Wikipedia

Coordinates: $14^h\,39^m\,36.4951^s$, −60° 50′ 02.308″

Alpha Centauri

Alpha Centauri (**α Centauri**, abbreviated **Alf Cen**, **α Cen**) is the closest star system to the Solar System, being 4.37 light-years (1.34 pc) from the Sun. It consists of three stars: Alpha Centauri A (also named Rigil Kentaurus[13]) and Alpha Centauri B, which form the binary star Alpha Centauri AB, and a small and faint red dwarf, Alpha Centauri C (also named Proxima Centauri[13]), which is loosely gravitationally bound and orbiting the other two at a current distance of about 13,000 astronomical units (0.21 ly). To the unaided eye, the two main components appear as a single point of light with an apparent visual magnitude of −0.27 , forming the brightest star in the southern constellation of Centaurus and is the third-brightest star in the night sky, outshone only by Sirius and Canopus.

Alpha Centauri A (α Cen A) has 1.1 times the mass and 1.519 times the luminosity of the Sun, while Alpha Centauri B (α Cen B) is smaller and cooler, at 0.907 times the Sun's mass and 0.445 times its visual luminosity.[14] During the pair's 79.91-year orbit about a common centre,[15] the distance between them varies from nearly that between Pluto and the Sun (35.6 AU) to that between Saturn and the Sun (11.2 AU).

Proxima Centauri (α Cen C) is at the slightly smaller distance of 4.24 light-years (1.30 pc) from the Sun, making it the closest star to the Sun, even though it is not visible to the naked eye. The separation of Proxima from Alpha Centauri AB is about 13,000 astronomical units (0.21 ly),[16] equivalent to about 430 times the size of Neptune's orbit. Proxima Centauri b, an Earth-sized exoplanet in the habitable zone of Proxima Centauri, was discovered in 2016.

Alpha Centauri

α Centauri AB is the bright star to the left, with Proxima Centauri circled in red. The bright star to the right is β Centauri

Observation data Epoch J2000.0 Equinox J2000.0	
Constellation	Centaurus
Alpha Centauri A	
Right ascension	$14^h\,39^m\,36.49400^s$[1]
Declination	−60° 50′ 02.3737″[1]
Apparent magnitude (V)	+0.01[2]
Alpha Centauri B	
Right ascension	$14^h\,39^m\,35.06311^s$[1]
Declination	−60° 50′ 15.0992″[1]
Apparent magnitude (V)	+1.33[2]

Contents

Nomenclature

α Centauri (Latinised to *Alpha Centauri*) is the system's Bayer designation. It bore the traditional name *Rigil Kentaurus*, which is a latinisation of the Arabic name رجل القنطورس *Rijl al-Qanṭūris,* meaning "Foot of the Centaur".[17][18]

Characteristics	
A	
Spectral type	G2V[3]
U−B colour index	+0.24[2]
B−V colour index	+0.71[2]
B	
Spectral type	K1V[3]
U−B colour index	+0.68[2]
B−V colour index	+0.88[2]
Astrometry	
A	
Radial velocity (R_v)	−21.4 ± 0.76[4] km/s
Proper motion (μ)	RA: −3679.25[1] mas/yr Dec.: 473.67[1] mas/yr
Parallax (π)	754.81 ± 4.11[1] mas
Distance	4.37[5] ly
Absolute magnitude (M_V)	4.38[6]
B	
Radial velocity (R_v)	−18.6 ± 1.64[4] km/s
Proper motion (μ)	RA: −3614.39[1] mas/yr Dec.: 802.98[1] mas/yr
Parallax (π)	754.81 ± 4.11[1] mas
Distance	4.37[5] ly
Absolute magnitude (M_V)	5.71[6]
Details	
Alpha Centauri A	
Mass	1.100[7] $M_\odot$
Radius	1.2234 ± 0.0053[8] $R_\odot$

Alpha Centauri C was discovered in 1915 by the Scottish astronomer Robert Innes, Director of the Union Observatory in Johannesburg, South Africa,[19] who suggested that it be named *Proxima Centauri*[20] (actually *Proxima Centaurus*).[21] The name is from Latin, meaning 'nearest [star] of Centaurus'.[22]

In 2016, the International Astronomical Union organized a Working Group on Star Names (WGSN)[23] to catalog and standardize proper names for stars. The WGSN states that in the case of multiple stars the name should be understood to be attributed to the brightest component by visual brightness.[24] The WGSN approved the name *Proxima Centauri* for *Alpha Centauri C* on 21 August 2016 and the name *Rigil Kentaurus* for *Alpha Centauri A* on 6 November 2016. They are now both so included in the List of IAU-approved Star Names.[13]

Nature and components

Alpha Centauri is the name given to what appears as a single star to the naked eye and the brightest star in the southern constellation of Centaurus. At −0.27 apparent visual magnitude (calculated from A and B magnitudes), it is fainter only than Sirius and Canopus. The next-brightest star in the night sky is Arcturus. Alpha Centauri is a multiple-star system, with its two main stars being Alpha Centauri A (α Cen A) and Alpha Centauri B (α Cen B), usually defined to identify them as the different components of the binary α Cen AB. A third companion—Proxima Centauri (or Proxima or α Cen C)—is much further away than the distance between stars A and B, but is still gravitationally associated with the AB system. As viewed from Earth, it is located at an angular separation of 2.2° from the two main stars. Proxima Centauri would appear to the naked eye as a separate star from α Cen AB if it were bright enough to be seen without a telescope. Alpha Centauri AB and Proxima Centauri form a *visual* double star. Together, the three components make a triple star system, referred to by double-star observers as the triple star (or multiple star), α Cen AB-C.

Together, the bright visible components of the binary star system are called Alpha Centauri AB (α Cen AB). This "AB" designation denotes the apparent gravitational centre of the main binary system relative to other companion star(s) in any multiple star system.[25] "AB-C" refers to the orbit of Proxima around the central binary, being the distance between the centre of gravity and the outlying companion. Some older references use the confusing and now discontinued designation of A×B. Because the distance between the Sun and Alpha Centauri AB does not differ significantly from either star, gravitationally this binary system is considered as if it were one object.[26]

Luminosity	1.519[7] $L_\odot$
Surface gravity (log *g*)	4.30[9] cgs
Temperature	5,790[7] K
Metallicity [Fe/H]	0.20[7] dex
Rotation	22[10] days
Age	≈4.4[11] Gyr
Alpha Centauri B	
Mass	0.907[7] $M_\odot$
Radius	0.8632 ± 0.0037[8] $R_\odot$
Luminosity	0.5002[7] $L_\odot$
Surface gravity (log *g*)	4.37[9] cgs
Temperature	5,260[7] K
Metallicity	0.23[7]
Rotation	41[10] days
Age	≈6.5[11] Gyr
Orbit[12]	
Primary	A
Companion	B
Period (P)	79.91 ± 0.011 yr
Semi-major axis (a)	17.57 ± 0.022″
Eccentricity (e)	0.5179 ± 0.000 76
Inclination (i)	79.205 ± 0.041°
Longitude of the node (Ω)	204.85 ± 0.084°
Periastron epoch (T)	1 875.66 ± 0.012
Argument of periastron (ω) (secondary)	231.65 ± 0.076°
Other designations	

