Yearbook of Astronomy

Glossary

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The 2018–2021 editions of the *Yearbook of Astronomy* include a Glossary at the back of the book. However, due to the increasing length of the Glossary, it has been decided to remove it from the book and instead publish it on the *Yearbook of Astronomy* website in the form of a downloadable PDF.

Readers of the *Yearbook* are invited to read through the Glossary and, if they feel that any important terms or definitions are missing, they may submit new entries. These should include the word or term itself along with the accompanying descriptive or explanatory text. If approved for use, they will be inserted into the Glossary and the name of the contributor will be added to this page. We reserve the right to edit contributions to conform to the style of the *Yearbook*.

Please send any proposed Glossary entries to us via the Contact page on our website at **YearbookOfAstronomy.com**

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Aberration

Aberration describes the change in the apparent direction of a star or ***planet*** due to the motion through space of the Earth or of the object being observed. There are two principal types of aberration:

Annual or **stellar aberration**

This is the change in apparent direction of a star or planet due to the Earth's ***orbital*** motion around the Sun. It results in a yearly periodic variation of the apparent position of the object by 20.5 arcseconds around its mean position. In 1727, James Bradley, the third Astronomer Royal, announced his observations of annual aberration in the position of Eltanin (γ Draconis), and thereby provided the first observational confirmation of the Copernican model of the ***Solar System***.

Planetary aberration

This is the correction which must be applied when calculating the apparent place of a planet as seen from Earth, to allow for the time taken for light to travel from the planet to the Earth. When we calculate the apparent direction of a planet seen from the Earth at time t, we must use the planet's position in its orbit at time $t - \tau$, where τ is the light travel time.

Ablation

Ablation is the loss and/or destruction of material from the surface of a body due to vaporisation or erosion. It can refer to ***meteoroids*** entering Earth's atmosphere and forming ***meteors***, or to the surface of ***comets*** being stripped by solar wind. Ablation can also refer to the burning away of the heat shield of a space capsule as it re-enters the Earth's atmosphere.

Absolute Magnitude

See ***magnitude***.

Absorption Line

See ***spectral line***. Also known as a ***Fraunhofer line***.

Absorption Nebula

See ***nebula***.

Accretion Disk

A disk of gas and dust that accumulates around a centre of gravity, such as a star or black hole. As the material spirals in to the centre, it can become hot enough to emit radiation.

Adaptive Optics (AO)

A method of improving the quality of the astronomical image from a telescope by detecting in the resultant light wave the turbulence caused by the atmosphere, and then deforming the shape of a thin mirror in the AO accessory to compensate for that turbulence. The light finally reaches the camera free of distortion.

Airburst

The violent explosion and resulting energy shockwave of a small ***asteroid*** or ***meteorite*** (***bolide***) which has entered the Earth's atmosphere, and which occurs before the object reaches the ground. The Tunguska event of 1908 is believed to have been an asteroid airburst.

Albedo

The fraction of incoming light reflected back into space by a body such as a ***planet***, ***comet***, or ***satellite***. Objects with high albedos (near 1) are very bright, while those with low albedos (near 0) are relatively dark. The overall albedo of the Moon is about 0.14.

Altitude

The altitude of a star or other object is its angular distance above the horizon. For example, if a star is located at the ***zenith***, or overhead point, its altitude is 90°. A star on the ***horizon*** has altitude 0°.

Angular Distance

The angular distance between two objects on the sky is the angle subtended between the directions to the two objects, either at the centre of the Earth (geocentric angular distance) or the observer's eye (apparent angular distance). It is most commonly expressed in degrees °, or for smaller angular distances, minutes of arc (*arcminutes*) ′, or seconds of arc (*arcseconds*) ″. Very small angles are expressed in milliarcseconds (mas), where 1000 mas equals one second of arc. Also called *angular separation*.

Anomalistic Month

See ***lunar month***.

Antoniadi Scale

A scale of ***seeing*** conditions named after Greek-French astronomer Eugène Michel Antoniadi (1870–1944) who devised it during the early twentieth century. It assesses the weather and seeing conditions under which astronomical observations are carried out. The Antoniadi scale has five gradations:

I. Perfect seeing with no quivering.
II. Good seeing, some slight undulations with frequent steady moments
III. Moderate seeing, about equal steady and turbulent moments.
IV. Poor seeing, with constant undulations making sketching difficult.
V. Very bad seeing, with turbulence scarcely allowing a sketch to be made.

Aphelion (plural: Aphelia)

This is the point at which an object, such as a ***planet***, ***comet***, or ***asteroid*** travelling in an ***elliptical orbit***, is at its maximum orbital distance from the Sun.

Apogee

This is the point at which an object, such as the Moon or artificial satellite, is at its maximum orbital distance from the Earth.

Apparent Magnitude

See ***magnitude*.**

Apparition

The period during which a ***planet*** is visible, usually starting at ***conjunction*** with the Sun, running through ***opposition*** (for a superior planet) or ***greatest elongation*** (for Mercury or Venus), and ending with the next conjunction with the Sun.

Appulse

The close approach, as seen from the Earth, between two ***Solar System*** bodies, or a Solar System body and a star. Also informally (but incorrectly) known as a ***conjunction***.

Apsis (plural: Apsides)

Either of the two points in an ***elliptical orbit*** of one body around another where the two objects are nearest to or furthest away from one another. Examples are ***apogee*** (furthest from Earth), ***perigee*** (nearest to Earth), ***aphelion*** (furthest from the Sun), ***perihelion*** (nearest to the Sun), etc.

Arcminute

See ***angular distance***.

Arcsecond

See ***angular distance***.

Ascending node

See ***node***.

Asterism

An asterism is grouping or collection of stars often (but not always) located within a ***constellation*** that forms an apparent and distinctive pattern in its own right. Well known examples include the Plough in Ursa Major; the False Cross, which is formed from stars in Carina and Vela; and the Summer Triangle, which is formed from the bright stars Vega (α Lyrae), Deneb (α Cygni) and Altair (α Aquilae).

Asteroid

A type of ***minor planet***.

Astrometric Binary

See ***binary star***.

Astrometry

The branch of astronomy which is concerned with measuring the positions of celestial objects.

Astronomical Twilight

See ***twilight***.

Astronomical Unit (au)

Often used to measure distances within our ***Solar System***, the astronomical unit is a unit of measurement equal to the average distance between the Earth and the Sun, or around 150 million kilometres (93 million miles).

Astronomy

The natural science which studies celestial objects and phenomena which occur in the universe.

Astrophysics

The branch of astronomy which is concerned with the physical properties of celestial bodies.

Aurora (plural: Aurorae)

A glow in a planet's ionosphere, caused by charged solar particles interacting with the planet's magnetic field. On Earth, an aurora in the northern hemisphere is called the *Aurora Borealis* or *northern lights*. In the southern hemisphere, an aurora is called the *Aurora Australis* or *southern lights*.

Autumnal Equinox

The autumnal equinox is the point at which the apparent path of the Sun, moving from north to south, crosses the ***celestial equator***. In the Earth's northern hemisphere this marks the start of autumn, whilst in the southern hemisphere it is the start of spring.

Averted Vision

Averted vision is a useful technique for observing faint objects which involves looking slightly to one side of the object under observation and, by doing so, allowing the light emitted by the object to fall on the part of the retina that is more sensitive at low light levels. Although you are not looking directly at the object, it is surprising how much more detail comes into view. This technique is also useful when observing double stars which have components of greatly contrasting brightness. Although direct vision may not reveal the glow of a faint companion star in the glare of a much brighter primary, averted vision may well bring the fainter star into view.

Axis

An imaginary line about which an object ***rotates***.

Azimuth

The azimuth of a star or other object is its angular position measured round the ***horizon*** from north (azimuth 0°) through east (azimuth 90°), south (azimuth 180°) and west (azimuth 270°). The azimuth and ***altitude***, taken together, define the position of the object referred to the observer's ***local horizon***.

Barycentre

The barycentre is the centre of mass of two or more bodies that are orbiting each other (such as a ***planet*** and ***satellite*** or two components of a ***binary star*** system) and which is therefore the point around which they both orbit.

Bayer Designation

A star's Bayer designation consists of a Greek letter (rarely a Latin letter) followed by the genitive form of the name of the ***constellation*** in which the star resides. The brightest star is usually labelled alpha α, the next brightest beta β, and so on. For example, Sirius, the brightest star in the constellation Canis Major, is α Canis Majoris. The labelling scheme was devised by German uranographer Johann Bayer (1572–1625) and introduced in his groundbreaking 1603 star atlas *Uranometria Omnium Asterismorum.* A listing of the Greek alphabet may be found at the end of this document.

