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aberration An effect that makes the observed position of a star slightly different from its true position. It results from a combination of the finite speed of the starlight and the motion through space of the observer on Earth. Most aberration is due to Earth's yearly motion in orbit around the Sun and is called annual aberration. A much smaller contribution from Earth's daily rotation is called diurnal aberration.

absolute magnitude A number that gives the true, relative brightness of an astronomical body, ignoring the dimming effect of distance. The absolute magnitude of a star is the ► *magnitude* it would appear to be if it were 10 ► *parsecs* away. The absolute magnitude of a planet, asteroid or comet is the ► *apparent magnitude* it would have if it were at a distance of 1 AU from both the Sun and Earth, with its disk fully illuminated.

absolute zero The lowest possible temperature. It is the zero point of the Kelvin temperature scale used in science. Its equivalent on the Celsius scale is -273.16°C .

absorption line A sharp dip in a continuous ► *spectrum*. Absorption lines look like narrow gaps in a spectrum. They are seen in the spectra of the majority of stars. In the case of the Sun, they are known as ► *Fraunhofer lines*.

Atoms create these dark lines by absorbing radiation. Each chemical element creates a unique pattern of lines. By measuring the strengths of absorption lines it is possible to deduce the abundance of the various elements, though the lines are also affected by temperature, density and other factors.

► *emission line*.

absorption nebula A dark interstellar cloud that blocks the light from stars and galaxies lying behind it. Absorption nebulae range in size from small ► *globules* to large clouds visible to the naked eye. Absorption nebulae contain both dust and gas, and the temperatures in them are low enough for simple molecules to form. Much of what is known about these nebulae comes from observing their infrared and radio radiation, which, unlike visible light, can pass through them. ► *molecular cloud*.

accelerating universe The concept that the expansion of the universe is speeding up. Evidence that the universe is now expanding at an ever faster rate first came from measurements made in the late 1990s of the distances to very remote galaxies in which there were ► *supernova* explosions. Astronomers estimate that the expansion of the universe began to accelerate about 5 billion

accretion disk



An [absorption nebula](#). Lanes of absorbing cold dust obscure the light of stars in the Milky Way in this infrared image.

years ago when the power of ➤ [dark energy](#) to propel the universe apart became greater than the power of gravity to hold back the expansion.

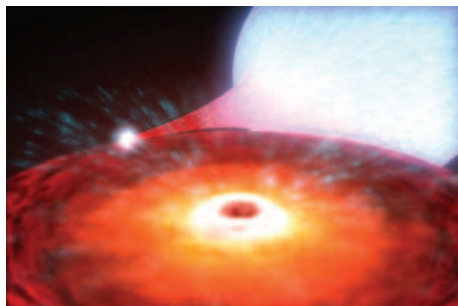
accretion disk A disk that forms around a spinning object, such as a star or ➤ [black hole](#), when its gravity draws in material from a companion star or from the ➤ [interstellar medium](#).

Achernar (Alpha Eridani) The brightest star in the constellation Eridanus, representing the River Eridanus. Its name comes from Arabic and means “the end of the river.” It marks the extreme southern point of the constellation. Achernar is a ➤ [B star](#) of magnitude 0.5 and is 144 light years away.

588 Achilles The first of the ➤ [Trojan asteroids](#) to be identified. Discovered by Max Wolf in 1906, its diameter is about 116 km (72 miles).

achondrite A type of stony ➤ [meteorite](#) that crystallized from molten rock. Unlike ➤ [chondrites](#), achondrites do not contain small mineral spheres known as ➤ [chondrules](#).

active region



An artist's impression of the [accretion disk](#) that forms around a black hole as it draws material from a companion star.

