

Glossary of Astronomical Terminologies:

Angular Size and Distance: The apparent size of an object in the sky, or the distance between two objects, measured as an angle. Your index finger held at arm's length spans about 1° , your fist about 10° .

Aperture: The diameter of a telescope's main lens or mirror — and the scope's most important attribute. As a rule of thumb, a telescope's maximum useful magnification is 50 times its aperture in inches (or twice its aperture in millimeters).

Asterism: Any prominent star pattern that isn't a whole constellation, such as the Northern Cross or the Big Dipper. Any pattern of stars recognizable in Earth's night sky, an asterism may form part of an official constellation or it may be composed of stars from more than one constellation.

Asteroid (Minor Planet): A solid body orbiting the Sun that consists of metal and rock. Most are only a few miles in diameter and are found between the orbits of Mars and Jupiter, too small and far away to be seen easily in a small telescope. A few venture closer to the Sun and cross Earth's orbit. A minor planet of the inner Solar System, i.e. one that orbits the Sun at a distance no greater than the orbit of Jupiter. Asteroids are somewhat arbitrarily distinguished from many different types of similar objects: small Solar System bodies primarily composed of dust and ice instead of mineral and rock are known as comets; bodies less than one meter in diameter are known as meteoroids; very large asteroids are sometimes called planetoids or planetesimals; and bodies similar to asteroids in size and composition but which lie beyond Jupiter are known as distant minor planets.

Asteroid belt: The circumstellar disc in the Solar System located roughly between the orbits of Mars and Jupiter that is occupied by numerous irregularly shaped small Solar System bodies ranging in size from dust particles to asteroids and minor planets. The asteroid belt is often called the *main asteroid belt* or *main belt* to distinguish it from other asteroid populations in other parts of the Solar System.

Astronomical Unit: The average distance from Earth to the Sun, slightly less than 93 million miles (150 million kilometers). A unit of length used primarily for measuring distances within the Solar System or secondarily between the Earth and distant stars. Originally conceived as the semimajor axis of the Earth's orbit around the Sun, the astronomical unit is now more rigidly defined as exactly 149,597,870.7 kilometres (92,956,000 miles; 4.8481×10^{-6} parsecs; 1.5813×10^{-5} light-years).

Averted Vision: Viewing an object by looking slightly to its side. This technique can help you detect faint objects that are invisible when you stare directly at them.

A-type star: In the Harvard spectral classification system, a class of main-sequence star having spectra dominated by Balmer absorption lines of hydrogen. Stars of spectral class A are typically blue-white or white in color, measure between 1.4 and 2.1 times the mass of the Sun, and have surface temperatures of 7,600–10,000 kelvin.

Apparent magnitude (Also visual brightness V): A measure of the brightness of a celestial body as seen by an observer on Earth, adjusted to the value it would have in the absence of the atmosphere. The brighter the object appears, the lower its magnitude.

Absolute magnitude: A measure of a star's absolute brightness. It is defined as the apparent magnitude the star would show if it were located at a distance of 10 parsecs, or 32.6 light-years.

Accretion disk: A roughly circular mass of diffuse material in orbit around a central object, such as a star or black hole. The material is acquired from a source external to the central object, and friction causes it to spiral inward towards the object.

Active Galactic Nuclei (AGN): A compact region in the center of a galaxy displaying a much higher than normal luminosity over some part of the electromagnetic spectrum with characteristics indicating that the luminosity is not produced by stars. A galaxy hosting an AGN is called an *active galaxy*.

Albedo: A measure of the proportion of the total solar radiation received by an astronomical body, such as a planet, that is diffusely reflected away from the body. It is a dimensionless quantity typically measured on a scale from 0 (indicating total absorption of all incident radiation, as by a black body) to 1 (indicating total reflection). The albedo reported for an astronomical body may vary widely by the spectral and angular distribution of the incident radiation, by the "layer" of the body being measured (e.g. upper atmosphere versus surface), and by local variation within these layers (e.g. cloud cover and geological or environmental surface features). Syrtis Major is a prominent dark albedo feature on Mars.

Albedo feature: A large area on the surface of a reflecting object that shows a significant contrast in brightness or darkness (albedo) compared to adjacent areas.

A-m star: A chemically peculiar star belonging to the more general class of A-type stars. The spectrum of the Am stars shows abnormal enhancements and deficiencies of certain metals.

Aphelion: The point at which a body orbiting the Earth's Sun is furthest from the Sun. Contrast *perihelion*.

Apoapsis: The point at which an orbiting body is furthest from its primary. Contrast *periapsis*.

Apogee: The point at which a body orbiting the Earth (such as the Moon or an artificial satellite) is furthest from the Earth. Contrast *perigee*.

Appulse: The closest approach of one celestial object to another, as viewed from a third body.

Apsis: In the orbit of a planetary body, one of the two extreme points of distance between the body and its primary – either the point of minimal distance, called the periapsis, or the point of maximal distance, called the apoapsis. The term may also be used to refer to the value of the distance rather than the point itself. All elliptical orbits have exactly two apsides.

Argument of periapsis (Also argument of perifocus or argument of pericenter): The angle from an orbiting body's ascending node to its periapsis, measured in the direction of motion. It is one of six canonical orbital elements used to characterize an orbit.

Artificial satellite: An object that has been intentionally placed into orbit by humans, often around the Earth but also around other bodies within the Solar System. Contrast *natural satellite*.

Ascending node (Also the north node): The orbital node at which an orbiting object moves north through the plane of reference (in geocentric and heliocentric orbits) or at which the orbiting object moves away from the observer (in orbits outside of the Solar System). The position of the ascending node with respect to a reference direction, called the longitude of the ascending node, is used along with other parameters to describe an orbit. Contrast *descending node*.

Aspect: The position of a planet or Earth's Moon with respect to the Sun, as viewed from Earth.

Astrobiology (Also exobiology): An interdisciplinary field that studies the origins, evolution, distribution, and future of living systems in the universe, encompassing research on organic compounds in space, abiogenesis and extreme-environment adaptation on Earth, the habitability of extrasolar planets, the possible existence of extraterrestrial life, and how humans might be able to detect extraterrestrial biosignatures, among other topics.

Astrogeology (Also planetary geology): A field that studies the geology of solidified bodies such as the planets and their moons, asteroids, comets, and meteorites. Investigations are centered around the composition, structure, processes, and history of these objects.

Astrometric binary: A type of binary system where evidence for an unseen orbiting companion is revealed by its periodic gravitational perturbation of the visible component.

Astrometry: The branch of astronomy that involves precise measurements of the positions and movements of stars and other celestial bodies.

Astronomical body (Also celestial body): A type of naturally occurring physical entity, association, or structure within the observable universe that is a single, tightly bound, contiguous structure, such as a star, planet, moon, or asteroid. Though the terms astronomical "body" and astronomical "object" are often used interchangeably, there are technical distinctions.

Astronomical catalogue: A list of astronomical objects, typically grouped together because they share a common type, morphology, origin, means of detection, or method of discovery.

Astronomical object (Also celestial object): A type of naturally occurring physical entity, association, or structure that exists within the observable universe but is a more complex, less cohesively bound structure than an astronomical body, consisting perhaps of multiple bodies or even other objects with substructures, such as a planetary system, star cluster, nebula, or galaxy. Though the terms astronomical "object" and astronomical "body" are often used interchangeably, there are technical distinctions.

Astronomical symbol: Any abstract pictorial symbol used to represent one or more astronomical objects, events, or theoretical constructs, e.g. those of the planets of the Solar System, the phases of the Moon, the zodiacal constellations, and the solstices and equinoxes. Many of these symbols were commonly used historically, though in the modern era they are usually limited to almanacs and astrology, and their appearance in scientific literature has become increasingly infrequent. Exceptions include the symbols for the Sun (\odot), the Earth (\square), and the Moon (\circlearrowleft), which are sometimes used for astronomical constants and in other forms of shorthand evolution.

Axial precession: A slow, continuous, gravity-induced change (a precession) in the orientation of an astronomical body's axis of rotation. The term often refers in particular to the gradual shift in the orientation of Earth's rotational axis with respect to its orbital plane over a cycle of approximately 25,772 years, which is caused predominantly by the gravitational influence of the Moon and the Sun on the Earth's equatorial bulge. The phenomenon is similar to but much larger in magnitude than other changes in the alignment of Earth's axis such as nutation and polar motion, and is the cause of the apparent precession of the equinoxes in the night sky.

Axial tilt (Also obliquity): The angle between an object's rotational axis and its orbital axis, or, equivalently, the angle between its equatorial plane and orbital plane. Axial tilt usually does not change considerably during a single orbital period; Earth's axial tilt is the cause of the seasons. Axial tilt is distinct from orbital inclination.

Azimuth: An angular measurement of an object's orientation along the horizon of the observer, relative to the direction of true north. When combined with the altitude above the horizon, it defines an object's current position in the spherical coordinate system.

Baily's Beads: A few "beads" of sunlight, shining between mountain peaks and through the valleys along the Moon's edge in the moment before totality.

Barlow Lens: A lens that's placed into the focusing tube to effectively double or triple a telescope's focal length and, in turn, the magnification of any eyepiece used with it.

Black Hole: A concentration of mass so dense that nothing — not even light — can escape its gravitational pull once swallowed up. The outer boundary of this region is called the event horizon. Many galaxies (including ours) have supermassive black holes at their centers.

Blue Moon: Traditionally, something that happens rarely or never. More recently, this has come to mean the second full Moon in a single calendar month.

Barycenter: The common center of mass about which any two or more bodies of a gravitationally bound system orbit. The barycenter is one of the foci of the elliptical orbit of each body participating in the system; its location is strongly influenced by the mass of each body and the distances between them. For example, in a planetary system where the mass of the central star is significantly larger than the mass of an orbiting planet, the barycenter may actually be located within the radius of the star, such that the planet appears to orbit the star itself, though both bodies actually orbit the shared barycenter.

Baryogenesis: The process by which the class of subatomic particles known as baryons were generated in the early Universe, including the means by which baryons outnumber antibaryons.

Big Bang: The prevailing cosmological model for the origin of the observable universe. It depicts a starting condition of extremely high density and temperature, followed by an ongoing expansion that led to the current conditions.

Binary star: A star system consisting of exactly two stars orbiting around their common barycenter. The term is often used interchangeably with double star, though the latter can also refer to an optical double star, a type of optical illusion which is entirely distinct from true binary star systems.

Blazar: A blazar is an active galactic nucleus (AGN) with a relativistic jet (a jet composed of ionized matter traveling at nearly the speed of light) directed very nearly towards an observer. Relativistic beaming of electromagnetic radiation from the jet makes blazars appear much brighter than they would be if the jet were pointed in a direction away from Earth

Break-up velocity (Also critical velocity or critical rotation): The surface velocity at which the centrifugal force generated by a rapidly spinning star matches the force of Newtonian gravity. At rotational velocities beyond this point, the star begins to eject matter from its surface.^[2]

Brown dwarf: A substellar object that is too low in mass to sustain the nuclear fusion of hydrogen-1 in its core, with the latter being a characteristic of stars on the main sequence. Brown dwarfs can still generate energy from gravitational contraction and by the fusion of deuterium.

Celestial Coordinates: A grid system for locating things in the sky. It's anchored to the celestial poles (directly above Earth's north and south poles) and the celestial equator (directly above Earth's equator). Declination and right ascension are the celestial equivalents of latitude and longitude.

Celestial equator: The imaginary great circle of a body's celestial sphere that is coplanar with the body's terrestrial equator. On Earth, the plane of the celestial equator is the basis of the equatorial coordinate system. Due to Earth's axial tilt, this plane is currently inclined at an angle of 23.44 degrees with respect to the ecliptic.

Celestial pole: One of two coordinates in the Earth's sky at which a hypothetical indefinite extension of the Earth's axis of rotation "intersects" the celestial sphere, i.e. the two points in the sky that are directly overhead the terrestrial North and South Poles, around which all fixed stars appear to revolve during the course of a day. The celestial poles form the north and south poles of the equatorial coordinate system.

Celestial sphere: An imaginary sphere that encompasses the Earth's entire sky and is stationary with respect to the background stars. It is the basis for spherical astronomy.

Circumpolar: Denotes an object near a celestial pole that never dips below the horizon as Earth rotates and thus does not rise or set.

Collimation: Aligning the optical elements of a telescope so that they all point in the proper direction. Most reflectors and compound telescopes require occasional collimation in order to produce the best possible images.

Comet: A comet is a "dirty snowball" of ice and rocky debris, typically a few miles across, that orbits the Sun in a long ellipse. When close to the Sun, the warmth evaporates the ice in the nucleus to form a coma (cloud of gas) and a tail. Named for their discoverers, comets sometimes make return visits after as little as a few years or as long as tens of thousands of years. A relatively small, icy body that displays extended features when it approaches the Sun. The energy from the Sun vaporizes volatiles on a comet's surface, producing a visible coma around the cometary body. Sometimes a comet can produce a long tail radiating away from the Sun.

Compound Telescope: A telescope with a mirror in the back and a lens in the front. The most popular designs are the Schmidt-Cassegrain telescope (SCT) and the Maksutov-Cassegrain telescope (commonly called a "Mak").

Conjunction: When the Moon or a planet appears especially close either to another planet or to a bright star. A phenomenon during which two astronomical objects or spacecraft have either the same right ascension or the same ecliptic longitude as observed from a third body (usually the Earth), such that, from the observer's perspective, the objects appear to closely approach each other in the sky.

