https://www.observatoiredeparis.psl.eu/proxima-bound-to-alpha.html

# Proxima bound to Alpha Centauri


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**Observatoire de Paris - PSL Centre de recherche en astronomie et astrophysique**

**Three astronomers, one from the Observatoire de Paris, demonstrated that Proxima, the closest star to the Sun, is gravitationally linked to its two neighbors Alpha Centauri A and "B". Our closest neighbor is therefore a triple star. This work appears in the journal Astronomy & Astrophysics.**

Alpha Centauri and Proxima are our nearest stellar neighbors, respectively at 4.37 and 4.24 light-years (a bit more than 40,000 billion kilometers, or 25,000 billion miles). Alpha Centauri is composed of two stars similar to the Sun (A and B), orbiting each other in approximately 80 years. Proxima is a very low mass red dwarf (1/8th of the mass of the Sun, 1/6th of its radius) around which a telluric planet has just been discovered in its habitable zone, Proxima b.

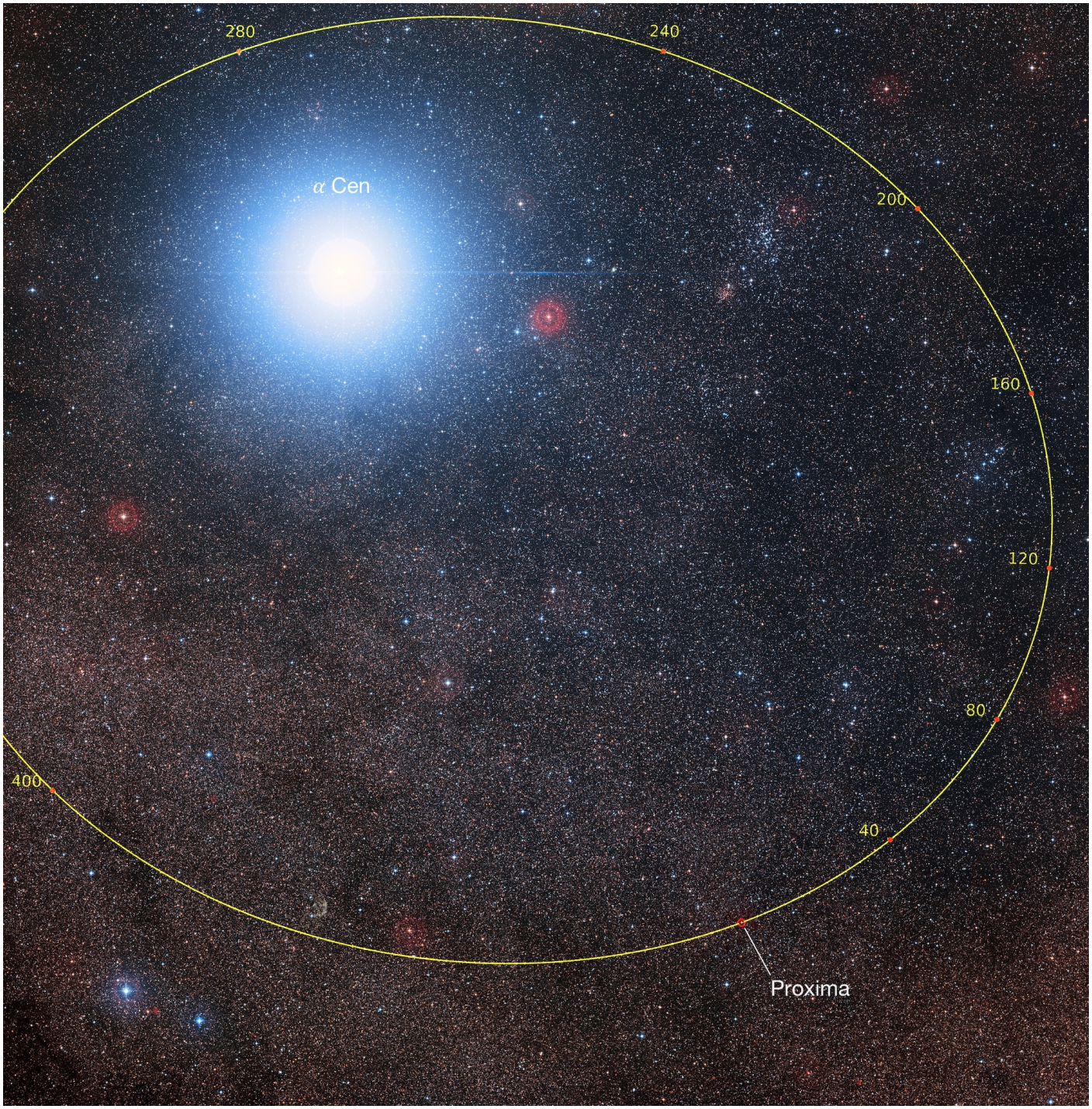
## To measure the relative velocity with a high precision

