating beauty, for example the Swan nebula, or the Rose nebula. Imaginations can run riot when we see those beautiful photographs in books and magazines. One imagines looking through a telescope and seeing colour in all magnificence in the night skies. The truth is, when we look through a telescope we see in the grey scale. It is only when taking a picture with colour cameras that the colour is sometimes partially visible. Finally, when the image is fully processed, the magnificent beauty and majesty creates the greatest sense of awe.

Stars are different, some of those, as in the Jewel Box, can be seen as red, blue, yellow, orangish and even white in colour like the diamond lights of the Butterfly Nebula.

Nebula is Latin for the word 'cloud' and that is precisely what a nebula is: A cloud of interstellar gas and dust, leftover from an exploding star.

There are three types of nebulae:

1. **Emission Nebulae**: These are bright and diffuse. Emitting light and other radiation as a result of the removal of electrons, also known as ionization, together with the ultra violet radiation of gas atoms. The ultra violet source being one or more very hot stars. Gas ions recombine with free electrons; in excited atoms, radiation is emitted. This gives rise to emission lines in the spectrum.
   Examples of emission nebulae are the H11 regions such as the Orion Nebula and the Ring Nebula in Lyra.

   Supernova remnants are a form of Emission Nebula in which the gas is made to glow, not by the ultra violet radiation of the star within, but by the frictional heating as it collides with surrounding interstellar gas. eg. The Cygnus Loop.
   The Crab Nebula is a type of supenova remnant that shines by synchroton radiation.

2. In contrast is the brightness of: **Reflection Nebulae**, which result from the scattering of light from nearby stars.

3. **Dark Nebulae**: Are not luminous at all. Dark nebulae happen when interstellar gas and dust absorbs light from background stars, producing dark patches in the sky. Dark Nebulae are known as Bok Globules which are dense absorption nebulae, nearly spherical in shape.

https://en.wikipedia.org/wiki/Nebula
https://www.nasa.gov/multimedia/imagegallery/image_feature_1863.html
Https://www.google.com/search?q=3+TYPES+OF+NEBULA&ie=utf-8&oe=utf-8&client=firefox-b&gfe_rd=cr&dcr=0&ei=D0TSWd6SNIWp8weRxZvgCg

*Below is a note on Synchroton radiation*:

## **Synchrotron Radiation:**

When moving charges spiral in a magnetic field, they produce radiation, as a result of their accelerations, which is called synchrotron radiation. The phenomenon is named after the General Electric Synchrotron, an accelerator which used magnetic fields to contain electrons which had been accelerated to high energies. Such radiation is observed in astronomical sources, such as the Crab Nebula. Its signature is that it does not follow the blackbody radiation curve, increasing toward lower frequencies rather than toward high (it is said to be "nonthermal"). It also shows characteristic polarization in the plane perpendicular to the magnetic field about which the charges are spiralling.

Because the spiralling charges are emitting energy, they will be slowing down and emitting at lower frequencies. When high frequency synchrotron radiation is observed steadily from astronomical sources, it implies that there is a source of energy of some kind to feed the process.

http://hyperphysics.phy-astr.gsu.edu/hbase/Astro/crab.html

https://www.nasa.gov/sites/default/files/thumbnails/image/stscihp1721af5290x5290.png
Crab Nebula.

## FAREWELL TO CASSINI AFTER THIRTEEN YEARS IN SPACE:

Cassini has ended its 13-year tour of the Saturn system with a plunge into the planet to ensure Saturn's moons – in particular Enceladus, with its subsurface ocean and signs of hydrothermal activity – remain pristine for future exploration.

The spacecraft's fateful dive was the final beat in the mission's Grand Finale, 22 weekly dives, which began in late April, through the gap between Saturn and its rings. No spacecraft has ever ventured so close to the planet before.