Asteroseismic studies, chromospheric activity, and stellar rotation (gyrochronology), are all consistent with the α Cen system being similar in age to, or slightly older than, the Sun, with typical ages quoted between 4.5 and 7 billion years (Gyr).[11] Asteroseismic analyses that incorporate the tight observational constraints on the stellar parameters for α Cen A and/or B have yielded age estimates of 4.85 ± 0.5 Gyr,[7] 5.0 ± 0.5 Gyr,[27] 5.2–7.1 Gyr,[28] 6.4 Gyr,[29] and 6.52 ± 0.3 Gyr.[30] Age estimates for stars A and B based on chromospheric activity (Calcium H & K emission) yield 4.4–6.5 Gyr, whereas gyrochronology yields 5.0 ± 0.3 Gyr.[11]

Alpha Centauri A

Alpha Centauri A, also known as Rigil Kentaurus, is the principal member, or *primary*, of the binary system, being slightly larger and more luminous than the Sun. It is a solar-like main-sequence star with a similar yellowish colour,[31] whose stellar classification is spectral type G2 V. From the determined mutual orbital parameters, Alpha Centauri A is about 10 percent more massive than the Sun, with a radius about 22 percent larger. The projected rotational velocity ($v \cdot \sin i$) of this star is 2.7 ± 0.7 km/s, resulting in an estimated rotational period of 22 days,[32] which gives it a slightly faster rotational period than the Sun's 25 days. When considered among the individual brightest stars in the sky (excluding the Sun), Alpha Centauri A is the fourth brightest at an apparent visual magnitude of +0.01, being fractionally fainter than Arcturus at an apparent visual magnitude of −0.04.

Alpha Centauri B

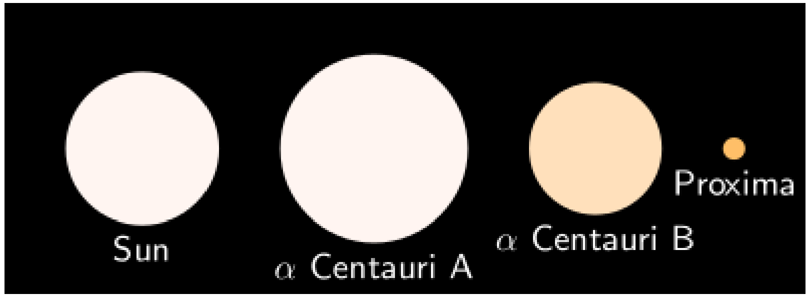
Alpha Centauri B is the companion star, or *secondary*, of the binary system, and is slightly smaller and less luminous than the Sun. It is a main-sequence star of spectral type K1 V, making it more an orange colour than the primary star.[31] Alpha Centauri B is about 90 percent the mass of the Sun and 14 percent smaller in radius. The projected rotational velocity ($v \cdot \sin i$) is 1.1 ± 0.8 km/s, resulting in an estimated rotational period of 41 days. (An earlier, 1995 estimate gave a similar rotation period of 36.8 days.)[33] Although it has a lower luminosity than component A, star B emits more energy in the X-ray band.[34] The light curve of B varies on a short time scale and there has been at least one observed flare.[34] Alpha Centauri B at an apparent visual magnitude of 1.33 would be twenty-first in brightness if it could be seen independently of Alpha Centauri A.

Alpha Centauri C (Proxima Centauri)

Toliman, Bungula, Gliese 559, FK5 538, CD−60°5483, CCDM J14396-6050, GC 19728	
α Cen A: Rigil Kentaurus, Rigil Kent, α[1] Centauri, HR 5459, HD 128620, GCTP 3309.00, LHS 50, SAO 252838, HIP 71683	
α Cen B: α[2] Centauri, HR 5460, HD 128621, LHS 51, HIP 71681	
Database references	
SIMBAD	AB (http://simbad.u-strasbg.fr/simbad/sim-id?Ident=alpha+centauri)
	A (http://simbad.u-strasbg.fr/simbad/sim-id?Ident=TYC+9007-5849-1)
	B (http://simbad.u-strasbg.fr/simbad/sim-id?Ident=TYC+9007-5848-1)
Exoplanet Archive	data (http://exoplanetarchive.ipac.caltech.edu/cgi-bin/DisplayOverview/nph-DisplayOverview?objname=alpha+centauri)
ARICNS	data (http://wwwadd.zah.uni-heidelberg.de/datenbanken/aricns/cnspages/4c01151.htm)
Extrasolar Planets	data (http://exoplanet.

Encyclopaedia	eu/star.php?st=alf+cen)

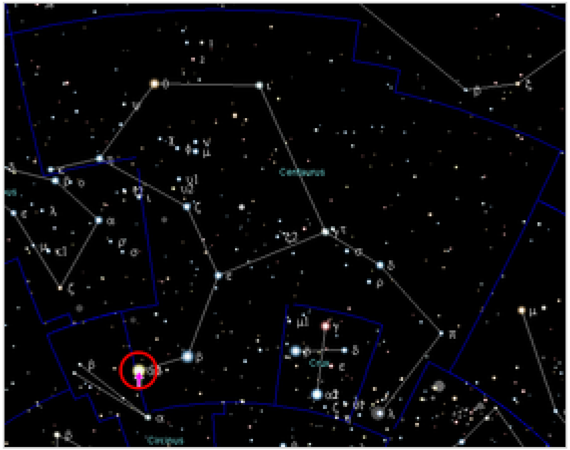
Alpha Centauri C, also known as Proxima Centauri, is of spectral class M6 Ve, a small main-sequence star (Type V) with emission lines. Its B–V colour index is +1.82 and its mass is about 0.123 solar masses ($M_{\odot}$), or 129 Jupiter masses.



The relative sizes and colours of stars in the Alpha Centauri system, compared to the Sun