Constellation: A distinctive pattern of stars used informally to organize a part of the sky. There are 88 official constellations, which technically define sections of the sky rather than collections of specific stars. A region on the celestial sphere surrounding a specific and identifiable grouping of stars. The names of constellations are assigned by tradition and often have an associated folklore based in mythology, while the modern demarcation of their borders was established by the International Astronomical Union in 1930.

Culmination: The moment when a celestial object crosses the meridian and is thus at its highest above the horizon.

Coudé spectrograph: This is a spectrograph placed at the Coudé focus of a reflecting telescope. The focus remains stationary as the telescope is re-oriented, which is advantageous for the stable mounting of heavy spectroscopic instruments.^[3]

Celestial mechanics: The branch of astronomy that studies the motions of all types of astronomical objects, including stars, planets, and natural and artificial satellites, among others.

Centaur: A small Solar System body with either a perihelion or a semi-major axis between those of the outer planets, i.e. generally inward of the Kuiper belt but beyond the Jupiter trojans. Centaurs are cis-Neptunian objects that typically exhibit characteristics of both asteroids and comets, and generally also have unstable orbits because they cross the orbits of one or more of the giant planets.

Central massive object (CMO): Any very large concentration of mass at the center of a galaxy, typically either a supermassive black hole or a compact stellar nucleus, but sometimes both.

Chromospheric activity index: A parameter indicating the magnetic activity in a star's chromosphere. Schröder et al. (2009) divide solar-type stars into four groups depending on their activity index: very active ($\log R'_{HK}$ above -4.2), active (-4.2 to -4.75), inactive (-4.75 to -5.1), and very inactive (below -5.1).

Color index: A numeric value that is used to compare the brightness of a star measured from different frequency bands of the electromagnetic spectrum. Because the energy output of a star varies by frequency as a function of temperature, the color index can be used to indicate the star's temperature.

Commensurability: A property of two objects orbiting the same body whose orbital periods are in a rational proportion. For example, the orbital period of Saturn around the Sun is very nearly $5/2$ the orbital period of Jupiter.

Common proper motion: A term used to indicate that two or more stars share the same motion through space, within the margin of observational error. That is, either they have nearly the same proper motion and radial velocity parameters, which may suggest that they are gravitationally bound or share a common origin,^[6] or they are known to be gravitationally bound (in which case their proper motions may be rather different but average to be the same over time).

Compact star (Also compact object): Any astronomical body with a very high mass relative to its radius, compared to most ordinary atomic matter. The term typically refers to very high-density objects such as white dwarfs, neutron stars, and black holes, or to stellar remnants with very small radii.

Corona: An aura of plasma that surrounds cooler stars such as the Sun. It can be observed during a solar eclipse as a bright glow surrounding the lunar disk. The temperature of the corona is much higher than that of the stellar surface, and the mechanism that creates this heat remains subject to debate among astronomers.

Coronal mass ejection (CME): A significant release of plasma and the accompanying magnetic field from the Sun's corona, often following a solar flare or present during a solar prominence eruption.

Cosmic distance ladder: Astronomers use various methods to measure relative distances in the Universe, depending upon the object being observed. Collectively these techniques are known as the cosmic distance

ladder. It's called a ladder for good reason — each rung or measurement technique relies upon the previous step for calibration.

Cosmic dust: Dust which exists in outer space or has fallen on Earth, generally composed of fine particles of solid matter far smaller than those found in terrestrial dust.

Cosmic microwave background radiation (CMBR): The cosmic microwave background (CMB or CMBR) is microwave radiation that fills all space in the observable universe. It is a remnant that provides an important source of data on the primordial universe.^[1] With a standard optical telescope, the background space between stars and galaxies is almost completely dark. However, a sufficiently sensitive radio telescope detects a faint background glow that is almost uniform and is not associated with any star, galaxy, or other object. This glow is strongest in the microwave region of the radio spectrum. The accidental discovery of the CMB in 1965 by American radio astronomers Arno Penzias and Robert Wilson was the culmination of work initiated in the 1940s.

Cosmic ray: A type of radiation consisting of high-energy protons and atomic nuclei which move through space at nearly the speed of light, and which may originate from the Sun or from outside the Solar System. Collisions of cosmic rays with the Earth's atmosphere can produce dramatic effects both in the air and on the surface.

Cosmogony: Any model concerning the origin of either the universe or the cosmos.

Cosmology: The scientific study of the origin, evolution, and eventual fate of the Universe.

Culmination (Also meridian transit): The apparent movement of an astronomical object (e.g. the Sun, the Moon, a planet, a star, a constellation, etc.) across the observer's local meridian. During each day, the Earth's rotation causes every astronomical object to appear to move along a circular path on the celestial sphere, creating two points at which it crosses the meridian: an *upper culmination*, at which the object reaches its highest point above the horizon, and a *lower culmination*, at which it reaches its lowest point, nearly 12 hours later. When not otherwise qualified, the *time of culmination* typically refers to the time at which the upper culmination occurs

Dark Adaptation: The eyes' transition to night vision, in order to see faint objects. Dark adaptation is rapid during the first 5 or 10 minutes after you leave a well-lit room, but full adaptation requires at least a half hour — and it can be ruined by a momentary glance at a bright light.

Declination (Dec.): The celestial equivalent of latitude, denoting how far (in degrees) an object in the sky lies north or south of the celestial equator.

Dobsonian (“Dob”): A type of Newtonian reflector, made popular by amateur astronomer John Dobson, that uses a simple but highly effective wooden mount. Dobs provide more aperture per dollar than any other telescope design.

Double Star (Binary Star): Two stars that lie very close to, and are often orbiting, each other. Line-of-sight doubles are a consequence of perspective and aren't physically related. Many stars are multiples (doubles, triples, or more) gravitationally bound together. Usually such stars orbit so closely that they appear as a single point of light even when viewed through professional telescopes.

Debris disk: A ring-shaped circumstellar disc of dust and debris orbiting its host star. It is created by collisions between planetesimals. A debris disk can be discerned from an infrared excess being emitted from the star system, as the orbiting debris re-radiates the star's energy into space as heat.

Declination: In the equatorial coordinate system, the celestial equivalent of terrestrial latitude. Coordinates north of the celestial equator are measured in positive degrees from 0° to 90° , while coordinates to the south are measured in negative degrees. See also *right ascension*.

Decretion disk: A circumstellar disc formed from gas ejected from a central star that now follows a nearly Keplerian orbit around it. This type of disk can be found around many B-spectral stars.

Deep-sky object (DSO): Any astronomical object that is not an individual star or an object within the Earth's Solar System. The classification is used mostly in amateur observational astronomy to distinguish faint objects in the night sky such as star clusters, nebulae, and galaxies.

Degenerate star: A star composed of degenerate matter, e.g. a white dwarf or a neutron star. These stars are in an advanced state of evolution and have suffered extreme gravitational collapse, such that normal atoms cannot exist in them.

Descending node (Also the **south node**): The orbital node at which an orbiting object moves south through the plane of reference (in geocentric and heliocentric orbits) or at which the orbiting object moves toward the observer (in orbits outside of the Solar System). Contrast *ascending node*.

Detached object (Also **distant detached object** and **extended scattered disc object**): A dynamical class of minor planet in the outer reaches of the Solar System whose point of closest approach to the Sun is so distant that the object is only moderately or weakly affected by the gravitational influence of Neptune and the other known planets, such that it appears to be "detached" from the rest of the Solar System. Detached objects are thus distinct from other populations of trans-Neptunian objects, such as cubewanos and scattered disc objects.

Diurnal motion: The apparent motion of an astronomical object (e.g. the Sun, a planet, or a distant star) around the two celestial poles in the Earth's night sky over the course of one day. Diurnal motion is caused by Earth's rotation about its own axis, such that every object appears to follow a circular path called the *diurnal circle*.

Double star: Any pair of stars which appear near each other on the celestial sphere, either because the two stars coincidentally lie along nearly the same line of sight from the Earth, though they are in fact physically distant from each other, or because the two stars are actually located in physical proximity to each other, by which they may form a co-moving pair or a binary star system.

Dwarf planet: A dwarf planet is a small planetary-mass object that is in direct orbit around the Sun, massive enough to be gravitationally rounded, but insufficient to achieve orbital dominance like the eight classical planets of the Solar System. The prototypical dwarf planet is Pluto, which for decades was regarded as a planet before the "dwarf" concept was adopted in 2006.

Dwarf star: Any star belonging to a category of ordinary main-sequence stars like the Sun, in contrast to evolved giant stars like Betelgeuse and Antares. Confusingly, the term has also come to include stellar remnants known as white dwarfs as well as low-mass substellar objects known as brown dwarfs.

Earthshine: Sunlight reflected by Earth that makes the otherwise dark part of the Moon glow faintly. It's especially obvious during the Moon's thin crescent phases.

Eccentricity: The measure of how much an orbit deviates from being circular.

Eclipse: An event that occurs when the shadow of a planet or moon falls upon a second body. A solar eclipse occurs when the Moon's shadow falls upon Earth, which we see as the Moon blocking the Sun. When Earth's shadow falls upon the Moon, it causes a lunar eclipse.

Ecliptic: The path among the stars traced by the Sun throughout the year. The Moon and planets never stray far from the ecliptic.

Elongation: The angular distance the Moon or a planet is from the Sun. The inner planets of Mercury and Venus are best seen when at maximum elongation, and thus are highest above the horizon before sunrise or after sunset.

Ephemeris: A timetable with celestial coordinates that indicates where a planet, comet, or other body moving in relation to background stars will be in the sky. Its plural is ephemerides (pronounced eff-uh-MEHR-ih-deez).

Equinox: The two times each year, near March 20th and September 22nd, when the Sun is directly overhead at noon as seen from Earth's equator. On an equinox date, day and night are of equal length.

Eyepiece: The part of a telescope that you look into. A telescope's magnification can be changed by using eyepieces with different focal lengths; shorter focal lengths yield higher magnifications. Most eyepieces have metal barrels that are 1¼ inches in diameter; other standard sizes are 0.965 and 2 inches across.

Early-type star: A hotter and more massive star, in contrast to late-type stars that are cooler and less massive. The term originated from historical stellar models that assumed stars began their early life at a high temperature then gradually cooled off as they aged. It may be used to refer to the higher-temperature members of any particular population or category of stars, rather than of all stars in general.

Ecliptic (Also ecliptic plane or plane of the ecliptic): The plane defined by the Earth's orbit around the Sun. Hence, the position of the Sun as viewed from the Earth defines the intersection of this plane with the celestial sphere. The ecliptic is widely used as a reference plane for describing the position of other Solar System bodies within various celestial coordinate systems. It differs from the celestial equator because of the axial tilt of the Earth.

Ecliptic coordinate system: An astronomical coordinate system commonly used to specify the apparent positions, orbits, and axial orientations of objects within the Solar System, with an origin at the geometric center of either the Sun or the Earth, a fundamental plane defined by the plane of Earth's orbit around the Sun (i.e. the plane of the ecliptic), a primary direction towards the vernal equinox, and a right-handed convention. This system is convenient because most of the planets and many small Solar System bodies orbit the Sun with only slight inclinations to the ecliptic. It may be implemented in either spherical or rectangular coordinates.

Effective temperature (of a star or planet): The temperature of an ideal black body that would emit the same total amount of electromagnetic radiation.

Elliptical galaxy: A type of galaxy with an approximately ellipsoidal shape and a smooth, nearly featureless appearance. They are one of three main morphological classes of galaxy, along with spiral and lenticular galaxies.

Elliptical orbit: A type of Kepler orbit with an orbital eccentricity of less than 1 (often inclusive of circular orbits, which have eccentricity equal to 0), or one with negative energy. Elliptical orbits take the shape of an ellipse, and are very common in two-body astronomical systems.

Elongation: The angular separation between the Sun and an orbiting body, such as a planet, as it appears from Earth.

Epoch: A moment in time used as a reference point for some time-varying astronomical quantity, such as the celestial coordinates or orbital elements of an astronomical object, because such quantities are subject to perturbations and change over time. The primary use of astronomical quantities specified by epochs is to calculate other relevant parameters of motion in order to predict future positions and velocities. In modern usage, astronomical quantities are often specified as a polynomial function of a particular time interval, with a given epoch as the temporal point of origin.

Equator: The imaginary line on a gravitationally rounded spheroid such as a planet that represents the intersection of the spheroid's surface with a plane perpendicular to its axis of rotation and equidistant from its geographical poles. The plane of the Earth's terrestrial equator is the basis for the celestial equator.

Equatorial coordinate system: An astronomical coordinate system defined by an origin at the geometric center of the Earth, a fundamental plane created by projecting the Earth's terrestrial equator onto the celestial sphere (forming the celestial equator), a primary direction towards the vernal equinox, and a right-handed convention. This system is widely used to specify the positions of celestial objects as viewed from Earth. It may be implemented in either spherical or rectangular coordinates.

Equinox: Either of the two precise times of year when the imaginary plane of the Earth's equator, extended indefinitely in all directions, passes through the center of the Sun (i.e. the two points at which this plane intersects the plane of the ecliptic); or, equivalently, when the Sun's apparent geocentric longitude is either 0 degrees or 180 degrees.^[10] The two equinoxes, known as the vernal equinox and the autumnal equinox, occur on or near March 20 and September 22 each year. On the day of an equinox, the center of the visible Sun appears to be directly above the equator, and the durations of day and night are approximately equal all over the planet.

Escape velocity: The minimum speed that must be achieved for a free, non-propelled object to escape from the gravitational influence of a massive body, i.e. to achieve an infinite distance from it; more generally, escape velocity is the speed at which the sum of an object's kinetic energy and gravitational potential energy is equal to zero. It is a function of the mass of the body and of the distance between the object and the body's center of mass. An object which has achieved escape velocity is neither on the surface nor in a closed orbit of any radius.