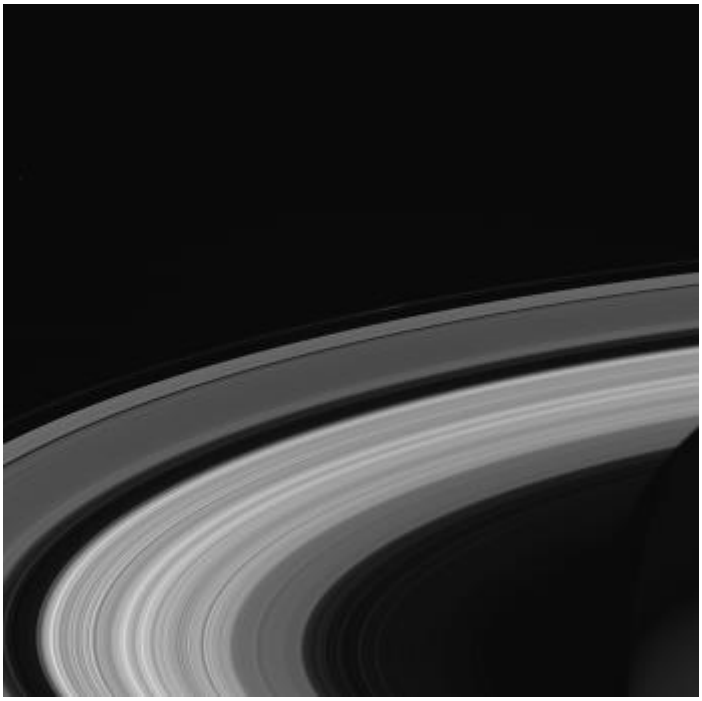
When Cassini first began its entry into Saturn's atmosphere, the spacecraft's attitude control thrusters fired in short bursts, to work against the thin gas and so kept Cassini's saucer-shaped high-gain antenna pointed at Earth to relay the mission's precious final data. As the atmosphere changed, the thrusters were forced to ramp up their activity, going from 10 percent of their capacity to 100 percent in about a minute. Once fired at full capacity, the thrusters kept Cassini firmly pointed in the right position, and the spacecraft tumbled.

Once the antenna pointed just a few fractions of a degree away from Earth, communications were permanently cut. Loss of signal occurred at 1,500 kms. above Saturn's cloud tops. The spacecraft burnt up like a meteor. 30 seconds following loss of signal, the spacecraft fell apart; within a couple of minutes, all remnants of the spacecraft were completely consumed in the atmosphere of Saturn.

Radio signals from Saturn took 83 minutes to reach Earth. This meant that as the spacecraft went out of communication, the radio signals were only received on Earth 83 minutes later.

"The spacecraft's final signal will be like an echo. It will radiate across the solar system for nearly an hour and a half after Cassini itself has gone," said Earl Maize, Cassini project manager at NASA's Jet Propulsion Laboratory (JPL) in Pasadena, California. "Even though we'll know that, at Saturn, Cassini has already met its fate, its mission isn't truly over for us on Earth as long as we're still receiving its signal."

https://saturn.jpl.nasa.gov/news/3119/cassini-spacecraft-makes-its-final-approach-to-saturn/



https://saturn.jpl.nasa.gov/galleries/images/

## CONSTELLATIONS AND STARS IN OCTOBER:

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, departed the western horizon at the end of September.

While passing on, 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.

Rising in the East we have the constellation Eridanus with its very bright star Achernar. At around 3am., one can follow Eridanus the river, all the way down to Rigel the bright blue-white star which represents one foot of Orion in the Orion constellation.

Hanging almost directly above it is a bright star called Formalhaut, almost at zenith in constellation Piscis Austrinus. Lying close by from east to west are Aquarius and Capricornus while lower down lies one of our five bird constellations, Grus, with its bright star Alnair.

Cygnus the Swan, graces our northern horizon presenting trickles of excitement at viewing the start our spring night skies. The Square of Pegasus hangs above the northern horizon offering the bright Andromeda and

Triangulam galaxies. Cygnus and Delphinus, together with little Sagitta lie off to the northwest beginning their downward run.

Southward, out of the flat starry plane of the Milky Way we observe deep galactic space. Here, in the southern hemisphere it appears to present a sense of emptiness or barreness, because of there being few relatively bright foreground stars. Perhaps it is just an impression created by the thin film of cloud, a forerunner of our summer weather.

The bright star Canopus in constellation Carina returns to the sky in the southeast while the Magellanic Clouds linger well above the south eastern horizon.

## START EXPLORING THE SKY IN SPRING OF 2017:

It's a beautiful spring night, we look upward, searching for all the familiar objects we put aside during the night cold of winter; knowing full well it is not what we should have done since we want to be budding astronomers. However, mankind is "only human" and easily gives way to creature comforts and warmth to endure the long, cold season and cold winters' nights.