Observation

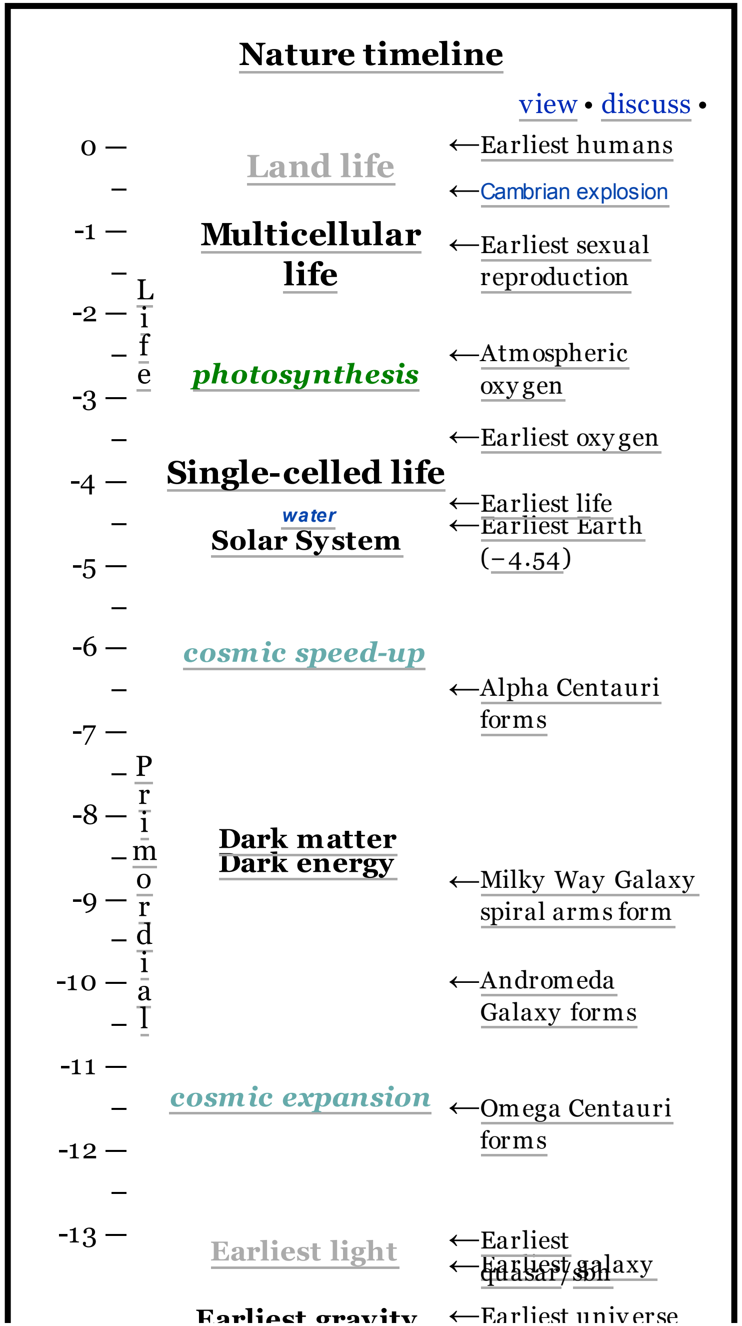
The two stars of the binary Alpha Centauri AB are too close together to be resolved by the naked eye, as apparent angular separation varies over about 80 years between 2 and 22 arcsec (the naked eye has a resolution of 60 arcsec),[35] but through much of the orbit, both are easily resolved in binoculars or small 5 cm (2 in) telescopes.[36]



Location of Alpha Centauri in Centaurus

In the southern hemisphere, Alpha Centauri forms the outer star of *The Pointers* or *The Southern Pointers*,[36] so called because the line through Beta Centauri (Hadar/Agena),[37] some 4.5° west,[36] points directly to the constellation Crux—the Southern Cross.[36] The Pointers easily distinguish the true Southern Cross from the fainter asterism known as the False Cross.[38]

South of about 29° S latitude, Alpha Centauri is circumpolar and never sets below the horizon.[40] Both stars and Crux are too far south to be visible for mid-latitude northern observers. Below about 29° N latitude to the equator (roughly Hermosillo, Chihuahua City in Mexico, Galveston, Texas, Ocala, Florida and Lanzarote, the Canary Islands of Spain) during the northern summer, Alpha Centauri lies close to the southern horizon.[37] The star culminates each year at midnight on 24 April or 9 p.m. on 8 June.[37][41]



Axis scale: billions of years ago.
Also see: *Human timeline* and *Life timeline*

As seen from Earth, Proxima Centauri is 2.2° southwest from Alpha Centauri AB.[42] This is about four times the angular diameter of the Full Moon, and almost exactly half the distance between Alpha Centauri AB and Beta Centauri. Proxima usually appears as a deep-red star of an apparent visual magnitude of 11.1 in a sparsely populated star field, requiring moderately sized telescopes to see. Listed as V645 Cen in the *General Catalogue of Variable Stars (G.C.V.S.) Version 4.2*, this UV Ceti-type flare star can unexpectedly brighten rapidly by as much as 0.6 magnitudes at visual wavelengths, then fade after only a few minutes.[43] Some amateur and professional astronomers regularly monitor for outbursts using either optical or radio telescopes.[44] In August 2015 the largest recorded flares of the star occurred, with the star becoming 8.3 times brighter than normal on 13 August.[45]

The two bright stars at the lower right are Alpha (right) and Beta Centauri (left, above antenna). A line drawn through them points to the four bright stars of the Southern Cross, just to the right of the dome of La Silla Observatory.[39]

Observational history

Alpha Centauri was listed in the 2nd-century star catalog of Ptolemy. He gives the ecliptic coordinates, but texts differ as to whether the ecliptic latitude reads 44° 10′ South or 41° 10′ South.[46] (Presently the ecliptic latitude is 43.5° South but it has decreased by a fraction of a degree since Ptolemy's time due to proper motion.) In Ptolemy's time Alpha Centauri was visible from his city of Alexandria, Egypt, at 31° N, but due to precession its declination is now –60° 51′ South and it can no longer be seen at that latitude.

English explorer Robert Hues brought Alpha Centauri to the attention of European observers in his 1592 work *Tractatus de Globis*, along with Canopus and Achernar, noting "Now, therefore, there are but three Stars of the first magnitude that I could perceive in all those parts which are never seene here in England. The first of these is that bright Star in the sterne of Argo which they call Canobus. The second is in the end of Eridanus. The third [Alpha Centauri] is in the right foote of the Centaure."[47]

View of Alpha Centauri from the Digitized Sky Survey 2

The binary nature of Alpha Centauri AB was first recognized in December 1689 by astronomer and Jesuit priest Jean Richaud. The finding was made incidentally while observing a passing comet from his station in Puducherry. Alpha Centauri was only the second binary star system to be discovered, preceded by Alpha Crucis.[48]

By 1752, French astronomer Nicolas Louis de Lacaille made astrometric positional measurements using state-of-the-art instruments of that time.[49] Its large proper motion was discovered by Manuel John Johnson, observing from Saint Helena, who informed Thomas Henderson at the Royal Observatory, Cape of Good Hope of it. The parallax of Alpha Centauri was subsequently determined by Henderson from many exacting positional observations of the AB system between April 1832 and May 1833. He withheld his results, however, because he suspected they were too large to be true, but eventually published them in 1839 after Friedrich Wilhelm Bessel released his own accurately determined parallax for 61 Cygni in 1838.[50] For this reason, Alpha Centauri is sometimes considered as the second star to have its distance measured because Henderson's work was not fully recognized at first.[50] (The distance of Alpha is now reckoned at 4.396 ly or 41.59 trillion km.)

Later, John Herschel made the first micrometrical observations in 1834.[51] Since the early 20th century, measures have been made with photographic plates.[52]

Compared to the Sun, Alpha Centauri A is of the same stellar type G2, while Alpha Centauri B is a K1-type star.[53]

By 1926, South African astronomer William Stephen Finsen calculated the approximate orbit elements close to those now accepted for this system.[54] All future positions are now sufficiently accurate for visual observers to determine the relative places of the stars from a binary star ephemeris.[55] Others, like the Belgian astronomer D. Pourbaix (2002), have regularly refined the precision of any new published orbital elements.[15]

Alpha Centauri is inside the G-cloud, and the nearest known system to it is the binary brown dwarf system Luhman 16 at 3.6 ly (1.1 pc).[56]

Scottish astronomer Robert T. A. Innes discovered Proxima Centauri in 1915 by blinking photographic plates taken at different times during a dedicated proper motion survey. This showed the large proper motion and parallax of the star was similar in both size and direction to those of Alpha Centauri AB, suggesting immediately it was part of the system and slightly closer to Earth than Alpha Centauri AB. Lying 4.24 ly (1.30 pc) away, Proxima Centauri is the nearest star to the Sun. All current derived distances for the three stars are from the parallaxes obtained from the Hipparcos star catalogue (HIP)[57][58][59][60] and the Hubble Space Telescope.[61]