Acrux (Alpha Crucis) The brightest star in the constellation Crux. To the naked eye it looks like a single white star of magnitude 0.9, but a telescope shows two [B stars](#), of magnitudes 1.4 and 1.9, separated by 4.4 arc seconds. The spectrum of the brighter one shows it has a very close companion so there are at least three stars in this system, which is 320 light years away.

active galactic nucleus (AGN) A small central region in a galaxy where exceptionally large amounts of energy are being generated. The only way such a concentrated source of power can be explained is by matter falling into a supermassive [black hole](#). Active galaxies are categorized by their appearance and the nature of the radiation they emit. [Quasars](#), [Seyfert galaxies](#), [radio galaxies](#), [N galaxies](#) and [blazars](#) are all examples.

AGNs have high-speed jets of material shooting out from them. The black hole is surrounded by a ring of dust and gas at right angles to the jets. The differences between the various categories of AGN can be accounted for by the level of their power output and the angle from which they are viewed. In radio galaxies, the ring is edge-on, hiding the light from the disk of hot material swirling into the black hole. In quasars and Seyfert galaxies, the ring is oriented so we can see the light emitted by the hot, glowing disk. Blazars are thought to have jets pointing directly at Earth.

active galaxy A galaxy with an [active galactic nucleus](#) at its center.

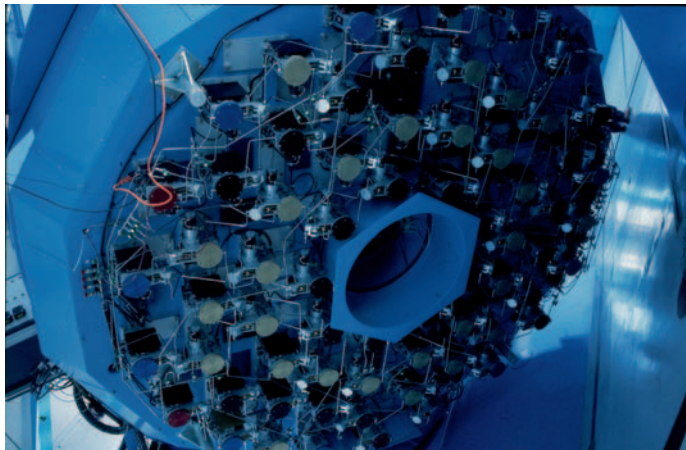
active optics A method of maintaining the precise shape of the main mirror in a reflecting telescope. A computer continually monitors the quality of the image and feeds the information back to a motorized support system under the mirror. Using active optics means that mirrors can be thinner and more light-weight. The mirror's tendency to change its shape under its own weight as the telescope moves can be corrected in just a few minutes.

active region A region in the outer layers of the Sun where there is [solar activity](#). Active regions develop where strong magnetic fields break through from below. [Sunspots](#), [plages](#) and [flares](#) are all evidence of an active region. The radiation given off is normally enhanced across the whole of the electromagnetic spectrum, from X-rays to radio waves, except in sunspots

Adams, John Couch (1819–92)



The [active galaxy](#) Centaurus A. This X-ray image shows a jet being fired from the center.



[Active optics](#). The computer-controlled supports under the 3.5-meter primary mirror of the WIYN Telescope at the Kitt Peak Observatory.

themselves, where the temperature is reduced and less light is emitted. There is a large variation in the size and duration of active regions: they may last from several hours up to a few months. Electrically charged particles and the enhanced ultraviolet and X-radiation from active regions affect the [interplanetary medium](#) and Earth's upper atmosphere.

Adams, John Couch (1819–92) John Couch Adams is chiefly remembered for predicting the existence and position of the planet Neptune in 1845 by

aeronomy

analyzing the way Uranus had departed from its expected orbit since it was discovered in 1781. A brilliant mathematician, he worked on the motion of the Moon and planets. He became a professor at the University of Cambridge in 1858 and director of the University Observatory in 1860.