Evolutionary track: A curve on the Hertzsprung–Russell diagram that a solitary star of a particular mass and composition is expected to follow during the course of its evolution. This curve predicts the combination of temperature and luminosity that a star will have during part or all of its lifetime.^[11]

Extinction: The absorption and scattering of electromagnetic radiation by matter (dust and gas) between an emitting astronomical object and the observer. Atmospheric extinction varies by the wavelength of the radiation, with the attenuation being greater for blue light than for red.

Extragalactic astronomy: The branch of astronomy that studies objects and phenomena outside of the Milky Way galaxy, i.e. all objects not covered by galactic astronomy.

Extrasolar object: Any astronomical object that exists outside the Solar System. The term is generally not applied to stars or any objects larger than a star or the Solar System itself, such as galaxies.

Facula: A bright spot on a star's photosphere formed by concentrations of magnetic field lines. For the Sun in particular, faculae are most readily observed near the solar limb. An increase in faculae as a result of a stellar cycle increases the star's total irradiance.

Field galaxy: Any galaxy that does not belong to a larger cluster of galaxies and is gravitationally isolated.

Field star: A randomly situated star that lies along the line of sight to a group of physically associated stars under study, such as a star cluster. These field stars are important to identify in order to prevent them from contaminating the results of a study.^[12]

First light: The first use of a newly constructed telescope or other instrument to take an astronomical image.

First magnitude star: A term used to classify the brightest stars in the night sky, with apparent magnitudes lower (i.e. brighter) than 1.50. There are 22 stars that are classified as first magnitude stars.

First Point of Aries (Also the Cusp of Aries): The location of the March equinox upon the celestial sphere, used as a reference point in celestial coordinate systems. Located in the constellation Pisces, the First Point of Aries defines the ecliptic coordinate of (0°, 0°) and represents the point at which the Sun meets the celestial equator while traveling from south to north each year. It is directly opposite the First Point of Libra.

First Point of Libra: The location of the September equinox upon the celestial sphere, used as a reference point in celestial coordinate systems. Located in the constellation Virgo, the First Point of Libra represents the point at which the Sun meets the celestial equator while traveling from north to south each year. It is directly opposite the First Point of Aries.

Fixed stars (Also background stars): The "background" of astronomical objects in the night sky which are so distant from observers on Earth that they do not appear to move relative to each other, as opposed to the "foreground" of objects within the Solar System which do. The fixed stars are typically taken to include all stars other than the Sun, as well as all other extrasolar and deep-sky objects.

Flare star: A class of variable star that undergoes sudden, dramatic increases in brightness due to magnetic activity on its surface. This change in brightness occurs across the electromagnetic spectrum from radio waves to X-rays. Most flare stars are faint red dwarfs.

Fulton gap: The apparent uncommonness of planets having a size between 1.5 and 2 times that of the Earth.

Field of View: The circle of sky that you see when you look through a telescope or binoculars. Generally, the lower the magnification, the wider the field of view.

Finderscope: A small telescope used to aim your main scope at an object in the sky. Finderscopes have low magnifications, wide fields of view, and (usually) crosshairs marking the center of the field.

Focal Length: The distance (usually expressed in millimeters) from a mirror or lens to the image that it forms. In most telescopes the focal length is roughly equal to the length of the tube. Some telescopes use extra lenses and/or mirrors to create a long effective focal length in a short tube.

Focal Ratio (f/number): A lens or mirror's focal length divided by its aperture. For instance, a telescope with an 80-mm-wide lens and a 400-mm focal length has a focal ratio of f/5.

Galaxy: A vast collection of stars, gas, and dust, typically 10,000 to 100,000 light-years in diameter and containing billions of stars (from *galaxias kuklos*, Greek for "circle of milk," originally used to describe our own Milky Way). Galaxies may be spiral (with one or more spiral-shape arms), elliptical (shaped more like fuzzy footballs with no distinguishing features), or irregular (chaotic appearance). A large, gravitationally bound system of stars, stellar remnants, interstellar gas, dust, and dark matter, each of which orbits a center of mass. Galaxies may contain hundreds of billions of stars and are categorized according to their visual morphology as elliptical, spiral, or irregular. Most of the galaxies in the observable universe are between 1,000 and 3,000 parsecs (3,300 and 9,800 ly) in diameter though some, including the Milky Way, are much larger.

Gibbous: When the Moon or other body appears more than half, but not fully, illuminated (from *gibbus*, Latin for "hump").

Galactic astronomy: The branch of astronomy that studies objects and phenomena within the Milky Way galaxy, as opposed to everything outside of the Milky Way, which is the domain of extragalactic astronomy.

Galactic anticenter: The direction in space that is directly opposite the center of the Milky Way Galaxy, as viewed from Earth; considered as a point on the celestial sphere, the Milky Way's anticenter is in the constellation Auriga.

Galactic Center: The rotational center of the Milky Way galaxy, consisting of a supermassive black hole of 4.100 ± 0.034 million solar masses. It is approximately 8,200 parsecs (27,000 ly) away from Earth in the direction of the constellations Sagittarius, Ophiuchus, and Scorpius, where the Milky Way appears brightest.

Galactic nucleus (Also galactic core or galactic center): The region at the center of a galaxy, usually home to a very dense concentration of stars and gas. It almost always includes a supermassive black hole which, when active, can generate a much higher luminosity in a compact region than its surroundings. This excess luminosity is known as an active galactic nucleus, and the brightest such active galaxies are known as quasars.

Galactic period (Also galactic year or cosmic year): The time a given astronomical object within a galaxy takes to complete one orbit around the galactic center. Estimates of the duration of one revolution of the Solar System about the center of the Milky Way range from 225 to 250 million terrestrial years.

Galactic tide: The tidal force experienced by objects subject to the gravitational field of a galaxy such as the Milky Way.

Galactocentric distance: A star or cluster's distance from the gravitational center of a particular galaxy. For example, the Sun is about 27,000 light-years (approximately 8 kiloparsecs) away from the Galactic Center of the Milky Way.^[13] Galactocentric distance may also refer to a galaxy's distance from another galaxy.

Galaxy cluster: A large-scale structure consisting of hundreds or thousands of galaxies bound together by gravity. Galaxy clusters are distinct from similarly named galactic clusters and other types of star clusters and from smaller aggregates of galaxies known as galaxy groups. Galaxy groups and galaxy clusters can themselves cluster together to form superclusters.

Galaxy group (Also group of galaxies GrG): A gravitationally bound aggregation of up to 50 galaxies, each at least as luminous as the Milky Way Galaxy. Larger aggregations may be called galaxy clusters, and galaxy groups and clusters can themselves cluster together to form superclusters.

Galilean moons: A collective name for the four moons of Jupiter discovered by Galileo Galilei in 1610: Io, Europa, Ganymede, and Callisto.

Gamma-ray astronomy: The subfield of astronomy that studies astronomical objects detectable at gamma-ray wavelengths.

Gamma-ray burst (GRB): A cataclysmic event that generates a brief but intense outburst of gamma ray radiation which can be detected from billions of light-years away. The source of most GRBs is theorized to be supernova or hypernova explosions of high-mass stars. Short GRBs may also result from the collision of neutron stars.

Gas giant: A giant planet composed mainly of hydrogen and helium gases rather than heavier elements, e.g. Jupiter and Saturn in the Solar System.

Geocenter: The geometric center of the Earth, i.e. the arithmetic mean position of all points within the oblate spheroid that is the precise shape of the Earth.

Geocentric: With reference to, or pertaining to, the geometric center of the Earth; centered upon the Earth, e.g. a geocentric orbit.

Geocentric zenith: The point projected upon the celestial sphere by a straight line that passes through the geocenter and an observer; i.e. the observer's zenith as defined with respect to the center of the Earth.^[14]

Geometric albedo: The ratio of the brightness of an astronomical body at a phase angle of zero to an idealized flat, fully reflecting, diffusively scattering (Lambertian) disk with the same cross-section. It is a measure of how much of the incoming illumination is being scattered back toward an observer and has a value between zero and one.

Geometric position: The position of an object (celestial or otherwise) with respect to the center of the Earth or to the position of an observer, i.e. as defined by a straight line between the center of the Earth (or the observer) and the object at a given time, without any corrections for light-time, aberration, etc.^[14]

Geostationary orbit (Also geosynchronous equatorial orbit GEO): A circular geosynchronous orbit, which maintains a constant altitude of 35,786 kilometres (22,236 mi) directly above Earth's equator in the same

direction as Earth's rotation such that, to an observer on Earth's surface, the orbiting object appears motionless, in a fixed position in the sky. Artificial satellites are often placed in geostationary orbit so that antennas on Earth do not have to rotate to track them.

Geosynchronous orbit (GSO): A synchronous orbit about the Earth, i.e. with an orbital period equal to Earth's rotational period, such that the orbiting object appears to return to exactly the same position in the sky after a period of one sidereal day. All geosynchronous orbits have a semi-major axis equal to 35,786 kilometres (22,236 mi); geostationary orbits are a special case of geosynchronous orbits.

Giant planet: Any very large or massive planet, including gas giants and ice giants.

Globular cluster: A tight, spherical conglomeration of many thousands of stars which are gravitationally bound to each other and which orbit a galactic core as a satellite. They differ from open clusters in having a much higher combined mass, with a typical lifespan extending for billions of years.

Gravitational collapse: **Gravitational collapse** is the contraction of an astronomical object due to the influence of its own gravity, which tends to draw matter inward toward the center of gravity.^[1] Gravitational collapse is a fundamental mechanism for structure formation in the universe. Over time an initial, relatively smooth distribution of matter, after sufficient accretion, may collapse to form pockets of higher density, such as stars or black holes. As a clandestine form of gravitational collapse, the gradual gravitational collapse of interstellar medium into clumps of molecular clouds and potential protostars, is the birth of a star. The compression caused by the collapse raises the temperature until thermonuclear fusion occurs at the center of the star, at which point the collapse gradually comes to a halt as the outward thermal pressure balances the gravitational forces. The star then exists in a state of dynamic equilibrium. During the star's evolution a star might collapse again and reach several new states of equilibrium.

Gravitational lens: Any very large distribution of mass, such as a galactic cluster, which can bend passing light from a distant source by a noticeable degree. The effect, known as gravitational lensing, can make background objects appear to an observer to take on a ring or arc shape.

Gravitational-wave astronomy: A branch of observational astronomy which analyzes minute distortions in the curvature of spacetime known as gravitational waves to collect observational data about astronomical objects and events such as neutron stars, black holes, supernovae, and the Big Bang.

Histogram: A plot of the number of pixels in an image at each brightness level. It's a useful tool for determining the optimum exposure time; the histogram of a properly exposed image generally peaks near the middle of the available brightness range and falls to zero before reaching either end.

H-II region: An ionized nebula powered by young, massive O-type stars. Ultraviolet photons from these hot stars ionize gas in the surrounding environment, and the nebular gas shines brightly in spectral lines of hydrogen and other elements. Because O-type stars have relatively short lifetimes (typically a few million years), the presence of an H II region indicates that massive star formation has taken place recently at that location. H II regions are often found in the arms of spiral galaxies and in star-forming irregular galaxies.

Heliocenter: The precise geometric center of the Earth's Sun, i.e. the arithmetic mean position of all points within the approximate spheroid that is the shape of the Sun.

Heliocentric: With reference to, or pertaining to, the geometric center of the Earth's Sun; centered upon the Sun, e.g. a heliocentric orbit.

Heliopause: The heliopause is the theoretical boundary where the Sun's solar wind is stopped by the interstellar medium; where the solar wind's strength is no longer great enough to push back the stellar winds of the surrounding stars. This is the boundary where the interstellar medium and solar wind pressures balance. The crossing of the heliopause should be signaled by a sharp drop in the temperature of solar wind-charged particles,^[30] a change in the direction of the magnetic field, and an increase in the number of galactic cosmic rays.

Heliosphere: The vast, bubble-like cavity in the interstellar medium which surrounds and is created by the plasma emanating from the Earth's Sun. The heliosphere encompasses the entirety of the Solar System and a vast region of space beyond it. Its outer limit is often considered the boundary between matter originating from the Sun and matter originating from the rest of the galaxy.

Hertzsprung–Russell diagram: A plot of luminosity versus effective temperature for a population of stars; depending on the usage, the star's absolute magnitude may be substituted for luminosity, and its color index or spectral type for temperature. Single stars of known mass and composition follow predictable tracks across this chart over the course of their evolution. Hence, knowing a star's mass and metallicity allows its age to be estimated. Stars of similar types are also found grouped together in specific regions of the chart, including main-sequence, red giant, and white dwarf stars.

Hill sphere (Also the Hill radius): The approximate region around an astronomical object within which its gravitational attraction dominates the motions of satellites. It is computed with respect to the next most gravitationally attractive object, such as the nearest star or the galactic core. Satellites moving outside this radius tend to be perturbed away from the main body.

Horizon: The apparent boundary between the surface of a celestial body and its sky when viewed from the perspective of an observer on or near that body's surface; more specifically, the plane perpendicular to a line from an observer to the zenith that passes through the point of observation.

Hour angle: For a given celestial object, the angular distance on the celestial sphere measured westward along the celestial equator from the observer's local meridian to the hour circle that passes through the celestial object;^[14] or, equivalently, the angle between the plane containing Earth's rotational axis and the zenith, and the plane containing Earth's rotational axis and the object of interest. Analogous to right ascension, the hour angle is one of many ways commonly used to specify the longitudinal position of an object upon the celestial sphere.