Big Bang

The hypothesis that the universe was created through expansion from an initial state of extremely high pressure and density. It was first proposed in the 1920s by Belgian physicist, astronomer, and mathematician Georges Henri Joseph Édouard Lemaître (1894–1966), and is now the accepted model for the origin of the universe. The name was coined disparagingly by British cosmologist Fred Hoyle (1915–2001), who favoured the rival 'Steady State' hypothesis.

Binary Star

A binary star is a system of two stars which are gravitationally bound and orbit each other. The brighter of the two stars is referred to as the *primary star* and the fainter as the *secondary star*. There are several types of binary stars:

Astrometric An *astrometric binary* appears as a single star rotating about a barycentre with an invisible companion; the companion star is too faint to be seen or is lost in the glare of the brighter primary, but its presence is inferred by the non-linear proper motion of the visible star.

Eclipsing An *eclipsing binary* occurs if their orbital plane is edge-on as viewed from the Earth, causing the two stars to eclipse each other as they revolve about their ***barycentre***.

Spectroscopic The two components of a *spectroscopic binary* are so close together that they can only be detected through ***Doppler*** shifts in their stellar ***spectral lines***.

Visual With the aid of a telescope, a *visual binary* can be resolved into two stars.

Black Hole

A region of space around a very compact and extremely massive collapsed star within which the gravitational field is so intense that not even light can escape.

Blueshift

When an object is moving toward an observer, its spectral lines decrease in wavelength and move toward the blue end of the spectrum due to the ***Doppler effect***. However, if an object is moving away from the observer, the spectral lines shift toward the red end of the spectrum. This is called a ***redshift***.

Bolide

An exceptionally bright ***meteor*** which may produce a sonic boom. Sometimes called a *fireball*.

Brown Dwarf

A brown dwarf is a substellar object which is not large enough to fuse hydrogen into helium in its core. Brown dwarfs are much larger than gas giants, typically at least 13 Jupiter masses, but smaller than the least massive star. They are thought to form like a star, through cloud collapse, rather than through an accretionary process like a ***planet***.

Brown Lunation Number

The English mathematician and astronomer Edward W. Brown (1866–1938) introduced a system for numbering ***lunations*** in a paper published in 1933 [The Motion of the Moon, 1923–1931. *Monthly Notices of the Royal Astronomical Society*, **93** (8), 603–619.] which discussed observations of ***occultations*** of the Moon in the years 1923 to 1931. For convenience, Brown combined the observations in each lunation, and numbered the lunations starting with the first New Moon of 1923, which fell on 17 January. There are a number of different ***lunation numbers*** in use but the *Brown Lunation Number* is perhaps the most well-known.

Calendar

A system for determining the length and divisions of a year. Calendars are usually based on the phases of the Moon or the seasons.

Lunar A *lunar calendar* is based on the ***phases*** of the Moon (***lunar*** or ***synodic month***). Because 12 lunar months is shorter than one year, a lunar calendar gradually gets out of alignment with the seasons. The Islamic calendar is an example of a lunar calendar that remains in widespread use.

Lunisolar A *lunisolar calendar* incorporates both ***lunar months*** and the cycle of the seasons. Every two or three years, an intercalary or leap month is inserted to bring the calendar back in to line with the Sun. The Hindu religious calendar and the Chinese traditional calendar are examples of lunisolar calendars in current use.

Solar A *solar calendar* is disconnected from lunar phases and is kept in step with the seasons. Every four years (with certain exceptions), an intercalary or leap day is inserted to keep the calendar in line with the Sun. The civil Gregorian calendar is a solar calendar, although the rules for calculating the date of Easter make it technically lunisolar.

Caldwell Catalogue (C)

This is a catalogue of 109 ***star clusters***, ***nebulae***, and ***galaxies*** compiled by Patrick Moore to complement the ***Messier Catalogue***. Intended for use as an observing guide by amateur astronomers, it includes a number of bright ***deep sky objects*** that did not find their way into the Messier Catalogue, which was originally compiled as a list of known objects that might be confused with comets. Moore used his other surname (Caldwell) to name the list and the objects within it (the first letter of 'Moore' having been used for the Messier Catalogue) and entries in the Caldwell Catalogue are designated with a 'C' followed by the catalogue number (1 to 109).

Amongst the 109 objects in the Caldwell Catalogue are the Sword Handle Double Cluster NGC 869 and NGC 884 (C14) in Perseus; supernova remnant(s) the East Veil Nebula and West Veil Nebula (C33 and C34) in Cygnus; the Hyades ***open cluster*** (C41) in Taurus; and Hubble's Variable Nebula (C46) in Monoceros. Unlike the Messier Catalogue, which was compiled from observations made by Charles Messier from Paris, the Caldwell Catalogue contains deep sky objects visible from the southern hemisphere, such as the Centaurus A galaxy (C77) and ***globular cluster*** Omega Centauri (C80) in Centaurus; the Jewel Box open star cluster (C94) in Crux and the globular cluster 47 Tucanae (C106) in Tucana.

Celestial Equator

The celestial equator is a projection of the Earth's ***equator*** onto the ***celestial sphere***, equidistant from the ***celestial poles*** and dividing the celestial sphere into two hemispheres.

Celestial Pole

The north and south celestial poles are points on the ***celestial sphere*** directly above the north and south terrestrial poles respectively around which the celestial sphere appears to rotate and through which extensions of the Earth's ***axis*** of rotation would pass.

The north celestial pole, the position of which is at marked at present by the relatively bright star Polaris (α Ursae Minoris), lies in the ***constellation*** Ursa Minor and would be seen directly overhead when viewed from the North Pole. There is no particularly bright star marking the position of the south celestial pole, which lies in the tiny constellation Octans and which would be situated directly overhead when seen from the South Pole. The north celestial pole lies in the direction of north when viewed from elsewhere on the Earth's surface and the south celestial pole lies in the direction of south when viewed from other locations.

Celestial Mechanics

The branch of astronomy which is concerned with the orbits of planets, satellites, comets and other objects in the ***solar system.*** It also encompasses the study of the orbits of exoplanetary systems.

Celestial Sphere

The imaginary sphere surrounding the Earth on which the stars appear to lie.

Chromosphere

A layer between the ***photosphere*** and the ***corona*** of a star. It has been observed both in the Sun and in other stars.

Circumpolar Star

A circumpolar star is a star which never sets from a given ***latitude***. When viewing the sky from either the North or South Pole, all stars will be circumpolar, although no stars are circumpolar when viewed from the equator.

Civil Twilight

See ***twilight***.

Cluster

See ***star clusters***.

Colour Index

Colour index is the difference between the magnitudes of a star measured at different wavelength ranges. The B−V colour index is the most commonly used. It is the difference between the B (blue) magnitude measured in a narrow wavelength range centred at 435 nm and the V (visual) magnitude measured in a wavelength range centred at 555 nm. A red star such as Aldebaran (α Tauri) has a B−V colour index of +1.4, whilst for a blue star such as Rigel (β Orionis), it is slightly negative at −0.03. The Sun has a B−V colour index of +0.66. The white star Vega (α Lyrae) is regarded as the zero point for the B−V colour index. A star's colour index is related directly to its surface temperature and spectral type.

Colour-Magnitude Diagram

A colour-magnitude diagram for a group of stars plots the absolute magnitude against the B−V ***colour index***. It is a form of the ***Hertzsprung-Russell diagram***.

Comet

A comet is an object comprised of a mixture of gas, dust and ice which travels around the Sun in an ***orbit*** that can elliptical, parabolic or hyperbolic. Most are thought to originate in either the ***Kuiper Belt*** or the ***Oort Cloud***.

Conjunction

This is the position at which two objects are lined up with each other (or nearly so) as seen from the Earth. Superior conjunction occurs when a ***planet*** is at the opposite side of the Sun as seen from the Earth and inferior conjunction when a planet lies between the Sun and the Earth. A conjunction is formally defined as the instant when two celestial bodies are at the same ecliptic ***longitude***.

Constellation

A constellation is an arbitrary grouping of stars forming a pattern or imaginary picture on the celestial sphere. Many of these have traditional names and date back to ancient Greece or even earlier and are associated with the folklore and mythology of the time. There are also some of what may be described as modern constellations, devised comparatively recently by astronomers during the last few centuries. There are 88 official constellations which together cover the entire sky, each one of which refers to and delineates that particular region of the ***celestial sphere***, the result being that every celestial object is described as being within one particular constellation or another.

