

## GLOSSARY

**Anti-center** The point in the sky opposite of the galactic center.

**Active galaxy** A galaxy of which the center has a much higher than normal luminosity.

**Altitude** The angle between an astronomical object and the observer's horizon, also called the elevation.

**Aperture** The diameter of the objective lens or mirror of a telescope.

**Atmospheric extinction** The amount of light that is absorbed by the air we look through. Stars near the horizon look dimmer than stars near the zenith because we look through a much thicker mass of air. Therefore astronomical objects are best observed when they appear high in the sky.

**Asteroid** A small rocky-icy or metallic body that orbits the Sun.

**Asterism** A striking pattern of stars, most of which are not physically related.

**Averted vision** A technique used to observe faint objects, most valuable in low light conditions. Instead of looking directly at the object, the observer looks off to the side. As such, the object is projected on the more sensitive area of the observer's retina.

**Binary star** A star system consisting of two stars that orbit a common center of mass.

**Black hole** A dense mass in space with such a large gravitational field that nothing can escape from it, not even light. Black holes are thus invisible. Their presence, however, can be noted by their interaction with their surroundings.

**Blue giant** A giant star with a spectral type of O or B. It is a massive and very luminous star that has exhausted the hydrogen in its core. When this happens, the star leaves the main sequence and expands into an object classified as a giant star.

**Blue straggler** Stars in clusters are believed to be formed around the same time. When the cluster ages, its most massive (blue and luminous) stars are the first to become giants and to die. Over time, the cluster becomes redder.

**Blue straggler** A main sequence star that appears bluer and more luminous than the age of the cluster it is in can allow. A possible explanation is that blue stragglers are mergers of individual stars.

**Brown dwarf** Star with a mass lower than 0.08 solar mass. Brown dwarfs don't have enough mass to fuse hydrogen. They are much cooler and dimmer than main sequence stars.

**Cluster** A star cluster is a group of stars. There are two types of star clusters: globular clusters and open clusters. Globular clusters are tight groups that are firmly bound by gravity. Globular clusters can be found in the halo surrounding our Milky Way. Open clusters (or galactic clusters) are loose collections of stars. They are formed in the galactic disk of the Milky Way. Open clusters disintegrate over time due to interactions with other stars and molecular clouds in the galactic disk. Our Sun, which travels in solitary through the galactic disk, is believed to have been born in an open cluster.

**Coating** A coating is used in an optical instrument to enhance the transmission of the captured light. Uncoated lenses reflect too much of the infalling light. Modern optics with multiple layers of broadband antireflective coatings on all the glass to air surfaces are labeled 'fully multicoated' (FMT).

**Comet** A small icy body that orbits the Sun. When the comet comes close enough to the Sun, streams of vapor and dust start to come out of the comet's nucleus.

**Conjunction** When two or more celestial objects appear in the same line of sight, then they are in conjunction.

**Constellation** A group of stars that form a pattern in the sky. There are 88 official constellations. A *circumpolar constellation* is a constellation that never sets or rises, as viewed from a given latitude on Earth. It is visible all night on every night of the year. A *seasonal constellation* on the other hand is only visible in a particular period of the year.

**Culmination** The maximum altitude of an object, which occurs when it crosses the observer's meridian.

**Deep-sky object (DSO)** An astronomical object beyond the Solar System. Typical DSO's are star clusters, nebulae and galaxies.

**Direct vision** The technique of looking direct at an object. For our direct vision, we make use of a small part of our retina, called the fovea. Direct vision offers sharp, colorful vision and works best in bright light.

**Double star** A true binary star system or two unrelated stars that happen to lie in the same line of sight.

**Ecliptic** The apparent path of the Sun against the background stars during the year. The Moon as well as the planets travel very close to the ecliptic, too.

**Exit pupil** The plane of the virtual aperture behind the eyepiece of a telescope where the image of the observed object is projected. The observer's eye must be aligned with the exit pupil. The diameter of the exit pupil equals the aperture of the telescope divided by the magnification.

**Eyepiece** The lens of a telescope through which the observer looks. The eyepiece determines the magnification of the telescope. Most telescopes have exchangeable eyepieces. Binoculars have fixed eyepieces.

**Eye relief** The distance between the eyepiece and the exit pupil. It is thus the distance at which the observer should hold his or her eye in order to see the full field of view. If the observer's eye is further away from the eyepiece, there will be a narrower field of view. Eyepieces with an eye relief of 15mm or larger are suitable for eyeglass wearers.