Unfortunately for Adams, in 1845 neither George Biddell [▶ Airy](#), the Astronomy Royal, nor the Director of the Cambridge Observatory, Professor James Challis, treated his prediction of a new planet with any seriousness or real urgency. Unknown to them, Urbain J. J. [▶ Leverrier](#) in France had independently made the same calculation. Acting on Leverrier's prediction, Johann Galle in Berlin discovered Neptune in 1846. Only later, and after a good deal of controversy, did Adams received credit for his work when Challis and John [▶ Herschel](#) pointed out that his prediction was made before Leverrier's.

adaptive optics A technique for improving the image an astronomical telescope makes by compensating for changes in the quality of [▶ seeing](#). A small, very thin, flexible mirror placed a short distance in front of the focus of the telescope corrects for the distortion. An image sensor detects the amount of distortion and feeds the information to a microprocessor, which controls actuators to bend the corrector mirror. The system has to respond to changes in less than a hundredth of a second.

Adhara (Epsilon Canis Majoris) The second-brightest star in the constellation Canis Major. Lying 425 light years away, it is a giant [▶ B star](#) of magnitude 1.5 with an eighth-magnitude companion. Derived from Arabic, Adhara means "the virgins," which may come from a name given to a triangle of stars of which Adhara is one.

2101 Adonis A small asteroid, discovered in 1936 by Eugene Delporte, which came within 2 million km (1.4 million miles) of Earth in 1937. After that it was lost until 1977 when it was recovered following a recomputation of its orbit. It is a member of the [▶ Apollo](#) asteroid group and is about 2 km across.

Adrastea A small inner moon of Jupiter discovered by David Jewitt in 1979. It measures 26×20×16 km (16×12×10 miles).

Advanced Electro-Optical System Telescope (AEOS Telescope) A US Air Force 3.67-m telescope at the Air Force Maui Optical Station in Hawaii. It is the world's largest telescope capable of tracking rapidly moving objects, such as satellites. Though built principally for military purposes, it is also used for astronomical research.

aerobot A scientific experiment package deployed in a planetary atmosphere using a balloon.

aerobraking The controlled use of atmospheric drag to reduce the speed of a satellite and modify its orbit.

aeronomy The study of physical and chemical processes in the upper atmosphere of Earth, or of any planet.

Agena

Agena An alternative name for the star ► *Hadar*.

Ahnighito meteorite ► *Cape York meteorite*.

airglow Faint light given out by Earth's own atmosphere. From space, it appears as a ring of greenish light around the Earth. It is caused by the Sun's radiation. The brightest airglow comes from a layer approximately 10–20 km (about 10 miles) thick at a height of around 100 km (60 miles). Glowing oxygen and sodium atoms are major contributors. Airglow does not include ► *thermal radiation*, ► *auroras*, lightning and ► *meteor* trains.

air shower A cascade of high-energy, electrically charged particles in the atmosphere, triggered by the collision of a ► *cosmic ray* particle with the nucleus of a gas atom. The nucleus that has been hit emits a number of fast-moving particles. They in turn strike other nuclei, which eject yet more particles.

Airy, Sir George Biddell (1801–92) Airy was one of the most prominent figures in British astronomy during the nineteenth century. He began his career at Cambridge University, where he became a professor of mathematics in 1826, then professor of astronomy and Director of the Observatory two years later. He was appointed ► *Astronomer Royal* in 1835 and held that position for 46 years until he retired at the age of 80. He was both a very able mathematician and a practical scientist who tackled many varied problems relating to astronomy and geophysics. He also had exceptional organizing ability. As Astronomer Royal, he re-equipped the Royal Observatory at Greenwich and improved the range and efficiency of its work.

Airy published hundreds of papers but he is now remembered most for his work in optics, his detailed analysis of the orbits of Earth and Venus, and estimating the mean density of Earth in an experiment involving pendulums at the top and bottom of a mineshaft. He was also responsible for establishing Greenwich Mean Time as the official time throughout Britain and the ► *transit circle* he had built at Greenwich in 1850 was later chosen as the zero point of longitude for the world.

Aitne A small outer moon of Jupiter discovered in 2001. Its diameter is about 3 km (2 miles).

albedo The proportion of the light falling on a body or surface that is reflected. Albedo is given either as a decimal between 0 (perfectly absorbing) and 1 (perfectly reflecting) or as an equivalent percentage. For a planet or asteroid, the ratio between the total amount of reflected light and the incident light is called the Bond albedo. The reflecting qualities of planetary bodies are also measured by their geometric albedo. Geometric albedo is formally defined as the ratio between the brightness of the body as viewed from the direction of the Sun and the brightness of a hypothetical white sphere of the same size and at the same distance that is diffusely reflecting sunlight.

