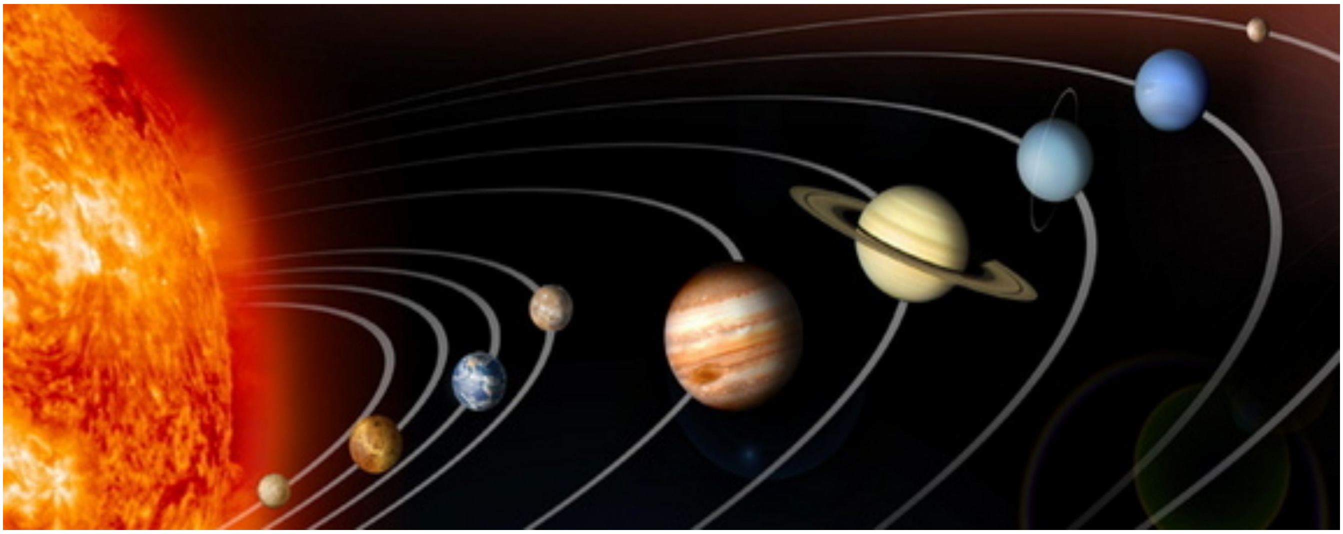
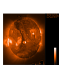
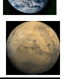
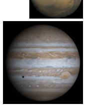
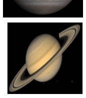
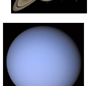
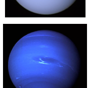
# The Solar System

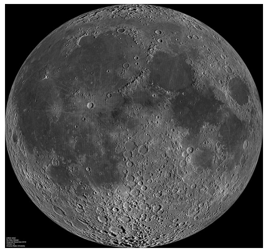


*Planets are not to scale: the inner four including earth (4) are relative in size to each other and the outer from Jupiter (5) are relative in size to each other Pluto (9) is also included but now is a minor planet.*

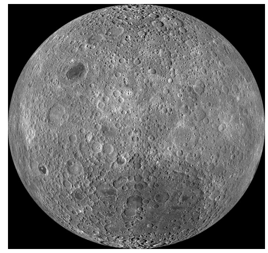
## Planetary Features

| Planet | Radius km | Average Distance from Sun, km | Composition | Sidereal Orbit days | Sidereal Rotation Period | Atmos Major | Moons | Temp Average | Other Features |
|---|---|---|---|---|---|---|---|---|---|
|  Sun | 696,000 | 0 | H/He | - | 609 hrs | - | - | 6000 C | sunspots |
|  Mercury | 2439.7 | 57 mill'n | solid | 87.96 | 1407.6 | vacuum | None | 167 | |
|  Venus | 6051.8 | 108 | solid | 224.7 | -5832.5 | $CO_2$ | None  | 464 | phases |
|  **Earth** | **6371** | **150** | **solid** | **365.24** | **23.93** | **N/O** | **1** | **15** | **Life** |
|  Mars | 3389 | 228 | solid | 686.97 | 24.62 | $CO_2$ | 2 | -63 | |
|  Jupiter | 69911 | 779 | Gas giant | 4332.6 | 9.925 | H/He | 67 | -161 | Rings |
|  Saturn | 58232 | 1.43 bill'n | Gas giant | 10759 | 10.656 | H/He | 62 | -139 to -189 | Rings |
|  Uranus | 25362 | 2.88 | Gas giant | 30685 | -17.24 | H/He | 27 | -197 to -220 | Rings |
|  Neptune | 24622 | 4.5 | Gas giant | 60189 | 16.11 | H/He | 14 | -201 to -208 | Rings |

