ASTRONOMICAL SOCIETY OF SOUTHERN AFRICA

'nDABA

Monthly Newsletter of the Durban Centre - August 2018

Table Of Contents

Jupiter captured by Angus Burns
from Newcastle, KZN

Member Submissions Disclaimer:

The views expressed in 'nDaba are solely those of the writer and are not necessarily the views of the Durban Centre, nor the Editor.

Chairman's Chatter

By Piet Strauss

Dear Members,

As you know Mike Hadlow stepped down as Chairman after serving the Society for two years in that capacity. We thank him again for all he has done as chairman and look forward to his continued contribution as a member of the Committee.

It is an honour for me to have been elected as Chairman at the Committee meeting held on 25 July. Debbie Abel will continue as Deputy Chair and will also assume the role as Treasurer. Brian Finch remains as Secretary.

We also welcome new members to the committee. A full list of the Committee and their functions/portfolios are contained in the nDaba.

Viewing conditions were mostly good during the winter period so far. Of course the Public viewing on 13 July was terminated before 8 pm when the clouds appeared. We thank Ooma, John Gill and Brian for hosting the event.

A successful viewing evening was hosted at the Monteseel Conservancy on 20 July, at their request. It was attended by about 100 people. Thanks to Mike Hadlow, Maryanne Jackson, Don Orsmond (new member)for bringing their telescopes as well as Sheryl Venter and Peter Wunderlin for assisting.

The owners of The Nest Hotel in the Southern Berg arranged a lunar Eclipse evening for their guests and local residents. ASSA was invited to give a talk and show the sky to the guests. Debbie Abel gave a most informative presentation to about 50 guests, (with Sheryl Venter and me in attendance). After dinner we all moved outside to see the start of the Lunar Eclipse. Venus was prominent as the bright evening star. It was really spectacular with crisp and clear skies. Mars was very prominent, being so close to earth.

As is clear, ASSA Durban is active in our "outreach" programs. We believe that this promotes astronomy in general and will also assist to attract more members. We urge all members to get more involved in these events.

Our next meeting on 8 August will be in the form of a Panel Discussion, answering questions submitted by members. If you have any questions, there is still time to submit it by email or message to myself or any committee member.

The next big event on the calendar is a Star Party at the Botanical Gardens on 7 September. More details will be communicated soon but for now, keep the date open.

Wishing you clear skies!

Piet.

The Flaming Star Nebula

By Brian Ventrudo

The Flaming Star Nebula (IC405) at upper right. The star AE Aurigae is the bright star in the right part of the nebula. Emission nebula IC410 is at lower left. Image credit: Terry Hancock.

Stars in the Milky Way tend to revolve around the center of the galaxy, bobbing slightly above and below the galactic plane as if in a perpetual cosmic merry-go-round. But sometimes a star gets catapulted across the sky by a close gravitational interaction with another star. One of the best-known “runaway stars” lies in the constellation Auriga, the Charioteer. Known as AE Aurigae, this blazing star is passing by chance through a cold cloud of interstellar gas. The result is ‘accidental’ emission nebula cataloged as IC 405, but more commonly called the *Flaming Star Nebula*.

The star AE Aurigae is a blazing-blue main sequence star about 17 times more massive than our Sun and 30,000 times as bright. But it was not formed in this part of the sky. Astronomers have traced its rapid motion back to a spot in the Orion Nebula. The star may have been ejected from the nebula about two million years ago, possibly by a close gravitational interaction of two multiple star systems in which some stars were flung away from Orion. Or it may have been were ejected by the gravitational effects of a supernova explosion of one of the massive blue stars that form in and around the constellation Orion.

Whatever happened to AE Aur, it was not alone in its fate. Two other fast-moving stars also trace their origins back to the area of the Orion Nebula about 2 million years ago. One, mu Columbae, is located in constellation Columba, the Dove, well south of Orion. The other is the star 53 Arietis in the constellation Aries to the north and west of Orion.

… The Flaming Star Nebula

You can see AE Aurigae in the image at top in the extreme right of the nebula IC405, which itself is at upper right of the image. For such an intrinsically bright star, AE Aur doesn’t look like much. That’s partly because it’s quite far, about 1,500 light years, and also because it’s dimmed by interstellar dust which knocks down the star’s brightness by a factor of two. The star is easily visible in a small telescope and binoculars. The nebula itself is more challenging, though is can be glimpsed visually in a small scope. It looks like faint flames emanating from the star. Because its moving so quickly, AE Aurigae will pass through the cloud of gas in just 20,000 years and the nebula will fade away.

The Flaming Star Nebula lies in an active and rich region of the sky. Just to the south lies the star-forming region marked by the emission nebula IC 410. Like the Orion Nebula, this is a star factory, and the gas is energized by its associated star cluster NGC 1893. In the foreground of the emission nebula are a patchwork of smaller dark nebulae sometimes called “The Tadpoles”. The entire complex lies about 12,000 light years away, about eight times as far as the Flaming Star.

A wide-field panorama in the constellation Auriga. The ‘Flaming Star Nebula’, IC405, is at extreme upper right. IC410 is below and to the left of IC 405. The open stars clusters M38 (above middle) and M36 (below and near left) are also visible in this area. The image covers 8 degrees x 2.7 degrees. Credit: Terry Hancock.

As shown in the wide-field image in this section there are fainter regions of nebulosity near the Flaming Star as well as two bright open star clusters Messier 36 and Messier 38. Both clusters, which are easily visible in binoculars, have shed the nebulosity of their birthplace millions of years ago. M36 and M38 are 25 million years old and about 4,000 light years away.

At the Eyepiece

August 2018 by Ray Field

THE MOON is Last Quarter on the 4th, NEW on the 11th, First Quarter on the 18th and FULL on the 26th. The bright orange-red star Aldebaran in the Hyades open cluster in Taurus, is occulted by the Moon on the morning of the 6th. The Moon is near Venus on the 14th, Jupiter on the 17th, Saturn on the 21st and Mars on the 24th.

MERCURY is visible briefly in the evening sky on the 1st, when it sets in the twilight, shortly after the Sun. Mercury reaches inferior conjunction on the 9th. By late August, it can be seen in the morning sky shortly before sunrise over the east. It is highest above the eastern horizon when it reaches greatest elongation of 18 degrees from the Sun on the 26th.

VENUS is the bright evening star this month. It is highest above the setting Sun when at its greatest elongation of 46 degrees from the Sun on the 17th. The Moon is near Venus on the 14th. In a telescope Venus looks like an half-illuminated disc.

MARS, in Capricornus, appears as a bright red-orange coloured object this month, following Sagittarius across the sky. Mars is visible nearly all night and sets about 5 a.m. Mars is about half the diameter of the Earth. The Moon is near Mars on the 23rd.

JUPITER, in Libra, is the very bright object about one degree from Libra's alpha star Zubenelgenubi this month. Scorpius follows Jupiter across the sky. Page 41 of SKYGUIDE 2018 shows the positions of Jupiter's 4 brightest moons as they orbit the planet. The Moon is near Jupiter on the 17th.

… At the Eyepiece

SATURN is in Sagittarius near the "lid" of the "Teapot" asterism this month and is visible nearly all night. It looks like a fairly-bright, yellowish "star". It is still in retrograde this month. It's largest moon Titan is bigger than the planet Mercury.

A finder chart for Saturn is given on page 79 of SKYGUIDE.

URANUS, in Aires, is a faint object and needs binoculars and a finder chart to be found. See page 79 of SKYGUIDE for the finder chart. Uranus rises at midnight on the 1st.

NEPTUNE is in Aquarius and is much fainter than Uranus. See the finder chart on page 79 of SKYGUIDE.

COMET 48 P/ JOHNSON reaches perihelion on the 12th. It's period is 6.5 years.

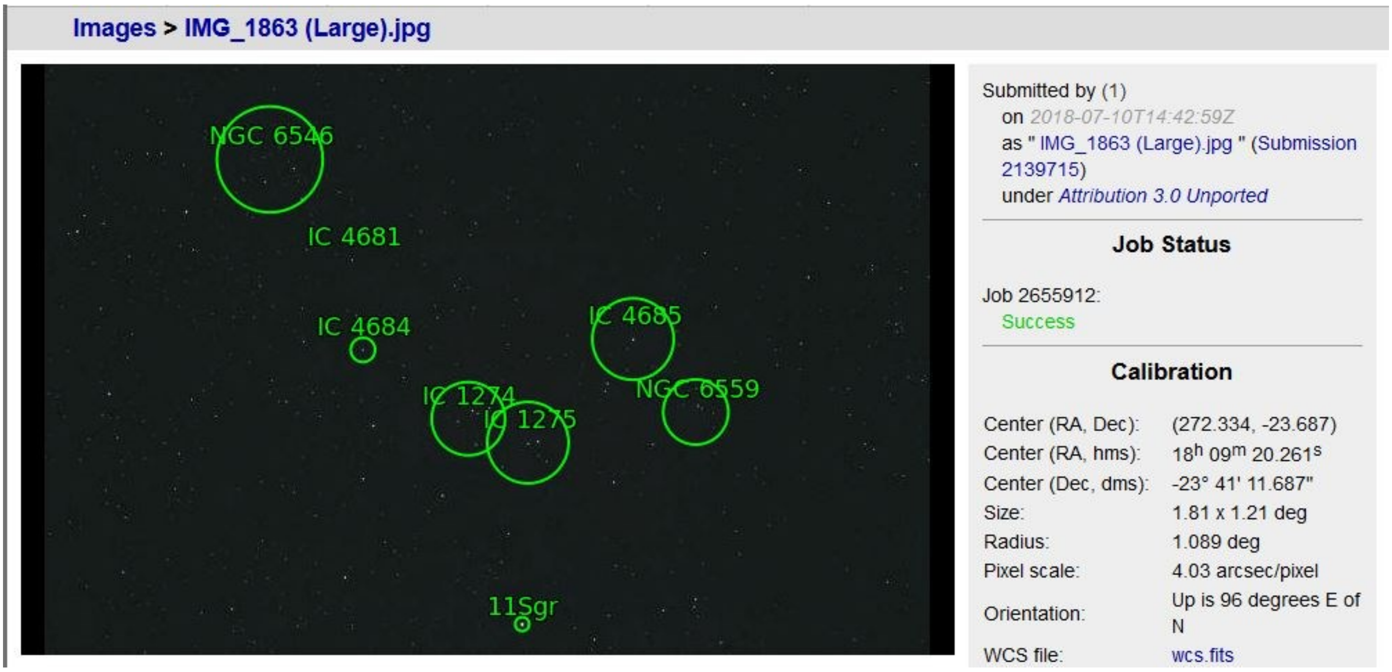
METEORS No predicted showers reach maximum this month but the tail-end of the 3 showers that reached maximum last month, may still be visible. See page 86 of SKYGUIDE for details.