Hour circle: Any imaginary great circle drawn upon the celestial sphere that passes through both of the celestial poles and is therefore perpendicular to the celestial equator. Similar to a meridian but additionally taking into account the terrain and the depth to the geocenter at a ground observer's particular location, the concept of the hour circle is employed to describe the longitudinal position of a celestial object relative to the observer's local meridian.

Hybrid pulsator: This is a class of pulsating stars that display pulsation frequencies of two different classes of variables. An example is variables displaying characteristic frequencies of both Delta Scuti and Gamma Doradus variables. On the Hertzsprung–Russell diagram, these stars are positioned where the instability strips of both variable classes overlap.

Hydrogen burning limit: A critical mass below which an astronomical object cannot sustain its surface luminosity through nuclear fusion. This mass limit, equal to about 7% of the mass of the Sun, forms the dividing line between brown dwarfs and hydrogen-fusing stars.

Hypergalaxy: A system consisting of a large galaxy accompanied by multiple smaller satellite galaxies (often elliptical) as well as its galactic corona. The Milky Way and Andromeda systems are examples of hypergalaxies.

Inclination: The angle between the plane of an orbit and a reference plane. For example, NASA satellites typically have orbits inclined 28° to Earth's equator.

Ice-giant: A giant planet composed mainly of elements heavier than hydrogen or helium (such as oxygen, carbon, nitrogen, and sulfur), especially chemical volatiles with freezing points above 100 K (-173°C), e.g. Uranus and Neptune in the Solar System.

Inferior planet: An archaic term that is sometimes used to refer to the planets Mercury and Venus. The name originated from the fact that these planets orbit closer to the Sun than the Earth and hence, in the geocentric cosmology of Ptolemy, both appear to travel with the Sun across the sky. This is in contrast to the so-called superior planets, such as Mars, which appear to move independently of the Sun.

Infrared-astronomy: The subfield of astronomy that studies astronomical objects detectable at infrared wavelengths.

Interstellar medium (ISM): The matter that exists in the space between the stars in a galaxy. This medium mainly consists of hydrogen and helium, but is enhanced by traces of other elements contributed by matter expelled from stars.

Interstellar reddening: An effect produced by the incremental absorption and scattering of electromagnetic energy from interstellar matter, known as extinction. This effect causes more distant objects such as stars to appear redder and dimmer than expected. It is not to be confused with the separate phenomenon of redshift.

Invariable plane (Also Laplace's invariable plane or the Laplace plane): The imaginary plane passing through the barycenter of a planetary system and perpendicular to its angular momentum vector, and which may be regarded as the weighted average of all planetary orbital and rotational planes comprising the system.

Irregular galaxy: It is a galaxy that does not have a distinct regular shape, unlike a spiral or an elliptical galaxy. Irregular galaxies do not fall into any of the regular classes of the Hubble sequence, and they are often chaotic in appearance, with neither a nuclear bulge nor any trace of spiral arm structure. Collectively they are thought to make up about a quarter of all galaxies. Some irregular galaxies were once spiral or elliptical galaxies but were deformed by an uneven external gravitational force. Irregular galaxies may contain abundant amounts of gas and dust. This is not necessarily true for dwarf irregulars. Irregular galaxies are commonly small, about one tenth the mass of the Milky Way galaxy. Due to their small sizes, they are prone to environmental effects like colliding with large galaxies and intergalactic clouds.

Irregular moon: A natural satellite following a distant, inclined, and often eccentric and retrograde orbit about its primary. Irregular moons are thought to be captured from other orbits, as opposed to regular moons, which are thought to form in situ.

Isochrone: A curve on the Hertzsprung–Russell diagram that represents the evolutionary positions of stars having the same age but differing masses. This is in contrast to an evolutionary track, which is a plot of stars having the same mass but differing ages. In fact, multiple evolutionary tracks can be used to build isochrones by

putting curves through equal-age points along the tracks. When the mass of a star can be determined, an isochrone can be used to estimate the star's age.

Jeans instability: A physical state in which an interstellar cloud of gas will begin to undergo collapse and form stars. A cloud can become unstable against collapse when it cools sufficiently or has perturbations of density, allowing gravity to overcome the gas pressure.

Julian year: A unit of time defined as exactly 365.25 days of 86,400 SI seconds each. Because these are units of constant duration, the Julian year is also constant and does not vary with a specific calendar or with any of the other means of determining the length of a year, such as the tropical year. It is therefore widely used as the basis for defining the standard astronomical epoch and the light-year.

Kelvin–Helmholtz mechanism: The Kelvin–Helmholtz mechanism is an astronomical process that occurs when the surface of a star or a planet cools. The cooling causes the internal pressure to drop, and the star or planet shrinks as a result. This compression, in turn, heats the core of the star/planet. This mechanism is evident on Jupiter and Saturn and on brown dwarfs whose central temperatures are not high enough to undergo hydrogen fusion. It is estimated that Jupiter radiates more energy through this mechanism than it receives from the Sun, but Saturn might not. Jupiter has been estimated to shrink at a rate of approximately 1 mm/year by this process, corresponding to an internal flux of 7.485 W/m^2 .

Kepler orbit (Also Keplerian orbit): The motion of one orbiting body relative to another, as an ellipse, parabola, or hyperbola, which forms a two-dimensional orbital plane (or sometimes a straight line) in three-dimensional space. Kepler orbits are idealized mathematical constructions which consider only the point-like gravitational attraction of two bodies, neglecting more complex orbital perturbations that may exist in reality.

Kuiper belt (Also Edgeworth–Kuiper belt): A circumstellar disc of small Solar System bodies such as asteroids, trojans, and centaurs in the outer Solar System, extending between 30 and 50 AU from the Sun. It is similar to the asteroid belt but far larger, and is home to several dwarf planets, including Pluto.

Lagrangian point (Also Lagrange point, libration point, or L-point): Any of a set of points near two large bodies in orbit at which a smaller object will maintain a constant position relative to the larger bodies. At other locations, a small object would eventually be pulled into its own orbit around one of the large bodies, but at the Lagrangian points the gravitational forces of the large bodies, the centripetal force of orbital motion, and (in certain scenarios) the Coriolis acceleration all align in a way that causes the small object to become "locked" in a stable or nearly stable relative position. For each combination of two orbital bodies, there are five such Lagrangian points, typically identified with the labels L_1 to L_5 . The phenomenon is the basis for the stable orbits of trojan satellites and is commonly exploited by man-made satellites.

Laniakea Supercluster is the galaxy super cluster that is home to the Milky Way and approximately 100,000 other nearby galaxies.

Late-type star: A star with a surface temperature cooler than the Sun, with a spectral type K, M, C, or S; G stars are often included as well. Late-type stars can be either of low mass, if they are on the main sequence, or more massive than the Sun if they are giants or supergiants. The designation 'late' derives from the time when it was wrongly thought that stars with K or M spectra were old and evolved.

Libration: A slight tipping and tilting (oscillating) of the Moon as seen from the earth from week to week that brings various features along the limb into better view. Also, the normally hidden portions of the Moon's far

side are sometimes visible along the limbs of the lunar disc. The main causes are two aspects of the Moon's orbit: its elliptical shape and inclination to the ecliptic.

Light-year (ly): A unit of length used to express astronomical distances that is equivalent to the distance that an object moving at the speed of light in vacuum would travel in one Julian year: approximately 9.46 trillion kilometres (9.46×10^{12} km) or 5.88 trillion miles (5.88×10^{12} mi). Though the light-year is often used to measure galactic-scale distances in non-specialist publications, the unit of length most commonly used in professional astrometry is the parsec.

Limb darkening: An optical effect seen in stars (including the Sun), where the center part of the disk appears brighter than the edge or *limb* of the image.

Line of apsides: The imaginary line connecting the two apsides (the periapsis and the apoapsis) of an elliptical orbit, and which therefore represents the distance of the orbit's longest axis.

Longitude of the ascending node (Ω or Ω): The angle between a specified reference direction, called the origin of longitude, and the direction of an orbit's ascending node, as measured on a specified plane of reference. The angle is typically measured eastwards from the reference direction to the ascending node (i.e. counterclockwise as seen from the north). It is one of six canonical orbital elements used to characterize an orbit.

Luminosity: The total amount of energy emitted per unit time by a star, galaxy, or other astronomical object. In SI units, luminosity is measured in joules per second or watts, and is often given in terms of astronomical magnitude. Luminosity is related to but distinct from visual brightness.

Lunar: Of or relating to the Earth's Moon.

Lunar phase (Also Moon phase): The shape of the portion of the Moon that is illuminated by direct sunlight as viewed from Earth. This shape is referred to as a phase because it gradually changes in a regular cycle over the course of a synodic month: as the orbital positions of the Moon around Earth and Earth around the Sun change, the visibility of the side of the Moon that constantly faces Earth alternates between completely illuminated (known as a full moon) and completely darkened by the Moon's own shadow (known as a new moon). There are also intermediate phases, during which the visible side may be only partially sunlit, e.g. when the Moon appears as a crescent. During the part of the lunar cycle in which the illuminated portion is growing larger, the Moon is said to be waxing; when the illuminated portion is becoming smaller, it is said to be waning. The phase of the Moon at any particular time appears the same from every point on Earth.

Light Pollution: A glow in the night sky or around your observing site caused by artificial light. It greatly reduces how many stars you can see. Special light-pollution filters can be used with your telescope to improve the visibility of celestial objects.

Massive compact halo object (MACHO): A kind of astronomical body that might explain the apparent presence of dark matter in galaxy halos. A MACHO is a body that emits little or no radiation and drifts through interstellar space unassociated with any planetary system. Examples of MACHOs include black holes or neutron stars as well as brown dwarfs and rogue planets.

Magnetosphere: A mostly convex region formed when a plasma, such as the solar wind, interacts with the magnetic field of a body, such as a planet or star.

Magnitude: A numerical logarithmic scale indicating the brightness of an astronomical object, where the lower the value, the brighter the object. By convention, a first magnitude star is 100 times as bright as a sixth magnitude star. Magnitude 6 is considered the lower limit of objects that can be seen with the naked eye, although this can vary depending on sky conditions and eyesight.

Main sequence: A category of stars which form a continuous and distinctive band on plots of stellar temperature versus luminosity, in particular the Hertzsprung–Russell diagram. These stars are characterized by being in hydrostatic equilibrium and undergoing nuclear fusion of Hydrogen-1 in their core region. The Sun is a main-sequence star..

March equinox: (Also the **Northward equinox**): The precise time of year on Earth when the Sun appears to cross the celestial equator, while generally trending northward at each zenith passage. It represents the moment at which the North Pole of the Earth begins to tilt toward the Sun, and typically occurs on or near March 20 each year. It is the *vernal equinox* in the Northern Hemisphere and the *autumnal equinox* in the Southern Hemisphere. Contrast is the *September equinox*.

Mean anomaly (M): The fraction of an elliptical orbit's period that has elapsed since the orbiting body passed periapsis, expressed as the angular distance from the pericenter which a fictitious body would have if it moved in a perfectly circular orbit in the same orbital period as the actual body in its elliptical orbit. Unlike the true anomaly, the mean anomaly does not correspond to a real geometric angle but is instead a contrived parameter used to make calculating the position of the orbiting body in the two-body problem mathematically convenient.

Meridian: A line running north–south across the sky and passing through the point directly overhead known as the zenith.

Meridian astronomy: The measurement of positions of celestial objects based on observation of the times of their transit across the meridian and of their zenith distance at those times, with the intention of obtaining accurate star positions which are self-consistent over large areas of sky.

Messier objects: One of a set of 110 "nebulous" astronomical objects, 103 of which were catalogued as non-comets by French comet hunter Charles Messier between 1771 and 1781. The Messier catalogue includes most of the deep-sky objects easily visible from the Northern Hemisphere.

Meteor (Also **shooting star** or **falling star**): The visible passage of a glowing meteoroid, micrometeoroid, comet, or asteroid through the Earth's atmosphere, usually as a long streak of light produced when such an object is heated to incandescence by collisions with air molecules in the upper atmosphere, leaving an ionization trail as a result of its rapid motion and sometimes also shedding material in its wake.

Meteorite: A solid piece of debris from a meteor that originated in outer space and survived its passage through the atmosphere to reach the surface of a planet or moon.

Meteoroid: A small rock or boulder that has entered a planetary atmosphere. If it survives to reach the surface, it is then termed a meteorite.

Meteor shower: A series of meteors that seemingly radiate from a single area in the night sky. These are produced by debris left over from a larger body, such as a comet, and hence they follow roughly the same orbit. This makes many meteor showers predictable events, as they recur every year.

Metallicity: A measure of the abundance of elements other than hydrogen and helium within an astronomical object. Note that this definition includes elements that are not traditionally considered metallic by chemical convention.

Micrometeorite: A very small meteorite that has survived its passage through the atmosphere to reach the surface of a planet or moon, usually ranging in size from 50 μm to 2 mm. Micrometeorites are a major component of cosmic dust.

Micrometeoroid: A very small meteoroid, usually weighing less than one gram. If it survives to reach a planetary surface, it is then termed a micrometeorite.

Microvariable: A stellar object such as a variable star that undergoes very small variations in luminosity, in which the amplitude of the fluctuations amounts to just a few thousandths of a magnitude. Detecting microvariability typically requires a sufficient number of observations to rule out random error as a source.

Milky Way: The barred spiral galaxy that includes the Earth's Solar System. The name describes the galaxy's appearance from the Earth: a hazy band of light visible in the night sky which from Earth appears as a band because the galaxy's disk-shaped structure is viewed side-on from within. It is formed from billions of stars that cannot be individually distinguished by the naked eye. The Milky Way Galaxy has a diameter of 100,000–200,000 light-years and is estimated to contain 100–400 billion stars and at least that number of planets. The Solar System is located on the inner edge of one of the Milky Way's spiral arms, about 27,000 light-years from the Galactic Center, which the Sun orbits with a period of 240 million years. The bright center of the Milky Way Galaxy is visible in dark skies on clear nights, in the direction of the constellation Sagittarius.

