ECLIPSE NEWSLETTER

The Eclipse Newsletter is dedicated to increasing the knowledge of those interested in Astronomy, Astrophysics, Cosmology and related subjects.

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NOVEMBER - DECEMBER 2017

PLEASE SEND ALL PHOTOS, QUESTIONS AND REQUST FOR ARTICLES TO
pestrattonmcag@gmail.com

MCAO PUBLIC NIGHTS AND FAMILY NIGHTS.

The general public and MCAO members are invited to visit the Observatory on select Monday evenings at 8PM for Public Night programs. These programs include discussions and illustrated talks on astronomy, planetarium programs and offer the opportunity to view the planets, moon and other objects through the telescope, weather permitting. Due to limited parking and seating at the observatory, admission is by reservation only.

Public Night attendance is limited to adults and students 5th grade and above. If you are interested in making reservations for a public night, you can contact us by calling 302-654-6407 between the hours of 9 am and 1 pm Monday through Friday. Or you can email us any time at KimGreenmcao@gmail.com or mtcuba@physics.udel.edu. The public nights will be presented even if the weather does not permit observation through the telescope. The admission fees are $3 for adults and $2 for children. There is no admission cost for MCAO members, but reservations are still required. If you are interested in becoming a MCAO member, please see the link for membership. We also offer family memberships.

Family Nights are scheduled from late spring to early fall on Friday nights at 8:30PM. These programs are opportunities for families with younger children to see and learn about astronomy by looking at and enjoying the sky and its wonders. It is meant to teach young children from ages 6-12 about astronomy in simple terms they can really understand. Reservations are required and admission fees are $3 for adults and $2 for children.

MCAO WEB SITE IS

mountcuba.org

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GLOSSARY:

celestial sphere - In astronomy the **celestial sphere** is an abstract sphere, with an arbitrarily large radius, that is concentric to Earth. All objects in the **observer's** sky can be conceived as projected upon the inner surface of the celestial sphere, as if it were the underside of a dome. The celestial sphere is a practical tool for spherical astronomy, allowing observers to plot positions of objects in the sky when their distances are unknown or trivial.

Ecliptic - the circular path on the celestial sphere that the Sun appears to follow over the course of a year; it is the basis of the ecliptic coordinate system. The term also refers to the plane of this path, which is coplanar with Earth's orbit around the Sun (and hence the Sun's apparent orbit around Earth). The ecliptic is not normally noticeable from Earth's surface because Earth rotates, carrying the observer through the cycles of sunrise and sunset, which obscure the Sun's apparent motion against the background of fixed stars.

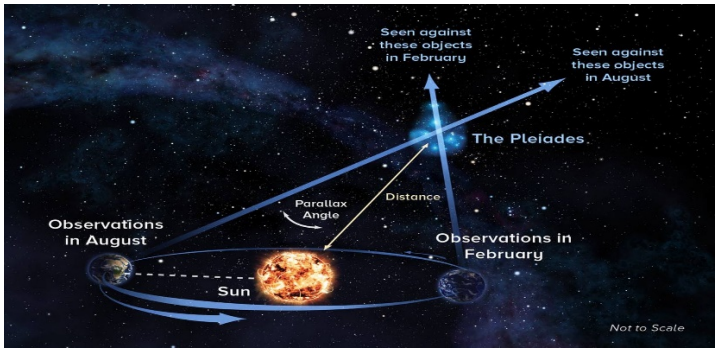
Kilonova - a transient astronomical event that occurs in a compact binary system when two neutron stars or a neutron star and a black hole merge into each other. Kilonovae are thought to emit short gamma ray bursts and strong electromagnetic radiation due to the radioactive decay of heavy r-process nuclei that are produced and ejected fairly isotopically during the merger process