# THE MOON



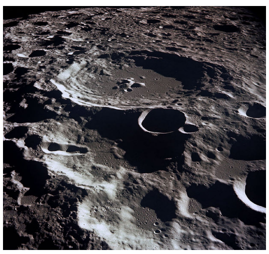
Nearside of the moon



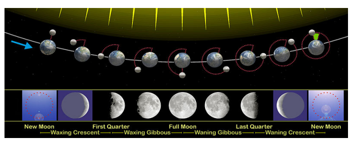
Far side of the Moon Note the almost complete lack of dark maria

Earthrise

Astronaut, crater and moon buggy



Lunar crater Daedalus on the Moon's far side

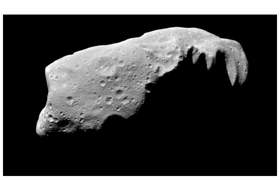



Phases of the Moon

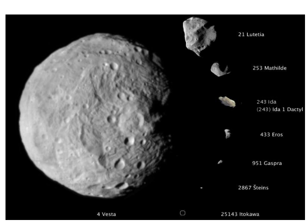
Lunar & Solar Eclipses

Neil Armstrong and a U.S. flag

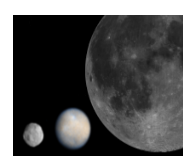
1. If the sun were as tall as a typical front door, Earth would be the size of a nickel and the moon would the size of a green pea.
2. The moon is Earth's satellite and orbits the Earth at a distance of about 384 thousand km (239 thousand miles) or 0.00257 AU ( One astronomical unit is the distance from the earth to the sun, 1AU = 93,000,000 miles.
3. The moon makes a complete orbit around Earth in 27 Earth days and rotates or spins at that same rate, or in that same amount of time. This causes the moon to keep the same side or *face* towards Earth during the course of its orbit.
4. The moon is a rocky, solid-surface body, with much of its surface cratered and pitted from impacts.
5. The moon has a very thin and tenuous (weak) atmosphere, called an exosphere.
6. The moon has no moons.
7. The moon has no rings.
8. More than 100 spacecraft been launched to explore the moon. It is the only celestial a body beyond Earth that has been visited by human beings (The Apollo Program).
9. The moon's weak atmosphere and its lack of liquid water cannot support life as we know it.
10. Surface features that create the face known as the "Man in the moon" are impact basins on the moon that are filled with dark basalt rocks.



Asteroid Ida taken by the Galileo probe (NASA/JPL)




As of 2011 Asteroids, from largest to smallest: 4 Vesta, 21 Lutetia, 253 Mathilde, 243 Ida and its moon Dactyl, 433 Eros, 951 Gaspra,2867 Šteins, 25143 Itokawa.



Vesta (left),with Ceres (center) and Earth's Moon (right) shown to scale

## Asteroids, meteors and meteorites

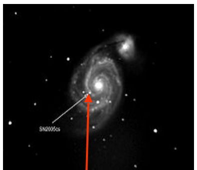
Asteroids are rocky or metallic objects mainly found orbiting the Sun in a region called the asteroid belt between Mars and Jupiter. Some are large - the biggest is Ceres with a diameter of nearly 600 miles (950km) - and are sometimes called minor planets or planetoids. There are millions of small asteroids. The smallest are sometimes called meteoroids. It is thought that asteroids are material leftover from the time that the planets formed.

Meteors are dust-sized particles that burn up as they plummet through Earth's atmosphere. Meteorites are larger, more durable objects that survive heating in the atmosphere and land on Earth.