THE STARRY SKY. By 7 p.m. mid-month the Southern Cross is well past it's highest. The Diamond Cross and False Cross are further down towards the horizon from it. Low over the NW, Arcturus is still visible and very low over the NNE, Vega is rising. Over the SSE Achernar is low and Fomalhaut and the "Southern Birds" are rising over the SE. The 2 brightest stars of Grus "The Crane", which are of different hues, and the brightest star of Pavo "the Peacock" are very noticeable in an otherwise rather "barren" area of the sky. Scorpius and Sagittarius are overhead. Hercules and Ophiuchus are well placed over the north. The bright star Aquila, with a fainter star either side of it, is well up over the north east.

REFERENCES: ASSA SKY GUIDE Africa South 2018, NORTON'S Star Atlas,
PHILIP'S Planisphere for 35 Degrees South.

The Cover Image - Liquorice All-Sorts

Below is the annotated image that was plate-solved at www.astrometry.net. As can been seen there are many NGC and IC objects in the area. Further down is a single image as seen by the camera. Note that there is only a scattering of stars visible and then finally is the 30 images that were "stacked" together. Some details and colour now start to appear as if by magic.



NGC 6546 is an Open Cluster of the Trumpler type III2m in the constellation Sagittarius on the Ecliptic.

NGC 6559 is a star-forming region located at a distance of about 5000 light-years from Earth, showing both emission (red) and reflection (bluish) regions.

This image contains several objects catalogued in the NGC and IC catalogues. IC 1274 is the bright, circular nebula in the middle of the image. Just below is the fainter circular nebula IC 1275.

Between the two is situated a wide dark nebula Barnard 91. To the right a bright filament known as NGC 6559. The thin dark lane above it is Barnard 303. The nebulosity around Barnard 303 is IC 4685. This complex in Sagittarius lies about slightly more than one degree of its much more famous neighbour, the Lagoon Nebula. In fact, some studies show that it is physically related to M8.

… Liquorice All-Sorts

Tech Specs:

APM APO 107/700 telescope on Celestron GCX mount and Canon 60Da camera. Autoguiding with ZWO Optics and Processed in PixInsight.

30 Lights @ ISO 100 for 360 seconds
60 Bias & Flats and 20 Darks

The Centre of The Milky Way

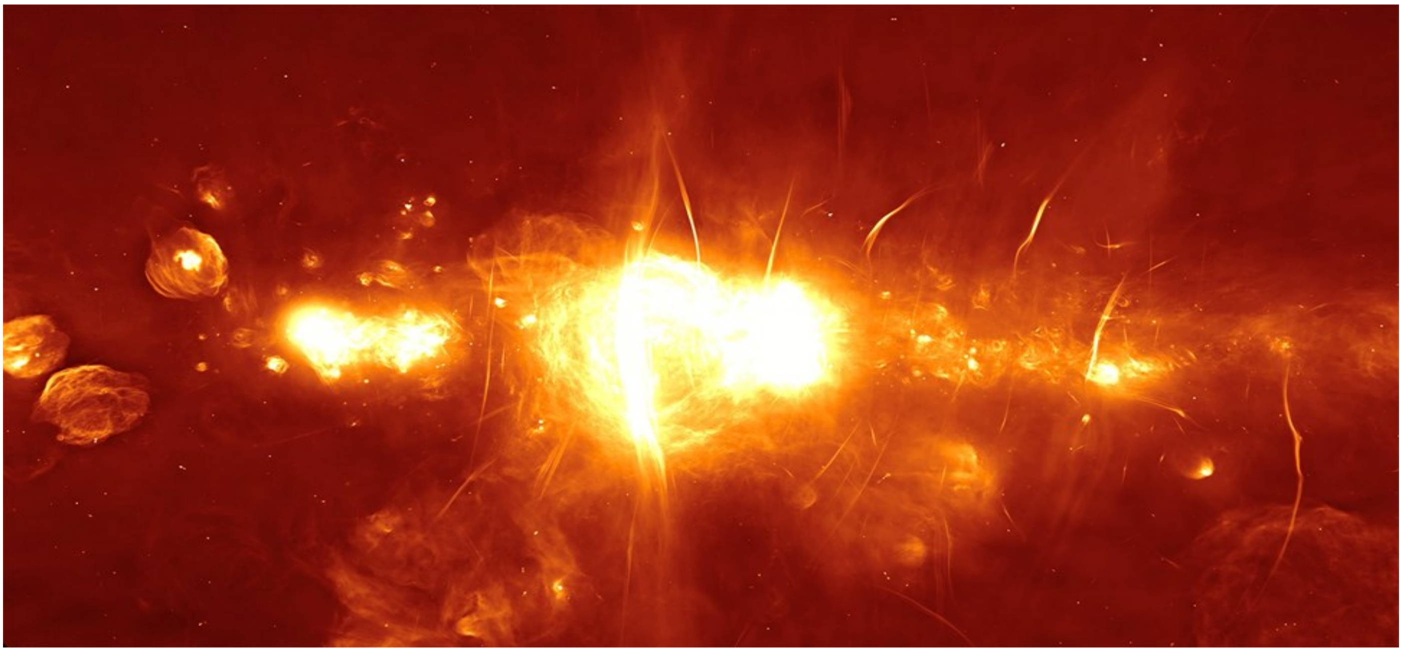
This is the blazing heart of our galaxy

FIONA MACDONALD

A mega new telescope has captured the clearest view to date of the centre of our Milky Way.

The fiery image shows in extraordinary detail the region surrounding the supermassive black hole at the heart of the galaxy - a target 25,000 light-years away.

The telescope is called the MeerKAT radio telescope, and it's actually made up of 64 individual dishes, all of which detect radio waves. They're built in the semi-desert Karoo region of South Africa and offer more sensitivity than any other telescope of its kind.



… The Center of The Milky Way

The colours here represent the brightness of the radio waves picked up by the telescope: ranging from red for faint emissions through orange and yellow to white for the strongest emissions.

While it looks like a fiery swirling mess, the image shows never-before-seen features, such as the compact sources of those long, magnetised filaments that come off the central region. It also provides a clearer view than ever before of previously known supernova remnants and star-forming regions.

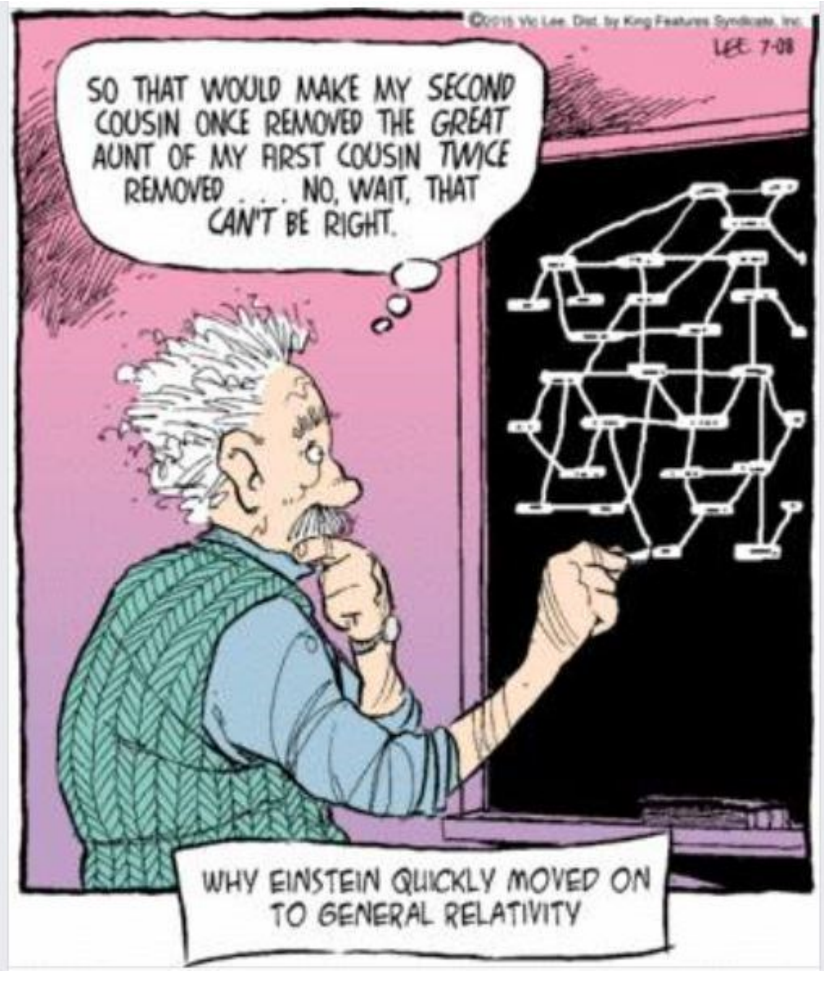
The long and narrow filaments you can see in the image were first discovered in the 1980s, but their origin has remained a mystery. They're seen near the central black hole of our galaxy, but nowhere else in the Milky Way.

"This image is remarkable", says Farhad Yusef-Zadeh of Northwestern University in Evanston, Illinois, an expert on the filaments. "It could provide the key to cracking the code and solve this three-decade riddle."

The centre of the Milky Way is incredibly hard to photograph, not only because it's 25,000 light-years away, but also because it lies behind the constellation Sagittarius and is constantly enshrouded by clouds of gas and dust, making it invisible from Earth using optical telescopes. But infrared, X-ray, and some radio wavelengths, like the ones MeerKAT detects, can penetrate this dust, providing a unique view of the region. The telescope's location in South Africa is also ideal, with the Milky Way passing overhead and visible for almost 12 hours each day.

"We wanted to show the science capabilities of this new instrument", says Fernando Camilo, chief scientist of the South African Radio Astronomy Observatory (SARAO), which built and operates MeerKAT.

"The centre of the galaxy was an obvious target: unique, visually striking and full of unexplained phenomena – but also notoriously hard to image using radio telescopes ... Although it's early days with MeerKAT, and a lot remains to be optimised, we decided to go for it – and were stunned by the results."



How Big Is The Andromeda Galaxy?

Astronomers used to believe that the Andromeda galaxy, our nearest galactic neighbour, was three times as massive as the Milky Way. Not anymore.

By Jake Parks

This image of the Andromeda galaxy, captured by NASA's Galaxy Evolution Explorer, shows the ultraviolet side of our familiar galactic neighbour.

Credit NASA/JPL-Caltech

Both the Milky Way and the Andromeda galaxy (M31) are giant spiral galaxies in our local universe. And in about 4 billion years, the Milky Way and Andromeda will collide in a gravitational sumo match that will ultimately bind them forever.

Because astronomers previously thought that Andromeda was up to three times as massive as the Milky Way, they expected that our galaxy would be easily overpowered and absorbed into our larger neighbor. But now, new research suggests we've overestimated our opponent.