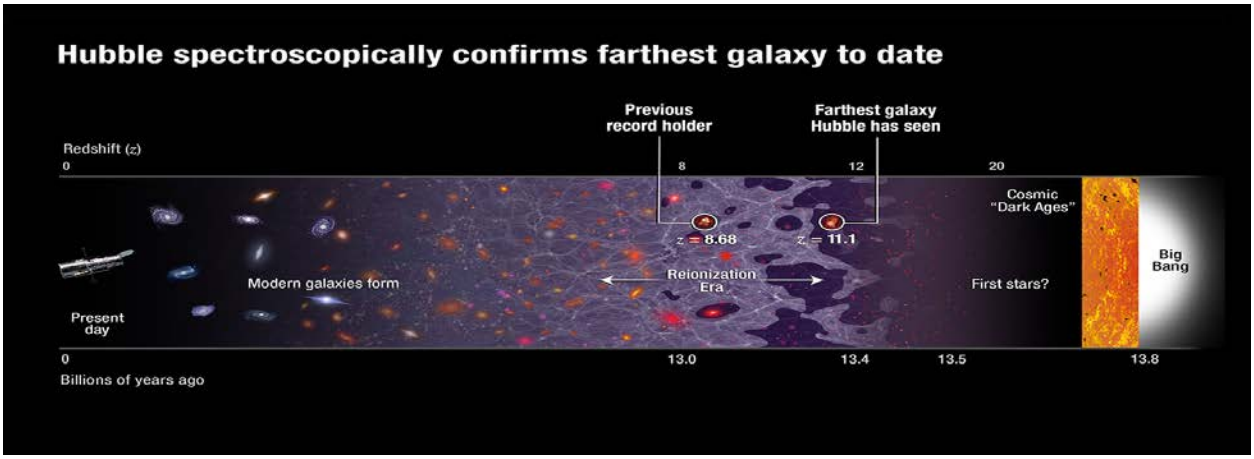
neutron star - a celestial object of very small radius (typically 18 miles/30 km) and very high density, composed predominantly of closely packed neutrons. Neutron stars are thought to form by the gravitational collapse of the remnant of a massive star after a supernova explosion, provided that the star is insufficiently massive to produce a black hole.

kiloparsecs - a unit of distance, equal to 1000 parsecs - a parsec is a unit of distance equal to that required to cause a heliocentric parallax of one second of an arc, equivalent to 206,265 times the distance from the earth to the sun, or 3.26 light-years..

HOW DO WE MEASURE THE DISTANCE TO A GALAXY?

PARALLAX





Astronomers have developed several techniques to indirectly measure the vast distances between Earth and the stars and galaxies. In many cases, these methods are mathematically complex and involve extensive computer modeling.

Parallax is the visual effect produced when, as an observer moves, nearby objects appear to shift position relative to more-distant objects. This common event is easily reproduced; hold your finger out at arm's length, and look at your fingertip first with one eye closed, then the other. The "motion" of your fingertip as seen against background objects is caused by the change in your viewing position -- about three inches from one eye to the other.

As Earth orbits the Sun, astronomers invoke this same principle to determine the distance to nearby stars. Just like your fingertip, stars that are closer to us shift positions relative to more-distant stars, which appear fixed. By carefully measuring the angle through which the stars appear to move over the course of the year, and knowing how far Earth has moved, astronomers are able to use basic high-school geometry to calculate the star's distance.

Parallax serves as the first "inch" on the yardstick with which astronomer's measure distances to objects that are even farther.

For example, they use a class of variable known as Cepheids, which pulsate in and out like beating hearts. There is a direct relationship between the length of a Cepheid's pulsation and its true brightness. Measuring a Cepheid's apparent brightness -- how bright it looks from Earth -- allows astronomers to calculate its true brightness, which in turn reveals its distance. For this technique to work correctly, though, astronomers must first use the parallax method to get the distances to some of the closer Cepheids. This allows them to calibrate a Cepheid's true brightness, which then can be used to calculate its distance. Cepheids are especially bright stars, so they are visible in galaxies that are tens of millions of light-years away.

For more-distant galaxies, astronomers rely on the exploding stars known as supernovae. Like Cepheids, the rate at which a certain class of supernovae brighten and fade reveals their true brightness, which then can be used to calculate their distance. But this technique also requires

good calibration using parallax and Cepheids. Without knowing the precise distances to a few supernovae, there is no way to determine their absolute brightness, so the technique would not work.

Parallax is a displacement or difference in the apparent position of an object viewed along two different lines of sight, and is measured by the angle or semi-angle of inclination between those two lines. The term is derived from the Greek word (parallaxis), meaning "alternation". Due to foreshortening, nearby objects show a larger parallax than farther objects when observed from different positions, so parallax can be used to determine distances.