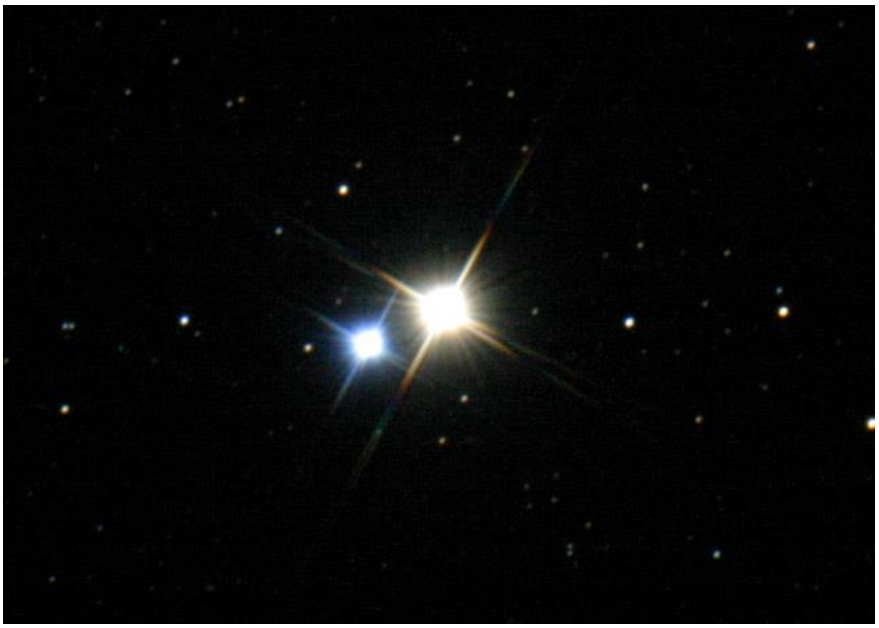
For Springtime, have some fun with your telescope, Scan the Milky Way! Just insert an eyepiece with a wide field of view. Switch off your laptop, ignore observing guides, turn off Go-To drives and just run your telescope up and down the Milky Way, slowly and by hand. You will be amazed at the fun you will have and what you see!

**Jupiter:** has been in our winter skies and next to the Sun and Moon, Jupiter has the most detail. Jupiters four largest moons look like bright stars in a line, or on either side of Jupiter. They are, Io, Europa, Ganymede and Callisto. Along with the moons are two dark stripes that represent the north and south equatorial belts. They are said to be of dust swept up in raging wind storms. The Great Red Spot and the Little Red Spot are hurricanes caused by those raging winds.

**Double Stars**: Take some time out to observe double stars. Stars look like single points to the naked eye, but, there are many that a telescope will split into pairs and it does not take a complicated telescope set up to do just that.

It is the pairs separation; which is the visual distance between the two stars, that is the important number for use to see if your telescope can split the stars. This is given in Arc seconds and represented by the symbol ". So, one arc second equals 1 threethousandth six hundredth of one degree. eg. 1" = 1/3600 of 1deg.

**Albireo:** is a star in constellation Cygnus the Swan just a colourful one of thousands of double stars.



https://www.google.com/search?q=show+picture+of+double+star+Albireo&client=firefox-b&sa=X&dcr=0&tbm=isch&imgil=ubrdIC0e8pm6HM%253A%253BhaxFLZBRWmILsM%253Bhttps%25253A%25252F%25252Fwritescience.wordpress.com%25252Ftag%25252Falbireo%25252F&source=iu&pf=m&fir=ubrdIC0e8pm6HM%253A%252ChaxFLZBRWmILsM%252C_&usg=__bYU-_UWjqYeWxklghpjpjXmVQ0E%3D&ved=0ahUKEwjjwtmO-bjWAhUlB8AKHdYEC5oQyjcIRg&ei=cxbFWaO9KKWOgAbWiazQCQ&biw=1440&bih=791#imgrc=ubrdIC0e8pm6HM:

## FAST RADIO BURSTS MAY BE FIRING OFF EVERY SECOND:

Release No.: 2017-28
Thursday, September 21, 2017 - 10:00am

When fast radio bursts, or FRBs, were first detected in 2001, astronomers had never seen anything like them before. Since then, astronomers have found a couple of dozen FRBs, but they still don't know what causes these rapid and powerful bursts of radio emission.

For the first time, two astronomers from the Harvard-Smithsonian Centre for Astrophysics (CfA) have estimated how many FRBs should occur over the entire observable universe. Their work indicates that at least one FRB is going off somewhere every second.

"If we are right about such a high rate of FRBs happening at any given time, you can imagine the sky is filled with flashes like paparazzi taking photos of a celebrity," said Anastasia Fialkov of the CfA, who led the study. "Instead of the light we can see with our eyes, these flashes come in radio waves."