In a study published today in the *Monthly Notices of the Royal Astronomical Society*, a team of Australian astronomers announced that Andromeda is not actually the heavyweight we once thought it was. Instead, they found that our nearest galactic neighbor is more or less the same mass as the Milky Way — some 800 billion times the mass of the Sun.

To determine the heft of the Andromeda galaxy, the team used a technique that calculates the speed required for a quick-moving star to escape the gravitational pull of its host galaxy. This required speed needed for ejection is known as an object's *escape velocity*.

"When a rocket is launched into space, it is thrown out with a speed of [6.8 miles per second (11 kilometers per second)] to overcome the Earth's gravitational pull," said Prajwal Kafle, an astrophysicist from the University of Western Australia branch of the International Centre for Radio Astronomy Research, in a press release.

… Andromeda

“Our home galaxy, the Milky Way, is over a trillion times heavier than our tiny planet Earth, so to escape its gravitational pull, we have to launch with a speed of [342 miles per second (550 kilometers per second)]. We used this technique to tie down the mass of Andromeda.”

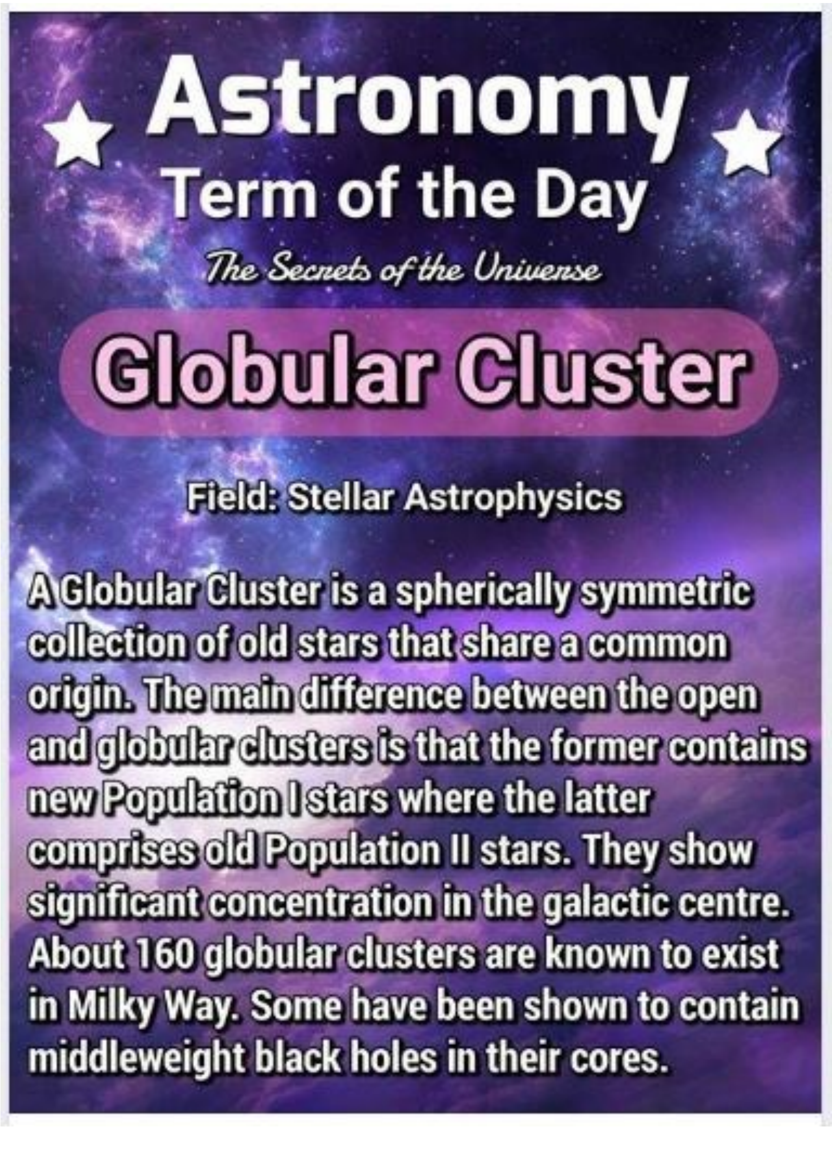
This is not the first time a galaxy’s weight has been recalculated based on analyzing the escape velocities of objects within it. In 2014, Kafle used a similar technique to revise down the mass of the Milky Way, showing that our galaxy has much less dark matter — a mysterious form of matter that has gravity but does not interact with light — than previously thought.

The nearby galaxy Andromeda will eventually (in about 4 to 5 billion years) merge with our own galaxy, the Milky Way. Although the Milky Way has not been involved in any recent large mergers, astronomers have observed the remnants of many previous smaller mergers.

Much like the 2014 study showed for the Milky Way, today’s paper suggests that previous research has overestimated the amount of dark matter present in the Andromeda galaxy. “By examining the orbits of high-speed stars, we discovered that [Andromeda] has far less dark matter than previously thought,” said Kafle, “and only a third of that uncovered in previous observations.”

Although revising down Andromeda’s overall mass may seem like it should help the Milky Way out during the galaxies’ eventual collision, the researchers say that new simulations are first needed to determine exactly what will happen when the galaxies meet. But no matter what happens in 4 billion years, Kafle says today’s new finding “completely transforms our understanding of the local group.”

For now, however, we can take solace in the newfound knowledge that the Milky Way is not nearly as overpowered by Andromeda as we once thought. As University of Sydney astrophysicist Geraint Lewis said, “We can put this gravitational arms race to rest.”



Exoplanet

From Wikipedia, the free encyclopedia

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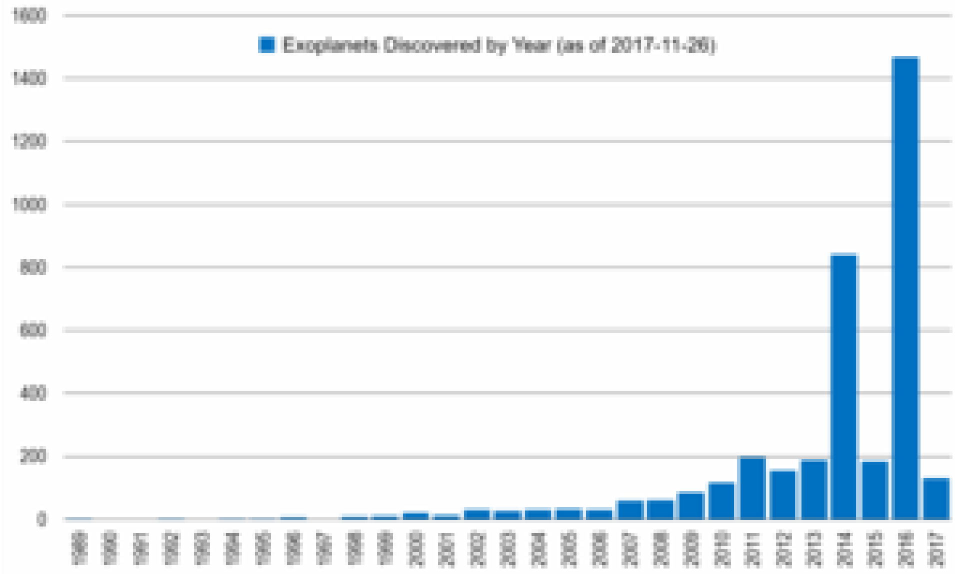
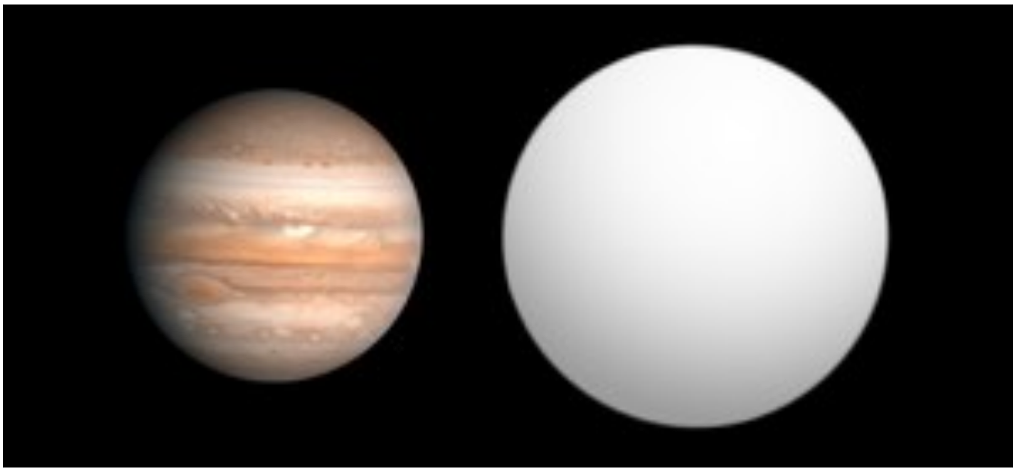
Artist's impression of how commonly planets orbit the stars in the Milky Way

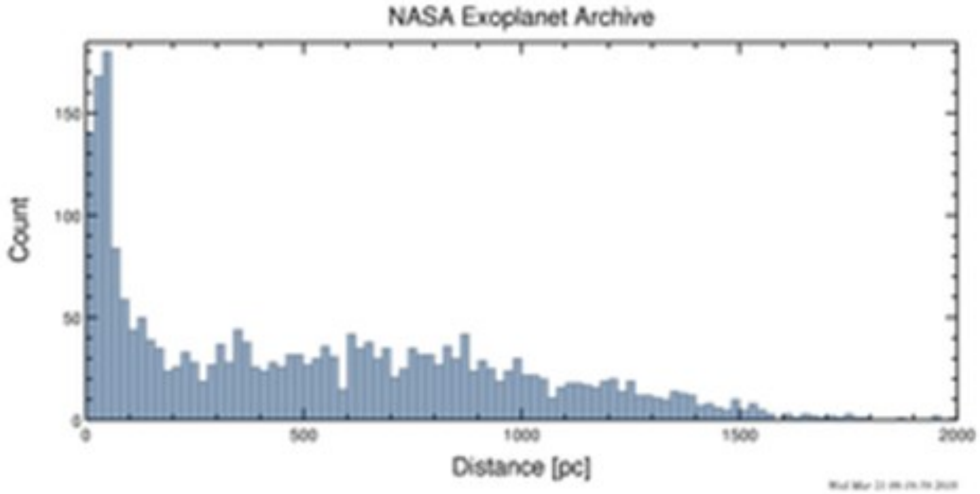


Discovered exoplanets each year as of 26 November 2017



Size comparison of Jupiter and the exoplanet TrES-3b. TrES-3b has an orbital period of only 31 hours and is classified as a Hot Jupiter for being large and close to its star, making it one of the easiest planets to detect by the transit method.