Corona

The outer part of the Sun's atmosphere which is made up of hot ***plasma*** with a temperature exceeding 1 million degrees Celsius. The corona can be observed using a special instrument called a coronagraph, invented in 1930 by the French astronomer Bernard Lyot (1897–1952). It can also be observed during a total solar ***eclipse***.

Coronal Mass Ejection (CME)

Coronal Mass Ejections are large expulsions of ***plasma*** and magnetic field from the Sun's ***corona***. Associated with significant ***auroral*** activity, CMEs disrupt the flow of the solar wind and cause disturbances that can damage satellites in Earth orbit and power grids on the Earth's surface. The frequency of CMEs varies with the 11-year solar cycle. At solar minimum the frequency is about one a week, although near solar maximum there may be an average of two to three CMEs per day.

Cosmic Rays

Extremely energetic particles which travel across space at almost the speed of light, they are mainly the nuclei of chemical elements and known as primary cosmic rays. ***Quasars*** may be the origin of the most energetic rays, whereas lower energy cosmic rays probably originate in our Galaxy from ***supernova*** explosions. They bombard the molecules of the Earth's atmosphere and produce secondary cosmic rays which are mainly elementary particles.

Cosmology

The branch of astronomy which is concerned with studying the nature of the universe, such as its origins, evolution, large-scale structures, and ultimate fate.

Crescent

Less than half illuminated as seen by the observer but not completely dark.

Dark Nebula

See ***nebula***.

Declination

Declination δ is the ***angular distance*** between a celestial object and the celestial equator. It is expressed in degrees, minutes, and seconds either north or south of the ***celestial equator***.

Decrescent Moon

(Obscure) The ***waning crescent*** Moon.

Deep Sky Object

Deep sky objects are objects (other than individual stars) which lie beyond the confines of our ***Solar System***. They may be either galactic or extra-galactic and include such things as ***star clusters***, ***nebulae*** and ***galaxies***.

Descending node

See ***node***.

Dichotomy

The Moon or ***inferior planet*** is at dichotomy when it is exactly half illuminated.

Direct Motion

A ***planet*** is in direct or *prograde* motion when its ***right ascension*** or ecliptic ***longitude*** is increasing with the passing of time. This means that it is moving eastwards with respect to the background stars.

Dog Star

This is the popular name for Sirius (α Canis Majoris) which, at apparent ***magnitude*** −1.46, is the brightest star in the ***constellation*** of Canis Major, the greater dog, and a well-known winter sight in the northern hemisphere.

Doppler Effect

The Doppler effect is the name given to the change in the frequency of a wave phenomenon such as light or sound when the observer is moving relative to the source. If the observer is moving towards the source, the observed frequency is higher, which is perceived as a higher-pitched sound or a ***blueshift*** of light. If the observer is moving away from the source, the observed frequency is lower, which is perceived as a lower-pitched sound or a ***redshift*** of light. The effect is named after the Austrian physicist Christian Doppler (1803–1853), who first described it.

Double Stars

Double stars are two stars which appear to be close together in space. *Optical doubles* are made up of two stars that only happen to lie in the same line of sight as seen from the Earth and are nothing more than chance alignments. Most are comprised of stars that are gravitationally linked and orbit each other, forming a genuine double-star system known as a ***binary star***.

Draconic Month

See ***lunar month***.

Draconic Year

See ***saros***.

Dwarf Planet

A dwarf planet is a small, spherical planetary body in orbit about the Sun which is not itself a ***satellite*** and does not dominate the space around its ***orbit***. The ***Solar System*** contains at least five dwarf planets: Ceres, Pluto, Haumea, Makemake, and Eris. Additional objects may be designated as dwarf planets in the future.

Earthshine

Sunlight reflected from the Earth onto the otherwise unilluminated portions of the Moon. This is particularly noticeable when the Moon is in its ***crescent phase***.

Eccentricity

This is a number which describes the shape of an ***orbit***. An eccentricity of 0 corresponds to a circular orbit, whilst an eccentricity between 0 and 1 yields an ***elliptical*** orbit. An eccentricity of exactly 1 describes a ***parabolic*** orbit, and an eccentricity greater than 1 defines a ***hyperbolic*** orbit.

Eclipse

An eclipse is the obscuration of one celestial object by another, such as the Sun by the Moon during a solar eclipse or one component of an eclipsing ***binary star*** by the companion star.

A **solar eclipse** occurs when the New Moon passes directly between the Earth and the Sun. There are four types of solar eclipse:

Total — A *total solar eclipse* takes place when the Moon completely obscures the Sun, during which event the Sun's corona, or outer atmosphere, is revealed.

Partial — A *partial solar eclipse* occurs when the lining up of the Earth, Moon and Sun is not exact and the Moon covers only a part of the Sun.

Annular — An *annular solar eclipse* takes place when the Moon is at or near its farthest from the Earth, at which time the lunar disc appears smaller and does not completely cover the solar disc, the Sun's visible outer edges forming a 'ring of light' or 'annulus' around the Moon.

Hybrid — A *hybrid eclipse* begins as an annular eclipse but becomes total along part of the path. These are quite rare.

A **lunar eclipse** occurs when the Earth passes between the Sun and the Full Moon, and the Earth's shadow is thrown onto the lunar surface. There are three types of lunar eclipse:

Total — A *total lunar eclipse* takes place when the Moon passes completely through the ***umbra*** of the Earth's shadow, during which process the Moon will gradually darken and take on a reddish/rusty hue.

Partial A *partial lunar eclipse* occurs when the Moon passes through the ***penumbra*** of the Earth's shadow and only part of it enters the umbra.

Penumbral A *penumbral lunar eclipse* takes place when the Moon only enters the ***penumbra*** of the Earth's shadow without touching or entering the umbra.

Eclipse Season

A period, occurring roughly every six months, when ***eclipses*** can occur. Only two or three eclipse seasons occur within a year, with each season lasting about 35 days.

Eclipse Year

See ***saros***.

Eclipsing Binary

See ***binary star***.

Ecliptic

As the Earth orbits the Sun, its position against the background stars changes slightly from day to day, the overall effect of this being that the Sun appears to travel completely around the ***celestial sphere*** over the course of a year. The apparent path of the Sun is known as the ecliptic and is superimposed against the band of ***constellations*** we call the ***Zodiac*** through which the Sun appears to move.

In positional astronomy, the ecliptic is defined by the orbit plane of the Earth, which changes over time due to perturbations by the other planets.

Einstein Ring

When light passes a body, its path is curved by the gravitational field of that body. Such a deviation caused by a body between us and the source can produce a ring of light from the source. Such perfect lensing, caused by an intervening ***galaxy***, has been observed from the quasar MG 1654+1348 in its radio emission.

Ellipse

The closed, oval-shaped form obtained by cutting through a cone at an angle to the main axis of the cone. The ***orbits*** of the ***planets*** around the Sun are all elliptical. The ***eccentricity*** of an object in an elliptical orbit is greater than 0 but less than 1. A circular orbit is a special case of an elliptical orbit where the eccentricity is exactly 0.

Elongation

In its most general sense, elongation refers to the angular separation between two celestial objects as seen from a third object. It is most often used to refer to the ***angular distance*** between the Sun and a ***planet*** or the Moon, as seen from the Earth.

The *greatest elongation* of Mercury or Venus is the maximum angular distance between the planet and the Sun as seen from the Earth, during a particular ***apparition***.

Emission Line

See ***spectral line***.

Emission Nebula

See ***nebula***.

Ephemeris (plural: Ephemerides)

Table showing the predicted positions of celestial objects such as ***comets*** or ***planets***.

Equator

The equator of a ***planet*** or other spheroidal celestial body is the great circle on the surface of the body whose latitude is zero, as defined by the ***axis*** of rotation. The ***celestial equator*** is the projection of the plane of the Earth's equator onto the sky.

Equinox

The equinoxes are the two points at which the ***ecliptic*** crosses the ***celestial equator*** (see also ***Autumnal Equinox*** and ***Vernal Equinox***). The term is also used to denote the dates on which the Sun passes these points on the ecliptic.

Event Horizon

The boundary of a ***black hole***. Matter and energy can pass through the event horizon toward the ***singularity*** but they cannot pass back out.

Exeligmos (plural: Exeligmoi)

A period of three ***saroi***, after which successive ***eclipses*** will occur with similar properties and longitudes.

Exoplanet

An exoplanet (or *extrasolar planet*) is a ***planet*** orbiting a star outside of our ***Solar System***.