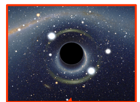
# Altrincham & District Astronomical Society

**Venue: Timperley Community Centre, Park Road, Timperley WA15 6QQ**

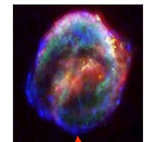
## SUPERNOVA



**Photograph of supernova in another galaxy.** The supernova is the bright spot pointed by the arrow. The other bright spots are stars of our own galaxy that happen to be in front of the other galaxy.

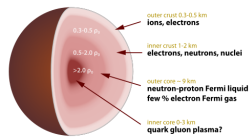


Simulated view of a black hole (center) in front of theLarge Magellanic Cloud



Kepler's Star of 1604 the most recent supernova in the Milky Way.

Neutron star cross section

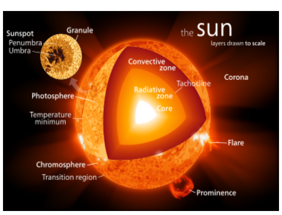



A supernova is when a very big star explodes. This happens when a star runs out of energy to make heat and light, so it collapses, then explodes. The biggest of these stars we know of are called **hypergiants** and smaller ones are called **supergiants**. They are very big and because of gravity they press on their centres very hard and use up their energy very quickly, so they usually only live for a few million years. After exploding, the remnant becomes a **black hole** or a **neutron star**. Most stars are small and do not explode. They cool and shrink down into a **white dwarf star**.

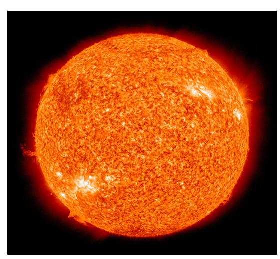
Supernovas are very big explosions. When the star explodes, it will be brighter than all other stars around it. If a supernova explosion happened near the Earth, we could see it in the sky even during the day.

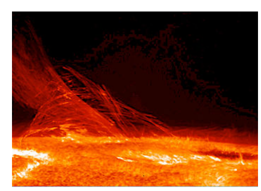
Supernova explosions happen rarely. **In our own galaxy, the Milky Way, the last supernova happened in the year 1604.** We can see supernovas in other galaxies too. Every year we see **300 supernovas in other galaxies**, because there are so many galaxies. Sometimes they are brighter than the whole rest of the galaxy.

## The SUN




The Structure of the SUN





Taken by Hinode's Solar Optical Telescope on January 12, 2007, this image of the Sun reveals the filamentary nature of the plasma connecting regions of different magnetic polarity

The Sun is the star at the centre of the Solar System. It is almost perfectly spherical and consists of hot plasma interwoven with magnetic fields. It has a diameter of about 1,392,684 km (865,374 mi), around 109 times that of Earth, and its mass (1.989×1030 kilograms, approximately 330,000 times the mass of Earth) accounts for about 99.86% of the total mass of the Solar System. Chemically, about three quarters of the Sun's mass consists of hydrogen, while the rest is mostly helium. The remainder (1.69%, which nonetheless equals 5,600 times the mass of Earth) consists of heavier elements, including oxygen, carbon, neon and iron, among others.