To make their estimate, Fialkov and co-author Avi Loeb assumed that FRB 121102, a fast radio burst located in a galaxy about 3 billion light years away, is representative of all FRBs. Because this FRB has produced repeated bursts since its discovery in 2002, astronomers have been able to study it in much more detail than other FRBs. Using that information, they projected how many FRBs would exist across the entire sky.

"In the time it takes you to drink a cup of coffee, hundreds of FRBs may have gone off somewhere in the Universe," said Avi Loeb. "If we can study even a fraction of those well enough, we should be able to unravel their origin."

While their exact nature is still unknown, most scientists think FRBs originate in galaxies billions of light years away. One leading idea is that FRBs are the by-products of young, rapidly spinning neutron stars with extraordinarily strong magnetic fields.

Fialkov and Loeb point out that FRBs can be used to study the structure and evolution of the Universe even though their origin is not yet fully understood. A large population of faraway FRBs could act as probes of material across gigantic distances. This intervening material blurs the signal from the cosmic microwave background (CMB), the leftover radiation from the Big Bang. A careful study of this intervening material should give an improved understanding of basic cosmic constituents, such as the relative amounts of ordinary matter, dark matter, and dark energy, which affect how rapidly the universe is expanding.

FRBs can also be used to trace what broke down the "fog" of hydrogen atoms that pervaded the early universe into free electrons and protons, when temperatures cooled down after the Big Bang. It is generally thought that ultraviolet (UV) light from the first stars travelled outwards to ionize the hydrogen gas, clearing the fog and allowing this UV light to escape. Studying very distant FRBs will allow scientists to study where, when and how this process of "reionization" occurred.

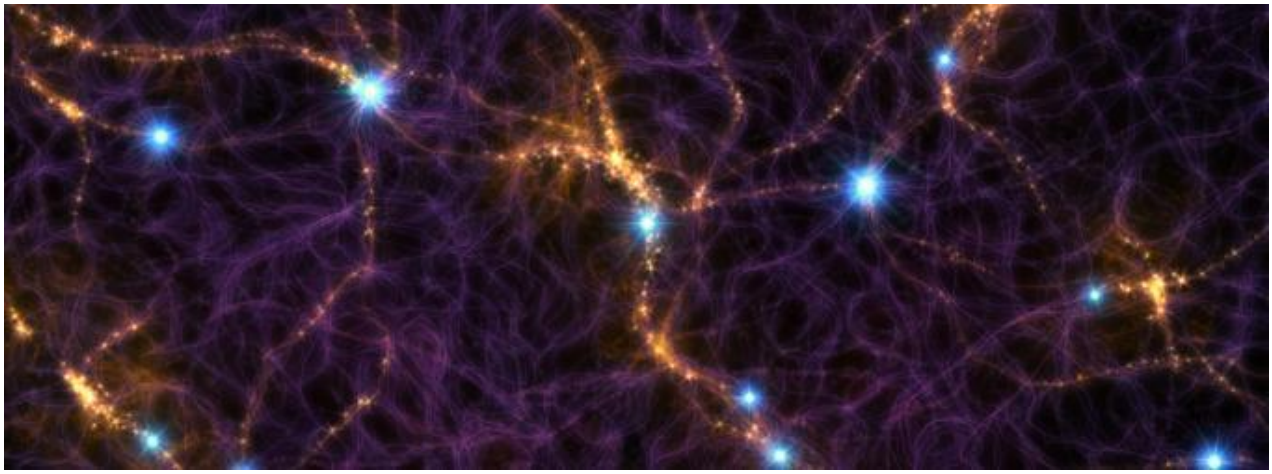
"FRBs are like incredibly powerful flashlights that we think can penetrate this fog and be seen over vast distances," said Fialkov. "This could allow us to study the 'dawn' of the universe in a new way."

The authors also examined how successful new radio telescopes – both those already in operation and, those planned for the future – may be at discovering large numbers of FRBs. For example, the Square Kilometre Array (SKA) currently being developed will be a powerful instrument for detecting

FRBs. The new study suggests that over the whole sky the SKA may be able to detect more than one FRB per minute that originates from the time when reionization occurred.