Extinction

The apparent dimming, caused by the Earth's atmosphere, of an object as it gets low to the horizon. Also the dimming of starlight caused by the ***interstellar medium***. See also ***reddening***.

Falling Star

This is a popular American word for a ***meteor***. The equivalent UK word is ***shooting star***.

Fireball

See ***bolide.***

First Point of Aries

The First Point of Aries is the point on the ***celestial sphere*** at which the ***ecliptic*** crosses the ***celestial equator*** from south to north. The Sun is at the First Point of Aries on the ***vernal equinox***. It is the

zero point from which ***right ascension*** and ecliptic ***longitude*** are measured. At present, the First Point of Aries is actually in the ***constellation*** of Pisces. Several centuries from now, ***precession*** will eventually carry it into Aquarius.

Fraunhofer Lines

Absorption lines found in the spectra of the Sun and other stars, named for German physicist Joseph Ritter von Fraunhofer (1787–1826), inventor of the modern ***spectroscope***. Although solar spectral lines were first observed by English chemist William Hyde Wollaston (1766–1828) in the early nineteenth century, Fraunhofer was the first person to investigate them more thoroughly.

Galactic Cluster

See ***star clusters***.

Galaxy

A galaxy is a vast collection of stars, gas and dust bound together by gravity and measuring many thousands of light years across. Galaxies occur in a wide variety of shapes and sizes including spiral, elliptical and irregular and most are so far away that their light has taken many millions of years to reach us. Our ***Solar System*** is situated in the ***Milky Way*** Galaxy, a spiral galaxy containing several billion stars. Located within the ***Local Group of Galaxies***, the Milky Way Galaxy is often referred to simply as the Galaxy. It is orbited by a number of ***globular clusters*** and dwarf galaxies.

Gibbous

More than half illuminated as seen by the observer but not completely full.

Globular Cluster

See ***star clusters***.

Greatest Elongation

See ***elongation***.

Hertzsprung-Russell Diagram

A pivotal diagram for astrophysicists, it describes the distribution of stars on a graph of true brightness (luminosity) on the vertical axis, and colour (temperature) on the horizontal axis. It shows how stars are grouped into populations according to their mass and age. Early versions of the Hertzsprung-Russell diagram represented the temperature by the ***spectral type***, but the B−V ***colour index*** is now more commonly used, and such diagrams are also known as ***colour-magnitude diagrams***. The Hertzsprung-Russell diagram was created independently in the early twentieth century by Danish astronomer Ejnar Hertzsprung (1873–1967) and American astronomer Henry Norris Russell (1877–1957).

Horizon

The horizon is a great circle that is theoretically defined by a zenith distance of 90°. In practice, the observer's ***local horizon*** will differ from this.

Hyperbola

The open form obtained by cutting through a cone at an angle to the main axis of the cone such that it never intersects the opposite side. The ***orbits*** of some ***comets*** around the Sun are hyperbolic. The ***eccentricity*** of an object in a hyperbolic orbit is greater than 1.

Inclination

This is an orbital parameter which describes the angle of the orbital plane of an object relative to a reference plane, usually the ***ecliptic***. The ***planets*** all have low inclinations but ***asteroids*** and ***comets*** may deviate far from the ecliptic plane. The inclination of the ***orbits*** of artificial satellites is more commonly measured relative to the Earth's equatorial plane.

Increscent Moon

(Obscure) The ***waxing crescent*** Moon.

Index Catalogue (IC)

References such as that for IC 2391 (in Vela) and IC 2602 (in Carina) are derived from their numbers in the *Index Catalogue*, published in 1895 as the first of two supplements (the second was published in 1908) to his ***New General Catalogue of Nebulae and Clusters of Stars*** by the Danish astronomer John Louis Emil Dreyer (1852–1926). Between them, the two *Index Catalogues* contained details of an additional 5,386 objects.

Inferior Planet

An inferior planet is a ***planet*** that travels around the Sun inside the ***orbit*** of the Earth. The inferior planets are Mercury and Venus.

International Astronomical Union (IAU)

Formed in 1919 and based at the Institut d'Astrophysique de Paris, this is the main coordinating body of world astronomy. Its main function is to promote, through international cooperation, all aspects of the science of astronomy. It is also the only authority responsible for the naming of celestial objects and the features on their surfaces.

Interstellar Medium (ISM)

The material that occupies the space between the stars, consisting of gas (99%) and dust (1%). The gas is comprised primarily of hydrogen with most of the rest helium, and is extremely cold at a temperature at about 10 K. Dust particles are very small (a fraction of a micron) and irregularly shaped, with a typical temperature ten times that of interstellar gas.

Kuiper Belt

The Kuiper Belt consists of icy and rocky ***trans-Neptunian objects*** orbiting the Sun between 30 au and about 50 au. Four of the five currently-defined ***dwarf planets*** — Pluto, Haumea, Makemake, and Eris — are Kuiper Belt Objects (KBOs). Many short-period ***comets*** are thought to have originated in the Kuiper Belt. The Kuiper Belt is named for Dutch astronomer Gerard Peter Kuiper (1905–1973) who suggested the existence of such a belt in the 1950s.

Latitude

The latitude β of the Sun, Moon or ***planet*** is its angular distance above or below the ***ecliptic***. Note that the ***angular distance*** of a celestial body north or south of the ***celestial equator*** is called ***declination***, and not latitude.

The latitude of a point on the surface of the Earth or other celestial body is its angular distance north or south of the ***equator***.

Light Year (ly)

To express distances to the stars and other ***galaxies*** in miles would involve numbers so huge that they would be unwieldy. Astronomers therefore use the term light year as a unit of distance. A light year is the distance that a beam of light, travelling at around 300,000 km (186,000 miles) per second, would travel in a year and is equivalent to just under 10 trillion kilometres (6 trillion miles).

Limb

The limb of a celestial body is the object's apparent edge against the sky.

Local Group of Galaxies

This is a gravitationally-bound collection of ***galaxies*** which contains over 50 individual members, one of which is our own ***Milky Way*** Galaxy. Other members include the Large Magellanic Cloud, the Small Magellanic Cloud, the Andromeda Galaxy (M31), the Triangulum Spiral Galaxy (M33) and many others.

Galaxies are usually found in groups or clusters. Apart from our own Local Group, many other groups of galaxies are known, typically containing anywhere up to 50 individual members. Even larger than the groups are clusters of galaxies which can contain hundreds or even thousands of individual galaxies. Groups and clusters of galaxies are found throughout the universe.

Local Horizon

The horizon seen by an observer on land or at sea differs from the ideal theoretical horizon, defined as 90° from the ***zenith***, due to several factors. This can affect astronomical observations. On land, distant features such as mountains may delay the appearance of the rising Sun, Moon or stars by minutes or even hours compared to rising times tabulated in almanacs. At sea, altitudes measured relative to the sea horizon are affected by the observer's height above sea level. At a height of 30 metres above sea level (an aircraft carrier deck, for example), this 'dip' of the sea horizon is 10 arcminutes, and the ***altitude*** of a star observed using a nautical sextant must have this amount subtracted before it can be used to determine position at sea. The effect may seem small, but 1 arcminute of observed altitude corresponds to one nautical mile, so ignoring the 10 arcminute dip correction would lead to an error of 10 nautical miles in the position of the ship.

Local Hour Angle

The local hour angle of a star or other celestial object is the difference between the local ***sidereal time*** and the object's ***right ascension***. At upper ***transit***, an object's local hour angle is zero. Before transit, the local hour angle is negative, whilst after transit, it is positive.

Longitude

The longitude λ of the Sun, Moon or ***planet*** is its angular position, measured along the ***ecliptic*** from the ***First Point of Aries***.

The longitude of a point on the surface of the Earth or other celestial body is its ***angular distance*** east or west of the ***prime meridian***. On the Earth, this is defined by the Greenwich meridian. By convention, terrestrial longitude is positive east of Greenwich and negative west of Greenwich.

Lower Transit

See ***transit***.

Lucida

The brightest star in a ***constellation***.

Luminosity Class

The luminosity class of a star is determined by pressure broadening of certain spectral lines in a star's spectrum and is denoted by a Roman numeral appended to the ***spectral type***. Hypergiants are assigned the luminosity class of 0 (zero) which, of course, is not a Roman numeral.

I. Supergiant
II. Bright giant
III. Giant
IV. Subgiant
V. Dwarf or ***main sequence***
VI. Subdwarf
VII. ***White dwarf***

Lunar

Of or appertaining to the Moon.