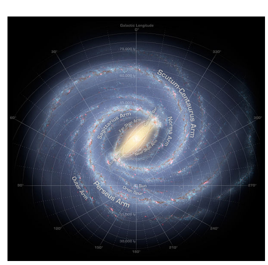


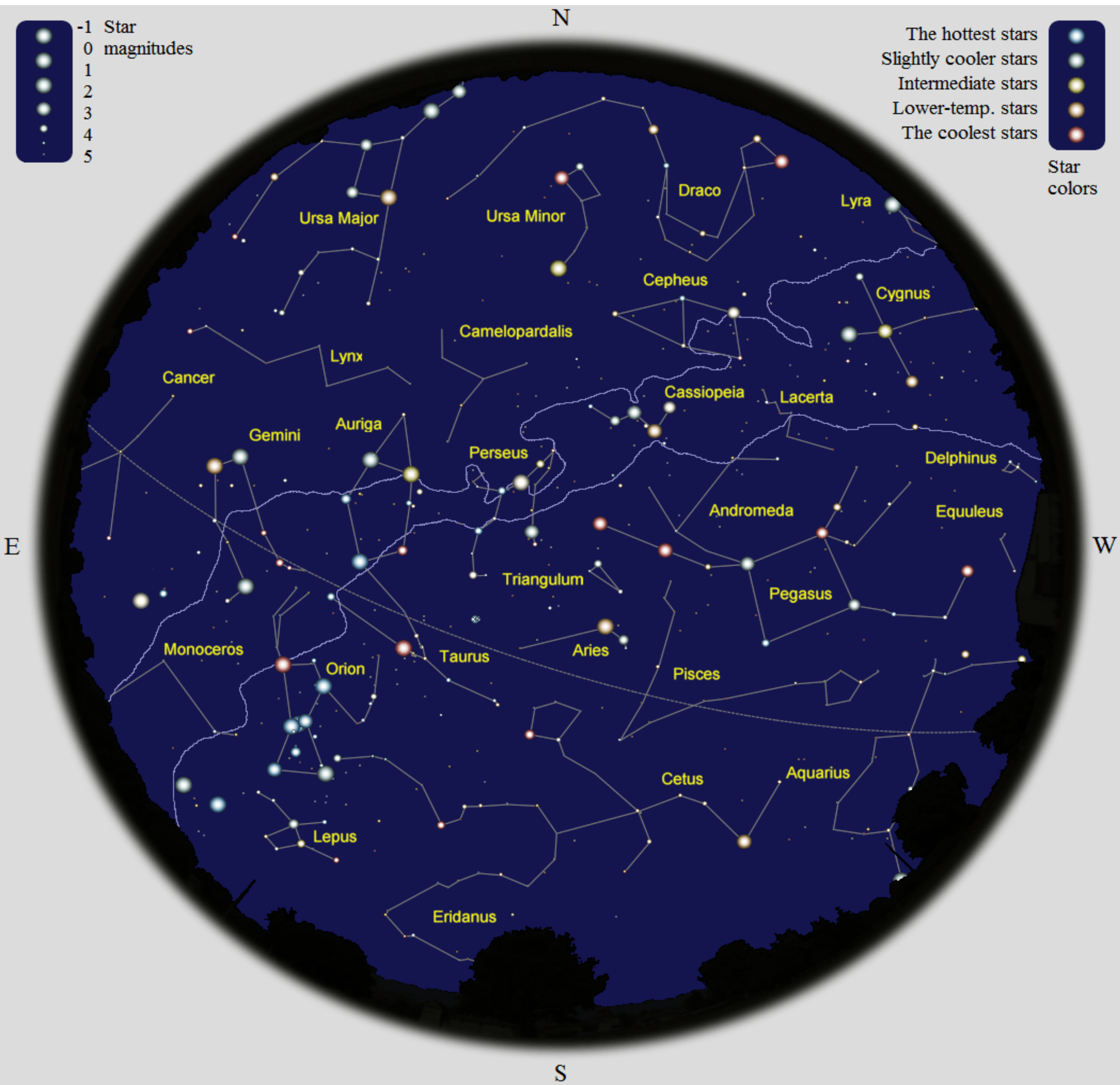
Illustration of the Milky Way galaxy, showing the location of the Sun.

# 50th ANNIVERSARY OF THE ALTRINCHAM & DISTRICT ASTRONOMICAL SOCIETY, NOVEMBER, 2014

# Altrincham & District Astronomical Society

**Venue: Timperley Community Centre, Park Road, Timperley WA15 6QQ**

## The Northern Hemisphere- All Sky Map



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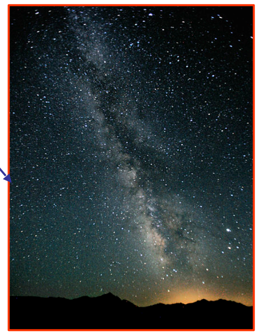
## Naked Eye Galaxies Of Interest & The Constellations of Origin

### Types of Galaxies : Spiral, Barred Spiral , Elliptical and Irregular

Our Own Milky Way,
(Lactae Via)
In Sagittarius



Andromeda Galaxy in Andromeda

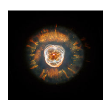
Sombrero Galaxy in Virgo

Bode’s & Pin Wheel Galaxies in Ursa Major

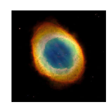
## Planetary nebula

NGC 6326, a planetary nebula with glowing wisps of outpouring gas that are lit up by a binary central star.