**Field of view (fov)** The true field of view is the angular extension of the observed scene that is visible in the eyepiece. Binoculars offer a true fov from 8° to 3.5°. Apparent field of view is the angular size of the image presented by the eyepiece. The apparent fov is a constant measure for a given eyepiece. Eyepieces have an apparent fov ranging from 40° to over 100°. Imagine that an eyepiece has an apparent fov of 50° and a magnification of 100. When you look at the full Moon, you will see in the eyepiece an image of the Moon as large as the whole apparent fov of 50°. But the true fov is only 30 arcminutes.

**Galactic center** The center of our Milky Way.

**Galactic disk** The plane of spiral and lenticular galaxies. The galactic disk contains mainly gas, dust and stars. These stars are called disk stars. Our Sun is a disk star.

**HII-region** Large cloud of gas in which active star formation is taking place.

**Hypergiant** An unusually massive star with a mass ranging from 70 to 250 solar masses. Hypergiant stars suffer from internal instabilities and have an extremely short lifetime. They are therefore very rare.

**IC catalog** *The Index Catalogue of Nebulae and Clusters of Stars*. This is a catalogue that was compiled by J. L. E. Dreyer in the 1880s and is a supplement to the NGC catalog.

**in.** Abbreviation for inch. Used to measure the size of a telescope. A 3-in. telescope has an aperture of 3 inches, or approximately 75mm. A 4-in. telescope has an aperture of 100mm.

**Interstellar medium** The matter (gas and dust) that exists in the space between the stars in a galaxy.

**Light pollution** An excess of artificial light. Light pollution brightens the night sky and washes out the stars, making it difficult to observe them. Cities and streetlights are main sources of light pollution.

**Light-year** The distance that light travels in one year, equal to about 10 trillion km or 6 trillion miles.

**Limiting magnitude (lm)** The faintest apparent magnitude that can be seen.

**Local Group** A group of more than 30 galaxies that includes our own galaxy.

**Local Supercluster (LSC)** A cluster of galaxy groups that includes the Local Group as well as the Virgo Cluster. Superclusters are the largest structures of the universe.

**Lucida** The brightest star of a cluster.

**Luminosity** The amount of energy that an astronomical object radiates per unit of time.

**Magnitude (mag)** A measure for the brightness of an astronomical object. The magnitude scale was invented by the Greek astronomer Hipparchus. He divided the visible stars in six categories. The brightest stars were said to be of first magnitude, the faintest stars of the sixth magnitude. The *apparent magnitude* is the brightness of an object as seen from an observer on Earth. The *absolute magnitude* equals the apparent luminosity of an object imagined at a standard distance of 32.6 l-y. The apparent magnitude of our Sun is  $-26.74$ . It is the brightest object in the sky. The apparent magnitude of the next brightest star, Sirius, is  $-1.46$ . The absolute magnitude of our Sun is 4.8, while the absolute magnitude of Sirius is 1.42. Thus Sirius is more luminous than our Sun.

**Main sequence** The generic term for stars that create energy in their cores from fusing hydrogen into helium. The main sequence phase comes right after the birth of a star. It is the most stable period in a star's life. Our Sun is halfway through its main sequence phase. Main sequence stars are also called dwarfs.

**Meridian** An imaginary great circle in the sky that passes from the north point on the horizon through the celestial pole, up to the zenith, and through the south point on the horizon. A star reaches its culmination when it crosses the meridian. Meridian comes from the Latin word for midday.

**Messier object** A deep-sky object from the catalog of the French astronomer Charles Messier.

**Metallicity** The proportion of chemical elements other than hydrogen and helium present in an astronomical object. Older stars have lower metallicities than younger stars, because younger stars formed in a 'metal'-rich environment.

**Meteor** The visible trace of a meteoroid as it enters the atmosphere, also misnamed a shooting star.

**Meteoroid** A particle of dust or a rock that moves through interplanetary space.

**Milky Way** Our home galaxy.

**Multiple star** A star system consisting of more than two stars that orbit a common center of mass.

**Nebula** An interstellar cloud of dust and gas. *Emission nebulae* produce light. *Reflection nebulae* reflect light from nearby stars. *Dark nebulae* absorb light from stars or emission nebulae in the background.

**Nelm (naked-eye limiting magnitude)** The magnitude of the faintest stars that can be seen with the naked eye. The nelm is used as a benchmark for the darkness of the sky. Light polluted skies have a poor nelm, while dark skies have a great nelm.

**Neutron star** The collapsed dense core of a star that went supernova. A typical neutron star has the mass of 1.3 to 2 solar masses compressed in a sphere as small as 24 km.

