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# Discovery: An Earth-Mass Exoplanet Orbiting Alpha Centauri B

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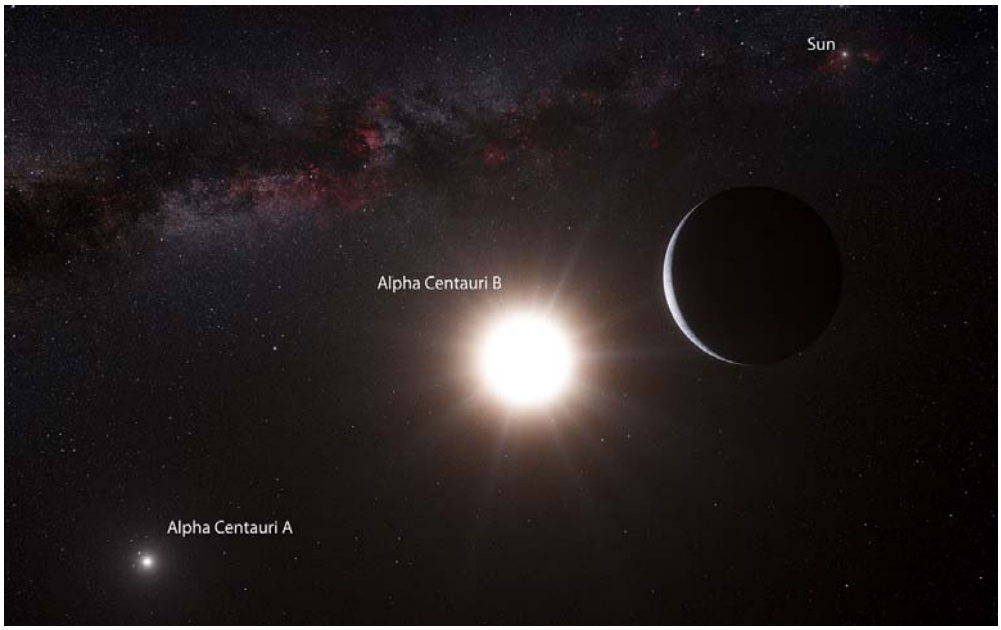
A planet around the mass of the Earth has been found, orbiting a star in the Alpha Centauri system; the nearest to Earth and also the lightest exoplanet ever discovered around a star like the Sun.

Alpha Centauri is one of the brightest stars in the southern skies and is the nearest stellar system to our Solar System, only 4.3 light-years away. It is actually a triple star — a system consisting of two stars similar to the Sun orbiting close to each other, designated Alpha Centauri A and B, and a more distant and faint red component known as Proxima Centauri. The components of a multiple star are named by adding uppercase letters to the name of the star. Alpha Centauri A is the brightest component, Alpha Centauri B is the slightly fainter second star and Alpha Centauri C is the much fainter Proxima Centauri. Proxima Centauri is slightly closer to Earth than A or B and hence is formally the closest star.

Since the nineteenth century astronomers have speculated about planets orbiting these bodies, the closest possible abodes for life beyond the Solar System, but searches of increasing precision had revealed nothing. Until now.

The newly found planet was detected using the HARPS instrument on the 3.6-metre telescope at ESO's La Silla Observatory in Chile.




*Artist's impression of the planet orbiting the star Alpha Centauri B, a member of the triple star system that is the closest to Earth. Alpha Centauri B is the most brilliant object in the sky and the other dazzling object is Alpha Centauri A. Our own Sun is visible to the upper right. The tiny signal of the planet was found with the HARPS spectrograph on the 3.6-metre telescope at ESO's La Silla Observatory in Chile. Credit: ESO/L. Calçada*

"Our observations extended over more than four years using the HARPS instrument and have revealed a tiny, but real, signal from a planet orbiting Alpha Centauri B every 3.2 days," says Xavier Dumusque (Geneva Observatory, Switzerland and Centro de Astrofisica da Universidade do Porto, Portugal), lead author of the paper. "It's an extraordinary discovery and it has pushed our technique to the limit!"

The European team detected the planet by picking up the tiny wobbles in the motion of the star Alpha Centauri B

created by the gravitational pull of the orbiting planet. HARPS measures the radial velocity of a star — its speed towards or away from the Earth — with extraordinary precision. A planet in orbit around a star causes the star to regularly move towards and away from a distant observer on Earth. Due to the Doppler effect, this radial velocity change induces a shift of the star's spectrum towards longer wavelengths as it moves away (called a redshift) and a blueshift (towards shorter wavelengths) as it approaches. This tiny shift of the star's spectrum can be measured with a high-precision spectrograph such as HARPS and used to infer the presence of a planet.

The effect is minute — it causes the star to move back and forth by no more than 51 centimeters per second (1.8 km/hour), about the speed of a baby crawling. This is the highest precision ever achieved using this method.

Alpha Centauri B is very similar to the Sun but slightly smaller and less bright. The newly discovered planet, with a mass of a little more than that of the Earth, is orbiting about six million kilometers away from the star, much closer than Mercury is to the Sun in the Solar System. The orbit of the other bright component of the double star, Alpha Centauri A, keeps it hundreds of times further away, but it would still be a very brilliant object in the planet's skies.



Using the radial velocity method, astronomers can only estimate a minimum mass for a planet as the mass estimate also depends on the tilt of the orbital plane relative to the line of sight, which is unknown. But, from a statistical point of view, this minimum mass is often close to the real mass of the planet. NASA's Kepler mission has found 2300 candidate planets using an alternative method — searching for the slight drop in the brightness of a star as a planet passes in front of it (transits) and blocks some of the light. The majority of planet candidates detected by this transit method are very distant from us. But, in contrast, the planets found by HARPS are around stars close to the Sun — with the new discovery being the closest yet. This makes them better targets for many kinds of additional follow-up observations such as characterizing the planet's atmosphere.

The first exoplanet around a Sun-like star was found by the same team back in 1995 and since then there have been more than 800 confirmed discoveries, but most are much bigger than the Earth, and many are as big as Jupiter. The challenge astronomers now face is to detect and characterise a planet of mass comparable to the Earth that is orbiting in the habitable zone around another star. The habitable zone is a narrow annular region around a star in which water may be present in liquid form if conditions are right.The first step has now been taken.

"This is the first planet with a mass similar to Earth ever found around a star like the Sun. Its orbit is very close to its star and it must be much too hot for life as we know it," adds Stéphane Udry (Geneva Observatory), a co-author of the paper and member of the team, "but it may well be just one planet in a system of several. Our other HARPS results, and new findings from Kepler, both show clearly that the majority of low-mass planets are found in such systems."

"This result represents a major step towards the detection of a twin Earth in the immediate vicinity of the Sun. We live in exciting times!" concludes Xavier Dumusque.

Citation: Xavier Dumusque, Francesco Pepe, Christophe Lovis, Damien Ségransan, Johannes Sahlmann, Willy Benz, François Bouchy, Michel Mayor, Didier Queloz, Nuno Santos and Stéphane Udry, 'An Earth mass planet orbiting Alpha Centauri B', Nature

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