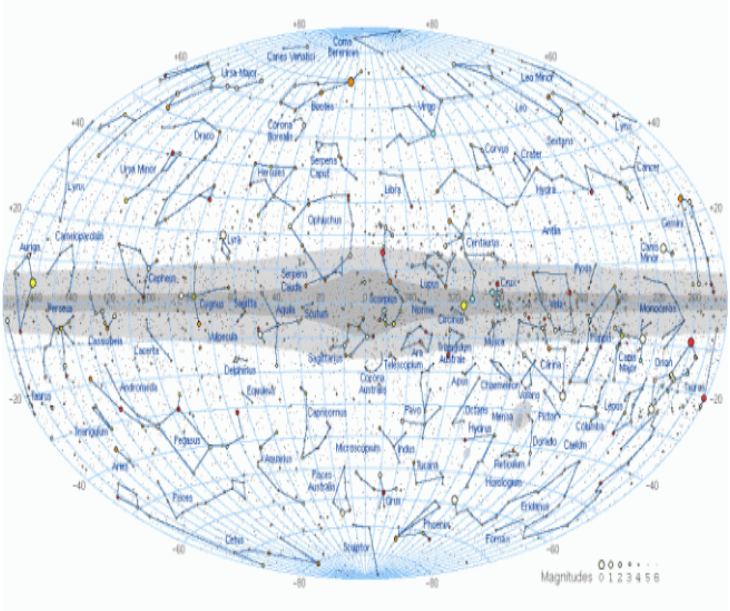
To measure large distances, such as the distance of a planet or a star from Earth, astronomers use the principle of parallax. Here, the term parallax is the semi-angle of inclination between two sight-lines to the star, as observed when Earth is on opposite sides of the Sun in its orbit.[3] These distances form the lowest rung of what is called "the cosmic distance ladder", the first in a succession of methods by which astronomers determine the distances to celestial objects, serving as a basis for other distance measurements in astronomy forming the higher rungs of the ladder.

HOW TO FIND CONSTELLATIONS

Step 1. Purchase a Star Chart as shown below. Mt. Cuba Astronomical Observatory sells this one for $4.00.

Step 2. Get acquainted with the Star Chart. You will notice there are two sides to the chart. One side is for viewing the sky to the North while the other side is for viewing to the South. Let's start with the side for the North. You will notice that the white part of the chart rotates. At the bottom of the white part, you will see months. Above the month is the date. On the blue part you will see times from 7 p.m. to 6 a.m. Select the month and date you are using the Chart. Rotate them to the time of day you are viewing. 3. Face North and look at the chart to pick out the object you want to find then look up at the sky. Compare the stars on the star chart and the stars you see in the night sky**.** 4. To view South, turn the chart over, face South and repeat above.

TEN INTERESTING FACTS ABOUT CONSTALLATIONS.



1: Constellations Are Star Patterns In The Night Sky

Constellations ("set of stars") are basically groups of stars that have imaginatively been linked together to depict mythological characters, animals and objects from mankind's past. This allowed early people to organize the night sky into a recognizable form to assist in their religious study of the celestial heavens, as well as more earthly applications, such as predicting the seasons for farming, measuring time or as a directional compass.

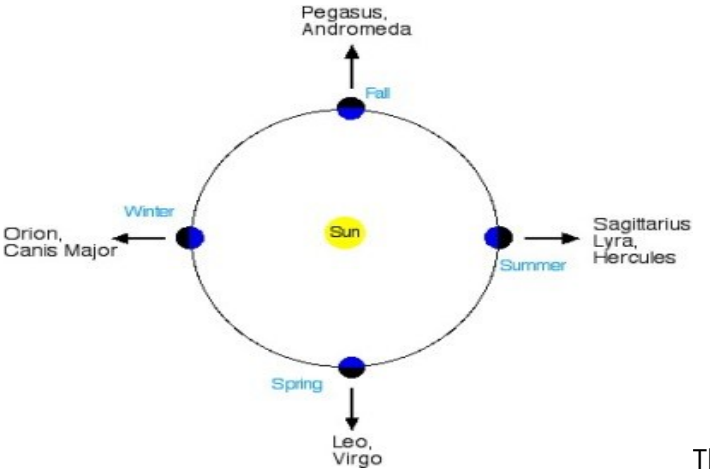
2: There Are 88 Official Constellations

In 1922, the International Astronomical Union (IAU) officially recognized 88 constellations, 48 of which were recorded by the Greek astronomer Ptolemy in his book 'Almagest' written around 150 AD. Ptolemy's chart had gaps, especially near the south celestial pole as this area was uncharted at the time, but over the centuries new constellations have been added to the list, including by Dutch explorers Gerardus Mercator (1551), and Pieter Keyser and Frederick de Hautmann near the turn of the 16th century. Polish astronomer Johannes Hevelius (1690), and French astronomer Nicolas Louis de Lacaille (1750s) later completed the remaining constellations we are now familiar with in the night sky.