**NGC catalogue** *The New General Catalogue of Nebulae and Clusters of Stars* was compiled by J. L. E. Dreyer in the 1880s. The NGC catalogue is based on the visual discoveries from William and John Herschel.

**Night vision** The ability to see in low light conditions. Human night vision makes use of the rods of the eye. Our night vision slowly develops when we enter the dark. After about 30 minutes in the dark, our eyes are completely dark adapted. They become even slightly more sensitive during the next 90 minutes in the dark.

**Nova** A variable star that undergoes an eruption. The star becomes suddenly much brighter. It takes months for its brightness to decline again. Novae are in fact close binary stars with one component a white dwarf. The latter captures gas from its companion. When enough hydrogen is collected and heated on the surface of the white dwarf, a violent nuclear reaction

turns the hydrogen into helium, which is responsible for a sudden outburst of light.

**OB association** A young stellar grouping that formed within a giant molecular cloud. It contains tens of massive stars of spectral class O and B.

**Planet** Literally a wandering star. Our ancestors noticed that some 'stars' wandered around in the sky. Today we know that these special stars are members of our Solar System. Planets are large bodies that orbit the Sun. They don't emit light, as stars do. We can see them because they reflect sunlight. Planets that orbit other stars are called extrasolar planets.

**Planetary nebula** A shell of glowing gas ejected by a star in its death throws. When this type of nebula was first discovered, it was confused with giant gas planets, hence the name. Planetary nebulae have little in common with planets.

**Pulsar** A neutron star that emits a beam of radiation along its rotating magnetic poles. When the beam hits Earth, the pulsar seems to flash like a lighthouse.

**Quasar** A quasi-stellar radio source. Quasars are the most luminous objects in the cosmos. They are believed to be the active centers of massive galaxies that host a supermassive black hole. Such black holes collect infalling material in a disk around the central body. The compression of the material in the disk is responsible for the radiation.

**Red giant** When a main sequence star (with a mass ranging from 0.5 solar masses to 6 solar masses) has consumed all the hydrogen in its core, the core starts to contract. This contraction heats up the star's shell outside the core, where hydrogen fusion commences. The released energy increases the star's luminosity greatly. The star begins to expand and enters the realm of the red giants.

**Red dwarf** A small star with a mass lower than 0.4 solar masses. Red dwarfs produce little energy and have less than a tenth of the Sun's luminosity. They are so energy efficient that are believed to have a longer lifespan than the age of the universe. This means that the first formed red dwarfs are still around.

**Runaway star** A star that is moving through space with an unusually high velocity. Runaway stars are believed to have left a multiple star system after a supernova explosion.

**Satellite** A naturally occurring object in order around another or an artificial object placed into orbit.

**Seeing** The atmospheric turbulence that cause the twinkling of the stars. When the seeing is good, detailed observations are possible. When the seeing is bad, stars seem to dance around when looked at through a telescope.

**Solar System** The Sun and all the bodies held in its gravitational field. Others stars also have their own solar systems.

**Star** A hot, luminous ball of mostly hydrogen and helium. A binary star consists of a pair of stars that orbit around a common center of mass. A multiple-star system consists of a small number of stars that orbit each other.

**Starburst** A region of a galaxy with an abnormally high rate of star formation.

**Supergiant** A star with a mass ranging from 10 to 70 solar masses. Supergiants are very luminous and have a rather short lifespan.

**Supernova** A violent stellar explosion in which most of the star's mass is blown away. Supernovae can be as bright as a whole galaxy.

**Supernova remnant** The debris cloud left behind by a star that went supernova.

**Transparency** A measure for the clarity of the atmosphere. When the air is polluted with vapor, dust or smog, the transparency is bad. There is more extinction and light scatter.

**Variable star** A star in which the apparent magnitude changes over time. This can be due to the star's luminosity, or to the transparency of the space between Earth and the star.

**White dwarf** Also called a degenerate dwarf. This is the final state of a star that lacks the mass to become a supernova. Once such stars have exhausted their core hydrogen supply, they become red giants. At the end of their red giant phase, these stars shed their outer layers in the form of a planetary nebula. What is left behind is the unveiled high density core of a former star. Its substance is inert. The white dwarf's fate is to radiate away its energy and cool down. Because white dwarfs typically have the mass of our Sun and the size of Earth, they need a very long time to cool down. Our universe is still too young to have any cooled down white dwarfs.

**Wolf-Rayet star** Evolved massive star that continually ejects large amounts of mass into space.

**Zenith** The point in the sky directly above the observer.

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