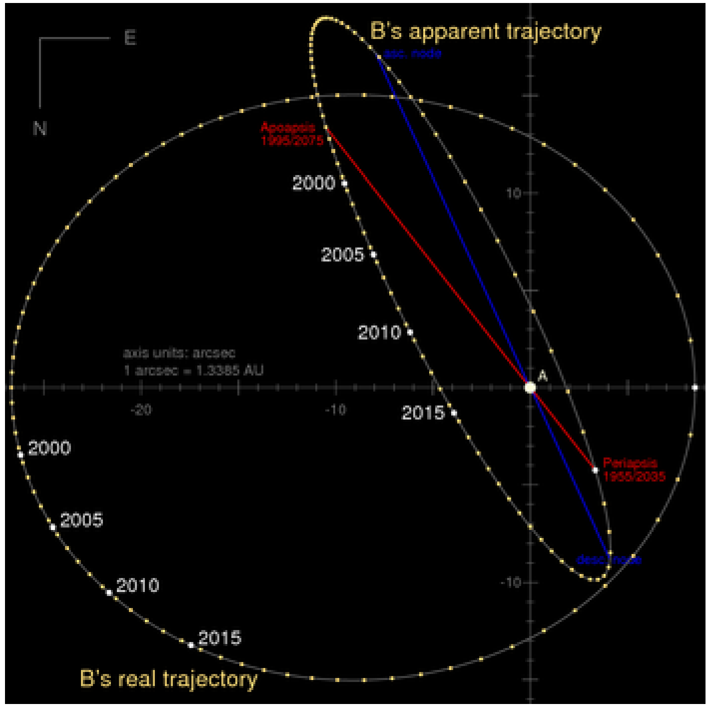
Binary system

With the orbital period of 79.91 years,[15] the A and B components of this binary star can approach each other to 11.2 AU (1.68 billion km), or about the mean distance between the Sun and Saturn; and may recede as far as 35.6 AU (5.33 billion km), approximately the distance from the Sun to Pluto.[15][62] This is a consequence of the binary's moderate orbital eccentricity $e = 0.5179$.[15] From the orbital elements, the total mass of both stars is about 2.0 $M_\odot$[63]—or twice that of the Sun.[62] The average individual stellar masses are 1.09 $M_\odot$ and 0.90 $M_\odot$, respectively,[64] though slightly higher masses have been quoted in recent years, such as 1.14 $M_\odot$ and 0.92 $M_\odot$,[65] or totalling 2.06 $M_\odot$. Alpha Centauri A and B have absolute magnitudes of +4.38 and +5.71, respectively. Stellar evolution theory implies both stars are slightly older than the Sun at 5 to 6 billion years, as derived by both mass and their spectral characteristics.[42][64]

Viewed from Earth, the *apparent orbit* of this binary star means that its separation and position angle (PA) are in continuous change throughout its projected orbit. Observed stellar positions in 2010 are separated by 6.74 arcsec through the PA of 245.7°, reducing to 6.04 arcsec through 251.8° in 2011.[15] The closest recent approach was in February 2016, at 4.0 arcsec through 300°.[15][66] The observed maximum separation of these stars is about 22 arcsec, while the minimum distance is 1.7 arcsec.[67] The widest separation occurred during February 1976 and the next will be in January 2056.[15]

In the *true orbit*, closest approach or periastron was in August 1955, and next in May 2035. Furthest orbital separation at apastron last occurred in May 1995 and the next will be in 2075. The apparent distance between the two stars is rapidly decreasing, at least until 2019.[15]

Proxima Centauri



Apparent and true orbits of Alpha Centauri. The A component is held stationary and the relative orbital motion of the B component is shown. The apparent orbit (thin ellipse) is the shape of the orbit as seen by an observer on Earth. The true orbit is the shape of the orbit viewed perpendicular to the plane of the orbital motion. According to the radial velocity vs. time [12] the radial separation of A and B along the line of sight had reached a maximum in 2007 with B being behind A. The orbit is divided here into 80 points, each step refers to a timestep of approx. 0.99888 years or 364.84 days.

The much fainter red dwarf Proxima Centauri, or simply Proxima, is about 13,000 astronomical units (AU) away from Alpha Centauri AB.[16][42][52] This is equivalent to 0.21 ly or 1.9 trillion km—about 5% the distance between Alpha Centauri AB and the Sun. Due to the large distance between Proxima and Alpha, it was long unknown whether they were gravitationally bound. The true orbital speed is necessarily small, and it was necessary to measure the speeds of Proxima and Alpha with a great precision. Otherwise it was impossible to ascertain whether Proxima is bound to Alpha or whether it is a completely unrelated star that happens to be undergoing a close approach at a low relative speed. Probability suggested that such low speed approaches would be rare and unlikely, but it could not be ruled out.

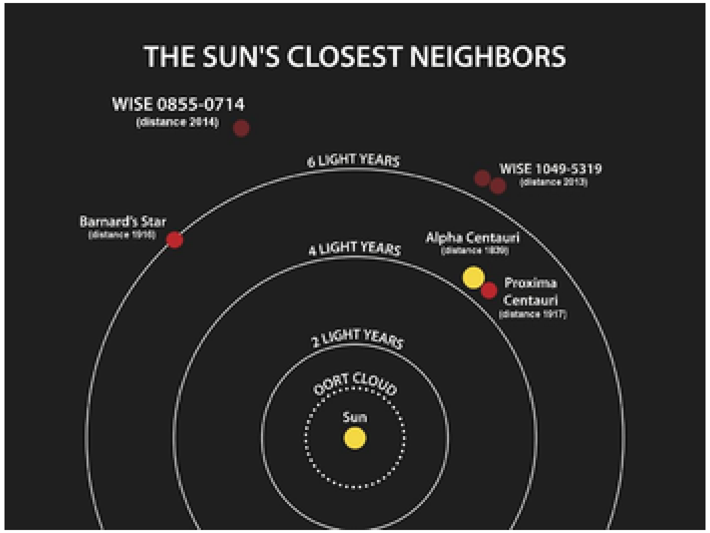
It was only in 2017 that a paper by Kervella, et al., showed that, based on high precision radial velocity measurements and with a high degree of confidence, Proxima and Alpha Centauri are in fact gravitationally bound.[16] The orbital period of Proxima is approximately 550,000 years, with an eccentricity of $0.50^{+0.08}_{-0.09}$. Proxima comes within 4300^{+1100}_{-900} AU of Alpha Centauri AB at periastron, and the apastron occurs at $13\,000^{+300}_{-100}$ AU.[16]

Relative positions of Sun, Alpha Centauri AB and Proxima Centauri. Grey dot is projection of Proxima Centauri

Proxima is a red dwarf of spectral class M6 Ve with an absolute magnitude of +15.60, which is only a small fraction of the Sun's luminosity. By mass, Proxima is calculated as $0.123 \pm 0.06\ M_{\odot}$ (rounded to $0.12\ M_{\odot}$) or about one-eighth that of the Sun.[68]

Kinematics

All components of Alpha Centauri display significant proper motions against the background sky, similar to the first-magnitude stars Sirius and Arcturus. Over the centuries, this causes the apparent stellar positions to slowly change. Such motions define the *high-proper-motion stars*.[70] These stellar motions were unknown to ancient astronomers. Most assumed that all stars were immortal and permanently fixed on the celestial sphere, as stated in the works of the philosopher Aristotle.[71]