Minor planet: An object in direct orbit around the Sun that is neither a dominant planet nor originally classified as a comet. A moon is not a minor planet because it orbits another body instead of the Sun.

Minor-planet moon: A natural satellite that orbits a minor planet. Also known as moonlet and *subsatellite*.

Molecular cloud: An interstellar cloud in which the prevailing physical conditions allow molecules to form, including molecular hydrogen.

Moment of inertia factor (*Also normalized polar moment of inertia*): A dimensionless quantity that characterizes the radial distribution of mass inside a planet or moon.

Moon: The solid, rocky body that orbits the Earth as its only natural satellite, completing a full orbit every 27.3 days. The Moon's gravitational influence is responsible for tides on Earth; because of tidal locking, only one side of the Moon is ever visible from the Earth. Sunlight reflected from its surface makes the Moon appear very bright in the night sky, though its orbital position with respect to the Earth and the Sun causes its visibility to change in a regular cycle of phases when viewed from the Earth. The adjectival *lunar* is often used specifically to describe the orbit, gravity, and other properties of the Earth's Moon.

Moonlet (*Also minor moon or minor natural satellite*): An especially small natural satellite orbiting a planet, dwarf planet, or other minor planet.

Morning width (Also rise width): The horizontal angular distance between the rise azimuth of a celestial body and the east direction.

Moving group (Also stellar association): A loose grouping of stars which travel together through space. Although the members were formed together in the same molecular cloud, they have since moved too far apart to be gravitationally bound as a cluster.

Multi-messenger astronomy: A type of astronomy based on the acquisition of information about astronomical objects through the coordinated observation and interpretation of four disparate classes of "messenger" signals with extrasolar origins: electromagnetic radiation, gravitational waves, neutrinos, and cosmic rays. Because these four extrasolar messengers are created by different astrophysical processes, their presence or absence during a celestial event can reveal useful information about their sources.

N galaxy: An early classification for active galaxies that had the visual appearance of a galaxy with a particularly bright, star-like nucleus. As a group, they are intermediate between Seyfert galaxies and Quasar. Most are giant ellipticals that are radio sources and display prominent emission lines.

Nadir: The point on the celestial sphere exactly opposite from the zenith. Thus, where the zenith is directly above an observer, the nadir is underfoot. The zenith and nadir form the two poles of the horizon line.

Naked eye (Also bare eye or unaided eye): The human eye as used without any magnifying or light-collecting optical aid, such as a telescope, nor any eye protection. Many astronomical objects emit or reflect visible light that is sufficiently bright to fall within the limits of normal human visual perception, allowing observers to see them from the Earth's surface without any special equipment. Vision corrected to normal acuity using eyeglasses or contact lenses is still considered unaided.

Natural satellite (Also moon): Any astronomical body that orbits a planet, minor planet, or sometimes another small Solar System body.

Near-Earth object (NEO): Any small Solar System body, such as an asteroid or comet, whose orbit brings it into proximity with Earth, generally by being less than 1.3 AU from the Sun at its closest approach.

Nebula: Any astronomical object of indistinct nebulosity. In modern usage, the term typically refers to an interstellar cloud of dust, hydrogen, helium, and other ionized gases. Historically, it was also used to refer to extended sources of luminosity that could not be resolved into their individual components, such as star clusters and galaxies.

Neutrino: A type of elementary particle, electrically neutral and with an extremely small rest mass, that interacts with other particles only via the weak interaction and the gravitational interaction. Neutrinos therefore typically pass through normal matter unimpeded and undetected.

Neutron star: A type of compact star that is composed almost entirely of neutrons, which are a type of subatomic particle with no electrical charge. Typically, neutron stars have a mass between about 1.35 and 2.0 times the mass of the Sun, but with a radius of only 12 km (7.5 mi), making them among the densest known objects in the universe.

New General Catalogue (NGC): An astronomical catalog of deep sky objects (galaxies, emission nebulae and star clusters) compiled by John Louis in 1888. It contained 7840 objects, and two supplements were added in 1895 and 1908, with further 5386 astronomical objects. The NGC or IC number of these is in best use till date.

Night Sky: The appearance of the Earth's sky at nighttime, when the Sun is below the horizon, and more specifically when clear weather and low levels of ambient light permit visibility of celestial objects such as stars, planets, and the Moon. The night sky remains a fundamental setting for both amateur and professional observational astronomy.

Non-inclined orbit: Any orbit that is coplanar with a specified plane of reference, such that the orbital inclination is 0 degrees for prograde orbits and 180 degrees for retrograde ones.

Nuclear star cluster (NSC): A compact and dense concentration of stars located at the center of a galaxy.

Number density: The quantity of some specified particle or object class per unit volume. For atoms, molecules, or subatomic particles, the volume is typically in cm^3 or m^3 . With stars, cubic parsecs (pc^3) are often used.

Nutation: A continuous, gravity-induced change in the orientation of an astronomical body's axis of rotation which results from the combined effects of small, short-term variations. Nutation is distinguished from precession, which is a similar but longer-term change in axial orientation.

O–C diagram: A diagram of observed minus calculated values over time, showing how observed data differ from theoretical values which have been calculated according to a particular scientific model. It is often used as a diagnostic tool to determine the accuracy of the model. With a variable star, it is typically used to compare phase differences over time.

OB association: A group of massive stars which are not gravitationally bound to each other, but move together through space in a loose association. The OB in the name is a reference to stars of stellar classifications O and B.

Observation arc (Also arc length): The duration of time between the earliest and latest observations made by astronomers of an object within the Solar System, which defines the length of the path traced by the object between these same observations. The term is primarily used in the discovery and tracking of asteroids and comets, which can be difficult to continuously track because of their size and great distance from Earth. Very short observation arcs, e.g. where the time between the initial observation and the most recent observation is less than 30 days, are of limited descriptive power because they represent only a very small fraction of the total path traced by the object in its orbit around the Sun (or other primary), and therefore result in a high degree of uncertainty when estimating the shape and characteristics of the object's orbit.

Observational astronomy: The practice and study of directly observing astronomical objects with the use of telescopes and other astronomical instruments. It is concerned with recording data about the observable universe, as opposed to theoretical astronomy, which is concerned with calculating the measurable implications of astronomical models.

Occultation: A celestial event that occurs when a distant astronomical body or object is hidden by another, nearer body or object that passes between it and the observer, thereby blocking the first object from view. Solar and lunar eclipses are specific types of occultations.

Oort cloud (Öpik–Oort cloud): A vast theoretical cloud of predominantly icy planetesimals hypothesized to surround the Sun at distances ranging from 2,000 to 200,000 AU. It is thought to be divided into two regions: a disc-shaped inner Oort cloud and a spherical outer Oort cloud. The outer limit of the Oort cloud is often considered the cosmographical boundary of the Solar System.

Opacity: A measure of the resistance of a medium to the radiative transmission of energy. Within a star, it is an important factor in determining whether convection occurs.

Open cluster: A gravitationally bound group of up to one thousand stars that formed together in the same molecular cloud.

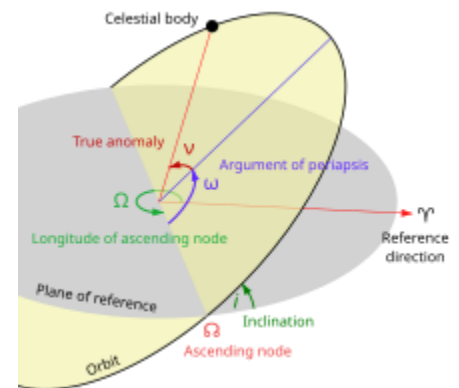
Opposition: The positioning of two celestial objects on opposite sides of the sky, from the perspective of an observer. This occurs, for example, when a planet makes its closest approach to the Earth, placing it in opposition to the Sun.

Orbit: The gravitationally curved trajectory of an object, such as the trajectory of a planet around a star or a natural satellite around a planet. Though the smaller body is often said to orbit the larger body itself, both bodies actually follow approximately elliptical orbits around a common center of mass positioned at a focal point of each ellipse. The word "orbit" can variously refer to the elliptical trajectory itself or the act of following this trajectory and can refer to a stable, regularly repeating trajectory as well as a non-repeating trajectory.

Orbit plot or orbital plot: A schematic diagram of a complete orbit. For a binary system, it is typically presented from the primary's frame of reference.

Orbital eccentricity: A parameter that determines how much an orbit deviates from a perfect circle. For an elliptical orbit, the eccentricity ranges from greater than zero to less than one.

Orbital elements: The set of parameters that uniquely define an orbit. The diagram showing four of the six canonical **orbital elements**. The orbital plane (yellow) intersects a reference plane (grey).



Orbital inclination: The tilt of an object's orbit around an astronomical body, expressed as the angle between the orbital plane or axis of direction of the orbiting object and a plane of reference.

Orbital node: One of two points at which the plane of an orbit intersects a specified plane of reference to which it is inclined; in some contexts, the two nodes may be distinguished as the ascending node and the descending node. A non-inclined orbit, which is coplanar with the reference plane, has no nodes.

Orbital period (Also revolution period): The time a given astronomical object takes to complete one orbit around another object. For objects in the Solar System, the orbital period is often referred to as the sidereal period.

Orbital plane: The imaginary geometric plane defined by the orbit of an astronomical body around its primary. The Earth's orbital plane, which defines the ecliptic, is commonly used as a plane of reference for the orbits of other objects in the Solar System.

Orbital resonance: The situation that occurs when two or more orbiting bodies exert regular, periodic gravitational influences on each other such that one or more of their orbital parameters (e.g. eccentricity, semi-major axis, inclination, etc., or any combination thereof) exist in some definite mathematical relationship with each other. Most commonly, the term refers to *mean-motion orbital resonance*, in which the bodies' orbital periods are related by a ratio of small integers. For example, the dwarf planet Pluto exists in a stable 2:3 resonance with Neptune, such that Pluto completes two orbits around the Sun in the same time it takes Neptune to complete three. Resonance may act on any time scale, from short-term to secular, and often leads to either long-term stabilization of the orbits or their eventual destabilization.

Orbital speed: The speed at which an astronomical body or object orbits around a barycenter, or its speed relative to the center of mass of the most massive body in the system. The term may be used to refer to either the mean orbital speed, i.e. the average speed over the entire orbital period, or the instantaneous speed at a particular point in the orbit. Maximum instantaneous orbital speed typically occurs at periapsis.

Osculating orbit: The hypothetical, idealized Keplerian orbit that an orbiting object would follow around its primary if all perturbations were absent, i.e. the orbit that coincides with the instantaneous orbital state vectors at a given moment in time.

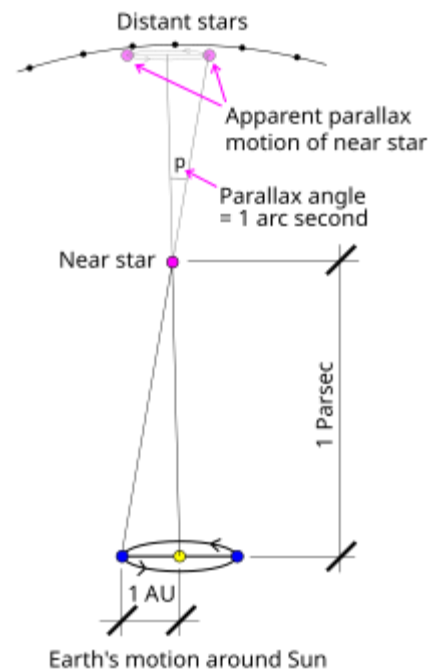
Outer space: The vast, nearly empty expanse that exists beyond the Earth and between all celestial bodies, characterized generally by extremely low densities of particles, extremely low temperatures, and minimal gravity. Most of the volume of the Universe is intergalactic space, and even galaxies and star systems consist almost entirely of empty space.

The **parallax** shift of a star at a distance of one parsec as seen from the Earth (not to scale). The **Parsec (pc)** is a unit of length defined as the distance at which a star would show a parallax shift of exactly one arc second as observed from Earth's orbit. It is equal to 3.2616 light-years or 206,265 astronomical units. The word "parsec" is a mixture of the words *parallax* and *second*.

Peak magnitude: For a variable star, this is the highest amplitude achieved during a rise in luminosity, followed by a decline. This data point can provide useful distance information for a cataclysmic variable. It can be determined from a light curve of the stellar variability.

Perturbation: The complex motion of an astronomical body that is subject to forces other than the gravitational attraction of its primary alone, or any force which complicates the orbital characteristics of the body such that the idealized Kepler orbit of the two-body problem is not an accurate representation of the body's actual orbit. Perturbing forces may include the gravitational forces exerted by any number of additional bodies, the off-center gravitational forces which are consequences of bodies not being perfectly spherical, and/or atmospheric resistance.

Phase angle: The elongation or angle between an orbiting body and the Sun as viewed from a particular perspective, such as the Earth. It determines the amount of a planet or moon's visible surface that lies in shadow. Inferior planets such as Venus generally have low phase angles as seen from Earth, so they often



appear as a slim crescent; superior planets such as Mars and Jupiter usually have high phase angles, so that little of the shadowed side is visible.

Plane of reference (Also reference plane): An arbitrarily chosen, imaginary plane from which to measure and define orbital elements such as inclination and longitude of the ascending node. The ecliptic plane, invariable plane, and equatorial plane are all commonly used as reference planes in various contexts.