Lunar Eclipse

See ***eclipse***.

Lunar Mansion

A segment of the ***ecliptic*** through which the Moon passes in its ***orbit*** around Earth. It was used in some ancient calendrical systems. Also known as a *lunar house*.

Lunar Month

There are several different types of lunar months:

Draconic A *draconic month* is the time it takes the Moon to pass through the same ecliptic ***node*** (either ascending or descending) twice in succession. It is approximately 27.21 days long. This is shorter than the sidereal month because the nodes of the Moon's orbit precess slowly backwards along the ecliptic.

Tropical A *tropical month* is the time it takes the Moon to pass through the same equatorial ***node*** (either ascending or descending) twice in succession. It is approximately 27.32 days long.

Sidereal A *sidereal month* is the time it takes the Moon to complete one ***orbit*** around Earth, measured with respect to a fixed direction in space. This type of month is used in cultures which divide the sky into ***lunar mansions***. It is approximately 27.32 days long.

Anomalistic An *anomalistic month* is the time it takes the Moon to pass through the same ***apsis*** (either ***apogee*** or ***perigee***) twice in succession. It is approximately 27.55 days long. This is longer than the sidereal month because the apsides of the Moon's orbit precess slowly forwards along the ecliptic.

Synodic A *synodic month* is the time it takes the Moon to complete a set of phases and is usually measured from New Moon to New Moon. It is also known as a *lunation*. Its average length is 29.53 days.

Lunar Standstill

See ***lunistice***.

Lunation

See ***lunar month (synodic)***.

Lunation Number

This is a number given to each ***lunation*** beginning from a specified starting point. The most commonly used one is the ***Brown Lunation Number*** which begins with the New Moon of January 1923.

Lunistice

These are the points at which the Moon is at its maximum angular distance or ***declination*** from the ***celestial equator*** over the course of a ***draconic month***. Also known as a *lunar standstill*.

Magnitude

The magnitude of a star is a measurement of its brightness.

Apparent magnitude

In around 150 BCE the Greek astronomer Hipparchus divided the stars up into six classes of brightness, the most prominent stars being ranked as first class and the faintest as sixth. This system classifies the stars and other celestial objects according to how bright they actually appear to the observer. In 1856 the English astronomer Norman Robert Pogson (1829–1891) refined the system devised by Hipparchus by classing a first-magnitude star as being 100 times as bright as one of sixth-magnitude, giving a difference between successive magnitudes of $\sqrt[5]{100}$ or about 2.512. In other words, a star of magnitude 1.0 is 2.512 times as bright as one of magnitude 2.0, 6.31 (2.512 × 2.512) times as bright as a star of magnitude 3.0 and so on. The same basic system is used today, although modern telescopes enable us to determine values to within 0.01 of a magnitude or better. Negative values are used for the brightest objects including the Sun (−26.8), the Full Moon (−12.9), Venus (−4.9 at its brightest) and Sirius (−1.46). Generally speaking, the faintest objects that can be seen with the naked eye under good viewing conditions are around sixth-magnitude, with binoculars allowing you to see stars and other objects down to around ninth-magnitude.

Absolute magnitude

The apparent magnitude of a star is not a reliable measure of the actual (intrinsic) luminosity of that star. For example, Deneb (α Cygni) and Rigil Kentaurus (α Centauri A) are both first-magnitude stars as seen from the Earth, but Deneb is 130,000 times more luminous than Rigil Kentaurus. The latter star appears brighter only because it is much closer to us. Astronomers correct for this distance effect by defining the absolute magnitude of a star as the apparent magnitude it would have if it were located at a standard distance of 10 ***parsecs*** (32.6 ***light years***). This enables astronomers to compare the intrinsic luminosities of stars directly. The absolute magnitude of the Sun is +4.87 whilst Rigil Kentaurus and Deneb have absolute magnitudes of +4.43 and −8.38 respectively.

Main Sequence

The main sequence is the dominant band on the ***Hertzsprung-Russell diagram***, running from the upper left down to the lower right. Stars on this band are fusing hydrogen to helium in their cores and are given the ***luminosity class*** of V. Main sequence stars, particularly cooler ones, are also called dwarf stars. The Sun is a main sequence star.

Meridian

This is a great circle crossing the ***celestial sphere*** and which passes through both ***celestial poles*** and the ***zenith***.

Messier Catalogue (M)

References such as that for Messier 1 (M1) in Taurus, Messier 31 (M31) in Andromeda and Messier 57 (M57) in Lyra relate to a range of deep sky objects derived from the *Catalogue des Nébuleuses et des Amas d'Étoiles* (Catalogue of Nebulae and Star Clusters) drawn up by the French astronomer Charles Messier (1730–1817) during the latter part of the eighteenth century.

Meteor

This is a streak of light in the sky seen as the result of the destruction through atmospheric friction of a ***meteoroid*** in the Earth's atmosphere. An extremely bright meteor causing a sonic boom may also be known as a ***bolide***

Meteorite

A meteorite is a ***meteoroid*** which is sufficiently large to at least partially survive the fall through the Earth's atmosphere.

Meteoroid

This is a term applied to particles of interplanetary meteoritic debris.

Meteor Shower

A meteor shower is an event when a larger-than-average number of ***meteors*** appear in the sky, all originating from a common point called the ***radiant***. A very intense shower may be called a *meteor storm*. Showers occur when the Earth collides with streams of interplanetary debris given off by bodies such as ***comets*** and ***asteroids***.

Milky Way

This is the name given to the faint pearly band of light that we sometimes see crossing the sky and which is formed from the collective glow of the combined light from the thousands of stars that lie along the main plane of our Galaxy as seen from the Earth. The vast majority of these stars are too faint to be seen individually without some form of optical aid. However, provided the sky is really dark and clear, the Milky Way itself is easily visible to the unaided eye, and any form of optical aid will show that it is indeed made up of many thousands of individual stars. Our ***Solar System*** lies within the main plane of the Milky Way Galaxy and is located inside one of its spiral arms. The Milky Way is actually our view of the Galaxy, looking along the main galactic plane. The glow we see is the combined light from many different stars and is visible as a continuous band of light stretching completely around the ***celestial sphere***.

Minor Planet

A minor planet is a ***Solar System*** object in orbit around the Sun that is neither a ***planet***, a ***satellite*** nor a ***comet***. ***Dwarf planets***, ***asteroids*** and ***Kuiper Belt*** Objects are considered minor planets.

Moving Group

See ***star clusters***.

Nadir

This is the point on the ***celestial sphere*** directly opposite the ***zenith***.

Nautical Twilight

See ***twilight***.

Nebula (plural: Nebulae)

Nebulae are huge interstellar clouds of gas and dust. Observed in other ***galaxies*** as well as our own, their collective name is from the Latin ‘nebula’ meaning ‘mist’ or ‘vapour’, and there are three basic types:

Emission — *Emission nebulae* contain young, hot stars that emit copious amounts of ultra-violet radiation which reacts with the gas in the nebula causing the nebula to shine at visible wavelengths and with a reddish colour characteristic of this type of nebula. In other words, emission nebulae *emit* their own light. A famous example is the Orion Nebula (M42) in the ***constellation*** Orion which is visible as a shimmering patch of light a little to the south of the three stars forming the Belt of Orion. ***Planetary nebulae*** and ***supernova remnants*** are both types of emission nebulae.

Reflection — The stars that exist in and around *reflection nebulae* are not hot enough to actually cause the nebula to give off its own light. Instead, the dust particles within them simply *reflect* the light from these stars. Members of the Pleiades ***star cluster*** (M45) in Taurus are surrounded by reflection nebulosity. Photographs of the Pleiades cluster show the nebulosity as a blue haze, this being the characteristic colour of reflection nebulae.

Dark — *Dark nebulae* are clouds of interstellar matter which contain no stars and whose dust particles simply blot out the light from objects beyond. They neither emit or reflect light and appear as dark patches against the brighter backdrop of stars or nebulosity, taking on the appearance of regions devoid of stars. They are sometimes called *absorption nebulae*. A good example is the Coal Sack (C99) in the constellation Crux, a huge blot of matter obscuring the star clouds of the southern Milky Way.

Neutron Star

This is the remnant of a massive star which has exploded as a ***supernova***.

New General Catalogue of Nebulae and Clusters of Stars (NGC)

References such as that for NGC 869 and NGC 884 (in Perseus) and NGC 4755 (in Crux) are derived from their numbers in the *New General Catalogue of Nebulae and Clusters of Stars* first published in 1888 by the Danish astronomer John Louis Emil Dreyer (1852–1926) and which contains details of 7,840 ***star clusters***, ***nebulae*** and ***galaxies***. It is a consolidation and expansion of the earlier works of William, Caroline, and John Herschel.