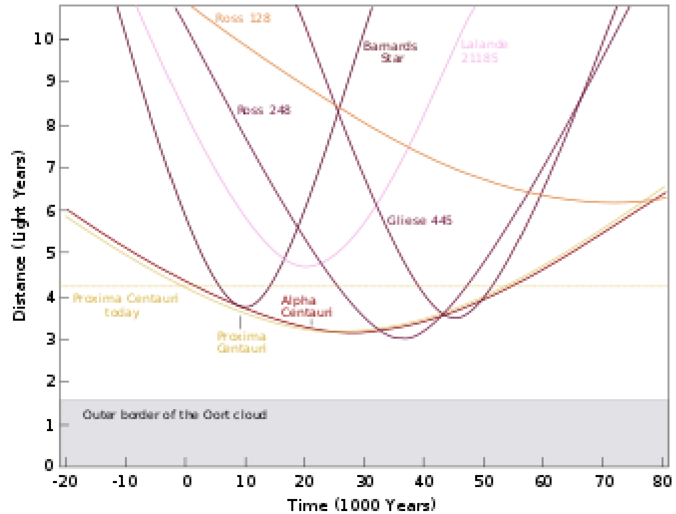


Stars closest to the Sun, including *Alpha Centauri* (25 April 2014).[69]

Edmond Halley in 1718 found that some stars had significantly moved from their ancient astrometric positions.[72] For example, the bright star Arcturus (α Boo) in the constellation of Boötes showed an almost 0.5° difference in 1800 years,[73] as did the brightest star, Sirius, in Canis Major (α CMa).[74] Halley's positional comparison was Ptolemy's catalogue of stars contained in the Almagest[75] whose original data included portions from an earlier catalogue by Hipparchos during the 1st century BCE.[76][77][78] Halley's proper motions were mostly for northern stars, so the southern star Alpha Centauri was not determined until the early 19th century.[67]

Scottish-born observer Thomas Henderson in the 1830s at the Royal Observatory at the Cape of Good Hope discovered the true distance to Alpha Centauri.[79][80] He soon realized this system was likely to have a high proper motion,[81][82][67] In this case, the apparent stellar motion was found using Nicolas Louis de Lacaille's astrometric observations of 1751–1752,[83] by the observed differences between the two measured positions in different epochs.

Combining the 2007 revised data from the Hipparcos Star Catalogue (HIP) for the main binary star components,[84][85] the average cumulative common proper motion (cpm.) of Alpha Centauri AB is about 6.1 arcmin each century, and 61.4 arcmin or 1.02° each millennium. These motions are about one-fifth and twice, respectively, the diameter of the full Moon. Using spectroscopy the mean radial velocity has been determined to be around 20 km/s towards the Solar System.[4]



Distances of the nearest stars from 20,000 years ago until 80,000 years in the future

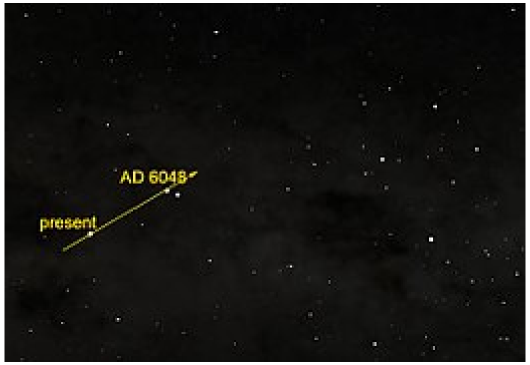
Since α Centauri A and B are almost exactly in the plane of the Milky Way as viewed from here, there are many stars behind them. In early May, 2028, α Centauri A will pass between us and a distant red star. There is a 45% probability that an Einstein ring may be observed. Other near conjunctions will also happen in the coming decades. These will allow very accurate measurements of the proper motions of the components and may give information on planets.[86]

Predicted Future Changes

As the stars of Alpha Centauri approach the Solar System, measured common proper motions and trigonometric parallaxes slowly increase.[42][87][84] These smaller effects will change until the star system becomes closest to Earth, and begin reversing as the distance increases again.[25] Furthermore, other small changes also occur with the binary star's orbital elements. For example, in the size of the semi-major axis of the orbital ellipse will increasing by 0.03 arcsec per century.[25] Also the observed position angles of the stars are also subject to small cumulative changes (additional to position angle changes caused by the Precession of the Equinoxes), as first determined by W. H. van den Bos in 1926.[88][89][90]

Based on knowing these common proper motions and radial velocities, Alpha Centauri will continue to gradually brighten, passing just north of the Southern Cross or Crux, before moving northwest and up towards the celestial equator and away from the galactic plane. By about 29,700 AD, in the present-day constellation of Hydra, Alpha Centauri will be 1.00 pc or 3.3 ly away.,[87] though later calculations suggest 0.90 pc or 2.9 ly in 29,000 AD.[91] Then it will reach the stationary radial velocity (RVel) of 0.0 km/s and the maximum apparent magnitude of −0.86v (which is comparable to present-day magnitude of Canopus). Even during the time of this nearest approach, however, the apparent magnitude of Alpha Centauri will still not surpass that of Sirius, which will brighten incrementally over the next 60,000 years, and will continue to be the brightest star as seen from Earth for the next 210,000 years.[92]

About 28,000 years from now, the Alpha Centauri system will then begin to move away from the Solar System, showing a positive radial velocity.[87] Because of visual perspective, these stars will reach a final vanishing point and slowly disappear among the countless stars of the Milky Way. Here this once bright yellow star will fall below naked-eye visibility. somewhere in the faint present day southern constellation of Telescopium. This unusual location results from the fact that Alpha Centauri's orbit around the galactic centre is highly tilted with respect to the plane of the Milky Way.[87]



Apparent motion of Alpha Centauri relative to Beta Centauri

Viewed from the Earth in about 6200 AD, the common proper motion of the main binary star Alpha Centaui AB will appear only 23 arcmin north (or two-thirds the diameter of the Moon) of Beta Centauri and form a spectacularly brilliant optical double star.[93] Beta Centauri is in reality far more distant than Alpha Centauri.

Planets

The Alpha Centauri planetary system

Companion (in order from star)	Mass	Semimajor axis (AU)	Orbital period (days)	Eccentricity	Inclination	Radius
Bc (unconfirmed)	—	0.141	20.4	<0.24	—	0.92 $R_\oplus$
Cb	≥1.27 $^{+0.19}_{-0.17}$ $M_\oplus$	0.0485 $^{+0.0041}_{-0.0051}$	11.186	<0.35	—	—

Note: Planet Bb disproven in 2015.