Helix



Eskimo

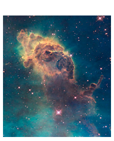


Ring

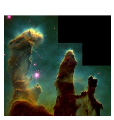
Lemon Slice

**A planetary nebula, often abbreviated as PN or plural PNe, is a kind of emission nebula consisting of an expanding glowing shell of ionised gas ejected from old red giant stars late in their lives. The word 'nebula' is Latin for mist or cloud and the term 'planetary nebula' is a misnomer that originated in the 1780s with astronomer William Herschel because when viewed through his telescope, these objects appeared to him to be newly forming planetary systems. Herschel's name for these objects was adopted by astronomers and has not been changed They are a relatively short-lived phenomenon, lasting a few tens of thousands of years, compared to a typical stellar lifetime of several billion years.**

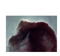
## Nebula



Carina



Pillars of creation-Eagle

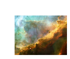


Horse Head

Crab

The triangulum

Flame



Omega

**A nebula (from Latin: "cloud"; pl. *nebulae* or *nebulæ*, with or *nebulas*) is an interstellar cloud of dust, hydrogen, helium and other ionised gases. Originally, *nebula* was a name for any diffuse astronomical object, including galaxies beyond the Milky Way. The Andromeda Galaxy, for instance, was referred to as the *Andromeda Nebula* (and spiral galaxy in general as "spiral nebulae") before the true nature of galaxies was confirmed in the early 20th century by Vesto Slipher, Edwin Hubble and other. Nebulae are often star-forming regions, such as in the Eagle Nebula. This nebula is depicted in one of NASA’s most famous images, the “pillars of creation". In these regions the formations of gas, dust, and other materials "clump" together to form larger masses, which attract further matter, and eventually will become massive enough to form stars. The remaining materials are then believed to form planets, and other planetary system objects.**

# Altrincham & District Astronomical Society

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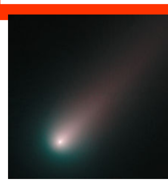
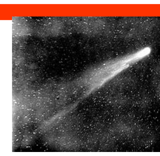
## SHORT AND LONG PERIOD COMETS

Comet Hale Bop, 1997

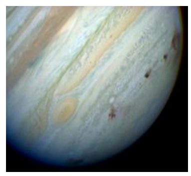


Comet ISON from the Hubble Telescope

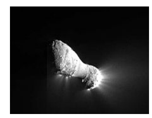


Halleys Comet, 1910 photo, observed every 76 years.

Halley's Comet appeared at the Battle of Hastings in 1066 (Bayeux Tapestry).



Brown spots mark impact sites of Comet Shoemaker-Levy on Jupiter



Nucleus of Comet 103P/Hartley as imaged during a spacecraft flyby. The nucleus is about 2 km in length.

New Horizons: Kuiper Belt Explorer

Comet McNaught, 2007

Short period comets have less than 200 year orbits, e.g., Halley's Comet, 76 years. Long period comets have orbits greater than 200 years to thousands of years, e.g., Comet McNaught, 92,600 years. The Kuiper Belt and Oort Cloud contain short and long period comets, respectively. The Kuiper Belt is a doughnut-shaped ring, extending just beyond the orbit of Neptune from about 30 to 55 AU. The Oort Cloud is a spherical shell, occupying space at a distance between five thousand and 100 thousand AU.

### Comets, What are these bodies composed of?

The solid, core structure of a comet is known as the nucleus. Cometary nuclei are composed of an amalgamation of rock, dust, water ice, and frozen gases such as carbon dioxide, carbon monoxide, methane, and ammonia. As such, they are popularly described as "dirty snowballs" after Fred Whipple's model. However, some comets may have a higher dust content, leading them to be called "icy dirtballs".