Node

Either of two points where an inclined ***orbital*** plane intersects a plane of reference.

Ascending The point in an orbit where an object passes through the reference plane south to north.

Descending The point in an orbit where an object passes through the reference plane north to south.

Northern Lights

See ***aurora***.

Nova (plural: Novae)

A nova is a transient event which results in a star suddenly brightening, only to slowly fade over several weeks or months. All novae are ***binary stars*** consisting of a ***white dwarf*** and a companion star. The brightening events occur when matter from the companion star impacts the surface of the white dwarf, or when an accretion disk around the white dwarf becomes unstable. Novae may recur whereas ***supernovae*** occur only once.

Nucleosynthesis

The creation of new atomic nuclei from pre-existing atoms. The first nuclei were formed in the first minutes of the ***Big Bang***. Stars create heavier elements through nuclear fusion in their cores. Other natural processes, such as ***supernova*** explosions, stellar mergers, ***cosmic ray*** spallation (cosmic rays splitting existing nuclei), and radioactive decay also contribute to the formation of new atomic nuclei.

Oblateness

This describes the deviation of the shape a celestial body from a perfect sphere due to its ***rotation***. Saturn is the most oblate of the ***planets***: its diameter measured from pole to pole is 10% smaller than the diameter measured across its equator. This is because Saturn is composed mainly of gas and because it rotates rather rapidly.

Obliquity

The obliquity of a spinning body is the angle between the object's ***axis*** of rotation and a line perpendicular to its orbital plane. The obliquity of the Earth varies over the course of 41,000 years but is currently approximately 23.5°.

Occultation

This is the temporary covering up of one celestial object, such as a star, by another, such as the Moon or a ***planet***.

Oort Cloud

First proposed by Dutch astronomer Jan Hendrick Oort (1900–1992), the Oort Cloud is a theoretical spherical shell of icy bodies of a surrounding the ***Solar System***. The diameter of the Oort Cloud is disputed but may stretch between 2,000 au to 200,000 au. Gravitational disruptions of the Oort Cloud caused by tidal effects of the Milky Way or passing stars may perturb Oort Cloud objects

(which are ***trans-Neptunian objects***) in toward the Sun or eject them entirely from the Solar System. The Oort Cloud is also sometimes known as the *Öpik-Oort Cloud*, in recognition of the contribution to the theory by Estonian astronomer Ernst Julius Öpik (1893–1985).

Open Cluster

See ***star clusters***.

Opposition

Opposition is the point in the ***orbit*** of a ***superior planet*** (or other celestial body outside the Earth's orbit, such as an ***asteroid***) when it is located directly opposite the Sun in the sky. An opposition is formally defined as the instant that a superior planet or asteroid is 180° from the Sun in ecliptic ***longitude***.

Optical Double

See ***double stars***.

Orbit

This is the path of one object around another under the influence of gravity.

Parabola

The open form obtained by cutting through a cone at an angle to the main axis of the cone such that it parallel to the opposite side. The ***orbits*** of some ***comets*** around the Sun are parabolic. The ***eccentricity*** of an object in a parabolic orbit is exactly 1.

Parallax

Parallax describes the change in the apparent direction to a distant object caused by a change in the observer's location. In astronomy, it refers specifically to the very small change in the position of a star when observed from opposite sides of the Earth's ***orbit***. This change, when measured, can be used to infer the distance to the star. The parallax of the nearest star, Proxima Centauri (α Centauri C), is 0.768 arcseconds.

Parsec (pc)

A unit of distance, often used by professional astronomers in preference to light years. A star at a distance of one parsec has a ***parallax*** of one second of arc. It is equal to 3.26 light years. The nearest star, Proxima Centauri (α Centauri C), is 1.3 parsecs from the Sun. Distances within our Galaxy are generally expressed in kiloparsecs (1,000 parsecs; abbreviation kpc), whilst distances between ***galaxies*** are expressed in megaparsecs (1,000,000 parsecs; abbreviation Mpc).

Penumbra (plural: Penumbrae)

This is the area of partial shadow around the main cone of shadow cast by the Moon during a solar ***eclipse*** or the Earth during a lunar ***eclipse***. The term penumbra is also applied to the lighter and less cool region of a ***sunspot***.

Perigee

This is the point at which an object, such as the Moon or artificial satellite, is at its minimum orbital distance from the Earth.

Perihelion (plural: Perihelia)

This is the point at which an object, such as a ***planet***, ***comet*** or ***asteroid*** is at its minimum orbital distance from the Sun.

Phase

The apparent change in the shape of the Moon (or other reflecting bodies such as ***planets***) as seen from the Earth. This is caused by the motion of the Earth and Moon (or planet) relative to the Sun.

Phases of the Moon

New Moon, ***waxing crescent***, First Quarter, waxing ***gibbous***, Full Moon, ***waning*** gibbous, Last Quarter, waning crescent.

Photosphere

The visible surface of the Sun.

Planet

A planet is a large spherical object that orbits a star and which is made visible by reflecting light from the parent star rather than by producing its own light. There are eight planets in our ***Solar System***: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune.

Planetary Nebula

Planetary ***nebulae*** consist of material ejected by a star during the latter stages of its evolution. The material thrown off forms a shell of gas surrounding the star whose newly-exposed surface is typically very hot. Planetary nebulae have nothing whatsoever to do with ***planets***. They derive their name from the fact that, when seen through a telescope, some planetary nebulae take on the appearance of luminous discs, resembling a gaseous planet such as Uranus or Neptune. Probably the best known examples are the famous Dumbbell Nebula (M27) in Vulpecula and the Ring Nebula (M57) in Lyra.

Plasma

An ionised gas consisting of atomic nuclei and free electrons.

Pole Star

This is the popular name for Polaris (α Ursae Minoris) which, at second ***magnitude***, is the brightest star in the ***constellation*** of Ursa Minor, the lesser bear, and also currently the brightest star near to the north ***celestial pole***.

Precession

The Earth's axis of rotation is an imaginary line which passes through the North and South Poles of the ***planet***. Extended into space, this line defines the north and south ***celestial poles*** in the sky. The north celestial pole currently lies close to Polaris (α Ursae Minoris) in Ursa Minor, so the daily rotation of our planet on its ***axis*** makes the rest of the stars in the sky appear to travel around Polaris, their paths through the sky being centred on the ***Pole Star***.

However, the position of the north celestial pole is slowly changing, this because of a gradual change in the Earth's axis of rotation. This motion is known as precession and is identical to the behaviour of a spinning top whose axis slowly moves in a cone. Precession is caused by the

combined gravitational influences of the Sun and Moon on our planet. Each resulting cycle of the Earth's axis takes around 25,800 years to complete, the net effect of precession being that, over this period, the north (and south) celestial poles trace out large circles around the northern (and southern) sky. This results in slow changes in the apparent locations of the celestial poles. Polaris will be closest to the north celestial pole in the year 2102, but it will then begin to move slowly away and eventually relinquish its position as the Pole Star. Vega (α Lyrae) will take on the role some 11,500 years from now.

Primary

See ***binary star***.

Prime Meridian

The celestial prime ***meridian*** is the meridian on the sky that passes through the ***First Point of Aries***. It marks the zero point for measuring ***right ascension*** and ecliptic ***longitude***.

On the surface of the Earth, the prime meridian is the line of constant ***longitude*** which passes through the centre of the Airy transit telescope at the Royal Observatory at Greenwich in London. It was adopted by international agreement in 1884 as the origin for measuring longitude. Unlike the celestial prime meridian, it has no physical significance.

Prograde Motion

See ***direct motion***.

Prominence

An explosion of hot ***plasma*** erupting from the ***photosphere*** of the Sun which loops upwards into the ***corona*** along solar magnetic field lines before returning to the surface. Some prominences break apart to give rise to ***coronal mass ejections***. They are associated with ***sunspot*** activity. Also known as a *solar flare*.

Proper Motion

This is the apparent angular motion across the sky of an object such as a star relative to the ***Solar System***. It is typically measured in milliarcseconds per year. Barnard's Star, a nearby dim red dwarf in the ***constellation*** of Ophiuchus, has the largest proper motion yet measured.

Pulsar

This is a rapidly-spinning ***neutron star*** which gives off regular bursts of radiation.