Proxima Centauri b

In August 2016, the European Southern Observatory announced the discovery of a planet slightly larger than the Earth orbiting Proxima Centauri.[94] Proxima Centauri b was found using the radial velocity method, where periodic Doppler shifts of spectral lines of the host star suggest an orbiting object. From these readings, the radial velocity of the parent star relative to the Earth is varying with an amplitude of about 2 metres (6.6 ft) per second.[94] The planet lies in the habitable zone of Proxima Centauri, but it is possible that the planet is tidally locked to the star,[94] resulting in temperature extremes that would be difficult for life to overcome.[95]

Alpha Centauri Bb & Bc

In 2012, a planet around Alpha Centauri B was announced, but in 2015 a new analysis concluded that it almost certainly does not exist and was just a spurious artefact of the data analysis.[96][97][98]

Alpha Centauri Bc was first announced in 2013 by Demory et al. It has an estimated orbital period of approximately 12 Earth days – smaller than that of Mercury – with a semimajor axis of 0.10 AU and an eccentricity smaller than 0.24.[99][100]

Possible detection of another planet

On 25 March 2015, a scientific paper by Demory and colleagues published transit results for Alpha Centauri B using the Hubble Space Telescope for a total of 40 hours.[101] They evidenced a transit event possibly corresponding to a planetary body with a radius around 0.92 $R_{\oplus}$. This planet would most likely orbit Alpha Centauri B with an orbital period of 20.4 days or less, with only a 5 percent chance of it having a longer orbit. The median average of the likely orbits is 12.4 days with an impact parameter of around 0–0.3. Its orbit would likely have an eccentricity of 0.24 or less. Like the probably spurious Alpha Centauri Bb, it likely has lakes of molten lava and would be far too close to Alpha Centauri B to harbour life.[102]

Possibility of additional planets

The discovery of planets orbiting other star systems, including similar binary systems (Gamma Cephei), raises the possibility that additional planets may exist in the Alpha Centauri system. Such planets could orbit Alpha Centauri A or Alpha Centauri B individually, or be on large orbits around the binary Alpha Centauri AB. Because both the principal stars are fairly similar to the Sun (for example, in age and metallicity), astronomers have been especially interested in making detailed searches for planets in the Alpha Centauri system. Several established planet-hunting teams have used various radial velocity or star transit methods in their searches around these two bright stars.[103] All the observational studies have so far failed to find any evidence for brown dwarfs or gas giants.[103][104]

In 2009, computer simulations showed that a planet might have been able to form near the inner edge of Alpha Centauri B's habitable zone, which extends from 0.5 to 0.9 AU from the star. Certain special assumptions, such as considering that Alpha Centauri A and B may have initially formed with a wider separation and later moved closer to each other (as might be possible if they formed in a dense star cluster) would permit an accretion-friendly environment farther from the star.[105] Bodies around A would be able to orbit at slightly farther distances due to A's stronger gravity. In addition, the lack of any brown dwarfs or gas giants in close orbits around A or B make the likelihood of terrestrial planets greater than otherwise.[106] Theoretical studies on the detectability via radial velocity analysis have shown that a dedicated campaign of high-cadence observations with a 1-meter class telescope can reliably detect a hypothetical planet of 1.8 $M_\oplus$ in the habitable zone of B within three years.[107]

Radial velocity measurements of Alpha Centauri B with High Accuracy Radial Velocity Planet Searcher spectrograph ruled out planets of more than 4 $M_\oplus$ to the distance of the habitable zone of the star (orbital period P = 200 days).[108]

Current estimates place the probability of finding an earth-like planet around Alpha Centauri A or B at roughly 85%, although this number remains uncertain.[109] The observational thresholds for planet detection in the habitable zones via the radial velocity method are currently (2017) estimated to be about 50 $M_\oplus$ for Alpha Centauri A, 8 $M_\oplus$ for B, and 0.5 $M_\oplus$ for Proxima.[110]

Theoretical planets

Early computer-generated models of planetary formation predicted the existence of terrestrial planets around both Alpha Centauri A and B,[107][111][112] but most recent numerical investigations have shown that the gravitational pull of the companion star renders the accretion of planets very difficult.[105][113] Despite these difficulties, given the similarities to the Sun in spectral types, star type, age and probable stability of the orbits, it has been suggested that this stellar system could hold one of the best possibilities for harbouring extraterrestrial life on a potential planet.[6][106][114][115]

In the Solar System both Jupiter and Saturn were probably crucial in perturbing comets into the inner Solar System. Here, the comets provided the inner planets with their own source of water and various other ices.[116] In the Alpha Centauri system, Proxima Centauri may have influenced the planetary disk as the Alpha Centauri system was forming, enriching the area around Alpha Centauri A and B with volatile materials.[117] This would be discounted if, for example, Alpha Centauri B happened to have gas giants orbiting Alpha Centauri A (or conversely, Alpha Centauri A for Alpha Centauri B), or if the stars B and A themselves were able to perturb comets into each other's inner system as Jupiter and Saturn presumably have done in the Solar System.[116] Such icy bodies probably also reside in Oort clouds of other planetary systems, when they are influenced gravitationally by either the gas giants or disruptions by passing nearby stars many of these icy bodies then travel starwards.[116] Such ideas also apply to the close approach of Alpha Centauri or other stars to the Solar System, where in the distant future of our Oort Cloud may be disrupted enough to see increased numbers of active comets.[87] There is no direct evidence yet of the existence of such an similar Oort cloud around Alpha Centauri AB, and theoretically this may have been totally destroyed during the system's formation.

To be in the star's habitable zone, any suspected planet around Alpha Centauri A would have to be optimally placed about 1.25 AU away – about halfway between the distances of Earth's orbit and Mars's orbit in the Solar System – so as to have similar planetary temperatures and conditions for liquid water to exist. For the slightly less luminous and cooler Alpha Centauri B, the habitable zone would lie closer at about 0.7 AU (100 million km), approximately the distance that Venus is from the Sun.[116][118]

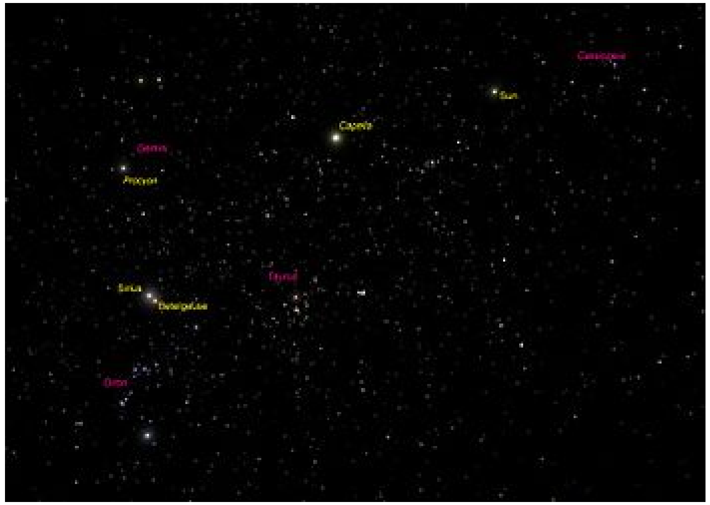
With the goal of finding evidence of such planets, both Proxima Centauri and Alpha Centauri AB were among the listed "Tier 1" target stars for NASA's Space Interferometry Mission (SIM). Detecting planets as small as three Earth-masses or smaller within two astronomical units of a "Tier 1" target would have been possible with this new instrument.[119] The SIM mission, however, was cancelled due to financial issues in 2010.[120]

Circumstellar discs

Based on observations between 2007 and 2012, a study found a slight excess of emissions in the 24 µm (mid/far-infrared) band surrounding α Centauri AB, which may be interpreted as evidence for a sparse circumstellar disc or dense interplanetary dust.[121] The total mass was estimated to be between 10^{-7} to 10^{-6} the mass of the Moon, or 10-100 times the mass of the Solar System's zodiacal cloud.[121] If such a disc existed around both stars, α Centauri A's disc would likely be stable to 2.8 AU, and α Centauri B's would likely be stable to 2.5 AU.[121] This would put A's disc entirely within the frost line, and a small part of B's outer disc just outside.[121]

View from this system

Viewed from near the Alpha Centauri system, the sky would appear very much as it does for an observer on Earth, except that Centaurus would be missing its brightest star. The Sun would be a yellow star of an apparent visual magnitude of +0.5 in eastern Cassiopeia, at the antipodal point of Alpha Centauri's current right ascension and declination, at $02^h\ 39^m\ 35^s$ +60° 50′ (2000). This place is close to the 3.4-magnitude star ε Cassiopeiae. Because of the placement of the Sun, an interstellar or alien observer would find the \/\/ of Cassiopeia had become a /\/\/ shape[note 1] nearly in front of the Heart Nebula in Cassiopeia. Sirius lies less than a degree from Betelgeuse in the otherwise unmodified Orion and with a magnitude of −1.2 is a little fainter than from Earth but still the brightest star in the Alpha Centauri sky. Procyon is also displaced into the middle of Gemini, outshining Pollux, whereas both Vega and Altair are shifted northwestward relative to Deneb (which barely moves, due to its great distance), giving the Summer Triangle a more equilateral appearance.