Plane of the sky: An imaginary plane that is perpendicular to the line of sight. Typically this is used as a reference plane for the inclination of an orbital plane of a distant star system.

Planet: A type of astronomical body orbiting the Sun, which is massive enough to be rounded by its own gravity (but not massive enough to achieve thermonuclear fusion) and has cleared its neighbouring region of all planetesimals. The term *exoplanet* is used in reference to a planet-like object that is not orbiting the Sun.

Planetary body or Object: Any secondary body that is geologically differentiated or in hydrostatic equilibrium and therefore has a planet-like geology, such as a planet, dwarf planet, or other planetary-mass object, but excluding smaller objects such as planetesimals.

Planetary differentiation: The process of separating out different constituents of a planetary body, causing it to develop compositionally distinct layers (such as a metallic core).

Planetary nebula: A type of emission nebula formed from a glowing shell of expanding plasma that has been ejected from a red giant star late in its life. The name derives from their resemblance to a planet. An example is the Ring Nebula.

Planetary science (Also sometimes called planetology): The scientific study of planets, moons, and planetary systems, with the aim of understanding their formation, composition, topography, dynamics, and interactions with other bodies.

Planetary system: Any set of gravitationally bound non-stellar objects in or out of orbit around a star or star system. In general, planetary systems include one or more planets, though such systems may also consist of dwarf planets, moons, asteroids, meteoroids, planetesimals, and debris discs, among other objects.

Planetesimal: Any solid object (generally larger than 1 kilometre (0.62 mi) in diameter) that arises during the formation of a planet whose internal strength is dominated by self-gravity and whose orbital dynamics are not significantly affected by gas drag. The term is most commonly applied to small bodies thought to exist in protoplanetary disks and debris disks during the process of planet formation, but is also sometimes used to refer to various types of small Solar System bodies which are left over from the formation process. There is no precise distinction between a planetesimal and a protoplanet.

Planetoid: Another name for a minor planet or dwarf planet.

Polar orbit: An orbit in which the orbiting object passes directly over or nearly over both poles of the body being orbited during each revolution. It therefore has an inclination equal or nearly equal to 90 degrees to the body's equator.

Precession: Any slow change in the orientation of an object's axis of rotation. For the Earth in particular, this phenomenon is referred to as the precession of the equinoxes. *Apsidal precession* refers to a steady change in

the orientation of an orbit, such as the precession in the orbit of Mercury that was explained by the theory of general relativity.

Primary (Also **gravitational primary**, **primary body**, or **central body**): The main physical body of a gravitationally bound, multi-object system. The primary constitutes most of the system's mass and is generally located near the system's barycenter.

Prograde motion (Also **direct motion**): Orbital or rotational motion of an object in the same direction as the rotation of the object's primary. The direction of rotation is determined by an inertial frame of reference such as the fixed stars. Contrast *retrograde motion*.

Projected separation: The observed physical separation between two astronomical objects, as determined from their angular separation and estimated distance. For planets and double stars, this distance is usually given in astronomical units. The actual separation of the two objects depends on the angle of the line between the two objects to the line-of-sight of the observer.

Proper motion: The rate of angular motion of an object over an interval of time, usually years. For stars, this is typically given in milli-arcseconds per year.

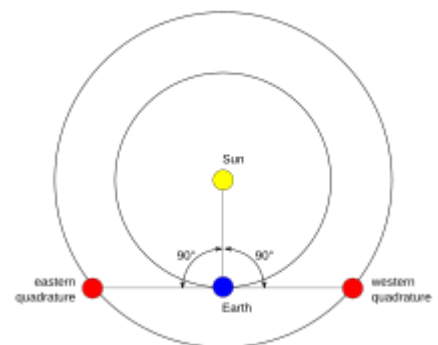
Protoplanet: A large planetary embryo that originated within a protoplanetary disk and has since undergone internal melting to produce an interior of non-uniform composition. Protoplanets represent an intermediate step in the formation of a full-sized planet; they are thought to form out of smaller planetesimals as they collide with each other and gradually coalesce into larger bodies.

Protostar: A concentration of mass formed out of the contraction of a collapsing interstellar cloud. Once sufficient mass has fallen onto this central core, it becomes a pre-main-sequence star.

Pulsar: A highly magnetized rotating neutron star or white dwarf that emits a beam of electromagnetic radiation. This beam is observed only when it is pointing toward Earth, making the object appear to pulse.

Quadratic field strength: A method of computing the mean strength of a varying stellar magnetic field. It is determined by calculating the root mean square of a series of longitudinal magnetic field strength measurements taken at different times.

Quadrature: A configuration in which two celestial bodies have apparent ecliptic longitudes that differ by 90 degrees as viewed from a third body, e.g. when a planet's elongation is perpendicular to the direction of the Sun as viewed from the Earth. The term is used especially to describe the position of a superior planet or the Moon at its first and last quarter phases. A moon or planet is said to be in **quadrature** when its position as viewed from Earth is at a right angle to the direction of the Sun. In such cases the moon or planet appears to be in its quarter phase (or nearly so), where half of the body is illuminated by the Sun and the other half is in shadow.



Quasar (Also **quasi-stellar radio source**): A distant, point-like energy source originating from a powerful active galactic nucleus. Its luminosity is generated by the accretion of gas onto a supermassive black hole. Quasars emit radiation across the electromagnetic spectrum from radio waves to X-rays, and their ultraviolet and optical spectra are characterized by strong, broad emission lines.

Radial velocity: The velocity of an object along the line of sight to the observer, which in astronomy is usually determined via Doppler spectroscopy. Positive values are used to indicate a receding object. An object such as a star can undergo changes in its radial velocity because of the gravitational perturbation of another body, or because of radial pulsations of its surface. The latter, for example, occurs with a Beta Cepheid variable star.

Radio astronomy: The subfield of astronomy that studies astronomical objects at radio frequencies, using large radio antennas known as radio telescopes.

Radio source: Any astronomical object that emits strong radio waves into space. These objects are the basis for radio astronomy.

Red-giant branch: A conspicuous trail of enlarged red stars found on the Hertzsprung–Russell diagram for a typical globular cluster. It begins at the main-sequence turnoff point and extends toward the higher luminosity and lower temperature range until reaching the red-giant tip. This branch consists of older stars that have evolved away from the main sequence but have not yet initiated helium fusion in their core region.

Regular moon: A natural satellite following a relatively close and prograde orbit with little or no orbital inclination or orbital eccentricity. Regular moons are thought to form *in situ* about their primary, as opposed to irregular moons, which are thought to be captured.

Relativistic jet: Relativistic jets are beams of ionised matter accelerated close to the speed of light. Most have been observationally associated with central black holes of some active galaxies, radio galaxies or quasars, and also by galactic stellar black holes, neutron stars or pulsars. Beam lengths may extend between several thousand, hundreds of thousands or millions of parsecs. Jet velocities when approaching the speed of light show significant effects of the special theory of relativity; for example, relativistic beaming that changes the apparent beam brightness.

Réseau: A grid of fine lines or crosshatches engraved upon a transparent glass plate, which when placed in front of film during a photographic exposure produces a corresponding grid in the resulting photograph by creating permanent shadows on the film negative. These grids are used in some photographic telescopes to produce reference markers in photographs of distant stars, allowing precise and convenient measurement of astrometric positions.

Retrograde motion: Orbital or rotational motion of an object in the direction opposite the rotation of the object's primary. The direction of rotation is determined by an inertial frame of reference such as the fixed stars. Contrast *prograde motion*. In a retrograde orbit, a satellite orbits in the direction opposite the rotation of its primary.

Right ascension: In the equatorial coordinate system, the celestial equivalent of terrestrial longitude. It divides the celestial equator into 24 hours, each of 60 minutes.

Ring system: A disk- or ring-shaped accumulation of various solid materials such as dust and moonlets that orbits an astronomical body such as a planet. Ring systems are common components of satellite systems around giant planets, as with the Rings of Saturn.

Roche limit: The distance from an astronomical object at which the tidal force matches an orbiting body's gravitational self-attraction. Inside this limit, the tidal forces will cause the orbiting body to disintegrate, usually to disperse and form a ring. Outside this limit, loose material will tend to coalesce.

Rogue planet (Also **interstellar planet**, **nomad planet**, **orphan planet**, and **starless planet**): Any planetary-mass object that orbits a galactic center directly rather than a star or substellar object. Such objects have often been ejected from the planetary system in which they formed, or otherwise have never been gravitationally bound to any star system.

Rosseland optical depth: An extinction coefficient of an atmosphere, which describes the net opacity to radiation at a given depth.

Rotation period: The time that an object takes to complete a single revolution about its own axis of rotation relative to the background stars. It is not necessarily the same as the object's synodic day or sidereal day.

Rotational modulation: A phenomenon which causes the luminosity of a star to vary as rotation carries star spots or other localized activity across the line of sight. Examples include RS CVn and BY Dra variables.

Saber's beads: A broken arc of illuminations seen at the limb of very young or very old lunar crescents. The visual similarity to the moments before and after a total solar eclipse was first noted by American astronomer Stephen Saber.

Satellite galaxy: A smaller companion galaxy that orbits within the gravitational potential of a more massive and luminous host galaxy; e.g. the Large Magellanic Cloud is a satellite galaxy of the Milky Way.

Scattered disc: It is a distant circumstellar disc in the Solar System that is sparsely populated by icy small Solar System bodies, which are a subset of the broader family of trans-Neptunian objects. The scattered-disc objects (SDOs) have orbital eccentricities ranging as high as 0.8, inclinations as high as 40° , and perihelia greater than 30 AU. These extreme orbits are thought to be the result of gravitational "scattering" by the gas giants, and the objects continue to be subject to perturbation by the planet Neptune

Scintillation (Also **twinkling**): Rapid variations in the apparent brightness, color, or position of a star (or any other distant luminous object) as viewed through a medium, such as the Earth's atmosphere, caused by the passing of light through layers of turbulence in the medium. Most terrestrial scintillation effects are the result of atmospheric refraction caused by small-scale fluctuations in air density, and is much more pronounced near the horizon, since light rays near the horizon must travel longer paths through the atmosphere before reaching the observer.

Secular: Continuing, or changing in a non-periodic way, over a long period of time.

Secular motion: Any change in movement that happens over a very long time period. Examples include the perihelion precession of Mercury, the tidal acceleration of the Earth–Moon system, and precession of the Earth's axis.

Selenocentric: With reference to, or pertaining to, the geometric center of the Earth's Moon.

Semi-diameter: The angle at the position of an observer subtended by the equatorial radius of the Sun, the Moon, or a planet.

Semi-major axis: One half of the longest diameter (the major axis) of an ellipse. It is expressed in units of length and often used to give a physical dimension to a two-body elliptical Kepler orbit, such as for a binary

star system or star–planet system. When the distance between the orbiting bodies is unknown, the semi-major axis may be given as an angle.

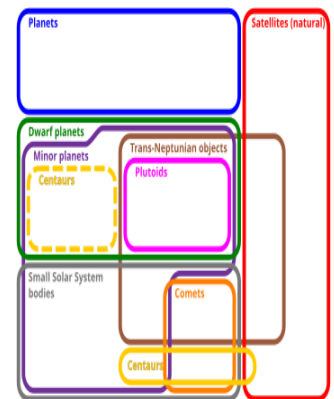
September equinox (Also **southward equinox**): The precise time of year on Earth when the Sun appears to cross the celestial equator, while generally trending southward at each zenith passage. It represents the moment at which the North Pole of the Earth begins to tilt away from the Sun, and typically occurs on or near September 22 each year. It is the *autumnal equinox* in the Northern Hemisphere and the *vernal equinox* in the Southern Hemisphere. Contrast *March equinox*.

Sidereal day: The rotation period of an object (e.g. the Earth) with respect to the distant fixed stars of its own celestial sphere (rather than to its primary star, e.g. the Sun), measured as the time it takes for the fixed stars, as viewed from a particular point on the object's surface, to return to the same position in the sky on consecutive nights. The Earth's sidereal day is equal to approximately 86,164.09 seconds (23 hours, 56 minutes, 4.09 seconds), about four minutes shorter than the solar day, which instead reckons time based on the Sun's position in the sky.

Sidereal period: The orbital period of an object within the Solar System, e.g. the Earth's orbital period around the Sun. The name "sidereal" implies that the object returns to the same position relative to the fixed stars of the celestial sphere as observed from the Earth.

Sidereal time: The calculation of the passage of time based on the diurnal motion of the fixed stars in the Earth's sky. The fundamental unit of sidereal time is the sidereal day, i.e. the time interval between two successive returns of the fixed stars to the local meridian, as viewed from a given location on the Earth's surface.

Small Solar System body (SSSB): This is an object in the Solar System that is neither a planet or a dwarf planet, nor a natural satellite. The term was first defined in 2006 by the International Astronomical Union (IAU) as follows: "All other objects, except satellites, orbiting the Sun shall be referred to collectively as 'Small Solar System Bodies'. This encompasses all comets and all minor planets other than those that are dwarf planets. Thus SSSBs are: the comets; the classical asteroids, with the exception of the dwarf planet Ceres; the Trojans; and the centaurs and trans-Neptunian objects, with the exception of the dwarf planets Pluto, Haumea, Makemake, Quaoar, Orcus, Sedna, Gonggong and Eris and others that may turn out to be dwarf planets.