Quadrature

This refers to the geometric configuration of the Sun, the Earth and a ***superior planet*** when the elongation of the planet from the Sun, as seen from the Earth, is 90°.

Quasar

These are small, extremely remote and highly luminous objects which at the cores of active ***galaxies***. They are comprised of a super-massive black hole surrounded by an accretion disk of gas which is falling into the black hole.

Radial Velocity

This is the velocity of a celestial object relative to the observer and may be measured through ***spectroscopy*** or through astrometric means. It is typically measured in kilometres per second.

Radiant

A radiant is a point in the sky from which ***meteor showers*** appear to originate.

Reddening

When light passes through the ***interstellar medium***, the shorter (blue) wavelengths can be scattered by dust, leaving the resulting light looking redder than it normally would. Additionally, the loss of the blue light leads to a dimming effect called ***extinction***. Reddening and extinction can make objects look farther away and cooler than they actually are.

Redshift

When an object is moving away from an observer, its spectral lines increase in wavelength and move toward the red end of the spectrum due to the ***Doppler effect***. However, if an object is approaching the observer, the spectral lines shift toward the blue end of the spectrum. This is called a ***blueshift***.

Reflection Nebula

See ***nebula***.

Retrograde Motion

A ***planet*** is in retrograde motion when its ***right ascension*** or ecliptic ***longitude*** is decreasing with the passing of time. This means that it is moving westwards with respect to the background stars. All ***superior planets*** undergo a period of retrograde motion around the time of ***opposition*** and the ***inferior planets*** undergo a period of retrograde motion around the time of inferior ***conjunction***.

Revolution

A single ***orbit*** around another object or centre of gravity.

Right Ascension

Right ascension α is the angular distance, measured eastwards, of a celestial object from the ***First Point of Aries***. Right ascension is expressed in hours, minutes, and seconds, with 24 hours comprising a complete circle.

Rotation

The spin of an object about its ***axis***.

Saros (plural: Saroi)

The period of 6585.32 days (18 years 10.32 or 11.32 days, depending on how leap years fall), after which solar or lunar ***eclipses*** recur, due to the Earth, Moon and Sun returning to almost the same relative positions. This results from an alignment of three periods in the Moon's orbital motion:

- *Anomalistic month*: The Moon's orbital period, equal to 27.55 days.
- *Synodic month*: The length of the cycle of its phases, i.e. the time between successive New or Full Moons, equal to 29.53 days.
- *Draconic year* or *eclipse year*: The interval between successive alignments of the Sun with the same ***node*** of the Moon's orbit, equal to 346.6 days.

The saros is exactly equal to 223 synodic months, and almost exactly equal to 19 draconic years and to 239 anomalistic months. Therefore, after that period, the Earth, Moon and Sun return to almost the same relative positions, and eclipses recur in almost identical circumstances — though each successive one moves 120° west in longitude, due to the third of a day.

A *saros series* is a series of eclipses at intervals of a saros. There are many interleaved saros series running concurrently.

Due to the saros being not quite an exact number of draconic years, the eclipses in a saros series also move slightly north or south in latitude, depending on whether they occur at the ascending or descending node. Therefore, saros series are finite; each one lasts around 1,300 years, begins with an eclipse near one pole and ends with one near the other pole.

Satellite

A satellite is a small object orbiting a larger one.

Secondary

See ***binary star***.

Seeing

The effects of atmospheric conditions on image quality experienced when carrying out visual observation and astronomical imaging of the night sky. See ***Antoniadi Scale***.

Shooting Star

A popular name for a ***meteor***.

Sidereal Month

See ***lunar month***.

Sidereal Period

The time taken for an object to complete one ***orbit*** around another, measured with respect to a fixed direction in space.

Sidereal Time

A celestial timescale which is defined by the rotation of the Earth. It is equal to the ***right ascension*** of objects that are currently crossing the ***meridian***. It is closely related to ***Universal Time***.

Singularity

The centre of a ***black hole*** where the curvature of space-time becomes infinite.

Solar

Of or appertaining to the Sun.

Solar Cycle

The periodic fluctuation in the occurrence of sunspots. The length of the cycle is usually taken as the interval between successive periods of minimal sunspot activity, and averages at around 11 years. The cycles from minimum to maximum sunspot activity does have considerable variation.

Solar Eclipse

See ***eclipse***.

Solar Flare

See ***prominence***.

Solar System

The Solar System is the collective description given to the system dominated by the Sun and which embraces all objects that come within its gravitational influence. These include the ***planets*** and their ***satellites*** and ring systems, ***minor planets***, ***comets***, ***meteoroids*** and other interplanetary debris, all of which travel in ***orbits*** around our parent star.

Solar Wind

The flow of charged particles originating at the Sun through the ***Solar System***.

Solstice

These are the points on the ***ecliptic*** at which the Sun is at its maximum angular distance or ***declination*** from the ***celestial equator***. The term is also used to denote the dates when the Sun passes these points on the ecliptic.

Southern Lights

See ***aurora***.

Spectral Line

Dips or peaks at certain wavelengths of a ***spectrum***, caused by transitions between different energy states within an atom or molecule. ***Absorption lines*** form when an atom or molecule absorbs energy at a particular wavelength. These show up as dark lines in continuous spectrum. ***Emission lines*** occur when an atom or molecule emits energy at a particular wavelength. These show up as bright lines. Atoms and molecules in Earth's atmosphere may contribute to ***telluric*** contamination of a spectrum.

Spectral Type

This is a classification system for stars based on the various characteristics of their spectral lines. The most common scheme in use is the *Harvard* classification system which uses the letters O, B,

A, F, G, K and M to describe stars from hottest (bluest) to coolest (reddest). There are additional letters to denote special types of stars such as ***brown dwarfs***, carbon stars and ***white dwarfs***. The *Yerkes* (or *Morgan-Keenan*) classification system adds a ***luminosity class*** to the Harvard system.

Spectroscope

An instrument used to split the light from a star into its different wavelengths or colours.

Spectroscopic Binary

See ***binary star***.

Spectroscopy

The study of the spectra of astronomical objects.

Spectrum (plural: Spectra)

A continuum of electromagnetic radiation and normally applied to the breakdown of white light into various colours. An astronomical spectrum observed on the Earth may contain ***spectral lines*** corresponding to elements present in the celestial object, the ***interstellar medium***, and/or the Earth's atmosphere.

Star

A star is a self-luminous object shining through the release of energy produced by nuclear reactions at its core.

Star Clusters

Although most of the stars that we see in the night sky are scattered randomly throughout the spiral arms of the Galaxy, many are found to be concentrated in relatively compact groups, referred to by astronomers as star clusters. There are three main types of star cluster:

Globular Cluster

Globular clusters, as their name suggests, are huge spherical collections of stars. Located in the area of space surrounding the Galaxy, they can have diameters of anything up to several hundred light years and typically contain many thousands of old stars with little or none of the nebulosity seen in open clusters. When seen through a small telescope or binoculars, they take on the appearance of faint, misty balls of greyish light superimposed against the background sky. Although some form of optical aid is usually needed to see globular clusters, there are three famous examples which can be spotted with the naked eye. These are 47 Tucanae (C106) in Tucana, Omega Centauri (C80) in Centaurus and the Great Hercules Cluster (M13) in Hercules. A globular cluster that has been torn apart by gravity and stretched out along its orbit is known as *stellar stream*.

Open Cluster

Open clusters, also known as *galactic clusters*, are found within the main disc of the Galaxy and have no particularly well-defined shape. Usually made up of young hot stars, over a thousand open clusters are known, their diameters generally being no more than a few tens of light years. They are believed to have formed from vast interstellar gas and dust clouds within our Galaxy and indeed occupy the same regions of the Galaxy as the ***nebulae***. A number of open clusters are visible to the naked eye including the Beehive or Praesepe (M44) in Cancer, the Hyades (C41) in Taurus and perhaps the most famous open cluster of all, the Pleiades (M45), also in Taurus.

Stellar Association

A *stellar association* is a very loose star cluster, usually containing between 10 and 100 stars. The members of an association are identified as having common ages, chemical compositions, and velocity vectors which indicate a common origin. However, the stars have become gravitationally unbound and are slowly drifting apart. If the members of an association move together in a more-or-less coherent fashion, they are termed a *moving group*.