3: Knowledge Of Constellations Came From Early Cultures

The Greeks knowledge of the constellations stretches way back in time at least to the 8th century BC when Homer made the earliest known Greek reference to the constellations Boötes, Orion, and Ursa Major in his epic poem the Iliad and the Odyssey. Nevertheless, much of the Greek's initial knowledge of the constellations came to them from the Ancient Egyptians, who likely inherited their understanding from Ancient Babylon and Sumeria before them. In fact, at least 30 modern constellations can be shown to date back to at around the Late Bronze Age (1650-1050 BC), with references to some of the constellations found in Mesopotamian clay writing tablets and Babylonian star constellation catalogs dating back to the 3rd millennium BCE. There are also references to be found in the Hebrew Bible, and Biblical texts. Orion is perhaps the most distinctive of all the constellations, and an amazing discovery was made in 1972 at the Ach valley in Germany after an image of Orion was found carved into a piece of mammoth ivory more than 32,000 years old.

4: Different Constellations Become Visible Throughout The Year



Throughout the year different parts of the sky and therefore different constellations become visible to us as the Earth completes its annual orbit around the Sun. The constellations we see at night are those that are located behind the Earth on our side of the Sun, as we cannot see those constellations in the opposite direction behind the bright Sun during the day.

To better understand why this is so, imagine sitting on a merry-go-round (Earth) with a very bright light (Sun) placed at its center. You will not be able to see past the light (Sun) because of its brightness, and so you can only see things by looking towards the outside of the merry-go-round, with the background changing as you spin around in a circle.

Which constellations can be viewed throughout the year depends upon your latitude and will vary from different locations around the world. In the northern hemisphere, for instance, the constellation of Orion is a winter constellation, while Leo is associated with spring, Scorpius with summer, and Pegasus with autumn.

5: Constellations Travel From East To West Like The Sun

Each night more stars and constellation begin to appear in the eastern part of the sky at dusk before moving across and disappearing over the western horizon by dawn. Likewise, those constellations which we had been able to see low near the western horizon after sunset will vanish from our view only to be replaced by constellations which had been higher in the sky at sunset just a few weeks earlier. The constellations which appear in the east have a daily shift rate close to one degree per day, as completing a 360 degrees circular journey around the Sun in 365 days produces roughly that rate. One full year later, and the stars subsequently return to the same position and rising time as the year before.

6: Rotation Of Constellations A Matter of Perspective

The direction in which the constellations appear to rotate in the night sky is truly a matter of perspective, and is determined by the Earth's rotation, as well as the direction in which an observer is facing. Looking north, the constellations appear to rotate counterclockwise around a fixed point in the night sky known as the north celestial pole, which is located near the north star Polaris. This is because the Earth spinning from West to East means the ground beneath you is rotating to your right, while above you the stars appear to follow an East to West direction (right to left) just like the Sun, Moon, and planets. If you face south, however, the stars would seem to revolve in a clockwise direction (left to right); while a person facing east would see the stars coming up in front of them and setting behind them. Likewise, a west facing observer will see the stars appearing to rise behind them before setting to their front (full article found here).

7: Zodiac Constellations Found Where Sun, Moon, and Planets Move

The most commonly known of all the 88 constellations are those of the Zodiac. However, less well known is the fact that there is in actual fact 13 zodiacal constellations, including Ophiuchus, the 'serpent-bearer.' All the Zodiac constellations appear within a 23.5 degree wide band of sky called the ecliptic plane, which the Sun seems to pass through from the Earth's perspective. The planets of our solar system also appear to orbit within this band of sky.