The surface of the nucleus is generally dry, dusty or rocky, suggesting that the ices are hidden beneath a surface crust several metres thick. In addition to the gases already mentioned, the nuclei contain a variety of organic compounds, which may include methanol, hydrogen cyanide, formaldehyde, ethanol, and ethane and perhaps more complex molecules such as long-chain hydrocarbons and amino acids. In 2009, it was confirmed that the amino acid, glycine, had been found in the comet dust recovered by NASA's Stardust mission. In August 2011, a report, based on NASA studies of meteorites found on Earth, was published suggesting DNA and RNA components, and related organic molecules may have been formed on asteroids and comets.

### COMA (Cometary tail)

The streams of dust and gas thus released form a huge and extremely thin atmosphere around the comet called the "coma", and the force exerted on the coma by the Sun's radiation pressure and solar wind cause an enormous "tail" to form pointing away from the Sun.

The coma is generally made of $H_2O$ and dust, with water making up to 90% of the volatiles that outflow from the nucleus when the comet is within 3 to 4 astronomical units (450,000,000 to 600,000,000 km; 280,000,000 to 370,000,000 mi) of the Sun. The $H_2O$ parent molecule is destroyed primarily through photodissociation, with the solar wind playing a minor role in the destruction of water. Larger dust particles are left along the comet's orbital path whereas smaller particles are pushed away from the Sun into the comet's tail by light pressure.

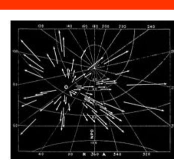


Diagram of Perseids meteors

### Relationship of Comets to Meteor Showers

As a result of outgassing, comets leave in their wake a trail of solid debris too large to be swept away by radiation pressure and the solar wind. If the comet's path crosses the path that the Earth follows in orbit around the Sun, then at that point there are likely to bemeteor showers as Earth passes through the trail of debris. The Perseid meteor shower, for example, occurs every year between August 9 and August 13, when Earth passes through the orbit of Comet Swift–Tuttle. Halley's comet is the source of the Orionid shower in October.

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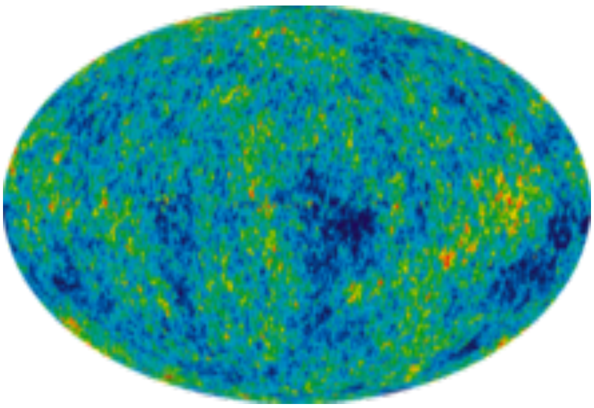
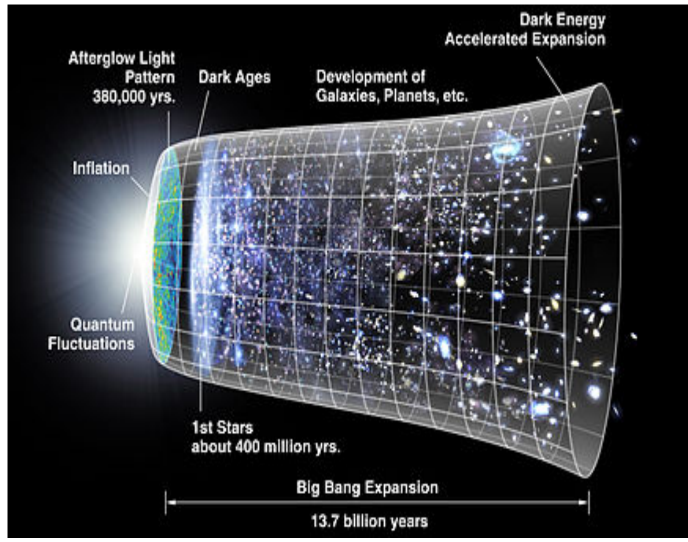
## The Universe, Its Dimensions and Age






The Universe is commonly defined as the totality of existence including planets, stars, galaxies, the contents of intergalactic space, the smallest subatomic particles, and all matter and energy. Similar terms include the *cosmos*, the *world*, *reality*, and *nature*.