Star Colours

When we look up into the night sky the stars appear much the same. Some stars appear brighter than others but, with a few exceptions, they all look white. However, if the stars are looked at more closely, even through a pair of binoculars or a small telescope, some appear to be different colours. A prominent example is the bright orange-red Arcturus (α Boötis) in the ***constellation*** of Boötes, which contrasts sharply with the nearby brilliant white Spica (α Virginis) in Virgo. Our own Sun is yellow, as is Capella (α Aurigae) in Auriga. Procyon (α Canis Minoris), the brightest star in Canis Minor, also has a yellowish tint. To the west of Canis Minor is the constellation of Orion the Hunter, which boasts two of the most conspicuous stars in the whole sky; the bright red Betelgeuse (α Orionis) and Rigel (β Orionis), the brilliant blue-white star that marks the Hunter's foot.

The colour of a star is a good guide to its temperature, the hottest stars being blue and blue-white with surface temperatures of 20,000 K or more. Classed as a yellow dwarf, the Sun is a fairly average star with a temperature of around 5,800 K. Red stars are much cooler still, with surface temperatures of under 3,500 K. Betelgeuse in Orion and Antares (α Scorpii) in Scorpius are both red giant stars that fall into this category.

The colour of a star can be represented quantitatively by its ***colour index***.

Stationary Point

A ***planet*** is at a stationary point when its motion with respect to the background stars changes from ***direct motion*** to ***retrograde motion*** or vice versa. All ***superior planets*** pass through two stationary points at each ***apparition***, once before ***opposition*** and again after opposition.

Stellar Association

See ***star clusters***.

Stellar Stream

See ***star clusters***.

Sunspot

Sunspots are temporary features on the visible surface of the Sun, the ***photosphere***. They appear relatively dark because they are cooler than the surrounding areas of the photosphere. They are associated with disturbances in the solar magnetic field.

Superior Planet

A superior planet is a ***planet*** that travels around the Sun outside the ***orbit*** of the Earth. The superior planets are Mars, Jupiter, Saturn, Uranus and Neptune.

Supernova (plural: Supernovae)

Supernovae are huge stellar explosions involving the destruction of massive stars and resulting in sudden and tremendous brightening of the stars involved.

Supernova Remnant

Supernova remnants consist of gas ejected by a ***supernova***, plus material from the ***interstellar medium*** that is swept up by the shockwave of the explosion. Supernova remnants are thought to be a major source of ***cosmic rays***. Probably the best known examples are the famous Crab Nebula (M1) in Taurus, Cassiopeia A, and the Cygnus Loop.

Synodic Month

See ***lunar month***.

Synodic Period

The synodic period of a ***planet*** is the interval between successive ***oppositions*** or ***conjunctions*** of that planet.

Telluric Lines

Lines in an astronomical ***spectrum*** which are due to elements in the Earth's atmosphere. Oxygen and water vapour are the major contributors to telluric contamination of spectra.

Terminator

A terminator is the moving line that divides the sunlit and dark side of a planetary body.

Terrestrial

Of or appertaining to the Earth.

Trans-Neptunian Object (TNO)

A trans-Neptunian object is any small ***Solar System*** body which orbits the Sun outside the (average) orbit of Neptune. Members of the ***Kuiper Belt*** and the ***Oort Cloud*** are both examples of trans-Neptunian objects.

Transit

In astronomy, a transit occurs when a relatively small body passes across the disk of a larger body, passing between the body and the observer.

- The passage of Mercury or Venus across the disk of the Sun (as seen from the Earth) or of a planetary ***satellite*** across the disk of the parent ***planet***.
- The passage of an ***exoplanet*** across the face of its parent star.
- Another type of transit takes place at the instant when an object crosses the local ***meridian***. When the object's ***local hour angle*** is zero, this is known as *upper transit*, and marks the maximum ***altitude*** of the object above the observer's ***horizon***. When the object's local hour angle is 12 hours, it is known as *lower transit*.

Twilight

The period immediately after sunset or immediately before sunrise is commonly known as twilight. Astronomers recognise three types of twilight, which are defined by the Sun's distance below the ***horizon***:

Civil — Evening *civil twilight* begins at sunset and ends when the centre of the Sun's disk is 6° below the horizon. If the sky is cloudless and there are no local obstructions, activities that require normal daylight (such as sports) can still be carried out until the end of civil twilight.

Nautical — Evening *nautical twilight* ends when the Sun is 12° below the horizon. At sea, it remains possible to discern the horizon until the end of nautical twilight, allowing navigational observations to be taken using a sextant.

Astronomical — Evening *astronomical twilight* ends when the Sun is 18° below the horizon. At this time, the sky is fully dark, and astronomical observations of the faintest objects becomes possible.

The sequence of twilights is reversed in the morning before sunrise. At the latitude of the United Kingdom, the Sun remains less than 18° below the horizon throughout the night for several weeks around the June solstice, so astronomical twilight never ends, and the sky is never truly dark.

Umbra

This is the main cone of shadow cast by the Moon during a solar ***eclipse*** or the Earth during a lunar eclipse. The term umbra is also applied to the darkest, coolest region of a ***sunspot***.

Universal Time (UT)

A terrestrial timescale which is defined by the rotation of the Earth. It is roughly equivalent to local mean solar time on the Greenwich Meridian, although it is no longer formally linked to Greenwich Mean Time. Universal Time is also not a uniform timescale, because the rotation of the Earth is not uniform. It is closely related to ***sidereal time***.

Upper Transit

See ***transit***.

Variable Stars

A variable star is a star whose brightness varies over a period of time. There are many different types of variable star, although the variations in brightness are basically due either to changes taking place within the star itself or the periodic obscuration, or eclipsing, of one member of a ***binary star*** by its companion.

Vernal Equinox

The vernal equinox is the point at which the apparent path of the Sun, moving from south to north, crosses the ***celestial equator***. In the Earth's northern hemisphere this marks the start of spring, whilst in the southern hemisphere it is the start of autumn.

Visual Binary

See ***binary star***.

Waning

The condition of becoming less illuminated. For example, the Moon is waning as it moves from Full Moon to New Moon.

Waxing

The condition of becoming more illuminated. For example, the Moon is waxing as it moves from New Moon to Full Moon.

White Dwarf

A white dwarf is a small, hot star which represents the last stage in the life of stars like the Sun. The nearest white dwarf to the ***Solar System*** is Sirius B (α Canis Majoris B).

Zenith

This is the point on the ***celestial sphere*** directly above the observer.

Zenithal Hourly Rate (ZHR)

The is the theoretical maximum number of ***meteors*** an observer would see under ideal conditions with the ***radiant*** directly overhead.

Zodiac

The Zodiac is the band of ***constellations*** along which the Sun appears to travel over the course of a year. It straddles the ***ecliptic*** and comprises the 12 constellations Aries, Taurus, Gemini, Cancer, Leo, Virgo, Libra, Scorpius, Sagittarius, Capricornus, Aquarius and Pisces. The ecliptic also passes through part of the constellation of Ophiuchus, as delimited by the boundaries defined by the ***International Astronomical Union***, but Ophiuchus is not traditionally considered a constellation of the Zodiac.

Miscellaneous Symbols

Greek Alphabet

The Greek alphabet was first used to label the brightest stars in a constellation by German uranographer Johann Bayer (1572–1625). See ***Bayer designation***.

α	alpha	ε	epsilon	ι	iota	ν	nu	ρ	rho	φ	phi
β	beta	ζ	zeta	κ	kappa	ξ	xi	σ	sigma	χ	chi
γ	gamma	η	eta	λ	lambda	o	omicron	τ	tau	ψ	psi
δ	delta	θ	theta	μ	mu	π	pi	υ	upsilon	ω	omega

Astronomical Symbols

The following are a collection of symbols that have been used in astronomical literature in the past. Most are now deprecated although the Sun and Earth symbols are still in use by scientists, as is the ascending node symbol (for the longitude of the ascending ***node***) and the Aries symbol (for the ***First Point of Aries***).

♈	Aries	☉	Sun	●	New Moon	☊	Ascending node
♉	Taurus	☿	Mercury	☽ / ☾	Waxing crescent Moon (north/south)	☋	Descending node
♊	Gemini	♀	Venus	◐ / ◑	First Quarter Moon (north/south)	☌	Conjunction
♋	Cancer	⊕	Earth	○	Full Moon	☍	Opposition
♌	Leo	♂	Mars	◑ / ◐	Last Quarter Moon (north/south)	□	Quadrature
♍	Virgo	♃	Jupiter	☾ / ☽	Waning crescent Moon (north/south)		
♎	Libra	♄	Saturn				
♏	Scorpius	♅	Uranus				
♐	Sagittarius	♆	Neptune				
♑	Capricornus	☄	Comet				
♒	Aquarius						
♓	Pisces						