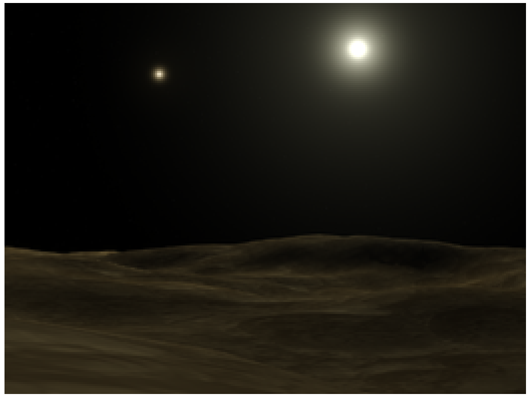
Looking towards the sky around Orion from Alpha Centauri with Sirius near Betelgeuse, Procyon in Gemini, and the Sun between Perseus and Cassiopeia generated by Celestia

From Proxima Centauri b

From Proxima Centauri b, Alpha Centauri AB would appear like two close bright stars with the combined apparent magnitude of −6.8. Depending on the binary's orbital position, the bright stars would appear noticeably divisible to the naked eye, or occasionally, but briefly, as a single unresolved star. Based on the calculated absolute magnitudes, the visual apparent magnitudes of Alpha Centauri A and B would be −6.5 and −5.2, respectively.[122]

From a hypothetical A or B planet

An observer on a hypothetical planet orbiting around either Alpha Centauri A or Alpha Centauri B would see the other star of the binary system as an intensely bright object in the night sky, showing a small but discernible disk while near periapse: A up to 210 arc seconds, B up to 155 arc seconds. Near apoapse, the disc would shrink to 60 arc seconds for A, 43 arc seconds for B, being too small to resolve by naked eye. In any case, the dazzling surface brightness could make the discs harder to resolve than a similarly sized less bright object.



Artist's rendition of the view from a hypothetical airless planet orbiting Alpha Centauri A

For example, some theoretical planet orbiting about 1.25 AU from Alpha Centauri A (so that the star appears roughly as bright as the Sun viewed from the Earth) would see Alpha Centauri B orbit the entire sky once roughly every one year and three months (or 1.3(4) a), the planet's own orbital period. Added to this would be the changing apparent position of Alpha Centauri B during its long eighty-year elliptical orbit with respect to Alpha Centauri A. (The average speed, at 4.5 degrees per Earth year, is comparable in speed to Uranus here. With the eccentricity of the orbit, the maximum speed near periapse, about 18 degrees per Earth year, is faster than Saturn, but slower than Jupiter. The minimum speed near apoapse, about 1.8 degrees per Earth year, is slower than Neptune.) Depending on its and the planet's position on their respective orbits, Alpha Centauri B would vary in apparent magnitude between −18.2 (dimmest) and −21.0 (brightest). These visual apparent magnitudes are much dimmer than the apparent magnitude of the Sun as viewed from the Earth (−26.7). The difference of 5.7 to 8.6 magnitudes means Alpha Centauri B would appear, on a linear scale, 2500 to 190 times dimmer than Alpha Centauri A (or the Sun viewed from the Earth), but also 190 to 2500 times brighter than the full Moon as seen from the Earth (−12.5).

Also, if another similar planet orbited at 0.71 AU from Alpha Centauri B (so that in turn Alpha Centauri B appeared as bright as the Sun seen from the Earth), this hypothetical planet would receive slightly more light from the more luminous Alpha Centauri A, which would shine 4.7 to 7.3 magnitudes dimmer than Alpha Centauri B (or the Sun seen from the Earth), ranging in apparent magnitude between −19.4 (dimmest) and −22.1 (brightest). Thus Alpha Centauri A would appear between 830 and 70 times dimmer than the Sun but some 580 to 6900 times brighter than the full Moon. During the orbital period of such a planet of 0.6(3) a, an observer on the planet would see this intensely bright companion star circle the sky just as humans see with the Solar System's planets. Furthermore, Alpha Centauri A's sidereal period of approximately eighty years means that this star would move through the local ecliptic as slowly as Uranus with its eighty-four year period, but as the orbit of Alpha Centauri A is more elliptical, its apparent magnitude will be far more variable. Although intensely bright to the eye, the overall illumination would not significantly affect climate nor influence normal plant photosynthesis.[116]

An observer on the hypothetical planet would notice a change in orientation to very-long-baseline interferometry reference points commensurate with the binary orbit periodicity plus or minus any local effects such as precession or nutation.

Assuming this hypothetical planet had a low orbital inclination with respect to the mutual orbit of Alpha Centauri A and B, then the secondary star would start beside the primary at "stellar" conjunction. Half the period later, at "stellar" opposition, both stars would be opposite each other in the sky. As a net result, both the local sun and the other star would each be in the sky for half a day, like Sun and Moon are both above the horizon for half a day. But during stellar conjunction, the other star being "new" would be in the sky during daytime, while during the opposition, the other star being "full" would be in the sky for the whole night. In an Earth-like atmosphere, the light of the other star would be appreciably scattered, causing the sky to be perceptibly blue though darker than during daytime, like during twilight or total solar eclipse. Humans could easily walk around and clearly see the surrounding terrain, and reading a book would be quite possible without any artificial light.[116] Over the following half period, the secondary star would be in the sky for a progressively decreasing part of the night (and an increasing part of the day) until at the next conjunction the secondary star would only be in the sky during daytime near the primary star.

From a planet orbiting Alpha Centauri A or B, Proxima Centauri would appear as a fourth to fifth magnitude star, as bright as the faint stars of the constellation of Ursa Minor.[123][124]

Other names

In modern literature, *Rigil Kent*[125] (also *Rigel Kent* and variants;[note 2] /ˈraɪdʒəl ˈkɛnt/)[17][126] and *Toliman*,[127] were cited as colloquial alternative names of Alpha Centauri.

Rigil Kent is short for *Rigil Kentaurus*,[128] which is sometimes further abbreviated to *Rigil* or *Rigel*, though that is ambiguous with Beta Orionis, which is also called Rigel. Although the short form *Rigel Kent* is often cited as an alternative name, the star system is most widely referred to by its Bayer designation *Alpha Centauri*.