The Canadian Hydrogen Intensity Mapping Experiment (CHIME), that recently began operating, will also be a powerful machine for detecting FRBs, although its ability to detect the bursts will depend on their spectrum, i.e. how the intensity of the radio waves depends on wavelength. If the spectrum of FRB 121102 is typical then CHIME may struggle to detect FRBs. However, for different types of spectra CHIME will succeed.

https://www.cfa.harvard.edu/news/2017-28
Harvard-Smithsonian Center for Astrophysics

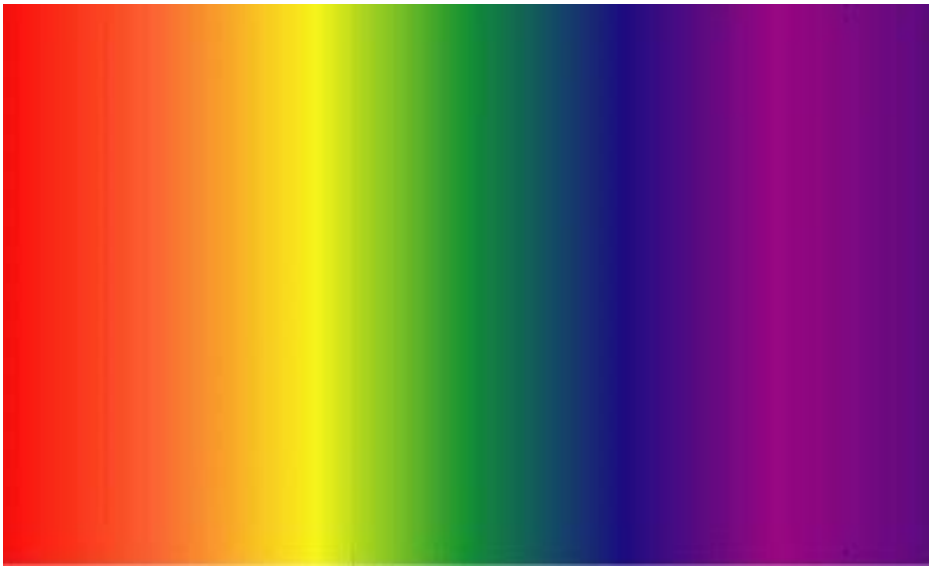


## REDSHIFT BLUESHIFT AND HUBBLE:

Redshift and blueshift describe how light changes as objects in space (such as stars or galaxies) move closer or farther away from us. The concept is key to charting the universe's expansion.

Visible light is a spectrum of colours, which is clear to anyone who has looked at a rainbow. When an object moves away from us, the light is shifted to the red end of the spectrum, as its wavelengths get longer. If an object moves closer, the light moves to the blue end of the spectrum, as its wavelengths get shorter.

To think of this more clearly, the European Space Agency (ESA) suggests, imagine yourself listening to a police siren as the car rushes by you on the road.



The visible light spectrum.
*Credit: NASA.*

Christian Andreas Doppler was the first to describe this sound and it is called the "Doppler effect".

Since light also emanates in wavelengths, this means that the wavelengths can stretch or crunch together depending on the relative position of objects. That said, we don't notice it on a daily-life-sized scale because light travels so much faster than the speed of sound — a million times faster, ESA noted.

American astronomer Edwin Hubble, was the first to describe the redshift phenomenon and tie it to an expanding universe. His observations, revealed in 1929, showed that nearly all galaxies he observed are moving away.

"This phenomenon was observed as a redshift of a galaxy's spectrum," NASA wrote. "This redshift appeared to be larger for faint, presumably further, galaxies. Hence, the farther a galaxy, the faster it is receding from Earth."

The first detection of gravitational redshift came in 1959, after scientists detected it occurring in gamma-ray light emanating from an Earth-based lab. Previous to 2011, it also was found in the sun and in nearby white dwarfs, or the dead stars that remain after sun-sized stars cease nuclear fusion late in their lives.

The galaxies are moving away from Earth because the fabric of space itself is expanding. While galaxies themselves are on the move, the Andromeda Galaxy and the Milky Way, for example, are on a collision course; there is an overall phenomenon of redshift happening as the Universe gets bigger.

The terms redshift and blueshift apply to any part of the electromagnetic spectrum, including radio waves, infrared, ultraviolet, X-rays and gamma

rays. So, if radio waves are shifted into the ultraviolet part of the spectrum, they are said to be redshifted, shifted toward the lower frequencies.

The redshift of an object is measured by examining the absorption or emission lines in its spectrum. These lines are unique for each element and always have the same spacing. When an object in space moves toward or away from us, the lines can be found at different wavelengths than where they would be if the object were not moving (relative to us).

Redshift is defined as the change in the wavelength of the light divided by the wavelength that the light would have if the source was not moving, called the rest wavelength:

At least three types of redshift occur in the universe:

1. From the universe's expansion.

2. From the movement of galaxies relative to each other.

3. From "gravitational redshift," which happens when light is shifted due to the massive amount of matter inside a galaxy.