Since the discovery of Proxima in 1915 by the scottish astronomer Robert Innes, its proximity in the sky with Alpha Centauri and the similarity of their distance to the Sun have led astronomers to suspect that they are gravitationnally bound. But to demonstrate this link, it is necessary to measure the relative velocity of Proxima with respect to Alpha Centauri with a high precision. If this velocity is too high, Proxima will escape from Alpha Cen. If it is sufficiently low, Proxima sill stay in orbit around Alpha Cen. The limit velocity between these two scenarios is called the escape velocity.


**Orbite de Proxima**
Orbite de Proxima autour d'Alpha Centauri (ellipse jaune) sur le fond de la Voie Lactée.
P. Kervella/ESO/S. Brunier

The low velocity of Proxima relative to Alpha Centauri demands a very high measurement precision. It is now possible to achieve it using the extremely stable spectrographs that were developed to search for planets (as Proxima b). The velocity of Proxima with respect to Alpha Centauri is measured at 309 +/- 55 m/s, that is, 1100 km/h. The escape velocity of Alpha Centauri at the distance of Proxima is 545 +/- 11 m/s, that is, significantly larger than the measured velocity. Proxima and Alpha Cen are therefore bound gravitationnally.




**Zoom sur l'orbite de Proxima**
Tracé de l'orbite de Proxima montrant sa position par rapport à Alpha Centauri au cours des prochains millénaires (les graduations sont en milliers d'années). Le grand nombre d'étoiles du champ provient du fait que Proxima est située très près du plan de la Voie Lactée, très riche en étoiles.
P. Kervella/ESO/Digitized Sky Survey 2/Davide De Martin/Mahdi Zamani

The computed orbit of Proxima has a very long period of 550,000 years, and a moderate excentricity of 0.50. Proxima is currently at about 13000 times the Earth-Sun distance from Alpha Cen. Projected on the plane of the sky, the orbit presents a very large angular size of more than 3 degrees, that corresponds approximately to the width of two fingers at arm's length. The european satellite Gaia will deliver in 2017 an extremely accurate measurement of the distance and proper motion of Proxima, that will be used to improve its orbital parameters.

## Proxima b is the eldest of the Earth of one or two billion years

The determination of the age of a red dwarf is very difficult, as these tiny stars evolve very slowly and therefore mostly do not change in appearance over their very long lifetime (several trillion years). As a result, the age of Proxima was essentially unknown. Proxima and Alpha Centauri being bound implies that they very likely formed together and have the same age (except if Proxima was captured by Alpha Centauri). The age of Alpha Centauri, estimated between 5 and 7 billion years, thus give us the age of Proxima and its planet Proxima b. This planet, potentially habitable, is therefore older than the Earth (4.6 Gyr) by one or two billion years. Proxima b is a prime target for a future interstellar probe as the Breakthrough Starshot project.

This work has been conducted by Pierre Kervella (CNRS / U. de Chile / Paris Observatory / LESIA), Frédéric Thévenin (Lagrande Laboratory, Côte d'Azur Observatory) and Christophe Lovis (Observatory of the University of Geneva, Switzerland). The Letter reporting these results will appear in the journal Astronomy & Astrophysics.