The observable universe is about 46 billion light years in radius.

One light year is the distance that light travels in one year which is equal to:

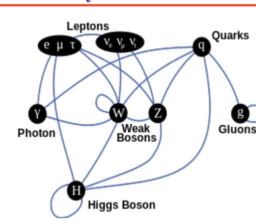
The speed of light, 186,000 miles per sec multiplied by the number of seconds in 1 year, 31,539,000 sec.
= 5,865,696,000,000 miles or 5865.696 billion miles.

Chronology/Timescale of the Universe

The Big Bang Expansion

The Age of the Universe is about 13.7 billion years

### The Elementary Particles of the Universe




The elementary particles from which the Universe is constructed. Six leptons and six quarks comprise most of thematter; for example, the protons and neutrons of atomic nuclei are composed of quarks, and the ubiquitous electron is a lepton. These particles interact via the gauge bosons shown in the middle row, each corresponding to a particular type of gauge symmetry. The Higgs boson is believed to confer mass on the particles with which it is connected. The graviton, a supposed gauge boson for gravity, is not shown.

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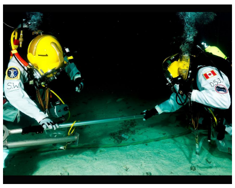
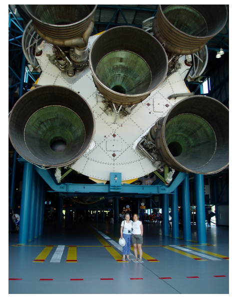
## Aspects of the Space Programme

**Simulation of space in water on Earth**



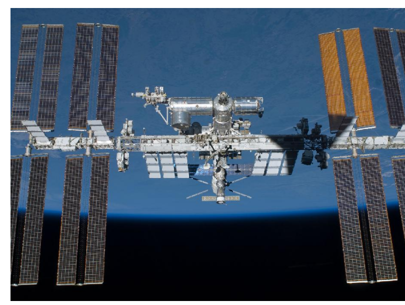
Under the sea



RELATIVE SIZE!

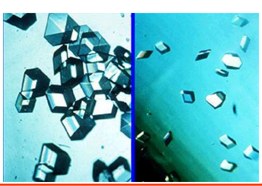
SHUTTLE LAUNCH

ENDEAVOUR MEETS DISCOVERY



International Space Station, ISS

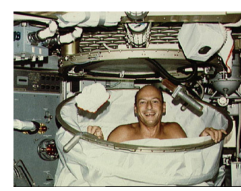
**Physical Differences in Earth and Space**



Insulin crystal growth in space and on earth

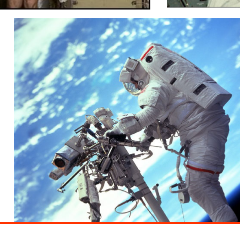
Earth and Moon in space in the same frame, first taken 1977

Keeping fit



Having a bath

Dressing

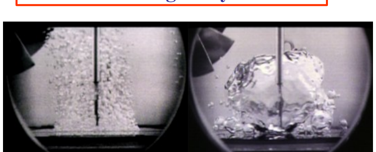


ACTIVITIES & WORKING IN SPACE


Candle Flame in space and microgravity

LONDON at night from Space

TOUCH DOWN




Water boiling on Earth and in Space

**50th ANNIVERSARY OF THE ALTRINCHAM & DISTRICT ASTRONOMICAL SOCIETY, NOVEMBER, 2014**

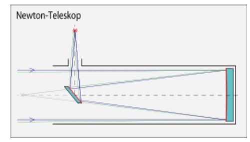
# Altrincham & District Astronomical Society

**Venue: Timperley Community Centre, Park Road, Timperley WA15 6QQ**

## Types of Historic Reflecting and Refracting Telescopes and Optics

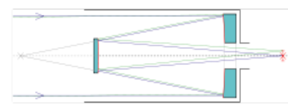
### A. Reflecting Telescopes

The Newtonian telescope was the first successful reflecting telescope, completed by Isaac Newton in 1668. It usually has a paraboloid primary mirror but at focal ratios of f/8 or longer a spherical primary mirror can be sufficient for high visual resolution. A flat secondary mirror reflects the light to a focal plane at the side of the top of the telescope tube. It is one of the simplest and least expensive designs for a given size of primary, and is popular with amateur telescope makers as a home-build project.