8: Some Constellations Have Families

A constellation family refers to a group of constellations located within the same region of the night sky. They usually take their names from their most important constellation, the most prolific of which is the Hercules Family containing 19 constellations. Others include the Ursa Major Family (10), the Perseus Family (9) and the Orion Family (5).

9: Notable Constellations

The biggest constellation is Hydra which extends over more than 3% of the night sky, while the smallest is Crux covering a mere 0.165%. Centaurus contains the largest number of visible stars at 101; while Canis Major contains the brightest star in the celestial heavens, namely Sirius, which has

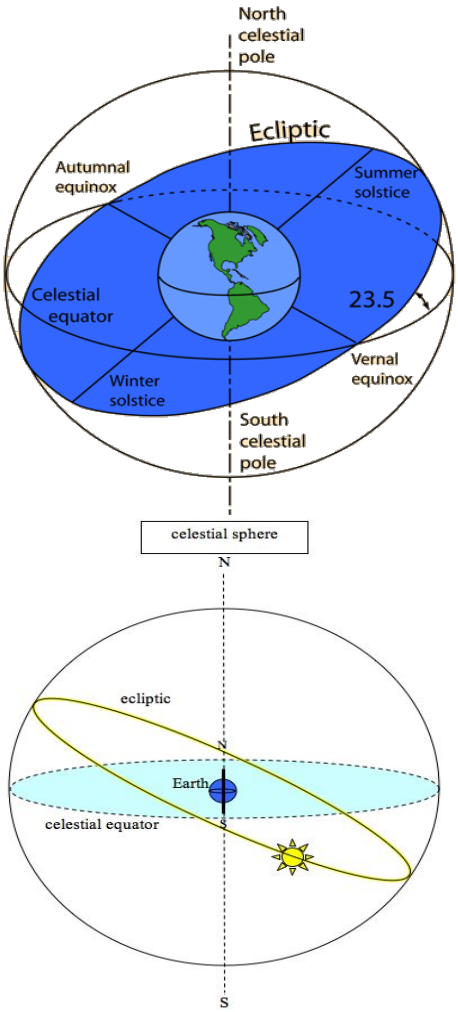
an apparent magnitude of -1.46 and means 'glowing' in Ancient Greek. Mensa, on the other hand, is the faintest constellation in the night sky as its brightest star has a visual magnitude of just 5.09.

10: Asterism Not Considered True Constellation

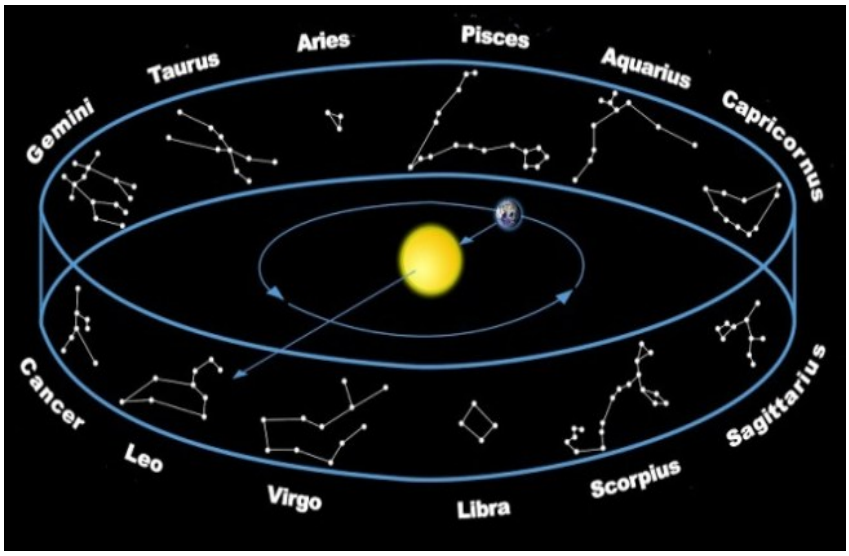
An asterism is a pattern of stars that are widely recognized and contained within an official constellation but is not counted as a true constellation in itself. The Big Dipper, for instance, is a famous asterism but the seven stars in this arrangement of stars represent less than half of the whole constellation known as Ursa Major. Another famous asterism is the three stars in a row which form Orion's belt.

WHAT IS THE ELIPIC?