This latter redshift is the subtlest of the three, but in 2011 scientists managed to identify it on a universe-size scale. Astronomers did a statistical analysis of a large catalogue known as the Sloan Digital Sky Survey, and found that gravitational redshift does happen, exactly in line with Einstein's theory of general relativity. This work was published in a Nature paper.

"We have independent measurements of the cluster masses, so we can calculate what the expectation for gravitational redshift based on general relativity is," said University of Copenhagen astrophysicist Radek Wojtak at the time. "It agrees to the first detection of gravitational redshift which came in 1959, after scientists detected it occurring in gamma-ray light emanating from an Earth-based lab. Before 2011, it was also found in the sun and in nearby white dwarfs, or the dead stars that remain after sun-sized stars cease nuclear fusion late in their lives exactly with the measurements of this effect."

https://www.space.com/25732-redshift-blueshift.html

The standard picture of cosmology, based on Einstein's general theory of relativity explains how to picture this expanding universe.
Consider a loaf of bread, with raisins sprinkled evenly throughout it. As the bread expands during cooking all the raisins are moved further and further apart from each other. Seen from any raisin,all the other raisins in the bread appear to be receding with some velocity.
This example also explains the linearity of the Hubble law, which means that the recession velocity is proportional to distance. If all the lengths in the universe double in 10 million years then something that was initially 1

megaparsec away from us will end up a further megaparsec away. Something that was 2 megaparsecs away from us will end up a further 2 megaparsecs away. In terms of the speed at which the objects appear to be receding from us, the object twice as distant has receded twice as fast!
On very large scales Einstein's theory predicts departures from a stricly linear Hubble law. The amount of departure, and the type, depends on the amount and types of mass and energy of the universe. In this way a plot of recession velocity (or redshift) vs. distance (a Hubble plot), which is a straight line at small distances, can tell us about the amount of matter in the universe and provide crucial information about dark matter.
http://w.astro.berkeley.edu/~mwhite/darkmatter/hubble.html

## DOUBLE STAR NOTES:

## RESOLUTION & MAGNITUDE LIMITS
## INTRODUCTION: PRECEPTS of RESOULTION:

## CLOSE PAIRS:

1) Resolving the closest pairs below about 1 or 2 arcsec can require the combination of aperture, moderate to high magnification and good seeing. This is also around the threshold of moderate seeing, meaning that in unfavourable conditions, these pairs may not be clearly split.

2) For the closest pairs, resolution assumes numbers of provisos being met. These include:

**a.** Both stars are equally 6.0v (visual) magnitude.
**b.** Both stars are solar-like yellow stars
**c.** Aperture is large enough to split the pair cleanly.
**d.** Optics are clean, freshly coated if reflectors, and have optical qualities better than about 1/8th wave.

3) Close pairs which are *brighter* than 6th magnitude become more difficult to resolve because of the overwhelming light of the components. This often requires either the light be reduced via an aperture stop — limiting the telescopes aperture or using neutral density filters.

4) Close pairs which are *fainter* in magnitude are also more difficult to resolve, and are much more problematic when nearing the faintest magnitude limit of the telescope.

5) Close pairs with increasing differences in magnitude (Δm) also become far more difficult to resolve, as the light of the primary star often overwhelms the nearby companion. For each magnitude in difference rises almost exponentially, roughly doubling in resolution for every two magnitudes.

6) Close pairs have commonly a transition phase from an apparent single star to seeing the pair cleanly resolved. Stars through telescopes are not real pinpoints, but, are seen as, Airy Disks — a central bright spot encircled by a number of much fainter rings — the two stars can appear elongated, joined or merged together. Clean separation is defined by dark space, existing between the components.

7) Close pairs on the Dawes Limit, may or may not be cleanly resolved. The empirical Dawes Limit is a result of a large sample of various sizes of telescopes, each being tested for their ability to split pairs by average observers through the Earth's atmosphere, defined by the simple equation;