… Exoplanets



NASA histogram chart of confirmed exoplanets by distance

An **exoplanet** (UK: /ˈɛk.soʊˌplæn.ɪt/, US: /ˌɛk.soʊˈplæn.ɪt/) or **extrasolar planet** is a planet outside our solar system. The first evidence of an exoplanet was noted as early as 1917, but was not recognized as such. However, the first scientific detection of an exoplanet was in 1988, although it was not accepted as an exoplanet until later. The first confirmed detection occurred in 1992. As of 1 July 2018, there are 3,797 confirmed planets in 2,841 systems, with 632 systems having more than one planet.

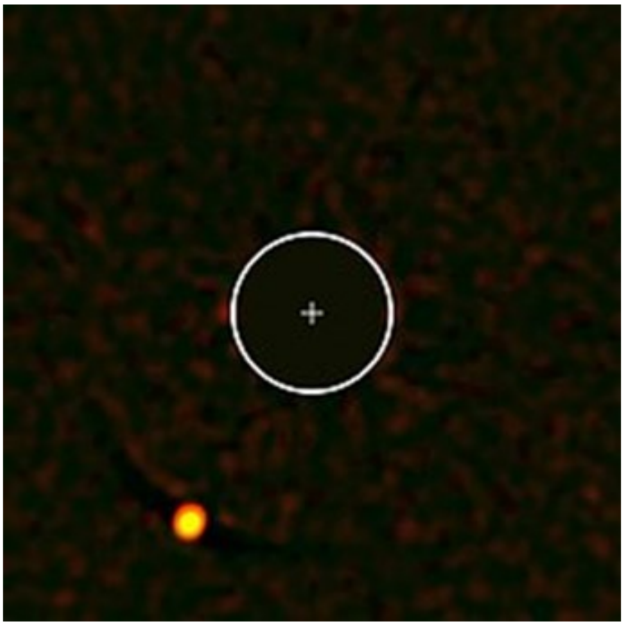
The High Accuracy Radial Velocity Planet Searcher (HARPS), since 2004) has discovered about a hundred exoplanets while the *Kepler* space telescope (since 2009) has found more than two thousand. *Kepler* has also detected a few thousand candidate planets, of which about 11% may be false positives. In several cases, multiple planets have been observed around a star. About 1 in 5 Sun-like stars have an "Earth-sized" planet in the habitable zone. Assuming there are 200 billion stars in the Milky Way, one can hypothesize that there are 11 billion potentially habitable Earth-sized planets in the Milky Way, rising to 40 billion if planets orbiting the numerous red dwarfs are included.

The least massive planet known is Draugr (also known as PSR B1257+12 A or PSR B1257+12 b), which is about twice the mass of the Moon. The most massive planet listed on the NASA Exoplanet Archive is HR 2562 b, about 30 times the mass of Jupiter, although according to some definitions of a planet, it is too massive to be a planet and may be a brown dwarf instead. There are planets that are so near to their star that they take only a few hours to orbit and there are others so far away that they take thousands of years to orbit. Some are so far out that it is difficult to tell whether they are gravitationally bound to the star. Almost all of the planets detected so far are within the Milky Way. Nonetheless, evidence suggests that extragalactic planets, exoplanets further away in galaxies beyond the local Milky Way galaxy, may exist. The nearest exoplanet is Proxima Centauri b, located 4.2 light-years (1.3 parsecs) from Earth and orbiting Proxima Centauri, the closest star to the Sun.

The discovery of exoplanets has intensified interest in the search for extraterrestrial life. There is special interest in planets that orbit in a star's habitable zone, where it is possible for liquid water, a prerequisite for life on Earth, to exist on the surface. The study of planetary habitability also considers a wide range of other factors in determining the suitability of a planet for hosting life.

Besides exoplanets, there are also rogue planets, which do not orbit any star and which tend to be considered separately, especially if they are gas giants, in which case they are often counted, like WISE 0855−0714, as sub-brown dwarfs. The rogue planets in the Milky Way possibly number in the billions (or more).

… Exoplanets



Exoplanet HIP 65426b is the first discovered planet around star HIP 65426

The convention for designating exoplanets is an extension of the system used for designating multiple-star systems as adopted by the International Astronomical Union (IAU). For exoplanets orbiting a single star, the designation is normally formed by taking the name or, more commonly, designation of its parent star and adding a lower case letter. The first planet discovered in a system is given the designation "b" (the parent star is considered to be "a") and later planets are given subsequent letters. If several planets in the same system are discovered at the same time, the closest one to the star gets the next letter, followed by the other planets in order of orbital size. A provisional IAU-sanctioned standard exists to accommodate the designation of circumbinary planets. A limited number of exoplanets have IAU-sanctioned proper names. Other naming systems exist.

History of detection

For centuries scientists, philosophers, and science fiction writers suspected that extrasolar planets existed, but there was no way of detecting them or of knowing their frequency or how similar they might be to the planets of the Solar System. Various detection claims made in the nineteenth century were rejected by astronomers.

The first evidence of an exoplanet was noted as early as 1917, but was not recognized as such. The first suspected scientific detection of an exoplanet occurred in 1988. Shortly afterwards, the first confirmed detection came in 1992, with the discovery of several terrestrial-mass planets orbiting the pulsar PSR B1257+12. The first confirmation of an exoplanet orbiting a main-sequence star was made in 1995, when a giant planet was found in a four-day orbit around the nearby star 51 Pegasi. Some exoplanets have been imaged directly by telescopes, but the vast majority have been detected through indirect methods, such as the transit method and the radial-velocity method. As of February 2018, researchers at the Chandra X-ray Observatory, combined with a planet detection technique called microlensing, found evidence that there are potentially one trillion extragalactic exoplanets, stating "Some of these exoplanets are as (relatively) small as the moon, while others are as massive as Jupiter.

Unlike Earth, most of the exoplanets are not tightly bound to stars, so they're actually wandering through space or loosely orbiting between stars. We can estimate that the number of planets in this [faraway] galaxy is more than a trillion."

This space we declare to be infinite... In it are an infinity of worlds of the same kind as our own.

— *Giordano Bruno (1584)*

… Exoplanets

In the sixteenth century the Italian philosopher Giordano Bruno, an early supporter of the Copernican theory that Earth and other planets orbit the Sun (heliocentrism), put forward the view that the fixed stars are similar to the Sun and are likewise accompanied by planets.

In the eighteenth century the same possibility was mentioned by Isaac Newton in the "General Scholium" that concludes his *Principia*. Making a comparison to the Sun's planets, he wrote "And if the fixed stars are the centers of similar systems, they will all be constructed according to a similar design and subject to the dominion of *One*."

In 1952, more than 40 years before the first hot Jupiter was discovered, Otto Struve wrote that there is no compelling reason why planets could not be much closer to their parent star than is the case in the Solar System, and proposed that Doppler spectroscopy and the transit method could detect super-Jupiters in short orbits.

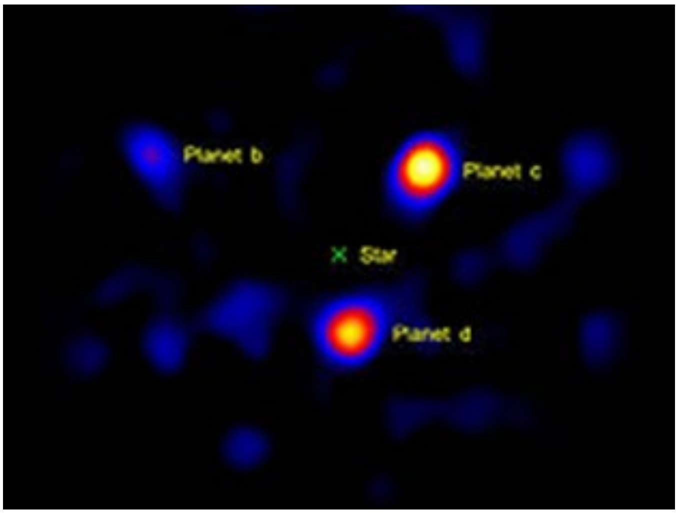
Discredited claims

Claims of exoplanet detections have been made since the nineteenth century. Some of the earliest involve the binary star 70 Ophiuchi. In 1855 William Stephen Jacob at the East India Company's Madras Observatory reported that orbital anomalies made it "highly probable" that there was a "planetary body" in this system.

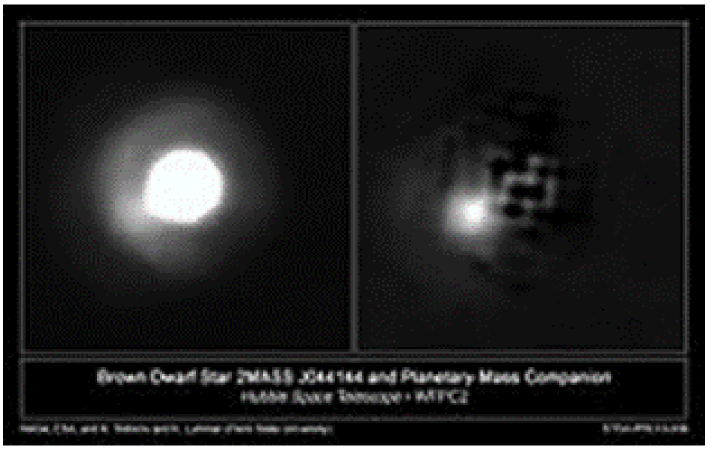
In the 1890s, Thomas J. J. See of the University of Chicago and the United States Naval Observatory stated that the orbital anomalies proved the existence of a dark body in the 70 Ophiuchi system with a 36-year period around one of the stars. However, Forest Ray Moulton published a paper proving that a three-body system with those orbital parameters would be highly unstable. During the 1950s and 1960s, Peter van de Kamp of Swarthmore College made another prominent series of detection claims, this time for planets orbiting Barnard's Star.

Astronomers now generally regard all the early reports of detection as erroneous.
In 1991 Andrew Lyne, M. Bailes and S. L. Shemar claimed to have discovered a pulsar planet in orbit around PSR 1829-10, using pulsar timing variations. The claim briefly received intense attention, but Lyne and his team soon retracted it.

Confirmed discoveries



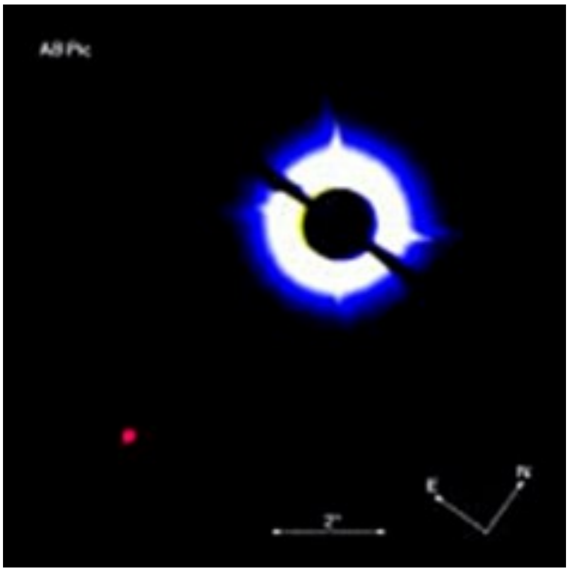
The three known planets of the star HR8799, as imaged by the Hale Telescope. The light from the central star was blanked out by a vector vortex coronagraph.