Algieba

719 Albert A small asteroid discovered from the Vienna Observatory in 1911 by Johann Palisa, who named it after a benefactor of the Observatory, Baron Albert Freiherr von Rothschild. It was subsequently lost for almost 80 years, but recovered by chance in May 2000. It is only about 2–4 km (2 miles) across but makes relatively close approaches to Earth of between 30 and 46 million km (19 and 29 million miles) every 30 years. 1911, the discovery year, was one such occasion.

Albiorix A small outer moon of Saturn in a very elliptical orbit. It was discovered in 2000 and its diameter is estimated to be 26 km (16 miles).

Albireo (Beta Cygni) The second brightest star in the constellation Cygnus. Visual observers regard it as one of the most beautiful double stars. The brightest of the pair is a giant, yellow-orange ➤ *K star* of magnitude 3.2 and is itself a double too close to be split in a telescope. Its companion is a bluish ➤ *B star* of magnitude 5.4. The two stars are separated by 34 arc seconds and are 380 light years away.

Alcaid Alternative form of ➤ *Alkaid*.

Alcor (80 Ursae Majoris) A fourth-magnitude ➤ *A star* very close to ➤ *Mizar*, one of the bright stars forming the “tail” of the Great Bear. The two stars are separated by 11.5 arc minutes on the sky and both can easily be seen by the naked eye. Though they look like a double star, their distances are not known accurately enough to say whether they form a real binary system or not. Alcor is about 81 light years away.

Alcyone (Eta Tauri) The brightest member of the ➤ *Pleiades* star cluster in the constellation Taurus. Alcyone is a ➤ *B star* of magnitude 2.9.

Aldebaran (Alpha Tauri) The brightest star in the constellation Taurus. Its Arabic name means “the follower.” Aldebaran is a giant ➤ *K star* of magnitude 0.9. Although it appears in the sky to be part of the Hyades star cluster, it is not in fact a cluster member, lying only half as far away at a distance of 65 light years.

Alderamin (Alpha Cephei) The brightest star in the constellation Cepheus. It is an ➤ *A star* of magnitude 2.7 lying 49 light years away. The name, which is of Arabic origin, means “the right arm.”

Algenib (Gamma Pegasi) One of the four stars marking the corners of the ➤ *Square of Pegasus*. It is a ➤ *B star* of magnitude 2.8 and is 335 light years away. The name comes from Arabic and means “the side.” The star Alpha Persei, more usually known as ➤ *Mirfak*, is also sometime called Algenib.

Algieba (Gamma Leonis) A second-magnitude star, which is the third brightest in the constellation Leo. Viewed through a telescope, Algieba is a ➤ *visual binary*, consisting of two yellowish giant stars separated by 4 arc seconds. Their individual magnitudes are 2.6 and 3.8, and they take more than 500 years to complete one orbit around each other. Algieba is 126 light years away. Its Arabic name means “the forehead.”

Algol

Algol (The Demon Star; Beta Persei) An ► *eclipsing binary* system in the constellation Perseus, which is one of the best-known of all variable stars. Algol varies between magnitudes 2.2 and 3.5 over a period of 2.87 days because the two stars regularly cross in front of each other as viewed from Earth.

The brighter member of the system is a ► *B star* and the fainter one a much larger but far cooler ► *G star*. As the G star cuts off light from its more brilliant companion, their combined brightness declines over 4 hours, reaching a minimum that lasts only 20 minutes. The eclipse of the dimmer star by its partner causes a dip in brightness of only 0.06 magnitude, which is not detectable by eye. Regular variations in the spectrum of Algol over a period of 1.862 years reveal the presence of a third, more distant star in the system.