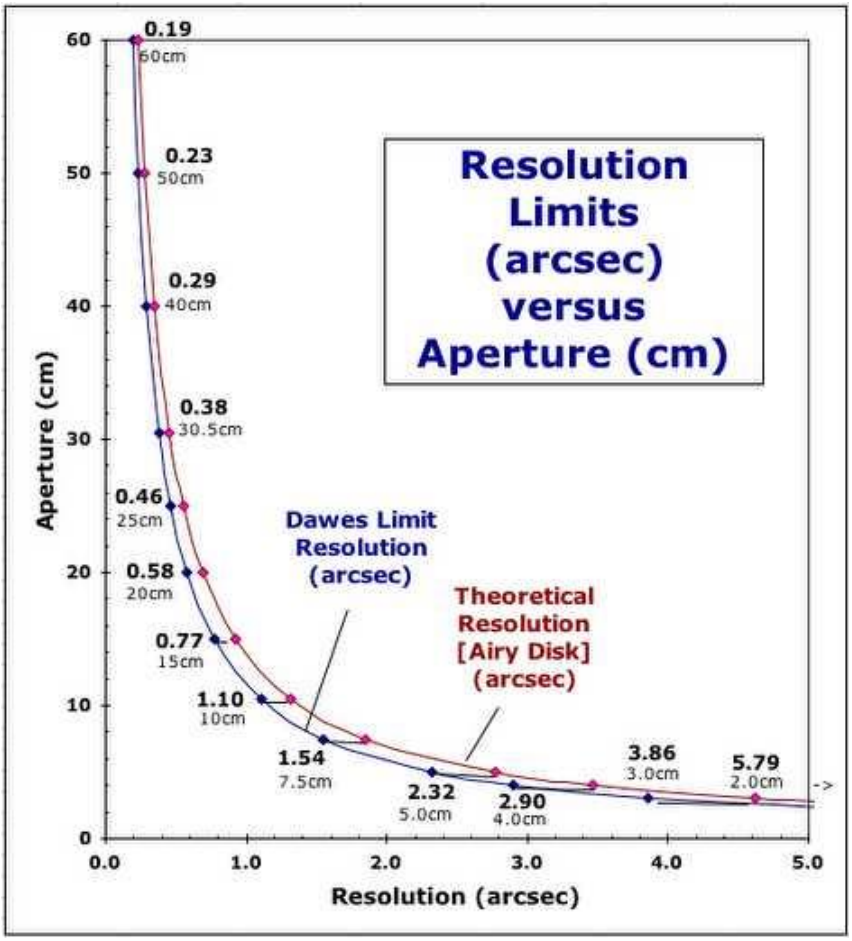
**Res (arcsec) = 11.58 / D (cm) or**
**Res (arcsec) = 4.54 / D (inches)**
**Where;**
**Res = Resolution in arcsec**
**D = Aperture in either centimetres or inches.**

I.e. 7.5cm (3-inch) is 1.52 arcsec, 10.5cm (4-inch) is 1.14 arcsec, 20cm (8-inch) is 0.57 arcsec, while 30cm (12.5-inch) is limited to 0.38 arcsec.

8) Resolution of Close Pairs also has the **Theoretical Limit**. This is based on the criteria from optical theory, and is made on the diameter of the third outer ring of the observed Airy disk. This limit is 20.9% bigger than the resolution of the Dawes Limit. I.e. 20cm sees 0.57 arcsec, but the Airy disk covers more like 0.69 arcsec. It is unlikely that an observer — regardless of the observing conditions — could exceed this limit. This limit can be calculated by the simple equation;

**TRes (arcsec) = 13.84 / A (cm) or**
**TRes (arcsec) = 5.43 / A (inches)**
**Where;**
**TRes = Theoretical Resolution is in arcsec**
**D = Aperture in either centimetres or inches.**

I.e. 7.5cm (3-inch) is 1.84 arcsec, 10.5cm (4-inch) is 1.31 arcsec, 20cm (8-inch) is 0.69 arcsec, while 30cm (12.5-inch) is limited to 0.46 arcsec




## STANDARD PAIRS:

1) All standard pairs (and wider pairs) usually are easy to resolve regardless of the conditions. Resolution is not necessarily limited by the atmospheric seeing, and these can be typically resolved using optimum telescope magnifications — sometimes called moderate magnifications.

2) Resolution of all standard pairs can be achieved in small telescopes but usually not so in binoculars

3) Problems may occur with very bright stars or those having significant differences in magnitude.

## WIDE PAIRS:

1) Wide pairs (and wider pairs) usually are always easy to resolve regardless of the conditions. Resolution is not limited at all by seeing, and these can be resolved using low telescope magnifications.

2) If both stars are viewed in dark skies and above about 10th magnitude, wide pairs are readily visible in binoculars. In city skies this may be limited to about 7th magnitude.

3) Most wide pairs are generally more spectacular in low magnifications because they can include the general field stars — especially when they reside in places in the Milky Way.

## MAGNITUDE LIMITS:

1) The other observational constraint on observing stars is the theoretical magnitude visible for the aperture used.