2MASS J044144 is a brown dwarf with a companion about 5–10 times the mass of Jupiter. It is not clear whether this companion object is a sub-brown dwarf or a planet.

… Exoplanets

As of 1 July 2018, a total of 3,797 confirmed exoplanets are listed in the Extrasolar Planets Encyclopaedia, including a few that were confirmations of controversial claims from the late 1980s. The first published discovery to receive subsequent confirmation was made in 1988 by the Canadian astronomers Bruce Campbell, G. A. H. Walker, and Stephenson Yang of the University of Victoria and the University of British Columbia. Although they were cautious about claiming a planetary detection, their radial-velocity observations suggested that a planet orbits the star Gamma Cephei. Partly because the observations were at the very limits of instrumental capabilities at the time, astronomers remained skeptical for several years about this and other similar observations. It was thought some of the apparent planets might instead have been brown dwarfs, objects intermediate in mass between planets and stars. In 1990 additional observations were published that supported the existence of the planet orbiting Gamma Cephei, but subsequent work in 1992 again raised serious doubts. Finally, in 2003, improved techniques allowed the planet's existence to be confirmed.



Coronagraphic image of AB Pictoris showing a companion (bottom left), which is either a brown dwarf or a massive planet. The data was obtained on 16 March 2003 with NACO on the VLT, using a 1.4 arcsec occulting mask on top of AB Pictoris.

On 9 January 1992, radio astronomers Aleksander Wolszczan and Dale Frail announced the discovery of two planets orbiting the pulsar PSR 1257+12. This discovery was confirmed, and is generally considered to be the first definitive detection of exoplanets. Follow-up observations solidified these results, and confirmation of a third planet in 1994 revived the topic in the popular press. These pulsar planets are thought to have formed from the unusual remnants of the supernova that produced the pulsar, in a second round of planet formation, or else to be the remaining rocky cores of gas giants that somehow survived the supernova and then decayed into their current orbits.

On 6 October 1995, Michel Mayor and Didier Queloz of the University of Geneva announced the first definitive detection of an exoplanet orbiting a main-sequence star, namely the nearby G-type star 51 Pegasi. This discovery, made at the Observatoire de Haute-Provence, ushered in the modern era of exoplanetary discovery. Technological advances, most notably in high-resolution spectroscopy, led to the rapid detection of many new exoplanets: astronomers could detect exoplanets indirectly by measuring their gravitational influence on the motion of their host stars. More extrasolar planets were later detected by observing the variation in a star's apparent luminosity as an orbiting planet passed in front of it.

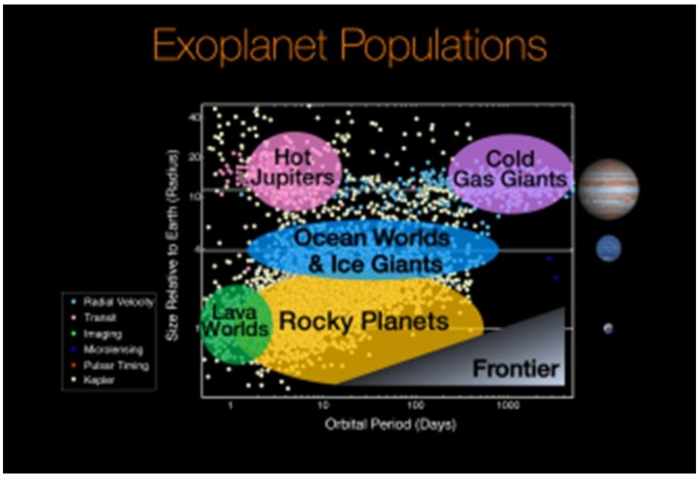
Initially, most known exoplanets were massive planets that orbited very close to their parent stars. Astronomers were surprised by these "hot Jupiters", because theories of planetary formation had indicated that giant planets should only form at large distances from stars. But eventually more planets of other sorts were found, and it is now clear that hot Jupiters make up the minority of exoplanets. In 1999, Upsilon Andromedae became the first main-sequence star known to have multiple planets. Kepler-16 contains the first discovered planet that orbits around a binary main-sequence star system.

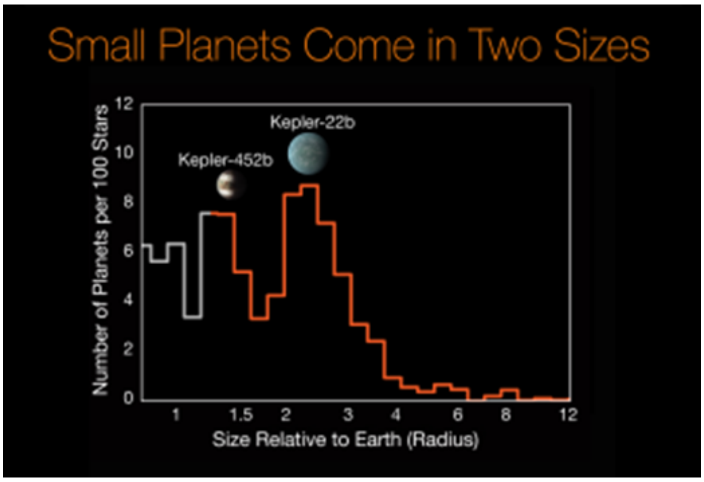
On 26 February 2014, NASA announced the discovery of 715 newly verified exoplanets around 305 stars by the Kepler Space Telescope. These exoplanets were checked using a statistical technique called "verification by multiplicity". Prior to these results, most confirmed planets were gas giants comparable in size to Jupiter or larger as they are more easily detected, but the Kepler planets are mostly between the size of Neptune and the size of Earth.

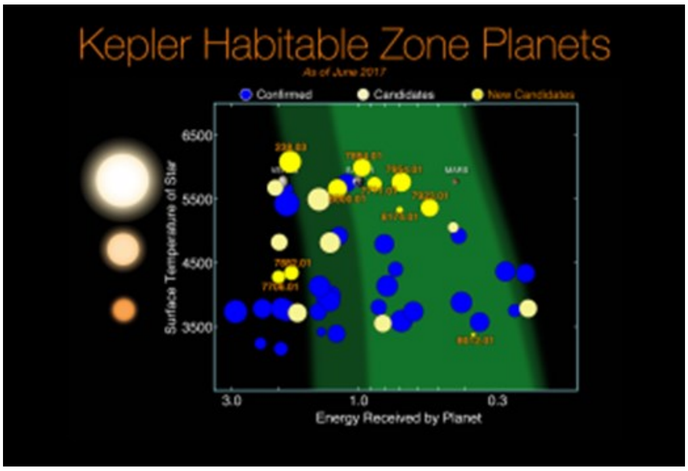
… Exoplanets

On 23 July 2015, NASA announced Kepler-452b, a near-Earth-size planet orbiting the habitable zone of a G2-type star.

Candidate discoveries
As of June 2017, NASA's Kepler mission had identified more than 5,000 planetary candidates, several of them being nearly Earth-sized and located in the habitable zone, some around Sun-like stars.



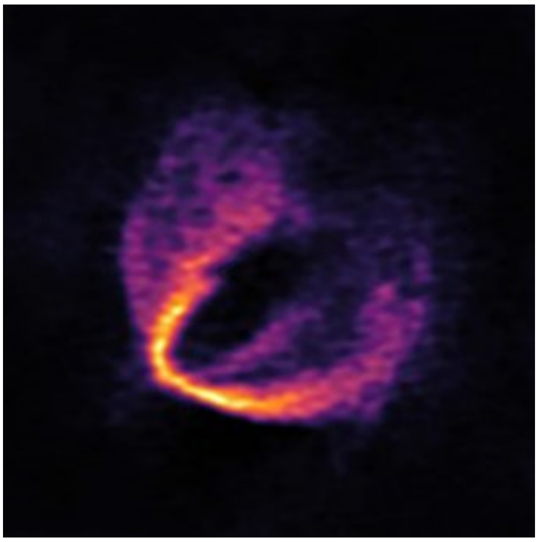




Methodology

The first exoplanet was detected on 6 October 1995, and was named 51 Pegasi b.When an extrasolar planet is observed to transit its parent star, astronomers are able to assess some physical properties of the planet from an interstellar distance, including planetary mass and size, which in turn provide fundamental constraints on models of their physical structure. Furthermore, such events afford the opportunity to study the dynamics and chemistry of its atmosphere.

Statistical surveys and individual characterization are the keys to addressing the fundamental questions in exoplanetology. As of August 2016, varying techniques have been used to discover 3,502 exoplanets. Documenting the properties of a large sample exoplanets at various ages, orbiting their parent stars of various types, will contribute to increased understanding —or better models— of planetary formation (accretion), geological evolution, orbit migration,and their potential habitability.Characterizing the atmospheres of extrasolar planets is the new frontier in exoplanetary science.



Detection techniques

Measuring the flow of gas within a protoplanetary disc allows the detection of exoplanets.

… Exoplanets

About 97% of all the confirmed exoplanets have been discovered by indirect techniques of detection, mainly by radial velocity measurements and transit monitoring techniques. The following methods have proved successful for discovering a new planet or confirming an already discovered planet:

- Radial velocity
- Gravitational microlensing
- Direct imaging
- Polarimetry
- Astrometry
- Transit photometry
  - Reflection/emission modulations
  - Light variations due to relativistic beaming
  - Light variations due to ellipsoidal variations
  - Timing variations
  - Pulsar timing
  - Variable star timing
  - Transit timing variation method
  - Transit duration variation method

Eclipsing binary minima timing

Formation and evolution

Planets form within a few tens of millions of years of their star forming. The planets of the Solar System can only be observed in their current state, but observations of different planetary systems of varying ages allows us to observe planets at different stages of evolution. Available observations range from young proto-planetary disks where planets are still forming to planetary systems of over 10 Gyr old. When terrestrial planets form in a gaseous protoplanetary disk, they have hydrogen envelopes that cool and contract over time and, depending on the mass of the planet, some or all of the hydrogen is eventually lost to space. This means that even terrestrial planets may start off with large radii if they form early enough. An example is Kepler-51b which has only about twice the mass of Earth but is almost the size of Saturn which is a hundred times the mass of Earth. Kepler-51b is quite young at a few hundred million years old.