The spectrum also reveals evidence for ► *mass transfer* between the two close companions, which are separated by less than one tenth the distance between the Sun and Earth. Observations that Algol is a radio star erratically flaring up to 20 times its normal radio brightness support the idea that mass transfer is taking place.

Alioth (Epsilon Ursae Majoris). The brightest star in the constellation Ursa Major, the Greek letters in this case being allotted in order of position rather than of brightness. Alioth is an ► *A star* of magnitude 1.8 and is 81 light years away.

Alkaid (Eta Ursae Majoris) A star in Ursa Major, at the end of the bear's "tail." It is a ► *B star* of magnitude 1.9. The Arabic name means "chief of the mourners," for the Arabs saw the constellation as a bier rather than a bear. Its distance is 100 light years.

Allan Hills A region in Antarctica from where large numbers of meteorites have been recovered. The meteorites become concentrated in the area by natural movements in the ice sheet, and are relatively easy to identify against the ice.

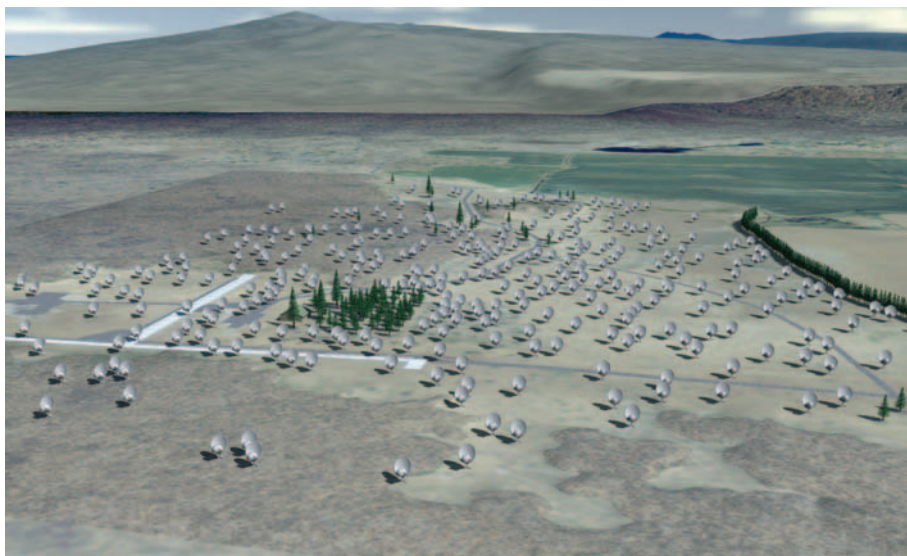
Allen Telescope Array A project of the ► *SETI Institute* and the University of California, Berkeley, to construct a radio telescope in the form of an array of dish antennas each 6.1 meters (200 feet) across. The main purpose is to seek signals from possible extraterrestrial civilizations, but the array will be available for conventional radio astronomy as well. Construction has begun at Hat Creek Observatory. The target is a total of 350 dishes sometime between 2015 and 2020.

Allende meteorite A meteorite of the ► *carbonaceous chondrite* type, which fell in Mexico in 1969. More than 2 tonnes of material was scattered over an area 48 km by 7 km (30 by 4 miles).

ALMA ► *Atacama Large Millimeter Array*.

Almagest A large astronomical work written by the Greek astronomer ► *Ptolemy* (Claudius Ptolemaeus), who worked in Alexandria between about AD 127 and 151. *Almagest* is an Arabic corruption of Greek, meaning "The Greatest," though Ptolemy's original title was *The Mathematical Collection*. It is one of the most important works on astronomy ever written. Ptolemy included a star

Alpha Centauri



The [Allen Telescope Array](#). An artist's impression of the array when complete.

catalog and dealt with the motion of the Moon and planets. The rules set out for calculating the future positions of the planets on the basis of an Earth-centered universe were used for centuries.

almanac A book of tables giving the future positions of the Moon, planets and other celestial objects. An almanac normally covers one calendar year.

Alnath An alternative spelling of the star name ► [Elnath](#).