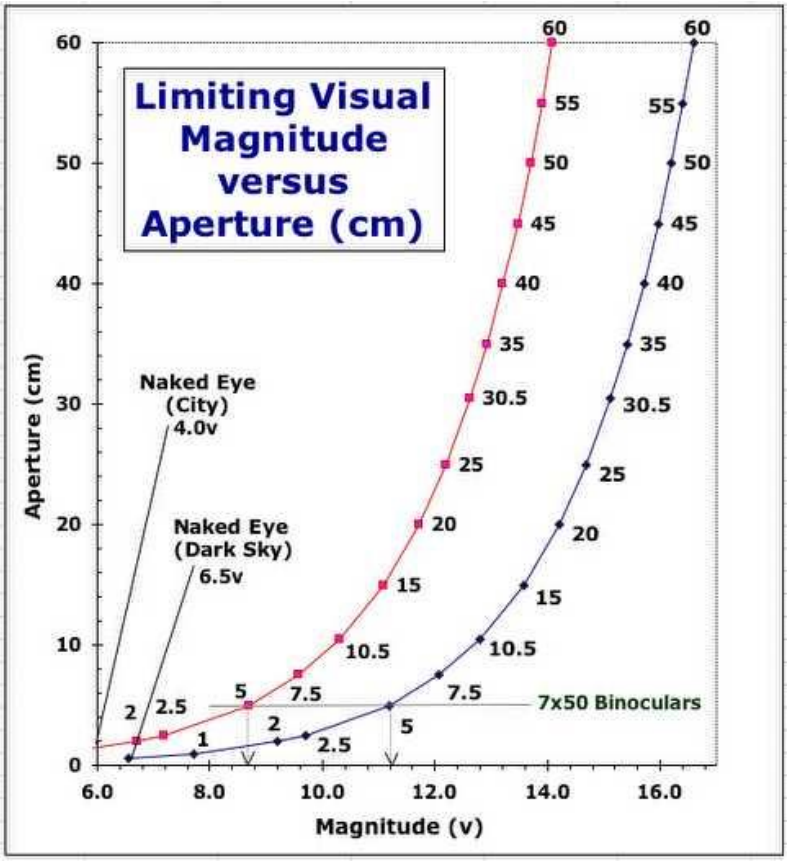
2) Magnitude limits or *limiting magnitude* are difficult quantities to ascertain because of many other influencing factors. This includes things such as the observing conditions (transparency), light pollution, the observer's eyesight, magnification or atmospheric seeing.

3) Based on the average observer, a practical simple calculation is based on either Observed or Theoretical magnitudes;

**m(v) = 2.7 + 5× log ( D (cm) / 10 )**
**Where;**
**m(v) = Observed Magnitude Limit.**
**D = Aperture in centimetres.**
**Where;**
**m(v) = Observed Magnitude Limit.**
**D = Aperture in centimetres**

| Aperture (cm.) | Limit Mag (v.) |
|---|---|
| 5 | 12.7 |
| 7.5 | 13.1 |
| 10.5 | 13.6 |
| 20 | 14.0 |
| 25 | 14.3 |
| 30 | 14.8 |
| 40 | 15.1 |
| 50 | 15.4 |

These determined limits are only a guide. Strong colours like deep red variables and luminous blue stars can likely be seen below the stated threshold limit. Colour contrasts for stars at the lower end of the range is likely to disappear at these particular, lower magnitudes. Furthermore, seeing and transparency conditions, dust or smoke, and proximity to urban skies through light pollution can drastically change the telescope magnitude limits. On the best nights, it is probably possible to get 0.5 magnitudes lower than the limit. It is also quite possible that with experience and tricks like averted vision may extend these to lower limits.




Observations and assumptions from which the table was constructed may be inapplicable to other conditions.;

1) Atmospheric seeing can render small instruments able to see fainter objects than larger ones.
2) Most telescopes and all observers are not 'normal'
3) Magnification and eyepiece type will affect the outcome.
4) Direct or averted vision
5) Type of telescope (loss of light in 2-degree spectrum)
6) Bright field objects affect dark adaptation

http://www.southastrodel.com/Page029e.htm

www.google.com/search?q=a+table+of+telescope+sizes+for+splitting+a+doublestars&ie=utf-8&oe=utf-8&client=firefox-b&gfe_rd=cr&dcr=0&ei=SQnFWcXuMpKp8wfQx53gCQ

## COMETS, ASTEROIDS AND METEORITES:

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.

**Orionids:** The Orionid meteor shower produces meteors from Halley's comet, which orbits the sun every 75 to 76 years. The Orionid shower happens every October and can last for a week, Favourable viewing will be from 2 October to 7 November peaking on 21 October.

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