Planet-hosting stars

The Morgan-Keenan spectral classification

Artist’s impression of exoplanet orbiting two stars

… Exoplanets

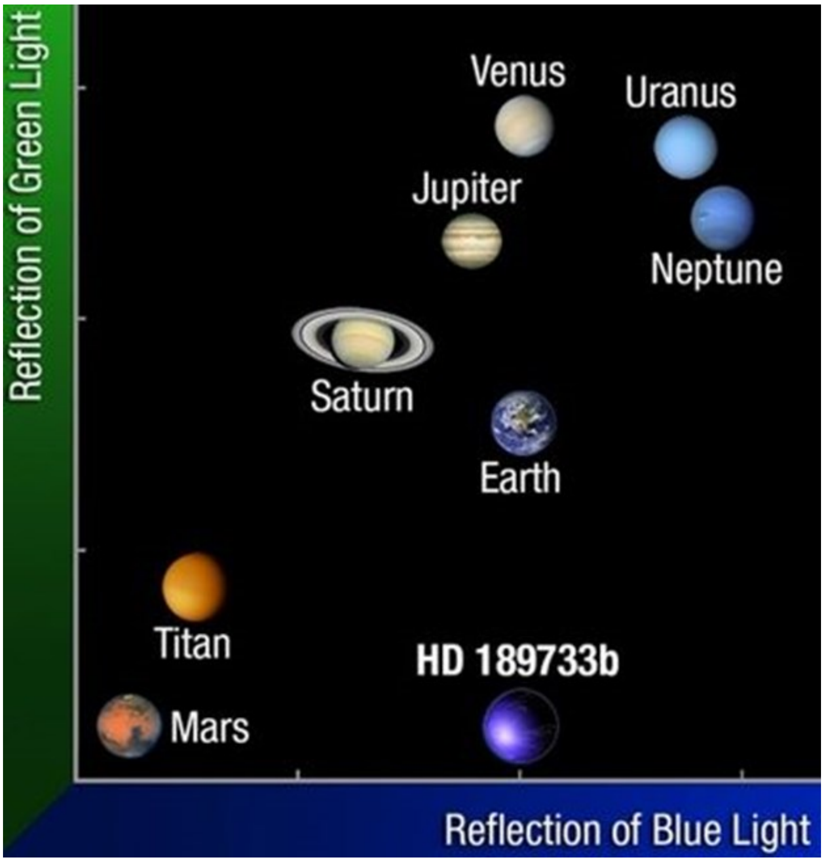
There is at least one planet on average per star. About 1 in 5 Sun-like stars have an "Earth-sized" planet in the habitable zone. Most known exoplanets orbit stars roughly similar to the Sun, i.e. main-sequence stars of spectral categories F, G, or K. Lower-mass stars (red dwarfs, of spectral category M) are less likely to have planets massive enough to be detected by the radial-velocity method. Despite this, several tens of planets around red dwarfs have been discovered by the *Kepler* spacecraft, which uses the transit method to detect smaller planets.

Using data from Kepler, a correlation has been found between the metallicity of a star and the probability that the star host planets. Stars with higher metallicity are more likely to have planets, especially giant planets, than stars with lower metallicity.

Some planets orbit one member of a binary star system, and several circumbinary planets have been discovered which orbit around both members of binary star. A few planets in triple star systems are known and one in the quadruple system Kepler-64.

General features

Color and brightness



This color–color diagram compares the colors of planets in the Solar System to exoplanet HD 189733b.

The exoplanet's deep blue color is produced by silicate droplets, which scatter blue light in its atmosphere.

In 2013 the color of an exoplanet was determined for the first time. The best-fit albedo measurements of HD 189733b suggest that it is deep dark blue. Later that same year, the colors of several other exoplanets were determined, including GJ 504 b which visually has a magenta color, and Kappa Andromedae b, which if seen up close would appear reddish in color.

The apparent brightness (apparent magnitude) of a planet depends on how far away the observer is, how reflective the planet is (albedo), and how much light the planet receives from its star, which depends on how far the planet is from the star and how bright the star is. So, a planet with a low albedo that is close to its star can appear brighter than a planet with high albedo that is far from the star.

The darkest known planet in terms of geometric albedo is TrES-2b, a hot Jupiter that reflects less than 1% of the light from its star, making it less reflective than coal or black acrylic paint. Hot Jupiters are expected to be quite dark due to sodium and potassium in their atmospheres but it is not known why TrES-2b is so dark—it could be due to an unknown chemical compound.

… Exoplanets

For gas giants, geometric albedo generally decreases with increasing metallicity or atmospheric temperature unless there are clouds to modify this effect. Increased cloud-column depth increases the albedo at optical wavelengths, but decreases it at some infrared wavelengths. Optical albedo increases with age, because older planets have higher cloud-column depths. Optical albedo decreases with increasing mass, because higher-mass giant planets have higher surface gravities, which produces lower cloud-column depths. Also, elliptical orbits can cause major fluctuations in atmospheric composition, which can have a significant effect.

There is more thermal emission than reflection at some near-infrared wavelengths for massive and/or young gas giants. So, although optical brightness is fully phase-dependent, this is not always the case in the near infrared. Temperatures of gas giants reduce over time and with distance from their star. Lowering the temperature increases optical albedo even without clouds. At a sufficiently low temperature, water clouds form, which further increase optical albedo. At even lower temperatures ammonia clouds form, resulting in the highest albedos at most optical and near-infrared wavelengths.

Magnetic field

In 2014, a magnetic field around HD 209458 b was inferred from the way hydrogen was evaporating from the planet. It is the first (indirect) detection of a magnetic field on an exoplanet. The magnetic field is estimated to be about one tenth as strong as Jupiter's. Interaction between a close-in planet's magnetic field and a star can produce spots on the star in a similar way to how the Galilean moons produce aurorae on Jupiter. Auroral radio emissions could be detected with radio telescopes such as LOFAR. The radio emissions could enable determination of the rotation rate of a planet which is difficult to detect otherwise.

Earth's magnetic field results from its flowing liquid metallic core, but in massive super-Earths with high pressure, different compounds may form which do not match those created under terrestrial conditions. Compounds may form with greater viscosities and high melting temperatures which could prevent the interiors from separating into different layers and so result in undifferentiated coreless mantles. Forms of magnesium oxide such as $MgSi_3O_{12}$ could be a liquid metal at the pressures and temperatures found in super-Earths and could generate a magnetic field in the mantles of super-Earths.

Hot Jupiters have been observed to have a larger radius than expected. This could be caused by the interaction between the stellar wind and the planet's magnetosphere creating an electric current through the planet that heats it up causing it to expand. The more magnetically active a star is the greater the stellar wind and the larger the electric current leading to more heating and expansion of the planet. This theory matches the observation that stellar activity is correlated with inflated planetary radii.

Plate tectonics

In 2007, two independent teams of researchers came to opposing conclusions about the likelihood of plate tectonics on larger super-Earths with one team saying that plate tectonics would be episodic or stagnantand the other team saying that plate tectonics is very likely on super-Earths even if the planet is dry. If super-Earths have more than 80 times as much water as Earth then they become ocean planets with all land completely submerged. However, if there is less water than this limit, then the deep water cycle will move enough water between the oceans and mantle to allow continents to exist.

Volcanism

Large surface temperature variations on 55 Cancri e have been attributed to possible volcanic activity releasing large clouds of dust which blanket the planet and block thermal emissions.

… Exoplanets

Rings

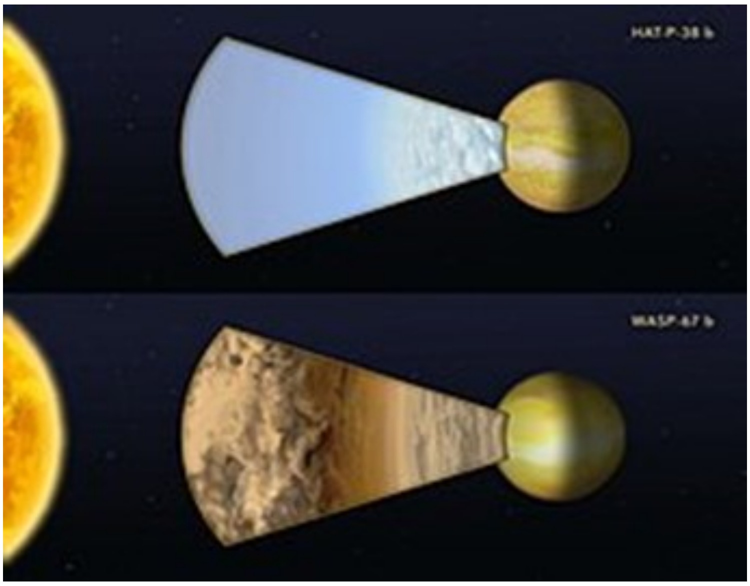
The star 1SWASP J140747.93-394542.6 is orbited by an object that is circled by a ring system much larger than Saturn's rings. However, the mass of the object is not known; it could be a brown dwarf or low-mass star instead of a planet. The brightness of optical images of Fomalhaut b could be due to starlight reflecting off a circumplanetary ring system with a radius between 20 and 40 times that of Jupiter's radius, about the size of the orbits of the Galilean moons.

The rings of the Solar System's gas giants are aligned with their planet's equator. However, for exoplanets that orbit close to their star, tidal forces from the star would lead to the outermost rings of a planet being aligned with the planet's orbital plane around the star. A planet's innermost rings would still be aligned with the planet's equator so that if the planet has a tilted rotational axis, then the different alignments between the inner and outer rings would create a warped ring system.

Moons

In December 2013 a candidate exomoon of a rogue planet was announced. No exomoons have been confirmed so far.

Atmospheres



Clear versus cloudy atmospheres on two exoplanets.

Atmospheres have been detected around several exoplanets. The first to be observed was HD 209458 b in 2001. KIC 12557548 b is a small rocky planet, very close to its star, that is evaporating and leaving a trailing tail of cloud and dust like a comet. The dust could be ash erupting from volcanos and escaping due to the small planet's low surface-gravity, or it could be from metals that are vaporized by the high temperatures of being so close to the star with the metal vapor then condensing into dust.

In June 2015, scientists reported that the atmosphere of GJ 436 b was evaporating, resulting in a giant cloud around the planet and, due to radiation from the host star, a long trailing tail 14×10^{6} km (9×10^{6} mi) long. In May 2017, glints of light from Earth, seen as twinkling from an orbiting satellite a million miles away, were found to be reflected light from ice crystals in the atmosphere. The technology used to determine this may be useful in studying the atmospheres of distant worlds, including those of exoplanets.