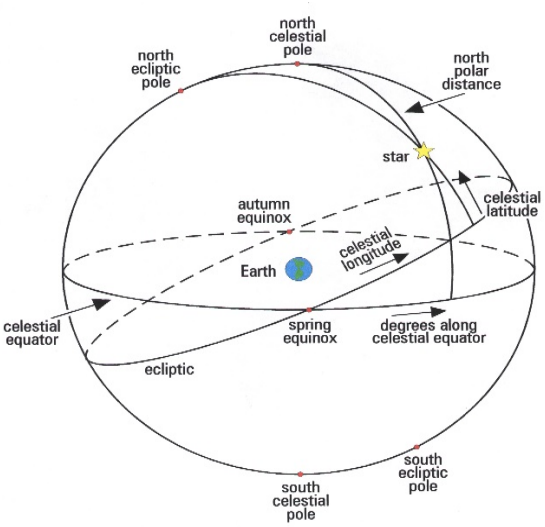
The Ecliptic. The apparent path of the Sun's motion on the celestial sphere as seen from Earth is called the ecliptic. The ecliptic plane is tilted 23.5° with respect to the plane of the celestial equator since the Earth's spin axis is tilted 23.5° with respect to its orbit around the sun.



Star Constellations: The Zodiac



There are 88 modern constellations occupying different regions of the sky, with the 12 zodiac constellations situated within a 9° band either side of the ecliptic plane, an imaginary line which traces the apparent path that the Sun, Moon, and planets take over the course of a year. The ecliptic encircles the celestial sphere at an angle of 23.5° relative to the celestial equator, with all the zodiac constellations located along this plane visible to stargazers at different times of the year from latitudes between +90° and -60°.
In astronomy, the degrees of longitude marking each zodiac constellations are not equally sized, and the number of days the Sun spends in each zodiac constellation varies accordingly. This can be seen in the following list (days in brackets), which also includes an unofficial thirteenth zodiac constellation called Ophiuchus, whose modern boundary also intersects the ecliptic: Sagittarius (32), Capricornus (23), Aquarius (24), Pisces (38), Aries (25), Taurus (37), Gemini (31), Cancer (20), Leo (37), Virgo (45), Libra (23), Scorpius (7), Ophiuchus (18).



THIS EDITIONS CONSTALLATION.
ARIES

Aries ("the ram") was a familiar sight to ancient civilizations, with this inconspicuous zodiacal constellation holding great importance on account of its location along the ecliptic. Aries was one of 48 constellations recorded by Greek astronomer Ptolemy in his treatise called Almagest (150AD), and in 1922 the International Astronomical Union (IAU) recognized it as one of the 88 official constellations. Interestingly it was only in 1930 that the outline of its boundaries were defined by Belgian astronomer Eugène Delporte.

Represents: Golden Fleece Ram

Although Aries is the 39th largest constellation in the sky and takes up an area of 441 square degrees, there is nothing in its shape that seems to justify such a large "surface area". Furthermore, even the most ardent student of constellation shapes would be hard pressed to identify a ram in the constellation, while practical-minded observers of Aries are likely to see nothing more than a kinked line made up of four moderately bright stars.

Location: Northern Constellation

Aries is a northern hemisphere constellation that can be observed from latitudes of between +90° and -60° , making it also visible to observers across much of the southern hemisphere. It can be

found between Taurus to the east and Pisces to the west, near the "Great Square" of Pegasus. This constellation can also be located by following an imaginary line from Polaris in Ursa Minor past the star Segin in the Cassiopeia, until you reach the Pleiades and the Great Square of Pegasus.

Best Seen: Winter/Spring

From the northern hemisphere, Aries is best seen in the winter and spring time, with the constellation culminating at about 10 p.m. local time during the last days of November, and again at about 8 p.m. local time in late December. During these times, Aries is visible for most of the night, but as it is not among the most conspicuous constellations, a dark sky is needed to see it best.

WHAT ARE THE MESSIER OBJECTS?

The Messier objects are a set of over 100 astronomical objects first listed by French astronomer Charles Messier in 1771.[1] Messier was a comet hunter, and was frustrated by objects which resembled but were not comets, so he compiled a list of them,[2] in collaboration with his assistant Pierre Méchain, to avoid wasting time on them. The number of objects in the lists he published reached 103, but a few more thought to have been observed by Messier have been added by other astronomers over the years.