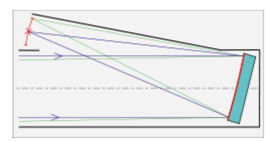


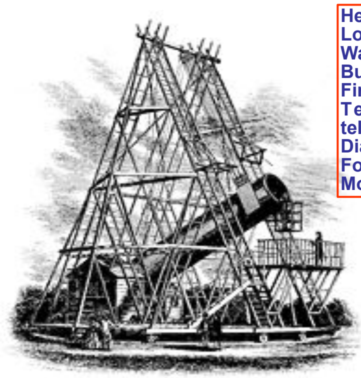

A replica of Newton's second reflecting telescope that he presented to the Royal Society in 1672.

The Cassegrain telescope (sometimes called the "Classic Cassegrain") was first published in an 1672 design attributed to Laurent Cassegrain. It has a parabolic primary mirror, and a hyperbolic secondary mirror that reflects the light back down through a hole in the primary. Folding and diverging effect of the secondary creates a telescope with a long focal length while having a short tube length

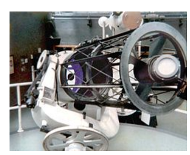


The Herschelian reflector is named after William Herschel, who used this design to build very large telescopes including a 49.5 inch (126 cm) diameter telescope in 1789. In the Herschelian reflector the primary mirror is tilted so the observer's head does not block the incoming light. Although this introduces geometrical aberrations, Herschel employed this design to avoid the use of a Newtonian secondary mirror since the speculum metal mirrors of that time tarnished quickly and could only achieve 60% reflectivity.

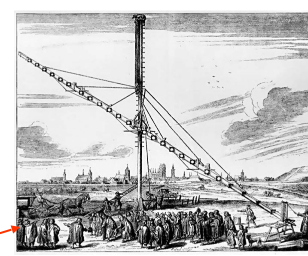




Herschel's 40 ft Telescope
Location Slough, England
Wavelength Optical
Built 1785-9
First Light 19 February 1787
Telescope style Reflecting telescope
Diameter 48 inch
Focal Length 40 ft
Mounting Alt-azimuth.



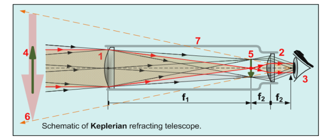
A more modern 24 inch convertible Newtonian/Cassegrain reflecting telescope at the Franklin Institute.



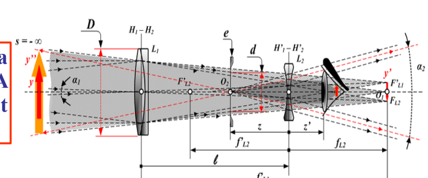
Woodcut illustration of a 46 m (150 ft) focal length Keplerian astronomical refracting telescope built by Johannes Hevelius

### B. Refracting Telescopes

Refractors were the earliest type of optical telescope. The first practical refracting telescopes appeared in the Netherlands about 1608, and were credited to three individuals, Hans Lippershey and Zacharias Janssen, spectacle-makers in Middelburg, and Jacob Metius of Alkmaar. Galileo Galilei, happening to be in Venice in about the month of May 1609, heard of the invention and constructed a version of his own. Galileo then communicated the details of his invention to the public, and presented the instrument itself to the Doge Leonardo Donato, sitting in full council.




The original design Galileo Galilei came up with in 1609 is commonly called a Galilean telescope. It used a convergent (plano-convex) objective lens and a divergent (plano-concave) eyepiece lens (Galileo, 1610). A Galilean telescope, because the design has no intermediary focus, results in an non-inverted and upright image.



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