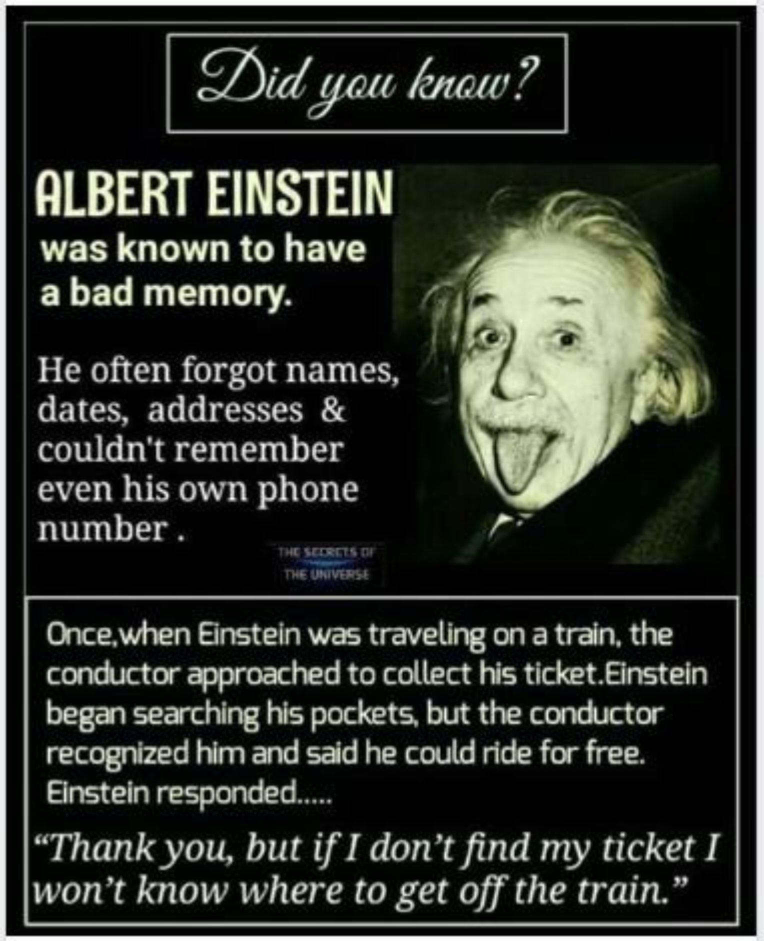
Insolation pattern

Tidally locked planets in a 1:1 spin–orbit resonance would have their star always shining directly overhead on one spot which would be hot with the opposite hemisphere receiving no light and being freezing cold. Such a planet could resemble an eyeball with the hotspot being the pupil. Planets with an eccentric orbit could be locked in other resonances. 3:2 and 5:2 resonances would result in a double-eyeball pattern with hotspots in both eastern and western hemispheres. Planets with both an eccentric orbit and a tilted axis of rotation would have more complicated insolation patterns.

… Exoplanets

As more planets are discovered, the field of exoplanetology continues to grow into a deeper study of extrasolar worlds, and will ultimately tackle the prospect of life on planets beyond the Solar System. At cosmic distances, life can only be detected if it is developed at a planetary scale and strongly modified the planetary environment, in such a way that the modifications cannot be explained by classical physico-chemical processes (out of equilibrium processes).

For example, molecular oxygen (O_2) in the atmosphere of Earth is a result of photosynthesis by living plants and many kinds of microorganisms, so it can be used as an indication of life on exoplanets, although small amounts of oxygen could also be produced by non-biological means. Furthermore, a potentially habitable planet must orbit a stable star at a distance within which planetary-mass objects with sufficient atmospheric pressure can support liquid water at their surfaces.



The blood moon from the 2018 Lunar eclipse. 12 images stacked from DSLR at prime focus with Celestron 8” EdgeHD and focal-reducer.

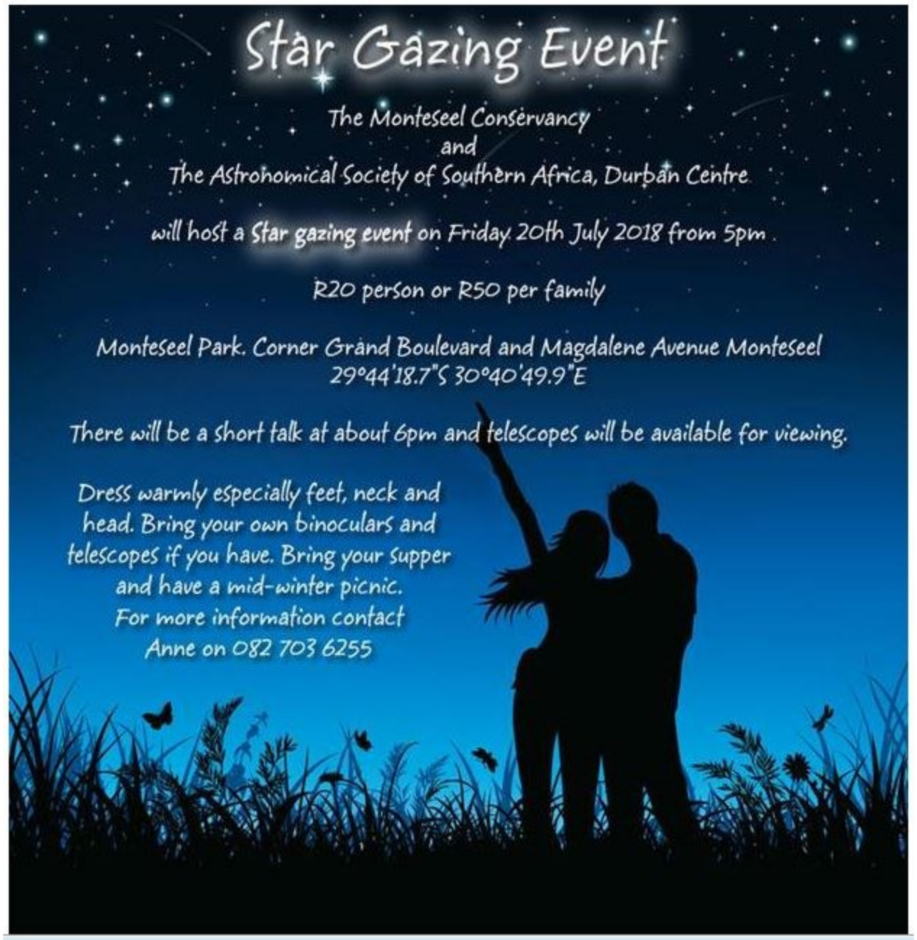
Out-Reach

By Sheryl Venter

MONTESEEL CONSERVANCY STAR GAZING EVENING

The Secretary of the Monteseel Conservancy, Anne Bruzas, contacted us to co-host a Star Gazing evening. We settled on 20th July at quite short notice and although some of the usual crew have been in attendance at most other outreach events recently, they came out again.

Thanks to Mike Hadlow, Maryanne Jackson, Don Orsmond for bringing their own telescopes. Don is a new member (only two months) and it was his first outing with us - a good example to other new members! Debbie Abel, Peter Wunderlin and myself were also there. One or two of the conservancy members also had small telescopes out.



Anne's beautiful poster was emailed out to our members, conservancies and other organisations so the turnout was very good - nearly 100 people, including many children. There was an entry fee of R20, which is reasonable for families with children. Events like this and the Botanic Gardens evening attract people who are keen to give their children the opportunity to view the sky through telescopes which is also very rewarding for us. These events also seem to attract the one or two knowledgeable people out there who have yet joined ASSA Durban and they are always good to meet. We hope Sabrina will join us as a member.

Mike's short talk on the viewing for the evening - all the visible planets and the Big Five, had an avid audience who quickly queued to Maryanne's telescope which happened to be the nearest one.

Although the sky was clear, no cloud at all, the moon was very bright and viewing was also affected by the all the domestic lights on the hills around the Monteseel area. The rate of urbanisation and night time lighting is increasing at a frightening rate. The air temperature was about 16 degrees: it wasn't too cold to braai and for people to sit out on blankets.

Anne is keen that we make this a annual event. Gate takings will be split between the Monteseel Conservancy and ASSA: Durban.

Another successful event presented by dedicated Durban ASSA members.

… Out-Reach

LUNAR ECLIPSE VIEWING AT THE NEST, WINTERTON

By Sheryl Venter

The owners of The Nest Hotel near Winterton in the Southern Drakensberg invited Astronomy Durban to present a talk on the lunar eclipse to their guests.

We drove up on Friday afternoon and were welcomed by Sarah at the front desk. Estelle, the bookkeeper whose idea it was to invite ASSA Durban, and Sally the co-owner with her husband Stuart, greeted us on arrival.

At six fifteen Debbie presented her interesting slide show to fifty guests seated in front of a roaring fire in the lounge. Each guest received a commemorative bookmark. Debbie also prepared a handout for each person to orient themselves to the stars.

Stuart and Sally, Connor (GM), Estelle, and Zinhle (PR) all attended the talk with the guests. Stuart welcomed everyone and Connor gave a brief insight into Debbie's impressive CV so the guests felt they were really being treated to expert advice, albeit from a self- styled amateur astronomer. Piet, the new chairman Of ASSA: Durban Centre, was also there. The event was open to hotel guests and locals who came for dinner.

After an excellent dinner with, Debbie, Piet, myself and the guests went outside to be treated with Gluhwein, blankets to keep warm and lit fires. The resident Husky dog lolled around soaking up the cold while the speed of the eclipse took us rather by surprise. Piet was unable to step up a telescope due to the steep slope. The site was perfectly adequate for viewing the eclipse. Once coverage had been reached only a few students stayed out to enjoy the fresh air and the rest of us opted to take cover from the cold.

In addition to the eclipse we saw the visible planets and constellations. One of the locals owns a permanently mounted telescope at his home. He comes to Durban regularly and promised to attend our meetings when he is in Durban.

Many of the visitors were not aware that a pair of binoculars is acceptable as a viewing aid. I had my birding binos and lent them to a few people who showed interest. Our lasers evoked the usual interest, although mine is temperamental when cold. We met one of the ladies, Jane, at her antique shop the next day and she told us of a suspected UFO landing site on top of a nearby mountain and that almost every evening is great for stargazing.

On Saturday morning, we went to visit Piet at his Winterton home. He has a well-equipped observatory. A Star Party in the Winterton area could be great fun – there are game farms, a winery, and all manner of daytime entertainments besides shopping and hiking.

We made the most of The Nest's hospitality. The rondavel was comfortable. With electric blankets we were warm all night, even when the outside temperature was 1 degree, as recorded by Debbie's 4x4. We enjoyed all the courses at every meal with attentive service overseen by Stuart.

Sihle asked that a book be dropped at Emofweni Guest Cottages where he had stayed with his Pathfinders group while on an outreach trip to the Berg. We were very happy to have had an open itinerary which allowed us to enjoy the hospitality and stimulating conversation of Rita and Jens.

We look forward to Stuart and Sally hosting another astronomy event and making this an annual outreach event with our Society, perhaps to be combined with a Star Party in the Southern Berg.

Members Moments

The latest "Big 5" members club. Left, Piet Strauss, Claire Odhav, Debbie Abel, Brian Finch, John Gill, Mike Hadlow, Sihle Kunene. (Amod Farouk absent)

Ken Pullock receiving a "Certificate of Appreciation" from Mike Hadlow.