For a list of Messier objects:

https://en.wikipedia.org/wiki/List of Messier objects

TO OPEN - SWIP AND SELECT OPEN HYPERLINK

MESSIER OBJECT – 31

The Andromeda Galaxy, also known as Messier 31, M31, or NGC 224, is a spiral galaxy approximately 780 kiloparsecs (2.5 million light-years) from Earth. It is the nearest major galaxy to the Milky Way and was often referred to as the Great Andromeda Nebula in older texts. It received its name from the area of the sky in which it appears, the constellation of Andromeda, which was named after the mythological princess Andromeda.

Andromeda is approximately 220,000 light years across, and it is the largest galaxy of the Local Group, which also contains the Milky Way, the Triangulum Galaxy, and other smaller galaxies. Despite earlier findings that suggested that the Milky Way contains more dark matter and could be the largest in the grouping,[12] the 2006 observations by the Spitzer Space Telescope revealed that Andromeda contains one trillion (10^{12}) stars: at least twice the number of stars in the Milky Way, which is estimated to be 200–400 billion. The mass of the Andromeda Galaxy is estimated to be 1.5×10^{12} solar masses,[9] while the Milky Way is estimated to be 8.5×10^{11} solar masses.

The Milky Way and Andromeda galaxies are expected to collide in 4.5 billion years, eventually merging to form a giant elliptical galaxy[j] or perhaps a large disc galaxy. The apparent magnitude of the Andromeda Galaxy, at 3.4, is among the brightest of the Messier objects,[16] making it visible to the naked eye on moonless nights, even when viewed from areas with moderate light pollution.

The Andromeda–Milky Way collision.

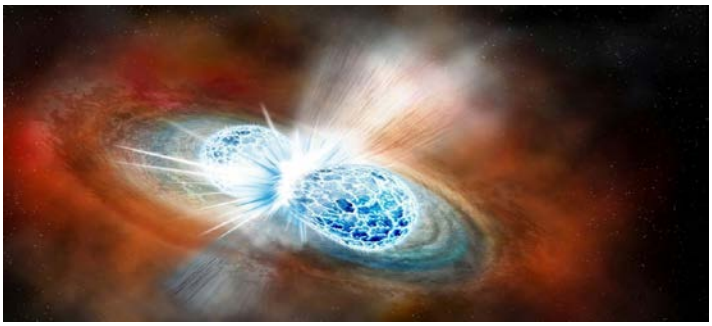
https://www.youtube.com/watch?v=mchzu-eB_wg

Very good explanation of the collision.

https://en.wikipedia.org/wiki/Andromeda%E2%80%93Milky_Way_collision#/media/File:Andromeda_Collides_Milky_Way.jpg

The **Andromeda–Milky Way collision** is a galactic collision predicted to occur in about 4 billion years between the two largest galaxies in the Local Group—the Milky Way (which contains the Solar System and Earth) and the Andromeda Galaxy. The stars involved are sufficiently far apart that it is improbable that any of them will individually collide. Some stars will be ejected from the resulting galaxy, nicknamed *Milkomeda* or *Milkdromeda*.

Astronomers strike gold, witness massive cosmic collision.



It was a faint signal, but it told of one of the most violent acts in the universe, and it would soon reveal secrets of the cosmos, including how gold was created.

Forbes estimated that the collision created an estimated $10 octillion in gold, which is $10 billion, billion, billion.

What they witnessed in mid-August and revealed Monday was the long-ago collision of two neutron stars — a phenomenon California Institute of Technology's David H. Reitze called "the most spectacular fireworks in the universe."

The crash happened 130 million years ago, while dinosaurs still roamed on Earth, but the signal didn't arrive on Earth until Aug. 17 after traveling 130 million light-years. A light-year is 5.88 trillion miles.

"We already knew that iron came from a stellar explosion, the calcium in your bones came from stars and now we know the gold in your wedding ring came from merging neutron stars," said University of California Santa Cruz's Ryan Foley.

Measurements of the light and other energy emanating from the crash have helped scientists explain how planet-killing gamma ray bursts are born, how fast the universe is expanding, and where heavy elements like platinum and gold come from.

"This is getting everything you wish for," said Syracuse University physics professor Duncan Brown, one of more than 4,000 scientists involved in the blitz of science that the crash kicked off. "This is our fantasy observation."