Solar day: A synodic day on Earth, i.e. the rotation period of the Earth with respect to the Sun, measured as the time it takes for the Sun, as viewed from a particular point on the Earth's surface, to return to the same position in the sky (e.g. to cross the same meridian) on consecutive days. Because the Earth's orbit around the Sun affects the angle at which the Sun is seen from the Earth, the Sun appears to take slightly longer to return to the same position than do the fixed stars, which results in the solar day being on average about four minutes longer than the sidereal day. The length of the solar day is also not constant, but rather changes over the course of the year because the Earth's orbit is not perfectly circular and because its rotational axis is not perpendicular to its orbital plane. One *mean* solar day (averaged over the Earth's orbital period) is currently equal to 86,400 seconds, or exactly 24 hours.

Solar eclipse: An occultation of the Sun by the Earth's Moon, in which a portion of the Earth passes through the shadow cast by the Moon, temporarily blocking sunlight, fully or partially, from reaching that portion of the Earth's surface. A solar eclipse occurs when the Moon is precisely aligned between the Sun and the Earth.

Because all three bodies are continuously moving, the shadow of the Moon traces out a narrow path across the Earth's surface, and from any given location within or very close to this path, the eclipse is visible only for a short duration. Depending on the observer's location and on the apparent sizes of the solar and lunar disks in the sky, an eclipse may appear to be total, partial, or annular.

Solar facula: They are bright spots in the photosphere of the Sun that form in the canyons between solar granules. They are produced by concentrations of magnetic field lines. The Sun's faculae are most readily observed near the solar limb. Faculae occur on other stars also.

Solar flare: It is a relatively intense, localized emission of electromagnetic radiation in the Sun's atmosphere. Flares occur in active regions and are often, but not always, accompanied by coronal mass ejections, solar particle events, and other eruptive solar phenomena. The occurrence of solar flares varies with the 11-year solar cycle. Solar flares are thought to occur when stored magnetic energy in the Sun's atmosphere accelerates charged particles in the surrounding plasma. This results in the emission of electromagnetic radiation across the electromagnetic spectrum.

Solar granule: In solar physics and observation, granules are convection cells in the Sun's photosphere. They are caused by currents of plasma in the Sun's convective zone, directly below the photosphere. The grainy appearance of the photosphere is produced by the tops of these convective cells; this pattern is referred to as granulation. The rising part of each granule is located in the center, where the plasma is hotter. The outer edges of the granules are darker due to cooler descending plasma

Solar Mass: A standard unit of mass equal to the mass of the Earth's Sun, or approximately 1.98847×10^{30} kg. It is commonly used to express the masses of other stars and astronomical objects relative to the Sun.

Solar prominence: A large, bright, transient feature, often in the shape of a loop, consisting of plasma extending outward from the Sun's photosphere into the corona. Prominences may be hundreds of thousands of kilometers long.

Solar radius: A standard unit of distance equal to the radius of the Earth's Sun (typically measured from the Sun's center to the layer in the photosphere at which the optical depth equals $2/3$), or approximately 695,700 Kilometers (432,300 mi). It is commonly used to express the radii of other stars and astronomical objects relative to the Sun.

Solar storm: It is a disturbance on the Sun, which can emanate outward across the Heliosphere, affecting the entire Solar System, including Earth and its magnetosphere, and is the cause of space weather in the short-term with long-term patterns comprising space climate

Solar System: The gravitationally bound planetary system of the Earth's Sun and all of the objects that orbit it, either directly or indirectly, including the eight true planets, five dwarf planets, and numerous small solar system bodies such as asteroids, comets, and natural satellites.

Solar time: The calculation of the passage of time based on the diurnal motion of the Sun in the Earth's sky. The fundamental unit of solar time is the solar day, i.e. the time interval between two successive returns of the Sun to the local meridian, as viewed from a given location on the Earth's surface. Because the duration of this interval changes during the Earth's orbit around the Sun, apparent solar time is distinguished from mean solar time. Solar time and sidereal time were employed by astronomers as time reckoning systems before the introduction of ephemeris time.

Solar wind: A stream of charged particles, primarily protons, electrons, and alpha particles, released from the Sun's corona and flowing outwards at up to 900 kilometres per second (2,000,000 mph) into interplanetary space. Phenomena influenced by the solar wind include aurora, geomagnetic storms, and the plasma tails of comets.

Solstice: Either of the two precise times of year when the Sun reaches its most northerly or most southerly point in the sky as seen from Earth; or, equivalently, when the Sun's apparent geocentric longitude is either 90 degrees or 270 degrees. The solstices occur on or near June 20 and December 21 each year. The June solstice, called the summer solstice in the Northern Hemisphere, is the annual date featuring the longest duration of daylight and the shortest duration of nighttime for any given point in the Northern Hemisphere; the reverse is true in the Southern Hemisphere, where the June date is the winter solstice.

Spectroscopic binary: A type of binary star system where the individual components have not been resolved with a telescope. Instead, the evidence for the binarity comes from shifts observed in the spectrum. This is caused by the Doppler effect as the radial velocity of the components change over the course of each orbit.

Spectroscopy: Study of the electromagnetic spectra in general. The Earth's atmosphere permits certain wavelengths of electromagnetic energy to pass through but reflects or absorbs others, making it difficult or impossible to detect them from the surface. As a result, spectroscopic instruments are often placed in orbit, above the atmosphere, where detection of all parts of the spectrum is uninhibited.

Spherical or positional astronomy: A branch of observational astronomy which is used to locate the positions of astronomical objects on the celestial sphere as they would appear from a particular date, time, and location on Earth. It relies on the mathematical methods of spherical geometry and the measurements of astrometry.

Spiral galaxy: They form a class of galaxy originally described by Edwin Hubble and, as such, form part of the Hubble sequence. Most spiral galaxies consist of a flat, rotating disk containing stars, gas and dust, and a central concentration of stars known as the bulge. These are often surrounded by a much fainter halo of stars, many of which reside in globular clusters. Spiral galaxies are named by their spiral structures that extend from the center into the galactic disc. The spiral arms are sites of ongoing star formation and are brighter than the surrounding disc because of the young, hot OB stars that inhabit them. Roughly two-thirds of all spirals are observed to have an additional component in the form of a bar-like structure, extending from the central bulge, at the ends of which the spiral arms begin. The proportion of barred spirals relative to barless spirals has likely changed over the history of the universe, with only about 10% containing bars about 8 billion years ago, to roughly a quarter 2.5 billion years ago, until present, where over two-thirds of the galaxies in the visible universe (Hubble volume) have bars

Standard acceleration due to gravity: The nominal gravitational acceleration of an object in a vacuum near the surface of the Earth, as a result of Earth's gravity and, less importantly, the centrifugal force generated by its rotation. It is by definition equal to 9.80665 m/s^2 (approximately 32.17405 ft/s^2).

Star: A massive, luminous spheroid of plasma held together by its own gravity which, for at least a portion of its life, radiates energy into outer space due to the thermonuclear fusion of hydrogen into helium within its core. Astronomers can determine the mass, age, temperature, chemical composition, and many other properties of a star by observing its motion through space, its luminosity, and its emission spectrum.

Star catalogue: A star catalogue is an astronomical catalogue that lists stars. In astronomy, many stars are referred to simply by catalogue numbers. There are a great many different star catalogues which have been produced for different purposes over the years, and this article covers only some of the more frequently quoted ones. Star catalogues were compiled by many different ancient people, including

the Babylonians, Greeks, Chinese, Persians, and Arabs. They were sometimes accompanied by a star chart for illustration. Most modern catalogues are available in electronic format and can be freely downloaded from space agencies' data centres. The largest is being compiled from the spacecraft Gaia and thus far has over a billion stars. Completeness and accuracy are described in Star catalogues by the faintest limiting magnitude V (largest number) and the accuracy of the positions.

Star or Stellar cluster: Star clusters are large groups of stars held together by self-gravitation. Two main types of star clusters can be distinguished. Globular clusters are tight groups of ten thousand to millions of old stars which are gravitationally bound. Open clusters are more loosely clustered groups of stars, generally containing fewer than a few hundred members, that are often very young. As they move through the galaxy, over time, open clusters become disrupted by the gravitational influence of giant molecular clouds. Even though they are no longer gravitationally bound, they will continue to move in broadly the same direction through space and are then known as stellar associations, sometimes referred to as moving groups.

Star system (Also stellar system) Any small number of stars that orbit each other, bound by gravitational attraction, such as a binary star system. In the broadest sense, very large groups of stars bound by gravitation such as star clusters and galaxies are also star systems. Star systems are distinct from planetary systems, which include planets and other bodies such as comets.

Starburst galaxy: Any galaxy that has an anomalously high rate of star formation. The criterion for a starburst is a star formation rate that would normally consume the galaxy's available supply of unbound gas within a time period shorter than the age of the galaxy. Most starbursts occur as a result of galactic interactions, such as a merger.

Starfield: Any set of stars visible in an arbitrarily sized field of view of a telescope, usually in the context of some region of interest within the celestial sphere. For example, the starfield surrounding the stars Betelgeuse and Rigel could be defined as encompassing some or the entire Orion constellation.

Stellar atmosphere (Also stellar envelope): The outermost region of a star, located above the stellar core, radiation zone, and convection zone. Although it constitutes only a small portion of the star's mass, for some evolved stars the stellar envelope can encompass a significant fraction of the radius.

Stellar classification (Also spectral classification): The categorization of stars based upon their spectra. The modern Morgan–Keenan spectral classification scheme is a two-dimensional classification based on temperature and luminosity.

Stellar dynamics: It is the branch of astrophysics which describes in a statistical way the collective motions of stars subject to their mutual gravity. The essential difference from celestial mechanics is that the number of bodies $N \gg 10$. Typical galaxies have upwards of millions of macroscopic gravitating bodies and countless number of neutrinos and perhaps other dark microscopic bodies. Also each star contributes more or less equally to the total gravitational field, whereas in celestial mechanics the pull of a massive body dominates any satellite orbit.

Stellar envelope: The region within the volume of a star that transports energy from the stellar core to the stellar atmosphere; or another name for the stellar atmosphere itself. Sometimes, the common envelope of gases encompassing a binary star system also falls under this category.

Stellar evolution Model: An astrophysical model of a star's stellar evolution over time based upon its mass and chemical composition.

Stellar magnetic field: A magnetic field generated by the convective motion of plasma inside a star, responsible for phenomena such as star spots and coronal loops.

Stellar remnant: In astronomy, this term refers collectively to white dwarfs, neutron stars, and black holes. It could also include exotic stars if such hypothetical, dense bodies are confirmed to exist. All of these are compact objects and have a high mass relative to their radius, giving them a very high density, compared to ordinary atomic matter. Remnants are often the endpoints of stellar evolution. The state and type of a stellar remnant depends primarily on the mass of the star that it formed from. The ambiguous term *compact object* is often used when the exact nature of the star is not known, but evidence suggests that it has a very small radius compared to ordinary stars. A compact object that is not a black hole may be called a degenerate star.

Submillimetre astronomy: The subfield of astronomy that studies astronomical objects detectable at submillimetre wavelengths (i.e. terahertz radiation).

Subsatellite: Any natural or artificial satellite that orbits another natural satellite, i.e. "a moon of a moon".

Substellar object (Also substar): An astronomical object whose mass is smaller than the smallest mass at which the fusion of hydrogen nuclei can be sustained (equivalent to approximately 0.08 solar masses), including brown dwarfs and some stellar remnants, as well as certain planetary-mass objects.

Supercluster: A **supercluster** is a large group of smaller galaxy clusters or galaxy groups; they are among the largest known structures in the universe. The Milky Way is part of the Local Group galaxy group (which contains more than 54 galaxies), which in turn is part of the Virgo Supercluster, which is part of the Laniakea Supercluster, which is part of the Pisces–Cetus Supercluster Complex. The large size and low density of superclusters means that they, unlike clusters, expand with the Hubble expansion. The number of superclusters in the observable universe is estimated to be 10 million.

Superior planet: An archaic term that is sometimes used to refer to planets that orbit further from the Sun than the Earth, such as Saturn. Contrast *inferior planet*.

Supermassive black hole (SMBH): One of a class of very large black holes which possess masses ranging from hundreds of thousands to many billions of times the mass of the Sun. These are typically found at a galactic core, where they can have a profound effect upon the evolution of the surrounding galaxy.

Supernova: An extremely luminous, transient stellar explosion occurring during a massive star's final evolutionary stages or when a white dwarf is triggered into runaway nuclear fusion.

Surface gravity (g): The gravitational acceleration experienced at the equatorial surface of an astronomical body or other object, including that produced by the effects of rotation. It is typically expressed in units of acceleration such as meters per second squared (m/s^2) or as a multiple of the Earth's standard gravity, which is equal to 9.80665 m/s^2 .

Synchronous orbit: Any orbit in which an object orbits its primary with an orbital period equal to the average rotational period of the primary and in the same direction as the primary's rotation.

Synodic day (Also synodic rotation period): The time it takes for an object to rotate once about its own axis (i.e. its rotation period) relative to the primary it is orbiting (rather than to the much more distant fixed stars). The synodic day may be described as the time between two consecutive sunrises (in the case where the

primary is a star), which is not necessarily the same as the sidereal day. As it does on Earth, an object's synodic day may change slightly in duration over the course of the orbital period due to eccentricity and axial tilt; Earth's synodic day is often called a solar day.

Synodic period: The time it takes for a body visible from another body (often the Earth) to complete a cycle with respect to the background stars visible in the second body's celestial sphere. Synodic period is most commonly used to indicate the elapsed time between a given body's consecutive appearances in the same location in the night sky as observed from Earth, but can in principle be calculated with respect to the sky as observed from anywhere. It is related to but distinct from the orbital period, a result of the fact that both the body being studied (e.g. Jupiter) and the body from which it is being observed (e.g. Earth) are independently orbiting a third body (the Sun).