The name *Toliman* originates with Jacobus Golius' edition of Al-Farghani's *Compendium* (published posthumously in 1669). *Tolimân* is Golius' latinization of the Arabic name الظلمان *al-Ẓulmān* "the ostriches", the name of an asterism of which Alpha Centauri formed the main star.[129]

During the 19th century, the northern amateur popularist Elijah H. Burritt used the now-obscure name *Bungula*,[130] possibly coined from "β" and the Latin *ungula* ("hoof").[17]

Together, Alpha and Beta Centauri form the "Southern Pointers" or "The Pointers", as they point towards the Southern Cross, the asterism of the constellation of Crux.[93]

In Standard Mandarin Chinese, 南門 *Nán Mén*, meaning *Southern Gate*, refers to an asterism consisting of α Centauri and ε Centauri. Consequently, α Centauri itself is known as 南門二 *Nán Mén Èr*, the Second Star of the Southern Gate.[131]

To the Australian aboriginal Boorong people of northwestern Victoria, Alpha and Beta Centauri are *Bermbermgle*,[132] two brothers noted for their courage and destructiveness, who speared and killed *Tchingal* "The Emu" (the Coalsack Nebula).[133] The form in Wotjobaluk is *Bram-bram-bult*.[132]

Exploration

Alpha Centauri is envisioned as a likely first target for manned or unmanned interstellar exploration. Crossing the huge distance between the Sun and Alpha Centauri using current spacecraft technologies would take several millennia, though the possibility of nuclear pulse propulsion or laser light sail technology, as considered in the Breakthrough Starshot program, could reduce the journey time to a matter of decades.[135][136][137]

Breakthrough Starshot is a proof-of-concept initiative to send a fleet of ultra-fast light-driven nanocraft to explore the Alpha Centauri system, which could pave the way for a first launch within the next generation. An objective of the mission would be to make a fly-by of, and possibly photograph, any planets that might exist in the system.[138][139] Proxima Centauri b, announced by the European Southern Observatory (ESO) in August 2016, would be a target for the Starshot program.[138][140]

In January 2017, Breakthrough Initiatives and the ESO entered a collaboration to enable and implement a search for habitable planets in the Alpha Centauri system. The agreement involves Breakthrough Initiatives providing funding for an upgrade to the VISIR (https://www.eso.org/public/teles-instr/vlt/vlt-instr/visir/) (VLT Imager and Spectrometer for mid-Infrared) instrument on ESO's Very Large Telescope (VLT) in Chile. This upgrade will greatly increase the likelihood of planet detection in the system.[134][141]

The Very Large Telescope and star system Alpha Centauri.[134]

Distance

Alpha Centauri AB distance estimates

Source	Parallax, mas	Distance, pc	Distance, ly	Distance, Pm	Ref.
Henderson (1839)	1160 ± 110	0.86 $^{+0.09}_{-0.07}$	2.81 $^{+0.29}_{-0.24}$	26.6 $^{+2.8}_{-2.3}$	[79]
Henderson (1842)	912.8 ± 64	1.10 $^{+0.08}_{-0.07}$	3.57 $^{+0.27}_{-0.23}$	33.8 $^{+2.5}_{-2.2}$	[142]
Maclear (1851)	918.7 ± 34	1.09 ± 0.04	3.55 $^{+0.14}_{-0.13}$	33.6 $^{+1.3}_{-1.2}$	[143]
Moesta (1868)	880 ± 68	1.14 $^{+0.10}_{-0.08}$	3.71 $^{+0.31}_{-0.27}$	35.1 $^{+2.9}_{-2.5}$	[144]
Gill & Elkin (1885)	750 ± 10	1.333 ± 0.018	4.35 ± 0.06	41.1 $^{+0.6}_{-0.5}$	[145]
Roberts (1895)	710 ± 50	1.41 $^{+0.11}_{-0.09}$	4.59 $^{+0.35}_{-0.30}$	43.5 $^{+3.3}_{-2.9}$	[146]
Woolley *et al.* (1970)	743 ± 7	1.346 ± 0.013	4.39 ± 0.04	41.5 ± 0.4	[147]
Gliese & Jahreiß (1991)	749.0 ± 4.7	1.335 ± 0.008	4.355 ± 0.027	41.20 ± 0.26	[148]
van Altena *et al.* (1995)	749.9 ± 5.4	1.334 ± 0.010	4.349 $^{+0.032}_{-0.031}$	41.15 $^{+0.30}_{-0.29}$	[149]
Perryman *et al.* (1997) (A and B)	742.12 ± 1.40	1.3475 ± 0.0025	4.395 ± 0.008	41.58 ± 0.08	[150] [151] [152] [153]
Söderhjelm (1999)	747.1 ± 1.2	1.3385 $^{+0.0022}_{-0.0021}$	4.366 ± 0.007	41.30 ± 0.07	[154]
van Leeuwen (2007) (A)	754.81 ± 4.11	1.325 ± 0.007	4.321 $^{+0.024}_{-0.023}$	40.88 ± 0.22	[155]
van Leeuwen (2007) (B)	796.92 ± 25.90	1.25 ± 0.04	4.09 $^{+0.14}_{-0.13}$	38.7 $^{+1.3}_{-1.2}$	[156]
RECONS TOP100 (2012)	747.23 ± 1.17[note 3]	1.3383 ± 0.0021	4.365 ± 0.007	41.29 ± 0.06	[65]

See also

- Alpha Centauri in fiction
- List of nearest stars and brown dwarfs
- Project Longshot

Notes

1. The coordinates of the Sun would be diametrically opposite Alpha Centauri AB, at α=02^h 39^m 36.4951^s, δ=+60° 50′ 02.308″
2. Spellings include *Rigjl Kentaurus*, Hyde T., "Ulugh Beighi Tabulae Stellarum Fixarum", *Tabulae Long. ac Lat. Stellarum Fixarum ex Observatione Ulugh Beighi*, Oxford, 1665, p. 142., Hyde T., "In Ulugh Beighi Tabulae Stellarum Fixarum Commentarii", *op. cit.*, p. 67., Portuguese *Riguel Kentaurus* da Silva Oliveira, R., "Crux Australis: o Cruzeiro do Sul" (http://www.asterdomus.com.br/Artigo_crux_australis.htm), Artigos: Planetario Movel Inflavel AsterDomus.
3. Weighted parallax based on parallaxes from van Altena *et al.* (1995) and Söderhjelm (1999).

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External links

- SIMBAD observational data (http://simbad.u-strasbg.fr/sim-id.pl?protocol=html&Ident=alpha+centauri)
- Sixth Catalogue of Orbits of Visual Binary Stars U.S.N.O. (http://ad.usno.navy.mil/wds/orb6.html)
- The Imperial Star – Alpha Centauri (http://www.southastrodel.com/PageAlphaCen001.htm)
- Alpha Centauri – A Voyage to Alpha Centauri (http://www.southastrodel.com/PageAlphaCen006.htm)
- Immediate History of Alpha Centauri (http://www.southastrodel.com/PageAlphaCen006.htm)
- eSky : Alpha Centauri (http://www.glyphweb.com/esky/stars/alphacentauri.html)
- Alpha Centauri at Constellation Guide (http://www.constellation-guide.com/alpha-centauri/)

Hypothetical planets or exploration

- "A Family Portrait of the Alpha Centauri System" (http://www.spaceref.com/news/viewpr.html?pid=11016). *SpaceRef.com*. Retrieved 21 March 2003.
- Alpha Centauri System (http://jumk.de/astronomie/near-stars/alpha-centauri.shtml)
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