Alnilam (Epsilon Orionis) One of the three bright stars forming Orion's belt. It is a ► [supergiant](#) ► [B star](#) of magnitude 1.7, estimated to be 1340 light years away. "Alnilam" comes from the Arabic for "string of pearls."

Alnitak (Zeta Orionis) One of the three bright stars forming Orion's belt. Its Arabic name means "the girdle." Alnitak is a ► [supergiant](#) ► [O star](#) of magnitude 1.8 and is about 800 light years away.

Alpha Centauri The brightest star in the constellation Centaurus and the nearest bright star to the Sun, at a distance of 4.36 light years. It is a ► [visual binary](#) star with an orbital period of 80 years. It consists of a ► [G star](#) and a ► [K star](#), which have a combined magnitude of 0.27. The eleventh-magnitude star Proxima Centauri, though two degrees away on the sky, is thought to be associated with this star system because it has a similar motion in space. Proxima, a dim ► [M star](#), is the nearest star to the Sun at a distance of 4.24 light years. Alpha Centauri is also called by the Arabic name Rigil Kentaurus (sometimes Rigil, or shortened to Rigil Kent), which means "the foot of the Centaur." Another alternative name is Toliman.

Alphard

Alphard (Alpha Hydrae) The brightest star in the constellation Hydra. Its Arabic name means “the solitary one of the serpent.” It is a ► *K star* of magnitude 2.0 lying 175 light years away.

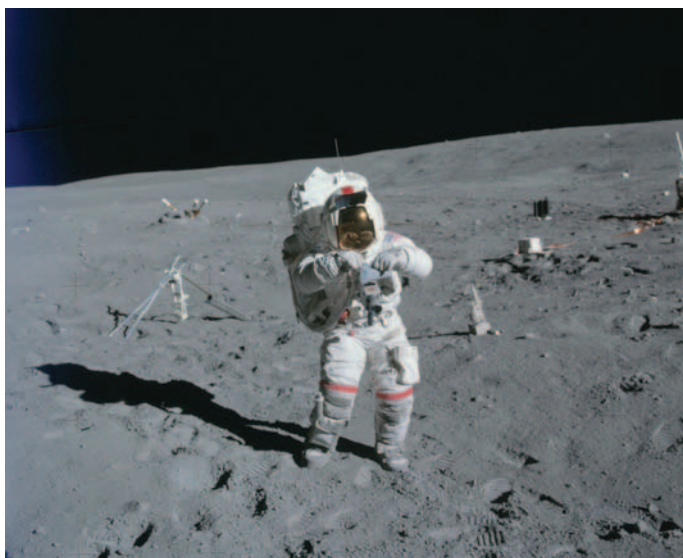
Alphekka (Gemma; Alpha Coronae Borealis) The brightest star in the constellation Corona Borealis. It is an ► *A star* of magnitude 2.2. The Arabic name, also spelt Alphecca, means “bright one.” This star is sometimes called by the Latin name Gemma, the “jewel” in the crown. Its distance is 75 light years.

Alpheratz (Sirrah; Alpha Andromedae) The brightest star in the constellation Andromeda, also marking one corner of the ► *Square of Pegasus*. It was formerly considered to belong to Pegasus and was designated Delta Pegasi. Alpheratz is an ► *A star* of magnitude 2.1 and is 97 light years away.

Alphonsus A lunar crater, 118 km (73 miles) in diameter. A prominent ridge runs across the center, almost along a north-south line, through a central peak about 1 km high. Temporary reddish clouds were observed there in 1958 and 1959, possibly due to the release of gas from the rocks.

Alpine Valley (Vallis Alpes) A flat-bottomed valley on the Moon, running for 150 km (95 miles). It crosses the lunar Alps and connects the Mare Frigoris with the Mare Imbrium.

ALSEP Abbreviation for Apollo Lunar Science Experiment Package, an experimental set-up deployed on the Moon by astronauts during the manned ► *Apollo program* (1969–72). One was left by every mission except the first. All the experiments were turned off in 1978.



The Apollo 16 **ALSEP** with astronaut John Young.