Synodic time: The calculation of the passage of time based on successive conjunctions of an astronomical object, such as a planet (i.e. successive returns of the object to the same aspect in the Earth's sky).

Syzygy: The straight-line configuration of three celestial bodies in a gravitational system.

Tangential velocity: The component of the velocity of a star or other astronomical body that is perpendicular to the line of sight of the observer (i.e. in the tangent plane). This component can be computed from the body's observed proper motion and its measured distance from the observer.

Telescope: A telescope is a device used to observe distant objects by their emission, absorption, or reflection of electromagnetic radiation. Originally, it was an optical instrument using lenses, curved mirrors, or a combination of both to observe distant objects – an optical telescope. Nowadays, the word "telescope" is defined as a wide range of instruments capable of detecting different regions of the electromagnetic spectrum, and in some cases other types of detectors. The first known practical telescopes were refracting telescopes with glass lenses and were invented in the Netherlands at the beginning of the 17th century. They were used for both terrestrial applications and astronomy. The reflecting telescope, which uses mirrors to collect and focus light, was invented within a few decades of the first refracting telescope. In the 20th century, many new types of telescopes were invented, including radio telescopes in the 1930s and infrared telescopes in the 1960s.

Telluric star: A star with nearly featureless continuum spectra that can be used to correct for the effect of telluric contamination of the Earth's atmosphere on the spectra of other stars. For example, water vapor in the atmosphere creates significant telluric absorption bands at wavelengths above 6800 Å. These features need to be corrected for in order to more accurately measure the spectrum.

Termination shock: The boundary within the Heliosphere, approximately 75 to 90 AU from the Sun, beyond which the solar wind slows to subsonic speeds (relative to the Sun) as a result of interactions with the local interstellar medium.

Terminator: The line that divides the illuminated side of a moon or planet from its dark side. The line moves as the object rotates with respect to its parent star.

Theoretical astronomy: A branch of astronomy that uses analytical and computational models based on principles from physics and chemistry to describe, explain, and model the properties of astronomical objects and phenomena, with the ultimate goal of accurately predicting the observable or testable consequences of those models.

Thick disk population: The thick disk is one of the structural components of about 2/3 of all disk galaxies, including the Milky Way. It was discovered first in external edge-on galaxies. Soon after, it was proposed as a

distinct galactic structure in the Milky Way, different from the thin disk and the halo. It is supposed to dominate the stellar number density between 1 and 5 kiloparsecs above the galactic plane and, in the solar neighborhood, is composed almost exclusively of older stars. Its stellar chemistry and stellar kinematics (composition and motion of its stars) are also said to set it apart from the thin disk. Compared to the thin disk, thick disk stars typically have significantly lower levels of metals—that is, the abundance of elements other than hydrogen and helium. The thick disk is a source of early kinematic and chemical evidence for a galaxy's composition and thus is regarded as a very significant component for understanding galaxy formation.

Thin disk population: The layer of the Milky Way galaxy where the spiral arms are found and where most of the star formation takes place. It is about 300–400 parsecs (980–1,300 light-years) deep and centered on the galactic plane. Stars belonging to this population generally follow orbits that lie close to this plane. This is in contrast to members of the thick disk population and halo stars.

Tidal braking (Also tidal acceleration): The transfer of momentum between an astronomical body and an orbiting satellite as the result of tidal forces. This can cause changes in the rotation periods for both bodies as well as modification of their mutual orbit. A satellite in a prograde orbit will gradually recede from its primary while slowing the rotation rate of both bodies.

Tidal force: The tidal force or tide-generating force is a gravitational effect that stretches a body along the line towards and away from the center of mass of another body due to spatial variations in strength in gravitational field from the other body. It is responsible for the tides and related phenomena, including solid-earth tides, tidal locking, breaking apart of celestial bodies and formation of ring systems within the Roche limit, and in extreme cases, spaghettification of objects. It arises because the gravitational field exerted on one body by another is not constant across its parts: the nearer side is attracted more strongly than the farther side. The difference is positive in the near side and negative in the far side, which causes a body to get stretched. Thus, the tidal force is also known as the differential force, residual force, or secondary effect of the gravitational field. In celestial mechanics, the expression *tidal force* can refer to a situation in which a body or material (for example, tidal water) is mainly under the gravitational influence of a second body (for example, the Earth), but is also perturbed by the gravitational effects of a third body (for example, the Moon). The perturbing force is sometimes in such cases called a tidal force (for example, the perturbing force on the Moon): it is the difference between the force exerted by the third body on the second and the force exerted by the third body on the first. Tidal forces have also been shown to be fundamentally related to gravitational waves

Tidal locking: The net result of continued tidal braking such that, over the course of an orbit, there is no net transfer of angular momentum between an astronomical body and its gravitational partner. When the orbital eccentricity is low, the result is that the satellite orbits with the same face always pointed toward its primary. An example is the Moon, which is tidally locked with the Earth.

Tidal stream: A stream of stars and gases which are stripped from gas clouds and star clusters because of interaction with the gravitational field of a galaxy such as the Milky Way.

Tilt erosion: The gradual reduction of the obliquity of an orbiting satellite due to tidal interaction.

Tisserand's parameter (T): A measure of the orbital motion of a relatively small body (e.g. an asteroid or comet) with respect to a larger, perturbing body (e.g. a planet), used for restricted three-body problems in which the three bodies all differ greatly in mass. The parameter is calculated from the orbital elements of each body, including the small body's semimajor axis, eccentricity, and inclination, and is useful in specifically identifying small bodies observed before and after planetary encounters, as its numerical value remains largely constant throughout the body's lifetime. It is also used to distinguish between different kinds of orbits which are characteristic of different classes of bodies.

Topocentric: With reference to, or pertaining to, a point on the surface of the Earth.

Trans-Neptunian object (TNO): A trans-Neptunian object (TNO), is any minor planet in the Solar System that orbits the Sun at a greater average distance than Neptune, which has an orbital semi-major axis of 30.1 AU. Typically, TNOs are further divided into the classical and resonant objects of the Kuiper belt, the scattered disc and detached objects with the sednoids being the most distant ones. As of July 2024, the catalog of minor planets contains 901 numbered and more than 3,000 unnumbered TNOs. However, nearly 5000 objects with semimajor axis over 30 AU are present in the MPC catalog, with 1000 being numbered. The first trans-Neptunian object to be discovered was Pluto in 1930. It took until 1992 to discover a second trans-Neptunian object orbiting the Sun directly, 15760 Albion. The most massive TNO known is Eris, followed by Pluto, Haumea, Makemake, and Gonggong. More than 80 satellites have been discovered in orbit of trans-Neptunian objects. TNOs vary in color and are either grey-blue (BB) or very red (RR). They are thought to be composed of mixtures of rock, amorphous carbon and volatile ices such as water and methane, coated with tholins and other organic compounds.

Transit: The passage of a particular celestial object across a particular meridian; an astronomical event during which a celestial body or object passes visibly across the face of a much larger body. An example is the transit of Venus across the face of the Sun, which was visible from Earth in 2004 and 2012. Because a transit results in a decrease in the net luminosity from the two objects, the transit method can be used to detect extrasolar planets as they pass in front of their host stars. A transit by an object that appears roughly the same size or larger than the body it is transiting is called an occultation or eclipse.

Trojan: In astronomy, it is term for a small celestial body (mostly asteroids) that shares the orbit of a larger body, remaining in a stable orbit approximately 60° ahead of or behind the main body near one of its Lagrangian points L_4 and L_5 . Trojans can share the orbits of planets or of large moons. Trojans are one type of co-orbital object. In this arrangement, a star and a planet orbit about their common barycenter, which is close to the center of the star because it is usually much more massive than the orbiting planet. In turn, a much smaller mass than both the star and the planet, located at one of the Lagrangian points of the star–planet system, is subject to a combined gravitational force that acts through this barycenter. Hence the smallest object orbits around the barycenter with the same orbital period as the planet, and the arrangement can remain stable over time.

Tropical year: A tropical year or solar year (or tropical period) is the time that the Sun takes to return to the same position in the sky – as viewed from the Earth or another celestial body of the Solar System – thus completing a full cycle of astronomical seasons. For example, it is the time from vernal equinox to the next vernal equinox or from summer solstice to the next summer solstice. It is the type of year used by tropical solar calendars. The tropical year is one type of astronomical year and particular orbital period. Another type is the sidereal year (or sidereal orbital period), which is the time it takes Earth to complete one full orbit around the Sun as measured with respect to the fixed stars, resulting in a duration of 20 minutes longer than the tropical year, because of the precession of the equinoxes.

True anomaly (v, θ , or f): The angle between the direction of periapsis and the current position of an orbiting body as it moves along an elliptical orbit, as measured from the nearest focus of the ellipse. The true anomaly is one of three angular parameters that define a position along an orbital path, the other two being the eccentric anomaly and the mean anomaly, and also one of six canonical orbital elements used to characterize an orbit.

Tully–Fisher relation: An empirical relationship between the mass or intrinsic luminosity of a spiral galaxy and its angular velocity or emission line width. It can be used to estimate the distance of the galaxy, and hence forms a rung on the cosmic distance ladder.

Twilight: The time period immediately before sunrise and after sunset during which, despite the Sun being completely below the horizon, the scattering of sunlight by the Earth's atmosphere supplies significant illumination to the ambient environment. Several definitions of twilight are commonly distinguished, including astronomical, civil, and nautical twilight.

Two-body problem: In classical mechanics or astronomy, it is the problem is to calculate and predict the motion of two massive bodies that are orbiting each other in space. The problem assumes that the two bodies are point particles that interact only with one another; the only force affecting each object arises from the other one, and all other objects are ignored. The most prominent example of the classical two-body problem is the gravitational case of Keplerian orbits, arising in astronomy for objects such as satellites, planets, and stars. A two-point-particle model of such a system nearly always describes its behavior well enough to provide useful insights and predictions.

A simpler "one body" model, the "central-force problem", treats one object as the immobile source of a force acting on the other. One then seeks to predict the motion of the single remaining mobile object. Such an approximation can give useful results when one object is much more massive than the other (as with a light planet orbiting a heavy star, where the star can be treated as essentially stationary). However, the one-body approximation is usually unnecessary except as a stepping stone. For many forces, including gravitational ones, the general version of the two-body problem can be reduced to a pair of one-body problems, allowing it to be solved completely, and giving a solution simple enough to be used effectively. By contrast, the three-body problem (and, more generally, the n -body problem for $n \geq 3$) cannot be solved in terms of first integrals, except in special cases.

UBV photometric system (Also the **Johnson system** or **Johnson–Morgan system**): The **UBV photometric system** (from Ultraviolet, Blue, Visual), is a photometric system usually employed for classifying stars according to their colors. It was the first standardized photometric system. The apparent magnitudes of stars in the system are often used to determine the color indices B–V and U–B, the difference between the B and V magnitudes and the U and B magnitudes respectively. The system is defined using a set of color optical filters in combination with a photomultiplier tube.

Universe: The entirety of space and time and their contents, including galaxies, stars, planets, all other forms of matter and energy, and the physical laws and constants that describe them. When not otherwise qualified, "the Universe" usually refers to the *entire* Universe, whose spatial extent is unknown because it is not directly measurable; this is distinguished from the observable universe, whose size it is possible to measure. It may be also one of many hypothetical parallel universes which exist as causally disconnected constituent parts of a larger multiverse, which itself comprises all of space and time and their contents.

Variable star: Any star that is observed to vary in brightness. This variation may be periodic, with one or more cycles that last hours, days, months, or even years. Some stars vary in an irregular manner, while others undergo cataclysmic changes in brightness. Other forms of variability are intrinsic changes to the star's radial velocity or its profile of spectral lines.

Velocity dispersion: The statistical dispersion of velocities about the mean velocity for a group of objects, such as stars in a globular cluster or galaxies in a galactic cluster. This value can be used to derive the combined mass of the group by using the virial theorem.

Weak-line star: A reference to the faintness of the spectral lines for a star compared to standard stars with the same stellar classification. Since most absorption lines are caused by elements other than hydrogen and helium—what astronomers refer to as "metals"—these are sometimes called metal weak stars.^[43]

White dwarf: A type of stellar remnant composed mostly of electron-degenerate matter. A white dwarf lacks the mass needed to continue the nuclear fusion process with its constituent atoms, so the object's energy output normally comes from radiative cooling as novae or supernovae.

Wilson–Bappu effect: A correlation between the width of the singly ionized calcium K-line (Ca II K) at 3933 \AA and the absolute visual magnitude of the emitting late-type stars. This linear relation makes it useful for determining the distances of G, K, and M-type stars.

XBONG (An acronym of **X-ray bright optically normal galaxy**): A seemingly normal galaxy that does not appear to have an active galactic nucleus, yet displays an anomalous level of excess X-ray emission.

X-ray source: A source of X-rays. They are usually produced when a high-mass object, usually a neutron star or black hole and a companion star are in a binary system.

Zenith: The point in the sky that is directly overhead from the perspective of a particular location on the Earth.

Zero-age main sequence (ZAMS): The sequence of positions along the Hertzsprung–Russell diagram achieved by newly formed, chemically homogeneous stars which have finished contracting and have reached hydrostatic equilibrium, with energy being derived solely from nuclear fusion.

Zodiac: The area of the sky that extends approximately 8 degrees north or south (in celestial latitude) of the ecliptic, the apparent path of the Sun across the celestial sphere over the course of the year as observed from Earth. The Sun, Moon, and visible planets appear to travel across a band of twelve Zodiac constellations within this belt as the Earth orbits the Sun.

Zodiacal light: A band of light in the night sky, thought to be sunlight reflected from cometary dust concentrated in the plane of the zodiac, or ecliptic.