It started in a galaxy called NGC 4993, seen from Earth in the Hydra constellation. Two neutron stars, collapsed cores of stars so dense that a teaspoon of their matter would weigh 1 billion tons, danced ever faster and closer together until they collided, said Carnegie Institution astronomer Maria Drout.

The crash, called a kilonova, generated a fierce burst of gamma rays and a gravitational wave, a faint ripple in the fabric of space and time, first theorized by Albert Einstein.

"This is like a cosmic atom smasher at a scale far beyond humans would be capable of building," said Andy Howell, a staff scientist at the Las Cumbres Observatory. "We finally now know what happens when an unstoppable force meets an immovable object and it's a kilonova."

Signals were picked up within 1.7 seconds of each other, by NASA's Fermi telescope, which detects gamma rays, and gravity wave detectors in Louisiana and Washington state that are a part of the LIGO Laboratory , whose founders won a Nobel Prize earlier this month. A worldwide alert went out to focus telescopes on what became the most well-observed astronomical event in history.

Before August, the only other gravity waves detected by LIGO were generated by colliding black holes. But black holes let no light escape, so astronomers could see nothing.

This time there was plenty to see, measure and analyze: matter, light, and other radiation. The Hubble Space Telescope even got a snapshot of the afterglow.

Finding where the crash happened wasn't easy. Eventually scientists narrowed the location down to 100 galaxies, began a closer search of those, and found it in the ninth galaxy they looked at.

It is like "the classic challenge of finding a needle in the haystack with the added challenge that the needle is fading away and the haystack is moving," said Marcelle Soares-Santos, an astrophysicist at Brandeis University.

"The completeness of this picture from the beginning to the end is unprecedented," said Columbia University physics professor Szabolcs Marka. "There are many, many extraordinary discoveries within the discovery."

The colliding stars spewed bright blue, super-hot debris that was dense and unstable. Some of it coalesced into heavy elements, like gold, platinum and uranium. Scientists had suspected neutron star collisions had enough power to create heavier elements, but weren't certain until they witnessed it.

"We see the gold being formed," said Syracuse's Brown.

Calculations from a telescope measuring ultraviolet light showed that the combined mass of the heavy elements from this explosion is 1,300 times the mass of Earth. And all that stuff — including lighter elements — was thrown out in all different directions and is now speeding across the universe.

Perhaps one day the material will clump together into planets the way ours was formed, Reitze said — maybe ones with rich veins of precious metals.

The crash also helped explain the origins of one of the most dangerous forces of the cosmos — short gamma ray bursts, focused beams of radiation that could erase life on any planet that happened to get in the way. These bursts shoot out in two different directions perpendicular to where the two neutron stars first crash, Reitze said.

Luckily for us, the beams of gamma rays were not focused on Earth and were generated too far away to be a threat, he said.

Scientists knew that the universe has been expanding since the Big Bang. By using LIGO to measure gravitational waves while watching this event unfold, researchers came up with a new estimate for how fast that is happening, the so-called Hubble Constant. Before this, scientists came up with two slightly different answers using different techniques. The rough figure that came out of this event is between the original two, Reitze said.

The first optical images showed a bright blue dot that was very hot, which was likely the start of the heavy element creation process amid the neutron star debris, Drout said. After a day or two that blue faded, becoming much fainter and redder. And after three weeks it was completely gone, she said.

This almost didn't happen. Eight days after the signal came through, the LIGO gravitational waves were shut down for a year's worth of planned upgrades. A month later the whole area where the crash happened would have been blocked from astronomers' prying eyes by the sun.

Scientists involved with the search for gravitational waves said this was the event they had prepared for over more than 20 years.

The findings are "of spectacular importance," said Penn State physicist Abhay Ashtekar, who wasn't part of the research. "This is really brand new."

Almost all of the discoveries confirmed existing theories, but had not been proven — an encouraging result for theorists who have been trying to explain what is happening in the cosmos, said France Cordova, an astrophysicist who directs the National Science Foundation.

"We so far have been unable to prove Einstein wrong," said Georgia Tech physics professor Laura Cadonati. "But we're going to keep trying."

UPCOMING STAR PARTIES

For more information on DAS STAR PARTIES, visit the mountcuba.org web site. Select Delaware Astronomical Society DAS.

Select Events at top and then STAR PARTIES.