Mike Hadlow receiving a "Certificate of Appreciation" from Logan Govender.

… Members Moments

Debbie Abel and Piet Strauss in Winterton

Lunar Eclipse 2018

Photos by Maryanne Jackson. Well done! Excellent!

The Month Ahead

MEETINGS:

The next meeting will be on Wednesday 8 August 2018 @ 19:30

MNASSA:

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

MEMBERSHIP FEES & BANKING:

Members - R 170 Family Membership - R 200 Joining Fee - R 35

EFT: **The Astronomical Society of Southern Africa - Natal Centre**.

Nedbank Account No. **1352 027 674** Durban North Branch Code **135 226**

Please include your initial and surname in the reference line.

POSTAL ADDRESS:

P O Box 20578, Durban North, 4016 or handed in to the treasurer

CONTACT US:

Chairman: Piet Strauss (+27) 83 703 1626

Vice Chairlady & Treasurer: Debbie Abel (+27) 83 326 4084

Secretary: Brian Finch (+27) 82 924 1222

Observatory Director: Mike Hadlow (+27) 83 326 4085

Publicity & Media: Logan Govender (+27) 83 228 6993

Publicity & Facbook: Brett Harding (+27) 72 964 0962

Out-Reach: Sihle Kunene (+27) 83 278 8485

Equipment Curator & Teas: Robert Suberg (+27) 73 232 4092

School Liaison, Meet & Greet: Maryanne Jackson (+27) 82 882 7200

Out-Reach & Events Co-Ordinator: Sheryl Venter (+27) 82 202 2874

Librarian: Clair Odhav (+27) 83 395 5160

Special Projects: Corinne Gill (+27) 84 777 0208

'nDaba Editor, Webmaster & Facebook: John Gill (+27) 83 378 8797

All other contact information is available on our website: www.astronomydurban.co.za

Emails can be sent to AstronomyDurban@gmail.com

ASSA Durban - Minutes of the Meeting

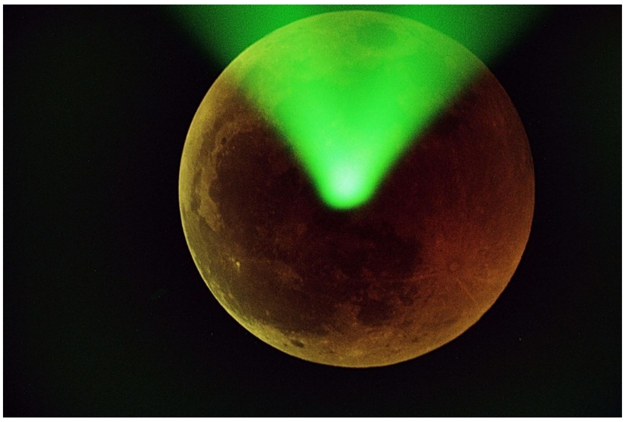
11 July 2018

1. Notice of Meeting was duly circulated.
2. **Welcome:** Chairman Mike Hadlow welcomed 20 members and 3 visitors.
3. **Apologies:** 8 Apologies received as per attendance register.
4. **Previous Minutes:** the Minutes of the AGM held on 12 July 2017 having been circulated, it was agreed that reading of same was unnecessary. Proposed by L. Govender and seconded by J. Senogles the Minutes were approved.
5. **Chairman's Report:** The chairman tabled the attached report. Logan Govender proposed a vote of thanks to the Chairman for his leadership and was unanimously supported.
6. **Treasurer's Report:** Treasurer Richard Rowland announced his resignation from the position of Honorary Treasurer and expressed his satisfaction that the society's finances were sound having achieved a surplus of R24000 in the 2017/18 year. Annual Subscriptions were to be increased to R200.00 and R170.00 for family members and single members respectively. The joining fee remain unchanged at R35.00. The Chairman thanked Richard for his years of service as Treasurer.
7. **Librarian's Report:** Nothing to report.
8. **Observatory Report:** Mike Hadlow tabled the attached report.
9. **Curator of Instruments Report:** Rob Suberg tabled the attached report.
10. **Media & Public Relations:** Logan Govender gave an audio-visual presentation of the year's activity. He thanked his many helpers for their welcome support.
11. **Election of Committee:** Of the present committee, J. Gill, Mike Hadlow, Maryanne Jackson, Richard Rowland and Robert Suberg, have still one more year to serve. However R. Rowland has tendered his resignation. In terms of the ASSA Constitution, those committee members who were required to stand down having served two years, ie. Debbie Abel, Brian Finch, Sihle Kunene, Pieter Strauss and Sheryl Venter all indicated their willingness to continue. In addition to the latter committee members being re-elected the following nominations were received from the floor and duly elected: Corinne Gill, Brett Harding, Claire Odhav and Avril Subramoney. Peter Dormehl and Logan Govender, as former Chairmen, would remain *ex officio* committee members but are not required to attend committee meetings.
12. **The Natal Centre Award:** Logan Govender explained that, in the absence of any outstanding Astronomical contribution, it had been decided not to make such award this year. However Certificates of Appreciation were awarded Ken Pullock and Mike Hadlow for their efforts in support of the Society over many years.
13. **Astronomy Big 5 presentation:** Piet Strauss explained the ASSA National BIG 5 project. The following persons, having qualified, were presented with commemorative mugs, certificates and pins: Sihle Kunene, Debbie Abel, Mike Hadlow, John Gill, Farouk Amod, Piet Strauss, Jean Senogles, Claire Odhav and Brian Finch.

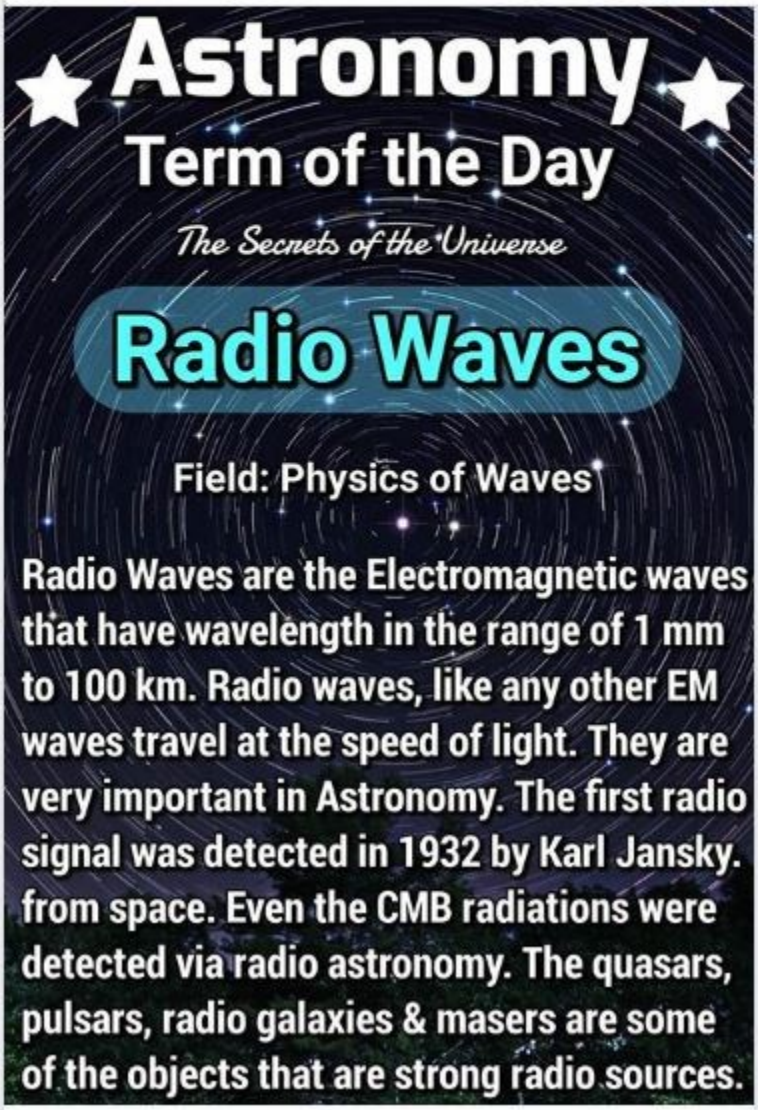
There being no further business, Mike Hadlow, thanked all those present, invited everyone to partake of the snacks and refreshments provided & declared the meeting closed at about 21:15

Public Viewing Roster

Name	Phone	Name	Phone	Assistant	New Moon	Public Viewing
John Gill	083 378 8797	Debbie Abel	083 326 4084	Sheryl Venter	13 June 2018	15 June 2018
Brian Finch	082 924 1222	Ooma Rambilass	083 739 3178	John Gill	13 July 2018	13 July 2018
Maryanne Jackson	082 882 7200	Johnny Visser	082 357 3091	Susan Knight	11 August 2018	10 August 2018
Mike Hadlow	083 326 4085	Navi Naidoo	084 466 0001	Sheryl Venter	9 September 2018	7 September 2018
Brian Finch	082 924 1222	Debbie Abel	083 326 4084	Mike Hadlow	9 October 2018	12 October 2018
John Gill	083 378 8797	Ooma Rambilass	083 739 3178	Susan Knight	7 November 2018	9 November 2018
Maryanne Jackson	082 882 7200	Johnny Visser	082 357 3091	Ooma Rambilass	7 December 2018	7 December 2018



Lunar eclipse 2018. This must be the aliens sending us a message …. Image by John Gill



Pre-Loved Astronomical Equipment

MEADE ETX105

Asking R10,000 for a computerised telescope complete with software, various lenses, LPI imager, tripod etc

Contact : Geoff Stepney on 031 337 975

Telescope
Sky-Watcher Skymax-127
Computerised Sync
Equatorial Stand
Battery Pack
Sun filter, T-Ring
Various Eyepieces and Barlow lens
Price: R5,000
Contact details: Tasja 0824868924

Green Laser Pointers

50mW — R 450 each
Contact Piet 083 703 1626
on WhatsApp or SMS.

Will also be available at next ASSA meeting.

Celestron 6SE

I still have all of the original packaging. Telescope is in excellent condition (Optically and mechanically) and is still used for Astrophotography and outreach projects. The imaging cameras for Astrophotography are not included in the package. The telescope runs on an external 12v supply, either using an AC adapter (not included) or a 12v cigarette lighter port (cable included).

Contact Amith Rajpal 083 335 8800

Amith.Rajpal@coretecit.co.za

Retail Price is over R 23 000 **Asking Price: R 17 500**

Standard items (included):
1. Original 2" Steel tripod.
2. 1.25" Diagonal.
3. 1.25" 25mm ELux Eyepiece.
4. Red Dot Finder.
5. Tripod Spreader.
6. Cover for Corrector Plate
7. Optical Tube Assembly
8. Fully GoTo 6SE mount

Plus loads of extra equipment